Model 4951B Protocol Analyzer

Operating Manual

HEWLETT PACKARD

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HP 4951B
Protocol Analyzer

Operating Manual

Serial Numbers

This manual applies directly to instruments
with serial numbers prefixed 2523A and 2529A.

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PRINTING HISTORY

Each new edition of this manual incorporates all material updated since the previous edition. Manual change sheets are issued between editions, allowing you to correct or insert information in the current edition.

The part number on the back cover changes only when each new edition is published. Minor corrections or additions may be made as the manual is reprinted between editions

First Printing.....September 1985

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products. For any assistance, contact your nearest Hewlett-Packard Sales and Service Office.

SAFETY CLASS

The HP 4951B is a Safety Class I instrument, provided with a protective earth terminal.

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of this instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

GROUND THE INSTRUMENT.

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet international Electrotechnical Commission (EC) safety standards.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

KEEP AWAY FROM LIVE CIRCUITS.

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE.

Do not attempt internal service or adjust unless another person, capable of rendering first aid and resuscitation, is present.

USE CAUTION WHEN EXPOSING OR HANDLING THE CRT.

Breakage of the Cathode-ray Tube (CRT) causes a high-velocity scattering of glass fragments (implosion). To prevent CRT implosion, avoid rough handling or jarring of the instrument. Handling of the CRT shall be done only by qualified maintenance personnel using approved safety mask and gloves.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification of the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

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Appendices

The following certification (shown in German, followed by an English translation) applies only to products shipped into Germany after June 1, 1985.

Herstellerbescheinigung

Hiermit wird bescheinigt, daß das Gerät/System

4951B

in Übereinstimmung mit den Bestimmungen der Postverfügung 1046/84 funkentstört ist.

Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes/Systems angezeigt und die Berechtigung zur Überprüfung der Serie auf Einhaltung der Bestimmungen eingeräumt.

Zusatzinformation für Meß- und Testgeräte

Werden Meß- und Testgeräte mit ungeschirmten Kabeln und/oder in offenen Meßaufbauten verwendet, so ist vom Betreiber sicherzustellen, daß die Funkentstörbestimmungen unter Betriebsbedingungen an seiner Grundstücksgrenze eingehalten werden.

Manufacturer's Declaration

This is to certify that the equipment

4951B

is in accordance with the Radio Interference Requirements of Directive FTZ 1046/1984. The German Bundespost was notified that this equipment was put into circulation. The right to check this model type for compliance with these requirements was granted.

Additional Information for Test- and Measurement Equipment

Note: If Test and Measurement Equipment is operated with unscreened cables and/or used for measurements on open set-ups, the user has to assure that under operating conditions the Radio Interference Limits are still met at the border of his premises.

PART I

GETTING STARTED

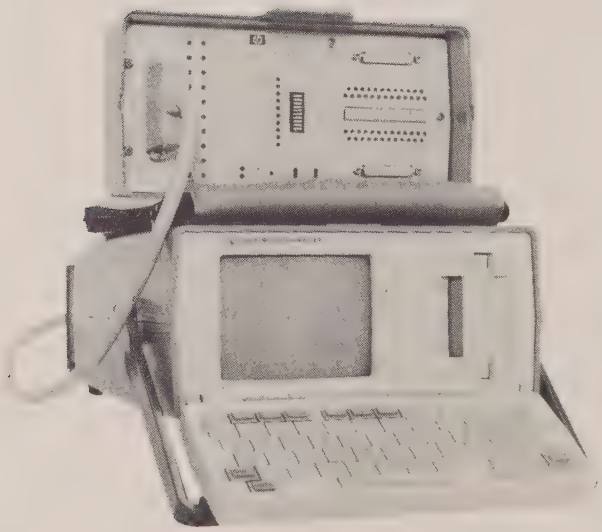


Figure 1-1. The 4951B with Interface Pod

CHAPTER I
LEARNING THE CONTROLS

Introduction

The HP 4951B is a portable, user-friendly protocol analyzer. Some unique features are:

- **Auto Configure.** Automatically determine line parameters and begin monitoring.
- **Post-Processing.** Use captured data repeatedly for new measurements.
- **Softkey guided measurements.** Simplifies setup and programming.
- **Full ASCII keyboard.** Enter all control or hex characters.
- **Nonvolatile memory.** 32 Kbytes for storing data line information. Additional 8 Kbytes for storing menus and programs.
- **Five display formats.** DTE Only, DCE Only, Two Line (DTE and DCE), Data & State (DTE and DCE with lead transitions), Frame & Packet (decoding of level 2 and 3).
- **Remote.** Transfer data, setups, monitor and simulate menus, timers and counters over a data link.
- **BERT.** Measure bit error rates, block errors, and percent error free seconds.
- **Tape Storage (option).** Mass storage of data, setups, programs, and measurements.
- **Printer Output.** Print data, monitor and simulate programs, setup and test results. Access printer from rear RS-232 port or interface pod.
- **External Video Driver.** Display real time data, buffer data, menus and programs on external monitor using rear RS-170 port.

How To Use This Manual

This manual is in two parts. **Part I** tells how to operate the HP 4951B: Use this part on the first day. **Part II** describes the menus in detail; Use this part after the first day.

PART I GETTING STARTED

Chapter 1 **Learning the Controls --** Describes the HP 4951B and its controls: Power Up, Front Panel, and the Top Level Menu.

Chapter 2 **The Three Instrument Functions --** Shows you how to perform the three HP 4951B functions: Monitoring, Simulation, and Bit Error Rate Tests.

Chapter 3 **A Self Demonstration --** You learn by actual operation.

PART II THE MENUS

Chapters 4 through 12 explain each menu in detail by following the order of the **Top Level** softkeys. The Top Level Menu (page 1-8) accesses all instrument functions. To access the Top Level Menu at any time, press EXIT.

MANUAL CONVENTIONS

Softkeys are enclosed by <>. Hardkeys are capitalized.

Before You Get Started

Initial Inspection. Inspect the analyzer and accessories for any physical damage sustained in transit. Ensure that you have received all the items that should accompany the analyzer (refer to the table of Accessories Supplied). If accessories are missing or if the unit is received in a damaged condition, notify the nearest HP Sales and Support Office and file a claim with the carrier.

Line Voltage Selection. Before connecting operating power, ensure the line voltage selection on the rear panel above the power jack is correct for your area. To change the line voltage selection or fuse, refer to Appendix G.

Grounding Requirements. The HP 4951B is equipped with a three-conductor power cable which, when connected to an appropriate power outlet, grounds the analyzer. To preserve this protection, do not operate the analyzer from a line power outlet that has no ground protection.

Power Cord. The cord packaged with each analyzer depends on its destination. Appendix G of this manual and the Service Manual contain a chart of power cord plugs matched to different areas. If the analyzer has the wrong plug for the area, contact your HP Sales and Support Office.

Shipment. Refer to Appendix G for packaging information. If your analyzer is being returned for service, contact the nearest HP Field Repair Center or Sales and Support office for complete shipping instructions.

Self-Tests. If your instrument comes up in the Top Level Menu after power-on, you can be confident that internal circuits (except tape drive and interface pod) are working correctly. Refer to Appendix G for complete information on performance verification procedures.

Power Up and Installation

TURNING THE HP 4951B ON

CAUTION

DO NOT PLUG IN THE INSTRUMENT UNTIL YOU ARE SURE THE LINE VOLTAGE SELECTION IS CORRECT.

CONNECTING THE POD

CAUTION

ALWAYS TURN THE INSTRUMENT OFF BEFORE CONNECTING OR DISCONNECTING THE POD.

TURNING THE HP 4951B OFF

CAUTION

ALWAYS GO TO THE TOP LEVEL MENU BEFORE TURNING THE INSTRUMENT OFF.

The HP 4951B contains a battery for maintaining current data and menu setups after turn off. However, if you turn off the analyzer at certain times (e.g., during a run) data or setups may be destroyed. A message to this effect then appears, and the analyzer resets itself automatically. To ensure that menus and setups are saved after turn off, always go to the Top Level Menu before turning the analyzer off. If you do not wish to save the menus and data, press <Reset> in the Top Level Menu to clear the memory and return to default settings. See Chapter 12.

HOOKUP

Hookup directions for monitoring, simulating and BERT are given in Chapter 2. BERT hookup is also shown in Chapter 9.

Front Panel Controls

KEYBOARD

The HP 4951B has a full ASCII keyboard. The following keys have special functions:

SOFTKEYS	The six function keys directly under the display.The label of each key, shown at the bottom of the display, changes for each menu and field. Except when entering keyboard characters, use the softkeys to enter all parameter selections.
CURSOR KEYS	The four arrow keys which move the cursor.
EXIT	Accesses the Top Level Menu. During a run, EXIT is a halt key. In some menus like BERT and Mass Store, you must press EXIT twice.
MORE	Accesses additional softkeys whenever more are available.
SHIFT	Selects lower-case characters when pressed with another key.
CNTL	Selects a control character (upper label on keycaps) when pressed with another key.
RTN	Moves the cursor onto the next lower field (same as cursor down).

DISPLAY

The 5 inch display shows 16 lines of 32 characters. **Softkey labels** occupy the bottom two lines.

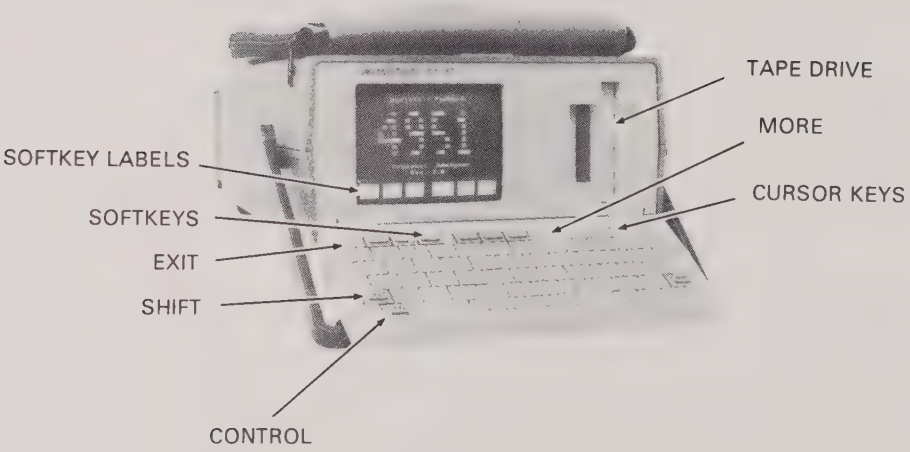
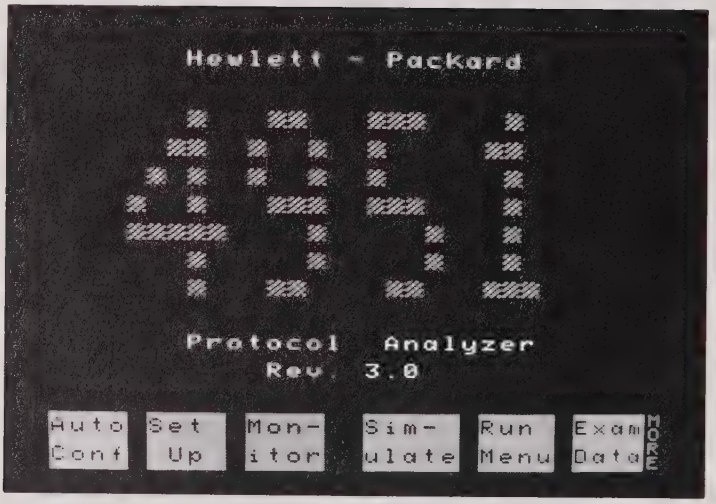


Figure 1-2. Front Panel Controls

The Top Level Menu

The Top Level Menu (Figure 1-3) accesses all instrument functions. The Top Level Menu comes up whenever the instrument is turned on. Press EXIT to access the Top Level Menu. Press MORE to see the other Top Level softkeys. Top Level softkeys are described below.

Auto Conf	Automatically configure to line parameters (when monitoring on-line).
Set Up	Manually configure to line parameters.
Monitor	Select monitoring measurements and triggers to analyze data.
Simulate	Select simulation measurements, triggers and send data.
Run Menu	Run monitor tests, simulation tests, or BERT tests.
Examine Data	Display data stored in the buffer or on tape.
Bert Menu	Configure Bit Error Rate Test parameters.
Remote	Transmit and receive menus and data to another HP 4951B, or to a 4955A or a 4953A.
Mass Store	Control tape functions.
Reset	Reset all menus to their default conditions and clear the buffer.
Self Test	Perform self-test procedures.



Auto-Config	Setup	Monitor	Simulate Menu	Run Data	Examine
					[MORE]
BERT Menu	Remote	Mass Store		Reset	Self Test

Figure 1-3. The Top Level Menu

Rear Panel Features

Here is a description of the HP 4951B rear panel features. Refer to Figure 1-4.

LINE SWITCH	Press the top of the line switch to turn the instrument on ("1" position). Press the bottom of the line switch to turn the instrument off ("0" position).
REMOTE/PRINTER	Use this connector to connect the HP 4951B in Remote Mode either as a controller or a slave unit. Refer to Chapter 10. Also use this connector to connect an ASCII printer through which you can print display data. Refer to Chapter 13.
INTERFACE POD	The interface pods are connected to this connector.
EXT VIDEO	This connector lets you connect an external video monitor to the HP 4951B. The video output follows RS-170 conventions.

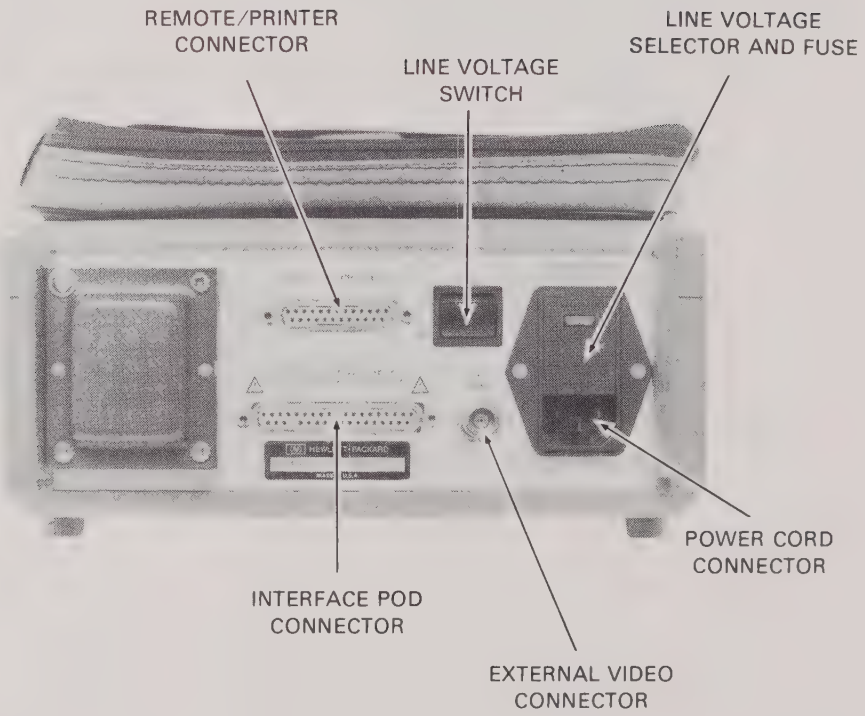


Figure 1-4. Rear Panel Features

CHAPTER 2
THE THREE INSTRUMENT FUNCTIONS
Introduction

This chapter describes the three basic functions of the instrument: **Monitoring**, **Simulating**, and **Bit Error Rate Tests**. For more information on these topics, or on any Top Level softkey, go to the chapter by that title.

After looking over this chapter, you may want to go right on to Chapter 3, which leads you through monitoring and simulating exercises with the instrument.

THINGS TO REMEMBER

The Top Level Menu (page 1-8) accesses all other menus. EXIT will access the Top Level Menu at any time. In some menus you must press EXIT twice.

EXIT acts like a halt key during program execution. EXIT stops execution and accesses the Top Level softkeys.

Press MORE to see any additional softkeys in any menu. A small vertical "more" at the lower right of the display prompts you whenever there is another softkey set in any menu.

Always go to the Top Level Menu before turning the analyzer off. This ensures that setups, data, and programs are saved in non-volatile memory.

Always turn the analyzer off before connecting and disconnecting the pod.

THE THREE INSTRUMENT FUNCTIONS

Monitoring

On-Line. Using Auto Configure or the correct manual setup, you can bridge into most data lines and begin observing the activity.

From Buffer. After having monitored the line for a few seconds, you will have captured data in the buffer memory. Once you have data in the buffer, you can repeatedly run any monitoring measurements, just as if you were monitoring on-line. You can also load the buffer from tape. This "Post-processing" lets you try many different measurements on the same data.

Simulation

You can substitute the HP 4951B for any DTE (Data Terminal Equipment) or DCE (Data Communications Equipment) on the line, performing measurements while you transmit and receive strings of data characters. The HP 4951B continuously monitors both channels while monitoring on-line or simulating.

Bit Error Rate Tests (BERT)

This function enables you to determine the data link quality. You can find bit and block errors, error seconds, and percent error free seconds.

Monitoring

The HP 4951B is a window through which you can observe the activity on a data link. The HP 4951B lets you trigger on events and make measurements either on-line, or from the buffer memory. With the latter capability, you can repeatedly post-process data after a run.

SUMMARY OF MONITORING STEPS (Described on the following pages)

1.	Hookup	Bridge the HP 4951B into line to be monitored.
2.	Setup	Using either Auto Configure or the Setup Menus, configure the HP 4951B to the line.
3.	Triggering	Set up any triggers or test conditions using the Monitor Menu. You need make no entries in the Monitor Menu. If you don't use the Monitor Menu, go directly to step 4.
4.	Running	Begin monitoring by accessing the Run Menu. The HP 4951B begins nonselectively displaying line data as soon as you enter the Run Mode.

STEP 1: HOOKUP

Bridge the HP 4951B into the line, using the correct pod (e.g., RS-232C/V.24 or RS-449) and cables, as shown below. If you already have data in the buffer from a previous run or via tape, you can monitor from buffer; and no pod is necessary. Always turn off the analyzer before connecting or disconnecting the interface pod.

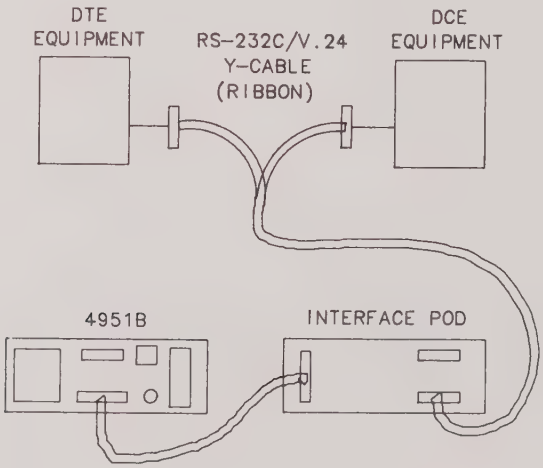


Figure 2-1. Hookup for Line Monitoring

STEP 2: SETUP

Prior to monitoring, you must configure the HP 4951B for the line. You should do this first, because setup selections affect the ability to capture meaningful data from the line. Also, setup selections determine the available choices in other menus.

You can use either Auto Configure or the Setup Menus. Using Auto Configure, the HP 4951B automatically configures to the line and begins monitoring. You may also use the Setup Menus and then go to the Run Menu.

Using Auto Configure for Setup

Press <Auto Configure>, the HP 4951B identifies line parameters and begins monitoring.

To change the **display format**, or to modify any setup parameters, halt the run by pressing EXIT, and go to the Setup Menus (See Chapter 5).

NOTE: In some nonstandard protocols, the HP 4951B may not be able to identify all the parameters. In that case, halt the run and modify the setup in the Setup Menus.

Using the Setup Menus for Setup

To manually configure the HP 4951B, or to modify Auto Configure results, press <Setup> on the Top Level Menu.

1. Select the appropriate protocol.

2. Change any parameter by moving the cursor to that field and pressing the desired softkey. See Chapter 5 for more details.

3. To begin monitoring, press EXIT and then <Run Menu>. Then press <Monitor Line>. The HP 4951B begins filling the buffer and displaying data.

What to Do When the Protocol is Nonstandard

If you have trouble configuring the analyzer because of a nonstandard protocol, or because of a defective line, use the following procedure.

1. Use Auto Configure to give you a starting point. See Chapter 4 for limitations.

2. Change the data code, or other parameters in the appropriate Setup Menu. See Chapter 5 if you need more details.

3. If some of the line data is still not meaningful, use the Char Async/Sync Setup Menu, as described in Chapters 5 and 8.

STEP 3: SETTING UP TRIGGERS

Optional Entry

You need make no entries in the Monitor Menu. You can go right to the Run Menu and begin monitoring.

Measurements in the Monitor Menu

If you just want to look at the data, you can go right to the Run Menu and begin monitoring. However, if you want to perform tests and analyze the data, the Monitor Menu gives you that capability.

Here's a summary of what the Monitor Menu can do:

Triggering	Define triggers with the <When> statement, enabling you to "look for" up to 63 events simultaneously. The HP 4951B will branch to another other action upon finding a trigger.
Timing	Five timers measure intervals between triggers with 1 millisecond resolution.
Counting	The HP 4951B's five counters will each count up to 9999 events.
Conditional Actions	The <If> statement performs actions conditionally, depending on the status of counter or of a lead at the time of the last trigger.

To access the Monitor Menu, press <Monitor> on the Top Level Menu.

STEP 4: RUNNING THE TEST

In Auto Configure, the HP 4951B automatically goes into the run mode and begins monitoring. Once Auto Configure has established the setup you can monitor the line or buffer on subsequent trials from the Run Menu.

If you are not using Auto Configure, press <Run Menu> on the Top Level Menu. To monitor on-line data, press <Monitor Line>. If data is already in the buffer from a previous run or from tape, press <Monitor Buffer> to do post processing. Monitoring on-line and monitoring from buffer are essentially the same processes. When monitoring starts,

1. All counters and timers are reset to zero.
2. Any programs in the Monitor Menu begin executing.
3. Buffer data is displayed starting at data block 1.

Halting the Run

Press EXIT to stop the test. The most recent data is displayed on the screen. (Without halting the test, you can freeze the display by pressing <Stop Display>.)

Changing Display Formats

To choose a different display format, halt the run and change the display format field in the Setup Menu. In HDLC, SDLC, and X.25, five formats are available: DTE, DCE, Two-Line, Data & State, and Frame & Packet. In the BSC and Char Async/Sync Menus, the Frame and Packet format is not available. See Chapters 7, and 8.

Simulating

The HP 4951B can take the place of either a DTE or DCE, by supplying clocks, data, and error checks in the selected data code and protocol.

SUMMARY OF SIMULATING STEPS (Described on the following pages)

1. Hookup — Substitute the HP 4951B for either the DTE or DCE.

2. Setup — Using either Auto Configure or the Setup Menus, configure the HP 4951B to the line.

3. Data, Triggers — Using the Simulate Menu:

    a. Select the device to be simulated: DTE or DCE.

    b. Configure the interface, using the <Set Lead> softkey.

    c. Transmit the desired characters, using the <Send> softkey.

    d. Use triggers, timers, etc., as in the monitor menu.

4. Running — To begin simulating enter the Run Menu. In synchronous setups, the ETC clock is automatically provided when simulating a DTE. The TC and RC clocks are automatically provided when simulating a DCE.

STEP 1: HOOKUP

Disconnect the line and substitute the HP 4951B for the device (DTE or DCE) being simulated. Always turn off the analyzer before connecting or disconnecting the interface pod. Remember that continuous memory saves setups, menus and data while the HP 4951B is turned off. Be sure to use the correct pod (RS-232C/V.24 or RS-449) and cables as shown below.

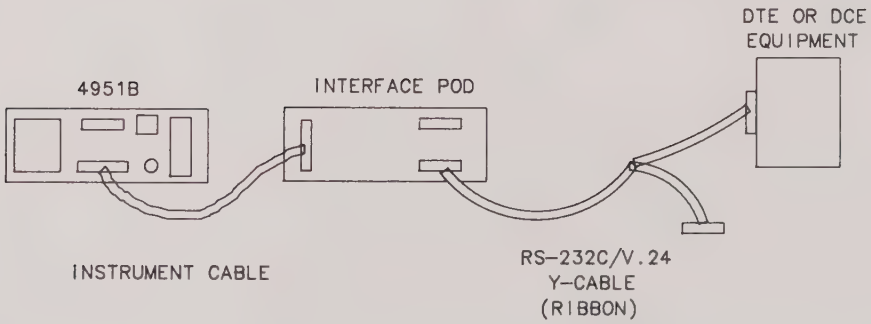


Figure 2-2. Simulation Hookup

STEP 2: SETUP

Use the Setup Menus to configure the HP 4951B to your system.

What If You Don't Know the Setup ?

You must know your system in order to simulate. However, you can find some parameters by observing the data line during monitor operation.

1. Hook up the HP 4951B for monitoring.

2. Use Auto Configure to find system parameters.

3. After monitoring for a few moments, go to the Examine Data Menu and look at the buffer data. To see the setup, press the <Timer & Counter> softkey.

4. Auto Configure selects SDLC for bit oriented protocols, and Char Async/Sync for character oriented protocols. You must observe the data in the buffer to find the exact Level 2 and Level 3 protocol on your line.

Setup Notes

1. If DTE clock, Bits/sec, and Sync/Async (Char Async/Sync Menu) selections are incorrect, no data can be received or displayed.

2. Protocol, data code, and error checking must be correct to ensure response by the device at the other end.

STEP 3: SIMULATE MENU SELECTIONS (Data and Triggers)

Make the following entries in the Simulate Menu.

1. Select DTE or DCE

Determine whether the HP 4951B is to be a DTE or a DCE. The HP 4951B sends data on pin 2 for simulating a DTE and sends data on pin 3 for simulating a DCE.

2. Handshaking

Determine the handshaking requirements on the RS-232C/V.24 or RS-449 leads. Use the <Set Lead> softkey to turn the leads on or off at the desired time. The HP 4951B normally sets all leads "off" before a test. The device at the other end may not respond if the appropriate control leads are not turned on or off at the proper times.

3. Transmitting Data

Use the <Send> softkey to enter the characters to be transmitted, otherwise the HP 4951B only sends idles. You must know the protocol and polling sequences being used on your line to ensure correct responses.

Other Entries

You can also set triggers, count events, measure time intervals, etc., in the Simulate Menu. See Chapter 6.

STEP 4: RUNNING THE TEST

To execute a simulation program, use the Run Menu: Press <Run> on the Top Level Menu and select <Simulate>. When simulation starts,

1. All counters and timers are reset to zero.

2. The HP 4951B turns on or off the leads as specified. Observe the pod LCDs or LEDs for lead activity, or use the Data & State display format.

3. The HP 4951B, acting like a DTE or DCE, sends out the specified data. Observe the pod LCDs or LEDs and the display.

4. In synchronous setups, the ETC clock is automatically provided when simulating a DTE. The TC and RC clocks are automatically provided when simulating a DCE. You must make the correct **clock source** setup selection to monitor the DTE line.

5. Line data and lead activity, from the HP 4951B and the other transmitting device, is stored in memory.

6. The display shows the data as it is stored in memory.

Press EXIT to stop the test. The last data loaded into memory is displayed on the screen. To execute the program again, press <Run Menu> on the Top Level Menu, and then <Simulate>.

Bit Error Rate Tests

Bit error rate tests measure the number of bit errors on a line: how often are "highs" changed to "lows", and vice versa.

BERT STEPS

1. **Hookup** (see Chapter 9)

   a. End-to-End. Substitute an HP 4951B for the DTE at both ends of the line. (Figure 2-3).

   b. Loopback. Substitute an HP 4951B for only one DTE and "loopback" the modem or terminal at the other end of the line. (Figure 2-4).

2. **Setup**

   Press <BERT> on the Top Level Menu and make the appropriate selections. NOTE: Select EXT for bits/sec and no framing on synchronous systems.

3. **Running**

   Press <Run Menu> on the Top Level Menu. In the Run Menu, press <BERT>. The HP 4951B begins transmitting and receiving, and a data screen shows test status. Press EXIT to halt the test.

"QUICK BROWN FOX" AND STARTUP TESTS

Use the Simulation Menu to perform these tests. See the examples in Appendix F.

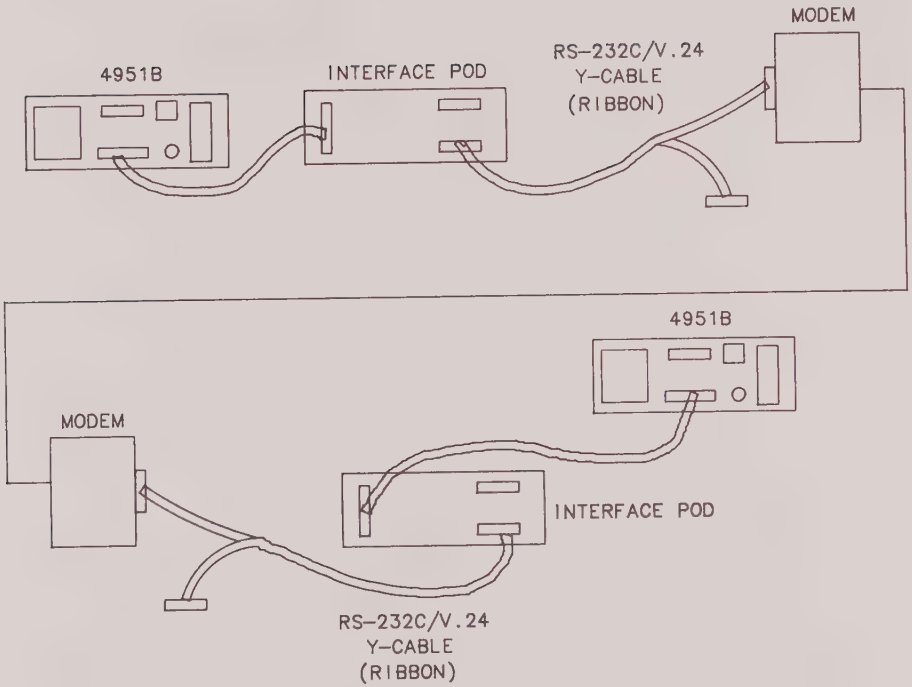


Figure 2-3. End-to-End BERT Hookup

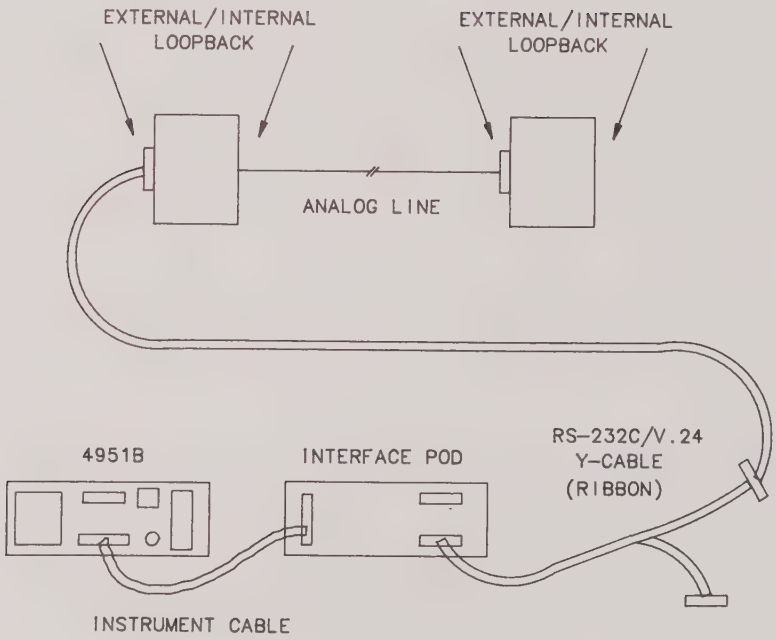


Figure 2-4. Loopback BERT Hookup

CHAPTER 3
A SELF DEMONSTRATION

Introduction

This chapter is for those who learn best by doing. In this chapter you will use the Setup, Monitor, Simulate, and Examine Data Menus. Follow the steps to become familiar with your HP 4951B.

This chapter is optional. The HP 4951B with Auto Configure is easy to operate. Just hook it up to the line, press Auto Configure and begin monitoring. To make any measurement or change any setup, just press a softkey. The softkey labels prompt you with the next choice.

SUMMARY OF STEPS

1. Connect the HP 4951B to the Interface Pod.
2. Set up the HP 4951B for protocol, data code, and bit rate.
3. Simulate a DCE: Control the interface leads and transmit strings.
4. Run the simulate program.
5. Observe the captured, looped-back data in the buffer.
6. Run a monitor program from buffer.

STEP 1: HOOK UP TO THE POD

Turn off the HP 4951B. Connect the analyzer to the interface pod, as shown in Figure 3-1 below. Always turn off the analyzer before connecting and disconnecting the pod.

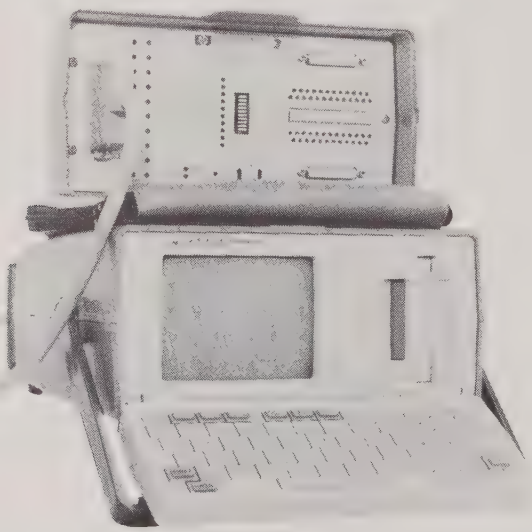


Figure 3-1. Hooking Up the Interface Pod

STEP 2: SETUP

Switch the HP 4951B on. Press <Reset> in the Top Level Menu, this sets all menus to their default parameters. You do not normally need to do this. Most of the time, you will want to take advantage of the HP 4951B's nonvolatile memory, which saves setups and buffer data after turn-off. Use <Reset> here to ensure a common starting setup.

Press <Setup> in the Top Level Menu. Select **Char Async/Sync** as the Setup Menu. Use the cursor and return keys to change fields. Make sure your setup has the following parameter entries:

```
Code:  ASCII 8                    Bits/sec:  1200

Mode:  Synchronous                Display mode:  Data & State

DTE clock:  DCE                   Suppress:  None

Sync on:  16  16          Err chk:  None
```

STEP 3: PROGRAM THE SIMULATE MENU

In this step you will program the analyzer to transmit characters and to turn on interface leads at the right time. In normal simulation, the correct leads must be set on and off, or the terminal on the other end of the line might not accept the message.

Press <Simulate> in the Top Level Menu. Use the cursor and return keys to change fields. Select **DCE** as the device to simulate. Enter the following program.

Block 1:	Set Lead CD On and then Send $S_Y S_Y S_X$ ABCDEFG E_X and then Wait 200 and then Set Lead CD Off and then Wait 200 and then Goto Block 1	This program causes the HP 4951B to repeatedly turn on lead CD and send the character string ABCDE. The 200 millisecond delay makes it easier to see CD transitions.

NOTE: In character oriented protocols, you must explicitly enter the sync characters, such as S_Y S_Y, to ensure that the receiving device accepts the message. Use the CNTL key to enter control characters: CNTL "V" for S_Y, CNTL "B" for S_X, CNTL "C" for E_X.

STEP 4: RUN THE SIMULATE PROGRAM

Press <Run Menu> in the Top Level Menu, then <Simulate>. The HP 4951B begins transmitting the character string, displaying what it is transmitting, and then storing it in the buffer. The data appears as if it were coming from the line. Note the following features:

Pod with LCD Indicators (18173A, 18174A, 18180A)

Four interface pod LCD indicators should be blinking: TC, RC, RD, and CD. If you were simulating a DTE (with DTE as clock source), the ETC, TD (DTE), and RTS leads would blink if programmed.

Pod with LED Indicators (18179A Superpod)

Indicators for CD (a mark and a space) should alternate. TC and RC should be on. DCE space should flash when the message is "transmitted". CTS and DSR should have their mark indicators on.

DCE and DTE Displays

The Data & State display format shows both DTE and DCE data, as well as timing relationships on four interface leads. DCE data appears in inverse video and DTE data appears in regular video. Try changing display formats in the Setup Menu.

The <Summary> and <Stop Display> Softkeys

Press <Summary>. Without stopping the run, you can at any time review the setup and observe timer and counter activity. Press <Stop Disp>. This freezes the display, but does not halt the run.

Block Numbers

Block numbers increase to 16 and start over at 1. A "block" of memory holds 2 Kbytes of information (data, timing information, and lead status).

STEP 5: OBSERVE THE BUFFER

During a run, data is constantly being loaded into the buffer. Press EXIT to halt the run. Press <Exam Data> in the Top Level Menu to observe the buffer. Note the following features:

Display Format

Go to the Setup Menu at any time to change the display format.

Character Decoding

Move the cursor through the characters. Each character is decoded in binary, hex, and octal, and its parity bit is displayed.

Bit Shifting

Note "shift = 0" at the top of the display. Press MORE to show the <bit shift> softkey. Because this is a character oriented protocol, you can shift bits up to one less than the size of the data code (e.g., six places in ASCII 7) while observing the change in the characters. This is useful in finding the correct character framing in unknown protocols.

Timer and Counter Display

Press <Timer & Cntr>. This shows you the setup and the state of the timers and counters at the end of the run.

STEP 6: RUNNING A MONITOR PROGRAM

Now that you have data in the buffer, you can repeatedly run monitor programs from buffer. Press <Monitor> in the Top Level Menu. Enter the following program:

```
Block 1:    When DCE A
              then goto Block 2
Block 2:    Start timer 1
            When DCE G
              then goto Block 3
Block 3:    Stop timer 1
```

This program measures the time interval between the start of the data string and the end.

Note: Each timer statement is tied to the <When> trigger statement preceding it. This is the correct way to measure time. Time measurements must be referenced to a specific event with a preceding <When> trigger statement.

Note: In Block 3 you could use "Stop Tests", which also stops the timer.

Go to the Run Menu and press <Monitor Buffer>. Data is now displayed, just as if you were running on-line.

In the Examine Data Menu press <Timers & Counters>. Timer 1 should show 40 msec (+/- 1 msec).

OBSERVING THE DTE CHANNEL

Jumpering Channels on the Pod

Up to now you have been able to observe what you are sending on the DCE channel because the HP 4951B always displays what it is sending.

To observe both channels, you can loop the DCE channel to the DTE channel. Use one of the small jumper wires supplied with the instrument to connect pin TD (DTE) on the interface pod to pin RD (DCE). Press <Run Menu> and then <Simulate>. You should now see DTE data (regular video) mixed with DCE data (inverse video).

PART II

THE MENUS

CHAPTER 4
AUTO CONFIGURE

How To Use Auto Configure

Hook up the analyzer to the line for monitoring. Press the <Auto Configure> softkey on the Top Level Menu. It's as simple as that!

The HP 4951B briefly displays its parameter selections in either the SDLC or the Char Asyn/Syn Setup Menu. Then it automatically goes into the Run Mode and begins monitoring. You may at anytime press the <Summary> softkey to review the Setup results. To change the **display format**, or any other setup parameter, halt the run by pressing EXIT, and then go back and modify the setup in the Setup Menu. Go to the Run Menu to again start the run.

NOTE: Auto Configure alters the Setup Menu and the buffer data; so if you need the present setup and buffer data, save them on tape.

Auto Configure as a Starting Point

Auto Configure works on most lines, with most protocols and data codes. Sometimes, however, there are nonstandard protocols where Auto Configure is unable to find all the parameters. The Setup Summary that appears before monitoring in Auto Configure tells you the missing parameters. You can then go to the appropriate Setup Menu and select the correct parameters, using the procedure on page 8-8. If Auto Configure has found all the parameters, but the data does not make sense, try another data code of the same size (e.g., substitute ASCII 8 for EBCDIC). Even in the case of nonstandard protocols, Auto Configure gives you a starting point to capture data. See pages 5-22 and 8-8.

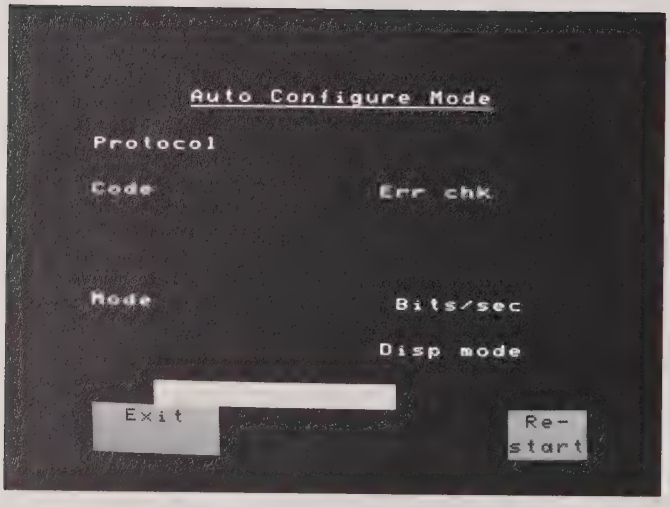


Figure 4-1. Auto Configure Display (before monitoring)

Bit Oriented Protocols

Auto Configure always selects SDLC for bit oriented protocols. Monitoring is always correct except in some cases of X.25, or HDLC with extended address and control. In these cases, the selected data code may be incorrect. Follow the procedures below.

Extended Address and Control in HDLC

To observe extended address and control on HDLC lines, go to the Setup Menu and change the protocol to HDLC. Turn on Extended Address and/or Extended Control, and change the display format to Frame & Packet. If the data does not make sense, try another data code.

Decoding Packets in X.25

To decode packet information on X.25 lines, monitor the line for a few moments to capture data in the buffer; or load the data from tape (Chapter 11). Then go to the Setup Menu and change the protocol to X.25. Change the display format to Frame & Packet. Go to the Examine Data Menu and observe the buffer data. If the data does not make sense, try another data code.

Packet information is automatically decoded in the Examine Data Menu using the Frame & Packet display format. See page 8-6.

Character Oriented Protocols

Auto Configure always selects Char Asyn/Sync for character oriented protocols. The HP 4951B finds the sync characters, data code, bit rate, etc. of most character oriented protocols.

Auto Configure and BSC

Because Auto Configure always selects Char Asyn/Syn for all character oriented protocols, you must determine the exact protocol from the parameters displayed. For example, standard BSC using EBCDIC data code would look like Figure 4-2.

Unlike standard BSC, Char Async/Sync allows full duplex operation. You can determine whether the line is standard, half duplex BSC by looking at the run-time or Examine Data display. Full duplex data looks like Figure 7-8; half duplex data looks like Figure 7-9.

IPARS -- When Bit Order and Bit Sense are Changed

On standard IPARS, the bit sense is inverted (1's are changed to 0's and vice versa), and the bit order is reversed (MSB is sent first). When Auto Configure recognizes an IPARS protocol, it automatically inverts the bit sense and reverses the bit order before storing the data in buffer memory. Thus, the data can be easily read when it appears on the display.

In some IPARS protocols the data has a different bit order and bit sense than the sync characters. Auto Configure always sets the bit sense and order so the sync characters are 3F 3E on the display. Thus, Auto Configure correctly captures and frames the data, but the displayed data may not make sense. Go to the Char Async/Sync Setup Menu and change the bit sense and/or bit order. Then look at the data again.

Monitor/Simulate Parameter Setup

Protocol Char Async/Sync

Bit order LSB first

Bit sense Normal

Code EBCDIC

Error Check CRC 16

Parity None

Start on S_H S_X
Stop on E_X E_B E_X E_B

Transparent text char None

DTE clock DCE

Mode Sync

Bits/sec 9600

Sync on 3_2 3_2

Display mode Data & State

Drop sync 1 chrs
after F_F F_F F_F F_F F_F F_F F_F

Suppress None

Figure 4-2. Standard BSC Setup Determined by Auto Configure

Auto Configure Assumptions

Auto Configure makes the following assumptions. If one or more of the following requirements are violated, Auto Configure may select IPARS as the data code. If you know that your line does not use IPARS, check that your line data satisfies these requirements.

1. Both data and idle conditions must be present. Asynchronous protocols must have a minimum of two idle characters between messages.

2. A transmit (TC or ETC) clock (x1) must be present for synchronous data. In synchronous NRZI mode, the clock must be encoded with the data.

3. Synchronous character oriented protocols must have sync characters present at least once in a 50-100 character sequence; and the sync pattern must be preceded by two idle characters.

4. Auto Configure requires a variety of alphanumeric, control, and binary characters in the data. There must be non-repetitive data of different types for Auto Configure to make an identification. For example, if only lower case ASCII characters are sent, EBCD code might be selected.

5. There must be at least one "0" bit preceded and followed by a "1" bit, and one "1" bit preceded and followed by a "0" bit, in a 50-100 character sequence.

6. In bit oriented protocols, there must be at least one good FCS.

7. In bit oriented protocols, at least one frame must be less than 255 characters in length.

Error Messages

No data present: There is no line data. Both data and idle conditions must be present.

No Idles: There are insufficient idles on the line. Both data and idles must be present. Asynchronous protocols must have minimum of two idle characters between messages.

No pod attached: The pod is not attached. Be sure to turn off the power before connecting the interface pod.

No Sync Characters: Could not find any of the sync characters listed on page 4-9.

Nonstandard Baud Rate: The bit rate is not within 5% of those listed on page 4-9.

Baud rate > 19200 bps: Auto Configure may work at higher rates.

Framing error: Could not find a "1" stop bit in an asynchronous protocol. This error may occur because a transmit clock (TC or ETC) is missing in a synchronous protocol. The HP 4951B assumes an asynchronous protocol, but cannot then find the stop bit.

Auto Configure Operating Characteristics

	BIT ORIENTED	CHARACTER (Sync)	CHARACTER (Async)
Mode	Sync, NRZI		Async (1 stop bit needed)
Code	ASCII 8, EBCDIC	ASCII 7, ASCII 8, EBCDIC, Hex,6,7,8; IPARS (0 idle), IPARS (1 idle), Transcode	ASCII 7, ASCII 8, EBCD, Baudot
Parity		None, Odd, Even, Ignore	None, Odd, Even, Ignore
Err Chk	CRC-CCITT	None, CRC-6, CRC-12, CRC-16, LRC, (IPARS: CRC-6 only) (Hex: no error checking)	None, CRC-6, CRC-12, CRC-16, LRC
DTE Clock Source	DTE, DCE	DTE, DCE	

	BIT ORIENTED (SDLC)	CHARACTER (Synchronous)	CHARACTER (Async)
Speed	(Within +/- 5 % , NRZI within +/- 0.5%)		
	50, 75, 110, 134.5 150, 200, 300, 600, 1200, 1800, *2000, 2400, 3200, 3600, 4800, 7200, 9600, *12k, 14.4k, *16k, 19.2k (* not NRZI)	50, 75, 110, 134.5 150, 200, 300, 600, 1200, 1800, 2000, 2400, 3200, 3600, 4800, 7200, 9600, 12k, 14.4k, 16k, 19.2k	50, 75, 110, 134.5 150, 200, 300 600, 1200, 1800 2000, 2400, 3200 3600, 4800, 7200 9600, 19.2k
Sync Chars	Flags (7E)	EBCDIC: 32 32 ASCII: 16 16 IPARS: 3F 3E Transcode: 3A 3A Hex: LSB of sync char must = 0 and both sync chars must be the same	
Transparent Text		EBCDIC: DL (10) ASCII: DL (10) Transcode: DL (1F) None	(Same as Synchronous)

	BIT ORIENTED (SDLC)	CHARACTER (Synchronous)	CHARACTER (Async)
Start BCC		EBCDIC: SX (02) or SH (01) ASCII: SX (02) or SH (01) Transcode: SX (0A) or SH (00)	(Same as Synchronous)
Stop BCC		EBCDIC: EX (03) or EB (26) ASCII: EX (03) or EB (17) Transcode: EX (2E) or EB (0F) Will not support ITB	(Same as Synchronous)
Bit Order	LSB 1st	LSB 1st,IPARS: MSB 1st	LSB 1st
Bit Sense	Normal	Normal, IPARS: Inverted	Normal
Idle Char	7E	FF, IPARS: FF or 00	FF

CHAPTER 5
THE SETUP MENUS

Introduction

HOW SETUP CONTROLS OTHER MENU SELECTIONS

Setup, whether performed manually or via Auto Configure, determines some choices in the other menus. For example, error checking is performed during monitoring according to the current setup. The appropriate error checking characters are automatically appended to Send strings. Data is displayed in the Examine Data or Run Menus according to the current setup. See Chapter 6.

THE FIVE SETUP MENUS

Press <Setup> on the Top Level Menu to access the Setup Menus. Move the cursor to the Protocol field and select one of the following:

HDLC (bit oriented)	Allows extended address and control fields.
SDLC (bit oriented)	Allows NRZI synchronizing. This setup is always selected when **Auto Configure** recognizes a bit oriented protocol.
X.25 (bit oriented)	Packet information is decoded in the Examine Data Menu
BSC (character oriented)	Supports standard half duplex, character oriented BSC.
CHAR ASYNC/SYNC	May be used to configure to most protocols. This setup is always selected when **Auto Configure** recognizes a character oriented protocol.

WHEN TO USE THE SETUP MENUS

When monitoring on-line, Auto Configure automatically configures the HP 4951B to most lines. You may, of course, use the Setup Menus to manually configure. Generally, however, use the Setup Menus for the following:

KNOWN LINE PARAMETERS. If you know what the line parameters are, Manually configuring may be faster and more accurate than Auto Configure.

MONITORING FROM BUFFER. For post-processing, use the setup menus. You can of course, use an "auto configured" setup from a previous run. Setups remain even after power off, unless you press <Reset>.

CHANGING DISPLAY FORMATS. Auto Configure always uses the display format currently selected in the Setup Menu. Use the Setup Menus to change display formats.

SUPPLEMENTING AUTO CONFIGURE. Use the Setup Menus to modify any parameters after initial setup with Auto Configure.

SIMULATING. Use the Setup Menus to determine send string format.

SAVING SETUPS

NONVOLATILE MEMORY. To save menu setups and buffer data, turn off the power only when in the Top Level Menu. Otherwise, some settings may be destroyed.

TAPE STORAGE. You can store Menus, or both Menus & Data, to tape. All menus except BERT are saved. See Chapter 11.

The Bit Oriented Menus

The three Bit Oriented Setup Menus are HDLC, SDLC, and X.25. Press <Setup> on the Top Level Menu and select HDLC, SDLC, or X.25.

To decode frames in bit oriented protocols, use Frame & Packet **display mode**. To decode X.25 packets, use the Examine Data Menu in frame & packet format.

The Bit Oriented Setup Menu, and the softkey options, are shown on page 5-5. Asterisks indicate differences between the three protocols. The default parameter selections, which appear after <Reset>, are listed in Chapter 12.

In Bit Oriented Setup, the HP 4951B performs automatic zero bit insertion/extraction.

HDLC and SDLC PROTOCOLS

Except for the following differences, HDLC and SDLC have the same format.

1. HDLC allows Extended Address and Control fields.

2. SDLC allows either normal Sync Mode or NRZI Sync.

X.25 PROTOCOL

X.25 is the same as HDLC except for allowing ISO Level 3 (network) data to be placed in the information field of Information Frames. Use the X.25 menu when monitoring or simulating X.25 lines. The Examine Data Menu decodes packets in Frame & Packet display format. See Chapter 8.

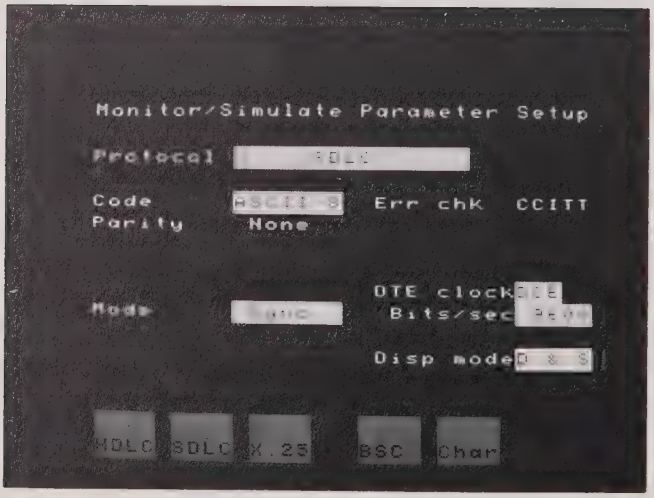


Figure 5-1. SDLC Setup Menu

BIT ORIENTED PROTOCOL SETUP MENUS

(* used only in HDLC)
(** used only in SDLC)

```
Protocol  [ HDLC ]
          [ SDLC ]
          [ X.25 ]


* Ext Addr  [ Off ]        * Ext Ctrl   [ Off ]
           [ On  ]                     [ On  ]


Code  [ ASCII 8 ]          Err chk      CCITT
      [ Hex 8   ]
      [ EBCDIC  ]

                           DTE clock  [ DCE ]
Parity      None                      [ DTE ]


Mode        Sync           Bits/sec   [ 19200 ] [  3600 ] [  200 ] [ 16000 ]
     ** [ Sync NRZI ]                  [  9600 ] [  3200 ] [  150 ] [ 14400 ]
                                       [  7200 ] [  2000 ] [134.5 ] [ 12000 ]
                                       [  4800 ] [  1800 ] [  110 ] [Teletext]
                                       [  2400 ] [   600 ] [   75 ]
                                       [  1200 ] [   300 ] [   50 ]


                           Disp mode  [ Two Line ]  [   Data & State ]
                                      [ DTE only ]  [ Frame & Packet ]
                                      [ DCE only ]
```

BIT ORIENTED MENU DEFINITIONS

EXT ADDR (HDLC)	HDLC allows an extended address field. When an additional address octet (byte) is to follow, the first or least significant bit of the address octet is set to 0. The last address octet in a series has the LSB set to 1.
EXT CTRL (HDLC)	HDLC allows a 16-bit control field to handle larger N(S) and N(R) counts.
CODE	The bit oriented menus allow ASCII 8, EBCDIC or, using Hex 8, any 8-bit code.
MODE	All bit-oriented protocols are synchronous: the data is transmitted with a clock. In **NRZI** (SDLC only) the clock is encoded within the data.
DTE CLOCK	DTE data can be synchronized to either a DCE or DTE clock. If this selection is incorrect, only DCE data will be displayed.
DISP MODE	All five display formats are available for the bit oriented menus. The Frame & Packet format decodes all control field bits. In addition, when viewing the buffer in this format, packet information is also decoded. See Chapters 7 and 8 for examples of the different types of displays.
BITS/SEC	Except for NRZI, all the selections shown on page 5-5 are supported. NRZI may not work at 16000, 12000, and 2000 bps. In **Teletext**, the DTE sends at 75 bps, and the DCE sends at 1200 bps.

HINTS FOR SETTING UP BIT ORIENTED LINES

Observe the Pod

The DTE and DCE lines on the pod LCDs or LEDs should be flashing. Except in the case of NRZI sync, there should also be clock activity.

Use Auto Configure

Use Auto Configure for initial setup. If the data is bit oriented, Auto Configure always selects SDLC as the protocol. You will have to change protocols in the following cases.

1. HDLC with Extended Address or Control. Change the protocol to HDLC with the following setup:

   ```
   Ext Addr and/or Ext Ctrl: On          Disp mode: Frame & Packet
   ```

2. X.25 Packets. If the protocol is X.25, change the setup to the following. After capturing data, use the Examine Data Menu to observe packet decoding.

   ```
   Protocol: X.25                        Disp mode: Frame & Packet
   ```

Choose the Appropriate Display Format

In the bit oriented menus, you can use any of the five display formats. For frame decoding, use Frame & Packet, as described on the following pages.

DECODING FRAMES WITH FRAME AND PACKET DISPLAY FORMAT

During run-time, the Frame & Packet display format decodes Level 2 frame information in HDLC, SDLC, or X.25. The frame information described below is decoded. See Figure 5-2.

After run-time, for HDLC or SDLC, the Frame & Packet display looks the same when observing the buffer in the Examine Data Menu, except that up to 57 data characters can be shown at the top of the display. See Figure 5-3.

ADDRESS	Hex address of the secondary channel. (Extended addresses can be seen when HDLC with extended address is being used).
TYPE	Identifies the type of frame from the Control Field.
N(S)	Send Sequence Number of the frame. (Normally modulo 8; but becomes modulo 128 when HDLC with extended control is being used).
P/F	Poll/Final Bit. Poll = 1, Final = 0.
N(R)	Receive Sequence Number of the frame. (Normally modulo 8; but becomes modulo 128 when HDLC with extended control is being used).
Data	Displays the first nine characters of the information field.
FCS	Indicates the status of the Frame Check Sequence (CRC-CCITT) as either good (GG), bad (BB), or indicates an aborted frame (AA).

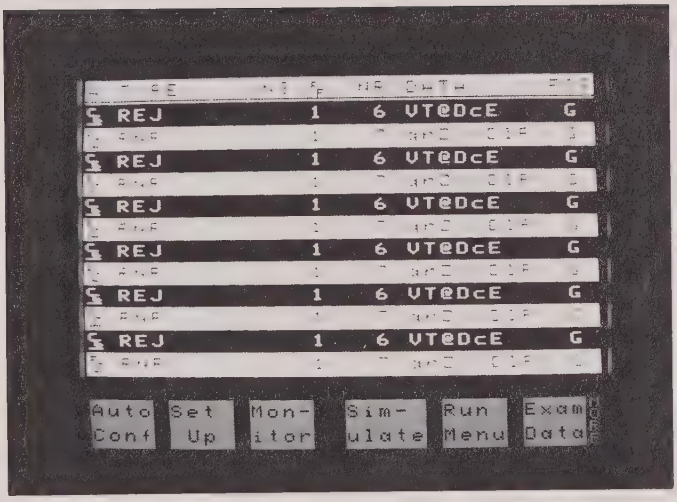


Figure 5-2. HDLC in Frame & Packet Display Format (run-time)

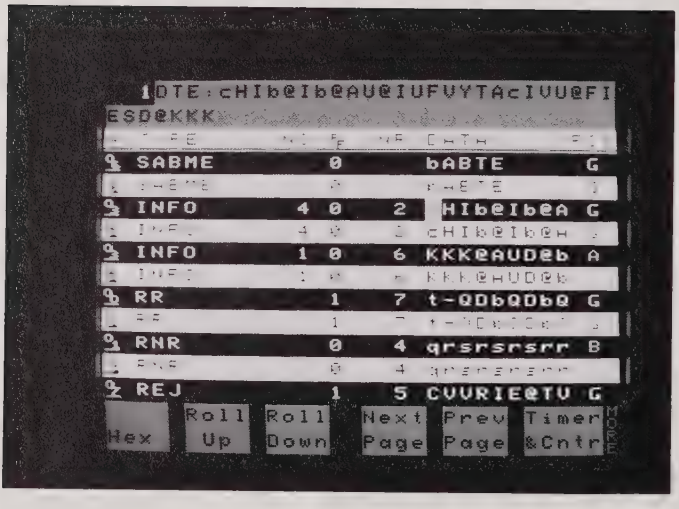


Figure 5-3. HDLC in Frame & Packet Display Format (Examine Data Menu)

DECODING X.25 PACKETS IN THE EXAMINE DATA MENU

X.25 looks the same as HDLC or SDLC when running in the frame and packet display format. After capturing data, however, the Examine Data Menu shows both frame decoding and packet decoding. As shown on the next page, packet information at the cursor location is decoded at the top of the display. The top of the display contains the following information.

Origin	DTE or DCE.
Q-Bit	Qualifier Bit.
D-Bit	Delivery Confirmation Bit.
MOD	Modulo 8 or 128.
LCN	Logical Channel Number.
TYPE	Type of packet.
P(S)	Packet Send Sequence Number.
M-Bit	More Data Mark.
P(R)	Packet Receive Sequence Number.
Data	Displays the first five characters of the data field.

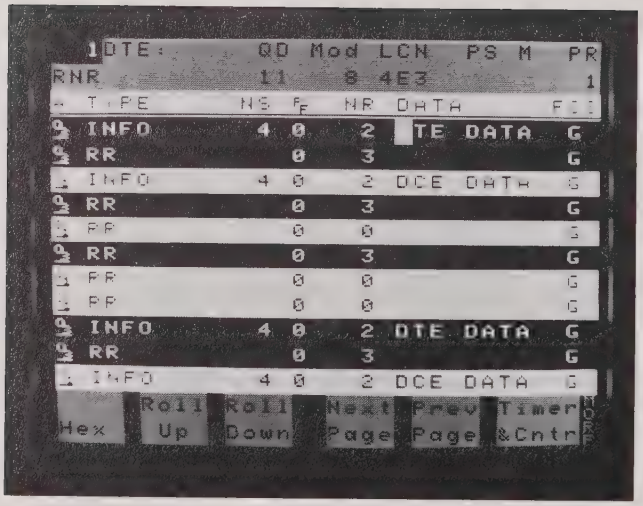


Figure 5-4. X.25 in Frame & Packet Display Format (Examine Data Menu)

The BSC Menu

The BSC Menu and available softkey selections are shown on the following page.

PARITY — BSC specifies odd parity for ASCII 7. There is no parity check for EBCDIC or Transcode. The HP 4951B automatically sets the parity condition for the chosen code. In simulate mode, BSC is transmitted with the correct parity.

Note: If "Send" or "When" characters are specified in hex, the parity bit is not changed to conform to the parity setup selection.

MODE — BSC is synchronous.

SYNC ON — The HP 4951B automatically chooses the correct sync characters for each data code. The sync characters are: 32 32 (EBCDIC), 16 16 (ASCII), or 3A 3A (Transcode). The HP 4951B requires at least two sync characters for proper framing.

ERR CHK — Select LRC or CRC-16 for ASCII or EBCDIC, and LRC or CRC-12 for Transcode.

BITS/SEC — The bit rates for BSC are the same as the bit oriented protocols.

DISP MODE — Frame & Packet display format is not used in BSC.

SUPPRESS — The BSC Menu lets you suppress almost any combination of text and control characters from the display. However, suppressed characters are not deleted from the buffer. Note that idle characters are assumed to be FF in BSC.

BSC SETUP MENU

```
Protocol  [ BSC ]

Code  [ ASCII 7   ]          Err chk    [ LRC    ]
      [ Transcode ]                     [ CRC 12 ]
      [ EBCDIC    ]                     [ CRC 16 ]

Parity   Odd  (ASCII 7)      DTE clock  [ DCE ]
         None (Transcode)               [ DTE ]
         None (EBCDIC)

                                Bits/sec  [ 19200 ] [  3600 ] [   200 ] [ 16000 ]
                                          [  9600 ] [  3200 ] [   150 ] [ 14400 ]
                                          [  7200 ] [  2000 ] [ 134.5 ] [ 12000 ]
Sync on   16  16  (ASCII 7)               [  4800 ] [  1800 ] [   110 ] [Teletext]
          3A  3A  (Transcode)             [  2400 ] [   600 ] [    75 ]
          32  32  (EBCDIC)                [  1200 ] [   300 ] [    50 ]

                                Disp mode [ Two Line ] [     DCE Only ]
                                          [ DTE Only ] [ Data & State ]

                                Suppress  [ None         ] [ Idle & Ctl    ]
                                          [ Idle         ] [ Idle & Txt    ]
                                          [ Null         ] [ Null & Ctl    ]
                                          [ Control      ] [ Null & Txt    ]
                                          [ Text         ] [ Id & Nu & Ctl ]
                                          [ Idles & Null ] [ Id & Nu & Txt ]
```

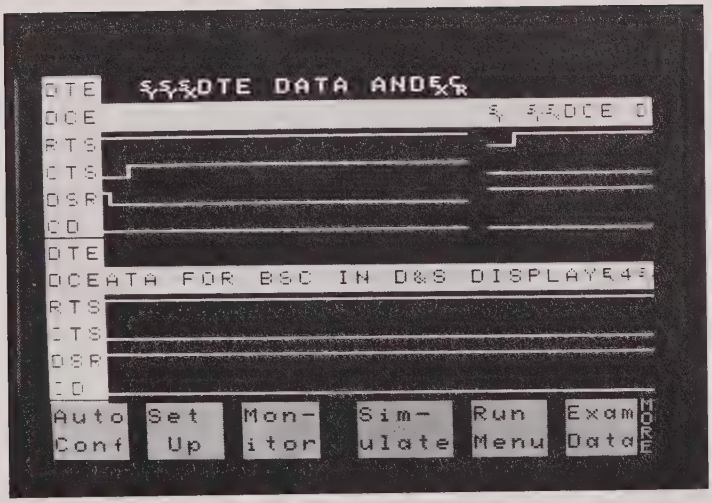


Figure 5-5. BSC in Data & State Display Format

The Char ASYNC/SYNC Menu

Shown on the next page is the Char Async/Sync Menu and its softkey selections. This Menu is a general purpose setup menu. You can use it to capture most protocols: synchronous or asynchronous.

Configuring to Any Data Code

Note the large number of codes available with this menu. In the Char Async/Sync Menu, you select all the parameters to go with your data code. This menu enables you to tailor the analyzer to many different codes with standard or nonstandard characteristics.

Note: The HP 4951B does not perform zero bit insertion or extraction for bit oriented protocols when in Char Async/Sync setup.

When to Use the Char Async/Sync Menu

1. For asynchronous lines.
2. For full duplex character oriented protocols.
3. To see all line activity, including line idles (See page 5-22).
4. For nonstandard protocols, such as asynchronous BSC.

CHAR ASYNC/SYNC SETUP MENU (* indicates synchronous mode only)

```
Bit order  [ LSB first ] [ MSB first ]          Bit sense  [ Normal ] [ Inverted ]

Code  [ ASCII 8 ] [ Hex 6  ] [ IPARS idle 0]         Err   [ CRC 6 ] [CRC 16 ]
      [ Hex 8   ] [ EBCDIC ] [ IPARS idle 1]          chk  [  LRC ] [ CRC 12 ]
      [ ASCII 7 ] [ Transcode ] [ Baudot ]                 [ None ]
      [ Hex 7   ] [ Hex 5  ] [ EBCD ]

                                      * Start on/Stop on  [ Use keyboard ]

Parity [ None ] [ Even ] [ Odd ] [ Ignore ]      * DTE clock  [ DCE ] [ DTE ]


Transparent  [    None ]          Bits/sec  [ 19200 ] [ 3600 ] [   150 ] [ 16000 ]
  text char  [ Use keyboard ]               [  9600 ] [ 3200 ] [ 134.5 ] [ 14400 ]
                                            [  7200 ] [ 2000 ] [   110 ] [ 12000 ]
Mode   [ Asyn 1   ]  [ Asyn 2 ]             [  4800 ] [ 1800 ] [    75 ]
       [ Asyn 1.5 ]  [ Sync   ]             [  2400 ] [  600 ] [    50 ]
                                            [  1200 ] [  300 ] [Teletxt]


* Sync on  [  Idles ]             Disp mode  [ Two Line ]  [ DCE Only ]
           [ Use keyboard ]                  [ DTE Only ]  [ Data & State ]


* Drop sync [ Use keyboard ] chrs       Suppress   [ None   ]  [ Idle & Ctl    ]
   after [ Use keyboard ] [ None ]                 [ Idle   ]  [ Idle & Txt    ]
                                                   [ Null   ]  [ Null & Ctl    ]
                                                   [ Control ]  [ Null & Txt    ]
                                                   [ Text    ]  [ Id & Nu & Ctl ]
                                                   [ Idles & Null ]
                                                   [ Id & Nu & Txt ]
```

CHAR ASYNC/SYNC DEFINITIONS

Bit Order/Sense. Normally, the LSB is sent first, and data is not inverted. Some protocols (e.g., IPARS) may be different. These selections affect only incoming and outgoing run-time data. Incoming data is changed at the input interface before processing. When simulating, data is changed at the output interface. Buffer data is not changed.

Start on/Stop on. Determines error checking bounds. Error checking starts on the character immediately after the **Start On** character; however, the **Stop On** character is included in the BCC. This selection does not appear if **Error chk** is None. See page 5-19 for hex entry.

Transparent Text. This character delimits the boundaries of a field, inside of which all control characters are to be treated as data. This is the same as the DLE character in BSC protocol. See page 5-19 for hex entry.

Mode. Synchronous, or Asynchronous (1, 1.5, 2 stop bits). The HP 4951B needs only one stop bit for asynchronous monitoring, even if more are present.

Sync on. Synchronous mode only. Selects the sync characters for proper framing. The HP 4951B requires at least two sync characters. The HP 4951B must see at least two of these characters to capture data when monitoring or simulating character oriented protocols. See page 5-19 for hex entry.

Drop sync after. Synchronous mode only. Tells the analyzer to "drop" sync (stop bringing in data) and start looking for sync characters again. See page 5-19 for hex entry.

DTE Clock. Synchronous mode only. Specifies the DTE transmit clock source.

Using Char ASYNC/SYNC

HEX ENTRIES and PARITY

There are several fields in the Char Async/Sync Menu which let you make hex entries: **sync on**, **drop sync**, **transparent text**, and **start on/stop on**. When making hexadecimal entries, the resulting parity bit might not conform to the parity setup selection. For example, with ASCII 7 and even parity, the sync characters should be 9_6 9_6, rather than 1_6 1_6. Of course, your line may still use 1_6 1_6, even though this would result in the wrong parity for sync characters. If your line satisfies the requirements on page 4-6, you can use Auto Configure to find the correct sync characters.

For hexadecimal entries, the resulting parity bit conforms to the following rules:

1. For data codes of 7 bits or less (e.g., ASCII 7, Baudot) the parity bit is not changed to conform with setup selection.

2. For 8-bit data codes (e.g., ASCII 8, EBCDIC) the parity bit always conforms to parity setup selection.

For 8-bit data codes with parity, the selected sync characters must be the same as the last 16 bits to enter the analyzer before non-sync data. For example, in EBCDIC the normal sync pattern is 3_2 3_2. With even parity, the binary pattern would be 100110010 100110010, or 18 bits. But only the last 16 bits are used by the analyzer as the sync pattern. Because least significant bits are sent first, the two bits in brackets are excluded from the sync pattern: 1001100[10] 100110010. Thus, you must enter 4_C 9_9 for the analyzer to accept data. Of course, Auto Configure will find the correct sync characters for you.

SYNC CHARACTERS (Synchronous mode only)

The **sync on** selection determines what sync characters the analyzer looks for. Unless the sync pattern is correct, the HP 4951B will not capture data. The HP 4951B requires at least two sync characters (i.e., the correct 16-bit pattern) to capture data when monitoring and simulating.

When you do not know the sync characters, use Auto Configure. You can also select **Sync on** Idles. This allows you to load line data even without the correct sync characters.

Note: The HP 4951B assumes that all character oriented protocols idle in FF. If your line uses some other condition, you must **Sync on** that condition.

DROP SYNC CHARACTERS (Synchronous mode only)

The **Drop sync** entry determines where the analyzer drops sync and begins looking again for the sync characters. If the analyzer did not drop sync, it would bring in all activity on the line, including idles.

Select seven characters on which to drop sync. The first character is the "within text" character. The analyzer only looks for this character if you have chosen **error checking**. Thus, if you **start on** STX and **stop on** ETX, the analyzer looks for the "within text" character between STX and ETX.

Note: Normally, the HP 4951B does not store idles. This is to prevent the buffer from being filled inefficiently.

To store all data, including idles, enter **Drop sync** 0 **chrs after** None. The analyzer will never drop sync, and will bring in all line data, including idles.

Drop Sync and Error Checking

The **Drop sync** selection interacts with the **Error check** selection in the following ways.

1. The first **drop sync** character specifies "within text". The analyzer looks for this character between the **start on** and **stop on** error checking limits. When error checking is "none", all text is outside; and the analyzer does not look for the first character.

2. The last six **drop sync** characters specify "outside text". The analyzer looks for these characters outside the **start on** and **stop on** error checking limits. The six "outside text" characters are ORed: the analyzer drops sync on any one of them that occurs outside the error checking limits.

3. The first, or "within text", character takes precedence over the six "outside text" characters. If the same character occurs both inside and outside the **start on** and **stop on** limits, the analyzer drops sync within text.

4. With error checking, the analyzer always drops sync after the BCC character(s) if it cannot find a "within text" character. For example, if you select CRC-16 error checking, with **Start on** STX and **Stop on** ETX, the analyzer drops sync after the two characters following ETX.

For example, **Drop sync** 1 **chrs after** B_B F_F F_F F_F 5_D A_4 B_3 causes the analyzer to drop sync one character after the first B_B character within the specified error checking limits. If the analyzer does not find the specified "within text" character, it drops sync either after the BCC character(s) or after one of the six "outside text" characters, whichever appears first.

Capturing Unknown Data

CAPTURING THE DATA

For nonstandard protocols in which Auto Configure may not work, perform the following procedure.

1. For unknown data codes, try an 8-bit code first. Select no parity and no error checking.

2. To load line data for study when you do not know the sync character, select **Sync on** idles.

   NOTE: The HP 4951B assumes that all character oriented protocols idle in FF. If your line uses some other idle character, you must sync on that character.

3. To store all data for study, including idles, enter **Drop sync** 0 **chrs after** None. The analyzer will never drop sync and will bring in all data, including idles.

   NOTE: Normally, idles are not stored to make efficient use of the buffer.

4. After making the above selections in the Char Async/Sync Menu, go to the Run Menu and <Monitor from Line> for a few moments to fill the buffer with data for study.

5. Go to the Examine Data Menu to view the data in buffer.

The buffer data will probably be meaningless because of incorrect character framing: The analyzer does not know where each character begins or ends. Now you need to find the correct sync pattern.

FINDING THE CORRECT FRAMING

Bit Shifting (BSC and Char Async/Sync only)

NOTE: Bit shifting does not work when data is brought in Most Significant Bit (MSB) first.

Even if you do succeed in bringing in data by synchronizing on idles, the displayed information will probably be meaningless because of incorrect framing. To make the data meaningful, go to the Examine Data Menu and <Bit Shift> the captured data.

NOTE: The HP 4951B does not shift through the parity bit. Unless you use a code with no parity (see Figure 5-4), you must use trial and error to find the correct framing.

If at least part of the data still does not become meaningful while bit shifting, change the data code to another without parity. When the data becomes meaningful, you can determine the correct sync characters. Change the **Sync on** selection to these characters.

ELIMINATING SUPERFLUOUS DATA

Dropping Sync (Synchronous mode only)

Once you find the correct framing through the above procedure, you can eliminate idles. Otherwise the buffer is mostly filled with idles. To eliminate idles, enter **Drop sync** 0 **chars after** FF. If the line idles in a character other than FF, enter that character instead.

Data Code	No Parity	Even or Odd Parity	Ignore Parity
Hex 5 Baudot	5 bits (no parity bit)	6 bits (including parity bit)	6 bits * (parity bit = 0)
Hex 6 EBCD IPARS Transcode	6 bits (no parity bit)	7 bits (including parity bit)	7 bits * (parity bit = 0)
Hex 7 ASCII 7	7 bits (no parity bit)	8 bits (including parity bit)	8 bits * (parity bit = 0)
Hex 8 ASCII 8 EBCDIC	8 bits (no parity bit)	9 bits (including parity bit)	9 bits * (parity bit = odd)

(* these settings are forced in Simulate)

Figure 5-6. Character Frame Sizes vs Data Code

CHAPTER 6
THE MONITOR AND SIMULATE MENUS
Introduction

This chapter explains how to make measurements. Because the HP 4951B uses triggering for all measurements, this chapter tells you how to tie your programs to trigger statements. Press <Monitor> on the Top Level Menu to access the monitor menu. Press <Simulate> to access the simulate menu.

DIFFERENCES BETWEEN MONITOR AND SIMULATE MENUS

Monitoring has no effect on the line: it is passive and non-interactive. Simulation is active: the HP 4951B takes the place of a DTE or DCE on the data line. There are five differences between the Monitor and Simulate Menus:

1. In Simulate, you must specify either DTE or DCE simulation.

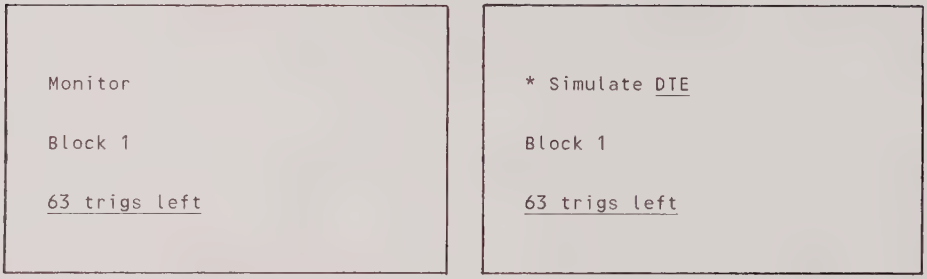
2. In Simulate Menu, you can transmit characters with the <Send> softkey.

3. In Simulate, you must program the interface with the <Set Lead> softkey.

4. In Simulate, you can delay output (Send, Set Lead) with the <Wait> statement.

5. In Simulate, clocks are automatically provided on the interface: ETC is provided when simulating a DTE; TC and RC are provided when simulating a DCE.

6. In Simulate, when transmitting "Send" strings in bit oriented protocols, frame error checking is automatically supplied.



Start	Stop	Inc Ctr	If	When	* Send

[MORE]

High-Light	Beep	Reset	Goto Blk	* Set Lead	* Wait

[MORE]

Insert Line	Delete Line	Delete Prog

(* Indicates Simulate only)

Figure 6-1. The Monitor and Simulate Menus

Programming

Always Do Setup First. If you change the setup menu after entering a program or change DTE to DCE (or vice versa) within a program, the program may have blinking entry fields indicating those entries are inappropriate for the setup. If you change the setup **data code** or **protocol** after entering a character string, you must retype the string (see pages 6-7, 6-27). The program will fail unless you change either the setup or the program.

Softkey Programming. The softkeys display only appropriate choices. Press one of the softkeys in the Monitor or Simulate Menu. Other choices will appear, leading you through the program. For example, pressing <Start> causes the new softkey choices <Display>, <Tape>, and <Timer> to appear. See Figures 6-2 and 6-3 (These figures are only for illustration: the display starts automatically).

Block Structure. Programs are organized in blocks. A maximum of 31 blocks is allowed. Blocks provide "reference spots" for looping back or jumping ahead.

Editing Programs. Use the third set of softkeys on the Monitor or Simulate Menu as shown on page 6-2, and the cursor keys. The third set of softkeys can be accessed by the MORE key when you are at the beginning of a line. Blocks cannot be inserted or deleted. It's a good idea to leave empty blocks between used blocks for future editing.

Running Programs. After the program is developed, press <Run Menu> on the Top Level Menu. Select either <Monitor> or <Simulate>, depending on whether your program is in the Monitor or the Simulate Menu. Select either <Monitor Line> or <Monitor Buffer>, depending on whether you want to monitor "on-line" or do post-processing on data already in the nonvolatile buffer. The HP 4951B lets you run programs over and over on the data in its nonvolatile buffer.

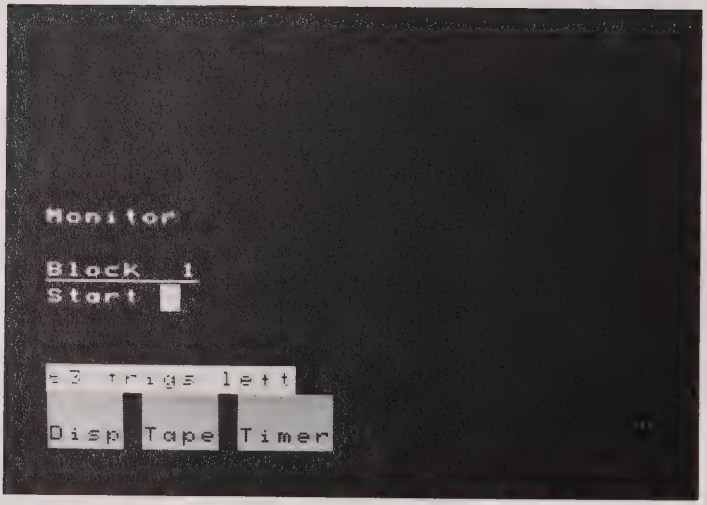


Figure 6-2. Softkey Programming

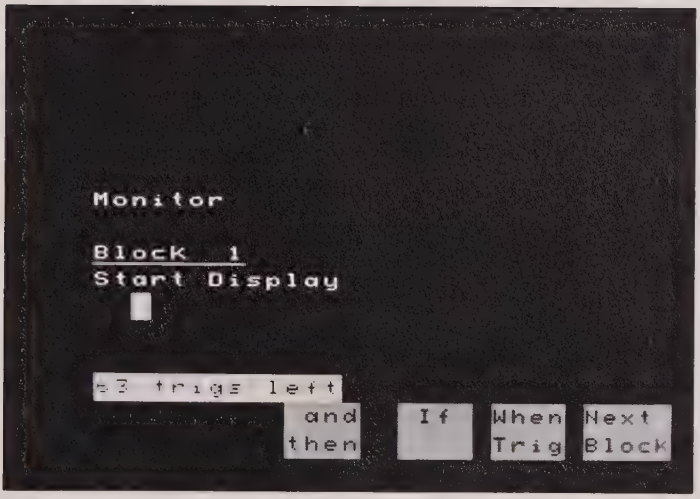


Figure 6-3. Softkey Programming

Triggering

The HP 4951B stores all line data in its buffer. You can trigger on any line event. With triggering, you can selectively analyze only events of interest.

"WHEN" DEFINES TRIGGERS

"When" is the only statement that can define a trigger. Each character in a "When" string constitutes one trigger. For example, "When DTE abcd" uses four triggers. A trigger "counter" in the display shows how many triggers are left. "When Timer" statements are not included in the trigger counter.

THINGS TO REMEMBER

1. The HP 4951B can "look for" up to 63 trigger events simultaneously.

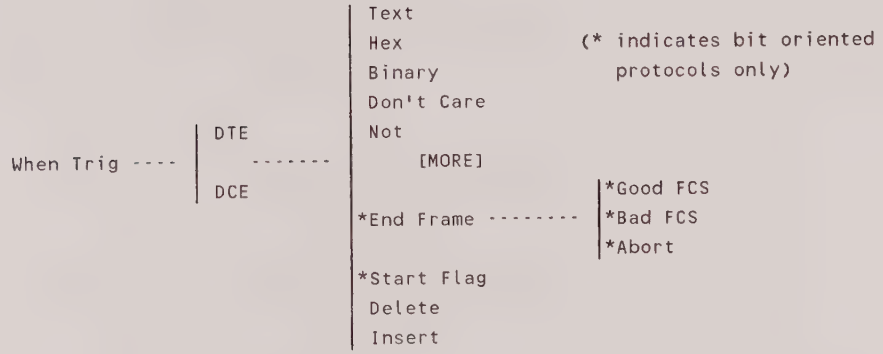
2. The HP 4951B can branch to any action as a result of a trigger. You must provide a block for the analyzer to branch to.

3. All monitor/simulate measurements must be tied to a preceding trigger statement. For example, when starting and stopping a timer, a "When" statement must precede the Start" and "Stop" statements. Thus, START, STOP, BEEP, HIGHLIGHT, and IF all refer to preceding "When" statements.

4. The program does not move out of a block containing a "When" statement until the statement is satisfied.

5. Once a trigger is satisfied, the trigger search mechanism is positioned in the buffer immediately after where the trigger was found. Thus, the next trigger does not miss any data.

Triggering on Characters



SELECTING CHARACTERS

Use the <Text> softkey for keyboard characters. The SHIFT key accesses lower-case characters; and the CNTL key accesses control characters. You can see the binary or hex value by positioning the cursor over that character and pressing <Hex> or <Binary>.

Editing Character Strings

Use the cursor keys, or the <Delete> and <Insert> softkeys to edit a string. Press MORE to access these softkeys when the cursor is positioned in the string.

Changing the Setup after Typing a String

If you change the data code or protocol in the Setup Menu after typing a character string, you must retype the string to avoid sending or triggering on the wrong characters. Characters in one code may not have the same meaning in another code. When you move the cursor to that character, the HP 4951B shows "**?**" if it cannot find the hex or text equivalent in the new code. The binary value of the character can always be viewed by pressing the <Binary> softkey.

When a Character is not on the Keyboard

EBCDIC and some other data codes have control characters which are not on the keyboard. Go to the table of data codes in the appendix and find the hexadecimal equivalent. Press the <Hex> or <Binary> softkey and enter that character from the keyboard.

Binary and Hex Characters

Use the <Hex> or <Binary> softkeys to enter hexadecimal characters or binary strings. Two hex numbers occupy each character position, requiring two keyboard entries. Hex characters are underlined to differentiate them from text control characters with the same abbreviation. When you press <Binary>, eight binary bits are displayed, allowing you to enter a 1 or 0 in any bit position from the softkeys. Once you move the cursor out of the binary string, it collapses to its hex equivalent; but it is underlined to indicate it was entered in binary.

If the data code selected in the Setup Menu is less than eight bits (e.g., Baudot or Transcode), the appropriate number of higher order bits are disregarded.

Masking out Characters

Use <Don't Care> to mask out string characters or bits of no interest. "Don't Care" characters are denoted by a boxed "**X**". If any bit in a binary string is designated as "don't care", the compressed character is denoted by "**?**". See Figure 6-4.

Excluding Characters

To trigger on "anything but" a particular character, use <Not>. "Not" characters are overlined. Observe the "3" and "5" in Figure 6-4.

Flags and Frame Check Characters

Unlike <Send> strings, flags and frame check characters are not automatically appended for <When Trig> strings. You can enter these characters using the MORE key. The MORE key accesses the "End Frame" characters (the FCS characters and the last flag). End Frame characters may be useful if you wish to trigger on Bad FCS or Abort Characters. Triggers for FCS errors or abort characters can only be programmed when a bit oriented protocol is selected on the setup menu.

Parity

When triggering on a character, the HP 4951B ignores the parity bit. You can see this by expanding the specified trigger character in binary when the setup is ASCII 7. The most significant (left) bit is designated "don't care" by a boxed "**X**". You can explicitly define this character by entering a 1 or 0 in binary. This overrides the Setup Menu. Triggers for parity errors can only be programmed when a character oriented protocol is selected in the setup menu.

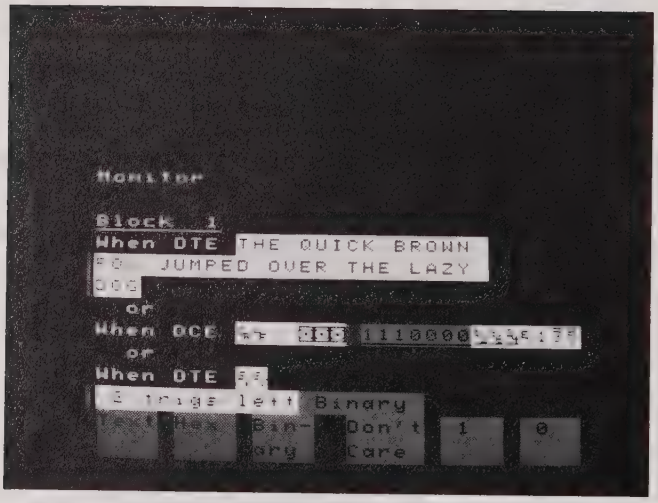
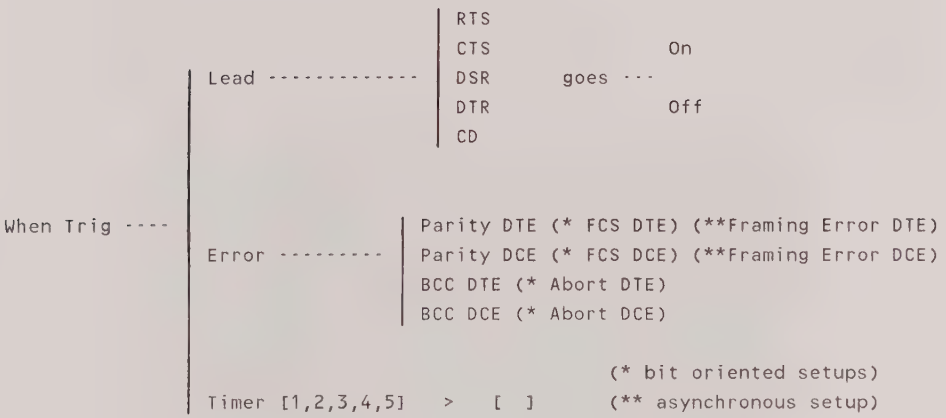


Figure 6-4. Triggering on Characters

Triggering on Errors, Leads, Timers



Leads. Only the RS-232C/V.24 leads are shown above. If a different pod, such as RS-449, is connected, those leads appear as softkey choices.

Types of Errors. BCC (Block Check Characters) and Parity errors are used only with character protocols. FCS (Frame Check Sequence) is used only with bit oriented protocols. Framing Errors appear only in asynchronous setup (Char Async/Sync Menu). The error softkeys appear automatically, according to the current Setup.

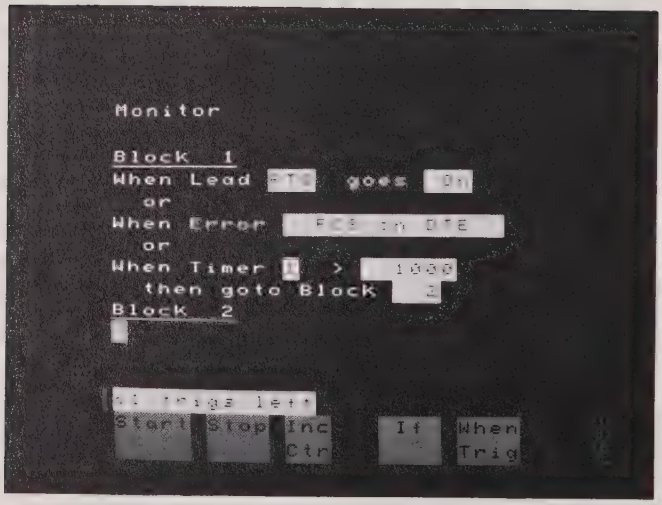


Figure 6-5. Triggering on Errors, Leads, Timers

Combining Triggers

COMBINING <WHEN TRIG> STATEMENTS

<When Trig> statements within the same block are ORed: the analyzer looks for them all simultaneously. If two are satisfied simultaneously, the first one listed takes priority. To sequence <When Trig> statements, put them in separate blocks.

HOW TO "OR" TRIGGERS

The <When Trig> statements in this example are ORed: The analyzer looks for all four simultaneously. Once a trigger is found, all other triggers in that block are disabled. If two <When Trig> statements are satisfied simultaneously, only the first one in the block is recognized. Note: You must have a character oriented protocol selected in the setup menu for this example.

Block 1:
When DTE abcd
then goto Block 2
When Error Parity on DTE
or
When Error Parity on DCE
then goto Block 3
When Lead RTS goes On
then goto Block 4

HOW TO SEQUENCE TRIGGERS

In this example, the HP 4951B must find the string "abcd" before it can look for string "efgh". To get to block 5, the analyzer must find both strings in order.

Block 1:
When DTE abcd
then goto Block 2

Block 2:
When DTE efgh
then goto Block 5

OVERLAPPING TRIGGERS

For overlapping triggers, the one found first disables the other triggers.

In this example "ab" will always be found first and will then disable the first <When Trig> statement.

```
Block 1:    When DTE abc
                then goto Block 2
            When DTE ab
                then goto Block 3
```

If the data is "yabc", only the first <When Trig> is satisfied. If the data is "ybc" only the second <When Trig> is satisfied. If the data is "yc", only the third <When Trig> is satisfied. The first <When Trig> to be satisfied disables the others.

```
Block 1:    When DTE abc
                then goto Block 2
            When DTE bc
                then goto Block 3
            When DTE c
                then goto Block 4
```

If the data is "ybc", only the trigger "c" is found.

```
Block 1:    When DTE c
                then goto Block 2
            When DTE bc
                then goto Block 3
```

Measuring Time Between Triggers

The HP 4951B has five timers which can each measure up to 65,535 msec. Timers are always reset to zero at the beginning of a run, i.e., when you press <Run Menu>. Timers are reset under program control with <Reset>. Timers are stopped under program control with <Stop Timer> or <Stop Tests>. In bit oriented protocols, the start flag and address of a string have the same time mark; and this is also true of the last character and the end flag.

As shown in the following examples, statements using timers or leads relate to the status of the line at the time of the last trigger. You should always make sure statements relating to line status are tied to a preceding trigger statement.

CORRECT WAY TO MEASURE TIME

This example shows the correct way to measure the time interval between two trigger conditions. The starting and stopping of the timer is entirely dependent upon the occurrence of the two trigger conditions.

```
Block 1:    When Lead RTS goes On
                then goto Block 2
Block 2:    Start Timer 1
Block 3:    When Lead CTS goes On
                then goto Block 4
Block 4:    Stop Timer 1
```

INCORRECT WAY TO MEASURE TIME

Timer 1 now starts when the run begins, rather than when RTS goes on. Timer 1 stops when RTS goes off. You are not measuring the time between trigger events.

```
Block 1:    Start Timer 1
            When RTS goes On
                then goto Block 2
Block 2:    Stop Timer 1
            When CTS goes On
                then goto Block ....
```

USING TIMERS IN SIMULATE

These simulate examples illustrate the same principles described above.

Simulate DTE. This example is correct. Timer 1 does not start or stop until the preceding <When Trig> statement is satisfied.

```
Block 1:    Set Lead RTS On
            When Lead RTS goes On
               then goto Block 2
Block 2:    Start Timer 1
            When Lead CTS goes On
               then goto Block 3
Block 3:    Stop Timer 1
```

Simulate DTE. This example is NOT correct. It is not known when Time 1 will start. Timing measurements should always reference a trigger.

```
Block 1:    Set Lead RTS On
Block 2:    Start Timer 1
            When Lead CTS goes On
               Then goto Block 3
Block 3:    Stop Timer 1
```

Counting Events -- INC CTR

Use the <Inc Ctr> statement for counting events. The HP 4951B has five counters, allowing you to count five different events simultaneously. "Events" may be characters or character strings occurring on the line, lead changes, timer changes, counter changes, or program loops; almost any action the analyzer performs can be counted. To use the counters effectively, place the increment counter statement directly after the event of interest.

Maximum Count. Each counter counts to 10,000 and then starts over from zero. By having one counter increment whenever a second counter overflows, you can count up to nearly 10,000 times 10,000. You can cascade all five counters this way.

Reset. Counters and timers are always reset to zero at the beginning of a run; i.e., when you press <Run>. Counters or timers may also be reset under program control with the <Reset> statement. When they are reset during a program, they go to zero and do not restart unless you start them again.

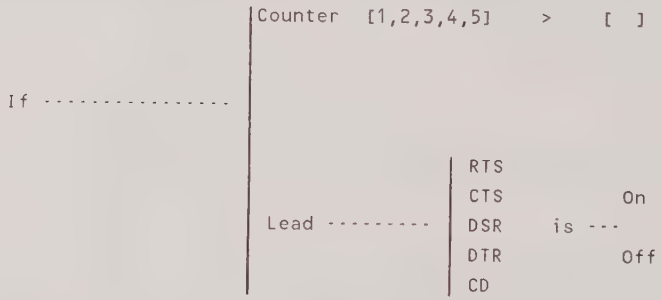
Examples. The first example below counts the number of parity errors on the DTE line. The second example counts the number of times RTS goes on. Note: You must have a character oriented protocol selected in the setup menu for this example.

```
Block 1:    When Error Parity on DTE
                then goto Block 2
Block 2:    Increment Counter 1
                and then goto Block 1

Block 1:    When Lead RTS goes On
                then goto Block 2
Block 2:    Increment Counter 2
                and then goto Block 1
```

Testing Status -- IF

The <If> statement tests current counter or lead status. For leads, "current" means at the time of the last trigger. Counters are independent of line status.



HOW <IF> AND <WHEN TRIG> ARE DIFFERENT

Only <When Trig> defines a trigger. "When" causes the analyzer to look for events or transitions starting from the point where the last trigger was satisfied. <If> is concerned only with current states. Unlike <If>, program flow stops until <When Trig> is satisfied.

COMBINING <IF> STATEMENTS

Just as with <When Trig> statements, <If> statements within the same block are "ORed". The first statement satisfied controls the branch.

USING <IF> WITH COUNTERS

Counters run independently of line status. Therefore, an <If> statement testing counter status need not be preceded by a <When Trig> trigger statement.

This example counts the number of times RTS goes on. When RTS goes on 100 times, the test stops.

```
Block 1:    When  RTS goes On
                then goto Block 2
Block 2:    Increment Counter 1
            If Counter 1  >  99
                then goto Block 4
Block 3:    Goto Block 1
Block 4:    Stop Tests
```

USING <IF> WITH LEADS

Line status can only be checked by a <When Trig> trigger statement. Therefore, an <If> statement testing a lead condition always refers to the line status at the time of the last trigger.

In this example, Block 2 tests CTS when the <When Trig> statement in Block 1 is satisfied.

```
Block 1:    When  Lead RTS goes On
                then goto Block 2
Block 2:    If  Lead CTS is On
                then goto Block 4
```

Marking Trigger Events

FILTERING DATA -- Start, Stop, Beep, Highlight

By using these four commands, you can have the HP 4951B notify you when it has found a particular event. (Events are defined by triggers.) As we discussed previously in this chapter, timers and lead status must be tied to a preceding <When Trig> statement. The same is true of the above four commands. For example, whenever you "Start" an action, always provide a reference to some line event with a preceding <When Trig> statement.

NOTE: The <Wait> statement should not be used with any of these commands. Use <Wait> only with <Send> and <Set Lead> to delay output.

<START> AND <STOP>

The <Start> and <Stop> statements can be used to filter events of interest: you let the HP 4951B do the watching for you. Define an event of interest in a preceding <When Trig> statement, and then "start" or "stop" the display, tape, or timers when that event occurs. Of course, no data is actually lost: line data is continuously filling the buffer.

Stop Display

The <Stop Display> statement freezes the display after the occurrence of some trigger event. That trigger event, and the immediately preceding data, are displayed on the screen. Note that the run is not stopped: the buffer is continually being filled with new data. To stop the run after the event, use <Stop Tests>.

Start & Stop Tape

The tape can be started and stopped only once during a program.

Start & Stop Timer

Timers measure intervals between trigger events. Always precede <Start> and<Stop> timer statements with a <When Trig> statement defining the event. Otherwise, your time measurements may not be accurate.

Stop Tests

The <Stop Tests> statement causes the analyzer to halt. No new data is loaded into the buffer or displayed, the tape stops, and any active timers stop. You can use this statement within a program to have the analyzer immediately stop upon finding some event.

Examples of Start and Stop

The first example below stops the run if there is a Negative Acknowledgment on the DTE line. Note that you enter the "NAK" by pressing the CNTL and "U" keys at the same time as indicated by the keycap. The second example freezes the display if there is a Frame Check Sequence error on the the DTE line.

```
Block 1:    When DTE NAK
              then goto Block 2
Block 2:    Stop Tests
```

```
Block 1:    When Error FCS on DTE
              then goto Block 2
Block 2:    Stop Display
```

<BEEP> AND <HIGHLIGHT>

Beep

The <Beep> statement provides an audible sound for some specified condition. You can have the analyzer beep anytime, and as often as desired.

Highlight

Use <Highlight> after a <When Trig> statement to mark trigger events in memory: characters, errors, lead or timer transitions. Highlighted characters appear in half-bright video both during run-time, and when looking at the buffer in <Exam Data> mode. Lead and timer transitions appear in the DCE line in <Exam Data> if you are not using <Data & State> display. The HP 4951B "remembers" the only the last 64 highlights in the buffer. Only the last character of a character string is highlighted.

Highlight examples are shown in Figure 6-6. Note that the clock timeout highlight is denoted by a small clock face symbol.

Examples of Highlight and Beep

The first example highlights the "z" in the "xyz" string whenever it occurs on the DCE line. The second example causes a continuous beep whenever the string "abc" occurs on the DTE line.

```
Block 1:    When DCE xyz
               then goto Block 2
Block 2:    Highlight
               then goto Block 1
```

```
Block 1:    When DTE abc
               then goto Block 2
Block 2:    Beep
               and then goto Block 1
```

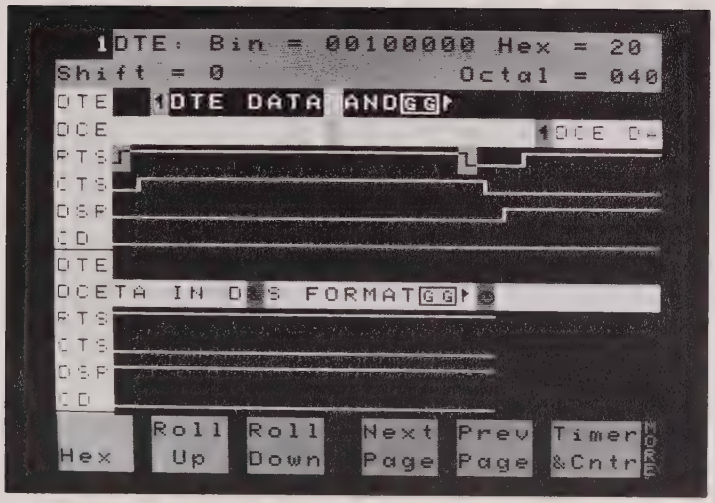


Figure 6-6. Highlights in the Buffer (Examine Data Menu)

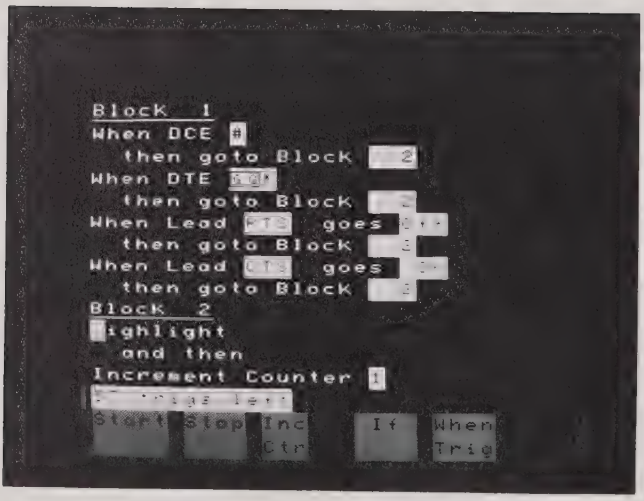


Figure 6-7. Portion of Program Producing the Display in Figure 6-6.

Transmitting Characters -- SEND

(Simulate only)

Using <Send>, you can simulate a DTE or DCE by sending any bit or character sequence in any of the codes supported by the HP 4951B. Maximum length for each string is 255 characters.

```
                        | Text
                        | Hex
                        | Binary
Send ------------------ | -------------- [input from the keyboard]
                        |    [MORE]
                        |
                        | Delete
                        | Insert
```

HANDSHAKING REQUIREMENTS ON THE INTERFACE

NOTE: DETERMINE WHICH INTERFACE LEADS MUST BE SET ON OR OFF BEFORE SENDING DATA. OTHERWISE, THE RECEIVING EQUIPMENT MAY NOT ACCEPT THE DATA.

The HP 4951B does not need to set control leads before sending data. However, the receiving equipment may require control signals before accepting the data you are sending. See page 6-31 for discussion of the <Set Lead> statement.

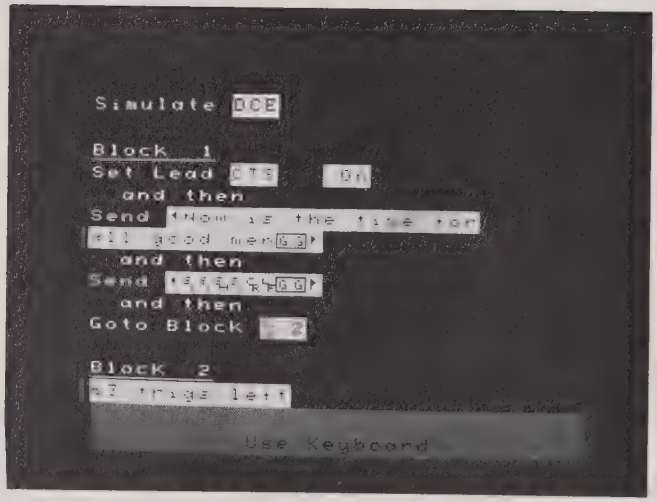


Figure 6-8. Sending Characters in Simulate

SELECTING SEND CHARACTERS

Use the <Text> softkey for keyboard characters. The SHIFT key accesses lower-case characters; and the CNTL key accesses control characters. You can see the binary or hex value by positioning the cursor over that character and pressing <Hex> or <Binary>.

NOTE: IN CHARACTER ORIENTED PROTOCOLS, YOU MUST EXPLICITLY ENTER SYNC CHARACTERS, SUCH AS SY SY. OTHERWISE, THE RECEIVING DEVICE WILL NOT RECOGNIZE THE MESSAGE.

When a Character is not on the Keyboard

EBCDIC and some other data codes have control characters which are not on the keyboard. Go to the table of data codes in the appendix and find the hexadecimal equivalent. Press the <Hex> or <Binary> softkey and enter that character from the keyboard.

Binary and Hex Characters

Use the <Hex> or <Binary> softkeys to enter hexadecimal characters or binary strings. Two hex numbers occupy each character position, requiring two keyboard entries. When you press <Binary>, eight binary bits are displayed, allowing you to enter a 1 or 0 in any BIT position from the softkeys. Once you move the cursor out of the binary string, it collapses to its hex equivalent.

Editing Strings

Use the <Delete> and <Insert> softkeys to edit a string. Press MORE to access these softkeys when the cursor is positioned in the string.

Sending Idles

During simulation, the HP 4951B continuously sends idles when not sending data. This is also true when using <Wait> to delay output. You can explicitly enter idles within text when simulating; but otherwise they are not stored in the buffer during normal monitoring or simulating.

Block Check Characters (BCC)

In character oriented protocols, the HP 4951B automatically appends the correct block check characters to <Send> strings. You can see these characters at run-time, or in the buffer after a run. In Char Async/Sync setup, you can select the characters on which error checking is to start and stop. **Start on** character starts error checking on the character following the designated character. **Stop on** character includes the designated character in the error check.

Flags and Frame Check Characters

Flags and frame check sequence (FCS) characters are automatically added whenever a bit oriented protocol (HDLC, SDLC, X.25) is selected in the Setup Menu. The HP 4951B does not show you the actual frame check character. For received data, **GG, BB,** or **AA** are displayed to indicate "good FCS", "bad FCS", or "abort". For Send strings, good FCS characters (**GG**) are automatically selected; but you may choose Bad FCS (**BB**) characters or Abort (**AA**) characters, either by moving the cursor to the frame check characters, or by pressing MORE and then the <End Frame> softkey. Flags and frame check characters disappear if you change the Setup to a character oriented protocol and again move the cursor into the string.

Parity Bits

In <Text> mode, the current setup determines the parity bit. In <Hex> or <Binary> mode, the current setup also determines the setup for 8-bit data codes (e.g., ASCII 8, EBCDIC). For less than 8-bit data codes (e.g., ASCII 7, Baudot), the parity bit is determined by the hex or binary entry. For example, assume the setup is ASCII 7 with odd parity. In the <Text> mode, if you enter an "E" in the send string, the transmitted binary code will be 01000101. The parity is 0 (left-most bit). To change the parity bit to 1, use <Binary> or <Hex> and enter 11000101 or C5.

NOTE: The run-time and Examine Data displays ignore the parity bit on transmitted data. In the above example, the run-time and examine data displays show an "E" even when you send C5. However, parity errors are detected on received data. When receiving a C5 with odd parity, the C5 appears as a blinking "E" in both displays; and the parity bit indicated in the examine data menu is 1.

Zero Bit Insertion

In bit oriented protocols, the HP 4951B automatically inserts a 0 after five consecutive 1's before transmitting non-flag characters (invisible to the user). When receiving, it automatically removes any 0 bits inserted by the transmitter. This is not true in Char Async/Sync setup.

Changing the Setup After Typing the String

If the data code or protocol are changed in the Setup Menu after typing a character string, you must retype the string. Characters in one code may not have the same meaning in another code. When you move the cursor to that character, the HP 4951B shows "**?**" if it cannot find the hex or text equivalent in the new code. The binary value of the character can always be viewed by pressing the <binary> softkey.

USING TIMERS WITH <SEND>

As always, timers measure intervals between trigger events. Each line event is "time stamped" as it is placed in the buffer. Timers are always referenced to the last preceding <When Trig> trigger statement.

As shown in the following examples, sync characters must be explicitly entered in character oriented protocols. Otherwise, the receiver will not accept the message.

This example is the correct way to measure the time it takes to send the string. The timer is activated by the preceding <When Trig> statement.

```
Block 1:    Send SY SY SX abcdefghijk EX
                and then goto Block 2
Block 2:    When DTE a
                then goto Block 3
Block 3:    Start Timer 1
            When DTE k
                then goto Block4
Block 4:    Stop Timer 1
```

This example is incorrect because the timer is not tied to a <When Trig> trigger statement. You can not measure the time it takes to send a string.

```
Block 1:    Start Timer 1
Block 2:    Send SY SY SX abcdefghijk EX
                and then
            Stop Timer 1
```

Controlling Interface Leads -- SET LEAD

(Simulate only)

In Simulate Mode, <Set Lead> turns on or off one of the RS-232C/V.24 or RS-449 leads. The HP 4951B always knows which pod is attached and displays the correct softkeys. With a RS-232C/V.24 interface, a lead is "on" when the voltage is high; it is "off" when the voltage is low. When simulating a DTE, you cannot control DCE leads, and vice versa: Only the appropriate softkeys are displayed, as shown below. (* indicates RS 449-leads). See Appendix C for more information.

	DTE		DCE
Set Lead	RTS (*RS) DTR (*TR)	Set Lead	CTS (*CS) DSR (*DM) CD (*RR)

LEAD STATUS DURING SIMULATION

NOTE: Determine which interface leads must be set on or off before sending data. Otherwise, the receiving equipment may not accept the data.

The HP 4951B must be programmed to control the leads in the simulate mode (this is the only time the HP 4951B controls the interface leads). At the beginning of a simulation run, the HP 4951B sets all the above interface leads off. You must actually turn these leads on with the <Set Lead> statement in order to do handshaking with a receiving device.

LEAD STATUS WHEN NOT SIMULATING

Lead status is independent of the HP 4951B except when it is simulating. Remember this when you use <If Lead> statement in a monitor program.

SET LEAD EXAMPLES

Because the HP 4951B always sets all five leads (DTR, RTS, DSR, CTS, CD) off at the beginning of the simulation run, <Set Lead> statements are needed to turn the appropriate leads back on before sending data. If this is not done, the receiving device might not accept data from the HP 4951B. You must know the handshaking requirements on your system in order to simulate correctly.

Simulate DTE

```
Block 1:    Set Lead DTR On
                and then goto Block 2
Block 2:    Wait 1000
                and then
            Set Lead RTS On
Block 3:    When Lead CTS goes On
                then goto Block 4
Block 4:    Send abcd
                and then
            Set Lead RTS Off
```

Simulate DCE

```
Block 1:    When Lead RTS goes On
                then goto Block 2
Block 2:    Wait 100
                and then
            Set Lead CTS On
                and then
            Set Lead CD On
                and then
            Send abcd
```

Delaying Output -- WAIT

(Simulate only)

WAIT CONTROLS OUTPUT

NOTE: THE <WAIT> STATEMENT CONTROLS OUTPUT ONLY.

Use <Wait> only with <Send> and <Set Lead> statements. <Wait> has no effect on program flow or timers.

DELAYING STRINGS OR LEADS

The <Wait> command can be set in 1 ms increments to cause delays of up to 65,535 ms. In combination with counters, very long delays can be set up. The following example repeatedly sends a string of numbers and then waits 50 ms.

```
Block 1:    Send 1234567
              and then
            Wait 50 msec
              and then goto Block 1
```

Error Messages

Max Length. This message appears if you attempt to specify more than 255 characters in a single string.

Max Strings. Appears if the Monitor and Simulate Menus combined contain strings which all together have a total of more than 2000 characters

Menu Full. Appears if the Monitor and Simulate Menus combined contain more than 143 steps.

Invalid Mon/Sim Menu. This may occur if you enter "When DTE/DCE" without completing the trigger branching instruction.

Status Messages (Current Mode of Entering Data)

Text. Enter a single keyboard character.

Hex. Enter two hex digits for a character.

Binary. Enter eight bits from softkeys. If the Setup data code is less than eight bits, the most significant bits are ignored.

End Frame. Enter the FCS character (good, bad, abort, don't care).

CHAPTER 7
THE RUN MENU

Except in Auto Configure, where the HP 4951B automatically goes into the run mode, use the Run Menu to execute all tests.

Monitoring On-Line

For a detailed description of monitoring on-line, see Chapters 2 and 6.

1. **Hookup**

   Connect the HP 4951B to the line to be monitored. See Chapter 2.

2. **Setup**

   Use Auto Configure, or the Setup Menus. See Chapters 4 and 5.

3. **Program the Monitor Menu**

   This step is optional. Go to the Monitor Menu and program any measurements you want the analyzer to make. See Chapter 6.

4. **Run Menu**

   In the Run Menu press <Monitor Line>. The HP 4951B displays the line data. Use the Setup Menus to change the display format.

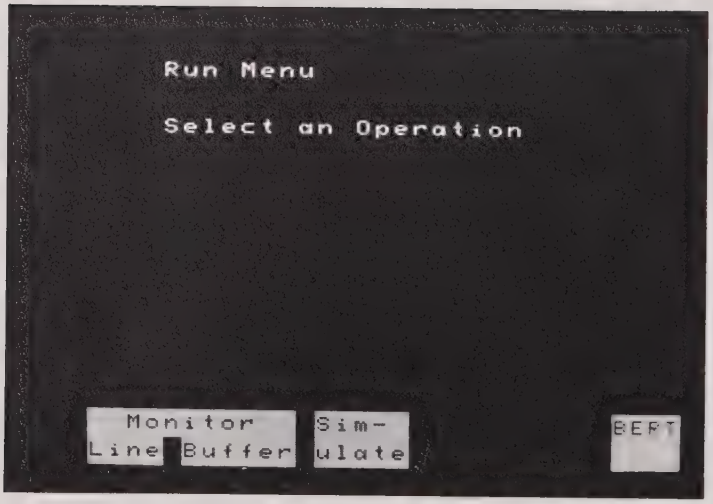


Figure 7-1. The Run Menu

Monitoring From Buffer

Running from Buffer is almost the same as running on-line.

1. Hookup

The HP 4951B need not be connected to the pod to monitor from buffer.

2. Load the Buffer

Load the buffer with data, either from the tape, or by running on-line. With the nonvolatile memory, previously loaded data can be used.

3. Setup

Use the Setup Menus. With the nonvolatile memory, previous setups are saved and can be used.

4. Program the Monitor Menu

Again, this step is optional: you may go right to the Run Menu. But one of the advantages of monitoring from buffer is that you can program the HP 4951B to run measurements over and over on the data in the nonvolatile buffer.

5. Run Menu

In the Run Menu press <Monitor Buffer>. The HP 4951B begins displaying buffer data and running any measurements you may have setup in the Monitor Menu.

Running Simulation

1. **Hookup**

   Substitute the HP 4951B for the DTE or DCE. See Chapter 2.

2. **Setup**

   Use the Setup Menus. See Chapter 5.

3. **Program the Simulate Menu**

   In the Simulate Menu, select either DTE or DCE. Using the softkeys, select the operations (e.g., Sending or Setting Leads) you want the HP 4951B to simulate. See Chapter 6.

4. **Run Menu**

   In the Run Menu press <Simulate>. To change the display format, go back to the Setup Menus.

Running BERT

Hook up the HP 4951B as a DTE. After the appropriate selections in the BERT menu, perform the BERT test by going to the Run Menu and pressing <BERT>. See Chapters 2 and 9.

Run-Time Softkeys

Softkeys and messages shown at the bottom of the display during run-time are:

```
Hex        Stop Disp        Block = n        Summary
```

Hex/Text. Pressing <Hex> converts all subsequent displayed data to hex format. The softkey label then changes to <Text> for changing the display back to the current data code.

Stop Display/Start Display. The <Stop Display> softkey alternates with <Start Display>. The <Stop Display> softkey freezes the display, and <Start Display> causes the most recent incoming data to be displayed. These do not affect the run, but the continuity of the run-time display may be lost.

Block = n. Message indicating which 2K bytes of memory (1 to 16) is being displayed. When memory wraparound occurs, the next 2K block to be loaded becomes Block 1. (When viewing the buffer after run-time with Examine Data, the oldest data becomes Block 1. In Examine Data, block numbers may go as high as 128 if the buffer data has been loaded from tape.)

Summary/Data Display. These alternate to show either data or the Setup Summary. Press <Summary> at anytime, without affecting the run, to review the current setup and observe the counters and timers (see Figure 7-2). The summary tracks the current Setup Menu. Timers are updated whenever a trigger is found. Counters are updated every 1/2 second. Counters automatically roll over at 9999 to 0. Press <Data> to return to the data display.

Run-Time Messages

Running. Message indicating data is being processed.

No Pod Attached. An interface pod must be attached in order to run BERT, Auto Configure, Simulation, and Monitor on-line. No pod is necessary to Monitor from Buffer.

Buffer Overflow. Data has filled the buffer and will begin to overwrite data that has not yet been processed. This can occur when storing data directly from the line to tape, or when incoming speed is higher than specified.

Receiver Overrun. The hardware capability to process serial input is being exceeded. Typically, this may occur at line speeds greater than 30 kbps in character oriented protocols, and speeds greater than 64 kbps in bit oriented protocols.

Invalid Monitor/Simulate Menu. This occurs because of incomplete <When> or <If> statements. For example, if you do not finish the statement "When DTE".

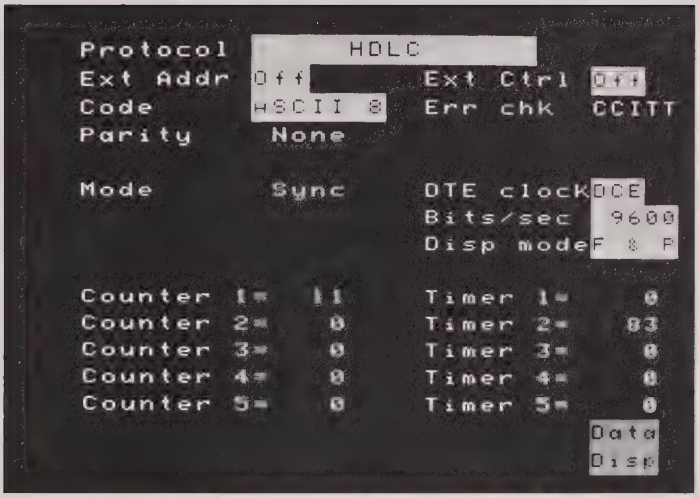


Figure 7-2. The Setup Summary Display

Displaying Data

Five display formats are available. Use the Setup Menus to change the display format. Figures 7-3 to 7-7 show examples of each format.

DTE	DTE data only. Displayed in regular video.
DCE	DCE data only, Displayed in inverse video.
Two Line	DTE over DCE. DCE data is displayed in inverse video.
Data & State	DTE over DCE data, and timing diagrams of four interface leads.
Frame & Packet	Decodes bit oriented frames. Decodes X.25 packets in the Examine Data Menu (see Chapter 8 for a definition of terms).

FULL DUPLEX AND HALF DUPLEX DATA

See Figures 7-8 and 7-9 for examples of full duplex and half duplex data. On half duplex data, the HP 4951B displays complete DTE messages alternating with complete DCE messages. On full duplex data, the HP 4951B displays the individual characters according to the timing order in which they are received.

BLINKING CHARACTERS

Blinking characters indicate failed error checks: BCC, FCS, parity, or framing errors resulting from incorrect setup or loss of synchronization. See Chapter 8.

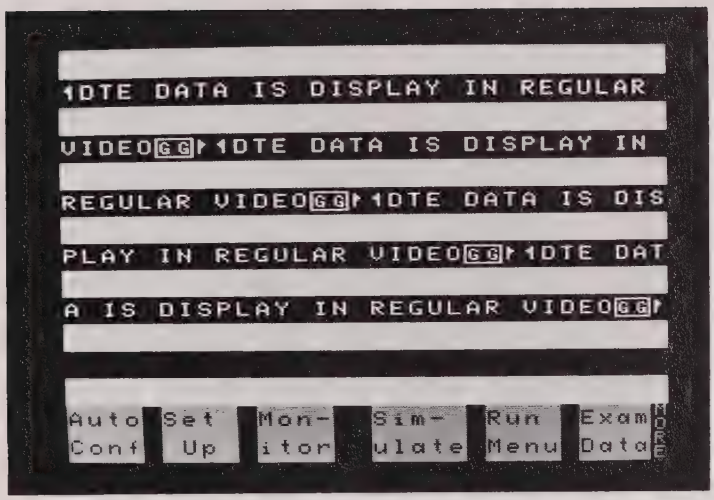


Figure 7-3. DTE Display Format

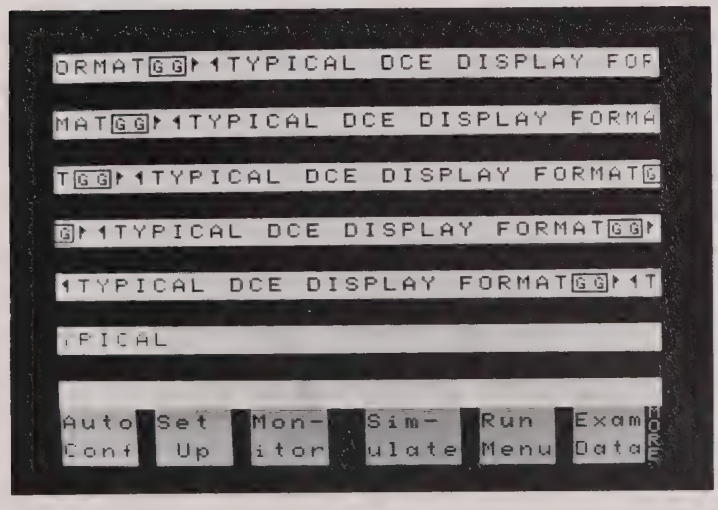


Figure 7-4. DCE Display Format

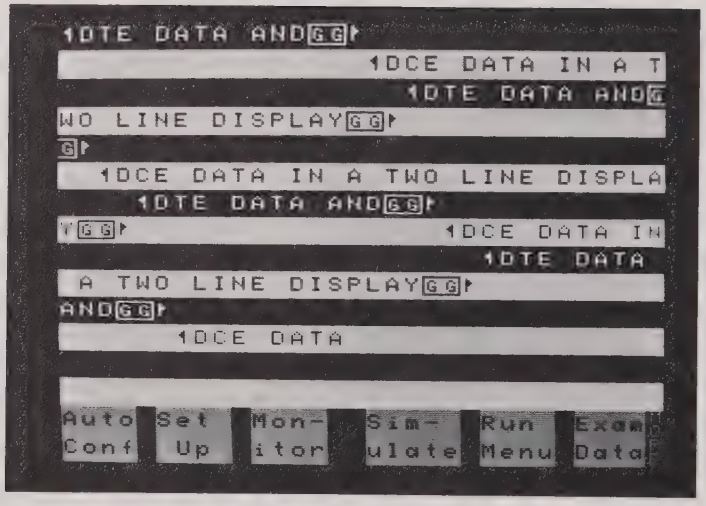


Figure 7-5. Two Line Display Format

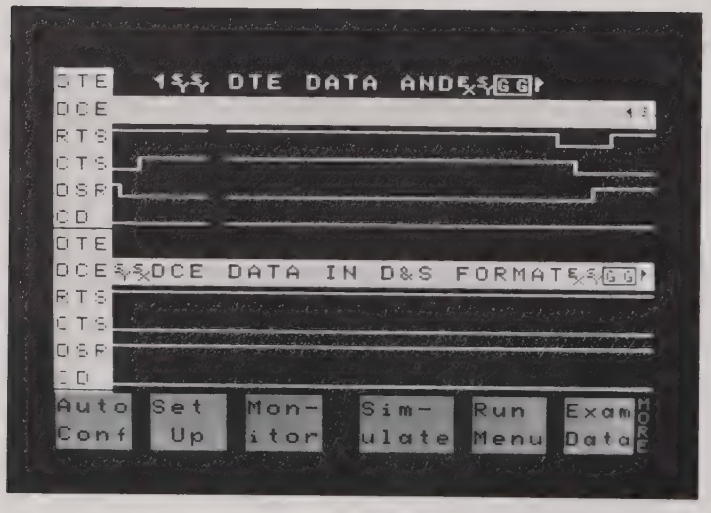


Figure 7-6. Data & State Display Format

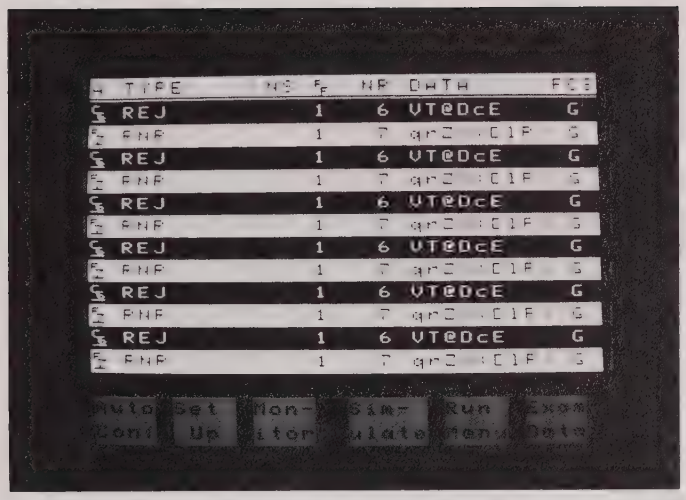


Figure 7-7. Frame & Packet Display Format (See Chapters 5 and 8 for definitions)

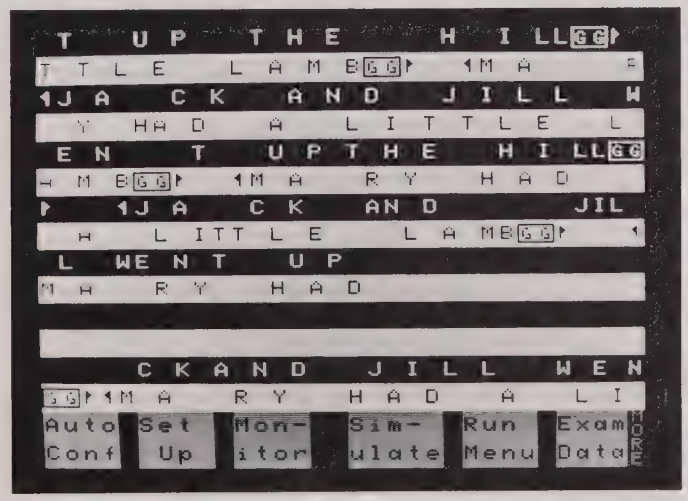


Figure 7-8. How Full Duplex Data Looks (See page 7-8)

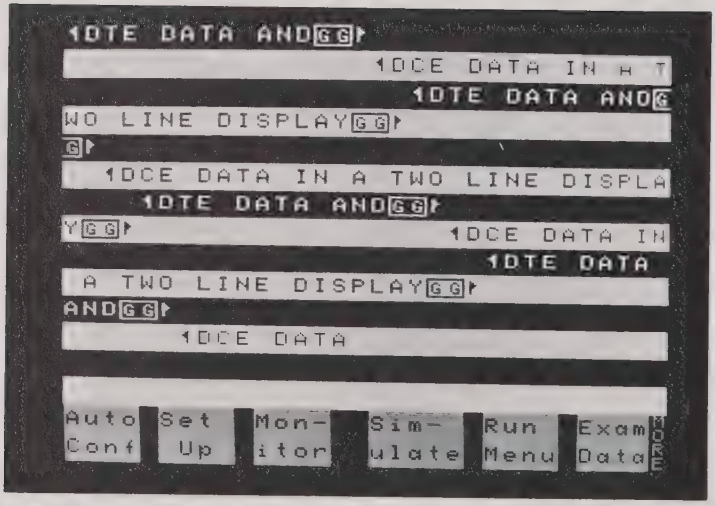


Figure 7-9. How Half Duplex Data Looks (See page 7-8)

CHAPTER 8
THE EXAMINE DATA MENU
Viewing the Buffer

Press <Exam Data> on the Top Level Menu to look at the buffer after run-time. Note how this differs from Monitoring On-line, Monitoring From Buffer, or Simulating: In all these, you are looking at the buffer during run-time; you can stop the display, but you cannot go backward. The Examine Data Menu lets you scroll through the entire 32 Kbyte buffer.

WHAT IS STORED IN THE BUFFER

Most line activity is stored in the buffer. This is what makes it possible for the HP 4951B to post-process data (monitor from buffer). The following are stored:

1. DTE and DCE characters.
2. Lead changes on the five interface leads. Select Data & State display format or use the highlight feature in the Monitor and Simulate Menus.
3. Errors, such as parity, BCC, and FCS.
4. Frame markers and packet markers.
5. Time marks and lead status.

HOW TO LOAD THE BUFFER

The buffer is always being continually loaded with data when monitoring on-line or simulating. The buffer can also be loaded from tape.

Uses for the Examine Data Menu

Viewing Timers and Counters after a run. The Examine Data Menu lets you look at the final state of the timers and counters after a run. The timers and counters will only be reset if (1) Another run is started; (2) <Reset> is pressed; or (3) Before load operations from tape.

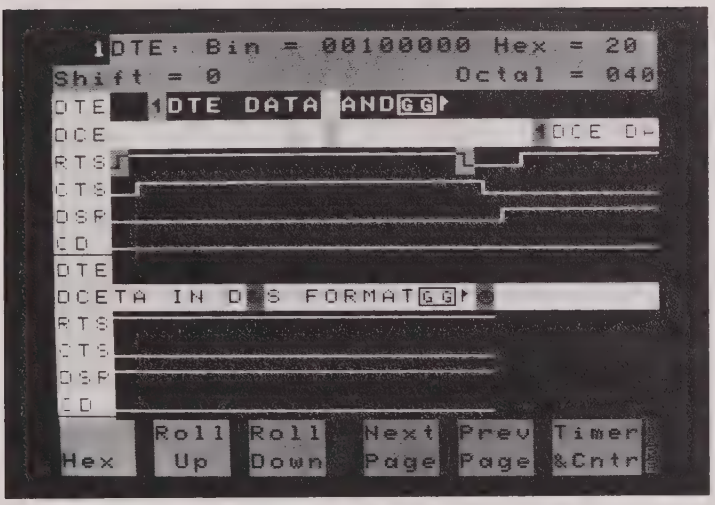
Viewing the Entire Buffer. During run-time you can stop the display; but you can't go back and look at what you've missed. The Examine Data Menu enables you to go back after a run and scroll through the buffer.

Bit Shifting. If the framing is off because the sync characters are unknown, use the bit shift softkey in the Examine Data Menu to realign the bits until the data becomes meaningful. See page 8-9.

Decoding Characters. Move the cursor to any character and observe the binary, hex, and octal equivalents at the top of the display. You can also see the parity bit for any character.

Decoding Packets. In X.25 setup and Frame & Packet display format, the HP 4951B will decode packet headers simultaneously with control field information in the Examine Data Menu. See page 8-6 for an illustration and description.

Decoding High Level Protocols. If the data contains other higher level protocol information (e.g., ISO levels 4-7, or SNA), the relevant fields can be read from the hex/octal/binary decoding at the top of the display.



Hex	Roll Up	Roll Down	Next Page	Prev Page	Timer &Cntr

MORE

Spec. Block	Next Hilit	Bit Shift

Figure 8-1. Buffer Display in Examine Data Menu (Data & State Display Format)

Softkeys

Hex/Text. Displays buffer data in either the code selected in the Setup Menu, or in hexadecimal.

Roll Up/Roll Down. For scrolling through the buffer.

Next Page/Prev Page. For moving from one display-full of data to another. A page is one full display of information.

Timers & Counters. You can at any time look at a summary of the Setup parameters, as well as the status of the timers and counters at the end of the last run.

Specify Block. For specifying any 2 Kbyte block. The block number indicates the first character's position in the buffer. Some buffer information, like time marks, is not displayed, so <Next Page> may cause the block number to jump by several numbers. Buffer data loaded from tape may have block numbers as high as 128.

Next Highlight. The <Highlight> softkey in the Monitor or Simulate Menus lets you mark trigger events. This softkey lets you move to the next highlighted event.

Next Segmt/Prev Segmt. With this feature you can examine the tape like the buffer. These softkeys will load either the next or the previous 16 Kbytes from tape into the buffer for observation. Appears only when you have loaded a tape file.

Bit Shift. Shifts framing of the displayed characters one bit at a time. Use this softkey to find the correct framing of unknown protocols (see page 8-9). The parity bit is not shifted. Appears only in character oriented setups.

Displaying Data

The same five formats available during run-time are available. See Figures 7-3 to 7-7.

DTE	DTE data only. Displayed in regular video.
DCE	DCE data only, Displayed in inverse video.
Two Line	DTE over DCE. DCE data is displayed in inverse video.
Data & State	DTE over DCE data, and timing diagrams of four interface leads.
Frame & Packet	Decodes bit oriented frames. In the Examine Data Menu only, decodes X.25 packets. See page 8-6.

HOW SETUP AFFECTS DISPLAY

In some display formats you may not be able to observe the buffer data. For example, with frame & packet format, you cannot see BSC data. Data & State format always shows any data in the buffer, even when it consists only of lead transitions.

BLINKING CHARACTERS

Blinking characters indicate failed error checks: BCC, FCS, parity, or framing errors resulting from incorrect setup or loss of synchronization. See page 8-8.

X.25 in Frame & Packet Display Format

X.25 looks the same as HDLC or SDLC when running in the frame and packet display format. After capturing data, however, the Examine Data Menu shows both frame decoding and packet decoding. As shown on the next page, packet information at the cursor location is decoded at the top of the display. The following packet information is displayed. See Appendix E for more details.

Q-Bit	Qualifier Bit.
D-Bit	Delivery Confirmation Bit.
MOD	Modulo 8 or 128.
LCN	Logical Channel Number.
TYPE	Type of packet. Displayed below DTC or DCE.
P(S)	Packet Send Sequence Number.
M-Bit	More Data Mark.
P(R)	Packet Receive Sequence Number.
Data	Displays the first five characters of the data field.

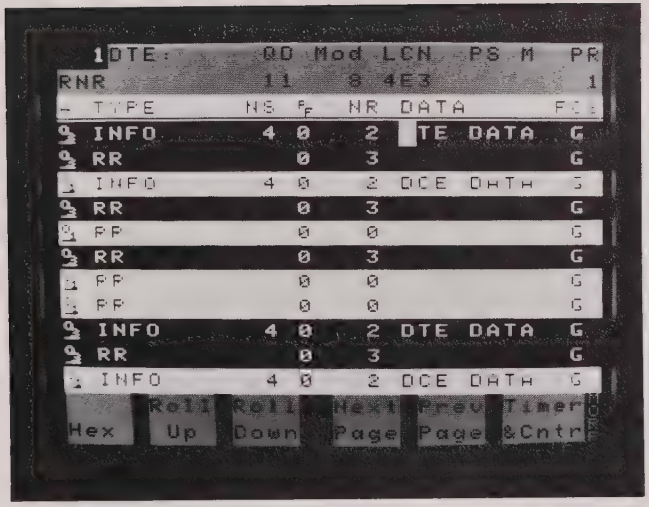


Figure 8-2. Decoding X.25 Packets with Frame & Packet Format

Finding Unknown Protocols

Use the Examine Data Menu in conjunction with the Char Asyn/Syn Menu to determine the parameters of unknown protocols. See also page 5-19.

Use Auto Configure as a Starting Point

Use Auto Configure to find at least some of the parameters and give you a starting point.

Set up the Char Async/Sync Menu

Set up the Char Asyn/Syn Menu to capture all the data on the line, including idles.

1. If you know the data code, **Sync on** idles. Otherwise, sync on FF or 00. Most character oriented protocols idle in FF. Some IPARS circuits idle in 00.

2. **Drop sync** 0 **chrs after** none. Now you never drop sync and thus take in all the data.

3. If you do not know the data code, initially use a data code with no parity of the same character frame size as was found by Auto Configure. See page 8-10.

Use the Examine Data Menu

Monitor the line to capture some data in the buffer.

1. In the Examine Data Menu, try bit shifting. If the data still does not make sense, go back to the Setup Menu and try another data code with no parity of the same character frame size. Because the HP 4951B does not shift through the parity bit, select a data code with no parity (see page 8-10).

2. Try data codes of a different size.

3. When you are able to identify the idles, change the **Sync on** to the two sync characters immediately following the idles. Change **Drop sync after** to the idle character.

4. If **bit sense** is inverted or **bit order** reversed (e.g., IPARS), you may need to go back and capture some new data with these two parameters changed.

5. Parity, block check, and frame check errors are indicated by blinking characters. Character frame length is affected both by the data code and the error checking. For example, ASCII 7 with odd parity uses an 8-bit character frame; whereas ASCII 8 with odd parity uses a 9-bit frame. See page 8-10.

Data Code	No Parity	Even or Odd Parity	Ignore Parity
Hex 5 Baudot	5 bits (no parity bit)	6 bits (including parity bit)	6 bits (parity bit = 0)
Hex 6 EBCD IPARS Transcode	6 bits (no parity bit)	7 bits (including parity bit)	7 bits (parity bit = 0)
Hex 7 ASCII 7	7 bits (no parity bit)	8 bits (including parity bit)	8 bits (parity bit = 0)
Hex 8 ASCII 8 EBCDIC	8 bits (no parity bit)	9 bits (including parity bit)	9 bits (parity bit = odd)

Figure 8-3. Frame Sizes vs Data Codes

Error Messages

No data in buffer -- Use EXIT key to exit. This occurs if the buffer is empty when you go to the Examine Data Menu. Monitor On-Line, or load from the tape to fill the buffer.

No displayable data in buffer for the selected display format. This indicates that the buffer contains non-displayable data, such as lead transitions. Use Data & State display format to see the lead transitions.

Tape removed during a Read operation. When you remove the tape during a load operation.

Tape read error: buffer data invalid. This may be caused by a broken tape controller, or by a worn out tape.

End of valid data. When you scroll to the end of buffer data.

Start of valid data. When you scroll to the beginning of buffer data.

No more highlights. When you press the <Next Hilit> key and there are no more highlights.

End of tape file. When you specify a block beyond the last block on tape.

CHAPTER 9
BIT ERROR RATE TESTS (BERT)
Definitions

Bit Error Rate Tests (BERT) measure digital noise: how often "highs" are changed to "lows", and vice versa

PRBS (Pseudo Random Bit Sequence). A BERT tester generates pseudo random bit sequences from a shift register of length L, where the sequence length is $N = 2^{\wedge L} - 1$ bits. A PRBS may be of any length, but certain pattern lengths have become standard. The HP 4951B uses PRBS lengths of 63, 511, or 2047.

Bit Error Rate. The number of bit errors divided by the number of bits received.

Blocks. Bit error rate does not give any idea of error distribution. For example, if most errors occur within a few moments of each other, it might indicate that the line was all right, but had perhaps been affected by a lightning hit or path switch. For this reason, bits are grouped in blocks for measuring block error rate.

NOTE: BERT "blocks" are not to be confused with the blocks used in other HP 4951B menus.

Block Error Rate. The number of block errors divided by the number of blocks received. Whether there is one error, or ten errors in a block, it is still counted as one block error.

Block Sizes. The Bell system uses a block size of 1000 bits. CCITT, the world-wide standard, uses a block size equal to the pattern size. For example, if the PRBS pattern is 511 bits, then the block size would also be 511 bits.

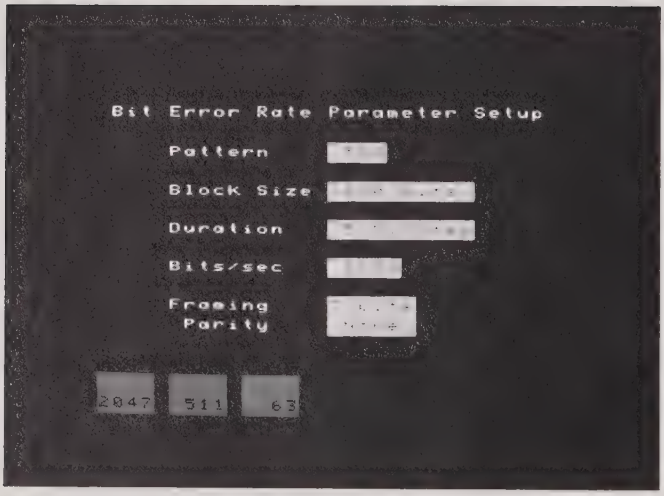


Figure 9-1. The BERT Menu

BERT Menu Softkeys

BERT Menu selections are shown on page 9-4. (Press BERT on the Top Level Menu).

Pattern. Three PRBS pattern lengths are available: 2047, 511, and 63 bits.

Block Size. Two selections are available: 1000 bits and CCITT specification. The 1000-bit block size is used in the US; and CCITT is used in other countries. When CCITT is selected, block size is always the same as pattern size.

Duration. You can select the length of the test either as a time interval, or as the number of bits sent. For later comparison, test durations must be the same.

Bits/Sec. Notice the Bits/Sec selections are different from the other menus.

Framing. Framing means that you will send standard asynchronous characters with one start bit and two stop bits. Thus, the frame size is equal to the start and stop bits, plus an optional parity bit, plus the selected character size. To select framing, choose the size of the data character (5, 6, 7, or 8 bits). An optional parity bit may be added immediately after the data character, before the two stop bits. Each frame alternates with an idle (high) time which is the same length as the frame. If you don't want framing, press <None>.

Parity. If you select framing, three new softkey choices appear. You can select odd or even parity, or have no parity bit at all.

BERT Menu Selections

Pattern

[2047]
[511]
[63]

Block Size

[1000 bits]
[CCITT spec]

Duration

[10^4] [10^9]
[10^5] [5 min]
[10^6] [10 min]
[10^7] [15 min]
[10^8] [Cont]

Framing

[None]
[5 bits]
[6 bits]
[7 bits]
[8 bits]

Parity

[None]
[Odd]
[Even]

Bits/sec

[19200]	[3600]	[200]
[9600]	[3200]	[134.5]
[7200]	[*2000]	[110]
[4800]	[1800]	[75]
[2400]	[600]	[50]
[1200]	[300]	[EXT]

* 2000 works only with framing

Running a BERT Test

Run Menu. After you have entered the test parameters in the BERT Menu, press <Run Menu>. In the Run Menu press <BERT>.

Data Screen. When you press <BERT> in the Run Menu, a run-time data screen continuously displays test progress. The data screen shows elapsed seconds since synchronization, number of bits and blocks sent, number of errors found, and the number of errored seconds.

Completion of a Test. When a receiving BERT tester receives all the bits required for the test, or when you press EXIT, the receiver stops the test. The transmitter continues to transmit, ensuring that the other receiver gets all needed test bits.

% Error-free Seconds. When the receiver is finished, or when you press EXIT, the % error-free seconds is computed.

Exit Key. EXIT halts reception. Press EXIT again to return to the Top Level.

Setup Summary. During a test, press <Summary> to look at the setup parameters without stopping the test. To change any of the setup parameters, stop the test by pressing EXIT twice and re-enter the BERT Menu.

Data Screen Definitions

Elapsed Seconds. Elapsed time since receiver synchronization.

Errored Seconds. Tells how many of the elapsed seconds had error occurrences.

% Error-Free Seconds. Errored Seconds divided by Elapsed Seconds. Displayed at the end of the test.

Block Count. Tells how many blocks have been sent thus far in the test.

Block Errors. Tells how many blocks had at least one error. Divide block errors by block count to get Block Error Rate.

Bit Count. The number of actual data bits sent since synchronization (excluding framing, start, stop, and parity bits).

Bit Errors. Divide bit errors by bit count to get Bit Error Rate.

Inject Error. Press <Inject Error> at any time during the test. The receiver at the other end should indicate one bit error. This function can be used at the beginning of the test to check for proper hookup.

Inject 10 Errors. This is a way of sending a burst of errors. The receiver at the other end should have counted ten bit errors, one or two block errors, and one or two errored seconds.

Requirements

SYNCHRONIZATION

Unless the BERT receiver is synchronized to the transmitter at the other end, the receiver has no way of knowing whether the next bit in the received PRBS pattern is correct. You should use BERT testers equivalent to the 4925B which have the following characteristics:

(1) For unframed patterns, the speed of the clock generating the transmitter pattern must be within 1% of the clock generating the receiver pattern.

(2) With framing, the clocks should be within 5% of each other.

HANDSHAKING

For BERT testing the HP 4951B simulates a DTE. At the beginning of the test, the HP 4951B sets the RTS and DTR interface leads "on" (For-RS 449 interfaces, it sets RS and DS on).

Error Messages

There are two possible error messages (both faults are automatically recoverable).

Out of lock -- data fault: The tester couldn't synchronize at the beginning of the test because of a wrong pattern, or the absence of data.

Out of lock -- sync loss: The tester lost synchronization during the test.

Examples

EXAMPLE 1: End-to-End Testing

Two BERT testers are connected to opposite ends of the line. Each BERT tester contains both a transmitter and a receiver, making it possible to check both send and receive channels simultaneously. The transmitter at each end is essentially a PRBS generator; the receivers are pattern checkers.

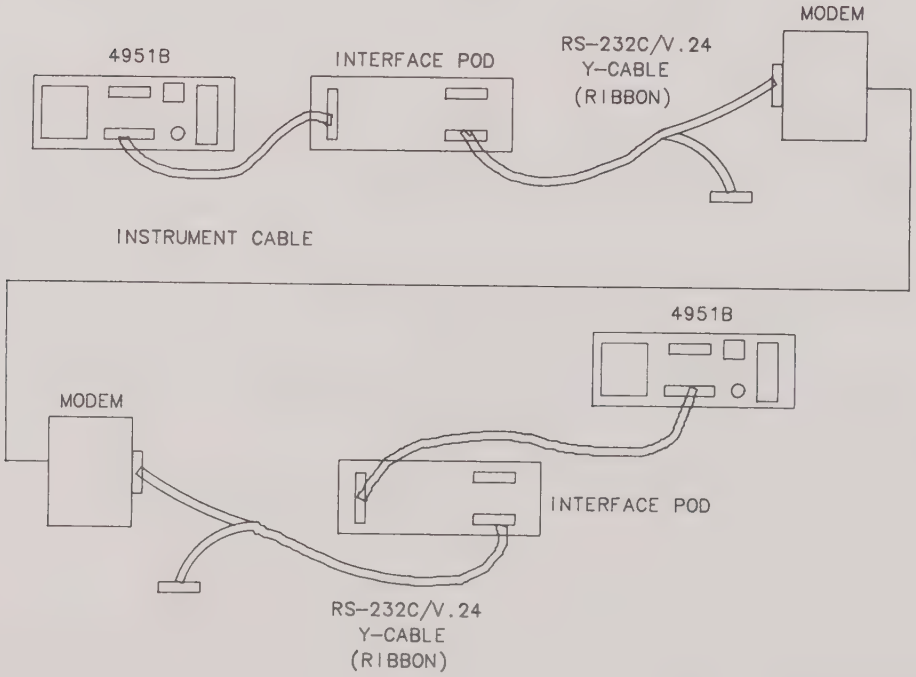


Figure 9-2. End-to-End Testing

EXAMPLE 2: Loopback Testing

If you have only one BERT tester, you can loop back at the other end. The BERT tester sends on one channel, and receive its own transmission on the other channel. Remember, if you loop back, you will be adding together the errors on both the send and receive channels: one channel may contain many more errors than the other channel.

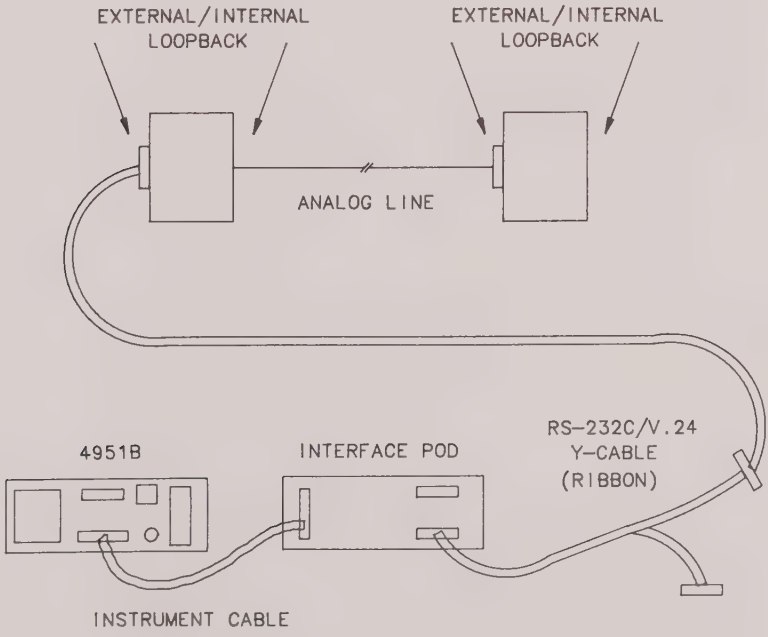


Figure 9-3. Loopback Testing

OTHER TESTS

Some BERT testers (such as the HP 4925B) perform the following character error checking besides BERT tests.

Quick Brown Fox Tests

The "Quick Brown Fox" message (or any message) tests the ability of terminals to receive messages. Use the Simulate Menu to run this test. The HP 4951B also checks parity errors. See Appendix F.

Startup Tests

The HP 4951B does many types of start-up tests, such as RTS - CTS delay. Use the Simulate Menu. See Appendix F.

CHAPTER 10
THE REMOTE MENU

Remote Operations

The HP 4951B can transmit and receive menus and buffer memory remotely to an HP 4951B, an HP 4955A, or an HP 4953A. For remote operations, the HP 4951B must be executing in the Remote Menu. The controller must successfully execute the **Slave's ID** operation before remote transfers can begin.

PROCEDURE

1. Connect both slave and controller to **asynchronous** modems via the RS-232 connector on the rear panel or through the interface pods. (See page 10-8 if you are not using modems).

2. At both sites go to the **Remote Menu** and select <Controller> or <Slave>.

3. Select the same **Bits/sec** for both slave and controller. When using an HP 4955A or HP 4953A as a controller, select the same address for slave and controller.

4. Select **<Slave's I.D.>** operation at the controller.

5. Press **<Execute>** at the slave, and then at the controller.

6. After establishing modem communication, at the controller site again <Execute> the <Slave's ID> operation. This is necessary to synchronize remote transfers.

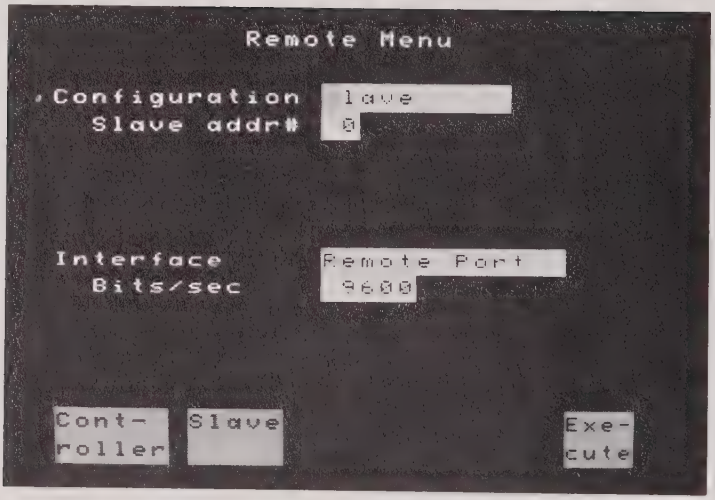


Figure 10-1. Remote Menu -- Slave Configuration

Using the HP 4951B as a Controller

CONTROLLER OPERATIONS

As a Controller, the HP 4951B downloads menus and data to the Slave. The HP 4951B can also receive uploaded information from the Slave.

Upload Menus. Receives setup, monitor, simulate, and run menus from the slave.

Upload Data. Receives buffer data from the slave. You must specify the correct block limits in the slave: Start Block n1, End Block n2.

Upload Appl. Receives an application program from the slave's Application Memory.

Download Menus. Transmits setup, monitor, simulate, and run menus to the slave.

Download Data. Transmits buffer data to the slave.

Download Appl. Transmits an application program from its Application Memory to that of the slave.

Slave Status. Requests the slave to transmit its current status.

Slave ID. Necessary to initiate and synchronize remote transfers after hookup. The slave transmits "HP 4951".

REMOTE MENU -- CONTROLLER CONFIGURATION

Configuration Controller

Operation

[Upload Menus]
[Upload Data]
[Upload Appl]
[Slave Status]
[Slave ID]
[Download Menus]
[Download Data]
[Download Appl]

Start Blk [ ] **End Blk** [ ]

Interface [Pod] or [Remote Port]

Bits/sec

[9600] [4800]
[2400] [1200]
[600] [300]
[200]

Status

Operation executing
Operation successful
Slave rejected operation
Slave not responding

Using the HP 4951B as a Slave

HP 4951B SLAVE RESPONSES

A slave HP 4951B responds to any of the previously listed commands from a controller HP 4951B. When in the remote menu, a slave HP 4951B transmits or receives menus, data, or application programs to the controller. Also, any error condition which occurred during the transfer can be obtained by the controller **Slave Status** controller command.

HP 4955A AND HP 4953A CONTROLLER COMMANDS

Application programs cannot be transferred between an HP 4955A or HP 4953A and a HP 4951B. Other than this exception, a HP 4951B responds to all the above commands from a Controller HP 4955A or HP 4953A.

The following operations are different when an HP 4955A or HP 4953A controls a HP 4951B Slave.

Upload Timers & Counters

Upon receiving this command from an HP 4955A or HP 4953A controller, a slave HP 4951B uploads the status of its timers and counters.

Address

The HP 4955A or HP 4953A specifies an address in all controller commands. The slave address must be selected to be the same. The address does not matter in operations between two HP 4951B's.

REMOTE MENU -- SLAVE CONFIGURATION

Configuration Slave

Slave Addr # [Use Keyboard] (Only HP 4955A's or HP 4953A's can request an address)

Interface [Pod] or [Remote Port]

Bits/sec
[9600]
[4800]
[2400]
[1200]
[600]
[300]
[200]

Status
Operation executing
Operation successful
Slave rejected operation
Slave not responding

Ending Remote Operations

To stop execution of any remote operation, press EXIT. If you press EXIT again the HP 4951B displays the following message:

To Disconnect the Remote Link,
press the HANG UP softkey,
otherwise press EXIT

Pressing EXIT returns you to the Top Level Menu. You can then go back to the Remote Menu at any time and perform any operation.

Pressing <Hang Up> turns off DTR.

If you press <Hang Up>, you must re-enter the Remote Menu and again press <Execute> at both ends of the line to raise DTR.

Handshaking Requirements

OPERATIONS WITH ASYNCHRONOUS MODEMS

NOTE: Only asynchronous modems can be used for remote transfers.

In remote operations, the HP 4951B is configured as a DTE. The following handshaking convention is used. (See also page 10-1).

1. DTR is turned on when you press <Execute>. You must press <Execute> at both ends of the line. The HP 4951B then waits for DSR to go on.

2. The HP 4951B then sets RTS on and waits for CTS and CD to go on.

OPERATIONS WITHOUT MODEMS

The HP 4951B is configured as a DTE for remote operations. If two units are connected directly without modems, one unit must be configured as a DCE. For applications with no modem, use a modem eliminator cable such as the RS-232C/V.24 printer cable M/M (HP # 13242G). You may also open all the breakout switches except pin 1 on one of the pods, and jumper the following pins: 2-3, 4-8, 5-6-20.

Slave Error Messages

Buffer Size Too Small. The controller is trying to download too much.

Start block# must = first. The controller has not specified the first block in the slave buffer. Note that the first block may not be "1" if the buffer data has been loaded from tape.

No data in requested blks. The controller has requested data from empty blocks.

Buffer empty. The slave buffer is empty.

Conversion error: menus reset. This might occur if the menus being transferred are invalid.

Menus incompatible with HP 4951B. This might occur for certain menus created by a HP 4955A or HP 4953A.

Modem handshake fails. The controller RTS, CTS handshaking has failed

Invalid Mon/Sim Menu. This can occur if you say "When DTE/DCE" and then do not specify a trigger.

Operation not valid for HP 4951B. The operation is one that only a HP 4955A can perform.

Issue ID request to enable slave. You must always <Execute> this operation immediately after establishing phone communication in order to synchronize remote transfers.

CHAPTER 11
THE MASS STORE MENU

Introduction

The tape drive is optional (Option 001): you may buy the HP 4951B with or without a tape drive.

WHY USE THE TAPE?

Because of the versatile triggering capability of the HP 4951B, you can usually find a problem before using all the memory. However, the tape drive has several advantages:

1. Store data directly from the line onto tape; this increases your buffer memory 16 times (see page 11-8).

2. Save all the menus and the buffer data for future reference. In the BERT Menu only the setup (not the results) is saved.

3. Use the tape like a large buffer. The HP 4951B nonvolatile buffer memory holds 32 Kbytes of data. A tape cartridge holds up to 512 Kbytes. Using the <Next Tape Segmt> and <Prev Tape Segmt> commands in the examine data menu, you can scroll through the tape.

4. Transfer menus and data between a HP 4951B and a HP 4955A or HP 4953A. HP 4951B tapes are compatible with HP 4955A or HP 4953A tapes.

5. Load application programs using the tape.

HOW TO USE THE TAPE DRIVE

Type of Cartridges

Specify HP 98200A to order a set of five certified blank cartridges.

Care of Cartridges

If the cartridge is placed near a strong magnetic field, some data on the tape may be lost. If many Time and Sync errors occur during tape load and store operations, use the <Tension> softkey in the Mass Store Menu; also check the tape drive for a dirty tape head.

Inserting Cartridges

Insert the tape cartridge with the RECORD slide located to the top right.

The RECORD slide is used to protect previously recorded tapes from being overwritten. To store data to tape, push the slide in the direction of the arrow. You may load (read) from the tape with the slide in either position.

Compatibility

Data and Menu files developed on the HP 4955A or HP 4953A are compatible with the HP 4951B.

The Mass Store Menu

The Mass Store Menu is used for tape operations. You cannot use this menu if you do not have the optional tape drive installed. The following softkeys appear when you press <Mass Store> in the Top Level Menu:

```
Tension    Initialize    Catalog    Load    Store
```

TENSION

Rewinds the tape to the correct tension. The tape is first rewound, then fast-forwarded, then rewound. This may be used if the tape is noticeably slack or if a large number of read errors are occurring (See page 11-10 for tape error messages). You can do other operations, such as menu setup, etc., while the tape is tensioning.

INITIALIZE

Erases the tape directory and formats the tape with a new directory. This must always be used for blank tapes. Do not initialize any tape you want to keep. Initializing erases the tape directory and you irrevocably lose any information on that tape.

CATALOG

The catalog operation displays the tape directory giving File Name, File Type, and a Comment field. Five file types are possible:

DATA	Both buffer data and menus (setup, monitor, simulate, BERT).
MENU	Consists of menus only (setup, monitor, simulate, BERT).
BDAT	Buffer data only. This HP 4955A or HP 4953A file type may be loaded into a HP 4951B.
APPL	Only HP 4951B application files can be loaded.
BASI	This HP 4955A file type may not be loaded into the HP 4951B.

Notice that only two types of files are generated by the HP 4951B: DATA and MENU. Data type files always contain both data and menus. Menu type files contain only menus. The HP 4951B loads BDATA files which have been generated by the HP 4955A or HP 4953A.

The **Comment** field is 32 characters long, but only the first 17 are displayed. All 32 are displayed on the HP 4955A or HP 4953A.

Group File Names

The HP 4955A or HP 4953A allow Group file names, but the HP 4951B ignores them. If two files generated by a HP 4955A or HP 4953A have the same file name (but belong to different groups), the HP 4951B lists both files in the catalog. Only the first file listed can be loaded.

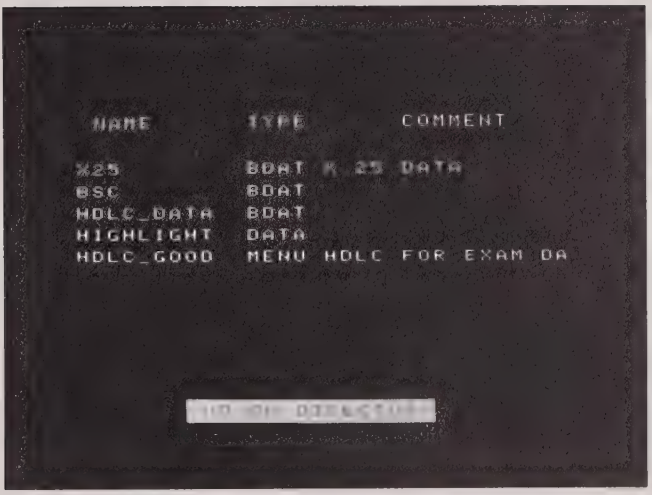


Figure 11-1. A Catalog Listing

Loading Data From Tape

HOW TO LOAD DATA INTO THE BUFFER

Insert the tape cartridge into the tape slot. Press <Catalog> in the Mass Store Menu to see how the file is listed on the tape. Press <Load> and type in the file name as it is listed in the catalog. Press <Execute> to load the file into the memory. The HP 4951B accepts all HP 4955A or HP 4953A file types except Basic and HP 4955A or HP 4953A applications.

Menu Changes

CAUTION

Do not perform the load operation if you want to save present menu setups.

Unless the file is of type BDAT (HP 4955A, HP 4953A), the HP 4951B menu setups are changed by the load operation. The Setup, Monitor, Simulate, and BERT setups are all modified to the new values. You must first store these menus to another tape if you want to save them.

LOADING FILES LARGER THAN THE BUFFER

When loading a tape file that is too large for the buffer the softkeys <Next Tape Segmt> and <Prev Tape Segmt> are automatically displayed in the <Exam Data> menu. You can scroll through the rest the file by using these softkeys. These softkeys scroll through the file in 16 Kbyte segments (1/2 the buffer size). Use these softkeys when running monitor programs on data files that are too large for the buffer.

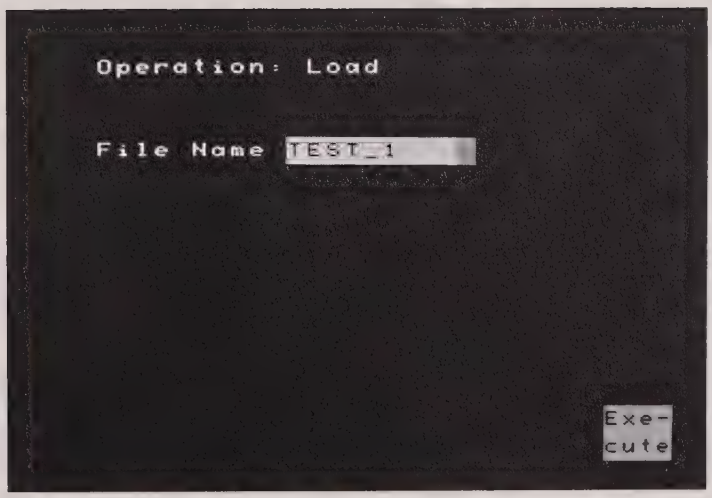


Figure 11-2. The Load Operation

Storing Data On Tape

WHAT YOU CAN STORE ON TAPE

Store both "Menus and Data", or "Menus" only. Menus saved are: Setup, Monitor, Simulate, and BERT (setups only). Highlights are not saved on tape; only data and timing information.

HOW TO STORE TO TAPE

Insert a tape cartridge and initialize if the tape is blank. Press <Store>, enter the file name, the file type, and an optional comment; then press <Execute>. If the tape has insufficient room for a file, "EOT" is displayed.

STORING DIRECTLY FROM THE LINE

To directly store to tape while monitoring on line, use <Start tape> and <Stop tape> instructions in the monitor and simulate menus.

NOTE: You can only start and stop the tape once by program control.

A file can only hold 128 Kbytes, after which the tape stops, and the message "File Full" is displayed. The tape can keep up at line bit rates of 9600 bps full duplex and 19.2 kbps half duplex. The tape is able to keep up at higher line bit rates if line utilization (percentage of data to idles) is low. If the tape cannot keep up, "Buffer Overflow" will be displayed. A tape cartridge contains two tracks, each of which can hold up to 256 Kbytes of data. Switching tracks takes about 20 seconds, however, and you may "overflow" the buffer" at this time.

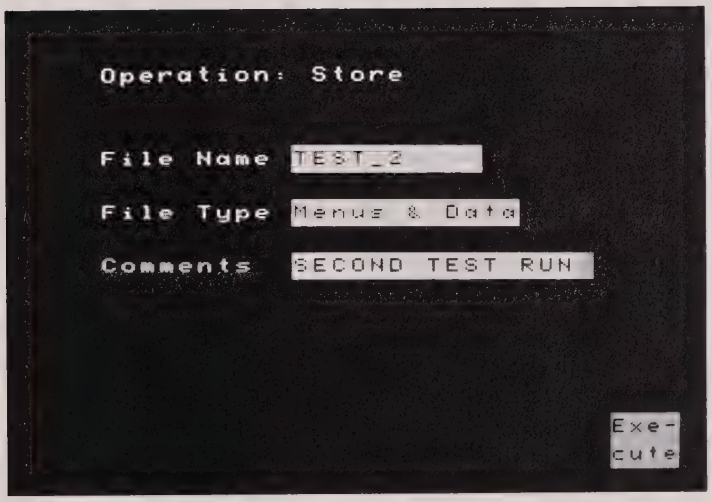


Figure 11-3. The Store Operation

Mass Store Error Messages

Invalid File Name. The first character of a file name must always be an upper case letter. After the first character, use any combination of upper and lower case letters, numbers, or underscores (_).

Tape Out. The tape is out at the beginning of the operation, or if the tape is taken out during the operation.

File Not Found. The HP 4951B cannot find the specified file during a load operation.

Time Error and **Sync Error**. These errors indicate either a hardware or tape problem. Tension the tape or use a different tape. Otherwise, see the Service Manual.

Protected. This indicates the tape is "write protected". Slide the Record tab on the tape cartridge in the direction of the arrow in order to store to tape.

De-spool. Tape either has run off the spool, or is about to. Wind the tape onto the empty spool. The tape drive needs service if it re-occurs

Checksum. Bit errors have occurred. Use the same procedure as for Time Errors.

Format. The tape is not in the proper format.

Servo. Motor speed is out of tolerance due to faulty motor electronics, or a jammed tape.

EOT. End of tape. The tape is full.

CHAPTER 12
RESET AND SELF TEST

The Reset Softkey

The <Reset> softkey enables you to clear the memory and go back to default entries in the Setup, Monitor, and Simulate Menus.

WHEN SETUPS AND BUFFER ARE NOT SAVED

Because the 4951B has a battery backed up memory, menu setups and buffer memory data are saved after turn off. The menus saved are: Setup, Monitor, and Simulate. However, setups and buffer data cannot be guaranteed in the following two cases:

1. The instrument was not turned off when it was in the Top Level Menu.

2. The battery has completely run down. This should never happen unless the instrument has been stored for more than a week in a very hot environment (or six months at room temperature).

In these cases the following message appears when you go to the monitor, simulate, or setup menus.

MENUS CORRUPT; MENUS HAVE BEEN
RESET TO THE DEFAULT CONDITION

The analyzer has been reset automatically: the buffer has been cleared, and setups return to their default values. Always press EXIT and go to the Top Level Menu before turning the instrument off.

Setup Menu Defaults

The following tables list default entries for the five Setup Menus: HDLC, SDLC, X.25, BSC, and Char Async/Sync. Whenever you press <Reset> on the Top Level Menu, these entries appear in each menu. Otherwise, the entries are whatever you had selected before you turned the power off.

HDLC PROTOCOL	SDLC PROTOCOL	X.25 PROTOCOL
External Address Off		
External Control Off		
Code ASCII 8	Code ASCII 8	Code ASCII 8
	Mode Sync	
DTE clock DCE	DTE clock DCE	DTE clock DCE
Bits/sec 9600	Bits/sec 9600	Bits/sec 9600
Display mode Data & State	Display mode Data & State	Display mode Data & State

Setup Menu Defaults (cont)

BSC PROTOCOL

Code ASCII 7

Error check LRC

Sync on 16 16

DTE clock DCE
Bits/sec 9600

Display mode Data & State

Suppress None

CHAR ASYNC/SYNC

Bit order LSB 1st Bit sense Norm

Code ASCII 7

Error check LRC

Parity None

Transparent text char None

Mode Sync
Sync on 32 32
Drop sync 10 characters
after 2D 2D 37 3D 70 7F FF

DTE clock DCE
Bits/sec 9600

Display mode Data & State

Suppress None

NOTE: When you select any error checking in Character Async/Sync following a <Reset> the 4951B defaults to Start on SOH STX and Stop on & ETX NUL NUL. These start and stop characters also appear if you first go to the BSC menu and then to Character Async/Sync after a <Reset>.

The Self Test Menu

Whenever you turn on the 4951B it first goes through a self-test. After approximately six seconds, it then displays the Top Level Menu. You can run the self-test at any time by pressing the <Self Test> softkey in the Top Level Menu. If you then press <Loop>, the analyzer will go through a self test cycle and display failure information for specific tests. See Appendix G for more information on the Self Test Menu.

CHAPTER 13
ASCII PRINTER OUTPUT

Introduction

The ASCII printer output application lets you print buffer data, monitor and simulate menus, timer and counter results, and tape catalogs. HP 4951B display information is sent to a printer via the RS-232 connector on the rear panel or the RS-232C/V.24 interface pod.

ITEMS REQUIRED

To use this feature, you need the Printer Output application tape (supplied with your instrument, and an ASCII Printer such as HP 2601A, HP 2934A of Thinkjet Printer. If you use the RS-232 connector on the rear panel, you need an RS-232 cable. If you use the pod connector you need an RS-232C/V.24 interface pod such as the HP 18179A, HP 18173A or HP 18180A.

SUMMARY OF PRINTER OPERATION

Hookup. Connect the ASCII printer to the RS-232 connector on the rear panel or to the RS-232C/V.24 pod.

Loading. Load the application program from the Mass Store Menu.

Setup. In the Top Level Menu, select Printer Menu and make the desired selections.

Execution. Press <Execute> when the cursor is in any printer menu field (except the last).

Halting. Press EXIT to halt printing at any time and return to the printer menu.

Hookup

Connect the ASCII printer to the RS-232 connector on the rear panel or to the RS-232C/V.24 interface pod, using the Y-ribbon cable supplied with the pod. See Figure 13-1 below.

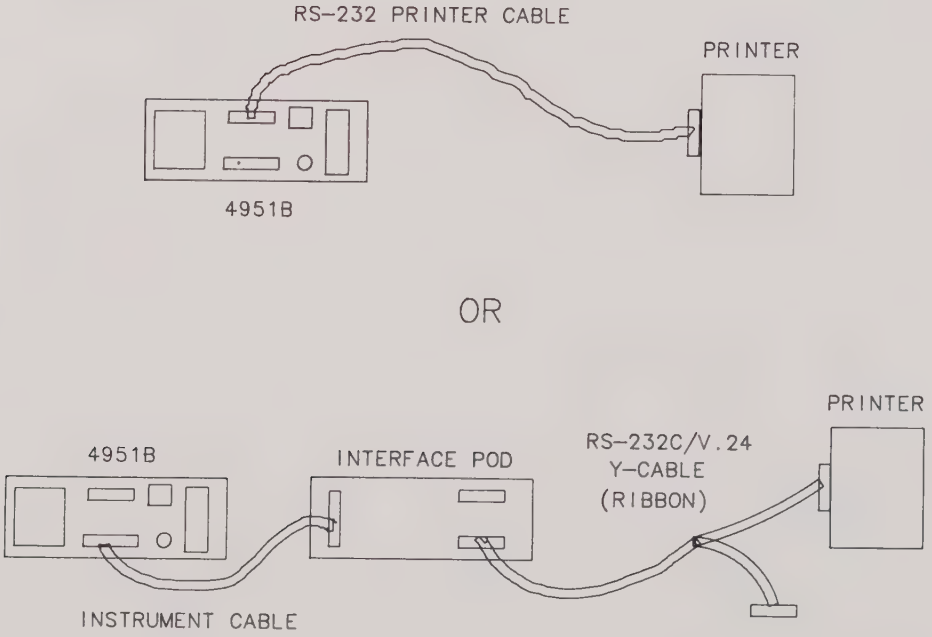


Figure 13-1. Connecting the Printer

Loading The Application

1. Insert the application tape.
2. Press the <Mass Store> softkey in the Top Level Menu.
3. Press the <Load> softkey.
4. Type APRINT (all caps) for file name.
5. Press <Execute> to load the printer application program.
6. The <Print> softkey should now appear on the top level menu softkeys (press MORE):

```
Hewlett-Packard
ASCII Printer Support
Rev 2506
Copyright 1985

4951B
Protocol Analyzer
```

Setup

Use the Printer Output Menu (Figure 13-2), which appears in the top level menu after loading the application, to configure for printing. You must know the correct settings for your ASCII printer.

Print Information

Select any of the displays shown on the softkeys. If you select <data buffer>, specify which buffer section is to be printed: the beginning of the buffer is displayed, with the following softkeys:

```
Print All      Start Here      Hex/Text
```

The default is "Text"; press <Hex> to represent the data in hex. The <Print All> softkey prints the entire buffer. To print only part of the buffer, move the cursor to the desired position and press <Start Here>. The following softkeys appear:

```
To End      End Here      Hex/Text
```

Press <To End> to print the buffer contents from the starting position to the end of the buffer. Otherwise move the cursor to the desired ending position. Press <End Here> to print the buffer from the starting position to the position indicated by the cursor.

Port

Select either the pod or the RS-232 port. If you select the pod, use the RS-232C/V.24 interface pod (HP 18179A, HP 18173A, or HP 18180A)

Bits/sec

You may send data to the printer at any one of the speeds shown in Figure 13-2.

Character Code

Select either ASCII 8 or ASCII 7.

Parity

Select none, even, or odd.

4951B Mode

Determines whether the HP 4951B behaves as a data termination equipment or as data communication equipment.

NOTE: When using the pod's Y-ribbon cable for printer connection, the HP 4951B should be configured as a DCE.

Handshake

Determines the printer handshake method. You can specify ENQ, ACK, XOn, or XOff characters by typing in the characters from the keyboard. Type in control characters, shown on the keycaps, by pressing CNTL simultaneously with the control character.

Line Terminators

Type in the line termination characters expected by the printer. Two characters may be specified, blanks being ignored. The standard sequence of a carriage return and line feed is the default.

Carriage Return Delay

Sets the delay after a carriage return in milliseconds. This field defaults to zero, but some printers require a delay to avoid a loss of characters. NOTE: The <Execute> key is not available in this field.

```
Print Information:      [ Data Buffer      ]   [ BERT Menu  ]
                        [ Setup            ]   [ Remote     ]
                        [ Monitor          ]   [ Catalog    ]
                        [ Simulate         ]   [ Print Menu ]
                        [ Run Summary      ]

Port:                   RS-232 Port  or  Pod

Bits/sec.:              [ 19200 ]  [ 7200 ]  [ 3200 ]  [ 1600  ]
                        [ 9600  ]  [ 4800 ]  [ 2000 ]  [ 14400 ]
                        [ 3600  ]  [ 2400 ]  [ 1800 ]  [ 12000 ]
                        [ 1200  ]  [ 600  ]  [ 150  ]  [ 134.5 ]
                        [ 300   ]  [ 110  ]  [ 75   ]  [ 50    ]

Character Code          [ ASCII 8 ]  [ ASCII 7 ]

Parity                  [None ]  [ Even ]  [ Odd ]

4951B Mode              [ DTE ]  [ DCE ]

Handshake               [ XON/XOFF ]  [ ENQ/ACK ]  [ Ctrl Lead ]

XON (ENQ) Character     [ keyboard entry ]
XOFF (ACK) Character    [ keyboard entry ]

Line Terminator         [ keyboard entry ]

Carriage Return Delay   [ keyboard entry ] ms
```

Figure 13-2. The Printer Output Menu

Execution

Press the <Execute> softkey. The <Execute> softkey appears when the cursor is in any field -- except Carriage Return Delay -- of the print menu. Pressing <Execute> initiates the printing process with the menu values that are currently displayed. Print menu parameters are saved. Thus, when you enter the print menu the next time, the fields will have the same values used for the preceding print operation.

Press EXIT to halt printing at any time and return to the printer menu.

Printer Handshaking

Your printer will use one or more of the following types of handshaking. You must determine which one, and configure the analyzer printer menu appropriately.

HARDWARE HANDSHAKING

The CTS and DTR leads are used for hardware handshaking. CTS is monitored by the HP 4951B when it is in the DTE mode. In the DCE mode the HP 4951B monitors DTR. If another line is to be used, the appropriate connections must be made via the pod breakout box. In order to print, the lead being used must be high. If the lead goes low, printing pauses until the lead goes high again.

ENQUIRE/ACKNOWLEDGE (ENQ/ACK) HANDSHAKING

In ENQ/ACK handshaking the HP 4951B enquires whether the printer is ready to receive characters. The HP 4951B sends an ENQ character (usually 05H) to the printer after each block of 40 characters. The printer must acknowledge the enquiry in order for printing to proceed. The printer will not respond to an ENQ until it is able to accept more characters into its buffer. When it is ready, the printer responds by sending an ACK character (usually 06H) to the HP 4951B. The ENQ and ACK characters may be different for various printers. You can specify the characters to be used in the Printer Menu.

XOn/XOff HANDSHAKING

XOn/XOff handshaking is initiated by the printer. When the printer is unable to continue receiving characters, it sends an XOff character (usually 13H) to the HP 4951B. The HP 4951B then suspends transmission until the printer sends an XOn character (usually 11H). Some printers use a second XOff character (usually 15H). One XOn character, and two XOff characters can be specified in the printer menu.

Diagnostic Messages

The following messages may appear at the bottom of the CRT. Press the EXIT hardkey to return to the printer menu and halt printing.

1. **No pod attached.** No pod is attached to the HP 4951B.

CAUTION

Turn off the HP 4951B before connecting or disconnnecting the pod.

2. **No Lead Change.** With hardware handshaking, no enabling lead has been detected for more than 60 seconds. The HP 4951B will wait for an enabling lead from the printer.

3. **No XON after XOFF.** With XOn/XOff handshaking, the printer sent an XOff and has not sent an XOn for more than 60 seconds. The HP 4951B will wait for the XOn character from the printer.

4. **No ACK after ENQ.** While using ENQ/ACK handshaking, the printer has not responded to with an ACK for more than 60 seconds after the HP 4951B sent an ENQ. The HP 4951B will wait for the ACK character from the printer.

5. **No Transmission occurring**. Check hardware connections.

To return to the printer menu after one of the above messages, press the EXIT hardkey. Check the printer if handshaking is not acknowledged.

How The Printer Displays Characters

The output format for the ASCII printer is essentially the same as for the CRT display, except as described below.

All hex codes are in upper case. All ASCII control characters are in lower case. All other sequences are: top character upper case, and lower character lower case.

All characters that have no ASCII representation are printed in hexadecimal mode.

HEXADECIMAL characters are printed in upper case, with the most significant digit over the least significant digit. For example, B7 hex is printed as:

B
7

ASCII control characters are printed in lower case with the same mnemonics as displayed on the CRT, but on two lines. For example, and ASCII acknowledge is printed as:

a
k

For data and state displays, after DTE, DCE, and lead level information is printed across the page, a blank line is left before the next group of lines is printed.

SPECIAL CHARACTERS

Don't Care	x X	Undefined Character	? ?
Start Flag	S f	End Flag	E f
Good FCS	GG gg	Bad FCS	BB bb
Abort	AA aa	Don't Care FCS	XX xx
Highlighted Timer	H t	Discontinuity	D c

LEAD LEVELS

Lead levels that are displayed on the CRT are printed as follows:

```
High    1          Low     0

Transition (rising or indeterminate)      /

Transition (falling or indeterminate)     \
```

Examples Of Printed Output

EXAMPLE OF DATA & STATE DISPLAY

```
DTE:        8 A B C D EGGE     Sd  e e
            0 B C D E fggf     f1  b q
DCE:         8 A B C D    EGGE   Sd e e
             0 B C D E    fggf   f1 b q
RTS:        00000000000000000000000000
CTS:        0000000000000000/111111111
DSR:        00000000000000000000000000
CD :        00000000000000000000000000


DTE:        d d e n h s d n e u f r s d
            2 4 m k t i l u c s s s h 3
DCE:         d d e n h s d n e u f r s
             2 4 m k t i l u c s s s h
RTS:        00000000000000000000000000
CTS:        11111111111111111111111111
DSR:        00000000000000000000000000
CD :        00000000000000000000000000
```

EXAMPLE OF FRAME & PACKET OUTPUT

```
Block 1
        A Type      NS PS NR Data          FCS          QD Mod LCN  PS M  PR

DCE:    0 INFO      0  0  0  UUd           G      Clear Request      01  8  555
        0                        3          g

DCE:    0 INFO      0  0  0  DDv           G      Call Request       01  8  444
        0                        t          g

DCE:    0 INFO      0  0  0  UUd           G      Clear Request      01  8  555
        0                        3          g

DCE:    0 INFO      0  0  0  DDv           G      Call Request       01  8  444
        0                        t          g
```

EXAMPLE OF RUN SUMMARY

Protocol	Char Async/Sync			
Bit order	LSB 1st	Bit Sense		Norm.
Code	ASCII 8	Err chk	None	
Parity	None			
Transpar	None			
Mode	Async 1			
		Bits/sec	9600	
		Disp mode		D & S
		Suppress	None	
Counter 1 =	0	Timer 1 =	0	
Counter 2 =	0	Timer 2 =	0	
Counter 3 =	0	Timer 3 =	0	
Counter 4 =	0	Timer 4 =	0	
Counter 5 =	0	Timer 5 =	0	

Copying The Printer Application

Your application tape contains two programs: APRINT which was described in the preceding section, and COPY. The COPY application allows you to duplicate the Printer Application, APRINT.

CAUTION

Buffer data and menus are destroyed when using the COPY program.

When you copy the printer application tape, copy both programs, COPY and APRINT. This allows you to use the copy application with the new tape.

NOTE

To return the HP 4951B to normal operation after the copy procedure, press <Reset> on the Top Level Menu.

Use the following procedure to copy the application tape.

1. Insert the ASCII printer application tape
2. Press the <Mass Store> softkey in the Top Level Menu.
3. Press the <Load> softkey and type COPY (all caps) for the file name.
4. Press <Execute> to load the copy application program.
5. Insert a destination tape, press <Store> and then <Execute>.
6. Again insert the printer application tape. Press <Load>, type APRINT for the file name, and press <Execute>.
7. Again insert the destination tape, press <Store> and then <Execute>.

Points To Remember

Use only an RS-232C/V.24 interface pod (such as HP 18173A, 18179A, 18180A).

Configure the HP 4951B as a DCE. If you use the ribbon cable supplied with the RS-232C/V.24 pod to connect the pod to the printer, set the 4951B MODE (in the printer menu) to DCE. If you wish to configure the HP 4951B as a DTE, you will need a modem eliminator cable (see chapter 10 in the HP 4951B operating manual).

Press EXIT to halt printing at any time and return to the printer menu.

Backup your printer application program by using the COPY application on the printer application tape. Also backup the copy application program.

Remember to save any important buffer data and menus before using the COPY application.

Press the <Reset> softkey in the top level menu to return to normal operation after using the COPY application.

You can also use the HP 4953A to copy HP 4951B application tapes. You can either load and then store each file to another tape, or you can use the TEDIT application supplied with the HP 4953A. However, you cannot use the APRINT application program supplied with an HP 4951A to drive a printer from the rear RS-232 port on the HP 4951B. See the HP 4953A operating manual.

APPENDIX A
SPECIFICATIONS

Operating Characteristics

Protocols

X.25, HDLC, SDLC (NRZI), BSC, and most character asynchronous or synchronous protocols.

Data Transfer Rates (bps)

50, 75, 100, 134.5, 150, 200, 300, 600, 1200, 1800, 2000, 2400, 3200, 3600, 4800, 7200, 9600, 12000, 14400, 16000, 19200, teletext 1200/75, and EXTERNAL up to 19200 full duplex for all monitoring, simulation, triggering, and BERT tests.

The HP 4951B can capture a complete buffer full of data at line speeds up to 64 kbps. (Bit oriented protocols only).

Clock Accuracy: 0.005%

Data Codes

ASCII, EBCDIC, Baudot, Six Bit Transcode, IPARS, and EBCD.

Mass Storage Memory

32 Kbytes of RAM stores data characters, timing, and lead status information.

Optional tape drive: Up to 512 Kbytes for storing data, timing information, menu configurations, and application programs. Write to tape: 9600 bps full duplex, 19200 bps half duplex.

Lead Status

The status of five control leads are stored for each interface. They are RTS, CTS, DTR, DSR, and CD for RS-232C/V.24, and CS, RS, RR, TR, and DM for RS-449.

Highlights

Highlight the last 63 triggers.

Character Framing

5, 6, 7, or 8 information bits, plus parity. For asynchronous systems select 1, 1.5, or 2 stop bits per character.

Error Checking

CRC-CCITT, CRC-16, CRC-12, CRC-6, LRC, and parity.

Triggers

63 triggers consisting of characters, errors, interface lead transitions, or timer values. All be simultaneously active up to 19200 bps.

Timers

Five timers, each of which has a maximum count of 65565 msec. Resolution 1 msec.

Counters

Five counters, each of which can be incremented up to 9999.

Keyboard

Full ASCII keyboard with six softkeys and cursor control.

Display

12.7 cm (5 in.) diagonal with 16 lines and 32 characters per line.

Display Formats

Five: DTE only, DCE only, DTE over DCE, Data and State, and Frame and Packet.

Send Strings

255 characters per string maximum, 1750 characters total.

Remote Capability

Over the RS-232C/V.24 link: transfer data, setups, and programs.

Self Test

Extensive self test and verification routines for isolating failures to a functional component group. Built-in signature analysis permits fault isolation to the component level.

Bit Error Rate Testing

Simultaneously measure bit errors, block errors, error seconds, and percent error free seconds.

Block Size: 63, 511, 1000, or 2047 bits.

Patterns: 63, 511, or 2047 bit pseudo random sequence.

Character Framing: Select 5, 6, 7, 8 bits per character and parity, or none (continuous). Select odd or even parity with character framing, or none with no framing.

Inject Errors: Inject single errors or bursts of errors.

Additional Characteristics

Auto-configuration of all setup parameters.

Battery maintained RAM for all setups, data, and menus.

Select **bit order** as LSB or MSB first and select **bit sense** as inverted or normal.

Interface Accessories

HP 18173A, HP 18174A, HP 18179A, and HP 18180A. Each interface is supplied with the appropriate 1.5 meter "Y" cable.

HP 18173A (RS-232C/V.24) Interface

Ten switches for line isolation. 25 test points for monitoring, forcing, or cross-patching. One non-dedicated MARK/SPACE monitor for user patching to any line. Nine hard-wired activity indicators: TD - Transmit Data, RD - Receive Data, TC - Transmit Clock, RC - Receive Clock, DTR - Data Terminal Ready, DSR - Data Set Ready, RTS - Request to Send, CTS - Clear to Send, and CD - Carrier Detect.

Mark/Space Monitor: Indicates voltages greater than +3.0 volts, and voltages less than -3.0 volts.

Interface Activity Indicators: These turn on at voltages greater than +2.75 volts, and off at voltages less than +0.25 volts.

Voltage Source: +/- 12 volts.

Weight: 0.6 kg (1.3 lb).

HP 18174A (RS-449) Interface

Nine dedicated activity indicators: SD - Send Data, RD - Receive Data, ST - Send Timing, RT - Receive Timing, RS - Request to Send, CS - Clear to Send, TR - Terminal Ready, DM - Data Mode, and RR - Receiver Ready.

Interface Activity Indicators: These turn on when the differential voltage is greater than 0.2 volts.

Weight: 0.6 kg (1.3 lb).

HP 18180A (Combination RS-232C/V.24 and RS-449 Interfaces).

Weight: 0.7 kg (1.5 lb).

HP 18179A (RS-232C/V.24) Interface

Full Breakout Box with 25 miniature switches provides access to all 25 conductors.

MARK/SPACE Monitor for user patching to any line.

Ten 3-state LEDs monitor primary interface signals at the source. DTE - Transmit Data, DCE - Receive Data, TC - Transmit Clock, RC - Receive Clock, DTR - Data Terminal Ready, DSR - Data Set Ready, RTS - Request to Send, CTS - Clear to Send, CD - Carrier Detect, and ETC - External Transmit Clock.

LED Indicators: Green -- Space (On). Red -- Mark (Off).

Input Voltage: +/- 25V as per EIA RS-232C or CCITT V.24 specifications.

Weight: 0.8 kg (1.8 lb).

Specifications

Weight

Net: 5.7 kg. (12.6 lbs.)
Shipping: 9.5 kg. (21 lbs.)

Size

Height: 11.2 cm, width 25.5 cm, depth 28.6 cm. (4.4 x 10.2 x 11.3 in.)

Temperature

Operating: 0 C to +55 C (+32 F to +131 F) **
Storage: -40 C to +75 C (-40 F to +167 F)

** The tape drive should only be operated from +5 C to +40 C (+41 F to +104 F).

Altitude

Operating: 4600 m (15000 ft).
Storage: 15300 m (50000 ft).

Power Requirements

100, 120, 220, 240 Vac, -10% to +10%; 48 to 66 Hz single phase.
Typical less than 15 VA, maximum less than 30 VA.

APPENDIX B
ACCESSORIES

Accessories

ACCESSORIES SUPPLIED

Power Cord (See Appendix G)	
Pod-Instrument Cable (for all pods)	HP 04951-61604
Operating Manual	HP 04951-90019
Jumper Cable	HP 8120-4218
Y Jumper Cable	HP 8120-4219

Interface pods, listed below, are not supplied and must be ordered separately.

ACCESSORIES AVAILABLE

18172A	Soft vinyl carrying case for extra pods
18173A	RS-232C/V.24 Interface Pod
18174A	RS-449 Interface Pod
18178A	X.21 Interface Kit
18179A	RS-232C/V.24 Interface Pod with Breakout Box and 3-state LEDs
18197A	X.21 Interface Kit
18180A	Combination RS-232C/V.24 and RS-449 Interface Pod
98200A	Certified blank tape cartridges (set of five)

Options

Option 001	Integral Tape Unit
Option 003	Katakana (JIS 7, JIS 8, EBCDIK) datacodes
Option 100	Adds accessory 18173A
Option 101	Adds accessory 18174A
Option 102	Adds accessory 18180A
Option 103	Adds accessory 18179A
Option 104	HP 18178A, X.21 Interface Kit
Option 106	HP 18197A, X.21 Interface Kit
Option 910	Extra operating and service manuals
Option 915	Service Manual
Option 916	Extra operating manual

APPENDIX C
THE INTERFACE

Introduction

An interface pod is required to connect the HP 4951B to the data line. The interface pod also forms the cover of the instrument. Interface pods are available for both the RS-232C/V.24 and RS-449 interfaces.

RS-232C/V.24

HP 18179A	This interface pod uses LEDs for showing all three conditions of the line: marks, spaces, and high impedance. Because it has a complete breakout box, this pod is useful for level 1 troubleshooting.
HP 18180A	The interface pod contains both a RS-232C/V.24 interface and a RS-449 interface. LCD indicators indicate only valid spaces.
HP 18173A	This is the same as the HP 18180A above, without the RS-449 interface.

RS-449

HP 18180A	This interface pod, described above, contains both a RS-232C/V.24 interface and a RS-449 interface. LCD indicators indicate valid spaces.
HP 18174A	This is the same as the HP 18180A above, without the RS-232C/V.24 interface.

Pod Installation

To connect the Interface Pod to the HP 4951B Protocol Analyzer, turn off the power and attach the interface pod cable to the port on the back of the Protocol Analyzer. Tighten the connector screws to ensure that the cable will not pull off during operation.

CAUTION

Turn off the Protocol Analyzer before connecting or disconnecting any Interface Pod.

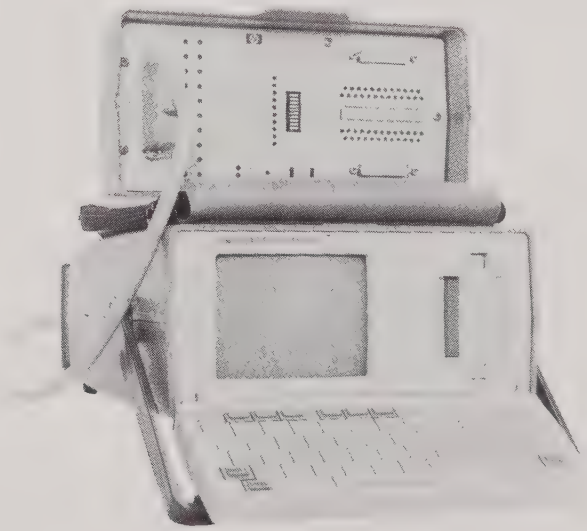


Figure C-1. Interface Pod Connection

The HP 18179A Interface Pod (RS-232C/V.24)

The HP 18179A is an RS-232C/V.24 interface pod which connects the HP 4951B to the DTE or DCE. The HP 18179A is compatible with CCITT V.24 and EIA RS-232C electrical, mechanical, functional, and procedural specifications.

The HP 18179A can be used for complete level 1 troubleshooting on RS-232C/V.24 interfaces. It contains 10 pairs of real-time LEDs which monitor data, clocks, and major control line activity.

The LEDs show all three possible line states. The green LEDs indicate "on" states, or valid spaces. The red LEDs indicate "off" states, or valid marks. The high impedance state is indicated when both the red and the green LEDs on a line are not lit. The LEDs also indicate real-time activity; that is they show actual transitions.

The HP 18179A also contains a complete breakout with switches for interrupting each of the the 25 conductors. Access to all 25 pins is provided by a complete set of 25 pins on each side of the switches, allowing you to connect any interface pin to any other.

In the DTE and DCE simulate modes RS-232C drivers are switched into the appropriate lead by latching relays. If monitor mode is selected all RS-232C drivers are disconnected from the line.

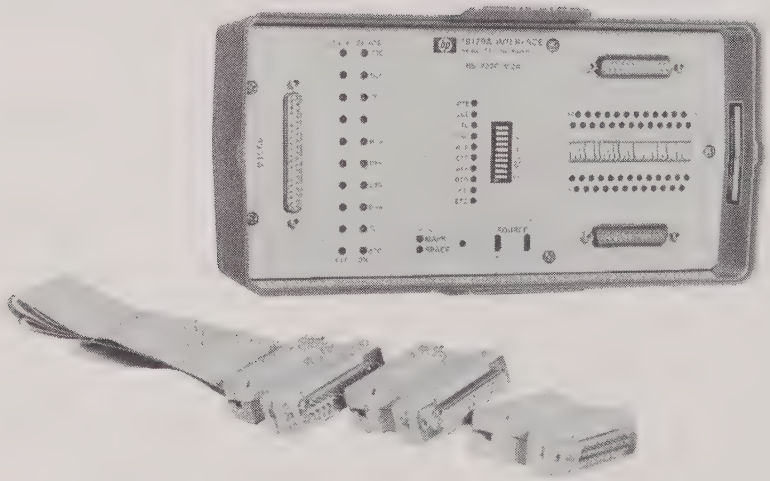


Figure C-2. The HP 18179A Interface Pod

HP 18179A INDICATORS AND CONNECTORS

LEDs

The 3-state indicators indicate activity on the interface pins. The high impedance state is indicated when both LEDs are off.

green: space (logic '0', positive voltage) turns on at >2.75 V, turns off at <0.25 V

red: mark (logic '1', negative voltage) turns on at < -3.0 V, turns off at > -3.0 V

Disconnect Switches

Pins 2, 3, 4, 5, 6, 8, 15, 17, 20, and 24 may be individually disconnected from the data link by switches. This lets you isolate non-driven interface lines from the HP 4951B. Non-driven lines may develop cross talk noise which will be mistaken by the analyzer for transitions.

Jacks for RS-232C/V.24 Y-Cable

These jacks connect the Interface Pod to the line for monitoring or simulation.

Full Breakout Box

The Breakout Box provides cross-patching, line-forcing, and monitoring capabilities for all of the RS-232C lines. The miniature switches isolate lines.

Jumper Pins

All 25 pins of the RS-232C jack are brought out for jumpering on both sides of the breakout switches. If your network cable has different pin assignments from the interface standard, you can use the supplied jumper wires to connect the interface lines to the desired pin on your cable.

+/-12 V Source Pins

The Source Pins supply +12 volts and - 12 volts. You may set any signal line on or off by jumpering that line to the Source Pins.

Mark/Space Indicator

The Mark/Space Indicator enables you to check the level of any signal line. Jumper any pin to this indicator to find its state.

Jack for Instrument Cable

This jack connects the Interface Pod to the HP 4951B via the Pod-Instrument cable supplied with this instrument.

RS-232/V.24 INTERFACE (HP 18173A, 18179A, and 18180A)

Pin	Circuit	Function	EIA	CCITT Source
1	GND	Protective Ground	AA	101 ...
2	TD	Transmitted Data	BA	103 DTE
3	RD	Received Data	BB	104 DCE
4	RTS	Request To Send	CA	105 DTE
5	CTS	Clear To Send	CD	106 DCE
6	DSR	Data Set Ready	CC	107 DCE
7	GND	Ground Signal	AB	102 ...
8	CD	Carrier Detect	CF	109 DCE
9-11	...	unassigned	...	... ...
12	SCD	Sec Carrier Detect	SCF	122 DCE
13	SCS	Sec Clear To Send	SCB	121 DCE
14	STX	Sec Transmitted Data	SBA	118 DTE
15	TC	Transmit Clock	DB	114 DCE
16	SRD	Sec Received Data	SBB	119 DCE
17	RC	Received Clock	DD	115 DCE
18	...	unassigned	...	... ...
19	SRS	Sec Request to Send	SCA	120 DTE
20	DTR	Data Terminal Ready	CD	108.2 DTE
21	SQ	Signal Quality	CG	110 DCE
22	RI	Ring Indicator	CE	125 DCE
23	DRS	Data Rate Selector	CH	111 DTE
			CI	112 DCE
24	ETC	Ext Transmit Clock	DA	113 DTE
25	...	unassigned	...	... ...

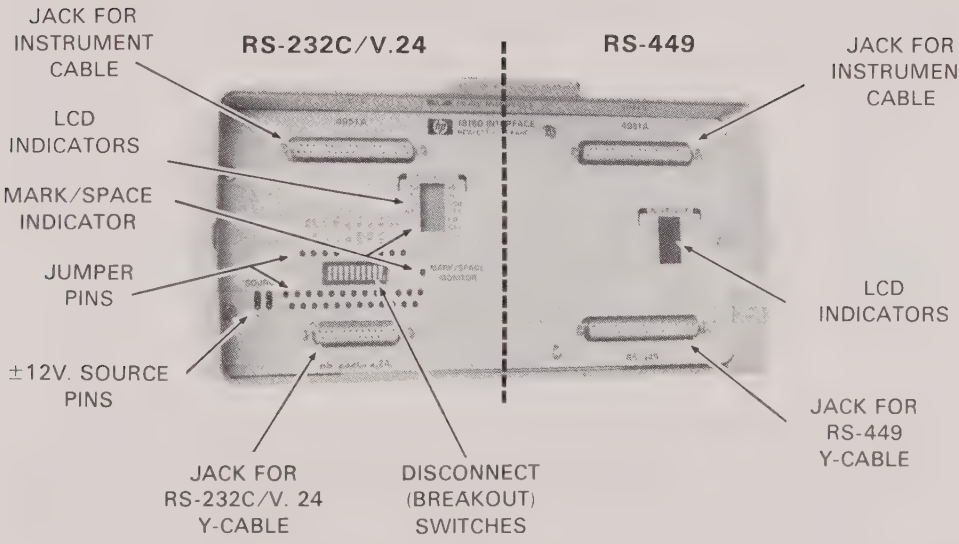


Figure C-3. The HP 18180A (Combination RS-232C/V.24 and RS-449 Interface)

The HP 18173A or HP 18180A (RS-232C/V.24)

The HP 18173A is an RS-232C/V.24 interface pod. The HP 18180A contains the HP 18173A, as well as the HP 18174A. The HP 18173A has slightly less capability than the HP 18179A pod. Its LCD indicators show only "on" or space states. Also, unlike the HP 18179A, the HP 18173A does not contain a full breakout box.

Jacks

The top jack, labeled HP 4951B, connects the interface pod to the HP 4951B via the Pod-Instrument cable supplied with the instrument. The bottom jack, labeled RS-232C/V.24 connects the Interface to the line for monitoring or simulation (see chapter 2 for Hookup).

Jumper Pins

All 25 pins of the bottom jack are brought out for jumpering. If your network cable has different pin assignments from the interface standard, you can use the supplied jumper wires to connect the interface lines to the desired pin on your cable. Pins 2, 3, 4, 5, 8, 15, 20, and 24 are also brought out on the other side of the breakout switches for jumpering.

Source Pins

The six Source Pins supply +12 volts and -12 volts. You may set any signal line on or off by jumpering that line to the Source Pins.

Disconnect (breakout) Switches

Pins 2, 3, 4, 5, 6, 8, 15, 17, 20, and 24 may be individually disconnected from the data link by means of switches. This lets you isolate non-driven interface lines from the HP 4951B.

LCD Indicators

The LCD indicator for a signal line is dark when that line is On or Spacing. The LCD indicator is blank when a line is Off, Marking, or 3-state. For the indicator to be dark the voltage on that line must be greater than +2.75 volts. Once the indicator is dark, it will not go blank until the voltage becomes less than +0.25 volts. Therefore, the LCD for individual lines do not distinguish Marking and 3-state. Use the Mark/Space Monitor to do this.

LCD Indicator	Interface Line
Dark	Logical "0" (Space, On, positive voltage)
Blank	Logical "1" (Mark, Off, negative voltage, 3-state)

Mark/Space Monitor

Use the Mark/Space Monitor Pin to check the level of any signal line. Jumper this pin to any signal pin and observe the ON/OFF LCD indicators. The On indicator is darkened for levels greater than +3 volts; the Off indicator is darkened for levels less than -3 volts. The other LCD indicators do not distinguish between Marking and 3-state conditions (they are blank below +0.25 volts). The Mark/Space Monitor lets you check these lines, or any other signal lines for mark/space levels.

The HP 18174A or HP 18180A (RS-449)

The HP 18174A follows the EIA RS-449/422A standard and is compatible with RS-423A specifications. The HP 18180A contains the HP 18174A as well as the HP 18173A. The RS-449 was intended by the Standards Committees as a replacement and enhancement for the RS-232C/V.24 interface and can be used for both low and high-speed applications. RS-449 is made up of two electrical standards, RS-423A and RS-422A.

The RS-422A uses a balanced signal lead configuration for data and clocks to enable high speed operation. RS-423A uses an unbalanced signal lead configuration. Because the HP 4951B implements RS-422A electrical standards for all category I circuits, it can also support RS-423A circuits.

The 18174A (or combination 18180A) interface does not have an integral breakout box for disconnecting and jumpering lines. Selected pins are, however, monitored by LCD indicators. For the LCD indicators to transition, the unbalanced or differential A-B voltage must be greater than 0.2 volts.

18174 INTERFACE (RS-449)

Pin	Circuit	Function
1	SHIELD	
2	SI	Signaling Rate Indicator
3	Spare	
4	SDa	Send Data (a)
5	STa	Send Timing (a)
6	RDa	Receive Data (a)
7	RSa	Request to Send (a)
8	RTa	Receive Timing (a)
9	CSa	Clear to Send (a)
10	LL	Local Loopback
11	DMa	Data Mode (a)
12	TRa	Terminal Ready (a)
13	RRa	Receiver Ready (a)
14	RL	Remote Loopback
15	IC	Incoming Call
16	SF/SR	Select Frequency/rate
17	TTa	Terminal Timing (a)
18	TM	Test Mode
19	SG	Signal Ground
20	RC	Receive Common
21	Spare	
22	SDb	Send Data (b)
23	STb	Send Timing (b)
24	RDb	Receive Data (b)
25	RSb	Request Send (b)
26	RTb	Receive Timing
27	CSb	Clear to Send
28	IS	Terminal in Service
29	DMb	Data Mode (b)
30	TRb	Terminal Ready (b)
31	RRb	Receiver Ready (b)
32	SS	Select Standby
33	SQ	Signal Quality
34	NS	New Signal
35	TT	Terminal Timing
36	SB	Standby Indicator
37	SC	Send Common

APPENDIX D
DATA CODE TABLES

ASCII Character Conversion Table

Dec Value	Binary	Hex	Displayed Character	Keyboard Mnemonic	Description
0	000 0000	00	NU	NUL	Null
1	000 0001	01	SH	SOH	Start of Header
2	000 0010	02	SX	STX	Start of Text
3	000 0011	03	EX	ETX	End of Text
4	000 0100	04	ET	EOT	End of Transmission
5	000 0101	05	EQ	ENQ	Enquiry
6	000 0110	06	AK	ACK	Positive Acknowledge
7	000 0111	07	BL	BEL	Bell
8	000 1000	08	BS	BS	Back Space
9	000 1001	09	HT	HT	Horizontal Tab
10	000 1010	0A	LF	LF	Line Feed
11	000 1011	0B	VT	VT	Vertical Tab
12	000 1100	0C	FF	FF	Form Feed
13	000 1101	0D	CR	CR	Carriage Return
14	000 1110	0E	SO	SO	Shift Out
15	000 1111	0F	SI	SI	Shift In
16	001 0000	10	DL	DLE	Data Link Escape
17	001 0001	11	D1	DC1	Device Control 1
18	001 0010	12	D2	DC2	Device Control 2
19	001 0011	13	D3	DC3	Device Control 3
20	001 0100	14	D4	DC4	Device Control 4
21	001 0101	15	NK	NAK	Negative Acknowledge
22	001 0110	16	SY	SYN	Synchronous Idle
23	001 0111	17	EB	ETB	End of Transmission Block
24	001 1000	18	CN	CAN	Cancel
25	001 1001	19	EM	EM	End of Medium
26	001 1010	1A	SB	SUB	Substitute
27	001 1011	1B	EC	ESC	Escape
28	001 1100	1C	FS	FS	File Separator
29	001 1101	1D	GS	GS	Group Separator
30	001 1110	1E	RS	RS	Record Separator
31	001 1111	1F	US	US	Unit Separator
32	010 0000	20	space		
33	010 0001	21	!		
34	010 0010	22	"		
35	010 0011	23	#		
36	010 0100	24	$		
37	010 0101	25	%		
38	010 0110	26	&		
39	010 0111	27	'		
40	010 1000	28			
41	010 1001	29			
42	010 1010	2A	*		
43	010 1011	2B	+		
44	010 1100	2C	,		

ASCII Character Conversion Table (Cont'd)

Dec Value	Binary	Hex	Displayed Character	Keyboard Mnemonic	Description
45	010 1101	2D	-		
46	010 1110	2E	.		
47	010 1111	2F	/		
48	011 0000	30	0		
49	011 0001	31	1		
50	011 0010	32	2		
51	011 0011	33	3		
52	011 0100	34	4		
53	011 0101	35	5		
54	011 0110	36	6		
55	011 0111	37	7		
56	011 1000	38	8		
57	011 1001	39	9		
58	011 1010	3A	:		
59	011 1011	3B	;		
60	011 1100	3C	<		
61	011 1101	3D	=		
62	011 1110	3E	>		
63	011 1111	3F	?		
64	100 0000	40	@		
65	100 0001	41	A		
66	100 0010	42	B		
67	100 0011	43	C		
68	100 0100	44	D		
69	100 0101	45	E		
70	100 0110	46	F		
71	100 0111	47	G		
72	100 1000	48	H		
73	100 1001	49	I		
74	100 1010	4A	J		
75	100 1011	4B	K		
76	100 1100	4C	L		
77	100 1101	4D	M		
78	100 1110	4E	N		
79	100 1111	4F	O		
80	101 0000	50	P		
81	101 0001	51	Q		
82	101 0010	52	R		
83	101 0011	53	S		
84	101 0100	54	T		
85	101 0101	55	U		
86	101 0110	56	V		
87	101 0111	57	W		
88	101 1000	58	X		
89	101 1001	59	Y		

ASCII Character Conversion Table (Cont'd)

Dec Value	Binary	Hex	Displayed Character	Keyboard Mnemonic	Description
90	101 1010	5A	Z		
91	101 1011	5B	[		
92	101 1100	5C	\		
93	101 1101	5D	]		
94	101 1110	5E	^		
95	101 1111	5F	_		
96	110 0000	60	`		
97	110 0001	61	a		
98	110 0010	62	b		
99	110 0011	63	c		
100	110 0100	64	d		
101	110 0101	65	e		
102	110 0110	66	f		
103	110 0111	67	g		
104	110 1000	68	h		
105	110 1001	69	i		
106	110 1010	6A	j		
107	110 1011	6B	k		
108	110 1100	6C	l		
109	110 1101	6D	m		
110	110 1110	6E	n		
111	110 1111	6F	o		
112	111 0000	70	p		
113	111 0001	71	q		
114	111 0010	72	r		
115	111 0011	73	s		
116	111 0100	74	t		
117	111 0101	75	u		
118	111 0110	76	v		
119	111 0111	77	w		
120	111 1000	78	x		
121	111 1001	79	y		
122	111 1010	7A	z		
123	111 1011	7B	{		
124	111 1100	7C	|		
125	111 1101	7D	}		
126	111 1110	7E	~		
127	111 1111	7F		DEL	Delete

EBCDIC Character Conversion Table

Dec Value	Binary	Hex	Displayed Character	Standard Mnemonic	Keyboard Entry If Other Than Standard	Description
0	0000 0000	00	NU	NUL		Null
1	0000 0001	01	SH	SOH		Start of Header
2	0000 0000	02	SX	STX		Start of Text
3	0000 0011	03	EX	ETX		End of Text
4	0000 0100	04	PF	PF	hex	Punch Off
5	0000 0101	05	HT	HT		Horizontal Tab
6	0000 0110	06	LC	LC	hex	Lower Case
7	0000 0111	07		DEL		Delete
8	0000 1000	08	hex			
9	0000 1001	09	RF	RLF	hex	
10	0000 1010	0A	SM	SMM	hex	Start Manual Message
11	0000 1011	0B	VT	VT		Vertical Tab
12	0000 1100	0C	FF	FF		Form Feed
13	0000 1101	0D	CR	CR		Carriage Return
14	0000 1110	0E	SO	SO		Shift Out
15	0000 1111	0F	SI	SI		Shift In
16	0001 0000	10	DL	DLE		Data Link Escape
17	0001 0001	11	D1	DC1		Device Control 1
18	0001 0010	12	D2	DC2		Device Control 2
19	0001 0011	13	D3	DC3		Device Control 3
20	0001 0100	14	RE	RES	hex	Restore
21	0001 0101	15	NL	NL	hex	New Line
22	0001 0110	16	BS	BS		Back Space
23	0001 0111	17	IL	IL	hex	Idle
24	0001 1000	18	CN	CAN		Cancel
25	0001 1001	19	EM	EM		End of Medium
26	0001 1010	1A	CC	CC	hex	Cursor Control
27	0001 1011	1B	C1	CU1	hex	
28	0001 1100	1C	FS	IFS	FS	Information File Separator
29	0001 1101	1D	GS	IGS	GS	Information Group Separator
30	0001 1110	1E	RS	IRS	RS	Information Record Separator
31	0001 1111	1F	US	IUS	US	Information Unit Separator
32	0010 0000	20	DS	DS	hex	Digit Select
33	0010 0001	21	SS	SOS	hex	Start of Significance
34	0010 0010	22	FS	FS	hex	Field Separator
35	0010 0011	23	hex			
36	0010 0100	24	BP	BYP	hex	Bypass
37	0010 0101	25	LF	LF		Line Feed
38	0010 0110	26	EB	ETB		End of Transmission Block
39	0010 0111	27	EC	ESC		Escape
40	0010 1000	28	hex			
41	0010 1001	29	hex			
42	0010 1010	2A	SM	SM	hex	Set Mode
43	0010 1011	2B	C2	CU2	hex	
44	0010 1100	2C	hex			

EBCDIC Character Conversion Table (Cont'd)

Dec Value	Binary	Hex	Displayed Character	Standard Mnemonic	Keyboard Entry If Other Than Standard	Description
45	0010 1101	2D	EQ	ENQ		Enquiry
46	0010 1110	2E	AK	ACK		Positive Acknowledge
47	0010 1111	2F	BL	BEL		Bell
48	0011 0000	30	(hex)			
49	0011 0001	31	(hex)			
50	0011 0010	32	SY	SYN		Synchronous Idle
51	0011 0011	33	(hex)			
52	0011 0100	34	PN	PN	(hex)	Punch On
53	0011 0101	35	RS	RS	(hex)	Reader Stop
54	0011 0110	36	UC	UC	hex	Upper Case
55	0011 0111	37	ET	EOT		End of Transmission
56	0011 1000	38	(hex)			
57	0011 1001	39	(hex)			
58	0011 1010	3A	hex)			
59	0011 1011	3B	C3	CU3	(hex.	
60	0011 1100	3C	D4	DC4		Device Control 4
61	0011 1101	3D	NK	NAK		Negative Acknowledge
62	0011 1110	3E	(hex)			
63	0011 1111	3F	SB	SUB		Substitute
64	0100 0000	40	(space)			
65	0100 0001	41	(hex)			
66	0100 0010	42	(hex)			
67	0100 0011	43	(hex)			
68	0100 0100	44	(hex)			
69	0100 0101	45	(hex)			
70	0100 0110	46	(hex)			
71	0100 0111	47	(hex)			
72	0100 1000	48	(hex)			
73	0100 1001	49	(hex)			
74	0100 1010	4A	¢		[	
75	0100 1011	4B	.			
76	0100 1100	4C	<			
77	0100 1101	4D	(			
78	0100 1110	4E	+			
79	0100 1111	4F	!		]	
80	0101 0000	50	&			
81	0101 0001	51	hex			
82	0101 0010	52	(hex			
83	0101 0011	53	hex			
84	0101 0100	54	(hex			
85	0101 0101	55	hex			
86	0101 0110	56	hex			
87	0101 0111	57	hex			
88	0101 1000	58	hex			
89	0101 1001	59	hex			

EBCDIC Character Conversion Table (Cont'd)

Dec Value	Binary	Hex	Displayed Character	Standard Mnemonic	Keyboard Entry If Other Than Standard	Description
90	0101 1010	5A	!			
91	0101 1011	5B	$			
92	0101 1100	5C	*			
93	0101 1101	5D	)			
94	0101 1110	5E	;			
95	0101 1111	5F	¬		^	
96	0110 0000	60	-			
97	0110 0001	61	/			
98	0110 0010	62	hex			
99	0110 0011	63	hex			
100	0110 0100	64	hex			
101	0110 0101	65	hex			
102	0110 0110	66	hex			
103	0110 0111	67	hex			
104	0110 1000	68	hex			
105	0110 1001	69	hex			
106	0110 1010	6A	¦			
107	0110 1011	6B	,			
108	0110 1100	6C	%			
109	0110 1101	6D	_			
110	0110 1110	6E	>			
111	0110 1111	6F	?			
112	0111 0000	70	hex			
113	0111 0001	71	hex			
114	0111 0010	72	hex			
115	0111 0011	73	hex			
116	0111 0100	74	hex			
117	0111 0101	75	hex			
118	0111 0110	76	hex			
119	0111 0111	77	hex			
120	0111 1000	78	hex			
121	0111 1001	79	`			
122	0111 1010	7A	:			
123	0111 1011	7B	#			
124	0111 1100	7C	@			
125	0111 1101	7D	'			
126	0111 1110	7E	=			
127	0111 1111	7F	"			
128	1000 0000	80	hex			
129	1000 0001	81	a			
130	1000 0010	82	b			
131	1000 0011	83	c			
132	1000 0100	84	d			
133	1000 0101	85	e			
134	1000 0110	86	f			

EBCDIC Character Conversion Table (Cont'd)

Dec Value	Binary	Hex	Displayed Character	Standard Mnemonic	Keyboard Entry If Other Than Standard	Description
135	1000 0111	87	g			
136	1000 1000	88	h			
137	1000 1001	89	i			
138	1000 1010	8A	hex			
139	1000 1011	8B	hex			
140	1000 1100	8C	hex			
141	1000 1101	8D	hex			
142	1000 1110	8E	hex			
143	1000 1111	8F	hex			
144	1001 0000	90	hex			
145	1001 0001	91	j			
146	1001 0010	92	k			
147	1001 0011	93	l			
148	1001 0100	94	m			
149	1001 0101	95	n			
150	1001 0110	96	o			
151	1001 0111	97	p			
152	1001 1000	98	q			
153	1001 1001	99	r			
154	1001 1010	9A	hex			
155	1001 1011	9B	hex			
156	1001 1100	9C	hex			
157	1001 1101	9D	hex			
158	1001 1110	9E	hex			
159	1001 1111	9F	hex			
160	1010 0000	A0	hex			
161	1010 0001	A1	~			
162	1010 0010	A2	s			
163	1010 0011	A3	t			
164	1010 0100	A4	u			
165	1010 0101	A5	v			
166	1010 0110	A6	w			
167	1010 0111	A7	x			
168	1010 1000	A8	y			
169	1010 1001	A9	z			
170	1010 1010	AA	hex			
171	1010 1011	AB	hex			
172	1010 1100	AC	hex			
173	1010 1101	AD	hex			
174	1010 1110	AE	hex			
175	1010 1111	AF	hex			
176	1011 0000	B0	hex			
177	1011 0001	B1	hex			
178	1011 0010	B2	hex			
179	1011 0101	B3	hex			

EBCDIC Character Conversion Table (Cont'd)

Dec Value	Binary	Hex	Displayed Character	Standard Mnemonic	Keyboard Entry If Other Than Standard	Description
180	1011 0100	B4	(hex)			
181	1011 0101	B5	(hex)			
182	1011 0110	B6	(hex)			
183	1011 0111	B7	(hex)			
184	1011 1000	B8	(hex)			
185	1011 1001	B9	(hex)			
186	1011 1010	BA	(hex)			
187	1011 1011	BB	(hex			
188	1011 1100	BC	(hex)			
189	1011 1101	BD	(hex)			
190	1011 1110	BE	(hex)			
191	1011 1111	BF	(hex)			
192	1100 0000	C0	{			
193	1100 0001	C1	A			
194	1100 0010	C2	B			
195	1100 0011	C3	C			
196	1100 0100	C4	D			
197	1100 0101	C5	E			
198	1100 0110	C6	F			
199	1100 0111	C7	G			
200	1100 1000	C8	H			
201	1100 1001	C9	I			
202	1100 1010	CA	hex			
203	1100 1011	CB	hex			
204	1100 1100	CC	⌐			
205	1100 1101	CD	hex			
206	1100 1110	CE	⌐			
207	1100 1111	CF	hex			
208	1101 0000	D0	}			
209	1101 0001	D1	J			
210	1101 0010	D2	K			
211	1101 0011	D3	L			
212	1101 0100	D4	M			
213	1101 0101	D5	N			
214	1101 0100	D6	O			
215	1101 0111	D7	P			
216	1101 1000	D8	Q			
217	1101 1001	D9	R			
218	1101 1010	DA	hex			
219	1101 1011	DB	hex			
220	1101 1100	DC	hex			
221	1101 1101	DD	hex			
222	1101 1110	DE	hex			
223	1101 1111	DF	hex			
224	1110 0000	E0				

*Use CNTL Key in conjunction with symbol

EBCDIC Character Conversion Table (Cont'd)

Dec Value	Binary	Hex	Displayed Character	Standard Mnemonic	Keyboard Entry If Other Than Standard	Description
225	1110 0001	E1	hex			
226	1110 0010	E2	S			
227	1110 0011	E3	T			
228	1110 0100	E4	U			
229	1110 0101	E5	V			
230	1110 0110	E6	W			
231	1110 0111	E7	X			
232	1110 1000	E8	Y			
233	1110 1001	E9	Z			
234	1110 1010	EA	hex			
235	1110 1011	EB	hex			
236	1110 1100	EC	⌐		-*	
237	1110 1101	ED	hex			
238	1110 1110	EE	hex			
239	1110 1111	EF	hex			
240	1111 0000	F0	0			
241	1111 0001	F1	1			
242	1111 0010	F2	2			
243	1111 0011	F3	3			
244	1111 0100	F4	4			
245	1111 0101	F5	5			
246	1111 0110	F6	6			
247	1111 0111	F7	7			
248	1111 1000	F8	8			
249	1111 1001	F9	9			
250	1111 1010	FA	!		/*	
251	1111 1011	FB	hex			
252	1111 1100	FC	hex			
253	1111 1101	FD	hex			
254	1111 1110	FE	hex			
255	1111 1111	FF	hex			

*Use CNTL Key in conjunction with symbol.

Baudot Character Conversion Table

Dec Value	Binary	Hex	Unshifted Characters (letters)	Shifted Characters (figures)
0	0 0000	00	NU	NU
1	0 0001	01	E	3
2	0 0010	02	LF	LF
3	0 0011	03	A	-
4	0 0100	04	(space)	(space)
5	0 0101	05	S	'
6	0 0110	06	I	8
7	0 0111	07	U	7
8	0 0100	08	CR	CR
9	0 1001	09	D	$
10	0 1010	0A	R	4
11	0 1011	0B	J	BL
12	0 1100	0C	N	,
13	0 1101	0D	F	!
14	0 1110	0E	C	:
15	0 1111	0F	K	
16	1 0000	10	T	5
17	1 0001	11	Z	"
18	1 0010	12	L	)
19	1 0011	13	W	2
20	1 0100	14	H	#
21	1 0101	15	Y	6
22	1 0110	16	P	0
23	1 0111	17	Q	1
24	1 1000	18	O	9
25	1 1001	19	B	?
26	1 1010	1A	G	&
27	1 1011	1B (figs)	SO (shift out)	SO (shift out)
28	1 1100	1C	M	.
29	1 1101	1D	X	/
30	1 1110	1E	V	;
31	1 1111	1F (LTRS)	SI (shift in)	SI shift in

EBCD Character Conversion Table

Dec Value	Binary	Hex	Unshifted Characters	Shifted Characters
0	00 0000	00	space	‹space›
1	00 0001	01	-	—
2	00 0010	02	@	‹hex› (¢)
3	00 0011	03	&	+
4	00 0100	04	8	*
5	00 0101	05	q	Q
6	00 0110	06	y	Y
7	00 0111	07	h	H
8	00 1000	08	4	:
9	00 1001	09	m	M
10	00 1010	0A	u	U
11	00 1011	0B	d	D
12	00 1100	0C	‹hex› ‹PN	‹hex› ‹PN
13	00 1101	0D	‹hex› ‹RES	‹hex› ‹RES›
14	00 1110	0E	‹hex› ‹BYP›	‹hex› ‹BYP›
15	00 1111	0F	‹hex› ‹PF	‹hex› ‹PF›
16	01 0000	10	2	<
17	01 0001	11	k	K
18	01 0010	12	s	S
19	01 0011	13	b	B
20	01 0100	14	O	,
21	01 0101	15	VT	VT
22	01 0110	16	FF	FF
23	01 0111	17	‹hex›	‹hex
24	01 1000	18	6	,
25	01 1001	19	o	O
26	01 1010	1A	w	W
27	01 1011	1B	f	F
28	01 1100	1C UC	SO ‹shift out›	SO ‹shift out›
29	01 1101	1D	BS	BS
30	01 1110	1E	EB	EB
31	01 1111	1F LC	SI ‹shift in›	SI ‹shift in›
32	10 0000	20	1	-
33	10 0001	21	j	J
34	10 0010	22	/	?
35	10 0011	23	a	A
36	10 0100	24	9	
37	10 0101	25	r	R
38	10 0110	26	z	Z
39	10 0111	27	i	I
40	10 1000	28	5	%
41	10 1001	29	n	N
42	10 1010	2A	v	V
43	10 1011	2B	e	E

EBCD Character Conversion Table (Cont'd)

Dec Value	Binary	Hex	Unshifted Characters	Shifted Characters
44	10 1100	2C	RS	RS
45	10 1101	2D	CR	CR
46	10 1110	2E	LF	LF
47	10 1111	2F	HT	HT
48	11 0000	30	3	;
49	11 0001	31	I	L
50	11 0010	32	t	T
51	11 0011	33	c	C
52	11 0100	34	#	"
53	11 0101	35	$	!
54	11 0110	36	,	,
55	11 0111	37	.	.
56	11 1000	38	7	>
57	11 1001	39	p	P
58	11 1010	3A	x	X
59	11 1011	3B	g	G
60	11 1100	3C	ET	ET
61	11 1101	3D	‹hex› ‹IL›	‹hex› ‹IL›
62	11 1110	3E	ESC	ESC
63	11 1111	3F	▨ ‹DEL›	▨ ‹DEL›

Transcode Character Conversion Table

Dec Value	Binary	Hex	Displayed Characters	Keyboard Mnemonic
0	00 0000	00	SH	SOH
1	00 0001	01	A	
2	00 0010	02	B	
3	00 0011	03	C	
4	00 0100	04	D	
5	00 0101	05	E	
6	00 0110	06	F	
7	00 0111	07	G	
8	00 1000	08	H	
9	00 1001	09	I	
10	00 1010	0A	SX	STX
11	00 1011	0B	.	
12	00 1100	0C	<	
13	00 1101	0D	BL	BEL
14	00 1110	0E	SB	SUB
15	00 1111	0F	EB	ETB
16	01 0000	10	&	
17	01 0001	11	J	
18	01 0010	12	K	
19	01 0011	13	L	
20	01 0100	14	M	
21	01 0101	15	N	
22	01 0110	16	O	
23	01 0111	17	P	
24	01 1000	18	Q	
25	01 1001	19	R	
26	01 1010	1A	‹space	
27	01 1011	1B	$	
28	01 1100	1C	*	
29	01 1101	1D	US	US
30	01 1110	1E	ET	EOT
31	01 1111	1F	DL	DLE
32	10 0000	20	-	
33	10 0001	21	/	
34	10 0010	22	S	
35	10 0011	23	T	
36	10 0100	24	U	
37	10 0101	25	V	
38	10 0110	26	W	
39	10 0111	27	X	
40	10 1000	28	Y	
41	10 1001	29	Z	
42	10 1010	2A	EC	ESC
43	10 1011	2B	,	

Transcode Character Conversion Table (Cont'd)

Dec Value	Binary	Hex	Displayed Characters	Keyboard Mnemonic
44	10 1100	2C	%	
45	10 1101	2D	EQ	ENQ
46	10 1110	2E	EX	ETX
47	10 1111	2F	HT	HT
48	11 0000	30	0	
49	11 0001	31	1	
50	11 0010	32	2	
51	11 0011	33	3	
52	11 0100	34	4	
53	11 0101	35	5	
54	11 0110	36	6	
55	11 0111	37	7	
56	11 1000	38	8	
57	11 1001	39	9	
58	11 1010	3A	SY	SYN
59	11 1011	3B	#	
60	11 1100	3C	@	
61	11 1101	3D	NK	NAK
62	11 1110	3E	EM	EM
63	11 1111	3F	▨	DEL

APPENDIX E
OSI LEVEL 2 AND 3 TABLES
Level 2: The Data Link Interface

CHARACTER ORIENTED PROTOCOLS: BSC

| SYN | SYN | SOH | Header | STX | Text | ITB / ETX / ETB | BCC | BCC |

BIT ORIENTED PROTOCOLS

| Flag | Address | Control | Data | FCS | FCS | Flag |

Flags: Flags (7E) act as frame delimiters

Address Field: Command frames contain receiving station's address. Response frames contain sending station's address.

Control Field: Identifies function and purpose of the frame. Contains commands, responses, and sequence numbers.

Information Field: Any number of bits, typically in multiples of 8 (octets).

FCS: Frame Checking Sequence for Error Detection.

TYPES OF BOP FRAMES (Indicated by the following control fields)

1. **Information (I) Frames:** For transferring information.

| N(R) | P/F | N(S) | 0 |

2. **Supervisory (S) Frames:** To acknowledge I frames, request re-transmission of I frames, and to communicate status (busy, ready).

Receive Ready (RR)

| N(R) | P/F | 0 0 | 0 1 |

Reject (REJ)

| N(R) | P/F | 0 1 | 0 1 |

Receive Not Ready (RNR)

| N(R) | P/F | 1 0 | 0 1 |

Selective Reject (SREJ)

| N(R) | P/F | 1 1 | 0 1 |

3. **Unnumbered (U) Frames:** To issue commands and responses.

| Type | P/F | Type | 1 1 |

UNNUMBERED FORMAT COMMANDS (P=Poll, F=Final)

Control Field Bits	Mnemonic	Name
msb lsb		
1 0 0 P 0 0 1 1	SNRM	Set Normal Response Mode
0 0 0 P 0 0 1 1	SARM	Set Asynchronous Response Mode
0 0 1 P 1 1 1 1	SABM	Set Asynchronous Balanced Mode
1 1 0 P 1 1 1 1	SNRME	Set Normal Response Mode Extended
0 1 0 P 1 1 1 1	SARME	Set Asynchronous Response Mode Extended
0 1 1 P 1 1 1 1	SABME	Set Asynchronous Balanced Mode Extended
0 0 0 P 0 1 1 1	SIM	Set Initialization Mode
0 1 0 P 0 0 1 1	DISC	Disconnect
0 0 0 P 0 0 1 1	UI	Unnumbered Information
0 0 1 P 0 0 1 1	UP	Unnumbered Poll
1 0 0 P 1 1 1 1	RSET	Reset
1 0 1 P 1 1 1 1	XID	Exchange Identification

UNNUMBERED FORMAT RESPONSES

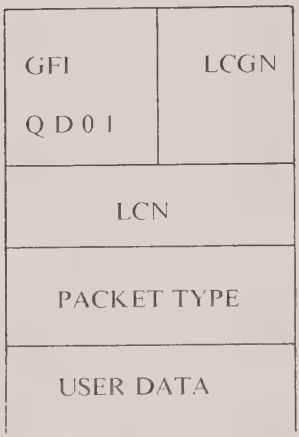
0 1 1 F 0 0 1 1	UA	Unnumbered Acknowledgement
0 0 0 F 1 1 1 1	DM	Disconnected Mode
0 0 0 F 0 1 1 1	RIM	Request Initialization Mode
0 0 0 F 0 0 1 1	UI	Unnumbered Information
1 0 0 F 0 1 1 1	FRMR	Frame Reject
1 0 1 F 1 1 1 1	XID	Exchange Identification
0 1 0 F 0 0 1 1	RD	Request Disconnect

SAMPLE MONITOR MENU TRIGGERS ("x" = don't care)

When DTE	Trigger on data from the DTE
When DTE (flag) 0_1	Address (second byte)
When DTE (flag) 0_1 xxxxxxxx	Control Field, don't cares (3rd byte)
When DTE (flag) 0_1 xxxxxx11	U-Frame
When DTE (flag) 0_1 100x0011	Type of U-Frame = SNRM
When DTE (flag) 0_1 10010011	Poll bit set to 1
When DTE (flag) 0_3 xxxx0001	S-Frame
When DTE (flag) 0_3 10110001	S-Frame, Type=RR, N(R)=5, P/F=1
When DTE (flag) 0_3 00100010	I-Frame, N(R)=1, N(S)=1, P/F=0 (This is an I-Frame)

Level 3

PACKET CONSTRUCTION (MODULO 8)



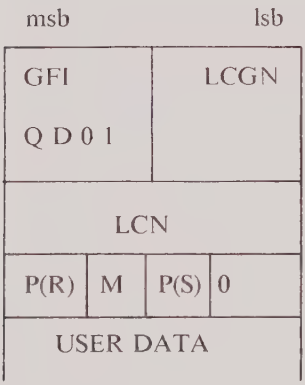
Packet Types RRR=N(R), SSS=N(S)

	msb lsb
Data	RRRMSSS0
Call Request	00001011
Call Accepted	00001111
Clear Request	00010011
Clear Confirmation	00010111
Interrupt	00100011
Interrupt Conf.	00100111
Receive Ready	RRR00001
Receive Not Ready	RRR00101
Reject	RRR01001
Reset Request	00011011
Reset Confirmation	00011111
Restart Request	11111011
Restart Conf.	11111111
Diagnostic	11110001

LCGN = Logical Channel Group Number
LCN = Logical Channel Number
Logical Channel Identifier = LCN + LCGN
P(R) = Next Receive Packet Expected
P(S) = Packet Send Sequence Number
M-bit = More Data Bit
Q-bit = Data Qualifier Bit
D-bit = Delivery Confirmation Bit

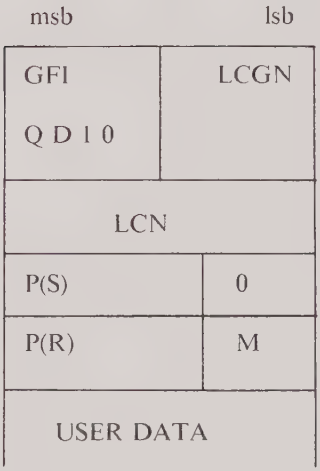
DATA PACKETS

MODULO 8



Octet 1
Octet 2
Octet 3
Octet 4

MODULO 128



CALL REQUEST/ INCOMING CALL PACKET

GFI	LCGN	Octet 1
LCN		Octet 2
0 0 0 0 1 0 1 1		Octet 3
Calling DTE Address Length	Called DTE Address Length	Octet 4
Called DTE Address		Octet 5
Calling DTE Address		Octet 6
0 0	Facility Field Length	Octet 7
Facility Codes and Parameters		Octet 8
Call User Data		

CALL ACCEPTED/ CALL CONNECTED PACKET

GFI	LCGN
LCN	
0 0 0 0 1 1 1 1	
Calling DTE Address Length	Called DTE Address Length
Called DTE Address	
Calling DTE Address	
0 0	Facility Field Length
Facilities	

APPENDIX F
EXAMPLES

EXAMPLE 1 MEASURING A SINGLE RTS-CTS DELAY

This test measures the time from when RTS goes on until CTS goes on. Use the <Monitor> menu for this example.

To view the timers and counters, press <Summary> during run-time, or <Timer & Cntr> in the Examine Data Menu after run-time.

Note that timer measurements must be referenced to a preceding trigger for accurate measurements.

PROGRAM		DESCRIPTION
Block 1:	When Lead RTS goes On then goto Block 2	
Block 2:	Start Timer 1	Timer 1 indicates RTS-CTS delay.
	When Lead CTS goes On then goto Block 3	Note that Start and Stop statements must be preceded by When statements for accurate timing.
Block 3:	Stop Tests	

EXAMPLE 2 MONITORING A DCE

In this example, you monitor a DCE by simulating the DTE through the <Simulate> menu. When simulating a DTE, the HP 4951B supplies the ETC clock. Upon receiving the proper clocks and lead commands, the DCE begins sending data, which the HP 4951B automatically stores and displays while in the simulate mode.

```
Simulate DTE

Block 1:      Set Lead DTR  On
                 and then

              Set Lead RTS  On
```

EXAMPLE 3 MONITORING A DTE

In this example, you monitor a DTE by simulating a DCE. When simulating a DCE, the HP 4951B automatically supplies both the TC and RC clocks. Upon receiving the proper clocks and lead commands, the DTE begins sending data, which the HP 4951B automatically stores and displays while in the simulate mode.

```
Simulate DCE

Block 1:      Set Lead DSR  On
                 and then
              Set Lead CD  On
                 and then
              Set Lead CTS  On
```

EXAMPLE 4 FOX MESSAGE

This test checks the ability of asynchronous terminals and printers to receive and display data. The "FOX" message is transmitted to the terminal using the <Simulate> menu and then the echo from the terminal is checked for parity errors.

```
Simulate DCE

Block 1:    Send THE QUICK BROWN FOX
            JUMPS OVER A LAZY DOG 012
            3456789.

Block 2:    When Error Parity on DTE
              then goto Block 3
            When DCE .
              then goto Block 1

Block 3:    Increment Counter 1
              and then
            Goto Block 2
```

EXAMPLE 5 COUNTING PARITY ERRORS

This program uses the <Monitor> menu to count the number of parity errors on both the DTE and DCE lines and keep track of the number of minutes of the test.

Block 1:	When DTE X or When DCE X then goto Block 2	Timer 5 starts when any character is sent on the DTE or DCE line. ("X" = don't care.)
Block 2:	Start Timer 5	Timer 5 counts milliseconds up to one minute.
Block 3:	When Error Parity on DTE then goto Block 4 When Error Parity on DCE then goto Block 5 When Timer 5 is > 59999 then goto Block 6	
Block 4:	Increment Counter 1 and then Goto Block 3	Counter 1 indicates DTE errors.
Block 5:	Increment Counter 2 and then Goto Block 3	Counter 2 indicates DCE errors.
Block 6:	Increment Counter 5 and then Reset Timer 5 and then Goto Block 2	Counter 5 keeps track of the number of minutes into the test.

EXAMPLE 6 MEASURING MORE THAN ONE RTS-CTS DELAY

This test measures RTS-CTS delays until stopped. Use the <Monitor> Menu for this example.

Timer 1 and Timer 2 measure alternate delays. If only one timer were used, you would not have had enough time to see the timer before it was reset.

To view the timers and counters press <Summary> in the Run Menu during run-time. After run-time press <Timer & Counter> in the Examine Data Menu.

```
Block 1:    When Lead RTS goes On
              then goto Block 2

Block 2:    Reset Timer 1                    Timer 1 measures the first
              and then                       RTS-CTS delay.
            Start Timer 1

            When Lead CTS goes On            The two "When" statements
              then goto Block 3              are ORed together.
            When Lead RTS goes Off
              then goto Block 6

Block 3:    Stop Timer 1

            When Lead RTS goes On            You can now view timer 1
              then goto Block 4              while the analyzer finds
                                             the next delay.
```

Block 4:	Reset Timer 2 and then Start Timer 2	Blocks 3-5 duplicate blocks 1-2. Timer 2 now measures the next RTS-CTS delay. Thus,
	When Lead CTS goes On then goto Block 5	the user has time to view timer 1 before it is reset.
	When Lead RTS goes Off then goto Block 6	The two "When" statements are ORed.
Block 5:	Stop Timer 2 and then Goto Block 1	Control is looped back to Block 1.
Block 6:	Reset Timer 1 and then Reset Timer 2 and then Beep and then Goto Block 1	If RTS goes off before CTS goes on the timers are reset and an alarm "beep" occurs.

EXAMPLE 7 SIMULATING RTS-CTS DELAY

In this test, you substitute the HP 4951B for the DTE. Thus, you can test the modem in isolation.

Timer 1 measures the time it takes for the modem to respond with CTS on.

```
Simulate DTE

Block 1:    Set Lead RTS On

            When Lead RTS goes On
              then goto Block 2

Block 2:    Reset Timer 1
              and then
            Start Timer 1
              and then
            Start Timer 5

            When Lead CTS goes On
              then goto Block 3
            When Timer 5 > 2000
              then goto Block 4
```

Timer 1 is reset because the program later loops back to this block.

Timer 1 shows CTS response time.

Timer 5 causes the instrument to beep if CTS does not go on within 2 seconds

Block 3:	Reset Timer 5 and then Stop Timer 1 and then Set Lead RTS Off and then Wait 29999 and then Goto Block 1	RTS is now turned off and the test begun again after 30 seconds. (You can change this delay.)
Block 4:	Reset Timer 5 and then Reset Timer 1 and then Beep and then Set Lead RTS Off and then Wait 250 and then Goto Block 1	Block 4 is the "error block". If CTS does not go on two seconds after RTS goes on, the analyzer beeps and restarts the test.

EXAMPLE 8 LOOPBACK

In this test, the local modem is looped back. The HP 4951B is substituted for the DTE and sends the "Quick Brown Fox" message 100 times. The modem is checked for proper handshaking and echo response.

```
Simulate DTE

Block 1:    Set Lead RTS On
              and then
            Start Timer 5

            When Lead CTS goes On                 The modem is checked for
              then goto Block 2                   correct handshaking response.

            When Timer 5 is > 2000                Timer 5 indicates whether the modem
              then goto Block 8                   responds within 2 seconds.

Block 2:    Reset Timer 5                         Timer 5 is reset for the next loop.
              and then
            Send THE QUICK BROWN FOX              The message is sent to the
            JUMPS OVER A LAZY DOG 012             modem.
            3456789.
              and then
            Set lead RTS Off
```

Block 3:	When DCE THE QUICK BROWN FOX JUMPS OVER A LAZY DOG 0123456789 then goto Block 5	The modem is checked to see whether it echoes back each character.
	When Lead CTS goes Off then goto Block 4	Because the two "When" statements are ORed, every character must be received before CTS goes off.
Block 4:	Increment Counter 2	Counter 2 indicates the number of times this does not happen.
Block 5:	Increment Counter 1	Counter 1 shows the total number of transactions up to 100.
	If Counter 1 is > 99 then goto Block 7	
Block 6:	Goto Block 1	The test starts over.
Block 7:	Stop Tests	
Block 8:	Reset Timer 5 and then Beep and then Goto Block 1	An alarm "beep" indicates a lack of modem response.

EXAMPLE 9 END-TO-END: TRANSMIT FIRST (HP 4925A Compatible)

The End-to-End test consists of the two programs described in Examples 9 and 10.

In the End-to-End Test, two HP 4951B's (or an HP 4951B and an HP 4925A) are substituted for the DTE's at both ends of a line. Handshaking and messages are performed and checked 100 times. Except for the fact that one DTE transmits first, and the other DTE receives first, both programs are identical. There are two sections to this program: In blocks 5-6 this DTE is transmitting; in blocks 1-4 this DTE is receiving. Counter 1 indicates how many times the test failed. Counter 2 indicates the total number of transactions.

NOTE: The "receive first" unit must be started first.

The proper setup is necessary for this test. Use the Char Async/Sync Menu with all the default selections (Chapter 12) except the following:

Data Code Hex 8 Drop sync 4 chrs after $1_8\ 1_8\ 1_8\ 1_8\ 1_8\ 1_8\ 1_8$

Sync on $F_F\ 9_3$

```
Simulate DTE

Block 1:    Goto Block 6                    The program immediately
                                            jumps to the transmit
                                            section.

Block 2:    Set Lead DTR On
            If Lead CD is On                The If and When statements
              then goto Block 3             are ORed.
            When Lead CD goes On
              then goto Block 3
```

Block 3:	When Lead CD goes Off then goto Block 4 When DCE $^{7}_{6}$ $^{B}_{3}$ $^{F}_{A}$ $^{4}_{1}$ then goto Block 5	The two When statements are ORed: If CD goes off before the message is received, then the error counter is incremented. The DCE characters are the same as those sent by the HP 4925A
Block 4:	Beep and then Increment Counter 1	
Block 5:	Increment Counter 2	Counter 2 tells total transactions.
Block 6:	Wait 100 msec and then Set Lead RTS On If Lead CTS is On then goto Block 7 When Lead CTS goes On then goto Block 7	The transmit section of the program begins.
Block 7:	Send $^{F}_{F}$ $^{9}_{3}$ $^{7}_{6}$ $^{B}_{3}$ $^{F}_{A}$ $^{4}_{1}$ $^{1}_{8}$ When DTE $^{1}_{8}$ then goto Block 8	This is the same message sent by a HP 4925A
Block 8:	Set Lead RTS Off If Counter 2 > 99 then goto Block 10	When Counter 2 reaches 100, the test is ended.
Block 9:	Goto Block 2	
Block 10:	Stop Tests	

EXAMPLE 10 END-TO-END: RECEIVE FIRST (HP 4925A Compatible)

This is the part of the END-TO-END TEST for the DTE which receives first. There are two sections to the program: In blocks 1-4 the DTE is transmitting; in blocks 5-6 the DTE is receiving. Counter 2 tells how many times the test failed. Counter 1 keeps track of the total number of transactions.

NOTE: The "receive first" unit must be started first.

Use the Char Async/Sync Menu for the setup. Use all the default selections (see Chapter 12) except the following:

Data Code Hex 8 Drop sync 4 chrs after $1_8\ 1_8\ 1_8\ 1_8\ 1_8\ 1_8\ 1_8$

Sync on $F_F\ 9_3$

```
Simulate DTE

Block 1:    Set Lead DTR On                    This is the Receive portion
                                               of the End-to-End test.
            If Lead CD is On
              then goto Block 2
            When Lead CD goes On
              then goto Block 2

Block 2:    When Lead CD goes Off              These two When statements
              then goto Block 3                are Ored.  If CD goes off
            When DCE 7 B F 4                   before this DTE has
                     6 3 A 1                   received the message,
              then goto Block 4                Counter 1 will indicate
                                               another failure.
```

Examples

Block 3:	Beep and then Increment Counter 1	
Block 4:	Increment Counter 2	Counter 2 indicates another transaction.
Block 5:	Wait 100 msec and then Set Lead RTS On	The transmit section of the program begins.
	If Lead CTS is On then goto Block 6 When Lead CTS goes On then goto Block 6	
Block 6:	Send $^{F}_{F}$ $^{9}_{3}$ $^{7}_{6}$ $^{B}_{3}$ $^{F}_{A}$ $^{4}_{1}$ $^{1}_{8}$	This is the same message as that sent by an HP 4925A
	When DTE $^{1}_{8}$ then goto Block 7	
Block 7:	Set Lead RTS Off	
	If Counter 2 > 99 then goto Block 9	When the total transactions = 100 the test is ended.
Block 8:	Goto Block 1	
Block 9:	Stop Tests	

APPENDIX G
SERVICE INFORMATION
POWER REQUIREMENTS

WARNING (voltage selection)

Before connecting this instrument to the line voltage, be sure the line voltage selector is set correctly. The voltage selection appears in a window above the power cord jack on the back panel. Damage to the instrument may occur if the line voltage selector is set to an incorrect voltage or if the wrong fuse is installed. See pages G-2 and G-3 for procedures on replacing the fuse and changing the voltage selection.

WARNING (grounding)

Before connecting this instrument to line voltage, the protective earth terminal of the instrument must be connected to the protective conductor of the main power cable. The main plug must be inserted in a socket outlet provided with a protective earth contact. The protective conductor must not be negated by the use of an extension cord without a protective grounding conductor. Grounding one conductor of a two-conductor outlet does not provide an instrument ground.

POWER CABLE

The instrument power cable has three wires. When connected to an appropriate power receptacle, this cable grounds the instrument cabinet. The type of power cable shipped with each instrument depends on the country of destination (see Table G-1). If the appropriate power cable is not included with the instrument, notify the nearest Hewlett-Packard Sales and Service office for a replacement.

LINE VOLTAGE SELECTION

The line voltage selector is located on the back panel, just above the line plug jack. The present voltage selected shows through the window in the cover.

There are four possible voltage selections: 100Vac, 120Vac, 220Vac, 240Vac. The HP 4951B allows a +/- 10% variance from these voltages. Generally, if your voltage is between two of these voltages, select the next higher voltage.

To change the voltage selector:

1. Unplug the instrument and remove the line cord from the instrument.

2. Insert a small screwdriver into the slot at the top of the cover. Pry out the cover from the top.

3. Remove the selector cam above the fuse. The dark plastic rotary cam is imprinted with the four possible line voltages: 100Vac, 120Vac, 220Vac, 240Vac.

4. Re-insert the cam with the desired voltage facing directly out. When you close the cover, the selected voltage should appear in the cover window.

CHANGING FUSES

The fuse is located behind the same back panel cover as the voltage selector cam. The fuse (HP #2110-0421) is a Time Delay fuse rated at .375A, 250V (type designator 2B250.375A). Use the same fuse for all four voltage selections.

To change the fuse:

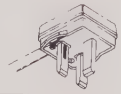
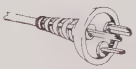
1. Unplug the instrument and remove the line cord from the instrument.

2. Insert a small screwdriver into the slot at the top of the cover. Pry out the cover from the top.

3. Pull out the light gray fuse holder located under the voltage selector cam. Replace the fuse.

4. Re-insert the fuse holder with the arrow facing in the same direction as the two arrows on the cover.

5. Close the cover. Make sure the desired voltage is still visible in the window.

Plug Type	Cable HP Part Number	CD	Plug Description	Cable Length (inches)	Cable Color	For Use In Country
250V 	8120-1351 8120-1703	0 6	Straight *BS1363A 90°	90 90	Mint Gray Mint Gray	United Kingdom Cyprus, Nigeria, Rhodesia, Singapore
250V 	8120-1369 8120-0696	0 4	Straight *NZSS198/ASC112 90°	79 87	Gray Gray	Australia New Zealand
250V 	8120-1689 8120-1692	7 2	Straight *CEE7-Y11 90°	79 79	Mint Gray Mint Gray	East and West Europe Saudi Arabia, Egypt So Africa, India unpolarized in many nations
125V 	8120-1348 8120-1398 8120-1754 8120-1378 8120-1521 8120-1676	5 5 7 1 6 2	Straight *NEMA5-15P 90° Straight *NEMA5-15P Straight *NEMA5-15P 90° Straight *NEMA5-15P	80 80 36 80 80 36	Black Black Black Jade Gray Jade Gray Jade Gray	United States, Canada Japan (100V or 200V), Mexico Philippines Taiwan
250V 	8120-2104	3	Straight *SEV1011 1959-24507 Type 12	79	Gray	Switzerland
250V 	8120-0698	6	Straight *NEMA6-15P			United States Canada
220V 	8120-1957 8120-2956	2 3	Straight *DHCK 107 90°	79 79	Gray Gray	Denmark
250V 	8120-1860	6	Straight *CEE22 VI (Systems Cabinet use			

*Part number shown for plug is industry identifier for plug only. Number shown for cable is HP Part Number for complete cable including plug.
E = Earth Ground, L = Line, N = Neutral

Table G-1. Power Cable Part Numbers

ADJUSTMENTS

There are no operator adjustments for the HP 4951B. Any internal adjustments must be made by a qualified service person.

PERFORMANCE VERIFICATION

Every time you turn the instrument on, self tests are automatically performed. These tests are completed in about 10 seconds. When the self tests are complete, the Top Level Menu is displayed. If the instrument comes up in the Top Level Menu, functional operation of 95% of the analyzer is verified. If there is a failure, the instrument does not come up in the Top Level Menu; instead it displays the failures that occurred during the self-test sequence.

The automatic turn-on self test check everything in the analyzer except the following:

1. Keyboard. Use the keyboard test on page G-8.
2. Tape drive. Use the tape I/O test on page G-6.
3. Interface pod. Use the interface pod test on page G-9.

TAPE I/O TEST

Tape board and drive failures are not displayed after the automatic self test. However, if files can be loaded and stored correctly, the proper functioning of the tape mechanism is verified. To detect a tape failure, merely store data or menus onto tape, press <Reset> to re-initialize the menus and clear memory, and then load the same file back into the instrument. The menus and data should be the same as when they were stored. A typical procedure would be like the following two checks.

Tape Drive Check

1. Insert a blank tape cartridge into the tape slot.

2. Press <Mass Store> on the Top Level Menu

3. In the mass store menu, press <Tension>. The tape will be rewound, fast-forwarded, and then rewound. You should be able to hear the tape running; and after a few moments, the tape should stop.

4. You should be using a blank tape, or one that does not contain files you wish to keep. In the mass store menu, press <Init> and then <Execute>.

Tape Read/Write Check

To check the tape board I/O circuits, modify one of the menus, store the menus to tape, re-initialize the menus, and then load the menus back into the instrument. In this example, we will modify the simulate menu.

1. In the simulate menu, press <DTE> and then <Send>. Type in some message, such as "The quick brown fox jumped over the lazy dog". Press EXIT to return to the Top Level Menu.

2. In the mass store menu, press <Init> and then <Execute>. Do not initialize the tape if it contains files you wish to keep.

3. In the mass store menu, press <Store>, type in a file name, and select <Menus> for the file type. Press <Execute>.

4. Once the menus are stored on tape, press <Reset> on the Top Level Menu to erase your previous simulate menu entries.

5. In the mass store menu, press <Load>, type in the file name you used when storing, and press <Execute>.

6. The simulate menu should contain your previous entries.

KEYBOARD TEST

The keyboard test verifies that the HP 4951B correctly identifies each key pressed.

Setup

1. Turn on the HP 4951B
2. Press MORE
3. Press the <Self Test> softkey in the Top Level Menu.
4. Press <KBD Test>.

Procedure

1. Press any key on the keyboard.
2. The display should read: LAST KEY PRESSED: "(name of key is displayed)".

   Note: The RETURN key effectively performs the same operation as "cursor down". When the RETURN key is pressed, CURSOR DOWN is displayed.
3. Press EXIT to end the test and display the self-test menu.

INTERFACE POD TEST

Description

This test checks the DLC (data link controller), the interface cable from the instrument to the pod, and the interface pod itself. It does not check the LCD (or LED) indicators and their drivers.

Setup

1. Press MORE in the Top Level Menu.
2. Press the <Self Test> softkey.
3. Press <Ext DLC>.

Procedure

When the <Ext DLC> softkey is pressed, the Interface Pod test is automatically performed. If the test passes, then "DLC Test Passed" will be displayed. Otherwise one of the following messages will appear:

No pod attached
DTE failed
DCE failed

Press EXIT to return to the Self Test Menu.

CRT TEST

Press <Self Test> in the Top Level Menu. Select <CRT Tests> and then <Test Ptrn>. The test pattern should look like the following:

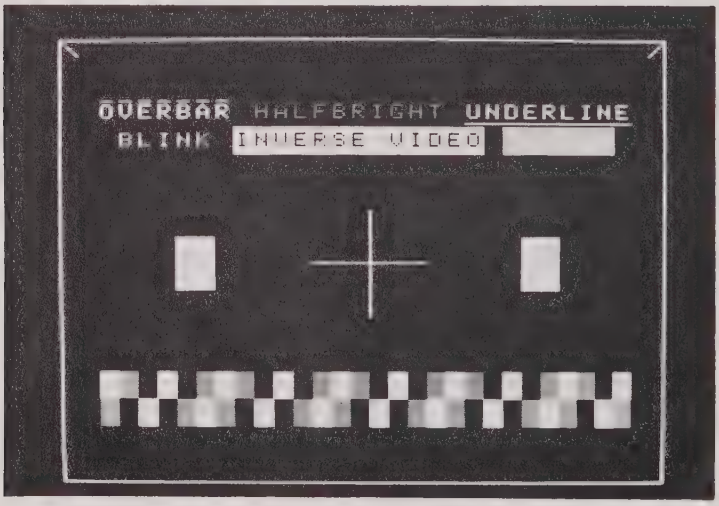


Figure G-2. CRT Test Pattern

PACKAGING

If the instrument is returned to Hewlett-Packard for service, complete one of the blue repair tags located in the back of this manual or in the pouch and attach it to the instrument.

Original Packaging

Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for service, attach a tag indicating the type of service required, return address, model number, and full serial number. Mark the container FRAGILE to ensure careful handling. In correspondence, refer to the instrument by model number and full serial number.

Other Packaging

Wrap the instrument in heavy paper or plastic. Use a strong shipping container: a double-walled carton made of 350-pound test material is suitable. Use a layer of shock-absorbing material 70-to 100mm (3 to 4 inches) thick around the sides of the instrument to provide firm cushioning and to prevent movement inside the container. Seal the container securely. Mark shipping container FRAGILE to ensure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

APPENDIX H
JIS OPTION

Introduction

The JIS option for the HP 4951B lets you display the JIS-7, JIS-8 or EBCDIK Katakana Data Codes during protocol analysis. This is a ROM replacement option which provides a character ROM for the Katakana character dot patterns and four System Code ROMs. See the HP 4951B Service Manual for more information.

Using the JIS Option

THE SETUP MENU

The HP 4951B functions normally in all respects with this option except that Data Code field choices EBCD, Transcode and IPARS are replaced with JIS-8, JIS-7 and EBCDIK. Thus, the JIS Option modifies the Setup menu depending on the protocol.

The HDLC, SDLC and X.25 protocol menus add the choice of JIS-8 and EBCDIK to the choices of HEX-8, EBCDIC and ASCII-8 to the Data Code field.

The Character Async/Sync menu replaces the EBCD, IPARS0, IPARS1 and Transcode Data Field choices with the JIS-7, JIS-8 and EBCDIK choices.

The BSC menu replaces the Transcode Data Code choice with the JIS-8 and EBCDIK choices. Also, the defaults for Sync Chars and Parity are set to $^{1}_{6}$ $^{1}_{6}$ and None for JIS-8, and $^{3}_{2}$ $^{3}_{2}$ and None for EBCDIK.

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Using the JIS Option

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The HDLC, SDLC and X.25 protocol menus add the choice of JIS-8 and EBCDIK to the choices of HEX-8, EBCDIC and ASCII-8 to the Data Code field.

The Character Async/Sync menu replaces the EBCD, IPARS0, IPARS1 and Transcode Data Field choices with the JIS-7, JIS-8 and EBCDIK choices.

The BSC menu replaces the Transcode Data Code choice with the JIS-8 and EBCDIK choices. Also, the defaults for Sync Chars and Parity are set to $^{1}_{6}$ $^{1}_{6}$ and None for JIS-8, and $^{3}_{2}$ $^{3}_{2}$ and None for EBCDIK.

MONITOR/SIMULATE MENU

Trigger strings and Send strings both function in a similar manner. ASCII control and text characters may be entered from the keyboard for JIS-8 and JIS-7. Katakana characters must be entered in hex code ($^{A}_{0}$ through $^{D}_{F}$). A Katakana character can be viewed by moving the cursor to the character and pressing the <Text> softkey. JIS-7 characters should be entered with the 8th bit set and sent after conversion to Text mode. This allows the parity bit to be set correctly.

Control and text characters in EBCDIK (excluding lower case) may be entered from the keyboard in Text mode. Katakana characters should be entered in Hex mode and converted as above. Some Katakana characters can be entered by typing lower case letters in Text mode.

Character conversion tables for JIS-7, JIS-8 and EBCDIK start on the next page.

RUN MENU AND EXAMINE DATA

Data containing Katakana characters is displayed when any operation except BERT is selected in the Run Menu and in Examine Data. JIS-8 and EBCDIK characters are displayed automatically and corresponding Hex values are displayed as described above. JIS-7 characters are displayed by looking for SHIFT IN (SI) and SHIFT OUT (SO) characters as the data is entering the box and keeping track of which mode the data is in. If the data is in the shifted mode the eighth bit of the data is set before being stored in the buffer. The JIS-7 data now appears as JIS-8 data except for codes $^{8}_{0}$ to $^{9}_{F}$ which appear as the ASCII control characters. If the Hex format is selected in either the Run Menu or Examine Data, the eighth bit is masked out and the correct Hex value for JIS-7 is displayed. Parity is checked but not stored.

Character conversion tables for JIS-7, JIS-8 and EBCDIK start on the next page.

AUTO CONFIGURE

Using Auto Configure causes JIS-8 to be selected instead of ASCII-8, JIS-7 instead of ASCII-7, and EBCDIK instead of EBCDIC for the system Data Code.

JIS-7 Character Conversion Table

Dec Value	Binary	Hex	Displayed Character	Dec Value	Binary	Hex	Displayed Character
0	000 0000	00	NU	45	010 1101	2D	ユ
1	000 0001	01	SH	46	010 1110	2E	ヨ
2	000 0010	02	SX	47	010 1111	2F	ッ
3	000 0011	03	EX	48	011 0000	30	ー
4	000 0100	04	ET	49	011 0001	31	ア
5	000 0101	05	EQ	50	011 0010	32	イ
6	000 0110	06	AK	51	011 0011	33	ウ
7	000 0111	07	BL	52	011 0100	34	エ
8	000 1000	08	BS	53	011 0101	35	オ
9	000 1001	09	HT	54	011 0110	36	カ
10	000 1010	0A	LF	55	011 0111	37	キ
11	000 1011	0B	VT	56	011 1000	38	ク
12	000 1100	0C	FF	57	011 1001	39	ケ
13	000 1101	0D	CR	58	011 1010	3A	コ
14	000 1110	0E	SO	59	011 1011	3B	サ
15	000 1111	0F	SI	60	011 1100	3C	シ
16	001 0000	10	DL	61	011 1101	3D	ス
17	001 0001	11	D1	62	011 1110	3E	セ
18	001 0010	12	D2	63	011 1111	3F	ン
19	001 0011	13	D3	64	100 0000	40	タ
20	001 0100	14	D4	65	100 0001	41	チ
21	001 0101	15	NK	66	100 0010	42	ツ
22	001 0110	16	SY	67	100 0011	43	テ
23	001 0111	17	EB	68	100 0100	44	ト
24	001 1000	18	CN	69	100 0101	45	ナ
25	001 1001	19	EM	70	100 0110	46	ニ
26	001 1010	1A	SB	71	100 0111	47	ヌ
27	001 1011	1B	EC	72	100 1000	48	ネ
28	001 1100	1C	FS	73	100 1001	49	ノ
29	001 1101	1D	GS	74	100 1010	4A	ハ
30	001 1110	1E	RS	75	100 1011	4B	ヒ
31	001 1111	1F	US	76	100 1100	4C	フ
32	010 0000	20	space	77	100 1101	4D	ヘ
33	010 0001	21	。	78	100 1110	4E	ホ
34	010 0010	22	「	79	100 1111	4F	マ
35	010 0011	23	」	80	101 0000	50	ミ
36	010 0100	24	、	81	101 0001	51	ム
37	010 0101	25	・	82	101 0010	52	メ
38	010 0110	26	ヲ	83	101 0011	53	モ
39	010 0111	27	ァ	84	101 0100	54	ヤ
40	010 1000	28	ィ	85	101 0101	55	ユ
41	010 1001	29	ゥ	86	101 0110	56	ヨ
42	010 1010	2A	ェ	87	101 0111	57	ラ
43	010 1011	2B	ォ	88	101 1000	58	リ
44	010 1100	2C	ャ	89	101 1001	59	ル

JIS-7 Character Conversion Table (cont.)

Dec Value	Binary	Hex	Displayed Character
90	101 1010	5A	レ
91	101 1011	5B	ロ
92	101 1100	5C	ワ
93	101 1101	5D	ン
94	101 1110	5E	゛
95	101 1111	5F	゜
96	110 0000	60	hex
97	110 0001	61	ｱhex
98	110 0010	62	ｲhex
99	110 0011	63	hex
100	110 0100	64	hex
101	110 0101	65	ｵhex
102	110 0110	66	ｶhex
103	110 0111	67	hex
104	110 1000	68	hex
105	110 1001	69	ｹhex
106	110 1010	6A	ｺhex
107	110 1011	6B	hex
108	110 1100	6C	ｼhex
109	110 1101	6D	ｽhex
110	110 1110	6E	ｾhex
111	110 1111	6F	ｿhex
112	111 0000	70	ﾀhex
113	111 0001	71	ﾁhex
114	111 0010	72	ｯhex
115	111 0011	73	ﾃhex
116	111 0100	74	ﾄhex
117	111 0101	75	ﾅhex
118	111 0110	76	ﾆhex
119	111 0111	77	ﾇhex
120	111 1000	78	ﾈhex
121	111 1001	79	ﾉhex
122	111 1010	7A	ﾊhex
123	111 1011	7B	ﾋhex
124	111 1100	7C	hex
125	111 1101	7D	ﾍhex
126	111 1110	7E	ﾎhex
127	111 1111	7F	▨

JIS-8 Character Conversion Table

Dec Value	Binary	Hex	Displayed Character	Dec Value	Binary	Hex	Displayed Character
0	000 0000	00	NU	45	010 1101	2D	-
1	000 0001	01	SH	46	010 1110	2E	.
2	000 0010	02	SX	47	010 1111	2F	/
3	000 0011	03	EX	48	011 0000	30	0
4	000 0100	04	ET	49	011 0001	31	1
5	000 0101	05	EQ	50	011 0010	32	2
6	000 0110	06	AK	51	011 0011	33	3
7	000 0111	07	BL	52	011 0100	34	4
8	000 1000	08	BS	53	011 0101	35	5
9	000 1001	09	HT	54	011 0110	36	6
10	000 1010	0A	LF	55	011 0111	37	7
11	000 1011	0B	VT	56	011 1000	38	8
12	000 1100	0C	FF	57	011 1001	39	9
13	000 1101	0D	CR	58	011 1010	3A	
14	000 1110	0E	SO	59	011 1011	3B	,
15	000 1111	0F	SI	60	011 1100	3C	<
16	001 0000	10	DL	61	011 1101	3D	=
17	001 0001	11	D1	62	011 1110	3E	>
18	001 0010	12	D2	63	011 1111	3F	?
19	001 0011	13	D3	64	100 0000	40	@
20	001 0100	14	D4	65	100 0001	41	A
21	001 0101	15	NK	66	100 0010	42	B
22	001 0110	16	SY	67	100 0011	43	C
23	001 0111	17	EB	68	100 0100	44	D
24	001 1000	18	CN	69	100 0101	45	E
25	001 1001	19	EM	70	100 0110	46	F
26	001 1010	1A	SB	71	100 0111	47	G
27	001 1011	1B	EC	72	100 1000	48	H
28	001 1100	1C	FS	73	100 1001	49	I
29	001 1101	1D	GS	74	100 1010	4A	J
30	001 1110	1E	RS	75	100 1011	4B	K
31	001 1111	1F	US	76	100 1100	4C	L
32	010 0000	20	space	77	100 1101	4D	M
33	010 0001	21	!	78	100 1110	4E	N
34	010 0010	22	"	79	100 1111	4F	O
35	010 0011	23	#	80	101 0000	50	P
36	010 0100	24	$	81	101 0001	51	Q
37	010 0101	25	%	82	101 0010	52	R
38	010 0110	26	&	83	101 0011	53	S
39	010 0111	27	'	84	101 0100	54	T
40	010 1000	28	(	85	101 0101	55	U
41	010 1001	29	)	86	101 0110	56	V
42	010 1010	2A	*	87	101 0111	57	W
43	010 1011	2B	+	88	101 1000	58	X
44	010 1100	2C	,	89	101 1001	59	Y

JIS-8 Character Conversion Table (cont.)

Dec Value	Binary	Hex	Displayed Character	Dec Value	Binary	Hex	Displayed Character
90	101 1010	5A	Z	135	1000 0111	87	hex
91	101 1011	5B		136	1000 1000	88	hex
92	101 1100	5C	¥	137	1000 1001	89	hex
93	101 1101	5D		138	1000 1010	8A	hex
94	101 1110	5E	^	139	1000 1011	8B	hex
95	101 1111	5F	_	140	1000 1100	8C	hex
96	110 0000	60	`	141	1000 1101	8D	hex
97	110 0001	61	a	142	1000 1110	8E	hex
98	110 0010	62	b	143	1000 1111	8F	hex
99	110 0011	63	c	144	1001 0000	90	hex
100	110 0100	64	d	145	1001 0001	91	hex
101	110 0101	65	e	146	1001 0010	92	hex
102	110 0110	66	f	147	1001 0011	93	hex
103	110 0111	67	g	148	1001 0100	94	hex
104	110 1000	68	h	149	1001 0101	95	hex
105	110 1001	69	i	150	1001 0110	96	hex
106	110 1010	6A	j	151	1001 0111	97	hex
107	110 1011	6B	k	152	1001 1000	98	hex
108	110 1100	6C	l	153	1001 1001	99	hex
109	110 1101	6D	m	154	1001 1010	9A	hex
110	110 1110	6E	n	155	1001 1011	9B	hex
111	110 1111	6F	o	156	1001 1100	9C	hex
112	111 0000	70	p	157	1001 1101	9D	hex
113	111 0001	71	q	158	1001 1110	9E	hex
114	111 0010	72	r	159	1001 1111	9F	hex
115	111 0011	73	s	160	1010 0000	A0	hex
116	111 0100	74	t	161	1010 0001	A1	。
117	111 0101	75	u	162	1010 0010	A2	「
118	111 0110	76	v	163	1010 0011	A3	」
119	111 0111	77	w	164	1010 0100	A4	、
120	111 1000	78	x	165	1010 0101	A5	・
121	111 1001	79	y	166	1010 0110	A6	ヲ
122	111 1010	7A	z	167	1010 0111	A7	ァ
123	111 1011	7B	{	168	1010 1000	A8	ィ
124	111 1100	7C		169	1010 1001	A9	ゥ
125	111 1101	7D	}	170	1010 1010	AA	ェ
126	111 1110	7E	~	171	1010 1011	AB	ォ
127	111 1111	7F		172	1010 1100	AC	ャ
128	1000 0000	80	hex	173	1010 1101	AD	ュ
129	1000 0001	81	hex	174	1010 1110	AE	ョ
130	1000 0010	82	hex	175	1010 1111	AF	ッ
131	1000 0011	83	hex	176	1011 0000	B0	ー
132	1000 0100	84	hex	177	1011 0001	B1	ア
133	1000 0101	85	hex	178	1011 0010	B2	イ
134	1000 0110	86	hex	179	1011 0101	B3	ウ

JIS-8 Character Conversion Table (cont.)

Dec Value	Binary	Hex	Displayed Character	Dec Value	Binary	Hex	Displayed Character
180	1011 0100	B4	エ	218	1101 1010	DA	レ
181	1011 0101	B5	オ	219	1101 1011	DB	ロ
182	1011 0110	B6	カ	220	1101 1100	DC	ワ
183	1011 0111	B7	キ	221	1101 1101	DD	ン
184	1011 1000	B8	ク	222	1101 1110	DE	゛
185	1011 1001	B9	ケ	223	1101 1111	DF	゜
186	1011 1010	BA	コ	224	1110 0000	E0	hex
187	1011 1011	BB	サ	225	1110 0001	E1	hex
188	1011 1100	BC	シ	226	1110 0010	E2	hex
189	1011 1101	BD	ス	227	1110 0011	E3	hex
190	1011 1110	BE	セ	228	1110 0100	E4	hex
191	1011 1111	BF	ソ	229	1110 0101	E5	hex
192	1100 0000	C0	タ	230	1110 0110	E6	hex
193	1100 0001	C1	チ	231	1110 0111	E7	hex
194	1100 0010	C2	ツ	232	1110 1000	E8	hex
195	1100 0011	C3	テ	233	1110 1001	E9	hex
196	1100 0100	C4	ト	234	1110 1010	EA	hex
197	1100 0101	C5	ナ	235	1110 1011	EB	hex
198	1100 0110	C6	ニ	236	1110 1100	EC	hex
199	1100 0111	C7	ヌ	237	1110 1101	ED	hex
200	1100 1000	C8	ネ	238	1110 1110	EE	hex
201	1100 1001	C9	ノ	239	1110 1111	EF	hex
202	1100 1010	CA	ハ	240	1111 0000	F0	hex
203	1100 1011	CB	ヒ	241	1111 0001	F1	hex
204	1100 1100	CC	フ	242	1111 0010	F2	hex
205	1100 1101	CD	ヘ	243	1111 0011	F3	hex
206	1100 1110	CE	ホ	244	1111 0100	F4	hex
207	1100 1111	CF	マ	245	1111 0101	F5	hex
208	1101 0000	D0	ミ	246	1111 0110	F6	hex
209	1101 0001	D1	ム	247	1111 0111	F7	hex
210	1101 0010	D2	メ	248	1111 1000	F8	hex
211	1101 0011	D3	モ	249	1111 1001	F9	hex
212	1101 0100	D4	ヤ	250	1111 1010	FA	hex
213	1101 0101	D5	ユ	251	1111 1011	FB	hex
214	1101 0100	D6	ヨ	252	1111 1100	FC	hex
215	1101 0111	D7	ラ	253	1111 1101	FD	hex
216	1101 1000	D8	リ	254	1111 1110	FE	hex
217	1101 1001	D9	ル	255	1111 1111	FF	hex

EBCDIK Character Conversion Table

Dec Value	Binary	Hex	Displayed Character
0	0000 0000	00	NU
1	0000 0001	01	SH
2	0000 0000	02	SX
3	0000 0011	03	EX
4	0000 0100	04	PF
5	0000 0101	05	HT
6	0000 0110	06	LC
7	0000 0111	07	[illegible]
8	0000 1000	08	hex
9	0000 1001	09	RF
10	0000 1010	0A	SM
11	0000 1011	0B	VT
12	0000 1100	0C	FF
13	0000 1101	0D	CR
14	0000 1110	0E	SO
15	0000 1111	0F	SI
16	0001 0000	10	DL
17	0001 0001	11	D1
18	0001 0010	12	D2
19	0001 0011	13	D3
20	0001 0100	14	RE
21	0001 0101	15	NL
22	0001 0110	16	BS
23	0001 0111	17	IL
24	0001 1000	18	CN
25	0001 1001	19	EM
26	0001 1010	1A	CC
27	0001 1011	1B	C1
28	0001 1100	1C	FS
29	0001 1101	1D	GS
30	0001 1110	1E	RS
31	0001 1111	1F	US
32	0010 0000	20	DS
33	0010 0001	21	SS
34	0010 0010	22	FS
35	0010 0011	23	hex
36	0010 0100	24	BP
37	0010 0101	25	LF
38	0010 0110	26	EB
39	0010 0111	27	EC
40	0010 1000	28	hex
41	0010 1001	29	hex
42	0010 1010	2A	SM
43	0010 1011	2B	C2
44	0010 1100	2C	hex
45	0010 1101	2D	EQ
46	0010 1110	2E	AK
47	0010 1111	2F	BL
48	0011 0000	30	hex
49	0011 0001	31	hex
50	0011 0010	32	SY
51	0011 0011	33	hex
52	0011 0100	34	PN
53	0011 0101	35	RS
54	0011 0110	36	UC
55	0011 0111	37	ET
56	0011 1000	38	hex
57	0011 1001	39	hex
58	0011 1010	3A	hex
59	0011 1011	3B	C3
60	0011 1100	3C	D4
61	0011 1101	3D	NK
62	0011 1110	3E	hex
63	0011 1111	3F	SB
64	0100 0000	40	space
65	0100 0001	41	hex
66	0100 0010	42	hex
67	0100 0011	43	hex
68	0100 0100	44	hex
69	0100 0101	45	hex
70	0100 0110	46	ヲ
71	0100 0111	47	ァ
72	0100 1000	48	ィ
73	0100 1001	49	ゥ
74	0100 1010	4A	[
75	0100 1011	4B	.
76	0100 1100	4C	<
77	0100 1101	4D	
78	0100 1110	4E	+
79	0100 1111	4F	!
80	0101 0000	50	&
81	0101 0001	51	エ
82	0101 0010	52	ォ
83	0101 0011	53	ヤ
84	0101 0100	54	ュ
85	0101 0101	55	ョ
86	0101 0110	56	ッ
87	0101 0111	57	hex
88	0101 1000	58	hex
89	0101 1001	59	hex

EBCDIK Character Conversion Table (cont.)

Dec Value	Binary	Hex	Displayed Character
90	0101 1010	5A	]
91	0101 1011	5B	¥
92	0101 1100	5C	*
93	0101 1101	5D	
94	0101 1110	5E	;
95	0101 1111	5F	¯¬
96	0110 0000	60	-
97	0110 0001	61	/
98	0110 0010	62	hex
99	0110 0011	63	hex
100	0110 0100	64	hex
101	0110 0101	65	hex
102	0110 0110	66	hex
103	0110 0111	67	hex
104	0110 1000	68	hex
105	0110 1001	69	hex
106	0110 1010	6A	hex
107	0110 1011	6B	,
108	0110 1100	6C	%
109	0110 1101	6D	–
110	0110 1110	6E	>
111	0110 1111	6F	?
112	0111 0000	70	hex
113	0111 0001	71	hex
114	0111 0010	72	hex
115	0111 0011	73	hex
116	0111 0100	74	hex
117	0111 0101	75	hex
118	0111 0110	76	hex
119	0111 0111	77	hex
120	0111 1000	78	hex
121	0111 1001	79	`
122	0111 1010	7A	:
123	0111 1011	7B	#
124	0111 1100	7C	@
125	0111 1101	7D	'
126	0111 1110	7E	=
127	0111 1111	7F	"
128	1000 0000	80	hex
129	1000 0001	81	ア
130	1000 0010	82	イ
131	1000 0011	83	ウ
132	1000 0100	84	エ
133	1000 0101	85	オ
134	1000 0110	86	カ

Dec Value	Binary	Hex	Displayed Character
135	1000 0111	87	キ
136	1000 1000	88	ク
137	1000 1001	89	ケ
138	1000 1010	8A	コ
139	1000 1011	8B	hex
140	1000 1100	8C	サ
141	1000 1101	8D	シ
142	1000 1110	8E	ス
143	1000 1111	8F	セ
144	1001 0000	90	ン
145	1001 0001	91	タ
146	1001 0010	92	チ
147	1001 0011	93	ツ
148	1001 0100	94	テ
149	1001 0101	95	ト
150	1001 0110	96	ナ
151	1001 0111	97	ニ
152	1001 1000	98	ヌ
153	1001 1001	99	ネ
154	1001 1010	9A	ノ
155	1001 1011	9B	hex
156	1001 1100	9C	hex
157	1001 1101	9D	ハ
158	1001 1110	9E	ヒ
159	1001 1111	9F	フ
160	1010 0000	A0	hex
161	1010 0001	A1	hex
162	1010 0010	A2	ヘ
163	1010 0011	A3	ホ
164	1010 0100	A4	マ
165	1010 0101	A5	ミ
166	1010 0110	A6	ム
167	1010 0111	A7	メ
168	1010 1000	A8	モ
169	1010 1001	A9	ヤ
170	1010 1010	AA	ユ
171	1010 1011	AB	hex
172	1010 1100	AC	ヨ
173	1010 1101	AD	ラ
174	1010 1110	AE	リ
175	1010 1111	AF	ル
176	1011 0000	B0	hex
177	1011 0001	B1	hex
178	1011 0010	B2	hex
179	1011 0101	B3	hex

EBCDIK Character Conversion Table (cont.)

Dec Value	Binary	Hex	Displayed Character
180	1011 0100	B4	hex
181	1011 0101	B5	hex
182	1011 0110	B6	hex
183	1011 0111	B7	hex
184	1011 1000	B8	hex
185	1011 1001	B9	hex
186	1011 1010	BA	レ
187	1011 1011	BB	□
188	1011 1100	BC	ワ
189	1011 1101	BD	ン
190	1011 1110	BE	゛
191	1011 1111	BF	゜
192	1100 0000	C0	hex
193	1100 0001	C1	A
194	1100 0010	C2	B
195	1100 0011	C3	C
196	1100 0100	C4	D
197	1100 0101	C5	E
198	1100 0110	C6	F
199	1100 0111	C7	G
200	1100 1000	C8	H
201	1100 1001	C9	I
202	1100 1010	CA	hex
203	1100 1011	CB	hex
204	1100 1100	CC	hex
205	1100 1101	CD	hex
206	1100 1110	CE	hex
207	1100 1111	CF	hex
208	1101 0000	D0	hex
209	1101 0001	D1	J
210	1101 0010	D2	K
211	1101 0011	D3	L
212	1101 0100	D4	M
213	1101 0101	D5	N
214	1101 0100	D6	O
215	1101 0111	D7	P
216	1101 1000	D8	Q
217	1101 1001	D9	R
218	1101 1010	DA	hex
219	1101 1011	DB	hex
220	1101 1100	DC	hex
221	1101 1101	DD	hex
222	1101 1110	DE	hex
223	1101 1111	DF	hex
224	1110 0000	E0	$

Dec Value	Binary	Hex	Displayed Character
225	1110 0001	E1	hex
226	1110 0010	E2	S
227	1110 0011	E3	T
228	1110 0100	E4	U
229	1110 0101	E5	V
230	1110 0110	E6	W
231	1110 0111	E7	X
232	1110 1000	E8	Y
233	1110 1001	E9	Z
234	1110 1010	EA	hex
235	1110 1011	EB	hex
236	1110 1100	EC	hex
237	1110 1101	ED	hex
238	1110 1110	EE	hex
239	1110 1111	EF	hex
240	1111 0000	F0	0
241	1111 0001	F1	1
242	1111 0010	F2	2
243	1111 0011	F3	3
244	1111 0100	F4	4
245	1111 0101	F5	5
246	1111 0110	F6	6
247	1111 0111	F7	7
248	1111 1000	F8	8
249	1111 1001	F9	9
250	1111 1010	FA	hex
251	1111 1011	FB	hex
252	1111 1100	FC	hex
253	1111 1101	FD	hex
254	1111 1110	FE	hex
255	1111 1111	FF	hex

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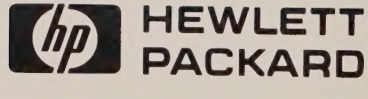
Softkeys are shown in arrow brackets; for example <Auto Conf>.



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