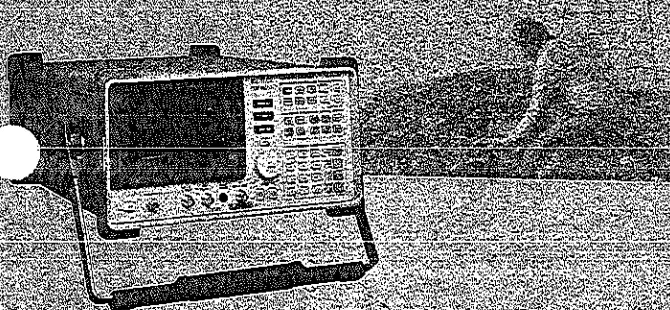
HEWLETT PACKARD

HP 8590A Portable RF Spectrum Analyzer

Programming Manual

HP-IB



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Programming Manual
HP-IB

HEWLETT PACKARD

Manual Part Number: 08590-90011
Microfiche Part Number: 08590-90012
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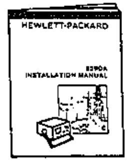
HP 8590A Documentation Description

Manuals shipped with your instrument:

Installation Manual
HP Part Number 08590-90003
- Tells you how to install the spectrum analyzer
- Tells you what to do in case of a failure

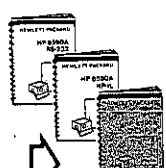


Operating Manual
HP Part Number 08590-90005
- Tells you how to make measurements with your spectrum analyzer
- Describes analyzer features

Options:

Support Manual (Option 915)
HP Part Number 08590-90008
- Describes troubleshooting and repair of the analyzer

Programming Manuals
HP Part Numbers:
HP-IB 08590-90011 (Option 021)
HP-IL 08590-90013 (Option 022)
RS-232 08590-90015 (Option 023)
- Describes analyzer operation via a remote controller (computer)



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 in [brackets] refer to softkeys that appear on the analyzer screen. Keys that appear on the front panel of the instrument appear (boxed).

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. Minor corrections or additions may be made as the manual is reprinted between editions.

Part Number 08590-90011
First Printing September 1986

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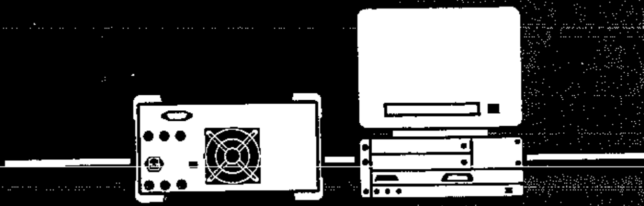
Chapter 1

Preparation for Use



What You'll Learn in This Chapter

This chapter tells you how to connect a computer to your HP 8590A Spectrum Analyzer with the Hewlett-Packard Interface Bus (HP-IB). The first part of this chapter describes the HP-IB system. The remainder of the chapter contains instructions on connecting specific computers to your spectrum analyzer.

Introducing the Hewlett-Packard Interface Bus

Your HP 8590A has an HP-IB connector on the rear panel, as shown in Figure 1-1.

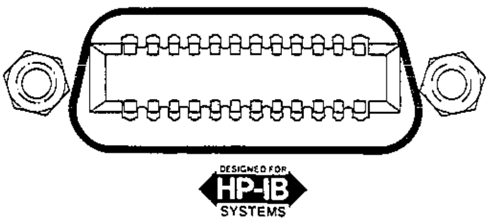


Figure 1-1

The HP-IB system utilizes a party-line bus structure. Devices such as the spectrum analyzer are connected on the party line with HP-IB cables. A computer gives orders (or instructions) and is the "controller." The spectrum analyzer takes orders and is the "listener." The analyzer can also transmit data over the party line. Devices that transmit data back to the computer are "talkers."

Each device on the party line has an address. Device addresses are used by the controller to specify who talks and who listens. A device's address is usually set at the factory.

When you turn on the HP 8590A, the HP-IB address will appear on the screen (for example, HP-IB ADRS: 18). If necessary, you can reset the address of the HP 8590A by pressing CONFIG and [ANALYZER ADDRESS]. (You can use any address from 0 through 30. Usually, 1 is set aside for printers and 5 is set aside for plotters.)

Connecting Your Analyzer to a Computer

The HP 8590A will work 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 interconnection 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 might include a printer, external disc drive, or plotter. Whenever you add another piece of equipment—for example your spectrum 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 a spectrum analyzer is connected: others 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 several computers.

The Test Program

To test the system configuration, a simple test program is provided for each computer listed. After you have connected your computer and analyzer, you should enter and run the 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 analyzer will display a statement when you run the program.

All of the test programs in this chapter 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 to learn how.

Computer/Analyzer Interconnections

This manual contains interconnection instructions for an HP 200 Series computer, an HP 300 Series computer, and the HP Vectra computer (with an HP-IB interface). 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 HP 8590A. Consult your computer documentation to determine how to connect external devices on the bus.

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.

Preparation

Interconnection Symptoms and Solutions

This section offers suggestions to help get your computer and spectrum 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 computer manual for correct BASIC syntax.
2. The program must be executed correctly. Refer to your computer manual for help in executing programs.

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. The analyzer must have the correct address setting. Press CONFIG and [ANALYZER ADDRESS].

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.

Preparation

HP Series 200 Personal Technical Computer

Equipment

HP 9816, 9826, or 9836
HP 8590A Spectrum Analyzer, Option 021
HP-IB Cable 10833A, B, C, D or equivalent

Interconnection Instructions

1. Connect the spectrum analyzer to the computer using the HP-IB cable. Figure 1-2 shows an HP Model 9836 connected to the analyzer.

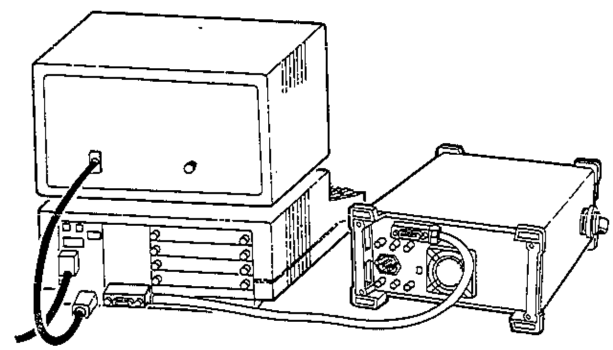


Figure 1-2

2. Check the HP-IB address of the spectrum 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

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. A BASIC READY message should appear and the computer is now ready for use.

If your language is soft-loaded, install the BASIC language disc into the proper drive. Turn the computer power off and on and, after a few seconds, the BASIC READY message will appear. The computer is now ready for use.

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.

Preparation

```
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 = 3.8E+8 HZ.` The program shows that the computer is able to send instructions to the analyzer and read information from the analyzer.

HP Series 300 Technical Computers

Equipment

HP 98580A, 98581A, 98582A, or 98583A
HP 8590A Spectrum Analyzer, Option 021
HP-IB cable 10833A, B, C, D or equivalent

Interconnection Instructions

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

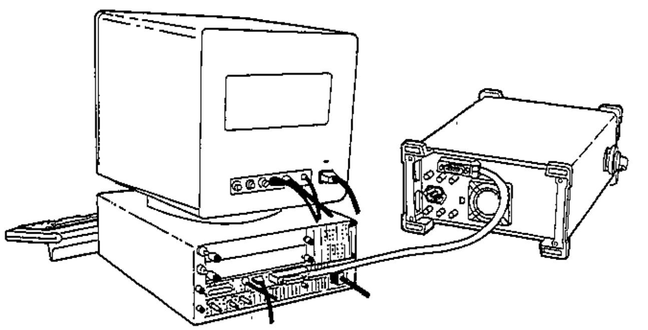


Figure 1-3

Preparation

Preparation

2. Check the HP-IB address of the spectrum 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

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

HP Vectra Personal Computer

Equipment

HP Vectra Personal Computer, Required
Option: HP 61062AA or 61062BA Interface and Command Library.
HP 8590A Spectrum Analyzer, Option 021
HP-IB cable 10833A, B, C, D, or equivalent

Interconnection Instructions

1. Connect the spectrum analyzer to the computer using the HP-IB cable as shown in Figure 1-4.

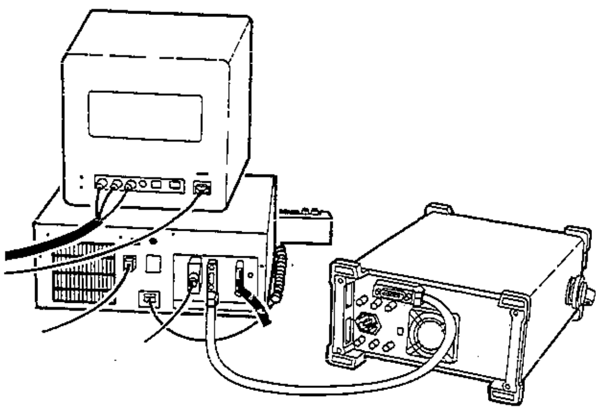


Figure 1-4

2. Check the HP-IB address of the spectrum 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.

3. Load BASIC in your computer. All instruments on the interface bus should be on when you load software in the computer.

Test Program

Before you test the computer/analyzer interface: you must load a "setup file" that allows your program to call subroutine files that are in the HP 61062 Command Library.

If you are using Interpretive BASIC on the HP Vectra PC, this setup file is called "SETUP.BAS". You must include the programming code in the SETUP.BAS file at the beginning of your test program.

The SETUP.BAS file is described in detail in the "HP-IB Command Library for MS-DOS" Manual. The command library described in this manual is a series of subroutines that let you control HP-IB instruments with personal computers such as the HP Vectra PC, the HP Touchscreen family (150 Series) PCs, and the IBM PC/XT/AT (and compatible) computers.

Preparation

The following computers use the BASIC language specified below:

- HP Vectra PC uses Vectra BASIC (HP 45952A). 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 by typing:

```
LOAD "SETUP"
```

Generally, lines 1 through 999 are reserved for the SETUP.BAS file information. The test program 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 FREQUENCY = ";A;"Hz";
1150 END
```

When you have entered the program, type:

```
SAVE "PROGRAM"
```

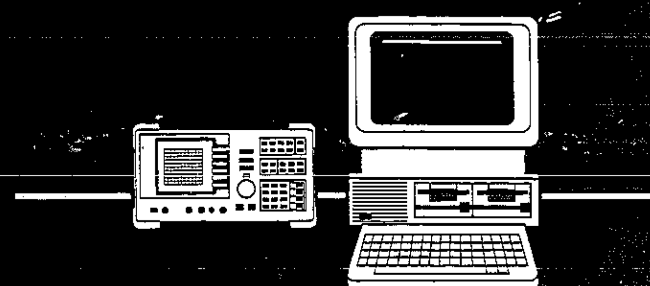
When you are ready to run the program, make sure the analyzer is on, and type:

```
RUN
```

Watch the display on the spectrum 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 FREQUENCY = 3.8E+8 HZ`. The program shows that the computer is able to send instructions to the analyzer and read information from the analyzer.

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 get data out of 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."

Note: All programming examples in this chapter are written in HP BASIC 4.0, using an HP Series 200 Computer. 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.

Writing Your First Program

When the analyzer has been connected to a computer via the HP-IB cable, 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 spectrum analyzer programs contain several common statements that address the spectrum analyzer, preset it, and select its sweep mode. As an example, we will write a short program that executes only these common statements.

The first line of our program assigns a variable called "Analyzer" to our spectrum 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.

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

The fourth line of our 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.

Before we end the program, we return the spectrum 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.

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

The finished program is shown below. Note the quotation marks that contain spectrum analyzer commands in each line. All spectrum analyzer commands must be contained in quotation marks. Also note the semicolons at the end of each line. Semicolons are 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.

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

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

Fundamentals

Modifying the Program

Remote operation of the spectrum 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 HP 8590A 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.

First, we can set the center frequency to 300 MHz. The CF command corresponds to the [CENTER FREQ] softkey on the analyzer. (All spectrum 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 spectrum 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;"
```

The finished program is shown below:

```
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
```

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

Fundamentals

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.

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.

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 following program, the "!" allows the words that follow to be ignored by the computer. Thus, they serve as comments in the program.

```
10  !FILE: "VAR10"
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(MHz)?",Center_freq
80   !ask for the desired span:
90  INPUT "SPAN(MHz)?",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
```

Getting Information from the Analyzer

The first part of this chapter demonstrated techniques for setting spectrum 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.

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 spectrum 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.

Fundamentals

Then, 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 ... MHz"
```

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

The modified program is shown on the next page:

Fundamentals

```
10 !FILE: "MKR"
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;" MHz"
270  !set the analyzer to continuous sweep mode:
280 OUTPUT Analyzer;"CONTS;"
290 LOCAL 7
300 END
```

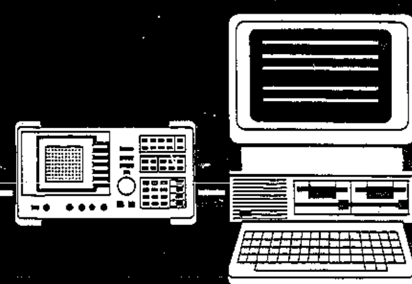
Programming Guidelines

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 spectrum analyzer functions.
3. Use variables for function values. List variables at the beginning of the program.
4. Activate spectrum analyzer functions in logical order. Place quotation marks around spectrum 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.

Fundamentals

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 are written in HP BASIC 4.0, using an HP Series 200 Computer. 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.

Advanced

Controlling Trace Data With a Computer

The spectrum 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 HP 8590A Spectrum Analyzer and stores the trace data in a variable.

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.

The new program is shown on the following page.

```
10 !FILE: "RTRACE"
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
```

Saving Trace Data

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

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.

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.)

Advanced

```
10 !FILE: "STRACE"
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
```

Reading Trace Data from a Computer Disc

If we want to return the trace data back to the spectrum 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 the variable Trace_a(*).

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.

```
10 !FILE: "GTRACE"
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 ENDts*
```

Saving and Recalling Instrument States

The spectrum 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 spectrum analyzer.

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

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Saving the Analyzer's State

The following program reads a trace from the spectrum analyzer and stores it in a 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 spectrum 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 HP 8590A 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 terminated. (EOI and line-feed are item terminators, and early termination will result in unpredictable behavior of the analyzer.) "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.

```
10 !FILE: "SSTATE"
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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Returning the Analyzer to its Former State

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

First, the settings of the spectrum analyzer 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" comand to format the trace data.

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```
10 !FILE: "PSTATE"
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
```

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Measuring Harmonic Distortion

The harmonic distortion program presented here illustrates how the spectrum 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. The following program measures percent of total harmonic distortion automatically, quickly, and accurately.

The program operates as if we were to make the measurement manually. The program prompts the operator to connect a source to the spectrum analyzer RF INPUT and enter the source frequency. It sets the spectrum 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. Extensive annotation has been added (behind the exclamation points) to help you understand the program.

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

```
10 !FILE: "THD_TEST"
20  ASSIGN @Sa TO 718   !assign IO path to spectrum 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 RF INPUT ON ANALYZER, 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 MHz span:
230 OUTPUT @Sa;"CF ";Fundamental;"MZ;"
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
410  !make the fundamental frequeny the center freq step size:
420 OUTPUT @Sa;"MKSS;"
430  !set the fundmental 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 MHz
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)
```

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

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Chapter 4

Programming Commands

What You'll Learn in This Chapter

This chapter is a reference for the HP 8590A command language. In this chapter are descriptions of each command recognized by the HP 8590A 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 Command Compatibility
- 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.

Figure 4-1

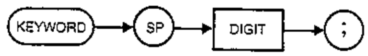


Figure 4-2

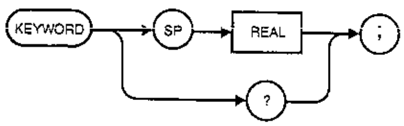


Figure 4-3

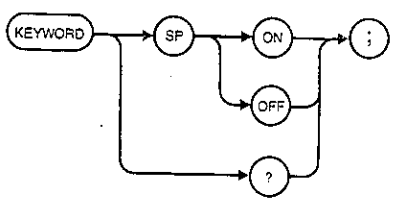


Figure 4-4

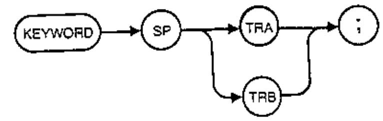


Figure 4-5

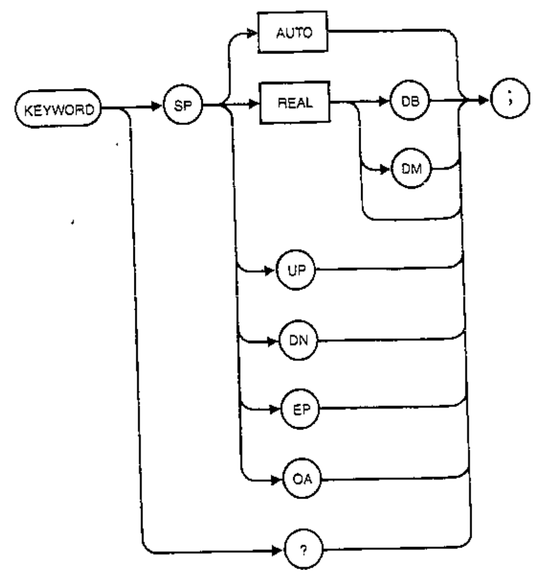


Figure 4-6

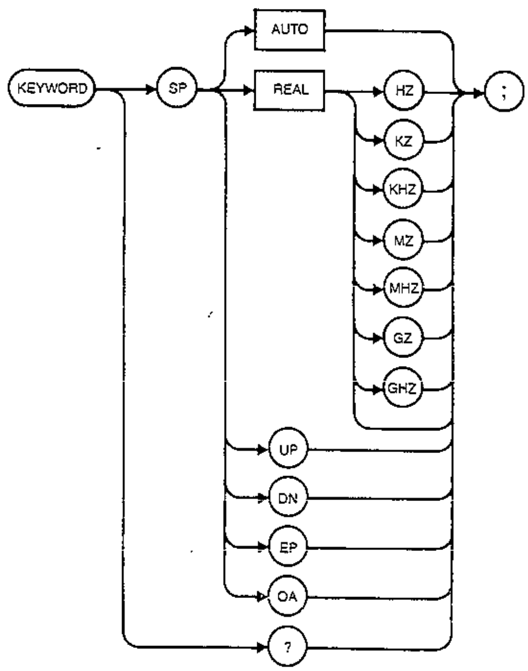


Figure 4-7

Table 4-1. Command Syntax Summary

Command	Syntax Diagram
AMB	Figure 4-4
AMBPL	Figure 4-1
APB	Figure 4-1
ANNOT	Figure 4-4
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
CNF	Figure 4-1
CONTS	Figure 4-1
DET	See Command Description
DL	Figure 4-6
DONE	Figure 4-1
DSPLY	See Command Description
EE	Figure 4-1
EK	Figure 4-1
EM	Figure 4-1
FA	Figure 4-7
FB	Figure 4-7
FFT	See Command Description
FOFFSET	See Command Description
GRAT	Figure 4-4

Table 4-1. Command Syntax Summary (continued)

Command	Syntax Diagram
HD	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 4-3
MKCF	Figure 4-1
MKD	Figure 4-7
MKF	Figure 4-7
MKMIN	Figure 4-1
MKN	Figure 4-7
MKNOISE	Figure 4-4
MKOFF	See Command Description
MKPAUSE	Figure 4-3
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

Commands

Table 4-1. Command Syntax Summary (continued)

Command	Syntax Diagram
M4	Figure 4-7
OL	Figure 4-1
PA	See Command Description
PD	Figure 4-1
PEAKS	See Command Description
PLOT	See Command Description
PR	See Command Description
PRINT	Figure 4-1
PU	Figure 4-1
RB	Figure 4-7
RC	Figure 4-2
REV	Figure 4-1
RL	Figure 4-6
ROFFSET	See Command Description
RQS	Figure 4-3
SNGLS	Figure 4-1
SP	Figure 4-7
SRQ	Figure 4-2
SS	Figure 4-7
ST	See Command Description
SV	Figure 4-2
TA	Figure 4-1
TB	Figure 4-1
TDF	See Command Description
TEXT	See Command Description
TH	Figure 4-6
TITLE	See Command Description

Table 4-1. Command Syntax Summary (continued)

Command	Syntax Diagram
TM	See Command Description
TRA/TRB	See Command Description
TS	Figure 4-1
TWNDOW	See Command Description
VAVG	See Command Description
VB	Figure 4-7
VBR	See Command Description
VIEW	Figure 4-5

Table 4-2. Syntax Elements Enclosed in Rectangles

Element	Description
A-Block Data Field	Absolute block data field consisting of #, A, Length, and Command List.
Average Length	Integer representing maximum number of sweeps executed for computing average.
Command List	Alphanumeric character comprising any spectrum analyzer command. ASCII characters 0 through 255
Data Bytes	8-bit bytes representing command list.
Delimiter	String Delimiter ! " $ % & ' / : = @
Detector Mode	Detection mode specifier. See command description for DET.
I-Block Data Field	Indefinite block data field consisting of #, I, Command List, and END.
Length	Two 8-bit bytes specifying length of command list in A-Block Data Field, in 8-bit bytes. The most significant byte is first: MSB LSB.

Table 4-2. Syntax Elements Enclosed in Rectangles (continued)

Element	Description
Measurement-Variable Identifier	Alpha characters representing instrument identifiers, such as CF or MA.
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, B, or a user-defined trace.

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

Element	Description
ALL	all
AMP	amplitude
AUTO	auto couple
B	8-bit byte
DB	decibel (unit)
DBM	absolute decibel milliwatt (unit)
DBMV	decibel millivolt
DBUV	decibel microvolt
DM	absolute decibel milliwatt (unit)
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)

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

Element	Description
NH	next highest
NL	next left
NR	next right
OA	output active. Returns the value of the active function.
OFF	turn function off
ON	turn function on
PER	period
POS	postive 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
UV	microvolts (unit)
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.

Table 4-4. Summary of Compatible Commands

The alternate commands (Alt. Comm.) listed in the left-hand column are provided to allow for backward compatibility with commands in the HP 8566A/B, HP 8568A/B, and HP 71000 instruments. The equivalent HP 8590A commands are listed in the right-hand column.

Alt. Comm.	Description	HP 8590A 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	coupled input attenuation	AT AUTO
CR	coupled resolution bw	RB AUTO
CS	coupled step size	SS AUTO
CT	coupled sweep time	ST AUTO
CV	coupled video bw	VB AUTO
C1	A − B off	AMB OFF
C2	A − B on	AMB ON

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

Alt. Comm.	Description	HP 8590A Command
EX	exchange trace A and B	AXB
E1	peak search	MKPK HI
E2	enter marker 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
KSB	dBmV amplitude units	AUNITS
KSC	dBμV amplitude units	AUNITS
KSD	Volt amplitude units	AUNITS
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
KSm	graticule off	GRAT OFF
KSo	annotation on	ANNOT ON
KSp	annotation off	ANNOT OFF
LO	display line off	DL OFF

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

Alt. Comm.	Description	HP 8590A Command
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	TDF
O2	output format	TDF
O3	output format	TDF
O4	output format	TDF
SAVES	save state	SV
S1	sweep continuous	CONTS
S2	sweep single	SNGLS
T0	threshold off	TH OFF
T1	trigger mode free run	TM
T2	trigger mode line	TM
T3	trigger mode external	TM
T4	trigger mode video	TM

Table 4-5. Functional Index

This functional index categorizes the HP 8590A 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
	Amplitude 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 and resolution bandwidth

Table 4-5. Functional Index (continued)

Command	Description
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

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
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	turns on beam to view vector
PR	draws vector from last absolute position (plot relative)
PRINT	prints screen data
PU	turns off beam, blanking vector
TEXT	writes text string to screen at current pen position
TITLE	writes text string to top line of analyzer screen

Table 4-5. Functional Index (continued)

Command	Description
Information and Service Diagnostic Commands	
ID	returns the HP model number of the analyzer used (HP 8590A)
REV	returns the analyzer revision number
RQS	provides the decimal weighting of service request mask bits which are enabled for service requests
SRQ	sets service request
Input/Output Commands	
EE	enables front-panel number entry
EK	enables front-panel knob control
DONE	sends a message to controller after preceding commands are executed
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
TA	trace A output control

Table 4-5. Functional Index (continued)

Command	Description
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
RC	recall state
SV	save state
	Marker Commands
MA	returns marker amplitude
MF	returns marker frequency
MKA	specifies amplitude of active marker, returns maker amplitude value
MKCF	enters marker frequency into center frequency
MKD	moves delta marker to specified frequency
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)

Table 4-5. Functional Index (continued)

Command	Description
MKNOISE	returns average value at marker, normalized to 1 Hz bandwidth
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

Table 4-5. Functional Index (continued)

Command	Description
	Plotter/Printer 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
TA	trace A output
TB	trace B output
TRA/TRB	trace data input/output control
TWNDOW	specifies trace window for FFT
VIEW	views specified trace register

Table 4-5. Functional Index (continued)

Command	Description
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
~~BML~~ BL	B − DL into B
VAVG	turns video average on or off

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 futher 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.

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

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

Note: The functions of the AMB and C2 commands and the [A − B → A] softkey are identical.

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 difference and sends the difference to trace A.

Syntax: See Figure 4-1

Example: `OUTPUT 718;"AMBPL;"`

ANNOT

Annotation

Description: The ANNOT command turns on or off all the words and numbers (annotation) on the analyzer screen. 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.

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 RF input attenuation from 0 to 60 dB, in 10-dB steps. Normally, the input attenuator is coupled 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 dBm. 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 change. If the attenuation is decreased from the coupled value using the AT command, the reference level will be increased. 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 is coupled.

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.

Syntax: See Figure 4-6

Example:

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

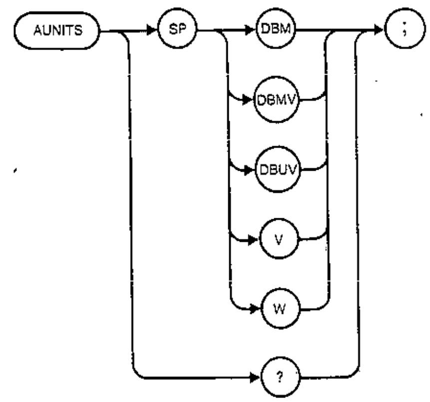
Line 10 sets the attenuation to 40 dB. Line 20 sets the attenuation to 50 dB. Only direct entry of "AT 0DB;" will achieve 0-dB attenuation.

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; "AUNIT DBMV;"`

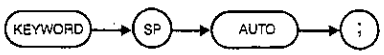
Note: Alternate commands allow you to set the amplitude units: KSA sets dBm units, KSB sets dBmV units, KSC sets dBμV units, and KSD sets volts.

AUTO

Auto Couple

Description: The AUTO command couples the attenuation (AT), step size (SS), sweep time (ST), resolution (RB) and video (VB) bandwidths to yield optimum amplitude accuracy. In addition, AUTO deactivates the display line (DL), threshold (TH), video averaging (VAVG), and markers. Individual functions can be coupled by entering the keyword for the command before AUTO (for example, "AT AUTO;").

Syntax:



Example: `OUTPUT 718;"AT AUTO;"`
`OUTPUT 718;"HD;AUTO;"`

The first line couples the attenuation. The second line couples all functions.

Note: Alternate commands allow you to couple individual functions: CR couples resolution bandwidth, CS couples step size, CT couples sweeptime, CV couples video bandwidth, CA and couples input attenuation. The functions of the AUTO command and the [AUTO COUPLE] key are identical.

AXB

Exchange Trace A and Trace B

Description: The AXB command exchanges trace A and trace B, point by point.

Syntax: See Figure 4-1

Example: `OUTPUT 718;"AXB;"`

Note: The functions of the AXB and EX commands and the [A EXCH B] softkey are identical.

BLANK

Blank Trace

Description: The BLANK command disconnects a trace from the input data source. The trace is not displayed.

Syntax: See Figure 4-5

Example: `OUTPUT 718;"BLANK TRA;"`

Note: The functions of the BLANK command and the [STORE BLANK A] and [STORE BLANK B] softkeys are identical.

BL

Trace B Minus Display Line

Description: The BL command subtracts the display line from trace B and sends the difference to trace B.

Syntax: See Figure 4-1

Example: `OUTPUT 718;"BL;"`

Note: The functions of the BL and BML commands and the [B − DL → B] softkey are identical.

CAL

Calibration

Description: The CAL command controls calibration functions. CAL initiates action according to the CAL parameters. The various parameters correspond to spectrum analyzer softkeys as shown below.

ON turns correction factors on and corresponds to [CORRECT ON off].

OFF turns correction factors off and corresponds to [CORRECT on OFF].

STORE saves the calibration data in the non-volatile memory of the analyzer and corresponds to [CAL STORE].

FETCH recalls the calibration data that was stored in the non-volatile memory of the analyzer and corresponds to [CAL FETCH]. It is a service function that should not be used without correct calibration data.

FREQ initiates the frequency calibration routine and corresponds to [CAL FREQ].

AMP initiates the amplitude calibration routine and corresponds to [CAL AMPTD].

DLY initiates the tuning delay calibration routine and corresponds to [CAL YTO DELAY].

ALL initiates frequency, amplitude, and tuning delay calibration routines.

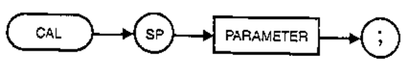
INIT clears all stored calibration data from the non-volatile memory of the analyzer and corresponds to [EEPROM INIT].

Note: When INIT is selected, the frequency, amplitude, and tuning delay calibration routines must be run again.

DBP displays calibration data on the analyzer screen and corresponds to [DISPLAY CAL DATA].

DUMP returns calibration data to the controller.

Syntax:



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

Note: See [CAL] under "Analyzer Functions" in the HP 8590A Operating Manual for more information.

CF

Center Frequency

Description: The CF command specifies the value of the center frequency, performing the same function as the [CENTER FREQ] softkey. When queried with OA or ?, CF returns the center frequency value as a real number followed by a carriage-return/line-feed.

Syntax: See Figure 4-7. The AUTO parameter does not apply.

Example: `OUTPUT 718;"CF 200MHZ;"`

CLRW

Clear Write

Description: The CLRW command starts a sequence of events. First, each element in the indicated trace is set to the bottom of screen. Then, new data from the detector is put in the trace with each sweep. Traces in CLRW mode are displayed on the spectrum analyzer screen.

Syntax: See Figure 4-5

Example: `OUTPUT 718;"CLRW TRA;"`

Note: The functions of the CLRW command and the [CLEAR WRITE A] and [CLEAR WRITE B] softkeys are identical. Alternate command A1 is identical to [CLEAR WRITE A] and B1 is identical to [CLEAR WRITE B].

CNF

Confidence Test

Description: The CNF command initiates a confidence test of the resolution bandwidth, video bandwidth, and step gain.

Syntax: See Figure 4-1

Example: `OUTPUT 718;"CNF;"`

Note: The functions of the CNF command and the [CONF TEST] softkey are identical.

CONTS

Continuous Sweep

Description: The CONTS command sets the analyzer to continuous sweep mode. In the continuous sweep mode, the analyzer takes its next sweep as soon as possible after the current sweep as long as the trigger conditions are met. A sweep may temporarily be interrupted by data entries made from the front panel or over the interface bus.

Syntax: See Figure 4-1

Example: `OUTPUT 718;"CONTS;"`

Note: The functions of the CONTS command and S1 commands and the [CONTS SWEEP] softkey are identical.

DET

Detection Mode

Description: The DET command selects the type of spectrum analyzer detection (positive peak or sample) and accesses service-diagnostic detection functions.

POS, the default detector mode, enables positive peak detection, which displays the maximum video signal excursions.

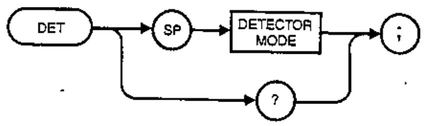
SMP enables sample detection, which displays the instantaneous signal value detected at the analyzer-to-digital converter output. Video averaging and noise-level markers, when activated, automatically activate sample detection.

Service Diagnostic Modes: The detector modes listed below are designed for troubleshooting and diagnostic tests of the HP 8590A. They are described in the HP 8590A Support Manual (HP Part Number 08590-90008), which is not supplied with the instrument. Contact your HP sales representative for more information.

AUXA, AUXB, BSPN, CDAC, DROOP, FDAC, FMD, FMSP, GND, MCD, MNSP, MTEN, PTEN, REF, SDAC, SWPR, XFIN.

When queried, DET returns the detection mode.

Syntax:



Example: `OUTPUT 718;"DET POS;"`
`OUTPUT 718;"DET SMP;"`

DL

Display Line

Description: The DL command defines the level of the display line in dBm and displays it on the analyzer screen. Activating video trigger mode activates the display line. The AUTO command and DL OFF turn off the display line.

Syntax: See Figure 4-6

Example: `OUTPUT 718;"DL AUTO;"`

Note: Alternate command L0 turns off the display line. The functions of the DL command and the [DISPLAY LINE] softkey are identical.

DONE

Done

Description: The DONE command is a synchronizing function. When DONE follows a command list, it sends the controller a 1 after the command list is executed. The TS command may also be a synchronizing function. When preceded by a TS command, the command list is executed after the sweep has been completed. (The command list is defined as any spectrum analyzer command from this chapter.)

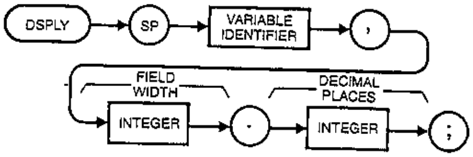
Syntax: See Figure 4-1

DSPLY

Display

Description: The DSPLY command displays the value of a variable anywhere on the spectrum analyzer display. Use the PU and PA commands to position the variable on the screen.

Syntax:



Field width specifies the number of digits displayed, including sign and decimal point. Places to the right of the decimal point are limited by places. For example, the number 123.45 has a field of 7, and 2 decimal places.

Example: `OUTPUT 718;"DSPLY P_OWER,6.3;"`

The DSPLY command allows the programmer to check the value of the P_OWER variable. The number, 6.3, is the total field width, 6, and the desired number of decimal places, 3.

EE

Enable Entry

Description: The EE command sends values entered by the operator on the spectrum analyzer number keyboard to the controller. Generally, the sequence of programmed events is as follows:

1. A program loop prevents the controller from using the entered value until the operator signals that the entry is complete.

2. The operator makes a DATA entry, which is stored in the analyzer internal data register.

3. The operator indicates completion of the entry.

4. The controller reads the value of the entry and continues to the next program step.

Syntax: See Figure 4-1

Example: The following program allows you to enter values on the spectrum analyzer. As values are entered, they appear on the computer screen. When 1 MHz is entered, "FINISHED" appears on the computer screen and the program is terminated.

```
10 ASSIGN @Sa TO 718
20 ON INTR 7 GOSUB Process_key
30 OUTPUT @Sa;"RQS 2;EE;"
40 ENABLE INTR 7;2
50 REPEAT
60  DISP "ENTER VALUE AND UNITS (ENTER 1MHZ
      TO EXIT)"
70 UNTIL New_value=1.E+6
80 OUTPUT @Sa;"HD;"!turn off active function
90 DISP "FINISHED"
100 STOP
110 !
120 Process_key:  !key process routine
130 A=SPOLL(@Sa)
140 IF BIT(A,1)=1 THEN
150  OUTPUT @Sa;"?;"
160  ENTER @Sa;New_value
170  PRINT "VALUE IS ";New_value
180  WAIT .1 !wait for value entry
190  OUTPUT @Sa;"EE;RQS 2;"
200  ENABLE INTR 7;2
210 ELSE !handle other interrupts here
220 END IF
230 RETURN
240 END
```

EK

Enable Knob

Description: The EK command allows data entry with the front-panel knob when the analyzer is under remote control. The knob is functional, but other front panel functions remain inoperative.

Syntax: See Figure 4-1

Example: While the program is paused, the operator positions a marker on a signal that needs further analysis. To provide time to turn the knob, pause the program after executing the EK command.

```
10 OUTPUT 718;"MKN;EK;"
20 PRINT "USE KNOB TO PLACE MARKER"
30 PRINT "PRESS CONTINUE WHEN DONE"
40 PAUSE
50 ! Analysis program inserted here
60 END
```

Press the CONTINUE key on the controller to resume program operation.

EM

Erase Graphics Memory

Description: The EM command blanks the spectrum analyzer screen in preparation for the display of custom graphics. Execute the following line to blank the analyzer screen:

```
OUTPUT 718;"EM;BLANK TRA;BLANK TRB;GRAT OFF;
TH OFF;DL OFF;"
```

To reinstate the analyzer display, execute the following program line:

```
OUTPUT 718;"EM;CLRW TRA;CLRW TRB;GRAT ON;ANNOT ON;"
```

Syntax: See Figure 4-1

Example: `OUTPUT 718;"EM;"`

FA

Start Frequency

Description: The FA command specifies the start frequency value, performing the same function as the [START FREQ] softkey. When queried (? or OA), FA returns the start frequency, a real number, followed by a carriage-return/line-feed. The End-or-identify state (EOI) is asserted.

Syntax: See Figure 4-7. The AUTO parameter does not apply.

Example: `OUTPUT 718;"FA 88MZ;"`

FB

Stop Frequency

Description: The FB command specifies the stop frequency value, performing the same function as the [STOP FREQ] softkey. When queried (? or OA), FB returns the stop frequency, a real number, followed by a carriage-return/line-feed. The End-or-identify state (EOI) is asserted.

Syntax: See Figure 4-7. The AUTO parameter does not apply.

Example: `OUTPUT 718;"FB 88MZ;"`

FFT

Fast Fourier Transform

Description: The FFT command performs a Discrete Fourier Transform on the source trace array and stores the logs of the magnitudes of the results in the destination array. The maximum length of any of the traces is 401 points.

If the analyzer is in logarithmic mode, the data in the source trace is assumed to be logarithmic and will be converted to linear before transformed with FFT. Next, the source array is weighted with the function in the window trace (described below) to minimize amplitude inaccuracies, side lobes, etc. Finally, the transform is computed and the results are placed in the destination array.

The FFT results are displayed on the spectrum analyzer in logarithmic scale. For the horizontal dimension, the frequency at the left side of the graph is 0 Hz, and at the right side is Fmax.

Fmax can be calculated using a few simple equations and the sweeptime of the analyzer. The sweeptime divided by the number of trace array elements containing amplitude information is equal to the sampling period. The reciprocal of the sampling period is the sampling rate. The sampling rate divided by two yields Fmax.

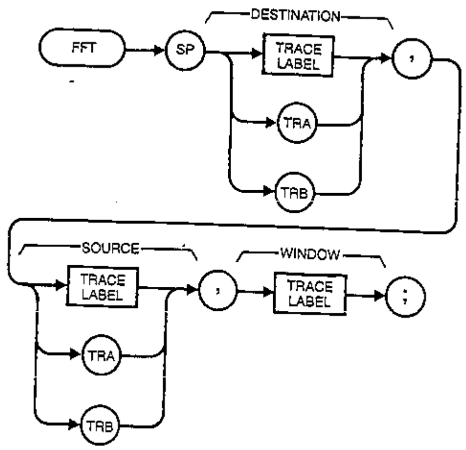
For example, let the sweep time of the analyzer be 20 ms and the number of trace elements be 400. 20 msec divided by 400 equals 50 μsec, the sampling period. The sample rate is 1/50 μsec. Fmax equals 1/50 μsec divided by 2, or 10 kHz.

FFT is designed to be used in transforming zero span information into the frequency domain. Performing FFT on a frequency sweep will not provide time domain results.

The windowing function stored in the window trace may be selected with the TRACE WINDOW (TWNDOW) command or by the user storing his own values in that trace. The values in the window trace range from −32768 to 32767 and are treated as fractional numbers. No offset is used. When FFT is called, the average window value is computed and used to correct the results in absolute units. Windowing is described under the TWNDOW command.

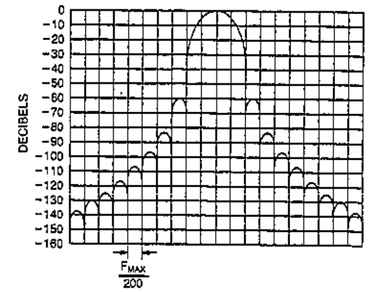
The Fourier transforms of the window functions (created with TWNDOW) are shown under "Filter Windows." Use the graphs to estimate resolution and amplitude uncertainty of a Fourier transform display. Each horizontal division of the graphs equals 1/sweep time or Fmax/200, and represents two trace array elements.

Syntax:

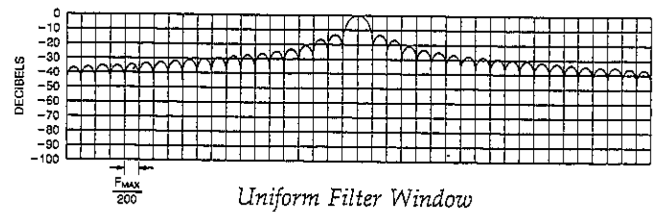


Commands

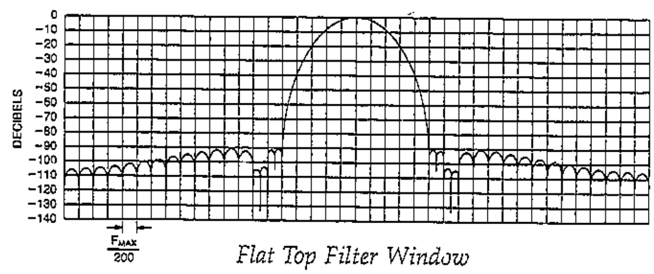
Filter Windows:



Hanning Filter Window



Uniform Filter Window



Flat Top Filter Window

Note: The [FFT MEAS] softkey initiates a routine that first selects sample-detection mode, takes a sweep, and stores and places trace A in view mode (DET SMP;TS;VIEW TRA). Then the routine sets the trace window to flattop (TWNDOW TRB,FLATTOP) and FFT is run (FFT TRA,TRA,TRB). Finally, markers are turned off, a marker is placed at the highest peak, the FFT marker-readout mode is set, and a normal marker is activated (MKOFF ALL; MKPK; MKREAD FFT;MKN).

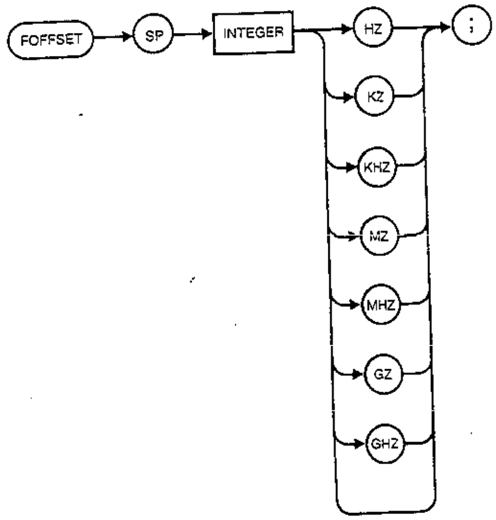
FOFFSET

Frequency Offset

Description: The FOFFSET command selects a value that offsets the frequency scale for all absolute frequency readouts (for example, center frequency). Relative values like span and delta marker are not offset.

After execution, the FOFFSET command displays the frequency offset in the active function readout. When offsets are in effect, they are displayed beneath the graticule line on the analyzer screen.

Syntax:



Example: `OUTPUT 718;"FOFFSET 100MZ;"`

This command adds 100 MHz to the readout of all frequencies except span.

Note: The functions of the FOFFSET command and the [FREQ OFFSET] softkey are identical.

GRAT

Graticule

Description: The GRAT command turns the graticule on and off. When queried (?), GRAT returns the graticule state: ON or OFF.

Syntax: See Figure 4-4

Example: `OUTPUT 718;"GRAT OFF;"`

Note: Alternate command KSm turns off the graticule and KSn turns it on. The functions of the GRAT command and the [GRAT ON OFF] softkey are identical.

HD

Hold Data Entry

Description: The HD command disables data entry via the front panel number keyboard and blanks the active function readout.

Syntax: See Figure 4-1

Example: `OUTPUT 718;"HD;"`

Note: The functions of the HD command and the [HOLD] key are identical.

ID

Identify

Description: The ID command returns the instrument identity to the controller (for example, HP8590A).

Syntax: See Figure 4-1

Example: The following program prints the instrument identifier on the computer screen.

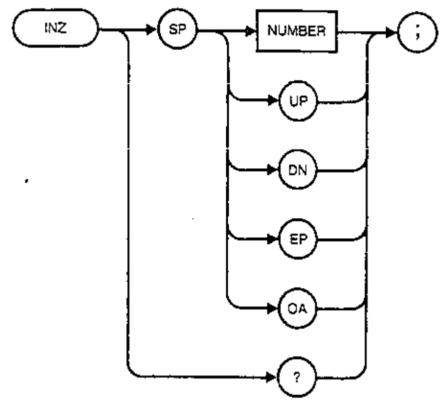
```
10 OUTPUT 718;"ID;"
20 ENTER 718;A
30 PRINTER IS 1
40 PRINT A
50 END
```

INZ

Input Impedance

Description: The INZ command is used for computation purposes during power/voltage conversions. The actual impedance can only be affected by internal hardware. The preset state is 50 ohms.

Syntax:



Example: `OUTPUT 718;"INZ 50;"`

Note: The functions of the INZ command and the [INPUT IMPEDNC] softkey are identical.

Commands

IP

Instrument Preset

Description: The instrument preset command, IP, executes the following commands:

AMB OFF: Turns off A − B mode.
ANNOT ON: Turns on annotation.
AUNITS DBM: Selects dBm amplitude units.
AUTO: Couples RB, AT, SS, ST, and VB. Turns off display line and threshold.
BLANK B: Blanks trace B.
CLRW A: Clears and writes trace A.
CONTS: Selects continuous sweep.
DET POS: Selects positive peak detection.
FA: Sets the start frequency. (0 MHz)
FB: Sets the stop frequency. (1500 MHz)
FOFFSET: 0
HD: Hold (Deactivates active function.)
GRAT ON: Turns on the graticule.
LG: Selects 10 dB/DIV log scale.
MDS W: Selects data size of one word, which is two 8-bit bytes.
MKNOISE OFF: Turns off noise markers.
MKOFF: Turns off all markers.
MKPAUSE OFF: Turns off marker pause mode.
MKPX: 6 dB minimum excursion for peak identification.
MKTRACK OFF: Turns off marker tracking.
ML: −10 dBm

PD: Puts pen down at current position.
RL: 0 dBm
ROFFSET: 0
R3: Allows SRQ 110.
STATUS BYTE: clear
SS: 100 MHz step size
TH: one division above bottom graticule line
TITLE: clear
TM FREE: Selects free run trigger mode.
TDF P: Selects parameter units output format.
VAVG OFF: Turns off video averaging.
VAVG LIMIT: 100

Instrument preset automatically occurs when you turn on the analyzer, and is a good starting point for many measurement processes. When IP is executed remotely, the analyzer does not necessarily execute a complete sweep.

Syntax: See Figure 4-1

Example: `OUTPUT 718;"IP;TS;"`

Commands

LG

Logarithmic Scale

Description: The LG command specifies the vertical graticule divisions as logarithmic units without changing the reference level. The vertical scale may be specified (in integers) between 1 and 20 dB per graticule division. When queried, LG returns the dB/division value. If "LG?;" returns 0, then the analyzer is in linear mode.

Syntax: See Figure 4-6

Example: `OUTPUT 718;"LG 1DB;"`

Note: The functions of the LG command and the [LOG dB/DIV] softkey are identical.

LN

Linear Scale

Description: The LN command selects the LINEAR mode of operation and scales the amplitude (vertical graticule divisions) proportionally to the input voltage, without changing the reference level. The bottom graticule line represents a signal level of zero volts.

Voltage entries are rounded to the nearest 0.1 dB. Thus, 30 mV become 30.16 mV, which equals −17.4 dBm.

Syntax: See Figure 4-1

Example:
```
OUTPUT 718;"LN;"
OUTPUT 718;"LN;RL 30MV;"
```

Note: The functions of the LN command and the [LINEAR] softkey are identical.

Commands

MA

Marker Amplitude Output

Description: If the marker is on the screen, the MA command returns the amplitude level of the active marker to the controller. If both the delta marker and active marker are on the screen, MA returns the amplitude difference between the two markers. The marker amplitude is also displayed in the upper-right corner of the analyzer screen.

Syntax: See Figure 4-1

Example: MA is used in the following program to determine the amplitude value of the marker.

```
10 PRINTER IS 701
20 OUTPUT 718;"IP;SNGLS;"
30 OUTPUT 718;"FA 80MZ;FB 120MZ;TS;"
40 OUTPUT 718;"MKN;MKPK;"
50 OUTPUT 718;"MA;"
60 ENTER 718;A
70 PRINT A
80 END
```

Line 30 sets the start and stop frequencies. Line 40 activates a normal marker and peak search. Line 60 returns the amplitude to the controller. Lines 60 and 70 assign the amplitude to variable A and print the amplitude.

An ENTER command must follow each output command or output data will be lost.

MDS

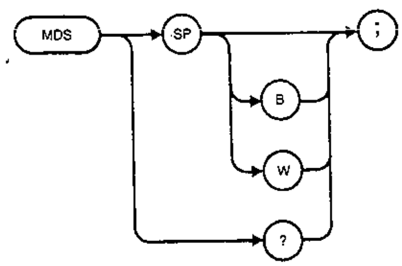
Measurement Data Size

Description: The MDS command formats binary measurements:

B selects a data size of one 8-bit byte.

W selects a data size of one word, which is two 8-bit bytes.

Syntax:



Example: `OUTPUT 718;"TDF B;MDS W;TRA?"`

These commands transfer trace A in binary, 2 bytes per word.

MF

Marker Frequency Output

Description: If the marker is on the screen, the MF command returns the frequency level of the active marker to the controller. If both the delta marker and active marker are on the screen, "MF?;" returns the frequency difference between the two markers. In zero span, "MF?;" returns the marker time.

Syntax: See Figure 4-1′

Example: MF is used in the following program to determine the frequency value of the marker.

```
10 PRINTER IS 701
20 OUTPUT 718;"IP;SNGLS;"
30 OUTPUT 718;"FA 80MZ;FB 120MZ;TS;"
40 OUTPUT 718;"MKN;MKPK;"
50 OUTPUT 718;"MF;"
60 ENTER 718;A
70 PRINT A
80 END
```

Line 40 sets the start and stop frequencies. Line 50 activates a normal marker and peak search. Line 60 returns the amplitude to the controller. Lines 70 and 80 assign the amplitude to variable A and print the amplitude.

An ENTER command must follow each output command, or output data is lost.

MKA

Marker Amplitude

Description: The MKA command specifies the amplitude of the active marker in dBm when the marker is the fixed or amplitude type. (See MKTYPE.) When queried, MKA returns the marker amplitude as a real number.

Syntax: See Figure 4-3

Example:

```
10 OUTPUT 718;"MKA?;"
20 ENTER 718;A
```

"A" will contain the amplitude value of the marker.

MKCF

Marker to Center Frequency

Description: The MKCF command sets the center frequency equal to the marker frequency and moves the marker to the center of the screen.

Syntax: See Figure 4-1

Example: `OUTPUT 718;"MKCF;"`

Note: The functions of the MKCF and E2 commands and the [MARKER → CF] softkey are identical.

Commands

MKD

Marker Delta

Description: The MKD function computes the frequency and amplitude difference between the active marker and the delta marker. These values are displayed on the analyzer screen.

If a delta marker is not on the screen, MKD places one at the specified frequency, or at the current active marker. If an active marker is not on the screen, MKD positions an active marker at center screen.

When queried (?), MKD returns the frequency difference between the delta and active marker. In zero span, MKD returns amplitude and time differences.

Syntax: See Figure 4-7

AUTO parameter turns markers off.

Example: `OUTPUT 718;"MKD;"`

Note: The functions of the MKD and M3 commands and the [MARKER DELTA] softkey are identical.

MKF

Marker Frequency

Description: The MKF command specifies the frequency value of the active marker. When queried, MKF returns the active marker frequency as a real number. In zero span, "MKF?;" returns the time values.

Syntax: See Figure 4-7. The UP and DOWN parameters do not apply.

MKMIN

Marker Minimum

Description: The MKMIN command moves the active marker to the minimum value detected.

Syntax: See Figure 4-1

Example: `OUTPUT 718;"MKMIN;"`

MKN

Marker Normal

Description: The MKN command activates and moves the marker to the specified frequency. "MKN?;" will return the frequency value. In zero span, "MKN?;" will return time values.

Syntax: See Figure 4-7. The AUTO parameter turns markers off.

Example: `OUTPUT 718;"MKN 300MHZ;"`

Note: The functions of the MKN and M2 commands and the [MARKER NORMAL] softkey are identical.

MKNOISE

Marker Noise

Description: The MKNOISE command displays the average noise level at the marker. The value is normalized to a 1-Hz bandwidth. When queried, MKNOISE returns ON or OFF.

Syntax: See Figure 4-4

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

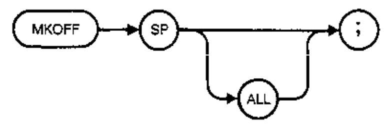
Note: The functions of the MKNOISE and KSM commands and the [MKNOISE on OFF] softkey are identical.

MKOFF

Marker Off

Description: The MKOFF command turns off either the active marker or all markers displayed on the screen. If the ALL parameter is omitted, only the active marker is turned off.

Syntax:



Example: `OUTPUT 718;"MKOFF ALL;"`

Note: The functions of the MKOFF and M1 commands and the [MARKERS OFF] softkey are identical.

Commands

MKPAUSE

Marker Pause

Description: The MKPAUSE command pauses the sweep at the active marker for the duration of the delay period. The "real" parameter refers to the delay period from 0 to 100 seconds. To turn pause off, turn off markers (or, send "MKPAUSE 0;").

Syntax: See Figure 4-3

Example: `OUTPUT 718;"MKPAUSE 100;"`

Note: The functions of the MKPAUSE command and the [MARKER PAUSE] softkey are identical.

MKPK

Marker Peak

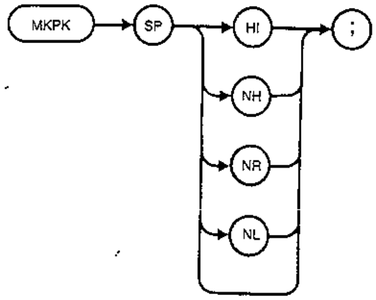
Description: The MKPK command positions the active marker on signal peaks. Executing MKPK HI, or simply MKPK, positions the active marker at the highest signal detected. If an active marker is on the screen, the parameters move the marker accordingly.

NH (next highest) moves the active marker to the next signal peak of lower amplitude.

NR (next right) moves the active marker to the next signal peak of higher frequency.

NL (next left) moves the active marker to the next signal peak of lower frequency.

Syntax:



Note: Alternate command E1 positions the marker at the highest signal peak. The functions of the MKPK HI command and the (PEAK SEARCH) key are identical. The MKPK parameters correspond to the [NEXT PEAK], [NEXT PK RIGHT], and [NEXT PK LEFT] softkeys.

Commands

MKPX

Marker Peak Excursion

Description: The MKPX command specifies the minimum signal excursion for the analyzer's internal peak-identification routine. When queried with ?, MKPX returns the excursion value.

Syntax: See Figure 4-6

Example: `OUTPUT 718;"MKPX 8DB;"`

Note: The functions of the MKPX command and the [PEAK EXCURSN] softkey are identical. (See MKPK and PEAKS.)

MKRL

Marker to Reference Level

Description: The MKRL command sets the reference level to the amplitude value of the active marker.

Syntax: See Figure 4-1

Example: `OUTPUT 718;"MKRL;"`

Note: The functions of the MKRL and E4 commands and the [MARKER → RL] softkey are identical.

MKSP

Marker to Span

Description: The MKSP command sets the start and stop frequencies to the values of the delta markers. (See MKD.) The left marker specifies start frequency, and the right marker specifies stop frequency. If MKD is off, there is no operation.

Syntax: See Figure 4-1

Example: `OUTPUT 718;"MKSP;"`

Note: The functions of the MKSP and KSO commands and the [MRK Δ → SPAN] softkey are identical.

MKSS

Marker Step Size

Description: The MKSS command sets the center frequency step size to the frequency of the active marker. If in delta mode, the step size becomes the delta frequency (absolute value).

Syntax: See Figure 4-1

Example: `OUTPUT 718;"MKSS;"`

Note: The functions of the MKSS and E3 commands and the [MARKER → STEP] softkey are identical.

MKTRACK

Marker Track

Description: The MKTRACK command moves the signal with an active marker to the center of the screen and fixes the signal there. To keep a drifting signal at center screen, place the active marker on the desired signal before executing MKTRACK.

Syntax: See Figure 4-4

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

Note: The functions of the MKTRACK command and the [SIGNAL TRACK] key are identical. Alternate command MT0 turns marker track off, and MT1 turns it on.

MKTYPE

Marker Type

Description: The MKTYPE command specifies the type of marker.

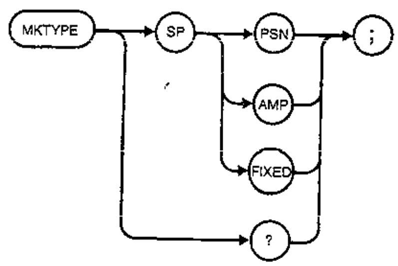
AMP allows markers to be positioned according to amplitude, as shown in the example.

Commands

PSN allows markers to be positioned according to the horizontal position on the display.

FIXED allows a marker to be placed at any fixed point on the analyzer screen.

Syntax:



Example: `OUTPUT 718;"MKTYPE AMP;MKA -3;"`

Note: The functions of the MKTYPE AMP and the [MARKER AMPTD] softkey are identical.

ML

Mixer Level

Description: The ML command specifies the maximum signal level that is applied to the input mixer for a signal that is equal to or below the reference level.

The effective mixer level is equal to the reference level minus the input attenuator setting. When ML is activated, the effective mixer level can be set from −10 dBm to −60 dBm in 10-dB steps. IP selects −10 dBm.

Syntax: See Figure 4-6

Example: `OUTPUT 718;"ML -40DM;"`

As the reference level is changed, the coupled input attenuator automatically changes to limit the maximum signal at the mixer input to −40 dBm for signals less than or equal to the reference level.

Note: The functions of the ML and KSO commands and the [MAX MXR LEVEL] softkey are identical. (Also see AT.)

MXMH

Maximum Hold

Description: While the trace is active and displayed, the MXMH command updates each trace element with the maximum level detected.

Syntax: See Figure 4-5

Example: `OUTPUT 718;"MXMH TRA;"`

Note: The functions of the MXMH TRA and A2 commands and the [MAX HOLD A] softkey are identical. The functions of the MXMH TRB and B2 commands and the [MAX HOLD B] softkey are identical.

M4

Marker Zoom

Description: The M4 command activates a single marker at center frequency. The knob changes the position of the marker and the step keys change the frequency span: the center frequency is set to the value of the marker frequency with each press of the step keys.

Syntax: See Figure 4-7

Example: `OUTPUT 718;"M4;"`

OL

Output Learn String

Description: The OL command transmits information to the controller that describes the state of the analyzer when the OL command is executed. This information is called the learn string. The learn string can be sent from the controller back to the analyzer to restore the analyzerto is original state.

The learn string requires 114 bytes of storage space as is shown in Chapter 3, "Advanced Programming." (See "Saving States" in Chapter 3.)

Syntax: See Figure 4-1

Example: `OUTPUT 718;"OL;"`

PA

Plot Absolute

Description: The PA command specifies in display units a vector location on the analyzer screen relative to reference coordinates 0,0. The vector is drawn on the screen if the pen-down (PD) command is in effect. If the pen-up (PU) command is in effect, the vector does not appear on the screen.

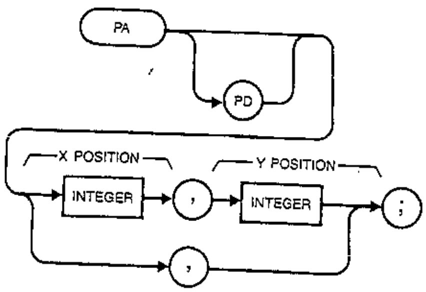
Commands

The lower-left coordinate corresponds to (Xmin, Ymin) and the upper-right coordinate corresponds to (Xmax, Ymax).

Screen Coordinates:
(Xmin, Ymin) = (−40, −22)
(Xmax, Ymax) = (471, 233)

Graticule Coordinates:
(Xmin, Ymin) = (0,0)
(Xmax, Ymax) = (400,200)

Syntax:



Example:

```
10 OUTPUT 718;"IP;BLANK TRA;"
20 OUTPUT 718;"ANNOT OFF;GRAT OFF;"
30 OUTPUT 718;"PU;"
40 OUTPUT 718;"PA 100,100;PD 100,150;"
50 OUTPUT 718;"150,150,150,100,100,100;"
60 END
```

Line 20 clears the display. Line 30 specifies PU, which prevents the initial vector from being drawn. Line 40 specifies the starting point of the rectangle to be drawn by the program. The PD command causes a vector to be drawn on the screen according to the coordinates specified in the program. Line 50 gives the coordinates for the remaining points of the rectangle.

PD

Pen Down

Description: The PD command drawns one or more vectors on the analyzer screen. The PA command, plot absolute, may be used to mark the starting point of the vector. PD may be used to drop the pen just as PU is used to lift the pen.

Syntax: See Figure 4-1

PEAKS

Peaks

Description: The PEAKS command sorts signal peaks by frequency or amplitude, stores the results in the destination trace, and returns the number of peaks found.

When sorting by frequency, PEAKS first computes the horizontal position of all peaks. These positions are consecutively loaded into the destination trace, the lowest value occupying the first element. Thus, signal frequencies, from low to high, determine the amplitude of the distination trace from left to right.

When sorting by amplitude, PEAKS first computes the amplitudes of all peaks in the source trace in measurement units, and sorts these values from high to low.

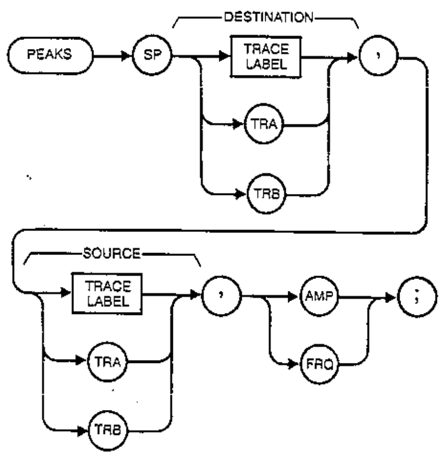
Commands

The positions of the peaks are then loaded into the destination trace, with the position of the highest value occupying the first element. PEAKS sorts only signals that are above the threshold value. To change the threshold, use the TH command before PEAKS is executed.

If necessary, the last sorted value is repeated to fill remaining elements of the destination trace.

To be classified as a signal peak, a signal must be MKPX above the threshold value and rise and fall the MKPX dB value.

Syntax:



Commands

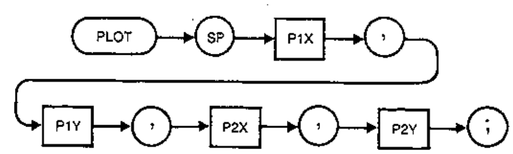
PLOT

Plot

Description: The trace data, graticule, and annotation of the analyzer's screen can be directly transferred to a plotter via the analyzer's interface. PLOT immediately initiates a plotter dump of the screen data to the specified plotter.

When using the PLOT command, the scaling points (P1x, P1y, P2x, P2y) must be specified. These scaling points specify the (x,y) coordinates which determine the size of the plot. (P1x,P1y) refers to the lower-left plotter dimension. (P2x,P2y) refers to the upper-right plotter dimension.

Syntax:



Commands

Note: The functions of the PLOT command and the [PLOT] key on the front of the analyzer are identical. Specify the plotter by pressing [CONFIG] and [PLOTTER ADDRESS] and entering an address.

Example: The following computer program is used to plot analyzer data. The plotter is at address 05 and the analyzer is at address 18. (The program is only valid for HP 200 and 300 series computers.)

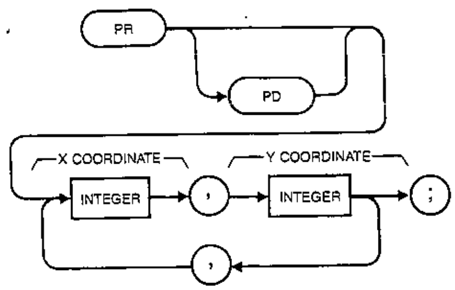
```
10 DIM P$[80]
20 OUTPUT 705;"OP;"
30 ENTER 705;P$
40 OUTPUT 718;"PLOT";P$
50 SEND 7;LISTEN 5 TALK 18 DATA
60 END
```

PR

Plot Relative

Description: The PR command specifies a plot location on the analyzer screen relative to the last plot point coordinates. Vector coordinate sets (x,y pairs) following the PR command can be either positive or negative, depending on the direction of the individual vectors to be drawn. PU (pen up) and PD (pen down) commands tell the analyzer to draw or not draw the vectors on the screen. (See the PU command.)

Syntax:



Commands

Example:

```
10 OUTPUT 718;"PU;PA 0,100;"
20 OUTPUT 718;"PD;PR 100,0,0,-100,-100,
  0,0,100;"
```

PD (pen down) tells the analyzer to display the vectors drawn in accordance with the vector coordinates (x,y pairs) that follow the PR command. Vectors are drawn to the four corners of a rectangle.

PRINT

Print

Description: The PRINT command initiates a print dump of the screen data to the specified printer.

Syntax: See Figure 4-1

Example: The following program is used to print analyzer data. The printer address is 1 and the plotter address is 18. (The program is only valid for HP 200 and 300 series computers with an HP raster graphics printer, such as the HP Thinkjet.)

```
10 OUTPUT 718;"PRINT;"
20 SEND 7;LISTEN 1 TALK 18 DATA
```

Note: The functions of the PRINT command and the [PRINT] key on the front of the analyzer are identical. Specify the printer by pressing [CONFIG], [PRINTER ADDRESS], and entering an address.

PU

Pen Up

Description: The PU command blocks the spectrum analyzer's beam to prevent plot vectors from being displayed on the analyzer screen.

Syntax: See Figure 4-1

RB

Resolution Bandwidth

Description: The RB command specifies the resolution bandwidth. Available bandwidths are 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, and 3 MHz. The resolution bandwidths, video bandwidths, and sweep time are normally coupled. Executing RB uncouples the resolution bandwidth from span. Execute RB AUTO to re-establish coupling. (Also see AUTO.)

Syntax: See Figure 4-7

Example: `OUTPUT 718;"RB 1KHZ;"`

Note: The functions of the RB command and the [RES BW] softkey are identical.

RC

Recall State

Description: The RC command recalls spectrum analyzer states from the nine state registers.

Syntax: See Figure 4-2

Example: `OUTPUT 718;"RC 3;"`

Note: The functions of the RC command and the [RECALL] key are identical.

REV

Revision

Description: The REV command returns the firmware revision number and HP date code (for example, 860910 indicates September 10, 1986). The firmware revision number and HP date code also appear when the instrument is first turned on.

Syntax: See Figure 4-1

Example: The following program prints the revision date on the computer screen.

```
10 OUTPUT 718;"REV;"
20 ENTER 718;A
30 PRINTER IS 1
40 PRINT A
50 END
```

Commands

RL

Reference Level

Description: The RL command specifies the amplitude value of the top graticule on the screen, which is called the reference level.

The reference level can be specified from −139.9 dBm to +50 dBm. The reference level and input attenuator are coupled to prevent gain compression. Signals with peaks at or below the reference level are not affected by gain compression.

CAUTION

Signal levels above +30 dBm will damage the spectrum analyzer.

Syntax: See Figure 4-6

Example: `OUTPUT 718;"RL -10DM;"`

Note: The functions of the RL command and the reference level function (accessed when [AMPLITUDE] is pressed) are identical.

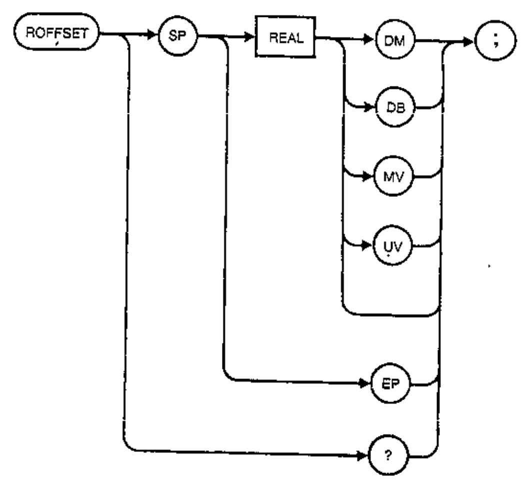
ROFFSET

Reference Level Offset

Description: The ROFFSET command offsets all amplitude readouts on the screen without affecting the trace. Once activated, the ROFFSET command displays the amplitude offset in the active function block. And, as long as the offset is in effect, the offset is displayed on the left side of the screen.

Entering "ROFFSET 0" eliminates an amplitude offset.

Syntax:



Commands

Example: `OUTPUT 718;"ROFFSET -12DM;"`

Note: The functions of the ROFFSET and KSZ commands and the [REF LVL OFFSET] softkey are identical.

RQS

Service Request Mask

Description: The RQS sets a bit mask for service requests. (See SRQ.) Each bit in the status byte is defined as follows:

1 indicates the units key was pressed and "SRQ 102" appears on the analyzer screen. (If you activate the units key bit, it will remain active until you activate EE and press a units key. See EE.)

2 indicates end of sweep and "SRQ 104" appears on the analyzer screen. (If you send any RQS value that contains mask value 4, another sweep will be taken. See example.)

3 indicates broken hardware and "SRQ 110" appears on the analyzer screen.

4 indicates completion of a command. It is triggered by EOI at the end of a command string or the completion of a print or plot.

5 indicates an illegal analyzer command was used and "SRQ 140" appears on the analyzer screen.

6 is used to poll instruments on the HP-IB bus to determine the origin of a service request.

0 (LSB) and 7 are not used.

Syntax: See Figure 4-3. The real value represents the bit mask for the service request.

Example: Assignment of values for the mask is as follows:

Illegal command	=	32
Command complete	=	16
Hardware broken	=	8
End of sweep	=	4
Units key pressed	=	2

To send a mask with hardware broken and end of sweep, the mask is equal to 10 (8 + 2).

Send: `OUTPUT 718;"RQS 10;"`

To activate all conditions in the mask, the mask value is equal to 62 (32 + 16 + 8 + 4 + 2).

Send: `OUTPUT 718;"RQS 62;"`

SNGLS

Single Sweep

Description: The SNGLS command sets the analyzer to single-sweep mode. Each time single sweep is pressed or TS (take sweep) is entered, one sweep is initiated, as long as the trigger and data entry conditions are met. (Also see TS.)

Syntax: See Figure 4-1

Example: `OUTPUT 718;"SNGLS;"`

Note: The functions of the SNGLS and S2 commands and the [SINGLE SWEEP] softkey are identical.

Commands

SP

Span

Description: The SP command changes the total displayed frequency range symmetrically about the center frequency. The frequency span readout refers to the displayed frequency range. Divide the readout by ten to determine the frequency span per division.

If span width is coupled to the resolution and video bandwidths, the bandwidths change with the span width to provide a predetermined level of resolution and noise averaging. Likewise, the sweep time changes to maintain a calibrated display, if coupled. All of these functions are normally coupled, unless RB, VB, or ST have been executed.

Specifying 0 Hz enables zero span mode, which configures the analyzer as a fixed-tuned receiver.

Syntax: See Figure 4-7. The AUTO parameter does not apply.

Example: `OUTPUT 718;"SP 10MZ;"`

Note: The functions of the SP command, the [SPAN] key, and the [SPAN] softkey are identical.

SRQ

Service Request

Description: A service request is an analyzer output that tells the controller a specific event has taken place in the analyzer. Service requests enable the analyzer to interrupt the controller program sequence, causing the program to branch to a subroutine.

For example, by using service requests, the controller can perform other operations while the analyzer is sweeping, and then service the analyzer when the sweep is completed. The analyzer sends its service request to the controller, which triggers the controller to take action, such as changing the instrument state or reading data from the display memory.

When making a service request, the analyzer places the SRQ line true and the analyzer screen reads out "SRQ" with a number. Setting the SRQ line true announces to the controller that the analyzer requires attention. The controller can then command the analyzer to send its "status byte." The status byte indicates the type of service request. (See RQS.)

Syntax: See Figure 4-2

Note: Alternate command R1 clears all service requests except SRQ140. R2 activates the end-of-sweep and illegal-command service request. R3 activates broken-hardware and illegal-command service requests. R4 activates units-key-pressed and illegal-command service requests.

SS

Center Frequency Step Size

Description: The SS command specifies center frequency step size.

Syntax: See Figure 4-7

Example: `OUTPUT 718;"SS 10MZ;"`

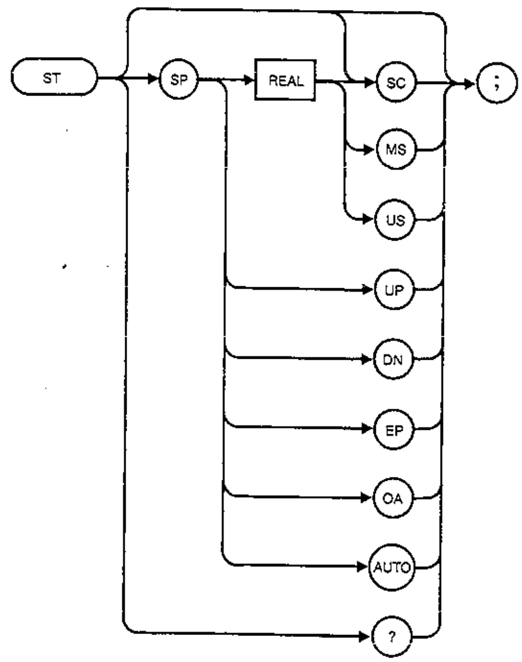
Note: The functions of the SS command and the [CF STEP SIZE] softkey are identical.

ST

Sweep Time

Description: ST specifies the rate at which the analyzer sweeps the displayed frequency range.

Syntax:



Commands

Example: `OUTPUT 718;"ST 100MS;"` sets the sweep time to 100 milliseconds.

Note: The functions of the ST command and the [SWEEP TIME] softkey are identical.

SV

Save State

Description: The SV command saves the current spectrum analyzer state in one of nine registers. Register contents are not affected by power loss, but previously saved data is erased when new data is saved in the same register.

Syntax: See Figure 4-2

Example: `OUTPUT 718;"SV 5;"`

Note: The functions of the SV and SAVES commands and the [SAVE] key are identical.

TA

Transfer A

Description: The TA command transfers trace A amplitude values from the analyzer to the controller. The display unit values are transferred in sequential order (from left to right) as seen on the screen. Transfer of trace amplitude data should be done only as follows:

1. Select single sweep mode (SNGLS).
2. Select desired analyzer settings.
3. Take one complete sweep (TS).
4. Transfer data (TA).

This procedure ensures that the current settings of the analyzer are reflected in the transferred data.

Syntax: See Figure 4-1

TB

Transfer B

Description: The TB command transfers trace B amplitude values from the analyzer to the controller. The operation of TB is similar to the operation of TA.

Syntax: See Figure 4-1

Example: `OUTPUT 718;"TB;"`

TDF

Trace Data Format

Description: The trace data format, TDF, command formats trace information for return to the controller.

M, measurement units, returns values in display units from −32768 to +32767.

P, parameter units, returns absolute measurement values such as dBm or Hz.

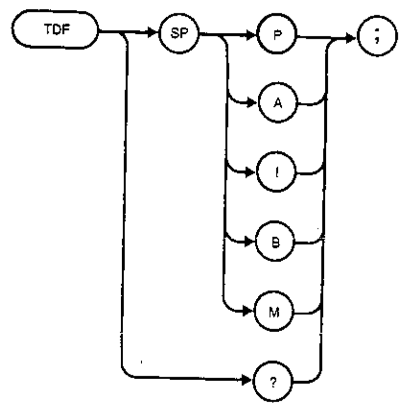
A returns data as an A-block data field. The MDS command determines whether data comprises one or two 8-bit bytes.

I returns data as an I-block data field. The MDS command determines whether data comprises one or two 8-bit bytes.

Specifying **B** enables binary format. The MDS command determines whether data comprises one or two 8-bit bytes.

A, **B**, **I**, and **M** are defined in the analyzer's internal amplitude units (log: hundredths of dBm; linear: 8,000 = top of screen and 0 = bottom of screen). **P** is in the current parameter unit specified by AUNITS.

Syntax:



Example: `OUTPUT 718;"TDF M;"`

Note: Alternate commands O1, O2, O3, and O4 provide backward compatibility for other Hewlett-Packard spectrum analyzers.

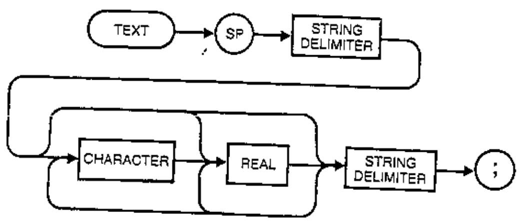
Commands

TEXT

Text

Description: The TEXT command writes text on the spectrum analyzer screen at the current pen position.

Syntax:



The string delimiters, which mark the beginning and end of the command list, must match. Characters are alphanumeric ASCII characters 32 through 126.

Example: `OUTPUT 718;"TEXT%CONNECT ANTENNA%;"`

TH

Threshold

Description: Similar to a base line clipper, the TH command blanks signal responses below the threshold level. The threshold level is nine graticule divisions below the reference level unless otherwise specified. The UP and DN commands move the threshold one division. (Also see AUTO.) The threshold level is annotated in reference level units at the lower-left corner of the analyzer screen.

Syntax: See Figure 4-6

Example: `OUTPUT 718;"TH UP;"`

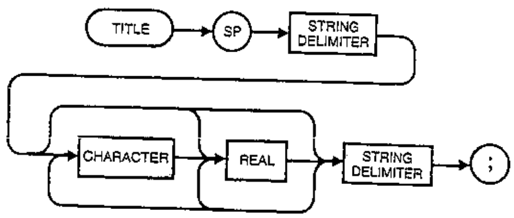
Note: Alternate command T0 turns the threshold off. The functions of the TH command and the [THRESHOLD] softkey are identical.

TITLE

Title

Description: The TITLE command activates the title mode. This function writes a message at the top of the analyzer screen. Any character on the controller keyboard can be written. The full width of the display is available for writing a maximum of 58 characters. However, the marker readout may interfere with the last 21 characters. IP removes the message.

Syntax:



Example: `20 OUTPUT 718;"TITLE%Adjust Antenna%;"`

Note: The functions of the TITLE command and the [SCREEN TITLE] softkey are identical.

TM

Trigger Mode

Description: The TM command selects a trigger mode: free, line, video, or external. Query returns the trigger mode. The conditions of the trigger modes are described below.

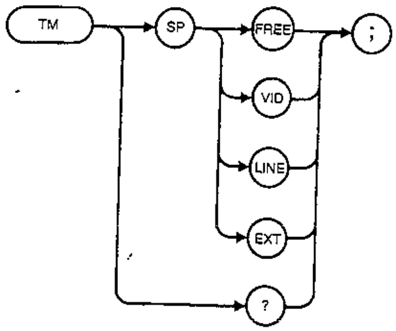
FREE allows the next sweep to start as soon as possible after the last sweep.

LINE allows the next sweep to start when the line voltage passes through zero, going positive.

VID allows the next sweep to start if the detected RF envelope voltage rises across a level set by the display line.

EXT allows the next sweep to start when an external voltage level passes through approximately 1.5 volts, going positive. The external trigger signal level must be between 0 V and +5 V.

Syntax:



Example: `OUTPUT 718;"TM EXT;"`

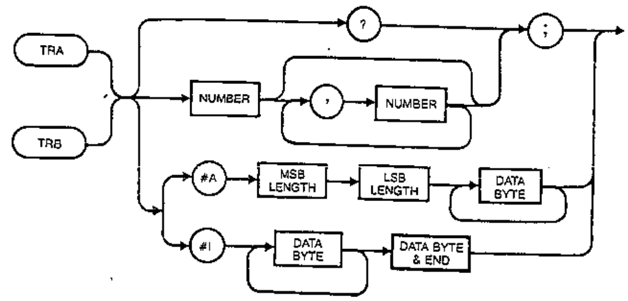
Note: The functions of the TM command and the [TRIG] key are identical. Alternate commands allow you to select the trigger modes: FREE (T1), LINE (T2), EXT (T3), VID (T4).

TRA/TRB

Trace Data Input/Output

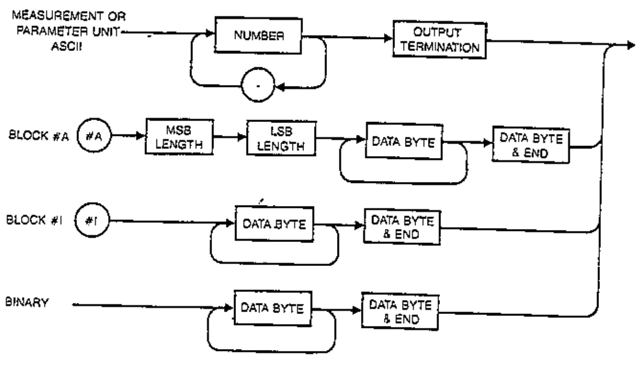
Description: This command provides a method for reading or storing values into a trace. Input in #A or #I is considered as measurement units independent of Trace Data Format (TDF). Enter words in measurement units only. The output format is specified according to TDF and MDS.

Syntax:



Commands

The form of the query response is dependent upon the previously used Trace Data Format command as follows:



Example: See "Saving Trace Data" in Chapter 3.

TS

Take Sweep

Description: The take sweep command starts and completes one full sweep before the next command is executed. TS is required for each sweep in the single sweep mode. TS prevents further input from the interface bus until the sweep is completed to allow synchronization with other instruments.

In the example below, the command sequence does not allow sufficient time for a full sweep of the specified span before VIEW is executed. Therefore, only the span set by the instrument is displayed in trace A.

```
OUTPUT 718;"IP;CF 11MZ;SP 20MZ;VIEW TRA;"
```

A TS command inserted before VIEW makes the analyzer take one complete sweep before displaying trace A. This allows the analyzer sufficient time to respond to each command in the sequence.

```
OUTPUT 718;"IP;CF 11MZ;SP 20MZ;TS;VIEW TRA;"
```

TS is recommended before transmission of marker data and before executing marker operations such as peak search. This is because the active marker is repositioned at the end of each sweep. When the analyzer receives a TS command, it is not ready to receive any more data until one full sweep has been completed. However, when slow sweep speeds are being used, the controller can be programmed to perform computations or address other instruments while the analyzer completes its sweep.

Syntax: See Figure 4-1

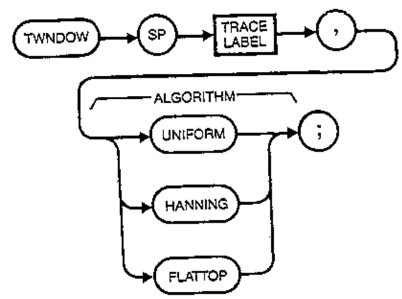
Example: `OUTPUT 718;"IP;SNGLS;TS;"`

TWNDOW

Trace Window

Description: The TWNDOW command creates a window trace array for the Fast Fourier Transform Function (FFT). The trace window function creates a trace array according to three built-in algorithms; UNIFORM, HANNING, or FLATTOP. When used with the FFT command, the three algorithms give resultant passband shapes that represent a give-and-take between amplitude uncertainty, sensitivity, and frequency resolution. See FFT for more information about these algorithms and the FFT function.

Syntax:



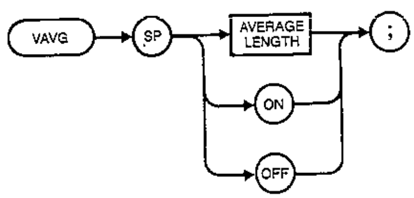
Commands

VAVG

Video Average

Description: The VAVG command enables the video averaging function, which averages trace points to smooth the displayed trace. Use VAVG to view low-level signals without slowing the sweep time. Video averaging can lower the noise floor more than a 1-Hz video bandwidth if a large number of sweeps has been specified for averaging. Video average may also be used to monitor instrument state changes (changing bandwidths, center frequencies, etc.) while maintaining a low noise floor. The active function readout indicates the number of sweeps to be averaged; the default is 100 unless otherwise specified.

Syntax:



Example: `OUTPUT 718;"VAVG 150;"`

Note: Alternate command KSG turns video averaging on and KSH turns it off. The functions of the VAVG command and the [VIDEO AVERAGE] softkey are identical.

VB

Video Bandwidth

Description: The video bandwidth command specifies the video bandwidth, which is a post-detection filter. VB allows you to change the post-detection filter from 30 Hz to 3 MHz in a 1, 3, 10 sequence. The resolution bandwidth, video bandwidth, and sweep time are normally coupled. Executing VB uncouples them. Executing AUTO recouples them.

Syntax: See Figure 4-7

Example: `OUTPUT 718;"VB 10KZ;"`

Note: The functions of the VB command and the [VIDEO BW] softkey are identical.

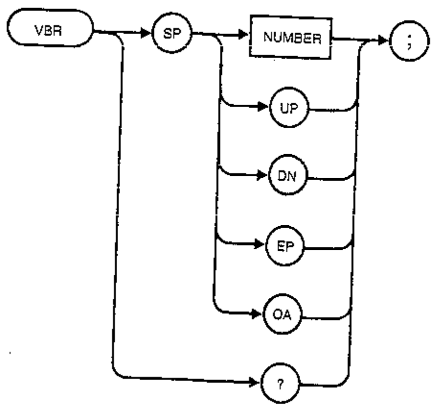
Commands

VBR

Video Bandwidth Ratio

Description: The VBR is multiplied by the resolution bandwidth to determine the automatic setting of video bandwidth. The VBR is selected in a 0.1, 0.3, 1, 3, 10 sequence.

Syntax:



Example: `OUTPUT 718;"VBR 1;"`

Note: The functions of the VBR command and the [VBW/RBW RATIO] softkey are identical.

Commands

VIEW

View

Description: The VIEW command displays trace A or trace B and stops the sweep. The trace is not updated. When VIEW TRA is executed, the contents of trace A are stored in display memory. When VIEW TRB is executed, the contents of trace B are stored in display memory.

Syntax: See Figure 4-5

Note: The functions of the VIEW TRA and A3 commands and the [VIEW TRACE A] softkey are identical. The functions of the VIEW TRB and B3 commands and the [VIEW TRACE B] softkey are identical.

Appendix A

HP 8590A Messages

The HP 8590A can generate various messages that appear on its screen during operation to provide an indication of progress through a procedure or to indicate a problem.

There are three types of messages: hardware error messages (H), user-created error messages (U), and informational messages (M).

- Hardware error messages indicate the HP 8590A hardware is probably broken.
- User-created error messages appear when the analyzer is used incorrectly. They are usually generated during remote operation.
- Informational messages indicate analyzer progress within a specific procedure.

The messages are listed in alphabetical order on the following pages: each message is defined, and its type is indicated by an (H), (U), or (M).

ADC-GND FAIL
Indicates a failure in the analog-to-digital converter. (H)

ADC-TIME FAIL
Indicates a failure in the analog-to-digital converter. (H)

ADC-2v FAIL
Indicates a failure in the analog-to-digital converter. (H)

CAL: FM SPAN SENS FAIL
The analyzer could not set up span sensitivity of the FM coil. (H)

CAL: LINEAR DET FAIL
The linear calibration routine failed. (H)

CAL: RES BW AMPL FAIL
The relative insertion loss of the resolution bandwidth is incorrect. (H)

CAL: SPAN SENS FAIL
The calibration span sensitivity routine failed. (H)

CAL:___
During the calibration routine, messages may appear on the display indicating the routine is progressing: MC DELAY, FM DELAY, DONE, SWEEP, SWP DELAY, FREQ, SPAN, AMPTD, 3dB BW, ATTEN, LOG AMP. (M)

COMMAND ERROR:___

The specified command is not recognized by the analyzer. The analyzer will recognize the commands described in Chapter 4. (U)

CONFLICT TABLE OVERFLOW

A command has been used that is not compatible with the HP 8590A. (U)

FAIL:___

An error was discovered during the power-up check. The 4-digit by 8-digit code indicates the type of error. (H)

INVALID AUNITS:___

The amplitude units are not valid. See AUNITS. (U)

INVALID BLOCK FORMAT: IF STATEMENT

An invalid block format appeared within the IF statement. (U)

INVALID CHECKSUM: USTATE

The user-defined state does not follow the expected format. (U)

INVALID COMPARE OPERATOR

An IF/THEN or DO/UNTIL routine is improperly constructed. (U)

INVALID DETECTOR:___

The specified detector is not valid. See DET. (U)

INVALID ENTER FORMAT
The enter format is not valid. See the appropriate command description to determine the correct format. (U)

INVALID HP-IB ADDRESS OR OPERATION
An HP-IB operation was aborted due to an incorrect address or invalid operation. (U)

INVALID HP-IB OPERATION REN TRUE
The HP-IB operation is not allowed. (Usually caused by print/plot when a calculator is on the interface bus.) (U)

INVALID HP-IL ADDRESS OR OPERATION
An HP-IL operation was aborted due to an incorrect address or invalid operation. (U)

INVALID HP-IL OPERATION REN TRUE
The HP-IL operation is not allowed. (Usually caused by print/plot when a calculator is on the interface bus.) (U)

INVALID KEYNAME:___
The specified keyname is not allowed. (The keyname may conflict with an analyzer command.) (U)

INVALID OUTPUT FORMAT
The output format is not valid. See the appropriate command description to determine the correct format. (U)

INVALID REPEAT MEM OVFL
Memory overflow occurred due to REPEAT routine. (U)

INVALID REPEAT NEST LEVEL
The nesting level in the REPEAT routine is improperly constructed. (U)

INVALID RS-232 ADDRESS OR OPERATION
An RS-232 operation was aborted due to an incorrect address or invalid operation. (U)

INVALID SAVE REG
Data has not been saved in the specified state register. (U)

INVALID SYMTAB: EEROM OVERFLOW
The operator has cataloged too much data. (U)

INVALID SYMTAB: SYMTAB OVERFLOW
There is a symbol table overflow. (U)

INVALID TRACE:___
The specified trace is invalid. See trace commands (VIEW, MXMH, CLRW, or BLANK). (U)

INVALID TRACE NAME:___
The specified trace name is not allowed. (U)

INVALID TRIGGER MODE:___
The specified trigger mode is invalid. See TM. (U)

INVALID VARDEF:___
The specified variable name is not allowed. (U)

INVALID WINDOW TYPE:___
The specified window is invalid. See TWNDOW. (U)

MEAS UNCAL
The measurement is uncalibrated. Check the sweep time, span, and bandwidth settings. (U)

PARAMETER ERROR:___
The specified parameter is not recognized by the analyzer. See the appropriate command description to determine the correct parameters. (U)

SOFTKEY OVFL
Softkey nesting exceeds the maximum number of levels. (U)

UNDEF KEY
A referenced softkey is not recognized by the analyzer. (U)

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