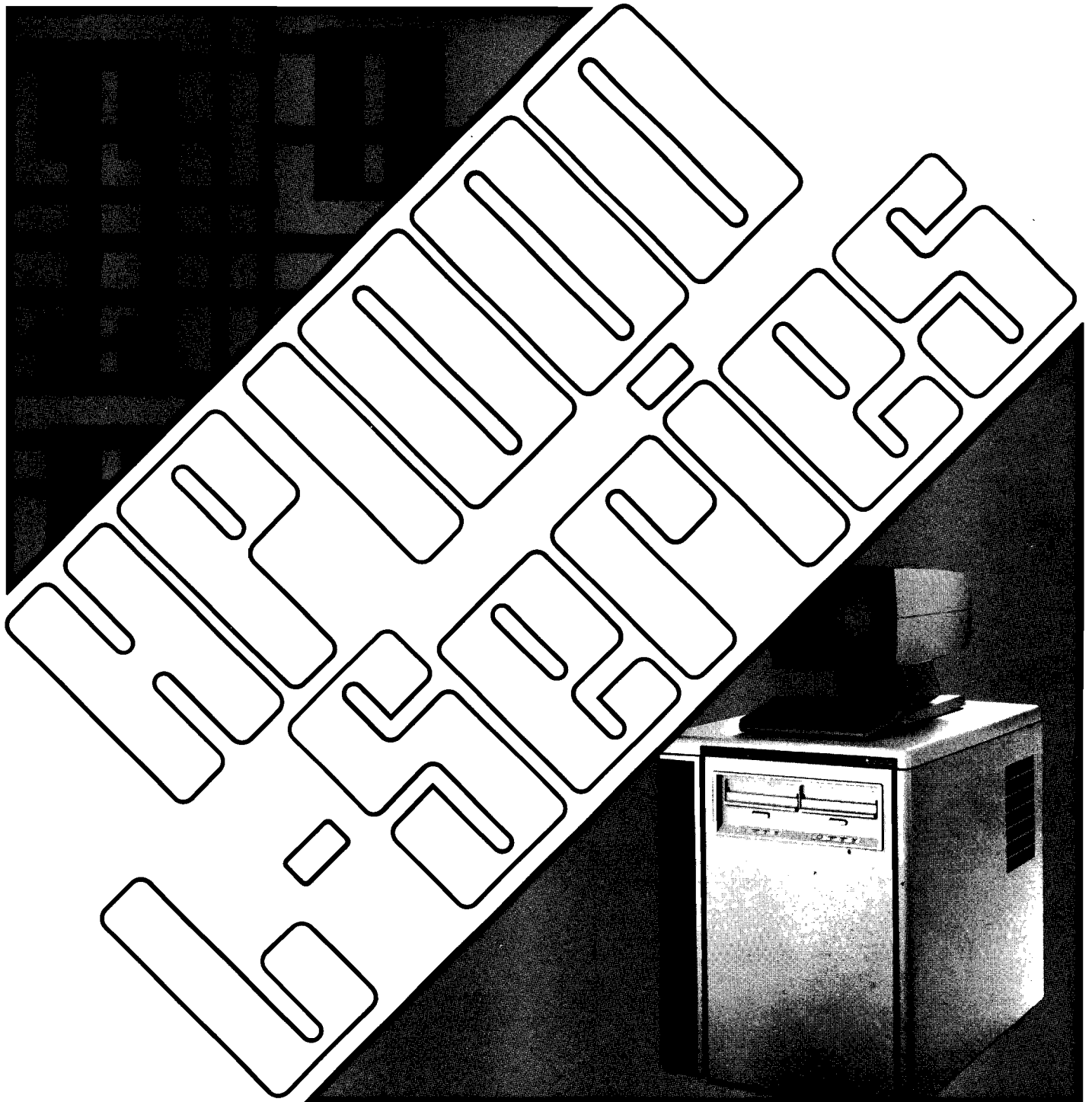


# HP 1000 L-Series Computer

## Hardware Troubleshooting Guide



# **HP 1000 L-SERIES COMPUTER**

## **hardware troubleshooting guide**

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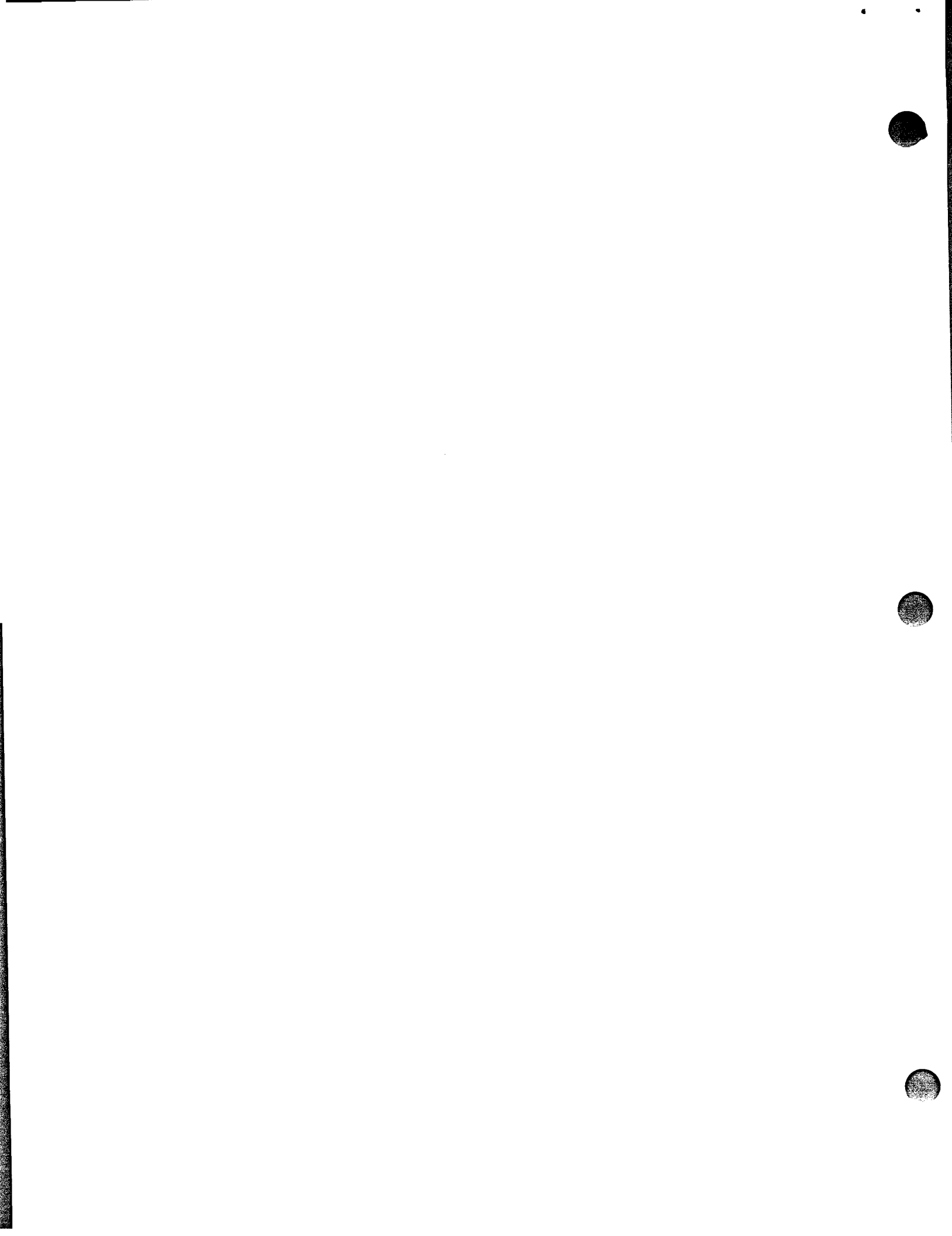
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This manual has been written to aid the user in troubleshooting the HP 1000 L-Series computer. The intent is to direct the user to the correct hardware troubleshooting tool and the documentation that describes the operation of the tool; not to describe each tool to the finest detail.

The L-Series computer has many troubleshooting features: some are designed into the hardware, while others are software test programs. These features are designed to quickly locate faulty hardware, reducing the service support costs. When the troubleshooting tools described in this manual do not isolate the failure and a Hewlett-Packard service call is required, please communicate to your Hewlett-Packard Customer Engineer the results of your investigation. This will ensure that the Customer Engineer will be better equipped to follow up on your problem.

The computer troubleshooting tools are designed in progression: starting with a hardware built-in self-test, proceeding with the kernel diagnostic and interface diagnostics, and ending with the Primary System. Each of these tools, and the other special tools, are described briefly in the following sections.





This chapter identifies the troubleshooting tools for each replaceable hardware module. In using this chapter, it is assumed that the troubleshooter has determined that the trouble is hardware related, and then determined which of the following hardware modules is suspected to be faulty. By executing the suggested tools in the order given, a pass/fail confidence check is performed on the suspected module. The next chapter briefly describes each troubleshooting tool and gives the documentation that describes it.

## 2.1 PROCESSOR CARD

1. L-Series Computer Self-Test
2. Kernel Diagnostic
3. Primary System
4. Diagnostic Design Language User-Written Programs

## 2.2 MEMORY CARD(s)

1. L-Series Computer Self-Test
2. Battery Backup Card Audible Alarm
3. Kernel Diagnostic (first 64k bytes)
4. Extended Memory Diagnostic (if 12002A/B memory controller installed)
5. Primary System

## 2.3 HP 12005A ASYNCHRONOUS SERIAL INTERFACE

1. L-Series Computer Self-Test
2. Kernel Diagnostic
3. HP 12005A Asynchronous Serial Interface Diagnostic
4. Primary System
5. Diagnostic Design Language User-Written Programs

2.4 HP 12006A PARALLEL INTERFACE

1. L-Series Computer Self-Test
2. Kernel Diagnostic
3. HP 12006A Parallel Interface Diagnostic
4. Primary System
5. Diagnostic Design Language User-Written Programs

2.5 HP 12007A/12044A HDLC

1. L-Series Computer Self-Test
2. HP 12007A/12044A HDLC Self-Test
3. Kernel Diagnostic
4. Programmable Serial Interface Diagnostic
5. Diagnostic Design Language User-Written Programs

2.6 HP 12008A PROM STORAGE MODULE

1. L-Series Computer Self-Test
2. Kernel Diagnostic
3. HP 12008A PROM Storage Module Diagnostic
4. Primary System
5. Diagnostic Design Language User-Written Programs

2.7 HP 12009A HP-IB INTERFACE

1. L-Series Computer Self-Test
2. Kernel Diagnostic
3. HP 12009A HP-IB Interface Diagnostic
4. Primary System and Functional Tests
5. Diagnostic Design Language User-Written Programs

2.8 HP 12013A BATTERY BACKUP CARD

1. Power Supply Self-Test
2. Battery Backup Card Audible Alarm
3. Kernel Diagnostic

## 2.9 HP 12035A POWER SUPPLY

1. Power Supply Self-Test
2. Battery Backup Card Audible Alarm
3. Kernel Diagnostic

## 2.10 BACKPLANE

1. Self-Test
2. Power Supply Self-Test
3. Kernel Diagnostic
4. Primary System
5. Diagnostic Design Language User-Written Programs

## 2.11 PERIPHERALS

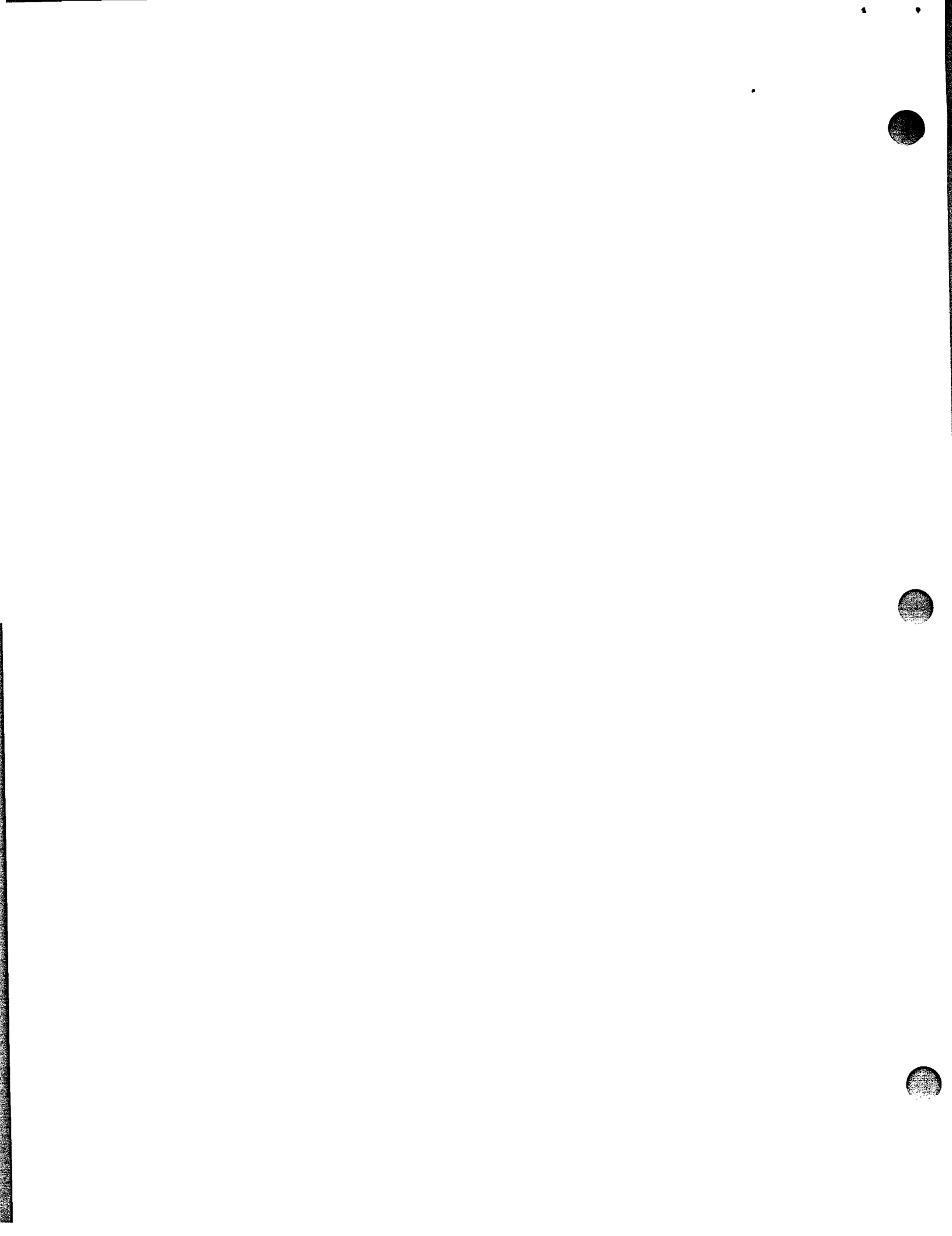
NOTE: Most computer peripherals have built in self-tests; also many of the DDL diagnostics written for the interface cards have optional peripheral device loop-back tests (e.g. HP-IB Interface diagnostic, Asynchronous Serial Interface diagnostic).

1. Peripheral Self-Test
2. Individual DDL Interface Card Diagnostic Written For The Peripheral Device Interface Card
3. Primary System
4. Diagnostic Design Language User-Written Programs

## 2.12 SYSTEM PROBLEMS

NOTE: A system problem is defined as a problem that occurs only when the hardware modules are connected together.

1. Primary System
2. Diagnostic Design Language User-Written Programs



TROUBLESHOOTING TOOLS DESCRIPTION	SECTION III
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The troubleshooting tools of the L-Series computer are briefly described below along with the documentation that fully describes and explains the operating procedures. Each troubleshooting tool is part of the multi-layered repair strategy as shown in figure 3-1.

### 3.1 L-SERIES COMPUTER SELF-TEST

The L-Series computer self-test consists of two test programs (Test 1 and Test 2) that automatically execute each time the computer is powered up and which provide a quick, convenient check of basic computer operation. (Also, the self-test can be executed by pressing the Test switch on the processor card.) If either self-test program fails, the computer will not operate. Test 1 is built into the CPU chip and checks logic on the processor card and 15 lines of the address and data buses; the sixteenth data line is checked by Test 2. Test 2 is stored in read-only memory (ROM) on the processor card and executes upon successful completion of Test 1. Test 2 checks the computer's basic instruction set, several internal registers, and the memory. It also checks some of the I/O logic on each interface card to ensure that data transfer, flag, direct memory access, and interrupt functions are processed correctly. The test will diagnose the CPU chip, processor, memory and I/O failures. Errors are reported via the eight LEDs on the processor board.

#### Documentation -

1. Processor LED Indications label on the computer card cage rear door.
2. HP 1000 L-Series Computer Installation and Service Manual,  
part no. 02103-90003,  
or  
HP 1000 L-Series Computer System Installation and Service Manual,  
part no. 02145-90003.

### 3.2 KERNEL DIAGNOSTIC

The Kernel Diagnostic is a stand-alone assembly language program that verifies the first 64k bytes of memory, all instructions, parity, I/O chip, interrupt system, power fail, DMA, memory protect, and the time base generator. The test will report errors via the virtual control panel or the processor LEDs.

Documentation -

1. Kernel Diagnostic Operating Manual,  
part no. 24397-90002.

### 3.3 XL MEMORY DIAGNOSTIC

The Extended Memory Diagnostic is written in the Diagnostic Design Language (DDL) and is available with the HP 24397A Diagnostic package. The diagnostic performs tests on the 12002A/B XL Memory Controller to insure all mapping capabilities function correctly. This includes cross loads and stores, map enable and DMA mapping. The entire memory array (12002A/B and 12003A) is tested in the same manner as the Kernel.

Documentation -

1. XL Memory Diagnostic Operating Manual,  
part no. 24397-90004.

### 3.4 INTERFACE DIAGNOSTICS

The interface diagnostics are individual programs written in the Diagnostic Design Language (DDL) and available with the HP 24397A and HP 24600A Diagnostic Packages. The diagnostics are written to be functional pass/fail tests of the interface cards, not tests to isolate down to the gate level. Failures are reported to the VCP or the processor LEDs.

Documentation -

1. For a complete list of the diagnostics and the diagnostic operating manuals refer to Appendix C.

### 3.5 DIAGNOSTIC DESIGN LANGUAGE USER-WRITTEN PROGRAMS

Diagnostic Design Language is a stand alone diagnostic language that allows the programmer to develop diagnostic programs useful for verifying and diagnosing interfaces and devices. It can also be used as an on-the-spot troubleshooting tool in diagnosing problems. Information is communicated via the virtual control panel.

#### Documentation -

1. Diagnostic Design Language Operating and Programming Manual, part no. 24397-90003.

### 3.6 PRIMARY SYSTEM

The Primary System is run under the RTE-L or RTE-XL operating systems and has test programs available to verify correct installation and operation of the L-Series systems. It is mainly used as a system verification test on the first day of operation, but can also be used later as a known good operating system.

#### Documentation -

1. Getting Started With the HP 1000 L-Series Computer manual, part no. 92070-90001.

### 3.7 POWER SUPPLY SELF-TEST

The power supply self-test is built into the power supply to insure the voltage levels are within tolerances before supplying power to any equipment. This test will diagnose operational failures of the power supply via the three LEDs on the power supply.

#### Documentation -

1. HP 1000 L-Series Computer Installation and Service Manual, part no. 2103-90003,  
or  
HP 1000 L-Series Computer System Installation and Service Manual, part no. 2145-90003.

### 3.8 BATTERY BACKUP CARD AUDIBLE ALARM

The audible alarm and alarm logic circuitry are built into the HP 12013A Battery Backup Card. The alarm signifies the following: (1) one second tone every ten seconds - battery backup is on and line power is lost, (2) two second tone - memory is lost, and (3) steady tone - memory card is configured improperly.

#### Documentation -

1. HP 1000 L-Series Computer Installation and Service Manual,  
part no. 02103-90003,  
or  
HP 1000 L-Series Computer System Installation and Service Manual,  
part no. 02145-90003.
2. HP 1000 L-Series Engineering Reference Document,  
part no. 02103-90009.

### 3.9 VIRTUAL CONTROL PANEL

The virtual control panel (VCP) program is an interactive program in firmware (not in memory and not loaded) that enables an external device (such as a terminal) to control the CPU in a manner similar to a conventional computer front panel. That is, it allows the operator to load programs using the loaders, to access the various registers (A, B, P, etc.), to examine or change memory, and to control execution of a program. Only one interface card in the computer can serve as a VCP interface.

#### Documentation -

1. HP 1000 L-Series Computer Reference Manual,  
part no. 02103-90007.





### 3.10 TROUBLESHOOTING TOOLS TABLE

Table 3-1 is a table of the various troubleshooting tools. This table is organized for various categories of users. A given computer user will usually fit into one of these three troubleshooting levels:

#### OPERATOR

The operator is the typical new terminal operator: limited troubleshooting and operating experience.

#### SYSTEM HARDWARE MANAGER

The system hardware manager is the L-Series computer hardware troubleshooter at the computer location: varied troubleshooting skills and many hours of operating experience.

#### DESIGNER

The designer is the L-Series hardware/software expert: extensive troubleshooting and operating skills and familiar with the inner-workings of the computer.

### 3.11 TROUBLESHOOTING TOOLS DIAGRAM

Figure 3-1 is a diagram of how the various troubleshooting tools fit into the overall repair strategy picture. The diagram graphically shows the multi-layered set of self-tests and diagnostics.

Table 3-1. Troubleshooting Tools Table

! T R O U B L E S H O O T I N G ! ! T O O L	! U S E R		
	! O P E R A T O R !	! S Y S T E M H / W ! ! M A N A G E R !	! D E S I G N E R !
! L-SERIES COMPUTER SELF-TEST	! X	! X	! X
! POWER SUPPLY SELF-TEST	! X	! X	! X
! VIRTUAL CONTROL PANEL	! X	! X	! X
! PRIMARY SYSTEM	! X	! X	! X
! KERNEL DIAGNOSTIC		! X	! X
! XL MEMORY DIAGNOSTIC		! X	! X
! INTERFACE DIAGNOSTICS		! X	! X
! DDL USER-WRITTEN PROGRAMS		! X	! X

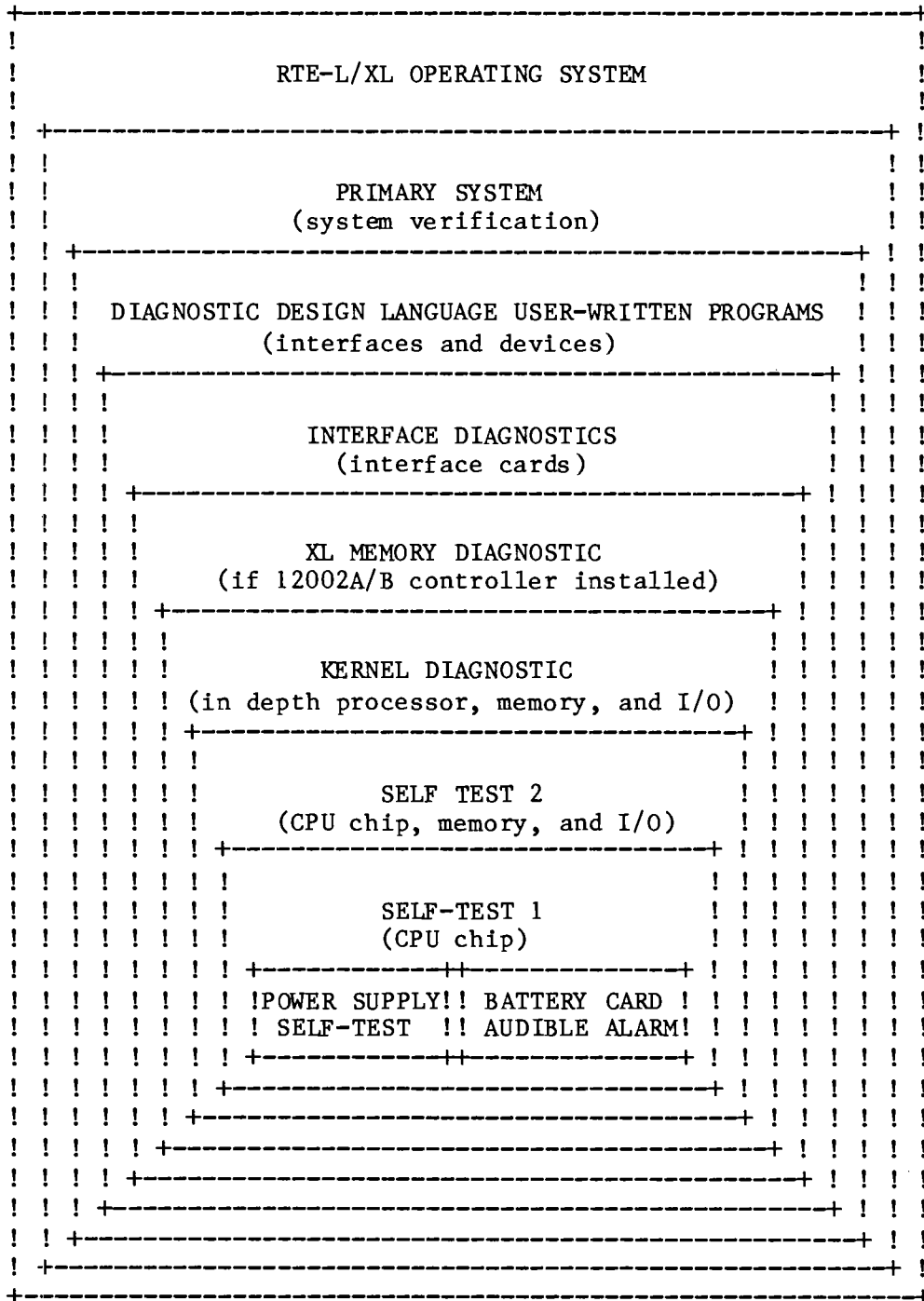


Figure 3-1. Troubleshooting Tools Diagram



#### 4.1 CREATING AUTOMATICALLY EXECUTABLE DIAGNOSTICS

The L-Series computer has the capability of automatically loading and executing, at power-up, a diagnostic program that is stored on flexible disc. Diagnostics that are stored on mini cartridge tape can not be automatically loaded into memory.

By following the procedures below, a diagnostic program supplied by Hewlett-Packard in the HP 24397A or the HP 24600A Diagnostic Package is copied onto a flexible disc. (This method can also be used for other HP-IB compatible discs.) This diagnostic is capable of being automatically loaded into memory.

1. Load into memory the desired L-Series diagnostic program using the procedures in section 2 of the corresponding diagnostic operating manual.
2. Insert a blank flexible disc into the flexible disc drive unit.
3. Press the "BREAK" key to enter the VCP routine. (Or type "BYE" if in the DDL Interpreter program.)

When operating an L-Series with extended memory, the A- and B-registers must be set to establish the size of the transfer from memory. These become the first two words of the file and are used when loading the program. The A-register represents the number of complete 64k byte blocks to be transferred (up to 8) and the B-register represents the remaining partial count.

Example: To save 96k bytes of memory, set A and B as follows: A-register = 1, B-register = @40000

All diagnostics require less than 64k bytes, however, hence the A-register can always be set to 0 and the B-register set equal to the partial count.

4. Type "%WDCffbusc<cr>", where "ffbusc" is an octal number defined as:

ff - is the file number on the flexible disc. This must be set to be equal to "00", because file number zero is the only file that can be automatically loaded into memory.

b - is the HP-IB address of the flexible disc drive unit (0 to 7).

u - is the flexible disc drive unit number.

sc - is the select code of the HP 12009A HP-IB Interface that the flexible disc unit is connected to.

Example: "%WDC007027"

This VCP command takes an absolute copy of the base 64k bytes of memory, and writes it onto file number zero of the flexible disc. No information is stored on the directory track of the disc.

#### 4.2 EXECUTING AUTOMATICALLY EXECUTABLE DIAGNOSTICS

To automatically execute on power-up the diagnostic program created in paragraph 4.1, follow the procedures in section 2 of the corresponding diagnostic operating manual.

## 5.1 GENERAL

At times, several diagnostic programs are needed to execute one after another with control passing from one to the next automatically. By following these procedures, the diagnostic programs supplied by Hewlett-Packard in the HP 24397A and HP 24600A Diagnostic Packages can be copied onto a flexible disc or mini cartridge tape and are capable of being sequentially loaded into memory.

The individual diagnostic programs need no special statements for sequential execution. After normal program completion, the current diagnostic will automatically exit and the next diagnostic will be loaded into memory.

The last diagnostic program can be written to either loop back to the first file or halt.

Two methods are available in writing diagnostics to loop back. One method is simply to use all 16 (0 to 17 octal) program files available. At the completion of the last program, number 17 octal, execution will automatically loop back to the first program. The other method should be used when there are less than sixteen programs to loop or when the sixteen programs do not fit on the storage media. The HP 7902A flexible disc can only store twelve files for the RTE-L format or fourteen files for the RTE-XL format. The mini cartridge tape storage capacity depends upon the number of blocks written for each file. This method has the DDL loop sequence program stored as the last program. A listing of this program can be found in the DDL Operating and Programming Manual, part number 24397-90003.

If the last DDL program has the "CLC 3" DDL statement as the last statement, sequential execution mode will halt and the virtual control panel routine will be executed.

Two methods are available to start the sequential execution of a series of diagnostic programs. One method is to have the first program automatically loaded into memory at power-up (flexible disc only). Refer to section IV of this manual for details of this method. The other method is to use the "%BCTffbusc" or "%BDCffbusc" VCP command.

## 5.2 CREATING SEQUENTIALLY EXECUTABLE DIAGNOSTICS (FLEXIBLE DISC)

To create a flexible disc containing diagnostic programs that are capable of sequential execution, follow the procedures in section 4.1. Repeat the procedure for each diagnostic program, incrementing the "ff" file number parameter each time.

The diagnostics are now stored on one flexible disc and they are capable of sequential execution.

## 5.3 EXECUTING SEQUENTIALLY EXECUTABLE DIAGNOSTICS (FLEXIBLE DISC)

To sequentially execute the diagnostic programs created in paragraph 5.2, follow these procedures:

1. Turn off the power to the computer.
2. Set the processor card switches to automatically load and execute, at power-up, from disc:

Processor Switch U1	1	2	3	4	5	6	7	8
Setting	1	1	1	0	0	0	0	1

1 = open = up, 0 = closed = down

3. Set the U1 switches on the HP 12009A HP-IB Interface that is connected to the flexible disc drive unit as follows (U1 is the switch pack facing the rear of the computer card cage). Check to ensure that this interface is the only interface with a select code of 27 octal (switches U1S3 through U1S8).

HP 12009A Switch U1	1	2	3	4	5	6	7	8
Setting	1	0	0	1	0	1	1	1

1 = open = up, 0 = closed = down

4. The U16 switches on the HP 12009A Interface can be set to any position; its configuration does not affect diagnostic operation (U16 is the switch pack facing the side of the computer card cage). The operation of the HP-IB diagnostic is an exception, refer to the diagnostic operating manual for the switch configuration.



5. Attach the flexible disc drive unit to the HP 12009A Interface using an HP-IB cable. The flexible disc drive must have an HP-IB address of two.
6. Insert the flexible disc that has the diagnostics stored on it into the disc drive unit number zero. The disc drive must be unit zero.
7. Install test hoods on all the interface cards that require one.
8. Turn on the power to the computer.
9. Each of the sequential programs will be loaded and executed, with control passing from one program to another. During program execution, all test hoods must be installed. At the completion of the last program in the sequence, program execution will loop back and will start on the first program again or will halt depending upon the last program.

#### 5.4 CREATING SEQUENTIALLY EXECUTABLE DIAGNOSTICS (CARTRIDGE TAPE)

To create a mini cartridge tape containing diagnostic programs that are capable of sequential execution, follow these procedures:

1. Load into memory the desired L-Series diagnostic program using the procedures in paragraph 2.2 of the corresponding diagnostic operating manual.
2. On a blank mini cartridge tape, move the tab marked RECORD at the rear of the cartridge tape in the direction of the arrow. This disables the write protect feature of the tape.
3. Insert the mini cartridge tape into the left tape drive of the HP 264X Terminal.
4. Press the "BREAK" key to enter the VCP routine.
5. Type "%WCTffbusc<cr>", where "ffbusc" is an octal number defined as:

ff - is the file number on the mini cartridge tape  
(0 to 17 octal).

Specifying zero (0) will start the record operation at the current mini cartridge tape location.

b - is the physical memory block number (0 is the first 4k word block, 1 is the second 4k word block, etc.).

u - is the mini cartridge tape unit number  
(0 is the left drive unit, 1 is the right drive unit).

sc - is the select code of the HP 12005A Asynchronous Serial Interface that the terminal is connected to.

Repeat the "%W" VCP command again (changing the memory block number) until the diagnostic program is completely stored on mini cartridge tape. Block numbers 0, 1, 2, and maybe 3 (depending upon the size) have to be recorded.

Example:

1. "%WCT010020<cr>" Record memory from 0 to 4K boundary starting at file number one.
2. "%WCT001020<cr>" Record memory from 4K to 8K boundary starting at current tape location.
3. "%WCT002020<cr>" Record memory from 8K to 12K boundary starting at current tape location.

These commands take an absolute copy of the first 12k words of memory, and write it onto file number one of the mini cartridge tape.

6. Mark the end of the mini cartridge tape file.
7. Repeat steps 1, 4, 5, and 6 for each of the diagnostic programs, incrementing the "ff" file number parameter for each diagnostic (only used during the first "%W" VCP command of every diagnostic).

NOTE: If several DDL diagnostics are to be executed one after another, only the statement file portion of memory needs to be loaded into memory. This is because the DDL Interpreter, stored by writing blocks number zero and one, is the same for each of these diagnostics and can be left in memory. So for the second DDL diagnostic to be stored on mini cartridge tape, step 5 can be replaced with the single command "%WCT002020<cr>". (The HP-IB diagnostic must be stored with the commands "%WCT002020<cr>" and "%WCT003020<cr>". It is larger than the 12K word boundary.) This method requires less tape to store the diagnostic programs and runs faster because the DDL Interpreter does not have to be read into memory everytime.

8. The diagnostics are now stored on one mini cartridge tape and they are capable of sequential operation.

NOTE: The %WCT command does not use the A- and B-registers for memory size, however it does place them in words 0 and 1 of block 0. (Thus only the base 64k bytes of memory can be stored using the %WCT command.)

## 5.5 EXECUTING SEQUENTIALLY EXECUTABLE DIAGNOSTICS (CARTRIDGE TAPE)

To sequentially execute the diagnostic programs created in paragraph 5.4, follow these procedures:

1. Turn off the power to the computer.
2. Set the processor card switches to enter the VCP routine on power-up (remember to return the switches to their original configuration after completion of the diagnostic session):

```
Processor Switch U1  1 2 3 4 5 6 7 8
Setting              1 0 0 0 0 0 0 1
```

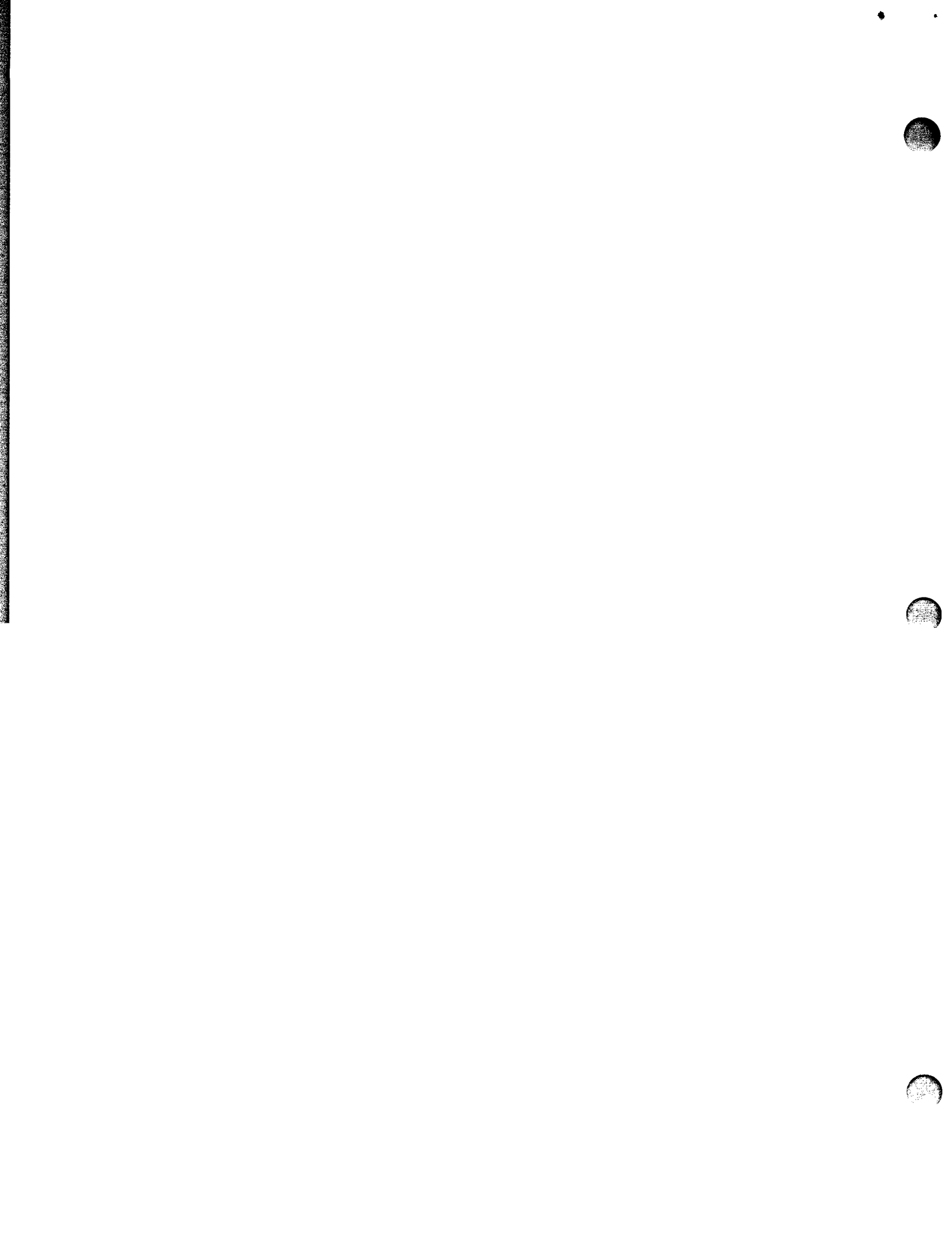
1 = open = up, 0 = closed = down

3. Set the U1 switches on the HP 12005A Asynchronous Serial Interface that is connected to the VCP as follows:

```
HP 12005A Switch U1  1 2 3 4 5 6 7 8
Setting              0 0 0 1 0 0 0 0
```

1 = open = up, 0 = closed = down

4. Install test hoods on all the interface cards that require one.
5. Turn on the power to the computer.
6. Insert the mini cartridge tape that contains the diagnostic programs into the left mini cartridge tape drive of the terminal. The right tape drive can not be used for sequential execution.
7. Type %BCTff<cr>" on the virtual control panel. The "ff" parameter is set to the file number of the first program to be executed.
8. Each of the sequential programs will be loaded and executed, with control passing from one program to another. During program execution, all test hoods must be installed. At the completion of the last program in the sequence, program execution will loop back and will start on the first program again or will halt depending upon the last program.



It is often useful to modify the DDL diagnostics that are sent with the HP 24397A or HP 24600A Diagnostic Package. An example would be adding a "STOP" statement after one of the program sections. Another example would be removing the "HOOD" statement in one of the diagnostics. By removing the "HOOD" statement, the "HOOD INSTALLED?" interactive question would not be displayed, and the program will execute assuming no diagnostic hood is installed. This would speed program execution if the diagnostic test hood is never attached.

The general procedures for program modifications follow:

1. Load into memory the desired L-Series diagnostic program using the procedures in paragraph 2.2 of the corresponding diagnostic operating manual.
2. Use the "LIST" DDL command to list the diagnostic statement file where the modification is to be made (refer to the DDL Operating and Programming manual).
3. Follow the procedures in paragraph 2.6, Replacing, Deleting, and Editing a Statement, of the DDL Operating and Programming manual to modify the diagnostic.
4. Follow the procedures in paragraph 2.9, Storing Your Created Program (Cartridge Tape), or 2.10, Storing Your Created Program (Flexible Disc), of the DDL Operating and Programming Manual to store the diagnostic back onto a blank flexible disc or mini cartridge tape.



REMOTE DIAGNOSIS	SECTION VII
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An L-Series computer is capable of being diagnosed from a VCP terminal remotely located from the computer via phone lines using Bell 103 or equivalent modems. The procedures for diagnostic operating are unchanged from paragraph 2.2 of the diagnostic operating manuals (operation with a virtual control panel). In addition to diagnostic operation, the remote operator has the capability to: halt the computer, reboot another diagnostic program or the RTE-L/XL operating system from the system disc, load in diagnostic programs from the mini cartridge tape units, and alter the contents of memory and registers. The HP 12005A Interface must be enabled to be the VCP. This is accomplished by switching processor card U1S5 switch to closed (down) and the HP 12005A card U1S1 switch to closed (down).

A typical set-up is shown in figure 7-1.

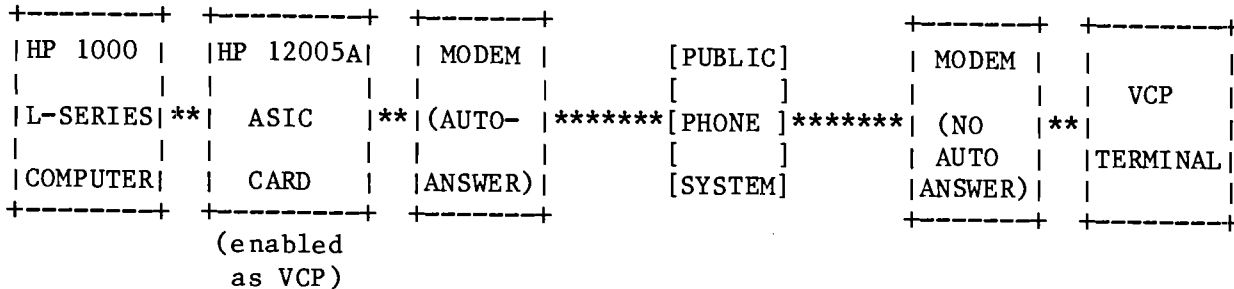
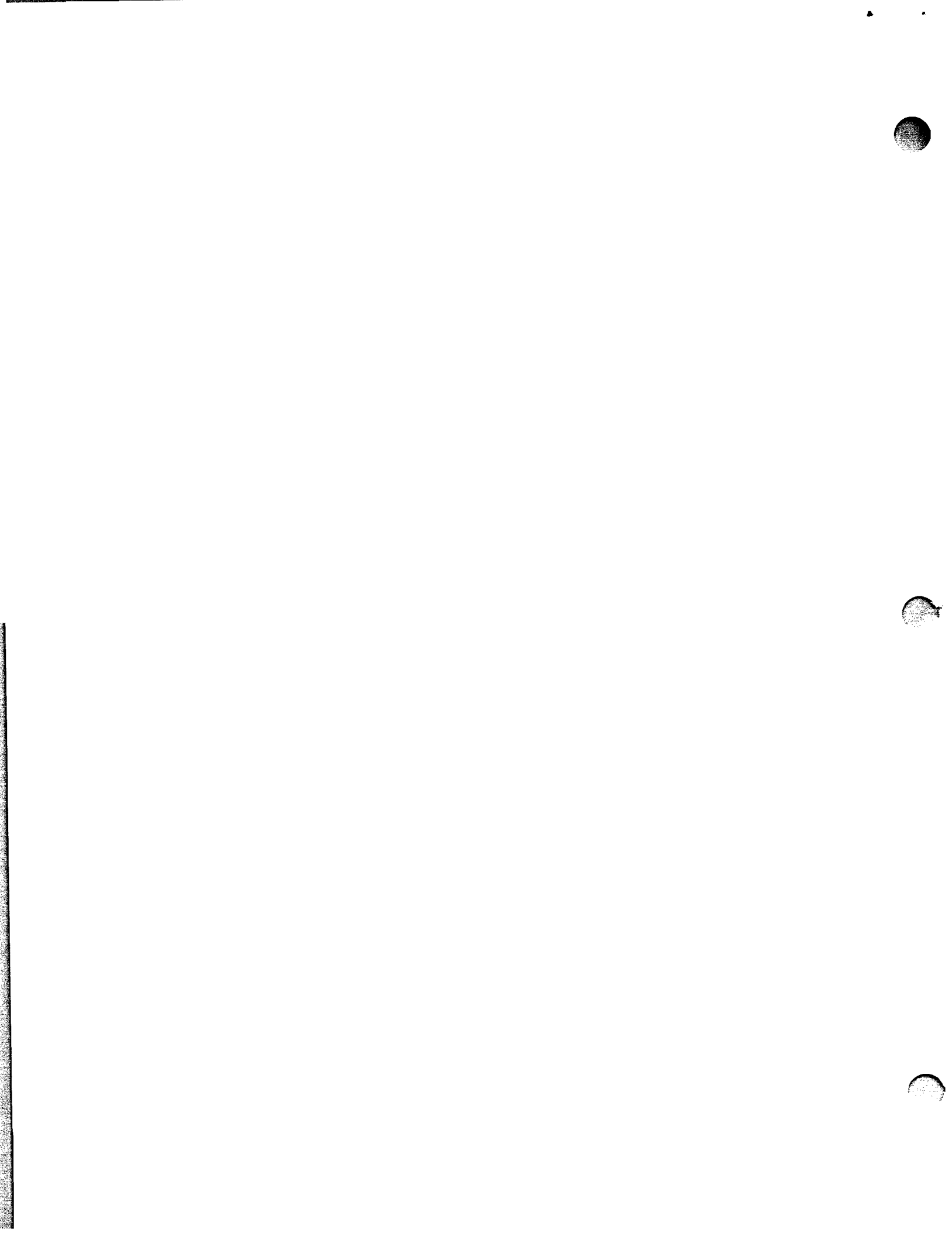


Figure 7-1. Remote Diagnosis Configuration





NOTE: RTE will refer to both RTE-L and RTE-XL in the subsequent discussions.

The following description explains some of the differences between the VCP disc file structure and RTE disc file structure. The VCP disc file structure is used by the "%WDC" virtual control panel command for writing onto disc units. The RTE disc file structure is used by the file management system of RTE.

The HP 24397A or HP 24600A Diagnostic Package programs stored on flexible disc are in memory image RTE type one fixed length format file structure, not in the VCP file structure. Refer to the RTE-L/XL File Management Reference Manual, part number 92070-90008, for details on file types. This allows consistency with the other RTE files to facilitate reproduction of diagnostics using system resources, but generally it does not allow sequential execution or automatic execution on power-up. The HP 24397A and HP 24600A flexible discs contain the boot extension program, BOOTEX, as the first file. The BOOTEX file allows bootup by ASCII file names. The descriptions in section IV, Automatically Executable Diagnostics, and section V, Sequentially Executable Diagnostics, of this manual describe how to create VCP type disc files from the RTE type disc files of the HP 24397A and HP 24600A flexible discs.

The HP 24397A or HP 24600A Diagnostic Package programs stored on mini cartridge tape are in the RTE type seven absolute binary file format. Refer to the RTE-L/XL File Management Reference Manual, part number 92070-90008, for details on file types. This is the same format the VCP routine uses to read and write to the mini cartridge tape, so these programs can be sequentially executed. The descriptions in section V, Sequentially Executable Diagnostics, of this manual describe how to create a sequentially executable mini cartridge tape containing the programs in the order of your choosing (vs. the order on the HP 24397A or HP 24600A mini cartridge tapes). Note that programs stored on mini cartridge tape can not be automatically loaded into memory.

The main difference between the VCP and RTE disc file structure is that VCP uses fixed file lengths, and the RTE uses variable file lengths. Figure A-1 shows the two file structures.

The advantages of the VCP file structure are that it allows the disc boot loaders to be independent of the type of the disc, automatic program execution on power-up (flexible disc only), and sequential program execution. The disadvantages of the VCP file structure are that it takes much more disc memory space than an RTE file structure, and it stores nothing on the directory track of the disc.





## DISC AND ROM LOADERS

The Disc loader imposes its own file definition which does not use the RTE-FMGR format. This was originally N tracks per file, where N is the smallest number of tracks required to contain 64k bytes of data (256 sectors). With the introduction of the expanded memory, it becomes necessary to change the file definition to be an exact multiple of 256 blocks, without regard to track boundaries. This is in order to simplify the loading of systems with more than 32k words of memory. Only the new file format will be supported for the expanded memory and the old format for the standard 64k byte memory. This implies that the same disc pack or floppy can not be used interchangeably between the standard and expanded memory computers for purposes of sequential loading.

In an unmapped CPU the storage area is always the last 64 words of memory. In an expanded memory CPU the storage area is allocated according to the file being loaded. This depends on the first 2 words of the file (refer to paragraph 4.1). A significant incompatibility exists in using RTE-L with expanded memory when a power fail occurs. Before the save area is used, the operating system type must be known; however, in order to determine the operating system type, temporary storage is required. This situation is only a problem if RTE-L is used with expanded memory and battery back-up. In order to protect the user, RTE-L is not allowed to be loaded with XL hardware if battery back-up is installed. RTE-L can be updated to allow booting with XL hardware and battery back-up.

The PROM loader operates in a similar manner.

Refer to Table 2-4 of the L-Series Computer Reference Manual, part no. 02103-90007, for more information on the file format.

Table A-1. VCP vs. RTE Disc File Compatibility

VCP FILE NUMBER	NUMBER OF BLOCKS FOR EACH DISC FILE					
	HP 7902		HP 7910		HP 7906/20/25	
	RTE-L	RTE-XL			RTE-L	RTE-XL
0	300	256	256	288	256	
1	300	256	256	288	256	
2	300	256	256	288	256	
3	300	256	256	288	256	
4	300	256	256	288	256	
5	300	256	256	288	256	
6	300	256	256	288	256	
7	300	256	256	288	256	
10	300	256	256	288	256	
11	300	256	256	288	256	
12	300	256	256	288	256	
13	300	256	256	288	256	
14		256	256	288	256	
15		256	256	288	256	
16			256	288	256	
17			256	288	256	

The HP 7902A can only store twelve (0 to 13 octal) VCP files on each flexible disc for the RTE-L format, or fourteen (0 to 15 octal) VCP files on each flexible disc for the RTE-XL format. An example follows on the next page.

Example:

The following FMGR commands create HP 7902A flexible disc files which are both VCP and RTE file compatible and are capable of sequential execution. In this example, the diagnostic programs have been previously stored on the HP 7910, LU = -10. The flexible disc is LU = -5. For proper sequential execution of the diagnostic flexible disc, the processor switches U1S1 through U1S3 must all be up, the flexible disc drive unit must be address two and unit zero.

:IN,HP,-5,5,SQDIAG,1	
:IN,HP,-5,5,SQDIAG,0	These two commands initialize the flexible disc with starting track of zero.
:PU,BOOTEX:-32767:-5	Purge the BOOTEX file.
:PK,-5	Pack the disc.
:CR,KRNL::-5:1:300	Create file number one.
:DU,KRNL::-10,KRNL::-5	Dump the Kernel diagnostic in file no. one.
:CR,ASIC::-5:1:300	Create file number two.
:DU,ASIC::-10,ASIC::-5	Dump the ASIC diagnostic in file no. two.
:CR,HPIB::-5:1:300	Create file number three.
:DU,HPIB::-10,HPIB::-5	Dump the HPIB diagnostic in file no. three.
:CR,PIC::-5:1:300	Create file number four.
:DU,PIC::-10,PIC::-5	Dump the PIC diagnostic in file no. four.
:CR,PROM::-5:1:300	Create file number five.
:DU,PROM::-10,PROM::-5	Dump the PROM diagnostic in file no. five.
:CR,END::-5:1:300	Create file number six.
:DU,END::-10,END::-5	Dump the END program in file no. six.
	END program is listed in the DDL O & P manual.
:CR,SYSTEM::-5:1:300	Create file number seven.
	{NOTE: If using RTE-XL, the blocks must be 256}
:DU,SYSTEM::-10,SYSTEM::-5	Dump the SYSTEM program in file no. seven.
	SYSTEM program is the RTE operating system.



The individual interface card identification numbers are unique ten bit numbers which are useful in diagnostic programs to determine the various board types and their date codes. The date code can be determined from the three least significant bits (the interface revision level) of the I.D. code. Programs can interrogate the interface cards for their identification numbers by entering diagnose mode one or by using the GTSC, Get Select Code, DDL statement. Refer to the DDL Operating and Programming Manual, part number 24397-90003, for both diagnose mode and GTSC programming information. Table B-1. lists these numbers.

Table B-1. Interface Identification Numbers

I.D. CODE (octal)	INTERFACE		DATE CODE
000000	HP 12005A	ASIC	2001
001000	HP 12006A	PIC	2001
003000	HP 12008A	PROM	2001
004000	HP 12009A	HPIB	2001
005000	HP 12010A	Breadboard	2001
102000	HP 12007A	HDLC (Modem)	2040
	HP 12044A	HDLC (D.C.)	





The L-Series Diagnostic Package provides stand alone testing of the processor, memory, and all interface cards. The diagnostic program software is available in: (1) mini cartridge tape for HP 264XA Terminals, or (2) flexible discs for HP flexible disc drive units.

#### SOFTWARE NUMBERING GUIDE

Included with the HP 24397A or the HP 24600A Diagnostic Package is a file titled "A24397" or "A24600", respectively. Each file lists all the (1) manuals, (2) test hoods, and (3) diagnostic programs included with the package. An example of the contents of each file is copied on the following pages.

To display the contents of the "A24397" file:

Flexible Disc - Type "LI, A24397<cr>" to display this file of the diagnostic flexible disc, part no. 24397-13401. This uses the RTE Operating System command "LIST".

Mini Cartridge Tape - Use the "READ" key on the HP 264X Terminal to read the fourth file of the diagnostic mini cartridge tape, part no. 24397-13301.

To display the contents of the "A24600" file:

Flexible Disc - Type "LI, A24600<cr>" to display this file of the diagnostic flexible disc, part no. 24600-13401. This uses the RTE Operating System command "LIST".

Mini Cartridge Tape - Use the "READ" key on the HP 264X Terminal to read the fourth file of the diagnostic mini cartridge type, part no. 24600-13301.

## REVISION CODE

The third statement line of every diagnostic in the HP 24397A or HP 24600A Package has the diagnostic date code in it. To display it, follow these procedures:

1. Load into memory the desired L-Series diagnostic program using the procedures in paragraph 2.2 of the corresponding diagnostic operating manual.
2. Type "LIST 3" following the ">" DDL prompt.

## ORDERING INDIVIDUAL PARTS

Each part in the HP 24397A or HP 24600A Diagnostic Package can be ordered separately. Note that service part numbers are not orderable; only the mini cartridge tape, flexible disc, manual and test hood part numbers are orderable.

\*\*\*\*\*

\* SOFTWARE PRODUCT CATALOG \*

\* \* \*

\* PRODUCT CATALOG FOR L-SERIES DIAGNOSTICS, 24397A \*

\* \* \*

\* Part Number 24397-18999 REV.2040 \*

\* \* \*

\*\*\*\*\*

\* \* \*

\* This file provides a list of the manuals, test hoods and \*  
\* software modules that comprise the product. The list is \*  
\* organized into three parts as follows: \*  
\* \* \*

\* A. MANUALS. The entry for each manual includes the title \*  
\* of the manual, manual part number, print date, and if \*  
\* applicable, the latest manual change number and date. \*  
\* \* \*

\* B. TEST HOODS. Test hoods are supplied with the standard \*  
\* product. The test hoods are not required in order to \*  
\* run the diagnostic, however, they allow a more thorough \*  
\* check of the board. \*  
\* \* \*

\* C. SOFTWARE MODULES. Each serviceable software module is \*  
\* listed by file type. The General Binary Files are Memory \*  
\* Image files (provided on 7902 Flexible Disc) of the \*  
\* Absolute Binary Files (provided on Minicartridge). \*  
\* As such, the source part and REV CODE of the files are \*  
\* the same, and any reference to one equally applies to \*  
\* the other. \*  
\* \* \*

\* This product is deliverable on the following media. The \*  
\* specific media is specified at time of order of the product. \*  
\* \* \*

\* 24397A Opt 020 MINICARTRIDGES 24397-133nn \*  
\* 24397A Opt 041 7902 FLEXIBLE DISC 24397-13401 \*  
\* \* \*

\* SECTION 1: MANUALS \*  
\* \* \*

PART NUMBER	DESCRIPTION	PRINT DATE	CHANGE	CHANGE DATE
24397-90001	HARDWARE TROUBLESHOOTING GUIDE	10/80		
24397-90002	KERNAL DIAGNOSTIC OPER MNL	10/80		
24397-90003	DIAG. DESIGN LANGUAGE OPER MNL	10/80		
24397-90004	12002A/B XL MEMORY DIAGNOSTIC	10/80		

```

* 24397-90005 12005A ASIC DIAG MNL 1/80 1 10/80 *
* 24397-90006 12006A PARALLEL DIAG MNL 10/80 *
* 24397-90008 12008A PROM DIAG MNL 10/80 *
* 24397-90009 12009A HP-IB DIAG MNL 10/80 *
*
*****
*
* SECTION 2: TEST HOODS
*
* PART DESCRIPTION
* -----
* 24397-60003 TEST HOOD FOR 12005A ASIC
* 24397-60004 TEST HOOD FOR 12006A PARALLEL
*
*****
*
* SECTION 3: SOFTWARE MODULES
*
* FILE SERVICE REV DESCRIPTION MEDIA
* NAME PART CODE -----
*
*
* (ASC) GENERAL ASCII FILES
*
* A24397 24397-18999 2040 S/W NUMBERING GUIDE FILE 24397-13301
* A24397 24397-18999 2040 S/W NUMBERING GUIDE FILE 24397-13401
*
* (BIN) GENERAL BINARY FILES
*
* BOOTEX 92071-16364 2040 BOOT EXTENSION 24397-13401
* KRNL 24397-16013 2040 KERNEL DIAGNOSTIC 24397-13401
* DDL 24397-16011 2040 DIAG. DESIGN LANGUAGE 24397-13401
* XLMD 24397-16016 2040 12002A/B XL MEMORY DIAG. 24397-13401
* ASIC 24397-16010 2040 12005A ASIC DIAGNOSTIC 24397-13401
* HPIB 24397-16012 2040 12009A HP-IB DIAGNOSTIC 24397-13401
* PIC 24397-16014 2040 12006A PARALLEL DIAGNOSTIC 24397-13401
* PROM 24397-16015 2040 12008A PROM DIAGNOSTIC 24397-13401
*
* (ABS) ABSOLUTE BINARY FILES
*
* !ASIC 24397-16005 2040 12005A ASIC DIAGNOSTIC 24397-13302
* !DDL 24397-16002 2040 DIAG. DESIGN LANGUAGE 24397-13301
* !HPIB 24397-16009 2040 12009A HP-IB DIAGNOSTIC 24397-13302
* !KRNL 24397-16002 2040 KERNEL DIAGNOSTIC 24397-13301
* !PIC 24397-16006 2040 12006A PARALLEL DIAGNOSTIC 24397-13302
* !PROM 24397-16008 2040 12008A PROM DIAGNOSTIC 24397-13303
* !XLMD 24397-16004 2040 12002A/B XL MEMORY DIAG. 24397-13303
*
*****

```

\*\*\*\*\*

\* SOFTWARE PRODUCT CATALOG \*

\* \*

\* PRODUCT CATALOG FOR L-SERIES DATA. COM. DIAGNOSTICS, 24600A \*

\* \*

\* Part Number 24600-18999 REV.2026 \*

\* \*

\*\*\*\*\*

\* \*

\* This file provides a list of the manuals, test hoods and \*

\* software modules that comprise the product. The list is \*

\* organized into three parts as follows: \*

\* \*

\* A. MANUALS. The entry for each manual includes the title \*

\* of the manual, manual part number, print date, and if \*

\* applicable, the latest manual change number and date. \*

\* \*

\* B. TEST HOODS. Test hoods are supplied with the standard \*

\* product. The test hoods are not required in order to \*

\* run the diagnostic, however, they allow a more thorough \*

\* check of the board. \*

\* \*

\* C. SOFTWARE MODULES. Each serviceable software module is \*

\* listed by file type. The General Binary Files are Memory \*

\* Image files (provided on 7902 Flexible Disc) of the \*

\* the Absolute Binary Files (provided on Minicartridge). \*

\* As such, the part number and REV CODE of the files are \*

\* the same, and any reference to one equally applies to \*

\* the other. \*

\* \*

\* This product is deliverable on the following media. The \*

\* specific media is specified at time of order of the product. \*

\* \*

\* 24600A Opt 020 MINICARTRIDGES 24600-13301 \*

\* 24600A Opt 041 7902 FLEXIBLE DISC 24600-13401 \*

\* \*

\* \*

\* SECTION 1: MANUALS \*

\* \*

\* \*

\* PART DESCRIPTION PRINT CHANGE DATE \*

\* NUMBER DATE CODE \*

\* -----

\* 24600-90001 PSI DIAG REF MNL 9/80 2026 \*

\* \*

```

*
* SECTION 2: TEST HOODS
*
*
*
* PART DESCRIPTION
* -----
* 5061-3453 TEST HOOD FOR MODEM CARD
* 5061-3460 TEST HOOD FOR HARDWIRE CARD
*
*****
* SECTION 3: SOFTWARE MODULES
*
* FILE SERVICE REV DESCRIPTION MEDIA
* NAME PART CODE
* -----
*
* (ASC) GENERAL ASCII FILES
*
* A24600 24600-18999 2026 S/W NUMBERING GUIDE FILE 24600-13301
* A24600 24600-18999 2026 S/W NUMBERING GUIDE FILE 24600-13401
*
* (BIN) GENERAL BINARY FILES
*
* BOOTEX 92071-16364 2026 BOOT EXTENSION 24600-13401
* PSI 24600-16002 2026 PSI DIAGNOSTIC 24600-13401
*
* (ABS) ABSOLUTE BINARY FILES
*
* !PSI 24600-16001 2026 PSI DIAGNOSTIC 24600-13301
*
*****

```

PROCESSOR LED DISPLAYS	APPENDIX D
------------------------	------------

The following is a list of the processor LED indications used in HP 1000 L-Series diagnostics. In some cases (Kernel and DDL) the LED patterns are not used when there is a VCP because the information is displayed on the terminal console.

A "1" indicates that an LED is on, and a "0" indicates the LED is off. The second left-most LED is used to denote whether the displayed pattern is section or subsection information; a "1" indicates section information while a "0" indicates subsection information.

It should be noted that the LED indications are inverted, hence they must be complemented to get the correct octal value. (e.g. "01101111" = 20 octal)

<u>LEDs</u>	<u>No.</u>	<u>Area</u>	<u>Meaning (sections only)</u>
11111111	-0	Self-test	Hardware
01111111	0	Processor	CPU Pre-test
01111110	1*	ROM Code	Processor Pre-test
01111101	2*		Memory Pre-test
01111100	3*		I/O Pre-test
01111011	4		ROM Loader in execution
01111010	5		ROM Loader error
01111001	6*		Extended Memory Pre-test
01111000	7		VCP Program in execution
01110111	10*	Kernel	CPU Test
01110110	11*	Diagnostic	Processor Test
01110101	12*		Memory Test
01110100	13*		I/O Tests
01110011	14*		Illegal Interrupt error
	15		
	16	Reserved	
	17		
01101111	20*	DDL	Run indication
01101110	21*	programs	Execution error
	22		reserved
01101100	23*		Interface Diagnostic error
	24		reserved
01101010	25*		Parity error
01101001	26*	Extended Memory	Diagnostic related error

\* - These indications may flash with other data (generally with subsection information).



Flashing Indications

01111110	1	Processor Pre-test
00111111	1+0	This will alternate with either of the following: a. A failure is detected on the processor card (CIR, TBG, or registers).
00XXXXXX	1+sc	b. An illegal interrupt occurred from a select code.
01110110	11	Processor Kernel
0011XXXX	11+X	This will alternate with the subsection in the Kernel that failed. The subsections are: 00111001 = Time Base Generator 00111000 = Memory Protect 00110111 = Unimplemented Instruction Trap
01111101	2	Memory Pre-test
01110101	12	Memory Kernel
00abbbbb	2+bit	This indicates a failure in the base 32K of memory. It will alternate with the bit identification data. a = upper or lower (1=lower, 0=upper) bbbb = bit number that failed 1111 = bit 0 0111 = parity bit 0XXXX = multi-bit failure (first bit displayed)
01111001	6	Extended Memory Pre-test
01101001	26	Extended Memory Diagnostic (with DDL)
0011XXXX	n6+B	This is used to indicate a data error has occurred in extended memory. The block number (XXXX) isolates the error down to a board in the case of the 12002A and 12003A, or to a row on the 12002B.



<u>LED Indications</u>	<u>12002A/12003A</u>	<u>12002B</u>
00111111 <-> 00111100	Contriller	Row 0
00111011 <-> 00111000	Array Board 1	Row 1
00110111 <-> 00110100	Array Board 2	Row 2
00110011 <-> 00110000	Array Board 3	Row 3

01111100	3	I/O Pre-test
01110100	13	I/O Kernel
01110011	14	I/O Kernel (illegal interrupt)
01101100	23	I/O Interface Diagnostic

These indications will generally flash with the select code of the interface that failed.

00XXXXXX	n3+sc	XXXXXX = select code of interface card
0011XXXX	3+X	If the display is for the Pre-test section, then the subsection information can also indicate:

- 00111111 = no I/O cards
- 00111110 = two or more cards enabled for break
- 00111101 = priority chain is broken
- 00111100 = duplicate select codes
- 00111011 = invalid select code (17 or less)

01101111	20	DDL (idle or run indication) If not flashing then DDL is in the idle or entry mode.
0011XXXX	20+X	If flashing, DDL is executing a diagnostic. If the diagnostic was loaded sequentially, then XXXX is the file number that was loaded. If loaded manually, then the file number is assumed to be zero. Note: The speed at which the LEDs flash will vary depending on the diagnostic .
01101110	21	DDL (execution error) This indication signifies that DDL has detected a statement file error. It will flash with the error number that would normally be printed on on the terminal console configured as the VCP. If a normal stop is encountered other than a STOP statement, then the displayed number is 77 octal.
00nnnnnn	21+n	Refer to Table A-1 of the DDL Operating and Programming Manual, part no. 24397-90003, for an explanation of the error numbers.
01101010	25	DDL (parity error) This indication signifies that during execution of the DDL program, a parity error occurred.
00111111	25+0	If the error is in the data area then DDL assumes that it can be recovered.
00111110	25+1	If the error is on a fetch or below the user data area then DDL assumes that it is not recoverable.

24397-90001

October 1980

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I use this book	rarely <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> often	Areas for improvement or commendation (reference by chapter/section/paragraph): _____ _____ _____ _____ _____ _____
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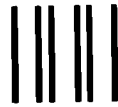
Name \_\_\_\_\_  
Job title \_\_\_\_\_  
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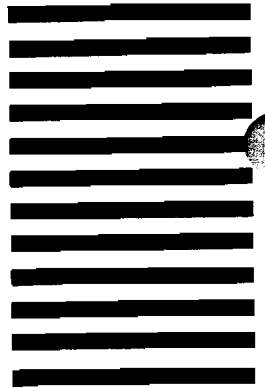
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# SALES & SUPPORT OFFICES

Arranged alphabetically by country



## Product Line Sales/Support Key

Key	Product Line
A	Analytical
CM	Components
C	Computer Systems
CP	Computer Systems Primary Service Responsible Office (SRO)
CS	Computer Systems Secondary SRO
E	Electronic Instruments & Measurement Systems
M	Medical Products
MP	Medical Products Primary SRO
MS	Medical Products Secondary SRO
P	Consumer Calculators
.	Sales only for specific product line
**	Support only for specific product line

**IMPORTANT:** These symbols designate general product line capability. They do not insure sales or support availability for all products within a line, at all locations. Contact your local sales office for information regarding locations where HP support is available for specific products.

*HP distributors are printed in italics.*

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*Caixa Postal 6487*  
**LUANDA**  
*Tel: 35515,35516*  
*A\*,E,M,P*

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*Tel: 798-6086, 792-1293*  
*Cable: HEWPACKARG*  
*A,E,CP,P*

*Biotron S.A.C.I.y.M*  
*Avenida Paseo Colon 221*  
*9 Piso*  
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*34-9356, 34-0460, 34-4551*  
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**1036 BUENOS AIRES**  
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*74-43459*  
*Telex: 18137, 22754*  
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*Telex: 62650*  
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## Queensland

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*Telex: 88419*  
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*Wael Pharmacy*  
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**BAHRAIN**  
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*Telex: 8550 WAEJ GJ*  
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*Bangladesh Ltd.*  
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*Dilkusha Commercial Area*  
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*Sami Amin Trading Office*  
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Arranged alphabetically by country

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F-57000 **METZ**  
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1348-3, Asahi-cho  
**ATSUGI, Kanagawa 243**  
Tel: (0462) 24-0451  
CM,C\*,E

Yokogawa-Hewlett-Packard Ltd.  
Kumagaya Ashai Building  
4 Tusukuba, 3-chome  
**KUMAGAYA, Saitama 360**  
Tel: (0485) 24-6563  
CM,CS,E

Yokogawa-Hewlett-Packard Ltd.  
Mito Mitsui Building  
4-73, San-no-maru, 1-chome  
**MITO, Ibaragi 310**  
Tel: (0292) 25-7470  
CM,CS,E

Yokogawa-Hewlett-Packard Ltd.  
Sunitomo Seimei Bldg.  
11-2 Shimo-sasajima-cho  
Nakamura-ku  
**NAGOYA, Aichi 450**  
Tel: (052) 581-1850  
CM,CS,E,MS

Yokogawa-Hewlett-Packard Ltd.  
Chuo Bldg., 4TH FLOOR  
54-20 Nishinakajima, 5-chome  
Yodogawa-ku, Osaka-shi  
**OSAKA, 532**  
Tel: (06) 304-6021  
Telex: 523-3624 YHPOSA  
A,CM,CP,E,MP,P\*

Yokogawa-Hewlett-Packard Ltd.  
29-21 Takaido-Higashi 3-chome  
Suginami-ku **TOKYO 168**  
Tel: (03) 331-6111  
Telex: 232-2024 YHPTOK  
Cable: YUHPMARKET TOK23 724  
A,CM,CP,E,MP,P\*

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

**JORDAN**

*Mouasher Cousins Company*  
P.O. Box 1387  
**AMMAN**  
Tel: 21456, 24907, 39907  
Telex: 21456 SABCO JO  
E,M,P

**KENYA**

*International Aeradio (E.A.) Ltd.*  
P.O. Box 95221

**MOMBASA**

*M*  
*ADCOM Ltd., Inc.*  
*City House, Wabera Street*  
P.O. Box 30635

**NAIROBI**

*M*  
Tel: 331955  
Telex: 22639  
A\*,E,M  
*International Aeradio (E.A.) Ltd*  
P.O. Box 19012

*Nairobi Airport*  
**NAIROBI**  
Tel: 336055, 336056  
Telex: 22201, 22301  
M

*M*  
**KOREA**  
*Samsung Electronics*  
C.P.O. 2775

**SEOUL**  
Tel: 8334311, 8330002, 8330006  
Telex: SAMSAN 27364  
A,C,E,M,P

**KUWAIT**

*Al-Khalidya Trading & Contracting*  
P.O. Box 830 Safat  
**KUWAIT**  
Tel: 42-4910, 41-1726  
Telex: 2481 Areeg kt  
A,E,M

*Photo & Cine Equipment*  
P.O. Box 270 Safat  
**KUWAIT**  
Tel: 42-2846, 42-3801  
Telex: 2247 Malin  
P

**LUXEMBOURG**

Hewlett-Packard Belgium S.A./N.V.  
Boulevard de la Woluwe 100  
Woluwedal  
B-1200 **BRUSSELS**  
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Telex: 23-494 paloben bru  
A,CP,E,MP,P

**MALAYSIA**

Hewlett-Packard Sales (Malaysia)  
Sdn. Bhd.  
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Jalan Ampang  
**KUALA LUMPUR**  
Tel: 483544  
Telex: MA31011  
A,CP,E,M,P\*

*Prolet Engineering*  
P.O. Box 1917  
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Telex: MA 70904 PROMAL  
Cable: PROTELENG  
A,E,M

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Hewlett-Packard Mexicana, S.A. de  
C.V.  
Av. Periferico Sur No. 6501  
Tepepan, Xochimilco  
**MEXICO CITY 23, D.F.**  
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Telex: 017-74-507  
A,CP,E,MS,P

Hewlett-Packard Mexicana, S.A. de  
C.V.  
Rio Volga #600 Colonia del Valle  
**MONTERREY, N.L.**  
Tel: 78-42-93, 78-42-40, 78-42-41  
Telex: 038-410  
CS

**MOROCCO**

*Dolbeau*  
81 rue Karatchi  
**CASABLANCA**  
Tel: 3041-82, 3068-38  
Telex: 23051, 22822  
E

*Gerep*  
2 rue d'Agadir  
Boite Postale 156  
**CASABLANCA**  
Tel: 272093, 272095  
Telex: 23 739  
P

**MOZAMBIQUE**

*A.N. Goncalves Ltd.*  
162, 1° Apt. 14 Av. D. Luis  
Caixa Postal 107  
**MAPUTO**  
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Telex: 6-203 NEGON Mo  
Cable: NEGON  
A,E,M,P

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A,CM,CP

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CM,CS,E,P\*

*Northrop Instruments & Systems*  
Ltd.  
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Tel: 794-091  
A,M

*Northrop Instruments & Systems*  
Ltd.  
Terrace House, 4 Oxford Terrace  
P.O. Box 8388  
**CHRISTCHURCH**  
Tel: 64-165  
A,M

Hewlett-Packard (N.Z.) Ltd.  
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Cable: HEWPACK Wellington  
CM,CP,E,P

*Northrop Instruments & Systems*  
Ltd.

*Sturdee House*  
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**WELLINGTON**  
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Telex: NZ 31296  
A,M

**NIGERIA**

*The Electronics Instrumentations*  
Ltd.  
N6B/770 Oyo Road  
Oluseun House  
P.M.B. 5402  
**IBADAN**  
Tel: 461577  
Telex: 31231 TEL NG  
A,E,M,P  
*The Electronics Instrumentations*  
Ltd.  
144 Agege Motor Road, Mushin  
P.O. Box 6645  
Mushin, **LAGOS**  
A,E,M,P

**NORTHERN IRELAND**

*Cardiac Services Company*  
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**BELFAST BT 10 OBY**  
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Telex: 747626  
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Hewlett-Packard Norge A/S  
Nygaardsgaten 114  
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N-5013 Nygaardsgaten, **BERGEN**  
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Telex: 16621 hpnas n  
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N-1345 **OESTERAAS**  
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Telex: 16621 hpnas n  
A\*,CM,CP,E,MS,P

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Telex: 3289 BROKER MB MUSCAT  
P

**PAKISTAN**

*Mushko & Company Ltd.*  
10, Bazar Road  
Sector G-6/4  
**ISLAMABAD**  
Tel: 28624  
Cable: FEMUS Rawalpindi  
A,E,M,P  
*Mushko & Company Ltd.*  
*Oosman Chambers*  
Abdullah Haroon Road  
**KARACHI 0302**  
Tel: 511027, 512927  
Telex: 2894 MUSHKO PK  
Cable: COOPERATOR Karachi  
A,E,M,P\*



# SALES & SUPPORT OFFICES

Arranged alphabetically by country

## PANAMA

Electronico Balboa, S.A.  
Apartado 4929  
Panama 5  
Calle Samuel Lewis  
Edificio "Aila" No. 2  
**CIUDAD DE PANAMA**  
Tel: 64-2700  
Telex: 3480380  
Cable: ELECTRON Panama  
A,E,M,P  
Foto Internacional, S.A.  
P.O. Box 2068  
Free Zone of Colon  
**COLON 3**  
Tel: 45-2333  
Telex: 3485126  
Cable: IMPORT COLON/Panama  
P

## PERU

Compania Electro Medica S.A.  
Los Flamencos 145, San Isidro  
Casilla 1030  
**LIMA 1**  
Tel: 41-4325  
Telex: Pub. Booth 25424 SISIDRO  
Cable: ELMED Lima  
A,E,M,P

## PHILIPPINES

The Online Advanced Systems  
Corporation  
Rico House, Amorsolo Cor. Herrera  
Street  
Legaspi Village, Makali  
P.O. Box 1510  
**Metro MANILA**  
Tel: 85-35-81, 85-34-91, 85-32-21  
Telex: 3274 ONLINE  
A,C,E,M  
Electronic Specialists and  
Proponents Inc.  
690-B Epifanio de los Santos  
Avenue  
**CUBAO, QUEZON CITY**  
P.O. Box 2649 Manila  
Tel: 98-96-81, 98-96-82, 98-96-83  
Telex: 742-40287  
Cable: ESPINC MANILA  
P  
**POLAND**  
Buro Informacji Technicznej  
Hewlett-Packard  
Ul Stawki 2, 6P  
**PL00-950 WARSZAWA**  
Tel: 39-59-62, 39-67-43  
Telex: 81 24 53  
A,C\*,E\*,M\*,P\*

## PORTUGAL

Telectra-Empresa Tecnica de  
Equipamentos Electricos S.a.r.l.  
Rua Rodrigo da Fonseca 103  
P.O. Box 2531  
**P-LISBON 1**  
Tel: (19) 68-60-72  
Telex: 12598  
A,C,E,P  
Mundinter  
Intercambio Mundial de Comercio  
S.a.r.l.  
P.O. Box 2761  
Avenida Antonio Augusto de Aguiar  
138  
**P-LISBON**  
Tel: (19) 53-21-31, 53-21-37  
Telex: 16691 munter p  
M

## PUERTO RICO

Hewlett-Packard Puerto Rico  
Calle 272  
#203 Urb. Country Club  
**RIO PIEDRAS**, Puerto Rico 00924  
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Telex: 345 0514  
A,CP

## QATAR

Business Communications Quatar  
P.O. Box 3656  
**DOHA**  
Tel: 5851  
Telex: 4454  
P  
Nasser Trading & Contracting  
P.O. Box 1563  
**DOHA**  
Tel: 22170  
Telex: 4439 NASSER  
M

## RHODESIA

Field Technical Sales  
45 Kelvin Road North  
P.O. Box 3548  
**SALISBURY**  
Tel: 705231  
Telex: RH 4122  
A,E,M,P

## ROMANIA

Hewlett-Packard Reprezentantia  
Boulevard Nicolae Balcescu 16  
**BUCURESTI**  
Tel: 130725  
Telex: 10440  
C\*,E\*

## SAUDI ARABIA

Modern Electronic Establishment  
P.O. Box 193  
**AL-KHOBAR**  
Tel: 44-678, 44-813  
Telex: 670136  
Cable: ELECTA AL-KHOBAR  
C,E,M,P  
Modern Electronic Establishment  
P.O. Box 1228, Baghdadiah Street  
**JEDDAH**  
Tel: 27-798  
Telex: 401035  
Cable: ELECTA JEDDAH  
C,E,M,P  
Modern Electronic Establishment  
P.O. Box 2728  
**RIYADH**  
Tel: 62-596, 66-232  
Telex: 202049  
C,E,M,P

## SCOTLAND

Hewlett-Packard Ltd.  
Royal Bank Buildings  
Swan Street  
**BRECHIN**, Angus, Scotland  
Tel: 3101, 3102  
CM,CS  
Hewlett-Packard Ltd.  
**SOUTH QUEENSFERRY**  
West Lothian, EH30 9TG  
GB-Scotland  
Tel: (031) 3311000  
Telex: 72682  
CM,CP,E,MS

## SINGAPORE

Hewlett-Packard Singapore (Pte.)  
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6th Floor, Inchcape House  
450-452 Alexandra Road  
**SINGAPORE 0511**  
P.O. Box 58 Alexandra Post Office  
Singapore 9115  
Tel: 631788  
Telex: HPSGSO RS 32409  
Cable: HEWPACK, Singapore  
A,CP,E,MS,P

## SOUTH AFRICA

Hewlett-Packard South Africa (Pty.)  
Ltd.  
Pine Park Center  
Forest Drive, Pinelands  
**CAPE PROVINCE, 7405**  
P.O. Box 120  
Howard Place  
**CAPE PROVINCE 7450**  
Tel: 53-7955, 53-7956, 53-7957,  
53-7958, 53-7959  
Telex: 57-0006  
A,CM,CS,E,MS,P  
Hewlett-Packard South Africa (Pty.)  
Ltd.  
P.O. Box 37066  
Overport  
**DURBAN 4067**  
Tel: 28-4178, 28-4179, 28-4110  
CM,CS  
Hewlett-Packard South Africa (Pty.)  
Ltd.  
Hewlett-Packard Centre  
Daphne Street  
Privale Bag Wendywood  
**SANDTON 2144**  
Tel: 802-5111  
Telex: 84782  
Cable: HEWPACK Johannesburg  
A,CM,CP,E,MS,P

## SPAIN

Hewlett-Packard Espanola S.A.  
c/Entenza 312  
**E-BARCELONA 29**  
Tel: (3) 322-24-51, 321-73-54  
Telex: 52603 hpbe e  
A,CM,CP,E,MS,P  
Hewlett-Packard Espanola S.A.  
c/San Vicente s/n  
Edificio Albia II, 7°B  
**E-BILBAO 1**  
Tel: 423-82-06, 423-83-06  
A,CM,E,MS  
Hewlett-Packard Espanola S.A.  
Calle Jerez 3  
**E-MADRID 16**  
Tel: (1) 458-2600  
Telex: 23515 hpe  
A,CM,E,MP,P  
Hewlett-Packard Espanola S.A.  
Colonia Mirasierra  
Edificio Juban  
c/o Costa Brava 13  
**E-MADRID 34**  
Tel: (1) 734-8061, 734-1162  
CM,CP  
Hewlett-Packard Espanola S.A.  
Av Ramon y Cajal 1  
Edificio Sevilla 1, Planta 9  
**E-SEVILLA 5**  
Tel: (954) 64-44-54, 64-44-58  
A,CM,CS,MS,P  
Hewlett-Packard Espanola S.A.  
C/Ramon Gordillo 1 (Entlo.)  
**E-VALENCIA 10**  
Tel: (96) 361-1354  
CM,CS,P

## SRI LANKA

Metropolitan Agencies Ltd.  
209/9 Union Place  
**COLOMBO 2**  
Tel: 35947  
Telex: 1377METROLTD CE  
Cable: METROLTD  
A,E,M,P

## SUDAN

Radison Trade  
P.O. Box 921  
**KHARTOUM**  
Tel: 44048  
Telex: 375  
A,E,M

## SURINAM

Surtel Radio Holland N.V.  
Grote Holstr. 3-5  
P.O. Box 155  
**PARAMARIBO**  
Tel: 72118, 77880  
Cable: Surtel  
E,M

## SWEDEN

Hewlett-Packard Sverige AB  
Enighetsvagen 3  
S-16120 **BROMMA**  
Tel: (08) 730-0550  
Telex: (854) 10721 MESSAGES  
Cable: MEASUREMENTS  
A,CM,CP,E,MS,P  
Hewlett-Packard Sverige AB  
Sunnanvagen 14K  
S-22226 **LUND**  
Tel: (46) 13-69-79  
CM,CS  
Hewlett-Packard Sverige AB  
Vastra Vintergatan 9  
S-70344 **OREBRO**  
Tel: (019) 14-07-20  
CM,CS  
Hewlett-Packard Sverige AB  
Frotallsgatan 30  
S-42132 **VASTRA-FROLUNDA**  
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Telex: 85410721  
CM,CS,E,P

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CH-4058 **BASEL**  
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A,CM  
Hewlett-Packard (Schweiz) AG  
Bahnhofstrasse 44  
3018 **BERN**  
Tel: (031) 56-24-22  
CM  
Hewlett-Packard (Schweiz) AG  
47 Avenue Blanc  
CH-1202 **GENEVA**  
Tel: (022) 32-30-05, 32-48-00  
CM,CP  
Hewlett-Packard (Schweiz) AG  
29 Chemin Chateau Bloc  
CH-1219 **LE LIGNON**-Geneva  
Tel: (022) 96-03-22  
Telex: 27333 hpag ch  
Cable: HEWPACKAG Geneva  
A,CM,E,MS,P  
Hewlett-Packard (Schweiz) AG  
Zurcherstrasse 20  
P.O. Box 307  
CH-8952 **SCHLIEREN**-Zurich  
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Telex: 53933 hpag ch  
Cable: HPAG CH  
A,CM,CP,E,MS,P

## SYRIA

General Electronic Inc.  
Nuri Basha-Ahmal Ebn Kays Street  
P.O. Box 5781  
**DAMASCUS**  
Tel: 33-24-87  
Telex: 11215 ITIKAL  
Cable: ELECTROBOR DAMASCUS  
E  
Sawah & Co.  
Place Azme  
Boite Postale 2308  
**DAMASCUS**  
Tel: 16-367, 19-697, 14-268  
Telex: 11304 SATACO SY  
Cable: SAWAH, DAMASCUS  
M

Suleiman Hilal El Mlawi  
P.O. Box 2528  
Mamoun Bitar Street, 56-58  
**DAMASCUS**  
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Telex: 11270  
Cable: HILAL DAMASCUS  
M

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Shin Shin, Chu  
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CS,E,MS,P  
Hewlett-Packard Far East Ltd.  
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205 Tun Hwa North Road  
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Tel: 751-0404  
Cable: HEWPACK Taipei  
A\*,CP,E,MS,P  
San Kwang Instruments Co., Ltd.  
20 Yung Sui Road  
**TAIPEI**  
Tel: 361-5446, 361-5447,  
361-5448, 361-5449  
Telex: 22894 SANKWANG  
Cable: SANKWANG Taipei  
A

## TANZANIA

International Aeradio (E.A.) Ltd.  
P.O. Box 861  
**DAR ES SALAAM**  
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Telex: 41030  
M

## THAILAND

UNIMESA Co. Ltd.  
Elcom Research Building  
2538 Sukhumvit Ave.  
Bangchak, **BANGKOK**  
Tel: 393-2387, 393-0338  
Telex: TH81160, 82938, 81038  
Cable: UNIMESA Bangkok  
A,E,M  
Bangkok Business Equipment Ltd.  
5/5-6 Dejo Road  
**BANGKOK**  
Tel: (022) 96-03-22,  
234-8672, 234-8673  
Cable: BUSIQUIPT Bangkok  
P

## TRINIDAD & TOBAGO

CARTEL  
Caribbean Telecoms Ltd  
P.O. Box 732  
50/A Jerningham Avenue  
**PORT-OF-SPAIN**  
Tel: 62 4214, 62 4213  
A,E,M,P



## TUNISIA

*Tunisie Electronique*  
31 Avenue de la Liberte  
**TUNIS**  
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E,P

*Corema*  
1 ter. Av. de Carthage  
**TUNIS**  
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Telex: 12319 CABAM TN  
M

## TURKEY

*Teknim Company Ltd.*  
Riza Sah Pehlivi  
Caddesi No. 7  
Kavaklidere, **ANKARA**  
Tel: 275800  
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E

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*Emilac Ltd.*  
P.O. Box 2711  
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E,M,P

*Emilac Ltd.*  
P.O. Box 1641  
**SHARJAH**  
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Hewlett-Packard Co.  
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Hewlett-Packard Co.  
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**PHOENIX, AZ** 85034  
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A,CM,CP,E,MS  
Hewlett-Packard Co.  
2424 East Aragon Road  
**TUCSON, AZ** 85706  
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Hewlett-Packard Co.  
P.O. Box 5646  
Brady Station  
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CM,MS

## California

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7621 Canoga Avenue  
**CANOGA PARK, CA** 91304  
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Hewlett-Packard Co.  
1579 W. Shaw Avenue  
**FRESNO, CA** 93771  
Tel: (209) 224-0582  
CM,MS

Hewlett-Packard Co.  
1430 East Orangethorpe  
**FULLERTON, CA** 92631  
Tel: (714) 870-1000  
CM,CP,E,MP

Hewlett-Packard Co.  
5400 W. Rosecrans Boulevard  
**LOS ANGELES, CA** 90260  
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CM,CP,MP

Hewlett-Packard Co.  
3939 Lankersham Blvd.  
**NORTH HOLLYWOOD, CA** 91604  
Tel: (213) 877-1282  
regional headquarters

Hewlett-Packard Co.  
3200 Hillview Avenue  
**PALO ALTO, CA** 94304  
Tel: (415) 857-8000  
CM,CP,E

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646 W. North Market Boulevard  
**SACRAMENTO, CA** 95834  
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A\*,CM,CS,E,MS

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**SAN DIEGO, CA** 92123  
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CM,CP,E,MP

Hewlett-Packard Co.  
363 Brookhollow Drive  
**SANTA ANA, CA** 92705  
Tel: (714) 641-0977  
A,CM,C\*,E

Hewlett-Packard Co.  
3003 Scott Boulevard  
**SANTA CLARA, CA** 95050  
Tel: (408) 988-7000  
A,CM,CP,E,MP

Hewlett-Packard Co.  
454 Carlton Court  
**SO. SAN FRANCISCO, CA** 94080  
Tel: (415) 877-0772  
CM,CP

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Hewlett-Packard Co.  
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Arranged alphabetically by country

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Hewlett-Packard Co.  
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### SOUTHERN USA

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