INSTALLATION AND SERVICE
MANUAL

# HP 12990A
# MEMORY EXTENDER

Manual Part No. 12990-90003
Microfiche Part No. 12990-90005

Printed: ARPIL 1976

HEWLETT hp PACKARD

HEWLETT PACKARD

# INSTALLATION AND SERVICE MANUAL

# HP 12990A MEMORY EXTENDER

Manual Part No. 12990-90003
Microfiche Part No. 12990-90005

Printed: ARPIL 1976

## OPTIONS COVERED

This manual covers option 015 as well as the basic memory extender.

HEWLETT-PACKARD COMPANY
11000 WOLFE ROAD, CUPERTINO, CALIFORNIA, U.S.A.

# LIST OF EFFECTIVE PAGES

Changed pages are identified by a change number adjacent to the page number. Changed information is indicated by a vertical line in the outer margin of the page. Original pages do not include a change number and are indicated as change number 0 on this page. Insert latest changed pages and destroy superseded pages.

Change 0 (Original) ..... April 1976


**NOTICE**

The information contained in this document is subject to change without notice.

HEWLETT-PACKARD MAKES NO WARRANTY OF ANY KIND WITH REGARD TO THIS MATERIAL, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Hewlett-Packard shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance or use of this material.

This document contains proprietary information which is protected by copyright. All rights are reserved. No part of this document may be photocopied or reproduced without the prior written consent of Hewlett-Packard Company.

Copyright © 1976 by HEWLETT-PACKARD COMPANY

# CONTENTS


Section I — Page

**GENERAL DESCRIPTION**

Equipment Supplied ..... 1-1
Specifications ..... 1-1
Options and Accessories ..... 1-1

Section II — Page

**INSTALLATION**

Site Preparation ..... 2-1
  Environmental Limitations ..... 2-1
  Power Requirements ..... 2-1
  Cooling Requirements ..... 2-1
  Mounting Considerations ..... 2-1
Unpacking and Inspection ..... 2-1
Installation Procedure ..... 2-1
  Tools and Test Equipment ..... 2-1
  AC Power Mains Outlet and External Ground ... 2-1
  Extender Mounting ..... 2-2
    Preliminary Procedure ..... 2-2
    Bench Mounting ..... 2-5
    Rack Mounting ..... 2-5
  Memory Module Installation ..... 2-5
  Cable Connections ..... 2-7
    Memory System Cable ..... 2-7
    Power Control Cable ..... 2-7
    External Batteries ..... 2-7
  Power Supply Adjustments ..... 2-7
Performance Verification Check ..... 2-13
Claims Procedure ..... 2-13
Repacking for Shipment ..... 2-13
  Shipment Using Original Packaging ..... 2-14
  Shipment Using New Packaging ..... 2-14

Section III — Page

**SERVICE**

Troubleshooting ..... 3-1
Subassembly Removal and Replacement ..... 3-1
  Top, Side, and Bottom Covers ..... 3-1
    Removal ..... 3-2
    Replacement ..... 3-2
  Memory Cage PCA's ..... 3-2
    Removal ..... 3-2
    Replacement ..... 3-2
  Memory Backplane ..... 3-2
    Removal ..... 3-2
    Replacement ..... 3-2
  Power Fail Recovery System ..... 3-2
    Battery Removal ..... 3-2
    Battery PCA Removal ..... 3-2
    Replacement ..... 3-2
  Power Supply ..... 3-2
    Removal ..... 3-2
    Replacement ..... 3-5
  Ventilating Fans ..... 3-5
    Removal ..... 3-5
    Replacement ..... 3-5
110/220V AC Reconfiguration ..... 3-5
Power Distribution Diagram ..... 3-5

Section IV — Page

**REPLACEABLE PARTS**

Replaceable Parts ..... 4-1
Ordering Information ..... 4-1


# ILLUSTRATIONS


**Title** — **Page**

HP 12990A Memory Extender ..... 1-1
AC Power Cord Sets ..... 2-3
Typical Computer Crossover PCA Power Connections ..... 2-4
HP 12990A Memory Extender Front View ..... 2-5
HP 2102 16K Memory Module Address Jumpers .... 2-8
HP 2102 8K Memory Module Address Jumpers ..... 2-9
HP 2102 4K Memory Module Address Jumpers .... 2-10
Typical Memory System Configuration ..... 2-11
Rear Panel Cabling ..... 2-12
External Battery Cabling ..... 2-13
Power Supply Adjustment and Voltage Test Points ..... 2-14
Troubleshooting Flowchart ..... 3-3
Power Distribution Diagram ..... 3-7
HP 12990A Memory Extender Exploded View ..... 4-3

# TABLES


| Title | Page |
|---|---|
| Specifications | 1-2 |
| Installation Test Equipment | 2-2 |
| Typical Memory Configuration (Example 1) | 2-6 |
| Typical Memory Configuration (Example 2) | 2-6 |
| Power Supply Voltage Tolerances | 2-13 |
| HP 12990A Memory Extender Replaceable Parts | 4-2 |

# GENERAL DESCRIPTION

SECTION I

The HP 12990A Memory Extender provides for the expansion of the memory capacity of HP 21MX Computers equipped with an HP 12976A Dynamic Mapping System. The extender has an internal power supply and space for eight semiconductor memory modules. Up to 131,536 words of memory may be added using 16K modules or up to 65,536 words using 8K modules.

## 1-1. EQUIPMENT SUPPLIED

The HP 12990A Memory Extender (figure 1-1) is shipped with the following items:

a. Power control cable assembly, part no. 12990-60014.

b. Extended memory system cable assembly, part no. 12990-60011.

c. Two ground strap cable assemblies, part no. 5061-1342.

## 1-2. SPECIFICATIONS

Specifications for the HP 12990A Memory Extender are provided in table 1-1.

## 1-3. OPTIONS AND ACCESSORIES

The following options and accessories are available for the memory extender:

a. 220V, 50-Hz power option (option 015).

b. HP 12991A Power Fail Recovery System.

c. HP 12903B Chassis Slide Kit.

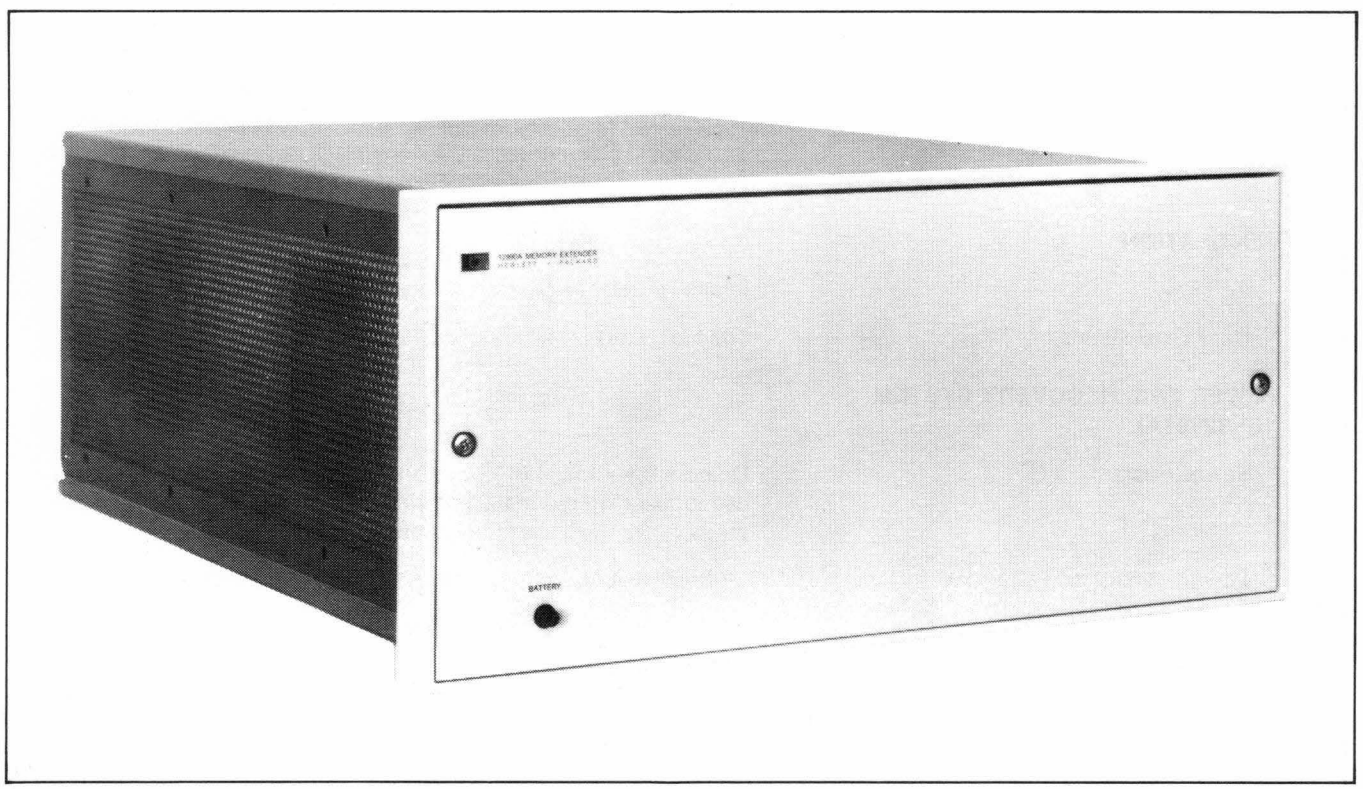



Figure 1-1. HP 12990A Memory Extender

Table 1-1. Specifications

| | |
|---|---|
| **PHYSICAL CHARACTERISTICS** | |
| Width: | 16-3/4 in. (42.55 cm) behind rack mount;<br>19 in. (48.26 cm) front panel width on sides. |
| Height: | 8-3/4 in. (22.23 cm) in rack mount. |
| Depth: | 23-1/2 in. (59.69 cm) overall;<br>23 in. (58.42 cm) behind rack-mounting ears. |
| Weight: | 40 lb (18.15 kg). |
| **ELECTRICAL CHARACTERISTICS** | |
| Input Line Voltage: | 110V or 220V ac (± 20%), single phase. |
| Line Frequency: | 47.5 to 66 Hz. |
| Power Dissipation: | 300W maximum. |
| Line Overvoltage Protect: | Input crowbar trips at line voltage 40% above nominal. |
| Output Protect: | All voltages protected against overvoltage and overcurrent. |
| Output Voltage Regulation: | ±5% |
| Thermal Sensing: | Monitors internal temperature and automatically shuts down if temperature exceeds safe level. |
| **ENVIRONMENT LIMITATIONS** | |
| Ambient Temperature: | Operating: 0° to 55°C (32° to 131°F).<br>Nonoperating: −40° to 75°C (−40° to 167°F). |
| Altitude: | Operating: 15,000 feet (4,573 meters).<br>Nonoperating: 50,000 feet (15,244 meters). |
| Relative Humidity: | 20% to 95% at 104°F (40°C), non-condensing. |
| Vibration and Shock: | Type tested to qualify for normal shipping and handling vibration and shock. Contact factory for any application regarding operation under continuous vibration. |
| **VENTILATION** | |
| Air Flow: | Intake on left-hand side and exhaust on right-hand side. |
| Heat Dissipation: | 1024 BTU's (258 kilocalories)/hour. |
| **POWER FAIL RECOVERY SYSTEM (HP 12991A)** | |
| Power Restart: | Detects resumption of power and generates an interrupt to trap cell for user written restart program which has been protected in memory by the sustaining batteries. |
| Power Control and Charger: | Monitors battery charge status and provides trickle charge. |
| Sustaining Batteries: | Type: 12V nickel cadmium (two).<br>Charging Rate: 350 milliamperes.<br>Capacity: Will sustain eight modules of memory for at least two hours. |

# SECTION II

# INSTALLATION

This section provides installation instructions for the HP 12990A Memory Extender. Included in these instructions are site preparation data, unpacking and inspection details, configuration requirements, installation procedures, performance verification, and recommended packing and shipping methods.

## 2-1. SITE PREPARATION

Site preparation information for the memory includes environmental limitations, power requirements, and mounting considerations. If the extender is purchased as part of a computer system, disregard the contents of paragraphs 2-2 through 2-5 herein and refer instead to the *Hewlett-Packard 2000 Computer Systems Site Preparation Manual*, part no. 02000-90097.

### 2-2. ENVIRONMENTAL LIMITATIONS

Environmental limitations for operating and nonoperating conditions of the extender are specified in table 1-1.

### 2-3. POWER REQUIREMENTS

The extender is shipped with the power supply configured to operate from single-phase power mains of 110 ±20% volts (standard) or 220 ±20% volts (option 015) as specified on the purchase order. The maximum power dissipation is 300 watts.

Various safety codes require that instrument chassis, panels, and housing be grounded to protect operating and service personnel. A grounded three-conductor female outlet must be available to satisfy this requirement.

### 2-4. COOLING REQUIREMENTS

There are no external cooling requirements for the extender. Two internal fans provide adequate ventilation when operated within the environmental limitations specified in table 1-1.

### 2-5. MOUNTING CONSIDERATIONS

The extender and the computer can be used freestanding or mounted in a standard 19-inch (483-millimeter) equipment rack. In either case, the extender must be mounted directly below and adjacent to the computer due to cabling limitations. Rack-mounting dimensions for the extender are specified in table 1-1.

## 2-6. UNPACKING AND INSPECTION

Inspect the shipping container immediately upon receipt for evidence of mishandling during transit. If the container is damaged or water stained, request the carrier's agent be present when the container is opened.

Unpack the extender and inspect it for external damage such as broken connectors, dented corners, bent panels, and scratches. Check also the packaging material for signs of deformation which could be indicative of rough handling during transit. If the extender includes the HP 12991A Power Fail Recovery System, ensure that battery printed-circuit assembly (PCA) (figure 4-1, index no. 21) is seated fully into mating receptacle on lower power supply PCA.

If the visual inspection reveals any damage to the extender, follow the damage claim procedure described in paragraph 2-23. Save the shipping container and packing material for examination in the settlement of claims or for future use.

## 2-7. INSTALLATION PROCEDURE

### 2-8. TOOLS AND TEST EQUIPMENT

No tools other than ordinary hand tools are required for installation. Test equipment required to verify the adequacy of the ac mains voltage and for power supply adjustments are listed in table 2-1.

### 2-9. AC POWER MAINS OUTLET AND EXTERNAL GROUND

The female power outlet to be used to supply ac mains power to the extender must be checked with an ac voltmeter by a qualified electrician to ensure that it furnishes the proper single-phase voltage for which the extender is configured. The outlet and its associated wiring and fuses (or circuit breakers) must be capable of carrying the current specified on the identification label on the extender rear

Table 2-1. Installation Test Equipment

| INSTRUMENT | CRITICAL SPECIFICATIONS | RECOMMENDED HP MODEL |
|---|---|---|
| Digital Voltmeter | At least four-digit readout. Minimum input impedance 10 megohms; full-scale ranges of 0.999 and 99.99 volts dc. | HP 3439A Digital Voltmeter with HP 3441A Range Selector. |
| AC Voltmeter | Expanded-scale or digital-readout type capable of measuring ac power mains to ±1.0%. Voltage range must be from 88 to 132 volts ac (standard) or 176 to 264 volts ac (option 015). | HP 3445 AC/DC Range Unit. (Also performs functions of HP 3441A Range Selector listed above. Requires an HP 3439A Digital Voltmeter.) |

panel. If the extender is configured for 110-volt operation, the mains voltage must be in the range of 88 to 132 volts ac (rms); for 220-volt operation, the main voltage must be in the range of 176 to 264 volts ac (rms). Bear in mind that the electrical load imposed by the extender and memory modules may reduce the line voltage below the no-load value.

If the line voltage is in the correct range, have the electrician also check the power outlet to ensure that it is wired correctly with respect to ac high potential, ac neutral, and earth ground. If the outlet is wired improperly, correction must be made by a qualified electrician. Local electrical codes must be observed if the installation is inside a building.

For safety reasons, it is *mandatory* that a connection be made between the extender chassis and earth ground. For installation in a mobile environment (e.g., ship, aircraft, or train), the earth ground wire in the extender ac power cord must be connected to the hull or metal frame of the vehicle.

Figure 2-1 illustrates and provides the necessary details of the various ac power cord configurations. If the extender is to be installed in a building, make sure that the power cord furnished with the extender complies with local electrical codes.

## 2-10. EXTENDER MOUNTING

**2-11. PRELIMINARY PROCEDURE.** Before mounting the extender, interchange the computer and extender bottom covers as follows:

**WARNING**

**Hazardous voltages are exposed when the bottom cover of the computer is removed and ac power is applied.**

**CAUTION**

All contents of memory will be lost when the mains (line) and battery voltages are both off. Therefore, before proceding, ensure that any contents of memory to be saved are stored in another medium for later retrieval.

a. Loosen screw in rear fold of extender bottom cover; slide cover toward the rear and remove.

b. Set computer ~LINE and BATTERY switches to OFF. Loosen screw in rear fold of computer bottom cover; slide cover toward rear and remove.

c. Interchange extender and computer bottom covers and secure in place by tightening screw in rear fold of each cover.

**2-12. Internal Battery Cables.** If a power fail recovery system is installed in the extender, proceed as follows:

a. Set extender BATTERY switch to EXT (external) position, which is effectively the "off" position when external batteries are not connected.

b. Loosen screw in rear fold of top cover; slide cover toward rear and remove.

c. Connect battery cables to the two connectors located on inside of rear panel. Replace top cover and tighten screw in rear fold.

**2-13. Ground Cables.** If your computer has a serial number prefix less than 1603, it will be necessary to install ground cable(s) assembly, part no. 5061-1342 in the computer. To install the ground cable(s), proceed as follows:

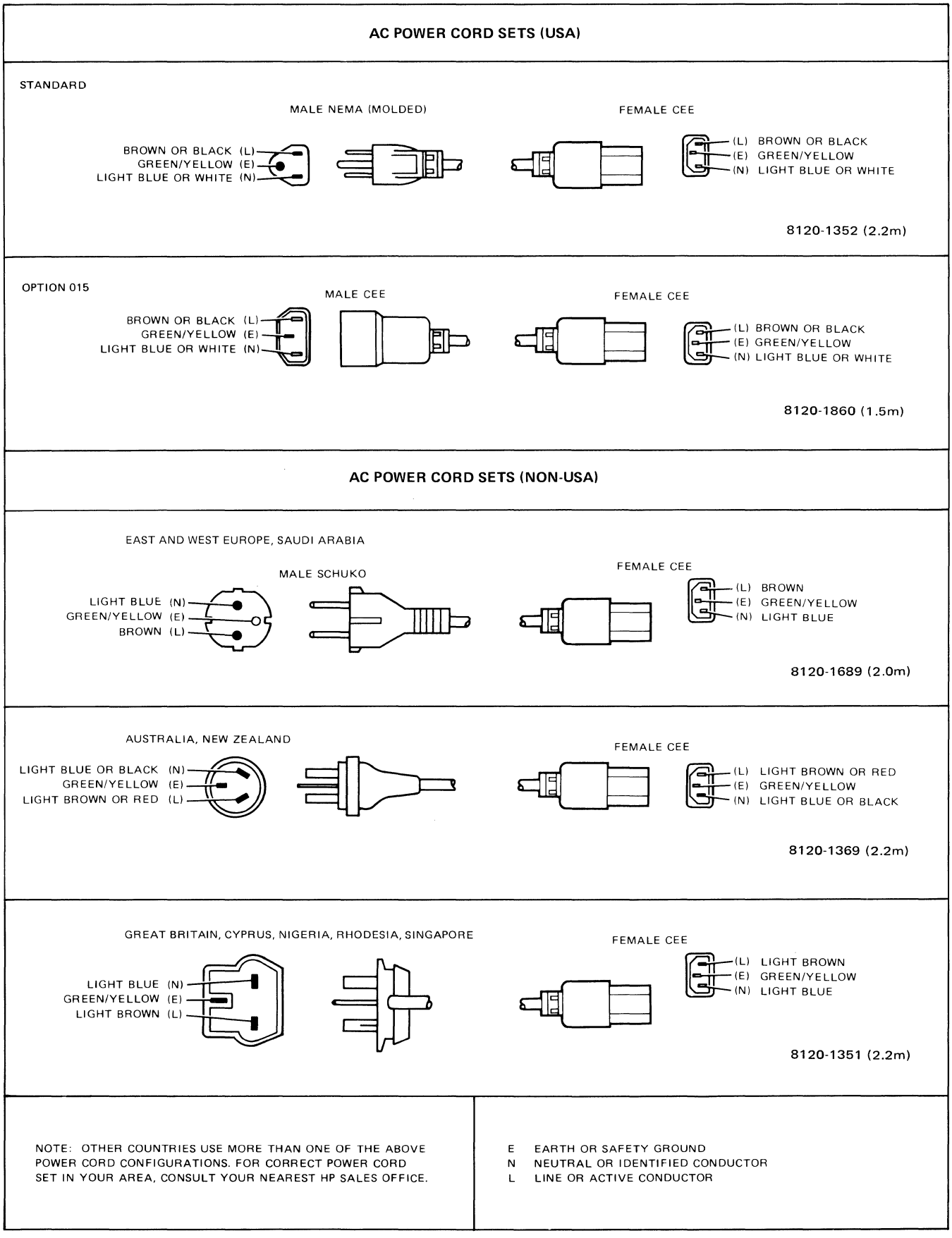



Figure 2-1. AC Power Cord Sets

**WARNING**

**Hazardous voltages are exposed when the top cover of the computer is removed and ac power is applied. Before proceeding, set ~LINE and BATTERY switches to OFF and disconnect the power cord.**

**CAUTION**

All contents of memory will be lost when the mains (line) and battery voltages are both off. Therefore, before proceeding, ensure that any contents of memory to be saved are stored in another medium for later retrieval.

a. Set ~LINE and BATTERY switches to OFF and remove power cord.

b. Loosen screw in rear fold of computer top cover; slide cover toward the rear and remove.

c. Connect the lug of the ground cable to a ground terminal on the crossover PCA as shown in figure 2-2. Some HP 2108A computers have terminal screws inserted from the bottom of the crossover PCA. If you have such a computer, remove the screw from one of the crossover PCA ground terminals, slide the terminals off of the PCA edge, reverse the terminal and secure it and the ground wires to the PCA by inserting the screw on top.

d. Remove the four mounting screws and lockwashers that secure voltage distribution panel to computer frame. (Two screws are located at the top of the panel and two screws are located at the bottom of the panel.)

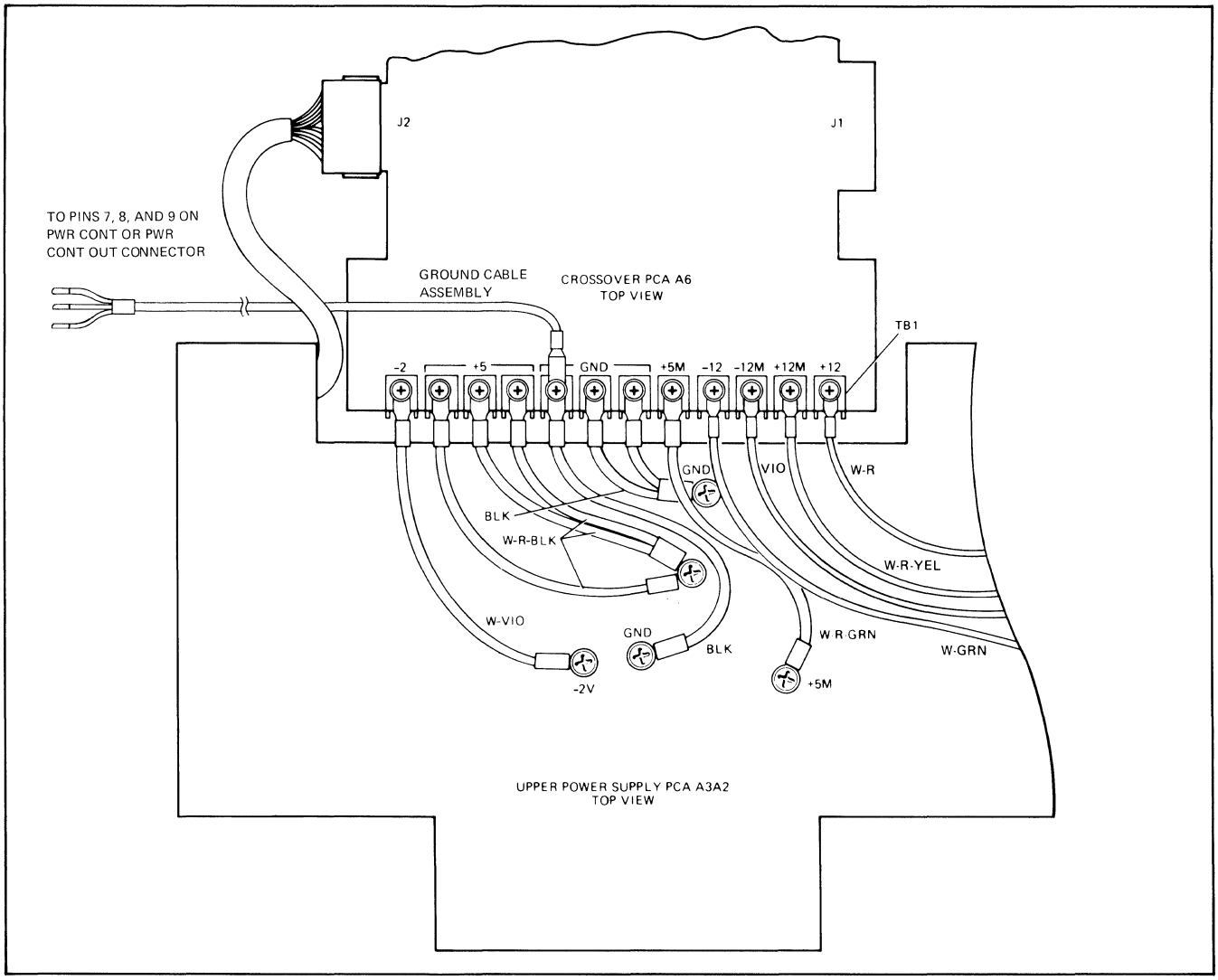



Figure 2-2. Typical Computer Crossover PCA Power Connections

e. Carefully swing the voltage distribution panel outward to expose terminal block TB1 and other components mounted on this panel.

f. For the HP 2108A, insert the ground cable's three loose ends into the unused holes (pins 7, 8, and 9) of the PWR CONT connector on the inside rear of the voltage distribution panel. For the HP 2112A, two cables must be used; one for the PWR CONT IN connector and one for the PWR CONT OUT connector.

g. Position voltage distribution panel in place and secure with the four mounting screws and lockwashers. Replace top cover of computer.

**2-14. BENCH MOUNTING.** If the computer is bench mounted, the memory extender must also be bench mounted due to the cabling restrictions. In a bench-mounted application, the computer is mounted on top of and supported by the extender. The only consideration here is that adequate space be allowed on each side of the computer and extender to ensure full intake and exhaust of ventilating air. Also bear in mind that a minimum clearance of 12 inches (30 centimeters) behind the computer is required when removing and installing input/output interface PCA's.

**2-15. RACK MOUNTING.** If the extender is to be rack mounted, it is recommended that both it and the computer be mounted with separate HP 12903B/C Chassis Slide Kits. If an HP 12903B Chassis Slide Kit has been ordered, rack mount the extender as follows:

a. Following the instructions furnished with the chassis slide kit, mount the kit components to the sides of the memory extender and to the inside of the rack.

b. Install the extender in the rack and secure in place with screws inserted through the mounting holes identified in figure 2-3.

NOTE

The extender is light enough to allow installation in the rack without being supported by any means other than the rack-mounting screws. However, it is recommended that additional support be provided by chassis slides or slide rails.

## 2-16. MEMORY MODULE INSTALLATION

When installing 8K and 16K memory modules in the same memory system there is only one restriction on how the modules may be grouped or mixed: each 16K module must be assigned two consecutive numbers of which the first

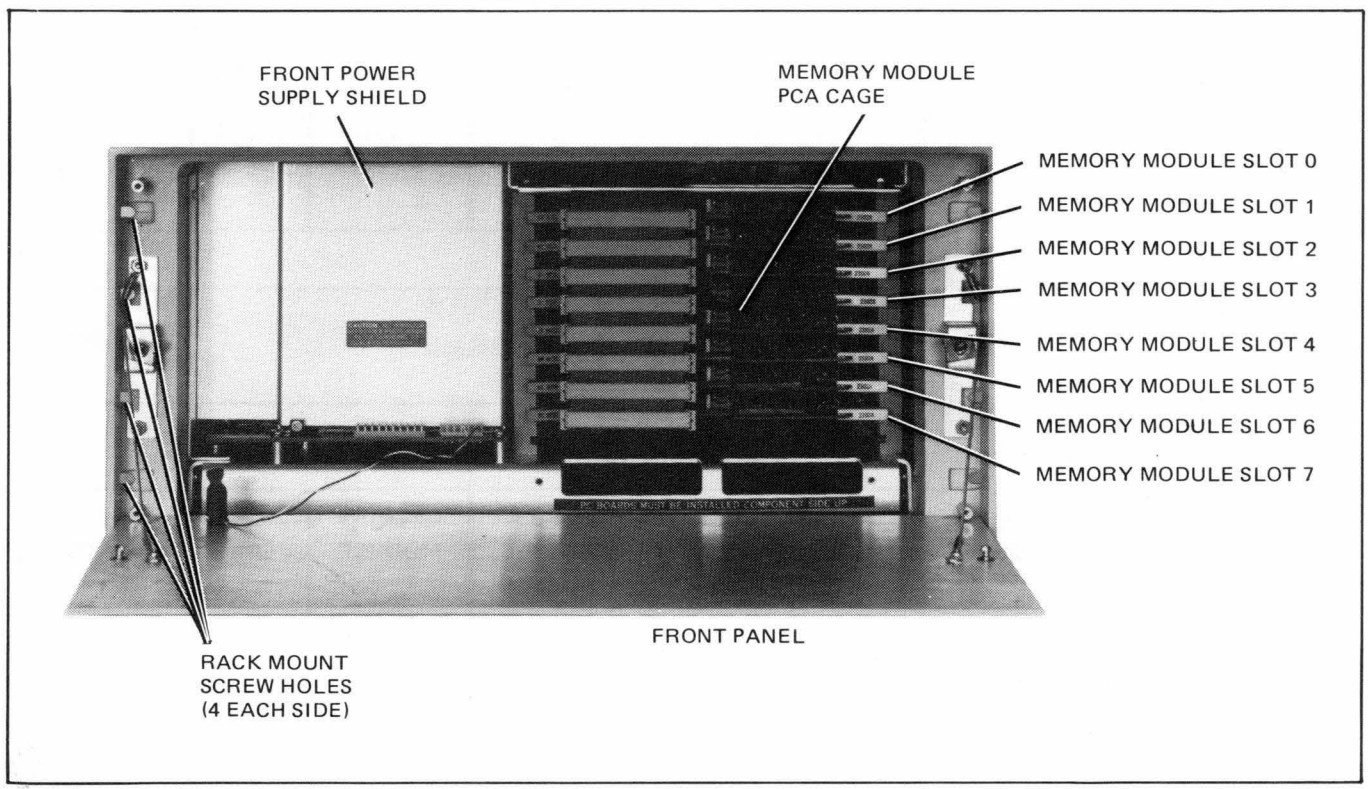



Figure 2-3. HP 12990A Memory Extender Front View

must be an even number. (See figure 2-4.) In a new system, future memory expansion will be easier if you assign low order module numbers (i.e., 0, 1, 2, 3, etc.) to the 16K modules. In a system that is being upgraded, it is more efficient to assign module numbers so that the minimum number of modules must be reassigned new numbers. Tables 2-2 and 2-3 show examples of memory configurations. Note that in the two examples the "new configuration" requires that only two modules be reassigned memory module numbers while the "alternate configuration" requires reassignment of four modules in the first example and six modules in the second.

Install memory modules in the memory extender as follows:

**CAUTION**

All contents of memory will be lost when the mains (line) and battery voltages are both off. Therefore, before proceeding with the installation, ensure that any contents of memory to be saved are stored in another medium for later retrieval.

a. On extender rear panel, set ~LINE switch to OFF. If an internal battery is installed, set BATTERY switch to EXT; if external batteries are used, set BATTERY switch to INT. If both internal and external batteries are used, disconnect external batteries and set BATTERY switch to EXT.

b. On computer rear panel, set ~LINE and BATTERY switches to OFF.

c. Loosen quarter-turn fasteners on memory extender front panel and lower it to memory access position. (See figure 2-3.) Remove memory PCA cage cover by removing the two screws and lockwashers.

d. Loosen quarter-turn fasteners on computer front panel and lower it to memory access position. Remove memory PCA cage cover by removing the two screws and lockwashers.

e. Remove the existing memory system cable present in computer. If necessary, remove memory controller and reinstall in the highest numbered computer memory slot; i.e., slot 118 (HP 2108A) or slot 123 (HP 2112A).

Table 2-2. Typical Memory Configuration (Example 1)

| OLD CONFIGURATION | | | NEW CONFIGURATION | | | ALTERNATE CONFIGURATION | | |
|---|---|---|---|---|---|---|---|---|
| MEMORY MODULE | QTY | MODULE NUMBER | MEMORY MODULE | QTY | MODULE NUMBER | MEMORY MODULE | QTY | MODULE NUMBER |
| 8K | 3 | 0, 1, 2 | 8K | 3 | 0, 1, 8 | 8K | 3 | 6, 7, 8 |
| 4K* | 1 | 3 | 4K* | 1 | 9 | 4K* | 1 | 9 |
| 16K | 0 | — | 16K | 3 | 2, 3, 4, 5, 6, 7 | 16K | 3 | 0, 1, 2, 3, 4, 5 |
| *Must always be highest numbered module in memory. | | | | | | | | |

Table 2-3. Typical Memory Configuration (Example 2)

| OLD CONFIGURATION | | | NEW CONFIGURATION | | | ALTERNATE CONFIGURATION | | |
|---|---|---|---|---|---|---|---|---|
| MEMORY MODULE | QTY | MODULE NUMBER | MEMORY MODULE | QTY | MODULE NUMBER | MEMORY MODULE | QTY | MODULE NUMBER |
| 16K | 2 | 0, 1, 2, 3 | 16K | 5 | 0, 1, 2, 3, 8, 9, 10, 11, 12, 13 | 16K | 5 | 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 |
| 8K | 5 | 4, 5, 6, 7, 8 | 8K | 5 | 4, 5, 6, 7, 14 | 8K | 5 | 10, 11, 12, 13, 14 |
| 4K* | 1 | 9 | 4K* | 1 | 15 | 4K* | 1 | 15 |
| *Must always be highest numbered module in memory. | | | | | | | | |

f. If the memory system is to include both 16K and 8K memory modules, refer to the discussion of memory module number assignment given above. Assign consecutive memory module numbers beginning with 0 by installing the 16K and 8K modules XW1 jumpers as specified in figures 2-4 and 2-5.

g. If the memory system is to include 16K or 8K memory modules (but not both), assign consecutive memory module numbers beginning with 0. Install the XW1 jumpers as specified in figure 2-4 or 2-5.

h. If a half-loaded memory module (i.e., 4K) is present, assign it the highest module number in the system and install XW1 jumpers as specified in figure 2-6.

i. Install the memory modules in the extender and the computer. For best power supply loading in both units, install the first memory module in the computer, the next eight modules in the extender, and any remaining modules in the computer. At least one memory module must be installed in the computer. Refer to figure 2-7 for a typical memory system installation.

## 2-17. CABLE CONNECTIONS

**2-18. MEMORY SYSTEM CABLE.** The extended memory system cable, part no. 12990-60011, includes seventeen 50-pin connectors. A space is included between the eighth and ninth connectors to account for the space existing between the memory controller in the computer and the topmost memory module in the extender. Connect the extended memory system cable as follows:

a. If you have an HP 2108A Computer, take a sharp knife or pair of scissors and cut the last four connectors off of the 9-connector half of the cable.

b. Gain access to memory PCA cages in computer and memory extender.

c. Pass eight cable connectors through bottom of computer and top of extender.

d. Connect cable to edge connector J1 on memory controller and to J1 on all memory modules.

**2-19. POWER CONTROL CABLE.** Connect one end of power control cable assembly, part no. 12990-60014, to PWR CONT or PWR CONT OUT connector on computer rear panel; connect free end of cable to PWR CONT IN connector on extender rear panel. (See figure 2-8.)

NOTE

The power control cable must be installed to ensure a common ground reference for the internal voltages in the computer and the memory extender.

**2-20. EXTERNAL BATTERIES.** The following materials are required if a power fail recovery system is not installed and it is desired to sustain memory with two external 12-volt batteries:

**CAUTION**

The extender provides a charging current of 350 milliamperes to each of the external batteries after they sustain memory and ac power is restored to the extender. Be sure that the external batteries used can accept the battery charging current. Special care must be taken to protect the external batteries' cables and terminals from electrical shorting. Also, be sure that the installation of external batteries complies with local safety codes.

a. Two two-pin female receptacles, Molex* part no. 03-09-1023.

b. Four female terminals, Molex part no. 02-09-5110.

c. Cable as required.

d. Battery PCA, part no. 02112-60003.

Assemble the two battery cables and observe the polarity and color codes as shown in figure 2-9. Set extender BATTERY switch to INT (internal) position, which is effectively the "off" position when internal batteries are not connected. Connect the battery cables to the two BAT. INPUT connectors. Insert battery PCA (figure 4-1, index 21) into mating receptacle on lower power supply PCA; the component side of the battery PCA must face the rear of the extender.

## 2-21. POWER SUPPLY ADJUSTMENTS

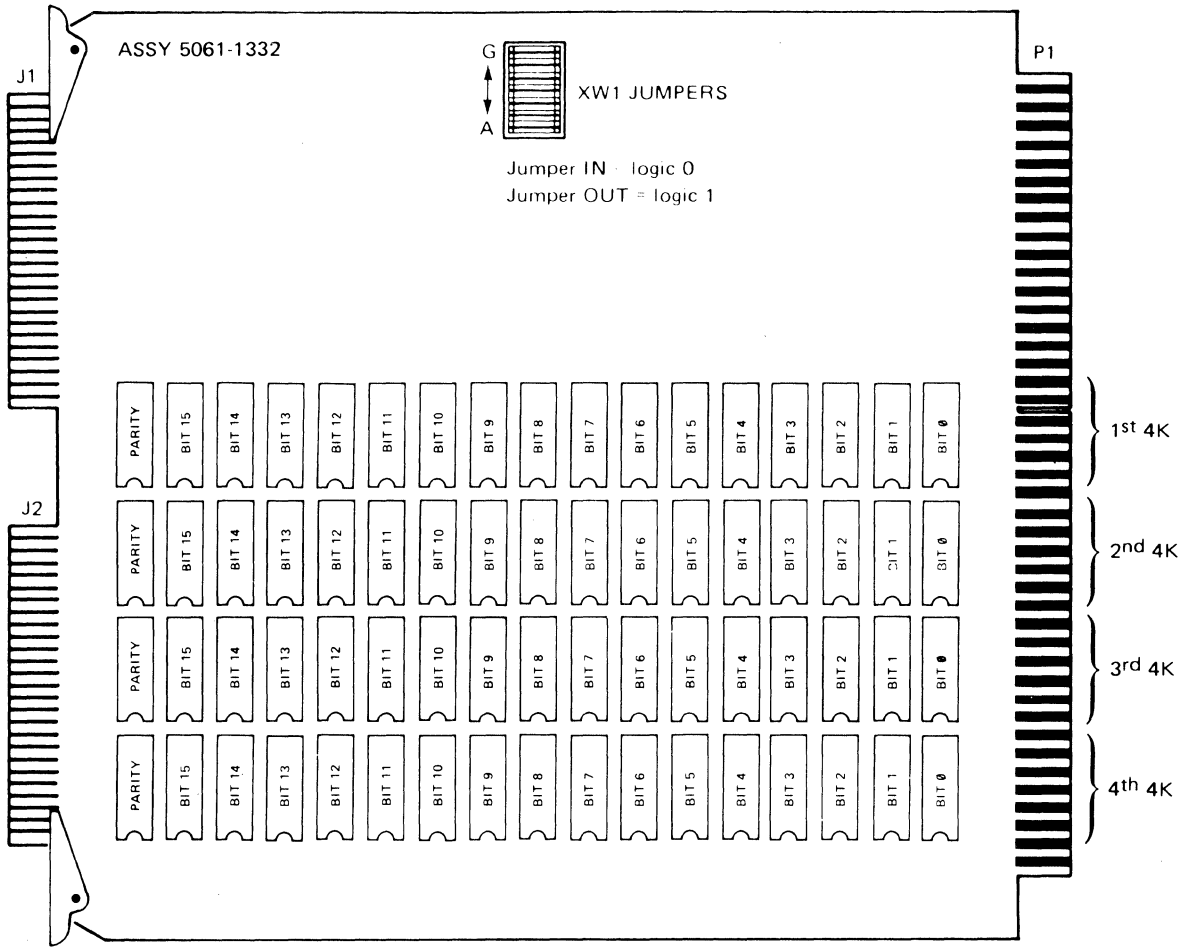
Energize the digital voltmeter and allow sufficient warmup time for the instrument to reach its rated accuracy. Plug the extender power cord into the power outlet and proceed as follows:

a. Loosen quarter-turn fasteners on memory extender front panel and lower it to memory access position.

b. On rear panel of extender, set ~LINE switch to ON. Set BATTERY switch to INT (internal) or EXT (external) as required to select battery.

---

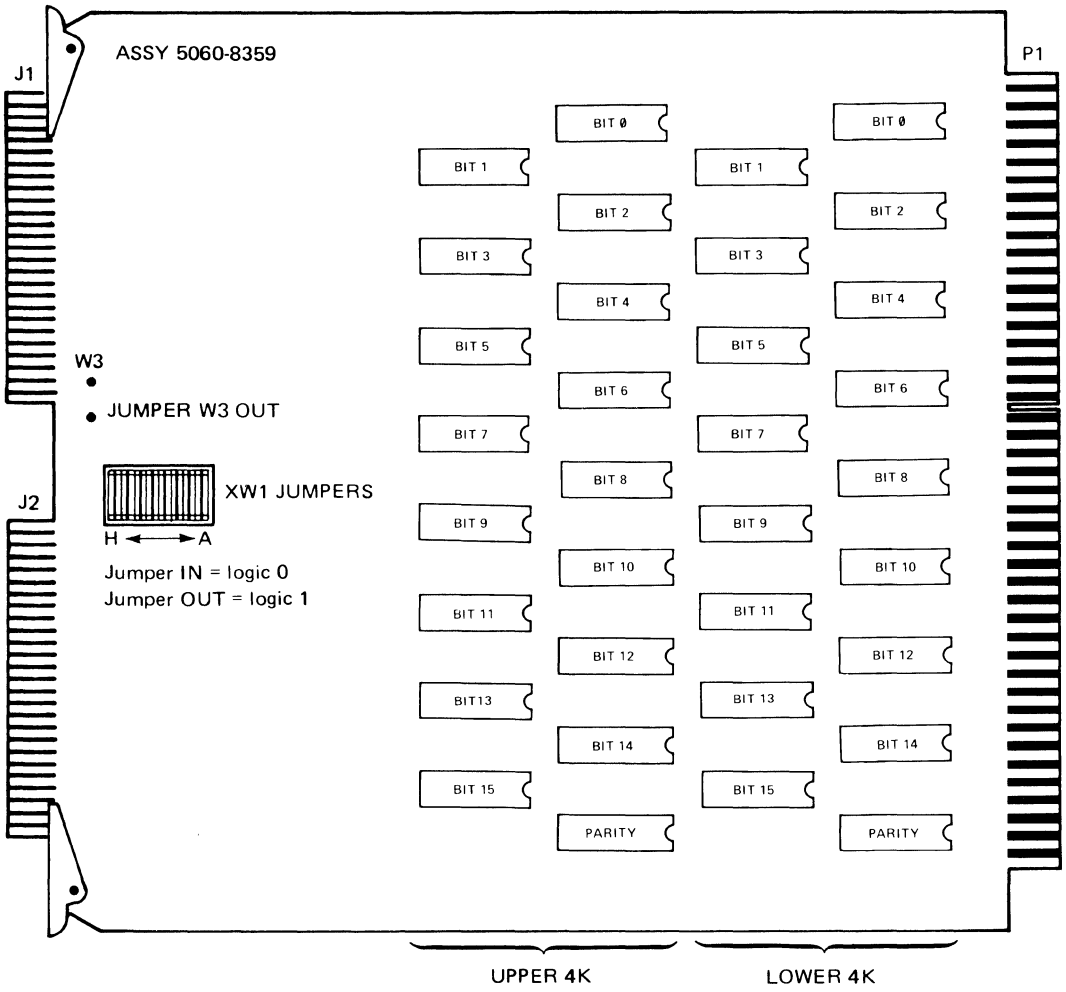
*Molex Products Co., 5224 Katrine Ave., Downers Grove, Illinois 60515




| MEMORY MODULE NO. | XW1 JUMPERS | | | | | | |
|---|---|---|---|---|---|---|---|
| | A ($2^0$) | B ($2^1$) | C ($2^2$) | D ($2^3$) | E ($2^4$) | F ($2^5$) | G |
| 0,1 | IN | IN | IN | IN | IN | IN | ALWAYS OUT |
| 2,3 | OUT | IN | IN | IN | IN | IN | |
| 4,5 | IN | OUT | IN | IN | IN | IN | |
| 6,7 | OUT | OUT | IN | IN | IN | IN | |
| 8,9 | IN | IN | OUT | IN | IN | IN | |
| 10,11 | OUT | IN | OUT | IN | IN | IN | |
| 12,13 | IN | OUT | OUT | IN | IN | IN | |
| 14,15 | OUT | OUT | OUT | IN | IN | IN | |
| 16,17 | IN | IN | IN | OUT | IN | IN | |
| 18,19 | OUT | IN | IN | OUT | IN | IN | |
| 20,21 | IN | OUT | IN | OUT | IN | IN | |
| 22,23 | OUT | OUT | IN | OUT | IN | IN | |
| 24,25 | IN | IN | OUT | OUT | IN | IN | |
| 26,27 | OUT | IN | OUT | OUT | IN | IN | |
| 28,29 | IN | OUT | OUT | OUT | IN | IN | |
| 30,31 | OUT | OUT | OUT | OUT | IN | IN | |
| 32,33 | IN | IN | IN | IN | OUT | IN | |

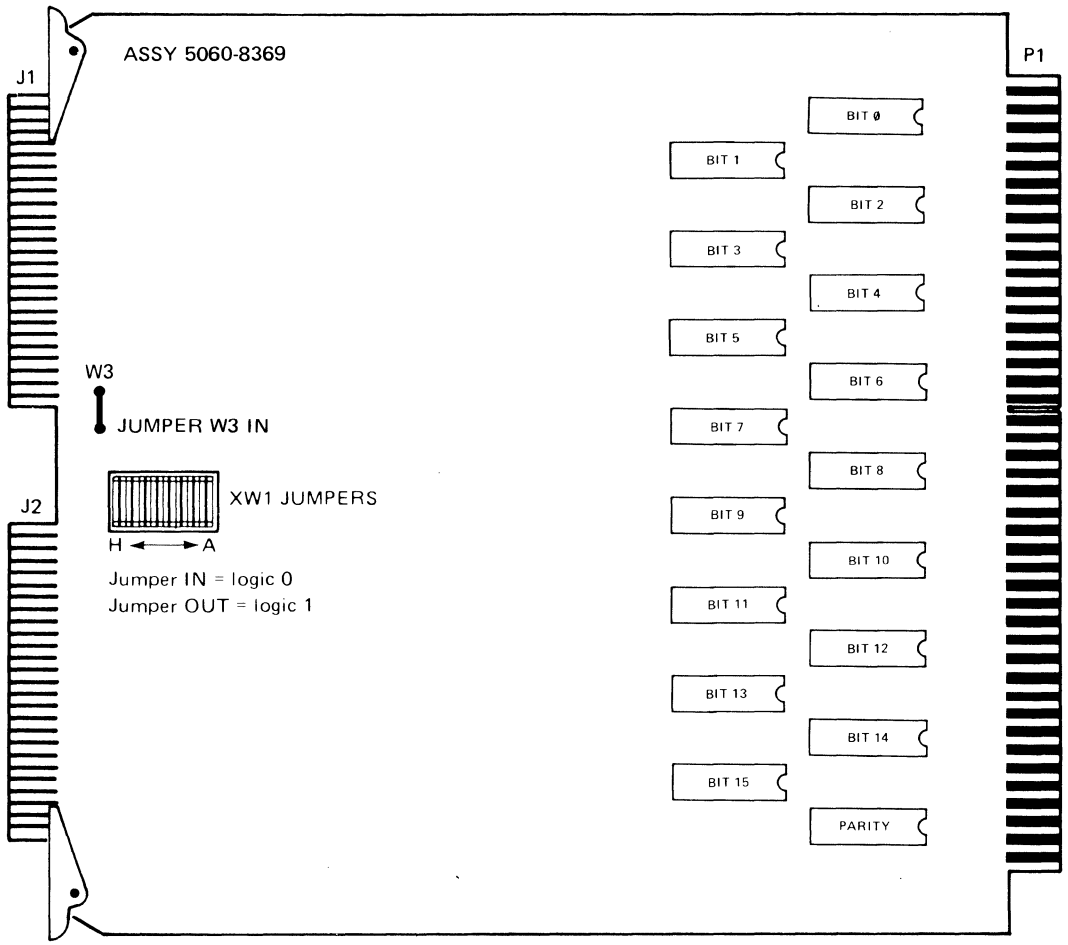
Note: The 16K modules are equivalent to two contiguous 8K modules.

Figure 2-4. HP 2102 16K Memory Module Address Jumpers




| MEMORY MODULE | W3 | XW1 JUMPERS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | A | B ($2^0$) | C ($2^1$) | D ($2^2$) | E ($2^3$) | F ($2^4$) | G ($2^5$) | H $2^6$) |
| 0 | ALWAYS OUT | DON'T CARE | IN | IN | IN | IN | IN | IN | IN |
| 1 | | | OUT | IN | IN | IN | IN | IN | IN |
| 2 | | | IN | OUT | IN | IN | IN | IN | IN |
| 3 | | | OUT | OUT | IN | IN | IN | IN | IN |
| 4 | | | IN | IN | OUT | IN | IN | IN | IN |
| 5 | | | OUT | IN | OUT | IN | IN | IN | IN |
| 6 | | | IN | OUT | OUT | IN | IN | IN | IN |
| 7 | | | OUT | OUT | OUT | IN | IN | IN | IN |
| 8 | | | IN | IN | IN | OUT | IN | IN | IN |
| 9 | | | OUT | IN | IN | OUT | IN | IN | IN |
| 10 | | | IN | OUT | IN | OUT | IN | IN | IN |
| 11 | | | OUT | OUT | IN | OUT | IN | IN | IN |
| 12 | | | IN | IN | OUT | OUT | IN | IN | IN |
| 13 | | | OUT | IN | OUT | OUT | IN | IN | IN |
| 14 | | | IN | OUT | OUT | OUT | IN | IN | IN |
| 15 | | | OUT | OUT | OUT | OUT | IN | IN | IN |
| 16 | | | IN | IN | IN | IN | OUT | IN | IN |

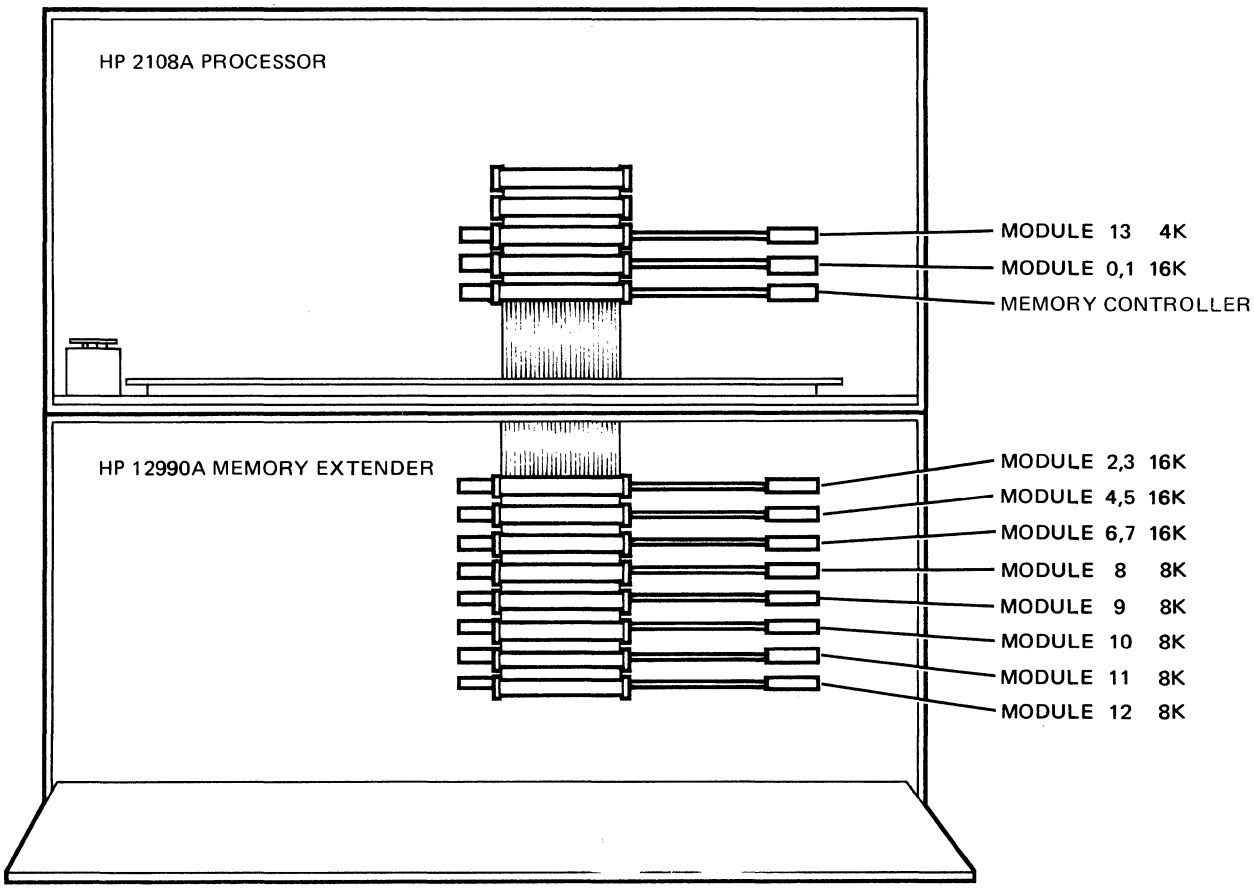
Figure 2-5. HP 2102 8K Memory Module Address Jumpers




| MEMORY MODULE | W3 | XW1 JUMPERS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | A | B ($2^0$) | C ($2^1$) | D ($2^2$) | E ($2^3$) | F ($2^4$) | G ($2^5$) | H ($2^6$) |
| 0 | ALWAYS IN | ALWAYS IN | IN | IN | IN | IN | IN | IN | IN |
| 1 | | | OUT | IN | IN | IN | IN | IN | IN |
| 2 | | | IN | OUT | IN | IN | IN | IN | IN |
| 3 | | | OUT | OUT | IN | IN | IN | IN | IN |
| 4 | | | IN | IN | OUT | IN | IN | IN | IN |
| 5 | | | OUT | IN | OUT | IN | IN | IN | IN |
| 6 | | | IN | OUT | OUT | IN | IN | IN | IN |
| 7 | | | OUT | OUT | OUT | IN | IN | IN | IN |
| 8 | | | IN | IN | IN | OUT | IN | IN | IN |
| 9 | | | OUT | IN | IN | OUT | IN | IN | IN |
| 10 | | | IN | OUT | IN | OUT | IN | IN | IN |
| 11 | | | OUT | OUT | IN | OUT | IN | IN | IN |
| 12 | | | IN | IN | OUT | OUT | IN | IN | IN |
| 13 | | | OUT | IN | OUT | OUT | IN | IN | IN |
| 14 | | | IN | OUT | OUT | OUT | IN | IN | IN |
| 15 | | | OUT | OUT | OUT | OUT | IN | IN | IN |
| 16 | | | IN | IN | IN | IN | OUT | IN | IN |

Note: This 4K module must be assigned the highest used memory module number regardless of the memory configuration. Only one 4K module allowed per configuration.

Figure 2-6. HP 2102 4K Memory Module Address Jumpers




NOTES:

1. Memory controller must be installed in highest numbered memory slot in the computer; i.e., slot 118 (HP 2108A) or slot 123 (HP 2112A).
2. Memory module numbers must be assigned consecutively beginning with module 0.
3. At least one memory module must be installed in the computer.
4. If installing a half-loaded module (i.e., 4K), it must be assigned the highest memory module number in the system. Only one half-loaded module is allowed in a system.
5. If installing a mix of both 16K and 8K modules, it is suggested that the 16K modules be assigned low order module numbers (0, 1, 2, 3, etc.). Refer to paragraph 2-16.

Figure 2-7. Typical Memory System Configuration

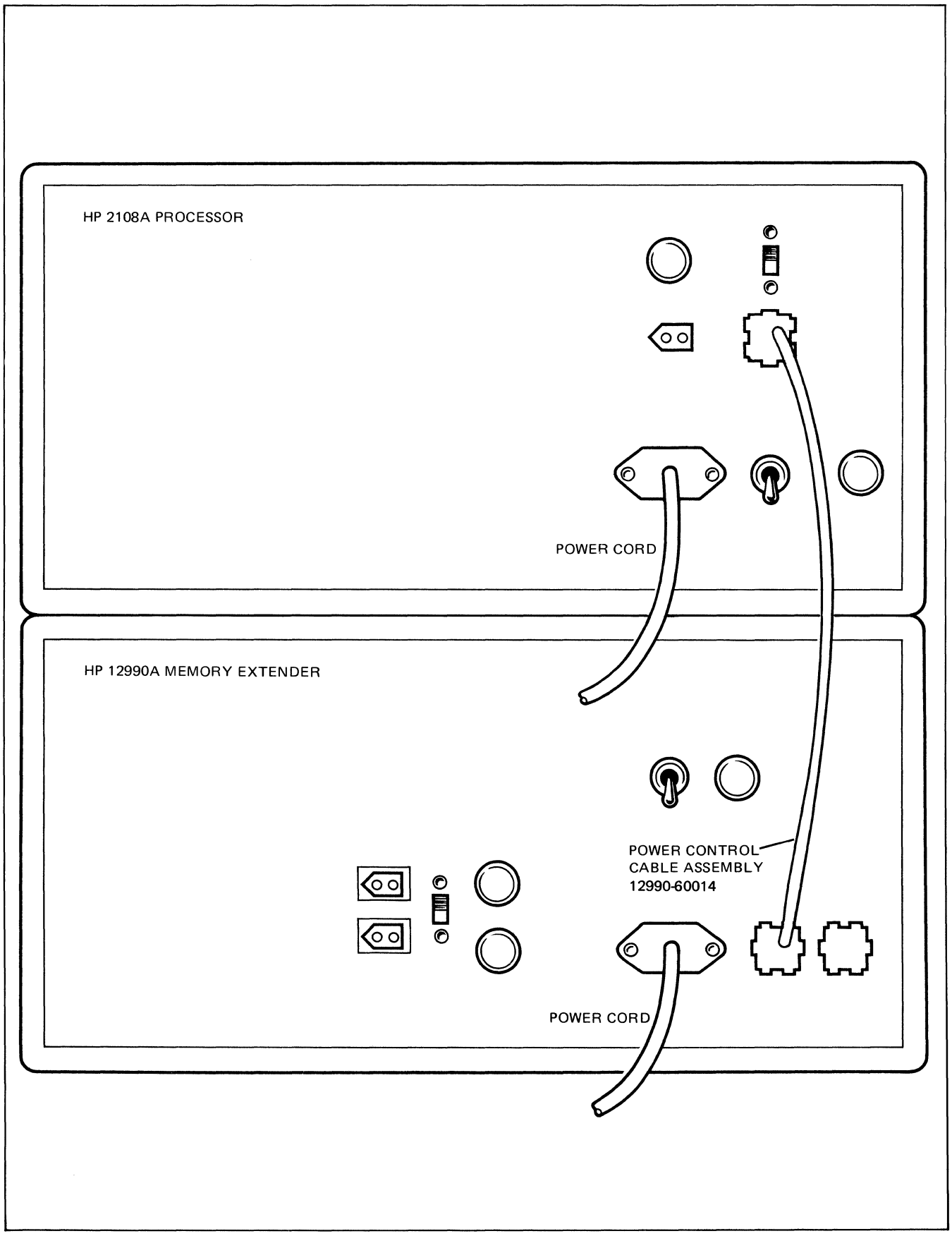



Figure 2-8. Rear Panel Cabling

NOTE

Internal batteries are completely discharged before shipment. Upon initial application of charging voltage, or after a prolonged power failure, the BATTERY indicator will flash on and off for approximately 16 hours until the battery contains a sufficient charge to sustain memory.

c. On rear panel of computer, set LINE and BATTERY switches to ON.

d. On front panel of computer, rotate key-operated switch to R (reset) and then to STANDBY.

e. Connect positive lead of digital voltmeter to J6-9 (+12VM test point) and connect common lead to J6-2 (common). (See figure 2-10.)

f. Adjust +12VM ADJ potentiometer to obtain voltmeter indication of +12.45 to +12.55 volts. This adjustment must be made with the memory modules installed to provide a power supply load.

g. Check tolerances of remaining supplies; test points and tolerances are listed in table 2-4. If any power supply is out of tolerance, notify the nearest Hewlett-Packard Sales and Service Office. Sales and Service Offices are listed at the rear of this manual.

h. Disconnect voltmeter, close extender front panel, and secure in place with the quarter-turn fasteners.

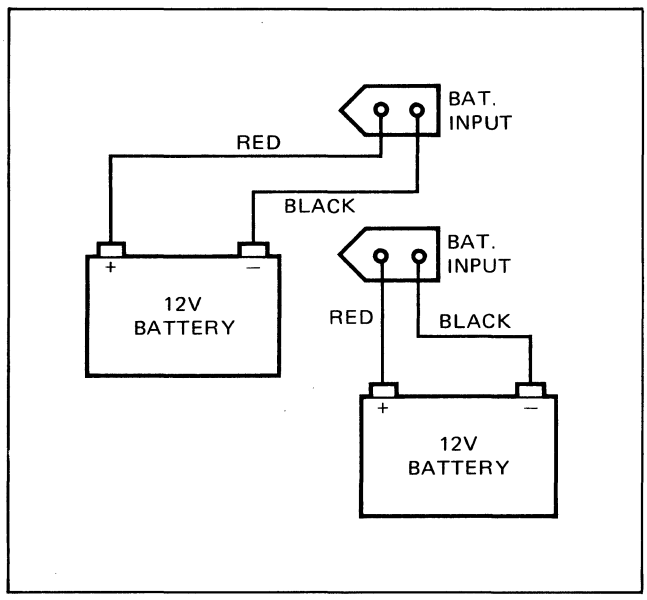



Figure 2-9. External Battery Cabling

Table 2-4. Power Supply Voltage Tolerances

| SUPPLY | TEST POINT* | TOLERANCE |
|---|---|---|
| $\overline{\text{PUUP}}$ | J6-1 | — |
| Common | J6-2 | — |
| +5V | J6-5 | ±0.25V |
| +5VM | J6-6 | ±0.25V |
| +5V | J6-7 | ±0.25V |
| +12VM | J6-9 | ±0.6V |
| −12VM | J6-10 | ±0.6V |

*J6 is mounted on lower power supply PCA. (See figure 2-10.)

## 2-22. PERFORMANCE VERIFICATION CHECK

Verify the system installation and operation as described in the *Semiconductor Memory Module Diagnostic Reference Manual*, part no. 24395-90001.

## 2-23. CLAIMS PROCEDURE

If the extender is damaged or fails to meet specifications, notify the nearest Hewlett-Packard Sales and Service Office. If damaged occured in transit, notify the carrier also. Hewlett-Packard will arrange for replacement or repair without waiting for settlement of claims against the carrier. In the event of damage in transit, retain the packing carton and packaging materials for inspection.

## 2-24. REPACKING FOR SHIPMENT

**CAUTION**

The power fail recovery system battery must be discharged before shipment. This can best be accomplished by disconnecting the power cord, setting the BATTERY switch to the INT position, and allowing the internal battery to discharge approximately 3 hours. After the battery is discharged, disconnect the battery cables from the battery input receptacles mounted on the inner side of the rear panel.

**CAUTION**

When shipping the extender with a power fail recovery system installed, secure the battery PCA in place with masking tape or equivalent.

## 2-25. SHIPMENT USING ORIGINAL PACKAGING

The same containers and materials used in factory packaging can be used for reshipment of the extender. Alternatively, containers and packing materials may be obtained from Hewlett-Packard Sales and Service Offices. If the extender is being sent to the factory for servicing, attach a tag to the extender specifying the type of service required together with the extender model number and full serial number. Mark the container "FRAGILE" to ensure careful handling. In any subsequent correspondence, refer to the extender by model number and full serial number.

## 2-26. SHIPMENT USING NEW PACKAGING

The following instructions should be used as a guide when packaging the extender with commercially available materials:

a. Wrap extender in heavy paper or sheet plastic. If shipping the extender to Hewlett-Packard, first attach a tag to the extender with your return address and indicating the type of service required. Include the extender model number and full serial number.

b. Use a strong shipping container. A double-wall carton constructed of 160-kilogram (350-pound) test material is adequate.

c. Use sufficient shock-absorbing material on all sides of the extender to provide a firm cushion and to prevent movement inside the container. Use particular care to protect the extender corners and front and rear panels.

d. Seal the shipping container securely and mark it "FRAGILE."

e. In any subsequent correspondence with Hewlett-Packard, refer to the extender by model number and full serial number.

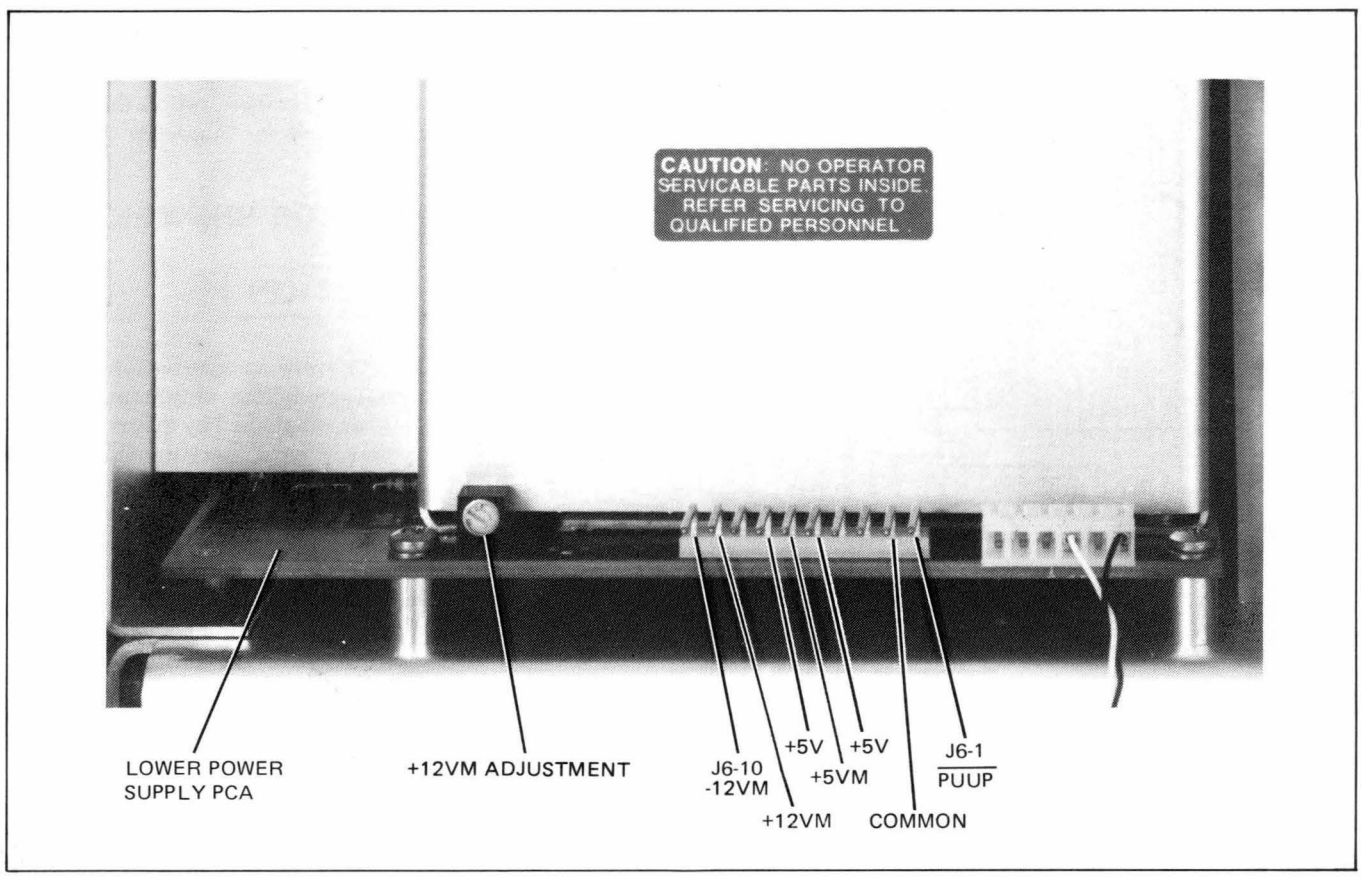



Figure 2-10. Power Supply Adjustment and Voltage Test Points

**3-4. REMOVAL.** Remove the top, side, and bottom covers as follows:

a. If present, remove extender memory system cable.

b. Loosen screw located on rear fold of top cover; slide cover towards rear and remove.

c. If present, remove chassis slide(s) from side cover(s). Loosen screw on rear fold of side cover; slide cover towards rear and remove.

d. Loosen screw located on rear fold of bottom cover; slide cover toward rear and remove.

**3-5. REPLACEMENT.** Replace the covers in the reverse order of the removal procedure.

## 3-6. MEMORY CAGE PCA's

**3-7. REMOVAL.** Remove the printed-circuit assemblies (PCA's) from the memory cage as follows:

a. Loosen two quarter-turn fasteners on memory extender front panel and lower it to memory access position.

b. Remove memory PCA cage cover by removing two screws and lockwashers.

c. Disconnect extender memory system cable from all PCA's.

d. Remove PCA by pulling forward on extractor levers.

**3-8. REPLACEMENT.** Replace memory PCA's in the reverse order of the removal procedure. When replacing a memory module, be sure to configure the memory module address jumpers correctly. Figures 2-4 through 2-6 illustrate the HP 2102 memory module address jumpers.

## 3-9. MEMORY BACKPLANE

**3-10. REMOVAL.** To remove the memory backplane, proceed as follows:

a. Disconnect memory system cable from all PCA's in memory cage.

b. Withdraw all memory PCA's approximately 2 inches (5 centimeters) to clear rear connectors from memory backplane receptacles.

c. Loosen screws securing six wires to memory backplane and disconnect wires from memory backplane.

d. Remove bolt securing memory backplane retainer to mainframe and withdraw memory backplane from mainframe.

**3-11. REPLACEMENT.** Replace the memory backplane in the reverse order of the removal procedure.

## 3-12. POWER FAIL RECOVERY SYSTEM

**3-13. BATTERY REMOVAL.** Remove the top cover from the extender. Set the BATTERY switch to EXT and disconnect the battery cables from the rear panel connectors. Remove the eight screws and lockwashers securing the cover to the battery housing. Remove the battery assemblies.

**3-14. BATTERY PCA REMOVAL.** Slide the extender top cover back to access the battery PCA. Grasp the battery PCA and pull it upward out of the board guides.

**3-15. REPLACEMENT.** Replace the batteries and battery PCA in the reverse order of the removal procedure.

## 3-16. POWER SUPPLY

**WARNING**

**Hazardous voltages are present with the ac power cord connected. Ensure that the ac power cord is disconnected before proceeding.**

**3-17. REMOVAL.** Remove extender top cover and proceed as follows:

a. Loosen two quarter-turn fasteners on extender front panel and lower it to access position. On lower power supply PCA, disconnect cable that goes to front panel.

b. Remove screw securing ground (black) wires to top of upper power supply PCA. Replace screw to secure only the ground wire going to memory backplane.

c. Loosen screws securing wires to memory backplane and disconnect wires from backplane.

d. Remove ground wires going to rear panel from wire harness.

e. Remove seven screws and lockwashers securing rear panel to main frame. Four of these screws are inside mainframe (figure 4-1) and three are along bottom of rear panel.

f. Remove four screws and lockwashers securing upper power supply PCA supports to left side of mainframe.

# SERVICE

SECTION III

This section includes information for isolating malfunctions to the subassembly level and procedures for removing and replacing the various extender subassemblies. Also included is a power distribution diagram.

## 3-1. TROUBLESHOOTING

Extender malfunctions can be isolated to a subassembly level by performing in sequence the procedure presented in figure 3-1. When a malfunction is encountered, replace the first suspect subassembly and repeat that portion of the procedure where the malfunction occured. (Subassembly removal and replacement procedures are given in the following paragraphs.) If the malfunction persists, reinstall the original subassembly, and again repeat the procedure. After the malfunction is cleared, contact the nearest Hewlett-Packard Sales and Service Office for instructions regarding shipment of the defective subassembly.

Attach a tag to the defective subassembly identifying the owner and specifying the type of malfunction. Include the model number and full serial number of your extender. Pack the defective subassembly in the packaging removed from the replacement subassembly, seal the shipping package, and mark it "FRAGILE" to ensure careful handling.

## 3-2. SUBASSEMBLY REMOVAL AND REPLACEMENT

**WARNING**

**Hazardous voltages are present inside the extender mainframe. Use extreme caution when working around the power supply area. Heed all WARNING — HAZARDOUS VOLTAGE labels.**

The following paragraphs, which describe procedures for removing and replacing various extender parts and subassemblies shown in figure 4-1, assume that the extender is installed as a freestanding device. If the extender is rack mounted, read the entire subassembly removal procedure and refer to figure 4-1. When it is obvious that the procedure cannot be performed with the extender in the rack, proceed as follows:

**CAUTION**

All contents of memory will be lost when the mains (line) and battery voltages are both off. Therefore, before proceeding, ensure that any contents of memory to be saved are stored in another medium for later retrieval.

a. On extender rear panel, set ~LINE switch to OFF. If an internal battery is installed, set BATTERY switch to EXT; if an external battery is used, set BATTERY switch to INT and disconnect battery cables. Disconnect ac power cord and power control cable (figure 2-8).

b. On computer rear panel, set ~LINE and BATTERY switches to OFF.

c. Loosen quarter-turn fasteners on memory extender front panel and lower it to memory access position. (See figure 2-3.) Remove memory PCA cage cover by removing the two screws and lockwashers.

d. Loosen quarter-turn fasteners on computer front panel and lower it to memory access position. Remove memory PCA cage cover by removing the two screws and lockwashers.

e. Disconnect extender memory system cable and remove cable.

f. Remove the screws that secure the front of the extender to the rack, close the front panel, and slide the extender out of the rack.

g. Remove the extender from the chassis slides.

h. To replace the extender in the rack, reverse the procedures contained in the previous steps.

## 3-3. TOP, SIDE, AND BOTTOM COVERS

**WARNING**

**Hazardous voltages are exposed when the covers are removed and ac power is applied.**

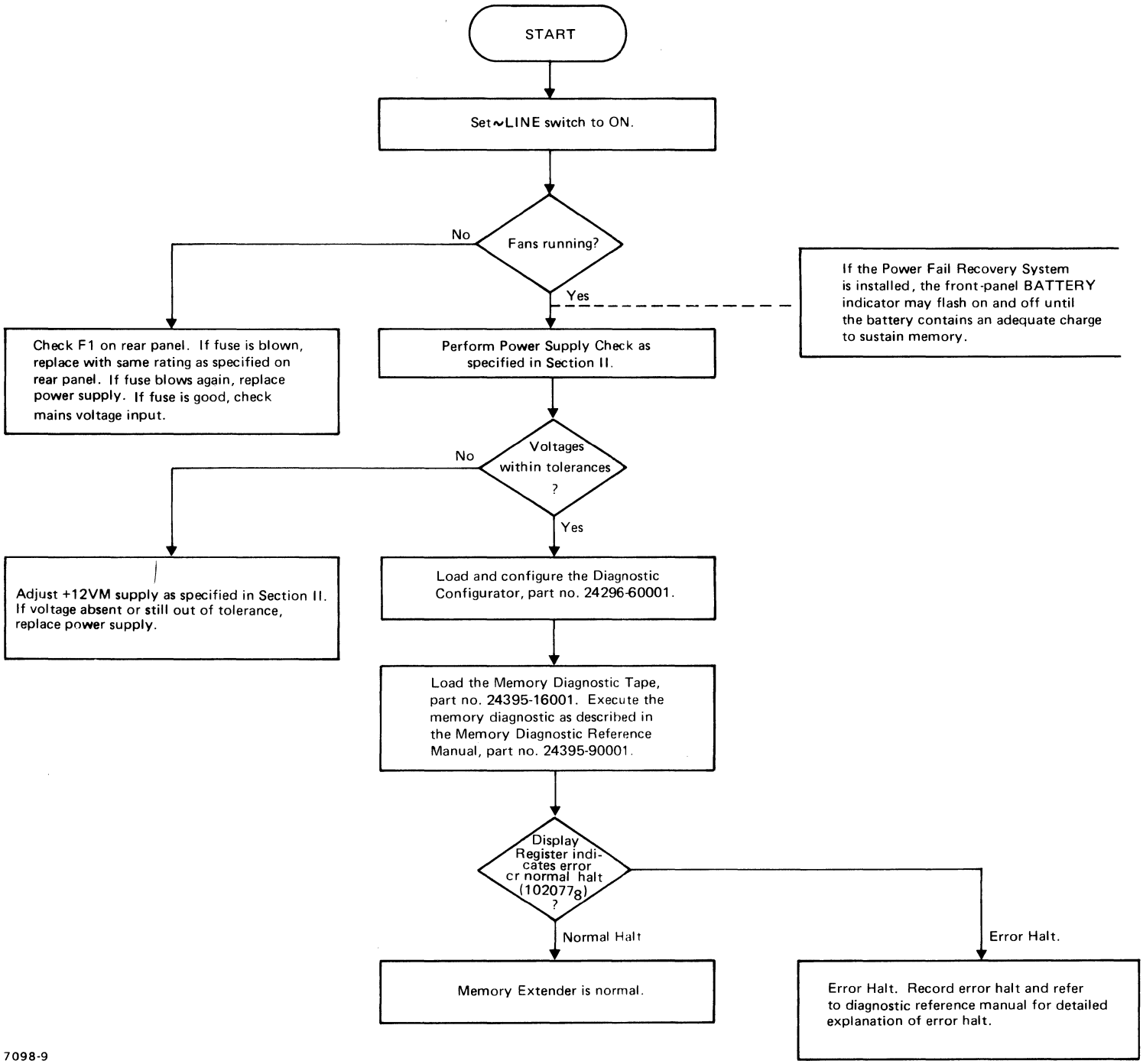



Figure 3-1. Troubleshooting Flowchart

g. Remove bolt, two screws and lockwashers securing power supply side shield to mainframe and remove shield.

h. If present, remove battery PCA from power supply.

i. Remove power supply front shield by removing screw and lockwasher.

j. Remove eight long slot-head screws and lockwashers securing upper power supply PCA to mainframe.

k. Remove front two screws and lockwashers securing lower power supply PCA to mainframe.

l. Disconnect two connectors from lower power supply PCA.

m. Disconnect connector from upper power supply PCA and unplug power cords from ventilating fans.

n. Lift power supply up out of mainframe.

**3-18. REPLACEMENT.** Replace the power supply in the reverse order of the removal procedure.

### 3-19. VENTILATING FANS

**WARNING**

**Hazardous voltages are present when working around the power supply area. Ensure that ac power is disconnected before proceeding.**

**3-20. REMOVAL.** Remove the memory extender top and left side covers and proceed as follows:

a. Disconnect the power lead at top of fan.

b. Remove four screws securing fan to mainframe. Pull fan upward and out of mainframe.

**3-21. REPLACEMENT.** Replace the ventilating fan(s) in the reverse order of the removal procedure.

## 3-22. 110/220V AC RECONFIGURATION

To reconfigure the memory extender to operate from 220-volt mains instead of 110-volt mains (or vice versa), refer to figure 3-2 and proceed as follows:

**WARNING**

**Hazardous voltages are present inside the mainframe. Before changing from 110V AC to 220V AC, or vice versa, set ~LINE switch to OFF, BATTERY switch to EXT, and disconnect the power cord. Failure to observe this precaution can result in serious injury or death.**

a. On extender rear panel, set ~LINE switch to OFF. If an internal battery is installed, set BATTERY switch to EXT; if an external battery is used, set BATTERY switch to INT and disconnect battery cables. Disconnect ac power cord.

b. Remove extender top cover.

c. Remove seven screws and lockwashers securing rear panel to mainframe. Four of these screws are inside mainframe (figure 4-1) and three are long bottom of rear panel.

d. Carefully swing the rear panel assembly outward to expose the terminal block, TB1, and other components mounted on this panel.

e. For 110V AC operation, connect a jumper wire between the WHT-YEL-GRA and WHT-BLU-GRA lead wires on terminal block TB1. Connect one side of each fan to the WHT-BRN-GRA lead wire on TB1; connect other side of each fan to the WHT-BLU-GRA lead wire on TB1 as shown in figure 3-2. Replace fuse F1 with the normal blow type and rating specified in table 4-1.

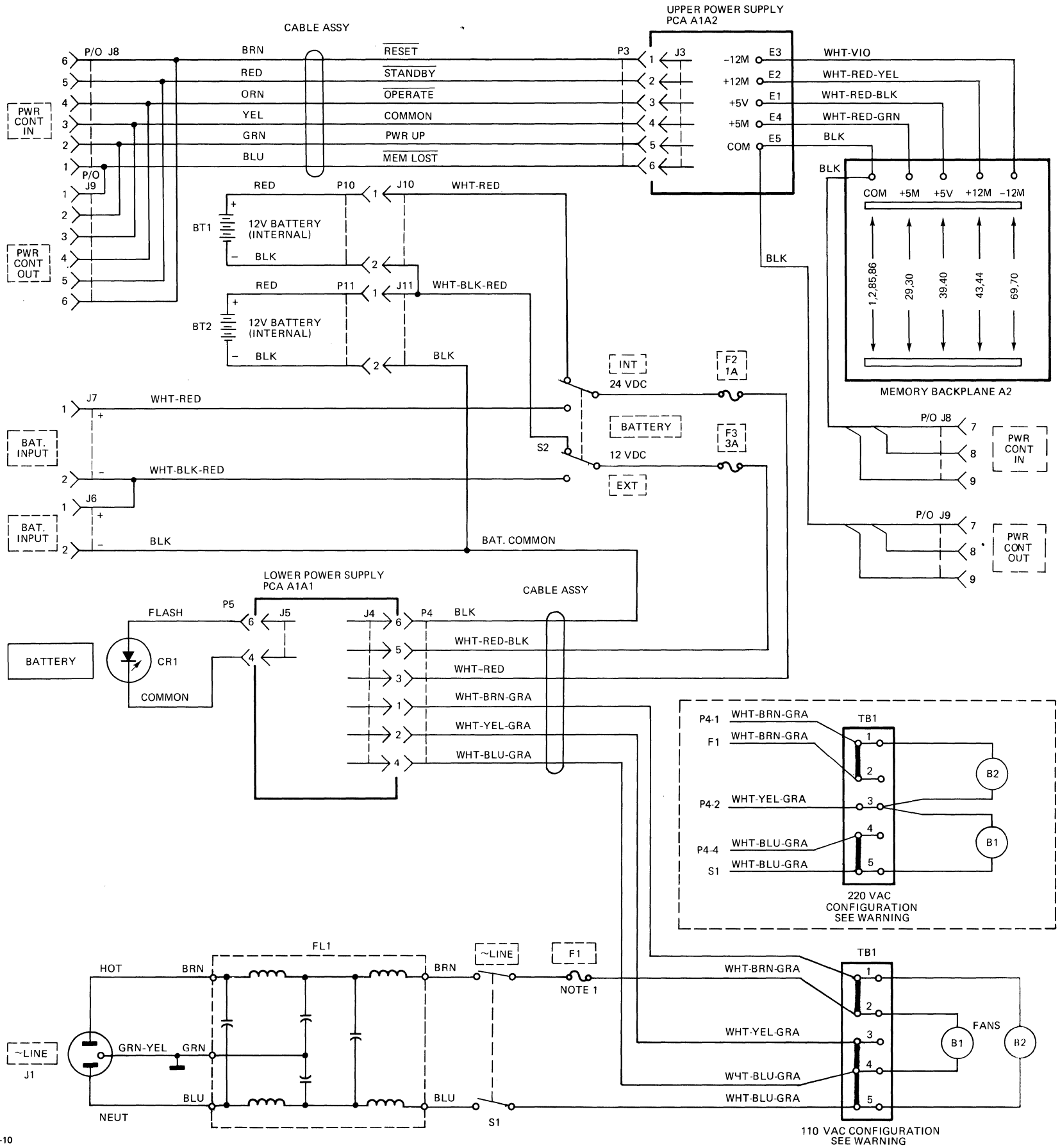
f. For 220V ac operation, remove jumper wire between the WHT-YEL-GRA and WHT-BLU-GRA lead wires on terminal block TB1. Connect one fan across the WHT-BRN-GRA and WHT-YEL-GRA lead wires; connect other fan across the WHT-YEL-GRA and WHT-BLU-GRA lead wires as shown in figure 3-2. Replace fuse F1 with normal blow type and rating specified in table 4-1.

g. Position rear panel in place and secure with the seven mounting screws and lockwashers.

h. For the correct ac power cord set, refer to paragraph 2-9 and figure 2-1.

## 3-23. POWER DISTRIBUTION DIAGRAM

Figure 3-2 shows the wiring between the memory extender backplane, power supply, and other subassemblies in the extender.




NOTES:
1. FUSE F1 RATED AT 4A FOR 110V; 2A FOR 220V.
2. [ ] DENOTES REAR PANEL NOMENCLATURE.
3. [ ] DENOTES FRONT PANEL NOMENCLATURE.

**WARNING**

HAZARDOUS VOLTAGES ARE PRESENT INSIDE THE EXTENDER MAINFRAME! BEFORE CHANGING FROM 110 VAC TO 220 VAC, OR VICE VERSA, SET [~LINE] AND [BATTERY] SWITCHES TO OFF AND *DISCONNECT THE POWER CORD!!* FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN SERIOUS INJURY OR *DEATH!*

Figure 3-2. Power Distribution Diagram

# REPLACEABLE PARTS

SECTION IV

This section provides a field-replaceable parts listing of the HP 12990A Memory Extender. Component parts of printed-circuit assemblies (PCA's) are not included, since these parts are considered replaceable only at the factory or a depot.

## 4-1. REPLACEABLE PARTS

The parts are listed in table 4-1 and illustrated in figure 4-1. The columns in table 4-1 provide the following information for each part:

a. FIG. & INDEX NO. The figure and index number where the replaceable parts are shown in an exploded view.

b. HP PART NO. The Hewlett-Packard part number for each replaceable part.

c. DESCRIPTION. The description of each replaceable part. One asterisk denotes a part or an assembly; two asterisks denote a subassembly or an attaching part of the previous assembly having one asterisk.

d. MFR. CODE. A five-digit code that denotes the manufacturer of the part.

e. MFR. PART NO. The manufacturer's part number for each replaceable part.

f. UNITS PER ASSY. The total number of each replaceable part of the memory extender.

## 4-2. ORDERING INFORMATION

To order replaceable parts, address the order to the local Hewlett- Packard Sales and Service Office listed at the end of this manual.

The following information should be included in the order for each replaceable part:

a. Complete model number (including options and accessories) and serial number.

b. Hewlett-Packard part number for each part.

c. Complete description for each part as provided in the replaceable parts list.

Table 4-1. HP 12990A Memory Extender Replaceable Parts

| FIG. & INDEX NO. | HP PART NO. | DESCRIPTION | MFR CODE | MFR PART NO. | UNITS PER ASSY |
|---|---|---|---|---|---|
| 4-1- | 12990A | MEMORY EXTENDER | 28480 | 12990A | |
| 1 | 12990-60001 | *Backplane Assy | 28480 | 12990-60001 | 1 |
| 2 | 12990-60002 | *Power Supply | 28480 | 12990-60002 | 1 |
| 3 | 12990-60003 | *Rear Panel Assy | 28480 | 12990-60003 | 1 |
| 4 | 0360-0624 | **Terminal Block TB1 | 28480 | 0360-0624 | 1 |
| 5 | 2110-0055 | **Fuse F1, 4A, Normal Blow (110V operation) | 28480 | 2110-0055 | 1 |
| | 2110-0002 | **Fuse F1, 2A, Normal Blow (230V operation) | 28480 | 2110-0002 | |
| 6 | 2110-0001 | **Fuse F2, 1A, Normal Blow | 28480 | 2110-0001 | 1 |
| 7 | 2110-0003 | **Fuse F3, 3A, Normal Blow | 28480 | 2110-0003 | 1 |
| 8 | 3101-0646 | **Toggle Switch S1 | 28480 | 3101-0646 | 1 |
| 9 | 9135-0030 | **Mains Filter | 28480 | 9135-0030 | 1 |
| 10 | 3101-0011 | **Slide Switch S2 | 28480 | 3101-0011 | 1 |
| 11 | 1251-2357 | **Mains Power Connector | 28480 | 1251-2357 | 1 |
| 12 | 12990-60006 | *Front Panel Assy | 28480 | 12990-60006 | 1 |
| 13 | 1990-0518 | **Light-Emitting Diode CR1 | 28480 | 1990-0518 | 1 |
| 14 | 1450-0167 | **Lampholder | 28480 | 1450-0167 | 1 |
| 15 | 02108-00017 | *Side Cover | 28480 | 02108-00017 | 1 |
| 16 | 02108-00034 | *Memory Cage Cover | 28480 | 02108-00034 | 1 |
| 17 | 3160-0224 | *Ventilating Fan | 28480 | 3160-0224 | 2 |
| 18 | 5020-7335 | *Front Frame | 28480 | 5020-7335 | 1 |
| 19 | 5020-8808 | *Rear Frame | 28480 | 5020-8808 | 1 |
| 20 | 12990-60011 | *Memory System Cable | 28480 | 12990-60011 | 1 |
| | Note 1 | *Power Fail Recovery System | | | |
| 21 | 02112-60003 | **Battery PCA | 28480 | 02112-60003 | 1 |
| 22 | 1420-0206 | **Battery | 28480 | 1420-0206 | 2 |

Note 1. Memory extender accessory. Refer to paragraph 1-3.

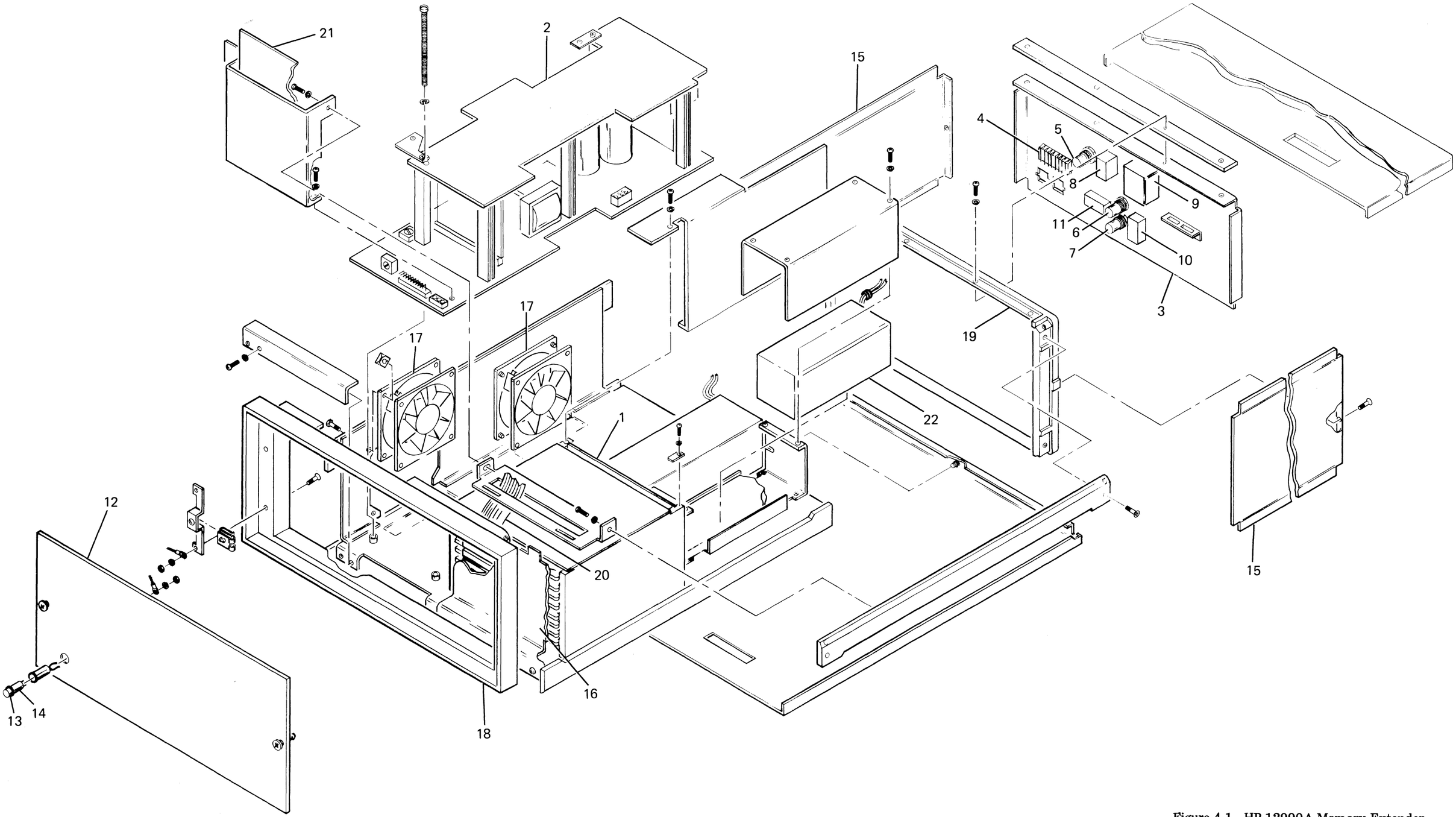



Figure 4-1. HP 12990A Memory Extender Exploded View

HEWLETT hp PACKARD

# SALES & SERVICE OFFICES

## UNITED STATES

**ALABAMA**
8290 Whitesburg Dr., S.E.
P.O. Box 4207
**Huntsville** 35802
Tel: (205) 881-4591
TWX: 810-726-2204

Medical Only
228 W. Valley Ave.,
Room 302
**Birmingham** 35209
Tel: (205) 879-2081/2

**ARIZONA**
2336 E. Magnolia St.
**Phoenix** 85034
Tel: (602) 244-1361
TWX: 910-951-1331

2424 East Aragon Rd.
**Tucson** 85706
Tel: (602) 889-4661

***ARKANSAS**
Medical Service Only
**Little Rock** 72205
Tel: (501) 664-8773

**CALIFORNIA**
1430 East Orangethorpe Ave.
**Fullerton** 92631
Tel: (714) 870-1000
TWX: 910-592-1288

3939 Lankershim Boulevard
**North Hollywood** 91604
Tel: (213) 877-1282
TWX: 910-499-2170

6305 Arizona Place
**Los Angeles** 90045
Tel: (213) 649-2511
TWX: 910-328-6147

***Los Angeles**
Tel: (213) 776-7500

3003 Scott Boulevard
**Santa Clara** 95050
Tel: (408) 249-7000
TWX: 910-338-0518

***Ridgecrest**
Tel: (714) 446-6165

2220 Watt Ave.
**Sacramento** 95825
Tel: (916) 482-1463
TWX: 910-367-2092

9606 Aero Drive
P.O. Box 23333
**San Diego** 92123
Tel: (714) 279-3200
TWX: 910-335-2000

Calculators Only
601 California St.
**San Francisco** 94108
Tel: (415) 989-8470

**COLORADO**
5600 South Ulster Parkway
**Englewood** 80110
Tel: (303) 771-3455
TWX: 910-935-0705

**CONNECTICUT**
12 Lunar Drive
**New Haven** 06525
Tel: (203) 389-6551
TWX: 710-465-2029

**FLORIDA**
P.O. Box 24210
2806 W. Oakland Park Blvd.
**Ft. Lauderdale** 33307
Tel: (305) 731-2020
TWX: 510-955-4099

***Jacksonville**
Medical Service only
Tel: (904) 725-6333

P.O. Box 13910
6177 Lake Ellenor Dr.
**Orlando** 32809
Tel: (305) 859-2900
TWX: 810-850-0113

21 East Wright St.
Suite 1
**Pensacola** 32501
Tel: (904) 434-3081

**GEORGIA**
P.O. Box 28234
450 Interstate North
**Atlanta** 30328
Tel: (404) 434-4000
TWX: 810-766-4890

**HAWAII**
2875 So. King Street
**Honolulu** 96814
Tel: (808) 955-4455

**ILLINOIS**
5500 Howard Street
**Skokie** 60076
Tel: (312) 677-0400
TWX: 910-223-3613

***St. Joseph**
Tel: (217) 469-2133

**INDIANA**
7301 North Shadeland Ave.
**Indianapolis** 46250
Tel: (317) 842-1000
TWX: 810-260-1796

**IOWA**
1902 Broadway
**Iowa City** 52240
Tel: (319) 338-9466
Night: (319) 338-9467

***KANSAS**
**Derby**
Tel: (316) 267-3655

**LOUISIANA**
P.O. Box 840
3239 Williams Boulevard
**Kenner** 70062
Tel: (504) 721-6201
TWX: 810-955-5524

**KENTUCKY**
Medical/Calculator Only
8003 Troutwood Court
**Louisville** 40291
Tel: (502) 426-4341

**MARYLAND**
6707 Whitestone Road
**Baltimore** 21207
Tel: (301) 944-5400
TWX: 710-862-9157

4 Choke Cherry Road
**Rockville** 20850
Tel: (301) 948-6370
TWX: 710-828-9685
710-828-0487

P.O. Box 1648
2 Choke Cherry Road
**Rockville** 20850
Tel: (301) 948-6370
TWX: 710-828-9684

**MASSACHUSETTS**
32 Hartwell Ave.
**Lexington** 02173
Tel: (617) 861-8960
TWX: 710-326-6904

**MICHIGAN**
23855 Research Drive
**Farmington** 48024
Tel: (313) 476-6400
TWX: 810-242-2900

**MINNESOTA**
2400 N. Prior Ave.
**Roseville** 55113
Tel: (612) 636-0700
TWX: 910-563-3734

**MISSISSIPPI**
***Jackson**
Medical Service only
Tel: (601) 982-9363

**MISSOURI**
11131 Colorado Ave.
**Kansas City** 64137
Tel: (816) 763-8000
TWX: 910-771-2087

148 Weldon Parkway
**Maryland Heights** 63043
Tel: (314) 567-1455
TWX: 910-764-0830

**NEBRASKA**
Medical Only
11902 Elm Street
Suite 4C
**Omaha** 68144
Tel: (402) 333-6017

**NEW JERSEY**
W. 120 Century Rd.
**Paramus** 07652
Tel: (201) 265-5000
TWX: 710-990-4951

**NEW MEXICO**
P.O. Box 11634
Station E
11300 Lomas Blvd., N.E.
**Albuquerque** 87123
Tel: (505) 292-1330
TWX: 910-989-1185

156 Wyatt Drive
**Las Cruces** 88001
Tel: (505) 526-2485
TWX: 910-983-0550

**NEW YORK**
6 Automation Lane
Computer Park
**Albany** 12205
Tel: (518) 458-1550
TWX: 710-441-8270

Calculators Only
1251 Avenue of the Americas
Floor 32 - Suite 3296
**New York City** 10020
Tel: (212) 265-5575

**New York City**
Manhattan, Bronx
Contact Paramus, NJ Office
Tel: (201) 265-5000
Brooklyn, Queens, Richmond
Contact Woodbury, NY Office
Tel: (516) 921-0300

201 South Avenue
**Poughkeepsie** 12601
Tel: (914) 454-7330
TWX: 510-248-0012

39 Saginaw Drive
**Rochester** 14623
Tel: (716) 473-9500
TWX: 510-253-5981

5858 East Molloy Road
**Syracuse** 13211
Tel: (315) 455-2486
TWX: 710-541-0482

1 Crossways Park West
**Woodbury** 11797
Tel: (516) 921-0300
TWX: 510-221-2168

**NORTH CAROLINA**
P.O. Box 5188
1923 North Main Street
**High Point** 27262
Tel: (919) 885-8101
TWX: 510-926-1516

**OHIO**
16500 Sprague Road
**Cleveland** 44130
Tel: (216) 243-7300
Night: 243-7305
TWX: 810-423-9431

330 Progress Rd.
**Dayton** 45449
Tel: (513) 859-8202
TWX: 810-459-1925

1041 Kingsmill Parkway
**Columbus** 43229
Tel: (614) 436-1041

**OKLAHOMA**
P.O. Box 32008
**Oklahoma City** 73132
Tel: (405) 721-0200
TWX: 910-830-6862

**OREGON**
17890 SW Boones Ferry Road
**Tualatin** 97062
Tel: (503) 620-3350
TWX: 910-467-8714

**PENNSYLVANIA**
111 Zeta Drive
**Pittsburgh** 15238
Tel: (412) 782-0400
Night: 782-0401
TWX: 710-795-3124

1021 8th Avenue
King of Prussia Industrial Park
**King of Prussia** 19406
Tel: (215) 265-7000
TWX: 510-660-2670

**SOUTH CAROLINA**
6941-0 N. Trenholm Road
**Columbia** 29260
Tel: (803) 782-6493

**TENNESSEE**
***Memphis**
Medical Service only
Tel: (901) 274-7472

***Nashville**
Medical Service only
Tel: (615) 244-5448

**TEXAS**
P.O. Box 1270
201 E. Arapaho Rd.
**Richardson** 75080
Tel: (214) 231-6101
TWX: 910-867-4723

P.O. Box 27409
6300 Westpark Drive
Suite 100
**Houston** 77027
Tel: (713) 781-6000
TWX: 910-881-2645

205 Billy Mitchell Road
**San Antonio** 78226
Tel: (512) 434-8241
TWX: 910-871-1170

**UTAH**
2160 South 3720 West Street
**Salt Lake City** 84119
Tel: (801) 487-0715

**VIRGINIA**
Medical Only
P.O. Box 12778
No. 7 Koger Exec. Center
Suite 212
**Norfolk** 23502
Tel: (804) 497-1026/7

P.O. Box 9854
2914 Hungary Springs Road
**Richmond** 23228
Tel: (804) 285-3431
TWX: 710-956-0157

**WASHINGTON**
Bellefield Office Pk.
1203-114th SE
**Bellevue** 98004
Tel: (206) 454-3971
TWX: 910-443-2446

***WEST VIRGINIA**
Medical/Analytical Only
**Charleston**
Tel: (304) 345-1640

**WISCONSIN**
9004 West Lincoln Ave.
**West Allis** 53227
Tel: (414) 541-0550

**FOR U.S. AREAS NOT LISTED:**
Contact the regional office nearest you: Atlanta, Georgia... North Hollywood, California... Rockville, (4 Choke Cherry Rd.) Maryland...Skokie, Illinois. Their complete addresses are listed above.

***Service Only**

## CANADA

**ALBERTA**
Hewlett-Packard (Canada) Ltd.
11748 Kingsway Ave.
**Edmonton** T5G 0X5
Tel: (403) 452-3670
TWX: 610-831-2431

Hewlett-Packard (Canada) Ltd.
915-42 Avenue S.E. Suite 102
**Calgary** T2G 1Z1
Tel: (403) 287-1672

**BRITISH COLUMBIA**
Hewlett-Packard (Canada) Ltd.
837 E. Cordova Street
**Vancouver** V6A 3R2
Tel: (604) 254-0531
TWX: 610-922-5059

**MANITOBA**
Hewlett-Packard (Canada) Ltd.
513 Century St.
St. James
**Winnipeg** R3H 0L8
Tel: (204) 786-7581
TWX: 610-671-3531

**NOVA SCOTIA**
Hewlett-Packard (Canada) Ltd.
800 Windmill Road
**Dartmouth** B3B 1L1
Tel: (902) 469-7820

**ONTARIO**
Hewlett-Packard (Canada) Ltd.
1785 Woodward Dr.
**Ottawa** K2C 0P9
Tel: (613) 225-6530
TWX: 610-562-8968

Hewlett-Packard (Canada) Ltd.
6877 Goreway Drive
**Mississauga** L4V 1L9
Tel: (416) 678-9430
TWX: 610-492-4246

**QUEBEC**
Hewlett-Packard (Canada) Ltd.
275 Hymus Blvd.
**Pointe Claire** H9R 1G7
Tel: (514) 697-4232
TWX: 610-422-3022
TLX: 05-821521 HPCL

Hewlett-Packard (Canada) Ltd.
2376 Galvani Street
**Ste-Foy** G1N 4G4
Tel: (418) 688-8710

**FOR CANADIAN AREAS NOT LISTED:**
Contact Hewlett-Packard (Canada) Ltd. in Mississauga.

## CENTRAL AND SOUTH AMERICA

**ARGENTINA**
Hewlett-Packard Argentina
S.A.C.e.I
Lavalle 1171-3° Piso
**Buenos Aires**
Tel: 35-0436, 35-0627, 35-0341
Telex: 012-1009
Cable: HEWPACK ARG

**BOLIVIA**
Stambuk & Mark (Bolivia) Ltda.
Av. Mariscal, Santa Cruz 1342
**La Paz**
Tel: 40626, 53163, 52421
Telex: 3560014
Cable: BUKMAR

**BRAZIL**
Hewlett-Packard Do Brasil
I.E.C. Ltda.
Rua Frei Caneca, 1.152-Bela Vista
01307-**São Paulo**-SP
Tel: 288-71-11, 287-81-20, 287-61-93
Telex: 309151/2/3
Cable: HEWPACK São Paulo

Hewlett-Packard Do Brasil
I.E.C. Ltda.
Praca Dom Feliciano, 78-8° andar (Sala 806/8)
9000-**Pôrto Alegre**-RS
Tel: 25-84-70-DDD (0512)
Cable: HEWPACK Pôrto Alegre

Hewlett-Packard Do Brasil
I.E.C. Ltda.
Rua Siqueira Campos, 53, 4° andar Copacabana
2000-**Rio de Janeiro**-GB
Tel: 257-80-94-DDD (021)
Telex: 2100 79 HEWPACK
Cable: HEWPACK
Rio de Janeiro

**CHILE**
Calcagni y Metcalfe Ltda.
Calle Lira 81, Oficina 5
Casilla 2118
**Santiago**, 1
Tel: 398613
Cable: CALMET

**COLOMBIA**
Instrumentación
Henrik A. Langebaek & Kier S.A.
Carrera 7 No. 48-59
Apartado Aéreo 6287
**Bogota**, 1 D.E.
Tel: 45-78-06, 45-55-46
Cable: AARIS Bogota
Telex: 44400INSTCO

**COSTA RICA**
Científica Costarricense S.A.
Apartado 10159
**San José**
Tel: 21-86-13
Cable: GALGUR San José

**GUATEMALA**
IPESA
Avenida La Reforma 3-48, Zona 9
**Guatemala**
Tel: 63627, 64786
Telex: 4192 TELTRO GU

**MEXICO**
Hewlett-Packard Mexicana, S.A. de C.V.
Torres Adalid No. 21, 11° Piso
Col. del Valle
**Mexico** 12, D.F.
Tel: (905) 543-42-32
Telex: 017-74-507

Hewlett-Packard Mexicana, S.A. de C.V.
Ave. Constitución No. 2184
**Monterrey**, N.L.
Tel: 48-71-32, 48-71-84

**NICARAGUA**
Roberto Terán G.
Apartado Postal 689
Edificio Terán
**Managua**
Tel: 3451, 3452
Cable: ROTERAN Managua

**PANAMA**
Electrónico Balboa, S.A.
P.O. Box 4929
Calle Samuel Lewis
**Cuidad de Panama**
Tel: 64-2700
Telex: 3431103 Curunda, Canal Zone
Cable: ELECTRON Panama

**PERU**
Compañia Electro Médica S.A.
Ave. Enrique Canaval 312
San Isidro
Casilla 1030
**Lima**
Tel: 22-3900
Cable: ELMED Lima

**PUERTO RICO**
San Juan Electronics, Inc.
P.O. Box 5167
Ponce de León 154
Pda. 3-PTA de Tierra
**San Juan** 00906
Tel: (809) 725-3342, 722-3342
Cable: SATRONICS San Juan
Telex: SATRON 3450 332

**URUGUAY**
Pablo Ferrando S.A.
Comercial e Industrial
Avenida Italia 2877
Casilla de Correo 370
**Montevideo**
Tel: 40-3102
Cable: RADIUM Montevideo

**VENEZUELA**
Hewlett-Packard de Venezuela C.A.
Apartado 50933
Edificio Segre
Tercera Transversal
Los Ruices Norte
**Caracas** 107
Tel: 35-00-11
Telex: 21146 HEWPACK
Cable: HEWPACK Caracas

**FOR AREAS NOT LISTED, CONTACT:**
Hewlett-Packard
Inter-Americas
3200 Hillview Ave.
**Palo Alto**, California 94304
Tel: (415) 493-1501
TWX: 910-373-1260
Cable: HEWPACK Palo Alto
Telex: 034-8300, 034-8493

# EUROPE

**AUSTRIA**
Hewlett-Packard Ges.m.b.H.
Handelska 52/3
P.O. Box 7
A-1205 **Vienna**
Tel: (0222) 35 16 20 to 29
Cable: HEWPAK Vienna
Telex: 75923 hewpak a

**BELGIUM**
Hewlett-Packard Benelux
S.A./N.V.
Avenue de Col-Vert, 1,
(Groenkraaglaan)
B-1170 **Brussels**
Tel: (02) 672 22 40
Cable: PALOBEN Brussels
Telex: 23 494 paloben bru

**DENMARK**
Hewlett-Packard A/S
Datavej 52
DK-3460 **Birkerød**
Tel: (02) 81 66 40
Cable: HEWPACK AS
Telex: 166 40 hpas

Hewlett-Packard A/S
Navervej 1
DK-8600 **Silkeborg**
Tel: (06) 82 71 66
Telex: 166 40 hp as
Cable: HEWPACK AS

**FINLAND**
Hewlett-Packard Oy
Nahkahousuntie 5
P.O. Box 6
SF-00211 **Helsinki** 21
Tel: 6923031
Cable: HEWPACKOY Helsinki
Telex: 12-15363

**FRANCE**
Hewlett-Packard France
Quartier de Courtaboeuf
Boite Postale No. 6
F-91401 **Orsay**
Tel: (1) 907 78 25
Cable: HEWPACK Orsay
Telex: 60048

Hewlett-Packard France
Agence Régional
Chemin des Mouilles
Boite Postale No. 12
F-69130 **Ecully**
Tel: (78) 33 81 25,
Cable: HEWPACK Ecully
Telex: 31 617

Hewlett-Packard France
Agence Régionale
Zone Aéronautique
Avenue Clément Ader
F-31770 **Colomiers**
Tel: (61) 78 11 55
Telex: 51957

Hewlett-Packard France
Agence Régionale
Centre d'aviation générale
F-13721 **Aéroport de Marignane**
Tel: (91) 89 12 36
TWX: 41770 F

Hewlett-Packard France
Agence Régionale
63, Avenue de Rochester
F-35000 **Rennes**
Tel: 74912 F
Telex: 74 912 F

Hewlett-Packard France
Agence Régionale
74, Allée de la Robertsau
F-67000 **Strasbourg**
Tel: (88) 35 23 20/21
Telex: 89141
Cable: HEWPACK STRBG

Medical/Calculator Only
Hewlett-Packard France
Agence Régionale
Centre Vaubain
201, rue Colbert
Entrée Az
F-59000 **Lille**
Tel: (20) 51 44 14

**GERMAN FEDERAL REPUBLIC**
Hewlett-Packard GmbH
Vertriebszentrale Frankfurt
Bernerstrasse 117
Postfach 560 140
D-6000 **Frankfurt** 56
Tel: (0611) 50 04-1
Cable: HEWPACKSA Frankfurt
Telex: 41 32 49 fra

Hewlett-Packard GmbH
Technisches Buero Böblingen
Herrenbergerstrasse 130
D-7030 **Böblingen**, Württemberg
Tel: (07031) 667-1
Cable: HEPAK Böblingen
Telex: 07265739 bbn

Hewlett-Packard GmbH
Technisches Buero Düsseldorf
Vogelsanger Weg 38
D-4000 **Dusseldorf**
Tel: (0211) 63 80 31/5
Telex: 85/86 533 hpdd d

Hewlett-Packard GmbH
Technisches Buero Hamburg
Wendenstrasse 23
D-2000 **Hamburg** 1
Tel: (040) 24 13 93
Cable: HEWPACKSA Hamburg
Telex: 21 63 032 hphh d

Hewlett-Packard GmbH
Technisches Buero Hannover
Mellendorfer Strasse 3
D-3000 **Hannover-Kleefeld**
Tel: (0511) 55 60 46
Telex: 092 3259

Hewlett-Packard GmbH
Technisches Buero Nuremberg
Neumeyer Str. 90
D-8500 **Nuremberg**
Tel: (0911) 56 30 83/85
Telex: 0623 860

Hewlett-Packard GmbH
Technisches Buero Müchen
Unterhachinger Strasse 28
ISAR Center
D-8012 **Ottobrunn**
Tel: (089) 601 30 61/7
Telex: 52 49 85
Cable: HEWPACKSA München

**(West Berlin)**
Hewlett-Packard GmbH
Technisches Buero Berlin
Keith Strasse 2-4
D-1000 **Berlin** 30
Tel: (030) 24 90 86
Telex: 18 34 05 hpbln d

**GREECE**
Kostas Karayannis
18, Ermou Street
GR-**Athens** 126
Tel: 3230-303 Sales/SVC
3230-305 Adm. Order Proc
Cable: RAKAR Athens
Telex: 21 59 62 rkar gr

Hewlett-Packard S.A.
Mediterranean & Middle East
Operations
35 Kolokotroni Street
Platia Kefallariou
Gr-Kifissia-**Athens**
Tel: 8080337, 8080359,
8080429, 8018693
Telex: 21 6588
Cable: HEWPACKSA Athens

Analytical Only
"INTECO" G. Papathanassiou & Co.
Marni 17
GR - **Athens** 103
Tel: 521 915
Cable: INTEKNIKA
Telex: 21 5329 INTE GR

Medical Only
Technomed Hellas Ltd.
52, Skoufa Street
GR - **Athens** 135
Tel: 626 972
Cable: ETALAK Athens
Telex: 21-4693 ETAL GR

**IRELAND**
Hewlett-Packard Ltd.
King Street Lane
Winnersh, Wokingham
GB-**Berkshire** RG11 5AR
Tel: Wokingham 784774
Telex: 847178/848179

Hewlett-Packard Ltd.
"The Graftons"
Stamford New Road
GB-**Altrincham**, Cheshire
Tel: (061) 928-9021
Telex: 668068

**ITALY**
Hewlett-Packard Italiana S.p.A.
Via Amerigo Vespucci 2
I-20124 **Milan**
Tel: (2) 6251 (10 lines)
Cable: HEWPACKIT Milan
Telex: 32046

Hewlett-Packard Italiana S.p.A.
Via Pietro Maroncelli 40
(ang. Via Visentin)
I-35100 **Padova**
Tel: 66 48 88
Telex: 32046 via Milan

Medical Only
Hewlett-Packard Italiana S.p.A.
Via Medaglie d'Oro, 2
I-56100 **Pisa**
Tel: (050) 2 32 04
Telex: 32046 via Milan

Hewlett-Packard S.p.A.
Via G. Armellini 10
I-00143 **Rome**-Eur
Tel: (6) 5912544/5
Telex: 61514
Cable: HEWPACKIT Rome

Hewlett-Packard Italiana S.p.A.
Via San Quintino, 46
I-10121 **Turin**
Tel: 53 82 64/54 84 68
Telex: 32046 via Milan

Medical/Calculators Only
Hewlett-Packard Italiana S.p.A.
Via Principe Nicola 43 G/C
I-95126 **Catania**
Tel: (095) 370505

**LUXEMBURG**
Hewlett-Packard Benelux
S.A./N.V.
Avenue de Col-Vert, 1,
(Groenkraaglaan)
B-1170 **Brussels**
Tel: (02) 672 22 40
Cable: PALOBEN Brussels
Telex: 23 494

**NETHERLANDS**
Hewlett-Packard Benelux N.V.
Van Heuven Goedhartlaan 121
P.O. Box 667
NL-1134 **Amstelveen**
Tel: (020) 47 20 21
Cable: PALOBEN Amsterdam
Telex: 13 216 hepa nl

**NORWAY**
Hewlett-Packard Norge A/S
Nesveien 13
Box 149
N-1344 **Haslum**
Tel: 25 38 360
Telex: 16621 hpnas n

**POLAND**
Analytical/Medical Only
Hewlett-Packard
Warsaw Technical Office
UL. Spitalne 1
00-120 **Warsaw**
Tel: 268031 ext. 30
Telex: 812453

**PORTUGAL**
Telectra-Empresa Técnica de
Equipamentos Eléctricos S.a.r.l.
Rua Rodrigo da Fonseca 103
P.O. Box 2531
P-**Lisbon** 1
Tel: (19) 68 60 72
Cable: TELECTRA Lisbon
Telex: 12598

Mundinter
Intercambio Mundial de Comércio
Sarl Avenida Antonio Augusto
de Aguiar 138
P.O. Box 2761
P - **Lisbon**
Tel: (19) 53 21 31/7
Cable: INTERCAMBIO Lisbon

**SPAIN**
Hewlett-Packard Española, S.A.
Jerez No. 3
E-**Madrid** 16
Tel: (1) 458 26 00 (10 lines)
Telex: 23515 hpe

Hewlett-Packard Española, S.A.
Milanesado 21-23
E-**Barcelona** 17
Tel: (3) 203 6200 (5 lines)
Telex: 52603 hpbe e

Hewlett-Packard Española, S.A.
Av Ramon y Cajal, 1
Edificio Sevilla I, planta 9°
E-**Seville**
Tel: 64 44 54/58

Hewlett-Packard Española S.A
Edificio Albia II 7° B
E-**Bilbao**
Tel: 23 83 06/23 82 06

Calculators Only
Hewlett-Packard Española S.A
Alvaro Bazen, 12
(Edificio Luz)
E - **Valencia** - 10
Tel: 60 42 00

**SWEDEN**
Hewlett-Packard Sverige AB
Enighetsvägen 1-3
Fack
S-161 20 **Bromma** 20
Tel: (08) 730 05 50
Cable: MEASUREMENTS
Stockholm
Telex: 10721

Hewlett-Packard Sverige AB
Hagakersgatan 9C
S-431 41 **Mölndal**
Tel: (031) 27 68 00/01
Telex: Via Bromma

**SWITZERLAND**
Hewlett-Packard (Schweiz) AG
Zücherstrasse 20
P.O. Box 64
CH-8952 Schlieren **Zurich**
Tel: (01) 98 18 21
Cable: HPAG CH
Telex: 53933 hpag

Hewlett-Packard (Schweiz) AG
9, chemin Louis-Pictet
CH-1214 Vernier-**Geneva**
Tel: (022) 41 49 50
Cable: HEWPACKSA Geneva
Telex: 27 333 hpsa ch

**TURKEY**
Telekom Engineering Bureau
Saglik Sok No. 15/1
Ayaspasa-Beyoglu
P.O. Box 437 Beyoglu
TR-**Istanbul**
Tel: 49 40 40
Cable: TELEMATION Istanbul

**UNITED KINGDOM**
Hewlett-Packard Ltd.
King Street Lane
Winnersh, Wokingham
GB-**Berkshire** RG11 5AR
Tel: Wokingham 784774
Telex: 847178/848179

Hewlett-Packard Ltd.
"The Graftons"
Stamford New Road
GB-**Altrincham**, Cheshire
Tel: (061) 928-9021
Telex: 668068

Hewlett-Packard Ltd.
c/o Makro
South Service Wholesale Centre
Amber Way
Halesowen Industrial Estate
GB-**Halesowen**, Worcs
Tel: Birmingham 7860

Hewlett-Packard Ltd.
4th Floor
Wedge House
799, London Road
GB-**Thornton Heath** CR4 6XL,
Surrey
Tel: (01) 684 0105
Telex: 946825

Hewlett-Packard Ltd.
c/o Makro
South Service Wholesale Centre
Wear Industrial Estate
Washington
GB-**New Town**, County Durham
Tel: Washington 464001 ext. 57/58

Hewlett-Packard Ltd.'s registered
address for V.A.T. purposes
only:
70, Finsbury Pavement
**London**, EC2A1SX
Registered No. 690597

**USSR**
Hewlett-Packard USSR
c/o Commercial Office
American Embassy (Box M)
A-1091 **Vienna**, Austria
Tel: 221-79-71
Telex: 7825 hewpak SU

**YUGOSLAVIA**
Iskra-Standard/Hewlett-Packard
Office
Miklosiceva 38/VII
61000 **Ljubljana**
Tel: 315-879/321-674
Telex: 31265

**SOCIALIST COUNTRIES PLEASE CONTACT:**
Hewlett-Packard S.A.
7, rue du Bois-du-Lan
P.O. Box 349
CH-1217 Meyrin 1 **Geneva**
Switzerland
Tel: (022) 41 54 00
Cable: HEWPACKSA Geneva
Telex: 2 24 86

# AFRICA, ASIA, AUSTRALIA

**ANGOLA**
Telectra
Empresa Técnica de
Equipamentos
Eléctricos, S.A.R.L.
R. Barbosa Rodrigues, 42-1°D1.°
Caixa Postal, 6487-**Luanda**
Tel: 35515/6
Cable: TELECTRA Luanda

**AUSTRALIA**
Hewlett-Packard Australia
Pty. Ltd.
31-41 Joseph Street
**Blackburn**, Victoria 3130
Tel: 89-6351, 89-6306
Telex: 31-024
Cable: HEWPARD Melbourne

Hewlett-Packard Australia
Pty. Ltd.
31 Bridge Street
**Pymble**,
New South Wales, 2073
Tel: 449-6566
Telex: 21561
Cable: HEWPARD Sydney

Hewlett-Packard Australia
Pty. Ltd.
97 Churchill Road
**Prospect** 5082
South Australia
Tel: 44 8151
Cable: HEWPARD Adelaide

Hewlett-Packard Australia
Pty. Ltd.
141 Stirling Highway
**Claremont**, W.A. 6010
Tel: 86-5455
Telex: 93859
Cable: HEWPARD

Hewlett-Packard Australia
Pty. Ltd.
121 Wollongong Street
**Fyshwick**, A.C.T., 2609
Tel: 95 3733

Hewlett-Packard Australia
Pty. Ltd.
5th Floor
Teachers Union Building
495-499 Boundary Street
**Spring Hill**, 4000 Queensland
Tel: 29-1544
Telex: AA-42133

**CEYLON**
United Electricals Ltd.
P.O. Box 681
60, Park St.
**Colombo** 2
Tel: 26696
Cable: HOTPOINT Colombo

**CYPRUS**
Kypronics
19 Gregorios & Xenopoulos Rd.
P.O. Box 1152
CY-**Nicosia**
Tel: 45628/29
Cable: KYPRONICS PANDEHIS

**HONG KONG**
Schmidt & Co.(Hong Kong) Ltd.
P.O. Box 297
Connaught Centre
39th Floor
Connaught Road, Central
**Hong Kong**
Tel: 255291
Telex: 74766SCHMCHX
Cable: SCHMIDTCO Hong Kong

**INDIA**
Blue Star Ltd.
Kasturi Buildings
Jamshedji Tata Rd.
**Bombay** 400 020
Tel: 29 50 21
Telex: 3751
Cable: BLUEFROST

Blue Star Ltd.
Sahas
414/2 Vir Savarkar Marg
Prabhadevi
**Bombay** 400 025
Tel: 45 78 87
Telex: 4093
Cable: FROSTBLUE

Blue Star Ltd.
Band Box House
Prabhadevi
**Bombay** 400 025
Tel: 45 73 01
Telex: 3751
Cable: BLUESTAR

Blue Star Ltd.
14/40 Civil Lines
**Kanpur** 208 001
Tel: 6 88 82
Cable: BLUESTAR

Blue Star Ltd.
7 Hare Street
P.O. Box 506
**Calcutta** 700 001
Tel: 23-0131
Telex: 655
Cable: BLUESTAR

Blue Star Ltd.
Blue Star House,
34 Ring Road
Lajpat Nagar
**New Delhi** 110 024
Tel: 62 32 76
Telex: 2463
Cable: BLUESTAR

Blue Star Ltd.
Blue Star House
11/11A Magarath Road
**Bangalore** 560 025
Tel: 55668
Telex: 430
Cable: BLUESTAR

Blue Star Ltd.
Meeakshi Mandiran
xxx/1678 Mahatma Gandhi Rd.
**Cochin** 682 016 Kerala

Blue Star Ltd.
1-1-117/1
Sarojini Devi Road
**Secunderabad** 500 003
Tel: 7 63 91, 7 73 93
Cable: BLUEFROST
Telex: 459

Blue Star Ltd.
23/24 Second Line Beach
**Madras** 600 001
Tel: 23954
Telex: 379
Cable: BLUESTAR

Blue Star Ltd.
Nathraj Mansions
2nd Floor Bistupur
**Jamshedpur** 831 001
Tel: 38 04
Cable: BLUESTAR
Telex: 240

**INDONESIA**
BERCA Indonesia P.T.
P.O. Box 496
1st Floor JL. Cikini Raya 61
**Jakarta**
Tel: 56038, 40369, 49886
Telex: 2895 Jakarta

**IRAN**
Multi Corp International Ltd.
Avenue Soraya 130
P.O. Box 1212
IR-**Teheran**
Tel: 83 10 35-39
Cable: MULTICORP Tehran
Telex: 2893 mci tn

**ISRAEL**
Electronics & Engineering
Div. of Motorola Israel Ltd.
17 Aminadav Street
**Tel-Aviv**
Tel: 36941 (3 lines)
Cable: BASTEL Tel-Aviv
Telex: 33569

**JAPAN**
Yokogawa-Hewlett-Packard Ltd.
Ohashi Building
1-59-1 Yoyogi
Shibuya-ku, **Tokyo**
Tel: 03-370-2281/92
Telex: 232-2024YHP
Cable: YHPMARKET TOK 23-724

Yokogawa-Hewlett-Packard Ltd.
Nisei Ibaragi Bldg.
2-2-8 Kasuga
Ibaragi-Shi
**Osaka**
Tel: (0726) 23-1641
Telex: 5332-385 YHP OSAKA

Yokogawa-Hewlett-Packard Ltd.
Nakamo Building
No. 24 Kamisasazima-cho
Nakamura-ku, **Nagoya** City
Tel: (052) 571-5171

Yokogawa-Hewlett-Packard Ltd.
Tanigawa Building
2-24-1 Tsuruya-cho
Kanagawa-ku
**Yokohama**, 221
Tel: 045-312-1252
Telex: 382-3204 YHP YOK

Yokogawa-Hewlett-Packard Ltd.
Mito Mitsui Building
1-4-73 San-no-maru
**Mito**, 310
Tel: 0292-25-7470

Yokogawa-Hewlett-Packard Ltd.
Inoue Building
1348-3, Asahi-cho, 1-chome
**Atsugi**, 243
Tel: 0462-24-0452

**KENYA**
Technical Engineering Services
P.O. Box 18311
**Nairobi**, Kenya
Tel: 57726
Cable: PROTON

**KOREA**
American Trading Company
Korea
I.P.O. Box 1103
Dae Kyung Bldg., 8th Floor
107 Sejong-Ro,
Chongro-Ku, **Seoul**
Tel: (4 lines) 73-8924-7
Cable: AMTRACO Seoul

**KUWAIT**
Al-Khaldiya Trading &
Contracting Co.
Al Soor Street
Michaan Bldg. No. 4
**Kuwait**
Tel: 42 99 10
Cable: VISCOUNT

**LEBANON**
Constantin E. Macridis
Clemenceau Street 34
P.O. Box 7213
RL-**Beirut**
Tel: 36.63.97/8
Telex: 21114 Leb
Cable: ELECTRONUCLEAR Beirut

**MALAYSIA**
MECOMB Malaysia Ltd.
2 Lorong 13/6A
Section 13
Petaling Jaya, **Selangor**
Cable: MECOMB Kuala Lumpur

**MOZAMBIQUE**
A.N. Goncalves, Lta.
162, 1° Apt. 14 Av. D. Luis
Caixa Postal 107
**Lourenco Marques**
Tel: 27091, 27114
Telex: 6-203 Negon Mo
Cable: NEGON

**NEW ZEALAND**
Hewlett-Packard (N.Z.) Ltd.
4-12 Cruickshank Street
Kilbirnie, Wellington 3
Mailing Address:
Hewlett-Packard (N.Z.) Ltd.
P.O. Box 9443
Courtney Place
**Wellington**
Tel: 877-199
Telex: NZ 3898

Hewlett-Packard (N.Z.) Ltd.
Pakuranga Professional Centre
267 Pakuranga Highway
Box 51092
**Pakuranga**
Tel: 569-651
Cable: HEWPACK, Auckland

Analytical/Medical Only
Dental & Medical Supply Co. Ltd.
Scientific Division
79 Carlton Gore Road
Newmarket
P.O. Box 1234
**Auckland**
Tel: 75-289
Cable: DENTAL Auckland

**NIGERIA**
The Electronics
Instrumentations Ltd.
N6B/770 Oyo Road
Oluseun House
P.M.B. 5402
**Ibadan**
Tel: 61577
Cable: THETEIL Ibadan

The Electronics Instrumenta-
tions Ltd., (TEIL)
16th Floor Cocoa House
P.M.B. 5402
**Ibadan**
Tel: 22325
Cable: THETEIL Ibadan

**PAKISTAN**
Mushko & Company, Ltd.
Oosman Chambers
Abdullah Haroon Road
**Karachi** 3
Tel: 511027, 512927
Cable: COOPERATOR Karachi

Mushko & Company, Ltd.
38B, Satellite Town
**Rawalpindi**
Tel: 41924
Cable: FEMUS Rawalpindi

**PHILIPPINES**
Electromex, Inc.
6th Floor, Amalgamated
Development Corp. Bldg.
Ayala Avenue, Makati, Rizal
C.C.P.O. Box 1028
**Makati**, Rizal
Tel: 86-18-87, 87-76-77,
Cable: ELEMEX Manila

**REUNION ISLANDS**
ZOOM
B.P. 938, 97400 Saint Denis
85 Rue Jean Chatel
Ile de la Reunion
Tel: 21-13-75
Cable: ZOOM

**SINGAPORE**
Mechanical & Combustion
Engineering Company Pte.,
Ltd.
10/12, Jalan Kilang
Red Hill Industrial Estate
**Singapore**, 3
Tel: 647151 (7 lines)
Cable: MECOMB Singapore

Hewlett-Packard Singapore
(Pte.) Ltd.
Blk. 2, 6th FLOOR, Jalan
Bukit Merah
Redhill Industrial Estate
Alexandra P.O. Box 87,
**Singapore** 3
Tel: 633022
Telex: HPSG RS 21486
Cable: HEWPACK, Singapore

**SOUTH AFRICA**
Hewlett-Packard South Africa
(Pty.), Ltd.
Hewlett-Packard House
Daphne Street, Wendywood
**Sandton**, Transvaal 2001
Tel: 802-1040
Telex: SA43-4782JH
Cable: HEWPACK

Hewlett-Packard South Africa
(Pty.), Ltd.
Breecastle House
Bree Street
**Cape Town**
Tel: 2-6941/2/3
Cable: HEWPACK Cape Town
Telex: 0006 CT

Hewlett-Packard South Africa
(Pty.), Ltd.
641 Ridge Road, Durban
P.O. Box 37099
**Overport**, Durban, 4067
Tel: 88-6102
Telex: 6-7954

**TAHITI**
Metagraph
BP 1741
**Papeete**
Tel: 20/320, 29/979

**TAIWAN**
Hewlett-Packard Taiwan
39 Chung Shiao West Road
Sec. 1 Overseas Insurance
Corp. Bldg. 7th Floor
**Taipei**
Tel: 389160,1,2,
Telex: TP824 HEWPACK
Cable: HEWPACK Taipei

Hewlett-Packard Taiwan
38, Po-Ai Lane, San Min Chu,
**Kaohsiung**
Tel: 297319

**THAILAND**
UNIMESA Co., Ltd.
Elsom Research Building
Bangjak Sukumvit Ave.
**Bangkok**
Tel: 932387, 930338
Cable: UNIMESA Bangkok

**VIETNAM**
Peninsular Trading Inc.
P.O. Box H-3
216 Hien-Vuong
**Saigon**
Tel: 20-805, 93398
Cable: PENTRA, SAIGON 242

**ZAMBIA**
R.J. Tilbury (Zambia) Ltd.
P.O. Box 2792
**Lusaka**
Zambia, Central Africa
Tel: 73793
Cable: ARJAYTEE, Lusaka

**MEDITERRANEAN AND MIDDLE EAST COUNTRIES NOT SHOWN PLEASE CONTACT:**
Hewlett-Packard S.A.
Mediterranean and Middle
East Operations
35, Kolokotroni Street
Platia Kefallariou
GR-Kifissia-**Athens**
Telex: 21-6588
Cable: HEWPACKSA Athens

**OTHER AREAS NOT LISTED, CONTACT:**
Hewlett-Packard
Export Trade Company
3200 Hillview Ave.
Palo Alto, California 94304
Tel: (415) 493-1501
TWX: 910-373-1267
Cable: HEWPACK Palo Alto
Telex: 034-8300, 034-8493

PRINTED IN U.S.A.