The Ohmeda Biox 3760 Pulse Oximeter

The pulse oximeter that's really going places.

It's the foremost portable, continuous oximeter with a built-in printer for hard copy recording. No other portable pulse oximeter comes close.

Plus, our 3760 has a whole range of easy-to-use, cost-effective probes for every patient.

And because of its size, its probes and its special features, you can take it everywhere: Homecare, Respiratory Therapy, In-Hospital and Field Transport, Patient Wards, EMS, and Dentists' and Physicians' Offices.

The Ohmeda Biox 3760 Pulse Oximeter. No wonder it's going places.

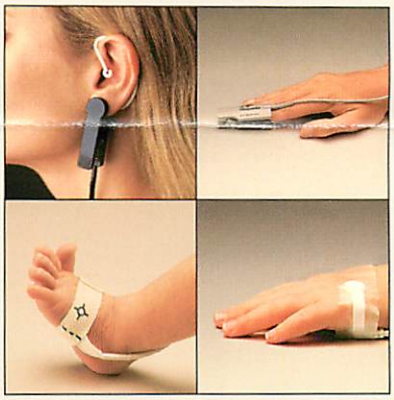
Shows and tells.
The 3760's easy-to-read, backlit LCD panel displays SaO_2 and pulse rate values.

And a low SaO_2 alarm with selectable limits alerts you to low saturation both visually and audibly.

On the go.
The 3760 is small and lightweight.

It's designed to save space everywhere you take it.

We make it handy, too, with carrying case and shoulder strap for easy transport.



Probes for every patient, every procedure.
With the Ohmeda family of probes, you can monitor any patient with the 3760.

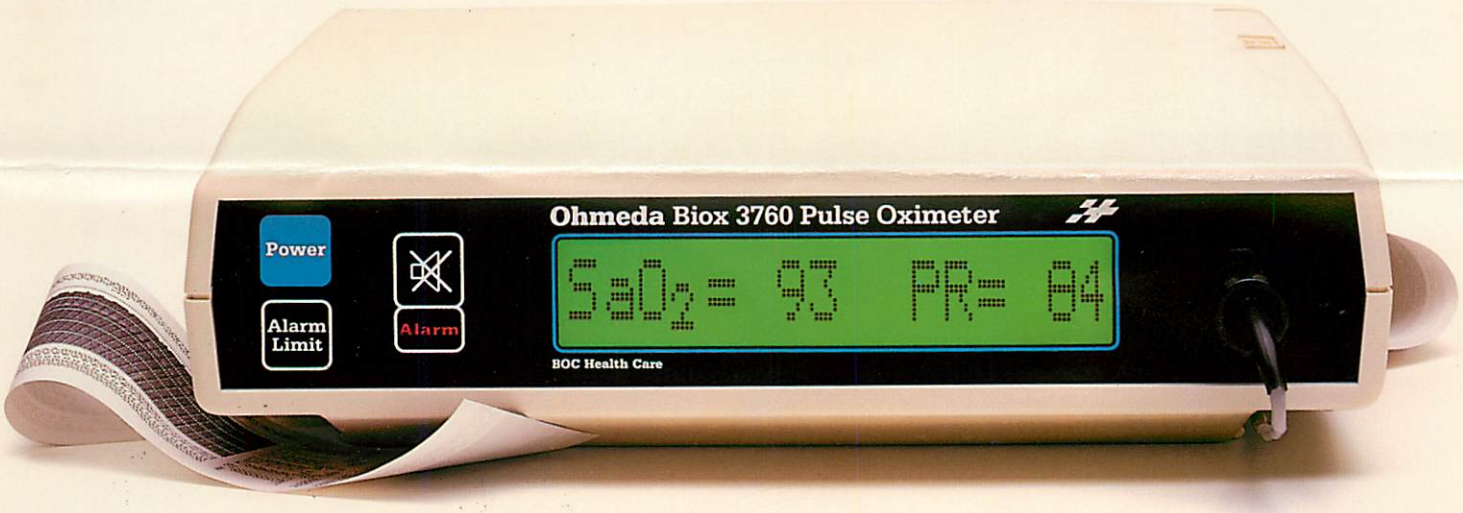
In addition to our new FingerClip probe for adult and pediatric patients and our EarProbe for a variety of patients, we offer the new, reusable SoftProbe as well as the Flex II Probe for neonatal and pediatric patients.

Fit to print.
SaO_2 and pulse rate readings can be recorded for O_2 justification records, sleep studies and patient charts with the special built-in, comprehensive printer.

You can choose from six print modes to record the information: graphic or numeric, open or filled trend, fast or slow.

And the 3760 delivers statistical analysis of SaO_2 over the total time monitored, calculates the average and lowest SaO_2 levels, and records date, time and pulse rate. Plus a histogram of the saturation data.

If hard copy documentation isn't needed, a printerless version of the 3760 is also available.



Ohmeda

Total oximetry. Only from Ohmeda.

Our 3760 is part of a Total Oximetry System—a network of pulse oximeters and probes connecting all levels of need with all degrees of therapy.

It includes the Ohmeda Biox 3700 Pulse Oximeter, our full-featured pulse oximeter specially designed for Anesthesia, NICU, and ICU. The 3740, the compact oximeter with just the right features for Recovery, Respiratory Therapy and Emergency Care. And the portable 3760 with printer for hard copy reporting.

Plus, our new family of probes.

Total oximetry. Only from Ohmeda.

Specifications

Operational

All operations are continuous.

Saturation Range:	0–100%
Saturation Accuracy:	1 standard deviation 90–100% 1.5% 80–90% 2.1% Overall Range 60–100% 2.4% Below 60% unspecified
Pulse Rate Range:	40–235 beats per minute
Pulse Rate Accuracy:	±1.7% of current reading

Physical

Dimensions:	3.2 x 10.3 x 10.8 inches 8.1 x 26.1 x 27.4 cm
Weight (with printer):	7 lbs., 3.2 kg
Weight (printerless):	6 lbs., 2.7 kg
Carrying Case:	The 3760 comes with a black soft-pak carrying case for the oximeter, probes and power cord.

Electrical

Battery:	Internal 12V, 1.9 ampere-hours sealed lead acid.
Battery Life:	3760 with printer: ≈ 3.25 hours 3760 printerless: ≈ 7.0 hours
Low Battery Message:	Displayed below 50% capacity
Battery Charge Time:	80% charge in 4 hours 100% charge in 4.5 hours
Wall Transformer:	Available for most AC mains power. See manual for line voltages and frequencies.

Alarms

Low Saturation Alarm:	Four alarm limits: 90%, 85%, 80% and Off
Alarm Silence Period:	60 seconds

Printer

Built-in. Six selectable print modes—2 numeric, 4 graphic.

Numeric Modes:	Print out records lowest SaO_2, and corresponding pulse rate over each 6 second (print fast) or 30 second (print slow) period (4.8 second and 28.8 second for 50 Hz units).
Graphic Modes:	Print out records graph of the lowest SaO_2 monitored over each 2 second (graph fast) or 6 second (graph slow) period (1.6 and 4.8 seconds on 50 Hz units).

Statistics

Automatic statistical analysis at completion of monitoring.

Cumulative:	Includes percent of time SaO_2 falls below 90%, 85%, 80%, and 70%, the average SaO_2, lowest SaO_2, and time of lowest SaO_2.
Histogram:	Graphic presentation of the percent time SaO_2 falls within specified ranges: 90–100%, 85–89%, 80–84%, 70–79%, <70%.

Real Time Clock

24 hours

This product is designed to meet UL specifications. U.S. patents 4394572, 4407290. Other patents pending. Specifications and warranties subject to change without notice.

Ordering Information

	Part Number	BX No.*
3760 Pulse Oximeter with printer (60 Hz)	0380-1000-082	8127-000
3760 Pulse Oximeter printerless (60 Hz)	0380-1000-083	8127-004
3760 Pulse Oximeter with printer (50 Hz–220/240 VAC)	N/A	8127-009
3760 Pulse Oximeter printerless (50 Hz–220/240 VAC)	N/A	8127-011
3760 Pulse Oximeter with printer (50 Hz–100 VAC)	N/A	8127-013
3760 Pulse Oximeter printerless (50 Hz–100 VAC)	N/A	8127-014

*Use BX number only with international and nonhospital orders.

Eastern Region
Executive Plaza
One Executive Drive
Fort Lee NJ 07024

Midwest Region
2101 S Arlington Heights Rd
Suite 145
Arlington Heights IL 60005

Western Region
5635 West Las Positas Blvd
Suite 406
Pleasanton CA 94566

Southern Region
4565 Winters Chapel Road
Atlanta GA 30360

Ohmeda

Ohmeda
1315 West Century Drive
Louisville CO 80027 USA
To order: Hospital 1 800 345 2700 Nonhospital 1 800 652 2469
Tel 303 666 7001 Telex 296 445 BTI UR
A Division of The BOC Group Inc

Rev. 4/88 Printed in USA

Form #E009

BOC Health Care

Most of time just probe goes bad — see pg 5-6

Service

Two things usually wrg probe +/Or low battery

1-800-433-5070

770-7137 Ed Benner can take care of low battery.

Repairs

PLEASE POST

Ohmeda Service and Distribution Center
7750 The Bluffs NW
Austell, GA 30001

FAX: 404/739-4770
Phone: 800/999-6277 X232
404/739-4774

All monitor repairs shipped to the above address.

Effective 5/1/90

Customer Service 800-652-2469
Orders, new units, probes, credit & technical support

ATTENTION ATTENTION ATTENTION

Please note, effective May 1, 1990 the **REMIT TO** address for Ohmeda Monitoring, Louisville, Colorado has been changed

From: Ohmeda
Dept. 471
Denver, CO 80271

To: Ohmeda
Dept. 532
Denver, CO 80291-0532

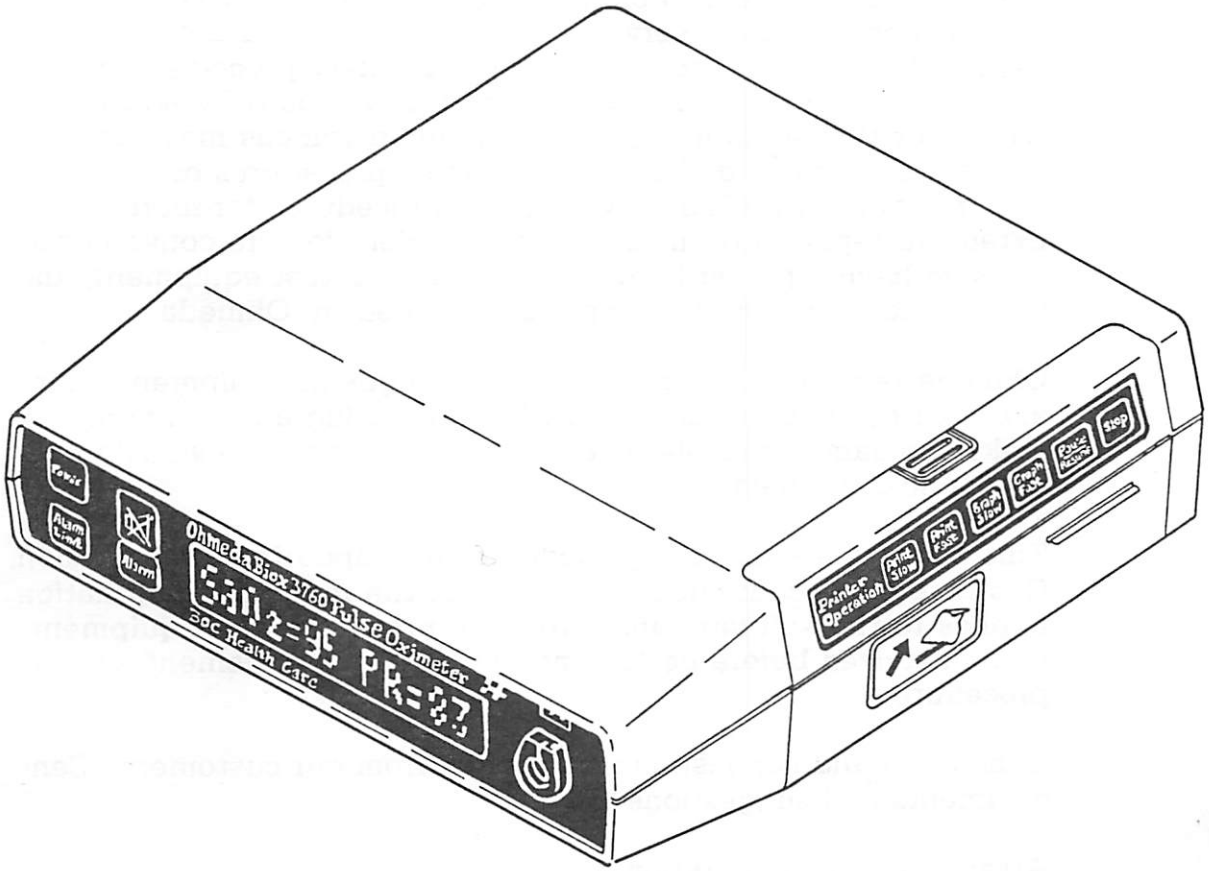
Please adjust your records accordingly.

Ohmeda

A BOC Health Care
Company
Critical Care
Worldwide

Biox 3760 Pulse Oximeter Service Manual

999-6277



Ohmeda
1315 West Century Drive
Louisville CO 80027
303 666 7001
800 652 2469
Telex 296 445 BTI UR
FAX 303 665 9176

Stock Number: 0380-0900-048
Biox Number: 1127-303

Important

The information in this service manual pertains only to those product models marketed by Ohmeda as of the effective date of this manual or the latest revision thereof. This service manual was prepared for exclusive use by Ohmeda-trained service personnel because of their training, experience, and access to parts, proper tools, and test equipment. Consequently, Ohmeda provides this service manual to our customers as a business convenience and for general information, with no warranty of the results of any application of this information.

Furthermore, because of the wide variety of circumstances under which maintenance and repair activities may be performed and the unique nature of each individual's own experience, capacity, and qualifications, the fact that the customer has received such information from Ohmeda does not imply in any way that Ohmeda deems said individual to be qualified to perform any such maintenance or repair service. Moreover, it should not be assumed that every acceptable test and safety procedure or method, precaution, tool, equipment, or device is referred to within, or that abnormal or unusual circumstances may not warrant or suggest different or additional procedures or requirements. Detailed drawings and procedures for more extensive repairs are included herein solely for the convenience of users having proper knowledge, tools, and test equipment, and for service representatives specially trained by Ohmeda.

Ohmeda reserves the right to make changes in equipment built and sold by them at anytime without incurring any obligation to make the same or similar changes on equipment previously built and/or sold by them.

This manual is subject to periodic review, updating, and revision. Customers are cautioned to verify that the manual's information applies to the software and hardware present in the equipment being serviced before performing any repair, replacement, or test procedure.

Comments and suggestions are invited from our customers. Send comments and suggestions to

Attention: Documentation
Ohmeda
1315 West Century Drive
Louisville, Colorado 80027
U.S.A.

Trademark Acknowledgments

Table of Contents

1/Product Overview

2/Theory of Operation

2/Theory of Operation (continued)

2/Theory of Operation (continued)

3/Tests and Adjustments

4/Troubleshooting

5/Repair Procedures

6/Parts and Schematics

Appendix W/Warranty

Illustrations

Figures

Assembly drawings and schematics

Chapter 1: Product Overview

This manual covers service instructions for the Ohmeda Biox 3760 Pulse Oximeter Monitor.

This chapter contains

- A general description of the monitor, its components, and its specifications.
- The policy to follow when returning the monitor for repair.
- The technical competency requirements for those who service the monitor.
- Service and packaging information for damaged monitors.
- The procedures to use to clean the monitor.
- The precautions, including specific warnings and cautions, to follow when servicing the monitor.

1.1 General description

The Ohmeda Biox 3760 Pulse Oximeter is a stand-alone, noninvasive, arterial oxygen saturation monitor. It measures and provides continuous, real-time arterial oxygen saturation (SaO_2) and pulse rate readings.

A liquid crystal display (LCD) presents patient data and information about the monitor's status. Printed copies of periodic readings and trend statistics are available for units equipped with a printer.

The monitor generates audible and visible alarms when patient readings fall below or exceed preset limits. Additional alarms warn of system failure.

1.1.1 Components

The major components of the monitor are the front panel assembly, the chassis, and, for monitors with a printer, the printer door assembly.

Front panel assembly

- Membrane panel (operator controls)
- Interconnect board
- LCD panel with backlight cable
- Probe cable

Chassis

- Power input cable, fuse, and power cable receptacle
- Battery
- Power supply board
- Speaker
- Transistor cable assembly
- MINX board
- MINX interface board
- Metal shield
- Printer terminator board (monitor without printer)
- Printer board (monitor with printer)
- Printer paper spindle (monitor with printer)

Printer door assembly

- Printer membrane panel (operator controls)
- Printer door and back door plate
- Printing mechanism (motor, paper feed, and print head)
- Printer connector board

1.1.2 Specifications

All specifications are nominal and subject to change without notice.

SaO_2 accuracy (1 standard deviation)

The following accuracy measurements are statistically derived and correlated to simultaneous oxygen averaging readings measured on an Ohmeda 3700 Pulse Oximeter, which, in turn, was calibrated with Co-oximeters.

SaO_2 Range	**Accuracy**
60% to 100%	2.4%
90% to 100%	1.5%
80% to 89.9%	2.1%
Below 60%	Unspecified

SaO_2 range: 0% to 100%

Interfering substances

Carboxyhemoglobin may erroneously increase readings. The level of increase is approximately equal to the amount of carboxyhemoglobin present.

Dyes, or any substances containing dyes that change the usual arterial pigmentation, may cause erroneous readings. (See the list of references in the *3760 Operations and Maintenance Manual*, Appendix B.)

Alarm limits

Low SaO_2 = 80, 85, 90, OFF (default = 90%)

Pulse rate

Accuracy: ± 1.7% of current reading (assuming a constant pulse rate)

Range: 40 to 235 beats per minute (BPM)

Note: The display can show readings from 0 to 255 beats per minute. However, readings from 0 to 39 (*shown as* dashes) and 236 to 255 may not be accurate.

Battery

Sealed lead-acid; 12 volt; 1.9 Ampere-hours minimum

Operation time (from a fully charged battery to automatic shutoff at 25% capacity):

Without printer:	7 hours (approximately)
With printer:	3.5 hours (approximately)

Charge time (from a 25% charge capacity; unit not operating):

80% capacity in 4 hours
100% capacity in 4.5 hours

Low battery indicator:

Message (LO BAT) appears when battery capacity is below 50%

Electrical requirements

Input power maximum: 15.5 volts AC ±5%, 50 or 60 Hz (noninterchangeable) at 1.4 A

- *100V charger*
  Input (AC mains): 100 VAC ±10%
  (217 mA maximum current draw)
  Output: 15.5 VAC at 1.4 A, 50/60 Hz

- *120V charger*
  Input (AC mains): 120 VAC ±10%
  (180 mA maximum current draw)
  Output: 15.5 VAC at 1.4 A, 50/60 Hz

- *220/240V charger*
  Input (AC mains): 220/240 VAC ±10%
  (100 mA maximum current draw)
  Output: 15.5 VAC at 1.4 A, 50/60 Hz

Dimensions and weight

Height:	3.2 in. (8.1 cm)
Width:	10.3 in. (26.1 cm)
Depth:	10.8 in. (27.4 cm)
Weight:	7 lb. (3.2 kg) with printer
	6 lb. (2.8 kg) without printer

Construction

Front panel display: 16 character dot-matrix liquid crystal display (LCD); backlighted

Probe connector: 9 pin, locking

Charging jack: 5 pin DIN

Environmental tolerances

Altitude: to 10,000 feet (3048 meters)

Humidity: 5% to 80% noncondensing

Temperature range:

- Operating: 10° to 45° C (50° to 115° F)
- Storage (with printer paper): -20° to 45° C (-4° to 115° F)
- Storage (without printer paper): -20° to 60° C (-4° to 140° F)

Note: At temperature extremes, the LCD may exhibit reduced contrast, ghosting, or darkening. When returning from temperature extremes, allow the monitor to return to room temperature before use.

Printer

Printer head life expectancy (approximate): 500,000 lines

Paper (thermal type) dimensions (approximate):

- Width: 2.25 in. (5.7 cm)
- Roll diameter: 1.5 in. (3.8 cm)
- Roll length: 52 ft. (15.8 cm)

Length of time one full roll of paper lasts (approximate):

Graph Fast	22 hrs.
Graph Slow	67 hrs.
Print Fast	10 hrs.
Print Slow	45 hrs.

Classifications

- Type of protection against electric shock—class I/internal electrical power source
- Degree of protection against ingress of liquids—ordinary
- Mode of operation—continuous
- Recommended methods of sterilization or disinfection—in this manual, see **1.3 Cleaning the monitor**. For safety procedures related to probes, refer to the *Ohmeda Probes Manual* (0380-0900-085; BX# 1000-304).
- Degree of safety of application in the presence of flammable anaesthetic mixed with air, oxygen, and/or nitrous oxide—monitor not suitable for use in the presence of a flammable anaesthetic mixture with air, oxygen, and/or nitrous oxide.

1.2 Service and repair policy

Warranty repair and service must be performed by an authorized Ohmeda Service facility. In cases where Ohmeda's warranty is not applicable, repairs will be made at Ohmeda's current list price for replacement part(s), plus a reasonable labor charge.

1.2.1 Technical competence

The procedures described in this manual must be performed by trained and authorized personnel only. Maintenance should be undertaken only by competent individuals who are Ohmeda-trained and experienced with this device.

CAUTION: No repair should ever be attempted by anyone not having such qualifications. Only individuals trained in the repair of this equipment should attempt to service it.

Follow these guidelines when servicing the monitor:

- Read each procedure completely before you start; any exceptions may result in failure to complete the procedure properly and safely.
- Give special attention to the **WARNINGS** and **CAUTIONS** that appear throughout this manual.
- Use **only** genuine replacement parts manufactured or sold by Ohmeda for all repairs.
- After repairs are complete, test the monitor to verify its compliance with the published specifications.

We recommend that a 3760 Operations and Maintenance Manual (0380-0900-047; BX#1127-302) be available for your reference.

1.2.2 Obtaining service

Hospitals and clinics (USA): For technical support, call 1-800-345-2700. For repairs, contact the nearest Ohmeda Regional Service Office listed on the back cover of this manual.

Non-hospitals (USA): For technical support, call Ohmeda at 1-800-345-2700 (inside Colorado, call 303-666-7001). For repairs, call the Ohmeda Service and Distribution Center (OSDC) at 1-800-999-6277.

Outside the USA: Contact the nearest Ohmeda Representative or office listed on the back cover.

1.2.3 Packaging and return procedure

If you are sending the monitor for repair,

- You must clean and properly decontaminate the monitor before you send it—see **1.3 Cleaning the monitor.**
- Package the monitor securely in the original shipping container, if possible.
- Ship it prepaid.

Enclose the following five items:

1. A letter that describes the problem in detail.
2. Warranty information (include a copy of the invoice or other applicable documentation).
3. Purchase order number to cover repairs (if warranty does not apply).
4. "Ship To" and "Bill To" information.
5. Person (name and telephone number, or telex number) to contact for questions and necessary repairs.

Inside the U.S.A.
After calling, send the monitor to the following address:

Attention: Service Center
Ohmeda Service and Distribution Center
7750 The Bluffs NW
Austell, GA 30001

Outside the U.S.A.
After calling, send the monitor to your local authorized service office as shown on the back cover of this manual.

1.3 Cleaning the monitor

When handling equipment that may be contaminated,
- Wear safety eyeglasses or a face guard.
- Wear disposable latex gloves.

Equipment and tools
- Safety eyeglasses (or face guard)
- Disposable latex-based gloves
- Cotton swabs, a soft cloth, and paper towels
- 70% isopropyl alcohol solution
- Mild liquid detergent and water solution

WARNING: Electrical shock and flammability hazard—Before servicing the monitor, always turn it off and disconnect it from AC mains power.

1. Power off. Disconnect the monitor from AC mains power.

Caution: Do not touch, press, or rub the display panel with abrasive cleaning compounds, instruments, brushes, rough surface materials, or bring it into contact with anything that could scratch the panel. Do not use solutions containing acetone to clean the display panel.

2. Use a cotton swab saturated with 70% isopropyl alcohol to gently wipe the panel.

Caution: Do not autoclave, pressure sterilize, or gas sterilize the monitor. Do not soak or immerse the monitor in liquid. Equipment damage will result.

3. Use a soft cloth lightly moistened with a solution of mild liquid detergent and water to wipe the outer surface of the monitor. To further disinfect the outer surface, use 70% isopropyl alcohol.
4. Wipe the surface of the monitor with a paper towel.
5. Discard used swabs, towels, and gloves.
6. Wait until the monitor surface is completely dry before you handle or use it.

1.4 Precautions

Two types of precautions appear at appropriate points throughout this manual: **warnings** and **cautions**.

1.4.1 Warnings

A **WARNING** indicates a potentially harmful situation that may cause injury to the patient or operator.

Data validity—An inflated blood pressure cuff on the same limb as the probe will cause erroneous readings. Select another site.

Excessive ambient light, excessive motion, low perfusion, or electrical interference at the probe site can result in the display of invalid data.

Do not allow tape to block the probe's light detector.

Patient safety—Do not, under any circumstances, perform any testing or maintenance on the monitor or on medical instruments that are being used to monitor a patient.

Use only probes and cables, identified in the *Ohmeda Probes Manual* (0380-0900-085; BX# 1000-304), with this monitor; otherwise, patient injury or equipment damage may result.

Prolonged monitoring or patient condition may require changing the probe test site periodically. Change the site at least every four hours to reduce the risk of blistering, skin erosion, or ischemic skin necrosis (especially if the site is poorly perfused).

Explosion hazard—Do not use in the presence of flammable anesthetics or other flammable substances.

Electrical shock and flammability hazard—Before servicing the monitor, always turn it off and disconnect it from AC mains power.

Electrical shock hazard—Do not touch any exposed wiring or conductive surface while the cover is off. The voltage present when the monitor is connected to electrical power can cause serious injury or death. Never work on an energized monitor.

Use only the charger supplied for this monitor. Using the wrong charger will damage the equipment.

Battery replacement—Unqualified personnel should not attempt to install, connect, or replace the monitor's battery.

- Removing the cover and/or faulty battery connections could be hazardous and will void the warranty.
- Reversing the battery connections could result in injury and will permanently damage the circuitry.

Proper grounding—For protection against shock hazards, connect the three-prong power plug on this equipment only to a three-wire, grounded, hospital-grade receptacle with the proper voltage. If only a two-wire receptacle is available, a qualified electrician must replace it with a properly grounded three-wire receptacle in accordance with the National Electrical Code, or appropriate Local Code.

- Do not, under any circumstances, remove the grounding prong from the power plug.
- Do not use extension cords or adapters of any type.
- The power cord and plug must be intact and undamaged.

Note: If the integrity of the protective earth conductor arrangement is in doubt, operate the monitor on internal battery power until the AC mains protective conductor is fully operational.

Failure of operation—If the monitor fails to respond as described, do not use it until the situation has been corrected by Ohmeda-trained service personnel.

Automatic shutoff—If the microcontroller fails, the monitor will shut down immediately to prevent the display of erroneous information. **Important:** No alarms forewarn of this action.

1.4.2 Cautions

A **CAUTION** indicates a condition that may lead to equipment damage or malfunction.

Static sensitivity—The monitor's electronic components are susceptible to damage by electrostatic discharge.

- When disassembling the monitor, work at a static control work station and wear a static control wrist strap to discharge accumulated static charges.
- Always handle circuit boards (replacement and defective) by their nonconductive edges and use anti-static containers when transporting them.

Storage temperatures—When the monitor contains paper, avoid storage temperatures below -20° C (-4° F) or above 45° C (115° F). When paper is not present, avoid storage temperatures below -20° C (-4° F) or above 60° C (140° F)

Do not touch, press, or rub the display panel with abrasive cleaning compounds, instruments, brushes, rough surface materials, or bring it into contact with anything that could scratch the panel. Do not use solutions containing acetone to clean the display panel.

Do not autoclave, pressure sterilize, or gas sterilize the monitor. Do not soak or immerse the monitor in liquid. Equipment damage will result.

Do not operate the printer without paper. Print head damage may result. The edges of the paper Ohmeda supplies are red near the end of the roll to indicate when to add paper.

Do not pull paper opposite the direction of the paper feed. This may damage the feeder mechanism.

Do not apply tension to the probe cable. Probe damage may result.

Do not turn the monitor back on after the Recharge Battery message appears without first connecting it to AC mains power. Operating the monitor on battery power during this message may permanently damage the lead-acid battery.

Repairs should be undertaken only by Ohmeda-trained service personnel.

Servicing of this product by Ohmeda-trained personnel, in accordance with this service manual, should never be undertaken in the absence of proper tools, test equipment, and the most recent revision of this service manual, which must be clearly and thoroughly understood.

After performing any repair or calibration procedure on the monitor, perform a final electrical safety check and leakage current test.

Federal law in the USA and Canada restricts this device to sale by or on the order of a licensed medical practitioner.

Chapter 2: Theory of Operation

This chapter covers the theory of operation for

- The monitor's oximetry function.
- The circuit boards associated with the oximetry function: the MINX board and the MINX interface board.
- The front panel interconnect board, the printer terminator board, and the power supply board.
- The monitor's printing function.
- The circuit boards associated with the printing function: the printer connector board and the printer board.

2.1 Oximeter operation

The Ohmeda 3760 Pulse Oximeter determines a patient's arterial oxygen saturation and pulse rate. It measures the absorption of selected light wavelengths that are generated in a probe. The light passes through the tissue and is converted into an electronic signal by a photodetector (some light is absorbed by the tissue). The electronic signal passes to the signal processing section of the MINX board where it is amplified and processed. The light intensity information is converted into SaO_2 and pulse rate values.

Note: The SaO_2 read by oximeters, and displayed on this monitor, is now referred to as SpO_2. This additional definition is required because a two-wavelength instrument cannot measure the presence of dyshemoglobins or other pigments. The presence of appreciable amounts of these substances may result in erroneous readings.

This function is based on the assumption that hemoglobin exists in two principle forms in the blood:

- Oxygenated (HbO_2)—O_2 molecules loosely bound to hemoglobin.
- Reduced (Hb)—no O_2 molecules bound to hemoglobin.

Arterial oxygen saturation (SaO_2) is defined as the ratio of oxygenated hemoglobin (HbO_2) to total hemoglobin [HbO_2 + Hb + others]:

$$SaO_2 = \frac{HbO_2}{HbO_2 + Hb + \text{others}^*}$$

* others = carboxyhemoglobin, methemoglobin, sulfhemoglobin, + ... , (For more information about interfering substances, refer to **1.1.2 Specifications**.)

Oxygenated hemoglobin (HbO_2) and reduced hemoglobin (Hb) exhibit markedly different absorption (extinction) characteristics to red light at 660 nm and infrared light at 940 nm. The different amounts of light absorbed at these wavelengths by HbO_2 and Hb are shown in Figure 2-a.

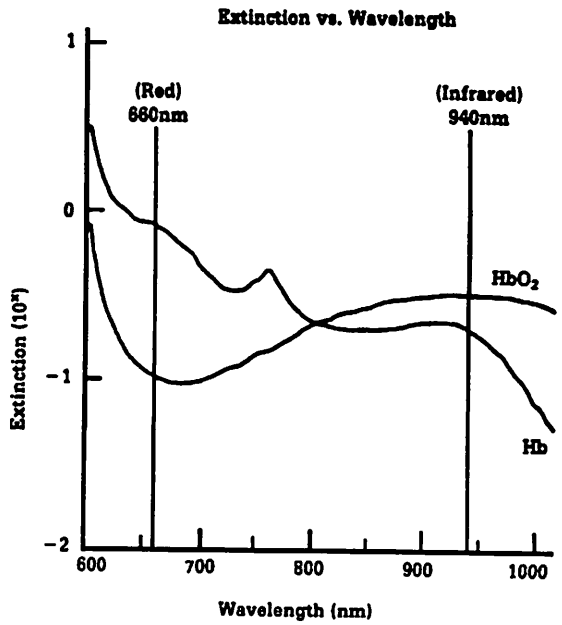


Figure 2-a. Extinction vs. Wavelength Graph

The MINX measures the relative absorption of red light at 660 nm and infrared light at 940 nm. Because HbO_2 and Hb allow different amounts of light to pass at these wavelengths, the MINX can convert this relative light intensity information into SaO_2 values.

The MINX differentiates between light absorption of hemoglobin and other fluid and tissue constituents with a patented two-wavelength, pulsatile system. This system

relies on the observation that arterial blood flow pulsates and other fluids and tissues do not.

The pulsating of the arterial blood flow modulates the light passing through it. The light is not modulated by the nonpulsing fluids and tissues. Therefore, the attenuation of light energy due to arterial blood flow can be detected and isolated (see Figure 2-b).

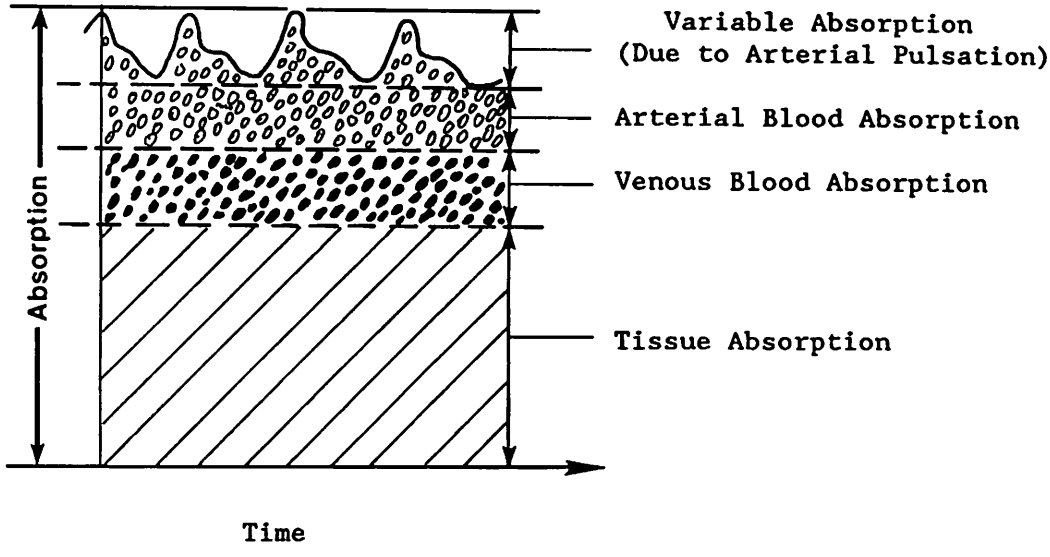


Figure 2-b. Signal Composite

The MINX uses electronic circuitry to determine SaO_2 and pulse rate values. The key elements are

- The probe
- The processing of the probe signal
- The calculations made by the microcontroller.

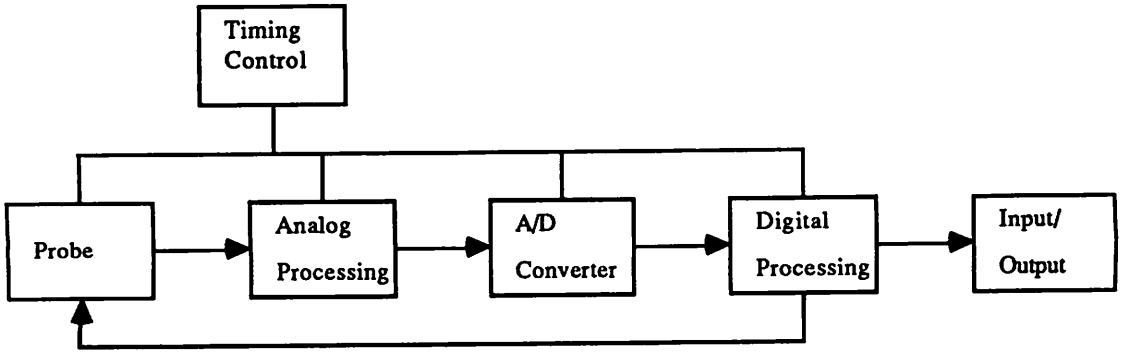


Figure 2-c. Functional Components

The probe consists of

- The light source—a red LED and an infrared LED.
- The photodetector—an electronic device that produces an electrical current proportional to incident light intensity.

The two light wavelengths generated by the LEDs pass through the tissue at the probe site. This light, which is partially absorbed and modulated, is then collected by the photodetector and converted into an electronic signal. This signal is sent to the MINX for processing.

The electronic circuitry takes the current generated by the photodetector, processes it, and passes it to the microcontroller for calculation of SaO_2 and pulse rate. The calculation of SaO_2 assumes 0.4% methemoglobin, 1.6% carboxyhemoglobin, and no other pigments. Appreciable variation from these values will influence the accuracy of SaO_2. (These values are based on the Ohmeda Biox 3700 Empirical Calibration Study.)

The microcontroller calculates the SaO_2 30 times per second (25 for 50 Hz model). To determine the displayed SaO_2, the calculations are averaged using a running weighted average method. (The weighted average is obtained by assigning a weight, or value, to each calculation based on the signal strength and the current average saturation.)

Mode	SaO_2 Averaging Period
Slow	12 seconds
Normal	6 seconds
Fast	3 seconds

The displayed SaO_2 and pulse rate values are updated every 2 seconds.

The running weighted average method allows erroneous SaO_2 values to be discarded from the determination of the displayed SaO_2. Erroneous values result from probe movement, electrosurgery, and other sources of signal interference. This averaging method provides a stable reading with low sensitivity to interference, while retaining the capability of responding quickly to saturation changes.

Staged alarm system

Software revision L modifies the MINX module's staged alarm system, which outputs messages to the monitor if low-quality signals are detected at the probe site.

The staged alarm system warns you that data may be unreliable and that you may need to check the probe site or check how the probe is applied to the patient. The heart of this system is an algorithm that checks signal quality from the probe site. This algorithm notes a low quality signal "event" when the signal quality deteriorates due to motion of the probe site, poor probe placement, electrical noise, or other factors. The MINX module initiates messages, then increases the alarm/message severity according to the number of these events that occur over a period of time.

The following table provides an overview of the staged alarm system.

Stage	MINX Module Function
1	• Operates normally; no message or problem indication.
2	• LOW QUAL SGNL appears on the display. • LOW QUAL SGNL prints on print-out (monitors with printer).
3	• SaO_2 and pulse rate readings appear as dashes on display. • LOW QUAL SGNL appears on the display. • LOW QUAL SGNL prints on print-out (monitors with printer).

2.2 MINX board

The MINX PCB drawing, components, and schematic are in section **6.15 MINX board**.

The MINX board's digital circuitry is based around the Intel® 80C196KA 16-bit microcontroller with an internal 10-bit A/D converter.

The analog section comprises approximately 70% of the MINX circuitry.

The power supplies for the MINX are as follows:

Circuitry	Voltage	Name
Logic	+ 5	+ 5
+ Analog	+ 5	+ V
– Analog	– 5	– V

Logic and analog supplies have separate grounds. Transzorbs D12, D13, and D14 provide protection from transients in the supply input lines.

Reference is made throughout this discussion of the MINX board circuitry to five timing signals: Red, RLT (Red LED time), IR (infrared), IRLT (infrared LED time), and Dark. These signals drive sections of the analog circuitry that multiplex and demultiplex the signals to and from the probe. The frequency of these signals is 480 Hz (400 Hz in 50 Hz mode). The relationship between these waveforms is illustrated in Figure 2-d.

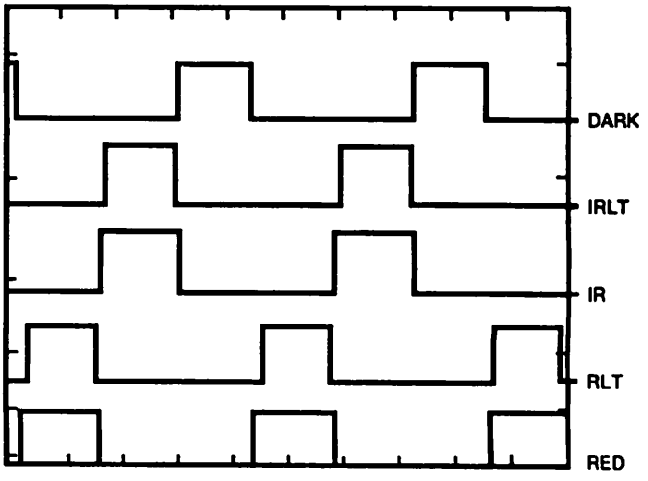


Figure 2-d. Waveform 5v/div 500 usec

Detector preamp

Amplifier U1A converts the probe's photodiode current into voltage. The diode current enters directly across the two input terminals of the op amp. R2 is a 1-Mohm feedback resistor. Each microampere of diode current causes the output of the op amp to swing one volt in the negative direction. C1 provides stability by offsetting the effects of the cable and detector capacitance.

R1 and R100 extend the rise time of a static transient that may occur as a probe is plugged in, but they have no measurable effect on normal circuit operation. R101 and R102 form a voltage divider from the positive supply that biases the noninverting input of the op amp at +2.5 volts. C101 filters the voltage divider.

Amplifier gain from the noninverting input to the amplifier output is unity. Therefore, with no input current, the amplifier output sits at +2.5 volts. Detector input current swings the output from +2.5 volts toward the -V rail. R3, R4, C13, and C14 decouple the preamp power supply inputs from the rest of the MINX circuitry. The preamp output is accessible at TP1. The microcontroller measures the voltage at this node via the PRE line that leads to the analog multiplexer.

Interference detection

This circuit detects the presence of high-frequency interference that might affect the readings. To avoid responding to the edges of the multiplexed waveform, a timed switch samples for interference only during the RLT. Switch U21B performs this function by closing during RLT. C61 holds the average DC value of Red during RLT (for the time period when the switch is open). R51 isolates the capacitance of C61 from the output of U1A.

C60 and R52 form a high-pass filter at 340 kHz. R49 and R50 establish a gain of 52 on op amp U43. C64 and R53 block the DC offset present at the output of the op amp. D6 and C65 peak rectify the amplified AC noise and pass it to the microcontroller A/D converter on input 3. R55 drains the charge off of C65 when interference has ended.

Input selection

U21 is actuated during the power-on self test and during Test Mode so that subsequent circuitry is driven by an internal test signal rather than by the detector preamp

stage. The TEST control line comes from the microcontroller via an 82C55 I/O line.

The test signal pulsatile component is generated by the D/A converter output that is normally used to drive the LEDs.

First low-pass filter

R12, U2, C8, C9, and C10 form a time multiplexed low-pass filter. Each of the three switches is closed in a sequence that corresponds to the driving phase of the probe LEDs. The corner frequency is 10 Hz. The filter output is buffered by voltage follower U1B, whose output is available at TP2.

Ambient light subtraction

Capacitor C98 and switch U8A are used to reject the DC component of ambient light that is often present in the detector signal. The switch is closed during the Dark timing period, in turn charging the capacitor to the ambient light voltage level. Thus, the subsequent stage is ground-referenced during Dark time and the ambient light is subtracted from the multiplexed signal.

DC gain

Signal levels leaving the detector can vary over a fairly wide range due to variability in probe placement, probe type, tissue thickness, and pigmentation.

A variable-gain stage is constructed by selecting various feedback resistors for op amp U4, using analog switch U5. Gains between 1 and 66 are available. Gains are set by the microcontroller as it measures the voltages at the output of the DC buffers.

Demux and 10 Hz low-pass filters

The signal at the output of the DC-gain stage requires demultiplexing into separate Red and IR signals so they can be read by the A/D converter. This is accomplished with circuits U8B, R13, C23 and U8C, R14, C25.

These networks form 10 Hz low-pass filters that are buffered by voltage followers U9 and U10 (outputs available at TP4 and TP5). The microcontroller reads the buffered Red and IR DC values through the analog multiplexer.

Adjustment of DC gain

The microcontroller decreases the gain if the DC voltage is more negative than -2.25 volts, and increases the gain if the voltage is closer to ground than -1.25 volts. If the voltage is more negative than -2.25 volts and the amplifier is already at minimum gain, the LED drive current decreases.

DC strippers

To block the average DC component of the oximetry signal, the Red and IR DC signals pass through 0.386 Hz high-pass filters C17, R84 and C18, R86. The remaining signal is the desired pulsatile oximetry component. This signal may be contaminated by motion artifact or transients generated by LED drive-adjustment and DC-gain changes.

The outputs of the high-pass filters are buffered by voltage followers U6 and U7, but these two signals may be too small to see clearly with an oscilloscope.

Very early recovery network

The very early recovery network (VERN) circuit improves the transient recovery time of the high-pass filter by increasing the 0.386 Hz corner frequency to 25 Hz. This is accomplished with switches U12A, U12C, R83, and R85.

The VERN control line is asserted by the microcontroller prior to adjustments in LED drive current or DC gain. It is deactivated shortly thereafter.

AC remultiplexing and AC gain

The AC-gain stage is preceded by switches U12B and U14A. They reconstruct a time division, multiplexed signal similar to that seen in the DC-gain path described previously. This new TDM waveform has only pulsatile oximetry components. The remultiplexed input signal is available at TP8, but this signal is generally of too low an amplitude to see clearly on an oscilloscope.

The AC-gain stage is identical to the DC-gain stage previously described except that the gain values range from 1 to 524. Software exempts the unity gain position from ever being used. The AC-gain level is determined by the microcontroller analyzing the AC signal level at the outputs of track and hold (see below). The amplifier output is accessible at TP9.

Fifth-order low-pass filters

The AC-gain stage output is demultiplexed by switches U14B and U14C. R59, C39, and U15 form an 18 Hz fifth-order, low-pass filter for the Red AC Signal while R60, C41, and U16 do the same for IR.

The filters' outputs are available at TP10 and TP11. (Capacitive loading of these two test points with 1X scope probes can result in filter instability or oscillation. Use 10X scope probes or 2.00 K ohm series resistors when observing these points.)

The microcontroller pulse width modulator (PWM) output generates a 7200 Hz square wave used to clock the filter ICs. This clock is centered about ground by C30, R87, and R79.

Transient snubbing

Filter IC latch-up due to input transients is prevented by Schottky diodes in D5. The anodes of the diodes are tied to a voltage clamp source that is 1.4 volts more positive than the negative supply rail.

The voltage source consists of the 2 silicon diodes in D7 forward-biased by R16. The clamping scheme prevents the pin 3 voltages of D5 from getting close to the negative supply rail.

Adjustment of AC gains

To determine if the setting of the AC-gain stage should be adjusted, the microcontroller analyzes the peak-to-peak amplitude of the AC components over a 1-second period.

- If amplitude > 5.4 volts p-p, gain is decreased.
- If the amplitude < 1.8 volts p-p, gain is increased.

Software precludes the lowest setting from being used.

Track and hold

The two pulsatile AC components are simultaneously sampled by U30 and U31 at a 30 Hz rate (60 Hz mode) or 25 Hz rate (50 Hz mode). C81 and C83 are the hold capacitors. The microcontroller S/H' output line is decreased in peak amplitude by R71 and R72.

Analog multiplexer and buffer

Various analog voltages are multiplexed and fed to A/D converter channel 0 of U24. This serves two purposes. First, it provides 15 more analog inputs to the microcontroller. Second, these analog voltages are scaled and offset so they fit into the 0 to 5 volt input range of the A/D converter.

Multiplexing is satisfied by U40 and U41, which are 8-input analog muxes. The inputs can swing anywhere between +V and -V. The desired input is selected by the microcontroller via the A, B, C, D, and D' control lines, which are generated by 82C55 output lines on U38.

The analog outputs of U40 and U41 are tied in parallel. The D and D' control lines are complementary so that only one mux is enabled at a time. The common output node is available at TP12.

R80 and R38 form a voltage divider that is referenced to the +V supply rail. This divides the input swing by 2 and centers it to 1/2 the +V rail. The net effect is that -V to +V voltages (at the output of the muxes) are translated to ground to +V swings to the input of U42.

U42 is connected as a voltage follower. The output of this unique type of op amp can track its input rail-to-rail in this configuration. (The output can be viewed at TP13.)

Voltage references

D8 is a 1.235-volt band gap reference, reverse biased by R32.

U17A, R33, R34, and trim potentiometer R35 form an inverting amplifier with a gain of 0.8. The resulting output is adjusted to –1.024 volts (–Vref). This is the voltage reference for the D/A converters (U32) that generate the 3 analog outputs of pulse rate, SaO_2, and plethysmograph.

Amplifier stage U17B (with R36 and R37) forms an inverting amplifier stage with a gain of -3.16. This produces the voltage reference (3.16 volts) for the D/A (U32) that generates the probe LED drive level and the pulsatile component of the test waveform.

Probe ID

R31 and R28 form a voltage divider. The midpoint of the divider is buffered by voltage follower U17C. The output

current of the buffer is limited by R18. The top of the divider is supplied by the switched reference voltage that sets the full scale range of the A/D converter. The ID resistor in the probe loads the midpoint of the voltage divider.

LED drive

The LED drive circuit translates the ground referenced control signal to a -V referenced drive scheme. This translation is necessary because the probe LED anodes are grounded to eliminate fault current paths.

Notice that an LM224 op amp is used—a type of op amp that includes the negative rail in the input common mode voltage range. The output can also swing close to the negative rail, typical of single-supply op amps with PNP input stages.

LED drive during dark time

Resistors R42 and R45 form a voltage divider between ground and the -V rail. The center point voltage is approximately -4.545 volts. This voltage is connected to the noninverting input of U18A. Switch U3A closes the feedback path around U18A, configuring it as a voltage follower. This results in the output settling to approximately -4.545 volts. Input resistors R41 and R44 essentially become load resistors tied to the output of U18A via switch U3A.

Meanwhile, the bases of transistors Q1 and Q2 are pulled to their emitter potentials by resistors R46 and R47. This results in no-current flow through the transistor collectors or the probe LEDs. Resistors R39 and R40 pull the collector voltages (the Dark time LED voltage drop) up to ground. This provides a lower source impedance for measuring Dark time LED voltage drop and also discharges the stored charge on the junction and cable capacitance.

LED drive during red time

Resistors R42 and R45 form a voltage divider between ground and the -V rail. The center-point voltage is approximately -4.545 volts. This voltage is connected to the noninverting input of U18A. U3B connects the op amp output to the base of Q2. The input of R41 is connected to the LED drive D/A and has a voltage corresponding to some

value of drive current (i.e., -3.16 volts, which would result in maximum LED current).

R41, R42, R44, and R45 should be recognized as a bridge configuration with the op amp inputs connected across the midpoints of the bridge. An input voltage more negative than ground unbalances the bridge such that the inverting op amp input moves toward the negative rail. The op amp responds by swinging positive from -4.545 volts, established during Dark time. At approximately -4.4 volts, the base of the Q2 becomes forward biased and its collector and emitter currents increase until 0.316 volts is displaced across R48. At this value, the bridge is again balanced through R44.

R48 is the current sense resistor for the LEDs. It establishes a feedback voltage for the R44 input of the bridge. The 10:1 ratio of R41 and R44 results in the 10:1 division of input-to-feedback voltage. Thus input voltages from 0 to -3.16 volts result in feedback voltages of 0 to .316 volts across R48. The value of R48 determines the current through the LED (0.316 V / 2.61 ohms = 121 mA).

Diode D9 improves settling time at low drive current levels if the op amp output swings into the -V supply rail.

Probe LED status

To confirm proper probe operation, switches U19A, B, C and U20A sample the forward voltage of the Red and IR LEDs. The allowed currents and voltages for each, in conjunction with specific probes, are shown below.

Probe Type	*Soft/Easy*		*Ear*		*Other*	
LED	*Red*	*IR*	*Red*	*IR*	*Red*	*IR*
Max Drive Current (mA)	40	60	120	120	120	60
Max Forward Drop (volts)	3.75	2.05	4.4	2.75 > V > 1.56	4.4	< 1.56
Min Forward Drop — Driven (volts)	1.3	0.63	1.3	0.63	1.3	0.63
Max Dark Voltage (volts)	0.33	0.33	0.33	0.33	0.33	0.33

Power on reset

R65 and C71 are the R/C network that ensures that the microcontroller is reset initially at power up. Diode D3 discharges C71 when power is turned off. Gate U22A squares up the slowly rising signal on C71. The output of U22A resets the two 82C55A I/O expanders and is further reinverted by U22B, which is connected to the microcontroller. Because the microcontroller's internal watchdog timer can short the reset input to ground, R15 limits output current from U22B. The EXT RES' line is available for resetting the module externally.

Microcontroller master clock

Y1, C73, and C74 attach to the oscillator inputs of the microcontroller. The CLKO oscillator output operates at 3.6864 MHz (half of the crystal frequency). This signal is available at edge connector pin J1-26C. Externally, this signal can be used to synchronize circuits that generate interference (such as backlight drivers) so that they do not interfere with the MINX.

Status indicator

U23A and U23B drive the small red/green LED status indicator mounted on the board near the EPROM socket. When the board is powered, the indicator toggles between red and green at a 1 Hz rate.

Address latch

The address latch, U25, latches the lower byte of the 16-bit address prior to date transfer on the data bus. This is necessary because the microcontroller multiplexes the lower byte of address with the 8-bit data path.

Memory map decoding

U22C, D; U23C, D; and U29 decode address locations for the memory mapped I/O devices (i.e., the 82C55s and the D/A converter).

High speed outputs

Six high-speed timer outputs and a pulse-width modulator generate timing signals for many of the circuits in the analog section. The signals are Red, IR, RLT, IRLT, Dark, S/H, and 7200. The microcontroller also generates the

VERN control line. These signals are grouped into the "HSO bus." Refer to the timing diagram waveform, Figure 2-d.

Analog to digital conversion

The MINX uses four of the eight analog inputs available on the microcontroller's (U24) internal 10-bit A/D converter. These four inputs are fed by the analog multiplexer (U40 and U41), the interference detection circuit (U43) , and the two probe ID circuits. The unused inputs are tied to analog ground.

Analog reset circuit

The analog portion of the microcontroller is powered through a high-current CMOS inverter constructed with MOSFET's Q3 and Q4. The input is driven by port line P1.3 via resistor R70. In the event that the microcontroller detects undefined operation of the A/D converter, the port line is toggled up and down to power the analog section off and on. The analog section is thus reset.

The +V SW line is also connected to the top of the probe ID resistor reference ladders so that the power inverter doesn't introduce any voltage errors in the Probe ID circuit. Dual diodes D10 and D11 prevent the microcontroller analog inputs from being driven below ground.

Memory

EPROM U26 stores the software for the microcontroller. It is enabled for read operations at addresses between 0000H and 7FFFH. RAM U28 stores the intermediate microcontroller results. It is enabled for read and write operations between addresses 8000H and BFFFH (although it only occupies the space between 8000H and 9FFFH).

I/O ports

Due to the limited number of I/O lines available on the microcontroller, two 82C55A's were added. Each 82C55A provides 24 lines of I/O. U38 is enabled for read and write operations between addresses C000H and CFFFH. Similarly, U39 is enabled for addresses D000H to DFFFH. Each occupies only the first 4 bytes of its address space (i.e., C000H to C003H and D000H to D003H).

D/A conversion

The MINX board provides three analog outputs for external use. (A fourth D/A channel is used for self-diagnostics and LED drive current adjustment.) The D/A conversion is accomplished by a quad D/A connected to the microcontroller data bus.

Each D/A has its own write address as follows:

E000H Pulse rate
E002H SaO_2
E004H Plethysmographic waveform
E006H LED drive and test waveform

The microcontroller is unable to read back the stored value in the D/A internal latches. Each D/A channel uses 1/4 of quad op amp U34. Capacitors C88, C89, C90, and C107 reduce glitch noise from each section.

Test signal

U18B, R56, R57, and R58 establish a stage that creates an artificial oximetry waveform. Switch U20C inserts the Dark time in the waveform. The test signal enters the analog path via the input select switch.

The D/A output for the LEDs generates the test waveform pulsatile component. This is possible because there is no need to drive the probe LEDs while the test waveform is being used. The D/A channel outputs an interleaved sine wave pattern that has an amplitude ratio of 2:1 (IR:Red). The frequency of the sine wave is 2 times the line frequency (120 BPM).

The amplifier output is accessible at TP14. TP14 precedes the Dark time switch; it contains only Red IR information, not Dark time information.

During normal module operation (not in Calibration Check mode), the waveform generator is still enabled. The test signal is meaningless, however, because the D/A channel is generating LED drive values. Since the input selector switch is not in the Test Mode position, the test signal has no destination.

2.3 MINX interface board

The MINX interface PCB drawing, components, and schematic are in section **6.14 MINX interface board**.

The MINX interface board

- Sends MINX messages to the LCD panel.
- Selects the line frequency for the MINX at J1.
- Generates and amplifies the speaker tone at U11 and U9.
- Acts as an intermediary between the power supply board and the MINX board—it buffers the condition signals received from the power supply board and sent to the MINX.

It also processes front panel commands and

- Triggers and latches the change of state from power-on to battery-backed standby.
- Buffers the alarm limit change switch.
- Processes the alarm trigger silence.

LOW BATT and RECHG are active low signals that enter the MINX interface board from the power supply at J6-1 and 3, respectively. These signals are inverted by NAND gate U3 and pass directly to the MINX connector, where they are read as active high signals (RECHG @ J4C-4 and LOW BATT @ J4C-3).

POWER UP and STANDBY are active low signals generated at the front membrane panel switch. They pass directly through the front panel interconnect board and enter the MINX interface board at J3-14. The low at J3-14 is inverted at NAND U2-3 and clocks FF U6. The resulting high at U6-1 is inverted at NAND U2-11 and presents a low to J6-10 (to the power supply). The low produced at U6-2 is inverted at NAND U2-4 and presents a high to J6-12. This "either/or" situation ensures that only one signal is active at any time.

Data handling

Data from the MINX for printing and display functions at J4C (pins 14-23) is routed directly through J5 (pins 14-23) to the printer board. Display data from the MINX returns from the printer board and is routed directly to the front panel interconnect board at J-3 (pins 4-13) on the MINX interface board.

In the absence of a printer, the printer terminator board forces data received from the MINX board directly to the front panel—see **2.5 Printer terminator board**.

Audio enable

A 550 Hz frequency for the audio, clock for U12, and alarm LED are generated by a 556 timer (U11). During unsilenced alarm conditions, the 550 Hz square wave from U11-5 is pulsed on and off by a 2 Hz square wave from U11-9. The 550 Hz wave goes to the drain of Q1 and U12-3, where it clocks the counter if the alarm is silenced. The signal is gated at Q1 by the 2 Hz square wave from U11-9. The ALARM signal is then enabled by a high at U5-2 (generated by counter U12-13) and a high from U14-11 (high output under any alarm condition).

The pulsed 550 Hz signal goes through voltage follower U10 and drives the speaker by way of U9 (a current amplifier). The 550 Hz square wave output from the drain of Q1 is OR'd through U7-4 and gates through U8-3 and U14-4 to drive the alarm LED.

Alarm silence signal

ALARM SILENCE is an active low signal. It does not stay active for more than 70 seconds in the case of LQS or Low Sat alarms.

Depressing the alarm silence switch on the front panel causes J3-19 to go momentarily low and causes NAND U1-3 to go low. This produces lows at U5-11, U7-13, and U4-1. Lows at U12-1, 7 (programmable counter) result in low output from U12-13. This low state is inverted to a high at U13-2 and, along with a high at AND gate U5-9 (LQS-Low Sat from U3-11), results in a high at U5-10. The high is then passed through OR gate U7-12, 11 to NAND U8-8 and is inverted at U13-14. The high is inverted at U13-15 and the flip-flop created by U5 (pins 8, 9, 10, 11, 12, and 13) produces lows at U12-1, 7.

The low at U12-13 is inverted to a high at U13-2 and will remain high for 50-70 seconds until counter U12 (which is clocked by 550 Hz from U11-5) times out. During this time, the inverted counter output at U13-2 is OR'd through U7-5 to hold a steady high state and prevent the alarm LED from flashing. At this point, U12-13 goes high and re-enables the audio at U5-2. If the alarm condition continues beyond the timeout period, the pulsed audio and alarm LED will continue.

2.4 Front panel interconnect board

The front panel interconnect PCB drawing, components, and schematic are in section **6.9 Front panel interconnect board**.

The front panel interconnect board, located in the front panel assembly, works as the display and switch interface which ultimately ties into the MINX board, via the MINX interface board. The board's three main functions are as follows:

- Picks up and directs the 14 signals to the LCD panel display controller.
- Inputs the three switch inputs from the front panel to the monitor.
- Lights the alarm LED, using a signal generated by the MINX board.

2.5 Printer terminator board

The printer terminator PCB drawing, components, and schematic are in section **6.10 Printer terminator board**.

The printer terminator board is installed only in monitors that do not have a printer. It allows the MINX board to send data directly to the MINX interface board, and from there to the display. (In monitors with a printer, MINX data is routed through the printer board.)

The printer terminator board is installed at J5 on the MINX interface board in all monitors that do not have a printer. It acts as a data patch. It forces data from the MINX directly to the front panel. The data is formatted only for the display. Conversely, when MINX data is routed through the printer board, the data is formatted for the printer and for the display.

The printer terminator board (0380-0500-052; BX# A127-004) is a useful troubleshooting tool. Its installation allows you to bypass the printer circuitry and separate the printer functions from the oximetry functions.

2.6 Power supply board

The power supply PCB drawing, components, and schematic are in section **6.13 Power supply board**.

Power control circuit

The power control circuit and random access memory (RAM) are powered at all times regardless of the position of the membrane panel power/standby switch, provided the battery is connected and holds an adequate charge. The rest of the monitor is powered when the membrane panel power switch is actuated. A shutdown operation takes place during a normal power-down operation or when the watchdog timer is not reset by the microcontroller.

When the membrane panel power switch is depressed, it generates active low signals POWER UP and STANDBY. These signals pass through the front panel interconnect board and enter the MINX interface board at J3-14. The active low that comes from the MINX interface board at J6 (pin 10) enters the power supply board at J3 (pin 10), where the signal name is STANDBY. The signal is routed to U10 (pin 6). U10 is a flip-flop, cross-coupled NAND gate and is set to the power-on condition.

As a result, the control signal OFF goes low (directing the microcontroller to leave the monitor on). U10 (pin 9) is asserted (high), causing the output at U10 (pin 10) to discharge C23 through CR16. The output of U8 (pin 4) then goes high, driving Q5's gate high to apply power to relay K1. The remainder of the monitor is powered through the relay contacts.

A second switch contact on the membrane panel power switch will make STANDBY, an active low signal on the MINX interface board at J6 (pin 1), go low momentarily. This sets the flip-flop, which consists of cross-coupled NAND gates U10 (pins 1, 2, 3) and U10 (pins 4, 5, 6). The reset condition of the flip-flop denotes the power-off state, and the control signal OFF is routed off-board to notify the microcontroller. The microcontroller senses the off condition at the next convenient interval (generally less than 100 msec). After the microcontroller has performed the necessary internal housekeeping, it asserts the SHUTDOWN signal.

When U8 (pins 1 and 2) receive the SHUTDOWN signal, the output at U8 (pin 3) goes low. This signal is inverted at U10 (pin 11) and the output goes high. This charges C23 through

CR19. When the threshold voltage at U8 (pins 5 and 6) is reached, the output at U8 (pin 4) switches to a low logic level, driving the gate of Q5 low. This interrupts the power to relay K1, dropping power to the rest of the monitor.

If the microcontroller fails to signal shutdown when the front panel switch is moved to the standby position, power-down will still occur in about 200 msec. This happens because U10 (pin 10) will charge C23 through R42. This results in power-down as described above and provides a fail-safe shutoff for the monitor.

Frequency detect circuit

The software computes the AC line frequency by sampling the squared-up signal F0. This signal is obtained by optically coupling the AC secondary circuit through U5 to generate a half-sine pulse at the input to U8 (pins 12 and 13). U8 (pin 11) outputs a clean pulse at J3-9 once for each cycle of the AC line. If the oximeter is not connected to the line, then no pulses are created.

AC to DC power conversion circuit

The monitor can be powered from an AC charger. The charger delivers a nonregulated 15.5 VAC RMS via a rear-panel DIN-style connector. AC power is rectified through full-wave bridge CR1 and filtered through C1. The output of this circuit is a nominal 18.8 VDC.

Battery charging circuit

The battery charging circuit charges the sealed lead-acid battery. The battery is the primary power source for the monitor. The charging circuit is controlled by the action of U2.

There are three charging modes: bulk charge, float charge, and trickle charge. The modes are controlled by R31, R32, and R13 through R16.

- **Bulk charge mode**—The circuit supplies a maximum charge current of 390 mA to the battery at a maximum level of 14.7 volts. This mode is terminated when the battery current acceptance falls below a fixed threshold of 80 mA. U2 then enters the float-charge mode.

- **Float charge mode**—The circuit supplies a constant 13.8 volts to the battery. This voltage can be maintained safely over an indefinite period of time. The resulting trickle of charge current can be distinguished from the true trickle-charge mode by examining the battery terminal voltage. The float charge is always delivered at 13.8 volts. The current can vary from 0 to 390 mA.

- **Trickle charge mode**—The circuit supplies approximately 2 mA. This mode is triggered if the terminal voltage falls below 10.5 volts. It protects the charging circuit if the battery fails.

Diodes CR11 and CR12 provide a current path for the monitor when the battery draws all available energy from the charger circuit. Diode CR13 prevents leakage from that path to the battery.

The battery circuit fuse should be serviced only by qualified service personnel. A blown fuse indicates one of the following problems:

- A defective charger circuit (delivery of an excessive charge current to the battery).
- A short-circuited load.

Switched-mode power supply

Five voltages are generated from the switched-mode power supply: +5 Logic, +V, -V, +15V, and -15V. These voltages are all created using a flyback (ringing choke) technique.

CR15 and R55 control the frequency of the internal clock of U9. Frequencies to observe at U9 - 11 are:

Minimum	Nominal	Maximum
33 kHz	39 kHz	46 kHz

The basic switching action is as follows: Q6 is turned on, allowing current to flow in the primary of T3. Current in the primary increases at a linear rate until a current threshold is exceeded, then Q6 is turned off. No current flows in the secondaries of T3 until current ceases to flow in the primary winding. Then, CR4, CR5, CR6, CR7, and CR21, in series with the output windings, become forward-biased. The rectified voltage is filtered by output capacitors C7 through 12, C16, C21, C23, and C24.

Control loops

The control loop for regulating the voltage is as follows: U9 drives the gate of Q6 with a duty cycle that increases with increasing demand on the supply outputs. Current in the primary winding is sensed across R57, filtered by R56 and C28, and routed to U9 (pins 3 and 4). U9 compares this voltage with an internal threshold programmed by R47 and R50 at pin 1 (C26 ramps this threshold up at power-up time to guarantee a soft start).

A second control loop tracks the +5V logic output through R52 and R54, then compares it to the internally generated 5.1-volt reference at pin 2 that is divided down by R48 and R49. U9 internally compares the error voltage to the current ramp and adjusts the switching duty cycle to maintain a constant output voltage on the sensed supply.

The other supply outputs are cross-regulated via the +5V secondary winding. Compensation of the control loop is achieved by compensation of the internal error amplifier with R53 and C20.

Backlight driver

The backlight driver sends an AC waveform to light the liquid crystal display (LCD) on the front panel. The processor oscillator runs at 3.68 MHz. This is divided by 8256 to provide an output signal of 450 Hz. The signal is transformer coupled and amplified to between 95 VAC and 130 VAC, and is then fed to the display EL panel.

Connector J5 on the power supply board acts as an interlock, allowing the signal only when the display is connected. The voltage coming from J5 (pins 1, 2, and 3) can be read from the black and red shielded LCD backlight cables where they connect to the LCD panel, which is part of the front panel assembly.

2.7 Printer operation

Thermal printing is based on the principle of heat transfer from a thermal print head to chemically treated paper (thermal paper). The thermal print head contains a row of eight, miniature heating elements that are constantly pressed against the thermal paper. The top seven heating elements are used for character printing; the eighth is used in graphics.

As a specific element generates heat, a thermo-chemical reaction takes place at the heat point on the paper and the paper colors. For example, Figure 2-e shows how a character composed of several dots can be printed on thermal paper by selectively heating various elements and moving the thermal head.

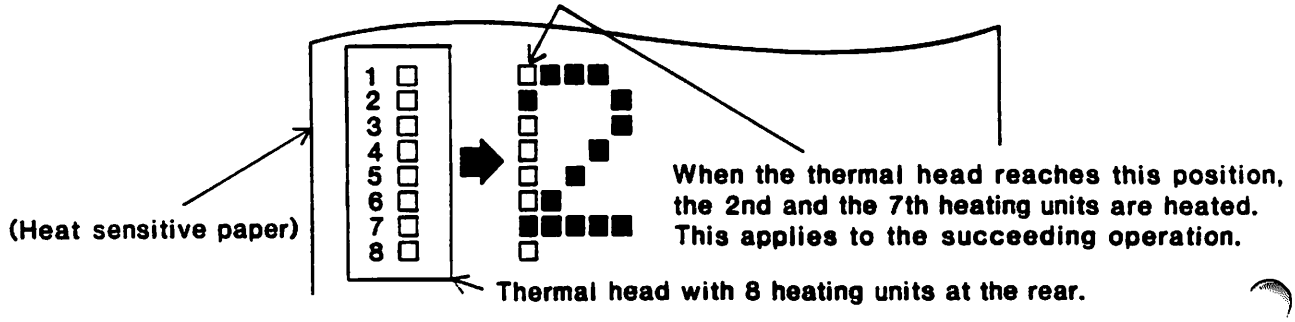


Figure 2-e. Printing a Character

Printing is performed by energizing a specific heating element on the thermal head. The energizing time (pulse width) must be carefully controlled to prevent the application of excessive energy to the heating element. This protects the thermal head and insures print quality.

Printer configuration

The microcontroller controls the circuits for pulse width, thermal head drivers, DC motor drive, and tachometer waveforms. The control circuit consists of four elements:

- Thermal head
- DC motor
- Tachometer
- Home switch

Thermal head—The microprocessor determines which of the vertical heating elements on the thermal head are energized. The pulse width control circuits ensure the print quality. The pulse width control is an oscillator whose frequency changes with voltage and ambient temperature. The required pulse width is obtained by counting a fixed number with the microprocessor. The control of two factors prevent the destruction of the thermal head:

- Control of the printing pulse width (t).
- Cooling time (T-t) for the heating unit after each pulse.

DC motor—A five-volt DC motor supplies the power for thermal head movement and the paper feed operation. The thermal head moves back and forth automatically when a direct current voltage is applied to the motor. Paper feed is performed as the thermal head returns.

Tachometer—The tachometer is coupled directly to the DC motor. It generates a two-cycle pseudo-sine wave for each motor revolution. The tachometer waveform shaping circuit converts the pseudo-sine wave into a square wave. The square wave functions as the timing signal for driving the thermal head.

Home switch—The home switch signals the microprocessor that the thermal head is correctly positioned to start a line of print. The home switch is a mechanical switch of the push open type. It opens when the thermal head is in the home position (left end). It closes as the thermal head moves to the right (from the home position).

2.8 Printer connector board

The printer connector PCB drawing, components, and schematic are in section **6.11 Printer connector board**.

The printer connector board acts as a data link between the printer board and the printer door mechanisms. It interfaces with the printer panel membrane switches, the print head, and the printer mechanism:

- Panel switch—takes the membrane switch status from the printer door and passes it to the printer board.
- Print head—acts as a direct link between the printer board and the thermal print heads.
- Printer mechanism—routes the printer timing and control signals between the printer board and the printer mechanism.

2.9 Printer board

The printer PCB drawing, components, and schematic are in section **6.12 Printer board**.

A Z80L microprocessor (U3) on the printer board controls the display and printer functions.

U2 contains the software that controls the display and printer—a 27C64, 8KB EPROM (Erasable Programmable Read Only Memory).

The RAM (U4) for the printer is a 6284 8K device.

Real-time clock (date and time)

Capacitors C1 and C3, crystal Y1, and a gate internal to chip U1 make up an oscillator running at 32.768 kHz. Trim capacitor C1 adjusts the clock speed. The chip is powered from the battery, when necessary.

Printer mechanism power supply

The motor is tied to +5V. FET's Q2 and Q3 pull the motor to ground during print cycles via logic from U5-1 and U15-8. Power for the print heads comes from FET array Q4 through Q11.

Data input

Input port U14 receives ASCII data or control characters from the MINX. This data is in the same format as the data used to drive the LCD panel. The input register select line (input RS) defines whether the input data is an ASCII character or a control word. The enable line (\E) latches the register select line (LRS) into half of a dual D flip-flop (U13) until the microprocessor can read the condition of input RS. Enable line \E also sets the other half of the flip-flop (1/2 U13). The flip-flop interrupts the microprocessor, requesting it to read the data from input port U14 and the individual switch status from the printer board. After the microprocessor reads the data, it resets the interrupt latch (U13) to wait for more data.

Input power (+V)

Input power for the printer board and the LCD is provided from the +5 volt digital supply on the power supply board via the MINX interface board.

Printer driver input port

Input port U20 reads the conditions of the switches on the printer door. In particular, it reads the home switch on the printer mechanism and the individual switch status from the printer board. The microprocessor deciphers the command response required.

Normally, the printer door switches are open and connected to +V PRINT (at +5 volts). These switches act against the pull-down resistors (RP3). When the print head is positioned to begin a new line, the home switch is open and pulls the home signal up. Otherwise, the home switch is closed (grounded). Resistor R9 and capacitor C34 make up a low-pass filter to debounce the home switch.

LCD data

The microprocessor sends data to the LCD through output port U6.

Printer system clock

A 1 MHz system clock drives the microprocessor. Crystal Y2, 1/6 of inverter U16, resistors R5 and R6, and capacitor C24 form a parallel resonant oscillator. A Quad Schmitt trigger (1/4 U15) is used to square up and buffer the waveform. This clock signal is sent into pin 6 of the microprocessor.

External reset

An external reset is provided to the board to synchronize timing. The power-on reset initializes the microprocessor to start its program at the beginning. In the off condition there is no voltage across capacitor C25. This means that the input of quad Schmitt trigger U15 is high and its output is low for reset (active low).

At power-on, resistor R7 starts charging C25, causing the input of U15-9 to slowly (approximately 1 second) drop to the input threshold. At this point the output of U15-8 switches to high (reset ends). During the reset process FET Q2 is off to prevent the printer motor from turning on. Diode CR3 provides a discharge path for C25 to protect the input of U15 during power-off.

Output control port

The U5 output port

1. Controls the printer motor by switching FET Q3 on and off.
2. Outputs the register select line (output RS) to the LCD.
3. Strobes data to the LCD with line \E.
4. Resets the U13 interrupt latch on the printer board.
5. Reinitializes the printer timer circuitry at U8.

Motor driver

The printer motor is a DC motor. It moves the print head and advances the printer paper. The printer motor is connected to +V PRINT to isolate the motor transients from the other circuitry. The motor is activated when FET's Q2 and Q3 turn on. Diode CR1 prevents large voltage spikes from occurring on the motor line as the motor is turned off.

Thermal head output port (U1)

The thermal heads are resistors connected to +V PRINT. They are located in the door assembly. An ON transistor (Q4 - Q11) heats its corresponding print head resistor.

Print timer tachometer input

A coil in the printer motor inputs a pseudo-sine wave cycle (tachometer signal) for every column position of the print head. A positive crossing of the tachometer signal defines the start of a column. Diode CR2, transistor Q1, and resistors R3 and R4 form an inverting zero crossing detector. This detector also shifts the tachometer signal to between 0 and 5 volts at the collector of Q1. Capacitor C22 filters noise to prevent false triggering of a falling tachometer signal. Schmitt trigger U15 squares up the signal before it passes to the digital circuitry.

One-half of flip-flop U8 trips on a rising clock signal at the time of a rising tachometer signal. Its Q output falls and enables both the print timer oscillator and print timer counter. The flip-flop set line (controlled by the microprocessor) is strobed to reinitialize all three print timer circuits for the next print column location.

Print timer oscillator

The print timer oscillator determines the print contrast. It is composed of three inverters from U16; resistors R10, R14, R15, R16; trim potentiometer R10; capacitor C35; diode CR5; and transistor Q1 in the door assembly. Flip-flop U8 divides the oscillator by two. Reset pin U8 and diode CR4 synchronize the oscillator and the divide-by-two stage with the start of a new column of dots. A faster oscillation frequency causes a lighter contrast.

Print timer counter

Counter U9 receives pulses on its clock line from the print timer oscillator. The first rising edge from the print timer oscillator represents the starting time of a print column. For print heads that were on during the printing of the previous column, the ninth rising edge denotes when they are turned off. This prevents overheating of those print heads.

The eleventh rising edge marks the time when the other print heads are turned off (i.e., all print heads are off at the end of a column). Output 0 of U9 signals both the start and stop points of the print column. Output 8 signals the point where some heads are turned off to prevent overheating. Output 0 and 8 are OR'd together with 1/4 of U10. The output is passed as a timing signal to the microprocessor in the form of a nonmaskable interrupt (\NMI).

Print timer time-out

The time-out circuit prevents the print heads from overheating if the microcontroller fails. Three conditions must be met before the print head resistors turn on:

1. The printer motor must be on.
2. Data must have been written to the head output port within the last 10 milliseconds (U-19-1 was recently strobed low).
3. The print head timer must have been tripped (U8-9 is high). This indicates a new column of dots is to occur.

If any of these conditions are not met, the print head driver transistors are turned off. They are turned off because retriggerable one-shot U12 causes the outputs of port U20 to enter the high impedance state allowing the pull-down resistors (RP2) to pull down the gates of the head driver transistors (Q4 - Q11). When these gates are pulled down, the transistors are turned off and power is not applied to the print heads (print head driver transistors).

Printer circuit timing

The printer circuit timings illustrated below in Figure 2-f are described on the pages that follow.

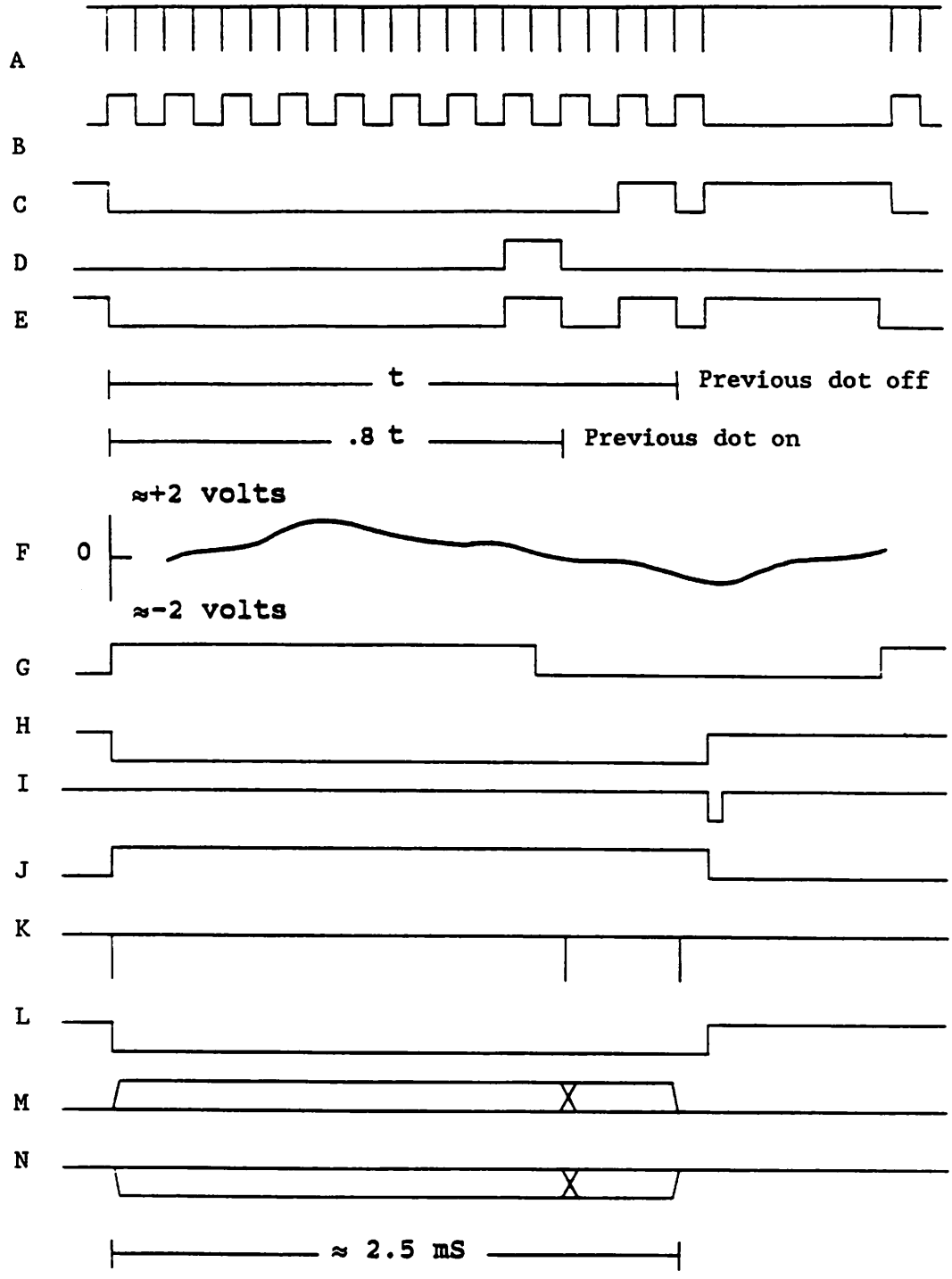


Figure 2-f. Printer Circuit Timing Chart

A Print oscillator output at approximately 8 kHz (U16-8). The frequency range is 6.7 kHz to 13.3 kHz, depending on the temperature of transistor Q1 in the door assembly, the supply voltage, and the setting of pot R10 on the printer board. The oscillator runs only when a column of dots is printed.

B Print oscillator output divided by 2 approximately equals 4 kHz (U8-5). The frequency range is 3.3 kHz to 6.7 kHz when the print oscillator is enabled. The output from U10-3 falling edge defines the nonmaskable interrupt (NMI) at the start of a column and at the end (all print heads off).

C Output 0 (U9-3). The output from U10-3 falling edge defines \NMI at the start of a column and at the end (all print heads off).

D Output 8 (U9-9). The falling edge output from U9-9 defines \NMI at .8t. (t = time required to print a column of dots). At this time the print heads, which were on during the printing of the last column, are turned off. This prevents excessive temperature rise of the print heads.

E Nonmaskable interrupt (\NMI) (U3-17). The \NMI causes the software program to jump to a routine that

- Turns on some print heads. Time 0t (the beginning of each print column)
- Turns off some print heads. Time .8t
- Turns off all the print heads. Time t (the end of each column)

F Tachometer cathode (CR2). A full pseudo-sine tracing represents 1 complete motor revolution and the width of 1 column of dots.

G Shaped and shifted tachometer (U8-11). The tachometer signal is squared up and level shifted to work with the digital circuitry.

H Print timer \RUNNING (U8-9). When this signal is low the print oscillator and 4017 counter (U9) will operate.

I Print timer ENABLE (U8-10). When the print timer is enabled, a low strobe comes from the microprocessor after a column is completed. This resets the printer circuitry for the next column.

J Print timer RUNNING inversion: \CLR = \H (U8-8). A high level allows the timeout circuit to enable the print head drivers.

K Printer SELECT (U8-11). A high level allows the timeout circuit to enable the print head drivers. Data is written to the print head output port U19 at the low strobes.

L Print head ENABLE (U19-1). A low level enables the print head drivers. If the microprocessor gets falters, the signal goes back to high in about 10 milliseconds, disabling the print head drivers.

M Data at print port (U19-12 through U19-19). The data at the print port controls the print head driver transistors. A high level turns on the driver and heats the print head. A low level turns off the print head.

N Print head drivers. The print head resistors are connected to +V PRINT. A low level at the drains of driver transistors Q4 through Q11 turns the print heads on.

Chapter 3: Tests and Adjustments

This chapter contains

- Important safety considerations for handling, testing, or making internal adjustments to the monitor.
- Procedures for checking the monitor's normal operation.
- Print contrast and display contrast adjustments.
- The procedure for testing and adjusting the real-time clock oscillator.
- The battery charging circuit test procedure.
- The procedure for checking the reference voltage on the MINX board.
- The leakage current test procedure.

3.1 Handling equipment safely

Before you test equipment that may be contaminated, comply with all safety procedures—see **1.3 Cleaning the monitor**.

Before you start a test procedure that involves disassembly of the monitor, **you must**

- Turn the monitor off.
- Disconnect the monitor from AC mains power.
- Disconnect any connected probe from the monitor.

3.1.1 Special tools

Use insulated tools when adjusting internal controls. The following tools are needed for the procedures in this chapter:

- Phillips screwdriver (#2)
- Slotted 1/16" screwdriver, nonconductive
- Static control work station
- Frequency counter
- Digital multimeter (300 mA capacity)
- Digital voltmeter
- Leakage current tester

3.2 Checking normal operation

Conduct these tests at regular intervals and every time the monitor is serviced. If any test fails, refer to **Chapter 4: Troubleshooting**.

3.2.1 Visual inspection

Visually inspect the monitor and verify the following:

- The case is undamaged.
- The display panel is clean.
- There is sufficient paper in the printer.
- All cables are in good condition and connected properly.
- The probe cable is not cut or crimped.

3.2.2 Power-up test

1. Connect the monitor to AC mains power.

WARNING: Patient safety—Do not, under any circumstances, perform any testing or maintenance on the monitor or on medical instruments that are being used to monitor a patient.

WARNING: Use only probes and cables, identified in the Ohmeda Probes Manual (0380-0900-085; BX# 1000-304), with this monitor; otherwise, patient injury or equipment damage may result.

WARNING: Prolonged monitoring or patient condition may require changing the probe test site periodically. Change the site at least every four hours to reduce the risk of blistering, skin erosion, or ischemic skin necrosis (especially if the site is poorly perfused).

2. Connect a probe to the monitor. Attach the probe to a finger or ear, depending on the type of probe.

3. Turn the monitor on and verify:
   - POWER ON is displayed and the power-up test begins.
   - When the test is finished, the following message is displayed: SYSTEM CHECK...
   - Shortly thereafter, SaO_2 and pulse rate data appear.

   Note: If the monitor fails the test, SERVICE UNIT displays. Power off and refer to **Chapter 4: Troubleshooting**.

4. Remove the probe from the finger or ear and verify:
   - The OFF PATIENT message is displayed. **Note:** This message may not appear when using the Flex II Probe or SoftProbe—the message may say LOW QUAL SGNL.
   - The alarm tone sounds and the red light flashes.

5. Unplug the probe from the monitor and verify:
   - The NO PROBE alarm message is displayed.
   - The alarm tone sounds and the red light flashes.
6. Turn the monitor off. The display should be blank.

3.2.3 Printer test

1. Power off. Disconnect the monitor from AC mains power.

CAUTION: Do not operate the printer without paper. Print head damage may result. The edges of the paper Ohmeda supplies are red near the end of the roll to indicate when to add paper.

2. Verify that the amount of printer paper is sufficient.

   If necessary, install a new roll of paper.

3. Check the date and time:
   a. Turn the monitor on.
   b. Hold down the Stop key until the date and time are displayed.
   c. Verify that the displayed date and time are accurate.
   d. If necessary, reset the date and time.

      For information on entering clock set mode to set he date and time, refer to Appendix B in the *3760 Operation and Maintenance Manual.*
   e. When you finish verifying or resetting the date and time, press the Stop key again.
   f. Verify that the displayed date and time are accurate.
   g. Turn the monitor off.
4. Hold down the Print Fast key and turn the monitor on.
5. Continue to hold down the Print Fast key until the display shows: * POWER ON *
6. Release the Print Fast key.
   - The display will briefly read: - PRINTER TEST -
   - After several other messages are displayed, the printer will begin to print.

   Note: Allow the printer to operate for at least 2 minutes before you attempt to adjust the print contrast (refer to **3.3 Print contrast adjustment**).
7. To stop the printer, press the Stop key.

3.3 Print contrast adjustment

The print contrast is adjusted by turning trim potentiometer R10, which is on the printer board. It is visible through the vent slot in the back of the monitor.

Equipment and tools

- Slotted 1/16" screwdriver, nonconductive

1. Power off. Disconnect the monitor from AC mains power.
2. Locate trim potentiometer R10:
   a. Turn the monitor so that the back faces you.
   b. Look through the vent hole slightly above and to the left of the power input jack.
   c. Notice the small screw (trim potentiometer R10) that's visible and accessible through the vent hole.
3. Hold down the Print Fast key and turn the monitor on.
4. Continue to hold down the Print Fast key until the display shows: * POWER ON *
5. To start the printer, release the Print Fast key.

   Note: Allow the printer to operate for at least 2 minutes before you attempt to adjust the print contrast.
6. While the printer is operating, use a nonconductive screwdriver to adjust trim potentiometer R10 for clear, readable printing.
   - To darken the print, turn the screw clockwise.
   - To lighten the print, turn the screw counterclockwise.

   The print should be free from bleeding and discernible from 3 feet.

   Note: Adjustments are not immediately reflected in the print-out.
7. When the print contrast is acceptable, press the Stop key.

3.4 Display contrast adjustment

The display contrast is adjusted by rotating trim potentiometer R6 on the MINX interface board.

Equipment and tools

- Phillips screwdriver (#2)
- Slotted 1/16" screwdriver, nonconductive

WARNING: Electrical shock and flammability hazard—Before servicing the monitor, always turn it off and disconnect it from AC mains power.

1. Power off. Disconnect the monitor from AC mains power.

CAUTION: Static sensitivity—The monitor's electronic components are susceptible to damage by electrostatic discharge. When disassembling the monitor, work at a static control work station and wear a static control wrist strap to discharge accumulated static charges.

2. Remove the top cover—see **5.2.1 Top cover removal**.
3. On the back left of the MINX interface board, locate trim potentiometer R6. It faces the front of the monitor.

Important: Avoid contact with the monitor's internal components during the following procedure to protect yourself from possible electric discharge.

4. Turn the monitor on.
5. Rotate R6 until the desired display contrast is achieved.
6. Turn the monitor off.
7. Install the top cover—see **5.2.6 Top cover installation**.
8. Test the monitor—see **3.2 Checking normal operation**.

3.5 Real-time clock oscillator adjustment

The real-time clock oscillator logs the time while the monitor provides patient readings. This procedure adjusts the frequency of the oscillator and resets the clock.

Use this procedure to help you determine if incorrectly displayed date and time result from a low battery, a problem with the printer board EPROM, or a defective printer board.

Equipment and tools

- Phillips screwdriver (#2)
- Slotted 1/16" screwdriver, nonconductive
- Frequency counter

WARNING: Electrical shock and flammability hazard—Before servicing the monitor, always turn it off and disconnect it from AC mains power.

1. Power off. Disconnect the monitor from AC mains power.

CAUTION: Static sensitivity—The monitor's electronic components are susceptible to damage by electrostatic discharge. When disassembling the monitor, work at a static control work station and wear a static control wrist strap to discharge accumulated static charges. Always handle circuit boards by their nonconductive edges.

2. Remove the top cover—see **5.2.1 Top cover removal.**

3. Access the printer board circuitry:
   a. Remove the 4 screws that fasten the board to the shield standoffs. Set them aside for reinstallation.
   b. Disconnect the cable from J2 on the printer board.
   c. Turn the board over. Rest it on an insulated surface.

Important: Avoid contact with the monitor's internal components during the following procedure to protect yourself from possible electric discharge.

4. Use a frequency counter to measure the frequency from U1 pin 8 (ground) to U1 pin 14.

5. Adjust the frequency:
   a. Turn the monitor on.
   b. Locate variable capacitor C1 in the bevelled corner of the printer board.
   c. Using a nonconductive slotted screwdriver, adjust C1 to set the signal output to 32.768 Hz ± 2 Hz.

      Note: On some adjustable capacitors, you may need to apply extra downward pressure.
   d. Turn the monitor off.
   e. Disconnect the frequency counter.
6. Connect the printer board:
   a. Connect the printer cable to J2 on the printer board.
   b. Turn the printer board over (component side down) and rest it on the standoffs.

Important: To avoid contact with the monitor's internal components during the following procedure, place the top cover on the monitor. You do not need to completely install it, but you **must** cover all internal components to protect yourself from possible electric discharge.

7. Turn the monitor on and hold down the Stop key until the date and time are displayed.
8. Check the settings (month, day, etc.) and reset the clock:

   Note: As you complete steps 8-a to 8-e, if some settings don't display correctly, try to reset them.

   a. To scroll through the months, hold down the Print Slow key. Verify that all 12 months display. Then scroll to and stop at the current month.
   b. To verify that all 7 days of the week display, hold down the Print Fast key. Then scroll to and stop at the current day.
   c. To verify that the last 2 digits of the year display, hold down the Graph Slow key. Then scroll to and stop at the current year.
   d. To verify that all the hours (01 to 12) display, hold down the Graph Fast key. Then scroll to and stop at the current hour.
   e. To verify that the minutes (00 to 59) display, hold down the Pause/Resume key. Then scroll to and stop at the current minute.

9. To set the clock, press the Stop key. Verify the settings.

   Note: If the date and/or time display incorrectly, there may be a problem with the printer EPROM.

10. Hold down the Stop key until the date and time are displayed again. Verify that they are displayed correctly.

    Note: If the date and/or time display incorrectly, the battery may be low. Recharge the battery and check the settings again, resetting them as needed. After resetting, if they're still incorrect, there may be a problem with the printer board.

11. Turn the monitor off.

12. Lift the cover off and install the 4 screws that fasten the printer board to the standoffs.

13. Install the top cover—see **5.2.6 Top cover installation**.

14. Test the monitor—see **3.2 Checking normal operation**.

3.6 Battery charging circuit test

This test checks the battery charging circuit on the power supply board to determine if the correct current is being supplied to the battery. Use this test when the battery is not holding a charge or charging, but appears to be in good working order.

Equipment and tools

- Phillips screwdriver (#2)
- Slotted 1/8" screwdriver, nonconductive
- Digital multimeter (300 mA capacity)

WARNING: Electrical shock and flammability hazard—Before servicing the monitor, always turn it off and disconnect it from AC mains power.

1. Power off. Disconnect the monitor from AC mains power.

CAUTION: Static sensitivity—The monitor's electronic components are susceptible to damage by electrostatic discharge. When disassembling the monitor, work at a static control work station and wear a static control wrist strap to discharge accumulated static charges. Always handle circuit boards by their nonconductive edges.

2. Remove the top cover—see **5.2.1 Top cover removal**.

3. Remove the printer board—see **5.2.2 Printer board removal**.

4. Remove the shield and board stack—see **5.2.3 Shield and board stack removal**.

Important: Avoid contact with the monitor's internal components during the following procedure to protect yourself from possible electric discharge.

5. Determine the current charge mode (bulk, float, or trickle) of the battery:

   Note: Do not disconnect the cables from the battery.

   a. Connect a digital multimeter to the red and black cable tab connectors on the battery.
   b. Connect the monitor to AC mains power and power on.
   c. Measure the voltage to determine the charge mode:
      - Trickle: $+V_{BATT}$ below 10.5 volts
      - Float: $+V_{BATT}$ at 13.8 volts
      - Bulk: $+V_{BATT}$ between 10.5 volts and 14.7 volts
   d. Disconnect the multimeter.

6. Determine if the battery charging circuit on the power supply board is providing the appropriate charge:

   a. Break into the circuit from the red battery cable to the + battery post and connect the digital multimeter in current mode.
   b. Measure the current to the battery and verify that it's in the acceptable range for the current charge mode.
      - Trickle: 2 mA
      - Float: 0 to 390 mA
      - Bulk: 80 to 390 mA
   c. Power off. Disconnect the monitor from AC mains power.
   d. Disconnect the multimeter.
   e. Reconnect the battery.

7. Install the shield and board stack—see **5.2.4 Shield and board stack installation**.

8. Install the printer board—see **5.2.5 Printer board installation**.

9. Install the top cover—see **5.2.6 Top cover installation**.

10. Test the monitor—see **3.2 Checking normal operation**.

3.7 MINX reference voltage check

Equipment and tools

- Phillips screwdriver (#2)
- Digital voltmeter

WARNING: Electrical shock and flammability hazard—Before servicing the monitor, always turn it off and disconnect it from AC mains power.

1. Power off. Disconnect the monitor from AC mains power.

CAUTION: Static sensitivity—The monitor's electronic components are susceptible to damage by electrostatic discharge. When disassembling the monitor, work at a static control work station and wear a static control wrist strap to discharge accumulated static charges. Always handle circuit boards by their nonconductive edges.

2. Remove the top cover—see **5.2.1 Top cover removal**.
3. If the monitor has a printer, remove the printer board:
   a. Remove the 4 screws that fasten the printer board to the shield.
   b. Disconnect the printer cable from J2 on the printer board.

      Note: Do not disconnect the printer board from the MINX interface board.
   c. Turn the board over. Rest it on an insulated surface.

Important: Avoid contact with the monitor's internal components during the rest of this procedure to protect yourself from possible electric discharge.

4. Connect the monitor to AC mains power and power on.
5. Using a voltmeter, measure the voltage across C54 on the MINX board.
   a. If the value is different from –1.024 volts ± 0.002, adjust R35 on the MINX board.
   b. Cycle power to the monitor and verify that the monitor passes self-calibration.
6. Power off. Disconnect the monitor from AC mains power.
7. If the self-calibration failed, replace the MINX board.

8. If the monitor has a printer, install the printer board:
   a. Connect the printer cable to J2 on the printer board.
   b. Place the printer board on the shield standoffs.
   c. Install the 4 screws into the standoffs.
9. Install the top cover——see **5.2.6 Top cover installation**.
10. Test the monitor—see **3.2 Checking normal operation**.

3.8 Leakage current test

Check the leakage current whenever the monitor is serviced—after completing all other repair and/or test procedures.

Equipment and tools

- Charger supplied with monitor
- Leakage current tester

1. Connect the monitor to AC mains power.
2. Follow the instructions supplied with your leakage current tester to measure the leakage current. It must not exceed 100 microamperes (USA/Canada).
3. Record the results for your reference in future leakage current tests. A significant change from test to test may indicate a pending failure.

Chapter 4: Troubleshooting

This chapter contains

- General guidelines for troubleshooting problems.
- Instructions for suppressing audible alarms.
- A list of the alarm messages, their possible causes, and related actions.
- A list of problems you might encounter, their causes, and possible actions to take to solve them.
- Instructions for separating the oximetry section from the printing section of the monitor to aid in troubleshooting.
- Guidelines for using the MINX board's red/green status indicator to identify and correct problems with the board.

4.1 Troubleshooting guidelines

You must thoroughly understand the normal operation of the monitor prior to servicing it. To learn how a properly operating monitor functions and to determine when it is functioning incorrectly, review the *3760 Pulse Oximeter Operation and Maintenance Manual*. Also, refer to the previous chapters of this manual.

Always inspect the monitor visually. Check for obvious conditions that may have caused the malfunction.

- Look for loose connections, broken wires, and broken or burned (discolored) components.
- Verify that all circuit boards are properly seated.
- Verify that all cables are properly connected.

Let the symptom be the guide.

- If only one function is not working, concentrate on the circuit that controls that function.
- If several functions are not working, locate a circuit that is common to all the affected functions.
- If the solution is not obvious, check the power supply circuits first.

4.2 Suppressing audible alarms

Low SaO_2 alarm

When the Low SaO_2 alarm limit is violated, an alarm tone sounds and the red alarm light flashes.

Pressing the Alarm Silence key suppresses the audible alarm for 60 seconds and changes the flashing red alarm light to steady red.

To review the current alarm limit setting, press the Alarm Limit Key.

Probe alarms

Probe alarms occur when the monitor detects conditions affecting the probe, its placement, or probe failure. Alarms can be silenced for 60 seconds with the following exceptions:

When OFF PATIENT or NO PROBE alarms occur,

- An alarm tone sounds.
- The red alarm light flashes.
- An alarm message is displayed.

Pressing the Alarm Silence key during either of the above alarms silences the audible alarm and changes the red alarm light from flashing to steady until one of the following conditions are met:

- The alarm condition is remedied.
- A different alarm condition is detected.
- A different message is displayed.

Note: No alarm sounds when the LOW LIGHT message is displayed. This is strictly a written message that is displayed when insufficient light is penetrating the tissue.

4.3 Alarm messages

Message	Possible Causes	Actions
CAL=--- PR=--- (message is displayed at start up for about 10 seconds)	MINX is in Calibration Mode. If message remains significantly longer than 10 seconds, the MINX board failed calibration.	Power off, then on. If this message is not replaced by a different message in about 10 seconds, replace MINX board.
CHECKSUM ERROR	Printer EPROM error.	Replace printer EPROM.
FIFO OVERFLOW	Buffer overflow.	Power off, then on. If this message reappears, power off. Disconnect battery. Wait 5 minutes, reconnect battery, and power on. If this message reappears, replace printer board.
ID ERROR	Probe not compatible with current software revision.	Use only probes specified for this monitor.
INTERFERENCE	High frequency interference at photodiode preamplifier output.	Operate from battery power or plug monitor into a different AC mains outlet. Shield probe site.
LO BAT (closing statistics print, then printer turns off)	Battery getting low—capacity below 50%.	Operate from AC mains power. Recharge battery.
LOW LIGHT (insufficient light penetrating tissue—no alarm sounds for this message)	Dirt on probe emitter, detector, or test site.	Clean probe and/or site.
	Thick tissue sample.	Select alternate site.
	Malpositioned probe.	Reposition probe.
	Light blocked by fingernail polish or pigmentation.	Remove polish or use alternate site.
	Detector failure.	Replace probe.

4.3 Alarm messages (continued)

Message	Possible Causes	Actions
LOW QUAL SGNL	Probe fell off.	Reattach probe.
	Improper use of probe.	Check probe attachment and placement. Use probe according to instructions for that model in.the *Ohmeda Probes Manual* (0380-0900-085; BX# 1000-304).
	Excessive motion at site.	Have patient remain as motionless as possible.
	Insufficient probe site perfusion.	Vigorously rub site 20-30 seconds. Check setup.
	Thick tissue sample.	Select alternate site.
		If problem persists, use a different probe.
LOW SaO_2 = xxx	Alarm limit setting has been violated.	**If appropriate**, change alarm set point.
NO PROBE	Probe improperly connected to monitor.	Insert probe fully into probe connector.
OFF PATIENT	Probe off patient.	Attach probe to patient.
PROBE/UNIT FAIL (2 second alarm, then shutoff)	Probe failure.	Replace probe or replace intermediate cable.
	Probe circuit failure.	Check for loose, pinched, or crimped wires and/or probe harness on MINX board. If problem persists, replace MINX board.
RAM ERROR	Error in RAM detected during power-up test.	Power off, then on. If this message reappears, power off. Disconnect battery. Wait 5 minutes, reconnect battery, and power on. If this message reappears, replace MINX board.

4.3 Alarm messages (continued)

Message	Possible Causes	Actions
RECHARGE BATT (monitor turns off 10 seconds after message appears)	Battery unable to supply proper operating voltage.	To continue operation, switch to AC mains power. Recharge battery.
ROM ERROR	Error in ROM detected during power-up test.	Power off, then on. If this message reappears, replace MINX board.
SaO_2=--- PR=--- **or** SaO_2=---.-PR=---.- (Fractional Mode)	Invalid readings at probe site due to ambient light, poor perfusion, or excessive motion.	Shield site from ambient light. Vigorously rub site to increase perfusion. Keep patient and probe still.
SERVICE UNIT	Error detected during power-up system test.	Power off. Check all wiring and harnesses.
	Faulty battery charging circuit on power supply board.	Test battery charging circuit on power supply board (see section **3.6**).
	Power supply failure.	Check voltages on power supply board (see table below). If any voltages are out of range, replace power supply board.

DVM Connection (Power Supply Board)

+	Common	Voltage (DC)	Power Supply
J3-4	J3-15	4.55 to 5.25	+ V RAM
J3-13	J3-15	4.75 to 5.25	+ 5 V
J3-23	J3-25	4.75 to 5.25	+ V
J3-21	J3-25	– 4.75 to – 5.25	– V
J3-17	J3-25	14.25 to 16.00	+ 15 V
J3-19	J3-25	– 14.75 to – 16.00	– 15 V

SYSTEM CHECK...	Power-up system test in progress.	Wait until test is finished before using monitor.
SYSTEM ERROR X (X = an error code)	Internal hardware failure detected during power up.	Replace MINX board.

4.4 Operational problems

Problem	Possible Causes	Actions
NO PROBE message does not appear when probe is removed.	MINX error.	Turn monitor off, then on. If problem persists, replace MINX board.
Display blank or hard to read (power is on).	Poor display contrast.	Adjust display contrast.
	Battery needs charging.	Operate from AC mains power. Recharge battery.
	Internal circuit failure or blown fuse.	If monitor won't operate on AC mains power, replace the fuse.
Incorrect date and/or time are displayed.	Clock set improperly.	Reset date and time.
	Low battery voltage.	Recharge battery.
	Real-time clock oscillator out of adjustment.	Adjust the real-time clock oscillator (see section **3.5**).
Monitor does not power on.	Improperly connected or damaged power or battery cables.	Check power and battery cable connections. Check for damaged cables.
	Defective membrane panel power switch.	Press membrane power switch and measure voltage. If voltage is not almost 0 volts, replace membrane panel.
	Improperly seated or defective power supply board.	Reseat board. If problem persists, replace power supply board.
Monitor on battery power does not power on.	Battery failure.	Recharge battery. If problem persists, replace battery.
	Faulty battery charging circuit on power supply board.	Test battery charging circuit on power supply board (see section **3.6**).

4.4 Operational problems (continued)

Problem	Possible Causes	Actions
Monitor on AC mains power does not power on.	Defective power input cable.	Replace power input cable assembly.
	Inadequate voltage from wall receptacle.	Check voltage from wall receptacle.
	Defective AC mains power line filter.	Replace AC mains power line filter.
	Defective fuse in power input cable assembly.	If green indicator lamp on front panel is not lit, replace the fuse.
	Defective power supply board.	Replace power supply board.
Monitor powers on, but shuts off immediately.	Defective probe.	Replace probe.
	Defective membrane panel power switch.	Press switch and measure voltage. If voltage is not almost 0 volts, replace membrane panel.
	Improperly seated MINX EPROM.	Reseat EPROM on MINX board.
	Defective power supply board.	Check voltages on power supply board. If voltages are out of range, replace power supply board.
	Defective MINX board.	Check red/green LED status indicator on MINX board. If it's not flashing, replace MINX board.
Monitor does not power off.	Defective membrane panel power switch.	Press switch and measure voltage. If voltage is not almost 0 volts, replace membrane panel.
	Defective power supply board.	Check voltages on power supply board. If voltages are out of range, replace power supply board.

4.4 Operational problems (continued)

Problem	Possible Cause	Actions
Battery won't charge or hold a charge.	Poor cable connections.	Check cable connections.
	Defective battery.	Replace battery.
	Faulty battery charging circuit on power supply board.	Test battery charging circuit on power supply board (see section **3.6**).
Print-out too light.	Poor print contrast.	Adjust print contrast.
Printer won't print.	Out of paper	Install new paper roll.
	Paper jammed.	Pull paper out through **front** of printer door. If necessary, open printer door and remove paper jam. Do not pull paper through back of printer door.
	Defective printer motor.	Replace printer mechanism.
	Loose connections to printer door or damaged cables.	Check all printer door connections. Check cables for damage.
Dots missing from print-out.	Defective print heads.	Replace printer mechanism.
	Print drivers stuck on high or low.	Replace printer board.

4.5 Monitor reconfiguration

This procedure is used only if the monitor has a printer. It removes the printer circuitry from between the oximetry section and the display.

Use this procedure to determine whether a fault lies within the oximetry section or within the printer section of the monitor.

Equipment and tools

- Phillips screwdriver (#2)
- Printer terminator board (0380-0500-052; BX# A127-004)

4.5.1 Bypass printer circuitry

WARNING: Electrical shock and flammability hazard—Before servicing the monitor, always turn it off and disconnect it from AC mains power.

1. Power off. Disconnect the monitor from AC mains power.

CAUTION: Static sensitivity—The monitor's electronic components are susceptible to damage by electrostatic discharge. When disassembling the monitor, work at a static control work station and wear a static control wrist strap to discharge accumulated static charges. Always handle circuit boards (replacement and defective) by their nonconductive edges and use anti-static containers when transporting them.

2. Remove the top cover—see **5.2.1 Top cover removal**.

3. Disconnect the printer board cable from J5 on the MINX interface board.

4. Install a printer terminator board on the MINX interface board at J5, carefully aligning the pins in the socket.

   Important: To avoid contact with the monitor's internal components during the following verification procedure, place the top cover on the monitor. You do not need to completely install it, but you **must** cover all internal components to protect yourself and others from possible electric discharge.

5. Turn the monitor on. Each of the following messages should briefly be displayed in the order shown:

   *** POWER ON ***

   SaO_2=--- PR=---

   NO PROBE

   Note: The three asterisks (instead of one) on each side of POWER ON indicate the exclusion of the printer circuitry.

4.5.2 Return to normal configuration

1. Turn the monitor off (if on).
2. Remove the top cover.
3. Remove the printer terminator board from J5 on the MINX interface board.
4. Reconnect the printer board cable you disconnected earlier to J5 on the MINX interface board.

   Important: To avoid contact with the monitor's internal components during the following verification procedure, place the top cover on the monitor. You do not need to completely install it, but you **must** cover all internal components to protect yourself and others from possible electric discharge.

5. Turn the monitor on. Each of the following messages should briefly be displayed in the order shown:

   * POWER ON *

   SaO_2=--- PR=---

   NO PROBE

   Note: The single asterisks (instead of three) on each side of POWER ON indicate the presence of the printer.

6. Turn the monitor off.
7. Reinstall the top cover—see **5.2.6 Top cover installation**.
8. Test the monitor—see **3.2 Checking normal operation**.

4.6 Using the MINX board status indicator

A red/green LED status indicator (D4) is located near the EPROM socket (U26) on the MINX board. When the board is powered, the indicator should toggle back and forth between red and green at a 1 Hz rate.

- If the indicator stops flashing approximately 8 seconds after the board is powered, the analog section of the board may be defective. Replace the MINX board.
- If the monitor is powered on and the indicator immediately fails to flash back and forth, the digital section of the board may be defective. Replace the MINX board.
- If the indicator flashes several times but stops in fewer than 8 seconds, the RAM or I/O chips may be defective. This situation may be accompanied by a RAM ERROR message on the monitor's screen. Replace the MINX board.

Verify that the EPROM is plugged into its socket if the status indicator is lit solidly (is not flashing).

Verify that the processor is plugged into its socket (U16) if the LEDs appear to turn on and off randomly.

Chapter 5: Repair Procedures

This chapter provides

- Important safely.procedures for repairing the monitor.
- Instructions for frequently used procedures, including how to remove and install the top cover, the printer board, and the shield and board stack.
- Procedures for replacing front panel components, including the probe cable assembly, membrane panel, interconnect board, and the LCD panel.
- Procedures for replacing the power supply board, transistor, battery, and the speaker.
- Replacement procedures for the MINX interface board, the MINX board, and the MINX EPROM.
- Procedures for replacing printer components, including the printer board, the printer EPROM, the printer door, and the printer door assembly.

Note: The parts used in these procedures are illustrated in sections **6.3 3760 with printer** and **6.4 3760 without printer**. Additional illustrations for a specific procedure are noted at the beginning of that procedure.

5.1 Handling equipment safely

Before you repair equipment that may be contaminated, comply with all safety procedures—see **1.3 Cleaning the monitor**.

Before you start any repair procedure that involves disassembly of the monitor, **you must**

- Turn the monitor off.
- Disconnect the monitor from AC mains power.
- Disconnect any connected probe from the monitor.

Use insulated tools when adjusting internal controls.

5.2 Frequently used repair procedures

Most repairs require the use of certain procedures, such as the removal and subsequent installation of the top cover. To avoid unnecessary repetition, the full procedures are included here; references to these procedures are provided when appropriate.

Note: For monitors that do not have a printer, disregard steps related to removing and installing the printer board.

Equipment and tools

- Phillips screwdriver (#2)

5.2.1 Top cover removal

WARNING: Electrical shock and flammability hazard—Before servicing the monitor, always turn it off and disconnect it from AC mains power.

CAUTION: Static sensitivity—The monitor's electronic components are susceptible to damage by electrostatic discharge. When disassembling the monitor, work at a static control work station and wear a static control wrist strap to discharge accumulated static charges. Always handle circuit boards (replacement and defective) by their nonconductive edges and use anti-static containers when transporting them.

1. Turn the monitor upside down.
2. Remove the 4 screws on the bottom of the monitor. Set them aside for reinstallation.
3. Turn the monitor right side up with the front panel facing toward you.
4. Open the door on the right side of the monitor.
5. Hold the sides of the top cover and gently lift it off. Turn it upside down and place it behind the monitor.

   Note: Do not separate the top cover and the attached power supply cable.

5.2.2 Printer board removal

This procedure assumes the top cover has been removed.

1. Disconnect the printer board cable from J5 on the MINX interface board.
2. Remove the 4 screws that attach the printer board to the shield standoffs. Set them aside for reinstallation.
3. Lift the board and turn it over, resting it on an insulated surface between the board and the printer door.

   Note: It is not necessary to disconnect the printer cable or to unclip the cable from its plastic clip next to the paper roll, except where noted in a specific procedure.

5.2.3 Shield and board stack removal

Several boards (Printer, MINX, MINX Interface, Power Supply) and other components, such as the speaker, are attached to the shield. Use this procedure to access the power input cable and fuse, the battery, speaker, transistor cable assembly, and the power supply board.

This procedure assumes the top cover **and** the printer board have been removed.

1. Remove the MINX board:
   a. Disconnect the probe cable from J2 on the MINX board.
   b. Remove the nut and washer that fasten the MINX board to the shield. Set them aside for reinstallation.
   c. Gently lift and disconnect the MINX board from J4 on the MINX interface board.
2. Detach the shield from the bottom case:
   a. Remove the 4 screws and washers that attach the back of the shield to the bottom case.
   b. Remove the screw and washer that attach the left side of the MINX interface board.
   c. On the MINX interface board, remove the screw, washer, and spacer that attach the toroid.
   d. Set all screws and washers aside for reinstallation.
3. Disconnect the MINX interface board cable from J1 on the front panel interconnect board.

4. Remove the shield:

   Note: The MINX interface board remains on top of the shield; the power supply board is underneath the shield.

   a. Carefully lift up the front of the shield.
   b. Disconnect the LCD backlight cable from J5 on the power supply board.
   c. Turn the shield over and rest it on an insulated surface.

      Note: Turn the battery with the shield.

   d. Note the routing of all cables.

5.2.4 Shield and board stack installation

1. Install the shield in the monitor:

   a. Turn the shield over and connect the LCD backlight cable to J5 on the power supply board.
   b. Route all cables as shown in **6.3 3760 with printer** or **6.4 3760 without printer**.
   c. Rest the shield on the bottom case bosses.

2. Connect the MINX interface board to J1 on the front panel interconnect board.

3. Attach the shield to the bottom case:

   a. Install the 4 washers and screws that attach the back of the shield to the bottom case.
   b. Install the washer and screw at the left side of the MINX interface board.
   c. On the MINX interface board, install the spacer, washer, and screw that attach the toroid.

4. Install the MINX board:

   a. Place the board on the shield, aligning the mounting bracket over the stud.
   b. Align the board with J4 on the MINX interface board, then firmly press the board into header J4.
   c. Install the mounting bracket washer and screw.
   d. Connect the probe cable to J2 on the MINX board.

5.2.5 Printer board installation

1. Place the printer board on the 4 standoffs attached to the shield (component side down).
2. Install the 4 screws that attach the board to the shield standoffs.
3. Connect the printer board cable to J5 on the MINX interface board.

   Note: It is not necessary to connect the printer cable or to clip the printer cable into its plastic clip next to the paper roll, except where noted in a specific procedure.

5.2.6 Top cover installation

1. Make sure that
   - The monitor is powered off and disconnected from AC mains power.
   - All wires and cables are inside the monitor and are routed properly.
   - The door pivot pins are in the bottom case slots and the door is open.
2. Slide the top cover onto the bottom case.
   - Make sure the door pin supports fit into the grooves on the bottom case next to the door.
   - Check for any pinched cables.
   - Make sure that the front panel slides into the groove in the front, underside of the top cover.
3. Hold the top cover in place with one hand and close the door, snapping it in place.
4. Hold the top cover firmly in place and turn the monitor upside down.
5. Install the 4 screws you removed earlier into the monitor's bottom case.
6. Turn the monitor right side up.

Important: You must check the monitor for normal operation after completing any procedure that involves removing the cover—see **3.2 Checking normal operation.**

5.3 Probe cable replacement

The parts used in this procedure are illustrated in sections **6.7 Front panel assembly** and **6.8 Probe cable assembly**.

Equipment and tools

- Phillips screwdriver (#2)
- Socket wrench, 1/4"
- Open-end wrench, 11/16"
- Pin extractor (X-Acto knife or Dupont P/N HT-80)

5.3.1 Probe cable removal

WARNING: Electrical shock and flammability hazard—Before servicing the monitor, always turn it off and disconnect it from AC mains power.

1. Power off. Disconnect the monitor from AC mains power.

CAUTION: Static sensitivity—The monitor's electronic components are susceptible to damage by electrostatic discharge. When disassembling the monitor, work at a static control work station and wear a static control wrist strap to discharge accumulated static charges. Always handle circuit boards by their nonconductive edges.

2. Remove the top cover—see **5.2.1 Top cover removal**.
3. Remove the printer board—see **5.2.2 Printer board removal**.
4. Disconnect the MINX interface board ribbon cable from J1 on the front panel interconnect board.
5. Lift the front panel from the bottom case slot and place it in front of the monitor.
6. Remove the plug housing from the probe cable:
   a. Disconnect the probe cable plug housing from J2 on the MINX board.
   b. Using a pin extractor, carefully lift the plug housing tab up and slide each pin out.

      Important: Do not cut or break the tab.
   c. If you are not replacing the plug housing, set it aside for reinstallation.

7. Remove the probe cable from the toroid:
   a. Remove the screw, washer, and spacer used to attach the toroid to the MINX interface board. Set them aside for reinstallation.
   b. Remove the cable clamp and unwrap the cable from the toroid.
   c. If you are not replacing the toroid and/or cable clamp, set them aside for reinstallation.
8. Remove the probe cable from the membrane panel:
   a. Remove the large nut and O-ring from the socket housing. Set them aside for reinstallation.
   b. Remove the socket housing and cable from the membrane panel.
   c. If you are not replacing the socket housing and cable, set them aside for reinstallation.

5.3.2 Probe cable installation

1. Install the probe cable socket housing:

   Note: Refer to **6.8 Probe cable assembly** for the location of socket housing pins 1 through 9.

   a. Verify that the colored probe cable wires are installed in the correct socket housing pins as shown below.

Wire Color/Type	Pin
Orange	1
Green	2
White	3
Red	4
Yellow	5
Blue	6
Violet	7
Black	8
(Shield)	9

Figure 5-a. Socket Housing Wire Placement

   b. From the front of the monitor, insert the cable through the membrane panel hole.
   c. Fit the socket housing notch into the groove in the membrane panel.
   d. At the back of the monitor, install the O-ring and large nut on the socket housing.

2. Attach the toroid:
   a. Wrap the cable around the toroid 5 times as shown in **6.7 Front panel assembly**.
   b. Attach the cable clamp to the new ring.
   c. Install the spacer, washer, and screw used to attach the toroid cable clamp to the MINX interface board.
3. Install the plug housing:

   Note: Refer to **6.7 Front panel assembly** for the location of plug housing pins 1 through 10.

   a. Insert each colored wire into the correct plug housing pin as shown in Figure 5-b. **Note:** Pin 10 is not used.

Wire Color/Type	Pin
Black	1
(Shield)	2
Violet	3
Red	4
White	5
Yellow	6
Blue	7
Green	8
Orange	9

Figure 5-b. Plug Housing Wire Placement

   b. Connect the probe cable plug housing to J2 on the MINX board.
4. Slide the front panel into the bottom case slot.
5. Connect the MINX interface board cable to J1 on the front panel interconnect board.
6. Install the printer board—see **5.2.5 Printer board installation**.
7. Install the top cover—see **5.2.6 Top cover installation**.
8. Test the monitor—see **3.2 Checking normal operation**.

5.4 Membrane panel replacement

The parts used in this procedure are illustrated in sections **6.7 Front panel assembly** and **6.8 Probe cable assembly**.

Equipment and tools

- Phillips screwdriver (#2)
- Socket wrench, 1/4"
- Open-end wrench, 11/16"
- Pin extractor (X-Acto knife or Dupont P/N HT-80)

1. Remove the probe cable—see **5.3.1 Probe cable removal**.
2. Detach the front panel interconnect board and LCD panel:
   a. Gently disconnect the membrane panel cable from J2 on the interconnect board.
   b. Remove the 3 nuts that attach the interconnect board to the membrane panel. Set them aside for reinstallation.
   c. Remove the 2 nuts that attach the LCD panel to the membrane panel. Set them aside for reinstallation.
   d. Gently lift the still-connected LCD panel and interconnect board from the 5 studs.

   Note: Do not remove the 2 plastic spacers.
3. Remove the 5 (one long; 4 short) plastic spacers from the old membrane panel studs. Note the location of the long spacer, then set all of the spacers aside for reinstallation.
4. On the new membrane panel, place the 5 plastic spacers on the 5 studs.
5. Attach the front panel interconnect board and LCD panel:
   a. Place the still-connected LCD panel and interconnect board on the 5 membrane panel studs.
   b. Install the 2 nuts that attach the LCD panel to the membrane panel.
   c. Install the 3 nuts that attach the interconnect board to the membrane panel.
   d. Gently connect the membrane panel cable to J2 on the interconnect board.
6. Install the probe cable assembly—see **5.3.2 Probe cable installation**.

5.5 Front panel interconnect board replacement

The parts used in this procedure are illustrated in sections **6.7 Front panel assembly** and **6.9 Front panel interconnect board**.

Equipment and tools

- Phillips screwdriver (#2)
- Socket wrench, 1/4"

WARNING: Electrical shock and flammability hazard—Before servicing the monitor, always turn it off and disconnect it from AC mains power.

1. Power off. Disconnect the monitor from AC mains power.

CAUTION: Static sensitivity—The monitor's electronic components are susceptible to damage by electrostatic discharge. When disassembling the monitor, work at a static control work station and wear a static control wrist strap to discharge accumulated static charges. Always handle circuit boards (replacement and defective) by their nonconductive edges and use anti-static containers when transporting them.

2. Remove the top cover—see **5.2.1 Top cover removal**.
3. Disconnect the MINX interface board cable from J1 on the front panel interconnect board.
4. Lift the front panel from the bottom case slot and place it in front of the monitor.
5. Disconnect and remove the front panel interconnect board.
   a. Gently disconnect the membrane panel cable from J2 on the interconnect board.
   b. Remove the 3 nuts that attach the interconnect board to the membrane panel and remove the board. Set the nuts aside for reinstallation.
6. Install the new front panel interconnect board:
   a. Place the new interconnect board on the 3 studs, aligning its display header with the LCD panel pins.
   b. Install the 3 nuts that attach the board to the membrane panel.
   c. Carefully connect the membrane panel cable to J2 on the interconnect board.
7. Slide the front panel into the bottom case slot.

8. Connect the MINX interface board cable to J1 on the interconnect board.
9. Install the top cover—see **5.2.6 Top cover installation**.
10. Test the monitor—see **3.2 Checking normal operation**.

5.6 LCD panel replacement

The parts used in this procedure are illustrated in section **6.7 Front panel assembly**.

Equipment and tools

- Phillips screwdriver (#2)
- Socket wrench, 1/4"

5.6.1 LCD panel removal

WARNING: Electrical shock and flammability hazard—Before servicing the monitor, always turn it off and disconnect it from AC mains power.

1. Power off. Disconnect the monitor from AC mains power.

CAUTION: Static sensitivity—The monitor's electronic components are susceptible to damage by electrostatic discharge. When disassembling the monitor, work at a static control work station and wear a static control wrist strap to discharge accumulated static charges. Always handle circuit boards (replacement and defective) by their nonconductive edges and use anti-static containers when transporting them.

2. Remove the top cover—see **5.2.1 Top cover removal**.
3. Remove the printer board—see **5.2.2 Printer board removal**.
4. Remove the shield to disconnect the LCD backlight cable—see **5.2.3 Shield and board stack removal**.

   Note: Do not turn the shield all the way over—just detach it from the bottom case.

5. Lift the front panel from the bottom case slot and place it in front of the monitor.

6. Remove the front panel interconnect board:
   a. Gently disconnect the membrane panel cable from J2 on the interconnect board.
   b. Remove the 3 nuts that attach the interconnect board to the membrane panel. Set them aside for reinstallation.
   c Lift the interconnect board, separating it from the LCD panel. Do not bend the LCD panel pins.
7. Remove the old LCD panel:
   a. Remove the 2 short plastic spacers and set them aside for reinstallation.
   b. Remove the 2 nuts that attach the right side of the LCD panel to the membrane panel. Set them aside for reinstallation.
   c. Lift the LCD panel from the 4 studs.

5.6.2 LCD panel installation

1. Inspect the new LCD panel for defects. If necessary, clean it with isopropyl alcohol on a lint-free cloth.
2. Place the new LCD panel on the 4 membrane panel studs and install the 2 nuts that attach it to the right side of the membrane panel.
3. Install the front panel interconnect board:
   a. Place the 2 short plastic spacers on the 2 studs at the left of the LCD panel.
   b. Place the interconnect board on its 3 studs, aligning its display header with the pins on the LCD panel.
   c. Install the 3 nuts that attach the board to the membrane panel.
   d. Connect the membrane panel cable to J2 on the interconnect board.
4. Slide the front panel into the bottom case slot.
5. Install the shield and board stack—see **5.2.4 Shield and board stack installation**.
6. Install the printer board—see **5.2.5 Printer board installation**.
7. Install the top cover—see **5.2.6 Top cover installation**.
8. Test the monitor—see **3.2 Checking normal operation**.

5.7 Power supply board replacement

Equipment and tools

- Phillips screwdriver (#2)
- Slotted 1/4" screwdriver, nonconductive

5.7.1 Power supply board removal

WARNING: Electrical shock and flammability hazard—Before servicing the monitor, always turn it off and disconnect it from AC mains power.

1. Power off. Disconnect the monitor from AC mains power.

CAUTION: Static sensitivity—The monitor's electronic components are susceptible to damage by electrostatic discharge. When disassembling the monitor, work at a static control work station and wear a static control wrist strap to discharge accumulated static charges. Always handle circuit boards (replacement and defective) by their nonconductive edges and use anti-static containers when transporting them.

2. Remove the top cover—see **5.2.1 Top cover removal**.
3. Remove the printer board—see **5.2.2 Printer board removal**.
4. Remove the shield and board stack—see **5.2.3 Shield and board stack removal**.
5. Detach the old power supply board:
   a. Unlatch and disconnect the MINX interface board ribbon cable from J3 on the power supply board.
   b. Unlatch and disconnect the power input cable from J1 on the power supply board.
   c. Remove the 4 screws and washers that attach the power supply board to the shield. Set them aside for reinstallation.
   d. Slide the board out from under the speaker.
6. Disconnect the transistor cable from J2 on the power supply board and remove the board.

5.7.2 Power supply board installation

1. Connect the transistor cable to J2 on the power supply board.
2. Install the new power supply board:
   a. Slide the board in under the speaker.
   b. Install the 4 washers and screws that attach the board to the shield.
   c. Connect the power input cable to J1 on the power supply board.
   d. Connect the MINX interface board cable to J3 on the power supply board.
3. Install the shield and board stack—see **5.2.4 Shield and board stack installation**.
4. Install the printer board—see **5.2.5 Printer board installation**.
5. Install the top cover—see **5.2.6 Top cover installation**.
6. Test the monitor—see **3.2 Checking normal operation**.

5.8 Transistor replacement

Equipment and tools

- Phillips screwdriver (#2)
- Slotted 1/4" screwdriver, nonconductive

1. Remove the power supply board—see **5.7.1 Power supply board removal**.
2. Turn the shield over and remove the screw and washer at the right side of the MINX interface board. Set them aside for reinstallation.
3. Remove the transistor screw and disconnect the transistor cable. Set the screw aside for reinstallation.
4. To install the new transistor, connect the new cable a install the screw.
5. Install the washer and screw that fasten the right sid of the MINX interface board to the shield.
6. Install the power supply board—see **5.7.2 Power supp board installation**.

5.9 Battery replacement

WARNING: Unqualified personnel should not attempt to install, connect, or replace the battery.

Equipment and tools

- Phillips screwdriver (#2)

WARNING: Electrical shock and flammability hazard—Before servicing the monitor, always turn it off and disconnect it from AC mains power.

1. Power off. Disconnect the monitor from AC mains power.

CAUTION: Static sensitivity—The monitor's electronic components are susceptible to damage by electrostatic discharge. When disassembling the monitor, work at a static control work station and wear a static control wrist strap to discharge accumulated static charges. Always handle circuit boards by their nonconductive edges.

2. Remove the top cover—see **5.2.1 Top cover removal**.
3. Remove the printer board—see **5.2.2 Printer board removal**.
4. Remove the shield and board stack—see **5.2.3 Shield and board stack removal**.
5. Disconnect the red and black cables at the battery terminals and remove the old battery.
6. Install the new battery:

WARNING: Battery replacement—Reversing the battery connections could result in injury and will permanently damage the circuitry.

   a. Connect the red cables to the positive battery terminal and the black cables to the negative battery terminal.
   b. Check the integrity of the fuse before completing reassembly.

7. Install the shield and board stack—see **5.2.4 Shield and board stack installation**.
8. Install the printer board—see **5.2.5 Printer board installation**.
9. Install the top cover—see **5.2.6 Top cover installation**.
10. Test the monitor—see **3.2 Checking normal operation**.

5.10 Speaker replacement

The parts used in this procedure are illustrated in section **6.6 Speaker assembly**.

Equipment and tools

- Phillips screwdriver (#2)
- Socket wrench, 1/2"

WARNING: Electrical shock and flammability hazard—Before servicing the monitor, always turn it off and disconnect it from AC mains power.

1. Power off. Disconnect the monitor from AC mains power.

CAUTION: Static sensitivity—The monitor's electronic components are susceptible to damage by electrostatic discharge. When disassembling the monitor, work at a static control work station and wear a static control wrist strap to discharge accumulated static charges. Always handle circuit boards by their nonconductive edges.

2. Remove the top cover—see **5.2.1 Top cover removal**.
3. Remove the printer board—see **5.2.2 Printer board removal**.
4. Remove the shield and board stack—see **5.2.3 Shield and board stack removal**.
5. Remove the old speaker:
   a. Disconnect it from J2 on the MINX interface board.
   b. Remove the 2 nuts and washers that connect the speaker to the shield studs and remove the speaker.
6. Install the new speaker:
   a. Place the speaker on the shield studs and install the 2 washers and nuts on the studs.
   b. Connect the speaker to J2 on the MINX interface board.
7. Install the shield and board stack—see **5.2.4 Shield and board stack installation**.
8. Install the printer board—see **5.2.6 Printer board installation**.
9. Install the top cover—see **5.2.6 Top cover installation**.
10. Test the monitor—see **3.2 Checking normal operation**.

5.11 MINX interface board replacement

Equipment and tools

- Phillips screwdrivers (#1 and #2)
- Socket wrenches (1/4" and 1/2")

5.11.1 MINX interface board removal

WARNING: Electrical shock and flammability hazard—Before servicing the monitor, always turn it off and disconnect it from AC mains power.

1. Power off. Disconnect the monitor from AC mains power.

CAUTION: Static sensitivity—The monitor's electronic components are susceptible to damage by electrostatic discharge. When disassembling the monitor, work at a static control work station and wear a static control wrist strap to discharge accumulated static charges. Always handle circuit boards (replacement and defective) by their nonconductive edges and use anti-static containers when transporting them.

2. Remove the top cover—see **5.2.1 Top cover removal**.
3. Remove the printer board—see **5.2.2 Printer board removal**.
4. Remove the shield and board stack—see **5.2.3 Shield and board stack removal**.

   Note: Do not turn the shield all the way over—just detach it from the bottom case.

5. Disconnect the speaker from J2 on the MINX interface board.
6. Lift the front of the shield. Unlatch and disconnect the interface board cable from J3 on the power supply board.
7. Remove the screw and washer that attach the right side of the board to the shield and lift the board out. Set the screw and washer aside for reinstallation.

5.11.2 MINX interface board installation

1. Place the new board on the shield and install the washer and screw that attach the right side of the board to the shield.
2. Lift the front of the shield and connect the MINX interface board cable to J3 on the power supply board.

3. Connect the speaker wires to J2 on the interface board.
4. Install the shield and board stack—see **5.2.4 Shield and board stack installation**.
5. Install the printer board—see **5.2.5 Printer board installation**.
6. Install the top cover—see **5.2.6 Top cover installation**.
7. Test the monitor—see **3.2 Checking normal operation**.

5.12 MINX board replacement

Equipment and tools

- Phillips screwdriver (#2)
- Socket wrenches (1/4" and 1/2")

5.12.1 MINX board removal

WARNING: Electrical shock and flammability hazard—Before servicing the monitor, always turn it off and disconnect it from AC mains power.

1. Power off. Disconnect the monitor from AC mains power.

CAUTION: Static sensitivity—The monitor's electronic components are susceptible to damage by electrostatic discharge. When disassembling the monitor, work at a static control work station and wear a static control wrist strap to discharge accumulated static charges. Always handle circuit boards (replacement and defective) by their nonconductive edges and use anti-static containers when transporting them.

2. Remove the top cover—see **5.2.1 Top cover removal**.
3. Remove the printer board—see **5.2.2 Printer board removal**.
4. Disconnect the probe cable from J2 on the MINX board.
5. Remove the nut and washer that attach the MINX board to the shield. Set them aside for reinstallation.
6. Gently lift and disconnect the MINX board from J4 on the MINX interface board.
7. Remove the mounting bracket from the board. Set the screw and bracket aside for reinstallation.

5.12.2 MINX board installation

1. Using the screw and bracket you removed earlier, attach the mounting bracket to the new MINX board.
2. Attach the new MINX board to the MINX interface board:
   a. Place the board on the shield, aligning the mounting bracket over the stud.
   b. Align the board with J4 on the MINX interface board. Firmly press the board into the header.
3. Install the washer and nut onto the shield stud.
4. Attach the probe cable to J2 on the MINX board.
5. Install the printer board—see **5.2.5 Printer board installation**.
6. Install the top cover—see **5.2.6 Top cover installation**
7. Test the monitor—see **3.2 Checking normal operation**.

5.13 MINX EPROM replacement

The parts used in this procedure are illustrated in section **6.15 MINX board**.

Equipment and tools

- Phillips screwdriver (#2)
- Burndy OILEXT extractor (0380-1500-124; BX# 7500-149)

WARNING: Electrical shock and flammability hazard—Before servicing the monitor, always turn it off and disconnect it from AC mains power.

1. Power off. Disconnect the monitor from AC mains power.

CAUTION: Static sensitivity—The monitor's electronic components are susceptible to damage by electrostatic discharge. When disassembling the monitor, work at a static control work station and wear a static control wrist strap to discharge accumulated static charges. Always handle circuit boards by their nonconductive edges.

2. Remove the top cover—see **5.2.1 Top cover removal**.
3. Remove the printer board—see **5.2.2 Printer board removal**.

4. Locate the EPROM (T128-004) on the MINX board.
5. Using a Burndy OILEXT extractor, remove the EPROM:
   a. Insert the two prongs on the extractor into the two slotted corners of the EPROM socket.
   b. Press in firmly on the ridged parts of the extractor's sides. Remove and discard the old EPROM.
6. Orient the notched corner of the new EPROM with the corresponding notched corner of the socket (Figure 5-c). The notched corner of the EPROM will always be in the upper left corner of the socket, with the MINX board oriented as shown in Figure 5-c.

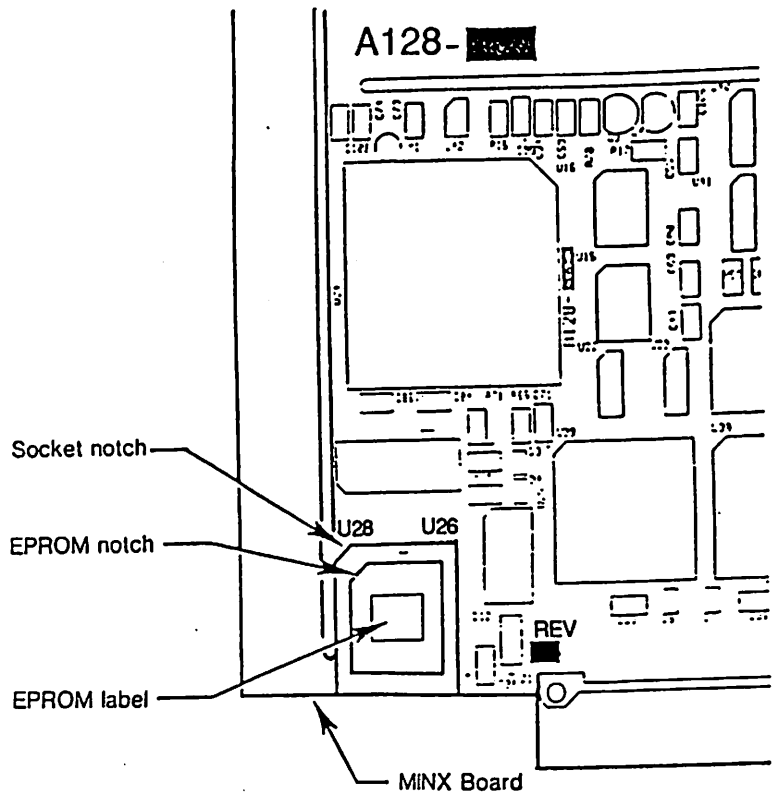


Figure 5-c. MINX EPROM Installation

7. Position the EPROM on the socket. Push down firmly.
8. Install the printer board—see **5.2.5 Printer board installation.**
9. Install the top cover—see **5.2.6 Top cover installation.**
10. Test the monitor—see **3.2 Checking normal operation.**

5.14 Printer board replacement

Equipment and tools

- Phillips screwdriver (#2)

WARNING: Electrical shock and flammability hazard—Before servicing the monitor, always turn it off and disconnect it from AC mains power.

1. Power off. Disconnect the monitor from AC mains power.

CAUTION: Static sensitivity—The monitor's electronic components are susceptible to damage by electrostatic discharge. When disassembling the monitor, work at a static control work station and wear a static control wrist strap to discharge accumulated static charges. Always handle circuit boards (replacement and defective) by their nonconductive edges and use anti-static containers when transporting them.

2. Remove the top cover—see **5.2.1 Top cover removal**.
3. Remove the printer board—see **5.2.2 Printer board removal**.
4. Disconnect the printer cable from J2 on the old printer board.
5. Connect the printer cable to J2 on the new printer board.
6. Install the new board—see **5.2.5 Printer board installation**.
7. Install the top cover—see **5.2.6 Top cover installation**.
8. Test the printer—see **3.2 Checking normal operation**.

5.15 Printer EPROM replacement

The parts used in this procedure are illustrated in section **6.12 Printer board**.

Equipment and tools

- Phillips screwdriver (#2)
- A small, flat-blade screwdriver

WARNING: Electrical shock and flammability hazard—Before servicing the monitor, always turn it off and disconnect it from AC mains power.

1. Power off. Disconnect the monitor from AC mains power.

CAUTION: Static sensitivity—The monitor's electronic components are susceptible to damage by electrostatic discharge. When disassembling the monitor, work at a static control work station and wear a static control wrist strap to discharge accumulated static charges. Always handle circuit boards by their nonconductive edges.

2. Remove the top cover—see **5.2.1 Top cover removal**.

3. Remove the printer board—see **5.2.2 Printer board removal**.

4. Remove the EPROM (T127-002) from the printer board:

   Note:

   - If the socket has a latch, follow steps 4-a to 4-d.
   - If the socket does not have a latch, use a small, flat-blade screwdriver and gently leverage the EPROM up and out of the socket.

   a. Locate the latch that holds the EPROM in the socket.

   b. Insert the end of a small, flat-blade screwdriver between the latch and the EPROM as shown below.

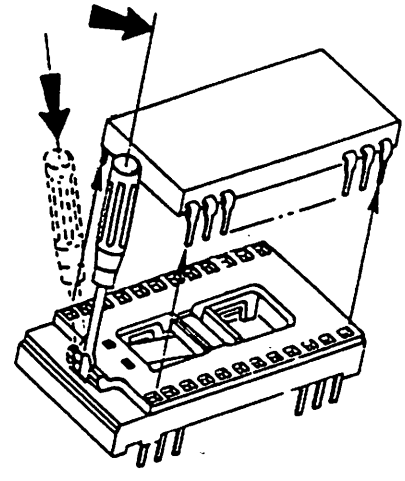


Figure 5-d. Printer EPROM Removal

   c. Press gently and slowly lever the screwdriver ***toward*** the EPROM until the latch releases.

   d. Remove the EPROM.

5. Install the new EPROM:
   a. Orient the new EPROM identically to the one you removed in the previous step.

   Important:
   - If the socket has a latch, align the notch on the EPROM with the latch.
   - If the socket does not have a latch, match the notch at the top of the EPROM with the notch in the socket.

   b. Carefully line up the pins with their respective holes.
   c. Press the EPROM firmly into the socket.
6. Install the printer board—see **5.2.5 Printer board installation**.
8. Install the top cover—see **5.2.6 Top cover installation**.
9. Test the monitor—see **3.2 Checking normal operation**.

5.16 Printer door replacement

The parts used in this procedure are illustrated in section **6.5 Printer door assembly**.

Equipment and tools

- Phillips screwdrivers (#1 and #2)

5.16.1 Printer door removal

1. Feed paper through the printer:
   a. Turn the monitor on.
   b. Press the Print Fast key.
   c. When about 1 inch of paper comes out the slot, turn the monitor off.

WARNING: Electrical shock and flammability hazard—Before servicing the monitor, always turn it off and disconnect it from AC mains power.

2. Power off. Disconnect the monitor from AC mains power.

CAUTION: Static sensitivity—The monitor's electronic components are susceptible to damage by electrostatic discharge. When disassembling the monitor, work at a static control work station and wear a static control wrist strap to discharge accumulated static charges. Always handle circuit boards by their nonconductive edges.

3. Remove the top cover—see **5.2.1 Top cover removal**.

4. Remove all paper from the printer:
   a. Turn the monitor until the printer door assembly is directly in front of you.
   b. **Inside** the printer door assembly (between the door and the paper roll), cut the printer paper.

CAUTION: Do not pull paper opposite the direction of the paper feed. This may damage the feeder mechanism.

   c. From the front of the printer door asssembly, pull the paper out through the slot. Do not remove the paper roll.

5. Unclip the printer cable from its plastic clip next to the paper roll.

6. Detach the printer door assembly:
   a. Lift the printer door assembly from the bottom case.
   b. Remove the 4 screws that fasten the door plate to the door. Set them aside for reinstallation.

      Important: Do not separate the **top** of the door plate from the **top** of the printer door. This may break the panel membrane cable or its connector.

   c. Slowly lift the **bottom** of the door plate (the side closest to the monitor), separating it from the door. Rotate it up and back toward you at a 45° angle.
   d. Disconnect the printer cable from J3 on the printer connector board.

7. Detach the printer door from the door plate:
   a. Rotate the door plate until it is vertical and at a right angle to the printer door.
   b. Gently disconnect the printer membrane panel cable from J1 on the printer connector board.
   c. Lay the door plate down with the circuit board up.

5.16.2 Printer door installation

1. Connect the printer membrane panel cable from the new printer door to J1 on the printer connector board.
2. Connect the printer cable to J3 on the printer connector board.
3. Attach the new printer door to the door plate:
   a. Lay the door plate on the printer door bosses.
   b. Loosely screw the 4 screws that attach the door plate to the printer door.
   c. Tighten the 4 screws until the door plate is flush with the walls of the printer door.

   Important: Do not tighten so the door plate is below flush. This may bind the printer.
4. Place the printer door assembly into its slots on the monitor's bottom case.
5. Clip the printer cable into its plastic clip next to the paper roll.
6. Install the top cover—see **5.2.6 Top cover installation**.
7. Load the printer paper:
   a. Turn the monitor on.
   b. Open the printer door.

   Note: The front edge of the printer paper to be fed must be clean and straight.

   c. Hold down the Print Fast key until the display shows: - PAPER FEED -
   d. Guide the paper through the door plate slot until the printer mechanism catches it. Do not force the paper.
   e. When the paper is visible outside the printer door, press the Stop key.
   f. Close the printer door.
8. Test the monitor—see **3.2 Checking normal operation**.

5.17 Printer door assembly replacement

The parts used in this procedure are illustrated in section **6.5 Printer door assembly**.

Equipment and tools

- Phillips screwdrivers (#1 and #2)

5.17.1 Printer door assembly removal

WARNING: Electrical shock and flammability hazard—Before servicing the monitor, always turn it off and disconnect it from AC mains power.

1. Power off. Disconnect the monitor from AC mains power.

CAUTION: Static sensitivity—The monitor's electronic components are susceptible to damage by electrostatic discharge. When disassembling the monitor, work at a static control work station and wear a static control wrist strap to discharge accumulated static charges. Always handle circuit boards by their nonconductive edges.

2. Remove the top cover—see **5.2.1 Top cover removal**.
3. Remove the printer board—see **5.2.2 Printer board removal**.
4. Disconnect the printer board from the printer:
   a. Unclip the printer cable from its plastic clip next to the paper roll.
   b. Disconnect the printer cable from J2 on the printer board.
5. Inside the printer door assembly (between the door and the paper roll), cut the printer paper.
6. Lift the printer door assembly from the monitor and set it aside.

5.17.2 Printer door assembly installation

1. Place the new printer door assembly into its slots on the monitor's bottom case.
2. Connect the printer board to the new printer:
   a. Clip the printer cable into its plastic clip next to the paper roll.
   b. Connect the printer cable to J2 on the printer board.
3. Install the printer board—see **5.2.5 Printer board installation**.
4. Install the top cover—see **5.2.6 Top cover installation**.
5. Load the printer paper:
   a. Turn the monitor on.
   b. Open the printer door.

      Note: The front edge of the printer paper to be fed must be clean and straight.

   c. Hold down the Print Fast key until the display shows: - PAPER FEED -
   d. Guide the paper through the door plate slot until the printer mechanism catches it. Do not force the paper.
   e. When the paper is visible outside the printer door, press the Stop key.
   f. Close the printer door.
6. Test the monitor—see **3.2 Checking normal operation**.

Chapter 6: Parts and Schematics

This chapter contains
- Information on how to order parts.
- A list of the parts and kits to order when replacements are needed.
- Detailed assembly drawings for all major sections of the monitor.
- A list of the components in each assembly and in each printed circuit board.
- Schematics of the monitor's main printed circuit boards.

6.1 How to order parts

The parts listed in this chapter are considered service items. Parts that do not appear on the list are either not considered service items or should be obtained in your local area.

Parts may be ordered through Ohmeda (see the back cover of this manual) or through an authorized representative.

Outside the U.S.A.

When ordering parts, please use the **BIOX Item Number (Bx#)** provided on the following pages.

Inside the U.S.A.

When ordering parts, please use the **Stock Number** provided on the following pages.

6.2 Service kits

The service kits and parts are referenced to the illustrations and lists of components as shown in the following example:

Battery.....0380-0200-129 4790-002
(6.3 & 6.4—#3)

- 6.3 & 6.4 refer to the sections in this chapter in which the part is illustrated.
- #3 refers to the item number (or reference designator).

Part or Assembly Name	Stock Number	Bx#
3760 Hardware Kit	0380-0800-060	8127-055

1	Cable clamp, hinged, adhesive backed
2	Cable clamp, nylon, 5/16"
6	Cable tie 3" lg
1	Extrusion, rubber—2"
2	Foot, adhesive backed rubber
3	Fuse, 3A, instr type, fast action
1	Grommet, flexible continuous—11.75"
2	Grommet, vibration
2	Guide, flex circuit
1	Label, printer door, IVA
2	Nut #2-56, hex steel
2	Nut #2-56, nylon insert stopnut
2	Nut #4-40, nylon insert stopnut
2	Nut #4-40, hex nylon
3	Nut #6-32, hex
2	Nut #6-32, nylon insert stopnut
2	Nut #6-32, hex nylon
2	O-ring, .612 I.D.
2	Screw #2-56, soc flt blk, .375
2	Screw #2-56, x .625 Phl pan stl
2	Screw #4-40, Phl pan stl, .375
3	Screw #4-40 ,Phl pan stl, 0.50"
2	Screw #4-40, Phl flat hd blk, .5L
2	Screw #6-32, Phl pan stl, .50
2	Screw #6-32, Phl pan stl, 1.0
2	Screw #6-32, slt rd nylon, .25
2	Screw #6-32, Phl pan stl, 1.25
10	Spacer, adh back foam, .25 x 2 x 6.5
2	Spacer, nylon, .25 OD x .375L
2	Spacer, nylon, .25" OD x .09L
2	Spacer, nylon, .312 OD x .218L
1	Standoff, 3/8" OD, 2 3/8"L
2	Standoff, 6-32 x .25 x .812L hex fem
2	Standoff, 6-32 x .25 x .938L hex fem
4	Tie, white wire twist, 4"
1	Toroid, core
2	Washer, finish shldr #4 x .25L
2	Washer #2 internal star
3	Washer #4 external star
2	Washer #6 internal star
2	Washer #6 external star

6.2 Service kits (continued)

Part or Assembly Name	Stock Number	Bx#
Adhesive, 99 (not shown)	0380-1500-096	6901-018
Adhesive, sicomet, 5023 (6.3 & 6.4—#25 and 6.13—#7)	0380-1500-095	6901-019
Battery (6.3 & 6.4—#3)	0380-0200-129	4790-002
Bracket, speaker (6.6—#1)	0380-0100-265	7500-108
Cable, 20 pin (6.14—#J3)	0380-0600-104	7000-146
Cable, 26 pin (6.14—#J6)	0380-0600-105	7000-147
Cable, 30 pin (6.12—#J1)	0380-0600-103	7000-145
Cable, DIN (6.3 & 6.4—#27)	0380-0600-102	7000-150
Cable, ribbon (not shown)	0380-0800-051	8127-057
Case Bottom Kit 1 Case bottom, 3760 (6.3 & 6.4—#37) 1 Leg, wire form, 3760 (6.3 & 6.4—#33) 6 Rubber foot, adhesive backed (6.3 & 6.4—#30)	0380-0800-059	8127-054
Case Top Kit 1 Case top, 3760 (6.3 & 6.4—#38) 2 Rubber foot, adhesive backed (6.3 & 6.4—#30)	0380-0800-052	8127-051
EPROM, MINX (6.15—not designated)	0380-0300-481	T128-004
EPROM, printer (6.12—#U2)	0380-0300-514	T127-002
Fuse, 3A (6.3 & 6.4—#48)	0380-0300-483	4230-015
Knob, side pot (not shown)	0380-0100-268	7700-120

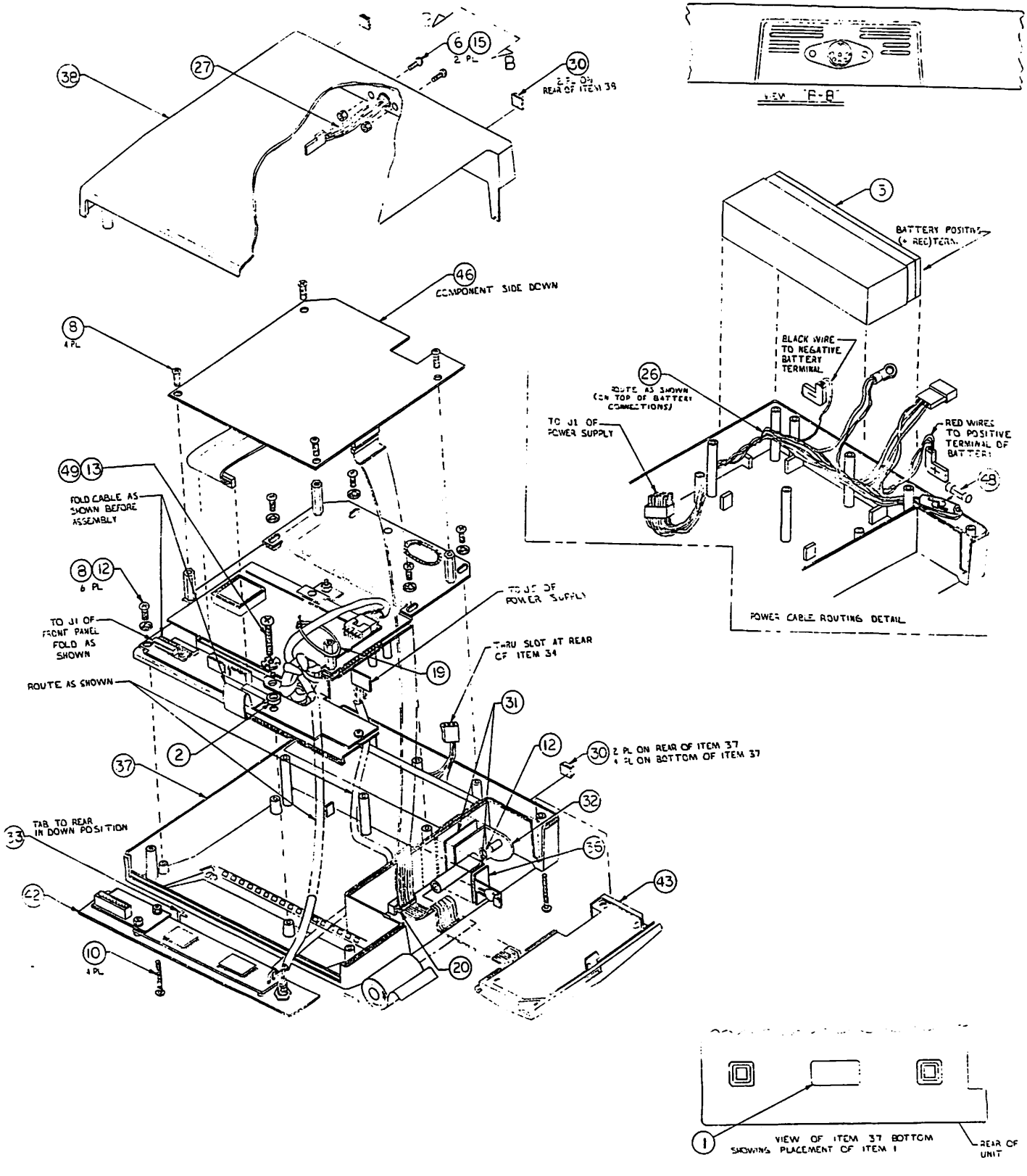
6.2 Service kits (continued)

Part or Assembly Name	Stock Number	Bx#
LCD panel (6.7—#2)	0380-0300-480	4410-014
Leg, wire form (6.3 & 6.4—#33)	0380-0100-266	7500-102
Membrane, front panel (6.7—#1)	0380-0600-101	7900-123
Microcontroller, MINX (6.15—#U24)	0380-0300-482	4300-030
PCB, MINX, 3760 (6.3 & 6.4—#44 and 6.15—all)	0380-0800-053	8127-008
PCB, MINX interface (6.3 & 6.4—#47 and 6.14—all)	0380-0500-054	A128-007
PCB, front panel interconnect (6.7—#3 and 6.9—all)	0380-0500-051	A127-001
PCB, power supply (6.3 & 6.4—#45 and 6.13—all)	0380-0800-117	A125-001X
PCB, printer (6.3—#46 and 6.12—all)	0380-0500-053	A127-005
PCB, printer terminator (6.4—#46 and 6.10—all)	0380-0500-052	A127-004
Power Input Cable Kit 1 Cable assy, power input, 3760 (6.3 & 6.4—#26))	0380-0800-057	8127-060
Printer Door Kit 1 Adhesive, quick gel (6.5—#9) 1 Adhesive, RTV, clear (6.5—#8) 1 Extrusion, rubber—2.25" (6.5—#13) 1 Label, printer door, IVA (6.5—#22) 1 Printer door, model IVA (6.5—#17) 1 Printer membrane panel, IVA (6.5—#19)	0380-0800-050	8127-053
Printer Door Assembly Kit (6.5—all)	0380-0800-128	8127-064

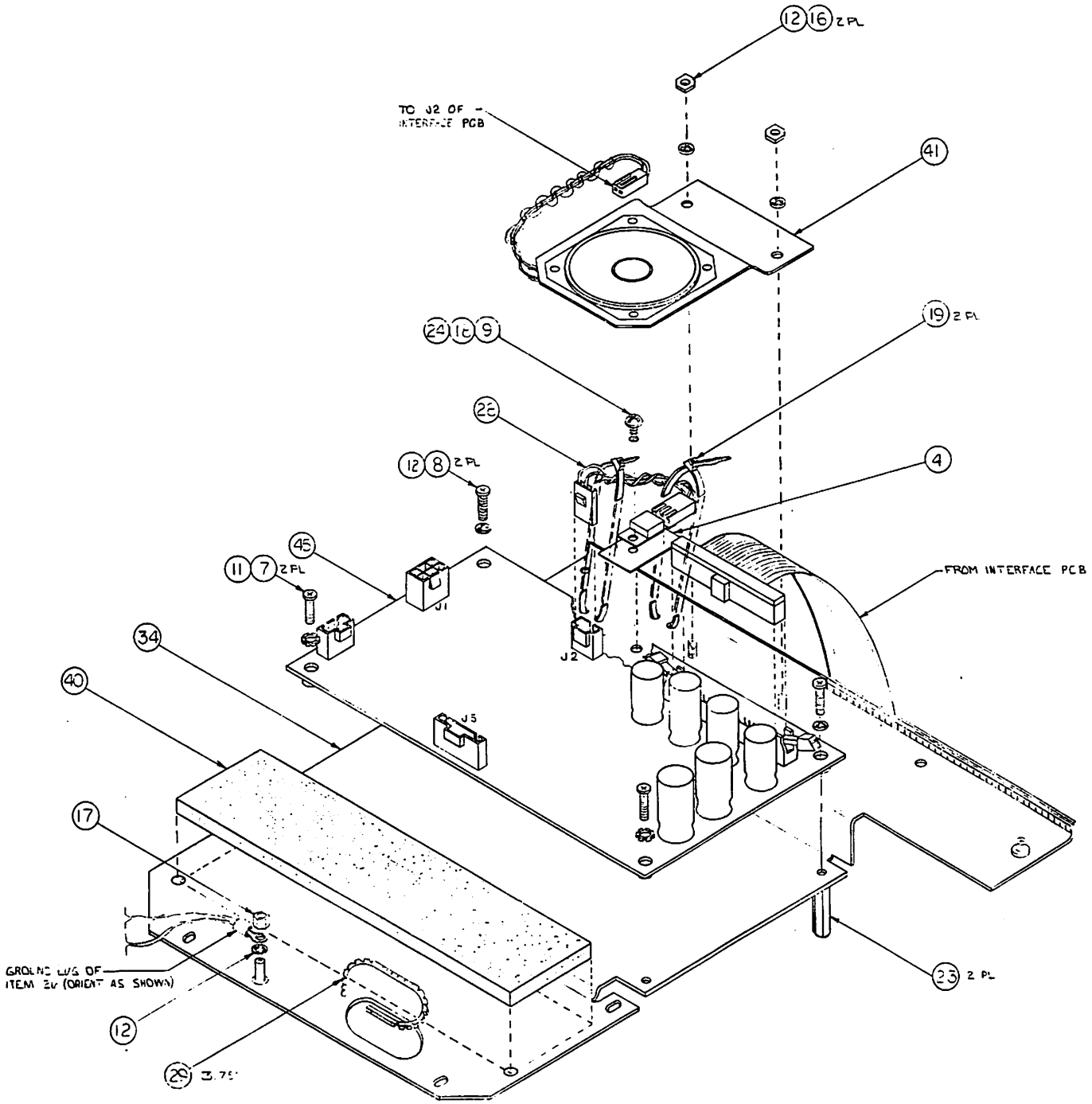
6.2 Service kits (continued)

Part or Assembly Name	Stock Number	Bx#
Probe Cable Kit	0380-0800-049	8127-050
1 Cable clamp, 5/16" nylon (6.7—#12)		
1 O-ring, .612 I.D. (6.7—#5)		
1 Plug housing, 10 pin (6.7—#11)		
1 Probe cable assembly, 3760 (6.7—#4 and 6.8—all)		
1 Torroid, core (6.7—#13)		
Shield Kit	0380-0800-054	8127-058
1 Grommet, flexible continuous—11.75" (6.3 & 6.4—#29)		
1 Shield, 3760 (6.3 & 6.4—#34)		
1 Spacer, adh bk foam, .25 x 2 x 6.5 (6.3 & 6.4—#40)		
Speaker Assy Kit (6.6—all)	0380-0800-115	8127-062
Spindle Kit	0380-0800-058	8127-061
1 Bracket, paper spindle (6.3—#32)		
1 Spindle cap (6.3—#36)		
1 Standoff, 3/8" OD, 2 3/8" long (6.3—#21)		
1 Tape, acrylic foam, dbl side—2.3" (6.3—#31)		
1 Washer, #6 internal star (6.3—#12)		
Torroid, core (6.7—#13)	0380-1500-097	4621-002
Transistor Cable Kit	0380-0800-056	8127-059
1 Cable assy, transistor, 3760 (6.3 & 6.4—#28)		
2 Cable tie, 3" long (6.3 & 6.4—#19)		
1 Nut, #6-32, hex nylon (6.3 & 6.4—#18)		
1 Screw, #6-32, slt rd nylon, .25 (6.3 & 6.4—#9)		
1 Thermal pad, 3223-07FR-54 (6.3 & 6.4—#4)		

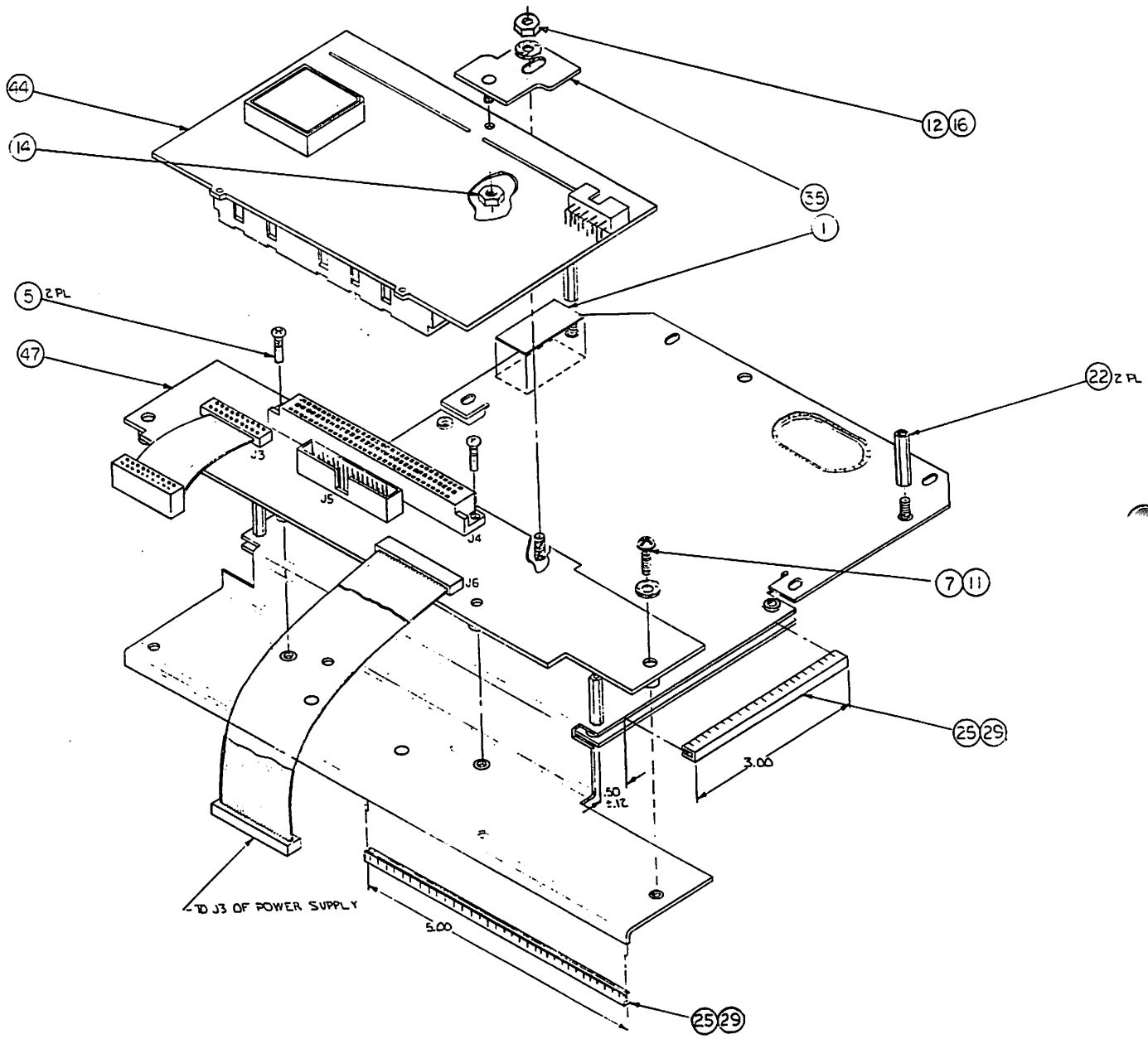
6.3 3760 with printer assembly, 60Hz (#1 of 3)



6.3 3760 with printer assembly, 60 Hz (#2 of 3)



6.3 3760 with printer assembly, 60 Hz (#3 of 3)



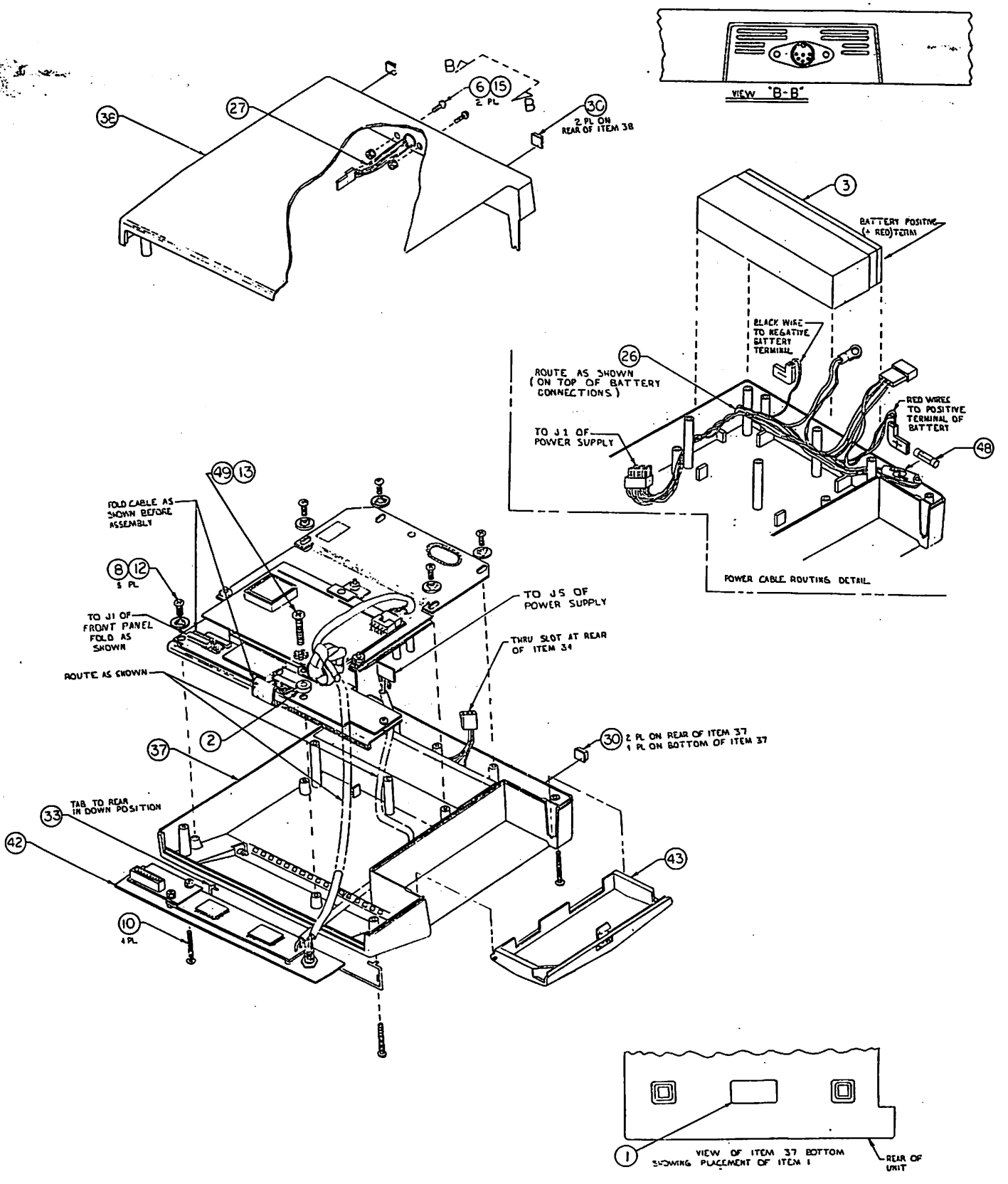
6.3.1 3760 with printer components

Item	Description	Qty
1	Label, serial number, 3700	2
2	Spacer, nylon .312 OD x .218 long	1
3	Battery, 12V, 1.9AH	1
4	Thermal pad (3223-07FR-54)	1
5	Screw, #2-56 x .625 Phl pan stl	2
6	Screw, #4-40 Phl pan stl, .375	2
7	Screw, #4-40 Phl pan stl, .5"	3
8	Screw, #6-32 Phl pan stl, .5"	11
9	Screw, #6-32 slt rd nylon, .25	1
10	Screw, #6-32 Phl pan stl, 1.25	4
11	Washer, #4 external star	3
12	Washer, #6 internal star	12
13	Washer, #6 external star	1
14	Nut, #2-56 nylon insert stopnut	1
15	Nut, #4-40 nylon insert stopnut	2
16	Nut, #6-32 hex	3
17	Nut, #6-32 nylon insert stopnut	1
18	Nut, #6-32 hex nylon	1
19	Cable tie, 3" long	2
20	Cable clamp, hinged, adhesive backed	1
21	Standoff, 3/8" OD, 2 3/8" long	1
22	Standoff, 6-32 x .25 x .812L hex fem	2
23	Standoff, 6-32 x .25 x .938L hex fem	2
24	Adhesive, loctite assure	1
25	Adhesive, sicomet 5023	1
26	Cable assy, power input, 3760	1
27	Cable assy, DIN, 3760	1
28	Cable assy, transistor, 3760	1
29	Grommet, flexible, continuous—11.75"	1
30	Rubber foot, adhesive backed	8
31	Tape, acrylic foam, double side—2.3"	1
32	Bracket, paper spindle	1
33	Leg, wire form, 3760	1
34	Shield, 3760	1
35	Bracket, MINX mounting, 3760	1
36	Spindle cap	1
37	Case, bottom, 3760	1
38	Case, top, 3760	1
39	Paper, thermal, 1.50 dia.	1
40	Spacer, adhesive backed foam, .25 x 2 x 6.5	1

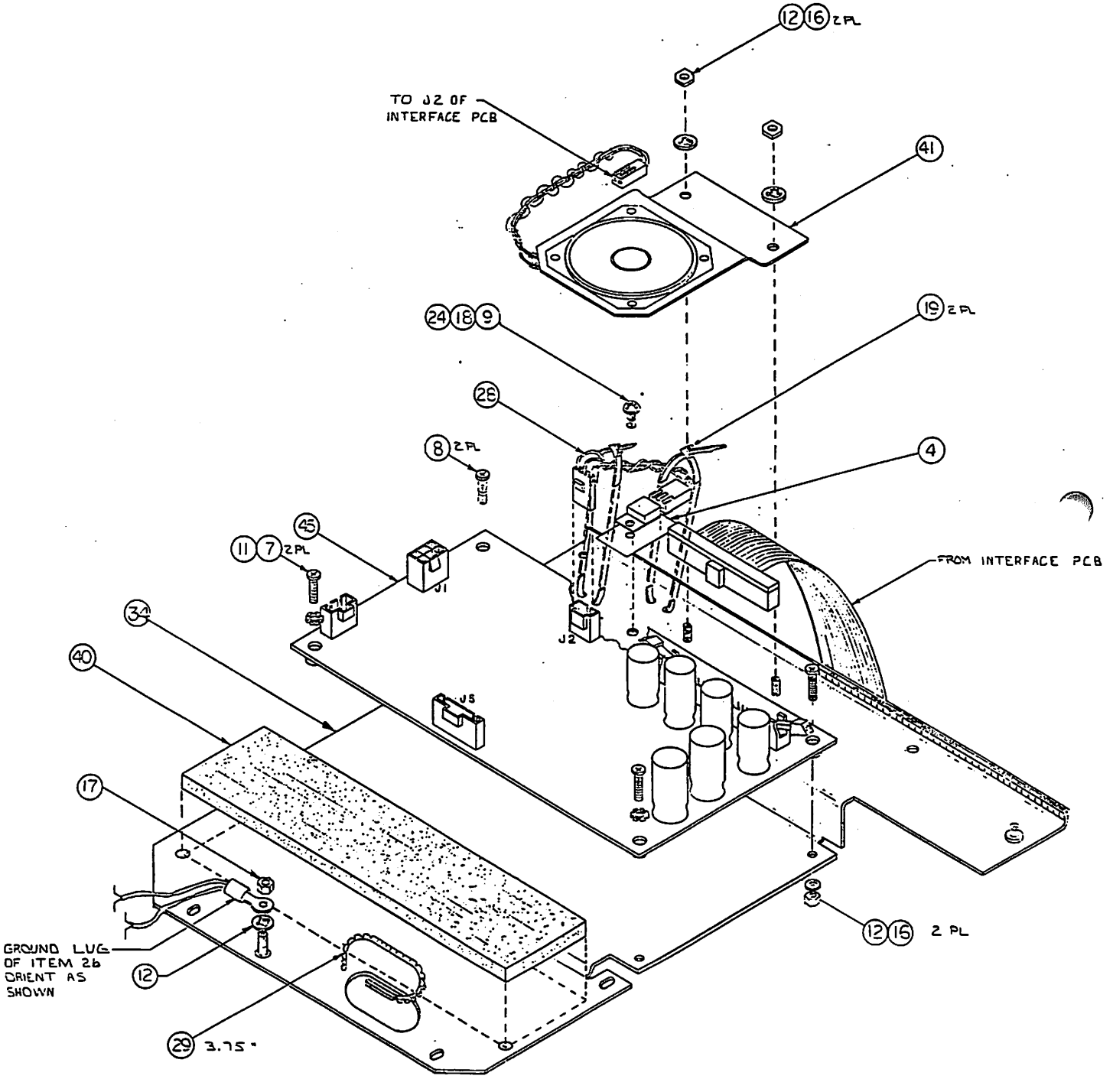
6.3.1 3760 with printer components (continued)

Item	Description	Qty
41	Assy, speaker, 3760	1
42	Assy, front panel, 3760	1
43	Assy, printer door, 3760	1
44	Assy, MINX PCB, 3760	1
45	Assy, power supply PCB, 3740/3760	1
46	Assy, printer PCB, 3760	1
47	Assy, MINX interface PCB, 3760, 60Hz	1
48	Fuse, 3A, instrument type, fast action	1
49	Screw, #6-32 Phl pan stl, 1.0	1

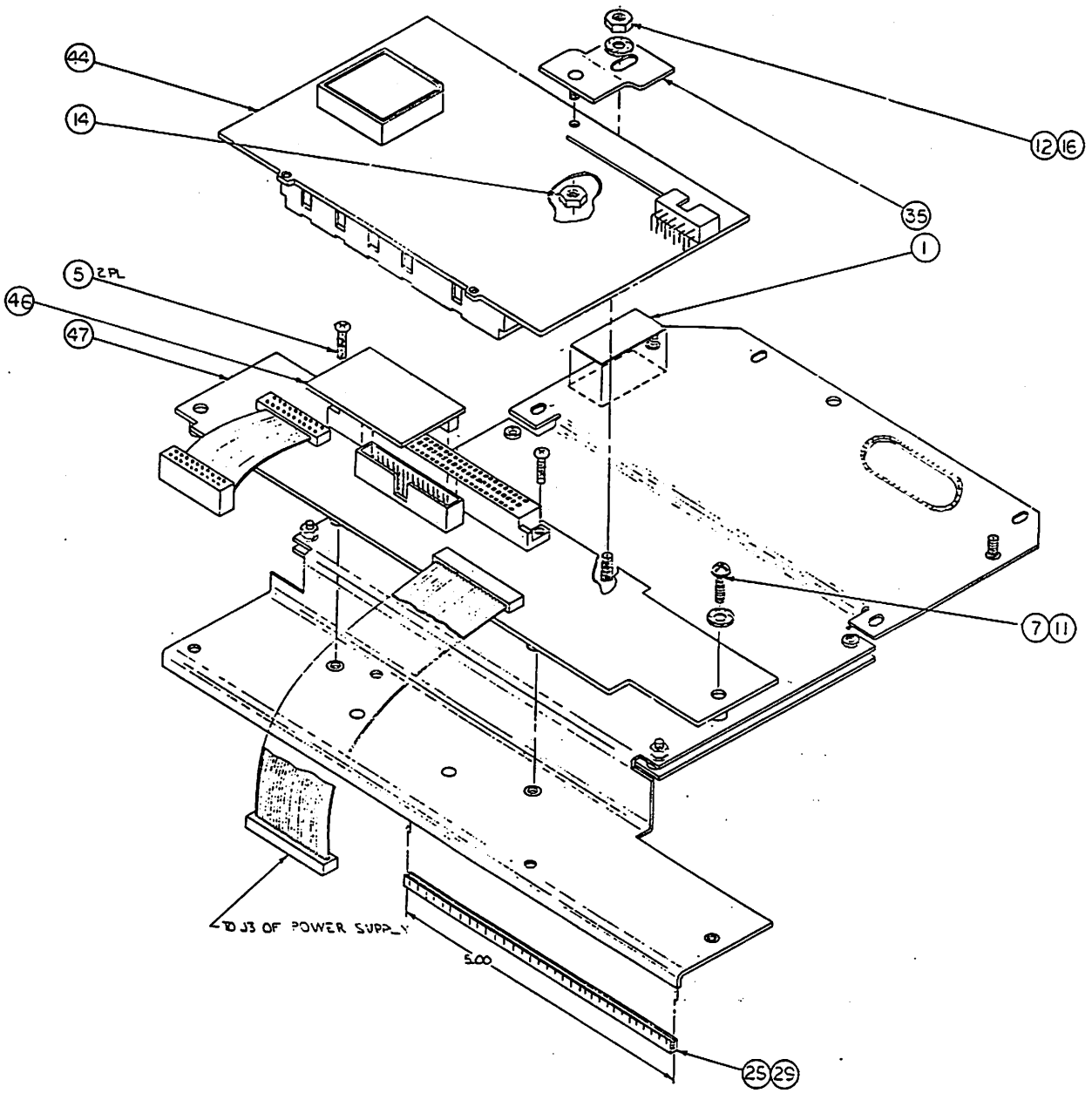
6.4 3760 without printer assembly, 60Hz (#1 of 3)



6.4 3760 without printer assembly, 60 Hz (#2 of 3)



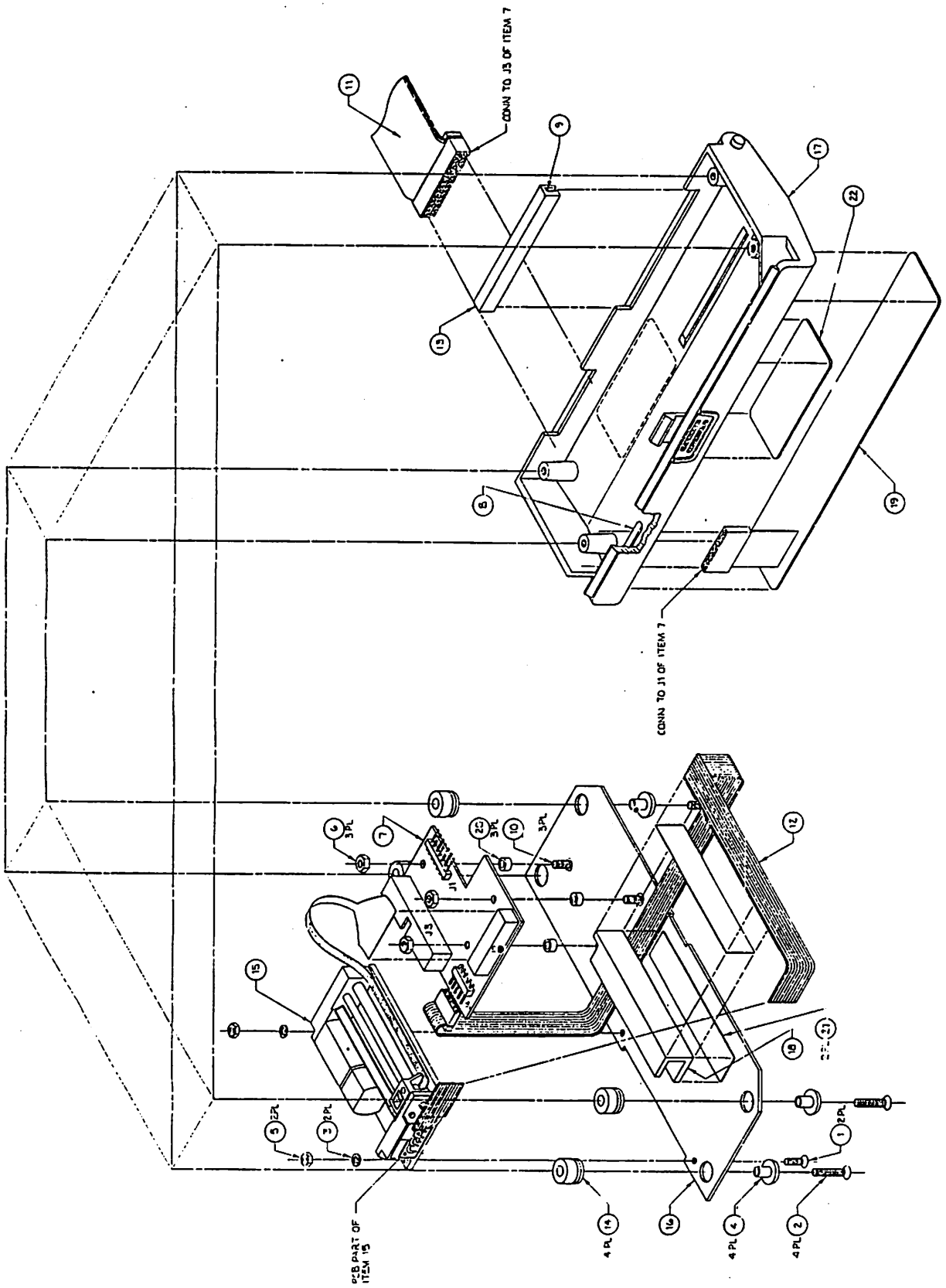
6.4 3760 without printer assembly, 60 Hz (#3 of 3)



6.4.1 3760 without printer components

Item	Description	Qty
1	Label, serial number, 3700	2
2	Spacer, nylon .312 OD x .218 long	1
3	Battery, 12V, 1.9AH	1
4	Thermal pad (3223-07FR-54)	1
5	Screw, #2-56 x .625 Phl pan stl	2
6	Screw, #4-40 Phl pan stl, .375	2
7	Screw, #4-40 Phl pan stl, .5"	3
8	Screw, #6-32 Phl pan stl, .5"	7
9	Screw, #6-32 slt rd nylon, .25	1
10	Screw, #6-32 Phl pan stl, 1.25	4
11	Washer, #4 external star	3
12	Washer, #6 internal star	11
13	Washer, #6 external star	1
14	Nut, #2-56 nylon insert stopnut	1
15	Nut, #4-40 nylon insert stopnut	2
16	Nut, #6-32 hex	5
17	Nut, #6-32 nylon insert stopnut	1
18	Nut, #6-32 hex nylon	1
19	Cable tie, 3" long	2
24	Adhesive, loctite assure	1
25	Adhesive, sicomet 5023	1
26	Cable assy, power input, 3760	1
27	Cable assy, DIN, 3760	1
28	Cable assy, transistor, 3760	1
29	Grommet, flexible, continuous—8.75"	1
30	Rubber foot, adhesive backed	8
33	Leg, wire form, 3760	1
34	Shield, 3760	1
35	Bracket, MINX mounting, 3760	1
37	Case, bottom, 3760	1
38	Case, top, 3760	1
40	Spacer, adhesive backed foam, .25 x 2 x 6.5	1
41	Assy, speaker, 3760	1
42	Assy, front panel, 3760	1
43	Door, blank, 3760	1
44	Assy, MINX PCB, 3760	1
45	Assy, power supply PCB, 3740/3760	1
46	Assy, printer terminator PCB, 3760	1
47	Assy, MINX interface PCB, 3760, 60Hz	1
48	Fuse, 3A, instrument type, fast action	1
49	Screw, #6-32 Phl pan stl, 1.0	1

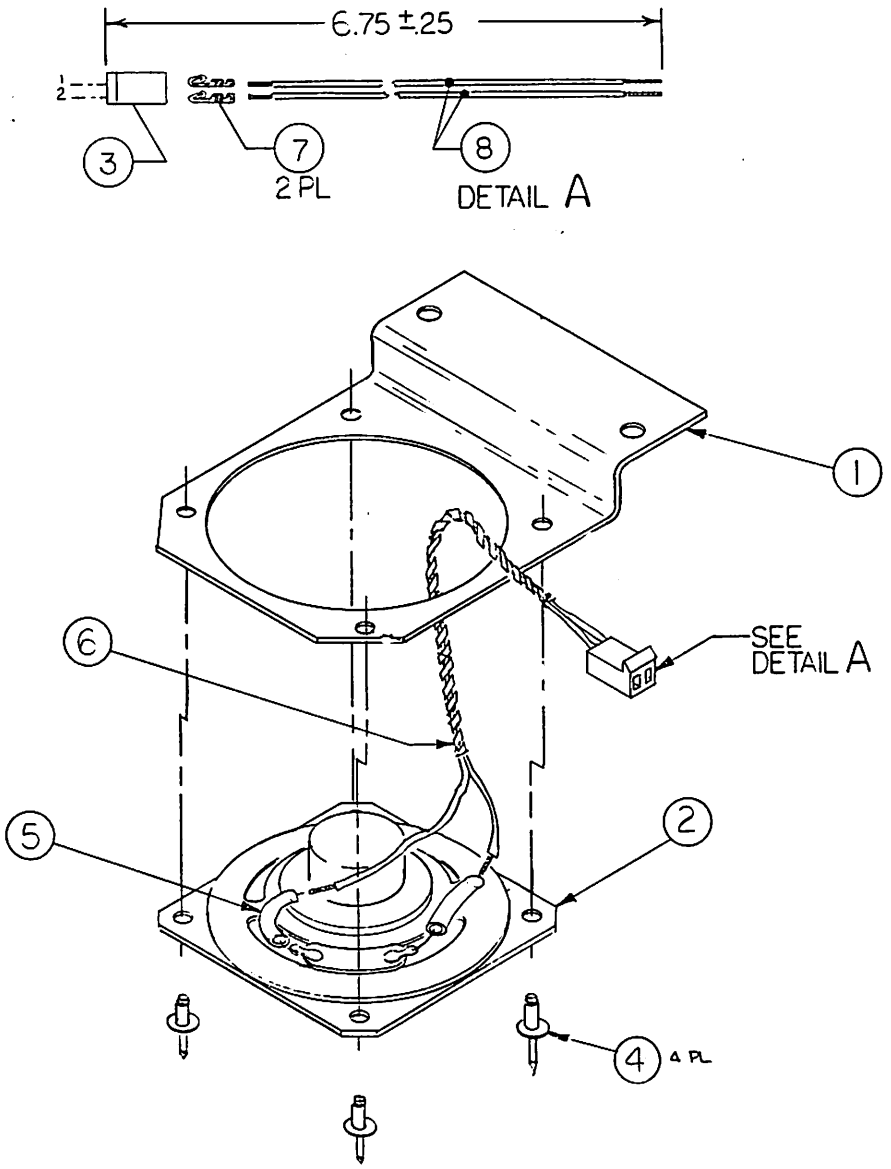
6.5 Printer door assembly



6.5.1 Printer door components

Item	Description	Qty
1	Screw, #2-56 soc flt blk, .375	2
2	Screw, #4-40, Phl flt hd, blk, .5L	4
3	Washer, #2 internal star	2
4	Washer, finish shldr, #4 x .25L	4
5	Nut, #2-56 hex steel	2
6	Nut, #4-40 nylon insert stopnut	3
7	Assy, printer connector PCB, IVA	1
8	Adhesive, RTV, clear	1
9	Adhesive, quick gel	1
11	Ribbon cable assy, 26 pin 6"	1
12	Cable assy, motor, IVA	1
13	Extrusion, rubber, IVA—2.25"	1
14	Grommet, vibration, IVA	4
15	Printer, thermal	1
16	Printer door plate, IVA	1
17	Door, model IVA	1
18	Guide, flex circuit	1
19	Printer membrane panel, IVA	1
20	Spacer, nylon .25 OD x .09L	3
21	Tape, foam, double sided, .50 wide—4.5"	1
22	Label, printer door	1

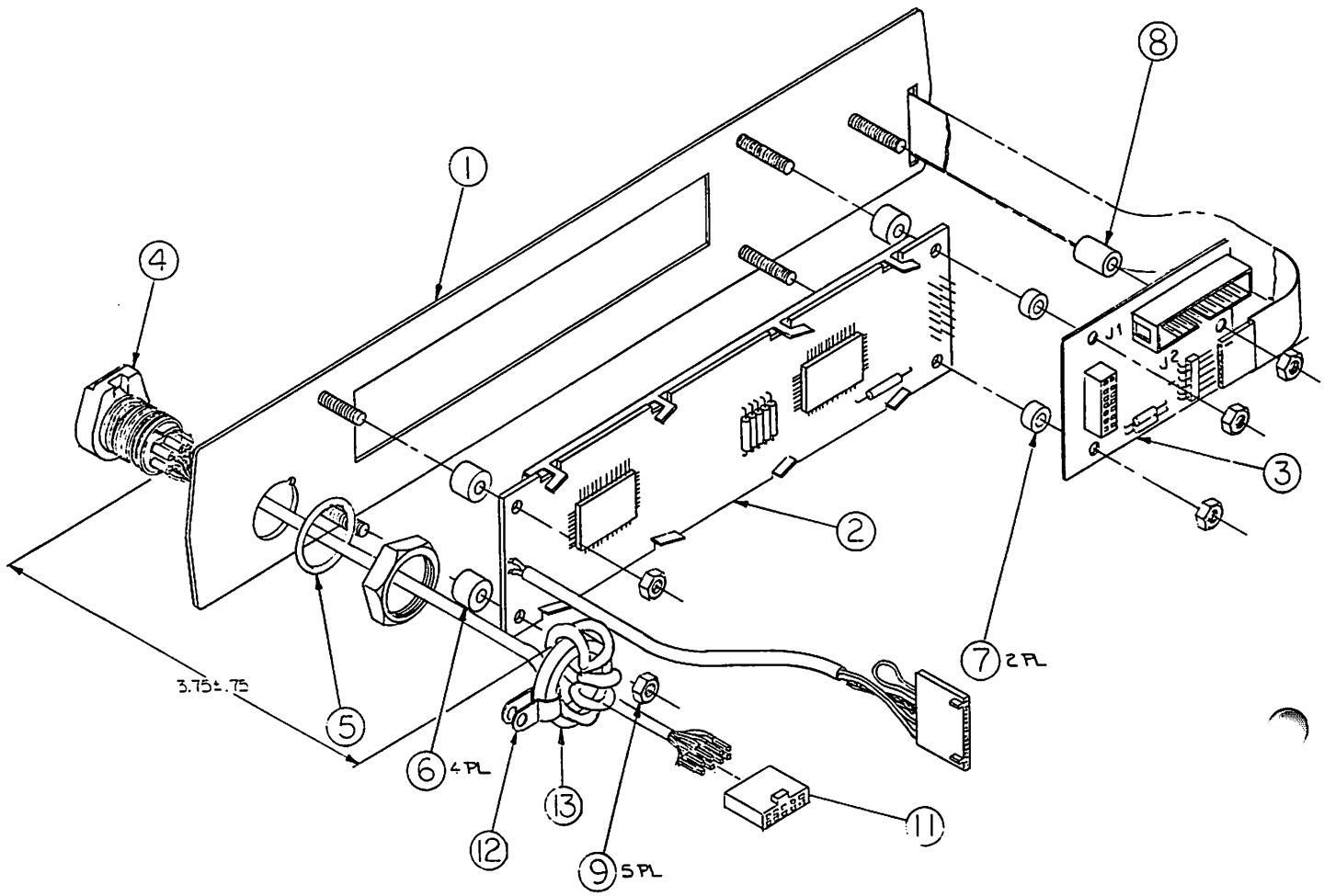
6.6 Speaker assembly

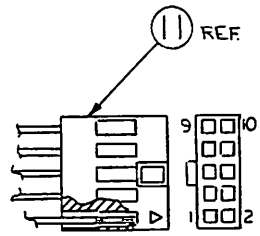


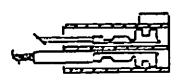
6.6.1 Speaker components

Item	Description	Qty
1	Bracket, speaker, 3760	1
2	Speaker, 8 ohm	1
3	Plug housing, 2 pin	1
4	Pop rivet, 3/32 x .25L	4
5	Tubing, shrink, clear, 1/8" diameter—1"	1
6	Sheathing, protective nylon, 1/8" OD—3"	1
7	Pin, conn, fem, tin, 22-30 awg	2
8	Wire, strand, 24 awg, 300V, brn—13"	1

6.7 Front panel assembly



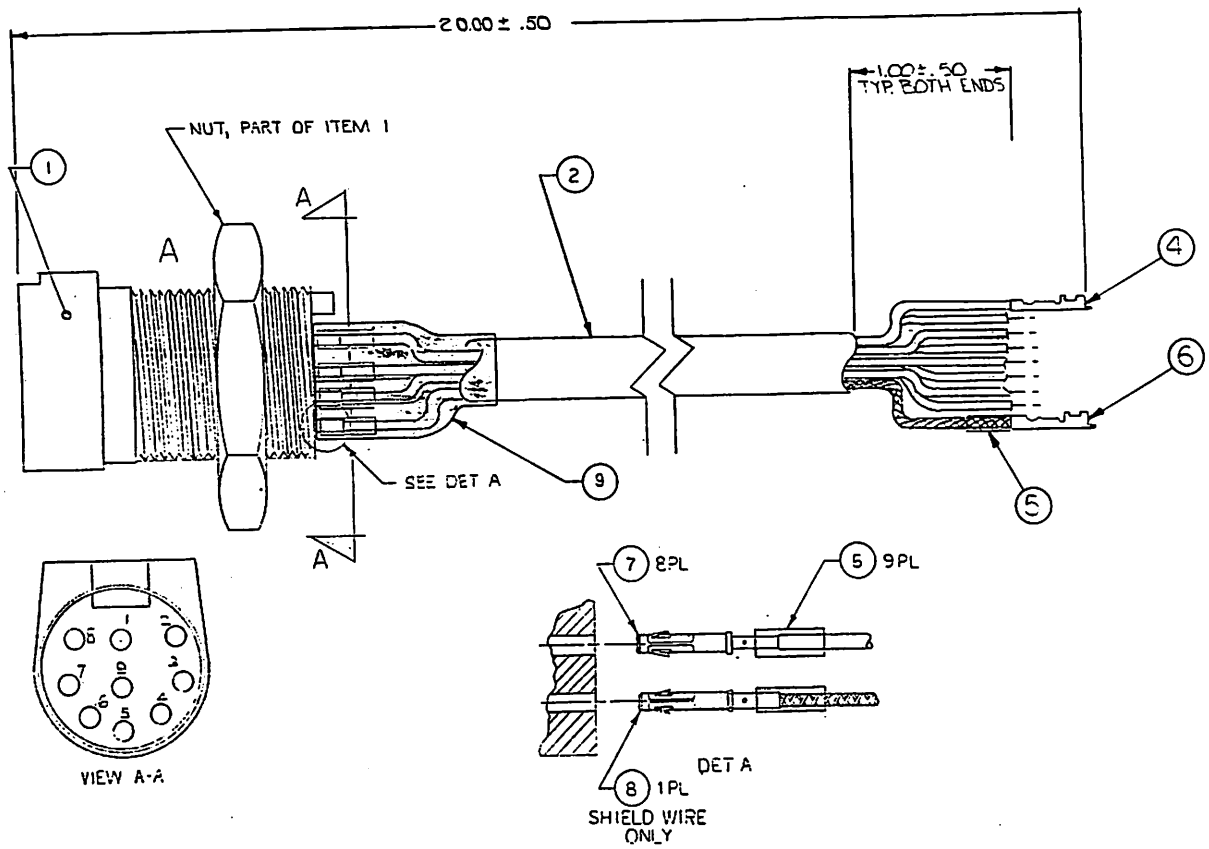




6.7.1 Front panel components

Item	Description	Qty
1	Membrane panel, 3760	1
2	Display, LCD, 16 ch, .50H, illuminate	1
3	Assy, front panel interconnect PCB, 3760	1
4	Cable assy, probe, 3760	1
5	O-ring, .612 I.D.	1
6	Spacer, nylon .312 OD x .218L	4
7	Spacer, nylon .25 OD x .09L	2
8	Spacer, nylon .25 OD x .375L	1
9	Nut, #4-40 nylon insert stopnut	5
11	Plug housing, 10 pin	1
12	Cable clamp, nylon, 5/16"	1
13	Torroid, core	1

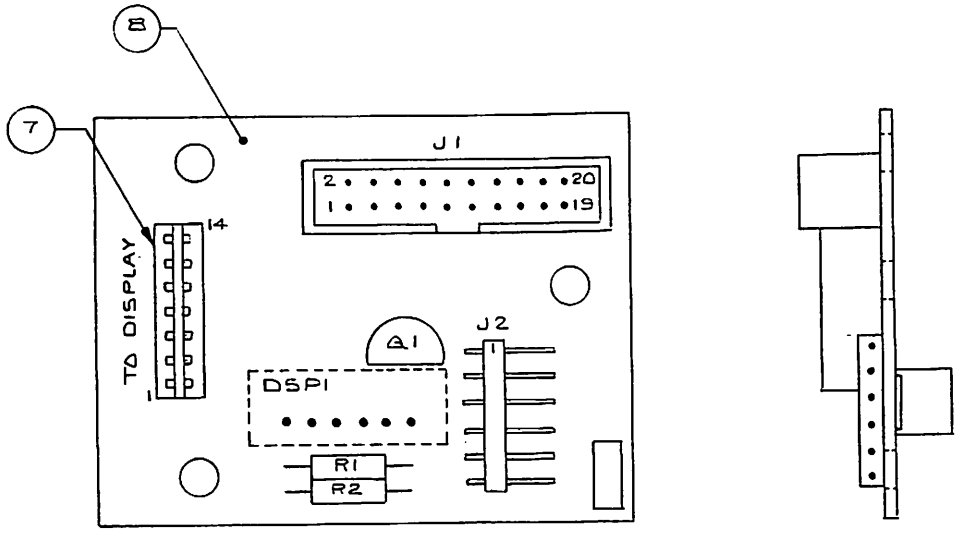
6.8 Probe cable assembly



6.8.1 Probe cable components

Item	Description	Qty
1	Socket housing, 9F, white	1
2	Cable 8 cond, 29 awg shield, blk—19"	1
4	Pin, conn, 28-32 awg	8
5	Tubing, shrink, clear, 1/16" diameter—5"	1
6	Pin, conn, 22-26 awg	1
7	Pin, female crimp, 28-24 awg	8
8	Pin, fem, crimp, 24-20 awg	1
9	Tubing, shrink, clear, 3/8" diameter—1.75"	1

6.9 Front panel interconnect board (A127-001)

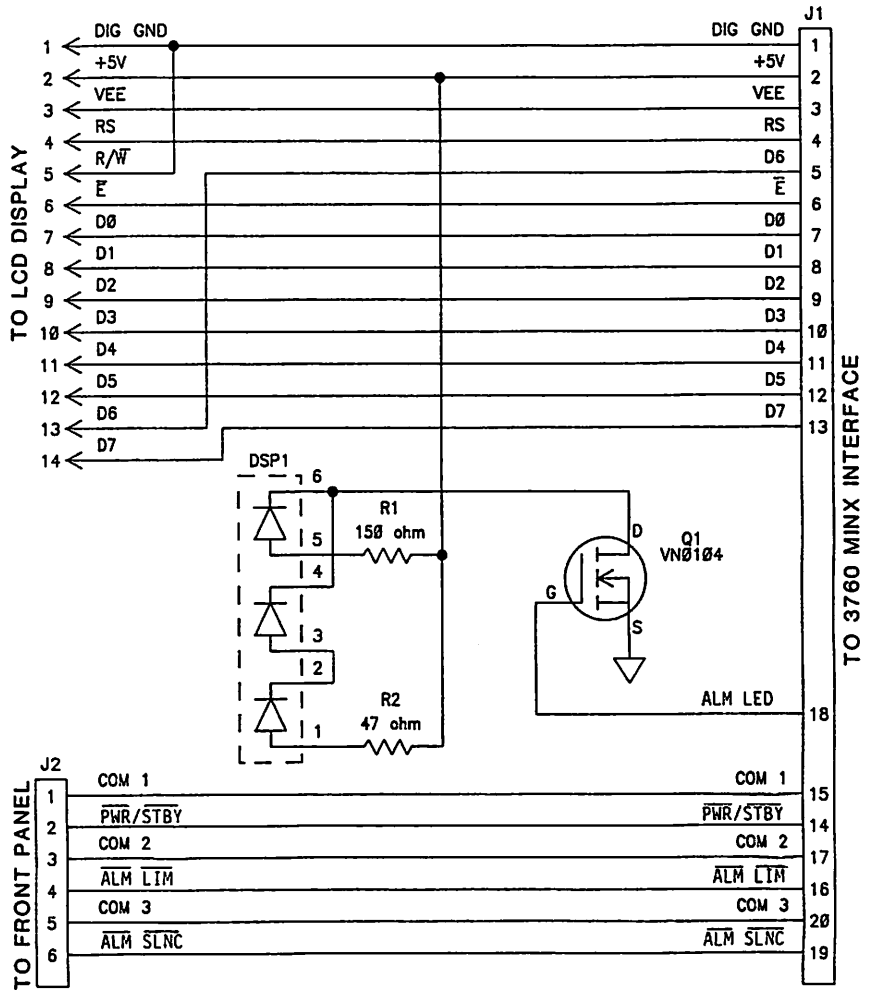


6.9.1 Front panel interconnect board components

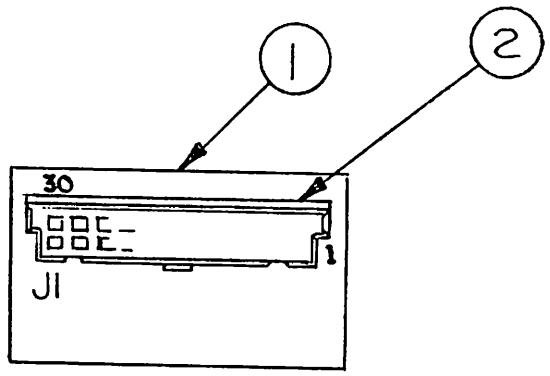
Item	Description	Qty
7	Header, fem, double row w/sldr msk	1
8	PCB, interconnect, front panel, 3760	1

Reference Designator	Part Description
Resistors	
R1	Resistor, carbfilm, 1/4W, 5%, 150
R2	Resistor, carbfilm, 1/4W, 5%, 47
Diodes	
Q1	Transistor, N-FET, VNO104N3
Headers	
J1	Header, 20 pin, str, shrouded
J2	Header, 6 pin, single row, 90°
Miscellaneous	
DSP1	LED, light bar, red

6.9.2 Front panel interconnect board schematic (S127-001)



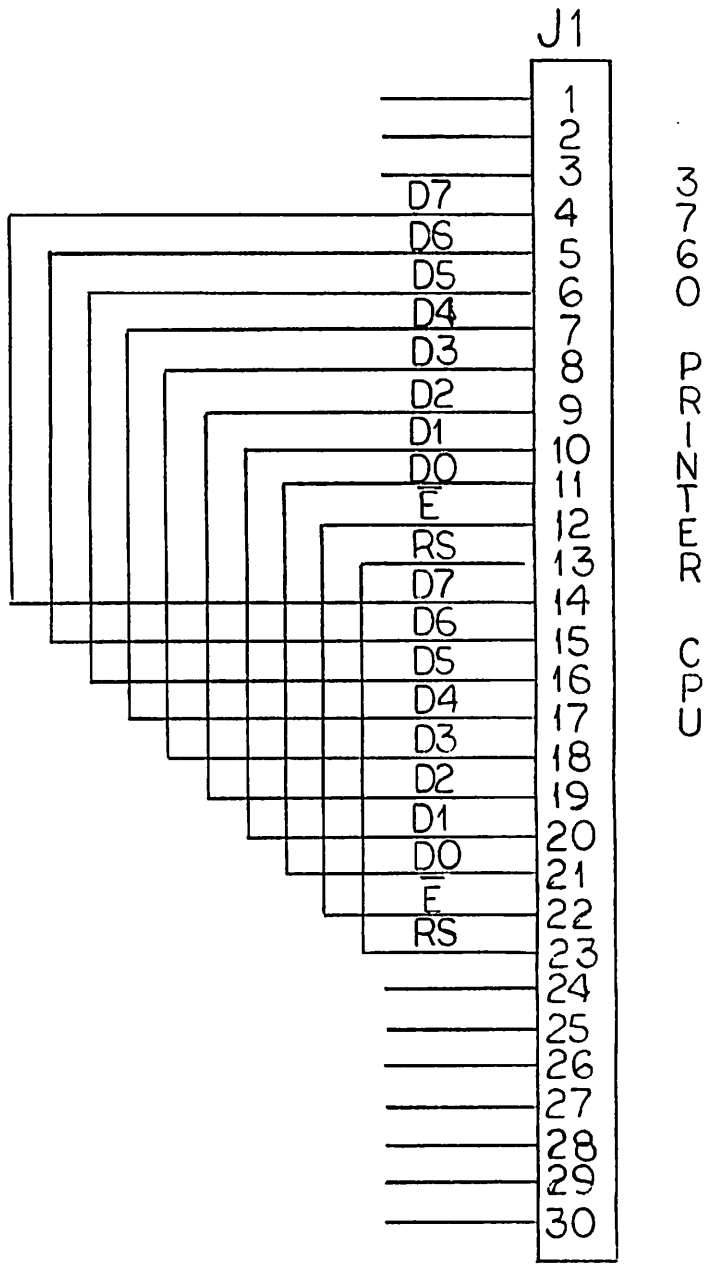
6.10 Printer terminator board (A127-004)



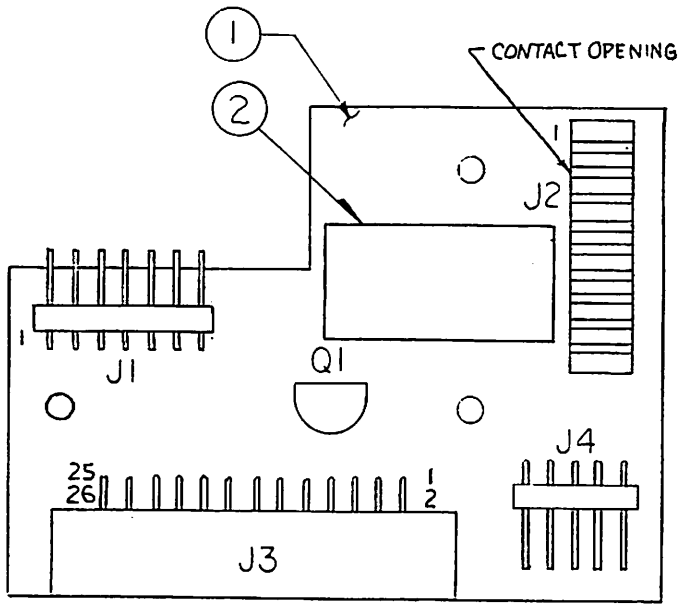
6.10.1 Printer terminator board components

Item	Description	Qty
1	PCB, printer terminator, 3760	1
2	Socket, 30 pin, board mount	1

6.10.2 Printer terminator board schematic (S127-004)



6.11 Printer connector board (A126-003)

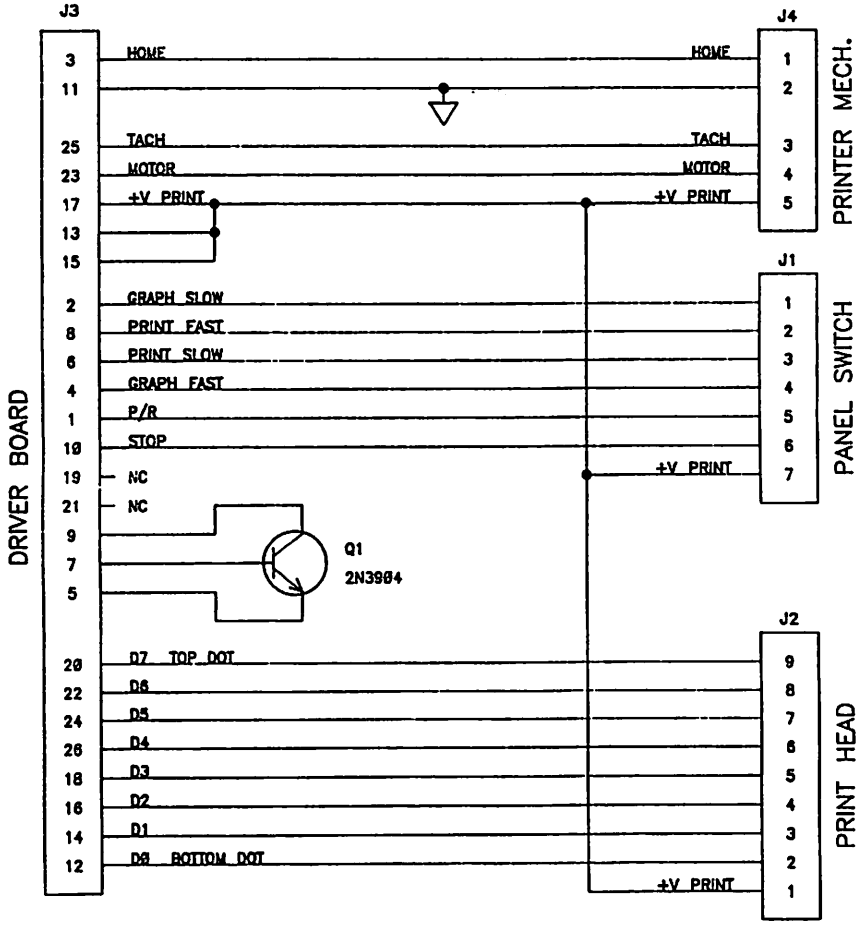


6.11.1 Printer connector board components

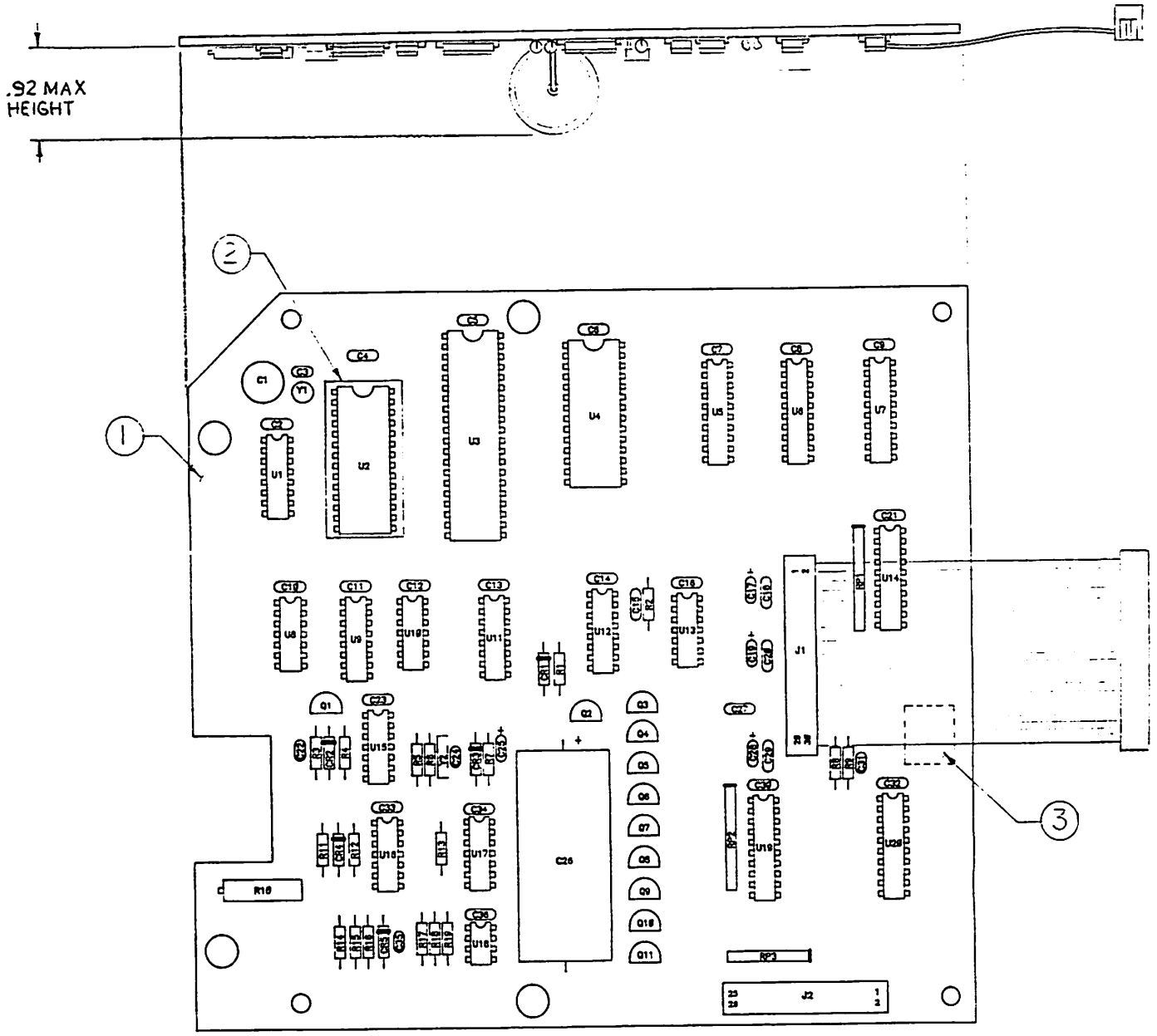
Item	Description	Qty
1	PCB, connector, IVA	1
2	Label, .75 x .25	1

Reference Designator	Part Description
Diodes	
Q1	Transistor, NPN, 2N3904
Headers	
J1	Header, 7 pin, single row, 90°
J2	Plug, flex circuit, 9 pin, .1 ctr
J3	Header, 26 pin, shrouded, 90°
J4	Header, 5 pin, single row, 90°

6.11.2 Printer connector board schematic (S126-003)



6.12 Printer board (A127-005)



6.12.1 Printer board components

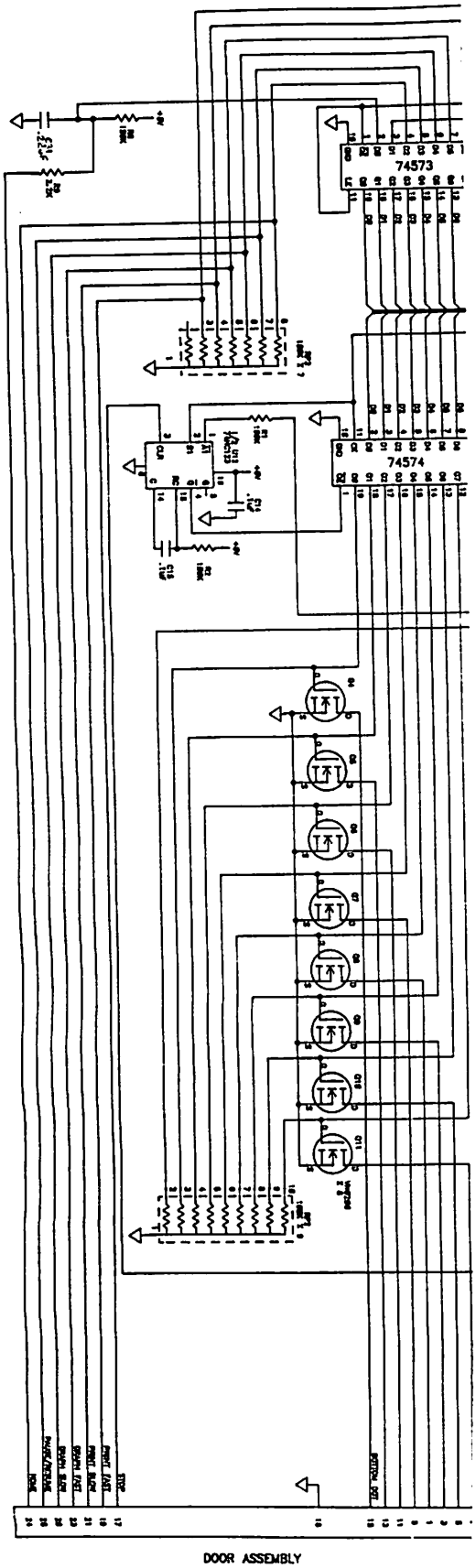
Item	Description	Qty
1	PCB, printer, 3760	1
2	Socket, 28 pin, DIP	1
3	Label, .75" x .25"	1

Reference Designator	Part Description
Capacitors	
C1	Cap, trim, top adj, 6-36PF
C2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 20, 21, 23, 27, 29, 30, 32, 33, 34, 36	Cap, monocer, 50V, 20%, .1UF
C3	Cap, monocer, 50V, 5%, 22PF
C17, 19, 25, 28	Cap, tant el, 25V, 20%, 10UF
C22	Cap, monocer, 50V, 5%, 470PF
C24	Cap, monocer, 50V, 5%, 10PF
C26	Cap, alumel, 16V, +50-20%, 10000UF
C31	Cap, monocer, 50V, 20%, .22UF
C35	Cap, monocer, 50V, 5%, .001UF
Resistors	
R1, 2, 3, 4, 7, 8, 12	Res, carbfilm, 1/4W, 5%, 100K
R5	Res, carbfilm, 1/4W, 5%, 3.3K
R6	Res, carbfilm, 1/4W, 5%, 22M
R9, 15	Res, carbfilm, 1/4W, 5%, 2.2K
R10	Pot, trim, multi-turn, 50K
R11	Res, carbfilm, 1/4W, 5%, 22K
R13	Res, carbfilm, 1/4W, 5%, 10K
R14	Res, carbfilm, 1/4W, 5%, 20K
R16	Res, carbfilm, 1/4W, 5%, 160K
R17	Res, metlfilm, 1/4W, 1%, 100K
R18	Res, metlfilm, 1/4W, 1%, 267K
R19	Res, metlfilm, 1/4W, 1%, 3.4M
RP1, RP2	R-pak, 100K x 9 (10 pin)
RP3	R-pak, 100K x 7 (8 pin)
Diodes	
CR1	Diode, 50V, 1 amp, 1N4001
CR2, 3, 4, 5	Diode, 1N914/1N4148
Q1	Transistor, NPN, 2N3904
Q2, 3, 4, 5, 6, 7, 8, 9, 10, 11	Transistor, N-FET, VN0206N3

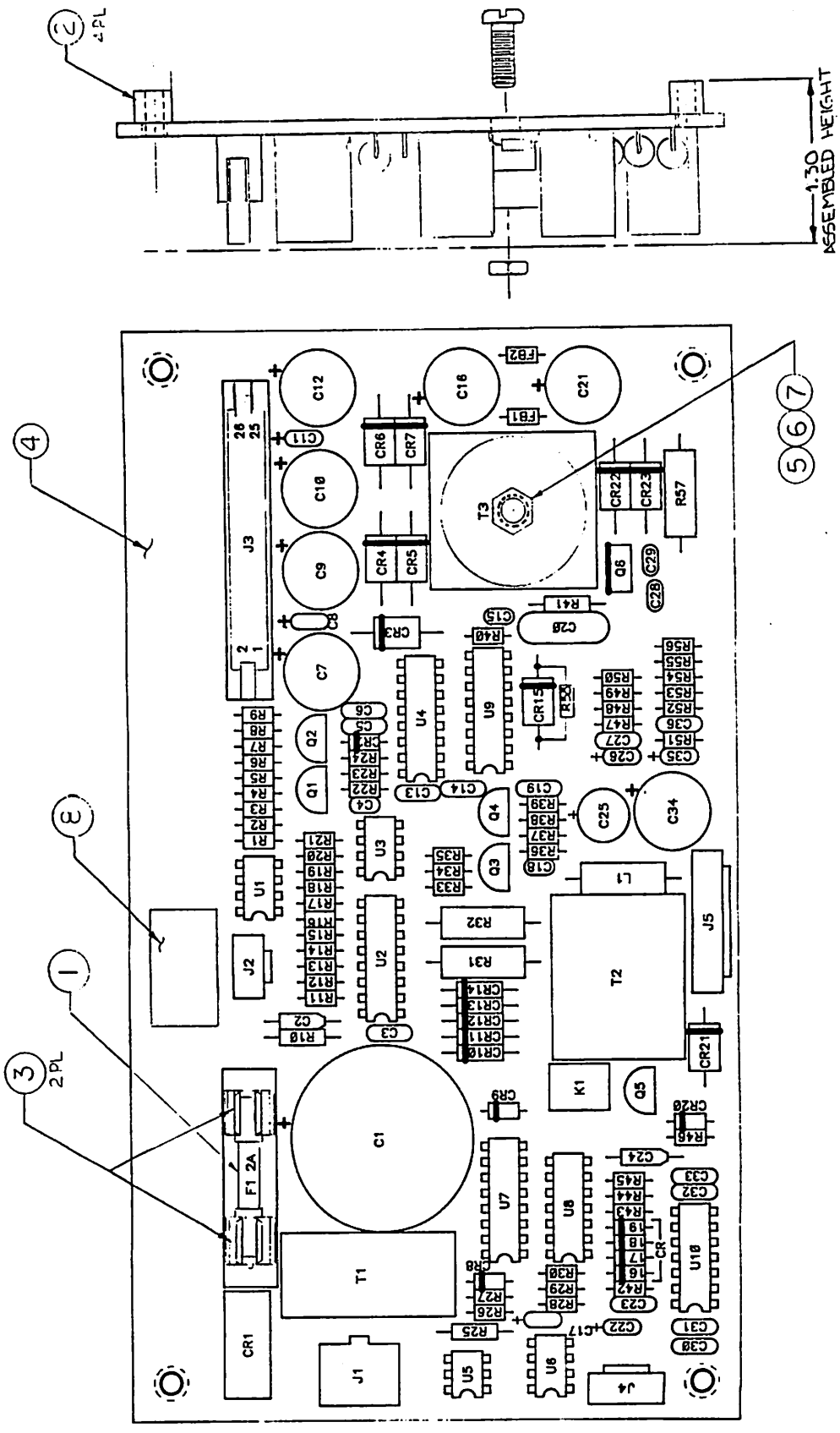
6.12.1 Printer board components (continued)

Reference Designator	Part Description
Integrated Circuits	
U1	Clock, CMOS real time
U2	EPROM assy, printer, 3760
U3	CPU, low power, Z80L
U4	CMOS, RAM 8K by 8, 6264
U5, 6, 19	Octal D-type flip-flop, 74HCT574
U7, 14, 20	Non-inverting latch, 74HCT573
U8, 13	HCMOS dual D flip-flop, 74HC74
U9	HCMOS decade coun/div, 74HC4017
U10	HCMOS quad 2 in OR gate, 74HC32
U11	1 of 8 decoder/demux, 74HCT138
U12	Dual retrig one shot, 74HC123A
U15	HCMOS qd NAND Shmt-trg, 74HC132
U16	HCMOS hex inv unbuff, 74HCU04
U17	Quad 2 input NOR, 74HC02
U18	CMOS, dual ov/un V dtcr, ICL7665
Headers	
J1	Rib cable assy, 30 pin, PCB mt, 4.5
J2	Header, 26 pin, str, shrouded
Miscellaneous	
Y1	Crystal, 32.768 kHz
Y2	Crystal, 1 MHz

6.12.2 Printer board schem



6.13 Power supply board (A125-001)



6.13.1 Power supply board components

Item	Description	Qty
1	Fuse, 2A, fast action, instrument type	1
2	Standoff, permanent, .143 ID x .125 lg	4
3	Fuse clip	2
4	PCB, power supply board, 3740/3760	1
5	Screw, #6-32 x 1L, pan nylon	1
6	Nut, #6-32, hex nylon	1
7	Adhesive, sicomet 5023	1
8	Label, .75" x .25"	1

Reference Designator	Part Description
Capacitors	
C1	Cap, alumel, 30VDC-25VDC, 6800UF
C2	Cap, tant el, 35V, 10%, .22UF
C3, 5, 6, 14, 19, 23, 27, 30, 31, 32	Cap, monocer, 50V, 20%, .1UF, .2L
C4, 33	Cap, monocer, 25V, 20%, .01UF
C7, 12	Cap, alumel, 35V, rad lead, 470UF
C8, 11, 35	Cap, tant el, 35V, 20%, 2.2UF
C9, 10, 16, 21, 34	Cap, alumel, 10V, rad lead, 1000UF
C13	Cap, tant el, 10V, 10%, 33UF
C15, 28, 29	Cap, monocer, 50V, 5%, .001UF
C17, 22, 26	Cap, tant el, 25V, 10%, 10UF
C18	Cap, monocer, 50V, 5%, 68PF
C20	Cap, polyest, 25V, 10%, .01UF
C24	Cap, tant el, 25V, 20%, .47UF
C25	Cap, alumel, 35V, hf, rdlead, 330UF
C36	Cap, monocer, 50V, .022UF
Resistors	
R1, 33, 34, 36	Res, metlfilm, 1/8W, 1%, 10K
R2, 9	Res, metlfilm, 1/8W, 1%, 121K
R3	Res, metlfilm, 1/4W, 1%, 1M
R4, 6	Res, metlfilm, 1/4W, 1%, 22.1M
R5	Res, metlfilm, 1/8W, 1%, 35.7K
R7, 13	Res, metlfilm, 1/8W, 1%, 63.4K
R8	Res, metlfilm, 1/8W, 1%, 1M
R10	Res, carbfilm, 1/4W, 5%, 750
R11	Res, metlfilm, 1/8W, 1%, 475 ohms
R12	Res, metlfilm, 1/8W, 1%, 1K
R14	Res, metlfilm, 1/8W, 1%, 9.31K
R15, 47	Res, metlfilm, 1/8W, 1%, 14.3K
R16	Res, metlfilm, 1/8W, 1%, 174K

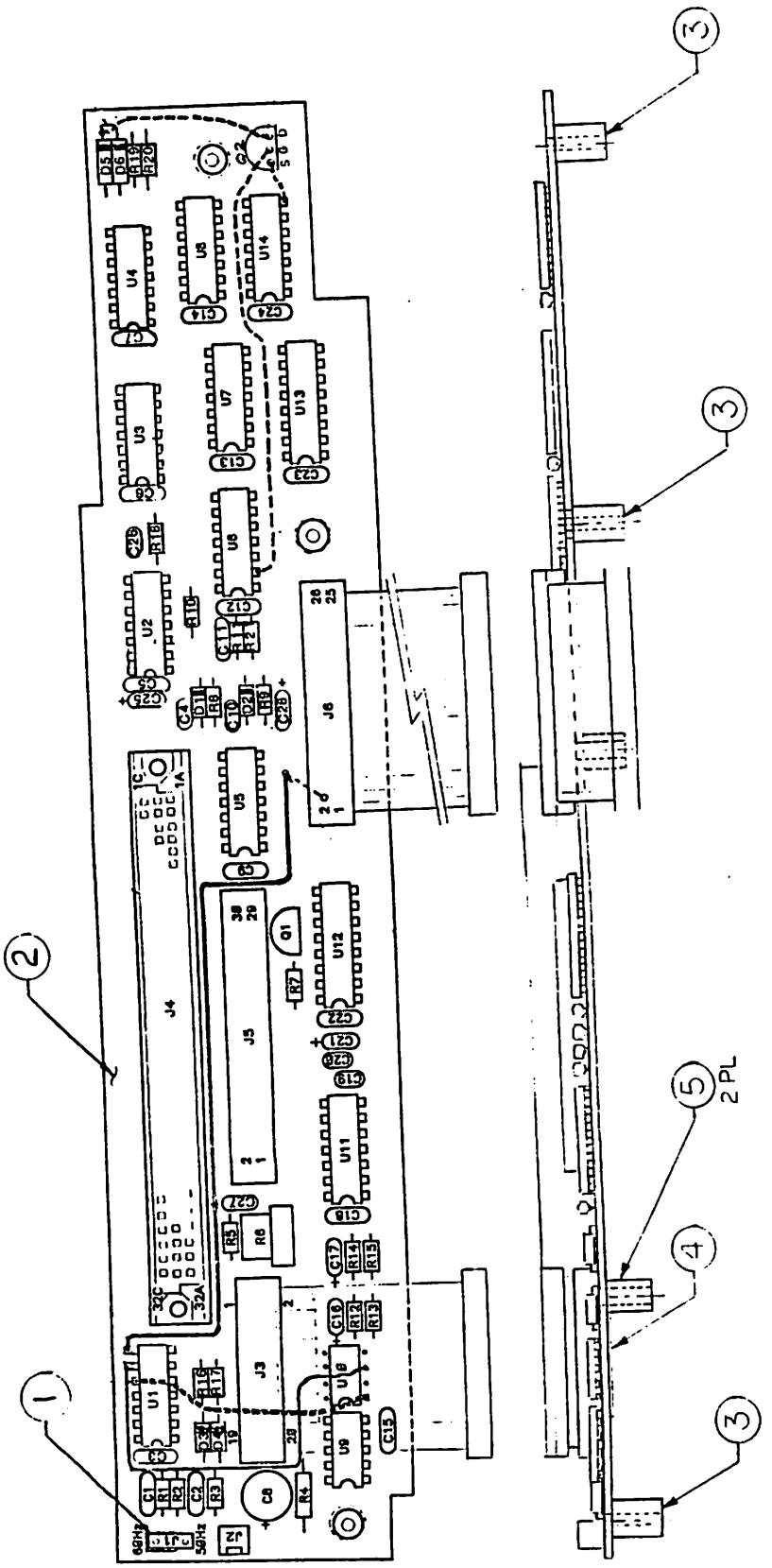
6.13.1 Power supply board components (continued)

Reference Designator	Part Description
Resistors (continued)	
R17	Res, metlfilm, 1/8W, 1%, 732K
R18	Res, metlfilm, 1/4W, 1%, 10M
R19	Res, metlfilm, 1/4W, 1%, 11.8M
R20, 23, 24, 35, 43	Res, metlfilm, 1/8W, 1%, 100K
R21	Res, metlfilm, 1/8W, 1%, 806K
R22	Res, metlfilm, 1/8W, 1%, 24.3K
R25	Res, carbfilm, 1/4W, 5%, 1.5K
R26, 27, 39, 56	Res, metlfilm, 1/8W, 1%, 2K
R28	Res, metlfilm, 1/8W, 1%, 332K
R29	Res, metlfilm, 1/8W, 1%, 681K
R30, 44, 45, 46	Res, metlfilm, 1/8W, 1%, 200K
R31, 32	Res, wirewound, 3W, 5%, .3 ohm
R37	Res, metlfilm, 1/8W, 1%, 3.01K
R38	Res, metlfilm, 1/8W, 1%, 392 ohms
R40	Res, metlfilm, 1/8W, 1%, 24.3 ohms
R41	Res, carbfilm, 1/4W, 5%, 180 ohms
R42	Res, metlfilm, 1/4W, 1%, 2M
R48, 49, 52	Res, metlfilm, 1/8W, 1%, 16.5K
R50	Res, metlfilm, 1/8W, 1%, 4.75K
R51	Res, metlfilm, 1/8W, 1%, 35.7 ohms
R53	Res, metlfilm, 1/8W, 1%, 511K
R54	Res, metlfilm, 1/4W, 1%, 15K
R55	Res, metlfilm, 1/4W, 1%, 51.1K
R57	Res, wirewound, 3W, 5%, .1 ohm
R58	Res, carbfilm, 1/4W, 5%, 18K
Diodes	
CR1	Rectifier, F-wave bridge, 3N254
CR2, 8, 9, 16, 17, 18, 19, 20	Diode, 1N914
CR3	Diode, transzorb, P6KE6.8
CR4, 5, 6, 7, 22	Rectifier, 6A, MUR405
CR10, 11, 12, 13, 14	Diode, 50V, 1 amp, 1N4001
CR15	Diode, 3A, Schottky, 1N5822
CR21	Diode, 1A, Schottky, 1N5817
CR23	Diode, ultrafast, 4 amp, 150V
Q1	Transistor, N-FET, VN0206N3
Q2, 5	Transistor, N-FET, VN0104N3
Q3, 4	Transistor, NPN, 2N3904
Q6	Transistor, N-FET, IRF532 & IRF530

6.13.1 Power supply board components (continued)

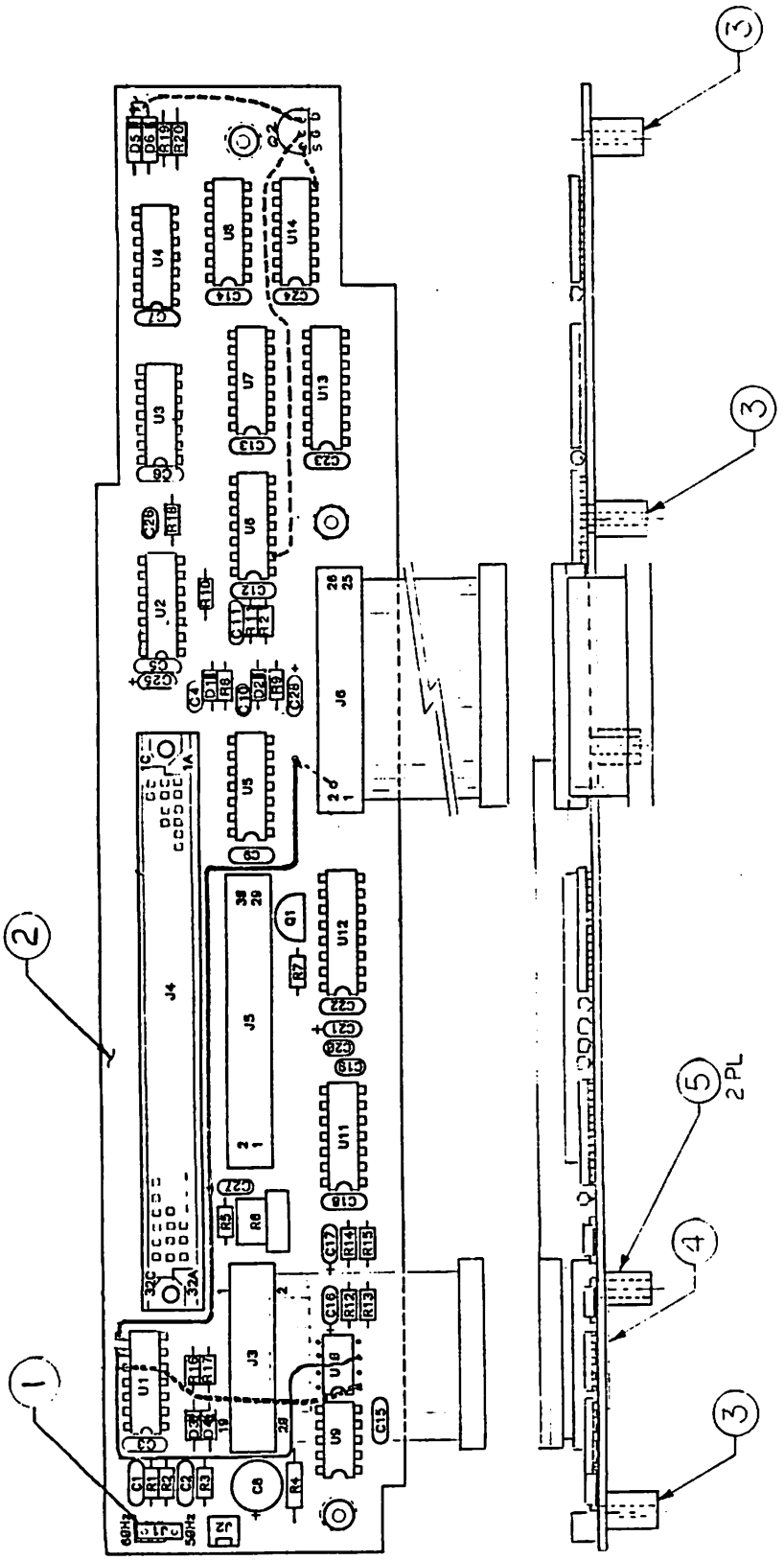
Reference Designator	Part Description
Integrated circuits	
U1, 3	CMOS, dual over/un V dtcr, ICL7665
U2	I.C., battery charger, UC3906
U4	HCMOS, counter, 14 bit, 74HC4020
U5	Optoisolator, 255
U6	CMOS, positive volt regulator, 7663
U7	CMOS, hex inverting buff, 4049UB
U8	CMOS, Schmitt Q-2 in NAND, 4093B
U9	I.C., pwm controller, UC3846J
U10	CMOS, quad 2 input NAND, 4011B
Headers	
J1	Header, 6 pin, double row, .165" ctr
J2	Header, 3 pin, locking, .1" ctr
J3	Header, 26 pin, str double w/lever
J4	Header, 4 pin, locking, .1" ctr
J5	Header, 8 pin, locking, .1" ctr
Miscellaneous	
F1	Fuse, 2A, fast action, instrmnt type
FB1, 2	Ferrite bead, .175"
FH1, 2	Fuse clip
K1	Relay, 12VDC, PCB mount, spdt
L1	Inductor, 33 µH @ 390 mA
T1	Inductor, EMI common mode
T2	Transfrmr, 5Vac-125Vac@5mA/450Hz
T3	Transformer, flyback, 5W

6.14 MINX interface board (A128-007)



There are no express or implied warranties that extend beyond the warranties hereinabove set forth. Ohmeda makes no warranty of merchantability or fitness for a particular purpose with respect to the product or parts thereof.

6.14 MINX interface board (A128-007)



6.14.1 MINX interface board components

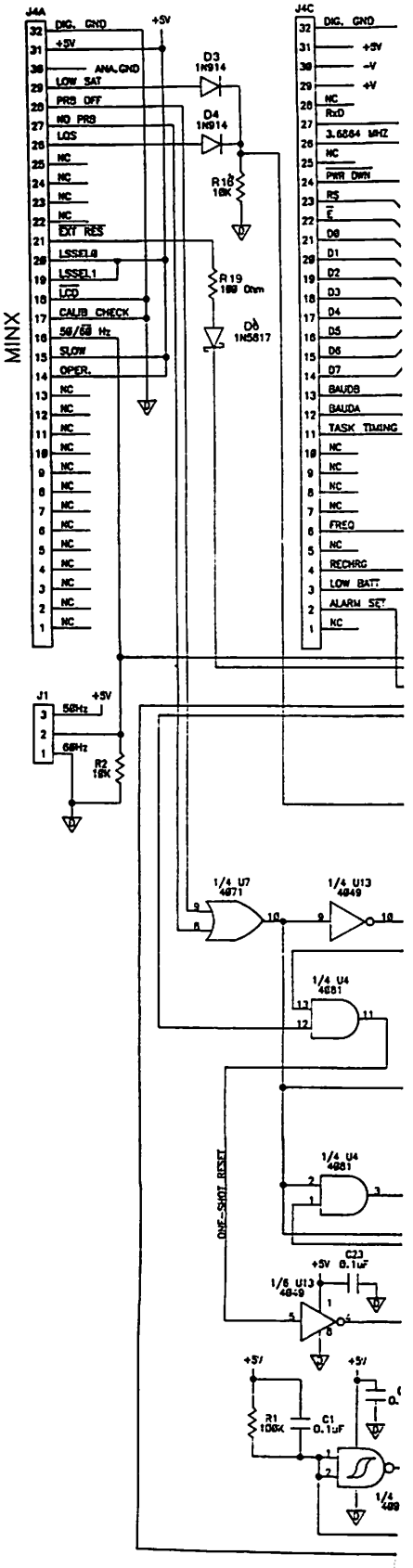
Item	Description	Qty
1	Shunt	1
2	PCB, interface, MINX	1
3	Standoff, .143 I.D. x .25	3
4	Label, .75" x .25"	1
5	Standoff, .166 I.D. x .25	2

Reference Designator	Part Description
Capacitors	
C1, 2, 3, 5, 6, 7, 9, 11, 12, 13, 14, 15, 18, 22, 23, 24	Cap, monocer, 50V, 20%, .1UF, .2L
C4, 10, 19, 20	Cap, monocer, 25V, 20%, .01UF
C8	Cap, alumel, 25V, rad lead, 100UF
C16	Cap, tant el, 25V, 10%, 0.1UF
C17	Cap, tant el, 25V, 10%, 10UF
C21, 27	Cap, tant el, 25V, 20%, 1UF
C25	Cap, tant el, 35V, 20%, 2.2UF
C26	Cap, monocer, 50V, 5%, .001UF
C28	Cap, tant el, 35V, 20%, 4.7UF
Resistors	
R1, 3, 8, 9, 11	Res, carbfilm, 1/8W, 5%, 100K
R2, 7, 16, 17, 18, 21	Res, carbfilm, 1/8W, 5%, 10K
R4	Res, carbfilm, 1/4W, 5%, 20 ohms
R5	Res, carbfilm, 1/8W, 5%, 15K
R6	Pot, trim, 5K, 3/4 turn
R10	Res, metlfilm, 1/8W, 1%, 1K
R12	Res, metlfilm, 1/8W, 1%, 14.3K
R13	Res, metlfilm, 1/8W, 1%, 5.49K
R14	Res, metlfilm, 1/8W, 1%, 36.5K
R15	Res, metlfilm, 1/8W, 1%, 15.4K
R19, 20	Res, carbfilm, 1/8W, 5%, 100
Diodes	
D1, 2, 3, 4	Diode, 1N914
D5, 6	Diode, 1A, Schottky, 1N5817
Q1, 2	Transistor, N-FET, VN0104N3

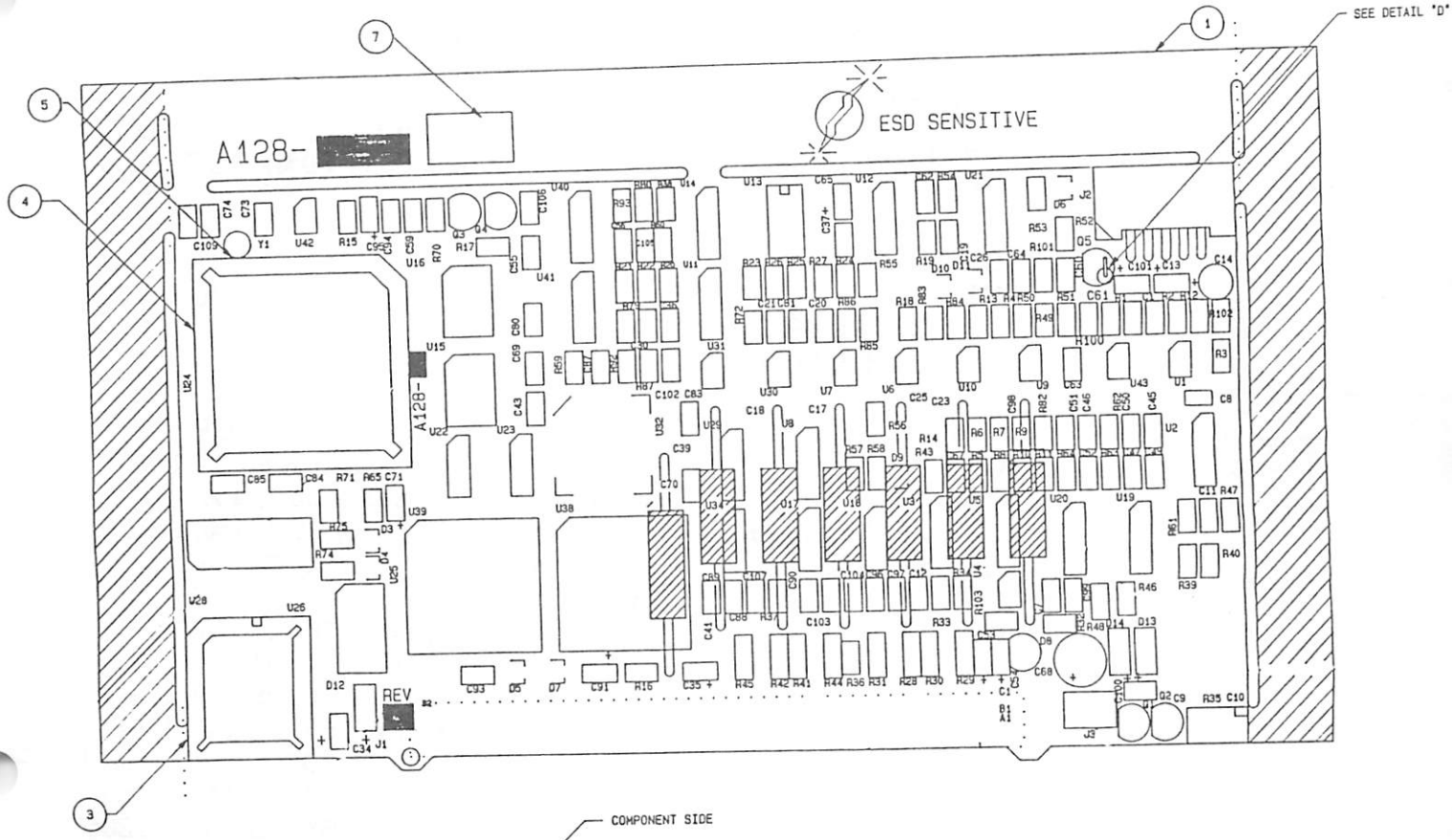
6.14.1 MINX interface board components (continued)

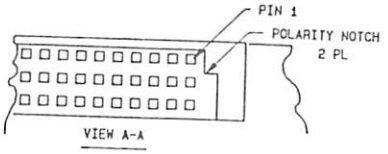
Reference Designator	Part Description
Integrated circuits	
U1, 2	CMOS, Q-2 in NAND Schmitt, 4093B
U3, 8, 14	CMOS, quad 2 input NAND, 4011B
U4, 5	CMOS, quad 2 input AND, 4081B
U6	CMOS, dual D flip-flop, 4013B
U7	CMOS, Q-2 input OR gate, 4071B
U9	Current amplifier, LH0002C
U11	CMOS, dual precision timer, 556
U12	Programmable timer, 4536B
U13	CMOS, hex inverting buffer, 4049UB
Headers	
J1	Header, 3 pin, single row
J2	Header, 2 pin, str, locking
J3	Rib cable assy, 20 pin, PCB mnt, 2.0
J4	Socket, 64 pin, A & C, DIN 41612
J5	Header, 30 pin, str, shrouded
J6	Rib cable assy, 26 pin, PCB mnt, 7.5

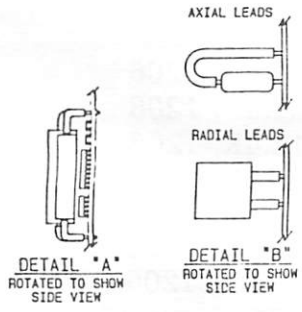
6.14.2 MINX interface boar

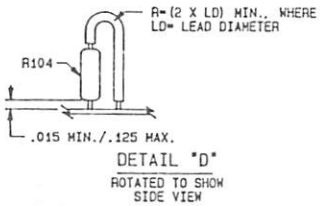


6.15 MINX board (8127-008)









6.15.1 MINX board components

Reference Designator	Part Description
Capacitors	
C1	Cap, monocer, 50V, 5%, 10PF, 1206
C7, 30, 45, 46, 47, 51, 52, 59, 62, 63, 85, 94, 96, 97, 99, 100, 109	Cap, monocer, 50V, 20%, .1UF, 1206
C8, 9, 10	Cap, polycarb, 25V, 1%, .22UF
C11, 12, 19, 20, 21, 26, 36, 37, 43, 49, 50, 55, 56, 67, 69, 70, 80, 84, 87, 93, 102, 103, 104	Cap, monocer, 25V, 20%, .22UF, 1206
C13, 34, 35, 91, 101	Cap, tant el, 25V, 20%, 4.7UF
C14	Cap, alumel, 16V, rad lead, 22UF
C17, 18	Cap, axial, polycarb, 25V, 1%, 1UF
C23, 25, 39, 41, 98	Cap, axial, polycarb, 25V, 1%, .22UF
C53, 54, 95	Cap, tant el, 35V, 20%, 2.2UF
C60	Cap, monocer, 50V, 5%, 47PF, 1206
C61, 64	Cap, monocer, 50V, 10%, .1UF, 1206
C65, 71	Cap, tant el, 25V, 20%, 1UF
C68	Cap, alumel, 25V, rad lead, 100UF
C73, 74	Cap, monocer, 50V, 5%, 33PF, 1206
C81, 83	Cap, monocer, 50V, 10%, .047UF 1206
C88, 89, 90	Cap, monocer, 50V, 5%, 100PF, 1206
C105, 106	Cap, monocer, 50V, 5%, .001UF, 1206
C107	Cap, monocer, 50V, 5%, 220PF, 1206
Resistors	
R1, 49, 51, 54, 61, 62, 63, 64, 92, 93, 100	Res, 1/8W, 1%, 1K, 1206
R2, 56	Res, 1/8W, 1%, 1M, 1206
R3, 4	Res, 1/8W, 1%, 49.9 ohms, 1206
R5	Res, 1/8W, 1%, 402K, 1206
R6	Res, 1/8W, 1%, 200K, 1206
R7, 33, 65, 101, 102	Res, 1/8W, 1%, 100K, 1206
R8	Res, 1/8W, 1%, 49.9K, 1206
R9	Res, 1/8W, 1%, 24.9K, 1206
R10	Res, 1/8W, 1%, 12.4K, 1206
R11, 82	Res, 1/8W, 1%, 6.19K, 1206
R12, 13, 14	Res, 1/8W, 1%, 21.5K, 1206
R15, 70, 87	Res, 1/8W, 1%, 2.21K, 1206
R16	Res, 1/8W, 1%, 1.50K, 1206
R17, 18, 19	Res, 1/8W, 1%, 221 ohms, 1206
R20	Res, 1/8W, 1%, 976K, 1206
R21	Res, 1/8W, 1%, 487K, 1206

6.15.1 MINX board components (continued)

Reference Designator	Part Description
Resistors (continued)	
R22	Res, 1/8W, 1%, 243K, 1206
R23	Res, 1/8W, 1%, 124K, 1206
R24	Res, 1/8W, 1%, 1.91K, 1206
R25, 79	Res, 1/8W, 1%, 61.9K, 1206
R26, 32, 37	Res, 1/8W, 1%, 30.9K, 1206
R27	Res, 1/8W, 1%, 15.4K, 1206
R28, 30	Res, thinfilm, 1/20W, .1%, 76.8K
R29, 31	Res, thinfilm, 1/20W, .1%, 51.1K
R34	Res, 1/8W, 1%, 80.6K, 1206
R35	Pot, trim, 10K
R36, 39, 40, 46, 47, 52, 53, 72, 83, 85	Res, 1/8W, 1%, 10K, 1206
R38, 55, 80	Res, 1/8W, 1%, 51.1K, 1206
R41, 42	Res, thinfilm, 1/20W, .1%, 10K
R43	Res, 1/8W, 1%, 511 ohms, 1206
R44, 45	Res, thinfilm, 1/20W, .1%, 1K
R48	Res, metlfilm, 1/4W, 1%, 2.61 ohms
R50	Res, 1/8W, 1%, 4.75K, 1206
R57	Res, 1/8W, 1%, 6.34K, 1206
R58	Res, 1/8W, 1%, 20K, 1206
R59, 69	Res, 1/8W, 1%, 19.6K, 1206
R71	Res, 1/8W, 1%, 3.65K, 1206
R74	Res, 1/8W, 1%, 499 ohms, 1206
R75	Res, 1/8W, 1%, 475 ohms, 1206
R84, 86	Res, 1/8W, 1%, 340K, 1206
R104	Res, metlfilm, 1/8W, 1%, 30.1 *ohms*
Diodes	
Q1, 2	Transistor, NPN, MPS6715
Q3	Transistor, P-FET, VP0104N3
Q4	Transistor, N-FET, VN0104N3
D3, 5, 6, 9, 10, 11	Diode, dual Schottky, SOT-23
D7	Diode, dual silicon, BAV99, SOT-23
D12, 13, 14	Diode, transzorb, SMT, SMBJ5.0

6.15.1 MINX board components (continued)

Reference Designator	Part Description
Integrated circuits	
U1	Low nse 2 JFET Opmp SO-8, TL072C
U2, 3, 8, 12, 14, 19, 20, 21	Triple 2 ch mux, S0-16, 74HC4053
U4, 6, 7, 9, 10	Opamp, ult-lw offst, SO-8, OP-07
U5, 11, 40, 41	8 to 1 MUX, SO-16, 74HC4051
U13	JFET-input Opamp, OP-15EZ
U15, 16	5 low PS filt, SOL-16, LTC1062
U17, 34	Low nse qd Opmp, SO-14, TL074AC
U18	Opamp, quad, SO-14, LM224A
U22	Quad NAND Schmitt, SO-14, 74HC132
U23	Quad NAND, SO-14, 74HC00
U24	CMOS, mcrcntlr, PLCC-68, N80C196KA
U25	CMOS, non-IV lch, SOL-20, 74HC573
U28	CMOS, RAM, 8K x 8, FP-28, 6264
U29	CMOS, DCDR 2, 2-4, SO-16, 74HC139
U30, 31	Prec sample & hold, SO-8, LF398
U32	Quad, 8-bit mlt, DAC PLCC-28, 8408
U38, 39	CMOS, prog prep, PLCC-44, 82C55A
U42	Opamp, SO-8, ALD1702
U43	JFET, wideband, 357 Opamp, SO-8
Headers	
J1	Header, 64 pin, DIN, A&C, 41612
J2	Header, 10 pin, shrouded, 90°
J3	Header, 6 pin, double row, 90°
Miscellaneous	
D4	LED, red/green, SOT-23
D8	Voltage reference, 1.235V, LM385
Y1	Crystal, parallel, 7.3728 MHz

Appendix W: Warranty

This product is sold by Ohmeda under the warranties set forth in the following paragraphs. Such warranties are extended only with respect to the purchase of this product directly from Ohmeda's Authorized Dealers as new merchandise and are extended to the first Buyer thereof, other than for resale.

For a period of twelve (12) months from the date of shipment, this product, other than its expendable parts, is warranted to be free from functional defects in materials and workmanship and to conform to the description of the product contained in the operating manual and accompanying labels and/or inserts, provided that same is properly operated under conditions of normal use, that regular periodic maintenance and service is performed, and that replacements and repairs are made in accordance with the instructions provided. For current warranty information on all probes, see the *Ohmeda Probes Manual* (0380-0900-085, BX#1000-304).

Ohmeda's sole and exclusive obligation and buyer's sole and exclusive remedy under the above warranties is limited to repairing or replacing, free of charge, at Ohmeda's option, a product which is telephonically reported to the Ohmeda Regional Service Office and which, if so advised by Ohmeda, is thereafter returned with a statement of the observed deficiency, not later than seven (7) days after the expiration date of the warranty, to Ohmeda during normal business hours, transporting charges prepaid, and which, upon Ohmeda's examination, is not found to conform with the above warranties. Ohmeda shall not be otherwise liable for any damages including but not limited to incidental damages, consequential damages, or special damages.

There are no express or implied warranties that extend beyond the warranties hereinabove set forth. Ohmeda makes no warranty of merchantability or fitness for a particular purpose with respect to the product or parts thereof.