89450A User's Guide

Agilent Technologies

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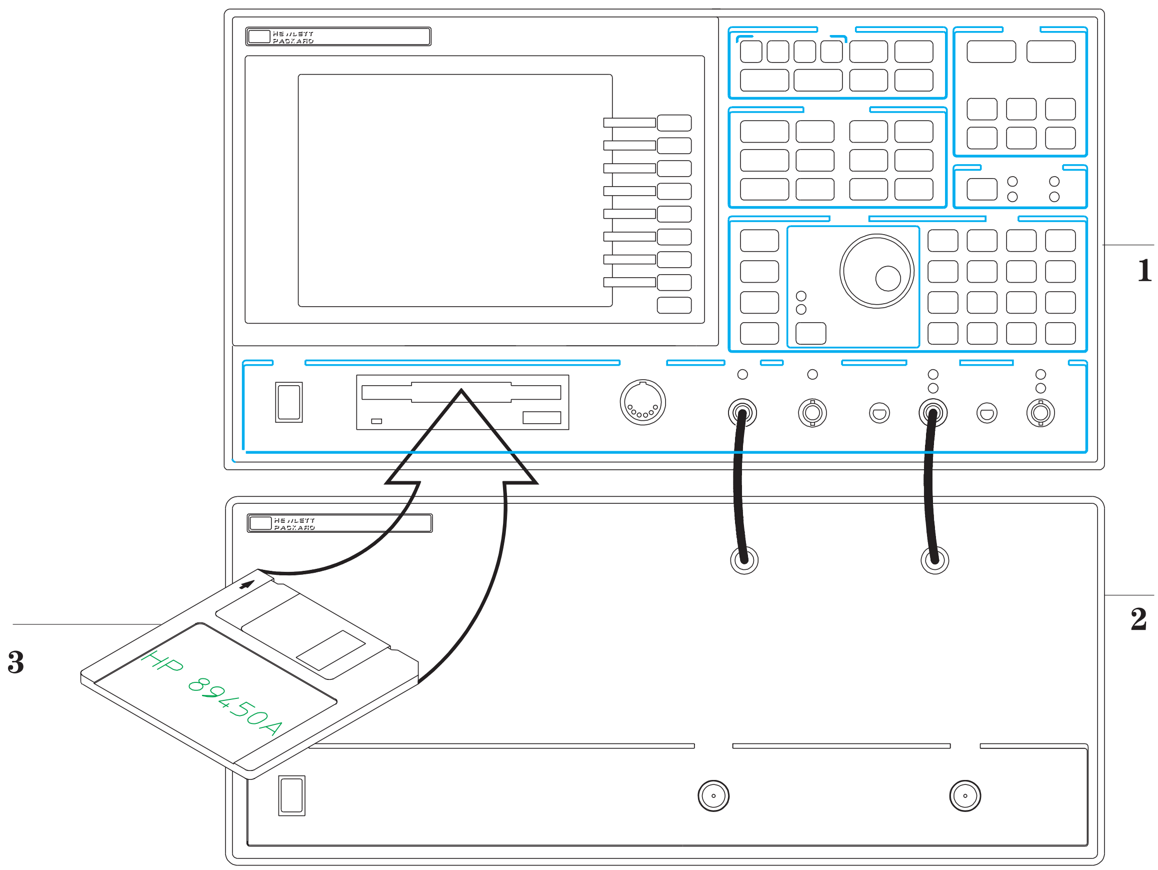
The HP 89450A at a Glance



Front Panel

1-This is the IF Section. The IF Section is the analyzer's measurement 'engine.' Use the IF Section to configure the analyzer and view measurement results.

2-This is the RF Section. The RF Section extends the frequency range of the IF Section and may contain an optional RF Source. The HP 89410A does not have an RF Section.

3-The HP 89450A consists of a diskette that adds M-16 QAM digital-demodulation capability to your HP 89400-Series analyzer.

This manual shows you how to install and use the HP 89450A in your HP 89400-Series analyzer. For details about your analyzer, see your analyzer's *Getting Started Guide* and *Operator's Guide*.

Notation Conventions

Before you use this book, it is important to understand the types of keys on the front panel of the analyzer and how they are denoted in this book.

Hardkeys Hardkeys are front-panel buttons whose functions are always the same. Hardkeys have a label printed directly on the key. In this book, they are printed like this: [**Hardkey**].

Softkeys Softkeys are keys whose functions change with the analyzer's current menu selection. A softkey's function is indicated by a video label to the left of the key (at the edge of the analyzer's screen). In this book, softkeys are printed like this: [softkey].

Toggle Softkeys Some softkeys toggle through multiple settings for a parameter. Toggle softkeys have a word highlighted (of a different color) in their label. Repeated presses of a toggle softkey changes which word is highlighted with each press of the softkey. In this book, toggle softkey presses are shown with the requested toggle state in bold type as follows:
"Press [key name **on**]" means "press the softkey [key name] until the selection on is active."

Shift Functions In addition to their normal labels, keys with blue lettering also have a shift function. This is similar to shift keys on an pocket calculator or the shift function on a typewriter or computer keyboard. Using a shift function is a two-step process. First, press the blue [**Shift**] key (at this point, the message "shift" appears on the display). Then press the key with the shift function you want to enable.
Shift function are printed as two key presses, like this:
[**Shift**] [**Shift Function**]

Numeric Entries Numeric values may be entered by using the numeric keys in the lower right hand ENTRY area of the analyzer front panel. In this book values which are to be entered from these keys are indicted only as numerals in the text, like this:
Press 50, [enter]

Ghosted Softkeys A softkey label may be shown in the menu when it is inactive. This occurs when a softkey function is not appropriate for a particular measurement or not available with the current analyzer configuration. To show that a softkey function is not available, the analyzer ''ghosts" the inactive softkey label. A ghosted softkey appears less bright than a normal softkey. Settings/values may be changed while they are inactive. If this occurs, the new settings are effective when the configuration changes such that the softkey function becomes active.

In This Book

This book, “HP 89450A User’s Guide”, shows you how to install and use the HP 89450A application software in an HP 89400-Series analyzer. This book also contains all HP-IB information for the HP 89450A application software.

To Learn More About the HP 89400-Series Analyzers

To learn more about HP 89400-Series analyzers, see the *Getting Started Guide* and *Operator’s Guide* shipped with your HP 89400-Series analyzer.

Table of Contents

1

Loading the HP 89450A Application

This chapter shows how to load and run the HP 89450A application in an HP 89400-Series Vector Signal Analyzer.

To determine if your analyzer can run the application

To run the HP 89450A application software, your analyzer must have the options and hardware shown below. The following steps show you how to determine if your analyzer has these options and hardware.

- Option AYA (Vector Modulation Analysis)
- A50 Digital Filter assembly, Revision C or newer (part number 89410-69550).

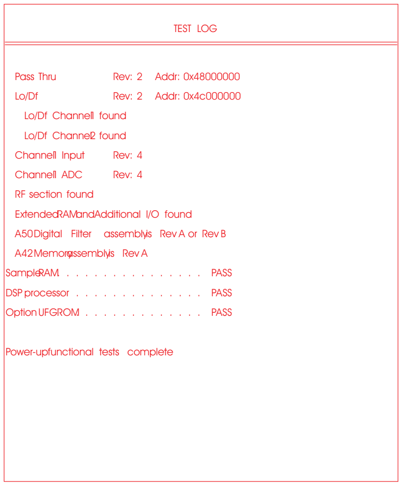
1 Display the `OPTIONS CONFIGURATION` table.
Press [**System Utility**], [options setup].

2 Check to see if option AYA is installed in your analyzer. The analyzer displays `YES` under `INSTALLED` if the option is installed.

3 Check to see if your A50 Digital Filter assembly is revision C or newer.
Set the power switch to OFF.
Set the power switch to ON to run the power-up tests.
Press [**System Utility**], [more], [diagnostics], [test log **on**].

The test log contains the results of the power-up tests. The power-up tests report the version of the A50 Digital Filter assembly. Verify that your analyzer has a revision greater than Rev B.

4 If your analyzer does not have all of the above options and hardware, you must purchase the options or hardware that you are missing. To do this, contact your Hewlett-Packard sales representative or your local Hewlett-Packard Sales and Service office (listed on the inside, rear cover of this manual).



The power-up tests report the version of your A50 Digital Filter assembly. This analyzer needs a new A50 Digital Filter Assembly because the version (Rev) is NOT Rev C or newer.

To give your analyzer permission to use the application

The HP 89450A application consists of an HP 89400-Series Firmware Update kit and two 3.5” disks: the *Install* disk and the *Application* disk. The firmware-update kit contains everything you need to install the latest firmware in your analyzer. The *Install* disk gives the analyzer permission to use the HP 89450A application. The *Application* disk contains the HP 89450A application software.

This procedure shows you how to give your analyzer permission to use the application.

1 Upgrade your instrument firmware.
Follow the instructions in the HP 89400-Series Firmware Update kit.

2 Set the line switches to ON.

3 Insert the Install disk into the analyzer’s internal disk drive.

4 Give your analyzer permission to use the application software:
Press [**System Utility**], [options setup], [install from option disk]

5 Remove the Install disk.

6 Cycle power (turn the power switch off, then on).

7 Check that your analyzer has permission to use the HP 89450A application:
Press [**System Utility**], [options setup]

Look for ***0 Custom Application* or ***1 Custom Application* in the OPTIONS CONFIGURATION table. This entry must exist for your analyzer to use the HP 89450A application. If this entry does not exist, repeat the above procedures.

To allocate memory for the application

The analyzer loads the HP 89450A application into RAM. The following procedure shows you how to allocate enough RAM for the HP 89450A application.

1 **Display the MEMORY USAGE table.**
Press [**System Utility**], [memory usage]

2 **Determine if sufficient memory is allocated for the HP 89450A application.**

The HP 89450A application requires approximately 200,000 bytes of RAM. If the number of bytes allocated for applications (*Applications* in the MEMORY USAGE table) is less than this, you must perform the following steps.

3 **If your analyzer has Option 1C2 (HP Instrument BASIC), perform steps 4 and 5. If your analyzer does not have Option 1C2 , skip steps 4 and 5.**

CAUTION

Steps 4 and 5 remove all IBASIC programs. If necessary, save all IBASIC programs before performing these steps. To allocate application memory in analyzers that have Option 1C2, you must first set IBASIC memory to zero. You can reallocate IBASIC memory after you allocate memory for applications.

4 **Note the amount of memory allocated for IBASIC. If IBASIC memory is zero, skip step 5; if is is not zero, you must perform step 5.**

5 **Set IBASIC memory to zero (the [configure IBASIC memory] softkey exists only in analyzers that have Option 1C2).**
Press [configure IBASIC memory], [IBASIC memory]
Press 0 (zero), [enter] to set IBASIC memory to zero.
Press [Return] (bottom softkey)

6 **Allocate memory for the application.**
Press [configure app memory], [Appl memory]
Press 200000, [enter] to allocate 200,000 bytes for the HP 89450A application.
Press [Return] (bottom softkey)

7 Look at *Bytes Allocated* for *Applications* in the MEMORY USAGE table and verify that 200,000 bytes (or more) are allocated for applications.

8 If desired, reallocate IBASIC memory (if your analyzer has Option 1C2).
Press [configure IBASIC memory], [IBASIC memory]
Set IBASIC memory to the size written down in step 4.
Press [Return] (bottom softkey)

HINT

You can install option UFG (4 MByte Extended RAM and Additional I/O) to add an additional 4 MegaBytes of memory. To order this option, contact your local Hewlett-Packard Sales representative.

HINT

You will need to allocate much more than 200,000 bytes if you have other applications loaded into the analyzer. In this case, allocate enough memory to load all applications.

To run the application, you must have at least 200,000 bytes allocated for application memory.

MEMORY USAGE

Purpose	Bytes Allocated	Bytes Used	Bytes Free
Measurement	896588	896588	0
LAN	300000	300000	0
Applications	200000	20	199980
IBASIC	0	0	0
RAM Disk	65536	65536	0
Data Regs	0	0	0
Trace Buffers	0	0	0
Unallocated	835992	0	835992

Meas Memory Configuration

Max frequency points:	1601
Num math temp:	6

Memory Usage Table

To load the application

Prior to loading the HP 89450A application software, you must complete the previous procedures. The previous procedures determine if your analyzer has the necessary options and hardware to load the application, give your analyzer permission to use the application, and allocate sufficient memory for the application.

1 Insert the Application disk into the analyzer's internal disk drive.

2 Make the internal disk drive the default disk:
Press [**Disk Utility**], [default disk], [internal].

3 Load the application:
Press [load application].

When you press [load application], the analyzer finds the first application on the default disk and loads that application into the analyzer's volatile RAM. If you want, you can now remove the application disk from the internal disk drive.

If you create a disk that has multiple applications on it, insert the disk, display the disk catalog, and then rotate the knob to select the desired application. In this case, the analyzer loads the selected application when you press [load application].

4 After the application is successfully loaded, display the application's main menu:
Press [**SHIFT**], [**Instrument Mode**].

The analyzer loads the application into volatile RAM. Therefore, the application must be reloaded if you cycle or remove power to the analyzer.

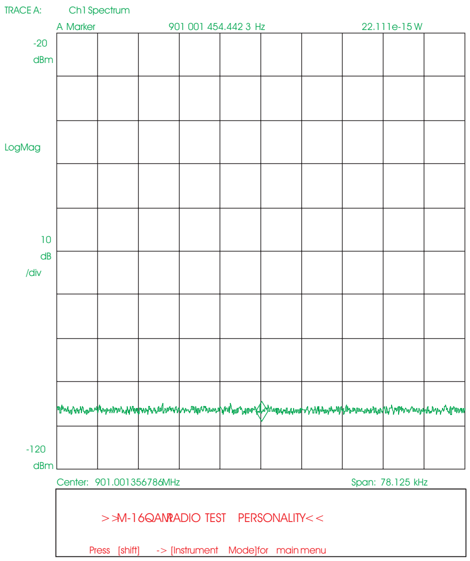
You can use the analyzer's auto-load feature to automatically load the application at power on. At power on, the analyzer searches its internal disk drive and NVRAM (non-volatile RAM) and automatically executes all files that end with .APP. The filename for the HP 89450A application is HP89450A.APP. Therefore, if you insert the Application disk in the analyzer's internal disk drive, the analyzer automatically loads the application (since it ends with .APP) at power on.

Hint

To override the analyzer's *auto-load* feature, press and hold [**Preset**] while powering on the analyzer.

Hint

You may want to store the application in the analyzer's non-volatile RAM (NVRAM). That way, you don't have to keep the application disk near the analyzer. To store the application in NVRAM, insert the *Application* disk and press [**Disk Utility**],[copy file]. Then set [source file] to `INT:HP89450A.APP` and [destn file] to `NVRAM:HP89450A.APP`, and press [perform file copy]. Since the filename ends in .APP, the analyzer will load the application from NVRAM at power on unless you hold the [**Preset**] hardkey.



The analyzer displays a message after successfully loading the application.

Application Loaded Into Analyzer

2

About the HP 89450A Application Software

This chapter describes the operation of the HP 89450A application software.

About the HP 89450A Application Software

The HP 89450A Application software adds M-16QAM digital demodulation to your HP 89400-Series analyzer. The application software:

- Lets you use other powerful features in the analyzer to customize measurements for your specific application (such as advanced signal analysis, display features, averaging, and triggering).
- Demodulates M-16QAM signals that conform to RCR Standard 32 (D-MCA).
- Demodulates outbound slots, inbound standard slots, and inbound sub-slots.
- Automatically configures the analyzer to perform the following one-button tests:
  - Modulation Accuracy
  - Adjacent Channel Power
  - Occupied Bandwidth
  - Burst Power Profile

Using the Application Software

The HP 89450A Application software works in any HP 89400-Series analyzer that has the following options and hardware installed (to determine if your analyzer has these, see "*To determine if your analyzer can run the application*" in chapter 1):

- Option AYA (Vector Modulation Analysis)
- A50 Digital Filter assembly greater than Rev. B

NOTE

The HP 89450A application software is designed for use with the Channel 1 input. The HP 89450A application software does not support the use of Channel 2 or the ch1 + j*ch2 receiver (under [**Instrument Mode**], [receiver]).

NOTE

You may want to install option UFG to improve resolution. With option UFG (4 MByte Extended RAM and Additional I/O), the HP 89450A application software provides up to 20 points-per-symbol resolution. Without option UFG, the maximum resolution is 10 points-per-symbol . For example, the burst-power profile is limited to a maximum of 10 points-per-symbol without option UFG; with option UFG, the maximum resolution is 20 points-per-symbol.

Displaying Application Menus

After loading the application, you display the application's main menu by pressing [**Shift**], [Instrument Mode]. The application contains several layers of menus. In other words, some softkeys display another menu, which in turn contain softkeys that display other menus.

If you are using one of the application's menus and you press any hardkey, the analyzer replaces that menu with the hardkey's menu. There are two ways to return to the application's menu:

- Press [**Shift**], [Instrument Mode] to return to the application's main menu. Then press the softkeys that display the desired menu.
- Press [**Shift**] [**.**]. In other words, press the [**Shift**] hardkey, followed by the decimal point hardkey (located on the numeric keypad). This feature quickly returns you to the last (previously displayed) application menu. If you preset the analyzer, you must display the application's main menu before you can use this feature.

Using Online Help

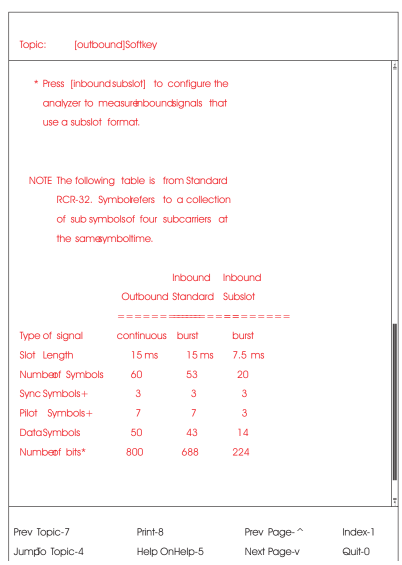
The application software comes with its own online help. You access online help for the application the same way you access online help for the analyzer—by pressing the [**Help**] hardkey.

As with the analyzer, use online help to learn specifics about any key. These specific details, often called *reference* information, are only located in online help—they are not contained in this manual. Therefore, for in-depth details about any key, you must use online help.

Here are some additional details you should know when using online help with the application software.

- The online help index does not contain index entries for application topics.

- To display helptext for application softkeys, the current softkey menu must be an application menu. Within online help you cannot press [**Shift**], [Instrument Mode] or [**Shift**], [.] to display an application menu– pressing [**Shift**] displays online help for the [**Shift**] hardkey; pressing [Instrument Mode] displays online help for the [Instrument Mode] hardkey; pressing [.] displays online help for the decimal point hardkey. For example, if you display online help for the application's [outbound] softkey, and then press [Average] to display online help for the Average hardkey, you cannot get back to the application's menu by pressing [**Shift**], [Instrument Mode]. To return to the application's menus, you must exit online help (by pressing [**Help**] or [0]) and press [**Shift**], [Instrument Mode].


Topic: [outbound]Softkey

* Press [inbound subslot] to configure the analyzer to measure inbound signals that use a subslot format.

NOTE The following table is from Standard RCR-32. Symbol refers to a collection of sub symbols of four subcarriers at the same symbol time.

	Outbound	Inbound Standard	Inbound Subslot
Type of signal	continuous	burst	burst
Slot Length	15 ms	15 ms	7.5 ms
Number of Symbols	60	53	20
Sync Symbols+	3	3	3
Pilot Symbols+	7	7	3
Data Symbols	50	43	14
Number of bits*	800	688	224

Prev Topic-7 Print-8 Prev Page-^ Index-1
Jump To Topic-4 Help On Help-5 Next Page-v Quit-0

Portion of Helptext for the [outbound] Softkey

Measurement Tips

The following lists some tips that you may find useful.

- Each test automatically sets the analyzer's symbol rate. If your signal uses a different symbol rate than that set by a test, simply press [**Instrument Mode**], [demodulation setup], [symbol rate] and enter the symbol rate for your signal.

- The Burst Power test displays measurement results as input time ([**Measurement Data**], [more choices], [input time]). Input time shows symbol locations on the time-domain waveform. Changing [pts/symbol] does not change the time resolution for input time because of the way the analyzer acquires this measurement data. To increase the time resolution for input time, increase the frequency span to 31.25 kHz or greater (you must have option UFG to do this), which changes the points-per-symbol from 10 to 20 (max time points may need to be 2048 or more to increase the frequency span to 31.25 kHz or greater– press [**System Utility**], [memory usage], [configure meas memory], [max time pts]). Remember too, that increasing the frequency span decreases measurement speed.

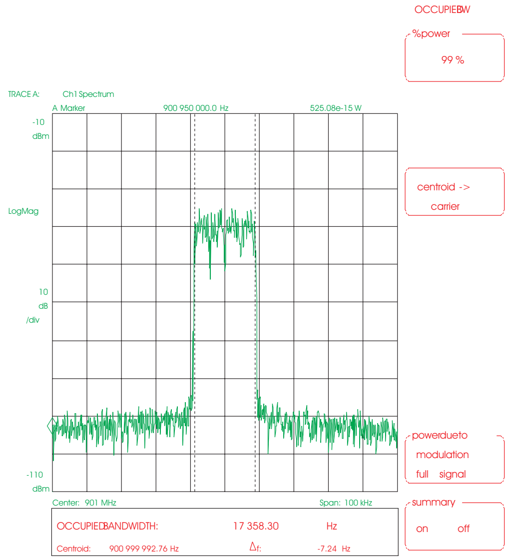
- You must set [max time pts] | 1024 and [max freq pts] | 1601 to obtain accurate results (press [**System Utility**] [memory usage] [configure meas memory]). The application displays a warning message if these values are too low. Best performance is achieved when [max time pts] = 1024. Measurement speed decreases if you increase [max time pts] above 1024.

Running a Test

You make measurements by running one of the application's one-button tests. Chapter 3 includes procedures that show you what to do before you run a test, how to run a test, and how to choose the best configuration.

Running a test displays another softkey menu that lets you modify parameters specific to the test. For example, pressing [Occupied Bandwidth] displays another softkey menu that, among other things, lets you select the percentage of power ([% power]) used in the measurement. You can change any selection in this menu and the analyzer will remember your changes until you run another test or press [Test Preset] or [**Preset**].

Menu displayed when you run the occupied-bandwidth test.



Parameters Set When You Run a Test

Table 2-1 shows the parameters set when you first run a test. Once the test is running, you can change any of these parameters and the test will use your changes for the duration of the test. For example, you may want to turn averaging off, or change parameters such as the frequency span or data format. Remember, though, that selecting another test reconfigures the analyzer for that test, which means that the test may override some or all of your changes.

Some of the parameters in Table 2-1 are also updated whenever you change the transmission format or the M-16QAM format. For example, if you are running a test and you change the transmission format, the analyzer automatically resets all trigger parameters to measure that transmission format.

As shown in Table 2-1, the Adjacent-Channel Power and Occupied-Bandwidth tests also set the trigger level. These tests only set the trigger level when the transmission format is inbound. For inbound signals, these test set the trigger level 40 dB below the current range setting. After you run either test, you can modify the trigger level, but if you change the range, the tests automatically set the trigger level 40 dB below the new range setting.

HINT

To see the value used for a parameter, run the test, then press the softkey that sets the parameter, or press [**View State**], [measurement state] or [input/source state].

HINT

If you modify test parameters, the quickest way to return them to their default values is to press [**Shift**], [**Instrument Mode**], [select test], [test preset].

Table 2-1: Parameters Set by Each Test

Parameters Set by All Tests		
Instrument Mode		
Averaging		
Trigger type ❑		
Measurement data		
Data format		
Summary views OFF		
Channel 1 input ON		
Burst Power and Modulation Tests	**Additional Parmeters Set by Burst Power Test**	**Additional Parameters Set by Modulation Test**
Alpha	Trace A active, input time	All traces active and overlayed
Symbol rate	Template ❍	Number sub channels: ALL
Measurement filter	slot view selected	
Reference filter	X-axis scaling (X scale markers)	
Points/symbol		
Result length ❑		
Pulse search ❑		
Sync search ❑		
Search length ❑		
Single grid		
Frequency span		
Pilot tracking: ON		
Occupied Bandwidth and Adjacent Channel Power Tests	**Additional Parameters Set by Occupied Bandwidth**	**Additional Parameters Set by Adjacent Channel Power**
RBW mode	power(%): 99%	Low and High adjacent-channel offsets
Window ❑		Adjacent channel bandwidth ❍
Time length		Reference channel bandwidth ❍
Frequency span ❍		
Power-due-to-full-signal ❑		
Single grid		
Trace A active, spectrum		
Trace B inactive, signal power versus time		
Trigger level (see text on previous page)		
Trigger holdoff		
Number of frequency points (1601)		

❑ A test sets this parameter the first time you run the test or when you change the transmission format.

❍ A test sets this parameter the first time you run the test or when you change the M-16QAM format.

Tracking Carrier-Frequency Drift

For demodulated measurements, such as the Burst Power or Modulation Test, you must set the analyzer's center frequency within 100 Hz of your carrier frequency to obtain carrier lock. If you don't know your carrier frequency, see "*To choose the best configuration*" in chapter 3 to learn how to find your carrier frequency.

Once carrier lock has been achieved, the analyzer can track carrier-frequency drift up to 100 Hz between measurements. The accumulated drift that the analyzer can track depends on the frequency span. With the default frequency span of 19.53125 kHz, the analyzer can track accumulative drifts up to (400 Hz. In other words, the analyzer can maintain carrier lock from one measurement to the next if your carrier frequency does not drift more than 100 Hz between measurements, and the accumulated drift does not exceed (400 Hz.

You can extend the accumulated drift that the analyzer can track by increasing the frequency span. However, increasing the frequency span decreases measurement speed.

$$\frac{Span - 18.5\,kHz}{2} - 100\,Hz = \pm Accumulated\ Drift$$

Carrier-Frequency Drift and SYNC NOT FOUND

The analyzer only tracks carrier-frequency drift from one measurement to the next. Drifts more than (100 Hz between measurements can cause unexpected loss of sync (SYNC NOT FOUND). For example, if you pause the Modulation Accuracy test, and your carrier-frequency drifts more than (100 Hz before the next measurement, sync can be lost until you manually retune the analyzer's center frequency to be within (100 Hz of the drifted carrier.

You may also notice this problem when performing lengthy time-capture measurements. For example, if you do a lengthy time-capture measurement and the carrier drifts more than (100 Hz before the next time-capture measurement, the analyzer will lose sync and display SYNC NOT FOUND.

About Adjacent Channel Power

There are many ways to define adjacent channel power measurements (ACP) for pulsed signals. Each method has it's advantages and disadvantages, and each provides a different result. What follows is a brief tutorial on the different approaches commonly used. The last paragraph of this section mentions the method used by the HP 89450A application.

As shown below, the power in a channel, or adjacent channel, can be determined from the power spectral density function (PSD) of a frequency waveform. In theory, it's necessary to observe the waveform over an infinite amount of time in order to compute PSD. However, since infinitely long observations aren't practical, the waveform is observed over shorter periods of time with a corresponding loss in frequency resolution.

The PSD function Gxx(f) is defined as:

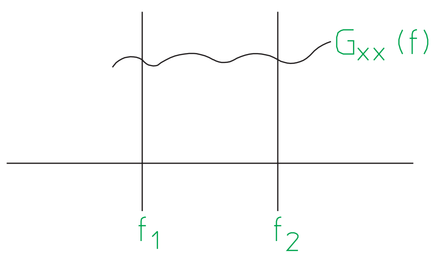
$$G_{xx}(f) = \lim_{T \to \infty} \frac{2}{T} E\left[\left| X(f,T) \right|^2 \right]$$

where:

$$X(f,T) = \int_{-\frac{T}{2}}^{\frac{T}{2}} x(t)\, e^{-j\,2\pi f t}\, dt$$

The power in the channel defined by f1, f2 is:

$$P = \int_{f_1}^{f_2} G_{xx}(f)\, df$$



Using PSD to Compute Channel Power

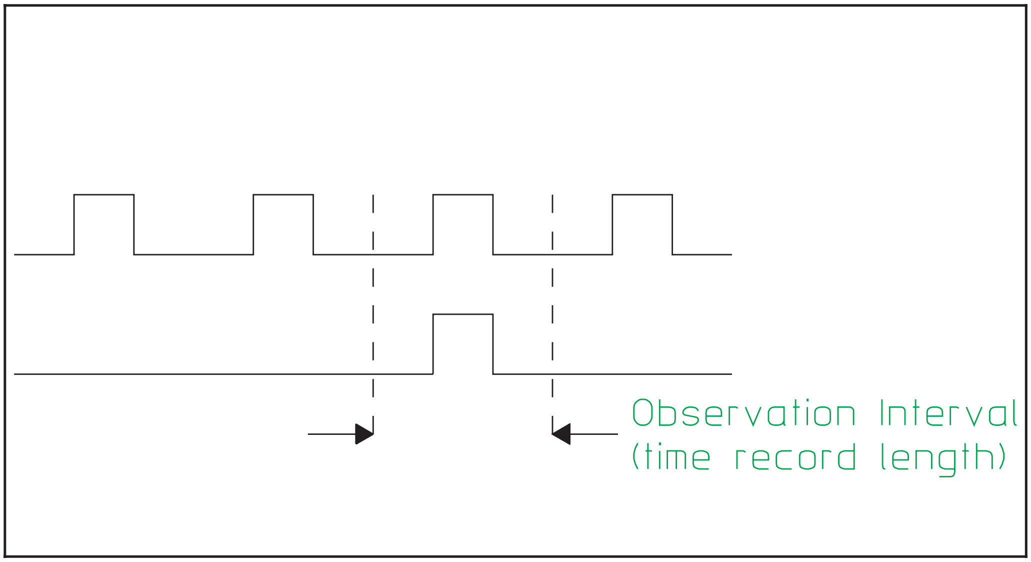
In general, shortening the observation interval does not degrade the estimate of PSD, provided that the signal appears to be stationary (in a statistical sense) within the period of observation. For pulsed signals, this would imply an observation interval that includes many pulses (i.e. many frames of a TDMA signal).

As the observation interval is decreased to the length of a pulse, or even shorter, the signal no longer appears stationary within the observation interval and the observed PSD becomes a function of time, length of observation, and also a function of the measurement method.

The adjacent channel power ratio (ACPR) is the ratio of the power of the transmitted signal in the assigned channel, to the power in an adjacent channel. It's intended to be a measure of a transmitters potential for interfering with a receiver on an adjacent (upper or lower) channel. Since receivers are sensitive to both the time and frequency distribution of the power, a measurement that observes a signal for a long period of time (several pulses) may not be a good indicator of a transmitter's potential for interference.

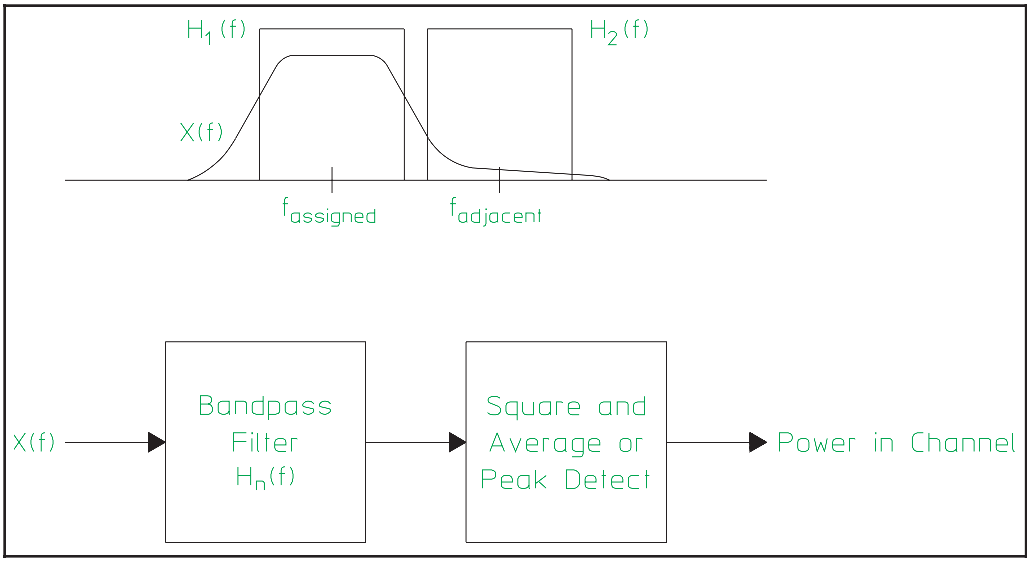
For example, a continuous carrier and a pulsed carrier can have the same average power. Yet, the peak power of the pulse modulated carrier is greater and is more likely to result in a bit error. For this reason, ACPR measurements, which by definition are frequency selective, are often designed to be time selective as well.

One method for determining the ACPR uses a PSD function that is defined as the theoretical PSD of a signal containing a single pulse. Using this definition, the minimum length of the observation interval is the pulse width, and maximum length of the interval is less than the pulse repetition rate. This method has two distinct advantages. First, measurements can be made very quickly using a vector signal analyzer. The analyzer digitizes the pulse and then uses an FFT to estimate PSD. Second, the result is not dependent on the settling characteristics of a measurement filter—a problem described below. It's worth noting that a window function is not used in the spectrum calculation, as the pulsed signal is self windowing.

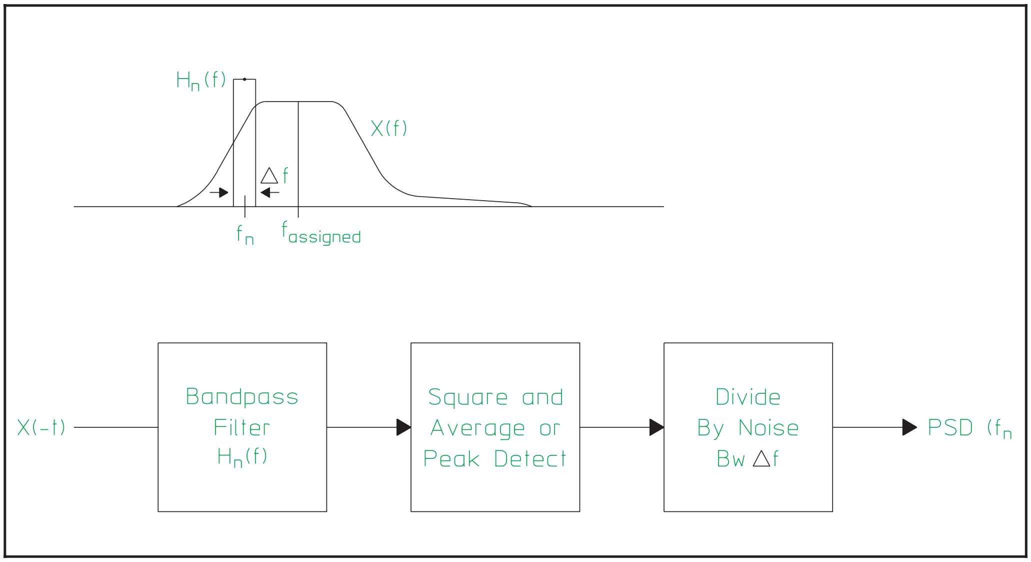


Using a Single Pulse to Determine ACPR

Another method for determining ACPR is to take the ratio between the detected powers at the output of two bandpass filters, each the width of the channel, as shown below. One filter is centered on the assigned channel, the other on an adjacent channel. The filters provide the necessary frequency selectivity in the power measurement. However, because the filters have a bandwidth that is wide enough to allow most of the signal to pass through it, the power at the output of each filter is a function of time, and in the case of the assigned channel filter, will closely follow the instantaneous power of the signal itself. As a result, the method used to determine the power at the output of the filter must be defined. For example, the power could be defined as: the average power over all time, the average power over the duration of the pulse, or the peak power.



Using Two Bandpass Filters to Determine ACPR



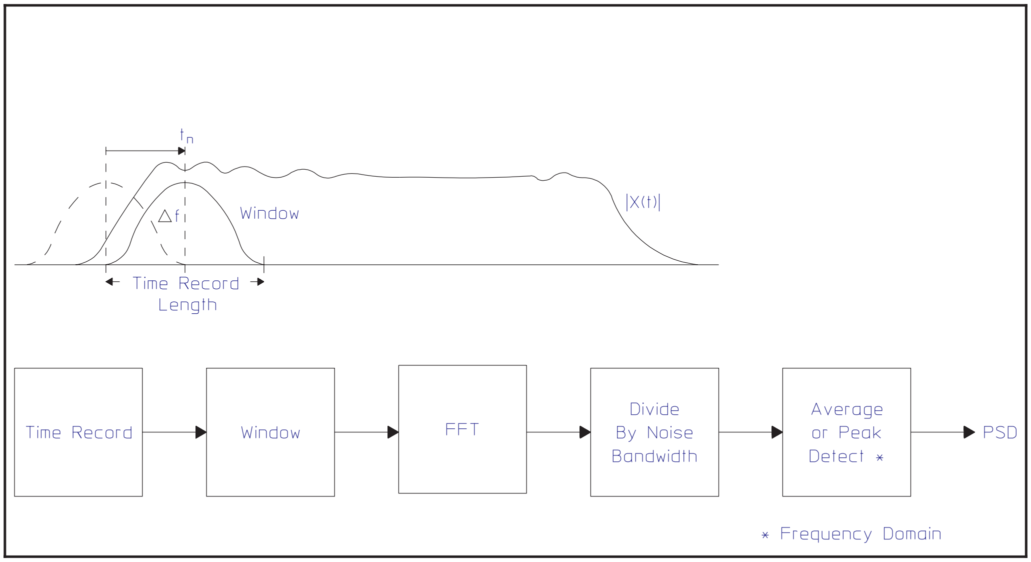
Using Narrow Filters to Determine PSD

The ACPR can also be determined using filters that are much narrower than the channel to estimate the PSD function over the frequency range of the assigned channel and the adjacent channel, as shown above. The PSD at the center of each filter is the detected power at the output of the filter divided by the filter's noise bandwidth. The PSD function, which has units of dBm/Hz, can then be integrated over the channel bandwidth to determine the total power in the channel. Often, the PSD function is weighted before integration to produce a result equivalent to the channel-filter method (assuming the channel filter is not rectangular).

In general, a narrower filter has a longer impulse response. When the impulse response of the filter is long, (e.g. relative to the pulse repetition rate of a TDMA signal), then a reasonable estimate of the theoretical PSD is obtained. However, as was mentioned earlier, the theoretical PSD based on long observations may not be a good basis for a measurement intended to predict interference. For shorter impulse responses, the measurement becomes time selective and the problem of filter settling must be again be addressed in the definition of ACPR.

This measurement method, and the channel-filter method described previously, are often implemented using analog swept-spectrum analyzers. With an analog spectrum analyzer there is only a single swept-tuned filter—the RBW filter. With a single filter, the measurement time is increased since the filter must be repositioned at each frequency to be measured. Also, the power measured in the assigned channel is measured at a different point in time than the power in the adjacent channel.

Using an FFT based approach, the vector signal analyzer can make a measurement similar to the swept spectrum analyzer except that the FFT is equivalent to a parallel bank of filters, which allows the power to be measured at all frequencies simultaneously. The problem of allowing the filters to settle still exists, but in a slightly different form. When the observation interval is shorter than a pulse, then the signal is no longer self windowing. In this case a window function, which weights the time data, must be used.



Using an FFT Based Approach to Determine ACPR

As might be expected, PSD computed using an FFT will be a function of both the placement of the window (in time), and also its shape. If the window is placed at the start of the pulse, and then successively moved a fraction of its overall width towards the end of the pulse, the effect is that of a convolution. In fact, the window shape is the impulse response. As with the analog filters, the power must be defined. For example, the power could be defined as a function of the peak PSD observed as the window is moved across the signal.

To make this measurement using the vector signal analyzer, an entire pulse (plus a little) would be captured and stored in the time capture buffer. A measurement would then be set up using overlap processing and peak hold averaging. A high degree of overlap would be selected, say 95%, and the main time-record length adjusted to control the length of the RBW filter's impulse response, or to set a specific RBW.

The single-pulse method for determining PSD and ACPR offers the best compromise between theory and practical time-selective measurements and is, in fact, the method used to determine ACPR in the HP 89450A application. In addition to being a very fast measurement method, the single-pulse method provides repeatable measurements since it does not depend on the designs of the bandpass filter and power detector.

3

Making Measurements

This chapter shows how to make measurements using the HP 89450A application software.

Before you run a test

This procedure shows you the initial steps you should follow before you run a test. Before you run your first test, read ''*To choose the best configuration*'' at the end of this chapter. That procedure shows you how to configure the analyzer for optimum performance.

1 Load the HP 89450A Application software as described in Chapter 1.

2 Connect your signal to the analyzer's RF input or the Channel 1 input.

3 Verify that the input range is correct (for details, see ''*To choose the best configuration*'').

4 Run the Occupied Bandwidth test.
Press [**Shift**], [**Instrument Mode**], [select test], [Occupied Bandwidth].

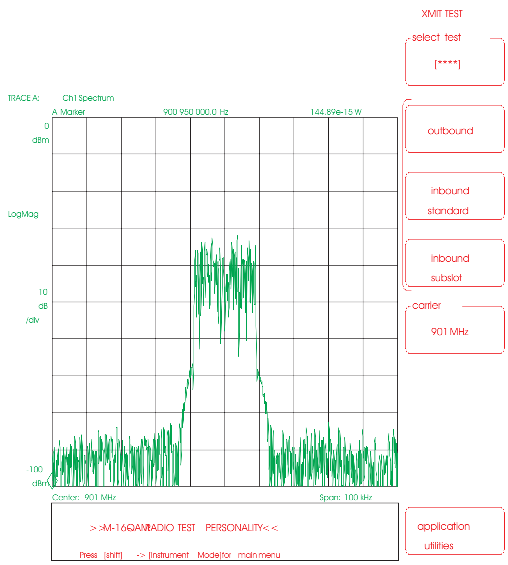
5 Set the analyzer's center frequency.
Press [centroid ™ carrier] to set the analyzer's center frequency as close as possible to the detected carrier frequency. The analyzer's center frequency must be correct for proper operation—for further details, see ''*To choose the best configuration*''.

6 Select the transmission format:
Press [**Shift**], [**Instrument Mode**], and press the appropriate softkey.

Press [outbound] if your signal is a continuous signal (from a base station repeater).

Press [inbound standard] if your signal is a burst signal (from a portable or mobile subscriber station) and your signal uses an inbound-basic slot format.

Press [inbound subslot] if your signal is a burst signal (from a portable or mobile subscriber station) and your signal uses an inbound subslot format.



HP 89450A Main Menu

To measure occupied bandwidth

Occupied Bandwidth finds the band of frequencies that contain a specified percentage of the total power within the span.

1 If you haven't already done so, perform the steps in "*Before you run a test*."

2 Display the application's main menu.
Press [**Shift**], [**Instrument Mode**].

3 Start the occupied bandwidth test.
Press [select test], [Occupied Bandwidth].

At this point, the analyzer starts the occupied bandwidth test and displays another softkey menu that lets you change parameters specific to the test.

The percentage of total power used in the measurement is set with [% power]. To modify this value, enter a new value. For example, to specify 50%, press 50%. The default value is 99%, as defined in Standard RCR-32.

The following illustration shows how the analyzer uses the value of [% power] to compute the occupied bandwidth. In this example, the analyzer searches forward from the start frequency until it finds 0.5% of the total power—this is the lower frequency point. It then searches back from the stop frequency until it finds 0.5% of the total power—this is the upper frequency point. The band of frequencies between these two points contain, in this case, 99% of the total power.

The analyzer displays a window below the trace that shows the following:

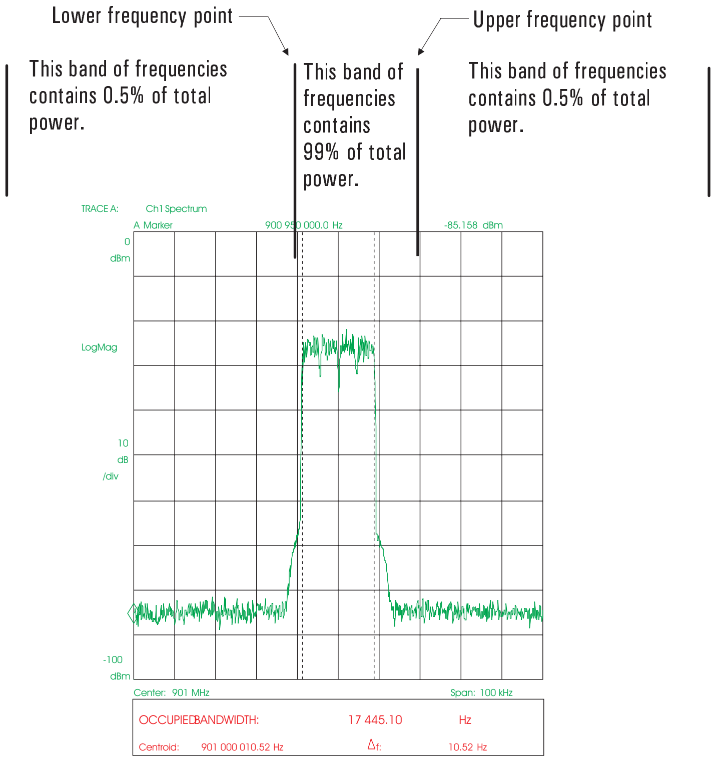
- *OCCUPIED BANDWIDTH* is the bandwidth (in Hertz) that contains the target "% power" of all power in the displayed frequency span. For burst signals, you can select [power due to **modulation**] to exclude the turn on, preamble, and turn off portion of the burst from the occupied-bandwidth computation. For details about this feature, see online help for the [power due to modulation/full signal] softkey.

- *Centroid* shows the frequency that is at the mid-point of the occupied bandwidth.

- Δf shows the difference between the Centroid and the analyzer's center (or carrier) frequency.

Note

By default, the occupied bandwidth test sets the y-axis units to dBm. If desired, you can increase measurement speed by changing the units to Watts (logarithmic units, such as dBm, require additional computation time). Units are set with the [**Ref Lvl/Scale**], [Y ref level] or [**Ref Lvl/Scale**], [X & Y units setup], [Y units] softkeys.



Occupied Bandwidth Using a Target of 99%

To measure adjacent-channel power

Adjacent-channel power measures the power in adjacent channels relative to the power in a reference channel. The analyzer's center frequency determines the center of the reference channel. Therefore, for best results set the analyzer's center frequency at the center of your spectrum.

1 If you haven't already done so, perform the steps in "*Before you run a test*."

2 Display the application's main menu.
Press [**Shift**], [**Instrument Mode**].

3 Start the adjacent channel power test.
Press [select test], [Adjacent Chan Pwr].

At this point, the analyzer starts the adjacent-channel power test and displays another softkey menu that lets you change parameters specific to the test. The test automatically selects:

- A reference channel that is 18.0 kHz wide, centered around the analyzer's center (carrier) frequency (you set the analyzer's center frequency in step 1).
- Adjacent channels that are 18 kHz wide, the center of which are offset from the analyzer's center (carrier) frequency by ± 25 kHz.

The adjacent-channel power test displays the power in the reference channel and the Adjacent-Channel Power (ACP) of the low and high channels. These values are computed as follows (the results are not normalized per unit Hertz).

$Reference_{dBm} = 10 \log \left(\frac{P_{ref}}{1mW} \right)$; P_{ref} is the total power in the reference channel.

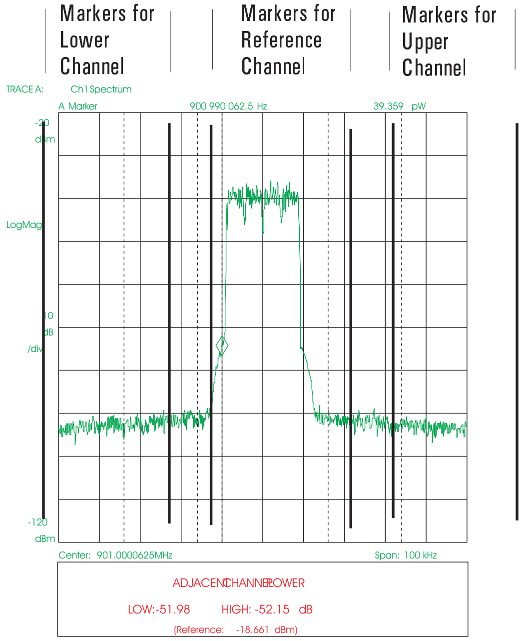
$LOW_{dB} = 10 \log \left(\frac{P_{low}}{P_{ref}} \right)$; P_{low} is the total power in the lower channel.

$HIGH_{dB} = 10 \log \left(\frac{P_{high}}{P_{ref}} \right)$; P_{high} is the total power in the upper channel.

For burst signals, you can select [power due to **modulation**] to exclude the turn on, preamble, and turn off portion of the burst from the Adjacent-Channel Power computations. For details about this feature, see online help for the [power due to modulation/full signal] softkey.

Note

The analyzer displays “****” if it cannot compute the power in an adjacent channel. This may occur if you specify a frequency span, low offset, or high offset, that places the adjacent channel too far outside the displayed span.



Adjacent-Channel Power Test

To measure burst power (transient response)

The HP 89450A lets you measure the power of burst, M-16QAM signals, such as those from a portable or mobile station. You can measure the power in a slot, or the power of the burst during turn-on or turn-off. You can also display a template to see if the burst profile conforms to that defined in Standard RCR-32. For this test, the analyzer's center frequency must be within ± 100 Hz of the detected carrier frequency to achieve carrier lock.

1 If you haven't already done so, perform the steps in ''*Before you run a test*.''

2 Display the application's main menu.
Press [**Shift**], [**Instrument Mode**].

3 Start the burst-power test.
Press [select test], [Burst Power].

At this point, the analyzer starts the burst-power test and displays another softkey menu that lets you analyze different portions of the burst. Online help provides details for each of these softkeys.

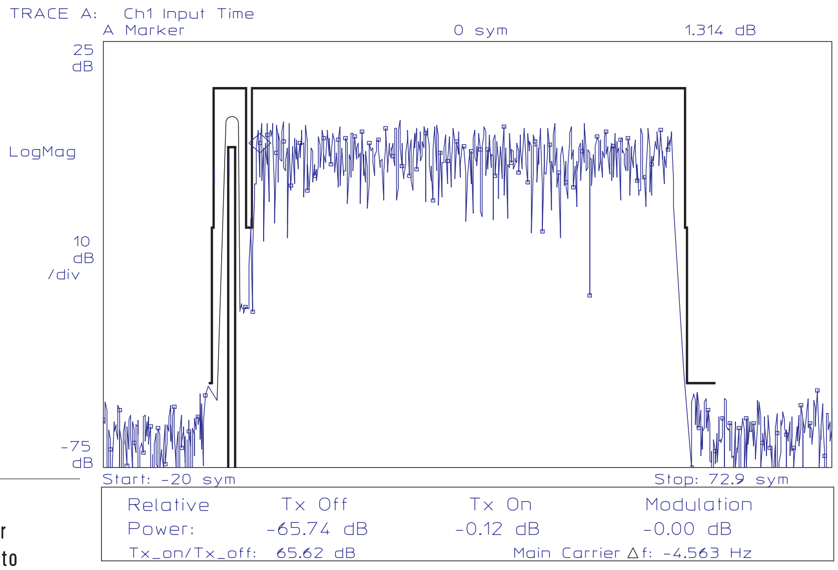
- Press [slot] if you want to see the power for a single slot (15 ms).
- Press [turn on] if you want to see the burst's rising edge, including preamble.
- Press [turn off] if you want to see the burst's trailing edge.
- Press [template™], [template **on**] to display the Standard RCR-32 template. Use this template to see if your burst profile conforms to that defined in Standard RCR-32. The analyzer only displays the template when [power **relative**] is selected (see text below). There is a separate template for slot, turn on, and turn off. The analyzer automatically displays the appropriate template.
- Press [summary **on**] to display the burst-power summary table. This table displays all results from the burst-power test, such as the carrier on/off ratio, the power contained in the preamble, and the symbol with the peak power.

The Burst Power test automatically selects [power **relative**]. With [power **relative**], the test computes the average power due to modulation (excluding power in the AGC preamble) and assigns this a value of 0 dB. The results of all other power computations (such as Tx Off and Tx On) are relative to this ''0 dB'' reference.

By default, power units are dBm and time units are symbols. To show power in Watts, press [**Data Format**], [magnitude **linear**]. To show time in seconds, press [**Ref Lvl/Scale**] [X & Y units setup] [X units] [s].

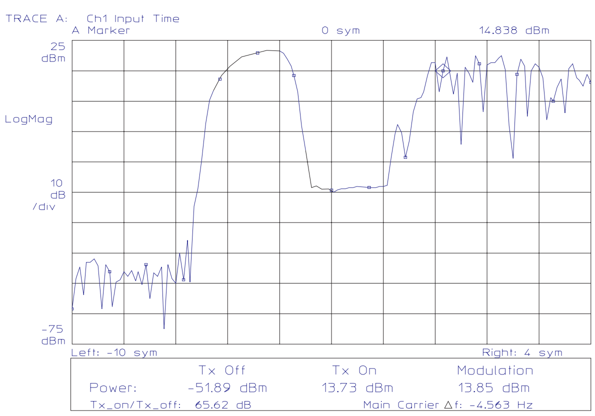
Note

The burst-power test shows power versus time. The occupied-bandwidth test and the adjacent-channel power test primarily show power versus frequency.

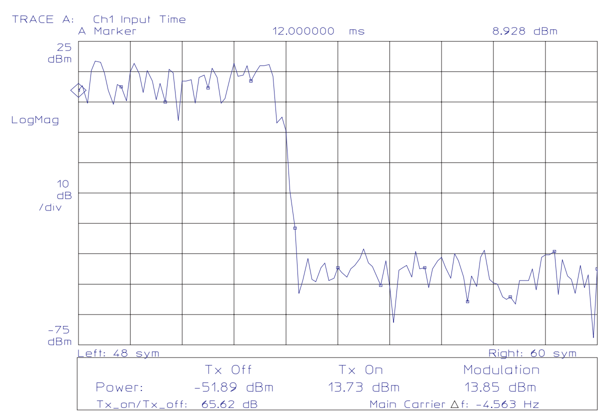


The first sync symbol is symbol 0. The Burst Power test displays symbols prior to the first sync symbol to show transmitter turn-on.

Burst Power in a Slot with Template ON and Relative Power



Displaying Turn On with Absolute Power



Displaying Turn Off with Absolute Power

To measure modulation accuracy

The modulation-accuracy test demodulates your M-16QAM signal and displays demodulated results and error information. You can display demodulated results for a single sub-channel, overlay demodulated results from all four sub-channels in a single grid, or display four separate grids—one for each sub-channel. For this test, the analyzer's center frequency must be within ±100 Hz of the detected carrier frequency to achieve carrier lock.

1 If you haven't already done so, perform the steps in "*Before you run a test*."

2 Display the application's main menu.
Press [**Shift**], [**Instrument Mode**].

3 Start the modulation test.
Press [select test], [Modulation].

At this point, the analyzer starts the modulation-accuracy test and displays another softkey menu that lets you change parameters specific to the test.

By default, the test overlays information from all four sub-channels in a single grid, where trace A is sub-channel 1; trace B is sub-channel 2; trace C is sub-channel 3; and trace D is sub-channel 4.. Press [grid **quad**] to display a separate grid for each sub-channel.

You can also isolate your analysis to a single sub-channel. Press [sub-chan 1] to only display information for sub-channel 1. Likewise, press [sub-chan 2] to only display information for sub-channel 2, and so forth. If [grid **quad**] is selected, the analyzer displays four traces for the selected sub-channel in four grids. Each trace shows different information for the selected sub-channel (for example, trace A may contain the constellation diagram, trace B may contain the error vector trace, trace C may contain the eye diagram, and trace D may contain the symbol table).

By default, circles show the specified error radius centered about ideal symbol locations, and crosses show the ideal location of pilot and sync symbols. The circle radius is specified as a peak EVM value (set with [**Data Format**], [more format setup], [state size]).

The test also displays a window at the bottom of the screen that shows the combined rms Error Vector Magnitude (EVM) of all four sub-channels, the rms EVM for each sub-channel, and the difference (Δf) between the analyzer's detected carrier frequency and the analyzer's center frequency.

The test also lets you display a *Modulation Results Summary* table, as shown in the following illustration. Press [summary **on**] to display this table. Online help for [summary **on**] describes each entry in the table.

MODULATION ACCURACY RESULTS SUMMARY

Signal Quality: GOOD

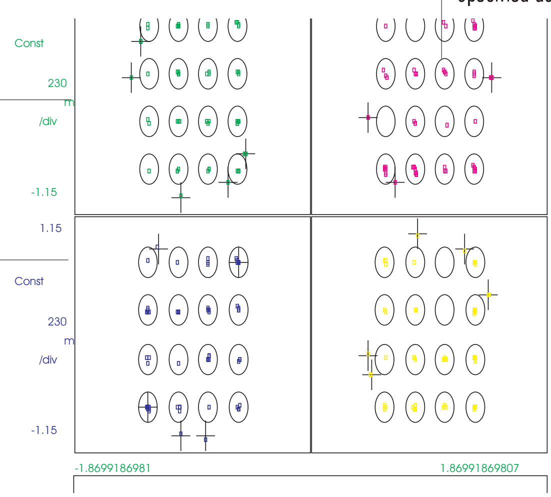
	Total	Sub_1	Sub_2	Sub_3	Sub_4	Unit
ERROR VECTOR MAGNITUDE						
rms:	1.7	1.2	2.1	2.2	1.3	%
peak:		2.6	3.6	4.4	2.3	%
symbol:		9	47	12	35	-
MAGNITUDE ERROR						
rms:	1.3	0.8	1.5	1.6	0.9	%
peak:		2.5	3.1	-4.2	-2.2	%
symbol:		9	47	21	23	-
PHASE ERROR						
rms:	1.3	1.0	1.5	1.6	0.9	deg
peak:		-3.5	-4.3	-5.9	3.1	deg
symbol:		4	40	58	24	-
FREQUENCY ERROR						
	0.05	-0.08	0.10	0.10	-0.12	Hz
ORIGIN OFFSET						
		-73.4	-77.0	-72.1	-73.5	dB
AMPLITUDE ERROR						
		0.00	0.02	-0.03	0.01	dB

Modulation Results Summary

Crosshairs show ideal locations of sync and pilot symbols. Circles show a specified error radius centered about ideal symbol locations. You determine circle radius with [**Display**], [more format setup], [state size]. Radius is specified as a peak EVM value.

Trace A shows demodulated results for sub-channel 1.

Trace B shows demodulated results for sub-channel 2.



Trace C shows demodulated results for sub-channel 3.

Trace D shows demodulated results for sub-channel 4.

Modulation Accuracy: All sub-channels, quad display

To test sub-carrier frequency tolerance

You use the modulation-accuracy test to test the sub-carrier frequency tolerance. The modulation-accuracy test lets you display a summary table that shows the carrier-frequency error of each sub-channel.

1 Run the modulation-accuracy test as shown earlier in this chapter under "*To measure modulation accuracy*."

2 Press [summary **on**] to display the summary table for the modulation-accuracy test.

The summary table displays all parameters obtained from the modulation-accuracy test. For a description of each parameter, see online help for the [summary on/off] softkey.

3 Observe the *FREQUENCY ERROR*.

The total *FREQUENCY ERROR* (also called Main Δf) is the difference between the detected carrier frequency and the analyzer's center frequency.

The FREQUENCY ERROR for a sub-channel is the difference between the sub-channel's detected frequency and ideal frequency. The analyzer computes these values as follows:

$$Frequency\ Error_1 = Detected_1 - ((CF + Main\ \Delta f) - 6.75\ kHz)$$
$$Frequency\ Error_2 = Detected_2 - ((CF + Main\ \Delta f) - 2.25\ kHz)$$
$$Frequency\ Error_3 = Detected_3 - ((CF + Main\ \Delta f) + 2.25\ kHz)$$
$$Frequency\ Error_4 = Detected_4 - ((CF + Main\ \Delta f) + 6.75\ kHz)$$

$Frequency\ Error_n$ is the sub-carrier frequency error for a sub-channel.

Main Δf is the total frequency error.

CF is the analyzer's center frequency (set with the [carrier] or [center] softkeys).

$Detected_n$ is the detected sub-carrier frequency for a sub-channel. The Burst Power test does not display this value.

4 Compare the sub-carrier frequency error for each sub-channel with your specification.

MODULATION ACCURACY RESULTS SUMMARY

Signal Quality: GOOD

	Total	Sub_1	Sub_2	Sub_3	Sub_4	Unit
			ERROR VECTOR MAGNITUDE			
rms:	1.7	1.2	2.1	2.2	1.3	%
peak:		2.6	3.6	4.4	2.3	%
symbol:		9	47	12	35	-
			MAGNITUDE ERROR			
rms:	1.3	0.8	1.5	1.6	0.9	%
peak:		2.5	3.1	-4.2	-2.2	%
symbol:		9	47	21	23	-
			PHASE ERROR			
rms:	1.3	1.0	1.5	1.6	0.9	deg
peak:		-3.5	-4.3	-5.9	3.1	deg
symbol:		4	40	58	24	-
			FREQUENCY ERROR			
	0.05	-0.08	0.10	0.10	-0.12	Hz
			ORIGIN OFFSET			
		-73.4	-77.0	-72.1	-73.5	dB
			AMPLITUDE ERROR			
		0.00	0.02	-0.03	0.01	dB

This row shows the frequency error for each sub-channel. The first entry in this row is the frequency error of the main carrier (also called Main Carrier Δf).

Summary Table for Modulation Accuracy Test

To test antenna-power tolerance

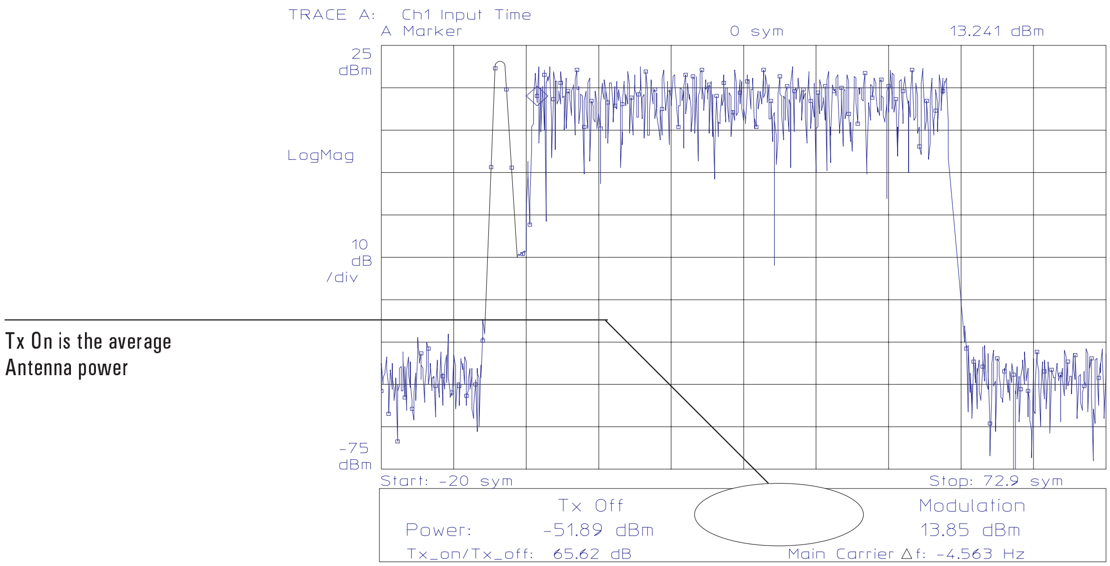
You can use the Burst-Power test or the Occupied Bandwidth test to test antenna-power tolerance. The Burst Power test displays the burst and lets you easily make power measurements in the time domain. The Occupied Bandwidth is a frequency-domain measurement— it is faster and measurement results are automatically averaged. The following steps show you how to use the Burst Power test. To learn how to use the Occupied Bandwidth test, see the last paragraph of this procedure.

1 Run the Burst Power test as shown earlier in this chapter under "*To measure burst power (transient response)*."

2 Select absolute power.
Press [power **absolute**].

3 Observe Tx On at the bottom of the display. Tx On is the average antenna power in a single slot.

You can also measure antenna power with the Occupied Bandwidth test. Simply run the Occupied Bandwidth test and select [power **due to full signal**]). The summary view in that test shows the "*Total power in span,*" which is equivalent to *Tx On* obtained in the Burst Power test. *Tx On* is a time-domain power measurement, wheras *Total power in span* is a frequency-domain power measurement.



Burst Power Test Results With Absolute Power

To test carrier-off leakage power

You use the burst-power test to test the carrier-off leakage power. The burst-power test displays the average power due to modulation, transmitter-on power, and the transmitter-off power. The transmitter-off power is the carrier-off leakage power.

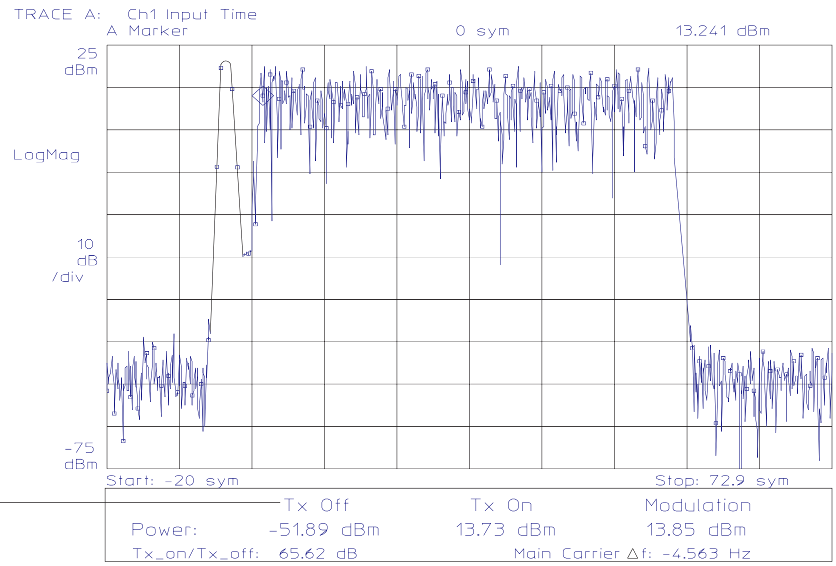
1 Run the burst-power test as shown earlier in this chapter under "*To measure burst power (transient response)*."

2 Select absolute power.
Press [power **absolute**].

3 Observe the power during the transmitter-off time (Tx Off at the bottom of the display). *Tx off* is the carrier-off leakage power.

The dynamic range of the on/off ratio is limited to approximately 71.5 dB when you use the default test setup and the input range is | – 25 dBm. This limitation is a function of the analyzer's nominal, input-noise floor and the frequency span used in data acquisition. These factors affect the minimum, measureable value of Tx Off, which is used to calculate the on/off ratio.

For input ranges ® – 30 dBm, the on/off ratio may be limited to approximately 66.5 dB. See the data sheet for your analyzer for additional information on dynamic range. For other details, see online help for the [Burst Power] softkey.



Carrier-off leakage power (Tx Off).

Burst Power Test Results with Absolute Power

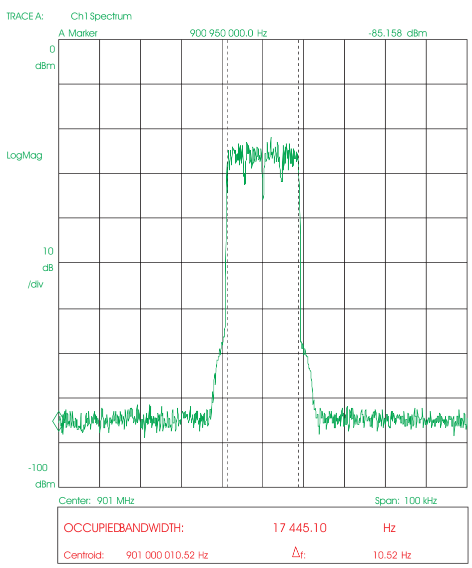
To test carrier frequency tolerance

You use the Occupied Bandwidth test to test the frequency tolerance of your carrier. The Occupied Bandwidth test displays the carrier-frequency error at the bottom of the display.

1 Run the Occupied Bandwidth test as shown earlier in this chapter under "*To measure occupied bandwidth*."

2 Observe Δf at the bottom of the display.

Δf is the carrier frequency error, and is the difference between the detected carrier frequency and the analyzer's center frequency.



Occupied Bandwidth Test

Carrier frequency error. This is the difference between the detected carrier frequency and the analyzer's center frequency.

To choose the best configuration

Measurement performance depends on analyzer configuration and the quality of your signal. This procedure shows you how to configure the analyzer for optimum performance.

1 Load the HP 89450A Application software as described in Chapter 1.

2 Verify the size of measurement memory.
Press [**System Utility**], [memory usage], [configure meas memory]. The value of [max freq pts] must be | 1601; the value of [max time pts] must be | 1024. Best measurement speed is achieved when [max time pts] = 1024 (higher values reduce measurement speed). Change these values if necessary.

3 Connect your signal to the analyzer's RF input or the Channel 1 input.

4 Verify that the analyzer's input circuitry is configured properly.
Press [**Input**] and verify the input impedance and, if necessary, the input coupling.

5 Verify that the input range is correct.
Press [**Range**], [ch1 range] and select the most sensitive range that does not overload the analyzer. The analyzer displays OV1 at the top of the display if the current range overloads the analyzer.

Since the analyzer only lets you set the range in 5dB increments, you may want to fine-tune your signal level to optimize measurement accuracy. To do this, select a range that does not overload the analyzer. Then decrease the range until the analyzer displays OV1 above the grid (for best accuracy when using the RF Section, keep the range above – 30 dBm). Now, decrease your signal level in very small increments until OV1 disappears.

6 Run the Occupied Bandwidth test.
Press [**Shift**], [**Instrument Mode**], [**select test**], [Occupied Bandwidth].

You should see the entire spectrum of your signal–if you don't, change the frequency span until you do.

7 Enter the carrier frequency of your RF signal.

The HP 89450A provides a [carrier] softkey that lets you enter the carrier frequency of your RF signal. This softkey sets the analyzer's center frequency. There are three ways to set the analyzer's center frequency:

press [**Shift**] [**Instrument Mode**] [carrier],
press [**Frequency**], [center],
or run the Occupied Bandwidth test and press [centroid ™ carrier].

For tests that use digital demodulation (Burst Power and Modulation), the analyzer's center frequency must be within (100 Hz of the detected carrier frequency, otherwise the analyzer's demodulator cannot lock onto your signal. Prior to running these tests, run the Occupied Bandwidth test and note the centroid frequency and Δf (at the bottom of the display). The centroid frequency is approximately the detected carrier frequency; Δf is the difference between the centroid frequency and the analyzer's center frequency. Verify that Δf is between –100 Hz and +100 Hz. Press [centroid ™ carrier] if Δf is incorrect.

For details about carrier drift, see ''Tracking Carrier-Frequency Drift'' in chapter 2.

8 For burst signals, examine the frequency-domain and time-domain waveforms.

Press [**Display**] [2 grids].

The Occupied Bandwidth and Adjacent-Channel Power tests automatically display the spectrum of your signal in the top grid, and the time-domain waveform in the bottom grid.

In the time-domain, the entire burst must be contained in the time record. In addition, the burst signal should be stable and approximately centered in the time record. The Occupied Bandwidth and Adjacent-Channel Power tests automatically set the trigger parameters to achieve this.

If your burst signal is *not* stable, you may need to adjust the trigger level (press [**Trigger**]). In this case, set the trigger level to obtain a stable waveform. Changing the trigger level also changes the position of the waveform in the time record.

4

HP-IB Command Reference

This chapter describes the HP-IB commands for the HP 89450A Application Software.

HP-IB Commands

This chapter describes the HP-IB commands for the HP 89450A Application software. These HP-IB commands let you control the application from an external controller.

The HP-IB commands are loaded into the analyzer with the application software. Therefore, you must load the application software to use these HP-IB commands.

The HP 89450A HP-IB commands operate the same way as the analyzer's HP-IB commands. Loading the HP 89450A Application software simply adds the HP 89450A HP-IB commands to the analyzer's HP-IB command set.

Hint

To learn how to program the analyzer with HP-IB commands, see the HP-IB documentation shipped with the analyzer.

This chapter contains the following information:

- HP-IB Cross Reference lists the HP 89450A softkeys and shows the equivalent HP-IB commands.
- HP-IB commands describe each HP-IB command for the HP 89450A application software.

HP-IB Cross Reference

Softkey	Equivalent HP-IB Command
[% power]	[SENSe:]DDEMod:MQAM:OCBandwidth:POWer:PERCentage
[Abort Test]	[SENSe:]DDEMod:MQAM:TEST:ABORt
[adj chan bw]	[SENSe:]DDEMod:MQAM:ACPower:ACBandwidth
[Adjacent Chan Pwr]	[SENSe:]DDEMod:MQAM:TEST ACP
[all sub chans]	DISPlay:MQAM:MACC:RES ALL
[Appl memory]	MEMory:MALLocate:APPLication
[Burst Power]	[SENSe:]DDEMod:MQAM:TEST BURSt
[carrier]	FREQ:CENT
[centroid → carrier]	[SENSe:]DDEMod:MQAM:OCBandwidth:CTOCenter
[composite symbol table]	CALCulate:FEED 'XTIM:DDEM:SYMB'
[D-MCA]	DDEM:MQAM:FORM DMCA
[Delete Application]	[SENSe:]DDEMod:MQAM:ABORt
[grid single/quad]	DISPlay:FORMat
[high offset]	[SENSe:]DDEMod:MQAM:ACPower:ACHoffset
[ideal state cross/circle]	DISPlay:WINDow[1–4]:TRACe:INDicator
[inbound standard]	DDEM:MQAM:SLOT:FORM INB
[inbound subslot]	DDEM:MQAM:SLOT:FORM ISUB
[input time]	CALCulate:FEED 'XTIM:DDEM:INP'
[load application]	MMEMory:LOAD:APPLication
[low offset]	[SENSe:]DDEMod:MQAM:ACPower:ACLoffset

HP-IB Cross Reference

Softkey	Equivalent HP-IB Command
[Modulation]	[SENSe:]DDEMod:MQAM:TEST MACC
[None]	[SENSe:]DDEMod:MQAM:TEST NONE
[Occupied Bandwidth]	[SENSe:]DDEMod:MQAM:TEST OBAN
[outbound]	DDEM:MQAM:SLOT:FORM OUTB
[pilot track on/off]	[SENSe:]DDEMod:MQAM:PTRack[:STATe]
[power due to modulation/full signal]	[SENSe:]SWEep:TIME:GATE:STATe
[ref chan bw]	[SENSe:]DDEMod:MQAM:ACPower:RCBandwidth
[slot]	DISPlay[:WINDow[1–4]]:MQAM:BURSt:FORMat SLOT
[state size]	DISPlay:WINDow[1–4]:TRACe:INDicator:SIZE
[sub-chan 1]	DISPlay:MQAM:MACC:RES SUB1
[sub-chan 2]	DISPlay:MQAM:MACC:RES SUB2
[sub-chan 3]	DISPlay:MQAM:MACC:RES SUB3
[sub-chan 4]	DISPlay:MQAM:MACC:RES SUB4
[summary on/off]	SCReen:CONTents:MQAM:SUMMary[:STATe]
[sym tbl fmt bin/hex]	DISP:WIND:TRAC:SYM:BITS
[Test Preset]	[SENSe:]DDEMod:MQAM:TEST:PRESet

CALCulate[1|2|3|4]:FEED — command/query

Selects the measurement data to be displayed.

Command Syntax:

```
CALCulate[1|2|3|4]:FEED <string>
```

<string> ::= (see below)

Example Statements:

```
OUTPUT 719;":CALCULATE4:FEED 'XTIM:DDEM:INP'"
OUTPUT 719;"calc2:feed 'XTIM:DDEM:SYMB'"
```

Query Syntax:

```
CALCulate[1|2|3|4]:FEED?
```

Return Format:

```
STRING
```

Attribute Summary:

```
Synchronization Required:  no
Preset State:  dependent on options installed
SCPI Compliance:  confirmed
```

Description:

This command is the same command as documented in the HP-IB Command Reference shipped with your analyzer.

The HP 89450A adds some additional measurement results, which are:

- input time (send CALC:FEED 'XTIM:DDEM:INP').
- composite symbol table (send CALC:FEED 'XTIM:DDEM:SYMB').
- sub-channel results for other measurement results documented in the HP-IB Command Reference.

Each of these measurement results are available only when the digital demodulation format is MQAM.

To obtain sub-channel results, simply append ":SUB n" to the end of a command. For example, your analyzer's HP-IB Command Reference instructs you to send CALC:FEED 'XTIM:DDEM:ERR:PHAS' to obtain phase-error results. With the HP 89450A, simply append ":SUB n" to the end of this command to obtain measurement results for a specific sub-channel. For example, send CALC:FEED 'XTIM:DDEM:ERR:PHAS:SUB 1' to obtain the phase-error results for sub-channel 1.

Note that when the digital demodulation format is MQAM, you use CALC:FEED 'XTIM:DDEM:SYMB' to select the composite symbol table, and CALC:FEED 'XTIM:DDEM:SYMB:SUB n' to select the symbol table for a sub-channel (where "n" is the number of the sub-channel).

CALCulate[1|2|3|4]:MQAM:RESult? query

Queries the selected test result.

Query Syntax:

```
CALCulate[1|2|3|4]:MQAM:RESult? <selection>
See CALCULATE:MQAM:TEST:RESult? for <selection>.
```

Example Statements:

```
OUTPUT 719;":CALCULATE4:MQAM:RES? MFTERROR"
OUTPUT 719;"calculate4:mqam:result? BTOFF"
```

Return Format:

```
Real
```

Attribute Summary:

```
Option:  AYA (vector modulation analysis)
Synchronization Required:  no
Preset State:  (see text)
SCPI Compliance:  instrument-specific
```

Description:

This command returns one result for any HP 89450A test.

The analyzer's memory contains separate arrays for each test. The size of the array depends on the test. For example, the array for the Modulation test is much larger than the array for the Burst Power test. An array is updated each time the test is run.

Use this command to return one result from an array. For example, sending ''CALCULATE1:MQAM:RES? BTOFF'' returns the transmitter-off leakage power obtained from the last time you ran the burst-power test.

For a list of the test results that you can query, see the "selection" column in the tables under CALCulate:MQAM:TEST:RESult?.

CALCulate[1|2|3|4]:MQAM:TEST:RESult? — query

Queries all results for the current test.

Query Syntax: `CALCulate[1|2|3|4]:MQAM:TEST:RESult?`

Example Statements:

```
OUTPUT 719;"Calc3:Mqam:Test:Res?"
OUTPUT 719;"CALCULATE:MQAM:TEST:RESULT?"
```

Return Format: `(see, text)`

Attribute Summary:

```
Option:  AYA (vector modulation analysis)
Synchronization Required:  no
Preset State:  not affected by Preset
SCPI Compliance:  instrument-specific
```

Description:

This query command returns ALL test results for the current test. The results are returned in a single array. The test determines the size of the array. For example, the array for Modulation Accuracy is much larger that the array for Burst Power (see the following tables).

Use CALCulate:MQAM:TEST:RESult:HEADer:POINts to determine the number of elements (points) in the array.

Test Results for Modulation Accuracy Test

Selection you can use with: CALC[1|2|3|4]:MQAM:RESult?	Array returned when using: CALC[1|2|3|4]:MQAM:TEST:RESult?	Description
METotal	result[0]	Total EVM (all sub-channels)
MERMs	result[1] – result[4]	EVM of a sub-channel ([1] is sub-channel 1, [2] is sub-channel 2, etc.)
MEPeak	result[5] – result[8]	Peak EVM of a sub-channel ([5] is sub-channel 1, [6] is sub-channel 2, etc.)
MEPSymbol	result[9] – result[12]	The symbol with the peak EVM ([9] is sub-channel 1, [10] is sub-channel 2, etc.)
MMTotal	result[13]	Total magnitude error (all sub-channels)
MMRMs	result[14] – result [17]	Magnitude error of a sub-channel ([14] is sub-channel 1, [15] is sub-channel 2, etc.)
MMPeak	result[18] – result[21]	Peak magnitude error of a sub-channel ([18] is sub-channel 1, [19] is sub-channel 2, etc.)
MMPSymbol	result[22] – result[25]	The symbol with the peak magnitude error ([22] is sub-channel 1, [23] is sub-channel 2, etc.)
MPTotal	result[26]	Total phase error (all sub-channels)
MPRMs	result[27] – result[30]	Phase error ([27] is sub-channel 1, [28] is sub-channel 2, etc.)
MPPeak	result[31] – result[34]	Peak phase-error ([31] is sub-channel 1, [32] is sub-channel 2, etc.)
MPPSymbol	result[35] – result[38]	The symbol with the peak phase-error ([35] is sub-channel 1, [36] is sub-channel 2, etc.)
MFTerror	result[39]	Combined frequency error (all sub-channels)
MFERror	result[40] – result[43]	Frequency error ([40] is sub-channel 1, [41] is sub-channel 2, etc.)
MOOFfset	result[44] – result[47]	Origin offset ([44] is sub-channel 1, [45] is sub-channel 2, etc.)
MAERror	result[48] – result[51]	Amplitude error ([48] is sub-channel 1, [49] is sub-channel 2, etc.)

Test Results For All Other Tests

Selection you can use with: CALC[1|2|3|4]: MQAM:RESult?	Array returned when using: CALC[1|2|3|4]: MQAM:TEST:RESult?	Description
Adjacent-Channel Power		
ACHigh	result[0]	Adjacent-channel power for upper (high) channel (power relative to reference channel)
ACLow	result[1]	Adjacent-channel power for lower (low) channel (power relative to reference channel)
ACRP	result[2]	Power in reference channel (dBm)
ACHPower	result[3]	Absolute power in high (upper) channel (dBm)
ACLPower	result[4]	Absolute power in low (lower) channel (dBm)
Occupied Bandwidth		
OBPower	result[0]	Power in the occupied bandwidth (occupied bandwidth is set with the [power %] softkey)
OBTPower	result[1]	Power in the measured span (the measured span is set with the [carrier] softkey)
OBPRatio	result[2]	Ratio of power in occupied bandwidth to power in measured span (result[1] / result[0])
OBLFrequency	result[3]	Occupied bandwidth's lower frequency (Hz.)
OBHFrequency	result[4]	Occupied bandwidth's upper frequency (Hz.)
OBANdwidth	result[5]	Occupied bandwidth (result[4] - result[3])
OBCentroid	result[6]	Occupied bandwidth's centroid frequency
Burst Power		
BTOFf	result[0]	Transmitter OFF (Carrier-off) leakage power
BTON	result[1]	Transmitter ON power
BTRatio	result[2]	Transmitter on/off power-ratio (result[1] / result[0])
BMODulation	result[3]	Modulation power
BPReamble	result[4]	Burst preamble power
BMPeak	result[5]	Burst modulation peak-power

CALCulate[1|2|3|4]:MQAM:TEST:RESult:HEADer:POINts? query

Queries the number of test results for the current test.

Query Syntax: `CALCulate[1|2|3|4]:MQAM:TEST:RESult:HEADer:POINts?`

Example Statements:

```
OUTPUT 719;":calc:mqam:test:res:header:poin?"
OUTPUT
719;"Calculate:Mqam:Test:Result:Head:Points?"
```

Return Format: `Real`

Attribute Summary:

```
Option:  AYA (vector modulation analysis)
Synchronization Required:  no
Preset State:  not affected by Preset
SCPI Compliance:  instrument-specific
```

Description:

This query command returns the number of test results available for the current test. Test results are stored in the analyzer's memory in arrays. There is a separate array for each test. The test determines the size of each array.

To view test results, use the CALCULATE:MQAM:TEST:RESult? command.

DISPlay[:WINDow[1|2|3|4]]:MQAM:BURSt:FORMat — command/query

Selects which portion of a burst to display for Burst Power measurements.

Command Syntax:
```
DISPlay[:WINDow[1|2|3|4]]:MQAM:BURSt:FORMat
SLOT|TXON|TXOFf
```

Example Statements:
```
OUTPUT 719;"DISP:WIND:MQAM:BURS:FORMAT TXON"
OUTPUT 719;"disp:mqam:burst:form TXON"
```

Query Syntax:
```
DISPlay[:WINDow[1|2|3|4]]:MQAM:BURSt:FORMat?
```

Return Format:
```
CHAR
```

Attribute Summary:
```
Synchronization Required:  no
Preset State:  SLOT
SCPI Compliance:  instrument-specific
```

Description:

This command affects all active traces regardless of whether a specific window/trace is used (e.g. DISP:WIND2).

This HP-IB command is used by the burst power test to determine which portion of the burst to display. You can display:

- An entire 15 ms slot, including turn-on, modulation, and turn-off events (SLOT).
- The turn-on portion (TXON).
- The turn-off portion. (TXOFF)

DISPlay[:WINDow[1 | 2 | 3 | 4]]:MQAM:BURSt:GRID[:STATe] command/query

Turns the burst-power template on or off.

Command Syntax:
```
DISPlay[:WINDow[1|2|3|4]]:MQAM:BURSt:GRID[:STATe]
OFF|0|ON|1
```

Example Statements:
```
OUTPUT 719;":Display:Mqam:Burs:Grid OFF"
OUTPUT 719;"DISP:WINDOW:MQAM:BURS:GRID:STAT ON"
```

Query Syntax:
```
DISPlay[:WINDow[1|2|3|4]]:MQAM:BURSt:GRID[:STATe]?
```

Return Format:
```
Integer
```

Attribute Summary:
```
Synchronization Required:  no
Preset State:  +0 (OFF)
SCPI Compliance:  instrument-specific
```

Description:

This command affects all active traces regardless of whether a specific window/trace is used (e.g. DISP:WIND2).

This command turns on or off the burst-power template when the analyzer is running the burst-power test. The burst-power template differs depending on which portion of the burst you display. For example, the template for a slot is different then the template for the turn-on portion of the burst.

The envelope displayed conforms to that defined for burst measurements in Standard RCR-32.

The template is displayed only when normalize is on.

DISPlay[:WINDow[1|2|3|4]]:MQAM:MACCuracy:RESult **command/query**

Determines which channels to display for the Modulation Accuracy test.

Command Syntax: `[SENSE:]DDEMod:MQAM:MACC <selection>`

<selection> ::= ALL|SUB1|SUB2|SUB3|SUB4

Example Statements:

```
OUTPUT 719;"display:wind4:mqam:maccuracy:res ALL"
OUTPUT 719;"Display:Mqam:Macc:Result SUB2"
```

Query Syntax: `DISPlay[:WINDow[1|2|3|4]]:MQAM:MACCuracy:RESult?`

Return Format: `CHAR`

Attribute Summary:

```
Synchronization Required:  no
Preset State:  ALL
SCPI Compliance:  instrument-specific
```

Description:

This command affects all active traces regardless of whether a specific window/trace is used (e.g. DISP:WIND2).

This command lets you choose the channels that the analzyer displays for the Modulation Accuracy test. You can display all sub-channels (ALL) or a single sub-channel. SUB1 displays results sub-channel 1; SUB2 for sub-channel 2, and so forth.

DISPlay[:WINDow[1|2|3|4]]:TRACe:INDicator command/query

Determines the character used to identify ideal states in a vector diagram when Digital Demodulation is selected.

Command Syntax:
```
DISPlay[:WINDow[1|2|3|4]]:TRACe:INDicator
CROSs|CIRCle
```

Example Statements:
```
OUTPUT 719;":DISP:TRACE:IND CROSS"
OUTPUT 719;"disp:window:trac:indicator CROSS"
```

Query Syntax:
```
DISPlay[:WINDow[1|2|3|4]]:TRACe:INDicator?
```

Return Format:
```
CHAR
```

Attribute Summary:
```
Option:  AYA (vector modulation analysis)
Synchronization Required:  no
Preset State:  Cross
SCPI Compliance:  instrument-specific
```

Description:

This command affects all active traces regardless of whether a specific window/trace is used (e.g. DISP:WIND2).

This command lets you select a cross-hair or circle to represent the ideal states (ideal symbol locations) in a vector diagram. The size of the circle or cross-hair corresponds to some percentage of Error Vector Magnitude (EVM), and is set with DISP:WIND:TRAC:IND:SIZE. For additional details, see online help for the [ideal state] softkey.

This command is not specific to the HP 89450A Radio Test Personality. This command was introduced when the HP 89450A was introduced, and may not be documented in your analyzer's HP-IB Command Reference. This command is available as part of the main instrument firmware (the HP 89450A Radio Test Personality does not have to be installed to use this command).

DISPlay[:WINDow[1 | 2 | 3 | 4]]:TRACe:INDicator:SIZE command/query

Determines the size, as a percentage of EVM, of ideal states in vector diagrams.

Command Syntax:

```
DISPlay[:WINDow[1|2|3|4]]:TRACe:INDicator:SIZE
{<number>[<unit>]}|<step>|<bound>
```

<number> ::= a real number (NRf data)
limits: 0.1:50

<unit> ::= [PCT]

<step> ::= UP|DOWN

<bound> ::= MAX|MIN

Example Statements:

```
OUTPUT 719;"Disp:Wind2:Trace:Ind:Size 34"
OUTPUT 719;"DISP:TRAC:INDICATOR:SIZE 3"
```

Query Syntax:

```
DISPlay[:WINDow[1|2|3|4]]:TRACe:INDicator:SIZE?
```

Return Format:

```
Integer
```

Attribute Summary:

```
Option:  AYA (vector modulation analysis)
Synchronization Required:  no
Preset State:  +15.0
SCPI Compliance:  instrument-specific
```

Description:

This command affects all active traces regardless of whether a specific window/trace is used (e.g. DISP:WIND2).

This command determines the size of the cross-hairs or circles used to indicate ideal states in vector diagrams when Digital Demodulation is selected.

The size is specified as a percentage of Error Vector Magnitude (EVM), and determines the radius of the circle or cross-hair. For example, if you specify a size of 15%, the radius of the circle or cross-hair represents and EVM of 15%. For additional details, see online help for the [state size] softkey.

This command is not specific to the HP 89450A Radio Test Personality. This command was introduced when the HP 89450A was introduced, and may not be documented in your analyzer's HP-IB Command Reference. This command is available as part of the main instrument firmware (the HP 89450A Radio Test Personality does not have to be installed to use this command).

DISPlay[:WINDow[1 | 2 | 3 | 4]]:TRACe:SYMBol:FORMat **command/query**

Determines the data format (hexadecimal or decimal) for symbol tables.

Command Syntax:
```
DISPlay[:WINDow[1|2|3|4]]:TRACe:SYMBol:FORMat
BIN|HEX
```

Example Statements:
```
OUTPUT 719;":display:trac:symb:format HEX"
OUTPUT 719;"Disp:Window:Trac:Symb:Format BIN"
```

Query Syntax:
```
DISPlay[:WINDow[1|2|3|4]]:TRACe:SYMBol:FORMat?
```

Return Format:
```
CHAR
```

Attribute Summary:
```
Synchronization Required:  no
Preset State:  BINary
SCPI Compliance:  instrument-specific
```

Description:

This command affects all active traces regardless of whether a specific window/trace is used (e.g. DISP:WIND2).

This command is valid only when the modulation format is MQAM. If MQAM is not selected, you cannot change the symbol-table format to hexadecimal. If MQAM is not selected, the symbol-table format is always decimal (binary).

MEMory:MALLocate:APPLication command/query

Specifies amount of memory to allocate for downloadable programs.

Command Syntax:

```
MEMory:MALLocate:APPLication
<number>|<step>|<bound>
```

<number> ::= a real number (NRf data)
limits: 0:3.40282347E+38

<step> ::= UP|DOWN

<bound> ::= MAX|MIN

Example Statements:

```
OUTPUT 719;"MEM:MALLOCATE:APPL 2147483647"
OUTPUT 719;"mem:mallocate:appl 2147483647"
```

Query Syntax: `MEMory:MALLocate:APPLication?`

Return Format: `Integer`

Attribute Summary:

```
Synchronization Required:  no
Preset State:  not applicable
SCPI Compliance:  instrument-specific
```

Description:

This HP-IB command specifies how much memory to allocate (in bytes) for applications. For best performance, set application memory to zero if there are no applications in the analyzer.

If you do have an application loaded into the analyzer, see the documentation shipped with the application to determine the amount of memory required for the application.

MMEMory:LOAD:APPLication — command

Loads the specified application.

Command Syntax:

```
MMEMory:LOAD:APPLication '[<msus>]<filespec>'
    <msus>    ::= RAM:|NVRAM:|INT:|EXT:
    <filespec>    ::= ASCII characters
(see MMEM:NAME for filename restrictions)
```

Example Statements:

```
OUTPUT 719;"mmem:load:application
'int:hp89450a.app'"
OUTPUT 719;"MMEM:LOAD:APPL 'HP89450A.APP'"
```

Attribute Summary:

```
Synchronization Required:  no
Preset State:  not applicable
SCPI Compliance:  instrument-specific
```

Description:

This command loads an application into the analyzer. The application is loaded into the analyzer's application memory. Before loading the application, you must allocate sufficient memory for the application—for details, see MEM:MALL:APPL.

If <msus> is not included in the syntax, the currently selected mass storage unit (disk) is assumed. To query or change the currently selected msus, use MMEM:MSIS.

SCReen:CONTents:MQAM:SUMMary[:STATe] command/query

Displays the summary table for the current test.

Command Syntax: `[SENSE:]DDEMod:MQAM:SUMMARY ON|1|OFF|0`

Example Statements:

```
OUTPUT 719;":Screen:Cont:Mqam:Summary ON"
OUTPUT 719;"SCR:CONTENTS:MQAM:SUMM:STATE ON"
```

Query Syntax: `SCReen:CONTents:MQAM:SUMMary[:STATe]?`

Return Format: `CHAR`

Attribute Summary:

```
Synchronization Required:  no
Preset State:  0 (OFF)
SCPI Compliance:  instrument-specific
```

Description:

You can display a summary table for each test that shows additional results for the test. Use this command to turn on, or off, the summary table for the current test.

This command only affects the current test. For example, sending this command to the analyzer turns on the summary table for the current test. If you change tests, you must send this command again to turn on the summary table for the new test.

[SENSe:]AVERage:COUNt:INTermediate? query

Returns the current average count.

Query Syntax: `[SENSe:]AVERage:COUNt:INTermediate?`

Example Statements:

```
OUTPUT 719;"sens:average:coun:int?"
OUTPUT 719;"Average:Coun:Intermediate?"
```

Return Format: `Integer`

Attribute Summary:

```
Synchronization Required:  no
Preset State:  not applicable
SCPI Compliance:  instrument-specific
```

Description:

This command returns the number of averages that have been completed. The number of averages that the analyzer performs is determined by [SENSE:]AVERage:COUNt.

This command is not specific to the HP 89450A Radio Test Personality. This command was introduced when the HP 89450A was introduced, and may not be documented in your analyzer's HP-IB Command Reference. This command is available as part of the main instrument firmware (the HP 89450A Radio Test Personality does not have to be installed to use this command).

[SENSe:]DDEMod:FORMat — command/query

Specifies the digital modulation format.

Command Syntax:
```
[SENSe:]DDEMod:FORMat QPSK|PSK|QAM|MSK|FSK|MQAM
```

Example Statements:
```
OUTPUT 719;":DDEM:FORM PSK"
OUTPUT 719;"sense:ddem:format QAM"
```

Query Syntax:
```
[SENSe:]DDEMod:FORMat?
```

Return Format:
```
CHAR
```

Attribute Summary:
```
Option:  AYA (vector modulation analysis)
Synchronization Required:  no
Preset State:  (see text below)
SCPI Compliance:  instrument-specific
```

Description:

The DDEMod:FORMat command lets you choose the modulation format used for digital demodulation. You can choose:

- QPSK (Quadrature Phase Shift Keyed)
- PSK (Phase Shift Keyed)
- QAM (Quadrature Amplitude Modulation)
- MSK (Minimum Shift Keyed)
- FSK (Frequency Shift Keyed)
- MQAM (Multiple-sync Quadrature Amplitude Modulation)–available only when the HP 89450A application is loaded into the analyzer.

The only demodulation format affected by preset is MQAM. Presetting the analyzer deselects MQAM.

[SENSe:]DDEMod:MQAM:ABORt command

Abort the current test and exit, then remove, the application.

Command Syntax: `[SENSe:]DDEMod:MQAM:ABORt`

Example Statements:

```
OUTPUT 719;"Sens:Ddem:Mqam:Abor"
OUTPUT 719;"DDEMOD:MQAM:ABOR"
```

Attribute Summary:

```
Synchronization Required:  no
Preset State:  not applicable
SCPI Compliance:  instrument-specific
```

Description:

This command aborts the current test, exits the application, and then removes the application from the analyzer's application memory. After removing the application, this command presets the analyzer to return all parameters to their default settings.

If you want to abort a test without removing the application, use DDEMOD:MQAM:TEST:ABORT.

[SENSe:]DDEMod:MQAM:ACPower:ACBandwidth command/query

Sets the bandwidth of the adjacent channels for the Adjacent-Channel Power test.

Command Syntax:

```
[SENSe:]DDEMod:MQAM:ACPower:ACBandwidth {<number>
[<unit>]}|<step>|<bound>
```

<number> ::= a real number (NRf data)

limits determined by current configuration

<unit> ::= [Hz]

<step> ::= UP|DOWN

<bound> ::= MAX|MIN

Example Statements:

```
OUTPUT 719;"SENSE:DDEM:MQAM:ACPOWER:ACB 10e3"
OUTPUT 719;"ddemod:mqam:acp:acbandwidth 15000"
```

Query Syntax:

```
[SENSe:]DDEMod:MQAM:ACPower:ACBandwidth?
```

Return Format: Real

Attribute Summary:

```
Synchronization Required:  no
Preset State:  18 kHz
SCPI Compliance:  instrument-specific
```

Description:

This command sets the bandwidth of the high (upper) and low (lower) channels for the Adjacent Channel Power test. For example, sending DDEMOD:MQAM:ACP:ACB 10000 sets the bandwidth of these two channels to 10 kHz.

[SENSe:]DDEMod:MQAM:ACPower:ACHoffset **command/query**

Sets the offset (offset from carrier) of the high (upper) channel for the Adjacent-Channel Power test.

Command Syntax:

```
[SENSe:]DDEMod:MQAM:ACPower:ACHoffset {<number>
[<unit>]}|<step>|<bound>
```

<number> ::= a real number (NRf data)
limits determined by current configuration

<unit> ::= [Hz]

<step> ::= UP|DOWN

<bound> ::= MAX|MIN

Example Statements:

```
OUTPUT 719;"SENSE:DDEM:MQAM:ACPOWER:ACHOFFSET
+25e3"
OUTPUT 719;"ddemod:mqam:acp:ach +25000"
```

Query Syntax: `[SENSe:]DDEMod:MQAM:ACPower:ACHoffset?`

Return Format: `Real`

Attribute Summary:

```
Synchronization Required:  no
Preset State:  25 kHz
SCPI Compliance:  instrument-specific
```

Description:

This command sets the offset used by the Adjacent-Channel Power test for the high (upper) channel. The offset determines the location of the upper channel's center frequency with respect to the carrier frequency. For example, an offset of +25 kHz places the upper channel's center frequency 25 kHz above the carrier frequency, whereas an offset of -25 kHz places the upper channel's center frequency 25 kHz below the carrier frequency,

[SENSe:]DDEMod:MQAM:ACPower:ACLoffset command/query

Sets the offset (offset from carrier) of the lower channel for the Adjacent-Channel Power test.

Command Syntax:

```
[SENSe:]DDEMod:MQAM:ACPower:ACLoffset {<number>
[<unit>]}|<step>|<bound>
```

<number> ::= a real number (NRf data)
limits determined by current configuration

<unit> ::= [Hz]

<step> ::= UP|DOWN

<bound> ::= MAX|MIN

Example Statements:

```
OUTPUT 719;"SENSE:DDEM:MQAM:ACPOWER:ACLOFFSET
-25e3"
OUTPUT 719;"ddemod:mqam:acp:acl -25000"
```

Query Syntax:

```
[SENSe:]DDEMod:MQAM:ACPower:ACLoffset?
```

Return Format: Real

Attribute Summary:

```
Synchronization Required:  no
Preset State:  –25 kHz
SCPI Compliance:  instrument-specific
```

Description:

This command sets the offset used by the Adjacent-Channel Power test for the lower channel. The offset determines the location of the lower channel's center frequency with respect to the carrier frequency. For example, an offset of -25 kHz places the lower channel's center frequency 25 kHz below the carrier frequency, whereas an offset of +25 kHz places the lower channel's center frequency 25 kHz above the carrier frequency.

[SENSe:]DDEMod:MQAM:ACPower:RCBandwidth command/query

Sets the bandwidth of the the reference channel for the Adjacent-Channel Power test.

Command Syntax:

```
[SENSe:]DDEMod:MQAM:ACPower:RCBandwidth {<number>
[<unit>]}|<step>|<bound>
```

<number> ::= a real number (NRf data)
limits determined by current configuration
<unit> ::= [Hz]
<step> ::= UP|DOWN
<bound> ::= MAX|MIN

Example Statements:

```
OUTPUT 719;"SENSE:DDEM:MQAM:ACPOWER:RCB 18e3"
OUTPUT 719;"ddemod:mqam:acp:rcbandwidth 18000"
```

Query Syntax: `[SENSe:]DDEMod:MQAM:ACPower:RCBandwidth?`

Return Format: `Real`

Attribute Summary:

```
Synchronization Required:  no
Preset State:  18 kHz
SCPI Compliance:  instrument-specific
```

Description:

This command sets the bandwidth of the reference channel for the Adjacent-Channel Power test.

[SENSe:]DDEMod:MQAM:BURSt:NORMalize — command/query

Determines how the Burst Power test computes power.

Command Syntax: `[SENSe:]DDEMod:MQAM:BURSt:NORMalize OFF|0|ON|1`

Example Statements:

```
OUTPUT 719;":ddemod:mqam:burst:norm OFF"
OUTPUT 719;"Sens:Ddemod:Mqam:Burst:Norm ON"
```

Query Syntax: `[SENSe:]DDEMod:MQAM:BURSt:NORMalize?`

Return Format: `Integer`

Attribute Summary:

```
Synchronization Required:  no
Preset State:  ON for D-MCA
SCPI Compliance:  instrument-specific
```

Description:

You can return Burst Power results as absolute or relative. Relative means that power computations are relative to (normalized to) the average power due to modulation. Absolute means power computations are absolute—they are not relative to the average power due to modulation. For additional details, see online help for the [power relative/absolute] softkey.

[SENSe:]DDEMod:MQAM:OCBandwidth:CTOCenter **command**

Sets the analyzer's center frequency to match the current centroid freq.

Command Syntax:
```
[SENSe:]DDEMod:MQAM:OCBandwidth:CTOCenter
```

Example Statements:
```
OUTPUT 719;"SENS:DDEMOD:MQAM:OCBANDWIDTH:CTOC"
OUTPUT 719;"ddem:mqam:ocb:ctocenter"
```

Attribute Summary:
```
Synchronization Required:  no
Preset State:  not applicable
SCPI Compliance:  instrument-specific
```

Description:

This command is applicable only when the Occupied Bandwidth Test is running. If the test is not running, sending this command does nothing. If the test is running, sending this command sets the analyzer's center frequency to match the current centroid frequency.

If the current centroid frequency is invalid (indicated by "****" on the display), sending this command does nothing.

The "centroid" frequency is the center point of the occupied bandwidth.

[SENSe:]DDEMod:MQAM:OCBandwidth:POWer:PERCentage command/query

Determines the percentage of power used for the Occupied Bandwidth test.

Command Syntax:

```
[SENSe:]DDEMod:MQAM:OCBandwidth:POWer:PERCentage
{<number>[<unit>]}|<step>|<bound>
```

<number>	::=	a real number (NRf data) limits: 1:100
<unit>	::=	[PCT]
<step>	::=	UP|DOWN
<bound>	::=	MAX|MIN

Example Statements:

```
OUTPUT 719;"SENSE:DDEM:MQAM:OCB:POW:PERC 99"
OUTPUT 719;"ddemod:mqam:ocb:power:percentage 50"
```

Query Syntax:

```
[SENSe:]DDEMod:MQAM:OCBandwidth:POWer:PERCentage?
```

Return Format: Real

Attribute Summary:

```
Synchronization Required:  no
Preset State:  99%
SCPI Compliance:  instrument-specific
```

Description:

This command sets the percentage of power used by the Occupied Bandwidth test. The test uses the percentage of power to compute the occupied bandwidth.

For example, if you send DDEM:MQAM:OCB:POW:PERC 50, the Occupied Bandwidth test finds the region of the spectrum that contains 50% of the total power in the frequency span. For additional details, see online help for the Occupied Bandwidth test.

[SENSe:]DDEMod:MQAM:PTRack[:STATe] command/query

Turns pilot tracking on or off.

Command Syntax: `[SENSE:]DDEMod:MQAM:PTRack:STATe ON|OFF`

Example Statements:
```
OUTPUT 719;":Ddem:Mqam:Ptrack OFF"
OUTPUT 719;"SENS:DDEMOD:MQAM:PTR:STATE OFF"
```

Query Syntax: `[SENSe:]DDEMod:MQAM:PTRack[:STATe]?`

Return Format: `Integer`

Attribute Summary:
```
Synchronization Required:  no
Preset State:  ON
SCPI Compliance:  instrument-specific
```

Description:

Send this command to enable (ON) or disable (OFF) pilot tracking.

[SENSe:]DDEMod:MQAM:SLOT:FORMat command/query

Selects the data slot format.

Command Syntax: `[SENSe:]DDEMod:MQAM:SLOT:FORMat IN-Bound|ISUBslot|OUTBound`

Example Statements:
```
OUTPUT 719;"sens:ddemod:mqam:slot:format ISUBSLOT"
OUTPUT 719;"Ddem:Mqam:Slot:Form OUTBOUND"
```

Query Syntax: `[SENSe:]DDEMod:MQAM:SLOT:FORMat?`

Return Format: CHAR

Attribute Summary:
```
Synchronization Required:  no
Preset State:  outbound
SCPI Compliance:  instrument-specific
```

Description:

This command selects the data slot format for MQAM measurements. You can select:

- Inbound slot format (INB)
- Inbound sub-slot format (ISUB)
- Outbound slot format (OUTB)

These slot formats conform to Standard RCR-32. For details, see Standard RCR-32 or see online help for the [inbound] softkey.

[SENSe:]DDEMod:MQAM:TEST command/query

Selects one of the HP 89450A application's tests.

Command Syntax: `[SENSE:]DDEMod:MQAM:TEST <selection>`

<selection> ::= MACCuracy|ACPower|OCBandwidth|BURST|NONE

Example Statements:

```
OUTPUT 719;":DDEMOD:MQAM:TEST NONE"
OUTPUT 719;"sens:ddem:mqam:test BURST"
```

Query Syntax: `[SENSe:]DDEMod:MQAM:TEST?`

Return Format: `CHAR`

Attribute Summary:

```
Synchronization Required:  yes
Preset State:  NONE
SCPI Compliance:  instrument-specific
```

Description:

This command selects a test. You can select the:

- Modulation Accuracy test (MACC)
- Adjacent-Channel Power test (ACP)
- Occupied Bandwidth test (OBAN)
- Burst Power test (BURST)

Sending this command configures the analyzer for the selected test. To learn how each test configures the analyzer, see the HP 89450A User's Guide.

"NONE" deselects a test. If no test is selected, "NONE" does nothing. If a test is selected, "NONE" aborts the current test.

Synchronization is required with this command. Therefore, use *WAI when using this command. For example, to select the Burst Power test, send DDEM:MQAM:TEST BURS;*WAI.

[SENSe:]DDEMod:MQAM:TEST:ABORt — command

Abort the current test.

Command Syntax: `[SENSe:]DDEMod:MQAM:TEST:ABORt`

Example Statements:

```
OUTPUT 719;"Sense:Ddem:Mqam:Test:Abor"
OUTPUT 719;"DDEMOD:MQAM:TEST:ABORT"
```

Attribute Summary:

```
Synchronization Required:  no
Preset State:  not applicable
SCPI Compliance:  instrument-specific
```

Description:

This command aborts the current test. This command does not change any configurations in the analyzer—it only aborts (terminates) the current test.

[SENSe:]DDEMod:MQAM:TEST:PRESet **command**

Presets the analyzer settings for the currently selected test, if any.

Command Syntax:

```
[SENSe:]DDEMod:MQAM:TEST:PRESet
```

Example Statements:

```
OUTPUT 719;":ddem:mqam:test:pres"
OUTPUT 719;"Sense:Ddem:Mqam:Test:Pres"
```

Attribute Summary:

```
Synchronization Required:  no
Preset State:  not applicable
SCPI Compliance:  instrument-specific
```

Description:

This command preserves the transmission format, center frequency, M-16QAM format, and input range. It then presets the analyzer, restores the parameters saved before the preset, and then reruns the currently selected test, if any.

If no test is currently selected, then this command only presets the analyzer.

Need Assistance?

If you need assistance, contact your nearest Hewlett-Packard Sales and Service Office listed in the HP Catalog, or contact your nearest regional office listed at the back of this guide. If you are contacting Hewlett-Packard about a problem with your analyzer, please provide the following information:

- ❑ Model number:
- ❑ Serial number:
- ❑ Options:
- ❑ Date the problem was first encountered:
- ❑ Circumstances in which the problem was encountered:
- ❑ Can you reproduce the problem?
- ❑ What effect does this problem have on you?

You may find the serial number and options from the front panel of your analyzer by executing the following:

Press [**System Utility**], [more], [serial number].

Press [**System Utility**], [options setup].

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About this edition

November 1994: First Edition. This edition documents the use of the HP 89450A Application personality software with HP 89400-Series analyzers that have software revision A.02.06 or later.