
PageWriter 100, 200 and 300 Series Cardiographs
M1770A, M1771A, and M1772A
Mobile Cart M1705B

Service Manual

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- Assembly operations, extensions, re-adjustments, modifications or repairs are done by persons authorized by Agilent Technologies.
- The electrical installation of the relevant room complies with the IEC or national requirements.
- The instrument is used according to the instructions for use presented in this manual.

WARNING

As with all electronic equipment, radio frequency interference between this cardiograph and any existing RF transmitting or receiving equipment at the installation site, including electrosurgical equipment, should be evaluated carefully and any limitations noted before the equipment is placed in service. Monitoring during electrosurgery should not be attempted and monitoring electrodes should be removed from the patient to preclude the possibility of burns. Radio frequency generation from electrosurgical equipment and close proximity transmitters may seriously degrade cardiograph performance. Agilent Technologies assumes no liability for failures resulting from RF interference between Agilent medical electronics and any radio frequency generating equipment at levels exceeding those established by applicable standards.

Notice

CAUTION

Like all electronic devices, this cardiograph is susceptible to electrostatic discharge (ESD). Electrostatic discharge typically occurs when electrostatic energy is transferred to the patient, the electrodes, or the cardiograph. ESD may result in ECG artifact that may appear as narrow spikes on the cardiograph display or on the printed report. When ESD occurs, the cardiograph's ECG interpretation may be inconsistent with the physician's interpretation.

ESD discharges to exposed metal on the rear of the cardiograph can occasionally cause an error message to appear on the cardiograph display. The cardiograph returns to normal operation after turning the power off, then on again.

CAUTION

The data transmission cable must have a suppression device attached to assure the cardiograph's compliance with the European Radiated Emissions Standard found in CISPR 11. If your data transmission cable does not include a suppression device, compliance can be achieved by attaching one of the following suppression devices to the cable, near the cardiograph:

part number 0443164251

Fair-Rite Products Corporation
P. O. Box J
One Commercial Row
Wallkill, New York 12589
telephone: (914) 895-2055
FAX: (914)895-2629

or

Euro-Schaffner, S. A.
1 B Avenue de Suisse - BP 16
68311 Illzach Cedex, France
telephone: 33-8-931-0400
FAX: 33-8-931-0401

part number 28B2025-0A0

Steward
East 36th Street
P. O. Box 510
Chattanooga, TN 37401
telephone: (615) 867-4100
FAX: (615) 867-4102

or

Steward EMC, S.A.
Rue Fritz-Couvoisier 40
Ch-2300 La Chaux-de-Fonds
Switzerland
telephone: 41-39-282-387
Fax: 41-39-280-277

This is to certify that this equipment is in accordance with the Radio Interference Requirements of the EMC Directive.

Notice

Medical Device Directive

The PageWriter M1770 series of cardiographs comply with the requirements of the Medical Device Directive 93/42/EEC and carries the **CE**₀₁₂₃ mark accordingly.

Authorized EU-representative:
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Herrenbergerstrasse 130
D-71034 Boeblingen,
Germany

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Agilent Technologies warrants this medical product against defects in materials and workmanship for a period of three years in certain geographics, or one year with onsite support.

If Agilent Technologies receives notice of such defects during the warranty period, Agilent Technologies shall, at its option, either repair or replace hardware products which prove to be defective.

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2. Buyer-supplied software or interfacing.
3. Unauthorized modification or misuse.
4. Operation outside of the environmental specifications for the product.
5. Improper site preparation and maintenance.

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December 1999	Edition 4

Safety Summary

Safety Symbols Marked on the Cardiograph

The following symbols are used on the cardiograph or the cart:



Caution - See operating instructions



Alternating current.



Meets IEC type CF leakage current requirements and is defibrillator protected. (Isolated ECG input.)



Equipotential (identifies independent protective earth conductor to the cardiograph).



Fuse.



Indicates power control for cardiograph.



Indicates operating frequency in cycles per second.



The maximum weight that the cart can hold



Displays the configuration menu on the PageWriter 200/200i/300pi.

Please see Chapter 2, “Performance Verification and Maintenance,” for safety requirements that apply to the cardiograph.

Conventions Used in This Manual

Conventions Used in This Manual

WARNING

Warning statements describe conditions or actions that can result in personal injury or loss of life.


CAUTION


Caution statements describe conditions or actions that can result in damage to the equipment or software.

NOTE

Notes contain additional information on cardiograph usage.

TEXT represents the labels that appear on the display.

 represents keys on the key panel.

 represents the temporary key labels that appear on the display.

Preface

This manual contains service information for the Agilent M1770A pageWriter 300pi, PageWriter 200i, M1771A PageWriter 200, and M1772A PageWriter 100 cardiographs. The information and procedures in this manual apply to all models unless otherwise specified.

This manual is organized as follows:

- **Chapter 1 — Introduction.** Contains a general description of the cardiographs, lists of technical specifications, and lists of accessories and options.
- **Chapter 2 — Performance Verification and Maintenance.** Explains how to check the cardiograph's performance using built-in self-tests, and lists maintenance procedures and safety requirements that apply to the cardiograph.
- **Chapter 3 — Theory of Operation.** Provides an overview of how the cardiograph works and describes the operation of the major subassemblies.
- **Chapter 4 — Troubleshooting.** Contains procedures and error codes to aid the service person in localizing faults to a replaceable subassembly.
- **Chapter 5 — Removal and Replacement.** Contains procedures for removing and replacing each of the cardiograph's major subassemblies.
- **Chapter 6 — Parts List.** Lists part numbers for the cardiograph's replaceable parts, and provides assembly drawings.
- **Appendix A — Connector Pin Assignments.** Identifies and defines the signals assigned to the subassembly interconnections.
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Introduction

This chapter introduces you to the M1770A PageWriter 200i/300pi, M1771A PageWriter 200, and M1772A PageWriter 100 cardiographs and lists their technical specifications.

WARNING

These cardiographs are only to be serviced by Agilent qualified personnel.

NOTE

Safe and effective use of medical instrumentation requires periodic inspection and preventive maintenance. Perform the preventive maintenance procedures in Chapter 2 of this manual at required intervals to ensure satisfactory instrument performance.

The cardiographs use a thermal printhead to record waveforms and label the ECG report. The paper supplied with the cardiographs is a thermal paper designed to work with this printhead and with the photo detector used to advancing the paper.

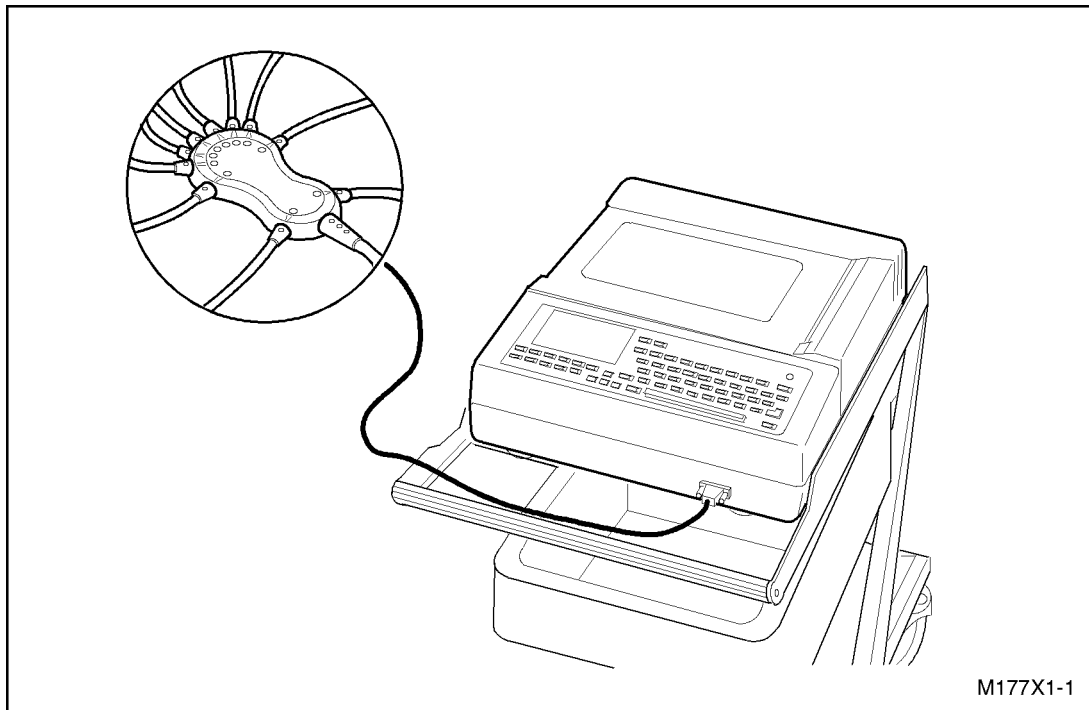
Agilent Technologies guarantees the performance of the cardiographs only when used with Agilent Technologies supplies, accessories, and paper that meet or exceed Agilent Technologies specifications.

PageWriter 100, 200, 200i, and 300pi Series Cardiographs

The M1770A PageWriter 200i/300pi is Agilent Technologies' economical, interpretive cardiograph. The M1771A PageWriter 200 is the economical, non-interpretive cardiograph. The M1772A PageWriter 100 is the most economical, non-interpretive cardiograph. The cardiograph contains the user controls, the printer, and all the processing circuitry. All models use the same enclosure. The M1705B cart is designed for these cardiographs. Figure 1-1 shows the M1770A mounted on the cart. Option #A05 provides transmission and storage capability for the M1770A and M1771A. The StressWriter option provides capability for communication between a PageWriter 100/200/200i/300pi cardiograph and a StressWriter system.

Figure 1-1

M1770A/M1771A PageWriter 300pi/200i/200 Cardiograph.



The PageWriter 100, 200, and 300 family of cardiographs print ECGs in Auto and Manual formats. All PageWriter cardiographs use a continuous feed, high-resolution, thermal array printer. This produces electrocardiograms on standard-size paper that can be included in patient records without cutting or mounting. ECG reports clearly show the ECG waveforms. The PageWriter 200 and 300 series cardiographs also annotate records with patient information and ECG measurements. The PageWriter 200i and 300pi also includes ECG interpretation for both adult and pediatric patients.

From a service standpoint, the PageWriter 100, 200, and 300 family of cardiographs are similar except for two major hardware differences:

- The M1770A has additional firmware for ECG measurements and interpretation.
- The M1771A has additional firmware for ECG measurements.
- The M1772A keypanel does not have an LCD preview display and uses operational keys instead of alphanumeric keys for user input.

All other model differences are found in the cardiograph's software.

The PageWriter 100, 200, and 300 family of cardiographs is designed for low-cost, long-term reliability. The modular design makes extensive use of VLSI and gate array technology, resulting in a minimum number of subassemblies. The modular approach means less down-time for the user, since replacing subassemblies allows faster field repairs. The internal self-test efficiently identifies faulty subassemblies, further speeding the repair process.

Inquiries

M1705B Cart

The optional M1705B Cart provides mobility for the PageWriter 100, 200, and 300 family of cardiographs. The large wheels make the cart easy to move, yet steady. Slots in the cardiograph's feet and a thumbscrew secure the cardiograph to the cart rails. The tray directly below the cardiograph provides storage for the user's guide. Storage for the power cable is built in. Other built-in cable retainers hold the patient data cable out of the way. Two compartmented trays provide storage for spare patient electrodes and patient cables, additional thermal paper, and consumable supplies.

Transmission and Storage, Option #A05

Transmission and storage features are available for the M1770A and M1771A with purchase of Option #A05. Up to thirty Auto ECGs can be stored in the cardiograph's internal flash memory. Stored ECGs can be recalled later for editing, re-analyzing, printing, or transmission to another PageWriter 200/200i/300pi equipped with Option #A05, a PageWriter XLi cardiograph, a TraceMaster ECG Management System, or facsimile machine. Manual ECGs cannot be transmitted or stored.

Inquiries

Refer any questions or comments regarding these instruments to the nearest Agilent Technologies Sales/Service Office or to one of Agilent Technologies' Service Dispatch Centers. Always identify the instrument by model number and serial number in all correspondence. Telephone numbers for Service Dispatch Centers and Sales/Service Offices are listed in Chapter 6, "Parts List."

Specification Data

The following tables list the technical specifications for the cardiographs and the mobile cart. Specifications are the same for all models except as noted

Table 1-1

Physical Specifications

Parameter	Specification
Dimensions (h × w × l) cardiograph cart	4 in × 15 in × 17 in (11.5 cm × 39.2 cm × 43.7 cm) 36 in × 17 in × 33 in (91.4 cm × 43.5 cm × 84.8 cm)
Weight cardiograph cart	18.7 lbs. (8.5 kg) or less (includes battery, 200 sheets of paper, patient cable, and power cord) 38 lbs. (17.24 kg)
Chemical resistance, cleaners	Withstands the following: isopropyl alcohol (except patient cable), mild soap and water, chlorine bleach and water (30 ml/l of water).

Specification Data

Table 1-2 Electrical Specifications

Parameter	Specification
Resolution ECG (internal) display	5 μ V 128 row pixels by 240 column pixels
display sweep speed	23.1 mm/sec \pm 1%
Input impedance	greater than 2.5 M Ω @ 10 Hz, typically greater than 100M Ω @ DC
Gain accuracy	\pm 5% of input signal or \pm 40 μ V, whichever is greater
Input bias	less than 40 nA for input leadwire, less than 500 nA for Right Leg output leadwire
Common mode rejection	110 dB or greater with AAMI test circuit
Defibrillator recovery	System recovery 8 seconds after 360 joule discharge, no damage
Crosstalk rejection	Less than 2% channel crosstalk
Sample rate	4.096M samples per second per input leadwire (unfiltered)
DC offset tolerance	$\geq \pm$ 300 mVdc with less than 5% gain change
Noise	\leq 30 μ V peak-to-peak RTI
Standardizing voltage	1 mV \pm 5% for 100 mSec \pm 5 mSec
50/60 Hz notch filter	50/60 Hz AC line rejection filters are always active.
Pacemaker pulse display	> 0.2 mV indication for pace pulses between 0.5 and 2 ms duration at amplitude 2 to 250 mV

Sampling Characteristics of Cardiograph

Physiological factors such as breathing can cause variation in amplitudes of heart beats, independent of the heart rate. In addition, sampled systems (as opposed to continuous systems) may show changes in the apparent height of the R-wave when sampling of the R-wave occurs slightly off-peak. Because the sampling rate and the heart rate are asynchronous, the time between the peak and an adjacent sample can vary from one QRS complex to the next. This results in a slight variation of displayed QRS amplitude. This effect is more pronounced with narrower signals, more commonly found in some pediatric electrocardiograms and in pacemaker pulses. The M177XA family of cardiographs minimizes this effect by:

- using an integrating-type A/D converter
- sampling all leadwires simultaneously
- oversampling the signals
- processing the oversampled signals with appropriate digital signal processing techniques

Specification Data

Table 1-3 ECG to Paper Specifications

Parameter	Specification	
Frequency response of PageWriter 200/200i/300pi (-3dB bandwidth)	High Pass	Low Pass
	0.05 Hz	150 Hz
	0.15 Hz	100 Hz
	0.5 Hz	40 Hz
Auto ECG	0.05 Hz	150 Hz
Manual ECG	0.15 Hz	100 Hz
	0.5 Hz	40 Hz
Frequency response of PageWriter 100		
Auto ECG	<3 dB down at (user selectable):	0.15-150 Hz or 0.15-40 Hz
Manual ECG	<3 dB down at (user selectable):	0.05-150 Hz or 0.05-40 Hz
ECG resolution on paper voltage axis time axis	Approximately 8 dots/mm (200 dots/in) Approximately 20 dots/mm (500 dots/in) at 25mm/sec and slower Approximately 10 dots/mm (250 dots/in) at 50mm/sec	
Recorder speed	5, 10, 25, and 50 mm/sec + 1.5%	
ECG visibility with pace pulse	Meets AMMI EC11-1991 standard for Diagnostic Electrocardiographic Devices	

Specification Data

Table 1-4 Power Supply and Battery Specifications

Parameter	Specification
AC line frequency 115 V setting 230 V setting AC input power rating	50 and 60 Hz (nominal) 90–132 Vac 198–264 Vac 50 VA
Battery voltage	6 V DC, 6.5 Ah
Battery recharge time with unit off (battery fully discharged) to 90% capacity to full capacity	7 hours typical 16 hours typical
Battery capacity Auto continuous rhythm (Manual mode)	40 ECGs 40 minutes
Battery life AC and battery operation battery only operation	Typically 24 months Typically 14–16 months
Low battery warning	At least 2 Auto ECGs or at least 2 minutes of Manual ECG is allowed after the Low Battery indication is given.

Table 1-5

Safety Specifications

Parameter	Specification
ECG leads source current to ground	Less than 10 μ A RMS
ECG leads sink current 120 Vac, 60 Hz 240 Vac, 50 Hz	Less than 20 μ A RMS with patient cable Less than 50 μ A RMS with patient cable
Ground wire integrity	Less than 100 m Ω @ 25 A AC
Shunting of defibrillator energy	< 10%
Operator safety during defibrillation	< 100 μ C

Specification Data

Table 1-6

Environmental Specifications

Parameter	Specification
Temperature operating storage	50° to 104° F (10° to 40° C) 32° to 122° F (0° to 50° C)
Humidity operating storage	15 to 80% RH, non-condensing 15 to 90% RH, non-condensing
Pressure (altitude) operating storage	15,000 ft. (4600 m) for 2 hours 15,000 ft. (4600 m)

Table 1-7

Miscellaneous Specifications

Parameter	Specification
Real time clock accuracy 10 to 40° C	Less than 3 minutes deviation per month.
Printhead life	Typically 100,000 pages

Table 1-8

Storage and Transmission Specifications (Option #A05 only)

Parameter	Specification
Auto ECG storage capacity	30 ECGs
Transmission Protocols DT SCP	Data transmission standard used between Agilent PageWriter cardiographs and Agilent TraceMaster ECG Management Systems Standard Communications Protocol
Modem command interfaces Data modem FAX modem	Standard AT command set EIA/TIA-578 Service Class 1
Modem protocols Modulation Error correction Compression FAX modulation	V.34 V.42 V.42 bis V.17

Options and Accessories

PageWriter 100, 200, 200i, and 300pi Cardiographs

These tables list the options and accessories available for the PageWriter 100, 200, and 300 family of cardiographs.

Country/Region Options

Each country/region option includes the appropriate power cord, voltage, printer, patient cable, and language. See Table 1-9, which shows the configuration of each country/region option.

Table 1-9 Country/Region Option Configurations

Option	Country/ Region	Labels	User Manuals	Printer ¹	AHA/ IEC	Volts	Power Cord ²	Electrodes
ABA	North America	English	English	A	AHA	120	903-US	Disposable
ABB	Europe English	English	English	A4	IEC	220	902-Europe	None
ABC	French Canada	French	French	A	AHA	120	903-US	Disposable
ABD	Germany	German	German	A4	IEC	220	902-Europe	None
ABE	Spain	Spanish	Spanish	A4	IEC	220	902-Europe	None
ABF	France	French	French	A4	IEC	220	902-Europe	None
ABG	Australia	English	English	A4	AHA	240	901-Australia	Welsh
ABH	Netherlands	Dutch	Dutch	A4	IEC	220	902-Europe	None
ABK	Intercon English, Taiwan	English	English	A	AHA	120	903-US	Welsh
ABM	Latin America	Spanish	Spanish	A	AHA	120	903-US	Welsh
ABN	Norwegian	Norwegian	Norwegian	A4	IEC	230	902-Europe	None
ABS	Sweden	Swedish	Swedish	A4	IEC	220	902-Europe	None
ABU	United Kingdom	English	English	A4	IEC	240	900-UK	None
ABX	Finland	Finnish	Finnish	A4	IEC	220	902-Europe	None
ABZ	Italy	Italian	Italian	A4	IEC	220	902-Europe	None
AB2	China	Chinese	Chinese	A4	IEC	220	922-China	Welsh
AB4	Singapore	English	English	A4	AHA	240	900-UK	Welsh
AC6	S. Korea	English	English	A	AHA	220	902-Europe	Welsh

Options and Accessories

Table 1-9 Country/Region Option Configurations

Option	Country/Region	Labels	User Manuals	Printer ¹	AHA/IEC	Volts	Power Cord ²	Electrodes
ACJ	India	English	English	A4	IEC	240	917-SA	Welsh
AKM	China	Chinese	English	A4	IEC	220	922-China	Welsh
ACQ	South Africa	English	English	A4	IEC	220	917-SA	None
AKV	South America	Spanish	Spanish	A	AHA	220	902-Europe	Welsh
AC4	Portugal	Portuguese	Portuguese	A4	IEC	230	902-Europe	None
AB9	Brazil	Portuguese	Portuguese	A	AHA	220	903-US	Welsh
ACB	Russia	Russian	Russian	A4	IEC	220	902-Europe	Welsh
AKD	Poland	Polish	Polish	A4	IEC	220	902-Europe	Welsh
AR2	Greece	English	Greek	A4	IEC	230	902-Europe	None

¹In Table 1-9 an “A” in the Printer column refers to 8.5 x 11-in. paper; “A4” refers to 210 x 297-mm paper

²See Table 1-11 for Agilent part numbers

NOTE

Switzerland should order the desired language (German, French, Italian, or English) and the Swiss power cord (Agilent 8120-2296).

Table 1-10 PageWriter 300pi, 200/200i and 100 Series Documentation Part Numbers

Document Title	Language	Part Number
PageWriter 100 Cardiograph User’s Guide (M1772A)	English	M1772-91900
	French	M1772-91901
	German	M1772-91902
	Dutch	M1772-91903
	Spanish	M1772-91904
	Italian	M1772-91905
	Finnish	M1772-91910
	Chinese	M1772-91908
	Portuguese	M1772-91913
	Russian	M1772-91914
	Polish	M1772-91919
	Greek	M1772-91917

Options and Accessories

Table 1-10

PageWriter 300pi, 200/200i and 100 Series Documentation Part Numbers

PageWriter 200/300pi Cardiograph Users's Guide	English	M1772-91900
	French	M1770-91901
	German	M1770-91902
	Dutch	M1770-91903
	Spanish	M1770-91904
	Italian	M1770-91905
	Swedish	M1770-91906
	Finnish	M1770-91910
	Chinese	M1770-91941
	Portuguese	M1770-91943
	Russian	M1770-91944
	Polish	M1770-91949
Greek	M1770-91947	

PageWriter 300pi Predictive Instruments Quick Reference Guide (M1770A with Serial # Prefix CND)	English	M1770-92800
	French	M1770-92801
	German	M1770-92802
	Dutch	M1770-92803
	Spanish	M1770-92804
	Italian	M1770-92805
	Swedish	M1770-92806
	Norwegian	M1770-92808
	Finnish	M1770-92809
	Chinese	M1770-92811
	Portuguese	M1770-92813
	Russian	M1770-92814
Polish	M1770-92819	
Greek	M1770-92817	

Options and Accessories

Table 1-10

PageWriter 300pi, 200/200i and 100 Series Documentation Part Numbers

Interpretive Physician's Guide (M1770A)	English	M1700-92908
	French	M1700-92918
	German	M1700-92928
	Dutch	M1700-92938
	Spanish	M1700-92948
	Italian	M1700-92958
Interpretive Physician's Guide - Addendum (M1770A)	English	M1700-90700
	French	M1700-90701
	German	M1700-90702
	Dutch	M1700-90703
	Spanish	M1700-90704
	Italian	M1700-90705
Predictive Instruments Physician's Guide (M1770A with Serial # Prefix CND)	English	M1792-93900
	French	M1792-93901
	German	M1792-93902
	Dutch	M1792-93903
	Spanish	M1792-93904
	Italian	M1792-93905

Table 1-11

Power Cord Part Numbers

Power Cord Key	Agilent Part Number
900	8120-1703
901	8120-4464
902	8120-1692
903	8120-5213
917	8120-4600
922	8120-8377

Options and Accessories

Table 1-12

Options

Option	Description
A05	Adds storage and transmission capability
M2488A-#A70, A71, A72	StressWriter system includes PageWriter cardiograph
M2488A-#C70	StressWriter system includes interface card for PageWriter cardiograph

Standard Accessories

Accessories included are based on model number and localization.

- 200 sheets of z-fold paper
 - English paper p/n M2481A
 - Metric paper p/n M2483A
- *PageWriter 200/300pi Agilent M1770A Cardiograph User's Guide*
- *Interpretive Cardiograph Physician's Guide (PageWriter 200i/300pi only)*
- *PageWriter 100 Agilent M1772A Cardiograph User's Guide (PageWriter 100 only)*
- *Using the PageWriter 200/200i Cardiograph Operator Training Video (PageWriter 200/200i, also for use with PageWriter 300pi)*
- *Using the PageWriter 100 Cardiograph Operator Training Video (PageWriter 100 only)*

Performance Verification and Maintenance

Introduction

This chapter describes how to verify the cardiograph's performance, explains preventive maintenance, presents patient safety information, and provides a performance verification checklist.

Performance Verification

Several procedures make up performance verification: visual inspection of the cardiograph exterior, execution of Extended Self-test, visual examination of an ECG recorded from an ECG patient simulator, and system safety tests using a safety analyzer.

A Performance Verification matrix which appears at the end of this section specifies the tests and inspections which must be performed following servicing of the PageWriter cardiographs. **The Performance Verification test results must be recorded on Customer Service order records**

Make copies of the matrix. Fill out a copy each time the cardiograph is tested. Attach the printer test output, and simulator ECG trace to the completed matrix and file with the cardiograph's permanent maintenance record.

NOTE

If any of the performance verification tests fail, refer to Chapter 4, **Troubleshooting**.

Visual Inspection and Power On Self Test

Before beginning the inspection, press the **On/Standby** key to put the cardiograph in **Standby** mode, and unplug the power cord from the wall outlet. Inspect the cardiograph for the following:

- Worn or damaged power cord
- Loose or missing hardware
- Mechanical damage
- Evidence of liquid spill
- Worn printer drive gear
- Worn printer roller
- Corroded or damaged reusable electrodes, if present
- Damaged patient cable
- Dirt/paper residue on the thermal printhead
- Frayed or damaged wiring

Replace any damaged or missing items, and clean the printhead and patient electrodes as necessary. Cleaning instructions are listed under “Preventive Maintenance” later in this chapter. Connect the cardiograph to AC power. Be sure that the AC indicator comes on. Turn the cardiograph **On** and observe that the display turns on (PageWriter 200/200i/300pi) or that the LED’s flash on (PageWriter 100).

Extended Self-test

The cardiograph’s extended self-test checks each major subassembly. The extended self-test consists of two sections: the testing of internal circuitry and the testing of printer, display, keyboard, and modem capabilities.

To begin the extended self-test, press and hold both the **Auto** and **Manual** keys while turning on the cardiograph with the **On/Standby** key.

To stop or exit extended self-test, you must press **On/Standby** to place the cardiograph in **Standby**.

Internal Circuitry Testing of PageWriter 100

These tests are performed on the internal circuitry:

- Memory
- Gate Array
- Front-End Interface
- Serial Interface

Each of these tests is described in detail later in this chapter.

When the internal circuitry test of the PageWriter 100 is performed, the LEDs show which test is being performed. The following table shows which LED is associated with each test.

Performance Verification

Table 2-1 PageWriter 100 Test LED's

Test Number	Test Name	LED(s) lit on Page-Writer 100	Comments/Expected Results
1	ROM-1	5 mm/mV	OK
2	ROM-2	10 mm/mV	Normally fails for 100.
3	ROM-X1	20 mm/mV	OK for A#10.
4	ROM-X2	V Leads	OK for A#10.
5	RAM	Filter	OK
6	NVRAM	Auto	OK
7	GA	I II III Lead Group	Will also flash all LEDs. OK
8	ECG FE	aVR aVL aVF Lead Group	OK
9	SIO	II aVF V2 Lead Group	OK for A#10.
A	REMOTE	V Leads	For future use - normally fails.
B	MODEM	5 mm/sec	OK for A#10, with modem or test tool attached
C	FLASH1	10 mm/sec	OK for A#10.
D	FLASH2	25 mm/sec	OK for A#10.

When the tests are completed, the results are also printed out in a pass/fail format on the left-hand side of the first page of the test report.

Table 2-2

Test Results Format

	Test Passes	Test Fails
Printed Result	OK	**

In some cases, a test failure halts the test/test printout and an error code indicating the failure is flashed on the LED's. See Chapter 4, "Troubleshooting," for a list of self-test failure codes and failure symptoms. The section "How the PageWriter 100 Communicates Error Codes and Messages" in Chapter 4 describes how to read the LED's.

Performance Verification

Internal Circuitry Testing of PageWriter 200/200i/300pi

These tests are performed on the internal circuitry:

- Memory
- Gate Array
- Front-End Interface
- Serial Interface

Each test is described detail later in this chapter.

When testing the internal circuitry of the PageWriter 200/200i/300pi, the numbers 1 through 9 and the characters A through D are displayed one at a time beginning with number 1. Each number represents a particular test. If the test fails, the character X is placed after the test number, for example, 3X. The test descriptions below are listed in the order the tests are performed.

Table 2-3 PageWriter 200/200i/300pi Test Numbers

Test Number	Test Name	Character Displayed on Page-Writer 200/200i/300pi	Comments
1	ROM-1	1	OK
2	ROM-2	2	Passes for 300pi, 200i, and 200 with software revision A.05.06 or later.
3	ROM-X1	3	Passes for Options #A05 and #A10 only.
4	ROM-X2	4	Passes for Options #A05 and #A10 only.
5	RAM	5	OK
6	NVRAM	6	OK
7	GA	7	OK
8	ECG FE	8	OK
9	SIO	9	Passes for Options #A05 and #A10 only.
A	REMOTE	A	For future use - normally fails
B	MODEM	B	Passes for Options #A05 and #A10 only, with modem or test tool attached
C	FLASH1	C	Passes for Options #A05 and #A10 only
D	FLASH2	D	For future use - normally fails

Performance Verification

CAUTION

If your cardiograph is equipped with Options #A05 or #A10, do not turn it off during Test C or D. If you turn off the cardiograph while Test C or D are in process, you could lose stored ECGs, the Log of ECGs Stored, or the Log of ECGs Taken.

When the tests are completed, the results are printed out in a pass/fail format on the left-hand side of the first page of the test report.

Table 2-4

Test Results Format

	Test Passes	Test Fails
Printed Result	OK	**

In some cases, a test failure halts the test/test printout and an error code indicating the failure appears on the display. See Chapter 4, “Troubleshooting,” for a list of self-test failure codes and failure symptoms.

Memory Test

This test looks for failures in the following memory subsystems:

- Read-Only Memory (ROM)
- Random Access Memory (RAM)
- Non-Volatile Random Access Memory (NVRAM)

Read-Only Memory (tests 1-4) . The cardiograph is designed to have up to four ROMs installed, two on the main control board and two on an option board. The Read-Only Memory test reads the contents and performs a 32-bit cyclic redundancy check (CRC) of each of the four ROM address spaces. The test of a ROM address space will fail if the ROM module is faulty or is **not present**. The four ROM address spaces are identified on the report as

- ROM-1
- ROM-2
- ROM-X1
- ROM-X2

Depending on the serial number and model of the unit you are servicing, the corresponding ROM part numbers vary. Refer to tables 2-5, 2-6, 2-7, and 2-8 for the correct ROM replacement part numbers.

Performance Verification

Table 2-5

ROM Replacement Part Numbers for PageWriter Cardiographs M1770, M1771A Serial Number Prefix CNA, CNB, or CNC, XXXA or , US001

Test	Part Number		Language	Part Number Labeled on ROM
ROM 1	U205 - Main CPU Board	M1770-89505		
ROM 2	U206 - Main CPU Board	M1770-89521 M1770-89521 M1770-89522 M1770-89523 M1770-89524 M1770-89525	English French German Dutch Spanish Italian	M1770-17905 M1770-17921 M1770-17922 M1770-17923 M1770-17924 M1770-17925
ROM X1	U9 - Interface Board	M2488-17901		
ROM X2	U10 - Interface Board	M2488-17902		

Table 2-6

ROM Replacement Part Numbers for PageWriter Cardiographs M1770, M1771A Serial Number Prefix CND or US002

Test	ROM Part Number		Language	Part Number Labeled on ROM
ROM 1 ROM 2	U205 - Main CPU Board	M1770-89550 M1770-89551 M1770-89552 M1770-89553 M1770-89554 M1770-89555 M1770-89556 M1770-89558 M1770-89559 M1770-89563 M1770-89564 M1770-89569	English French German Dutch Spanish Italian Swedish Norwegian Finnish Portuguese Russian Polish	M1770-84000 M1770-84001 M1770-84002 M1770-84003 M1770-84004 M1770-84005 M1770-84006 M1770-84008 M1770-84009 M1770-84013 M1770-84014 M1770-84019
ROM X1	U9 - Interface Board	M2488-17901		
ROM X2	U10 - Interface Board	M2488-17902		

Performance Verification

Table 2-7

ROM Replacement Part Numbers for PageWriter Cardiographs M1772A Serial Number Prefix CNA, CNB, or CNC, XXXA or US001

Test	ROM Part Number	
ROM 1	U205 - Main CPU Board	M1770-89505
ROM 2	Not Required	
ROM X1	U9 - Interface Board	M2488-17901
ROM X2	U10 - Interface Board	M2488-17902

Table 2-8

ROM Replacement Part Numbers for PageWriter Cardiographs M1772A Serial Number Prefix CND, or US002

Test	ROM Part Number	
ROM 1 ROM 2	U205 - Main CPU Board	M1770-89550
ROM X1	U9 - Interface Board	M2488-17901
ROM X2	U10 - Interface Board	M2488-17902

NOTE

If ROM-1 is defective, it is unlikely this test or any other cardiograph function will operate.

Random-Access Memory (test 5) . The RAM test performs a read/write test of the instrument's memory. If this subsystem is defective, it is unlikely this test or any other cardiograph functions will operate. The RAM is identified on the report as

- RAM

Performance Verification

Non-Volatile Random Access Memory (test 6) . Each 2-byte location of NVRAM is written and read with a pseudo-random pattern. This is a non-destructive test. The contents of the NVRAM are saved in RAM prior to this test, and then restored when the test is complete. The NVRAM test result is identified on the report as

- NVRAM

System Gate Array Test (test 7) . Various registers in the System Gate Array are read and written. The System Gate Array test result is identified on the report as

- GA

Front-End Interface Test (test 8) . The front-end interface test verifies that the ECG front-end circuitry is responding to commands, and that the input multiplexers are operating between ground and internal reference voltage. The front-end interface test result is identified on the report as

- ECG FE

Manufacturing/Serial Interface Test (test 9) . The manufacturing/serial interface test checks for proper communication with the optional expansion card UART. For this test to pass, an extender card must be plugged into the expansion connector. The serial interface test result is identified on the report as

- SIO

Remote Test (test A). The remote test checks the ability to transmit and receive data through the spare remote port on the optional expansion board. The remote test is identified on the report as

- REMOTE

Modem Test (test B) . The modem test verifies that the cardiograph is sending the expected signals to the modem, and that the modem is receiving and responding appropriately to signals from the cardiograph. The optional expansion board must be installed to connect to the modem. The front end and RS-232 port test tool described in Chapter 4 can help differentiate modem and cardiograph problems. See the section in Chapter 4 titled “Test Tools” for instructions about using this tool. The modem test is identified on the report as

- MODEM

Performance Verification

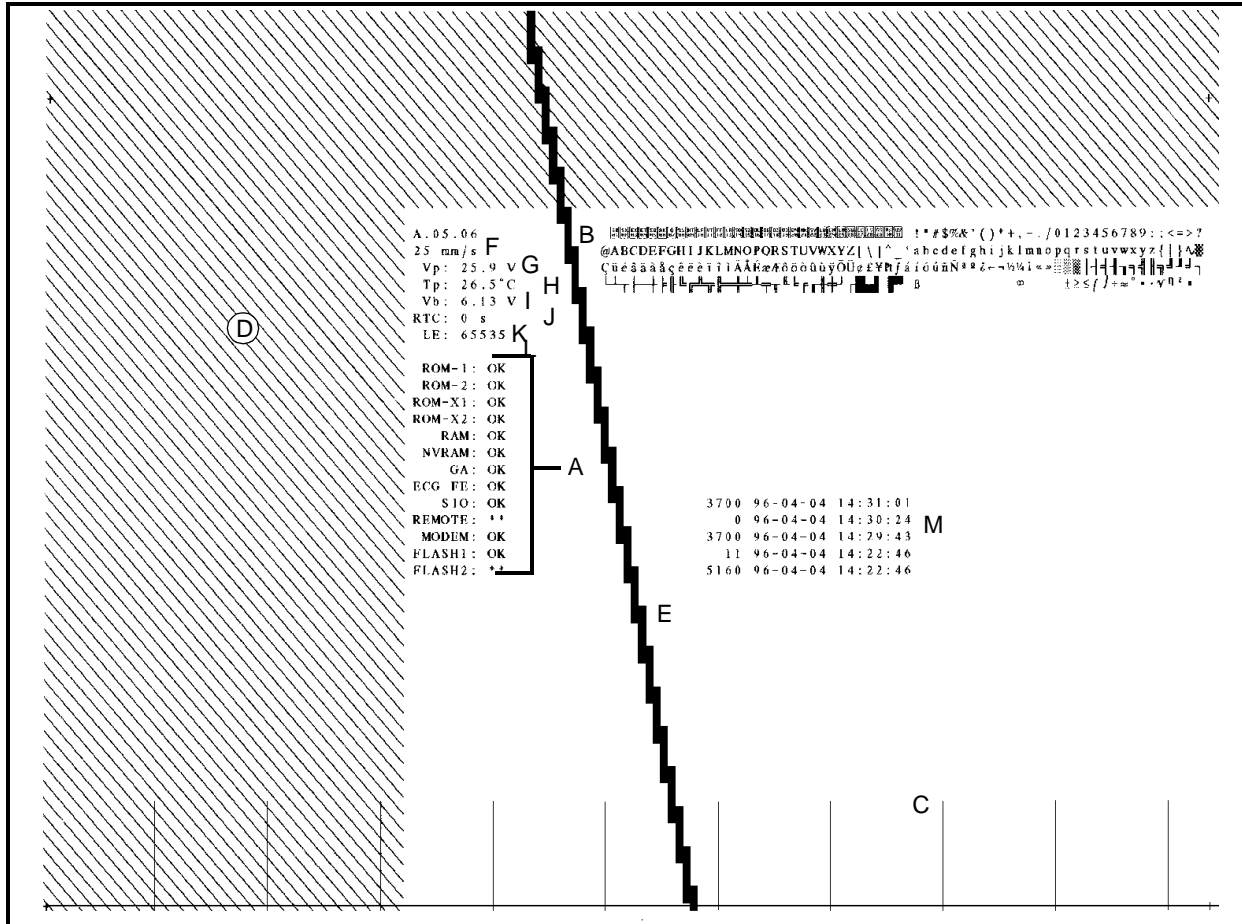
Flash Memory Tests (tests C and D) . The flash memory tests verify that the flash memory on the optional expansion board can be erase, and that information can be stored and retrieved. The flash memory tests are identified on the report as

- FLASH1
- FLASH2

CAUTION

If your cardiograph is equipped with Option #A05 or #A10, do not turn it off during Test C or D. If you turn off the cardiograph while Test C or D are in process, you could lose stored ECGs, the Log of ECGs Stored, or the Log of ECGs Taken.

Figure 2-1 An Extended Self-Test Report Example



- A. Test Results
- B. Character Set
- C. Timing Tics
- D. Diagonal Lines
- E. Stepped Bars
- F. Software Revision
- G. Printer Speed
- H. Printhead Voltage
- I. Printhead Temperature
- J. Battery Voltage
- K. Time Stamp
- L. Last Error
- M. Event Log (Option #A05 only)

Performance Verification

How to Read the Extended Self-Test Report

Each printed page of the extended self-test contains the following information:

- A Test Results - See the previous section.
- B Character Set - Characters 0 through 255 are printed as a table 4x64 characters in size. This checks the character tables and printhead performance.
- C Timing Tics - Vertical lines are drawn from the bottom of the page. Each vertical line is 25 mm long as measured from the horizontal line drawn across the bottom of the page. Spacing between timing ticks is $25 \text{ mm} \pm 1.5\%$.
- D Diagonal Lines - These dense diagonal lines are printed across the top 2 inches of the report and quickly show speed variations. An 8 cm wide column of diagonal lines is also printed down the left-hand side of the report, starting at the top-of-form hole, to show whether the print roller is round.
- E Stepped Bars - The stepped bars are 1/4-inch thick and 3/4-inch tall, stepping from the top of the page to the bottom of the page. These bars are used to show printhead dots that are burned out.
- F Software Revision - The software revision number for the base ROM.
- G Printer Speed - mm/sec
- H Printhead Voltage - Voltage range is 25.6 to 26.6 V
- I Printhead Temperature - degrees Celsius.
- J Battery Voltage - Voltage range is 5.2 - 7.5 V.
- K Time Stamp - Number of seconds that the printer test has run.
- L Last Error - The last error code encountered. An error code of 65535 indicates that no errors have occurred since the instrument left the factory. See Table 4-1 for the table of error codes.
- M Event Log - List of the last 46 events with time and date stamp. The events are listed with the most recent first. Event sub-codes have the same time stamp as the event code, and appear on the line above the event code. See Table 4-2 for a table of event codes.

Performance Verification

Display Test (PageWriter 200/200i/300pi only)

The display test shows test patterns on the display. Each of the following patterns appear in this order:

- all pixels lit to create a black screen
- no pixels lit to create a white screen
- a vertical bar scrolling from left to right

You must observe the display while the test pattern is running to ensure:

- no burned out pixels
- no random lines or dots in the display
- no permanent patterns visible at normal contrast. Patterns may be visible at low contrast (darker screen); this is normal.
- no LCD flickering

NOTE

It is normal for the top row of the LCD to have some pixels on during the first sweep of the vertical bar.

This test relies on the visual inspection of the test patterns for detecting failures. There is no failure message for the display test.

Indicator Light Test (PageWriter 100 only)

During this test, all indicator lights turn on and off at least once. At one point, the indicator lights flash rapidly for a short time.

Printer Test

The printer test exercises the printhead and paper drive mechanism by printing test patterns and diagnostic data on the page. The patterns consist of a rectangular area that contains the entire character font set, timing tics, diagonal lines, and stepped bars. On the PageWriter 200/200i/300pi cardiographs, the printer test and the display test are conducted simultaneously. The printer test continues until the cardiograph is placed in **Standby** mode.

When the printout is complete, inspect it for:

- straight diagonal lines
- even spacing between diagonal lines
- consistent print quality for all patterns
- constant width between timing tics (25 mm \pm 1%)
- consistent length of timing tics
- accurate rendition of all characters
- clean stepped bars with no dropout in black areas
- even spacing between diagonal lines at the beginning of the page

Performance Verification


Keyboard Tests

The keyboard tests are not automatically performed during the extended self-test. These must be manually performed and the results visually inspected to verify correctness.

PageWriter 200/200i/300pi Keyboard Test

The keyboard test for 200/200i/300pi models involves pressing each key one at a time and observing that the key character and/or key hex number is displayed on the display. The keyboard test can be performed anytime after the extended self-test has started.


NOTE

Pressing  changes the speed of the printer test pattern and restarts the extended self-test.

PageWriter 100 Keyboard Test

To test the keyboard press each key, cycling through the available choices. Be sure that each LED associated with a key lights when you cycle through the choices. This test is not performed as part of the extended self-test.

NOTE

Pressing the  key changes the speed of the printer test pattern and restarts the extended self-test.

Performance Verification

ECG Simulation

Taking an ECG using a 12-lead ECG simulator allows you to verify areas of operation that the extended self-test cannot check:

- integrity of the patient cable
- accuracy of the paper speed (not available on all simulators)
- accuracy of the gain settings (not available on all simulators)

The recorded ECG trace should look similar to the one shown in Figure 2-2. Trace differences may result from differences in simulators, simulator settings, and from differences in configuration and control settings on the cardiograph. To make a recording similar to the one in Figure 2-2:

1. Connect the patient cable leadwires to the simulator.
2. On a PageWriter 200/200i/300pi, verify that all leadwires are connected by cycling through each lead group and observing the display for flatline. Firmly pull each lead-wire taut and look for excessive noise on the display.
3. Select the 12-lead Manual format on the front panel display.

NOTE

If you are using a PageWriter 100, cycle through all lead group selections to verify the performance of all leads.

4. Press **Manual** twice to start the recording.
5. Print approximately 2-1/2 pages. Press **Stop**.
6. Press **Auto** twice to print an Auto ECG. Make sure the cardiograph advances the paper to the top of form.

When the recording is complete:

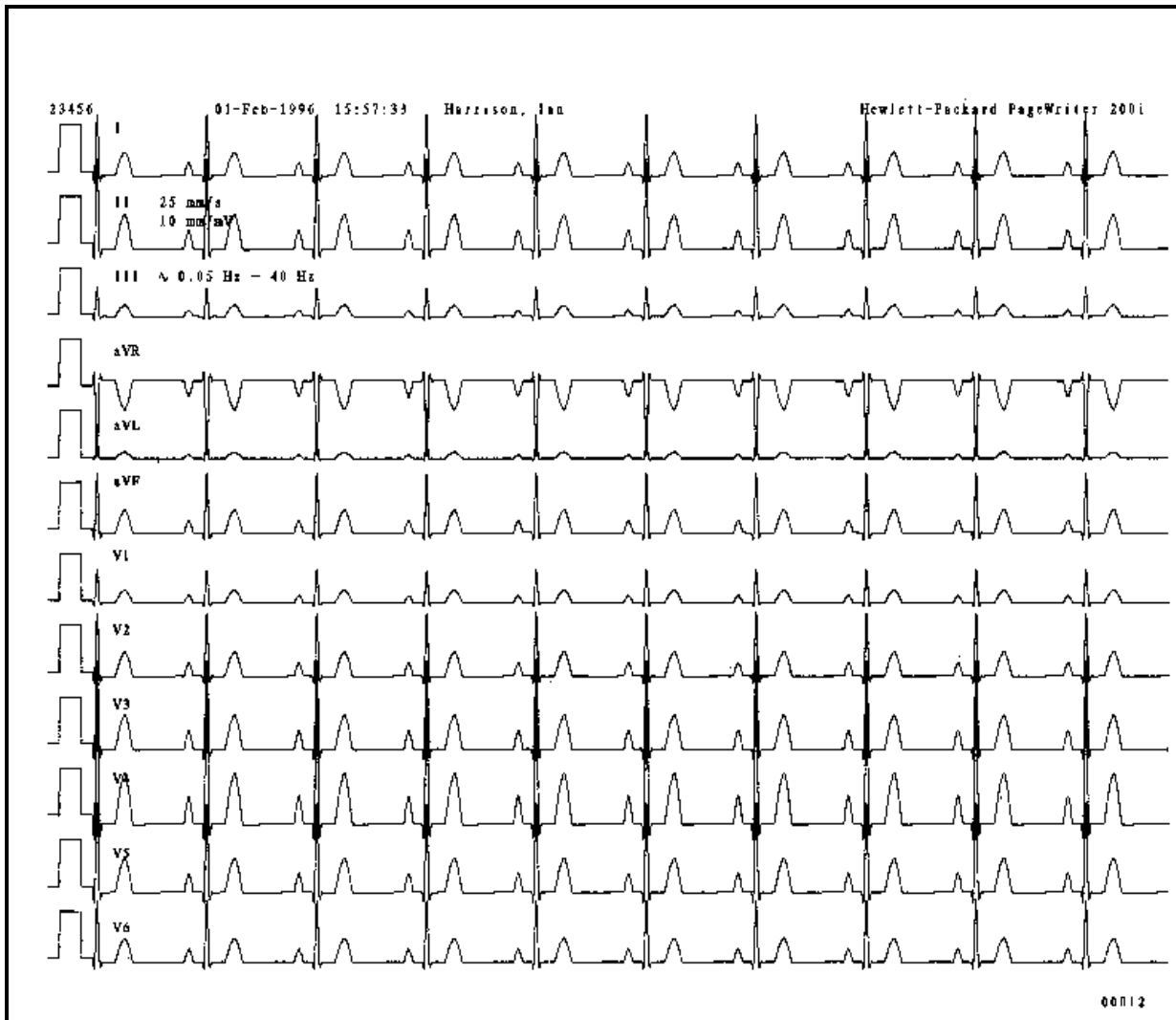
- Verify trace activity for all 12 leads. This assures integrity of all patient electrodes and leadwires. Noise should measure less than 1 mm, and there should be no baseline wander.
- Verify no gross distortion of complexes or calibration pulses (no overshoot, etc.).
- Verify that calibration pulses are of proper duration. This assures the correct paper speed. With the cardiograph set to record at 25 mm/sec, the calibration pulse should measure 5 mm (calibration pulse duration is 200 ms).
- Verify that calibration pulse amplitude is correct.

NOTE

An arrhythmia simulator is not an acceptable tool for verifying computerized ECG analysis. The analysis software is biased to process human ECG data.

Performance Verification

Figure 2-2 12-Lead ECG from ECG Simulator (200/200i/300pi only).















Changing the Default Operating Language (200/200i/300pi Only)

The default operating language is selected by holding down the desired key combination while turning on the instrument. Table 2-9 lists the key combinations.

Table 2-9

Language Key Combinations

Language	PageWriter 200/200i/300pi
English	 -0
French	 -1
German	 -2
Dutch	 -3
Spanish	 -4
Italian	 -5
Swedish	 -6*
Finnish	 -8*
Norwegian	 -9*
Portuguese	 -6*
Polish	 -8*
Russian	 -9*

*Only available on certain models.

Resetting the Cardiograph to the Factory Default State

Resetting the cardiograph sets the Auto ECG report counter to 0, and resets the PageWriter 200/200i/300pi configuration to the factory default.

Resetting the PageWriter 200/200i/300pi

To reset the PageWriter 200/200i/300pi perform the following steps:

1. Using Table 2-9, turn the cardiograph **On** in a language different from the current language.
2. The cardiograph is now reset to the factory default state.
3. If it is necessary to operate the cardiograph in the original language, turn the cardiograph to **Standby**, then turn the cardiograph **On** using the appropriate key combination from Table 2-9.

Resetting the PageWriter 100

To reset the PageWriter 100 perform the following steps:

1. Turn the cardiograph to **Standby**.
2. Press and hold **Copy** and **Page Advance** while turning the cardiograph on.
3. Turn the cardiograph to **Standby**.
4. Press and hold **Copy** and **Chart Speed** while turning the cardiograph on.
5. The cardiograph is now reset to the factory default state.

Preventive Maintenance

Routine maintenance of the cardiograph consists of cleaning and inspection. This should be done as needed.

CAUTION

The cardiograph does not require lubrication. Lubricating any part of the cardiograph could damage it or diminish its performance.

Care and Cleaning

The outside surfaces of the cardiograph and its accessories (except the patient cable) can be cleaned by mild soap and water or isopropyl alcohol. The patient cable cannot be cleaned with isopropyl alcohol. The patient cable can be cleaned only with mild disinfectant or soap and water.

Cleaning the Cardiograph

1. Unplug the power cord and ensure that the cardiograph is in **Standby** mode (the display is off).
2. Wipe the external surfaces of the cardiograph with a soft cloth dampened with mild soap and water or isopropyl alcohol. Avoid applying cleaning fluids to cable connectors.

CAUTION

Do not use any strong solvents or abrasive cleaning materials.

Do not spill any liquids on the surface of the cardiograph. Service the cardiograph immediately if any liquids spill on the surface.

Do not use any of the following to clean the cardiograph:

- Acetone
 - Chlorine bleach
 - Ammonia-based cleaners
 - Iodine-based cleaners
 - Phenol-based cleaners
 - Ethylene oxide sterilization (ETO)
 - Autoclave
-

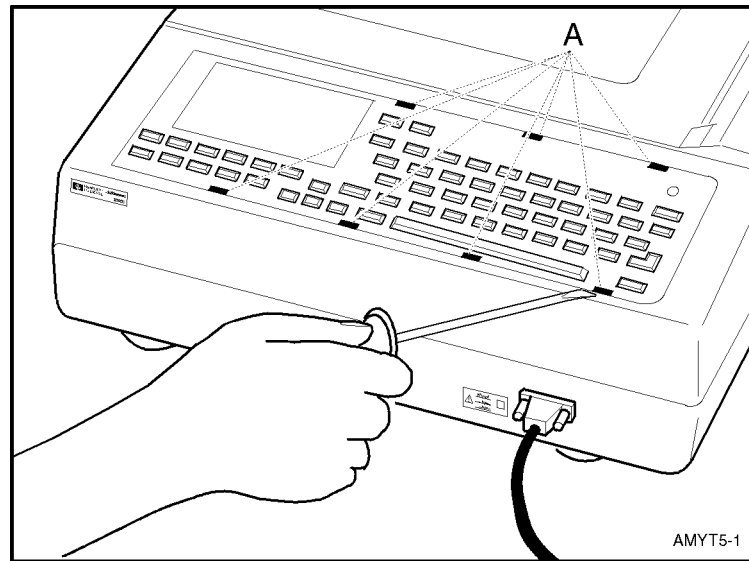
Preventive Maintenance

Cleaning the Keyboard Overlay

1. Carefully insert a small flat-bladed screwdriver into the notches at the front edge of the keyboard overlay and pry the front edge of the keyboard overlay up. Refer to Figure 2-3.
2. Repeat with the rear notches of the keyboard overlay and remove the overlay.

Figure 2-3

Removing the Keyboard Overlay



A. Notches

CAUTION

Do not wash the keyboard overlay in hot water. Do not attempt to clean the keyboard overlay in a dishwasher.

CAUTION

3. Rinse off the keyboard overlay and thoroughly dry it.

The rubber keypad and/or keyboard assembly may be damaged if any key or LED becomes trapped under the overlay while replacing the overlay. Make sure each and every key and LED comes through its hole in the overlay before snapping the overlay into place.

4. Align the overlay with each of the keyboard keys and LEDs. Position your thumbs along the front edge of the overlay near each end. Apply pressure on the overlay toward the rear of the unit and then press down on the overlay in one continuous motion. The front of the overlay should now be snapped into place. Snap the rear of the overlay into place.

Preventive Maintenance

Cleaning the Digital Array Printhead and Paper Sensor

If you use Agilent Technologies recording paper, you should not have to clean the printhead for the life of the product. If you need to clean the printhead, this is the procedure to follow. These are the materials required:

- Foam swabs — Agilent Technologies part number 9310-0468 or 9300-0767
- 90% Isopropyl Alcohol — Agilent Technologies part number 8500-0559 or equivalent
- Dry, lint-free tissue — Kimwipes® or Agilent Technologies lint-free wipes (Agilent Technologies part number 92193W)

To clean the printhead:

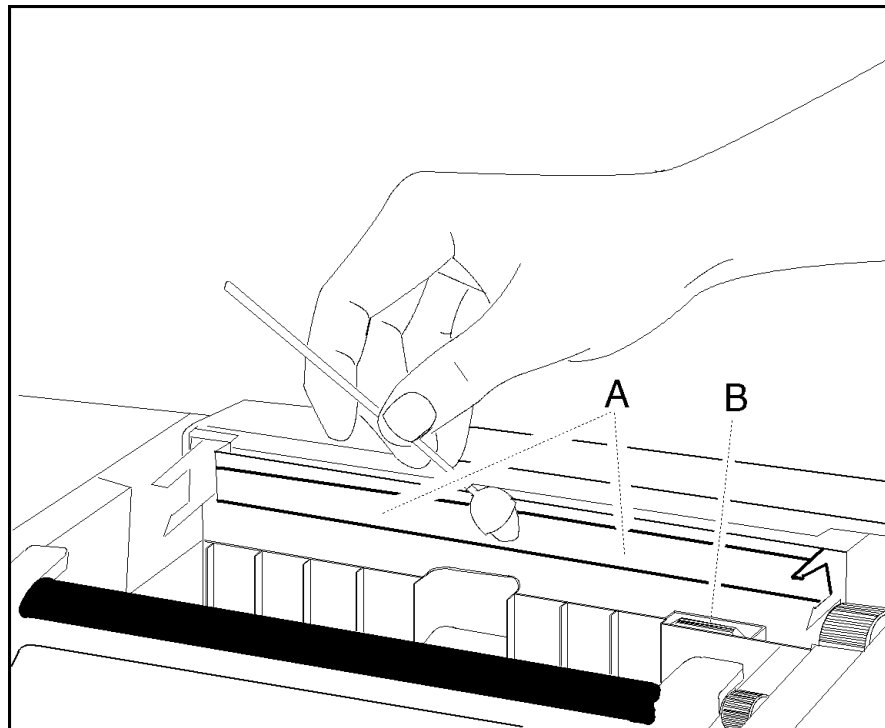
CAUTION

Touch the equipotential connector on the back of the cardiograph to discharge any static electricity stored on your skin before touching the printhead. The printhead can be damaged by static electricity.

1. From the front of the cardiograph, unlatch and open the paper door. The printhead is to the right under the paper blade, behind the ESD brush (see Figure 2-4).

Figure 2-4

Cleaning the Digital Array Printhead.



- A. Printhead
B. Paper Sensor

Preventive Maintenance

2. Wipe the printhead with a foam swab dipped in 90% isopropyl alcohol. Scrub until all visible residue is removed.
3. Dry the printhead with a clean lint-free tissue.

To clean the paper sensor lens:

1. From the front of the cardiograph, unlatch and open the paper door. The paper sensor lens is to the right under the printhead (see Figure 2-4).
2. Lightly wipe the paper dust off of the paper sensor lens with a dry foam swab. Do not use alcohol.

Cleaning the Electrodes and Cables

Clean the reusable electrodes and patient cable with a soft cloth moistened with a recommended disinfectant or cleaning agent from the following list:

- Cetylcide® (may discolor cable)
- Cidex®
- Lysol® Disinfectant
- Lysol® Deodorizing Cleaner (may discolor cable)
- Dial® Liquid Antibacterial Soap
- ammonia
- 409® (may discolor cable)
- 10% solution of Clorox® in water (may discolor cable)
- Murphy® Household Cleaner, or
- Ves-phene II®.

Wring any excess moisture from the cloth before cleaning.

CAUTION

- Do not clean the patient cable with alcohol. Alcohol can cause the plastic to become brittle and may cause the cable to fail prematurely.
 - Do not autoclave the cable or use ultrasonic cleaners.
 - Do not immerse the patient cable.
 - Do not use abrasive materials to clean metal surfaces—scratches on them can cause artifacts on the ECG report.
 - Do not expose the connectors to liquids, especially the 15-pin connector.
-

Caring for the Battery

The battery must be installed for proper operation of the cardiograph. Even if the cardiograph is plugged into AC power, it cannot print an ECG report without the battery. For information about removing or replacing the battery, refer to Chapter 5, **Removal and Replacement**.

The sealed lead-acid battery used in the PageWriter 100, 200, and 300 family of cardiographs will provide optimum life when the unit is continuously connected to AC power and fully charged after each use. A depleted battery requires 16 hours of continuous charge time to fully charge. Because it is not always possible to allow a full charge cycle between uses, the cardiograph was designed to charge a depleted battery to 90% of its capacity in approximately seven hours.

CAUTION

Repeated undercharging of the battery will damage the battery and reduce battery life.

NOTE

Agilent Technologies recommends that the cardiograph be plugged into AC power whenever possible to maximize battery life.

Battery life varies depending on frequency of use and maintenance. For improved battery life, keep the cardiograph plugged in when not in use. If the battery has been fully charged and requires recharging after a few ECGs, consider replacing it. Use only the Agilent battery, part number M2460A.

NOTE

Battery should be removed from unit and placed in storage if the cardiograph will not be used for more than three months.

Storing the Battery

To prepare the battery for storage, charge it in the cardiograph for 16 hours. Remove the battery and store it in a cool, dry location. Recharge a lead-acid battery in storage for at least 16 hours every six months. This ensures that the battery does not completely discharge while in storage. The battery's shelf life is longer with cooler temperatures, but do not store below freezing.

Caring for the Battery

Safety Tests

Perform the following tests as part of your preventive maintenance program, and after any corrective maintenance.

- Chassis-to-ground resistance
- Ground wire leakage current
- Enclosure leakage current
- Patient lead leakage current (source leakage) to ground
- Leakage current between patient leads
- Patient lead leakage current (sink current) with line voltage applied

To perform these tests, use a safety tester or analyzer designed specifically for this purpose. Follow the manufacturer's operating instructions.

Record results as indicated in the Performance Verification Matrix.

PageWriter 100, 200/200i, and 300pi Series Performance Verification Matrix

The following Performance Verification matrix lists all the tests and inspection procedures which must be performed on the M1770A, M1771A, or M1772A cardiographs after servicing. Instructions for executing each test or inspection are described in this manual.

Table 2-10 summarizes performance verification for the PageWriter 300pi/200i/200/100 cardiographs; including test name, test or inspection to perform, expected test results, and data to record. Functional tests include ROM/RAM tests, transmission tests, ECG Front-End tests, Flash Memory tests, Display tests, indicator LED tests, printer and keyboard tests. Simulated ECG and Safety testing are also required.

Table 2-10 Performance Verification: PageWriter 300pi/200i/200/100 (M1770A, M1771A, M1772A)

<u>Test Block Name</u>	<u>Test or "Inspection" to Perform</u>	<u>Expected (Passing) Test Results</u>	<u>Data to Record</u> <u>x=p (pass) or</u> <u>f (fail)</u>
Visual Inspection (V)	Look for: <ul style="list-style-type: none"> • Worn or damaged power cord • Mechanical damage • Corroded or damaged reusable electrodes • Loose or missing hardware • Worn printer drive gear • Worn or damaged patient cable 	Inspected parts appear intact and undamaged	V:x <i>example: V:p</i>
Power On Self Test (PO)	Power on the unit <ul style="list-style-type: none"> • For M1770A, M1771A - watch display for error code • For M1772A - watch keypanel LEDs for indication of error code (<i>refer to the Troubleshooting section of the Service Manual for a list of codes</i>) 	<ul style="list-style-type: none"> • the display should show a three lead screen, with no error codes • the LEDs will momentarily light and then indicate the configuration, no blinking light should be seen 	PO:x <i>example: PO:p</i>

Table 2-10 Performance Verification: PageWriter 300pi/200i/200/100 (M1770A, M1771A, M1772A)

<u>Test Block Name</u>	<u>Test or "Inspection" to Perform</u>	<u>Expected (Passing) Test Results</u>	<u>Data to Record</u> <u>x=p (pass) or</u> <u>f (fail)</u>
Extended Self Test			
Function Tests (F)	Run Extended Self Test; verify: <ul style="list-style-type: none"> • ROM-1 • ROM-X1 (for A05 & A10) • RAM • GA • SIO(for A05 & A10) • MODEM (for A05 & A10) with (M1770-87909) test tool attached) • ROM-2 (for M1770 & M1771) • ROM-X2 (for A05 & A10) • NVRAM • ECG FE • REMOTE (for future use) • FLASH1 (for A05 & A10 option) • FLASH2 (for future use) 	"OK" for tests applicable to the device and the device's options <i>Note: ROM-2 will be "OK" for A.05.06 or later</i>	F:x <i>example: F:p</i>
Display test (D) <i>for M1770A & M1771</i>	Verify the following patterns: <ul style="list-style-type: none"> • all pixels lit to create a black screen • no pixels lit to create a white screen • scrolling vertical bar from left to right 	No burned pixels, no random lines on display, no permanent patterns at normal contrast, no LCD flicker	D:x <i>example: D:p</i>
Indicator Light Test (L) <i>for M1772</i>	Verify: <ul style="list-style-type: none"> • indicator lights turn on and off • all lights flash briefly 	All indicator lights are turned on and off individually; all lights flash briefly.	L:x <i>example: L:p</i>

Table 2-10 Performance Verification: PageWriter 300pi/200i/200/100 (M1770A, M1771A, M1772A)

<u>Test Block Name</u>	<u>Test or "Inspection" to Perform</u>	<u>Expected (Passing) Test Results</u>	<u>Data to Record</u> <u>x=p (pass) or</u> <u>f (fail)</u>
Printer Test (P) <i>for M1772</i>	Verify: <ul style="list-style-type: none"> • straight diagonal lines • even spacing between diagonal lines • consistent print quality • consistent width between and length of timing tics • accurate rendition of all characters • clean stepped bars with no drop out in black areas • all lights flash briefly 	All criteria visually verified.	P:x <i>example: P:p</i>
Keyboard Test (K)	Depress each key	For M1770A/M1771A, character displayed is correct or function operates properly. For M1772A, the corresponding LED lights and turns off.	K:x <i>example: K:p</i>
ECG Simulation (ECG)	Connect a 12 Lead Patient Simulator to the Patient Cable and print a 12 lead ECG. Visually analyze the printout.	Trace activity in all 12 leads; no notable distortion or noise; cal pulses of proper duration and amplitude.	ECG:x <i>example: ECG:p</i>

Table 2-10 Performance Verification: PageWriter 300pi/200i/200/100 (M1770A, M1771A, M1772A)

<u>Test Block Name</u>	<u>Test or "Inspection" to Perform</u>	<u>Expected (Passing) Test Results</u>	<u>Data to Record</u> <u>x=p (pass) or</u> <u>f (fail)</u>
<p>System Safety (S)</p> <p><i>Use Safety Analyzer</i></p>	<p>Check:</p> <p>Chassis-to-Ground Resistance</p> <p>Groundwire Leakage Current (Normal condition)</p> <p>Groundwire Leakage Current (Single Fault)</p> <p>Patient Lead Leakage Current</p> <ul style="list-style-type: none"> •Source (Normal Condition) •Source (Single Fault Condition) •With Mains on applied part (Single Fault Condition) •Auxiliary (Normal Condition) •Auxiliary (Single Fault Condition) <p>Indicate Applicable Safety Standard as follows:</p> <p>Note: All leakage current test are Normal and Reverse Polarity Conditions</p> <p><i>For the above - record the worst case value for multiple lead measurements.</i></p>	<p>≤ 200 mΩ aaa</p> <p>≤500 uA (≤300uA UL) bbb</p> <p>≤1000 uA cccc</p> <p>≤10 uA dd</p> <p>≤50 uA ee</p> <p>≤50 uA (≤ 20 uA UL) ff</p> <p>≤10 uA gg</p> <p>≤50 uA hh</p> <p>i=I for IEC i i=U for UL</p>	<p>S:aaa,bbb,ccc,dd,ee,ff,gg,hh,i</p> <p><i>example:</i> <i>S:09,400,900,8,40,30,8,40,I</i></p>
<p><i>Note: When recording test results, separate tests by a semi-colon(;). For example: V:p;PO:p;F:p;D:p;L:p;P:p;K:p;ECG:p;S:90,400,900,8,40,30,8,40,I</i></p>			

PageWriter 100, 200/200i, and 300pi Series Performance Verification Matrix

Theory of Operation

This chapter contains an overview of the cardiograph operation, and circuit descriptions of the major subassemblies. Except as noted, the information in this chapter applies to the M1770A PageWriter 200i/300pi, the M1771A PageWriter 200, and the M1772A PageWriter 100.

The last section in this chapter describes the Option #A05 printed circuit assembly.

Operational Overview

This overview covers two areas of cardiograph operation: the path that ECG data follows from collection to display, and the cardiograph's power-on/power-off sequence.

ECG Data Path

Analog ECG data are collected through the patient cable to the ECG Front End on the CPU Assembly Board in the cardiograph. The ECG Front End performs analog-to-digital conversion before sending the data to the System Gate Array. The System Gate Array receives the ECG data and processes it. The data may be interpreted (200i/300pi only), displayed (200/200i/300pi only), printed, or stored in system RAM. PageWriter 200/200i/300pi cardiographs equipped with Option #A05 can also store up to thirty ECGs, and transmit ECGs to TraceMaster ECG Management Systems, ECG Manager software, other PageWriter cardiographs, facsimile machines, and other Agilent equipment.

Power-on and Power-off Sequences

When the cardiograph is turned on or off, it follows a sequence of events in applying power to or removing power from its circuits. The System Gate Array controls this sequence because the System Gate Array remains powered up even when the cardiograph is in **Standby**.

Power-on

The system gate array is powered from a supply which is always turned on (Unswitched 5V). When it detects that the **On/Standby** key has been pressed, it sends the ENBL5V signal to the power supply to turn on the Switched 5V supply and reset the other circuitry.

When the CPU is taken out of reset mode, the processor begins execution of the software located in ROM. The software sets up the system, decides what type of keyboard is attached, calibrates the ECG Front End, and initializes the display, if present.

Circuit Descriptions

Power-off

The power-off sequence is software controlled. The power-off sequence is initiated when the **On/Standby** key is pressed, battery time-out occurs, or the battery is too low to continue. At power-off, the software begins housekeeping tasks such as turning off the printer, disabling the keyboard, and turning off the display, if present. When the housekeeping is complete, the software instructs the System Gate Array to turn off the Switched 5V supply. The details of how the power supply shuts down are described later in this chapter in the power supply description.

Circuit Descriptions

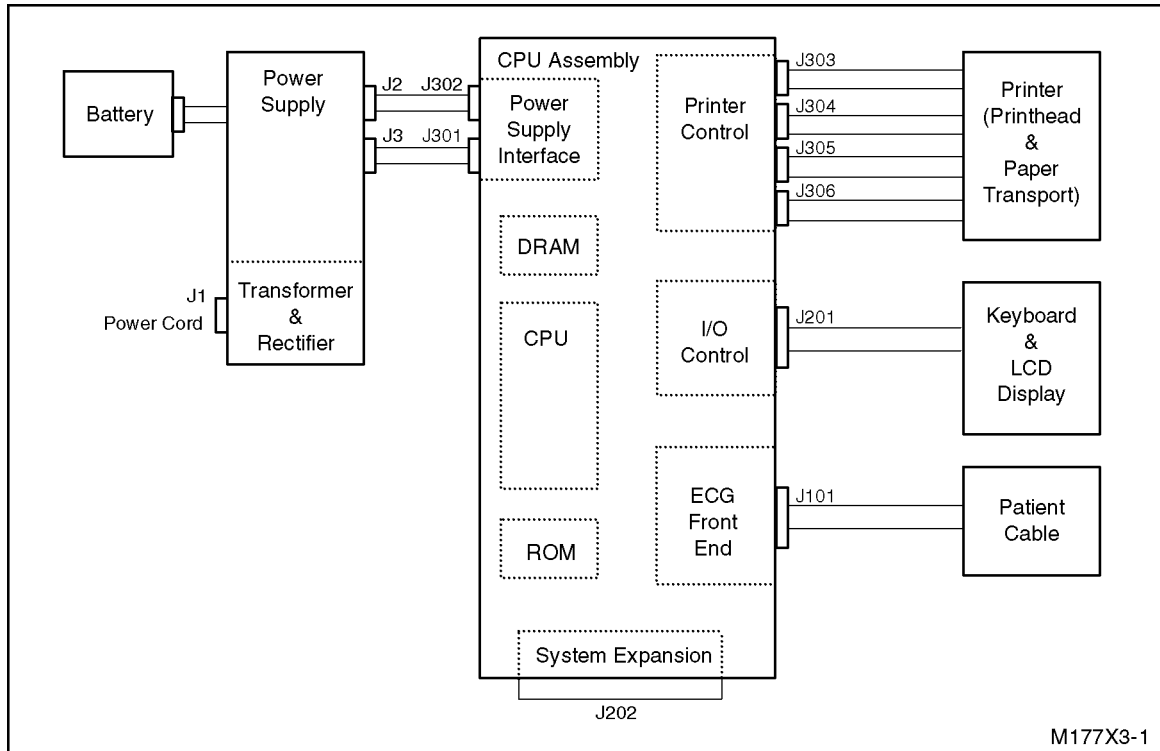
The M177XA family of cardiographs has a common set of major subassemblies: a Power Supply board, a CPU Assembly board, and a Keyboard (including a Display on the 200/200i/300pi). The design also includes a thermal print mechanism. The power supply design requires a battery for all operations. Option #A05 adds a storage and transmission board.

Option #A10 adds an interface board for communication to the Agilent StressWriter system.

The CPU assembly is the same for all cardiographs except that some models of the PageWriter 200/200i CPU assembly have an extra ROM to accommodate the ECG measurements and interpretation software. The subassemblies, including the CPU assembly and its major circuit groups, are shown in Figure 3-1.

The Patient Cable

Figure 3-1 Simplified System Block Diagram



The Patient Cable

The patient cable used in the PageWriter 100/200/200i/300pi family is a passive design using no active components. The leadwires each contain a resistor designed to protect the instrument from the energy used in defibrillation.

The cable simply conducts the analog ECG data from the patient to the ECG Front End on the CPU Assembly Board.

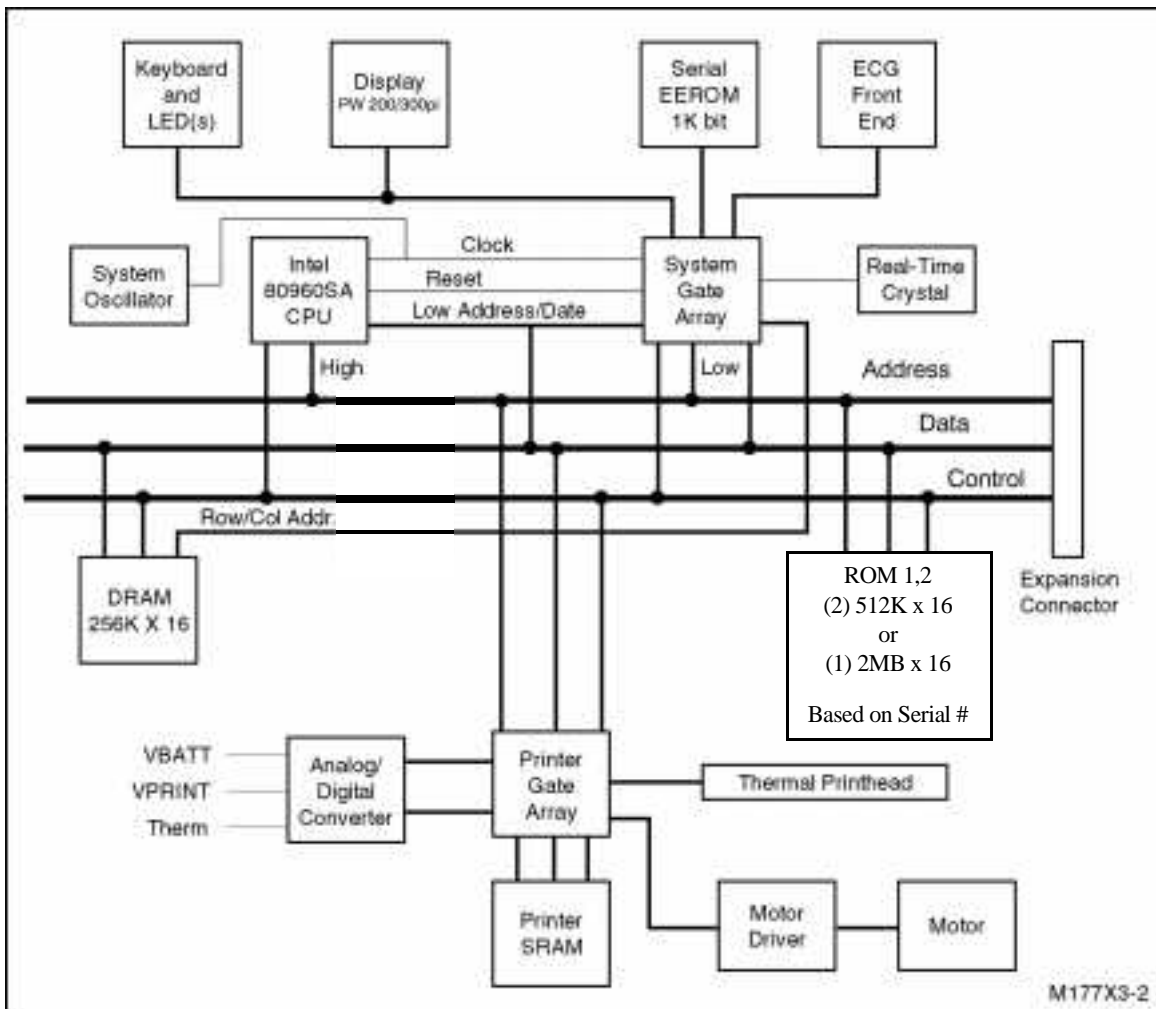
CPU Assembly

This discussion of the CPU assembly covers the following circuits:

- CPU
- System Gate Array
- Serial EEROM
- System Memory (DRAM)
- ROM
- Printer Gate Array/SRAM
- Analog/Digital Converter
- System Expansion Connector

The block diagram in Figure 3-2 shows these circuits and how they interconnect.

Figure 3-2 CPU Block Diagram



CPU/System Oscillator

The CPU (Central Processing Unit) is the processing engine for the instrument. The microprocessor used is the Intel 80960SA, a 32 bit microprocessor with a 32-bit address bus and a 16-bit external data bus (32 bit internal data bus). The lower 16 bits of the address bus are multiplexed with the data bus; these lines are de-multiplexed by the System Gate Array. The processor operates at 16 MHz off of a 32 MHz System Oscillator. The data and address buses are shown in the above block diagram.

Instructions for the CPU are stored in RAM and ROM external to the CPU.

System Gate Array/Real-Time Crystal

The System Gate Array provides the following functions:

- ECG Front End control
- Interrupt control
- DMA for ECG data
- DMA for LCD data
- System reset circuitry
- Watch-dog circuitry
- Real-time clock (including driving the external Real-Time crystal)
- DRAM RAS and CAS generation and refresh
- Interface to the Serial EEROM
- Address decoding for the Printer Gate Array and ROMs
- Keyboard scan and LED drive
- LCD control (for the PageWriter 200/300 series)

ECG Front End Control

The ECG Front End control interface consists of serial command data to the front end, and serial data (ECG or status) from the front end.

The input command data consists of a single 24-bit word containing an address field and a control field. Depending on the data in the address field, the contents of the control field apply to either

- configuring each individual front end integrated circuit,
- configuring both front end integrated circuits together as a system, or
- setting the calibration value of the front end integrated circuit

Interrupt Control

The interrupt control interface manages two of the four processor interrupt signals. The processor interrupt signal names are nINT0, INT1, INT2, and nINT3. nINT0 and nINT3 are controlled by the System Gate Array. INT1 is for interrupts from an expansion board (such as the Option #A05 storage and transmission board) connected to the System Expansion Connector. INT2 is controlled by the Printer Gate Array.

CPU Assembly

DMA for ECG Data

The System Gate Array receives data from the ECG Front End in serial form. When 16 bits have been received, the System Gate Array places the CPU in a HOLD state, and generates the necessary address and control signals needed to write the data into the System Memory (DRAM). After the data are successfully written, the HOLD state is discontinued and the CPU resumes its processing. The System Gate Array can also deliver interrupts to the CPU to indicate when a frame (1 msec) and/or a buffer-full (100 msec) of data have been written into memory.

DMA for LCD Data

In the 200/200i/300pi, the System Gate Array reads 16 bits of LCD data from System Memory (DRAM) and delivers it to the LCD for display at an approximately 8 μ sec intervals. The process of reading the 16 bits is to first place the CPU in a HOLD state, then to generate the necessary address and control signals to read the data, then to discontinue the HOLD state and allow the CPU to resume processing. The data are delivered one nibble (4 bits) at a time to the LCD, after which time the HOLD cycle is repeated.

System Reset Circuitry

At a normal power on (pressing **On/Standby**), the CPU and most other circuits are reset to a known initial state by the internally generated signal NRESET. This signal is created within the System Gate Array, which is always active and operating.

Removing all power resets all circuits, including the System Gate Array, via the signal NNEW5V. Removing all power also resets the real-time clock and date.

Watch-dog Circuitry

The watch-dog circuit will turn off the instrument within 7-8 seconds unless periodically reset by the control software.

Real-Time Clock

The real-time clock maintains the current date and time. This clock operates off the cardiograph battery and will run as long as the battery is installed and charged.

DRAM RAS and CAS Generation and Refresh

Refresh of the DRAM is accomplished using a CAS (Column Address Strobe) before RAS (Row Address Strobe) technique. RAS and CAS are DRAM control signals used to latch the desired memory address location. A refresh of one row in the DRAM occurs approximately every 15 μ sec.

CPU Assembly

NVRAM Interface

The NVRAM contains 1K bits of non-volatile storage for the cardiograph configuration.

Keyboard Interface

The passive Keyboard is scanned by the System Gate Array for keypresses. The LED(s) are also driven by the System Gate Array. The software is responsible for determining which keyboard is loaded and configuring the instrument for proper operation.

Display Control for PageWriter 200 and 300 Series

The display is a 240 x 128 dot super-twisted nematic Liquid Crystal Display module with integrated driver circuitry. Its operation is controlled by the System Gate Array.

NVRAM

The NVRAM stores configuration information. It is written to by the System Gate Array under software control and requires no power to retain its data.

ECG Front End

The ECG Front end is described in "ECG Front End".

DRAM

The DRAM (Dynamic Random Access Memory) is a 256K x 16 bit read/write memory. The System Gate Array provides the multiplexed address information, generates RAS and CAS, and provides the timing and control required for memory transfers from and to the CPU. The DRAM connects directly to the Data bus.

ROM-1 and ROM-2 Address Space

Cardiographs with serial number prefix CNA, CNB, CNC, or 3807A or earlier have a Control Board with space for two ROMs (Read Only Memory) to provide data and instructions for the CPU. In addition, the Control Board expansion connector and System Gate Array provide for additional expansion. Each ROM contains 512K x 16 bits of read-only memory.

Cardiographs with serial # prefix CND have one 2MB EPROM on the control board which defines the ROM1 and ROM2 address spaces. The ROM contains 2MB x 16 bits of read-only memory.

Printer Gate Array/SRAM

The printer gate array is the principal component of the printer control circuitry. It buffers print data from the system, and status data going to the system. It also controls printer timing and the printer RAM, regulates motor speed, monitors printhead temperature, monitors the battery condition, and provides the interface between the printer and the system CPU.

The printer RAM consists of 32K of static RAM used to store printer data and the printer look-up table data. The look-up table data is used to compensate the motor drive signals and the printer enable pulses for variations in the operating environment. The look-up table data also includes the motor settings and the motor ramp-up profile.

Motor Driver

The phase signals from the printer gate array enable the motor driver circuit, which switches current through the stepper motor in the paper transport.

Analog/Digital Converter

This 8-bit parallel A/D converter measures printhead temperature, battery voltage, and printer supply voltage.

Thermal Printhead

The thermal printhead is a line of 1728 printing elements. Each printing element is a resistive heater. Heat from these elements blackens the thermoreactive paper, creating an image. A 1728-bit shift register (on the printhead) contains the dot data for the print line. Data is serially loaded into the shift register, then latched so that data for the next line may be shifted into the head while the present line prints. A strobe signal enables printing. The pulse width of the strobe is adjusted to compensate for different recording speeds and variations in supply voltage, average resistance, and temperature. The temperature is sensed by a thermistor on the printhead heat sink.

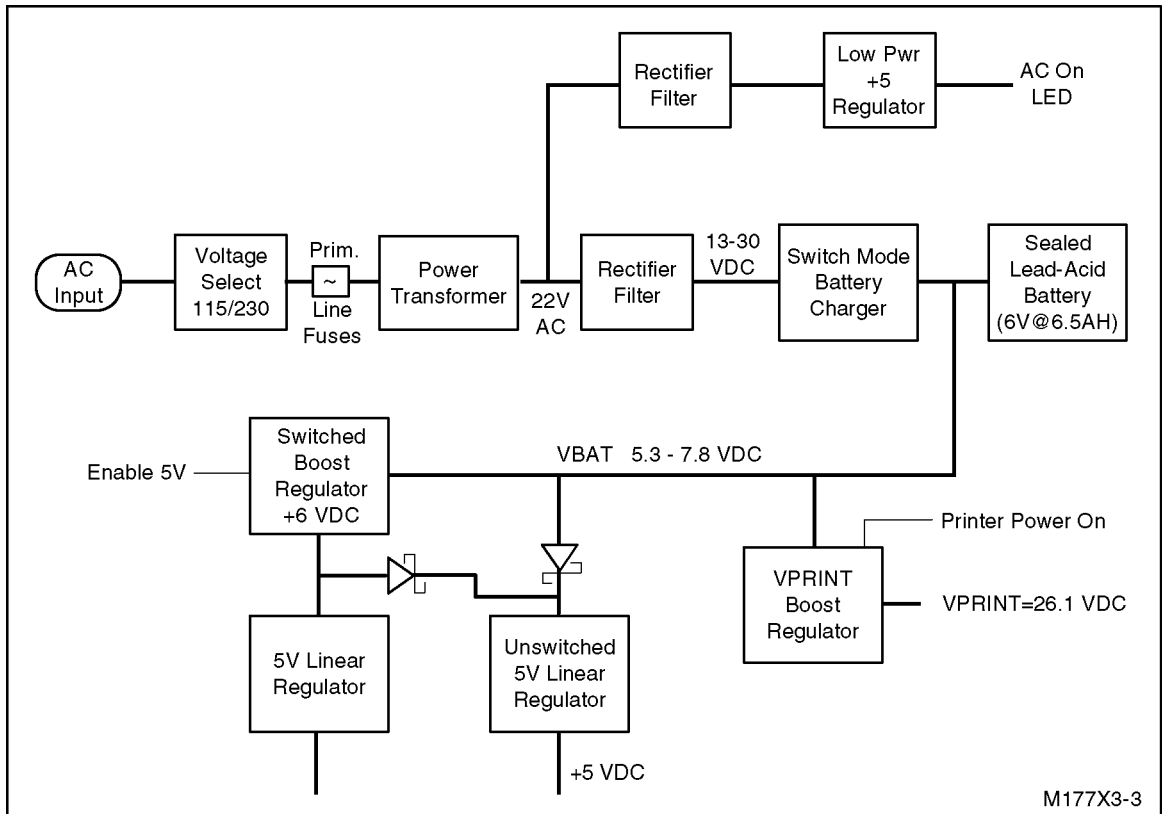
System Expansion Connector

The System Expansion Connector provides the instrument with future expansion capability, such as Option #A05, #A10.

Power Supply

The Power Supply connects the instrument to the AC line to charge the battery and power the circuitry. It conditions and regulates all power supplied to the Main Board.

Figure 3-3 Power Supply Block Diagram



Voltage Selector

The voltage selector connects the line input to the proper windings on the Power Transformer to produce the correct secondary voltage at the output of the Transformer.

Primary Line Fuses

The Primary Line Fuses protect the power supply from catastrophic failures.

Power Transformer

The power transformer reduces the input voltage to 22V AC (nominal).

Power Supply

Rectifier/Filter

This circuitry rectifies and filters the AC voltage to produce a DC voltage for the rest of the power supply.

Switch-Mode Battery Charger

The battery charger converts the output from the Rectifier/Filter to one of two levels. The first level is called the float voltage and equals 6.85 VDC (nominal at 25 C). The second level, called the overcharge voltage, is 7.4 VDC (nominal at 25 C). Both of these levels are temperature compensated. The charger is capable of delivering a maximum of 1.5A at its output in either the float mode or overcharge mode. The charger is a pulse width modulated switching type that has a nominal switching frequency of 100 KHz.

The charger enters the overcharge mode when any one of the following conditions are met: VBAT drops below 6.1V (nominal at 25 C), the instrument is turned on, a print operation starts, or the instrument is plugged into AC power. The charger changes into the float mode when the current into the battery is less than 80 mA.

Battery

The battery is a lead-acid 6 volt unit, providing 6.5 Amp-Hours of current when fully charged.

VPRINT Boost Regulator

The VPRINT Boost Regulator converts its input voltage to the 26 V supply required for operation of the thermal printhead.

Switched +6V Boost Regulator

The boost regulator is activated by turning the instrument **On**. It eliminates the heavy transients induced into the +5V supplies by the printing subsystem during normal printing. The output from this switching regulator is the input to both of the +5V Linear Regulators when the instrument is **On**. When the instrument is in **Standby** mode, the battery powers the unswitched +5V Linear Regulator.

5V Linear Regulators

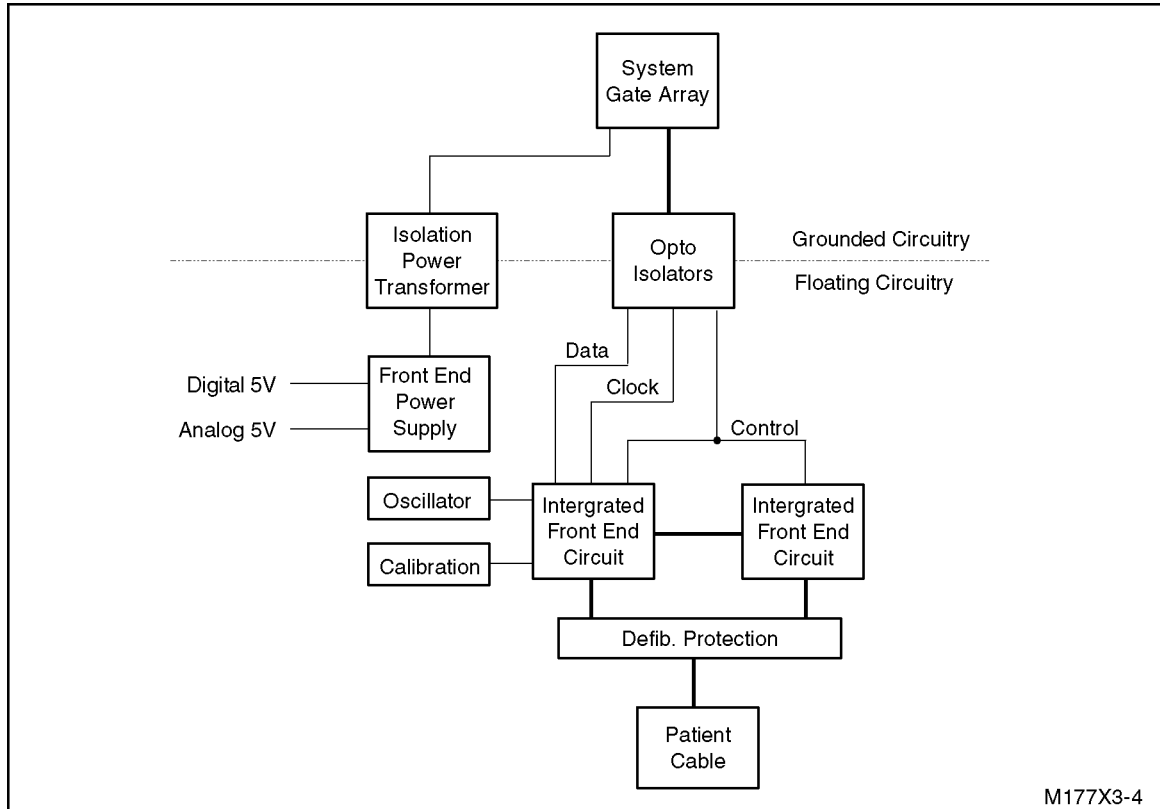
There are two regulators, both linear, described here. The first is the unswitched +5V regulator that provides power for circuitry active in the **Standby** mode. The System Gate Array circuitry active in **Standby** mode includes the real time clock.

The second +5V Linear Regulator provides the bulk of the operating power for the rest of the instrument when the instrument is **On**. This regulator is off when the instrument is in **Standby** mode.

ECG Front End

The ECG Front End provides the interface between the system and the patient. It electrically isolates the patient to prevent excess leakage current, protects the system from defibrillator and electrostatic discharges, and converts the analog electrical signals present on the patient to digital samples for processing and printing.

Figure 3-4 Front End Block Diagram



Isolation Power Transformer

The Isolation Power Transformer passes power to the ECG Front End and electrically isolates the patient-connected circuitry of the Front End from the rest of the instrument.

Front End Power Supply

The Front End Power Supply delivers separate, regulated power at 5V to the digital and analog circuitry.

ECG Front End

Opto-Isolators

Opto-Isolators pass the digital sample data from the patient-connected circuitry to the rest of the instrument, providing electrical isolation.

Integrated Front End Circuits/Oscillator

The Integrated Front End Circuits sample the patient leads at 4.096M samples per second per lead. The data are then filtered to 12 bits at 5 μ V/LSB and 2 msec per sample. The circuits include protection circuitry, gain, A/D conversion, and Oscillator control. These circuits have a master/slave arrangement, with the master driving the Oscillator and communicating all data to the System Gate Array through the opto-isolators.

Calibration

This circuitry is used to set ECG gain for the Integrated Front End Circuits.

Defibrillator Protection

Defibrillation Protection is provided by resistors in the patient cable combined with circuitry in the Integrated Front End Circuits.

Storage and Transmission (Option #A05 Only)

The Option #A05 PC assembly plugs into the cardiograph expansion slot, where it connects to the main PC assembly as shown in Figure 3-1. The cardiograph main board provides power and access to the cardiograph system electronics. The Option #A05 PC assembly contains all the circuitry needed to store and transmit ECGs.

Figure 3-5

M177XA Cardiograph Connections to Option #A05 PC Assembly

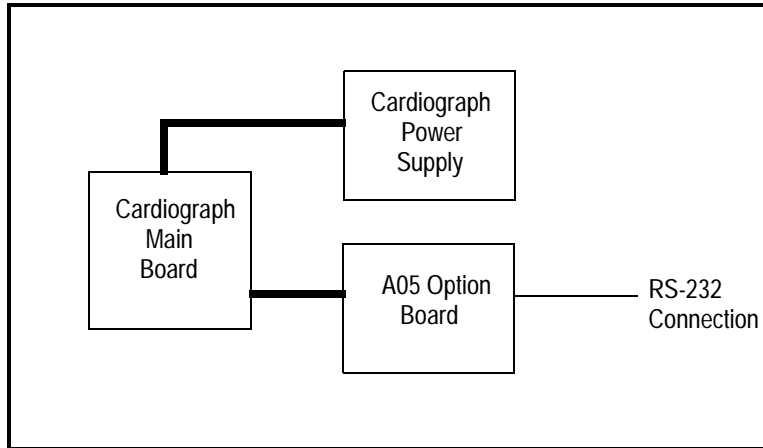
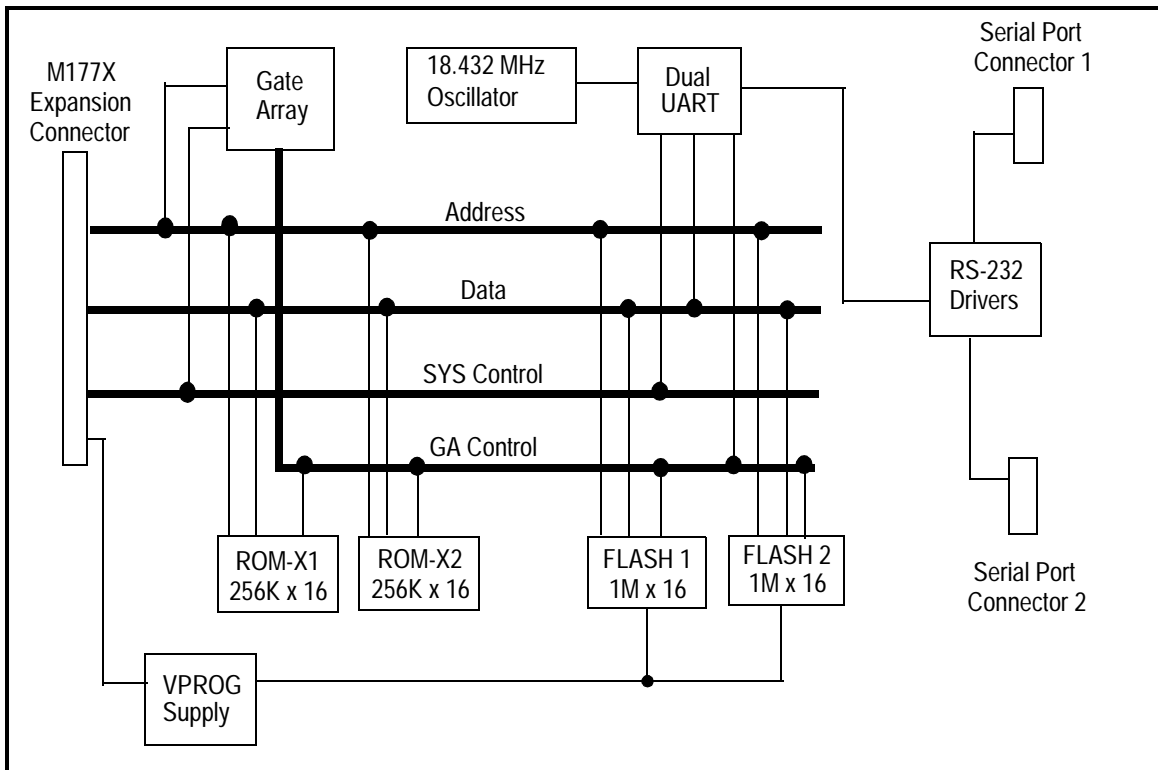


Figure 3-6 Option #A05 PC Assembly Block Diagram



M177XA Expansion Connector

The expansion connector on the Option #A05 PC assembly mates with the M177XA cardiograph expansion connector. This connection provides the Option #A05 PC assembly access to the cardiograph Address Bus, Data Bus, System Control Bus, and power supplies.

Gate Array

The gate array integrates the following functions:

- Address decoding and chip selects for the expansion ROMs (ROM-X1 and ROM-X2)
- Flash memory controller
- Interface to the Dual UART

ROM-X1, ROM-X2

ROM-X1 and ROM-X2 are ROMs provided for the cardiograph firmware expansion. The cardiograph CPU controls and execute the firmware in these ROMs.

Flash1, Flash2

FLASH1 and FLASH2 are 1M x 16 bit flash ROMs. The gate array provides control and timing functions required to interface these parts to the address and data bus. FLASH1 is used for non-volatile ECG storage. FLASH2 is provided for expansion memory. It is not normally present on the Option #A05 printed circuit assembly.

VPROG Power Supply

The VPROG power supply provides a 12V DC programming voltage to FLASH1 and FLASH2 during erase and write operations. The source for the supply is the cardiograph printhead supply voltage, which is turned on and off by the software. The VPROG supply circuit contains a 12V linear regulator that drops the printhead supply voltage to the required 12 volts for FLASH1 and FLASH2.

Dual UART

The Dual UART (Universal Asynchronous Receiver/Transmitter) contains two independent UARTs with the following capabilities:

- modem control
- baud rate generator
- 16 byte FIFO (first-in-first-out) buffer

Each UART is used to implement an RS232 port by translating between serial and parallel data.

18.432 MHz Oscillator

The 18.432 MHz Oscillator provides a clock for the internal functions of the Dual UART.

RS232 Drivers

The RS232 Drivers perform the voltage level translation between TTL logic level signals from the Dual UART and the ± 10 volt RS232 signals.

Serial Port Connectors 1 and 2

These connectors are 9-pin D-subminiature connectors that are located at the back panel of the cardiograph, and provide access to the two RS232 ports. The serial port marked RS-232 is used for ECG transmission. The other serial port is reserved for future use.

The #A10 interface board also, provides storage and transmission capability in addition to the Agilent StressWriter interface.

Storage and Transmission (Option #A05 Only)

Troubleshooting

Introduction

This chapter provides information for localizing cardiograph problems to the subassembly level. This information is designed for use with the cardiograph's Extended Self-test to help you efficiently repair the cardiograph with a minimum of equipment.

Maintenance Philosophy

The maintenance philosophy for the cardiograph is subassembly replacement. Replaceable subassemblies are identified in Chapter 6, "Parts List".

CAUTION

Individual component replacement should not be attempted outside of an authorized Agilent Technologies' repair facility. Component level repair is extremely difficult due to the extensive use of surface mount technology and the high parts density on the circuit boards. Unauthorized component replacement can impair cardiograph performance, compromise patient safety, and jeopardize credit towards a replacement assembly.

Test Equipment

The following test equipment is required to troubleshoot the cardiograph as described in this chapter:

- A digital voltmeter such as the HP E2373A hand-held multimeter.
- A 12-lead ECG simulator.
- A jumper wire with Pomona Micrograbber test clips or equivalent. Ordering information:

ITT Pomona 1500 East Ninth St.
P.O. Box 2767
Pomona, CA 91769
Sales: (909) 469-2900

Test Tools

Two troubleshooting tools are provided with each instrument:

- patient cable test tool (M1770-87908)
- front end and transmission test tool (M1770-87909, Rev. B)

Patient Cable Test Tool (M1770-87908)

This tool is attached inside the battery compartment, beneath the battery. To locate it, open the battery compartment door and lift the battery.

This tool is used to short the lead wires together to test lead wire integrity and detect potential "opens" within the cable. To test the leads, plug all ten lead wire posts into the holes of the tool and print an ECG. If all leads print clear, solid flat lines, the lead wires are intact.

Patient Cable Test Procedures for Internally Shorted Lead Wires

For PageWriter Models M1771A, M1770A, and M1772 (excluding software revisions A.01.02 or A.01.08) test the patient cable for internally shorted lead wires by following the steps in the procedure below:

1. Plug the patient cable into the cardiograph.
2. Make sure the individual lead wires do not touch each other or any conductive material.
3. Switch the cardiograph to the ON position.
4. The top line of the display or top line of an AUTO recorded ECG [Printed Form] should indicate RL (AHA) or N (IEC) or RL/N (combined AHA/IEC).
5. If the top line of the display or the top line of the AUTO recorded ECG [Printed Form] shows leads other than RL, N, or RL/N, then an internally shorted lead has been detected, and the patient cable must be replaced.

For PageWriter M1772 Models with software revisions A.01.02 or A.01.08, test the patient cable for internally shorted lead wires by following the steps in the procedure below:

1. Place the cardiograph in the Standby mode [if the cardiograph was ON, then you will need to depress the **On/Standby** button to place the cardiograph in the Standby mode.]
2. Depress and hold down keys **Auto** and **Page Advance** with fingers of one hand, and then depress **On/Standby** with a finger of the other hand. This puts the car-

Test Tools

diograph in a special "QA mode" which will enable the operator to perform this evaluation.

3. The patient cable is then securely plugged into the cardiograph's patient cable connector and ensure the individual lead wires do not touch each other or any electrically conductive surface. Verify that the cable is not swinging or otherwise in motion. Do not hold or touch the trunk cable during the test.
4. Depress and then release the **Auto** key. Wait approximately 15 seconds. The cardiograph will generate one sheet of paper with 2 or 3 rows of information on the bottom left side of the paper. [If you do not see this information printed on the paper, then go back to step 1 and repeat the procedure to enable the QA mode]
5. Note the second line from the bottom of the information will contain 9 separate 3 digit numbers. There may also be present a 10th group of digits which contain an @ sign. This 10th group of digits with the @ sign and any digits in that group should be ignored.

Example 1:

006-005-007 009-008-063-007-008-007

A.01.02 4350 25.4°C 7.74V 26.24V Battery OK AC

Example 2:

000-000-000 000-000-000-000-000-000 000

006-005-007 009-008-063-007-008-007 1511@64

A.01.08 4350 25.4°C 7.74V 26.24V Battery OK AC

6. Check the first nine groups of three-digit numbers in the second row from the bottom. If ANY three-digit number is greater than **025**, then an internally shorted lead has been detected and the patient cable must be replaced. If none of the three-digit numbers exceed **025**, then the cable is free of defects known as internally shorted leads and may continue to be used. In the example above, the 6th three-digit number is **063**, which exceeds **025** for an acceptable cable. Therefore, this cable is defective.
7. Place the cardiograph back into the Standby mode by depressing the **On/Standby** button again.
8. Depress and hold down the keys **Auto** and **Page Advance** with fingers of one hand, and then depress **On/Standby** again with a finger of the other hand. This will restore the cardiograph to its normal operating state.

Depress and then release the **Auto** key. Wait approximately 15 seconds. The cardiograph will generate one sheet of information on recording paper. Note that on the bottom left side of the recording there are no longer any lines of information as previously seen in step 5. If you continue to see this information, then repeat step 7 and step 8 to disable the "QA mode".

The Error and Event Logging

Front End and RS-232 Port Test Tool (M1770-87909, Rev. B)

This tool is located on the lower side of the printer door. To remove it, open the printer door and reach underneath it. The tool has two test plugs, one used to test the instrument signal path, and one used to test the cardiograph's RS-232 port.

Testing the Instrument Signal Path

To test the instrument signal path, plug the larger connector into the patient cable connector on the front of the cardiograph. Print an ECG. If the front end is operating properly, all leads will show clear, solid flat lines with little or no noise.

NOTE

You can use the patient cable test tool and the front end test tool to isolate patient cable problems and cardiograph problems.

Testing the Cardiograph's RS-232 Port

To test the cardiograph's RS-232 port, plug the smaller connector into the RS-232 port, in place of the modem. Run the extended self-test described in Chapter 2. The modem test will pass if the cardiograph RS-232 port is operating properly. This can help differentiate between cardiograph problems, and cable or modem problems.

NOTE

You can use the front end and RS-232 port test tool to isolate modem problems and cardiograph problems.

NOTE

The RS-232 port test connector is available only on Revision B of the M1770-87909.

The Error and Event Logging

The last error that was displayed can be printed by starting the Extended Self-test. The error code is useful in diagnosing what was last wrong with the cardiograph. See "How to Read the Extended Self-Test Report" in Chapter 2 for the location of the last error on the Extended Self-test report.

The last 46 events recorded in the Events Log are also printed on the Extended Self-Test Report for cardiographs equipped with Option #A05.

Using Extended Self-test in Troubleshooting

The cardiograph's Extended Self-test is a simple-to-use, looping test that gives you pass/fail status for each of these major subassemblies:

- CPU assembly
- Printer
- Keyboard display (M1772A excluded)
- Modem (Option #A05 only)

Instructions for entering and using Extended Self-test are found in Chapter 2.

How the PageWriter 100 Communicates Error Codes and Messages

The PageWriter 100 uses its LEDs to communicate error codes and messages.

PageWriter 100 Error Code Communication

When an error is detected, all LED's light for 1/2 second, then the LED's above the error code digits light in turn for 1/2 seconds each, beginning with the leftmost digit. For example, error code 3527 will cause the following LED's to blink in the order given: 3

(Filter), 5 (Auto), 2 (V Leads), 7 (all Manual lead group LED's).

PageWriter 100 Error Message Communication

The PageWriter 100 communicates the following error messages with these corresponding LED's:

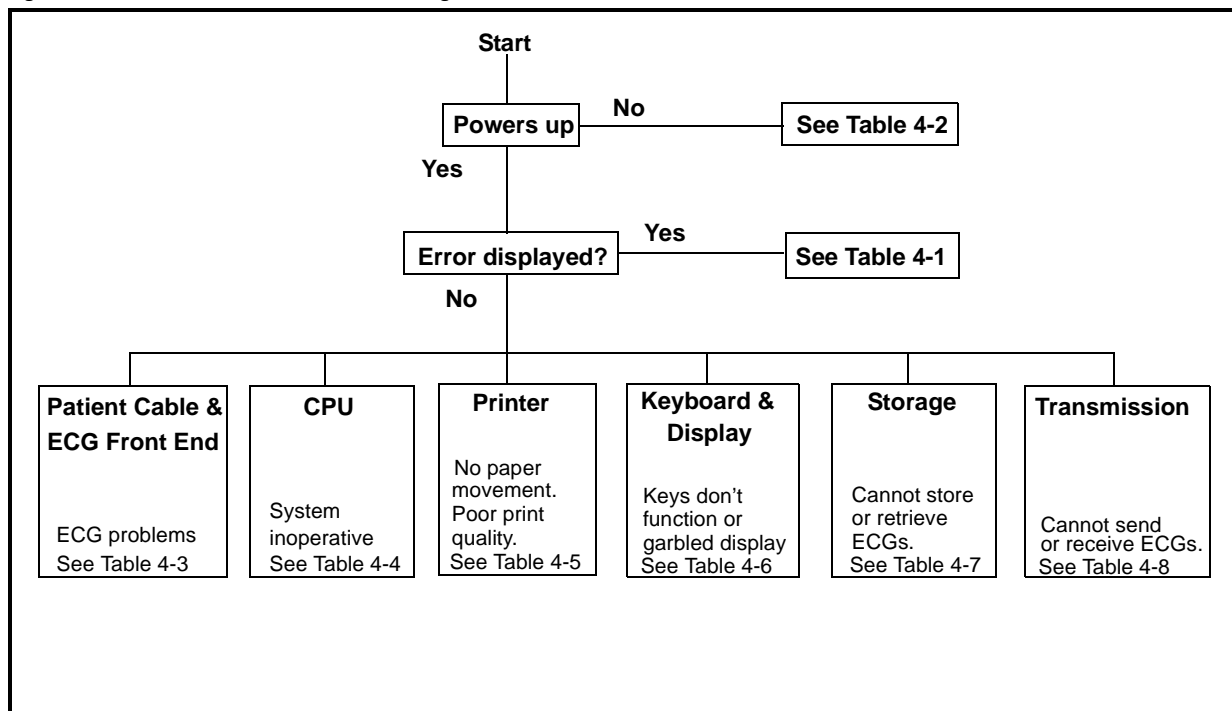
Leads off	All Manual lead group LED's blink alternately with Auto LED.
Check Paper Supply	The current Chart Speed LED blinks.
Printer Door Open	The current Chart Speed LED blinks.

Troubleshooting Tables

The troubleshooting tables in this section help you to localize a fault and correct it. The troubleshooting flowchart in Figure 4-1 guides you to the troubleshooting table that covers a particular functional area of the cardiograph.

Table 4-1 lists errors that can occur during operation and will appear only as numbers on the display. The table defines and explains each error, and suggests one or more corrective actions for each.

Figure 4-1 Troubleshooting Flowchart



Troubleshooting Tables

CAUTION

Before removing or inserting any board or connector, make sure AC power is off and the battery is removed.

The error codes listed below appear on the extended self-test report in the last error column or in the event log (Option #A05 only) described in Chapter 2.

Table 4-1 Error Codes

Error #	Definition	Corrective Action
1010, 1217, 1221, 5223	Memory allocation fault	<ol style="list-style-type: none"> 1. Turn off, wait 30 seconds, turn on. 2. Retry the operation.
1100, 1102-1107, 1200, 5327-5331, 3515, 5177	Defective ROMs or other related hardware problem on CPU assembly.	<ol style="list-style-type: none"> 1. Turn off, wait 30 seconds, turn on. 2. Replace CPU assembly, if error code persists.
1101	ECG front end could not calibrate due to excessive ambient noise.	If the cardiograph uses software release A.01.02, modify the cardiograph using upgrade kit M1770-89520.
2000-2003, 5221	Power supply fault.	<ol style="list-style-type: none"> 1. Test the power supply (refer to “Testing the Power Supply). Replace power supply if defective. 2. Inspect cabling between power supply and CPU. 3. Replace CPU assembly, if error code persists.
3517-3527	Advisory codes appear during power-on and indicate an abnormal cardiograph shutdown.	Turn off, wait 30 seconds, turn on.
3510, 7000, 7001	Defective keyboard or keyboard cable	Replace keyboard if the error persists.
3531	Defective FLASH memory.	<ol style="list-style-type: none"> 1. Perform the extended self-test (refer to Chapter 2). 2. If the extended self-test fails, replace the Option #A05 PCA.
5033-5077	Defective CPU assembly.	<ol style="list-style-type: none"> 1. Turn off, wait 30 seconds, turn on. 2. Replace CPU assembly, if error code persists.
5155	Defective UART.	<ol style="list-style-type: none"> 1. Perform the extended self-test (refer to Chapter 2). 2. If the extended self-test fails, replace the Option #A05 PCA.
All other error codes	Bad configuration. Defective CPU assembly	<ol style="list-style-type: none"> 1. Reset configuration. Refer to “Resetting the Cardiograph to the Factory Default State.” 2. Replace CPU assembly, if error code persists.

Troubleshooting Tables

Table 4-2 Power Supply and Battery

Symptom	Possible Cause	Corrective Action
AC indicator not lit.	Power cord unplugged. AC line voltage switch in wrong position. One or both AC fuses are blown. Power supply to CPU interface cables or keyboard cable not fully seated. Bad power supply to CPU interface cable(s). Bad keyboard circuit board. Bad power supply. Bad CPU assembly.	Plug in power cord. Move to correct position. Replace AC fuse(s). Reseat cables. Replace cable(s). Replace keyboard assembly. Replace power supply. Replace CPU assembly.
Cardiograph doesn't run on battery, but runs on AC.	Battery connector is loose or defective. Low battery or defective battery. Software has stopped. Battery fuse is blown. Battery charger is defective.	Make sure battery connector is properly seated and not defective. Charge or replace battery. Unplug from AC power. Remove battery. Wait 2 minutes. Reinstall battery and turn instrument on. Disconnect the battery and visually inspect the battery fuse on the battery. Replace the battery, if necessary. Replace power supply assembly.
Cardiograph won't power up on AC or battery.	Power supply to CPU interface cables or keyboard cable not fully seated. Power supply to CPU interface cable(s) is defective. Software has stopped. Keyboard circuit board is defective. Power supply is defective. CPU assembly is defective.	Reseat cables. Replace the power supply to CPU interface cable(s). Unplug from AC power. Remove battery. Wait 2 minutes. Reinstall battery and turn instrument on. Replace the keyboard assembly. Replace power supply assembly. Replace CPU assembly.
Battery does not charge.	AC line voltage switch in wrong position. Defective power supply. Defective battery.	Move to correct position Remove battery. Using a voltmeter, measure for approximately 6.8 Vdc across the battery connector in the unit. Replace power supply, if absent. Replace battery.
Battery capacity too low.	Battery is not fully charged. AC line voltage switch in wrong position. Defective or worn-out battery.	Fully charge battery. Move to correct position. Replace battery.
Cardiograph turns itself off while plugged into AC power.	AC line voltage switch in wrong position. Power supply to CPU interface cables or keyboard cable not fully seated. Defective power supply.	Move to correct position. Reseat cables. Replace power supply.

Troubleshooting Tables

Table 4-2 Power Supply and Battery

Symptom	Possible Cause	Corrective Action
Low Battery light or Low Battery message remains on during extended self-test.	Low battery or defective battery. Battery fuse is blown. Battery charger is defective.	Charge or replace battery. Disconnect the battery and visually inspect the battery fuse on the battery. Replace the battery, if necessary. Replace power supply assembly
Low Battery light or Low Battery message blinks.	Low battery.	Fully charge battery.
One or more power supply voltages missing (see “Testing the Power Supply” at the end of this chapter).	Defective regulator circuit(s).	Replace power supply assembly.

Table 4-3 Patient Cable and ECG Front End

Symptom	Possible Cause	Corrective Action
”Leads off” not indicated when wire is off.	Dirty contacts on patient cable connector. Defective or dirty leadwire. Defective ECG front end.	Ensure the contacts on the patient cable connector are clean and dry. Reseat the patient cable connector. Clean leadwire. Replace patient cable if leadwire defective. Replace CPU assembly.
”Leads off” indicated when wire is not off.	Poor electrode contact. Defective leadwire.	Improve patient preparation. Clean leadwire. Replace patient cable if leadwire defective.

Troubleshooting Tables

Table 4-3 Patient Cable and ECG Front End

Symptom	Possible Cause	Corrective Action
<p>Bad ECG:</p> <p>Good calibration pulse in channels where traces are not good.</p> <p>A lead is missing — dotted line on trace.</p> <p>Noisy lead(s): “AC” (regular pattern) — for 60 Hz, 12 peaks/5 mm at 25 mm/sec; for 50 Hz, 10 peaks/5 mm.</p>	<p>Faulty operator technique; poor electrode contact</p> <p>Defective leadwires.</p> <p>Defective ECG front end.</p> <p>Faulty operator technique; poor electrode contact.</p> <p>Defective leadwires.</p> <p>Defective ECG front end.</p> <p>Faulty operator technique; poor electrode contact.</p> <p>Patient or patient cable near AC power.</p> <p>Lead wires may be picking up interference from poorly grounded equipment near the patient.</p> <p>Patient cable is too close to the cardiograph or other power cords.</p>	<p>Refer to Table 6-2 in user’s manual.</p> <p>Replace patient cable.</p> <p>Replace CPU assembly.</p> <p>Refer to Table 6-2 in user’s manual.</p> <p>Replace patient cable.</p> <p>Replace CPU assembly.</p> <p>Refer to Table 6-2 in user guide.</p> <p>Reposition patient cable. Refer to Table 6-2 in user guide. Try unplugging cardiograph from the AC outlet.</p> <p>Route lead wires along limbs and away from other electrical equipment. Fix or move poorly grounded equipment.</p> <p>Move the cardiograph away from the patient. Unplug the cardiograph and operate on battery. Unplug the electric bed.</p>
<p>Noisy leads: Muscle artifact.</p> <p>Noisy lead(s): I, III, aVL</p> <p>Noisy lead(s): II, III, aVF</p> <p>Noisy lead(s): I, II, aVR</p> <p>Noise in only one V lead.</p> <p>Noise in general.</p>	<p>Patient is not relaxed or skin has been irritated.</p> <p>Low quality disposable electrodes, leadwire adapters.</p> <p>LA leadwire defective.</p> <p>LL leadwire defective.</p> <p>RA leadwire defective.</p> <p>Faulty operator technique; poor electrode contact.</p> <p>Defective leadwires</p> <p>Faulty operator technique; poor electrode contact.</p> <p>Defective leadwires.</p>	<p>Refer to Table 6-2 in User Guide.</p> <p>Replace disposable electrodes or leadwire adapters.</p> <p>Test with ECG simulator. Replace patient cable.</p> <p>Replace patient cable.</p> <p>Replace patient cable.</p> <p>Replace patient cable.</p> <p>Refer to Table 6-2 in user guide.</p> <p>Replace patient cable.</p> <p>Refer to Table 6-2 in user guide.</p> <p>Replace patient cable.</p>

NOTE

Remember that most noise results from poor patient-electrode connections or poor quality electrodes. If noise persists after checking electrode placement and lead-electrode connections, the noise may be due to poor quality electrodes. Some electrodes have a shelf life of 48 hours or less once the foil package is opened. Eliminate electrode placement, connections, and freshness as the causes of the noise before replacing the patient cable.

Troubleshooting Tables

NOTE

You can use the patient cable test tool and the ECG front end test tool to determine whether a problem is caused by a poor patient to electrode connection, a defective cable or a defective cardiograph. See the section titled “Test Tools” in this chapter for more information about using the patient cable test tool.

Table 4-4 CPU Assembly

Symptom	Possible Cause	Corrective Action
System turns on but won't run. Power supply OK.	A cable is not fully seated. Defective CPU assembly.	Reseat all cables. Replace CPU assembly.
System won't turn off.	Software has stopped. Defective CPU assembly	Unplug from AC power. Remove battery. Wait 2 minutes. Replace battery and turn unit on. Replace CPU assembly.

Table 4-5 Printer

Symptom	Possible Cause	Corrective Action
Paper doesn't move; printer error message displayed Check paper supply or the current Chart Speed LED is flashing.	A printer cable is not fully seated. Defective sensor assembly. Defective motor assembly. Defective motor drive assembly. Defective roller. Defective roller.	Replace paper or clear paper jam. Reseat connectors J303 through J306. Replace sensor assembly. Replace motor assembly. Replace CPU assembly. Replace printer door assembly.
Paper moves then stops and displays error message Check paper supply or the current Chart Speed LED is flashing.	Paper loaded incorrectly. Dirty sensor lens. A printer cable is not fully seated. Defective sensor assembly. Defective sensor circuit. Defective roller.	Make sure cardiograph is loaded properly with approved thermal paper. Clean sensor lens. Reseat connectors J303 through J306. Replace sensor assembly. Replace CPU assembly. Replace printer door assembly.
Paper stops in the wrong place after pressing Page Advance or Auto . No error message.	Wrong type of paper. Sensor hole not cut out properly on paper. A printer cable is not fully seated. Dirty sensor lens. Defective sensor. Defective sensor circuit	Make sure cardiograph is loaded properly with approved thermal paper. Remove defective sheet of paper. Reseat connectors J303 through J306. Clean sensor lens. Replace sensor assembly. Replace CPU assembly.

Troubleshooting Tables

Table 4-5 Printer



Symptom	Possible Cause	Corrective Action
Message: Printer door open or the current Chart Speed LED is flashing.	Door is ajar. A printer cable is not fully seated. Printhead contact switch clip or leaf spring touching contact post. Defective sensor assembly. Defective door-detect circuit.	Close door. Reseat connectors J303 through J306. Check leaf spring behind printhead and contact post. Replace sensor assembly. Replace CPU assembly.
Wavy diagonal lines on printer self-test or distortion of printouts in the time axis.	Improper meshing of gears in printer drive assembly or door assembly.	Replace printer drive assembly or door assembly. Make sure the printer drive assembly is properly mounted on the top cover.
Printing is dark on one side of page but faint on the other side.	Printhead is not free to float and provide even (uniform) pressure distribution across platen roller.	Make sure there is slack in the printhead cables. Replace printer door. Replace printhead assembly.
Paper moves but nothing prints.	Paper loaded incorrectly, or non-approved or non-thermal paper installed. A printer cable is not fully seated. VPRINT supply defective. Insufficient leaf spring tension or printhead out of position. Defective printhead or printhead cables. Defective component in printer circuitry.	Make sure cardiograph is properly loaded with approved thermal paper. Reseat connectors J303 through J306. Test VPRINT. If defective, replace power supply. Check leaf spring for printhead platen pressure, door latch. Replace printhead assembly or printhead cables. Replace CPU assembly.
Paper moves but printing is faint.	Door improperly latched. Paper loaded incorrectly, or non-approved or non-thermal paper installed. A printer cable is not fully seated. VPRINT supply defective. Insufficient leaf spring tension or printhead out of position. Defective printhead or printhead cables. Defective component in printer circuitry. Capacitor assembly defective.	Close door properly. Make sure cardiograph is properly loaded with approved thermal paper. Reseat connectors J302 through J306, and connectors on the capacitor board Test VPRINT. If defective, replace power supply. Check leaf spring for printhead platen pressure, door latch. Replace printhead assembly. Replace CPU assembly. Replace capacitor assembly.

Troubleshooting Tables

Table 4-5 Printer

Symptom	Possible Cause	Corrective Action
Printed data are garbled.	A printer cable is not fully seated. Defective printhead. Defective component in data path.	Reseat connector J304. Replace printhead assembly. 1. Replace printhead control cable. 2. Replace CPU assembly.
Poor print quality or some dots not printing.	Dirty printhead. Loose ESD brush fibers. Incorrect printhead or sensor cable routing. Defective printhead or printhead cables. Defective component in printer circuitry.	Clean printhead. Remove loose brush fibers and clean printhead. Make sure there is slack in the printhead cables. Replace printhead assembly or printhead cables. Replace CPU assembly.
Some dots always on.	Defective printhead. Defective printhead or printhead cables.	Replace printhead assembly. Replace printhead assembly or printhead cables.

Table 4-6 Keyboard and Display (LCD)

Symptom	Possible Cause	Corrective Action
Display stays blank or all black. (M1770A/M1771A only)	Contrast misadjusted. Keyboard cable is not fully seated. No power being supplied to keyboard assembly. Defective keyboard assembly. Defective LCD assembly Defective contrast control in CPU assembly.	Adjust contrast using the Shift and  or  keys. Reseat keyboard cable. Test power supply. Replace if defective. Replace keyboard assembly. Replace LCD assembly. Replace CPU assembly.
Keys won't work. Unable to enter data or operate controls.	Keyboard cable unplugged. Keyboard circuit board defective. CPU assembly defective.	Reconnect keyboard cable. Replace keyboard assembly. Replace CPU assembly.
Garbled data on display.	Keyboard cable not seated correctly. Keyboard flex cable connection is poor. Defective LCD. Defective keyboard assembly. Defective CPU assembly.	Make sure cable from keyboard to CPU assembly is properly seated. Make sure flex cable is fully inserted and locked in each connector. Replace LCD assembly. Replace keyboard assembly. Replace CPU assembly.

Troubleshooting Tables

Table 4-7 Storage (Option #A05 Only)

Message	Possible Cause	Possible Solutions
ECG too noisy to store (This message appears briefly on the screen)	<p>Poor electrode contact. Dry or dirty electrodes.</p> <p>Patient moving or not relaxed.</p> <p>Lead wires may be picking up interference from poorly grounded equipment near the patient.</p> <p>Patient cable is too close to the cardiograph or other power cords.</p>	<p>Use new electrodes. Abrade skin. Reapply electrodes. Check expiration date on disposable electrodes.</p> <p>Reassure and relax the patient. Press the Filter key if it is configured for Artifact.</p> <p>Route lead wires along limbs and away from other electrical equipment. Fix or move poorly grounded equipment.</p> <p>Move the cardiograph away from the patient. Unplug the cardiograph and operate on battery power. Move other electrical equipment away from patient. Unplug electric bed.</p>
"Storage system full" message appears when fewer than 30 ECGs are stored.	<p>30 ECGs stored in memory.</p> <p>Storage memory gradually wears out after many thousand store/erase cycles. Consequently, ECG storage capacity decreases gradually over the life of the product.</p>	<p>Delete some ECGs.</p> <p>If under warranty, call Agilent service. Generally, stored ECGs are retrievable. If remaining ECG storage capacity is unacceptable, call Agilent service.</p>
Unable to store ECG (This message appears briefly on the screen)	A fault exists in the storage hardware.	Call Agilent service
Unable to retrieve ECG (This message appears briefly on the screen)	A fault exists in the storage hardware.	Call Agilent service

Troubleshooting Tables

Table 4-8 Transmission (Option #A05 only)

Message	Possible Cause	Possible Solutions
Telephone busy, waiting to redial	Busy telephone ay remote site.	Normal event. The cardiograph will redial, waiting 30 seconds between attempts, until the line is open or until the operator stops the transmission.
No answer, re-dialing	Remote modem not connected, or the cardiograph modem is set to wait for an answer for too few rings	Be sure the remote site is ready to receive the transmission. If necessary, extend the time the modem will wait for a connection by adding the string "S7=90" to the modem initialization string.
Check telephone cable	No dial tone.	Check the telephone cable connection to the modem. Attach the telephone cable to a telephone to verify a dial tone on the line.
Check modem and cable	No power to modem, or poor modem cable connection. Defective cable. Defective modem.	Check that the data cable is attached to the modem and to the cardiograph's RS-232 port. Check operation of the RS-232 port. Replace the data cable. Run the modem self-test. Replace modem if defective.
Check cable	Poor cable connection between cardiograph and TraceMaster system. Defective cable.	Check that the data cable is attached to the cardiograph's RS-232 port. Check operation of the RS-232 port. Replace the data cable.
Check modem configuration	Incompatible or improperly initialized modem	Check the modem initialization string for legal modem commands. See you modem documentation for legal commands for your modem.

Troubleshooting Tables

Table 4-8 Transmission (Option #A05 only)

Message	Possible Cause	Possible Solutions
No modem at remote site	<p>The local modem could not complete the connection. The most likely causes are:</p> <ol style="list-style-type: none"> 1. Telephone cable disconnected from local modem. 2. Remote modem turned off or disconnected from telephone line. 3. Telephone prematurely disconnected at remote site. 4. Excessive noise on the telephone line. 5. Incompatible transmission protocols on remote and local modems. 6. Incompatible modem setup strings on the remote and local modems. 7. The remote modem did not answer the phone call within the time specified in the modem's S7 register, and the @ symbol is not present in the telephone number string in the cardiograph telephone directory. 	<ol style="list-style-type: none"> 1. Check all cable connections. 2. Be sure the remote modem is turned on and connected to the telephone cable. 3. Retry the transmission. 4. Retry the transmission. 5. Check the cardiograph telephone directory and verify telephone number, device type, and transmission speed. 6. Check the modem initialization string commands that allow compatibility with the remote modem. 7. Be sure the remote site is ready to receive the transmission. Consider extending the time the modem waits for a connection by adding the string "S7=90" to the modem initialization string.
<p>Transmission stopped unexpectedly. X of N ECGs received.</p> <p>Cable/ modem problem, Press any key to continue.</p>	No power to modem, or poor modem cable connection.	<p>Check that at least one of the modem's LEDs is on. Check that the data cable is attached to the modem and to the cardiograph's RS-232 port. Check operation of the RS-232 port.</p>
<p>Transmission stopped unexpectedly. X of N ECGs received.</p> <p>Modem was disconnected. Press any key to continue.</p>	Problem with telephone line or remote modem.	<p>Check that at least one of the modem's LEDs is on. Check that the data cable is attached to the modem and to the cardiograph's RS-232 port. Check operation of the RS-232 port.</p> <p>Be sure the remote site is ready to receive the transmission.</p> <p>Retry the transmission at 2400 bps.</p>
<p>Transmission stopped unexpectedly. X of N ECGs sent. Remote site stopped communication (nnnn). Press any key to continue.</p> <p>or</p> <p>Transmission stopped unexpectedly. X of N ECGs received. Remote site stopped communication (nnnn). Press any key to continue.</p>	<p>Communication speed of the remote device does not match that of the cardiograph, or the remote site modem malfunctions. The (nnnn) is the event code associated with the message, and is recorded in the event log when this message appears. These events relate to the transmission protocol. See Table 4-9 for a list of event codes.</p>	<p>Be sure the remote site is ready to receive the transmission.</p> <p>Be sure the remote site is ready to send the transmission.</p>

Troubleshooting Tables

In addition to the error codes listed above, the following event codes are displayed on the extended self-test report for cardiographs equipped with Option #A05.

Table 4-9 Event Codes (Option #A05 only)

Event #	Definition	Corrective Action
1223	Record corrupted during transmission. This code is followed by an sub-error code.	Retry the transmission.
3573	1. The battery was removed when the cardiograph was not plugged in to AC power. 2. The battery fuse is defective.	Replace the battery.
3575	The cardiograph turned off due to inactivity.	Normal event. No action required.
3577	The cardiograph turned off due to low battery.	Plug cardiograph into AC power.
3700	The power was cycled quickly.	Normal event. No action required.
3701	Errors were detected in the front end communication link.	Run the extended self-test to check operation of the front-end.
5160, sub code 3	No modem at remote site.	1. Check all cable connections. 2. Be sure the remote modem is turned on and connected to the telephone cable. 3. Check the cardiograph telephone directory and verify telephone number, device type, and transmission speed. 4. Check the modem initialization string commands that allow compatibility with the remote modem. 5. Be sure the remote site is ready to receive the transmission. Consider extending the time the modem waits for a connection by adding the string "S7=90" to the modem initialization string. 6. Retry the transmission
5160, sub code 4	Check modem configuration.	Check the modem initialization string for legal modem commands. See your modem documentation for legal commands for your modem.
5160, sub code 5	Check telephone cable.	Check the telephone cable connection to the modem. Attach the telephone cable to a telephone to verify a dial tone on the line.
5160, sub code 6	Telephone busy, waiting to redial... (after 30 seconds, this message appears:) Telephone busy, redialing...	Normal event. The cardiograph will redial, waiting 30 seconds between attempts, until the line is open or until the operator stops the transmission.
5160, sub code 7	No answer, waiting to redial... (after 30 seconds, this message appears:) No answer, redialing...	Be sure the remote site is ready to receive a transmission. If necessary, extend the time the modem will wait for a connection by adding the string "S7=90" to the modem initialization string.

Troubleshooting Tables

Event #	Definition	Corrective Action
5160, sub codes 10 and 11	<p>Check cable. (This message appears when the transmission type is Direct or Direct SCP)</p> <p>Check modem and cable. (This message appears when the transmission type is Modem or Modem SCP.)</p>	<p>Check that at least one of the modem's LEDs is on. Check that the data cable is attached to the modem and to the cardiograph's RS-232 port. Check operation of the RS-232 port.</p>
5161	<p>Transmission stopped unexpectedly. x of n ECGs sent Cable/modem problem Press any key to continue</p> <p>or</p> <p>Transmission stopped unexpectedly. x of n ECGs received Cable/modem problem Press any key to continue</p>	<p>Check that at least one of the modem's LEDs is on. Check that the data cable is attached to the modem and to the cardiograph's RS-232 port. when transmitting or receiving ECGs. Check operation of the RS-232 port.</p>
5162	<p>Transmission stopped unexpectedly. x of n ECGs received Modem was disconnected Press any key to continue</p>	<ol style="list-style-type: none"> 1. Check that at least one of the modem's LEDs is on. Check that the data cable is attached to the modem and to the cardiograph's RS-232 port when transmitting or receiving ECGs. Check operation of the RS-232 port. 2. Retry transmission at 2400 bps.
5163	<p>Transmission stopped unexpectedly. x of n ECGs sent Remote site stopped communication Press any key to continue</p> <p>or</p> <p>Transmission stopped unexpectedly. x of n ECGs sent Remote site stopped communication Press any key to continue</p>	<p>Be sure the remote site is ready to send or receive the transmission.</p>
7127-7141	<p>Fax transmission problems.</p>	<ol style="list-style-type: none"> 1. Verify that the remote fax is a group III fax machine. 2. Check the fax machine initialization string.
9001-9007	<p>Sender time-out while waiting for response from receiver during transmission using Direct transmission protocol.</p>	<p>Retry transmission at 2400 bps.</p>
9010-9015	<p>Receiver time-out waiting for response from sender.</p>	<p>Retry transmission at 2400 bps.</p>
9021	<p>Normal Direct transmission link termination.</p>	<p>No action. Normal event. Transmission completed successfully</p>
9022	<p>Operator stopped transmission at remote site.</p>	<p>Contact the remote site.</p>
9023	<p>Cardiograph stopped transmission due to a system error at the local or remote site. The most common remote site error is missing paper on the receiving cardiograph.</p>	<p>Check the receiving device to make sure it is ready to receive the transmission.</p>

Troubleshooting Tables

Event #	Definition	Corrective Action
9030-9035, 9042-9045, 9050, 9051, 9069-9085	Direct transmission protocol error.	Retry transmission.
9038	A non-specific error occurred during transmission.	Retry transmission at 2400 bps.
9046	Remote device not supported.	Verify that the remote site is compatible with the PageWriter cardiograph.
9047-9049	Requested an ECG from an unrecognized device.	Verify that the remote site is a TraceMaster ECG Management System.
9052-9065	Premature quit command received from remote site.	Contact remote site.
9066	Defective FLASH memory	<ol style="list-style-type: none"> 1. Perform the extended self-test (refer to Chapter 2). 2. If the extended self-test fails, replace the Option #A05 PCA.
9067	Memory allocation fault during transmission.	<ol style="list-style-type: none"> 1. Turn off, wait 30 seconds, turn on. 2. Retry transmission.
9086	Unrecognized device for transmission	Verify that the remote site is compatible with the PageWriter cardiograph.
9087-9089	Printer problem during transmission.	<ol style="list-style-type: none"> 1. Check the paper supply. 2. Be sure the printer door is closed. 3. Retry the transmission.
9163	<p>Transmission stopped unexpectedly. x of n ECGs sent Remote site stopped communication Press any key to continue</p> <p>or</p> <p>Transmission stopped unexpectedly. x of n ECGs received Remote site stopped communication Press any key to continue</p>	<ol style="list-style-type: none"> 1. Verify the transmission speed matches that of the remote site. 2. Verify the remote system communication is operating correctly
9200	An ECG was requested from a FAX machine.	Select a connection type of Modem, Direct, Modem-SCP, or DirectSCP to request an ECG from a remote site.
9500-9674	Unable to build an SCP record for transmission.	Turn off, wait 30 seconds, turn on. Retry the transmission. If the error persists, call Agilent.
9575-9895	SCP transmission errors.	Retry the transmission. Call Agilent if the error persists.
9585, 9586	The ECG transmission stalled before completion, either because the file transfer protocol is absent or is in an unexpected state, or another communication error occurred.	Wait one minute, then retry the transmission. Check or restart the communication software at the remote site. If the error persists, call Agilent.

Troubleshooting Tables

Event #	Definition	Corrective Action
9640, 9769	The receiving device rejected a transmitted ECG because of data errors.	Wait one minute, then retry the transmission. If the error persists, call Agilent.

Table 4-10 Recorder Problems

Problem	Corrective Action
Is the cardiograph turned on?	The LCD screen should be on. Use the shift and up/down key to increase/decrease intensity.
Is the AC power light on?	If the cardiograph is plugged in and the AC light is not on, check fuses.
Is the battery adequately charged?	The low battery message (in the upper-left corner of the screen) will appear if the battery is not charged.
Is the cardiograph out of paper or is paper jammed?	The cardiograph will not record an ECG unless paper is loaded and no jam exists.
Is the paper sensor lens dirty or obstructed?	Clean sensor lens.
Is the paper door completely closed?	Open paper door slightly and close it. Listen for the door safety latch to lock.
Is there an error message?	<p>The error messages that display on the screen will instruct you as to what action to take. If it is something that you can correct, the message will instruct you as to what to do. If an error number displays, perform the following steps:</p> <ol style="list-style-type: none"> 1. Turn the cardiograph to STANDBY from the front panel. 2. Wait 20 seconds or more and turn the unit on again. 3. Press AUTO or MANUAL. If the cardiograph turns itself to STANDBY, the battery is not operating properly. 4. If error persists, call Agilent Medical Call Center 1 800 548-8833

Testing the Power Supply

Use this procedure to check the voltages produced by the power supply. The cardiograph must be connected to AC power to test all the power supply voltages. All the voltage measurements are taken with respect to ground, unless indicated. Refer to Figure 4-2 for voltage test point locations.

WARNING

When the cardiograph is connected to AC power, there are dangerous voltages present in the areas indicated in Figure 4-2 and on the Capacitor Assembly. Do not touch any exposed metal while the cardiograph is open and AC power is connected.

1. Open the top cover assembly as described in Chapter 5.
2. Without replacing the top cover, plug the keyboard cable into J201.
3. With the battery removed, plug the unit into AC power.

CAUTION

Be very careful to not short any signal to ground or to other pins. This will result in cardiograph failure.

4. Verify AC LED is lit. If it is not lit, measure ACON between ground and the back-plane pin 5 of J3. It should read approximately 5 Vdc. The presence of this voltage confirms the proper operation of the primary transformer, fuses and ACON regulator circuit.
5. Measure VSEC between the anode of CR1 (-VSEC) and the cathode of CR8 (+VSEC). It should read approximately 25 Vdc. The presence of this voltage confirms the proper operation of the mains transformer/primary power circuit and the secondary rectifier filter.
6. Measure VBAT between ground and the point marked VBAT. It should read approximately 6.7 (minimum) to 7.03 (maximum) Vdc @ 25° C. This voltage confirms the proper operation of the battery charger.

NOTE

The voltage range for environments with temperatures other than 25° C can be calculated from the following equations:

$$V_{\min} = [2.220 - (T - 25)3.9 \times 10^{-3}]3.016, \text{ where } T = \text{temperature in } ^\circ\text{C}$$

$$V_{\max} = [2.315 - (T - 25)3.9 \times 10^{-3}]3.024$$

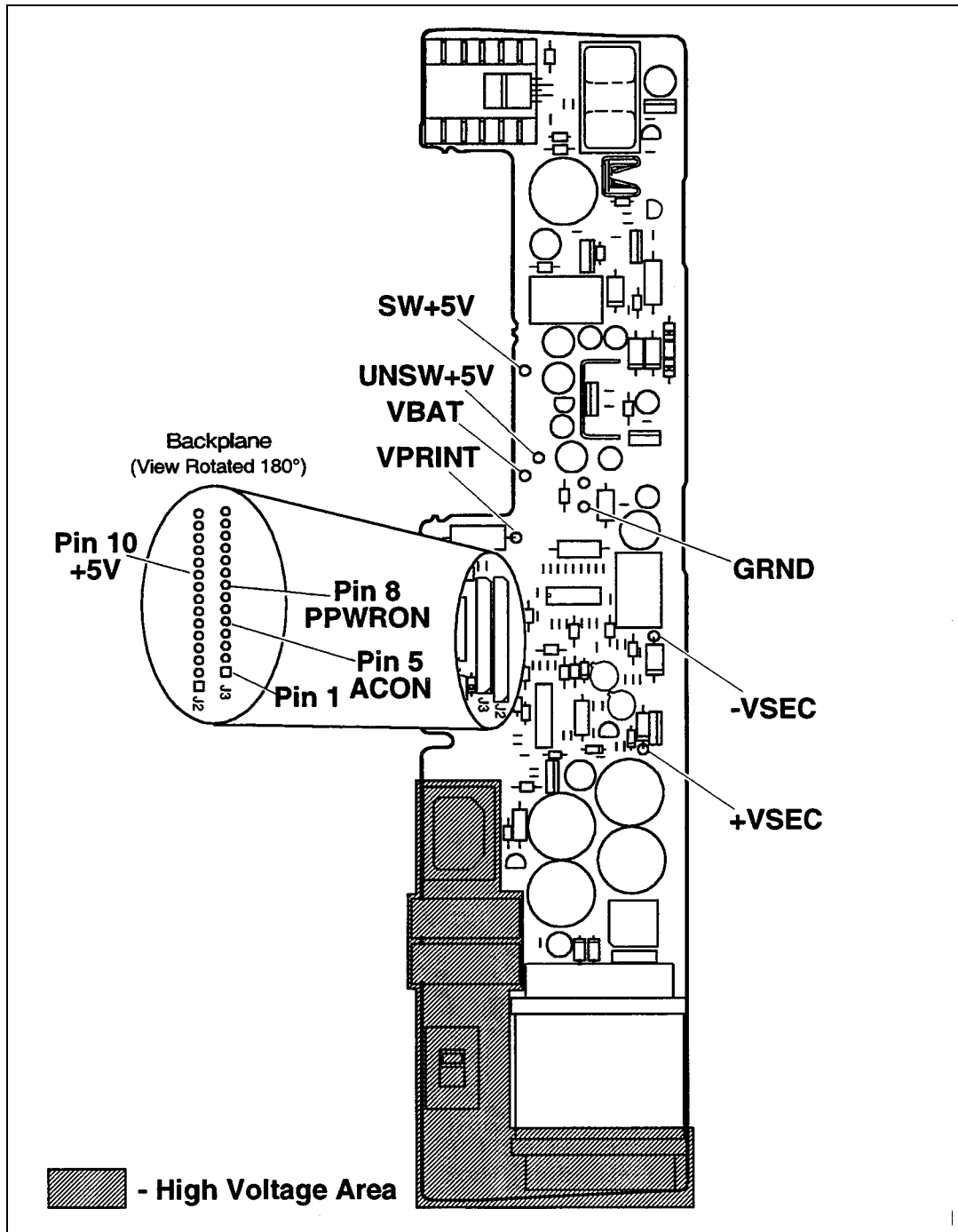
7. Measure UNSW+5V between ground and the point marked UNSW+5V. It should read 5 Vdc. Its presence confirms the proper operation of the unswitched 5 volt regulator.
-

Testing the Power Supply

8. Turn the cardiograph **On** by pressing **On/Standby**.
9. Measure SW+5V between ground and the point marked SW+5V. It should read +5 Vdc. Its presence confirms the proper operation of the switched 5 volt regulator and boost regulator.
10. Turn the cardiograph to **Standby**.
11. Unplug the cardiograph from AC power.
12. Look on the first page of the Extended Self-test printout and verify that the printhead voltage is approximately 26.1 Vdc. If the voltage is correct then the power supply test is complete and the cardiograph may be reassembled. If the voltage is incorrect or the printer is inoperative then proceed with the following steps.
13. Disconnect the keyboard connector from J201. Place the upper case on top of the bottom case assembly. Turn the unit bottom-side up.
14. Install the battery and turn the unit top-side up.
15. Remove the upper case.
16. Connect the keyboard cable to J201.
17. Turn the cardiograph **On**.
18. Connect one end of a jumper wire with grabber clips to pin 1 of VR5. The jumper wire is now connected to +5V. Connect the other end to the lead of R37. The other end is now connected to PPWRON.
19. Measure VPRINT between ground and the point marked VPRINT. It should read approximately 26.1 V DC. Its presence confirms the proper operation of the printing supply circuit.
20. Remove the jumper wire.
21. Turn the cardiograph to **Standby**.
22. Close the top cover assembly.

Figure 4-2

Voltage Test Locations



Testing the Power Supply

Removal and Replacement

Introduction

This chapter contains procedures for removing and replacing these cardiograph subassemblies:

- battery
- keyboard and the keyboard display assembly
- top cover assembly
- printer drive assembly
- printhead assembly
- CPU assembly
- power supply assembly
- internal cabling
- #A05 storage and transmission assembly

NOTE

The way in which wires and cables are routed and dressed inside the main chassis plays an important part in reducing electromagnetic and radio frequency interference emitted by the cardiograph. When you disassemble any part of the cardiograph, pay special attention to the way cables and wires are routed and dressed. When you reassemble the cardiograph, be sure to route and dress all cables and wires as they were originally.

Tool Requirements

These are the tools you need to remove and replace the cardiograph's subassemblies:

- 7-mm or 9/32-inch wrench
- 7/32-inch wrench
- 2 flat-bladed screwdrivers
- #0 Phillips screwdriver
- T-10 Torx drivers (or Torx driver kit, Agilent part number 5181-1933)
- Long-nose pliers
- IC Extraction Tool (AMP 821591-1 size 44)

The Battery

NOTE

The directions in this chapter generally assume you are facing the front of the cardiograph as you work. Thus, for example, the “left side of the cardiograph” means “your left side as you face the front of the unit.”

The Battery

This section explains how to remove and replace the battery. These procedures apply to all units.

Removing the Battery

To remove the battery:

1. Turn the cardiograph to **Standby**.
2. Unplug the cardiograph from AC power.
3. Turn the cardiograph bottom-side up.
4. Slide the battery door in the direction of the arrow until it unlatches (approximately 1/2 inch), as shown in Figure 5-1. Lift off the door.
5. Unplug the battery connector from the cardiograph by squeezing the locking tabs of the connector and pulling it straight out from the cardiograph.
6. Remove the battery.

To replace the battery, perform the procedure *Removing the Battery* in reverse.

WARNING

Dispose of or recycle depleted batteries according to local regulations. Do not disassemble, puncture, or incinerate the battery assembly.

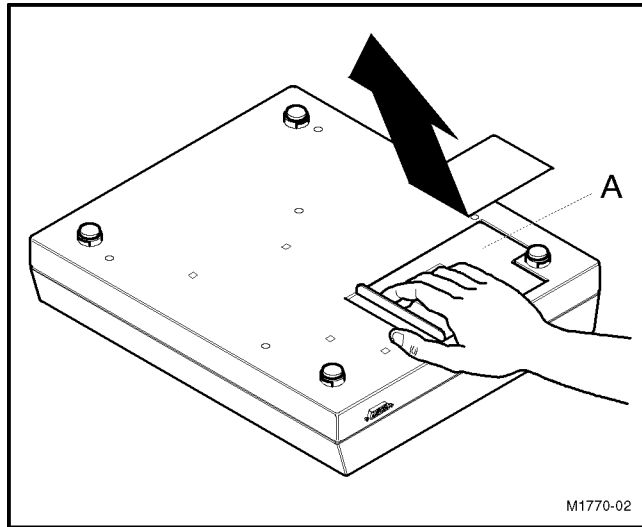
NOTE

To insure full battery capacity, connect the cardiograph to AC power and charge the battery for 16 hours with the cardiograph in **Standby** mode.

The Battery

Figure 5-1

Removing the Battery Door.



A Battery door

The Keyboard Assembly

This section explains how to remove and replace the keyboard assembly. The keyboard procedures apply to all models. The keyboard display procedures only apply to PageWriter 200/200i/300pi.

Note that replacement part numbers for keyboard assembly components vary with the unit serial number. Refer to the Part List section of this manual to verify replacement part numbers.

Removing the Keyboard

The keyboard assembly consists of the keyboard overlay, the keyboard assembly, the flexible circuit, and the keyboard display.

Removing the Keyboard Assembly

CAUTION

Use an electrostatic wrist band or other approved method for protection against electrostatic discharge when handling the keyboard assembly.

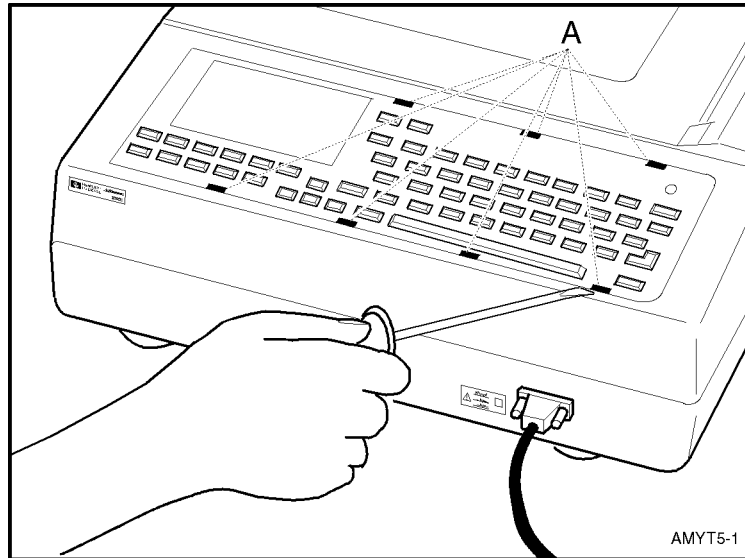
To remove the keyboard assembly:

1. Perform the procedure *Removing the Battery*.
2. Turn the cardiograph top-side up.
3. Carefully insert a flat-bladed screwdriver into the notches at the front edge of the keyboard overlay and pry the front edge of the keyboard overlay up. Refer to Figure 5-2.
4. Repeat with the rear notches of the keyboard overlay and remove the overlay.

The Keyboard Assembly

Figure 5-2

Removing the Keyboard Overlay

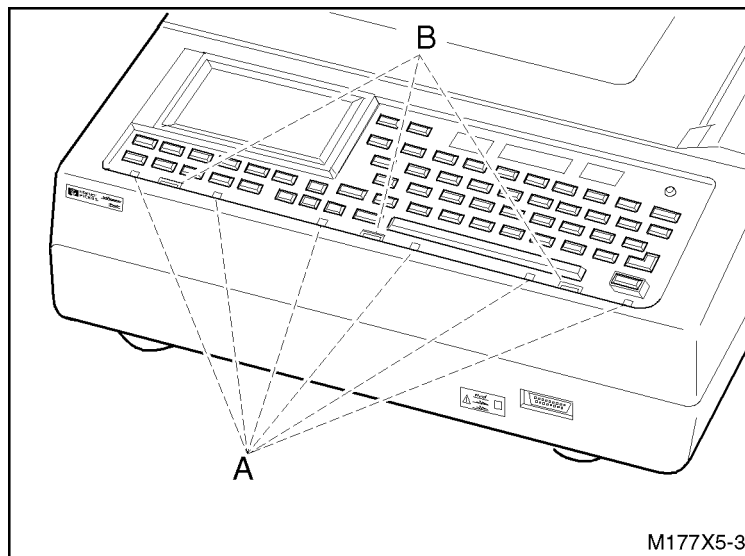


A. Overlay notches

5. Using two screwdrivers, place the blade of one screwdriver on the leftmost latch of the keyboard assembly and push toward the rear of the cardiograph. See Figure 5-3. Carefully insert the blade of the second screwdriver in a notch to the right or left of the latch and lift up on the keyboard assembly. The leftmost latch should unlatch. Repeat with the center and rightmost latches.

Figure 5-3

Removing the Keyboard.



A. Notches

B. Latches

The Keyboard Assembly

6. Carefully lift the assembly and tilt it until the keyboard and control board are accessible.
7. Disconnect the keyboard ribbon cable from J201 on the control board.
8. Disconnect the green wire from the keyboard.
9. Remove the keyboard.

CAUTION

Do not remove the keyboard circuit board from the keyboard bezel. Removing the board can impair the long-term reliability of the cardiograph.

Removing the Keyboard Flexible Circuit

To remove the keyboard flexible circuit:

1. Perform the procedures *Removing the Battery* and *Removing the Keyboard Assembly*.
2. Place the keyboard assembly with the keys down on a flat surface.
3. Grasp the tabs at the ends of one of the connectors and gently pull toward the flexible circuit. The locking sleeve should now be extended.
4. Repeat with the other connector.
5. Remove the keyboard flexible circuit.

To replace the keyboard flexible circuit, perform the above procedure in reverse.

Removing the Keyboard Display

The keyboard display consists of the LCD, display shield, and mounting hardware.

1. Perform the procedure *Removing the Keyboard Assembly*.
2. Using a #0 Phillips screwdriver, remove the 4 screws that secure the LCD display.
3. Remove the display shield and 4 rubber o-rings.
4. To remove the flexible circuit, grasp the tabs at the ends of one of the connectors and gently pull toward the flexible circuit. The locking sleeve should now be extended. Repeat with the other connector. Lift the flexible circuit out.
5. Remove the LCD.

To replace the keyboard display, perform the above procedure in reverse.

The Keyboard Assembly

Replacing the Keyboard

To replace the keyboard, perform the following steps:

1. Connect the green wire to the spade connector on the keyboard.
2. Connect the keyboard ribbon cable to J201 on the control board.
3. Position the top of the keyboard so the four tabs on the top of the keyboard frame are placed under the lip on keyboard well.
4. Press down on the base of the keyboard until each latch is latched.

CAUTION

The rubber keypad and/or keyboard assembly may be damaged if any key or LED becomes trapped under the overlay while replacing the overlay. Make sure each and every key and LED comes through its hole in the overlay.

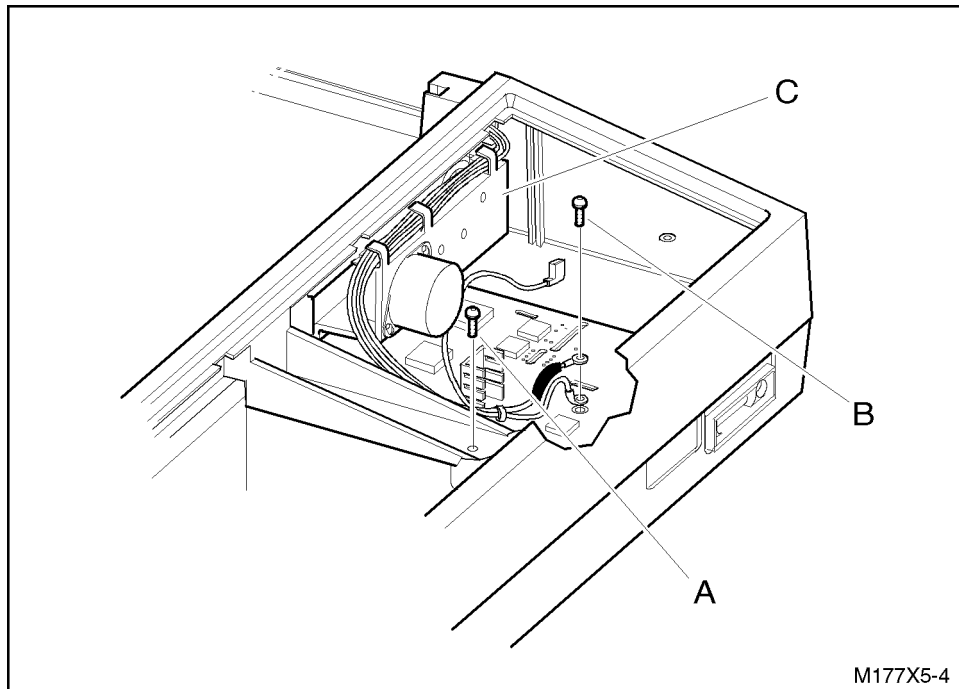
5. Align the overlay with each of the keyboard keys and LEDs. Position your thumbs along the front edge of the overlay near each end. Apply pressure on the overlay toward the rear of the unit and then press down on the overlay. This is one continuous motion. The front of the overlay should now be snapped into place. Snap the rear of the overlay into place.

The Top Cover Assembly

This section describes how to remove and replace the top cover assembly. The top cover assembly includes the upper chassis, the printer door, and the printer assembly.

Figure 5-4

Interior Details of Top Cover Removal



- A. Chassis screw
- B. Control board screw
- C. Printer drive assembly

Opening and Removing the Top Cover Assembly

To open the top cover assembly:

1. Perform the procedures *Removing the Battery* and *Removing the Keyboard Assembly*.
2. Turn the cardiograph bottom-side up.
3. Using a Torx T-10 screwdriver, remove the five screws that secure the upper and lower parts of the chassis.
4. Turn the chassis upright. This will cause the five screws to fall out of the chassis. Perform this step slowly to avoid losing the screws.
5. Using a Torx T-10 screwdriver, remove the chassis screw seen through the keyboard opening. Refer to Figure 5-4.

The Top Cover Assembly

WARNING

The capacitors on the connection assembly next to the control board store hazardous amounts of energy during AC and battery operation. Be careful not to touch any of the exposed capacitor connections.

6. Disconnect control board connector J303 by grasping all the wires of the connector and gently pulling straight up. Repeat with connectors J304, J306, and capacitor board connector J4.
7. Using a Torx T-10 screwdriver, remove the screw that secures the 2 green wires to the control board, as shown in Figure 5-4.
8. Lift the top cover off of the chassis.

Replacing the Top Cover Assembly

To replace the top cover assembly, perform the above procedure in reverse order.

NOTE

Place the long side of the foam block in between the side of the top case and the side of the printhead well to keep the printhead wiring in place.

NOTE

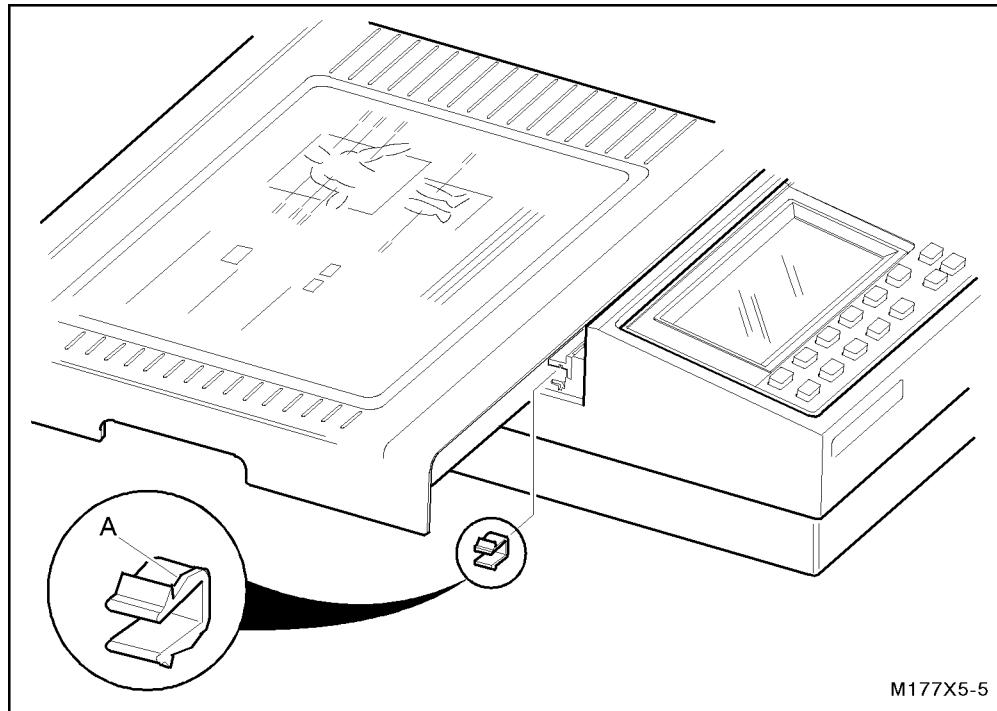
When securing the 2 green ground wires to the control board, make sure the lugs on the ground wires point toward the battery compartment.

The Printer Door Assembly

This section describes how to remove and replace the printer door assembly.

Figure 5-5

Removing the Printer Door Retainer Clip



A. Retainer clip

Removing the Printer Door Assembly

To remove the printer door assembly:

1. Release the door latch and slide the printer door out to the first stop.
2. Compress and remove the plastic retainer clip visible at the end of the front guide rail, as shown in Figure 5-5.
3. Slide the door out of the rails.

The Printer Drive Assembly

Replacing the Printer Door

To replace the printer door, perform the above procedure in reverse order.

NOTE

Be sure to orient the ridges of the retainer clip with the grooves in the rail prior to replacing the clip, as shown in Figure 5-5.

The Printer Drive Assembly

This section describes how to remove and replace the printer drive assembly.

Removing the Printer Drive Assembly

To remove the printer drive assembly:

1. Perform the procedures *Removing the Battery* and *Removing the Keyboard Assembly*.
2. Perform the procedure *Removing the Printer Door Assembly*.
3. Perform the procedure *Opening and Removing the Top Cover Assembly*.
4. Turn the top cover bottom-side up.

NOTE

The way in which wires and cables are routed and dressed inside the main chassis plays an important part in reducing electromagnetic and radio frequency interference emitted by the cardiograph. When you disassemble any part of the cardiograph, pay special attention to the way cables and wires are routed and dressed. When you reassemble the cardiograph, be sure to route and dress all cables and wires as they were originally. Refer to Figure 5-4.

5. Using a Torx T-10 screwdriver, remove the two screws fastening the printer drive assembly to the top case.
6. Lift the printer drive assembly up and away from the top case. Be sure not to tip the assembly back as the individual gears may fall out.

The Printer Drive Assembly

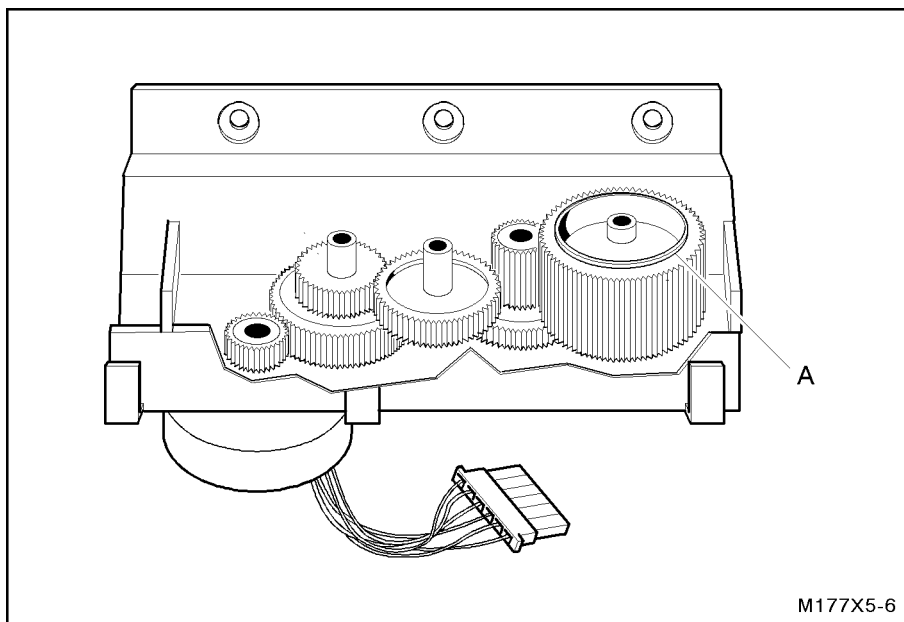
Replacing the Printer Drive Assembly

To replace the printer drive assembly:

- If necessary, reinstall the gears. The gears are arranged on the shafts in the gear housing as shown in Figure 5-6. Each gear has a number molded into it. That number corresponds to a number molded into the gear housing next to the appropriate shaft. Insert gears with molded numbers facing up.
- Pay special attention to gear #1. The top of the gear has a short lip molded close to the teeth. The bottom of the gear has a taller lip molded next to the hole for the shaft. Make sure the short lip and molded number face up.

Figure 5-6

The Printer Drive Gears.



A. Gear #1

- Perform the removal procedure in reverse order.

NOTE

Make sure none of the printer cables are pinched between the printer drive assembly and the top cover.

The Printhead Assembly

This section describes how to remove and replace the printhead assembly.

Removing the Printhead Assembly

To remove the printhead:

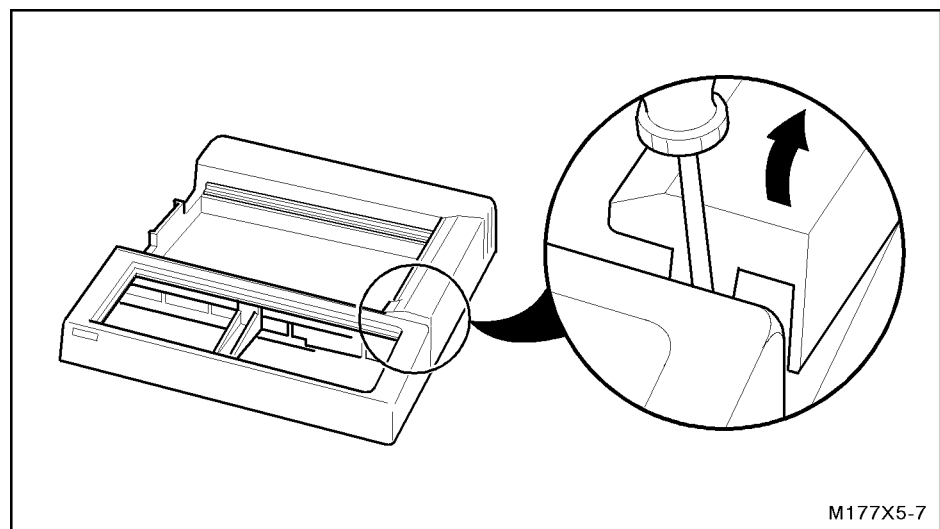
CAUTION

Use an electrostatic wrist band or other approved method for protection against electrostatic discharge when disconnecting and handling the printhead assembly.

1. Perform the procedures *Removing the Battery* and *Removing the Keyboard Assembly*.
2. Perform the procedure *Removing the Printer Door Assembly*.
3. Perform the procedure *Opening and Removing the Top Cover Assembly*.
4. Remove the foam block from the top cover.
5. Gently remove the printhead wires from the hooks on the printer drive assembly.
6. Center the tip of a thin-blade flat-tip screwdriver between the printhead cover and the cardiograph case as in Figure 5-7. Slightly pry the screwdriver to the rear of the cardiograph. The printhead cover will lift up.

Figure 5-7

Removing the Printhead Cover.



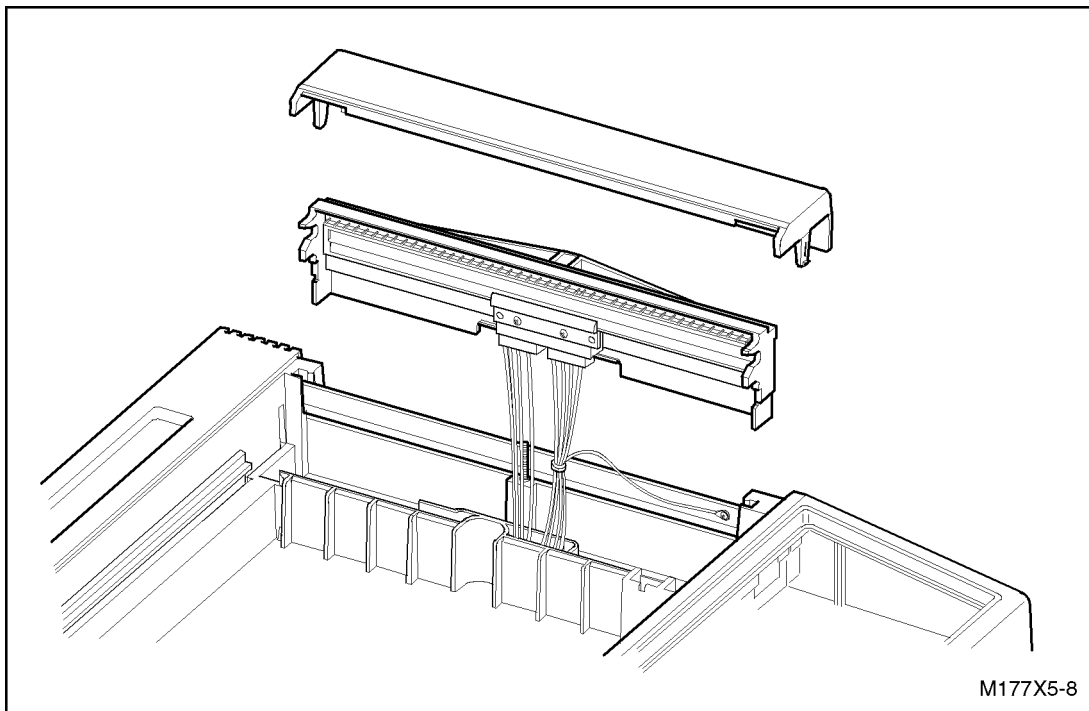
7. Remove the printhead cover.

The Printhead Assembly

8. Carefully slide the printhead assembly up and out of the printer well. Pull the two bundles of wires and the ground wire from the slot in the top cover. Refer to Figure 5-8.
9. Using a Torx T-10 screwdriver, remove the four screws on the back side of the printhead assembly. Note the position of the ring terminal on the ground wire.
10. Disconnect the two printhead cables and the ground wire from the printhead assembly.

Figure 5-8

Removing the Printhead Cover and Printhead.



Removing the Optical Paper Sensor

Remove the optical paper sensor as follows:

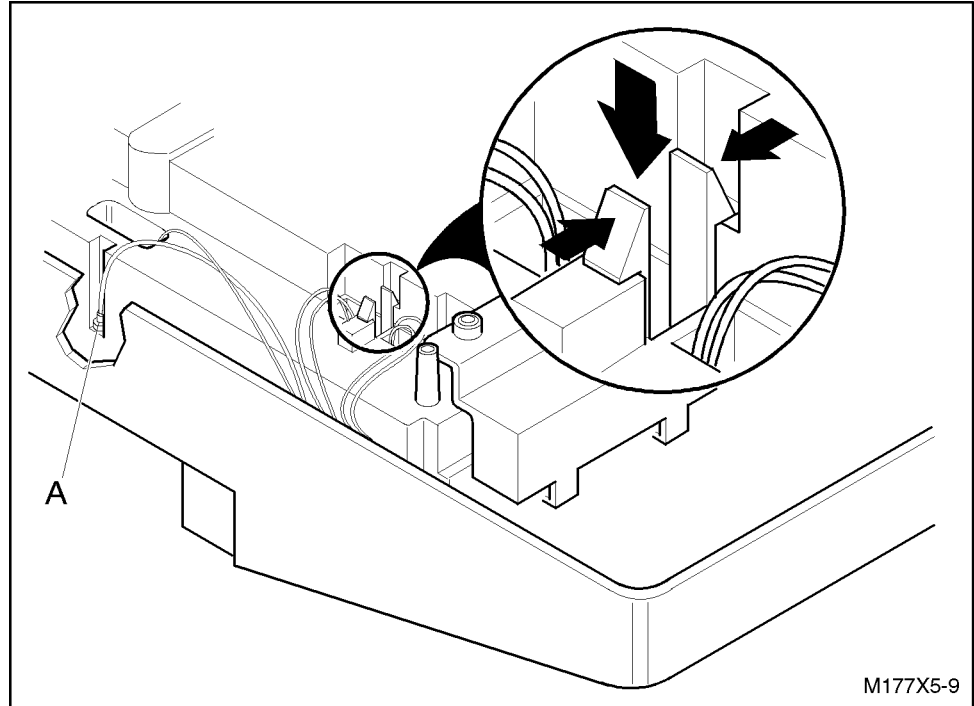
1. Using a Torx T-10 screwdriver and a 7/32-inch nutdriver, remove the ground wire attached to the metal printhead spring.
2. Turn the top cover bottom-side up.
3. Using long-nosed pliers, carefully grasp the metal sleeve connector attached to the printhead switch pin. Pull up to disconnect wire.
4. Squeeze together the ends of the clip that holds the sensor lens in place. Refer to Figure 5-9.

The Printhead Assembly

5. Push the lens through the mounting hole.
6. Finish removing the sensor by pulling the sensor through the mounting hole.

Figure 5-9

Removing the Optical Paper Sensor



A. Printhead switch pin

Replacing the Printhead Assembly

To replace the printhead assembly, perform the above procedure in reverse order. See Figure 5-11 for the correct positioning of the printhead.

1. Tuck the printhead wires behind the hooks on the printer drive assembly.
2. Place a finger under the printhead wires to create slack, as shown in Figure 5-10. Be sure there is enough slack in the cables to allow the printhead full range of motion.
3. Place the long side of the foam block in the top cover assembly between the side of the top cover and the printhead well to keep the wiring in place. Be sure to maintain the slack in the cables while inserting the foam block.

The Printhead Assembly

Figure 5-10

Replacing the Foam Block

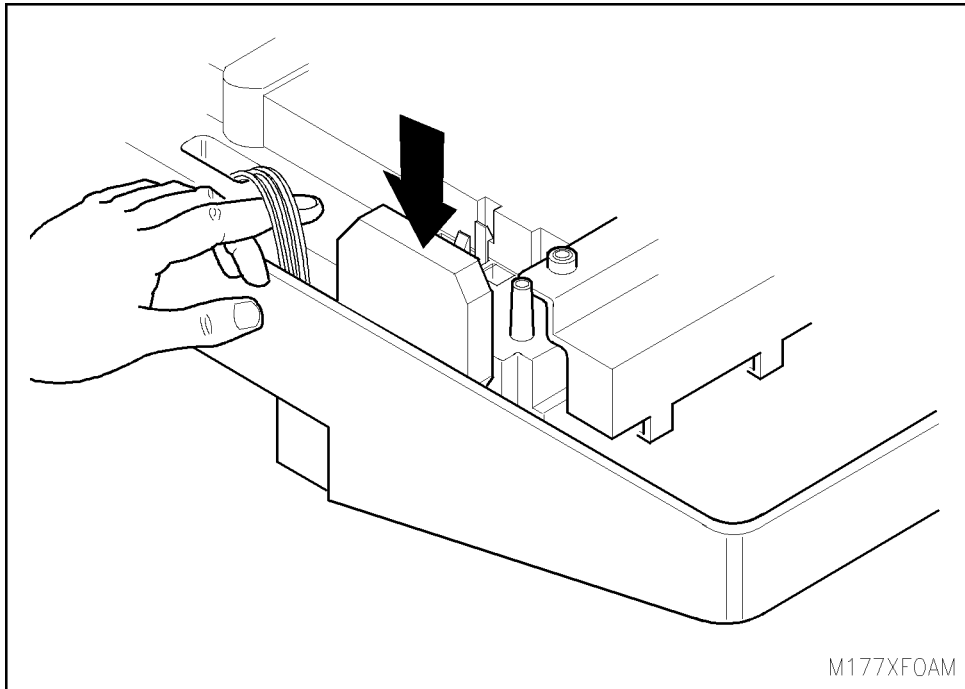
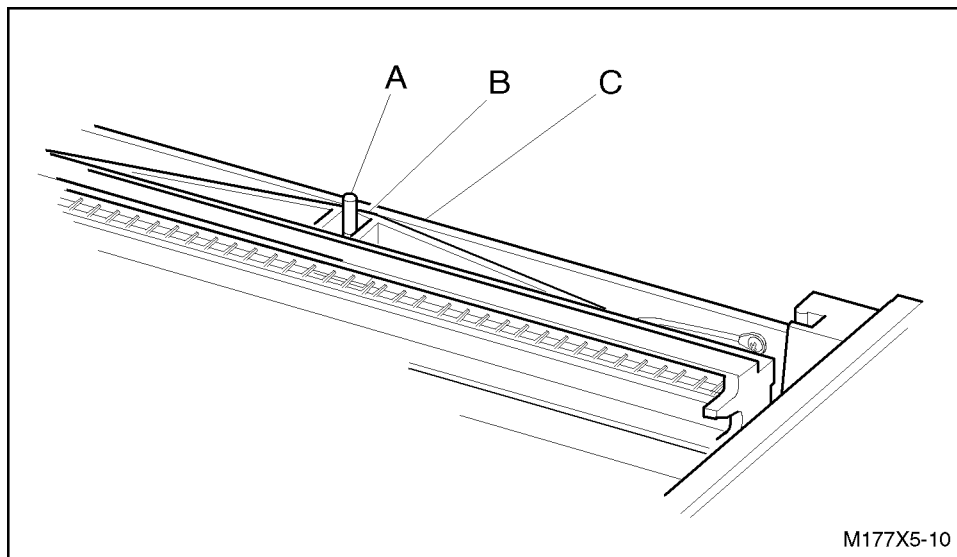


Figure 5-11

Positioning of the Printhead



- A. Printhead switch pin
- B. Printhead
- C. Leaf spring

The Control Board Assembly

This section describes how to remove and replace the control board assembly. This procedure applies to all units.

Removing the Control Board Assembly

To remove the control board assembly:

CAUTION

Use an electrostatic wrist band or other approved method for protection against electrostatic discharge when disconnecting cables from and handling the control board assembly.

1. Perform the procedures *Removing the Battery* and *Removing the Keyboard Assembly*.
2. Perform the procedure *Opening and Removing the Top Cover Assembly*.

NOTE

Connectors J301 and J302 are very tight. A firm grasp is necessary to disconnect them.

3. Disconnect control board connector J301 by grasping all the wires of the connector and pulling straight out. Repeat with connector J302.
4. Disconnect control board connector J305 by lifting the capacitor board up and off its mounting posts. Then grasp the large ferrite bead and pull straight up from J305.
5. Using a wide thin-bladed flat-tip screwdriver, remove the two jack nuts securing the patient cable connector on the front of the unit.
6. Slide the control board toward the rear of the unit and lift out.

Replacing the Control Board Assembly

To replace the control board assembly, perform the above procedure in reverse order.

NOTE

Make sure the jack screws are tight.

The Power Supply

This section explains how to remove and replace the power supply.

CAUTION

Use an electrostatic wrist band or other approved method for protection against electrostatic discharge when handling the keyboard assembly and power supply.

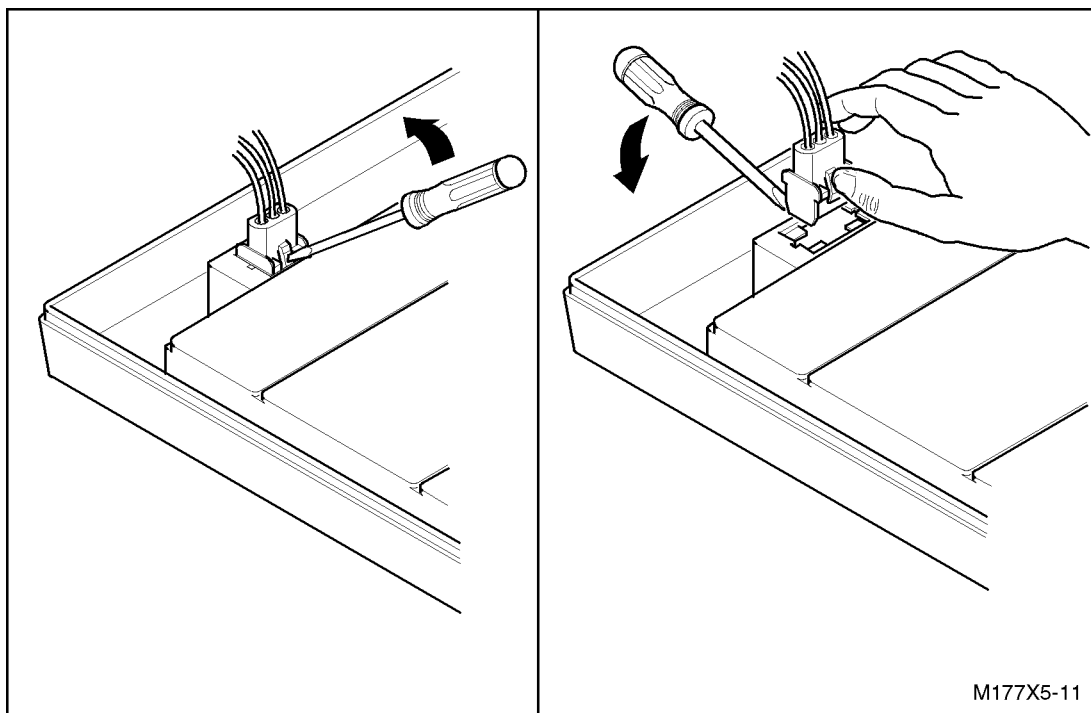
Removing the Power Supply

To remove the power supply:

1. Perform the procedures *Removing the Battery* and *Removing the Keyboard Assembly*.
2. Perform the procedure *Opening and Removing the Top Cover Assembly*.

Figure 5-12

Removing the Battery Connector



3. Using a thin-blade flat-tip screwdriver, gently remove the battery connector. Compress the clip on one side of the connector while pulling the connector in the opposite direction, as shown in Figure 5-12. Repeat this action with the clip on the other side of the connector. Pull the connector from its mounting.
4. Using a 7-mm or 9/32-inch wrench, loosen the nut on the ground lug.

The Power Supply

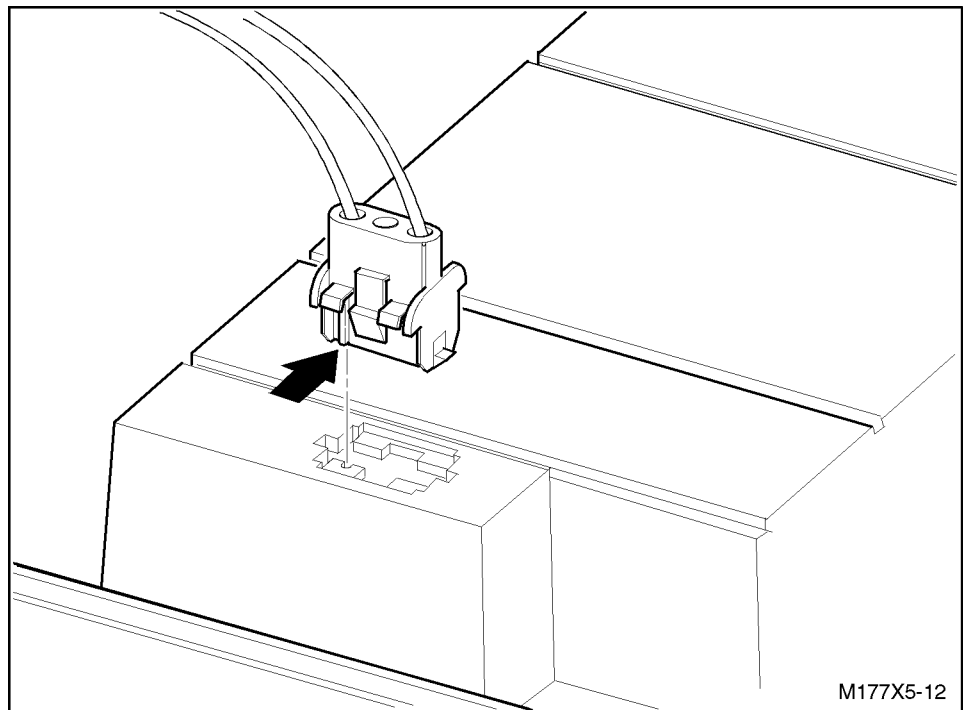
5. Separate the power supply from the lower case.
6. Disconnect connector J2 from the power supply by grasping all the wires of the connector and pulling up. Repeat with connector J3.

Replacing the Power Supply Assembly

To replace the power supply assembly, perform the above procedure in reverse order. Figure 5-13 shows how to correctly install the battery connector. Be sure to align the ridge on the battery connector, as pointed to by the arrow in Figure 5-13, with the groove in the mounting.

Figure 5-13

Installing the Battery Connector



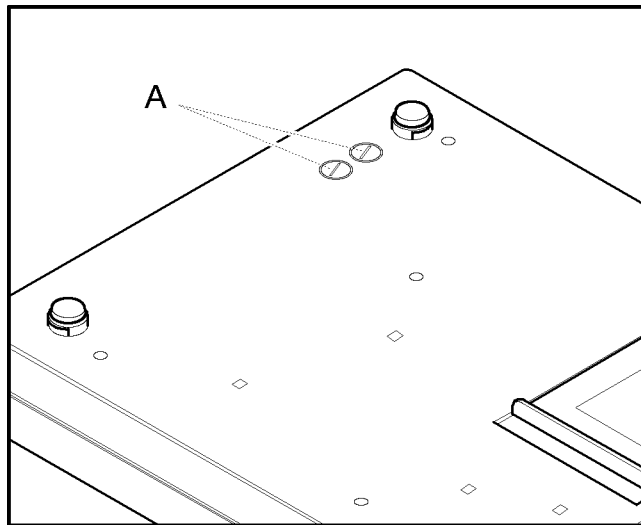
The Fuses

To replace the AC fuses:

1. Unplug the cardiograph from AC power.
2. Turn the cardiograph bottom-side up.
3. Locate the two AC fuse holders on the bottom of the cardiograph, as shown in Figure 5-14.
4. Using a screwdriver, turn the fuse cap 1/2-turn counter-clockwise. As the fuse cap is untwisted, it extends above the surface of the cardiograph case.
5. Pull the fuse cap straight up approximately 2-1/2 cm (1-inch), until it stops.
6. Remove the fuse. You may need to tap the fuse holder to shake the fuse out.
7. Insert a new fuse in the holder and slide the fuse cap back into the case. Fuse must be of the same type and rating as described on the label located next to the fuse holders.
8. Tighten the fuse cap 1/2 turn clockwise.
9. Repeat the operation for the other AC fuse.

Figure 5-14

The AC Fuse Holders.



A. AC Fuse holders (2)

The Internal Cables

Cabling between the power supply board, the control board, the capacitor board, and the printhead has changed since the PageWriter 100, 200, 200i, and 300pi cardiographs were introduced. The cabling for your cardiograph may be different from the replacement parts you are installing. Refer to the exploded drawings and replacement parts lists in Chapter 6 for an explanation of the changes.

Replacing the Power Supply Cables

NOTE

Your power supply cables may have different part numbers. See *Bottom Case Assembly Parts* in Chapter 6 for replacement history.

Two cables connect the power supply board and the control board. To replace these cables:

1. Perform the procedures “Removing the Battery” and “Removing the Keyboard Assembly”.
2. Perform the procedure “Opening and Removing the Top Cover Assembly”.
3. Using a 7 mm or 9/32 inch wrench, loosen the nut on the ground lug.
4. Separate the power supply board from the lower case.
5. Lift the black ferrite bead on the battery cable out of its pocket in the lower case.
6. Disconnect the cable from the power supply by grasping all the wires of the cable and evenly pulling away from the power supply board.
7. Disconnect the other end of the cable from the control board. If the cable you are replacing is part number M1770-61604, there is also a connection to the capacitor board. In this case, you must also replace the old capacitor board with the new capacitor board (p/n M1770-60172), and add the new cable (p/n M1770-61666) between the capacitor board and the control board.
8. Connect the replacement cable to the control board using the end of the cable closest to the ferrite bead. Substantial force is needed to fully seat the connectors.
9. Connect the other end of the cable to the power supply board.
10. Pull the power supply cables snugly, but not too tightly, around the back and under the power supply board so that the cables are aligned with the slot in the bottom edge of the board.

The Internal Cables

11. Hold the cables in this position while sliding the power supply board into its guide slots in the lower case. Be careful not to pinch the cables between the lower case and the bottom edge of the board.
12. Be sure the bottom edge of the power supply board is seated in the lower case. Tighten the ground lug nut.
13. Hook the fold-over tabs of the plastic insulator sheet over the top of the power supply board.
14. Route the power supply cables, except the battery cable, through the center of the ferrite mounting bracket in the lower case.
15. Snap the ferrite bead on the battery cable into the mounting posts with the axis of the bead going from side to side. Make sure the battery cables exiting each end of the ferrite bead are captured between the lower case mounting posts.

Replacing the Capacitor Board Cable

To replace the cables connecting the capacitor board to the control board:

1. Perform the procedures “Removing the Battery” and “Removing the Keyboard Assembly”.
2. Perform the procedure “Opening and Removing the Top Cover Assembly”.
3. Lift the capacitor board off its mounting posts and disconnect the cable from control board connector J305 by pulling straight up on the large ferrite bead.
4. Disconnect the cable from the capacitor board connector J5 by pulling the large ferrite bead directly away from the capacitor board.
5. Plug either end of the replacement cable into J5 on the capacitor board. Substantial force is required to fully seat the connectors.
6. Pull gently on both ends of the cable to ensure the cable is tightly wrapped around the ferrite bead.
7. Plug the other end of the cable into connector J305 on the control board.
8. Tuck the ferrite bead into the space beneath connector J4 on the capacitor board so that the axis of the bead is aligned from side to side.
9. Place the capacitor board on its mounting posts. Make sure the wires that wrap around the ferrite bead are between the capacitor locating fences in the lower case. If excessive force is required to fully seat the capacitor board in its mounting posts, make sure the cable wires are wrapped tightly around the ferrite bead and are not being pinched by the capacitor locating fences.

Replacing the Printer Cables

More detailed instructions for replacing the printhead power cable and the paper sensor cable are found in “The Printhead Assembly” section of this chapter. This section includes notes about installing and routing the cables.

The cable connecting the printhead and the capacitor board has changed since the PageWriter 100, 200, and 200i cardiographs were introduced. On some units, the printhead power cable does not have a ferrite bead, and attaches to connector J305 on the control board. On other units, the printhead power cable does not have a ferrite bead, and attaches to connector J4 on the capacitor board. On the most recent units, the printhead power cable has a ferrite bead, and attaches to connector J4 on the capacitor board.

When installing the replacement printhead power cable (p/n M1770-61670), attach it to the same connector as the cable you are replacing. If the cable is attached to connector J4 on the capacitor board, tuck the cable’s ferrite bead between the motor and the capacitor board.

Before routing the cables from the printhead along the side of the unit and through the retaining hooks on top of the printer drive assembly, make sure there is enough slack in the printhead power cable to allow the printhead to move freely during operation. Make sure the paper sensor cable has enough slack to prevent strain on the paper sensor. Maintain the slack on these two cables while installing the foam retaining block.

The Storage and Transmission Board Assembly

Perform the following steps when removing and replacing the storage and transmission board PC assembly in a PageWriter 200, 200i or 300pi.

Removing the Storage and Transmission Board Assembly

CAUTION

Use an approved method of electrostatic discharge protection, such as an electrostatic grounding wristband, while modifying the cardiograph.

1. Perform the procedure “Removing the Battery”.
2. Using a T-10 screwdriver, remove the screws at the right and left sides of the expansion slot bracket at the left rear of the cardiograph.
3. There are two slots along the bottom edge of the bracket. Insert a screwdriver blade less than 0.25 inches wide into a slot, and gently pry the storage and transmission board out of the cardiograph.

The Storage and Transmission Board Assembly

4. When the storage and transmission board assembly has been pried out at least 0.25 inches, it should slide out freely.
5. Install the new storage and transmission board assembly by sliding it between the guides in the expansion slot. Be sure the assembly is aligned between the guides.
6. The board assembly should slide freely until the last 0.25 inches.
7. Press firmly on the board assembly bracket to mate the assembly with the connector inside the cardiograph. The face of the bracket should now be nearly flush with the cardiograph case.
8. Install the two screws at the right and left side of the bracket using a T-10 screwdriver.

Parts Lists

Introduction

This chapter contains the parts lists for the cardiograph and cart. The numbers on each figure or exploded view refer to the parts list on the facing page.

Ordering Information

Ordering Information

You can order any of the parts listed through your local Agilent Technologies Sales/Service Office listed below. In the United States and Canada you can call the Direct Customer Order Center toll-free at 1-800-227-8164.

In the United States, you can order medical supplies for the cardiograph by calling toll-free 1-800-225-0230.

You can also visit our web site at: www.healthcare.agilent.com/mpgsupplies.

Calling for Service

Here are the numbers you can use to call Agilent Technologies Service for technical assistance. You may also visit our website at: www.healthcare.agilent.com/mpgcsd.

United States of America:

Agilent Technologies, Incorporated
Healthcare Solutions Group Headquarters
3000 Minuteman Road
Andover, Massachusetts

Medical Customer Information

1-800-934-7372

Canada:

Agilent Technologies (Canada) Ltd.
5150 Spectrum Way
Mississauga, Ontario L4w 5G1
(905) 206-4725

Marketing Center Europe:

Agilent Technologies GmbH
Schickardstr.4
71034 Boeblingen
Germany
Fax: (+49) 7031 14 4096

Latin America:

Agilent Technologies Latin America
5200 Blue Lagoon Drive
9th Floor
Miami, Florida 33126
(305) 267-4220

Medical Distribution:

Europe/Middle East/Africa
39 rue Veyrot
1217 Meyrin 1
Geneva, Switzerland
(+41) 22 780 4111

Asia Pacific Headquarters:

Agilent Technologies Asia Pacific Ltd.
17-21/F Shell Tower, Times Square
1 Matheson Street, Causeway Bay
Hong Kong
(+852) 2599 7777

Parts List

Parts List

NOTE

All references to AHA mean that the color code conforms to recommendations of the American Heart Association.

NOTE

All references to IEC mean that the color code conforms to International Electrotechnical Commission Standards. Refer to Table 1-9 for your geographical location.

Table 6-1 Part Numbers for Rebuilt Units

Description		M1770A Serial # Prefix CND PageWriter 300pi	M1770A Serial # Prefix CNA,CNB, CNC 3807A or earlier PageWriter 200i	M1771A PageWriter 200	M1772A PageWriter 100	M1770A #A05 Serial # Prefix CNA,CNB, CNC 3807A or earlier PageWriter 200i	M1770A #A05 Serial # Prefix CND PageWriter 300pi with Storage and Trans. Interface	M1771A #A05 PageWriter 200
Opt.	Lang. (Paper)							
ABA ABK Inter.	English (Eng)	M1770- 68015	M1770- 68000	M1771- 68000	M1772- 68000	M1770- 68010	M1770- 68020	M1771- 68010
ABK	Taiwan (Eng)	M1770- 68300	M1770- 68200	M1771- 68200	M1772- 68200	N/A	N/A	N/A
ABB ABG ABU AB4 ACQ AR2	English (Metr)	M1770- 68500	M1770- 68400	M1771- 68400	M1772- 68400	M1770- 68410	M1770- 68510	M1771- 68410
ABC	French (Eng)	M1770- 68016	M1770- 68001	M1771- 68001	M1772- 68001	M1770- 68011	M1770- 68021	M1771- 68011
ABF	French (Metr)	M1770- 68501	M1770- 68401	M1771- 68401	M1772- 68401	M1770- 68411	M1770- 68511	M1771- 68411
ABD	German (Metr)	M1770- 68502	M1770- 68402	M1771- 68402	M1772- 68402	M1770- 68412	M1770- 68512	M1771- 68412
ABH	Dutch (Metr)	M1770- 68503	M1770- 68403	M1771- 68403	M1772- 68403	M1770- 68413	M1770- 68513	M1771- 68413
ABM AKV	Spanish (Eng)	M1770- 68024	M1770- 68004	M1771- 68004	M1772- 68004	M1770- 68014	M1770- 68025	M1771- 68014
ABE	Spanish (Metr)	M1770- 68504	M1770- 68404	M1771- 68404	M1772- 68404	M1770- 68414	M1770- 68514	M1771- 68414

Parts List

Table 6-1 Part Numbers for Rebuilt Units

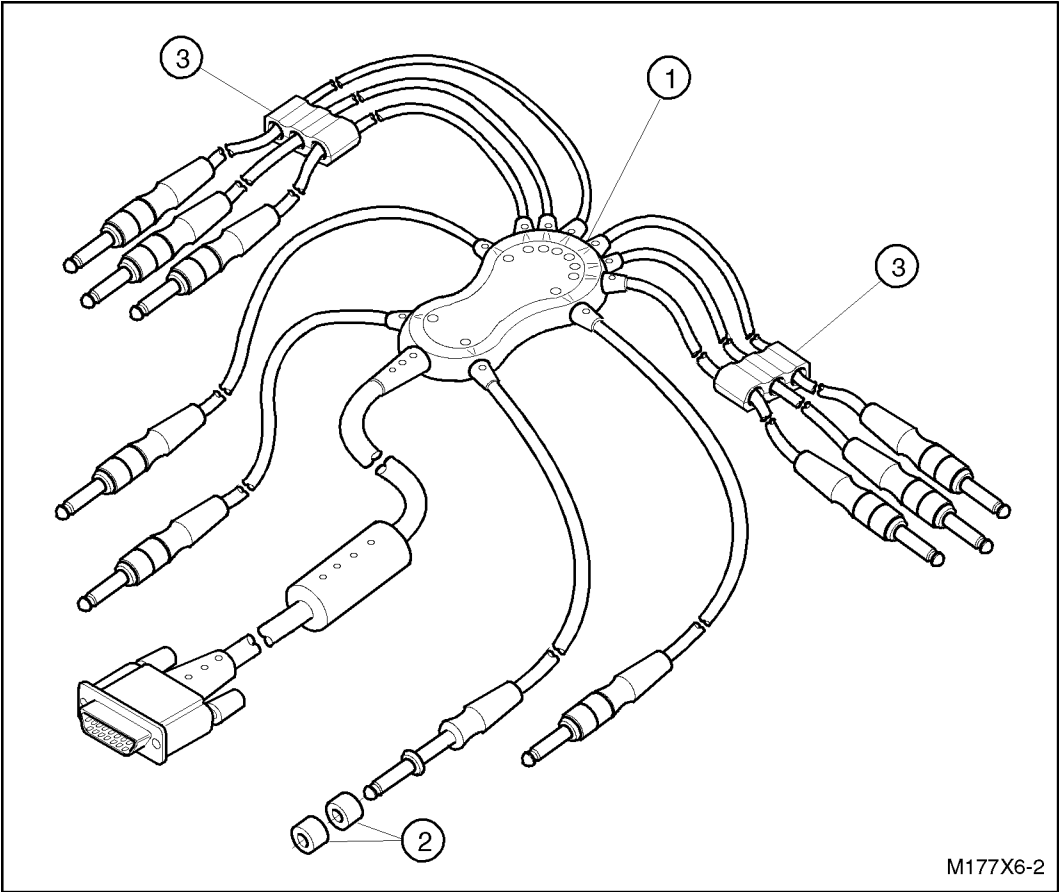
Description		M1770A Serial # Prefix CND PageWriter 300pi	M1770A Serial # Prefix CNA,CNB, CNC 3807A or earlier PageWriter 200i	M1771A PageWriter 200	M1772A PageWriter 100	M1770A #A05 Serial # Prefix CNA,CNB, CNC 3807A or earlier PageWriter 200i	M1770A #A05 Serial # Prefix CND PageWriter 300pi with Storage and Trans. Interface	M1771A #A05 PageWriter 200
Opt.	Lang. (Paper)							
ABZ	Italian (Metr)	M1770- 68505	M1770- 68405	M1771- 68405	M1772- 68405	M1770- 68415	M1770- 68515	M1771- 68415
ABX	Finn. (Metr)	M1770- 68509	M1770- 68409	M1771- 68409	M1772- 68409	M1770- 68419	M1770- 68519	M1771- 68419
ABS	Swed. (Metr)	M1770- 68506	M1770- 68406	M1771- 68406	N/A	M1770- 68416	M1770- 68516	M1771- 68416
ABN	Norw. (Metr)	M1770- 68508	N/A	N/A	N/A	N/A	M1770- 68518	N/A
AB2	Chin. (Metr)	N/A	N/A	N/A	M1772- 68408	N/A	N/A	N/A
AKM	Chin. (Metr)	N/A	N/A	N/A	M1772- 68428	N/A	N/A	N/A
ACJ	India (Metr)	N/A	N/A	N/A	M1772- 68420	N/A	N/A	N/A
AKD	Polish (Metr)	M1770- 68529	N/A	M1771- 68429	M1772- 68429	N/A	M1770- 68539	M1771- 68439
ACB	Russian (Metr)	M1770- 68524	N/A	M1771- 68424	M1772- 68424	N/A	M1770- 68534	M1771- 68434
AC4	Portu. (Metr)	M1770- 68523	N/A	M1771- 68423	M1772- 68423	N/A	M1770- 68533	M1771- 68433
AB9	Portu. (Eng.)	M1770- 68017	N/A	M1771- 68003	M1772- 68013	N/A	M1770- 68022	M1771- 68013

NOTE

Patient cables, power cords, batteries, and other accessories are not supplied with rebuilt units.

Figure 6-1

Patient Cable Exploded Diagram



M177X6-2

Parts List

Table 6-2

Patient Cable Parts List

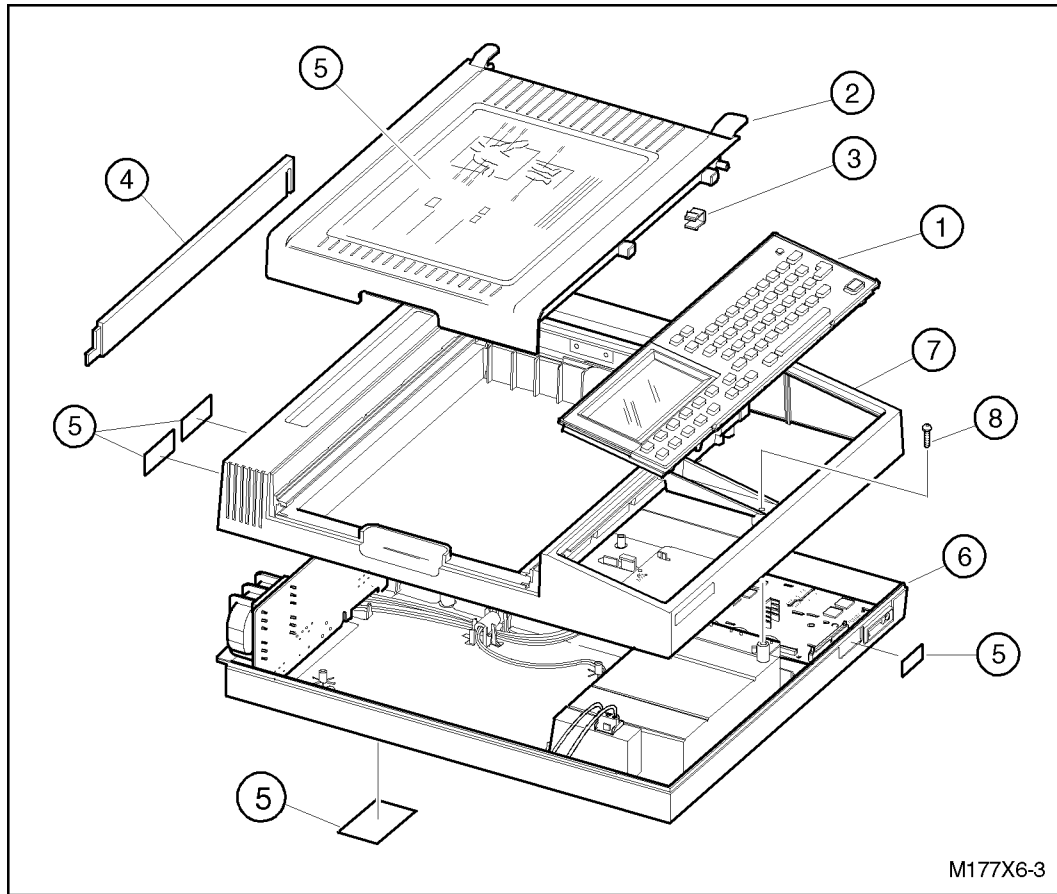
Ref. No.	Description	Part No.
1	Patient cable, AHA ¹	M2461A
	Patient cable, IEC ¹	M2462A
	Patient cable, AHA ¹	M3702A, M3702B, M3702C
	Patient cable, IEC ¹	M3703A, M3703B, M3703C
2	Color ring set	
	AHA (1 set of 20 rings and 2 lead separators)	M1770-89501
	IEC (1 set of 20 rings and 2 lead separators)	M1770-89502
3	Lead separator (2 required)	M1700-47228

¹Includes 2 and 3.

Parts List

Figure 6-2

Main Assembly Exploded Diagram



Parts List

Table 6-3

Main Assembly Parts List

Ref. No.	Description	Part No.
1	Keypanel assembly M1770A/M1771A M1772A	see Table 6-10 see Table 6-11
2	Printer door assembly English (8½" x 11" paper) Metric (210mm x 297mm paper)	M1700-67106 M1700-67107
3	Snap-Door Stop	M1700-47104
4	Metric spacer (Use with metric printer door assembly)	M1700-47316
5	Case label set—English Case label set—French Case label set—German Case label set—Dutch Case label set—Spanish Case label set—Italian Case label set—Swedish Case label set—Finnish Case label set - Norwegian	M1770-84500 M1770-84501 M1770-84502 M1770-84503 M1770-84504 M1770-84505 M1770-84506 M1770-84509 M1770-84518
	Case label set - Portuguese	M1770-84513
	Case label set - Russian	M1770-84514
	Case label set - Polish	M1770-84519
	Case label set - Chinese (M1772A only)	M1770-84508
6	Bottom case assembly	see Table 6-4, Table 6-6, and Table 6-8
7	Top case assembly	see Table 6-9
8	Screw-M3 x 0.5 8mm long	0515-0372

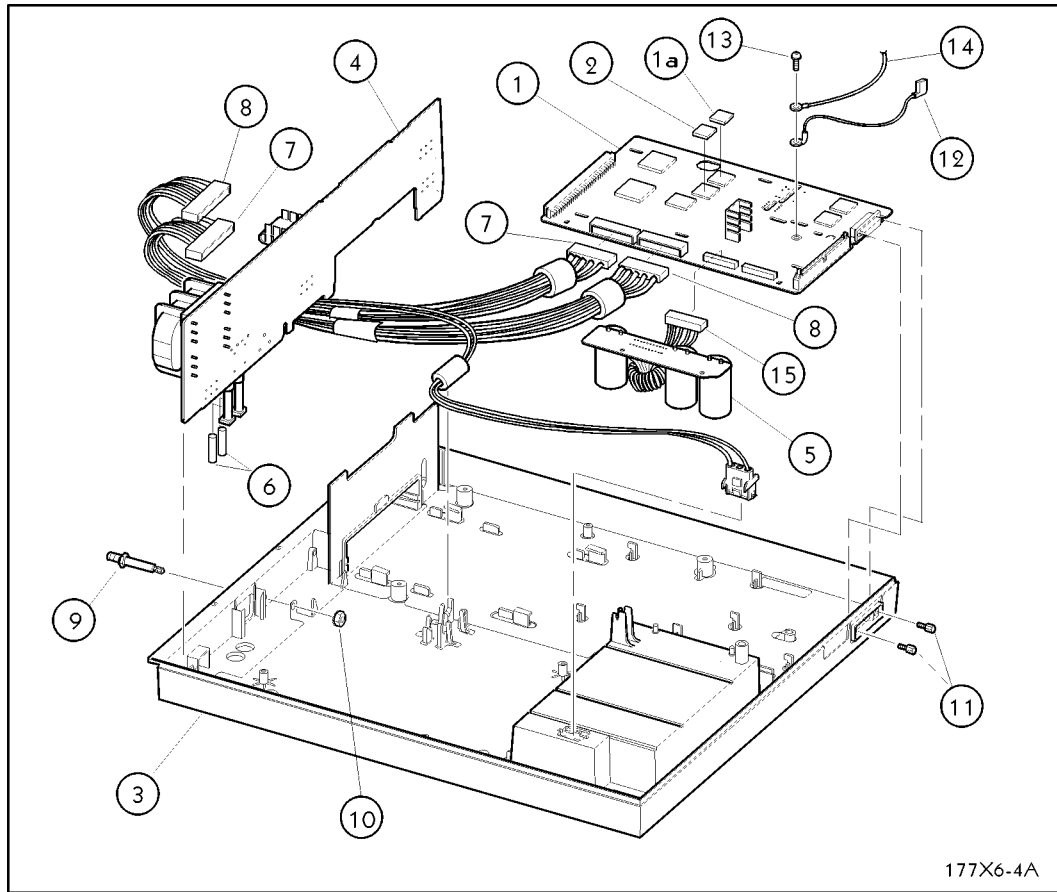
NOTE

The printer door assembly does not include the door label. To get the label, order the Case label set for the language needed.

Parts List

Figure 6-3

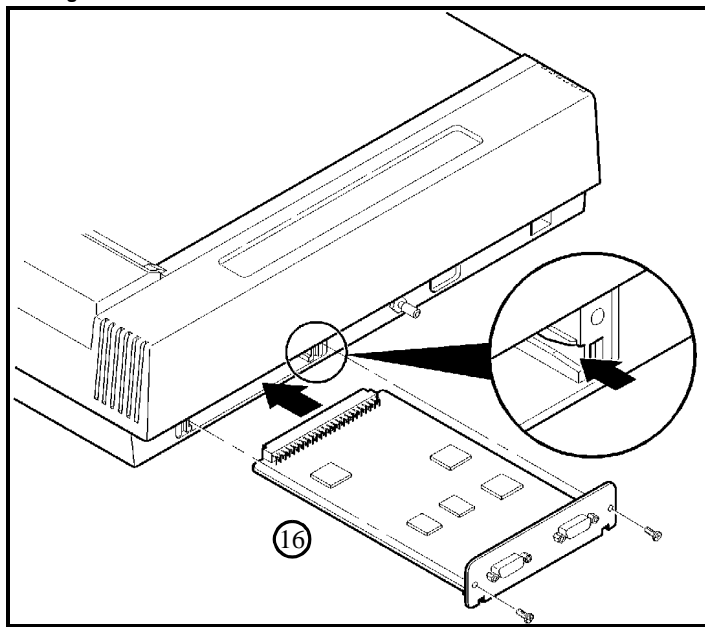
Bottom Case Exploded Diagram



177X6-4A

Figure 6-4

Storage and Transmission Board



Parts List

Table 6-4

Bottom Case Assembly Parts List (Serial Number Prefix CNA, CNB, CNC, 3807A or earlier)

Ref. No.	Description	Part No.
1	PCA, main (includes 1a)	M1770-68150
1a	Programmed ROM, U205	M1770-89505
2	Programmed ROM, U206 (M1770A and M1771A only)	see Table 6-5
3	Case assembly, lower (includes shield, insulator, and feet)	M1770-69513
4	Power supply assembly	M1770-68161
5	Capacitor assembly ¹	M1770-60172
6	Fuse (2 required) (400 mA, 250 V AC)	2110-0620
7	Cable assembly, power supply/main #1 ²	M1770-61669
8	Cable assembly, power supply/main #2 ³	M1770-61665
9	Ground lug	M1770-27301
10	Nut-hex M4 x 0.7	0535-0076
11	Jack nut (2 required)	M1700-27903
12	Ground strap, keyboard	M1770-61608
13	Screw-M3 x 0.5 8 mm long	0515-0372
14	Portion of Printer ground strap	see Table 6-7
15	Cable assembly, main/capacitor ⁴	M1770-61666
16	Storage and Transmission Board (Option #A05 only)	M1770-60180

¹When replacing capacitor assembly M1770-60162 or cable assembly M1770-61604, both parts must be replaced with capacitor assembly M1770-60172 and cable assemblies M1770-61665 and M1770-61666.

²M1770-61669 replaces M1770-61603

³M1770-61665 replaces M1770-61604 or M1770-61667

⁴M1770-61666 replaces M1770-61668

Parts List

Table 6-5

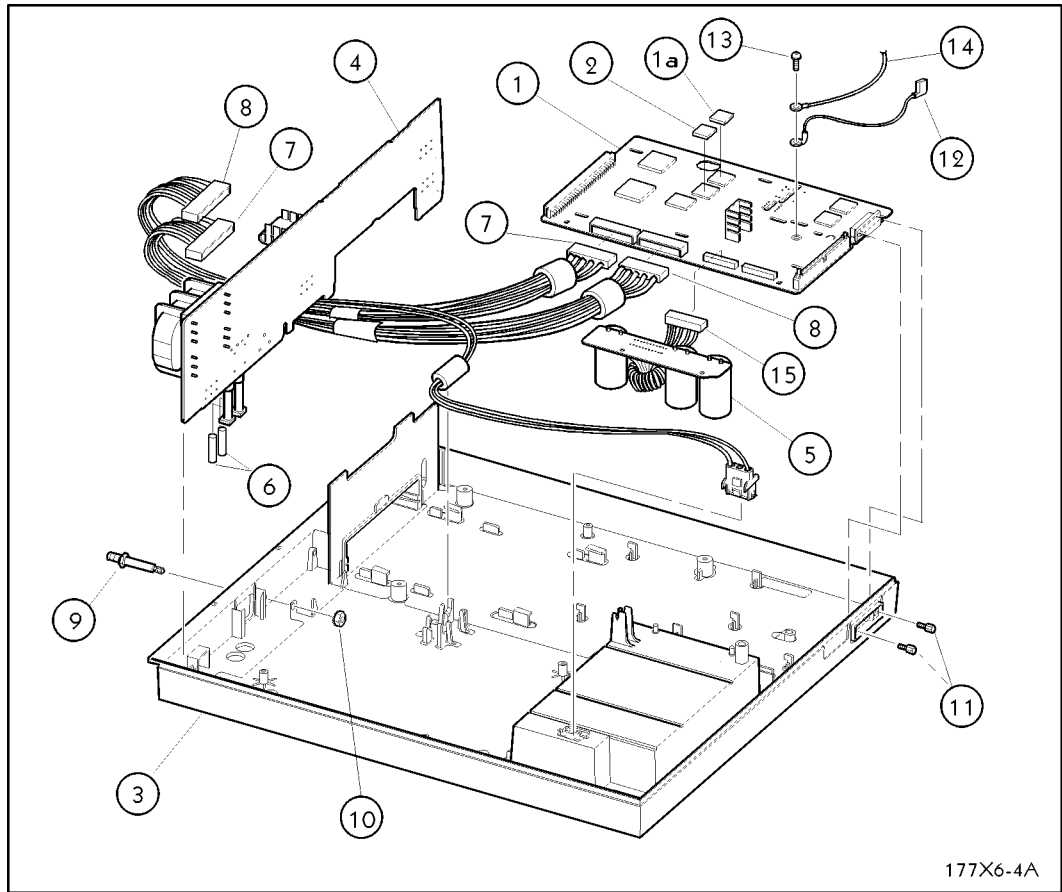
U206 Part Number by Language (Serial Number Prefix CNA, CNB, CNC, 3807A or earlier)

Language	Part Number	Part Number Labeled on ROM	Replaces
English	M1770-89521	M1770-17921	M1770-89506
French	M1770-89521	M177-17921	M1770-89506
German	M1770-89522	M1770-17922	M1770-89506
Spanish	M1770-89524	M1770-17924	M1770-89506
Dutch	M1770-89523	M1770-17923	M1770-89516
Italian	M1770-89525		M1770-89516

Parts List

Figure 6-5

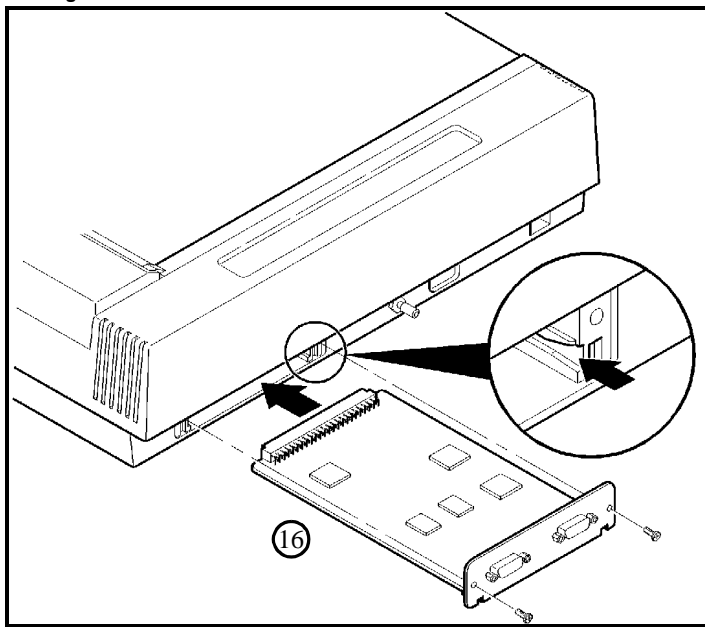
Bottom Case Exploded Diagram



177X6-4A

Figure 6-6

Storage and Transmission Board



Parts List

Table 6-6

Bottom Case Assembly Parts List (Serial Number Prefix CND)

Ref. No.	Description	Part No.
1	PCA, main (includes 1a)	M1770-68160
1a	Programmed ROM, U205	see Table 6-7
2	Not Used	N/A
3	Case assembly, lower (includes shield, insulator, and feet)	M1770-69513
4	Power supply assembly	M1770-68161
5	Capacitor assembly ¹	M1770-60172
6	Fuse (2 required) (400 mA, 250 V AC)	2110-0620
7	Cable assembly, power supply/main #1 ²	M1770-61669
8	Cable assembly, power supply/main #2 ³	M1770-61665
9	Ground lug	M1770-27301
10	Nut-hex M4 x 0.7	0535-0076
11	Jack nut (2 required)	M1700-27903
12	Ground strap, keyboard	M1770-61608
13	Screw-M3 x 0.5 8 mm long	0515-0372
14	Portion of Printer ground strap	see Table 6-9
15	Cable assembly, main/capacitor ⁴	M1770-61666
16	Storage and Transmission Board (Option #A05 only)	M1770-60180

¹When replacing capacitor assembly M1770-60162 or cable assembly M1770-61604, both parts must be replaced with capacitor assembly M1770-60172 and cable assemblies M1770-61665 and M1770-61666.

²M1770-61669 replaces M1770-61603

³M1770-61665 replaces M1770-61604 or M1770-61667

⁴M1770-61666 replaces M1770-61668

Parts List

Table 6-7

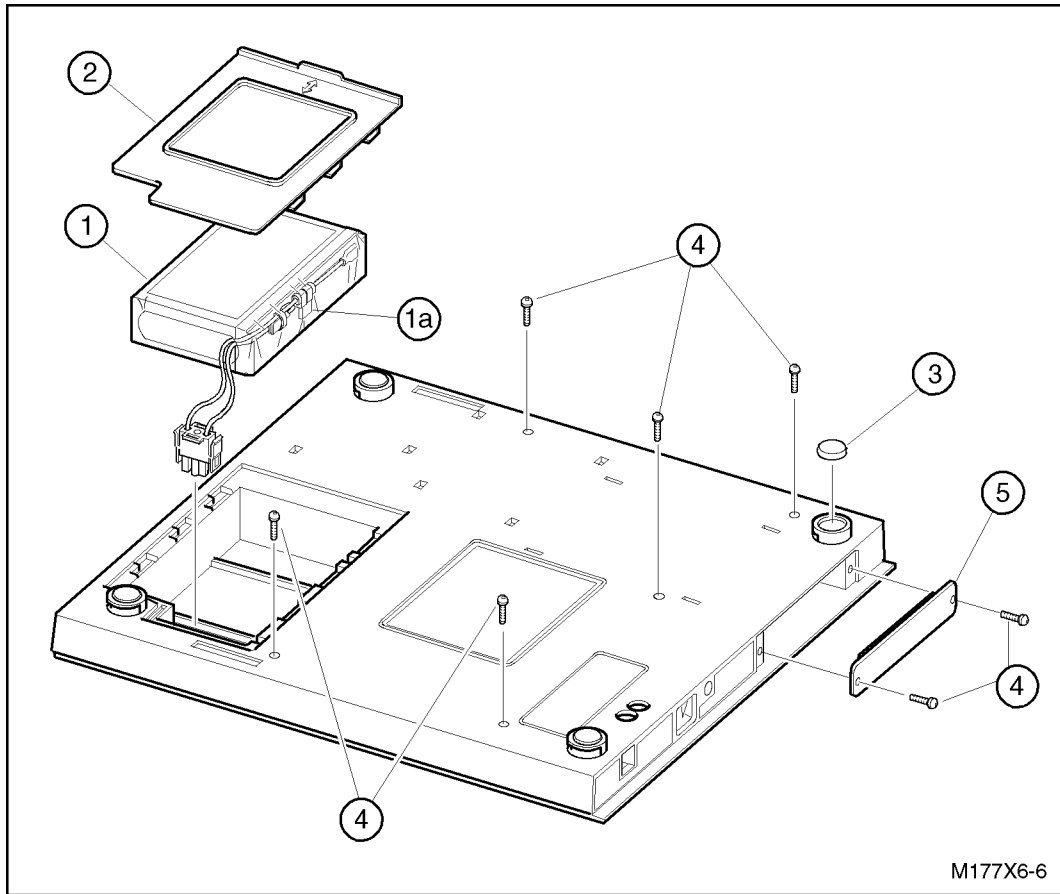
U205 Part Number by Language (Serial Number Prefix CND)

Language	Part Number
English	M1770-89550
French	M1770-89551
German	M1770-89552
Spanish	M1770-89554
Dutch	M1770-89553
Italian	M1770-89555
Swedish	M1770-89556
Norwegian	M1770-89558
Finnish	M1770-89559
Portuguese	M1770-89563
Russian	M1770-89564
Polish	M1770-89569

Parts List

Figure 6-7

Bottom Case-External Exploded Diagram



M177X6-6

Parts List

Table 6-8

Bottom Case Assembly—External View Parts List

Ref. No.	Description	Part No.
1	Battery, 6V (includes item 1a)	M2460A
1a	Fuse (10 A, 35 V)	2110-0930
2	Door, battery	M1770-47203
3	Foot, plastic (4 req'd)	0403-0767
4	Screw, M3 X 0.5 8mm long (7 req'd)	0515-0372
5	Cover, option slot	M1770-47211

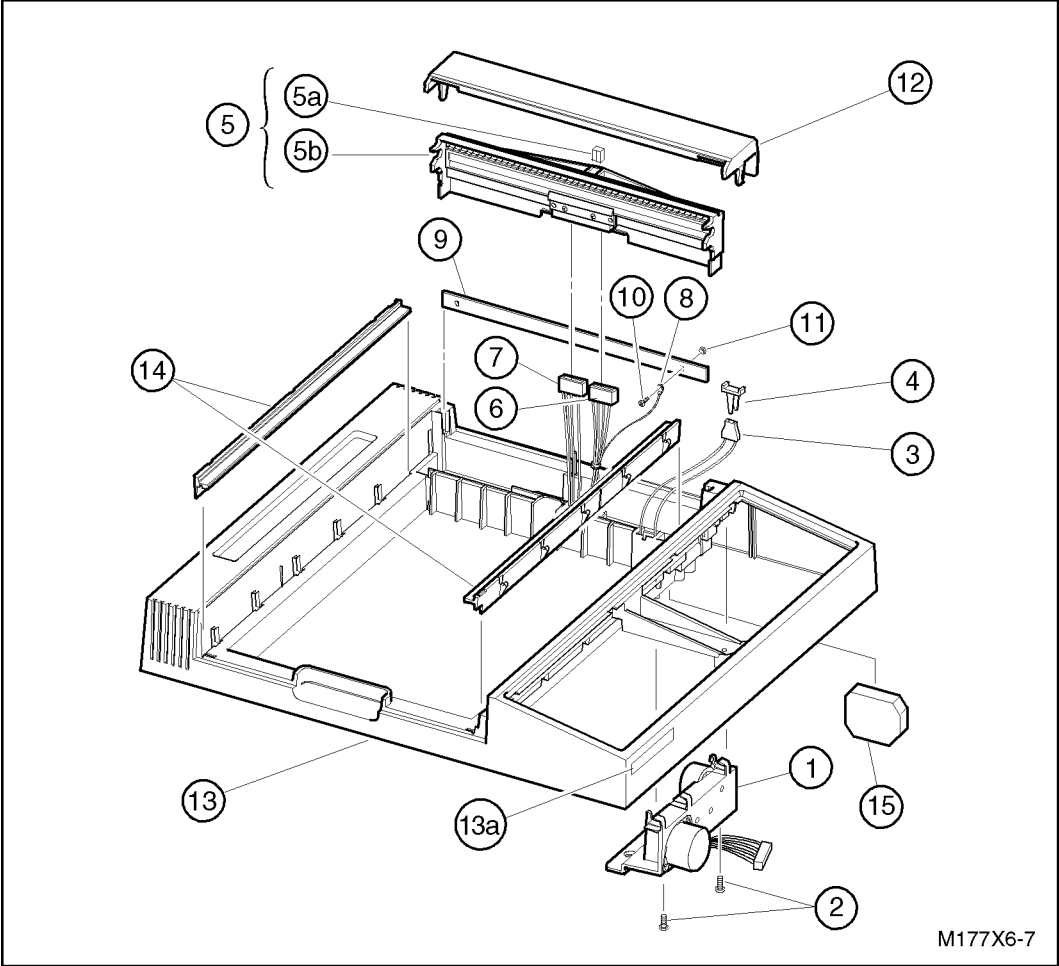
NOTE

The battery door assembly does not include the door label. To get the label, order the case label set for the language needed.

Parts List

Figure 6-8

Upper Case Exploded Diagram



Parts List

Table 6-9

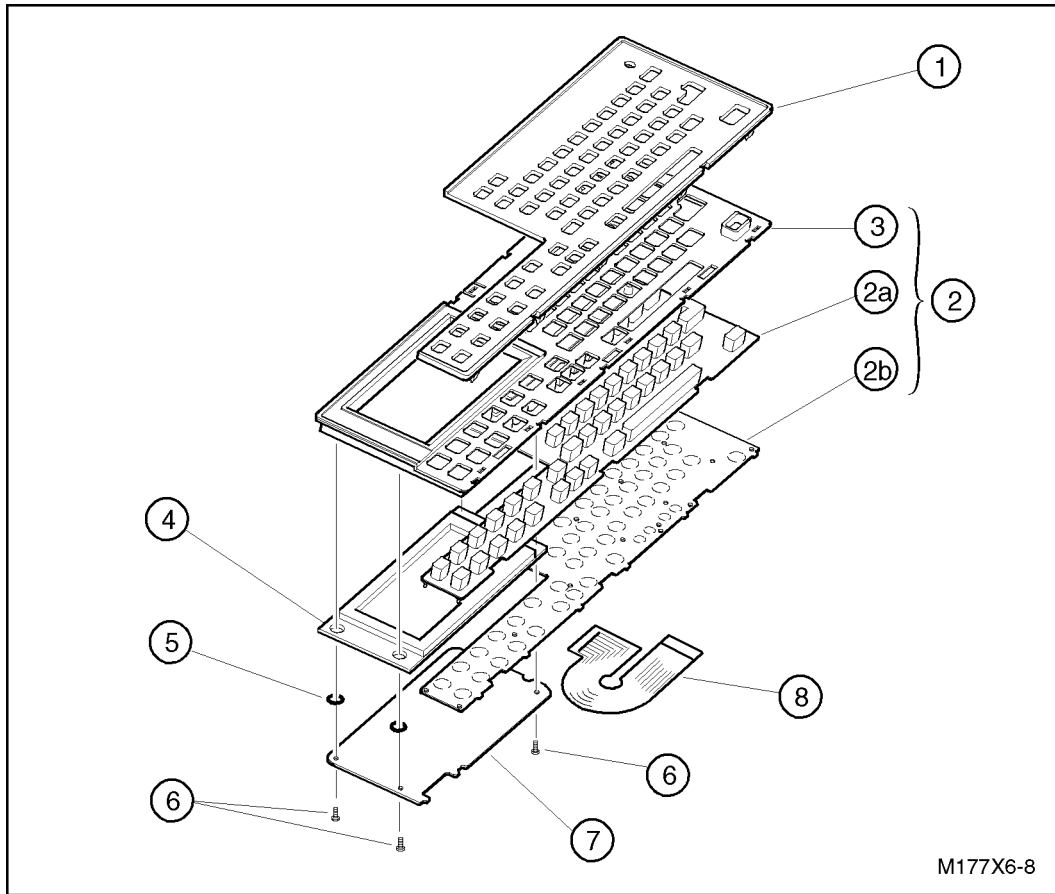
Upper Case Assembly Parts List

Ref. No.	Description	Part No.
1	Gear plate and motor assembly	M1770-67400
2	Screw, M3 X 0.5 8mm long (2 req'd)	0515-0372
3	Sensor assembly, printer	M1770-61901
4	Lens, clear	M1700-43301
5	Printhead assembly (includes items 5a and 5b)	M1770-69515
5a	Clip-switch contact	M1770-04701
5b	Bracket-printhead	M1770-47204
6	Cable assembly, printhead power ¹	M1770-61670
7	Cable assembly, printhead control	M1770-61605
8	Ground strap-printer	M1770-61609
9	Spring, leaf	M1700-27406
10	Screw-M3 x 0.5 8 mm long	0515-0372
11	Nut-Hex M3 x 0.5	0535-0031
12	Cover, printhead	M1770-47209
13	Case assembly, upper (includes pressed-in switch pin and item 13a)	
	M1770A (Serial # prefix CNA, CNB, CNC, 3807A or earlier)	M1770-69510
	(Serial # prefix CND)	M1770-69520
	M1771A	M1771-69511
	M1772A	M1772-69512
13a	Product label	
	M1770A (Serial # prefix CNA, CNB, CNC, 3807A or earlier - PageWriter 200i)	M1770-84510
	(Serial # prefix CND - PageWriter 300pi)	M1770-84515
	M1771A - PageWriter 200	M1771-84511
	M1772A - PageWriter 100	M1772-84512
14	Rail-paper tray (2 req'd)	M1770-47202
15	Foam block	M1770-87906

¹M1770-61670 replaces M1770-61606

Figure 6-9

M1770A/M1771A Keyboard Exploded Diagram



Parts List

Table 6-10 M1770A/M1771A Keyboard Assembly Parts List

Ref. No.	Description	Part No. (S/N Prefix CNA, CNB, CNC 3807A or earlier)	Part No. (S/N Prefix CND)
	Keypanel Assembly—English ¹	M1770-69500	M1770-69530
	Keypanel assembly—French ¹	M1770-69501	M1770-69531
	Keypanel assembly—German ¹	M1770-69502	M1770-69532
	Keypanel assembly—Dutch ¹	M1770-69503	M1770-69533
	Keypanel assembly—Spanish ¹	M1770-69504	M1770-69534
	Keypanel assembly—Italian ¹	M1770-69505	M1770-69535
	Keypanel assembly—Swedish ¹	M1770-69506	M1770-69536
	Keypanel assembly—Norwegian ¹	N/A	M1770-69538
	Keypanel assembly—Finnish ¹	M1770-69509	M1770-69539
	Keypanel assembly—Portuguese ¹		M1770-69583
	Keypanel assembly—Russian ¹		M1770-69584
	Keypanel assembly—Polish ¹		M1770-69589
1	Keyboard overlay—English	M1770-69600	
	Keyboard overlay—French	M1770-69601	
	Keyboard overlay—German	M1770-69602	
	Keyboard overlay—Dutch	M1770-69603	
	Keyboard overlay—Spanish	M1770-69604	
	Keyboard overlay—Italian	M1770-69605	
	Keyboard overlay—Swedish	M1770-69606	
	Keyboard overlay—Norwegian	M1770-69608	
	Keyboard overlay—Finnish	M1770-69609	
	Keyboard overlay—Portuguese	M1770-69613	
	Keyboard overlay—Russian	M1770-69614	
	Keyboard overlay—Polish	M1770-69619	
2	Keyboard Assembly (includes items 2a, 2b, 3)	M1770-67235	M1770-67240
	Keyboard Assembly—Cyrillic		M1770-67250
2a	Rubber keypad ²	M1770-47205 ²	M1770-47213
2b	Keyboard circuit board ²	M1770-60115 ²	

Parts List

Table 6-10 M1770A/M1771A Keyboard Assembly Parts List

Ref. No.	Description	Part No. (S/N Prefix CNA, CNB, CNC 3807A or earlier)	Part No. (S/N Prefix CND)
3	Keyboard frame ²	M1770-47206 ²	
4	LCD display	M1770-89503	M1770-89504
5	O-ring (4 req'd)	0905-0804	0905-1076
6	Screw-pan M2 x.4 x 4 mm (4 req'd)	0515-1473	
7	Shield-display	M1770-07603	
8	Flex circuit	M1770-81601	

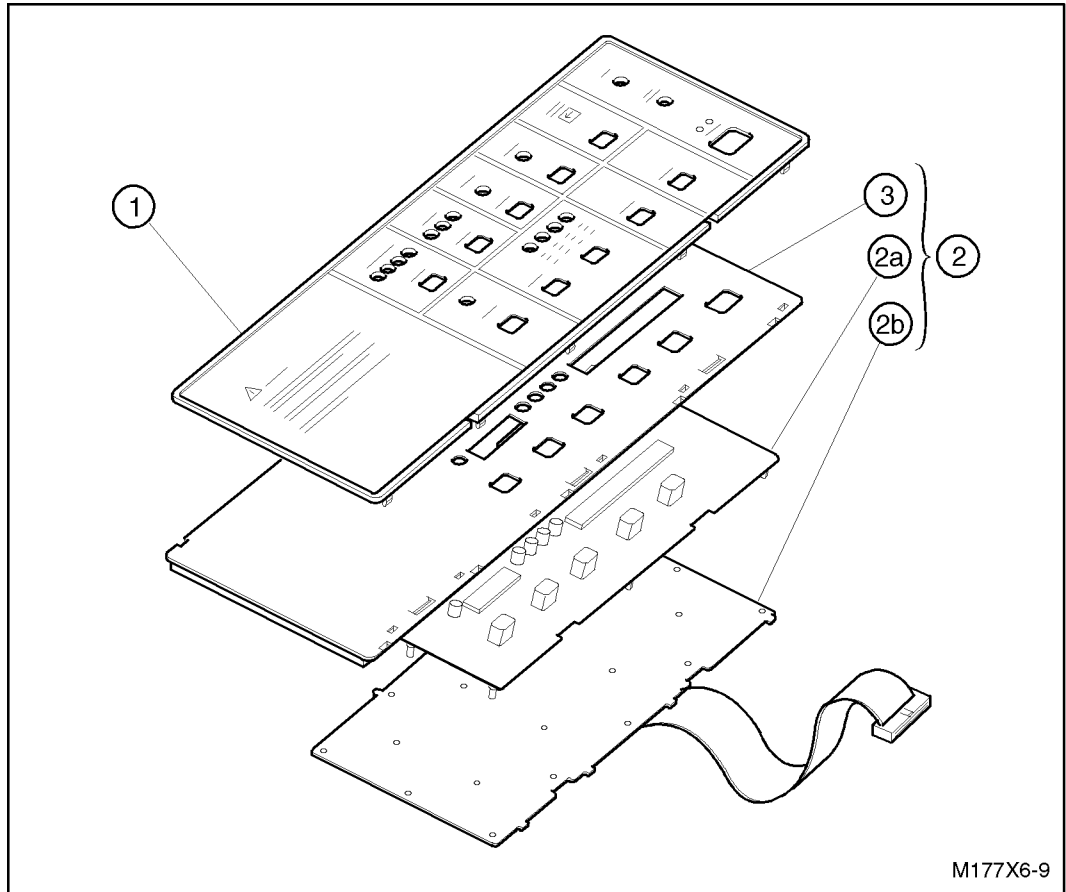
¹Complete assembly of items 1-8

²Items 2a, 2b, and 3 are not individually replaceable. These parts require factory assembly. Refer to item 2.

Parts List

Figure 6-10

M1772A Keyboard Exploded Diagram



M177X6-9

Parts List

Table 6-11

M1772A Keyboard Assembly Parts List

Ref. No.	Description	Part No.
	Keypanel Assembly—English ¹	M1772-69500
	Keypanel assembly—French ¹	M1772-69501
	Keypanel assembly—German ¹	M1772-69502
	Keypanel assembly—Dutch ¹	M1772-69503
	Keypanel assembly—Spanish ¹	M1772-69504
	Keypanel assembly—Italian ¹	M1772-69505
	Keypanel assembly—Chinese ¹	M1772-69508
	Keypanel assembly—Finnish ¹	M1772-69500
	Keypanel assembly—Portuguese ¹	M1772-69513
	Keypanel assembly—Russian ¹	M1772-69514
	Keypanel assembly—Polish ¹	M1772-69515
1	Keyboard overlay—English	M1772-69600
	Keyboard overlay—French	M1772-69601
	Keyboard overlay—German	M1772-69602
	Keyboard overlay—Dutch	M1772-69603
	Keyboard overlay—Spanish	M1772-69604
	Keyboard overlay—Italian	M1772-69605
	Keyboard overlay—Chinese	M1772-69608
	Keyboard overlay—Finnish	M1772-69609
	Keyboard overlay—Portuguese	M1772-69613
	Keyboard overlay—Russian	M1772-69614
	Keyboard overlay—Russian	M1772-69619

Parts List

Table 6-11

M1772A Keyboard Assembly Parts List

Ref. No.	Description	Part No.
2	Keypad Assembly (includes items 2a, 2b, and 3)	M1772-69536
2a	Rubber keypad ²	M1772-47255
2b	Keypad circuit board ²	M1772-60117
3	Keypad Frame ²	M1772-47256

¹Complete assembly of items 1-3

²Items 2a, 2b, and 3 are not individually replaceable. These part require factory assembly.
Refer to item 2.

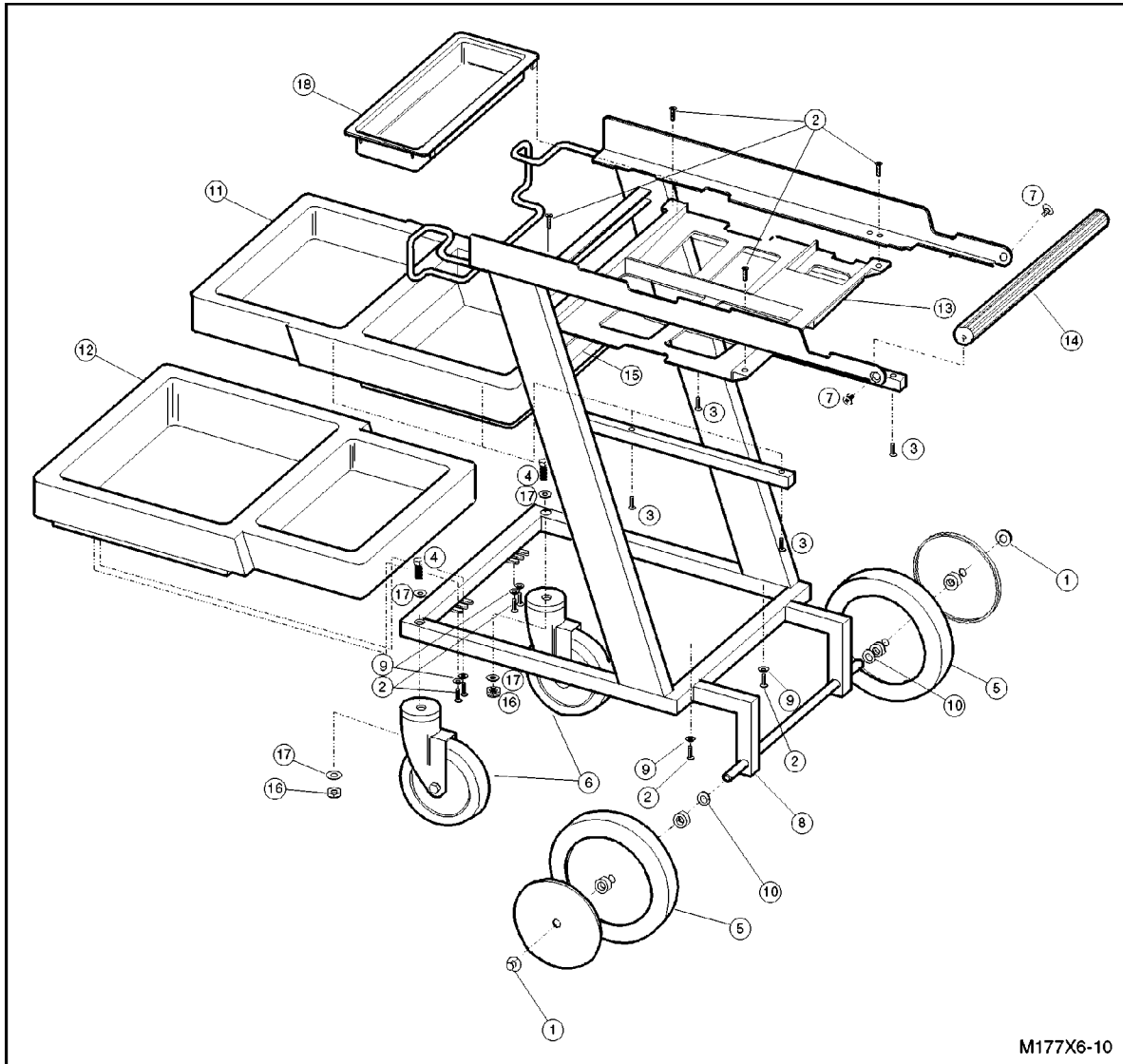
NOTE

Any attempt to replace the rubber keypad may reduce the overall reliability of the keyboard.

Parts List

Figure 6-11

M1705B Cart Exploded Diagram.



Parts List**Table 6-12 M1705B Cart Parts List**

Ref. No.	Description	Part No.
	Cart assembly	M1705-69500
1	Retainer cap (2 req'd)	0590-1977
2	Screw, tpg. 6-19 (10 req'd)	0624-0400
3	Screw, tpg. 6-19 (4 req'd)	0624-0654
4	Hex-head captive screw 3/8 - 16 × 2 (2 req'd)	2940-0201
5	Rear wheel (2 req'd)	1492-0129
6	Front caster (2 req'd)	1492-0150
7	Handle bolt (2 req'd)	2940-0281
8	Frame	M1705-27301
9	Metal washer (6 req'd)	2190-0758
10	Flat washer (2 req'd)	3050-1401
11	Upper tray	M1705-47301
12	Lower tray	M1705-47302
13	Paper tray	M1705-47305
14	Handle	M1705-67300
15	Cart label	M1705-84502
16	Lock nut 3/8 (2 req'd)	0590-1037
17	Flat washers; 2 per front caster 4 req'd)	2190-0457
18	Filler tray	M1705-47313
	Touch-Up Paint "Parchment White"	6010-1148

Parts List

Connector Pin Assignments

The tables in this appendix list the pin assignments for each connector on the CPU assembly and the power supply boards. Following each table is a dictionary of the signal names listed in the table. Signal names that begin with a lowercase n are active low signals. NC means no connection to a pin. Refer to Figure 3-1 to see how the system interconnects.

CPU Assembly Connectors

NOTE

The system's 5 V power supply is divided into several circuits, each of which is passively filtered for EMI. Therefore, the +5V signal shown in the pin assignment tables does not always represent the same filtered 5 volt circuit.

CPU Assembly Connectors

Table A-1

Control Board J201 to M1770A/71A Keyboard and Keyboard Display (LCD) Connector J101

Pin	Signal	Pin	Signal	Pin	Signal
1	ground	15	ROWSA_1	28	CP
2	KEYIN7	16	ROWSD_0	29	ground
3	ROWSG_0	17	ground	30	KEYIN0
4	ROWSB_0	18	KEYIN4	31	LOAD
5	ground	19	ROWSD_1	32	DF
6	KEYIN1	20	DD0	33	YD
7	ROWSC_1	21	ground	34	ONSTBY
8	ROWSA_0	22	KEYIN5	35	ACONLED
9	ground	23	DD1	36	DOFF
10	KEYIN2	24	DD2	37	VCCV
11	ROWSB_1	25	ground	38	+5KBD
12	ROWSC_0	26	KEYIN6	39	+5KBD
13	ground	27	DD3	40	ground
14	KEYIN3				

NOTE

The connector listed in this table is shared by the keyboard and the preview screen. Pins 1–11 serve the keyboard, while pins 12–26 serve the keyboard display. All of the signal lines (except ground) are filtered before they pass through this connector.

CPU Assembly Connectors

Signal	Definition
+5KBD	5 volt supply for keyboard assembly.
ACONLED	AC on LED. Drives the AC indicator LED on the keyboard.
CP	LCD Clock pulse.
DD0-DD3	Four data bits for keyboard LCD.
DF	LCD frame inversion signal.
DOFF	Signal to blank LCD (active low).
ground	ground.
KEYIN0-KEYIN7	Sense lines for key contact scanning.
LOAD	LCD row latch.
ONSTBY	Signal generated by <u>On-Standby</u> key — active low.
ROWSA_0-ROWSD_0	Drive lines for key contact scanning.
ROWSA_1-ROWSD_1	Drive lines for key contact scanning.
ROWSG_0	Drive lines for key contact scanning.
VCCV	Contrast control voltage.
YD	LCD frame sync.

CPU Assembly Connectors

Table A-2

M1770A/71A Keyboard Connector J102 to LCD Module

Pin	Signal	Pin	Signal
1	DF	9	DD2
2	Reserved	10	DD3
3	ground	11	+5KBD
4	ground	12	LOAD
5	CP	13	VCCV
6	DOFF	14	YD
7	DD0	15	VSS
8	DD1		

Signal

Definition

CP	LCD Clock pulse.
DD0-DD3	Data bits for LCD.
DF	LCD frame inversion signal.
DOFF	Signal to blank LCD (active low).
LOAD	LCD row latch.
VCCV	Contrast control voltage.
YD	LCD frame sync.

CPU Assembly Connectors

Table A-3 Control Board J201 to M1772A Keyboard Connector J101

Pin	Signal	Pin	Signal	Pin	Signal
1	ground	15	ROWSA_1	28	LED11
2	KEYIN7	16	LED5	29	ground
3	ROWSG_0	17	ground	30	KEYIN0
4	LED1	18	KEYIN4	31	LED12
5	ground	19	LED6	32	LED13
6	KEYIN1	20	LED7	33	LED14
7	LED4	21	ground	34	ONSTBY
8	ROWSA_0	22	KEYIN5	35	ACONLED
9	ground	23	LED8	36	LED15
10	KEYIN2	24	LED9	37	N.C.
11	LED2	25	ground	38	+5KBD
12	LED2	26	KEYIN6	39	+5KBD
13	ground	27	LED10	40	IMAGE
14	KEYIN3				

CPU Assembly Connectors

Signal	Definition
+5KBD	5 volt supply for keyboard assembly.
ACONLED	AC on LED. Drives the AC indicator LED on the keyboard.
ground	ground.
KEYIN0-KEYIN7	Sense lines for key contact scanning.
LED1	AUTO LED signal.
LED2	MANUAL (I, II, III) LED signal.
LED3	MANUAL (aVR, aVL, aVF) LED signal.
LED4	MANUAL (II, aVF, V2) LED signal.
LED5	MANUAL (V1 - V6) LED signal.
LED6	V Leads LED signal.
LED7	Filter LED signal.
LED8	ECG Size 10mm/mv LED signal.
LED9	ECG Size 20 mm/mv LED signal.
LED10	Chart Speed 50mm/sec LED signal.
LED11	ECG Size 5 mm/mv LED signal.
LED12	Chart Speed 10 mm/sec LED signal.
LED13	Chart Speed 25 mm/sec LED signal.
LED14	Chart Speed 5 mm/sec LED signal.
LED15	Low battery LED signal.
ONSTBY	Signal generated by <input type="checkbox"/> On/Standby key — active low. Initiates the DRAM gate array during power-up.
ROWSA_0	Drive lines for key contact scanning.
ROWSA_1	Drive lines for key contact scanning.
ROWSG_0	Drive lines for key contact scanning.

CPU Assembly Connectors

Table A-4

Control Board Connector J304 to Printhead Logic

Pin	Signal	Pin	Signal
1	DATA_OUT	8	nSTROBE3
2	FSW_+5V	9	nSTROBE4
3	GROUND	10	PRCLK
4	THERMISTOR	11	unlatch
5	THERMISTOR	12	DATA
6	nSTROBE1	13	N.C.
7	nSTROBE2		

Signal	Definition
DATA	Print data to printhead.
DATA_OUT	Print data output from printhead.
FSW_+5V	Filtered switched +5 volts.
nLATCH	Printhead latch — latches a line of print data.
nSTROB1-nSTROBE4	Printhead strobe — enables the dot drivers.
PRCLK	Printhead clock. Clocks serial data into printhead at 4 MHz.
THERMISTOR	Voltage from printhead thermistor — indicates printhead temperature.

CPU Assembly Connectors

Table A-5

Control Board Connector J303 to Paper Sensor

Pin	Signal	Pin	Signal
1	DOOR	4	GROUND
2	GROUND	5	DETECTOR
3	EMITTER		

Signal	Definition
DETECTOR	Paper sensor detector.
DOOR	Indicates the state of the printer compartment door. High when door closed.
EMITTER	Paper sensor emitter.

Table A-6

Control Board Connector J306 to Printer Motor

Pin	Signal	Pin	Signal
1	PHASE4	4	PHASE2
2	V_MOTOR	5	V_MOTOR
3	PHASE3	6	PHASE1

Signal	Definition
PHASE1-PHASE4	Drive signals for the printer's four-phase stepper motor.
V_MOTOR	Power to the motor. Enabled with +5READY signal.

CPU Assembly Connectors

Table A-7

Power Supply Connector J3 to Control Board Connector J301

Pin	Signal	Pin	Signal
1	ENBL5V	8	PPWRON
2	GROUND	9	GROUND
3	GROUND	10	Reserved
4	GROUND	11	GROUND
5	ACON	12	VBAT
6	VBATMEAS	13	VBAT
7	GROUND	14	PLOADON

Signal

Definition

ACON

AC on LED. Drives the AC indicator LED on the keyboard.

ENBL5V

Signal from System Gate Array to power supply. When high, power supply turns on SW_+5V.

PLOADON

Signal to power supply which turns on the internal VPRINT load.

PPWRON

Signal to power supply which turns on VPRINT.

VBAT

Battery voltage.

VBATMEAS

Sense line for measuring VBAT attenuated.

CPU Assembly Connectors

Table A-8

Power Supply Connector J2 to Control Board J302

Pin	Signal	Pin	Signal
1	GROUND	9	+5V
2	GROUND	10	+5V
3	GROUND	11	V_PRINT
4	GROUND	12	V_PRINT
5	GROUND	13	V_PRINT
6	SW_+5V	14	V_PRINT
7	SW_+5V	15	V_PRINT
8	SW_+5V		

Signal

Definition

V_PRINT

Power to the printhead. Enabled with +5READY signal.

+5V

Unswitched 5 volts.

SW_+5V

Switched 5 volts.

Table A-9

Control Board Connector J305 to Capacitor Board Connector J5 and Capacitor Board Connector J4 to Printhead Power

Pin	Signal	Pin	Signal
1	V_PRINT	6	GROUND
2	V_PRINT	7	GROUND
3	V_PRINT	8	GROUND
4	V_PRINT	9	GROUND
5	GROUND	10	FSW_+5V

Signal

Definition

V_PRINT

Power to the printhead. Enabled with +5READY signal.

FSW_+5V

Filtered switched +5 volts (SW_+5V).

CPU Assembly Connectors

Table A-10

Control Board Connector J101 to Patient Cable

Pin	Signal	Pin	Signal
1	V2	10	LA
2	V3	11	LL
3	V4	12	V1
4	V5	13	N.C.
5	V6	14	RL
6	SHIELD	15	N.C.
7	N.C.	16	SHELL
8	N.C.	17 SHELL	
9	RA		

Signal	Definition
LA	Left arm signal from the patient cable.
LL	Left leg signal from the patient cable.
RA	Right arm signal from the patient cable.
RL	Right leg signal from the patient cable.
SHELL	Connector shell.
SHIELD	Patient cable shield.
V1-V6	Chest lead signals from the patient cable.

NOTE

Although AHA designations are used as signal names, IEC designations are more accurate descriptors.

CPU Assembly Connectors

Table A-11 System Expansion Connector J12

Pin	Row A	Row B	Row C	Pin	Row A	Row B	Row C
1	GROUND	GROUND	GROUND	17	A25	A27	GROUND
2	V_PRINT	VBAT	VBAT	18	A22	A24	A23
3	HLDA	Reserved	PPWRON	19	A19	A21	A20
4	PLOADON	ACON	Reserved	20	A16	A18	A17
5	ENBL5V	nNEW5V	AD8	21	A1	A3	A2
6	AD7	AD6	AD5	22	FSW_+5V	FSW_+5V	FSW_+5V
7	AD9	AD10	AD11	23	LAD13	LAD15	LAD14
8	AD4	AD3	AD2	24	LAD10	LAD12	LAD11
9	AD12	AD13	AD14	25	LAD7	LAD9	LAD8
10	AD1	AD15	D0	26	LAD7	LAD6	LAD5
11	F_+5V	F_+5V	F_+5V	27	ALE	infecting	FEDATA
12	GPIO0	GPIO1	XWAIT	28	nDEN	FEPWR	nFECLK
13	A31	GPIO2	GPIO3	29	nRESET	nAS	nREADY
14	A28	A30	A29	30	nBE0	DTnR	nBLAST
15	nXROMCS	nROMOE	ONSTBY	31	nBE1	INT1	WnR
16	GROUND	GROUND	GROUND	32	GROUND	CLK2A	GROUND

Signal

A1-A3

Definition

CPU address bus.

A16-A31

CPU address bus.

ACON

Goes high when unit is attached to AC power source.

AD1-AD15

Multiplexed address/data bus.

ALE

Address latch enable.

CLK2A

32 MHz clock.

D0

Data bit 0

DTnR

Data transmit/receive.

ENBL5V

System Gate Array output to turn on SW_+5V/F_+5V.

F_+5V

Unswitched 5 V.

CPU Assembly Connectors

Signal	Definition
FEDATA	Serial data from front end.
FEPWR	Front end transformer drive control.
FSW_+5V	Filtered switched 5 V.
GPIO0-GPIO3	General purpose I/O bits
GROUND	ground.
HLDA	Hold acknowledge from CPU.
INT1	Interrupt to CPU.
LAD4-LAD15	Latched CPU address bus.
nAS	CPU address strobe.
nBE0, BE1	CPU byte enable — low/high.
nBLAST	Indicates last byte of CPU burst transfer.
nDEN	CPU data enable.
nFECLK	Serial clock from front end.
infecting	Serial control data to front-end.
nNEW5V	Master reset to System Gate Array.
nREADY	Derived from wait state generator. Terminates current bus cycle.
nRESET	CPU reset.
nROMOE	ROM output enable.
nXROMCS	Extended ROM chip select.
ONSTBY	On/Standby signal from <u>On-Standby</u> key.
PLOADON	Signal indicating Print internal load is on.
PPWRON	Signal indicating Vprint is on.
V_PRINT	Printer power.
VBAT	Battery voltage.
WnR	Write/Read. CPU control bus signal. Distinguishes write cycles from read cycles.
XWAIT	Input to request additional CPU wait states.

CPU Assembly Connectors

Table A-12

Power Supply J1 to AC Input Cable

Pin	Signal
1	L1
2	EARTH_GND
3	L2

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A

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