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Errata

Title & Document Type: 8592A Portable Microwave Spectrum Analyzer Programming Manual

Manual Part Number: 08592-90010

Revision Date: August 1987

HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this manual copy. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

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HEWLETT PACKARD

HP 8592A Portable Microwave Spectrum Analyzer

Programming Manual

HP-IB, HP-IL, RS-232

Manual Part Number: HP PN 08592-90010
Microfiche Part Number: 08592-90011
Printed in U.S.A.

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HP 8592A Documentation Description

Manuals shipped with your analyzer:



Installation Manual*
HP Part Number 08592-90003
- Tells you how to install the spectrum analyzer
- Tells you what to do in case of a failure



Operating Manual*
HP Part Number 08592-90005
- Tells you how to make measurements with your spectrum analyzer
- Describes analyzer features



Options:

Support Manual (HP 8592A Option 915)**
HP Part Number 08592-90008
- Describes troubleshooting and repair of the analyzer

You are here!

Programming Manual
HP Part Number: 08592-90010 (HP 8592A Option 021, 022, 023)
- Describes analyzer operation via a remote controller (computer)



* Additional copies of the Operating Manual and the Installation Manual are not available separately; together, they constitute the HP 8592A Documentation Package and must be ordered by its HP Part Number — 08592-90001.

** Option 915, Service Documentation (08592-90007), consists of one copy each of the Support Manual, the Installation Manual, and the Operating Manual.

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How to Use This Manual

Where to Start

If you have not configured your spectrum analyzer in your computer system, first read Chapter 1, "Preparation for Use." This chapter tells you how to set up your computer/spectrum analyzer system.

If you are familiar with spectrum analyzer programming and wish to find the description of a programming command, turn to Chapter 4, "Programming Commands."

If you are not familiar with spectrum analyzer programming:

Turn to Chapter 2, "Programming Fundamentals." This chapter introduces spectrum analyzer programming by leading you through a simple spectrum analyzer measurement.

After you've successfully made your first measurement (or if you are experienced in remote operation of the spectrum analyzer), you may turn to Chapter 3, "Advanced Programming" which demonstrates advanced programming techniques. Or, if you begin writing your own programs, turn to Chapter 4, "Programming Commands" for command descriptions.

Manual Terms and Conventions

Words in this manual that appear CAPITALIZED in [BRACKETS] refer to softkeys that appear on the analyzer screen. Keys that appear on the front panel of the instrument appear in ***BOLD ITALICS***.

Printing History

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

The manual part number changes only when a new edition is published. Corrections or additions may be made as the manual is reprinted between editions.

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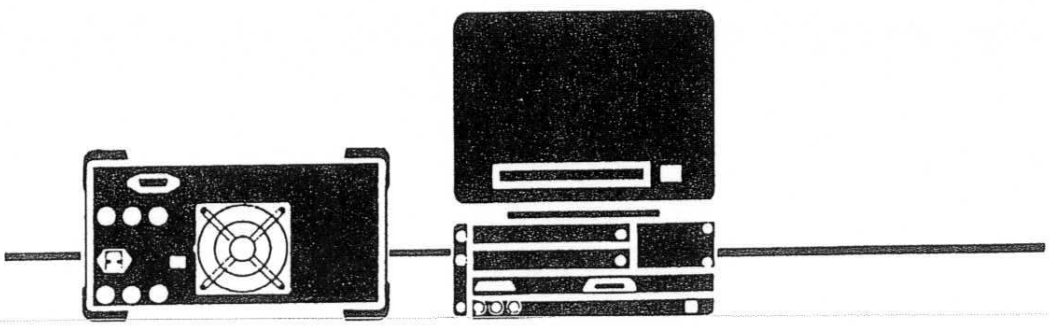
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Chapter 1

Preparation for Use



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CHAPTER 1
PREPARATION FOR USE

What You'll Find in This Chapter

This chapter explains how to connect your analyzer to a printer or plotter, and how to connect it to a computer using either the Hewlett-Packard Interface Bus (HP-IB), the RS-232 Interface, or the Hewlett-Packard Interface Loop (HP-IL). The remainder of this chapter covers procedures to follow if a problem is encountered.

Connecting Your Analyzer to a Printer or Plotter

You may wish to obtain a permanent record of data that is displayed on the screen of the analyzer. This can be done using the ***PRNT*** or ***PLOT*** keys of the analyzer, provided that the following has been done:

1. A printer or plotter, or both, have been connected with any other devices (possibly including a computer) to the analyzer in an HP-IB party-line bus structure, an RS-232 serial data transmission, or in an HP-IL loop. **Note:** The analyzer is **not** likely to print or plot without disconnecting the computer.

   To connect the HP-IB:
   a. Turn off all of the devices to be connected.
   b. Connect all devices (including the analyzer) together in a party line using the appropriate HP-IB cable.
   c. Turn on all devices involved.

   To connect the RS-232:
   a. Turn off the device to be connected. (**Note:** There should only be one device connected to the RS-232 interface since it is not a party line.)
   b. Connect the device using the appropriate RS-232 cable.
   c. Turn on all devices connected to the serial connector.

   To connect the HP-IL loop:
   a. Turn off all of the devices to be connected.
   b. Connect all devices (including the analyzer) together in a loop using the appropriate HP-IL cables.
   c. Turn on all devices on the loop.

2. The analyzer has been told where the printer and plotter are connected by setting the analyzer printer and plotter addresses from the front panel. When the ***PRNT*** or ***PLOT*** key is pressed, the analyzer becomes the controller and it configures the transmission.

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To set the printer address for the HP-IB:

a. Turn on the power to the analyzer.
b. On the analyzer, press ***CONFIG*** [PRINTER ADDRESS].
c. The printer usually resides at the first device address. To set the address, press ***1 Hz*** to enter the address 1 for the printer.

To set the plotter address for the HP-IB:

a. On the analyzer, press ***CONFIG,*** [PLOTTER ADDRESS].
b. The plotter usually resides at the fifth device address. To set this address, press ***5 Hz*** to enter the address 5 for the plotter.

To set the baud rate for the RS-232:

a. Turn on the power to the analyzer.
b. See Appendix D of this manual for the appropriate RS-232 cable connectors.
c. Press the ***CONFIG*** key on the analyzer.
d. Press the [BAUD RATE] softkey.
e. Press these numerical keys: ***9, 6, 0, 0, Hz***. To set the baud rate to 1200 baud, substitute these keypad keys: ***1, 2, 0, 0, Hz***.

Note: Some of the programs in this manual require 1200 baud for proper operation. If your system uses the RS-232 handshake lines, you can use 9600 baud for all of the programs.

To set the printer address for the HP-IL:

a. Turn on the power to the analyzer.
b. On the analyzer, press ***CONFIG*** [PRINTER ADDRESS].
c. If the printer is the first device connected to the OUT receptacle of the analyzer, then its address is 1. Press ***1 Hz*** to enter the address 1 for the printer.

To set the plotter address for the HP-IL:

a. On the analyzer, press ***CONFIG,*** [PLOTTER ADDRESS].
b. If the plotter is the second device connected to the loop from the OUT receptacle of the analyzer, then its address is 2. Press ***2 Hz*** to enter the address 2 for the plotter.

Note: For the HP-IL Interface, the addresses that are set on the analyzer are the loop positions of the printer or plotter with respect to the OUT receptacle of the analyzer.

To test the connection, press ***PRNT*** if you have a printer, or ***PLOT*** if you have a plotter. The printer or plotter should immediately start producing a copy of what is on the display of the analyzer.

The analyzer will remember these addresses, even though the power is turned off, so there is no need to re-enter them when the analyzer is turned off and on. However, when using the HP-IL, if the order of devices on the loop changes, these addresses must be changed to match the new loop configuration. (RS-232 interfaces do not have addresses.)

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Connecting Your Analyzer to a Computer

The analyzer works with many popular computers. However, the steps required to connect your spectrum analyzer to a specific computer will depend upon which computer you are using. Before turning to the inter-connection instructions for your computer, please read the following general information.

Configuring Your Computer System

Every computer system has a specific configuration, or set of components. Your system configuration may include a printer, external disc drive, and/or plotter. Whenever you add another piece of equipment — for example the analyzer — you may need to configure your computer system so that the computer will know where and how to send information to the newly added device.

Some computers do not require any configuring when an analyzer is connected; other computers require a simple modification. The most common modification is changing the configuration information stored on the computer's operating system disc. A few computers require the insertion of an add-on board or "card." Step-by-step configuration instructions are provided in this chapter for each interface.

All of the test programs for the HP-IB, HP-IL, and the RS-232, are written using the BASIC language of the computer under consideration. If you have never entered or run a BASIC program, refer to your computer documentation.

Computer/Analyzer Interconnections

HP-IB

The HP-IB interface is described in Appendix B.

Interconnection instructions for the HP-IB interface are provided for use on an HP 200 Series computer, an HP 300 Series computer, and the HP Vectra computer. If your computer is not listed and it supports an HP-IB interface, there is a good possibility that it can be connected to the analyzer. Consult your computer documentation to determine how to connect external devices on the bus.

RS-232

The RS-232 interface is described in Appendix D.

Interconnection instructions for an HP Vectra PC and the IBM PC/XT/AT or compatible computer are provided for the RS-232. If your computer is not listed and it supports a standard RS-232 interface, there is a good possibility that the analyzer may be connected to the computer. Consult your computer documentation to determine how to connect external devices to your computer's RS-232 connector.

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There are two basic RS-232 connections: Data Terminal Equipment (DTE) and Data Communications Equipment (DCE). Types of DTE devices include CRT terminals. DCE equipment includes modems and, generally, other computer RS-232 connectors. The analyzer RS-232 port is the DCE-type. Connections for the computer (DCE) to the analyzer (DCE) hookup are shown in Appendix D.

HP-IL

The HP-IL interface is described in Appendix C.

When using the HP-IL controller and advanced programming commands, a special input/output read-only memory (I/O ROM; HP Part Number 00075-15001) must be added to the HP-75D to enhance its BASIC language capabilities. The HP-IL interface is built into the HP-75D computer.

The HP-71B computer requires the addition of the HP-IL option (the HP 82401A HP-IL Interface) in order to interface with the analyzer.

If you have a computer other than the HP-71B or HP-75D and it supports an HP-IL interface, it probably can be connected to the analyzer. Consult your computer documentation to determine how to connect external devices on the loop.

The Test Program

To test the system configuration when the analyzer has been installed, a simple test program is provided for each computer interface type listed. After you have connected your computer and analyzer, you should enter and run the appropriate test program on your computer to make sure it is sending instructions to the analyzer through the interface cable. If the interface is working and the program is entered correctly, the computer will display a statement when you run the program.

Note: The listed computer and analyzer equipment includes the minimum components necessary to establish communication between your analyzer and computer. If you will be using application software, check with your software supplier for specific computer hardware and memory requirements.

Note: Using an interface cable other than the one listed with your computer's interconnection instructions may prevent proper communication between the analyzer and computer.

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HP Series 200 Personal Technical Computer

Equipment

- HP 9816, 9826, or 9836
- HP 8592A Spectrum Analyzer, Optional 021
- HP-IB Cable 10833A, B, C, D, or equivalent

Interconnection Instructions

1. Connect the analyzer to the computer using the HP-IB cable. Figure 1-1 shows an HP Model 9836 connected to the analyzer.

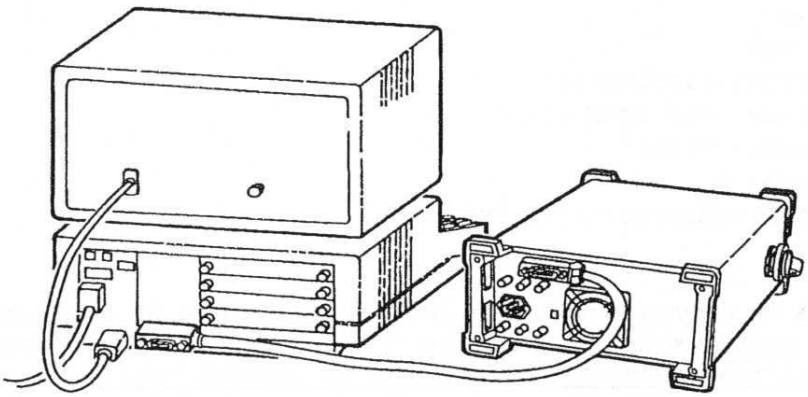


Figure 1-1

2. Check the HP-IB address of the analyzer. Press ***CONFIG*** and [ANALYZER ADDRESS]. If necessary, reset the address of the analyzer: press***CONFIG***, [ANALYZER ADDRESS], ***1***, ***8***, ***HZ***, (or enter the appropriate address).

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Test Program (HP-IB)

To test the computer/analyzer interface, turn on your computer and analyzer and follow the instructions below:

Your HP Series 200 computer may have either a soft-loaded or built-in language system. If your language system is built-in, remove any discs from the drives and press the power switch.

If your language is soft-loaded, install the BASIC language disc into the proper drive.

For further information on booting your system, refer to your BASIC manual.

Enter the following program and press ***RUN*** on the computer. If you need help entering and running the program, refer to your computer and software documentation.

```
10 PRINTER IS 1
20 Analyzer=718
30 CLEAR Analyzer
40 OUTPUT Analyzer;"IP;SNGLS;"
50 OUTPUT Analyzer;"CF 300MZ;TS;"
60 OUTPUT Analyzer;"CF?;"
70 ENTER Analyzer;A
80 PRINT "CENTER FREQUENCY =";A;"Hz";
90 END
```

The program tells the analyzer to perform an instrument preset and enter single sweep mode. Next, the program sets the center frequency to 300 MHz and takes a sweep. The program then queries the center frequency value and the computer prints `CENTER FREQUENCY = 3.0E+8 HZ`. The program shows that the computer is able to send instructions to the analyzer and read information from the analyzer.

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HP Series 300 Technical Computers

Equipment

- HP 98580A, 98581A, 98582A, or 98583A
- HP 8592A Spectrum Analyzer, Optional 021
- HP-IB Cable 10833A, B, C, D, or equivalent

Interconnection Instructions

1. Connect the analyzer to the computer using the HP-IB cable as shown in Figure 1-2.

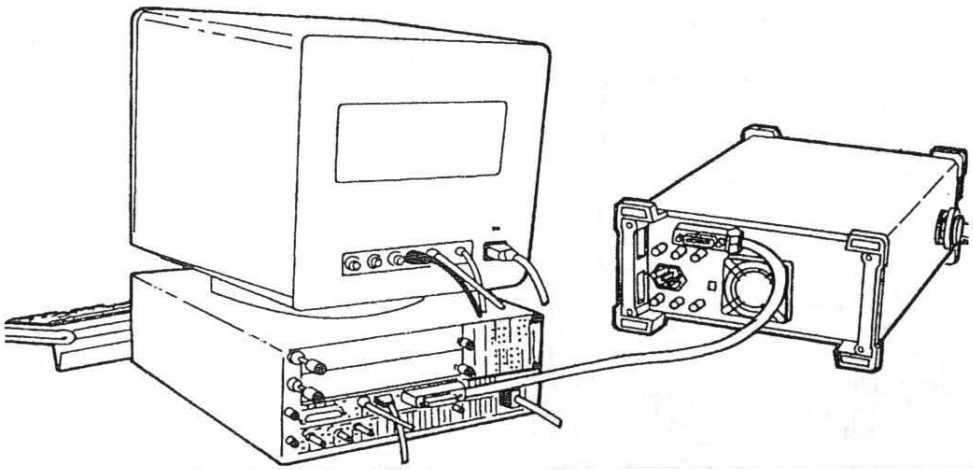


Figure 1-2

2. Check the HP-IB address of the analyzer. Press ***CONFIG*** and [ANALYZER ADDRESS]. If necessary, reset the address of the analyzer: press ***CONFIG***, [ANALYZER ADDRESS], ***1***, ***8***, ***HZ***, or enter the appropriate address.

Test Program (HP-IB)

To test the computer/analyzer interface, follow the test program instructions for HP Series 200 Computers.

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HP Vectra Personal Computer

Equipment

HP-IB

- HP Vectra Personal Computer, Required. Option: HP 61062AA or 61062BA Interface and Command Library
- HP 8592A Spectrum Analyzer, Option 021
- HP-IB cable 10833A, B, C, D, or equivalent

Interconnection Instructions

1. Connect the analyzer to the computer using the HP-IB cable as shown in Figure 1-3.

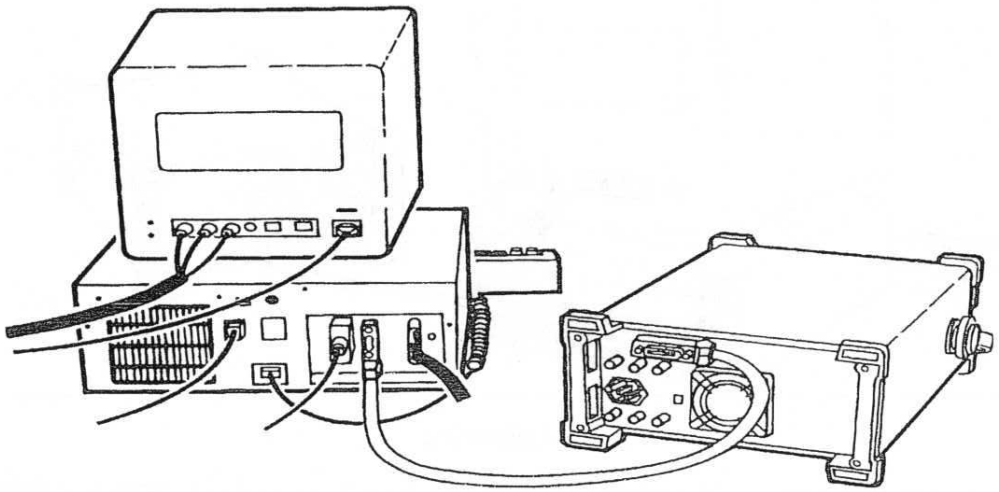


Figure 1-3

Test Program (HP-IB)

To test the computer/analyzer interface, follow the test program instructions for HP Series 200 Computers.

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HP Vectra Personal Computer

Equipment

RS-232 (using a 9 pin female port)

- HP Vectra PC with RS-232 Interface
- HP 8592A Spectrum Analyzer, Option 023
- HP 24542G RS-232 Cable

Interconnection Instructions

1. Connect the analyzer to the computer, using the RS-232 cable. Figure 1-4 shows an HP Vectra PC connected to the analyzer.

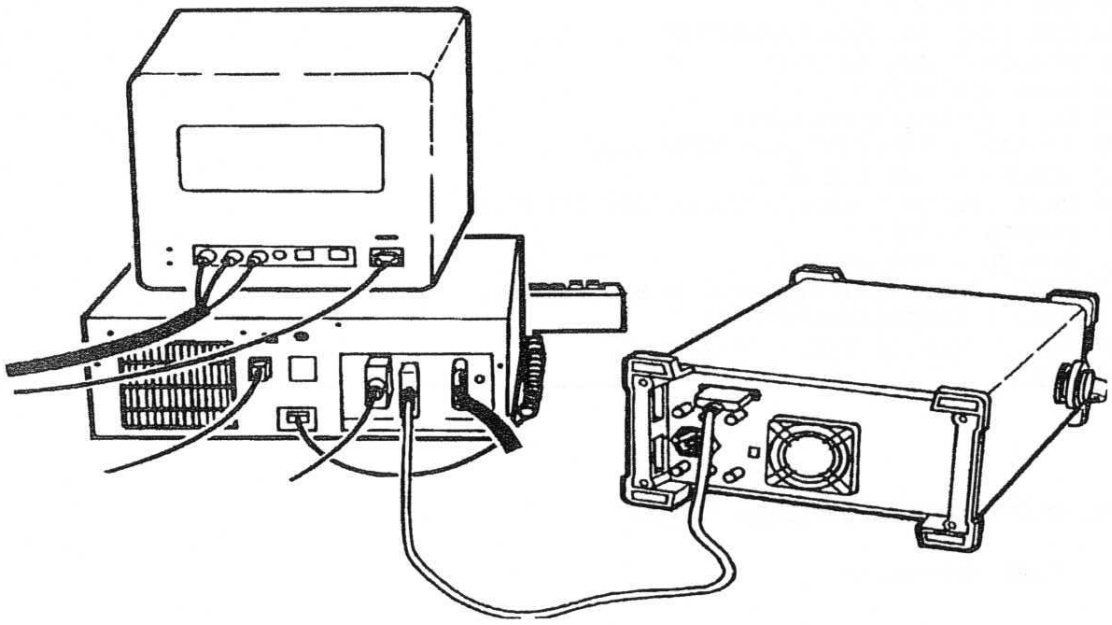


Figure 1-4

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The following computers use the BASIC language specified below:

- HP Vectra PC uses Vectra BASIC (HP45952A). The MS BASIC Interpreter (HP 35190A) is compatible with Vectra BASIC.
- HP Series 150 computers use GW BASIC (HP 45450A)
- IBM (or compatible) computers use BASICA version 2.0 or later.

To test the interface: from BASIC, load SETUP.BAS on the computer by typing:

```
LOAD "SETUP"
```

Generally, lines 1 through 999 are reserved for the SETUP.BAS file information; thus, the test program below should begin after line 1000.

```
1010 OPTION BASE 1
1020 MAX.ELEMENTS = 20
1030 DIM READINGS(MAX.ELEMENTS)
1040 CODES$ = SPACE$(50)
1050 ANALYZER = 718
1060 CALL IOCLEAR(ANALYZER)
1070 CODES$ = "IP;SNGLS;CF 300MZ;TS;"
1080 LENGTH = LEN (CODES$)
1090 CALL IOOUTPUTS(ANALYZER,CODES$,LENGTH)
1100 CODES$ = "CF?;"
1110 LENGTH = LEN(CODES$)
1120 CALL IOOUTPUTS(ANALYZER,CODES$,LENGTH)
1130 CALL IOENTER(ANALYZER,A)
1140 PRINT "CENTER FREQ = ";A;"Hz";
1150 END
```

When you have entered the program, type:

```
SAVE "PROGRAM"
```

When you are ready to run the program, make sure the analyzer is on, and type:

```
RUN
```

Watch the display on the analyzer. The program tells the analyzer to perform an instrument preset, enter single sweep mode, set the center frequency to 300 MHz, and take a sweep. The program then queries the center frequency value and the computer prints `CENTER FREQ = 3.0E+8 Hz`. The program proves that the computer is able to send instructions to the analyzer and read information from the analyzer.

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Test Program for RS-232 Computers

The test program provided in this section should work with any of the following computers and BASIC language versions:

- HP Vectra PC uses Vectra BASIC (HP45952A). The MS BASIC Interpreter (HP35190A) is compatible with Vectra BASIC.
- IBM PC/XT/AT and compatible computers use BASICA version 2.0 or later or GW BASIC.

To test the interface, first load the BASIC language for your computer and specify a communications buffer of 4096 bytes. Use the following command:

```
BASICA/C:4096
```

Set the analyzer baud rate to 1200, to match the baud rate set up for the computer port in the test program. (In line 20, the "1200" indicates 1200 baud for the computer port.) Refer to Appendix D for details on setting the analyzer baud rate.

Enter the following test program.

```
10 'File = TESTPGM
20 OPEN "COM1:1200,N,8,1" AS #1
30 PRINT #1,"IP;"
40 PRINT #1,"SNGLS;"
50 PRINT #1,"CF 300MZ;TS;"
60 PRINT #1,"CF?;"
70 INPUT #1,CENTER
80 PRINT,"CENTER FREQ = ";CENTER;"Hz"
90 END
```

When you have entered the program, type:

```
SAVE "TESTPGM"
```

When you are ready to run the program, turn on the analyzer and run your program.

Watch the display on the analyzer. The program tells the analyzer to perform an instrument preset and enter single-sweep mode. Next, the program sets the center frequency to 300 MHz and takes a sweep. The program then queries the center frequency value and the computer prints `CENTER FREQ = 3.0E+8 Hz`. This proves that the computer is able to send instructions to the analyzer and read information from the analyzer.

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IBM PC/XT/AT and Compatible Computers

Equipment

- IBM PC/XT/AT or compatible with RS-232 Interface
- HP 8592A Spectrum Analyzer, Option 023
- RS-232 Cable (DCE-DCE), 7 pins used (See Apendix B for wiring of this cable.)

Interconnection Instructions

1. Connect the analyzer to the computer, using the RS-232 cable. Figure 1-5. Note the gender of the connectors. The analyzer uses a female RS-232 connector. The IBM PC/XT/AT computer usually uses a male RS-232 connector. Some compatibles use a female RS-232 connector.

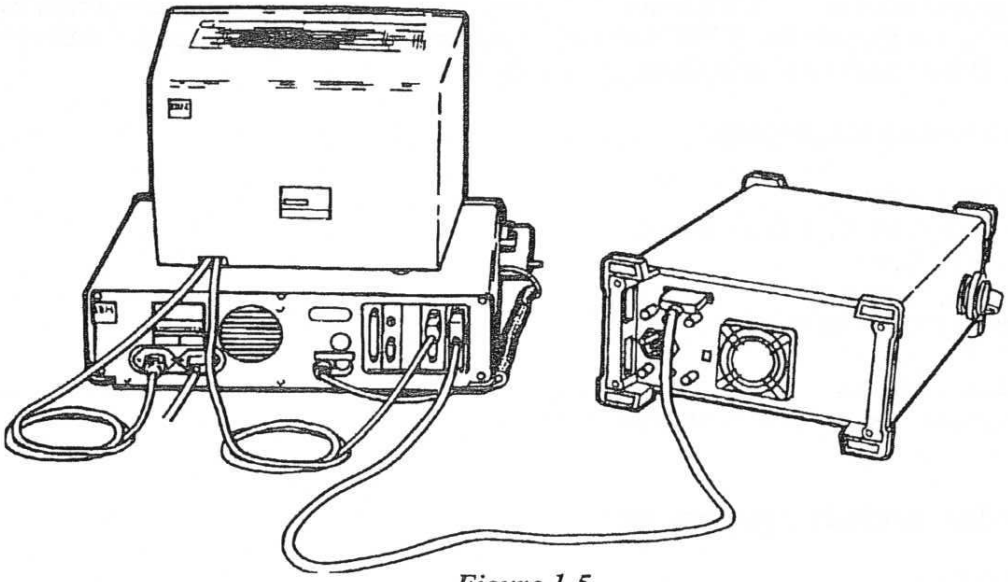


Figure 1-5

Test Program (RS-232)

To test the computer/analyzer interface, follow the test program instructions for the HP Vectra Personal Computer.

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HP-71B Handheld Computer

Equipment

- HP-71B Handheld Computer
- HP 82401A HP-IL Interface
- HP 8592A Spectrum Analyzer, Option 022
- HP 82167A, B or D, HP-IL Cables, (2 required)

Interconnection Instructions

1. Turn off the computer and all other devices in the loop (if any).
2. Using the two HP-IL cables, connect the analyzer to the computer, as shown in Figure 1-6.

   Note: If more than one device is in the loop, make sure that the analyzer is at position 1 in the loop; the analyzer connects to the HP-71B OUT connector, as shown in the figure.

3. Turn on all peripheral devices in the loop, including the analyzer.
4. Turn on the HP-71B.
5. Type `RESTORE IO` on the HP-71B keyboard. This configures the loop for the set of devices currently connected.

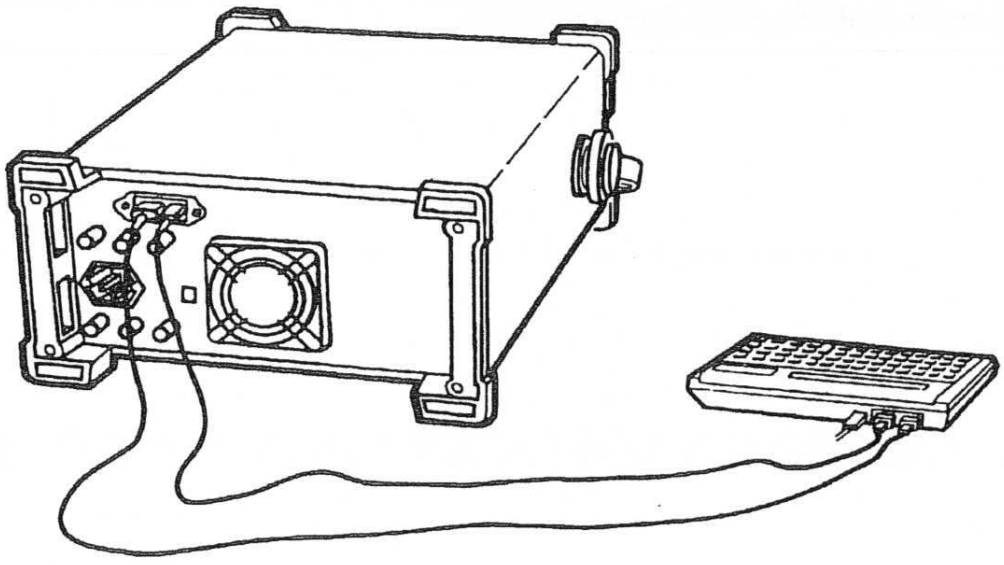


Figure 1-6

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Test Program (HP-IL)

Enter the following test program. This program is written in the BASIC language for the HP-71B.

```
10 ! File = TSTPGM71
20 RESET HPIL ! resets HP-IL interface in HP-71B
30 RESTORE IO ! reconfigures the HP-IL loop
40 DESTROY ALL ! set variables to 0
50 REAL C
60 A=1 ! A equals analyzer loop address
70 CLEAR :A
80 OUTPUT :A ;"IP;SNGLS;"
90 OUTPUT :A ;"CF 300MZ;TS;"
100 OUTPUT :A ;"CF?;"
110 ENTER :A ;C
120 FIX 2 ! set the HP-71B display format
130 DISP "CENTER FREQ =";C/1000000;" MHZ"
140 END
```

When you are ready to run the program, make sure the analyzer is on, and that it is the first device in the loop. Press the ***RUN*** key on the HP-71B keyboard.

Watch the display on the analyzer. The program tells the analyzer to perform an instrument preset, enter single sweep mode, set the center frequency to 300 MHz, and take a sweep. The program then queries the center frequency value and the computer prints `CENTER FREQ = 300.00 MHZ`. This proves that the computer is able to send instructions to the analyzer and read information from the analyzer.

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HP-75D Handheld Computer

Equipment

- HP-75D Handheld Computer
- HP 00075-15001 I/O ROM
- HP 8592A Spectrum Analyzer, Option 022
- HP 82167A, B or D, HP-IL Cables, (2 required)

HP-75D Interconnection Instructions

1. Turn off the computer and all other devices in the loop (if any).
2. Using the two HP-IL cables, connect the analyzer to the computer, as shown in Figure 1-7.

   Note: If more than one device is in the loop, make sure that the analyzer is at position 1 in the loop; the analyzer connects to the HP-75D OUT connector, as shown in the figure.
3. Turn on all peripheral devices in the loop, including the analyzer.
4. Turn on the HP-75D.

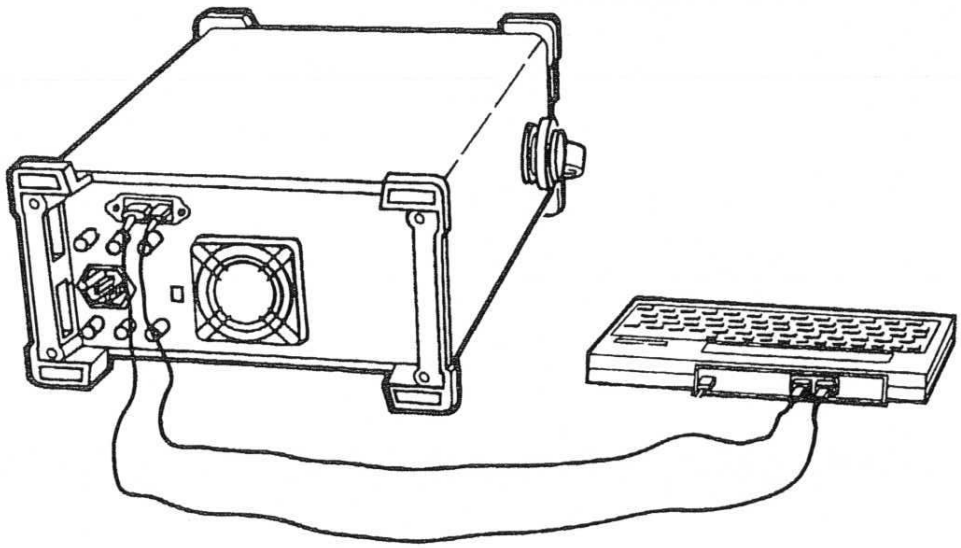


Figure 1-7

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Test Program

Enter the following test program. This program is written in the BASIC language for the HP-75D.

```
10 ! File = TSTPGM75
20 ASSIGN LOOP
30 REAL C
40 A=1 ! A equals analyzer loop address
50 ! Send a device clear to the analyzer
60 SENDIO "","UNT,UNL,LAD"&STR$(A)&",SDC",""
70 OUTPUT A ; "IP;SNGLS;"
80 OUTPUT A ; "CF 300MZ;TS;"
90 OUTPUT A ; "CF?;"
100 ENTER A ;C
110 DISP USING "K,4D.DD,K" ; "CENTER FREQ =";C/1000000;" MHZ"
120 END
```

When you are ready to run the program, make sure the analyzer is on, and that it is the first device in the loop. Press the ***RUN*** key on the HP-75D.

Watch the display on the analyzer. The program tells the analyzer to perform an instrument preset, enter single sweep mode, set the center frequency to 300 MHz, and take a sweep. The program then queries the center frequency value and the computer prints `CENTER FREQ = 300.00 MHZ`. This proves that the computer is able to send instructions to the analyzer and read information from the analyzer.

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If There is a Problem

This section offers suggestions to help get your computer and analyzer working as a system. The test programs provided in the remainder of this chapter let you know if the computer/analyzer interface is working properly. If the test program does not run:

1. You may need to modify the program if the program syntax is wrong for the computer. Refer to your BASIC manual for correct syntax.

2. The program must be executed correctly. Refer to your computer manual for help in executing programs.

3. Check for errors in the test program stored in your computer.

If the test program runs on the computer, but the analyzer does not respond:

1. Make sure the analyzer is turned on. If the analyzer has power, the green indicator above the line switch will light.

2. Make sure the interface cable is securely connected. Check the interface cable for defects. Make sure the correct cable is used.

3. If you are using the HP-IB or HP-IL interfaces, the analyzer must have the correct address setting. Press ***CONFIG*** and [ANALYZER ADDRESS].

4. If you are using the HP-IL interface, verify that the analyzer is the first device connected to the OUT receptacle of the computer (address = 1). The analyzer address is its position in the loop.

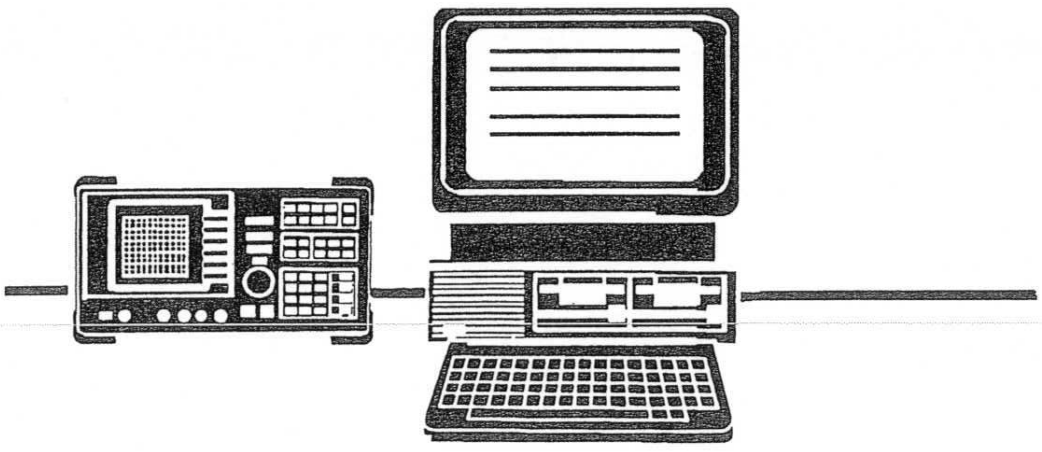
5. If you are using the RS-232 interface, check the analyzer baud rate. Refer to Appendix D to set the baud rate on the analyzer.

If you suspect your computer is causing the problems, check it by running a program that you know works. If your system still has problems, contact your HP salesperson. Your salesperson will be able to help solve the problem or refer you to someone who can.

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Chapter 2

Programming Fundamentals



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CHAPTER 2

PROGRAMMING FUNDAMENTALS

What You'll Learn in This Chapter

This chapter introduces spectrum analyzer programming. The first section of this chapter helps you write your first spectrum analyzer program and introduces programming fundamentals. The second section shows how to extract data from the spectrum analyzer. A summary at the end of this chapter reviews the programming guidelines introduced.

If the computer is not connected to the analyzer, follow the instructions in Chapter 1, "Preparation for Use."

To best understand this chapter, a general knowledge of the BASIC language is recommended. (Refer to your software documentation manuals.) For reference, Chapter 4 of this manual presents spectrum analyzer commands alphabetically.

Note: All programming examples in this chapter for the HP-IB interface are written in HP BASIC 4.0, using an HP Series 200 Computer. Examples for the HP-IL interface are written in HP BASIC for the HP-71B Handheld Computer. If you use the HP-75D computer, you may need to do some code translation. For the RS-232 interface, examples are written in GWBASIC, using an HP Vectra PC or compatible.

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Writing Your First Program

When the analyzer has been connected to a computer via the HP-IB, HP-IL, or RS-232 interfaces, the computer can be used to send instructions to the analyzer. These instructions tell the analyzer such things as the frequency span, the resolution bandwidth, and the sweep mode. If a properly selected sequence of instructions is sent to the analyzer, a measurement is made. Sequences of coded instructions are called programs.

Composing the Program

Most analyzer programs contain several common statements that address the analyzer, preset it, and select its sweep mode. As an example, we will write a short program that executes only these common statements.

The finished programs for the three different languages are shown below. Note the quotation marks that contain analyzer commands in each line. Also note the semicolons at the end of each line, inserted at the end of each set of analyzer commands (within the quotes). Using semicolons makes programs easier to read, prevents command misinterpretation, and is recommended by IEEE Standard 728.

Note: in commands where quotation marks occur, the computer recognizes data as character data.

(For the HP-IB Interface)

```
05 !File: "IBPROG1"
10 Analyzer=718
20 CLEAR Analyzer
30 OUTPUT Analyzer;"IP;"
40 OUTPUT Analyzer;"SNGLS;TS;"
50 LOCAL 7
60 END
```

Line 10 of the program assigns a variable called "Analyzer" to our analyzer at address 718. This instruction is followed by the HP BASIC "CLEAR" command, which resets the analyzer on the HP-IB. With these two program lines, we have set up a clear communication path between the computer and the analyzer.

Line 30 of the program introduces the Instrument Preset (IP) command, which corresponds to the ***PRESET*** key on the analyzer. The IP command sets all of the analog parameters of the analyzer to known values and provides a good starting point for every measurement. (All manual functions on the analyzer have corresponding programming commands. As you continue programming, you will learn the command names that correspond to the front-panel keys and softkeys.)

Line 40 of the program activates single-sweep mode. Most remotely controlled measurements require control of the sweep. Once SNGLS has activated the single-sweep mode, take sweep (TS) starts and completes one full sweep. TS maintains absolute control over the sweep, which is necessary for accurate computer data transfer and reduced program execution time.

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Before we end the program, we return the analyzer to front-panel control with the "LOCAL 7" command. The "LOCAL" command corresponds to the ***LOCAL*** key on the front panel of the analyzer. ("LOCAL 7" commands everything on the bus to go to local mode.)

Finally, in line 60, we end the program with the "END" command. (If you forget to include the END command, the computer will give an error message.)

Enter the program, press ***RUN*** on the computer, and watch the analyzer as it completes each instruction.

(For the RS-232 Interface)

```
10 'File = 232PROG1
20 OPEN "COM1:9600,N,8,1" AS #1
30 PRINT #1,"IP;"
40 PRINT #1,"SNGLS;TS;"
50 END
```

Line 20 of the program opens the RS-232 COM1: line, identified as #1, and sets the RS-232 parameters as:

9600 baud
no parity
8 bits/character
1 stop bit

Line 30 of the program introduces the Instrument Preset (IP) command, which corresponds to the ***PRESET*** key on the analyzer. The IP command sets all of the analog parameters of the analyzer to known values and provides a good starting point for every measurement. (All manual functions on the analyzer have corresponding programming commands. As you continue programming, you will learn the command names that correspond to the front-panel keys and softkeys.)

Line 40 activates single-sweep mode. Most remotely controlled measurements require control of the sweep. Once SNGLS has activated the single-sweep mode, Take Sweep (TS) starts and completes one full sweep. The TS command maintains absolute control over the sweep, which is necessary for accurate computer data transfer and reduced program execution time. Finally, in line 50, end the program with the "END" command.

Make sure that the analyzer baud rate is 9600 via the [BAUD RATE] softkey. Enter the program, then run the program. Watch the analyzer as it completes each instruction.

Note: When using an HP Series 200 or 300 computer, END commands are necessary. When using an HP Vectra computer, END commands are suggested, but not necessary. Refer to your BASIC manual to determine END statement requirements for your specific computer.

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(For the HP-IL Interface)

```
10 ! File = ILPROG1
20 RESET HPIL
30 RESTORE IO
40 DESTROY ALL
50 A=1
60 CLEAR :A
70 OUTPUT :A ;"IP;"
80 OUTPUT :A ;"SNGLS;TS;"
90 END
```

Line 20 of the program resets the HP-IL interface in the computer. The next line addresses the peripherals on the loop. Line 40 resets all variables to zero. Placing these three lines at the beginning of a program will insure fewer problems when running programs for the analyzer.

Line 50 of the program assigns a variable called "A" to the analyzer at loop address 1. This instruction is followed by the HP BASIC "CLEAR-HP BASIC Commands" command, which resets the analyzer on the HP-IL. These program lines set up a clear communication path between the computer and the analyzer.

Line 70 introduces the Instrument Preset (IP) command, which corresponds to the ***PRESET*** key on the analyzer. IP command sets all of the analog parameters of the analyzer to known values and provides a good starting point for every measurement. (All manual functions on the analyzer have corresponding programming commands. As you continue programming, you will learn the command names that correspond to the front-panel keys and softkeys.)

Line 80 of the program activates the single-sweep mode. Most remotely controlled measurements require control of the sweep. Once SNGLS has activated the single-sweep mode, Take Sweep (TS) starts and completes one full sweep. TS maintains absolute control over the sweep, which is necessary for accurate computer data transfer and reduced program execution time. Finally, in the last line, end the program with the "END" command.

Run the program. See that the analyzer does an instrument preset and is then put into single-sweep mode.

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Modifying the Program

Remote operation of the analyzer is similar to manual operation. Remote measurements are executed by commands that correspond to the front-panel keys and softkeys.

The first chapter in the Operating Manual shows you how to make a simple measurement using the calibration signal. We can add instructions to our program so that it will make the same measurement. (Since the manual process closely resembles that of the program, you may want to review "Making Your First Measurement" in the Operating Manual.)

By inserting a few lines into the initial program, we can set functions such as the center frequency and span, and we can activate a marker to find a signal's frequency and amplitude.

(For the HP-IB Interface)

```
05 !File: "IBPROG2"
10 Analyzer=718
20 CLEAR Analyzer
30 OUTPUT Analyzer;"IP;"
40 OUTPUT Analyzer;"SNGLS;TS;"
41 OUTPUT Analyzer;"CF 300MZ;"
42 OUTPUT Analyzer;"SP 200MZ;"
43 OUTPUT Analyzer;"TS;"
44 OUTPUT Analyzer;"MKPK HI;"
50 LOCAL 7
60 END
```

First, we can set the center frequency to 300 MHz. The CF command corresponds to the ***FREQUENCY*** key on the analyzer. (All analyzer commands, such as CF, are described in Chapter 4.) Insert the following program line between lines 40 and 50:

```
41 OUTPUT Analyzer;"CF 300MZ;"
```

Next, we set the span to 200 MHz with the SP command. Add the following programming line:

```
42 OUTPUT Analyzer;"SP 200MZ;"
```

Since we are controlling the sweep, we must update the analyzer display screen with the following program line:

```
43 OUTPUT Analyzer;"TS;"
```

When the program is run, the analyzer will take one full sweep before executing the next line. This changes the center frequency to 300 MHz and the span to 200 MHz. Last, we place a marker at the highest peak on the trace. Enter the following line:

```
44 OUTPUT Analyzer;"MKPK HI;"
```


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Run the program to make the measurement. Watch the analyzer as it completes each instruction. Notice that the program executes the instructions faster than is possible from the front panel.

When a certain measurement is repeated often, a computer program can save time. In addition, the computer will be less likely to make an error than an operator manually entering the same instructions through the front panel.

(For the RS-232 Interface)

```
10 'File = 232PROG2
20 OPEN "COM1:9600,N,8,1" AS #1
30 PRINT #1,"IP;"
40 PRINT #1,"SNGLS;TS;"
41 PRINT #1,"CF 300MZ;"
42 PRINT #1,"SP 200MZ;"
43 PRINT #1,"TS;"
44 PRINT #1,"MKPK HI;"
50 END
```

First, set the center frequency to 300 MHz. The CF command corresponds to the ***FREQUENCY*** key on the analyzer. (All analyzer commands, such as CF, are described in Chapter 4.)

Insert the following program lines between lines 40 and 50 of the previous program.

```
41 PRINT #1,"CF 300MZ;"
```

Next, set the span to 200 MHz with the SP command. Add the following programming line:

```
42 PRINT #1,"SP 200MZ;"
```

Since we are controlling the sweep, we must update the analyzer display screen with the following program line:

```
43 PRINT #1,"TS;"
```

When PROG2 is run, the analyzer will take one full sweep before executing the next line. This changes the center frequency to 300 MHz and the span to 200 MHz. Last, place a marker at the highest peak on the trace.

Enter the following line:

```
44 PRINT #1,"MKPK HI;"
```

Run the program to make the measurement. Watch the analyzer as it completes each instruction. When a certain measurement is repeated often, a computer program can save time. Also, the computer will be much less likely to make an error than an operator manually entering the same instructions through the front panel.

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(For the HP-IL Interface)

```
10 ! File = ILPROG2
20 RESET HPIL
30 RESTORE IO
40 DESTROY ALL
50 A=1
60 CLEAR :A
70 OUTPUT :A ;"IP;"
80 OUTPUT :A ;"SNGLS;TS;"
81 OUTPUT :A ;"CF 300MZ;"
82 OUTPUT :A ;"SP 200MZ;"
83 OUTPUT :A ;"TS;"
84 OUTPUT :A ;"MKPK HI;"
90 END
```

First, set the center frequency to 300 MHz. The CF command corresponds to the ***FREQUENCY*** key on the analyzer. (All analyzer commands, such as CF, are described in Chapter 4.) Insert the following program line between lines 80 and 90 of ILPROG1:

```
81 OUTPUT :A ;"CF 300MZ;"
```

Next, set the span to 200 MHz with the SP command. Add another programming line:

```
82 OUTPUT :A ;"SP 200MZ;"
```

Since we are controlling the sweep, we must update the analyzer display screen with the following program line:

```
83 OUTPUT :A ;"TS;"
```

When the program is run, the analyzer will take one full sweep before executing the next line. This changes the center frequency to 300 MHz and the span to 200 MHz. Last, place a marker at the highest peak on the trace.

Enter the following line:

```
84 OUTPUT :A ;"MKPK HI;"
```

Run the program to make the measurement. Watch the analyzer as it completes each instruction. Notice that the program executes the instructions faster than is possible from the front panel.

When a certain measurement is repeated often, a computer program can save time. In addition, the computer will be less likely to make an error than an operator manually entering the same instructions through the front panel.

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Enhancing the Program with Variables

In the last program, specific center frequency and span values were set. By modifying the program, we can cause different values to be set each time the program is run.

(For the HP-IB Interface)

```
10  !FILE: "IBPROG3"
20  REAL Center_freq,Span  !define the variables
30  Analyzer=718
40  CLEAR Analyzer
50  OUTPUT Analyzer;"IP;SNGLS;TS;"
60   !ask for the desired center frequency:
70  INPUT "CENTER FREQUENCY(MZ)?",Center_freq
80   !ask for the desired span:
90  INPUT "SPAN(MZ)?",Span
100  !send the center frequency and span to the
110  !analyzer and take a sweep to update the
120  !analyzer screen:
130 OUTPUT Analyzer;"CF ";Center_freq;"MZ;"
140 OUTPUT Analyzer;"SP ";Span;"MZ;"
150 OUTPUT Analyzer;"TS;"
160  !find the signal peak with peak search:
170 OUTPUT Analyzer;"MKPK HI;"
180 LOCAL 7
190 END
```

Three modifications are made to the previous program in order to include center frequency and span variables. First, using the HP BASIC "REAL" command, we define two variables, Center_freq and Span. These variables will be used to store the frequency and span parameters that will be sent to the analyzer. (See line 20 in the program.)

Second, using the HP BASIC "INPUT" command, we ask the computer operator to enter the desired center frequency and span. The center frequency and span values are entered on the computer. Since the measurement units will be entered by the program, the operator does not enter them on the computer. (See lines 70 to 140.)

Third, we modify the output parameter statements so that the values stored in the Center_freq and Span variables are sent to the analyzer. (See lines 130 to 140.)

A sweep is taken after the parameters are sent to the analyzer to ensure that the analyzer screen is updated before the marker is placed on the highest signal peak. In the program, the "!" allows the words that follow to be ignored by the computer. Thus, they serve as comments in the program.

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(For the RS-232 Interface)

```
10 'File = 232PROG3
20 OPEN "COM1:9600,N,8,1" AS #1
30 PRINT #1,"IP;"
40 PRINT #1,"SNGLS;TS;"
50 'Ask for the center frequency and span
60 PRINT "INPUT THE CENTER FREQUENCY (MZ)   ";
70 INPUT CENTER
80 PRINT "INPUT THE SPAN (MZ)   ";
90 INPUT SPAN
100 'Send center freq and span to analyzer
110 'take a sweep to update screen
120 PRINT #1,"CF ";CENTER;"MZ;"
130 PRINT #1,"SP ";SPAN;"MZ;"
140 PRINT #1,"TS;"
150 'find the signal peak with peak search
160 PRINT #1,"MKPK HI;"
170 END
```

Three modifications are made to the previous program, 232PROG2, in order to include center frequency and span variables. We first define two variables, CENTER and SPAN. These variables will be used to store the frequency and span parameters that will be sent to the analyzer.

Second, using the BASIC "INPUT Commands" command, we ask the computer operator to enter the desired center frequency and span from the computer. (See lines 70 and 90 in program 232PROG3.)

Third, we modify the output parameter statements so that the values stored in the CENTER and SPAN variables are sent to the analyzer. (See lines 120 and 130.) A sweep is taken after the parameters are sent to the analyzer to ensure that the analyzer screen is updated before the marker is placed on the highest signal peak.

In the program, the single quote (') is used to precede phrases used as program comments. This helps to clarify program operation.

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(For the HP-IL Interface)

```
10 ! File = ILPROG3
20 RESET HPIL ! reset the HP-IL interface in the HP-71B
30 RESTORE IO ! reconfigure the HP-IL loop
40 DESTROY ALL ! reset all variables to 0
50 REAL C,S ! define the variables
60 A=1
70 CLEAR :A
80 OUTPUT :A ;"IP;SNGLS;TS;"
90 ! ask for the desired center frequency
100 INPUT "CENTER FREQ(MZ)?";C
110 ! ask for the desired span
120 INPUT "SPAN(MZ)?";S
130 ! send the center frequency and span to the
140 ! analyzer and take a sweep to update the
150 ! analyzer screen
160 OUTPUT :A ;"CF ";C;"MZ;"
170 OUTPUT :A ;"SP ";S;"MZ;"
180 OUTPUT :A ;"TS;"
190 ! find the signal peak with peak search
200 OUTPUT :A ;"MKPK HI;"
210 END
```

First, using the HP BASIC "REAL" command, define two variables, "C" and "S". These variables will be used to store the frequency and span parameters that will be sent to the analyzer. (See line 50 in the following program, ILPROG3.)

Second, using the HP BASIC "INPUT Commands" command, the program asks the operator to enter the desired center frequency and span. The center frequency and span values are entered on the computer. Since the measurement units will be entered by the program, do not enter them on the computer. (See lines 100 and 120.)

Third, send the values for center frequency and span to the analyzer (variables "C" and "S"). (See lines 160 and 170.)

Next, a sweep is taken (line 180) to ensure that the analyzer screen is updated before the next command. Last, the marker is placed at the highest signal peak (line 200).

In the program, the "!" allows the words that follow to be ignored by the computer. Thus, they serve to comment the program.

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Getting Information from the Analyzer

The first part of this chapter demonstrated techniques for setting analyzer parameters. This section will demonstrate a technique for getting information out of the analyzer.

In our second program (earlier in this chapter), we placed a marker at the highest peak on a trace. The value of the marker could be read from the upper-right corner of the analyzer.

If we add some commands to that program, we can read the values of the marker from the computer.

(For the HP-IB Interface)

```
10 !FILE: "IBPROG4"
20 REAL Amp_marker,Freq_marker !define variables
30 Analyzer=718
40 OUTPUT Analyzer;"IP;"
50  !set the output format of the analyzer for
60  !real numbers:
70 OUTPUT Analyzer;"TDF P;"
80  !set the analyzer parameters:
90 OUTPUT Analyzer;"SNGLS;"
100 OUTPUT Analyzer;"CF 300MZ;"
110 OUTPUT Analyzer;"SP 200MZ;"
120 OUTPUT Analyzer;"TS;"
130 OUTPUT Analyzer;"MKPK HI;"
140  !ask the analyzer for the marker's
150  !amplitude value:
160 OUTPUT Analyzer;"MKA?;"
170  !send the amplitude value to the computer:
180 ENTER Analyzer;Amp_marker
190  !ask the analyzer for the marker's
200  !frequency value:
210 OUTPUT Analyzer;"MKF?;"
220  !send the frequency value to the computer:
230 ENTER Analyzer;Freq_marker
240  !print the amplitude and frequency:
250 PRINT "THE SIGNAL PEAK IS ";Amp_marker;
260 PRINT " dBm AT ";Freq_marker/1.E+6;" MZ"
270  !set the analyzer to continuous sweep mode:
280 OUTPUT Analyzer;"CONTS;"
290 LOCAL 7
300 END
```

First, using the HP BASIC "REAL" command, we define two variables, Amp_marker and Freq_marker. These variables will be used to store the amplitude and frequency values of the marker. (See line 20.)

Second, we set the output format of the analyzer for real numbers with the analyzer's trace data format (TDF) command. (See line 70.) As in our original program, we set the center frequency and span values. A sweep is taken and the marker is placed on the trace.

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Next, we ask the analyzer for the amplitude value of the marker. We have the analyzer send the marker amplitude value to the computer. We also ask the analyzer for the frequency value of the marker, and we have the analyzer send the marker frequency value to the computer. (See lines 100 through 230.)

Finally, we print the values on the computer screen:

```
"THE SIGNAL PEAK IS ... dBm AT ... MZ"
```

Before we end the program, we return the analyzer to continuous sweep mode and local control.

(For the RS-232 Interface)

```
10 File = 232PROG4
20 OPEN "COM1:9600,N,8,1" AS #1
30 PRINT #1,"IP;"
40 'set the output format of the analyzer for
50 'real numbers
60 PRINT #1,"TDF P;"
70 'set the analyzer's parameters
80 PRINT #1,"SNGLS;"
90 PRINT #1,"CF 300MZ;"
100 PRINT #1,"SP 200MZ;"
110 PRINT #1,"TS;"
120 PRINT #1,"MKPK HI;"
130 'ask the analyzer for the marker's
140 'amplitude value
150 PRINT #1,"MKA?;"
160 'get the amplitude from the analyzer
170 INPUT #1,AMPMARKER
180 'ask the analyzer for the marker's frequency value
190 PRINT #1,"MKF?;"
200 'get the frequency value from the analyzer
210 INPUT #1,FREQMARKER
220 'print the amplitude and frequency
230 PRINT "THE SIGNAL PEAK IS ";AMPMARKER;
240 PRINT " dbm AT ";FREQMARKER/1000000!;" MZ"
250 'set the analyzer to continuous sweep mode
260 PRINT #1,"CONTS;"
270 END
```

First, set the output format of the analyzer to real numbers with the analyzer's trace data format (TDF) command (line 60).

As in the original program, the center frequency and span values are set and a sweep is taken. Next, the marker is placed on the trace.

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Two additional variables are used for AMPMARKER and FREQMARKER. These variables store the amplitude and frequency values of the marker (lines 170 and 210). The program requests the amplitude and frequency values of the marker (lines 150 and 190). Finally, the amplitude and frequency values from the analyzer are displayed on the computer screen:

```
"THE SIGNAL PEAK IS ... dBm AT ... MZ"
```

The program then returns the analyzer to continuous sweep mode and ends.

(For the HP-IL Interface)

```
10 ! File = ILPROG4
20 RESET HPIL
30 RESTORE IO
40 DESTROY ALL
50 REAL M1,M2 ! define variables
60 A=1
70 OUTPUT :A ;"IP;"
80 ! set the output format of the analyzer for
90 ! real numbers
100 OUTPUT :A ;"TDF P;"
110 ! set the analyzer parameters
120 OUTPUT :A ;"SNGLS;"
130 OUTPUT :A ;"CF 300MZ;"
140 OUTPUT :A ;"SP 200MZ;"
150 OUTPUT :A ;"TS;"
160 OUTPUT :A ;"MKPK HI;"
170 ! ask the analyzer for the marker's
180 ! amplitude value
190 OUTPUT :A ;"MKA?;"
200 ! send the amplitude value to the computer
210 ENTER :A ;M1
220 ! ask the analyzer for the marker's
230 ! frequency value
240 OUTPUT :A ;"MKF?;"
250 ! send the frequency value to the computer
260 ENTER :A ;M2
270 ! set the HP_71B display format
280 FIX 2
290 ! display the amplitude and frequency
300 DISP "THE SIGNAL PEAK IS ";M1;
310 DISP " dBm AT ";M2/1000000;" MZ"
320 ! set the analyzer to continuous-sweep mode
330 OUTPUT :A ;"CONTS;"
340 END
```

First, using the HP BASIC "REAL" command, define two variables, M1 and M2. These variables will be used to store the amplitude and frequency values of the marker. (See line 50.)

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Second, set the output format of the analyzer for real numbers with the analyzer's Trace Data Format (TDF) command. (See line 100.)

As in the original program, set the center frequency and span values. The analyzer takes a sweep, placing the marker on the trace.

The program then asks the analyzer for the amplitude value of the marker. The marker amplitude value is stored in the marker variable, M1. The program also asks the analyzer for the frequency value of the marker, storing the marker frequency value in the frequency variable, M2. (See lines 190 through 260.) Finally, print the values on the computer screen:

```
"THE SIGNAL PEAK IS ... dBm AT ... MZ"
```

Before the program ends, the program returns the analyzer to continuous-sweep mode and local control.

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Programming Guidelines

1. Perform the measurement manually, keeping track of the sequence of functions used.
2. In the written program, execute an instrument preset and set single sweep mode before setting other analyzer functions.
3. Use variables for function values. List variables at the beginning of the program.
4. Activate analyzer functions in logical order. Place quotation marks around analyzer commands. Separate commands with semicolons.
5. After setting analyzer functions, execute a take sweep command before reading data or activating markers.
6. Use the "!" to include comment lines in the program when using the HP BASIC connectors.

   When using GW BASIC, use the single quote " ' " or REM to include comment lines in the program.

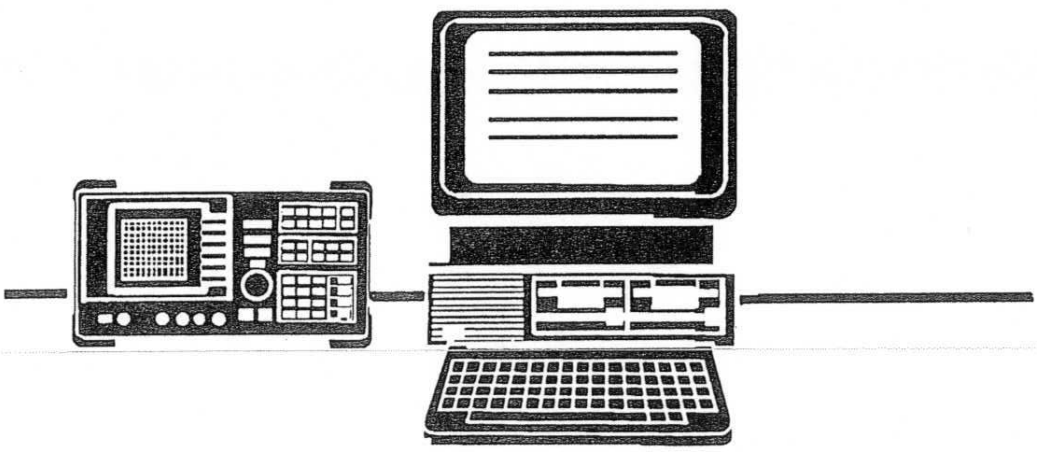
   (The "!" and " ' " are controller/language dependent, not interface dependent, and may vary for your system.)

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Chapter 3

Advanced Programming



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CHAPTER 3

ADVANCED PROGRAMMING

What You'll Learn in This Chapter

This chapter demonstrates advanced programming techniques. In the first section, traces are read from the spectrum analyzer and saved with the computer. In the second section, spectrum analyzer states are saved with the computer, and then the states are placed back into the spectrum analyzer. In the last section, a harmonic distortion program illustrates programming techniques used to develop spectrum analyzer measurements.

Many of the programming suggestions discussed in Chapter 2, "Programming Fundamentals," have been incorporated into the programs in this chapter.

Note: All programming examples in this chapter for the HP-IB interface are written in HP BASIC 4.0, using an HP Series 200 Computer. Examples for the HP-IL interface are written in HP BASIC for the HP-71B Handheld Computer. If you use the HP-75D computer, you may need to do some code translation. For the RS-232 interface, examples are written in GWBASIC, using an HP Vectra or PC compatible.

To best understand this chapter, a general knowledge of the BASIC language is recommended. (Refer to your software documentation manuals.) Chapter 4 of this manual, "Programming Commands," defines analyzer commands alphabetically.

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Controlling Trace Data With a Computer

The analyzer reserves an area in its memory, called an array, for trace information. Whenever a trace is swept, the analyzer updates the array with new data. Two separate traces may be alternately swept, trace A and trace B.

Using sample programs, this section shows you how to read trace data and store the data with your computer.

Reading Trace Data

The following program, which has been annotated with comments, reads a trace from the analyzer and stores the trace data in a variable.

(For the HP-IB Interface)

```
10 !FILE: "IBPROG5"
20  !create a 401 point trace array:
30 REAL Trace_a(1:401)
40 Analyzer=718
50 OUTPUT Analyzer;"IP;"
60  !set the output format of the analyzer for
70  !real numbers:
80 OUTPUT Analyzer;"TDF P;"
90  !set the analyzer parameters:
100 OUTPUT Analyzer;"SNGLS;"
110 OUTPUT Analyzer;"CF 300MZ;"
120 OUTPUT Analyzer;"SP 200MZ;"
130 OUTPUT Analyzer;"TS;"
140 OUTPUT Analyzer;"MKPK HI;"
150  !move peak to center of analyzer screen:
160 OUTPUT Analyzer;"MKCF;"
170 OUTPUT Analyzer;"TS;"
180  !ask the analyzer for trace data:
190 OUTPUT Analyzer;"TRA?;"
200  !send the trace data to the computer:
210 ENTER Analyzer;Trace_a(*)
220 OUTPUT Analyzer;"CONTS;"
230 LOCAL 7
240 END
```

Trace data can be read with the computer by making three changes to the program built in Chapter 2. First, we will modify the program to create a 401-point trace array, called "Trace_a," in which the trace data will be stored. Second, the program will use the TRA command to request trace A data. (The MKA and MKF commands are deleted from the original program.) Third, we will have the analyzer send the trace A data into the Trace_a variable.

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(For the RS 232 Interface)

```
10 'File = 232PROG5
20 OPEN "COM1:9600,N,8,1" AS #1
30 'create a 401-point trace array
40 DIM TRCA(401)
50 PRINT #1,"IP;"
60 'set output format of analyzer for real numbers
70 PRINT #1,"TDF P;"
80 'set analyzer parameters
90 PRINT #1,"SNGLS;"
100 PRINT #1,"CF 300MZ;"
110 PRINT #1,"SP 200MZ;"
120 PRINT #1,"TS;"
130 PRINT #1,"MKPK;"
140 'move peak to center of analyzer screen
150 PRINT #1,"MKCF;"
160 PRINT #1,"TS;"
170 'ask analyzer for trace data
180 PRINT #1,"TRA?;"
190 'retrieve trace data from analyzer
200 FOR I=1 TO 401
210 INPUT #1,TRCA(I)
220 NEXT I
230 'set continuous-sweep mode
240 PRINT #1,"CONTS;"
250 END
```

Trace data can be read with the computer by making three changes to the program built in Chapter 2. First, we will modify the program to create a 401-point trace array, called "TRCA" in which the trace data will be stored (line 40). Second, the program will use the TRA command to request trace A data (line 180). (The MKA and MKF commands are deleted from the original program.) Third, we will have the analyzer send the trace A data into the TRCA variable (line 210).

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(For the HP-IL Interface)

```
10 ! File = ILPROG5
20 RESET HPIL
30 RESTORE IO
40 DESTROY ALL
50 OPTION BASE 1 ! set arrays to begin at index 1
60 ! create a 401-point trace array
70 REAL T(401)
80 ! find the loop address of the analyzer
90 ! and put it in the variable A
100 A=DEVADDR("HP8592A")
110 OUTPUT :A ;"IP;"
120 ! set the output format of the analyzer for
130 ! real numbers
140 OUTPUT :A ;"TDF P;"
150 ! set the analyzer parameters
160 OUTPUT :A ;"SNGLS;"
170 OUTPUT :A ;"CF 300MZ;"
180 OUTPUT :A ;"SP 200MZ;"
190 OUTPUT :A ;"TS;"
200 OUTPUT :A ;"MKPK HI;"
210 ! move peak to center of analyzer screen
220 OUTPUT :A ;"MKCF;"
230 OUTPUT :A ;"TS;"
240 ! ask the analyzer for trace data
250 OUTPUT :A ;"TA;"
260 ! enter the trace data into the computer
270 ! the process takes about 30 seconds
280 FOR I=1 TO 401
290 ENTER :A ;T(I)
300 NEXT I
310 OUTPUT :A ;"CONTS;"
320 END
```

In line 100, notice that the variable A, which contains the analyzer address, is not assigned the value 1. Instead, the variable A is assigned the value of the address of the analyzer using the "DEVADDR" statement. This statement has the computer find the address of the analyzer. The program is no longer dependent on the physical position of the analyzer in the loop. This type of addressing scheme can be applied to any device on the HP-IL loop.

The statement Option Base 1 (line 50) tells the computer that all arrays will start with the index of 1. The trace will be put into the array T, which is declared in line 70. There are 401 data points across the screen, so the array must be 401 points long.

The TA command requests that the trace data be sent to the computer (line 250). The TA command is used instead of the TRA? command, because the HP-71B requires that each number in the trace array sent by the analyzer be separated from each other number by a carriage return/line feed (rather than by commas, as provided by "TRA?,").

A "FOR NEXT" loop (lines 280-300) transfers the trace data from the analyzer to the array T.

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Saving Trace Data

The trace data in the previous program can be stored on a computer disc by making three program modifications.

(For the HP-IB Interface)

```
10 !FILE: "IBPROG6"
20  !create a 401 point trace array:
30 REAL Trace_a(1:401)
40 Analyzer=718
50 OUTPUT Analyzer;"IP;"
60  !set the output format of the analyzer for
70  !real numbers:
80 OUTPUT Analyzer;"TDF P;"
90  !set the analyzer parameters:
100 OUTPUT Analyzer;"SNGLS;"
110 OUTPUT Analyzer;"CF 300MZ;"
120 OUTPUT Analyzer;"SP 200MZ;"
130 OUTPUT Analyzer;"TS;"
140 OUTPUT Analyzer;"MKPK HI;"
150  !move peak to center of analyzer screen:
160 OUTPUT Analyzer;"MKCF;"
170 OUTPUT Analyzer;"TS;"
180  !ask the analyzer for trace data:
190 OUTPUT Analyzer;"TRA?;"
200  !send the trace data to the computer:
210 ENTER Analyzer;Trace_a(*)
220  !create file to store trace
230  !file is 13 records long:
240 CREATE BDAT "DATA_A",13
250  !assign path for the file:
260 ASSIGN @File TO "DATA_A"
270  !send trace data to the file:
280 OUTPUT @File;Trace_a(*)
290 OUTPUT Analyzer;"CONTS;"
300 LOCAL 7
310  !close file:
320 ASSIGN @File TO *
330 END
```

First, using the "CREATE" command, we create an empty file on the disc in which to store the trace. The file is 13 records long. (To determine the number of records, the 401-point trace is multiplied by 8 bytes per point, the storage required for real numbers, and divided by 256 bytes per record. The result is rounded to the next largest integer.)

Next, we assign an input/output path to the file "DATA_A." Then we send the trace data to the file. (See lines 260 through 280.) Finally, in line 320, we close the file.

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The program is shown on the following page. Lines 20 through 210 are identical to the previous program.

Note: If a program containing the CREATE command is run twice, the computer will report an error the second time as the file will already exist. To prevent this error, place an exclamation mark before the CREATE command to "comment out" the line after the first run. (See line 240.)

(For the RS 232 Interface)

```
10 'File = 232PROG6
20 OPEN "COM1:9600,N,8,1" AS #1
30 'create a 401-point trace array
40 DIM TRCA(401)
50 PRINT #1,"IP;"
60 'set output format of analyzer for real numbers
70 PRINT #1,"TDF P;"
80 'set analyzer parameters
90 PRINT #1,"SNGLS;"
100 PRINT #1,"CF 300MZ;"
110 PRINT #1,"SP 200MZ;"
120 PRINT #1,"TS;"
130 PRINT #1,"MKPK;"
140 'move peak to center of analyzer screen
150 PRINT #1,"MKCF;"
160 PRINT #1,"TS;"
170 'ask analyzer for trace data
180 PRINT #1,"TRA?;"
190 'input the trace data to the BASIC program
200 FOR I=1 TO 401
210 INPUT #1,TRCA(I) 'data input in dBm
220 NEXT I
230 'create file to store trace on disc
240 OPEN "TRACEA" FOR OUTPUT AS #2
250 'print the trace data to the disc
260 FOR I=1 TO 401
270 PRINT #2,TRCA(I)
280 NEXT I
290 'put analyzer into continuous-sweep mode
300 PRINT #1,"CONTS;"
310 END
```

First, we assign an input/output path to the file "TRACEA" (lines 200 through 220).

Using the "OPEN" command, we create an empty file on the disc in which to store the trace. Then we send the trace data to the file. (See lines 230 through 280.)

Lines 20 through 180 of 232PROG6 are identical to the previous program, 232PROG5.

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(For the HP-IL Interface)

```
10 ! File = ILPROG6
20 RESET HPIL
30 RESTORE IO
40 DESTROY ALL
50 OPTION BASE 1 ! set arrays to begin with an index of 1
60 ! create a 401-point trace array
70 REAL T(401)
80 ! find the address of the analyzer
90 ! and put it in the variable A
100 A=DEVADDR("HP 8592A")
110 OUTPUT :A ;"IP;"
120 ! set the output format of the analyzer for
130 ! real numbers
140 OUTPUT :A ;"TDF P;"
150 ! set the analyzer parameters
160 OUTPUT :A ;"SNGLS;"
170 OUTPUT :A ;"CF 300MZ;"
180 OUTPUT :A ;"SP 200MZ;"
190 OUTPUT :A ;"TS;"
200 OUTPUT :A ;"MKPK HI;"
210 ! move peak to center of analyzer screen
220 OUTPUT :A ;"MKCF;"
230 OUTPUT :A ;"TS;"
240 ! ask the analyzer for trace data
250 OUTPUT :A ;"TA;"
260 ! enter the trace data into the computer
270 ! the process takes about 30 seconds
280 FOR I=1 TO 401
290 ENTER :A ;T(I)
300 NEXT I
310 ! open file TRACEA and assign it to channel 1
320 ASSIGN #1 TO TRACEA
330 ! print the trace data to the file
340 PRINT #1;T()
350 ! close file and channel 1
360 ASSIGN #1 TO *
370 OUTPUT :A ;"CONTS;"
380 END
```

First, using the "ASSIGN" command, the program creates a channel for the file TRACEA (line 320). If the file does not exist, the HP-71B creates the new file. If the file exists, the HP-71B writes over the old file.

Next, send the trace data to the file (line 340). Finally, in line 360, the program closes the file. The program, ILPROG6, is shown below. Lines 20 through 300 are identical to the previous program, ILPROG5.

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Reading Trace Data from a Computer Disc

If we want to return the trace data back to the analyzer for later viewing, we must work the "saving" process in reverse. The following program reads a trace previously stored on a computer disc and stores the trace in a variable.

(For the HP-IB Interface)

```
10 !FILE: "IBPROG7"
20  !create a 401 point trace array:
30 REAL Trace_a(1:401)
40  !assign path to the file with the
50  !trace in it:
60 ASSIGN @File TO "DATA_A"
70  !enter trace into variable Trace_a:
80 ENTER @File;Trace_a(*)
90  !close file:
100 ASSIGN @File TO *
110 END
```

First, in line 30, the program creates a 401-point trace array. Then, in line 60, the program assigns a path to the trace file. Finally, in line 80, the program sends the trace data to the variable Trace_a(*).

(For the RS-232 Interface)

```
10 'File = 232PROG7
20 OPEN "COM1:9600,N,8,1" AS #1
30 'create a 401-point trace array
40 DIM TRCA(401)
50 'assign number to file with trace data in it
60 OPEN "TRACEA" FOR INPUT AS #2
70 'enter the trace into the array
80 FOR I=1 TO 401
90 INPUT #2,TRCA(I)
100 NEXT I
110 CLOSE
120 END
```

First, in line 40, the program creates a 401-point trace array. Then, in lines 60 through 100, the program reads the disc file TRACEA and stores data in the array variable TRCA.

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(For the HP-IL Interface)

```
10 ! File = ILPROG7
20 DESTROY ALL
30 OPTION BASE 1
40 ! create 401-point trace array
50 REAL T(401)
60 ! open file TRACEA and assign it to channel 1
70 ASSIGN #1 TO TRACEA
80 ! read trace from file into T()
90 READ #1;T()
100 ! close file and channel 1
110 ASSIGN #1 TO *
120 END
```

First, in line 50, the program creates a 401-point trace array. Then, in line 70, the program assigns a path to the trace file. Finally, line 90 reads the trace data from the file "TRACEA" into the array variable T( ).

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Saving and Recalling Instrument States

The analyzer's control settings (or its "state") can be saved with a computer and retrieved later to streamline test sequences or repeat manual measurements. Control settings can be stored in one of the nine state registers in the analyzer, in computer memory, or on a computer disc.

The first program in this section demonstrates techniques for saving an instrument state along with its current trace A data with a computer. The second program demonstrates how the state information and the trace data is read from the computer and replaced in the analyzer.

If you wish to save states in the analyzer, see the descriptions of the Save State (SAVES) and Recall State (RCLS) commands.

Saving the Analyzer's State

The following three programs read a trace from the analyzer and store the trace.

(For the HP-IB Interface)

```
10 !FILE: "IBPROG8"
20  !define 114 character string:
30 DIM Learn_string$[114]
40  !create 401 point array to store trace:
50 INTEGER Trace_a(1:401)
60 Analyzer=718
70  !set output format for two byte integers:
80 OUTPUT Analyzer;"TDF B;"
90  !ask analyzer for trace data:
100 OUTPUT Analyzer;"TRA?;"
110  !send trace to the computer:
120 ENTER Analyzer USING "#,W";Trace_a(*)
130  !get learnstring from analyzer:
140 OUTPUT Analyzer;"OL;"
150 ENTER Analyzer USING "#,114A";Learn_string$
160  !create file to store trace:
170 CREATE BDAT "STATE",4
180  !assign path to the file:
190 ASSIGN @File TO "STATE"
200  !send trace to the file:
210 OUTPUT @File;Learn_string$,Trace_a(*)
220  !return output format to default mode:
230 OUTPUT Analyzer;"TDF P;"
240  !close file:
250 ASSIGN @File TO *
260 END
```


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The HP-IB version stores the trace in the variable called Trace_a(*). The state of the analyzer is stored in the variable Learn_string$. These two variables are then saved in a file called "STATE." Finally, the file is stored on a disc.

Using the data stored in STATE, the analyzer settings can be reset according to the saved state.

Then, using the stored trace data, trace data can be viewed on the analyzer screen.

Line 30 gives the dimensions of the learn string using the HP BASIC "DIM" command. Learn strings for the analyzer require 114 bytes of storage space. (Also see the Output Learn String (OL) command.)

When the trace and state data is sent from the analyzer to the computer, it must be formatted. Lines 120 and 150 format the trace data with the HP BASIC "USING" command. In the formatting statement, "#" indicates the statement is terminated when the last ENTER item is filled. (EOI and line-feed are item terminators, and early termination will result in an inaccurate learn string.) "W" specifies word format. "114A" indicates the size of the learn string.

Line 170 creates a file called "STATE" that is 4 records long. (To determine the number of records for the computer in our example, the 401-point trace is multiplied by 2 bytes per point and the 114-byte learn string is added to give 916 bytes total. This total is divided by 256 bytes per record, resulting in 4 records.)

Note: As in the previous program, if the program containing the CREATE command is run twice, the computer will report an error the second time as the file will already exist. To prevent this, place an exclamation mark before the CREATE command to "comment out" line 170 after the program has been run.

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(For the RS 232 Interface)

```
10 'File = 232PROG8
20 OPEN "COM1:1200,N,8,1" AS #1
30 'Define 114_character string
40 DIM LEARN$(114)
50 'Create 802-character string to store trace data
60 DIM TR1$(200),TR2$(200),TR3$(200)
70 DIM TR4$(200),TR5$(2),TR6$(200)
80 'ask analyzer for trace data in binary format
90 PRINT #1,"TDF B; TRA?;"
100 'enter trace data from analyzer
110 TR1$=INPUT$(200,#1) 'first 200 characters
120 TR2$=INPUT$(200,#1) 'second 200 characters
130 TR3$=INPUT$(200,#1) 'third 200 characters
140 TR4$=INPUT$(200,#1) 'fourth 200 characters
150 TR5$=INPUT$(2,#1) 'last two characters
160 'ask for learn string from analyzer
170 PRINT #1,"OL;"
180 'get learn string from analyzer
190 LEARN$=INPUT$(114,#1)
200 'create file to store trace on disc
210 OPEN "TRACEA" FOR OUTPUT AS #2
220 'change ASCII data to integers for disc storage
230 'because ASC 26 will put EOF on disc
240 DEFINT X,Y,I 'integer variables
250 DIM X1(114),Y1(802)  'arrays for the data
260 'first format the learn string
270 FOR I=1 TO 114
280 'get ASCII character from string
290 L2$=MID$(LEARN$,I,1)
300 'make integer of ASCII value 0-255
310 X1(I)=ASC(L2$)
320 NEXT I
330 'format the data strings
340 T5=1  'set counter
350 TR6$=TR1$ 'set string to be converted360 GOSUB 580 'do the conversion
370 T5=201 'set counter
380 TR6$=TR2$ 'set string to be converted
390 GOSUB 620 'do conversion
400 T5=401
410 TR6$=TR3$
420 GOSUB 620
430 T5=601
440 TR6$=TR4$
450 GOSUB 620
460 'convert last two characters
470 L2$=MID$(TR5$,1,1)
480 Y1(801)=ASC(L2$)
490 L2$=MID$(TR5$,2,1)
500 Y1(802)=ASC(L2$)
510 'data is now formatted, write to disc
520 FOR I=1 TO 114
530 PRINT #2,X1(I)
540 NEXT I
```


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```
550 FOR I=1 TO 802
560 PRINT #2,Y1(I)
570 NEXT I
580 'close the data file
590 CLOSE
600 GOTO 680
610 'subroutine for converting data:
620 FOR I=1 TO 200
630 L2$=MID$(TR6$,I,1) 'get ASCII character
640 Y1(T5)=ASC(L2$)    'set value in array
650 T5=T5+1
660 NEXT I
670 RETURN    'done with conversion
680 END
```

This program, 232PROG8, reads a trace from the analyzer and stores it in a variable called TRCA. The state of the analyzer is stored in the variable LEARN$. These two variables are then saved in a file called TRACEA. Finally, the file is stored on a disc.

Using the data stored in TRCA, the analyzer settings can be reset according to the saved state. Then, using the stored trace data, trace data can be viewed on the analyzer screen.

Line 40 gives the dimensions of the learn string using the HP BASIC "DIM" command. Learn strings for the analyzer require 114 bytes of storage space. (Also see the Output Learn String (OL) command.)

When the trace and state data is sent from the analyzer to the computer, it must be formatted. Lines 270 through 320 format the trace data.

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For the HP-IL Interface)

```
10 ! File = ILPROG8
20 RESET HPIL
30 RESTORE IO
40 DESTROY ALL
50 ! dimension trace and learnstring strings
60 DIM T$[802],L$[114]
70 A=DEVADDR("analyzer") ! analyzer address
80 ! set output format for two_byte integers
90 OUTPUT :A ;"TDF B;"
100 ! ask analyzer for trace data
110 OUTPUT :A ;"TRA?;"
120 ! enter trace data into string T$
130 ENTER :A USING "#,802A";T$
140 ! ask analyzer for learnstring
150 OUTPUT :A ;"OL;"
160 ! enter learnstring into string L$
170 ENTER :A USING "#,114A";L$
180 ! open file STATE and assign it to channel 1
190 ASSIGN #1 TO STATE
200 ! print the trace data and learnstring to the file
210 PRINT #1;T$,L$
220 ! close file and channel 1
230 ASSIGN #1 TO *
240 END
```

This program, ILPROG8, saves the state of the analyzer along with trace A in a file named "STATE". Using data stored in STATE, the analyzer settings can be reset according to the saved state. The stored trace data then can be replaced into the analyzer and viewed on the analyzer screen.

In ILPROG8, unlike ILPROG6, the trace data is taken from the analyzer in binary format. The binary format reduces the amount of memory space needed to store trace data by a factor of 4 when compared to real format. If it is necessary to analyze trace data with a computer program, use the technique shown in ILPROG6. Binary output format is set in line 90.

Line 60 dimensions the trace string (T$) and learnstring string (L$), using the HP BASIC "DIM" command. A binary-formatted trace from the analyzer takes up 802 bytes of storage space. Learn strings for the analyzer are 114 bytes long. (Also see the Output Learn String (OL) command.)

In line 130, the trace data is entered into the string T$. The computer is told that there are 802 bytes of binary data to be entered with the USING option of the ENTER command. The format of the incoming data is defined in the format statement "#,802A".

In line 150, the OL command instructs the analyzer to send the analyzer learn string to the computer. In line 170, the learn string is entered into the variable L$.

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Returning the Analyzer to its Former State

The following three programs read a trace stored in a file and load the trace into the variable Trace_a(*).

(For the HP-IB Interface)

```
10 !FILE: "IBPROG9"
20  !define 114 character string:
30 DIM Learn_string$[114]
40  !create 401 point array to store trace:
50 INTEGER Trace_a(1:401)
60 Analyzer=718
70  !assign path to the file:
80 ASSIGN @File TO "STATE"
90  !get values for Learn_string$
100  !and Trace_a(*) from disc:
110 ENTER @File;Learn_string$,Trace_a(*)
120  !send learnstring to analyzer:
130 OUTPUT Analyzer;"IP DONE;"
140 ENTER Analyzer
150 OUTPUT Analyzer;Learn_string$
160  !set single sweep mode:
170 OUTPUT Analyzer;"SNGLS;"
180  !prepare analyzer for a trace from
190  !the computer:
200 OUTPUT Analyzer;"TRA #A";
210  !send trace to the analyzer
220 OUTPUT Analyzer USING "#,W";802,Trace_a(*)
230  !view trace to see it was sent:
240 OUTPUT Analyzer;"VIEW TRA;"
250  !close file:
260 ASSIGN @File TO *
270 END
```

The HP-IB program reads a trace stored in the file "STATE" and loads it into the variable Trace_a(*).

The settings in force when the trace was stored are placed into the variable Learn_string$. Then, previously stored trace data is returned to the analyzer and the trace is viewed on the analyzer screen. Finally, line 220 uses the HP BASIC "USING" command to format the trace data.

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(For the RS 232 Interface)

```
10 'File = 232PROG9
20 OPEN "COM1:1200,N,8,1" AS #1
30 DEFINT X,Y,I 'integer variables
40 'define 114-character string
50 DIM LEARN$(114),X1(114)
60 'create an 802-character string to store disc data
70 DIM TR1$(200),TR2$(200),TR3$(200),TR4$(200)
80 DIM TR5$(2),TR6$(200),Y1(802)
90 'open disc file "TRACEA"
100 OPEN "TRACEA" FOR INPUT AS #2
110 'enter learn array from disc
120 FOR I=1 TO 114
130 INPUT #2,X1(I) 'get integer variable from disc
140 NEXT I
150 'enter trace data from disc
160 FOR I=1 TO 802
170 INPUT #2,Y1(I)
180 NEXT I
190 'close the disc file
200 CLOSE #2
210 'format the integer data into strings
220 'for the analyzer. see 232PROG8 for explanation.
230 LEARN$=""  'null out the learn string
240 FOR I=1 TO 114  'format learn string first
250 LEARN$=LEARN$+CHR$(X1(I))
260 NEXT I
270 'format the trace data
280 I2=1 'set counter
290 GOSUB 500 'do the conversion
300 TR1$=TR6$ 'set the string
310 I2=201 'set the counter
320 GOSUB 500  'do the conversion
330 TR2$=TR6$
340 I2=401
350 GOSUB 500
360 TR3$=TR6$
370 I2=601
380 GOSUB 500
390 TR4$=TR6$
400 'format last two characters
410 TR5$=""
420 TR5$=TR5$+CHR$(Y1(801))+CHR$(Y1(802))
430 'write to analyzer
440 PRINT #1,LEARN$
450 'output trace data
460 PRINT #1,"IB";TR1$;TR2$;TR3$;TR4$;TR5$;";
470 PRINT #1,"VIEW TRB;"
480 GOTO 560 'end the program
490 'subroutine for converting integer data to ASCII
500 TR6$="" 'set the string to a null value
510 FOR I=1 TO 200
```


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```
520 TR6$=TR6$+CHR$(Y1(I2))
530 I2=I2+1
540 NEXT I
550 RETURN 'done with conversion
560 END
```

The RS-232 program, 232PROG9, reads a trace stored in the file TRACEA and loads it into the variable TRCA. This program assumes that trace data is stored on the disc in the previous program example, 232PROG8.

First, the settings of the analyzer in force when the trace was stored are placed into the variable LEARN$. Then, previously stored trace data is returned to the analyzer and the trace is viewed on the analyzer screen.

(For the HP-IL Interface)

```
10 ! File = ILPROG9
20 RESET HPIL
30 RESTORE IO
40 DESTROY ALL
50 ! dimension trace and learnstring strings
60 DIM T$[802],L$[114]
70 A=DEVADDR("analyzer") ! ANALYZER ADDRESS
80 ! open the file STATE and assign it to channel 1
90 ASSIGN #1 TO STATE
100 ! read the trace data and learnstring into
110 ! the strings T$ and L$
120 READ #1;T$,L$
130 ! close file and channel 1
140 ASSIGN #1 TO *
150 OUTPUT :A ;"IP DONE;"
160 ENTER :A ;Z
170 ! send learnstring to analyzer
180 OUTPUT :A USING "114A";L$
190 ! send trace data to Trace B of analyzer
200 OUTPUT :A USING "2A,802A";"IB";T$
210 ! view Trace B to see it was sent
220 OUTPUT :A ;"VIEW TRB;"
230 END
```

The HP-IL program, ILPROG9, reads a trace and a learnstring stored in the file "STATE" and loads them into the analyzer.

Line 180 formats and sends the learnstring to the analyzer. The analyzer recognizes that it is a learnstring and performs the appropriate operations. Line 200 formats and appends the command IB to the trace data before it sends it to the analyzer. This puts the trace data into trace B. Line 220 allows us to view the previously sampled and stored data.

(The Input Trace B (IB) command transmits the contents of an array, located in the controller, to trace B memory. This command is used specifically in this HP-IL program and is not documented in Chapter 4.)

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Measuring Harmonic Distortion

The harmonic distortion program presented here illustrates how the analyzer can be directed by a computer to make a complete measurement. Measuring the percent of total harmonic distortion is tedious when performed manually: it involves tuning to the fundamental and to each harmonic of interest, recording the amplitude of each signal, converting these amplitudes to linear units (volts), and calculating the result from a formula. Extensive annotation has been added to help you understand the programs.

The following programs measure percent of total harmonic distortion automatically, quickly, and accurately. The programs operate as if we were to make the measurement manually.

(For the HP-IB Interface)

```
10 !FILE: "THD_TEST"
20  ASSIGN @Sa TO 718    !assign IO path to analyzer
30 Variables:        !define variables:
40  REAL Fundamental,Fund_amptd_v,Fund_amptd_dbm
50  REAL Prcnt_distort,Sum_sqr
60  INTEGER Max_harmonic,I,Number
70   !allow user to change the number of harmonics:
80  Max_harmonic=4
90  ALLOCATE REAL Harmonic_v(2:Max_harmonic),Harmonic_dbc(2:Max_harmonic)
100 GOSUB Clearscreen    !clear the alpha screen
110  !ask for the frequency of the fundamental:
120 OUTPUT CRT USING "4/,10X,K,3/";"**** HARMONIC DISTORTION ****"
130 OUTPUT CRT USING "K,/";"CONNECT SOURCE TO ANALYZER INPUT, THEN"
140 OUTPUT CRT USING "K,2/";"ENTER FREQUENCY OF FUNDAMENTAL IN MHZ "
150 OUTPUT CRT USING "10X,K";"WHEN READY  => press ENTER "
160 INPUT Fundamental
170 GOSUB Clearscreen    !clear the alpha screen
180 Fundamental:       !write "measuring fundamental" on screen:
190 DISP "MEASURING FUNDAMENTAL"
200  !preset the analyzer, set single sweep mode, and take sweep:
210 OUTPUT @Sa;"IP; SNGLS; TS;"
220  !tune the analyzer to the fundamental freq and set 20 MZ span:
230 OUTPUT @Sa;"CF ";Fundamental;"MHZ;"
240 OUTPUT @Sa;"SP 20MZ; TS;"
250  !put a marker on signal peak, move marker to reference level:
260 OUTPUT @Sa;"MKPK HI; MKRL; TS;"
270  !find signal peak, activate signal track, and narrow span:
280 OUTPUT @Sa;"MKPK HI; TS;"
290 OUTPUT @Sa;"MKTRACK ON; SP 100KZ; TS;"
300  !turn off signal track:
310 OUTPUT @Sa;"MKTRACK OFF;"
320  !find the peak of the signal; move peak to center of screen:
330 OUTPUT @Sa;"AUNITS V;"! MAKE READOUT UNITS VOLTS
340  !find peak of signal; send amplitude value to computer
350  !enter the amplitude of the fundamental:
360 OUTPUT @Sa;"MKPK HI; MKA?;"
370 ENTER @Sa;Fund_amptd_v
380  !send marker frequency to the computer, enter frequency value:
390 OUTPUT @Sa;"MKF?;"
400 ENTER @Sa;Fundamental
```


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```
410  !make the fundamental frequency the center freq step size:
420 OUTPUT @Sa;"MKSS;"
430  !set the fundamental frequency units to MHZ:
440 Fundamental=Fundamental/1.E+6
450 Harmonics:        !measure the amplitudes of the harmonics:
460 FOR Number=2 TO Max_harmonic
470  DISP "MEASURING HARMONIC #";Number
480  OUTPUT @Sa;"SP 20MZ;" !set span to 20 MZ
490  OUTPUT @Sa;"CF UP; TS;" !tune to next harmonic
500  !take second sweep to allow analyzer to move to the center
510  !frequency; find the signal peak; activate signal track:
520  OUTPUT @Sa;"TS;"
530  OUTPUT @Sa;"MKPK HI; MKTRACK ON; SP 100KZ; TS;"
540  !turn of signal track:
550  OUTPUT @Sa;"MKTRACK OFF;"
560  !find signal peak; send amplitude value to computer
570  !enter the amplitude of the harmonic:
580  OUTPUT @Sa;"MKPK HI; MKA?;"
590  ENTER @Sa;Harmonic_v(Number)
600 NEXT Number
610  !set amplitude units to dBm:
620 OUTPUT @Sa;"AUNITS DBM;"
630  !calculate the fundamental amplitude in dBm since
640  !it was measured in volts:
650 Fund_amptd_dbm=10*LGT(Fund_amptd_v^2/.05)
660  !calculate the sum of the squares of the amplitudes
670  !of the harmonics; calculate amplitudes of harmonics (dBm):
680 Sum_sqr=0
690 FOR I=2 TO Max_harmonic
700  Sum_sqr=Sum_sqr+Harmonic_v(I)^2
710  Harmonic_dbc(I)=20*LGT(Fund_amptd_v/Harmonic_v(I))
720 NEXT I
730  !calculate the percent distortion:
740 Prcnt_distort=SQR(Sum_sqr)/Fund_amptd_v*100
750 GOSUB Clearscreen   !clear the alpha screen:
760 Output_data: !
770  !send data to the screen of the computer:
780 OUTPUT CRT USING "7/,1X,K";"HARMONIC DISTORTION RESULTS"
790 OUTPUT CRT USING "11X,K,DDDD.D,K";"FREQUENCY  = ";Fundamental;" MHZ"
800 OUTPUT CRT USING "11X,K,DDDD.D,K";"AMPLITUDE  = ";Fund_amptd_dbm;" dBm"
810 OUTPUT CRT USING "11X,K,DDD.D,K";"2nd HARMONIC = -
";Harmonic_dbc(2);"dBc"
820 OUTPUT CRT USING "11X,K,DDD.D,K";"3rd HARMONIC = -";Harmonic_dbc(3);" dBc"
830 FOR I=4 TO Max_harmonic
840  OUTPUT CRT USING "10X,DD,K,DDD.D,K";I;"th HARMONIC = -";Harmonic_dbc(I);"
850 NEXT I
860 OUTPUT CRT USING "11X,K,DDD.D,K";"TOTAL DISTORTION = ";Prcnt_distort;" %"
870 !
880 LOCAL 7
890 STOP
900 !
910 Clearscreen:   !alpha clear subroutine
```


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```
920 !the statement below presses the "CLR SCR" key on the keyboard:
930 OUTPUT KBD USING "#,B";255,75
940 RETURN
950 END
```

The HP-IB program prompts the operator to connect a source to the analyzer INPUT and enter the source frequency. It sets the analyzer center frequency to the value of the source, or fundamental, frequency. It measures and records the frequency and amplitude of the fundamental, then measures and records the amplitude of the second, third, and fourth harmonics. These values are used to compute percent of harmonic distortion. The percent of harmonic distortion results, plus harmonic amplitudes in dBc (decibels relative to the carrier), are displayed on the computer screen.

If necessary, change the number of harmonics on line 80.

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(For the RS 232 Interface)

```
10 'File = THDTEST
20 OPEN "COM1:9600,N,8,1" AS #1
30 'allow user to change the number of harmonics
40 MAXHARMONIC=4
50 DIM HARMONICV(10),HARMONICDBC(10)
60 'clear the screen
70 CLS
80 'ask for the frequency of the fundamental
90 PRINT "******* HARMONIC DISTORTION **********"
100 PRINT
110 PRINT "CONNECT SOURCE TO ANALYZER INPUT, THEN"
120 PRINT "ENTER FREQUENCY OF THE FUNDAMENTAL IN MHZ"
130 PRINT
140 INPUT FUNDAMENTAL
150 CLS
160 'print measuring fundamental on screen
170 PRINT "MEASURING FUNDAMENTAL"
180 'preset the analyzer, set single-sweep and take sweep
190 PRINT #1,"IP;SNGLS;TS;"
200 PRINT #1,"DONE;"
210 INPUT #1,DONE
220 'tune the analyzer to the fundamental freq and set 20-MZ span
230 PRINT #1,"CF ";FUNDAMENTAL;"MHZ"
240 PRINT #1,"SP 20MZ;TS;"
250 PRINT #1,"DONE;"
260 INPUT #1,DONE
270 'put a marker on signal peak, move marker to reference level
280 PRINT #1,"MKPK HI;MKRL;TS;"
290 'find signal peak, activate signal track, and narrow span
300 PRINT #1,"MKPK HI;TS;"
310 PRINT #1,"MKTRACK ON;SP 100KZ;TS;"
320 PRINT #1,"DONE;"
330 INPUT #1,DONE
340 'turn off signal track
350 PRINT #1,"MKTRACK OFF;"
360 'find peak of signal, move peak to center of screen
370 'make units in volts
380 PRINT #1,"AUNITS V;"
390 'find peak of signal, send amplitude value to computer
400 PRINT #1,"MKPK HI;MKA?;"
410 INPUT #1,FUNDAMPTDV
420 'send marker frequency to computer, enter frequency value
430 PRINT #1,"MKF?;"
440 INPUT #1,FUNDAMENTAL
450 'make the fundamental frequency the center freq step size
460 PRINT #1,"MKSS;"
470 'set the fundamental frequency units to MHZ
480 FUNDAMENTAL =FUNDAMENTAL/1000000!
490 FOR NUMBER = 2 TO MAXHARMONIC
500 PRINT "MEASURING HARMONIC # ";NUMBER
510 'set span and tune to next harmonic
520 PRINT #1,"SP 20MZ;"
530 PRINT #1,"CF UP;TS;"
540 PRINT #1,"DONE;"
```


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```
550 INPUT #1,DONE
560 'take a second sweep to allow analyzer to move to
570 'the center frequency, find the signal peak, activate the signal track
580 PRINT #1,"TS;"
585 PRINT #1,"MKPK HI;MKTRACK ON;SP 100KZ;TS;"
590 'turn off signal track
600 PRINT #1,"MKTRACK OFF;"
610 'find signal peak, send amplitude value to computer
620 'enter amplitude of harmonic
630 PRINT #1,"MKPK HI;MKA?;"
640 INPUT #1,HARMONICV(NUMBER)
650 NEXT NUMBER
660 'set amplitude units to dBm
670 PRINT #1,"AUNITS DBM;"
680 'calculate the fundamental amplitude in dBm since
690 'it was measured in volts
700 FUNDAMPTDDBM=10*(LOG(FUNDAMPTDV^2/.05)/2.3026)
710 'calculate the sum of the squares of the amplitudes
720 'of the harmonics, calculate amplitudes of harmonics (dBm)
730 SUMSQR=0
740 FOR I=2 TO MAXHARMONIC
750 SUMSQR=SUMSQR+HARMONICV(I)^2
760 HARMONICDBC(I)=20*(LOG(FUNDAMPTDV/HARMONICV(I))/2.3026)
770 NEXT I
780 'calculate the percent distortion
790 PRCNTDISTORT=SQR(SUMSQR)/FUNDAMPTDV*100
800 CLS
810 'output the data
820 PRINT "******* HARMONIC DISTORTION RESULTS ********"
830 PRINT "FREQUENCY = ";FUNDAMENTAL;" MHZ"
840 PRINT "AMPLITUDE = ";FUNDAMPTDDBM;" dbm"
850 FOR I=2 TO MAXHARMONIC
860 PRINT "HARMONIC # ";I;" = -";HARMONICDBC(I);" dbm"
870 NEXT I
880 PRINT "TOTAL DISTORTION = ";PRCNTDISTORT;" %"
890 END
```

The RS-232 program prompts the operator to connect a source to the analyzer INPUT and enter the source frequency. It sets the analyzer center frequency to the value of the source, or fundamental, frequency. It measures and records the frequency and amplitude of the fundamental, then measures and records the amplitude of the second, third, and fourth harmonics. These values are used to compute percent of harmonic distortion. The percent of harmonic distortion results, plus harmonic amplitudes in dBc (decibels relative to the carrier), are displayed on the computer screen.

If necessary, change the number of harmonics on line 40.

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(For the HP-IL Interface)

```
10 ! File = THDTEST
20 RESET HPIL
30 RESTORE IO
40 DESTROY ALL
50 ! F1 is the frequency of the fundamental
60 ! F2 is the amplitude of the fundamental in volts
70 ! F3 is the amplitude of the fundamental in dBm
80 REAL F1,F2,F3
90 ! P1 is the percent total harmonic distortion
100 ! S1 is the sum of the squares of the harmonics
110 REAL P1,S1
120 ! H1() are the harmonic amplitudes in volts
130 ! H2() are the harmonic amplitudes in dBc
140 REAL H1(10),H2(10)
150 ! M1 is the number of the max harmonic to be measured
160 ! I is the loop index used in the program
170 ! X,Y is the starting position of output data printout
180 INTEGER M1,I,X,Y
190 A=DEVADDR("analyzer")
200 M1=4 ! change this line to change max harmonic measured
210 DISP "HARMONIC DISTORTION"
220 ! turn off the annotation and the graticule
230 ! blank trace A and blank trace B
240 OUTPUT :A ;"ANNOT OFF;GRAT OFF;BLANK TRA;BLANK TRB;"
250 ! set pen to absolute mode
260 ! move the pen to the position -20,120 on the screen
270 OUTPUT :A ;"PU;PA-20,120;"
280 ! print the message at the current pen position
290 OUTPUT :A ;"TEXT/CONNECT SOURCE TO ANALYZER INPUT/"
300 OUTPUT :A ;"PU;PA-20,100;"
310 OUTPUT :A ;"TEXT!ENTER FREQUENCY OF FUNDAMENTAL IN MHZ ON 71B KEYBOARD!"
320 DISP "MHZ?";
330 INPUT "";F1
340 ! erase the screen
350 OUTPUT :A ;"EM;"
360 OUTPUT :A ;"PU;PA-20,120;"
370 OUTPUT :A ;"TEXT!PRESS ENDLINE WHEN READY TO START MEASUREMENT!;"
380 INPUT "";Z$
390 ! FUNDAMENTAL MEASUREMENTS
400 ! preset the analyzer, set single_sweep mode, and take sweep
410 OUTPUT :A ;"IP;SNGLS;TS;"
420 ! put MEASURING FUNDAMENTAL in title block
430 OUTPUT :A ;"TITLE! MEASURING FUNDAMENTAL!"
440 ! tune the analyzer to the fundamental freq and set 20 MZ span
450 OUTPUT :A ;"CF ";F1;"MHZ;"
460 OUTPUT :A ;"SP 20MZ;TS;"
470 ! put marker on signal peak, move marker to reference level
480 OUTPUT :A ;"MKPK HI;MKRL;TS;"
490 ! find signal peak, activate signal track, and narrow the span
500 OUTPUT :A ;"MKPK HI;TS;"
510 OUTPUT :A ;"MKTRACK ON;SP 100KZ;TS;"
520 ! turn off signal track
530 OUTPUT :A ;"MKTRACK OFF;"
540 ! make readout units volts
```


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```
550 OUTPUT :A ;"AUNITS V;"
560 ! find peak of signal, ask for maker amplitude
570 ! enter the amplitude of the fundamental
580 OUTPUT :A ;"MKPK HI;MKA?;"
590 ENTER :A ;F2
600 ! ask for the marker frequency
610 ! enter the frequency of the fundamental
620 OUTPUT :A ;"MKF?;"
630 ENTER :A ;F1
640 ! make the fundamental frequency the center freq step size
650 OUTPUT :A ;"MKSS;"
660 ! set the fundamental frequency units in MHZ
670 F1=F1/1000000
680 ! HARMONIC MEASUREMENTS
690 FOR I=2 TO M1
700 OUTPUT :A ;"TITLE! MEASURING HARMONIC # ";STR$(I)[1,1];"!"
710 OUTPUT :A ;"SP 20MZ;"
720 OUTPUT :A ;"CF UP;TS;" ! tune to next harmonic
730 ! take second sweep to allow analyzer to move to the center
740 ! frequency; find the signal peak; activate signal track;
750 ! narrow the span;
760 OUTPUT :A ;"TS;"
770 OUTPUT :A ;"MKPK HI;MKTRACK ON;SP 100KZ;TS;"
780 ! turn off signal track
790 OUTPUT :A ;"MKTRACK OFF;"
800 ! find signal peak; ask for marker amplitude
810 ! enter the amplitude of the harmonic
820 OUTPUT :A ;"MKPK HI;MKA?;"
830 ENTER :A ;H1(I)
840 NEXT I
850 ! set amplitude units to dBm
860 OUTPUT :A ;"AUNITS DBM;"
870 ! calculate the fundamental amplitude in dBm since
880 ! it was measured in volts
890 F3=10*LGT(F2^2/.05)
900 ! calculate the sum of the squares of the amplitudes
910 ! of the harmonics; calculate amplitudes of harmonics (dBm)
920 S1=0
930 FOR I=2 TO M1
940 S1=S1+H1(I)^2
950 H2(I)=20*LGT(F2/H1(I))
960 NEXT I
970 ! calculate the percent distortion
980 P1=SQR(S1)/F2*100
990 ! output the data onto the analyzer screen
1000 ! clear the title block
1010 OUTPUT :A ;"TITLE"
1020 OUTPUT :A ;"ANNOT OFF;GRAT OFF;BLANK TRA;BLANK TRB;"
1030 ! use fixed data format with two decimal places
1040 FIX 2
1050 ! set the starting x and y position of the printed data1060 X=50
1070 Y=150
1080 OUTPUT :A ;"PU;PA";X;",";Y;";"
1090 OUTPUT :A ;"TEXT/HARMONIC RESULTS/"
1100 OUTPUT :A ;"PU;PA";X;",";Y-20;";"
1110 OUTPUT :A ;"TEXT/FUND FREQ = ";F1;" MHZ/"
```


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```
1120 OUTPUT :A ;"PU;PA";X;",";Y-30;";"
1130 OUTPUT :A ;"TEXT/FUND AMP = ";F3;" dBm/"
1140 OUTPUT :A ;"PU;PA";X;",";Y-40;";"
1150 OUTPUT :A ;"TEXT/2nd HARMONIC = ";H2(2);" dBc/"
1160 OUTPUT :A ;"PU;PA";X;",";Y-50;";"
1170 OUTPUT :A ;"TEXT/3rd HARMONIC = ";H2(3);" dBc/"
1180 FOR I=4 TO M1
1190 OUTPUT :A ;"PU;PA";X;",";Y-(I+2)*10;";"
1200 OUTPUT :A ;"TEXT/";STR$(I)[1,1];"th HARMONIC = ";H2(I);" dBc/"
1210 NEXT I
1220 OUTPUT :A ;"PU;PA";X;",";Y-(I+2)*10;";"
1230 OUTPUT :A ;"TEXT/TOTAL HARMONIC DISTORTION = ";P1;" %/"
1240 END
```

The HP-IL program shows how to use the signal track and auto-zoom feature of the analyzer from a computer. It also demonstrates that the 22-character, single-line display of the HP-71B is not a limiting factor. The analyzer can easily display prompts and data.

On the analyzer screen, the program prompts the operator to connect a source to the analyzer INPUT and enter the source frequency. The program then sets the analyzer center frequency to the value entered through the HP-71B.

Next, the program measures and records the frequency and amplitude of the fundamental; then it does the same thing with the second, third, and fourth harmonics. The analyzer displays the name of the signal being measured in the TITLE area of the display. These values are used to compute the percent of harmonic distortion. The harmonic amplitudes in dBc (decibels relative to the carrier), are also displayed on the analyzer screen.

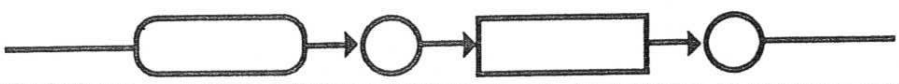
To save memory space, the comments may be deleted from the program. This can reduce the memory taken up by a program by more than 50%.

If necessary, you can change the number of harmonics on line 200.

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Chapter 4

Programming Commands



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CHAPTER 4

PROGRAMMING COMMANDS

What You'll Learn in This Chapter

This chapter is a reference for the HP 8592A command language. In this chapter are descriptions of commands recognized by the HP 8592A Spectrum Analyzer. This chapter is a command dictionary; commands are listed alphabetically.

To find a programming command which performs a particular function, first refer to the Functional Index (Table 4-5) where commands are categorized by function. Once the desired command is found, refer to the alphabetical listing.

If you are totally unfamiliar with spectrum analyzer programming, do not start with this chapter. New programmers should refer to Chapter 2, "Programming Fundamentals."

This chapter includes several reference tables as listed below:

- Table 4-1 Command Syntax Summary
- Table 4-2 Syntax Elements Enclosed in Rectangles
- Table 4-3 Command Parameters
- Table 4-4 Summary of Compatible Commands
- Table 4-5 Functional Index

Syntax Conventions

Command syntax is represented pictorially. Many commands have identical syntax diagrams. Seven of the most common diagrams are shown in Figures 4-1 through 4-7; these diagrams are referred to throughout the remainder of Chapter 4.

Symbols in Syntax Diagrams

- Narrow ovals surround command names.
- Circles and wide ovals surround secondary keywords, or special numbers and characters.
- Rectangles contain the description of a syntax element defined in Table 4-2.
- Solid lines represent the recommended path.
- Semicolons are the recommended command terminators. Semicolons are inserted at the end of each line and between spectrum analyzer commands. Using semicolons makes programs easier to read, prevents command misinterpretation, and is recommended by IEEE Standard 728. Optional command terminators (line feed, carriage return, space, and comma) can replace semicolons as terminators in most instances.

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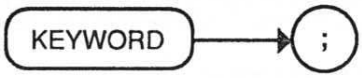


Figure 4-1

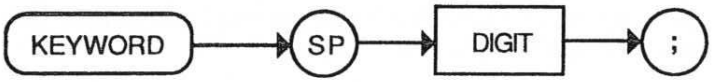


Figure 4-2

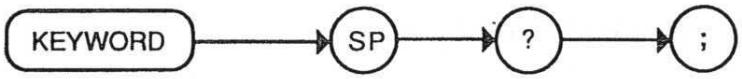


Figure 4-3

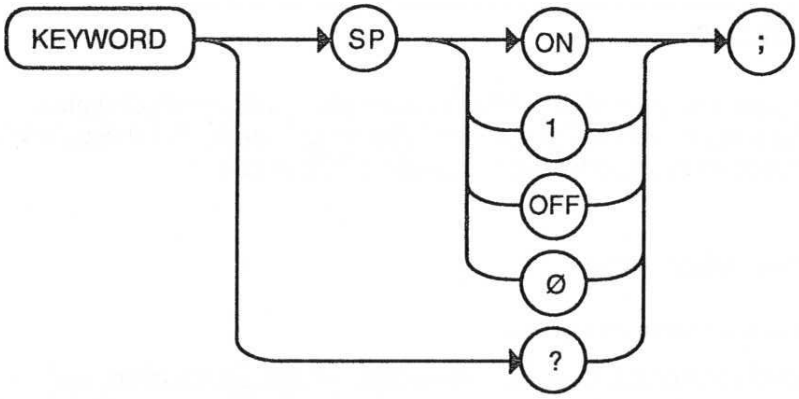


Figure 4-4

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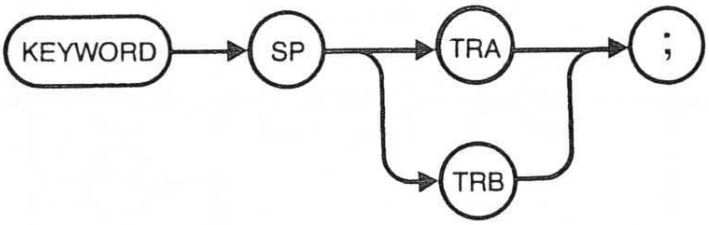


Figure 4-5

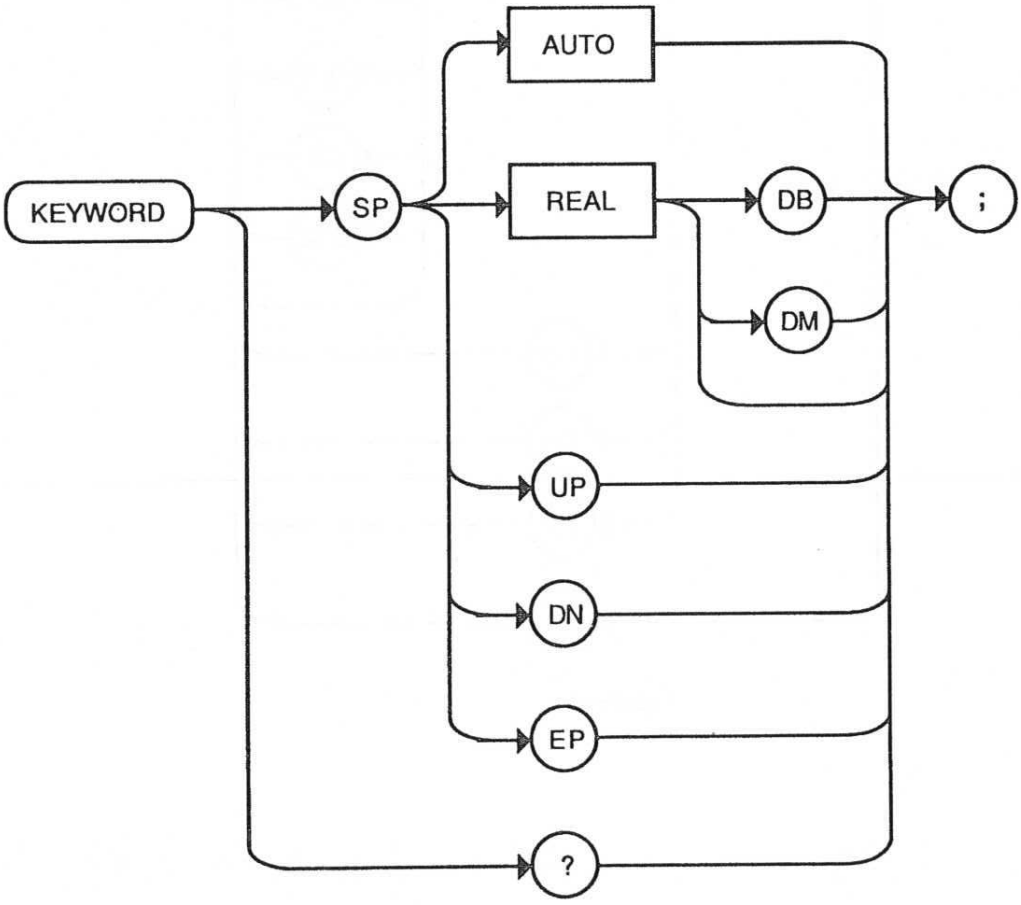


Figure 4-6

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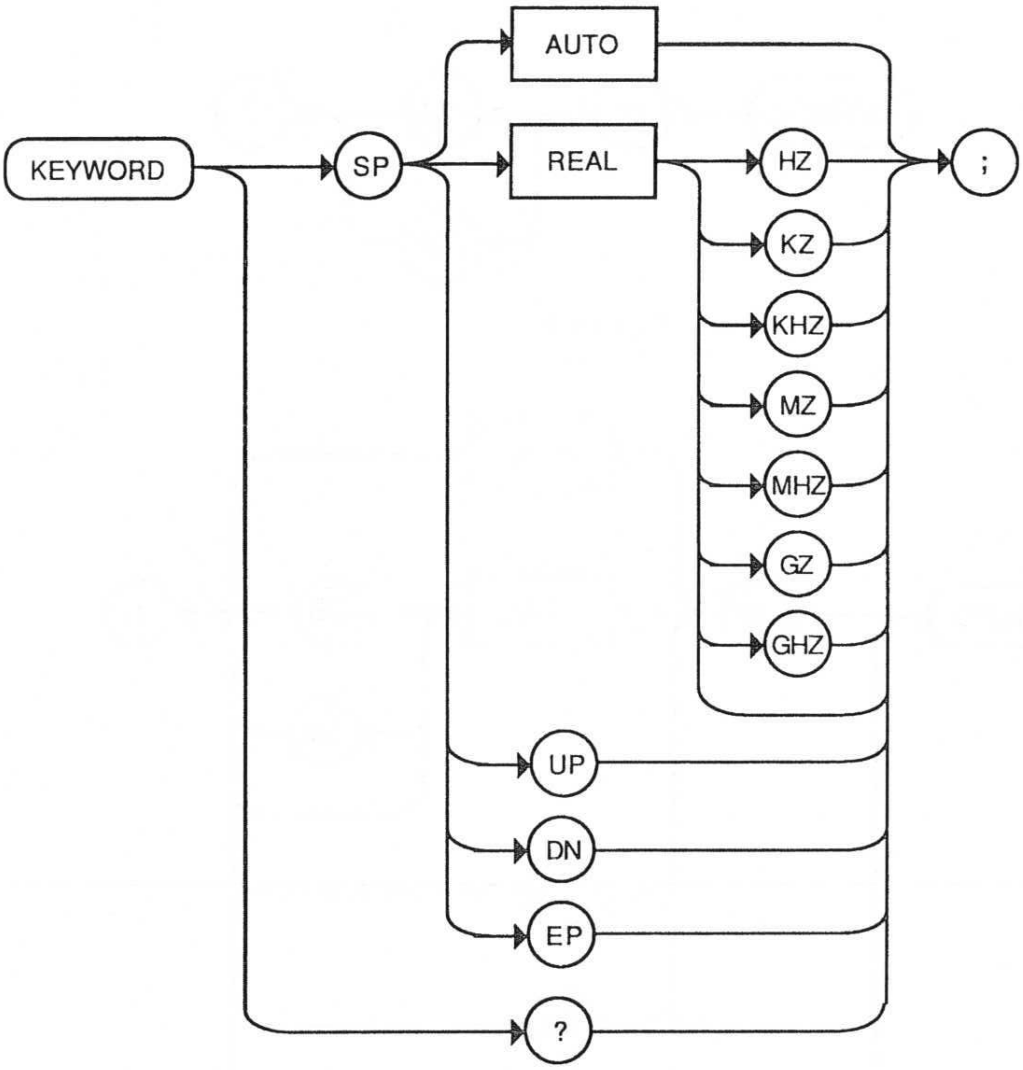


Figure 4-7

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Table 4-1. Command Syntax Summary

Command	Syntax Diagram
AMB	Figure 4-4*
AMBPL	Figure 4-4
ANNOT	Figure 4-4
APB	Figure 4-1
AT	Figure 4-6*
AUNITS	See Command Description
AUTO	See Command Description
AXB	Figure 4-1
BLANK	Figure 4-5
BL	Figure 4-1
CAL	See Command Description
CF	Figure 4-7
CLRW	Figure 4-5
CLS	Figure 4-1
CNF	Figure 4-1
CONTS	Figure 4-1
DET	See Command Description
DL	Figure 4-6*
DN	Figure 4-1
DONE	Figure 4-1*
DSPLY	See Command Description
EE	Figure 4-1
EK	Figure 4-1
EM	Figure 4-1
EP	Figure 4-1
FA	Figure 4-7
FB	Figure 4-7
FFT	See Command Description
FOFFSET	See Command Description
GRAT	Figure 4-4
HD	Figure 4-1
HN	Figure 4-3
HNLOCK	See Command Description
HNUNLK	Figure 4-1
ID	Figure 4-1
INZ	See Command Description
IP	Figure 4-1
LG	Figure 4-6*
LN	Figure 4-1
MA	Figure 4-1
MDS	See Command Description
MF	Figure 4-1
MKA	Figure 4-6*
MKCF	Figure 4-1
MKD	Figure 4-7*
MKF	Figure 4-7*
MKMIN	Figure 4-1

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Table 4-1. Command Syntax Summary (continued)

Command	Syntax Diagram
MKN	Figure 4-7
MKNOISE	Figure 4-4
MKOFF	See Command Description
MKPAUSE	See Command Description
MKPK	See Command Description
MKPX	Figure 4-6*
MKRL	Figure 4-1
MKSP	Figure 4-1
MKSS	Figure 4-1
MKTRACK	Figure 4-4
MKTYPE	See Command Description
ML	Figure 4-6*
MXMH	Figure 4-5
M4	Figure 4-7*
OA	Figure 4-1
OL	Figure 4-1
PA	See Command Description
PD	Figure 4-1
PEAKS	See Command Description
PLOT	See Command Description
PP	Figure 4-1
PR	See Command Description
PRINT	Figure 4-1
PRSDAC	See Command Description
PSTATE	Figure 4-4
PU	Figure 4-1
RB	Figure 4-7
RCLS	Figure 4-2
RCLT	See Command Description
REV	Figure 4-1
RL	Figure 4-6*
ROFFSET	See Command Description
RQS	See Command Description
SAVES	See Command Description
SAVET	See Command Description
SNGLS	Figure 4-1
SP	Figure 4-7*
SRQ	Figure 4-2
SS	Figure 4-7*
ST	See Command Description
STB	See Command Description
TA	Figure 4-1
TB	Figure 4-1
TDF	See Command Description
TEXT	See Command Description
TH	Figure 4-6*
TITLE	See Command Description

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Table 4-1. Command Syntax Summary (continued)

Command	Syntax Diagram
TM	See Command Description
TRA/TRB	See Command Description
TRCMEM	Figure 4-3
TS	Figure 4-1
TWNDOW	See Command Description
VAVG	See Command Description
VB	Figure 4-7
VBR	See Command Description
VIEW	Figure 4-5
*Slight differences may occur in syntax diagrams; refer to specific Syntax descriptions for complete variances.	

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Table 4-2. Syntax Elements Enclosed in Rectangles

Element	Description
A-Block Data Field	Absolute block data field consisting of #, A, Length
Command List	Alphanumeric character comprising any analyzer command. ASCII characters 0 through 255.
Data Bytes	8-bit bytes representing ASCII command list or trace data.
Delimiter	String Delimiter ! " $ % & ' / : = @
Detector Mode	Detection mode specifier. See command description for DET.
I-Block Data Field	Indefinite block data field consisting of #, I, and Data Bytes with END or Identity line asserted on Last Data Byte.
Length	Two 8-bit bytes specifying number of 2-bit bytes. A-Block Data Field. The most significant byte is first: MSB LSB.
Output Termination	Carriage-return/line-feed with End-or-identify (EOI) asserted.
P1X and P1Y	Integer representing plotter-dependent values that specify lower-left plotter dimension.
P2X and P2Y	Integer representing plotter-dependent values that specify upper-right plotter dimension.
String Delimiter	! " $ % & ' / : = @
Trace Element	Any element (point) of trace A or B.

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Table 4-3. Command Parameters
(Syntax Elements Enclosed in Circles)

Element	Description
ALL	all
AMP	amplitude
AUTO	auto couple (command)
B	8-bit byte
DB	decibel (unit)
DBM	absolute decibel milliwatt (unit)
DBMV	decibel millivolt
DBUV	decibel microvolt
DM	absolute decibel milliwatt (unit)
DN	decreases the parameter one step size (command)
EP	pauses program for data entry from front panel
EXT	external
FIXED	fixed
FREE	free run
FRQ	frequency
GHZ	gigahertz (unit)
GZ	gigahertz (unit)
HI	highest
HZ	hertz (unit)
KHZ	kilohertz (unit)
KZ	kilohertz (unit)
LINE	line, as power line
MHZ	megahertz (unit)
MS	millisecond (unit)
MV	millivolts (unit)
MZ	megahertz (unit)
NH	next highest
NL	next left
NR	next right
OA	Output active function value (command)
OFF	turn function off
ON	turn function on
PER	period
POS	positive peak detection mode
PSN	position
SC	seconds (unit)
SMP	sample detection mode
SP	space
SWT	sweep time
TRA	trace A
TRB	trace B
UP	increases the parameter one step size (command)
UV	microvolts (unit)

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Table 4-3. Command Parameters (continued)
(Syntax Elements Enclosed in Circles)

Element	Description
US	microseconds (unit)
V	volts (unit)
VID	video
W	word
?	Returns a query response containing the value or state of the associated parameter. The query response is followed by a carriage-return/line-feed.

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Table 4-4. Summary of Compatible Commands

The alternate commands (Alt. Comm.) listed in the left-hand column are supported by the HP 8592A and are provided to allow for backward compatibility with commands in the HP 8566A/B, HP 8568A/B, and HP 71000 instruments. The new equivalent HP 8592A commands, listed in the right-hand column, may also be used.

Alt. Comm.	Description	HP 8592A Command
A1	clear write trace A	CLRW TRA
A2	max hold trace A	MXMH TRA
A3	store and view trace A	VIEW TRA
A4	store and blank trace A	BLANK TRA
BL	B — DL → B	BML
B1	clear write trace B	CLRW TRB
B2	max hold trace B	MXMH TRB
B3	store and view trace B	VIEW TRB
B4	store and blank trace B	BLANK TRB
CA	couple input attenuation	AT AUTO
CR	couple resolution bw	RB AUTO
CS	couple step size	SS AUTO
CT	couple sweep time	ST AUTO
CV	couple video bw	VB AUTO
C1	A — B off	AMB OFF
C2	A — B on	AMB ON
EX	exchange trace A and B	AXB
E1	peak search	MKPK HI
E2	enter marker frequency into center frequency	MKCF
E3	enter marker delta into center frequency step size	MKSS
E4	enter marker amplitude into reference level	MKRL
KSA	dBm amplitude units	AUNITS DBM
KSB	dBmV amplitude units	AUNITS DBMV
KSC	dBμV amplitude units	AUNITS DBUV
KSD	Volt amplitude units	AUNITS V
KSE	screen title	TITLE
KSG	video average on	VAVG ON
KSH	video average off	VAVG OFF
KSM	marker noise	MKNOISE
KSO	marker value to span	MKSP
KSZ	reference level offset	ROFFSET
KSc	A + B → A	APB
KSn	graticule on	GRAT ON

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Table 4-4. Summary of Compatible Commands (Continued)

Alt. Comm.	Description	HP 8592A Command
KSm	graticule off	GRAT OFF
KSo	annotation on	ANNOT ON
KSp	annotation off	ANNOT OFF
LO	display line off	DL OFF
MT0	marker track off	MKTRACK OFF
MT1	marker track on	MKTRACK ON
M1	marker off	MKOFF
M2	marker normal	MKN
M3	marker delta	MKD
O1	output format — real	TDF P
O2	output format — word	TDF B MDS W
O3	output format — measurement unit	TDF M
O4	output format — byte	TDF B MDS B
RC	recall states	RCLS
R1	activates illegal command service request only	RQS 32
R2	activates end-of-sweep, illegal command	RQS 36
R3	activates broken hardware, illegal command	RQS 40
R4	activates units-key pressed, illegal command	RQS 34
SV	save state	SAVES
S1	sweep continuous	CONTS
S2	sweep single	SNGLS
T0	threshold off	TH OFF
T1	trigger mode free run	TM FREE
T2	trigger mode line	TM LINE
T3	trigger mode external	TM EXT
T4	trigger mode video	TM VID

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Table 4-5. Functional Index

This functional index categorizes the HP 8592A commands by type or function. To find a programming command which performs a particular function, first refer to the index below. The command and a brief definition are shown. Once the desired command is found, refer to the alphabetical listing for further command definition.

Command	Description
Amplitute Commands	
AT	specifies input attenuation
AUNITS	specifies amplitude units for input, output, and display
INZ	specifies input impedance
LG	selects log scale
LN	selects linear scale
MKRL	moves active marker to reference level
ML	specifies mixer level
RL	specifies reference level
ROFFSET	specifies reference level offset
Bandwidth Commands	
RB	specifies resolution bandwidth
VB	specifies video bandwidth
VBR	specifies coupling ratio of video bandwidth to resolution bandwidth
Calibration and Diagnostic Control	
CAL	calibrate
CNF	confidence test
Coupling Control	
AUTO	recouples specified function or recouples all functions
Display Commands	
ANNOT	turns annotation on or off; preset condition is on
AUNITS	specifies amplitude units for input, output, and display
DL	specifies display line level in dBm
DSPLY	writes the value of a variable on the analyzer screen
GRAT	turns graticule on or off; preset condition is on
HD	holds or disables data entry and blanks active function readout
LG	selects log scale
LN	selects linear scale
TH	specifies display threshold value
TITLE	writes text string to the top line of the analyzer screen

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Table 4-5. Functional Index (Continued)

Command	Description
Frequency Commands	
CF	specifies center frequency
FA	specifies start frequency
FB	specifies stop frequency
FOFFSET	specifies frequency offset
HN	specifies harmonic number
HNLOCK	specifies harmonic lock
HNUNLK	specifies harmonic unlock
SP	specifies frequency span
SS	specifies center frequency step size
Graphics Commands	
EM	removes graphics from screen
PA	draws vectors to specified x and y positions
PD	pen down (for drawing graphics)
PR	draws vector from last absolute position (plot relative)
PRINT	prints screen data
PU	pen up (for drawing blank vectors)
TEXT	writes text string to screen at current pen position
TITLE	writes text string to top line of analyzer screen
Information and Service Diagnostic Commands	
CLS	clears status byte
ID	returns the HP model number of the analyzer used (HP 8592A)
REV	returns the firmware revision number
RQS	provides the decimal weighting of service request mask bits which are enabled for service requests
SRQ	sets service request
STB	reads status byte, then clears status byte
Input/Output Commands	
EE	enable entry
EK	enables front-panel knob control
EP	enables front-panel number entry
DONE	sends a message to controller after preceding commands are initiated
HD	holds or disables data entry and blanks active function readout
MA	returns marker amplitude
MDS	specifies measurement data size to byte or word; preset condition is word
MF	returns marker frequency
MKA	specifies amplitude of active marker
MKF	specifies frequency of active marker
OL	returns learn string
RQS	provides the decimal weighting of service request mask bits which are enabled for service requests

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Table 4-5. Functional Index (Continued)

Command	Description
Input/Output Commands (continued)	
TA	trace A output control
TB	trace B output control
TRA/TRB	trace data input/output control
TDF	selects trace data output format
TS	takes a sweep
Instrument State Commands	
IP	instrument preset
RCLS	recall state
SAVES	save state
Marker Commands	
MA	returns marker amplitude
MF	returns marker frequency
MKA	specifies amplitude of active marker, returns marker amplitude value
MKCF	enters marker frequency into center frequency
MKD	moves delta marker to specified frequency or activates delta marker
MKF	specifies frequency of active marker, returns marker frequency for non-zero span (or time in zero span)
MKMIN	moves active marker to minimum signal detected
MKN	moves active marker to specified frequency (or time in zero span)
MKNOISE	returns average noise value at marker, normalized to 1 Hz bandwidth connection for res bandwidth and detection mode
MKOFF	turns off all markers or turns off active marker
MKPAUSE	pauses sweep at marker for duration of specified delay time (in seconds)
MKPK	moves active marker to maximum signal detected
MKPX	specifies minimum excursion for peak identification; preset value is 6 dB
MKRL	moves active marker to reference level
MKSP	moves marker delta frequency into span
MKSS	moves marker to center frequency step size
MKTRACK	turns signal track on or off
MKTYPE	specifies the marker type
M4	turns on marker zoom
Operator Entry Commands	
EE	enables front panel data number entry
EK	enables front panel knob control
HD	holds or disables entry and blanks active function readout
Plotter/Printer Commands	
PLOT	plots screen data
PRINT	prints screen data

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Table 4-5. Functional Index (Continued)

Command	Description
Sweep and Trigger Commands	
CONTS	selects continuous-sweep mode
SNGLS	selects single-sweep mode
ST	specifies sweep time
TM	specifies trigger mode
TS	takes a sweep
Synchronization Commands	
TS	takes a sweep
DONE	sends message to controller after preceding commands are executed
Trace Commands	
AUNITS	specifies amplitude units for input, output, and display
BLANK	stores and blanks specified trace register
CLRW	clear-writes specified trace register
DET	specifies detection mode
FFT	initiates Fast Fourier Transform
PEAKS	specifies trace peaks
RCLT	recalls a saved trace
SAVET	saves a trace
TA	trace A output
TB	trace B output
TRA/TRB	trace data input/output control
TRCMEM	trace memory
TWNDOW	specifies trace window for FFT
VIEW	views specified trace register
Trace Math Commands	
AMB	A - B into A
AMBPL	A - B + display line into A
APB	A + B into A
AXB	exchanges A and B
BL	B - DL into B
VAVG	turns video average on or off, as well as setting the number of counts to average

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Command Descriptions

This section is a command dictionary; commands are listed alphabetically by their programming names. Each command entry includes a command description and a syntax diagram or a reference to one of the seven common syntax diagrams shown in Figures 4-1 through 4-7 (at the beginning of this chapter).

To find a programming command which performs a particular function, first refer to the Functional Index in the preceding pages (Table 4-5). The commands are grouped by function. Once the desired command is found, refer to this section for further command definition and syntax information.

Note: Most command descriptions provide an example of command usage. The examples use an HP BASIC "OUTPUT 718" output statement that sends the commands inside the quote fields to the analyzer. If you are using a different computer or language, you will need to substitute a different output statement in your programs. To determine the appropriate output statement, refer to the examples provided earlier in this manual and to your computer documentation.

Example: For HP-IB, HP BASIC, you may use: `OUTPUT 718;"IP;"`
For HP-IL, HP BASIC, you may use: `OUTPUT:A;"IP;"`
For RS-232, GW BASIC, you may use: `PRINT #1,"IP;"`

Note: UPPERCASE is recommended and preferred for entering all commands.

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AMB

Trace A Minus Trace B

Description: The AMB command subtracts trace B from trace A, point by point, and sends the difference to trace A.

Syntax: See Figure 4-4, without query.

Example: `OUTPUT 718;"AMB ON;"`

Note: The functions of the AMB and C1 or C2 commands and the [A — B → A] softkey are identical. AMB returns "ON" or "OFF" if queried.

AMBPL

Trace A Minus Trace B Plus Display Line

Description: The AMBPL command subtracts trace B from trace A, point by point, adds the display line value to the result and sends the answer to trace A.

Syntax: See Figure 4-4

Example: `OUTPUT 718;"AMBPL;"`

ANNOT

Annotation

Description: The ANNOT command turns on or off all the words and numbers (annotation) on the analyzer screen (except softkey labels). When queried, ANNOT reports the annotation state: ON or OFF.

Syntax: See Figure 4-4

Example: `OUTPUT 718;"ANNOT ON;"`

Note: Alternate command KSo turns the annotation off and KSp turns the annotation on. The functions of the ANNOT command and [ANOTATN ON OFF] softkey are identical.

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APB

Trace A Plus Trace B

Description: The APB command adds trace A and trace B, point by point, and sends the result to trace A.

Syntax: See Figure 4-1

Example: `OUTPUT 718;"APB;"`

AT

Attenuation

Description: The AT command specifies the input attenuation from 0 to 70 dB, in 10 dB steps. Normally, the input attenuator couples to the reference level. When a continuous wave signal is displayed with its peak at or below the reference level, the coupling keeps the mixer input level at or below the specified level (also see ML). Instrument preset sets the attenuation to +10 dB. The AT command allows less than the specified value at the mixer input.

When the attenuation is increased with the AT command, the reference level does not automatically change. If the attenuation is decreased from the coupled value by the AT command, the reference level may decrease. When the reference level is changed with the RL command, the input attenuation changes to maintain a constant signal level on the screen if attenuation couples.

Executing AUTO (auto couple) resets the attenuation value so that a continuous wave signal displayed at the reference level yields +10 dBm (or the specified mixer level) at the mixer input.

When queried with ? or OA, AT returns the attenuation value as a real number, followed by a carriage-return/line-feed.

Only direct entry of "AT 0DB;" will achieve 0-dB attenuation. The step keys, knob, and DN parameter will stop at 10dB.

Syntax: See Figure 4-6

Example:

```
10 OUTPUT 718;"AT 40;"
20 OUTPUT 718;"AT UP;"
```

Line 10 sets the attenuation to 40 dB. Line 20 sets the attenuation to 50 dB.

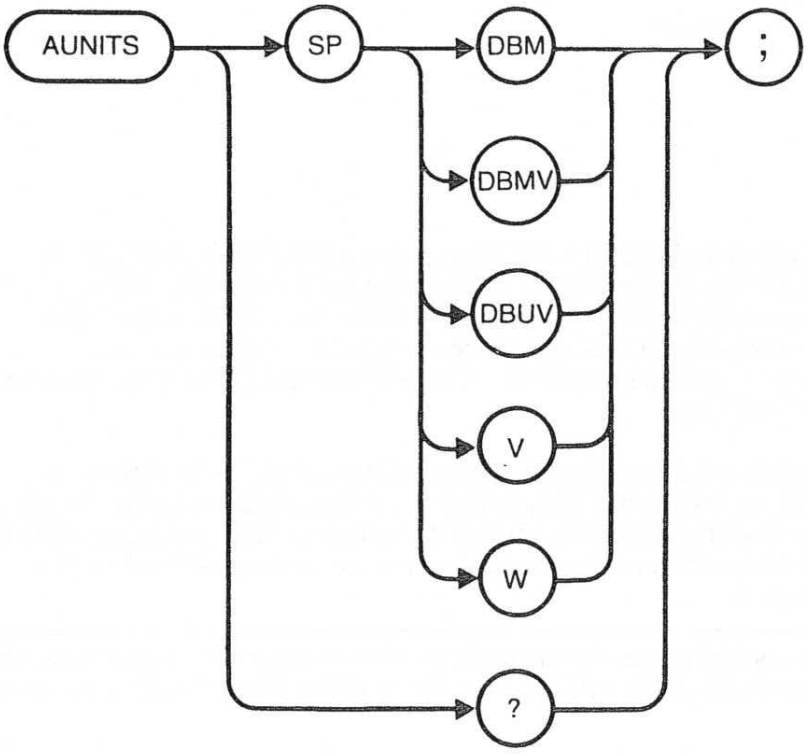
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AUNITS

Amplitude Units

Description: The AUNITS command sets the amplitude readouts (reference level, marker, display line, and threshold) to the specified units.

Syntax:



Example: `OUTPUT 718; "AUNITS DBMV;"`

Note: Alternate commands allow you to set the amplitude units: KSA sets dBm units, KSB sets dBmV units, KSC sets dBμV units, and KSD sets volts.

Note: The AUNITS command changes to "DBM" if "IP;" is executed.

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