Manufacturer's Declaration

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

HP 4951C Protocol Analyzer

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 Funk-entstörbestimmungen unter Betriebsbedingungen an seiner Grundstücksgrenze eingehalten werden.

Manufacturer's Declaration

This is to certify that the equipment

HP 4951C Protocol Analyzer

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.

Grounding

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 compatible with an approved three-contact electrical outlet. The power jack and mating plug of the power cord must meet International Electrotechnical Commission (IEC) safety standards.

Environment

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.

Service and Adjustment

Dangerous voltages exist within this instrument. Service and adjustment of this instrument is to be performed only by trained service personnel Operating personnel are not authorized to remove the instrument covers or to perform any internal service or adjustment procedure.

Do not replace components with the power cable connected. Dangerous voltages may be present even when the power cable is disconnected.

Do not perform internal servicing or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

CRT Handling

Rough handling or jarring of the instrument can break the CRT (cathode ray tube). The resulting implosion will scatter glass fragments at high velocity. Removal or installation of the CRT is to be performed only by qualified maintenance personnel using approved safety mask and gloves.

Unauthorized Service

The installation of substitute parts or the installation of any instrument modification not authorized by Hewlett-Packard is specifically forbidden. The performance of such unauthorized service can negate the instrument warranty or any maintenance agreements.

Return the instrument to a Hewlett-Packard Sales and Service Office for authorized service and repair.

Syntax Conventions

The following symbols, abbreviations, and other conventions are used in this publication.

Symbol	Definition
Setup Menu	A softkey.
[Reset]	A keyboard command entry.
[CTRL] [U]	A control character entry from the keyboard where both the [CTRL] key and an alphanumeric key are pressed at the same time. To enter CONTROL U press [CTRL] and [U].
[Shift] softkey	A keyboard entry where both the [Shift] and a softkey are pressed at the same time to select an auxiliary softkey function.
FILENAME	Within menus or screens, a parameter that must be entered in the exact format shown.
filename	Within menus or screens, a user-defined parameter.

Warning An operating procedure, practice, etc., which, if not correctly followed, could result in personal injury or loss of life.

Caution An operating procedure, practice, etc. which, if not strictly observed, could result in damage to, or destruction of, equipment or software.

Note Explanatory comments or supplementary instructions.

Table of Contents

1. Introducing the HP 4951C Protocol Analyzer

How To Use This Manual 1-2
  Part 1 Getting Started 1-2
  Part 2 The Menus 1-2
  Manual Conventions 1-2
Before You Get Started 1-3
  Initial Inspection 1-3
  Line Voltage Selection 1-3
  Grounding Requirements 1-3
  Power Cord 1-3
  Shipment 1-3
Power Up and Installation 1-4
  Turning the HP 4951C On 1-4
  Connecting the Pod 1-4
  Turning the HP 4951 Off 1-4
  Hookup 1-5
Front Panel Controls 1-6
  Keyboard 1-6
The Top Level Menu 1-8
Rear Panel Features 1-10

2. The Three Instrument Functions

Things To Remember 2-1
The Three Instrument Functions 2-2
  I. Monitoring 2-2
  II. Simulation 2-2
  III. Bit Error Rate Tests (BERT) 2-2

5. The Setup Menus
How Setup Controls Other Menu Selections 5-1
The Five Setup Menus 5-1
When to Use the Setup Menus 5-2
Saving Setups 5-2
The Bit Oriented Menus 5-3
HDLC and SDLC Protocols 5-3
X.25 Protocol 5-3
Bit Oriented Protocol Setup Menus 5-5
Bit Oriented Menu Definitions 5-6
Hints for Setting Up Bit Oriented Lines 5-7
Decoding Frames With Frame and Packet Display Format 5-8
Decoding X.25 Packets in the Examine Data Menu 5-10
The BSC Menu 5-12
BSC Setup Menu 5-13
The Char ASYNC/SYNC Menu 5-15
Configuring to Any Data Code 5-15
When to Use the Char Async/Sync Menu 5-15
Char ASYNC/SYNC Setup Menu 5-16
Char ASYNC/SYNC Definitions 5-17
Using Char ASYNC/SYNC 5-18
Unusual Protocol Settings 5-24
IPARS Setup 5-24
IPARS Setup Parameters 5-25
Modified Error Check (MEC) 5-26
Timing Suppression 5-26

6. The Monitor and Simulate Menus
Differences Between Monitor and Simulate Menus 6-1
Programming 6-2
Always Do Setup First 6-2
Softkey Programming 6-2
Block Structure 6-2
Editing Programs 6-2
Running Programs 6-2

Selecting Send Characters....6-22
When a Character is Not on the Keyboard....6-22
Binary and Hex Characters....6-22
Editing Strings....6-22
Sending Idles....6-22
Block Check Characters (BCC)....6-22
Flags and Frame Check Characters....6-23
Parity Bits....6-23
Zero Bit Insertion....6-23
Changing the Setup After Typing the String....6-23
Using Timers with <Send>....6-24
Controlling Interface Leads -- <SET LEAD>....6-25
Lead Status During Simulation....6-25
Lead Status When Not Simulating....6-26
Set Lead Examples....6-26
Delaying Output - WAIT....6-27
Delaying Strings or Leads....6-27
Error Messages....6-28
Status Messages....6-28

7. The Run Menu
Monitoring On-Line....7-1
Monitoring From Buffer....7-2
Running Simulation....7-3
Running BERT....7-3
Run-Time Softkeys....7-4
Run-Time Messages....7-5
Displaying Data....7-6

8. The Examine Data Menu
What is Stored in the Buffer....8-1
How to Load the Buffer....8-1
Uses for the Examine Data Menu....8-2
Viewing Timers and Counters After a Run....8-2
Viewing the Entire Buffer....8-2
Bit Shifting....8-2
Decoding Characters....8-2
Decoding Packets....8-2
Decoding High Level Protocols....8-2
Softkeys....8-4

Error Messages ... 9-6
- Out of Lock-Data Fault ... 9-6
- Out of Lock - Sync Loss ... 9-6

Examples ... 9-7
- End-to-End Testing ... 9-7
- Loopback Testing ... 9-8
- Other Tests ... 9-9
- Quick Brown Fox Tests ... 9-9
- Startup Tests ... 9-9
- BERT Configuration Modes ... 9-9

10. The Remote Menu

Remote Operations ... 10-1
Using the HP 4951C as a Controller ... 10-2
Using the HP 4951C as a Slave ... 10-4
- HP 4955A and HP 4953A Controller Commands ... 10-4
- Upload Timer and Counters ... 10-4
- Address ... 10-4

Ending Remote Operations ... 10-6
Handshaking Requirements ... 10-7
- Operations with Asynchronous Modems ... 10-7
- Operations Without Modems ... 10-7

Slave Error Messages ... 10-8

11. Mass Storage

How to Use the Disc Drive ... 11-2
- Type of Discs ... 11-2
- Care and Handling of Discs ... 11-2
- Inserting Discs ... 11-3
- Removing a Disc ... 11-3
- Write-Protecting the Disc ... 11-4

The Mass Store Menu ... 11-5
- Directory ... 11-5
- Format ... 11-6
- Load ... 11-6
- Store ... 11-6
- Delete ... 11-6
- Recover ... 11-7
- Pack Disc ... 11-7
- Rename ... 11-7
- Convert ... 11-7
- Print Appl ... 11-7

14. Examples
Measuring a Single RTS-CTS Delay 14-1
Monitoring a DCE 14-2
Monitoring a DTE 14-2
FOX Message 14-3
Counting Parity Errors 14-4
Measuring More Than One RTS-CTS Delay 14-5
Simulating RTS-CTS Delay 14-7
Loopback 14-9
End-To-End: Transmit First 14-11
End-To-End: Receive First 14-13

15. The Interface
Introduction 15-1
RS-232C/V.24 Interfaces 15-1
RS-449 Interfaces 15-1
V.35 Interfaces 15-2
Pod Installation 15-3
The HP 18179A Interface Pod 15-5
LEDs 15-5
Disconnect Switches 15-5
RS-232/V.24 Interface 15-7
The HP 18180A 15-8
The HP 18174A 15-11
The HP 18177A/G 15-12
The HP 18160A/G 15-13
RS-232/V.24 Breakout Box 15-13
Monitor, DCE Simulate & DTE Simulate Modes 15-14
LEDs 15-14

16. JIS Option
The Setup Menu 16-1
Monitor/Simulate Menu 16-1
Run Menu and Examine Data 16-2
Auto Configure 16-2
JIS-7 Character Conversion Table 16-3
JIS-8 Character Conversion Table 16-5
EBCDIK Character Conversion Table 16-8

C. Accessories

Accessories Supplied C-1
Accessories Available C-2
Options C-2
Interface Accessories C-3

D. OSI Level 2 and 3 Tables

Level 2: The Data Link Interface D-1
Bit Oriented Protocols D-1
Unnumbered Format Commands D-3
Unnumbered Format Response D-3

E. Service Information

Power Cable E-1
Adjustments E-4
Performance Verification E-4
Disc I/O Test E-5
Disc Drive Check E-5
Keyboard Test E-7
Interface Pod Test E-8
Display Test E-9
Packaging E-10

F. External Video Output

What is RS-170? F-1
Usage F-1
Recommended Video Monitors F-1

G. Data Code Tables

ASCII Character Conversion Table G-1
EBCDIC Character Conversion Table G-5
Baudot Character Conversion Table G-6
EBCD Character Conversion Table G-12
Transcode Character Conversion Table G-14
IPARS Character Conversion Table G-15

1

Introducing the HP 4951C Protocol Analyzer

The HP 4951C is a portable, data communications protocol analyzer that contains the essential features required to install, maintain and design data networks up to 19.2 kbps. Here are some unique features:

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.

Disc Storage. Mass storage of data, setups, programs, and measurements.

Printer Output. Print data, monitor and simulate programs, setup and test results. Access printer from rear panel RS-232C port or interface pod.

External Video Driver. Display real time data, buffer data, menus and programs on external monitor using rear RS-170 port.

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 Accessories Supplied in Appendix C). 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 any ac power, be sure the line voltage for your area is between 100 - 240 Vac +-10% at 48 to 66 Hz. There is no line voltage selection. To change the fuse, refer to Appendix E.

Grounding Requirements

The HP 4951C 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 power cord packaged with each analyzer depends on its destination. Appendix E has a chart of power cord plugs matched to different areas. If the analyzer has the wrong power cord for the area, contact your HP Sales and Support Office.

Shipment

Refer to Appendix E 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.

The HP 4951C 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.

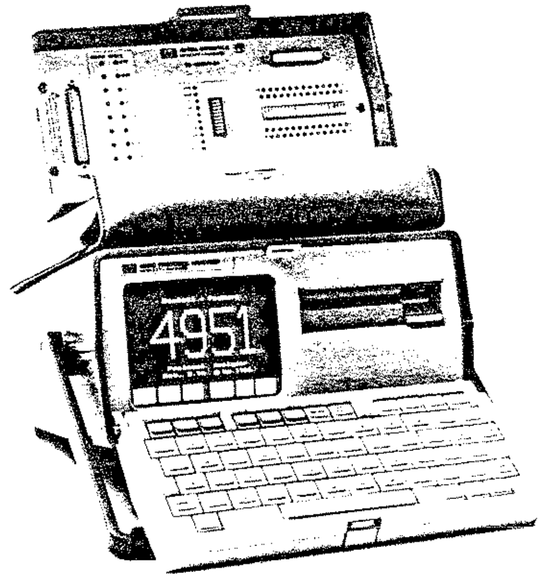


Figure 1-1. Front Panel Controls

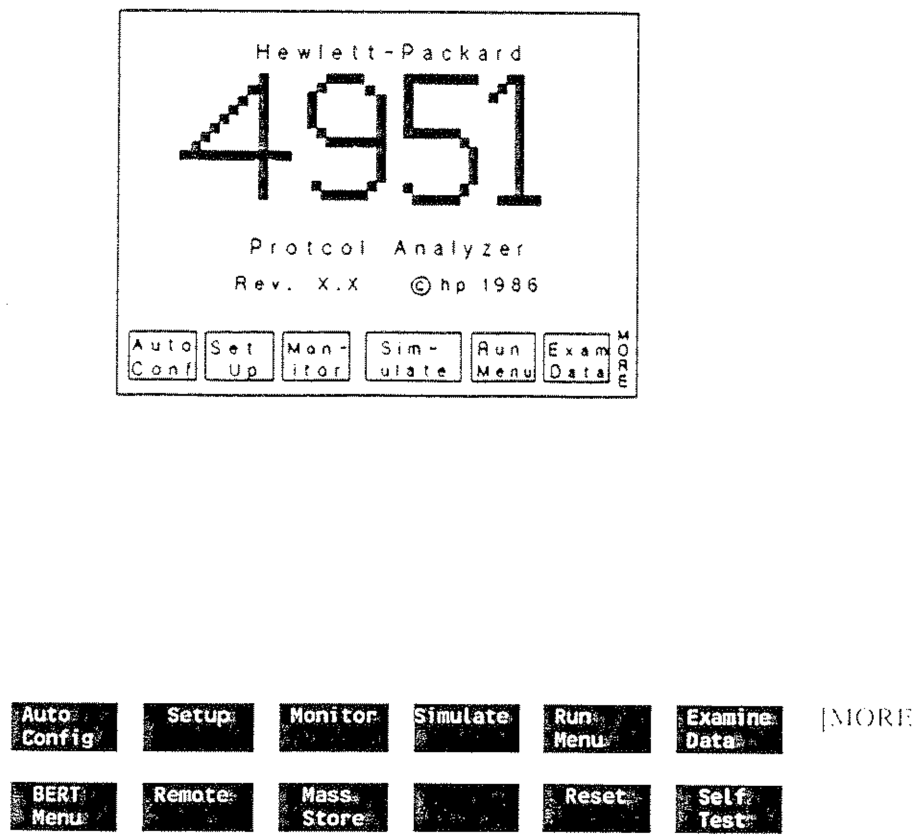


Figure 1-2. The Top Level Menu

2

The Three Instrument Functions

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 accesses all other menus. EXIT will access the Top Level Menu at anytime. 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.

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

I. Monitoring

The HP 4951C is a "window" through which you can observe the activity on a data link. The HP 4951C lets you trigger on events and make measurements either on-line, or from the buffer memory.

By monitoring from buffer memory, you can repeatedly post-process/review data after a run. This can be especially advantageous for "glitch" or "after hours" type problems that do not occur "on demand".

Summary of Monitoring Steps

1. Hookup	Bridge the HP 4951C into line to be monitored.
2. Setup	Using either Auto Configure or the Setup Menus, configure the HP 4951C 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 4951C begins non-selectively displaying line data as soon as you enter the Run Mode.

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.

It might help to think of the Menu choices as a "logical programming language" for the HP 4951C which lets you control the manner in which the HP 4951C monitors the data.

Here is 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 4951C will branch to another action upon finding a trigger.
Timing	Five timers measure intervals between triggers with 1 millisecond resolution.
Counting	The HP 4951Cs' five counters can each count up to 9999 events.
Conditional Actions	The **If** statement performs actions conditionally, depending on the status of a counter or a lead at the time of the last trigger.

To access the Monitor Menu, press **Monitor** in the Top Level Menu. Then utilize the softkeys to modify or "build" a custom menu.

Step 4: Running the Test

In Auto Configure, the HP 4951C 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 disc, 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.

Step 5: Halting the Run

Press EXIT to stop the test. The most recent data is displayed. You can freeze the display without halting the test 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 BSSC and Char Async/Sync Menus, the Frame and Packet format is not available. See chapters 7 and 8.

II. Simulating

The HP 4951C can take the place of either a DTE (Data Terminal Equipment) or DCE (Data Circuit-Terminating Equipment), by supplying clocks, data, and error checks in the selected data code and protocol.

Summary of Simulating Steps

1. Hookup	Substitute the HP 4951C for either the DTE or DCE.
2. Setup	Using either Auto Configure or the Setup Menus, configure the HP 4951C 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 4951C for the device (DTE or DCE) being simulated.

Note Always turn off the analyzer before connecting or disconnecting the interface pod.

Remember that non-volatile memory saves setups, menus and data while the HP 4951C is turned off. Be sure to use the correct pod (RS-232C/V.24,V.35, or RS-449) and cables as shown in figure 2-2 below.

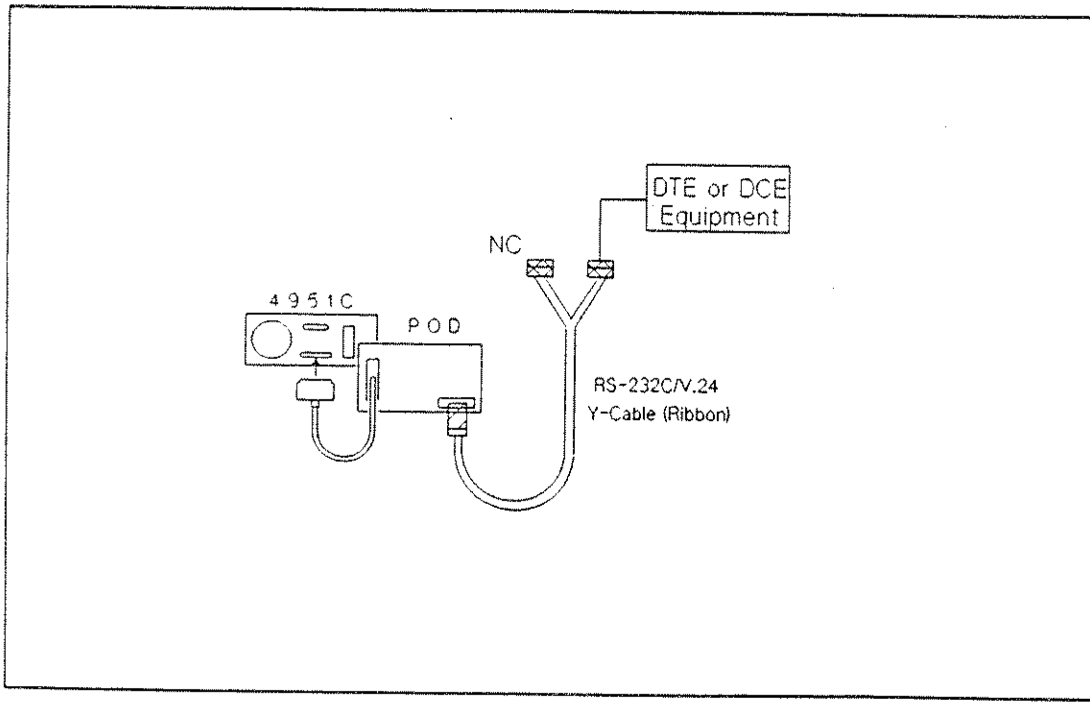


Figure 2-2. Simulation Hookup

Step 2: Setup

Use the Setup Menus to configure the HP 4951C 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 4951C 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

- If DTE clock, Bits/sec, and Sync/Async (Char Async/Sync Menu) selections are incorrect, no data can be received or displayed.
- Protocol, data code, and error checking must be correct to ensure response by the devise at the other end.

Step 3: Simulate Menu Selections (Data and Triggers)

Make the following entries in the Simulate Menu.

Select DTE or DCE

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

Handshaking

Determine the handshaking requirements on the leads. Use the **Set Lead** softkey to turn the leads on or off at the desired time. The HP 4951C 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.

Transmitting Data

Use the **Send** softkey to enter the characters to be transmitted, otherwise the HP 4951C 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 4951C 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 4951C, 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 4951C 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. To execute the program again, press **Run Menu** on the Top Level Menu, and then **Simulate**.

III. 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. For more detailed descriptions see chapter 9.

Bert Steps

1. Hookup

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

   b. Loopback. Substitute an HP 4951C 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 4951C begins transmitting and receiving, and the display 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 chapter 14.

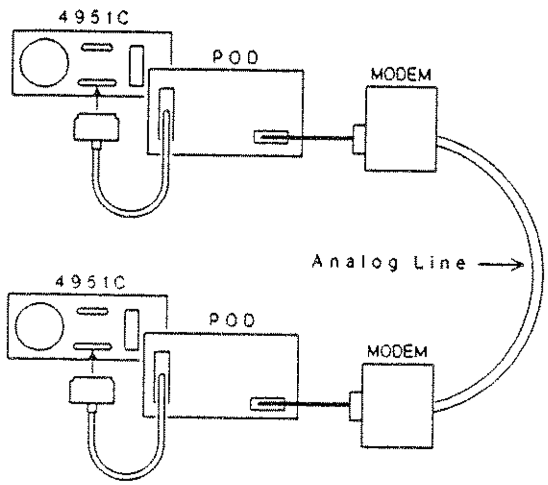


Figure 2-3. End-to-End BERT Hookup

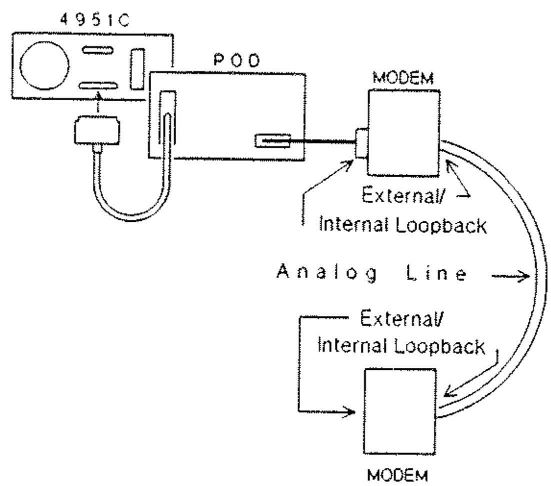


Figure 2-4. Loopback BERT Hookup

Three Instrument Functions

3

Self Demonstration

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

This chapter is optional. The HP 4951C with Auto Configure is easy to operate. 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 4951C to the Interface Pod.
2. Set up the HP 4951C 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 4951C. Connect the analyzer to the interface pod as shown in Figure 3-1 below.

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

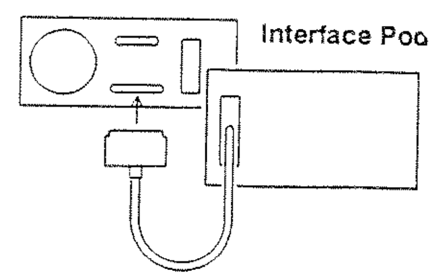


Figure 3-1. Hooking up an Interface Pod

Step 2: Setup

Switch on the HP 4951C. Press **More**, then 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 4951C'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 by pressing **Char**. 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 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	This program causes the HP
	and then	4951C to repeatedly turn on
	Send $S_Y S_Y S_X$ABCDEE_X	lead CD and send the character
	and then	string ABCDE. The 200
	Wait 200	millisecond delay makes it
	and then	easier to see CD transitions.
	Set Lead CD Off	
	and then	
	Wait 200	
	and then	
	Goto Block 1	

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, etc.

Step 4: Run the Simulate Program

Press **Run Menu** in the Top Level Menu, then **Simulate**. The HP 451C 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 (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 (18177A, 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

The buffer block numbers increase to 16 and then start over at 1. The buffer is a "circular buffer" and stores the last 16 blocks of information received. Once filled (16 blocks), it starts storing new information in block 1 again. A "block" of memory holds 2 Kbytes of information (data, timing information, and lead status).

Self Demonstration

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. Remember that the buffer only holds the last 16 blocks of information. 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 he 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.

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.

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

Up to now you have been able to observe what you are sending on the DCE channel because the HP 4951C 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).

4

Auto Configure

How To Use Auto Configure

Hook up the analyzer to the line for monitoring (Refer to Figure 2-1 for 'hook up' instructions). Press the **Auto Configure** softkey on the Top Level Menu. It's as simple as that!

The HP 4951C briefly displays its parameter selections in either the SDLC or the Char Asyn/Syn Setup Menu. 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 disc.

If unable to autoconfigure, the HP 4951C may not have seen enough data to make a good decision as to what is going on. Try these two suggestions to enable the HP 4951C to "lock on":

1. Have a large file sent from the host device to the device being monitored.

2. Hold the return key down on the terminal or device being monitored.

Auto Configure as a Starting Point

Auto Configure works on most lines, with most protocols and data codes. Sometimes, however, there are non-standard 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 non-standard protocols, Auto Configure gives you a starting point to capture data.

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 is incorrect or corrupt, 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 disc (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 4951C 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 7-7. Half duplex data looks like figure 7-8.

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   SH SX
                                    Stop on    EX EB EX EB

Transparent text char   None       DTE clock   DCE

Mode   Sync                        Bits/sec   9600

Sync on   32 32                    Display mode   Data & State

Drop sync  1  chrs                 Suppress   None
  after FF FF FF FF FF FF FF
```

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

IPARS -- Inverted Passenger Airline Reservation System

The Auto Configure menu will not obtain all the parameters for IPARS. After Auto Configure is complete, go to the Setup menu and fill in the parameters that Auto Configure missed. See figure 4-3.

Note that Auto Configure does not always 'lock onto' the correct drop sync characters.

The most frequently used drop sync characters used are $^{0}0^{3}F$. You have to place those in the setup initially found by Auto Configure. An example setup menu is shown on the next page.

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 most 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 $^{3}F^{3}E$ 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  MSB                 Bit sense   Invrt

Code   IPARS0                  Error Check   CRC 6

Parity   None                  Start on   3E 3E  (HEX)

                               Stop on   0D 1D 2D 3D  (HEX)

Transparent text char None     DTE clock   DCE

Mode   Sync                    Bits/sec   2400

Sync on  3F 3E (HEX)           Display mode   2 LINE


Drop sync  0  chrs             Suppress   None
  after 00 3F FF FF FF FF FF
```

Figure 4-3. IPARS Setup Determined by Auto Configure

Figure 4-3 is a set up menu for three major airlines. The bits per-second selection will vary for each of the networks. The same set up is used for simulation except that the data code should be set for **IPARS1** when the line idles in 1's or **IPARS0** when the line idles in 0's. Either of these selections may be used when monitoring this protocol.

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 to 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 to 100 character sequence.

6. In bit oriented protocols, there must be at least one good Frame Check Sequence (FCS).

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

Auto Configure 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 a minimum of two idle characters between messages.

No pod attached

The pod is not attached.

No Sync Characters

Could not find any of the sync characters listed on page 4-10.

Nonstandard Baud Rate

The bit rate is not within 5% 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 4951C assumes an asynchronous protocol, because it cannot find the stop bit.

Auto Configure Operating Characteristics

	BIT ORIENTED (SDLC)	CHARACTER (Synchronous)	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, EBCDIC, 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	

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

	BIT ORIENTED (SDLC)	CHARACTER (Synchronous)	CHARACTER (Async)
Sync Chars	Flags (7E)	EBCDIC: 32 32 IPARS: 3F 3E Transcode: 3A 3A Hex: LSB of sync char must = 0 and both sync chars must be the same	ASCII: 16 16
Transparent Text		EBCDIC:DL (10) ASCII:DL (10) Transcode:DL (1F) None	(Same as Synchronous)
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

5

The Setup Menu

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. 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 7.

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 character oriented protocol.

When to Use the Setup Menus

When monitoring on-line, Auto Configure can automatically configure the HP 4951C to most lines. 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 use an "auto configured" setup from a previous run. Setups remain constant and non-volatile 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 Menu 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.

Disc Storage

You can store Menus, or both Menus & Data, to disc. 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 4951C 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.

```
Monitor/Simulate Parameter Setup

Protocol      SDLC

Code    ASCII 8    Err chk   CCITT
Parity    None

                      DTE clock  DCE
Mode       Sync        Bits/sec   9600

                      Disp mode  D & S

HDLC SDLC X.25  BSC  Char
```

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 ] [   100 ] [Teletext]*
                                                [  2400 ] [  600 ] [    75 ]
                                                [  1200 ] [  300 ] [    50 ]

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

*  Teletext data is transmitted on pin 16
```

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.

Note When Teletext is selected for the bit rate, the DCE data is sent by the network on pin 16. You must jumper pin 16 to pin 3 on a breakout box to monitor on an HP 4951C.

Hints for Setting Up Bit Oriented Lines

Observe the Pod

The pod LCDs or LEDs marked DTE and DCE should b... ...cept in the case of NRZI sync, there should also be clock activity.

Use Auto Configure

Copy

Use Auto Configure for initial setup. If ... ... always selects SDLC as the protocol. You will have to c...

1. HDLC with Extended Address or C... ...col to HDLC with the following setup:

   Ext Addr and/or Ext Ctrl: On   Disp m...: 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. In the command mode this bit is a P-bit and is normally "0". If the primary requires an immediate response from the secondary, it sets the P-bit to a "1". The subsequent response is identified, since the Final bit is set to a "1".

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).

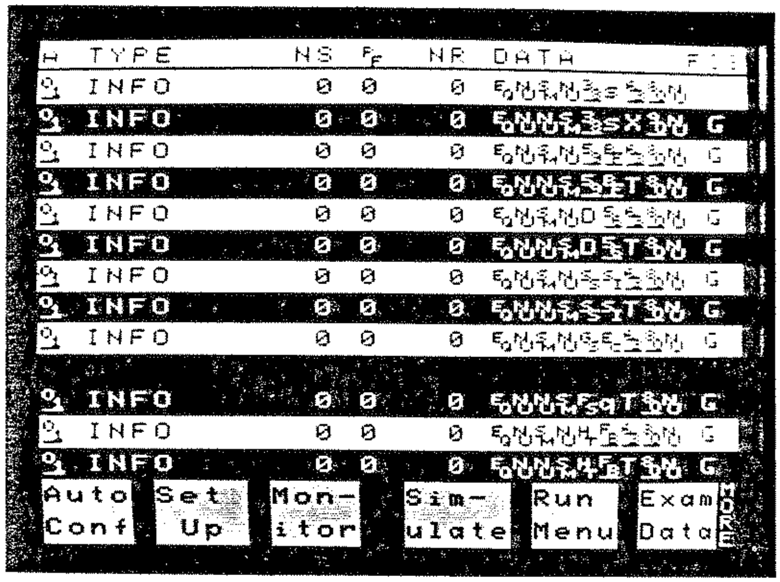


Figure 5-2. HDLC in Frame & Packet Display Format (run-time)

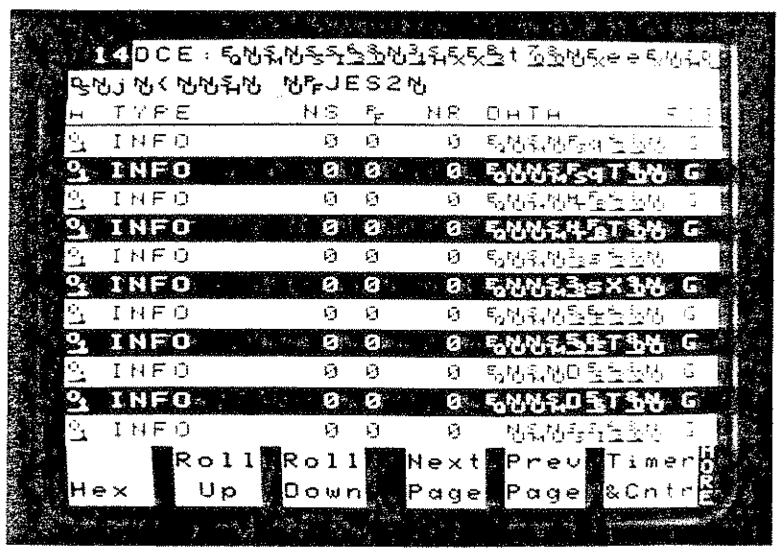


Figure 5-3. HDLC in Frame & Packet Display Format (Examine Data Menu)

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.

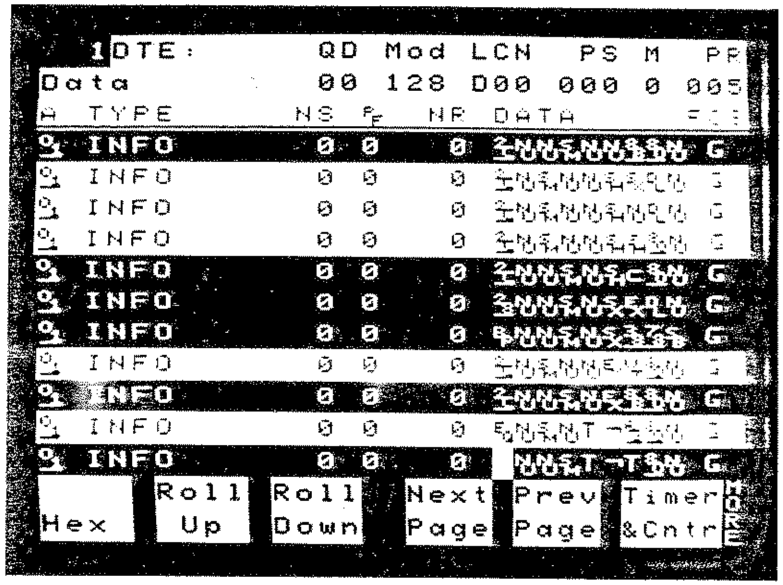


Figure 5-4. X.25 in Frame & Packet Display Format (Examine Data Menu)

The BSC Menu

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

BSC specifies odd parity for ASCII 7. There is no parity check for EBCDIC or Transcode. The HP 4951C 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 is not changed to conform to the parity setup selection.

Mode	BSC is Synchronous.
Sync On	The HP 4951C 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 4951C requires at least two sync characters for proper framing.
Err Chk	Select LRC or CRC-16 for ASCII or EBCDIC, and select 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 17      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 ]
```

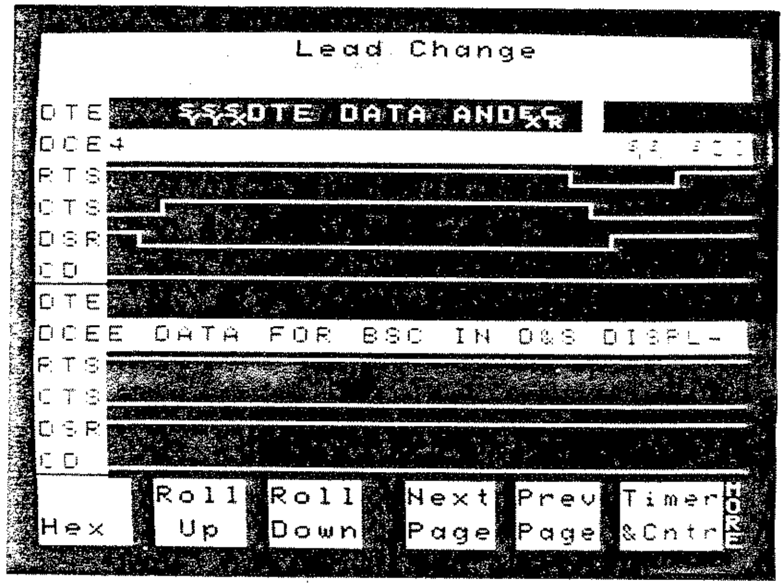


Figure 5-5. BSC in Data & State Display Format

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 lets you tailor the analyzer to many different codes with standard or nonstandard characteristics.

The HP 4951C 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 5-21.
4. For non-standard 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      ] [ 200   ]
                                           [  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 ]
```

** Teletext data is transmitted on pin 16. Jumper pin 16 to pin 3 to monitor on the HP 4951C

Char ASYNC/SYNC Definitions

Bit Order/Sense

Normally, the least significant bit 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 5-18 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 5-18 for hex entry.

Mode

Synchronous or asynchronous (1, 1.5, 2 stop bits). The HP 4951C 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 4951C requires at least two sync characters. The HP 4951C must see at least two of these characters to capture data when monitoring or simulating character oriented protocols. See page 5-18 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 5-18 for hex entry.

DTE Clock

Synchronous mode only. Specifies the DTE transmit clock source.

Using Char ASYNC/SYNC

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. Each is detailed in the following paragraphs.

HEX Entries and Parity

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 4-7, 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 codes of 7 bits or less (e.g., ASCII 7, Baudot) the parity 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. 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 4951C will not capture data. The HP 4951C 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.

The HP 4951C 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.

Normally, the HP 4951C 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 never drops sync, and brings 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 six "outside text" characters take precedence over the one "within text" character. If the same character is entered for both inside and outside the start on and stop on limits, the analyzer drops sync outside 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 BB 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

The following methodologies are presented to aid when the user does not know all the details of the data to be monitored. Consider each one in respect to what is known and utilize as applicable.

For non-standard 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. The HP 4951C assumes that all character oriented protocols idle in $^F F$. 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 never drops sync and brings in all data, including idles. .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 since the analyzer does not know where each character begins or ends. Now you need to find the correct sync pattern.

Setup Menus

Finding the Correct Framing

Bit shifting does not work when data is brought in with the 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.

The HP 4951C 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 part of the data still does not become meaningful while bit shifting, change the data code to one 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

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 ^F_F. If the line idles in a character other than ^F_F, 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

Unusual Protocol Settings

This is the build-your-own menu for Character oriented protocols. Select **Char** in the Setup menu. Then look for the protocol in the left column below. Enter the settings given to the right of the protocol.

Protocol	Code	Parity	Err Chk	Sync Char	Text Char	Mode
Burroughs BASIC	ASCII7	odd	VRC	16 16	dl	Sync, Async 1
Burroughs Poll-Sel	ASCII7	odd,SYNC even,ASYNC	LRC	16 16	None	Sync (or Async), Async1
HASP	EBCDIC	None	CRC-16	32 32	dl	Sync
IPARS	IPARS	None	CRC-6	3F 3E	None	Sync Bit sense - Invert Order - MSB First
MODE 4c	ASCII7	odd	LRC	16 16	dl	Sync
UNISCOPE	ASCII7	odd, SYNC	LRC	16 16	dl	Sync
VIP7700	ASCII7	odd,SYNC	LRC	16 16	d1	Sync

IPARS Setup

Sync1 (S1 or 3F hex) characters are not captured. When the IPARS application is loaded, any triggering on the start of a message should be made on the Sync2 (S2 or 3E hex) character.

The HP 4951C resident IPARS function can be set up without the IPARS application loaded, but erroneous results will occur when monitoring or simulating.

IPARS Setup Parameters

The IPARS Data Code has specific settings which you must select. These settings are given below.

Protocol	Char
Bit order	MSB
Code	IPARS0 or IPARS1. The 0 or 1 refers to the idle state transmitted for normal bit sense. IPARS0 will leave the line idling in 1's when transmitting if "Bit sense = Inverted". IPARS1 will idle the line in 0's if "Bit sense = Inverted".
Parity	None
Transparent text char	None
Mode	Sync
Sync on	${}^{3}_{F}{}^{3}_{E}$
Drop sync	Operator created (usually 0) after ${}^{0}_{0}{}^{3}_{F}{}^{F}_{F}{}^{F}_{F}{}^{F}_{F}{}^{F}_{F}{}^{F}_{F}$. This field is used to specify other conditions that the HP 4951C will use to go out of sync and begin searching for sync.
Err chk	CRC 6
Start on	${}^{3}_{E}{}^{3}_{E}$. Each IPARS message begins with a sequence ${}^{3}_{F}{}^{3}_{E}$. In this field, the HP 4951C wants two individual start characters, not a sequence. For IPARS both of the characters should be ${}^{3}_{E}$ which is the last character of the only valid start sequence for IPARS.
Stop on	${}^{0}_{D}{}^{1}_{D}{}^{2}_{D}{}^{3}_{D}$. This field is used to specify end-of-message characters. When the HP 4951C sees one of these characters, it will stop accumulating CRC and will expect the total CRC count. As in the "Start on" field, these four characters are individual stop characters, not a sequence.
Bit sense	Most commonly set to Inverted.

Bits/sec	Line Speed.
Display	Choose the display format that is best for your needs.
Suppress	Depends on your needs.

Modified Error Check (MEC)

The Modified Error Check (MEC) application is useful when the protocol being monitored has multiple "Start on BCC" characters before data begins, and it is not an IPARS protocol.

The Modified Error Checking application which is located on the HP 4952A Utility Disc (filename IPARS_MEC) must be loaded before being used. The Top Level Menu will change to show that Modified Error Checking (MEC) has been loaded.

The Modified Error Check application is invoked during a run when the data code is not IPARS0 or IPARS1, and both the "Start on BCC" characters are the same. The modified error calculation makes sure that CRC or LRC calculations begin only after the last "Start on BCC" character encountered. When this application is not loaded, the HP 4951C begins calculating the error check after the first "Start on BCC" character encountered.

Timing Suppression

This HP4951C application filters timing information (timestamps) the data capture buffer while monitoring or simulating. This modification allows more efficient use of the data capture buffer, but means timing measurements can not be made on this data in the future.

The applications NOTIMECOPS and NOTIMEBOPS are both included on the HP 4951C Utility Disc (HP part number 04951-16702 Rev. A.00.00). Utility disc filename NOTIMECOPS should be used when testing Character Oriented Protocols (specifically when the Char Async/Sync protocol is entered in the Setup Menu). Utility disc filename NOTIMEBOPS should be used when testing Bit Oriented Protocols (SDLC, HDLC, X.25 etc.). If you are not familiar with loading an application, refer to the Mass Storage chapter in this manual.

Note This application will only operate with HP 4951C system revision 5.0 (or higher if any).

Using the Application

Note Auto configure can not be run with this application. The **Auto Config** softkey is removed from the top level menu when this application is loaded. To restore this softkey, delete this application by pressing the **reset** softkey.

This application has the following limitations:

1. If the Bisync (BSC) protocol is used on your network, configure the analyzer to "Char Async/Sync" in the protocol field of the Setup menu. See figure 5-6 for an example. The application will not work if Bisync is entered as the protocol in the field.

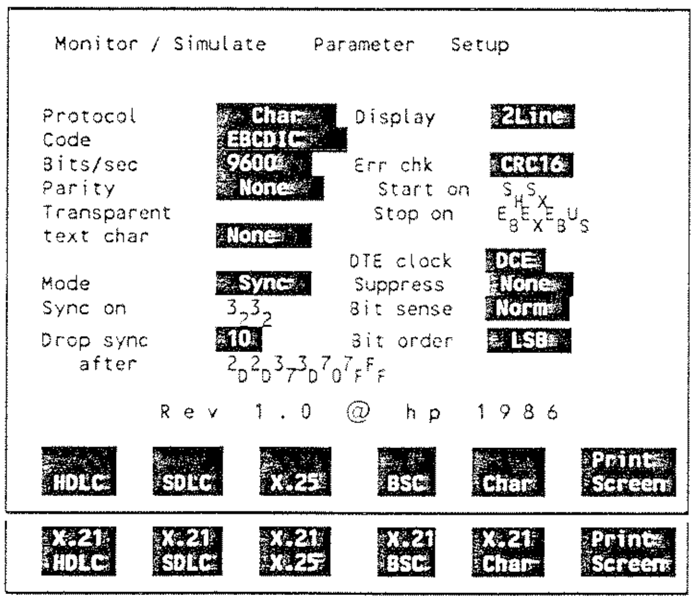


Figure 5-6. Use the Char Setup Menu to Configure BSC

2. All timing measurements performed on data captured while the application is loaded will be inaccurate.

3. No lead change information is captured when this application is loaded.

4. In order to use this application, you must have HP 4951C system revision 5.0 (or greater - if any). The HP 4951C system revision number is displayed in the top level menu screen.

As soon as the application is loaded from the Mass Store menu, your instrument is automatically configured to filter timing information.

Note Label your disc file in the comment field to remind you that the timing stamps have been removed since there is no way to tell if the timing stamps are present or not.

6

The Monitor and Simulate Menus

This chapter explains how to make measurements. Because the HP 4951C 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 4951C 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 Menu, you must specify either DTE or DCE simulation.
2. In Simulate Menu, you can transmit characters with the **Send** softkey.
3. In Simulate Menu, you must program the interface with the **Set Lead** softkey.
4. In Simulate Menu, 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.

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 6-6, 6-25). 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, Disc, and Timer to appear.

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 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 is 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, epending on whether you want to monitor "on-line" or do postprocessing on data already in the non-volatile buffer. The HP 4951C lets you run programs over and over on the data in its nonvolatile buffer.

Triggering

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

2. The HP 4951C can branch to any action as a result of a trigger. You must provide a block for the analyzer to branch to (e.g., then goto Block 4).

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. 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

```
                          | Text
                          | Hex           (* indicates bit oriented
                          | Binary           protocols only)
                          | Don't Care
                | DTE     | Not
When Trig ----  |  ------- |    [MORE]
                | DCE     |                 |*Good FCS
                          |*End Frame ----- |*Bad FCS
                          |                 |*Abort
                          |*Start Flag
                          | Delete
                          | Insert
```

Monitor and Simulate Menus

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 4951C 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 data code tables in Appendix B 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.

Simulate Menus

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 6-1.

Excluding Characters

To trigger on "anything but" a particular character, use Not. "Not" characters are overlined. Observe the "3" and "5" in figure 6-1.

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 4951C 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.

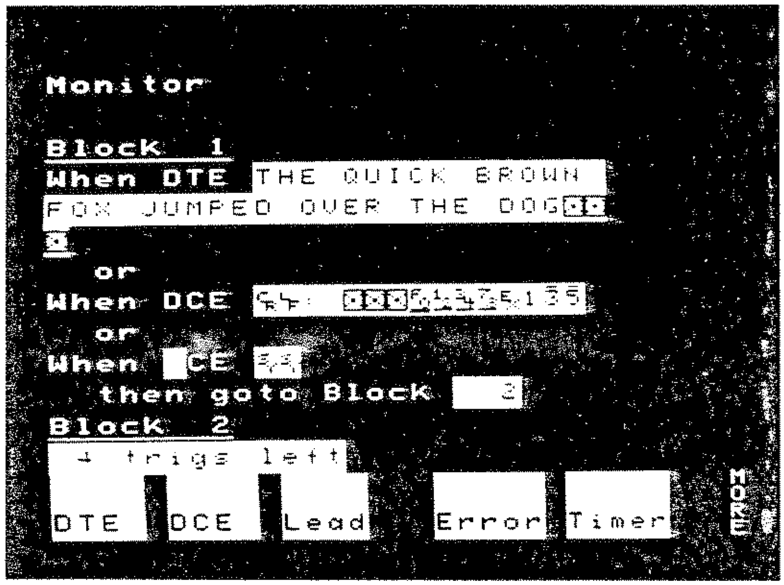


Figure 6-1. Triggering on Characters

Triggering on Errors, Leads, Timers

```
                                  | RTS
                                  | CTS               On
             | Lead ------------- | DSR      goes ---
             |                    | DTR               Off
             |                    | CD
             |
             |
When Trig ---- |                  | Parity DTE (* FCS DTE) (**Framing Error DTE)
             | Error ---------    | Parity DCE (* FCS DCE) (**Framing Error DCE)
             |                    | BCC DTE (* Abort DTE)
             |                    | BCC DCE (* Abort DCE)
             |
             |                                  (* bit oriented setups)
             | Timer [1,2,3,4,5]   >   [  ]      (** asynchronous setup)
```

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.

```
Monitor

Block 1
When Lead RTS goes On
     or
When Error  FCS on DTE
     or
When Timer 1 > 1000
     then goto Block 2

Block 2

63 trigs left


Start  Stop  Inc     If   When
             Ctr          Trig
```

Figure 6-2. Triggering on Errors, Leads, Timers

Combining Triggers

When Trig statements within the same block are ORed: the analyzer looks for them 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 4951C 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 trigger found first disables the other triggers.
In this example "ab" is always found first and then disable the first **When Trig** statement.

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

In this example 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  ab
              then goto Block 3
```

In this example 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 4951C has five timers which can each measure up to 65,535 milliseconds. 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. 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. Be sure statements relating to line status are tied to a preceding trigger statement.

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 ....
```

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

Using Timers in Simulate

These simulate examples illustrate the same principles described above.

This example is NOT correct. It is not known when Timer 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
```

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
```

Monitor and Simulate Menus

Counting Events -- INC CTR

Use the **Inc Ctr** statement for counting events. The HP 4951C has five counters which let you 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 9,999 and then starts over from zero. By having one counter increment whenever a second counter overflows, you can count up to 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.

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

The second example counts the number of times RTS goes on.

Note You must have a character oriented protocol selected for this example.

```
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.

```
                   |Counter  [1,2,3,4,5]    > [  ]
                   |
                   |
If --------------- |
                   |               | RTS
                   |               | CTS       On
                   | Lead -------- | DSR    is--
                                   | DTR       Off
                                   | CD
```

How IF and WHEN 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
```

Monitor and Simulate Menus

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

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

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 4951C do the watching for you. Define an event of interest in a preceding **When Trig** statement, and then start" or "stop" the display, disc, or timers when that event occurs. Of course, no data is actually lost; line data is continuously filling the buffer.

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**.

The disc 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 disc stops, and any active timers stop. You can use this statement within a program to have the analyzer immediately stop upon finding some event.

Monitor and Simulate Menus

Examples of Start and Stop

The first example stops the run for a Negative Acknowledgment on the DTE line. You enter the "NAK" by pressing the CNTL and "U" keys at the same time as indicated by the keycap.

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

The second example stops the display at a Frame Check Sequence error on the DTE line.

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

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. Highlighted characters appear in half-bright video 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 the **Data & State** display. The HP 4951C remembers only the last 64 highlights in the buffer. Only the last character of a string is highlighted (see Figure 6-3). The clock timeout highlight is denoted by a small clock face symbol.

Examples of Highlight and Beep

This example highlights the "z" in the "xyz" string whenever it occurs on the DCE line.

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

This example causes a continuous beep whenever the string "abc" occurs on the DTE line.

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

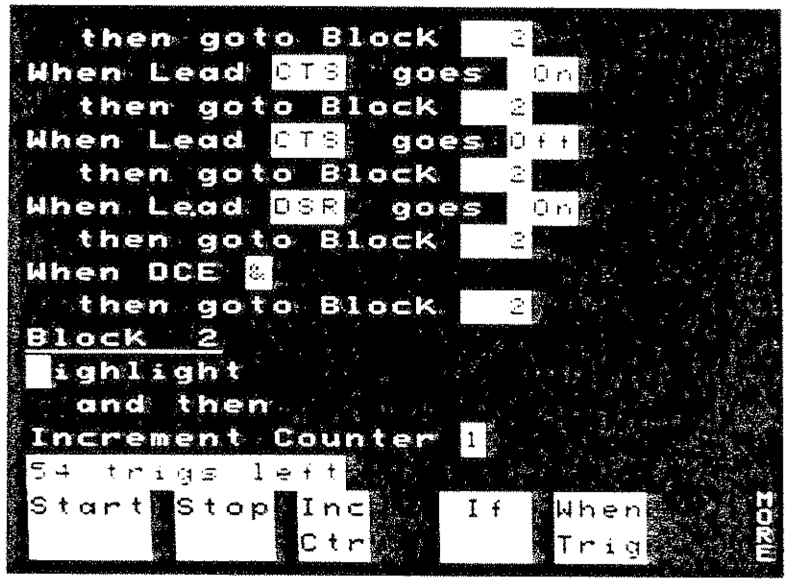


Figure 6-3. Highlights in the Buffer (Examine Data Menu)

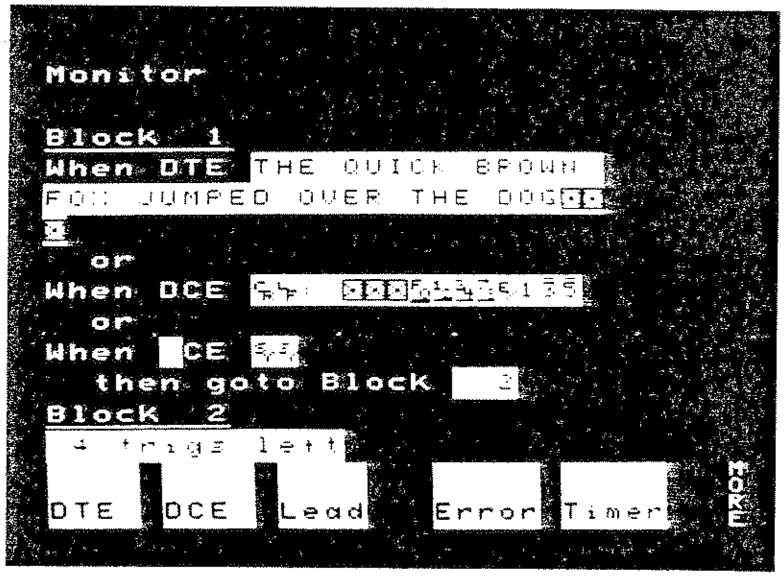


Figure 6-4. Portion of Program Producing the Display in Figure 6-3.

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 4951C. Maximum length for each string is 255 characters.

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

Handshaking Requirements on the Interface

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

The HP 4951C 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 6-27 for discussion of the **Set Lead** statement.

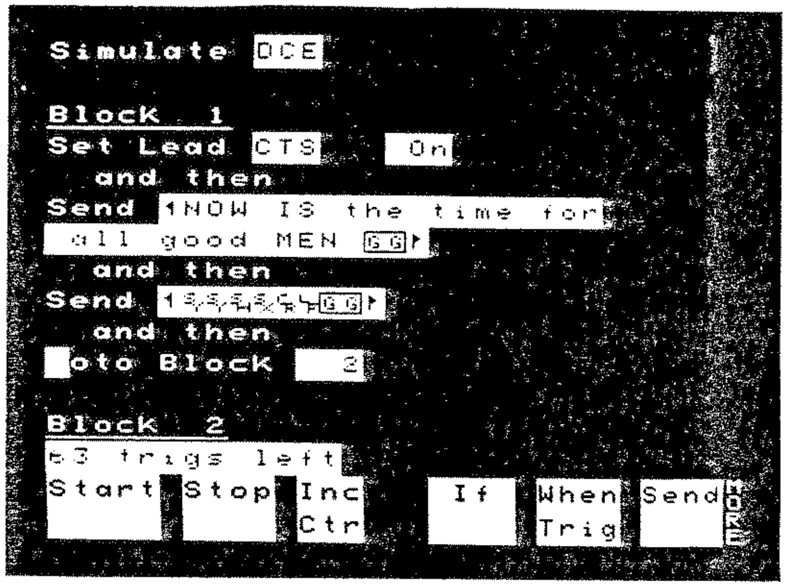


Figure 6-5. Sending Characters in Simulate

Using Timers With <Send>

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

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

The next 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
```

The next example is incorrect because the timer is not tied to a **When Trig** trigger statement. You cannot 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 4951C 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 lead softkeys are displayed, as shown below (* indicates RS 449-leads). See Chapter 15 for more information.

```
               DTE                            DCE

             | RTS  (*RS)                   | CTS  (*CS)
  Set Lead   | DTR  (*TR)       Set Lead    | DSR  (*DM)
                                            | CD   (*RR)
```

Lead Status During Simulation

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

The HP 4951C must be programmed to control the leads in the simulate mode (this is the only time the HP 4951C controls the interface leads). At the beginning of a simulation run, the HP 4951C sets all the interface leads listed above off. You must 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 4951C except when it is simulating. Remember this when you use **If Lead** statement in a monitor program.

Set Lead Examples

Because the HP 4951C 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 4951C. 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
```

Monitor and Simulate Menus

Delaying Output -- WAIT (Simulate only)

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 millisecond increments to cause delays of up to 65,535 milliseconds. In combination with counters, very long delays can be set up.

The following example repeatedly sends a string of numbers and then waits 50 milliseconds.

```
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 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 digits for each hex 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).

7

The Run Menu

Except in Auto Configure, where the HP 4951C automatically goes into the run mode, use the Run Menu to execute all tests. After pressing **Run Menu**, the following softkey choices appear.

Monitor Line→Buffer	**Simulate**	**BERT**

Monitoring On-Line

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

1. Hookup	Connect the HP 4951C 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 4951C displays the line data. Use the Setup Menus to change the display format.

Run Menu

Run Menu

Monitoring From Buffer

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

1. Hookup	The HP 4951C need not be connected to the pod to monitor from buffer.
2. Load the Buffer	Load the buffer with data, either from the disc, or by running 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	This step is optional. You may go right to the Run Menu. One of the advantages of monitoring from buffer is that you can program the HP 4951C 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 4951C begins displaying buffer data and running any measurements you may have setup in the Monitor Menu.

Running Simulation

1. Hookup	Substitute the HP 4951C 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 softkey, select the operations (e.g., Sending or Setting Leads) you want the HP 4951C 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 4951C 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

The following is a listing of the Run Menu Softkeys and messages shown at the bottom of the display.

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 Disp **Start Disp**

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

The message line indicates which 2 Kbyte block of memory (1 to 16) is being displayed. When memory wraparound occurs, the next 2 Kbyte 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 disc.

Summary **Data Display**

These keys alternate to show either data or the Setup Summary. Press **Summary** at any time, without affecting the run, to review the current setup and observe the counters and timers (see figure 7-1). The summary tracks the current Setup Menu. Timers are updated whenever a trigger is found. Counters are updated every half second. Counters automatically roll over to 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 (16 blocks) and will begin to overwrite data (in block 1) that has not yet been processed. This can occur when storing data directly from the line to disc, 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 per second in character oriented protocols, and speeds greater than 64 Kbps per second 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").

```
Protocol        HDLC
Ext Addr    OFF                 Ext Ctrl        Off
Code        ASCII 8             Err chk         CCITT
Parity          None

Mode            Sync            DTEclock        DCE
                                Bits/sec         9600
                                Dispmode        F & P

Counter 1 =     11              Timer 1 =       0
Counter 2 =      0              Timer 2 =       83
Counter 3 =      0              Timer 3 =       0
Counter 4 =      0              Timer 4 =       0
Counter 5 =      0              Timer 5 =       0
                                                 Data
                                                 Disp
```

Figure 7-1. The Setup Summary Display

Displaying Data

Five display formats are available. Use the Setup Menus to change the display format. Figures 7-2 to 7-6 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 7-7 and 7-8 for examples of full duplex and half duplex data. On half duplex data, the HP 4951C displays complete DTE messages alternating with complete DCE messages. On full duplex data, the HP 4951C 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.

Run Menu

8

The Examine Data Menu

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 4951C to post-process data from the buffer.

The following items 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 continually being loaded with data when monitoring on-line or simulating. The buffer can also be loaded from disc.

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 are only reset if (1) another run is started, (2) Reset is pressed, or (3) before loading data from disc.

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 lets you 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

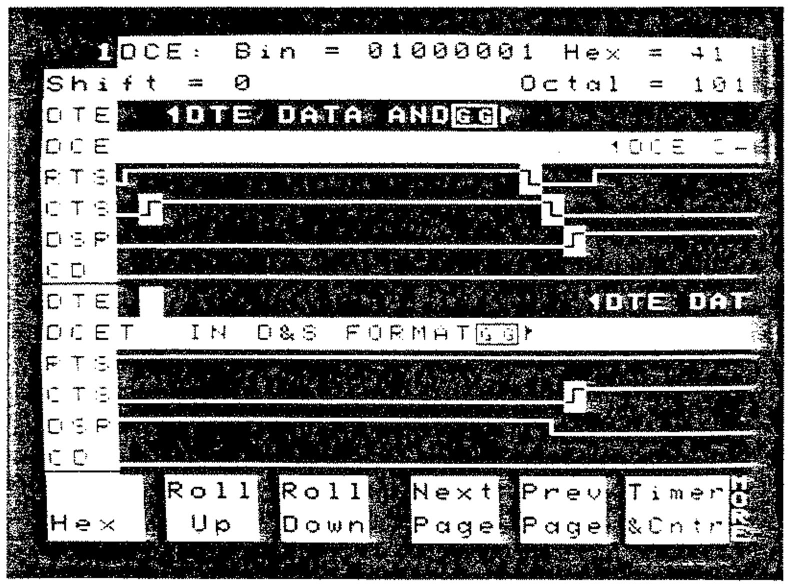
Move the cursor to any character and observe the binary, hex, and octal equivalents at the top of the display. You can also see the parity bit for any character.

Decoding Packets

In X.25 setup and Frame & Packet display format, the HP 4951C decodes packet headers simultaneously with control field information in the Examine Data Menu. See page 8-6 for a 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

Softkeys

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

Roll Up/Roll Down Lets you move the displayed buffer data up or down one line at a time.

Next Page/Prev Page Moves 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 a particular two 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 disc may have block numbers as high as 308.

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 disc like the buffer. These softkeys load either the next or the previous 16 bytes of data from disc into the buffer for observation. This choice appears only when you have loaded a disc 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. This choice appears only in character oriented setups.

Displaying Data

The same five display formats available during run-time are available in examine data. See figures 7-2 to 7-6.

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, 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 C 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.

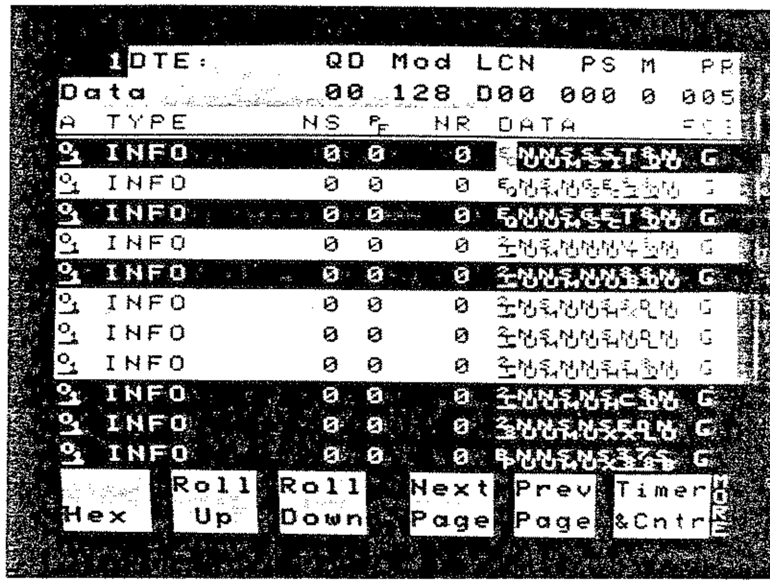


Figure 8-2. Decoding X.25 Packets with Frame & Packet Format

Finding Unknown Protocols

Use the Examine Data Menu in conjunction with the Char Asyn/Syn Menu to determine the parameters of unknown protocols.

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. Mod character oriented protocols idle in FF. Some PIARS 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.

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 4951C does not shift through the parity bit, select a data code with no parity.

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 orders** reversed (e.g. IPARS), you may need to go back and capture some new data with these two parameters changes.

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.

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 disc 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.

Disc removed during a Read operation.

When you remove the disc during a load operation, the buffer data is invalid. Use the EXIT key to exit. Try loading the data again.

Disc read error: buffer data invalid.

This may be caused by a broken disc controller, or by a worn out disc. Use the EXIT key to exit. Try another disc to help isolate the problem.

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 disc file.

When you specify a block number beyond the last block on disc.

9

Bit Error Rate Tests (BERT)

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 equals $2^{L} - 1$ bits. A PRBS may be of any length, but certain pattern lengths have become standard. The HP 4951C 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.

BERT "blocks" are not to be confused with the blocks used in other HP 4951C 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, the block size would also be 511 bits.

BERT Menu Softkeys

Press BERT on the Top Level Menu. The BERT Menu selections are shown on the next page.

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 ITT 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 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 top 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  ]          Framing   [ None   ]
              [ CCITT spec  ]                    [ 5 bits ]
                                                 [ 6 bits ]
Duration      [ 10^4 ]  [    10^9   ]            [ 7 bits ]
              [ 10^5 ]  [  5 min    ]            [ 8 bits ]
              [ 10^6 ]  [ 10 min    ]
              [ 10^7 ]  [ 15 min    ]  Parity    [ None   ]
              [ 10^8 ]  [    Cont   ]            [ 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 reenter the BERT Menu.

Data Display 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

Sychronization and handshaking requirements must be met to properly perform accurate BERT testing and are detailed in the following paragraphs.

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 4925 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 4951C simulates a DTE. At the beginning of the test the HP 4951C sets the RTS and DTR interface leads "on". For RS-449 interfaces, 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 pssible to check both send and receive channels simultaneously. The transmitter at each end is essentially a PRBS generator; The receivers are pattern checkers.

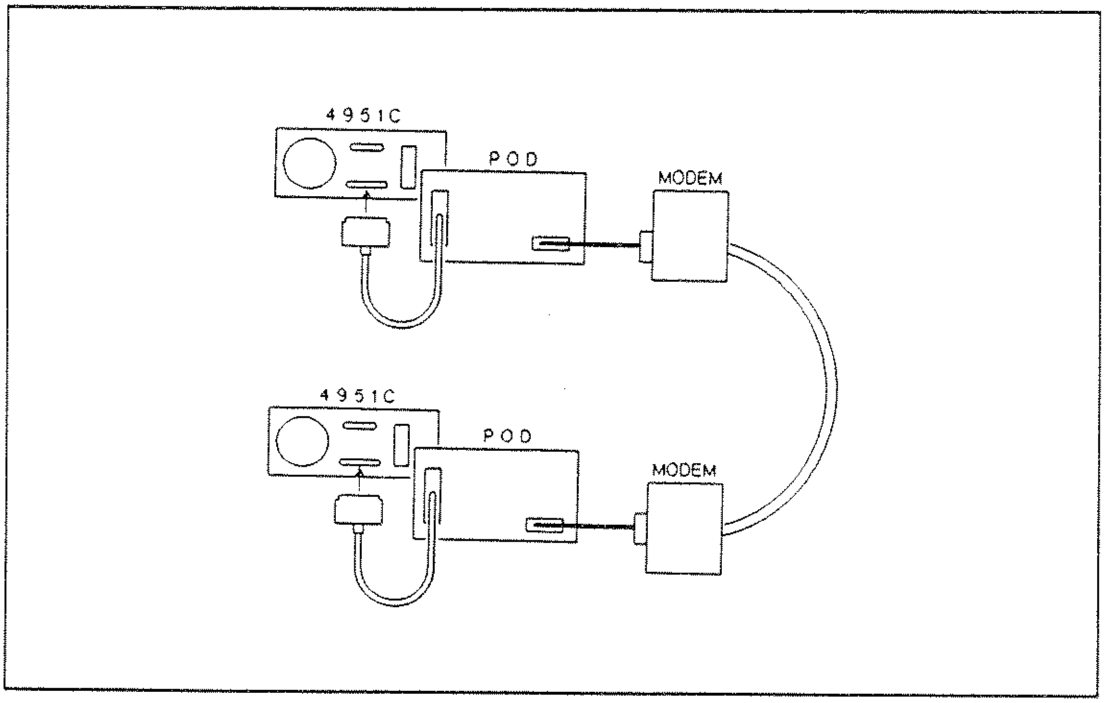


Figure 9-1. End-to-End Testing

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 receives 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.

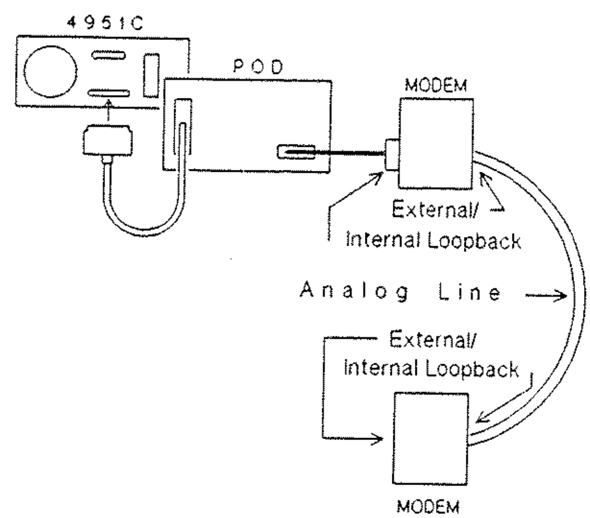


Figure 9-2. Loopback Testing

Other Tests

Some BERT testers (such as the HP 4925) perform the following character error ch... 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 4951C also checks parity errors. See example 4 in chapter 14.

Startup Tests

The HP 4951C does many types of start-up tests, such as RTS - CTS delay. Use the Simulate Menu. See chapter 14.

BERT Configuration Modes

The Bit Error Rate Parameter Setup menu is where you select the specific BERT configuration for your application. BERT can be configured to run in Asynchronous, Synchronous, or Isochronous mode.

The Bit Error Rate Parameter Setup menu fields "Pattern", "Block Size", and "Duration" have no effect on the mode of transmission. Only the fields Bits/sec and Framing fields affect the transmission mode. The different setups that determine transmission are listed below.

Asychronous: Bits/sec = Other than Ext; Framing = On (other than none)

Synchronous: Bits/sec = Ext; Framing = None

Isochronous: Bits/sec = Ext; Framing = On (other than none)

10

The Remote Menu

The HP 4951C can transmit and receive menus and buffer memory remotely to an HP 4951A/B/C, an HP 4952A, an HP 4954A, an HP 4955A, or an HP 4953A. The menus and/or buffer data must currently be in the HP 4951C memory to be available for transmission. Once transmitted, the menus or buffer data should be saved on mass storage for future use or reference (the next remote transfer could inadvertently overwrite and destroy the menu or buffer data downloaded). For remote operations, the HP 4951C must be executing in the Remote Menu. The controller must successfully execute the Slave's ID operation before remote transfers can begin.

Remote Operation

1. Connect both slave and controller to asynchronous modems via the Remote/Printer (RS-232/V.24) connector on the rear panel. The units can also be connected without modems by using the interface pods. See page 10-7 if you are not using modems.

2. At both sites go to the Remote Menu and select one as **Controller** and the other as **Slave** .

3. Select the same Bits/sec for both slave and controller. When using an HP 4953, HP 4954A, or HP 4953A as a controller, select the same address for slave and controller.

4. Select **Slave's ID** operation at the controller.

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

6. After establishing modem communication, repeat the Slave ID operation (steps 4 and 5). This is necessary to synchronize remote transfers.

Using the HP 4951C as a Controller

As a Controller, the HP 4951C downloads menus and data to the slave. The HP 4951C 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 the slave.

Slave Status

Requests the slave to transmit its current status.

Slave ID

Initiates and synchronizes remote transfers after hookup. The slave transmits "HP 4951C".

```
Configuration     Controller

Operation         [ Upload Menus   ]     Start Blk [ ] End   Blk [   ]
                  [ Upload Data    ]
                  [ Upload Appl    ]
                  [ Slave Status   ]
                  [ Slave ID       ]
                  [ Download Menus ]
                  [ Download Data  ]
                  [ Download Appl  ]

Interface         [Pod] or [Remote Port]

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

                  The following status messages appear during execution.

Status            Operation executing
                  Operation successful
                  Slave rejected operation
                  Slave not responding
```

Figure 10-1. Remote Menu - Controller Configuration

Using the HP 4951C as a Slave

A slave HP 4951C responds to any of the commands from a controller HP 4951C (See the operation list on the previous page). When in the remote menu, a slave HP 4951C 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's Slave Status command.

HP 4955A and HP 4953A Controller Commands

Application programs cannot be transferred between an HP 4955A or HP 4953A and a HP 4951C. Other than this exception, an HP 4951C responds to all the commands from a Controller HP 4955A or HP 4953A (See the operation list on the previous page).

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

Upload Timers & Counters

Upon receiving this command from an HP 4955A or HP 4953A controller, a slave HP 4951C 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 4951Cs.

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

     The following status messages appear during execution.

Status                  Operation executing
                        Operation successful
                        Slave rejected operation
                        Slave not responding
```

Figure 10-2. Remote Menu - Slave Configuration

Remote Menu

Ending Remote Operations

To stop execution of any remote operation, press EXIT. If you press EXIT again the HP 4951C 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 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 4951C is configured as a DTE. The following handshaking convention is used.

1. DTR is turned on when you press **Execute** . You must press **Execute** at both ends of the line. The HP 4951C then waits for DSR to go on.
2. The HP 4951C then sets RTS on and waits for CTS and CD to go on.

Operations Without Modems

The HP 4951C 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 to 3, 4 to 8, and 5 to 6 and 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 disc.

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 4951C

This might occur for certain menus created by a HP 4955A or HP 4953A.

Modem handshake fails

The controller RTS, CTS handshaking 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 4951C

The operation is one that only an HP 4955A can perform.

Issue ID request to enable slave

You must **Execute** this operation immediately after establishing phone communication to synchronize remote transfers.

11

Mass Storage

Note The Continuous Store to Disc feature puts an additional demand on the disc drive. It is especially important to follow the "CARE AND HANDLING OF DISCS" instructions on the next page. Avoid prolonged use in a harsh environment, and consider cleaning the drive heads periodically.

Because of the versatile triggering capability of the HP 4951C, you can usually find data communication problems before using all the memory. However, the disc drive has several advantages:

1. Store data directly from the line onto disc; this increases your buffer memory to the size of the space on the disc.

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 disc like a large buffer. The HP 4951C nonvolatile buffer memory holds 32 Kbytes of data. A disc holds up to 618 Kbytes. Using the **Next Disc Segmt** and **Prev Disc Segmt** commands in the examine data menu, you can scroll through the disc.

4. Load application programs using the disc.

How to Use the Disc Drive

Always install the transportation disc in the disc drive when transporting or shipping the HP 4951C from place to place. The transportation disc helps prevent damage to the disc drive from bumps and vibration that may occur. The warranty may be voided if the transportation disc is not used during transit.

Type of Discs

The HP 4951C disc drive uses 3 1/2 inch, double-sided, double-density flexible discs. Specify part number HP 92192A to order a set of ten discs.

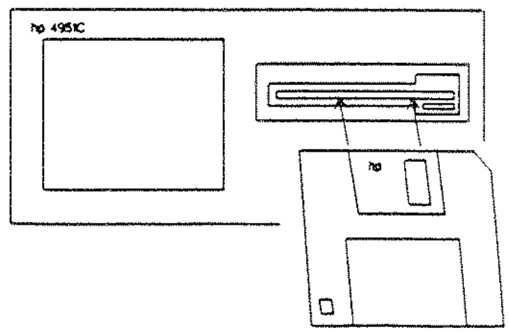
Care and Handling of Discs

Discs require a clean, dust-free environment. To avoid damaging your discs and losing information, follow these rules for handling and caring for your flexible discs.

1. Make certain the shutter (the metal guard) is closed when the disc is not in use. The shutter protects the disc from dirt, fingerprints, and scratches.
2. Use discs in a clean environment. Avoid getting smoke, dust, eraser particles, salt air, food crumbs, hair, or fingerprints on your discs. Dust and dirt particles can scratch the disc surface which may cause loss of information.
3. Keep discs stored upright in a cool, dry place. The storage temperature range for discs is $4^{O}C$ to $53^{O}C$ ($39.2^{O}F$ to $127.4^{O}F$) with a relative humidity between 8% and 90%. Heat and moisture can damage your discs.
4. To avoid losing important information, copy and backup your discs frequently.
5. Do not put discs near anything that generates a magnetic field, such as a telephone, magnetic paper clip holders, or appliances with motors.
6. Do not touch the disc surface. Scratches or contaminants can reduce the life of your disc.
7. Do not try to clean the disc. The plastic jacket contains its own cleaning device. Other cleaning methods can damage the disc.

Inserting Discs

Hold the disc in your hand with the label side up and the metal shutter pointing towards the drive. Your fingers should be on the edge of the disc that has the paper label on it, and not the metal shutter. You do not need to open the shutter, it will open automatically in the disc drive slot. Insert the disc firmly but gently into the disc slot until the disc touches the back of the slot. Continue pressing until you hear a click and the disc is pulled down into the drive.



Removing a Disc

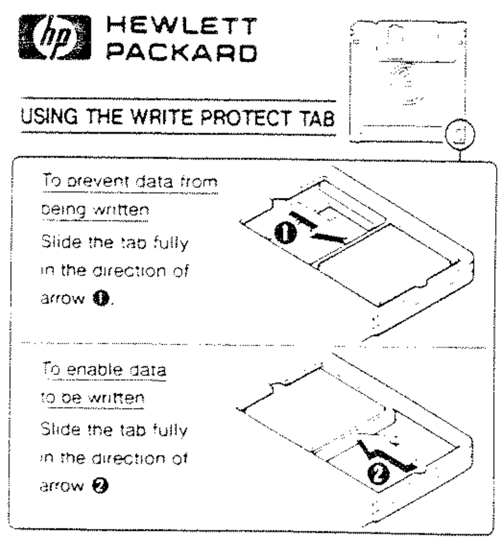
To remove a disc from the disc drive, press the gray button just below the drive. The disc will pop out part of the way. Pull the disc straight out. Check to see that the metal shutter is closed before you put the disc away.

Write-Protecting the Disc

You can protect data on a disc to ensure that no one can inadvertently write over or delete the information on the disc. To write protect a disc, use the following procedure.

1. Turn the disc over so you are looking at the back.
2. Place the tip of a pen in the small hole at the top of the write protect tab.
3. Slide the tab downward until it locks into place. The tab will no longer be visible from the front of the disc.

You can load (read) from the disc with the protect tab in either position.



The Mass Store Menu

The Mass Store Menu is used for disc operations. You cannot use this menu if you have the delete disc drive option installed. The following softkeys appear when you press **Mass Store** in the Top Level Menu:

	Dir	Load	Store	Del ete	Re cover
For mat	Pack Disc	Con- vert	Print Appl	Re- name	

Directory

The directory (**Dir**) operation displays the disc contents giving File Name, File Type, and a Comment field. Five defined file types are possible:

MENU & DATA Both buffer data and menus (setup, monitor, simulate, BERT).

MENU Consists of menus only (setup, monitor, simulate, BERT).

DATA Buffer data only.

APPLIC Only HP 4951C application files can be loaded.

XTUNDAT Created during a continuous store capture from line during run-time.

Identical file names may coexist if the file types are different. Notice that only three types of files are generated by the HP 4951C: DATA, MENU and MENU & DATA. Data type files always contain ONLY data. Menu type files contain only menus.

The Comment field is 32 characters long, with all characters displayed on the file the cursor is highlighting.

The cursor keys can be used to "scroll" through the files on the directory. The ◀ key acts as a previous page for long directories. The ▶ key acts as a next page for long directories.

Function Name	Directory Type	Sectors
Self_Demo	Menu	33
X25_DECODE	Applic	97
SNA	Applic	97
SNA_DATA	Menu & Data	556

Space Available = 1669 Sectors

Figure 11-1. A Directory Listing

Format

Erases the disc directory and places a new format on every track of the disc. This must always be used for blank discs. This process of formatting should take approximately 45 seconds.

Load

Allows files to be loaded from the disc. File names may be entered via the keyboard or by scrolling to the file name using the cursor arrow keys before pressing the **Load** key.

Store

Allows files to be stored to the disc. File names may be entered via the keyboard or by scrolling to the file name using the cursor arrow keys before modifying the name and then pressing the **Store** key. File type must be specified and a comment is allowed to aid in file identification.

The Store to disc operation will reclaim space from files that have been deleted. The HP 4951C will try to store to empty sectors at the end of the disc. If there is not enough space at the end of the disc it will look for deleted file space. If there is a large enough hole it will store, if not the message `Disc is full` message will appear. The overwritten file can no longer be recovered.

Delete

Allows files to be marked for removal from the disc. File names may be entered via the keyboard or by 'scrolling' to the file name using the cursor keys arrows before pressing the **Delete** key. The file is marked for deletion in the directory (a Del in the right most columns) but actually not deleted until a **Pack Disc** or **Store** writes over the data.

Recover

Allows files marked for removal from the disc to be restored as valid active files in the directory. Only files created on a HP 4951 disc series protocol analyzer may be recovered. Each file name must be entered via the keyboard or by scrolling to the file name using the cursor arrow keys before pressing the **Recover** key and then modifying the name. This can only be done before the disc has been packed.

Pack Disc

Lets the directory regain use of disc space lost when files are deleted and when run-time files are created. The Pack Disc operation packs all existing and non-deleted files together.

Once pack disc has been completed there is no way for the HP 4951C to recover the deleted files.

Rename

Allows a file to be renamed or the comment associated with a file to be changed.

Convert

Converts the ExtRunDat file type to a Menu & Data file type so that other Hewlett-Packard protocol analyzers can read the data file. Only ExtRunDat file types may be converted.

Print Appl

Loads the Printer Application stored in firmware into the Application RAM. Any application currently loaded will be overwritten.

How to Load Data Into the Buffer

Insert the disc into the disc slot. Press **Dir** in the Mass Store Menu to see how the file is listed on the disc. Cursor to the file name or type in the file name as it is listed in the catalog. Press **Load** and then **Execute** to load the file into the memory.

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

The HP 4951C 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 disc if you want to save them.

Loading Files Larger Than the Buffer

When loading a disc file that is too large for the buffer the softkeys **Next Disc Segmt** and **Prev Disc Segmt** are automatically displayed in the **Exam Data** menu. You can scroll through the rest of 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.

Autoapplic

You can rename any application file to AUTOAPPLIC and have it automatically loaded when the HP 4951C is switched on. Just insert the disc with the "autoapplic" file into a 4951C and switch the power on. This should be used with caution as it conceivably could result in a menu or data being written over when the application is loaded. Always save data or menu files to disc that might possibly need to be re-used.

Mass Store Menu

What You Can Store on Disc

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

How to Store to Disc

Insert a disc and format the disc if it is blank. Press **Store** , enter the file name, the file type, and an optional comment; then press **Execute**. If the disc has insufficient room for a file, "Disc Full" is displayed.

Storing Directly to the Disc from the Line

To store directly to disc while monitoring or simulating on line, the **Start disc** command must be placed in the Monitor or Simulate program.

For example:

```
Monitor

Block  1
Start Disc
```

Note You can only start and stop the disc once by program control.

The actual storing of data from the line to disc occurs when Monitor Line or Simulate is executed. To execute either of these commands, first press **Run Menu** in the top level menu. Then either elect **Monitor Line** or **Simulate**, then **Execute**. If the Start disc command is present in your Monitor or Simulate program, you will be prompted to give the disc file name (File Name) and mode of storing to disc (Run Mode).

Note When storing to disc during a run operation, the HP 4951C will never try to reclaim disc space. Files that are marked for deletion will not be overwritten. Only empty sector space will be used and the disc full message will appear.

There are two modes of storing to disc. These are: Continuous Loop (Cont Loop), and Until Full.

"Continuous Loop" Versus" Until Full" When Storing from Line

Continuous Loop.

The Continuous Loop command instructs the HP 4951C to continue storing to the disc even after the disc is full. The HP 4951C will continue to store to disc until the [EXIT] key is pressed. The data on the disc will be overwritten in a circular fashion. The most recently stored data will be on the disc after the [EXIT] key is pressed.

The created disc file type will be "ExtRunDat" if data from the line actually wraps around and overwrites data on the disc. If the data does not wrap around, then the created file type will be "Menu&Data".

The file type "ExtRunDat" (Extended Run Data) is compatible with the HP 4954A "Ext. run data" file, with the two instruments being able to read each others' files.

Note An HP 4954A formatted disc is not optimized for high speed capture on the HP 4951C, and should not be used to capture data on a HP 4951C. The disc should be first reformatted by an HP 4951C.

ExtRunDat files can not be read by an HP 4952A (or an HP 4951C with less than REV 5.0 firmware) without first being "Converted".

Until Full.

The Until Full command fills the disc with data until it is full, after which the disc stops, and the message "Disc Full" is displayed. The file type created on the disc will be "Menu&Data".

Convert Command.

The "Convert" command converts an ExtRunData file to a Menu&Data file type. The Convert key is located in the second row of softkeys in the Mass Store menu. It will only convert ExtRunDat files.

Disc Capture Capabilities.

The disc can typically keep up at line bit rates of 9600 bps full duplex and 19.2 kbps half duplex. The disc is able to keep up at higher line bit rates if line utilization (percentage of data to idles) is low. If the disc cannot keep up, "Buffer Overflow" is displayed.

12

Reset and Self Test

The Reset Softkey

The **Reset** softkey lets you 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 HP 4951C has a battery powered back-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 cases:

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

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

BSC PROTOCOL	CHAR ASYNC/SYNC
	Bit order LSB 1st Bit sense Norm
Code ASCII 7	Code ASCII 7
Error check LRC	Error check LRC
	Parity None
	Transparent text char None
	Mode Sync
Sync on 16 16	Sync on 32 32
	Drop sync 10 characters
	after 2D 20 37 3D 70 7F FF
DTE clock DCE	DTE clock DCE
Bits/sec 9600	Bits/sec 9600
Display mode Data & State	Display mode Data & State
Suppress None	Suppress None

When you select any error checking in Character Async/Sync following a **Reset** the HP 4951C 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 HP 4951C 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 goes through a self test cycle and displays failure information for specific tests. See Appendix E for more information on the Self Test Menu.

13

ASCII Printer Output

Introduction

The ASCII printer output application (supplied internally with the HP 4951C) lets you print buffer data, monitor and simulate menus, timer and counter results, and disc directories. HP 4951C display information can be sent to a printer via the Remote/Printer (RS-232C/V.24) connector on the rear panel or via the Interface Pod connector using the RS-232C/V.24 interface pod.

Items Required

To use this feature, you need to access the Printer Output application under the Mass Store menu. Use an ASCII Printer such as the HP 2601A, HP 2934A or ThinkJet Printer (HP 2225D).

If you use the Remote/Printer connector on the rear panel, you need a modem eliminator cable (HP 13242G).

If you use the Interface Pod connector on the rear panel, you need an RS-232C/V.24 interface pod such as the HP 18179A or HP 18180A.

Summary of Printer Operation

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

2. Load the printer output application program from the Mass Store Menu.

3. In the Top Level Menu, select **Printer Menu** and make the desired selections. The default conditions will work with a ThinkJet (HP 2225D) with all the back switches down.

Note If you are printing a data file greater than 32 Kbytes such as a very large data file captured with "continuous store to disc", then refer to the end of this chapter for special printing instructions.

---

4. Press **Execute** when the cursor is in any printer menu field (except the last).

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

Connecting the Printer

Connect the ASCII printer to the Printer/Remote connector on the rear panel using the HP 13242G cable, or to the RS-232C/V.24 interface pod, using the Y-ribbon cable supplied with the pod. See Figure 13-1 below.

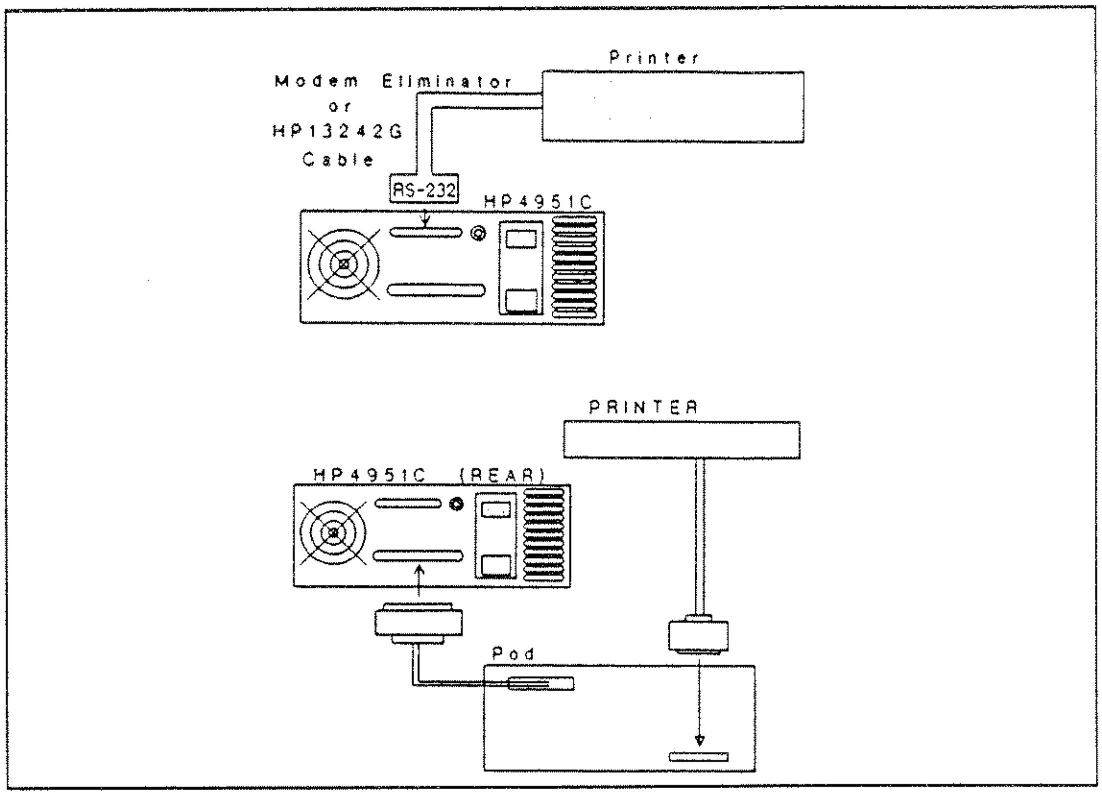


Figure 13-1. Connecting the Printer

Loading The Application

1. Press the More key in the top level menu.
2. Press the **Mass Store** softkey in the Top Level Menu.
3. Press the More key.
4. Press the **Print Appl** softkey.
5. Press **Execute** to load the printer application program.
6. The **Print** softkey should now appear on the top level menu softkeys (press MORE to see this selection).

Printer Menu

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 the connection you are using; either the interface pod (pod) or the Remote/Printer connector (RS-232 Port).

Bits/sec

You can 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.

4951C Mode

Determines whether the HP 4951C behaves as a Data Termination Equipment (DTE) or as Data Circuit-Terminating Equipment (DCE).

When using the pod's Y-ribbon cable for printer connection, the HP 4951C 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 are 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. Please note that the **Execute** key is not available in this field.

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

Port:                  Remote  or  Pod

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

Character Code         [ ASCII 8 ]  [ ASCII 7 ]

Parity                 [None ]  [ Even ]  [ Odd ]

4951C 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

Starting the Print Operation

After filling out the printer output menu, 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 using 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 previous 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 4951C when it is in the DTE mode. In the DCE mode the HP 4951C monitors DTR. If another line is to be used, the appropriate connections must be made via the interface 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 4951C inquires whether the printer is ready to receive characters. The HP 4951C sends an ENQ character (usually 05 hex) to the printer after each block of 40 characters. The printer must acknowledge the enquiry in order for printing to proceed. The printer does 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 06 hex) to the HP 4951C. 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 13 hex) to the HP 4951C. The HP 4951C then suspends transmission until the printer sends an XOn character (usually 11 hex). Some printers use a second XOff character (usually 15 hex). One XOn character, and two XOff characters can be specified in the printer menu.

Error Messages

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

No pod attached

No pod is attached to the HP 4951C.

No Lead Change

With hardware handshaking, no enabling lead has been detected for more than 60 seconds. The HP 4951C waits for an enabling lead from the printer.

No ACK after ENQ

While using ENQ/ACK handshaking, the printer has not responded with an ACK for more than 60 seconds after the HP 4951C sent an ENQ. The HP 4951C waits for the ACK character from the printer.

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 4951C waits for the XOn character from the printer.

No Transmission occurring

Check hardware connections.

To return to the printer menu after one of the above messages, press the EXIT key. 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 HP 4951C 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 except they are printed 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	? ?
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 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:      0000000000000000000000000000
CTS:      000000000000000000/111111111
DSR:      0000000000000000000000000000
CD :      0000000000000000000000000000
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:      000000000000000000000000000
CTS:      111111111111111111111111111
DSR:      000000000000000000000000000
CD :      000000000000000000000000000
```

Example of Frame & Packet

```
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
```

Printing Data Files Greater Than 32 Kbytes

Perform the following to print a data file which is greater than 32 Kbytes such as a very large data file captured with "continuous store to disc". It is assumed that the Print application has been loaded and the first 32 Kbytes (first segment) of the data file has been printed.

1. From the Print menu, press EXIT
2. Press Examine Data , then MORE.
3. Press MORE, then press Next Data Segmnt twice to load in the next 32 Kbytes of data.

Note Each time Next Data Segmnt or Prev Data Segmnt is pressed, 16 Kbytes (8 blocks) of data is loaded into the 32 Kbyte data buffer.

---

4. After the next data segment is loaded press EXIT.
5. Press MORE, Print , then Execute .
6. Press Print All .
7. Repeat steps 1 through 6 until the entire data file is printed.

14

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 preceeding trigger for accurate measurements.

```
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      Note that Start and Stop
             then goto Block 3        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 4951C supplies the ETC clock. Upon receiving the proper clocks and lead commands, the DCE begins sending data, which the HP 4951C 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 4951C automatically supplies both the TC and RC clocks. Upon receiving the proper clocks and lead commands, the DTE begins sending data, which the HP 4951C 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             The two "When"
             then goto Block 3                  statements are
           When DCE .                           ORed together.
             then goto Block 1

Block 3:   Increment Counter 1
             and then
           Goto Block 2
```

Examples

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                 Timer 5 starts when any
             or                       character is sent on the
           When DCE X                 DTE or DCE line.  ("X" =
             then goto Block 2        don't care.)

Block 2:   Start Timer 5              Timer 5 counts milliseconds
                                      up to one minute.

Block 3:   When Error Parity on DTE   The three "When" statements
             then goto Block 4        are ORed together.
           When Error Parity on DCE
             then goto Block 5
           When Timer 5 is > 59999
             then goto Block 6

Block 4:   Increment Counter 1        Counter 1 indicates DTE
             and then                 errors.
           Goto Block 3

Block 5:   Increment Counter 2        Counter 2 indicates DCE
             and then                 errors.
           Goto Block 3

Block 6:   Increment Counter 5        Counter 5 keeps track of the
             and then                 number of minutes into the
                                      test.
           Reset Timer 5
             and then
           Goto Block 2
```

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 4951C 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              Timer 1 is reset because the
             and then                 program later loops back to
           Start Timer 1              this block.
             and then
           Start Timer 5              Timer 1 shows CTS response
                                      time.
           When Lead CTS goes On      The two "When" statements
             then goto Block 3        are ORed together.
           When Timer 5 > 2000        Timer 5 causes the instru-
             then goto Block 4        ment 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 4951C 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.
                                           The two  "When" statements
                                           are ORed together.
           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

The End-to-End test consists of the two programs described in Examples 9 and 10.

In the End-to-End Test, two HP 4951C's (or an HP 4951C and an HP 4925B) 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  18 18 18 18 18 18 18

        Sync on  FF 93

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 incriminated. The DCE characters are the same as those sent by the HP 4925B
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 an HP 4925B
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

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  18 18 18 18 18 18 18

        Sync on  FF 93

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        The "If" and "When"
          When Lead CD goes On       statements are ORed.
            then goto Block 2        together.

Block 2:  When Lead CD goes Off      These two When statements
            then goto Block 3        are Ored.  If CD goes off
          When DCE 76 B3 FA 41       before this DTE has
            then goto Block 4        received the message,
                                     Counter 1 will indicate
                                     another failure.
```

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	The "If" and "When" statements are ORed together.
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 4925B
	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	

15

The Interface

Introduction

An interface pod is required to connect the HP 4951C to the data line. The interface pod also forms the cover of the instrument. Interface pods are available for the RS-232C/V.24, RS-449, and V.35 interfaces.

RS-232C/V.24 Interfaces

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

This interface pod contains both a EIA RS-232C / CCITT V.24 interface and an RS-449/422A/423A interface.

The RS-232C is compatible with MIL-188C. Ten switches are provided for line isolation. LCD indicators indicate only line activity on: TD, RD, C, RC, DTR, DSR, RTS, CTS, CD. A manually connected MARK/SPACE monitor is available.

The RS-449 interface utilizes balanced RS-422A drivers. LCD indicators indicate only line activity on: SD, RD, ST, RT, RS, CS, TR, DM, RR.

RS-449 Interfaces

HP 18174A

This interface pod contains a RS-449/422A/423A interface. RS-449 interface utilizes balanced RS-422A drivers. LCD indicators indicate only line activity on: SD, RD, ST, RT, RS, CS, TR, DM, RR.

HP 18180A

This interface pod contains both a EIA RS-232C / CITT V.24 interface and an RS-449/422/433A interface.

The RS-449 interface utilizes balanced RS-422A drivers. LCD indicators indicate only line activity on: SD, RD, ST, RT, RS, CS, TR, DM, RR.

The RS-232C is compatible with MIL-188C. Ten switches are provided for line isolation. LCD indicators indicate only line activity on: TD, RD, TC, RC, DTR, DSR, RTS, CTS, CD. A manually connected MARK/SPACE monitor is available.

V.35 Interfaces

HP 18160A/G

This interface pod contains both a V.35 and RS-232C/V.24 interface. The RS-232C portion of the interface is simular to the HP 18179A. The V.35 portion of the V.35 interface is simular to the HP 18177A/G.

HP 18177A/G

This pod contains hardware for the V.35 interface. This interface pod uses LEDs for showing all three conditions of the line: marks, spaces, and high impedance. The lines monitored are: DTE, DCE, SCE, SCT, SCR, RS, DTR, CS, DSR, CD.

Pod Installation

To connect the Interface Pod to the HP 4951C Protocol Analyzer, set the HP 4951C power switch to off and attach the interface pod cable to the Interface Pod connector on the rear panel. 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.

The pod can be secured to the top of the analyzer's pouch by using the strap provided on the pouch.

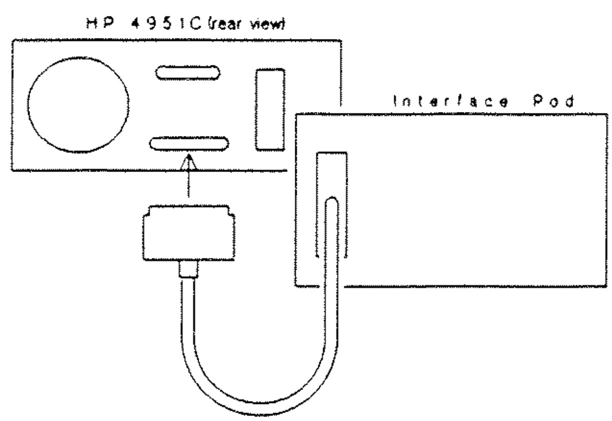


Figure 15-1. Interface Pod Connection

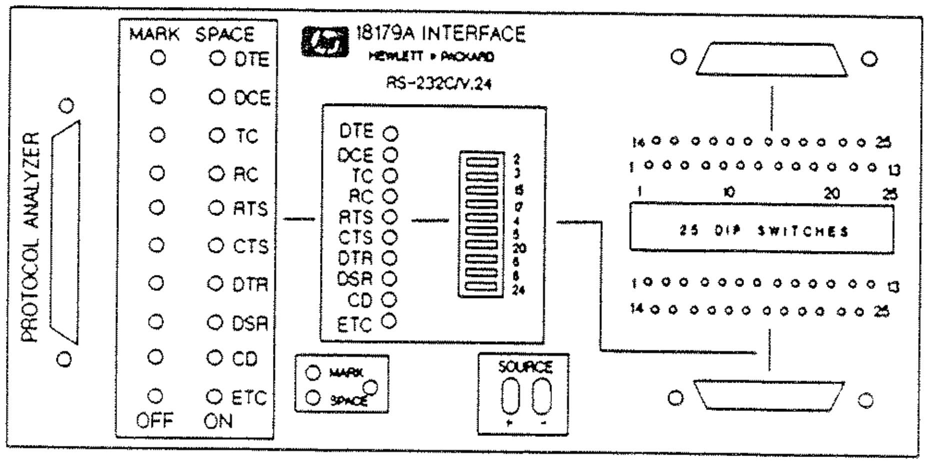


Figure 15-2. The HP 18179A Interface Pod

Interfaces

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

The HP 18179A is an RS-232C/V.24 interface pod which connects the HP 4951C 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/V.24 drivers are switched into the appropriate lead by latching relays. If monitor mode is selected all RS-232C/V.24 drivers are disconnected from the line.

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 nominally at >2.75 V, turns off at < 0.25 V

red: mark (logic '1', negative voltage) turns on nominally 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 4951C. Non-driven lines may develop cross talk noise which can be mistaken by the analyzer for transitions.

Interfaces

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

These connectors connect the Interface Pod to the line for monitoring or simulation. Connect the Y-cable to the top connector to include the breakout box in series with the line. Connect the Y-cable to the bottom connector to by-pass the breakout box.

Full Breakout Box

he Breakout Box provides cross-patching, line-forcing, and monitoring capabilities for all of the RS-232C/V.24 lines. The miniature switches isolate lines. Connect the Y-cable to the top connector to use the breakout box.

Jumper Pins

All 25 pins of the RS-232C/V.24 connector 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 lets you check the level of any signal line. Jumper any pin to this indicator to find its state.

Instrument Cable Connector

This connector connects the Interface Pod to the HP 4951C via the Pod-Instrument cable supplied with the instrument.

RS-232/V.24 Interface (HP18179A, 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	...	... ...

Interfaces

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

The HP 18180A is an RS-232C/V.24 interface pod as well as RS-449/422A/423A. The HP 18180A 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 18180A does not contain a full breakout box.

Connectors

The top connector, labeled PROTOCOL ANALYZER, connects the interface pod to the HP 4951C via the Pod-Instrument cable supplied with the instrument. The bottom connector, 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 connector 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, 6, 8, 15, 17, 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 4951C.

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 in tri-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 tri-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, tri-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 tri-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.

Interfaces

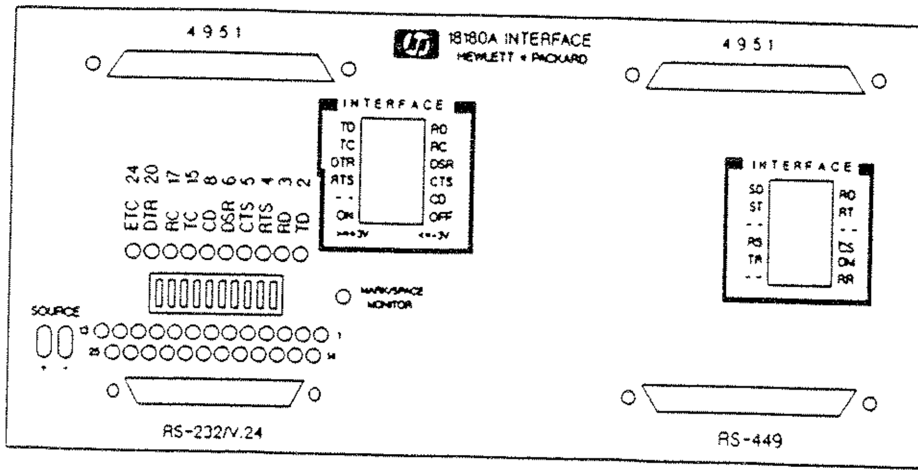


Figure 15-3. The HP 18180A (Combination RS-232C/V.24 and RS-449)

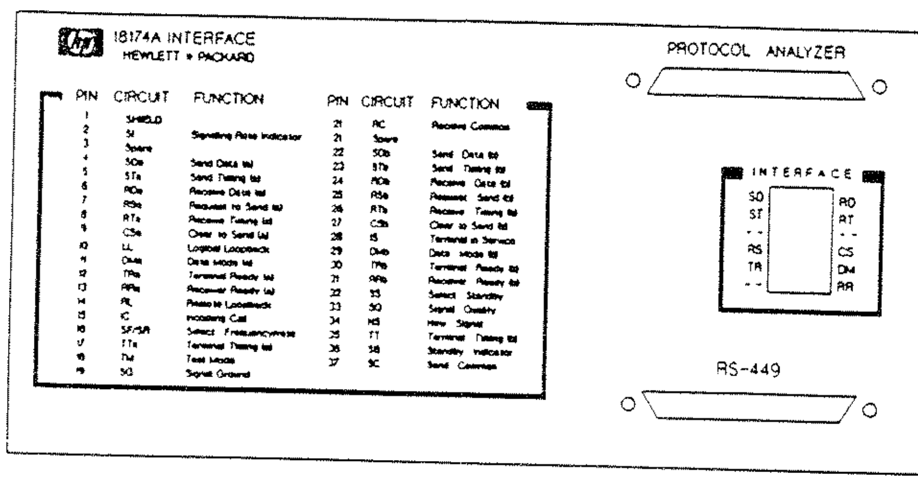


Figure 15-4. The HP 18174A (RS-449 Interface)

The HP 18174A (RS-449)

The HP 18174A follows the EIA RS-449/422A/423A standard. 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 4951C implements RS-422A electrical standards for all category I circuits, it can also support RS-423A circuits.

The 18174A 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 nominally greater than 0.2 volts.

The RS-449 Interface

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

The HP 18177A/G - Interface

This pod is a V.35 interface. The HP 18177A/G follows V.28/V.35 electrical specifications, V.24 functional specifications, and ISO 2593 mechanical specifications.

The mark/space LEDS can indicate a Mark or a Space. If both are off at the same time the indication is that no signal is present on the line.

The HP 18177A/G specifies a differential voltage resolution on Mark/Space detect of nominally .55 volts +-30% for Data and Clock lines.

The V.28 control lines are specified as follows:

```
OFF LED nominally on indicates < -2.8 volts on the line.

ON LED nominally on indicates > .25 volts on the line.

Neither LED on indicates -2,8 < volts < .25 on the line.
```

The outputs of the control lines RS, DTR, CS, DSR, RLSD conform to the CCITT V.28 electrical standard (same as RS-232C). This entails -12 volts for a mark (1, off) and +12 volts for a space (0, on).

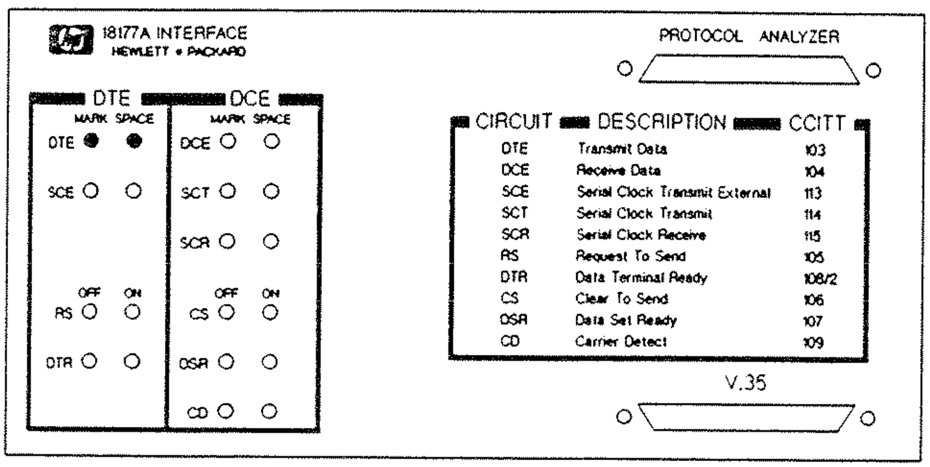


Figure 15-5. The HP 18177A/G (Interface)

The HP 18160A/G Interface (V.35 and RS232C)

The HP 18160A/G is a combination RS-232C/V.24 and V.35 interface pod. The HP 18160A/G follows V.28/V.35 and RS-232C/V.24 electrical specifications, functional specifications, and ISO 2593 mechanical specifications.

The HP 18160A/G can be used for level 1 troubleshooting on V.28/V.35 and RS-232C/V.24 interfaces. It contains 10 pairs of realtime 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.

Because some of the circuits are shared, you must select which part of the pod you want to use with the RS-232C/V.24 V.35 interface select switch located on the right-side of the pod front panel. See figure 15-6.

Note Only connect one type of network (either RS-232C or V.35) to the interface at a time, because the lines on the unused (unselected) interface connector(s) are still driven in Simulate mode.

RS-232C/V.24 Breakout Box

The Breakout Box provides cross-patching, line-forcing, and monitoring capabilities for ten of the RS-232C/V.24 lines.

When monitoring or simulating a DCE, use only the DCE breakout switches, and connect the Y-cable to the Simulate DCE connector.

When monitoring or simulating a DTE, use only the DTE breakout switches, and connect the Y-cable to the Simulate DTE connector.

Monitor, DCE Simulate, and DTE Simulate Modes

The pod can be configured to one of three desired modes of operation: either monitor, DCE simulation, or DTE simulation mode. Select these three modes from the HP 4951C Monitor and Simulate menus.

When you select DCE in a Simulate program (in the HP 4951C Simulate menu) as the type of device you are simulating, you must connect the network to the "Simulate DCE" connector on the HP 18160A/G pod. No signal traffic will occur on the "Simulate DTE" connector in the above state. The opposite is true when you are writing a program to simulate a DTE (use the "Simulate DTE" connector).

When you are monitoring, you can use either the "Simulate DTE" or "Simulate DCE" connector.

LEDs

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

Interfaces

During V.35 operation, these LEDs indicate the following condition on the V.35 data and clock lines:

Red (Mark) is ON when (B) > (A) + 0.175* volts

Green (Space) is ON when (A) > (B) + 0.175* volts

Note CCITT V.35 specifications call for a transmitting differential voltage of 0.55 volts + - 20%. The HP 18160A/G is specified to 0.55 volts + - 30%

During RS-232C/V.24 operation, these LEDs indicate the following conditions on the RS-232C/V.24 data and clock lines.

Red (Mark) logic 1, negative voltage turned ON at < -3.0 volts, turned OFF at > -3.0 volts.

Green (Space) logic 0, positive voltage turned ON at > 2.75 volts, turned OFF at < .25 volts.

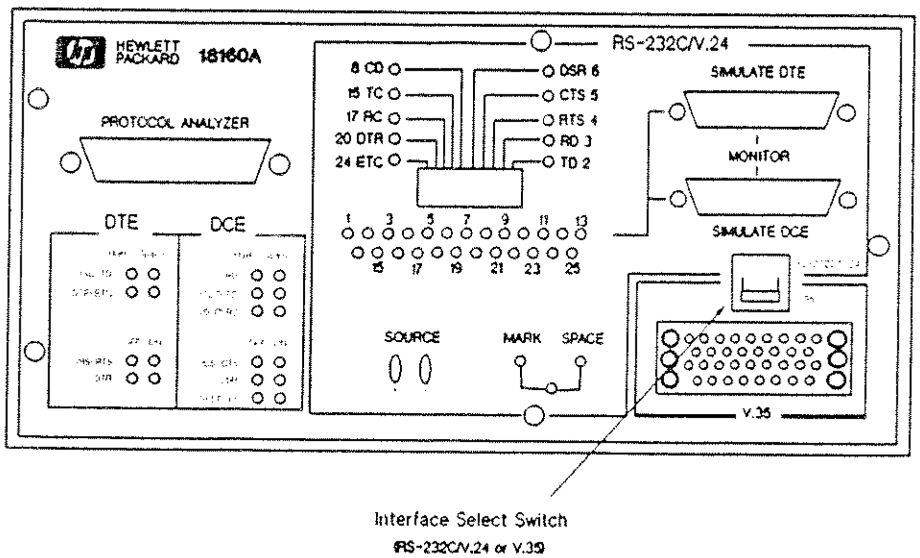


Figure 15-6. The HP 18160A/G (Interface)

Pod Configuration for RS-232C/V.24

For Both Monitor and Simulate Modes

In this configuration you will not have to disconnect the cables to monitor and simulate.

Additional "Y" cables can be ordered as HP part number 18173-61602

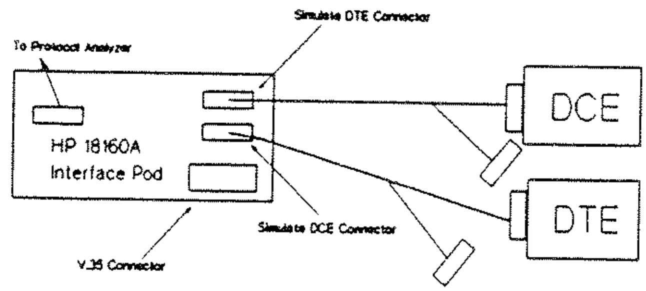


Figure 15-7. RS-232C/V.24 Pod Configuration - Monitor/Simulate

Pod Configuration for RS-232C/V.24

Monitor Mode Using the Simulate DCE Connector.

Both Simulate DCE and Simulate DTE connectors are physically connected when running a Monitor program. Therefore, it does not matter which connector you use during the Monitor mode of operation.

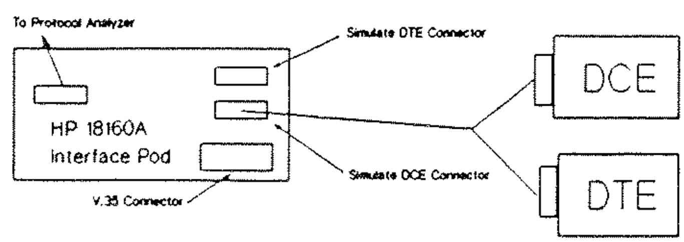


Figure 15-8. RS-232C/V.24 Pod Configuration-Monitor Mode Only

Pod Configuration for V.35
Monitor Mode

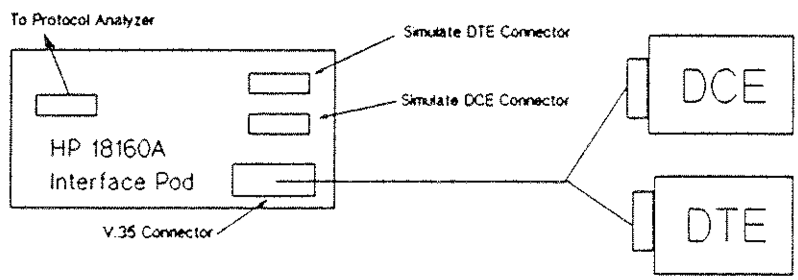


Figure 15-9. V.35 Pod Configuration - Monitor Mode Only

Pod Configuration for V.35
Simulating a DTE

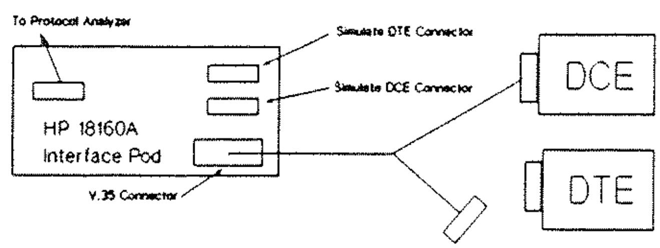


Figure 15-10. V.35 Pod Configuration - Simulating a DTE

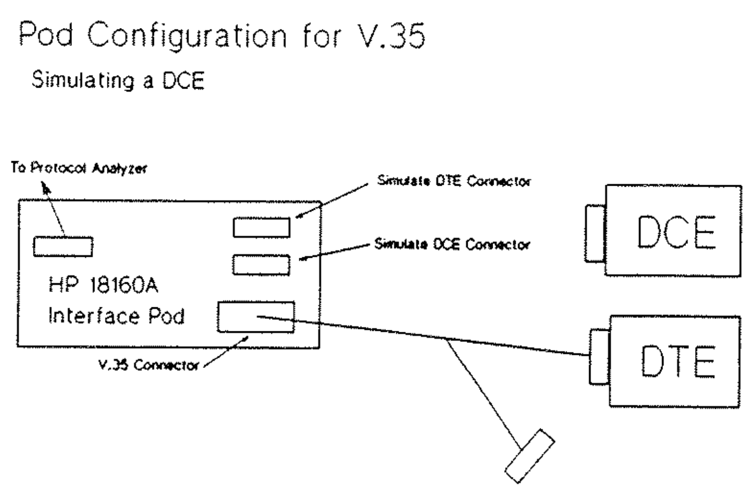


Figure 15-11. V.35 Pod Configuration - Simulating a DCE

16

JIS Option

The JIS option for the HP 4951C 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 4951C Service Manual for more information.

The Setup Menu

The HP 4951C 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 16 16 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. JIS-8 characters must be entered in hex code. A Katakana character can be viewed by moving the cursor to the character and pressing **Text** .

JIS-7 characters should be entered in binary with the 8th bit set to "one" and then converted back to Text mode in order to be displayed in Simulate or Monitor menu strings. Setting this parity bit triggers the HP 4951C to display the JIS-7 character instead of displaying the ASCII-7 character. No matter how the JIS-7 character strings are entered in the menus, you must precede the JIS-7 strings with a Shift In (SI) character, and end the JIS-7 string with a Shift Out (SO) character.

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 80 to 9F 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.

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.

Character conversion tables for JIS-7, JIS-8 and EBCDIK start on the next page.

Table 16-1. 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	ュ
1	000 0001	01	SH	46	010 1110	2E	ョ
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	ソ
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

Table 16-1. 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	hex
98	110 0010	62	hex
99	110 0011	63	hex
100	110 0100	64	hex
101	110 0101	65	hex
102	110 0110	66	hex
103	110 0111	67	hex
104	110 1000	68	hex
105	110 1001	69	hex
106	110 1010	6A	hex
107	110 1011	6B	hex
108	110 1100	6C	hex
109	110 1101	6D	hex
110	110 1110	6E	hex
111	110 1111	6F	hex
112	111 0000	70	hex
113	111 0001	71	hex
114	111 0010	72	hex
115	111 0011	73	hex
116	111 0100	74	hex
117	111 0101	75	hex
118	111 0110	76	hex
119	111 0111	77	hex
120	111 1000	78	hex
121	111 1001	79	hex
122	111 1010	7A	hex
123	111 1011	7B	hex
124	111 1100	7C	hex
125	111 1101	7D	hex
126	111 1110	7E	hex
127	111 1111	7F	

Table 16-2. 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

Table 16-2. 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

Table 16-2. 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 0110	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

Table 16-3. EBCDIK Character Conversion Table

Dec Value	Binary	Hex	Displayed Character	Dec Value	Binary	Hex	Displayed Character
0	0000 0000	00	NU	45	0010 1101	2D	EQ
1	0000 0001	01	SH	46	0010 1110	2E	AK
2	0000 0000	02	SX	47	0010 1111	2F	BL
3	0000 0011	03	EX	48	0011 0000	30	hex
4	0000 0100	04	PF	49	0011 0001	31	hex
5	0000 0101	05	HT	50	0011 0010	32	SY
6	0000 0110	06	LC	51	0011 0011	33	hex
7	0000 0111	07		52	0011 0100	34	PN
8	0000 1000	08	hex	53	0011 0101	35	RS
9	0000 1001	09	RF	54	0011 0110	36	UC
10	0000 1010	0A	SM	55	0011 0111	37	ET
11	0000 1011	0B	VT	56	0011 1000	38	hex
12	0000 1100	0C	FF	57	0011 1001	39	hex
13	0000 1101	0D	CR	58	0011 1010	3A	hex
14	0000 1110	0E	SO	59	0011 1011	3B	C3
15	0000 1111	0F	SI	60	0011 1100	3C	D4
16	0001 0000	10	DL'	61	0011 1101	3D	NK
17	0001 0001	11	D1	62	0011 1110	3E	hex
18	0001 0010	12	D2	63	0011 1111	3F	SB
19	0001 0011	13	D3	64	0100 0000	40	space
20	0001 0100	14	RE	65	0100 0001	41	hex
21	0001 0101	15	NL	66	0100 0010	42	hex
22	0001 0110	16	BS	67	0100 0011	43	hex
23	0001 0111	17	IL	68	0100 0100	44	hex
24	0001 1000	18	CN	69	0100 0101	45	hex
25	0001 1001	19	EM	70	0100 0110	46	ｦ
26	0001 1010	1A	CC	71	0100 0111	47	ｧ
27	0001 1011	1B	C1	72	0100 1000	48	ｨ
28	0001 1100	1C	FS	73	0100 1001	49	ｩ
29	0001 1101	1D	GS	74	0100 1010	4A	[
30	0001 1110	1E	RS	75	0100 1011	4B	.
31	0001 1111	1F	US	76	0100 1100	4C	<
32	0010 0000	20	DS	77	0100 1101	4D	
33	0010 0001	21	SS	78	0100 1110	4E	+
34	0010 0010	22	FS	79	0100 1111	4F	hex
35	0010 0011	23	hex	80	0101 0000	50	&
36	0010 0100	24	BP	81	0101 0001	51	ｪ
37	0010 0101	25	LF	82	0101 0010	52	ｫ
38	0010 0110	26	EB	83	0101 0011	53	ｬ
39	0010 0111	27	EC	84	0101 0100	54	ｭ
40	0010 1000	28	hex	85	0101 0101	55	ｮ
41	0010 1001	29	hex	86	0101 0110	56	ｯ
42	0010 1010	2A	SM	87	0101 0111	57	hex
43	0010 1011	2B	C2	88	0101 1000	58	hex
44	0010 1100	2C	hex	89	0101 1001	59	hex

Table 16-3. 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	ﾛ
188	1011 1100	BC	ﾜ
189	1011 1101	BD	ﾝ
190	1011 1110	BE	ﾞ
191	1011 1111	BF	ﾟ
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	S
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

17

Async Terminal Emulator

The Asynchronous Terminal Emulator application lets you use the HP Model 4951C as an asynchronous terminal. After the application is loaded into the HP 4951C, a new menu is supplied which allows the instrument to be be configured as an asynchronous terminal. You can now send and receive information over a datacomm link asynchronously using the HP 4951C keyboard and display.

Equipment Supplied

The Async Terminal Emulator is included with the HP 4951C. A utility disc contains the Async Terminal Emulator application program. A second disc is provided to save a master copy backup.

Read the section in this chapter titled "Getting Started" describing how to change the terminal default parameters before the application is stored to the working disc. Making a working copy is discussed after the getting started section.

Applications

The Async Terminal Emulator application is very useful in the field service environment where you must carry a protocol analyzer and a terminal. The application allows the HP 4951C to perform just like an asynchronous terminal so that you can send and receive electronic mail from the main office computer, check terminal problems, configure intelligent devices, download daily trouble reports or read the daily computer mail while in the field. The Async Terminal Emulator application allows the office computer to be accessed from the field without the need for a separate terminal.

The Async Terminal Emulator application can also be used to pin-point problems to a terminal. When a problem is suspected with an asynchronous terminal, the HP 4951C can replace the terminal to verify it as the faulty component.

Often intelligent devices must be configured with an asynchronous terminal. For example, some statistical multiplexers must be configured through an asynchronous terminal connected to them. The Async Terminal Emulator application is very useful for this purpose.

Features

DTE or **DCE** - The HP 4951C can be configured as a DTE (Data Terminal Equipment) or DCE to avoid the need for a modem eliminator. A modem eliminator is a cable or connector which allows one DTE to transmit data directly to another DTE.

TWO HANDSHAKES - Two types of handshaking can be used: ENQ/ACK or NONE.

HDX or **FDX** - The terminal emulator can be used in either Half- or Full-duplex environments. (see page 17-10 for limits on the specific protocol handshake.

LOCAL ECHO - A local echo is available for systems in which the main office computer does not have remote echo.

BELL - A bell in the HP 4951C can be enabled or disabled to respond to a Bell character coming from the main office computer of the datacomm link.

BREAK - A Break key is available on a softkey to send a Break.

SEND, RECEIVE DATA VIEWED SIMULTANEOUSLY - Data sent and received are shown simultaneously on the HP 4951C display.

Specifications

Physical Interface	- RS-232C/V.24
Data Codes	- ASCII 7, ASCII 8
Parity	- Odd, Even, None
Error Handling	- None
Stop Bits	- Transmit - 2
	Receive - at least 1 bit
Data Rates	- to 19.2 kbps

Getting Started

To load the application do the following:

1. Insert the HP 4951C PROTOCOL ANALYZER UTILITY Disc into the disc drive of HP 4951C.

2. Press the MORE key until **Mass Store** softkey appears.

3. Press the **Mass Store** softkey.

4. Place the cursor in "TERMINAL" and press **Load**

   OR

   Use the keyboard and type in a file name such as "TERMINAL" for file name if the application has been modified and given a new name and then press **Load** .

5. Press **Execute** softkey to load Async Terminal Emulator application program.

6. If the application loaded properly the HP 4951C shows the main Async Terminal Emulator display.

Terminal Setup

After the application is loaded, a new softkey appears in the top level menu (by pressing the MORE key) called **Term Setup**. This softkey accesses the Terminal Setup menu where the terminal parameters can be set. Shown below is the Terminal Setup menu with the parameters set to the default values.

Data code	*ASCII 8*
Parity	[None]
Bits/sec	[9600]
Mode	[DTE]
Handshake	[None]
Line terminator	[CR]
Local echo	[Off]
Bell	[Enabled]

* * - currently selected parameter
[ ] - inverse video

There are several system parameters which must be known before the Async Terminal Emulator can be used. These parameters can usually be obtained from the data communications manager at the main office computer location. Wrong parameter choices will not result in damage to the system, only the inability to use the Async Terminal Emulator. To change the parameters, use the up and down cursor keys and then press the softkey to choose the appropriate system parameters.

Data Code Field

The softkey labels for the Data Code field are ASCII 7 and ASCII 8.

Parity Field

The softkey labels for the Parity field are None, Even, and Odd.

Bits/sec Field

Select the desired bits per second rate from the softkey selections.

Mode Field

The HP 4951C can be put into the DTE (Data Circuit Terminating Equipment) or DCE (Data Communication Equipment) mode. This removes the need for a modem eliminator.

Handshake Field

Two types of software handshakes are available. For more information on handshaking, refer to "Software Handshake" on page 17-10. The softkey labels for the Handshake field are as None, and ENQ/ACK.

The ENQ and ACK characters can be entered in Text or Hex.

Handshake	[ENQ/ACK]
ENQ character	EQ
ACK character	AK

Line Terminator Field

The line terminator can be set at CR or CR/LF. Usually when the main office computer receives a CR it echoes back a CR/LF. The only time CR/LF need be chosen as the line terminator is when the CPU does not echo a CR/LF for a CR.

Local Echo Field

The HP 4951C can be configured with or without local echo. If the main computer in the system echoes back each character received (remote echo), the local echo should be turned Off or double characters will appear on the HP 4951C display.

Bell Field

When the system CPU sends a Bell character (BEL) the HP 4951C can be set to beep or disregard the character.

Operation

Pressing the **Execute** softkey causes the HP 4951C to go into the terminal mode. The display is cleared and the cursor is placed in the home position, top row far left column. Two softkeys appear at the bottom of the display. The first softkey is the **CAPS LOCK** key. An "*" in this label indicates that the CAPS LOCK is ON. To set the CAPS LOCK OFF, press **CAP LOCK** softkey. The sixth softkey (softkeys two through five are not used) is the **BREAK** key. A BREAK interrupts computer operations. It is a space condition (logical 0). A break is sent as long as this softkey is held down. The shortest break possible is 6 ms.

If local or remote echo is in effect, characters appear on the display as they are typed. Pressing the left cursor key causes a backspace character (08H) to be transmitted and the cursor moves one space to the left. Typing a CNTL H also results in a backspace. The terminal has a 14-line by 32-column display. When a line exceeds 32 columns it wraps around to the next line. When the display is full it scrolls up and a new line appears at the bottom.

When operating in the terminal mode, the HP 4951C functions as a "dumb" terminal, when a character is typed it is immediately transmitted. The terminal is designed to receive one or more stop bits and transmit two stop bits, making it compatible with all asynchronous devices.

Control characters can be sent by simultaneously holding down the CONTROL [CNTL] key and striking the desired character key. Hexadecimal characters cannot be entered. The terminal ignores most control characters and does not display them. Control characters that the terminal does respond to (but not displayed) are as follows:

ASCII	Hex	Response
BEL	07	Beep
BS	08	Backspace
HT	09	Tab one space
LF	0A	Line feed
CR	0D	Carriage return
ENQ	User Defn	Transmit ACK

Pressing EXIT in the terminal mode returns the HP 4951C to the Terminal Setup menu. Pressing the **Execute** softkey puts the HP 4951C back in the terminal mode and the last terminal session appears on the display. This arrangement lets you switch to the Terminal Setup menu for a quick parameter change and then return to the terminal mode to continue the current terminal mode session. Pressing EXIT in the Terminal Setup menu returns the HP 4951C to the top level menu. All normal HP 4951C menus remain as they were before the terminal session was entered.

Making A Working Copy

If you are not familiar with the basic features of the HP 4951C, use the following procedure to copy the menu for a particular terminal application:

1. Load application from utility disc.

   If you want to store a Terminal Setup menu with parameters other than the default parameters, follow steps 2 through 4. If not, go to step 5.

2. Press MORE until **Term Setup** softkey appears.

3. Press **Term Setup** softkey.

4. Change desired parameters.

5. Replace master disc in HP 4951C disc drive with blank formatted disc.

   Make sure the WRITE PROTECT TAB on the on blank disc is placed in the position to close the hole made for the tab in the disc; otherwise, a write protect error occurs when you attempt to store data.

6. Press EXIT to return to top level menu.

7. Press MORE until **Mass Store** softkey appears.

8. Press **Mass Store** softkey.

9. Press **Store** softkey.

10. Type in desired File Name. You may assign the file any name desired, e.g. 'Term' or 'T'. A suggestion might be the terminal manufacturer and or model number or a subset of each - e.g. HP2628.

11. Press cursor key. Press **Applic Progm** softkey to insure the correct File Type (application).

12. Press cursor key and type in a comment if desired. A comment is highly recommended to allow the identification of files at a later date.

13. Press **Execute** softkey.

14. A working copy has now been made. Return the WRITE PROTECT TAB on disc to write protected position (push in direction to OPEN the hole in the disc for the write protect tab).

Hardware Handshake

The hardware handshake is the electronic handshake that occurs at the physical level of the communications link before data is transferred across the link.

When using the application in DTE mode, the DATA TERMINAL READY (DTR) and the REQUEST TO SEND (RTS) leads are set ON to ensure communications; however, the Async Terminal Emulator Application will transmit despite the state of DATA SET READY (DSR), CLEAR TO SEND (CTS), and CARRIER DETECT (CD) from the other device. When using the application in DCE mode, the DSR, CTS, and CD leads are set ON but the Async Terminal Emulator Application will transmit despite the state of DTR and RTS from the other device.

Software Handshake

The software handshake is different than the hardware handshake. It controls the flow of data between devices so that overflows do not occur. Although very few "dumb" terminals are designed to handle software handshaking, the Async Terminal Emulator Application supports ENQ/ACK and NONE.

ENQ/ACK Handshake

ENQ/ACK is initiated by the main office computer in the system. The computer is set up to send a specified number of characters (e.g., 80) followed by an ENQ character (usually 05H). When the terminal has processed all the transmitted characters and is ready to receive more, it sends an ACK character (usually 06H). To handle this type of software handshake choose ENQ/ACK in the Terminal Setup menu. When ENQ/ACK is selected for the handshake parameter, two new parameters appear which allow you to select the ENQ character and the ACK character. These characters are entered in Text or Hex using the keyboard.

Terminal Emulator

"NONE" Handshake

If the system uses no handshake or some mode of handshaking other than ENQ/ACK, select NONE in the Terminal Setup menu. When the terminal is in the NONE handshake mode, all characters received are placed into an 8 kbyte buffer. If the buffer becomes full, the HP 4951C stops receiving data and an error message appears at the bottom of the display indicating the buffer has overflowed. A softkey labeled **Continue** also appears at the bottom of the display. Pressing this key resumes data flow into the buffer. The overflow message then disappears. If you expect a large file from the CPU, manual flow control should be used in order to view all of the data.

Manual Flow Control

In the terminal mode of operation, if a main office computer downloads a file of data which is larger than that which can be displayed on the HP 4951C, you can manually control the data flow using the Xon and Xoff characters. To stop the flow of data, transmit an Xoff signal (usually press CNTL S). To resume the flow of data, transmit an Xon signal (usually press CNTL Q). This method of flow control can be used with either ENQ/ACK or NONE handshaking.

A

Error Messages

Application Denied

CAUSE This occurs when an attempt is made to load or rename an illegal application. This might be an application copied on another device other than another HP 4951C.

ACTION Use only working copies of applications made on an HP 4951C.

Application Not Copiable

CAUSE This occurs when an attempt is made to store an application that is not copiable.

ACTION Reload the application from the master disc before a ttempting to make a working copy.

Bad Disc

CAUSE The disc will not format due to having one or more bad tracks.

ACTION Use another disc.

Baud rate > 19200 bps

CAUSE Auto Configure may work at higher rates.

ACTION Reduce the system bit rate to < = 19200 bps.

Buffer empty

CAUSE The slave buffer is empty.

ACTION Check the content of the slave buffer with examine data. Retry the upload.

Buffer Overflow

CAUSE Data is coming into the instrument faster than it can be processed. Storing data to disc faster than it can output to display.

ACTION Possible Monitor or Simulate menu error.

Buffer Size Too Small

CAUSE The controller is trying to download too much.

ACTION Reduce the size of the buffer being sent over the remote link to the slave HP 4951C

Checksum error

CAUSE Bit errors have occurred. A bad CRC check occurred when attempting to read or write a file on the disc. Data is assumed to be corrupt when this error occurs.

ACTION Retry the operation. Disc may no longer be useable. Try another disc to help isolate the problem.

Controller Error

CAUSE The disc controller is not working properly.

ACTION Run disc self test to verify disc controller error. Call your nearest Hewlett-Packard Sales/Service Office for repair.

Conversion error: menus reset

CAUSE This might occur if the menus being transferred are invalid.

ACTION Check menu compatibility. Retry menu transfer.

Drive Error

CAUSE The disc drive is not working properly. A hardware failure has occurred.

ACTION Run disc self test to verify disc controller error. Call your nearest Hewlett-Packard Sales/Service Office for repairs.

Directory Full

CAUSE The directory on the disc is full, and no other can be written onto the disc. The directory can contain eighty files maximum.

ACTION Reduce the number of file names.

Disc Full

CAUSE The disc is full of data and no more will fit. This error occurs during write operations.

ACTION You can "pack" the disc using the **Pack Disc** softkey to possibly make enough space for the new file to fit.

Disc not formatted

CAUSE The disc has not been formatted.

ACTION The disc must be formatted before you can use it in the HP 4951C.

Disc option not installed or malfunctioning.

CAUSE Disc failed self test.

ACTION Re-run self test. Call your nearest sales service office for repair.

Disc Out

CAUSE The disc is out at the beginning of a disc operation, or the disc is taken out during a disc operation.

ACTION Make sure a disc is installed in the disc drive. Press **Dir** .

Disc removed during a Read operation

CAUSE — When you remove the disc during a load operation, the buffer data is invalid.

ACTION — Use the EXIT key to exit. Try loading the data again.

Disc read error: buffer data invalid

CAUSE — This may be caused by, checkrun error, a record not found, a corrupt file on disc, a broken disc controller, or by a worn out disc.

ACTION — Use the EXIT key to exit. Try another disc to help isolate the problem.

Directory too large

CAUSE — The disc has a directory that is too large. Disc is formated ten sectors for 80 entries for the directory.

ACTION — Reformat the disc on an HP 4951C or use another one.

EOF error

CAUSE — An attempt was made to read more records than exist in the file. The End Of File was found before the read completed.

ACTION — RETRY, if it fails again. Retry on a different disc. If the error persists, suspect a disc controller failure.

End of disc file

CAUSE When you specify a block number beyond the last block on disc.

ACTION Correct the block number specified so as to specify a block number on the disc.

End of valid data

CAUSE When you scroll to the end of buffer data.

ACTION Scroll backward.

File cannot be stored

CAUSE Tried to store file as an ExtRunDat file type. ExtRunDat file type can only be created during run time using the Cont Loop command.

ACTION Change file type to legal file type, i.e., Menu, Menu & Data, Data, etc.

File does not exist

CAUSE Attempt to load a file that does not exist or has been deleted.

ACTION Recheck the directory for the file name or use the Recover function of mass store menu to try to replace the file into the directory so that it may be accessed.

File is not recoverable

CAUSE	Attempt to recover a file that is not recoverable. Probably a file created on an instrument other than an HP 4951C.
ACTION	Recheck the file and insure it's compatibility to the HP 4951C.

File already exists

CAUSE	Attempt to store or convert a file with a name and type that already exists.
ACTION	Recheck the name and/or type to insure either the name or the type is different from existing files.

File Not Compatible

CAUSE	Attempt to load a file that is not compatible with the HP 4951. This file could have the correct type but perhaps might be an application not compatible with the HP 4951C.
ACTION	Recheck the file and insure it's compatibility to the HP 4951C.

File type must be ExtRunDat

CAUSE	The Convert command can only convert ExtRunDat files to Menu&Data files.
ACTION	Convert the ExtRunDat files to Menu&Data type.

Framing error

CAUSE 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 4951C assumes an asynchronous protocol, but cannot then find the stop bit.

ACTION Check transmit clock indicators on the pod. Check protocol setup. Retry the transmission.

Improper format

CAUSE The disc format is not compatible with the HP 4951C for run time use. The disc format is LIF but not formatted on an HP 4951C and will not work at runtime for writing to the disc.

ACTION Format the disc on an HP 4951C.

Invalid File Name

CAUSE Attempt to enter an invalid file name.

ACTION Correct the file name. Allowable characters are A - Z, numbers, and the underscore character. The file name must start with a capitol alpha character.

Invalid File Type

CAUSE Attempt to load or store a file with a file type that is not valid on a HP 4951C.

ACTION Correct the file type to match with a compatible file type on the HP 4951C.

Invalid Mon/Sim Menu

CAUSE — This may occur if you enter "When DTE/DCE" without completing the trigger branching instruction.

ACTION — Examine monitor/simulate menu for incorrect parameter. Correct the error and retry.

Issue ID request to enable slave

CAUSE — Failure to issue ID request to enable slave.

ACTION — You must always **Execute** this operation immediately after establishing phone communication in order to synchronize remote transfers.

Max Length

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

ACTION — Reduce the number of characters in the string.

Max Strings

CAUSE — Appears if the Monitor and Simulate Menus combined contain strings which have a total of more than 2000 characters.

ACTION — Reduce the number of characters in the string.

Media Wear Protected

CAUSE — The disc is write protected because of excess wear on the disc. This prevents you from writing on a disc surface that is marginal.

ACTION — Use another disc and copy this to that new disc as soon as possible.

Menu Full

CAUSE — Appears if the Monitor and Simulate Menus combined contain more than 143 steps.

ACTION — Reduce the number of steps.

Menus incompatible or corrupt

CAUSE — This might occur for certain menus created by an HP 4952A.

ACTION — It may be possible to modify the existing menu to run on the HP 4951C. Examine the menu for any illegal parameters, correct and retry.

Modem handshake fails

CAUSE — The controller RTS, CTS handshaking has failed.

ACTION — Retry, while monitoring RTS & CTS line activity to help isolate the problem.

New name already exsits

CAUSE Attempt to rename a file with a name and type that already exists.

ACTION Recheck the name and/or type to insure either the name or the type is different from existing files.

No application loaded

CAUSE Attempt to store an application when no application was loaded in the application portion of RAM.

ACTION Load the application desired into the HP 4951C before trying to store it. empty when you go to the Examine Data Menu.

No Data in buffer - Use EXIT key to exit

CAUSE This occurs if the buffer is empty when you go to the Examine Menu

ACTION Monitor On-Line , or load from the disc to fill the buffer.

No data in capture buffer

CAUSE This occurs if the buffer is empty when you try to store a menus & data file or a data file.

ACTION Monitor On-Line, or load from the disc to fill the buffer.

No disc drive

CAUSE This indicates that a monitor or simulate menu was attempted to be executed with a "Start Disc" command and a disc is either not installed or is malfunctioning.

ACTION Use the self test mode to insure proper disc operation and/or insure that a disc drive is installed.

No displayable data in buffer for the selected display format

CAUSE This indicates that the buffer contains non-displayable data, such as lead transitions.

ACTION Use Data & State display format to see the lead transitions.

No data in requested blks

CAUSE The controller has requested data from empty blocks.

ACTION Adjust the blocks requested.

No data present

CAUSE There is no line data.

ACTION Both data and idle conditions must be present.

No Idles

CAUSE There are insufficient idles on the line.

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

No pod attached

CAUSE The pod is not attached.

ACTION Turn off the power before connecting the interface pod.

No Sync Characters

CAUSE Could not find any of the sync characters listed on page 4-9.

ACTION Try to sync on idles to capture all the data on the line and then check the data with examine data menu for the presence of sync characters.

Non LIF format

CAUSE The disc has been formatted, but the format is not LIF format used by the HP 4951C.

ACTION Format the disc on a HP 4951C.

Nonstandard Baud Rate

CAUSE The bit rate is not within 5% of those listed on page 4-9.

ACTION Adjust bit rate of system the HP 4951C is attached to for monitoring/simulating.

No more highlights

CAUSE When you press the Next Hilit key and there are no more highlights.

ACTION View highlights again by returning to start of buffer (use Spec Block) and then Next Hilit.

Out of lock -- data fault

CAUSE The tester couldn't synchronize at the beginning of the test because of a wrong pattern, or the absence of data.

ACTION Modify the Setup Menu and/or insure data is being sent over the line.

Out of lock -- sync loss

CAUSE The tester lost synchronization during the test.

ACTION Check the set up for sync characters and try again.

Operation not valid for HP 4951C

CAUSE The operation is one that only an HP 4955A or HP 4953A can perform.

ACTION Amend operation to comply with HP 4951C capabilities.

Record Not Found

CAUSE — A track or sector was not found during a disc operation which could indicate a corrupt format on the disc or a worn disc.

ACTION — Re-try the read or write operation.

Single sided disc

CAUSE — The disc has been formatted as a single-sided disc.

ACTION — Reformat the disc or use another one.

Seek error

CAUSE — The disc controller can not find a location on the disc that it expects to find.

ACTION — Retry the operation. Retry the operation on another disc. If the error persists, destroy the disk the failure occurred on, and use another. Call your nearest Hewlett-Packard Sales/Service Office for repair.

Start block# must = first

CAUSE — The controller has not specified the first block in the slave buffer.

ACTION — Note that the first block may not be "1" if the buffer data has been loaded from disc.

Start of valid data

CAUSE When you scroll to the beginning of buffer data.

ACTION Scroll forward.

Write Protected

CAUSE The disc "write protect" tab is in the "protect" position. The tab will not be visible and a physical hole will exist in that portion of the disc case.

ACTION To store information on a write protected disc, slide the protect tab to the opposite position.

B

Specifications

Radio Frequency Interference

HP guarantees the HP 4951C will comply with applicable EMI regulations while operating with all detachable probes, leads and cables disconnected.

The user is responsible for insuring that emissions from equipment operating with connected test probes/cables do no exceed the EMI limits at the border of their property.

Weight

Net: 6.7 kg. (14.8 lbs.)
Shipping: 12.2 kg. (27 lbs.)

Size

Height: 16 cm, width 27.9 cm, depth 34.3 cm. (6.3 x 11 x 13.5 in.)

Temperature (with media inserted)

Operating: 0^{o}C to $+55^{o}$C ($+32^{o}$F to $+131^{o}$F) **

Storage: -20^{o}C to $+75^{o}$C (-20^{o}F to $+167^{o}$F)

** The disc drive should only be operated from $+5^{o}$C to $+50^{o}$C ($+41^{o}$F to $+122^{o}$F) due to media limitations. The drive shouldn't be stored beyond 4^{o}C to 53^{o}C (39^{o}F to 127^{o}F) at 8% to 80% humidity when media is inserted.

Power Requirements

100 to 240 Vac, -10% to +10%; 48 to 66 Hz single phase.

Typical less than 15 VA, maximum less than 35 VA.

Altitude

Operation to 15,000 ft.
Storage to 50,000 ft.

Electromagnetic Capability

Complies with the VDE 0871/6.78 Limit B, and is licensed per FTZ 1046/84.

Clock Accuracy

.01% at all supported speeds except 2 kHz, 12 kHz, and 16 kHz. Equivalent accuracies can be achieved at 2 kHz, 12 kHz and 16 kHz through the use of an externally provided clock.

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 monitoring, simulation, triggering, and BERT tests.

Higher line utilization and/or the number of triggers specified will cause degradation of the data transfer rate at which the HP 4951C can operate.

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

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 disc drive: Up to 512 kbytes for storing data, timing information, menu configurations, and application programs. Write to disc: 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.

Auto-Load of applications programs by renaming them "autoapplic".

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.

C

Accessories

Accessories Supplied

Asynchronous Terminal Emulator Software Package

Power Cord	(See Appendix E)
Pod-Instrument Cable (for all pods)	5062-2127
Operating Manual	HP 04951-90765
Getting Started	HP 04951-90766
Jumper Cable	HP 8120-4218
Y Jumper Cable	HP 8120-4219
Transportation Disc	HP 5060-7177

Interface pods, listed on the next page, are not supplied and must be ordered separately.

Accessories Available

18160A	V.35 and RS-232 C/V.24 Interface Pod
18174A	RS-449 Interface Pod
18177A/G	V.35 Interface Pod (to 19.2 Kbps.)
18179A	RS-232C/V.24 Interface Pod with Breakout Box and 3-state LEDs
18180A	Combination RS-232C/V.24 and RS-449 Interface Pod
18190A	Soft Vinyl Carrying Case
18192A	Soft vinyl carrying case for extra pods
18331D	Advance Protocol Analysis (SNA, DDCMP, X.25)
18332D	"3270" Installation and Maintenance
18333D	SNA and X.25 Link Level Performance Analysis
18347A	HP 4951C Customer Training - One day - Intensive
92192A	Set of 10 blank discs
9211-1290	Hard transit case
2225D	RS-232/V.24 ThinkJet Printer
82913A	12-inch RS-170 Video Monitor

One of the cables listed below is included with the appropriate interface.

RS-232C/V.24 Y-Ribbon Cable	HP 18173-61602
RS-449 Y-Ribbon Cable	HP 18174-61601 Extra
V.35 Y Cable	HP 18177-61601

Options

Option 002	Delete Integral Disc Drive
Option 003	Katakana (JIS 7, JIS 8, EBCDIK) datacodes
Option 101	Adds accessory 18174A
Option 102	Adds accessory 18180A
Option 103	Adds accessory 18179A
Option 105	Adds accessory 18177A/G
Option 500	Japanese Operating Manual
Option 501	French Operating Manual
Option 502	German Operating Manual
Option 908	Rack Mount Kit
W30	Three Year extended hardware support. Provides two additional years of return-to-HP hardware support (for 2nd and 3rd years).

Interface Accessories

HP 18174A, HP 18179A, HP 18177A/G, and HP 18180A. Each interface is supplied with the appropriate 1.5 meter "Y" cable.

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 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).

HP 18177A/G (V.35) Interface

Ten dedicated activity indicators: DCE, SCE, RS, DTR, DCE, SCT, SCR, CS, DSR, and CD.

The outputs of control lines RS, DTR, CS, DSR, RLSD conform to CCITT V.28 electrical standard (same as RS-232C). This entails -12 volts for a mark (1, off), and +12 volts for a space (0, on).

The HP 18177A/G specifies a differential voltage resolution on Mark/Space detect of .55 volts +-30% for Data and Clock lines.

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).

D

OSI Level 2 and 3 Tables

Level 2: The Data Link Interface

Character Oriented Protocols: BSC

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

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 (indicates by the following control fields)

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

| N(R) | P/F | N(S)

2. Supervisory (S) Frames: To acknowledge I frames, request retransmission of I frames, and to communicate status (busy, ready).

Receive Ready (RR) | N(R) | P/F | 00 | 01 |

Reject (REJ) | N(R) | P/F | 10 | 01 |

Receive Not Ready (RNR) | N(R) | P/F | 01 | 01 |

Selective Reject (SREJ) | N(R) | P/F | 11 | 01 |

3. Unnumbered (U) Frames: To issue commands and responses.

| Type | P/F | Type | 11 |

Unnumbered Format Commands (P=Poll, F=Final)

Control Field Bits msb lsb	Mnemonic	Name
1 0 0 P 0 0 1 1	NRM	Set Normal Response Mode
0 0 0 P 1 1 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 Ext.
0 1 1 P 1 1 1 1	SABME	Set Asynchronous Balanced Mode Ext.
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

Control Field Bits msb lsb	Mnemonic	Name
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 x x x x x x x x	Control Field, don't cares (3rd byte)
When DTE (flag) 0_1 x x x x x x 1 1	U-Frame
When DTE (flag) 0_1 1 0 0 x 0 0 1 1	Type of U-Frame = SNRM
When DTE (flag) 0_1 1 0 0 1 0 0 1 1	Poll bit set to 1
When DTE (flag) 0_3 x x x x 0 0 0 1	S-Frame
When DTE (flag) 0_3 1 0 1 1 0 0 0 1	S-Frame, Type=RR, N(R)=5, P/F=1
When DTE (flag) 0_3 0 0 1 0 0 0 1 0	I-Frame, N(R)=1, N(S)=1, P/F=0 (This is an I-Frame)

Level 3

Packet Construction (Modulo 8)

msb	lsb	
GFI Q D 0 1	LCGN	Octet 1
LCN		Octet 2
PACKET TYPE		Octet 3
USER DATA		

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

	msb				lsb
Octet 1	GFI Q D 0 1				LCGN
Octet 2	LCN				
Octet 3	P(R)	M	P(S)	0	
Octet 4	USER DATA				

MODULO 128

	msb	lsb
Octet 1	GFI Q D 1 0	LCGN
Octet 2	LCN	
Octet 3	P(S)	0
Octet 4	P(R)	M
	USER DATA	

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	

E

Service Information

Warning Before connecting the HP 4951C to any line voltage, be sure the correct fuse is installed. Damage to the instrument may occur if the wrong fuse is installed. See the next page for procedures to replace the fuse.

Warning Before connecting the HP 4951C to any line voltage, the protective earth terminal of the instrument must be connected to the protective conductor of the line power cable. The line plug must be inserted in an 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 HP 4951C power cable has three wires. When connected to an appropriate power receptacle, this cable grounds the instrument chassis. The type of power cable shipped with each instrument depends on the country of destination (see Table E-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

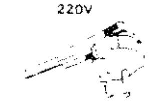
The line voltage selector is not available on the HP 4951C as the line voltage is not selectable.

Changing Fuses

The fuse is located behind the same back panel cover as the voltage selector cam. The fuse (HP #2110-0758) is a Time Delay fuse rated at .6A, 250V. 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.

Table E-1. Power Cable Part Numbers

Plug Type	Cable HP Part Number	C D	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			
250V 	8120-4600 8120-4211	8 7	Straight BS 546/SABS 164 90°	98 98	Black Black	So. Africa India

*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

Adjustments

There are no operator adjustments for the HP 4951C. 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 checks everything in the analyzer except the following:

1. Keyboard. Use the keyboard test on page E-7.
2. Disc drive. Use the disc I/O test on page E-5.
3. Interface pod. Use the interface pod test on page E-8.

Disc I/O Test

Disc controller 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 disc mechanism is verified. To detect a disc failure, merely store data or menus onto disc, 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.

Disc Drive Check

1. Insert a blank disc into the disc slot.
2. Press **Mass Store** on the Top Level Menu
3. You should be using a blank disc, or one that does not contain files you wish to keep. In the mass store menu, press **Format** and then **Execute**.
4. The disc should initialize properly.

Disc Read/Write Check

To check the disc I/O circuits, modify one of the menus, store the menus to disc, re-initialize the menus, and then load the menus back into the instrument. In this example, the simulate menu is modified.

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 **Format** and then **Execute**. Do not initialize the disc 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 disc, 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 4951C correctly identifies each key pressed.

1. Turn on the HP 4951C.
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 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

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" is displayed. Otherwise one of the following messages appears:

No pod attached
DTE failed
DCE failed

Press EXIT to return to the Self Test Menu.

Display Test

Press **Self Test** in the Top Level Menu. Select **CRT Tests** and then **Test Ptrn**. The test pattern should look like the following:

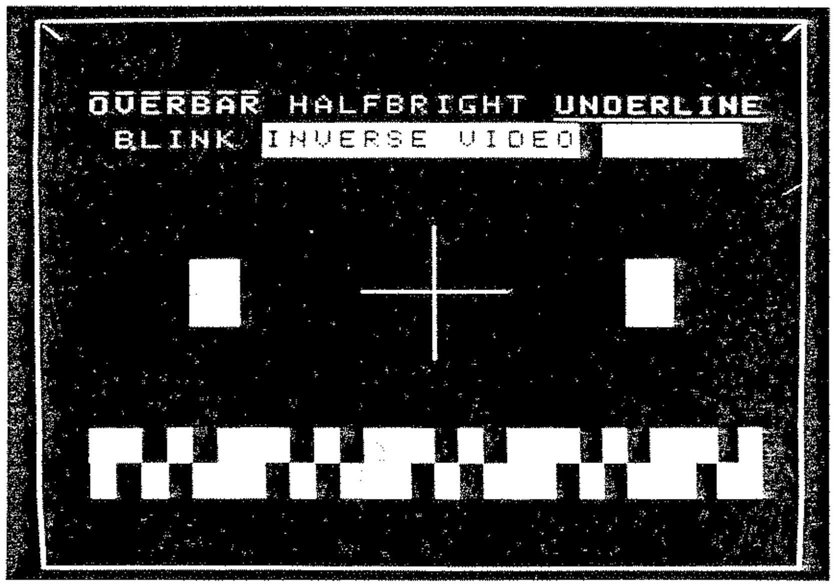


Figure E-1. Display Test Pattern

Packaging

If the instrument is returned to Hewlett-Packard for service, complete one of the blue repair tags located in the pouch and attach it to the instrument.

Caution Always install the transportation disc in the disc drive when transporting or shipping the HP 4951C.

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.

F

External Video Output

The external video output is located on the rear panel of the HP 4951C. It is utilized for displaying the internal CRT monitor in an external monitor.

What is RS-170?

This strange sounding specification is really the electrical characteristic for the video signal on monochrome video monitors. The HP 4951C utilizes this specification to display the internal CRT monitor on an external monitor. An example monitor is the HP 82913A which utilizes this standard.

RS-170 specifies the following: 525 lines per frame, 60 Hz refresh rate, a horizontal scan rate of 15.75 kHz.

Usage

The HP 4951C does not work well with standard television monitors. The reason for this is that standard television monitors are designed to overscan the picture/frame displayed. This means that standard television monitors are not designed to display the edges of the frame received (approximately 10% of the frame is not shown). The HP 4951C does display 100% of the frame and therefore the frame displayed on a standard television would not show the 10% of the edges of the frame shown on the internal HP 4951C monitor screen. The physical connector on the back of the HP4951C is a 75 ohm BNC type connector.

Recommended Video Monitors

Europe: 82913A opt. 1, 12" screen, cable 5061-6533
U.S: 82913A, 12" screen, cable 8120-4703

G

Data Code Tables

ASCII Character Conversion Table G-2

EBCDIC Character Conversion Table G-5

Baudot Character Conversion Table G-11

EBCD Character Conversion Table G-12

Transcode Character Conversion Table G-14

IPARS Character Table G-15

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			

Data Code Tables

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	[
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	l	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

IPARS Character Conversion Table

Dec Value	Binary	Hex	Displayed Character	Keyboard Function
0	00 0000	00	(hex)	
1	00 0001	01	1	
2	00 0010	02	2	
3	00 0011	03	3	
4	00 0100	04	4	
5	00 0101	05	5	
6	00 0110	06	6	
7	00 0111	07	7	
8	00 1000	08	8	
9	00 1001	09	9	
10	00 1010	0A	0	
11	00 1011	0B	'	
12	00 1100	0C	CR	Return
13	00 1101	0D	EI	End of Medium, Incomplete
14	00 1110	0E		Sense

Data Code Tables

Dec Value	Binary	Hex	Displayed Character	Keyboard Function
15	00 1111	0F	(hex)	Go-Ahead
16	01 0000	10	(hex)	Write
17	01 0001	11	/	Erase/Write
18	01 0010	12	S	
19	01 0011	13	T	
20	01 0100	14	U	
21	01 0101	15	V	
22	01 0110	16	W	
23	01 0111	17	X	
24	01 1000	18	Y	
25	01 1001	19	Z	
26	01 1010	1A	,	
27	01 1011	1B	≠	
28	01 1100	1C	(space)	
29	01 1101	1D	EC	End of Medium, Complete
30	01 1110	1E	[	Start
31	01 1111	1F	.	
32	10 0000	20	@	
33	10 0001	21	J	
34	10 0010	22	K	
35	10 0011	23	L	
36	10 0100	24	M	
37	10 0101	25	N	
38	10 0110	26	O	
39	10 0111	27	P	
40	10 1000	28	Q	
41	10 1001	29	R	
42	10 1010	2A		UMSG
43	10 1011	2B	<	
44	10 1100	2C	-	
45	10 1101	2D	EU	End of Medium, Unsolicited
46	10 1110	2E	,	
47	10 1111	2F	'	
48	11 0000	30	s	
49	11 0001	31	A	
50	11 0010	32	B	
51	11 0011	33	C	
52	11 0100	34	D	
53	11 0101	35	E	
54	11 0110	36	F	
55	11 0111	37	G	
56	11 1000	38	H	
57	11 1001	39	I	
58	11 1010	3A	?	
59	11 1011	3B		
60	11 1100	3C	%	
61	11 1101	3D	EP	End of Medium, Push Button
62	11 1110	3E	S2	Sync 2
63	11 1111	3F	S1	Sync 1, Reset

Note The SYN keycap maps to the Sync 2, hex 3E character.

Index

A

abort characters
  triggering on 6-4, 6-8
accessories Appendix C
ASCII printer output Chapter 13
  diagnostic messages 13-8
  displaying characters 13-9
  handshaking 13-7
  hookup 13-3
  loading the application 13-4
  setup 13-4~5
Auto Configure Chapter 4
Auto Conf softkey Chapter 4
  and the setup menu 5-2, 5-7
  in the top level menu 1-8

B

BCC DTE or BCC DCE softkeys 6-8
beep softkey 6-19
BERT Menu softkey
  in the top level menu 1-8
  running 7-3,4
block check characters (BCC)
  blinking 7-6, 8-5
  triggering on errors 6-8
block numbers 3-5, 7-4
block (in BERT) 9-1, 9-2
block error rate (in BERT) 9-1

bit error rate tests (BERT) Chapter 9
  error messages 9-7, Appendix A
  examples 9-8~10
  function 2-2, 2-14
bit error rate tests (BERT) Chapter 9
  handshaking 9-6
  running 7-3, 9-4
  synchronization 9-6
bit oriented protocols 5-3~7
  using autoconfigure 4-3, 4-8~10
  setup menu 5-5
Bit Shift softkey
  observing data 3-6, 8-4
  setup menu requirements 5-23
BSC
  autoconfigure 4-4
  setup menu 5-1, 5-12~14
buffer
  examine data menu 8-1~5
  use with mass storage 11-1
  effect of Reset softkey 12-1

C

care of discs 11-2
catalog (of disc files) 11-5
capturing data 5-22
char async/sync
  autoconfigure 4-4
  determining unknown protocol 8-8
  setup menu 3-3, 5-1, 5-15~21
character frame 5-23~24
character oriented protocols
  autoconfigure 4-4
CNTL key 1-6
cursor keys 1-6

D

data codes — Appendix G
directory (of disc files) — 11-5
disc information — Chapter 11
disc
  capacity — B-3
  directory (of files) — 11-5
  drive use — 11-1~4
  error messages — Appendix A
  file types — 11-5
  format — 11-6
  loading from — 11-6,8
  saving setups — 5-2
  storing to — 11-6,8
  start and stop — 6-17
  tests — E-5,6
displaying data — 7-6~10, 8-5

E

error messages — Appendix A
  autoconfigure — 4-8
  BERT — 9-7
  examine data — 8-10
  monitor and simulate — 6-30
  printer — 13-8
  remote operation — 10-8
Exam Data softkey — Chapter 8
  in top level menu — 1-8
  error messages — 8-10
  example — 3-6
examples — Chapter 14
  BERT — 9-8,9
  counting parity errors — 14-4
  end-to-end: receive first — 14-13
  end-to-end: transmit first — 14-11

J

JIS Option Chapter 16

K

keyboard
  tests E-7
  use 1-6

L

level 2 and 3 (OSI) Appendix D
line
  fuse E-2
  switch 1-4, 1-10
  voltage 1-3, E-1, E-2
loading files (from disc) 11-6

M

marking triggers 6-17
  beep softkey 6-19
  highlight softkey 6-19
Mass Store softkey Chapter 11
  error messages Appendix A
  in top level menu 1-8
Monitor softkey Chapter 6
  buffer 5-2, 7-2
  examples
    RTS-CTS delay 14-1
    DCE/DTE 14-2
    parity errors 14-4
    using timers 3-7
  function 2-2
  halting 2-8
  hookup 2-4

in top level menu 1-8
on-line 7-1
running 2-8, 6-2
setup 2-5
triggering 2-7, 6-3~13
using autoconfigure 2-5
MORE key 1-6, 2-1

N

NRZI 4-7, 5-1

O

OSI level 2 and 3 Appendix D

P

packaging E-10
parity
errors 6-8
simulation 6-25
performance verification
general E-4
interface pod E-8
keyboard E-7
disc E-5
pod...see interface pod
power
cord 1-3, E-3
fuses E-2
printer output, ASCII Chapter 13

programming (monitor, simulate) 6-2
  counters 6-14
  status (if statement) 6-15
  timers 6-12
  triggering (when statement) 6-4
protocol
  determining unknown type 8-8

R

Remote menu softkey Chapter 10
  controller 10-2~3
  ending 10-6
  error messages 10-8, Appendix A
  handshaking 10-7
  in top level menu 1-8
  Remote/Printer connection 1-10
  slave 10-4~5
Reset softkey Chapter 12
  examine data 8-2
  in top level menu 1-8
RTN key 1-6
Run Menu softkey Chapter 7
  in top level menu 1-8
  monitor on-line 7-1
  monitor buffer 7-2
run-time messages 7-5

S

SDLC
  autoconfigure 4-3
  setup menu 5-1, 5-3, 5-4, 5-8
Self Test softkey 1-8, 12-4

S

Send softkey
  transmitting characters (simulation) 6-21~26
  using timers 6-26
service information Appendix E
Set Lead softkey 6-27,28
Set Up softkey Chapter 5
  bit oriented protocol 5-3, 5-5~7
  BSC 5-12~14
  Char Async/Sync 3-3, 5-15, 8-8
  defaults 12-2,3
  displaying data 8-5
  in top level menu 1-8
  Saving (in memory) 5-2
  Saving (to disc) 5-2
  SDLC 5-3~4
  when programming monitor, simulate 6-2
SHIFT key 1-6
shipping E-11
Simulate softkey Chapter 6
  block check characters 6-24
  delaying output 6-29
  error messages 6-30, Appendix A
  examples
    DCE, character protocol 3-4
    delaying output 6-29
    setting leads 6-28
    using timers 6-26
  flags 6-24
  frame check characters 6-24
  function 2-2
  handshaking 2-12, 6-21
  hookup 2-10
  in top level menu 1-8
  leads 6-27
  parity bits 6-25
  running 2-13, 3-5, 7-4

Simulate softkey Chapter 6
  selecting DTE or DCE 2-12
  sending idles 2-12, 6-24
  setup 2-11, 5-2
  sync characters 6-23
  transmitting data 2-12
  using timers 6-26
  zero bit insertion 6-25
softkeys 1-6
specifications Appendix B
status messages 6-30
start softkey
  display 6-17
  timer 6-18
stop softkey
  display 6-17
  tests 6-18
  timer 6-18
storing (to disc) 11-6
  from the line 11-8
  menus 5-2, 11-8
  menus & data 5-2, 11-6,8
stop disp softkey 3-5
summary softkey 3-5
sync characters 6-23

T

Terminal Emulator Chapter 17
  handshaking 17-9
  operation 17-6
  specification 17-3
  terminal setup 17-4
Text softkey 7-4
Timer & Cntr softkey
  observing the buffer (examine data) 3-6, 8-2
  use with send softkey 6-26
Timing Supression Application 5-21
top level menu 1-8
transmitting (simulation) 2-12, 6-21

triggering when trig softkey 6-4, 6-10
on abort characters 6-8
on block check characters 6-8
on DCE or DTE 6-4
on characters 6-5~7
on error 6-8,9
on flags 6-8
on frame check 6-8
on lead 6-8
on not 6-6
on parity 6-6
on parity on DCE 6-10
on parity on DTE 6-10
on timer 6-12
triggers
combining 6-10
overlapping 6-11
sequential 6-10
time between 6-12
turning on the analyzer 1-4
turning off the analyzer 1-4

V

video, external 1-1, 1-10, Appendix F

W

Wait softkey 6-17, 6-29
when statement When Trig softkey 6-4

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Introduction

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Bit Error Rate Test

ASCII Printer Output

ASYNC Terminal Emulator

Three Instrument Functions

Monitor and Simulate Menus

Remote Menu

Examples

Appendices

Self Demonstration

Run Menu

Mass Store Menu

Interfaces

Auto Configure

Examine Data Menu

Reset and Self Test

JIS Option

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