Errata

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HP 85713A
Digital Radio
Measurements Personality
User's Guide

HEWLETT PACKARD

HP Part No. 85713-90004
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How to Use This Manual

Chapter 1, "Introducing the Personality," introduces you to the Digital Radio Measurement Personality and its features.

Chapter 2, "Installing the Program," describes how to install, access, and delete the program.

Chapter 3, "Digital Radio Measurements," shows you how to make measurements using the personality.

Chapter 4, "User-Defined Masks," describes how to create your own user-defined masks. An example mask is included.

Chapter 5, "Softkey Reference," defines each menu softkey in alphabetical order.

Note

If you have not installed or are not familiar with your spectrum analyzer, refer the *HP 8590 Series Spectrum Analyzer User's Guide.* It describes analyzer features and tells you how to make spectrum analyzer measurements. Consult this manual whenever you have a question about standard spectrum analyzer use.

Note

Generic HP 8590 series spectrum analyzer front and back panel illustrations are used throughout this manual. Your analyzer's front and rear panels may be different, depending on the model number and options.

Contents

Figures

1

Introducing the Personality

This chapter introduces the HP 85713A Digital Radio Measurements Personality. It contains the following information.

Introduction

When installed in an HP 8592B/D (with Option 003), HP 8593A/E, HP 8594A/E, HP 8595A/E, or an HP 8596E spectrum analyzer, the HP 85713A provides all the capabilities and functions of the standard analyzer with the addition of very specific digital radio measurement functions. The personality's main menu is displayed in two pages. See Figure 1-1.

Softkeys in the main menu's first page allow you to recall, save, create, and edit "masks." Softkeys in the second page perform measurements on the signal of interest.

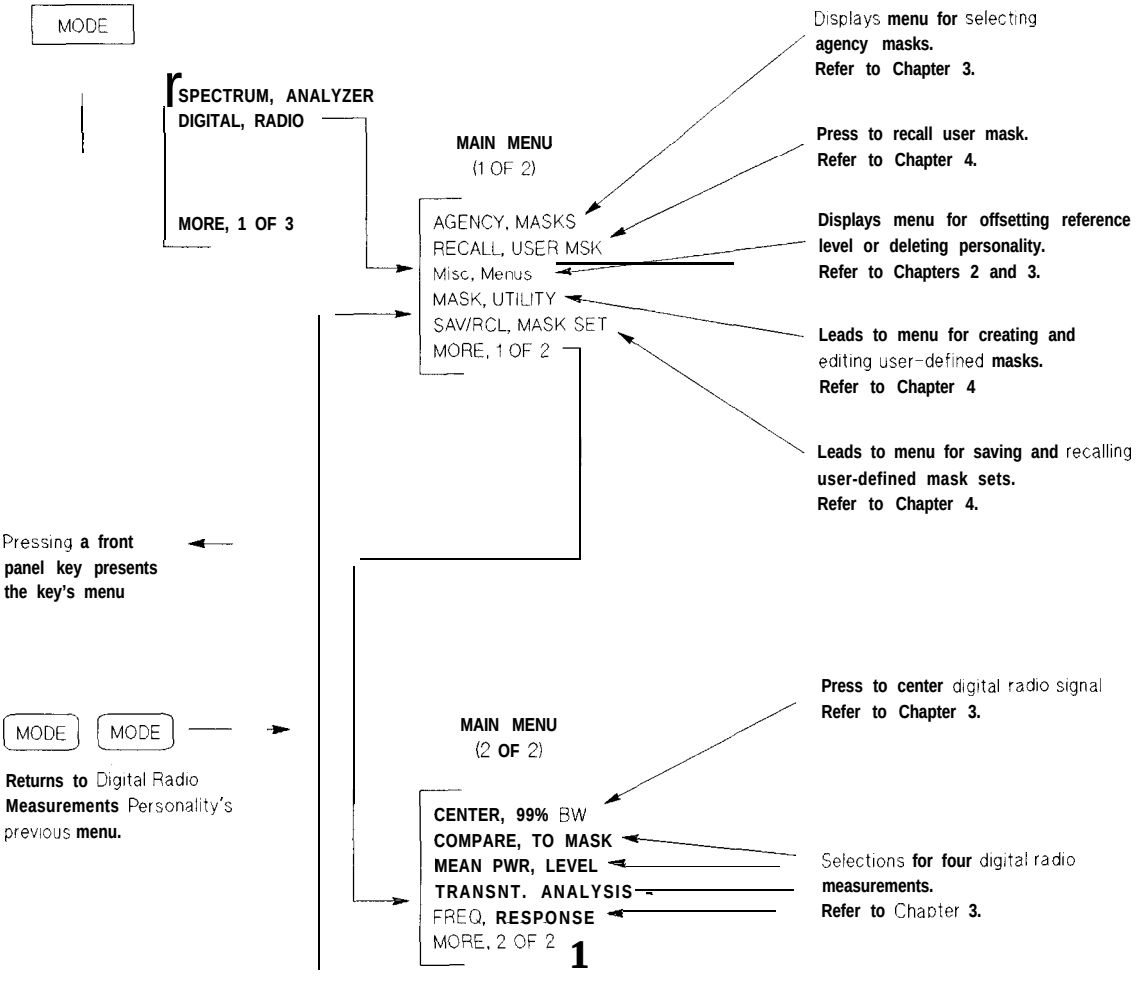

Figure I-I. The Main Menu

What Is a Mask?

A mask is a graphical representation of the FCC (or other government agency) specifications for the transmitted spectrum of a digital radio system. A mask outlines the authorized bandwidth that must contain the modulated spectrum. The analyzer stores the mask in trace C.

Note

During operation of the digital radio measurements personality, the softkey menus are blanked. When the analyzer is busy drawing a mask on the screen, the word COMPUTING is displayed. The softkey menu will be redisplayed on the screen when the measurement has been completed.

Getting Started

Refer to Chapter 2 to install the personality. After installation, use one of the following two methods to access the personality:

1. At any time, press (MODE) and then DIGITAL RADIO .
2. After leaving the digital radio personality menus (by using any standard spectrum analyzer function), press [MODE) (MODE).

Note

Pressing front-panel keys while using the Digital Radio Measurements Personality causes the spectrum analyzer to activate that key and its menu. You can return to the previous digital radio menu by pressing the (MODE) key twice in succession.

Personality Features

This section lists the main features of the digital radio measurements personality.

Five Built-In Agency Masks

Five major agency masks are built in for ease of use in testing FCC, UK, or FRG digital radio specifications for band occupancy. Masks available are the 4 GHz, 6 GHz, and 11 GHz FCC masks used in the United States, the 13 GHz United Kingdom mask, and the West German 13 GHz FRG mask.

Eleven User-Created Masks

The HP 85713A can store up to 11 custom masks. Masks are entered, by the user, from the front panel and easily tailored to specific measurement needs. Masks may be either relative or absolute (the maximum power level is referenced to the peak of the unmodulated carrier power level).

Each mask may have as many as nine breakpoints on each side of its center frequency. These breakpoints, or test limits, are set when creating a mask by entering the desired frequency and amplitude. The frequency of a breakpoint can increase or remain the same. However the amplitude of a breakpoint can increase, decrease, or remain the same.

Mean Power Level Measurement

Makes automated power level measurements using the modulated spectrum of the digital radio signal. If the signal level is greater than the reference level, an additional 10 dB of attenuation is switched in, and the measurement is repeated automatically.

Compare to Mask (Relative or Absolute Level)

This measurement procedure first makes an automated mean power level measurement, then compares the result to the selected mask limits. After the measurement is complete, a marker indicates either the frequency where the least difference between mask and signal occurred (if the comparison'met the mask limits) or the frequency where the most difference between mask and signal occurred (if the comparison failed).

Record Transient Occurrence (Monitor Mode)

The Transient Analysis Monitor Mode looks at the digital radio modulated signal and centers the signal on the 25 dB down point. The spectrum analyzer then is switched to zero span and its sweep time set to 30 seconds. At the end of each sweep a "peaks" command is executed, which looks for signal peaks (transients that occurred if the signal frequency shifted). The number of amplitude peaks that occurred during each sweep are recorded at the top of the spectrum analyzer's display.

Frequency shifts meeting *both* of the following requirements will be recorded as transients:

- Shifts beyond the signal's 25 dB bandwidth.

- Shifts causing an amplitude change of 5 dB or greater from the signal's -25 dB level.

Frequency Response Measurement (Compare to Reference)

This measurement allows the user to set up a digital signal as a reference on the spectrum analyzer's display with the desired frequency span and center frequency. After this initial setup is complete the reference trace is stored. The instrument may be carried to another site where the frequency response can be tested by comparison to the previously stored reference trace.

Create Mask at One Frequency, Use at Another

Masks that are created, then stored, may easily be recalled by answering the prompt:

```
ENTER # OF MASK <=11
```

Once a mask has been recalled by entering a mask number greater than zero but less than or equal to 11, it may be moved to a different center frequency simply by pressing CENTER FREQ and using the knob or keying in the new center frequency for the mask.

Print Hardcopy Output with Text

At the completion of a measurement, the user can press PRINT RECORD, which initiates a print dump of the screen data without an external controller. The screen remains frozen until the data transfer to the printer is complete.

Note

During operation of the digital radio measurements personality, the softkey menus are blanked. When the analyzer is busy drawing a mask on the screen, the word COMPUTING is displayed. The softkey menu will be redisplayed on the screen when the measurement has been completed.

Manual Terms and Conventions

Key	A boxed name in this typeface represents a key physically located on the instrument.
Softkey	A boxed word written in this typeface indicates a "softkey," a key whose label is determined by the instrument's firmware.
Display Text	Text printed in this typeface indicates text displayed on the analyzer's screen.

If Something Goes Wrong

This chapter tells you what to do if you have a problem. Your spectrum analyzer, with its digital radio measurement personality, is built to provide dependable service. It is unlikely you will experience a problem, but in the event something goes wrong, refer to the *HP 8590 Series Spectrum Analyzer User's Guide* and review "Problems and Error Messages". It is very important that you complete all basic checks for the analyzer before calling Hewlett-Packard or returning the analyzer. This should avoid unnecessary repair work and waiting time. If the problem still is not resolved, call your nearest HP Sales and Service Office.

Service Options

If you want to service the analyzer yourself after the warranty expires, you can purchase service documentation that provides all necessary test and maintenance information. Refer to the description of options in the *HP 8590 Series Spectrum Analyzer User's Guide.*

2

Installing the Personality

Installation

1. Locate the arrow printed on the digital radio measurements personality card's label.
2. Insert the card into the spectrum analyzer with its arrow matching the raised arrow on the bezel around the card-insertion slot. See Figure 2-l.

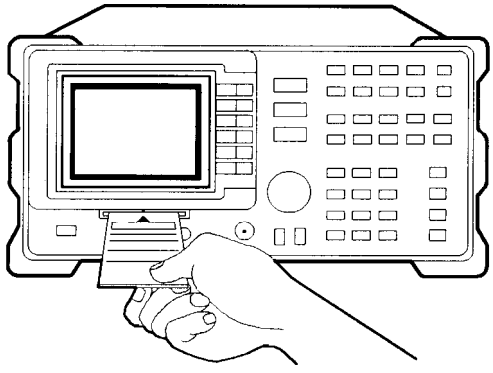

Figure 2-1. Inserting the Card

3. Press the card into the slot. When correctly inserted, about 19 mm (0.75 in) of the card extends from the slot.
4. Press [RECALL).
5. Select the memory card by pressing INTERNAL CARD to underline CARD.
6. Press CATALOG CARD CATALOG ALL.
7. Use the knob to highlight dDIGRAD_1, the digital radio measurements personality.
8. Press LOAD FILE. It takes approximately 60 seconds to load the file.

9. Press (MODE) DIGITAL RADIO LOAD MASK SET. This loads all the data for the agency masks included with the measurement personality.
10. The masks data and the digital radio measurements personality are now completely loaded and ready for use. To verify, press the following keys:
    (MODE) DIGITAL RADIO AGENCY MASKS 6GHZ FCC MASK.

    The 6 GHz FCC mask should appear, as illustrated in Appendix B, "Agency Masks."
11. Remove the card from the spectrum analyzer.

Accessing the Personality

After installing the personality, use one of the following two methods to access it:

1. At any time press (MODE) and then DIGITAL RADIO .
2. After leaving the digital radio personality menus (by using any standard spectrum analyzer function), press (MODE) (MODE).

Note

Pressing front-panel keys while using the Digital Radio Measurements Personality causes the spectrum analyzer to activate that key and its menu. You can return to the previous digital radio menu by pressing the (MODE) key twice in succession.

The normal spectrum analyzer display can be restored at any time by pressing (MODE) and then SPECTRUM ANALYZER.

Exiting the Personality

You can exit from the personality at any time by pressing (MODE) SPECTRUM ANALYZER.

Deleting the Personality

To remove the personality, press the following keys from the main manu: Misc Menus, DISPOSE MENU, and DISPOSE DGRD DISPOSE DGRD . The personality is now purged from the spectrum analyzer's memory.

Deleting All Personalities

Caution

The following process purges all personalities from the spectrum analyzer's memory. If you have them on a memory card, the desired personalities can be reloaded using the procedure described above.

1. Press (CONFIG) MORE 1 of 2.
2. Press DISPOSE USER MEM two times.

All personalities have been purged from the spectrum analyzer's memory.

3

Digital Radio Measurements

To perform a digital radio measurement, you must do the following tasks:

1. Select an Agency or User-defined Mask.
2. Select one of four measurements.

This chapter describes four measurements and two functions available with the personality. The following topics are discussed:

Selecting a Mask

The Digital Radio Measurements Personality allows you to use one of five agency masks or one of 11 user-defined custom masks.

To create user-defined masks, refer to Chapter 4. Chapter 4 also documents the Monitor Jack Mask provided with the personality. This is an example mask that allows you to examine digital radio signals before the final power amplifier stage.

Figure 3-l shows the Agency Menu for selecting an agency mask.

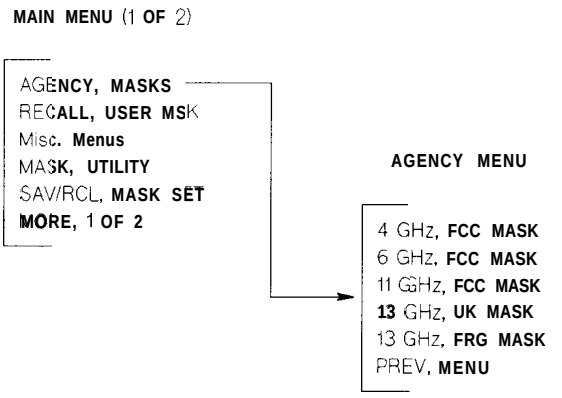

Figure 3-1. Agency Menu Selections

To select an agency mask, select AGENCY MASKS from the main menu. This leads to a menu listing the five agency masks. Choosing one of the agency masks automatically sets the analyzer's center frequency and span width.

If a signal with a power level greater than -40 dBm is present, the signal will be centered and the Measurement Menu displayed.

A signal with a power level below -40 dBm is ignored. **NO** MEASURABLE SIGNAL DETECTED appears on screen and the measurement menu is displayed again.

Note During the operation of the digital radio measurements personality, the softkey menus are blanked. While the analyzer draws a mask on the screen, the word COMPUTING is displayed. The softkey menu will be re-displayed on the screen when the measurement has been completed.

Note Appendix B, "Agency Masks," has sample displays of each agency mask, and includes the data necessary to recreate the agency masks. The agency mask data can be changed and used to create a user-defined custom mask by following the procedure in Chapter 4, "User-Defined Masks."

Measurement Functions

Page 2 of the main menu provides four measurement functions and a signal centering function. See Figure 3-2.

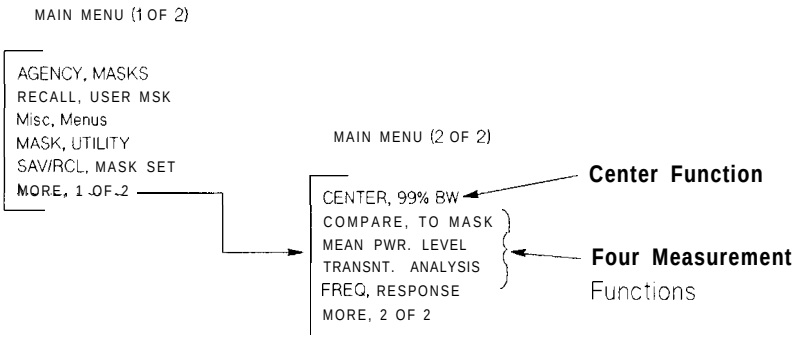

Figure 3-2. Main Menu Measurement Selections

In addition, the Miscellaneous Menu contains a function for reference level offset. See Figure 3-3.

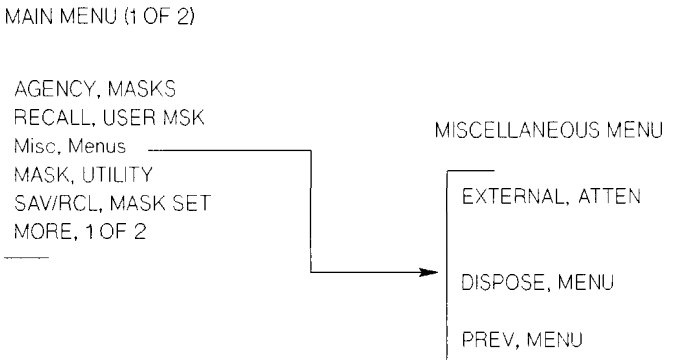

Figure 3-3. External Attenuation Softkey Location

EXTERNAL ATTEN

If external attenuation is used in the test setup, use this function to offset the amplitude of the reference level without affecting the trace. The function uses the spectrum analyzer reference level offset function. Figure 3-3 shows the location of the softkey in the Miscellaneous Menu.

CENTER 99% BW

This function centers the 99% power bandwidth of the digital radio signal on the screen. Use this function if the center frequency has been changed or the signal has drifted.

COMPARE TO MASK

Makes a mean power measurement, then compares the result to the selected mask. If the mask is absolute, the top of the mask is referenced to the peak of the unmodulated carrier level and the modulated spectrum is compared to the mask. See Figure 3-4. Figure 3-5 illustrates the display of relative mask.

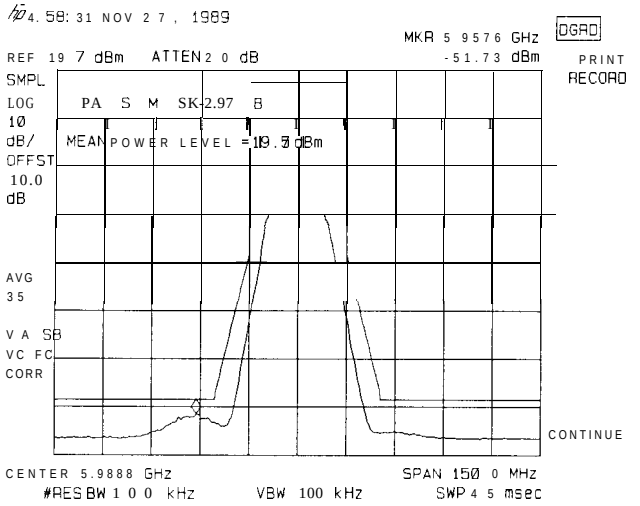

Figure 3-4. Display of Absolute Mask (Compare to Mask)

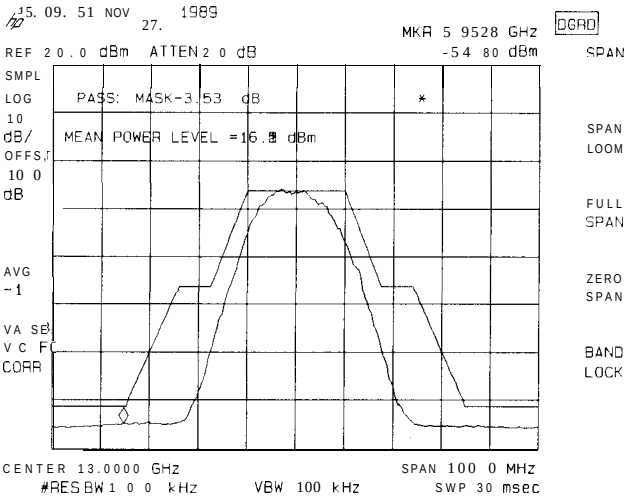

Figure 3-5. Display of Relative Mask (Compare to Mask)

After comparison, the PRINT RECORD /CONTINUE menu is displayed, and the mean power level and the PASS or FAIL message appear on screen. The marker indicates:

- The frequency where the least difference between the mask and signal occurred if the comparison passed.
- The frequency where the most difference between mask and signal occurred if the comparison failed.

MEAN PWR LEVEL

This function determines the mean power level of the unmodulated carrier. The measurement is made on the modulated spectrum response of the digital radio signal. Incorrect power levels result when using the mean power level routine on a CW signal.

For signal levels greater than 0 dBm up to +30 dBm, additional attenuation is switched in and the measurement is repeated. At the completion of the measurement the PRINT RECORD /CONTINUE menu is displayed.

TRANSNT ANALYSIS

This transient analysis measurement looks for a signal within a mask's span on the display. If the signal is greater than -40 dBm, the -25 dB bandwidth is determined, the signal is video-averaged 35 times, then centered on the 25 dB down point. The analyzer is switched to zero span, and its sweep time is set to 30 seconds. At the end of each sweep, amplitude peak excursions of 5 dB or more are recorded.

If the signal is less than -40 dBm, the message NO SIGNAL? is displayed.

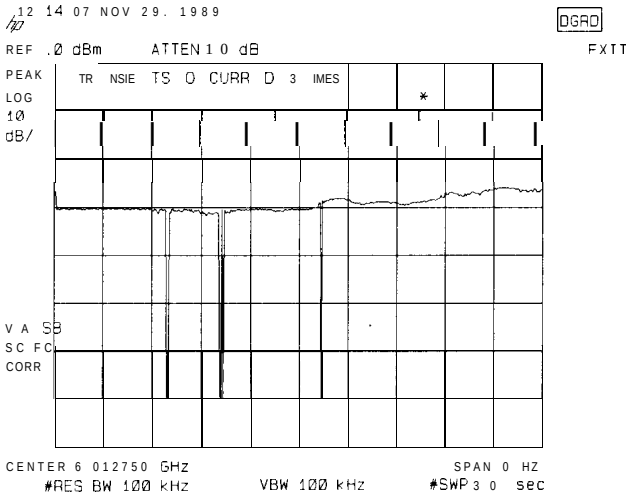

Figure 3-6. Transient Analysis Display

The amplitude changes occur due to signal frequency shifting. Frequency shifts meeting both of the following requirements will be recorded as transients:

- Shifts beyond the signal's 25 dB bandwidth.
- Shifts causing an amplitude change of 5 dB or greater from the signal's -25 dB level.

The number of amplitude excursions of 5 dB or more that occur during each sweep is displayed with the message TRANSIENTS OCCURRED XXXX TIMES.

Note

This measurement continues until the EXIT key is pressed. To get a hardcopy of this measurement, press (COPY).

FREQ RESPONSE

Use this function for frequency response comparisons in digital radio systems. The measurement consists of the following two steps:

1. Entering the reference response.
2. Comparing the responses.

Because the reference response is stored even when the instrument is turned off, frequency responses at different locations can be compared. A digital radio signal must be present to perform this measurement.

Pressing this key displays the frequency response menus shown in Figure 3-7.

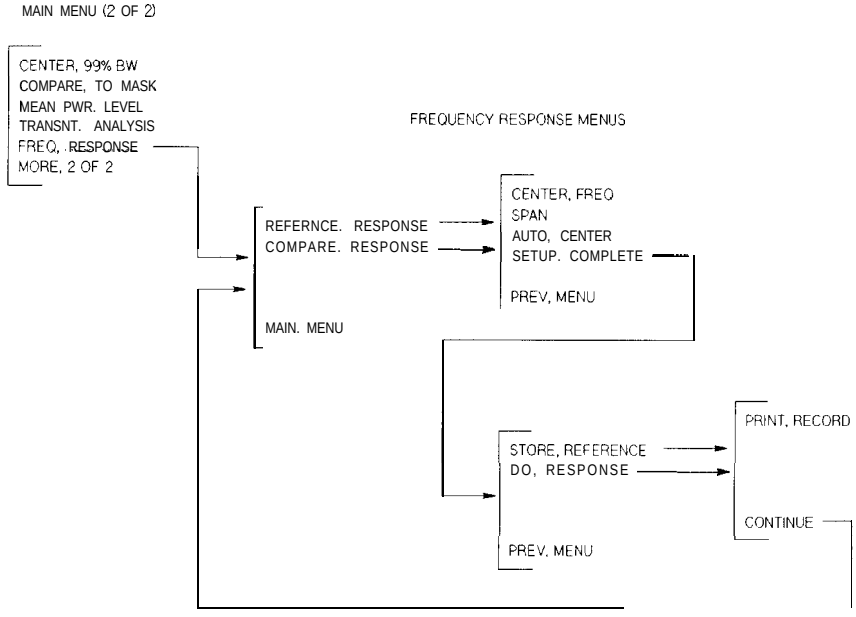

Figure 3-7. Frequency Response Menus

Entering the Reference Response

1. Press REFERENCE RESPONSE. Using the softkeys, set the center frequency and span width. Press AUTO CENTER to center the signal. If not satisfied with this centering, press CENTER and use the knob or (▲) and (▼) to set the center frequency. The spectrum analyzer span width also may be set as desired.
2. After the reference response has been set on screen, press SETUP COMPLETE. See Figure 3-8.

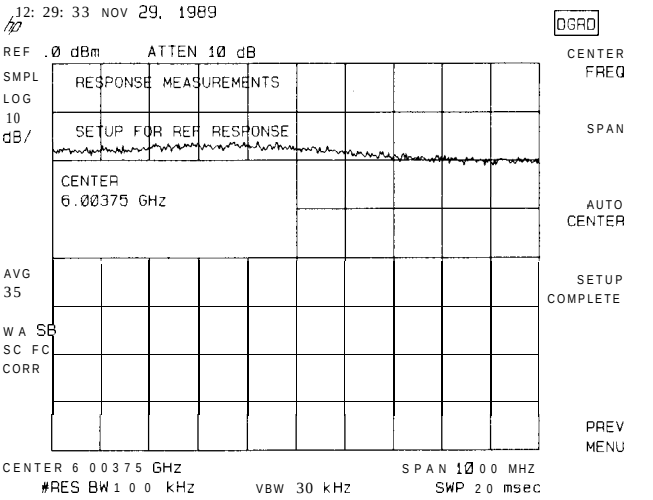

Figure 3-8. Example of Reference Response Display

Note

The left side of the displayed reference trace occasionally may have the incorrect amplitude values assigned to the first one or two display positions. Incorrect amplitude values appear as a vertical discontinuity at the start of the displayed trace. This does not affect the accuracy of the reference response trace, and may be cleared by pressing REFERENCE RESPONSE.

3. Press STORE REFERENCE. After the response has been stored, the response measurement menu returns. This reference is stored even when the instrument is turned off, so the instrument may be taken to a different location to compare a frequency response with the stored reference trace. The instrument may be used for other measurements.

Note

Using the (SAVE) [0] function with traces A, B, or C erases the stored reference trace.

Comparing the Responses

4. Connect the signal to be measured to the analyzer.
5. Set up the response comparison by pressing:

   [MODE] DIGITAL RADIO MORE 1 of 2 RESPONSE MSRMENT COMPARE RESPONSE.

6. Set the center frequency of the analyzer. Note that the span width cannot be changed.
7. Press SETUP COMPLETE DO COMPARE . The analyzer prompts for a PASS/FAIL criterion. Enter the required ± tolerance value, and terminate with the [dB] key. For example, press [2] [dB].

8. After the response comparison, the Log scale is adjusted to give best resolution to the response difference and PASS or FAIL is displayed on the screen. See Figure 3-9.

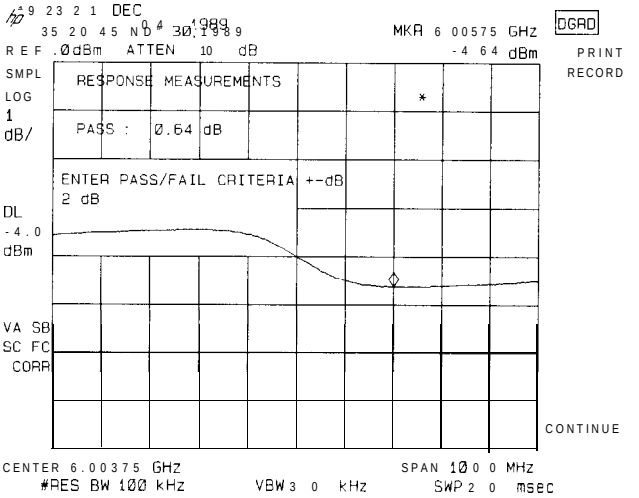

Figure 3-9. Compared Response

4

User-Defined Masks

This chapter explains how to create and use user-defined masks. User-defined masks allow you to customize digital radio measurements to your needs.

The personality includes user-defined mask 11, the Monitor Jack Mask as an example. Refer to “Monitor Jack Mask.”

The following topics are covered:

Two menus of softkeys, the Mask Utility Menu and the SAV/RCL Mask Menu, provide the functions for working with user-defined masks. Each menu is accessed from page 2 of the Main Menu. See Figure 4-l. An additional function, for recalling user masks, is accessed from the Main Menu.

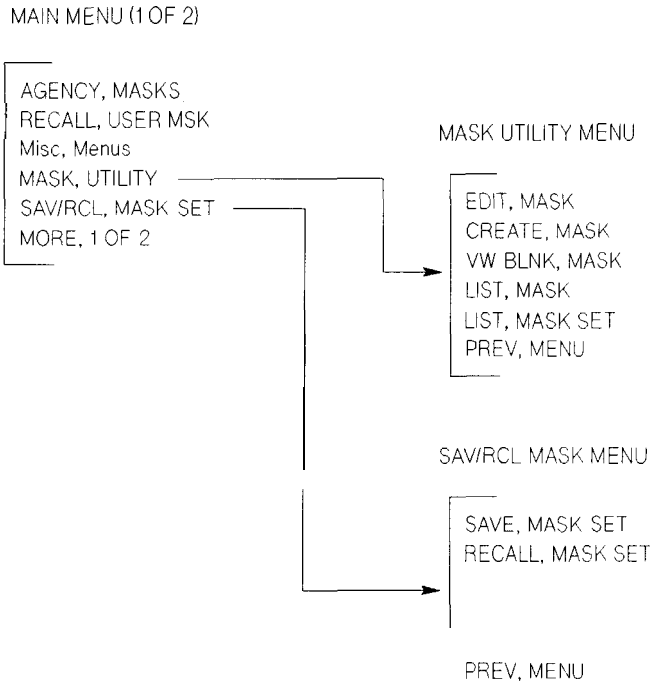

Figure 4-1. Utility and Save/Recall Mask Menus

Mask Utility Functions

RECALL USER MSK

Recall user masks with this function. (The softkey is located on page 1 of the Main Menu.) After pressing this key, enter the number of the user-defined mask to be recalled (ENTER # OF MASK <=11). Requires a number between 1 and 11 inclusive. An entry from 12 through 16 causes an agency mask to be displayed. When the mask is recalled, it sets the analyzer's state.

EDIT MASK

Using this key you can change any parameter of any mask in the set of 16 masks in the memory of the analyzer.

You enter the number of the mask you wish to change, and then press NEXT ENTRY to recall the mask data to make changes, or PREVIOUS MENU to start over or make a different choice.

Refer to "Editing a Mask" in this chapter for complete step-by-step instructions on editing a mask.

CREATE MASK

Enters the procedure for creating a mask customized to your specific requirements. The mask is created symmetrically around the center frequency. The first breakpoint is fixed at 0 MHz relative center frequency, and an amplitude of 0 dB. You will start to enter data from the second breakpoint. The frequency for the last breakpoint will be half the span set initially in defining the mask parameters.

Refer to "Creating a Mask" in this chapter for complete step-by-step instructions on creating a sample mask.

VW BLNK MASK

Allows the selected mask to be blanked or viewed as desired during the initial setup of a digital radio signal.

LIST MASK

Displays all the parameters of the selected mask on the display. This includes the mask center frequency, span width, measurement bandwidth, and the number of breakpoints. A table listing each breakpoint frequency, amplitude, and corrected amplitude also is displayed. For absolute masks, the corrected amplitude is the entered amplitude minus 10 LOG_{10} (RBW/Meas BW;) that is, ten times the log to the base 10 of the ratio of the spectrum analyzer bandwidth to the authorized measurement bandwidth.

LIST MASK SET

Displays a tabular listing of all masks currently stored in the spectrum analyzer's memory. The table shows the mask number, center frequency, span width, and type, where type refers to a relative mask (1) or an absolute mask (2). The last five masks listed are the agency masks included in the digital radio measurements personality.

Save/Recall Mask Functions

SAVE MASK SET — Allows the operator to save the current mask set in one of three files on the memory card. The three possible file names are tMASK_1, tMASK_2, and tMASK_3.

RECALL MASK SET — Allows the operator to recall one of three previously saved mask sets. The three possible file names are tMASK_1, tMASK_2, and tMASK_3. If the file doesn't exist, the current mask set isn't changed.

Note — RECALL MASK SET uses state register 8 during the recall process. Any state stored in register #8 will be lost.

Monitor Jack Mask

The personality includes user-defined mask 11, the Monitor Jack Mask. This mask is provided as an example for using user-defined masks.

Many digital radio transmitters provide a jack for monitoring the RF output before the final power amplifier stage. This output does not include any additional filtering by the final stage. The Monitor Jack Mask, see Figure 4-2, is an example of a mask that might be used to test a signal at this location.

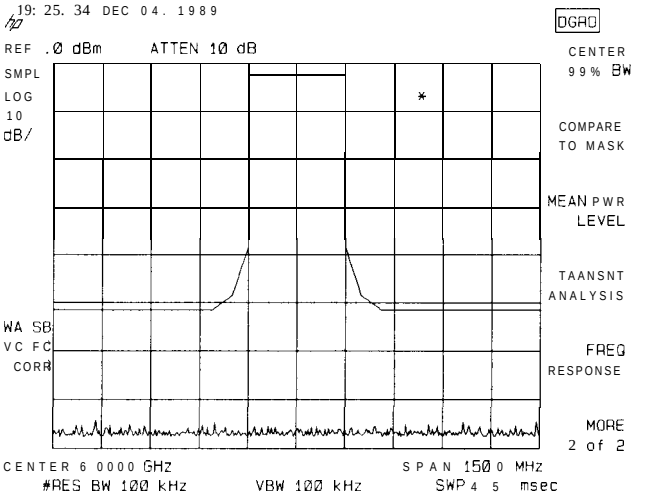

Figure 4-2. Monitor Jack Example Mask

Reference Level	1 (relative)
Center Frequency	6 GHz
Span	150 MHz
Measurement Bandwidth	4 kHz
Number of Breakpoints	6
Breakpoint 1	0 MHz, 0 dB
Breakpoint 2	15 MHz, 0 dB
Breakpoint 3	15 MHz, -50 dB
Breakpoint 4	20 MHz, -60 dB
Breakpoint 5	26.3 MHz, -63 dB
Breakpoint 6	75 MHz, -63 dB

Creating a Mask

The following step-by-step instructions demonstrate creating a sample mask. The sample 6 GHz FCC mask is created symmetrically around the center frequency. The first breakpoint is fixed at 0 MHz relative center frequency and an amplitude of 0 dB. You will start to enter data from the second breakpoint. The frequency for the last breakpoint will be half the span set when defining the mask parameters.

1. To create a new mask, press the following keys in sequence: MASK UTILITY CREATE MASK.

   The analyzer displays the mask parameters screen and, in the lower right corner, a highlighted block with the note STARTING NEW MASK. See Figure 4-3.

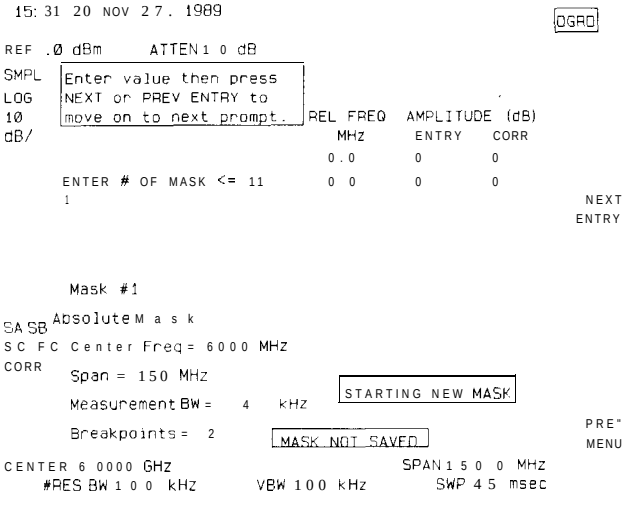

Figure 4-3. Sample Data Table for User-Created Mask

2. Answer all prompts. The first is:

   ENTER # OF MASK <=11

   Entering a number greater than 11 causes the mask number prompt to be reset to 1, repeating the request to enter a mask number.

   For your sample mask, enter 5 Hz, *and press* NEXT ENTRY.

   To correct a mistake made during mask entry:

   a. Press PREVIOUS ENTRY until you get the correct prompt.

   b. Reenter data to correct the mistake, then press NEXT ENTRY. Continue to press NEXT ENTRY until the desired entry is displayed.

c. Continue to enter data for the remaining breakpoints. After the last breakpoint has been entered, press DRAW USER MASK .

3. The next prompt sets an absolute or relative mask. The prompt is:

   REL OR ABS MASK?
   REL = 1, ABS = 2

   Entering [2] (Hz) for an absolute mask sets the top of the mask to the unmodulated amplitude level of the carrier. For a relative mask, enter [1] [Hz].

   For your sample mask, enter [2] *(Hz), and press* NEXT ENTRY .

4. MASK CENTER **FREQUENCY?**
   For your sample mask, enter [6] [GHz], *and press* NEXT ENTRY .

Note

Note that a mask created at one frequency can be used anywhere in the frequency range of the spectrum analyzer.

5. MASK SPAN?

   The span entered remains fixed throughout the use of the mask. Any changes made later from the front panel are automatically reset to this entered span value before a measurement, by the HP 85713A personality.

   For your sample mask, enter [1] [5] [0] *(MHz), then press* NEXT ENTRY.

6. MSRMNT BW OF MASK?

   This prompt is only for absolute masks. It does not appear for relative mask entries. This feature is provided because absolute masks often are specified for a specific bandwidth. The FCC specifies a 4 kHz bandwidth.

   For your sample mask, enter [4] [kHz], *then press* NEXT ENTRY.

   If the mask data is in a 4 kHz bandwidth, entering 4 kHz at this prompt corrects the subsequent amplitude data entry to the actual measurement bandwidth of the analyzer. The mask also is drawn to the amplitude values corresponding to the measurement bandwidth used by the analyzer. The user may enter mask data in any bandwidth.

7. ENTER # OF BREAKPTS <=9

   The maximum number of breakpoints allowed for a

mask is nine. An entry greater than nine or less than two returns the prompt ENTER # OF BRKPTS <=9 to the screen.

For your sample mask, enter 5 Hz*, then press* NEXT ENTRY .

8. The remaining prompts create relative frequency and amplitude of the breakpoints.

   For your sample mask, enter the following frequency-amplitude data in sequence:

Note

The mask is created symmetrically around the center frequency. The first breakpoint of 0 MHz and 0 dB amplitude is entered for you. You will start to enter data from the second breakpoint. The frequency for the last breakpoint will be half the span set when defining the mask parameters.

Breakpoint	Frequency	Amplitude
1	0 MHz	0 dB
2	15 MHz	0 dB
3	15 MHz	-50 dB
4	15.1 MHz	-50 dB
5	26.3 MHz	-80 dB
6	75 MHz	-80 dB

After mask amplitude data has been entered, a table is displayed on the screen showing relative frequency, entered amplitude, and corrected amplitude. For absolute masks, the corrected amplitude is the entered amplitude minus 10 Log_{10} (RBW/Meas SW); that is, 10 times the log, base 10, of the ratio of the spectrum analyzer bandwidth to the authorized measurement bandwidth.

Entry of a relative frequency less than the previous frequency causes the previous frequency to be entered. The breakpoint data has to be reentered, with the correct relative frequency. Therefore, the relative frequencies of the breakpoints must increase or remain the same as the previous breakpoint. However, the amplitude can increase, decrease, or remain the same.

When the last breakpoint data entry is terminated, the draw and save user mask menu is displayed. See Figure 4-4.

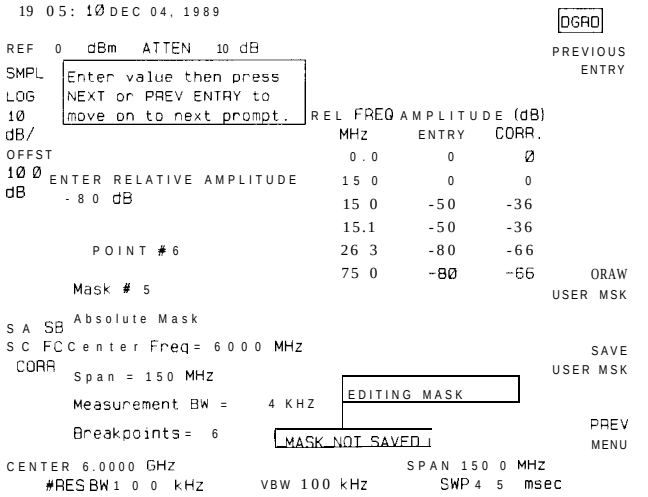

Figure 4-4. Display After the Last Breakpoint Data Entry

9. Press DRAW USER MSK.

Note

During operation of the digital radio measurements personality, the softkey menus are blanked. When the analyzer is busy drawing a mask on the screen, the word COMPUTING is displayed. The softkey menu will be re-displayed on the screen when the measurement has been completed.

If the mask you have created is correct, press PREVIOUS MENU, then SAVE USER MSK . See Figure 4-5. If you wish to make any changes, press PREVIOUS ENTRY or NEXT ENTRY , and change the mask data. The user-created mask must be saved if it is to be used. After SAVE USER MSK, press PREVIOUS MENU twice to display the main menu.

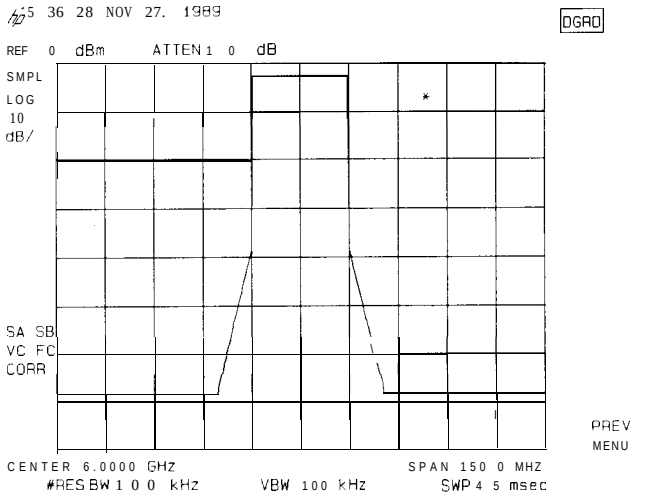

Figure 4-5. Sample of User-Created Mask

10. Press SAVE USER MSK . If the mask is not saved, all mask parameters will need to be reentered if the mask is needed later.

Note

The top of the mask is 2.5 dB below the reference level line to adjust for the 2.5 dB correction applied during a mean power level measurement. The 2.5 dB error compensates for the log amplifier noise and peak detector characteristics. For more information, refer to Hewlett-Packard application note AN 150-4, “Noise Measurements.”

Recalling a Mask

The following procedure demonstrates recalling a user-defined mask.

1. Load the digital radio measurements personality and recall a user-defined mask by pressing the following keys:

   DIGITAL RADIO RECALL USER MSK

2. The following prompt is displayed: ENTER # OF MASK <=11. Enter the number of the mask to be recalled and press (ENTER). The number must be between 1 and 11 inclusive.

After the mask is recalled, the data stored in the mask about the analyzer's center frequency and span width sets the analyzer state. See Figure 4-6.

A signal greater than -40 dBm causes the signal to be centered on the screen and the measurement menu to be displayed.

The presence of a signal with a power level below -40 dBm causes the message NO MEASURABLE SIGNAL DETECTED and the measurement softkey menu to be displayed.

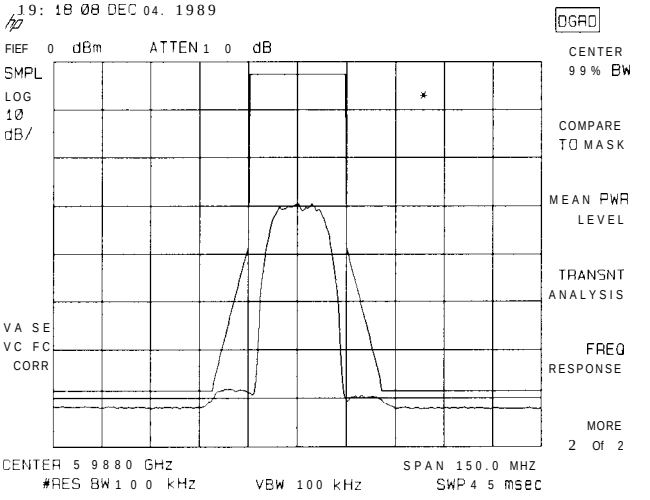

Figure 4-6. Recalled Mask Display

Editing a Mask

Use the following procedure to edit any mask. The procedure first activates a mask and then brings the mask into the editor.

If you are editing a user mask, you can skip activating the mask in steps 1 and 2 and directly enter the mask number in step 3. (Skipping steps 1 and 2 eliminates the need to recall a mask along with its attempt to locate a signal. However, you cannot edit an agency mask if these steps are skipped.)

Note

Entering the number of a mask that has not been created displays the message Valid mask must be loaded or you must start a new mask.

1. Activate the mask to be edited using one of the following methods:
   - Press RECALL USER MSK and select a user mask.
   - Press AGENCY MASKS and select an agency mask.
2. Press MORE 2 of 2 .
3. Press MASK UTILITY and then EDIT MASK to display the first edit prompt: ENTER # OF MASK <= 11.
4. Press NEXT ENTRY or, if step 1 was skipped, enter the number of the mask to edit and press ENTER. (Agency mask numbers cannot be entered.)
5. The indicator EDITING MASK appears on screen. The mask data is ready to be edited.
6. Locate the appropriate data prompt using the NEXT ENTRY and PREVIOUS ENTRY softkeys and enter the new data. (The prompts are listed below in the order presented.)

   ENTER # OF MASK <= 11
   REL OR ABS MASK?
   MASK CENTER FREQUENCY?
   MASK SPAN?
   MSRMNT BW OF MASK?
   ENTER # OF BREAKPTS <=9
   ENTER RELATIVE FREQUENCY
   ENTER RELATIVE AMPLITUDE

7. To correct a mistake made during editing:
   a. Press PREVIOUS ENTRY until you get the correct prompt.
   b. Reenter data to correct the mistake, then press NEXT ENTRY. Continue to press NEXT ENTRY until the desired entry is displayed.
   c. Continue to enter data for the remaining breakpoints. After the last breakpoint has been entered, press DRAW USER MASK .

8. After editing the mask, press SAVE USER MSK to save the mask data.

Copying a Mask

Use the following procedure to copy a mask. The procedure first activates a mask and then brings the mask into the editor.

If you are copying data from a user mask, you can skip activating the mask in steps 1 and 2 and directly enter the mask number in step 3. (Skipping steps 1 and 2 eliminates the need to recall a mask along with its attempt to locate a signal. However, you cannot copy from an agency mask if these steps are skipped.)

Note

Entering the number of a mask that has not been created displays the message Valid mask mustbe loadedor you must start a new mask.

1. Activate the mask to be copied using one of the following methods:
   - Press RECALL USER MSK and select a user mask.
   - Press AGENCY MASKS and select an agency mask.
2. Press MORE 2 of 2 .
3. Press MASK UTILITY and then EDIT MASK to display the first edit prompt: ENTER # OF MASK <= 11.
4. Press NEXT ENTRY or, if step 1 was skipped, enter the number of the mask to copy data from and press [ENTER). (Agency mask numbers cannot be entered.)
5. The indicator EDITING MASK appears on screen.
6. Press PREVIOUS ENTRY if displayed.
7. Enter the number of the new mask, and press (ENTER).
8. Press the SAVE USER MSK to save the mask dataunder the new mask number.

5

Softkey Reference

This chapter lists in alphabetical order each of the personalities main softkeys. A description of each key is provided.

4 **GHZ FCC**

This mask conforms to the FCC specifications listed below. Refer to Appendix B Agency Masks for complete mask specifications.

Center Frequency: . . . . . 4 GHz
Bandwidth: . . . . . 20 MHz
Attenuation below carrier power:

$$A_{dB} = 35 + 0.8(n - 50) + 10logBW$$

where:
A: attenuation in dB
n: percent of bandwidth offset from center frequency (up to 250%)
BW: 20 (specified bandwidth in MHz)

6 **GHZ FCC**

This mask conforms to the FCC specifications listed below. Refer to Appendix B Agency Masks for complete mask specifications.

Center Frequency: . . . . . 6 GHz
Bandwidth: . . . . . 30 MHz
Attenuation below carrier power:

$$A_{dB} = 35 + 0.8(n - 50) + 10logBW$$

where:
A: attenuation in dB
n: percent of bandwidth offset from center frequency (up to 250%)
BW: 30 (specified bandwidth in MHz)

11 GHZ FCC

This mask conforms to FCC specifications. Refer to Appendix B Agency Masks for complete mask specifications.

Center Frequency: .....11 GHz
Bandwidth: ..... 40 MHz
Attenuation below carrier power:

$$A_{dB} = 35 + 0.8\,(n - 50) + 10 log BW$$

where:
A: attenuation in dB
n: percent of bandwidth offset from center frequency (up to 250%)
BW: 40 (specified bandwidth in MHz)

13 GHZ UK MASK

This mask is the UK MPT 1403 test limits for a 13 GHz, 34 Mb/s QPSK radio system. It is a relative mask, meaning the top of the mask is referenced to the peak of the signal being analyzed. Refer to Appendix B, "Agency Masks," for complete mask specifications.

13 GHZ FRG MASK

This mask is the tolerance mask for a West German QPSK earth station transmitter. It is a relative mask, meaning the top of the mask is referenced to the peak of the signal being analyzed. Refer to Appendix B, "Agency Masks," for compete mask specifications.

ABORT

Allows the operator to leave the frequency response comparison setup and either start over, or return through the frequency response menus to the digital radio measurement personalities main menu.

AGENCY MASKS

Leads to a menu listing the five agency masks. Choosing one of the agency masks automatically sets the analyzer's center frequency and span width. A signal with a power level less than -40 dBm causes NO MEASURABLE SIGNAL DETECTED to be displayed. A signal with a power level greater than -40 dBm will be centered. The measurement menu then is displayed.

AUTO CENTER

Invokes a built-in firmware routine that automatically centers a displayed signal on the spectrum analyzer's screen.

CENTER 99% BW

This function centers the 99% power bandwidth of the digital radio signal on the screen. Use this function if the center

frequency has been changed or the signal has drifted.

CENTER FREQ Allows the center frequency of the spectrum analyzer to be set as desired for the signal to be measured.

COMPARE RESPONSE Leads to a menu for setting the signal measurement conditions prior to making a frequency response measurement. The signal's center frequency and span width can be set. An **AUTO CENTER** softkey invokes a built-in routine that automatically centers the signal on the spectrum analyzer's screen.

COMPARE TO MASK Makes a mean power measurement, then compares the result to the selected mask. If the mask is absolute, the top of the mask is referenced to the peak of the unmodulated carrier level and the modulated spectrum is compared to the mask. If the mask is relative, the mask is shifted to the peak of the signal and the comparison made.

After comparison, the PRINT RECORD/CONTINUE menu is displayed, and the mean power level and the **PASS** or **FAIL** message appears on screen. The marker indicates:

- the frequency where the least difference between the mask and signal occurred if the comparison passed, or
- the frequency where the most difference between mask and signal occurred if the comparison failed.

CREATE MASK Enters the procedure for creating a mask customized to your specific requirements. The mask is created symmetrically around the center frequency. The first breakpoint is fixed at 0 MHz relative center frequency, and an amplitude of 0 dB. You will start to enter data from the second breakpoint. The frequency for the last breakpoint will be half the span set initially in defining the mask parameters. Refer to Chapter 4, "Creating a Mask," for complete step-by-step instructions to create a sample mask.

DIGITAL RADIO	Appears on the right side of the display after the spectrum analyzer has been turned on, or (PRESET) has been pressed, and the digital radio measurements personality is loaded in the analyzer memory.
DISPOSE DIGRAD	Removes all of the Digital Radio Personality from the analyzer's internal memory. No other currently loaded downloadable programs will be removed from the analyzer.
DISPOSE MENU	Leads to the DISPOSE DIGRAD and PREV MENU softkeys. DISPOSE DIGRAD must be pressed twice to delete the personality.
DO COMPARE	Allows the operator to enter a Pass/Fail criteria in dB. The reference frequency response and the compare frequency response are then compared.
DRAW USER MSK	Draws the current mask being edited or created. This key is invisible when creating a mask until the operator has entered the last amplitude value.
EDIT MASK	Asks you to enter the number of the mask you wish to change. You must then press NEXT ENTRY to recall the mask data to make changes, or PREVIOUS ENTRY to start over or make a different choice.
EXIT	Allows the user to stop a transient analysis measurement.
EXTERNAL ATTEN	Offsets the amplitude of the reference level without affecting the trace when external attenuation is used in the test setup. It uses the spectrum analyzer reference level offset function.
FREQ RESPONSE	Leads to a frequency response measurement setup menu. This measurement allows the user to set up a reference signal response on the spectrum analyzer's display with the desired frequency span and center frequency. After the initial setup is complete, the reference trace is stored. The spectrum analyzer may be carried to another site where the frequency response can be tested

by comparison to the previously stored reference trace.

LIST MASK

Displays all the parameters of the selected mask on the display. This includes the mask center frequency, span width, measurement bandwidth, and the number of breakpoints. A table listing each breakpoint frequency, amplitude, and corrected amplitude also is displayed. For absolute masks, the corrected amplitude is the entered amplitude minus 10 LOG_{10} (RBW/Meas BW;) that is, ten times the log to the base 10 of the ratio of the spectrum analyzer bandwidth to the authorized measurement bandwidth.

LIST MASK SET

Displays a tabular listing of all masks currently stored in the spectrum analyzer's memory. The table shows the mask number, center frequency, span width, and type, where type refers to a relative mask (1) or an absolute mask (2). The last five masks listed are the agency masks included in the digital radio measurements personality.

MASK UTILITY

Leads to the menu that allows the operator to edit a mask, create a mask, view or blank a mask, list a mask and its parameters, list the complete set of masks now in memory, or return to the previous menu.

MEAN PWR LEVEL

Makes a mean power level measurement. For signal levels greater than 0 dBm up to +30 dBm, additional attenuation is switched in and the measurement is repeated. At the completion of the measurement the PRINT RECORD/CONTINUE menu is displayed.

The mean power level measurement is made on the modulated spectrum response of the digital radio signal. It determines the mean power level of the unmodulated carrier. Incorrect power levels result when using the mean power level routine on a CW signal.

Misc Menus	Leads to a menu listing the EXTERNAL **ATTEN** and DISPOSE MENU softkeys.
NEXT ENTRY	Moves on to the next prompt when creating or editing a mask.
PREVMENU	Returns you to the menu that preceded the last softkey pressed.
PREVIOUS ENTRY	Moves on to the previous prompt when creating or editing a mask.
PRINT RECORD	This key makes a hardcopy of the screen. If the analyzer is connected to a printer, additional text for keeping a record of the current measurement is added to the bottom of the printout. This key is available under the COMPARE TO MASK, MEAN PWR LEVEL, and RESPONSE MSRMENT keys.
RECALL MASK SET	Recall user masks with this function. Allows the operator to recall one of three previously saved mask sets. The three possible file names are tMASK_1, tMASK_2, and tMASK_3. If the file doesn't exist, the current mask set isn't changed.
RECALL USER MSK	After pressing this key, enter the number of the user-defined mask to be recalled (ENTER # OF MASK <=11). Requires a number between 1 and 11 inclusive. When the mask is recalled, it sets the analyzer's state.
REFERENCE RESPONSE	Leads to a menu for setting the signal comparison conditions prior to making a frequency response measurement. The signal's center frequency and span width can be set. An AUTO CENTER softkey invokes a built-in firmware routine that automatically centers a displayed signal on the spectrum analyzer's screen.

SAVE MASK SET	Allows the operator to save the current mask set in one of three files on the memory card. The three possible file names are tMASK_1, tMASK_2, and tMASK_3.
SAVE USER MSK	Saves and draws the mask being editing or creating. This key is invisible when creating a mask until the operator has entered the last amplitude value.
SAV/RCL MASK SET	Leads to the **SAVE MASK SET** and **RECALL MASK SET** softkeys that allow the operator to save or recall a set of masks to or from a RAM memory card.
SETUP COMPLETE	Proceeds to video-average 35 sweeps of the signal conditions set after pressing the COMPARE **RESPONSE** or **REFERENCE RESPONSE** softkey. If part of the COMPARE RESPONSE procedure, the spectrum analyzer will again do a video average of 35 sweeps of the signal trace compared to the reference trace. After completing the video average and pressing **DO COMPARE**, the operator will be asked to **ENTER PASS/FAIL CRITERIA +-dB**. After entering the comparison criteria, the signal and reference trace comparison will be displayed with the pass or fail criteria in dB.
SPAN	Allows the span width of the spectrum analyzer to be set as desired for the signal to be measured.
STORE REFERENCE	Allows the operator to store the reference frequency response in Trace 0.

TRANSNT ANALYSIS

This transient analysis measurement looks for a signal within a mask's span on the display. If the signal is greater than -40 dBm, the -25 dB bandwidth is determined, the signal is video-averaged 35 times, then centered on the 25 dB down point. The analyzer is switched to zero span, and its sweep time is set to **30** seconds. At the end of each sweep, amplitude peak excursions of 5 dB or more are recorded.

If the signal is less than -40 dBm, the message **NO SIGNAL?** is displayed.

The amplitude changes occur due to signal frequency shifting. Frequency shifts meeting *both* of the following requirements will be recorded as transients:

- shifts beyond the signal's 25 dB bandwidth.
- shifts causing an amplitude change of 5 dB or greater from the signal's -25 dB level.

The number of amplitude excursions of 5 dB or more that occur during each sweep is displayed with the message **TRANSIENTS OCCURRED XXXX TIMES**.

VW BLNK MASK

Allows the selected mask to be blanked or viewed as desired during the initial setup of a digital radio signal. If a mask has not been recalled or has been corrupted, this key will do nothing.

A

Digital Radio Measurements Personality Terms

Absolute Mask

An absolute mask references the power level of the modulated spectrum response to the unmodulated carrier power level. The FCC 6 GHz band specification sets the level for the spectrum response 15 MHz away from the carrier frequency at 50 dB down from the absolute carrier power level. This type of mask is used primarily in the United States.

Breakpoint

A breakpoint is where a discontinuity occurs in either frequency or amplitude on a mask. The relative frequency of one breakpoint to another can only increase or remain the same. The amplitude of breakpoints can increase, decrease, or remain the same.

CENTER 99% BW

This softkey evokes a built-in routine that computes the bandwidth containing 99% of the total power of the signal response, then centers that bandwidth on the screen.

Firmware

The digital radio measurements personality requires the HP 8593A firmware to be 8593A rev D (dated 26.6.89) or newer. This date is shown on the display when the instrument first is turned on.

Mask

A mask is a graphical representation of the FCC (or other government agency) specifications for the transmitted spectrum of a digital radio system. A mask outlines the authorized bandwidth that must contain the modulated spectrum.

Mean Power Level Measurement

This measurement of mean power is performed by an internal firmware and software routine. This measurement is made on the

modulated spectrum response and determines the mean power level of the unmodulated carrier.

Note

An attempt to use the mean power measurement on a CW signal would result in erroneous power levels.

Measurement Bandwidth

To ensure the spectrum analyzer has enough sensitivity, and the displayed noise level is below the digital radio signal, a narrow bandwidth is normally used (100 kHz and below). If the mask data is given in a 4 kHz bandwidth, as for the FCC absolute masks, entering 4 kHz to the prompt ENTER MEASUREMENT BW OF MASK corrects the entered amplitude data to the actual measurement bandwidth of the spectrum analyzer. The corrected amplitude is equal to the entered amplitude of the mask minus 10 Log_{10} (RBW/Meas SW); that is, 10 times the log, base 10, of the ratio of the spectrum analyzer's bandwidth to the authorized measurement bandwidth.

Reference

HP Application Note 355, *Digital Radio Theory and Measurements.* This application note is suggested as a reference to digital radio principles and practices.

Relative Mask

A relative mask sets the maximum power level of the mask at the peak of the modulated spectrum response, centered within the mask. This type of mask is used primarily outside the United States.

Transient Analysis Measurement

This softkey evokes a monitor routine built into the digital radio measurements personality. Any changes in amplitude or frequency that occur will be seen on screen and logged. After the selected time period has passed, the total number of transients that occurred will have been logged on screen.

B

Agency Masks

Definitions

Mask Number	1 through 11 for user-defined masks; 12 through 16 for agency masks.
Reference Level	1 = mask positioned on peak of displayed modulated signal. 2 = mask positioned relative to peak of unmodulated carrier.
Center Frequency	Desired center frequency of mask.
Span	Desired span; should allow for sidelobes as well as spurs.
Measurement Bandwidth	Noise power bandwidth for which to adjust mask. (Often specified by communications agency; for example, FCC = 4 kHz.)
Number of Breakpoints	≤ 9; assumes a symmetrical mask.
Breakpoints	Enter frequency in offset from center of mask. Enter amplitude in $\pm$dB relative to center point of the mask.

4 GHz FCC Mask

Mask Number 12
Reference Level . . . . . 2 (absolute)
Center Frequency . . . . . 4 GHz
Span . . . . . 100 MHz
Measurement Bandwidth . . . . . 4 kHz
Number of Breakpoints 6
Breakpoint 1 . . . . . 0 MHz, 0 dB
Breakpoint 2 . . . . . 10 MHz, 0 dB
Breakpoint 3 . . . . . 10 MHz, -50 dB
Breakpoint 4 . . . . . 10.5 MHz, -50 dB
Breakpoint 5 . . . . . 18 MHz, -80 dB
Breakpoint 6 . . . . . 50 MHz, -80 dB

This mask is described as the attenuation below carrier power by the following formula:

$$A_{dB} = 35 + 0.8\,(n - 50) + 10 log BW$$

where:

A: attenuation in dB

n: percent of bandwidth offset from center frequency (up to *250%)*

BW: 20 (specified bandwidth in MHz)

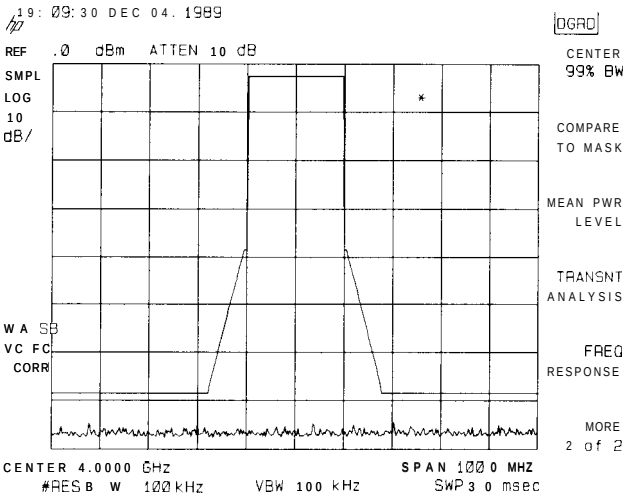

Figure B-1. 4 GHz FCC Mask

6 GHz FCC Mask

Mask Number 13
Reference Level . . . . . 2 (absolute)
Center Frequency . . . . . 6 GHz
Span . . . . . 150 MHz
Measurement Bandwidth . . . . . 4 kHz
Number of Breakpoints 6
Breakpoint 1 . . . . . 0 MHz, 0 dB
Breakpoint 2 . . . . . 15 MHz, 0 dB
Breakpoint 3 . . . . . 15 MHz, -50 dB
Breakpoint 4 . . . . . 15.1 MHz, -50 dB
Breakpoint 5 . . . . . 26.3 MHz, -80 dB
Breakpoint 6 . . . . . 75 MHz, -80 dB

This mask is described as the attenuation below carrier power by the following formula:

$$A_{dB} = 35 + 0.8\,(n - 50) + 10 log BW$$

where:

A: attenuation in dB

n: percent of bandwidth offset from center frequency (up to **250%)**

BW: 30 (specified bandwidth in MHz)

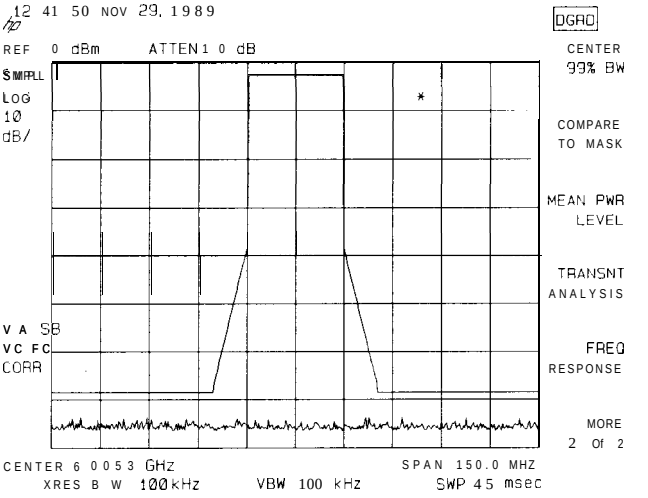

Figure B-2. 6 GHz FCC Mask

11 GHz FCC Mask

Mask Number 14
Reference Level . . . . . 2 (absolute)
Center Frequency . . . . . 11 GHz
Span . . . . . 200 MHz
Measurement Bandwidth . . . . . 4 kHz
Number of Breakpoints 5
Breakpoint 1 . . . . . 0 MHz, 0 dB
Breakpoint 2 . . . . . 20 MHz, 0 dB
Breakpoint 3 . . . . . 20 MHz, -51 dB
Breakpoint 4 . . . . . 34.5 MHz, -80 dB
Breakpoint 5 . . . . . 100 MHz, -80 dB

This mask is described as the attenuation below carrier power by the following formula:

$$A_{dB} = 35 + 0.8\,(n - 50) + 10 log BW$$

where:
A: attenuation in dB
n: percent of bandwidth offset from center frequency (up to **250%)**
BW: 40 (specified bandwidth in MHz)

Note

The displayed average noise specification for the HP 8593A and the HP 8596E in the 100 kHz resolution and video bandwidths used for this mask, is -79 dBm. The typical displayed average noise floors will be at or below the -80 dBm floor of the 11 GHz mask. Signals at this noise floor peak approximately 3 dB above the displayed noise level. Unwanted spurious signals, or signals above the -80 dBm mask floor, can be seen on both the HP 8593A and the HP 8596E.

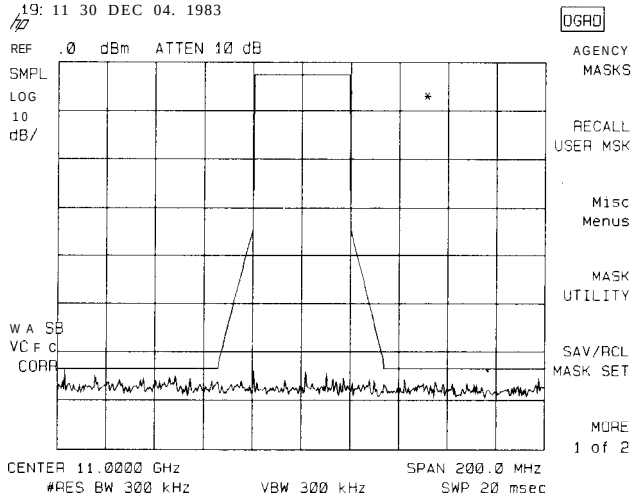

Figure B-3. 11 GHz FCC Mask

13 GHz UK Mask

Mask Number	15
Reference Level	1 (relative)
Center Frequency	13 GHz
Span	100 MHz
Measurement Bandwidth	not applicable
Number of Breakpoints	6
Breakpoint 1	0 MHz, 0 dB
Breakpoint 2	10 MHz, 0 dB
Breakpoint 3	17.5 MHz, -20 dB
Breakpoint 4	24 MHz, -20 dB
Breakpoint 5	35 MHz, -45 dB
Breakpoint 6	50 MHz, -45 dB

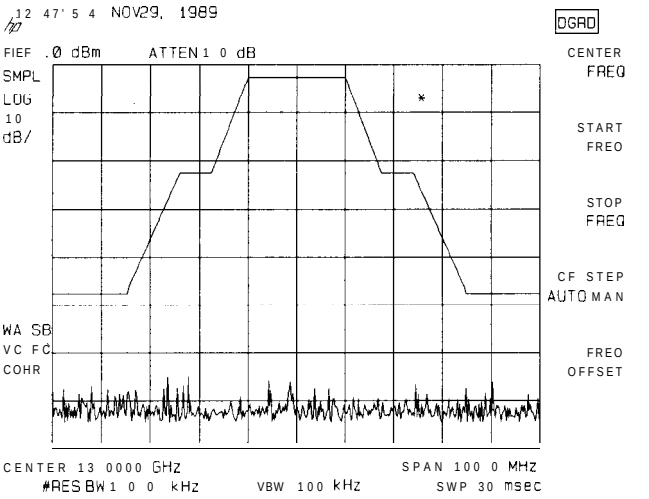

Figure B-4. 13 GHz UK Mask

13 GHz FRG Mask

Mask Number	16
Reference Level	1 (relative)
Center Frequency	13 GHz
Span	100 MHz
Measurement Bandwidth	not applicable
Number of Breakpoints	8
Breakpoint 1	0 MHz, 0 dB
Breakpoint 2	10 MHz, 0 dB
Breakpoint 3	10 MHz, -10 dB
Breakpoint 4	19 MHz, -10 dB
Breakpoint 5	19 MHz, -20 dB
Breakpoint 6	25 MHz, -20 dB
Breakpoint 7	45 MHz, -37 dB
Breakpoint 8	50 MHz, -37 dB

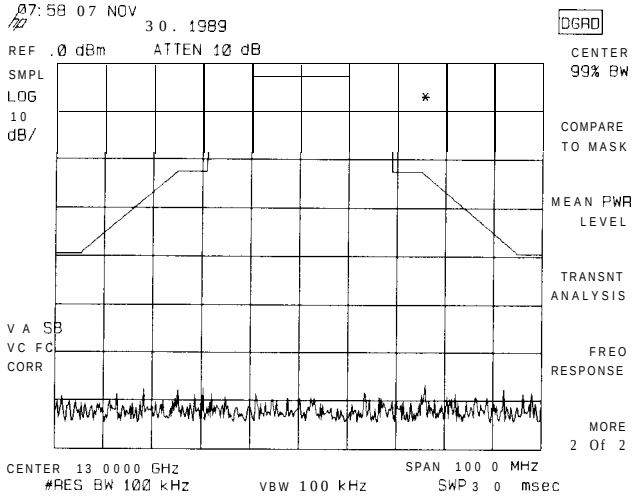

Figure B-5. 13 GHz FRG Mask

Menu Map

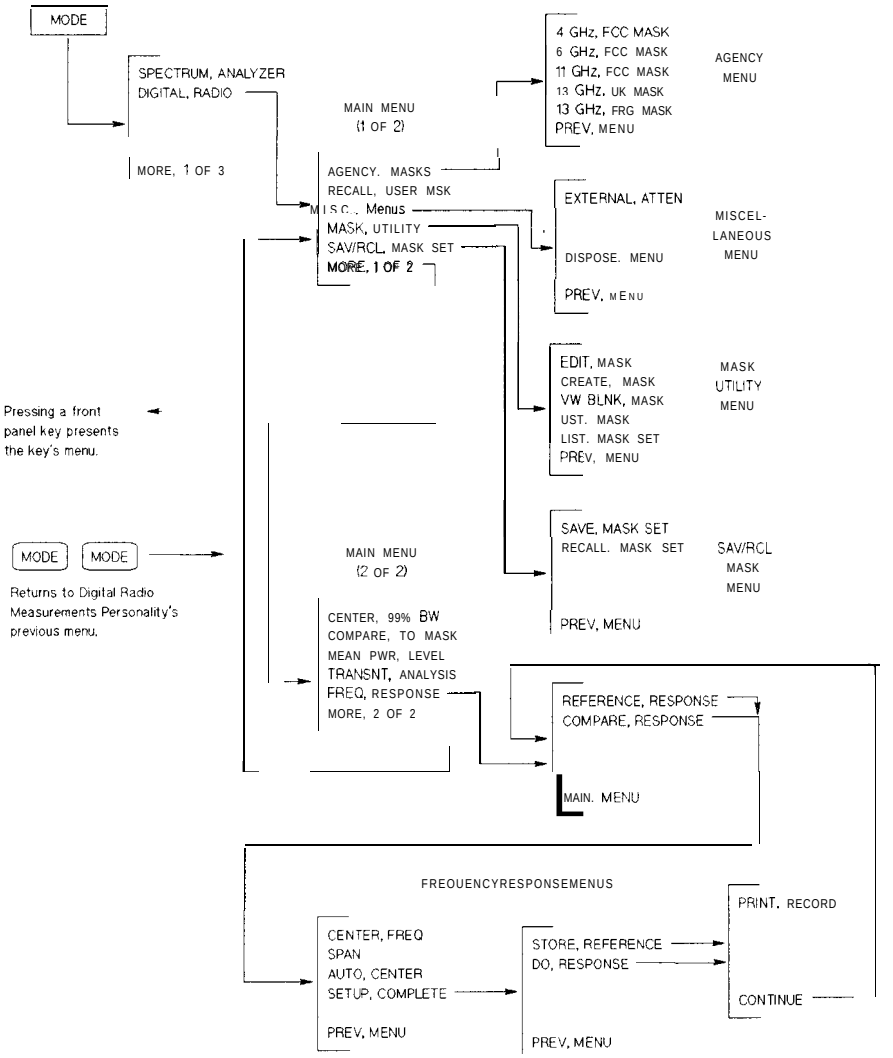

Figure C-l. HP 85713A Menu Map

Index