Programmer's Guide

HP ESA-L1500A Spectrum Analyzer

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CAUTION

Caution denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, would result in damage to or destruction of the instrument. Do not proceed beyond a caution until the indicated conditions are fully understood and met.

WARNING:

Warning denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.

WARNING:

This is a Safety Class 1 Product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.

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Preparing for Use and Printing

Connecting Your Spectrum Analyzer

These topics are covered in the following section:

- Connecting the Hewlett-Packard Interface Bus (HP-IB) to the computer
- Connecting the RS-232 interface to your computer
- Connecting your spectrum analyzer to a printer
- If there is a problem
- Information about HP-IB and RS-232

Connecting Your Spectrum Analyzer to a Computer

The spectrum analyzer works with many popular computers. However, the steps required to connect your spectrum analyzer to a specific computer depend on the 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. Your system configuration might include a printer or an external disk drive. Whenever you add another piece of equipment (for example, your spectrum analyzer), you may need to reconfigure your computer system so that the computer knows where and how to send information to the newly added device.

Some computers do not require 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 disk. A few computers require the insertion of an add-on board, or "card." Refer to your computer documentation if your system needs these modifications.

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

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 spectrum analyzer, you should enter and run the test program on your computer to make sure the computer is sending instructions to the spectrum analyzer through the interface cable. If the interface is working and the program is entered correctly, a statement is displayed on the computer screen.

NOTE: The listed computer and spectrum analyzer equipment includes the minimum components necessary to establish communication between your spectrum analyzer and computer. If you are 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 spectrum analyzer and computer.

Pressing the spectrum analyzer's **System (Local)** key removes it from remote mode and enables front panel control.

For the HP-IB Interface

Refer to the end of this chapter for a detailed description of the HP-IB interface. It also contains instructions for connecting the spectrum analyzer's HP-IB interface to several different computers. If your computer is not listed, but it supports an HP-IB interface, there is a good possibility that it can be connected to the spectrum analyzer. Consult your computer documentation to determine how to connect external devices on the bus.

For the RS-232 Interface

Refer to the end of this chapter for a detailed description of the RS-232 interface. It also contains instructions for connecting the spectrum analyzer's RS-232 interface to several different computers. If your computer is not listed, but it supports a standard RS-232 interface, there is a good possibility that the spectrum analyzer may be connected to the computer. Consult your computer documentation to determine how to connect external devices to your computer's RS-232 connector.

There are two types of RS-232 devices: data terminal equipment (DTE) and data communication equipment (DCE). Types of DTE devices include display terminals. DCE equipment includes modems and, generally, other computer RS-232 devices. The spectrum analyzer RS-232 port is the DTE-type. Connections from the computer (DCE) to the spectrum analyzer (DTE) are shown.

Connecting the HP-IB to the Computer

Equipment

- HP ESA-L1500A spectrum analyzer with option A4H
- HP 10833A (or equivalent) HP-IB cable
- Computer:

  HP Series 300 technical computer (with RMB)
  HP workstation (with RMB)
  HP Vectra or IBM compatible pc (with HP BASIC for Windows)

Interconnection Instructions

Connect the spectrum analyzer to the computer using the HP-IB cable. Figure 1 shows the spectrum analyzer interface board.

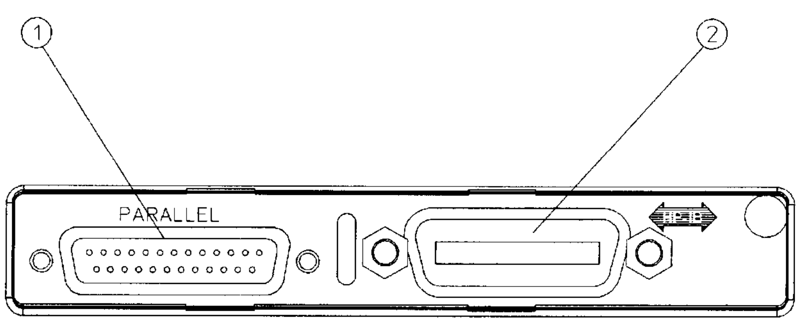


Figure 1 **Connecting the Spectrum Analyzer HP-IB to a Computer**

1 The parallel connector is for printing only.

2 Connect to the computer using the HP-IB cable.

NOTE: The spectrum analyzer rear panel slots 1 and 2 can both be used for the remote interface board. The analyzer will search for an interface board in slot 1 before looking in slot 2.

Test Program

To test the connection between the computer and the spectrum analyzer, turn on your spectrum analyzer and follow the instructions below.

1 To use the test program below, you will need to have BASIC available on your computer. Consult your BASIC manual for further information on loading BASIC on your system.

2 Check the HP-IB address of the spectrum analyzer: press **System**, **Remote Port HP-IB**. The usual address for the spectrum analyzer is 18. If necessary, reset the address of the spectrum analyzer to 18 (or select an appropriate address) and press **Enter**.

3 Enter the following test program and run it. The program shows that the computer is able to send instructions to, and read information from, the spectrum analyzer. If you need help entering and running the program, refer to your computer and software documentation.

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

The program tells the spectrum 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 tells the computer to display `CENTER FREQUENCY = 3.0E+8 Hz.`

If the computer does not display the center frequency, see “If There Is a Problem” at the end of this chapter.

Connecting the RS-232 Interface to an HP Vectra or IBM Compatible Personal Computer

Equipment

- HP ESA-L1500A spectrum analyzer with Option 1AX
- HP 245426 9-pin to 25-pin RS-232 cable for computers with a 25-pin female RS-232 port
- HP 24542U 9-pin to 9-pin RS-232 cable for computers with a 9-pin female RS-232 port
- Computer:

  HP Vectra or
  IBM compatible PC (with Microsoft QuickBasic for Windows)

NOTE: Refer to the section at the end of this chapter for information on cable wiring.

Interconnection Instructions

Connect the spectrum analyzer to the computer using the RS-232 cable. Figure 2 shows the spectrum analyzer interface.

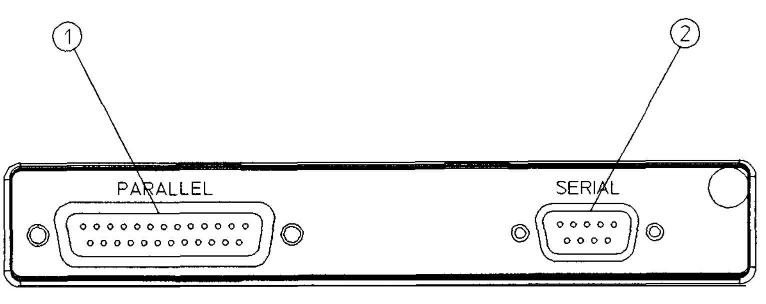


Figure 2 **Connecting the Personal Computer to the Spectrum Analyzer**

1 The parallel connector is for printing only.

2 Connect to the computer using the RS-232 cable.

NOTE: The spectrum analyzer rear panel slots 1 and 2 can both be used for the remote interface board. If there are boards in both slots, the analyzer will only use the board in slot 1.

Test Program

To test the connection between the computer and the spectrum analyzer, turn on your spectrum analyzer and follow the instructions below.

1. To use the test program below, you will need to have Microsoft QuickBasic available on your computer. Load the QuickBasic and specify a communications buffer of 4096 bytes. (Consult your QuickBasic manual for further information on loading QuickBasic on your system.)
2. Set the spectrum analyzer baud rate to 9600, to match the baud rate set up for the computer port in the test program. In line 20, the "9600" indicates 9600 baud for the computer port. Press the following keys to set the baud rate: **System**, **Remote Port** (serial), **Baud Rate**, 9600, **Enter**.
3. Enter the following test program and run it. The program shows that the computer is able to send instructions to, and read information from, the spectrum analyzer. If you need help entering and running the program, refer to your computer and software documentation.

```
10 !File = TESTPGM
20 OPEN "COM1:9600,N,8,1" AS #1
30 PRINT #1,"IP;"
40 PRINT #1,"SNGLS;"
50 PRINT #1,"CF 300MZ;TS;"
60 PRINT #1,"CF?;"
70 INPUT #1,CENTER
80 PRINT,"CENTER FREQ = ";CENTER;"Hz"
90 END
```

The program tells the spectrum 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 tells the computerto display `CENTER FREQUENCY = 3.0E+8 Hz.`

If the computer does not display the center frequency, see "If There Is a Problem" at the end of this chapter.

If There Is a Problem

This section offers suggestions to help get your computer and spectrum analyzer working as a system. The test programs provided in this chapter let you know if the connection between the computer and the spectrum analyzer is working properly. The analyzer **Esc** key can be used to abort the printing process.

If the test program does not run, try the following suggestions:

1 Check your program for errors.

2 You may need to modify the program syntax to work with your computer. Refer to your software manual for correct syntax.

3 The program must be executed correctly. Refer to your computer manual for information about program execution.

If the test program runs on the computer, but the spectrum analyzer does not respond, try the following suggestions:

1 Make sure the spectrum analyzer is turned on. If the spectrum analyzer has power, the fan should be running.

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

3 If you are using an HP-IB interface, the spectrum analyzer must be set to the correct address. Press **System**, **Remote Port**.

4 If you are using the RS-232 interface, check the spectrum analyzer baud rate. Refer to the section at the end of this chapter for information about setting the baud rate on the spectrum analyzer.

5 If you wish to reset the spectrum analyzer configuration to the state it was in when it was originally shipped from the factory, load the defaults. Press **System**, **More**, **Default Config**.

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 the sales and service office nearest you. Your salesperson will either be able to help solve the problem or refer you to someone who can.

Printing

You may wish to obtain a permanent record of data displayed on the spectrum analyzer screen. This can be done using the **Print** key of the spectrum analyzer, and a printer.

Printing Using a Parallel Interface

Equipment

- HP ESA-L1500A spectrum analyzer with option 1AX or A4H
- HP C2950A parallel printer cable
- Printer with parallel interface. (Some models support color printing.)

Interconnection and Printing Instructions

1 Turn off the printer and the spectrum analyzer.

2 If your printer has configuration switches, now is the time to set them. See Figure 3 or refer to your printer's documentation for more specific information on your printer's configuration.

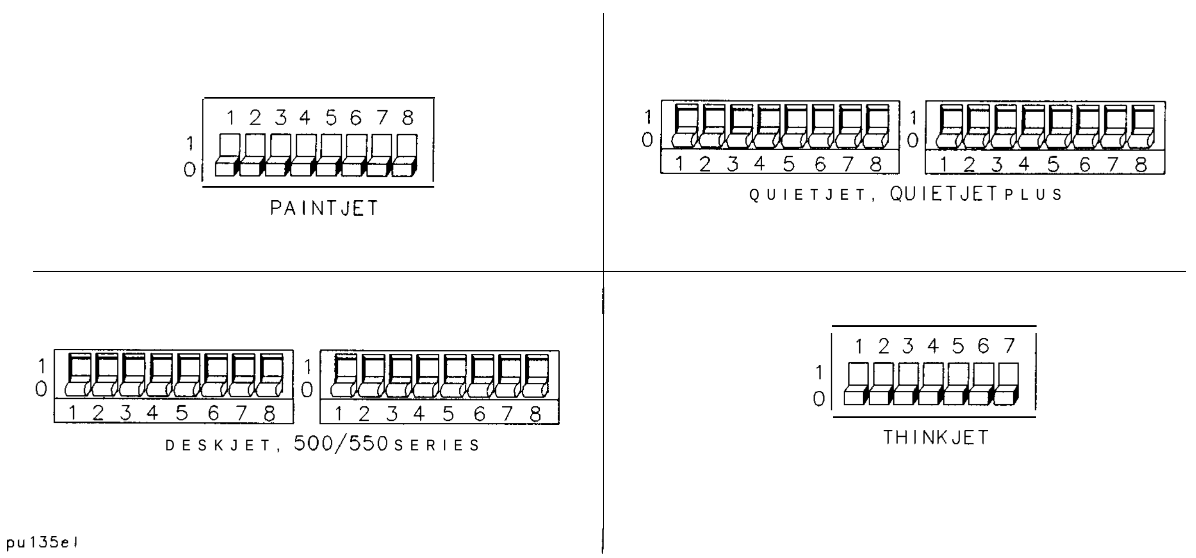


Figure 3 **Parallel Printer Switch Settings**

3 Connect the printer to the spectrum analyzer using the parallel printer cable.

4 Turn on the spectrum analyzer and printer.

5 On the spectrum analyzer, press **System**, **Printer**, **Port**, **Parallel** (so that Parallel is underlined).

6 Choose your printer from those available in the **System**, **Printer**, **Select Printer** menu. If your printer is not listed, you may be able to use it by selecting **User Defined** and making the appropriate choices. Refer to the user's guide for more information about defining a printer.

7 If you want the softkey labels to be printed with the spectrum analyzer display printout, press **System, Printer, Print Softkeys On Off** so that On is underlined.

8 Press **Print**.

Printing Using an RS-232 Interface

Equipment

- HP ESA-L1500A spectrum analyzer with option 1AX
- One of the following cables:

  HP 245426 9-pin to 25-pin RS-232 cable
  HP 24542U 9-pin (f) to 9-pin (f) RS-232 cable
  HP C2932A 9-pin (f) to 9-pin (m) RS-232 cable (for use with LaserJet 4P and 4Plus)

- Printer with RS-232 Interface. (Some models support color printing.)

Interconnection and Printing Instructions

1 Turn off the spectrum analyzer and the printer.

NOTE: The RS-232 interface allows only one device to be connected to the spectrum analyzer. Refer to the section at the end of the chapter for more information on RS-232 protocol and cable wiring.

2 Figure 4 shows examples of some of the printer's configuration switches set up for 9600 baud. See your printer's documentation for more specific information.

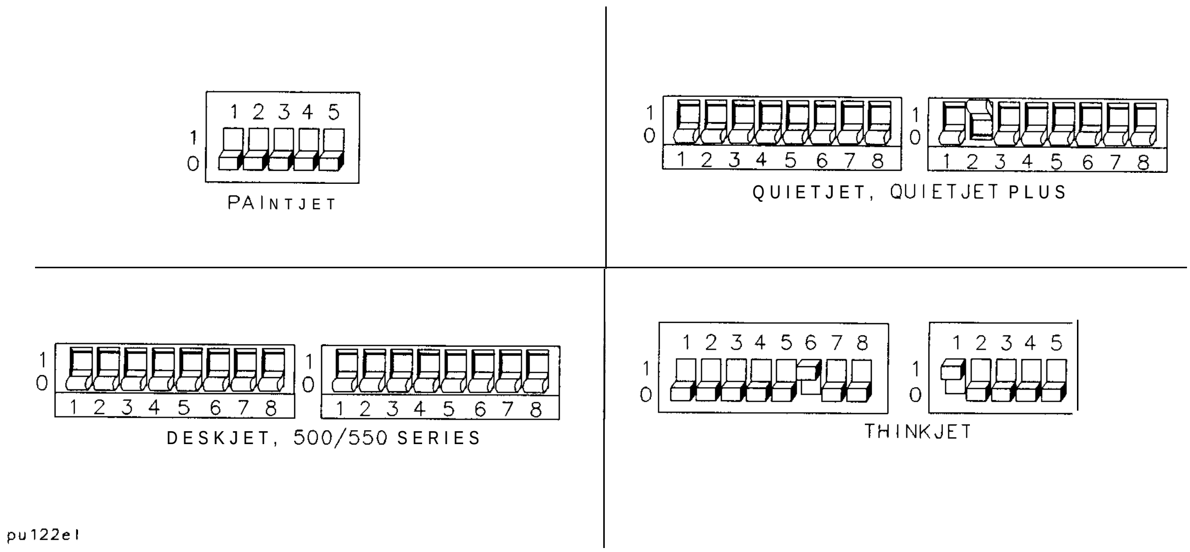


Figure 4 **9600 Baud Settings for Serial Printers**

3 Connect the printer using an RS-232 cable.

4 Turn on the spectrum analyzer and printer.

5 Choose your printer from those available in the analyzer **System**, **Printer**, **Select Printer** menu. If your printer is not listed you may be able to use it by selecting **User Defined** and making the appropriate choices. Refer to the user's guide for more information about defining a printer.

6 Press **System**, **Printer**, **Port**, **Serial** (so that Serial is underlined).

7 To set the baud rate to 9600 baud, press **Baud Rate**, 9600, **Enter**.

8 If you want the softkey labels to be printed with the spectrum analyzer display printout, press **System, Printer, Print Softkeys On Off** so that On is underlined.

9 Press **Print**.

Printing Using an HP-IB Interface

Equipment

- HP ESA-L1500A spectrum analyzer with option A4H
- HP 10833A (or equivalent) HP-IB cable
- Printer with HP-IB Interface. (Some models support color printing.)

Interconnection and Printing Instructions

1 Turn off the printer and the spectrum analyzer.

2 Connect the printer to the spectrum analyzer using the HP-IB cable. The printer is usually set to device address 1. The printer's mode switches must be set correctly for use with the spectrum analyzer. Refer to Figure 5 for the correct settings for using an HP 2225A ThinkJet printer.

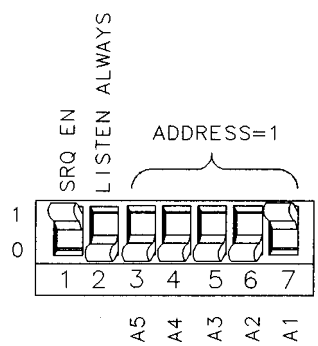


Figure 5 **ThinkJet Printer Switch Settings**

NOTE: Because the spectrum analyzer cannot print with two controllers (the computer and the spectrum analyzer) connected, the computer must be disconnected from the HP-IB before printing. In most cases, it is sufficient to simply turn the computer OFF.

3 Turn on the spectrum analyzer and printer.

4 On the spectrum analyzer, press **System**, **Printer**, **Port**, (so that HP-IB is underlined).

5 The printer is usually set to device address 1. To enter address 1 for the printer, press **1**, **Enter**.

6 Choose your printer from those available in the **System**, **Printer**, **Select Printer** menu. If your printer is not listed you may still be able to use it by selecting **User Defined** and making the appropriate choices. Refer to the user's and calibration guide for more information about a user defined printer.

7 If you want the softkey labels to be printed with the spectrum analyzer display printout, press **System, Printer, Print Softkeys On Off** (so that On is underlined).

8 Press **Print**.

What is HP-IB?

Your Option A4H spectrum analyzer has a Hewlett-Packard Interface Bus (HP-IB) connector on the rear panel, as shown in Figure 6.

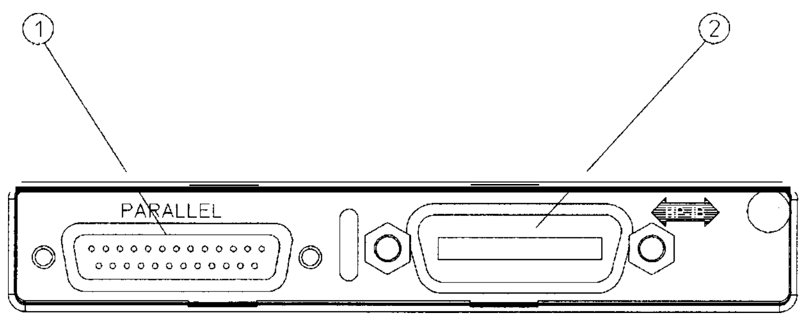


Figure 6 **HP-IB Connector**

Item 2 is the HP-IB connector. 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 instructions and is the "controller." The spectrum analyzer takes orders and is the "listener." The spectrum analyzer is also capable of transmitting 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.

The number preceding the device's address (for example, the number 7 when **Analyzer=718**), signifies that the HP-IB interface is selected.

When you turn on the spectrum analyzer, the HP-IB address appears on the screen (for example, HP-IB **ADRS : 18**). If necessary, you can reset the address of the spectrum analyzer by pressing **System, Remote Port, HP-IB,** entering in the address number using the front-panel number keys, then pressing **Enter**. You may use any address between 0 and 30 which is not already being used in your system. (Usually, 1 is reserved for printers, and 21 is reserved for controllers.)

What is the RS-232 Bus

Your option 1 AX spectrum analyzer has an RS-232 serial connector on the rear panel, as shown in Figure 7. This section contains information pertaining to RS-232 signals, cable connections, and baud rate.

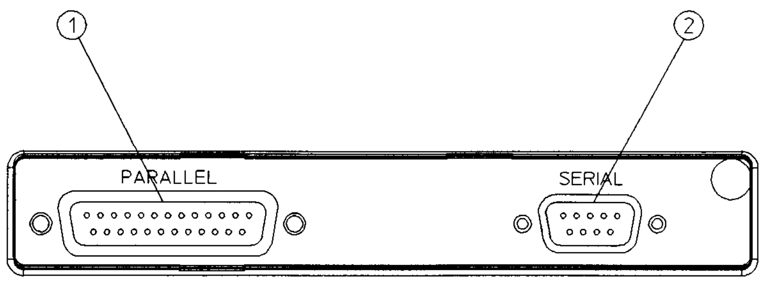


Figure 7 **RS-232 Connector**

The RS-232 interface utilizes serial data transmission. Data is sent, one bit at a time, in groups of 10 to 12 data-bits.

Two devices, such as the spectrum analyzer and a computer, can exchange commands and data over the RS-232 connection. This interface uses two serial data lines and five handshaking lines. Handshaking signals are required for full hardware control of the information exchange. It is possible to use a three wire connection, in some situations (typically at a low "baud", or data rate).

Another parameter for the RS-232 interface is the "baud", or data rate. This is the speed at which the computer and spectrum analyzer exchange data. The baud rate of each of the two RS-232 devices must be the same.

The RS-232 Data Lines

RS-232 uses serial data transmission, meaning that data is transmitted one bit at a time. There are two data lines carrying signals:

- Transmit data (TxD) – the serial data output. This line is connected to the RxD input line.
- Receive data (RxD) -the serial data input. This line is connected to the TxD output line.

The RS-232 Handshaking Lines

In addition to the data signals, there are five other signal lines (called handshaking lines), used to control the flow of data. Listed below are the handshake signal descriptions:

- Request to send (RTS) – Output signal indicates that the spectrum analyzer is ready to communicate. This line is true at power-up and stays true while power is on.
- Clear to send (CTS) – Input signal indicates that the external controller is ready to receive data.
- Data terminal ready (DTR) -Output signal from the spectrum analyzer. When the input buffer is full, this line goes false.
- Data set ready (DSR) – Is not available.
- Data carrier detect (DCD) – Input to the spectrum analyzer. If DCD is true, the spectrum analyzer will receive data from the controller. If false, no data will be input. The data will be ignored.

The spectrum analyzer checks its CTS input before transmitting data to the computer. If the CTS line is false, the spectrum analyzer will not transmit data. The spectrum analyzer transmits data when the CTS line is true.

The spectrum analyzer sets the DTR line (PC CTS) false when its input buffer is full.

Baud Rate

The speed at which data is exchanged is called the baud rate or data rate. This is usually expressed in baud or bits per second. Common baud rates are 1200 and 9600. It is critical that the baud rate of the spectrum analyzer be the same as that of the printer.

If you need to change the baud rate, refer to the "Setting the Spectrum Analyzer Baud Rate" in this section.

Protocol

The RS-232 protocol is as follows:

Baud rate 300 to 57,000 baud
8 bits per character
1 stop bit
No parity
Software handshake – none
Xon/Xoff and ENQ/ACK not supported by the spectrum analyzer

When BREAK is issued to the spectrum analyzer, the following occurs:

1 The present command is aborted
2 The input buffer is cleared
3 The output buffer is cleared
4 All trace output is stopped
5 The command parser is reinitialized

BREAK does not perform any of the following:

- Invoke instrument preset
- Clear illegal command off screen

The RTS signal goes true on power-up and does not go false during any communication. It stays true while power is on.

Figure 8 and Figure 9 lists the signal connections between a personal computer and the spectrum analyzer.

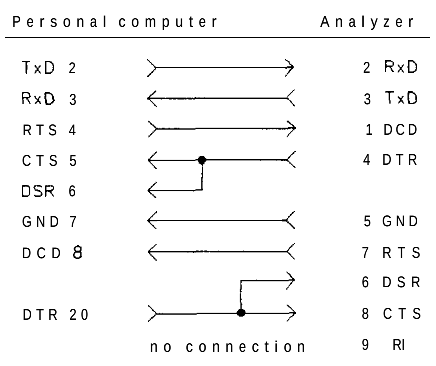


Figure 8 **HP 245426 25-pin to 9-pin Full Handshaking Connection**

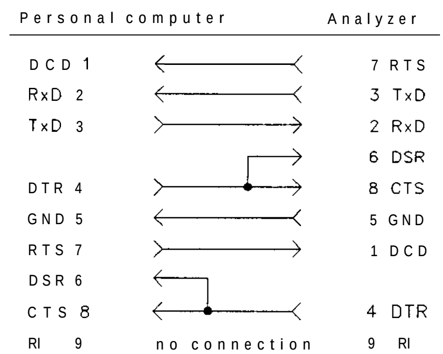


Figure 9 **HP 24542U 9-pin to 9-pin Full Handshaking Connection**

ThinkJet Printer Connections

To connect an HP ThinkJet printer to the spectrum analyzer, use the information in Figure 10 which describes the wiring configuration. Information about the printer mode switch settings is indicated in the following tables. See the thinkJet printer manual for more information.

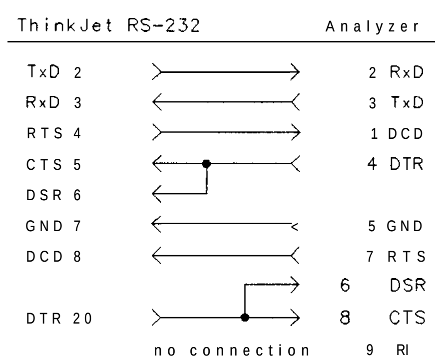


Figure 10 **25-pin to 9-pin ThinkJet Printer Connection**

Table 1 **Setting of Thinkjet Printer Mode Switches**

Switch Number	Setting	Comments
1	down	Printer performs a carriage return only.
2	down	Printer perform a line feed only.
3	up	Sets the printer to skip paper perforations.
4	down	Sets the printer for a paper length of 11 inches.
5	down	Sets the printer to HP MODE.
6	“p	
7	down	Sets the printer to USASCII.
8	down	

Table 2 **Setting of RS-232 Switches**

Switch Number	Setting	Comments
1	up	DTR.
2	down	no parity, 8 bits.
3	down	
4	down	9600 baud.
5	down	

Table 3 **Setting the Baud Rate**

Switch Number	Baud Rate		
	1200	2400	9600
4	up	up	down
5	up	down	down

Connecting a Laser Jet Printer

To connect an HP LaserJet printer to the spectrum analyzer, use the information in Figure 11.

LaserJet 4P/4MP		Analyzer
RTS 1	→	1 DCD
TxD 2	→	2 RxD
RxD 3	←	3 TxD
DSR 4	←	4 DTR
GND 5	←	5 GND
DTR 6	→	6 DSR
nc 7	---optional---	7 RTS
DTR 8	→	a CTS
nc 9	---optional---	7 RI

Figure 11 **HP C2932A 9-pin to 9-pin LaserJet Printer Connection**

Connecting a Modem

To connect a modem to the spectrum analyzer for remote queries, use the information in Figure 12. The connection is for a Hayes 1200 Modem and the spectrum analyzer.

Modem		Analyzer
TxD 2	←	3 TxD
RxD 3	→	2 RxD
RTS 4	←	7 RTS
CTS 5	→	8 CTS
DSR 6	←	6 DSR
GND 7	←	5 GND
DCD 8	→	1 DCD
DTR 20	←	4 DTR
RI 22	no connection	9 RI

Figure 12 **25-pin to 9-pin Modem Connection**

Select 1200 baud for both the modem and the spectrum analyzer.

Setting the Spectrum Analyzer Baud Rate

The baud rates of the spectrum analyzer and the personal computer must be the same. For example, to set the spectrum analyzer to 9600 baud, use the following procedure:

1. Press the **System, Remote Port** (with Serial selected.)
2. Press the keys: 9600, **Enter**. To set the baud rate to 1200 baud, press these keys: 1200, **Enter**.

2

Programming Basics

What's In This Chapter

- Writing your first program
- Modifying your program
- Enhancing your program
- Getting data from the spectrum analyzer

If the computer is not connected to the spectrum analyzer, follow the instructions in Chapter 1.

A general knowledge of the BASIC programming language and the spectrum analyzer is recommended before reading this chapter. Refer to your software documentation manuals for more information about BASIC. Chapter 5 of this manual provides information about the spectrum analyzer commands in alphabetical order.

NOTE: All programming examples in this chapter for the HP-IB interface are written in HP BASIC for Windows, using an HP Vectra PC. For the RS-232 interface, examples are written in Microsoft Quick BASIC, using an HP Vectra personal computer or compatible controller.

Writing Your First Program

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

Composing the Program

Most spectrum analyzer programs contain several common statements, or "commands," 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 commands.

The following programs are for the HP-IB and the RS-232 interfaces. Note the quotation marks that contain spectrum analyzer commands in each line. Also note the semicolons at the end of each line, inserted at the end of each set of spectrum analyzer commands within the quotation marks. Using semicolons makes programs easier to read, prevents command misinterpretation, and is recommended by IEEE Standard 728.

NOTE: In commands where quotation marks occur, the computer recognizes data as character data and not BASIC programming language commands.

Program Example for the HP-IB Interface

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

Line 10 of 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 spectrum analyzer on the HP-IB. With these two program lines, we have set up a clear communication path between the computer and the spectrum analyzer.

Line 30 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.

NOTE: All **softkey** 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.

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

Before we end the program, we return the spectrum analyzer to front-panel control with line 50, `LOCAL 7`. The LOCAL command corresponds to the System (Local) key on the front panel of the spectrum analyzer. (`LOCAL 7` commands everything on the bus to go to local mode.)

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

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

Program Example for the RS-232 Interface

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

Line 20 of the program opens the RS-232 COM1: line, identifies it as **#1,** and sets the RS-232 parameters as follows:

9600 baud
no parity
8 bits/character
1 stop bit

Line 30 of the program introduces the instrument preset (IP) command, which corresponds to the Preset key on the 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.

NOTE: Most softkey 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.

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

Make sure that the spectrum analyzer baud rate is 9600 using the **Baud Rate** softkey. Enter the program lines, then press **RUN** on the computer. Watch the spectrum analyzer display as it completes each instruction.

Programming Guidelines

The following steps should be used to generate a spectrum analyzer program:

1. Perform the measurement manually, keeping track of the sequence of functions used.
2. In the written program, execute an instrument preset (IP) and set single-sweep mode (SNGLS) 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 spectrum analyzer functions, execute a take sweep (TS) command before reading data or activating markers.
6. The spectrum analyzer can return only one value per programming line. Do not have more than one query per programming line.
7. Use the exclamation point (!) to include comment lines when using HP BASIC for Windows. Use the apostrophe (‘) or REM to create comment lines when using Microsoft Quick BASIC. The use of the exclamation point and the apostrophe to create comment lines are dependent on the controller and the programming language (not interface-dependent) and may be different for your system.

File Naming Rules

File names for storing states, traces, limit lines or amplitude correction data files in the analyzer should follow the conventions as indicated below:

- They can be up to eight characters long. In addition, they can have a file extension up to three characters long. The analyzer assigns the extension.

- They are not case sensitive. It does not matter whether you use upper case or lower case letters when you type them.
- They can contain only the letters A through Z, the number 0 through 9, and the following special characters:

Character	Description
_	underscore
^	carat
$	dollar sign
~	tilde
` !	exclamation point
#	number sign
%	percent sign
&	ampersand
-	hyphen
{ }	braces
@	at sign
‘	single quotation mark
’	apostrophe
0	parenthesis

No other characters are valid.

- They cannot contain spaces, commas, backslashes, or periods. (except the period that separates the name from the extension.)
- They cannot be identical to the name of another file in the same directory.

Modifying the Program

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

The spectrum analyzer user's and calibration guide shows you how to make a simple measurement. We can add instructions to our program so that it will make the same measurement. Because the manual process closely resembles that of the program, you may want to review the some of the measurements in the user's and calibration guide.

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.

Program Example for the HP-IB Interface

NOTE: This example requires a 300 MHz signal at the input of the spectrum analyzer.

First, we set the center frequency to 300 MHz. The CF command corresponds to the center frequency function, **Center Freq**. (All spectrum analyzer commands, such as CF, are described in Chapter 5.)

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 program line:

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

Because 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 executed, the spectrum analyzer takes one full sweep before executing line 41. Line 41 changes the center frequency to 300 MHz, and line 42 changes the span to 200 MHz.

Enter the following program line to place a marker at the highest peak on the trace with a MKPK HI command:

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

The completed program is shown below:

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

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

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

Program Example for the RS-232 Interface

NOTE: This example requires a 300 MHz signal at the input of the spectrum analyzer.

First, we set the center frequency to 300 MHz. The CF command corresponds to the center frequency function, **Center Freq**. (All spectrum analyzer commands, such as CF, are described in Chapter 5.)

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

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

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

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

Because we are controlling the sweep, we must update the spectrum analyzer display with the following program line:

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

When the program is executed, the spectrum analyzer takes one full sweep before executing line 41. Line 41 changes the center frequency to 300 MHz. Line 42 changes the span to 200 MHz.

Enter the following program line to place a marker at the highest peak on the trace:

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

The completed program is shown below:

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

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

Program Example for the HP-IB Interface

In the following program, the exclamation point (!) allows the words that follow to be ignored by the computer. Thus, they serve as comments in the program.

```
10   !FILE: "VAR10"
20  REAL C_freq,S_pan  !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)?",C_freq
80    !ask for the desired span:
90  INPUT "SPAN(MHz)?",S_pan
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 ";C_freq;"MZ;"
140 OUTPUT Analyzer;"SP ";S_pan;"MZ;"
150 OUTPUT Analyzer;"TS;"
160  !find the signal peak with peak search:
170 OUTPUT Analyzer;"MKPK HI;"
180 LOCAL 7
190 END
```

Three modifications are made to a previous programming example so it includes center frequency and span variables. First, using the HP BASIC REAL command, we define two variables, **C_freq** and **S_pan**. The frequency and span parameters are stored in these variables. (Refer to line 20.)

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

Third, we modify the output parameter statements so that the values stored in **C_freq** and **S_pan** are sent to the spectrum analyzer. (See lines 130 to 140.)

A sweep is taken after the parameters are sent to the spectrum analyzer, to ensure that the spectrum analyzer screen is updated before the marker is placed on the highest signal peak.

Program Example for the RS-232 Interface

In the following program, the apostrophe (') allows the words that follow to be ignored by the computer. Thus, they serve as comments in the program.

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

Three modifications are made to an earlier programming example in order to include center frequency and span variables. First, we use two variables, CENTER and SPAN, to store the frequency and span parameters.

Second, using the BASIC INPUT command, we ask the computer operator to enter the desired center frequency and span. (See lines 70 and 90 in previous program example). Next, we modify the output parameter statements so that the values stored in the CENTER and SPAN variables are sent to the spectrum analyzer. (See lines 120 and 130.) A sweep is taken after the parameters are sent to the spectrum analyzer, to ensure that the spectrum analyzer screen is updated before the marker is placed on the highest signal peak.

Getting Data from the Spectrum Analyzer

This section demonstrates a technique for getting information out of the spectrum analyzer. In an earlier program in this chapter, we placed a marker at the highest peak of a trace and the value of the marker could be read in the upper right-hand corner of the spectrum analyzer display. In the following program, we will add some commands that will read the marker's frequency and amplitude value and return those values to the computer.

Program Example for the HP-IB Interface

NOTE: This example requires a 300 MHz signal at the input of the spectrum analyzer.

```
10  !FILE: "MKR"
20 REAL A_mpmarker,F_reqmarker !define variables
30 Analyzer=718
40 OUTPUT Analyzer;"IP;"
50  !set the output format of the spectrum analyzer for
60  !real numbers:
70 OUTPUT Analyzer;"TDF P;"
80  !set the spectrum 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 spectrum analyzer for the marker's
150  !amplitude value:
160 OUTPUT Analyzer;"MKA?;"
170  !send the amplitude value to the computer:
180 ENTER Analyzer;A_mpmarker
190  !ask the spectrum analyzer for the marker's
200  !frequency value:
210 OUTPUT Analyzer;"MKF?;"
220  !send the frequency value to the computer:
230 ENTER Analyzer;F_reqmarker
240  !print the amplitude and frequency:
250 PRINT "THE SIGNAL PEAK IS ";A_mpmarker;
260 PRINT " dBm AT ";F_reqmarker/1.E+6;" MHz"
270  !set the spectrum analyzer to continuous sweep mode:
280 OUTPUT Analyzer;"CONTS;"
290 LOCAL 7
300 END
```

First, using the HP BASIC REAL command, we define two variables, **A_mpmarker** and **F_reqmarker**. The amplitude and frequency values of the marker are stored in these variables. (See line 20.)

Second, we set the output format of the spectrum analyzer for real numbers with the spectrum 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.

Next, we ask the spectrum analyzer for the amplitude value of the marker. We have the spectrum analyzer send the marker amplitude value to the computer. Note that there can be only one spectrum analyzer query per programming line. We also ask the spectrum analyzer for the frequency value of the marker, and we have the spectrum analyzer send the marker frequency value to the computer. (See lines 140 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.

Program Example for the RS-232 Interface

NOTE: This example requires a 300 MHz signal at the input of the spectrum analyzer.

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

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

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

Two additional variables are used for AMPMARKER and FREQMARKER. The amplitude and frequency values of the marker are stored in these variables (lines 170 and 210). The program requests the amplitude and frequency values of the marker (lines 150 and 190). Note that there can be only one spectrum analyzer query per programming line.

Finally, the amplitude and frequency values are displayed on the computer screen:

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

3

Programming Examples

What You'll Find in This Chapter

NOTE: The following programming examples are written in HP BASIC using the HP-IB interface. (Use HP BASIC for windows on the PC or RMB on a UNIX workstation.) See Examples Using the RS-232 Interface on page 85, for examples using Quick BASIC on the RS-232 interface.

General knowledge of the BASIC programming language is recommended before reading this chapter. (Refer to your software documentation manuals.) Chapter 5 of this manual defines spectrum analyzer commands alphabetically.

Reading Trace Data Into a Variable

The following program reads a trace from the spectrum analyzer and stores the trace data in a variable.

Program Example:

```
10  !Program reads in trace data and stores it in a variable
20  !
30   ! Create a 401 point trace array
40     REAL Trace_a(1:401)
50     ASSIGN @Sa TO 718
60    ! Set the output format of the spectrum analyzer for
70    ! real numbers
80     OUTPUT @Sa;"TDF P;"
90    ! Set the spectrum'analyzer parameters
100    OUTPUT @Sa;"IP;RFCALIB ON;SNGLS;" ! Turns 50 MHz sig on
110    OUTPUT @Sa;"CF 50 MZ;SP 10 MZ;TS;"  ! Set up and take sweep
120    OUTPUT @Sa;"MKPK HI;"  ! Marker to peak of response
130   ! Move peak to center of spectrum analyzer screen
140    OUTPUT @Sa;"MKCF;TS;"
150   ! Ask the spectrum analyzer for trace data
160    OUTPUT @Sa;"TRA?;"
170   ! Send the trace data to the computer
180    ENTER @Sa;Trace_a(*)
190    PRINT Trace-a(*)
200    END
```

Trace data can be read with the computer. We will start with a program created in Chapter 2. We modify the program to create a 401-point trace array, called Trace-a, in which the trace data will be stored. The program uses the TRA command to request trace A data. (The MKA and MKF commands from the previous program have been deleted.) The spectrum analyzer then sends trace A data to the variable, Trace-a.

Saving Trace Data in a computer

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

Program Example:

```
10   ! Reads in trace data and stores it in a variable
20  !
30     REAL Trace_a(1:401)! Create 401 point array
40     ASSIGN @Sa TO 718
50   ! Set the output format of the spectrum analyzer for
60   ! real numbers
70     OUTPUT @Sa;"TDF P;"
80   ! Set the spectrum analyzer parameters
90     OUTPUT @Sa;"IP;RFCALIB ON;SNGLS;"
100    OUTPUT @Sa;"CF 50 MZ;SP 10 MZ;TS;"
110    OUTPUT @Sa;"MKPK HI;"
120 ! Move peak to center of spectrum analyzer screen
130    OUTPUT @Sa;"MKCF;"
140    OUTPUT @Sa;"TS;"
150 ! Ask the spectrum analyzer for trace data
160    OUTPUT @Sa;"TRA?;"
170 ! Send the trace data to the computer
180    ENTER @Sa;Trace_a(*)
190 ! Create file to store trace
200 ! File is 13 records long
210    CREATE BDAT "DATA_A",13
220 ! Assign path for the file
230    ASSIGN @File TO "DATA-A"
240 ! Send trace data to the file
250    OUTPUT @File;Trace_a(*)
260    OUTPUT @Sa;"CONTS;"
270    LOCAL 7
280 ! Close file
290    ASSIGN @File TO *
300    ASSIGN @Sa TO *
310    END
```

First, using the CREATE command, we create an empty file on the disk for storing 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, then divided by 256 bytes per record. The result is rounded to the next largest integer.)

Next, we assign an input and an output path to the file DATA-A. Then, we send the trace data to the file. (See lines 220 through 260.) Finally, in line 290, we close the file.

NOTE: If a program containing the CREATE command is run twice, the computer will report an error the second time because the file already exists. To prevent this error, place an exclamation mark before the CREATE command to “comment out” the line after you run the program the first time. (See line 210.)

When using this program as part of a larger program, the “file exists” error should be trapped out and then the new file will overwrite the existing file.

Loading Trace Data from a Computer Disk

If we want to return trace data to the spectrum analyzer for later viewing, we must work the “saving” process in reverse. The following program loads a trace that was previously saved on a computer disk into an array variable in the computer.

Program Example:

```
10 !Program reads trace data from computer file into a variable
20 !
30    REAL Trace_a(1:401)       ! Create a 401-point trace array
40    ASSIGN @File TO "DATA_A" ! Assign path to file
50    ENTER @File;Trace_a(*)    ! Enter trace into variable Trace-a
60    ASSIGN @File TO *         ! Close file
70    END
```

Different Formats for Trace Data Transfers

One way to format trace data using the TDF command was introduced earlier in this chapter (TDF P). This section describes all the available trace data formats.

The spectrum analyzer provides five formats for trace data transfers: real number (P) format, binary (B) format, A-block format, I-block format, and measurement units (M) format.

The following table shows the data transmission sequence for trace data transfers for each trace data format, for a 5-element trace. The values of these elements are -5.23 dBm, -12.18 dBm, -24.83 dBm, -16.47 dBm, and -9.34 dBm. The reference level is 0.0 dBm and the logarithmic scale is 10 dB/div.

Parenthesis indicate the ASCII character represented by the data transmitted. Table entries without parenthesis indicate the decimal value of the data. A value followed by "-EOI" indicates that the HP-IB line EOI is asserted along with that data byte. For example, 10-EOI means that a linefeed (decimal value 10) is sent with EOI asserted.

Table 4 **HP-IB Transmission Sequence for Trace Data Formats (TDF)**

Byte	TDF P	TDF M	TDF A (byte)	TDF A (word)	TDF I (byte)	TDF I (word)	TDF B (byte)	TDF B (word)
1	(–)	(7)	(#)	(#)	(#)	(#)	233	29
2	(5)	(4)	(A)	(A)	(I)	(I)	211	53
3	(.)	(7)	0	0	233	29	172	26
4	(2)	(7)	5	10	211	53	198	126
5	(3)	(,)	233	29	172	26	220-EOI	21
6	(,)	(6)	211	53	198	126		141
7	(–)	(7)	172	26	220-EOI	21		24
8	(1)	(8)	198	126		141		209
9	(2)	(2)	220-EOI	21		24		27
10	(.)	(,)		141		209		154-EOI
11	(1)	(5)		24		27		
12	(8)	(5)		209		154-EOI		
13	(,)	(1)		27				

Table 4 **HP-IB Transmission Sequence for Trace Data Formats (TDF)**

Byte	TDF P	TDF M	TDF A (byte)	TDF A (word)	TDF I (byte)	TDF I (word)	TDF B (byte)	TDF B (word)
14	(–)	(7)		154-EOI				
15	(2)	(,)						
16	(4)	(6)						
17	(.)	(3)						
18	(8)	(5)						
19	(3)	(3)						
20	(,)	(,)						
21	(–)	(7)						
22	(1)	(0)						
23	(6)	(6)						
24	(.)	(6)						
25	(4)	10-EOI						
26	(7)							
27	(,)							
28	(–)							
29	(9)							
30	(.)							
31	(3)							
32	(4)							
33	10-EOI							

M Format

The M format is for sending trace data only. It formats the trace data in the internal format used by the spectrum analyzer, also known as measurement units. The range of the measurement units differs depending the current instrument settings. The MDU command can be used to query various aspects of measurement units.

Example Range of Measurement Units

The analyzer is often set to a logarithmic display using logarithmic units of 10 dB/ division. Figure 13 shows the range of measurements that the HP ESA-L1500A will use with these settings.

The displayed amplitude of each trace element falls on one of 10,000 vertical points with 8000 equal to the reference level, and -2000 equal to the bottom of the display. For log scale data, each point is equal to 0.01 dB. The peak of the signal in the figure is equal to -25 dBm, or two and a half divisions below the reference level. In measurement units, it is equal to 5500 (8000 – 2500 = 5500). The range of internal data is -32,768 to +32,767. In practice however, the range limits can be reached during trace math operations only.

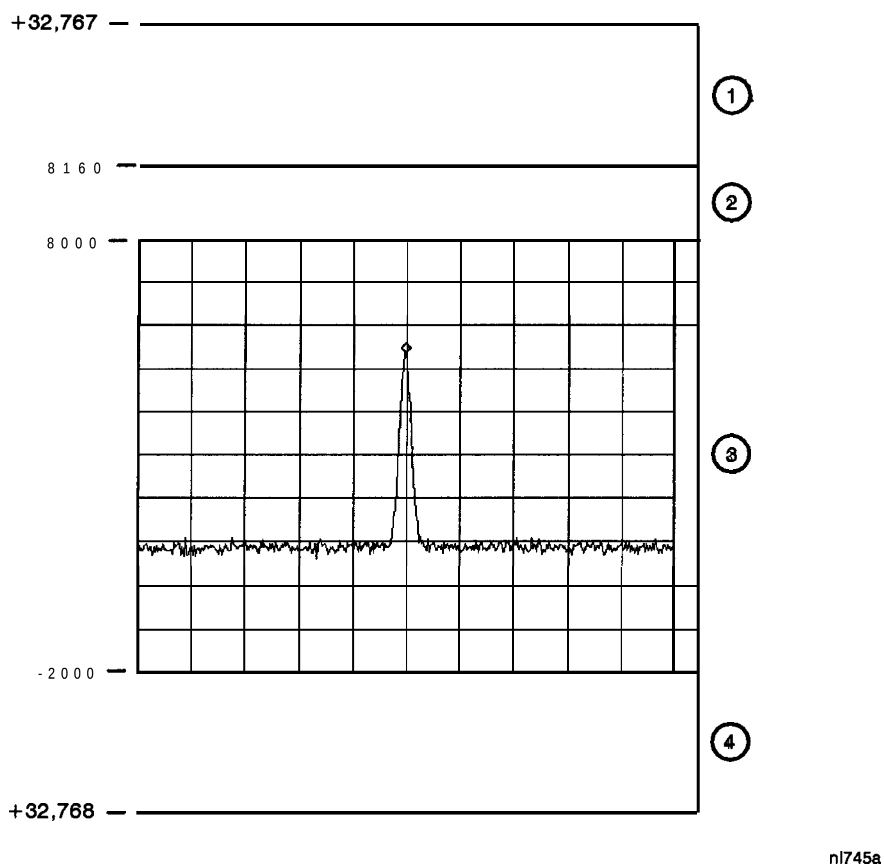


Figure 13 **Measurement Unit Range and Trace Amplitudes**

Callout	Description
1	A number within the range of 8161 to 32,767 measurement units is obtainable with trace math operations only.
2	The area from 8000 (reference level) to 8 160 (1.6 dB above reference level) represents the amount a trace element's displayed amplitude can exceed the top graticule and still be valid.
3	The area from -2000 to 8000 represents the displayed range for trace amplitude data. The range of -2000 to 8000 varies according to the amplitude scale of the spectrum analyzer as follows: • In 10 dB/division, the range is from -2000 to 8000 • In 5 dB/div, the range is from 4000 to 8000 • In 2 dB/div, the range is from 6000 to 8000 • In 1 dB/div, the range is from 7000 to 8000
4	A number within the range of -2000 to -32,768 measurement units is obtainable with trace math operations only.

Example of Using the M Format

This example sends trace data from the spectrum analyzer to the computer in M format.

Program Example:

```
10 !Example using trace data in M format
20 !
30     INTEGER A(1:401) ! Declare array for number of trace points
40     ASSIGN @Sa TO 718
50     OUTPUT @Sa;"IP;RFCALIB ON;SNGLS;TS;" !50 MHz sig on
60     OUTPUT @Sa;"CF 50 MZ;SP 20 MZ;TS;"    ! Take meas sweep
70     OUTPUT @Sa;"TDF M;TRA?;"      ! Send trace A data in M format
80     ENTER @Sa;A(*)                ! Computer receives data
90     PRINT A(*)                    ! Print trace data
100    END
```

NOTE: All trace math functions are done using measurement units. See Chapter 4 for a list of all trace math functions. See the description for the AML command in Chapter 5 for an example of trace math subtraction in measurement units.

The result is in measurement units. For more detailed information about the M format, see the description for TDF in Chapter 5.

Table 5 **Summary of the Trace Data Formats**

Trace Data Format	Description	Remarks
TDF P	Real number format	To send the trace data back to the spectrum analyzer, the data must be converted to measurement units.
TDFB	binary format	Fastest format for trace data transfers. Use the A-block format to send data back to the spectrum analyzer.
TDF A	A-block data format	Trace data preceded by "#," "A," and a two byte number. To use the A-block format for sending data, you must provide the number of data bytes.
TDF I	I-block data format	Trace data preceded by "#," and "I." This format is not recommended for use with an RS-232 interface. Unlike using the A-block format, you do not provide the number of data bytes when sending data.
TDF M	Measurement data format	TDF M can be used to send trace data back to the spectrum analyzer.

P Format

The P format allows you to receive or send trace data in a real-number format. This is the default format when the instrument is powered up. A parameter unit is a standard scientific unit. It depends on the current selected amplitude units (dBm, dBmV, dBμV, V, W). Numbers are in dBm, dBmV, dBμV, volts, or watts. The AUNITS command can be used to specify the amplitude units. Real-number data may be an advantage if you wish to use the data later in a program. However, data transfers using P format tend to be slow and take up a lot of memory (compared to binary format, the P format can take up to four times the amount of memory). Data is transferred as ASCII.

Although the spectrum analyzer can send the trace data to the computer as real numbers, the trace data cannot be sent back to the spectrum analyzer without changing it to measurement units (integers). See the following example.

Example of Using the P Format

This example sends trace data to the computer using P format, changes it to measurement units, and then returns it to the spectrum analyzer. The following equations describe the relationship of logarithmic (dBm) and linear (volts) P format data to trace data in measurement units.

For a logarithmic display using logarithmic units:

$$\text{dBm} = (\text{Trace data} - MU_{\text{ref level}}) \times MU_{\text{res}} + \text{Ref level (in dBm)}$$

For a linear display using linear units:

$$\text{Volts} = \frac{\text{Reference level}}{MU_{\text{ref level}}} \times \text{Trace data}$$

Where:

$MU_{\text{ref level}}$ = Measurement Units for the Reference Level

MU_{res} = Measurement Unit Resolution

The measurement unit resolution and the value for the reference level can be queried from the analyzer using the MDU command as in the following example.

Program Example:

```
10 !Example using trace data in P format
20 !
30    ASSIGN @Sa TO 718
40    REAL Trace_data(1:401) !Declare array for trace data
50    OUTPUT @Sa;"IP;TS;RFCALIB ON;"! Initialize, 50 MHz Sig on
60    OUTPUT @Sa;"CF 50 MZ;SP 10 MZ;SNGLS;TS;"! Take meas sweep
70    OUTPUT @Sa;"MDU RL_LOG?;"! Get meas unit at ref level in Log
80    ENTER @Sa;Mdu_rl
90    OUTPUT @Sa;"MDU LOG-RES?;"! Get meas unit resolution in Log
100   ENTER @Sa;Mdu_res
110   OUTPUT @Sa;"TDF P;TRA?;"! Use P format, output trace A
120   ENTER @Sa;Trace_data(*) ! Computer receives data
130   OUTPUT @Sa;"VIEW TRA;MOV TRA,0;"! Verify transfer, set trace=0
140   OUTPUT @Sa;"RL?;"! Use RL ampl to change integers to reals
150   ENTER @Sa;Ref_level ! Get ref level
160   DISP 'Press CONTINUE when ready"
170   PAUSE
180   DISP
190   MAT Trace-data= Trace-data-(Ref-level) !Changes trace data
200   MAT Trace-data= Trace_data/(Mdu_res) !from reals to integers
210   MAT Trace-data= Trace_data+(Mdu_rl)   ! (in meas units)
220   PRINT Trace-data(*)
230   OUTPUT @Sa;"TRA";
```

```
240   OUTPUT @Sa;Trace_data(*)  ! Trace data to SA in meas units
250   LOCAL @Sa
260   END
```

For more detailed information about the P format, see the description for TDF in Chapter 5.

B Format

The B format allows you to receive trace data in a binary format. The B format provides the fastest data transfer and requires the least amount of memory to store data. Each data point is transferred in binary as two 8-bit bytes. The data points are in the internal representation of measurement units. The B format does not send a header. (The A-block format is described below and it does send a header before the data.) An end-or-identify (EOI) is sent with the last byte of data. See "P Format" above for more info about measurement units.

Example of Using the B Format

This example sends trace data from the spectrum analyzer in B format. The trace data format must be changed to A-block format to return the trace data to the spectrum analyzer. See following example.

NOTE: It is not possible to return data to the spectrum analyzer using binary format. You must use either A-block, I-block, or M-block format to return the trace data to the spectrum analyzer.

Program Example:

```
10 ! This example uses trace data in B-format
20 !
30    INTEGER Tra_binary(1:401)    ! Declare array for trace data
40    ASSIGN @Sa TO 718;FORMAT OFF
50    OUTPUT @Sa;"IP;TS;RFCALIB ON;"  ! Turns 50 MHz signal on
60    OUTPUT @Sa;"CF 50 MZ;SP 10 MZ;SNGLS;TS;" ! Take meas sweep
70    OUTPUT @Sa;"MDS W;TDF B;TRA?;"        ! Output trace A data
80    ENTER @Sa;Tra_binary(*)
90    OUTPUT @Sa;"TDF A;"         ! Change data to A-block format
100   OUTPUT @Sa;"MOV TRA,0;"     ! Verify transfer;set trace=0's
110   DISP 'Press CONTINUE when ready"
120   PAUSE
130   DISP
140   OUTPUT @Sa USING "#,K,W";"TRA#A",802 ! Prepare SA for data
150   OUTPUT @Sa;Tra_binary(*)             ! Transfer data to SA
160   OUTPUT @Sa;"VIEW TRA;"
170   LOCAL @Sa
180   END
```

The result is transmitted as binary information. The MDS command can be used to change the data format from two 8-bit bytes to one 8-bit byte. For more detailed information about the B format and the MDS command, see the descriptions for TDF and MDS in Chapter 5.

Binary data can be converted to dBm or volts. For example, use the following equation to change the trace data (in measurement units) to a real logarithmic number (dBm):

$$\text{dBm} = (\text{Trace data} - MU_{\text{ref level}}) \times MU_{\text{res}} + \text{Ref level (in dBm)}$$

To change the trace data (in measurement units) to linear data (volts):

$$\text{volts} = \frac{\text{reference level}}{MU_{\text{ref level}}} \times \text{trace data}$$

Where:

$MU_{\text{ref level}}$ = Measurement Units for the Reference Level

MU_{res} = Measurement Unit Resolution

The following programming converts binary data to dBm.

Program Example:

```
10 ! This example converts binary data to dBm
20  !
30    ASSIGN @Sa_bin TO 718;FORMAT OFF
40    ASSIGN @Sa TO 718
50    INTEGER Trace_a(1:401)
60    OUTPUT @Sa;"AUNITS DBM;"
70    OUTPUT @Sa;"RL?;"
80    ENTER @Sa;Ref_lev
90    OUTPUT @Sa;"MDU RL_LOG?;"
100   ENTER @Sa;Mdu_rl
110   OUTPUT @Sa;"MDU LOG-RES?;"
120   ENTER @Sa;Mdu_res
130   OUTPUT @Sa;"TDF B;TRA?;"
140   ENTER @Sa_bin;Trace_a(*)
150 ! Now the spectrum analyzer has all the data to determine
160 ! the measured trace data
170   REAL Trace_a_real(1:401)
180   MAT Trace-a= Trace_a-(Mdu_rl)      ! Results in hundreths of
190                                      ! dB below ref level
200   MAT Trace-a-real= Trace_a*(Mdu_res) ! Now in dB below ref lev
220   MAT Trace-a-real= Trace_a_real+(Ref_lev)
230   FOR I=1 TO 401
240   PRINT Trace-a-real(I)
250   NEXT I
260   END
```

The following programming converts binary data to volts.

Program Example:

```
10 ! Program converts binary data to volts
20  !
30    ASSIGN @Sa_bin TO 718;FORMAT OFF
40    ASSIGN @Sa TO 718
```

```
50    INTEGER Trace_a(1:401)
60    OUTPUT @Sa;"LN;AUNITS V;"
70    OUTPUT @Sa;"RL?;"
80    ENTER @Sa;Ref_lev
90    OUTPUT @Sa;"MDU RL_LIN?;"
100   ENTER @Sa;Mdu_rl
110   Ref_lev_factor=Ref_lev/Mdu_rl
120   OUTPUT @Sa;"TDF B;TRA?;"
130   ENTER @Sa_bin;Trace_a(*)
140 ! Now the spectrum analyzer has all the data to determine
150 ! the measured trace data
160   REAL Trace_a_real(1:401)
170   MAT Trace-a-real= Trace_a*(Ref_lev_factor)
180   FOR I=1 TO 401
190     PRINT Trace-a-real(I)
200   NEXT I
210   END
```

A-Block Format

The A-block format is similar to binary format in that each data point is sent as two 8-bit bytes. This format is in the internal representation of measurement units. See "P Format" above for more information about measurement units. A-block format also transfers a four-byte header before the 401 points (802 bytes) of trace data. These bytes are the ASCII character "#", "A", and two-byte number representing the length of the trace data, followed by the data bytes.

Using A-block format allows you to write your program so that it reads the header data first and determines how many bytes will follow. It can then allocate the proper sized array for the data based on that information.

Example of Using the A-Block Format

This example sends trace data from the spectrum analyzer to the computer and back to the spectrum analyzer in A-block format.

Program Example:

```
10  ! This example uses trace data in A-block format
20  !
30    ASSIGN @Sa TO 718
40    INTEGER Tra bin(1:401)    ! Declare array for trace data
50  ! Declare string for #, A, MSB length, and LSB length header
60    DIM Header$[4]
70    OUTPUT @Sa;"IP;TS;RFCALIB ON;"
80    OUTPUT @Sa;"CF 50 MZ;SP 10MZ;SNGLS;TS;"   ! Take meas sweep
90  ! Send trace A to the computer in A block format
100   OUTPUT @Sa;"MDS W;TDF A;TRA?;"
110 ! Receive the header and the trace data from analyzer
120   ENTER @Sa USING "#,4A,401(W)";Header$,Tra_bin(*)
130   PRINT 'Press CONTINUE to return data to the analyzer"
140   PAUSE
150   OUTPUT @Sa;"IP;TS;VIEW TRA;" ! Preset analyzer, view trace A
```

```
160   OUTPUT @Sa;"TDF A;"
170 ! Receive trace data from the computer
180   OUTPUT @Sa USING "#,K,W,401(W),K";"TRA#A",802,Tra_bin(*),";"
190   END
```

The transferred trace data consists of **#A,** a two-byte number representing the most significant byte (MSB), and the least significant byte (LSB) of the length of the data to follow. Depending on the computer you are using, the data bytes may appear as symbols instead of numbers or they may not appear at all since some data bytes have values representing unprintable characters. Consult your computer documentation to determine the numeric value of the data bytes.

For more detailed information about the A-block format and the MDS command, see the descriptions for TDF and MDS in Chapter 5.

I-Block Format

NOTE: The I-block format is not recommended for use with the RS-232 interface (Option 1AX).

The I-block format transfers data points as two 8-bit bytes in the internal representation of measurement data. In addition to transferring trace data, I-block format also transfers the characters "#" and "I". These characters indicate that the trace data is in I-block format. The I-block format allows the spectrum analyzer to accept up to 401 points of trace data when using I-block format. Fewer than 401 points of trace data can be specified, and the spectrum analyzer will accept data until an EOI signal is sent to it. Therefore, returning the trace data to the spectrum analyzer requires the END instruction. END asserts the EOI line on HP-IB with the last data byte transferred. (See the following example.)

Example of Using the I-Block Format

This example sends trace data from the spectrum analyzer to the computer and back to the spectrum analyzer in I-block format.

Program Example:

```
10   ! Example using trace data in I-block format
20   !
30     INTEGER Tra_binary(1:401) ! Declare array for trace data
40     DIM Header$[2] ! Declare array for # and I header
50     ASSIGN @Sa TO 718
60     OUTPUT @Sa;"IP;SNGLS;RFCALIB ON;TS;" ! Turn 50 MHz sig on
61     OUTPUT @Sa;"CF 50 MZ;SP 10 MZ;TS;" ! Take meas sweep
70     OUTPUT @Sa;"TDF I;TRA?;"      ! Send trace A data in I format
71   ! Receive the header and the trace data from the analyzer
80     ENTER @Sa USING "#,2A,401(W)";Header$,Tra_binary(*)
90     PRINT "Press CONTINUE to return data to the analyzer"
100    PAUSE
110    OUTPUT @Sa;"IP;TS;VIEW TRA;" ! View trace A
```

```
120   OUTPUT @Sa;"TDF I;"
121 ! Receive trace data from the computer
130   OUTPUT @Sa USING "#,K,W,401(W)";"TRA#I",Tra_binary(*)END
140   END
```

The END statement in line 130 sends the spectrum analyzer the last data byte stored in the array and sets the HP-IB EOI line “true,” as required by the I-block format.

The transferred trace data consists of `#I,` followed by data bytes until the EOI line is set true.

For more detailed information about the I-block format and the MDS command, see the descriptions for TDF and MDS in Chapter 5.

Saving and Loading 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 a state file in the spectrum analyzer (25 maximum), in computer memory, or on a computer disk.

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

If you wish to save states in the spectrum analyzer, see the descriptions of the save (SAVE) and load (LOAD) commands in Chapter 5.

Saving the Spectrum Analyzer's State

The following program saves and loads a state and trace from the spectrum analyzer to a computer file.

Program Example:

```
10  !Program saves a SA state and trace in the computer
20  !
30   ! Define 202 character string:
40     DIM Learn_string$[202]
50   ! Create 401-point array to store trace:
60     INTEGER Trace_a(1:401)
70     ASSIGN @Sa TO 718
80     OUTPUT @Sa;"IP;SNGLS;RFCALIB ON;TS;" ! Initialize
90     OUTPUT @Sa;"CF 50 MZ;SP 10 MZ;TS;"
100  ! Set output format for two byte integers:
110    OUTPUT @Sa;"TDF B:"
120  ! Ask spectrum analyzer for trace data:
130    OUTPUT @Sa;"TRA?;"
140  ! Send trace to the computer:
150    ENTER @Sa USING "#,W";Trace_a(*)
160  ! Get learnstring from spectrum analyzer:
170    OUTPUT @Sa;"OL;"
180    ENTER @Sa USING "#,202A";Learn_string$
190  ! Create file to store trace:
200    CREATE BDAT "STATE",4
210  ! Assign path to the file:
220    ASSIGN @File TO "STATE"
230 !  Send trace to the file:
240    OUTPUT @File;Learn_string$,Trace_a(*)
250  ! Return output format to default mode:
260    OUTPUT @Sa;"TDF P;"
270  ! Close file:
280    ASSIGN @File TO *
```

```
290   END
```

This HP-IB program stores the trace in the variable called Trace-a(*). The state of the spectrum 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 disk.

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 spectrum analyzer display.

Line 40 gives the dimensions of the learn string using the HP BASIC DIM command. Learn strings for the spectrum analyzer require 202 bytes of storage space. Also see the output learn string (OL) command.

Line 110 uses TDF B to format the output in binary. Binary provides the fastest data transfer and requires the least amount of memory to store data. Each data point is transferred in binary as two 8-bit bytes. The data points are in the internal representation of measurement data. (See Table 5 in this chapter for more information about trace data formats.)

When the trace and state data are sent from the spectrum analyzer to the computer, they must be formatted. Lines 150 and 180 format trace data with the BASIC USING command. In the formatting statement, "#" indicates that the statement is terminated when the last ENTER item is terminated. EOI (end-or-identify) and LF (line feed) are item terminators, and early termination will result in an inaccurate learn string. "W" specifies word format. "202A" indicates the size of the learn string.

Line 200 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 202-byte learn string is added to give 1004 bytes total. This total is divided by 256 bytes per record, resulting in 4 records.)

NOTE:

If a program containing the CREATE command is run twice, the computer will report an error the second time because the tile already exists. To prevent this error, place an exclamation mark before the CREATE command to "comment out" the line after you run the program the first time. (See line 200.)

When using this program as part of a larger program, the "file exists" error should be trapped out and then the new file will overwrite the existing file.

Returning the Spectrum Analyzer to its Former State

The following program reads a state and trace stored in a file from the previous example and loads it into the spectrum analyzer.

Program Example:

```
10 !Program gets trace file from computer, puts SA back in
20  !
30  !define 202 character string:
40    DIM Learn_string$[202]
50  !create 401 point array to store trace:
60    INTEGER Trace_a(1:401)
70    ASSIGN @Sa TO 718
80  !assign path to the file:
90    ASSIGN @File TO "STATE"
100 !get values for Learn_string$
110  !and Trace-a(*) from disk:
120   ENTER @File;Learn_string$,Trace_a(*)
130  !send learnstring to spectrum analyzer:
140   OUTPUT @Sa;"IP;DONE;"
150   ENTER @Sa
160   OUTPUT @Sa;Learn_string$
170 !set single sweep mode:
180   OUTPUT @Sa;"SNGLS;"
190  !prepare spectrum analyzer for a trace from
200  !the computer:
210   OUTPUT @Sa;"TRA #A";
220  !send trace to the spectrum analyzer
230   OUTPUT @Sa USING "#,W";802,Trace_a(*)
240  !view trace to see it was sent:
250   OUTPUT @Sa;"VIEW TRA;"
260  !close file:
270   ASSIGN @File TO *
280   END
```

This program reads the state and trace data stored in the file STATE, then loads it into the variables Learn-string$ and Trace-a(*).

First, the settings of the spectrum analyzer that were stored in the variable Learn-string$ are recalled. The spectrum analyzer state is changed to the same state as when the trace was stored. Then previously stored trace data is returned to the spectrum analyzer and the trace is viewed on the spectrum analyzer screen. Line 230 uses the HP BASIC USING command to format the trace data.

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 using a formula. The following program measures percent of total harmonic distortion automatically, quickly, and accurately.

The program operates as if we were making the measurement manually.

NOTE: This program is designed to measure harmonics of a signal that is greater than 20 MHz.

Program Example for the HP-IB Interface:

```
10  !Program measures total harmonic distortion
20  !
30    ASSIGN @Sa TO 718   ! assign IO path to spectrum analyzer
40 Variables:             ! define variables:
50    REAL Fundamental,Fund_amptd_v,Fund_amptd_dbm
60    REAL Prcnt_distort,Sum_sqr
70    INTEGER Max_harmonic,I,Number
80   !allow user to change the number of harmonics:
90    Max_harmonic=4
100   ALLOCATE REAL Harm_v(2:Max_harmonic)
110   ALLOCATE REAL Harm_dbc(2:Max_harmonic)
120   GOSUB Clearscreen !  clear the alpha screen
130  !ask for the frequency of the fundamental:
140   OUTPUT CRT USING "4/,10X,K,3/";"***HARMONIC DISTORTION***"
150   OUTPUT CRT USING "10X,K";"CONNECT SOURCE TO INPUT"
160   OUTPUT CRT USING "10X,K";"ENTER FUNDAMENTAL FREQUENCY IN MHz"
170   OUTPUT CRT USING "10X,K";"WHEN READY, PRESS ENTER "
180   INPUT Fundamental
190   GOSUB Clearscreen! clear the alpha screen
200 Fundamental:       ! write message on screen:
210   DISP "MEASURING FUNDAMENTAL"
220  !preset the spectrum analyzer, set single sweep mode, and
230  !take sweep:
240   OUTPUT @Sa;"IP; SNGLS; TS;"
250  !tune the spectrum analyzer to the fundamental freq and set
260  !20 MHz span:
270   OUTPUT @Sa;"CF ";Fundamental;"MZ;"
280   OUTPUT @Sa;"SP 20MZ; TS;"
290  !put a marker on signal peak, move marker to
300  !reference level:
310   OUTPUT @Sa;"MKPK HI; MKRL; TS;"
320  !find signal peak, activate signal track, and
330  !narrow span:
340   OUTPUT @Sa;"MKPK HI; TS;"
350   OUTPUT @Sa;"MKTRACK ON; SP 100KZ; TS;"
360  !turn off signal track:
```

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

```
Harm_dbc(I); "dBc"
970   NEXT I
980 OUTPUT CRT USING "11X,K,DDD.D,K";"Tot Dist=";Prcnt_distort;" %"
990   !
1000  LOCAL 7
1010  STOP
1020 !
1030 Clearscreen:  !alpha clear subroutine
1040 !the statement below presses the 'CLR SCR" key on
1050 !the keyboard:
1060 OUTPUT KBD USING "#,B";255,75
1070  RETURN
1080  END
```

The program prompts the user to connect a source to the spectrum analyzer 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 result of the harmonic distortion percentage computation, plus harmonic amplitudes in dBc (decibels relative to the carrier), are displayed on the computer display. Comments have been added (after the exclamation points) to help clarify the program.

If necessary, change the number of harmonics in line 90.

Monitoring System Operation

The following information only applies to remote operation using the HP-IB interface.

The programming techniques discussed so far describe communication between the analyzer and the computer, where the sequence of all data transfer is controlled by a computer program. This section describes how the analyzer can interrupt computer operation when it has attained a particular state.

The interrupting process is called a service request. Service requests have many applications. They facilitate economical use of computer-processing time when the analyzer is part of a large measurement system. For example, after the computer initiates an analyzer measurement, the computer can make calculations or control other devices via HP-IB while the analyzer is measuring. When the analyzer is through, it signals the computer with a service request. The computer service-request subprogram then determines what the computer will do next. Service requests can also be used to report analyzer errors and other analyzer events, such as end-of-sweep.

Programming Steps Using Service Requests

The main points to using service requests are highlighted below:

1 Choose the conditions for generating service requests.
2 Set a bit mask that enables only these chosen conditions.
3 Prepare the computer to accept service requests. Use the ON INTR.. .GOSUB and ENABLE INTR statements.
4 Once an interrupt is triggered, use the analyzer STB command or the SPOLL statement to read the interrupt.

Interrupt Process

The interrupt process begins when the analyzer "requests" attention by setting the HP-IB service-request line (SRQ) true. The computer must be programmed to respond to this event. Typically, the computer is programmed to interrupt normal program execution and call a user-specified subroutine when the service request occurs. If multiple instruments are being controlled remotely, this subroutine determines which instrument or instruments on HP-IB caused the service request. Then, it may be necessary to call another subroutine that determines why a particular instrument requested service (because there can be more than one possible cause). Finally, one or more subroutines will be called to respond to the indicated events. Note that more than one instrument can request service simultaneously, and each instrument can have more than one event to report. These steps are summarized below.

1 Computer monitors HP-IB service request line (SRQ).
2 Analyzer requests service by setting the SRQ line true.
3 Computer branches to routine that determines the instrument or instruments that caused the SRQ.
4 Computer branches to routine that determines why a particular instrument is requesting service.
5 Computer branches to routine to process a specific event in a particular instrument.

Some of the routines (that are shown above) can be omitted, if only one instrument has been instructed to use the SRQ line, or if a particular instrument has been instructed to use the SRQ line for only one event.

Several system-level statements are required to make the computer respond to service requests. The HP BASIC statement, ENABLE INTR (enable interrupt), tells the computer to monitor the service-request line. The on-interrupt statement, ON INTR, specifies where the computer program will branch when a service request occurs. If more than one instrument could cause the service request, or if an instrument can cause a service request for more than one reason, the serial-poll statement, SPOLL, is used. The serial-poll statement is always required to clear the service request being generated by the instrument.

Analyzer Status Byte

The analyzer **status byte** indicates the status or occurrence of certain analyzer functions. The status byte contains eight bits, numbered 0 to 7, with bit 0 being the least significant bit.

Bits 0, 1, 2, 3, 4, 5, and 7 represent specific conditions or events. These bits are referred to as **condition bits** and **event bits**. Condition bits reflect a condition in the analyzer that can be present or absent at any given moment. Event bits reflect the occurrence of a transition or event within the analyzer.

Bit 6 is set by the analyzer to indicate whether or not it is requesting service.

When the analyzer is instructed not to use the service request line on HP-IB, the status bits always reflect the current condition of the analyzer. In this situation, the ***event bits*** in the status byte should not be used. Event bits are only true at the exact instant of a transition in the analyzer and as such are not reliable when service requests are disabled.

When the analyzer is instructed to generate service requests for one or more conditions or events, the status bits reflect the current condition of the analyzer until a service request is generated. Then, the bits that are generating the service request are held true until the status byte is read out of the analyzer (by the HP BASIC SPOLL system-level statement), by the **STB?** command, or until an HP-IB DEVICE CLEAR (HP BASIC CLEAR system-level statement) is received. These actions clear the status byte to once again reflect the current conditions and events within the analyzer.

The Service-Request Mask

The service-request mode is enabled and controlled by the request service condition command, RQS. It defines a **service-request mask** that specifies which of the status byte bits can generate a service request. Below, RQS specifies the ILLEGAL-COMMAND and COMMAND-COMPLETE states (bits 5 and 4, respectively) for service requests.

```
OUTPUT @Sa;"RQS ";DVAL("00110000",2)
```

Selects bit 5 and 4 (32+16=48) to enable service request mode for ILLEGAL-COMMAND and COMMAND-COMPLETE.

```
OUTPUT @Sa;"RQS 48;"
```

Also selects bits 5 and 4 as above, but is somewhat easier to read.

Once RQS is executed, the analyzer requests service by setting the SRQ line true when the desired conditions or events occur.

Table 6 **Status Register**

Bit Number	Decimal Equivalent	Analyzer State	Description	(E)vent or (C)ondition
7	128		Not used	
6	64	RQS	Requests service	
5	32	ILLEGAL COMMAND	Set when illegal command is received	
4	16	COMMAND COMPLETE	Any command is completed	
3	8	HARDWARE BROKEN	Set when hardware error occurs	
2	4	END OF SWEEP	Set when any sweep is completed	
1	2	UNIT KEY PRESSED	Set when any units key is pressed	

Table 6 **Status Register**

Bit Number	Decimal Equivalent	Analyzer State	Description	(E)vent or (C)ondition
0	1	OPERATOR NOTIFICATION	Set if an overload is detected on the analyzer RF input, if excessive reverse power is detected on the RF output (options 1DN or 1DQ only), or if the tracking generator becomes unleveled (options 1DN or 1DQ only).	

Computer Interrupt Statements

Now that the spectrum analyzer is prepared to trigger service requests, you must prepare the computer to accept this type of interrupt. Use the BASIC statements ON INTR.. .GOTO or CALL or GOSUB and ENABLE INTR. ON INTR.. .GOTO causes the computer to branch to a subroutine or some other part of the program when an interrupt is generated. ENABLE INTR enables the computer to accept an interrupt. These two commands appear below.

```
10 OUTPUT @Sa;"RQS 16;"
20 ON INTR 7 GOSUB Srq
30 ENABLE INTR 7;2
```

In this example, Line 20 indicates that if an interrupt appears (ON INTR 7), the computer is to go to the subroutine Srq (GOSUB Srq). The 7 specifies the interface select code; in this case, it refers to the Hewlett-Packard Interface Bus (HP-IB). Line 30 enables the computer to accept an interrupt. Here, the 7 again specifies the HP-IB select code. The semicolon is part of the BASIC statement ENABLE INTR. The 2 indicates that the interrupt is specifically a service request interrupt, which is asserted from the SRQ line of the HP-IB. From Line 10, you know the interrupt will be a service request triggered from a "command complete" condition.

Now that the spectrum analyzer and computer can assert and accept service-request interrupts, choose an event that will trigger the service request and create a subroutine to handle the interrupt. In the example below, the take sweep command (TS) is used to trigger a command complete signal. (Because 10 video-averaging sweeps are desired, this signal does not occur until after the selected number of averages is complete.) This service request will cause the computer to go to the subroutine Srq. The subroutine identifies the type of service request and prints it on the computer screen. See Example 1.

Example 1:

```
10 ASSIGN @Sa TO 718
20    OUTPUT @Sa;"IP;SNGLS;RFCALIB ON;TS;" ! Initialize
30    OUTPUT @Sa;"CF 50 MZ;RB .3 MZ;SP 10 MZ;TS;"    ! Set analyzer
50    OUTPUT @Sa;"RQS 16;"  ! Set mask for command complete
60    ON INTR 7 GOTO Srq
      ENABLE INTR 7;2
70    OUTPUT @Sa;"VAVG 30;TS;" END ! Video avg on, assert EOI
80 Idle:GOTO Idle
90 Srq:Sbyte=SPOLL(718)
100   PRINT Sbyte
110   PRINT "VIDEO AVERAGING IS COMPLETE"
120   OUTPUT @Sa;"RQS 0;"
130   END
```

Line 20 sets the desired instrument state. Note that the instrument is set to single-sweep mode. This allows the video averages to happen only when the take-sweep command is sent.

Line 50 directs that the computer should execute the Srq routine when an interrupt occurs.

Line 60 enables the computer to accept the interrupt.

Line 70 selects the number of video averages desired.

Line 80 sends the take-sweep command; during the 30 video averages that will now occur, the computer remains on line 80. When the video averaging is complete, TS is complete and the "command complete" condition is satisfied. The computer then branches to the subroutine Srq.

Lines 90 and 100 causes the computer to read the decimal equivalent of the generated service request into the variable Sbyte. The computer then prints the value, alerting you that the interrupt has occurred.

Line 120 returns the status register to its initial state (that is, no conditions are masked).

Reading Service Request Data

In the above example, you used the serial-poll statement (SPOLL) to read the service request data into a variable. The STB (status byte query) command also reads service request data. Example 2 shows how.

Example 2:

```
10    ASSIGN @Sa TO 718
20    OUTPUT @Sa;"IP;SNGLS;RFCALIB ON;TS;"
30    OUTPUT @Sa;"CF 50 MZ;RB .3 MZ;SP 10 MZ;TS;"
40    OUTPUT @Sa;"RQS 16;"
```

```
50     ON INTR 7 GOSUB Srq
60     ENABLE INTR 7;2
70     Done=0
80     OUTPUT @Sa;"VAVG 30;TS;";END
90 Idle:IF Done=0 THEN
100       GOTO Idle
110       STOP
120 Srq:OUTPUT @Sa;"STB?;";
130       ENTER @Sa;Sbyte
140       PRINT sbyte
150       PRINT "VIDEO AVERAGING IS COMPLETE"
160       OUTPUT @Sa;"RQS 0;"
170       Done=1
180       RETURN
190    END IF
200    END
```

Line 40 sets the bit mask so that only the "command complete" condition is set. On Line 120, once the "command complete" condition is satisfied (in this case, after 30 video averages), the STB command queries the spectrum analyzer for the service-request data. The data is then entered into variable Sbyte and printed. The value returned is the decimal equivalent of the generated service request.

Reading Service Requests From More Than One Instrument

Most instruments that can be controlled remotely have service request capability similar to that in the spectrum analyzer. You may want to take advantage of this capability in other instruments also. If you have more than one instrument on a bus that can generate a service request, you need to modify the above program to look for interrupts from more than one instrument. See Example 3.

Example 3:

```
10     ASSIGN @Sa TO 718
20     OUTPUT @Sa;"IP;SNGLS;RFCALIB ON;TS;"
30     OUTPUT @Sa;"CF 50 MZ;RB .3 MZ;SP 10 MZ;TS;"
40     OUTPUT @Sa;"RQS 16;"
50     ON INTR 7 GOSUB Srq
60     ENABLE INTR 7;2
70     Done=0
80     OUTPUT @Sa;"VAVG 30;TS;";END
90 Idle:IF Done=0 THEN
100       GOTO Idle
110       STOP
120 Srq:Sbyte_1=SPOLL(718)
130       Sbyte_2=SPOLL(705)
140       IF BIT(Sbyte_1,6)=1 THEN
150         PRINT "SERVICE REQUEST",Sbyte_1,"ON ADDRESS 18"
160         OUTPUT @Sa;"RQS 0;"
170         STOP
180       END IF
190       IF BIT(Sbyte_2,6)=1 THEN
200         PRINT "SERVICE REQUEST",Sbyte_2,"ON ADDRESS 5"
210       END IF
220       ENABLE INTR 7;2
```

```
230     Done=1
240     RETURN
250   END IF
260   END
```

In this example, you execute the SPOLL command for each instrument that can cause a service request interrupt; in this case, the analyzer or an instrument that is set to address 5. Once the instruments are queried for interrupts, the IF...THEN statements provide a way to branch to the appropriate routine.

Testing Service Request Routines

In the previous programming examples, you knew that a service request would be generated when the VAVG command was completed. You could easily test the program and make sure that it worked. However, service requests may not always be so predictable; this can make a program difficult to test. The spectrum analyzer SRQ command automatically triggers any service request you choose. Of course, as with other service requests, you must set the bit mask before executing the SRQ command. See Example 4.

Example 4:

```
10    ASSIGN @Sa TO 718
20    OUTPUT @Sa;"IP;SNGLS;RFCALIB ON;TS;"
30    OUTPUT @Sa;"CF 50 MZ;RB .3 MZ;SP 10 MZ;TS;"
40    OUTPUT @Sa;"RQS 16;"
50    ON INTR 7 GOSUB Srq
60    ENABLE INTR 7;2
70    Done=0
80    OUTPUT @Sa;"SRQ 16;"
90 Idle:IF Done=0 THEN
100     GOTO Idle
110     STOP
120 Srq:Sbyte=SPOLL(718)
130     PRINT Sbyte
140     PRINT "INTERRUPT GENERATED"
150     OUTPUT @Sa;"RQS 0;"
160     Done=1
170     RETURN
180   END IF
190   END
```

On Line 80 a “command complete” service request is immediately generated, and you can be sure that the routine will work.

Using Markers

Markers can be used to locate signal peaks. A markers position is defined by two values, the amplitude and the frequency (or time.) The frequency, amplitude, or time values of a marker can be queried. This information can be used to identify signals and to redefine the analyzer's displayed frequency span or amplitude. The following program lines show several different marker commands being used.

Program Example:

```
10  !Program fragment outputs different marker types
20 OUTPUT @Sa;"TDF P;MKREAD FRQ;MKF?;"  !Freq,if not 0 span
30 OUTPUT @Sa;"TDF P;MKREAD FRQ;MKF?;"  !Marker time(s), if 0 span
40 OUTPUT @Sa;"TDF P;MKREAD PER;MKF?;"  !Time of l/marker freq (s)
50 OUTPUT @Sa;"TDF P;MKREAD SWT;MKF?;"  !Marker time (in seconds)
60 OUTPUT @Sa;"TDF P;MKREAD IST;MKF?;"  !Freq of l/marker time
70 OUTPUT @Sa;"TDF P;MKREAD FFT;MKF?;"  !Marker freq (Hz)
```

MKF results with TDF set to A or I:

If the trace data format is set to trace data format A, the result depends on the setting of the MDS command.

Program Example:

```
10 OUTPUT @Sa;"TDF A;MDS B;MKF?;"  !One byte of marker position
20 OUTPUT @Sa;"TDF A;MDS W;MKF?;" !Two byte binary word (1 to 401)
```

Using the trace data format I is equivalent to the TDF A format.

MKF results with TDF set to M:

If the trace data format is used with trace data format M, the result is the marker horizontal position value, from 1 to 401, in ASCII.

Program Example:

```
10 OUTPUT @Sa;"TDF M;MKF?;"  !Marker horizontal position (ASCII)
```

Program Example:

```
10 !Finds signal peak using markers
20 !
30   ASSIGN @Sa TO 718  ! assign IO path to spectrum analyzer
40   OUTPUT @Sa;"IP;RFCALIB ON;SNGLS;"
50   OUTPUT @Sa;"CF 50 MZ;SP 50 MZ;TS;"   ! Initialize, start/stop
60   INPUT "ENTER IN PEAK EXCURSION, IN DB ",Excursion
70   OUTPUT @Sa;"MKPX ";Excursion;"DB;" ! Change peak excursion lvl
80   OUTPUT @Sa;"TS;MKPK HI;"   ! Search for highest peak
```

```
90    OUTPUT @Sa;"MKF?;"  ! Find freq of peaks
100   ENTER @Sa;Freq      ! Put response in variable
110   IF Freq<>0 THEN     ! Output results if frequency was not 0
120     PRINT "PEAK FOUND"
130   ELSE                ! Prints, No peaks found, if variable=0
140     PRINT "NO PEAKS FOUND"
150   END IF
160   END
```

Program Example:

```
10 !Delta marker example
20 !
30    ASSIGN @Sa TO 718   ! Assign IO path to spectrum analyzer
40    OUTPUT @Sa;"IP;SNGLS;" ! Initialize SA, goto single sweep
50    INPUT "Enter the Start Frequency, in MHz",Start_freq
60    INPUT ‘Enter the Stop Frequency, in MHz",Stop_freq
70    OUTPUT @Sa;"FA “;Start_freq;"MHZ;" ! Set start freq
80    OUTPUT @Sa;"FB “;Stop_freq;"MHZ;"   ! Set stop freq
90 !  Update trace, find peak, and minimum. Return delta frequency
100   OUTPUT @Sa;"TS;MKPK HI;MKD;MKMIN;MKF?;"
110   ENTER @Sa;Delta_freq!Get results
120   PRINT "The difference in Frequency is “,Delta_freq,"Hz"
130   END
```

Using Limit Lines

Example 1

This example enters segments into the upper limit-line table, then enters a segment into the lower limit-line table. (Upper and lower limit lines are treated as separate tables). Line 50 demonstrates deleting a limit-line table.

Program Example:

```
10   ! Limit line example where the upper & lower limits are
20   ! treated as seperate tables
30  !
40     ASSIGN @Sa TO 718   ! assign IO path to spectrum analyzer
50     OUTPUT @Sa;"LIMIDEL;" ! Del current table, sets fixed type
60     OUTPUT @Sa;"LIMIHALF UPPER;"  ! Selects upper limit table
70     OUTPUT @Sa;"LIMIFT FREQ;"  ! Limit lines based on freq
80     OUTPUT @Sa;"LIMISEG 300MHZ,-30DB,FLAT;" ! Enter segment
90     OUTPUT @Sa;"LIMIHALF LOWER;"  ! Selects lower limit table
100    OUTPUT @Sa;"LIMISEG 300MHZ,-70DB,FLAT;" ! Enter segment
110    OUTPUT @Sa;"SEGDEL 1;"  ! Delete segment from lower table
120    END
```

Measure Signal Bandwidth

It is often necessary to characterize a bandpass filter. A common figure of merit is its shape factor, that is the ratio of the bandwidth 3 dB down from the peak to the bandwidth 60 dB down from the peak. The following program measures shape factor.

This example finds the shape factor of a filter.

Program Example:

```
10  !Example finds the shape factor of a filter
20  !
30    ASSIGN @Sa TO 718    ! assign IO path to spectrum analyzer
40    OUTPUT @Sa;"IP;RFCALIB ON;SNGLS;TS;" ! Turn 50 MHz sig on
50    OUTPUT @Sa;"CF 50 MZ;SP 10 MZ;RL -25 DM;RB .3 MZ;TS;"
60    OUTPUT @Sa;"NDBPNT 1;" ! Turns on NdB points measurement
70    OUTPUT @Sa;"NDB -3DB;TS;"  ! Set to measure 3 dB bandwidth
80    OUTPUT @Sa;"NDBPNTR?;"     ! Query for results
90    ENTER @Sa;Three            ! Store results in variable
100   OUTPUT @Sa;"NDB -60DB;TS;" ! Set to measure 60 dB bandwidth
110   OUTPUT @Sa;"NDBPNTR?;"     ! Query for results
120   ENTER @Sa;Sixty            ! Store results in variable
130   IF Three<>-100 AND Sixty<>-100 THEN
140    PRINT "Shape factor is ",Sixty/Three ! then print shape factor
150   ELSE                     ! If either result couldn't be found
160     PRINT "Error, bandwidth could not be determined"
170   END IF
180   OUTPUT @Sa;"NDBPNT 0;"  ! Turn off NdB points measurement
190   END
```

Line 130 checks the 3 dB and 60 dB bandwidth measurement results. A value of -100 indicates that the function did not find a valid signal to measure.

Measuring Noise

The system noise level often needs to be measured. This signal to noise ratio is used to quantify the noise. In communications systems, the power of the carrier signal is measured and compared to the power level of the noise floor. See the following example.

Program Example:

```
10  !Program measures carrier to noise ratio, uses noise marker
20  !
30    ASSIGN @Sa TO 718
40    OUTPUT @Sa;"IP;TS;RFCALIB ON;" ! Initialize, turn source on
50    OUTPUT @Sa;"CF 50 MZ;SP 10 MZ;SNGLS;TS;"
60   ! Marker to highest peak
70    OUTPUT @Sa;"MKPK HI;TS;"
80   ! Move marker off peak and measure noise
90    OUTPUT @Sa;"MKD UP;UP;MKNOISE ON;TS;MKA?;"
100   ENTER @Sa;C_to_n             ! Put marker value into variable
110   OUTPUT @Sa;"MKNOISE OFF;"    ! Turn off noise marker
120   PRINT 'Carrier to Noise Ratio in 1 Hz BW is ";C_to_n;"dB"
130   END
```

Using Amplitude Correction

You can correct the amplitude of the displayed trace data for known system conditions. Amplitude correction values can be entered for known frequencies. The trace data will be corrected at these values, with interpolation done on the values between the given points.

Compensate for frequency-dependent amplitude inaccuracies at the input.

Program Example:

```
10  ! This program uses amplitude correction
20  !
30    ASSIGN @Sa TO 718
40    DIM A$[200]
50    OUTPUT @Sa;"CF 1GHZ;SP 200MHZ;"
60  ! Store freq/ampl pairs, in ascending order
70    OUTPUT @Sa;"AMPCOR 100MHZ,5DB,1GHZ,-5DB,1.5GHZ,10DB;"
80    OUTPUT @Sa;"AMPCOR?;"      ! Get amp cor value from SA
90    ENTER @Sa;A$
100   PRINT "AMPCOR ON:",A$      ! Display freq/ampl pairs
110   OUTPUT @Sa;"AMPCOR OFF;"
120   OUTPUT @Sa;"AMPCOR?;"
130   ENTER @Sa;A$
140   PRINT "AMPCOR OFF:",A$   ! AMPCOR is off, "0,0" is displayed
150   END
```

Examples Using the RS-232 Interface

The examples in this section are written for the RS-232 interface using Quick BASIC.

Reading Trace Data

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

Program Example:

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

The program creates a 401 -point trace array, called TRCA, in which the trace data will be stored. Then it uses the TRA command to request trace A data. The spectrum analyzer sends trace A data to the variable, TRCA.

Saving Trace Data

The trace data in the previous program can be stored on a computer disk. See the following example.

Program Example:

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

Using the OPEN command, we create an empty file on the disk for storing the trace and assign an output path to the file TRACEA. Then we send the trace data to the file. (See lines 260 through 280.)

Reading Trace Data from a Computer Disk

If we want to return trace data 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 disk and stores the trace in an array variable.

Program Example:

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

```
90 INPUT #2, TRCA(I)
100 NEXT I
110 CLOSE
120 END
```

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

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 files in the spectrum analyzer, in computer memory, or on a computer disk. This program demonstrates how the state information and the trace data is read from the spectrum analyzer.

Program Example:

```
10 'File = 232PROG8
20 OPEN "COM1:9600,N,8,1" FOR RANDOM AS #1
30 'Define 210-character string
40 DIM LEARN$(210)
50 'Create 802-character string to store trace data
60 DIM TR1$(200), TR2$(200), TR3$(200)
70 DIM TR4$(200), TR5$(2), TR6$(200)
80 'ask spectrum analyzer for trace data in binary format
90 PRINT #1, 'TDF B; TRA?;"
100 'enter trace data from spectrum analyzer
110 TR1$ = INPUT$(200, #1)'first 200 characters
120 TR2$ = INPUT$(200, #1)'second 200 characters
130 TR3$ = INPUT$(200, #1)'third 200 characters
140 TR4$ = INPUT$(200, #1)'fourth 200 characters
150 TR5$ = INPUT$(2, #1)'last two characters
160 'ask for learn string from spectrum analyzer
170 PRINT #1, "OL;"
180 'get learn string from spectrum analyzer
190 LEARN$ = INPUT$(210, #1)
200 'create file to store trace on disk
210 OPEN "TRACEA" FOR OUTPUT AS #2
220 'change ASCII data to integers for disk storage
230 'because ASCII 26 will put EOF on disk
240 DEFINT I, X-Y'integer variables
250 DIM X1(210), Y1(802)'arrays for the data
260 'first format the learn string
270 FOR I = 1 TO 210
280 'get ASCII character from string
290 L2$ = MID$(LEARN$, I, 1)
300 'make integer of ASCII value 0-255
310 X1(I) = ASC(L2$)
320 NEXT I
330 'format the data strings
340 T5 = l'set counter
350 TR6$ = TR1$'set string to be converted
360 GOSUB 620 'do the conversion
```

```
370 T5 = 201'set counter
380 TR6$ = TR2$'set string to be converted
390 GOSUB 620 'do conversion
400 T5 = 401
410 TR6$ = TR3$
420 GOSUB 620
430 T5 = 601
440 TR6$ = TR4$
450 GOSUB 620
460 'convert last two characters
470 L2$ = MID$(TR5$, 1, 1)
480 Y1(801) = ASC(L2$)
490 L2$ = MID$(TR5$, 2, 1)
500 Y1(802) = ASC(L2$)
510 'data is now formatted, write to disk
520 FOR I = 1 TO 210
530 PRINT #2, X1(I)
540 NEXT I
550 FOR I = 1 TO 802
560 PRINT #2, Y1(I)
570 NEXT I
580 'close the data file
590 CLOSE #2
600 GOTO 680
610 'subroutine for converting data:
620 FOR I = 1 TO 200
630 L2$ = MID$(TR6$, I, 1)'get ASCII character
640 Y1(T5) = ASC(L2$) 'set value in array
650 T5 = T5 + 1
660 NEXT I
670 RETURN   'done with conversion
680 END
```

This program reads a trace and state from the spectrum analyzer. The trace information is stored in five string variables. These variables are then converted to a numeric array. The state of the spectrum analyzer is stored in the string variable LEARN$. This variable is also converted to numeric array. These two numeric arrays are then saved to a file on a disk called TRACEA.

Line 40 gives the dimensions of the learn string using the Quick BASIC DIM command. Learn strings for the spectrum analyzer require 210 bytes of storage space. Refer to the output learn string (OL) command description in Chapter 5 for more information.

Line 90 uses TDF B to format the output in binary. Binary provides the fastest data transfer and requires the least amount of memory to store data. Each data point is transferred in binary as two 8-bit bytes. The data points are in the internal representation of measurement data. (See Different Formats for Trace Data Transfers on page 55 for more information about trace data formats.)

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

Lines 330 to 510 format the trace data.

Returning the Spectrum Analyzer to its Former State

The following program reads a state and trace stored in a file and loads it into the spectrum analyzer.

Program Example:

```
10 'File = 232PROG9
20 OPEN "COM1:9600,N,8,1" FOR RANDOM AS #1
30 DEFINT I, X-Y'integer variable
40 'define 210-character string
50 DIM LEARN$(210), X1(210)
60 'create an 802-character string to store disk data
70 DIM TR1$(200), TR2$(200), TR3$(200), TR4$(200)
80 DIM TR5$(2), TR6$(200), Y1(802)
90 'open disk file "TRACEA"
100 OPEN "TRACEA" FOR INPUT AS #2
110 'enter learn array from disk
120 FOR I = 1 TO 210
130 INPUT #2, X1(I) 'get integer variable from disk
140 NEXT I
150 'enter trace data from disk
160 FOR I = 1 TO 802
170 INPUT #2, Y1(I)
180 NEXT I
190 'close the disk file
200 CLOSE #2
210 'format the integer data into strings
220 'for the spectrum analyzer. See 232PROG8 for explanation
230 LEARN$ = ""'null out the learn string
240 FOR I = 1 TO 210'format learn string first
250 LEARN$ = LEARN$ + CHR$(X1(I))
260 NEXT I
270 'format the trace data
280 I2 = 1'set the counter
290 GOSUB 500 'do the conversion
300 TR1$ = TR6$'set the string
310 I2 = 201
320 GOSUB 500 'do the conversion
330 TR2$ = TR6$
340 I2 = 401
350 GOSUB 500
360 TR3$ = TR6$
370 I2 = 601
380 GOSUB 500
390 TR4$ = TR6$
400 'format last two characters
410 TR5$ = ""
420 TR5$ = TR5$ + CHR$(Y1(801)) + CHR$(Y1(802))
430 'write to spectrum analyzer
440 PRINT #1, LEARN$
445  SLEEP 3
450 'output trace data
460 PRINT #1, "TRA"; TR1$; TR2$; TR3$; TR4$; TR5$;
470 PRINT #1, 'VIEW TRB;"
480 GOTO 560 'end program
490 'subroutine for converting integer data to ASCII
500 TR6$ = ""'set the string to a null value
```

```
510 FOR I = 1 TO 200
520 TR6$ = TR6$ + CHR$(Y1(I2))
530 I2 = I2 + 1
540 NEXT I
550 RETURN 'done with conversion
560 END
```

The program reads a state and trace stored in the file TRACEA. This program assumes that trace data is stored on the disk using the previous program example.

First, the settings of the spectrum analyzer that were stored in the variable LEARN$ are recalled. The spectrum analyzer state is changed to the same state as when the trace was stored. Then previously stored trace data is returned to the spectrum analyzer and the trace is viewed on the spectrum analyzer screen.

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 using a formula. The following program measures percent of total harmonic distortion automatically, quickly, and accurately.

The program operates as if we were making the measurement manually.

NOTE: This program is designed to measure harmonics of a signal that is greater than 20 MHz.

Program Example:

```
10 'File = THDTEST
20 OPEN "COM1:9600,N,8,1" FOR RANDOM AS #1
30 'allow user to change the number of harmonics
40 MAXHARMONIC = 4
50 DIM HARMONICV(10), HARMONICDBC(10)
60 'clear the screen
70 CLS
80 'ask for the frequency of the fundamental
90 PRINT "******* HARMONIC DISTORTION *******"
100 PRINT
110 PRINT "CONNECT SOURCE TO ANALYZER INPUT, THEN"
120 PRINT "ENTER FREQUENCY OF THE FUNDAMENTAL IN MHZ"
130 PRINT
140 INPUT FUNDAMENTAL
150 CLS
160 'print measuring fundamental on screen
170 PRINT "MEASURING FUNDAMENTAL"
180 'preset the spectrum analyzer, set single-sweep and
185 'take sweep
190 PRINT #1, "IP;SNGLS;TS;"
```

```
200 PRINT #1, "DONE;"
210 INPUT #1, DONE
220 ‘tune the spectrum analyzer to the fundamental freq and set
225 ‘20 MHz span
230 PRINT #1, ‘CF “; FUNDAMENTAL; "MHZ"
240 PRINT #1, "SP 20MZ;TS;”
250 PRINT #1, "DONE;"
260 INPUT #1, DONE
270 'put a marker on signal peak, move marker to
275 'reference level
280 PRINT #1, “MKPK HI;MKRL;TS;"
290 'find signal peak, activate signal track, and
295 'narrow span
300 PRINT #1, “MKPK HI;TS;”
310 PRINT #1, "MKTRACK ON;SP 100KZ;TS;”
320 PRINT #1, "DONE;"
330 INPUT #1, DONE
340 ‘turn off signal track
350 PRINT #1, "MKTRACK OFF;"
360 ‘find peak of signal, move peak to center of screen
370 ‘make units in volts
380 PRINT #1, “AUNITS V;"
390 ‘find peak of signal, send amplitude value to
395 'computer
400 PRINT #1, "MKPK HI;MKA?;”
410 INPUT #1, FUNDAMPTDV
420 ‘send marker frequency to computer, enter frequency
425 ‘value
430 PRINT #1, "MKF?;"
440 INPUT #1, FUNDAMENTAL
450 ‘make the fundamental frequency the center freq
455 'step size
460 PRINT #1, ‘MKSS;"
470 ‘set the fundamental frequency units to MHZ
480 FUNDAMENTAL = FUNDAMENTAL / 1000000!
490 FOR NUMBER = 2 TO MAXHARMONIC
500 PRINT "MEASURING HARMONIC # “; NUMBER
510 'set span and tune to next harmonic
520 PRINT #1, ‘SP 20MZ;”
530 PRINT #1, ‘CF UP;TS;"
540 PRINT #1, "DONE;"
550 INPUT #1, DONE
560 'take a second sweep to allow spectrum analyzer to move to
570 'the center frequency, find the signal peak,
575 ‘activate the signal track
580 PRINT #1, ‘TS;"
590 PRINT #1, ‘MKPK HI;MKTRACK ON;SP 100KZ;TS;”
600 PRINT #1, "MKTRACK OFF;"
610 ‘find signal peak, send amplitude value to computer
620 ‘enter amplitude of harmonic
630 PRINT #1, "MKPK HI;MKA?;”
640 INPUT #1, HARMONICV(NUMBER)
650 NEXT NUMBER
660 'set amplitude units to dBm
670 PRINT #1, “AUNITS DBM;"
680 'calculate the fundamental amplitude in dBm because
690 'it was measured in volts
700 FUNDAMPTDDBM = 10 * (LOG(FUNDAMPTDV ^ 2 / .05) / 2.3026)
710 'calculate the sum of the squares of the amplitudes
720 ‘of the harmonics, calculate amplitudes of
725 ‘harmonics (dBm)
```

```
730 SUMSQR = 0
740 FOR I = 2 TO MAXHARMONIC
750 SUMSQR = SUMSQR + HARMONICV(I) ^ 2
760 HARMONICDBC(I) = 20 * (LOG(FUNDAMPTDV / HARMONICV(I)) / 2.3026)
770 NEXT I
780 'calculate the percent distortion
790 PRCNTDISTORT = SQR(SUMSQR) / FUNDAMPTDV * 100
800 CLS
810 'output the data
820 PRINT "******* HARMONIC DISTORTION RESULTS *******"
830 PRINT "FREQUENCY = "; FUNDAMENTAL; "MHZ"
840 PRINT "AMPLITUDE = "; FUNDAMPTDDBM; " dbc"
850 FOR I = 2 TO MAXHARMONIC
860 PRINT "HARMONIC # "; I; " = -"; HARMONICDBC(I); " dbm"
870 NEXT I
880 PRINT "TOTAL DISTORTION = "; PRCNTDISTORT; " %"
890 END
```

The program prompts the operator to connect a source to the spectrum analyzer 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 results of the harmonic distortion percentage computation, plus harmonic amplitude in dBc (decibels relative to the carrier), are displayed on the computer display.

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

4

Programming Command Cross References

Command to Front-Panel

Command	Corresponding Key Function	Description
ALIGN	Align Now or Auto Align	Controls automatic alignment of measurement systems.
AMPCOR	Ampcor	Applies amplitude corrections at specified frequencies.
ANNOT	Annotation On Off	Turns on or off the screen annotation.
APB	none	Adds trace A to trace B and sends the result to trace A.
AT	Attenuation Auto Man	Specifies RF input attenuation.
ATC	$A \rightarrow C$	Transfers trace A into trace C.
AUNITS	Amptd Units	Specifies amplitude units for input, output, and display.
AUTO	Auto Couple	Couples the active functions automatically.
AXB	$A \leftrightarrow B$	Exchanges trace A and trace B.
BAUDRATE	Baud Rate	Specifies the baud rate of a spectrum analyzer with Option 1AX installed in it.
BLANK	Blank A, Blank B, or Blank C	Blanks trace A, trace B, or trace C and stops taking new data into the specified trace.
BML	$B - DL \rightarrow B$	Subtracts display line from trace B and places the result in trace B.
BRIGHT	(two front panel keys)	The two keys adjust the brightness of the display, up and down.
BTC	$B \rightarrow C$	Transfers trace B into trace C.
BXC	$B \leftrightarrow C$	Exchanges trace B and trace C.
CAT	none	Displays/returns directory information from memory.

Command	Corresponding Key Function	Description
CF	Center Freq	Specifies center frequency.
CLRAVG	Video Average On Off	Restarts video averaging.
CLRW	Clear Write A, Clear Write B, or Clear Write C.	Clears the specified trace and enables trace data acquisition.
CLS	none	Clears all status bits.
CMDERRQ	none	Allows query of error queue
CONTRAST	Contrast	Adjusts the display contrast.
CONTS	Sweep Cont Single (Cont)	Sets the spectrum analyzer to the continuous sweep mode.
CORREK	none	Query the box for the state of corrections
DATASTAT	none	Indicates certain conditions of the instrument.
DATEMODE	Datemode MDY DMY	Allows you to set the format for displaying the real-time clock.
DEFCONFIG	Default Config	Resets the analyzer to the user configuration originally set at the factory.
DELETE	Delete	Deletes a file from memory.
DEMOD	Demod	Turns the demodulator on or off, and selects between AM, FM, or quasi-peak demodulation.
DEMODT	Dwell Time On Off	Sets demodulation time.
DET	Detector	Selects the spectrum analyzer detection mode.
DL	Display Line On Off	Defines the level of the display line in the active amplitude units and displays the display line on the spectrum analyzer screen.
DN	↓ key	Reduces the active function by the applicable step size.

Command	Corresponding Key Function	Description
DONE	Done	Allows you to determine when the spectrum analyzer has started to execute all commands prior to and including DONE.
ERASE	none	Purges all state and trace registers and deletes limit-lines and ampcor information.
ERR	none	Returns power-on test results.
EXITSHOW-SYS	none	Exits show system information. See SHOWSYS.
FA	Start Freq	Specifies the start frequency.
FB	Stop Freq	Specifies the stop frequency.
FOFFSET	Freq Offset	Specifies the frequency offset for all absolute frequency readouts such as center frequency.
FREF	none	Returns the source of the 10 MHz frequency reference.
FS	Full Span	Sets the frequency span of the spectrum analyzer to full span.
GETPRNT	Print	Initiates output of the spectrum analyzer display to a printer.
GRAT	Graticule On Off	Turns the graticule on or off.
HD	Esc	Disables data entry via the spectrum analyzer numeric keypad, knob, or step keys. The active function readout is blanked, and any active function is deactivated.
ID	Show System	Returns the spectrum analyzer model number.
INVERTLCD	Invert	Inverts the display. (Use with an external display.)
INZ	Input Z	Specifies the value of input impedance expected at the active input port.
IP	Preset	Performs an instrument preset.

Command	Corresponding Key Function	Description
LG	Scale Type Log Lin (Log)	Specifies the vertical graticule divisions as logarithmic units, without changing the reference level.
LIMIDEL	Delete Limits	Deletes all segments in the current limit-line table.
LIMIDISP	Limit Display Y N Auto	Controls when the limit line (or limit lines) are displayed.
LIMIFAIL	Limit Test On Off	Returns a "0" if the last measurement sweep of trace A is equal to or within the limit-line bounds.
LIMIFT	X Axis Units Freq Time	Selects how the limit-line segments are placed on the spectrum analyzer display, according to frequency, or according to the sweep time setting of the spectrum analyzer.
LIMIHALF	Select Line Upper Lower	Selects the upper or lower limit-line for editing.
LIMILINE	Edit Limits	Accesses limit-line functions.
LIMIREL	Limits Fixed Rel	Specifies the current limit lines as fixed or relative.
LIMISEG	Edit Line	Adds new segments to the current frequency limit line in either the upper limit line or the lower limit line.
LIMISEGT	Edit Line (time limit lines)	Adds new segments to the current sweep time limit line in either the upper limit line or the lower limit line.
LIMITEST	Limit Test On Off	Compares trace A with the current limit-line data.
LN	Scale Type Log Lin (Lin)	Specifies the vertical graticule divisions as linear units, without changing the reference level.
LOAD	Load	to load a trace, amp, limit, state
LSPAN	Last Span	Changes the spectrum analyzer's span to the previous span setting.

Command	Corresponding Key Function	Description
MDS	none	Specifies measurement data size as byte or word.
MDU	none	Returns values for the spectrum analyzer's baseline and reference level.
MEAN	none	Returns the mean value of the given trace in measurement units.
MEANTH	none	Returns the mean value of the given trace above the threshold, in measurement units.
MF	Mkr Readout	Returns the frequency (or time) of the on-screen active marker.
MINH	Min Hold C	Updates trace C elements with minimum level detected.
MKA	none	Specifies amplitude of the active marker.
MKACT	Select Marker 12 3 4	Specifies the active marker.
MKBW	N dB Points On Off (On)	Returns the bandwidth at the specified power level relative to an on-screen marker (if present) or the signal peak (if no on-screen marker is present).
MKCF	**Mkr → CF**	Sets the center frequency equal to the marker frequency and moves the marker to the center of the screen.
MKD	Marker A	Activates the delta marker.
MKF	none	Specifies the frequency value of the active marker.
MKFA	Mkr → Start	Sets the start frequency to the frequency of the active marker.
MKFB	Mkr → Stop	Sets the stop frequency to the frequency of the active marker.
MKFC	Marker Count On Off	Turns on or off marker frequency counter.

Command	Corresponding Key Function	Description
MKFCR	Resolution Auto Man	Sets the resolution of the marker frequency counter.
MKMIN	Min Search	Moves active marker to minimum signal detected.
MKN	Marker Normal	Activates and moves the marker to the specified frequency.
MKNOISE	Marker Noise On Off (On)	Displays the average noise level at the marker.
MKOFF	Marker All Off	Turns off either the active marker or all the markers.
MKP	none	Places the active marker at the given x-coordinate.
MKPAUSE	Dwell Time On Off	Pauses the sweep at the active marker for the duration of the delay period.
MKPK	Peak Search	Positions the active marker on a signal peak.
MKPP	Pk-Pk Search	Finds and displays the frequency and amplitude differences between the highest and lowest trace points.
MKPX	Peak Excursn	Specifies the minimum signal excursion for the spectrum analyzer's internal peak-identification routine.
MKREAD	Mkr Readout	Selects the type of active trace information displayed by the spectrum analyzer marker readout.
MKRL	Mkr → Ref Lvl	Sets the reference level to the amplitude value of the active marker.
MKSP	Mkr A → Span	Sets the start and stop frequencies to the values of the delta markers.
MKSS	Mkr → CF Step	Sets the center-frequency step-size to the marker frequency.
MKTH	Pk Threshold	Sets a lower boundary to the active trace.

Command	Corresponding Key Function	Description
MKTRACE	Marker Trace Auto A B C	Moves the active marker to a corresponding position in trace A, trace B, or trace C.
MKTRACK	Signal Track On Off (On)	Moves the signal with an active marker to the center of the spectrum analyzer display and keeps the signal peak at center screen.
ML	Max Mixer Lvl	Specifies the maximum signal level that is applied to the input mixer for a signal that is equal to or below the reference level.
MOV	none	Copies the source values into the destination.
MXMH	Max Hold A or Max Hold B	Updates trace elements with maximum level detected.
NDB	N dB Points On Off (On)	Specifies the distance (in dB) from the signal peak for the N dB points measurement (NDBPNT).
NDBPNT	N dB Points On Off	Turns on or off the N dB points measurement.
NDBPNTR	none	Returns the bandwidth measured by the N dB points measurement (NDBPT).
NORMLIZE	Normalize	Normalizes the current data with the values previously stored in Trace A.
NRL	Norm Ref Lvl	Sets the normalized reference level.
NRPOS	Normal Position	Sets the position of the normalized reference.
OL	none	Output current state in learn string format.
PCTAM	%AMOnOff	Turns on or off the percent AM measurement.
PCTAMR	%AMOnOff (On)	Returns the percent AM measured by the percent AM measurement (PCTAM).

Command	Corresponding Key Function	Description
PEAKS	none	Sorts signal peaks by frequency or amplitude, stores the results in the destination trace, and returns the number of peaks found.
POWERON	Power On IP Last	Selects the state the spectrum analyzer will be in when it is turned on: IP(instrument preset) or LAST state.
PREAMPG	Ext Amp Gain	Subtracts a positive or negative preamplifier gain value from the displayed signal.
PRINT	none	Initiates output of the spectrum analyzer display to a controller.
PRNPRT	Port	Directs the printer output to HP-IB, serial or parallel ports.
PRNTADRS	Printer Addr	Allows you to set the HP-IB address of the printer.
PRNTMARGB	Bottom Margin	Adjusts the white space below a print.
PRNTMARGT	Top Margin	Adjusts the white space above a print.
PRNTRES	Resolution	Selects the resolution number to be sent to the printer.
PSTATE	Internal Lock On Off (On)	Protects all of the spectrum analyzer's user state and trace registers from being changed.
PWRBW	none	Computes the bandwidth around the trace center, which includes signals whose total power is a specified percentage of the total trace signal power.
PWRUPTIME	none	Returns the number of milliseconds that have elapsed since the spectrum analyzer was turned on.
RB	Resolution BW Auto Man	Specifies the resolution bandwidth.

Command	Corresponding Key Function	Description
RCLS	Load	Recalls spectrum analyzer state data from one of nine state registers in spectrum analyzer memory. These registers do not appear in a FILE catalog.
RCLT	Load	Recalls previously saved trace data, amplitude factors, or limit-line data from the trace registers in spectrum analyzer memory. These registers are specially mapped to named files.
REV	Show System	Returns the date code of the firmware revision number in YYYYMMDD format.
RFCALIB	50 MHz osc On Off	Turns the internal 50 MHz alignment signal on or off.
RL	Ref Level	Specifies the amplitude value of the reference level.
RMS	none	Returns the root mean square value of the trace in measurement units.
ROFFSET	Ref Lvl Offst	Offsets all amplitude readouts without affecting the trace.
RQS	none	Sets a bit mask for service requests.
SAVE	Save	Saves a specified file in spectrum analyzer memory.
SAVES	Save	Saves the currently displayed instrument state in spectrum analyzer memory. These registers do not appear in a FILE catalog.
SEGDEL	Del Segment	Deletes the specified segment from the limit-line tables.
SER	Show System	Returns the serial number suffix of the spectrum analyzer.
SETDATE	Set Date	Sets the date of the real-time clock.
SET-TIME	Set Time	Sets the time of the real-time clock.

Command	Corresponding Key Function	Description
SHOWSYS	Show System	Displays the model number, product number, serial number, firmware revision, and options that are installed in the spectrum analyzer.
SMOOTH	Video	Smooths the trace according to the number of points specified for the running average.
SNGLS	Sweep Cont Single (Single)	Selects single-sweep mode.
SP	Span	Changes the total displayed frequency range symmetrically about the center frequency.
SPEARER	Speaker On Off	Turns on or off the internal speaker.
SPZOOM	Span Zoom	Places a marker on the highest on-screen signal (if an on-screen marker is not present), turns on the signal track function, and activates the span function.
SQR	none	Places the square root of the source into the destination.
SRCAT	Attenuation Auto Man	Attenuates the source output level.
SRCPOFS	Amptd Offset	Offsets the source power level readout.
SRCPSTP	Amptd Step Auto Man	Selects the source-power step size.
SRCPSWP	Power Sweep On Off	Selects sweep range of the source output.
SRCPWR	Amplitude On Off	Selects the source power level.
SRQ	none	Used by an external controller to simulate interrupts from the spectrum analyzer.
SS	CF Step Auto Man	Specifies center-frequency step size.
ST	Sweep Time Auto Man	Specifies the time in which the spectrum analyzer sweeps the displayed frequency range.

Command	Corresponding Key Function	Description
STB	none	Returns to the controller the decimal equivalent of the status byte.
STDEV	none	Returns the standard deviation of the trace amplitude in measurement units.
SUM	none	Returns the sum of the amplitudes of the trace elements in measurement units.
SUMSQR	none	Returns the sum of the squares of the amplitude of each trace element.
SWPCPL	Swp Coupling SR SA	Selects a stimulus-response (SR) or spectrum-analyzer (SA) auto-coupled sweep time.
TDF	none	Formats trace information for return to the controller.
TH	Threshold On Off	Clips signal responses below the threshold level.
TIMEBASEC	Timebase Coarse	Controls coarse tuning of the timebase frequency.
TIMEBASEF	Timebase Fine	Controls fine tuning of the timebase frequency.
TIMEDATE	Time/Date	Sets the time and date of the real-time clock.
TIMEDSP	Time/Date On Off	Turns on or off the display of the real-time clock.
TITLE	Change Title	Activates the screen title mode.
TM	Trig	Specifies trigger mode.
TOI	TOI On Off	Turns on or off the third-order intermodulation (TOI) measurement.
TOIR	none	Returns the highest third-order intermodulation product measured by the third-order intermodulation measurement(TOI).
TRA, TRB, TRC	Trace A, Trace B, or Trace C	Controls trace data input or output.

Command	Corresponding Key Function	Description
TRSTAT	none	Returns the status of traces A, B, and C: clear write, blank, view, minimum hold, or maximum hold.
TS	Sweep Cont Single (Single)	Starts and completes one full sweep before the next command is executed.
UP	↑ key	Increases the active function by the applicable step size.
VARIANCE	none	Returns the amplitude variance of the specified trace, in measurement units.
VAVG	Video Average On Off	Enables the video-averaging function, which averages trace points to smooth the displayed trace.
VB	Video BW Auto Man	Specifies the video bandwidth.
VBR	**VBW/RBW** Ratio	Specifies coupling ratio of video bandwidth to resolution bandwidth.
VIEW	View	Displays trace A, trace B, or trace C, and stops taking new data into the viewed trace.
XCH	**A ↔ B, B ↔ C**	Exchanges traces.

Front-Panel to Command

Key Label	Remote Command
% AM On Off	PCTAM
50 MHz osc On Off	RFCALIB
Align Now, RF	RFCALIB
A ↔ B	AXB
A → C	ATC
Align Now	ALIGN
Alignments	ALIGN
All Memory	ERASE
AM	DEMOD
Ampcor	AMPCOR
Amplitude On Off	SRCPWR
Amptd Offset	SRCPOFS
Amptd Step Auto Man	SRCPSTP
Amptd Units	AUNITS
Annotation On Off	ANNOT
Attenuation Auto Man	AT, SRCAT
Auto Align	ALIGN
Auto Couple	AUTO
B ↔ C	BXC
B → C	BTC
B – DL → B	BML
Baud Rate	BAUDRATE
Blank A, B, C	BLANK

Key Label	Remote Command
Bottom Margin	PRNTMARGB
brightness keys	BRIGHT
BW/Avg	RB, VAVG
Center Freq	CF
CF Step Auto Man	SS
Change Title	TITLE
Clear Title	TITLE
Clear Write A, B, C	CLRW
Color Printing On Off	PRINT
Contrast	CONTRAST
Datemode MDY DMY	DATEMODE
Default Config	DEFCONFIG
Define Printer	PRNTMARGB, PRNTMARGT, PRNTRES
Del Segment	SEGDEL
Delete	DELETE
Delete Limits	LIMIDEL
Demod	DEMOD
Detector	DET
Display Line On Off	DL
Dwell Time On Off	DEMODT, MKPAUSE
Edit Limits	LIMILINE
Edit Line	LIMILINE
Erase Internal	ERASE
Esc	HD
Execute Title	TITLE

Key Label	Remote Command
Expand On Off	none
Ext Amp Gain	PREAMPG
External	TM
Form Feed	none
Free Run	TM
Freq Correct On Off	ALIGN
Freq Count	MKFC
Freq Offset	FOFFSET
Frequency	CF, FA, FB
Full Span	FS
Graticule On Off	GRAT
HP-IB	PRNPRT, PRNTADRS
HP Color Mode PJ DJ Off	PRINT
Input Z Corr 50 75	INZ
Internal Lock On Off	PSTATE
Inverse Time	MKREAD
Inverse Video On Off	INVERTLCD
Last Span	LSPAN
Limit Display Y N Auto	LIMIDISP
Limit Test On Off	LIMITEST
Limits	LIMILINE
Limits Fixed Rel	LIMIREL
Line	TM
Load	LOAD
Load Defaults	CORREK
Marker Δ	MKD

Key Label	Remote Command
Marker # On Off	MKACT, MKOFF
Marker All Off	MKOFF
Marker Count On Off	MKFC
Marker Noise On Off	MKNOISE
Marker Normal	MKN
Marker Trace Auto A B C	MKTRACE
Max Hold A, B	MXMH
Max Mixer Lvl	ML
Max Pk → CF	none
Min Hold C	MINH
Min Search	MKMIN
Mkr Δ → Span	MKSP
Mkr → CF	MKCF
Mkr → CF Step	MKSS
Mkr → Ref Lvl	MKRL
Mkr → Start	MKFA
Mkr → Stop	MKFB
Mkr Readout	MKREAD
N dB Points On Off	NDB, NDBPNT
Negative Peak	DET
New Filename	SAVE
Next Peak	MKPK
Next Pk Left	MKPK
Next Pk Right	MKPK
Norm Ref Lvl	**NRL**
Norm Ref Posn	NRPOS

Key Label	Remote Command
Normalize On Off	NORMLIZE
Parallel	PRNPRT
Peak Excursn	MKPX
Peak Search	MKPK
Period	MKREAD
Pk-Pk Search	MKPP
Pk Threshold	MKTH
Port	PRNPRT
Power On IP Last	POWERON
Power Sweep On Off	SRCPSWP
Preset	IP
Print	PRINT
Print Softkeys On Off	none
Printer Addr	PRNTADRS
Purge Ampcor	AMPCOR
Ref Lvl Offst	ROFFSET
Ref Level	RL
Resolution	MKFCR, PRNTRES
Resolution Auto Man	MKFCR
Resolution BW Auto Man	RB
Sample	DET
Save	SAVE
Scale/Div	LG
Scale Type Log Lin	LG, LN
Search	MKPK
Select Line Upper Lower	LIMIHALF

Key Label	Remote Command
Select Marker 1 2 3 4	MKACT
Serial	PRNPRT, BAUDRATE
Set Date	SETDATE
Set Time	SETTIME
Show System	ID, REV, SER, EXITSHOWSYS
Signal Track On Off	MKTRACK
Single Sweep	SNGLS
Source Amptd	SRCPWR
Span	SP
Span Zoom	SPZOOM
Speaker On Off	SPEAKER
Start Freq	FA
Stop Freq	FB
Sweep Cont Single	CONTS, SNGLS, TS
Sweep Time Auto Man	ST
Swp Coupling SR SA	SWPCPL
Threshold On Off	TH
Time	MKREAD
Time/Date	SETTIME, SETDATE
Time/Date On Off	TIMEDSP
Timebase	TIMEBASEC, TIMEBASEF
Title	TITLE
Top Margin	PRNTMARGT
Trace A B C	TRA, TRB, TRC
Trig	TM

Key Label	Remote Command
User Defined	PRNTMARGB, PRNTMARGT, PRNTRES
VBW/RBW Ratio	VB
Video	TM
Video Average On Off	VAVG
Video BW Auto Man	VB
View A, B, C	VIEW
X Axis Units Freq Time	LIMIFT
Zero Span	SP

Functional Index

This functional index categorizes the programming commands by the type of function that the command performs. The functional index contains the following information: the programming command mnemonic, the softkey or front-panel key that corresponds to the command's function, and a brief definition of the command. Once the desired command is found, refer to the alphabetical listing of commands later in this chapter for more information about the command.

Function Category	Command	Corresponding Key Function
ALIGNMENT	ALIGN	**Alignments** functions
	RFCALIB	**Align Now, RF**
AMPLITUDE	AMPCOR	**Ampcor** functions
	AT	**Attenuation Auto Man**
	AUNITS	**Amptd Units**
	LG	**Scale Type Log Lin** (Log)
	LN	**Scale Type Log Lin** (Lin)
	ML	**Max Mixer Lvl**
	NRL	**Norm Ref Lvl**
	PREAMPG	**Ext Amp Gain**
	RL	**Ref Level**
	ROFFSET	**Ref Lvl Offst**
BANDWIDTH	RB	**Resolution BW Auto Man**
	VAVG	**Video Average On Off**
	VB	**Video BW Auto Man**
	VBR	**VBW/RBW Ratio**
CONFIGURATION	BAUDRATE	**Baud Rate**
	DATEMODE	**Datemode MDY DMY**
	DEFCONFIG	**Default Config**

Function Category	Command	Corresponding Key Function
	POWERON	**Power On IP Last**
	TITLE	**Change Title**
	PRNPRT	**Port, HPIB**
	PRNPRT	**Port, Serial**
	PRNPRT	**Port, Parallel**
	SETDATE	**Set Date**
	SETTIME	**Set Time**
	TIMEDATE	**Time/Date**
	TIMEDSP	**Time/Date On Off**
COUPLING	AUTO	**Auto Couple**
DELETE, LOAD or SAVE	DELETE	**Delete**
	LOAD	**Load**
	PSTATE	**Internal Lock On Off**
	SAVE	**Save**
DISPLAY	ANNOT	**Annotation On Off**
	DL	**Display Line On Off**
	BRIGHT	brightness up/down keys on bezel
	GRAT	**Graticule On Off**
	HD	**Esc**
	TH	**Threshold On Off**
	TITLE	**Change Title**
FREQUENCY	CF	**Center Freq**
	FA	**Start Freq**
	FB	**Stop Freq**
	FOFFSET	**Freq Offset**

Function Category	Command	Corresponding Key Function
	s s	**CF Step Auto Man**
INFORMATION	CLS	
	CORREK	
	ERR	
	FREF	
	ID	**Show System**
	MDU	
	REV	**Show System**
	RQS	
	SER	**Show System**
	SRQ	
	STB	
INPUT and OUTPUT	OL	
	TDF	
	TRATRBTRC	**Trace A, Trace B, Trace C**
LIMIT LINES	LIMIDEL	**Delete Limits**
	LIMIDISP	**Limit Display Y N Auto**
	LIMIFAIL	**Limit Test On Off**
	LIMIFT	**X Axis Units Freq Time**
	LIMIHALF	**Select Line Upper Lower**
	LIMILINE	**Edit Limits**
	LIMIREL	**Limits Fixed Rel**
	LIMITEST	**Limit Test On Off**
	SEGDEL	**Del Segment**
MARKER	MDS	
	MF	**Mkr Readout**

Function Category	Command	Corresponding Key Function
	MKA	
	MKACT	**Select Marker 1 2 3 4**
	MKBW	**N dB Points On Off**
	MKCF	**Mkr → CF**
	MKD	**Marker** A
	MKF	
	MKFC	**Marker Count On Off**
	MKFCR	**Resolution Auto Man**
	MKMIN	**Min Search**
	MKN	**Marker Normal**
	MKNOISE	**Marker Noise On Off**
	MKOFF	**Marker All Off**
	MKP	
	MKPAUSE	
	MKPK	**Peak Search, Search, Next Peak, Next Pk Right, Next Pk Left**
	MKPX	**Peak Excursn**
	MKREAD	**Mkr Readout**
	MKRL	**Mkr → Ref Lvl**
	MKSP	**Mkr** A **→ Span**
	MKSS	**Mkr → CF Step**
	MKFA	**Mkr → Start**
	MKFB	**Mkr → Stop**
	MKTRACE	**Marker Trace Auto A B C**
	MKTRACK	**Signal Track On Off**

Function Category	Command	Corresponding Key Function
MEASURE	DEMOD	**Demod**
	NDB	**N dB Points On Off**
	NDBPNT	**N dB Points On Off**
	NDBPNTR	
	NRL	**Norm Ref Lvl**
	PCTAM	**% AM On Off**
	PCTAMR	**% AM On Off**
	TOI	**TOI On Off**
	TOIR	
OPERATOR ENTRY	DN	↓ key
	HD	**Esc**
	UP	↑ key
PRESET	IP	**Preset**
	POWERON	**Power On IP Last**
	PRINT	
PRINTING	PRINT	
	PRNTADRS	**Printer Addr**
	PRNTMARGB	**Bottom Margin**
	PRNTMARGT	**Top Margin**
	PRNTRES	**Resolution**
SOURCE	SRCAT	**Attenuation Auto Man**
	SRCPOFS	**Amptd Offset**
	SRCPSTP	**Amptd Step Auto Man**
	SRCPSWP	**Power Sweep On Off**
	SRCPWR	**Amplitude On Off**
	SWPCPL	**Swp Coupling SR SA**

Function Category	Command	Corresponding Key Function
SPAN	FS	**Full Span**
	LSPAN	**Last Span**
	SP	**Span**
	SPZOOM	**Span Zoom**
SPEAKER	SPEAKER	**Speaker On Off**
SWEEP	CONTS	**Sweep Cont Single** (Cont)
	s s	**CF Step Auto Man**
	ST	**Sweep Time Auto Man**
SYNCHRONIZATION	DONE	**Done**
	TS	**Sweep Cont Single** (Single)
TRACE	AXB	**A ↔ B**
	BLANK	**Blank A B C**
	BML	**B – DL → B**
	BTC	**B → C**
	BXC	**B ↔ C**
	CLRW	**Clear Write A, B, or C**
	DET	**Detector**
	MINH	**Min Hold C**
	MOV	
	MXMH	**Max Hold A or B**
	TRA TRB TRC	**Trace A, Trace B, Trace C**
	TRSTAT	
	VAVG	**Video Average On Off**
	VIEW	**View A B C**
TRACE MATH	APB	
	CLRAVG	**Video Average On Off**

Function Category	Command	Corresponding Key Function
	MEAN	
	MEANTH	
	PEAKS	
	RMS	
	SMOOTH	**Video**
	SQR	
	STDEV	
	SUM	
	SUMSQR	
	VARIANCE	
	XCH	**A ↔ B, B ↔ C**
TRIGGER	SNGLS	**Sweep Cont Single** (Single)
	TM	**Trig**
	TS	**Sweep Cont Single** (Single)

Command Backwards Compatibility

The alternate commands provide compatibility with commands used by the HP 8566A/B, HP 8568A/B, and HP 70000 Series instruments. The equivalent commands for the HP ESA-L1500A spectrum analyzer are listed in the right column.

Alternate Commands	Description	HP ESA-L1500A 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
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
BL	B – DL -> B	BML
CA	Coupled input attenuation	AT AUTO
CR	Coupled resolution bandwidth	RB AUTO
CS	Coupled step size	SS AUTO
CT	Coupled sweep time	ST AUTO
CV	Coupled video bandwidth	VB AUTO
E1	Peak search	MKPK HI
E2	Enter marker into center frequency	MKCF
E3	Enter marker delta into center frequency stepsize	MKSS
E4	Enter marker amplitude into reference level	MKRL
EX	Exchange trace A and B	AXB

Alternate Commands	Description	HP ESA-L1500A Comman
LO	Display line off	DL OFF
M1	Marker off	MKOFF
M2	Marker normal	MKN
M3	Marker delta	MKD
MA	Marker amplitude	MKA
MC	Marker count	MKFC
MT	Signal track on off	MKTRACK ON/OFF
01	Output format, in real number format	TDF P
02	Output format, in binary format, two bytes (word) perelement	TDF B;MDS W
03	Output format, in measurement data format	TDFM
04	Output format, in binary format, 1 byte per element	TDF B;MDS B
R1	Activates illegal command service requestonly	RQS 32
R2	Activates end-of-sweep, illegal command	RQS 36
R3	Activates broken hardware, illegal command	RQS 40
R4	Activates units-key pressed, illegal command	RQS 34
RC	Recall state	RCLS
S1	Sweep continuous	CONTS
S2	Sweep single	SNGLS
TA	Transfers trace A to the controller in display units.	TDF M;TRA

Alternate Commands	Description	HP ESA-L1500A Command
TB	Transfers trace B to the controller in display units.	TDF M;TRB
TO	Threshold off	TH OFF
T1	Trigger mode free run	TM FREE
T2	Trigger mode line	TM LINE
T3	Trigger mode external	TM EXT
T4	Trigger mode video	TM VID

5

Programming Commands

Command Syntax Conventions

Command syntax is represented pictorially.

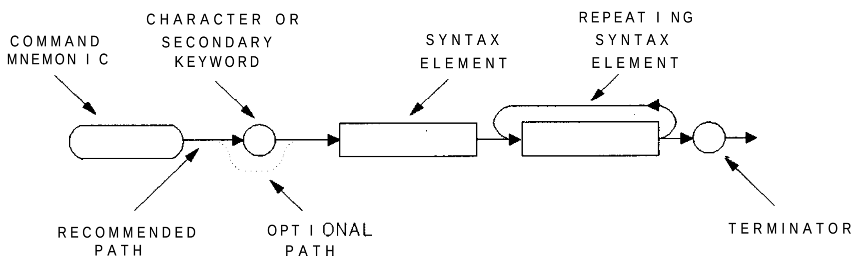


Figure 14 **Command Syntax Figure**

- Ovals enclose command mnemonics. The command mnemonic must be entered exactly as shown.
- Circles and ovals surround secondary keywords or special numbers and characters. The characters in circles and ovals are considered reserved words and must be entered exactly as shown. See Table 8.
- Rectangles contain the description of a syntax element defined in Table 7.
- A loop above a syntax element indicates that the syntax element can be repeated.
- Solid lines represent the recommended path.
- Dotted lines indicate an optional path for bypassing secondary keywords or using alternate units.
- Arrows and curved intersections indicate command path direction.
- Semicolons are the recommended command terminators. Using semicolons makes programs easier to read, prevents command misinterpretation, and is recommended by IEEE Standard 728.

NOTE: Uppercase is recommended for entering all commands unless otherwise noted.

Syntax Elements are shown in the syntax diagrams as elements within rectangles. In the syntax diagrams, characters and secondary keywords are shown within circles or ovals. Characters and secondary keywords must be entered exactly as shown.

Table 7 **Syntax Elements**

Syntax Component	Definition/Range
Analyzer command	Any spectrum analyzer command in this chapter, with required parameters and terminators.
Character	S_P a b c d e f g h i j k l m n o p q r s t u v w x y z databyte.
Character & EOI	8-bit byte containing only character data and followed by end-or-identify (EOI) condition, where the EOI control line on HP-IB is asserted to indicate the end of the transmission. END signifies the EOI condition.
Character string	A list of characters.
Data byte	S-bit byte containing numeric or character data.
Data byte & EOI	8-bit byte containing numeric or character data followed by end-or-identify (EOI) condition, where the EOI control line on HP-IB is asserted to indicate the end of the transmission. END signifies the EOI condition.
Delimiter	I \ @ ^ $ % ; ! Matching characters that mark the beginning and end of a character string, or a list of spectrum analyzer commands. Choose delimiting characters that are not used within the string they delimit.
Digit	0 1 2 3 4 5 6 7 8 9
lsb length	Represents the least significant byte of a two-byte word that describes the number of bytes returned or transmitted. See msb length.
msb length	Represents the most significant byte of a two-byte word that describes the number of bytes returned or transmitted. See lsb length.
Number	Expressed as integer, decimal, or in exponential (E) form. Real Number Range: $\pm$ 1.797693 1348623 15 $\times 10^{308}$, including 0. Up to 15 significant figures allowed. Numbers may be as small as $\pm$ 2.225073858507202 $\times 10^{-308}$ Integer Number Range: -32,768 through +32,767
Output termination	Carriage return(C_R) and line feed (L_F), with end-or-identify (EOI) condition. ASCII codes 13 (carriage return) and 10 (line feed) is sent via HP-IB, then the end-or-identify control line on HP-IB sets to indicate the end of the transmission.
Trace element	Value contained in one trace point. Notated as TRA[N] where N specifies the point position in the trace array. Values for N are 1 to 401 (for traces A, B, C). The same values apply to trace B(TRB[N]), and trace C (TRC[N]).

Table 7 **Syntax Elements**

Syntax Component	Definition/Range
Trace range	Values contained in trace segment. Multi-point segments are notated as TRA[N,M], where N and M are end points of a segment and specify point positions in trace array. Values for N or M are 1 to 401 (for traces A, B, C). The same values apply to trace B(TRB[N,M]) and trace C (TRC[N,M]). Single-point segments are notated the same as the trace element above.
Units	Represent standard scientific units. Frequency Units: GHZ or GZ, MHZ or MZ, KHZ or KZ, HZ Amplitude Units: DB, DM, DBMV, DBUV, V, MV, UV, W, MW, UW Time Units: SC, MS, US Current Units: A, MA, UA Impedance Units: OHM

Table 8 **Characters and Secondary Keywords (Reserved Words)**

Element	Description
A	Amp (unit) or A-block data field
ABSHZ	Absolute Hz (unit)
AC	Alternating current
ALL	All
AM	Amplitude modulation
AMP	Amplitude
AMPCOR	Amplitude correction
AUTO	Auto couple or set to automatic
AVG	Average
B	8-bit byte or binary format
BW	Black and white
CNT	Counter-lock
COLOR	Color

Table 8 **Characters and Secondary Keywords (Reserved Words)**

Element	Description
DB	Decibel (unit)
DBM	Absolute decibel milliwatt (unit)
DBMV	Decibel millivolt (unit)
DBUV	Decibel microvolt (unit)
DC	Direct current
DELTA	Delta
DISP	Display
DM	Absolute decibel milliwatt (unit)
DMY	Day, month, year format
DN	Decreases parameter one step size
DUMP	Dump
EXT	External trigger
FIXED	Fixed
FLAT	Flat
FMD	Frequency modulation demodulator
FM	Frequency modulation
FMV	Frequency modulation detection
FREE	Free run
FREQ or FRQ	Frequency
GHZ	Gigahertz (unit)
GZ	Gigahertz (unit)
HI	Highest
HPIB	HP-IB
HZ	Hertz (unit)

Table 8 **Characters and Secondary Keywords (Reserved Words)**

Element	Description
I	I-block data field
INT	Internal or integer
IP	Instrument preset
IST	Inverse sweep time
KHZ	Kilohertz (unit)
KZ	Kilohertz (unit)
LAST	Last state
LIMILINE	Limit line
LINE	Line trigger
LOAD	Load operation
LOWER	Lower limit line
M	Measurement units
MA	Milliamp (unit)
MDY	Month, day, year format
MHZ	Megahertz (unit)
MS	Millisecond (unit)
MTR	Meter
MV	Millivolts (unit)
MW	Milliwatt (unit)
MZ	Megahertz (unit)
NEG	Negative
NH	Next highest peak
NL	Next peak left
NONE	No units
NR	Next peak right

Table 8 **Characters and Secondary Keywords (Reserved Words)**

Element	Description
NRM or NORMAL	Normal
OA	Output amplitude
OFF	Turns off function
ON	Turns on function
P	Parameter units
PER	Period
PKAVG	Peak average
PKPIT	Peak pit
POINT	Point
POS	Positive
PSN	Position
RS232	RS-232 interface
SA	Signal analysis
SC	Seconds (unit)
SLOPE	Slope
SMP	Sample detection mode
SP	Space
SR	Stimulus response
STATE	State register
STEP	Step key ability
STORE	Store
SWT	Sweep time
TG	Tracking generator
TRA	Trace A

Table 8 **Characters and Secondary Keywords (Reserved Words)**

Element	Description
TRB	Trace B
TRC	Trace C
UA	Microamp (unit)
UP	Increases the parameter one step size
UPLOW	Upper and lower limit lines
UPPER	Upper limit line
US	Microseconds (unit)
UV	Microvolts (unit)
UW	Microwatt (unit)
V	Volts (unit)
VID	Video trigger
W	Watts or word (for MDS command)
*	Asterisk (used as a wildcard)
	Semicolon (ASCII code 59)
,	Comma (ASCII code 44)
0	Off (command argument)
1	On (command argument)
50	50 Ω
75	75 Ω
?	Returns a query response containing the value or state of the associated parameter. The query response is followed by a carriage-return/line-feed.

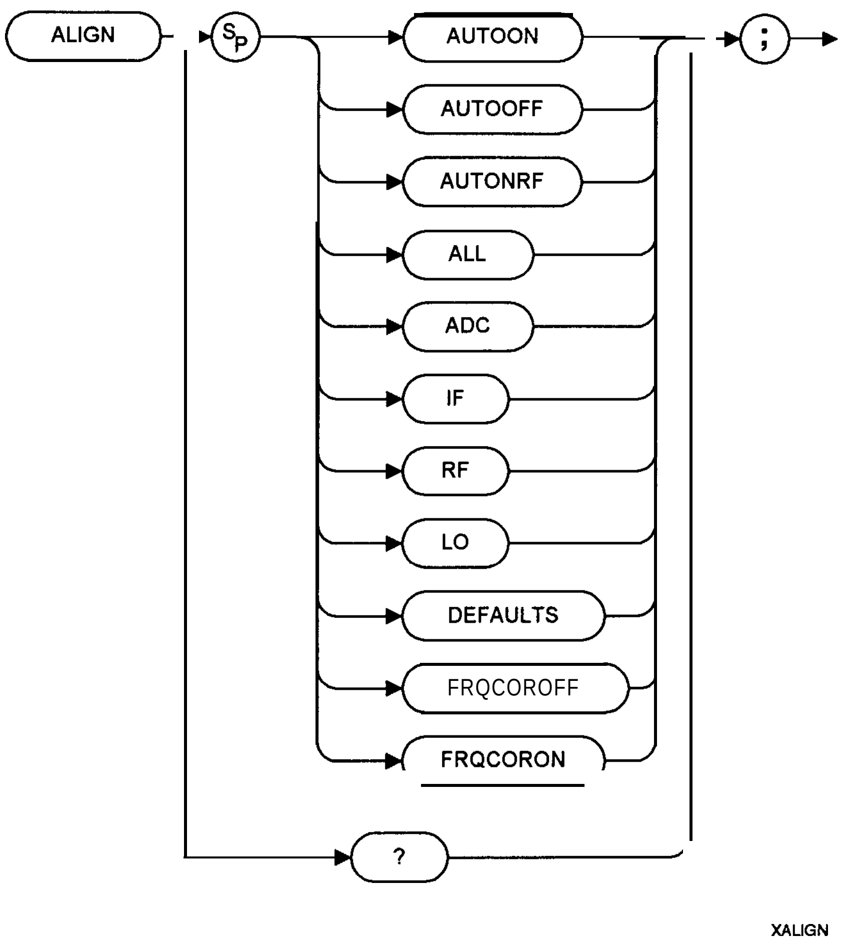
Programming Command Descriptions

To find a programming command that performs a particular function refer to the chapter of cross-reference information where commands are categorized by function. Once the desired command is found in the functional index, refer to the description for the command in this chapter.

ALIGN Self-alignment Routines

Initiates self-alignment routines.

Syntax



Preset State: ALIGN AUTOON
Equivalent Key: The softkeys accessed by **Auto Align** and **Align Now**
Related Command: CORREK

Example

```
10 OUTPUT 718;"ALIGN ALL;"
```

Performs an immediate alignment of all sub-assemblies.

Description

The ALIGN command controls alignment functions. ALIGN initiates action according to the ALIGN parameters. The various parameters correspond to spectrum analyzer softkeys as follows:

AUTOON enables the automatic alignment of all assemblies within the instrument. AUTOON corresponds to **ALL** under the **Auto Align** key.

AUTOOFF disables the automatic alignment of all assemblies within the instrument. AUTOOFF corresponds to Off under the **Auto Align** key.

NOTE: When auto alignment is disabled, instrument calibration may no longer be valid. Refer to the specifications chapter in the User's and Calibration Guide, for conditions under which the spectrum analyzer will meet its specifications when the auto alignment routine is disabled.

AUTONRF enables the automatic alignment of all assemblies except the RF assembly. AUTONRF corresponds to **All but RF** under the **Auto Align** key.

Eliminating the automatic alignment of the RF prevents changes in the input impedance between sweeps, which could cause input device instability.

ALL performs an alignment of all assemblies within the instrument. ALL corresponds to **All** under the **Align Now** key.

ADC performs an alignment of the instrument ADC circuitry. ADC corresponds to **ADC** under the **Align Now** key.

IF performs an alignment o the instrument IF assembly. IF corresponds to under the **Align Now** key.

LO performs an alignment of the instrument LO assembly. LO corresponds to **LO** under the **Align Now** key.

RF performs an alignment of the instrument RF assembly. RF corresponds to RF under the **Align Now** key.

NOTE: ALIGN ALL and ALIGN RF use the internal 50 MHz oscillator. When this is done, the spectrum analyzer input impedance becomes an "open" between sweeps. This impedance mismatch could cause input device instability.

DEFAULTS initializes the alignment data. DEFAULTS corresponds to **Load Defaults** under the **Alignments** key. The ALIGN DEFAULTS command must be followed by an ALIGN ALL command.

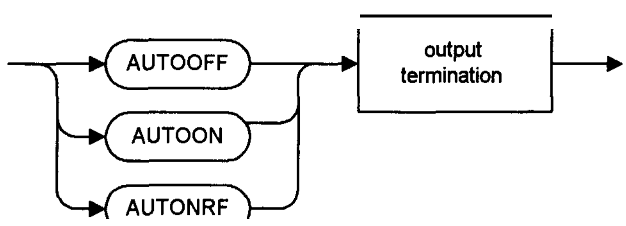
FRQCOROFF disables the application of frequency corrections generated by the instrument alignment. FRQCOROFF corresponds to **Freq Correct On** Off under the **Alignments** key.

NOTE: When auto alignment is disabled, instrument calibration may no longer be valid. Refer to the specifications chapter in the User's and Calibration Guide, for conditions under which the spectrum analyzer will meet its specifications when the auto alignment routine is disabled.

FRQCORON enables the application of frequency corrections generated by the instrument alignment. FRQCORON corresponds to **Freq Correct On** Off under the **Alignments** key.

NOTE: The frequency correction application is enabled whenever the ac power is cycled, or the instrument is preset.

Query Response

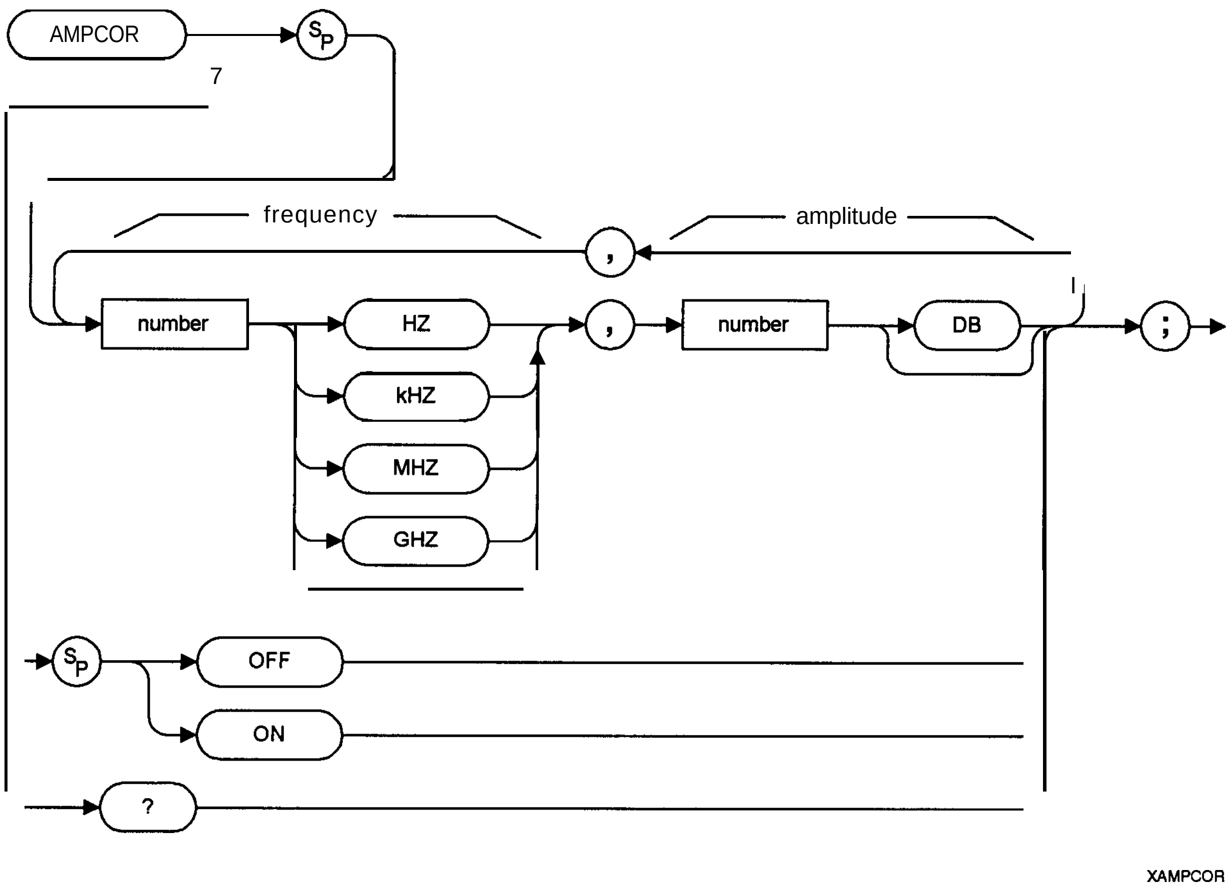


QALIGN

AMPCOR Amplitude Correction

Applies amplitude corrections at specified frequencies.

Syntax



Item	Description/Default	Range
Number	Any real or integer number. Default unit is dB.	Frequency: 0 to 1000 GHz Amplitude: ±327 dB.

Equivalent Keys: the softkeys accessed by **Ampcor**
Preset State: AMPCOR OFF
Related Commands: AT, RL

Example

Compensate for frequency dependent amplitude inaccuracies at the input.

```
10    DIM A$[200]
```

```
20    OUTPUT 718;"CF lGHZ;SP 200MHZ;"
```

Sets center frequency and span.

```
30    OUTPUT 718;"AMPCOR 100MHZ,5DB,1GHZ,-5DB,1.5GHZ,10DB;"
```

Stores frequency-amplitude pairs in spectrum analyzer. Notice that frequencies are in ascending order.

```
40    OUTPUT 718;"AMPCOR?;"
```

Returns correction values to computer.

```
50    ENTER 718;A$
```

```
60    PRINT A$
```

Displays the frequency-amplitude pairs.

```
70    OUTPUT 718;"AMPCOR OFF;"
```

Turns off the amplitude correction constants.

```
80    OUTPUT 718;"AMPCOR?;"
```

```
90    ENTER 718;A$
```

```
100   PRINT A$
```

Because AMPCOR is off, "0,0" is displayed.

```
110   END
```

Description

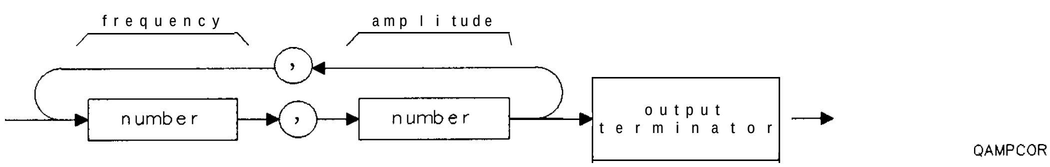
Use AMPCOR to compensate for frequency dependent amplitude variations at the spectrum analyzer input. Up to 80 pairs of amplitude correction points can be entered. The frequency values entered must either be equal or in increasing order, or an error condition results. Whenever AMPCOR is on, the correction values are applied to all measurement results. Executing "AMPCOR ON;" or entering frequency and amplitude corrections, turns on the amplitude correction factors. Performing an instrument preset (IP) or turning off the spectrum analyzer sets AMPCOR to OFF. (Setting AMPCOR to OFF does not change the frequency amplitude correction factors that have been entered.)

The values of the correction points are applied across the active measurement range. Between points, the correction values are interpolated. When measuring at frequencies outside the first and last correction points, these values are used as the correction value. If you do not want any amplitude correction outside of the first and last correction points, set the amplitude correction to 0 at the frequencies that are outside of the first and last correction values.

Amplitude correction factors can be stored in spectrum analyzer memory with the SAVE command. The amplitude correction factors can be edited and viewed with the ampcor softkey functions.

Query Response

AMPCOR? returns the frequency and amplitude correction pairs.

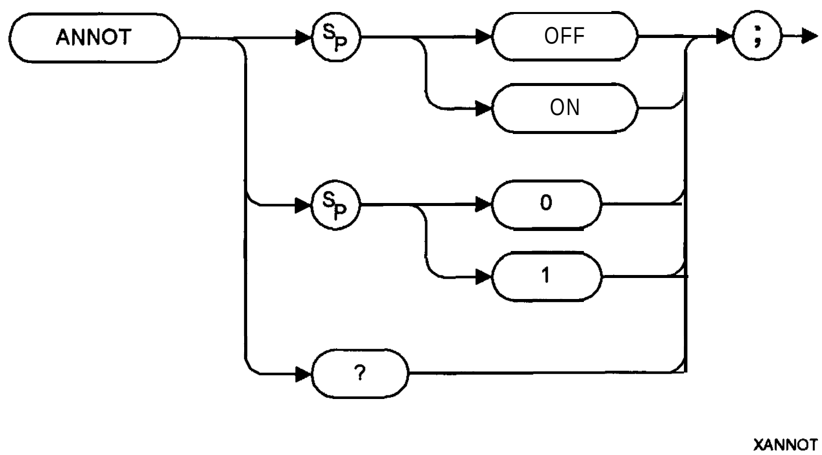


Returned values are 0,0 when AMPCOR is set to OFF.

ANNOT Annotation

Turns on or off the display annotation.

Syntax



Equivalent Key: **Annotation On Off**
Preset State: ANNOT ON
Related Commands: GRAT, TITLE

Example

```
10 OUTPUT 718;"ANNOT ON;"
```

Turns on the annotation.

```
20 OUTPUT 718;"ANNOT?;"
```

Queries state of the annotation function.

```
30 ENTER 718;Reply$
```

Places response in a variable.

```
40 DISP Reply$
```

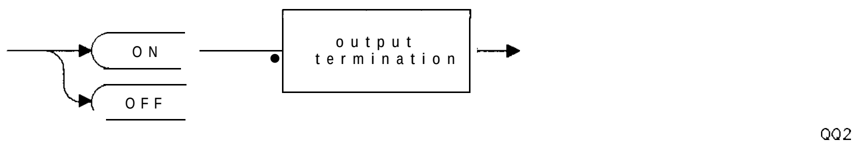
Displays response on the computer screen.

```
50 END
```

Description

The ANNOT command turns on or off all the words and numbers (annotation) on the spectrum analyzer display (except for the softkey labels).

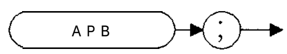
Query Response



APB Trace A Plus Trace B

Adds trace A to trace B and sends the result to trace A.

Syntax



XAPB

Related Commands: CLRW, SNGLS, TS, VIEW.

Example

```
10 OUTPUT 718;"IP;SNGLS;"
```

Initializes spectrum analyzer, changes to single-sweep mode.

```
20 OUTPUT 718;"TS;"
```

Updates the trace.

```
30 OUTPUT 718;"VIEW TRA;RL −20DM;CLRW TRB;"
```

Changes the reference level.

```
40 OUTPUT 718;"TS;VIEW TRB;"
```

Takes a measurement sweep.

```
50 OUTPUT 718;"APB;"
```

Activates APB command.

```
60 OUTPUT 718;"BLANK TRB;VIEW TRA;"
```

Displays the result of APB.

```
70 END
```

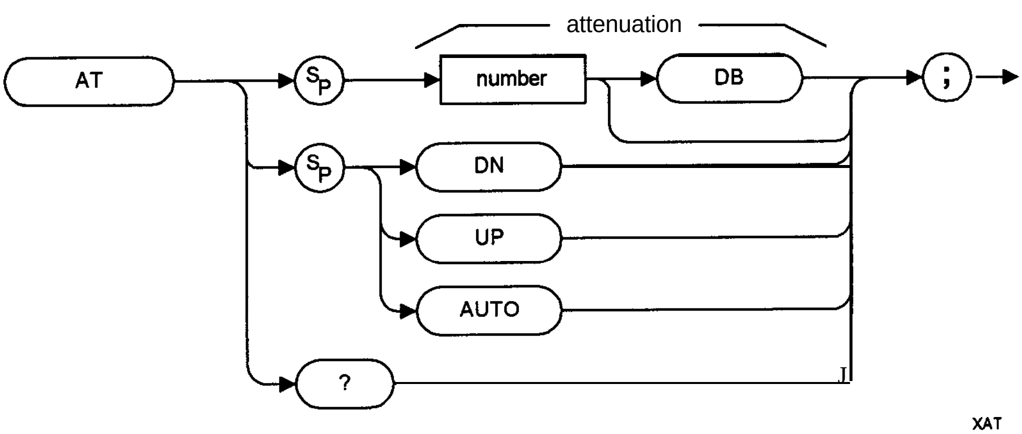
Description

The traces are added as 16-bit integers. Negative numbers are represented in two's complement format. The two's complement representation of a negative number is obtained by changing the 1s to 0s in the binary representation of the number, and then adding 1.

AT Attenuation

Specifies the RF input attenuation.

Syntax



Item	Description/Default	Range
Number	Any real or integer. Default units are dB.	Input attenuator range of spectrum analyzer

Equivalent Key: **Attenuation Auto Man** is similar
Preset State: 10 dB
Step Increment: in 5 dB steps
Related Commands: AUTO, ML, RL

Example

```
10 OUTPUT 718;"AT 40DB;"
```

Sets the attenuation to 40 dB.

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

Increases the attenuation to 45 dB.

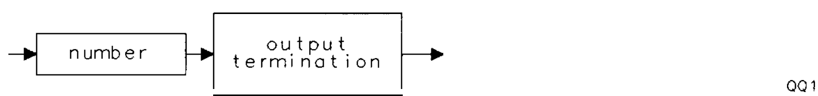
Description

The AT command specifies the input attenuation in 5 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 the command "ML"). 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 decreased. When the reference level is changed using the RL command, the input attenuation changes to maintain a constant signal level on the screen if attenuation is auto-coupled. Using auto-coupling 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.

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

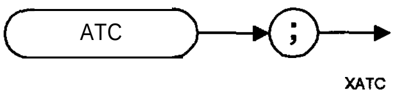
Query Response



ATC Transfer Trace A to Trace C

Transfers trace A into trace C.

Syntax



Equivalent Key: **A ->** C.
Related Commands: BLANK, CLRW, SNGLS, TS, VIEW.

Example

```
10 OUTPUT 718;"IP;"
```

Initializes spectrum analyzer.

```
20 OUTPUT 718;"SNGLS;"
```

Activates single-sweep mode.

```
40 OUTPUT 718;"CF 300 MHZ;SP 1MHZ;"
```

Sets up measurement range.

```
50 OUTPUT 718;"CLRW TRA;TS;"
```

Takes measurement sweep.

```
60 OUTPUT 718;"ATC;"
```

Moves trace A to trace C.

```
70 OUTPUT 718;"BLANK TRA;VIEW TRC;"
```

Displays result in trace C.

```
80 END
```

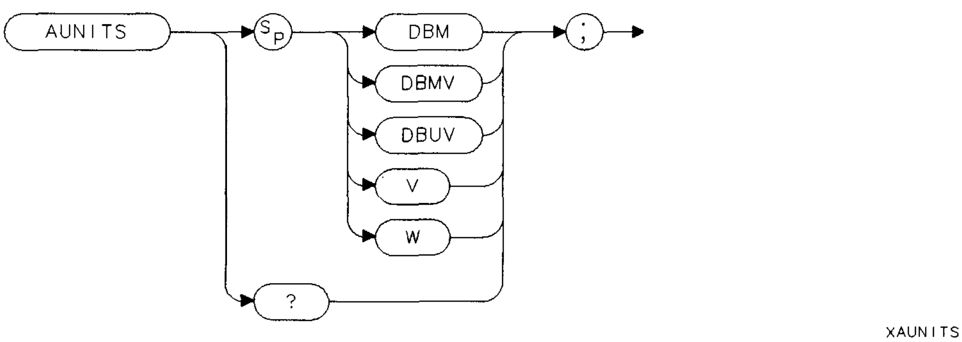
Description

The ATC command moves trace A into trace C, then stops updating trace C by placing it in the view mode. Trace A is unchanged by ATC. Trace A must contain a complete sweep of measurement information.

AUNITS Amplitude Units

Specifies the amplitude units for input, output, and display.

Syntax



Equivalent Key: **Amptd Units**
Related Commands: DL, MKA, RL, TH

Example

```
10 OUTPUT 718;"LN;"
```

Changes spectrum analyzer to linear mode.

```
20 OUTPUT 718;"AUNITS DBMV;"
```

Changes the linear amplitude units to DBMV.

```
30 OUTPUT 718;"AUNITS?;"
```

Queries current amplitude units.

```
40 ENTER 718;Reply$
```

Puts response in a variable.

```
50 DISP Reply$
```

Displays response on the computer screen.

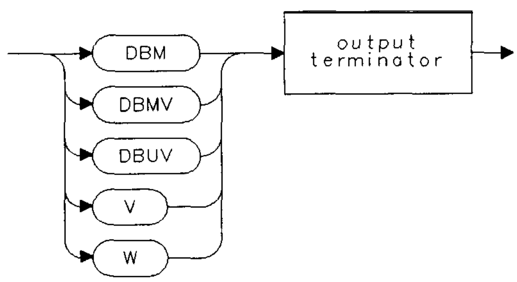
Description

The **AUNITS** command sets the amplitude readouts (reference level, marker, display line, and threshold) to the specified units. Different amplitude units can be set for log and linear amplitude scales.

When watts are selected as the units of measure, values below 1 **pW** are rounded to 0 pw.

Query Response

The query response returns the current amplitude units for the current amplitude scale.

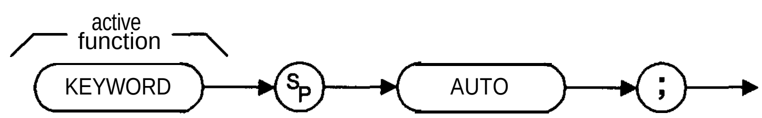


QAUNITS

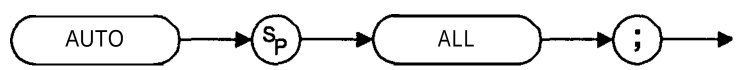
AUTO Auto Couple

Couples functions which have an AUTO parameter and sets the sweep coupling mode.

Syntax



XAUTO1



XAUTO2

Equivalent Key: **Auto Couple**
Related Commands: AT, LIMIDISP, MKFCR, RB, SRCAT, SRCPSTP, SWPCPL, SS, ST, VB , VBR

Example #1

```
10 OUTPUT 718;"AT AUTO;"
```

Couples the attenuation.

Example #2

```
10 OUTPUT 718;"AUTO ALL;"
```

Couples all functions.

Description

The result of the AUTO command depends on the active function it acts upon. The following are the functions that are affected by the AUTO parameter:

AT	couples attenuation to the reference level
MKFCR	deactivates use of user-supplied counter resolution value without changing the value of resolution

LIMIDISP	allows LIMITEST to control the display of limit lines
RB	couples resolution bandwidth to frequency span
SRCAT	couples the source attenuator to the source output level
SRCPSTP	couples the source power level step size to the reference level
SS	couples step size to frequency span
ST	couples sweep time to frequency span
SWPCPL	selects spectrum analysis auto-coupled sweeptimes
VB	couples video bandwidth to resolution bandwidth
VBR	sets the video to bandwidth ratio to 0.3

Individual functions can be coupled by entering the keyword for the command before AUTO, (for example, "AT AUTO;").

Executing "AUTO ALL;" couples all functions.

AXB Exchange Trace A and Trace B

Exchanges trace A and trace B.

Syntax

Equivalent Key: **A <-> B**
Related Commands: CLRW, SNGLS, TS, VIEW

Example

```
10 OUTPUT 718;"IP;"
```
Initializes spectrum analyzer.

```
20 OUTPUT 718;"SNGLS;"
```
Activates single-sweep mode.

```
30 OUTPUT 718;"DET POS;TS;"
```
Activates positive-peak detection of trace A.

```
40 OUTPUT 718;"VIEW TRA;"
```
Stores results, displays trace A.

```
50 OUTPUT 718;"DET SMP;"
```
Activates sample detection.

```
60 OUTPUT 718;"CLRW TRB;TS;"
```
Clear-writes trace B and takes sweep.

```
70 OUTPUT 718;"VIEW TRB;"
```
Stores results of sweep in trace B.

```
80 OUTPUT 718;"AXB;"
```
Exchanges trace A with trace B.

```
90 OUTPUT 718;"BLANK TRB;"
```
Blanks trace B, leaving only trace A on screen.

```
100 END
```

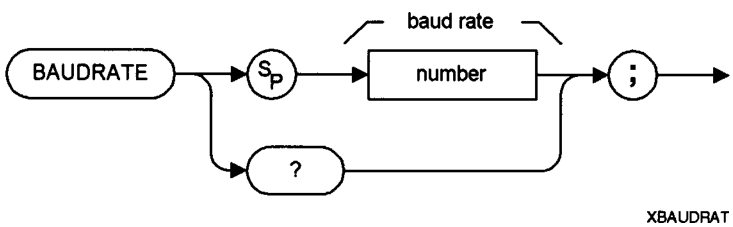
Description

The AXB command exchanges trace A and trace B, point by point. AXB sets trace A and trace B to the view mode.

BAUDRATE Baud Rate of Spectrum Analyzer

Specifies the baud rate of a spectrum analyzer with Option 1AX (the RS-232 and parallel interface) installed in it.

Syntax



Item	Description/Default	Range
Number	Any valid integer number	110 to 115200

Equivalent Key: **Baud Rate**
Option Required: Option 1AX

Example

The following example allows you to use a softkey to change the baud rate of the spectrum analyzer to 2400 baud.

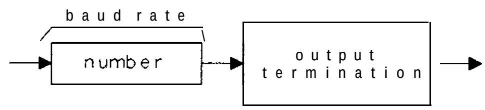
```
10 OUTPUT 718;"BAUDRATE 2400;"
```

Description

The BAUDRATE command changes the baud rate of the spectrum analyzer to one of the standard baud rates. The standard baud rates are as follows: 110,300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200. If you specify a baud rate other than one of the standard baud rates, the nearest standard baud rate will be used.

To communicate with the computer, the baud rates of the spectrum analyzer and the computer must be the same. Because changing the baud rate of the spectrum analyzer within a program ends communication with the computer, you should only use BAUDRATE within a remote program or when using the external keyboard to enter programming commands. To reestablish communication with the computer, you must set the baud rate back to the baud rate of the computer.

Query Response

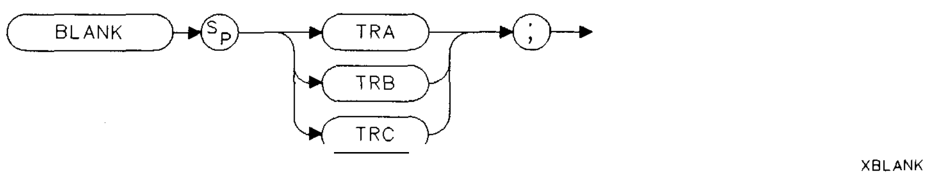


QBAUDRATE

BLANK Blank Trace

Blanks trace A, trace B, or trace C and stops taking new data into the specified trace.

Syntax



Equivalent Keys: **Blank A**, **Blank B**, and **Blank C**
Preset State: BLANK TRB, BLANK TRC
Related Commands: CLRW, MXMH, TRDSP, VIEW

Example

```
10 OUTPUT 718;"BLANK TRA;"
```

BML Trace B Minus Display Line

Subtracts display line from trace B and places the result in trace B.

Syntax

Equivalent Key: B – **DL ->** B
Related Commands: BLANK, CLRW, SUB, TS

Example

```
10 OUTPUT 718;"IP;SNGLS;"
```

Initializes spectrum analyzer, activates single-sweep mode.

```
20 OUTPUT 718;"BLANK TRA;"
```

Blanks trace A.

```
30 OUTPUT 718;"CLRW TRB;TS;"
```

Clear-writes trace B, takes sweep.

```
40 OUTPUT 718;"DL -70DM;"
```

Sets the display line to -70 dBm.

```
50 OUTPUT 718;"BML;"
```

Activates BML function.

```
60 END
```

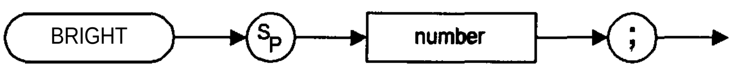
Description

The BML command subtracts the display line from trace B (point by point), and sends the difference to trace B.

BRIGHT Display Brightness

Specifies the brightness of the display backlight.

Syntax



XBRIGHT

Item	Description/Default	Range
Number	Any integer number	Values between 0 and 255

Equivalent Key: **Hardkeys** located to the upper left of the display
Related Commands: CONTRAST

Example

```
10 OUTPUT 718;"BRIGHT 88;"
```

Sets the brightness to a value of 88.

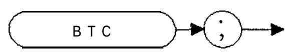
Description

The BRIGHT command specifies the amount of display backlight brightness using whole number values from 0 to 255. The two **hardkeys** at the upper left portion of the display vary the brightness.

BTC Transfer Trace B to Trace C

Transfers trace B into trace C.

Syntax



XBTC

Equivalent Key: B -> C
Related Commands: BLANK, CLRW, SNGLS, TS, VIEW

Example

`10 OUTPUT 718;"IP;"`

Initializes spectrum analyzer.

`20 OUTPUT 718;"SNGLS;"`

Activates single-sweep mode.

`30 OUTPUT 718;"BLANK TRA;"`

Blanks trace A.

`40 OUTPUT 718;"CF 300 MHZ;SP 1MHZ;"`

Sets up measurement range.

`50 OUTPUT 718;"CLRW TRB;TS;"`

Takes measurement sweep.

`60 OUTPUT 718;"BTC;"`

Moves trace B to trace C.

`70 OUTPUT 718;"BLANK TRB;VIEW TRC;"`

Displays result in trace C.

`80 END`

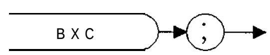
Description

The BTC command moves trace B into trace C, then stops updating trace C by placing it in the view mode. Trace B is unchanged by BTC. Trace B must contain a complete sweep of measurement information.

BXC Trace B Exchange Trace C

Exchanges trace B and trace C.

Syntax



XBXC

Equivalent Key: **B <-> C**
Related Commands: BLANK, CLRW, SNGLS, TS

Example

```
10 OUTPUT 718;"IP;BLANK TRA"
```

Initializes spectrum analyzer.

```
20 OUTPUT 718;"SNGLS;"
```

Activates single-sweep mode.

```
30 OUTPUT 718;"DET POS;CLRW TRB;TS;"
```

Activates positive-peak detection of trace B.

```
40 OUTPUT 718;"VIEW TRB;"
```

Stores results and displays trace B.

```
50 OUTPUT 718;"DET SMP;CLRW TRC;"
```

Activates sample detection.

```
60 OUTPUT 718;"TS;"
```

```
70 OUTPUT 718;"VIEW TRC;"
```

Stores results of sweep in trace C.

```
80 OUTPUT 718;"BXC;"
```

Exchanges trace B with trace C.

```
90 OUTPUT 718;"BLANK TRB;"
```

Blanks trace B leaving only trace C on screen.

```
100 END
```

Description

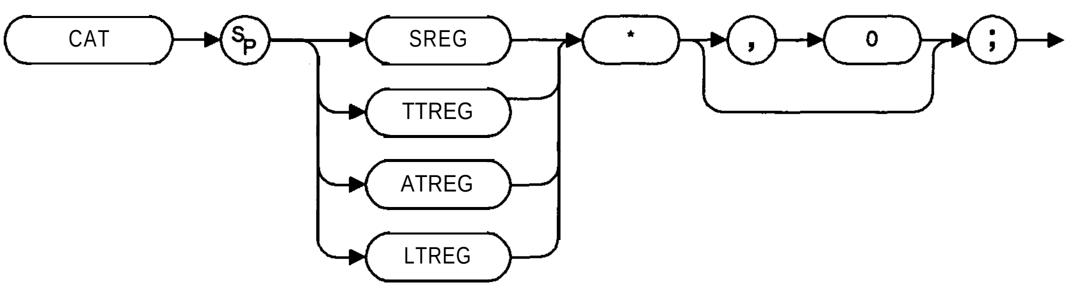
The BXC command exchanges the contents of traces B and C, then places both traces in the view mode.

To retain all data, trace B and trace C should contain a complete sweep of measurement data before BXC is executed.

CAT Catalog

Catalogs spectrum analyzer memory and returns the catalog information to the controller.

Syntax



XCAT

Equivalent Keys: the functions accessed by **Save** or **Load**
Related Commands: LOAD, SAVE

Example

This example returns the catalog information for the states stored in the memory. Catalog information is sent as individual catalog lines that are separated by a carriage return and a line feed. A carriage return, a line feed, and a line feed with an EOI (equivalent to a carriage return, a line feed, and a line feed) is asserted after the last item.

```
10 DIM User$[2000],Catalog$ (1:100)[80]
```

Dimensions strings to store the catalog information. User$ stores the entire string of catalog information. Catalog$ stores the catalog information line by line (up to 80 lines and 100 characters long).

```
20 INTEGER I,Pos_lf
```

I and Pos_lf are used to search through User$ string.

```
30 OUTPUT 718;"CAT SREG*;
```

The spectrum analyzer sends catalog information for all the states stored in memory.

```
40 ENTER 718 USING "#,-K";User$
```

Reads the catalog information into the User$ string.

```
50 I=O
```

```
60 WHILE LEN(User$)>1
```

Loops until the User$ string is empty.

```
70 I=I+1
```

```
80 Pos_lf=POS(User$,CHR$(10))
```

Checks for line feeds. CHR$(10) represents the line feed, the ASCII code for a line feed is "10."

```
90 Catalog$(I)=User$[1,Pos_lf-2]
```

Extracts catalog line.

```
100 OUTPUT CRT;Catalog$(I)
```

Displays catalog line.

```
120 User$=User$[Pos_lf+1]
```

```
130 END WHILE
```

```
140 END
```

Description

To use the CAT command, you must specify the type of information to be cataloged. After the spectrum analyzer has sent the catalog information to the controller, the spectrum analyzer sends two line feed characters to the controller. The register types are:

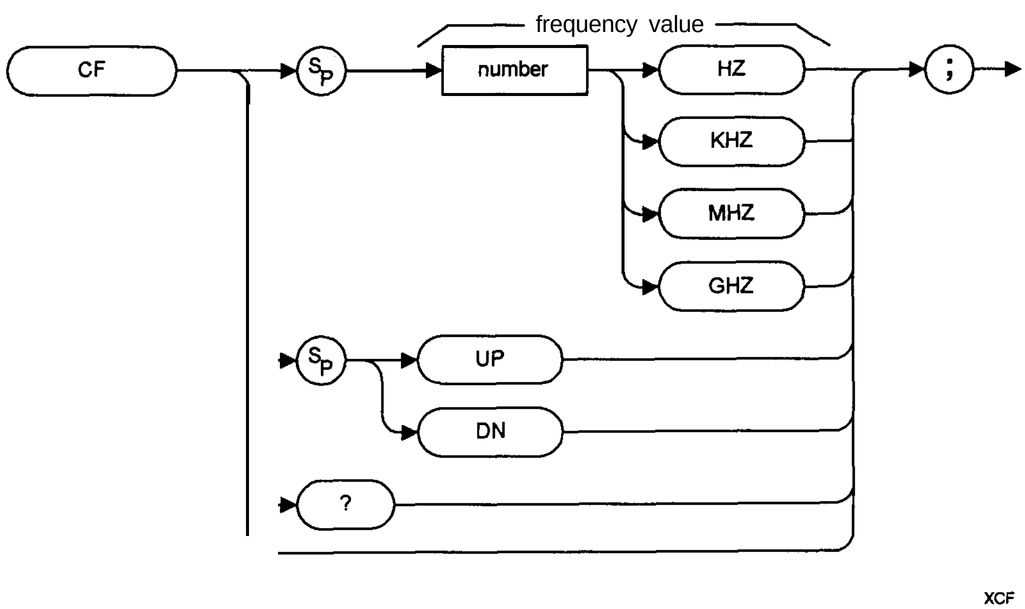
Syntax	Register Type
SREG	State
TTREG	Trace Data
ATREG	Ampcor Data
LTREG	Limit Line Data

The zero in the command syntax indicates that the catalog information comes from the spectrum analyzer. If the zero is not specified when the command is sent, the analyzer will assume it.

CF Center Frequency

Specifies the center frequency.

Syntax



Item	Description/Default	Range
Number	Any real or integer number. Default unit is Hz.	Frequency range of the spectrum analyzer

Equivalent Key: **Center Freq**
Step Increment: If uncoupled, step size is determined by the SS command. If coupled, step size is 10% of span.
Related Commands: FA, FB, FOFFSET, FS, MKCF, MKSS, SP, SS

NOTE: Although the spectrum analyzer allows entry of frequencies not in the specified frequency range, using frequencies outside the frequency span of the spectrum analyzer is not recommended and is not warranted to meet specifications.

Example

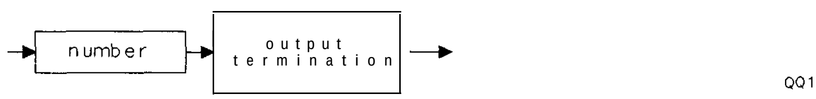
```
10 OUTPUT 718;"CF 300MHZ;"
```

Sets the center frequency to 300 MHz.

Description

The CF command specifies the value of the center frequency.

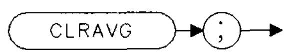
Query Response



CLRAVG Clear Average

Restarts video averaging.

Syntax



XCLRAVG

Equivalent Key: **Video Average**
Related Commands: CLRW, MINH, MXMH, VAVG

Example

```
10 OUTPUT 718;"IP;"
```

Initializes the spectrum analyzer.

```
20 OUTPUT 718;"VAVG 100;"
```

Initializes video averaging.

```
30 WAIT 30
```

```
40 OUTPUT 718;"CLRAVG;"
```

Restarts video averaging.

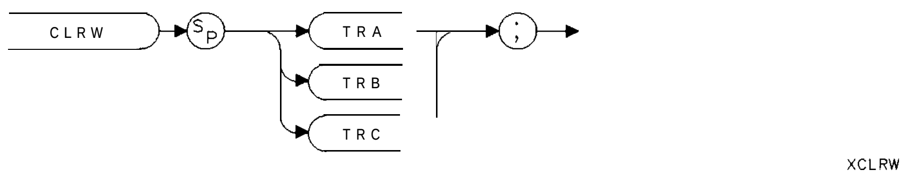
Description

The CLRAVG command restarts the VAVG command by resetting the number of averaged sweeps to one. The video averaging routine resets the number of sweeps, but does not stop video averaging. Use "VAVG OFF;" to stop video averaging.

CLRW Clear Write

Clears the specified trace and enables trace data acquisition.

Syntax



Equivalent Keys: **Clear Write A**, **Clear Write B**, and **Clear Write C**
Preset State: CLRW TRA
Related Commands: BLANK, DET, MINH, MXMH, VAVG, VIEW

Example

```
10 OUTPUT 718;"CLRW TRA;"
```

Description

The CLRW command places the indicated trace in the clear-write mode. Data acquisition begins at the next sweep. (See "TS" for more information about data acquisition.)

CLS Clear Status Byte

Clears all status bits.

Syntax

XCLS

Related Commands: RQS, SRQ, STB

Example

```
10 OUTPUT 718;"CLS;"
```

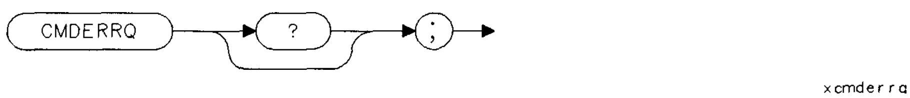
Description

The CLS command clears all the status bits in the status byte. (See "SRQ" for more information on the status byte.)

CMDERRQ Command Error Query

The CMDERRQ command returns the current buffer of illegal commands and then clears the illegal-command buffer from the spectrum analyzer.

Syntax



Example

```
10 OUTPUT 718;"XYZ;"
20 OUTPUT 718;"CMDERRQ;"
```
Initiates the command

```
30 ENTER 718;A$
```
Displays the response

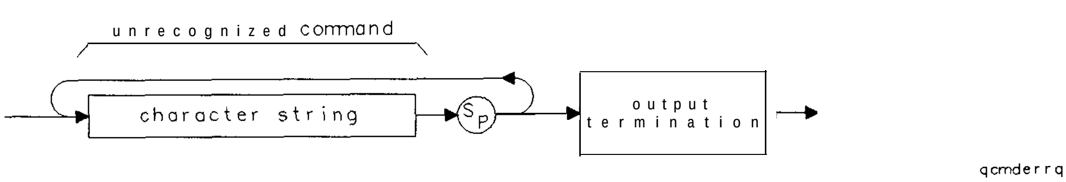
```
XYZ
```

Description

Executing the CMDERRQ command does the following:

- Returns the most recently stored illegal or unrecognized command characters.
- Returns up to 45 characters of an illegal command or commands.
- Erases the illegal command buffer.

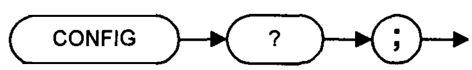
Query Response



CONFIG Configuration

Returns the analyzer configuration information to the controller.

Syntax



XCONFIG

Related Command: SHOWSYS

Example

This example returns the configuration information for the analyzer. Configuration information is sent as individual lines that are separated by a carriage return and a line feed. A carriage return, a line feed, and a line feed with an EOI (equivalent to a carriage return, a line feed, and a line feed) is asserted after the last item.

```
10 DIM User$[2000],Config$(1:100)[80]
```

Dimensions strings to store the configuration information. User$ stores the entire string of configuration information. Config$ stores the configuration information line by line (up to 80 lines and 100 characters long).

```
20 INTEGER I,Pos_lf
```

I and Pos_lf are used to search through User$ string.

```
30 OUTPUT 718;"CONFIG?;
```

The spectrum analyzer sends configuration information.

```
40 ENTER 718 USING "#,-K";User$
```

Reads the catalog information into the User$ string.

```
50 I=0
```

```
60 WHILE LEN(User$)>1
```

Loops until the User$ string is empty.

```
70 I=I+1
```

```
80  Pos_lf=POS(User$,CHR$(10))
```

Checks for line feeds. CHR$(10) represents the line feed, the ASCII code for a line feed is "10."

```
90  Config$(I)=User$[1,Pos_lf-2]
```

Extracts catalog line.

```
100 OUTPUT CRT;Config$(I)
```

Displays catalog line.

```
120  User$=User$[Pos_lf+1]
```

```
130 END WHILE
```

```
140  END
```

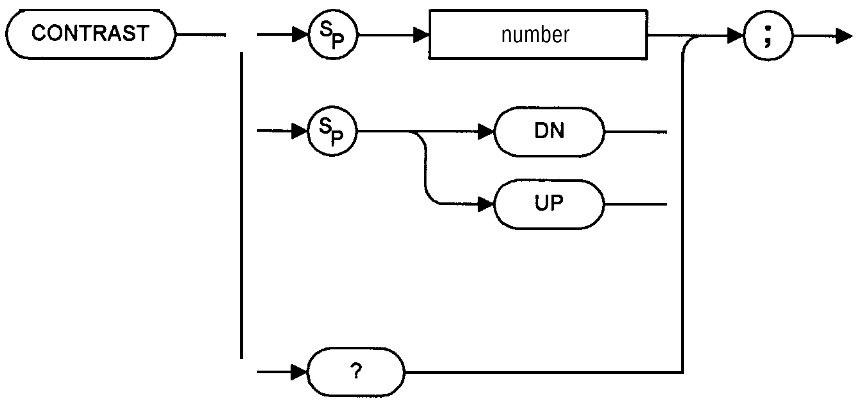
Description

The CONFIG command is used to query the contents of the Show System screen. It contains analyzer configuration information such as the instrument model number, serial number, firmware revision, and options. After the analyzer has sent the configuration information to the controller, the analyzer sends two line feed characters to the controller.

CONTRAST Display Contrast

Specifies the amount of contrast for the display.

Syntax



XCONTRAS

Item	Description/Default	Range
Number	Any integer number.	Values between 0 and 255.

Equivalent Key: **Contrast**.
Step Increment: 1.

Example

```
10 OUTPUT 718;"CONTRAST 88;"
```

Sets the contrast to a value of 88.

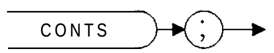
Description

The CONTRAST command specifies the viewing angle of the LCD display in arbitrary units. Be careful not to program a value that results in a display that cannot be viewed; the last value set is used following a power cycle.

CONTS Continuous Sweep

Sets the spectrum analyzer to the continuous sweep mode.

Syntax



XCONTS

Equivalent Key: **Sweep Cont Single** (when Cont is underlined)
Preset State: CONTS
Related Commands: SNGLS, ST, TM

Example

```
10 OUTPUT 718;"CONTS;"
```

Description

The CONTS command sets the spectrum analyzer to continuous sweep mode. In the continuous sweep mode, the spectrum 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 remote interface.

CORREK Correction Factors On

Returns a “1” if the frequency correction factors are on, a “0” if they are off.

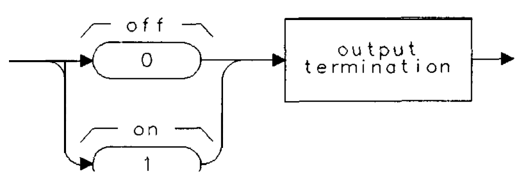
Syntax

Equivalent Key: **Freq Correct**
Related Commands: ALIGN FRQCORON, ALIGN FRQCOROFF

Example

```
10 OUTPUT 718;"CORREK FREQ?;"
20 ENTER 718;A
30 DISP A
```

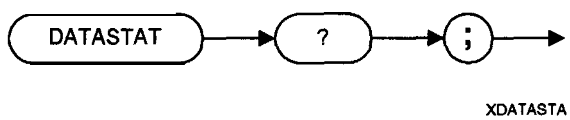
Query Response



DATASTAT Data Status

Indicates the status of certain conditions of the analyzer.

Syntax



Example

```
10 OUTPUT 718;"DATASTAT?;"
20 ENTER 718; Datastat
```

Description

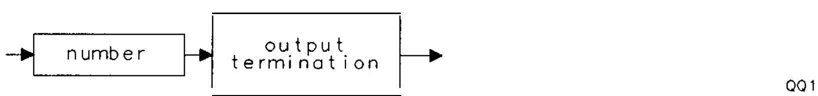
The DATASTAT command is used to verify that the trace data is valid as well as checking on other analyzer conditions.

The command returns a number representing a 16 bit word. The presence of a 1 (one) indicates that the condition exists. The bit definitions are listed below:

Bit Number	Decimal Equivalent	Definition
0	1	Instrument corrections are off
1	2	Span/frequency change is not finished
2	4	Sweep time setting is not finished
3	8	Trace A invalid
4	16	Trace B invalid
5	32	Trace C invalid
6	64	Marker is not counted
7	128	Sweep time too fast for resolution BW or video BW

Bit Number	Decimal Equivalent	Definition
8	256	TG is unleveled
9	512	Decrease span for valid frequency count measurement
10	1024	Degenerate limit line
11	2048	reserved
12	4096	Frequency corrections are off
13	8192	reserved
14	16384	reserved
15	32768	Signal track lost the signal

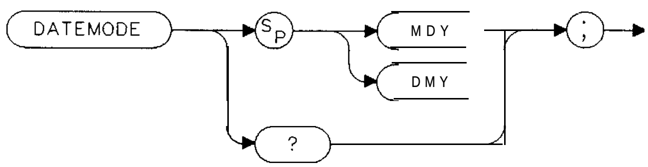
Query Response



DATEMODE Date Mode

Allows you to set the format for displaying the real-time clock in either the month, day, year format or the day, month, year format.

Syntax



XDATEMODE

Equivalent Key: **Datemode MDY DMY**

Example

```
10 OUTPUT 718;"DATEMODE DMY;"
```

Sets the date mode to day, month, year format.

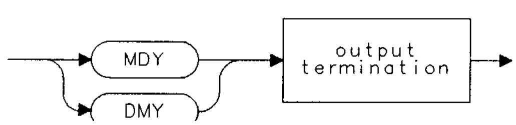
```
20 OUTPUT 718;"DATEMODE?;"
```

Queries the format of the display of the real-time clock.

```
30 ENTER 718;A$
```

```
40 DISP A$
```

Query Response

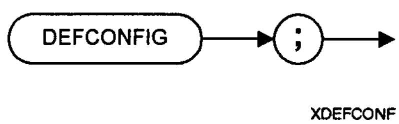


QDATEMODE

DEFCONFIG Default Configuration

Resets the user configuration to the defaults and performs an instrument preset.

Syntax



Equivalent Key: **Default Config**

Example

```
10 OUTPUT 718;"DEFCONFIG;"
```

Description

The DEFCONFIG command resets the spectrum analyzer to the user configuration originally set at the factory and performs an instrument preset, IP. The following table shows the default user configuration settings which result from executing the command:

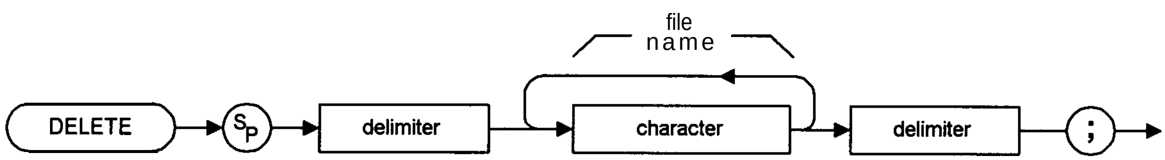
Command	Value
Analyzer address (Option A4H)[a]	18
BAUDRATE (Option 1AX)	9600
DATEMODE	MDY
PSTATE	OFF
POWERON	IP
ALIGN	AUTOON
PRNTADRS (Option A4H)	1
PRNPRT (Options A4H and 1AX)	4 (Parallel)
TIMEDSP	On

a. No remote command is associated with this command.

DELETE File

Deletes identified file.

Syntax



XDELETE

Item	Description/Default	Range
Delimiter	Matching characters marking the beginning and end of the filename	I\@ ^ $%;!
Filename	Any valid character	Any valid file name

Equivalent Key: **Delete** and **Delete Now**
Related Commands: ERASE

Example

```
10 OUTPUT 718;"DELETE @MY.TRC@;"
```

Deletes MY.TRC file from spectrum analyzer memory.

Description

The DELETE command is used to delete files from analyzer memory. There are several different types of file data. The type of data, and its corresponding data destination, are shown in the following table. To use the DELETE command you must specify the file name including the appropriate file extension.

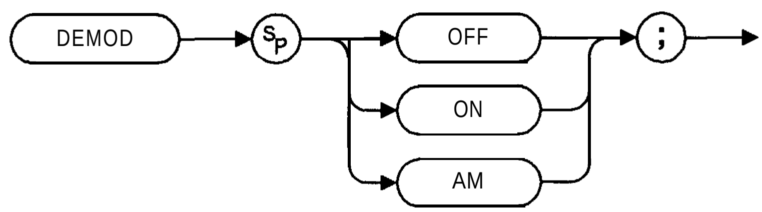
Some of the characters that are available to use as delimiters for the file name are also allowed in the file name. Do not use any of the same characters for the delimiters as are used in the file name. The analyzer will interpret the second occurrence of the character as the end delimiter, rather than a part of the file name.

Data Source	Type of Data Transferred	File Extension
TRA	Trace	.TRC
TRB	Trace	.TRC
TRC	Trace	.TRC
STATE!	Instrument state	.STA
LIMILINE	Limit lines	.LIM
AMPCOR	Amplitude correction factors	.AMP

DEMOD Demodulation

Turns the demodulator on or off, and selects AM demodulation.

Syntax



XDEMOD

Equivalent Key: **Demod On** Off is similar
Related Commands: DEMODT, SPEAKER

Example

This example demonstrates AM demodulation in a span greater than zero.

10 OUTPUT 718;"IP;FA 500KHZ;"

Sets start frequency.

20 OUTPUT 718;"FB 1600KHZ;"

Sets stop frequency.

30 OUTPUT 718;"TS;MKPK HI;MKCF;"

Places marker on the highest peak and brings the peak to center frequency.

40 OUTPUT 718;"DEMOD ON;DEMOD AM;"

Turns on AM demodulation.

50 OUTPUT 718;"DEMODT 500MS;"

Turns on marker pause.

60 END

Description

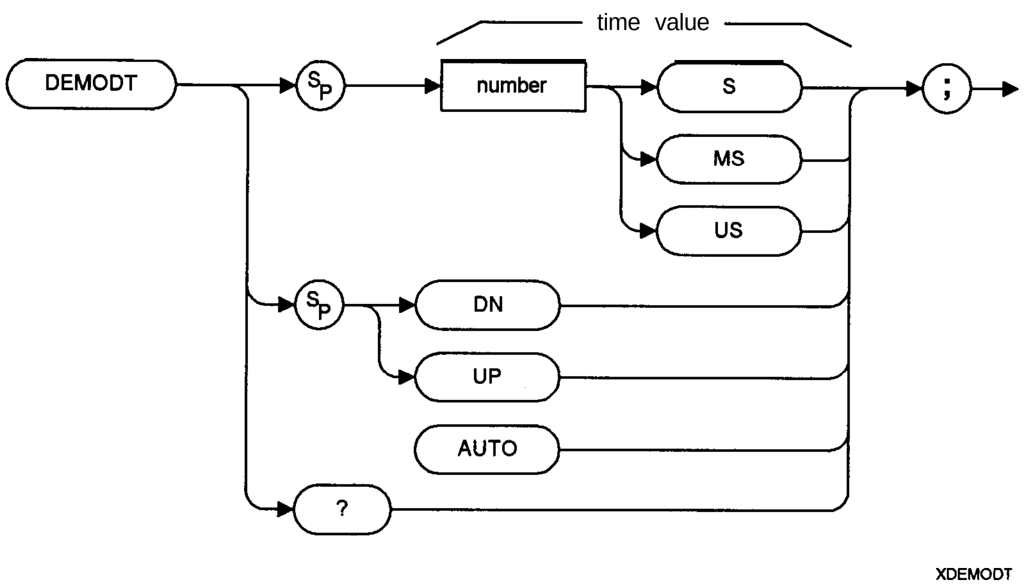
Execute "DEMOD ON;" to turn on the demodulator. "DEMOD AM;" selects the demodulation mode, but does not turn on the demodulator.

For AM demodulation in nonzero frequency spans, use DEMODT to set the dwell time.

DEMODT Demodulation Time (Dwell Time)

Pauses the sweep at the active marker for the duration of the delay period.

Syntax



Item	Description/Default	Range
Number	Any real or integer number	2 ms to 100 s

Restrictions: Not available with negative peak detection
Equivalent Key: **Dwell Time On Off**
Step Increment: 1, 2, 5, 10 sequence
Related Commands: DEMOD, DEMODT, MKA, MKF, MKFC, MKN, MKOFF, ST

Example

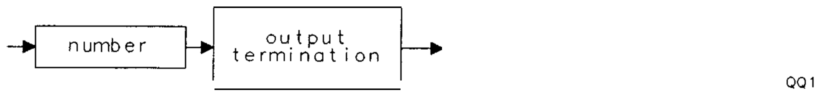
```
10 OUTPUT 718;"DEMODT 10SC;"
```

Changes the marker pause time to 10 seconds.

Description

To turn DEMODT off send “DEMODT 0;”.

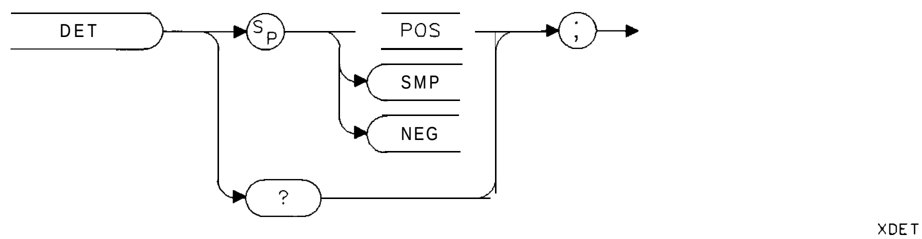
Query Response



DET Detection Mode

Selects the spectrum analyzer detection mode.

Syntax



Equivalent Key: **Detector**
Preset State: DET POS
Related Commands: MEANTH

Example

10 OUTPUT 718;"IP;"

Initializes the spectrum analyzer.

20 OUTPUT 718;"SNGLS;"

Activates single-sweep mode.

30 OUTPUT 718;"DET POS;TS;"

Activates the positive-peak detection of trace A.

40 OUTPUT 718;"VIEW **TRA;"**

Stores results in trace A.

50 OUTPUT 718;"DET **SMP;"**

Activates sample detection for trace B.

60 OUTPUT 718;"CLRW **TRB;TS;"**

Measures with trace B.

70 OUTPUT 718;"VIEW **TRB;"**

Stores results in trace B.

80 OUTPUT 718;"AVG TRA,TRB,2;"

Averages trace A and B with a ratio of 2, and stores the results in trace A.

90 OUTPUT 718;"BLANK **TRB;"**

Blanks trace B, leaving only averaged results on screen.

100 END

Description

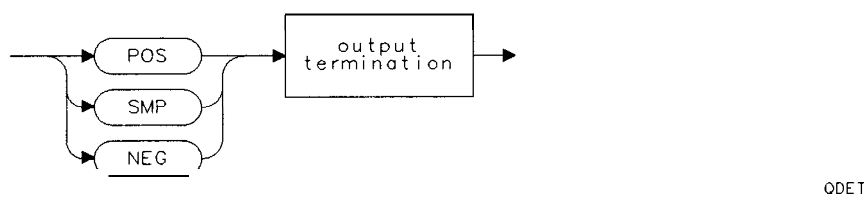
The DET command selects the type of spectrum analyzer detection **(positive-**peak, sample, or negative) and accesses service-diagnostic detection functions.

POS enables positive-peak detection, which displays the maximum video signal detected over a number of instantaneous samples for a particular frequency.

SMP enables sample detection, which uses the instantaneous video signal value. Video averaging and noise-level markers, when activated, activate sample detection automatically.

NEG enables negative peak detection in sweep times of less than or equal to 200 ms.

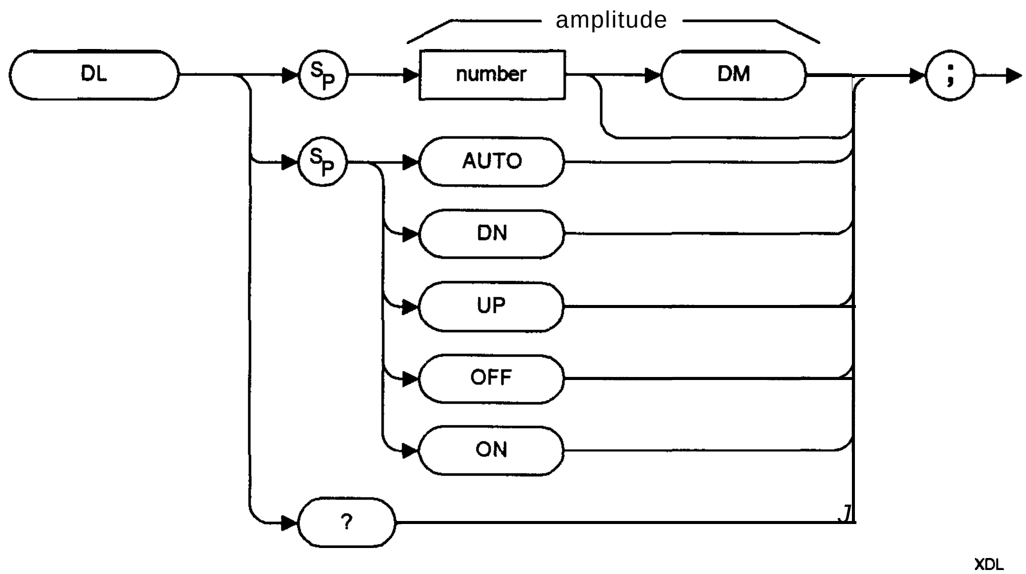
Query Response



DL Display Line

Defines the level of the display line in the active amplitude units and displays the display line on the spectrum analyzer screen.

Syntax



Item	Description/Default	Range
Number	Any real or integer number. Default units are dBm.	Dependent on the reference level

Equivalent Key: **Display Line On Off**
Preset State: DL OFF
Step Increment: 1 major division
Related Commands: AUNITS, AUTO, LG, LN, NRL, RL, ROFFSET, TH

Example

```
10 OUTPUT 718;"AUNITS DBM;"
```

Changes the active amplitude units to dBm.

```
20 OUTPUT 718;"DL ON;"
```

Turns on the display line.

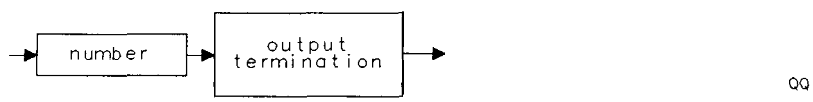
```
30 OUTPUT 718;"DL -5DM;"
```

Changes display line to -5 dBm.

Description

Activating video trigger mode activates the display line. The AUTO command and "DL OFF;" turn off the display line. See "AUNITS" for more information on changing the active amplitude units.

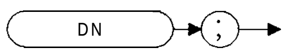
Query Response



DN Down

Reduces the active function by the applicable step size.

Syntax



XDN

Equivalent Key: ↓
Related Commands: See the list of active functions listed in the description for DN

Example

```
10 OUTPUT 718;"SS 1MHZ;CF 1GHZ;DN;"
```

Sets center frequency to 1 GHz.

```
20 OUTPUT 718;"SP 40MHZ;MKPK;DN;"
```

Decreases the frequency span.

Description

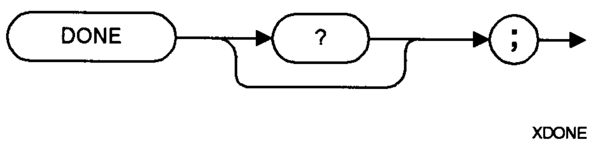
Before executing DN, be sure that the function to be decreased is the active function. For example, the second line of the programming example decreases the span, because marker peak (MKPK) is not an active function.

The active functions are AT, CF, CONTRAST, DEMODT, DL, FA, FB, LG, MKA, MKD, MKFCR, MKN, MKPAUSE, MKPX, MKTH, ML, NDB, NRL, NRPOS, PRNTMARB, PRNTMARGT, PRNTRES, RB, ROFFSET, RL, SET-DATE, SET-TIME, SP, SRCALC, SRCAT, SRCPOFS, SRCPSWP, SRCPWR, SS, ST, TH, TIMEBASEC, TIMEBASEF, VB, and VBR.

DONE Done

Allows you to determine when the spectrum analyzer has parsed the spectrum analyzer commands and has started to execute all commands prior to and including DONE. The spectrum analyzer returns a value of "1" when all commands in a command string entered before DONE have been started.

Syntax



Related Commands: TS

Example 1

```
10 OUTPUT 718;"IP;SNGLS;CF 1GHZ;SP 1GHZ;TS;DONE;"
```

The take sweep (TS) must be completed before the DONE command is executed so that the auto-coupled functions and trace data have been changed before the DONE command is executed.

```
20 ENTER 718;Done
```

Stores 1 in computer variable, called Done.

```
30 DISP Done
```

Example 2

```
10 OUTPUT 718;"IP;SNGLS;CF 1GHZ;SP 1GHZ;DONE;"
```

There is no TS command before the DONE command in this example. Because of this, the center frequency and span values are set before DONE returns a "1." Functions coupled to span (SP), such as RB, have not been changed, and there is no trace data associated with the new frequency settings.

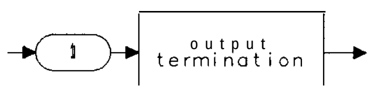
```
20 ENTER 718;Done
```

```
30 DISP Done
```

Description

As shown by the example, if a take sweep (TS) precedes the DONE command, DONE is executed after all the preceding commands have been completed. Use a take sweep (TS) to ensure all previous commands have completed before DONE returns a "1."

Query Response



ERASE Erase

Purges all state and trace registers, deletes limit lines and AMPCOR information.

Syntax

Equivalent Key: **ALL MEMORY**.
Related Commands: PSTATE.

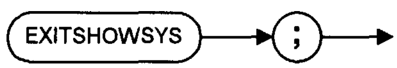
Example

```
10 OUTPUT 718;"ERASE;"
```

EXITSHOWSYS Exit Config/Show System Screen

Erases the display for the function that shows the analyzer's current system configuration.

Syntax



XEXITSHO

Related Softkey: **Show System, Done**
Related Commands: SHOWSYS

Example

```
10 OUTPUT 718;"EXITSHOWSYS;"
```

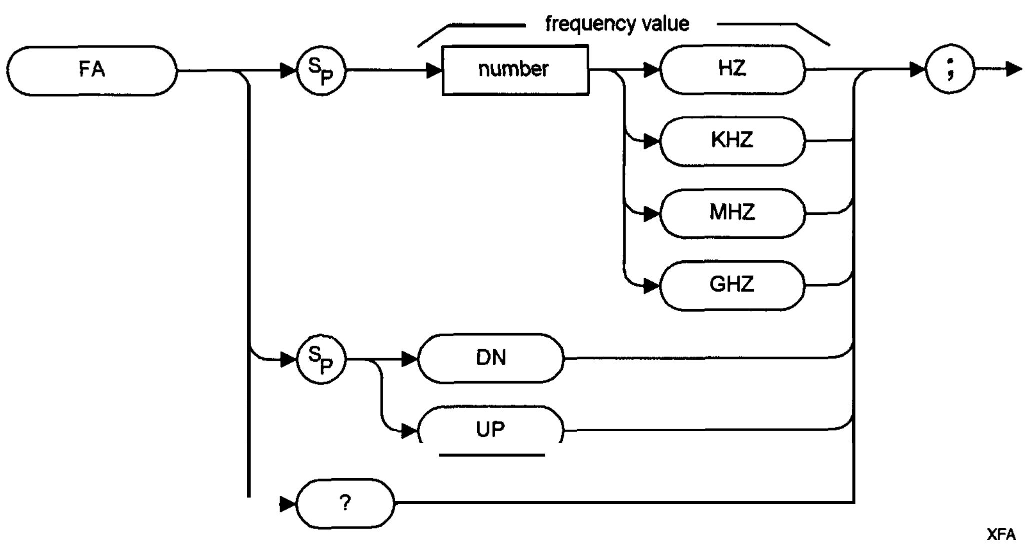
Description

The show system function prints the analyzer configuration on the display screen. EXITSHOWSYS is used to remove the configuration screen and return to normal instrument operation.

FA Start Frequency

Specifies the start frequency.

Syntax



Item	Description/Default	Range
Number	Any real or integer number. Default unit is Hz.	Frequency range of the spectrum analyzer

Equivalent Key: **Start Freq**
Step Increment: Frequency span divided by 10
Related Commands: CF, FB, FOFFSET, FS, MKF, SP

Example

```
10 OUTPUT 718;"FA 88MHZ;FB 108MHZ;"
```

Sets the start frequency to 88 MHz, the stop frequency to 108 MHz.

```
20 OUTPUT 718;"FA?;"
```

Returns the start frequency.

```
30 ENTER 718;Freq
```

Stores the response from the spectrum analyzer.

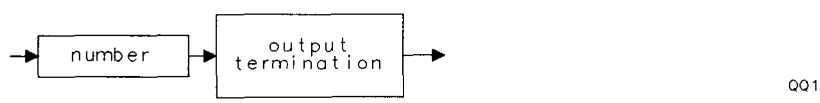
```
40 DISP Freq
```

Displays the frequency on the computer screen.

Description

The FA command specifies the start frequency value. The start frequency is equal to the center frequency minus the span divided by two (FA = CF − SP/2). Changing the start frequency changes the center frequency and span.

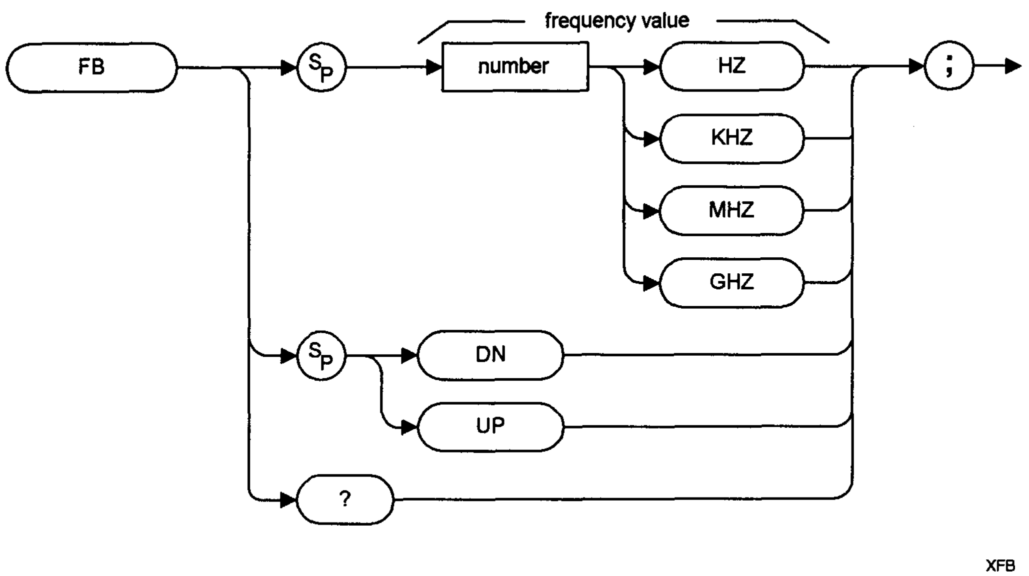
Query Response



FB Stop Frequency

Specifies the stop frequency.

Syntax



Item	Description/Default	Range
Number	Any real or integer number. Default unit is Hz.	Frequency range of the spectrum analyzer

Equivalent Key: **Stop Freq**
Step Increment: Frequency span divided by 10
Related Commands: CF, FA, FOFFSET, FS, MKF, SP

Example

```
10 OUTPUT 718;"FA 88MHZ;FB 108MHZ;"
```

Sets the start frequency to 88 MHz, the stop frequency to 108 MHz.

```
20 OUTPUT 718;"FB?;"
```

Returns the stop frequency.

30 ENTER `718;Freq`

Stores the response from the spectrum analyzer.

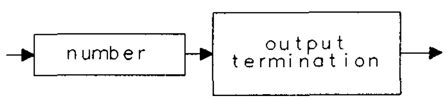
40 DISP Freq

Displays the frequency on the computer screen.

Description

The FB command specifies the stop frequency value. The stop frequency is equal to the center frequency plus the span divided by two (FB = CF + SP/2). Changing the stop frequency changes the center frequency and span.

Query Response

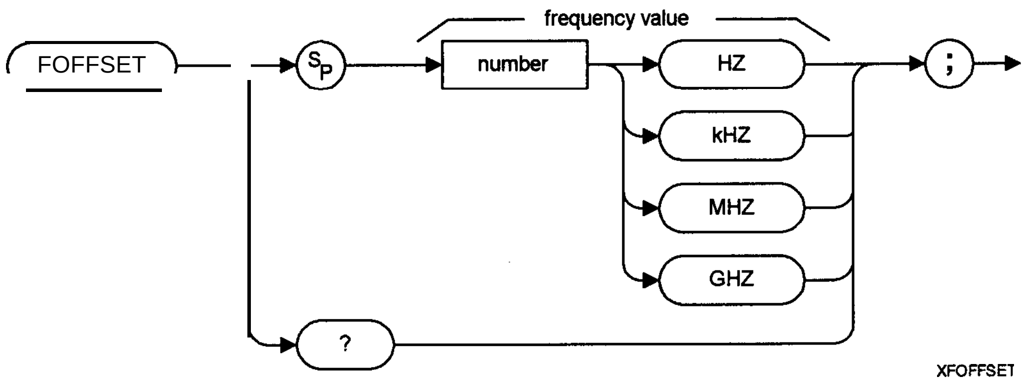


QQ1

FOFFSET Frequency Offset

Specifies the frequency offset for all absolute frequency readouts such as center frequency.

Syntax



Item	Description/Default	Range
Number	Any real or integer number. Default unit is Hz.	

Equivalent Key: **Freq** Offset
Preset State: 0 Hz
Related Commands: CF, FA, FB, MKN, MKF, MKSP, MKSS

Example

```
10 OUTPUT 718;"IP;FA 200MZ;"
```

Initializes spectrum analyzer. Sets start frequency.

```
20 OUTPUT 718;"FB 1GZ;"
```

Sets stop frequency.

```
30 OUTPUT 718;"TS;MKPK HI;"
```

Places marker on signal peak.

```
40 OUTPUT 718;"MF;"
```

Finds frequency of marker.

```
50 ENTER 718;A
```

```
60 PRINT A
```

Prints frequency of marker.

```
70 OUTPUT 718;"FOFFSET 500MZ;"
```

Adds a frequency offset.

```
80 OUTPUT 718;"TS;MF;"
```

The frequency of the marker now is the frequency of the signal peak plus the frequency offset.

```
90 ENTER 718;A
```

```
100 PRINT A
```

The displayed frequency is 500 MHz greater than the frequency displayed in line 60.

```
110 END
```

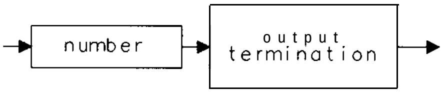
Description

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

After execution, the FOFFSET command displays the frequency offset in the active function readout. When an offset is in effect, it is displayed beneath the bottom graticule line on the spectrum analyzer screen.

Execute "FOFFSET 0;" or "IP;" to turn off the offset.

Query Response

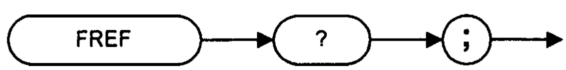


QQ1

FREF Frequency Reference

Returns the source of the 10 MHz frequency reference.

Syntax



XFREF1

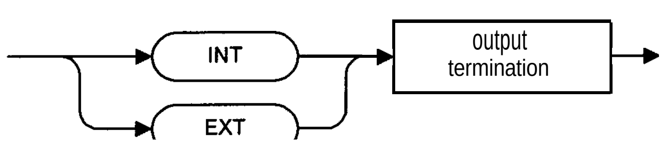
Example

```
10 OUTPUT 718;"FREF?;"
20 ENTER 718;SOURCE$
30 PRINT "THE FREQUENCY REF SOURCE IS";SOURCE IS";SOURCE$
40 END
```

Description

The FREF command is used to query the source of the frequency reference, which is supplied from an internal (INT) or external (EXT) 10 MHz source.

Query Response

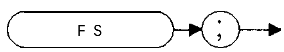


XFREF2

FS Full Span

Sets the frequency span of the spectrum analyzer to **full** span.

Syntax



XFS

Equivalent Key: **Full Span**
Related Commands: CF, FA, FB, HNLOCK, SP, SS

Example

```
10 OUTPUT 718;"FS;"
```

Puts the spectrum analyzer in full-span mode.

Description

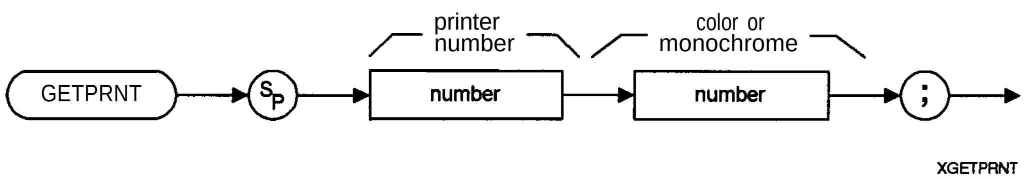
The FS command selects both the start frequency and the stop frequency according to the frequency span of the spectrum analyzer. Resolution bandwidth, video bandwidth, and sweep time are all set to auto-coupled.

Spectrum Analyzer Model	Start Frequency	Stop Frequency
HP ESA-L1500A	0 Hz	1.5 GHz

GETPRNT Get Print

Initiates output of the spectrum analyzer display to a printer. GETPRNT is meant to be used within a remote program.

Syntax



Equivalent Key: **Print**
Related Commands: GETPLOT, PRNPRT

Example for the HP-IB Interface

This example illustrates how you can use a softkey to print the spectrum analyzer display, and then have the printer perform a page feed. This example assumes that the printer is at address 1 and the spectrum analyzer is at address 18. (This example is only valid for HP 9000 series 200 and 300 computers.)

```
10 OUTPUT 718;PRNPRT 4;
```

Prints the contents of the display in monochrome to an HP Deskjet 850 printer.

```
20 OUTPUT 718;"GETPRNT 14,0;"
```

Prints the contents of the display in monochrome to an HP Deskjet 850 printer.

```
30 OUTPUT 718;"GETPRNT 14,1;"
```

Prints the contents of the display in color to an HP Deskjet 850 printer.

Description

The data is output in HP raster graphics or Epson graphics format.

The following table lists available printers and their associated numbers, for use in the GETPRNT remote command. The printers listed in your spectrum analyzer may be different than those listed in the table due to differences in firmware versions.

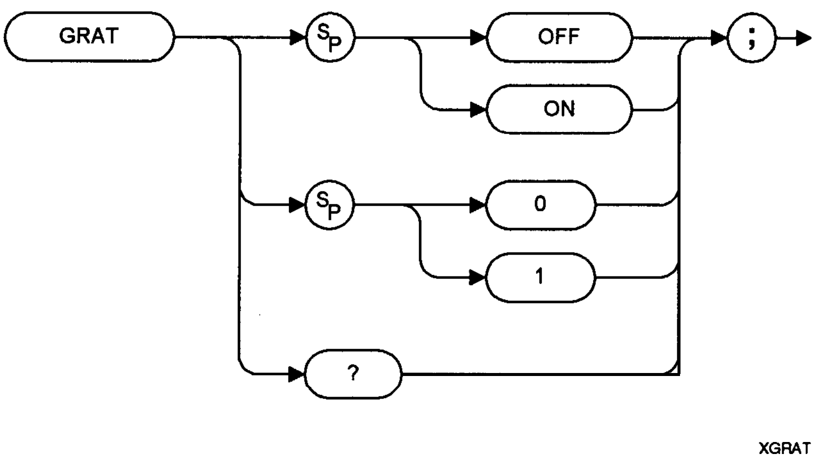
Printer Model	Printer Number
HP DeskJet 3 10	0
HP DeskJet 320	1
HP DeskJet 340	2
HP DeskJet 400	3
HP DeskJet 500	4
HP DeskJet 500C	5
HP DeskJet 520	6
HP DeskJet 540	7
HP DeskJet 550C	8
HP DeskJet 560C	9
HP DeskJet 600	10
HP DeskJet 660C	11
HP DeskJet 680C	12
HP DeskJet 690C	13
HP DeskJet 850C	14
HP DeskJet 870C	15
HP DeskJet 1200C	16
HP DeskJet 1600C	17
HP DeskJet Plus	18
HP DeskJet Portable	19
HP DeskJet	20
HP ThinkJet	21
HP QuietJet	22

Printer Model	Printer Number
HP PaintJet	23
HP LaserJet III	24
HP LaserJet 4	25
HP LaserJet 4L	26
HP LaserJet 4P	27
HP LaserJet 4Plus	28
HP LaserJet 5	29
HP LaserJet 5L	30
HP LaserJet 5P	31
Epson FX-85	32
Epson LQ-570	33

GRAT Graticule

Turns on or off the graticule.

Syntax



Equivalent Key: **Graticule On Off**
Preset State: GRAT ON
Related Commands: ANNOT

Example

```
10 OUTPUT 718;"GRAT OFF;"
```

Turns off the graticule.

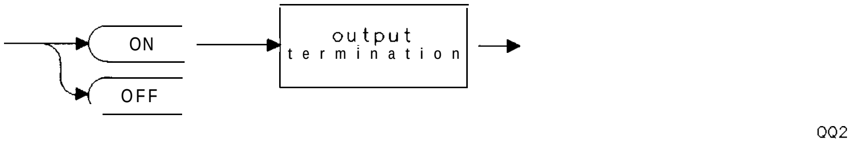
```
20 OUTPUT 718;"GRAT?;"
```

Gets response from the spectrum analyzer.

```
30 DISP Grat$
```

Displays OFF on the computer screen.

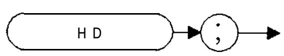
Query Response



HD Hold Data Entry

Disables data entry via the spectrum analyzer numeric keypad, knob, or step keys. The active function readout is blanked, and any active function is deactivated.

Syntax



XHD

Equivalent Key: **Esc**
Related Commands: Any active function. See the description below for a list of the active functions

Example

```
10 OUTPUT 718;"HD;"
```

Disables the active function and clears the active function block area on the spectrum analyzer screen.

```
20 OUTPUT 718;"CF 600MHZ;HD;700MHZ;"
```

This will leave the center frequency at 600 MHz, because HD deactivates any current function.

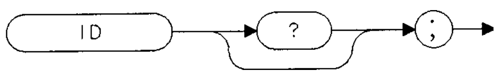
Description

The active functions are AT, BAUDRATE, CF, CONTRAST, DEMODT, DL, FA, FB, INZ, LG, MKA, MKD, MKFC, MKFCR, MKN, MKPAUSE, MKPX, MKTH, ML, MODE, NDB, NRL, NRPOS, PREAMPG, PRNTMARGB, PRNTMARGT, PRNTRES, RB, ROFFSET, RL, SETDATE, SETTIME, SP, SRCAT, SRCPOFS, SRCPSTP, SRCPSWP, SRCPWR, SS, ST, TH, TIMEBASEC, TIMEBASEF, TIMEDATE, VAVG, VB, and VBR.

ID Identify

Returns the spectrum analyzer model number to the controller (for example, "HP ESA-L1500A").

Syntax



Equivalent Key: **Show Config**
Related Commands: REV, SER

Example

`10 ALLOCATE A$[50]`

Allocates string to hold model number.

`20 OUTPUT 718;"ID;"`

Gets model number.

`30 ENTER 718;A$`

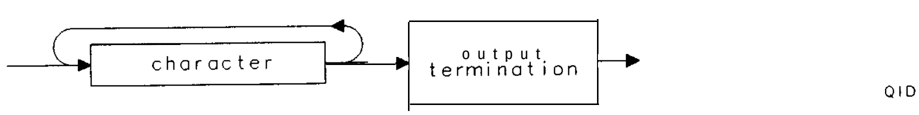
Transfers number to computer.

`40 DISP A$`

Displays model number.

`50 END`

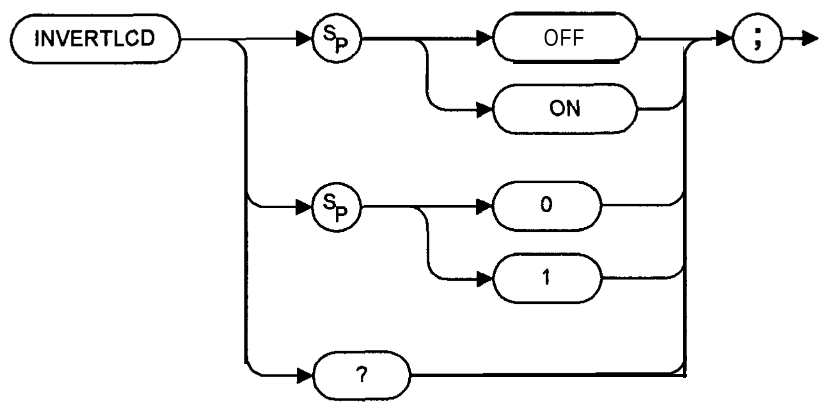
Query Response



INVERTLCD Inverse Video

Inverts the LCD display (black for white, or white for black).

Syntax



XINVERTLCD

Equivalent Key: **Inverse Video On Off**
Preset State: Inverse Video Off

Example

```
10 OUTPUT 718;"INVERTLCD On;"
```

Inverts the display.

```
20 OUTPUT 718;"INVERTLCD?;"
```

```
30 ENTER 718;INVERTLCD$
```

Gets response from the spectrum analyzer.

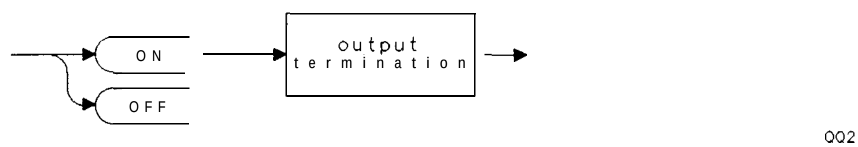
```
40 DISP INVERTLCD$
```

Displays OFF on the computer screen.

Description

Inverts the LCD display and also affects the VGA monitor colors. The colors are changed by assigning a color setting number equal to 63 minus the original color number. For example, red 10, green 20, and blue 30 would be changed to red 53, green 43, and blue 33. INVERTLCD can be used in environments where viewing the normal display color is undesirable.

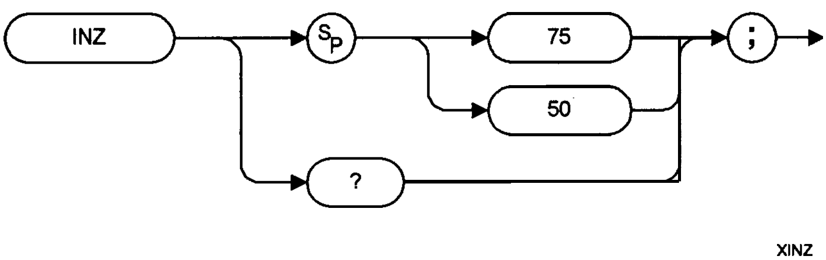
Query Response



INZ Input Impedance

Specifies the value of input impedance expected at the active input port.

Syntax



Equivalent Softkey: **Input Z Corr 50 75**
Preset Value: The value is unaffected by preset
Related Commands: AUNITS

Example

```
10 OUTPUT 718;"INZ 75;"
```

Changes input impedance to 75 ohms.

```
20 OUTPUT 718;"AUNITS V;"
```

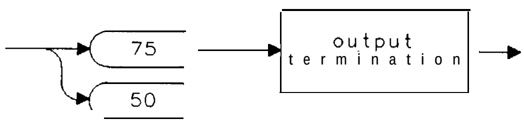
Changes amplitude units to volts.

Description

The actual impedance can be affected only by internal hardware. With the exception of Option 1DP or 1DQ, the spectrum analyzer hardware supports 50 Ω only. The INZ command is used for computation purposes during power or voltage conversions.

The INZ command affects only the amplitude results that are reported in absolute relative power (dBm units or watts). (See "AUNITS.")

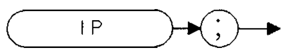
Query Response



IP Instrument Preset

Performs an instrument preset.

Syntax



XIP

Equivalent Key: **Preset** is similar

Example

```
10 OUTPUT 718;"IP;"
```

Description

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

AMPCOR	Turns off amplitude correction factors.
ANNOT	Turns on annotation.
AT	Couples the attenuation to the reference level.
AUNITS	Loads the amplitude units from a configuration location in spectrum analyzer memory.
BLANK B, BLANK C	Blanks trace B and trace C.
CLRW A	Clears and writes trace A.
CONTS	Selects continuous sweep mode.
DEMODT	Sets demodulation dwell time to 500 ms.
DET	Selects positive peak detection.
DL	Turns off the display line.
FOFFSET	Sets the frequency offset to 0 Hz.
GRAT	Turns on the graticule.
LG	Selects 10 dB per division log scale.
LIMIDISP	Sets LIMIDISP to AUTO.

LIMIHALF	Clears any limit line trace specified by LIMIHALF.
LIMITEST	Turns off limit line testing.
MDS	Selects data size of one word, which is two S-bit bytes.
MKFCR	Marker counter resolution is set to AUTO, but a calculated value other than 0 may be returned if the marker counter resolution is queried.
MKNOISE	Turns off noise markers.
MKOFF	Turns off all markers.
MKPAUSE	Turns off marker pause mode.
MKPX	Minimum excursion for peak identification is set to 6 dB.
MKREAD	Sets marker readouts to frequency.
MKTH	Sets the marker threshold to -90 dBm.
MKTRACK	Turns off signal track.
ML	Sets mixer level to -10 dBm.
NDB	Sets the number of dB for the NDBPNT measurement to -3 dB.
NORMLIZE	Turns off normalization.
NRPOS	Sets the normalize reference level position to 10.
RB	Couples the resolution bandwidth to the frequency span.
RFCALIB	Turns off the 50 MHz oscillator.
RL	Sets reference level to 0 dBm.
ROFFSET	Sets reference offset to 0.
RQS 41	Allows SRQ 101 for operator notification, SRQ 110 for illegal commands, or SRQ 140 for broken hardware.
SPEAKER	Turns on the speaker.
SRCPSWP	Sets the source power sweep to off (Option 1DN or 1DQ only).
SRCPWR	Sets the source power level to -10 dBm (Option 1DN or 1DQ only).
SS	Couples the center frequency step size to the span.
STB	Clear the status byte.

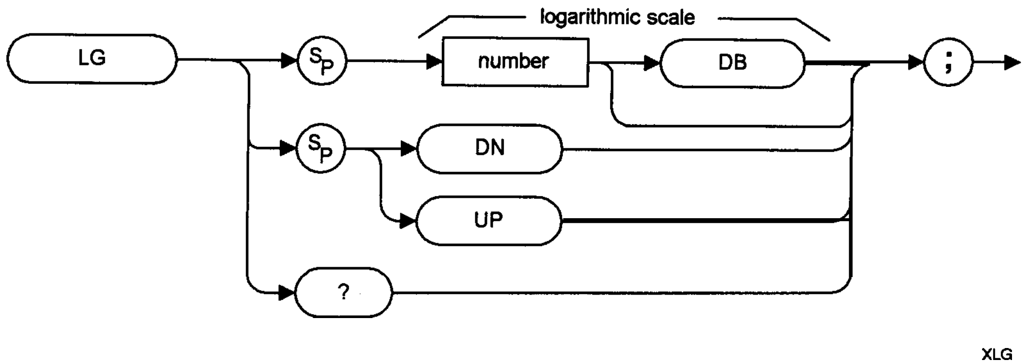
TH	One division above bottom graticule line, threshold line off.
TITLE	Clears the title from the spectrum analyzer screen.
TM	Selects free run trigger mode.
TDF	Selects parameter units output format.
TRC	Sets the trace values to the top graticule line.
VAVG	Turns off video averaging and sets the video averaging limit to 100.
VB	Couples the video bandwidth to the resolution bandwidth.
VBR	Sets VBR to 0.300.

Instrument preset automatically occurs when you turn on the spectrum analyzer. IP is a good starting point for many measurement processes. When IP is executed remotely, the spectrum analyzer does not necessarily execute a complete sweep, however. You should execute a take sweep (TS) to ensure that the trace data is valid after an IP.

LG Logarithmic Scale

Specifies the vertical graticule divisions as logarithmic units, without changing the reference level.

Syntax



Item	Description/Default	Range
Number	Any real or integer number. Default units are dB.	O.lto 20 dB.

Equivalent Key: **Scale Log Lin** (when Log is underlined)
Preset State: 10 dB
Related Commands: LN

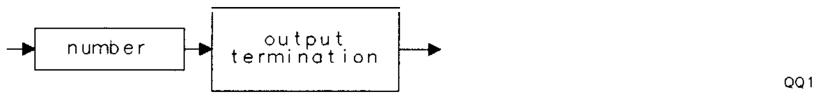
Example

```
10 OUTPUT 718;"LG 1DB;"
```

Description

The vertical scale can be specified (in tenths) from 0.1 to 0.9 dB, or in integers from 1 to 20 dB per graticule division.

Query Response



LIMIDEL Delete limit line Table

Deletes all upper and lower segments in the current limit line table.

Syntax

XLIMIDEL

Equivalent Key: **Delete Limits**
Related Commands: LIMIFT, LIMIREL, LIMISEG, LIMISEGT, SEGDEL

Example

```
20 OUTPUT 718;"LIMIDEL;"
```

Description

Use LIMIDEL before entering a new limit line.

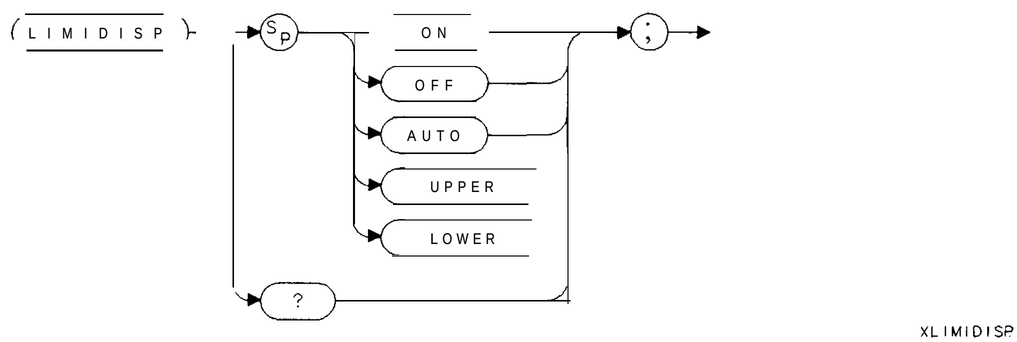
NOTE: Use SAVE if you want to save the current limit line table. LIMIDEL does not affect stored limit line data.

LIMIDEL sets LIMIREL OFF (specifies that the limit line is fixed) and LIMIFT FREQ (specifies that the limit line is based on frequency). See "LIMILINE" for more information about limit line construction.

LIMIDISP Limit Line Display

Controls when the limit line (or limit lines) are displayed.

Syntax



Equivalent Key: **Limit Display Y N Auto**
Preset Value: AUTO
Related Commands: LIMILINE, LIMITEST

Example

```
10 OUTPUT 718;"LIMIDISP ON;"
```

Displays any portion of the limit lines that are currently within the spectrum analyzer screen boundaries.

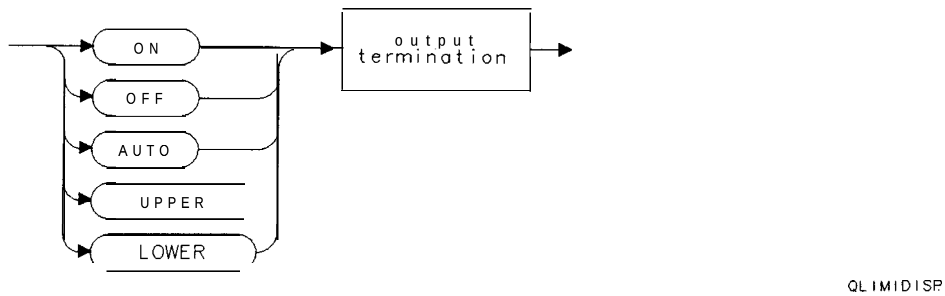
Description

If a limit line is currently in spectrum analyzer memory, you can use LIMIDISP to control the display of the limit lines. The parameters of LIMIDISP do the following:

ON	Turns on the limit line display.
OFF	Turns off the limit line display.
AUTO	Allows LIMITEST to control the display of the limit lines. If LIMITEST is on, the limit lines will be displayed. If LIMITEST is off, the limit lines will not be displayed.
UPPER	Displays the upper limit line only.

LOWER Displays the lower limit line only.

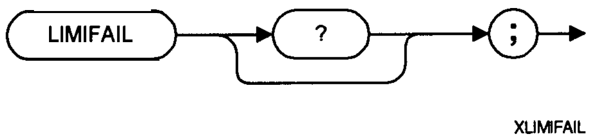
Query Response



LIMIFAIL Limits Failed

Returns a **"0"** if the last measurement sweep of trace A is equal to or within the limit line bounds.

Syntax



Related Commands: LIMILINE, LIMISEG, LIMISEGT, LIMITEST

Example

10 OUTPUT 718;"IP;SNGLS;CF300MHZ;SP100MHZ;"

Initializes spectrum analyzer and changes the frequency and span settings.

20 OUTPUT 718;"LIMIDEL;"

Deletes any limit line tables, sets the table type to fixed.

30 OUTPUT 718;"LIMIHALF **UPPER;"**

Specifies the upper limit line table.

40 OUTPUT 718;"LIMISEG 250MHZ,-60DB,FLAT;"

Creates an entry for the upper limit line table. Because the LIMISEG command is used, the limit line will be based on the frequency.

50 OUTPUT 718;"LIMISEG 290MHZ,-60DB,SLOPE;"

60 OUTPUT 718;"LIMISEG 295MHZ,-15DB,FLAT;"

70 OUTPUT 718;"LIMISEG 305MHZ,-15DB,SLOPE;"

80 OUTPUT 718;"LIMISEG 310MHZ,-60DB,FLAT;"

90 OUTPUT 718;"LIMISEG 910MHZ,-60DB,FLAT;"

```
100 OUTPUT 718;"LIMITEST ON;TS;"
```

Turns on limit line testing.

```
110 OUTPUT 718;"LIMIFAIL?;"
```

Returns the status of the limit line testing.

```
120   ENTER 718;A
```

```
130 DISP A
```

Displays the result.

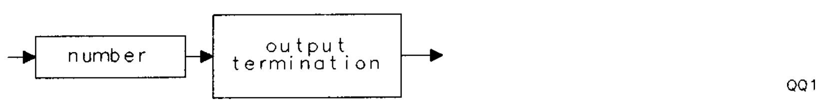
```
140 END
```

Description

LIMIFAIL returns one of the following values:

0 indicates that the measurement sweep was within the limit line bounds.
1 indicates that the measurement sweep failed the lower limit.
2 indicates that the measurement sweep failed the upper limit.
3 indicates that the measurement sweep failed both the lower and upper limits.
4 indicates that no test was performed. A "4" is returned if LIMITEST is set to OFF.

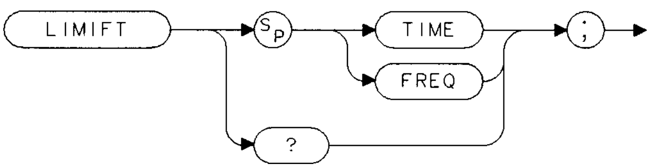
Query Response



LIMIFT Select Frequency or Time Limit Line

Selects how the limit line segments are defined: according to frequency, or according to the sweep time setting of the spectrum analyzer.

Syntax



XLIMIFT

Equivalent Key: **X Axis Units Freq Time**
Related Commands: LIMIDEL, LIMILINE, LIMIHALF, LIMIREL, LIMISEG, LIMISEGT, SEGDEL

Example

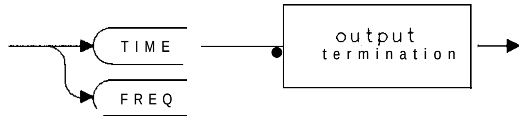
```
10 OUTPUT 718;"LIMIFT TIME;"
```

If the current limit line table is a frequency limit line table, it is purged. LIMIFT TIME places the limit line segments on the spectrum analyzer display with respect to the sweep time of the spectrum analyzer.

Description

If you execute "LIMIFT TIME;" or LIMISEGT the limit line segments are placed on the spectrum analyzer display with respect to the sweep time setting of the spectrum analyzer. If you execute "LIMIFT FREQ;" or LIMISEG the limit line segments are placed according to the frequency that is specified for each segment. If a limit line has already been defined, changing the LIMIFT setting clears the existing limit line.

Query Response

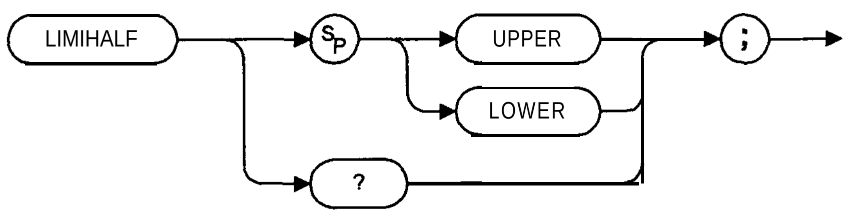


QLIMIFT

LIMIHALF Select Upper or Lower Limit Line

Determines whether the limit line entries are treated as upper amplitude values, lower amplitude values.

Syntax



XLIMIHALF

Equivalent Key: **Select Line Upper Lower**
Related Commands: LIMILINE, LIMISEG, LIMISEGT, SEGDEL

Example

This example uses LIMIHALF to enter segments into the upper limit line table, and then to enter a segment into the lower limit line table (upper and lower limit lines are treated as separate tables). Line 60 demonstrates entering a segment into a combined upper and lower limit line table.

```
10 OUTPUT 718;"LIMIDEL;"
```

Deletes the current limit line table, sets the table type to fixed.

```
20 OUTPUT 718;"LIMIHALF UPPER;"
```

Specifies the upper limit line table.

```
30 OUTPUT 718;"LIMIFT FREQ;"
```

Selects a limit line based on frequency.

```
40 OUTPUT 718;"LIMISEG 300MHZ,-30DB,SLOPE;"
```

Enters a segment into the upper limit line table. Because the LIMISEG command is used, the limit line table will be based on frequency.

```
50 OUTPUT 718;"LIMIHALF LOWER;"
```

Specifies the lower limit line table.

```
60 OUTPUT 718;"LIMISEG 300MHZ,-70DB,SLOPE;"
```

Enters a segment into the lower limit line table.

```
70 OUTPUT 718;"LIMIDISP ON;"
```

Displays the limit lines.

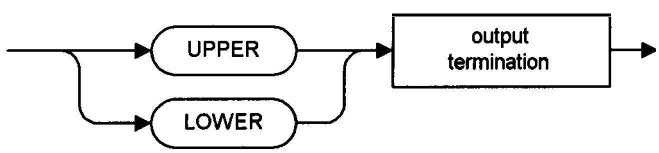
```
80 END
```

Description

Use LIMIHALF in conjunction with LIMISEG, LIMISEGT. Specify LIMIHALF UPPER or LIMIHALF LOWER before using LIMISEG or LIMISEGT.

The LIMIHALF command determines whether the limit line table entries are to be treated separately (upper or lower) or together (upper and lower) when deleting a segment with SEGDEL (see "SEGDEL").

Query Response

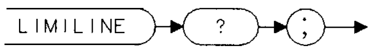


QLIMIHAL

LIMILINE Limit Lines

Outputs the current limit line table definitions.

Syntax



XLIMILINE

Related Commands: LIMIFT, LIMIREL, LIMIHALF, LIMIREL, LIMISEG, LIMISEGT, LIMITEST

Example

```
10 DIM States$[2000]
```

Dimensions an array to store the limit line information.

```
20 OUTPUT 718;"IP;CF300MHZ;SP100MHZ;"
```

Initializes spectrum analyzer.

```
30 OUTPUT 718;"LIMIDEL;"
```

Deletes any limit line tables, sets the table type to fixed.

```
40 OUTPUT 718;"LIMIHALF UPPER;"
```

Specifies the upper limit line table.

```
45 OUTPUT 718;"LIMIFT FREQ;"
```

Selects a limit line based on frequency.

```
50 OUTPUT 718;"LIMISEG 250MHZ,-60DB,FLAT;"
```

Enters a value for the upper limit line table. Because the LIMISEG command is used, the limit line segment is for a limit line based on frequency.

```
60 OUTPUT 718;"LIMISEG 290MHZ,-60DB,SLOPE;"

70 OUTPUT 718;"LIMISEG 295MHZ,-15DB,FLAT;"

80 OUTPUT 718;"LIMISEG 305MHZ,-15DB,SLOPE;"

90 OUTPUT 718;"LIMISEG 310MHZ,-60DB,FLAT;"
```

```
100 OUTPUT 718;"LIMISEG 910MHZ,-60DB,FLAT;"
```

```
110 OUTPUT 718;"LIMILINE?;"
```

Gets the current limit line table definitions.

```
120 ENTER 718 USING "#,-K";States$
```

Enters information into array.

```
130 PRINT States$
```

Prints the current limit line table definitions.

```
140 END
```

Description

LIMILINE is used to query the current limit line. Executing LIMILINE returns an ASCII string containing the commands needed to create the limit line.

Use these commands (in the order given) to build a limit line:

1 Use LIMIDEL to clear the limit line table.

2 Use LIMIFT to select a limit line that is either based on frequency or sweep time.

3 Use LIMIREL to determine whether the values of the limit line are absolute values or positioned relative to the reference level and center frequency settings.

4 Use LIMIHALF, LIMISEG, LIMISEGT to enter the limit line segments. (Use LIMISEG for a limit line based on frequency; use LIMISEGT for a limit line based on sweep time.)

5 Use the LIMIDISP command to select if the limit line is displayed or not.

6 Use the LIMITEST command to turn on limit line testing.

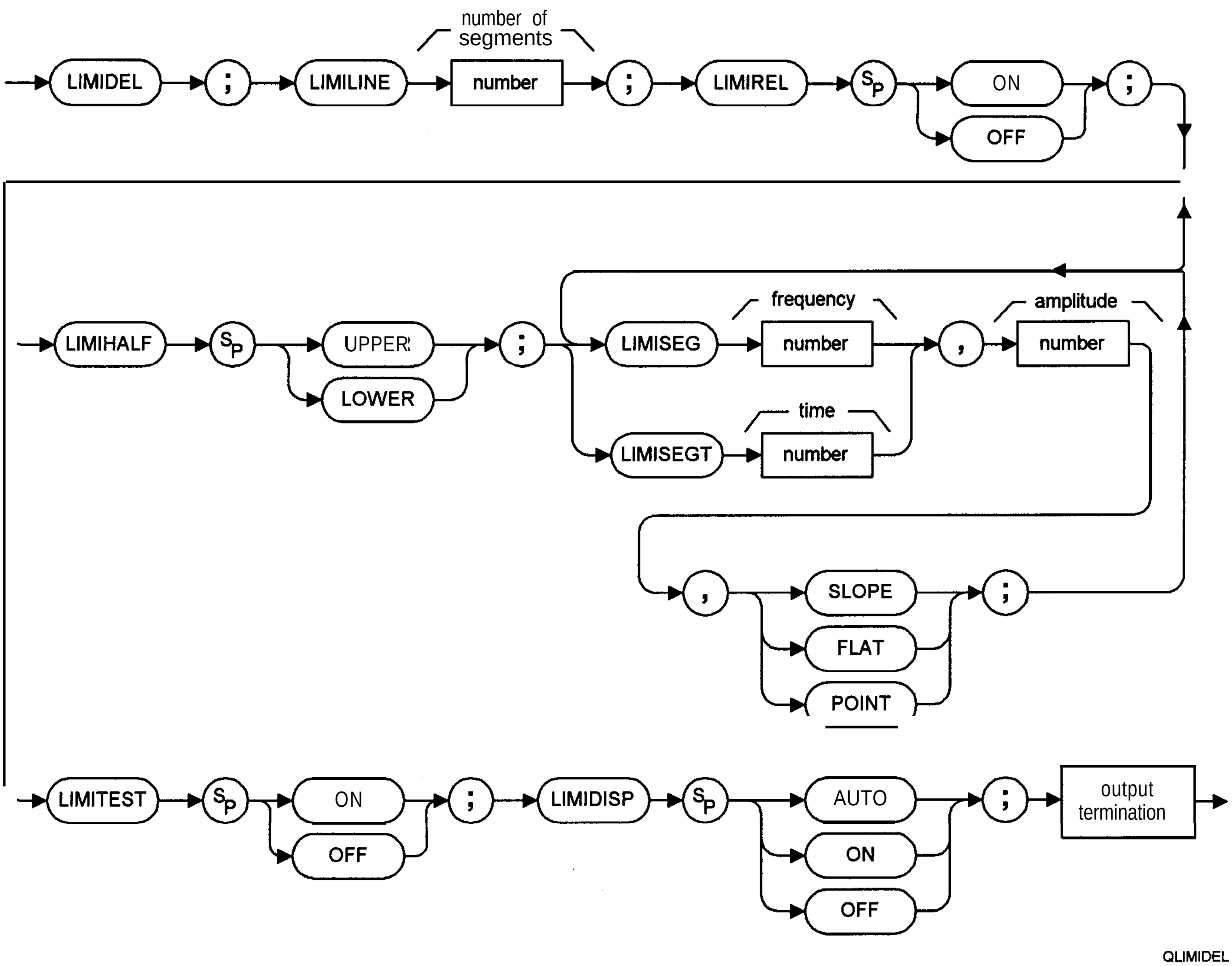
7 Use the LIMIFAIL command to determine if the measurement sweep passed or failed the limit line boundaries.

Enabling limit line testing: When limit testing is enabled, the segments in the current table are interpolated into the limit line traces according to the current span and center frequency or sweep time of the spectrum analyzer. After the sweep, each value in trace A is compared to its corresponding value in the limit line traces. If the current limit line table is empty (for instance after using the command LIMIDEL) and limit testing is enabled, then the limit line traces are blanked and set to out-of-range values. By using the SUB, MKPK HI, and MKF? commands, you can read the point of greatest difference between the trace and limit line. See “LIMITEST” for more information about limit line testing.

Saving the limit line table: Once you have built the limit line, you can save the limit line table in spectrum analyzer memory. Use SAVE to store the limit line table in spectrum analyzer memory.

Query Response

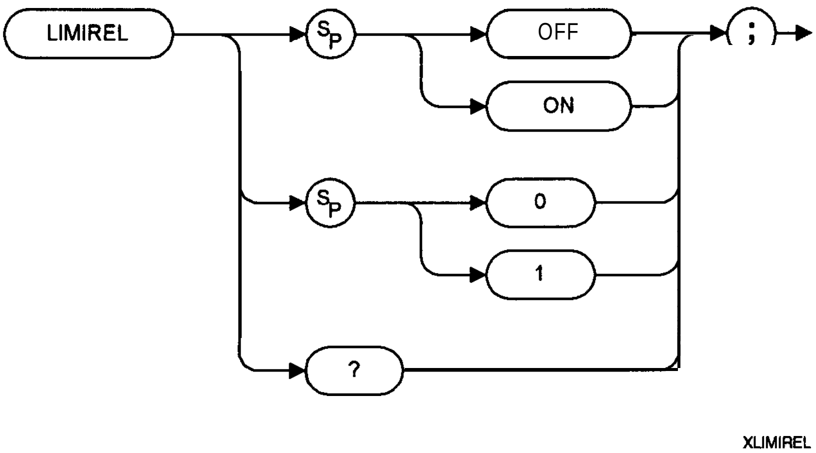
The query response is a character string consisting of LIMILINE, LIMIREL, LIMIHALF, LIMISEG, or LIMISEGT commands.



LIMIREL Relative Limit Lines

Specifies whether the current limit lines are fixed or relative.

Syntax



Equivalent Key: **Limits Fixed Rel**
Related Commands: LIMIDEL, LIMIFT, LIMILINE

Example

```
10 OUTPUT 718;"LIMIFT FREQ;"
```

Selects a limit line based on frequency.

```
20 OUTPUT 718;"LIMIREL ON;"
```

Specifies that the limit line will be relative to the reference-level and center-frequency settings.

Description

You should use LIMIFT to select whether the limit lines are based on frequency or sweep time before using LIMIREL, because changing between a frequency or sweep time limit line purges the current limit line table and sets LIMIREL to OFF.

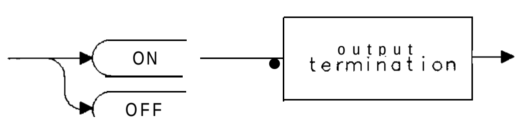
LIMIREL and the reference level: Regardless of whether the limit line is based on frequency or sweep time, LIMIREL determines if the amplitude parameter in a limit line table represents absolute values or relative values. If LIMIREL is set to OFF, the limit lines amplitude values are specified in absolute amplitude and do not depend on the reference level (RL) setting. If LIMIREL is set to On, the limit line amplitude values are relative to the current reference level (RL) setting.

For limit lines that are based on frequency: The LIMIREL command determines whether the frequency parameter in a limit line table represent absolute or relative values that are referenced to the center-frequency settings.

- Executing "LIMIREL OFF;" specifies that the frequency values in a limit line table are fixed values, and the limit line is positioned accordingly. Fixed limit lines are specified in absolute frequency and do not depend upon the center frequency value.
- Executing "LIMIREL ON;" specifies that the frequency values in a limit line table are relative values and positions the limit line relative to the center-frequency settings. Relative limit lines are specified in relative frequency and are positioned with respect to the current center frequency. When the current center frequency value is changed, the segment frequencies are converted according to the current center frequency value.

For limit lines that are based on the sweep time: Limit lines that are based on sweep time are always relative to the start time, and the horizontal position of the limit line is not affected by the setting of LIMIREL.

Query Response

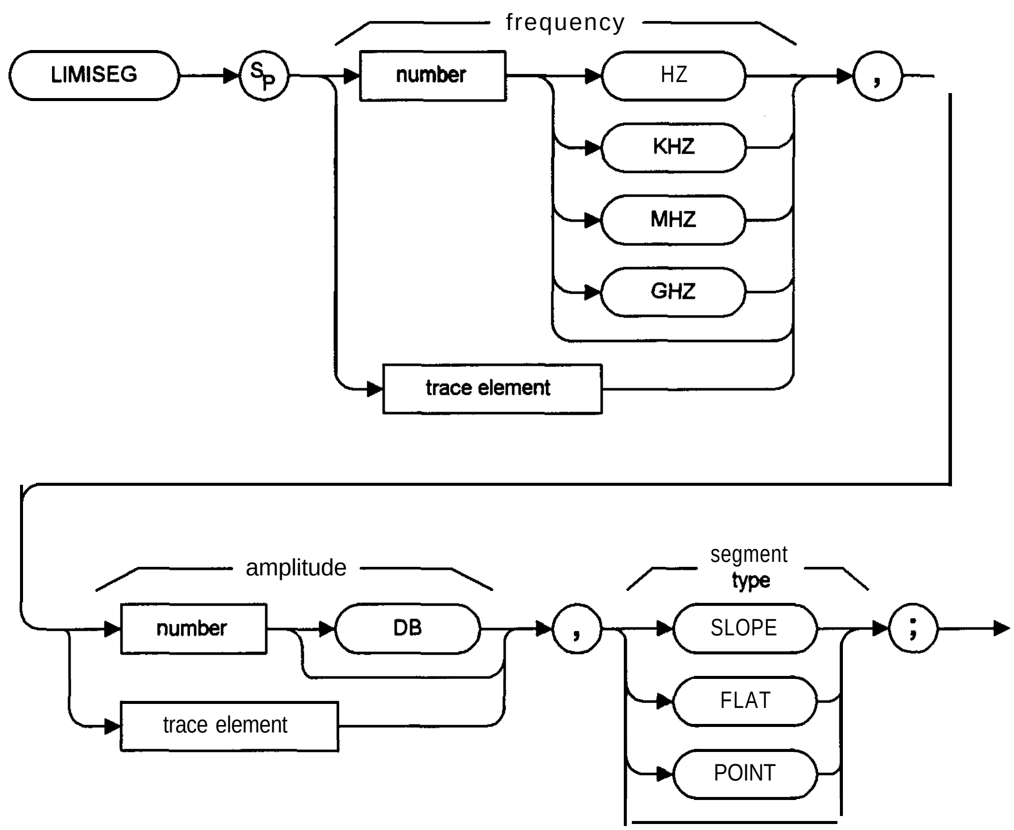


QQ2

LIMISEG Enter limit line Segment for Frequency

Adds new segments to the current frequency limit line in either the upper limit line or the lower limit line.

Syntax



XLIMISEG

Item	Description/Default	Range
Number	Any real or integer number. Default unit is dBm.	Varies with FOFFSET and ROFFSET.

Equivalent Key: **Segment**
Related Commands: LIMIDEL, LIMILINE, LIMIHALF, LIMIREL, SEGDEL

Example

```
10    OUTPUT 718;"IP;SNGLS;CF300MHZ;SP100MHZ;RB 3MHZ;"
```

Initializes spectrum analyzer, changes the frequency, span, and bandwidth.

```
20    OUTPUT 718;"LIMIDEL;"
```

Deletes the current limit line table, sets the table type to fixed.

```
30    OUTPUT 718;"LIMIHALF UPPER;"
```

Specifies the upper limit line table.

```
35    OUTPUT 718;"LIMIFT FREQ;"
```

Selects a limit line based on frequency.

```
40    OUTPUT 718;"LIMISEG 250MHZ,-60DB,FLAT;"
```

Adds segment to the upper limit line table.

```
50    OUTPUT 718;"LIMISEG 290MHZ,-60DB,SLOPE;"
60    OUTPUT 718;"LIMISEG 295MHZ,-15DB,FLAT;"
70    OUTPUT 718;"LIMISEG 305MHZ,-15DB,SLOPE;"
80    OUTPUT 718;"LIMISEG 310MHZ,-60DB,FLAT;"
90    OUTPUT 718;"LIMISEG 910MHZ,-60DB,FLAT;"
100   OUTPUT 718;"LIMIHALF LOWER;"
```

Specifies the lower limit line table.

```
110   OUTPUT 718;"LIMISEG 250MHZ,-75DB,FLAT;"
```

Adds segment to the lower limit line table.

```
120   OUTPUT 718;"LIMISEG 910MHZ,-75DB,FLAT;"
130   OUTPUT 718;"LIMITEST ON;TS;"
```

Enables limit line testing.

```
140   OUTPUT 718;"LIMIFAIL?;"
```

Returns the result of limit line testing.

```
150   ENTER 718;A
```

```
160   DISP A
```

Displays the result.

```
170   END
```

Description

If the current limit line table contains lines based on sweep time (as opposed to a limit line based on the frequency), executing LIMISEG will clear the current sweep time limit line table, and set **LIMIREL** to **OFF.**

Each limit line segment is specified with a starting frequency, an amplitude, and a segment type. The segment type defines how the line segment is to extend from its starting point to the next segment. The segment types are **FLAT,** SLOPE, and POINT.

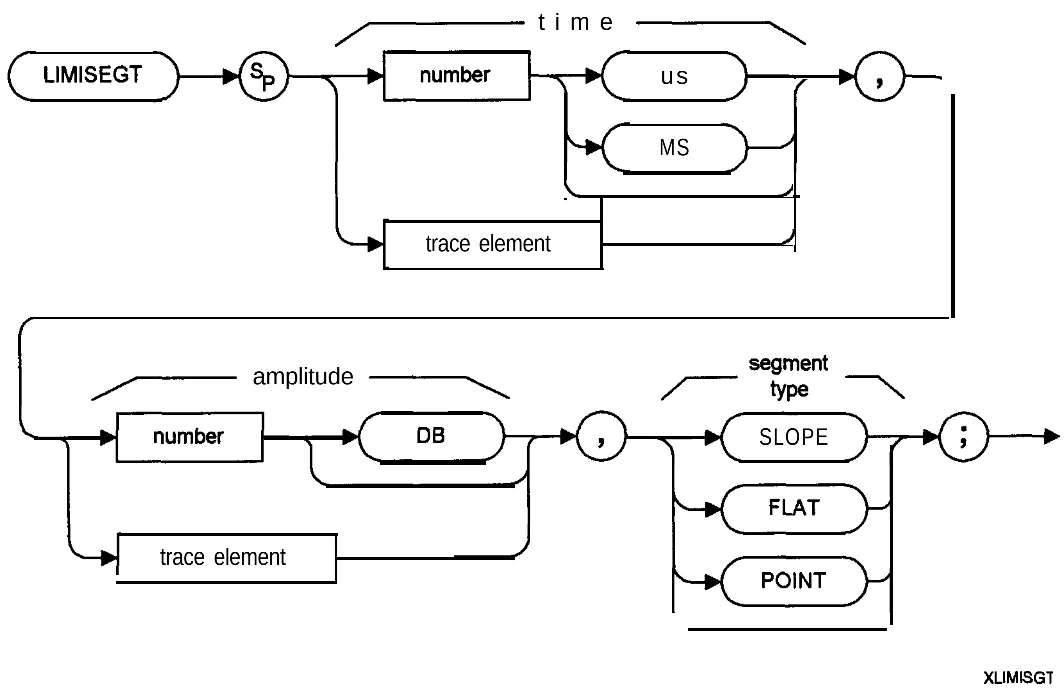
- FLAT draws a zero-slope line between the coordinate point of the current segment and the coordinate point of the next segment, producing limit line values equal in amplitude for all frequencies between the two points. If the amplitude values of the two segments differ, the limit line will “step” to the value of the second segment.
- SLOPE draws a straight line between the coordinate point of the current segment and the coordinate point of the next segment, producing limit line values for all frequencies between the two points.
- POINT specifies a limit value for the coordinate point, and no other frequency points, so that a POINT segment specifies a limit value for a single frequency. For an upper limit line, a POINT segment is indicated by a line drawn from the coordinate point, to a point that is vertically off the top of screen. For a lower limit line, a POINT segment is indicated by a line drawn from the coordinate point, to a point that is vertically off the bottom of screen. The POINT segment type should be used as the last segment in the limit line table. However, if the last segment in the table is not specified as the POINT segment type, an implicit point is used automatically. If a visible POINT segment at the right edge of the display is not desired, add an explicit last point segment (higher in frequency than the stop frequency) to the limit line table.

Segments are sorted according to starting frequency. A maximum of 20 segments can be defined in each of the upper and lower halves of a limit line. When the segment type is omitted, the last type given (or SLOPE if no previous type has been given) is used. Use LIMISEG if you want to enter amplitude data in the upper or lower limit lines.

LIMISEGT Enter limit line Segment for Sweep Time

Adds new segments to the current sweep time limit line in either the upper limit line or the lower limit line.

Syntax



Item	Description/Default	Range
Number	Any real or integer number. For the sweep time, the default unit is seconds. For the amplitude value, the default unit is dBm.	The range of the sweep time is 0 to 100 s. The range of the amplitude varies with ROFFSET.

Equivalent Key: **Segment**
Related Commands: LIMIDEL, LIMIFT, LIMIHALF, LIMILINE, LIMIREL, SEG-DEL

Example

10 OUTPUT 718;"LIMIDEL;"

Deletes the current limit line table, sets the table type to fixed.

20 OUTPUT 718;"LIMIHALF **UPPER;"**

Specifies the upper limit line table.

30 OUTPUT 718;"LIMIFT **TIME;"**

Selects a limit line based on the sweep time.

40 OUTPUT 718;"LIMISEGT 0MS,–60DB,FLAT;"

Adds segment to the upper limit line table.

50 OUTPUT 718;"LIMISEGT 6MS,–60DB,SLOPE;"

60 OUTPUT 718;"LIMISEGT 8MS,–15DB,FLAT;"

70 **OUTPUT** 718;"LIMISEGT 11MS,–20DB,SLOPE;"

80 OUTPUT 718;"LIMISEGT 14MS,–60DB,FLAT;"

90 OUTPUT 718;"LIMISEGT 20MS,–60DB,POINT;"

100 OUTPUT 718;"LIMIHALF **LOWER;"**

Specifies the lower limit line table.

110 OUTPUT 718;"LIMISEGT 0MS,–75DB,FLAT;"

Adds segment to the lower limit line table.

120 OUTPUT 718;"LIMISEGT 20MS,–75DB,POINT;"

130 OUTPUT 718;"LIMITEST ON;TS;"

Enables limit line testing.

140 OUTPUT 718;"LIMIFAIL?;"

Returns the result of limit line testing.

150 ENTER 718;A

160 DISP A

Displays the result.

Description

Each limit line segment is specified with a starting sweep time, an amplitude, and a segment type.

NOTE: If the current limit line table contains limit lines based on frequency (as opposed to a limit line based on the sweep time), executing LIMISEGT will clear the current frequency limit line table, and set LIMIREL to OFF.

Starting sweep time: When you specify the starting sweep time, you are specifying the starting sweep time with respect to the sweep time of the spectrum analyzer. For example, if you specify a starting sweep time of 0, the limit line segment will start at the left side of the spectrum analyzer display.

Segment type: The segment type defines how the line segment is to extend from its starting point to the next segment. The segment types are FLAT, SLOPE, and POINT.

- FLAT draws a zero-slope line between the coordinate point of the current segment and the coordinate point of the next segment, producing limit line values equal in amplitude for all sweep times between the two points. If the amplitude values of the two segments differ, the limit line will "step" to the value of the second segment.
- SLOPE draws a straight line between the coordinate point of the current segment and the coordinate point of the next segment, interpolating amplitude values for all sweep times between the two points.
- POINT specifies a limit value for the coordinate point, and no other sweep time points, so that a POINT segment specifies an amplitude value for a single sweep time. For an upper limit line, a POINT segment is indicated by a line drawn from the coordinate point, to a point that is vertically off the top of the graticule area. For a lower limit line, a POINT segment is indicated by a line drawn from the coordinate point, to a point that is vertically off the bottom of the graticule area. The POINT segment type should be used as the last segment in the limit line table. However, if the last segment in the table is not specified as the POINT segment type, an implicit point is used automatically. If a visible POINT segment at the right edge of the display is not desired, add an explicit last point segment to (higher in sweep time than the current sweep time setting of the spectrum analyzer) the limit line table.

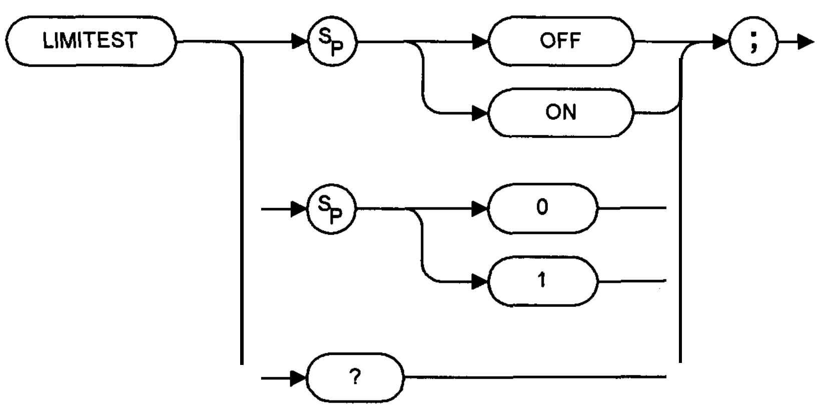
Segments are sorted according to starting sweep time. A maximum of 20 segments can be defined in each of the upper and lower halves of a limit line.

Use LIMISEGT if you want to enter amplitude data in the upper or lower limit lines. Use LIMIHALF to specify entry into the upper limit line table or the lower limit line table (see line 30 of example).

LIMITEST Enable Limit Line Testing

Compares trace A with the current limit line data.

Syntax



XLIMITEST

Equivalent Key: **Limit Test On Off**
Preset State: LIMITEST OFF
Related Commands: LIMIFAIL, LIMISEG, LIMISEGT

Example

```
10    OUTPUT 718;"IP;SNGLS;CF300MHZ;SP100MHZ;"
```

Initializes spectrum analyzer and changes the frequency and span settings.

```
20    OUTPUT 718;"LIMIDEL;"
```

Deletes any limit line tables, sets the table type to fixed.

```
30    OUTPUT 718;"LIMIHLF UPPER;"
```

Specifies the upper limit line table.

```
35    OUTPUT 718;"LIMIFT FREQ;"
```

Selects a limit line based on frequency.

```
40    OUTPUT 718;"LIMISEG 250MHZ,-60DB,FLAT;"
```

Creates an entry to the upper limit line table.

```
50     OUTPUT 718;"LIMISEG 290MHZ,-60DB,SLOPE;"
60     OUTPUT 718;"LIMISEG 295MHZ,-15DB,FLAT;"
70     OUTPUT 718;"LIMISEG 305MHZ,-15DB,SLOPE;"
80     OUTPUT 718;"LIMISEG 310MHZ,-60DB,FLAT;"
90     OUTPUT 718;"LIMISEG 910MHZ,-60DB,FLAT;"
100    OUTPUT 718;"LIMITEST ON;TS;"
```

Turns on limit line testing.

```
110    OUTPUT 718;"LIMIFAIL?;"
```

Returns the status of the limit line testing.

```
120    ENTER 718;A
130    DISP A
```

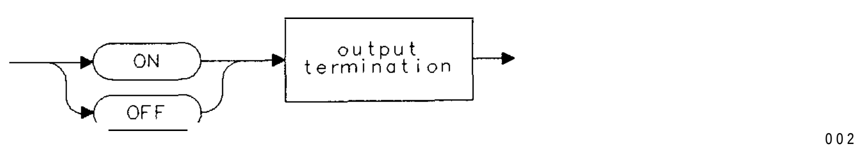
Displays the result.

```
140    END
```

Description

A test is made of the data in **TRA** (trace A), and the result can be read, using LIMIFAIL, after each sweep.

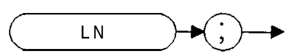
Query Response



LN Linear Scale

Specifies the vertical graticule divisions as linear units, without changing the reference level.

Syntax



XLN

Equivalent Key: **Scale Log Lin** (when Lin is underlined)
Related Commands: LG, RL

Example

```
10 OUTPUT 718;"LN;"
```

Selects linear mode.

```
20 OUTPUT 718;"LN;RL 30MV;"
```

Description

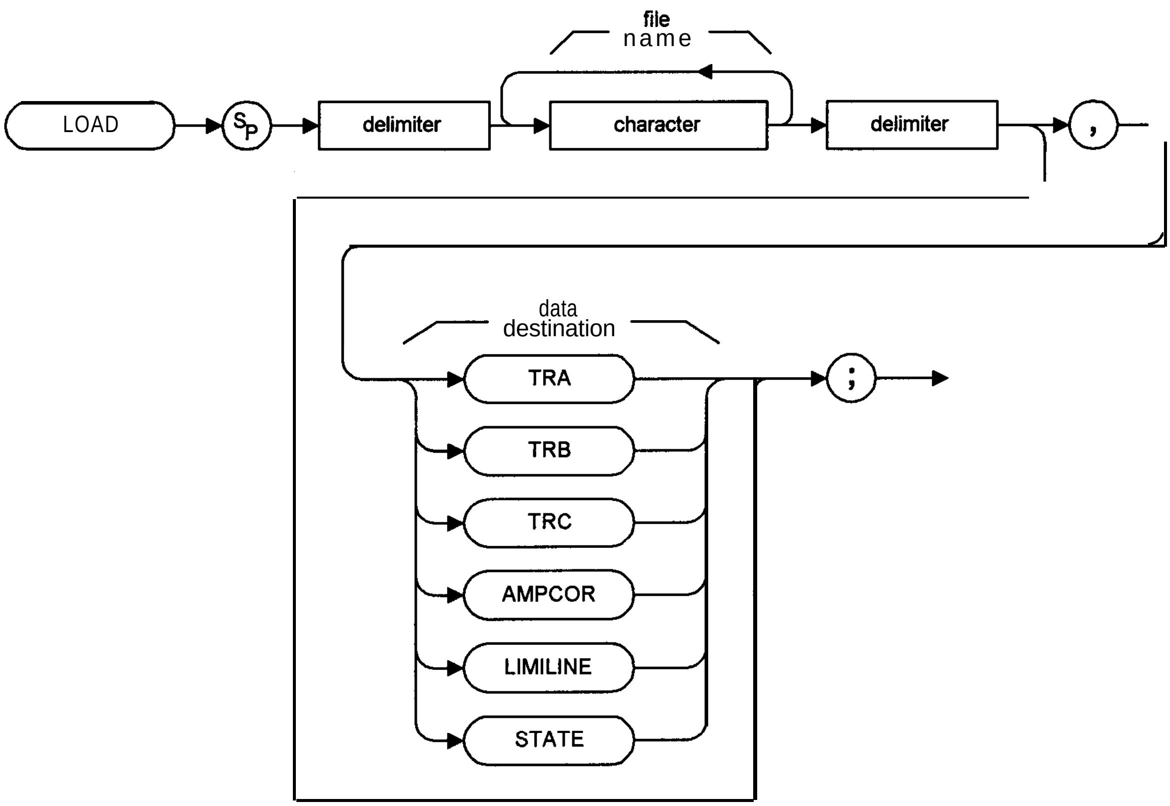
The LN command scales the amplitude (vertical graticule divisions) proportionally to the input voltage, without changing the reference level. The bottom graticule line represents a signal level of zero volts.

Voltage entries are rounded to the nearest 0.1 dB. Thus, 30.16 mV becomes -17.4 dBm for a 50 Ω spectrum analyzer system.

LOAD Load

Specifies the file to be loaded into the analyzer.

Syntax



XLOAD

Item	Description/Default	Range
Character	Any valid character	Any valid file name
Delimiter	Matching characters marking the beginning and end of the file name	I\@ ^ $ % ;!

Equivalent Key: **Load**
Related Commands: Delete, Save

Example

```
10 OUTPUT 718;"LOAD %MYTRA.TRC%,TRA;"
```

Loads MYTRA from the memory into trace A.

Description

The LOAD command is used to load files into the analyzer from the memory. There are several different types of file data. The type of data, and its corresponding data destination, are shown in the following table.

To use the LOAD command, you must specify the file name of the file to be loaded from the memory, including the appropriate file extension. If you are loading trace data, you must also specify the trace destination, TRA, TRB or TRC. Trace A will be assumed if you do not specify the destination.

Some of the characters that are available to use as delimiters are also allowed in the file name. Do not use any of the same characters for the delimiters as are used in the file name. The analyzer will interpret the second occurrence of the character as the end delimiter, rather than a part of the file name.

Data Source	Type of Data Transferred	File Extension
TRA	Trace	.TRC
TRB	Trace	.TRC
TRC	Trace	.TRC
STATE	Instrument state	.STA
LIMILINE	Limit lines	.LIM
AMPCOR	Amplitude correction factors	.AMP

When recalling trace data, you need to specify either TRA, TRB, or TRC as the destination. You can omit the destination information when recalling states, limit line tables, or amplitude correction factors as long as the file extension is correctly specified.

LSPAN Last Span

Changes the spectrum analyzer's span to the previous span setting.

Syntax

XLSPAN

Equivalent Key: **Last Span**
Related Commands: SP

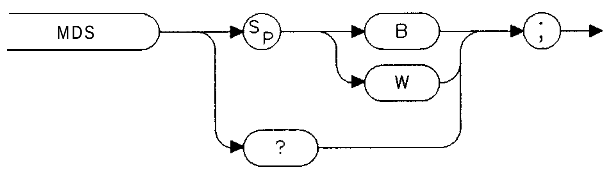
Example

```
10 OUTPUT 718;"LSPAN;"
```

MDS Measurement Data Size

Specifies measurement data size as byte or word when the trace data format mode is B, A, or I. See the TDF command for more information.

Syntax



XMDS

Related Commands: MKA, TDF, TRA
Preset State: W

Example

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

```
10 INTEGER TRACE-A (1:401)
```

Declares variable, Trace-A.

```
20 OUTPUT 718;"SNGLS;TS;"
```

Activates single-sweep, updates trace A.

```
30 OUTPUT 718;"TDF B;MDS W;TRA?;"
```

Reads trace A in “word” format.

```
40 ENTER 718 USING "#,401(W)";TRACE_A()
```

Formats trace A output using data size of one word.

```
50 PRINT TRACE-A(*)
```

Prints trace A.

Description

The MDS command formats binary data in one of the following formats:

B	selects a data size of one 8-bit byte. When transferring trace data, MDS B transfers trace data the faster than MDS W

because only 401 bytes are transferred. Because MDS B combines two bytes into one byte, some resolution is lost.

W selects a data size of one word, which is two 8-bit bytes. When transferring trace data, MDS W transfers 802 bytes of trace data with no loss of resolution.

How data is represented with MDS W: When data is sent with MDS W, the trace data is converted into two bytes as follows:

1 The trace element's amplitude (in measurement units) is divided by 256. The binary representation of the result is placed in the most significant byte (MSB).

2 The binary representation of the remainder is placed in the least significant byte (LSB).

For example, a trace element that is at the reference level has the value of 8000 (in measurement units). The result of 8000 divided by 256 is 30, with a remainder of 120. For this data, the contents of the MSB would contain the binary representation for 30.

0	0	0	1	1	1	1	0

For this data, the contents of the LSB would contain the binary representation for 120.

0	1	1	1	1	0	0	0

How data is represented with MDS B: When data is sent with MDS B, the trace data is converted into one byte as follows:

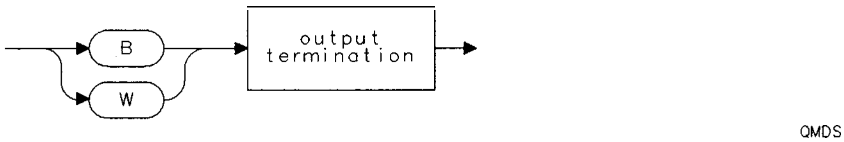
- The trace element's amplitude (in measurement units) is divided by 32. The binary representation of the result is placed into one byte.

For example, a trace element that is at the reference level has the value of 8000 (in measurement units). The result of 8000 divided by 32 is 250. For this data, the contents of the byte would contain the binary representation for 250.

1	1	1	1	1	0	1	0

See "TDF" for information about using MDS for trace data transfers.

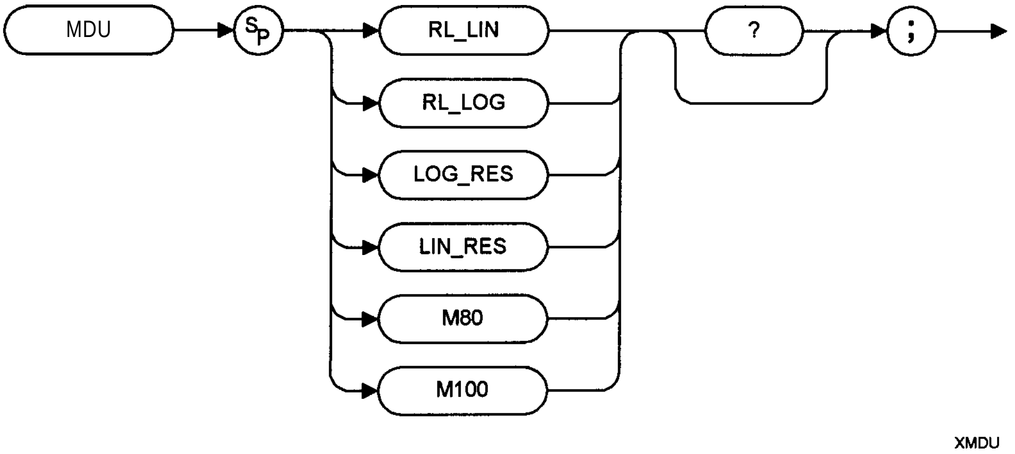
Query Response:



MDU Measurement Data Units

Returns values for the indicated display location in measurement units based on the current analyzer settings.

Syntax



Related Commands: TDF

Example

10 OUTPUT 718;"IP;TDF M;"

Initializes the spectrum analyzer and formats the trace data in measurement units.

20 OUTPUT 718;"RL **-10DM;"**

Changes the reference level to -10 dBm.

30 OUTPUT 718;"MDU RL_LOG?;"

Queries the value of the top graticule, the reference level.

40 ENTER 718;Reflevel

Moves the spectrum analyzer response to the computer.

30 OUTPUT 718;"MDU **LOG-RES?;"**

Queries the value of one measurement unit.

40 ENTER `718;Res`

Moves the spectrum analyzer response to the computer.

30 OUTPUT `718;"MDU M80?;"`

Queries the value at 80 dB down from the top graticule.

40 ENTER `718;Minus80`

Moves the spectrum analyzer response to the computer.

50 PRINT `Reflevel,Res,Minus80`

Displays the results on the computer screen.

60 END

The example returns the following to the controller for a logarithmic analyzer display with 10 dB/division: 8000, 0.01, 0. The first number indicates the value of the top graticule. The second number received indicates that 0.01 dB is the resolution of a measurement unit, so a value of 7999 is 0.01 dB below the reference level or -10.01 dB. The last value is the measurement units of a position 80 dB below the top of screen.

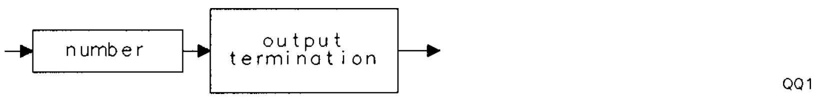
Description

The MDU command returns information about the measurement units based on the current analyzer settings. Measurement units are an internal format for trace data related to display location. The range of valid numbers changes depending on whether the analyzer is in linear or logarithmic display mode. The value, in measurements units, of various locations on the display can be queried to determine the values for the current instrument settings. The values that can be queried are indicated in the following table.

Secondary Keyword	Variable Returned	Value
RL_LIN	The top-of-screen value (in linear mode)	**8000**
RL_LOG	The top-of-screen value (in log mode)	**8000**
LOG_RES	The resolution of one measurement unit (in log mode)	0.01
LIN_RES	The resolution of one measurement unit (in linear mode)	0.000125 =1/8000

Secondary Keyword	Variable Returned	Value
M80	The value 80 dB down from the reference level (in log mode)	0
M100	The value 100 dB down from the reference level (in log mode)	-2000
invalid keyword	A value returned if an invalid keyword is sent	**-32768**

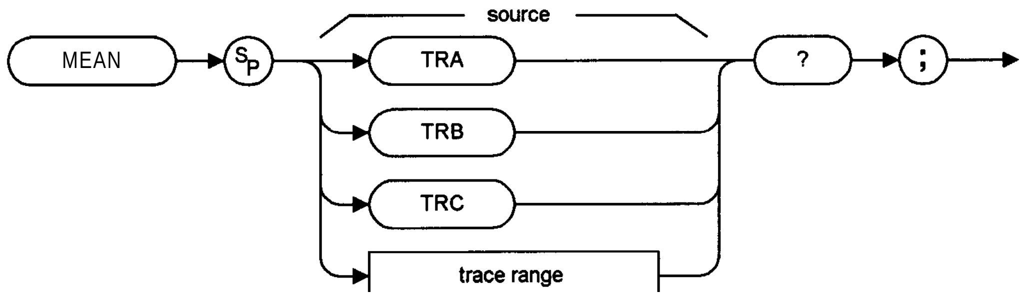
Query Response



MEAN Trace Mean

Returns the mean value of the given trace in measurement units.

Syntax



XMEAN

Item	Description/Default	Range
Trace Range	A segment of trace A, trace B, trace C	

Prerequisite Commands: TS when using trace data
Related Commands: MEANTH, RMS, STDEV, VARIANCE

Example

```
10 OUTPUT 718;"IP;"
```

Initializes spectrum analyzer.

```
20 OUTPUT 718;"SNGLS;"
```

Activates the single-sweep mode.

```
30 OUTPUT 718;"CF 300MHZ;SP 1MHZ;"
```

Sets measurement range.

```
40 OUTPUT 718;"TS;"
```

Sweeps trace A.

```
50 OUTPUT 718;"MEAN TRA?;"
```

Returns the mean value of trace A to the computer.

```
60 ENTER 718;Number
```

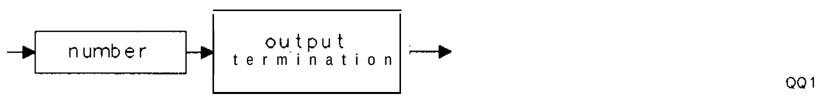
Assigns value to computer variable, Number.

```
70 DISP "MEAN OF TRACE A IS ";Number
```

Displays result on the computer screen.

```
80 END
```

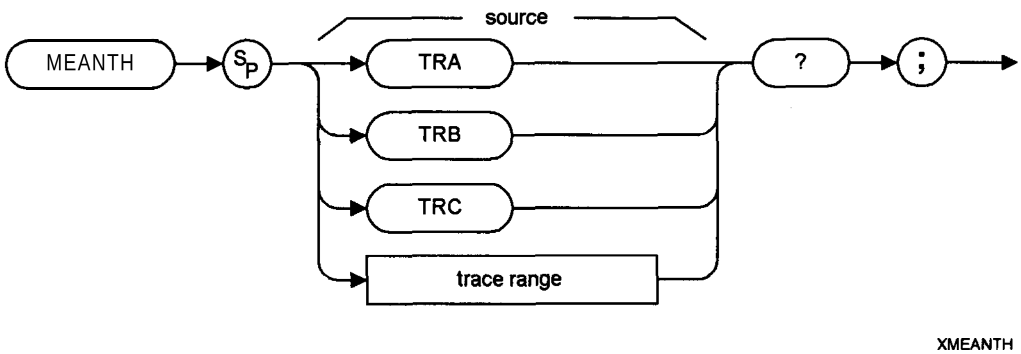
Query Response



MEANTH Trace Mean Above Threshold

Returns the mean value of the given trace above the threshold, in measurement units.

Syntax



Item	Description/Default	Range
Trace Range	A segment of trace A, trace B, trace C	

Prerequisite Commands: TS when using trace data.
Related Commands: MEAN, RMS, STDEV, TH, VARIANCE.

Example

```
10 OUTPUT 718;"IP;"
```

Initializes spectrum analyzer.

```
20 OUTPUT 718;"SNGLS;"
```

Activates the single-sweep mode.

```
30 OUTPUT 718;"CF 300MHZ;SP 1GHZ;"
```

Sets measurement range.

```
40 OUTPUT 718;"TH -40;"
```

Sets threshold level to -40 dB.

```
50 OUTPUT 718;"TS;"
```

Sweeps trace A.

```
60 OUTPUT 718;"MEANTH TRA?;"
```

Returns the mean value of trace A above the threshold to the computer.

```
70 ENTER 718;Number
```

Assigns value to computer variable, Number.

```
80 DISP "MEAN OF TRACE A ABOVE THE THRESHOLD IS ";Number
```

Displays result on the computer screen.

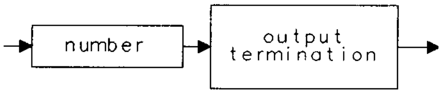
```
90 END
```

Description

MEANTH returns the mean value of the trace above the threshold; MEAN returns the mean value of the trace, regardless of the threshold level. MEANTH returns a "0" if there is not a signal above the threshold.

Use TH (threshold) to set the threshold level.

Query Response

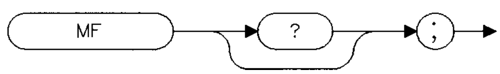


QQ1

MF Marker Frequency Output

Returns the frequency (or time) of the on-screen active marker.

Syntax



XMF

Related Key: **Marker Normal.**
Related Commands: MKA, MKCF, MKD, MKF, MKN, MKPK, MKREAD.

Example

```
10 OUTPUT 718;"IP;SNGLS;"
```

Initializes the spectrum analyzer, activates single-sweep mode.

```
20 OUTPUT 718;"FA 280MHZ;FB 320MHZ;TS;"
```

Sets up the measurement range.

```
30 OUTPUT 718;"MKN;MKPK HI;"
```

Places marker on peak of a 300 MHz input signal.

```
40 OUTPUT 718;"MF;"
```

Takes frequency of marker.

```
50 ENTER 718;A
```

Returns frequency to the computer.

```
60 PRINT A
```

Prints the frequency on the computer screen.

Description

The MF command returns the frequency of the active marker to the controller if the marker is on screen. In delta marker mode, **nonzero** span, "MF;" returns the frequency difference between the two markers. In zero span, "MF;" returns the marker time, or the delta marker time.

The data that is returned by "MF;" depends on many command conditions including TDF, MKREAD, and MDS.

If the trace data format P is used with MF, the result is one real value in time units or frequency units, depending on the marker readout format. (See "MKREAD.")

Example 1

```
10 OUTPUT 718;"TDF P;MKREAD FRQ;MF;"
```

This returns a frequency value (in Hz) if not in zero-span.

```
20 OUTPUT 718;"TDF P;MKREAD FRQ;MF;"
```

This returns a time value (in seconds) if in zero-span.

```
30 OUTPUT 718;"TDF P;MKREAD PER;MF;"
```

This returns the time value (in seconds) of l/(marker frequency).

```
40 OUTPUT 718;"TDF P;MKREAD SWT;MF;"
```

This returns the marker time value (in seconds).

```
50 OUTPUT 718;"TDF P;MKREAD IST;MF;"
```

This returns the frequency value (in Hz) for l/(marker time).

If the trace data format is used with trace data format A, the result depends on the setting of the MDS command.

Example 2

```
10 OUTPUT 718;"TDF A;MDS B;MF;"
```

Returns one byte representing the marker position. The byte can assume values 0 to 100. Where 0 is the left edge screen position and 100 is the right edge screen position.

```
20 OUTPUT 718;"TDF A;MDS W;MF;"
```

Returns two bytes in a binary word format that has a value from 1 to 40 1.

If the trace data format is used with trace data format M, the result is the marker horizontal position value, from 1 to 401, in ASCII.

Example 3

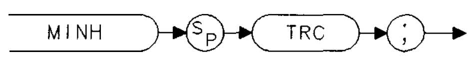
```
10 OUTPUT 718;"TDF M;MF;"
```

Returns marker horizontal position value in ASCII.

MINH Minimum Hold

Updates trace C with the minimum level detected.

Syntax



XMINH

Equivalent Key: **Min Hold C**.
Related Commands: BLANK, CLRW, MXMH, VAVG, VIEW.

Example

```
10 OUTPUT 718;"CLRW TRC;CONTS;"
```

Clears trace C and begin taking data.

```
20 OUTPUT 718;"MINH TRC;"
```

Updates trace C with the minimum level detected.

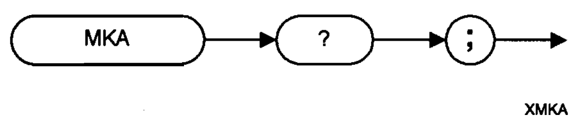
Description

MINH updates trace C with a new value from a detector only if the new value is smaller than the previous trace data value.

MKA Marker Amplitude

Returns the marker amplitude, independent of marker type.

Syntax



Item	Description/Default	Range
Number	Any real or integer number. Unit is current amplitude type.	Amplitude range of spectrum analyzer

Related Key: **Marker Normal**

Example

```
10 OUTPUT 718;"IP;"
```

Initializes the spectrum analyzer.

```
30 OUTPUT 718;"MKA -50;"
```

Places the marker at -50 dBm.

Description

If both the delta marker and active marker are on the screen, "MKA?;" returns the amplitude difference between the two markers.If the trace data format P (TDF P), is used with MKA, the result is one real value in the current amplitude units (AUNITS can be used to change the current amplitude units).

Example

```
10 OUTPUT 718;"TDF P;AUNITS DBM;MKA?;"
```

This returns the amplitude value of the marker (amplitude unit is dBm).

If the trace data format is used with trace data format A, the result depends on the setting of the MDS command.

Example

```
10 OUTPUT 718;"TDF A;MDS B;MKA?;"
```

Returns one byte representing the marker vertical position (-32,768 to 32,767) divided by 32 and then ANDed with 255.

```
20 OUTPUT 718;"TDF A;MDS W;MKA?;"
```

Returns two bytes in a binary word format that has a value from -32,768 to 32,767. The value represents the binary trace amplitude value.

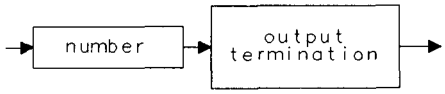
Using the trace data format I is equivalent to the TDF A format. If the trace data format is used with trace data format M, the result is returned in ASCII measurement units (-32,768 to 32,767).

Example

```
10 OUTPUT 718;"TDF M;MKA?;"
```

Returns one vertical position value in measurement units.

Query Response

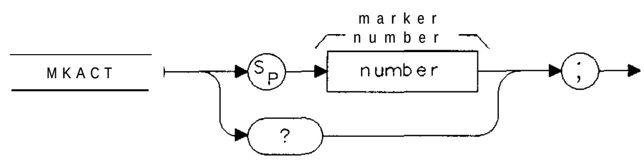


QQ1

MKACT Activate Marker

Specifies the active marker.

Syntax



XMKACT

Item	Description/Default	Range
Number	Any valid integer. Default value is 1.	1 to 4

Equivalent Key: **Select Marker 1 2 3 4**
Related Commands: MKA, MKF

Example

```
10 OUTPUT 718;"MKACT 4;"
```

Marker 4 becomes the active marker.

Description

There can be four different markers, but only one marker can be active at any time.

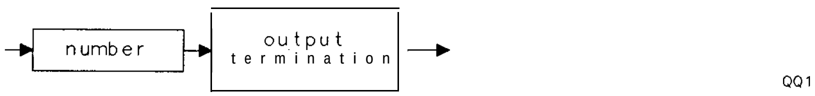
When this command is used, the following results occur:

- The marker number supplied by the command is made the active marker.
- If the marker number is not already on, the marker is turned on with preset type (position), and the marker is placed at center screen. The trace chosen is the first displayed trace found: trace A, trace B, trace C.

NOTE: If the MKACT command is used to return to a marker that was already active, but was a different marker type, it replaces that marker with the new marker function. The amplitude and frequency for the previous marker are not saved.

Query Response

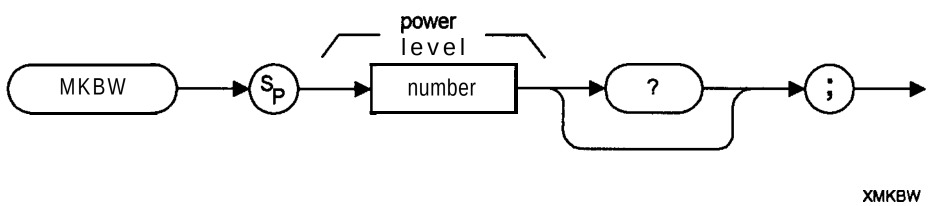
"MKACT?;" returns the marker number.



MKBW Marker Bandwidth

Returns the bandwidth at the specified power level relative to an on-screen marker (if present) or the signal peak (if no on-screen marker is present).

Syntax



Item	Description/Default	Range
Number	Any valid negative integer	0 to the amplitude of the noise floor

Equivalent Key: is similar to **N dB Points On Off**.

Example

```
10 OUTPUT 718;"IP;"
```

Initializes spectrum analyzer.

```
20 OUTPUT 718;"CF 300MHZ;SP 100MHZ;SNGLS;"
```

Changes the center frequency and span, then activates the single-sweep mode.

```
30 OUTPUT 718;"TS;MKPK HI;"
```

Updates the sweep, places marker on signal peak.

```
40 OUTPUT 718;"MKBW -3;"
```

Uses the MKBW function to find the signal bandwidth at -3 dB below the marker.

Description

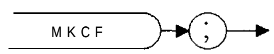
The MKBW command also displays (in the message area) the bandwidth at the power level in dB below the current marker position or the current signal peak.

MKBW finds the bandwidth at the specified power level for one measurement sweep. If you want the spectrum analyzer to find the bandwidth at the specified power level during every measurement sweep, use the NDBPNT command instead of MKBW.

MKCF Marker to Center Frequency

Sets the center frequency equal to the marker frequency and moves the marker to the center of the screen.

Syntax



XMKCF

Equivalent Key: **Mkr -> CF**.
Related Commands: CF, MKF.

Example

This example provides a quick way to center the desired frequency on the spectrum analyzer screen.

```
10 OUTPUT 718;"IP;SP 1MHZ;SNGLS;"
```

Initializes spectrum analyzer, activates single-sweep mode.

```
20 INPUT "ENTER IN DESIRED STATION FREQUENCY, IN MHZ",Freq
```

```
30 OUTPUT 718;"CF ";Freq;"MHZ;"
```

Changes spectrum analyzer center frequency.

```
40 OUTPUT 718;"TS;MKPK HI;MKCF;TS;"
```

Updates the trace, places marker at the signal peak and centers it on screen.

```
60 END
```

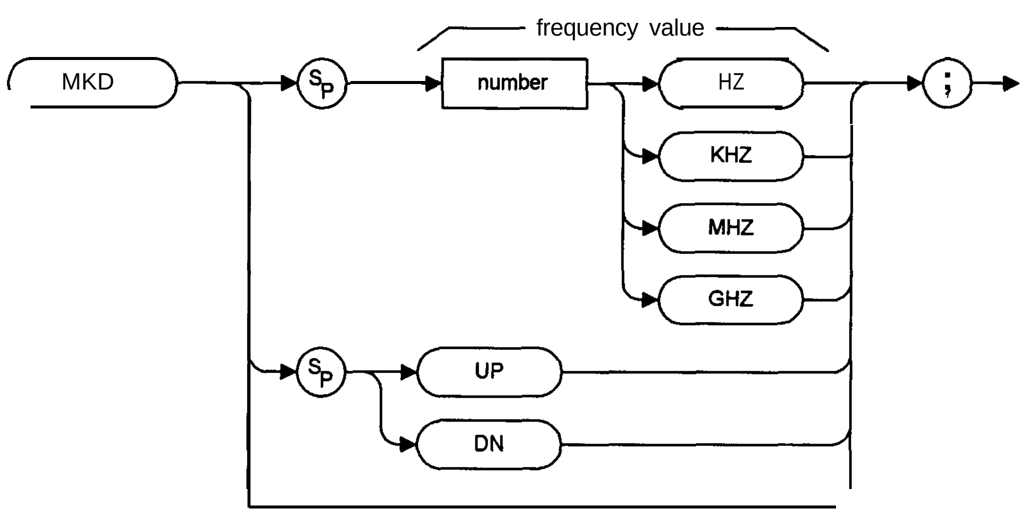
Description

This command is performed only if an active marker is present on screen.

MKD Marker Delta

Activates the delta marker.

Syntax



XMKD

Item	Description/Default	Range
Number	Any real or integer number. Default unit is Hz, default value is value of the active marker.	Start frequency to stop frequency of spectrum analyzer

Equivalent Key: **Marker A**
Step Increment: by 1/10 of the frequency span
Related Commands: AUTO, MKCF, MKF, MKN, MKSP, MKSS, MKPK

Example

```
10 OUTPUT 718;"IP;"
```

Initializes spectrum analyzer.

```
20 OUTPUT 718;"MKMIN;"
```

Places a marker at the minimum amplitude of trace.

```
30 OUTPUT 718;"MKD;"
```

Activates marker delta.

```
40 OUTPUT 718;"MKPK HI;"
```

Places marker at highest amplitude of trace.

```
50 OUTPUT 718;"MKSP;"
```

Changes span to the values of the left and right markers.

```
60 END
```

Description

The MKD command computes the frequency and amplitude difference of the active marker and a special marker, called the delta or differential marker. These values are displayed in the display readout.

The differential value of the frequency is equal to the active marker frequency minus the delta marker frequency. The differential value of the amplitude is equal to the active marker amplitude minus the delta marker amplitude.

If an active marker is not on the screen, MKD positions an active marker at center screen. If a delta marker is not on the screen, MKD places one at the specified frequency, or at the current active marker. If the active marker is in amplitude mode, the delta marker is placed at the same amplitude as the active marker (or a specified value).

To read the amplitude, use MKA?. To read the frequency, use MKF? The results are displayed on the spectrum analyzer screen.

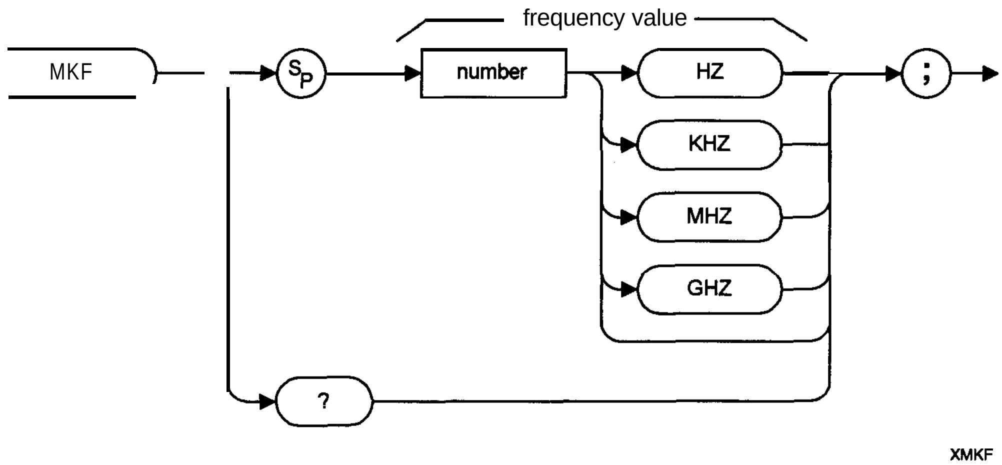
In linear mode, MKD computes the ratio of the amplitudes of the active and delta markers rather than the difference. This results in similar treatment for logarithmic and linear data because the delta (or, the difference) of two logarithmically generated numbers is the logarithm of the linear ratio of the two numbers. You should not change reference level when making a marker delta measurement, however.

If the marker delta function is on, the noise marker can be activated (MKN) and moved to measure the noise floor. The marker readout will then display the signal-to-noise ratio.

MKF Marker Frequency

Returns the frequency value of the active marker.

Syntax



Item	Description/Default	Range
Number	Any real or integer number. Default unit is Hz.	Start frequency to stop frequency of spectrum analyzer

Related Key: **Marker Normal**
Related Commands: AUTO, MKA, MKD, MKCF, MKPK

Example

```
10 OUTPUT 718;"MKF 600MHZ;"
```

Places an active marker at 600 MHz.

Description

In nonzero frequency spans, MKF returns the active marker frequency as a real number when MKF is queried. In zero span, "MKF?;" returns the time value.

The data that is returned by MKF depends on many command conditions, including TDF, MKREAD, and MDS.

MKF results with TDF set to P: If the trace data format P is used with MKF, the result is one real value in time units or frequency units, depending on MKREAD.

Example

```
10 OUTPUT 718;"TDF P;MKREAD FRQ;MKF?;"
```

This returns a frequency value (in Hz) if not in zero-span.

```
20 OUTPUT 718;"TDF P;MKREAD FRQ;MKF?;"
```

This returns a time value (in seconds) if in zero-span.

```
30 OUTPUT 718;"TDF P;MKREAD PER;MKF?;"
```

This returns the time value (in seconds) of 1/(marker frequency).

```
40 OUTPUT 718;"TDF P;MKREAD SWT;MKF?;"
```

This returns the marker time value (in seconds).

```
50 OUTPUT 718;"TDF P;MKREAD IST;MKF?;"
```

This returns the frequency value (in Hz) for l/(marker time).

MKF results with TDF set to A or I: If the trace data format is used with trace data format A, the result depends on the setting of the MDS command.

Example

```
10 OUTPUT 718;"TDF A;MDS B;MKF?;"
```

Returns one byte representing the marker position.

```
20 OUTPUT 718;"TDF A;MDS W;MKF?;"
```

Returns two bytes in a binary word format that has a value from 1 to 401.

Using the trace data format I is equivalent to the TDF A format.

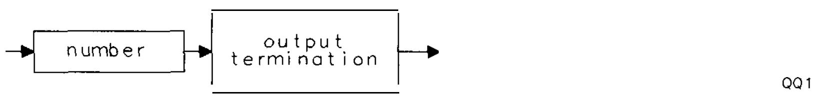
MKF results with TDF set to M: If the trace data format is used with trace data format M, the result is the marker horizontal position value, from 1 to 401, in ASCII.

Example

```
10 OUTPUT 718;"TDF M;MKF?;"
```

Returns marker horizontal position value in ASCII.

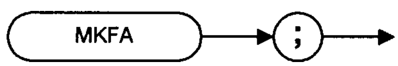
Query Response



MKFA Marker to Start Frequency

Sets the analyzer start frequency to the marker frequency and moves the marker to the left edge of the screen.

Syntax



XMKFA

Equivalent Key: **Mkr -> Start**.
Related Commands: FA, MKF.

Example

This example provides a quick way to change the start frequency on the spectrum analyzer screen.

```
10 OUTPUT 718;"IP;SP 1MHZ;SNGLS;"
```

Initializes spectrum analyzer, activates single-sweep mode.

```
20 INPUT "ENTER IN DESIRED STATION FREQUENCY, IN MHZ",Freq
```

```
30 OUTPUT 718;"CF ";Freq;"MHZ;"
```

Changes spectrum analyzer center frequency.

```
40 OUTPUT 718;"TS;MKPK HI;MKFA;TS;"
```

Updates the trace, places marker at the signal peak and changes the displayed start frequency to the signal frequency.

```
60 END
```

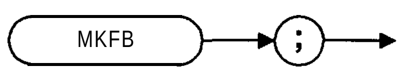
Description

This command is performed only if an active marker is present on screen.

MKFB Marker to Stop Frequency

Sets the analyzer stop frequency to the marker frequency and moves the marker to the right edge of the screen.

Syntax



XMKFB

Equivalent Key: **Mkr -> Stop**.
Related Commands: FB, MKF.

Example

This example provides a quick way to change the stop frequency on the spectrum analyzer screen.

```
10 OUTPUT 718;"IP;SP 1MHZ;SNGLS;"
```

Initializes spectrum analyzer, activates single-sweep mode.

```
20 INPUT "ENTER IN DESIRED STATION FREQUENCY, IN MHZ",Freq
```

```
30 OUTPUT 718;"CF ";Freq;"MHZ;"
```

Changes spectrum analyzer center frequency.

```
40 OUTPUT 718;"TS;MKPK HI;MKFB;TS;"
```

Updates the trace, places marker at the signal peak and changes the displayed stop frequency to the signal frequency.

```
60 END
```

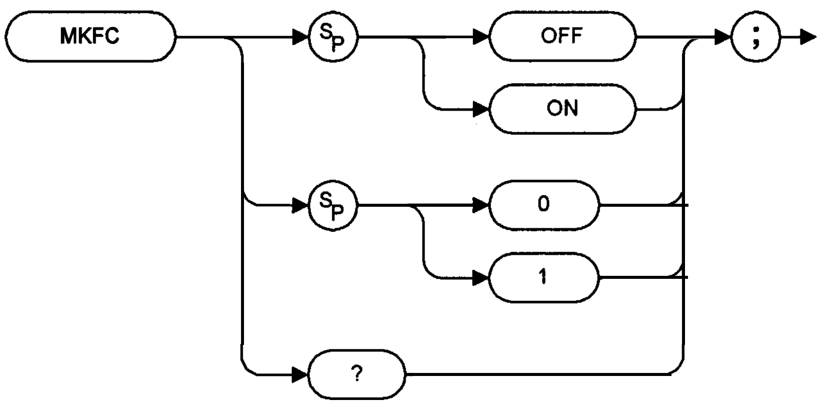
Description

This command is performed only if an active marker is present on screen.

MKFC Marker Counter

Turns on or off the marker frequency counter.

Syntax



XMKFC

Equivalent Key: **Freq Count** or **Marker Count On Off**.
Related Commands: MKFCR, MKN.

Example

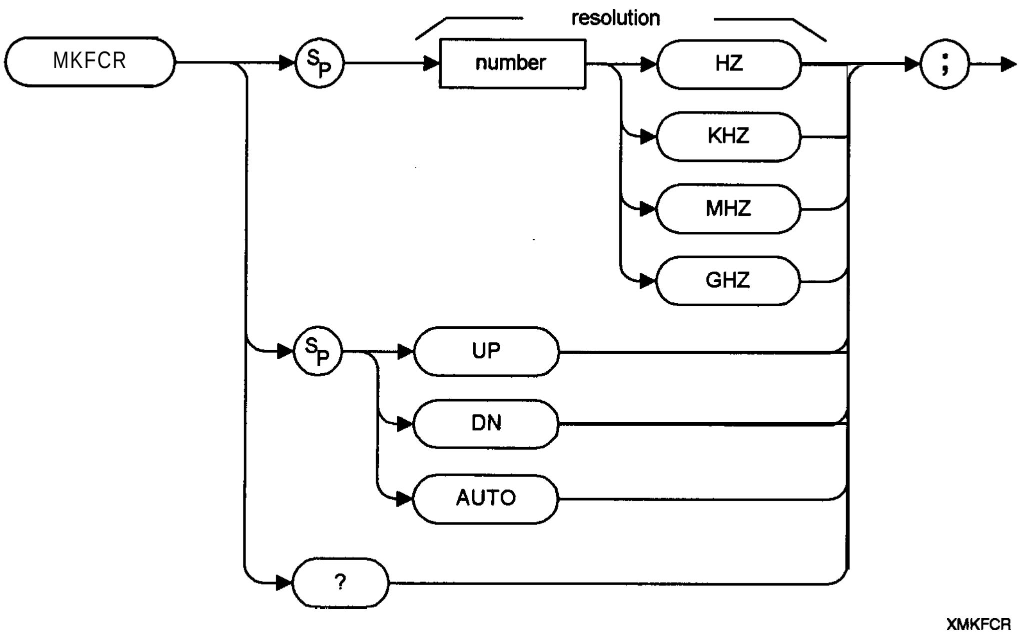
```
10 OUTPUT 718;"MKFC ON;"
```

Turns on the marker counter.

MKFCR Marker Counter Resolution

Sets the resolution of the marker frequency counter.

Syntax



Item	Description/Default	Range
Number	Any real or integer number. Default unit is Hz.	0 Hz to 100 kHz

Equivalent Key: **Resolution Auto Man.**
Preset State: Marker counter resolution is set to AUTO. The calculated value for the marker counter resolution is returned if the MKFCR is queried.
Related Commands: AUTO. MKFC.

Example

```
10 OUTPUT 718;"MKFCR 10KHZ;"
```

Sets the marker counter resolution to 10 kHz.

```
20 OUTPUT 718;"MKFCR?;"
```

Queries the marker counter resolution.

```
30 ENTER 718;A
```

Gets the query response.

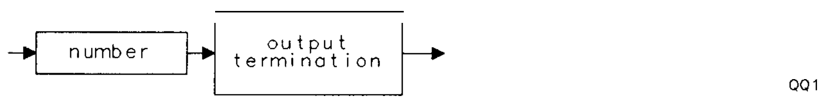
```
40 DISP A
```

Displays the marker counter resolution.

Description

Executing either "MKFCR 0;" or "MKFCR AUTO;" auto-couples the marker counter resolution to the frequency span.

Query Response



MKMIN Marker Minimum

Moves the active marker to the minimum value detected.

Syntax

XMKMIN

Related Commands: MKPK, SMOOTH, MKTH, VAVG.

Example

```
10 OUTPUT 718;"IP;SNGLS;"
```

Initializes spectrum analyzer, activates single-sweep mode.

```
20 INPUT "ENTER IN THE START FREQUENCY,IN MHZ",Start_freq
```

```
30 INPUT "ENTER IN THE STOP FREQUENCY,IN MHZ",Stop_freq
```

```
40 OUTPUT 718;"FA ";Start_freq;"MHZ"
```

Sets the start frequency.

```
50 OUTPUT 718;"FB ";Stop_freq;"MHZ"
```

Sets the stop frequency.

```
60 OUTPUT 718;"TS;MKPK HI;MKD;MKMIN;MKF?;"
```

Updates trace, finds trace peak, turns on marker delta function, finds the minimum value of trace, and return the frequency delta.

```
70 ENTER 718;Delta_freq
```

Gets the result from spectrum analyzer.

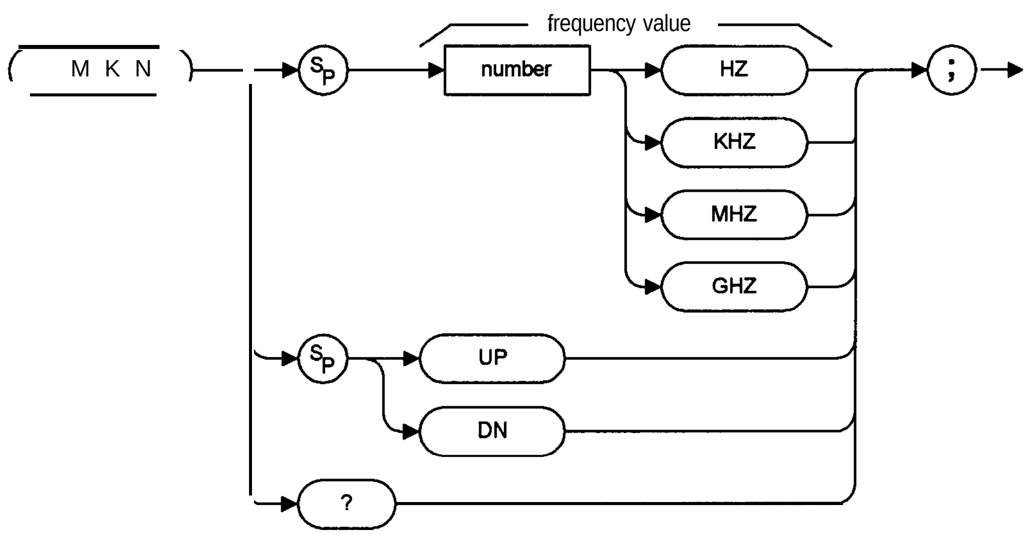
```
80 PRINT "DIFFERENCE IN FREQUENCY IS ",Delta_freq,"HZ"
```

```
90 END
```

MKN Marker Normal

Activates and moves the marker to the specified frequency.

Syntax



XMKN

Item	Description/Default	Range
Number	Any real or integer number. Default unit is Hz. Default value is the center frequency of the spectrum analyzer.	Start frequency to stop frequency of spectrum analyzer

Equivalent Key: **Marker Normal**.
Step Increment: by 1/10 of the frequency span.
Related Commands: AUTO, DEMOD, MKA, MKD, MKF, MKPK.

Example

```
10 INPUT "ENTER IN THE START FREQUENCY, IN MHZ",Start_freq
20 INPUT "ENTER IN THE STOP FREQUENCY, IN MHZ",Stop_freq
30 OUTPUT 718;"IP;FA ";Start_freq;"MHZ"
```

Initializes spectrum analyzer and changes the start frequency.

```
40 OUTPUT 718;"FB ";Stop_freq;"MHZ"
```

Changes the stop frequency.

```
50 OUTPUT 718;"MKN EK;"
```

Enables the front-panel knob.

```
60 PRINT "PLACE MARKER ON THE DESIRED SIGNAL"
70 PRINT "PRESS HOLD THEN PRESS CONTINUE"
80 PAUSE
90 OUTPUT 718;"MKN?;"
```

Gets the frequency of the marker.

```
100 ENTER 718;Mkr
```

Puts the frequency value into the computer variable, Mkr.

```
110 PRINT "MARKER FREQUENCY IS ",Mkr,"Hz"
```

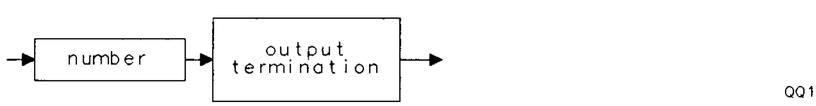
Prints the result.

```
120 END
```

Description

In nonzero span, "MKN?;" returns the frequency value. In zero span, "MKN?;" returns the time value.

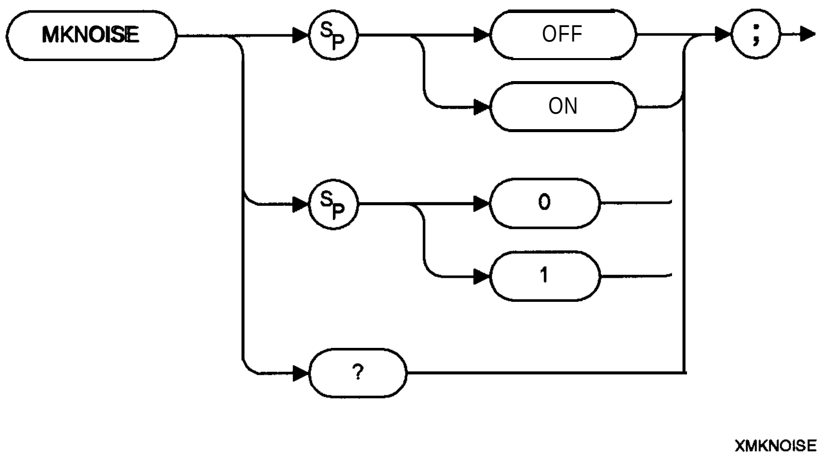
Query Response



MKNOISE Marker Noise

Displays the average noise level at the marker.

Syntax



Equivalent Key: **Marker Noise On Off**.
Related Commands: MKA, MKF, MKMIN, MKN.

Example

This programming example measures carrier to noise ratio, using the noise marker.

```
10      ASSIGN @Sa TO 718
```

Sets the spectrum analyzer HP-IB address to 718.

```
20      OUTPUT @Sa;"IP;TS;RFCALIB ON;"
```

Initializes the analyzer and turns on the internal 50 MHz source.

```
30      OUTPUT @Sa;"CF 50 MZ;SP 10 MZ;SNGLS;TS;"
```

Sets up the measurement conditions.

```
40      OUTPUT @Sa;"MKPK HI;TS;"
```

Puts the marker on the highest peak.

```
50   OUTPUT @Sa;"MKD UP;UP;MKNOISE ON;TS;MKA?;"
```

Moves the marker off the peak and measure noise.

```
60   ENTER @Sa;C_to_n
```

Puts the marker value into a variable.

```
70   OUTPUT @Sa;"MKNOISE OFF;"
```

Turns off the noise marker.

```
80   PRINT "Carrier to Noise Ratio in 1 Hz BW is ";C_to_n;"dB"

90   END
```

Description

The marker value is normalized to a 1 Hz bandwidth. Use "MKA?;" to read the noise marker value. If the marker delta function is on and the noise marker is activated and moved to measure the noise floor, the marker readout will display the signal-to-noise ratio.

The noise marker averages 32 trace data values about the location of the marker on the frequency or time scale. The 32 values averaged, except for the first 15 or last 14 values in the trace, commence with the 16th point to the left of the marker, and end with the 15th point to the right of the marker. Note that the data values averaged are not exactly symmetrical with respect to marker position. At the trace end points, the spectrum analyzer uses the nearest 32 data values. So while the marker may be moved to trace position 1 to 15, the actual amplitude value returned will be the same value for any marker position from 1 to 15. A similar situation applies for markers at the end of the trace.

A nominal correction for equivalent noise bandwidths is made by the firmware based on a nominal 3 dB resolution bandwidth. The firmware assumes the noise bandwidth is 1.12 times the resolution bandwidth. This means the shape of the resolution bandwidth filters cause the noise power to be overstated by 1.12 times. The detection mode also affects the measurement. If in log mode, the log detector understates the noise response. To compensate, 2.5 dB is added to the measurement. If the detector is in linear mode, the firmware uses 1.05 dB as a correction value.

In log detector mode, the final reported value will then be, with the result reported in dBm in a 1 Hz bandwidth:

$$(\text{Averaged value over 32 values}) - 10 \times (\log[1.12 \times \text{Resolution bandwidth}]) + 2.5\ \text{dB}$$

In linear detector mode (dBm) units, the final reported value will then be, with the result reported in dBm in a l-Hz bandwidth:

(Averaged value over 32 values) – 10 x (log[1.12 x Resolution bandwidth]) + 1.05 dB

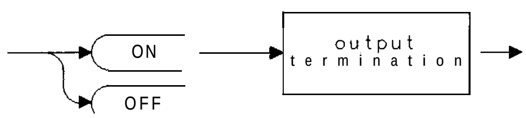
In linear detector mode with the normal display of voltage units, the noise marker voltage value will be related to the present marker voltage by this relation.

(V-noise-marker)* = (V-average)* x 1.12 x Resolution bandwidth x 0.7824

V-noise-marker = V-average/(1.12 x Resolution bandwidth x $0.7824)^{0.5}$

V-noise-marker = V-average x 1.06633/(Resolution bandwidth$)^{0.5}$

Query Response

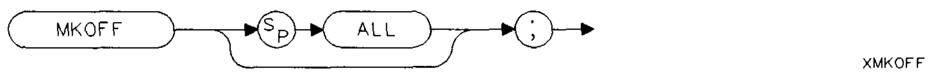


QQ2

MKOFF Marker Off

Turns off either the active marker or all the markers.

Syntax



Equivalent Key: **Marker All Off.**
Related Commands: MKA, MKACT, MKACTV, MKCF, MKD, MKF, MKN, MKPK.

Example

```
10 OUTPUT 718;"MKOFF ALL;"
```

Turns off all the on-screen markers.

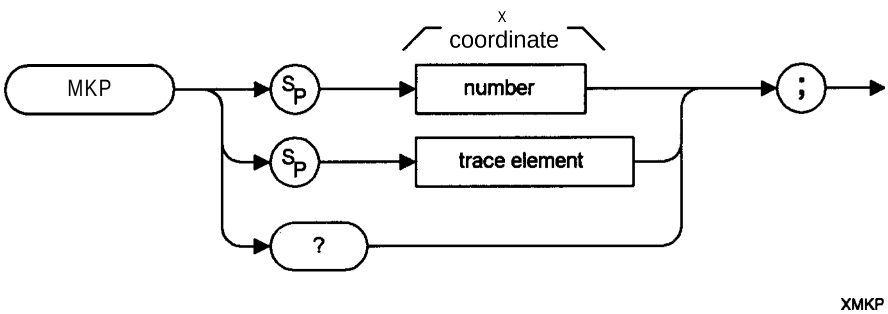
Description

If the ALL parameter is omitted, only the active marker is turned off.

MKP Marker Position

Places the active marker at the given x-coordinate.

Syntax



Item	Description/Default	Range
Number	Any valid integer	-401 to 401
Trace element	An element of trace A, trace B, trace C	

Related Commands: MKA, MKCF, MKD, MKMIN.

Example

```
10 OUTPUT 718;"IP;"
```

Initializes spectrum analyzer.

```
20 OUTPUT 718;"MKP 100;"
```

Moves the active marker to a element 100 of trace A.

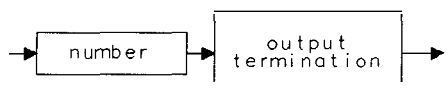
Description

If no marker is active, the marker is turned on with preset type (position) and marker is placed at the given screen position. The marker is placed on the first displayed trace that is found (in order): trace A, trace B, or trace C.

If the marker delta mode is active, the value of the marker position is relative to the fixed marker, and therefore MKP can return a negative position.

Note that MKP and MKCF commands perform different functions. MKCF sets the center frequency equal to the marker frequency and moves the marker to the center of the screen. MKP places the marker to the position of the element specified.

Query Response

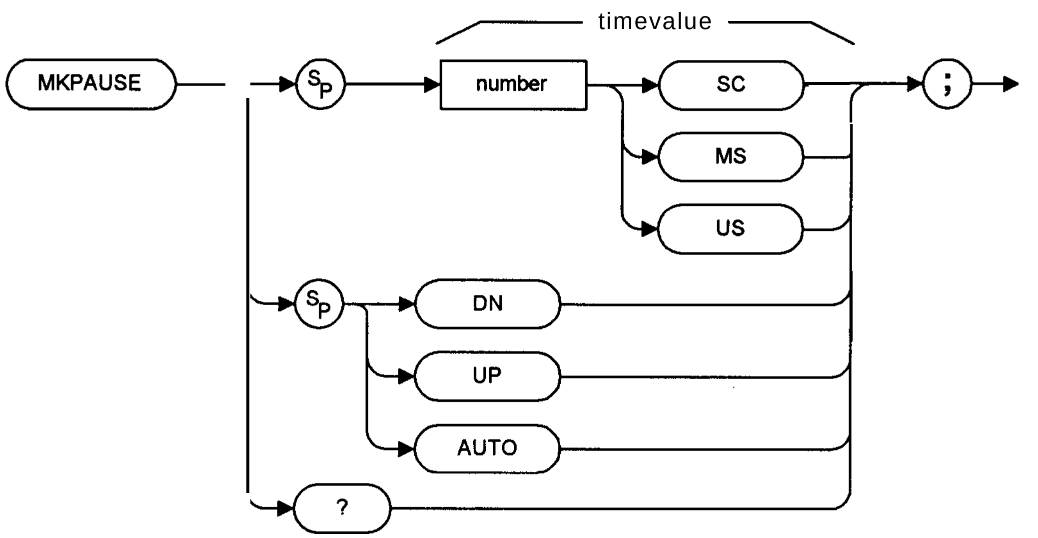


QQ1

MKPAUSE Marker Pause

Pauses the sweep at the active marker for the duration of the delay period.

Syntax



XMKPAUSE

Item	Description/Default	Range
Number	Any real or integer number	2 ms to 100 s

Restrictions: Not available with negative peak detection.
Equivalent Key: is similar to **Dwell Time On Off**.
Step Increment: 1, 2, 5, 10 sequence
Related Commands: DEMOD, DEMODT, MKA, MKF, MKFC, MKN, MKOFF, ST.

Example

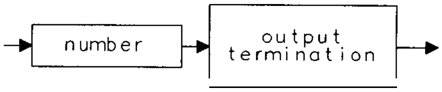
```
10 OUTPUT 718;"MKPAUSE 10SC;"
```

Changes the marker pause time to 10 seconds.

Description

To turn MKPAUSE off send "MKPAUSE 0;".

Query Response

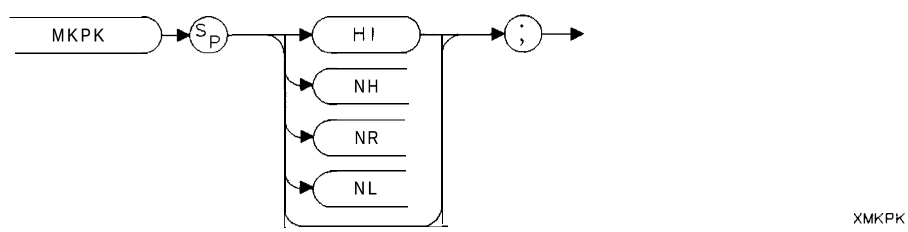


QQ1

MKPK Marker Peak

Positions the active marker on a signal peak.

Syntax



Related Keys: **Search**, **Next Peak**, **Next Pk Right**, **Next Pk Left**, and **Peak Search**.
Related Commands: MKCF, MKF, MKOFF, MKPX, MKTH.

Example

```
10 OUTPUT 718;"IP;"
```

Initializes the spectrum analyzer.

```
20 OUTPUT 718;"SNGLS;TS;MKPK HI;"
```

Places active marker on highest peak.

```
30 OUTPUT 718;"MKA?;"
```

Returns amplitude value of marker to the computer.

```
40 ENTER 718;A
```

Puts the spectrum analyzer response in the computer variable, A.

```
50 DISP A
```

Displays amplitude value.

```
60 END
```

Description

Executing MKPK HI, or simply MKPK, positions the active marker at the highest signal detected. If an active marker is on the screen, the MKPK parameters move the marker as follows:

HI (highest) moves the active marker to the highest peak.

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.

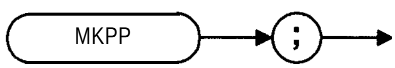
NL (next left) moves the active marker to the next signal peak of lower frequency.

NOTE: This function is for use with the frequency markers only.

MKPP Marker Peak-to-Peak

Positions markers on the highest and lowest points on the trace and displays the frequency and amplitude differences.

Syntax



XMKPP

Related Keys: **Search**, **Peak Search**.
Related Commands: MKPK, MKF, MKOFF, MKPX, MKTH.

Example

```
10 OUTPUT 718;"IP;"
```

Initializes the spectrum analyzer.

```
20 OUTPUT 718;"SNGLS;TS;MKPP;"
```

Places markers on highest peak and lowest point.

```
30 OUTPUT 718;"MKA?;"
```

Returns amplitude value of delta marker to the computer.

```
40 ENTER 718;A
```

Puts the spectrum analyzer response in the computer variable, A.

```
50 DISP A
```

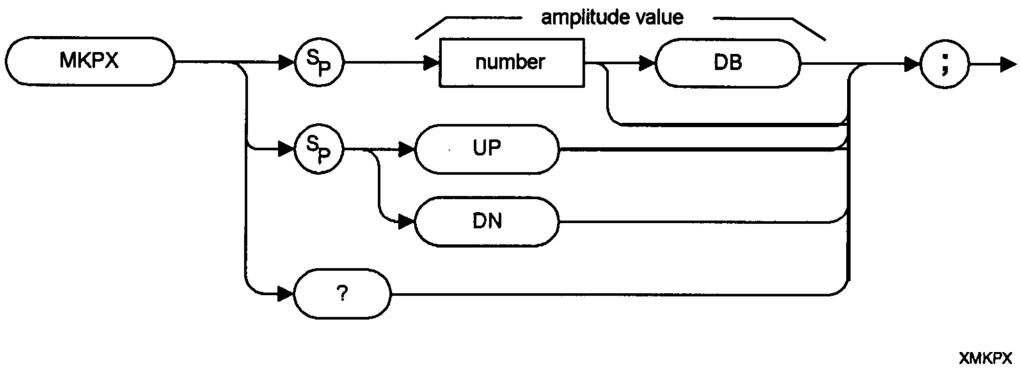
Displays amplitude value.

```
60 END
```

MKPX Marker Peak Excursion

Specifies the minimum signal excursion for the spectrum analyzer's internal peak identification routine.

Syntax



Item	Description/Default	Range
Number	Any real or integer number. Default unit is dB.	Oto 100 dB

Equivalent Key: **Peak Excursn.**
Preset State: 6 dB.
Step Increment: by 1 dB.
Related Commands: MKPK, PEAKS.

Example

```
10 OUTPUT 718;"IP;CF 300MHZ;SP 1GHZ;"
```

Initializes spectrum analyzer, changes start and stop frequencies.

```
20 INPUT "ENTER IN PEAK EXCURSION, IN DB ",Excursion
30 OUTPUT 718;"MKPX ";Excursion;"DB;"
```

Changes peak excursion level.

```
40 OUTPUT 718;"TS;MKPK HI;MKPK NH;"
```

Searches for highest peaks of trace.

```
50 OUTPUT 718;"MKF?;"
```

Finds frequency difference between peaks.

```
60 ENTER 718;Freq
```

Puts the spectrum analyzer response in the computer variable, Freq.

```
70 IF Freq <> 0 THEN
```

Outputs results if marker amplitude was not 0.

```
80 PRINT "PEAK FOUND"
```

```
90 ELSE
```

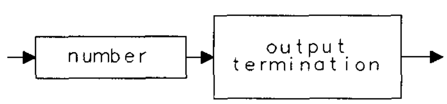
Prints “NO PEAKS FOUND” if Freq = 0.

```
100 PRINT "NO PEAKS FOUND"
```

```
110 END IF
```

```
120 END
```

Query Response

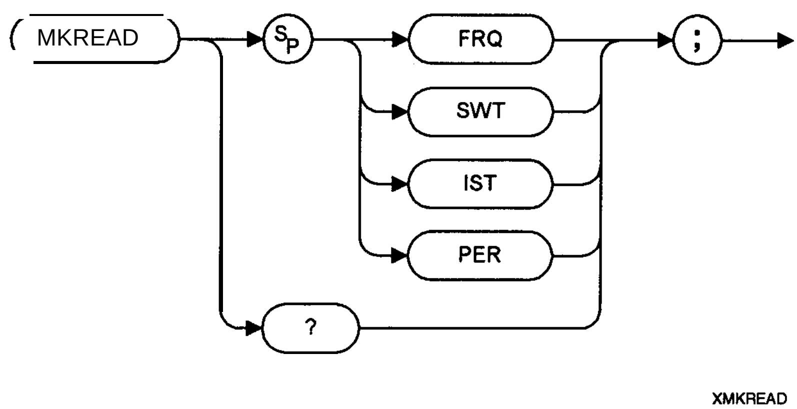


QQ1

MKREAD Marker Readout

Selects the type of active trace information displayed by the spectrum analyzer marker readout.

Syntax



Equivalent Key: **Mkr Readout** provides the marker readouts in the frequency, sweep time, inverse sweep time, and period. The fast Fourier transform readout is not available with the **softkey**, however.
Related Commands: MKF, MKTYPE.

Example

```
10 OUTPUT 718;"TDF P;MKREAD FRQ;MF;"
```

This returns a frequency value (in Hz) if not in zero-span.

Description

The MKREAD command can select the following types of active trace information:

FRQ frequency

SWT sweep time

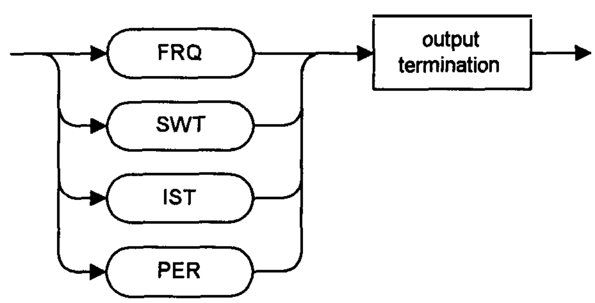
IST inverse sweep time

PER period

The results of the data depend on the MKREAD parameter, the frequency span, and if the marker delta function is used.

MKREAD Type	Non-Zero Span	Non-Zero Span Delta	Zero Span	Zero Span Delta
FRQ	Reads frequency	Reads delta frequency	Reads time	Reads delta time
SWT	Reads time since the start of sweep	Reads delta time between end points	Waveform measurements of detected modulation	Waveform measurements of detected modulation
IST	N/A	N/A	N/A	Computes frequency corresponding to delta of markers. Performs $1/(T_1 - T_2)$
PER	Period of frequency	(Pulse measurement) delta time	N/A	N/A

Query Response

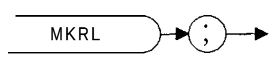


QMKREAD

MKRL Marker to Reference Level

Sets the reference level to the amplitude value of the active marker.

Syntax



XMKRL

Equivalent Key: **Mkr -> RL**.
Related Commands: MKOFF, RL.

Example

```
10 OUTPUT 718;"IP;SNGLS;CF 300MHZ;SP 20MHZ;"
```

Initializes spectrum analyzer, changes center frequency and span.

```
20 OUTPUT 718;"TS;MKPK HI;MKRL;TS;"
```

Places a marker on trace peak, sets the reference level to the amplitude of the active marker, updates the sweep.

```
30 OUTPUT 718;"RL?;"
```

Gets the reference level.

```
40 ENTER 718 USING "K";Ref_level
```

Puts the spectrum analyzer response in the computer variable, Ref_level.

```
50 OUTPUT 718;"AUNITS?;"
```

Gets the current amplitude units.

```
60 ENTER 718;Aunits$
```

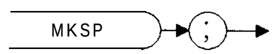
```
50 PRINT "REFERENCE LEVEL IS",Ref_level,Aunits$
```

```
60 END
```

MKSP Marker to Span

Sets the start and stop frequencies to the values of the delta markers.

Syntax



XMKSP

Equivalent Key: **Mkr A -> Span.**

Related Commands: MKD, SP.

Example

```
10 OUTPUT 718;"IP;"
```

Initializes spectrum analyzer.

```
20 OUTPUT 718;"MKMIN;"
```

Places a marker at the minimum amplitude of trace.

```
30 OUTPUT 718;"MKD;"
```

Activates marker delta.

```
40 OUTPUT 718;"MKPK HI;"
```

Places marker at highest amplitude of trace.

```
50 OUTPUT 718;"MKSP;"
```

Changes span to the values of the left and right markers.

```
60 END
```

Description

The left marker specifies start frequency, and the right marker specifies stop frequency. If MKD is off, no operation is performed.

MKSS Marker to Step Size

Sets the center-frequency step-size to the marker frequency.

Syntax

XMKSS

Equivalent Key: **Mkr -> CF Step**.

Related Commands: CF, MKA, MKCF, MKD, MKF, SS.

Example

This example uses a 300 MHz input signal with harmonics.

```
20 OUTPUT 718;"IP;SNGLS;CF 300MHZ;SP 20MHZ;TS;"
```

Initializes spectrum analyzer, activates single-sweep mode, changes center frequency and span, updates trace.

```
30 OUTPUT 718;"MKPK HI;MKSS;MKD;CF UP;TS;MKPK HI;"
```

Places the marker on the highest point of the trace, changes the step size to the marker frequency, activates marker delta, increase center frequency, update trace, places the marker at highest point of the trace.

```
40 OUTPUT 718;"MKA?;"
```

Gets the amplitude of the marker.

```
50 ENTER 718;Delta_amp
```

Puts the spectrum analyzer response in the computer variable, Delta-Amp.

```
60 OUTPUT 718;"MKF?;"
```

Gets the frequency of the marker.

```
70 ENTER 718;Delta_freq
```

Puts the spectrum analyzer response in the computer variable, Delta-freq.

```
80 PRINT "DIFFERENCE IN AMPLITUDE IS ",Delta_amp,"dB"
90 PRINT "DIFFERENCE IN FREQUENCY IS ",Delta_freq,"Hz"
```

```
100 END
```

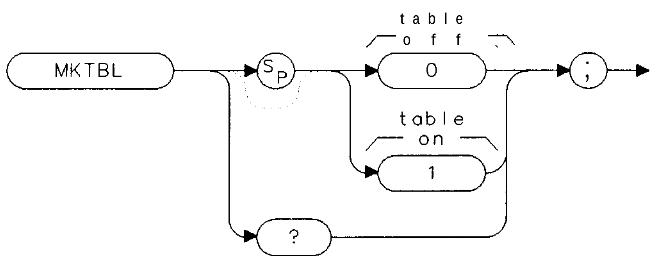
Description

Sets the center-frequency step-size equal to the marker frequency. If in the delta mode, the step size is set to the delta frequency (absolute value).

MKTBL Marker Table

Turns on or off the marker table.

Syntax



Equivalent Softkey: Mk Table On Off
Preset State: 0 (marker table is off)
Related Commands: DL, PEAKS

Example

```
OUTPUT 718;"MOV MKTBL,1;"
```

Turns on the marker table.

Description

When the marker table is turned on, the spectrum analyzer screen displays two windows. The upper window displays the traces and the graticule, and the lower window displays the marker table. The marker table displays the following information about the on-screen markers: the trace (trace A, B, or C) on which the marker is located, the type of marker (frequency, time, inverse sweep time, or period), the frequency or time of the marker, and the amplitude of the marker. While the marker table is turned on, the marker table data is updated at the end of every sweep, or whenever a marker is moved. (MKTBL command uses the ONMKRU command to update the marker table information).

The marker table is displayed on the spectrum analyzer display only. To obtain the information that is displayed in the marker table remotely, you must use the following programming commands.

- Use MKACT to select a marker. Use the MKACTV command makes the selected marker the active function.

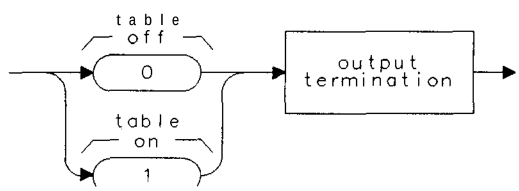
- Use MKA? to determine the amplitude of a marker.
- Use MKF? to determine the frequency or time of a marker.
- Use MKREAD? to determine the type of marker.
- Use MKTRACE? to determine which trace the marker is located on.

Restrictions Turning on the marker table turns off following functions: windows display mode (WINON), N dB point measurement (NDBPNT), the FFT menu measurements (FFTAUTO, FFTCONTS, FFTSNGLS), gate utility functions (GDRVUTIL), TOI measurement (TOI), peak table (PKTBL), percent AM (PCTAM), peak zoom (PKZOOM), and power menu measurements (ACP, ACPE, CHP, and OBW). Marker noise (MKNOISE) and marker counter (MKFC) are not available with the marker table.

You can execute the MKTBL command two different ways. You can either execute the MKTBL command directly (for example, **"MKTBL 1;"**) or use the MOV command to move the 1 or 0 into the MKTBL command (for example, **"MOV MKTBL, 1;"**). If you use the MOV command, no text is displayed in the active function area during command execution.

You should turn off the marker table (set MKTBL to 0) when you are done with the marker table.

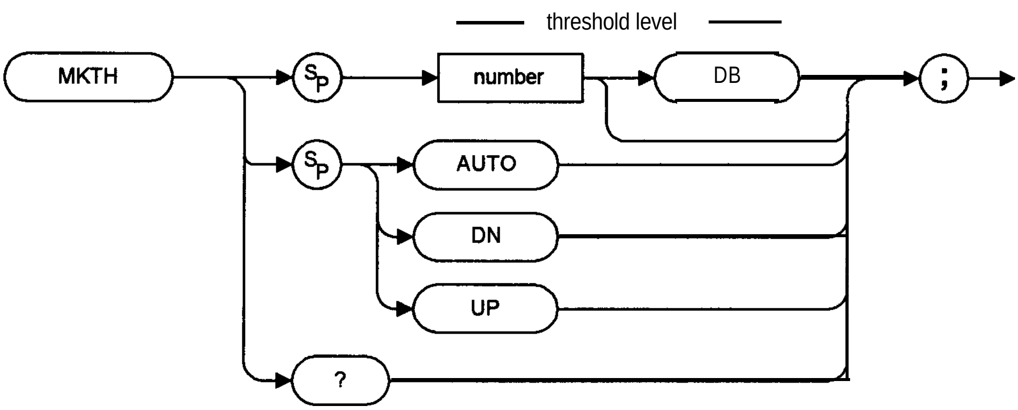
Query Response



MKTH Peak Threshold

Sets a lower boundary to the trace and "clips" signals that appear below the threshold level.

Syntax



Item	Description/Default	Range
Number	Any real or integer number. Default unit is dBm.	Range dependent on RL setting

Equivalent Key: **Pk Threshold**
Preset State: -90 dBm
Step Increment: One division
Related Commands: MKPX, MKPK, PEAKS

Example

```
10 OUTPUT 718;"MKTH UP;"
```

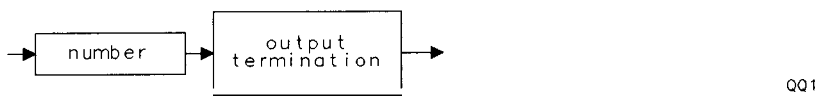
Increases the threshold level.

Description

The MKTH command sets a lower boundary to the active trace. The threshold line "clips" signals that appear below the line when this function is on. The boundary is defined in amplitude units that correspond to its vertical position when compared to the reference level. In other words, if the reference level is -10 dBm, and the threshold is set to -75 dBm, the threshold will remain 65 dB below the reference level as the reference level is changed.

The value of the threshold appears in the active function block and on the lower left side of the display. The threshold level does not influence the trace memory or marker position. The peaks found by the markers must be at least the peak excursion value above the threshold level. Use the MKPX command to change the value of peak excursion. The threshold value affects peak searching functions, except for MKPK.

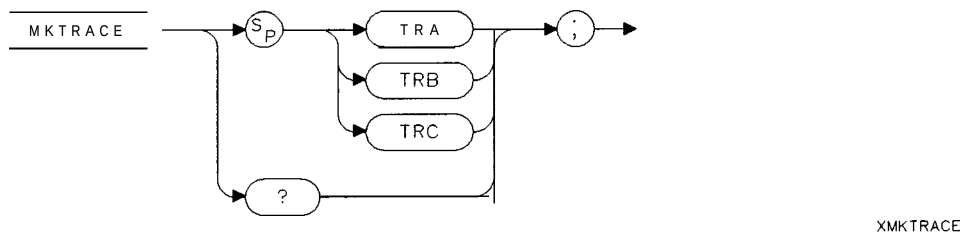
Query Response



MKTRACE Marker Trace

Moves the active marker to a corresponding position in trace A, trace B, or trace C.

Syntax



Equivalent Key: **Marker Trace Auto A B C.**

Example

```
10 OUTPUT 718;"IP;"
```

Initializes spectrum analyzer.

```
20 OUTPUT 718;"MKMIN;"
```

Finds the lowest amplitude of trace.

```
30 OUTPUT 718;"MKTRACE TRB;"
```

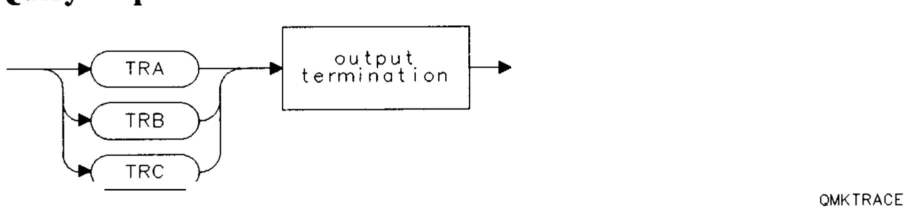
Moves marker to corresponding position on trace B.

```
40 OUTPUT 718;"BLANK TRA;CLRW TRB;"
```

Blanks trace A and displays trace B.

```
50 END
```

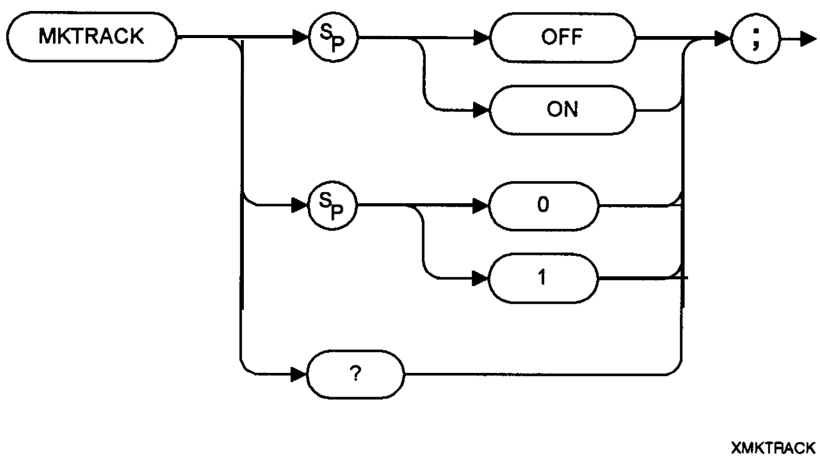
Query Response



MKTRACK Marker Track

Moves the signal on which the active marker is located, to the center of the spectrum analyzer display and keeps the signal peak at center screen.

Syntax



Equivalent Key: **Signal Track On Off**.
Related Commands: MKA, MKCF, MKF.

Example

10 OUTPUT 718;"IP;"

Initializes spectrum analyzer.

20 OUTPUT 718;"CF 300MHZ;TS;"

Changes the center frequency.

30 OUTPUT 718;"MKTRACK **ON;**"

Activates the marker track.

40 OUTPUT 718;"SP 10MHZ;TS;"

Changes the span.

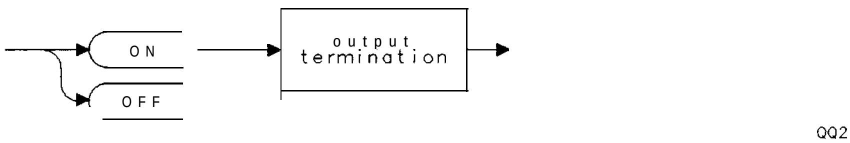
50 OUTPUT 718;"MKTRACK **OFF;**"

Turns off the marker track.

Description

To keep a drifting signal at center screen, place the active marker on the desired signal before turning on MKTRACK.

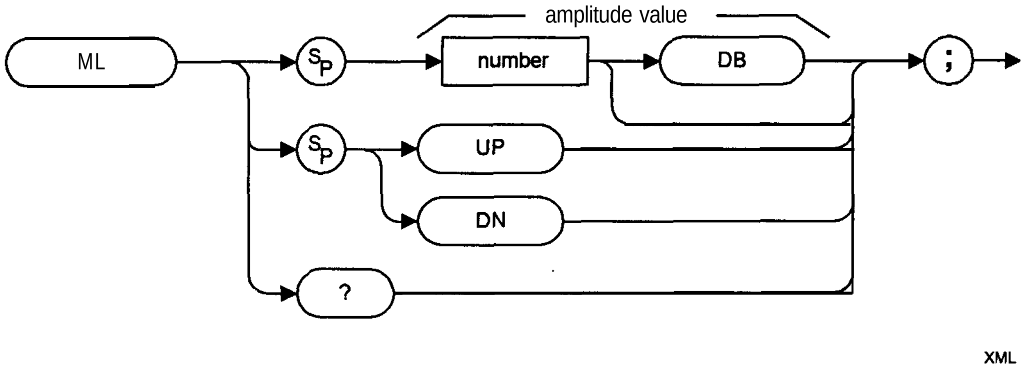
Query Response



ML Mixer Level

Specifies the maximum signal level that is applied to the input mixer for a signal that is equal to or below the reference level.

Syntax



Item	Description/Default	Range
Number	Any real or integer number. Default unit is dBm.	-10 to -60 dBm

Equivalent Key: **Max Mixer Lvl**.
Preset State: -10 dBm.
Step Increment: 10 dB minimum.
Related Commands: AT, ROFFSET.

Example

```
10 OUTPUT 718;"ML -40DM;"
```

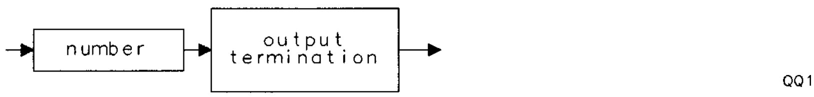
As the reference level is changed, the coupled input attenuator is changed automatically. This limits the maximum signal at the mixer input to -40 dBm for signals less than or equal to the reference level.

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 1 dB steps.

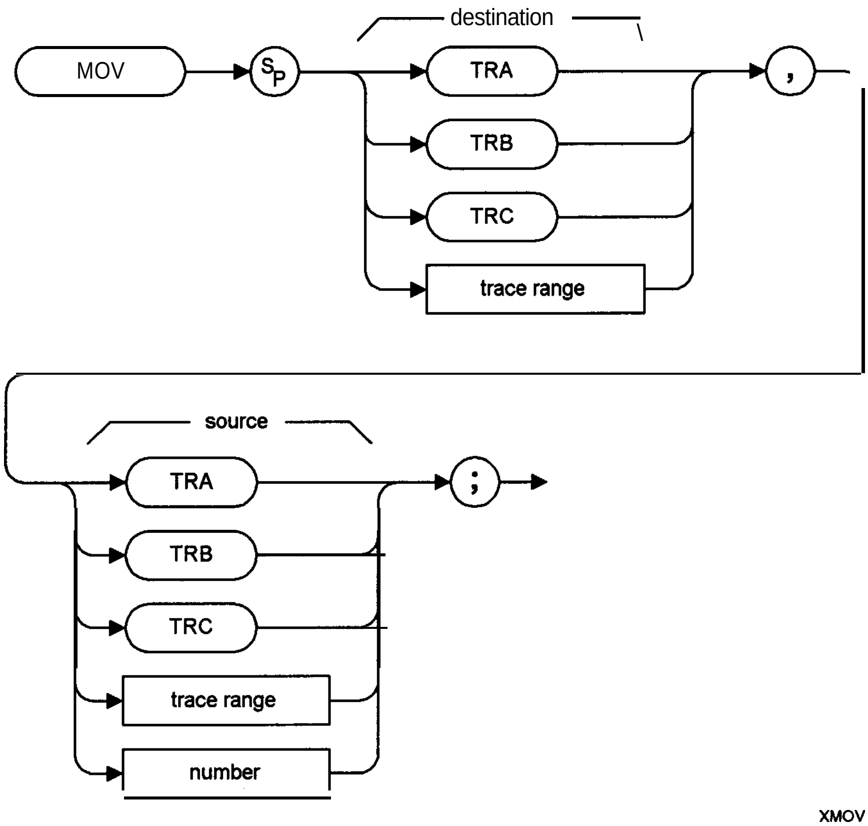
Query Response



MOV Move

Copies the source values into the destination.

Syntax



Item	Description/Default	Range
Trace range	A segment of trace A, trace B, trace C, or a user-defined trace.	
Number	Any real or integer number.	Real number range.

Example

```
10 INTEGER Tra_binary(1:401)
```

Declare an array for the trace data.

```
20 ASSIGN @Sa TO 718;FORMAT OFF
30 OUTPUT @Sa;"IP;TS;RFCALIB ON;"
```

Turn on the internal 50 MHz signal.

```
40 OUTPUT @Sa;"CF 50 MZ;SP 10 MZ;SNGLS;TS;"
```

Set up the analyzer and take a sweep.

```
50 OUTPUT @Sa;"MDS W;TDF B;TRA?;"
```

Output the trace A data.

```
60 ENTER @Sa;Tra_binary(*)
70 OUTPUT @Sa;"TDF A;"
```

Change the trace data to A-block format.

```
80 OUTPUT @Sa;"MOV TRA,0;"
```

Set the trace A data to 0's.

```
90 DISP "Press CONTINUE when ready"
100 PAUSE
110 DISP
120 OUTPUT @Sa USING "#,K,W";"TRA#A",802
```

Prepare the spectrum analyzer for the data.

```
130 OUTPUT @Sa;Tra_binary(*)
```

Transfer the data to the analyzer.

```
140 OUTPUT @Sa;"VIEW TRA;"
150 LOCAL @Sa
160 END
```

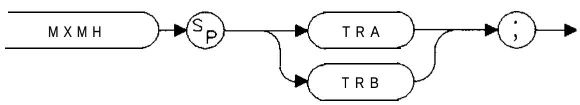
Description

When the source is longer than the destination, the source is truncated to fit. When the source is shorter than the destination, the last element is repeated to fill the destination.

MXMH Maximum Hold

Updates each trace element with the maximum level detected.

Syntax



XMXMH

Equivalent Keys: Max **Hold A** and **Max Hold B**.
Related Commands: BLANK, CLRW, MINH, VAVG, VIEW.

Example

```
10 OUTPUT 718;"MXMH TRA;"
```

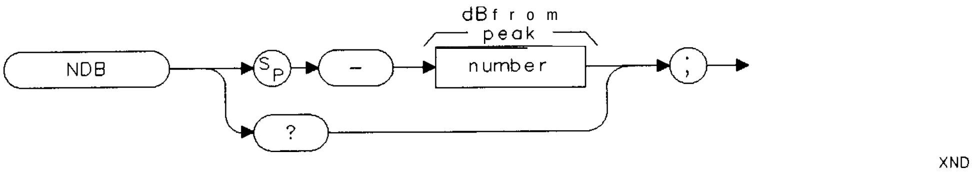
Description

MXMH updates the specified trace (either trace A or trace B) with a new value from a detector only if the new value is larger than the previous trace data value.

NDB Number of dB

Specifies the distance (in dB) from the signal peak for the N dB points measurement (NDBPNT).

Syntax



Item	Description/Default	Range
Number	Any negative real or negative integer number. Default unit is dB.	-1 to -80 dB

Equivalent Key: **N dB Points On Off**
Preset State: -3 dB.
Related Commands: MKBW, MKPX, NDB, NDBPNT, NDBPNTR, MKTH.

Example

```
10 OUTPUT 718;"NDBPNT 1;"
```

Turns on the N dB points measurement.

```
20 OUTPUT 718;"NDB -6DB;"
```

Sets the N dB points measurement to measure 6 dB below the signal's peak.

```
30 OUTPUT 718;"NDBPNTR?;"
```

Queries NDBPNTR. NDBPNTR contains the measurement results of the N dB points measurement.

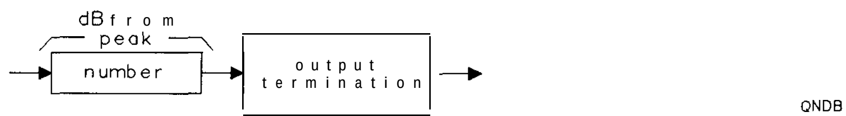
```
40 ENTER 718;Six
```

Stores the result in the variable Six.

Description

When the N dB points function is turned on, the spectrum analyzer finds the bandwidth, at the number of dB down specified by the NDB command, of the highest on-screen signal. The highest on-screen signal must be greater than the peak excursion above the current threshold, but the N dB points may fall below the threshold.

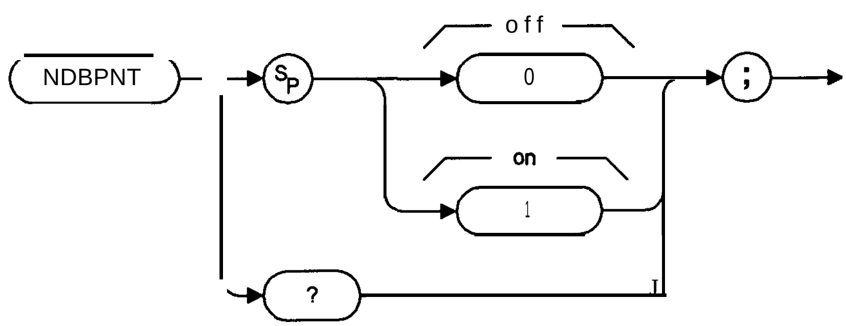
Query Response



NDBPNT N dB Points

Turns on or off the N dB points function.

Syntax



XNDBPNT

Equivalent Key: **N dB Points On Off.**
Related Commands: MKBW, MKPX, NDB, NDBPNTR, MKTH.

Example

This example finds the shape factor of a signal.

10 OUTPUT 718;"NDBPNT 1;"

Turns on the N dB points measurement.

20 OUTPUT 718;"NDB -6DB;"

Sets the N dB points measurement to measure 6 dB below the signal's peak.

30 OUTPUT 718;"NDBPNTR?;"

Queries NDBPNTR. NDBPNTR contains the measurement results of the N dB points measurement.

40 ENTER 718;Six

Stores the result in the variable Six.

50 OUTPUT 718;"NDB -60DB;"

Sets the N dB points measurement to measure 60 dB below the signal's peak.

```
60 OUTPUT 718;"NDBPNTR?;"
```

Queries NDBPNTR.

```
70 ENTER 718;Sixty
```

Stores the result in the variable Sixty.

```
80 IF Six <> -100 AND Sixty <> -100 THEN
```

If both the measurement at -6 dB and -60 dB were valid, print the shape factor of the signal.

```
90 PRINT "Shape factor is ",Sixty/Six
```

Prints the shape factor of the signal.

```
100 ELSE
```

If the bandwidth at -6 dB or -60 dB could not be found, an error statement is printed.

```
110 PRINT "Error, bandwidth could not be determined"
```

```
120 END IF
```

```
130 OUTPUT 718;"NDBPNT 0;"
```

Turns off the N dB points measurement.

Description

Setting NDBPNT to 1 turns on the N dB points measurement. Setting NDBPNT to 0 turns off the N dB points measurement. When the NdB points function is turned on, the spectrum analyzer finds the bandwidth, at the number of dB down specified by the NDB command, of the highest on-screen signal. The N dB points measurement is repeated at the end of every sweep, to update the measurement data, until you turn it off. To determine the bandwidth measured by NDBPNT, you must query NDBPNTR.

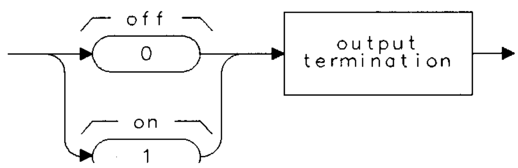
To be able to measure a signal with NDBPNT, there must be an on-screen signal that is greater than the peak excursion (see "MKPX" for more information about the peak excursion) above the threshold, and there cannot be any other signals with amplitudes within N dB of the peak of the highest signal. If a signal cannot be found or there is more than one signal within the value of NDB of the highest signal, the value of NDBPNTR will be -100.

You can execute the NDBPNT function by using the command, `"NDBPNT 1;"`).

Restrictions Turning on the NDBPNT function turns off the following functions: TOI measurement (TOI), percent AM (PCTAM), and span zoom (SPZOOM).

You should turn off the N dB points measurement (set NDBPNT to 0) when you are done with it.

Query Response



QNDBPNT

NDBPNTR N dB Points Bandwidth

Returns the bandwidth measured by the N dB points measurement (NDBPT).

Syntax

Equivalent Key: **N dB Points On Off**
Related Commands: MKPX, NDB, NDBPNT, MKTH.

Example

10 OUTPUT 718;"NDBPNT **1;"**

Turns on the N dB points measurement.

20 OUTPUT 718;"NDB —6DB;"

Sets the N dB points measurement to measure 6 dB below the signal's peak.

30 OUTPUT 718;"NDBPNTR?;"

Queries NDBPNTR. NDBPNTR contains the measurement results of the N dB points measurement.

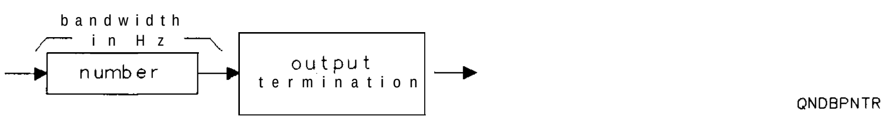
40 ENTER 718;Six

Stores the result in the variable Six.

Description

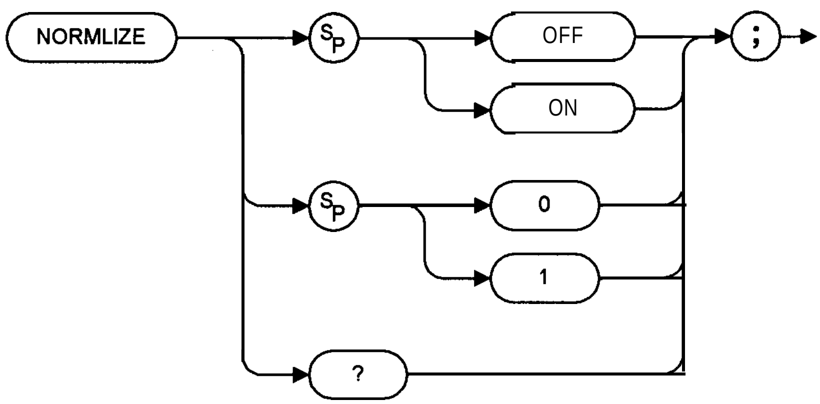
NDBPNTR returns a -100 if the NDBPNT function has not been turned on, or if NDBPNT did not find a signal to measure. (For NDBPNT to be able to measure a signal, there must be an on-screen signal that is greater than the peak excursion above the threshold, and there cannot be any other signals with amplitudes that are within N dB of the peak of the highest signal.)

Query Response



NORMLIZE Normalize Trace Data

Syntax



XNORMLIZE

Equivalent Key: **Normalize**
Preset State: OFF
Restrictions: Will not work with linear display mode
Related Commands: NRPOS, NRL, RL

Example

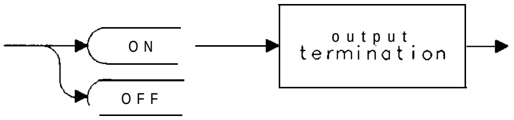
```
10   OUTPUT 718;"IP;SNGLS;"
20   OUTPUT 718;"FA 300KHZ;FB 1GHZ;"
30   OUTPUT 718;"SRCPWR ON;"
40   OUTPUT 718;"SWPCPL SR;"
50   OUTPUT 718;"RB 100KHZ;"
60   PRINT "CONNECT THRU. PRESS CONTINUE WHEN READY TO STORE."
70   PAUSE
80  OUTPUT 718;"TS;DONE?;"
90  ENTER 718;Done
100 OUTPUT 718;"NORMLIZE ON;"
110  OUTPUT 718;"TS;DONE?;"
120  ENTER 718;Done
130  LOCAL 718
140  END
```

Description

When the NORMLIZE command is first turned on trace A is copied to trace B so that trace B can be used as the reference trace. Each sweep A – B + top of screen (the normalized reference level) is calculated and the results are displayed in trace A. Any changes to the absolute reference level (RL command) are reflected in the normalized reference level (NRL command) and in the reference trace data.

When the normalize function is on, the reference level annotation on screen is changed to display the relative reference level, which is effectively the normalized reference level. However, a remote query with the RL command will still return the absolute reference level.

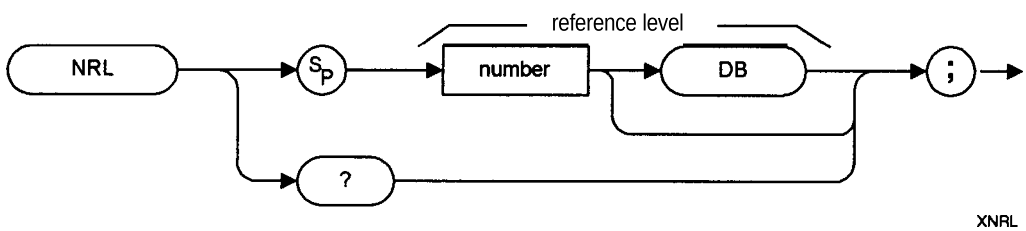
Query Response



NRL Normalized Reference Level

Sets the normalized reference level.

Syntax



Item	Description/Default	Range
Number	Any real or integer number. Default unit is dBm.	

Equivalent Key: **Norm Ref Lvl**
Preset State: 0 dB
Related Commands: NORMLIZE, RL, NRPOS

Example

```
150   OUTPUT 718;"NRL 40DB;"
```

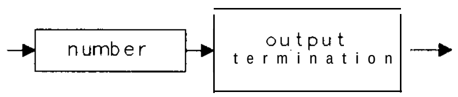
Sets the normalized reference level to 40 dBm.

Description

This function is a trace-offset function that enables you to offset the displayed trace without introducing hardware-switching errors into the stimulus-response measurement. The input attenuator and IF step gains are not affected when using NRL.

In absolute power mode (dBm), reference level affects the gain and RF attenuation settings of the instrument, which affects the measurement or dynamic range. In normalized mode (relative power or dB-measurement mode), NRL offsets the trace data on-screen and does not affect the instrument gain or attenuation settings. This allows the displayed normalized trace to be moved without decreasing the measurement accuracy due to changes in gain or RF attenuation. If the measurement range must be changed to bring trace data on-screen, then the range level should be adjusted. Adjusting the range-level normalized mode has the same effect on the instrument settings as does reference level in absolute power mode (normalize off).

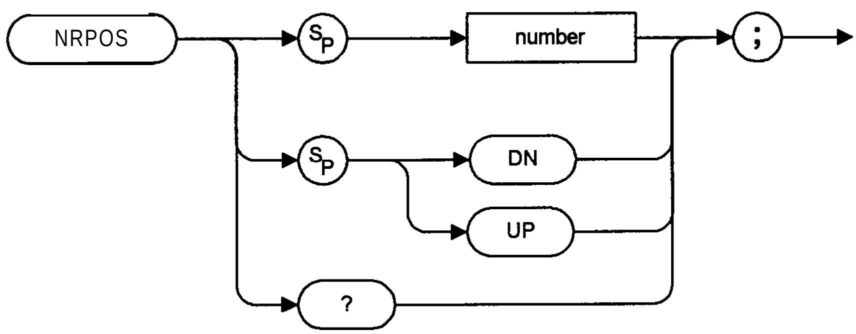
Query Response



QQ1

NRPOS Normalized Reference Position

Syntax



XNRPOS

Item	Description/Default	Range
Number	Any integer number	0 to 10

Equivalent Key: **Norm Ref Posn**.
Preset State: 10 (top graticule line)
Step Increment: 1

Example

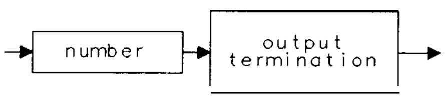
```
10   OUTPUT 718;"IP;SNGLS;"
20   OUTPUT 718;"FA 300KHZ;FB 1GHZ;"
30   OUTPUT 718;"SRCPWR ON;"
40   OUTPUT 718;"SWPCPL SR;"
50   PRINT "CONNECT THRU.  PRESS CONTINUE WHEN READY TO STORE."
60   PAUSE
70   OUTPUT 718;"TS;DONE?;"
80 ENTER 718;Done
90 OUTPUT 718;"STORETHRU;"
100 OUTPUT 718;"TS;DONE?;"
110  ENTER 718;Done
120 OUTPUT 718;"NORMLIZE ON;"
130 OUTPUT 718;"TS;DONE?;"
140  ENTER 718;Done
150 OUTPUT 718;"NRPOS 5;TS;"
160 PRINT "RECONNECT DUT.  PRESS CONTINUE WHEN READY."
170  PAUSE
180 OUTPUT 718;"NRL -10DB;"
190 OUTPUT 718;"TS;DONE?;"
200  ENTER 718;Done
```

```
210 LOCAL 718
220 END
```

Description

The NRPOS command adjusts the normalized reference-position that corresponds to the position on the graticule where the difference between the measured and calibrated traces resides. The **dB** value of the normalized reference-position is equal to the normalized reference level. The normalized reference-position can be adjusted between 0 and 10, corresponding to the bottom and top graticule lines, respectively.

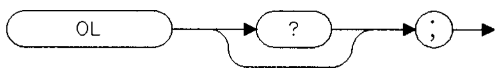
Query Response



OL Output Learn String

Transmits information to the controller that describes the state of the spectrum analyzer when the OL command is executed.

Syntax



Example

```
10 DIM Header_str$[10]
```

Allocates memory space for the Learn-String.

```
20 OUTPUT 718;"OL;"
```

Asks for first state.

```
30 ENTER 718 USING "#,10A"; Header_str$
```

Computer receives the length information.

```
40 OUTPUT CRT;"Header string= ";Header_str$[1,4]
50 OUTPUT CRT;"MSB length= ";NUM(Header_str$[5])
60 OUTPUT CRT;"LSB length= ";NUM(Header_str$[6])
70 OUTPUT CRT;"MSB FW rev= ";NUM(Header_str$[7])
80 OUTPUT CRT;"LSB FW rev= ";NUM(Header_str$[8])
90 OUTPUT CRT;"Zero pad byte= ";NUM(Header_str$[9])
100 OUTPUT CRT;"ID byte= ";NUM(Header_str$[10])
110 Read_bytes=NUM(Header_str$[5])*256+NUM(Header_str$[6])
120 Read_bytes=Read_bytes-4
130 OUTPUT CRT;"Bytes to read= ";Read_bytes
```

```
140 DIM State_str$[1000]

150 State_str$=Header_str$

160 FOR I=11 To Read_bytes+10

170   ENTER 718 USING "#,A;State_str$[I;1]

180 NEXT I

190 PAUSE
```

Send state information back to the analyzer.

```
200 OUTPUT 718;State_str$;
```

Returns the spectrum analyzer to its former state (when OL was first activated in line 20).

```
210 END
```

Description

The information received from the spectrum analyzer using the OL command is called the learn string. The learn string can be sent from the controller back to the spectrum analyzer to restore the spectrum analyzer to its original state after executing other commands.

The learn string requires a maximum of 210 bytes of storage space. See the information on saving and loading instrument states," in Chapter 3 for more information. To conserve memory space, the length of the learn string can be queried. Then the destination string can be allocated for the exact size needed.

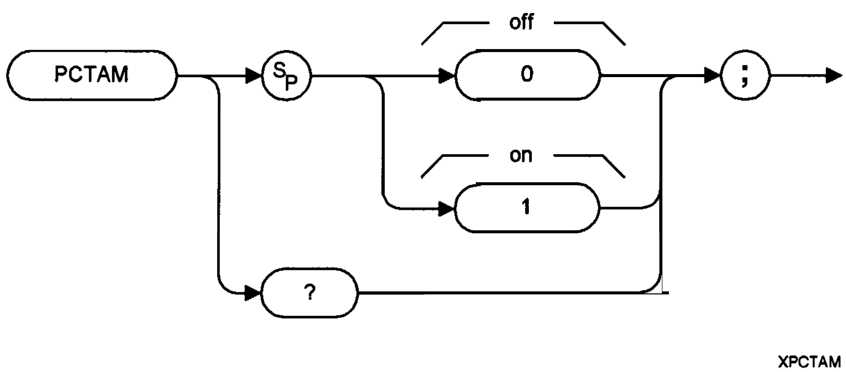
The learn string contains the following information:

<I><L><#><A><MSB of data length><LSB of data length>
<MSB of firmware revision><LSB of firmware revision>
<MSB of identification><LSB of identification><binary MSTATE data>

PCTAM Percent AM

Turns on or off the percent AM measurement.

Syntax



Equivalent Key: % **AM On Off**.
Related Commands: MKPX, PCTAMR, MKTH.

Example

`10 OUTPUT 718;"PCTAM 1;"`

Turns on the percent AM measurement.

`20 OUTPUT 718;"PCTAMR?;"`

Queries PCTAMR. PCTAMR contains the results of the percent AM measurement.

`30 ENTER 718;Percent`

Stores the value of PCTAMR in the variable Percent.

`40 PRINT "Percent AM is ",Percent`

Prints the results.

`50 OUTPUT 718;"PCTAM 0;"`

Turns off the percent AM measurement.

Description

Setting PCTAM to 0 turns off the percent AM function. Setting PCTAM to 1 turns on the percent AM function. When the percent AM function is turned on, the spectrum analyzer finds the signal with the highest amplitude, and then finds two signals (with lower amplitudes) on either side of the highest signal. The highest on-screen signal is assumed to be the carrier, and the adjacent signals are assumed to be the sidebands. The amplitude levels of all three signals are measured, and the percent AM is calculated using the carrier level and the sideband with the higher amplitude level. Percent AM is calculated as follows:

$$PercentAM = 200 \times \frac{Level_{Carrier}}{Level_{Sideband}}$$

The percent AM measurement is repeated at the end of every sweep until you turn it off. You must query PCTAMR to determine the percent AM.

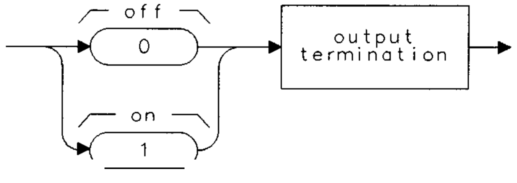
PCTAM can perform the percent AM measurement only if there are three on-screen signals that have the characteristics of a carrier with two sidebands. Also, to be considered a signal, the levels of the carrier and sideband signals must be greater than the peak excursion above the threshold. If there are not three signals that fit the characteristics of a carrier with two sidebands, the value of PCTAMR will be -100.

You can execute the PCTAM function using the command, `"PCTAM 1;"`).

Restrictions Turning on the PCTAM function turns off the following functions: N dB point measurement (NDBPNT), TOI measurement (TOI), and span zoom (SPZOOM).

You should turn off the percent AM measurement (set PCTAM to 0) when you are finished.

Query Response

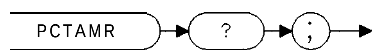


QPCTAM

PCTAMR Percent AM Response

Returns the percent AM measured by the percent AM measurement (PCTAM).

Syntax



XPCTAMR

Equivalent Key: % **AM On Off**.
Related Commands: MKPX, PCTAM, MKTH.

Example

```
10 OUTPUT 718;"PCTAM 1;"
```

Turns on the percent AM measurement.

```
20 OUTPUT 718;"PCTAMR?;"
```

Queries PCTAMR. PCTAMR contains the results of the percent AM measurement.

```
30 ENTER 718;Percent
```

Stores the value of PCTAMR in the variable Percent.

```
40 PRINT "Percent AM is ",Percent
```

Prints the results.

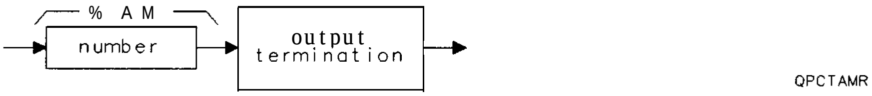
```
50 OUTPUT 718;"PCTAM 0;"
```

Turns off the percent AM measurement.

Description

PCTAMR returns a -100 if the PCTAM function has not been turned on, or if the on-screen signal is not valid or is not present. PCTAM can perform the percent AM measurement only if there are three on-screen signals that have the characteristics of a carrier and two sidebands. Also, to be considered a signal, the levels of the carrier and sideband signals must be greater than the peak excursion above the threshold.

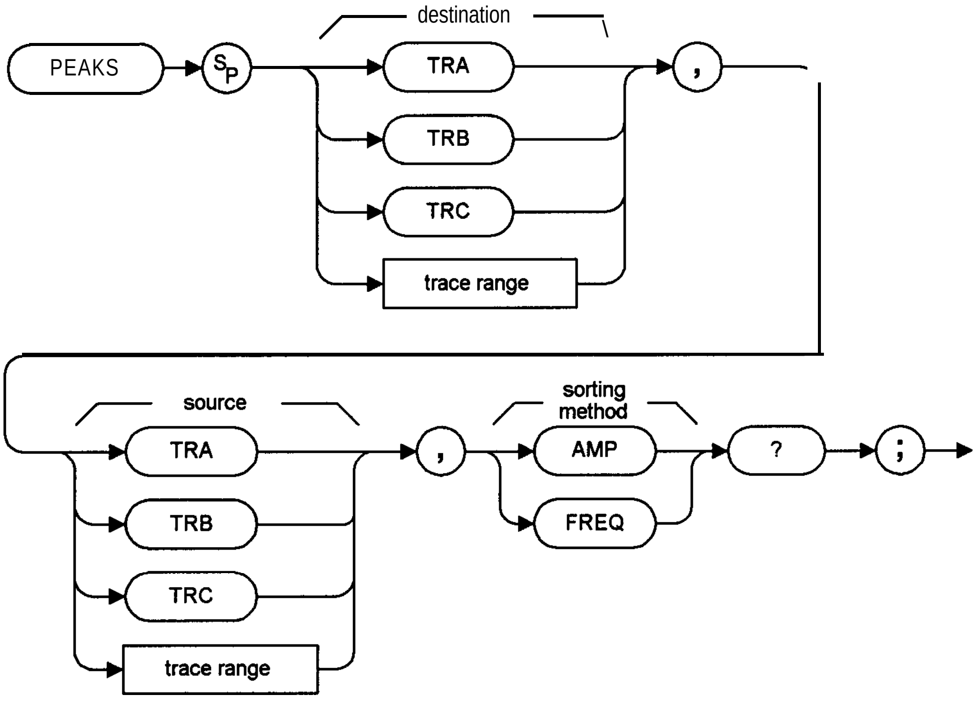
Query Response



PEAKS Peaks

Sorts signal peaks by frequency or amplitude, stores the results in the destination trace, and returns the number of peaks found.

Syntax



XPEAKS

Item	Description/Default	Range
Trace range	A segment of trace A, trace B, trace C	

Prerequisite Commands: TS when using trace data
Related Commands: MKPX, MKTH

Example

The example uses the internal 50 MHz alignment signal.

```
10     OUTPUT 718;"IP;"
```

Initializes spectrum analyzer.

```
20     OUTPUT 718;"RFCALIB ON;CF 160MHZ;SP 300MHZ;RB 30KHZ;SNGLS;"
```

Turns on the internal 50 MHz signal and sets the analyzer state to view the signal.

```
30     OUTPUT 718;"RL -10DB;MKTH -80DB;MKPX 10 DB;TS;"
```

Sets up threshold, sets minimum peak excursion.

```
40     OUTPUT 718;"PEAKS TRB,TRA,FREQ?;"
```

Returns the number of peaks in trace A above the threshold.

```
50     ENTER 718;Number
```

Gets the number of peaks from the spectrum analyzer.

```
60     DISP Number
```

Displays the result on the computer screen.

```
70     FOR I=1 TO Number
```

For one to the number of peaks, do the following steps.

```
80       OUTPUT 718;"MKP TRB[";I;"]";
```

Place marker at the position of the first trace B element.

```
90       OUTPUT 718;"MKA?;"
```

Find the amplitude of the marker.

```
100      ENTER 718;A
```

```
110      OUTPUT 718;"MKF?;"
```

Find the frequency of the marker.

```
120      ENTER 718;B
```

```
130      PRINT A,B
```

Print the amplitude and the frequency of the marker.

```
140    NEXT I
```

Repeat the FOR NEXT loop for all of the peaks that were found.

```
150    END
```

Description

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

When sorting by amplitude (AMP), PEAKS first computes the amplitudes of all peaks in the source trace in measurement units, and sorts these values from high to low. The positions of the peaks are then loaded into the destination trace, with the position of the highest amplitude value occupying the first element.

For example, the following spectrum analyzer display shows several peaks:

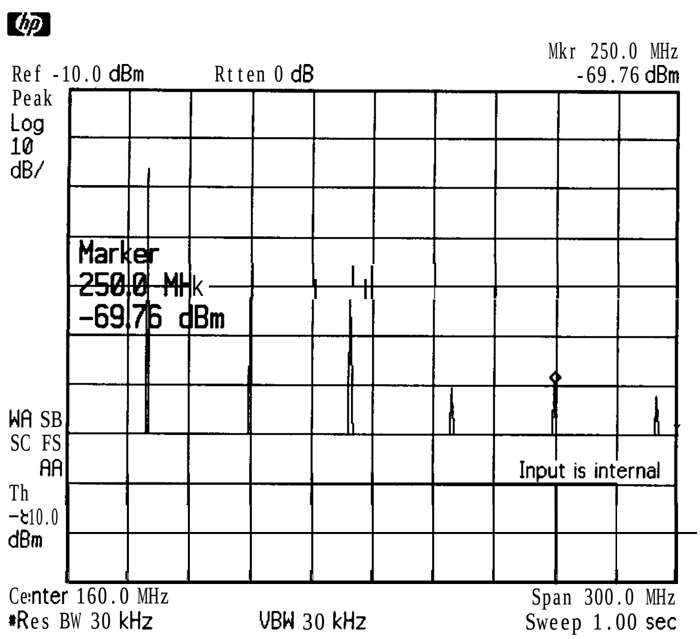


Figure 15 **Frequency and Amplitude of the Peaks**

If the FREQ parameter is used with the PEAKS command, the displayed peaks would be described by the values shown in the following table.

Trace Element	Amplitude	Frequency
TRB[1]	-25.85	4.98E+7
TRB[2]	-53.82	1.E+8
TRB[3]	-46.17	1.495E+8
TRB[4]	-68.65	2.5E+8

If the AMP parameter is used with the PEAKS command, the displayed peaks would be described by the values that are shown in the following table.

Trace Element	Amplitude	Frequency
TRB[1]	-25.85	4.98E+7
TRB[2]	–46.21	1.495E+8
TRB[3]	–53.81	1.E+8
TRB[4]	–68.24	2.5E+8

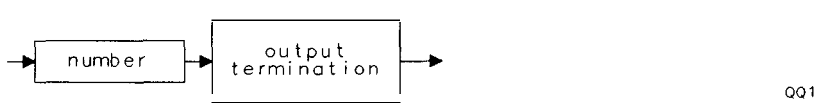
Notice that **MKA?** and MKF? are used to determine the amplitude and frequency of the peak position.

PEAKS sorts only signals that are above the threshold value. To be classified as a signal peak, a signal must be MKPX above the threshold value and it must rise and fall at least the peak excursion (MKPX value). To change the threshold, use the MKTH command before PEAKS is executed.

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

PEAKS must be used as a query. Form a query by ending the PEAKS statement with a "?." When used as a query, PEAKS returns the number of peaks found.

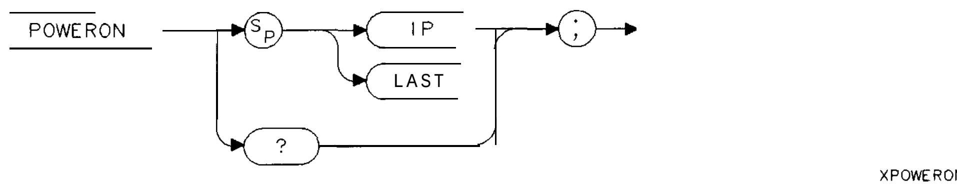
Query Response



POWERON Power-On State

Selects the state of the spectrum analyzer when the spectrum analyzer is turned on: the IP state (same state as an instrument preset command) or last state (the state the spectrum analyzer was in when the spectrum analyzer was turned off).

Syntax



Equivalent Key: **Power On IP Last**.

Example

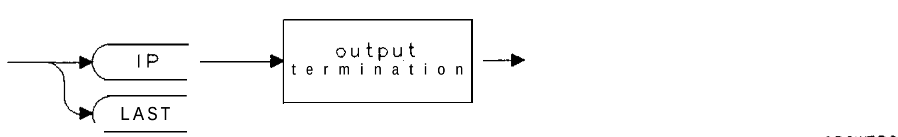
```
10 OUTPUT 718;"POWERON LAST;"
```

Description

POWERON LAST restores the last state of the spectrum analyzer. Limit line testing is not considered to be a spectrum analyzer state and is not resumed after the spectrum analyzer is turned off. The limit line table will be restored even if the spectrum analyzer is turned off, however.

NOTE: The last state of the spectrum analyzer is not retained in the case of battery power failure of the spectrum analyzer's internal battery.

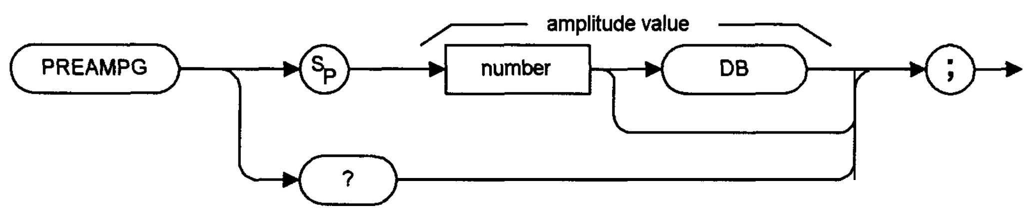
Query Response



PREAMPG External Preamplifier Gain

Subtracts a positive or negative preamplifier gain value from the displayed signal.

Syntax



XPREAMPG

Equivalent Key: **Ext Amp Gain**

Example

```
10 OUTPUT 718;"PREAMPG 10DB;"
```

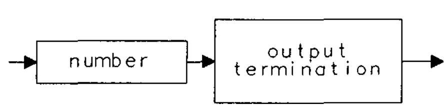
Description

Unlike using ROFFSET, PREAMPG can change the attenuation depending on the preamplifier gain entered.

A preamplifier gain offset is used for measurements that require an external preamplifier or long cables. The offset is subtracted from the amplitude readout so that the displayed signal level represents the signal level at the input of the preamplifier or long cable. The preamplifier gain offset is displayed at the top of the screen and is removed by entering zero.

NOTE: PREAMPG is not reset to 0 by an instrument preset (IP). Be sure to execute "PREAMPG 0;" when the preamplifier gain is no longer needed.

Query Response

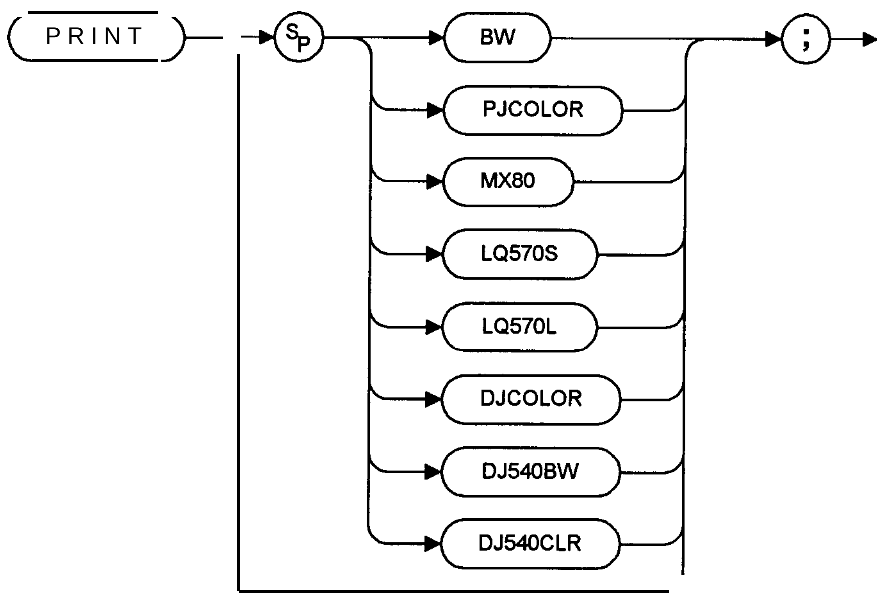


QQ1

PRINT Print

Initiates a output of the screen data to the remote interface. With appropriate commands, the data can be routed to an external printer.

Syntax



XPRINT

Equivalent Key: **Printer.**
Related Commands: GETPRNT, PLOT.

Example for the HP-IB Interface

The printer usually resides at address 1. (The program is only valid for HP 9000 Series 200 and 300 computers and HP Vectra personal computer with an HP raster graphics printer, such as the HP ThinkJet.)

This example illustrates how an external controller can initiate the sending of print data to an external printer.

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

Sends data to printer.

NOTE: To print without disconnecting the computer, you must execute the following BASIC commands: **ABORT 7 LOCAL 7.** Then press **Print**.

Description

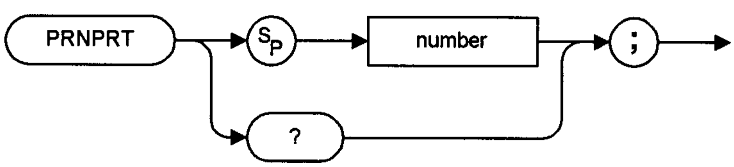
The data is output in HP raster graphics format. PRINT, PRINT 0, or PRINT BW produces a monochrome printout. PRINT 1 and PRINT PJCOLOR produces a "color format" output for an HP PaintJet printer. Execute "MENU 0;" before printing to blank the softkeys.

To send printer data to a parallel printer, see the GETPRNT command.

PRNPRT Printer Port

Selects which port to output printer data from the analyzer. (Option 1AX or Option A4H)

Syntax



XPRNPRT

Equivalent Key: **Port.**
Related Commands: PRINT. GETPRINT, PARSTAT, PLTPRT

Example

```
10 OUTPUT 718;"PRNPRT 4;"
```

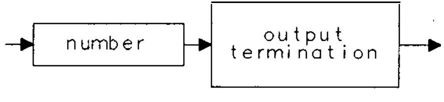
Routes the print information to the serial port for Option 1AX.

Description

PRNPRT 0 = HP-IB port of Option A4H
PRNPRT 3 = serial port of Option 1AX
PRNPRT 4 = parallel port of Option A4H
PRNPRT 4 = parallel port of Option 1AX

NOTE: Setting the PRNPRT to a port inconsistent with the installed hardware option is ignored, so executing PRNPRT 3 on an HP-IB equipped analyzer is ignored.

Query Response

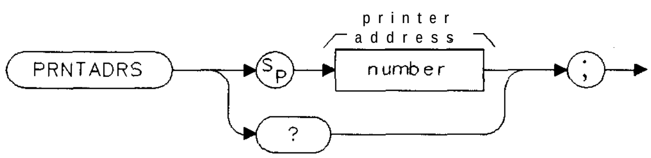


QQ1

PRNTADRS Printer Address

Sets the HP-IB address of the printer.

Syntax



XPRNTADRS

Item	Description/Default	Range
Number	Any valid integer number	0 to 30

Equivalent Key: **Printer Addr**
Option Required: Option A4H

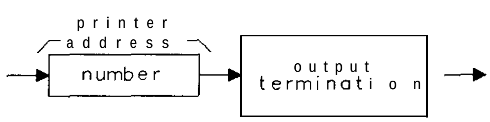
Example

```
20 OUTPUT 718;"PRNTADRS 1;"
```

Sets the HP-IB address of the printer to 1.

Query Response

PRNTADRS? returns the current HP-IB address of the printer.

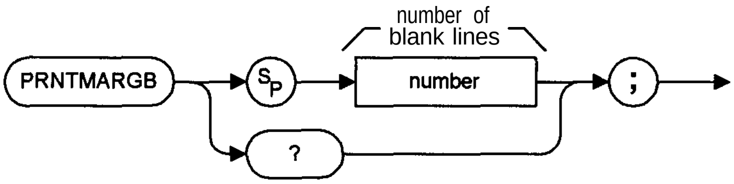


QPRNTADRS

PRNTMARGB Printer Margin Bottom

Allows you to set the printer's bottom margin when using a user defined printer.

Syntax



XPRNTMRB

Item	Description/Default	Range
Number	Any valid integer number	0 to 3000

Equivalent Key: **Bottom Margin**.
Option Required: Option 1AX or A4H.

Example

```
20 OUTPUT 718;"PRNTMARGB 10;"
```

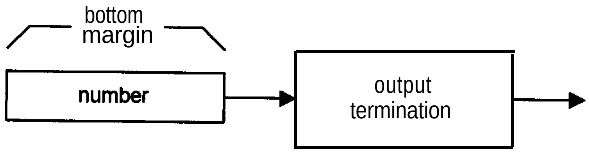
Sets the user defined printer bottom margin to 10 blank raster lines.

Description

When specifying a user defined printer, the bottom margin can be set using the PRNTMARGB command. It is set in terms of blank raster lines. The equivalent height, in cm, varies depending on the printer resolution.

Query Response

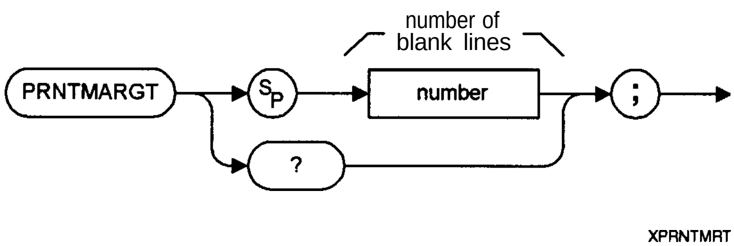
The PRNTMARGB command returns the number of lines in the current bottom margin of the user defined printer.


bottom
margin
number
output
termination

PRNTMARGT Printer Margin Top

Allows you to set the printer's top margin when using a user defined printer.

Syntax



Item	Description/Default	Range
Number	Any valid integer number	0 to 3000

Equivalent Key: **Top Margin**.
Option Required: Option 1AX, A4H.

Example

```
20 OUTPUT 718;"PRNTMARGT 10;"
```

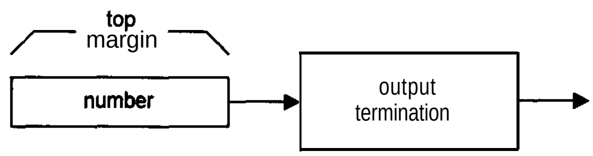
Sets the user defined printer top margin to 10 blank raster lines.

Description

When specifying a user defined printer, the top margin can be set using the PRNTMARGT command. It is set in terms of blank raster lines. The equivalent height, in cm, varies depending on the printer resolution.

Query Response

The PRNTMARGT command returns the number of lines in the current top margin of the user defined printer.

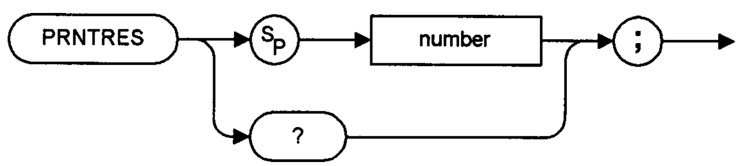


QPRNTMRT

PRNTRES Printer Resolution

Allows you to set the printer resolution when using a user defined printer.

Syntax



XPRNTRES

Item	Description/Default	Range
Number	Any valid integer number	75 to 2600

Equivalent Key: **Resolution**.
Option Required: Option 1 AX, A4H.

Example

```
20 OUTPUT 718;"PRNTRES 75;"
```

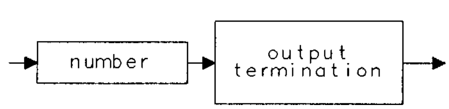
Sets the user defined printer resolution to 75.

Description

When specifying a user defined printer, the resolution can be set using the PRNTRES command. Set the value appropriate for your printer. Typical values might be 75, 100,300. Decreasing the value of the printer resolution will increase the size of the printed image.

Query Response

The PRNTRES command returns the resolution of the user defined printer.

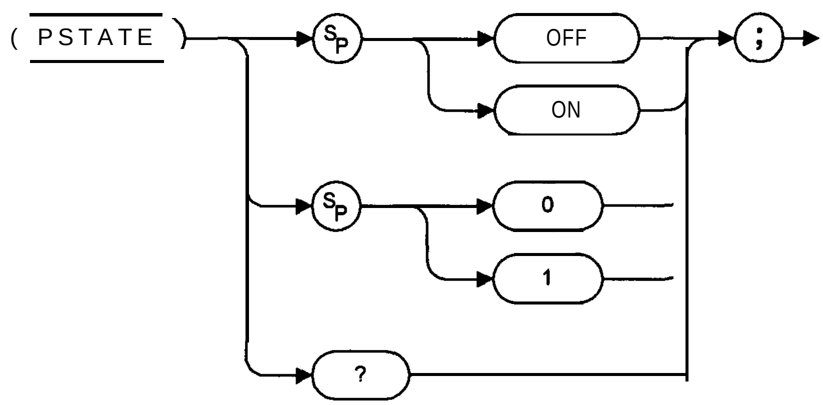


QQ1

PSTATE Protect State

Protects all of the spectrum analyzer's user state and trace registers from being changed.

Syntax



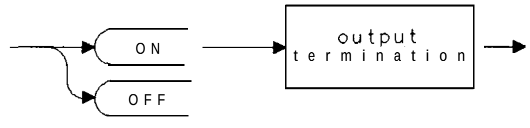
XPSTATE

Equivalent Key: **Internal Lock On Off**
Related Commands: ERASE, DELETE, SAVE, LOAD

Example

```
10 OUTPUT 718;"PSTATE ON;"
```

Query Response

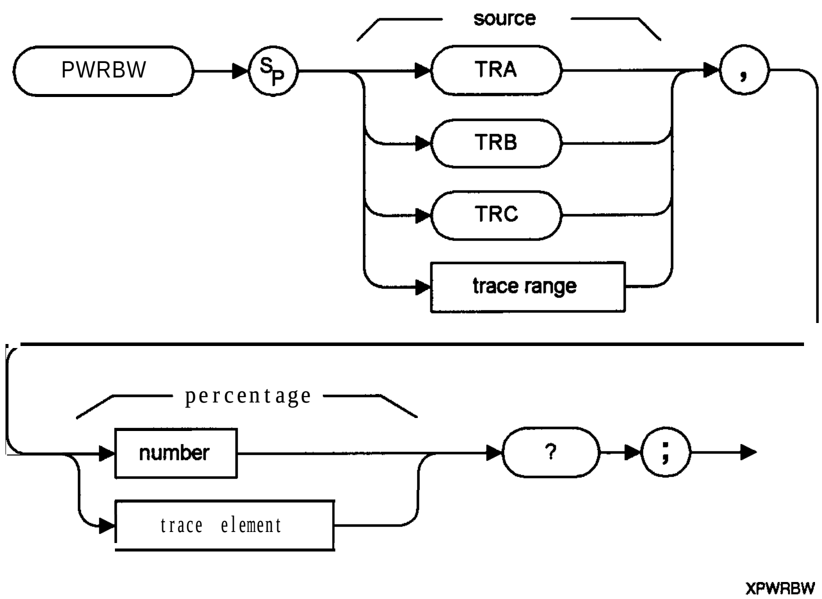


QQ2

PWRBW Power Bandwidth

Computes the bandwidth around the trace center, which includes signals whose total power is a specified percentage of the total trace signal power.

Syntax



Item	Description/Default	Range
Trace range	A segment of trace A, trace B, trace C	
Trace element	An element of trace A, trace B, trace C	
Number	Any real or integer number	0 to 100

Parameter Values: The field used for the percentage must be a value between 0 and 100.

Prerequisite Commands: TS when using trace data.
Related Commands: RB, SP.

Example

```
10 OUTPUT 718;"IP;"
```

Initializes spectrum analyzer.

```
20 PAUSE
```

```
30 DISP "TURN ON THE 50 MHz OSCILLATOR"
```

Displays a user prompt.

```
40 OUTPUT 718;"SNGLS;"
```

Activates single-sweep mode.

```
50 OUTPUT 718;"CF 50MHZ;SP lMHZ;RB 300KHZ;"
```

Changes center frequency, span, and bandwidth.

```
60 OUTPUT 718;"MXMH TRA;TS;TS;TS;TS;"
```

Activates the maximum hold of trace A, sweep 4 times.

```
70 OUTPUT 718;"PWRBW TRA, 99.0;"
```

Returns the 99% power bandwidth.

```
80 ENTER 718;P
```

Gets the result from the spectrum analyzer.

```
90 DISP "THE POWER BANDWIDTH AT 99 PERCENT IS";P/1.0E+3;"kHz"
```

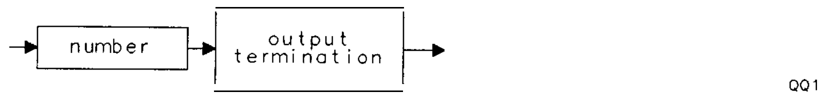
Displays the frequency of the power bandwidth specified on the computer screen.

Description

If trace A is the source, a delta marker is set at the start and stop frequencies.

If 100% is specified, the power bandwidth equals the frequency range of the screen display. If 50% is specified, trace elements are eliminated from either end of the array, until the combined power of the remaining signal responses equals half of the original power computed. The frequency span of these remaining trace elements is the power bandwidth returned.

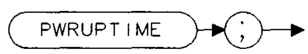
Query Response



PWRUPTIME Power Up Time

Returns the number of milliseconds that have elapsed since the spectrum analyzer was turned on.

Syntax



XPWRUPTIME

Example

`10 OUTPUT 718;"PWRUPTIME;"`

Executes PWRUPTIME.

`20 ENTER 718;A`

Places the result of PWRUPTIME into A.

`30 A = A/1000`

Changes the milliseconds to seconds.

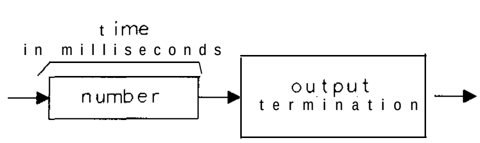
`40 PRINT "Minutes elapsed ",A/60`

Prints the number of minutes that have elapsed since the spectrum analyzer was turned on.

Description

PWRUPTIME can count the number of milliseconds for up to 2^{32} milliseconds (2^{32} milliseconds is equivalent to 49.7 days). If the spectrum analyzer is left on for more than 49.7 days, PWRUPTIME is reset to 0 and restarts the count.

Query Response

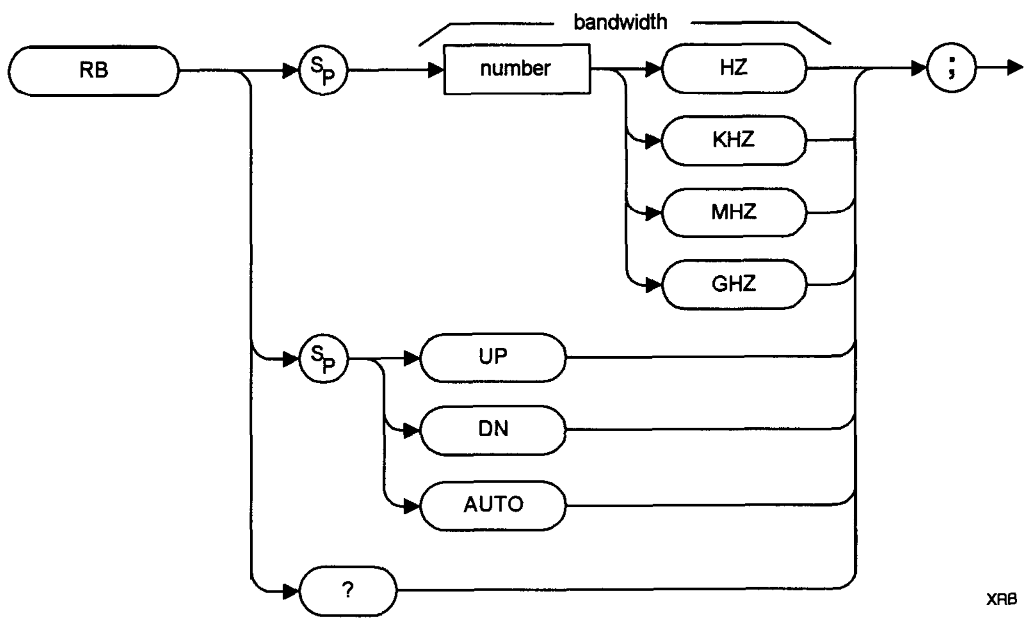


QPWRUPTIME

RB Resolution Bandwidth

Specifies the resolution bandwidth.

Syntax



Item	Description/Default	Range
Number	Any real or integer number. Default unit is Hz.	1 kHz to 3 MHz

Equivalent Key: **Resolution BW Auto Man**.
Preset State: 3 MHz.
Step Increment: In a 1, 3, 10.
Related Commands: AUTO, SP, ST, VB, VBR.

Example

```
10 OUTPUT 718;"RB 1KHZ;"
```

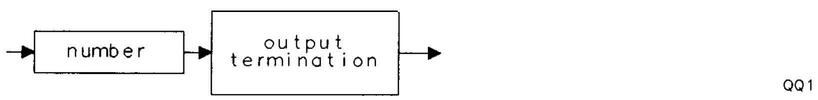
Sets the resolution bandwidth to 1 kHz.

Description

The coupling between sweep time and resolution bandwidth is terminated by this command. Execute RB AUTO to reestablish coupling. (Also see "AUTO.")

The front-panel knob, step increment keys, and auto-coupled settings provide a 1, 3, 10 resolution bandwidth sequence only. Frequencies are rounded to the nearest value in the 1, 3, 10 sequence.

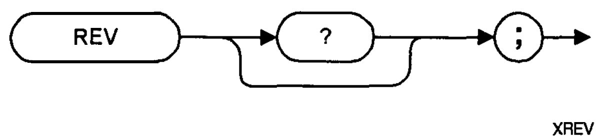
Query Response



REV Revision

Returns the date code of the firmware revision date in YYYYMMDD format (for example, 199709 10 indicates 10 September 1997).

Syntax



Equivalent Key: **Show Config** displays the firmware revision date
Related Commands: ID, SER, SHOWSYS, TIMEDATE

Example

10 OUTPUT 718;"REV;"

Gets the firmware revision date of spectrum analyzer.

20 ENTER 718;A

Puts the spectrum analyzer response in the computer variable, A.

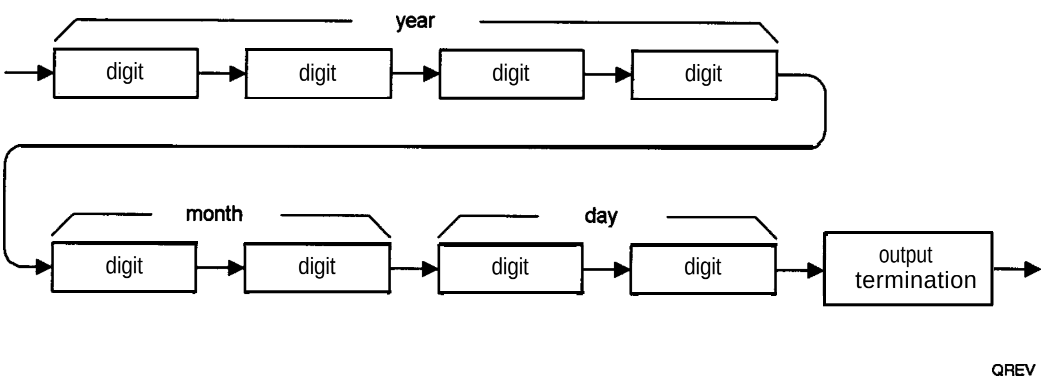
30 DISP A

Displays the firmware revision date on the computer screen.

Description

The date of the firmware revision also appears when the instrument is first turned on.

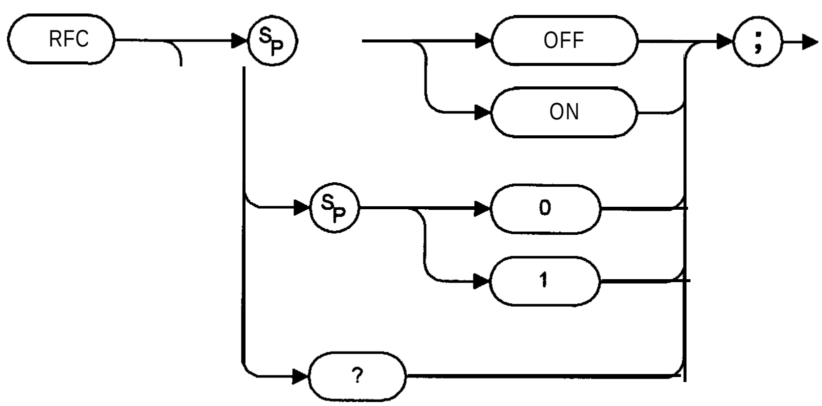
Query Response



RFCALIB 50 MHz Signal

Turns on or off the internal 50 MHz alignment signal.

Syntax



XRFCALIB

Equivalent Command: 50 **MHz osc On Off**
Preset State: 50 MHz osc Off

Example

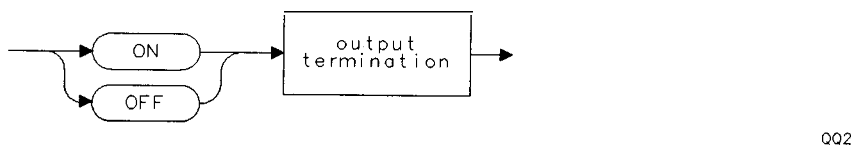
```
10 OUTPUT 718;"RFCALIB OFF;"
```

Description

With the RFCALIB command on, a 50 MHz alignment signal is routed through internal circuitry to the analyzer's RF input and the front panel RF INPUT connector is disconnected.

NOTE: The impedance match with the device under test (DUT) varies as the internal alignment signal is switched in and out. When the internal signal is on, the RF INPUT port is switched off presenting a high impedance to the DUT.

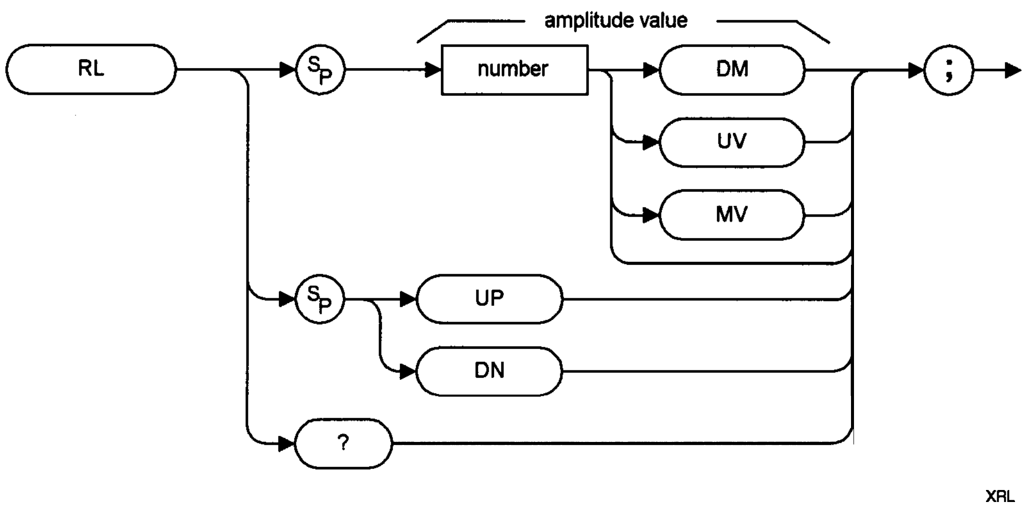
Query Response



RL Reference Level

Specifies the amplitude value of the reference level.

Syntax



Item	Description/Default	Range
Number	Any real or integer number. Default unit is the current amplitude unit.	Amplitude range of the spectrum analyzer

Equivalent Key: **Ref Level**
Preset State: 0 dBm
Step Increment: by 10 dBm
Related Commands: AT, MKRL, ML

Example

`10 OUTPUT 718;"IP;SNGLS;CF 300MHZ;SP 20MHZ;"`

Initializes spectrum analyzer, activates single-sweep mode, changes center frequency, span.

`20 OUTPUT 718;"TS;MKPK HI;MKRL;TS;"`

Takes sweep, places marker on signal peak, sets ref level to marker level.

```
30 OUTPUT 718;"RL?;"
```

Queries reference level.

```
40 ENTER 718;Ref_level
```

Puts the spectrum analyzer response in the computer variable, Ref_level.

```
50 PRINT "REFERENCE LEVEL IS",Ref_level,"DM"
60 END
```

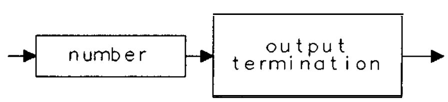
Description

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.

RL may affect the attenuation value.

Query Response

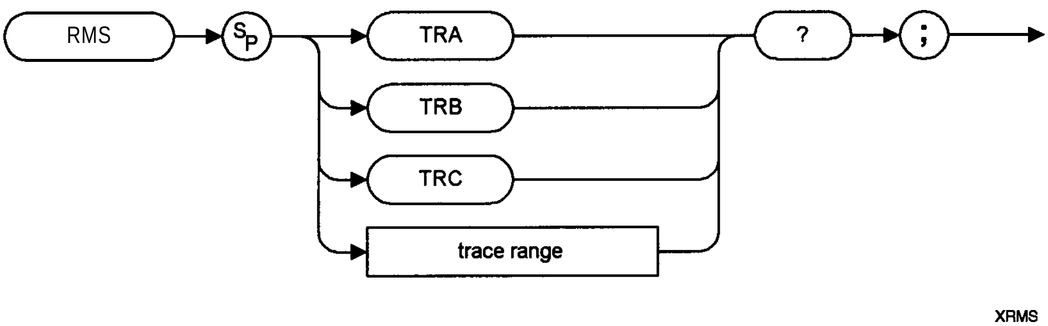


QQ1

RMS Root Mean Square Value

Returns the root mean square value of the trace in measurement units.

Syntax



Item	Description/Default	Range
Trace range	A segment of trace A, trace B, trace C	

Prerequisite Commands: TS when using trace data.
Related Commands: MEAN, STDEV, VARIANCE.

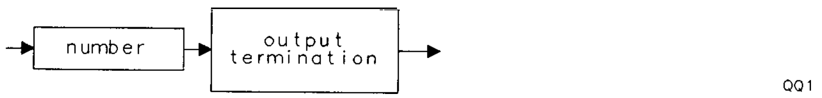
Example

```
10 OUTPUT 718;"IP;SNGLS;TS;"
20 OUTPUT 718;"RMS TRA?;"
30 ENTER 718;Number
40 DISP Number
```

Description

Trace data, user-defined trace data, and trace range data are treated as 16-bit integers.

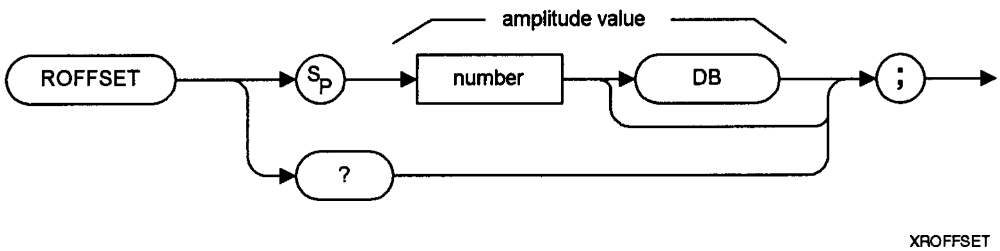
Query Response



ROFFSET Reference Level Offset

Offsets all amplitude readouts without affecting the trace.

Syntax



Item	Description/Default	Range
Number	Any real or integer number. Default unit is dB.	−200 dB to +200 dB

Equivalent Key: Ref **Lev Offst**.
Preset State: 0 dB.
Related Commands: AT, RL.

Example

```
10 OUTPUT 718;"IP;"
```

Initializes spectrum analyzer.

```
20 OUTPUT 718;"RL −20DB;"
```

Changes the reference level.

```
30 OUTPUT 718;"ROFFSET -10;"
```

Changes spectrum analyzer reference offset value.

```
40 OUTPUT 718;"RL?;"
```

Gets the reference value from spectrum analyzer.

```
50 ENTER 718;Ref
```

Puts the spectrum analyzer response in the computer variable, Ref.

```
60 DISP "THE NEW REFERENCE LEVEL IS ",Ref
```

Displays -30 as the new reference level.

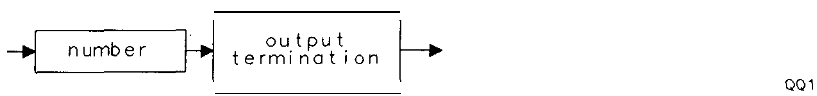
```
70 END
```

Description

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 or presetting the spectrum analyzer eliminates an amplitude offset.

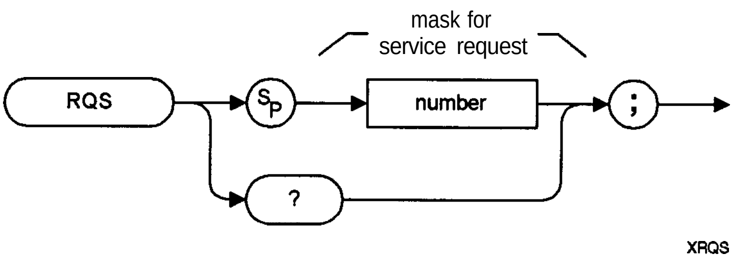
Query Response



RQS Service Request Mask

Sets a bit mask for service requests (see "SRQ").

Syntax



Item	Description/Default	Range
Number	Any valid integer	0 to 63

Related Commands: SRQ, STB
Preset State: 41

Example

```
10 OUTPUT 718;"RQS 12;"
```

Sends a mask bit for hardware broken and end of sweep.

Description

Assignment of values for the mask is as follows:

32 = Illegal command (bit 5)
16 = Command complete (bit 4)
8 = Hardware broken (bit 3)
4 = End of sweep (bit 2)
2 = Units key pressed (bit 1)
1 = Operator notification (bit 0)

As shown in the example, a mask with hardware broken and end of sweep is equal to 12 (8 + 4). The mask also disables command complete, illegal command, units key pressed, and operator notification interrupts.

To activate all conditions in the mask, the mask value is equal to 63 (32 + 16 + 8 + 4 + 2 + 1). To set the service request mask for all conditions, execute **OUTPUT 718;"RQS 63;".**

Each bit in the status byte is defined as follows:

0 Indicates that an operator notification has occurred. SRQ **S** appears on the analyzer screen. Operator notification occurs if an overload is detected on the analyzer RF input, if excessive reverse power is detected on the RF output (options IDN or 1DQ only), or if the tracking generator becomes unleveled (options 1DN or 1DQ only.)

1 Indicates that the units key was pressed. SRQ **S** appears on the spectrum 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. SRQ **S** appears on the spectrum analyzer screen. If you send any RQS value that contains mask value 4, another sweep will be taken.

3 Indicates broken hardware. SRQ **S** appears on the spectrum 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 spectrum analyzer command was used. SRQ **S** appears on the spectrum analyzer screen.

0 (LSB), 6, and 7 are not used.

A service request is generated only if the proper request mask bit has been set, and either the condition itself or the Force Service Request (see "SRQ") is sent. To set the request mask, choose the desired interrupt conditions and sum their assigned values. Executing the RQS command with this value sets the bit mask. After setting the bit mask, only the chosen conditions can produce an interrupt. Generally, you must set the bit mask using the RQS command. However, the "hardware broken", "operator notification" and "illegal remote command" conditions are automatically enabled after presetting or sending the IP command. Pressing **Preset** or sending the IP command, then, produces the same interrupt bit mask as sending "RQS 41;" (decimal 41 is the sum of the assigned values of these three interrupt bits, 32 = Bit 5, 8 = Bit 3, and 1 = Bit 0).

For most conditions, the RQS mask bit stays set until the next IP or RQS command is executed. The only condition in which this does not apply is the Units Key Pressed bit. When this bit (bit 1) is set in the RQS mask, a Units Key Pressed interrupt occurs if EE (enable entry mode) is executed and a front-panel units key such as Hz, kHz, MHz, or GHz is pressed.

When a units key is pressed, the interrupt occurs and the Units Key Pressed bit in the RQS mask is reset. To re-enable the Units Key Pressed interrupt, you must send a new RQS mask.

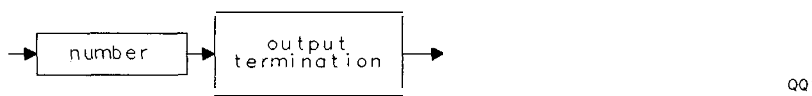
Use SRQ to Check for an Overpower Condition at the Input

The analyzer checks for an overpower condition at the input. It may respond to an overload by changing the attenuation setting or by switching out the input. This can cause misleading results in a measurement. The status bit should be monitored for this condition to avoid incorrect measurement results. See the following error message descriptions for more details about these conditions:

Atten auto set to 15 dB

Overload: Reduce Signal

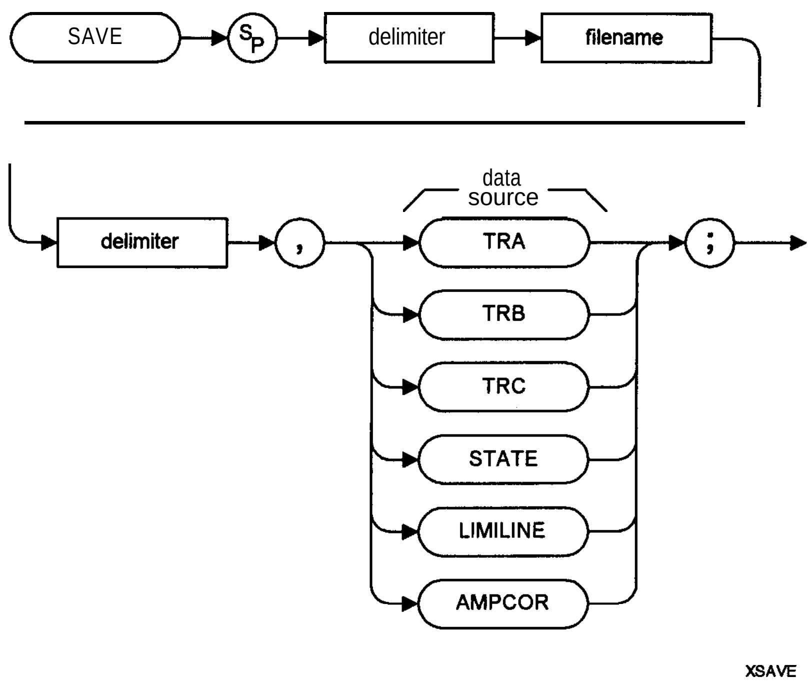
Query Response



SAVE Save File

Specifies the file to be saved in memory.

Syntax



Item	Description/Default	Range
Delimiter	Matching characters marking the beginning and end of the filename	I\@ ^ $%;!
Filename	See the file naming rules below	

Related Commands: LOAD, DELETE, PSTATE

File Naming Rules

File names for storing states, traces, limit lines or amplitude correction data files should follow the conventions as indicated below:

- They can be up to eight characters long. In addition, they can have a tile extension up to three characters long. The analyzer assigns the extension.
- They are not case sensitive. It does not matter whether you use upper case or lower case letters when you type them.
- They can contain only the letters A through Z, the number 0 through 9, and the following special characters. No other characters are valid.

Character	Description
	underscore
^	carat
$	dollar sign
~	tilde
!	exclamation point
#	number sign
%	percent sign
&	ampersand
-	hyphen
{ }	braces
@	at sign
‘	single quotation mark
’	apostrophe
0	parenthesis

- They cannot contain spaces, commas, backslashes, or periods. (except the period that separates the name from the extension.)
- They cannot be identical to the name of another file in the same directory.

Example

```
10 OUTPUT 718;"SAVE %MYSTATE%,STATE;"
```

Saves analyzer state data in a file named MYSTATE.STA.

Description

The SAVE command is used to save files in analyzer memory. There are several different types of file data. The type of data saved, and its corresponding data source, are shown in the following table.The data source must be specified when the command is sent. The analyzer will attach the appropriate file extension to the filename you supplied.

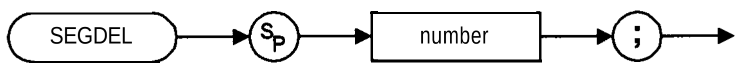
Some of the characters that are available to use as delimiters are also allowed in the file name. Do not use the same character for the delimiters as you intend to use in the file name, since the analyzer will interpret the character as the end delimiter, rather than a part of the file name. Do not use any of the common characters twice in the file name, as the analyzer will interpret them as delimiters.

Data Source	Type of Data Transferred	File Extension
TRA	Trace A	.TRC
TRB	Trace B	.TRC
TRC	Trace C.	.TRC
STATE	Instrument state	.STA
LIMILINE	Limit lines	.LIM
AMPCOR	Amplitude correction factors	.AMP

SEGDEL Segment Delete

Deletes the specified segment from the limit line tables.

Syntax



XSEGDEL

Related Commands: LIMIHALF, LIMISEG, LIMISEGT

Example 1

This example uses LIMIHALF for entering segments into the upper limit line table, then entering a segment into the lower limit line table (upper and lower limit lines are treated as separate tables).

```
10 OUTPUT 718;"LIMIDEL;"
```

Deletes the current limit line table, sets the table type to fixed.

```
20 OUTPUT 718;"LIMIHALF UPPER;"
```

Specifies the upper limit line table.

```
25 OUTPUT 718;"LIMIFT FREQ;"
```

Limit lines to be based on frequency.

```
30 OUTPUT 718;"LIMISEG 300MHZ,-30DB,FLAT;"
```

Enters a segment into the upper limit line table.

```
40 OUTPUT 718;"LIMIHALF LOWER;"
```

Specifies the lower limit line table.

```
50 OUTPUT 718;"LIMISEG 300MHZ,-70DB,FLAT;"
```

Enters a segment into the lower limit line table.

```
60 OUTPUT 718;"SEGDEL 1;"
```

Deletes the segment from the lower limit line table.

Description

The result of SEGDEL depends on the setting of the LIMIHALF command as shown in the following table.

LIMIHALF Setting	Result of SEGDEL
LIMIHALF LOWER	Deletes specified segment from the lower limit line table.
LIMIHALF UPLOW	Deletes specified segment from the upper and lower limit line table.

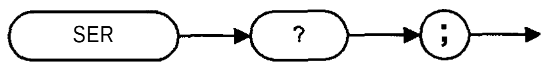
You may want to query LIMIHALF before using SEGDEL if you are unsure of the LIMIHALF setting.

To determine the number of each segment, you can use the softkeys accessed by **Edit Limit** to display the limit line table. Limit line entries are sorted according to frequency or time.

SER Serial Number

Returns the serial number of the spectrum analyzer.

Syntax



XSER

Related Commands: ID, REV, SHOWSYS

Example

10 DIM Serial$[24]

Displays the serial number on the analyzer display.

20 OUTPUT 718;"SER?;"

Gets the serial number from the spectrum analyzer.

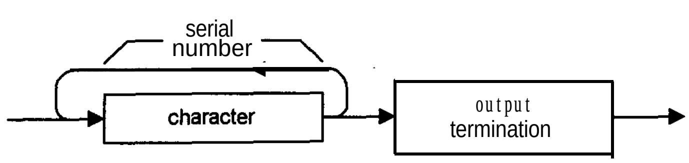
30 ENTER 718;Serial$

Puts the spectrum analyzer response in the computer variable.

40 PRINT Serial$

Prints the serial number.

Query Response

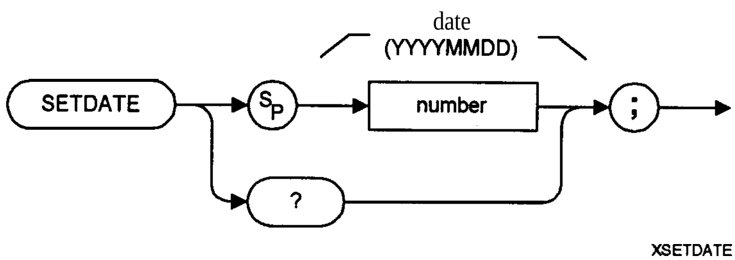


QSER

SETDATE Set Date

Allows you to set the date of the real-time clock of the spectrum analyzer.

Syntax



Item	Description/Default	Range
Number	A number in the YYYYMMDD format	Valid year, month, and day

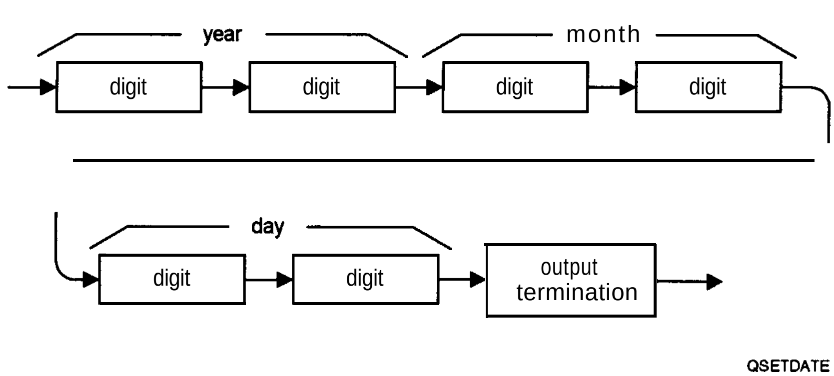
Equivalent Key: Set **Date**.
Related Commands: SETTIME, TIMEDATE, TIMEDSP.

Example

```
10 OUTPUT 718;"SETDATE 890212;"
```

Sets the date to February 12, 1989.

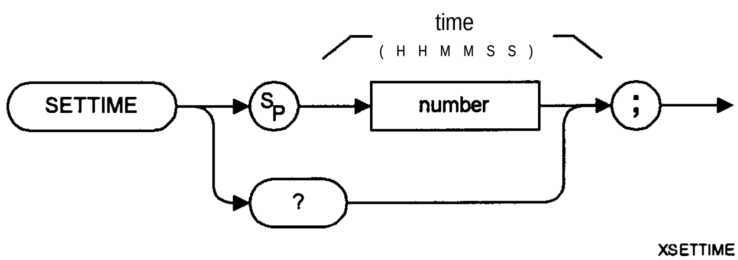
Query Response



SETTIME Set Time

Allows you to set the time of the real-time clock of the spectrum analyzer.

Syntax



Item	Description/Default	Range
Number	A number in the HHMMSS (24 hour) format	0 to 235959

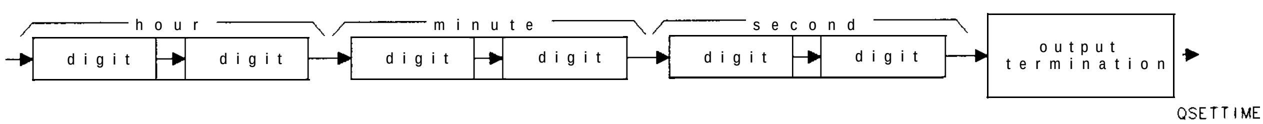
Equivalent Key: **Set Time**.
Related Commands: SETDATE, TIMEDATE, TIMEDSP.

Example

```
10 OUTPUT 718;"SETTIME 135501;"
```

Sets the time to 1:55:01 P.M.

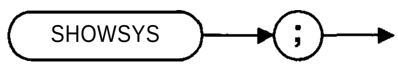
Query Response



SHOWSYS Show System

Shows the system configuration on the spectrum analyzer display.

Syntax



XSHOWSYS

Equivalent Key: Show System
Related Commands: ID, SER, REV

Example

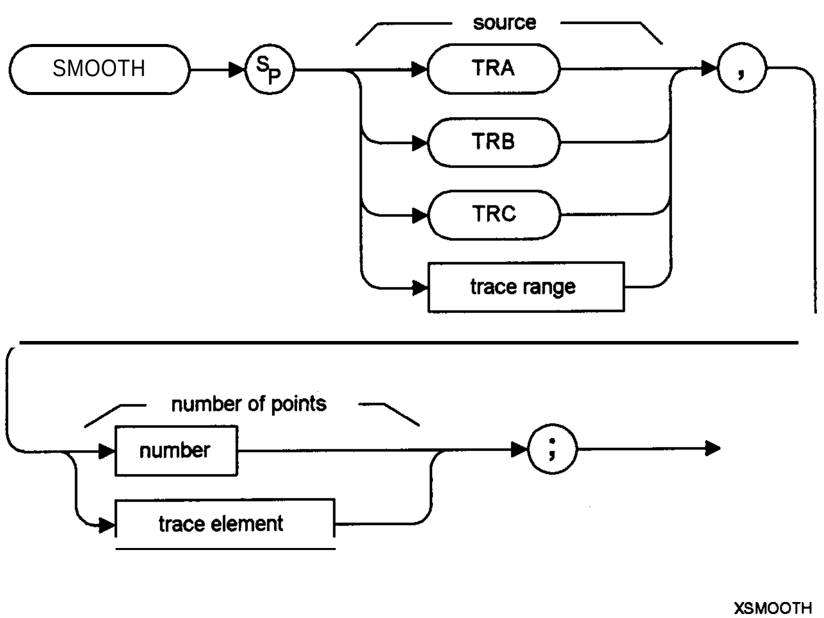
```
10 OUTPUT 718;"SHOWSYS;"
```

Displays the system configuration on the analyzer display.

SMOOTH Smooth Trace

Smooths the trace according to the number of points specified for the running average.

Syntax



Item	Description/Default	Range
Trace range	A segment of trace A, trace B, trace C	
Number	Any real or integer number	Real number range
Trace element	An element of trace A, trace B, trace C	

Prerequisite Commands: TS when using trace data.
Related Commands: SNGLS, TS, VAVG.

Example

`10 OUTPUT 718;"IP;"`

Initializes spectrum analyzer.

`20 OUTPUT 718;"SNGLS;TS;"`

Activates single-sweep mode, takes a sweep.

`30 OUTPUT 718;"VIEW TRA;"`

Stores results of trace A.

`40 OUTPUT 718;"SMOOTH TRA,10;"`

Smooths trace A.

`50 OUTPUT 718;"VIEW TRA;"`

Displays the result.

`60 END`

Description

Each point value is replaced with the average of the values (in measurement units) of the given number of points centered on it. Increasing the number of points increases smoothing at the cost of decreasing resolution. If the number of points is an even number, then the number of points is increased by one. If the number of points is larger than the size of SOURCE, then the size of SOURCE is used (unless size of SOURCE is even, in which case the size of SOURCE minus one is used). Smoothing decreases at the endpoints.

The purpose of this function is to perform a spatial video averaging as compared to the temporal version supplied by the video-average (VAVG) command. The functions of SMOOTH and VAVG are not interchangeable however. Unlike VAVG, SMOOTH averages values that occur before and after the data point in time. This can cause some display irregularities at the start and stop frequencies. Use low values for the SMOOTH parameter to avoid signal distortion.

By replacing the value of each point in a trace with the average of the values of a number of points centered about that point, any rapid variations in video noise or signals are smoothed into more gradual variations. It thereby performs a function similar to reducing the video bandwidth without the corresponding changes in sweep time. As such, it does result in a reduction of frequency resolution. Also, signal peaks are reduced with large smoothing values, and this can cause the amplitude to appear to be low.

This command requires user memory for its execution. Memory is not permanently allocated, so the largest amount of memory is available for the functions that are used in a particular application. When the command is complete, memory is returned to the free user memory.

SNGLS Single Sweep

Sets the spectrum analyzer to single-sweep mode.

Syntax

XSNGLS

Equivalent Keys: **Single Sweep** or **Sweep Cont Single** (Single is underlined).
Related Commands: CLRW, CONTS, TM, TS.

Example

```
10 OUTPUT 718;"SNGLS;"
```

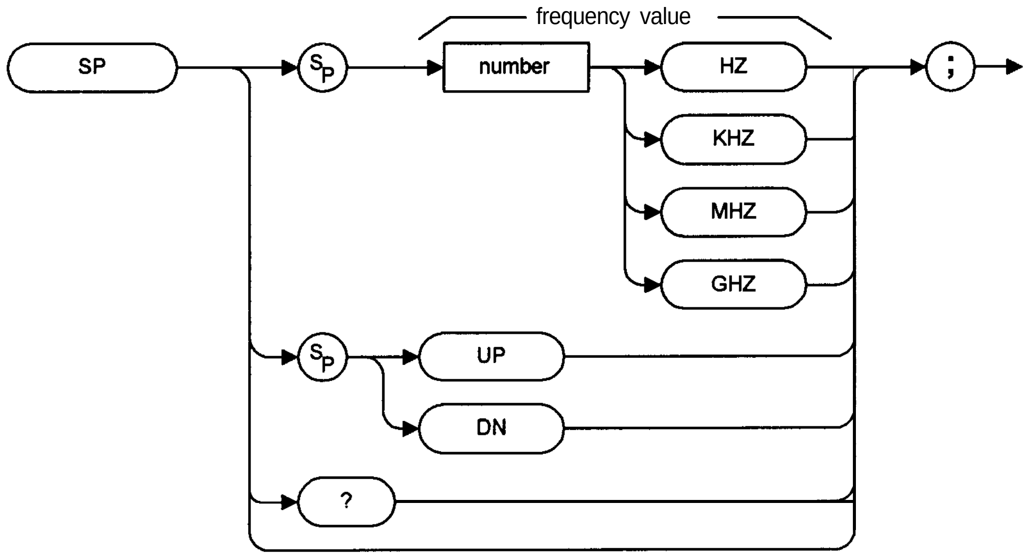
Description

Each time TS (take sweep) is sent, one sweep is initiated, as long as the trigger and data entry conditions are met.

SP Span

Changes the total displayed frequency range symmetrically about the center frequency.

Syntax



XSP

Item	Description/Default	Range
Number	Any real or integer number. Default unit is Hz.	Frequency span of the spectrum analyzer

Equivalent Key: **Span**
Step Increment: 1, 2, 5, 10 sequence (up to the stop frequency of the spectrum analyzer)
Related Commands: CF, FA, FB, FOFFSET, FS, RB, ST, VB

Example

```
10 OUTPUT 718;"IP;SP 20MHZ;"
```

Initializes spectrum analyzer, changes frequency span.

```
20 OUTPUT 718;"SP?;"
```

Gets the span value from the spectrum analyzer.

```
30 ENTER 718;Span
```

Puts the spectrum analyzer response in the computer variable, Span.

```
40 PRINT Span
```

Displays the span value.

Description

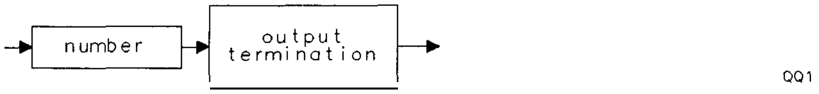
The frequency span readout refers to the displayed frequency range. Dividing the readout by 10 yields the frequency span per division.

If resolution and video bandwidths are coupled to the span width, 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.

Because span is affected by frequency, change the frequency before changing span.

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

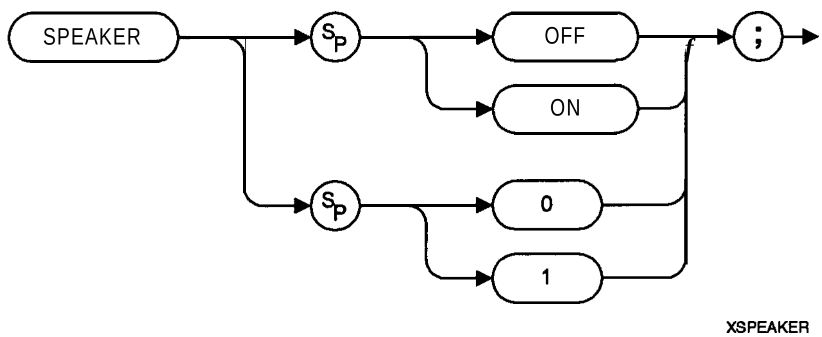
Query Response



SPEAKER Speaker

Turns on or off the internal speaker.

Syntax



Preset State: SPEAKER ON
Related Commands: DEMOD

Example

```
10 OUTPUT 718;"SPEAKER OFF;"
```

SPZOOM Span Zoom

Places a marker on the highest on-screen signal (if an on-screen marker is not present), turns on the signal track function, and activates the span function.

Syntax

XSPZOOM

Equivalent Key: **Span Zoom**.

Example

```
10 OUTPUT 718;"IP;CF 300MZ;TS;"
20 OUTPUT 718;"SPZOOM;"
```

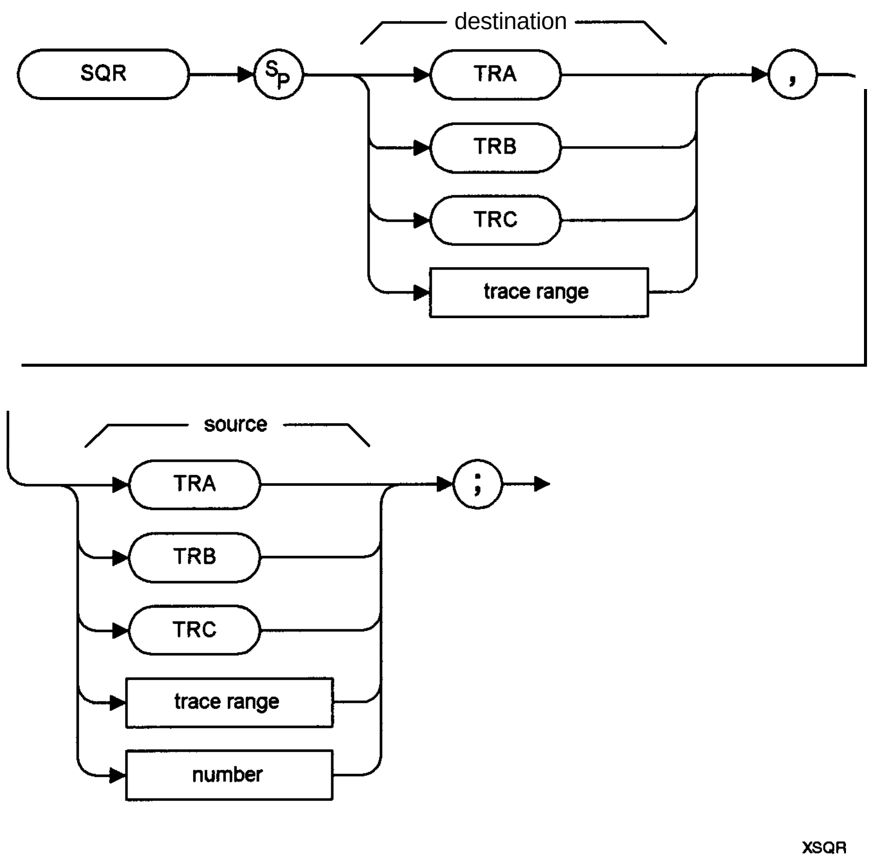
Description

If a marker is present before SPZOOM is executed, SPZOOM turns on the signal track function and activates the span function.

SQR Square Root

Places the square root of the source into the destination.

Syntax



Item	Description/Default	Range
Trace range	A segment of trace A, trace B, trace C	
Number	Any real or integer number	Real number range

Prerequisite Commands: TS when using trace data
Related Commands: STDEV

Example

```
10 OUTPUT 718;"SQR SP,1E8;"
```

Changes the span to 10 kHz.

Description

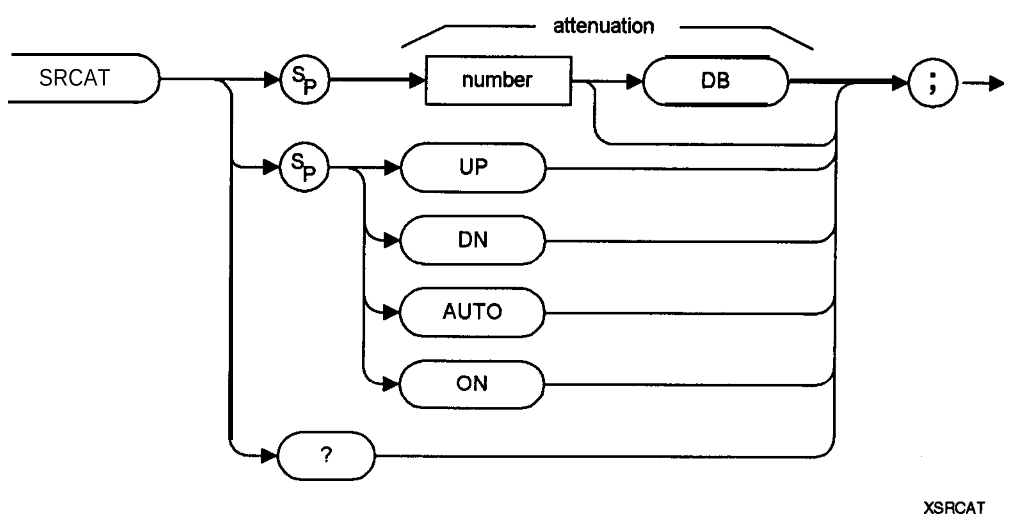
If the source is negative, the square root of the absolute value will be returned.

When the source is longer than the destination, the source is truncated to fit. When the source is shorter than the destination, the last element is repeated to fill the destination.

SRCAT Source Attenuator

Attenuates the source output level.

Syntax



Item	Description/Default	Range
Number	Any real or integer number, specified in multiples of 10 dB	0 to 60 dB

Equivalent Key: **Attenuation Auto Man**
Option Required: Option 1DN or 1DQ
Coupling: Coupled to power level of the source output (SRCPWR) when set to auto (SRCAT AUTO)
Related Commands: SRCPSTP
Preset State: SRCAT AUTO

Example

The following example uses the SRCAT command to attenuate the source output.

```
10 OUTPUT 718;"SRCAT AUTO;"
```

Activates source-attenuation coupling.

```
20 OUTPUT 718;"SRCPWR -20DB;"
```

Activates source output.

```
30 OUTPUT 718;"SRCAT 20DB;"
```

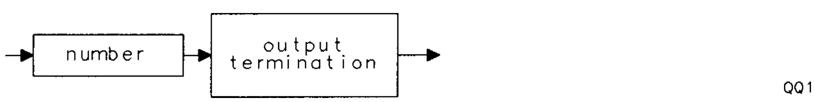
Sets attenuator to 20 dB. This de-couples the attenuator from the source power-level setting.

Description

The SRCAT command attenuates the output level of the source. Use SRCAT to attenuate the power level of the source manually, from 0 to 60 dB in 10 dB steps.

"SRCAT AUTO;" automatically adjusts the attenuator to yield the source amplitude level specified by the SRCPWR command.

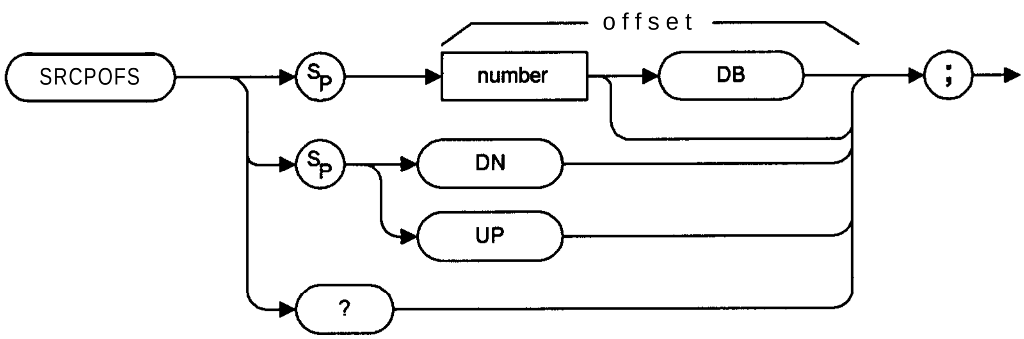
Query Response



SRCPOFS Source Power Offset

Offsets the source power level readout.

Syntax



XSRCPOFS

Item	Description/Default	Range
Number	Any real or integer number	

Option Required: Option 1DN or 1DQ.
Equivalent Key: **Amptd Offset**.
Related Commands: SRCPWR, SRCPSWP.
Step Increment: Determined by SRCPSTP.
Preset State: 0 dB.

Example

Use SRCPOFS to offset the power-level readout for the tracking-generator source.

```
20 OUTPUT 718;"SRCPWR -10DB;"
```

Turns on source output.

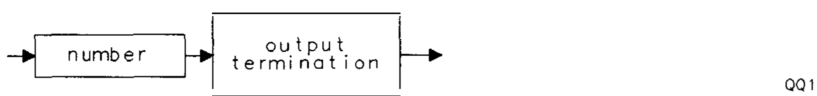
```
30 OUTPUT 718;"SRCPOFS 13DB;"
```

Offsets power-level readout for source by 13 dB.

Description

The SRCPOFS command offsets the displayed power of the built-in tracking generator. This function may be used to take into account system losses (for example, cable loss) or gains (for example, preamplifier gain) reflecting the actual power delivered to the device under test.

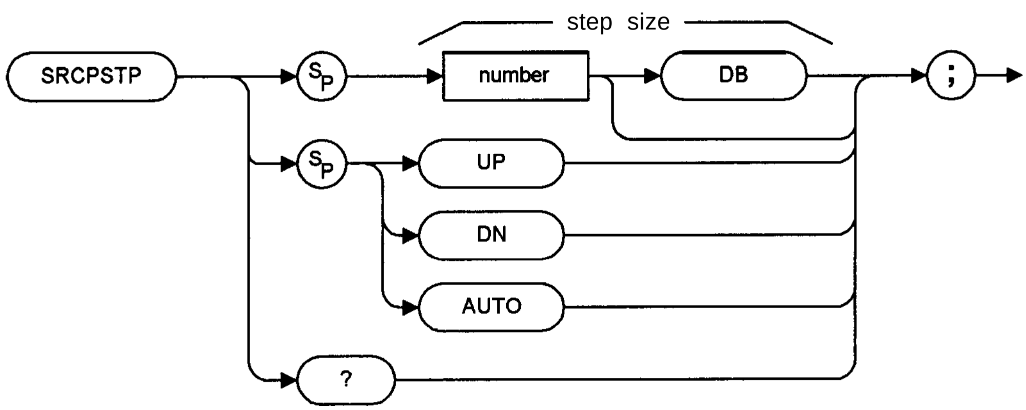
Query Response



SRCPSTP Source Power-Level Step Size

Selects the source-power step size.

Syntax



XSRCPSTP

Item	Description/Default	Range
Number	Any real or integer number	

Option Required: Option 1DN or 1DQ.
Equivalent Key: **Amptd Step**.
Step Increment: 0.1 dB.
Related Commands: SRCPWR, SRCPOFS, SRCPSWP.
Preset State: SRCPSTP AUTO (one major vertical scale division).

Example

Select incremental changes of power effected by "SRCPWR UP;", "SRCPWR DN;" commands, or the step keys.

```
20 OUTPUT 718;"SRCPWR -10DB;"
```

Turns on the source output.

```
30 OUTPUT 718;"SRCPSTP .3DB;"
```

Sets power-level step size to 0.3 dB.

```
40 OUTPUT 718;"SRCPWR UP;"
```

Increases the power level.

Description

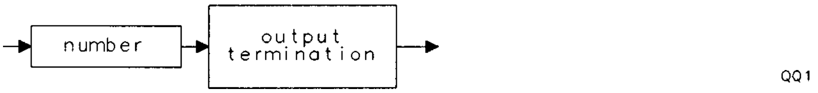
The SRCPSTP command selects the step size for the following source commands:

- Power offset (SRCPOFS).
- Power sweep (SRCPSWP).
- Power (SRCPWR).

Use SRCPSTP to set the step size to a specific value.

"SRCPSTP AUTO;" sets the step size to one vertical scale division.

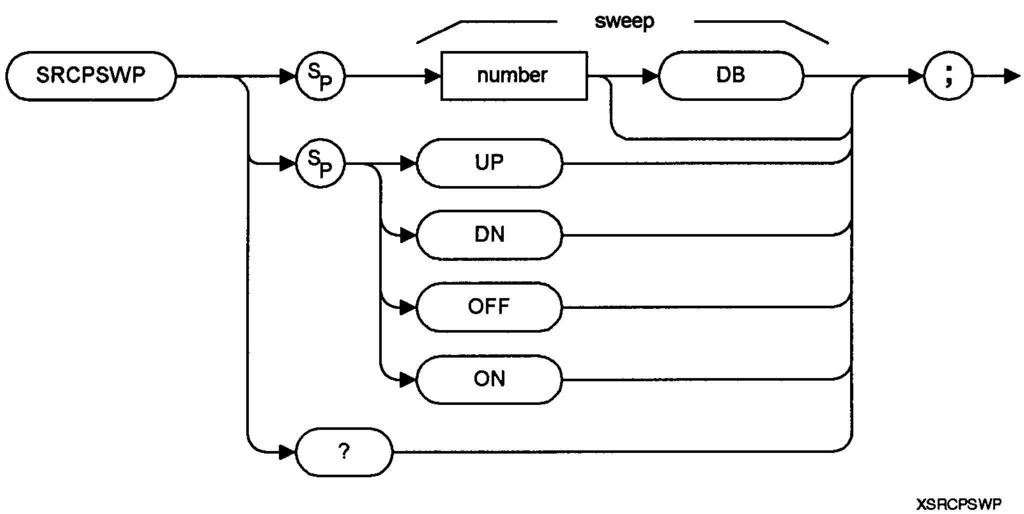
Query Response



SRCPSWP Source Power Sweep

Selects the sweep range of the source output.

Syntax



Item	Description/Default	Range
Number	Any real or integer number	

Option Required: Option 1DN or 1DQ.
Equivalent Key: **Power Sweep On Off**.
Step Increment: Determined by SRCPSTP.
Related Commands: SRCPSWP, SRCPOFS, SRCPSTP.
Preset State: SRCPSWP OFF.

Example

Use SRCPSWP to sweep the power level of the source output.

```
20 OUTPUT 718;"SRCPWR -10DM;"
```

Sets power level of source output to –10 dBm.

```
30 OUTPUT 718;"SP 0;"
```

Sets span to 0 Hz.

```
40 OUTPUT 718;"SRCPSWP 10DB;"
```

Sweeps source output from -10 dBm to 0 dBm.

Description

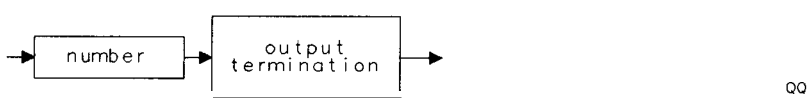
The SRCPSWP command works in conjunction with the SRCPWR (source power) command to sweep the amplitude level of the source output. The SRCPWR setting determines the amplitude level at the beginning of the sweep. The SRCPSWP command determines the change in amplitude level of the sweep.

For example, if SRCPWR and SRCPSWP are set to -15 dBm and 4 dB respectively, the source sweeps from -15 dBm to -11 dBm.

NOTE: Power is swept from low to high.

The minimum sweep time is limited to 50 ms when performing a source power sweep.

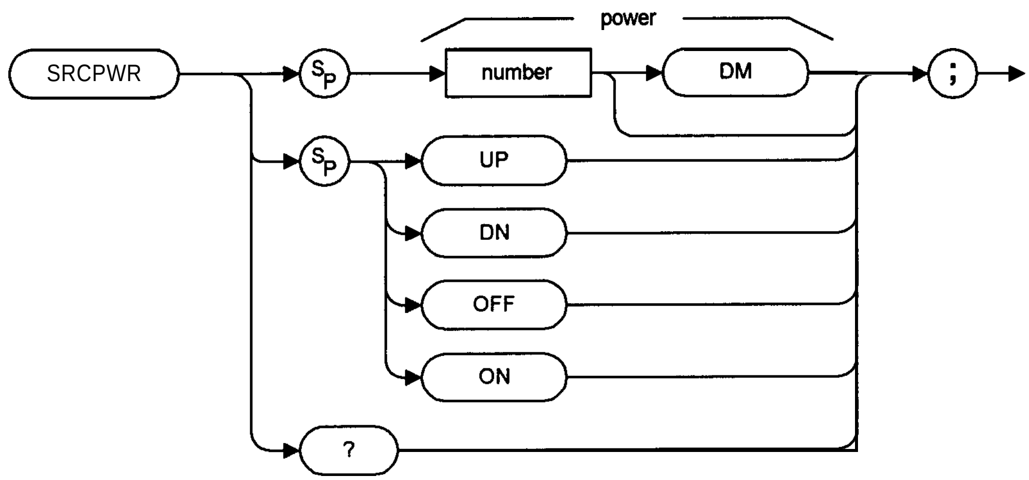
Query Response



SRCPWR Source Power

Selects the source power level.

Syntax



XSRCPWR

Item	Description/Default	Range
Number	Any real or integer number. Default unit is the current amplitude unit.	Actual range is hardware dependent

Option Required: Option 1DN or 1DQ.
Equivalent Key: **Amplitude On Off**.
Step Increment: Set by SRCPSTP.
Related Commands: SRCAT, SRCPSTP, SRCPSWP.
Preset State: -10 dBm.

Example

Use SRCPWR to turn on the source and adjust its power level.

```
10 OUTPUT 718;"SRCPWR -20DM;"
```

Changes power level to -20 dBm.

```
20 OUTPUT 718;"AUNITS DBMV;"
```

Changes the current amplitude unit.

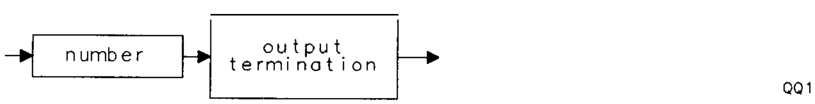
```
30 OUTPUT 718;"SRCPWR 37;"
```

The source power is now 37 dBmV.

Description

The SRCPWR command turns the source off or on and sets the power level of the source. The source is turned on automatically whenever its value is specified with SRCPWR. Also see “SRCPSTP.”

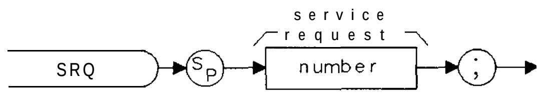
Query Response



SRQ Force Service Request

The SRQ command is used by an external controller to simulate interrupts from the spectrum analyzer.

Syntax



Item	Description/Default	Range
Number	Any valid integer	1 to 127

Related Commands: CLS, RQS, STB

Example

```
10 OUTPUT 718;"RQS 8;SRQ 8;"
```

Sets bit mask for a hardware broken service request, generates a hardware broken interrupt.

NOTE: A program can respond to the interrupt in the same way it would under a true service request condition.

Description

The service request condition is also displayed on the spectrum analyzer screen with the annotation s in the upper right comer.

The conditions that can generate a service request are as follows:

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

A service request is generated only if the proper request mask bit has been set (see "RQS"), and either the condition itself or the Force Service Request is sent. To set the request mask, choose the desired interrupt conditions and sum their assigned values. Executing the RQS command with this value sets the bit mask. After setting the bit mask, only the chosen conditions can produce an interrupt.

Each bit in the status byte is defined as shown in the following table. Bit numbers **6** and 7 are not used.

Table 9 **Spectrum Analyzer Status Byte**

Bit Number	Decimal Equivalent	Spectrum Analyzer State	Description
5	32	Set when an illegal command is present	**S** appears on the spectrum analyzer screen,
4	16	Set when any command is completed	It is triggered by EOI at the end of a command string or the completion of a print or plot.
3	8	Indicates hardware broken condition	**S** appears on the spectrum analyzer screen.
2	4	Indicates end of sweep	**S** appears on the spectrum analyzer screen. If you send any RQS value that contains mask value 4, another sweep will be taken.
1	2	Indicates a units key was pressed	**S** appears on the spectrum analyzer screen. If you activate the units key bit, it will remain active until you activate "EE" and press a units key. (See "EE.")
0	1	Operator notification	**S** appears on the spectrum analyzer screen. Operator notification occurs if an overload is detected on the analyzer RF input, if excessive reverse power is detected on the RF output (options 1DN or 1DQ only), or if the tracking generator becomes unleveled (options 1DN or 1DQ only.)

Generally, you must set the bit mask using the RQS command. However, the "hardware broken", "operator notification" and "illegal remote command" conditions are automatically enabled after presetting or sending the IP command. Pressing Preset or sending the IP command, then, produces the same interrupt bit mask as sending "RQS 41;" (decimal 41 is the sum of the assigned values of these three interrupt bits, 32 = bit 5, 8 = bit 3, and 1 = bit 0).

For most conditions, the RQS mask bit stays set until the next instrument preset (IP), or RQS command is executed. The only condition to which this does not apply is the Units Key Pressed bit. When this bit (bit 1) is set in the RQS mask, a Units Key Pressed interrupt occurs if EE (enable entry mode) is executed and a front-panel units key such as Hz, kHz, MHz, or GHz is pressed.

When a units key is pressed, the interrupt occurs and the Units Key Pressed bit in the RQS mask is reset. To re-enable the Units Key Pressed interrupt, you must send a new RQS mask. See "RQS" for detailed information.

As mentioned, you can simulate a service request condition. Choose the desired interrupt conditions from the RQS command table (see "RQS"), and sum their assigned values. Use the RQS command with this value to set the bit mask. By setting the corresponding bits in the SRQ command and sending the SRQ command to the spectrum analyzer, the desired interrupt occurs. This allows the user to verify proper operation of software routines designed to handle infrequent or unlikely interrupts.

Interface Differences

As implemented on the HP-IB interface, an spectrum analyzer service request asserts the SRQ control line on the HP-IB.

On the RS-232 interface, the spectrum analyzer does not have a way of signaling the interrupt condition to a controller. In this case, the controller must operate in a polled mode if it requires interrupt information (see "Polled Mode of Operation" below for a discussion of the polled mode).

Interrupt-Related Commands Common to All Interfaces:

- CLS Clear status byte, without read
- RQS Request mask
- SRQ Force service request
- STB Read then clear status byte

The HP-IB interface supports interface commands to read the status byte

On HP-IB in HP 9000 Series 200 or 300 BASIC, the statement SPOLL (Device-address) can be used to read the status byte.

Polled Mode of Operation

The polled mode of operation is probably most applicable to an RS-232 interface user. Because there is no interrupt signal to the RS-232 controller, the user must periodically ask the spectrum analyzer, via the "STB?" command, for the contents of its status register. For example, the RS-232 controller could periodically check for the hardware-broken condition by executing the "STB?" command and reading the results.

Use SRQ to Check for an Overpower Condition at the Input

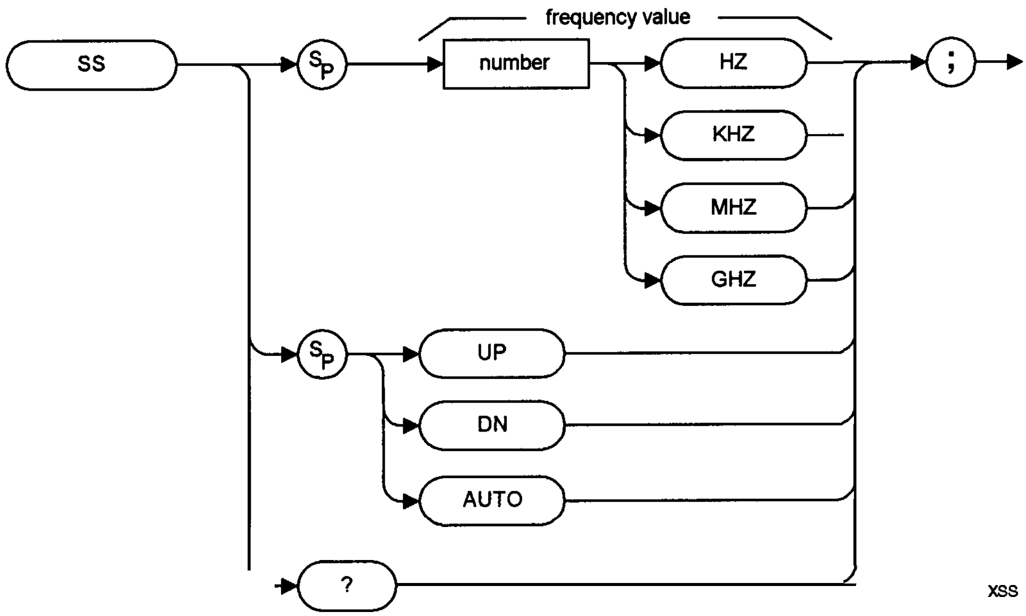
The analyzer checks for an overpower condition at the input. It may respond to an overload by changing the attenuation setting or by switching out the input. This can cause misleading results in a measurement. The status bit should be monitored for this condition to avoid incorrect measurement results. See the following error message descriptions for more details about these conditions:

Atten auto set to 15 dB
Overload: Reduce Signal

SS Center Frequency Step Size

Specifies center frequency step size.

Syntax



Item	Description/Default	Range
Number	Any real or integer number. Default unit is Hz.	Frequency range of the spectrum analyzer

Equivalent Key: **CF Step Auto Man**.
Preset State: 100 MHz.
Step Increment: 1, 2, 5, 10 sequence.
Related Commands: AUTO, CF, FOFFSET, SP.

Example

```
10 CLEAR 718
```

Clears the HP-IB.

```
20 OUTPUT 718;"IP;SNGLS;CF 300MHZ;SP 20MHZ;TS;"
```

Initializes the spectrum analyzer, activates single-sweep mode, changes the center frequency, span, takes sweep.

```
30 OUTPUT 718;"MKPK HI;MKRL;TS;MKF?;"
```

Finds the highest peak, changes the reference level to the marker, takes sweep, returns the frequency of the marker.

```
40 ENTER 718 USING "K";Mk_freq
```

Puts the spectrum analyzer response in the computer variable, **Mk_freq**.

```
50 OUTPUT 718;"MKA?;"
```

Returns the amplitude of the marker.

```
60 ENTER 718 USING "K";Mk-amp
```

Puts the spectrum analyzer response in the computer variable, **Mk_amp**.

```
70 OUTPUT 718;"SS ";Mk_freq;"HZ"
```

Changes the step size to the marker frequency.

```
80 OUTPUT 718;"CF UP;TS;MKPK HI;MKA?;"
```

Increases the center frequency, takes sweep, puts the marker on the highest peak and returns the amplitude of the marker.

```
90 ENTER 718;Mk_ampl
```

Puts the spectrum analyzer response in the computer variable, **Mk_ampl**.

```
100 PRINT "THE FUNDAMENTAL IS ";Mk_amp-Mk_ampl
110 PRINT "dB ABOVE THE SECOND HARMONIC"
```

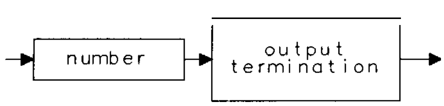
Outputs the result.

```
120 END
```

Description

The AUTO parameter removes SS as an active function but does not have an effect on its value.

Query Response

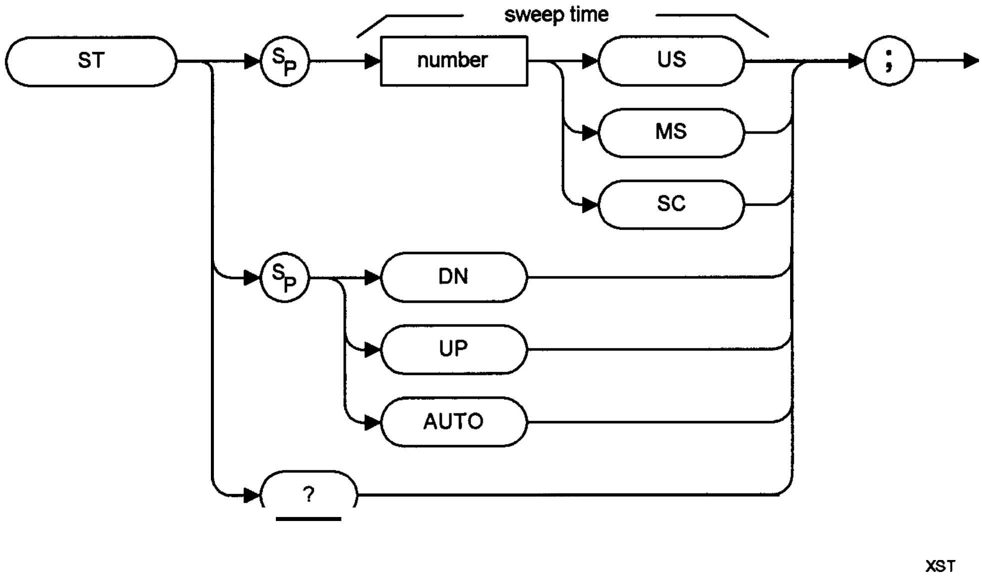


QQ1

ST Sweep Time

Specifies the time in which the spectrum analyzer sweeps the displayed frequency range.

Syntax



Item	Description/Default	Range
Number	Any real or integer number. Default unit is seconds.	Within the sweep time range of the spectrum analyzer

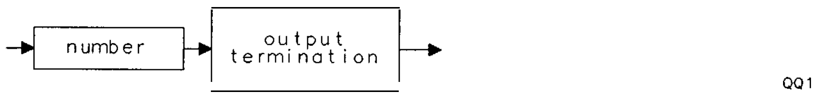
Equivalent Key: **Sweep Time Auto Man**
Sweep Time Range: 5 ms to 2000s
Step Increment: 2, 3, 5, 7.5, 10, 15 sequence
Related Commands: AUTO, CONTS, RB, SNGLS, SP, SRCPSWP, TS

Example

```
10 OUTPUT 718;"ST 100MS;"
```

Sets the sweep time to 100 milliseconds.

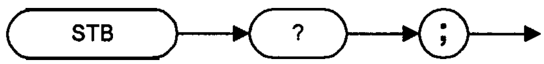
Query Response



STB Status Byte Query

Returns to the controller the decimal equivalent of the status byte.

Syntax



XSTB

Related Commands: RQS, SRQ.

Example

`10 OUTPUT 718;"IP;"`

Initializes spectrum analyzer.

`20 OUTPUT 718;"SNGLS;"`

Activates single-sweep mode.

`30 OUTPUT 718;"CLS;"`

Clears the status bits.

`40 OUTPUT 718;"TS;"`

Takes sweep.

`50 OUTPUT 718;"STB?;"`

Returns the status bits.

`60 ENTER 718;Status_Byte`

Puts the spectrum analyzer response in the computer variable, Status-Byte.

`70 PRINT Status-byte`

Displays the result.

`80 END`

Description

The **STB** command is equivalent to a serial poll command. The RQS and associated bits are cleared in the same way that a serial poll command would clear them. The bits in the status byte are explained under the RQS command.

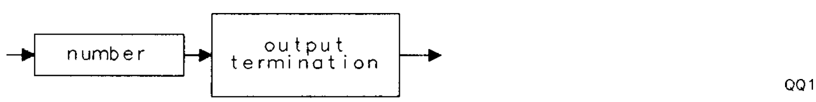
Use SRQ to Check for an Overpower Condition at the Input

The analyzer checks for an overpower condition at the input. It may respond to an overload by changing the attenuation setting or by switching out the input. This can cause misleading results in a measurement. The status bit should be monitored for this condition to avoid incorrect measurement results. See the following error message descriptions for more details about these conditions:

Atten auto set to 15 dB

Overload: Reduce Signal

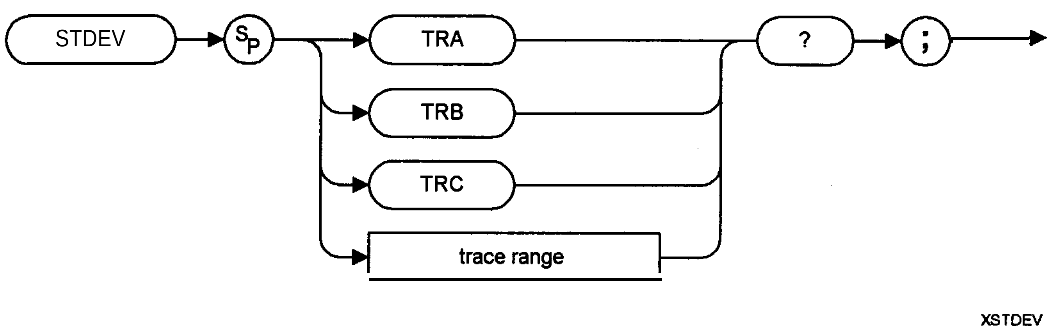
Query Response



STDEV Standard Deviation of Trace Amplitudes

Returns the standard deviation of the trace amplitude in measurement units.

Syntax



Item	Description/Default	Range
Trace range	A segment of trace A, trace B, trace C, or a user-defined trace.	

Prerequisite Commands: TS when using trace data
Related Commands: MEAN, VARIANCE

Example

The following program segment finds the standard deviation of the amplitude of trace A.

```
10 OUTPUT 718;"IP;"
```

Initializes spectrum analyzer.

```
20 OUTPUT 718;"SNGLS;"
```

Activates single-sweep mode.

```
30 OUTPUT 718;"CF 300MHZ;SP 2MHZ;RB 100KHZ;"
```

Changes the center frequency, span, and resolution bandwidth.

```
40 OUTPUT 718;"TS;"
```

Takes sweep.

```
50 OUTPUT 718;"STDEV TRA?;"
```

Finds the standard deviation of trace A.

```
60 ENTER 718;Number
```

Get the response from the spectrum analyzer.

```
70 PRINT "THE STANDARD DEVIATION OF TRACE A ";Number/100;"DB"
```

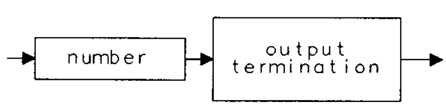
Description

The formula to calculate the standard deviation is as follows:

$$\sqrt{\frac{\sum_{i=1}^{n} (\bar{x} - x_i)^2}{n-1}}$$

n	represents the number of data points.
x_i	represents a data point.
$\bar{x}$	represents the mean of data.

Query Response

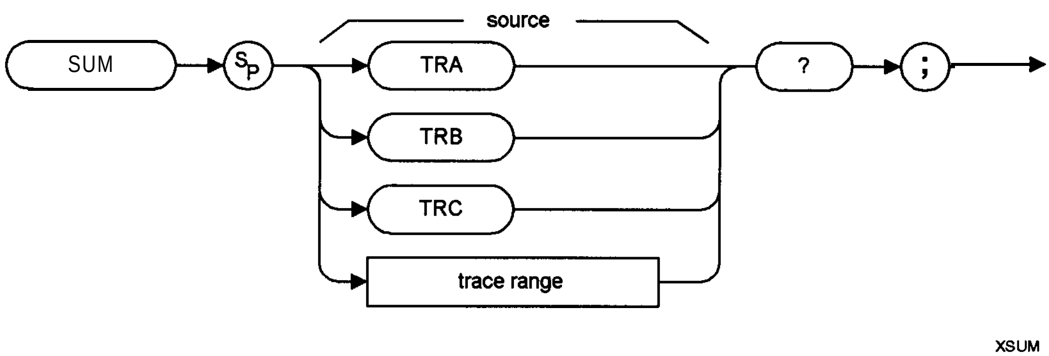


QQ1

SUM Sum of Trace Amplitudes

Returns the sum of the amplitudes of the trace elements in measurement units.

Syntax



Item	Description/Default	Range
Trace range	A segment of trace A, trace B, trace C, or a user-defined trace	

Prerequisite Commands: TS when using trace data
Related Commands: MEAN, TS, VARIANCE

Example

10 OUTPUT 718;"IP;"

Initializes spectrum analyzer.

20 OUTPUT 718;"SNGLS;TS;"

Activates single-sweep mode, takes sweep.

30 OUTPUT 718;"SUM **TRA?;"**

Gets the result.

40 **ENTER** 718;Trace_sum

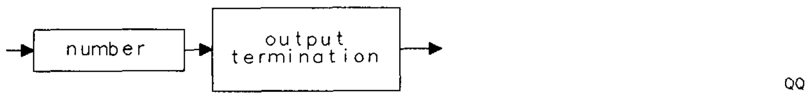
Puts the spectrum analyzer response in the computer variable, Trace-sum.

```
50 DISP Trace-sum;"MEASUREMENT UNITS"
```

Displays the result.

```
60 END
```

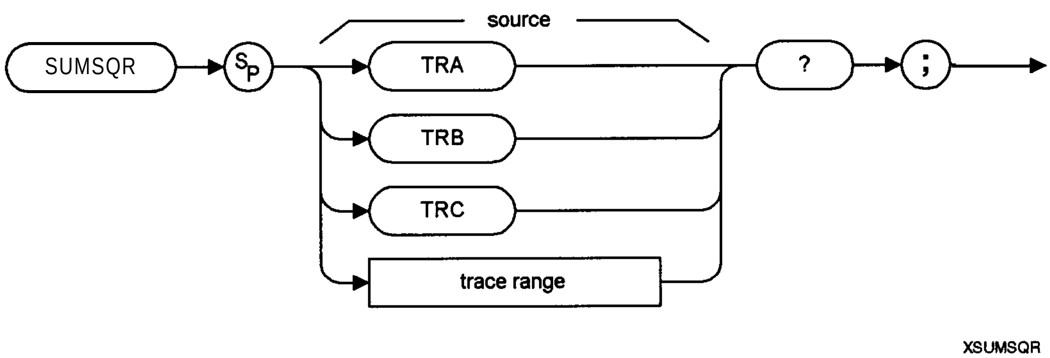
Query Response



SUMSQR Sum of Squared Trace Amplitudes

Returns the sum of the squares of the amplitude of each trace element in measurement units.

Syntax



Item	Description/Default	Range
Trace range	A segment of trace A, trace B, trace C, or a user-defined trace	

Prerequisite Commands: TS when using trace data.

Example

`10 OUTPUT 718;"IP;"`

Initializes spectrum analyzer.

`20 OUTPUT 718;"SNGLS;TS;"`

Activates single-sweep mode, takes sweep.

`30 OUTPUT 718;"SUMSQR TRA?;"`

Gets the result.

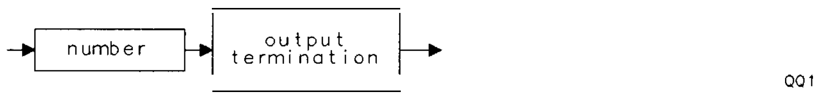
`40 ENTER 718;Trace_sqrsum`

Puts the spectrum analyzer response in the computer variable, Trace-sqrsum.

```
50 DISP Trace-sqrsum;"MEASUREMENT UNITS"
```

Displays the result.

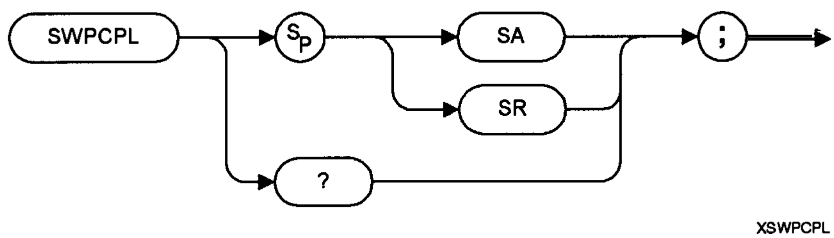
Query Response



SWPCPL Sweep Couple

Selects either a stimulus response (SR) or spectrum-analyzer (SA) auto-coupled sweep time.

Syntax



Equivalent Key: **Swp Coupling SR SA**.
Option Required: Option 1DN or 1DQ.
Preset State: SWPCPL SA.
Related Commands: SRCPWR.

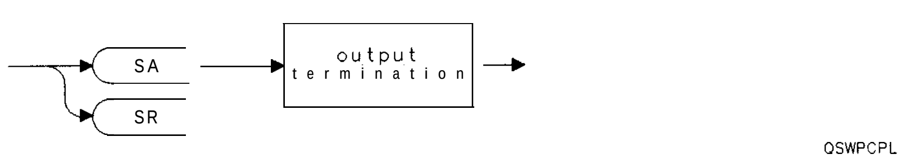
Example

```
10  OUTPUT 718;"IP;SNGLS;"
20 OUTPUT 718;"FA 300KHZ;FB 1GHZ;"
30 OUTPUT 718;"SRCPWR −10DB;"
40 OUTPUT 718;"SWPCPL SR;"
50  LOCAL 718
60  END
```

Description

In stimulus-response mode, auto-coupled sweep times are usually much faster for swept-response measurements. Stimulus-response auto-coupled sweep times are typically valid in stimulus-response measurements when the system's frequency span is less than 20 times the bandwidth of the device under test.

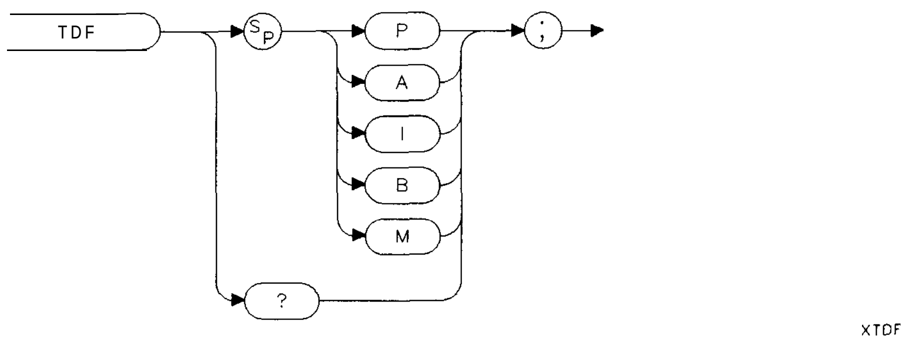
Query Response



TDF Trace Data Format

Formats trace information for return to the controller.

Syntax



Related Commands: MDS, MKA, TRA

Example

```
10 DIM A(401)
```
Holds trace data.

```
20 OUTPUT 718;"IP;"
```
Initializes analyzer.

```
30 OUTPUT 718;"BLANK TRA;CLRW TRB;"
```
Views trace B.

```
40 OUTPUT 718;"SNGLS;CF 300MHZ;SP 2MHZ;TS;"
```
Activates single-sweep mode, changes center frequency and span.

```
50 OUTPUT 718;"TDF P;TRB;"
```
Formats trace data.

```
60 FOR N = 1 TO 401
```
Transfers trace data to array A, one element at a time.

```
70 ENTER 718 USING "#,K";A(N)
```

```
80 NEXT N
```

```
90 FOR N = 1 TO 401
```

Loop prints out trace B data.

```
100 PRINT A(N)
```

Prints out the results.

```
110 NEXT N
```

Description

More information about trace data formats is also included in Chapter 3. The different trace data formats are as follows:

TDF P

Description: TDF P is the real number format. An example of a trace element returned with the real number format is 10.00 dB. When querying the trace or marker value, the value is returned using the amplitude unit set by AUNITS (for example, watts or dBm).

Restrictions: The spectrum analyzer must be in log scale to use TDF P. To send the trace data back to the spectrum analyzer, the data must be converted to measurement units.

How data is returned: The following table describes what is transferred when the trace data format is set to P, but the AUNITS are changed. In every case, the trace data transfer is ended by a carriage return, and a line feed with an EOI.

Table 10 **Trace Data Transfers with TDF P**

AUNITS Setting	Example	Description
Watts	TDF P; AUNITS W; TRA;	Transfers 401 real values, in watts, with each value separated by a carriage return and a line feed.
dBm	TDF P; AUNITS DBM;TRA;	Transfers 401 real values, in dBm, with each value separated by a carriage return and a line feed.
dBmV	TDF P; AUNITS DBMV;TRA;	Transfers 401 real values, in dBmV, with each value separated by a carriage return and a line feed.

Table 10 **Trace Data Transfers with TDF P**

AUNITS Setting	Example	Description
dBμV	TDF P;AUNITS DBUV;TRA;	Transfers 401 real values, in dBμV, with each value separated by a carriage return and a line feed.
Volts	TDF P;AUNITS V;TRA;	Transfers 401 real values, in volts, with each value separated by a carriage return and a line feed.

Example of how data is returned: For example, if the reference level of the spectrum analyzer is set to -10 dBm, the amplitude scale is set to 10 dB per division. For this example trace A could contain the following data:

TRA[1] = 8000 (in measurement units), indicating it is at the reference level.
TRA[2] = 7000 (in measurement units), indicating it is 10 dB below the reference level at -10 dBm.
TRA[3] through TRA[401] each contain 6000 (in measurement units), indicating that the trace elements 3 through 401 are all 20 dB below the reference level at -20 dB.

Querying trace A with the TDF P format and AUNITS set to DBM returns ASCII character codes for the following:

–10.00,–20.00,–30.00, (-30.00 is repeated 398 times), **<CR><LF><EOI>**

TDF A

Description: TDF A is the A-block data format. With the A-block data format, trace data is preceded by **"#,"** "A," and a two-byte number (the two byte number indicates the number of trace data bytes). The setting of the MDS command determines whether the trace data is transferred as one or two 8-bit bytes.

Restrictions: To use the A-block format for sending data, you must provide the number of data bytes.

How data is returned: The following table describes what is transferred when the trace data format is set to A, but the MDS setting is changed.

Table 11 **Trace Data Transfers with TDF A**

MDS Setting	Example	Description
Binary	TDF A;MDS B;TRA;	Transfers "#A," the number of bytes of trace data, then the 401 bytes of trace data. Using MDS B "reduces" each trace value into one byte by dividing (DIV) the trace value by 32. The trace data transfer is ended with an EOI.
Word	TDF A;MDS W;TRA;	Transfers "#A," the number of bytes of trace data, then 802 bytes of trace data. MDS W uses two bytes per trace element to transfer trace data. The first byte contains the trace value divided by (DIV) 256, the second byte contains the remainder (MOD) of that division. The trace data transfer is ended with an EOI.

Example of how data is returned: For the same example and trace A data that is used in the TDF P description, querying trace A with the TDF A format and MDS set to binary (MDS B) would return the ASCII character codes for the following:

#A(401 div 256)(401 mod 256)(8000 div 32)(7000 div 32)(6000 div 32)(the number for 6000 div 32 is repeated 398 times)<EOI>

Notice that #A is followed by the two bytes that contain the number of trace elements. Because MDS is set to binary, the number of trace elements is 401.

If MDS is set to W, querying trace A with the TDF A format would return the ASCII character codes for the following:

#A(802 div 256)(802 mod 256)(8000 div 256)(8000 mod 256)(7000 div 256)(7000 mod 256)(6000 div 256)(6000 mod 256)(the number for 6000 div 256, then the number for 6000 mod 256 is repeated 398 times)

Notice that #A is followed by the two bytes that contain the number of trace elements. Because MDS is set to W (word), the number of trace elements is 802.

TDF I

Description: TDF I is the I-block data format. With the I-block data format, trace data must be preceded by "#," and "I." The setting of the MDS command determines whether the trace data is transferred as one or two 8-bit bytes. Unlike using the A-block format, you do not provide the number of data bytes when sending trace data back to the spectrum analyzer.

Restrictions: This format is not recommended for use with an RS-232 interface.

How data is returned: The following table describes what is transferred when the trace data format is set to I, but the MDS setting is changed.

MDS Setting	Example	Description
Binary	TDF I;MDS B; TRA;	Transfers "#I," then the 401 bytes of trace data. Using MDS B "reduces" the trace value into 1 byte by dividing (DIV) the trace value by 32. The trace data transfer is ended with an EOI.
Word	TDF I;MDS W; TRA;	Transfers "#A," two bytes with length information, then 802 bytes of trace data. MDS W uses two bytes per trace element to transfer trace data. The first byte contains the trace value divided by (DIV) 256, the second byte contains the remainder (MOD) of that division. The trace data transfer is ended with an EOI.

Example of how data is returned: For the same example and trace A data that is used in the TDF P description, querying trace A with the TDF I format and MDS set to binary (MDS B) would return the ASCII character codes for the following:

#I(8000 div 32)(7000 div 32)(6000 div 32)(the number for 6000 div 32 is repeated 398 times)

If MDS is set to W, querying trace A with the TDF I format would return the ASCII character codes for the following:

#I(8000 div 256)(8000 mod 256)(7000 div 32)(7000 mod 256)(6000 div 256)(6000 mod 256)(the number for 6000 div 256, then the number for 6000 mod 256 is repeated 398 times)

TDF B

Description: TDF B enables the binary format. With the binary format, the marker or trace data is transferred as bytes. Of all the trace data formats, TDF B transfers trace data the fastest. The setting of the MDS command determines whether the trace data is transferred as one or two 8-bit bytes.

Restrictions: The TDF B format cannot be used to send data back to the spectrum analyzer (you must use the A-block format to send data back to the spectrum analyzer).

How data is returned: The following table describes what is transferred when the trace data format is set to B, but the MDS setting is changed.

Table 12 **Trace Data Transfers with TDF B**

MDS Setting	Example	Description
Binary	TDF B;MDS B; TRA;	Transfers the 401 bytes of trace data. Using MDS B "reduces" the trace value into 1 byte by dividing (DIV) the trace value by 32. The trace data transfer is ended with an EOI.
Word	TDF B;MDS W; TRA;	Transfers the 802 bytes of trace data.MDS W uses two bytes per trace element to transfer trace data. The first byte contains the trace value divided by (DIV) 256, the second byte contains the remainder (MOD) of that division. The trace data transfer is ended with an EOI.

Example of how data is returned: For the same trace A data that is used in the TDF P description, querying trace A with the TDF B format and MDS set to binary (MDS B) would return the ASCII character codes for the following:

(8000 div 32)(7000 div 32)(6000 div 32)(the number for 6000 div 32 is repeated 398 times)

If MDS is set to W, querying trace A with the TDF B format would return the ASCII character codes for following:

(8000 div 256)(8000 mod 256)(7000 div 32)(7000 mod 256)(6000 div 256)(6000 mod 256)(the number for 6000 div 256, then the number for 6000 mod 256 is repeated 398 times)

TDF M

Description: TDF M is the measurement data format. The measurement data format transfers trace data in measurement units, and the measurement data can range from -32768 to +32767.

Restrictions: TDF M cannot be used to send trace data back to the spectrum analyzer.

How trace data is returned: The following table describes what is transferred when the trace data format is set to M.

Table 13 **Trace Data Transfers with TDF M**

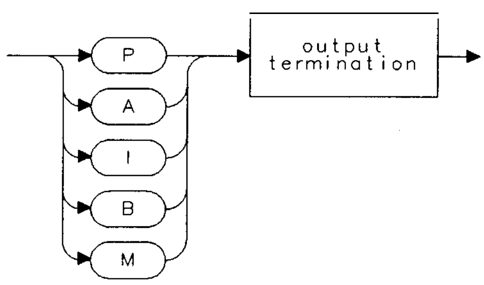
Example	Description
TDF M;TRA;	Transfers 401 bytes, with each trace value in measurement units. The trace data transfer is ended with a carriage return, a line feed with an EOI.

Example of how data is returned: For the same example and trace A data that is used in the TDF P description, querying trace A with the TDF M would return the ASCII character codes for the following:

8000,7000,6000,(6000 repeated 398 times),<CR><LF>

Refer to "Different Formats for Trace Data Transfers" on page 55 for more information about transferring trace data.

Query Response

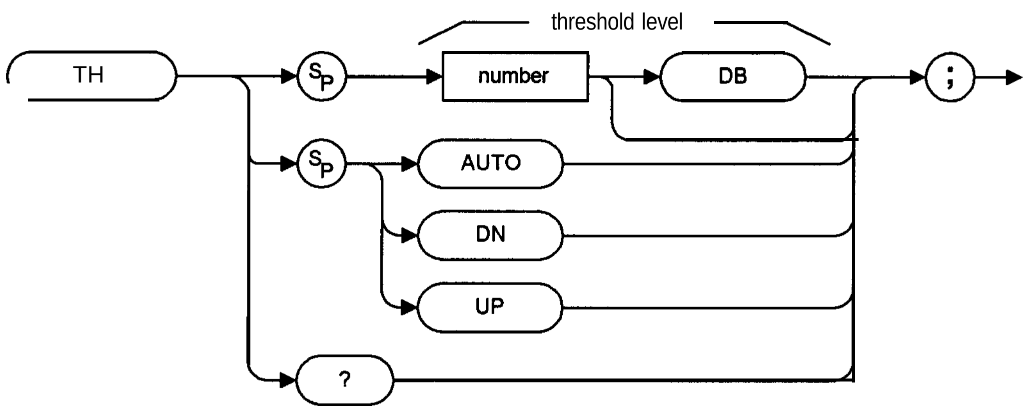


QTDF

TH Threshold

Clips signal responses below the threshold level.

Syntax



XTH

Item	Description/Default	Range
Number	Any real or integer number. Default unit is dBm.	Range dependent on RL setting

Equivalent Key: **Threshold On Off**.
Preset State: Clip off, positioned one division above bottom graticule line.
Step Increment: One division.
Related Commands: AUTO, DL, MEANTH, MKPK, PEAKS, RL.

Example

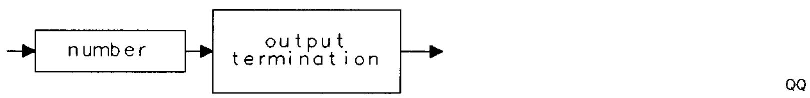
```
10 OUTPUT 718;"TH UP;"
```

Increases the threshold level.

Description

The threshold level is eight graticule divisions below the top of the screen unless otherwise specified. The threshold level is annotated in reference level units at the lower-left comer of the spectrum analyzer screen. AUTO deactivates clipping. The TH level is used for next peak marker movements (see “MKPK”) and the PEAKS command even if the display clipping is off.

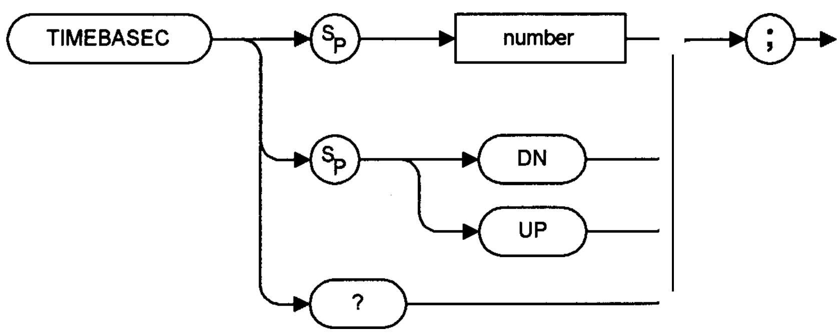
Query Response



TIMEBASEC Timebase Coarse Adjustment

Allows coarse adjustment of the analyzer timebase.

Syntax



XTIMEBSC

Item	Description/Default	Range
Number	Any integer number	0 to 255

Equivalent Key: **Timebase Coarse**
Step Increment: One division
Related Commands: TIMEBASEF

NOTE: The value of the timebase coarse adjustment is not reset to the factory value by an instrument preset (IP).

Example

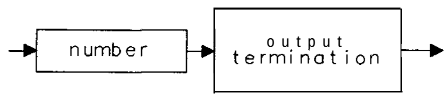
```
10 OUTPUT 718;"TIMEBASEC 128;"
```

Sets the timebase coarse adjustment to 128.

Description

The TIMEBASEC command makes coarse adjustments to the timebase. The timebase is the spectrum analyzer's internal 10 MHz reference oscillator. The timebase coarse value is reset to the factory default at power on.

Query Response

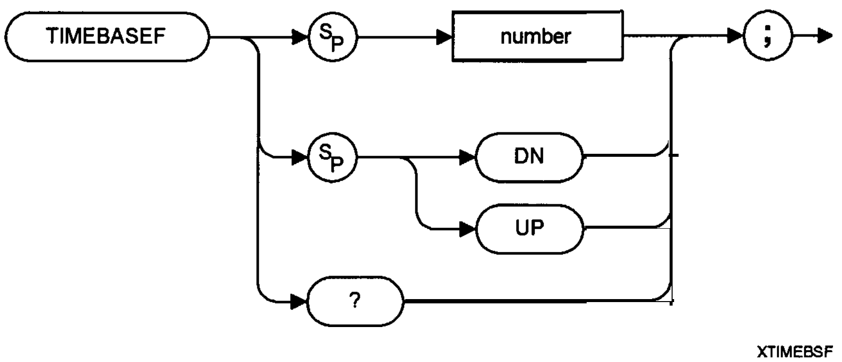


QQ1

TIMEBASEF Timebase Fine Adjustment

Allows fine adjustment of the analyzer timebase.

Syntax



Item	Description/Default	Range
Number	Any integer number	0 to 255

Equivalent Key: **Timebase Fine**
Step Increment: One division
Related Commands: TIMEBASEC

NOTE: The value of the timebase fine adjustment is not reset to the factory default by an instrument preset (IP).

Example

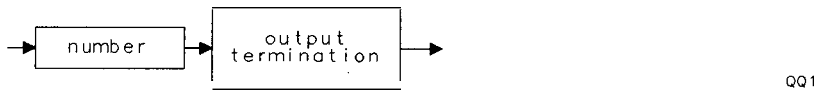
```
10 OUTPUT 718;"TIMEBASEF 128;"
```

Sets the timebase fine adjustment to 128.

Description

The TIMEBASEF command makes fine adjustments to the timebase. The timebase is the spectrum analyzer's internal 10 MHz reference oscillator. The timebase fine value is reset to the factory default at power on.

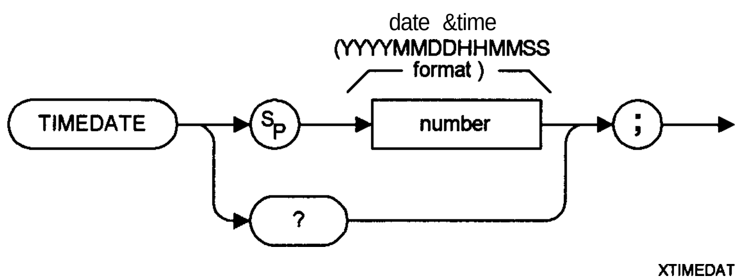
Query Response



TIMEDATE Time Date

Allows you to set the time and date for the spectrum analyzer real-time clock in the YYYYMMDDHHMMSS format.

Syntax



Item	Description/Default	Range
Number	A number representing the date and time in the YYYYMMDDHHMMSS (24 hour) format	A valid date and time

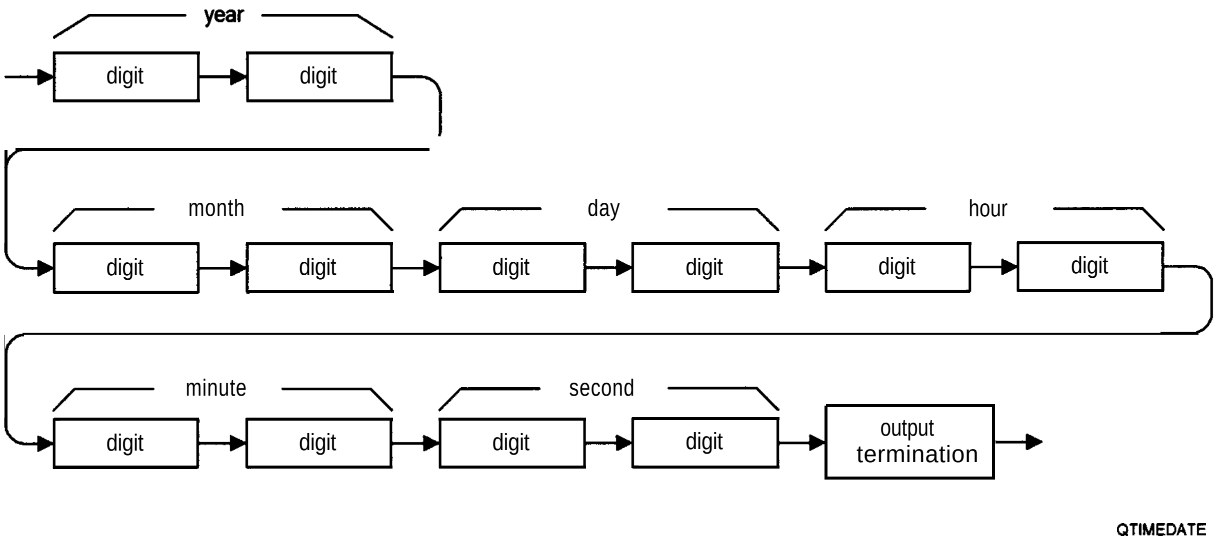
Equivalent Keys: **Set Time**, **Set Date.**
Related Commands: SETDATE, SETTIME, TIMEDSP.

Example

```
10 OUTPUT 718;"TIMEDATE 19971231135501;"
```

Sets the analyzer time and date to 1:55:01 P.M. on 31 December 1997.

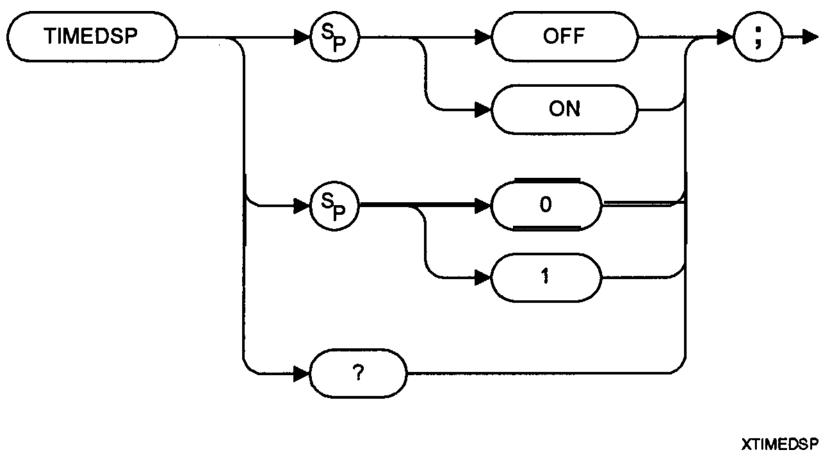
Query Response



TIMEDSP Time Display

Enables the display of the time and date on the spectrum analyzer screen.

Syntax

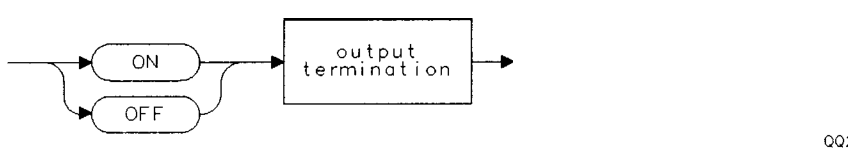


Equivalent Key: **Time/Date On Off**.
Related Commands: ANNOT, SETDATE, SETTIME, TIMEDATE.

Example

```
10 OUTPUT 718;"TIMEDSP OFF;"
```

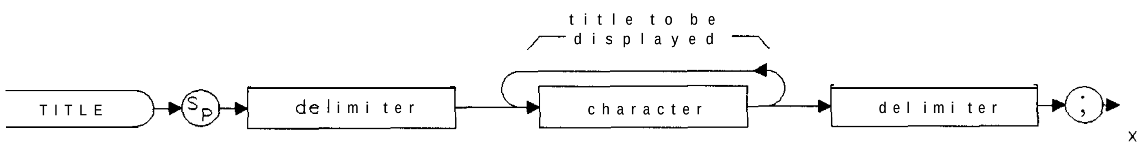
Query Response



TITLE Title

Activates the screen title mode. The title is displayed above the top graticule and is left justified.

Syntax



Item	Description/Default	Range
Delimiter	Matching characters marking the beginning and end of the list of analyzer commands	I \ @ ^ $ % ;!
Character	Any valid character	Up to 53 characters

Equivalent Key: **Title**
Related Commands: IP, SAVE, LOAD

Example

```
10 OUTPUT 718;"TITLE %ADJUST ANTENNA%;"
```

Displays "ADJUST ANTENNA" on the analyzer screen.

Description

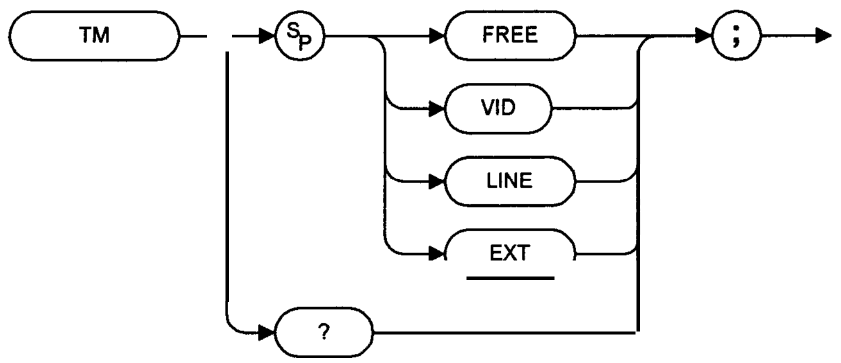
This function writes a message at the top of the spectrum analyzer screen. The full width of the display is available for writing a maximum of 53 characters. However, the marker readout may interfere with the last 26 characters. IP removes the message.

The SAVE command saves the screen title along with the trace in the trace register.

TM Trigger Mode

Selects a trigger mode: free, line, video, or external.

Syntax



XTM

Equivalent Keys: **Trig**
Related Commands: DL

Example

```
10 OUTPUT 718;"TM EXT;"
```

Activates the external trigger mode.

Description

The conditions of the four trigger modes are as follows:

FREE allows the next sweep to start as soon as possible after the last sweep. The functions of TM FREE and **FREE RUN** are identical.

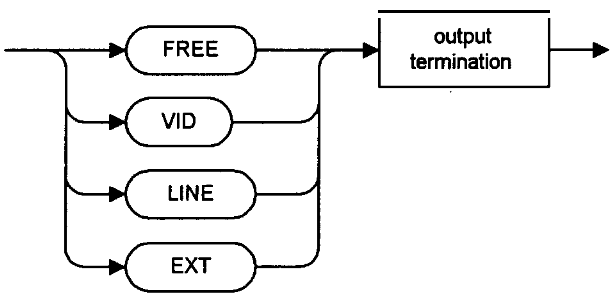
VID allows the next sweep to start if the trace data rises across a level set by the display line. The functions of TM VID and **VIDEO** are identical.

LINE allows the next sweep to start when the line voltage passes through zero, going positive. The functions of TM LINE and **LINE** are identical.

EXT allows the next sweep to start when an external voltage level passes through approximately 1.5 V, going positive. The external trigger signal level must be between 0 V and +5 V. Connect the external trigger to the EXT TRIG INPUT. The functions of TM EXT and **EXTERNAL** are identical.

NOTE: Some spectrum analyzer functions are not performed until the spectrum analyzer is triggered.

Query Response

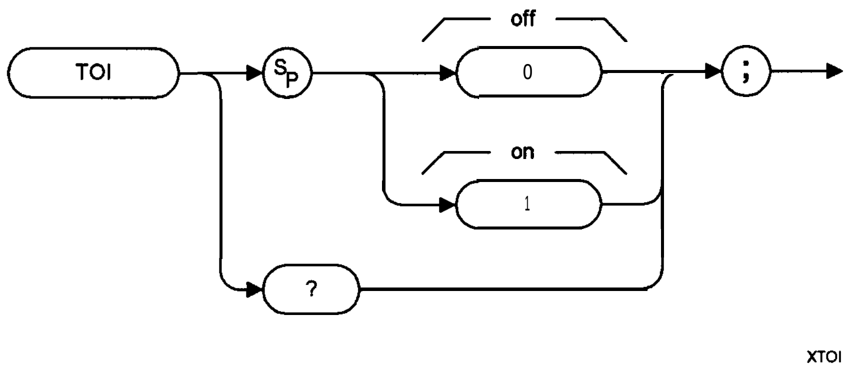


QTM

TOI Third-Order Intermodulation Measurement

Turns on or off the third-order intermodulation (TOI) measurement.

Syntax



Equivalent Key: **TOI On Off**.
Related Commands: AUNITS, MKPX, TH, TOIR.

Example

```
10 OUTPUT 718;"TOI 1;"
```

Turns on the third-order intermodulation measurement.

```
20 OUTPUT 718;"TOIR?;"
```

Queries TOIR. TOIR contains the results of the third-order intermodulation measurement.

```
30 ENTER 718;Toi
```

Stores the value of TOIR in the variable Toi.

```
40 PRINT "Third-order intermodulation is ",Toi
```

Prints the results.

```
50 OUTPUT 718;"TOI 0;"
```

Turns off the third-order intermodulation measurement.

Description

Setting **TOI** to 1 turns on the third-order intermodulation measurement. Setting **TOI** to 0 turns off the third-order intermodulation measurement. When the **third-**order intermodulation measurement is turned on, the spectrum analyzer first determines that there are four signals on the spectrum analyzer display; the four signals must be the two fundamental signals and two distortion products. All of the signals must be greater than the peak excursion above the threshold. If four valid signals could not be found for the third-order intermodulation measurement, the value of TOIR is -100. If four valid signals could be found, the spectrum analyzer does the following:

1 Finds the four highest on-screen signals. (If the four highest on-screen signals are not the two signals and two distortion products, the **TOI** measurement cannot be performed.)

2 Determines the spacing between the highest two signals. The highest two signals are tone A and tone B.

3 Verifies that the third and fourth highest signals (distortion A and distortion B) fall above and below tone A and tone B by the frequency difference between tone A and tone B.

4 Measures the levels of the four signals (tone A, tone B, distortion A, and distortion B) and calculates the third-order intermodulation intercept.

The third-order intermodulation intercept is calculated as follows:

$$TOI = \frac{2 \times Level_{ToneA} - Level_{DistortionA} + Level_{ToneB}}{2}$$

The frequency of the distortion product (Distortion A) is equal to the following:

$$Frequency_{DistortionA} = 2 \times Frequency_{ToneA} - Frequency_{ToneB}$$

You must query TOIR to determine the value of the higher third-order **intermodu**lation product.

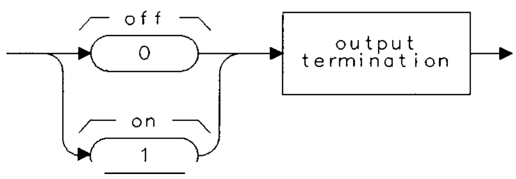
The third-order intermodulation measurement is repeated at the end of every sweep, to update the measurement data, until you turn it off.

Restrictions Turning the TOI measurement on turns off the following functions: N dB point measurement (NDBPNT), percent AM (PCTAM), and span zoom (SPZOOM).

You can execute the TOI function by using the command **"TOI 1;"**.

Because TOI is performed at the end of every measurement sweep, you should turn off the third-order intermodulation measurement (set TOI to 0) when you are done with it.

Query Response

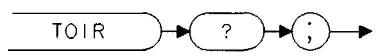


QTOI

TOIR Third-Order Intermodulation Response

Returns the intercept point for the highest third-order intermodulation product measured by the third-order intermodulation measurement (TOI).

Syntax



XTOIR

Equivalent Key: **TOI On Off**.
Related Commands: AUNITS, MKPX, TH, TOI.

Example

```
10 OUTPUT 718;"TOI 1;"
```

Turns on the third-order intermodulation measurement.

```
20 OUTPUT 718;"TOIR?;"
```

Queries TOIR. TOIR contains the results of the third-order intermodulation measurement.

```
30 ENTER 718;Toi
```

Stores the value of TOIR in the variable Toi.

```
40 PRINT "Third-order intermodulation is ",Toi
```

Prints the results.

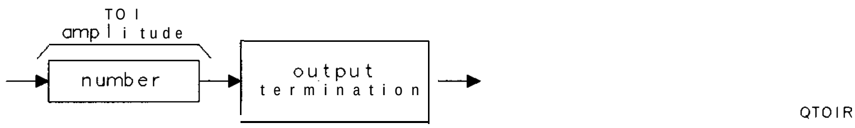
```
50 OUTPUT 718;"TOI 0;"
```

Turns off the third-order intermodulation measurement.

Description

TOIR returns a -100 if the TOI function has not been turned on, or if four on-screen signals are not valid or are not present. For TOI to perform a third-order intermodulation measurement, there needs to be four signals on the spectrum analyzer display, and all four signals must be greater than the peak excursion above the threshold.

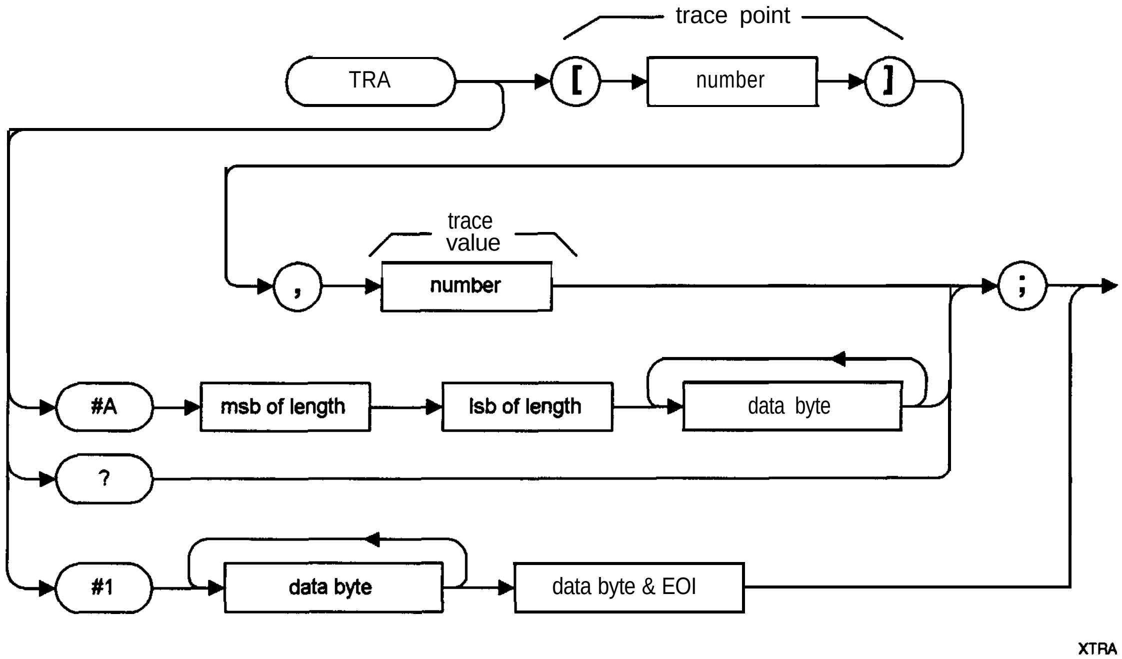
Query Response



TRA/TRB/TRC Trace Data Input and Output

The TRA/TRB/TRC commands provide a method for returning, storing or changing the 16-bit trace values.

Syntax



Use the same syntax for TRB and TRC as shown for TRA, just substitute TRB or TRC for TRA.

Item	Description/Default	Range
Trace point number	Integer number that identifies a specific trace point	0 to 400
Trace value number	Integer number that describes the value of a trace point, in measurement units	Varies depending on display mode and units selected. See the trace data format examples on page 55

Item	Description/Default	Range
MSB length	Most significant byte of a two-byte word that describes the number of bytes transmitted	
LSB length	Least significant byte of a two-byte word that describes the number of bytes transmitted	
Data byte	8-bit byte containing numeric or character data. A typical trace has 401 data bytes.	
Data byte & EOI	8-bit byte containing numeric or character data followed by END character	

Related Commands: LOAD, SAVE, DELETE, TDF

Example

`10 REAL Trace_a(1:401)`

Creates a 401-point trace array.

`20 OUTPUT 718;"IP;"`

Initializes analyzer.

`30 OUTPUT 718;"TDF P;"`

Changes the format for real numbers.

`40 OUTPUT 718;"SNGLS;"`

`50 OUTPUT 718;"CF 300MHZ;"`

Changes the center frequency.

`60 OUTPUT 718;"SP 200MHZ;"`

Changes the span.

`70 OUTPUT 718;"TS;"`

`80 OUTPUT 718;"MKPK HI;"`

`90 OUTPUT 718;"MKCF;"`

Moves peak to center of analyzer screen.

`100 OUTPUT 718;"TS;"`

Updates measurement trace.

```
110 OUTPUT 718;"TRA?;"
```

Gets the trace data.

```
120 ENTER 718;Trace_a(*)
```

Sends the trace data to the computer.

```
130 OUTPUT 718;"CONTS;"
```

Activates continuous sweep mode.

```
140 END
```

Description

The TRA command may be used to input integer data to traces. See the information on saving trace data in Chapter 3. Because the lengths of trace A, trace B, and trace C are fixed, there are always 401 bytes transferred during binary input mode.

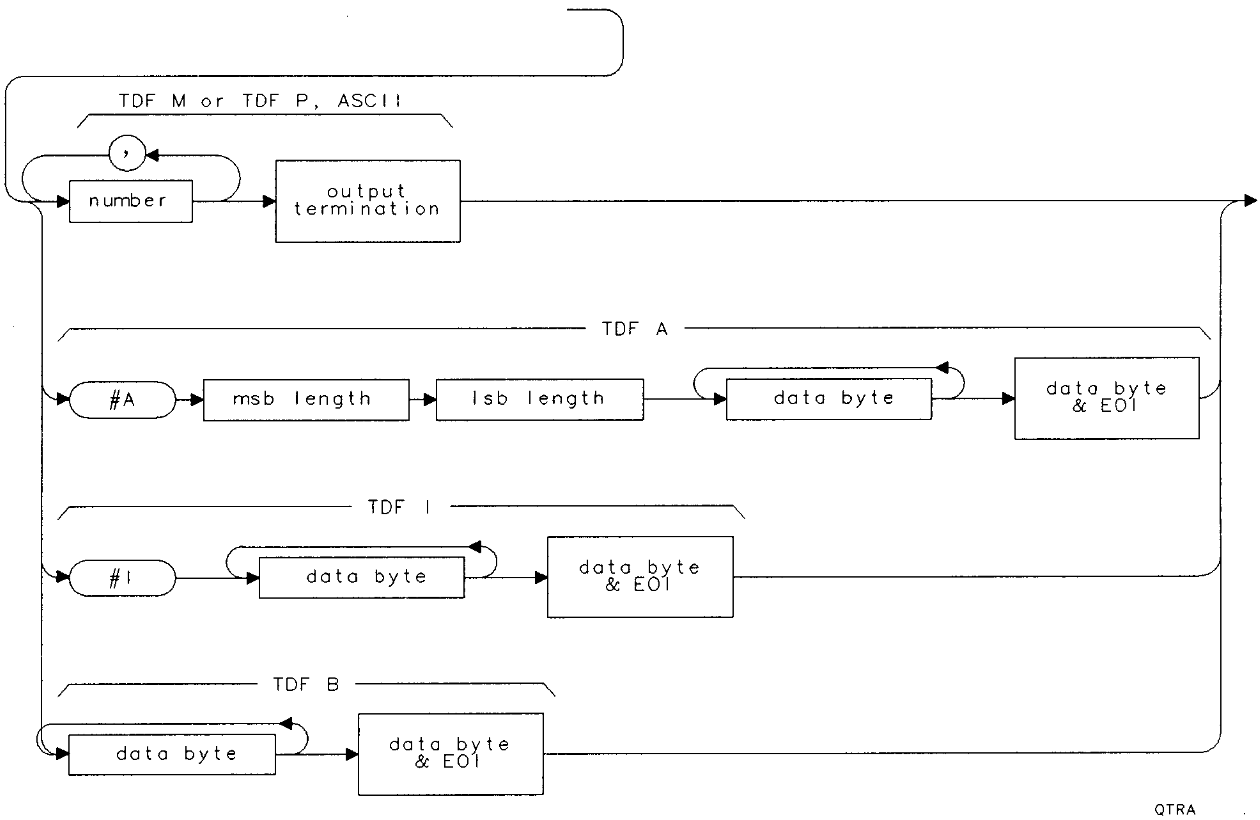
Trace data that is input in the A-block or the I-block format is treated as measurement units independent of trace data format (TDF) and is preceeded by a #A or #I (See the command syntax.) For a 401 point trace, the lsb of the length is 145 (401-256) and the msb of the length is 1 (the integer part of 401/256). Trace data that is input in the A-block, I-block, or B-block format can be sent in byte or word format (MDS). Enter words in measurement units only.

A single trace point can be input by identifying which of the 401 trace points it is, and sending the desired trace value in measurement units.

Query Response

When TRA is queried to output trace data, the output format is specified by the TDF and MDS commands. Because the lengths of trace A, trace B, and trace C are fixed, there are always 802 bytes transferred during binary output mode.

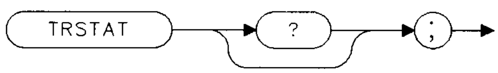
The form of the query response is dependent upon the previously used TDF and MDS commands as follows:


TDF M or TDF P, ASCII
,
number
output termination
TDF A
#A
msb length
lsb length
data byte
data byte & EOI
TDF I
#I
data byte
data byte & EOI
TDF B
data byte
data byte & EOI
QTRA

TRSTAT Trace Status

Returns the status of traces A, B, and C: clear write, blank, view, minimum hold, or maximum hold.

Syntax



XTRSTAT

Related Commands: BLANK, CLRW, DET, MINH, TRDSP, VIEW.

Example

This example returns the measurement state of traces A, B, and C.

```
10 DIM States$[40]
```

Declares array for results.

```
20 OUTPUT 718;"TRSTAT?;"
```

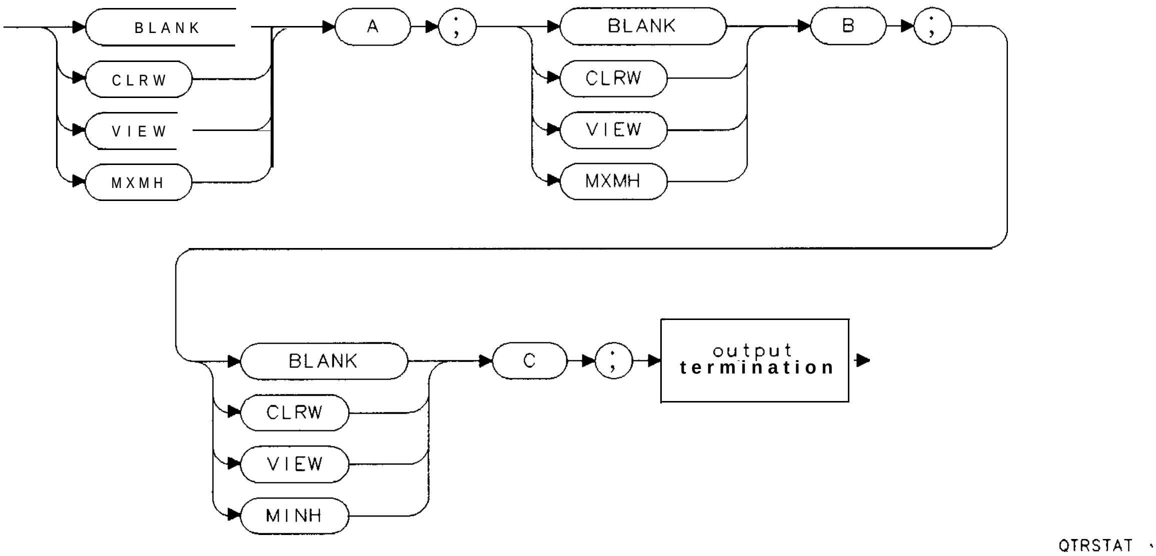
```
30 ENTER 718 USING "—K";States$
```

Returns the status results to the computer.

```
40 PRINT States$
```

Prints out status of traces.

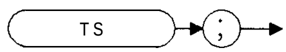
Query Response



TS Take Sweep

Starts and completes one full sweep before the next command is executed.

Syntax



XTS

Equivalent Key: Single
Related Commands: SNGLS, TM

Example

```
10 OUTPUT 718;"SNGLS;TS;"
```

Activates the single-sweep mode, and takes a sweep.

Description

A take sweep 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;SNGLS;CF 400MHZ;SP 20KHZ;VIEW TRA;"
```

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

```
OUTPUT 718;"IP;CF 400MHZ;SP 20MHZ;TS;VIEW TRA;"
```

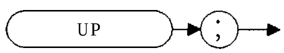
TS is recommended before transmission of marker data and before executing marker operations such as peak search. This is because the active marker is repositioned at the end of each sweep. When the spectrum analyzer receives a TS command, it is not ready to receive any more data until one full sweep 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 spectrum analyzer completes its sweep.

NOTE: When MKPAUSE or MKSTOP are activated, TS considers the sweep complete when it reaches the active marker.

UP up

Increases the value of the active function by the applicable step size.

Syntax



XUP

Equivalent Key: ‘I
Related Commands: See the list of active functions listed in the description for UP

Example

```
10 OUTPUT 718;"IP;MKN;RB 10KHZ;MKPK NH;UP;"
```

Increases the resolution bandwidth to 30 kHz because MKPK NH does not change the active function.

Description

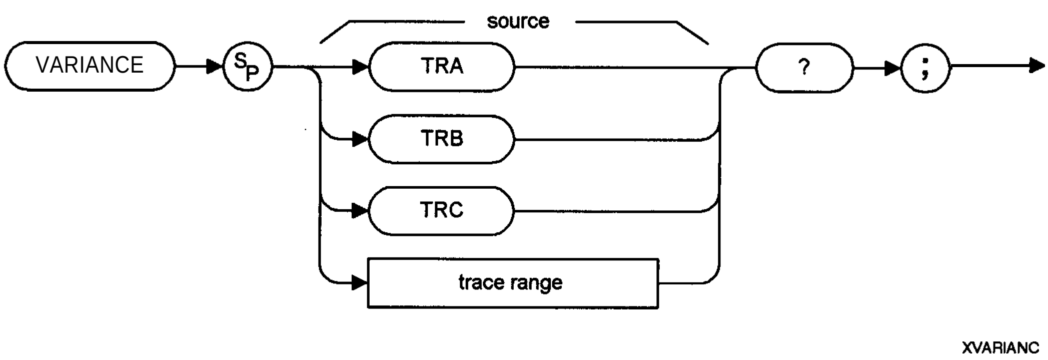
Before executing UP, be sure that the function to be increased is the active function. For example, the programming example increases the resolution bandwidth, because marker peak (MKPK) is not an active function.

The active functions are AT, CF, CONTRAST, DEMODT, DL, FA, FB, LG, MKA, MKD, MKFCR, MKN, MKPAUSE, MKPX, MKTH, ML, NDB, NRL, NRPOS, PRNTMARGB, PRNTMARGT, PRNTRES, RB, ROFFSET, RL, SETDATE, SETTIME, SP, SRCALC, SRCAT, SRCPOFS, SRCPSWP, SRCPWR, SRCTK, SS, ST, TH, TIMEBASEC, TIMEBASEF, VB, and VBR.

VARIANCE Variance of Trace Amplitudes

Returns the amplitude variance of the specified trace, in measurement units.

Syntax



Item	Description/Default	Range
Trace range	A segment of trace A, trace B, trace C	

Prerequisite Commands: TS when using trace data.
Related Commands: MEAN, RMS, STDEV.

Example

10 OUTPUT `718;"IP;"`

Initializes analyzer.

20 OUTPUT `718;"SNGLS;TS;"`

Activates single-sweep mode.

30 OUTPUT `718;"VARIANCE` **TRA?;"**

Returns variance of trace A to computer.

40 ENTER `718;Number`

Stores value in computer variable.

50 DISP Number;"MEASUREMENT UNITS"

Displays the results on computer screen.

Description

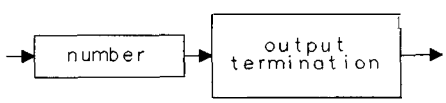
Taking the square root of a variance yields the standard deviation value.

The formula to calculate the variance is as follows:

$$\frac{\sum_{i=1}^{n}(\bar{x}-x_i)^2}{n-1}$$

n	represents the number of data points.
x_i	represents a data point.
$\bar{x}$	represents the mean of data.

Query Response

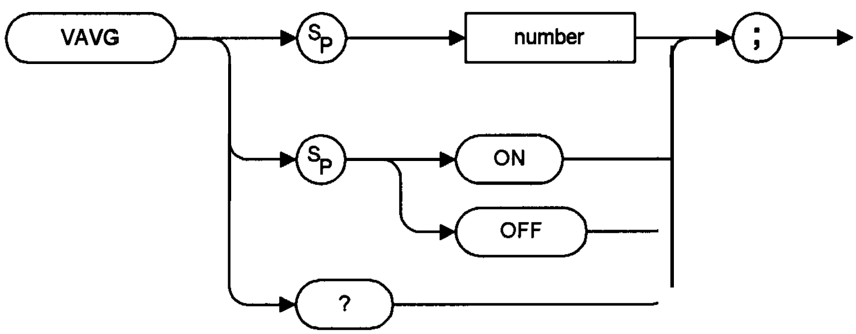


QQ1

VAVG Video Average

Enables the video-averaging function, which averages trace points to smooth the displayed trace.

Syntax



XVAVG

Item	Description/Default	Range
Number	Any valid integer. Default is 100.	1 to 16384

Equivalent Key: **Video Average On Off**
Related Commands: AUTO, CLRAVG, IP, SMOOTH

Example

```
10 OUTPUT 718;"VAVG 150;"
```

Video averages the trace.

Description

Use VAVG to view low-level signals without slowing the sweep time. Video averaging can lower the noise floor by more than a 30 Hz video bandwidth if a large number of sweeps has been specified for averaging. VAVG may also be used to monitor instrument state changes (for example, changing bandwidths, center frequencies) while maintaining a low noise floor.

The active function readout indicates the number of sweeps to be averaged. The default for the number of sweeps is 100 unless otherwise specified. If the number of sweeps is changed, the new number will be remembered when the function is turned off and back on again.

In single sweep mode the selected number of sweeps (N) are taken. Executing "VAVG OFF;" or "VAVG ON;" turns off/on video averaging, but will not trigger a trace when in single sweep mode. A TS command must be sent. After each sweep, the new value of each display point is averaged in with the previously averaged data using the following formula:

$$A_{avg} = \left(\frac{M-1}{M}\right)A_{\text{prior avg}} + \left(\frac{1}{M}\right)A_m$$

Where:

A_{avg} = new average value

$A_{\text{prior avg}}$ = average from prior sweep

A_m = measured value on current sweep

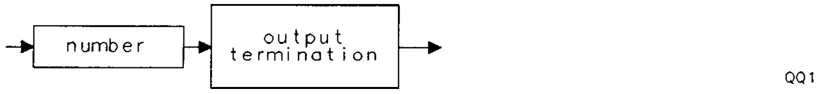
M = number of current sweep

In continuous sweep mode the same sequence is followed until M=N. At that point, the sweeps continue rather than stopping. For each new sweep, the current sweep's measured value divided by N is added to **(N-1)/N** times the prior average, creating a weighted rolling average.

If any measurement parameter such as center frequency, span, amplitude, or N is changed while video average is on, the video average counter is reset to 0. If the analyzer is in single sweep mode, a new set of sweeps is taken only after a TS or SS command is sent again.

When video averaging is turned on the sample detector mode is automatically switched in. When the averaging is switched off, the detector mode is reset to the previous mode.

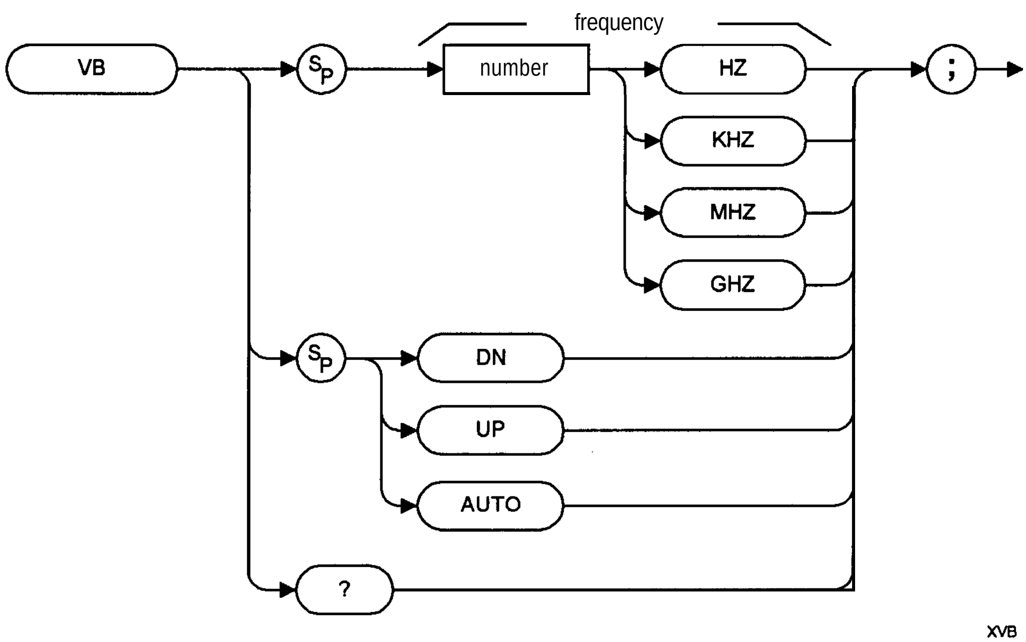
Query Response



VB Video Bandwidth

Specifies the video bandwidth, which is a post-detection, low-pass filter.

Syntax



Item	Description/Default	Range
Number	Any real or integer number. Default unit is Hz.	30Hz to 3 MHz

Equivalent Key: **Video BW Auto Man.**
Preset State: 1 MHz.
Step Increment: In a 1, 3, 10 sequence.
Related Commands: AUTO, RB, SP, ST, VBR.

Example

```
10 OUTPUT 718;"VB 10KHZ;"
```

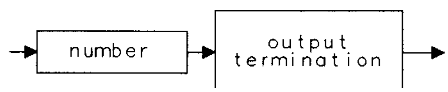
Changes the video bandwidth to 10 kHz.

Description

The resolution bandwidth, video bandwidth, and sweep time are normally coupled to the span. Executing VB uncouples video bandwidth from resolution bandwidth (it does nothing to the sweep-time, resolution-bandwidth, and span coupling). Executing AUTO re-couples video bandwidth to the resolution bandwidth.

Frequency values other than the values in the 1, 3, 10 sequence are rounded to the nearest permissible value.

Query Response

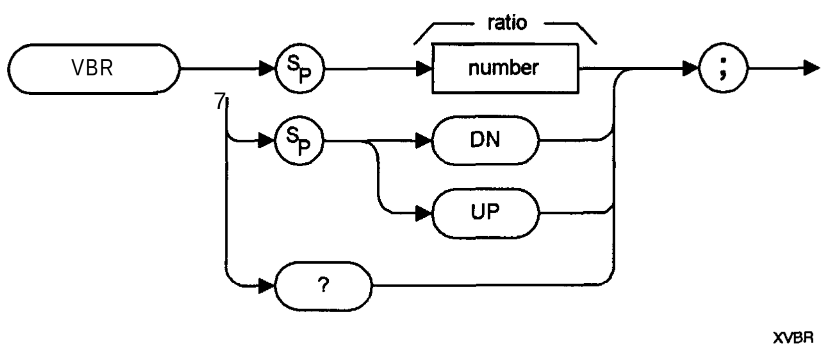


QQ1

VBR Video Bandwidth Ratio

The VBR parameter is multiplied by the resolution bandwidth to determine the automatic setting of video bandwidth.

Syntax



Item	Description/Default	Range
Number	Any valid real number	0 to 3000000

Equivalent Key: **VBW/RBW Ratio.**
Preset State: 0.300.
Step Increment: 1, 3, 10 sequence.
Related Commands: AUTO, RB, SP, VB.

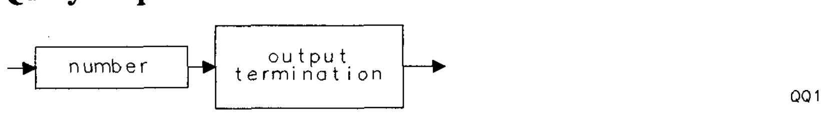
Example

```
10 OUTPUT 718;"VBR 1;"
```

Description

Ratio values other than the values in the 1, 3, 10 sequence are rounded to the nearest permissible value.

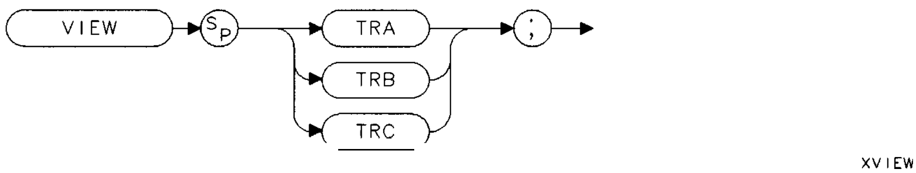
Query Response



VIEW View Trace

Displays trace A, trace B, or trace C, and stops taking new data into the viewed trace.

Syntax



Equivalent Key: **View A**, **View B**, and **View C**.
Related Commands: BLANK, CLRW, MINH, MXMH.

Example

```
10 OUTPUT 718;"VIEW TRA;"
```

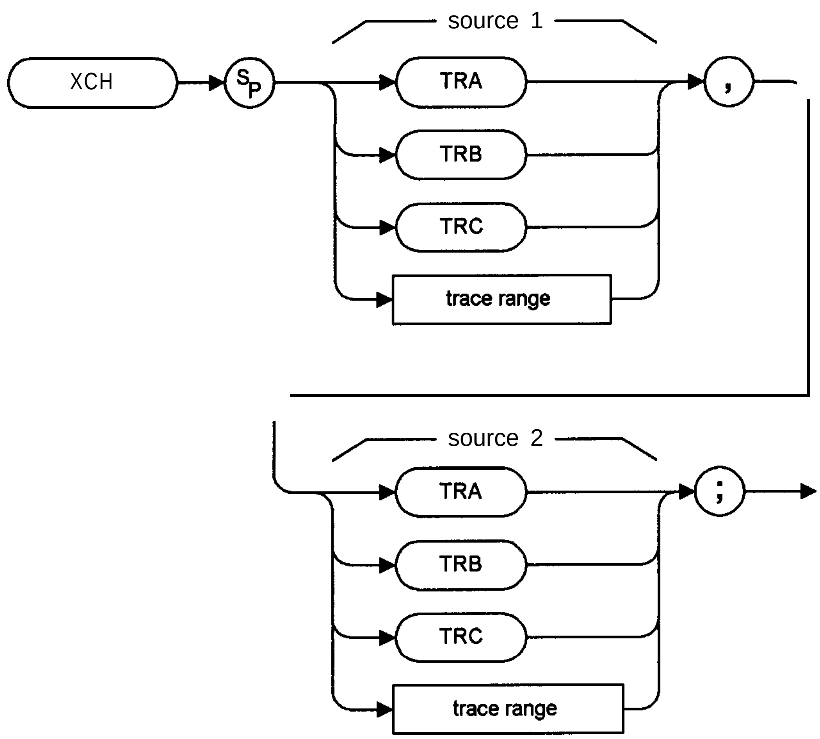
Description

In the VIEW mode the trace is not updated. When VIEW is executed, the contents of the trace are stored in display memory.

XCH Exchange

Exchanges the contents of sources 1 and 2.

Syntax



XXCH

Prerequisite Commands: TS when using trace data
Related Commands: AXB, BXC

Example

```
10 OUTPUT 718;"XCH TRA,TRB;"
```

Exchanges the contents of trace A with trace B.

Description

When the source is longer than the destination, the source is truncated to fit. When the source is shorter than the destination, the last element is repeated to fill the destination.

6

Error Messages

Descriptions

The spectrum analyzer can generate various messages that appear on its screen during operation 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 spectrum analyzer hardware is probably broken. Additional troubleshooting should be done to verify the failure.
- User-created error messages appear when the spectrum analyzer is used incorrectly. They are often generated during remote operation (entering programming commands using either a controller or the external keyboard).
- Informational messages provide information indicating the spectrum analyzer's 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-2V fail Indicates a hardware failure. (H)

ADC-Gnd fail Indicates a hardware failure. (H)

ADC-time fail Indicates a hardware failure. (H)

Align IF: gain limited, may recover next alignment Indicates that an Align Now for the IF Assembly reached a hardware limit. Perform another Align Now IF. If the mesage persists there may be a hardware failure. Load the default values by pressing **System**, **Alignments**, **Load Defaults** and see if the alignment process fixes the problem. (M) or(H)

Align IF: symmetry limited, may recover next alignment Indicates that anAlign Now for the IF Assembly reached a hardware limit. Perform another Align Now IF. If the message persists there may be a hardware failure. Load the default values by pressing **System**, **Alignments**, **Load Defaults** and see if the alignment process fixes the problem. (M) or(H)

Align Now All needed The instrument requires an Align Now, All. (M)

Align RF skipped 50 MHz detected Indicates that an Auto Align of the RF Assembly was not performed because of an input signal at 50 MHz that is >–25 dBm. The alignment will not work when there is too much input power at 50 MHz. The analyzer will continue to measure properly, but automatic RF alignment will not function. To remove the message, remove the 50 MHz input signal and perform an Align Now RF. (U) or (M)

Align RF skipped No **align signal** Indicates that an Auto Align of the RF Assembly was not performed because the instrument's internal alignment signal was not detected or was invalid. This could be due to a problem with the accuracy or stability of the external 10 MHz reference, if one is present. (U) or (H)

Alignment Needed Occurs after a 'Load Defaults' of alignment data. A complete alignment must be performed. Press **Align Now**, **All**. (U) or (M)

Atten auto set to 15 dB Indicates that an input signal has been detected which is of sufficient level to force the input attenuator to be auto-coupled at 15 dB. No operator intervention is required. If the signal level is reduced the attenuator will stay at 15 dB.

This overload protection occurs at an input power level of 13 dBm ±7 dB (nominal), when the input attenuation is auto-coupled and set to <1 5 dB. To return to the original measurement setup, reduce the input signal level and press **Amplitude**. Then press **Attenuation Auto Man** twice, to toggle back to Auto. (U) or (M)

When operating remotely, the status bit should be monitored for this condition to avoid incorrect measurement results.

Cannot reach N dB points Indicates that the number of dB specified for the N dB PTS function is greater than the distance of the signal peak from the spectrum analyzer noise floor or peak threshold. (U)

CMD ERR:- _ _ The specified programming command is not recognized by the spectrum analyzer. (U)

Configuration error: Front Panel/Display ID not recognized At power on an error was encountered identifying the Front Panel/Display assembly. (H)

Configuration error: Option ID not recognized The hardware for an option was identified in an instrument that does not support it. (H)

Configuration error: RF Assembly ID not recognized At power on an error was encountered when identifying the RF Assembly. (H)

Configuration error: RF-Source Impedance mismatch A power up check determined that the RF Assembly and optional Tracking Generator Assembly do not have the same impedance. (H)

Data Memory Full<data type>:_ _ _ An attempt was made to save a file of <data type> to memory, however the memory space is full. (U)

EXT REF Indicates that the frequency reference is being supplied by an external 10 MHz source. (M)

EXT Reference in use An attempt to perform a Timebase alignment with an External Reference in use. (U)

FILE NOT FOUND Indicates that the specified file could not be loaded into spectrum analyzer memory or purged from memory because the tile name cannot be found. (U)

Freq corr off Indicates that the Freq Correct selection if Off. (M)

Input is internal Indicates that the 50 MHz osc selection is On. With the 50 MHz oscillator On, the input is routed through an internal signal path. (M)

INVALID AMPCOR: FREQ For the AMPCOR command, the frequency data must be entered in increasing order. See the description for the AMPCOR programming command for more information. (U)

INVALID CHECKSUM: USTATE The user-defined state does not follow the expected format. (U)

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

INVALID FILE NAME <file name> Indicates the specified file name is invalid. A file name is invalid if there is no file name specified or the tile name is too long. See the description for the SAVE programming command for more information. (U)

Invalid flatness data:_ _ _ A power up check determined an error in the instrument's flatness data. The 4-digit code may indicate the type of error. Error codes are described in the spectrum analyzer's service guide. (H)

INVALID HP-IB ADRS/OPERATION An HP-IB operation was aborted due to an incorrect address or invalid operation. Check that there is only one controller (the spectrum analyzer) connected to the printer. (U)

INVALID HP-IB OPERATION REN TRUE The HP-IB operation is not allowed. (This is usually caused by trying to print when a controller is on the interface bus with the spectrum analyzer.) To print to an HP-IB printer from the spectrum analyzer, you must disconnect any other controllers on the HP-IB. If you are using programming commands to print, you can use an HP BASIC command instead of disconnecting the controller. See the description for the PRINT command for more information. (U)

INVALID ITEM: Indicates an invalid parameter has been used in a programming command. (U)

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

INVALID RANGE: Stop c Start Indicates that the first trace element specified for a range of trace elements is larger than the ending trace element. When specifying a trace range the starting element must be less than the ending element. For example, TRA[2,300] is legal but TRA[300,2] is not. (U)

INVALID RS-232/OPERATION An RS-232 operation was aborted due to an invalid operation. (U)

INVALID START INDEX Indicates that the first trace element specified for a range of trace elements is not within the trace range of the specified trace. (U)

INVALID STOP INDEX Indicates that the ending trace element specified for a range of trace elements is not within the trace range of the specified trace. (U)

INVALID STORE DEST: _ _ _ The specified destination field is invalid. (U)

INVALID TRACE: _ _ _ The specified trace is invalid. (U)

INVALID VALUE PARAMETER: _ _ _ The specified value parameter is invalid. (U)

Marker Count Reduce SPAN Indicates the resolution bandwidth to span ratio is too small to use the frequency count function. Check the span and resolution bandwidth settings. The acceptable Span/Res BW ratio is 1500. (U)

Marker Count Widen Res BW Indicates that the current resolution bandwidth setting is too narrow to use with the marker counter function. (U)

Meas uncal The measurement is uncalibrated. Check the sweep time, span, and bandwidth settings, or press **AUTO COUPLE**. (U)

No points defined Indicates the specified limit line or amplitude correction function cannot be performed because no limit line segments or amplitude correction factors have been defined. (U)

Overload: Reduce Signal A signal has been applied to the input connector that caused the overload protection circuitry to engage. The input signal must be reduced. After the signal is reduced, press **Esc**. The change in the instrument's amplitude state will disengage the overload protection function. Overload protection engages under the following conditions: (U) or (M)

Attenuator Setting	Attenuator Coupling	Input Power Level
215 dB	Auto or Man	33 dBm ±3 dB (nominal)
<15 dB	Man	13 dBm ±7 dB (nominal)

CAUTION: Exposing the analyzer to high levels of input power over a prolonged time period can damage the circuitry.

When operating remotely, the status bit should be monitored for this condition to avoid incorrect measurement results.

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

Password required Indicates that the service function cannot be accessed without the password. (U)

Power-up selftest failed Boot ROM checksum: Indicates a test of the bootrom produced a checksum error. (H)

Power-up selftest failed RAM error: Indicates a test of RAM produced an error. (H)

Power-up selftest failed Checksum: Indicates a test of the instrument ROM produced a checksum error. (H)

Require 1 signal > PEAK EXCURSION above PEAK THRESHOLD Indicates that the N **dB** PTS routine cannot locate a signal that is high enough to measure. The signal must be greater than the peak excursion above the threshold level to measure. (U)

Require 3 signals > PEAK EXCURSION above PEAK THRESHOLD Indicates that the % AM routine cannot locate three signals that are high enough to measure. The signals must be greater than the peak excursion above the threshold level to measure. (U)

Require 4 signals > PEAK EXCURSION above PEAK THRESHOLD Indicates that the TOI routine cannot locate four signals that are high enough to measure. The signals must be greater than the peak excursion above the threshold level to measure. (U)

Required option not installed Indicates that the function selected requires optional hardware that is not currently available. (U)

RF LO Unlocked Indicates that the local oscillator within the instrument's RF assembly is unlocked. (H)

S in the status area of the display indicates that the service request is active. Service requests are a form of informational message. More information is available in the Programmer's Guide. (M)

SAVE LOCK The spectrum analyzer's internal memory has been locked. To unlock the memory, press **Internal Lock On Off** so that Off is underlined. For remote operation, use PSTATE OFF. (U)

Signals do not fit expected % AM pattern Indicates that the % AM routine cannot perform the percent AM measurement because the on-screen signals do not have the characteristics of a carrier with two sidebands. (U)

Signals do not fit expected TOI pattern Indicates that the TOI routine cannot perform the third-order intermodulation measurement because the on-screen signals do not have the characteristics of two signals and two distortion products. (U)

Source Protected A signal has been applied to the RF OUT connector which caused the source output protection circuitry to engage. The signal must be reduced. After the signal is reduced, press the **Esc** key to disengage the source output protection circuitry. (U) or (M)

TABLE FULL Indicates the upper or lower table of limit lines contains the maximum number of entries allowed. Additional entries to the table are ignored. (U)

TG LO Unlocked Indicates that the local oscillator within the instrument's tracking generator assembly is unlocked. (H)

TG unleveled This message can indicate the following: that the source power is set higher or lower than the spectrum analyzer can provide, that the frequency span extends beyond the specified frequency range of the tracking generator, or that the calibration data for the tracking generator is incorrect. See "Stimulus-Response Measurements" in the User's Guide for more information. (U)

Too many signal with valid N dB points Indicates the N dB PTS function has located two or more signals that have amplitudes within the specified dB from the signal peak.

If this happens, you should decrease the span of the spectrum analyzer so that only the signal that you want to measure is displayed. (U)

Trace A is not available Indicates that trace A is in the store-blank mode and cannot be used for limit-line testing. Use **CLEAR WRITE A** or **VIEW A** to change trace A from the store-blank mode to the clear write mode, and then turn on limit-line testing. (U)

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