User's Guide

Agilent Technologies
ESA-E Series Spectrum Analyzers
Phase Noise Measurement Personality
Option 226

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Contents

1 Getting Started

Introduction

The Option 226 Phase Noise Measurement Personality is a downloadable program (DLP) that is used with the ESA-E Series spectrum analyzers. You need the following equipment to use the utility:

Table 1-1

Phase Noise Measurement Personality	Spectrum Analyzer
Option 226	E4401B (firmware A.04.07 and later) E4402B (firmware A.04.07 and later) E4404B (firmware A.04.07 and later) E4405B (firmware A.04.07 and later) E4407B (firmware A.04.07 and later)

The following procedures describe how to install the file and access the utility.

Checking the Shipment

Verify that the following items are in this shipment. Contact your nearest Agilent Technologies sales or service office if any items are missing.

Refer to the "Agilent Technologies Sales and Service Offices" on page 38.

Table 1-2 Option 226 Materials Supplied

Description	Agilent Technologies Part Number	Quantity
Option 226 Phase Noise Personality User's Guide	E4401-90275	1
Phase noise personality	E4401-10008	1

Licensing the Phase Noise Personality

In order to start using the features of the phase noise personality, it must be licensed. To license your phase noise personality use the following procedure.

NOTE If your analyzer came with the phase noise personality installed, you can skip the Licensing and Installation instructions.

1. Turn on the spectrum analyzer. After the analyzer has completed the power up sequence:

   Press the **System** key, then the **More 1 of 3** softkey, the **More 2 of 3** softkey, then the **Licensing** softkey.

2. Press the **Option** softkey, and use the numeric key pad to enter the name of the option. For the phase noise personality the option name is 226.

3. Press the **Return** key, to go back to the licensing menu and select the **License Key** softkey. Use the numeric key pad and the alpha editor softkeys to enter the appropriate licensing keyword for your spectrum analyzer.

NOTE If a licensing keyword was not provided, contact your Agilent Technologies representative.

4. Press the **Return** key to go back to the licensing menu. Press the **Activate** softkey to license your downloadable personality.

Installing the Phase Noise Personality

The phase noise personality comes on one floppy disk. To install the utility into the spectrum analyzer use the following steps.

1. Press the **System** key on the front panel.
2. Press the **More 1 of 3** softkey, the **More 2 of 3** softkey, then the **Personalities** softkey. The display screen will list the personalities currently installed in your spectrum analyzer.
3. Insert your phase noise personality floppy disk into the analyzer's disk drive and press the **Install** softkey. The installer utility will ask you to install or verify the disk. Press the **Install Now** softkey to install the personality .

NOTE Previously installed versions of the phase noise personality will be overwritten when the new personality is installed.

4. After the installation is complete exit the installer by pressing the **Exit Installer** key and power cycle the analyzer.
5. To verify that the phase noise personality was properly installed, press the **MODE** key, and check that the **Phase Noise** softkey is present.

Starting the Phase Noise Personality

The phase noise personality can be started easily once the program has been licensed and installed.

Press the **MODE** key, then the **Phase Noise** softkey, to start the utility.

Removing the Phase Noise Personality

To uninstall the phase noise personality from the spectrum analyzer use the following steps:

1. Press the **System** key, the **More 1 of 3** softkey, the **More 2 of 3** softkey, and then the **Personalities** softkey.
2. Press the **Uninstall** softkey, and using the up ⇑ and the down ⇓ arrows select the "`Phase Noise Personality`" field.
3. Press the **Uninstall Now** softkey. The analyzer will ask you to confirm the command by pressing the **Uninstall Now** softkey again. Afterwards, the phase noise personality will be uninstalled.

2 Using the Phase Noise Personality

Using the Phase Noise Personality

This chapter includes the following:

- Making a log plot measurement
- Functionality
  - The Configuration Screen
  - Log Plot Measurements
  - Spot Frequency Measurements
  - Smoothing, Averaging, or Filtering
  - Signal Tracking
- Specifications and Characteristics
- Measurement Considerations
  - Offsets ≥1 MHz
  - Slowly Drifting Signals
  - System Noise Floor
  - Using the Bottom Division of the Display
- Other Documentation

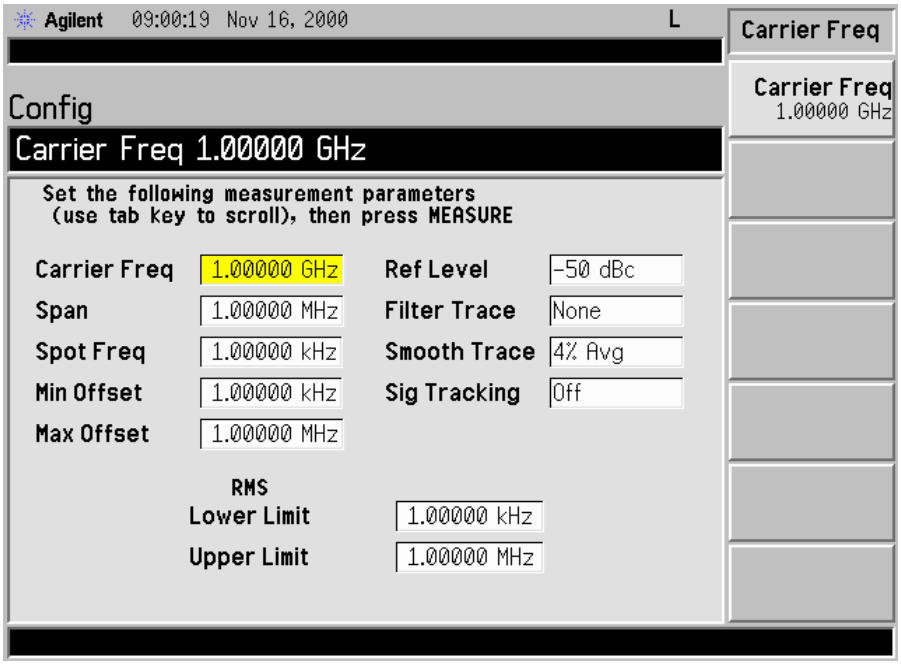
Using the Phase Noise Personality

The phase noise personality uses a configuration screen to set up all the necessary measurement parameters as well as a series of softkey menus to navigate to different measurements.

Once you enter the phase noise analyzer mode, the configuration screen can be accessed by pressing the **Mode Setup** key, then the **Config** softkey. See Figure 2-1.

Use the tab keys at the bottom of the analyzer's display to select the parameters that need changing. Use the softkey choices for each of the parameter fields to change the value of that parameter. In some cases you can also use the numeric key pad to change the parameter's value.

Figure 2-1 Configuration Screen



Once the parameters of the configuration screen are set, press the **MEASURE** key to access the utility's main menu.

To exit the phase noise personality select a different analyzer mode from the **MODE** key.

Using the Phase Noise Personality

The phase noise personality main menu contains the following softkey options:

1. **Measure Log Plot**

   Makes a phase noise measurement over a range of offset frequencies and integrates the phase noise measurement over selected frequency range to get the RMS noise.

2. **Measure Spot Freq**

   Continuously measures phase noise at a single offset frequency.

3. **Setup**

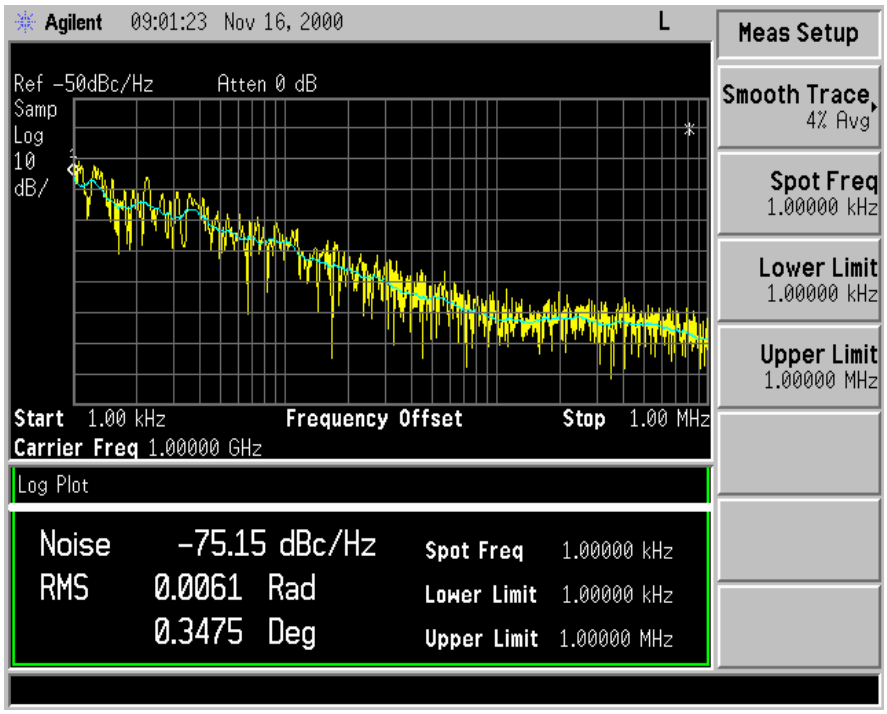
   This softkey is used to exit the log plot and spot frequency measurements and to view the signal of interest.

Making a Log Plot Measurement

A log plot measurement of phase noise is probably the most common use of the phase noise personality. See the following example.

1. Connect your signal of interest to the spectrum analyzer's input.
2. Press the **MODE** key, then press the **Phase Noise** softkey to enter the phase noise personality. Make sure that the **Setup** softkey is highlighted.
3. Press the **Mode Setup** key then the **Config** softkey to access the configuration screen. Select the desired carrier frequency and span for the signal of interest. Also, set the `Min Offset` field to 1 kHz and the `Max Offset` field to 1 MHz.
4. Press the **MEASURE** key. Make sure that the desired signal is on the display.
5. Press the **Measure Log Plot** softkey to start the phase noise measurement. See Figure 2-2.

Figure 2-2 Log Plot Measurement



6. To change the readout of the spot frequency or marker placement on screen press the **Meas Setup** key, then the **Spot Frequency** softkey, and change the spot frequency selection to a value between the minimum and maximum offset frequencies.

7. Press the **Meas Setup** key, then the **Smooth Trace** softkey, to select different amounts of smoothing and notice the effects on the trace.

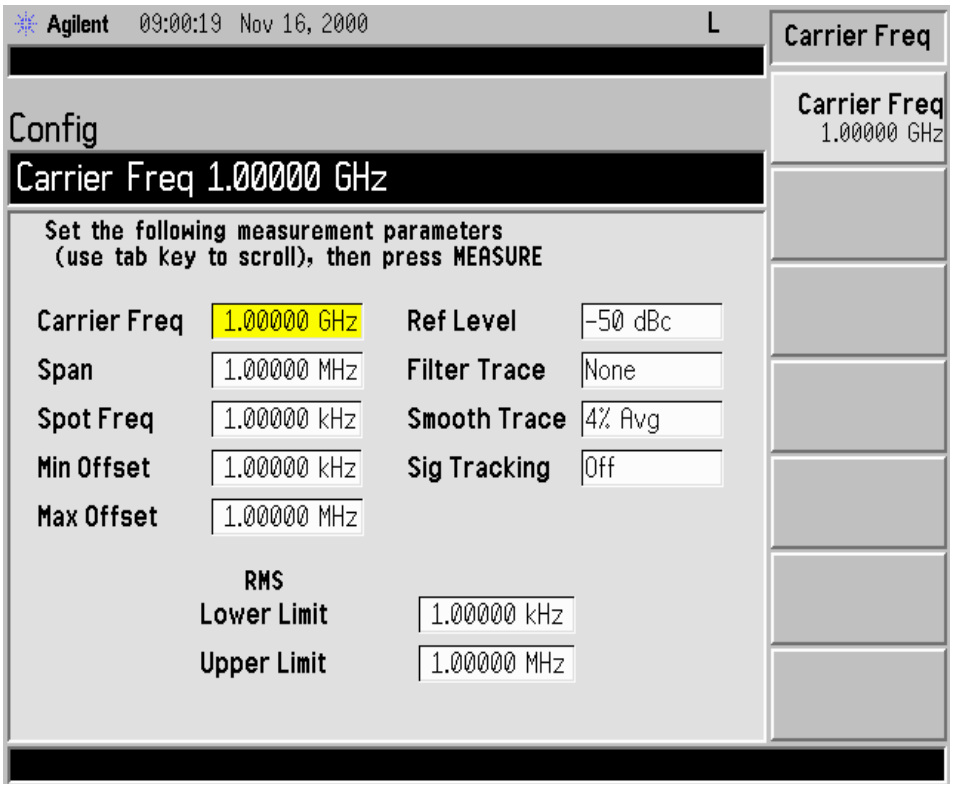
NOTE See “Using the Phase Noise Personality” on page 2-11 for more details.

Functionality

The Configuration Screen

When the spectrum analyzer is in the phase noise mode, the configuration screen can be accessed by pressing: **Mode Setup** key then **Config** softkey. The screen displays the configuration screen as shown in Figure 2-3.

Figure 2-3 **Configuration Screen**



If a displayed parameter needs to be changed, this can be done by choosing a new value from the softkeys at the right of the screen or by entering a value with the numeric key pad.

Once the desired values are chosen, a phase noise measurement may be made either at a single offset frequency **Measure Spot Freq** or over a range of offset frequencies **Measure Log Plot**.

Pressing the **MODE** key, and then the **SA** softkey returns the instrument to the normal spectrum analyzer operation. The change from one mode to another may take several seconds.

Log Plot Measurements

The log plot measurement approximates a logarithmic frequency sweep with a set of linear sweeps pieced together to give a display of dBc/Hz versus logarithmic frequency offset. Trace 1, which is the yellow trace, displays the point-by-point data as measured. Trace 2, the blue trace, displays a smoothed version of trace 1. The amount of smoothing is determined by the current setting of the smoothing parameter. The phase noise at the selected spot frequency and the RMS noise over the selected limits are also displayed numerically.

The **Measure Log Plot** softkey or the **Restart** key allows a measurement to be repeated with a single key press. This is useful for seeing effects of circuit changes where the carrier and offset frequencies of interest do not change.

The display includes a numerical readout of a single offset frequency that may be changed with the **Spot Freq** softkey. Changing the spot frequency will move the marker to the new position and display the new value for the spot measurement.

When making several spot frequency measurements at different frequencies, set the minimum and maximum offset frequencies wide enough to include all of the desired frequencies.

Modifying the spot frequency marker using the knob is not possible.

Phase noise measurement results can be integrated over a selected frequency range to get the total RMS (root mean squared) noise in a given bandwidth. The frequency limits used for integration may be selected by pressing the **Meas Setup** key. The results are displayed in radians and degrees.

Spot Frequency Measurements

A continuous phase noise measurement can be made at a single offset frequency using the spot frequency measurement function.

Smoothing, Averaging, or Filtering

Noise reduction on the trace can be accomplished several different ways. Smoothing is used with log plot measurements while trace averaging is used with spot frequency measurements. Video filtering can be used with both types of measurements.

The smoothing process averages a number of adjacent trace points of trace 1 and displays the result in trace 2 for a log plot measurement. Smoothing is faster, but less accurate, especially for rapid changes in the trace like a trace with a discrete signal such as a spurious sideband. Choose the smooth trace field in the configuration screen or press the **Meas Setup** key, then the **Smooth Trace** softkey while inside the log plot measurement to display a menu of softkeys that allows different amounts of smoothing. While inside the log plot measurement each amount of smoothing can be tried without having to make a new measurement.

Trace averaging can be used when making spot frequency measurements. Since noise is not correlated from sweep to sweep, successive traces can be averaged to reduce the peak to peak amplitude of the noise. Trace averaging gives more repeatable results.

Video filtering can be applied to the active trace when making spot frequency or log plot measurements. The amount of filtering can be changed from the configuration screen. Additional filtering can increase the accuracy and repeatability of the measurement, but it will also make the measurement process slower. The filtering softkeys change the ratio of the video bandwidth to the resolution bandwidth.

Signal Tracking

Signal tracking can be used for log plot measurements to measure a slowly drifting signal. When it is enabled (On), the measurement will follow a very slowly drifting signal by reacquiring the signal between each of the ten sweeps that make up one complete log plot.

When signal tracking is on, a slowly drifting signal will be tracked during a log plot measurement. The maximum drift rate that can be tracked will depend on instrument settings such as minimum offset frequency and the amount of filtering.

If the signal is not tracked correctly, the drift may not be completely compensated for, causing the measured phase noise to appear either higher or lower than it actually is.

Specifications and Characteristics

Specifications shown are based on the operation of the phase noise personality with an Agilent ESA-E Series spectrum analyzer.

Measurement Characteristics	
Measurement modes	Measure log plot Measure spot frequency Measure RMS Noise
Maximum number of decades	5 (whole decades only)
Filtering (ratio of video bandwidth to resolution bandwidth)	None (VBW/RBW=10) Medium (VBW/RBW=0.1 Maximum (VBW/RBW=0.03)
Smoothing	2% 4% 8% 16%

Carrier Frequency Range	
9 kHz to 1.5 GHz 9 kHz to 3.0 GHz 9 kHz to 6.7 GHz 9 kHz to 13.2 GHz 9 kHz to 26.5 GHz	E4401B E4402B E4404B E4405B E4407B

Offset Frequency	
Range	100 Hz to 100 MHz
The minimum range is limited to 10 × the narrowest resolution bandwidth of the spectrum analyzer.	

Measurement Accuracy (Characteristic)	
Amplitude Accuracy	±1.6 dB (≥10 dB above system noise floor)
Amplitude Repeatability. See Table 2-2.	

Table 2-1 Log Graph Frequency Accuracy

Number of Decades in Sweep	Accuracy[a]
2	<3%
3	<6%
4	<12%
5	<18 %

a. Accuracy relative to the highest frequency in the decade being measured

Table 2-2 Amplitude Repeatability

Filtering	Repeatability Characteristics[a]	
	No Smoothing	**12 Point Smoothing**
none	±6 dB	±1.5 dB
medium	±3 dB	±1 dB
maximum	±2.5 dB	±1 dB

a. Smoothing can cause additional amplitude errors near rapid transitions of the data, such as with discrete spurious signals and impulsive noise. The effect is more pronounced as the number of points smoothed increases.

Figure 2-4 **Agilent ESA E4401B System Noise Floor Characteristics**

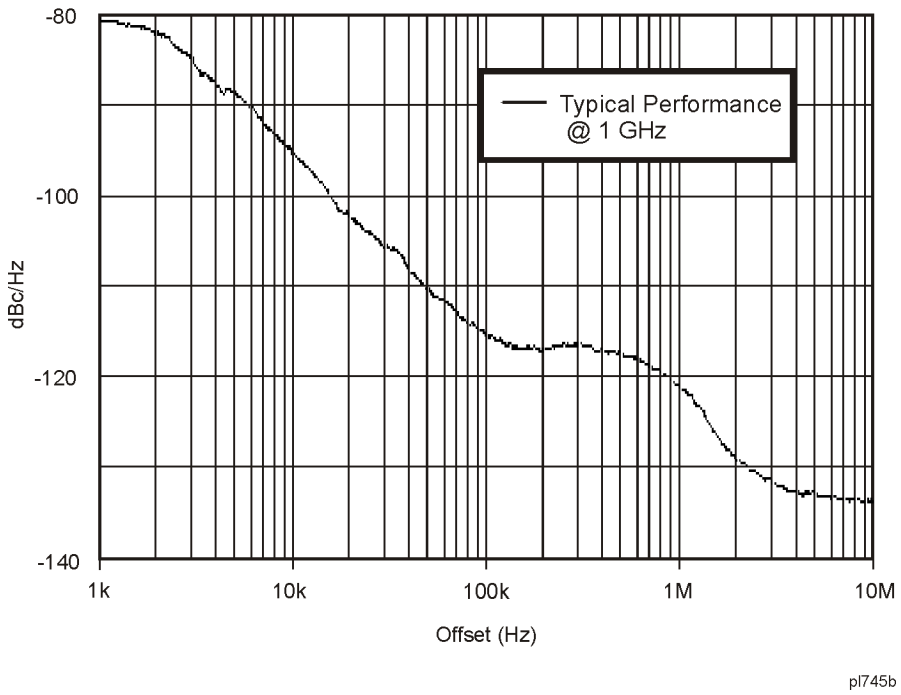
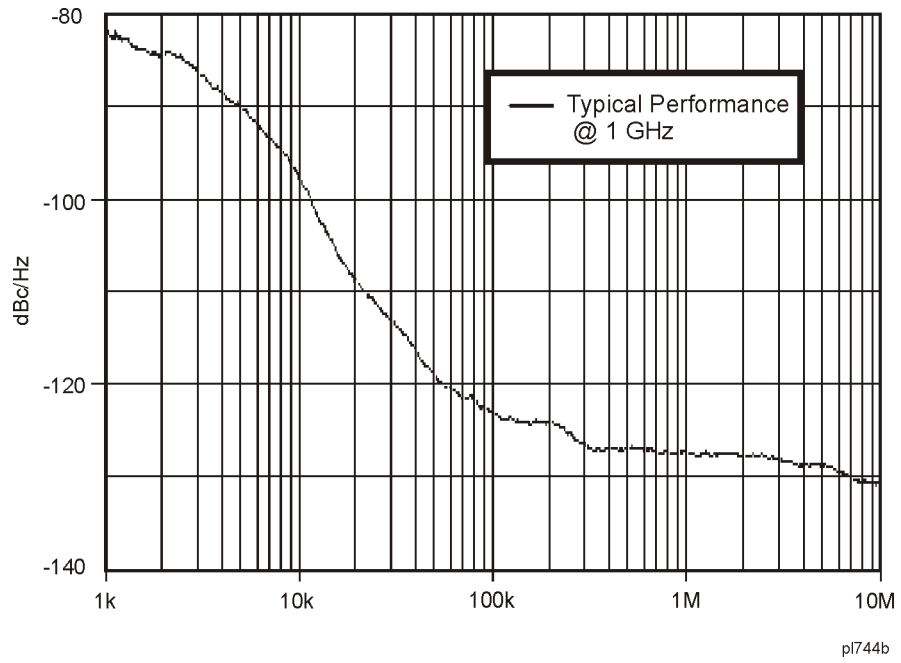


Figure 2-5 **Agilent ESA E4402B, E4404B, E4405B, and E4407B System Noise Floor Characteristics**



NOTE Refer to the ESA-E Series specifications guide for more information.

Measurement Considerations

Offsets ≥ 1 MHz

For measurements at offsets of ≥1 MHz the spectrum analyzer noise floor is typically about −125 dBc/Hz + 20 logN, where N is the spectrum analyzer's harmonic mixing mode.

Slowly Drifting Signals

A log plot measurement can be made on a slowly drifting signal using the signal tracking function, but the measured value will be slightly inaccurate. The maximum drift rate that can be tracked will depend on instrument settings such as minimum offset frequency and the amount of averaging. Depending on the direction of the drift, the phase noise will appear either higher or lower than it actually is.

If the drift rate is excessive–it has high residual FM–discontinuities in the displayed trace may occur. Refer to Log Plot Measurement has Unexpected Discontinuities on page 37.

System Noise Floor

The system noise floor should be checked with a clean source for the frequency offsets that will be measured. The signal frequency should be the same as the signal to be measured, since the system phase noise is a function of the spectrum analyzer center frequency.

Display Accuracy at 10 dB Per Division

When the amplitude scale setting is 10 dB per division, the phase noise measurements are most accurate in the upper half of the display. In particular, if the measurements are occurring in the bottom 1 ½ divisions of the display, it is best to decrease the reference level until the result is displayed in the upper half.

To change the scale setting to 10 dB per division, press **Setup**, **AMPLITUDE**, then the **Scale/Div** softkey.

Frequency Offset Limitations

The phase noise personality allows you to define the range of offset frequencies to be measured using the `Min Offset` and `Max Offset` configuration screen fields. There are limits on the number of significant digits entered when setting the minimum and maximum offset frequencies. The entry will be rounded to the nearest acceptable value.

The offset range must be set to a decade multiple from 1 to 5. For minimum offsets of less than 200 Hz, the offset range must be at least 2 decades.

When Signal Tracking is On, the minimum offset is limited to 1 kHz.

Other Documentation

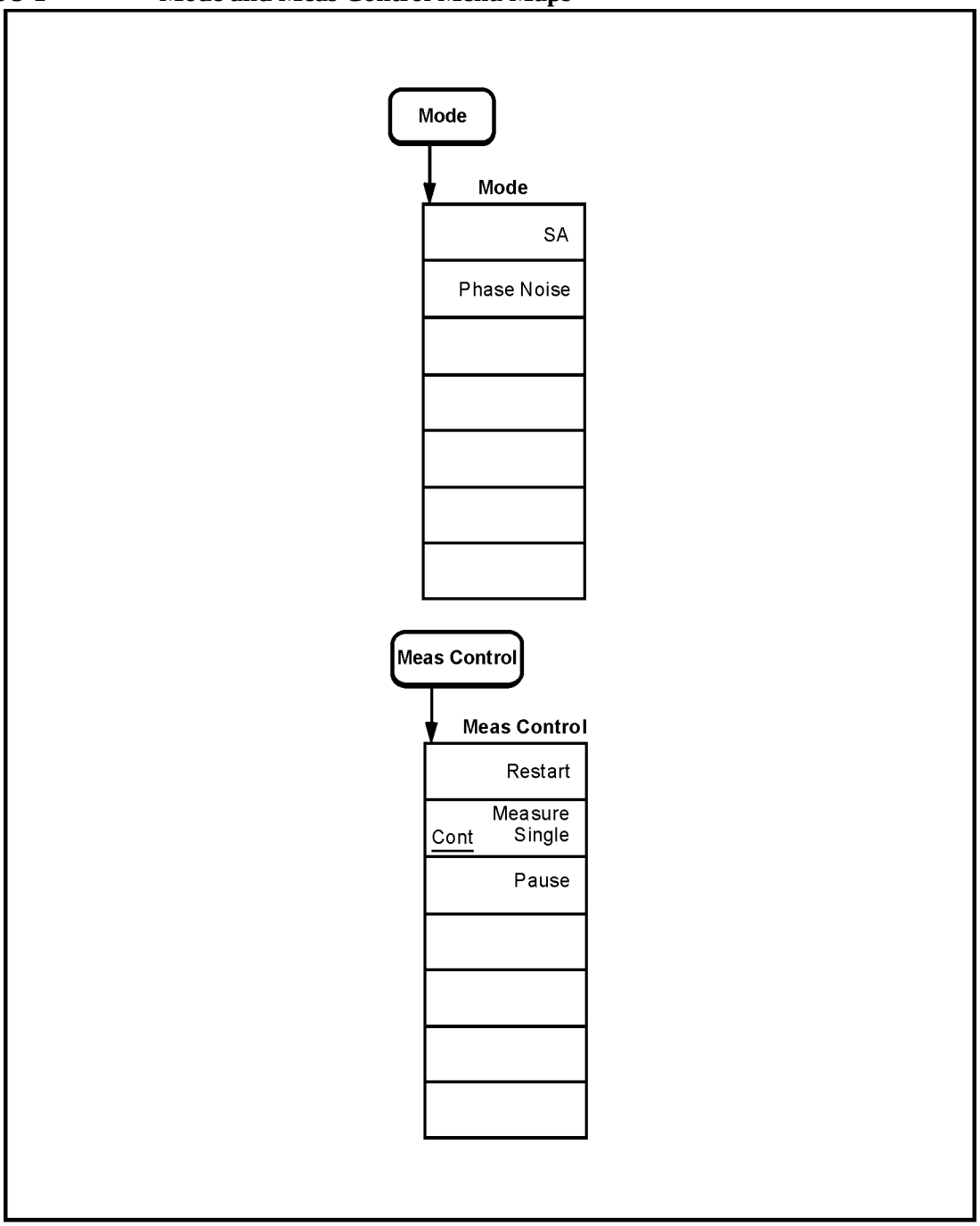
The document listed below provides information on making phase noise measurements. It can be obtained through your local Agilent Technologies office.

Agilent Part Number	Title
1000-1132	*RF and Microwave Phase Noise Measurement Seminar*

3 Softkey Menus and Descriptions

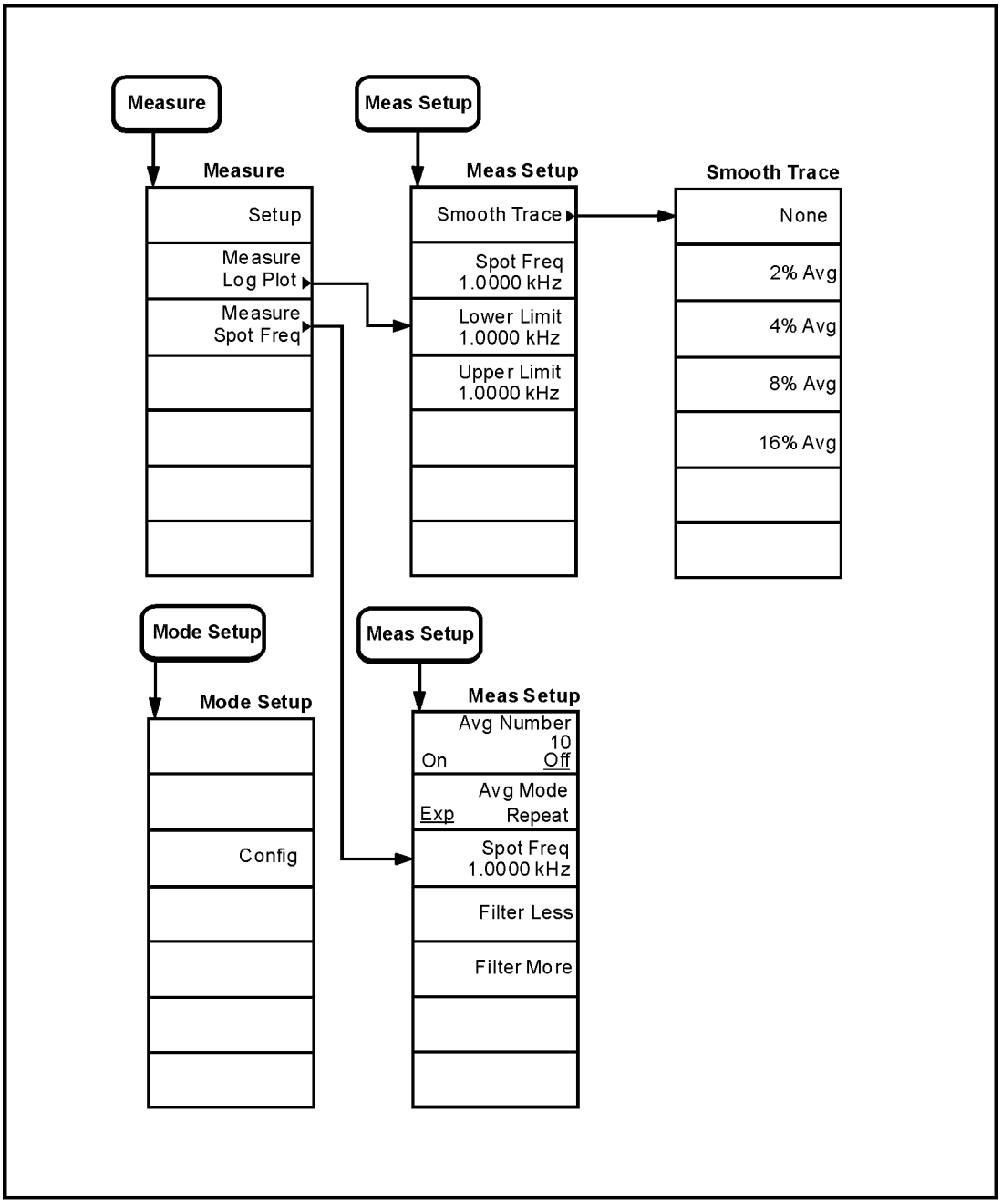
Menu Maps

Figure 3-1 Mode and Meas Control Menu Maps



pl738b

Figure 3-2 Measure and Setup Menu Maps



pl740b

Softkey Descriptions

To access the phase noise personality, press the front-panel **MODE** key, and then the **Phase Noise** softkey. Referring to the menu maps on previous pages, the following softkeys will become accessible:

2% through 16%

Set the amount of trace smoothing to be used on a log plot measurement. A running average is taken with the selected quantity of trace points from trace 1 being averaged and put into trace 2. The indicated averaging is based on there being 1010 points in a trace.

Press the **MEASURE** key, the **Measure Log Plot** softkey, the **Meas Setup** key, and then the **Smooth Trace** softkey or select the `Smooth Trace` field in the configuration screen to access these soft keys.

Avg Mode Exp/Repeat

Toggles the averaging mode of successive traces so that the averaging is repeated every “n” number of traces or stops after the first “n” number of traces. (Where “n” is the average number of traces selected in **Avg Number**.)

Press the **MEASURE** key, the **Measure Spot Freq** softkey and then the **Meas Setup** key to access this softkey.

Avg Number On/Off

Toggles trace averaging, and allows the user to change the number of successive traces that are averaged. Trace averaging helps reduce the peak to peak amplitude of the noise, since noise is not correlated from sweep to sweep. Like video filtering, trace averaging gives a more repeatable result.

Press the **Measure Spot Freq** softkey, and then the **Meas Setup** key to access this softkey.

Carrier Freq

Allows the user to change the signal which is selected for phase noise measurement.

Selecting this field in the configuration screen will display that parameter as the active function. You then enter a value using the numeric key pad and terminate the entry with a units key such as the **Hz** softkey, or the **MHz** softkey.

To enter the configuration screen, press the **Mode Setup** key, and then the **Config** softkey. Use the **Tab** keys to select the desired field.

Config

When a parameter field is selected, it brings up the softkeys that allow the measurement parameters to be changed. Some parameters accept numeric key pad entries.

To enter the configuration screen, press the **Mode Setup** key, and then the **Config** softkey. Use the **Tab** keys to navigate through the screen’s fields.

Filter Less and Filter More

Change the amount of video filtering applied to the active trace when making a spot frequency phase noise measurement. Pressing the **Filter More** softkey will reduce the peak-to-peak amplitude of the noise, and give more repeatable results while lengthening the sweep time. Pressing the **Filter Less** softkey will increase the video bandwidth. There is no speed advantage in increasing the video bandwidth beyond the resolution bandwidth.

Press the **MEASURE** key, **Measure Spot Freq** softkey, and then the **Meas Setup** key to access these softkeys.

Filter Trace

Sets how much video filtering is to be applied when the log plot phase noise measurement is done. More filtering will increase the accuracy and repeatability of the measurement, but will take a longer time. The different softkeys change the ratio of the video bandwidth to the resolution bandwidth, changing the amount of filtering. There are three different levels of filtering available; None, Medium, and Maximum.

To enter the configuration screen, press the **Mode Setup** key, and then the **Config** softkey. Use the **Tab** keys to navigate through the screen's fields.

Lower Limit

Sets the lower-frequency integration limit for the RMS noise calculation. The value must be between the minimum offset frequency of the log plot measurement and the upper-frequency integration limit.

To change the lower limit value, access its softkey by pressing the front-panel **MODE** key, then the **Phase Noise** softkey, the **MEASURE** key, the **Measure Log Plot** softkey, and then the **Meas Setup** key, or select the `Lower Limit`, field in the configuration screen.See Figure 2-1 on page 11.

Max Offset

Prompts the user for a new maximum offset frequency. This value is the maximum offset frequency displayed by a log plot measurement. All entries are rounded up to give an integral number of decades of offset frequency range, based on the minimum frequency offset setting. The maximum number of decades of frequency offset range is limited to five. The minimum number of decades of frequency offset range is dependent on the carrier frequency and the current setting of the minimum offset frequency.

After the maximum frequency offset is changed, the spot frequency will also be adjusted, if necessary, to keep it between the minimum and maximum offset frequencies. The maximum offset frequency available for the ESA-E series analyzer is 100 MHz.

To enter the configuration screen, press the **Mode Setup** key, and then the **Config** softkey. Use the **Tab** keys to select the desired field.

Measure Log Plot

Initiates a phase noise measurement over the range of offset frequencies shown on the configuration screen. The results are displayed on a dBc/Hz versus log frequency screen. A numeric readout is made at the selected spot frequency. The personality measures only the upper noise sidebands.

It also allows integration of the noise displayed by trace 2. The integration can be done over a selected frequency range to get the total RMS noise in a given bandwidth. The results are displayed in both radians and degrees. The integration limits are the current upper and lower limit values. These must be within the range of the offset frequencies.

The integration is performed using single-sideband data, and a single-to-double-sideband correction is added to yield the RMS noise of a double-sideband measurement.

Press **MEASURE** to access this softkey.

Measure Spot Freq

Puts the spectrum analyzer in the appropriate state for continuously measuring the phase noise at a single offset frequency. The span is set to four times the offset frequency, with the carrier in the center of the displayed frequency range. The spectrum analyzer remains sweeping continuously. The resultant noise amplitude at the spot frequency is indicated by the spectrum analyzer's noise marker. The numeric value is in the upper right hand corner of the screen. The **Measure Spot Freq** softkey gives a single frequency measurement more quickly than using the **Measure Log Plot** softkey.

The personality measures only the upper noise sidebands.

Press **MEASURE** to access this softkey.

Min Offset

Prompts the user for a new minimum offset frequency. This value is the minimum offset frequency displayed by a log plot measurement. All entries are rounded to one significant digit, and must be between 100 Hz and 10 MHz, inclusive. The minimum offset frequency that can be selected is determined by 10 times the narrowest resolution bandwidth available.

After the minimum frequency offset is changed, the spot frequency will also be adjusted, if necessary, to keep it between the minimum and maximum offset frequencies.

To enter the configuration screen, press the **Mode Setup** key, and then the **Config** softkey. Use the **Tab** keys to select the desired field.

Ref Level

Changes the dB/Hz value corresponding to the top graticule line for the log plot display. The reference level may need to be changed depending on the phase noise level of the source and the frequency offset range being measured. Pressing this softkey brings up a menu that can be used to select reference levels of –20 dBc, –30 dBc, –40 dBc, or –50 dBc.

To enter the configuration screen, press the **Mode Setup** key, and then the **Config** softkey. Use the **Tab** keys to select the desired field.

Setup

Used to exit the log plot or spot frequency measurements. After changes are made in the configuration screen to setup the signal of interest, the signal can be viewed in the setup screen before a measurement is performed.

Press **MEASURE** to access this softkey.

Sig Tracking On/Off

Enables and disables the signal tracking mode for log plot measurements. When it is enabled (On), the measurement will follow a very slowly drifting signal by reacquiring the signal between each of the ten sweeps that make up one complete log plot. With signal track on, the measurement will be somewhat slower.

When signal tracking is on, a slowly drifting signal will be tracked during a log plot measurement. The maximum drift rate that can be tracked will depend on instrument settings such as minimum offset frequency and the amount of averaging.

Depending on the direction of drift, the phase noise will appear either higher or lower than it actually is.

To enter the configuration screen, press the **Mode Setup** key, and then the **Config** softkey. Use the **Tab** keys to select the desired field.

Smooth Trace

Changes the amount of smoothing that is done after the measurement is complete. The smoothing function is much faster than filtering. However, it may cause errors if the noise changes rapidly with frequency, or if there are discrete signals present.

The function takes a running average of points across the screen from trace 1 and puts the average into trace 2. The number of points to be averaged is selectable by softkeys. Each softkey label shows the associated percent averaging, which is the number of points in the average divided by the total number of points in the trace (1010).

When the amount of smoothing is set from within the configuration screen, the value is updated and used when the measurement is restarted.

When smoothing is selected from the **Measure Log Plot**, **Meas Setup** menu, the smoothing occurs immediately after the softkey is pressed. The result is shown on the screen with trace 2. Different amounts of smoothing can be quickly evaluated. The log plot display reflects any spot frequency amplitude change that may have occurred because of a change in smoothing.

Press the **MEASURE** key and the **Measure Log Plot** softkey and then press the **Meas Setup** key to access the smooth trace softkey. The `Smooth Trace` value can also be changed by selecting the appropriate field in the configuration screen. See Figure 2-1 on page 11.

Spot Freq

Prompts the user for a new frequency offset to be measured. This function can be used to change the frequency for a spot frequency measurement, or to select a frequency where the noise amplitude will be displayed for a log plot measurement.

The frequency entered must be between the minimum and maximum frequencies displayed on the configuration screen.

After an entry has been made, the analyzer will be set to measure the phase noise at the selected offset frequency. If a spot frequency measurement is being made, the frequency will be changed and the measurement will restart. If a log plot measurement is being made, the spot frequency marker position is updated, and the noise amplitude at the new frequency is displayed.

To change the spot frequency value press either the **Measure Log Plot** softkey, or the **Meas Spot Freq** softkey, then select the **Meas Setup** key. You can also select the `Spot Freq`, screen field from the configuration screen. See Figure 2-1 on page 11.

Upper Limit

Sets the upper-frequency integration limit for the RMS noise calculation. The value must be between the lower-frequency integration limit and the maximum offset frequency of the log plot measurement.

Press the **MEASURE** key, the **Measure Log Plot** softkey, and then the **Meas Setup** key, or select the `Upper Limit` screen field in the configuration screen. See Figure 2-1 on page 11.

4 SCPI Commands

What You Will Find in This Chapter

This chapter contains the SCPI commands used with the Phase Noise Measurement Personality.

Some familiarity with the SCPI language is necessary to run these commands properly. A copy of all four volumes of the SCPI Standard can be obtained through the SCPI Consortium. For more information, visit their web site at www.scpiconsortium.org/scpistandard.htm.

Table 4-1 on page 4-33 contains the SCPI commands used with the Phase Noise Measurement Personality. A French brace notation { } is used in some cases to show the allowed set of values. The square brace notation [ ] is used for default SCPI nodes.

Before any measurement is performed, it is important to use the corresponding [SENSe]commands to set the desired configuration parameters. For example, to set the carrier frequency to 50 MHz and the span to 1 MHz the user would type:

FREQ:CARR 50e6;

FREQ:SPAN 1e6;

For each measurement there is a MEASure group of commands that allows the user to control the measurement process in varying degrees. MEASure:<MEAS>? (where <MEAS> is the SCPI command for the desired measurement) performs the complete process where the analyzer is configured, a measurement is performed and the specified results are returned.

When more control of the measurement is required, combining the CONFigure:<MEAS>? and READ:<MEAS>? commands is equivalent to the MEASure:<MEAS>? command, but with more flexibility. The analyzer's configuration is performed with the CONFigure:<MEAS>? command, and the READ:<MEAS>? command runs the measurement and returns the requested value.

Furthermore, the same effects of the READ:<MEAS>? command can be obtained by combining the INITiate:[IMMediate] and FETCh:<MEAS>? commands. INITiate:[IMMediate] takes care of the data acquisition while FETCh:<MEAS>? functions on a single set of acquired data.

It is important to make sure that the SCPI commands allow enough time for the measurement to produce a result, otherwise you might experience time-out errors.

Commands and Descriptions

Table 4-1 SCPI Commands

Command	Description
:CONFigure:LPLot	Configure Log Plot Measurement
:CONFigure:SETup	Enter Setup Screen
:CONFigure:SFRequency	Configure Spot Frequency Measurement
:FETCh:LPLot?	Return noise level at selected spot frequency from log plot measurement
:FETCh:RMS?	Return RMS value in radians and degrees
:FETCh:SFRequency?	Return noise level at selected spot frequency
:INSTrument [:SELect] {'SA'|'PNOISE'[b]}	Change between SA modes and Phase Noise
:INSTrument:NSELect {#}	Select mode by number (Phase Noise = 14)
:MEASure:LPLot?	Measure noise level at selected spot frequency in log plot measurement
:MEASure:RMS?	Measure RMS value in radians and degrees
:MEASure:SFRequency?	Measure noise level at selected spot frequency
:READ:LPLot?	Return noise level at selected spot frequency log plot measurement
:READ:RMS?	Return RMS value in radians and degrees
:READ:SFRequency?	Return noise level at selected spot frequency
[:SENSe] :FILTer {NONE|MEDium|MAXimum}	Set/Query degree of data filtering[a]
[:SENSe] :FREQuency:CARRier	Set/Query carrier frequency[a]
[:SENSe] :FREQuency:LOWer	Set/Query lower frequency limit for RMS
[:SENSe] :FREQuency:MAXOFFSET[b]	Set/Query maximum frequency offset[a]
[:SENSe] :FREQuency:MINOFFSET[b]	Set/Query minimum frequency offset[a]
[:SENSe] :FREQuency:SPAN	Set/Query span[a]

Table 4-1 SCPI Commands

Command	Description
[:SENSe] :FREQuency:SFRequency	Set/Query Spot Frequency
[:SENSe] :FREQuency:UPPer	Set/Query upper frequency limit for RMS
[:SENSe] :RLEVel {REF20|REF30|REF40|REF50}	Set/Query reference level[a]
[:SENSe] :STRack {ON|OFF}	Set/Query signal tracking[a]
[:SENSe] :SMOoth {NONe|TWO|FOUR|EIGHt|SIXTeen}	Set/Query smoothing of data
[:SENSe] :SFRequency:AVERage:COUNt	Set/Query average count for the spot frequency measurement
[:SENSe] :SFRequency:AVERage:[STATe]	Set/Query average on/off for the spot frequency
[:SENSe] :SFRequency:AVERage:TCONtrol{EXP|REP}	Set/Query average time control

a. If these commands are used to set new parameter values while inside the log plot measurement, the measurement must be restarted using the :MEAS:LPL or :CONF:LPL command to get results with the new parameter values.
b. This SCPI command has no short form.

5 If You Have A Problem

If You Have a Problem

Signal Disappears During Measurement

If the output frequency of the device under test is sensitive to changes in match, such as an unbuffered oscillator, the signal may disappear during the measurement process. The input attenuation, and therefore the input match, of the spectrum analyzer is varied during the measurement process. A buffer (attenuation and/or amplification) between the device and the spectrum analyzer may be required.

Repeated Measurements have Different Results

If you make the same phase noise measurement several times and the results keep changing, either getting better or getting worse, it may be because the signal is drifting and the rate of drift is changing. It may be possible to measure a drifting signal, but the phase noise can appear either higher or lower than it actually is, depending on the direction of the drift. This effect is usually more noticeable when the device is first turned on.

A signal with a constant drift rate will have a repeatable, but incorrect, phase noise plot. Drift can easily be verified by making a spot frequency measurement which does not track drift.

Measured Value or Noise Floor is not Correct

The system noise floor is affecting the measurement. It must be checked with a clean source for the frequency offsets being examined, such as an Agilent 8662A or 8663A. Set the source frequency the same as the signal to be tested, since the system phase noise is a function of the spectrum analyzer center frequency. Do **NOT** use the internal calibrator to find the noise floor because phase noise cancellation will occur. This will make the noise floor appear to be lower than it actually is.

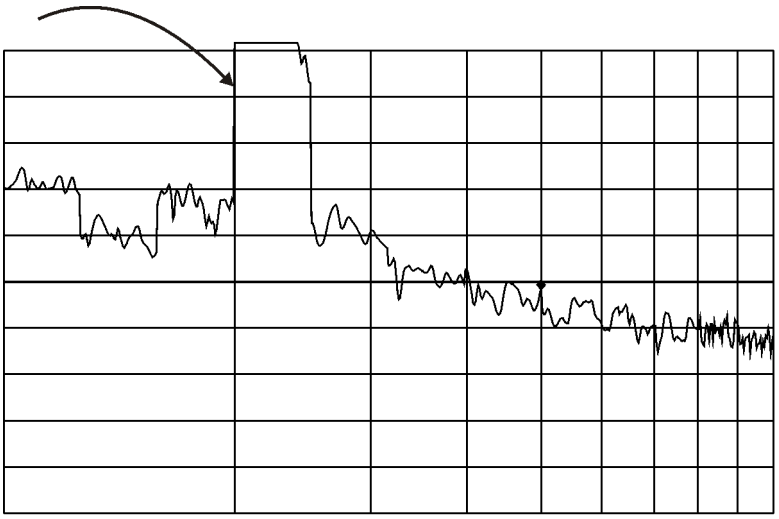
Phase noise measurements made in the bottom 1 ½ divisions of the display will not be as accurate as the remainder of the display. If measurements are occurring in the bottom 1 ½ divisions, the reference level (under the **Config** softkey) should be decreased (made more negative).

The phase noise can appear to be either higher or lower than it actually is. When signal tracking is on, a slowly drifting signal will be tracked during a log plot measurement. The maximum drift rate will depend on settings such as minimum offset frequency and the amount of averaging. Depending on the direction of drift, the phase noise will appear either higher or lower than it actually is.

Log Plot Measurement has Unexpected Discontinuities

Discontinuities like those shown in Figure 5-1 can occur if the minimum frequency offset is less than the residual FM of the signal. The utility makes a log plot measurement in ten successive sweeps. If the signal has enough residual FM that the resolution bandwidth misses the peak on some of the sweeps, the measured power will be incorrect and the trace will have discontinuities.

Figure 5-1 Unexpected Discontinuities



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