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Quick Start Guide

HP 71209A Microwave Spectrum Analyzer



**HP Part No. 71209-90001
Printed in USA October 1991**

Edition B.0.0

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WARNING

Before applying power to this instrument, make sure it has been properly grounded through the protective conductor of the ac power cable to a socket outlet provided with protective earth contact. Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal can result in personal injury.

CAUTION

Before applying power to this instrument, make sure its primary power circuitry has been adapted to the voltage of the ac power source. Failure to set the ac power input to the correct voltage could cause damage to the instrument when the ac power cable is plugged in.

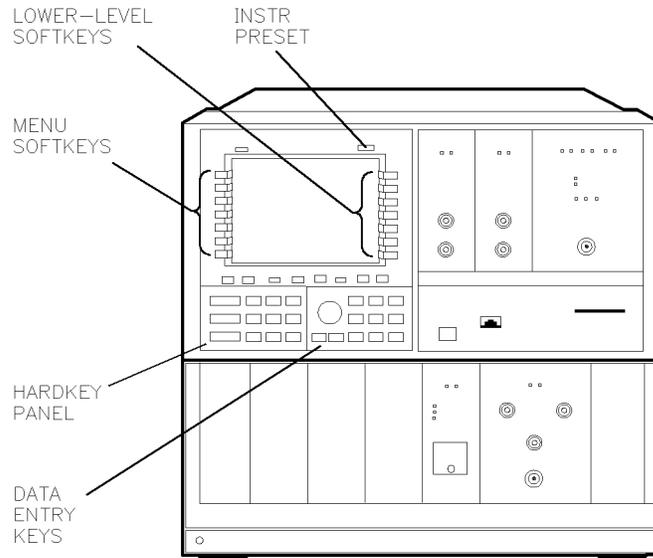
CAUTION

Total input power to the front-panel RF INPUT connector must not exceed +30 dBm. Power in excess of +30 dBm may damage the instrument.

CAUTION

Electrostatic discharge (ESD) can damage circuits associated with rear-panel connectors. Therefore, before connecting any cable to a rear-panel connector, momentarily short the center and outer conductors of the cable together. Avoid touching the rear-panel connectors without first touching the frame of the instrument. Be sure that the spectrum analyzer is properly earth-grounded to prevent buildup of static charge.

The HP 71209A - At A Glance



qdb 1.

The HP 71209A modular spectrum analyzer has a full-band sweep from 100 Hz to 26.5 GHz and built-in external millimeter mixer capability. The standard system consists of an HP 70909A RF section, the HP 70004A color display, the HP 70001A mainframe, the HP 70900B local oscillator module, the HP 70902A and HP 70903A IF sections, and an HP 70310A precision frequency reference. Options on the standard system can add or delete modules.

The *INST PRESET key* (instrument preset key) sets the microwave spectrum analyzer to a preset condition.

The *lower-level softkeys* execute instrument or display functions, depending on whether **DISPLAY**, **MENU**, or **USER** was selected. These softkeys are also dependent upon which menu softkey is selected and can have several levels, each accessed by pressing the bottom softkey.

The *menu softkeys* allow users access to all of the main functions of the microwave spectrum analyzer.

The *hardkey panel* supplies quick access to commonly-used spectrum analyzer functions. (Each of these functions can also be accessed using the softkey menus.)

The *data entry* keys and knob allow you to manually enter and change data values.

In This Book

About This Book

This *HP 71209A Modular Spectrum Analyzer Quick Start Guide* provides step-by-step instructions for some of the most common tasks for the HP 71209A modular spectrum analyzer.

How To Use This Book

Start with the quick overview of the product on the preceding two pages of this book.

Once you have a picture of what the product is and what it does, put it to work with a few basic tasks as demonstrated in “System Measurement Tasks.”

Text Conventions

The following conventions are used throughout this quick start guide:

Key	A word shown like this represents a key physically located on the instrument.
Softkeys	A word shown like this indicates a “softkey,” a key whose label is determined by the instrument’s software or firmware.
Screen Text	Text shown like this indicates text displayed on the display screen.

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System Measurement Tasks

Note

Specified performance requires that the spectrum analyzer warmup for approximately 30 minutes before making any measurements.

At initial power up, the HP 70310A precision frequency reference displays an **oven cold** error message. After approximately 10 minutes of warmup, the **oven cold** error message can be removed by pressing **DISPLAY**, then **REPORT ERRORS**.

The examples in this chapter are written to be done in the order given. Doing them out of sequence may require extra steps. The purpose of these examples are to provide you with a quick path to familiar measurements that you might normally use.

Hardkey Panel Functions

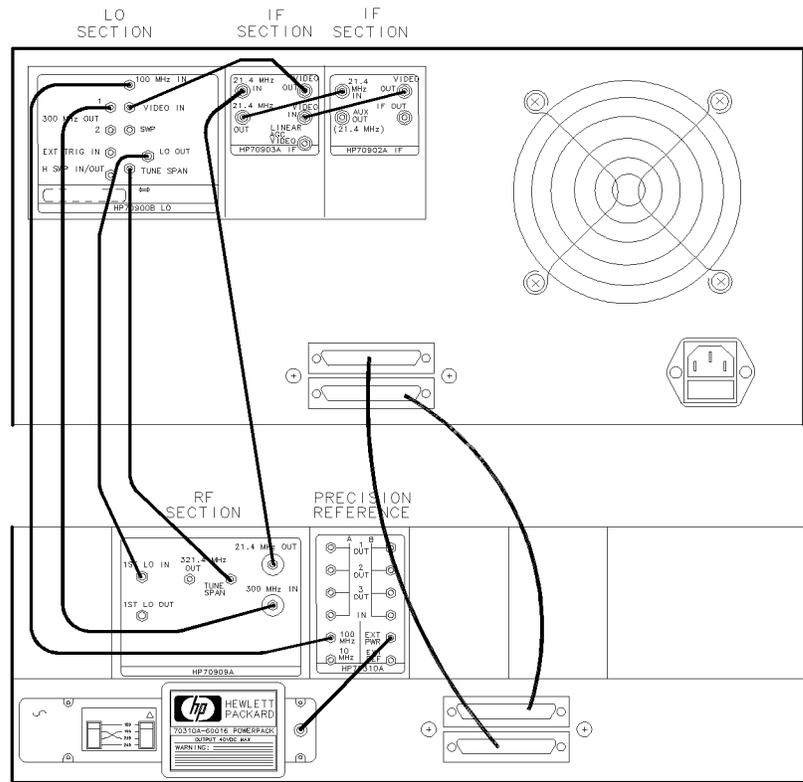
The *hardkey panel* is available only with the HP 70004A color display.

When using this quick start guide with an HP 70205A graphics display or an HP 70206A system graphics display, the hardkey panel is not available. However, the hardkey-panel functions are available for all displays and can be accessed by using the softkey path listed below.

HP 70004A Hardkey Panel Key	All Displays Softkey Path
CENTER	Freq , CENTER
SPAN	Freq , SPAN
START FREQ	Freq , START
STOP FREQ	Freq , STOP
REF LEVEL	Amptd , REF LVL
NORMAL	Marker , MKR NRM On Off
Δ	Marker , DELTA
PEAK SEARCH	Marker , HIGHEST PEAK
NEXT PEAK	Marker , NEXT PEAK
SIGNAL TRACK	Marker , SIG TRK On Off
SAVE	State , save
RECALL	State , recall

HP 71209A Modular Spectrum Analyzer System

Before starting the tasks in this chapter, make sure that your system is properly connected. The standard system configuration rear-panel connections are shown below. Refer to the *HP 70000 Installation and Verification Manual* for alternative system configurations, if necessary.



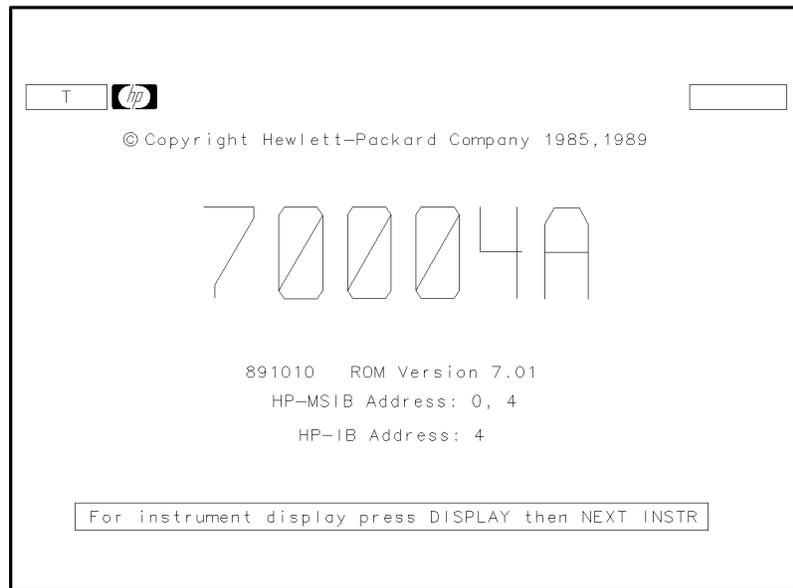
qdb2

Example 1. Set up and initialize the system

Make sure that the spectrum analyzer is set to a known state by setting up and initializing the system with this example. This ensures that the local-oscillator module is in control and that the menu softkeys that contain the spectrum-analyzer functions are displayed.

1. Turn on the modular spectrum analyzer system.

The system is initialized as either a display, as shown in the figure below, or as a spectrum analyzer, as shown in step 3. If the system is initialized as a spectrum analyzer, skip to step 3.



qdb3

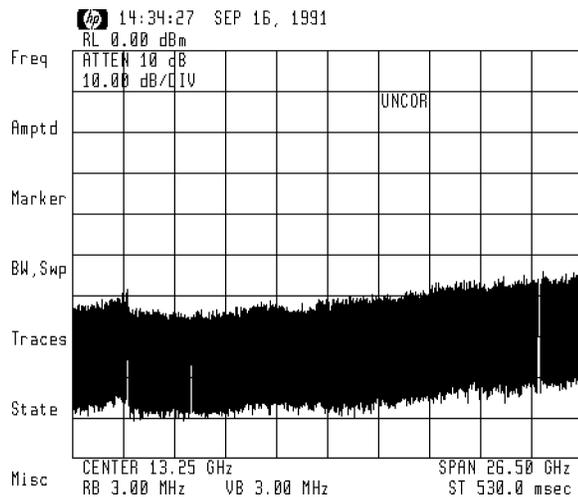
2. Press **DISPLAY**, then **NEXT INSTR** until the spectrum-analyzer display appears.

This key sequence should display the HP-MSIB address of the HP 70900B local-oscillator (master) module at the bottom of the display screen when the spectrum-analyzer display appears. For example:

Row 0 Column 18: 70900B,Lo/Ctrlr

3. Press **MENU**.

Pressing **MENU** accesses the spectrum analyzer softkey functions as shown in the following figure.



Example 2. Calibrate the system

You will want to calibrate your signal path to eliminate the **UNCOR** message on the display. This ensures that your instrument is operating and that calibration corrections have been made.

1. Press **INSTR PRESET**.

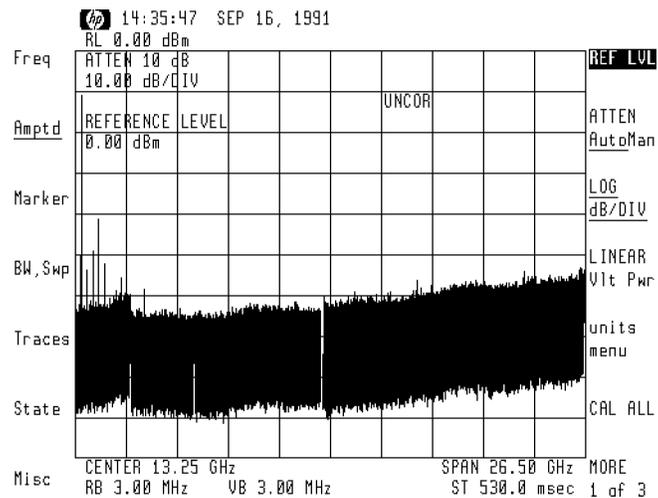
The HP 71209A modular spectrum analyzer is placed in a known state by setting all spectrum-analyzer functions to their preset state.

2. Connect the 300 MHz CALIBRATOR output to the RF INPUT connector on the HP 70900B front panel.

The calibrator signal will be used to calibrate the system.

3. Press **Amptd**.

Pressing **Amptd** accesses amplitude and calibration softkeys as shown below.



4. Press **CAL ALL**.

Pressing **CAL ALL** executes all internal signal-path calibration routines that take approximately 2 to 3 minutes to complete. After the routines are finished, the instrument resumes the state at which the calibration routines were initiated. In this case, the instrument-preset state is resumed.

The **UNCOR** message displayed in the message area (as shown in the figure above) will disappear after the calibration routine is complete.

Example 3. Measure a continuous-wave signal

For demonstration purposes and convenience, use the calibrator signal to measure a continuous-wave (CW) signal.

1. Press **Freq**.

Pressing **Freq** accesses the frequency menu of softkeys and automatically activates center frequency.

2. Press **3**, **0**, **0**, and **MHz**.

This key sequence sets the center frequency to 300 MHz.

3. Press **SPAN**, then **1**, **0**, and **MHz**.

This key sequence sets the frequency span to 10 MHz.

4. Press **Marker**.

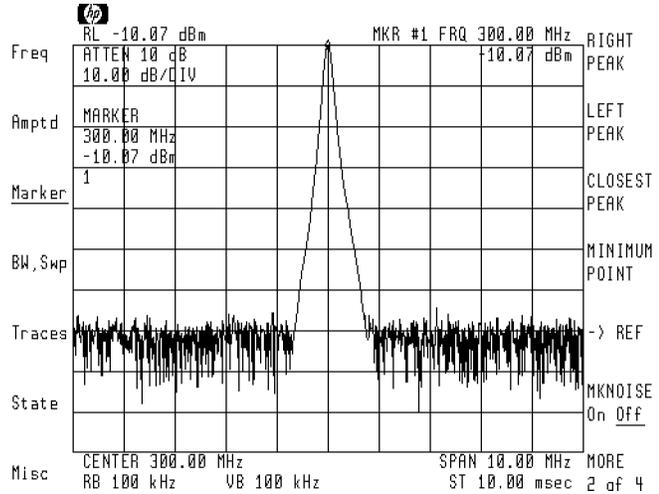
Pressing **Marker** activates the marker mode and places a marker at the top of the highest signal. The marker displays both the frequency and amplitude of the signal peak in the active-function readout area and in the upper right-hand corner of the display.

5. Press **MORE 1 of 4**, then **-> REF**.

This key sequence positions the peak of the signal at the reference level (top graticule line).

6. Note the frequency and amplitude values of the calibrator signal.

The calibrator signal frequency and amplitude values will be displayed in the active-function readout area on the display screen as shown in the following figure.



Example 4. Measure a CW signal using signal track

Use signal tracking as a convenient method to keep the signal onscreen while centering it.

1. Press **INSTR PRESET**.

Pressing **INSTR PRESET** resets the system and places it in a known state.

2. Press **Freq**, **MORE 1 of 3**, then **BNKSTRT On Off**.

This key sequence sets the blank-start frequency to ON and blanks the local-oscillator (LO) feedthrough at the beginning of the sweep.

3. Press **PEAK SEARCH** on the hardkey panel.

Pressing the peak-search key initiates a marker to find the highest signal level and position the marker at its peak.

4. Press **SIGNAL TRACK** on the hardkey panel.

Pressing the signal-track key continuously activates a highest peak on the marked signal, then moves the signal to center screen by automatically changing the center frequency.

5. Press **SPAN** on the hardkey panel, then press **1**, **0**, and **kHz**.

Pressing **SPAN** and entering 10 kHz instructs the instrument to go down to a 10 kHz frequency span. Because signal tracking was enabled in the previous step, the signal will stay centered onscreen while the span is successively narrowed.

Example 5. Make a carrier-to-noise measurement

A carrier-to-noise measurement can be made very simply by using the delta-marker function. This can be demonstrated by using the calibrator signal, placing a marker at the peak of the signal, then placing a delta marker somewhere in the noise. The carrier-to-noise measurement result is displayed in the active function area and is normalized to a 1 Hz bandwidth.

1. Press **SIGNAL TRACK** on the hardkey panel, then the **BNKSTRT On Off**, **Marker**, and **MKR NRM On Off** softkeys.

Pressing these keys at this time turns off the signal-tracking, blank-start, and marker functions from the previous measurement example.

2. Press **REF LEVEL** on the hardkey panel and use the **▼** (down-arrow) step key to place the signal near the top graticule.

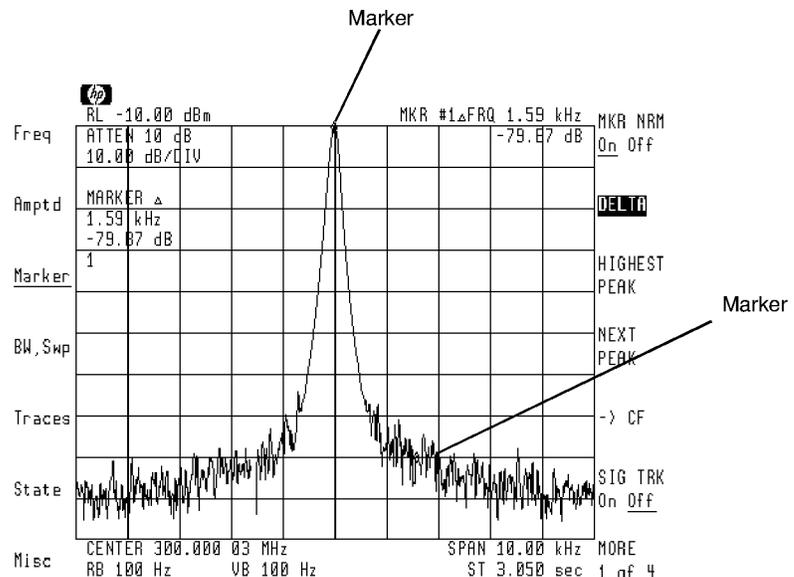
Pressing the reference-level key enables the signal reference level to be set. The noise floor is also raised so that any noise measurements can be made above the bottom division.

3. Press **PEAK SEARCH** on the hardkey panel.

Pressing the **PEAK SEARCH** key places a marker on the highest signal found.

4. Press **Marker**, **DELTA**, and then use **▲**, **▼**, or the knob to position the delta marker on the noise.

Pressing **DELTA** activates the delta-marker function. Using the step keys or knob, position the delta marker wherever you want to measure. See the following figure for an example of where the active marker is placed.



5. Press **MORE 1 of 4**, then **MKNOISE On Off**.

Pressing **MKNOISE On Off** turns on the marker-noise function. The spectrum analyzer enables sample detection mode and performs a digital average for ± 16 bits around the active marker. The marker readout in the active function area on the display reads out the difference between the markers in dBc/1 Hz. This is the carrier-to-noise (C/N) measurement normalized to a 1 Hz bandwidth.

To normalize to other bandwidths, use the following formula:

$$\text{marker noise readout} + 10\log\left(\frac{\text{new bandwidth}}{1\text{Hz}}\right) = C/N_{\text{endeqn}}$$

where C/N is referenced to the new bandwidth.

Example 6. Measure the difference between two traces

The difference between two traces can be measured very easily using the delta-marker function. This example demonstrates the delta-marker function while measuring the calibrator signal when it is connected and not connected.

1. Press **Marker**, then **MKR NRM On Off** twice.

This key sequence turns off the delta marker first and then turns off the active marker from the previous measurement example.

2. Press **PEAK SEARCH** on the hardkey panel.

Pressing the **PEAK SEARCH** key places a marker on the highest signal.

3. Press **Traces**, then **STORE A**.

Pressing these softkeys stores Trace A.

4. Press **trace A B C** until B is underlined, then press **CLEAR WRT B**.

This key sequence selects Trace B as the active trace.

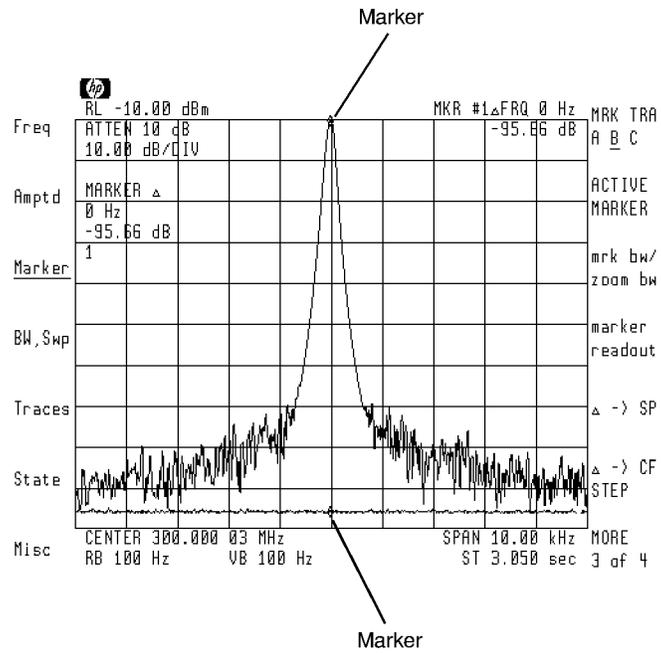
5. Disconnect the cable from the CALIBRATOR output.

Trace B is now displayed as a trace without a signal.

6. Press the following keys:

Δ (MARKER) key on the hardkey panel
Marker, **MORE 1 of 4**, **MORE 2 of 4**
MRK TRA A B C until B is underlined

The delta-marker is set on Trace B. Since the delta-marker function is active, the difference between Trace B and Trace A is displayed in the active function readout area as shown in the following figure.



7. Note the amplitude difference between the two traces.

The amplitude difference between the two traces is displayed in the active-function readout area on the display.

Example 7. Measure the fundamental and harmonics of a source

The calibrator signal can be used to simulate a source and its harmonics. In this case, the calibrator signal is the fundamental. With the fundamental and harmonics all visibly displayed at the same time, the measurement can be made easily with the markers.

1. Press **INSTR PRESET** and reconnect the calibrator signal.

Pressing **INSTR PRESET** resets the system and places it in a known state.

2. Press **STOP FREQ** on the hardkey panel and then **2**, **0**, **5**, **GHz**.

This key sequence sets the stop frequency just above the highest harmonic frequency to be measured.

3. Press **BW, Swp**, **VID BW AutoMan**, then press the **▼** step key until a video bandwidth of 10 kHz is reached.

This key sequence decreases the video filtering to 10 kHz so that the noise floor is decreased.

4. Press **PEAK SEARCH**, then **Δ** (MARKER) on the hardkey panel.

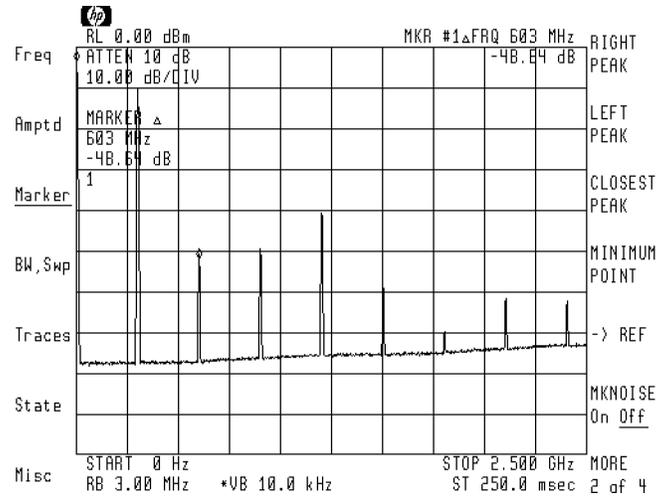
This key sequence sets up the delta-marker function.

5. Press **Marker**, **MORE 1 of 4**, then **RIGHT PEAK**.

Once the delta-marker function has been activated, pressing **RIGHT PEAK** will position the delta marker on the next highest peak to the right. The amplitude and frequency difference between the fundamental and the first harmonic is displayed in the active function readout area.

6. Press **RIGHT PEAK**.

Successively pressing **RIGHT PEAK** enables you to continue measuring the third and higher harmonics. See the figure below.



Example 8. Create a limit line

Build a test limit line around the 300 MHz calibrator signal. By using the limit-line editing functions and the knob, limit lines can be created very quickly.

1. Press **INSTR PRESET**, **CENTER** 300 MHz, and **SPAN** 1 MHz.

This key sequence resets the instrument and positions the 300 MHz calibrator signal at center screen in a 1 MHz span.

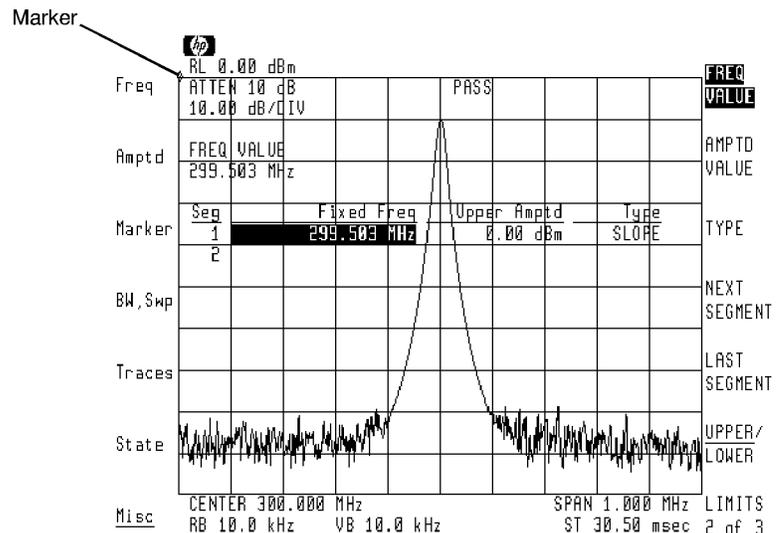
2. Press **Misc**, **MORE 1 of 3**, **limit lines**, then **enter limit**.

This key sequence accesses the limit-line editing softkey functions. Pressing **enter limit** displays the limit-line table onscreen, accesses the softkey functions that define a segment's parameters, and automatically activates the **FREQ VALUE** softkey.

If a limit-line table already exists, the **edit limit** softkey appears in place of the **enter limit** softkey.

3. Initially position the marker at the left-hand side of the display screen by using the knob.

Using the knob is a very easy and convenient method of setting the frequency value of the first segment.



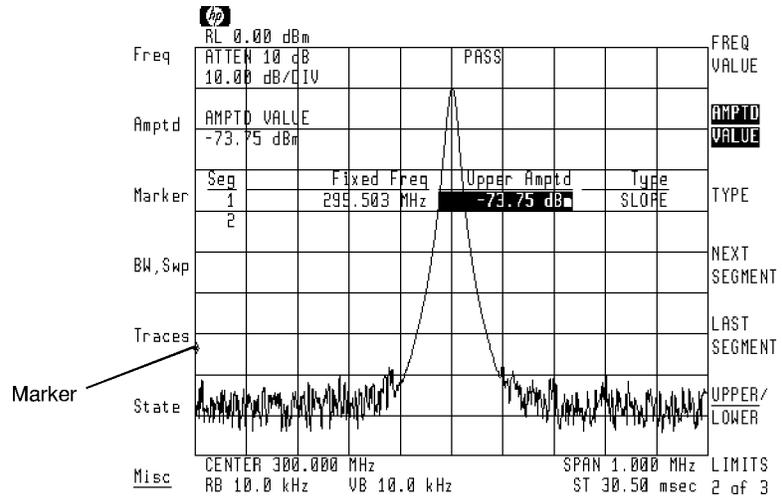
4. Press **AMPTD VALUE**, then use the knob to position the marker above the noise as shown below.

Pressing **AMPTD VALUE** activates the amplitude value of the segment to be set. Use the knob, or any other data entry method, to enter in the desired amplitude value.

5. Press **TYPE**, then select **SLOPE**.

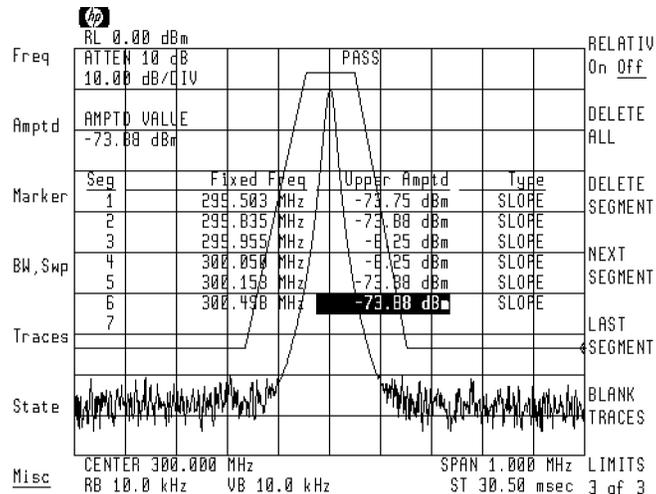
This step is necessary to select the limit-line type. For the purpose of this example, the limit-line type for each segment is set

to slope. Since slope is always set as the default type, there is no need to make this selection at this time. Slope connects two segments in a line.



- Press **NEXT SEGMENT**, then **FREQ VALUE** and repeat steps 3 through 6 until all segments for your limit-line table have been created.

Using steps 3, 4, 5, and 6 enable you to define frequency, amplitude, and type parameters for each segment of your limit-line table. The following figure illustrates a completed limit-line table and the limit line.



- Press **SAVE LIMIT**, enter a register number, then press **ENTER**.

This key sequence saves the limit-line table in the register of your choice.

Example 9. Format a memory card and save a trace

This task describes how to format and save information on a memory card. Information from the spectrum analyzer is sent via the MSIB path to the HP 70004A's display where the memory card reader is located.

1. Check that the memory card “write protect” switch is off.

This step is necessary to ensure that the memory card can be read and written to by the card reader.

2. Place the memory card in the HP 70004A's memory-card reader.

To ensure that the memory card is selected as the mass storage device, a memory card must first be present in the card reader. If a memory card is not inserted and the **HP-MSIB CARD** softkey is activated, an error will occur in the local-oscillator module.

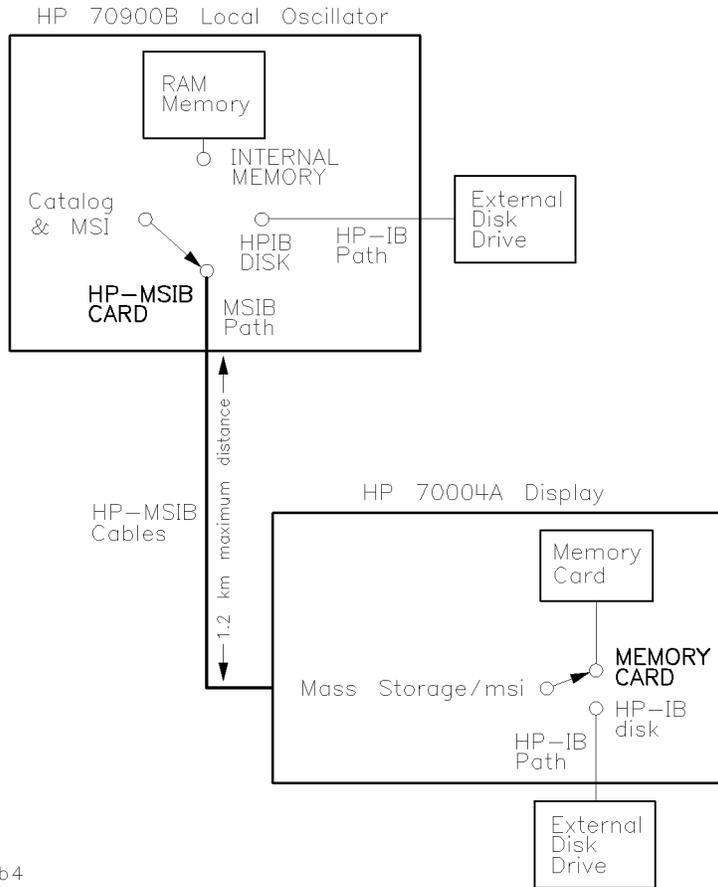
3. Press **DISPLAY** on the display instrument front panel.

This step accesses the display menus.

4. Press **MASS STORAGE**, **msi**, then **Memory Card**.

This key sequence selects the memory card as the mass storage device for the display instrument. This selection defines the “path” to the memory card by selecting (via softkeys) the proper mass storage “switch” in both the HP 70900B and the display.

The following figure illustrates how the “switch” in both the local oscillator and the display must be set in order for them to communicate properly with one another.



qdb4

5. Press **MENU**.

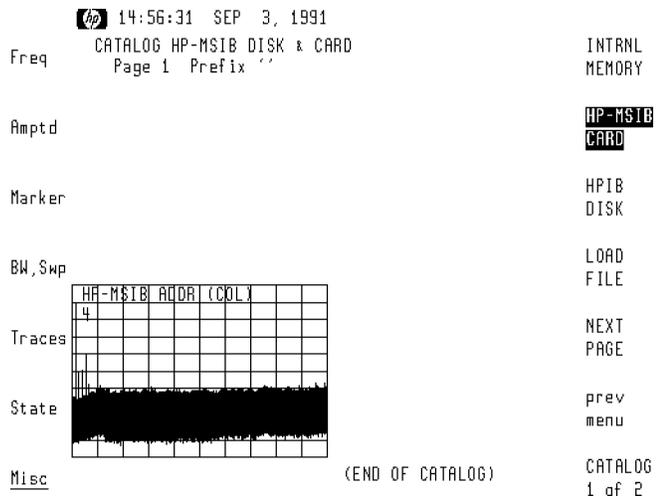
Pressing **MENU** accesses the menu softkeys that contain the spectrum-analyzer functions.

- Press **Misc**, **MORE 1 of 3**, **catalog & MSI**, then **HP-MSIB CARD** and enter **4**.

This key sequence specifies that mass storage information for the HP 70900B local oscillator will be sent to the display at HP-MSIB address 4 (default address). The mass-storage device link between the spectrum analyzer and the display is now established so that they communicate properly.

If the display address is *not* set to 4, then you will get an error when you try to access the card reader. Note that the display address is shown in the spectrum-analyzer display on the display screen as shown in the following figure.

Memory card contents, if any, will appear under “Page 1 Prefix ””.



CAUTION

Formatting a memory card will erase all previously-stored contents.

7. Press `CATALOG 1 of 2`, `FORMAT`, then `CONFIRM FORMAT`.

This key sequence formats the HP-MSIB card that is in the memory-card reader.

8. Press `SAVE` on the hardkey panel, `SAVE TRACE A`, `1`, then `ENTER`.

This key sequence saves Trace A in trace register 1 on the memory card. Once the path is selected, this step is all that you need to do for the next save operation.

Example 10. Execute the HP 70000 Customer Demo Downloadable Program (DLP)

Downloadable programs are programs resident in the spectrum analyzer that are executable without an external computer. These programs can be either one-button solutions or interactive routines. DLPs can be accessed using the front-panel softkeys. They can also be accessed via an external computer by sending the appropriate programming commands allowing distributed processing.

A set of four example DLPs are downloaded into the HP 71209A system before it is sent out from the factory. A package containing these DLPs is included with your shipment if these DLPs are missing. The HP 70000 Customer Demo DLP package contains: a floppy disk with the four programs, an operation note with complete DLP loading instructions, and the *Downloadable Programming Guide and DLP Toolkit Manual* that describes how to create your own DLP.

1. Press **USER** and note if the **DLPDEMO** softkey appears.

This step verifies that the DLPDEMO program is loaded in the instrument. If the HP 70000 Customer Demo DLP is already loaded into internal memory, you may skip step 2.

2. Load the program file "MMS_DLP" from the HP 70000 Customer Demo DLP disk according to the Operation Note instructions.

Follow the Operation Note instructions (that were provided with the HP 70000 Customer Demo DLP package) for loading the DLP into the instrument from a computer. This Operation Note provides complete information on equipment requirements and explicit step-by-step loading instructions.

3. Press **USER**.

Pressing **USER** accesses the user softkey menu that contains the HP 70000 Customer Demo DLP.

4. Press **DLPDEMO**.

Pressing **DLPDEMO** accesses the HP 70000 Customer Demo DLP that contains the following four programs:

- **Total HarmDis**
- **Monitor Signal**
- **Water Fall**
- **Spur Search**

The HP 70000 Customer Demo DLP is for demonstration purposes only, but the DLPs can be used for making measurements. Use the DLP Toolkit manual provided with this DLP package either to modify the existing DLPs or to write your own DLP.

In using the DLPs, you will find that they are self-explanatory and very easy to use. Use the **DLP Intro** softkey to display more information regarding DLPs.

5. To exit the HP 70000 Customer Demo DLP, press **EXIT**.

Pressing **EXIT** from any of the four program demonstrations places you back at the beginning of the **DLPDEMO** program. Pressing **EXIT** again at this time leaves the **DLPDEMO** program and places you back at the user softkey main menu.

If you try to recall a saved trace and it fails

- Check the selected mass storage device of the local oscillator and that of the display.
 - To check the mass storage device of the HP 70900B, press the following softkeys:

```
Misc
MORE 1 of 3
catalog & MSI
```

- To check the mass storage device of the display, press the following keys:

```
DISPLAY
Mass Storage
```

For example, if the memory card is the desired mass storage device, then set the HP 70900B mass storage device to the display by pressing `HP-MSIB CARD` which selects the path for memory-card access. Then set the display's mass storage device to the memory card.

- Check that the selected mass storage device is installed properly.
 - If the memory card has been selected, make sure that a memory card has been properly inserted.
 - If the HP-IB disk has been selected, make sure that the disk has been properly installed in the correct disk drive.
- Check that the selected mass storage device is addressed correctly.

If the memory card has been selected as the mass storage device, then the HP-MSIB address must be set to the address of the HP 70004A in order for you to access the memory card reader.

The default address of the HP 70004A is 4. To confirm this, press `DISPLAY`, `Address Map`, then scroll with the knob until 70004A DISPLAY appears. Note the column number which is the same as the address.

The selected MSI address and the MSIB address of the selected display can be any legal address, but they *must* be the same.

