User's Guide

Agilent Technologies 85672A Spurious Response Utility

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The following safety notes are used throughout this manual. Familiarize yourself with each of the symbols and its meaning before operating this instrument.

Caution

The *caution* note denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in damage to or destruction of the instrument. Do not proceed beyond a *caution* sign until the indicated conditions are fully understood and met.

Warning

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

Instruction Manual

The **instruction manual** symbol. The product is marked with this symbol when it is necessary for the user to refer to the instructions in the manual.

General Safety Considerations

Warning

Before the spectrum analyzer is switched on, **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 the spectrum analyzer is switched on, 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.

How to Use This Guide

Key Conventions.

The following key conventions are used in this guide:

Front-panel key	Text shown like this represents a key physically located on the spectrum analyzer.
`Softkey`	Text shown like this represents a softkey. (The softkeys are located next to the softkey labels, and the softkey labels are the annotation on the right side of the spectrum analyzer display.)
`Screen Text`	Text printed in this typeface indicates text displayed on the instrument screen.

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Installing and Starting the Utility

The 85672A Spurious Response Measurements Utility is a down-loadable program (DLP) that is used with the 8560 E-Series and EC-Series spectrum analyzers. To install the utility, you also need an 85620A Mass Memory Module and one of the 8560 E-Series or EC-Series spectrum analyzers listed in the following table. Please note the firmware revisions required of the various equipment.

Equipment and Firmware Revisions Required

Spurious Response Measurements Utility	Mass Memory Module	Spectrum Analyzer
85672A	85620A (firmware revision C, 910116 and later)	8560A (firmware 890720 and later) 8560E/EC (all revisions of firmware) 8561A (all revisions of firmware) 8561B (firmware 890720 and later) 8561E/EC (all revisions of firmware) 8562A (firmware 870728 and later) 8562B (firmware 870728 and later) 8562E/EC (all revisions of firmware) 8563A (all revisions of firmware) 8563E/EC (all revisions of firmware) 8564E/EC (all revisions of firmware) 8565E/EC (all revisions of firmware)

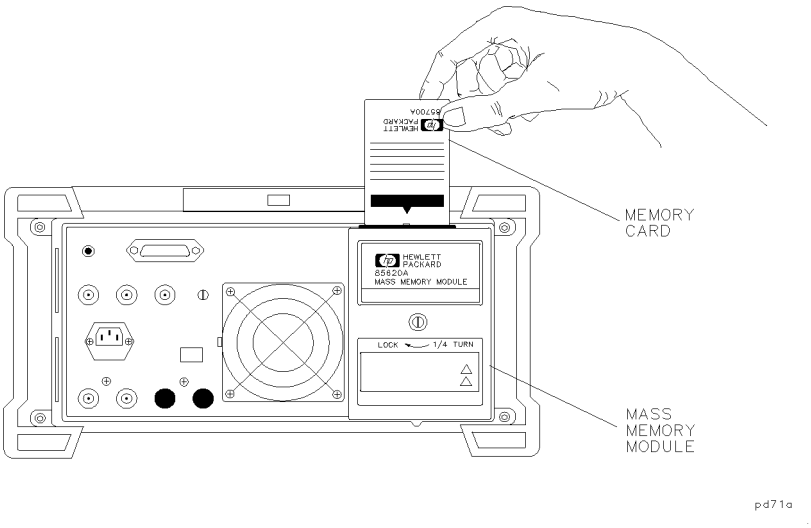

Figure 1-1.
Equipment Used with the Spurious Response Measurements Utility

The spurious response measurements utility is shipped on three memory cards that must be installed into the mass memory module before it can be used by the spectrum analyzer.

The spectrum analyzer has direct access to the mass memory module using the (MODULE) key. To access the spurious response measurements utility from the front panel of the spectrum analyzer, label one of the blank softkeys on the user menu. The following procedures describe how to copy the file, label the softkeys, and access the utility.

Loading the Utility Into Memory and Labeling a Softkey

The spurious response measurements utility is contained on three memory cards. Cards 1 of 3 and 2 of 3 contain the files SPURS1, and SPURS2, respectively. These files contain the entire program. Card 3 of 3 contains the removal routine SP_REMOVE, to be used only to erase the utility at a later time, if desired. The filename PH_EXIT is also on memory card 3 of 3. It is for users that alternately use the 85671A Phase Noise Utility, and then the 85672A Spurious Response Measurements Utility. See "Alternating Between the 85672A Spurious Response Measurements Utility and the 85671A Phase Noise Utility" in this chapter for more information about the use of this file.

Use the following procedure to install the utility for the first time, or to re-install the utility after troubleshooting.

Note

If you are re-installing the utility, first perform the procedure under "Removing the Utility From Memory," in this chapter. While it is possible to simply overwrite the utility without removing it first, removing and then re-installing it is much faster.

1. With the spectrum analyzer turned off, attach the mass memory module to the rear panel of the spectrum analyzer if it is not already attached.
2. Insert 85672A memory card 1 of 3 into the module. Make sure the arrow on the card is facing the matching arrow on the rim of the module card slot.
3. Turn on the spectrum analyzer. After it completes its power-on sequence, press the (MODULE) key on the front panel.
4. Press the UTILITY softkey. After a short wait, the screen will list the current contents of the mass memory module.
5. Verify that there is at least 65 KB of free memory. If not, delete unwanted saved traces and files to make room. This utility will fit along with the 85671A Phase Noise Utility with approximately 10 KB of free memory left.
6. Press the CATALOG MEM CARD key so that CARD is underlined. The spectrum analyzer should now display the contents of the memory card. It should show file SPURS1 for card 1 of 3.
7. Move the knob so that SPURS1 is highlighted and press the COPY TO MEMORY softkey. This will copy the utility from the memory card to the mass memory module in less than one minute.
8. Remove the memory card and insert memory card 2 of 3 into the mass memory module. It is *not* necessary to turn off the spectrum analyzer.
9. Press the CATALOG MEM CARD key twice so that CARD is underlined again. This will show the contents of the second memory card. Repeat the above process to copy file SPURS2 into the mass memory module. The copying process for card 2

of 3 takes less than one minute. The utility is now loaded into memory.

10. Press (MODULE) KEYDEF CHOOSE DLP and then locate and highlight filename SP_SETUP, using the step keys, the NEXT COLUMN, and NEXT PAGE keys.

11. Press EXECUTE NOW and follow the instructions on the display. Choose the softkey associated with the desired location of the spurious response measurements utility softkey. Press the key labeled NO KEY if you do not want to label a softkey.

    The setup routine can be used to label only the first five user keys. If you have other programs in use which are using all of those softkeys, press the NO KEY softkey.

    If you press a softkey that is already labeled, it will be overwritten with the spurious response measurement utility label. If a softkey other than NO KEY is pressed, that softkey is labeled SPURS, and the installation is complete.

Moving the Mass Memory Module (and Utility) to Another Analyzer

The following procedure must be performed whenever the 85620A Mass Memory Module, with the loaded utility, is moved from one spectrum analyzer to another having a different model number.

The utility is saved in the mass memory module non-volatile memory. Therefore, the utility remains in the module when it is physically moved to another spectrum analyzer. The utility does not need to be re-installed after this is done, but the utility program variables should be reset to their factory default values. This procedure performs this task and helps prevent failure of the utility. This can occur when a utility variable saved in the module while connected to one spectrum analyzer becomes invalid when the module is moved to another analyzer having different specifications.

1. Press (MODULE) KEYDEF and then rotate the knob to highlight filename SP_SETUP.
2. Press CHOOSE DLP and then locate and highlight filename SP_SETUP, using the step keys, and the NEXT COLUMN and NEXT PAGE keys.
3. Press EXECUTE NOW and follow the instructions on the display. Choose the softkey associated with the desired location of the spurious response measurements utility softkey. Press the key labeled NO KEY if you do not want to label a softkey.

   The setup routine can be used to label only the first five user keys. If you have other programs in use which are using all of those softkeys, press the NO KEY softkey.

   If you press a softkey that is already labeled, it will be overwritten with the spurious response measurement utility label. If a softkey other than NO KEY is pressed, that softkey is labeled SPURS, and the installation is complete.

Removing the Utility From Memory

The following procedure removes the utility from the mass memory module memory. This is done to free up memory space, and to speed up re-installation of the utility.

1. With the spectrum analyzer turned off, attach the mass memory module to the rear panel of the spectrum analyzer if it is not already attached.
2. Insert 85672A memory card 3 of 3 into the module. Make sure the arrow on the card is facing the matching arrow on the rim of the module card slot.
3. Turn on the spectrum analyzer. After it completes its power-on sequence, press the (MODULE) key on the front panel.
4. Press the `UTILITY` softkey. After a short wait, the screen will list the current contents of the mass memory module.
5. Press the `CATALOG MEM CARD` key so that CARD is underlined. This will show the contents of the memory card.
6. Move the knob to highlight the filename `SP_REMOVE` and then press the `COPY TO MEMORY` softkey.
7. Press the hardkey (MODULE). Then press softkeys `AUTOEXEC MENU` `EDIT AUTOEXEC` `CHOOSE DLP`. Use the up/down keys and softkeys `NEXT PAGE` and `NEXT COLUMN` to highlight filename `SP_REMOVE`, and press `EXECUTE NOW`. All spurious response measurements utility files are removed in about one minute. This procedure is now complete.

   The filename PH_EXIT is also on memory card 3 of 3. It is for users that alternately use the Agilent 85671A Phase Noise Utility, and then the 85672A Spurious Response Measurements Utility. See "Alternating Between the 85672A Spurious Response Measurements Utility and the Agilent 85671A Phase Noise Utility" in this chapter for more information about the use of this file.

Note

In some cases, an unwanted file named `SP_JUNK` is saved to memory after this procedure. If this occurs, then press hardkey (MODULE). Press softkey `KEYDEF`, use the knob to highlight `SP_JUNK`, and then press `CLEAR`.

Starting the Spurious Response Measurements Utility

The spurious response measurements utility can be started easily once the program is in the mass memory module and a spectrum analyzer user key has been labeled to access it.

The desired carrier signal should be visible on the spectrum analyzer before starting the utility. When the utility is started, it finds the largest signal in the current span and assumes this will be the carrier frequency.

1. With the spectrum analyzer turned off, attach the mass memory module to the rear panel of the spectrum analyzer if it is not already attached.
2. Turn on the spectrum analyzer. After it completes its power-on sequence, press the (MODULE) key on the front panel.
3. Press `USER KEYS`. This will display the user-defined softkey menu. The label `SPURS` should be on the softkey selected in the installation.
4. Press the `SPURS` softkey to start the utility.

Using the Spurious Response Measurements Utility

The spurious response measurements utility uses a series of softkey menus displayed along the right edge of the spectrum analyzer display. Always use the `EXIT ALL` softkey to exit the utility.

Note

DO NOT use other front-panel keys when the utility is running, except to enter data, or you will exit the utility prematurely. *DO NOT* turn the knob when the utility is running, or the spectrum analyzer may stop responding to key presses, requiring the ac power to be cycled.

The spurious response measurements utility main menu prompts you to choose from one of the following keys:

`MEASURE TOI/IMD`
: Immediately measure third order intercept and intermodulation distortion of an amplifier (there is no intermediate setup menu). The two primary signals *must* be visible on the display before starting the utility.

`HARMONIC MENU`
: Configure or measure harmonic amplitudes and total harmonic distortion within a spectrum. The fundamental signal *must* be visible on the display before starting the utility.

`GEN SPUR MENU`
: Configure or measure general spurious signals within a spectrum. When this measurement is configured to measure relative signal levels (dBc), then the reference signal *must* be visible on the display before starting the utility.

`SIDEBAND MENU`
: Configure or measure the close-in sidebands of a carrier. The carrier signal *must* be visible on the display before starting the utility.

`MIXER MENU`
: Configure or measure the mixing products of a mixer.

`EXIT ALL`
: Exits the spurious response measurements utility and recalls the menu invoked by pressing the (MODULE) hardkey.

Alternating Between the 85672A Spurious Response Measurements Utility and the 85671A Phase Noise Utility

Both the 85672A Spurious Response Measurements Utility and the 85671A Phase Noise Utility can reside in memory at the same time. However, when exiting the phase noise utility, the user softkeys are blanked unless a file named PH_EXIT is loaded into memory.

The following procedure allows the user softkeys to be displayed when switching between the phase noise utility and the spurious response measurements utility. Perform this procedure *after* the phase noise utility has been installed, and also whenever it has been reloaded.

1. With the spectrum analyzer turned off, attach the mass memory module to the rear panel of the spectrum analyzer if it is not already attached.

   85672A memory card 3 of 3 into the module. Make sure the arrow on the card is facing the matching arrow on the rim of the module card slot.

2. Turn on the spectrum analyzer. After it completes its power-on sequence, press the (MODULE) key on the front panel.

3. Press the `UTILITY` softkey. After a short wait, the screen will list the current contents of the mass memory module.

4. Press the `CATALOG MEM CARD` key so that CARD is underlined. This will show the contents of the memory card.

5. Move the knob to highlight the filename `PH_EXIT` and then press the `COPY TO MEMORY` softkey. This procedure is now complete.

2

Measurement Examples

This chapter gives examples of each spurious measurement performed by the 85672SA Spurious Response Measurements Utility, including typical equipment setups and example output displays. See Chapter 4, "Measurement Functions and Considerations," for measurement conditions, limits, and default values.

Making A Third Order Intercept Measurement

The third order products at the output of a device (such as an amplifier) are measured, and both the extrapolated intercept point, and the intermodulation distortion are calculated. Make sure the signals are visible on the display in spectrum analyzer mode before invoking the spurious response measurements utility to run this measurement. Unlike the other spurious response measurements, this measurement is performed without any prior configuration by the user.

Procedure

1. Connect the equipment for the measurement as shown in Figure 2-1. The signal generators are typically set to frequencies that are about 10 kHz to 1 MHz apart. In any case, their frequencies should be well within the bandwidth of the device under test. The amplitudes should be approximately equal. Your particular setup may be different.

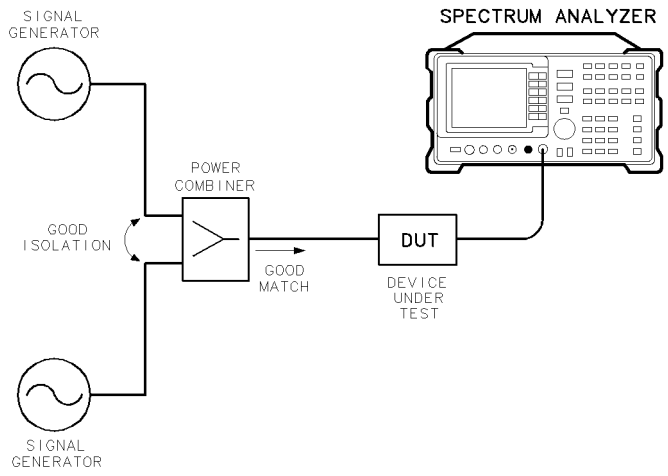

Figure 2-1. Typical TOI/IMD Measurement Equipment Setup

2. Adjust the analyzer so that the signals are visible on the display before invoking the utility. In addition, the power level of the carriers must be greater than −40 dBm. If these conditions are not met, the utility will not make the measurement. Figure 2-2 shows an example of a typical spectrum analyzer display of a third order intercept measurement.

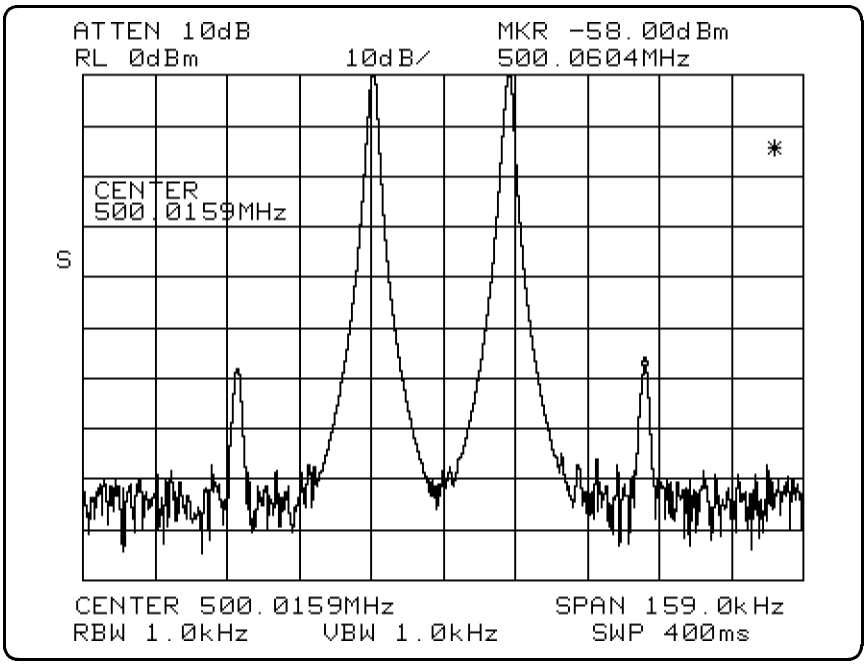

Figure 2-2. Typical TOI/IMD Measurement Spectrum Display

3. On the spectrum analyzer press (MODULE) USER KEYS SPURS.

4. Press MEASURE TOI/IMD. The utility makes the measurement and displays the results on the screen, as shown in Figure 2-3. Press HARD COPY to access a menu to print or plot the results.

```
09:58  05/01/96

INTERMODULATION MEASUREMENT RESULTS

LOWER SIGNAL:   500.0 MHz        0 dBm
UPPER SIGNAL:   500.0 MHz        0 dBm

SIGNAL SPACING:   29.92 kHz

IMD (LOWER PRODUCT):     -79.5 dBc
IMD (UPPER PRODUCT):     -79.3 dBc

TOI/IP3 (LOWER PRODUCT):      39.8 dBm
TOI/IP3 (UPPER PRODUCT):      39.7 dBm
```

Figure 2-3. TOI/IMD Measurement Results

Refer to Chapter 4, “Measurement Functions and Considerations,” for measurement limitations of this measurement.

Making A Harmonic Measurement

The harmonic power output of a device (such as an amplifier) is measured and the total harmonic distortion (based on the measured harmonics) is calculated. Make sure the fundamental is visible on the display in spectrum analyzer mode before invoking the spurious response measurements utility to run this measurement.

Procedure

1. Connect the equipment for the measurement as shown in Figure 2-4. The purpose of the low pass filter is to filter any harmonics appearing in the signal generator output. Any generated harmonics, then, are due to characteristics of the device under test. Your particular setup may be different.

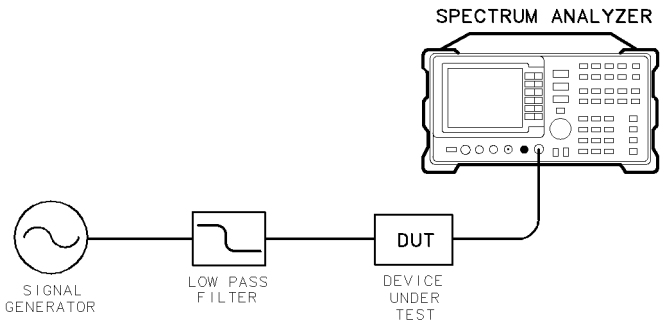

Figure 2-4. Typical Harmonic Measurement Equipment Setup

2. Set the signal generator and device under test to a CW frequency and power level that will show several harmonics within the frequency and power handling capabilities of the spectrum analyzer. Figure 2-5 shows an example of a typical spectrum analyzer display of a harmonic measurement.
3. Make sure the fundamental is visible on the display in spectrum analyzer mode before invoking the spurious response measurements utility.

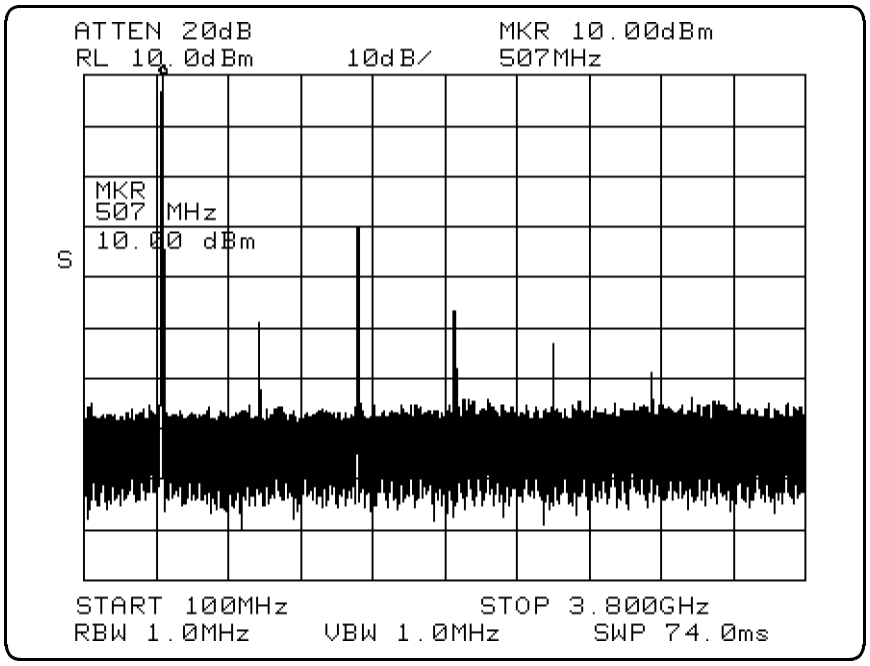

Figure 2-5. Typical Harmonic Measurement Spectrum Display

4. On the spectrum analyzer press (MODULE) USER KEYS SPURS.

5. Press HARMONIC MENU. The display now shows the configuration settings, and should look like Figure 2-6. If these settings are not appropriate, press CONFIG HARMONIC and change them to suitable values. When finished, press CONFIG DONE.

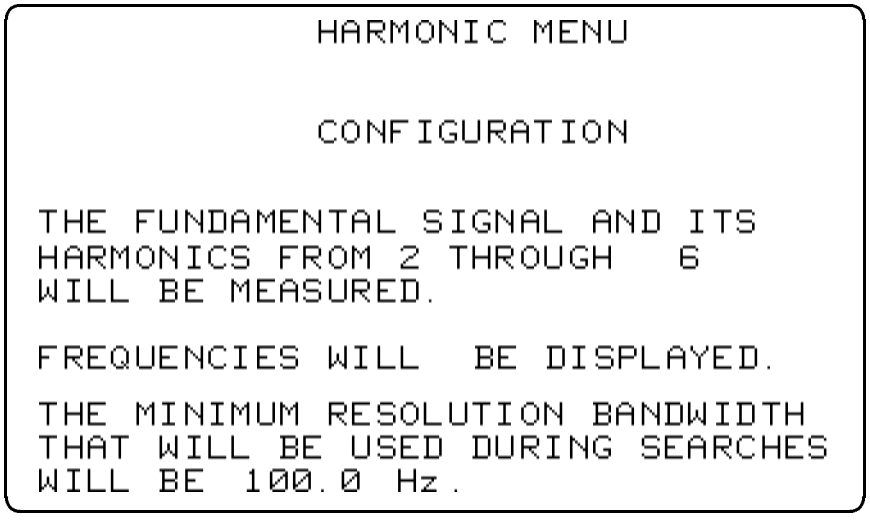

Figure 2-6. Harmonic Menu Configuration

6. Press MEASURE HARMONIC. The utility makes the measurement and displays the results on the screen, as shown in Figure 2-7. Press HARD COPY to access a menu to print or plot the results.

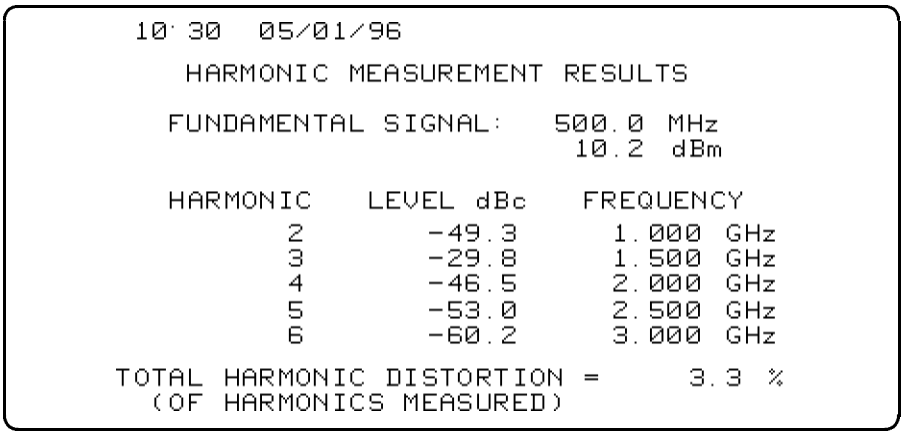

Figure 2-7. Harmonic Measurement Results

Refer to Chapter 4, "Measurement Functions and Considerations," for configuration descriptions and limitations of this measurement.

Making A General Spurious Measurement

The general spurious signal frequencies and power levels from a device (such as an amplifier) are measured, within specified frequency and amplitude bounds. The measurement results list spurious signal power levels and frequencies in a table whose data can be sorted in order of amplitude, or frequency.

You can choose to measure spurious signals in relative, or absolute power levels. If relative power levels (dBc) are desired, the spectrum analyzer must be adjusted so that the reference signal is visible on the display before invoking the utility.

The desired search area is a "window" within which the utility will search for spurious signals. If none are found within this window, the results table will report `TOTAL OF 0 SPURS FOUND`, even though significant spurious signals may appear close to (but outside of) this area. Figure 3-6 shows an example of a bounded search area.

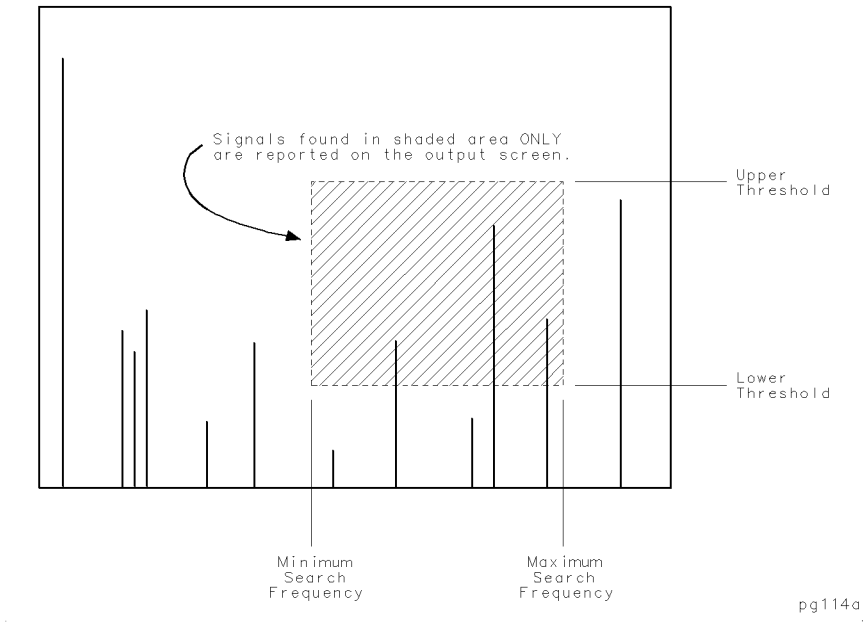

Figure 2-8.
Spurious Response Measurement Frequency and Power Level Bounds

Procedure

1. Connect the equipment for the measurement as shown in Figure 2-9. Your particular setup may be different.

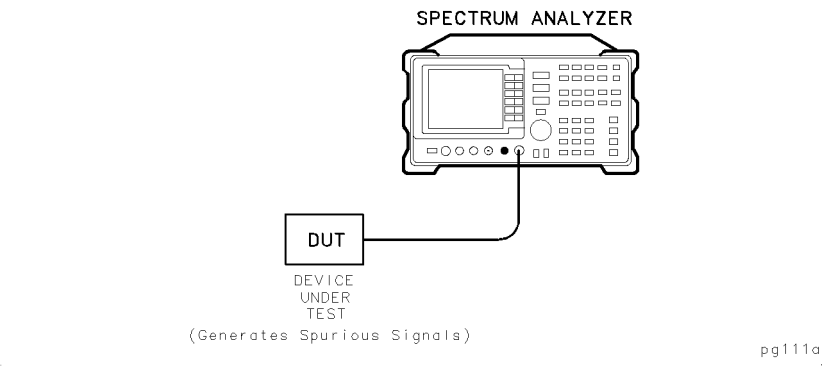

Figure 2-9.
Typical General Spurious Measurement Equipment Setup

2. Make sure that the spurious signals output from the device under test are within the frequency and power handling capabilities of the spectrum analyzer. Figure 2-10 shows an example of a typical spectrum analyzer display of a general spurious measurement.

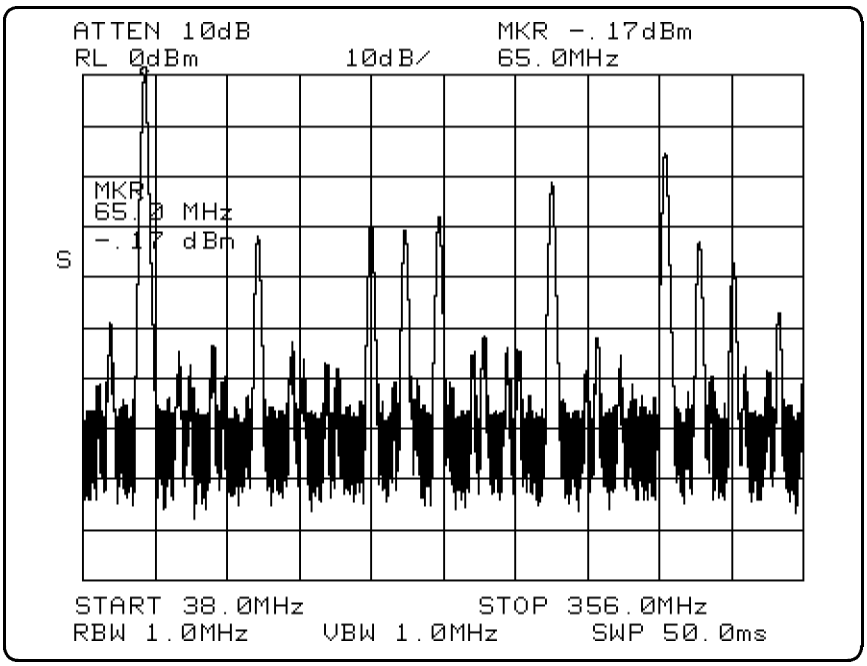

Figure 2-10.
Typical General Spurious Measurement Spectrum Display

3. If spurious signals relative power levels (dBc) are desired, adjust the spectrum analyzer so that the reference signal is visible on the display before invoking the utility.
4. On the spectrum analyzer press (MODULE) USER KEYS SPURS.
5. Press GEN SPUR MENU CONFIG SPURS. The display now shows the configuration settings, and should look like Figure 2-11. If these settings are not appropriate, press CONFIG SPURS and change them to suitable values. When finished, press CONFIG DONE.

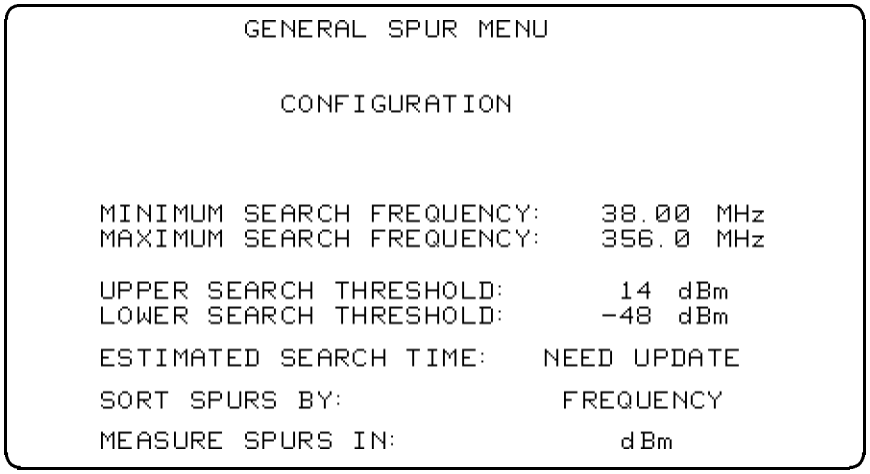

Figure 2-11. Spurious Menu Configuration

6. Press MEASURE SPURS. The utility makes the measurement and displays the results on the screen. Figure 2-12 shows the results of choosing an absolute power output (dBm). Figure 2-13 shows the results of choosing a relative power output (dBc). If relative power levels (dBc) are desired, the spectrum analyzer must be adjusted so that the reference signal is visible on the display before invoking the utility.
7. Press HARD COPY to access a menu to print or plot the results.

Refer to Chapter 4, "Measurement Functions and Considerations," for configuration descriptions and limitations of this measurement.

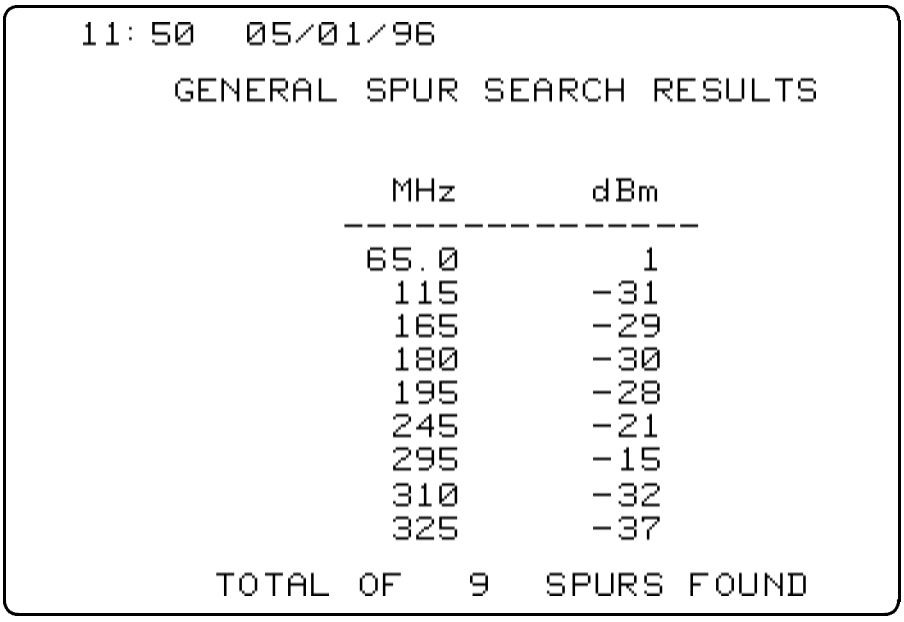

Figure 2-12.
General Spurious Measurement Results (Power in dBm)

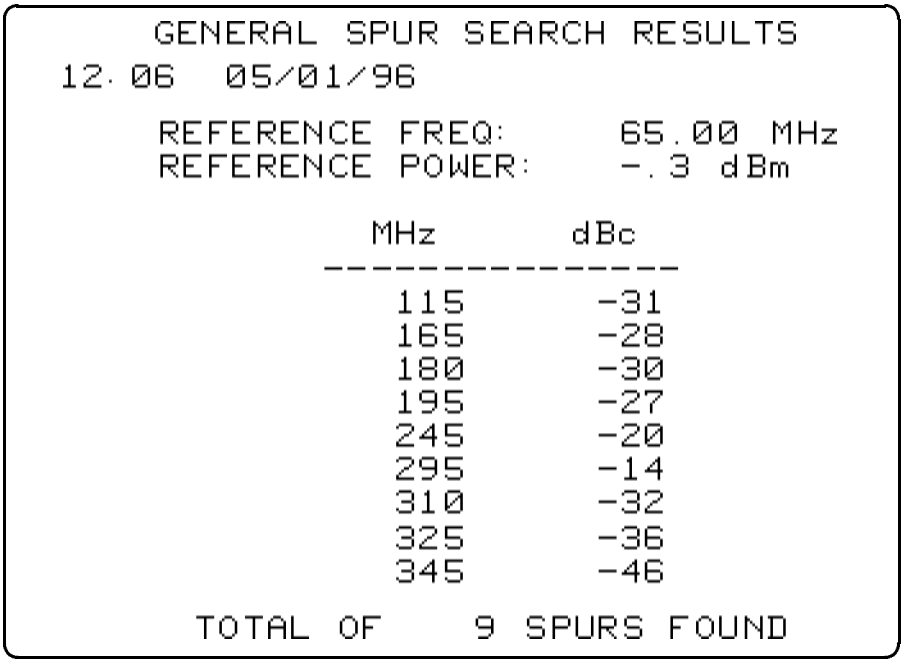

Figure 2-13.
General Spurious Measurement Results (Power in dBc)

Making A Discrete Sidebands Measurement

The discrete sidebands close to and on either side of a carrier signal are measured within specified frequency bounds.

The desired search area is bounded by a minimum and a maximum frequency from the carrier, between which bounds the utility will search for discrete sideband spurious signals. If none are found within this window, the results table will report `FOUND: 0 SETS OF SIDEBANDS`, even though significant sideband spurious signals may appear close to (but outside of) this area. Figure 2-14 shows an example of a bounded search area defined by minimum and maximum frequency offset values.

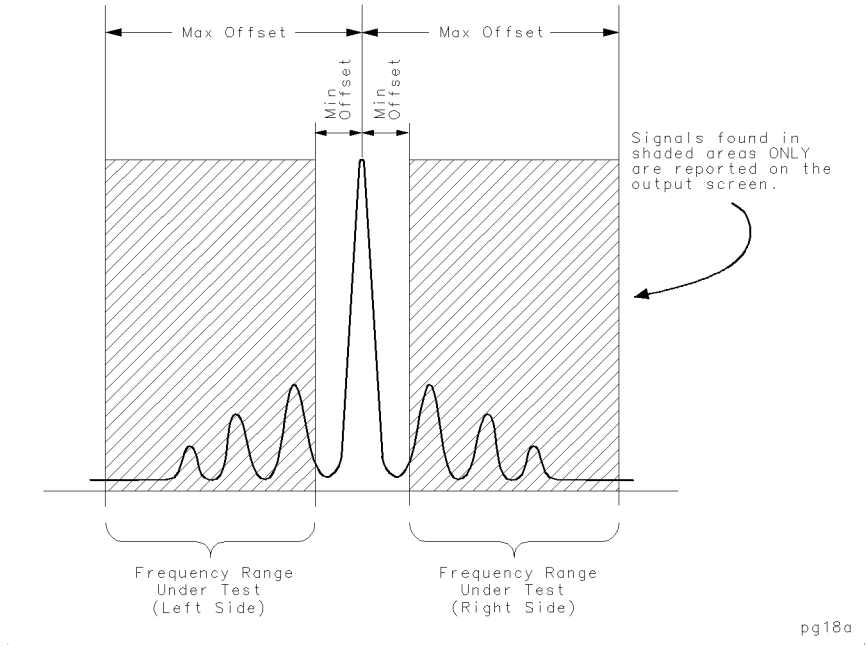

Figure 2-14. Sidebands Frequency Offset Range Limits

Procedure

1. Connect the equipment for the measurement as shown in Figure 2-15. Your particular setup may be different.

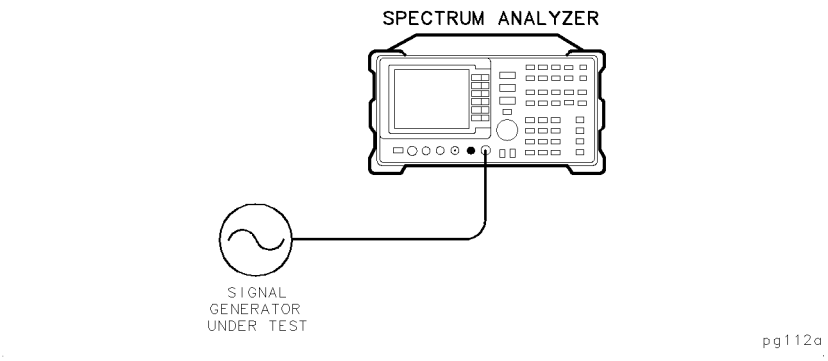

Figure 2-15.
Typical Carrier Sidebands Measurement Equipment Setup

2. Set the signal source to generate an FM signal whose frequencies and power levels are within the frequency and power handling capabilities of the spectrum analyzer. Figure 2-16 shows an example of a typical spectrum analyzer display of a discrete sidebands measurement.

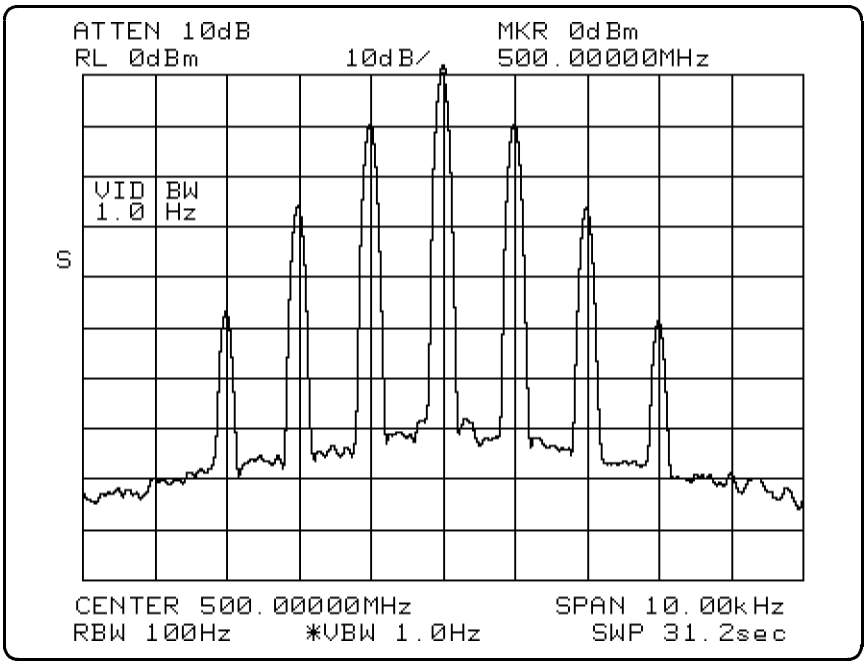

Figure 2-16.
Typical Discrete Sidebands Measurement Spectrum Display

3. Adjust the analyzer so that the carrier is visible on the display before performing this measurement. In addition, the power level of the carrier must be greater than −50 dBm. If these conditions are not met, the utility will not make the measurement.

4. On the spectrum analyzer press (MODULE) USER KEYS SPURS.

5. Press SIDEBAND MENU. The display now shows the configuration settings, and should look like Figure 2-17. If these settings are not appropriate, press CONFIG SIDEBNDS and change them to suitable values. When finished, press CONFIG DONE.

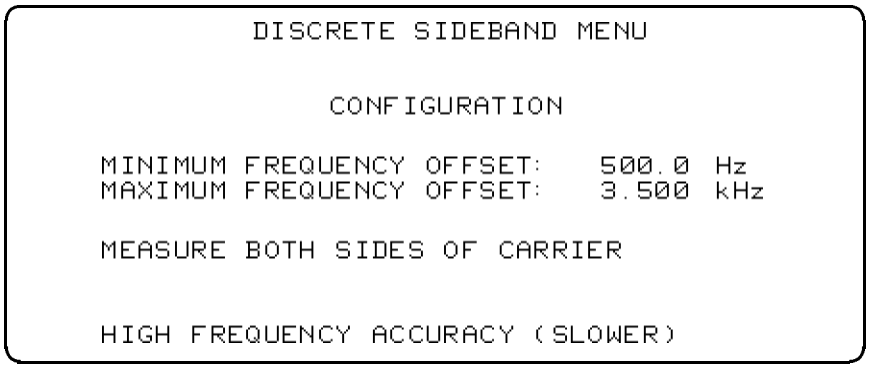

Figure 2-17. Discrete Sidebands Menu Configuration

6. Press MEASURE SIDEBNDS. The utility makes the measurement and displays the results on the screen, as shown in Figure 2-18. Press HARD COPY to access a menu to print or plot the results.

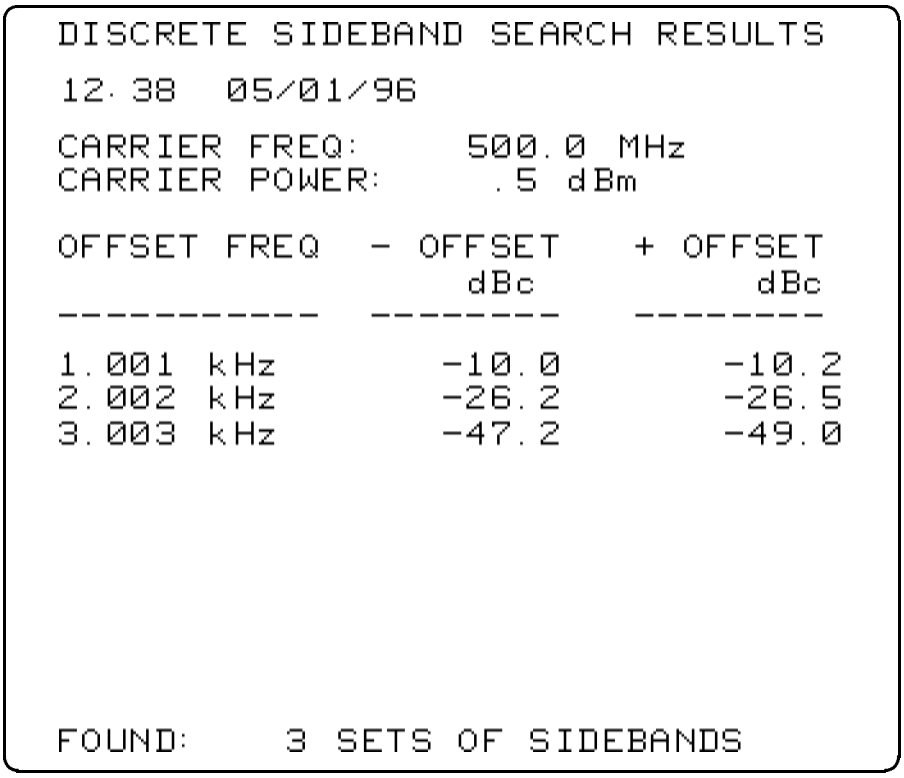

Figure 2-18. Carrier Sidebands Measurement Results

Refer to Chapter 4, "Measurement Functions and Considerations," for configuration descriptions and limitations of this measurement.

Making A Mixing Products Measurement

The amplitudes of mixer products are measured, and the results are listed in terms most commonly given in specification data sheets by mixer manufacturers.

Power levels of mixing products are measured relative to the signal at either LO + RF, or |LO − RF|. Mixing product frequencies are determined by the equations N (LO) + M (RF), or |N (LO) − M (RF)|. Valid values of either N or M range from 1 to 10 in any combination. A table lists the measurement results of mixing products defined by their N and M values in relative dB power levels.

You can view a selected mixing product in spectrum analyzer mode without leaving the utility by choosing an LO product (N) and an RF product (M) following a measurement.

Procedure

1. Connect the equipment for the measurement as shown in Figure 2-19. Your particular setup may be different.

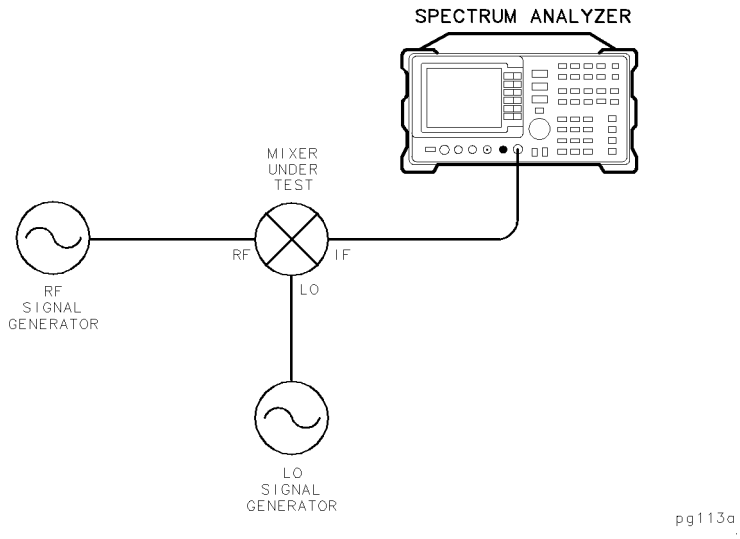

Figure 2-19. Typical Mixer Measurement Equipment Setup

2. Set the signal generators to CW frequencies and power levels that are appropriate to the mixer under test. Figure 2-20 shows an example of a typical spectrum analyzer display of a mixing products measurement.

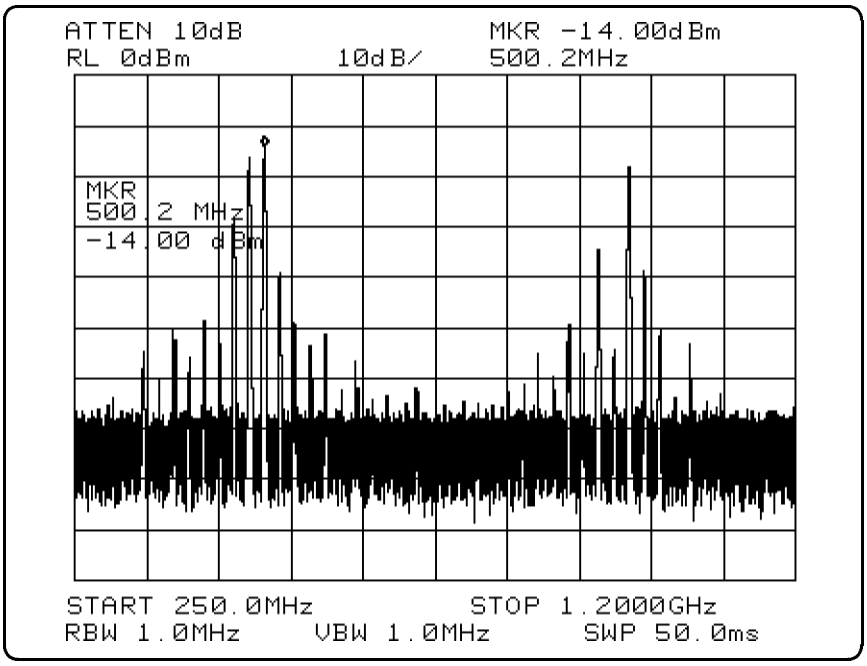

Figure 2-20.
Typical Mixing Products Measurement Spectrum Display

3. On the spectrum analyzer press (MODULE) USER KEYS SPURS.

4. Press MIXER MENU. The display now shows the configuration settings, and should look like Figure 2-21. If these settings are not appropriate, press CONFIG MIXER and change them to suitable values. When finished, press CONFIG DONE.

```
                MIXER MENU

              CONFIGURATION

   MIXING PRODUCTS OF:      |N*LO-M*RF|
   WILL BE MEASURED FOR:
                            N FROM 1 TO   4
                            M FROM 1 TO   4

   WITH:  LO FREQUENCY =   480.0 MHz
          RF FREQUENCY =   500.0 MHz

   RESULTS WILL BE IN dB BELOW
        THE REFERENCE SIGNAL AT   |LO-RF|.

   THE MINIMUM RESOLUTION BANDWIDTH
   THAT WILL BE USED DURING SEARCHES
   WILL BE  100.0 Hz.
```

Figure 2-21. Mixer Menu Configuration

5. Press MEASURE MIXER. The utility makes the measurement and displays the results on the screen, as shown in Figure 2-22. Press HARD COPY to access a menu to print or plot the results.

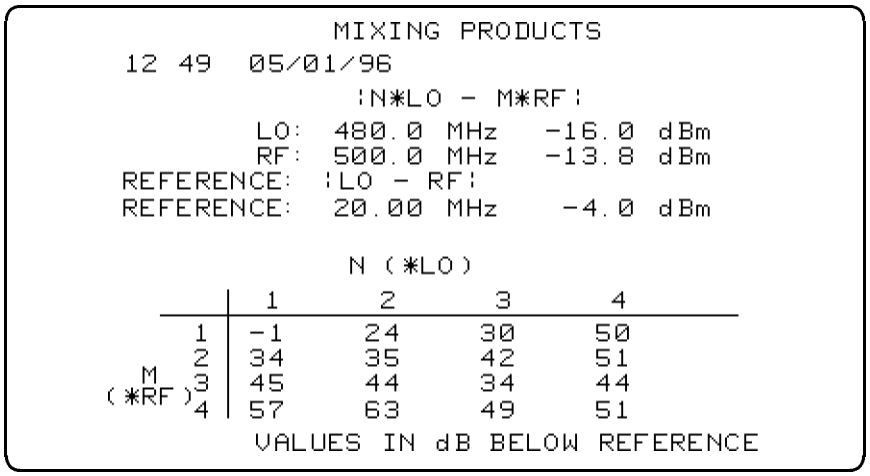

Figure 2-22. Mixer Measurement Results

6. Press VIEW PRODUCT and select the softkeys that identify a measured mixing product using N and M values to view a product in real-time spectrum analyzer mode. Figure 2-23 shows the N value selection screen, and an example of a viewed product is shown in Figure 2-24.

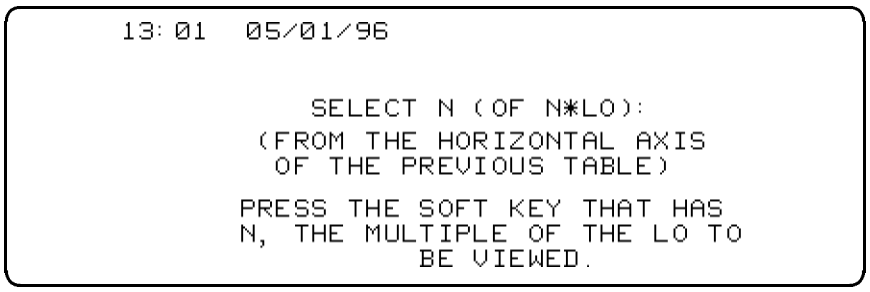

Figure 2-23. Selecting A Mixing Product to View

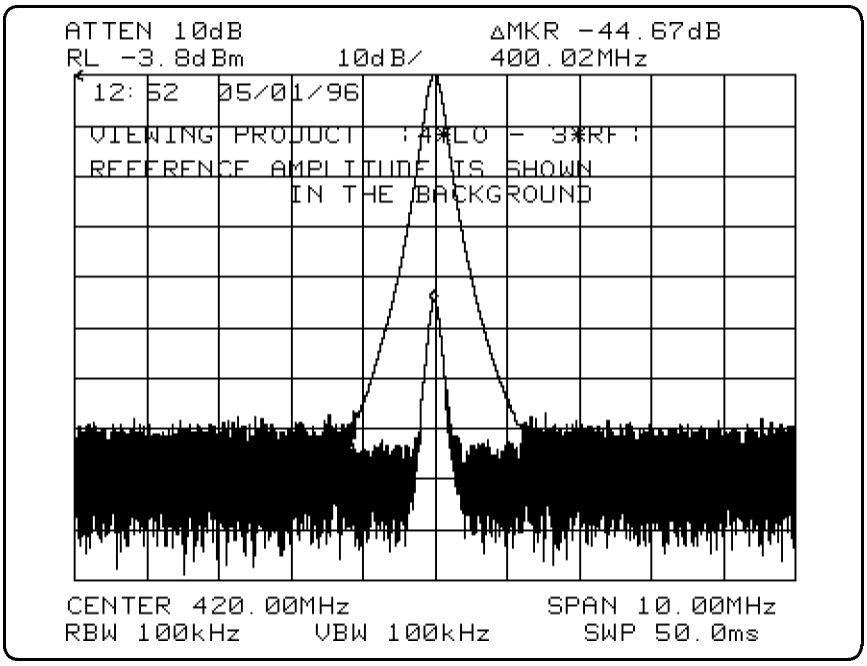

Figure 2-24. Viewing a Product

Refer to Chapter 4, "Measurement Functions and Considerations," for configuration descriptions and limitations of this measurement.

3

Softkey Menus and Descriptions

This chapter includes the following:

- An overall menu of the 85726A Spurious Response Measurements Utility
- Menus of the five specific measurements featured in the measurements utility
- Short descriptions of each softkey, including some parameter limits

Refer to Chapter 4, "Measurement Functions and Considerations," for measurement conditions, limits and default values.

Overall Menu Map

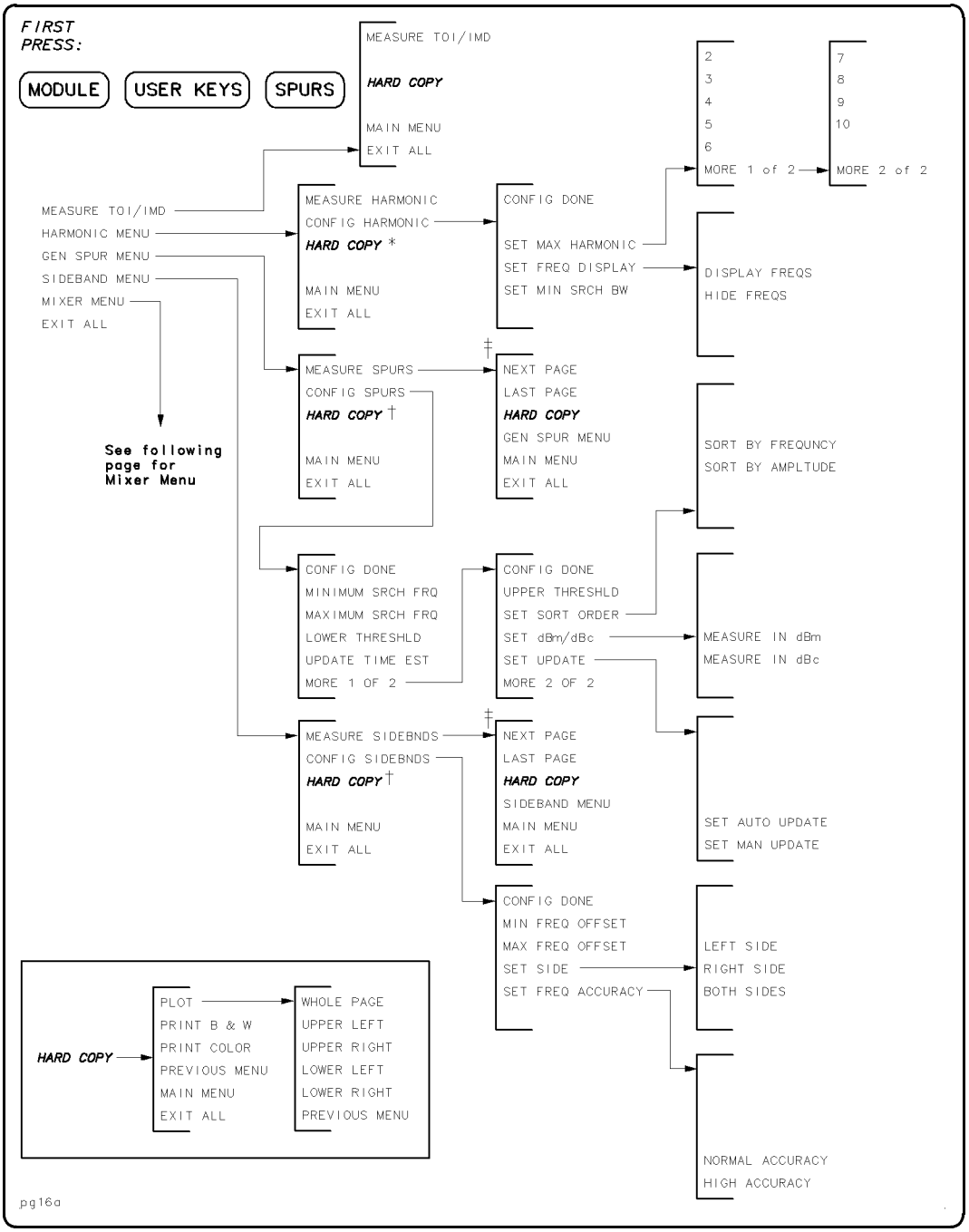

Figure 3-1. Overall Menu Map (1 of 2)

* Present only following a measurement.

† Present only following a measurement with one page of data.

‡ Present only following a measurement with more than two pages of data. The page wording changes as various pages are viewed.

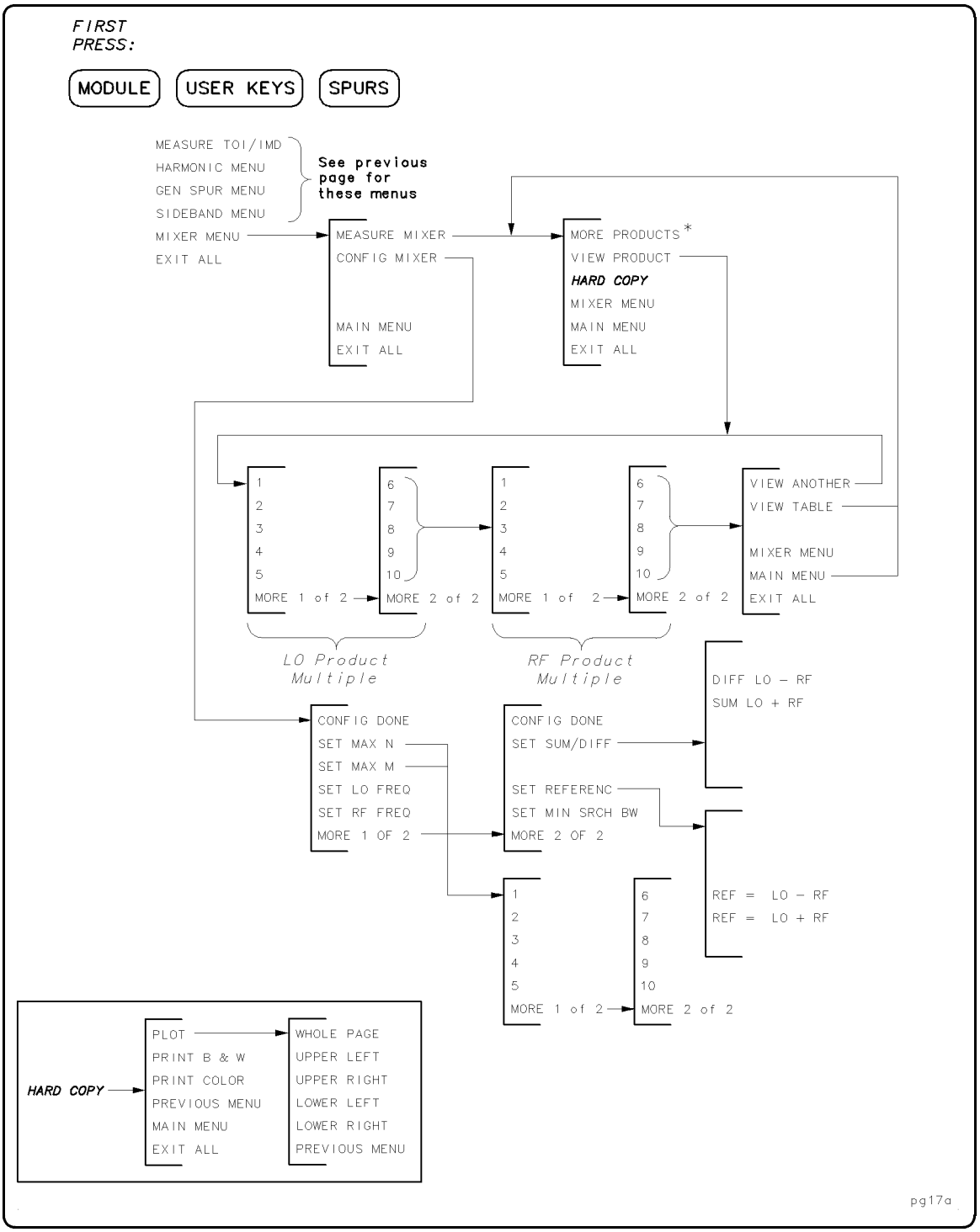

Figure 3-2. Overall Menu Map (2 of 2)

* Present only following a measurement with more than one page of data.

Third-Order Intercept and Intermodulation Distortion Menu

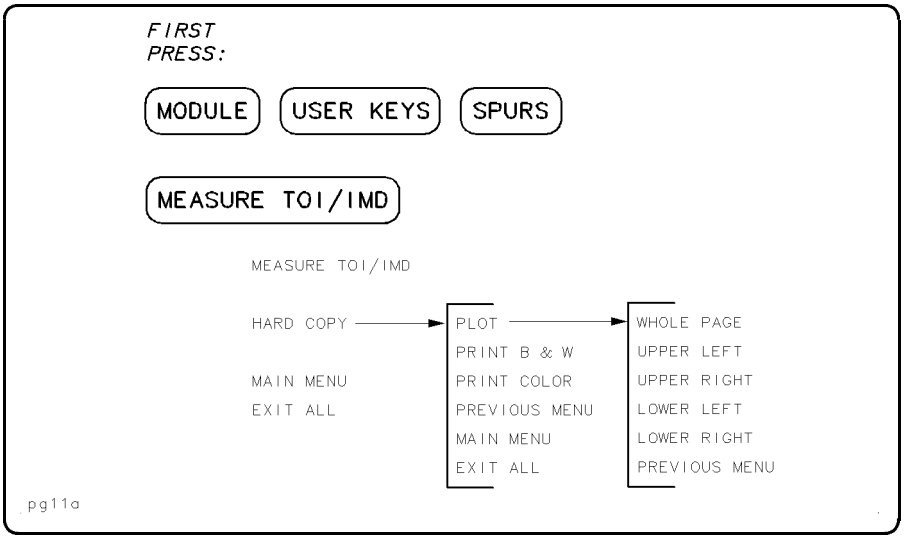

Figure 3-3. TOI/IMD Menu

`MEASURE TOI/IMD` Press this key to begin a third-order intercept and intermodulation distortion measurement. The measurement begins immediately; there is no setup menu for this measurement. Make sure that the two carriers are visible on the display before entering the utility to make this measurement.

`HARD COPY` Press this key to access the softkeys that control direct printer or plotter outputs from the spurious response measurements utility. See "Printing and Plotting" at the end of this chapter for a description of this softkey and the keys in the menus associated with it.

`MAIN MENU` Press this key to access the main menu; this is the menu shown upon starting the utility.

`EXIT ALL` Press this key to access the `USER KEYS` menu or to return to spectrum analyzer mode (this allows you to use the hard keys).

Harmonic Menu

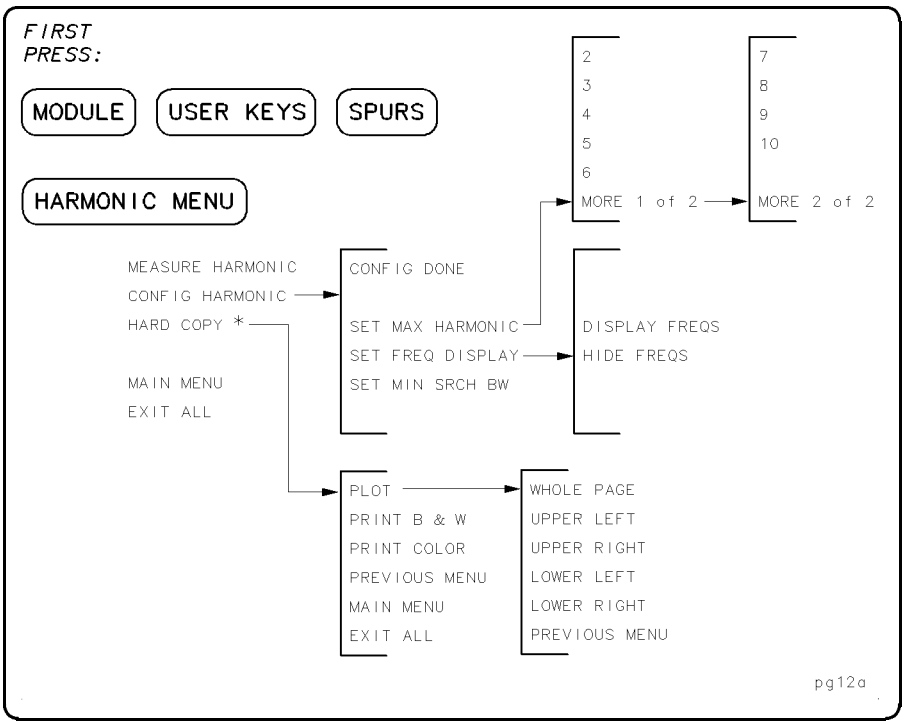

Figure 3-4. Harmonic Menu

* Present only following a measurement.

`HARMONIC MENU` Press this key to access the harmonic menu.

`MEASURE HARMONIC` Press this key to begin a harmonic measurement. If no parameters are set prior to pressing this key, parameters that were set for the most recent harmonic measurement are used. Make sure the fundamental is visible on the display in spectrum analyzer mode before invoking the spurious response measurements utility.

`CONFIG HARMONIC` Press this key to access the harmonic configuration menu. Parameters that can be set in this menu are maximum harmonic to be measured, minimum search bandwidth, and whether or not to display the frequencies in the results table.

`CONFIG DONE` Press this key to access the previous menu to make a measurement after setting any desired configurations. It is not necessary to press this key to store updated configuration information into memory, but it is the only way to exit from the `CONFIG` menu softkeys.

SET MAX HARMONIC

Press this key to set the maximum harmonic to be measured; then choose the softkey that corresponds with the maximum harmonic that you want to measure. The allowable range is 2 through 10; the default value is 6. The minimum value for this parameter is 2 because the fundamental is considered to be harmonic number 1.

SET FREQ DISPLAY

Press this key to cause the utility to either display the harmonic frequencies in the results table (DISPLAY FREQS), or to omit the frequency information (HIDE FREQS). Measurement speed is increased when HIDE FREQS is chosen.

SET MIN SRCH BW

This key is used to control the depth of the harmonic search. If the measured harmonic is near or in the noise, the program will zoom in on the frequency by reducing the analyzer span and bandwidth. This key sets the limit at which the zoom will stop.

Measurement time will either decrease or stay the same by setting minimum search bandwidth to a larger value. Set a lesser value of minimum search bandwidth to increase sensitivity. The default is 100 Hz. The allowable range is from the minimum resolution bandwidth of the spectrum analyzer up to 10 kHz.

HARD COPY

Press this key to access the softkeys that control direct printer or plotter outputs from the spurious response measurements utility. This key is present only following a measurement. See "Printing and Plotting" at the end of this chapter for a description of this softkey and the keys in the menus associated with it.

MAIN MENU

Press this key to access the main menu; this is the menu shown upon starting the utility.

EXIT ALL

Press this key to access the USER KEYS menu or to return to spectrum analyzer mode (this allows you to use the hard keys).

General Spurious Menu

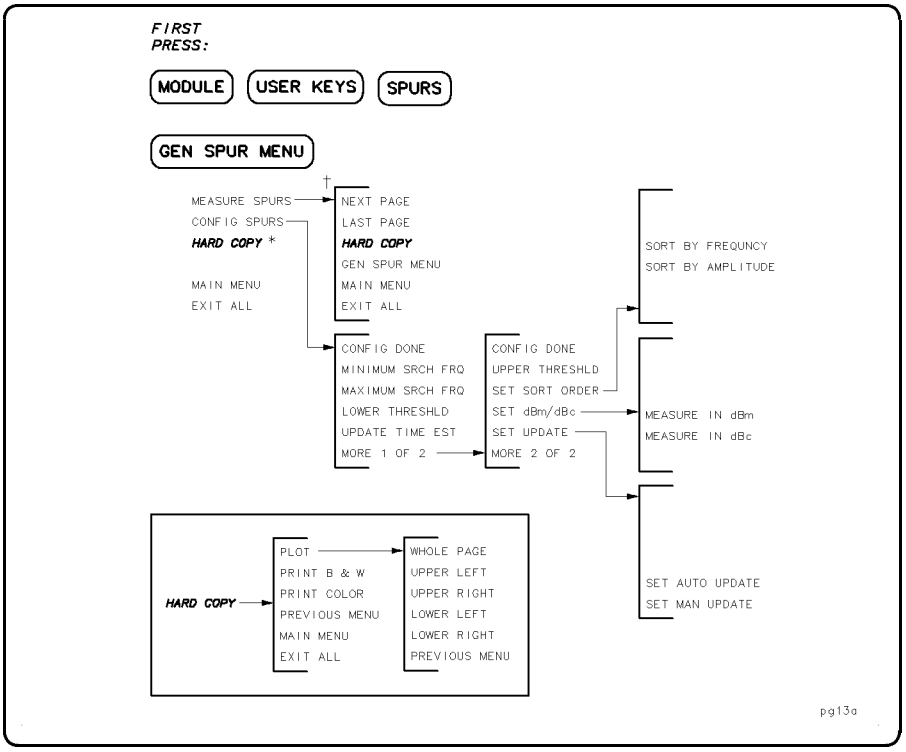

Figure 3-5. General Spurious Menu

* Present only following a measurement with one table of data.

† Present only following a measurement with more than two tables of data.

`GEN SPUR MENU`
Press this key to access the general spurious measurements menu.

`MEASURE SPURS`
Press this key to make a general spurious signals measurement. After the measurement, a table lists the frequency and power levels of all spurious signals within the measurement parameters. The frequency and power level of the reference signal is also given, if the dBm/dBc parameter is set to dBc. If in dBc mode, power levels of all spurious signals are shown in dBc, relative to the reference signal. If no parameters are set prior to pressing this key, parameters that were set for the most recent general spurious measurement are used.

`NEXT PAGE`
Press this key to access the menu showing the next page of measurement data. This key appears only when there are more than two pages of data. The softkey wording changes to `FIRST PAGE` or `LAST PAGE` as various pages are viewed.

LAST PAGE	Press this key to access the menu showing the last page of measurement data. This key appears in this location only when there are more than two pages of data. The softkey wording changes to PREVIOUS PAGE as various pages are viewed.
HARD COPY	Press this key to access the softkeys that control direct printer or plotter outputs from the spurious response measurements utility. See "Printing and Plotting" at the end of this chapter for a description of this softkey and the keys in the menus associated with it.
GEN SPUR MENU	Press this key to access the general spurious measurements menu.
MAIN MENU	Press this key to access the main menu; this is the menu shown upon starting the utility.
EXIT ALL	Press this key to access the USER KEYS menu or to return to spectrum analyzer mode (this allows you to use the hard keys).
CONFIG SPURS	Press this key to set various parameters prior to the measurement. These include search frequency and amplitude threshold ranges, as well as choosing the method by which the results table will be sorted (amplitude or frequency), and whether the power levels are listed in relative or absolute values (dBc or dBm).
CONFIG DONE	Press this key to access the previous menu to make a measurement after setting any desired configurations. It is not necessary to press this key to store updated configuration information into memory, but it is the only way to exit from the CONFIG menu softkeys.
MINIMUM SRCH FRQ MAXIMUM SRCH FRQ	Press these keys to set a range of minimum and maximum search frequencies between which the spectrum analyzer will search to measure spurious signals. Figure 3-6 shows an example of a bounded search area.

LOWER THRESHLD

Press this key and the UPPER THRESHLD softkey to set the minimum and maximum power level threshold between which the spectrum analyzer will search to measure spurious signals. The UPPER THRESHLD softkey is located in the second configuration menu (press MORE 1 OF 2). Figure 3-6 shows an example of a bounded search area.

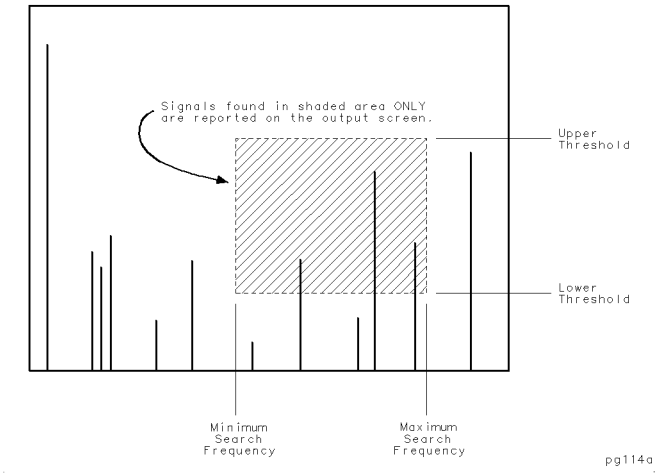

Figure 3-6.
Spurious Measurement Frequency and Power Level Bounds

UPDATE TIME EST

Press this key to obtain a time estimate of the duration of any general spurious measurement prior to running the measurement. The time estimate can be set to automatic or manual mode by pressing the SET UPDATE, and then the SET AUTO UPDATE or SET MAN UPDATE softkeys. Press MORE 1 OF 2 to access these keys.

When the time estimate function is set to automatic, a new search time estimate is generated whenever there is a change in any of these parameters:

MINIMUM SEARCH FREQUENCY

MAXIMUM SEARCH FREQUENCY

LOWER SEARCH THRESHOLD

SET dBm/dBc

When the function is set to manual, a new search time estimate is generated only when the UPDATE TIME EST softkey is pressed.

A numeric time estimate is shown on the General Spur Menu Configuration screen following the words: ESTIMATED SEARCH TIME:. The time estimate value changes to the words NEED UPDATE in manual update mode whenever any of the previous list of parameters is changed. The default setting is manual mode.

CONFIG DONE Press this key to access the previous menu to make a measurement after setting any desired configurations. It is not necessary to press this key to store updated configuration information into memory, but it is the only way to exit from the CONFIG menu softkeys.

UPPER THRESHLD See the description for the LOWER THRESHLD softkey earlier in this chapter.

SET SORT ORDER Press this key to set the sort criteria in the measurement results table between frequency (SORT BY FREQUNCY) or amplitude (SORT BY AMPLTUDE). The current sort criteria is listed at the bottom of the screen. The default is set to sort by frequency.

SET dBc/dBm Press this key to set the method by which harmonic power levels are listed in the measurements results table. Choose MEASURE IN dBm to view absolute amplitude, or MEASURE IN dBc to view relative amplitude values. The default is set to measure in dBc.

SET UPDATE Press this key to set the measurement time estimate function to either automatic (SET AUTO UPDATE), or to manual (SET MAN UPDATE). See the description of the UPDATE TIME EST softkey for an explanation of this function.

HARD COPY Press this key to access the softkeys that control direct printer or plotter outputs from the spurious response measurements utility. This key is present only following a measurement with one page of data. See "Printing and Plotting" at the end of this chapter for a description of this softkey and the keys in the menus associated with it.

MAIN MENU Press this key to access the main menu; this is the menu shown upon starting the utility.

EXIT ALL Press this key to access the USER KEYS menu or to return to spectrum analyzer mode (this allows you to use the hard keys).

Sideband Menu

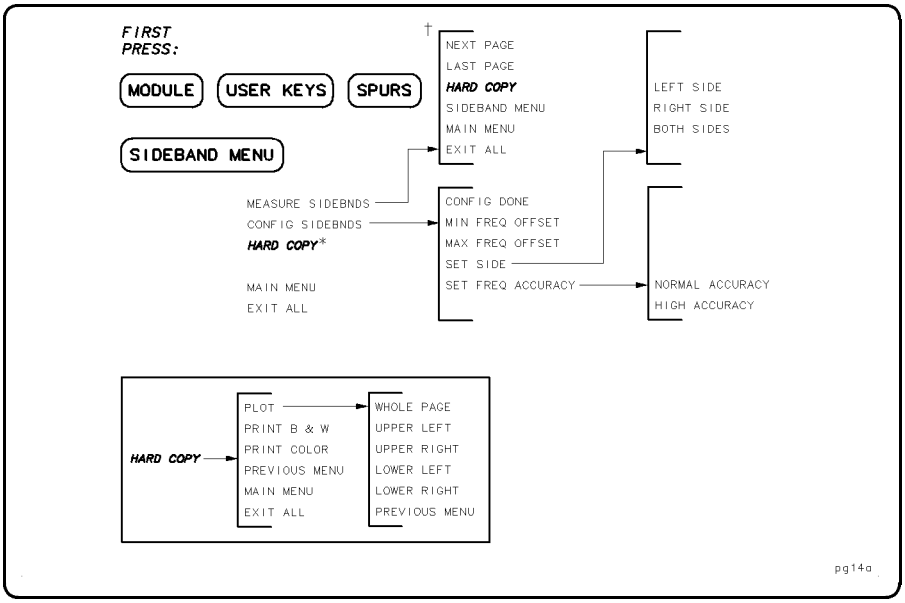

Figure 3-7. Sideband Menu

* Present only following a measurement.

† Present only following a measurement with more than two tables of data.

`SIDEBAND MENU` Press this key to access the discrete sideband measurements menu. This is used to measure discrete sidebands that are relatively close to a carrier.

`MEASURE SIDEBNDS` Press this key to make a discrete sidebands measurement. Adjust the analyzer so that the carrier is visible on the display before performing this measurement. If no parameters are set prior to pressing this key, parameters that were set for the most recent sidebands measurement are used.

`NEXT PAGE` Press this key to access the menu showing the next page of measurement data. This key appears only when there are more than two pages of data. The softkey wording changes to `FIRST PAGE` or `LAST PAGE` as various pages are viewed.

`LAST PAGE` Press this key to access the menu showing the last page of measurement data. This key appears in this location only when there are more than two pages of data. The softkey wording changes to `PREVIOUS PAGE` as various pages are viewed.

`HARD COPY` Press this key to access the softkeys that control direct printer or plotter outputs from the spurious response measurements utility. See “Printing and Plotting” at the end of this chapter for a description of this softkey and the keys in the menus associated with it.

SIDEBAND MENU	Press this key to access the sideband measurements menu.
MAIN MENU	Press this key to access the main menu; this is the menu shown upon starting the utility.
EXIT ALL	Press this key to access the USER KEYS menu or to return to spectrum analyzer mode (this allows you to use the hard keys).
CONFIG SIDEBNDS	Press this key to set various parameters prior to the measurement. These include setting the spectrum analyzer to measure: the sidebands frequency range from the carrier (minimum and maximum offset frequencies), carrier side, sensitivity, and frequency accuracy. Measurement speed is increased when each of these criteria are set to minimum amount required.
CONFIG DONE	Press this key to access the previous menu to make a measurement after setting any desired configurations. It is not necessary to press this key to store updated configuration information into memory, but it is the only way to exit from the CONFIG menu softkeys.
MIN FREQ OFFSET	See MAX FREQ OFFSET.
MAX FREQ OFFSET	Press these keys to set a range of minimum and maximum frequencies offset from the carrier between which the spectrum analyzer will measure discrete sideband spurious signals. All offset values are entered as positive numbers, regardless of the carrier side to which they apply. Figure 3-8 shows an example of a bounded search area defined by minimum and maximum frequency offset values.

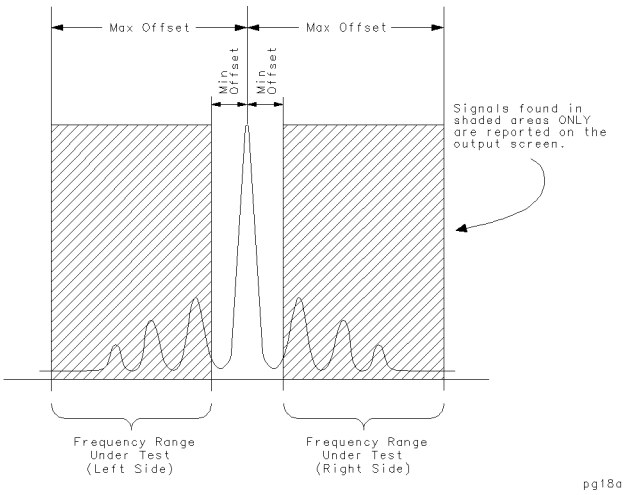

Figure 3-8.
Sidebands Frequency Offset Range Limits

`SET SIDE`

Press this key to set the carrier side or sides that the spectrum analyzer will measure discrete sideband spurious signals. The choices are: `LEFT SIDE` (frequencies less than the carrier), `RIGHT SIDE` (frequencies greater than the carrier), and `BOTH SIDES` (frequencies less than and greater than the carrier). The default is set to left side.

`SET FREQ ACCURACY`

Press this key to access a menu to set the frequency measurement accuracy to normal (`NORMAL ACCURACY`) or high (`HIGH ACCURACY`). A normal accuracy setting yields normal measurement speed. A high accuracy setting yields slower measurement speed because it requires that the spectrum analyzer internal frequency counter be used.

`HARD COPY`

Press this key to access the softkeys that control direct printer or plotter outputs from the spurious response measurements utility. This key is present only following a measurement. See "Printing and Plotting" at the end of this chapter for a description of this softkey and the keys in the menus associated with it.

`MAIN MENU`

Press this key to access the main menu; this is the menu shown upon starting the utility.

`EXIT ALL`

Press this key to access the `USER KEYS` menu or to return to spectrum analyzer mode (this allows you to use the hard keys).

Mixer Menu

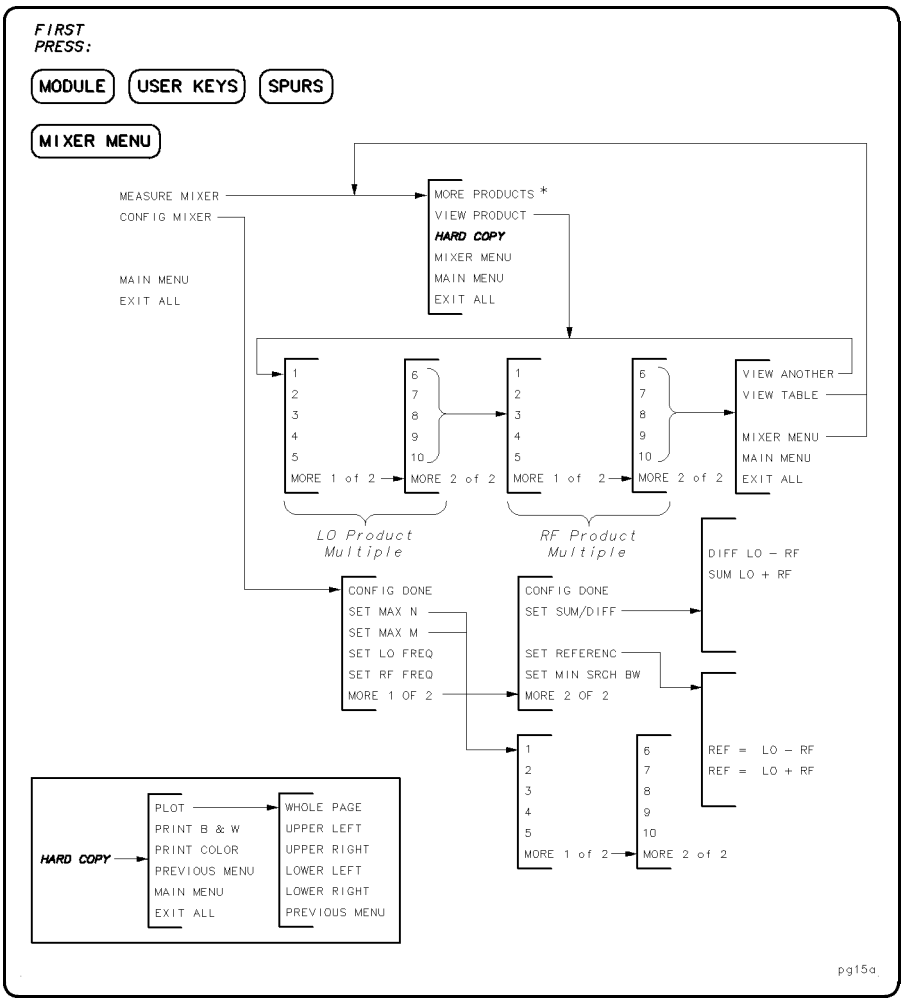

Figure 3-9. Mixer Menu

`MIXER MENU` Press this key to access the mixer measurements menu. This menu allows measurements of mixer products according to M and N numbers in the equation: N X LO ± M X RF. The measured power levels of mixing products are shown in terms of dBc relative to the reference signal at LO + RF, or |LO − RF|. Frequencies of mixing products are *not* given, but can be shown individually using `VIEW PRODUCT`.

`MEASURE MIXER` Press this key to make a mixer products measurement. If no parameters are set prior to pressing this key, parameters that were set for the most recent mixer measurement are used.

`MORE PRODUCTS` This key appears only when there are two or more pages of results data. Press this key to access the next page of data.

`VIEW PRODUCT`

Press this key to view a selected mixing product real-time by choosing an LO multiple (N) and an RF multiple (M). Valid integers for both N and M are 1 through 10, chosen using softkeys after this key is pressed.

`VIEW ANOTHER`

Press this key to view another selected mixing product real-time. You will be asked to choose another LO multiple (N) and an RF multiple (M) prior to viewing.

`VIEW TABLE`

Press this key to see the measurement results table again. The `VIEW PRODUCT` softkey menu is accessed when you press `VIEW TABLE`, so that you can easily view a selected product after seeing data in the results table.

`HARD COPY`

Press this key to access the softkeys that control direct printer or plotter outputs from the spurious response measurements utility. See "Printing and Plotting" at the end of this chapter for a description of this softkey and the keys in the menus associated with it.

`MIXER MENU`

Press this key to access the mixer measurements menu.

`MAIN MENU`

Press this key to access the main menu; this is the menu shown upon starting the utility.

`EXIT ALL`

Press this key to access the `USER KEYS` menu or to return to spectrum analyzer mode (this allows you to use the hard keys).

`CONFIG MIXER`

Press this key to set various parameters prior to the measurement. These include setting the following:

- Maximum values of N and M
- The LO and RF frequencies
- Whether to measure the sum products (LO + RF), or difference products (|LO − RF|)
- Designating the reference signal (|LO − RF|), or (LO + RF).

If no parameters are set prior to pressing this key, default parameters, or parameters that were set for the most recent mixer measurement are used.

`CONFIG DONE`

Press this key to access the previous menu to make a measurement after setting any desired configurations. It is not necessary to press this key to store updated configuration information into memory, but it is the only way to exit from the `CONFIG` menu softkeys.

SET MAX N	See SET MAX M.
SET MAX M	Press these keys to set the maximum values of N and M for use in the mixing products equation: N X LO ± M X RF. These values determine the number of mixing products that will be measured. For example, for N and M set to 3, there will be 9 products measured. Valid integers for both N and M are 1 through 10.
SET LO FREQ	See SET RF FREQ.
SET RF FREQ	These keys designate the LO and RF frequencies of the device being measured.
CONFIG DONE	Press this key to access the previous menu to make a measurement after setting any desired configurations. It is not necessary to press this key to store updated configuration information into memory, but it is the only way to exit from the CONFIG menu softkeys.
SET SUM/DIFF	Press this key to choose either the difference mixer products (DIFF LO − RF), or the sum mixer products (SUM LO + RF) to be measured. The spurious response measurements utility cannot measure the sum *and* difference mixer products at the same time.
SET REFERENC	Press this key to choose which first-order mixing product |LO − RF| (REF = LO − RF), or LO + RF (REF = LO + RF) will provide the power level reference for all other mixing products.
SET MIN SRCH BW	This key is used to control the depth of the mixing products search. If the measured signal is near or in the noise, the program will zoom in on the frequency by reducing the analyzer span and bandwidth. This key sets the limit at which the zoom will stop. Measurement time will either decrease or stay the same by setting minimum search bandwidth to a larger value. Set a lesser value of minimum search bandwidth to increase sensitivity. The default is 100 Hz. The allowable range is from the analyzer minimum resolution bandwidth up to 10 kHz.
MAIN MENU	Press this key to access the main menu; this is the menu shown upon starting the utility.
EXIT ALL	Press this key to access the USER KEYS menu or to return to spectrum analyzer mode (this allows you to use the hard keys).

Printing and Plotting

HARD COPY

Press this key to access the softkeys that control direct printer or plotter outputs from the spurious response measurements utility. HPGL plotters and HP raster graphics printers are supported. To use LaserJets, DeskJets, and other PCL printers, contact your local Agilent Technologies sales and service office. A list of these offices are located at the end of Chapter 5, "If You Have a Problem."

When using a plotter or printer with the spurious response measurements utility, make a trial plot from the normal spectrum analyzer mode to verify plotter operation whenever a change in the plotter setup has occurred.

PLOT

Press this key to access the softkeys that initiate a screen dump to an attached GPIB HPGL plotter. The plotter GPIB address must be set to 5. All of the display is plotted with the exception of the softkey labels.

The plotter must be set up correctly. It must be turned on, have paper loaded, have the correct address, and be connected. Make sure that it is not set to LISTEN ALWAYS mode. If the plotter is not set up properly when WHOLE PAGE, UPPER LEFT, UPPER RIGHT, LOWER LEFT, or LOWER RIGHT is pressed, the spectrum analyzer is likely to lock up and require the power be turned off and then back on. This is why a test plot from normal spectrum analyzer mode is highly recommended.

Some plotters must be configured to respond to HP-GL commands (as opposed to HP-GL/2 commands). For example, the 7550B must be set to 7550A emulation mode before it can be used.

PRINT B&W

Press this key to initiate a screen dump to an attached black and white GPIB printer that supports HP raster graphics, such as an HP ThinkJet or QuietJet. The printer GPIB address must be set to 1. All of the display is printed with the exception of the softkeys.

The printer must be set up correctly. It must be turned on, have paper loaded, have the correct address, and be connected. If the printer is not set up properly when PRINT B&W is pressed, the spectrum analyzer is likely to lock up and require the power be turned off and then back on.

PRINT COLOR

Press this key to initiate a screen dump to an attached color GPIB printer that supports HP raster graphics, such as the HP PaintJet. The printer GPIB address must be set to 1. All of the display is printed with the exception of the softkeys.

The printer must be set up correctly. It must be turned on, have paper loaded, have the correct address, and be connected. If the printer is not set up properly when PRINT COLOR is pressed, the spectrum analyzer is likely to lock up and require the power be turned off and then back on.

WHOLE PAGE

Press this key to cause the spectrum analyzer to plot the display contents to a full page.

UPPER LEFT

Press this key to cause the spectrum analyzer to plot the display contents in the upper left quadrant of the page.

UPPER RIGHT

Press this key to cause the spectrum analyzer to plot the display contents in the upper right quadrant of the page.

LOWER LEFT

Press this key to cause the spectrum analyzer to plot the display contents in the lower left quadrant of the page.

LOWER RIGHT

Press this key to cause the spectrum analyzer to plot the display contents in the lower right quadrant of the page.

Quitting the Utility

To quit the utility and return to spectrum analyzer mode, press EXIT ALL at the main menu.

Pressing EXIT ALL returns the instrument to the state that existed when the utility was first invoked. This is the only recommended way to exit the spurious response measurements utility. Using other keys such as (PRESET) may exit the utility, but may also put the utility in a state that will cause unpredictable results the next time the utility is run.

4

Measurement Functions and Considerations

The main function of this utility is to make five different types of spurious measurements:

- TOI/IMD
- Harmonics
- General spurious
- Carrier sidebands
- Mixer products

This chapter describes the purposes and limits of each of these measurements. It also lists the range limitations and default values of the configuration settings for each measurement.

The Main Menu

When the spurious response measurements utility is started, the screen displays the main menu showing the various spurious measurements, as shown in Figure 4-1.

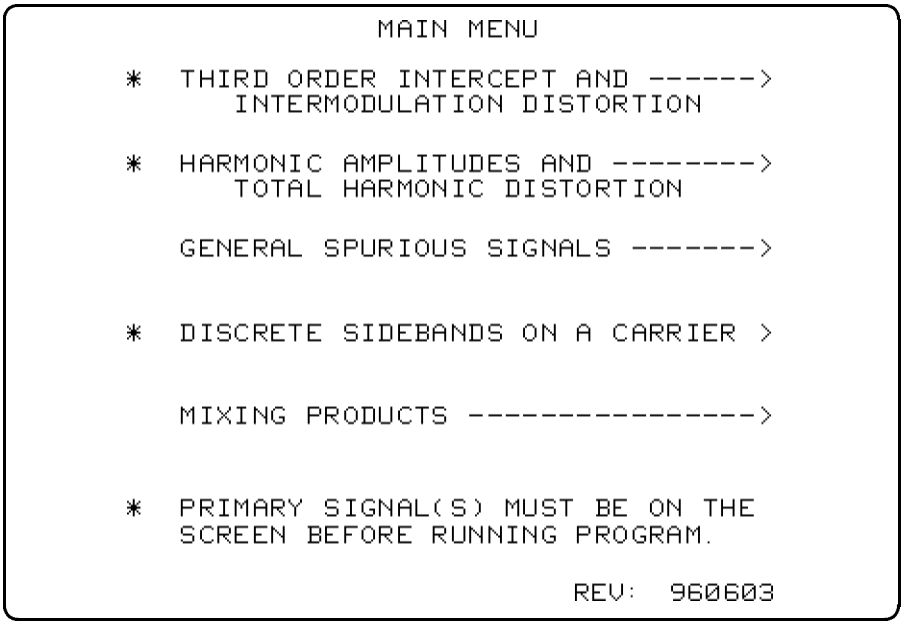

Figure 4-1. Main Menu

The configuration parameters are either the default set for the first time the program is run, or they are the same as the last time the program was used. The only exceptions to this are frequency and amplitude of:

- The two tones for the TOI/IMD measurement
- The fundamental signal in the harmonic measurement
- The reference signal in the general spurious measurement
- The carrier signal in the carrier sidebands measurement

These signals represent the largest signals on the spectrum analyzer display when the spurious response measurements utility is invoked, and are identified in the main menu and shown in Figure 4-1 by a single asterisk (*). `GENERAL SPURIOUS SIGNALS` is identified with an asterisk if the measurement is configured to measure relative signal amplitudes (dBc).

Note

General spurious measurements can be configured to make absolute power measurements, or measurements relative to a reference signal. If relative power level (dBc) is chosen in the `CONFIG SPURS` menu, then the reference signal must be on the display prior to invoking the utility.

Exiting the Utility

To quit the utility and return to spectrum analyzer mode, press `EXIT ALL` at the main menu.

Pressing `EXIT ALL` returns the instrument to the state that existed when the utility was first invoked. This is the only recommended way to exit the spurious response measurements utility. Using other keys such as (PRESET) may exit the utility, but may also put the utility in a state that will cause unpredictable results the next time the utility is run.

Third Order Intercept Measurement

Description

From the main menu, press `MEASURE TOI/IMD` to measure the third order intercept point and the third order distortion. There is no pre-measurement configuration. The two primary signals must be visible and distinguishable from each other on the display *before* running the utility. The third order products need not be on-screen.

The utility measures all four signals and adjusts the spectrum analyzer settings appropriately so that the measured distortion is not affected by distortion from the analyzer itself. In addition, any difference in the amplitudes of the two primary signals will be taken into account in the calculation of the intercept point.

The signal information and calculation results are displayed on screen at the end of the measurement. The third order intercept is calculated from both the upper and lower third order product. If the amplitude of the distortion products was close to the noise level, the results are flagged with a double asterisk, and an explanatory note is displayed. The results screen may be printed or plotted using the `HARD COPY` softkey.

Measurement Configuration

There is no configuration available for this measurement.

Measurement Limitations

The measurement is limited by the following criteria:

- The amplitude of the two primary signals must be at least −40 dBm.
- The primary signals should have reasonably low phase noise compared to the frequency spacing and distortion product level.
- The primary signal spacing must be greater or equal to 100 Hz.
- The primary signals should be stable, especially when distortion products are low. In this case, the utility will narrow the span and bandwidth in an attempt to obtain a valid measurement.
- Both primary signals must be $\geq$−40 dBm, and visible on the screen, before invoking the utility.

Harmonics Measurements

Description

This measurement searches for the even and odd harmonics of a signal and computes the total harmonic distortion based on the measured harmonics. Harmonic numbers up to the tenth harmonic are chosen by the user via a configuration menu prior to the measurement. In addition, the user can configure the display and minimum search bandwidth to optimize the measurement speed.

The fundamental frequency must be visible on the display before the utility is invoked. If the harmonic to be measured is near or below the noise level, the utility will adjust the span and bandwidth in an attempt to obtain a valid measurement. The program also adjusts the spectrum analyzer settings to eliminate any internal analyzer contribution to the second or third harmonic distortions. If the noise cannot be reduced enough for the analyzer to make a valid measurement on a given harmonic, the results are flagged with a double asterisk, and an explanatory note is displayed. The results screen may be printed or plotted using the `HARD COPY` softkey.

The % total harmonic distortion is determined using the equation:

$$\%THD = (100) \times \frac{\sum_{n=2}^{m} \sqrt{V^2(f_n)}}{V(f_o)}$$

where: n = 2 to 10 maximum

m = 10 maximum

V = harmonic voltage

f_o = fundamental signal

Measurement Configuration

The configuration menu provides for the following settings:

- Set the number of harmonics to be measured.
- Omit, or retain harmonic frequency information in the results table.
- Control the depth of the harmonic search for signals near the noise level.

Use the `CONFIG HARMONIC` softkey to set the number of harmonics to be measured. This configuration must be set prior to a making a harmonic measurement. Harmonic number 1 is considered to be the fundamental; the range of harmonic multiples of the fundamental is from 2 to 10.

The two other configuration settings are optional. You can opt to omit the harmonic frequencies in the measurement results table (SET FREQ DISPLAY). This omission slightly increases measurement speed. You can also set the minimum search bandwidth (SET MIN SRCH BW), which is used to control the depth of the harmonic search if a signal is near or in the noise. It sets the frequency limit at which the spectrum analyzer will zoom in on the frequency by reducing the span and the bandwidth. The default value is 100 Hz. The allowable range is from the analyzer minimum resolution bandwidth up to 10 kHz. Measurement speed either increases or stays the same as the minimum search bandwidth frequency is increased.

Measurement Configuration Menu Variable Limits

Table 4-1 lists the configuration variables, their limits, and initial default values.

Table 4-1.
Harmonics Measurement Configuration Variable Limits

Configuration Variable	Limit/Range	Initial Default Value
SET MAX HARMONIC	2 to 10	6
SET FREQ DISPLAY	HIDE FREQS or DISPLAY FREQS	HIDE FREQS
SET MIN SRCH BW	1 Hz* to 10 kHz	100 Hz

* This value is the minimum bandwidth limit of the spectrum analyzer used. Your analyzer may have a different limit.

See Chapter 3, "Softkey Menus and Descriptions" for more information about these variables, as well as descriptions of all softkeys.

Measurement Limitations

The measurement is limited by the following criteria:

- The fundamental amplitude must be at least –50 dBm.
- The greatest harmonic number to be measured may be reduced during measurement execution if the spectrum analyzer frequency range is exceeded.
- The fundamental frequency should be stable in order to measure low-amplitude harmonics, since the utility narrows the span in an effort to obtain a valid measurement.
- When measuring very low amplitude harmonics, it may be necessary to have a common frequency reference for both the spectrum analyzer and the source signal. This assures that frequency reference inaccuracies will not affect the ability of the utility to narrow the span and bandwidth without losing the harmonic.

  It will be necessary to use the spectrum analyzer 10 MHz reference as the common frequency reference. An external frequency reference will not be used during execution of the spurious response measurements utility, except when in remote operation. In this case, refer to Chapter 7, "Remote Programming Commands and Examples," for more information.

General Spurious Measurement

Description

The general spurious measurement searches for any signals within prescribed frequency and amplitude bounds.

The desired search area is a "window" within which the utility will search for spurious signals. If none are found within this window, the results table will report `TOTAL OF 0 SPURS FOUND`, even though significant spurious signals may appear close to (but outside of) this area. Figure 4-2 shows an example of a bounded search area.

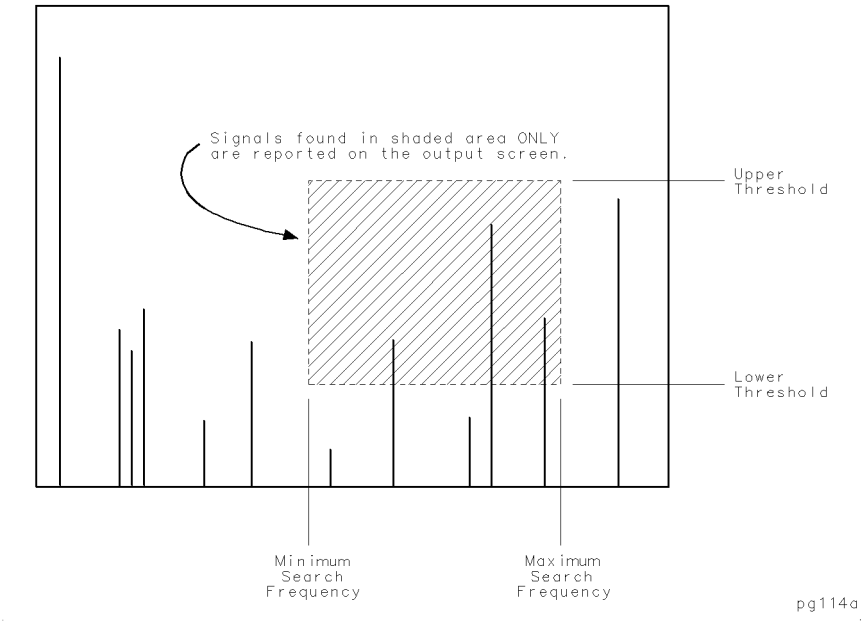

Figure 4-2.
Spurious Measurement Frequency and Power Level Bounds

Output amplitudes can be expressed in dBm or dBc. If the dBc mode is chosen, there must be a reference signal greater than –50 dBm on the screen before invoking the utility.

The time required to execute a search can vary widely. The time depends heavily on the lower amplitude search threshold and also on the search frequency range. In general, it is best to start with a lower search threshold at –60 dBm or greater, note the measurement time required, and then reduce the threshold in steps of approximately 5 dB until the time becomes excessive, or the threshold meets the target. An estimate of the search time is presented to help make reasonable configuration choices.

When measuring amplitudes with respect to a reference signal (dBc mode), the search time is dependent upon the reference signal amplitude, as well as the other factors already mentioned. A new estimate of the search time should be made whenever the amplitude of the reference signal is changed.

The measurement results lists all signals found within the search criteria window. You can choose to list signals in order of frequency or amplitude using the configuration menu. The default listing is in frequency order. If many signals are found, the utility may require several minutes to reorder the signals by amplitude. The results screen may be printed or plotted using the `HARD COPY` softkey.

Measurement Configuration

The configuration menu provides for the following settings:

- Set the lower (minimum search) frequency limit for the search.
- Set the upper (maximum search) frequency limit for the search.
- Set the lower threshold (minimum amplitude) that a measured signal may have and still be retained.
- Set the upper threshold (maximum amplitude) that a measured signal may have and still be retained. Signals having amplitudes greater than this threshold are discarded.
- Order the measured signals in the results screen by either ascending frequency or descending amplitude.
- Express measured signal amplitudes in dBm, or dBc relative to a reference signal. For dBc configurations, the reference signal must be visible on the display before the utility is invoked.
- Set the general spurious measurement time estimate function to either update automatically, or to update manually. This function is useful to obtain a time estimate of the duration of any general spurious measurement prior to running the measurement.

  The default setting is automatic mode.

Configuration Menu Variable Limits

Table 4-2 lists the configuration variables, their limits, and initial default values.

Table 4-2.
Spurious Measurement Configuration Variable Limits

Configuration Variable	Limit/Range	Initial Default Value
MINIMUM SRCH FRQ	> 1 MHz to analyzer upper limit	100 MHz
MAXIMUM SRCH FRQ	> 100 kHz above MINIMUM SRCH FRQ, up to the spectrum analyzer upper limit	1 GHz
LOWER THRESHLD	−130 dBm to +40 dBm*	−60 dBm
UPPER THRESHLD	−100 dBm to +50 dBm*	+50 dBm*
SET SORT ORDER	AMPLITUDE or FREQUENCY	FREQUENCY
SET dBm/dBc	MEASURE IN dBm, or dBc	MEASURE IN dBm
SET UPDATE	AUTOMATIC, or MANUAL UPDATE	AUTOMATIC UPDATE

* Do *not* exceed the maximum input signal amplitude to the spectrum analyzer. See the following CAUTION statement.

Caution

Maximum input signal amplitude to the spectrum analyzer is +30 dBm with at least 10 dB of input attenuation. Higher amplitude signals can result in damage to the input attenuator or to the input mixer.

See Chapter 3, "Softkey Menus and Descriptions" for more information about these variables, as well as descriptions of all softkeys.

Measurement Limitations

The measurement is limited by the following criteria:

- A maximum of 50 spurious signals are retained from the measurement. Those kept are the first ones found.
- When configured to measure signals in dBc, signal amplitudes must be less than the reference signal amplitude.
- When configured to measure signals in dBc, the reference signal must be visible on the screen before the utility is invoked. It must also be the greatest signal amplitude on the screen, and at least −50 dBm.

- When the time estimate function is set to automatic, then a new search time estimate is generated whenever there is a change in any of these parameters:
  - □ MINIMUM SEARCH FREQUENCY
  - □ MAXIMUM SEARCH FREQUENCY
  - □ LOWER SEARCH THRESHOLD
  - □ SET dBm/dBc

  When the function is set to manual, then a new search time estimate is generated only when the `UPDATE TIME EST` softkey is pressed.

  The time estimate is shown on the General Spur Menu Configuration screen following the words: `ESTIMATED SEARCH TIME:`. The time estimate value changes to the words `NEED UPDATE` in manual update mode whenever any of the parameters in the previous list is changed.

  If the maximum search frequency is set below the minimum search frequency and a time estimate is requested, the display will show: `ESTIMATED SEARCH TIME: ******`

Discrete Sidebands Measurement

Description

The sidebands measurement searches one or both sides of a carrier for discrete sidebands. If both sides are desired, the program searches the right side to find sidebands, then it measures the amplitudes for the same sidebands on the left side of the carrier, assuming that all of the sidebands occur in pairs. The offset numbers are always positive, even when searching the left side.

The desired search area is bounded by a minimum and a maximum frequency from the carrier, between which bounds the utility will search for spurious sideband signals. If none are found within this window, the results table will report `FOUND: 0 SETS OF SIDEBANDS`, even though significant sideband spurious signals may appear close to (but outside of) this area. Figure 4-3 shows an example of a bounded search area.

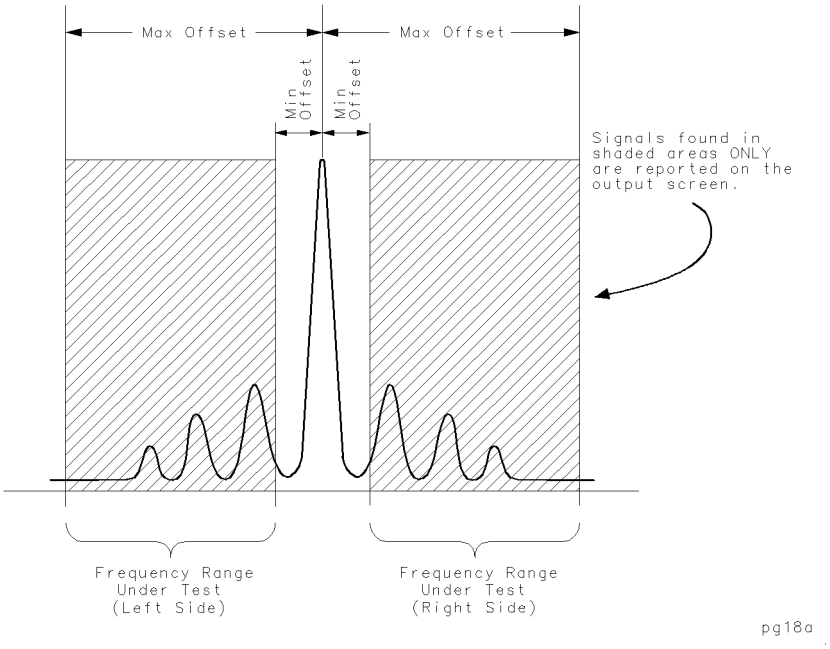

Figure 4-3. Sidebands Frequency Offset Range Limits

The carrier must be visible on the display before the utility is invoked.

The output table lists the sideband offset frequencies and their respective power levels in dBc from the carrier. Also displayed is the carrier frequency, and amplitude in dBm. The normal offset frequency accuracy is about ±10%. This accuracy can be greatly improved by setting the frequency accuracy to high. But this setting requires use of the analyzer internal frequency counter, and reduces measurement speed. The results screen may be printed or plotted using the `HARD COPY` softkey.

Measurement Configuration

The configuration menu provides for the following settings:

- Minimum frequency offset from the carrier (from which to search).
- Maximum frequency offset from the carrier (from which to search).
- Search the left side, right side, or both sides of the carrier.
- Set the frequency accuracy (either normal, or high).

Configuration Menu Variable Limits

Table 4-3 lists the configuration variables, their limits, and initial default values.

Table 4-3.
Sidebands Measurement Configuration Variable Limits

Configuration Variable	Limit/Range	Initial Default Value
MIN FREQ OFFSET	≥ 50 Hz to analyzer upper limit	1 kHz
MAX FREQ OFFSET	≥ 1 kHz and > MIN FREQ OFFSET, up to the spectrum analyzer upper limit	1 MHz
SET SIDE	LEFT, or RIGHT, or BOTH SIDES	LEFT SIDE
SET FREQ ACCURACY	NORMAL, or HIGH ACCURACY	NORMAL ACCURACY

See Chapter 3, "Softkey Menus and Descriptions" for more information about these variables, as well as descriptions of all softkeys.

Measurement Limitations

The measurement is limited by the following criteria:

- The carrier frequency less the maximum offset frequency must be greater than 100 kHz.
- The carrier amplitude must be at least –50 dBm.
- A maximum of 25 sets of sidebands will be retained from the measurement.
- Closely-spaced sidebands may not be resolved.
- If the carrier is drifty or unstable, the measurement will be accurate only for frequency offsets that are much greater than the instability.

- Noise bursts and pulse noise will cause erratic results.
- When measuring sidebands on both sides, it is expected that all sidebands occur in pairs. The detection is done on the right side, and only the amplitudes are measured on the left side.
- The normal frequency offset accuracy is about ±10%.
- Using high frequency offset accuracy requires use of the analyzer internal frequency counter, and reduces measurement speed.

Mixing Products Measurement

Description

The mixer products measurement identifies the amplitudes of the mixing products generated by designated RF and LO signals. The RF and LO frequencies and maximum M and N product values to be measured must be specified by you prior to making a measurement. These are set in the configuration menu, along with two other important settings:

Mixing products are determined by using the equation (N X LO ± M X RF), but the utility measures either sum products, or difference products during each measurement. For example, if you select sum products (`SUM LO + RF`), then the program calculates (N X LO + M X RF). If you select difference products (`DIFF LO – RF`), then the program calculates (|N X LO – M X RF|). This is set in the configuration menu.

Measured product amplitudes are expressed in dB below a reference product. You set the reference to be the signal at either frequency (LO + RF), or at frequency (|LO – RF|). This is set in the configuration menu.

The output screen displays a table of amplitudes with the rows corresponding to the RF harmonics, and the columns corresponding to the LO harmonics. The top of the display shows the basic configuration. More than one table is displayed if all the data cannot fit on a single screen. Products with a 0 Hz frequency are not measured, and a - appears in the results table in place of a measured amplitude value. If a product is near or in the noise (or if it drifts out of range), an asterisk appears next to the amplitude value.

After each measurement is completed, you may view any particular product in spectrum analyzer mode by specifying the appropriate multiples of RF and LO associated with the desired product. The results screen may be printed or plotted using the `HARD COPY` softkey.

Measurement Configuration

The configuration menu provides for the following settings:

- MAX N sets the maximum LO multiple to use in the search equation.
- MAX M sets the maximum RF multiple to use in the search equation.
- LO FREQ specifies the frequency of the LO signal.
- RF FREQ specifies the frequency of the RF signal.
- SET SUM/DIFF specifies whether (N X LO + M X RF) or (|N X LO – M X RF|) is used.
- SET REFERENC specifies whether to use (LO + RF) or (|LO – RF|) for the reference.

- SET MIN SRCH BW controls the depth of the mixer product search for signals near the noise level.

You can optionally set the minimum search bandwidth (`SET MIN SRCH BW`), which is used to control the depth of the mixer product search if a signal is near or in the noise. It sets the frequency limit at which the spectrum analyzer will zoom in on the frequency by reducing the span and the bandwidth. The default value is 100 Hz. The allowable range is from the analyzer minimum resolution bandwidth up to 10 kHz. Measurement speed either increases or stays the same as the minimum search bandwidth frequency is increased.

Configuration Menu Variable Limits

Table 4-4 lists the configuration variables, their limits, and initial default values.

Table 4-4.
Mixer Measurement Configuration Variable Limits

Configuration Variable	Limit/Range	Initial Default Value
`SET MAX N`	1 to 10	4
`SET MAX M`	1 to 10	4
`SET LO FREQ`	≥ 1 MHz up to the spectrum analyzer upper limit	310 MHz
`SET RF FREQ`	≥ 1 MHz up to the spectrum analyzer upper limit	300 MHz
`SET SUM/DIFF`	DIFF LO – RF*, or SUM LO + RF	DIFF LO – RF
`SET REFERENC`	REF = LO – RF*, or REF = LO + RF	REF = LO – RF
`SET MIN SRCH BW`	1 Hz† to 10 kHz	100 Hz

*This quantity is actually |LO – RF|.
† This value is the minimum bandwidth limit of the spectrum analyzer used. Your analyzer may have a different limit.

See Chapter 3, "Softkey Menus and Descriptions" for more information about these variables, as well as descriptions of all softkeys.

Measurement Limitations

The measurement is limited by the following criteria:

- The LO and RF frequencies must differ by at least 100 kHz.
- The LO amplitude must be at least −50 dBm.
- The RF amplitude must be at least −60 dBm.
- The reference amplitude must be greater than that of the products to be measured.

Mixing Product Frequency is 0 Hz

Invalid results occur if the frequency of any mixing product is 0 Hz. In this case, the result is flagged with "—" to denote a meaningless measurement. This situation occurs if the following things are true:

1. The difference products |N X LO - M X RF| are being measured.
2. The following fraction can be reduced by removing common factors until both the numerator and denominator are integers:

   $$\frac{LO Frequency}{RF Frequency}$$

   and,

   the numerator $\leq$ Max N, and the denominator $\leq$ Max M

For example:

Measure |N X LO - M X RF|

Max N = 10
Max M = 10
LO Frequency = 300 MHz
RF Frequency = 270 MHz

$$Fraction = \frac{LO Frequency}{RF Frequency} = \frac{300}{270} = \frac{10}{9}$$

In this example, an invalid result will occur. However, if Max N is set to 9, a valid result will occur.

Products with a 0 Hz frequency are not measured, and a - appears in the results table in place of a measured amplitude value. When this occurs, the table usually has several - entries, and multiple entries with the same value (which represent multiple products at the same frequency).

Different Mixing Product Frequencies are Equal

Invalid results will occur when different mixing products are at the same frequency. In this case, the combination of the products will be measured and reported at all of the contributing LO and RF multiples. This will occur if the fraction:

$$\frac{LO Frequency}{RF Frequency}$$

can be reduced to integers in both the numerator and the denominator such that the numerator $\leq$ 2 X Max N and the denominator $\leq$ 2 X Max M.

For example:

Measure |N X LO - M X RF|

Max N = 7
Max M = 7
LO Frequency = 819 MHz
RF Frequency = 756 MHz

$$Fraction = \frac{LO Frequency}{RF Frequency} = \frac{819}{756} = \frac{13}{12}$$

since $13 \leq$ 2 X Max N = 14

and $12 \leq$ 2 X Max M = 14

then different mixing products will occur at the same frequency. With the frequencies in this example and N = 7 and M = 7, the product frequency is 441 MHz. With the same frequencies, but N = 5 and M = 6, the product frequency is also 441 MHz.

If the frequencies are such that different mixing products are close to each other but not exactly identical, the wrong product may be measured. This is because several products will appear in a single span. This situation is difficult to predict because it depends on amplitude levels as well as frequencies. The best check is to observe the display while the utility performs the measurement to see if multiple signals appear at the measurement for any given product.

Printing and Plotting

Measurement results for each measurement may be sent to a GPIB plotter or GPIB printer such as a Hewlett-Packard ThinkJet or PaintJet by using the HARD COPY softkey. This softkey menu structure is shown in Figure 4-4.

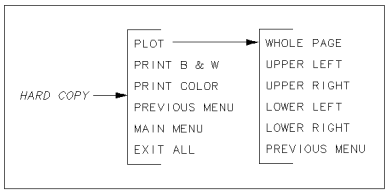

Figure 4-4. Copy Menu

The PLOT softkey will plot everything on the screen except the softkey annotation to a GPIB plotter set to address 5. The PRINT B&W softkey should be used with monochrome printers, such as the HP ThinkJet. The printer needs to have its GPIB address set to 1. The PRINT COLOR softkey should be used with HP PaintJets. Their GPIB addresses should also be set to 1.

Press the WHOLE PAGE softkey to cause the spectrum analyzer to plot the display contents to a full page.

Press the UPPER LEFT softkey to cause the spectrum analyzer to plot the display contents in the upper left quadrant of the page.

Press the UPPER RIGHT softkey to cause the spectrum analyzer to plot the display contents in the upper right quadrant of the page.

Press the LOWER LEFT softkey to cause the spectrum analyzer to plot the display contents in the lower left quadrant of the page.

Press the LOWER RIGHT softkey to cause the spectrum analyzer to plot the display contents in the lower right quadrant of the page.

Note

Only the softkeys in the utility should be used to plot or print. Unpredictable results will occur if any other keys are used, such as the (COPY) key. It is also important that the plotter or printer be connected and functional (that it have paper ready and be on line). If this is not the case, the spectrum analyzer may lock up and need to be turned off and back on to recover. When using a plotter or printer with the spurious response measurements utility, make a trial plot using the normal spectrum analyzer mode and the (COPY) key to verify plotter operation whenever a change in the plotter setup has occurred.

5

If You Have a Problem

How to terminate the program during a measurement

At times you may want to stop a measurement in progress (for instance, when it appears as if the measurement is taking too long). To stop a measurement, first press (PRESET). Then press (RECALL) `Recall State` `More 1 of 2` `STATE 9`. This will normally bring the spectrum analyzer back to the same settings that were in effect before the utility was last started.

In rare cases, the utility may not begin correctly the next time it is started after pressing the above keys. In this case, cycle power, run the utility, and Press `EXIT ALL` to exit. The utility should function normally the next time it is run.

Cannot print or plot

- The printer or plotter must be functional before trying to output. It is a good idea to try it before starting the spurious response measurements utility. If it is not functional, the spectrum analyzer power must be turned off and on to recover. Check the following:
  - ☐ The power is turned on.
  - ☐ The printer is on line.
  - ☐ The paper is in place.
  - ☐ It is a GPIB printer or plotter.
  - ☐ The GPIB cable connected.
  - ☐ The GPIB address is set to 5 for a plotter.
  - ☐ If a plotter is connected, it is *not* set to `LISTEN ALWAYS`.
  - ☐ The GPIB address is set to 1 for a printer.

Spectrum analyzer states are lost

- The spurious response measurements utility should not be invoked if a state is already saved in state 9 that must not be overwritten. This state register is used to save the initial instrument settings so that they can be restored when the utility is finished.

Spurious response measurements utility terminates unexpectedly

Pressing almost any of the front panel hard keys will abort the utility. After the DLP is started, no hard keys should be pressed except when there is an active function waiting for a user input. Then use the number keys and the terminators (such as kHz, or MHz). The knob should never be turned when the utility is running because it can cause the spectrum analyzer not to accept any key presses, requiring the ac power to by cycled.

The (PRESET) key may be used to exit the utility in the middle of a measurement. Use of the (PRESET) key will prevent the original instrument state from being restored. This may give unpredictable results when the utility is restarted. The original instrument state can be restored by recalling state 9. If the power is turned off and back on again the utility can be restarted.

The utility behavior is erratic

First, try resetting the utility variables to factory default values. This procedure is described under "Moving the Mass Memory Module (and Utility) to Another Analyzer," in Chapter 1, "Installing and Starting the Utility."

Second, try removing, then re-installing the utility as described in Chapter 1, "Installing and Starting the Utility." While it is possible to simply overwrite the utility without removing it first, removing and then re-installing it is much faster.

Unexpected measurement results

Avoid the following situations; they can cause unexpected measurement results:

- TOI/IMD
  - Extraneous signals near the desired signals
  - Drifting primary signals
  - Modulation on the primary signals
- Harmonics
  - Extraneous signals
  - Drifting fundamental, especially when measuring harmonics having low amplitude and high harmonic numbers
  - Modulation on the carrier, especially when measuring harmonics having high harmonic numbers
- General Spurious
  - Excess noise floor that is not monotonic with frequency

- Sidebands
  - Drifting carrier
  - Extraneous signals near the carrier
- Mixing Products
  - Drifting LO or RF signal, especially when measuring products having high M or N numbers, and low-level products
  - Extraneous signals
  - Modulation on the RF or LO signals, especially when measuring products having high M or N numbers

For spurious sidebands, and general spurious measurements, it is possible that noise will be detected and displayed as a signal. This is rare, but is possible due to the randomness of noise, and to setting the thresholds and bandwidths to minimize search time while maximizing spurious detection.

Third order intercept results can vary with signal amplitude, even though theoretically results should be constant. Use a constant power level when comparing data from different devices under test.

Table 5-1. Agilent Technologies Sales and Service Offices

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Instrument Support Center
Agilent Technologies
(800) 403-0801

EUROPEAN FIELD OPERATIONS

Headquarters
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Agilent Technologies (Canada) Ltd.
17500 South Service Road
Trans-Canada Highway
Kirkland, Quebec H9J 2X8
Canada
(514) 697-4232

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China Agilent Technologies
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Kanagawa 229, Japan
(81 427) 59-1311

Singapore
Agilent Technologies Singapore (Pte.) Ltd.
150 Beach Road
#29-00 Gateway West
Singapore 0718
(65) 291-9088

Taiwan
Agilent Technologies Taiwan
8th Floor, H-P Building
337 Fu Hsing North Road
Taipei, Taiwan
(886 2) 712-0404

6

Specifications and Characteristics

Specifications and Characteristics

Measurement accuracy depends upon the specifications of the host spectrum analyzer and on the characteristics of the signal. In general, the amplitude specifications that may be pertinent for a given measurement are as follows:

A. Reference Level Uncertainty (Frequency Response)

B. Bandswitching Uncertainty

C. Input Attenuator Switching Uncertainty

D. IF Gain Uncertainty

E. Resolution Bandwidth Switching Uncertainty

F. Scale Fidelity

G. Marker Amplitude Resolution

H. Calibrator Uncertainty

The equations listed in the following discussions of the individual utility measurements refer to the characteristics in the preceding list, by letter.

TOI and IMD

IMD Uncertainty = 2 X (D+E+G) + F

TOI/IP3 Uncertainty = 2 X (D+E+G) + A+B+H + (.5 X F)

These are worst-case uncertainties based on the primary signals being within approximately 1 MHz of each other. The bandswitching uncertainty (B) can be omitted if the signals are less than 2.9 GHz. The input attenuator switching uncertainty (C) must be included if the attenuator changes settings during the measurement. This may happen if the fundamental signals are greater than 0 dBm, or if the TOI/IP3 value is greater than 10 dBm.

Harmonics

Harmonic Uncertainties = 2 X (A+B+D+E+G) + F

This is a worst-case number. If the fundamental and all of the measured harmonics fall within the same band, 2 X B may be omitted. If the fundamental amplitude is greater than 0 dBm, the input attenuator switching uncertainty (C) must be included. This quantity (C) may also need to be added to the second and third harmonic uncertainties if those amplitudes are small compared to the spectrum analyzer distortion. (In this case, the input attenuation will increase to ensure a valid measurement.)

General Spurious Signals

In the relative power level mode (dBc), the accuracy considerations are the same as for harmonics. In the absolute power level mode (dBm), the following applies:

Spurious Uncertainty = A+B+D+E+F+G+H

This is a worst-case number. If the search range is confined to 2.9 GHz or less, the bandswitching uncertainty (B) may be omitted.

Sidebands

Sideband Uncertainty = 2 X (D+E+G) + F

This is a worst-case number. This assumes that the sidebands are within about 1 MHz of the carrier frequency. If the carrier amplitude is greater than 0 dBm, the input attenuator switching uncertainty (C) must be included.

Mixing Products

Mixing Products Uncertainty = 2 X (A+B+D+E+G) + F

This is a worst-case number.

Repeatability

The repeatability of any of the measurements is primarily a function of how close the signal is to the noise. In general, all measurements that are not flagged as being near the noise are repeatable to at least ±2 dB.

7

Remote Programming Commands and Examples

This chapter explains how functions of the 85672A Spurious Response Measurements Utility can be executed by using programming commands. This is done by using a computer to remotely send instructions to the spectrum analyzer to operate the utility instead of pressing the softkeys.

Before you can program the spectrum analyzer, you must connect the spectrum analyzer to the computer. See the programming documentation for the spectrum analyzer for more information.

All the programming examples in this chapter are written in HP BASIC.

Programming Notes

Command Syntax Basics

In general, commands are issued just like the standard GPIB commands. For example, in the Basic programming language, executing the TOI/IMD measurement is done with the command:

```
OUTPUT 718;"SP_TOI;";
```

All commands associated with the Spurious Response Measurements Utility begin with `SP_`.

All commands should be issued in capital letters.

Before a particular measurement program is invoked, the variable `SP_RMT` should be set to 1. This tells the program to save the current state in state register 9 so that the state can be restored with `SP_EXIT` after the program has terminated. See the example programs.

Note

Spurious response measurements utility command syntax is different than GPIB command syntax. For example, the GPIB command set does not include the `MOV` command. Also, units terminators such as Hz and dB, required with GPIB commands, are absent in utility commands. For example, the utility command `OUTPUT 718;"MOV SP_HBWMIN,100;"` refers to 100 Hz, but lacks the units terminator Hz. An example of the `MOV` command is shown in the next paragraph under “Setting Configuration Parameters.”

Setting Configuration Parameters

A configuration parameter is set using the keyword MOV. The syntax is: MOV {destination},{source}. For example, to set the maximum harmonic to be measured to 7, issue the command: OUTPUT 718;"MOV SP_H_MAX,7;";. Note the comma between the variable and the value.

Changing the Analyzer Mode from Remote to Local

Use SP_EXIT to end any remote measurements and return the spectrum analyzer to its original state.

Using Queries to Obtain Results

A result is obtained by first querying the host spectrum analyzer and then reading the value. A query is formed by sending the variable name followed by a question mark and semicolon. For example, to read the TOI based on the lower distortion product, issue the following commands:

```
OUTPUT 718;"SP_TOI_A?;";

ENTER 718;Toi_lwr
```

In the previous example, the BASIC variable Toi_lwr can be changed to any valid variable name desired.

Some of the results are stored in arrays. Individual elements of any array can be accessed by using square brackets with an index inside. For example, OUTPUT 718;"SP_H_LVL[3]?;"; requests the amplitude of the third harmonic.

An entire array can be accessed with the base name. For example, OUTPUT 718;"SP_H_LVL?;"; In this case, the ENTER statement that follows the array statement must be configured to accept the entire array. An array from the spectrum analyzer is sent as a string of ASCII characters which are comma delimited.

The computer must wait for the measurement to be completed before querying for results. This can be done with a simple WAIT statement, but the maximum expected wait execution time must be given. Use the GPIB DONE command instead. See the example programs in this chapter for more details about how this command is used.

Remote Error Codes

If a measurement does not complete successfully, an error code will be contained in the variable SP_OK. If the measurement is successful, the value will be 1. 0 designates an unknown error, although one known situation that will generate this will be if the measurement did not execute to completion. This can occur if a wait time was not long enough, or if the interrupt scheme did not function correctly. Negative error code numbers refer to specific errors; these are listed with the remote description of each module, in this chapter.

Using an External 10 MHz Reference

An external 10 MHz reference can be used when making measurements in remote operation only. To do this, set the variable SP_EXTREF equal to 1 by using the command:

OUTPUT @Sa;"MOV SP_EXTREF,1;";

To use the internal frequency reference, set SP_EXTREF to 0 (its default value).

The state of the SP_EXTREF variable remains in effect for all measurements (including manual mode) until it is remotely reset.

Remote Measurement of TOI/IMD

Execute Command

SP_TOI

Output Variables

TOI/IMD Output Variables

Variable	Description
SP_TOIFA	Lower Primary Signal Frequency in Hz
SP_TOIFB	Upper Primary Signal Frequency in Hz
SP_TOIFS	Primary Signal Frequency Spacing in Hz
SP_TOI_SL	Lower Signal Amplitude in dBm
SP_TOI_SU	Upper Signal Amplitude in dBm
SP_TOI_PL	Lower Distortion Product Amplitude in dBm
SP_TOI_PU	Upper Distortion Product Amplitude in dBm
SP_TOI_A	Third Order Intercept Point based on the lower distortion product in dBm
SP_TOI_B	Third Order Intercept Point based on the upper distortion product in dBm
SP_TOINA	If this flag = 1, the lower distortion product was near the noise level, and SP_TOI_A is likely to be higher than reported. This flag = 0 for a good measurement.
SP_TOINB	If this equals 1, the upper distortion product was near the noise level, and SP_TOI_B is likely to be higher than reported. This could also occur if a primary signal is drifting in frequency. This flag = 0 for a good measurement.

Error Codes

TOI/IMD Error Codes

Error Code	Description
1	Successful Measurement
0	Unsuccessful Measurement, unknown reason This may occur if the measurement was interrupted before complete.
-101	The spacing between the two signals was not 100 Hz or greater.
-102	Two signals above -40 dBm were not found.

Remote Third Order Intercept (TOI) Measurement Example

This example shows how you can remotely measure TOI with the 85672A Spurious Response Measurements Utility.

```
10    !
20    !
30    !
40    !************************************************************************
50    !************************************************************************
60    !
70    !     EXAMPLE OF REMOTE MEASUREMENT OF THIRD ORDER DISTORTION
80    !
90    !************************************************************************
100   !
110    ASSIGN @Sa TO 718
120   !
130    CLEAR SCREEN
140    OPTION BASE 1                          ! Start array index with 1
150   !
160   !               Declare and Dimension the Variables
170   !
180    REAL Sigampl1                 ! Lower Signal's Amplitude
190    REAL Sigampl2                 ! Upper Signal's Amplitude
200    REAL Dstampl1                 ! Lower Distortion Product's Amplitude
210    REAL Dstampl2                 ! Upper Distortion Product's Amplitude
220    REAL Toi1                     ! TOI from Lower Product
230    REAL Toi2                     ! TOI from Upper Product
240    REAL Imd1                     ! IMD from Lower Product
250    REAL Imd2                     ! IMD from Upper Product
260    REAL Sigspcg                  ! Signal Spacing
270    REAL Freq                     ! Temporary Frequency Variable
280    INTEGER Sflg                  ! The Completion Status
290    INTEGER Done                  ! Status Byte from Analyzer
300   !
310   !                Do the Measurement
320   !
330    OUTPUT @Sa;"SP_TOI;";
340   !
350   !                Sense when the Measurement is done
360   !
370    OFF TIMEOUT 7                          ! Use this or a long timeout
380                                           !   for Ibasic for Windows
390    OUTPUT @Sa;"DONE?;";                   ! Ask for DONE flag
400    ENTER @Sa;Done                         ! This will be read only when all
410                                           !    commands have completed
420   !
430   !                Get the Results
440   !
450    OUTPUT @Sa;"SP_OK?;";                  ! Ask for status code
460    ENTER @Sa USING "K,%";Sflg             ! Save the status code in Sflg
470    IF Sflg<.5 THEN                        ! If there was an error ...
480       PRINT "Error in the measurement. Error flag: ",Sflg
490    ELSE                                   ! If there were no errors ...
500       OUTPUT @Sa;"SP_TOI_SL?;";
510       ENTER @Sa USING "K,%";Sigampl1
```

```
520       OUTPUT @Sa;"SP_TOI_SU?;";
530       ENTER @Sa USING "K,%";Sigampl2
540       OUTPUT @Sa;"SP_TOI_PL?;";
550       ENTER @Sa USING "K,%";Dstampl1
560       OUTPUT @Sa;"SP_TOI_PU?;";
570       ENTER @Sa USING "K,%";Dstampl2
580       OUTPUT @Sa;"SP_TOI_A?;";
590       ENTER @Sa USING "K,%";Toi1
600       OUTPUT @Sa;"SP_TOI_B?;";
610       ENTER @Sa USING "K,%";Toi2
620       OUTPUT @Sa;"SP_TOIFS?;";
630       ENTER @Sa USING "K,%";Sigspcg
640   !
650   !                Do the Necessary Calculations
660   !
670       Imd1=Dstampl1-Sigampl1
680       Imd2=Dstampl2-Sigampl2
690       Freq=Sigspcg
700   !
710   !               Display the Results
720   !
730       CLEAR SCREEN
740       PRINT ""                              ! Print a couple blank lines
750       PRINT ""
760       PRINT "  THIRD HARMONIC DISTORTION"
770       PRINT ""
780       PRINT "       FROM       FROM"
790       PRINT "       LOWER      UPPER"
800       PRINT "       SIGNAL     SIGNAL"
810       PRINT USING "K,3X,DDD.D,5X,DDD.D,3X,K";"TOI:";Toi1;Toi2;"dBm"
820       PRINT USING "K,2X,DDDD.D,4X,DDDD.D,3X,K";"IMD:";Imd1;Imd2;"dBc"
830       PRINT ""
840       PRINT "SIGNAL SPACING:";
850       IF Freq>999999 THEN
860          PRINT USING "3X,DDD.D,K";Freq/1.E+6;" MHz"
870          Freq=0
880       END IF
890       IF Freq>999 THEN
900          PRINT USING "3X,DDD.D,K";Freq/1000.;" kHz"
910          Freq=0
920       END IF
930       IF Freq>0 THEN
940          PRINT USING "3X,DDD.D,K";Freq;" Hz"
950       END IF
960       PRINT ""
970    END IF
980   !
990   !               Exit Gracefully
1000  !
1010   OUTPUT @Sa;"SP_EXIT;";
1020   OUTPUT @Sa;"DONE?;";                   ! Ask for DONE flag
1030   ENTER @Sa;Done                         !
1040  !
1050   LOCAL @Sa
1060  !
1070   END
```

Remote Measurement of Harmonics

Execute Command SP_HARM

Configuration Variables

Harmonics Configuration Variables

Variable	Description
SP_H_MAX	Maximum harmonic to be measured. Range is from 2 to 10. If SP_H_MAX is 5, the 2nd, 3rd, 4th, and 5th harmonics will be measured.
SP_H_FFLG	Display or hide the frequencies of the harmonics on the screen. If the value is 0, frequencies will not be displayed. If the value is 1, frequencies will be displayed. The harmonic measurement will executed slightly faster if frequencies are not displayed.
SP_HBWMIN	Sets the minimum resolution bandwidth of the spectrum analyzer that will be used when searching (zooming in) for a harmonic that starts out in or near the noise level. Execution is faster with larger bandwidths, but the dynamic range is more limited. This number has a range of the minimum resolution bandwidth of the host spectrum analyzer up to a maximum of 10 kHz, and it has the units of Hz.

Output Variables

Harmonics Output Variables

Variable	Description
SP_H_LVL[1-10]	Array of amplitudes for each harmonic in dBc relative to the fundamental. SP_H_LVL[1] = 0 (the level of the fundamental in dBc). The index is the number of the harmonic. The value in SP_H_LVL[11] contains invalid data.
SP_H_THD	Total Harmonic Distortion in percent
SP_H_NS[1-10]	Array of flags corresponding to each measurement in the SP_H_LVL[] array. A value of 0 denotes a good measurement. A value of 1 indicates that the measured level was near or in the noise level. This could also be caused by a drifting fundamental frequency. SP_H_NS[11] contains invalid data.
SP_H_FRQ	Frequency of the Fundamental in Hz
SP_H_AMP	Amplitude of the Fundamental in dBm

Error Codes

Harmonics Error Codes

Error Code	Description
1	Successful Measurement
0	Unsuccessful Measurement for an unknown reason. This may occur if the measurement was interrupted before complete.
-201	A Fundamental was not found above -50 dBm.
-202	No harmonics are in the spectrum analyzer frequency range.
-203	The maximum harmonic to measure is not 10 or less.
-204	The maximum harmonic to measure is not 2 or greater.
-205	Minimum search bandwidth is not equal to or greater than the spectrum analyzer minimum resolution bandwidth.
-206	The minimum search bandwidth is not 10 kHz or less.

Remote Harmonics Measurement Example

This example shows how you can remotely measure harmonics with the 85672A Spurious Response Measurements Utility.

```
10    !
20    !*************************************************************************
30    !*************************************************************************
40    !
50    !             EXAMPLE OF REMOTE MEASUREMENT OF HARMONICS
60    !
70    !*************************************************************************
80    !
90     ASSIGN @Sa TO 718
100   !
110    CLEAR SCREEN
120    OPTION BASE 1                          ! Start array index with 1
130   !
140   !               Declare and Dimension the Variables
150   !
160    INTEGER Hmax                           ! The Maximum Harmonic to Measure
170    REAL Hlvls(10)                         ! The Harmonic Levels
180    INTEGER Hflgs(10)                      ! The Near-the-Noise Flags
190    REAL Thd                               ! Total Harmonic Distortion
200    REAL Fundfreq                          ! Fundamental Frequency
210    REAL Fundampl                          ! Fundamental Amplitude
220    INTEGER Sflg                           ! Completion Status Code
230    INTEGER Done                           ! Accepts the DONE command output
240    INTEGER I                              ! A Counter Index
250   !
260   !                Configure the Measurement
270   !
280    Hmax=4
290    OUTPUT @Sa;"MOV SP_H_MAX,";Hmax;";";
300    OUTPUT @Sa;"MOV SP_H_FFLG,0;";         ! Don't display frequencies
310    OUTPUT @Sa;"MOV SP_HBWMIN,100;";       ! Limit searching to 100 Hz
320   !
330   !              Do the Measurement
340   !
350    OUTPUT @Sa;"SP_HARM;";
360   !
370   !                Sense when the Measurement is done
380   !
390    OFF TIMEOUT 7                          ! Use this or a long timeout
400                                           !   for Ibasic for Windows
410    OUTPUT @Sa;"DONE?;";                   ! Ask for DONE flag
420    ENTER @Sa;Done                         ! This will be read only when all
430                                           !    commands have completed
440   !
450   !                Get the Results
460   !
470    OUTPUT @Sa;"SP_OK?;";                  ! Ask for status code
480    ENTER @Sa USING "K,%";Sflg             ! Save the status code in Sflg
```

```
490    IF Sflg<.5 THEN                          ! If there was an error ...
500       PRINT "Error in the measurement. Error flag: ",Sflg
510    ELSE                                     ! If there were no errors ...
520       OUTPUT @Sa;"SP_H_LVL?;";              ! Ask for the harmonic levels
530       ENTER @Sa USING "K,%";Hlvls(*)        ! 2nd Harmonic is in 2nd Index
540       OUTPUT @Sa;"SP_H_NS?;";               ! Ask for the near-noise flags
550       ENTER @Sa USING "K,%";Hflgs(*)        ! These match Hlvls
560       OUTPUT @Sa;"SP_THD?;";                ! Ask for the THD
570       ENTER @Sa USING "K,%";Thd
580       OUTPUT @Sa;"SP_H_FRQ?;";              ! Get the fundamental frequency
590       ENTER @Sa USING "K,%";Fundfreq
600       Fundfreq=Fundfreq/1.E+6               ! Convert to MHz
610       OUTPUT @Sa;"SP_H_AMP?;";              ! Get the fundamental amplitude
620       ENTER @Sa USING "K,%";Fundampl
630    !
640    !                Display the Results
650    !
660       PRINT ""                              ! Print a couple blank lines
670       PRINT ""
680       PRINT USING "K,5D.D,K";"FUNDAMENTAL FREQUENCY: ";Fundfreq;" MHz"
690       PRINT "FUNDAMENTAL AMPLITUDE: ";Fundampl;" dBm"
700       PRINT ""
710       PRINT "HARMONIC    HARMONIC"
720       PRINT " NUMBER       LEVEL "
730       PRINT "               dBc  "
740       FOR I=2 TO Hmax
750          PRINT USING "3X,DD,7X,5D.D,#";I;Hlvls(I)
760          IF Hflgs(I)>.5 THEN               ! If harmonic near the noise...
770             PRINT USING "X,2A,#";"**"      !    print a noise flag
780          END IF
790          PRINT ""                          ! Start a new line
800       NEXT I
810       PRINT ""
820       PRINT "TOTAL HARMONIC DISTORTION"
830       PRINT USING "6X,DDD.D,A";Thd,"%"
840       PRINT ""
850    END IF
860    !
870    !               Exit Gracefully
880    !
890    OUTPUT @Sa;"SP_EXIT;";
900    OUTPUT @Sa;"DONE?;";
910    ENTER @Sa;Done
920    LOCAL @Sa
930    !
940    END
```

Remote Measurement of General Spurious Signals

Execute Commands

General Spurious Execute Commands

Command	Description
SP_TIME	Generates an estimate of the search time required for the current configuration. This should be run whenever SP_DBCFLG is changed; or when the reference signal amplitude is changed, if in dBc mode.
SP_GEN	Does the general spurious search

Configuration Variables

General Spurious Configuration Variables

Variable	Description
SP_SR_FL	Lower search frequency limit in Hz. This must be at least 1 MHz, and must be at least 100 kHz below the upper search frequency limit.
SP_SR_FU	Upper search frequency limit in Hz. This must be at least 1.1 MHz, and must be at least 100 kHz above the lower search frequency limit.
SP_DBCFLG	Express results in dBm (value = 0) or dBc (value = 1). If dBc is used, the reference signal will be the largest signal on the screen when this utility is invoked. That signal must be at least -50 dBm in amplitude.
SP_SR_TH	Lower search amplitude limit in dBc or dBm. The value for this parameter must be between -150 dB and +40 dB.
SP_SR_TG	Upper search amplitude limit in dBc or dBm. The value for this parameter must be between -100 dB and +50 dB.
SP_SRTFL	Sort flag: 0 = sort output by frequency. 1 = sort output by amplitude. Sorting by amplitude will take more time, especially if many spurious signals are detected.

Output Variables

General Spurious Output Variables

Variable	Description
SP_SR_TM	Estimated search time in seconds
SP_NUMSP	Number of spurious signals found
SP_SR_F[1-50]	Array of frequencies in Hz for spurious signals found
SP_SR_A[1-50]	Array of amplitudes of the spurious signals found in dBc or dBm, depending on SP_DBCFLG
SP_SR_CF	Reference Frequency in Hz for dBc mode
SP_SR_CP	Reference Amplitude in dBm for dBc mode

Error Codes

General Spurious Error Codes

Error Code	Description
1	Successful Measurement
0	Unsuccessful Measurement, unknown reason This may occur if the measurement was interrupted before complete.
-301	A reference signal was not found above -50 dBm.
-302	The Minimum Search Frequency is not 1 MHz or greater.
-303	The Maximum Search Frequency is not 1.1 MHz or greater.
-304	The Maximum Search Frequency is not greater than the Minimum Search Frequency + 100 kHz.
-305	The Lower Search Threshold is not -130 dB or greater.
-306	The Lower Search Threshold is not +40 dB or less.
-307	The Upper Search Threshold is not -100 dB or greater.
-308	The Upper Search Threshold is not +50 dB or less.
-309	The Upper Search Threshold is not less than the Lower Search Threshold.
-310	The Estimated Search Time is not less than 24 hours.
-311	The Lower Search Threshold is too low for the host spectrum analyzer.

Remote General Spurious Signals Measurement Example

This example shows how you can remotely measure general spurious signals with the 85672A Spurious Response Measurements Utility.

```
10    !
20    !*************************************************************************
30    !*************************************************************************
40    !
50    !             EXAMPLE OF REMOTE GENERAL SPURIOUS SEARCH
60    !
70    !*************************************************************************
80    !
90     ASSIGN @Sa TO 718
100   !
110    OPTION BASE 1                          ! Start array index with 1
120    CLEAR SCREEN
130   !
140   !               Declare and Dimension the Variables
150   !
160    REAL Fmin                              ! Minimum Search Frequency
170    REAL Fmax                              ! Maximum Search Frequency
180    REAL Amin                              ! Lower Amplitude Threshold
190    REAL Amax                              ! Upper Amplitude Threshold
200    REAL Stime                             ! Estimated Search Time
210    REAL Spfreq(50)                        ! Frequency of spurs found
220    REAL Spampl(50)                        ! Amplitude of spurs found
230    INTEGER Spnum                          ! Number of spurs found
240    INTEGER Sflg                           ! The completion status
250    INTEGER Done                           ! Command complete flag
260    INTEGER I                              ! A Counter Index
270   !
280   !                Configure the Measurement
290   !
300    Fmin=1.E+8                             ! Fmin is 100 MHz
310    Fmax=2.E+9                             ! Fmax is 2 GHz
320    Amin=-65                               ! Lower Threshold is -65 dBm
330    Amax=-20                               ! Upper Threshold is -20 dBm
340    OUTPUT @Sa;"MOV SP_SR_TH,";Amin;";";   ! Lower Threshold
350    OUTPUT @Sa;"MOV SP_SR_TG,";Amax;";";   ! Upper Threshold
360    OUTPUT @Sa;"MOV SP_SR_FL,";Fmin;";";   ! Minimum Offset Frequency
370    OUTPUT @Sa;"MOV SP_SR_FU,";Fmax;";";   ! Maximum Offset Frequency
380    OUTPUT @Sa;"MOV SP_DBCFLG,0;";         ! Measure in dBm
390    OUTPUT @Sa;"MOV SP_SRTFLG,0;";         ! Sort by Frequency
400   !
410   !                Estimate the Search Time
420   !
430    OUTPUT @Sa;"SP_TIME;";                 ! Estimate the search time
440   !
450   !             Sense when the Time Estimation is done
460   !
470    OFF TIMEOUT 7                          ! Use this or a long timeout
480                                           !   for Ibasic for Windows
490    OUTPUT @Sa;"DONE?;";                   ! Ask for DONE flag
500    ENTER @Sa;Done                         ! This will be read only when all
510                                           !    commands have completed
```

```
520  !
530  !             Check for errors
540  !
550   OUTPUT @Sa;"SP_OK?;";                  ! Ask for status code
560   ENTER @Sa USING "K,%";Sflg              ! Save the status code in Sflg
570   IF Sflg<.5 THEN                        ! If there was an error ...
580      PRINT "Error in the measurement. Error flag: ",Sflg
590      OUTPUT @Sa;"SP_EXIT;";
600      OUTPUT @Sa;"DONE?;";                ! Ask for DONE flag
610      ENTER @Sa;Done                      !
620      LOCAL @Sa
630      STOP
640   END IF
650  !
660  !        If no Errors, Get the Estimate
670  !
680   OUTPUT @Sa;"SP_SR_TM?;";               ! Ask for the estimate
690   ENTER @Sa USING "K,%";Stime            ! Receive the estimate
700   IF Stime<60 THEN
710      IF Stime<0 THEN
720         PRINT "Sweep time estimate is negative."
730         PRINT "Invalid parameters.  The upper frequency"
740         PRINT "limit is probably less than the lower one."
750      ELSE
760         PRINT USING "K,DD,K";"Estimated Search Time is ";Stime;" Seconds"
770      END IF
780   ELSE
790      Stime=Stime/60
800      PRINT "Estimated Search Time is ";Stime;" Minutes"
810   END IF
820   PRINT ""
830  !           This is a place to let the user change the lower    !
840  !           amplitude threshold or the frequency search range   !
850  !           if the estimated search time is excessive.          !
860  !
870  !                Do the Spurious Search
880  !
890   OUTPUT @Sa;"SP_GEN;";
900  !
910  !                Sense when the Measurement is done
920  !
930   OFF TIMEOUT 7                          ! Use this or a long timeout
940                                          !   for Ibasic for Windows
950   OUTPUT @Sa;"DONE?;";                   ! Ask for DONE flag
960   ENTER @Sa;Done                         ! This will be read only when all
970                                          !    commands have completed
```

```
!
!               Get the Results
!
 OUTPUT @Sa;"SP_OK?;";                  ! Ask for status code
 ENTER @Sa USING "K,%";Sflg             ! Save the status code in Sflg
 IF Sflg<.5 THEN                        ! If there was an error ...
    PRINT "Error in the measurement. Error flag: ",Sflg
 ELSE                                   ! If there were no errors ...
    OUTPUT @Sa;"SP_NUMSP?;";            ! Ask for number of spurs
    ENTER @Sa USING "K,%";Spnum         !
    IF Spnum>0 THEN
       FOR I=1 TO Spnum
          OUTPUT @Sa;"SP_SR_F[";I;"]?;";  ! Ask for the spurious freq
          ENTER @Sa USING "K,%";Spfreq(I) ! Retrieve the frequency
          OUTPUT @Sa;"SP_SR_A[";I;"]?;";
          ENTER @Sa USING "K,%";Spampl(I)
       NEXT I
!
!               Display the Results
!
       PRINT ""                         ! Print a couple blank lines
       PRINT ""
       IF Spnum>1 THEN
          PRINT "  FOUND ";Spnum;" SPURIOUS SIGNALS"
       ELSE
          PRINT "  FOUND ";Spnum;" SPURIOUS SIGNAL"
       END IF
       PRINT ""
       PRINT "  FREQUENCY     AMPLITUDE "
       PRINT "     MHz           dBm"
       FOR I=1 TO Spnum
          Spfreq(I)=Spfreq(I)/1.E+6             ! Convert to MHz
          PRINT USING "3X,DDDD.D,#";Spfreq(I)
          PRINT USING "9X,DDD.D,13X";Spampl(I)
       NEXT I
       PRINT ""
    ELSE
       PRINT "No Spurious Signals Found!"
    END IF                                  ! End of Spnum>0 test
 END IF                                     ! End of SP_OK test
!
!              Exit Gracefully
!
 OUTPUT @Sa;"SP_EXIT;";
 OUTPUT @Sa;"DONE?;";                   ! Ask for DONE flag
 ENTER @Sa;Done                         !
!
 LOCAL @Sa
!
 END
```

Remote Measurement of Sidebands

Execute Command SP_SIDEBD

Configuration Variables

Sidebands Configuration Variables

Variable	Description
SP_SB_FL	Minimum frequency offset in Hz . Must be at least 50 Hz.
SP_SB_FU	Maximum frequency offset in Hz. Must be at least 300 Hz, and must be greater than SP_SB_FL. If measuring the left side sidebands (or both sides), the carrier frequency minus SP_SB_FU must be greater than 100 kHz.
SP_SB_SD	Side(s) of carrier to measure: 0=Left, 1=Both, 2=Right
SP_SB_FC	Frequency Accuracy: 0=Normal, 1=High (Uses Frequency Counter)

Output Variables

Sidebands Output Variables

Variable	Description
SP_SB_NUM	Number of sideband sets found
SP_SB_F[1-25]	Array of sideband frequencies in Hz
SP_SB_AL[1-25]	Array of sideband amplitudes on the left side of the carrier in dBc
SP_SB_AR[1-25]	Array of sideband amplitudes on the right side of the carrier in dBc
SP_SB_CF	Carrier Frequency in Hz
SP_SB_CP	Carrier Amplitude in dBm

Error Codes

Sidebands Error Codes

Error Code	Description
1	Successful Measurement
0	Unsuccessful Measurement for an unknown reason. This may occur if the measurement was interrupted before completion.
-401	A Carrier was not found above -50 dBm.
-402	The Carrier Frequency is not 100 kHz or greater
-403	The Minimum Frequency Offset is not 50 Hz or greater.
-404	The Maximum Offset Frequency is not 300 Hz or greater.
-405	The Maximum Offset Frequency is not greater than the Minimum Offset Frequency.
-406	The Lowest Frequency to be measured is not 100 kHz or greater.

Remote Discrete Sideband Signals Measurement Example

This example shows how you can remotely measure discrete sideband signals with the 85672A Spurious Response Measurements Utility.

```
10    !
20    !*************************************************************************
30    !*************************************************************************
40    !
50    !             EXAMPLE OF REMOTE MEASUREMENT OF SIDEBANDS
60    !
70    !*************************************************************************
80    !
90     ASSIGN @Sa TO 718
100   !
110    OPTION BASE 1                          ! Start array index with 1
120    CLEAR SCREEN
130   !
140   !               Declare and Dimension the Variables
150   !
160    REAL Fmin                              ! Minimum Offset Frequency
170    REAL Fmax                              ! Maximum Offset Frequency
180    REAL Fcarrier                          ! Carrier Frequency
190    REAL Acarrier                          ! Carrier Amplitude
200    REAL Sbfreq(25)                        ! Sideband Frequencies
210    REAL Sbamplft(25)                      ! Left Sideband Amplitudes
220    REAL Sbamprght(25)                     ! Right Sideband Amplitudes
230    INTEGER Sbnum                          ! Number of sets of sidebands
240    INTEGER Sbside                         ! 0=left, 1=both, 2=right side
250    INTEGER Sflg                           ! The completion status
260    INTEGER Done                           ! Completion Flag
270    INTEGER I                              ! A Counter Index
280   !
290   !                Configure the Measurement
300   !
310    Fmin=1000.                             ! Fmin is 1 kHz
320    Fmax=1.E+6                             ! Fmax is 1 MHz
330    Sbside=1                               ! 0=left, 1=both, 2=right side
340    OUTPUT @Sa;"MOV SP_SB_FL,";Fmin;";";   ! Minimum Offset Frequency
350    OUTPUT @Sa;"MOV SP_SB_FU,";Fmax;";";   ! Maximum Offset Frequency
360    OUTPUT @Sa;"MOV SP_SB_SD,";Sbside;";"; ! Search right side only
370    OUTPUT @Sa;"MOV SP_SB_FC,0;";          ! Normal frequency accuracy
380   !
390   !                Do the Measurement
400   !
410    OUTPUT @Sa;"SP_SIDEBD;";
420   !
430   !                Sense when the Measurement is done
440   !
450    OFF TIMEOUT 7                          ! Use this or a long timeout
460                                           !   for Ibasic for Windows
470    OUTPUT @Sa;"DONE?;";                   ! Ask for DONE flag
480    ENTER @Sa;Done                         ! This will be read only when all
490                                           !    commands have completed
```

```
500   !
510   !               Get the Results
520   !
530    OUTPUT @Sa;"SP_OK?;";                  ! Ask for status code
540    ENTER @Sa USING "K,%";Sflg             ! Save the status code in Sflg
550    IF Sflg<.5 THEN                        ! If there was an error ...
560      PRINT "Error in the measurement. Error flag: ",Sflg
570    ELSE                                   ! If there were no errors ...
580      OUTPUT @Sa;"SP_SB_NUM?;";            ! Ask for number of sidebands
590      ENTER @Sa USING "K,%";Sbnum          !
600      IF Sbnum>0 THEN
610        FOR I=1 TO Sbnum
620          OUTPUT @Sa;"SP_SB_F[";I;"]?;";     ! Ask for the sideband freq
630          ENTER @Sa USING "K,%";Sbfreq(I)    ! Retrieve the frequency
640          IF Sbside<1.5 THEN                 ! Left side measured?
650            OUTPUT @Sa;"SP_SB_AL[";I;"]?;";
660            ENTER @Sa USING "K,%";Sbamplft(I)
670          END IF
680          IF Sbside>.5 THEN                  ! Right side measured?
690            OUTPUT @Sa;"SP_SB_AR[";I;"]?;";
700            ENTER @Sa USING "K,%";Sbamprght(I)
710          END IF
720        NEXT I
730   !
740   !               Display the Results
750   !
760        PRINT ""                           ! Print a couple blank lines
770        PRINT ""
780        PRINT "  NUMBER OF SIDEBANDS = ";Sbnum
790        PRINT ""
800        PRINT "  SIDEBAND    LEFT SIDEBAND    RIGHT SIDEBAND"
810        PRINT "  FREQUENCY       LEVEL             LEVEL"
820        PRINT "     kHz           dBc               dBc "
830        FOR I=1 TO Sbnum
840          Sbfreq(I)=Sbfreq(I)/1000             ! Convert to kHz
850          PRINT USING "2X,DDDD.DD,#";Sbfreq(I)
860          IF Sbside<1.5 THEN
870            PRINT USING "9X,DDD.D,13X,#";Sbamplft(I)
880          ELSE
890            PRINT USING "27X,#"
900          END IF
910          IF Sbside>.5 THEN
920            PRINT USING "DDD.D,#";Sbamprght(I)
930          END IF
940          PRINT ""                           ! Start a new line
950        NEXT I
960        PRINT ""
970      ELSE
980        PRINT "No Sidebands Found!"
990      END IF                           ! End of Sbnum>0 test
1000   END IF                             ! End of SP_OK test
1010  !
1020  !               Exit Gracefully
1030  !
1040   OUTPUT @Sa;"SP_EXIT;";
1050   OUTPUT @Sa;"DONE?;";                   ! Ask for DONE flag
1060   ENTER @Sa;Done                         !
1070  !
1080   LOCAL @Sa
1090  !
1100   END
```

Remote Measurement of Mixing Products

Execute Command SP_MXR

Configuration Variables

Mixing Products Configuration Variables

Variable	Description
SP_MX_RF	RF frequency entered by user in Hz. It must be at least 100 kHz and at least 100 kHz separate from the LO frequency.
SP_MX_LO	LO frequency entered by user in Hz. It must be at least 100 kHz and at least 100 kHz separate from the RF frequency.
SP_MXMMAX	Maximum multiple of RF frequency to be searched. Range is 1 through 10.
SP_MXNMAX	Maximum multiple of LO frequency to be searched. Range is 1 through 10.
SP_MXPFLG	Polarity flag: 0 = N*LO-M*RF; 1 = N*LO+M*RF
SP_MXRFLG	Reference flag: 0 = |LO-RF|; 1 = LO+RF
SP_MBWMIN	Minimum Search Bandwidth to be used. Range is from the minimum resolution bandwidth of the host spectrum analyzer through 10 kHz.

Output Variables

Mixing Products Output Variables

Variable	Description
SP_MXRF_F	Measured RF frequency in Hz
SP_MXLO_F	Measured LO frequency in Hz
SP_MXLO_A	Measured LO amplitude in dBm
SP_MXRF_A	Measured RF amplitude in dBm
SP_MXREFF	Reference frequency in Hz
SP_MXREFA	Reference amplitude in dBm
SP_MX_A[100]	Amplitudes of the mixing products. N (LO Multiple) changes with each array index (inner loop) while M (RF Multiple) changes after Nmax indices. The following shows the array indices for Nmax=3 and Nmax=3: The unused values of the array are set to 0 (in the case of the table above, data with indices above 9 would have zeroes).
SP_MX_NF[100]	Array of flags that correspond to the amplitudes of the mixing products in SP_MX_A. The flag has a value of 0 for a good measurement and has a value of 1 if the reading was in the noise or near the noise level.

Error Codes

Mixing Products Error Codes

Error Code	Description
1	Successful Measurement
0	Unsuccessful Measurement, unknown reason This may occur if the measurement was interrupted before complete.
-501	Nmax, the maximum N, is not 1 or greater.
-502	Nmax, the maximum N, is not 10 or less.
-503	Mmax, the maximum M, is not 1 or greater.
-504	Mmax, the maximum M, is not 10 or less.
-505	The LO Frequency is not 100 kHz or greater.
-506	The LO Frequency is greater than the maximum frequency of the host spectrum analyzer.
-507	The LO Signal was not found above -50 dBm.
-508	The RF Frequency is not 100 kHz or greater.
-509	The RF Frequency is greater than the maximum frequency of the host spectrum analyzer.
-510	The RF Signal was not found above -60 dBm.
-511	The difference in frequency between the LO and the RF is not 100 kHz or greater.
-512	The Minimum Search Bandwidth is not equal or greater than the minimum bandwidth of the host spectrum analyzer.
-513	The Minimum Search Bandwidth is not 10 kHz or less.

Remote Mixing Products Measurement Example

This example shows how you can remotely measure mixing products with the 85672A Spurious Response Measurements Utility.

```
10    !
20    !*************************************************************************
30    !*************************************************************************
40    !
50    !             EXAMPLE OF REMOTE MEASUREMENT OF MIXING PRODUCTS
60    !
70    !*************************************************************************
80    !
90     ASSIGN @Sa TO 718
100   !
110    OPTION BASE 1                          ! Start array index with 1
120    CLEAR SCREEN
130   !
140   !               Declare and Dimension the Variables
150   !
160    REAL Flo                               ! LO Frequency
170    REAL Frf                               ! RF Frequency
180    REAL Sbfreq(25)                        ! Sideband Frequencies
190    REAL Levels(10,10)                     ! Product Amplitude Array
200    REAL Noise(10,10)                      ! Associated Near-Noise Flags
210    INTEGER Mmax                           ! Maximum RF Multiple
220    INTEGER Nmax                           ! Maximum LO Multiple
230    INTEGER Sumdiff                        ! 0=Difference, 1=Sum Products
240    INTEGER Refpol                         ! 0=|LO-RF|, 1=LO+RF
250    INTEGER Sflg                           ! The completion status
260    INTEGER Done                           ! Placeholder for DONE flag
270    INTEGER I                              ! A Counter Index
280    INTEGER J                              ! Another Counter Index
290    INTEGER K                              ! Yet another Counter Index
300   !
310   !                Configure the Measurement
320   !
330    Mmax=2
340    Nmax=2
350    Flo=3.1E+8
360    Frf=3.E+8
370    Sumdiff=0
380    Refpol=0
390    OUTPUT @Sa;"MOV SP_MXMMAX,";Mmax;";";
400    OUTPUT @Sa;"MOV SP_MXNMAX,";Nmax;";";
410    OUTPUT @Sa;"MOV SP_MX_LO,";Flo;";";
420    OUTPUT @Sa;"MOV SP_MX_RF,";Frf;";";
430    OUTPUT @Sa;"MOV SP_MXPFLG,";Sumdiff;";";
440    OUTPUT @Sa;"MOV SP_MXRFLG,";Refpol;";";
450    OUTPUT @Sa;"MOV SP_MBWMIN,100;";          ! Limit searching to 100 Hz
460   !
470   !                Do the Measurement
480   !
490    OFF TIMEOUT 7                          ! Use this or a long timeout
500    OUTPUT @Sa;"SP_MXR;";
```

```
!
!               Sense when the Measurement is done
!
                                        !   for Ibasic for Windows
 OUTPUT @Sa;"DONE?;";                   ! Ask for DONE flag
 ENTER @Sa;Done                         ! This will be read only when all
                                        !    commands have completed
!
!               Get the Results
!
 OUTPUT @Sa;"SP_OK?;";                  ! Ask for status code
 ENTER @Sa USING "K,%";Sflg             ! Save the status code in Sflg
 IF Sflg<.5 THEN                        ! If there was an error ...
    PRINT "Error in the measurement. Error flag: ",Sflg
 ELSE                                   ! If there were no errors ...
!
!                The values in the spectrum analyzer are stored in
!                a single-dimensioned array (SP_MX_A).  N, the LO
!                multiple is the inner (fastest changing) index,
!                while M is the outer index.  Below, the values
!                are read, using the index K, into a two-dimensional
!                array (Levels) where the first index corresponds
!                to M (the RF multiple) and the second index
!                corresponds to N (the LO multiple).
    K=1
    FOR I=1 TO Mmax
       FOR J=1 TO Nmax
          OUTPUT @Sa;"SP_MX_A[";K;"]?;";  ! Request a data point
          ENTER @Sa USING "K,%";Levels(I,J)
          OUTPUT @Sa;"SP_MX_NF[";K;"]?;"; ! Request associated noise flag
          ENTER @Sa USING "K,%";Noise(I,J)
          K=K+1
       NEXT J
    NEXT I
!
!               Display the Results
!
    PRINT ""                            ! Print a couple blank lines
    PRINT ""
    PRINT USING "12X,K";"     MIXING PRODUCTS"
    PRINT USING "12X,K";"   dBc BELOW REFERENCE"
    PRINT ""
    PRINT USING "12X,K";"       N (*LO)"
!
    PRINT USING "8X,#"
    FOR J=1 TO Nmax                     ! Print LO Multiple Number Headings
       PRINT USING "5X,DD,#";J
    NEXT J
    PRINT ""
    PRINT ""
```

```
1010  !
1020      PRINT " M (*RF) 1";                 ! Print first row of products
1030      FOR J=1 TO Nmax
1040         PRINT USING "2X,DDD,#";Levels(1,J)
1050         IF Noise(1,J)>.5 THEN
1060            PRINT "**";
1070         ELSE
1080            PRINT "  ";
1090         END IF
1100      NEXT J
1110      FOR I=2 TO Mmax                     ! Print rest of products
1120         PRINT ""
1130         PRINT USING "8X,DD,#";I
1140         FOR J=1 TO Nmax
1150            PRINT USING "2X,DDD,#";Levels(I,J)
1160            IF Noise(I,J)>.5 THEN
1170               PRINT "**";
1180            ELSE
1190               PRINT "  ";
1200            END IF
1210         NEXT J
1220      NEXT I
1230   END IF                                 ! End of SP_OK test
1240  !
1250  !               Exit Gracefully
1260  !
1270   OUTPUT @Sa;"SP_EXIT;";
1280   OUTPUT @Sa;"DONE?;";                   ! Ask for DONE flag to show that
1290   ENTER @Sa;Done                         !   SP_EXIT has finished.
1300  !
1310   LOCAL @Sa
1320  !
1330   END
```

Index