HEWLETT PACKARD

Diagnostic and Verification Manual

HP 2250 Measurement and Control

MANUAL UPDATE

MANUAL IDENTIFICATION

Title: HP 2250 Measurement and Control Processor Diagnostic and Verification Manual
Part Number: 25595-90001

UPDATE IDENTIFICATION

Update Number 1 (September 1982)

This Update Goes With: First edition (March 1981)

THE PURPOSE OF THIS MANUAL UPDATE

is to provide new information for your manual to bring it up to date. This is important because it ensures that your manual accurately documents the current version of the product.

THIS UPDATE CONSISTS OF

this cover sheet, a printing history page, all replacement pages, and write-in instructions (if any). Replacement pages are identified by the update number at the bottom of the page. A vertical line (change bar) in the outside margin indicates new or changed text material. The change bar is not used for typographical or editorial changes that do not affect the text.

TO UPDATE YOUR MANUAL

identify the latest update (if any) already contained in your manual by referring to the printing history page. Incorporate only the updates from this packet not already included in your manual. Following the instructions on the back of this page, replace existing pages with the update pages and insert new pages as indicated. If any page is changed in two or more updates, such as the printing history page which is furnished new for each update, only the latest page will be included in the update package. Destroy all replaced pages. If "write-in" instructions are included they are listed on the back of this page.

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TECHNICAL MANUAL UPDATE
(25595-90001)

Note that "*" indicates a changed page.

UPDATE DESCRIPTION

1 A. Insert the following replacement pages in place of existing pages:

title* / ii*	3-7* / 3-8*
iii* / iv*	B-35* / B-36*
v* / blank	B-37* / B-38*
1-1* / 1-2*	C-11* / C-12*
1-3* / blank	C-13* / C-14*
3-3* / 3-4	C-15* / C-16*

B. Change "Programmer's Reference Manual" to "Hardware Reference Manual" in the following locations:

page B-10 (first paragraph under "Notes")
page B-15 (first paragraph under "Notes")
page B-20 (first paragraph under "Notes")
page B-25 (first paragraph under "Notes")

HP 2250
Measurement and Control Processor Diagnostic and Verification Manual

HEWLETT PACKARD

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PRINTING HISTORY

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First edition ..... March 1981
Update 1 ..... September 1982

Preface

Purpose:

This manual tells you how to run the HP 2250 diagnostic programs. These programs test the controller cards and the function cards of the HP 2250 measurement and control processor, and either verify that the cards are functioning properly or indicate problem areas on the cards.

Assumptions:

This manual assumes that you are familiar with the basic set-up and function of the HP 2250 hardware. If you need further information on these topics, refer to the manuals listed below.

Organization:

This manual is divided into four sections and three appendices, as follows:

Chapter 1 - Introduction: briefly describes the types of diagnostic programs available for the HP 2250.

Chapter 2 - Self-test: tells how to run the HP 2250 self-test.

Chapter 3 - Level 1 diagnostics: tells how to set up and run the level 1 diagnostic programs.

Chapter 4 - Level 2 diagnostics: tells how to set up and run the level 2 diagnostic programs.

Appendix A - Self-test error messages.

Appendix B - Level 1 error messages.

Appendix C - Level 2 error messages.

Related Reading:

You can find additional information on the HP 2250 in these manuals:

1. HP 2250 Measurement and Control Processor Programmer's Manual, part number 25580-90001
2. HP 2250 Measurement and Control Processor System Introduction Manual, part number 02250-90011

3. HP 2250 Measurement and Control Processor Installation and Start-Up Manual, part number 02250-90012

4. HP 2250 Measurement and Control Processor Hardware Reference Manual, part number 02250-90001

5. HP 25581A Automation Library Manual, part number 25581-90001

Table of Contents

Chapter 1
Introduction

1.1 INTRODUCTION

This manual provides information for verifying the operation of the HP 2250 Measurement and Control Processor (or simply HP 2250) and its measurement and control function cards. The verification tests are divided into three main categories: HP 2250 self-test, level 1 diagnostic testing (without using the HP 25590A Diagnostic Interface Unit), and level 2 diagnostic testing (using the HP 25590A Diagnostic Interface Unit). The HP 25590A Diagnostic Interface Unit (DIU) is an external test unit used for making extensive tests on the function cards.

The self-test is performed automatically during power-up of the HP 2250. The self-test consists of firmware routines permanently residing in the ROMs of the HP 12070A RRACK memory card and the HP 12001D processor card. These tests detect a large percentage of hardware faults and return a limited amount of error information on the HP 12001D processor card LEDs and the HP 2250 status panel. The LEDs on the status panel correspond directly to those on the processor card (leftmost LED on processor card = top LED on status panel).

The level 1 and level 2 diagnostics are loaded from magnetic tape cartridges which are inserted into a terminal tape drive. These diagnostics consist of detailed software routines to not only detect more hardware faults but to return more detailed error information on the fault. These tests are executed off-line; that is, the HP 2250 is not performing measurement and control functions while the tests are running.

The level 1 diagnostics provide a general interface test of the measurement and control function cards; the level 2 diagnostics provide an in-depth test of the operation of the function cards themselves by use of the DIU. The function cards are listed in Table 1-1.

Table 1-1. Measurement and Control Function Cards

Analog Function Cards
HP 25501 16-Channel High Speed Analog Input Card
HP 25502 32-Channel High-Level Solid State Multiplexer Card
HP 25503 32-Channel Low-Level Solid State Multiplexer Card
HP 25504 16-Channel Isolated Relay Multiplexer Card
HP 25510 4-Channel Isolated Voltage/Current Analog Output Card
Digital Function Cards
HP 25511 32-Point Digital Input Function Card
HP 25512 Counter Input Card
HP 25513 32-Point Digital Output Function Card
HP 25514 16-Point Relay Output Function Card
HP 25515 4-Channel Pulse Output Card
HP 25516 Digital Multifunction Card

1.2 REQUIRED SOFTWARE

The diagnostic programs, which reside on magnetic tape mini-cartridges, are listed in Table 1-2, showing their file numbers and program names. Option 20 of the HP 25595A product is the diagnostic software formatted for use on an HP 264x terminal. The kernel, RRACK, and MCI/BIF diagnostics are written in assembly language and the rest are written in Diagnostic Design Language (DDL). For more information on DDL, refer to the Diagnostic Design Language User's Guide, part number 24397-90003.

Table 1-2. HP 25595A Diagnostic Programs, Option 20

PART NUMBER	FILE	FILE CONTENTS
Tape 1 (25595-13301)		Controller Cards Diagnostics
	1	Directory File
	2	Software Numbering File (A25595)
24397-16002	3	Kernel Diagnostic
25595-16001	4	Memory Diagnostic
25595-16002	5	MCI/BIF Diagnostic
24397-16009	6	HP-IB Diagnostic
Tape 2 (25595-13302)		Function Cards Diagnostics
	1	Directory File
24397-16003	2	DDL
25595-16003	3	All Analog Cards (level 1)
25595-16007	4	HP 25511 Digital Input (level 1)
25595-16009	5	HP 25513 Digital Output (level 1)
25595-16011	6	HP 25514 Relay Output (level 1)
Tape 3 (25595-13303)		Function Cards Diagnostics
	1	Directory File
24397-16003	2	DDL
25595-16013	3	HP 25516 Dig. Multifunction (level 1)
25595-16015	4	HP 25515 Pulse Output (level 1)
25595-16017	5	HP 25512 Counter Input (level 1)

3. The interface between the terminal and the HP 2250 is provided by an ASIC card and its cable. For the ASIC card to operate as the virtual control panel (VCP), set its switch U1S1 to the closed (down) position. Set U1S3 through U1S8 (S8 is the least significant bit) to octal 20. See figure 3-1 for the location of switch U1, the select code switch.

   In addition, if you are using an HP-85 and a DIU, set switch U21S7 on the ASIC card to the closed (down) position and switch U21S8 to the open (up) position to supply the clock signal from the ASIC card to the DIU (for level 2 diagnostics). Switch U21 is located on the side of the ASIC card, directly behind the select code switch.

   Next insert the ASIC card into the backplane of the processor unit. Place the card in the first vacant slot following the controller cards.

   How you connect the ASIC card to the terminal depends on whether or not you plan to use a DIU (for running level 2 diagnostics). If you don't use a DIU, simply connect the terminal to the ASIC card using an RS-232 cable that has an edge connector on each end. If you do use a DIU, follow the set-up instructions in the next chapter.

4. Set the HP 2250 and the HP 264x-series terminal POWER to ON. When power is restored, the HP 2250 scans the controller cards in the card cage and records their select codes. These select codes will be used when the diagnostics are executed.

5. Press the BREAK key on the terminal to enter VCP mode. Then enter "%P" to preset the controller cards in the HP 2250.

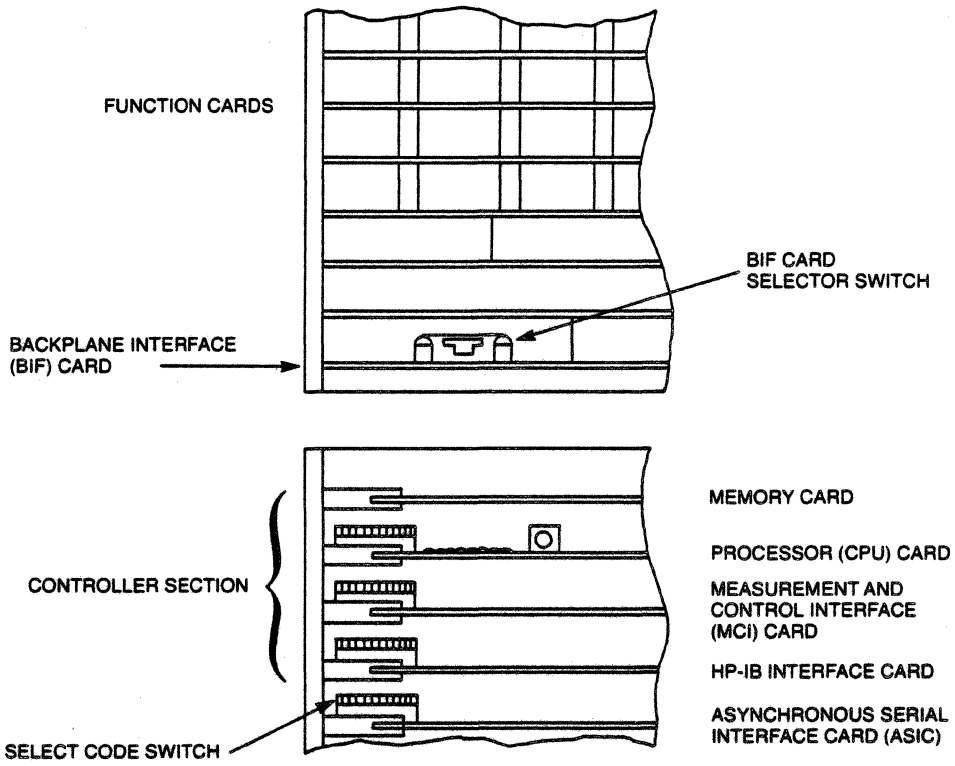


Figure 3-1. Location of Select Code Switches

3.2 LOADING AND RUNNING THE DIAGNOSTICS

All HP 2250 diagnostic programs are supplied in absolute binary form on a series of mini-cartridge tapes. Table 1-2 shows which tapes contain which diagnostics. The first three diagnostics (kernel, memory, and MCI/BIF) are written in assembly language; the remainder (HP-IB and all function cards) are written in Diagnostic Design Language (DDL). The difference in source language causes a slight difference in loading procedure, as you will see below. We will first describe the loading and execution of the controller card diagnostics, and then the loading and execution of the level 1 function card diagnostics.

3.2.1.3 MCI/BIF Diagnostic

The MCI/BIF diagnostic is an assembly language routine that tests the functioning of the MCI and BIF cards. To run the MCI/BIF diagnostic, take the following steps:

1) Insert the tape containing the diagnostic into the cartridge tape unit of the terminal. If you are using an HP 264x-series terminal, use the LEFT cartridge tape unit; the VCP commands given here operate on the left tape unit.

2) Press the BREAK key to enter VCP mode. The terminal will respond by displaying the contents of five CPU registers.

3) Load the diagnostic by entering "%LCTn", where n is the file number of the diagnostic on tape. The terminal will respond "LC" to indicate that the load is complete.

4) Execute the MCI/BIF diagnostic by entering "%E". The diagnostic will run and, if there are no errors, it will return to VCP mode and display a HALT 77 (octal 102077) in the T register. If, at this point, you want the diagnostic to loop continuously, enter "T 0" to set the T register to zero, and then enter "%R". The diagnostic will then loop continuously and display the number of successful passes on the terminal. You can ignore the TEST 30 warning for a disconnected test hood; such a test hood is used only at the factory.

   If the diagnostic encounters an error it will display an error message on the terminal. It will also display an error message in octal numbers on the LEDs of the status panel. Meanings of the error messages are given in appendix B of this manual. With the exception of the TEST 30 warning mentioned above, any errors encountered by the diagnostic are fatal; that is, the diagnostic halts after the error and can not continue. You can return to VCP mode by pressing the BREAK key.

   You can interrupt the diagnostic at any time by pressing the BREAK key. This will stop the diagnostic and return you to VCP mode. You can restart the diagnostic by entering "%E".

   Note that the MCI/BIF diagnostic can test only one MCI/BIF combination at a time, and that the box index for the BIF card (as set by the thumbwheel switch on the left side of the card) must be zero. If you want to test more than one BIF card, you must set the box index of each card to zero in turn (while disconnecting all other BIF cards) and run the

diagnostic to test that MCI/BIF combination. After you finish running the MCI/BIF diagnostic, remember to set up the BIF cards the way they were when you started.

3.2.1.4 HP-IB Diagnostic

The HP-IB diagnostic is a DDL diagnostic that tests the functioning of the HP-IB card. To run the HP-IB diagnostic, take the following steps:

1) Insert the tape containing the diagnostic into the cartridge tape unit of the terminal. If you are using an HP 264x-series terminal, use the LEFT cartridge tape unit; the VCP commands given here operate on the left tape unit.

2) Press the BREAK key to enter VCP mode. The terminal will respond by displaying the contents of five CPU registers.

3) Load the diagnostic. Note that the diagnostic file on tape includes the DDL interpreter program. (DDL reads and executes the diagnostic code.) Load the diagnostic by entering "%LCTn", where n is the file number of the HP-IB diagnostic on the tape. The terminal will respond "LC" to indicate that the load is complete.

129-144). Error R1 indicates that the value of the interrupt status register was not the same as the expected value, and an additional line indicates which type of register was being tested.

The value of register 242 should have been zero. Error R2 indicates that it was not zero.

ERROR R3: INTERRUPT REG NOT CLEARING

The diagnostic read the interrupt status register (register 241) twice in succession. The register should have been cleared after the first read, leaving a value of zero in the register. Error R3 indicates that the value obtained by the second read was not zero.

B.3.5 HP 25512 Counter Card Diagnostic

Both the internal (level 1) and external (level 2) diagnostic tests for the counter card are contained in one diagnostic program. The error messages for both level 1 and level 2 are given in appendix C of this manual.

B.3.6 HP 25515 Pulse Output Card Diagnostic

The level 1 diagnostic program for the pulse card tests the internal workings of the card. (It does not test the transmission of signals between the card and the field wiring.) has passed the diagnostic test.

The messages given by the level 1 pulse card diagnostic are listed here, along with brief explanations of the diagnostic procedure that generated each message. The messages are given in the order in which they occur in the program.

Note that when the diagnostic tests the values in the registers, it tests only registers in the range of 129 through 256, since these are the only registers physically present on the card. The Hardware Reference Manual gives full details on the location and content of each of the registers on the card.

Error messages:

TIMEOUT ERROR

The diagnostic issued a command to the card, and a timeout occurred before the command was executed. The diagnostic program stops after a timeout error.

INITIALIZATION ERROR REGISTER: xxxx

The diagnostic issued a system normalize (SYN!) command to reset the registers and then compared the values in the registers with the correct power-on values. This error indicates that the diagnostic encountered an incorrect value in the given register. After an error of this type, the diagnostic continues checking the remaining registers.

RAM WRITE/READ ERROR REGISTER: xxxx

The diagnostic wrote all zeroes or all ones to each register, read back the value in the register, and compared the value read to the value written. This error indicates that the value read back from the given register was not the same as that written to that register.

STATUS ERROR: PULSES IN PROGRESS, FMODE

The diagnostic cleared the INTER ENABLE and INTERRUPT registers, configured the four channels for frequency generation mode at four different rates, and started all four channels. It then read the CARD STATUS register to see whether it showed that pulses were in progress on all four channels. This error indicates that the CARD STATUS register did not show pulses in progress on all four channels.

STATUS ERROR: PULSES NOT IN PROGRESS

Following the above test, the diagnostic stopped the pulses on channel 1 and then checked the CARD STATUS register. The CARD STATUS register should have shown pulses in progress on channels 2, 3, and 4, but not on channel 1. This message indicates that the CARD STATUS register did not show the correct information.

STATUS ERROR: WAITING FOR STROBE

The diagnostic left channels 2, 3, and 4 running in frequency generation mode, enabled all interrupts, and configured channel 1 for pulse generation mode. It then turned the internal execute strobe signal off, gave the command for pulses to start on channel 1, and read the CARD STATUS register. The CARD STATUS register should have shown channels 2, 3, and 4 with pulses in progress, and channel 1 waiting fror strobe. This message indicates that the CARD STATUS register did not show the expected status.

STATUS ERROR: PULSES NOT IN PROGRESS, PMODE

The diagnostic turned on the internal execute strobe (on the previous read command) and read the CARD STATUS register again. This should have caused the pulse train on channel 1 to start (when the previous read was executed with the strobe on) and the CARD STATUS register should have shown pulses in progress on all four channels. This message indicates that the CARD STATUS register did not show pulses in progress on all four channels.

INTERRUPT ERROR: END OF PULSES NOT DETECTED
CONTENTS OF INTERRUPT REGISTER: xxxxxx

The diagnostic kept reading the REM PULSES register for channel 1 until the pulse train on that channel completed (REM PULSES = 0). It then read the INTERRUPT register. (All interrupts were enabled previously, as mentioned above.) The normal termination of the pulse train on channel 1 should have caused an interrupt to be recorded in the INTERRUPT register. This message indicates that the interrupt was not correctly recorded.

INTERRUPT ERROR: REGISTER NOT CLEARED

The diagnostic read the INTERRUPT register again. The previous read of the INTERRUPT register should have cleared the register. This message indicates that the INTERRUPT register was not cleared by the previous read.

STATUS ERROR: END OF PULSES NOT DETECTED

The diagnostic next read the CARD STATUS register. This register should have indicated that pulses were in progress on channels 2, 3, and 4, and that pulses were not in progress on channel 1. This message indicates that the CARD STATUS register did not contain the expected information.

STATUS ERROR: ALL CHANNELS STOPPED NOT DETECTED

The diagnostic stopped all pulses on channels 2, 3, and 4, and read the CARD STATUS register. This register should have indicated that there were no pulses in progress on any channel, and that there were no channels waiting for strobe. This message indicates that the CARD STATUS register did not contain the expected information.

C.2.1 HP 25512 Counter Card Diagnostic

NOTE

A Diagnostic SCM Adapter is required for level 2 testing of the counter card. This adapter will become available during the first quarter of 1983. Level 1 testing can be performed without the adapter.

The diagnostic for the counter card performs both internal (level 1) and external (level 2) testing of the card. These tests make use of the internal and external loopback features of the card. The diagnostic program causes the microprocessor on the counter card to simulate input signals. For internal testing, these input signals are routed directly to the counter circuitry; for external testing, the simulated input signals are routed out of the card through the diagnostic output pins, passed through a diagnostic SCM adapter, and routed in through the card inputs. The diagnostic compares the counts made by the counter circuitry with the signals that were simulated by the microprocessor.

User interaction:

When the RUN command is given, a list of the card IDs of all the cards in the system is printed. If no ID code is printed for an occupied slot, this means that the card did not respond when it was asked for its ID. If the slot holding a counter card is listed with an incorrect ID (anything but 12) then the card is not identifying itself properly. In either case, the card cannot be tested until it can do something as simple as identifying itself. Reseating the card may correct the problem (power down first, of course). Note that if there are other confused cards in the system, they may be the cause of whatever counter card problems you are seeing.

When the card ID information is done printing, the diagnostic asks some questions about what kind of testing you want to do. The first question you are asked is what kind of test you want to run. Your choices are:

1) Fast superficial testing of each channel using internal loopback

2) More complete testing of most counting modes for each channel using the internal loopback feature

3) External testing using the diagnostic SCM adapter to test the SCMs and the edge detection circuitry, which can not be tested with the internal loopback circuitry

The next question asked is what slot and channel should be tested. If you are only interested in a particular channel, you specify the slot (1-64) and channel (1-4) you want to test. If you are checking out the whole system, hitting RETURN will default to testing all counter card channels in the system. This diagnostic will only test those cards which have identified themselves as counter cards.

The last question is how many passes to make before returning to DDL. A pass is one run of the selected test type on the channel you specified. If you replied with a RETURN to the previous question (all cards in system) then one pass consists of one run of the selected test type on all the channels in the system. The traditional limit of 32767 passes applies. If you enter -1, the diagnostic will loop until you BREAK and restart the diagnostic. This is useful for finding problems that are not 100% reproducible.

The defaults for the "slot/channel" and "number of passes" questions were selected for making one pass through all counter cards in the system.

If an error of some sort is detected, the diagnostic will print out a terse message describing the problem. It will then ask what you want to do about it. Choices include stopping the diagnostic, trying to ignore the error, and moving on to the next channel to be tested.

If you attempt to continue, the diagnostic continues with the hope that the problem will go away. It does NOT retry the thing that failed. Attempting to continue may get you through the test, but remember that the card really did have a problem with that channel.

Suggested test procedure:

A good starting point is to run a fast test on all counter cards in the system. It takes only a couple of seconds per channel. Respond 'F' to the test type question and default the others. If a counter card is skipped, it is probably because it did not correctly identify itself. Was it listed correctly when the diagnostic was started?

If you are testing the entire system rather than troubleshooting a specific problem, the more intensive internal loopback tests should come next. This option checks out most of the possible counting modes without disturbing the field wiring. It will take a while to check all channels if there are many counter cards in the system.

The external loopback test requires you to remove the field wiring and connect the diagnostic SCM adapter, so you probably want to leave this phase of testing for last. Of course, if you have reason to suspect that an SCM is bad, you can go straight to the external test.

The worst-case SCM is very slow, so the external loopback tests must wait a long time for the simulated input signals to appear at the counter circuitry. For this reason the external loopback test checks out only the front end (SCMs and edge detectors). The bulk of the counter card functions are NOT tested by external loopback. A thorough card test requires running both the internal and external tests.

All of the tests will print a message and wait for instructions if they get a serious error.

Error messages:

ABORTING FAST TEST ON THIS CHANNEL
ABORTING INTERNAL LOOPBACK TEST OF THIS CHANNEL
ABORTING EXTERNAL LOOPBACK TEST OF THIS CHANNEL

These messages occur when you get an error and tell the the diagnostic to proceed to the next channel. It is a reminder that the diagnostic did not try to finish testing the channel.

START COMMAND DID NOT CLEAR THE COUNTER

The channel was programmed for totalize mode and started (should clear the counter), but the current count is not zero. This is the first count reading done by the fast test mode, so it may also be a data path error rather than a counter chip failure.

INTERNAL LOOPBACK PULSE FAILED TO INCREMENT COUNTER

The internal loopback circuit was pulsed but the counter failed to go from zero to one. This is the first attempt to register a data pulse, so the problem may be in the path between the front end and the counter chip.

INITIAL COUNT INCORRECT IN EXTENDED TOTALIZE MODE

The 32-bit counting mode was configured, but the start command did not initialize the counter to the expected state.

EXTENDED TOTALIZE COUNT INCORRECT
EXPECTED DATA WORDS nnnnnn nnnnnn
GOT DATA WORDS nnnnnn nnnnnn

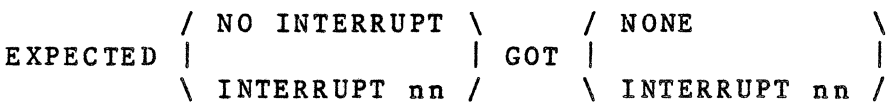
The diagnostic did not get the expected 32-bit count after pulsing the input.

DID NOT GET A POSITIVE COUNT

No clock pulses were counted during the time periods the counter was allowed to count. The clock signal may not be getting through to the counter chip input, or an incorrect pulse rate may be selected.

COUNTER INCORRECT, EXPECTED nnnnnn GOT nnnnnn

The exact meaning depends on the counting mode, but basically the counter did not report the exact value that the diagnostic expected. Try continuing the test on this channel and see if the reported value tracks the expected value with a constant offset. If the difference between the values remains constant, the card has probably lost a pulse or counted one twice. If the value returned from the counter never changes, then the counter has stopped counting entirely.



The interrupt status read from the interrupt registers on the counter card did not agree with the diagnostic's expectations. The interrupt numbers given are in the MCL convention. The exact meaning depends on the mode being tested, but basically they are:

n	Channel n count complete
n+16	Channel n count overflow
n+24	Channel n count underflow

INTERRUPT nn DID NOT CLEAR AFTER BEING READ

The interrupt register is supposed to clear when it is read so that each interrupt is reported exactly once.

Possible causes for this error include a count getting lost or getting counted twice, since most interrupts are caused by the

current count reaching a specific value. If this is the case and you continue the diagnostic, the missing or extra interrupt may show up eventually (probably causing another error message of this type).

CHANNEL CONFIGURED WRONG, STATUS = nnnnnn

The card status register indicates that the channel configuration failed. The diagnostic does NOT do this on purpose. You may want to try to continue and hope it is just a stuck bit.

The bits in the card status register are kept in hardware registers rather than firmware memory. They are set and cleared by the microprocessor, but are read directly by the hardware. Thus they are susceptible to different problems than, for example, the interrupt bits, which live in microprocessor RAM.

```
                / WAS NOT SET IN UNGATED MODE          \
DATA READY BIT  | IS SET WHEN IT SHOULD NOT BE         |
                | IS CLEAR WHEN IT SHOULD BE SET       |
                \ DID NOT CLEAR WHEN COUNT WAS READ    /
```

The data ready bit for this channel is not in the correct state. In the ungated modes, the bit is supposed to be set when the channel is started, since the data is always available and valid. In the gated modes, the bit is supposed to get set when a count of some sort becomes available, and clear when the data has been read once by the user. The count is supposed to stay around until the next gate, but the data ready bit is cleared because the count has already been read.

The data ready bits are in the hardware status register. See above for comments about the status register.

DATA READY BIT WAS NOT SET IN A REASONABLE PERIOD

Some of the time-related counting modes count for a period of time and then make the results available. When the data becomes available, the data ready bit is set. Possible problem causes include the gate counter not getting clock pulses, the gate counter being dead, and hardware status register problems (see above for comments on the status register).

```
                / UNMASKING \
READBACK ERROR  |           | INTERRUPTS
                \ MASKING   /
```

The interrupt mask registers do not read back the same data that was written to them. This is probably a microprocessor or

data communication problem, possibly a stuck bit on the card or the backplane. This message is somewhat vague, but this is one of the first functions done to a channel; you cannot assume that much of the card is already working when you get this message. In any case, something pretty fundamental to the card is broken.

MULTIPLE INTERRUPTS, INTERRUPT WORDS = nnnnnn nnnnnn
RETURNING INTERRUPT CODE nn

The diagnostic test cases should not cause more than one interrupt at a time. The code printed is the one that will be processed if you continue. The others will be ignored.

MCI DRIVER TIMEOUT

The MCI card did not complete a DMA transaction in the usual amount of time. This is usually caused by an HP 2250 function card not responding when it is addressed. Check that the board is really a counter card and is seated correctly. Make sure that the card has not lost power.

WRITE TO MCI R200 TIMED OUT, MCI IS DEAD

Writes to MCI internal register R200 are done through DMA transactions. This error message results when the DMA does not complete within the timeout period. This is probably not an HP 2250 function card problem, but rather a problem with the MCI card, and is beyond the scope of this diagnostic. Try the MCI diagnostic to fix this one.

HP 2250
Measurement and Control Processor
Diagnostic and Verification Manual

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Chapter 4 - Level 2 diagnostics: tells how to set up and run the level 2 diagnostic programs.

Appendix A - Self-test error messages.

Appendix B - Level 1 error messages.

Appendix C - Level 2 error messages.

Related Reading:

If you need detailed information on the Monitor software or the operation of the HP 25590A Diagnostic Interface Unit (DIU), refer to:

1. HP 25590A Diagnostic Interface Unit Operating and Service Manual, part number 25590-90001

You can find additional information on the HP 2250 in these manuals:

2. HP 2250 Measurement and Control Processor Programmer's Manual, part number 25580-90001

3. HP 2250 Measurement and Control Processor Programmer's Reference Manual, part number 22580-90005

4. HP 2250 Measurement and Control Processor System Introduction Manual, part number 02250-90011

5. HP 2250 Measurement and Control Processor Site Preparation Manual, part number 02250-90010

6. HP 2250 Measurement and Control Processor Installation and Start-Up Manual, part number 02250-90012

7. HP 2250 Measurement and Control Processor Hardware Reference Manual, part number 02250-90001

8. HP 25581A Automation Library Manual, part number 25581-90001

Table of Contents

CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

This manual provides information for verifying the operation of the HP 2250 Measurement and Control Processor (or simply HP 2250) and its measurement and control function cards. The verification tests are divided into three main categories: HP 2250 self-test, level 1 diagnostic testing (without using the HP 25590A Diagnostic Interface Unit), and level 2 diagnostic testing (using the HP 25590A Diagnostic Interface Unit). The HP 25590A Diagnostic Interface Unit (DIU) is an external test unit used for making extensive tests on the function cards. For a description and detailed information concerning the operation of the DIU, refer to the HP 25590A Operating and Service Manual, part number 25590-90001.

The self-test is performed automatically during power-up of the HP 2250. The self-test consists of firmware routines permanently residing in the ROMs of the HP 12070A RRACK memory card and the HP 12001B processor card. These tests detect a large percentage of hardware faults and return a limited amount of error information on the HP 12001B processor card LEDs and the HP 2250 status panel. The LEDs on the status panel correspond directly to those on the processor card (leftmost LED on processor card = top LED on status panel).

The level 1 and level 2 diagnostics are loaded from magnetic tape cartridges which are inserted into a terminal tape drive. These diagnostics consist of detailed software routines to not only detect more hardware faults but to return more detailed error information on the fault. These tests are executed off-line; that is, the HP 2250 is not performing measurement and control functions while the tests are running.

The level 1 diagnostics provide a general interface test of the measurement and control function cards; the level 2 diagnostics provide an in-depth test of the operation of the function cards themselves by use of the DIU. The function cards are listed in Table 1-1.

Table 1-1. Measurement and Control Function Cards

Analog Function Cards
HP 25501A 16-Channel High Speed Analog Input Card
HP 25502A 32-Channel High-Level Solid State Multiplexer Card
HP 25503A 32-Channel Low-Level Solid State Multiplexer Card
HP 25504A 16-Channel Isolated Relay Multiplexer Card
HP 25510A 4-Channel Isolated Voltage/Current Analog Output Card
Digital Function Cards
HP 25511A 32-Point Digital Input Function Card
HP 25513A 32-Point Digital Output Function Card
HP 25514A 16-Point Relay Output Function Card
HP 25516A Digital Multifunction Card

1.2 REQUIRED SOFTWARE

The diagnostic programs which reside on magnetic tape cartridges are listed in Table 1-2, showing their file numbers and program names. Note that the software is option 20 of the HP 25595A product. The kernel, RRACK, and MCI/BIF diagnostics are written in assembly language and the rest are written in Diagnostic Design Language (DDL). For more information on DDL, refer to the Diagnostic Design Language User's Guide, part number 24397-90003.

A program (Monitor), written in DDL, is an integral part of each level 2 diagnostic. It permits direct user interaction during execution of the diagnostics. By entering command strings from the terminal, the user can control the actions of the DIU and the function cards. The use and operation of the Monitor program is described in the DIU manual (HP 25590A Operating and Service Manual, part number 25590-90001).

Table 1-2. HP 25595A Diagnostic Programs, Option 20

PART NUMBER	FILE	FILE CONTENTS
Tape 1 (25595-13301)		Controller Cards Diagnostics
24397-16002	1	Kernel Diagnostic
25595-16001	2	Memory Diagnostic
25595-16002	3	MCI/BIF Diagnostic
24397-16003	4	DDL
24397-16009	5	HP-IB Diagnostic
Tape 2 (25595-13302)		Analog Function Cards Diagnostics
24397-16003	1	DDL
25595-16003	2	All Analog Cards (level 1)
25595-16004	3	HP 25501A 16-Bit Input (level 2)
25595-16005	4	All Analog Multiplexers (level 2)
25595-16006	5	HP 22510A 4-Channel Output (level 2)
Tape 3 (25595-13303)		Digital Function Cards Diagnostics (HP 25511A and HP 25513A)
24397-16003	1	DDL
25595-16007	2	HP 25511A Digital Input (level 1)
25595-16008	3	HP 25511A Digital Input (level 2)
25595-16009	4	HP 25513A Digital Output (level 1)
25595-16010	5	HP 25513A Digital Output (level 2)
Tape 4 (25595-13304)		Digital Function Cards Diagnostics (HP 25514A and HP 25516A)
24397-16003	1	DDL
25595-16011	2	HP 25514A Relay Output (level 1)
25595-16012	3	HP 25514A Relay Output (level 2)
25595-16013	4	HP 25516A Multifunction (level 1)
25595-16014	5	HP 25516A Multifunction (level 2-A)
25595-16015	6	HP 25516A Multifunction (level 2-B)

CHAPTER 2
SELF TEST

To assure reliable hardware operation of the HP 2250, self-test routines are executed prior to initialization of the firmware. The self-test is performed during power-up on the HP 2250. This test verifies functions in the controller cards and backplane interface (BIF) cards only; no testing is performed on the function cards.

At the completion of the HP 2250 self-test the second LED (counting from the top) on the status panel should be off. If this LED remains lit then a self-test error or an HP 2250 initialization error has occurred. All errors detected during the self-test are considered fatal and result in halting the HP 2250. Upon occurrence of an error, an eight-bit error code is displayed on the status panel LED indicators (see figure 2-1). The table in appendix A lists and describes the possible self-test error codes.

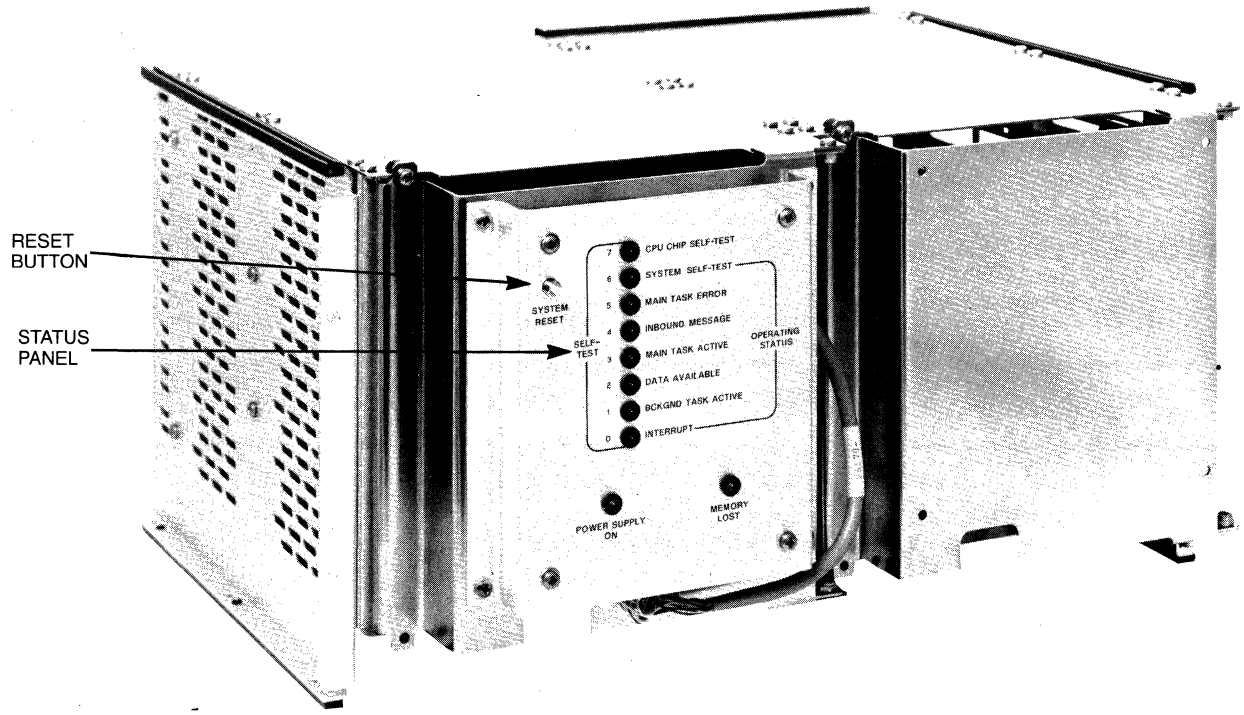

Figure 2-1. HP 2104A, showing Status Panel

2.1 PREPARATION FOR SELF-TEST

You shouldn't have to do anything special to prepare your HP 2250 for self-test. It was shipped from the factory with a standard configuration of the controller cards that is appropriate for running the self-test. If you have any questions about switch settings, cabling, or the order of controller cards in the card cage, refer to the HP 2250 Measurement and Control Processor Installation and Start-Up Manual, part number 02250-90012.

You can start the self-test in one easy step: press the RESET button on the status panel. (If your HP 2250 does not have a battery backup card, you can accomplish the same thing by turning off the power and turning it back on again.)

2.2 SELF-TEST

When the RESET button is pressed, or at power ON in a system that doesn't have battery back-up, the HP 2250 will perform the self-test. Initially, the self-test executes a hardware controlled data path check which gates the address bus to the data bus and checks for malfunctioning address and data lines. Upon successful completion of the data path check, the top LED on the status panel is OFF. If it is ON an error has occurred; refer to the table in appendix A.

Following the data path check, a pretest is performed which tests the basic I/O and processing capability. A description of the pretest is provided below:

CPU Test

Tests basic instruction set, which consists of alter-skip, memory reference, and shift-rotate instructions.

Processor Card Test

Tests interrupt flag, time base generator, LIA/B instructions, and global register flag.

Memory Test

A non-destructive memory test is performed on all RAM memory. If memory backup has been lost all of the RAM memory is cleared prior to execution of the memory test.

I/O Test

Each I/O integrated circuit is tested to ensure that data transfer, flag, and DMA functions are handled correctly.

The successful completion of the pretest results in direct execution of the remainder of the self-test which resides in the HP 2250 firmware. The self-test, therefore, continues testing with only pretested functions and resources. Re-execution of the self-test can be performed by setting the power to OFF and then to ON or by pressing the RESET button on the status panel.

If an error occurs, the self-test halts and the error code (see appendix A) is displayed on the status panel LED indicators. If no errors occur, the second (next-to-top) LED will be OFF at the end of the test.

The following describes the self-tests in the order that they occur:

RAM Memory Test

All 16k words of RAM memory are tested with a destructive uniqueness test. This test is skipped if memory backup has not been lost.

Base Register Test

The base register and stack operations are tested. These tests are also skipped if memory backup has not been lost.

ROM Test

Each 4k block of ROM firmware code is run through a checksum computation and checked for proper positioning on the memory card.

Self-Test System Configuration

The processor card enters the diagnose mode to determine the select codes, fill interrupt trap cells, and initialize the stacks.

MCI Card Tests

Tests are performed on internal timers, internal registers, and DMA transfers.

BIF Tests

The interrupt status and data registers are tested.

HP-IB Card Tests

Tests are performed on the PHI integrated circuit registers, card control register, and DMA transfers.

2.3 HP 2250 FIRMWARE INITIALIZATION

Upon completion of the HP 2250 self-test, the processor card execution proceeds into initialization of the HP 2250 firmware, thereby preparing it to perform measurement and control functions. After firmware initialization the status panel LEDs are used to indicate the on-line status of the HP 2250. See appendix A for a list of the LED status codes.

CHAPTER 3
LEVEL 1 DIAGNOSTICS

This chapter tells you how to set up and operate the controller card diagnostics and the level 1 function card diagnostics for the HP 2250. Explanations of the error messages returned by these diagnostics can be found in appendix B of this manual.

In this chapter we refer to the controller card diagnostics and the level 1 function card diagnostics collectively as "level 1 diagnostics". These diagnostics are all of level 1 in the sense that they don't make use of external stimuli and measurements from the DIU, as do the level 2 diagnostics.

The level 1 diagnostic programs test the controller cards and the function cards of the HP 2250 "from the inside". That is, they cause the processor unit (the HP 2104) to test the functioning of the various cards without regard to the field wiring connections. In general, the level 1 diagnostics test for proper retention of values written to storage registers and correct propagation of signals (such as interrupts) within each card. The functions tested are all internal to the card.

The level 1 diagnostics are not capable of testing for correct transmission of signals between the cards and the field wiring; such testing is carried out by level 2 diagnostics, as described in the next chapter of this manual.

In our discussion here we will first cover the general hardware set-up and then the loading and execution of the diagnostic software.

3.1 SETTING UP THE HARDWARE

In addition to your HP 2250, you need the following equipment to run the diagnostic programs:

1) Terminal. The terminal must have a cartridge tape unit, as the diagnostics are supplied on mini-cartridge tapes. You will load the diagnostic programs from this terminal, and you will issue commands from the terminal to run the

diagnostics. The terminal may be an HP 264x-series terminal (as long as it has a cartridge tape unit) or an HP-85 computer using terminal emulator software. (Note that while you can use either of these terminal types, they are not directly interchangeable since they use different tape formats. Make sure that the tapes that you use are formatted for your terminal type.)

2) ASIC card. Your processor unit must contain an HP 12005A Asynchronous Serial Interface Card (ASIC card). You will connect the terminal to the processor unit through this card.

   If you are using an HP-85 as your terminal, and if you plan on using the HP 25590A Diagnostic Interface Unit (DIU) in running level 2 diagnostics, you must use an ASIC card with a part number of 12005-60007 (date code A-2046 or later). This is because the DIU requires an external clock signal that this version of the ASIC card provides. The ASIC card must be used in this case because the HP-85 can not provide such a signal.

   If, on the other hand, you are using an HP 264x-series terminal, the DIU can use the clock signal from the terminal. In such a case, you can use any HP 12005A ASIC card.

3) Optionally, an HP 25590A Diagnostic Interface Unit (DIU). If you intend to use a DIU (which you need for running the level 2 diagnostics) you might want to connect it now and have it in place for the level 2 tests.

The processor card and the HP-IB card of the HP 2250 are identical to those of the HP 1000 L-series computer. Accordingly, the procedures for setting up the hardware and loading the diagnostic software are similar to those used with the L-series computer. In particular, the diagnostics are controlled through the processor's virtual control panel (VCP).

Set up the cards in the processor unit (the HP 2104) in the following way:

1. Set the HP 2250 POWER to OFF.

2. Ensure that the HP 2250 controller cards and function cards are installed along with their interconnecting cables. Refer to the HP 2250 Measurement and Control Processor Installation and Start-Up Manual (part number 02250-90012) and the HP 2250 Measurement and Control Processor Hardware Reference Manual (part number 02250-90001) for proper installation of the HP 2250 and its function cards.

3. The interface between the terminal and the HP 2250 is provided by an ASIC card and its cable. For the ASIC card to operate as the virtual control panel (VCP), set its switch U1S1 to the closed (down) position. Set U1S3 through U1S8 (S8 is the least significant bit) to octal 20. See figure 3-1 for the location of switch U1, the select code switch.

   In addition, if you are using an HP-85 and a DIU, set switch U21S7 on the ASIC card to the closed (down) position and switch U21S8 to the open (up) position to supply the clock signal from the ASIC card to the DIU (for level 2 diagnostics). Switch U21 is located on the side of the ASIC card, directly behind the select code switch.

   Next insert the ASIC card into the backplane of the processor unit. Place the card in the first vacant slot following the controller cards.

   How you connect the ASIC card to the terminal depends on whether or not you plan to use a DIU (for running level 2 diagnostics). If you don't use a DIU, simply connect the terminal to the ASIC card using an RS-232 cable that has an edge connector on each end. If you do use a DIU, follow the set-up instructions in the next chapter.

4. Set the HP 2250 and the HP 264x-series terminal POWER to ON. When power is restored, the HP 2250 scans the controller cards in the card cage and records their select codes. These select codes will be used when the diagnostics are executed.

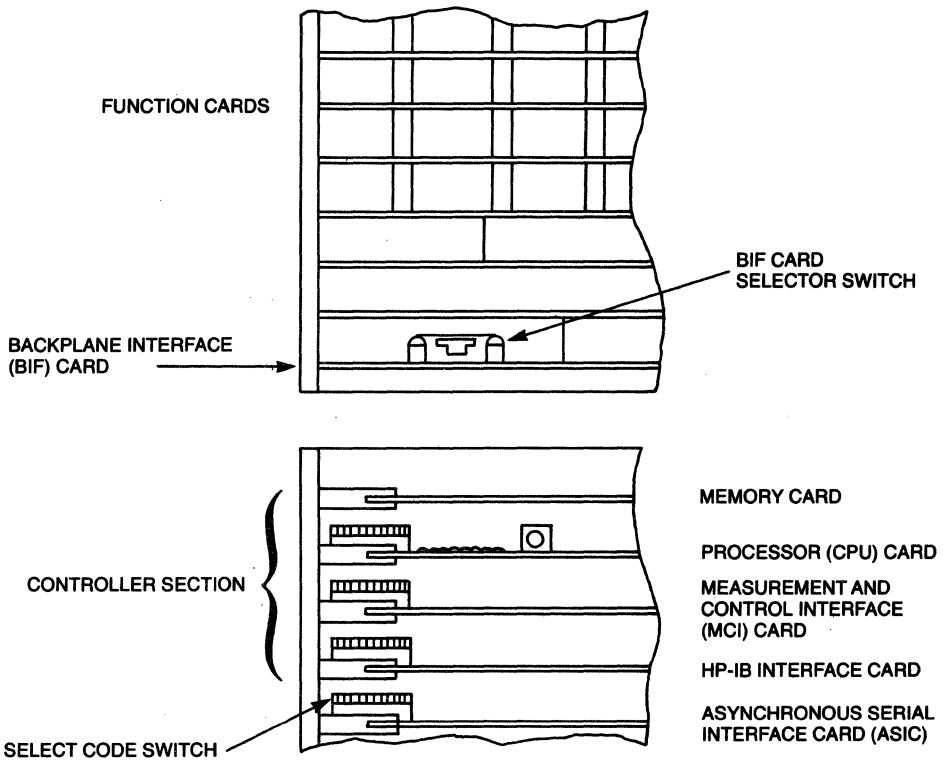

Figure 3-1. Location of Select Code Switches

3.2 LOADING AND RUNNING THE DIAGNOSTICS

All HP 2250 diagnostic programs are supplied in absolute binary form on a series of mini-cartridge tapes. Table 1-2 shows which tapes contain which diagnostics. The first three diagnostics (kernel, memory, and MCI/BIF) are written in assembly language; the remainder (HP-IB and all function cards) are written in Diagnostic Design Language (DDL). The difference in source language causes a slight difference in loading procedure, as you will see below. We will first describe the loading and execution of the controller card diagnostics, and then the loading and execution of the level 1 function card diagnostics.

3.2.1 Controller Card Diagnostics

The kernel diagnostic and the HP-IB diagnostic are the standard diagnostics for the HP 1000 L-series computer. We describe the loading and execution procedures for these diagnostics in this section; these procedures are also described fully in the Kernel Diagnostic Operating Manual (part number 24397-90002) and the HP 12009A HP-IB Interface Diagnostic Operating Manual (part number 24397-90009). If you use these manuals, follow the instructions for diagnostic tests with VCP, using mini-cartridge tapes. Note that the load commands in those manuals are for a different tape; the file numbers shown are not correct for use with the HP 2250 diagnostic tapes. Use the load procedure shown in this section.

Loading and execution instructions for each of the controller card diagnostics are given individually below. The instructions assume that you are using an HP 264x-series terminal. If you are using an HP-85 computer in terminal emulator mode, the documentation for the terminal emulator software will tell you how to enter the equivalent commands.

3.2.1.1 Kernel Diagnostic

The kernel diagnostic is an assembly language routine that tests the functioning of the processor card, portions of the RRACK memory card, and the I/O capability of the controller cards. To run the kernel diagnostic, take the following steps:

1) Insert the tape containing the diagnostic into the cartridge tape unit of the terminal. If you are using an HP 264x-series terminal, use the LEFT cartridge tape unit; the VCP commands given here operate on the left tape unit.

2) Press the BREAK key to enter VCP mode. The terminal will respond by displaying the contents of five CPU registers.

3) Load the diagnostic by entering "%LCTn", where n is the file number of the diagnostic on tape. The terminal will respond "LC" to indicate that the load is complete.

4) Execute the kernel diagnostic by entering "%E". The diagnostic will run and, if there are no errors, it will return to VCP mode and display a HALT 77 message (octal 102077) in the T register.

   If the diagnostic encounters an error, it will return to VCP

mode and display an error message in the T and A registers. It will also display an error message on the LEDs of the status panel. Meanings of the error messages are given in appendix B of this manual. Any error encountered is fatal; that is, the diagnostic halts after the error and can not continue.

You can interrupt the diagnostic by pressing the BREAK key. This will stop the diagnostic and return you to VCP mode. You can restart the diagnostic by entering "%E".

3.2.1.2 Memory Diagnostic

The memory diagnostic is an assembly language routine that tests the functioning of the RRACK memory card. To run the memory diagnostic take the following steps:

1) Insert the tape containing the diagnostic into the cartridge tape unit of the terminal. If you are using an HP 264x-series terminal, use the LEFT cartridge tape unit; the VCP commands given here operate on the left tape unit.

2) Press the BREAK key to enter VCP mode. The terminal will respond by displaying the contents of five CPU registers.

3) Load the diagnostic by entering "%LCTn", where n is the file number of the diagnostic on tape. The terminal will respond "LC" to indicate that the load is complete.

4) Execute the memory diagnostic by entering "%E". The diagnostic will run and, if there are no errors, it will return to VCP mode and display a HALT 77 (octal 102077) in the T register. If, at this point, you want the diagnostic to loop continuously, enter "T 0" to set the T register to zero, and then enter "%R". The diagnostic will then loop continuously and display the number of successful passes on the terminal.

   If the diagnostic encounters an error, it will display an error message on the terminal. It will also display an error message on the LEDs of the status panel. Meanings of the error messages are given in appendix B of this manual. Any error encountered is fatal; that is, the diagnostic halts after the error and can not continue.

   You can interrupt the diagnostic by pressing the BREAK key. This will stop the diagnostic and return you to VCP mode. You can restart the diagnostic by entering "%E".

3.2.1.3 MCI/BIF Diagnostic

The MCI/BIF diagnostic is an assembly language routine that tests the functioning of the MCI and BIF cards. To run the MCI/BIF diagnostic, take the following steps:

1) Insert the tape containing the diagnostic into the cartridge tape unit of the terminal. If you are using an HP 264x-series terminal, use the LEFT cartridge tape unit; the VCP commands given here operate on the left tape unit.

2) Press the BREAK key to enter VCP mode. The terminal will respond by displaying the contents of five CPU registers.

3) Load the diagnostic by entering "%LCTn", where n is the file number of the diagnostic on tape. The terminal will respond "LC" to indicate that the load is complete.

4) Execute the MCI/BIF diagnostic by entering "%E". The diagnostic will run and, if there are no errors, it will return to VCP mode and display a HALT 77 (octal 102077) in the T register. If, at this point, you want the diagnostic to loop continuously, enter "T 0" to set the T register to zero, and then enter "%R". The diagnostic will then loop continuously and display the number of successful passes on the terminal. You can ignore the TEST 30 warning for a disconnected test hood; such a test hood is used only at the factory.

   If the diagnostic encounters an error it will display an error message on the terminal. It will also display an error message in octal numbers on the LEDs of the status panel. Meanings of the error messages are given in appendix B of this manual. With the exception of the TEST 30 warning mentioned above, any errors encountered by the diagnostic are fatal; that is, the diagnostic halts after the error and can not continue. You can return to VCP mode by pressing the BREAK key.

   You can interrupt the diagnostic at any time by pressing the BREAK key. This will stop the diagnostic and return you to VCP mode. You can restart the diagnostic by entering "%E".

   Note that the MCI/BIF diagnostic can test only one MCI/BIF combination at a time, and that the box index for the BIF card (as set by the thumbwheel switch on the left side of the card) must be zero. If you want to test more than one BIF card, you must set the box index of each card to zero in turn (while setting all other BIFs to non-zero values) and

run the diagnostic to test that MCI/BIF combination. After you finish running the MCI/BIF diagnostic, remember to set up the BIF cards the way they were when you started.

3.2.1.4 HP-IB Diagnostic

The HP-IB diagnostic is a DDL diagnostic that tests the functioning of the HP-IB card. To run the HP-IB diagnostic, take the following steps:

1) Insert the tape containing the diagnostic into the cartridge tape unit of the terminal. If you are using an HP 264x-series terminal, use the LEFT cartridge tape unit; the VCP commands given here operate on the left tape unit.

2) Press the BREAK key to enter VCP mode. The terminal will respond by displaying the contents of five CPU registers.

3) Load the diagnostic. Since this diagnostic is written in DDL, loading is done in two steps:

   a) Load DDL. (This is the DDL interpreter program; this program reads and executes the diagnostic program that you will load later.) Load DDL by entering "%LCTn", where n is the file number of the DDL program on tape. The terminal will respond "LC" to indicate that the load is complete.

      If the last diagnostic you ran was a DDL diagnostic, you can skip this step. There is no need to reload the DDL program if it is already in memory. You can go on and load the diagnostic program.

      If this is the first time that you have loaded DDL (that is, if the DDL program is not already in memory) you must execute the DDL program before you load the diagnostic program. Do this by entering %E. The terminal will display a ready message along with the DDL prompt (">"). Now press the BREAK key to return to VCP mode.

   b) Load the HP-IB diagnostic program by entering "%LCTn", where n is the file number of the HP-IB diagnostic on tape. The terminal will respond "LC" to indicate that the load is complete.

4) Execute DDL by entering %E. The terminal will respond with the DDL ready message and the DDL prompt (">"). You can now choose from two ways of running the HP-IB diagnostic, depending on whether you want to run the diagnostic once or many times.

   a) To execute the HP-IB diagnostic just once, enter "RUN !". The space between the "RUN" and the "!" is important; don't omit it.

      The diagnostic will run once and stop. During execution, the diagnostic will display a few messages. The first message will be "SELECT CODE xx UNDER TEST", where xx is the octal select code of the HP-IB card (probably 30). The next messages will be "CARD NOT SYSTEM CONTROLLER" and "ON-LINE TEST NOT EXECUTED". These messages appear because the HP-IB card in the HP 2250 is not acting as the bus controller card. (Remember, the HP-IB diagnostic is doing double duty here; it was originally designed to test the HP-IB card in an L-series computer system, and in such a system discs drives are interfaced through an HP-IB card.) Since you shouldn't have a disc drive attached to the HP-IB card of your HP 2250, you can ignore these messages.

      If the diagnostic encounters no errors, it will display on the terminal the messages "PASS COMPLETE" and "DIAGNOSTIC COMPLETE", followed by the DDL prompt (">").

      If the diagnostic encounters any errors, it will display an error message on the terminal. Explanations of the error messages are given in appendix B of this manual. Any error encountered is fatal; that is, the diagnostic halts and returns you to DDL (indicated by the ">" prompt).

      You can interrupt the diagnostic by pressing the BREAK key. This will stop the diagnostic and return you to VCP mode. You can return to DDL by entering %E, and after you receive the ">" prompt you can run the HP-IB diagnostic again.

   b) You can give yourself the option of running the HP-IB diagnostic more than once by entering "RUN". The diagnostic will then ask you to "INPUT SELECT CODE". Enter the select code of the HP-IB card (probably 30).

      Once you have entered the select code, the diagnostic will proceed with its testing. You will receive the messages "CARD NOT SYSTEM CONTROLLER" and "ON-LINE TEST NOT EXECUTED", as mentioned above. You can ignore them.

If the diagnostic encounters no errors, it will issue the message "PASS COMPLETE", and will then ask you again to "INPUT SELECT CODE". At this point you can make one of three responses:

Enter 0. This will cause the HP-IB diagnostic to terminate and return you to DDL (the ">" prompt).

OR

Enter the same select code. This will cause the diagnostic to execute once more and come back with the "INPUT SELECT CODE" message.

OR

Press the RETURN key. This will cause the diagnostic to loop continuously until you interrupt it by pressing the BREAK key. The diagnostic will display the number of successful passes on the terminal.

As above, if the diagnostic encounters an error it displays it on the terminal and returns to VCP mode. Also as above, you can interrupt the diagnostic by pressing the BREAK key, which also returns you to VCP mode.

3.2.2 Level 1 Function Card Diagnostics

The level 1 function card diagnostics comprise a series of non-interactive tests of the HP 2250 function cards. (They are non-interactive for the most part: some diagnostics report errors in a manner that lets you decide whether to continue the test, stop the test, go on to the next card, or repeat the test on the current card; such choices are necessarily interactive.)

All analog function cards are tested by one diagnostic program; each type of digital function card has its own diagnostic program. Each diagnostic automatically tests all function cards of its type that are installed in the HP 2250.

Since all of the level 1 function card diagnostics are written in DDL, they all have the same procedure for loading and execution. The instructions given below assume that you are using an HP 264x-series terminal. If you are using an HP-85 computer in terminal emulator mode, the documentation for the terminal emulator software will tell you how to enter the equivalent commands.

1) Insert the tape containing the diagnostic that you want to run into the cartridge tape unit of the terminal. (You can find which tape contains which diagnostics from table 1-2.) If you are using an HP 264x-series terminal, make sure that you use the LEFT cartridge tape unit; the VCP commands given in this section operate on the left tape unit.

2) Press the BREAK key to get into VCP mode. The terminal will display the octal values of five CPU registers.

3) Load the diagnostic. Since these diagnostics written in DDL, loading is done in two steps:

   a) Load DDL. If the DDL interpreter program is already in memory, you can skip this step. If not, load DDL by entering "%LCTn", where n is the file number of the DDL program on tape. The terminal will respond "LC" to indicate that the load is complete.

      After DDL is first loaded, it must be executed before a diagnostic program can be loaded. Execute DDL by entering %E. The terminal will display a ready messagee, along with the DDL prompt (">"). Now press the BREAK key to return to VCP mode.

   b) Load the diagnostic by entering "%LCTn", where n is the file number of the diagnostic on tape. The terminal will respond "LC" to indicate that the load is complete.

4) Execute the diagnostic. In order to execute the diagnostic, you must first execute the DDL program. Do this by entering "%E". The terminal will respond with the DDL ready message and the DDL prompt (">").

   At this point you can select whether you want the diagnostic to run once and stop or loop continuously. If you want it to run once and stop, enter "RUN". The diagnostic will run once, and when it has finished you will receive the DDL prompt again.

   If you want the diagnostic to loop continuously, enter "R=1". Then, when you receive the ">" prompt, enter RUN. The diagnostic will loop continuously and display the number of successful passes on the terminal. (The "R=1" is entered as a value in DDL, so any DDL-based diagnostics that you load subsequently will also loop continuously if the value of R is left at 1. You can return to single-pass operation either by reloading DDL or by entering "R=0" in response to the ">" DDL prompt.)

   Each diagnostic searches all of the function card slots in

the HP 2250 to find the cards of the type(s) that it is designed to test. The card type of each function card is listed as it is searched. When the diagnostic finds a card that it can test, it reports an ID match and notes that it is testing that card. If the diagnostic doesn't find any cards that it can test, it sends a message to that effect to the terminal. (Note that the ID number of the card type, set by resistors on the card, matches the last two digits of the card's product number. For example, an HP 25511A digital input card has an ID number of 11.)

If the diagnostic encounters an error, it reports the error on the terminal. Explanations of the error messages are listed in appendix B of this manual. Digital card diagnostics continue after reporting an error. The analog cards diagnostic stops after each error and asks how you want to handle the error (continue, stop, go to the next card, or start the current card again); you can continue the test simply by pressing the RETURN key.

Note that diagnostics written in DDL regard patience as a virtue. If you answer a question before the diagnostic has finished writing the question on the terminal, DDL takes your unsolicited interruption as a request to abort the diagnostic program. In such a case, the diagnostic will be terminated and you will receive the DDL prompt.

If you want to interrupt the diagnostic, press the BREAK key. This will stop the diagnostic and put you into VCP mode. From the VCP you can enter "%E" to run DDL and get the ">" prompt again.

5) When you have finished running the diagnostic, press the BREAK key to get into VCP mode. If you want to run another diagnostic, go to step 6. If you don't want to run any more diagnostics, go to step 7.

6) Load the next diagnostic:

   a) If the new diagnostic is a controller card diagnostic, follow the instructions for the specific diagnostic (above).

   b) If the new diagnostic is a function card diagnostic, you don't have to re-load DDL. All you have to do is:

      1. Enter %LCTn, where n is the file number of the new diagnostic on tape. This will load the new diagnostic, overwriting the previous diagnostic. The DDL program will be unaffected by the load, and will be ready to run.

2. Go to step 4 (execute the diagnostic).

7) When you have finished running diagnostics and fixing or replacing any faulty cards you may have found, do the following to return your HP 2250 to normal operation:

   a) Remove the ASIC card and disconnect any cables from the terminal and the DIU.

   b) Press the RESET button on the status panel. This will cause the HP 2250 to initialize its memory.

   c) Go for it.

CHAPTER 4
LEVEL 2 DIAGNOSTICS

This chapter tells you how to set up and operate the level 2 function card diagnostics for the HP 2250. (There are no level 2 controller card diagnostics.) The error messages returned by these diagnostics are explained in appendix B of this manual.

The level 2 diagnostics are interactive diagnostic programs written in Diagnostic Design Language (DDL). All of the level 2 diagnostics make use of the HP 25590A Diagnostic Interface Unit (DIU). These diagnostics test the function cards "from the outside". That is, they use the DIU to simulate the devices to which the function cards are normally connected. The DIU generates signals that are read and measured by the input function cards, and reads and measures the signals that are generated by the output function cards. This allows thorough testing of the input/output and conversion functions (A-to-D and D-to-A) of the cards.

Note that the level 2 diagnostics are functional tests; they do not test the performance (calibration) of the cards.

If you are testing analog cards, you may want to calibrate them before you run the diagnostics. Out-of-calibration cards will sometimes fail the diagnostic tests.

Since the multiplexer (MUX) cards use an associated analog input card to perform analog-to-digital conversions, the causes of errors reported by the MUX diagnostic are not always unambiguous: a faulty analog input card could cause the MUX diagnostic to fail, even though the MUX itself was working properly. You can avoid most of this ambiguity by testing the analog input cards in your system before you test the MUX cards; that will assure you that the analog-to-digital converter (ADC) is functioning correctly.

(Note that even then the results are not entirely unambiguous. The analog input card diagnostic is not exhaustive; it tests the ADC and the 16 input channels on the analog input card, but it does not test the channel used by the MUX cards. The functioning of the multiplexer channel does not go untested, however; it is tested by the MUX diagnostic. Thus, it is possible for a fault in the multiplexer channel of the analog input card to cause the MUX diagnostic to fail, even though the card passed the analog input card diagnostic.)

Before you run the level 2 diagnostics, make sure that you have on hand a map that shows which function cards are in which slots of the HP 2250. You also need to know which external strobe units and signal conditioning modules (SCMs) are in which positions on each of the function cards.

4.1 SETTING UP THE HARDWARE

The hardware set-up for the level 2 diagnostics is very similar to that for the level 1 diagnostics. (In fact, if you are going to run both level 1 and level 2 diagnostics, you can use the level 2 set-up for both.) You need the following equipment, in addition to your HP 2250, to run the level 2 diagnostics:

1) Terminal with cartridge tape unit. This is either an HP 264x-series terminal with cartridge tape units or an HP-85 computer with terminal emulator software.

2) ASIC card. This is the HP 12005A Asynchronous Serial Interface Card. If you are using an HP-85 computer as the terminal, you must use an ASIC card with a part number of 12005-60007 (date code A-2046 or later).

3) DIU. This is the HP 25590A Diagnostic Interface Unit. The cables you need are supplied with the DIU.

Set up the hardware in the following way:

1) Set the HP 2250 POWER to OFF.

2) Ensure that the HP 2250 controller cards and function cards are installed along with their connecting cables. Make sure that the field wiring connectors are DISCONNECTED from the function cards.

3) Insert the ASIC card in the first vacant controller card slot. Set switch U1S1 to the closed (down) position, and switches U1S3 through U1S8 to octal 20. If you are using an HP-85 as the terminal, set switch U21S7 on the ASIC card to the closed (down) position and switch U21S8 to the open (up) position. This provides the ASIC card's external clock signal to the DIU.

4) Connect the ASIC card to the CONTROLLER INTERFACE connector on the DIU, using cable 12005-60003. (See figure 4.1)

5) Connect the terminal to the TERMINAL INTERFACE connector on the DIU. If you are using an HP 264x-series terminal, use cable 02640-60059. If you are using an HP-85 computer as your terminal, use the cable and adapter supplied with the HP-85.

6) Connect a 28V power cable, part number 02251-60002, from the BIF card to the POWER CONNECT connector on the DIU. (This is the same type of connection you would make if you were connecting an additional 2251 measurement and control unit.)

7) Connect a ground cable, part number 25590-60011, fron the BIF ground to the BIF INTERFACE connector on the DIU.

8) Set the OPERATE/BYPASS switch on the DIU to OPERATE.

9) Set the HP 2250, terminal, and DIU POWER switches to ON.

Note that at this point you should not have connected any cables between the DIU and the function cards. The DIU undergoes its own self-test when its power is turned on, and this self-test assumes that there are no connections to the function cards. If there are function cards connected when the DIU power is turned on, the self-test will fail and the DIU will not operate. All connections to the function cards must be made after the DIU power is turned on.

When the hardware is connected in this manner, the DIU will ignore commands from the level 1 diagnostics, but will execute the appropriate commands when the level 2 diagnostics are run.

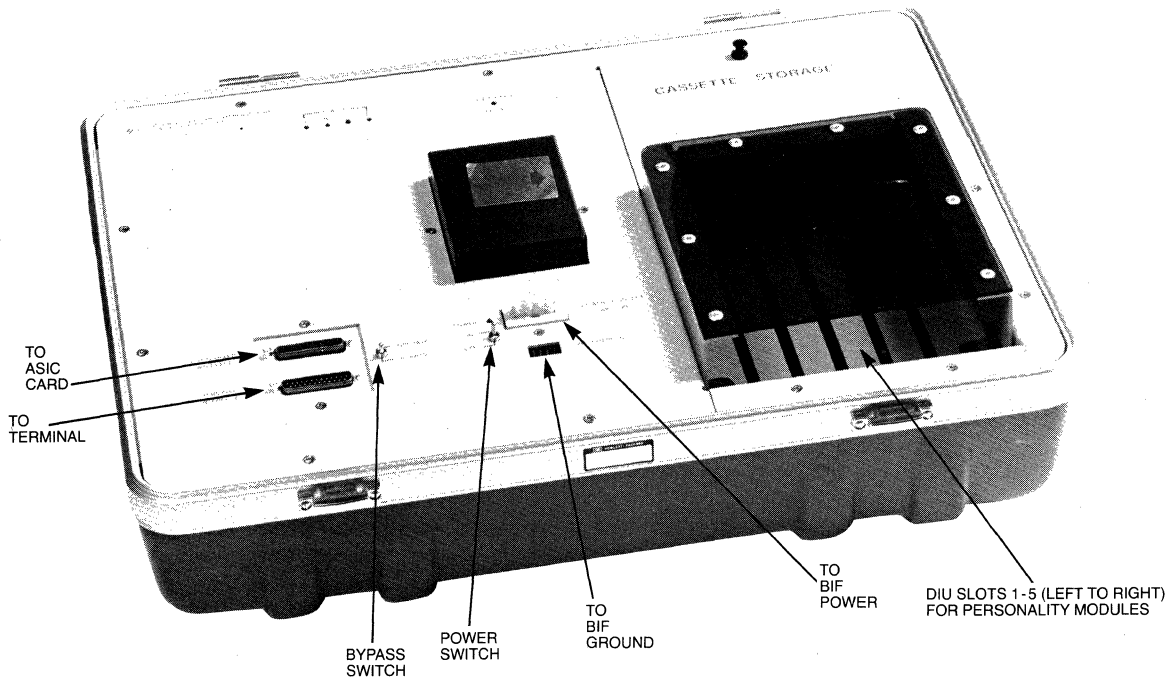

Figure 4-1. DIU Connectors and Switches

4.2 LOADING AND RUNNING THE DIAGNOSTICS

The procedure for loading the level 2 diagnostics is the same as that for loading the level 1 function card diagnostics. The instructions given below assume that you are using an HP 264x-series terminal. If you are using an HP-85 computer in terminal emulator mode, the documentation for the terminal emulator software will tell which keys to use to enter the

equivalent commands.

1) Insert the tape containing the diagnostic that you want to run into the cartridge tape unit of the terminal. (You can find which tape contains which diagnostics from table 1-2. Note that the level 2 diagnostic for the digital multifunction card comes in two parts, one for input functions (the "A" part) and one for output functions (the "B" part). Each part is separate and must be loaded and executed independently.) If you are using an HP 264x-series terminal, make sure that you use the LEFT cartridge tape unit; the VCP commands given in this section operate on the left tape unit.

2) Press the BREAK key to get into VCP mode. The terminal will display the octal values of five CPU registers.

3) Load the diagnostic. Since these diagnostics written in DDL, loading is done in two steps:

   a) Load DDL. If the DDL interpreter program is already in memory, you can skip this step. If not, load DDL by entering "%LCTn", where n is the file number of the DDL program on tape. The terminal will respond "LC" to indicate that the load is complete.

      After DDL is first loaded, it must be executed before a diagnostic program can be loaded. Execute DDL by entering %E. The terminal will display a ready messagee, along with the DDL prompt (">"). Now press the BREAK key to return to VCP mode.

   b) Load the diagnostic by entering "%LCTn", where n is the file number of the diagnostic on tape. The terminal will respond "LC" to indicate that the load is complete.

4) Execute the diagnostic. In order to execute the diagnostic, you must first execute the DDL program. Do this by entering "%E". The terminal will respond with the DDL ready message and the DDL prompt (">").

   At this point you can select whether you want the diagnostic to run once and stop or loop continuously. If you want it to run once and stop, enter "RUN". The diagnostic will run once, and when it has finished you will receive the DDL prompt again.

If, instead, you want the diagnostic to loop continuously, enter "R=1". Then, when you receive the ">" prompt, enter RUN. The diagnostic will loop continuously and display the number of successful passes on the terminal. (The "R=1" is entered as a value in DDL, so any DDL-based diagnostics that you load subsequently will also loop continuously if the value of R is left at 1. You can return to single-pass operation either by reloading DDL or by entering "R=0" in response to the ">" DDL prompt.)

Each diagnostic searches all of the function card slots in the HP 2250 to find the cards of the type(s) that it is designed to test. The card type of each function card is listed as it is searched. When the diagnostic finds a card that it can test, it reports an ID match and notes that it is testing that card. If the diagnostic doesn't find any cards that it can test, it sends a message to that effect to the terminal. (Note that the ID number of the card type, set by resistors on the card, matches the last two digits of the card's product number. For example, an HP 25511A digital input card has an ID number of 11.)

If you want the diagnostic to loop continuously, enter "R=1". Then, when you receive the ">" prompt, enter RUN. The diagnostic will loop continuously. You can stop the diagnostic by pressing the BREAK key. This will put you into VCP mode; if you enter %E you will execute DDL and receive the ">" prompt.

Each diagnostic searches all of the function card slots in the HP 2250 to find the cards of the type(s) that it is designed to test. The card type of each function card is listed as it is searched. If the diagnostic doesn't find any cards that it can test, it sends a message to that effect to the terminal.

Both the analog and digital diagnostics will prompt you to insert certain "personality modules" (small printed circuit boards, identified by ten-digit part numbers) into certain slots of the DIU, and to connect the personality modules to certain connector blocks on the function card using certain cables (also identified by part number).

Insert each personality module so that the connector is on the right side of the card. Several DIU slots can contain personality modules at the same time, as long as the modules do not physically interfere with each other. Note, however, that only one cable may be connected between the personality modules and the card under test at any one time. After you have connected the cable between the personality module and the function card, make sure that the transparent cover over

the DIU slots is closed. The DIU will not operate if the cover is open.

Each diagnostic will also prompt you to move the cable to the next connector block when it has finished testing the circuits connected to that block. As part of the prompt, the diagnostic will ask "HOOD INSTALLED?". Answer "YES" after you have installed the test hood (cable) in its new position; the diagnostic will continue testing. (If you answer "NO", the diagnostic will abort.) In addition, the diagnostics for the digital cards will ask you to specify information about the external strobe units and the SCMs installed on the cards.

If the diagnostic encounters an error, it reports the error on the terminal. Explanations of the error messages are listed in appendix C of this manual. Digital card diagnostics continue after reporting an error. The analog card diagnostics stop after each error and ask how you want to handle the error (continue, stop, go to the next card, or start the current card again); you can continue the test simply by pressing the RETURN key.

As was the case with the level 1 function card diagnostics, the level 2 diagnostics are insistent about finishing whatever they start to say before allowing you to reply. If you try to respond to a question from the diagnostic before the diagnostic finishes asking it, the diagnostic will be terminated and you will receive the DDL prompt.

If you want to interrupt the diagnostic, press the BREAK key. This will stop the diagnostic and put you into VCP mode. From the VCP you can enter "%E" to run DDL and get the ">" prompt again.

5) When you have finished running the diagnostic, press the BREAK key to get into VCP mode. If you want to run another diagnostic, go to step 6. If you don't want to run any more diagnostics, go to step 7.

6) Load the next diagnostic:

   a) If the new diagnostic is a controller card diagnostic, follow the instructions for the specific diagnostic. (See chapter 3 of this manual).

b) If the new diagnostic is a function card diagnostic, you don't have to re-load DDL. All you have to do is:

   1. Enter %LCTn, where n is the file number of the new diagnostic on tape. This will load the new diagnostic, overwriting the previous diagnostic. The DDL program will be unaffected by the load, and will be ready to run.

   2. Go to step 4 (execute the diagnostic).

   Note that you can intermix level 1 and level 2 diagnostics in any order.

7) When you have finished running diagnostics and fixing or replacing any faulty cards you may have found, do the following to return your HP 2250 to normal operation:

   a) Remove the ASIC card and disconnect any cables from the terminal and the DIU.

   b) Reconnect the field wiring to the function cards.

   c) Turn the HP 2250 power OFF and then ON. This will cause the HP 2250 to initialize its memory.

   You're now ready to return to normal operation.

APPENDIX A
SELF TEST ERROR MESSAGES

Table A-1. Self-Test Error Codes

LED Error Code	DESCRIPION (1 = ON, 0 = OFF)
11111111	Data Path Check Pretest -------
01111111	CPU Test Failure
01111110	Processor Test Failure -- This pattern may alternate with the select code of the illegally interrupting I/O card. (The select code is displayed in inverted logic: lit LED is logic 0, unlit LED is logic 1.)
01111101	Memory Test Failure
01111100	I/O Test Failure -- This pattern may alternate with any of the following patterns: 00111111 = No chips detected. At least one I/O card must be installed. 00111110 = Two or more I/O cards are configured for virtual control panel (VCP) interfacing (not allowed). 00111101 = I/O priority chain broken. Vacant slots between plug-in cards not allowed. 00111100 = Two or more I/O cards are set for the same select code (not allowed). 00111011 = An I/O card is set for a select code less than 20 (not allowed). 00111010 = The I/O card set for VCP interfacing has the wrong select code.

Table A-1. Self-Test Error Codes (continued)

LED Error Code	DESCRIPTION (1 = ON, 0 = OFF)
01111100	00xxxxxx = None of the above. This is the select code of an I/O card that failed. (The select code is displayed in inverted logic: lit LED is logic 0, unlit LED is logic 1.)
01111011	Executing Loader
01111010	Loader Error
01111001	Loader Error
01111000	Executing Virtual Control Panel (VCP)
	Self-Test, RAM Tests
01110011	Fill RAM With Post-Inc Base Register Function
01110010	Test RAM With Pre-Dec Base Register Function
01110001	Fill Base Register Offset Table
01110000	Test Base Register Offsets
	Self-Test, ROM Tests
01101111	Position Check, ROM Locations 40000 thru 47777
01101110	Checksum Test, ROM Locations 40000 thru 47777
01101101	Position Check, ROM Locations 50000 thru 57777
01101100	Checksum Test, ROM Locations 50000 thru 57777
01101011	Position Check, ROM Locations 60000 thru 67777
01101010	Checksum Test, ROM Locations 60000 thru 67777
01101001	Position Check, ROM Locations 70000 thru 77777
01101000	Checksum Test, ROM Locations 70000 thru 77777
	Self-Test, Configuration and MCI Tests
01100111	No MCI Card Found
01100110	No HP-IB Card Found
01100101	Trap Cells
	continued

Table A-1. Self-Test Error Codes (Continued)

LED Error Code	DESCRIPTION (1 = ON, 0 = OFF)
	Self-Test, MCI Errors
01100100	Initialize and Last Control Word Interrupt
01100011	MCI Internal Registers
01100010	Time of Day Clock
01100001	Watchdog Timer
01100000	Timeout Interrupt
	Self-Test, BIF Tests
01011111	Box 1
01011110	Box 2
01011101	Box 3
01011100	Box 4
01011011	Box 5
01011010	Box 6
01011001	Box 7
01011000	Box 8
01010111	Box 9
01010110	Box 10
01010101	Box 11
01010100	Box 12
01010011	Box 13
01010010	Box 14
01010001	Box 15
01010000	Box 16
	Self-Test, HP-IB Tests
01001111	HP-IB Initialization, Clear
01001110	HP-IB Data Bus
01001101	PHI Initialize, Flush FIFOS
01001100	Output Data Transfer, Interrupts
01001011	Input data Transfer
01000000	Firmware initialization
00xxxxxx	Self-Test Passed (xxxxxx = don't care)

APPENDIX B
LEVEL 1 ERROR MESSAGES

B.1 CONTROLLER CARD DIAGNOSTICS

B.1.1. Kernel Diagnostic

Error messages resulting from the kernel diagnostic are displayed as octal numbers in the T and A registers of the VCP, and as flashing LED patterns on the HP 2250 status panel. Since the meanings of the two sets of messages are the same, we show only the VCP version here. (See table B-1, below.) If you need to know the LED messages, refer to appendix A of the Kernel Diagnostic Operating Manual, part number 24397-90002.

For all errors except the memory protect error (T = 102003), you can get more information by entering "%R". You can then return to the error display by entering "%R" again.

Table B-1. Kernel Diagnostic Error Messages

T Register (all numbers are octal)	A Register	Explanation
102077	124003	Successful completion
102003	(don't care)	Processor card memory protect hangup
102010	100000	CPU chip
102011	110004	Processor card power fail system
102011	110005	Processor card parity error system
102011	110006	Processor card time base generator
102011	110007	Processor card memory protect
102011	110010	Processor card unimplemented instruction
102012	1200xx xx < 20 (xx=octal bit number)	Memory card single bit error in row 0 RAMs
102012	1200xx 17< xx <40 (xx=octal bit number)	Memory card parity bit or multi-bit error in row 0 RAMs
102012	1200xx 37< xx <60 (xx=octal bit number)	Memory card single bit error in row 1 RAMs
102012	1200xx 57 < xx (xx=octal bit number)	Memory card parity bit or multi-bit error in row 1 RAMs
102013	1200sc	Interface card in select code "sc"
102014	1400sc	Illegal interrupt from select code "sc"

B.1.2. Memory Diagnostic

The memory diagnostic reports test status and errors on both the terminal and the status panel LEDs.

As the test proceeds, messages displayed on the terminal tell which section of the test is currently executing. In addition, the status panel LEDs indicate the same information. (See table B-1, below. If the diagnostic encounters an error, the appropriate error message is displayed on the screen, and the status panel LEDs flash between the memory diagnostic number (01111101) and the error number (see table B-2, below). The diagnostic stops after encountering an error.

Table B-2. Memory Diagnostic Messages

TEST SECTION IDENTIFIERS

Binary	Octal	Comments
00001000	010	Refresh test
00010000	020	Base register uniqueness test
00011000	030	Predecrement and postincrement test
00100000	040	Base registers offset test
00101000	050	Overflow interrupt test
Status panel LEDs: 0=off, 1=on		

Table B-2. Memory Diagnostic Messages (Continued)

ERROR MESSAGES

Binary	Octal	Comments
00000001	001	Refresh failed
00000010	002	A different base register was modified
00000011	003	Contents of base register were modified
00000100	004	Predecrement error: wrong address read
00000101	005	Base register incorrectly predecremented
00000110	006	Postincrement error: wrong address read
00000111	007	Base register incorrectly postincremented
00001000	010	Offset failed
00001001	011	Overflow interrupt failed using predecrement
00001010	012	Overflow interrupt failed using postincrement
Status panel LEDs: 0=off, 1=on		

B.1.3. MCI/BIF Diagnostic

The MCI/BIF diagnostic loops continuously and displays the pass count on the terminal. If it encounters an error, it displays the error number and a brief description of the error on the terminal. In addition, it flashes the octal error number on the status panel LEDs. Table B-2 lists the MCI/BIF errors.

You can ignore the TEST 30 warning; the test hood is used only at the factory.

Table B-3. MCI/BIF Diagnostic Error Messages

LED	Terminal	Comment
000	ERROR TEST 0	DMA timeout error
001	ERROR TEST 1	First address readback
002	ERROR TEST 2	Second address readback
003	ERROR TEST 3	Third address readback
004	ERROR TEST 4	Fourth address readback
005	ERROR TEST 5	Odd bits data register
006	ERROR TEST 6	Even bits data register
007	ERROR TEST 7	Block bit readback
010	ERROR TEST 10	Channel pace bit readback
	Time-of-day clock readback errors	
011	ERROR TEST 11	Least sig. byte, least sig. counter
012	ERROR TEST 12	Most sig. byte, least sig. counter
013	ERROR TEST 13	Least sig. byte, middle counter
014	ERROR TEST 14	Most sig. byte, middle counter
015	ERROR TEST 15	Least sig. byte, most sig. counter
016	ERROR TEST 16	Most sig. byte, most sig. counter
017	ERROR TEST 17	BIF mask not 0
020	ERROR TEST 20	BIF mask slot 1
021	ERROR TEST 21	BIF mask slot 2
022	ERROR TEST 22	BIF mask slot 3
023	ERROR TEST 23	BIF mask slot 4
024	ERROR TEST 24	BIF mask slot 5
025	ERROR TEST 25	BIF mask slot 6
026	ERROR TEST 26	BIF mask slot 7
027	ERROR TEST 27	BIF mask slot 8
030	WARNING TEST 30	No backplane interrupt (test hood needed)
031	ERROR TEST 31	Backplane interrupt won't clear
032	ERROR TEST 32	No last control word interrupt
033	ERROR TEST 33	No watchdog interrupt
034	ERROR TEST 34	No timeout interrupt
035	ERROR TEST 35	No interrupts
037	ERROR TEST 37	Timeout interrupt status won't clear
040	ERROR TEST 40	Time-of-day pulsing error
041	ERROR TEST 41	Wrong select code for MCI (must be 31B)
042	ERROR TEST 42	No MCI card present

B.1.4 HP-IB Diagnostic

The HP-IB diagnostic may cause the following messages to be displayed on the VCP. Further information may be found in appendix B of the HP 12009A HP-IB Interface Diagnostic Operating Manual, part number 24397-90009,

ERROR - CARD BUS CHECK

Failure in the internal HP-IB interface card bus, or a failure in one of the data registers that interfaced with the PHI chip and the backplane.

ERROR - CARD-CARD TEST FAILURE

Faulure when two HP 12009A HP-IB cards tried to communicate with each other. Could be a problem in line drivers and receivers.

ERROR - CARD RESET

Card reset failed after an OTA @32 or CLCC 0 statement.

ERROR - CONTROL REGISTER CHECK

Control register failed to hold data properly. Also displayed if the select code entered is not correct.

ERROR - DMA CHECK

A direct memory access write/read to the data registers on the interface card (not PHI chip) has failed.

ERROR - HP-IB INTERACTIVE TEST FAILURE

A failure with the HP-IB drivers, with the PHI chip interaction with the actual HP-IB, or with the HP-IB disc interface that is being used to loop data back to the PHI chip over HP-IB. This test will also indicate if there is a failure in data transmission, since several types of data patterns are used. It probably indicates a failure in communicating with the last disc under test (e.g., the last HP-IB address displayed by the diagnostic).

ERROR - ON-LINE TEST FAILURE

Failure when the PHI chip was placed on-line, and was detected when the PHI chip generated an SRQ, when a DMA transfer did not complete while waiting for a parallel poll, or when the PHI chip did not change state when an IFC was generated.

ERROR - PHI CHIP/HP-IB CARD FAILURE

The card did not interact correctly with the PHI chip. This could be an incorrect DMA completion, an expected interrupt that did not occur, or an error in the status register.

B.2 ANALOG FUNCTION CARDS DIAGNOSTIC

One level 1 diagnostic is used to test all of the analog function cards. Since this diagnostic tests only functions that are internal to the card, and since the internal registers of analog cards are very straightforward, the tests are quite simple. Exhaustive testing is done by the level 2 diagnostics, using the Diagnostic Interface Unit (DIU).

Error messages:

```
WHAT WOULD YOU LIKE TO DO NEXT?

SKIP SLOT AND GO TO NEXT CARD..1
START TEST ON CARD OVER.......2
HALT THE TEST.................3
CONTINUE PRESENT TEST.....(NULL)
```

If an error occurs, the diagnostic prints the appropriate error message and asks the above question. Specify which action you want by entering the corresponding number. If you want to continue the test in progress, press the RETURN key.

```
ERROR 1 !!  WRITE/READ
NOT CORRECTLY COMPLETED AT
ADDRESS xxx
```

The diagnostic performed an anticipatory read of all registers on the card. The diagnostic checked for completion of the read by making sure that the read request did not time out. The value returned by the read request was not checked.

If a read request times out, the above error message is issued.

```
ERROR 2 !!  MEMORY FLAW.
WHAT WAS WRITTEN AND WHAT
WAS READ DO NOT COINCIDE.
ADDRESS xxx
DATA WRITTEN WAS xxxxxx
DATA READ WAS xxxxxx
```

For each gain register (registers 193-225) the diagnostic wrote a series of bit patterns to the register, and read the patterns back. The error message above is issued if the value read back from a register is not the same as the value written to that register.

B.3 DIGITAL FUNCTION CARD DIAGNOSTICS

B.3.1 HP 25511A Digital Input Card Diagnostic

This diagnostic performs a non-interactive test of functions that are internal to the digital input card. External functions involving signal conditioning and input from field wiring are tested by the level 2 diagnostic, using the diagnostic interface unit (DIU).

The following notes on the operation of the card should help you to understand the error messages.

Notes:

The digital input card contains 256 register addresses, of which 45 are used. The assignment of registers is shown in the Programmer's Reference Manual.

Point input registers 1 through 16 correspond to bits 0 through 15 of field input register 1, and point input registers 17 through 32 correspond to bits 0 through 15 of field input register 2. Any change in the point registers causes a corresponding change in the field registers, and vice versa.

Input data that appear at the input points are transmitted to the input storage registers on receipt of a strobe signal. (As this diagnostic makes minimal use of the strobe mechanism, we will not discuss strobing here.) In addition, the arrival of input data may cause bits to be set in the interrupt registers, depending on bit settings in a number of other registers.

The sense, sense override, and unmask registers act as filters that govern whether input data cause bits to be set in the interrupt registers. There are two registers of each type, and the bits in those registers correspond to the bits of the field input registers. (For example, input point 5 corresponds to bit 4 of field input register 1. Its interrupt functions are governed by bit 4 of sense register 1, bit 4 of sense override register 1, and bit 4 of unmask register 1. Its interrupt status is recorded by bit 4 of interrupt status register 1.)

Bit settings in the sense and sense override registers determine when an event is detected; an event may be defined as a 0-to-1

transition of an input datum, a 1-to-0 transition of that datum, or either transition. A detected event will propagate through to the interrupt status register only if the unmask bit for that input point is set. An example should help to make the process clear.

Let's say that you wanted to monitor the 0-to-1 transitions (but not the 1-to-0 transitions) of input point 14. (This would be the same as monitoring bit 13 of field input register 1.) You would set the corresponding bit (bit 13) of sense register 1; this would cause a 0-to-1 transition of point 14 to be detected as an event. You would also clear bit 13 of sense override register 1; this would limit event detection on point 14 to the mode specified in the sense register. In addition, you would set bit 13 of unmask register 1; with this setting, any event (0-to-1 transition) detected at input point 14 would cause bit 13 of the interrupt status register to be set.

Note that when this diagnostic tests the interrupt function it generates signals that are detected as events regardless of the settings of the sense and sense override registers. Therefore, you will not see references to those registers in the description of the interrupt test.

Error messages:

EXPECTED DATA (DEC): dddddd
(BINARY): bbbbbbbbbbbbbbbb

RETURNED DATA (DEC): dddddd
(BINARY): bbbbbbbbbbbbbbbb

If an error has occurred (other than the timeout error), these messages are printed out along with the error message.

TIMEOUT ERROR

The diagnostic issued a command to the card and a timeout occurred before the command was executed. The diagnostic program stops after a timeout error.

ERROR 1: ID CODE

The diagnostic read the card ID register and found a card type other than 11 (digital input card).

ERROR 2: FIELD 1 INPUTS

ERROR 3: FIELD 2 INPUTS

The diagnostic issued a system normalize command (SYN) to reset the card to its power-on state. Among other things, this should have cleared the input fields (set the bits to zero). The diagnostic then read the values of the input fields and compared them to zero. Error 2 indicates that the field 1 input storage register was not zero. Error 3 indicates that the field 2 input storage register was not zero.

ERROR 4: CARD STATUS REGISTER

ERROR 5: CARD STATUS REGISTER

After a system normalize (SYN) was issued, the diagnostic set IEX false and read the card status register. Bits 0 and 1 of the status register should have been set (ones). Error 4 indicates that they were not properly set.

Next, the diagnostic set IEX true and read the card status register. This should have cleared (set to zero) the status register. Error 5 indicates that the status register was not cleared properly.

Note that errors 4 and 5 have different causes, even though the wording of the error messages is the same.

ERROR 6: CARD CONFIGURATION REGISTER

ERROR 7: CARD CONFIGURATION AFTER NORMALIZE

ERROR 8: CARD CONFIGURATION REGISTER

The diagnostic wrote all ones to the card configuration register, and then read the register back. This should have shown bits 0, 1, 8, and 9 to be set (the other bits of the configuration register are not defined). Error 6 indicates that the bits were not set properly.

Next, the diagnostic issued a system normalize (SYN) command and read back the card configuration register. This should have set (to ones) bits 8 and 9 of the register and cleared (set to zero) the rest of the bits. Error 7 indicates that that bit pattern was not set properly.

Next, the diagnostic wrote all zeros to the card configuration register and read the register back. Error 8 indicates that the the bits were not all set to zero.

Note that errors 6 and 8 have slightly different causes, even though their error messages have the same wording.

ERROR 9: INTERRUPT STATUS
REGISTER 1

ERROR 10: INTERRUPT STATUS
REGISTER 2

The diagnostic set (to ones) all bits in unmask register 1 and unmask register 2, and generated a series of bit patterns. It then wrote each pattern to the field input registers, read back each pattern from the interrupt status registers, and compared the patterns. Since all of the unmask bits were set, all bit patterns appearing at the field input registers should have been transmitted to the interrupt status registers. Error 9 indicates that the bit pattern read back from interrupt status register 1 was not the same as that written to field input register 1. Error 10 indicates that the bit pattern read back from interrupt satus register 2 was not the same as that written to field input register 2.

ERROR 11: SENSE REGISTER 1

ERROR 12: SENSE REGISTER 2

ERROR 13: SENSE OVERRIDE
REGISTER 1

ERROR 14: SENSE OVERRIDE
REGISTER 2

The diagnostic generated a series of bit patterns and wrote those patterns to sense register 1, sense register 2, sense override register 1, and sense override register 2. It then read back those patterns and compared them with the original patterns.

Error 11 indicates that the bit pattern read back from sense register 1 was not the same as the pattern written to that register. Error 12 indicates the same thing for sense register 2. Error 13 indicates that the bit pattern read back from sense override register 1 was not the same as the pattern written to that register, and error 14 indicates the same thing for sense override register 2.

ERROR 15: UNMASK REGISTER 1

ERROR 16: UNMASK REGISTER 2

The diagnostic generated a series of bit patterns and wrote them to unmask register 1 and unmask register 2. It then read those patterns back and compared them with the original patterns. Error 15 indicates that the pattern read back from unmask register 1 was not the same as the pattern written to that register. Error 16 indicates the same thing for unmask register 2.

ERROR 17: INTERRUPT STATUS
NOT EQUAL TO UNMASK
UNMASK REG 1 (DEC): dddddd
(BINARY): bbbbbbbbbbbbbbbb
INTERRUPT STATUS REGISTER 1

ERROR 18: INTERRUPT STATUS
NOT EQUAL TO UNMASK
UNMASK REG 2 (DEC): dddddd
(BINARY): bbbbbbbbbbbbbbbb
INTERRUPT STATUS REGISTER 2

The diagnostic generated a series of bit patterns. For each of these patterns the diagnostic:

1) wrote the pattern to the unmask registers,

2) wrote a pattern of all ones to the field input registers,

3) read the interrupt status registers, and

4) compared the interrupt status registers with the original pattern.

The bit patterns that propagated through to the interrupt registers should have been the same as those written to the unmask registers. Error 17 indicates that the bit pattern read back from interrupt status register 1 was not equal to the pattern written to unmask register 1. Error 18 indicates that the bit pattern read back from interrupt status register 2 was not equal to the pattern written to unmask register 2.

B.3.2 HP 25513A Digital Output Card Diagnostic

This diagnostic performs a non-interactive test of functions that are internal to the digital output card. Functions that are external to the card, involving signal conditioning and output to field wiring, are tested by the level 2 diagnostic, using the diagnostic interface unit (DIU).

The following notes on the operation of the card should help you to understand the error messages.

Notes:

The digital output card contains 256 register addresses, of which 37 are used. The assignment of registers is shown in the Programmer's Reference Manual.

Point output registers 1 through 16 correspond to bits 0 through 15 of field output register 1, and point output registers 17 through 32 correspond to bits 0 through 15 of field output register 2. Any change in the point registers causes a corresponding change in the field registers, and vice versa.

Each of the output registers has two ranks of storage, rank 1 and rank 2. Rank 1 is internal to the card; rank 2 is connected to the output points of the card, and from there to the field wiring. When data are programmed for output, they are written to rank 1 registers; they are moved to rank 2 registers on receipt of a strobe signal. The strobe signal may be either internal (from the card) or external (from the field wiring). Bit settings in the card configuration register determine whether internal or external strobing is used. This diagnostic uses only internal strobing, so we will not discuss external strobing here.

Internal strobing is governed by two control signals, IEX (immediate execute) and XCUT (execute). If IEX is true and data are programmed for output, the internal strobe occurs immediately after the output data are written to the rank 1 registers. This causes an immediate transfer of data from rank 1 registers to rank 2 registers. If IEX is false during output, the output data are written to the rank 1 registers but no internal strobe signal is issued. Data transfer from rank 1 registers to rank 2 registers is delayed until an internal strobe occurs. This internal strobe may be caused by a pulse of the XCUT line, or it may result from a command issued with IEX turned on. (The strobe signal that accompanies execution of the later command also causes transfer of data set up by the earlier command.)

A write command writes output data to rank 1 registers; a read command reads output data from rank 2 registers.

Note that several of the tests performed by this diagnostic build on the results of tests made earlier in the diagnostic. If an earlier test fails, it may produce incorrect buffers that will cause subsequent tests to fail, even though they might have succeeded if the correct buffers had been available.

Error messages:

EXPECTED DATA (DEC): dddddd
(BINARY): bbbbbbbbbbbbbbbb

RETURNED DATA (DEC): dddddd
(BINARY): bbbbbbbbbbbbbbbb

If an error has occurred (other than the timeout error), these messages are printed out along with the error message.

ERROR 1: TIMEOUT ERROR

The diagnostic issued a command to the card and a timeout occurred before the command was executed. The diagnostic program stops after a timeout error.

ERROR 2: INCORRECT ID CODE

The diagnostic read the card ID register and found a card type other than 13 (digital output card).

ERROR 3: FIELD 1 CHANGING
WITHOUT STROBE

ERROR 4: FIELD 2 CHANGING
WITHOUT STROBE

ERROR 5: STATUS NOT SETTING
ON DELAYED STROBE

After clearing all registers (setting all bits to zero) the diagnostic set IEX false, wrote a bit pattern to the two field output registers (to rank 1), and then read the field output registers (from rank 2). Since the diagnostic did not pulse the XCUT line, the states of the rank 2 registers should not

have changed; all bits should still have been zero. Error 3 indicates that rank 2 of the field 1 register changed from zero without receiving the XCUT pulse. Error 4 indicates the same thing for field 2.

When output data are in the rank 1 registers of the output fields awaiting the XCUT pulse, bits 0 and 1 of the card status register should be set (ones). Error 5 indicates that the diagnostic found that those bits were not set properly.

ERROR 6: XCUT NOT STROBING FLD 1

ERROR 7: XCUT NOT STROBING FLD 2

ERROR 8: XCUT NOT CLEARING
CARD STATUS

The diagnostic set IEX false and wrote a bit pattern to rank 1 of both field output registers. The diagnostic then pulsed the XCUT line to move the data from rank 1 to rank 2 and read the data back from rank 2. Errors 6 and 7 indicate that the transfer of data from rank 1 to rank 2 did not occur properly.

As soon as the strobe signal (XCUT) caused transfer of data from rank 1 to rank 2, the card was no longer waiting for a strobe signal. Bits 0 and 1 of the card status register should have been cleared (set to zero) to indicate this state. Error 8 indicates that those bits were not cleared.

ERROR 9: CONFG REGISTER
NOT SETTING

The diagnostic wrote a bit pattern to the card configuration register and read it back. Error 9 indicates that the two bit patterns were not the same.

ERROR 10: CONFIGURATION REG
NOT CLEARING

ERROR 11: FIELD 1 NOT CLEARING
AFTER NORMALIZE

ERROR 12: FIELD 2 NOT CLEARING
AFTER NORMALIZE

ERROR 13: STATUS NOT CLEARING
AFTER NORMALIZE

The diagnostic wrote data to the card configuration register, the card status register, and both field output registers. Then it issued a system normalize command (which should have cleared all registers) and read the contents of those registers. These errors indicate that those registers were not cleared properly.

ERROR 14: FLD 1 READ WITH IEX
NOT STROBING DATA

ERROR 15: FLD 2 READ WITH IEX
NOT STROBING DATA

ERROR 16: READ WITH IEX
NOT CLEARING STATUS

The diagnostic set IEX false and wrote a bit pattern to both field output registers (rank 1) and then read those register back (from rank 2) with IEX true. The read command should have caused the data in the rank 1 registers to be transferred to the rank 2 registers. Errors 14 and 15 indicate that the transfer was not successful.

The write with IEX false should have set bits 0 and 1 in the card status register to indicate that the field output registers were waiting for a strobe signal; the read with IEX true should have cleared those status bits. Error 16 indicates that those bits were not cleared properly.

ERROR 17: FIELD 1 DATA INCORRECT

ERROR 18: FIELD 2 DATA INCORRECT

The diagnostic wrote a series of buffers to the field output registers and read them back. Errors 17 and 18 indicate that the buffers that were read back were not the same as those that were written out.

ERROR 19: OUTPUT POINT xx

The diagnostic wrote a series of bit patterns to the point output registers, such that all odd-numbered points were the same and all even-numbered points were the same. It then read back both of those sets, point by point, to make sure that the values stored in those points were correct. Error 19 indicates that a point was not correct when it was read back.

ERROR 20: FLD 1 NOT EQUAL
TO POINTS 1-16

ERROR 21: FLD 2 NOT EQUAL
TO POINTS 17-32

The diagnostic wrote bit patterns to the point output registers and read back the field output registers. Error 20 indicates that the bits of field output register 1 did not match points 1 through 16. Error 21 indicates that the bits of field output register 2 did not match points 17 through 32.

B.3.3 HP 25514A Relay Output Card Diagnostic

This diagnostic performs a non-interactive test of functions that are internal to the relay output card. Functions that are external to the card, involving signal conditioning and output to field wiring, are tested by the level 2 diagnostic, using the diagnostic interface unit (DIU).

The following notes on the operation of the card should help you to understand the error messages. As this diagnostic is very similar to the diagnostic for the digital output card, the notes and error message explanations are also very similar.

Notes:

The relay output card contains 256 register addresses, of which 20 are used. The assignment of registers is shown in the Programmer's Reference Manual.

Point output registers 1 through 16 correspond to bits 0 through 15 of the field output register. Any change in the point registers causes a corresponding change in the field register, and vice versa.

The output register has two ranks of storage, rank 1 and rank 2. Rank 1 is internal to the card; rank 2 is connected to the output points of the card, and from there to the field wiring. When data are programmed for output, they are written to rank 1 registers; they are moved to rank 2 registers on receipt of a strobe signal. The strobe signal may be either internal (from the card) or external (from the field wiring). Bit settings in the card configuration register determine whether internal or external strobing is used. This diagnostic uses only internal strobing, so we will not discuss external strobing here.

Internal strobing is governed by two control signals, IEX (immediate execute) and XCUT (execute). If IEX is turned on and data are programmed for output, the internal strobe occurs immediately after the output data are written to the rank 1 registers. This causes an immediate transfer of data from rank 1 registers to rank 2 registers. If IEX is turned off during output, the output data are written to the rank 1 registers but no internal strobe signal is issued. Transfer of data from the rank 1 registers to the rank 2 registers is delayed until an internal strobe occurs. This internal strobe may be caused by a pulse of the XCUT line, or it may result from a command issued with IEX turned on. (The strobe signal that accompanies execution of the

later command also causes transfer of data set up by the earlier command.)

A write command writes output data to rank 1 registers; a read command reads output data from rank 2 registers.

Note that several of the tests performed by this diagnostic build on the results of tests made earlier in the diagnostic. If an earlier test fails, it may produce incorrect buffers that will cause subsequent tests to fail, even though they might have succeeded if the correct buffers had been available.

Error messages:

EXPECTED DATA (DEC): dddddd
(BINARY): bbbbbbbbbbbbbbbb

RETURNED DATA (DEC): dddddd
(BINARY): bbbbbbbbbbbbbbbb

If an error has occurred (other than the timeout error), these messages are printed out along with the error message.

ERROR 1: TIMEOUT ERROR

The diagnostic issued a command to the card and a timeout occurred before the command was executed. The diagnostic program stops after a timeout error.

ERROR 2: INCORRECT ID CODE

The diagnostic read the card ID register and found a card type other than 14 (relay output card).

ERROR 3: FIELD CHANGING
WITHOUT STROBE

ERROR 4: STATUS NOT SETTING
ON DELAYED STROBE

After clearing all registers (setting all bits to zero) the diagnostic set IEX false, wrote a bit pattern to the field output register (to rank 1), and then read the field output register (from rank 2). Since the diagnostic did not pulse the XCUT line, the state of the rank 2 register should not have

changed; all bits should still have been zero. Error 3 indicates that rank 2 of the field register changed from zero without receiving the XCUT pulse.

When an output datum is in the rank 1 register of the output field awaiting the XCUT pulse, bit 0 of the card status register should be set (one). Error 4 indicates that the diagnostic found that that bit was not set properly.

ERROR 5: XCUT NOT STROBING
FIELD OUTPUT

ERROR 6: XCUT NOT CLEARING
CARD STATUS

The diagnostic set IEX false and wrote a bit pattern to rank 1 of the field output register. The diagnostic then pulsed the XCUT line to move the datum from rank 1 to rank 2 and read the datum back from rank 2. Error 5 indicates that the transfer of the datum from rank 1 to rank 2 did not occur properly.

As soon as the strobe signal (XCUT) caused transfer of the datum from rank 1 to rank 2, the card was no longer waiting for a strobe signal. Bit 0 of the card status register should have been cleared (set to zero) to indicate this state. Error 6 indicates that that bit was not cleared.

ERROR 7: CONFG REGISTER
NOT SETTING

The diagnostic wrote a bit pattern to the card configuration register and read it back. Error 9 indicates that the two bit patterns were not the same.

ERROR 8: CONFG REGISTER NOT
CLEARING AFTER NORMALIZE

ERROR 9: FIELD NOT CLEARING
AFTER NORMALIZE

ERROR 10: STATUS NOT
CLEARING AFTER NORMALIZE

The diagnostic wrote data to the card configuration register, the card status register, and the field output register. Then it issued a system normalize command (which should have cleared all registers) and read the contents of those registers. These errors indicate that those registers were not cleared properly.

ERROR 11: FLD READ WITH
IEX NOT STROBING DATA

ERROR 12: READ WITH IEX NOT
NOT CLEARING STATUS

The diagnostic set IEX false and wrote a bit pattern to the field output register (rank 1) and then read that register back (from rank 2) with IEX true. The read command should have caused the datum in the rank 1 register to be transferred to the rank 2 register. Error 11 indicates that the transfer was not successful.

The write with IEX false should have set bit 0 in the card status register to indicate that the field output register was waiting for a strobe signal; the read with IEX true should have cleared that status bit. Error 12 indicates that that bit was not cleared properly.

ERROR 13: FIELD DATA INCORRECT

The diagnostic wrote a series of buffers to the field output register and read them back. Error 17 indicates that the buffers that were read back were not the same as those that were written out.

ERROR 14: OUTPUT POINT xx

The diagnostic wrote a series of bit patterns to the point output registers, such that all odd-numbered points were the same and all even-numbered points were the same. It then read back both of those sets, point by point, to make sure that the values stored in those points were correct. Error 14 indicates that a point was not correct when it was read back.

ERROR 15: OUTPUT FIELD NOT EQUAL TO POINTS

The diagnostic wrote bit patterns to the point output register and read back the field output register. Error 15 indicates that the bits of the field output register did not match points 1 through 16.

B.3.4 HP 25516A Multifunction Card Diagnostic

This diagnostic performs a non-interactive test of functions that are internal to the digital input card. External functions involving signal conditioning and input and output to and from field wiring are tested by the level 2 diagnostic, using the diagnostic interface unit (DIU).

The following notes on the operation of the card should help you to understand the error messages.

Notes:

The multifunction card contains 256 register addresses, of which 74 are used. The assignment of registers is shown in the Programmer's Reference Manual.

Input functions. Point input registers 1 through 16 correspond to bits 0 through 15 of the field input register. Any change in the point registers causes a corresponding change in the field register, and vice versa.

Input data that appear at the input points are transmitted to the input storage registers on receipt of a strobe signal. The strobe signal may be either internal (from the card) or external (from the field wiring). Bit settings in the card configuration register determine whether internal or external strobing is used. Since this diagnostic does not use external strobing, we will not discuss that mechanism here.

Internal strobing is governed by two control signals, IEX (immediate execute) and XCUT (execute). When IEX is turned on, a read command generates an internal strobe signal that causes immediate transfer of data from the input points to the input storage registers. If IEX is turned off during a read operation, no internal strobe signal is generated; transfer of data from the input points to the input storage registers does not occur until the next strobe signal is issued. This strobe signal may be caused by a pulse of the XCUT line, or it may result from a following read or write command with IEX on.

Input signals may also cause bits to be set in the interrupt register, depending on bit settings in a number of other registers. The sense, sense override, count, preset, rollover, and unmask registers act as filters that control whether input data cause bits to be set in the interrupt register.

Bit settings in the sense and sense override registers determine

when an event is detected. The bits in these registers correspond to the bits in the field input register. For example, the settings of bit 3 of the sense register and bit 3 of the sense override register determine whether the data arriving at bit 3 of the field input register (that's the same as input point 4) are interpreted as an event. If a bit in the sense override register is clear (zero) and the corresponding bit in the sense register is set (one), only 0-to-1 transitions of the corresponding input point are detected as events. If that sense bit is clear (zero), only 1-to-0 transitions are detected. If the sense override bit is set (one), either transition is detected as an event, regardless of the bit setting in the sense register.

When an event is detected, the value in the corresponding count register is increased by one. If the value in the count register increases past 255, and if the corresponding bit in the unmask register is set to one, an interrupt is generated and the corresponding bit in the interrupt register is set to one. At the same time, the count register rolls over to a value of zero (if the corresponding bit in the rollover register is set to zero) or to the value contained in the corresponding preset register (if the corresponding bit in the rollover register is set to one).

Since these interrelationships may not be immediately clear, we'll provide an example.

Assume the following register settings:

Sense register, bit 9: 1
Sense override register, bit 9: 0
Count register 10: 254
Preset register 10: 246
Rollover register, bit 9: 1
Unmask register, bit 9: 1
Interrupt register, bit 9: 0

Because of the settings of the sense and sense override registers, any 0-to-1 transitions of input point 10 will cause the count register to be incremented. The first such transition will increase the count to 255. The second transition will cause the count to exceed 255. Because the unmask bit is set, an interrupt is recorded in the interrupt register; because the rollover bit is set, the count register rolls over to 246 (the value contained in the preset register). The process will repeat on every tenth 0-to-1 transition of input point 10.

Note that when this diagnostic tests the interrupt function it generates signals that are detected as events regardless of the settings of the sense and sense override registers. Therefore, you will not see references to those registers in the description of the interrupt test.

Output functions. Point output registers 1 through 16 correspond to bits 0 through 15 of field output register 1. Any change in the point registers causes a corresponding change in the field registers, and vice versa.

The output register has two ranks of storage, rank 1 and rank 2. Rank 1 is internal to the card; rank 2 is connected to the output points of the card, and from there to the field wiring. When data are programmed for output, they are written to rank 1 registers; they are moved to rank 2 registers on receipt of an internal strobe signal.

Internal output strobing is governed by the same two control signals, IEX (immediate execute) and XCUT (execute), that are used for input strobing. If IEX is turned on and data are programmed for output, the internal strobe occurs immediately after the output data are written to the rank 1 registers. This causes an immediate transfer of data from rank 1 registers to rank 2 registers. If IEX is turned off during output, the output data are written to the rank 1 registers but no internal strobe signal is issued. Transfer of data from the rank 1 registers to the rank 2 registers is delayed until an internal strobe occurs. This internal strobe may be caused by a pulse of the XCUT line, or it may result from a command issued with IEX turned on. (The strobe signal that accompanies execution of the later command also causes transfer of data set up by the earlier command.)

A write command writes output data to rank 1 registers; a read command reads output data from rank 2 registers. The rank 1 registers can be read only with a double word read command; in such a read, the rank 1 value is returned in the second word.

Note that several of the tests performed by this diagnostic build on the results of tests made earlier in the diagnostic. If an earlier test fails, it may produce incorrect buffers that will cause subsequent tests to fail, even though they might have succeeded if the correct buffers had been available.

Error messages:

```
EXPECTED DATA (DEC): dddddd
(BINARY): bbbbbbbbbbbbbbbb

RETURNED DATA (DEC): dddddd
(BINARY): bbbbbbbbbbbbbbbb
```

If an error has occurred (other than the timeout error), these messages are printed out along with the error message.

```
TIMEOUT ERROR
```

The diagnostic issued a command to the card and a timeout occurred before the command was executed. The diagnostic program stops after a timeout error.

```
ERROR M0: ROLLOVER/COUNTER
FUNCTION ON PT.  xx
```

With all count registers set at 255, the diagnostic wrote a bit pattern to the rollover register and wrote all ones to the field input register. It then checked to see that the counts had rolled over to zero or to the preset value, according to the bit settings in the rollover register.

Error M0 indicates that the specified count register did not roll over to the correct value.

```
ERROR M1: OUTPUT FIELD
RANK 2 SHOULD BE ZERO
WITHOUT A TRIGGER TO
STORE RANK1 => RANK2

ERROR M2: OUTPUT FIELD RANK1

ERROR M3: OUTPOINT 1 CHANGING
WITHOUT TRIGGER

ERROR M4: OUTPOINT 1 RANK 1
NOT SETTING
```

The diagnostic cleared the field output register (register 177) and wrote an odd number to that register with IEX (immediate execute) off. It then performed a double word read of that register, with IEX still off. Since turning IEX off suppressed the internal strobe signal, the value written to the field output register should have been stored in rank 1 of that

register, but should not have been transmitted to rank 2 of that register. The rank 2 value was returned as the first word of the double word read, and the rank 1 value was returned as the second word. Thus, the first word should have contained zero and the second word should have contained the value that was written to the field output register.

Error M1 indicates that the value of the first word was not zero. Error M2 indicates that the second word did not contain the value that was written to the field output retgister.

The diagnostic also performed a double word read on point output register 1 (register 65), again with IEX off. Since point output register 1 corresponds to the first bit (bit 0) of the field output register, and since the number was odd, rank 1 of point output register 1 should have contained a one and rank 2 of that register should have contained a zero. As with the field output register, the double word read returned the contents of rank 2 in word 1 and the contents of rank 1 in word 2. Thus, the first word should have contained a zero and the second word should have contained a one.

Error M3 indicates that the value of the first word was not zero. Error M4 indicates that the value of the second word was not one.

ERROR M5: OUTPUT FIELD RANK2
NOT STORED BY XCUT

ERROR M6: OUTPUT FIELD RANK1
CHANGED ILLEGALLY

ERROR M7: OUTPOINT1 RANK2
NOT STORED BY XCUT

ERROR M8: OUTPOINT1 RANK1
CHANGED ILLEGALLY

After the operations described above, the diagnostic issued an XCUT pulse (to generate an internal strobe signal) and then performed a double word read of the field output register (register 177) with IEX off. The strobe signal should have caused the contents of rank 1 of the field output register to be transmitted to rank 2. Thus, both words read from the field output register (that is, rank 1 and rank 2) should contain the value that was written to that register.

Error M5 indicates that the value of the first word read from the field output register was not the same as the value that was originally written to that register. (That is, the rank 1

value was not transmitted to rank 2.) Error M6 indicates the same thing for the second word read from the field output register. (That is, the rank 1 value changed.)

The diagnostic then performed a double word read of point output register 1, with IEX off. This should, by the same reasoning, have resulted in a value of one for both words read from point output register 1. Error M7 indicates that the first word read from that register did not have a value of one. (That is, the rank 1 value was not transmitted to rank 2.) Error M8 indicates the same thing for the second word. (That is, the rank 1 value changed.)

ERROR M9: WRITING ZERO
TO OUTPOINT 1
NOT DECREMENTING OUTFIELD
RANK2 CONTENTS

ERROR M10: WRITING ZERO
TO OUTPOINT 1
NOT DECREMENTING OUTFIELD
RANK1 CONTENTS

After the operations described above, the diagnostic wrote a value of zero to output point 1 (with IEX on). This should have changed the value of output point 1 from one to zero, and should have decreased the value in the field output register by one (since output point 1 is the least significant bit of the field output register). The diagnostic then performed a double word read of the field output register with IEX off. The values read from both rank 2 and rank 1 of the field output register should have been one less than the value originally written to the field output register.

Error M9 indicates that the first word (the rank 2 contents) did not have the correct value. Error M10 indicates that the second word (the rank 1 contents) did not have the correct value.

ERROR M11: STATUS NOT SETTING

ERROR M12: REG 252 NONZERO

ERROR M13: STATUS NOT CLEARING

The diagnostic read the field input register (register 161) with IEX off, and then read the card status register (register 251) and register 252, also with IEX off. Reading the field input register with IEX off should have caused bit 0 of the

card status register to be set to indicate that the card was waiting for a strobe signal. (Reading the card status register with IEX off left the contents of that register unchanged; a read with IEX on would have issued a strobe signal, which would have invalidated the reading obtained from the card status register.)

Error M11 indicates that the "strobe waiting" bit (bit 0) of the card status register was not set by a read with IEX off.

The value of register 252 should have always been zero. Error M12 indicates that it was not zero.

The diagnostic then issued an XCUT pulse (an internal strobe signal) and then read the card status register once more, with IEX again off. The XCUT pulse should have completed the pending read and cleared the card status register (reset it to zero). Error M13 indicates that the card status register was not reset to zero.

ERROR I1: NORMALIZED CARD CONFIG

ERROR I2: REG 250 NONZERO

The diagnostic issued a system normalize (SYN) command and then checked the contents of registers 249 (card configuration register) and 250. The value of register 249 should have been 256 (bit 8 set); error I1 indicates that it was not. The value of register 250 should have been zero; error I2 indicates that it was not.

ERROR I3: OUTPUT RANK 2
DURING INITIALIZATION

ERROR I4: OUTPUT RANK 1
DURING INITIALIZATION

The diagnostic wrote zeros to the field output register (register 177) and read back that register and register 178. Both registers should have contained a value of zero. Error I3 indicates that the value of register 177 was not zero. Error I4 indicates that the value of register 178 was not zero.

ERROR I5: INPUTS NONZERO
CABLES DISCONNECTED?

The diagnostic read the field input register (register 161). The contents of this register should have been zero if the field wiring was disconnected before the diagnostic started executing. Error I5 indicates that the value read from the field input register was not zero.

ERROR I6: INTRPTS NOT CLEARING
AFTER 2ND READ

The diagnostic read the interrupt status register (register 241) twice. Since the interrupt status register is cleared after a read, the value returned by the second read should have been zero. Error I6 indicates that that value was not zero.

ERROR I7: STATUS NONZERO
DURING INITIALIZATION

The diagnostic read the contents of the card status register (register 251). Since the card should not have been waiting for a strobe signal (as the previous I/O command was a read with IEX true), the value of the card status register should have been zero. Error I7 indicates that the value of that register was not zero.

ERROR C1: CARD CONFIG REG
NOT 257 FROM -1
(WHEN ALL 1'S LOADED, ONLY
BITS 0,8 SHOULD = 1)

The diagnostic wrote all ones to the card configuration register. This should have set bits 0 and 8 (the other bits in the register are undefined), leaving a value of 257 in the register. The diagnostic then read back the register and checked its contents. Error C1 indicates that the value of the card configuration register was not 257.

ERROR C2: CARD CONFIG REG
NOT LOADING ZEROES

The diagnostic wrote all zeros to the card configuration register (register 249) and read back the contents of the register. Error C2 indicates that the value read back from the register was not zero.

ERROR C3: CARD CONFIG REGISTER

The diagnostic wrote a value to the card configuration register (register 249) and read back the contents of that register. Error C3 indicates that the value read back from the register was not the same as that written to the register.

ERROR P1: PRESET REG #xx

The diagnostic wrote numbers to the preset registers (registers 145-160) and read them back. Error P1 indicates that the value read back from the specified register was not the same as the value that was written to that register.

ERROR D1: ROLLOVER
REGISTER (REG 193)

ERROR D2: REG 194 NONZERO

The diagnostic wrote a value to the rollover register (register 194), and then read back that register and register 194. Register 194 should have had a value of zero. Error D1 indicates that the value read back from register 193 was not the value that was written to it. Error D2 indicates that the value of register 194 was not zero.

ERROR D3: SENSE REGISTER
(REG 209)

ERROR D4: REG 210 NONZERO

The diagnostic wrote a value to the sense register (register 209), and read back that register and register 210. The contents of register 210 should have been zero. Error D3 indicates that the value read back from register 209 was not the value that was written to it. Error D4 indicates that the value of register 210 was not zero.

ERROR D5: SENSE OVERRIDE
REG (REG 211)

ERROR D6: REG 212 NONZERO

The diagnostic wrote a value to the sense override register (register 211), and read back that register and register 212. The contents of register 212 should have been zero. Error D5 indicates that the value read back from register 211 was not the same as the value written to that register. Error D6 indicates that the value of register 212 was not zero.

ERROR D7: UNMASK REGISTER (REG 225)

ERROR D8: REG 226 NONZERO

The diagnostic wrote a value to the unmask register (register 225), and read back that register and register 225. The contents of register 226 should have been zero. Error D7 indicates that the value read back from register 225 was not the same as the value written to it. Error D8 indicates that the value of register 226 was not zero.

ERROR N1: COUNT REGISTER #xx

The diagnostic wrote an array of numbers to the count registers (registers 124-144), read those registers back, and compared their contents to the original array. Error N1 indicates that the value read back from a specified count register was not the same as the value that was written to that register.

ERROR R1: INTERRUPT STATUS REG
DETECTED DURING THE
UNMASK REGISTER (REG 225) CHECK

ROLLOVER REGISTER (REG 193) CHECK

COUNTER CHECK (REGS 129-144)

ERROR R2: REG 242 NONZERO

The diagnostic wrote ones to the field input register (register 161) and read back the interrupt status register (register 241) and register 242. It compared the value of the interrupt status register with an expected value; that expected value differed according to whether the diagnostic was testing the operation of the unmask register (register 225), the rollover register (register 193), or the counter registers (registers

129-144). Error R1 indicates that the value of the interrupt status register was not the same as the expected value, and an additional line indicates which type of register was being tested.

The value of register 242 should have been zero. Error R2 indicates that it was not zero.

ERROR R3: INTERRUPT REG NOT CLEARING

The diagnostic read the interrupt status register (register 241) twice in succession. The register should have been cleared after the first read, leaving a value of zero in the register. Error R3 indicates that the value obtained by the second read was not zero.

APPENDIX C
LEVEL 2 ERROR MESSAGES

C.1 ANALOG FUNCTION CARD DIAGNOSTICS

All analog function card diagnostics tell you:

1) which diagnostic interface unit (DIU) personality module is to be used for the test,

2) which DIU slot is to hold the personality module, and

3) which cable is to be used to connect the personality module to the function card.

In addition, all analog function card diagnostics give you the option of skipping a card and going on to the next card.

C.1.1 HP 25501A Analog Input Card Diagnostic

Notes:

The connection between the diagnostic interface unit (DIU) and the analog input card is made with a cable that handles only eight channels at a time. The diagnostic will specify the DIU personality module to be used, the DIU slot that is to hold it, and the cable that is to connect the personality module to the card under test. At the start of the diagnostic, the cable should be connected to the first block of eight channels on the analog input card. The diagnostic will ask you to move the cable to the last eight channels after it has tested the operation of the first eight channels.

Different channels of the analog input card are used in tests of different functions. The gain ranges of the channels are set accordingly. Channel 1 is set to a gain of 1; channel 2 is set to a gain of 2; channel 3 is set to a gain of 4; channel 4 is set to a gain of 8; channel 5 is set for autoranging; and all other channels are set to a gain of 1.

In the messages below, a slot number refers to the slot (in a measurement and control unit) that holds an analog input card. A channel number refers to an input channel on the analog input card being tested.

Error messages:

```
WHAT WOULD YOU LIKE TO DO NEXT?

SKIP SLOT AND GO TO NEXT CARD..1
START TEST ON CARD OVER.........2
HALT THE TEST...................3
CONTINUE PRESENT TEST.....(NULL)
```

If an error occurs, the diagnostic prints the appropriate error message and asks the above question. Specify which action you want to take by entering the corresponding number. If you want to continue the test in progress, press the RETURN key.

```
ERROR 11 !!  BIT x MALFUNCTION
CHANNEL !  ADC IN SLOT xx
LAST VALUE READ WAS xxxxxx
```

(The three least significant bits in an analog-to-digital conversion can be affected by system noise. This section of the diagnostic tests to see that those bits do work -- that they turn on and off -- but does not test the accuracy of bit settings in that range.)

The diagnostic tested each of the three least significant bits of the analog-to-digital converter (ADC) to make sure that the ADC would read in the proper range. Because of possible noise contamination, the diagnostic made several readings until it read the programmed value. Error 11 indicates that the diagnostic made 200 readings without encountering the programmed value.

Note that "origin one" bit numbers are used in this error message; that is, bit 1 is the first bit of the ADC register, bit 2 is the second bit of the ADC register, and so on. (Usually the first bit is bit 0, the second is bit 1, and so on.) Note also that the first two bits of the ADC register are not used. Thus, bit 3 is the least significant bit of that register.

```
ERROR 12 !!  BIT VALUE ERROR
SLOT xx CHANNEL 1
UPPER LIM xxxxxx LOWER LIM xxxxxx
WRITTEN VALUE xxxxxx
READ VALUE xxxxxx
```

(The remaining bits are tested by direct measurement of voltages generated by the DIU. Due to noise that may be present in the system, the diagnostic checks to see that the voltage read by the ADC falls within an acceptable range.)

The diagnostic asked the DIU to output a voltage to the analog input card, and then read the value of that voltage from the ADC register of the card. Error 12 indicates that the voltage read from the card did not fall within an acceptable range.

```
ERROR 13 !!  GAIN MALFUNCTION
SLOT xx CHANNEL xx
UPPER LIM xxxxxx LOWER LIM xxxxxx
VALUE READ xxxxxx GAIN READ xxx
```

The diagnostic caused the DIU to output a voltage to the specified channel of the analog input card, and then read back the voltage from the ADC register of the card. Error 13 indicates that the voltage read from the ADC register did not fall within acceptable limits.

```
ERROR 14 !!  AUTO RANGE ERROR
SLOT xx CHANNEL xx
UPPER LIM xxxxxx LOWER LIM xxxxxx
GAIN xxx VALUE READ xxxxxx
GAIN READ xxxxxx
```

The diagnostic caused the DIU to output a series of voltages at different gains to the analog input card to check the card's ability to change gain ranges automatically. The diagnostic then read the values of the voltages from the ADC register of the card and checked to see that they were within specified limits. Error 14 indicates that the value read back from the card did not fall within the acceptable range, or that the gain read back from the card was not correct.

ERROR 15 !! OVERANGE MALFUNCTION
SLOT xx READ VALUE xxxxxx
READ GAIN VALUE xxxxxx

The diagnostic caused the DIU to write overrange voltages, both positive and negative, to the analog input card. It then checked to see that the overrange bit was being set in the ADC register. Error 15 indicates that the overrange bit was not set.

ERROR 16 !! CHANNEL xx ERROR
SLOT xx UPPER LIM xxxxxx
LOWER LIM xxxxxx
VALUE READ xxxxxx

The diagnostic caused the DIU to output a voltage to the specified channel of the analog input card, and then read the value of that voltage from the ADC register of the card. Error 16 indicates that the voltage read from the analog input card did not fall within an acceptable range.

C.1.2 HP 25502A, HP 25503A, and 25504A Multiplexer Cards Diagnostic

Notes:

The connection between the diagnostic interface unit (DIU) and the multiplexer (MUX) card is made with a cable that handles only eight channels at a time. The diagnostic will specify the DIU personality module to be used, the DIU slot that is to hold it, and the cable that is to connect the personality module to the card under test. At the start of the diagnostic, the cable should be connected to the first block of eight channels on the MUX card. After the diagnostic has finished testing a block of eight channels, it will ask you to move the cable to the next block of eight channels.

The diagnostic automatically adjusts itself to test the proper number of channels: 32 channels on the high-level and low-level MUX cards, and 16 channels on the relay MUX card. The diagnostic uses different channels of the card under test for different tests. Channel 1 is used for the overrange test. Channels 1, 2, and 3 of the low-level and relay MUX cards are set to different gain ranges and used for the gain test. (The high-level MUX dard has only one gain range, so the gain test is not performed on it.) All channels not tested in the gain test are given a general test to see that input voltages are properly read.

In the messages below, a slot number refers to the slot (in a measurement and control unit) that holds an analog input card. A channel number refers to an input channel on the analog input card being tested.

Error messages:

```
WHAT WOULD YOU LIKE TO DO NEXT?

SKIP SLOT AND GO TO NEXT CARD..1
START TEST ON CARD OVER.......2
HALT THE TEST.................3
CONTINUE PRESENT TEST.....(NULL)
```

If an error occurs, the diagnostic prints the appropriate error message and asks the above question. Specify which action you want to take by entering the corresponding number. If you want to continue the test in progress, press the RETURN key.

```
ERROR 21 !!  GAIN ERROR
SLOT xx CHANNEL xx
UPPER LIM xxxxxx LOWER LIM xxxxxx
READ VALUE xxxxxx
READ GAIN xxxxxx
```

If the card under test was a low-level or relay MUX card, the diagnostic set channels 1, 2, and 3 to different gain ranges and caused the DIU to output voltages to those channels in those ranges. The diagnostic then caused those channels to read the voltages, and checked to see that they were within acceptable limits. Error 21 indicates that the voltage read by the specified channel was not within acceptable limits.

If the card under test was a high-level MUX card, this test was skipped.

```
ERROR 22 !!  OVERRANGE ERROR
SLOT xxxxxx READ VALUE xxxxxx
READ GAIN VALUE xxxxxx
```

The diagnostic caused the DIU to write overrange voltages, both positive and negative, to channel 1 of the MUX card under test. It then checked to see that the overrange bit was set. Error 22 indicates that the overrange bit was not set.

```
ERROR 23 !!  CHANNEL ERROR
SLOT xx CHANNEL xx
UPPER LIM xxxxxx LOWER LIM xxxxxx
READ VALUE xxxxxx
```

For each channel not checked by the gain test, the diagnostic caused the DIU to write a voltage to that channel. It then caused the channel to read that voltage and checked to see that the voltage read was acceptably close to to the voltage written. Error 23 indicates that the voltage read did not fall within an acceptable range.

C.1.3 HP 25510A Analog Output Card Diagnostic

Notes:

This diagnostic tests the analog output card by causing the card to output a series of voltages which are measured by the diagnostic interface unit (DIU).

Since the function of the analog output card is very straightforward (voltage or current output on any of four channels), there is only one error message furnished by this diagnostic.

Error messages:

```
WHAT WOULD YOU LIKE TO DO NEXT?

SKIP SLOT AND GO TO NEXT CARD..1
START TEST ON CARD OVER.......2
HALT THE TEST.................3
CONTINUE PRESENT TEST.....(NULL)
```

If an error occurs, the diagnostic prints the appropriate error message and asks the above question. Specify which action you want to take by entering the corresponding number. If you want to continue the test in progress, press the RETURN key.

```
CHANNEL x IS IN THE
CURRENT MODE

BI-POLAR VOLTAGE MODE

UNI-POLAR VOLTAGE MODE
```

This is an informational message, not an error message. The diagnostic has parsed the contents of the card configuration register to find the mode of operation of each channel (current output, bi-polar voltage output, or uni-polar voltage output). This message reports the operating mode of each channel.

```
ERROR 105!!  OUT OF BOUND VALUE
CHANNEL x WRITTEN DATA xxxxxx
CORRECT VALUE xxxxxx
LOWER LIM xxxxxx UPPER LIM xxxxxx
READ VALUE xxxxxx
```

The diagnostic caused the analog output card to output a voltage or current to the DIU. Error 105 indicates that the voltage measured by the DIU deviated too far from the requested value. The diagnostic stops after this error occurs.

C.2 DIGITAL FUNCTION CARD DIAGNOSTICS

Notes:

The level 2 digital function card diagnostics all operate in a similar way. They all ask you to supply information about the arrangement of signal conditioning modules (SCMs) on the card under test; they all prompt you with changes in the cabling between the diagnostic interface unit (DIU) and the card; and they all report simple pass/fail results on each digital input/output point.

The diagnostics ask for SCM information for a particular set of input/output points by presenting you with a menu; you reply by specifying the number of the item on the menu that matches the SCM. The following menu from the digital input card diagnostic is typical:

```
NON-ISOLATED  ISOLATED  SUFFIX
------------ --------- --------
 1: 31/35B    7: 33/37B (-60001)
 2: 31/35C    8: 33/37C (-60002)
 3: 31/35D    9: 33/37D (-60003)
 4: 31/35E   10: 33/37E (-60004)
 5: 31/35K   11: 33/37F (-60005)
 6: 31/35L   12: 33/37G (-60006)
             13: 33/37H (-60007)
             14: 33/37J (-60008)
15: NONE
16: SKIP TO NEXT 25511A CARD
17: STOP
18: RESTART
RETURN: same as previous SCM
```

If, for example, the SCM for the points under test were an isolated D-type SCM, part number 25537-60003, you would enter 9. The diagnostic would then test those points using signals appropriate for an isolated D-type SCM. If the card had no SCM for the points under test, you would enter 15 (none); you would enter 16 to skip to the next digital input card; 17 to terminate the diagnostic; and 18 to start testing the same card from the beginning again. If the current SCM were of the same type as the previous one, you would just press RETURN.

For correct connection between the DIU and the card under test, the diagnostic specifies:

1) which cable is to be used (by part number),

2) which DIU personality module is to be used (also by part number),

3) which DIU slot is to hold the personality module,

4) which function card is to be tested (by slot number), and

5) which connector block on the function card is to be used.

Each of these items is specified only if it changes after the test of the previous set of points.

Error Messages:

POINT xx . . . . . [OK]

POINT xx . . . . . FAILED
HIT RETURN TO CONTINUE.

Each input/output point is tested individually by whatever method is appropriate for that point's function and its signal conditioning. The diagnostics report pass/fail results for each point. If a point fails, the diagnostic pauses; press the RETURN key to continue execution.

If a point fails,you should first check to make sure that the cable from the DIU is connected to the correct connector block on the correct function card. (Connection to the wrong points is the most common cause of failure.)

You can retest a failed point by using the options provided by the next SCM menu: you can go back to the beginning of the card by entering the number that corresponds to "restart"; from there, you can skip SCMs by entering the number that corresponds to "none" until you get back to the SCM that covers the failed point.

READER COMMENT SHEET

HP 2250 Measurement and Control Processor
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Printed March 1981

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