HP AdvanceNet

LAN3000/V Diagnostic and Troubleshooting Guide

This Manual Contains

IEEE 802.3 LAN

Diagnostic Software Information

For HP 3000 MPE-V Systems

HEWLETT PACKARD

HEWLETT-PACKARD COMPANY
Roseville Networks Division
8000 Foothills Boulevard
Roseville, California 95678

Manual Part Number 30242-90003
E0887
Printed in U. S. A.
August 1987

Notice

Printing History

New editions are complete revisions of the manual. Update packages, which are issued between editions, contain additional and replacement pages to be merged into the manual by the customer. The dates on the title page change only when a new edition or a new update is published. No information is incorporated into a reprinting unless it appears as a prior update; the edition does not change when an update is incorporated.

The software code printed alongside the date indicates the version level of the software product at the time the manual or update was issued. Many product updates and fixes do not require manual changes and, conversely, manual corrections may be done without accompanying product changes. Therefore, do not expect a one-to-one correspondence between product updates and manual updates.

Edition 1 .... June 1985 (32189B.51.00)
Edition 2 .... August 1987 (32033G.02.01)

Preface

This guide describes tools to troubleshoot IEEE 802.3 LAN link hardware connecting HP 3000 MPE-V systems.

The primary tool described is LANDIAG, the HP 3000 Local Area Network (LAN) Diagnostic software utility. If you have a hardware problem on your HP 3000 LAN link, you can use LANDIAG along with the other tools to locate the Field Replaceable Unit (FRU) at fault. You must then repair or replace the faulty FRU.

This guide supplements other LAN troubleshooting manuals, as follows:

1. The *LAN Link Hardware Troubleshooting Manual, IEEE 802.3 Coaxial Cable LAN*, 5955-7681, covers the troubleshooting of HP ThinLANs and ThickLANs (thin and thick coaxial cable LANs) comprised of dissimilar systems (such as HP 1000 RTE-A, HP 9000 Series 300, 500 and 800 HP-UX, and HP 3000 MPE-V systems). It uses a portion of the LANDIAG software information contained here. (The HP CE Handbook version of this manual is 5959-2217.)

2. The *HP ThinLAN Diagnostics and Troubleshooting Manual for PCs*, 50909-90060, is directed toward HP personal computer ThinLAN networks. When HP 3000 systems are connected, the LANDIAG information presented here is essential.

3. The troubleshooting process for HP StarLAN, featuring twisted-pair cables, is covered by the *HP StarLAN Diagnostics and Troubleshooting Manual for PCs*, 50906-90060. When HP 3000 MPE-V systems are connected to StarLAN, the LANDIAG information presented here is also needed.

4. If the problem lies in LAN software, rather then the hardware, the *NS3000/V Network Manager Reference Manual* (32344-90002) should be consulted.

The intended audiences for this guide include the Network Manager, the Network Consultant, the Data Comm Specialist, and the Hewlett-Packard Customer Engineer (CE) and Systems Engineer (SE).

How To Use This Guide

All users should read Chapter 1 to become acquainted with general troubleshooting considerations and tools covered by this guide. As a reference manual, users can subsequently proceed to the chapter describing the particular tool of interest.

For those users who lack troubleshooting procedures, Appendix A is provided. Appendix A provides procedures, as a series of decision-tree flowcharts, to help isolate HP 3000 LAN link hardware faults. These procedures utilize LANDIAG and other tools presented in the various chapters.

Organization Of This Guide

This guide consists of the following chapters:

Additional References

When using this manual, you should be familiar with the basic operating principles of HP 3000 computers and the MPE-V operating system. In addition, you should be familiar with the subjects covered in the following manuals, as appropriate:

- HP 3000 Computer Systems, MPE V Commands Reference Manual (32033-90006)
- HP 3000 Computer Systems, MPE V Intrinsics Reference Manual (32033-90007).
- HP 3000 Computer Systems, MPE V System Operation and Resource Management Reference Manual (32033-90005)
- Fundamental Data Communications Handbook (5979-4634)
- LAN Cable and Accessories Installation Manual (5955-7680), for coaxial cable LANs
- HP 3000 LAN Link installation and service manuals, including
  - HP 30240A LAN3000/V Link LANIC Installation and Service Manual (part number depends on the product option selected)
  - HP 30265A StarLAN/3000 Link Installation and Service Manual (30265-90001), for Series 37 and MICRO 3000 systems
- NS3000/V Network Manager Reference Manual (Volume 1, 32344-90002; Volume 2, 32344-90012)
- NS3000/V User/Programmer Reference Manual (32344-90001)
- NS3000/V Error Message and Recovery Manual (32344-90005)
- HP StarLAN Planning Guide for PCs (50906-90020)
- HP SiteWire Planning Guide (5959-2201)

Contents

Contents (continued)

Figures and Tables

Figure or Flowchart **Page**

Conventions Used

NOTATION	DESCRIPTION
UPPERCASE **Boldface**	Words in uppercase or boldface text must be entered exactly as shown. Punctuation characters other than brackets, braces and ellipses must also be entered exactly as shown. For example: `EXIT;`
italics	Words in syntax statements that are in italics denote a parameter that must be replaced by a user-supplied variable. For example: CLOSE *filename*
lowercase nonbold	Words in lowercase or nonbold text denote substitutable variables or user-defined strings.
[ ]	An element inside brackets in a syntax statement is optional. Several elements stacked inside brackets means the user may select any one or none of these elements. For example: [A / B] User *may* select A, B or neither. When brackets are nested, parameters within inner brackets can be specified only if parameters in the outer brackets or commas (place holders) are specified. For example: `[parm1[,parm2[,parm3]]]` can be entered as: `parm1,parm2,parm3 or parm1,,parm3` etc. Optional parameters that are not position-related are as follows: `[parm1] [,parm2]`
{ }	When several elements are stacked within braces in a syntax statement, the user must select one of those elements. For example: {A / B / C} User *must* select A or B or C.
| |	Vertical parallel lines indicate that any or none of the options can be used in any sequence but none of the elements may appear more than once. For example: | A / B / C | Choose A,B,C, or C,A, or B, etc.

Conventions Used (continued)

NOTATION	DESCRIPTION
...	A horizontal ellipsis in a syntax statement indicates that a previous element can be repeated. For example: `[,itemname]...;` A vertical or horizontal ellipsis may also denote omission or repetition.
, (shaded)	A shaded delimiter preceding a parameter in a syntax statement indicates that the delimiter *must* be supplied whenever (a) that parameter is included or (b) that parameter is omitted and any *other* parameter that follows is included. For example: *itema*[,*itemb*][,*itemc*] means that the following are allowed: *itema* *itema*,*itemb* *itema*,*itemb*,*itemc* *itema*,,*itemc*
Δ	When necessary for clarity, the symbol Δ can be used in a syntax statement to indicate a required blank or an exact number of blanks. For example: SET[(*modifier*)]Δ(*variable*);
underlining	When necessary for clarity in an example, user input can be underlined. For example: NEW NAME? ALPHA In addition, brackets, braces or ellipses appearing in syntax or format statements that must be entered as shown will be underlined. For example: LET *var*[[*subscript*]]=*value*
shading	Shading represents inverse video on the terminal screen. Shading is also used to emphasize key portions of an example.
[ ]	The symbol [ ] indicates a key on the terminal keyboard. For example, [RETURN] indicates the RETURN key.
[CONTROL]*char*	Control characters are indicated by [CONTROL] followed by the character. For example, [CONTROL]Y means hold the CONTROL key and press Y simultaneously.

Reader Comment Sheet

Information Networks Group

LAN3000/V Diagnostic and Troubleshooting Guide

30242-90003 August 1987

We welcome your evaluation of this manual. Your comments and suggestions help us to improve our publications. Please explain your answers under Comments, below, and use additional pages if necessary.

Is this manual technically accurate? ___ **Yes** ___ **No**

Are the concepts and wording easy to understand? ___ **Yes** ___ **No**

Is the format of this manual convenient in size, arrangement, and readability? ___ **Yes** ___ **No**

Comments:

This form requires no postage stamp if mailed in the U.S. For locations outside the U.S., your local company representative will ensure that your comments are forwarded.

FROM: **Date** ____________________

Name ____________________

Company ____________________

Address ____________________

____

____

FOLD FOLD

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 256 ROSEVILLE, CALIFORNIA

POSTAGE WILL BE PAID BY ADDRESSEE

Publications Manager
HEWLETT-PACKARD COMPANY
Roseville Networks Division
8000 Foothills Boulevard
Roseville, California 95678-6598

FOLD FOLD

General Information 1

Introduction

An IEEE 802.3 Local Area Network (LAN) presents a relatively complex hardware troubleshooting environment. The connection of one computer system (i.e., node) to another may involve many hardware components.

Figure 1-1, for example, shows four HP 3000 MPE-V systems connected together on different LANs or LAN segments. Each system connection requires hardware that depends on the type of LAN cable. Furthermore, various combinations of Hubs, Bridges, and Repeaters are used to extend or join the individual LANs.

As the network grows, network troubleshooting becomes more complex. Additional systems (such as HP 9000s, HP 1000s, personal computers, or other HP 3000s), cabling, and LAN extension hardware provide additional sources of network faults.

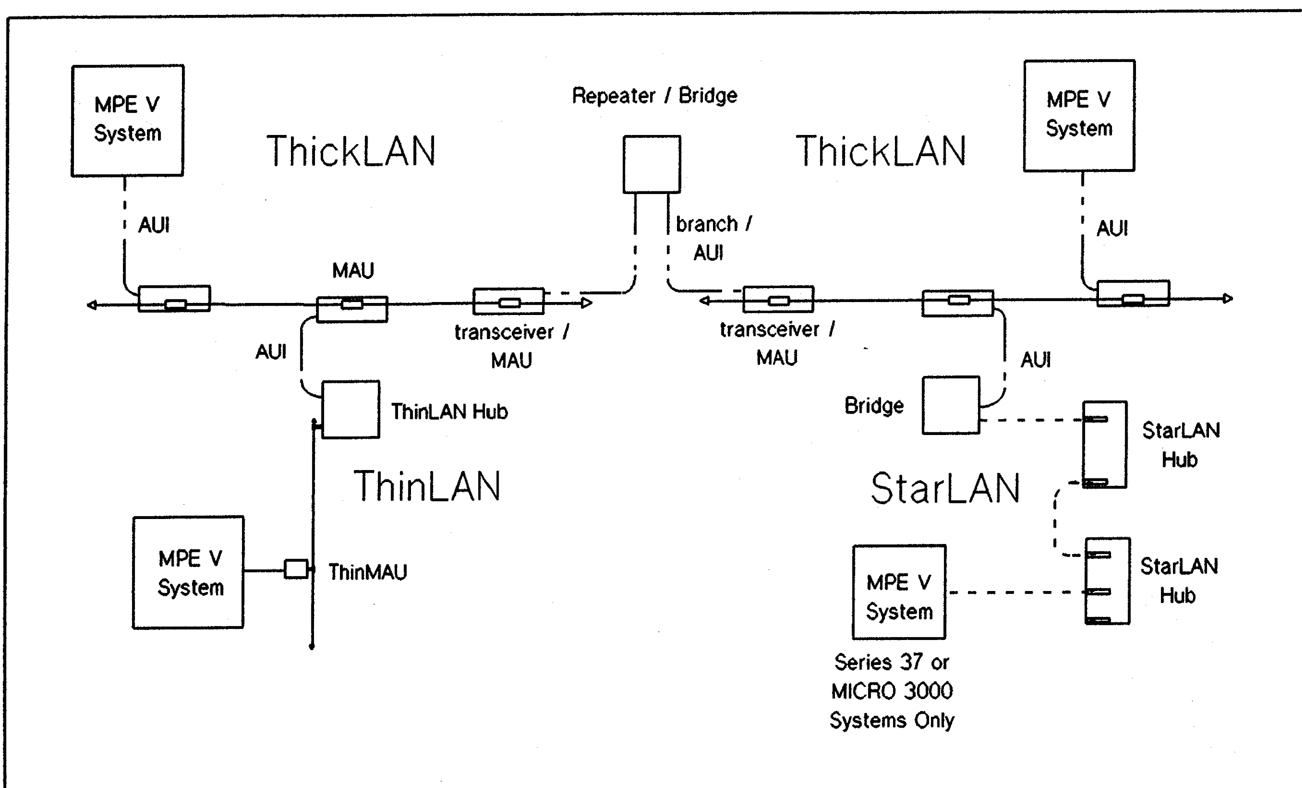


Figure 1-1. LAN Hardware Troubleshooting Complexity

Various tools are available on MPE-V systems to assist in the LAN troubleshooting process. As they pertain to LAN troubleshooting, the following tools are described in this manual:

- SHOWCOM: for monitoring the communication line.
- Activity LEDs: for monitoring activity on AUI or StarLAN node cabling, and on the LANIC card.
- LANDIAG: the LAN Diagnostic program for testing composite LAN link hardware.
- Self Test and selftest LEDs: primarily used for testing the LANIC card circuitry.
- Tracing: for analyzing protocol activity of the network at the link level.
- Memory Dump: for analyzing a system crash in relation to a LAN problem.
- NSDPAN5/NSDUMPJ: for formatting memory dumps.
- LISTLOG5: for analyzing the system log.
- NMMAINT: for analyzing the NMS log.
- CSLIST: for checking the version of communications software.
- DSLIST: for obtaining a list of DS software module versions.

Applicable Networks

The tools provided in this guide are described as they pertain to troubleshooting LANs that conform to Hewlett-Packard implementations of the IEEE 802.3 standards. These LANs feature baseband signaling, and a Carrier Sense Multiple Access with Collision Detection (CSMA/CD) network access protocol.

Coaxial Cable LANs

Hewlett-Packard coaxial cable LANs feature 10-megabit per second burst transfer rates over a coaxial cable bus to which each node attaches.

IEEE 802.3 Type 10BASE5 Standard

This LAN uses a "thick" (0.4 inch/10 mm diameter) coaxial cable. Thick cable LANs feature connection of up to 100 nodes on a single 500 metre bus segment.

HP 3000 MPE-V systems connect to this LAN using the HP LAN3000/V link product. Hardware included with this product consist of a Local Area Network Interface Controller (LANIC) interface card, an Attachment Unit Interface (AUI) cable, and an HP 30241A Medium Attachment Unit (MAU) and tap assembly for cable access.

IEEE 802.3 Type 10BASE2 Standard

This LAN uses a "thin" This LAN uses a "thin" (0.19 inch/4.9 mm diameter) RG58 C/U coaxial cable. ThinLAN cables feature connection of up to 30 nodes on a single 185 metre bus segment.

HP 3000 MPE-V systems connect to this LAN using the HP ThinLAN3000/V link product. Applicable hardware consists of the LANIC interface card, and HP 28641A ThinMAU and BNC tee connector for cable access.

Twisted Pair LAN

IEEE 802.3 Type 1BASE5 Standard (Proposed)

The Hewlett-Packard twisted pair cable LAN, HP StarLAN, features a 1-megabit per second burst transfer rate through a hierarchical structure of HP 27212A StarLAN Hubs. Nodes connect to the Hubs via the twisted pair cables; each cable can be up to 250 metres in length.

HP 3000 MPE-V systems (Series 37 and MICRO 3000 systems only) connect to this LAN using the HP StarLAN3000/V link product. Applicable hardware consists of the interface card, and twisted pair cable ordered separately.

Fault Isolation and Repair Strategy

LAN hardware faults must be located and corrected. Because LANs are comprised of many pieces of hardware, faults must identified to the *field replaceable unit* (FRU) level of assembly. If the faulty FRU cannot be immediately corrected, it is replaced with a new or functional unit. (For repair, replacement, or return procedures, consult the installation or service manual for the failed unit.)

LAN faults can be classified into two categories: Node faults, and Network faults. A Node fault is characterized by a single node failure that does not affect the other nodes on the network. A Network fault is characterized by multiple node failures, where it is likely that a piece of hardware used commonly by the nodes has failed. Fault isolation procedures for both types of faults are needed.

The following manuals provide both node and network fault isolation procedures. They are differentiated by the type of network to which they apply.

- For coaxial cable LANs, refer to the *LAN Link Hardware Troubleshooting Manual*, 5955-7681. (HP CE Handbook version, 5959-2217.)

- For HP StarLAN, refer to the *HP StarLAN Diagnostics and Troubleshooting Guide for PCs*, 50906-90060.

Appendix A of this guide provides fault isolation procedures, in flowchart format, for HP 3000 MPE-V links. Although network considerations are not excluded, these procedures focus on MPE-V link Node faults. They complement the above troubleshooting manuals by providing an alternative set of procedures that use more features of the tools described in this guide.

Network Map

When troubleshooting a network, the availability of a network map will be critical, especially for large complex networks. As required by Hewlett-Packard, the network map should have been developed during the configuration of the network, and maintained to reflect any growth or modification.

A network map provides the physical layout of nodes on the network, including distances from one to another. Physical layout means the placement of all cables, MAUs and Taps, Hubs and all related network computer equipment. In addition, the network map should be labeled with relevant node information, including node names, globally administered station addresses, and any locally administered station addresses. The configuration of relevant network software on each node would be helpful.

If a network map is not available, you should make one. Refer to the *NS3000/V Network Manager Reference Manual* (Volume 1, 32344-90002; Volume 2, 32344-90012) for information on addresses and other configured items included in the network map. Also, refer to the *HP SiteWire Planning Guide* (5959-2201) for additional information.

Abbreviations and Nomenclature

You may find the following terminology useful when reading this guide.

AUI	Attachment Unit Interface.
Bridge	Address filtering device connecting different LANs, such as coaxial cable LAN to coaxial cable LAN, or coax cable LAN to twisted-pair cable LAN.
Coax	Coaxial cable medium for 802.3 networks.
CR-SR	Control Register - Status Register.
CRC	Cyclical Redundancy Check.
DMA	Direct Memory Access.
DRT	Device Reference Table.
FRU	Field Replaceable Unit (e.g. interface card, or cable section.
Heartbeat	After successful frame transmission, a short collision indicator test signal.
IMB	Inter-Module Bus, the bus supporting I/O in HP 3000 systems (Series 4X/5X/6X/70).
I/O	Input/Output.
Hub	A central device to which multiple cables (hence nodes) connect, e.g., StarLAN Hub, ThinLAN Hub.
Jabber	Excessive LANIC transmission. A jabbering node prevents other nodes from gaining access to the network medium.
LAN	Local Area Network.

LANIC	Local Area Network Interface Controller for IEEE 802.3 LAN I/O (the interface card in HP 3000 MPE-V systems).
LED	Light Emitting Diode.
Loopback	Transmission and receipt of data to verify operation of the communication path.
MAU	Medium Attachment Unit, a device that provides the LANIC with access to a coaxial cable medium.
MAUPON	MAU Power On signal.
MAUPS	MAU Power Sense signal.
MC	A multicast message; a type of broadcast message sent to a group of stations, but not necessarily to all the stations.
Monitor	RAM resident Z80 code used together with the self test in order to upload detailed test results to the HP 3000.
NMI	Non-Maskable Interrupt.
MPU	A Z80 microprocessor on the LANIC.
Node	Uniquely addressable station on a LAN.
NS	HP Network Services for the HP3000.
OBII	Obtain Interrupt - An IMB/SIMB command.
RNT	Remote Node Test.
SIMB	Synchronous Inter-Module Bus, the bus connecting the CPU, Memory, and I/O in HP 3000 Series 37 and MICRO 3000 systems.
SPU	System Processor Unit on HP 3000.
STREG	Self Test Register.
Twisted-pair	Twisted-pair cable for IEEE 802.3 networks.

SHOWCOM 2

The SHOWCOM command is a useful tool for monitoring the status of a line while it is in use. To use SHOWCOM, you normally must have operator (OP) capability, and you must be on the system console.

Syntax

```
:SHOWCOM xxx [;ERRORS]  [;RESET]
```

Where xxx indicates the logical device (ldev) number of a Communication System (CS) device, i.e., the LANIC card.

The ERRORS option causes SHOWCOM to display all available information. RESET causes all fields to be reset to zero after they are displayed.

For example:

```
:SHOWCOM 100;ERRORS

   TRANSMIT               LDN - 100          RECEIVE
MESSAGES SENT           7364        MESSAGES RECVD 9941
COLLISIONS              0           BCC/CRC ERRORS 0
EXC COLLISION ERRS      30          BUFF OVERFLOWS 3676
UNDERRUNS               0           OVERRUNS       0
CLR TO SEND LOSSES      0           LENGTH ERRORS  0
            # OF RECOVERABLE ERRORS   32
            LAST RECOVERABLE ERROR    6
            # OF IRRECOVERABLE ERRORS 4
            LAST IRRECOVERABLE ERROR  201
            LINE IS CONNECTED
```

Interpreting Results

Transmit Fields

MESSAGE SENT	This is the number of frames that the HP 3000 gives to the LANIC, and is not necessarily the number of frames that were actually transmitted onto the LAN When this value increases with time, it means that the driver continued to give frames to the LANIC card whether or not the frames were successfully transmitted. This number will include protocol reply frames, such as those in response to XID or TEST frames received from a remote node. Such response frames are internal to the driver/firmware and are counted even though the responses were transparent to higher level processes.
COLLISIONS	This is the number of times that the LANIC card experienced a collision on transmit. A large number here may mean excessive network traffic, a topology violation (e.g., excessive distances), or excessive jitter. On a coaxial cable LAN, the local MAU/ThinMAU may be faulty, or a remote MAU/ThinMAU may be "leaky." On a StarLAN, a Hub or LANIC card may be faulty.
EXC COLLISION ERRS	This statistic is incremented if, after 16 collisions, a frame was not successfully transmitted onto the LAN.
UNDERRUNS	The LANIC card transmits data onto the line at a high rate. This field shows the number of times, if any, that data could not be transmitted onto the line at the required rate.
CLR TO SEND LOSSES	Not meaningful for the LANIC card (applies to INP interface card).

Receive Fields

MESSAGES RECVD

This includes frames actually passed from the LANIC card to the 3000. Errors detected by the LANIC that do not cross the LANIC-to-HP 3000 boundary are not included. Therefore, frames with length or CRC errors, and multicast frames that do not pass the LANIC card's filtering algorithm are not counted. However, protocol frames that are received do pass across the LANIC-to-HP 3000 boundary and are therefore counted in this statistic.

BCC/CRC ERRORS

A frame was received with bad checksum (CRC). This is an indication that a bit error probably occurred. Since the bit error rate is supposed to be very close to zero, a large number here is probably cause for concern. On a coaxial cable LAN, there may be excessive jitter, too many nodes, nodes not properly spaced on the cable, improper AUI cables, cables of low quality, bad MAU, or bad LANIC. On StarLAN, there may be excessive jitter, excessively long or poor quality cables, a bad Hub, or bad LANIC.

BUFF OVERFLOWS

This means we received a frame but didn't have a buffer to put it into. A large number here probably means that too few receive buffers were configured, too few "maximum reads outstanding" were configured, or the system is too busy or has too little real memory. The number of buffers probably needs to be increased.

OVERRUNS

Incremented for every inbound frame for which the LAN controller chip attempted to write a data word to memory. It was delayed so long by the bus latency that inbound data was lost (the FIFO on the LANIC card overflowed). A large number here means we have too much bandwidth of the IMB/SIMB utilized. This may mean that too many high-speed channels are connected on the same IMB/SIMB.

LENGTH ERRORS

Incremented for every frame where the length-field in the 802 frame does not match the number of bytes actually received. This also includes frames over 1522 bytes in length (including FCS, frame check sequence field). A very large number here probably indicates that a non-802.3 compatible node (e.g., Ethernet) is transmitting, or that there is some bad hardware transmitting to us. There could also be someone transmitting frames longer than 1522 bytes.

Errors

# OF RECOVERABLE ERRORS	The number of errors reported by the driver that did not cause the link to be disconnected.
LAST RECOVERABLE ERROR	This gives the last non-zero CS error number returned by the driver. The completion status can be anything other than IRRECOVERABLE ERROR (completion status 3) or CATASTROPHE (completion status 5). This includes CS "recoverable error codes" as well as error numbers that are normally "irrecoverable error codes" but were completed with good status so as not to cause the translator to shut down the link.
# OF IRRECOVERABLE ERRORS	The number of errors that would force the link to be disconnected, e.g., on a coaxial cable LAN, could not turn on MAU/ThinMAU power.
LAST IRRECOVERABLE ERROR	This is the last non-zero CS error code that the driver gave when it completed a request with IRRECOVERABLE ERROR (completion status 3) or CATASTROPHE (completion status 5). This will not be updated for CS error codes 63 and 64, since these are not really "errors" but are normal completion codes for ABORTIO (function code 66), generated on all process terminations (called from EXPIRE), and the HARD ABORT, generated when the translator detects other errors.

The line will always be in any one of four states:

(1) CONNECTED	The driver is active, firmware has been downloaded and command and response queues have been initialized. Basically, the driver and hardware are ready to receive and transmit frames.
(2) DISCONNECTED	The driver and hardware have not finished initializing or an irrecoverable error has occurred. Basically, the driver and hardware are not ready to receive and transmit frames.
(3) CLOSED	The LDEV is not allocated (not in use).
(4) UNDEFINED	Software error.

Activity LEDs 3

There are 15 LEDs located on the edge of each LANIC card. Figures 3-1 and 3-2 show the LED locations for Series 4X/5X/6X/70 and Series 37/MICRO3000 systems, respectively.

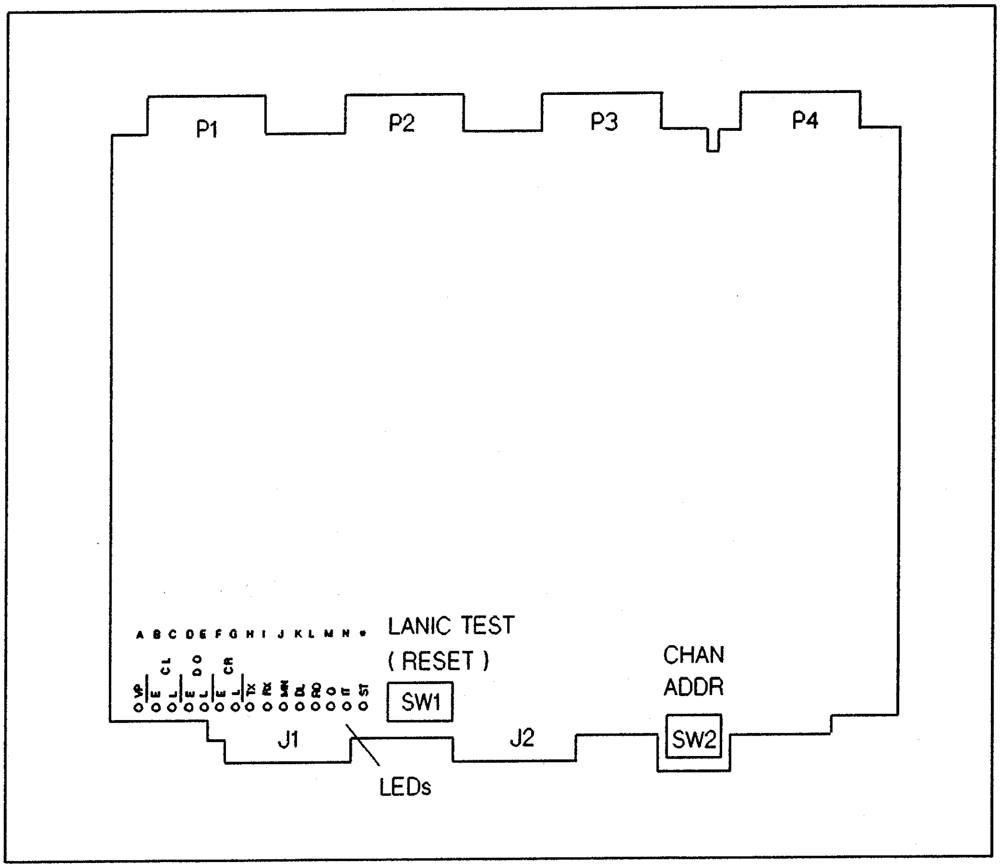


Figure 3-1. LANIC Card LEDs On Series 4X/5X/6X/70 Systems

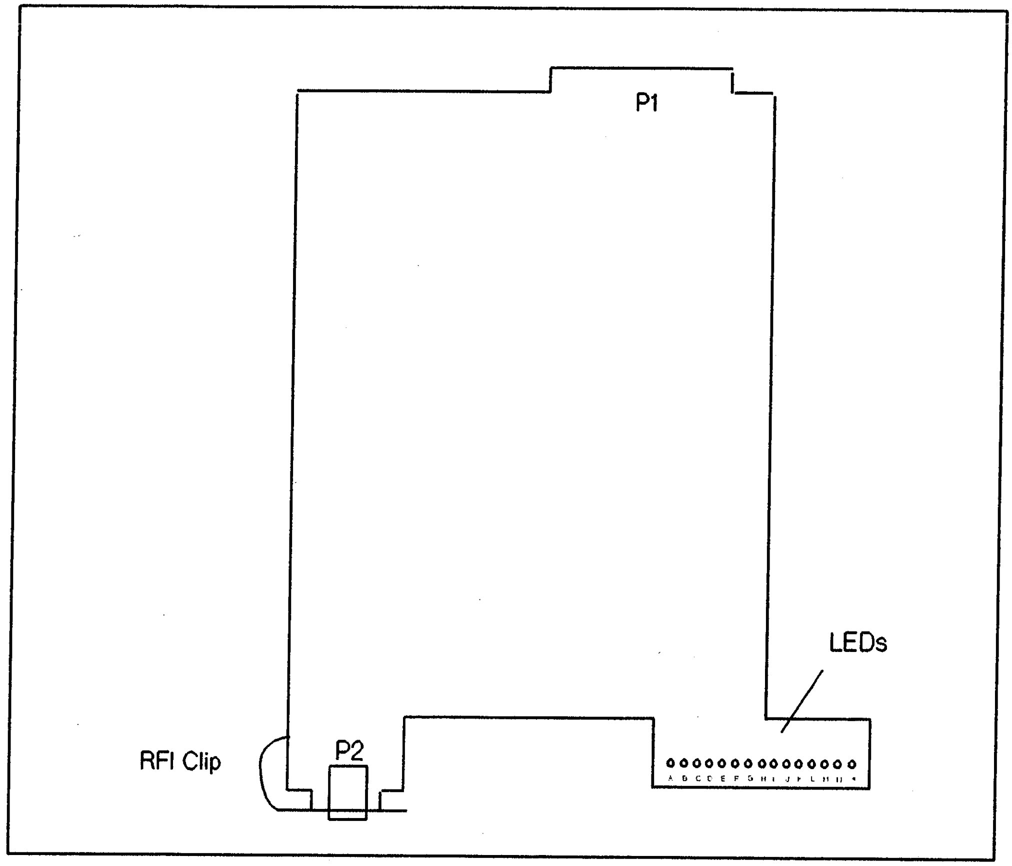
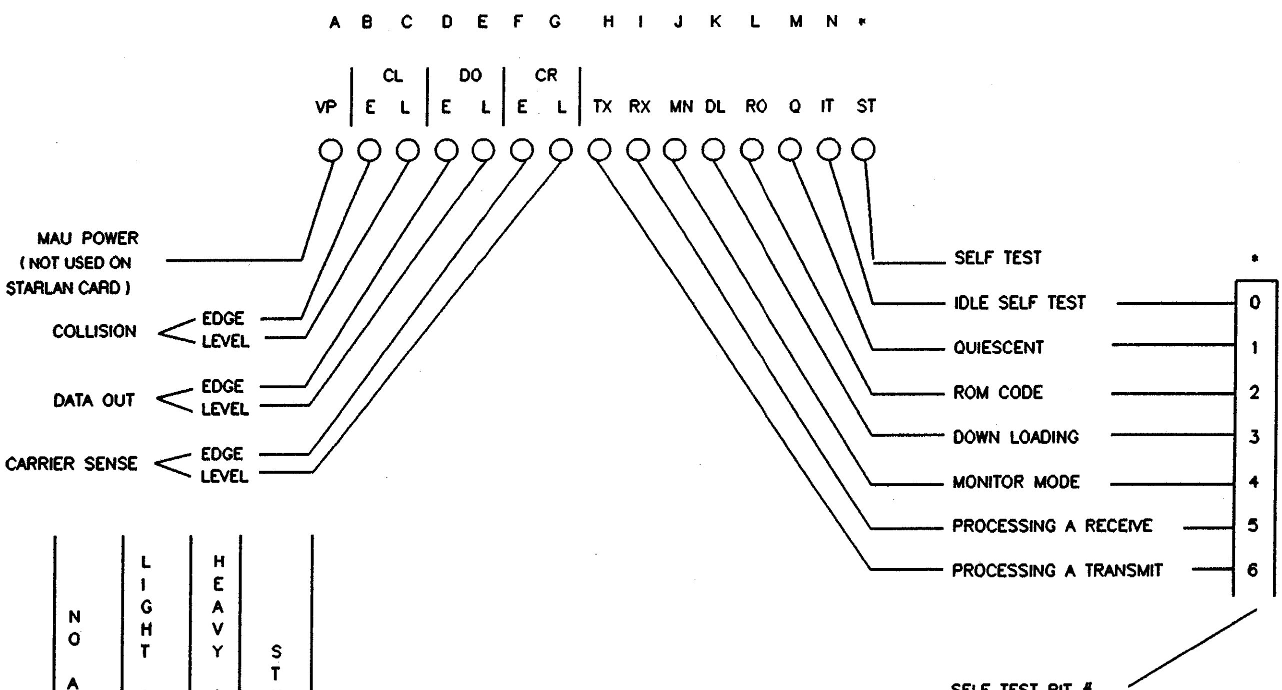


Figure 3-2. LANIC Card LEDs On Series 37 and MICRO3000 Systems

Each of the 15 LEDs is labeled with different labels. The single alphabetic labels provide a quick reference to the LEDs. In addition, one- and two-letter mnemonics are provided to remind users of the LED function. The labels and functions of the LEDs are shown in Figure 3-3.

The LEDs can be classified into the following groups:

- Cable Interface Activity LEDs. The seven LEDs on the left, labeled "A" through "G", monitor activity on the cable, hence the network.
- MPU Activity LEDs. *During normal operation*, the eight LEDs on the right ("H" through "N" plus "*") monitor LANIC card MPU activity. However, these LEDs are also used by card self test (refer to Chapter 5). When used by self test, LED mnemonics do not apply.



	NO ACTIVITY	LIGHT ACTIVITY	HEAVY ACTIVITY	STUCK ON
EDGE	OFF	BLINK	ON	OFF
LEVEL	OFF	OFF	ON	ON

Figure 3-3. LED Labels and Functions

Table 3-1 provides a descriptive summary of the LEDs during normal operation.

Table 3-1. LED Description During Normal Operation

LED	Mnemonic	Description
A	VP	For Coaxial Cable LAN: ON when power is available to the MAU/ThinMAU. For StarLAN: Not used, always OFF.
B	CL-E	ON when the collision line goes active.
C	CL-L	ON for steady collision detect signal from the Manchester encoder/decoder.
D	DO-E	ON when the Data Out signal from the Manchester encoder/decoder goes from false to true.
E	DO-L	ON if there is a steady Data Out signal from the Manchester encoder/decoder.
F	CR-E	ON when the carrier sense signal from the Manchester encoder/decoder goes from false to true.
G	CR-L	ON if there is a steady carrier sense signal from the Manchester encoder/decoder.
H	TX	ON when the card is processing and transmitting a frame.
I	RX	ON when the card is processing a frame addressed to this node.
J	MN	ON when the card is monitoring all link activity, or is monitoring activity sent to a particular address not its own.
K	DL	ON when the download command is received from the SPU to download operating firmware. OFF when the SPU commands the MPU to begin executing the download feature.
L	RO	ON when ROM-resident firmware is being executed by the MPU; OFF when RAM-resident (downloaded) firmware is being executed.
M	Q	ON when the MPU is quiescent (waiting for a host command or I/O completion), during which it checks for activity needing attention.
N	IT	ON when the MPU is executing an idle test of internal card circuitry, during which the MPU tests card hardware that will not affect the readiness to process frames. The idle test also runs before the node becomes operational on the link.
*	ST	ON when the MPU is executing ROM-resident self test. When ST is lit, LEDs H through N are selftest progress and failure indicators, rather than as defined above.

Cable Interface Activity LEDs

The cable interface LEDs monitor the four functions shown below:

DO — **Data out.** These LEDs are ON when data is transferred from this LANIC onto the Data-Out/Transmit signal pair.

CL — **Collision detect.** On a coaxial cable LAN, these LEDs are ON when a collision is detected by the MAU/ThinMAU on this node. For receiver-based collision detection devices, collisions are monitored continuously (whether transmitting or not) -- the CL LEDs indicate virtually every collision that occurs on the coaxial cable. For transmit-based collision detection devices, the CL LEDs indicate collisions that occur only when transmitting.

Note that the CL LEDs are blocked from lighting during the IEEE 802.3 SQE heartbeat signals, which occur after each transmission.

On a StarLAN, these LEDs are ON when a collision pattern is output by the Hub to which this node is connected. The CL LEDs will be active whether or not the LANIC is transmitting. (Heartbeat signals are not employed on StarLAN.)

CR — **Carrier sense.** These LEDs are ON when data is detected coming into the node on the Data-In/Receive signal pair, or when the collision function is detecting collisions. For coaxial cable connections, the CR LEDs do not light for SQE heartbeat signals (StarLAN connections do not employ heartbeat).

VP — **Voltage plus.** For coaxial cable connections, this LED is connected through a current limiting resistor directly to the VP AUI lead. When ON, it indicates power (+12V) is available to the MAU/ThinMAU.

For StarLAN connections, this LED is not used and is always OFF.

The E and L Indicators

Each of the DO, CL and CR functions consist of a pair of LEDs, labeled E and L (for Edge and Level, respectively). The pair is driven in such a manner that all conditions of activity -- from occasional isolated events to continuous events -- are visually distinguishable. The LEDs are encoded as follows:

- "E" LED. Turns ON each time a monitored event begins. It remains ON for 6 milliseconds regardless of the length of the event.

- "L" LED. Turns ON at the beginning of the event and turns off at the end of the event.

Following this algorithm, a single isolated event of short duration produces a 6 millisecond blink of the E LED, and the L LED is on for the length of the event, which is short. Therefore, the L LED appears to remain off.

As the frequency of events of short duration increases, the E LED appears to be constantly illuminated, and the L LED begins to glow.

When short duration events occur constantly, both the E and L LEDs will appear to be constantly illuminated.

A single event of very long duration produces a single 6 millisecond blink of the E LED at the beginning of the event, and the L LED turns on and stays on for a long time, until the event is completed.

Events that continue for a "very long" time will cause the E LED to blink at the beginning of each event for 6 milliseconds, and the L LED will appear to be constantly illuminated.

Events on a normally-operating network are all of short duration. For reference, see Table 3-2.

Table 3-2. Approximate Duration References

Event	Approximate Duration	
	Coaxial Cable	StarLAN
Maximum frame length transmission	1.2 ms	12 ms
Minimum frame length transmission	0.051 ms	0.51 ms
Collisions	0.049 ms	0.49 ms

For events of short duration, such as those in Table 3-2, note the following:

- As the frequency of activity increases, the frequency of flashing of the E LED increases while the L LED is off or very dim.
- When the frequency of activity is very high, and the E LED appears to be ON continuously, the L LED indicates further increase in activity by becoming brighter and brighter until it reaches full intensity. This state of the E and L LEDs indicates continuous short events.

Relationship to Cable Signals

To understand the indications given by the DO, CL and CR LEDs, it is necessary to understand how the signals that drive these LEDs are related to the lines of the attached cables.

For coaxial cable LAN connections, the HP AUI cable contains three signal pairs used by the MAU/ThinMAU: the Data-Out pair, the Data-In pair, and the Control-In pair.

For StarLAN connections, the HP StarLAN cable contains two signal pairs: the Transmit pair, and the Receive pair. The Receive pair is used for frame reception and collision signals.

DO LED Events

The event indicated by the DO LEDs is the enabling of the data encoder by the protocol controller on the LANIC. The event begins when the encoder is turned on. While the encoder is on, a continuous stream of encoded data bits is transmitted by the LANIC onto the Data-Out/Transmit signal pair. The event ends when the data encoder is disabled. When the encoder is disabled, data bits are no longer sent onto the Data-Out/Transmit pair.

The transmission of a single frame onto the cable Data-Out/Transmit pair is one event, and will cause the E LED to blink ON for 6 ms. The L LED will be illuminated for the length of time required to transmit the data bits onto the Data-Out/Transmit pair.

CL LED Events

The event indicated by the CL LEDs is the occurrence of the Signal Quality Error (Collision) signal on the Control-In/Receive pair of the attached cable. The event begins when the first transition of the collision SQE signal is received at the LANIC, and ends 200 nanoseconds after the last transition is received.

Coaxial Cable LAN Connection. On collision detection, the MAU/ThinMAU sends the SQE signal (a 10 MHz signal) to the LANIC on the Control-In pair of the AUI cable.

The SQE heartbeat, a short burst of 10 MHz signal returned on the Control-In pair after each successful transmission, is used to test the collision detection circuitry. SQE heartbeat does not cause the CL-E LED to blink. For a period of 5.3 microseconds after a successful transmission, the CL-E LED is blocked from collision signals. Therefore, heartbeat and normal collisions that occur during this period will not activate the CL-E LED.

Heartbeat will cause the illumination of the L LED for approximately 1 microsecond; however, this is too short to be seen.

StarLAN Connection. On collision detection, the StarLAN Hub to which the LANIC is connected sends a Collision Presence Signal (CPS) -- a 1 MHz signal -- to the LANIC on the Receive pair of the StarLAN cable.

Heartbeat signals are not used on StarLAN. Note that software used to monitor card statistics may increment heartbeat errors. Such errors should be disregarded when they occur with a StarLAN card.

CR LED Events

There are two events indicated by the CR LEDs:

- Reception of data on the Data-In/Receive lines of the attached cable, or

- Occurrence of a collision signal as described above (see "CL LED Events").

The event begins when the first data transition arrives on the Data-In/Receive pair, or when the collision event begins, whichever occurs first. The event ends 200 nanoseconds after the last data transition on the Data-In/Receive pair, or after the collision event ends, whichever occurs last.

MPU Activity LEDs

When the LANIC card has been reset either by power-up of the system or by the operating software, all eight of the MPU activity indicators (LEDs "H" through "N" and "*") will be on continuously. This indicates that the MPU is not executing.

The cable interface LEDs will all be off. For coaxial LANs, this includes the VP LED, indicating the MAU/ThinMAU is not powered.

After the LANIC has successfully passed self test (see Chapter 5), the "*" LED will be OFF, and the other seven MPU activity LEDs will now indicate MPU activity. When the "*" LED is OFF, the "H" through "N" LEDs should be interpreted according to their two-letter mnemonics.

When self test passes, the system processor unit (SPU) is interrupted and notified of the event. Between the time that this interrupt is given and the time when the SPU begins to access the LANIC, the "RO" and "Q" LEDs will be illuminated. This indicates that the LANIC is executing ROM code and is quiescent, while waiting for the SPU to take control. (For coaxial LAN connections, the VP LED will be illuminated, indicating that the MAU is powered.)

Any activity on the network will be reflected by the state of the CL and CR LEDs. The LANIC will never transmit in this state, and therefore, the DO LEDs will remain inactive.

On command from operating software, the SPU prepares the LANIC for operation. It must first download the operating firmware from system memory to the LANIC. When this process begins, the "DL" LED turns ON, and the "Q" and "IT" LEDs will extinguish. After each download command, the "Q" LED lights for a few milliseconds. At least 7 download commands occur, but they may not be separately distinguishable. Note that the pattern that occurs on one working system will occur on all other working systems. So if you are suspicious of this process on your system, compare the download pattern on the suspect system with a system that works.

After the download is complete, the SPU will instruct the MPU to begin to execute the downloaded firmware. When this occurs, the "RO" and "DL" LEDs will extinguish. The "Q" and "IT" LEDs will turn ON.

A short time later the SPU will instruct the LANIC to set its individual node (station) address. When this occurs, the LANIC performs a duplicate address check, which is accomplished by transmitting 10 self-addressed frames onto the network with a 500 ms separation between frames. The "TX" and "DO-E" LEDs will both turn ON for each of the 10 frames. In addition, the "CR-E" LED will indicate that the frames were sent onto the coax and caused carrier to come on. If collisions occur, frame transmission will be retried up to 15 times each, with the resultant activity indicated on the "CL" LEDs.

Because the frames are self-addressed, the "RX" LED should not light during the duplicate address check. If the "RX" LED does light, it is due to a frame received from a remote node. This may occur, for example, if a duplicate station exists, or an ordinary frame is addressed to the local LANIC.

If a reply to the duplicate address check is received, the duplicate address check fails. No further check frames will be sent. The system software will close the link and clear the LANIC, forcing all the LANIC card activity LEDs to turn ON and stay ON. The LEDs will indicate extended idle self test in progress.

If the duplicate address check passes, the link is opened, and frame transmission and reception will commence. The LEDs will indicate activity as it occurs.

Presuming the network and LANIC card are idle prior to a transmit request from the SPU to the LANIC card, frame transmission should behave as follows during normal network operation:

- While idle, "Q" and "IT" LEDs are ON. For coaxial LAN connections, the "VP" LED is ON.

- When the MPU begins processing the transmit command, the "Q" and "IT" LEDs will extinguish, and the "TX" LED will light. The LANIC begins the transmit process by reading the frame from system to on-card memory.

- Once the frame is in LANIC card local memory, and the network is free, the serial transmission process begins. This causes the "DO-E" LED to light. The "DO-L" LED will also light for the duration of the frame transmission, but this may or may not be visible depending upon the length of the individual frame being sent.

- For coaxial LAN connections, the serial data reaches the MAU/ThinMAU and is transmitted onto the coaxial cable. The MAU/ThinMAU receives its own signal off of the coax, and sends it back down the AUI cable on the Data-In signal pair.

  For StarLAN, the serial data is transmitted on the StarLAN cable. The Hub receives the data and sends it down the Receive signal pair.

  The LANIC card detects data arriving on the Data-In/Receive pair of the attached cable, resulting in the "CR-E" LED turning ON. The "CR-L" LED will also be illuminated for the duration of the frame, but this may or may not be visible. If the "DO-L" LED is visible, the "CR-L" LED will also be visible for approximately the same length of time.

- If no collision is encountered, the "CR-E" and "DO-E" LEDs will go OFF after 6 milliseconds, followed quickly by the "TX" LED going OFF, and the "Q" and "IT" LEDs turning ON.

  If a collision is encountered, the "CL-E" LED will turn ON, and up to 15 additional attempts to transmit the frame will occur. From the retransmission attempts, the "DO" and "CR-E" LEDs may appear to be ON, and the "DO" and "CR-L" LEDs will probably appear to be partially illuminated. The intensity of the "-L" LEDs will be determined by frame length, the number of retransmissions, and the time separation of the retransmissions. The "CL" LEDs will also display behavior similar to the "CR" and "DO" LEDs if multiple retransmissions are required before the frame is successfully transmitted.

  In the collision case, it must be remembered that other network activity may also cause the "CL" and "CR" LEDs to light, and the activity caused by the LANIC will be superimposed upon the network activity being displayed in the "CR" and "CL" LEDs.

Network Fault LED Examples

This section provides examples of LAN faults and the resulting display of a LANIC card's cable interface activity LEDs.

We presume that the LANIC card is enabled for operation on the network and the LANIC card driver is turned on. This can be verified by the SHOWCOM command (see Chapter 2): the line must be "CONNECTED".

NOTE

The LANIC card LEDs will not reflect network activity if the line is not CONNECTED. For some faults, system software may shut down and reset the card, resulting in a DISCONNECTED line.

Due to hardware differences, coaxial cable connection faults differ from StarLAN connection faults.

Coaxial Cable LAN

The following faults and cable interface activity LED displays pertain to coaxial cable LAN connections.

Open Tap

If the tap on the coax is not making contact with either the center conductor or shield, the LEDs will indicate no network activity.

When the LANIC tries to transmit, a collision will occur. Thus, the DO-E, CR-E and CL-E LEDs will all light.

Open Coax

Open coax faults include missing or loose terminators, loose barrel connectors, or even breaks in the cable. For open coax faults, attempted transmission by any node attached to the cable will result in a collision. For nontransmitting nodes, the CR-E and CL-E LEDs may light. For transmitting nodes, the DO-E, CR-E and CL-E LEDs will light.

Note that, unlike an open tap fault where only the single node is affected, all HP 3000 nodes connected to the open coax cable will display these symptoms.

Shorted Coax

For a shorted coax, the voltage associated with any transmission attempt will be clamped to zero (loss of carrier). If the coax is shorted close to the MAU/ThinMAU, the CR-E and DO-E LEDs will flash when the node attempts to transmit.

Short On MAU/ThinMAU Power Circuit (VP)

If there is a short on the power lines going to the MAU/ThinMAU, the LANIC overcurrent protect switch will turn the power off, and the VP LED will turn OFF. If this occurs during the self test, a failure code, 24H, will result.

If the short occurs during normal operation of the board, card firmware will attempt to turn the power back on. This may occur up to 20 times. If this fails, the firmware will report a fatal error to the driver and enter a soft reset state in which the RO and Q LEDs will be lit. When the upper level software recognizes the fatal error, it will do a hard reset on the card, leaving LEDs "H" through "*" lit.

Continuous Transmission From a Remote Node

If some other node is transmitting continuously, and its MAU/ThinMAU fails to terminate its transmission, the local LANIC card will detect carrier. Thus, its CR-L LED will be ON.

Constant Collision on the Network

Excessive voltages on the coax are interpreted as collisions, for example, when multiple transmissions simultaneously exist on the cable, or a faulty MAU/ThinMAU is leaking a DC voltage onto the coax. The local MAU/ThinMAU detects such voltages and actuates the Control-IN (CI) signal line. This will cause the CL-L and CR-L LEDs to turn ON.

Open or Shorted Data Out Signal Lines

If the Data Out signal pair in the AUI is open or shorted, the LANIC will not be able to transmit. During transmit attempts, the DO-E LED will flash. However, since no transmission occurs, carrier will not be detected and the CR LEDs will not turn on.

Note, however, that the LANIC will be able to receive frames. Received frames will light the CR LEDs.

Open or Shorted DI Pair in AUI

If the Data-In signal pair is disabled due to a short or a open, normal network activity will not be detected by the CR LEDs.

However, the CR LEDs are lit for collision signals on the Control-In signal pair, so a collision will cause the CR-E LED along with the CL-E LED to blink ON.

External Loopback

Table 3-3 provides possible causes of network errors based on cable activity LEDs that turn ON during a transmit. A transmit can be invoked by conducting a loopback test, Test 14, of the LAN Node diagnostic (LANDIAG3000/V). See Chapter 4.

NOTE

The causes listed should not be construed as being complete. They only serve as suggestions on where to look for possible faults. Note that only single faults are presumed. Multiple faults may result in other symptoms.

Table 3-3. AUI Cable Activity LEDs and Possible Causes on Transmit

LEDs that Turn ON During Loopback	Possible Causes from a Single System	Possible Causes from Multiple Systems
NONE	Bad LANIC	
DO only	Bad AUI or connection; Bad MAU; Bad LANIC; Shorted Coax	Shorted Coax
DO and CR	Bad MAU; Bad LANIC; Bad Coax	Bad Coax
DO and CR and CL	Bad Tap; Bad terminator; Bad barrel	Bad terminator; Bad barrel
VP not lit	Shorted AUI; Bad MAU; Bad LANIC	

StarLAN

The following faults and symptoms pertain to HP StarLAN connections.

Bad Hub

If the StarLAN Hub is not able to process network traffic, neither collisions nor frames will be sensed by any LANIC card. Each card's CR or CL LEDs will be OFF.

If any LANIC transmits, the the Transmit line will be active and the DO-E LED will light.

Note that these symptoms apply to all HP 3000 nodes connected to the Hub.

Bad Connection

If the cable is not mated properly at each end, or the cable is severed, the symptoms are the same as for a bad Hub, but apply only to the affected node.

Open or Shorted Transmit Pair

If the cable's transmit pair is open or shorted, the LANIC will not be able to transmit. During transmit attempts, the DO-E LED will flash. However, since no transmission occurs, carrier will not be detected and the CR LEDs will not turn ON for this attempted transmission.

Note, however, that the LANIC will be able to receive frames and detect collisions. These events will light the CR and CL LEDs.

Open or Shorted Receive Pair

If the receive signal pair is disabled due to a short or open, normal network activity will not be detected by the CL or CR LEDs.

Continuous Transmission From a Remote Node

If some other node is transmitting continuously and its Hub fails to terminate its transmission, the local LANIC card will detect carrier via the receive signal pair. Therefore, the CL-L and CR-L LEDs will turn ON.

Constant Collision on the Network

For StarLAN, the Hub generates collision signals and disseminates them on the receive signal pair. If collision signals are constant, the the CL-L and CR-L LEDs will be ON.

External Loopback

Table 3-4 provides possible causes of network errors based on cable activity LEDs that turn ON during a transmit. A transmit can be invoked by conducting a loopback test, Test 14, of the LAN Node diagnostic (LANDIAG3000/V). See Chapter 4.

NOTE

The causes listed should not be construed as being complete. They only serve as suggestions on where to look for possible faults. Note that only single faults are presumed. Multiple faults may result in other symptoms.

Table 3-4. StarLAN Cable Activity LEDs and Possible Causes on Transmit

LEDs that Turn ON During Loopback	Possible Causes from a Single System	Possible Causes from Multiple Systems
NONE	Bad LANIC	
DO only	Bad Hub; Bad Cable	Shorted Coax
DO and CR	Bad Hub; Bad LANIC; Bad Cable	Bad Hub
DO and CR and CL	Bad Hub; Bad LANIC	Bad Hub
VP not lit	Shorted AUI; Bad MAU; Bad LANIC	

LAN Node Diagnostic 4

General Information

This chapter describes the LAN Node Diagnostic as a tool in troubleshooting an MPE-V system link.

What is the LAN Node Diagnostic?

The LAN Node Diagnostic, or LANDIAG, is an interactive online program designed to help identify malfunctioning LAN link hardware. The diagnostic performs a series of tests upon the LANIC card and interface hardware. Each test diagnoses a subset of the node's link hardware. Although it can help to identify a particular field replaceable unit (FRU), it may may not be able to distinguish which particular circuit within the FRU is malfunctioning.

As a program running on the HP3000, LANDIAG tests the connection between the host computer and the main module of the LANIC card. The main module is that part of the LANIC card hardware which performs the network interface activities.

LANDIAG can be used to initiate card self test. The LANIC self test checks the components on the card for operation in the IEEE 802.3 environment. For more information on LANIC card self test, see Chapter 5.

Required Hardware

LANDIAG is provided with the link products and HP network services (NS3000/V) software. When running this software, the system must have a minimum of two megabytes of memory and the Expanded System Table Microcode. (Systems that are now memory-limited should add one megabyte to maintain current performance.)

When using LANDIAG, one of the following LAN link products should be installed:

- ThinLAN3000/V or LAN3000/V links, for connecting HP 3000 Series 3X/4X/5X/6X/7X and MICRO3000 systems to a ThinLAN or ThickLAN coaxial cable, respectively.
- StarLAN3000/V link, for connecting HP 3000 Series 37 or MICRO3000 systems to an HP StarLAN twisted pair cable.

A maximum of one LAN hardware link per system is supported.

For general LANIC card installation guidelines, and interdependencies with other I/O cards, refer to the LANIC installation manual provided with your particular link product.

Required Software

LANDIAG3000/V, version A.55.27.000, runs on HP 3000 or MICRO3000 systems executing the MPE V/E operating system, version U-B-delta-1 (or later). This version of LANDIAG incorporates changes required for the support of StarLAN connections. In addition, known bugs were corrected.

The diagnostic is provided on a master installation tape (MIT). It is provided along with the LANIC card driver and NS3000/V.

The diagnostic is intended to be an online program, running on the MPE-V operating system. It may be run timeshared with other programs, so that the LAN hardware may be inspected without disrupting the activities of users who do not need to access the network.

NOTE

All network activity, including NS3000/V, must be halted before the diagnostic can be executed.

System Tables

LANDIAG is normally installed with NS3000/V and the driver. Before configuring and activating NS3000/V and the LAN link, you should check the system tables. Consult the "System Configuration" sections in the *NS3000/V Network Manager Reference Manual*, 32344-90002, for guidelines on system table modifications required.

Execution Time

The diagnostic can execute one complete cycle of tests in under one minute. This is all the time needed to determine that the hardware is free from most defects. However, if there are intermittent or unusual problems, many passes through the diagnostic may be required.

Tests Included

Table 4-1 lists the primary tests run from LANDIAG. These are described in detail later in this chapter.

Table 4-1. LAN Node Diagnostic Tests

1	Roll Call
2	Channel ID
3	Initialization
4	Self Test
5	Interrupts
6	Soft Reset
7	CR SR Loop
8	Bus Conflict
9	Address Offset
10	Extended Address
11	FIFO Write
12	F/P Conflict
13	Coprocessor
14	MAU Loopback (also used for StarLAN loopback)
15	Date Code
16	Loopback Hood (Not Applicable for StarLAN Connections)
17	Remote Node

Diagnostic Limitations

The following conditions are not tested from LANDIAG:

1. Selftest toggle switch failure (does not apply to Series 37 and MICRO3000 LANIC cards).

2. Light emitting diode failure.

   These are not tested by the diagnostic because they cannot be handled programmatically. It would be a simple matter to verify their operation by observation after initiating self test.

3. Priority logic failure.

   The diagnostic cannot explicitly control or implicitly predict the state of the priority lines, so testing is not possible. However, failure recognition is possible. If the priority logic does not work, one of the following will likely result:

   - erratic LANIC card operation,
   - performance degradation, or
   - SIMB/IMB deadlock.

4. Powerfail warning holdoff of master handshake.

   Testing this condition would require creating a powerfail condition in the host, which is beyond the scope of this diagnostic.

5. SIMB/IMB parity errors.

   To test the parity error detector circuit, it would be necessary to risk system integrity by deliberately introducing parity errors into memory.

   The need to test the parity error detection circuit from LANDIAG was not felt to be necessary. Such faults are not catastrophic to system or network operation. In addition, other cards on the system would eventually detect a parity error.

6. Faulty bank lines that address out of bounds memory.

   Though this condition will not be tested explicitly, it would be apparent if it occurred. For example, on the series 39, 4x or 6x systems, the IMB would hang if out of bounds addressing occurred.

7. Holdoff of reset until handshake ends.

   For Series 39 through 70 systems, the LANIC is protected from data loss if the selftest switch is inadvertently pushed during a handshake. This feature is not tested because it requires direct manual intervention. If the implementation circuitry were to fail and go undetected, the functionality of the LANIC card would not be significantly impaired.

Guidelines for Setting Up and Using LANDIAG

This section contains information that you will need to know before using LANDIAG.

System Information

When the HP 3000 is configured, it needs to be told everything about the LANIC card, including its LDEV number, DRT number, driver name, device type and device subtype. The following information should be provided:

- Driver name: *IOLANO.PUB.SYS*
- Device type: *17*
- Device subtype: *9*

The LDEV number and the DRT number depend on the particular system configuration. Refer to the *MPE V System Operation and Resource Management Reference Manual* (32033-90005) for system configuration details.

To use LANDIAG, you will need the LDEV number of your LANIC card. It is the first item requested by the diagnostic. The diagnostic locates the LANIC card by entering the I/O configuration table at the specified LDEV. If the table indicates that the LDEV is not device type 17 and subtype 9, the user is told:

```
That LDEV is not configured as a LANIC.
```

Capability Levels

Because the diagnostic has direct access to every location in memory, use of the program is controlled.

The user must have one of these three capabilities in order to run the diagnostic:

OP - system supervisor or operator
DI - diagnostician
SM - system manager

If the user's security level is not sufficient, the following error message will be displayed on the screen:

```
OP, DI or SM capability needed to run diagnostic.
```

For LANDIAG Test 17 (Remote Node Test), a CS capability -- allowing access to the Communications Subsystem -- is also required.

System Type Check

For Series 30/33 systems, the diagnostic will continue to run, but the following warning is issued:

```
Diagnostic not designed for HP3000 /30 or/33.
```

Operation with Network Services

Refer to the *NS3000/V Network Manager Reference Manual* (32344-90002) for software configuration of network services on the system.

When a communication subsystem has control of the LANIC card, any attempt to allocate it by the diagnostic will fail. The diagnostic will report a warning. The message will be:

```
The LANIC could not be allocated.
```

To use the diagnostic, the LANIC card must be in an "AVAILABLE" state. You can tell if the card is "AVAILABLE" as follows:

- From MPE, issue the SHOWDEV command. The LDEVs will be listed along with availability information. Locate the LDEV of the LANIC card; the status must indicate "AVAILABLE".

- From MPE, issue the SHOWCOM command, specifying the LDEV of the LANIC card (see Chapter 2). The card is available if the `LINE` is `DISCONNECTED` or `CLOSED`.

With the NS3000/V services installed, the command sequence:

```
:NSCONTROL STOP
:NETCONTROL STOP
```

will disconnect the user's node from the network. For more information on the use of these commands, refer to the *NS/3000 Network Manager Reference Manual* (32344-90002).

The user may run the diagnostic when the communication subsystems have released the LANIC card. The system can recover control of the LANIC if there should be a crash while the diagnostic is running.

Reliability and Recovery from Power Failure

In the event of a power failure MPE-V/E will protect the integrity of the system tables. For the Series 6x/70 systems, the diagnostic process will resume operation; no reinitialization will be necessary. For the Series 4x/5x systems, you have to restart the diagnostic.

The test which was underway when the power failure occurred will probably report a failure, whether or not the circuit being checked was actually faulty. This mistake will arise because the diagnostic will almost certainly timeout waiting for a response from the LANIC. This is because the LANIC (which derives its power from the backplane) will lose the execution context as its microprocessor and RAM will lose power due to power failure. Also, the LANIC performs a self test at power on, including a memory test which obliterates the contents of local RAM.

When a power failure has taken place, you should redo any test that failed.

Integrity of the System

The diagnostic will expose any defect in the LANIC card which compromises system integrity. If the LANIC card contains such defects, there is an unavoidable risk of altering memory or system crashes. Because the diagnostic performs rigorous testing of all LANIC circuits, including those that implement direct memory access, intermittent problems will be exposed.

The diagnostic will not cause any crashes or damage to system memory when good LANIC cards are tested. The diagnostic is no more likely to cause system problems than normal use of the LANIC by the LAN link and NS3000/V products.

When a LANIC is installed or replaced, the diagnostic should be executed and system integrity verified before user processes are permitted to execute. If system failures are observed during normal operation and the LANIC is suspected to be the cause of the failures, users should be removed from the system prior to diagnostic execution.

If a LANIC card malfunction is suspected, but LANIC usage does not appear to have compromised subsystem integrity, it is unlikely that diagnostic execution will cause system integrity to be compromised. In this case the diagnostic can be executed without removing the users from the system.

Each time LANDIAG is run, it enforces conditional execution of its tests in order to significantly reduce the probability of system halts. Table 4-2 shows various test completion states and their impact on other tests. (Note that intermittent failures on the LANIC card may defeat the protection provided.)

Table 4-2. Test Dependencies

Control Test (State)	Dependent Test (State)
Roll Call (test 1) ran and found that the channel # corresponding to the specified LDEV did not respond.	No other test is allowed to run because a non-responding channel will cause a a system halt for addressed IMB instructions.
Channel ID (test 2) ran and found that responding channel at specified LDEV does not appear to be a LANIC.	Test 3 thru 17 are not allowed to run because certain LANIC instructions may cause a system halt if issued to other than a LANIC.
Network Service is still active as determined during the diagnostic initialization process.	All tests except Roll Call (test 1) and Channel ID (test 2) are prevented from executing since they will alter the state of the LANIC, thus disrupting Network Service.
Address offset (test 9) ran and encountered a failure. This most likely indicates the LANIC is unable to address memory correctly while reading. Extended address (test 10) encountered a failure. This most likely indicates the LANIC is unable to address memory correctly while reading.	The FIFO write (test 11), F/P conflict (test 12) and Date Code (test 15) tests are not allowed to run because each of these tests write into system memory. If an addressing failure exists then the write may alter memory not allocated to the diagnostic.

Running LANDIAG

To run LANDIAG, type the following at the MPE prompt:

```
run landiag.pub.sys
```

LANDIAG will ask you for the LDEV number of your LANIC card. If it is a valid LDEV, LANDIAG will be ready to use. LANDIAG uses the ">" character to prompt you for input.

Figure 4-1 illustrates a typical user running LANDIAG.

```
:run landiag

LAN Node Diagnostic, version A.55.27.000  HP1984 (c).
Please enter ldev number of LANIC to be tested.
36
Enter 'H' for help.
>
```

Figure 4-1. Running LANDIAG

Figure 4-2 is a high level state diagram for the use of LANDIAG. It demonstrates the path that a user will follow to execute the diagnostic. Further details will be provided later in this chapter.

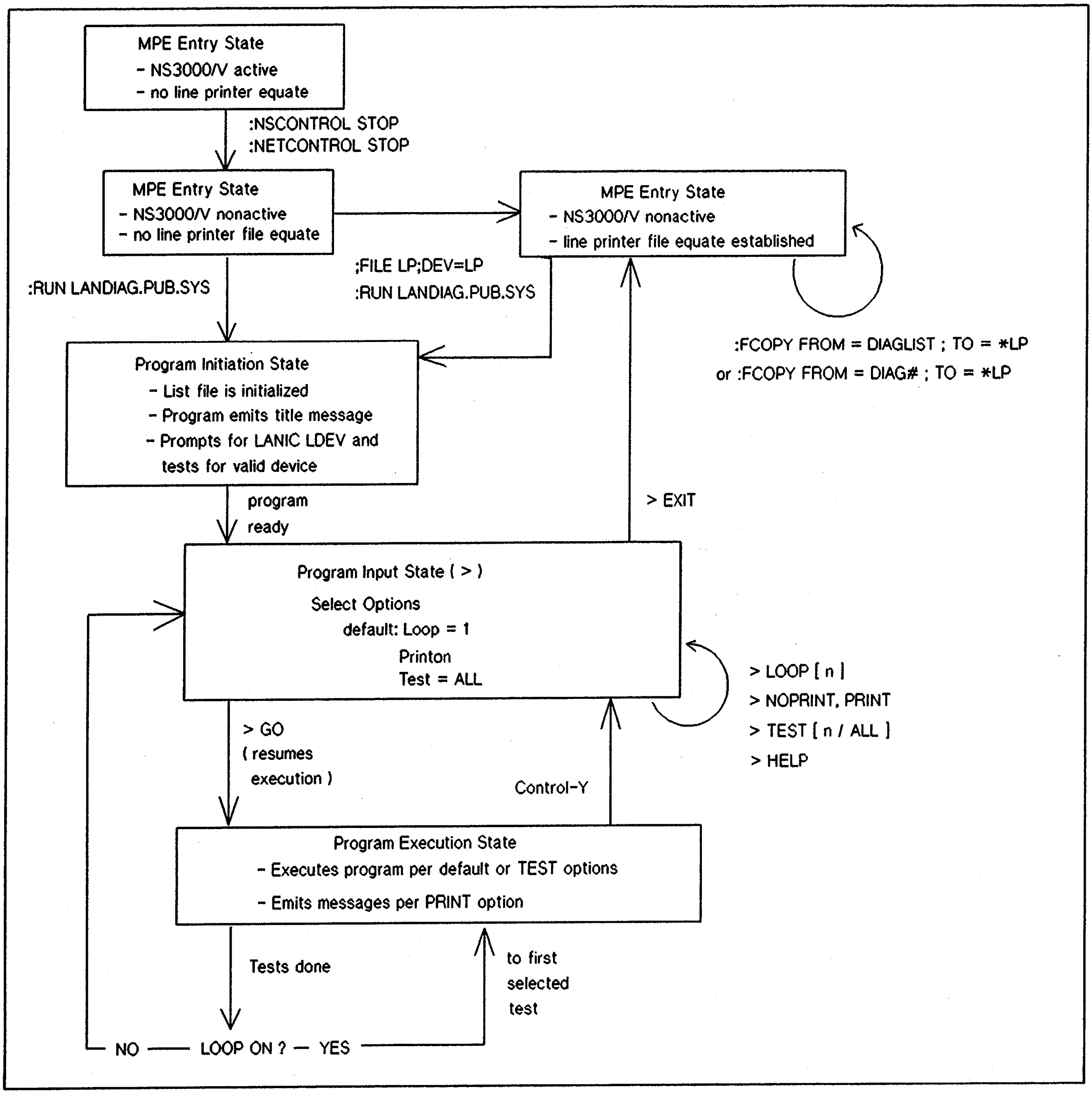


Figure 4-2. Program State Diagram

User Interface

The diagnostic is an interactive program. The user determines the type of operation, performs a diagnosis, and is permitted to change the operating condition and test again, as many times as desired. The diagnostic is divided into three sections:

- Initialization, in which setup takes place, transparently to the user, except for being asked LDEV number and getting initialization error messages if they occur.

- Command entry, in which the user specifies the type of diagnostic operation.

- Test execution, in which the hardware is inspected, faults are detected, and the results are output.

After test execution is complete, or the user aborts test execution with a [CONTROL]Y, the program will return to the command entry mode. Subsequently, the user may change the type of operation and test again, or exit from LANDIAG to MPE.

The LAN Node Diagnostic can be used in either of two ways, **Active** mode or **Standard** mode:

- **Standard** mode: a predetermined sequence of tests is run; the user is not able to specify which tests to run. (Refer to the `GO` command, later in this chapter.)

- **Active** mode: tests are user specified. (Refer to the `TEST` command, later in this chapter.)

Activity Indicator

LANDIAG time requirements for test completion depend on the test(s) run. If tests are repeated (`LOOP` command), completion time is extended. To provide status of test progress, the diagnostic provides activity indicators. Before any test is begun, the number of the test is displayed on the screen. As each step within the test is begun, an asterisk (*) is displayed on the screen.

If the system hangs, the user can determine which test and step was running just prior to the hang. This information may prove useful for identifying and correcting a problem. After the last step in a test is completed, the message

```
end of pass
```

is displayed.

How to Get Output From LANDIAG

While all prompts, echoes, activity indicators and other useful information will be sent to the user's screen, a summary of diagnostic results will be directed to both the screen and the file known as DIAGLIST, if the diagnostic was invoked with :RUN LANDIAG.

The file can also be named DIAG# where #=*LDEV#* if the diagnostic is invoked with:

:RUN LANDIAG;parm=*LDEV#*.

For example, if :RUN LANDIAG;parm=36 is used, diagnostic results are directed to a file DIAG36.

The user will not be able to use a file equation to associate the diagnostic output file with another file or device. In order to obtain hard copy of the diagnostic activity, the user should direct the diagnostic output to a printer after the process is complete.

The command sequence is as follows:

```
:FILE LP;DEV=LP
:FCOPY FROM =DIAGLIST;TO=*LP   , or
:FCOPY FROM =DIAG#;TO=*LP
```

NOTE

DIAGLIST (or DIAG#) is reinitialized every time LANDIAG is invoked, hence results from a previous diagnostic pass are lost. The user may save the results by either printing a hardcopy as shown above or renaming the previous diagnostic list file as follows:

:RENAME DIAGLIST, *filename* , or
:RENAME DIAG#, *filename*

Where #=LDEV number of LANIC being tested.

Station (Link-Level) Addresses

Each node on the LAN is identified at the link level by a unique station address. The station address is a 12 digit hexadecimal number stored on the LANIC card in ROM. It is normally labeled on the card, and documented on the network map. (Do not confuse the station address with the IP address of the node. The IP address is an upper layer address for connecting processes.)

For some tests, specifically the Remote Node Test, the station address of various nodes may be needed. For HP 3000 systems, the station address can be obtained through LANDIAG. **However, you must be on the system to get the station address of the LANIC card installed in that system.**

If tests 1, 2, and 13 of LANDIAG have been successfully run, the station address will be displayed at the bottom of the screen resulting from the `HELP` command. The `HELP` command is described later in this chapter.

Command Set

Seven commands are available to the user: EXIT, GO, HELP, LOOP, PRINT, NOPRINT and TEST. Single letter abbreviations will be accepted and both upper case and lower case letters will be understood. There is another input the user can give, the CONTROL Y, which returns control from test execution back to the command entry mode.

NOTE

During the execution of most LANDIAG tests, response to a CONTROL Y may be delayed until after execution of a test step.

Due to programmatic protection, aborting a Remote Node Test (LANDIAG Test 17) may require multiple CONTROL Y entries (i.e., you may be required to enter CONTROL Y several times). The test will normally abort with CONTROL Y after it has received a loopback response frame, or after it has timed out waiting for a response frame.

During the command entry phase of the program, the user may issue instructions to control the operation of the diagnostic. Whenever a ">" prompt is provided, a command is expected. If the command set is used incorrectly, a error message to help the user will be given. Refer to the "Error Messages" section at the end of this chapter.

The diagnostic is designed with default settings for all parameters except the LDEV to be tested. In most cases, use of commands other than TEST, GO, and EXIT will be rarely needed.

The tests are designed to be executed in sequence. Each time LANDIAG is run, test dependencies are enforced to ensure system integrity. See Table 4-3.

Table 4-3. Test Dependencies

Test must be run and pass	before this test(s) is allowed to execute.
Roll Call (Test 1)	ALL other tests
Channel ID (Test 2)	Tests 3 through 17
Address offset (Test 9)	FIFO write (Test 11) F/P conflict (Test 12) Date code (Test 15) Remote Node (Test 17)
Extended address (Test 10)	FIFO write (Test 11) F/P conflict (Test 12) Date code (Test 15) Remote Node (Test 17)

In Table 4-3, the last two dependencies ensure that system memory "reads" work properly before system memory "writes" are allowed.

The Hood Loopback test and Remote Node test must be individually specified with the TEST command. They are special tests used for identifying FRU's and network faults. They should only be run after all previous tests have executed successfully. The individual commands are explained in greater detail on the following pages.

Diagnostic Dialogue Example

An example of running and using LANDIAG is provided below.

```
:NSCONTROL STOP               << shuts down network services >>
:NETCONTROL STOP              << shuts down lower level NS >>
:RUN LANDIAG.PUB.SYS          << invoke LAN Node Diagnostic >>

LAN Node Diagnostic (version A.55.27.000)  HP1984 (c)
Please enter LDEV number of LANIC to be tested.
36                            << LDEV may be found in I/O
                                 configuration table >>
Type 'H' for HELP

> TEST 9                      << indicates only test 9 is to be run >>
> GO                          << initiates last test entered >>

  9                           << test dependencies invoked >>

Tests 1 & 2 must pass for this test to execute.

> TEST 1                      << run test 1 only >>
> GO                          << initiates last test entered >>

  1 *   End of Pass           << test 1 completed successfully >>

> TEST 2                      << run test 2 only >>
> GO                          << initiates last test entered >>

  2 *   End of Pass           << test 2 completed successfully >>

> TEST 9                      << run test 9 only >>
> GO                          << initiates last test entered >>

  9 ***** End of Pass         << test 9 completed successfully >>
```

(Continued on the next page)

```
> TEST 5                      << run test 5 only >>
> LOOP 3                      << sets the test loop parameter to 3 >>
> GO                          << initiates last test entered >>

  5 **** End of Pass          << test 5 pass 1 completed successfully >>

  5 ****                      << test 5 pass 2 detected an error >>

 Error in test 5, step  4 (Interrupt Test)  MON, APR 6, 1987, 10:17 AM
  End of Pass

  5 **** End of Pass          << test 5 pass 3 completed successfully >>

> run                         << user input an invalid command >>

Bad input - Try again or enter "Help".

> GO                          << initiates last test entered >>

  5 ****  End of Pass         << test 5 pass 1 completed successfully >>

  5 ****  End of Pass         << test 5 pass 2 completed successfully >>

  5 ****  End of Pass         << test 5 pass 3 completed successfully >>

> EXIT                  << stop execution of LAN Node Diagnostic >>

End of LAN Node Diagnostic.
```

Command Entry Abbreviations

Command entries may be abbreviated. The first character of the command is normally sufficient, followed by the appropriate parameters. For example, the following command entries are equivalent:

```
HELP = H
LOOP = L
LOOP 5 = LOOP5 = L 5 = L5
TEST 1 = TEST1 = T 1 = T1
GO = G
```

Fault Messages

If a fault is detected during a test, an error message is returned to both the user's terminal and the output file. This message takes the following form:

```
Error in test <testnum>, step <stepnum> (<testname>)
```

Where,

<testnum> - Identifies the number of the test that was running when the fault was detected.

<stepnum> - The number of the step in the test where the fault was detected.

<testname> - Identifies the name of the test that was running when the fault was detected.

The message will also contain the date and time.

HELP Command

HELP provides a list of commands and tests. The HELP screen is shown here:

```
                    Node Diagnostic Commands and Tests

EXIT      terminates this program and returns to MPE.
GO        initiates execution of the test set.
HELP      displays this screen.
LOOP [N]  chooses the number of times the test set is executed.
          (Default = 1)
NOPRINT   suppresses terminal and file output.
PRINT     resumes generation of output.  (Default)
TEST < n / ALL >  selects a single test or tests 1-15.
                  (Default = ALL)

type < control - y > to discontinue testing.

#1 Roll Call Test        #7 CR SR Loop Test         #13 LAN Coprocessor Test
#2 Channel ID Test       #8 Bus Conflict Test       #14 MAU Loopback Test
#3 Initialization Test   #9 Address Offset Test     #15 Date Code Test
#4 Self Test            #10 Extended Address Test   #16 Hood Loopback Test
#5 Interrupt Test       #11 Fifo Write Test         #17 Remote Node Test
#6 Soft Reset Test      #12 F/P Conflict Test

Local station address is given in help menu after test 13 is run.
```

In a given LANDIAG session, the HELP command can be used to identify the local station (link-level) address stored on the LANIC card, but only after Test #13 is run. The local station address will be displayed at the bottom of the HELP screen as follows:

`Local station address is` *nnnn nnnn nnnn nnnn*

where *n* is a hexadecimal digit.

EXIT Command

EXIT terminates the diagnostic and returns to MPE.

Execution of the EXIT command is the only way to return control to MPE. When the user stops the test execution with the CONTROL Y character, the diagnostic will not terminate. It merely returns to the command mode.

GO Command

GO begins or continues execution of tests. The tests that are performed when the GO command is entered are determined by the test selected with the latest TEST<n/all> command. The number of times the test is looped is set by the LOOP command. If neither command was given, GO will cause the initiation of one pass of the complete test set (Test 1-15).

Once testing has begun, testing may be stopped before completion of the selected test (with the specified number of loops) by entering a CONTROL Y character. This will return the user to the command entry mode, identified by the > prompt. After a CONTROL Y, a subsequent GO command will simply restart the same test.

LOOP Command

The LOOP command establishes the number of times that a test, specified by the TEST command, is continuously run. Using this command, a test may be run a number of times without repeated command entry.

If LOOP is not specified during a LANDIAG session, its value defaults to "1". The number of times a test is repeated is determined by the parameter *N* following the LOOP command. This is illustrated as follows:

```
> LOOP 5    : N = 5, the test will be run 5 times.
> LOOP 1    : N = 1, the test will be run once.
> LOOP      : N = 0, the test will be run continuously.
```

The LOOP command is used primarily to find intermittent problems, or to study the link hardware with an oscilloscope. It is recommended that oscilloscope loops be performed with "print off" (see the NOPRINT command).

Once testing has begun, the only way to terminate execution before *N* iterations of the test is with CONTROL Y. This will return the user to the command entry mode, identified by the ">" prompt.

NOPRINT Command

NOPRINT suppresses terminal and file output. It is useful during loop tests with an oscilloscope since it eliminates overhead associated with such output and increases the speed by which an iteration is made.

PRINT Command

PRINT resumes generation of terminal and file output, which is the default state. The *filename* being logged to depends on the way in which you invoked the diagnostic.

If PARM is used in the LANDIAG run string to specify the card's LDEV, then the log file name is DIAG#, where #=*PARM=LDEV*. This is illustrated below:

```
:RUN LANDIAG.PUB.SYS; PARM=LDEV
```

If PARM is not used, then the log file is DIAGLIST.

Note that DIAG# or DIAGLIST will be in the group.account from which you invoked LANDIAG.

TEST N/ALL Command

The TEST command is used to select the LANDIAG test to be run. The desired test is specified by a parameter, *N*, in the command run string. Note the following:

TEST	:	N = default (see "N = ALL", below)
TEST 0	:	N = default (see "N = ALL", below)
TEST 1	:	N = 1, Test 1 is run.
TEST 2	:	N = 2, Test 2 is run.
.		.
.		.
TEST 15	:	N = 15, Test 15 is run.
TEST ALL	:	N = ALL, Tests 1 through 15 are run.
TEST 16	:	N = 16, Test 16 is run (coax LANs only).
TEST 17	:	N = 17, Test 17 is run.

There are a couple of noteworthy points:

- If *N* is "0" or not specified, the default is *ALL*.
- Tests 16 or 17 can be executed only with the commands TEST 16 or TEST 17, respectively, followed by the GO command.

Test Descriptions

LANDIAG provides a number of *Tests*, each consisting of multiple *Steps*.

A Test is a sequence of interactions between the host system and and the LANIC card designed to verify the correctness of data and control paths.

A Step is a single interaction between the host and the LANIC intended to gather some information about a particular data or control path, contributing to the evaluation of that path.

Each test will begin with a reset of the LANIC card, to bring it into a known state. In some of the tests, the next step will be to download a small piece of Z80 software. This code will prepare the LANIC card to perform subsequent steps.

This section describes each LANDIAG test.

Test #1. Roll Call Test

The roll call test verifies that the channel specified by the user, via the LDEV, responds to the IMB\SIMB roll call instruction. The diagnostic requires the user to run this test prior to other tests since a nonresponding channel will cause a system halt. **If this test fails, all subsequent tests are not allowed to run.**

Possible causes of failure include:

- The system I/O table does not match the hardware configuration.
- The I/O configuration table has been corrupted.
- The LANIC card is faulty.

If Test #1 fails, you should acquire a listing of the system I/O configuration (may use `SYSDUMP $NULL,$STDLIST`) and verify that the mapping of LDEVs, DRT#s, and thumbwheel settings of all I/O channels are consistent. For help, refer to *HP 3000 Computer Systems, MPE V System Operation and Resource Management Reference Manual* (32033-90005).

Correct any discrepancies found between the hardware channel settings and the system I/O configuration table. If there are no discrepancies, try replacing the LANIC card.

NOTE

The success of this test does not prove that there is a LANIC card at the correct channel number, only that there is a channel present. The next test verifies that the channel is a LANIC card.

Test #2. Channel ID Test

Test #2 verifies that the channel specified by the user, via the LDEV, is indeed a LANIC card. First, a check is made on the results of the Roll Call test (Test #1). If a responding channel is not present at the specified LDEV, Test #2 is not allowed to run. Next, register 14 (configuration register) of the specified channel is read and compared to a special ID code assigned to the LANIC card. If the channel responds with the correct ID code, the test passes.

If Test #2 test fails, a flag is set that prevents all subsequent tests from running. This prevents the possibility of system halts.

Possible causes of test failure include:

- The channel specified by the LDEV is not a LANIC card. This assumes that the system has been configured correctly.

- There are non-LANIC card channels with the same channel number as the LANIC card being tested (i.e., thumbwheel switches set to the same number).

- The system I/O table does not match the hardware configuration.

- The I/O configuration table has been corrupted.

- The LANIC card is faulty.

If Test #2 fails, you should acquire a listing of the system I/O configuration (may use `:SYSDUMP $null,$stdlist`). Verify that the mapping of LDEVs and DRT#s and thumbwheel settings of all I/O channels are correct.

If there are discrepancies between the hardware channel settings and the system I/O configuration table, correct them. If there are no discrepancies, try replacing the LANIC card.

Test #3. Initialization Test

Test #3 determines if the LANIC responds to the IMB/SIMB INIT instruction by halting the Z80 and clearing the CRFULL bit (an indication that an internal reset pulse is generated). There are 3 steps to this test:

Step 1: The Z80 is launched into a self test to ensure that it is not initially in a halted state. A write to the control register is then performed to set the CRFULL bit. Subsequently, the CRFULL bit is checked; if it is not set, Step 1 fails.

A Step 1 failure most likely indicates a LANIC failure. Replace the LANIC.

Step 2: An INIT is issued to the LANIC card. This should halt the Z80 and clear the CRFULL bit. Subsequently, the CRFULL bit is checked; if it is not cleared, Step 2 fails.

A failure in Step 2 most likely indicates a LANIC card failure. Replace the LANIC.

Step 3: This step verifies that the Z80 was actually halted by the INIT in Step 2. Another write to the Control register is performed to set the CRFULL bit. The diagnostic then pauses for 5 seconds; if the Z80 was not halted by Step 2, the CRFULL bit will be cleared. Subsequently, the CRFULL bit is checked; if it has been cleared, Step 3 fails.

A failure in step 3 most likely indicates a LANIC card fault. Replace the LANIC card.

Test #4. Self Test

Test #4 programmatically initiates the LANIC card selftest program contained in ROM on the card. The self test is a comprehensive verification of the LANIC main module, that is, all circuitry not associated with the IMB/SIMB interface. Refer to Chapter 5 for selftest LEDs and failure codes.

There are three steps to this test:

Step 1: This step issues an INIT to the LANIC card, then writes to the control register the code indicating that a full self test is to be run. Then it reads the status of the CRFULL bit, which should be set to acknowledge the control register write. If the CRFULL bit is not set, this step fails.

A Step 1 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Step 2: This step consists of the following sequence.

a. A write to the selftest control register is made. This starts the Z80 and clears the interrupt mask.

b. The interrupt mask is set.

c. The diagnostic waits up to 10 seconds for a system interrupt 0, which indicates selftest completion.

d. The selftest result register is read. The least significant bit (LSB) of this register is set only while the self test is running.

If the system interrupt is not detected, Step 2 fails.

A Step 2 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Step 3: If the LSB of the selftest register is cleared, then self test has completed. The contents of the selftest result register are checked to see if self test completed without detecting a failure. If a failure was detected, Step 3 fails and the result is reported on the screen.

A Step 3 failure does not necessarily mean a LANIC card fault.

If a selftest error is detected, it is displayed as an encoded decimal number and referred to as a "step number". For example, in Figure 4-3, "`step number  46`" implies the decimal error code is 46.

```
> TEST 4
> GO

 4 ***
Error in test  4, step  3 (Self Test)   MON, APR 6, 1987, 11:00 AM
Self test step number is  46
 End of Pass
```

Figure 4-3. Selftest Error Message Example

For a coaxial cable connection, selftest steps number 36 (MAU power failure) or number 46 (external loopback failure) may result from a fault external to the LANIC card. To isolate such faults, refer to Test 16 (Hood Loopback Test).

For a StarLAN connection, MAUs are not used. Therefore, a step number 36 code should not be returned unless there is a card fault. If error code 36 occurs, replace the LANIC card.

NOTE

For selftest step number 46 to pass, the LANIC card must be properly connected to the network, or to an appropriate loopback hood. Before detailed troubleshooting, you should check the cables and their connections.

If any other selftest error codes (i.e., step numbers) are returned, replace the LANIC card.

Test #5. Interrupt Test

Test #5 verifies that the LANIC system interrupt mask is functioning properly and that the LANIC can issue a system interrupt 1. Note that system interrupt 0 was checked in test 4. These are the only two system interrupts that the LANIC card can issue.

This test is comprised of 4 steps:

Step 1: The diagnostic issues an IMB/SIMB INIT instruction to place the LANIC card into a known state. It then writes the skip selftest code to the control register and starts the Z80 by writing to the selftest control register. This should put the LANIC in the kernel state. Finally, the diagnostic reads the OBII register. If the device number field of the OBII register is not equal to 1 then Step 1 fails.

A Step 1 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Step 2: The diagnostic then checks the IRQ bit of the OBII register. Since the LANIC interrupt mask is cleared, the IRQ bit should be unasserted. If the IRQ bit is asserted then Step 2 fails, otherwise it passes.

A Step 2 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Step 3: The diagnostic issues a NOP kernel command to the LANIC card which should cause it to respond with a system interrupt 1. However, since the LANIC interrupt mask is still not set, the interrupt should be internally pending. The diagnostic reads the OBII register and verifies that the IRQ bit is still unasserted. If the IRQ bit is asserted, Step 3 fails.

A Step 3 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Step 4: The diagnostic does the following:

a. Checks whether any interrupts have been detected since the test began,

b. sets the LANIC interrupt mask, and then

c. checks to see if the pending interrupt from step 3 is detected.

If either an interrupt was detected before the mask was set, or no interrupt is detected after the mask is set, Step 4 fails.

A Step 4 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Test #6. Soft Reset Test

Test #6 verifies that a host write to the soft reset register does indeed cause a soft reset in the LANIC card. There are 3 steps to this test:

Step 1: The diagnostic performs the following:

a. Issues an INIT to the LANIC card,

b. Writes to the control register the code indicating that a full self test is to be run,

c. Checks the status of the CRFULL bit, which should be set, acknowledging the control register write.

If the CRFULL bit is not set, Step 1 fails.

A Step 1 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Step 2: The diagnostic performs the following:

a. Writes to the selftest control register. This causes a hard reset which starts the Z80.

b. Sets the interrupt mask which was cleared by the hard reset.

c. Reads the selftest register and verifies that bit 0 is set, indicating the self test is running.

If bit 0 of the selftest register is not set, Step 2 fails.

A Step 2 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Step 3: The diagnostic performs the following:

a. Writes 01H to the soft reset register. This should cause a soft reset, which aborts the self test and starts the KERNEL firmware.

b. Writes a NOP to the control register, which causes the KERNEL to respond with a system interrupt 1.

If a system interrupt 1 is not detected, Step 3 fails.

A Step 3 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Test #7. CR-SR Loop Test

This test verifies that writes to the LANIC card control register (CR), and reads from the status register (SR), are processed correctly by the LANIC card.

The LANIC CR-SR kernel command is used for this test. This command causes the last word read from the control register to be written back out to the status register.

There are 6 steps to this test:

Step 1: Reset the LANIC card and issue the CR-SR loop kernel command with the test pattern = AAAAH. If an error is detected while issuing the kernel command, Step 1 fails.

A Step 1 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Step 2: After the kernel command completes, a system interrupt 1 should be issued indicating to the host that the command has completed. If a system interrupt 1 is not detected then Step 2 fails.

A Step 2 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Step 3: The diagnostic then reads the status register. This register should contain the alternating 1's and 0's test pattern (AAAAH) written to the control register in Step 1. If the status register does not contain AAAAH step 3 fails.

A Step 3 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Step 4: The diagnostic again issues the CR-SR loopback kernel command, this time with 5555H as the test pattern. If an error is detected while issuing the command, Step 4 fails.

A Step 4 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Step 5: After the kernel command completes, a system interrupt 1 should be issued indicating to the host that the command has completed. If a system interrupt 1 is not detected, Step 5 fails.

A Step 5 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Step 6: The diagnostic reads the status register. It should contain the test pattern 5555H, the last word written to the control register in the CR-SR kernel command. If the status register does not contain 5555H, Step 6 fails.

A Step 6 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Test #8. Bus Conflict Test

Test #8 verifies that simultaneous requests made on the LANIC card backplane interface from both the LANIC card main module and the IMB/SIMB are properly arbitrated. The interlock kernel command is used to invoke write alternating AAAAH and 5555H test patterns to the status register. Concurrently, the host is reading the status register. If there is an arbitration error, one or more status register reads by the host will be other than the test patterns described above.

There are 2 steps to this test:

Step 1: The LANIC is first reset, which should place it in the kernel state, ready to accept commands from the host. The interlock command is then issued and the return code checked. If an error was detected while issuing the kernel command, Step 1 fails.

A Step 1 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Step 2: The diagnostic reads the status register 500 times with interrupts disabled. The interrupts are disabled to ensure that the 500 status register reads take place while the LANIC is executing the interlock kernel command. The diagnostic then verifies that each of the status register reads was either AAAAH or 5555H. If an invalid test pattern is detected, Step 2 fails.

A Step 2 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Test #9. Address Offset Test

Test #9 verifies the operation of the LANIC card IMB/SIMB address drivers. The download kernel command is an integral part of the test. It is used to download a block of words from host memory. The success of the transaction is checked by comparing its computed checksum to that computed by the diagnostic. Note that 'Data Bus' failures can also cause a bad checksum; however, these failures should be exposed by Test #4 (Self Test) or Test #7 (CR-SR Loopback), depending on the location of the fault.

There are 5 steps to this test:

Step 1: The diagnostic first places the LANIC in the kernel state, ready to accept interactive commands from the host. It then enables the LANIC master handshake circuitry, thus allowing the LANIC to read form host memory. This step fails if either the LANIC card was not successfully placed in the kernel state, or the master handshake could not be enabled.

A Step 1 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Step 2: A block of words from bank 1 in host memory is read and a checksum computed by the diagnostic. The LANIC card is then instructed to read the same block of words via the download kernel command. Finally, the diagnostic once again reads the same block of words from host memory. If the first and second read by the diagnostic are not the same, the sequence of three host memory reads -- by the diagnostic and LANIC card -- is repeated. This is done up to 3 additional times, after which the diagnostic aborts Step 2 and reports a failure.

A failure of Step 2 does NOT indicate a LANIC card fault. It indicates that the diagnostic was unable to use the predefined test block for this test -- either it changed too often or a memory failure exists. Try to rerun this test when the system is under less load.

Step 3: After it issued the download kernel command in Step 2, the diagnostic:

- waited for a system interrupt 1 from the LANIC card indicating that the download had completed, and

- read the status register which contained the completion code from the kernel indicating whether the checksums matched.

If either a system interrupt 1 was not detected, or the completion code did not indicate a successful download, Step 3 fails.

The successful completion of Step 2 and a failure in Step 3 most likely indicates a LANIC card fault. Replace the LANIC card.

Step 4: The diagnostic reads a block of words in bank 1 of memory, however, the bank offset is chosen so that the address lines are the complement of those used in Step 2. The diagnostic then instructs the LANIC card to read the same block of words and compare the the checksum to that computed by the diagnostic. The diagnostic reads the test block again and compares it to the first read. If the first and second read do not match, the sequence of three host memory reads between the diagnostic and LANIC is repeated. This is done up to 3 additional times, after which the diagnostic aborts Step 4 and reports a failure.

A failure in Step 4 does NOT indicate a failure of the LANIC. It indicates that the diagnostic was unable to use the predefined test block for this test because either it changed too often, or a memory failure exists. Try to rerun this test when the system is under less load.

Step 5: After it issued the download kernel command in Step 4, the diagnostic:

- waited for a system interrupt 1 from the LANIC card indicating that it had completed the download, and

- read the status register which contained the completion code from the kernel indicating whether the checksums matched.

If either a system interrupt 1 was not detected, or the completion code did not indicate a successful download, Step 5 fails.

If Step 4 completes successfully while Step 5 fails, a LANIC card fault is likely. Replace the LANIC card.

Test #10. Extended Address Test

Test #10 verifies the operation of the LANIC card extended address bus drivers. Like the Address Offset test (Test #9), the diagnostic uses the download kernel command to download a block of words from host memory, and checks the success of the transaction. The diagnostic starts with bank 1 and proceeds bank by bank until the next bank to be tested exceeds the maximum bank of configured memory.

Note that this test depends on the amount of memory configured in the host. Only those extended address bits required to access this memory are tested.

Also, note that failures of the 'Data Bus' or 'Lower (Offset) Address Bus' on the LANIC card could cause this test to fail. However, such failures should be exposed in previous tests (e.g., Self Test, CR-SR Loopback and/or Address Offset tests).

Step 1: The diagnostic performs the following:

- prepares the LANIC card for this test by placing it in the kernel state, and
- enables its master handshake.

If the diagnostic detects an error either while placing the LANIC card in the kernel state, or attempting to enable master handshake, Step 1 fails.

A Step 1 failure most likely indicates a LANIC card fault. Replace the LANIC card.

The following steps are systematically repeated (i.e., first Step X, then Step Y) for each memory bank tested:

Step X: The diagnostic reads a block of words from bank N (where N = 1, 2, 4, 8, ..., until the next bank to be tested exceeds the maximum bank of configured memory) in host memory and computes the checksum. The LANIC card is then instructed to read the same block of words via the download kernel command. Finally, the diagnostic again reads the same block of words. If the first and second reads by the diagnostic are not the same, the entire sequence is repeated. This is done up to 3 additional times, after which the diagnostic aborts the test on this bank and reports a failure in this step.

A failure in Step "X" does NOT indicate a failure of the LANIC. It indicates that the diagnostic was unable to use a specific bank of host memory for this test because either it changed too often, or a memory failure exists. Try to rerun this test when the system is under less load.

Step Y: After it issued the download kernel command in the previous step (Step X), the diagnostic:

- waited for a system interrupt 1 from the LANIC card indicating that the transaction completed, and

- read the status register that contained the completion code from the kernel indicating whether the checksums matched.

If either a system interrupt 1 was not detected, or the completion code did not indicate a successful download, this step fails.

A failure in Step Y (presuming Step X passed) most likely indicates a LANIC card fault. Replace the LANIC card.

Test #11. FIFO Write Test

Test #11 exercises the LANIC card master handshake logic not tested by the Address Offset test (Test #9). Firmware is downloaded to the LANIC card that will write a predefined test frame into the extra data segment allocated to the diagnostic. The diagnostic then compares its copy of the test frame to that written by the LANIC card. An error is reported if the frames are not the same.

The test includes 5 steps:

Step 1: The LANIC card is reset and the master handshake is enabled, thereby preparing it for the download process. If either the reset or handshake enable were not successful then Step 1 fails.

A Step 1 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Step 2: The diagnostic moves the firmware to the LANIC card via the download kernel command. Then, it waits for a system interrupt 1 that indicates the download has completed.

After the interrupt is detected, or a time out occurs, the diagnostic reads the download completion code from the status register. If either the interrupt is not detected, or an unsuccessful completion code is encountered, Step 2 fails.

A failure of Step 2 most likely indicates a LANIC card fault. Replace the LANIC card.

If a failure was detected while attempting to download the firmware, the diagnostic will not continue the test, that is, Steps 3 thru 5 are not performed.

Step 3: If the download was successful, the LANIC is instructed to start execution of the code. The diagnostic then waits for a system interrupt 1 that indicates firmware code completion. If the interrupt is not detected within the time allotted, Step 3 fails.

A failure of Step 3 most likely indicates a LANIC card fault. Replace the LANIC card.

Step 4: Before issuing the system interrupt 1, the firmware writes a completion code into the status register. The diagnostic then reads the completion code from the status register.

If the completion code does not indicate the test completed without error, Step 4 fails.

A failure of Step 4 most likely indicates a LANIC card fault. Replace the LANIC card.

Step 5: In this step, the diagnostic compares its copy of the downloaded test frame with that returned by the LANIC card. If the frames do not match, Step 5 fails.

A failure of Step 5 most likely indicates a LANIC card fault. Replace the LANIC card.

Test #12. F/P Conflict Test

Test #12 verifies that the LANIC card is able to properly arbitrate master handshake requests between its "first-in-first-out" (FIFO) buffers and processor.

The following sequence is performed:

- The FIFOs are loaded with 16 words of a test frame and are held off from writing to system memory until instructed by the host.
- After the FIFOs are full, the Z80 processor notifies the host that the LANIC is ready to start the test.
- Upon receiving the acknowledgment, the Z80 will simultaneously enable the FIFO writes to system memory and write its own test frames to another section of system memory.
- The diagnostic will pause to allow the processor and FIFOs time to complete their writes to host memory.
- The Z80 processor checks the FIFO out/in status before its first and second write to host memory and after its last write.
- The Z80 processor then reports the results in the status register.

There are 5 steps to this test:

Step 1: The LANIC card is reset and its master handshakes enabled in preparation for the download process. If an error was detected during this initialization Step 1 fails.

A Step 1 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Step 2: In this step, the following occurs:

- The diagnostic erases any previous data from the extra data segment to prevent interpretation of erroneous data.
- The diagnostic downloads firmware to the LANIC card, then waits for a system interrupt 1 (download completion) or a time out.
- After the interrupt or time out, the diagnostic reads the status register. The register should contain the completion code of the download process.

If either the interrupt was not detected, or the completion code indicates an unsuccessful transaction, Step 2 fails.

A failure in Step 2 most likely indicates a LANIC card fault. Replace the LANIC card.

The following steps are executed only if Step 2 passes:

Step 3: In this step, the following occurs:

- The diagnostic issues the start code kernel command to start execution of the downloaded firmware.
- The diagnostic waits for a system interrupt 1, indicating the firmware has finished setting up the test.
- The status register is read for the appropriate initialization completion code provided by the firmware.

If the interrupt is not detected after a predefined interval, or the completion code indicates the LANIC did not set up correctly, Step 3 fails.

A failure of Step 3 most likely indicates a LANIC card fault.

Replace the LANIC card.

Step 4: If a system interrupt 1 is correctly received in Step 3, the diagnostic writes the GO command to the control register. This causes the FIFO and Z80 processor to write to host memory in a round robin fashion. Subsequently, the diagnostic waits for a system interrupt 1, indicating the LANIC card has completed the test.

After an interrupt or time out, the diagnostic reads the completion code in the status register. If either the interrupt was not detected, or the completion code does not indicate successful completion of the firmware, Step 4 fails.

A Step 4 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Step 5: Finally, the diagnostic moves the test frames (written by the FIFOs and Z80 processor) from the extra data segment to the stack, and checks their contents. If they contain errors, Step 5 fails.

A Step 5 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Test #13. Coprocessor Test

Test #13 verifies that the LAN coprocessor (INTEL 82586) can detect/report a CRC error and correctly process multicast frames received by it.

There are 5 steps to this test:

Step 1: In this step, the following occurs:

- The diagnostic resets the LANIC card and downloads firmware.
- The diagnostic waits for a system interrupt 1, indicating the download has completed, or a time out.
- After the interrupt or timing out, the diagnostic reads the status register for the proper completion code of the download process.

If the interrupt was not detected, or the completion code indicates an unsuccessful transaction, Step 1 fails.

A Step 1 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Step 2: If the download was successful,

- the diagnostic initiates the downloaded code and waits for a system interrupt 1 from the LANIC card.
- It reads the status register and checks for the proper status code that indicates the firmware is ready to continue testing.

If a system interrupt 1 is not detected, or the code in the status register indicates an error, Step 2 fails.

A failure in Step 2 most likely indicates a LANIC card fault. Replace the LANIC card.

The following steps are executed only if Steps 1 and 2 pass.

Step 3: Coprocessor Initialization. In this step, the following occurs:

- The diagnostic instructs the firmware to continue the test.
- The diagnostic waits for another system interrupt 1, which indicates that the firmware has completed the test and has placed the first result in the status register.
- On detecting the interrupt, or if a time out occurs, the diagnostic reads the first test result from the status register.

If the interrupt is not detected, or the first result reported (Coprocessor initialization step) has failed, Step 3 fails.

A failure in Step 3 most likely indicates a LANIC card fault. Replace the LANIC card.

Step 4: Multicast Test. As the firmware test code continues, the diagnostic reads the status register again, which should now contain the results of the multicast test. If test results indicate a failure, then Step 4 fails.

A failure in Step 4 most likely indicates a LANIC card fault. Replace the LANIC card.

Step 5: CRC Test. As the firmware test code continues, the diagnostic reads the status register again, which should now contain the result of the CRC test. If test results indicate a failure, Step 5 fails.

A failure in Step 5 most likely indicates a LANIC card fault. Replace the LANIC card.

Test #14. MAU Loopback Test

Test #14 verifies operation of the connection to the LAN. For coaxial cable connections, this includes the LANIC card, AUI cabling, and MAU/Tap or ThinMAU/BNC-Tee, as appropriate. For HP StarLAN connections, this includes the LANIC card and twisted-pair cable.

NOTE

Despite its name, Test #14 is used for testing connections to an HP StarLAN as well as a coaxial cable LAN.

For Test #14 to pass, the LANIC cards must be properly connected to a functional coaxial cable or StarLAN Hub, or to appropriate loopback hoods.

External loopback test firmware is downloaded to the LANIC card. This code will sequentially transmit and receive (i.e., loopback) 8 test frames to and from the LAN medium. Results are reported to the diagnostic in the status register. This includes:

1. Whether MAU/ThinMAU power could be turned on (for the StarLAN card, the power line is tested even though there is no MAU/ThinMAU attached).
2. The number of attempts required to turn the MAU/ThinMAU power on (tested for StarLAN cards even though there is no MAU/ThinMAU attached).
3. The number of frames successfully looped back.
4. The number of heartbeats detected from the MAU/ThinMAU (not tested on StarLAN cards).
5. The number of collisions detected.
6. The number of times a transmit was aborted due to excessive collisions.
7. Whether the MAU/ThinMAU jabbed too soon (not tested for StarLAN cards).
8. Whether the MAU did not jab at all (not tested for StarLAN cards).

9. Whether the LANIC could reset the MAU from a jabber condition (not tested for StarLAN cards).

10. Whether the SQE disable function on the LANIC is operational (not tested for StarLAN cards).

There are 9 steps to this test:

Step 1: The diagnostic resets the LANIC card and downloads the external loopback test firmware. Subsequently, the diagnostic waits for a system interrupt 1 indicating the download has completed. A read of the status register is made -- it should contain the download completion code.

If the interrupt is not detected within a predefined time interval, or the completion code indicates an unsuccessful transaction, Step 1 fails.

A Step 1 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Step 2: If the download completed successfully, the diagnostic initiates execution of the downloaded firmware. The diagnostic waits for a system interrupt 1, indicating the LANIC card has completed initialization and is ready to execute the tests. After receiving the interrupt, or if a time out occurs, the diagnostic reads the status register for a ready code returned by the firmware.

If the system interrupt 1 was not detected, or the status register does not contain the appropriate ready code, Step 2 fails.

A Step 2 failure most likely indicates a LANIC card fault. Replace the LANIC card.

The following steps are executed only if Steps 1 and 2 passed.

Step 3: MAU/ThinMAU power line tests. If the download and start code (Steps 1 and 2) were correctly returned, the LANIC card is instructed to turn the MAU power supply line on. The diagnostic then waits for a system interrupt 1, indicating completion of this task. Subsequently, the diagnostic reads the status register for results returned by the firmware.

The results indicate the status of two internal signals, MAUPWR and V12SENSE, specifically, whether or not MAU/ThinMAU power is on and how many attempts were required to turn the power on.

If the task completion interrupt was not detected, or either of the internal signals indicate lack of MAU/ThinMAU power, Step 3 fails.

For coaxial cable LAN connections, a Step 3 failure can result from a LANIC card, AUI cable, or MAU/ThinMAU fault. Refer to Test #16 (Hood Loopback Test) to find the faulty unit(s).

For StarLAN connections, the LANIC card most likely contains a fault and should be replaced. Test #16 does not operate for StarLAN connections.

Step 4: External loopback tests. The diagnostic instructs the LANIC card to loop 8 test frames to the LAN and back. The firmware transmits and receives the test frames.

During these loopback tests, the firmware monitors the number of collisions, aborts due excessive collisions, heartbeats received from the MAU/ThinMAU (if applicable), and frames received without error.

The diagnostic waits for the LANIC card to issue a system interrupt 1 indicating that it has completed the external loopback tests. Subsequently, the status register is read for results returned by the firmware. If the interrupt is not received, or the number of frames received without error is less than four, Step 4 fails.

For a coaxial cable LAN, a Step 4 failure may indicate a faulty LANIC card, AUI cable, MAU/Tap or ThinMAU/BNC-tee (as appropriate), or the coax cable. Using a loopback hood and this test, or Test #16, the fault may be isolated.

For StarLAN, a Step 4 failure may indicate a faulty card, StarLAN cable, or StarLAN Hub. Using a StarLAN loopback connector and this test, the fault can be isolated. See Figure 4-4.

For either type of LAN, a Step 4 failure may indicate excessive traffic on the LAN.

NOTE

For HP StarLAN connections, the following steps in Test #14 are not performed.

Step 5: For coaxial cable LANs, the diagnostic checks the number of times a heartbeat was detected in Step 4. A heartbeat should be detected after each successful transmission. If a predefined number of heartbeat errors occur, Step 5 fails.

A Step 5 failure most likely indicates a MAU/ThinMAU fault. However, it can also occur for AUI cable or LANIC card faults. Use a loopback hood with this test, or Test #16 (Hood Loopback Test), to help identify the failure.

Step 6: For coaxial cable LAN connections, the diagnostic instructs the LANIC to run the jabber test. The jabber test involves transmitting frames that exceed allowable frame lengths, and monitoring the Control In (CI) signal pair for MAU/ThinMAU jabber operation.

The SQE disable function of the LANIC card is also tested at this time.

Finally, the firmware resets the MAU/ThinMAU by cycling the power. The CI signal pair is checked to verify that jabber operation in the MAU/ThinMAU has been reset.

While the firmware executes this test, the diagnostic is waiting for a system interrupt 1, indicating that the test has completed. After it detects the interrupt, or a time out occurs, the status register is read for test results returned by the firmware.

If the interrupt was not detected within a predefined time interval, or a jabber condition was detected too early in the test process, Step 6 fails.

A Step 6 failure suggests a LANIC card or MAU/ThinMAU fault. A loopback hood with this test, or Test #16 (Hood Loopback Test) should be used to isolate the faulty unit.

Step 7: From Step 6, the diagnostic checks whether the jabber condition was detected in the jabber test. If the test completion system interrupt was not detected, or the jabber condition did not occur, Step 7 fails.

A Step 7 failure most likely indicates a MAU/ThinMAU fault. However, LANIC card or AUI cable faults are possible. Use a loopback hood with this test, or Test #16 (Hood Loopback Test), to isolate the faulty unit.

Step 8: The diagnostic checks whether the jabber condition could be reset by cycling the power to the MAU/ThinMAU. If the jabber condition was never detected then the results from this test are invalid.

If the test completion system interrupt 1 was not detected, or the jabber condition appears to be active after MAU/ThinMAU power cycling, Step 8 fails.

A Step 8 failure suggests that LANIC card or MAU/ThinMAU are faulty. Use a loopback hood with this test, or Test #16 (Hood Loopback Test) to help isolate the fault.

Step 9: The diagnostic checks whether the SQE disable function is operating properly. If either the system interrupt 1 was not detected in Step 6, or the firmware reports a failure in the SQE disable test, Step 9 fails.

A Step 9 failure most likely indicates a LANIC card fault. Replace the LANIC card.

StarLAN Connection Fault Isolation Procedures

Using a StarLAN loopback connector (see Figure 4-4), part number 5061-4977, Test 14 is used to isolate faulty FRUs on StarLAN connections. The procedure is illustrated in Figure 4-5, and described below.

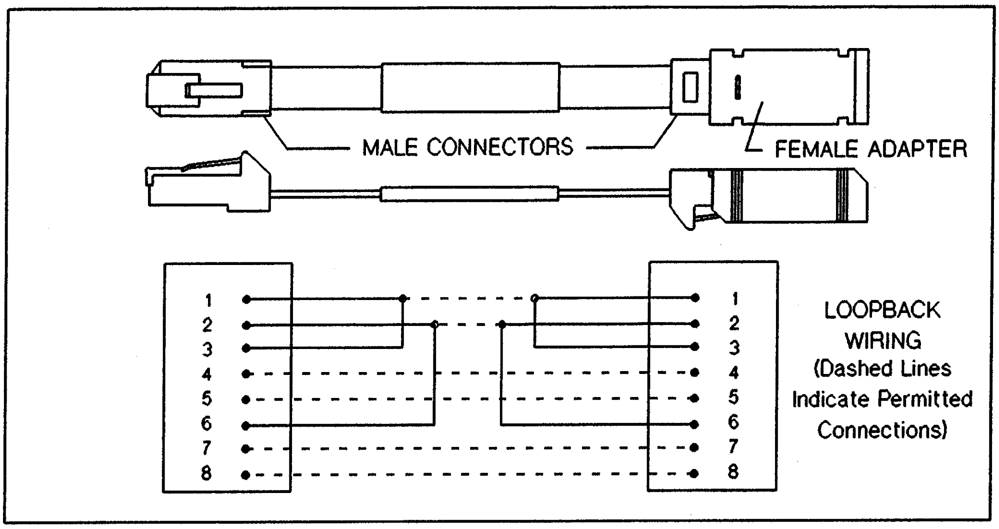


Figure 4-4. StarLAN Loopback Connector

Test A. With the connection set up as in Figure 4-5, "Test A Configuration", Test 14 is run. If Test 14 fails, the LANIC card, StarLAN cable, or StarLAN Hub may be faulty. Proceed to Test B.

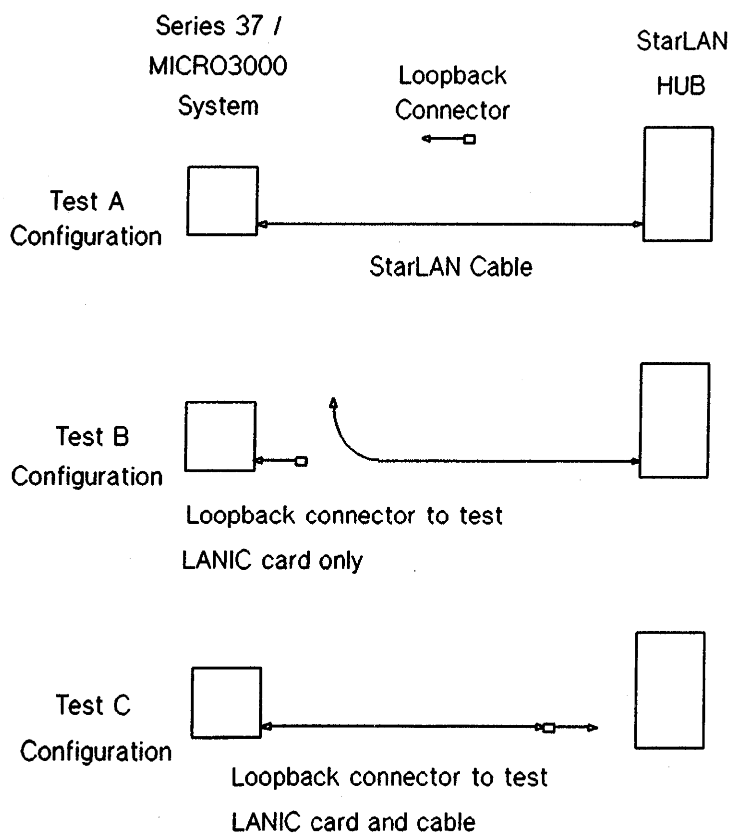
Test B. Disconnect the StarLAN cable from the LANIC, and replace it with the StarLAN loopback connector, as shown in the "Test B Configuration". Test 14 is again run. If Test 14 fails, the LANIC card is faulty and should be replaced. If it passes, the LANIC card is good, so proceed to Test C.

Test C. If Test 14 passes the "Test B Configuration", try the configuration in the "Test C Configuration". The StarLAN cable is reconnected to the LANIC card. At the Hub end, the StarLAN cable is disconnected from the Hub, and attached to the StarLAN loopback connector. Then, Test 14 is repeated.

NOTE

Because the maximum distance between a StarLAN node and Hub is 250 metres, Test C results are reliable for cables up to 125 metres only. Where StarLAN cables exceed this distance, use of the loopback connector in the "Test C Configuration" is not supported. Instead, use of a *known good Hub* substituted for the existing Hub may be required.

If Test 14 passes, the LANIC card and cable are good, and a fault exists on the Hub or some other part of the StarLAN. Refer to the *HP StarLAN Diagnostics and Troubleshooting Manual for PCs* (50906-90060) for isolating StarLAN hardware faults.



Test 14 Loopback Test

Result	Possible Fault
Test A Failed	Bad LANIC Bad Cable Bad Hub or Port
Test B Failed	Bad LANIC
Test B Passed	Bad Cable Bad Hub or Port
Test C Failed	Bad Cable
Test C Passed	Bad Hub or Port

Figure 4-5. StarLAN Connection Fault Isolation Using Test 14

Test #15. Date Code Test

Test #15 verifies that the LANIC card and ROM firmware are current. Because this test depends on a properly operating LANIC card, it is performed after Tests 1 through 14.

This test uses the dump hardware kernel command to read the ROM and LANIC card date codes. It consists of 3 steps:

Step 1: The diagnostic first resets the LANIC card and enables the LANIC card master handshake. It then issues the dump hardware kernel command and waits for a system interrupt 1, which indicates that the dump is complete. The diagnostic finally moves the dump from the extra data segment to the stack.

If any of the following occurs, Step 1 fails:

- the interrupt was not detected.
- the kernel command was not issued successfully, or
- the data move from the data segment to the stack failed.

A Step 1 failure most likely indicates a LANIC card fault. Replace the LANIC card.

Step 2: The diagnostic checks the ROM date code against the expected date code hardcoded in the diagnostic. If the ROM date code is earlier in the time then the date code expected, Step 2 fails.

A Step 2 failure indicates that the LANIC is either an outdated card, or the dump failed. In either case replace the LANIC card.

Step 3: The diagnostic checks the board date code against expected date code hardcoded in the diagnostic. If the board date code is earlier in time then the expected date code, Step 3 fails.

A Step 3 failure indicates that the LANIC is either an outdated card, or the dump failed. In either case replace the LANIC card.

Test #16. Hood Loopback Test

NOTE

Test #16 is not executed with HP StarLAN connections. Attempts to do so will result in the following message:

```
Test 16 is not valid for HP30265A StarLANIC
```

Test #16 is used on coaxial cable LAN connections, and helps identify the faulty units associated with an external loopback (Test #14) failure. This section contains the following information:

- Required Hardware
- Functional Description
- Using Test 16

Required Hardware

For isolating faults with Test 16, the following hardware is required:

Part Number	Description
30241A 28641A	Known good MAU or ThinMAU, for ThickLAN or ThinLAN connections, respectively.
92257B 92227Q	Terminated loopback hoods for ThickLAN or ThinLAN connections, respectively. See Figures 4-6 and 4-7.
30241-60009	Known good AUI cable for connecting the MAU/loopback hood.
30241-60002	For Series 39/40/42/52, known good Internal Cable, LANIC card to Junction panel. (Used to distinguish LANIC card faults from internal cable faults.)
30241-60003	For Series 44/48/58/6X/70, known good Internal Cable, LANIC card to Junction panel. (Used to distinguish LANIC card faults from internal cable faults.)

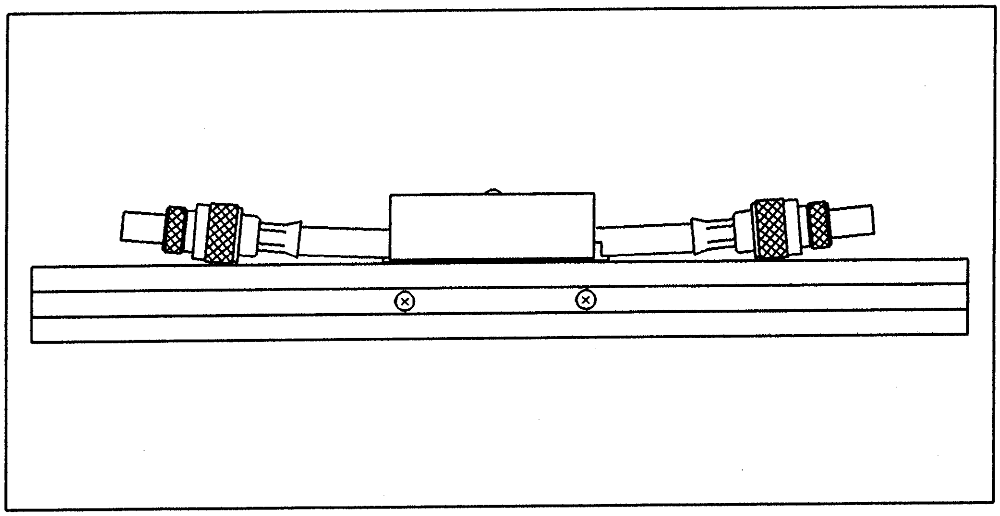


Figure 4-6. Loopback Hood on MAU

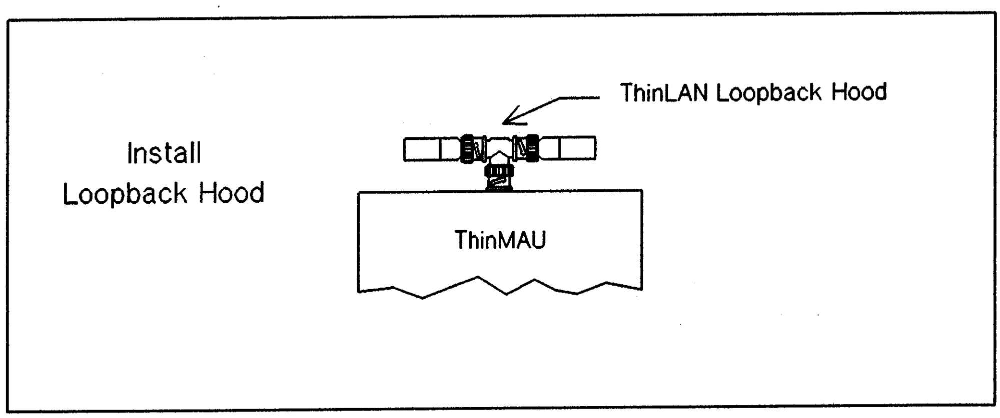


Figure 4-7. Loopback Hood on ThinMAU

Functional Description

Test 16 is an interactive test with its own user interface. After Test 16 is specified, and the GO command is issued, the following menu is displayed, followed by the Test 16 prompt:

```
                 HOOD LOOPBACK TEST
1.  Test LANIC interface and AUI (25 ohm termination)
2.  Test for collision detection (50 ohm termination)
3.  Test coax interface (MAU on coaxial cable)
4.  Hood Test done, return to main menu
        Please select test format by number

TEST 16 >
```

A test or action is selected by entering its identification number at the Test 16 prompt. For example,

```
TEST 16 > 1
```

will select the "LANIC interface and AUI (25 ohm termination)" test.

The tests listed above are described briefly in the following paragraphs.

1. Test LANIC interface and AUI (25 ohm termination)

This test is useful for evaluating the LANIC card to AUI cable interface, and individual sections of AUI cable.

To perform this test, a a known good MAU/ThinMAU with terminated loopback hood is substituted for the installed MAU/ThinMAU. Fifty (50) ohm terminators must be installed on each end of the loopback hood, resulting in an effective resistance of 25 ohms to the MAU/ThinMAU.

This test is comprised of the following subtests:

a. LANIC power switch (supplies power to the MAU/ThinMAU)
b. Test frame loopback from MAU/ThinMAU
c. MAU/ThinMAU jabber detection

A typical output from this test is as follows:

```
            MAU POWER SWITCH STATUS
The MAUPON signal is  TRUE, expecting TRUE
The MAUPS (v12_Sense) signal is TRUE, expecting TRUE
The number of power-on tries is 1, expecting fewer than five.

             FRAME LOOPBACK STATUS
The number of correctly received frames is 8, expecting 8
The number heartbeats detected is 7, expecting 7
The number collisions detected is 0, expecting 0
The number of times the backoff retry limit was exhausted is 0, expecting 0

              JABBER STATUS
MAU Jabber was detected correctly.
```

---

2. Test for collision detection (50 ohm termination)

This test is useful for verifying the collision detection capability of the node.

To perform this test, a loopback hood is attached to either the installed MAU/ThinMAU, or a known good MAU/ThinMAU substituted for the installed unit. One of the 50 ohm terminators on the loopback hood is is removed, leaving the remaining 50 ohm terminator in series between the coaxial cable conductors.

Collision detection tests include:

1. Detection of collision signal levels on the coax by the MAU/ThinMAU,
2. Reporting of collisions by the MAU/ThinMAU via SQE signals on the CI pair,
3. Transmission of SQE signals from the MAU/ThinMAU to the LANIC card via the CI pair,
4. Detection and recognition of SQE signals by the LANIC. This test is composed of the following subtests:
   a. LANIC card power switch to MAU/ThinMAU,
   b. Test frame loopback from MAU/ThinMAU (note that a collision is expected for every attempted transmission).

A typical output from this test is as follows:

```
                 COLLISION STATUS
The number of correctly received frames is 0, expecting 0
The number of collisions detected is 128, expecting 128
The number of times the backoff retry limit was exhausted is 8, expecting 8
```

3. Test coax interface (MAU on coaxial cable)

This test serves as a final evaluation of the node connected to the network coax. Faults associated with a coaxial cable Tap (for ThickLAN connections), or faults external to the node (i.e., network faults), can be detected.

This test is comprised of the following subtests:

a. LANIC power switch (supplies power to the MAU/ThinMAU).
b. Test frame loopback from a MAU/ThinMAU connected to the network.

A typical output from this test is as follows:

```
              MAU POWER SWITCH STATUS
The MAUPON signal is TRUE, expecting TRUE
The MAUPS (V12_Sense) signal is TRUE, expecting TRUE
The number of power-on tries is 1, expecting fewer than five.

              FRAME LOOPBACK STATUS
The number of correctly received frames is 8, expecting 8
The number of heartbeats detected is 7, expecting 7
The number of collisions detected is 0
     (expected value depends on the amount of network traffic)
The number of times the backoff retry limit was exhausted is 0
     (expected value depends on the amount of network traffic)
```

Using Test 16

In this section, general procedures are provided for using Test 16. Once understood, these procedures can be adapted to the particular installation.

NOTE

The following discussion presumes that Test 14, loopback test, failed. Be sure to check the node connections before proceeding with the procedures below.

Procedure 1 - Part A

Attach a terminated loopback hood to a known good MAU/ThinMAU. Connect this assembly to the LANIC card. For MAU connections to Series 39/4X/5X/6X/70 systems, a known good AUI cable is required to connect to the system junction box (internally connected to the internal cable and LANIC card).

Run test 1 of Test 16 ("25 ohm termination" test), to exercise the following hardware:

a. LANIC power switch
b. LANIC AUI driver
c. LANIC AUI receivers
d. Internal cable (if applicable)

Test passes. If test frames are successfully looped back, and MAU heartbeats are detected, the LANIC-to-AUI interface circuitry (including the internal cable, if applicable) is functioning properly.

Proceed to Part B of Procedure 1.

Test fails. Check for the following failure conditions:

- The number of correctly received frames is less than 8 (< 8), but heartbeats detected equals 8 (= 8). This suggests a faulty LANIC card Data In (DI) receiver or a faulty internal cable DI signal pair.

- The number of heartbeats detected < 7, but the correctly received frames = 8. This suggests a faulty LANIC card Control In (CI) receiver, or a faulty internal cable CI pair.

- The number of heartbeats detected < 7, and the correctly received frames < 8. This suggests the following faults may exist:

  * LANIC card power switch,
  * LANIC card Data Out (DO) driver,
  * Internal cable DO pair,
  * Internal cable power pair (assuming only a single failure).

- The number of received frames < 8, and number of collisions > 0. This suggests the MAU/ThinMAU and loopback hood are not operating properly.

  Since the MAU/ThinMAU and loopback hood are presumed to be good, check the loopback hood connection and verify that both 50 ohm terminators are securely fastened.

- Either the MAUPON signal was false, the MAUPS signal was false, or the number of power-on retries > 5. This suggests the following faults may exist:

  * There is a short between the VP & VC signal lines,
  * The Z80 is unable to turn the power on,
  * The Z80 is unable to detect that the power is on.

For the failures listed, replace the LANIC card, internal cable, or both. By systematically replacing one or the other, the faulty unit can be uniquely identified.

NOTE

Only authorized service personnel, such as Hewlett-Packard Customer Engineers **(HP CE) are permitted to access and replace hardware internal to HP 3000** computer systems.

Procedure 1 - Part B

Remove one of the terminators, and run test 2 of Test 16 ("50 ohm termination" test). This is a crude verification of the collision detection and indicator circuitry of the node.

Test passes. If the number of times the back off retry limit is exhausted is 8 then collision detection circuits are functioning properly. Go on to Procedure 2.

Test fails. If the retry limit is exhausted is not 8, then the collision detection circuits are faulty. Since the MAU/ThinMAU and loopback hood are presumed good, check their connection. Since they must operate properly for remaining tests, replace them if there are doubts. If the test continues to fail, systematically replace the LANIC card (and internal cable, if applicable) until the test passes.

Procedure 2

Procedure 2 primarily addresses ThickLAN connections where multiple AUI cables may be installed.

Attach the known good MAU and loopback hood to the end each section of AUI cable starting with the one connected directly to the host. For each section of AUI cable, run test 1 of Test 16 (the "25 ohm terminator" test). Figure 4-8 illustrates this process.

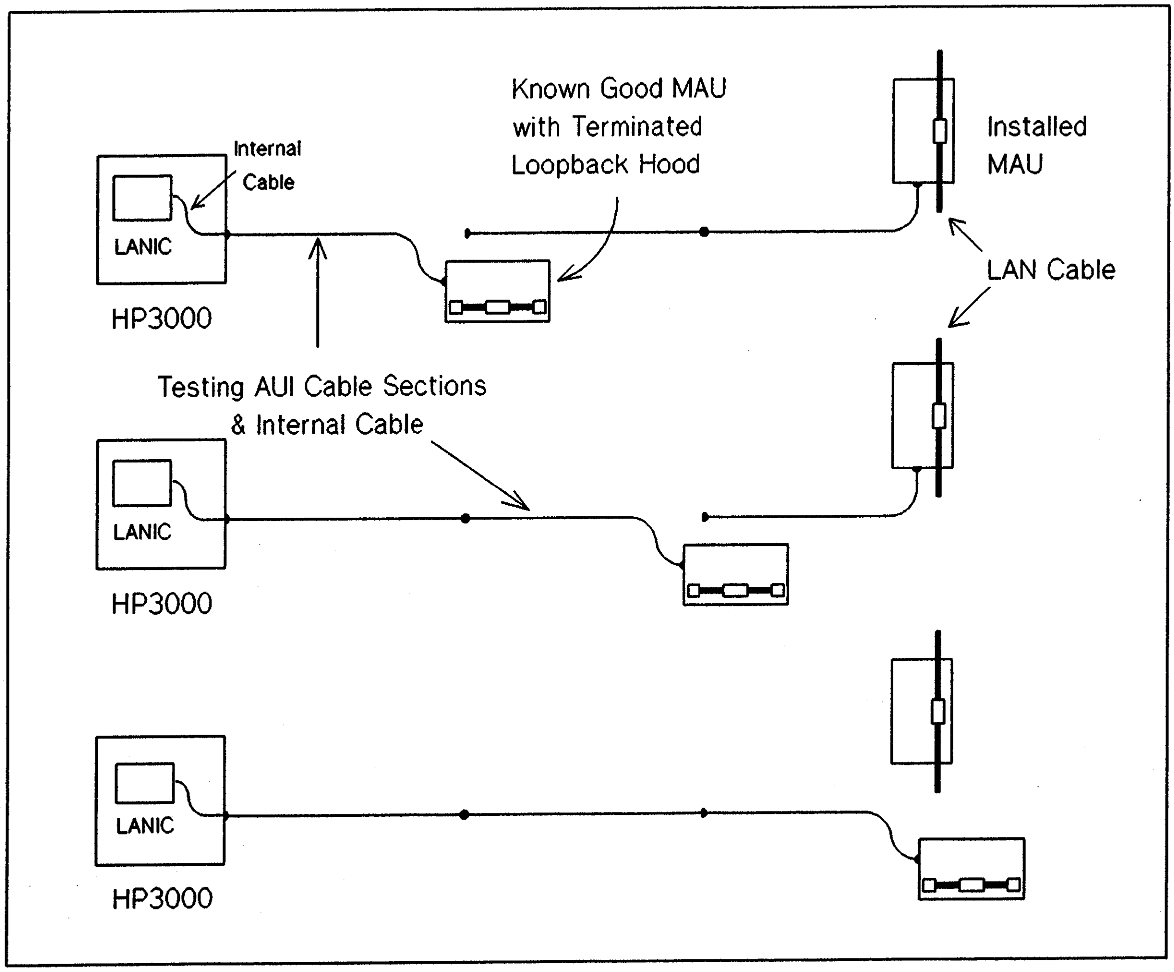


Figure 4-8. Testing AUI Cable Sections

Test passes. If the number of correctly received frames = 8, and the number of heartbeats detected = 7, the test passes. Consequently, the AUI cable under test is presumed good.

Test Fails. Check for the following failure conditions:

- The number of correctly received frames is less than 8 (< 8), and the number of heartbeats detected equals 7 (= 7). This suggests a faulty DI signal pair of the AUI cable.

- The number of correctly received frames = 8, and the number of heartbeats detected < 7. This suggests a faulty CI signal pair of the AUI cable.

- The number of correctly received frames < 8, and number of heartbeats detected < 7. This suggests a faulty DO signal pair, or faulty power pair the AUI cable.

- MAUPON or MAUPS indicates "`false`", or the number of power-on retries > 5. This suggests a short circuit between the VP & VC lines in the AUI cable under test.

After all AUI cable sections have been tested and presumed good, proceed to Procedure 3.

Procedure 3

Procedure 3 addresses MAU/ThinMAU or coaxial cable faults.

Attach a loopback connector to the original MAU/ThinMAU. Using this assembly in place of the known good MAU/ThinMAU, repeat Procedure 1, Parts A and B, to verify operation of the MAU/ThinMAU.

Test passes. If errors are not indicated, the MAU/ThinMAU is presumed good, and the fault is presumed to be elsewhere on the LAN cable (e.g., a Tap/BNC tee, cable or remote node fault). You will need to perform other tests. (see "Other tests", below).

Test fails. If errors occur, replace the MAU/ThinMAU, reconnect the node to the network, and run test 3 of Test 16.

Other tests. To test the original Tap, try moving to some other node location (i.e., some other Tap) on the same coax, and run test 3 of Test 16. If no errors are indicated, the original Tap is probably faulty. If errors persist, the original Tap is probably good, and the fault exists elsewhere (coax cable or other node).

To troubleshoot the coax network, refer to the *LAN Link Hardware Troubleshooting Manual* (5955-7681).

After the network fault is corrected, reconnect the local node and verify operation by running test 3 of Test 16.

Test #17. Remote Node Test

Test #17 allows the user to send frames to, and receive frames from, remote nodes on the network. This test assists in diagnosing network faults that lie outside of the local node hardware. Such faults include:

- topological problems
- faulty hardware in the remote nodes
- network performance degradation

This section contains the following information:

- Requirements
- Functional Description
- Interpreting Test 17

Requirements

Before running Test 17, there are various requirements that must be met.

Local Node Requirements.

- LDEV number. You must know the LDEV number of your LANIC card.
- "AVAILABLE" state. If your LANIC card is not "AVAILABLE", that is, the line is "DISCONNECTED" or "CLOSED", you must shut down LAN activity on your computer.
- Good node hardware. Using other diagnostic tests, the operation of the local node hardware has been verified (i.e., good LANIC card, AUI or StarLAN cables, MAU/ThinMAU as appropriate).
- LANDIAG tests 1 - 15. In a given LANDIAG session, the default series of tests, Tests 1 through 15, must have been run prior to Test 17.

Remote Node Requirements.

- Station (link-level) address. You must know the 12-digit hexadecimal station address of the remote LANIC card. The best source for this information is the Network Map.

  The station address of the remote node can be determined through the use of software on the remote node. Since you cannot use LANDIAG3000/V to remotely determine this address, **you must be at the remote computer to identify the station address.**

  If your remote computer is a Hewlett- Packard personal computer (or equivalent) supported on the network, use the DIAGNET or DIAGLINK utility to find the station address (refer to the *HP StarLAN Diagnostics and Troubleshooting Manual for PCs*, 50906-90060, or the *HP ThinLAN Diagnostics and Troubleshooting Manual for PCs*, 50909-90060).

  If the remote computer is an HP 3000 MPE-V system, use the LANDIAG3000/V "HELP" command.

- If the remote computer is an HP 3000 MPE-V system, its response to the RNT requires its driver be active. The driver is active if

  a. a network service must be running (e.g., NS3000/V) and have control of the LANIC card, or

  b. a Test 17 must have been initiated but held in a wait state (waiting for a carriage return that actually starts the transmit/receive process).

Functional Description

Remote Node Test examples are provided below. The examples presume that Tests 1 through 15 have been completed. Underlined text indicates user input. Refer to these examples during the discussion that follows.

EXAMPLE. Remote Node Test - Normal Completion

```
    .
    .
> TEST 17
> GO
Please enter the station address of the destination node.
MARKETING
A twelve digit hexadecimal number is required.
Please enter the station address of the destination node.
0800 0901 1806
Attempting to open LANIC driver ... please wait
Driver now ready to echo link level packets.

! is displayed for each test packet looped back successfully.
# is displayed for each failure to loop back a test packet.

Hit return to initiate looping of test frames (1000 max),
use <control-y> to stop.
 [RETURN]

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

100% of the test frames were acknowledged.  (1000/1000)
The average response time was 208 milliseconds.
  End of Pass
```

EXAMPLE. Remote Node Test - Nonexistent Remote Node

```
> GO
Please enter the station address of the destination node.
0800 0900 A208

Attempting to open LANIC driver ... please wait
Driver now ready to echo link level packets.

! is displayed for each test packet looped back successfully.
# is displayed for each failure to loop back a test packet.

Hit return to initiate looping of test frames (1000 max),
use <control-y> to stop.
 [RETURN]

##### [CONTROL]Y

0% of the test frames were acknowledged.  (0/5)
  End of Pass
```

EXAMPLE. Remote Node Test - Degraded Performance or Network Problem

```
> GO
Please enter the station address of the destination node.
0800 0900 EF08
Attempting to open LANIC driver ... please wait
Driver now ready to echo link level packets.

! is displayed for each test packet looped back successfully.
# is displayed for each failure to loop back a test packet.

Hit return to initiate looping of test frames (1000 max),
use <control-y> to stop.
RETURN

!!!##!!!!#!!!!!#!!###!!!!!#!!!!!! CONTROL Y

76% of the test frames were acknowledged.  (25/33)
The average response time was 201 milliseconds.
  End of Pass
```

General Information

You must be able to access and exit the test, select the remote node with which to run the test, and obtain test results. Note the following:

- Driver statistics are not provided; they can be obtained via the SHOWCOM command from MPE (see Chapter 2).
- All terminal I/O is echoed to the list file, consistent with the rest of the diagnostic. This presumes the NOPRINT facility was not activated.
- The LOOP and NOPRINT facilities are disabled for Test 17.

Accessing the Remote Node Test

Before accessing the Remote Node Test, ensure all requirements listed in the "Requirements" section have been met.

To run the RNT, specify Test 17 in a TEST command (> TEST 17), and follow it with a GO command. Consistent with the diagnostic, subsequent GO commands will rerun Test 17 if it was the last test specified.

After the GO command is issued, the user is prompted for the station address of the remote node. The diagnostic expects a 12-digit hexadecimal number for the station address (upper or lower case characters are accepted). Leading, trailing and embedded blanks are permitted, as illustrated by the following examples:

hh hh hh hh hh hh
hhhh hhhh hhhh
hhhhhhhhhhhh

where *h* is a hexadecimal digit.

If an improper user entry is made, the following message is returned:

```
A twelve digit hexadecimal number is required.
```

followed by another prompt for a station address.

If a proper station address is not supplied after four attempts, the diagnostic issues the following message:

```
Bad input - I assume you want the main menu.
```

and returns to the LANDIAG command prompt, ">".

Nonexistent Nodes. If a 12 digit hexadecimal number is entered, no further error checking is performed. Thus, a proper entry may not be a valid one, that is, there may be no node on the network with the station address specified. The diagnostic will still try to send test packets to the address entered. Response frames will not occur, and the "no-reply" timer will expire, resulting in a failure.

NOTE

Test 17 does not distinguish between remote nodes that are broken, too busy to respond, isolated by a network fault, or nonexistent.

Initiating Transmissions. After a proper station address is entered, the LANIC card driver is activated, and the user is directed to "Hit return" to start test frame transmission and reception.

NOTE

If RETURN is not entered, Test 17 is idle. The ability to have Test 17 idle, that is, to open the driver without actually transmitting test frames, is a necessary feature for MPE V systems. This is especially true when the system does not have network services installed and is the remote node in a Remote Node Test.

On an MPE V system, the LANIC driver must be active with buffers ready before frames can be received or transmitted. If a remote HP 3000 does not have network services installed, it can run Test 17 to activate the driver yet remain in an idle state. In this way, it can respond to test frames transmitted by the local node on which Test 17 is active.

Once RETURN is entered, the diagnostic begins sending test frames to the node specified and checks for proper response frames.

A test frame transmission and associated response frame reception constitutes a single test cycle. Each test cycle should be identical to all others. Up to 1000 test cycles are attempted unless the diagnostic is interrupted with a CONTROL Y. If a CONTROL Y is issued during an individual test cycle, the diagnostic will allow that test cycle to complete before exiting the test.

Activity Indicator

During each test cycle, either a response frame is received, or a timer within the diagnostic expires. A response frame properly received results in a "!", while an improper frame or frame not received results in a "#" character.

The return of these characters allows the user to know that the diagnostic is running properly.

Test Results

Test 17 Results. When Test 17 completes, either normally or by a "CONTROL Y", the results of the test are summarized. The following is returned:

- Percent of test frames transmitted that were properly acknowledged. The actual numbers are also indicated in a ratio format.

- Average response time for response frames acknowledged. This is returned only if there were response frames received.

Driver Statistics. The LANIC card driver collects useful statistics about the node's use of the network. This includes counts of overruns, underruns, CRC errors, retransmissions required, etc. LANDIAG does not provide this data to the user; the data is accessed via the SHOWCOM command with the ERROR parameter from MPE, as follows:

:SHOWCOM *LDEV*; ERROR

Test 17 resets all the statistics. Therefore, for long term intermittent error analysis, use SHOWCOM prior to Test 17.

During a network fault isolation process, use SHOWCOM after Test 17. The statistics will describe only those network events that have taken place since the last time the driver was opened.

NOTE

For more information on SHOWCOM, see Chapter 2.

Interpreting Test 17

Performance degradation between two nodes can occur from hardware or software faults, extremely busy nodes, or excessive traffic on the network. Test 17 can indicate degraded performance if either of the following result:

- Less than 95% of properly transmitted test frames result in proper responses.

- The average response time is more than 550 milliseconds.

On a small network, Test 17 can be run using all remote nodes. On a large network, however, a sampling of nodes might be more appropriate. When sampling, select nodes that are both near and far, where distance is measured by lengths of network cable a frame must traverse. For problems with a specific node, run the Remote Node Test with that node.

For network fault isolation, you should refer to the appropriate LAN troubleshooting manual:

- *LAN Link Hardware Troubleshooting Manual*, 5955-7681, for IEEE 802.3 coaxial cable LANs,

- *HP StarLAN Diagnostics and Troubleshooting Manual for PCs*, 50906-90060, for IEEE 802.3 twisted pair HP StarLAN.

However, the results of Test 17 tests may suggest possible faults that can be further investigated directly. For example, consider the following:

1. A series of Remote Node Tests indicates that only one remote node is faulty.

   At the faulty node, determine whether NS3000 is up.

   Run LANDIAG on that node. Verify that all node FRUs on that system are operating properly.

   If the remote node is connected to a coaxial cable LAN, check for a "marginal" MAU/ThinMAU. A node containing a marginal MAU/ThinMAU can communicate with nearby nodes, but cannot communicate with distant nodes. If LANDIAG Test 16 (MAU loopback) passes while Test 17 (Remote Node) fails for distant nodes only, the MAU/ThinMAU should be replaced.

2. Communication is difficult or impossible with every node.

   The local node may have a defective FRU. Ensure other tests of LANDIAG have already been run and passed.

   If the local node is connected to a StarLAN, check for a damaged cable or faulty Hub.

   If the local node is connected to a coaxial cable LAN, check for a marginal MAU/ThinMAU (Test 16 passes, Test 17 fails for distant nodes only). Check for loose connectors or terminators. Check the coaxial cable for damage -- it may be severed, crimped or frayed.

   If you have one, a Time Domain Reflectometer (TDR) can be used to test the coax to locate cable faults. Also, useful information can be gained by measuring the resistance across the contacts at the nearest Tap:

   a. A resistance of about 25 to 30 ohms between the center conductor and braided shield is acceptable.

   b. A resistance of 50 ohms suggests that one terminator is absent or that there is an open circuit somewhere in the coax.

   c. A very large resistance suggests that both terminators are absent.

   d. A very small resistance suggests a short between the shield and the center conductor.

   For resistance faults that are difficult to find, TDR testing is recommended (see the *LAN Link Hardware Troubleshooting Manual*, 5955-7681, for more information).

3. Test 17 results indicate poor response from several adjacent nodes.

   For StarLAN connections, the Hub to which the remote nodes are connected is probably faulty.

   For coax connections, the coax may be partially damaged between a node that successfully responds and one that does not.

4. For coax connections, Test 17 results indicate performance degrades steadily with distance from the local node.

   The local node probably has a marginal transmitter. Replace the MAU/ThinMAU at the local node.

5. All nodes were checked with Test 17, and there was no trouble communicating with any of them.

   If a communication problem exists, it is likely due to a software fault in a user application.

6. Test 17 could not send out any test frames.

   a. For some reason, LANDIAG may not have been able to open the driver. (A CS error code will be returned if this is the case.) Check the following:

      - Ensure that NS3000/V is down, and that no other processes are using the LANIC card.

      - Ensure the LANIC card can pass self test, which is a prerequisite for opening the driver. Selftest failures are commonly due connection faults between the LANIC card and the LAN.

   b. The diagnostic may have been unable to obtain an extra data segment to use as a frame buffer. This condition points to a software error.

7. If Test 17 returns a message indicating that Tests 1, 2, 9 and 10 before Test 17 can be run, perform these LANDIAG tests.

Error Messages

The following is a list of error messages associated with LANDIAG.

- `There is no LANIC present at that location.`

  The LDEV specified by the user does not respond to a roll call during initialization.

- `The diagnostic needs driver version B011000 or newer.`

  Software compatibility must be maintained between the diagnostic and the driver. However, it may be possible to continue diagnostic testing in spite of this warning.

- `The LANIC could not be allocated.`

  Network Services (NS) is probably running. NS has already allocated the LANIC and has not released it.

- `An extra data segment could not be created.`

  This reflects an operating system problem or a system resource shortage.

- `That LDEV is not configured as a LANIC.`

  The LDEV entry in the I/O configuration table is not a LANIC of type 17, subtype 9.

- `OP, DI, or SM capability needed to run diagnostic.`

  Have the system manager provide you DI (diagnostician) capability.

- `The output file could not be opened.`

  Logging of diagnostic results to an output file is disabled, but the diagnostic can still be run.

- `Diagnostic not designed for HP3000/30 or 33.`

  Diagnostic test results on Series 30/33 systems may not be valid; LAN services are not supported on Series 30s or 33s.

- `Bad input - Try again or enter "Help".`

  Command entry error. The HELP message includes a list of all the commands.

- `Test's parameter must be 1 to 17 or "ALL".`

  Parameter error on a TEST command. Note that "ALL" includes Tests 1-15 only. "ALL" is default if no parameter is provided.

- `Exit failed to return all resources.`

  This reflects an operating system problem.

- `Bad input - I assume you want the main menu.`

  Improper parameter entered in Tests 16 or 17 more than three consecutive times. Returns to LANDIAG prompt ">".

- `A small integer input was expected.  Please retry.`

  Test 16 prompt expects input range 1 through 4. Non-numeric character entry was made.

- `Test 1 must run for this test to run.`

  Test dependency message.

- `Test 1 and 2 must pass for this test to run.`

  Test dependency message.

- `Test 1,2,9 and 10 must pass for this test to run.`

  Test dependency message.

- `A twelve digit hexadecimal number is required.`

  For Test 17 (Remote Node Test), a proper station address must be entered. Leading, trailing and embedded blanks are permitted. Upper and lower case characters are accepted.

- `MPE commands are not permitted.`

  Access to MPE, via a colon (:) followed by an MPE command, during a LANDIAG session is not permitted.

- `This test can't run while NS/3000 is up.`

  With NS running and in control of the LANIC card, Tests 3 through 17 cannot be initiated.

- `You must have CS capability to run this test.`

  For Test 17, capability to use the Communication Subsystem is necessary.

- `You must specify an individual address.`
  `(The first byte of the address must be even).`

  For Test 17, a proper station address must be entered. The address cannot be a group address, that is, its first byte cannot be an odd value.

`Test 16 is not valid for the HP30265A StarLANIC.`

Test 16 does not apply to systems with HP StarLAN connections. Use Test 14, instead.

LANIC Self Test 5

The LANIC card contains a self test routine in ROM. An understanding of this self test can help you identify whether or not a LANIC card is faulty and requires replacement. For more information on LANIC card self test, refer to your LANIC card installation and service manual.

The Scope of LANIC Card Self Test

The LANIC card self test checks the operation of the card and LAN connection hardware.

The hardware tested depends partially on the type of LAN card connection: coax cable LAN, or HP StarLAN. The following circuitry is common to both types of LAN cards:

- Microprocessor and associated circuitry
- ROM
- RAM
- Timer [Chip]
- FIFOs [Receive Data Buffers]
- Protocol Controller [82586 Chip]

Card specific circuitry tested includes:

Coax LAN card

- MAU Power Circuitry
- Analog Driver [8023]

StarLAN card

- StarLAN media interface [7960]

By testing the above circuitry, the operation of the LANIC card's *main module* **(all circuitry not associated with the SIMB/IMB interface)** is verified.

In addition, the self test performs an external loopback test to verify the card-to-LAN interface. If the card is not connected to its respective LAN, the self test will fail this portion of the test.

Self Test Limitations

The following LANIC card circuitry or functions are not tested by self test. However, these items can be exercised by using LANDIAG3000/V (see Chapter 4).

- IMB/SIMB Interface, including data and address lines
- Master and slave handshakes
- Interrupt mask flipflop
- Z80/82586 to master handshake arbitration
- Slave handshake vs Z80 arbitration (system accesses)
- Slave handshake vs Z80 arbitration (I/O)
- 82586 collision recovery, and identification of bad packets
- Collision detect or jabber functions

How To Read Selftest LEDs

There are 15 LEDs located on the edge of the LANIC card, eight of which are accessed by the self test. For location and identification of these LEDs see Chapter 3.

The eight LEDs used by self test are labeled H to N, and "*". These eight LEDs are also labeled with mnemonics to indicate their function during normal operation, as follows:

TX	:	ON when a XMIT command is started
RX	:	ON when a RCV command is started
MN	:	ON when in monitor mode
DL	:	ON when the DOWNLOAD command is started
RO	:	ON when ROM-resident firmware is in control
Q	:	ON when microprocessor is waiting for a command
IT	:	ON when microprocessor is running an idle selftest routine
ST	:	ON when self test is running

Depending on your particular system, the LED labeled "ST" (the rightmost LED) will be in one of three states: off, on, or blinking.

ST is OFF (applies to all MPE-V systems).
When the ST is off, self test is not running, and the other seven LEDs perform their mnemonic functions as noted above.

ST is ON (applies to all MPE-V systems).
However, when ST is on, the self test is in progress. The self test consists of many subtests ; while the self test is executing, the remaining seven LEDs are used to display a code indicating which subtest is executing. See Table 5-1.

If the self test completes with no errors, the selftest LED will be on and the other seven LEDs will be off (a code of all zeros) for five seconds. After five seconds, the self test LED (ST) will go off, and the remaining LEDs perform their normal LANIC card functions.

ST is Blinking.
If self test fails on Series 39/4X/5X/6X/70 systems, the ST LED will blink slowly, and the code of the subtest that failed will be displayed for about 20 seconds.

The ST LED does not blink on cards installed on Series 37/MICRO3000 systems. If self test fails at power-on, a hexadecimal failure code is returned to the system console under the heading "Local Area Network Interface Controller". When self test is initiated from LANDIAG, failures are reported to LANDIAG (see Chapter 4).

How To Use the Self Test

Invoking Self Test

Methods of invoking LANIC card self test depends on the computer type.

LANDIAG. For all MPE-V computer systems, the self test can be invoked by LANDIAG Test #4. Refer to Chapter 4.

Power-On. For all MPE-V computer systems, self test may be manually initiated by powering on the computer.

For Series 39/4X/5X/6X/70 systems, the self test will first blink the 8 self test LEDs on and off slowly for approximately 13 seconds, after which self test will run.

For Series 37/MICRO3000 systems, self test will simply run at power up.

Reset Switch. For Series 39/4X/5X/6X/70 systems, the LANIC card contains a LANIC Test Reset Switch located on the card edge.

CAUTION

Pressing the reset switch performs a hard reset on the LANIC card before the self test is initiated. Be sure that no network activity is in progress that may be destroyed by pressing the reset switch.

To use the reset switch to run the self test, perform the following:

1. Ensure the LANIC card is not in use. Do a SHOWCOM and look for LINE UNCONNECTED, or CLOSED.

2. Open the computer card cage to observe the selftest LEDs. Note the present LED indications. If the ST LED is on, and the remaining seven LEDs are displaying a steady pattern, make a written record of which LEDs are lit. (This information may be needed later if the problem persists beyond the initial steps of troubleshooting.)

3. Press the LANIC TEST RESET switch to initiate the self test. See Chapter 3 for location of this switch.

4. Observe the selftest LEDs. Refer to Table 5-1 to interpret the various LED patterns displayed.

   If the self test completes with no errors, the selftest LED (ST/*) will be on and the LEDs H through N will be off (a code of zeros) for about five seconds. Then, the ST/* LED will go off, and LEDs H through N will perform their normal operating functions.

   If the self test fails, the code of the test that failed will be displayed by LEDs H through N and the ST/* LED will blink slowly for at least 20 seconds.

   Table 5-2 provides codes for unexpected results from the self test. If such an event occurs, the ST/* LED will be on (not blinking) and LEDS H through N will display one of the codes described in Table 5-1.

5. If the LANIC fails the self test, the failure is most likely in the LANIC card. However, failures of tests 36 (24 HEX, MAU Power) or 46 (2E HEX, external loopback) may indicate problems with the AUI, MAU, or coax. If in doubt, run the self test with a loopback hood, or use LANDIAG

Looping

Looping on the self test is useful for catching intermittent errors.

For all MPE-V systems, selftest looping can be invoked from LANDIAG, using the following command sequence:

```
> LOOP 1000
> TEST 4
> GO
```

For Series 39/4X/5X/6X/70 systems, self test may be manually looped by continuously depressing the LANIC Test Switch, such as with a clip. The looping continues until a error is detected. Self test will halt with the failed subtest number indicated by the selftest LEDs. The ST LED will blink until the switch is released.

CAUTION

If self test is run during normal LAN activity, the LANIC card and network operations will cease. Recovery may be possible in higher software levels; however, avoidance of this situation is recommended. Results of self test may be erroneous.

Observing Self Test

While the self test is cycling through its "subtests", the LEDs will display which subtest is running. Refer to the paragraphs under "How to Read Selftest LEDs", presented earlier in this chapter.

Selftest Failure

With two exceptions, replace the LANIC card if any subtests within the self test fail. The exceptions are:

- Test 36 (24 HEX, MAU Power). Applies to coaxial cable LAN connections only.

- Test 46 (2E HEX, External loopback). Requires connection to the LAN or applicable loopback connector to pass.

Failures of these two tests may require additional troubleshooting using a loopback hood and/or LANDIAG.

Table 5-1. Selftest LEDs and Subtest Descriptions

CODE										SUBTEST	DESCRIPTION
		LED INDICATION									
DEC	HEX NO.	H	I	J	K	L	M	N	*		
1	1	0	0	0	0	0	0	1	1	Z80	Instruction set
2	2	0	0	0	0	0	1	0	1	EPROM	Checksum
3	3	0	0	0	0	0	1	1	1	Station Address PROM	Checksum
4	4	0	0	0	0	1	0	0	1	High Byte Latch	
5	5	0	0	0	0	1	0	1	1	Byte RAM Data	Even addresses
6	6	0	0	0	0	1	1	0	1	Byte RAM Data	Odd addresses
7	7	0	0	0	0	1	1	1	1	Byte RAM Address	Incrementing addresses
8	8	0	0	0	1	0	0	0	1	Byte RAM Address	Decrementing addresses
9	9	0	0	0	1	0	0	1	1	Word RAM	Address tests
10	A	0	0	0	1	0	1	0	1	Word/Byte Address	Address mapping
11	B	0	0	0	1	0	1	1	1	Z80	Memory reference instructions
12	C	0	0	0	1	1	0	0	1	MDIAG register SYSCON register	Proper state after reset
13	D	0	0	0	1	1	0	1	1	CTC	Data test
14	E	0	0	0	1	1	1	0	1	CTC	Mode 0 counting
15	F	0	0	0	1	1	1	1	1	CTC	Mode 2 counting
16	10	0	0	1	0	0	0	0	1	CTC	Mode 4 counting
17	11	0	0	1	0	0	0	1	1	Interrupt PAL	Bit 4 set and cleared
18	12	0	0	1	0	0	1	0	1	Z80 interrupt	
19	13	0	0	1	0	0	1	1	1	Z80 NMI	Non-Maskable Interrupt
20	14	0	0	1	0	1	0	0	1	MHSDIS	DMA Handshake Disabled

Table 5-1. Selftest LEDs and Subtest Descriptions (continued)

CODE										SUBTEST	DESCRIPTION
DEC	HEX NO.	LED INDICATION									
		H	I	J	K	L	M	N	*		
21	15	0	0	1	0	1	0	1	1	PADDR to BADDR bus	Low 15 bits
22	16	0	0	1	0	1	1	0	1	ZBANKL register	Low Z-80 bank bit
23	17	0	0	1	0	1	1	1	1	ZBANKH register	Eight high Z-80 bank bits
24	18	0	0	1	1	0	0	0	1	Preliminary FIFO	INREADY, ADVREADY, OUTREADY
25	19	0	0	1	1	0	0	1	1	FIFO Data	BDATA(7)
26	1A	0	0	1	1	0	1	0	1	FIFO Data	BEA(7,8)
27	1B	0	0	1	1	0	1	1	1	FIFO Data	BDATA(2:6)
28	1C	0	0	1	1	1	0	0	1	FIFO Data	BDATA(0,1,13:15)
29	1D	0	0	1	1	1	0	1	1	FIFO Data	BDATA(8:12)
30	1E	0	0	1	1	1	1	0	1	FIFO Data	BA(11:15)
31	1F	0	0	1	1	1	1	1	1	FIFO Data	BA(6:10)
32	20	0	1	0	0	0	0	0	1	FIFO Data	BA(1:5)
33	21	0	1	0	0	0	0	1	1	R14	Configuration register
34	22	0	1	0	0	0	1	0	1	OBII register	Value; Channel number not 0
35	23	0	1	0	0	0	1	1	1	COMCON register	Values from reset
36	24	0	1	0	0	1	0	0	1	MAU Power	On/Off (AUI/MAU not required)
37	25	0	1	0	0	1	0	1	1	R13	CR, CR Full Bit
38	26	0	1	0	0	1	1	0	1	R15	Selftest Result register

Table 5-1. Selftest LEDs and Subtest Descriptions (continued)

CODE											SUBTEST	DESCRIPTION
		LED INDICATION										
DEC	HEX NO.	H	I	J	K	L	M	N	*		SUBTEST	DESCRIPTION
39	27	0	1	0	0	1	1	1	1		82586	Interrupt
40	28	0	1	0	1	0	0	0	1		82586	Reset
41	29	0	1	0	1	0	0	1	1		PBUS register addressing	
42	2A	0	1	0	1	0	1	0	1		82586	RAM addressing
43	2B	0	1	0	1	0	1	1	1		82586	Diagnose
44	2C	0	1	0	1	1	0	0	1		8023	Loopback
45	2D	0	1	0	1	1	0	1	1		82586	Write to FIFOs
46	2E	0	1	0	1	1	1	0	1		External loopback	Loopback to/from LAN **

where "*" is the ST (Self Test) LED

** Note: Failure of this test is normal if the LANIC card is not connected to the LAN or applicable loopback connector.

The final test in Table 5-1, the External loopback test, transmits and receives a 1148 byte frame on the LAN or loopback connector. The frame contains the following information:

Destination and Source Address fields. These fields each contain the LANIC card's 6 byte station address stored in PROM. The first 3 bytes are 00 08 09 hexadecimal, and the last 3 bytes are identifiable by the 6 hexadecimal digits labeled on the PROM.

Length field. This field consists of 2 bytes indicating the length of the Data field (in this case, 1134 bytes)

<u>Data field</u>. The data field contains data to be interpreted by the receiving node. The first 3 bytes are encoded to indicate the following:

- The frame is an IEEE 802.3 "TEST Command" frame.
- A "TEST Response" frame must be returned by the remote node.
- The command and response is handled at the IEEE 802.3 Media Access Control (MAC) layer. For HP 3000 systems, the MAC layer consists of the LANIC card and driver.

Next, the following 31 bytes of ASCII data are provided:

HP3000 NODE *xxxxxxxxxxxx* TEST

where *xxxxxxxxxxxx* is the station address in ASCII.

The remaining data consist of 1100 bytes with a binary incrementing pattern.

Table 5-2. Reporting of Unexpected Results from Self Test

CODE										
		LED INDICATION								
DEC	HEX NO.	H	I	J	K	L	M	N	*	DESCRIPTION OF FAILURE
122	7A	1	1	1	1	0	1	0	1	The 82586 failed to clear its command word.
123	7B	1	1	1	1	0	1	1	1	Selftest Result register (R15) bit 0 bad.
124	7C	1	1	1	1	1	0	0	1	Z80 stack underflow during self test.
125	7D	1	1	1	1	1	0	1	1	Unexpected Z80 Non-Maskable Interrupt (NMI).
126	7E	1	1	1	1	1	1	0	1	Unexpected Z80 interrupt.
127	7F	1	1	1	1	1	1	1	1	The LANIC was reset, but self test never started, or LED circuitry failed.

where "*" is the ST (Self Test) LED

Tracing 6

General Information

The CS/3000 Trace Facility is used to provide a record of the line actions, CS states and events that occur during Network Services operation. When problems occur during operation, the trace facility provides the means to pinpoint the problem area. For example, suppose you are experiencing a data integrity problem between two computers in your network; the information that you send to one computer isn't the same information that is being received at the other end. A trace could be enabled to monitor the data in your subsystem to try to "trap" the data transfer error when it occurs.

The trace facility is invoked by the operator with a :LINKCONTROL command. Tracing can be enabled/disabled when OPENing the line, or before or after the line is opened. Tracing can be invoked for any communication line that Network Services uses. Once invoked for a particular communications line, the trace facility continues to record line activity until the user issues a new :LINKCONTROL command with the TRACE=OFF parameter. The trace facility keeps track of actions, states and events in the form of trace entries.

The trace entries are grouped into trace records: one trace record for each CS intrinsic called by Network Services. The trace records are permanently stored in a system-generated file named LINKTxxx, or in a user-specified trace file. The contents of a CS/3000 trace file can be formatted and printed through the use of a trace dump utility program. There are two link level trace formatting programs for Network Services: CSDUMP and DSDUMP. CSDUMP does some formatting and displays all trace file data in a raw form. DSDUMP allows you to choose a subset of the trace file to be formatted, and will also analyze the chosen data. In addition, CSDUMP will display all of the bisynchronous line protocol, while DSDUMP only displays the DS protocol. The trace facility must be terminated before CSDUMP and DSDUMP can be run. Refer to the *Fundamental Data Communications Handbook* for additional information on the CSTRACE.

Linkcontrol Trace=On

LINKCONTROL TRACE=ON activates the Trace Facility, that is, link-level tracing is activated on a communication line's link.

Syntax

```
LINKCONTROL LinkName;TRACE=ON
            [;ALL] [;Mask] [;NumEntries] [;WRAP] [;FileName]
```

Parameters

LinkName	The configured name in NMMGR of an active data communications line.
ALL	Generate trace records for *all* line activity. If you omit this parameter, only I/O errors are traced.
Mask	An Octal number preceded by a percent sign, %*nnn*. The *Mask* is used to select the type of trace entries generated. Refer to Table 6-2 for a detailed description of the *Mask* parameter protocols.

Combine these values for *Mask*:

- %001 = Protocol Send Text (PSTX) entries.
- %002 = Protocol Send Control (PSCT) entries.
- %004 = Protocol Receive Text (PRTX) entries.
- %010 = Protocol Receive Control (PRCT) entries.
- %040 = Protocol State Transition (PSTN) entries.
- %100 = INP interconnect entries.
- %200 = Generate IMF (bisync only) control unit state transition entries.

numentries	The value of entries is used to derive the size of trace file record. Trace entries are deposited in a record in a circular manner. A driver dependent default of 24 will be used if the parameter is omitted. Default = 24.
WRAP	Specifies that if the trace record is full for a given CS intrinsic, previous entries are overlayed. Its absence indicates that succeeding entries will be flushed. This parameter does not affect the EOF marker of the file.
filename	Trace output will be sent to a specified file name which has been previously built. If a file name is not specified, the default destination will be LINKT*nnn*, where *nnn* is the MPE logical number of the CS device. If a trace file exists, it will be purged and a new trace file will be created.

Discussion

Refer to NS3000/V Network Manager Reference Manual (32344-90002).

Example

```
:LINKCONTROL NEWYORK;TRACE=ON,ALL,,24,WRAP,NYC000
```

Link level tracing is activated for the **NEWYORK** CS device. Records of all line activity and all trace entries, except for PSTN are generated and sent to file **NYC000** in the logon group and account. Each trace record has no more than 24 entries. Overflow entries overlay prior trace entries.

Linkcontrol Trace=Off

`LINKCONTROL TRACE=OFF` deactivates the Trace Facility.

Syntax

```
LINKCONTROL LinkName;TRACE=OFF
```

Parameters

LinkName	The configured name of an active data communications line.

Discussion

This command deactivates link level tracing on the specified communications line. The link must have been started before you can issue this command. *LinkName* is NMMGR configuration, not sysdump.

Example

:<u>LINKCONTROL NEWYORK; TRACE=OFF</u>

Link level tracing is deactivated for the `NEWYORK` LANIC.

Using CSDUMP Formatting Program

```
:RUN CSDUMP.PUB.SYS[,OCTAL][,HEX][;PARM={0|1|2}]
```

The trace dump program uses the CSTRACE file as input and produces a formatted trace listing on the LIST file.

The secondary entry point OCTAL allows you to specify that all raw data will be output in octal, otherwise it will be output in hexadecimal. (The entry point HEX, allowing you to specify hexadecimal for the output, has been retained for backward compatibility to the time when the default was octal.) If you specify PARM=0 or 1 all entries will be output by time; however, if you specify PARM=2 only CS/3000 intrinsics will be output by time.

Various conditions can cause this program to abort. These are indicated in an information error message, and in parameter values of the QUIT intrinsic shown in Table 6-1.

Table 6-1. CSDUMP Error Message Parameter

Parameter	Meaning
1	Illegal dump format request
2	Open failure on trace file
3	Open failure on list file
4	Trace file access error
5	Open failure on temporary file
6	Temporary file access error
7	List file access error

Defining a Trace File for CSDUMP

The program expects a trace file named CSTRACE. If your trace file has a different name, such as the default file name LINKTnnn, you will need to equate the trace file name to CSTRACE. Use the MPE :FILE command this way:

```
:FILE CSTRACE=LINKTnnn.PUB.SYS
```

Defining a CSDUMP Listing File

The formal file designator of the trace listing file for CSDUMP is LIST. The file may be defined as a CRT terminal, a line printer, or a disc file. To define the list file, enter an MPE :FILE command prior to initiating the CSDUMP program. Some typical examples are:

:FILE LIST;DEV=LP	LP is assumed to be the device class name for one or more line printers.
:FILE LIST=FILENAME	FILENAME is assumed to be the name of an old temporary or permanent disc file.

If a list file does not exist or is not designated by a :FILE command, and PARM of the RUN command is not 1, the CSDUMP program employs the user's session/job output device as the list file. If PARM is set to 1, then the dump program attempts to open the file LIST as an old job or system file. If this fails because LIST does not exist, then LIST is opened as a new file in the system domain. After the CSDUMP program has run, the contents of this file may be accessed via a text editor, such as EDIT/3000.

Initiation the CSDUMP Program

After the CSTRACE and LIST files have been defined, enter the following command:

```
                                     {0}
:RUN CSDUMP.PUB.SYS[,OCTAL][;PARM={1}]
                                     {2}
```

The trace dump program uses the CSTRACE file as input and produces a formatted trace listing on the LIST file. The format of the trace listing is described in the following text. If the secondary entry point OCTAL is specified when CSDUMP is run, the numeric codes for both control characters and data will be printed in octal instead of hexadecimal. If you specify PARM=0 or 1, all entries will be output by time; however, if you specify PARM=2 only CS/3000 intrinsics will be output by time.

Formatted CSDUMP Trace Listing

A CSDUMP Trace listing has a specific format. The components of a Trace listing are a header message; the beginning-of-trace message; the opening Line Information Display box; a series of trace records, each consisting of a record header and one or more consecutively numbered entries; an end-of-trace message; and the closing Line Information Display box. These components are discussed in detail on the following pages. The examples of the various components are taken from a trace of a line connected to a LANIC.

CSDUMP Listing Header Message

NOTE

Items under discussion are shaded for easy identification.

At the start of the trace listing is a header message (Figure 6-1) that tells the date and time of day when the listing was printed and the fully-qualified name of the trace file. The meanings of the two remaining items in the header message are:

Item	Meaning
LAST OPENED ON ...	This tells you the date and time of day when the trace was executed.
SYSTEM ID=v.uu.ff	This tells you the version (v), update level (uu) and the fix level (ff) of the MPE operating system that was being used when the trace was performed.

```
CS TRACE ANALYZER (B.00.23)      MON, JUN  6, 1984, 11:48 AM

TRACE FILE IS LINK36.PUB.SYS
ALL ENTRIES DUMPED BY TIME

LAST OPENED ON MON, APR 18, 1984, 11:46 AM

SYSTEM ID=00.20
```

Figure 6-1. Trace Listing Header

Begin Tracing and Line Information Messages

The BEGIN TRACING... message appears in the listing when the line to be traced is opened. The message tells you the decimal logical device number of the line (36 in the example in Figure 6-2). It indicates the line's activities are now being monitored by the trace facility. It is followed by the Line Information Display describing the state of the line when tracing started.

```
*******************************
* BEGIN TRACING FOR DEVICE 36 *
*******************************

**************************************************
*-L-I-N-E---I-N-F-O-R-M-A-T-I-O-N---D-I-S-P-L-A-Y*
**************************************************
*  LINE NUMBER: 3       LOGICAL DEV. NUMBER: 36   *
*  DEV. TYPE: 17        SUBTYPE: 3    VER: x.55.23 *
*              0123456789012345                   *
*    COPTIONS: 0000100010000010                   *
*    AOPTIONS: 0000000100001101                   *
*    DOPTIONS: 0000010000000000                   *
*  NETWORK'ID: 0000000000000000                   *
*  NUMBUFFERS: 1           BUFFSIZE: 1500 (BYTES) *
*  INSPEED: 1200000        OUTSPEED: 1200000      *
*  MISCARRAY:        RECEIVE TIMEOUT: 20    SECS. *
*                      LOCAL TIMEOUT: 60    SECS. *
*                    CONNECT TIMEOUT: 900   SECS. *
*                   RESPONSE TIMEOUT: 0    HSECS. *
*                   LINE BID TIMEOUT: 60    SECS. *
*                  NO. ERROR RETRIES: 0           *
*                CLEAR-TO-SEND DELAY: 00.0  SECS. *
*               DATA-SET-READY DELAY: DISABLED.   *
*                  TRANSMISSION MODE: DUPLEX      *
*              MMSTAT TRACE FACILITY: DISABLED    *
*  DRIVERNAME: IOLANO                             *
*  DOWNLOAD FILE: csdlan1.pub.sys                 *
*  CTRACEINFO:    ENTRIES=24      MASK=011111000  *
*                 TYPE OF TRACE = ALL, NOWRAP     *
*  PHONELIST:    ENTRIES=0        INDEX=0         *
*  IDLIST:       ENTRIES=0        INDEX=0         *
*  ERRORCODE:   RECOVERABLE=0   IRRECOVERABLE=0   *
*  MSGSENT: 1               MSGRECV: 1            *
*  RECOVERRORS: 0           IRRECOVERRORS: 0      *
**************************************************
```

Figure 6-2. Begin Tracing and Line Information Messages

The opening Line Information Display box contains detailed information on how the line was opened, how the communications controller was configured (transmission speeds, timeout values, logical device number, etc.) and trace parameters selected. In the example in Figure 6-2, we know that:

- the communications controller is an LANIC, because DEV. TYPE (device type) is 17 and DRIVERNAME is IOLANO,
- it is a synchronous, switched line (i.e., dial-up), because it is SUBTYPE 9,
- BUFFSIZE is 1500 WORDS, so the configured line buffer size is 4095,
- INSPEED and OUTSPEED (transmission speeds) are 1200000 characters per second.
- MASK is 011111000 (%37; for LANIC ignores the three zeroes on the right),
- ENTRIES=24 is the maximum number of entries in each trace record. (24 is the default.)
- ALL events will be traced
- Overflow record entries will be discarded (NOWRAP).

Trace Record and Header Message

The trace listing is organized into a series of trace records, each consisting of a series of trace entries. Every trace record pertains to a particular request.

A trace record is signified by a header message. The header message identifies the CS intrinsic call that generated the trace record. The header (see the example in Figure 6-3) shows the name of the CS intrinsic, where the intrinsic was called from the program, the calling parameters and a REQUEST ID that is the same as the REQUEST ID for the corresponding record entries.

```
************************************************************************
* CREAD                               REQUEST ID=%044347(!48E7)          *
* CALLER: SEGMENT=PRG %000            ADDRESS=%000276                    *
* STATE:  LINE STATE=DISCONNECT       COPTIONS=%004201  DOPTIONS=%002000 *
* INPUT:  IN BUF=%000000 LENGTH=0         SPEC. STATION #=0   COMP #=0   *
* OUTPUT: TRANSMISSION LOG=0              RESP. STATION #=0   COMP #=0   *
************************************************************************
```

Figure 6-3. Trace Record Header

Trace Entry Format

All entries in a trace listing contain a prefix consisting of four fields:

1. An entry number (0 in the example in Figure 6-4).
2. A "time stamp" in seconds and thousandths of seconds (17.073 in the example).
3. An entry-type mnemonic (PCMP in the example). Mnemonics are described later in this chapter.
4. A "request ID" that correlates the entry with a particular intrinsic call (%043136 in Figure 6-4).

The first entry is numbered zero, and successive entries throughout the rest of this trace record are numbered consecutively in ascending order (1, 2, 3 and so on). The "time stamp" makes it possible for you to determine the elapsed time between one trace entry and another. The mnemonic tells you what type of trace entry you are examining. There are five types of trace entries used in Network Services. They are summarized in Table 6-2 and described in greater detail on the following pages. The body of each trace entry tells you the pertinent information for the particular activity that has happened or is about to happen.

```
0         17.073 PCMP REQUEST ID=%043136(!465E)
                      ERROR CODE=0      LAST RECOVERABLE ERROR CODE= 0
                       FUNC CODE=7            LAST FATAL ERROR CODE= 0
                      #MSG SENT=1       #MSG RECV=1        STATE=CONNECTED
                      # RECOVERABLE ERR=0       # IRRECOVERABLE ERR=0
```

Figure 6-4. Sample Trace Entry

Missing Entries Message

If `MISSING ENTRIES` appears in the listing, it means that the record was not large enough to accommodate all of the trace entries and some entries were lost. If `WRAP` was not specified (`NOWRAP`), then the missing entries were at the end just before the PCMP entry; otherwise they are missing from the beginning where they were overlaid by the trace entries that extended past the end of the record. If the missing entries are crucial:

1. Purge the trace file.
2. Invoke trace again, issuing `:LINKCONTROL` with
   a. a larger *numentries* value
   b. a mask setting that will produce only those trace entries you are really interested in.

Trace Entry Mnemonics

There are five types of trace entries created by the LANIC driver. There are no conflicts with NMS tracing. A received frame will generate the following sequence of entries which are summarized in Table 6-2 and described in greater detail on the pages following this table.

Table 6-2. Trace Entry Type Mnemonics

Mnemonic	Entry Type	Definition
PRCT	Receive Control Sequence	Generated each time a control character sequence is received from the remote station. The PRCT trace entry shows (in octal or hexadecimal) the exact sequence of bytes that was received.
PSCT	Send Control Sequence	Generated each time the driver sends a control character sequence to the remote station. The PSCT trace entry shows (in octal or hexadecimal) the exact sequence of bytes that was sent.
PRTX	Receive Text	Generated each time a message is received from a remote station. The PRTX trace entry shows (in octal or hexadecimal) the exact sequence of bytes received.
PSTX	Send Text	Generated each time the driver sends a message to the remote station. The PSTX entry shows (in octal or hexadecimal) the exact sequence of bytes sent. There is one PRCT entry for every frame received.
PCMP	User Request Completed	Generated each time an I/O operation to the LANIC occurs. The PCMP trace entry summarizes the line activity, such as the number of frames sent and received and the number of errors that have occurred.

PSCT (PRCT) Trace Entries

The PSCT (PRCT), meaning "Sent (Received) Control", is really the first part of a text block. The way it works is that there is one PSCT (PRCT) entry and zero or more PSTX (PRTX), meaning "Sent (Received) Text" entries for every transmission (received) frame traced. The PSCT (PRCT) entry will contain the first 32 bytes of sent/received frame, and the remaining bytes will be included in subsequent PSTX (PRTX) entries.

The first 32 bytes of a sent (received) LANIC frame will a contain a header. An example is shown in Figure 6-5.

```
5     59.274 PRCT REQUEST ID=%043622(!4792)
                  MUI  P/F=0 DEST=0800 0900 0821    DSAP=18
                              SRC=0800 0900 1808    SSAP=18 C/R=0
                           FLOW ID=420 07D2 F40D
```

The header data will also be included, unformatted, in the raw data:

```
0 8.0 0 0 9.0 0 0 8.2 1 0 8.0 0 0 9.0 0 1 8.0 9
BS  NUL HT  NUL BS  !  BS  NUL HT  NUL CAN HT
1 8.1 8 0 4.2 0 0 7.D 2 F 4.0 D 0 3.8 5 0 8.0 0
CAN CAN EOT     BEL R  |  CR  ETX ENQ BS  NUL
0 9.0 0 1 8.0 9 0 0.2 B 1 8.1 8
HT  NUL CAN HT  NUL +   CAN CAN
```

Figure 6-5. PRCT Trace Entry

The meaning of the various items are as follows:

MUI	Mode-independent Unnumbered Information (frame type), other options are XID (exchange Identity), TEST (test), and !xx (undecodable).
P/F	Poll/Final bit (0 or 1).
DEST	This the destination address.
DSAP	Destination Service Access Point points to the proper protocol the next higher level.
SRC	This is the source address.
SSAP	Source Service Access Point points from the proper protocol of the next higher level.
C/R	Command = 0 and Response = 1.
FLOW ID	This is a unique 48-bit quantity that is not used presently.

Note that, in order to facilitate tracing, the format of the 32 byte header does not coincide with the data actually sent or received on the wire. The LANIC driver header contains data that allows the dump reader to match the link-level trace entries with higher level trace entries. The formats are provided on the next page.

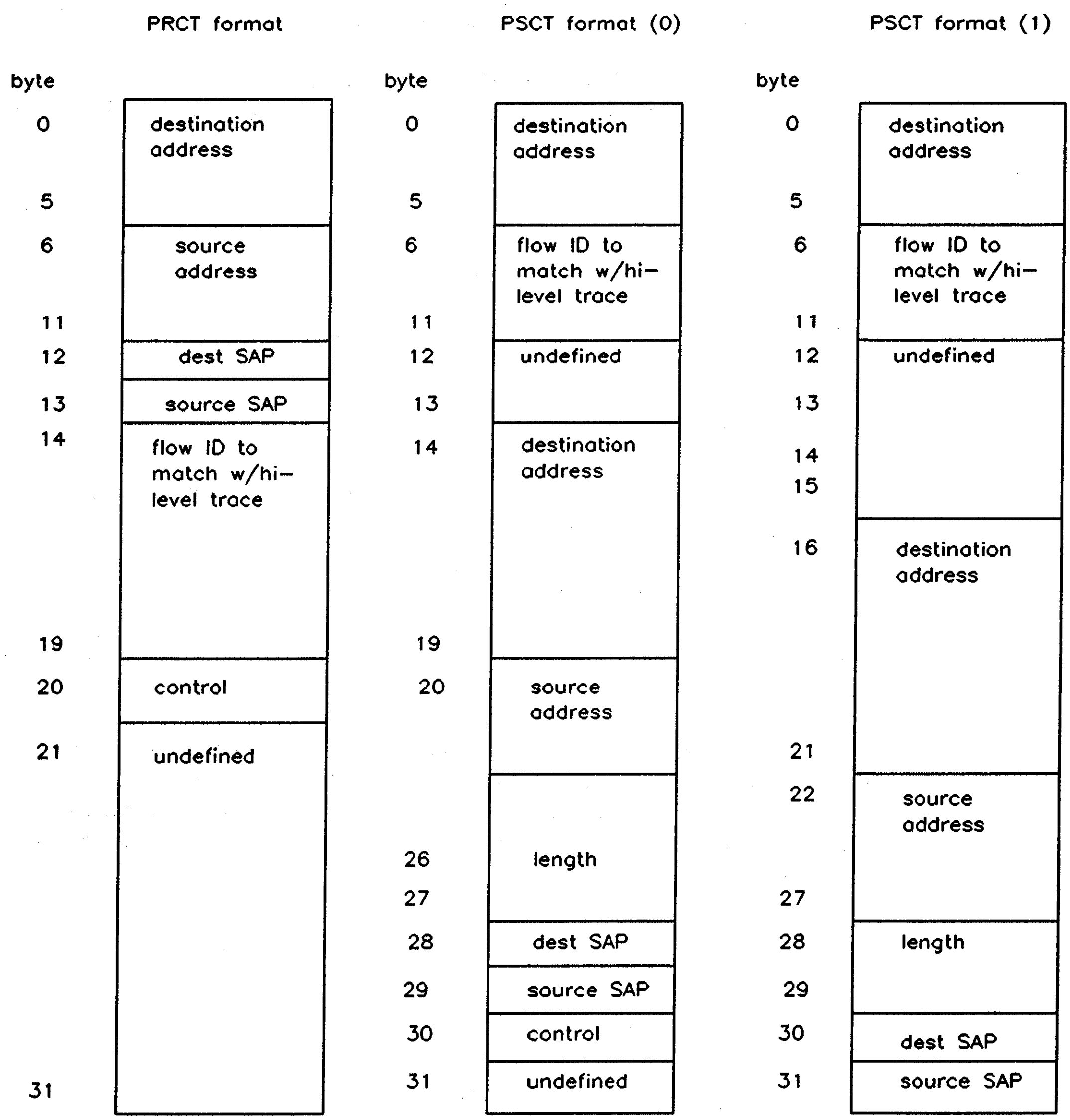


Figure 6-6. PRCT and PSCT Formats

The difference in format between the two PSCT entries is whether the user data started on an even byte [PSCT(0)] or an odd byte [PSCT(1)]. Now, in the case of PSCT format 0 (even-byte user data), the data field will begin the first byte (i.e., byte 0) of the PSTX entry immediately following the PSCT entry. The data actually transmitted onto the AUI (and therefore onto the coaxial cable) begins at byte 14, and byte 31 will be discarded before transmission.

For the PSCT format 1 (odd-byte user data) and the PRCT entries, the first PSTX/PRTX entries will contain a garbage byte (this will actually contain the control field). In this case, the data actually transmitted on to the AUI (and therefore onto the coaxial cable) begins at byte 16, and all bytes will be transmitted (no bytes are discarded before transmission).

NOTE

It is important to recognize that this byte exists in all received packets and in some transmit packets if the trace output is to be understood correctly.

PCMP Trace Entries

A PCMP trace entry is generated each time an I/O request is completed. An example is shown in Figure 6-6.

```
4       72.717 PCMP REQUEST ID=%043533(!475B)
                ERROR CODE=0      LAST RECOVERABLE ERROR CODE= 0
                FUNC CODE= 0            LAST FATAL ERROR CODE= 0
                #MSG SENT=2       #MSG RECV=2       STATE=CONNECTED
                # RECOVERABLE ERR=1      # IRRECOVERABLE ERR=0
```

Figure 6-7. PCMP Trace Entry

The meanings of the various items are as follows:

ERROR CODE: The code of the request's most recent Recoverable Error or Irrecoverable Error (see the CS trace section of the *Fundamental Data Communications Handbook* for CS error codes).

FUNC CODE: This describes the nature of the operation whose completion is being traced by the PCMP trace entry (refer to table 6-3).

MSG SENT: The total number of text messages sent so far for this connection.

MSG RECV: The total number of text messages received so far for this connection.

STATE: The line state after the completion of the user request. In the example it is in the connected state.

RECOVERABLE ERR: The total number of Recoverable Errors that have occurred so far for this connection.

IRRECOVERABLE ERR: The total number of Irrecoverable Errors that have occurred so far for this connection. Note the Last Fatal Error Code is the Last Irrecoverable Error Code.

Table 6-3. Function Codes

FUNC CODE	FUNCTION
0	READ
1	WRITE
5	CONTROL
7	INFO TRANSFER
9	HARD ABORT
66	ABORT IO

End of Trace and Line Information Messages

The `END OF TRACE....` message appears in the listing when the trace is turned off. The message tells you the decimal logical number of the line (36 in the example in Figure 6-7) and indicates that the line's activities are no longer being monitored by the trace facility. It is followed by the Line Information Display, showing the state of the line just before tracing was stopped. Note the counts of messages sent (1 in our example), messages received (1 in our example), number of recoverable errors (4 in our example), and number of irrecoverable errors (0 in our example).

```
********************************
* END OF TRACE FOR DEVICE  36  *
********************************

**************************************************
*-L-I-N-E---I-N-F-O-R-M-A-T-I-O-N---D-I-S-P-L-A-Y*
**************************************************
*  LINE NUMBER: 4      LOGICAL DEV. NUMBER: 36   *
*  DEV. TYPE: 17       SUBTYPE: 3   VER: X.55.23 *
*              0123456789012345                  *
*    COPTIONS: 0000100010000010                  *
*    AOPTIONS: 0000000100001101                  *
*    DOPTIONS: 0000010000000000                  *
*  NETWORK'ID: 0000000000000000                  *
*  NUMBUFFERS: 1          BUFFSIZE: 1500 (BYTES) *
*  INSPEED: 1200000       OUTSPEED: 1200000      *
*  MISCARRAY:         RECEIVE TIMEOUT: 20    SECS. *
*                       LOCAL TIMEOUT: 60    SECS. *
*                     CONNECT TIMEOUT: 900   SECS. *
*                    RESPONSE TIMEOUT: 0    HSECS. *
*                    LINE BID TIMEOUT: 60    SECS. *
*                   NO. ERROR RETRIES: 0           *
*                 CLEAR-TO-SEND DELAY: 00.0  SECS. *
*                DATA-SET-READY DELAY: DISABLED.   *
*                   TRANSMISSION MODE: DUPLEX.     *
*             MMSTAT TRACE FACILITY: DISABLED.   *
*  DRIVERNAME: IOLANO                            *
*  DOWNLOAD FILE: csdlan1.pub.sys                *
*  CTRACEINFO:   ENTRIES=24     MASK=011111000   *
*                TYPE OF TRACE = ALL, NOWRAP     *
*  PHONELIST:   ENTRIES=0        INDEX=0         *
*  IDLIST:      ENTRIES=0        INDEX=0         *
*  ERRORCODE:  RECOVERABLE=0   IRRECOVERABLE=0   *
*  MSGSENT: 1             MSGRECV: 1             *
*  RECOVERRORS: 0         IRRECOVERRORS: 0       *
**************************************************
END OF JOB.
```

Figure 6-8. End of Trace and Closing Line Information

CS Error Codes

Table 6-4. Code Meaning of Irrecoverable Errors

Code (Decimal)	**Meaning**
0	No error.
13	Text overflow (> 1500 bytes of user data).
52	Invalid operator.
63	No I/O found to abort.
64	Abort ignored because I/O already completed or aborted.
116	Software timeout.
117	Invalid interrupt.
120	Driver internal error.
121	Self test failure.
130	System fail, LANIC.
131	Power failure.
133	TRANSMIT: Transmit incomplete in absence of abnormal condition.
134	Fatal MAU power error.
135	MAU jabber error occurred.
153	Duplicate address.
160	An internal error detected by MPE.
201	Operation aborted.
223	RECEIVE: buffer space, ran out.

Table 6-5. Code Meaning of Recovered Errors

Code (Decimal)	Meaning
0	No error.
2	RECEIVE: frame too short, length field error, unintelligible sequence received.
3	RECEIVE: FCS error (CRC).
16	RECEIVE: overrun (DMA).
17	TRANSMIT: underrun.
121	Self test failure.
134	MAU power, recovered.
135	MAU jabber, recovered.
136	TRANSMIT: CRS on always, SQE not on always, DI not on always.
137	TRANSMIT: DI never idle, SQE not on always.
138	TRANSMIT: SQE on always, DI not on always.
139	TRANSMIT: SQE on always, DI never idle.
207	Excessive collisions.

Software Tools 7

Memory Dump

When a SYSFAIL or some other severe condition occurs, refer to the *MPE V System Operation and Resource Management Reference Manual* (32033-90005) for instructions on doing a memory dump.

NSDPAN5/NSDUMPJ

The NSDPAN5 program produces a formatted listing of main memory, based on a memory dump taken after a system failure, HALT, or other abnormal condition.

Obtaining an NSDPAN5 Listing

1. Immediately after system termination, use the Software Dump Facility (SDF) to make a main memory dump. This facility gives you the capability of storing main memory to either a serial disc, cartridge tape, or magnetic tape. It operates in a stand-alone environment after a system failure has occurred or a system halt has been performed. The SDF is described in the *MPE V System Operation and Resource Management Reference Manual* (32033-90005).

2. When the system has been restarted, enter the command:

   ```
   :STREAM NSDUMPJ.NET.SYS
   ```

This version of NSDPAN5 has several advantages:

- It is customized to show NS data structures.
- It saves virtual memory
- If the problem is in another product, this dump still applies.

LISTLOG5

LISTLOG5 analyzes files in the MPE system log file. An MPE log file records events such as session or job initiation and termination, process termination, file closure, I/O errors, and system shutdown. Refer to the *MPE V System Operation and Resource Management Reference Manual* (32033-90005) for more information on system logging.

NOTE

Refer to *NS3000/V Network Manager Reference Manual* (32344-90002) for information on NMDUMP and NMS logging.

System manager (SM) capability is needed to run `LISTLOG5`.

Log files are named by the following convention, where *nnnn* is a four-digit number:

```
LOGnnnn.PUB.SYS
```

The formal file designator of the output file is `LOGLIST`, with the default device class `LP`. `LOGLIST` is opened as new, and closed as a permanent file.

Operation of LISTLOG5

1. To find out which log files are on the system before you run LISTLOG5, enter the following:

   ```
   :LISTF LOG@.PUB.SYS
   ```

   MPE returns a list of filenames numbers for all of the log files currently on the system. These are the valid logfile numbers you can choose from when you run LISTLOG5. For example:

```
FILENAME

LOG
LOG1970     LOG1971     LOG1972     LOG1973     LOG1974     LOG1975
LOG1976     LOG1977     LOG1978     LOG1979     LOG1980
```

2. To run LISTLOG5, type:

   :RUN LISTLOG5.PUB.SYS

3. LISTLOG5 identifies itself and asks for the number of the first log file to print:

```
LISTLOG5 G.00.00 (C) HEWLETT-PACKARD CO., 1982
     ENTER FIRST AND LAST LOG FILES TO BE ANALYZED
     FIRST? 1973
```

   Enter the four-digit numbers from the list of log files. If you only want to analyze one file, enter it as the first file number and press RETURN in response to the "LAST?" prompt.

4. You are then prompted for the four-digit number of the last log file to print. Press RETURN to list only the first file.

```
LAST? 1980
```

5. LISTLOG5 now displays a numbered list of events for which histories can be printed:

TYPE NO.	EVENT
0	LOG FAILURE
1	SYSTEM UP
2	JOB INITIATION
3	JOB TERMINATION
4	PROCESS TERMINATION
5	FILE CLOSE
6	SYSTEM SHUTDOWN
7	POWER FAILURE
8	SPOOLING LOG RECORD
9	LINE DISCONNECTION
10	LINE CLOSE
11	I/O ERRORS
12	PRIVATE VOLUMES
13	PRIVATE VOLUMES
14	TAPE LABELS
15	CONSOLE LOG RECORDS
16	PROGRAM FILE EVENT
17	DCE PROVIDED INFO
18	MAINTENANCE REQUEST
19	DIAGNOSTIC CONTROL UNIT

6. At the end of the list of events, you are prompted for input with the message:

```
ENTER EVENT NUMBERS SEPARATED BY COMMAS?
A CARRIAGE RETURN ASSUMES ALL EVENTS WILL BE EVALUATED.
```

Type the event numbers and press RETURN. LISTLOG5 creates spool files of the events that you requested. There are no messages echoed back to your terminal if your request is successful. If you request is not successful, one of two messages will be displayed: 1) an error message in the format described under "ERROR CONDITIONS", or 2) a message indicating that there are no events for the log file numbers that you requested:

```
NO DESIRED EVENTS FOUND IN LOGFILE 1980
```

If events have been found for a log file, it's number will not appear in the NO DESIRED EVENTS list:

```
NO DESIRED EVENTS FOUND IN LOGFILE  1978
NO DESIRED EVENTS FOUND IN LOGFILE  1979
```

Events have been found for all other requested log files, so they do not appear in this list.

7. LISTLOG5 then asks:

```
DO YOU WANT TO PURGE LOG FILES?
```

If you answer YES, then log files are printed and then purged from the system. If you answer NO, the files are printed and also retained by the system. You are now asked if you want to return to the program; Type YES to continue with LOGLIST5, NO or N to terminate:

```
DO YOU WISH TO RUN AGAIN (Y OR N)? N
```

NMMAINT

The NM Maintenance Utility (NMMAINT) is a utility program supplied with HP 3000 LAN link products as part of the Node Management Services (NMS). NMMAINT is used to display the individual and overall version numbers for the software modules of the data communications products that use the Node Management Services (NMS). These products include the NS3000/V, SNA IMF, and SNA NRJE Network Services products as well as the SNA and LAN3000/V Network Link products.

NMS defines one or more subsystems for each of the data communications products. For the HP3000 LAN link, there are three subsystems defined: the Node Management Services, the Network Transport, and the Link Services subsystems. For NS3000/V, there is one subsystem, the Network Services. Each software module within a subsystem, such as a program file or SL segment, has its own version ID number. If the version, update, and fix levels of these modules do not match, the subsystem will not work correctly. NMMAINT can be used to determine if you have an invalid software installation or if the software modules of a subsystem are mismatched. The information provided by NMMAINT should be included in any SR submitted. Refer to the *NS3000/V Network Manager Reference Manual.*

To run NMMAINT, issue the command:

```
:RUN NMMAINT.PUB.SYS
```

NMMAINT will respond with the following:

```
32099-11018A.01.00 NM Maintenance Utility  (C) Hewlett Packard
Co. 1985
```

NMMAINT then lists the version identification numbers for each software module as well as subsystem information for each subsystem. As shown in the example below, the NMMAINT utility displays version information for the subsystems of the products actually installed on your system. The Node Management Services, Link Services, and Network Transport subsystems are displayed if the HP 3000 LAN link product is installed. The Network Services subsystem is displayed if the NS3000/V product is installed. The SNA Transport, NRJE, and IMF subsystems are displayed if the appropriate HP to IBM data communications products are installed on your system. The example shows a system with NS3000/V and the HP 3000 LAN link installed. The subsystems are always displayed in the same order, which is the Node Management Services subsystem first, followed by SNA Transport, NRJE, and IMF, then the Network Transport, Network Services, and Link Services subsystems. The last version ID number listed is the port software, `IPCVERSION`. This is not part of the NetworkIPC user service, nor does it form a subsystem as the previous sets, but its individual version ID number is displayed by NMMAINT for your information.

As described, version ID numbers include version, update, and fix levels as well as an internal fix level in the format *vuuffiii*. In the example below, where NMVERS00 is listed, its version ID number is A0100016. The A is the version level, the next two zeros represent the update level, and the following two zeros are the fix level. The remaining numbers, 016, show the internal fix level, which is used only within Hewlett-Packard.

Example

The following example shows the information displayed when you use the NMMAINT utility. A discussion follows the example.

```
:RUN NMMAINT.PUB.SYS

32099-11018A.01.00 NM Maintenance Utility  (C) Hewlett Packard Co. 1985

Subsystem version ID's

Node Management Services 32099-11018 module versions:

SL procedure:   NMVERS00                      Version:  A0100000
SL procedure:   NMVERS01                      Version:  A0100000
SL procedure:   NMLOGSLVERS                   Version:  A0100000
SL procedure:   NMLOGDATAVERS                 Version:  A0100000
SL procedure:   NMVERS04                      Version:  A0100000
SL procedure:   NMVERS05                      Version:  A0100000
SL procedure:   NMVERS06                      Version:  A0100000
SL procedure:   MCVERS                        Version:  A0100000
Program file:   NMMAINT.PUB.SYS               Version:  A0100000
Program file:   NMFILE.PUB.SYS                Version:  A0100000
Program file:   NMLOGMON.PUB.SYS              Version:  A0100000
Program file:   NMMGR.PUB.SYS                 Version:  A0100000
V+ forms file:  NMMGRF.PUB.SYS                Version:  A0100000
Program file:   NMMGRVER.PUB.SYS              Version:  A0100000
Program file:   NMDUMP.PUB.SYS                Version:  A0100000
Catalog file:   NMCAT.PUB.SYS                 Version:  A0100000

Node Management Services 32099-11018 overall version = A.01.00
```

(Continued on Next Page)

```
Network Transport Module Versions :

Program File : NETCP.NET.SYS                    Version: A0000000
Program File : NETSERVE.NET.SYS                 Version: A0000000
Program File : SOCKREG.NET.SYS                  Version: A0000000
Program File : NETMSG.NET.SYS                   Version: A0000000
Message File : NET'SM4'VERS                     Version: A0000000
SL Procedure : NET'UI'VERS                      Version: A0000000
SL Procedure : NET'SL'VERS                      Version: A0000000
SL Procedure : NET'NI'VERS                      Version: A0000000
SL Procedure : NET'PROBE'VERS                   Version: A0000000
SL Procedure : NET'TCP0'VERS                    Version: A0000000
SL Procedure : NET'TCP1'VERS                    Version: A0000000
SL Procedure : NET'PXP0'VERS                    Version: A0000000
SL Procedure : NET'PXP1'VERS                    Version: A0000000
SL Procedure : NET'IP'VERS                      Version: A0000000
SL Procedure : NET'IPU'VERS                     Version: A0000000
SL Procedure : NET'PD'VERS                      Version: A0000000
SL Procedure : SOCKIOVERS                       Version: A0000000
SL Procedure : SOCKACCESSVERS                   Version: A0000000
SL Procedure : SOCKMISC1VERS                    Version: A0000000
SL Procedure : SUBSYS3FMTVERS                   Version: A0000000
SL Procedure : SUBSYS5FMTVERS                   Version: A0000000
SL Procedure : TRIGVERS                         ** Not Installed

Network Transport Overall Version : A.00.00


Network Services HP32344 individual module versions:

SL procedure:   ASCXVERS                         Version:   A0000000
SL procedure:   ASBUFVERS                        Version:   A0000000
SL procedure:   ASENVVERS                        Version:   A0000000
SL procedure:   DSUTILVERS                       Version:   A0000000
SL procedure:   ASRFAVERS                        Version:   A0000000
SL procedure:   VTSVERS1                         Version:   A0000000
SL procedure:   VTSVERS2                         Version:   A0000000
SL procedure:   ASPTOPVERS                       Version:   A0000000
SL procedure:   ASRPMVERS                        Version:   A0000000
SL procedure:   SUBSYS6FMTVERS                   Version:   A0000000
Program file:   DSDAD.NET.SYS                    Version:   A0000000
Program file:   DSSERVER.NET.SYS                 Version:   A0000000
Program file:   IOVTERMO.PUB.SYS                 Version:   A0000000
Program file:   NFT.NET.SYS                      Version:   A0000000

Network Services HP32344 overall subsystem version:   A.00.00
```

```
LINK SERVICE Subsystems VERSION      module versions:

SL procedure:   TRAN'VERS0                    Version:  B0206000
SL procedure:   TRAN'VERS1                    Version:  B0206000
SL procedure:   BFMICSVERS                    Version:  B0206000
SL procedure:   BFMVERS                       Version:  B0206000
SL procedure:   SUBSYS8FMTVERS                Version:  B0206000
SL procedure:   LINKVERS                      Version:  B0206000
Program file:   LINKMGR.PUB.SYS               Version:  B0206000

LINK SERVICE Subsystems VERSION      overall version = B.02.06
SL Procedure:   IPCVERSION          Version:  B0204000
```

In the previous example, the first group of numbers listed are the version ID numbers of the modules of the Node Management Services subsystem, part of the HP 3000 LAN link. Notice that the first five characters of the version for each module listed in this group are A0100. This means that all the software modules in the subsystem match. This must be true for all the modules of a given subsystem. If a subsystem module is invalid, the following error message is printed:

```
Program file:  NMMAINT.PUB.SYS              ** MODULE ERROR **
ONE OR MORE SUBSYSTEM MODULES ARE INVALID.  (NMERR 105)
```

This message indicates that the modules of the subsystem are not compatible. Because the module version ID numbers match, NMMAINT displays the overall subsystem version number for NMS as A.01.00. The rest of the subsystems are handled in a similar fashion.

NMMAINT also checks that all the modules that belong with a particular subsystem are present. If a module is missing, NMMAINT displays the name of the module with the following error message in place of the version number.

```
SL procedure:  NMVERS01                        **  REQ'D MODULE MISSING
ONE OR MORE REQUIRED SUBSYSTEM MODULES ARE MISSING.    (NMERR 104)
```

If this is a new software installation, check your installation procedure.

If the modules were correct when installed, only unusual circumstances, such as a reload, a disc problem, or a system failure, result in missing or invalid modules. Restore a known valid version of such modules. Refer to the *NS3000/V Network Manager Reference Manual.*

The missing module may be optional. For example:

```
SL Procedure : TRIGVERS                          **Not installed
```

This module, TRIGVERS, is not normally present on the system. It is only installed by an HP system engineer if needed for troubleshooting.

Question marks in the overall version number indicate that the fix levels of the individual modules do not match. Remember that the internal fix level, represented by the last three numbers of the version ID, does not need to match between modules for the software to be compatible; therefore it may be disregarded. The fix numbers are requested for Service Requests; it makes a considerable difference to HP when troubleshooting.

As each subsystem is displayed, NMMAINT checks that all the modules are present and compatible with each other. However, NMMAINT does not perform any cross-subsystem version verification. When a system has HP to IBM products as well as HP to HP products installed, you need to be aware of the fact that the Node Management Services, the Link Services, and the port software are used by both types of data communications products. Therefore, it is important to check that the version numbers of these common subsystems and port software modules are correct. It is possible for the HP to IBM products to use previous versions of the common software that are not compatible with the HP to HP products. For more information, refer to the *NS3000/V Network Manager Reference Manual.*

NMMAINT only displays information on the subsystems for the products that are installed on your system. Thus, the NMMAINT display from different systems may vary, depending on which products are installed on the system. In the example above, the SNA Link, SNA NRJE, and SNA IMF products were not installed, so the the SNA Transport, NRJE and IMF subsystems were not displayed.

CSLIST

The Communications Systems (CS/3000) subsystem consists of the software modules used for link management and diagnostics. It is used by all HP data communications network link products, including the HP 3000 LAN link and the DS Compatible Links. The CSLIST utility lists the version numbers for the software modules of the CS subsystem. CSLIST also provides detailed information on the INP and LANIC download files on your system. *The information provided by CSLIST must be included in any Service Request submitted to HP.* Refer to the *NS3000/V Network Manager Reference Manual.*

Example 1 shows how to run CSLIST.

Example 1

```
:RUN CSLIST.PUB.SYS

HP30131A.55.25 CSLIST/3000  SUN, MAR 17, 1984, 9:05 AM
(C) HEWLETT-PACKARD CO. 1980

THIS ROUTINE HAS TWO MAJOR FUNCTIONS - ONE ASSOCIATED WITH
THE CS MODULES AND ONE ASSOCIATED WITH THE DOWNLOAD FILES.

THE FIRST PORTION REPORTS THE CS MODULES INSTALLED
ON THE SYSTEM.
NOTINSTD INDICATES THE MODULE HAS NOT BEEN INSTALLED ON THE SYSTEM.

CSLIST ALSO ALLOWS THE USER TO OBTAIN INFORMATION
CONCERNING THE HP-STANDARD DOWNLOAD FILES.
THIS INFORMATION INCLUDES PROTOCOL TYPE, BOARD TYPE,
COMPILE DATE, AND VERSION NUMBER INFORMATION.

DO YOU WANT A COMPLETE LISTING OF INSTALLED VUFS? YES

DO YOU WANT THE DOWNLOAD FILE INFORMATION?  NO

SHOULD OUTPUT BE DIRECTED TO THE LP? YES
```

After the the RUN command for CSLIST is issued, CSLIST displays a header and a description, followed by a series of prompts. In the first example, the user requested a complete listing of the CS module version numbers, without the download file information, and specified that the output should be directed to the lineprinter (device LP).

Example 2 shows a typical listing of CS modules produced by CSLIST.

Example 2

```
HP30131v.uu.ff CSLIST/3000  SUN, MAR 17, 1985, 9:05 AM
(C) HEWLETT-PACKARD CO. 1980

COMPLETE LISTING OF INSTALLED VUFS NOW BEING PRODUCED.
OUTPUT GOING TO DEVICE LP.

COMSYS1     INSTALLED VUF IS v.uu.ff
COMSYS2     INSTALLED VUF IS v.uu.ff
COMSYS3     INSTALLED VUF IS v.uu.ff
COMSYS4     INSTALLED VUF IS v.uu.ff
COMSYS5     INSTALLED VUF IS v.uu.ff
CSUTILITY   INSTALLED VUF IS v.uu.ff
CSDUMMY     INSTALLED VUF IS v.uu.ff
CSDUMP      INSTALLED VUF IS v.uu.ff
TRACPROG    INSTALLED VUF IS v.uu.ff
IOINPO      INSTALLED VUF IS v.uu.ff
DSM         INSTALLED VUF IS v.uu.ff
INPDPAN     INSTALLED VUF IS v.uu.ff
NETCONF     INSTALLED VUF IS v.uu.ff
CSLIST      INSTALLED VUF IS v.uu.ff
IOLANO      INSTALLED VUF IS v.uu.ff
LANDPAN     INSTALLED VUF IS v.uu.ff
LANDIAG     INSTALLED VUF IS v.uu.ff
```

In the first example, the download file information was not selected. Since CSLIST lists information on all of the download files for all of the HP 3000 products installed on your system, requesting the download file information may produce a lengthy listing.

The alternative, recommended if you want to check a specific download file, is to use CSLIST with an entrypoint. The entrypoint, either LAN or INP, is appended to the run command, as shown in Example 3 below. When you use CSLIST with an entrypoint, CSLIST displays an abbreviated description and prompts for the download file for which you need information.

Example 3

```
:RUN CSLIST.PUB.SYS,LAN


CSLIST ALLOWS THE USER TO OBTAIN INFORMATION
CONCERNING USER-SPECIFIED DOWNLOAD FILES.  THIS
INFORMATION INCLUDES PROTOCOL TYPE, BOARD TYPE,
COMPILE DATE, AND VERSION NUMBER INFORMATION.

SHOULD OUTPUT BE DIRECTED TO THE LP?

DOWNLOAD FILE NAME =CSDLAN1.PUB.SYS

LAN DOWNLOAD FILE = CSDLAN1.PUB.SYS
LAST MODIFIED WED, NOV 21, 1984,  9:41 AM
DRIVER OPTIONS = %000000
DATE CODE = B.00.014.077

DOWNLOAD FILE NAME =CSDLAPB2.PUB.SYS

DOWNLOADFILE= CSDLAPB2.PUB.SYS              PROTOCOL TYPE=  X.25
BOARD TYPE=  INP 20B  COMPILE DATE= WED, JUL 4, 1984,  6:26 PM
      IC VERSION = 01.02
PROTOCOL VERSION = 01.04
   TRACE VERSION = 02.06
   RAMCP VERSION = 05.04

DOWNLOAD FILE NAME =CSDBSC2.PUB.SYS

DOWNLOADFILE= CSDBSC2.PUB.SYS               PROTOCOL TYPE= BISYNC (DS,RJE,X.21)
BOARD TYPE=  INP 20B  COMPILE DATE= THU, OCT 25, 1984,  1:56 PM
      IC VERSION = 01.02
PROTOCOL VERSION = 01.11
   TRACE VERSION = 02.06
   RAMCP VERSION = 05.05

DOWNLOAD FILE NAME =

END OF PROGRAM
```

The download files specified in Example 3 were for a LAN link (LANIC), a Point-to-Point Link (INP), and an X.25 Link (INP). Notice that CSLIST provided information on all three download files, even though two are for the INP.

DSLIST

For the modules of the DS Services subsystem of NS3000/V, and for any of the DS Compatible Links installed on your system, use the DSLIST program installed in the PUB group of the SYS account to obtain a list of the versions of the software modules.

In the DSLIST display, shown in the example below, notice that most of the modules are grouped under a product number heading. There is also a common module heading for the utilities, including this one, that apply to all the DS compatible links.

All modules shown, except those for DSN/X.25, should be displayed on your system. The DSN/DS HP32189B modules are used by the Point-to-Point Links and by the DS Services subsystem of NS3000/V. The DSN/X.25 HP32191B modules are installed with the X.25 Network Link; they only appear if an X.25 Link is installed on your system. The CS HP30131A modules show a subset of the display provided by CSLIST. The COMSYS module is an overall version number for the CS modules. The NETCONF module is the utility used for the network configuration of the X.25 Network Link, described in the *DSN/X.25 for the HP 3000 Reference Manual.*

It is essential that:

- all the DS software modules installed on the system have the same version identification;
- all the X.25 software modules (if installed) have the same version; and,
- all the common and CS modules have the same version

in order to ensure successful operation. The information provided by DSLIST should be included in any SR submitted. Refer to the *NS3000/V Network Manager Reference Manual.*

Example

```
:RUN DSLIST.PUB.SYS

HEWLETT PACKARD 32189v.uu.ff DSLIST/3000 SUN, MAR 17, 1985,  7:07 PM

DSN/DS HP32189B:
   MODULE      VERSION
SL DSSEGS      v.uu.ff, INTERNAL FIX xxx
SL DSRTECALL   v.uu.ff, INTERNAL FIX xxx
   DSMON       v.uu.ff, INTERNAL FIX xxx
   DSTEST      v.uu.ff, INTERNAL FIX xxx
   DS2026      v.uu.ff, INTERNAL FIX xxx
   DS2026CN    v.uu.ff, INTERNAL FIX xxx
   DSCOPY      v.uu.ff, INTERNAL FIX xxx
   IODS0       v.uu.ff, INTERNAL FIX xxx
   IODSTRM0    v.uu.ff, INTERNAL FIX xxx
   IODSTRMX    v.uu.ff, INTERNAL FIX xxx

DSN/X.25 HP32191B:
   MODULE      VERSION
   DSMONX      v.uu.ff, INTERNAL FIX xxx
   IODSX       v.uu.ff, INTERNAL FIX xxx
   IOPAD0      v.uu.ff, INTERNAL FIX xxx
   IOPAD1      v.uu.ff, INTERNAL FIX xxx

COMMON MODULES:
   MODULE      VERSION
SL DSIOM       v.uu.ff, INTERNAL FIX xxx
   DSDUMP      v.uu.ff, INTERNAL FIX xxx
   DSLIST      v.uu.ff, INTERNAL FIX xxx

CS SUBSYSTEM HP30131A:
   MODULE      VERSION
SL COMSYS      v.uu.ff, INTERNAL FIX xxx
   NETCONF     v.uu.ff, INTERNAL FIX xxx

END OF PROGRAM
:
```

In the example, both Point-to-Point and X.25 Network Links were installed on the system. If X.25 was not installed, the DSLIST program would display a message "NOT INSTALLED" under the DSN/X.25 HP32191B heading, and the CS module NETCONF would not be displayed.

Troubleshooting Flowcharts A

Introduction

This appendix suggests some procedures, in flowchart format, for use in troubleshooting your IEEE 802.3 LAN link. These procedures can help you find a faulty field replaceable unit (FRU).

A LAN comprised of HP 3000 MPE-V based nodes is presumed. For a more general IEEE 802.3 LAN troubleshooting approach, refer to the *LAN Link Hardware Troubleshooting Manual* (Coaxial Cable LANs), 5955-7681 (HP CE Handbook version 5959-2217), or the *HP StarLAN Diagnostics and Troubleshooting Manual for PCs*, 50906-90060.

Figure A-1 is an overview of the procedures, followed by the following:

- the troubleshooting flowcharts,
- supplemental Remote Note Testing information, and
- Use of "Software Line Tests".

The troubleshooting procedures can be modified as the conditions require. Experienced users may wish to alter the sequence (or actual implementation) of each procedure, especially for obvious faults. However, because each path in the procedures depends on previous outcomes, deviating from the procedures may cause troubleshooting errors that can be misleading.

NOTE

Recall that the LAN Node Diagnostic (LANDIAG) Test 16, Hood Loopback Test, does not apply to HP StarLAN connections. For StarLAN connections, refer to LANDIAG Test 14 (see Chapter 4).

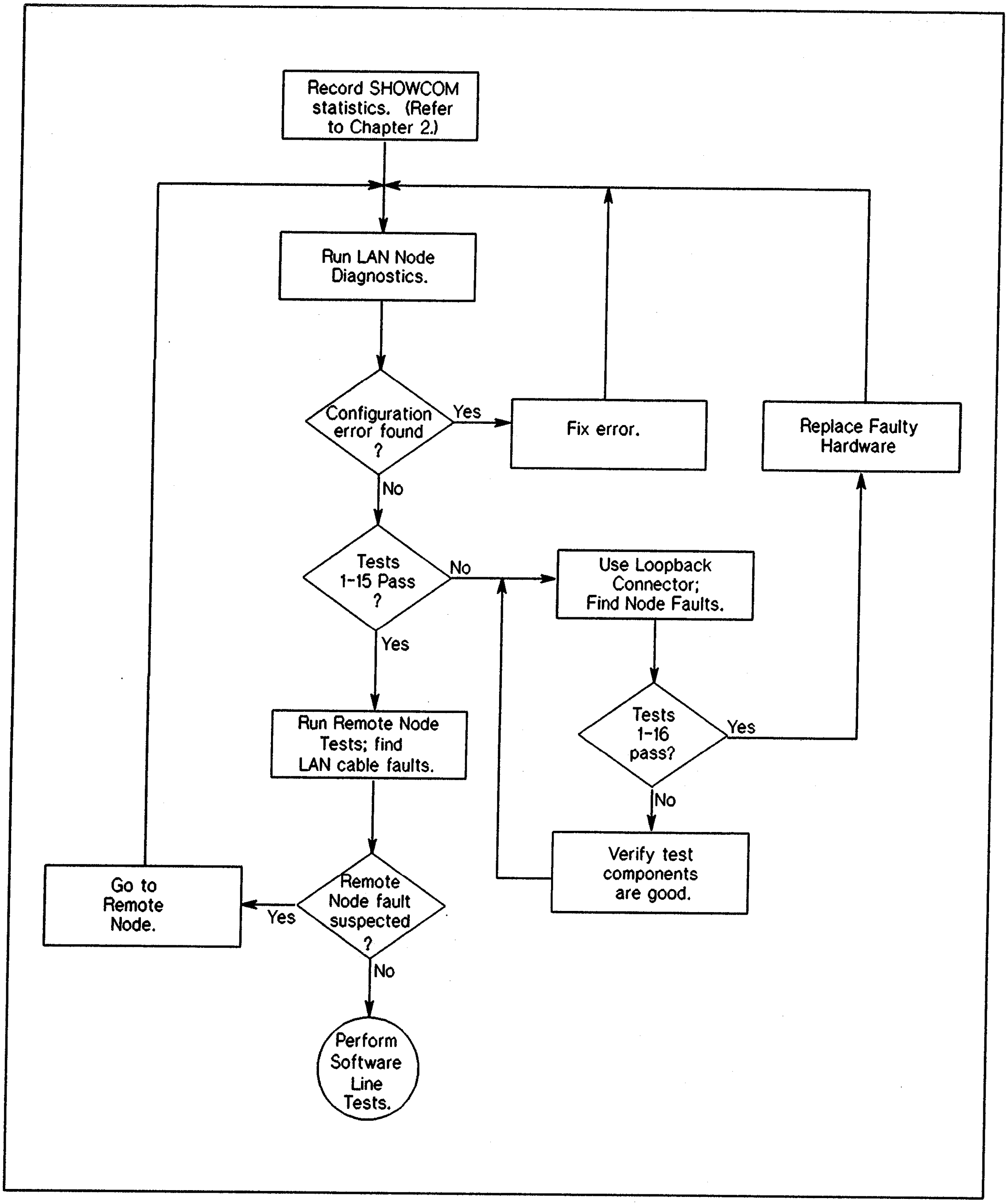


Figure A-1. Hardware Troubleshooting Overview

LAN Node Diagnostic Flowcharts

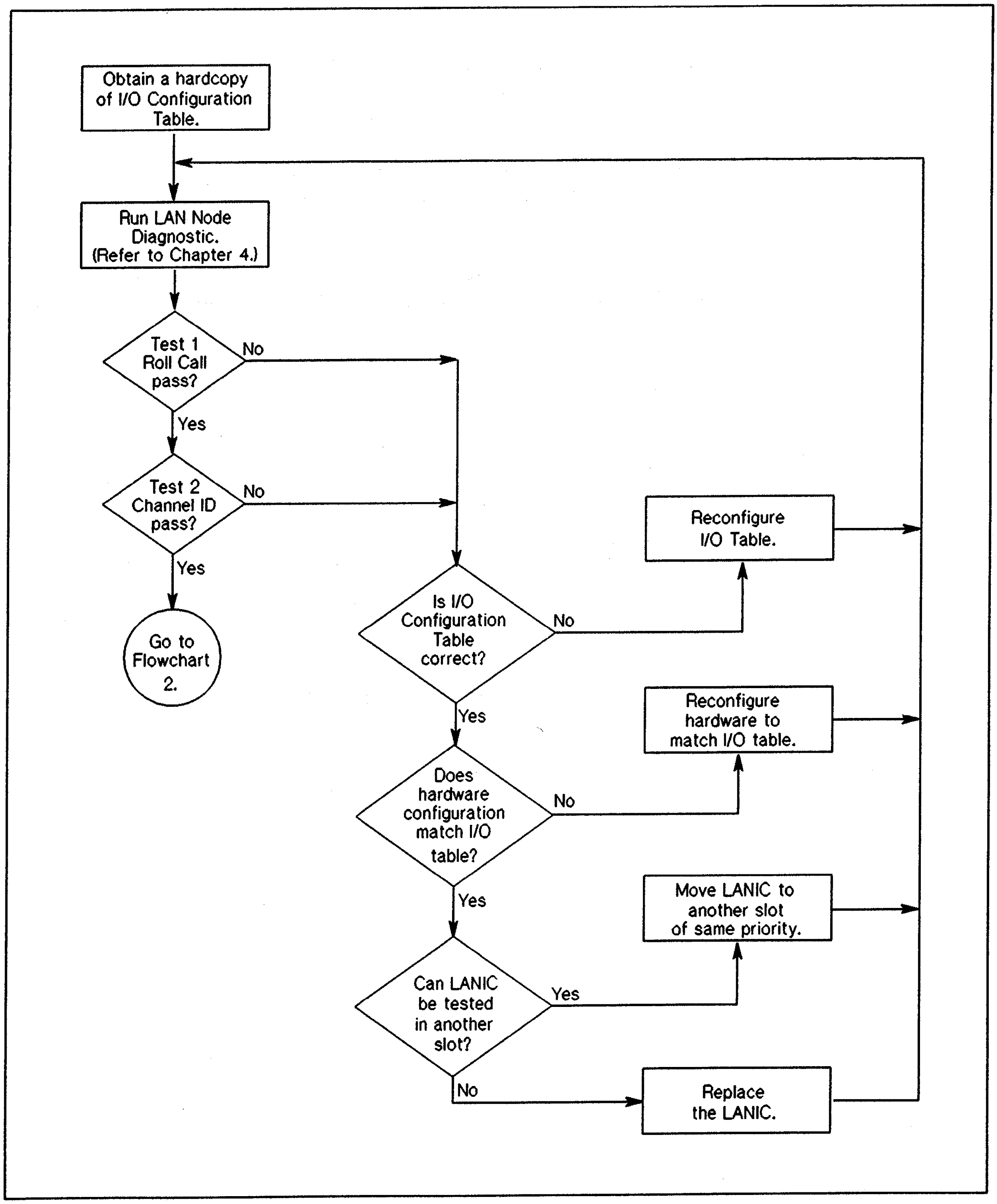
The troubleshooting flowcharts are presented on the following pages. Start with Flowchart 1.

Flowchart 1

The first task involves determining if the configuration table and hardware match. For example, there is a possibility that the I/O configuration table for the LANIC card may have been entered wrong or the wrong LDEV was specified.

Refer to Chapter 4 for details on running the LAN Node diagnostic.

On successful completion of this flowchart, you should be confident that the host has confirmed a responding channel exists at the specified LDEV, and that it is a LANIC card. Refer to the *NS3000/V Network Manager Reference Manual* for information about verification of Network (NMMGR) configuration.



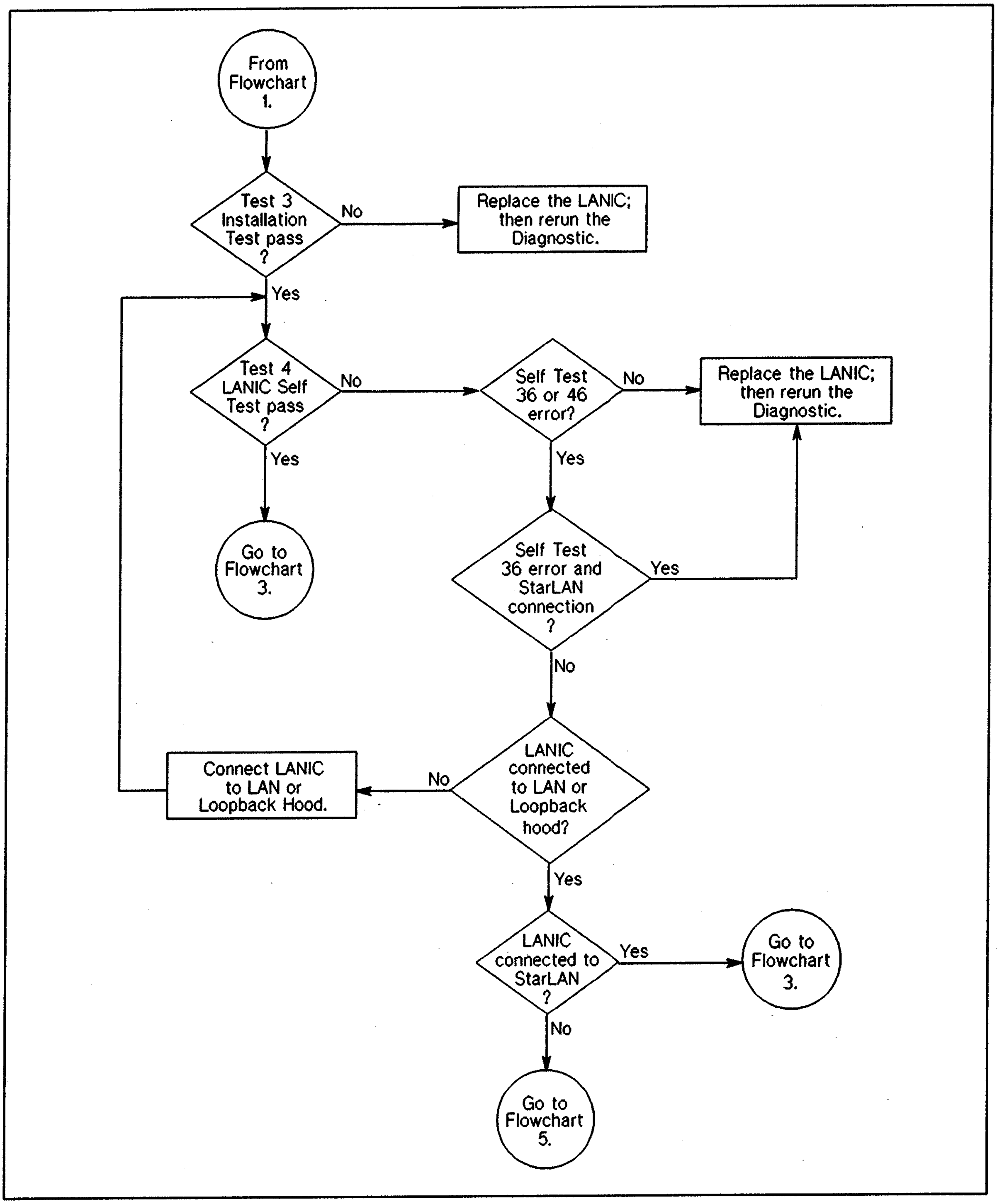
Flowchart 1. Verification of System and Hardware Configuration

Flowchart 2

Flowchart 2 determines whether or not the LANIC card can be initialized, and verifies that most of the LANIC card is operating properly. The LANIC card self test is used. For more information on self test, refer to Chapter 5.

A selftest failure does NOT always imply a faulty LANIC card. For successful selftest completion, the card must be connected to the LAN, or loopback connector.

If Flowchart 2 yields no faults, you can be confident that the LANIC card can be initialized, and the microprocessor and LAN connection appear to operate properly.



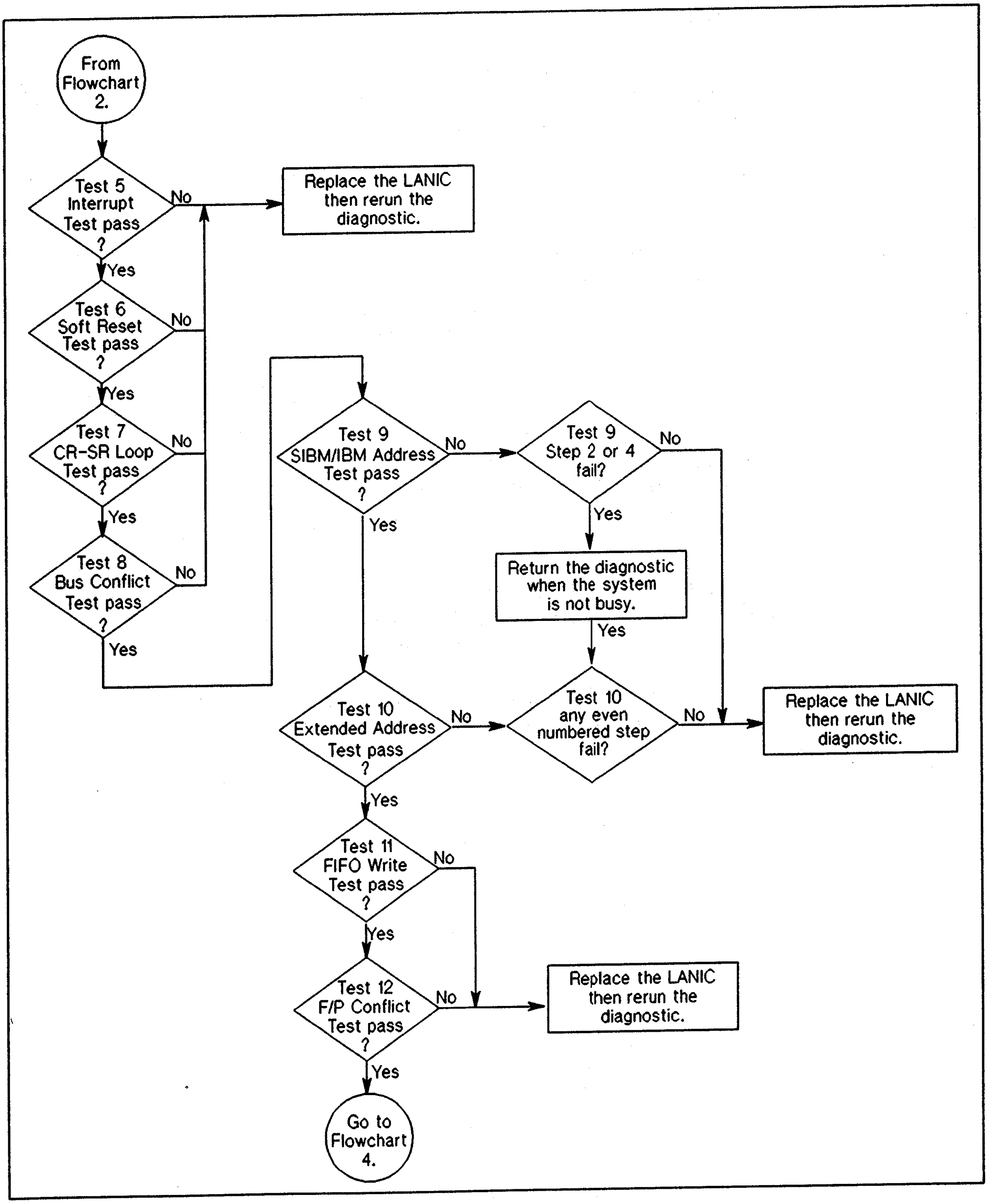
Flowchart 2. LANIC Initialization and Main Module Verification

Flowchart 3

Flowchart 3 verifies operation of the LANIC card to SIMB/IMB interface. A subtle dependency exists between system operation and test execution. Refer to detailed descriptions of LANDIAG Tests 9 and 10 if these tests fail (see Chapter 4).

If Flowchart 3 successfully passes, the following are true:

- the HP 3000 can communicate with the LANIC,
- the LANIC card responds as expected, and
- the LANIC can correctly access system memory for DMA processes.



Flowchart 3. Interrupt, Soft Reset, and SIMB/IMB Interface Verification

Flowchart 4

In Flowchart 4, LANDIAG evaluates that portion of the node directly related to communications on the LAN. Specifically, the LAN coprocessor, card-to-LAN interface, and LAN attachment hardware are exercised.

Other LAN features tested during self test include:

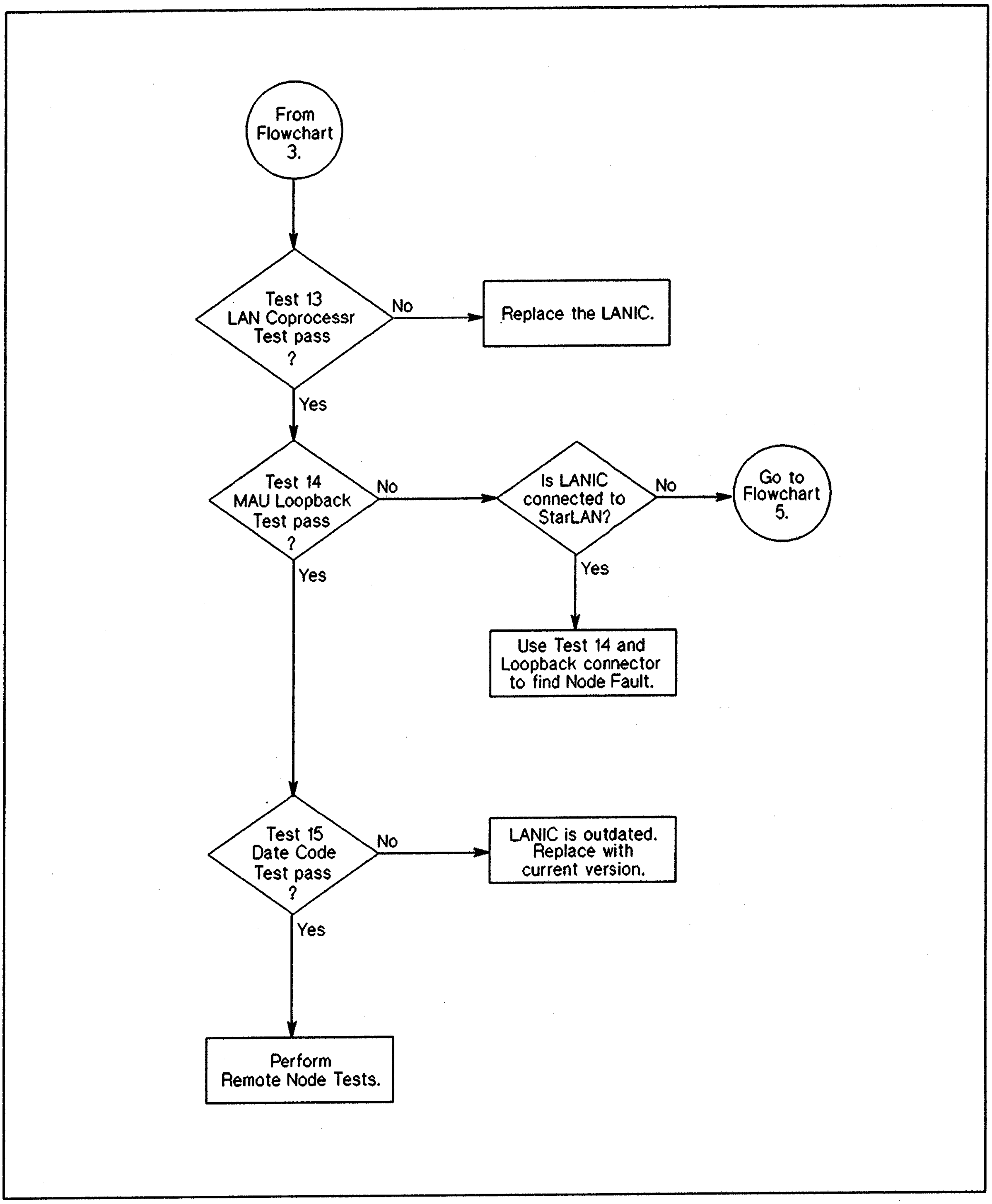
1. multicast addressing
2. CRC generation/detection
3. MAU/ThinMAU jabber protection (coaxial cable connections only)
4. SQE disable operation (coaxial cable connections only)
5. heartbeat detection (coaxial cable connections only)

If Flowcharts 1 through 4 pass with no faults indicated, the node hardware is presumed good.

However, marginal hardware faults may still exist, especially for coaxial LAN connections. These include MAU/ThinMAU faults that are difficult to detect by simply by bouncing test frames off the LAN cable.

Marginal faults generally result in network performance degradation. For example, slight collision detect circuitry faults may cause frame check sequence (FCS) errors, Or, a weak MAU/ThinMAU transmitter or receiver may result in frames not being received by the intended node.

The remaining flowcharts (Flowcharts 5 through 9) are intended to help find marginal faults on coaxial cable LAN connections.



Flowchart 4. LAN Coprocessor, Loopback and Date Code Verification

Flowchart 5

NOTE

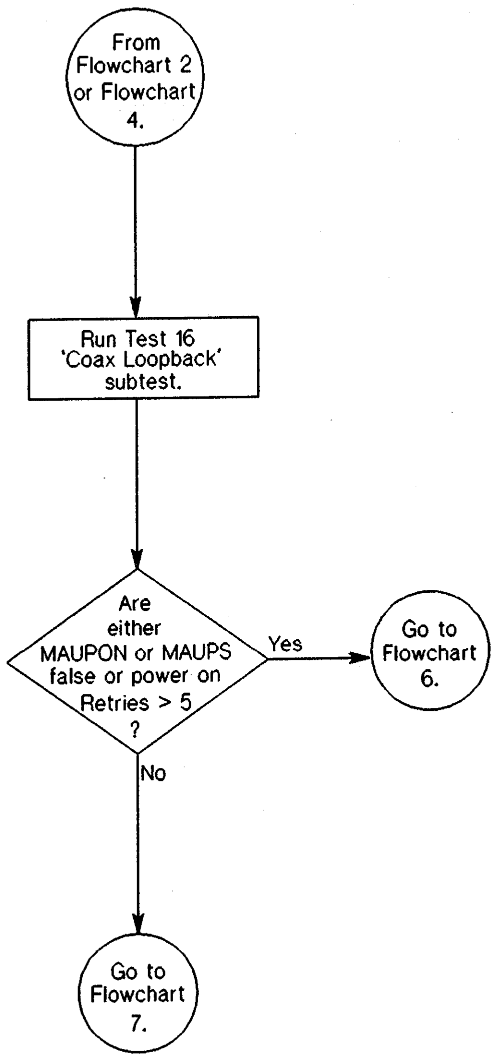
Flowcharts 5 through 9 employ LANDIAG Test #16 and apply to coaxial cable LAN connections only.

Flowchart 5 implements LANDIAG Test #16 to directly or indirectly check the following hardware:

1. LANIC card,
2. LANIC card cable (internal AUI for Series 39/4X/5X/6X/70 systems),
3. AUI cabling,
4. MAU/ThinMAU,
5. Coaxial cable and associated hardware (Tap/BNC Tee connectors, barrels, connectors, terminators, etc.).

For running Test 16, use of a known good loopback hood and MAU/ThinMAU is required. A loopback hood and MAU/ThinMAU can be verified as known good by testing them on a good node. Refer to Chapter 4 for the use of Test 16.

Flowchart 5 checks for "MAU power-on" errors arising from Test 16, and directs the user to the next flowchart, as appropriate.



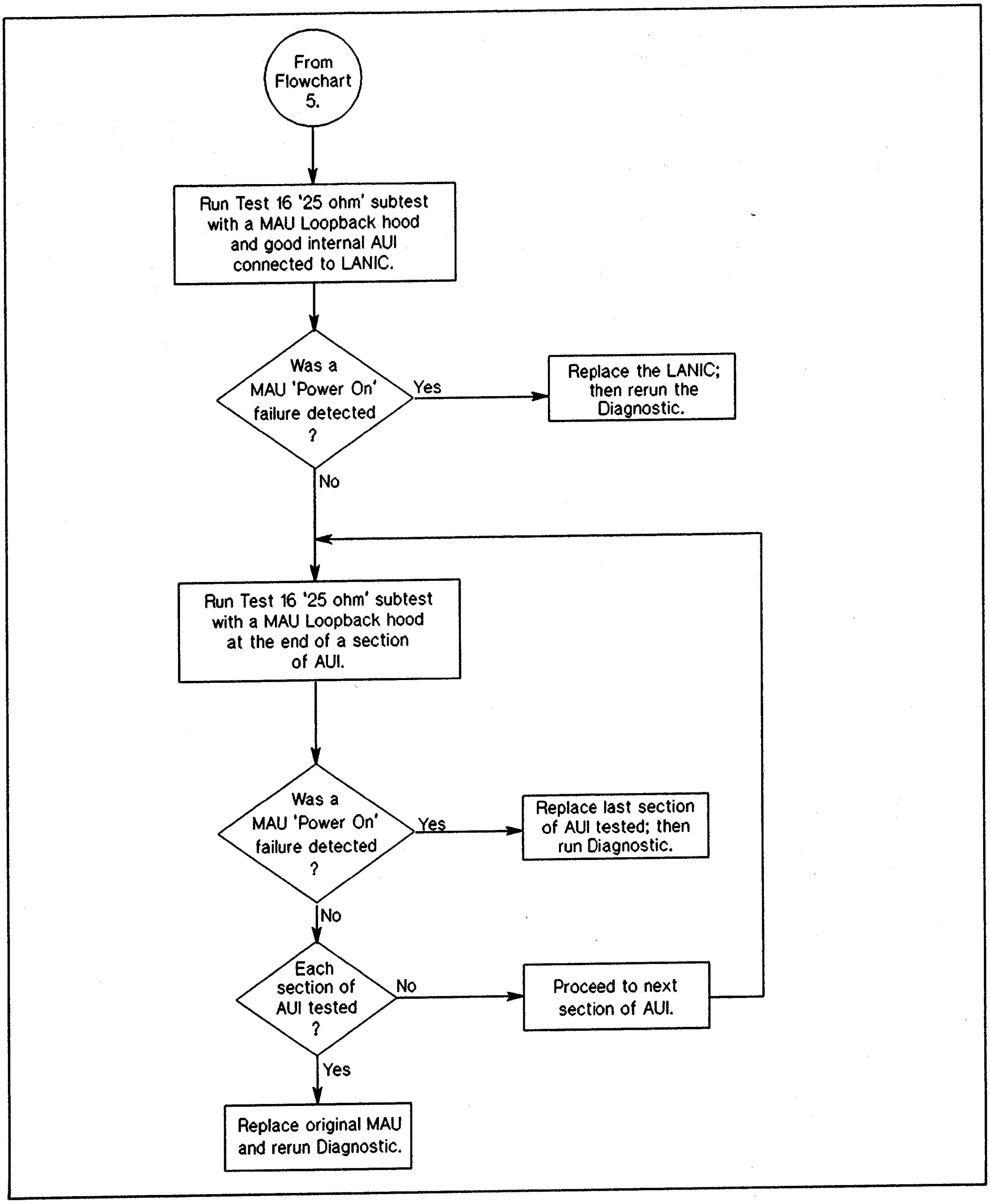
Flowchart 5. Identifying Failed FRU in Hood Loopback Test

Flowchart 6

If MAU/ThinMAU power-on errors occur, or power-on attempts are excessive (more than 5), the following hardware may be faulty:

1. LANIC card
2. Internal cable short circuits (Series 39/4X/5X/6X/70 systems only),
3. AUI cable short circuits,
4. MAU/ThinMAU.

Flowchart 5 provides steps to identify faulty hardware.

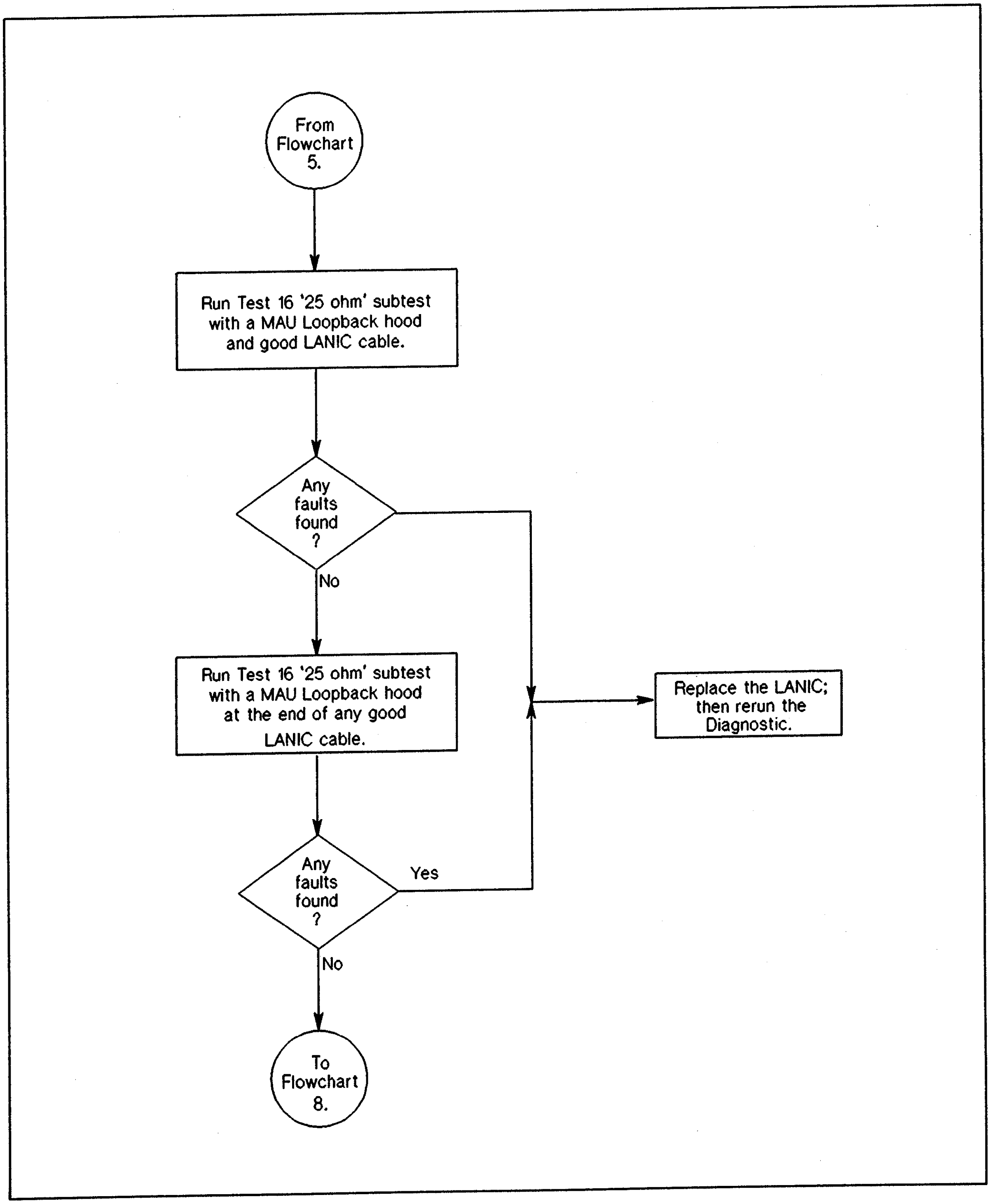


Flowchart 6. Identifying MAU/ThinMAU Power-On Faults

Flowchart 7

Flowchart 7 checks the ability of the LANIC card to transmit and receive packets on the LAN cable by using a known good loopback hood and MAU/ThinMAU.

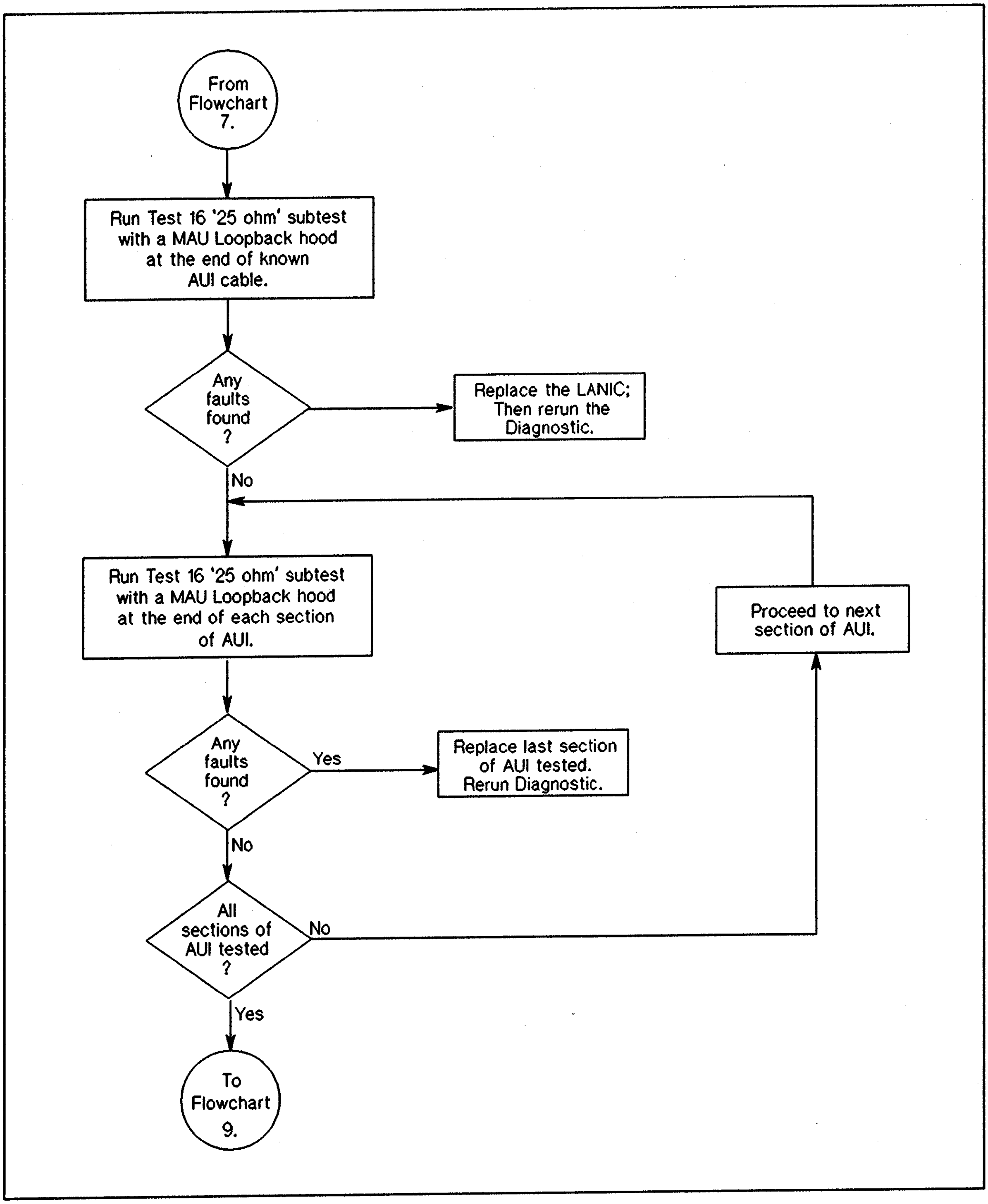
Note that both "25 ohm" and "50 ohm" subtests are performed. The "50 ohm" subtest verifies collision detection operation. This is important because the inability of a node to detect collisions can cause serious degradation of network performance.



Flowchart 7. Testing Coax LAN Connection AUI Interface

Flowchart 8

Flowchart 8 systematically checks each AUI cable connecting the LANIC card to the LAN. Only the '25 ohm' test is used.



Flowchart 8. Testing AUI Cables

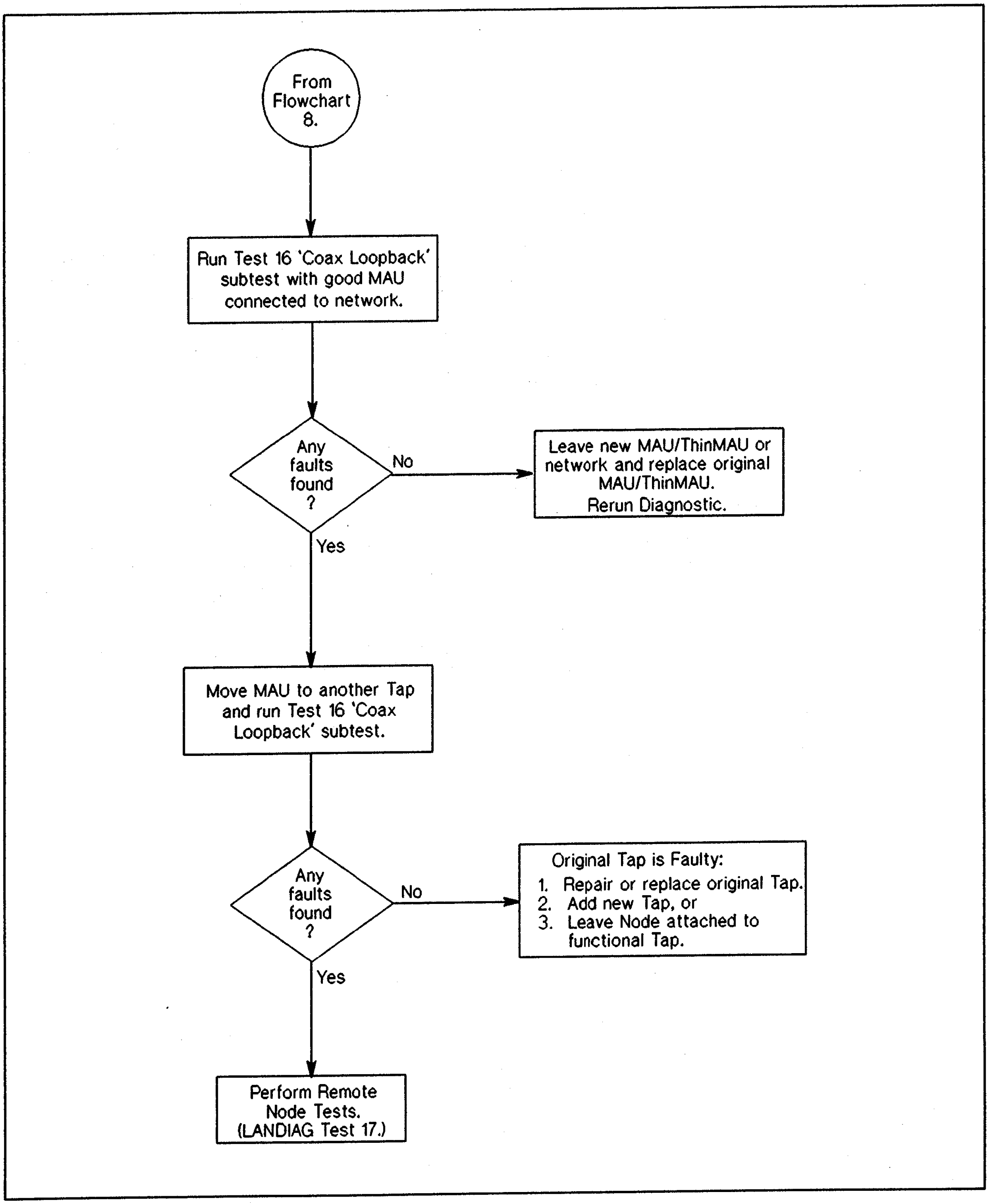
Flowchart 9

Using Test 16, Flowchart 9 checks the operation of the coaxial cable. Here, the loopback hood is removed, and the known good MAU/ThinMAU is attached to the coaxial cable in place of the originally installed MAU/ThinMAU.

If the test now runs successfully, the originally installed MAU/ThinMAU is faulty.

If the test still fails, the coaxial cable contains a fault. An open Tap, that is, one that does not make contact with the coaxial cable conductors, can be verified by repeating the test on a nearby Tap. A shorted Tap is not easily verified, since the entire cable will appear faulty.

If the coaxial cable appears to be faulty, perform LANDIAG Test #17, Remote Node Tests, or refer to the *LAN Link Hardware Troubleshooting Manual*, 5955-7681 (HP CE Handbook version 5959-2217).



Flowchart 9. Testing MAU/ThinMAU Connection

Using Test 17 - The Remote Node Test (RNT)

LANDIAG Test 17, the Remote Node Test, allows the user to send frames to and receive frames from remote nodes on the network. It can be used to isolate faults on the LAN between operational nodes. (Refer to Chapter 4, LAN Node Diagnostic, for details on performing LANDIAG Test 17.)

Coaxial Cable LAN. For coax LANs, a binary search is used in conjunction with Test 17. In a binary search, the coax cable is first divided into two smaller LANs, which are each tested using Test 17. Each smaller LAN that fails is further divided, and the process continues until the LAN cable sections can no longer be conveniently divided. At that point, either the fault is found and corrected, or the faulty cable section is replaced.

For other alternatives, refer to the *LAN Link Hardware Troubleshooting Manual*, 5955-7681 (HP CE Handbook version 5959-2217).

HP StarLAN. For a StarLAN with multiple Hubs, the Hubs are systematically isolated from one another while Test 17 is run between connected nodes. In this way, faults associated with a Hub or remote node can be quickly found.

For more information, refer to the *HP StarLAN Diagnostics and Troubleshooting Manual for PCs*, 50906-90060.

Using Software Line Tests

In this section, a brief discussion of software line tests used to troubleshoot Network Services application software is provided. Figure A-2 illustrates the coverage of various testing tools available. Network Services operation and use of troubleshooting tools are fully discussed in the *NS3000/V Network Manager Reference Manual*, (Volume 1, 32344-90002; Volume 2, 32344-90012).

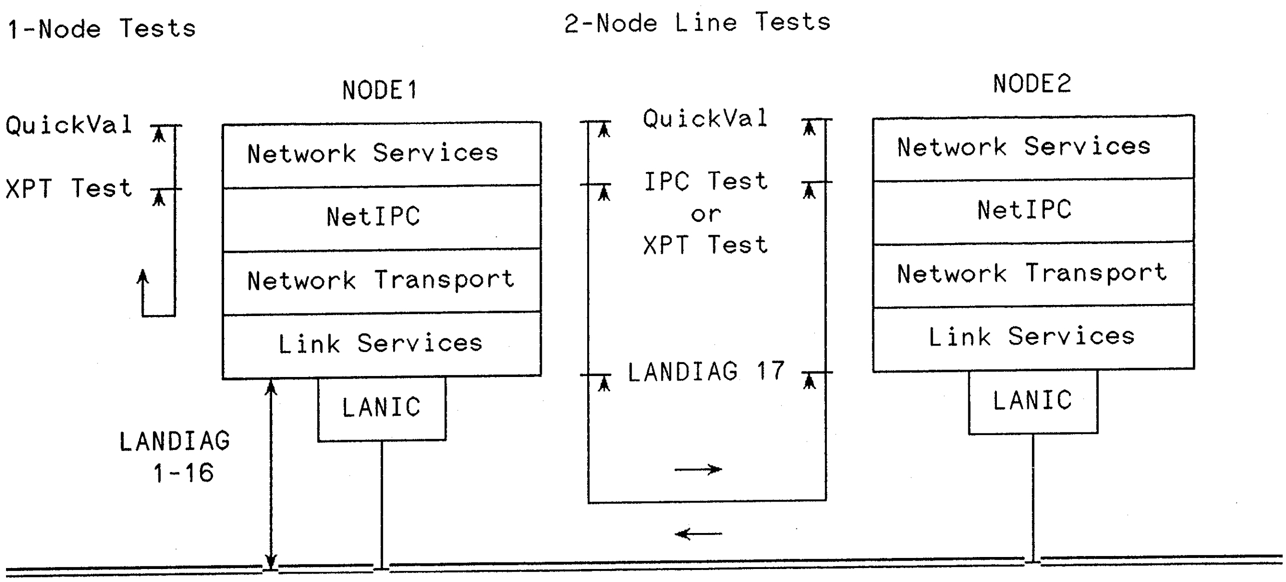


Figure A-2. Software Line Tests

NOTE

Before running the software line tests, use the LAN Node Diagnostic (LANDIAG) to ensure that there are no hardware problems.

Also, the software should be reset -- shut down and restart the Network Transport and Network Services. Issue the command

```
SHOWCOM ldev; RESET
```

to set the values of the SHOWCOM status display to zero.

Be sure to refer to the *NS3000/V Network Manager Reference Manual* before attempting to perform software line tests.

The HP 3000 LAN link includes three software line tests that can be used to verify the operation of the NS3000/V and LAN link software. The line tests are XPT, IPC and QuickVal. They can be run on a single node (software loopback), and between nodes.

The XPT and IPC line tests are both interactive and use the NetIPC intrinsics. They verify operation of the Network Transport Level.

QuickVal, which runs in batch mode, checks the network services.

Procedures

Single Node Testing. On a single node, XPT verifies operation of the local Network Transport. If it is not functioning properly, the LAN problem has probably been found and further line testing may not be necessary.

If the local Transport is operating properly, run QuickVal to verify operation of the services on the node.

Finally, perform a two-node XPT line test.

Two-Node Testing. The two-node XPT line test checks the remote Transport level, and the local and remote links. If this test reveals an error, refer to the *NS3000/V Network Manager Reference Manual* to interpret the results. Perform any hardware troubleshooting required.

If both the single-node software loopback and two-node XPT line tests reveal no errors, run the IPC line test between nodes. (Running this test on a single node, i.e., software loopback, is not necessary since you already checked the transport.) The two-node IPC line test, in addition to checking the Network Transport and both links, uses Network Services, specifically Remote Process Management (RPM). This means that if this test fails, the problem probably lies within the RPM capabilities of the Network Services.

If the IPC two-node test reveals no errors, you should run QuickVal between nodes to check all Network Services other than RPM. QuickVal tests the services by executing the intrinsics and commands of each service.

If more than one service is not working, it could mean that DSDAD and its associated modules are not functioning properly. DSDAD is the control process for all Network Services.

Index

T

Product Line Sales/Support Key

Key Product Line
A Analytical
CM Components
C Computer Systems
E Electronic Instruments & Measurement Systems
M Medical Products
P Personal Computation Products
*** 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.

HEADQUARTERS OFFICES

If there is no sales office listed for your area, contact one of these headquarters offices.

NORTH/CENTRAL AFRICA
Hewlett-Packard S.A.
7, rue du Bois-du-Lan
CH-1217 **MEYRIN** 1, Switzerland
Tel: (022) 83 12 12
Telex: 27835 hmea
Cable: HEWPACKSA Geneve

ASIA
Hewlett-Packard Asia Ltd.
47/F, 26 Harbour Rd.,
Wanchai, **HONG KONG**
G.P.O. Box 863, Hong Kong
Tel: 5-8330833
Telex: 76793 HPA HX
Cable: HPASIAL TD

CANADA
Hewlett-Packard (Canada) Ltd.
6877 Goreway Drive
MISSISSAUGA, Ontario L4V 1M8
Tel: (416) 678-9430
Telex: 610-492-4246

EASTERN EUROPE
Hewlett-Packard Ges.m.b.h.
Lieblgasse 1
P.O.Box 72
A-1222 **VIENNA,** Austria
Tel: (222) 2500-0
Telex: 1 3 4425 HEPA A

NORTHERN EUROPE
Hewlett-Packard S.A.
Uilenstede 475
P.O.Box 999
NL-1183 AG **AMSTELVEEN**
The Netherlands
Tel: 20 437771
Telex: 18 919 hpner nl

SOUTH EAST EUROPE
Hewlett-Packard S.A.
World Trade Center
110 Avenue Louis Casai
1215 Cointrin, **GENEVA,** Switzerland
Tel: (022) 98 96 51
Telex: 27225 hpser

MEDITERRANEAN AND MIDDLE EAST
Hewlett-Packard S.A.
Mediterranean and Middle East Operations
Atrina Centre
32 Kifissias Ave.
Paradissos-Amarousion, **ATHENS**
Greece
Tel: 682 88 11
Telex: 21-6588 HPAT GR
Cable: HEWPACKSA Athens

UNITED KINGDOM
Hewlett-Packard Ltd.
Nine Mile Ride
Easthampstead, **WOKINGHAM**
Berkshire, IRGII 3LL
Tel: 0344 773100
Telex: 848805

EASTERN USA
Hewlett-Packard Co.
4 Choke Cherry Road
ROCKVILLE, MD 20850
Tel: (301) 258-2000

MIDWESTERN USA
Hewlett-Packard Co.
5201 Tollview Drive
ROLLING MEADOWS, IL 60008
Tel: (312) 255-9800

SOUTHERN USA
Hewlett-Packard Co.
2000 South Park Place
P.O. Box 105005
ATLANTA, GA 30348
Tel: (404) 955-1500

WESTERN USA
Hewlett-Packard Co.
3939 Lankershim Blvd.
P.O. Box 3919
LOS ANGELES, CA 91604
Tel: (213) 506-3700

OTHER INTERNATIONAL AREAS
Hewlett-Packard Co.
Intercontinental Headquarters
3495 Deer Creek Road
PALO ALTO, CA 94304
Tel: (415) 857-1501
Telex: 034-8300
Cable: HEWPACK

ANGOLA
Telectra Angola LDA
Empresa Técnica de Equipamentos
Rua Conselheiro Julio de Vilhema, 16
Caixa Postal 6487
LUANDA
Tel: 35515,35516
Telex: 3134
E,C*

ARGENTINA
Hewlett-Packard Argentina S.A.
Montaneses 2140/50
1428 **BUENOS AIRES**
Tel: 783-4886/4836/4730
Cable: HEWPACKARG
A,C,CM,E,P

Biotron S.A.C.I.e.I.
Av. Paso Colon 221, Piso 9
1399 **BUENOS AIRES**
CM

Laboratorio Rodriguez
Corswant S.R.L.
Misiones, 1156 - 1876
Bernal, Oeste
BUENOS AIRES
Tel: 252-3958, 252-4991
A

Argentina Esanco S.R.L.
Avasco 2328
1416 **BUENOS AIRES**
Tel: 541-58-1981, 541-59-2767
A

AUSTRALIA

Adelaide, South Australia Office
Hewlett-Packard Australia Ltd.
153 Greenhill Road
PARKSIDE, S.A. 5063
Tel: 272-5911
Telex: 82536
Cable: HEWPARD Adelaide
A*,C,CM,E,M,P

Brisbane, Queensland Office
Hewlett-Packard Australia Ltd.
10 Payne Road
THE GAP, Queensland 4061
Tel: 30-4133
Telex: 42133
Cable: HEWPARD Brisbane
A,C,CM,E,M,P

Canberra, Australia Capital Territory Office
Hewlett-Packard Australia Ltd.
121 Wollongong Street
FYSHWICK, A.C.T. 2609
Tel: 80 4244
Telex: 62650
Cable: HEWPARD Canberra
C,CM,E,P

Melbourne, Victoria Office
Hewlett-Packard Australia Ltd.
31-41 Joseph Street
BLACKBURN, Victoria 3130
Tel: 895-2895
Telex: 31-024
Cable: HEWPARD Melbourne
A,C,CM,E,M,P

Perth, Western Australia Office
Hewlett-Packard Australia Ltd.
261 Stirling Highway
CLAREMONT, W.A. 6010
Tel: 383-2188
Telex: 93859
Cable: HEWPARD Perth
A,C,CM,E,M,P

Sydney, New South Wales Office
Hewlett-Packard Australia Ltd.
17-23 Talavera Road
P.O. Box 308
NORTH RYDE, N.S.W. 2113
Tel: 888-4444
Telex: 21561
Cable: HEWPARD Sydney
A,C,CM,E,M,P

AUSTRIA
Hewlett-Packard Ges.m.b.h.
Verkauisbüro Graz
Grottenhofstrasse 94
A-8052 **GRAZ**
Tel: (0316) 291 56 60
Telex: 32375
C,E

Hewlett-Packard Ges.m.b.h.
Lieblgasse 1
P.O. Box 72
A-1222 **VIENNA**
Tel: (0222) 2500-0
Telex: 134425 HEPA A
A,C,CM,E,M,P

BAHRAIN
Green Salon
P.O. Box 557
MANAMA
Tel: 255503-255950
Telex: 8441
P

Wael Pharmacy
P.O. Box 648
MANAMA
Tel: 256123
Telex: 8550 WAEL BN
E,M

Zayani Computer Systems
218 Shaik Mubarak Building
Government Avenue
P.O. Box 5918
MANAMA
Tel: 276278
Telex: 9015
P

BELGIUM
Hewlett-Packard Belgium S.A./N.V.
Blvd de la Woluwe, 100
Woluwedal
B-1200 **BRUSSELS**
Tel: (02) 762-32-00
Telex: 23-494 paloben bru
A,C,CM,E,M,P

BERMUDA
Applied Computer Technologies
Atlantic House Building
Par-La-Ville Road
Hamilton 5
Tel: 295-1616
P

BRAZIL
Hewlett-Packard do Brasil
I.e.C. Ltda.
Alameda Rio Negro, 750
Alphaville
06400 **BARUERI SP**
Tel: (011) 421.1311
Telex: (011) 33872 HPBR-BR
Cable: HEWPACK Sao Paulo
A,C,CM,E,M,P

Hewlett-Packard do Brasil
I.e.C. Ltda.
Praia de Botafago 228
6° Andar-conj 614
Edificio Argentina - Ala A
22250 **RIO DE JANEIRO**
Tel: (02l) 552-6422
Telex: 21905 HPBR-BR
Cable: HEWPACK Rio de Janeiro
A,C,CM,E,P*

Convex/Van Den
Rua Jose Bonifacio
458 Todos Os Santos
CEP 20771
RIO DE JANEIRO, RJ
Tel: 591-0197
Telex: 33487 EGLB BR
A

ANAMED I.C.E.I. Ltda.
Rua Bage, 103
04012 **SAO PAULO,** SP
Tel: (011) 572-6537
Telex: 24720 HPBR-BR
M

Datatronix Electronica Ltda.
Av. Pacaembu 746-C11
SAO PAULO, SP
Tel: (118) 260111
CM

CAMEROON
Beriac
B. P. 23
DOUALA
Tel: 420153
Telex: 5351
C,P

CANADA

Alberta
Hewlett-Packard (Canada) Ltd.
3030 3rd Avenue N.E.
CALGARY, Alberta T2A 6T7
Tel: (403) 235-3100
A,C,CM,E*,M,P*

Hewlett-Packard (Canada) Ltd.
11120-178th Street
EDMONTON, Alberta T5S 1P2
Tel: (403) 486-6666
A,C,CM,E,M,P

SALES & SUPPORT OFFICES
Arranged alphabetically by country

CANADA (Cont'd)

British Columbia
Hewlett-Packard (Canada) Ltd.
10691 Shellbridge Way
RICHMOND,
British Columbia V6X 2W7
Tel: (604) 270-2277
Telex: 610-922-5059
A,C,CM,E*,M,P*

Hewlett-Packard (Canada) Ltd.
121 - 3350 Douglas Street
VICTORIA, British Columbia V8Z 3L1
Tel: (604) 381-6616
C

Manitoba
Hewlett-Packard (Canada) Ltd.
1825 Inkster Blvd.
WINNIPEG, Manitoba R2X 1R3
Tel: (204) 694-2777
A,C,CM,E,M,P*

New Brunswick
Hewlett-Packard (Canada) Ltd.
814 Main Street
MONCTON, New Brunswick E1C 1E6
Tel: (506) 855-2841
C

Nova Scotia
Hewlett-Packard (Canada) Ltd.
Suite 111
900 Windmill Road
DARTMOUTH, Nova Scotia B3B 1P7
Tel: (902) 469-7820
C,CM,E*,M,P*

Ontario
Hewlett-Packard (Canada) Ltd.
3325 N. Service Rd., Unit 3
BURLINGTON, Ontario L7N 3G2
Tel: (416) 335-8644
C,M*

Hewlett-Packard (Canada) Ltd.
496 Days Road
KINGSTON, Ontario K7M 5R4
Tel: (613) 384-2088
C

Hewlett-Packard (Canada) Ltd.
552 Newbold Street
LONDON, Ontario N6E 2S5
Tel: (519) 686-9181
A,C,CM,E*,M,P*

Hewlett-Packard (Canada) Ltd.
6877 Goreway Drive
MISSISSAUGA, Ontario L4V 1M8
Tel: (416) 678-9430
A,C,CM,E,M,P

Hewlett-Packard (Canada) Ltd.
2670 Queensview Dr.
OTTAWA, Ontario K2B 8K1
Tel: (613) 820-6483
A,C,CM,E*,M,P*

Hewlett-Packard (Canada) Ltd.
The Oaks Plaza, Unit #9
2140 Regent Street
SUDBURY, Ontario, P3E 5S8
Tel: (705) 522-0202
C

Hewlett-Packard (Canada) Ltd.
3790 Victoria Park Ave.
WILLOWDALE, Ontario M2H 3H7
Tel: (416) 499-2550
C

Quebec
Hewlett-Packard (Canada) Ltd.
17500 Trans Canada Highway
South Service Road
KIRKLAND, Quebec H9J 2X8
Tel: (514) 697-4232
A,C,CM,E,M,P*

Hewlett-Packard (Canada) Ltd.
1150 rue Claire Fontaine
QUEBEC CITY, Quebec G1R 5G4
Tel: (418) 648-0726
C

Hewlett-Packard (Canada) Ltd.
130 Robin Crescent
SASKATOON, Saskatchewan S7L 6M7
Tel: (306) 242-3702
C

CHILE
ASC Ltda.
Austria 2041
SANTIAGO
Tel: 223-5946, 223-6148
Telex: 340192 ASC CK
C,P

Isical Ltda.
Av. Italia 634 Santiago
Casilla 16475
SANTIAGO 9
Tel: 222-0222
Telex: 440283 JCYCL CZ
CM,E,M

Metrolab S.A.
Monjitas 454 of. 206
SANTIAGO
Tel: 395752, 398296
Telex: 340866 METLAB CK
A

Olympia (Chile) Ltda.
Av. Rodrigo de Araya 1045
Casilla 256-V
SANTIAGO 21
Tel: 225-5044
Telex: 340892 OLYMP
Cable: Olympiachile Santiagochile
C,P

CHINA, People's Republic of
China Hewlett-Packard, Ltd.
47/F China Resources Bldg.
26 Harbour Road
HONG KONG
Tel: 5-8330833
Telex: 76793 HPA HX
Cable: HP ASIA LTD
A*,M*

China Hewlett-Packard, Ltd.
P.O. Box 9610, Beijing
4th Floor, 2nd Watch Factory Main Bldg.
Shuang Yu Shu, Bei San Huan Rd.
Hai Dian District
BEIJING
Tel: 28-0567
Telex: 22601 CTSHP CN
Cable: 1920 Beijing
A,C,CM,E,M,P

COLOMBIA
Instrumentación
H. A. Langebaek & Kier S.A.
Carrera 4A No. 52A-26
Apartado Aereo 6287
BOGOTA 1, D.E.
Tel: 212-1466
Telex: 44400 INST CO
Cable: AARIS Bogota
CM,E,M

Nefromedicas Ltda.
Calle 123 No. 9B-31
Apartado Aereo 100-958
BOGOTA D.E., 10
Tel: 213-5267, 213-1615
Telex: 43415 HEGAS CO
A

Compumundo
Avenida 15 # 107-80
BOGOTA D.E.
Tel: 214-4458
Telex: 45466 MARICO
P

Carvajal, S.A.
Calle 29 Norte No. 6A-40
Apartado Aereo 46
CALI
Tel: 368-1111
Telex: 55650
C,E,P

CONGO
Seric-Congo
B. P. 2105
BRAZZAVILLE
Tel: 815034
Telex: 5262

COSTA RICA
Cientifica Costarricense S.A.
Avenida 2, Calle 5
San Pedro de Montes de Oca
Apartado 10159
SAN JOSÉ
Tel: 24-38-20, 24-08-19
Telex: 2367 GALGUR CR
CM,E,M

CYPRUS
Telerexa Ltd.
P.O. Box 4809
14C Stassinos Avenue
NICOSIA
Tel: 62698
Telex: 2894 LEVIDO CY
E,M,P

DENMARK
Hewlett-Packard A/S
Datavej 52
DK-3460 **BIRKEROD**
Tel: (02) 81-66-40
Telex: 37409 hpas dk
A,C,CM,E,M,P

Hewlett-Packard A/S
Rolighedsvej 32
DK-8240 **RISSKOV,** Aarhus
Tel: (06) 17-60-00
Telex: 37409 hpas dk
C,E

DOMINICAN REPUBLIC
Microprog S.A.
Juan Tomás Mejía y Cotes No. 60
Arroyo Hondo
SANTO DOMINGO
Tel: 565-6268
Telex: 4510 ARENTA DR (RCA)
P

ECUADOR
CYEDE Cia. Ltda.
Avenida Eloy Alfaro 1749
y Belgica
Casilla 6423 CCI
QUITO
Tel: 450-975, 243-052
Telex: 22548 CYEDE ED
CM,E,P

Medtronics
Valladolid 524 Madrid
P.O. 9171, **QUITO**
Tel: 223-8951
Telex: 2298 ECKAME ED
A

Hospitalar S.A.
Robles 625
Casilla 3590
QUITO
Tel: 545-250, 545-122
Telex: 2485 HOSPTL ED
Cable: HOSPITALAR-Quito
M

Ecuador Overseas Agencies C.A.
Calle 9 de Octubre #818
P.O. Box 1296, Guayaquil
QUITO
Tel: 306022
Telex: 3361 PBCGYE ED
M

EGYPT
Sakrco Enterprises
70, Mossadak Str.
Dokki, Giza
CAIRO
Tel: 706440
Telex: 93146
C

International Engineering Associates
24 Hussein Hegazi Street
Kasr-el-Ain
CAIRO
Tel: 23829, 21641
Telex: 93830 IEA UN
Cable: INTEGASSO
E,M*

S.S.C. Medical
40 Gezerat El Arab Street
Mohandessin
CAIRO
Tel: 803844, 805998, 810263
Telex: 20503 SSC UN
M*

EL SALVADOR
IPESA de El Salvador S.A.
29 Avenida Norte 1223
SAN SALVADOR
Tel: 26-6858, 26-6868
Telex: 20539 IPESA SAL
A,C,CM,E,P

ETHIOPIA
Seric-Ethiopia
P.O. Box 2764
ADDIS ABABA
Tel: 185114
Telex: 21150
C,P

FINLAND
Hewlett-Packard Oy
Piispankalliontie 17
02200 **ESPOO**
Tel: 00358-0-88721
Telex: 121563 HEWPA SF
A,C,CM,E,M,P

FRANCE
Hewlett-Packard France
Z.I. Mercure B
Rue Berthelot
13763 Les Milles Cedex
AIX-EN-PROVENCE
Tel: (42) 59-41-02
Telex: 410770F
A,C,E,M,P*

Hewlett-Packard France
64, rue Marchand Saillant
61000 **ALENCON**
Tel: (33) 29 04 42

Hewlett-Packard France
28 rue de la Republique
Boite Postale 503
25026 **BESANCON** Cedex
Tel: (81) 83-16-22
Telex: 361157
C,M

Hewlett-Packard France
Chemin des Mouilles
Boite Postale 162
69130 **ECULLY** Cedex (Lyon)
Tel: (78) 833-81-25
Telex: 310617F
A,C,E,M

Hewlett-Packard France
Parc d'activités du Bois Briard
2, avenue du Lac
91040 **EVRY** Cedex
Tel: 6 077-96 60
Telex: 692315F
E

Hewlett-Packard France
5, avenue Raymond Chanas
38320 **EYBENS** (Grenoble)
Tel: (76) 62-57-98
Telex: 980124 HP GRENOB EYBE
C

Hewlett-Packard France
Rue Fernand. Forest
Z.A. Kergaradec
29239 **GOUESNOU**
Tel: (98) 41-87-90

Hewlett-Packard France
Centre d'affaires Paris-Nord
Bâtiment Ampère
Rue de la Commune de Paris
Boite Postale 300
93153 **LE BLANC-MESNIL**
Tel: (1) 865-44-52
Telex: 211032F
C,E,M

Hewlett-Packard France
Parc d'activités Cadera
Quartier Jean-Mermoz
Avenue du Président JF Kennedy
F-33700 **MÉRIGNAC** (Bordeaux)
Tel: (56) 34-00-84
Telex: 550105F
C,E,M

Hewlett-Packard France
Immueble "Les 3 B"
Nouveau chemin de la Garde
ZAC du Bois Briand
44085 **NANTES** Cedex
Tel: (40) 50-32-22
Telex: 711085F
C**

Hewlett-Packard France
125, rue du Faubourg Bannier
45000 **ORLEANS**
Tel: (38) 68 01 63

IANCE (Cont'd)

wlett-Packard France
ne Industrielle de Courtaboeuf
enue des Tropiques
947 Les Ulis Cedex **ORSAY**
: (6) 907-78-25
ex: 600048F
C,CM,E,M,P

wlett-Packard France
ris Porte-Maillot
, boulevard de L'Amiral-Bruix
782 **PARIS** Cedex 16
l: (1) 502-12-20
lex: 613663F
M,P

wlett-Packard France
4, Boulevard Tourasse
000 **PAU**
l: (59) 80 38 02

ewlett-Packard France
Allée de la Bourgonnette
100 **RENNES**
l: (99) 51-42-44
lex: 740912F
CM,E,M,P*

ewlett-Packard France
} avenue de Bretagne
5100 **ROUEN**
el: (35) 63-57-66
elex: 770035F

ewlett-Packard France
rue Thomas-Mann
oite Postale 56
7033 **STRASBOURG** Cedex
el: (88) 28-56-46
elex: 890141F
,E,M,P*

ewlett-Packard France
a Péripole III
0, chemin du Pigeonnier de la Cépière
-31083 **TOULOUSE** Cedex
el: (61) 40-11-12
elex: 531639F
,C,E,P*

lewlett-Packard France
, rue Baudin
6000 **VALENCE**
el: (75) 42 76 16

lewlett-Packard France
Carolor
AC de Bois Briand
57640 **VIGY** (Metz)
el: (8) 771 20 22
C

lewlett-Packard France
Parc d'activité des Prés
l, rue Papin
59658 **VILLENEUVE D'ASCQ** Cedex
Tel: (20) 47 78 78
Telex: 160124F
C,E,M,P*

GABON

Sho Gabon
P.O. Box 89
LIBREVILLE
Tel: 721 484
Telex: 5230

GERMAN FEDERAL REPUBLIC

Hewlett-Packard GmbH
Geschäftsstelle
Keithstrasse 2-4
D-1000 **BERLIN** 30
Tel: (030) 21 99 04-0
Telex: 018 3405 hpbln d
A,C,E,M,P

Hewlett-Packard GmbH
Vertriebszentrun Südwest
Schickardstrasse 2
D-7030 **BÖBLINGEN**
Tel: (07031) 645-0
Telex: 7265 743 hep
A,C,CM,E,M,P

Hewlett-Packard GmbH
Vertriebszentrum West
Berliner Strasse III
D-4030 **RATINGEN** 3
Tel: (02102) 494-0
Telex: 589 070 hprad
A,C,E,M,P

Hewlett-Packard GmbH
Geschäftsstelle
Schleefstr. 28a
D-4600 **DORTMUND**-41
Tel: (0231) 45001
Telex: 822858 hepdad
A,C,E

Hewlett-Packard GmbH
Vertriebszentrum Mitte
Hewlett-Packard-Strasse
D-6380 **BAD HOMBURG**
Tel: (06172) 400-0
Telex: 410 844 hpbhg
A,C,E,M,P

Hewlett-Packard GmbH
Vertriebszentrum Nord
Kapstadtring 5
D-2000 **HAMBURG** 60
Tel: (040) 63804-1
Telex: 021 63 032 hphh d
A,C,E,M,P

Hewlett-Packard GmbH
Geschäftsstelle
Heidering 37-39
D-3000 **HANNOVER** 61
Tel: (0511) 5706-0
Telex: 092 3259
A,C,CM,E,M,P

Hewlett-Packard GmbH
Geschäftsstelle
Rosslauer Weg 2-4
D-6800 **MANNHEIM**
Tel: (0621) 70 05-0
Telex: 0462105
A,C,E

Hewlett-Packard GmbH
Geschäftsstelle
Messerschmittstrasse 7
D-7910 **NEU ULM**
Tel: (0731) 70 73-0
Telex: 0712816 HP ULM-D
A,C,E*

Hewlett-Packard GmbH
Geschäftsstelle
Emmericher Strasse 13
D-8500 **NÜRNBERG** 10
Tel: (0911) 5205-0
Telex: 0623 860 hpnbg
C,CM,E,M,P

Hewlett-Packard GmbH
Vertriebszentrum Süd
Eschenstrasse 5
D-8028 **TAUFKIRCHEN**
Tel: (089) 61 20 7-0
Telex: 0524985
A,C,CM,E,M,P

Hewlett-Packard GmbH
Geschäftsstelle
Ermlisallee
7517 **WALDBRONN** 2
Tel: (07243) 602-0
Telex: 782 838 hepk
A,C,E

GREAT BRITAIN

See United Kingdom

GREECE

Hewlett-Packard A.E.
178, Kifissias Avenue
6th Floor
Halandri-**ATHENS**
Greece
Tel: 6471543, 6471673, 6472971
Telex: 221 286 HPHLGR
A,C,CM**,E,M,P

Kostas Karaynnis S.A.
8, Omirou Street
ATHENS 133
Tel: 32 30 303, 32 37 371
Telex: 215962 RKAR GR
A,C*,CM,E

Impexin
Intelect Div.
209 Mesogion
11525 **ATHENS**
Tel: 6474481/2
Telex: 216286
P

Haril Company
38, Mihalakopoulou
ATHENS 612
Tel: 7236071
Telex: 218767
M*

Hellamco
P.O. Box 87528
18507 **PIRAEUS**
Tel: 4827049
Telex: 241441
A

GUATEMALA

IPESA
Avenida Reforma 3-48, Zona 9
GUATEMALA CITY
Tel: 316627, 314786
Telex: 3055765 IPESA GU
A,C,CM,E,M,P

HONG KONG

Hewlett-Packard Hong Kong, Ltd.
G.P.O. Box 795
5th Floor, Sun Hung Kai Centre
30 Harbour Road
HONG KONG
Tel: 5-8323211
Telex: 66678 HEWPA HX
Cable: HEWPACK Hong Kong
E,C,P

CET Ltd.
10th Floor, Hua Asia Bldg.
64-66 Gloulester Road
HONG KONG
Tel: (5) 200922
Telex: 85148 CET HX
CM

Schmidt & Co. (Hong Kong) Ltd.
18th Floor, Great Eagle Centre
23 Harbour Road
HONG KONG
Tel: 5-8330222
Telex: 74766 SCHMC HX
A,M

ICELAND

Hewlett-Packard Iceland
Hoefdabakka 9
110 **Reykjavik**
Tel: (1) 67 1000
A,C,CM,E,M,P

INDIA

Computer products are sold through Blue Star Ltd.All computer repairs and maintenance service is done through Computer Maintenance Corp.

Blue Star Ltd.
Sabri Complex 2nd Floor
24 Residency Rd.
BANGALORE 560 025
Tel: 55660, 578881
Telex: 0845-430
Cable: BLUESTAR
A,C*,CM,E

Blue Star Ltd.
Band Box House
Prabhadevi
BOMBAY 400 025
Tel: 4933101, 4933222
Telex: 011-71051
Cable: BLUESTAR
A,M

Blue Star Ltd.
Sahas
414/2 Vir Savarkar Marg
Prabhadevi
BOMBAY 400 025
Tel: 422-6155, 422-6556
Telex: 011-71193 BSSS IN
Cable: FROSTBLUE
A,C*,CM,E,M

Blue Star Ltd.
Kalyan, 19 Vishwas Colony
Alkapuri, **BORODA**, 390 005
Tel: 65235, 65236
Cable: BLUE STAR
A

Blue Star Ltd.
7 Hare Street
CALCUTTA 700 001
Tel: 230131, 230132
Telex: 021-7655
Cable: BLUESTAR
A,M

Blue Star Ltd.
133 Kodambakkam High Road
MADRAS 600 034
Tel: 472056, 470238
Telex: 041-379
Cable: BLUESTAR
A,M

Blue Star Ltd.
13 Community Center
New Friends Colony
NEW DELHI 110 065
Tel: 633773, 634473
Telex: 031-61120
Cable: BLUEFROST
A,C*,CM,E,M

Blue Star Ltd.
15/16 C Wellesley Rd.
PUNE 411 011
Tel: 22775
Cable: BLUE STAR
A

Blue Star Ltd.
2-2-47/1108 Bolarum Rd.
SECUNDERABAD 500 003
Tel: 72057, 72058
Telex: 0155645
Cable: BLUEFROST
A,E

Blue Star Ltd.
T.C. 7/603 Poornima
Maruthunkuzhi
TRIVANDRUM 695 013
Tel: 65799, 65820
Telex: 0884-259
Cable: BLUESTAR
E

Computer Maintenance Corporation Ltd.
115, Sarojini Devi Road
SECUNDERABAD 500 003
Tel: 310-184, 345-774
Telex: 031-2960
C**

INDONESIA

BERCA Indonesia P.T.
P.O.Box 496/Jkt.
Jl. Abdul Muis 62
JAKARTA
Tel: 21-373009
Telex: 46748 BERSAL IA
Cable: BERSAL JAKARTA
P

BERCA Indonesia P.T.
P.O.Box 2497/Jkt
Antara Bldg., 12th Floor
Jl. Medan Merdeka Selatan 17
JAKARTA-PUSAT
Tel: 21-340417, 341445
Telex: 46748 BERSAL IA
A,C,E,M

BERCA Indonesia P.T.
Jalan Kutai 24
SURABAYA
Tel: 67118
Telex: 31146 BERSAL SB
Cable: BERSAL-SURABAYA
A*,E,M,P

IRAQ

Hewlett-Packard Trading S.A.
Service Operation
Al Mansoor City 9B/3/7
BAGHDAD
Tel: 551-49-73
Telex: 212-455 HEPAIRAQ IK
C

IRELAND

Hewlett-Packard Ireland Ltd.
82/83 Lower Leeson Street
DUBLIN 2
Tel: 0001 608800
Telex: 30439
A,C,CM,E,M,P

Cardiac Services Ltd.
Kilmore Road
Artane
DUBLIN 5
Tel: (01) 351820
Telex: 30439
M

SALES & SUPPORT OFFICES
Arranged alphabetically by country

ISRAEL
Eldan Electronic Instrument Ltd.
P.O.Box 1270
JERUSALEM 91000
16, Ohaliav St.
JERUSALEM 94467
Tel: 533 221, 553 242
Telex: 25231 AB/PAKRD IL
A,M

Computation and Measurement Systems (CMS) Ltd.
11 Masad Street
67060
TEL-AVIV
Tel: 388 388
Telex: 33569 Motil IL
C,CM,E,P

ITALY
Hewlett-Packard Italiana S.p.A
Traversa 99C
Via Giulio Petroni, 19
I-70124 **BARI**
Tel: (080) 41-07-44
C,M

Hewlett-Packard Italiana S.p.A.
Via Emilia, 51/C
I-40011 **BOLOGNA** Anzola Dell'Emilia
Tel: (051) 731061
Telex: 511630
C,E,M

Hewlett-Packard Italiana S.p.A.
Via Principe Nicola 43G/C
I-95126 **CATANIA**
Tel: (095) 37-10-87
Telex: 970291
C

Hewlett-Packard Italiana S.p.A.
Via G. Di Vittorio 9
I-20063 **CERNUSCO SUL NAVIGLIO**
(Milano)
Tel: (02) 4459041
Telex: 334632
A,C,CM,E,M,P

Hewlett-Packard Italiana S.p.A.
Via C. Colombo 49
I-20090 **TREZZANO SUL NAVIGLIO**
(Milano)
Tel: (02) 4459041
Telex: 322116
C

Hewlett-Packard Italiana S.p.A.
Via Nuova San Rocco a Capodimonte, 62/A
I-80131 **NAPOLI**
Tel: (081) 7413544
Telex: 710698
A**,C,E,M

Hewlett-Packard Italiana S.p.A.
Viale G. Modugno 33
I-16156 **GENOVA PEGLI**
Tel: (010) 68-37-07
Telex: 215238
C,E

Hewlett-Packard Italiana S.p.A.
Via Pelizzo 15
I-35128 **PADOVA**
Tel: (049) 664888
Telex: 430315
A,C,E,M

Hewlett-Packard Italiana S.p.A.
Viale C. Pavese 340
I-00144 **ROMA EUR**
Tel: (06) 54831
Telex: 610514
A,C,E,M,P*

Hewlett-Packard Italiana S.p.A.
Via di Casellina 57/C
I-50018 **SCANDICCI-FIRENZE**
Tel: (055) 753863
C,E,M

Hewlett-Packard Italiana S.p.A.
Corso Svizzera, 185
I-10144 **TORINO**
Tel: (011) 74 4044
Telex: 221079
A*,C,E

IVORY COAST
S.I.T.E.L.
Societe Ivoirienne de Telecommunications
Bd. Giscard d'Estaing
Carrefour Marcory
Zone 4.A.
Boite postale 2580
ABIDJAN 01
Tel: 353600
Telex: 43175
E

S.I.T.I.
Immeuble "Le General"
Av. du General de Gaulle
01 BP 161
ABIDJAN 01
Tel: 321227
C,P

JAPAN
Yokogawa-Hewlett-Packard Ltd.
152-1, Onna
ATSUGI, Kanagawa, 243
Tel: (0462) 25-0031
C,CM,E

Yokogawa-Hewlett-Packard Ltd.
Meiji-Seimei Bldg. 6F
3-1 Hon Chiba-Cho
CHIBA, 280
Tel: 472 25 7701
C,E

Yokogawa-Hewlett-Packard Ltd.
Yasuda-Seimei Hiroshima Bldg.
6-11, Hon-dori, Naka-ku
HIROSHIMA, 730
Tel: 82-241-0611

Yokogawa-Hewlett-Packard Ltd.
Towa Building
2-3, Kaigan-dori, 2 Chome Chuo-ku
KOBE, 650
Tel: (078) 392-4791
C,E

Yokogawa-Hewlett-Packard Ltd.
Kumagaya Asahi 82 Bldg
3-4 Tsukuba
KUMAGAYA, Saitama 360
Tel: (0485) 24-6563
C,CM,E

Yokogawa-Hewlett-Packard Ltd.
Asahi Shinbun Daiichi Seimei Bldg.
4-7, Hanabata-cho
KUMAMOTO, 860
Tel: (096) 354-7311
C,E

Yokogawa-Hewlett-Packard Ltd.
Shin-Kyoto Center Bldg.
614, Higashi-Shiokoji-cho
Karasuma-Nishiiru
Shiokoji-dori, Shimogyo-ku
KYOTO, 600
Tel: 075-343-0921
C,E

Yokogawa-Hewlett-Packard Ltd.
Mito Mitsui Bldg
4-73, Sanno-maru, 1 Chome
MITO, Ibaraki 310
Tel: (0292) 25-7470
C,CM,E

Yokogawa-Hewlett-Packard Ltd.
Meiji-Seimei Kokubun Bldg. 7-8
Kokubun, 1 Chome, Sendai
MIYAGI, 980
Tel: (0222) 25-1011
C,E

Yokogawa-Hewlett-Packard Ltd.
Nagoya Kokusai Center Building
47-1, Nagono, 1 Chome
Nakamura-ku
NAGOYA, 450
Tel: (052) 571-5171
C,CM,E,M

Yokogawa-Hewlett-Packard Ltd.
Saikyoren Building
1-2 Dote-machi, **OHMIYA**
Saitama 330
Tel: (0486) 45-8031

Yokogawa-Hewlett-Packard Ltd.
Chuo Bldg.,
4-20 Nishinakajima, 5 Chome
Yodogawa-ku
OSAKA, 532
Tel: (06) 304-6021
Telex: YHPOSA 523-3624
A,C,CM,E,M,P*

Yokogawa-Hewlett-Packard Ltd.
27-15, Yabe, 1 Chome
SAGAMIHARA Kanagawa, 229
Tel: 0427 59-1311

Yokogawa-Hewlett-Packard Ltd.
Daiichi Seimei Bldg.
7-1, Nishi Shinjuku, 2 Chome
Shinjuku-ku,**TOKYO** 160
Tel: 03-348-4611
C,E

Yokogawa-Hewlett-Packard Ltd.
29-21 Takaido-Higashi, 3 Chome
Suginami-ku **TOKYO** 168
Tel: (03) 331-6111
Telex: 232-2024 YHPTOK
A,C,CM,E,M,P*

Yokogawa Hokushin Electric Corp.
9-32 Nokacho 2 Chome
2 Chome Musashino-shi
TOKYO, 180
Tel: (0422) 54-1111
Telex: 02822-421 YEW MTK J
A

Yokogawa-Hewlett-Packard Ltd.
Meiji-Seimei
Utsunomiya Odori Building
1-5 Odori, 2 Chome
UTSUNOMIYA, Tochigi 320
Tel: (0286) 33-1153
C,E

Yokogawa-Hewlett-Packard Ltd.
Yasuda Seimei Yokohama Nishiguchi Bldg.
30-4 Tsuruya-cho, 3 Chome
YOKOHAMA 221
Tel: (045) 312-1252
C,E

JORDAN
Scientific and Medical Supplies Co.
P.O. Box 1387
AMMAN
Tel: 24907, 39907
Telex: 21456 SABCO JO
C,E,M,P

KENYA
ADCOM Ltd., Inc., Kenya
P.O.Box 30070
NAIROBI
Tel: 331955
Telex: 22639
E,M

KOREA
Samsung Hewlett-Packard Co. Ltd.
Dongbang Yeoeuido Building
12-16th Floors
36-1 Yeoeuido-dong
Yongdeungpo-ku
SEOUL
Tel: 784-2666, 784-4666
Telex: 25166 SAMSAN K
A,C,CM,E,M,P

Young In Scientific Co., Ltd.
Youngwha Building
547 Shinsa Dong, Kangnam-ku
SEOUL 135
Tel: 5467771
Telex: K23457 GINSCO
A

KUWAIT
Al-Khaldiya Trading & Contracting
P.O. Box 830
SAFAT
Tel: 424910, 411726
Telex: 22481 AREEG KT
Cable: VISCOUNT
E,M,A

Gulf Computing Systems
P.O. Box 25125
SAFAT
Tel: 435969
Telex: 23648
P

Photo & Cine Equipment
P.O. Box 270
SAFAT
Tel: 2445111
Telex: 22247 MATIN KT
Cable: MATIN KUWAIT
P

W.J. Towell Computer Services
P.O. Box 5897
SAFAT
Tel: 2462640
Telex: 30336 TOWELL KT
C

LEBANON
Computer Information Systems S.A.L.
Chammas Building
P.O. Box 11-6274 Dora
BEIRUT
Tel: 89 40 73
Telex: 42309
C,E,M,P

LIBERIA
Unichemicals Inc.
P.O. Box 4509
MONROVIA
Tel: 224282
Telex: 4509
E

MADAGASCAR
Technique et Precision
12, rue de Nice
P.O. Box 1227
101 **ANTANANARIVO**
Tel: 22090
Telex: 22255
P

LUXEMBOURG
Hewlett-Packard Belgium S.A./N.V.
Blvd de la Woluwe, 100
Woluwedal
B-1200 **BRUSSELS**
Tel: (02) 762-32-00
Telex: 23-494 paloben bru
A,C,CM,E,M,P

MALAYSIA
Hewlett-Packard Sales (Malaysia) Sdn. Bhd.
9th Floor
Chung Khiaw Bank Building
46, Jalan Raja Laut
KUALA LUMPUR
Tel: 03-986555
Telex: 31011 HPSM MA
A,C,E,M,P*

Protel Engineering
P.O.Box 1917
Lot 6624, Section 64
23/4 Pending Road
Kuching, **SARAWAK**
Tel: 36299
Telex: 70904 PROMAL MA
Cable: PROTELENG
A,E,M

MALTA
Philip Toledo Ltd.
Birkirkara P.O. Box 11
Notabile Rd.
MRIEHEL
Tel: 447 47, 455 66
Telex: 1649
E,M,P

MAURITIUS
Blanche Birger Co. Ltd.
18, Jules Koenig Street
PORT LOUIS
Tel: 20828
Telex: 4296
P

MEXICO
Hewlett-Packard de Mexico, S.A.
Francisco J. Allan #30
Colonia Nueva
Los Angeles 27140
COAHUILA, Torreon
Tel: 37220
P

Hewlett-Packard de Mexico, S.A.
Monti Morelos 299
Fraccionamiento Loma Bonita 45060
GUADALAJARA, Jalisco
Tel: 316630/314600
Telex: 0684 186 ECOME
P

MEXICO (Cont'd)

Microcomputadoras Hewlett-Packard, S.A.
Monti Pelvoux 115
LOS LOMAS, Mexico, D.F.
Tel: 520-9127
P

Hewlett-Packard Mexicana, S.A. de C.V.
Av. Periferico Sur No. 6501
Tepepan, Xochimilco
16020 **MEXICO D.F.**
Tel: 6-76-46-00
Telex: 17-74-507 HEWPACK MEX
A,C,CM,E,M,P

Hewlett-Packard De Mexico (Polanco)
Avenida Ejercito Nacional #579
2da y 3er piso
Colonia Granada 11560
MEXICO D.F.
Tel: 254-4433
P

Hewlett-Packard De Mexico, S.A. de C.V.
Czda. del Valle
409 Ote. 4th Piso
Colonia del Valle
Municipio de Garza Garciá
66220 **MONTERREY,** Nuevo León
Tel: 78 42 41
Telex: 038 410
P

MOROCCO

Etablissement Hubert Dolbeau & Fils
81 rue Karatchi
B.P. 11133
CASABLANCA
Tel: 3041-82, 3068-38
Telex: 23051, 22822
E

Gerep
2, rue Agadir
Boite Postale 156
CASABLANCA 01
Tel: 272093, 272095
Telex: 23 739
P

Sema-Maroc
Dept. Seric
6, rue Lapebie
CASABLANCA
Tel: 260980
Telex: 21641
C,P

NETHERLANDS

Hewlett-Packard Nederland B.V.
Startbaan 16
1187 XR **AMSTELVEEN**
P.O. Box 667
NL1180 AR **AMSTELVEEN**
Tel: (020) 547-6911
Telex: 13 216 HEPA NL
A,C,CM,E,M,P

Hewlett-Packard Nederland B.V.
Bongerd 2
NL 2906VK **CAPELLE A/D IJSSEL**
P.O. Box 41
NL 2900AA **CAPELLE A/D IJSSEL**
Tel: (10) 51-64-44
Telex: 21261 HEPAC NL
C,E

Hewlett-Packard Nederland B.V.
Pastoor Petersstraat 134-136
NL 5612 LV **EINDHOVEN**
P.O. Box 2342
NL 5600 CH **EINDHOVEN**
Tel: (040) 326911
Telex: 51484 hepae nl
A,C,E,M,P

NEW ZEALAND

Hewlett-Packard (N.Z.) Ltd.
5 Owens Road
P.O. Box 26-189
Epsom, **AUCKLAND**
Tel: 687-159
Cable: HEWPAK Auckland
C,CM,E,P*

Hewlett-Packard (N.Z.) Ltd.
4-12 Cruickshank Street
Kilbirnie, **WELLINGTON 3**
P.O. Box 9443
Courtenay Place, **WELLINGTON 3**
Tel: 877-199
Cable: HEWPACK Wellington
C,CM,E,P

Northrop Instruments & Systems Ltd.
369 Khyber Pass Road
P.O. Box 8602
AUCKLAND
Tel: 794-091
Telex: 60605
A,M

Northrop Instruments & Systems Ltd.
110 Mandeville St.
P.O. Box 8388
CHRISTCHURCH
Tel: 488-873
Telex: 4203
A,M

Northrop Instruments & Systems Ltd.
Sturdee House
85-87 Ghuznee Street
P.O. Box 2406
WELLINGTON
Tel: 850-091
Telex: NZ 3380
A,M

NIGERIA

Elmeco Nigeria Ltd.
46, Calcutta Crescent Apapa
P.O. Box 244and
LAGOS
E

NORTHERN IRELAND

See United Kingdom

NORWAY

Hewlett-Packard Norge A/S
Folke Bernadottes vei 50
P.O. Box 3558
N-5033 **FYLLINGSDALEN** (Bergen)
Tel: 0047/5/16 55 40
Telex: 76621 hpnas n
C,E,M

Hewlett-Packard Norge A/S
Osterndalen 16-18
P.O. Box 34
N-1345 **ØSTERÅS**
Tel: 0047/2/17 11 80
Telex: 76621 hpnas n
A,C,CM,E,M,P

OMAN

Khimjil Ramdas
P.O. Box 19
MUSCAT/SULTANATE OF OMAN
Tel: 745601
Telex: 5289 BROKER MB MUSCAT
P

Suhail & Saud Bahwan
P.O.Box 169
MUSCAT/SULTANATE OF OMAN
Tel: 734201
Telex: 5274 BAHWAN MB
E

Imtac LLC
P.O. Box 8676
MUTRAH/SULTANATE OF OMAN
Tel: 601695
Telex: 5741 Tawoos On
A,C,M

PAKISTAN

Mushko & Company Ltd.
House No. 16, Street No. 16
Sector F-6/3
ISLAMABAD
Tel: 824545
Cable: FEMUS Islamabad
A,E,M,P*

Mushko & Company Ltd.
Oosman Chambers
Abdullah Haroon Road
KARACHI 0302
Tel: 524131, 524132
Telex: 2894 MUSKO PK
Cable: COOPERATOR Karachi
A,E,M,P*

PANAMA

Electronico Balboa, S.A.
Calle Samuel Lewis, Ed. Alfa
Apartado 4929
PANAMA 5
Tel: 64-2700
Telex: 3483 ELECTRON PG
A,CM,E,M,P

PERU

Cía Electro Médica S.A.
Los Flamencos 145, Ofc. 301/2
San Isidro
Casilla 1030
LIMA 1
Tel: 41-4325, 41-3705
Telex: Pub. Booth 25306 PEC PISIDR
CM,E,M,P

SAMS
Arenida Republica de Panama 3534
San Isidro, LIMA
Tel: 419928/417108
Telex: 20450 PE LIBERTAD
A,C,P

PHILIPPINES

The Online Advanced Systems Corp.
2nd Floor, Electra House
115-117 Esteban Street
Legaspi Village, Makati
P.O. Box 1510
Metro **MANILA**
Tel: 815-38-10 (up to 16)
Telex: 63274 ONLINE PN
A,C,E,M,P

PORTUGAL

Mundinter Intercambio
Mundial de Comércio S.A.R.L.
Av. Antonio Augusto Aguiar 138
Apartado 2761
LISBON
Tel: (19) 53-21-31, 53-21-37
Telex: 16691 munter p
M

Soquimica
Av. da Liberdade, 220-2
1298 **LISBOA** Codex
Tel: 56-21-82
Telex: 13316 SABASA
A

Telectra-Empresa Técnica de Equipmentos Eléctricos S.A.R.L.
Rua Rodrigo da Fonseca 103
P.O. Box 2531
LISBON 1
Tel: (19) 68-60-72
Telex: 12598
CM,E

C.P.C.S.I.
Rua de Costa Cabral 575
4200 **PORTO**
Tel: 499174/495173
Telex: 26054
C,P

PUERTO RICO

Hewlett-Packard Puerto Rico
101 Muñoz Rivera Av
Esu. Calle Ochoa
HATO REY, Puerto Rico 00918
Tel: (809) 754-7800
A,C,CM,M,E,P

QATAR

Computer Arabia
P.O. Box 2750
DOHA
Tel: 428555
Telex: 4806 CHPARB
P

Nasser Trading & Contracting
P.O.Box 1563
DOHA
Tel: 422170
Telex: 4439 NASSER DH
M

SAUDI ARABIA

Modern Electronics Establishment
Hewlett-Packard Division
P.O. Box 281
Thouqbah
AL-KHOBAR 31952
Tel: 895-1760, 895-1764
Telex: 671 106 HPMEEK SJ
Cable: ELECTA AL-KHOBAR
C,E,M

Modern Electronics Establishment
Hewlett-Packard Division
P.O. Box 1228
JEDDAH
Tel: 644 96 28
Telex: 4027 12 FARNAS SJ
Cable: ELECTA JEDDAH
A,C,CM,E,M,P

Modern Electronics Establishment
Hewlett-Packard Division
P.O.Box 22015
RIYADH 11495
Tel: 476-3030
Telex: 202049 MEERYD SJ
A,C,CM,E,M,P

Abdul Ghani El Ajou Corp.
P.O. Box 78
RIYADH
Tel: 40 41 717
Telex: 200 931 EL AJOU
P

SCOTLAND

See United Kingdom

SENEGAL

Societe Hussein Ayad & Cie.
76, Avenue Georges Pompidou
B.P. 305
DAKAR
Tel: 32339
Cable: AYAD-Dakar
E

Moneger Distribution S.A.
1, Rue Parent
B.P. 148
DAKAR
Tel: 215 671
Telex: 587
P

Systeme Service Conseil (SSC)
14, Avenue du Parachois
DAKAR ETOILE
Tel: 219976
Telex: 577
C,P

SINGAPORE

Hewlett-Packard Singapore (Sales) Pte. Ltd.
08-00 Inchcape House
450-2 Alexandra Road
Alexandra P.O. Box 58
SINGAPORE, 9115
Tel: 4731788
Telex: 34209 HPSGSO RS
Cable: HEWPACK, Singapore
A,C,E,M,P

Dynamar International Ltd.
Unit 05-11 Block 6
Kolam Ayer Industrial Estate
SINGAPORE 1334
Tel: 747-6188
Telex: 26283 RS
CM

SOUTH AFRICA

Hewlett-Packard So Africa (Pty.) Ltd.
P.O. Box 120
Howard Place **CAPE PROVINCE** 7450
Pine Park Center, Forest Drive, Pinelands
CAPE PROVINCE 7405
Tel: (021) 53 7954
Telex: 57-20006
A,C,CM,E,M,P

Hewlett-Packard So Africa (Pty.) Ltd.
2nd Floor Juniper House
92 Overport Drive
DURBAN 4067
Tel: (031) 28-4178
Telex: 6-22954
C

Hewlett-Packard So Africa (Pty.) Ltd.
6 Linton Arcade
511 Cape Road
Linton Grange
PORT ELIZABETH 6001
Tel: 041-301201
Telex: 24-2916
C

SALES & SUPPORT OFFICES
Arranged alphabetically by country

SOUTH AFRICA (Cont'd)

Hewlett-Packard So Africa (Pty.) Ltd.
Fountain Center
Kalkden Str.
Monument Park Ext 2
PRETORIA 0105
Tel: (012) 45 57258
Telex: 3-21063
C,E

Hewlett-Packard So Africa (Pty.) Ltd.
Private Bag Wendywood
SANDTON 2144
Tel: 802-5111, 802-5125
Telex: 4-20877 SA
Cable: HEWPACK Johannesburg
A,C,CM,E,M,P

SPAIN

Hewlett-Packard Española S.A.
Calle Entenza, 321
08029 **BARCELONA**
Tel: 3/322 24 51, 321 73 54
Telex: 52603 hpbee
A,C,E,M,P

Hewlett-Packard Española S.A.
Calle San Vicente S/N
Edificio Albia II-7B
48001 **BILBAO**
Tel: 4/423 83 06
A,C,E,M

Hewlett-Packard Española S.A.
Crta. de la Coruña, Km. 16, 400
Las Rozas
E-**MADRID**
Tel: (1) 637.00.11
Telex: 23515 HPE
C,M

Hewlett-Packard Española S.A.
Avda. S. Francisco Javier, S/N
Planta 10. Edificio Sevilla 2
41005 **SEVILLA**
Tel: 54/64 44 54
Telex: 72933
A,C,M,P

Hewlett-Packard Española S.A.
Isabel La Catolica, 8
46004 **VALENCIA**
Tel: 0034/6/351 59 44
C,P

SWEDEN

Hewlett-Packard Sverige AB
Ostra Tullgatan 3
S-21128 **MALMÖ**
Tel: (040) 70270
Telex: (854) 17886 (via Spånga office)
C,P

Hewlett-Packard Sverige AB
Skalholtsgatan 9, Kista
Box 19
S-16393 **SPÅNGA**
Tel: (08) 750-2000
Telex: (854) 17886
Telefax: (08) 7527781
A,C,CM,E,M,P

Hewlett-Packard Sverige AB
Frötallsgatan 30
S-42132 **VÄSTRA-FRÖLUNDA** (Gothenburg)
Tel: (031) 49-09-50
Telex: (854) 17886 (via Spånga office)
A,C,CM,E,M,P

SUDAN

Mediterranean Engineering & Trading Co. Ltd.
P.O. Box 1025
KHARTOUM
Tel: 41184
Telex: 24052
C,P

SWITZERLAND

Hewlett-Packard (Schweiz) AG
Clarastrasse 12
CH-4058 **BASEL**
Tel: (61) 33-59-20
A

Hewlett-Packard (Schweiz) AG
7, rue du Bois-du-Lan
Case postale 365
CH-1217 **MEYRIN** 1
Tel: (0041) 22-83-11-11
Telex:27333 HPAG CH
C,CM

Hewlett-Packard (Schweiz) AG
Allmend 2
CH-8967 **WIDEN**
Tel: (0041) 57 31 21 11
Telex: 53933 hpag ch
Cable: HPAG CH
A,C,CM,E,M,P

SYRIA

General Electronic Inc.
Nuri Basha Ahnaf Ebn Kays Street
P.O. Box 5781
DAMASCUS
Tel: 33-24-87
Telex: 411 215
Cable: ELECTROBOR DAMASCUS
E

Middle East Electronics
P.O.Box 2308
Abu Rumaneh
DAMASCUS
Tel: 33 45 92
Telex: 411 771
M

TAIWAN

Hewlett-Packard Taiwan
Kaohsiung Office
11/F, 456, Chung Hsiao 1st Road
KAOHSIUNG
Tel: (07) 2412318
C,E

Hewlett-Packard Taiwan
8th Floor, Hewlett-Packard Building
337 Fu Hsing North Road
TAIPEI
Tel: (02) 712-0404
Telex: 24439 HEWPACK
Cable:HEWPACK Taipei
A,C,CM,E,M,P

Ing Lih Trading Co.
3rd Floor, 7 Jen-Ai Road, Sec. 2
TAIPEI 100
Tel: (02) 3948191
Cable: INGLIH Taipei
A

THAILAND

Unimesa Co. Ltd.
30 Patpong Ave., Suriwong
BANGKOK 5
Tel: 235-5727
Telex: 84439 Simonco TH
Cable: UNIMESA Bangkok
A,C,E,M

Bangkok Business Equipment Ltd.
5/5-6 Dejo Road
BANGKOK
Tel: 234-8670, 234-8671
Telex: 87699-BEQUIPT TH
Cable: BUSIQUIPT Bangkok
P

TOGO

Societe Africaine De Promotion
Immeuble Sagap
22, Rue d'Atakpame
B.P. 4150
LOME
Tel: 21-62-88
Telex: 5304
P

TRINIDAD & TOBAGO

Caribbean Telecoms Ltd.
Corner McAllister Street & Eastern Main Road, Laventille
P.O. Box 732
PORT-OF-SPAIN
Tel: 624-4213
Telex: 22561 CARTEL WG
Cable: CARTEL, PORT OF SPAIN
CM,E,M,P

Computer and Controls Ltd.
P.O. Box 51
66 Independence Square
PORT-OF-SPAIN
Tel: 62-279-85
Telex: 3000 POSTLX WG, ACCT LOO9O AGENCY 1264
A,P

Feral Assoc.
8 Fitzgerald Lane
PORT-OF-SPAIN
Tel: 62-36864, 62-39255
Telex: 22432 FERALCO
Cable: FERALCO
M

TUNISIA

Precision Electronique S.A.R.L.
31 Avenue de la Liberte
TUNIS
Tel: 893937
Telex: 13238
P

Tunisie Electronique S.A.R.L.
94, Av. Jugurtha, Mutuelleville
1002 **TUNIS-BELVEDERE**
Tel: 280144
Telex: 13238
C,E,P

Corema S.A.
23, bis Rue de Marseille
TUNIS
Tel: 253-821
Telex: 14812 CABAM TN
M

TURKEY

E.M.A
Mediha Eldem Sokak No. 41/6
Yenisehir
ANKARA
Tel: 319175
Telex: 46912 KTX TR
Cable: EMATRADE ANKARA
M

Teknim Company Ltd.
Iran Caddesi No. 7
Kavaklidere
ANKARA
Tel: 275800
Telex: 42155 TKNM TR
E,CM

Saniva Bilgisayar Sistemleri A.S.
Buyukdere Caddesi 103/6
Gayrettene
ISTANBUL
Tel: 1727030
Telex: 26345 SANI TR
C,P

Best Inc.
Esentepe, Gazeteciler Sitesi
Keskin Kalemy
Sokak 6/3, Gayrettepe
ISTANBUL
Tel: 1721328
Telex: 42490
A

UNITED ARAB EMIRATES

Emitac Ltd.
P.O. Box 1641
SHARJAH
Tel: 591181
Telex: 68136 EMITAC EM
Cable: EMITAC SHARJAH
E,C,M,P,A

Emitac Ltd.
P.O. Box 2711
ABU DHABI
Tel: 820419-20
Cable: EMITACH ABUDHABI

Emitac Ltd.
P.O. Box 8391
DUBAI,
Tel: 377591

Emitac Ltd.
P.O. Box 473
RAS AL KHAIMAH
Tel: 28133, 21270

UNITED KINGDOM

GREAT BRITAIN

Hewlett-Packard Ltd.
Trafalgar House
Navigation Road
ALTRINCHAM
Cheshire WA14 1NU
Tel: 061 928 6422
Telex: 668068
A,C,E,M,P

Hewlett-Packard Ltd.
Miller House
The Ring, **BRACKNELL**
Berks RG12 1XN
Tel: 0344 424898
Telex: 848733
E

Hewlett-Packard Ltd.
Elstree House, Elstree Way
BOREHAMWOOD, Herts WD6 1SG
Tel: 01 207 5000
Telex: 8952716
C,E

Hewlett-Packard Ltd.
Oakfield House, Oakfield Grove
Clifton **BRISTOL,** Avon BS8 2BN
Tel: 0272 736806
Telex: 444302
C,E,P

Hewlett-Packard Ltd.
Bridewell House
9 Bridewell Place
LONDON EC4V 6BS
Tel: 01 583 6565
Telex: 298163
C,P

Hewlett-Packard Ltd.
Pontefract Road
NORMANTON, West Yorkshire WF6 1RN
Tel: 0924 895566
Telex: 557355
C,P

Hewlett-Packard Ltd.
The Quadrangle
106-118 Station Road
REDHILL, Surrey RH1 1PS
Tel: 0737 68655
Telex: 947234
C,E,P

Hewlett-Packard Ltd.
Avon House
435 Stratford Road
Shirley, **SOLIHULL,** West Midlands
B90 4BL
Tel: 021 745 8800
Telex: 339105
C,E,P

Hewlett-Packard Ltd.
West End House
41 High Street, West End
SOUTHAMPTON
Hampshire S03 3DQ
Tel: 0703 476767
Telex: 477138
C,P

Hewlett-Packard Ltd.
Harmon House
No. 1 George Street
UXBRIDGE, Middlesex UX8 1YH
Tel: 895 720 20
Telex: 893134/5
C,CM,E,M,P

Hewlett-Packard Ltd.
King Street Lane
Winnersh, **WOKINGHAM**
Berkshire RG11 5AR
Tel: 0734 784774
Telex: 847178
A,C,E,M,P

IRELAND

NORTHERN IRELAND

Hewlett-Packard (Ireland) Ltd.
Carrickfergus Industrial Centre
75 Belfast Road, Carrickfergus
BELFAST BT38 8PH
Tel: 09603 67333
Telex: 747626
C,E

SCOTLAND

Hewlett-Packard Ltd.
8 Woodside Place
GLASGOW, G3 7QF
Tel: 041 332 6232
Telex: 779615
C,E

Hewlett-Packard Ltd.
SOUTH QUEENSFERRY
West Lothian, EH30 9TG
Tel: 031 331 1188
Telex: 72682
C,CM,E,M,P

UNITED STATES

Alabama

Hewlett-Packard Co.
700 Century Park South, Suite 128
BIRMINGHAM, AL 35226
Tel: (205) 822-6802
A,C,M,P*

Hewlett-Packard Co.
420 Wynn Drive
HUNTSVILLE, AL 35805
Tel: (205) 830-2000
C,CM,E,M*

Alaska

Hewlett-Packard Co.
3601 C St., Suite 1416
ANCHORAGE, AK 99503
Tel: (907) 563-8855
C,E

Arizona

Hewlett-Packard Co.
8080 Pointe Parkway West
PHOENIX, AZ 85044
Tel: (602) 273-8000
A,C,CM,E,M,P

Hewlett-Packard Co.
3400 East Britannia Dr.
Bldg. C, Suite 124
TUCSON, AZ 85706
Tel: (602) 573-7400
C,E,M**

California

Hewlett-Packard Co.
99 South Hill Dr.
BRISBANE, CA 94005
Tel: (415) 330-2500
C

Hewlett-Packard Co.
5060 E. Clinton Avenue, Suite 102
FRESNO, CA 93727
Tel: (209) 252-9652
C,M

Hewlett-Packard Co.
1421 S. Manhattan Av.
FULLERTON, CA 92631
Tel: (714) 999-6700
C,CM,E,M

Hewlett-Packard Co.
7408 Hollister Ave. #A
GOLETA, CA 93117
Tel: (805) 685-6100
C,E

Hewlett-Packard Co.
5400 W. Rosecrans Blvd.
LAWNDALE, CA 90260
Tel: (213) 643-7500
Telex: 910-325-6608
C,M

Hewlett-Packard Co.
2525 Grand Avenue
Long Beach, CA 90815
Tel: (213) 498-1111
C

Hewlett-Packard Co.
3155 Porter Drive
PALO ALTO, CA 94304
Tel: (415) 857-8000
C,E

Hewlett-Packard Co.
4244 So. Market Court, Suite A
SACRAMENTO, CA 95834
Tel: (916) 929-7222
A*,C,E,M

Hewlett-Packard Co.
9606 Aero Drive
SAN DIEGO, CA 92123
Tel: (619) 279-3200
C,CM,E,M

Hewlett-Packard Co.
5725 W. Las Positas Blvd.
Pleasanton, CA 94566
Tel: (415) 460-0282
C

Hewlett-Packard Co.
3003 Scott Boulevard
SANTA CLARA, CA 95054
Tel: (408) 988-7000
Telex: 910-338-0586
A,C,CM,E

Hewlett-Packard Co.
2150 W. Hillcrest Dr.
THOUSAND OAKS, CA 91320
(805) 373-7000
C,CM,E

Colorado

Hewlett-Packard Co.
2945 Center Green Court South
Suite A
BOULDER, CO 80301
Tel: (303) 938-3005
A,C,E

Hewlett-Packard Co.
24 Inverness Place, East
ENGLEWOOD, CO 80112
Tel: (303) 649-5000
A,C,CM,E,M

Connecticut

Hewlett-Packard Co.
500 Sylvan Av.
BRIDGEPORT, CT 06606
Tel: (203) 371-6454
C,E

Hewlett-Packard Co.
47 Barnes Industrial Road South
WALLINGFORD, CT 06492
Tel: (203) 265-7801
A,C,CM,E,M

Florida

Hewlett-Packard Co.
2901 N.W. 62nd Street
FORT LAUDERDALE, FL 33309
Tel: (305) 973-2600
C,E,M,P*

Hewlett-Packard Co.
6800 South Point Parkway
Suite 301
JACKSONVILLE, FL 32216
Tel: (904) 398-0663
C*,M**

Hewlett-Packard Co.
6177 Lake Ellenor Drive
ORLANDO, FL 32809
Tel: (305) 859-2900
A,C,CM,E,P*

Hewlett-Packard Co.
4700 Bayou Blvd.
Building 5
PENSACOLA, FL 32503
Tel: (904) 476-8422
A,C,M

Hewlett-Packard Co.
5550 W. Idlewild, 150
TAMPA, FL 33614
Tel: (813) 884-3282
C,E,M,P

Georgia

Hewlett-Packard Co.
2000 South Park Place
ATLANTA, GA 30339
Tel: (404) 955-1500
Telex: 810-766-4890
A,C,CM,E,M,P*

Hewlett-Packard Co.
3607 Parkway Lane
Suite 300
NORCROSS, GA 30092
Tel: (404) 448-1894
C,E,P

Hawaii

Hewlett-Packard Co.
Kawaiahao Plaza, Suite 190
567 South King Street
HONOLULU, HI 96813
Tel: (808) 526-1555
A,C,E,M

Idaho

Hewlett-Packard Co.
11309 Chinden Blvd.
BOISE, ID 83707
Tel: (208) 323-2700
C

Illinois

Hewlett-Packard Co.
304 Eldorado Road
P.O. Box 1607
BLOOMINGTON, IL 61701
Tel: (309) 662-9411
C,M**

Hewlett-Packard Co.
525 W. Monroe, 1308
CHICAGO, IL 60606
Tel: (312) 930-0010
C

Hewlett-Packard Co.
1200 East Diehl Road
NAPERVILLE, IL 60566
Tel: (312) 357-8800
C

Hewlett-Packard Co.
5201 Tollview Drive
ROLLING MEADOWS, IL 60008
Tel: (312) 255-9800
Telex: 910-687-1066
A,C,CM,E,M

Indiana

Hewlett-Packard Co.
11911 N. Meridian St.
CARMEL, IN 46032
Tel: (317) 844-4100
A,C,CM,E,M

Hewlett-Packard Co.
3702 Rupp Drive
FT. WAYNE, IN 46815
Tel: (219) 482-4283
C,E

Iowa

Hewlett-Packard Co.
4070 22nd Av. SW
CEDAR RAPIDS, IA 52404
Tel: (319) 390-4250
C,E,M

Hewlett-Packard Co.
4201 Corporate Dr.
WEST DES MOINES, IA 50265
Tel: (515) 224-1435
A**,C,M**

Kansas

Hewlett-Packard Co.
7804 East Funston Road, 203
WICHITA, KS 67207
Tel: (316) 684-8491
C,E

Kentucky

Hewlett-Packard Co.
10300 Linn Station Road, 100
LOUISVILLE, KY 40223
Tel: (502) 426-0100
A,C,M

Louisiana

Hewlett-Packard Co.
160 James Drive East
ST. ROSE, LA 70087
P.O. Box 1449
KENNER, LA 70063
Tel: (504) 467-4100
A,C,E,M,P

Maryland

Hewlett-Packard Co.
3701 Koppers Street
BALTIMORE, MD 21227
Tel: (301) 644-5800
Telex: 710-862-1943
A,C,CM,E,M

Hewlett-Packard Co.
2 Choke Cherry Road
ROCKVILLE, MD 20850
Tel: (301) 948-6370
A,C,CM,E,M

Massachusetts

Hewlett-Packard Co.
1775 Minuteman Road
ANDOVER, MA 01810
Tel: (617) 682-1500
A,C,CM,E,M,P*

Hewlett-Packard Co.
32 Hartwell Avenue
LEXINGTON, MA 02173
Tel: (617) 861-8960
C,E

Michigan

Hewlett-Packard Co.
4326 Cascade Road S.E.
GRAND RAPIDS, MI 49506
Tel: (616) 957-1970
C,M

Hewlett-Packard Co.
39550 Orchard Hill Place Drive
NOVI, MI 48020
Tel: (313) 349-9200
A,C,E,M

Hewlett-Packard Co.
1771 W. Big Beaver Road
TROY, MI 48084
Tel: (313) 643-6474
C

Minnesota

Hewlett-Packard Co.
2025 W. Larpenteur Ave.
ST. PAUL, MN 55113
Tel: (612) 644-1100
A,C,CM,E,M

Missouri

Hewlett-Packard Co.
1001 E. 101st Terrace Suite 120
KANSAS CITY, MO 64131-3368
Tel: (816) 941-0411
A,C,CM,E,M

Hewlett-Packard Co.
13001 Hollenberg Drive
BRIDGETON, MO 63044
Tel: (314) 344-5100
A,C,E,M

Nebraska

Hewlett-Packard
10824 Old Mill Rd., Suite 3
OMAHA, NE 68154
Tel: (402) 334-1813
C,E,M

New Jersey

Hewlett-Packard Co.
120 W. Century Road
PARAMUS, NJ 07653
Tel: (201) 265-5000
A,C,CM,E,M

Hewlett-Packard Co.
20 New England Av. West
PISCATAWAY, NJ 08854
Tel: (201) 562-6100
A,C,CM,E

New Mexico

Hewlett-Packard Co.
7801 Jefferson N.E.
ALBUQUERQUE, NM 87109
Tel: (505) 292-1330
C,E,M

New York

Hewlett-Packard Co.
5 Computer Drive South
ALBANY, NY 12205
Tel: (518) 458-1550
A,C,E,M

Hewlett-Packard Co.
9600 Main Street
CLARENCE, NY 14031
Tel: (716) 759-8621
C,E

Hewlett-Packard Co.
200 Cross Keys Office Park
FAIRPORT, NY 14450
Tel: (716) 223-9950
A,C,CM,E,M

Hewlett-Packard Co.
7641 Henry Clay Blvd.
LIVERPOOL, NY 13088
Tel: (315) 451-1820
A,C,CM,E,M

Hewlett-Packard Co.
No. 1 Pennsylvania Plaza
55th Floor
34th Street & 8th Avenue
MANHATTAN NY 10119
Tel: (212) 971-0800
C,M*

Hewlett-Packard Co.
15 Myers Corner Rd.
Hollowbrook Park, Suite 20
WAPPINGER FALLS, NY 12590
CM,E

Hewlett-Packard Co.
250 Westchester Avenue
WHITE PLAINS, NY 10604
Tel: (914) 684-6100
C,CM,E

Hewlett-Packard Co.
3 Crossways Park West
WOODBURY, NY 11797
Tel: (516) 682-7800
A,C,CM,E,M

SALES & SUPPORT OFFICES
Arranged alphabetically by country

UNITED STATES (Cont'd)

North Carolina
Hewlett-Packard Co.
305 Gregson Dr.
CARY, NC 27511
Tel: (919) 467-6600
C,CM,E,M,P*

Hewlett-Packard Co.
9600-H Southern Pine Blvd.
CHARLOTTE, NC 28210
Tel: (704) 527-8780
C*

Hewlett-Packard Co.
5605 Roanne Way
GREENSBORO, NC 27420
Tel: (919) 852-1800
A,C,CM,E,M,P*

Ohio
Hewlett-Packard Co.
2717 S. Arlington Road
AKRON, OH 44312
Tel: (216) 644-2270
C,E

Hewlett-Packard Co.
23200 Chagrin Blvd #100
BEACHWOOD, OH 44122
Tel: (216) 292-4677
C,P

Hewlett-Packard Co.
9920 Carver Road
CINCINNATI, OH 45242
Tel: (513) 891-9870
C,M

Hewlett-Packard Co.
16500 Sprague Road
CLEVELAND, OH 44130
Tel: (216) 243-7300
A,C,CM,E,M

Hewlett-Packard Co.
9080 Springboro Pike
MIAMISBURG, OH 45342
Tel: (513) 433-2223
A,C,CM,E*,M

Hewlett-Packard Co.
One Maritime Plaza, 5th Floor
720 Water Street
TOLEDO, OH 43604
Tel: (419) 242-2200
C

Hewlett-Packard Co.
675 Brooksedge Blvd.
WESTERVILLE, OH 43081
Tel: (614) 891-3344
C,CM,E*

Oklahoma
Hewlett-Packard Co.
3525 N.W. 56th St.
Suite C-100
OKLAHOMA CITY, OK 73112
Tel: (405) 946-9499
C,E*,M

Hewlett-Packard Co.
3840 S. 103rd E. Ave., 100
TULSA, OK 74146
Tel: (918) 665-3300
A**,C,E,M*,P*

Oregon
Hewlett-Packard Co.
9255 S. W. Pioneer Court
WILSONVILLE, OR 97070
Tel: (503) 682-8000
A,C,E*,M

Pennsylvania
Hewlett-Packard Co.
50 Dorchester Rd.
HARRISBURG, PA 17112
Tel: (717) 657-5900
C

Hewlett-Packard Co.
111 Zeta Drive
PITTSBURGH, PA 15238
Tel: (412) 782-0400
A,C,E,M

Hewlett-Packard Co.
2750 Monroe Boulevard
VALLEY FORGE, PA 19482
Tel: (215) 666-9000
A,C,CM,E,M

South Carolina
Hewlett-Packard Co.
Brookside Park, Suite 122
1 Harbison Way
COLUMBIA, SC 29210
Tel: (803) 732-0400
C,M

Hewlett-Packard Co.
555 N. Pleasantburg Dr.
Suite 107
GREENVILLE, SC 29607
Tel: (803) 232-8002
C

Tennessee
Hewlett-Packard Co.
One Energy Centr. 200
Pellissippi Pkwy.
KNOXVILLE, TN 37932
Tel: (615) 966-4747
A,C,M

Hewlett-Packard Co.
3070 Directors Row
Directors Square
MEMPHIS, TN 38131
Tel: (901) 346-8370
A,C,M

Hewlett-Packard Co.
220 Great Circle Road, Suite 116
NASHVILLE, TN 37228
Tel: (615) 255-1271
C,M,P*

Texas
Hewlett-Packard Co.
1826-P Kramer Lane
AUSTIN, TX 78758
Tel: (512) 835-6771
C,E,P*

Hewlett-Packard Co.
5700 Cromo Dr
EL PASO, TX 79912
Tel: (915) 833-4400
C,E*,M**

Hewlett-Packard Co.
3952 Sandshell Drive
FORT WORTH, TX 76137
Tel: (817) 232-9500
C

Hewlett-Packard Co.
10535 Harwin Drive
HOUSTON, TX 77036
Tel: (713) 776-6400
A,C,E,M,P*

Hewlett-Packard Co.
511 E. John W. Carpenter Fwy.
Royal Tech. Center 100
IRVING, TX 75062
Tel: (214) 556-1950
C,E

Hewlett-Packard Co.
109 E. Toronto, Suite 100
McALLEN, TX 78503
Tel: (512) 630-3030
C

Hewlett-Packard Co.
930 E. Campbell Rd.
RICHARDSON, TX 75081
Tel: (214) 231-6101
A,C,CM,E,M,P*

Hewlett-Packard Co.
1020 Central Parkway South
SAN ANTONIO, TX 78216
Tel: (512) 494-9336
A,C,E,M,P*

Utah
Hewlett-Packard Co.
3530 W. 2100 South
SALT LAKE CITY, UT 84119
Tel: (801) 974-1700
A,C,E,M

Virginia
Hewlett-Packard Co.
4305 Cox Road
GLEN ALLEN, VA 23060
Tel: (804) 747-7750
A,C,E,M,P*

Hewlett-Packard Co.
Tanglewood West Bldg.
Suite 240
3959 Electric Road
ROANOKE, VA 24018
Tel: (703) 774-3444
C,E,P

Washington
Hewlett-Packard Co.
15815 S.E. 37th Street
BELLEVUE, WA 98006
Tel: (206) 643-4000
A,C,CM,E,M

Hewlett-Packard Co.
708 North Argonne Road
SPOKANE, WA 99212-2793
Tel: (509) 922-7000
C

West Virginia
Hewlett-Packard Co.
501 56th
CHARLESTON, WV 25304
Tel: (304) 925-0492
A,C,M

Wisconsin
Hewlett-Packard Co.
275 N. Corporate Dr.
BROOKFIELD, WI 53005
Tel: (414) 784-8800
A,C,E*,M

URUGUAY
Pablo Ferrando S.A.C. e I.
Avenida Italia 2877
Casilla de Correo 370
MONTEVIDEO
Tel: 80-2586
Telex: 802586
A,CM,E,M

Olympia de Uruguay S.A.
Maquines de Oficina
Avda. del Libertador 1997
Casilla de Correos 6644
MONTEVIDEO
Tel: 91-1809, 98-3807
Telex: 6342 OROU UY
P

VENEZUELA
Hewlett-Packard de Venezuela C.A.
3A Transversal Los Ruices Norte
Edificio Segre 2 & 3
Apartado 50933
CARACAS 1071
Tel: 239-4133
Telex: 251046 HEWPACK
A,C,CM,E,M,P

Hewlett-Packard de Venezuela, C.A.
Centro Civdad Comercial Tamanaco
Nivel C-2 (Nueva Etapa)
Local 53H05
Chuao, **CARACAS**
Tel: 928291
P

Albis Venezolana S.R.L.
Av. Las Marias, Ota. Alix,
El Pedregal
Apartado 81025
CARACAS 1080A
Tel: 747984, 742146
Telex: 24009 ALBIS VC
A

Tecnologica Medica del Caribe, C.A.
Multicentro Empresarial del Este
Ave. Libertador
Edif. Libertador
Nucleo "C" - Oficina 51-52
CARACAS
Tel: 339867/333780
M

Hewlett-Packard de Venezuela C.A.
Residencias Tia Betty Local 1
Avenida 3 y con calfe 75
MARACAIBO, Estado Zulia
Apartado 2646
Tel: (061) 75801-75805-75806-80304
Telex: 62464 HPMAR
C,E*

Hewlett-Packard de Venezuela C.A.
Urb. Lomas de Este
Torre Trebol — Piso 11
VALENCIA, Estado Carabobo
Apartado 3347
Tel: (041) 222992/223024
C,P

YUGOSLAVIA
Do Hermes
General Zdanova 4
YU-11000 **BEOGRAD**
Tel: 340 327, 342 641
Telex: 11433
A,C,E,P

Hermes
Titova 50
YU-61000 **LJUBLJANA**
Tel: 324 856, 324 858
Telex: 31583
C,E,M,P

Elektrotehna
Titova 51
YU-61000 **LJUBLJANA**
CM

ZAIRE
Computer & Industrial Engineering
25, Avenue de la Justice
B.P. 12797
KINSHASA, Gombe
Tel: 32063
Telex: 21552
C,P

ZAMBIA
R.J. Tilbury (Zambia) Ltd.
P.O. Box 32792
LUSAKA
Tel: 215590
Telex: 40128
E

ZIMBABWE
Field Technical Sales (Private) Limited
45, Kelvin Road North
P.O. Box 3458
HARARE
Tel: 705 231
Telex: 4-122 RH
E,P

Manual Part Number: 30242-90003
Printed in U.S.A., August 1987
Edition 2
E0887

HEWLETT
PACKARD