Quick Start

Quick Start helps you to understand the E5052B operation quickly.

- Overview
    - Front Panel
    - Rear Panel
    - Screen Area
- Three Methods of Operation
- Measurement Example
    - VCO Measurement
    - Phase Noise Measurement for 1 GHz signal
    - Frequency, power and DC current Measurement for VCO
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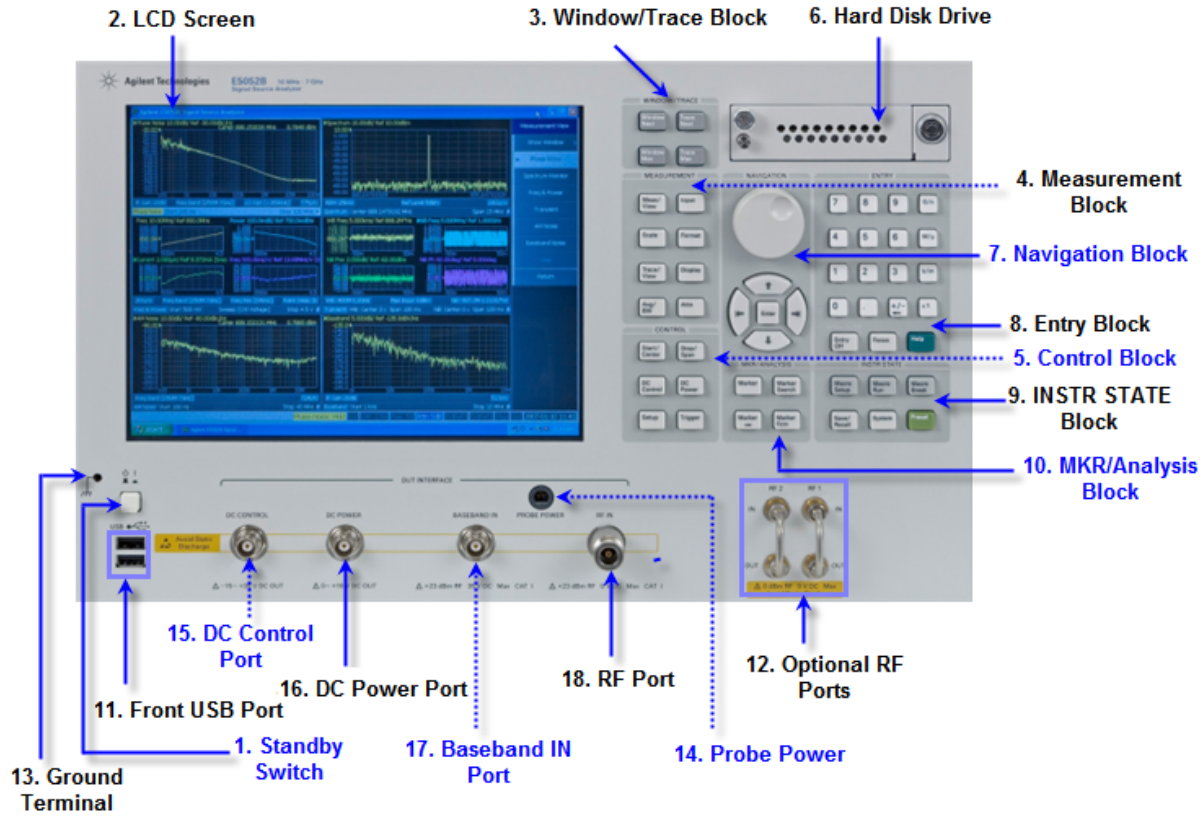
    - AM Noise Measurement for 1 GHz signal
    - Baseband Noise Measurement for DC control source for VCO
    - Transient Measurement for a PLL synthesizer (1.75 GHz)
- Overall Instrument Operation

Overview

Front Panel: Names and Functions of Parts



1. Standby Switch

NOTE Used for choosing between power-on (|) and standby (O) state of E5052B.

To turn off the power for the E5052B, be sure to follow the steps described below:

1. First, press this standby switch or send a shutdown command from the external controller to activate the shutdown process (the processing of software and hardware necessary to turn off the power supply). This will put the E5052B into the standby state.

2. Next, if necessary, turn off power supply to the Power Cable Receptacle (to LINE) on the rear panel.

CAUTION Under normal use, never directly interrupt the power supply to the power cable receptacle on the rear panel when the power

supply is on. Always keep the Line Switch (Always ON) at (|). Never turn it off (O).

If you directly interrupt the power supply to the power cable receptacle when the power supply is on, or turn off the Line Switch (Always ON), the shutdown process will not work. This could damage the software and hardware of the E5052B and lead to device failure.

Turning on the power supply after a faulty shutdown may cause the system to start up in a condition called "safe mode." If this occurs, first shut down the system to put it into the standby state and then turn on the power supply again to start up the system in normal mode.

2. LCD Screen

The E5052B is equipped with a 10.4-inch TFT color, touch-sensitive LCD screen for displaying traces, scales, settings, softkeys and other measurement related information. The touch screen LCD allows you to manipulate softkeys by touching the LCD screen directly with a finger. For more on the LCD screen, see Screen Area: Names and Functions of Parts.

NOTE Do not press the surface of the LCD screen with a sharp object (e.g., a nail, pen, or screwdriver). Pressing the surface with a sharp-pointed object will damage the LCD screen surface or cause the screen to fail.

NOTE Occasionally, a few pixels may appear on the screen as a fixed point of blue, green or red. Please note that this is not a failure and does not affect the performance of your product.

3. Window / Trace Block

A group of keys for selecting active measurement windows and traces. For more on the concepts of measurement windows and traces, see Setting Trace layout.

Key Name	Description
Window Next Key	Pressing this key causes the active measurement window to switch over to the next higher window number of seven measurement windows. It is possible to define sweep range and other parameters of an active measurement window. To change

	the settings of a window, use this key to first activate the window.
Window Max Key	Switches over between normal and maximum display of the active measurement window. In normal display, all seven measurement windows (both active and non-active) are displayed in split views on the screen. In maximum display, only the active measurement window is displayed over the entire area, without showing non-active measurement windows. You can also switch over between the normal and maximum windows by double-clicking the measurement window frame. Measurements are also carried out on the non-active measurement windows that are not displayed.
Trace Next Key	Selects the next trace as the active trace. (Each time the key is pressed causes the active trace to step up from the trace with the currently designated number to one with a higher number.) An active trace is one for which the measurement parameters are defined. To change the settings for a trace, use this key to first make the trace active.
Trace Max Key	Switches over between normal and maximum display of the active trace within the measurement window. In normal display, all traces are displayed in split views on the measurement window. For the maximum display, only the active trace is maximized, while non-active traces are not displayed. To maximize the active trace, you can also double-click the area inside the measurement window (excluding the frame). Measurements are also carried out on the non-active traces that are not displayed.

4. Measurement Block

A group of keys used mainly for setting up measurements on the E5052B.

Key Name	Description
Meas/View Key	Displays the Measurement View Menu in the right part of the screen. Manipulating in the Measurement View Menu enables you to select any active measurement window. Active measurement windows are also selectable in maximum display. In this case, the measurement window in maximum display will

	switch over to the one you have selected.
Input Key	Displays the Input Menu in the right part of the screen. Manipulating the Input Menu enables you to select any port for the measurement signal input.
Scale Key	Displays the Scale Menu in the right part of the screen. Manipulating the Scale Menu enables you to specify the scale for displaying a trace (magnitude per division, value of the reference line, etc.) for each trace.
Format Key	Displays the Format Menu on the right side of the screen. Manipulating the Format Menu enables you to specify the data format (data transformation and graph formats) for each trace.
Trace/View Key	Displays the Trace View Menu in the right part of the screen. Manipulating the Trace View Menu enables you to specify the data smoothing, data saving on memory, title of trace, the setup for data math, etc. for each trace.
Display Key	Displays the Display Menu on the right side of the screen. Manipulating the Display Menu enables you to specify the marker information, measurement condition, update, the title label, etc.
Avg/BW Key	Displays the Average Menu in the right part of the screen. Manipulating the Average Menu enables you to specify enabling/disabling and number of times for averaging, etc. For spectrum measurements only, you can specify the bandwidth of resolution.
Attn Key	Displays the *Attenuator* Menu in the right part of the screen. Manipulating the Attenuator Menu enables you to change the setting of the input signal attenuator

5. Control Block

A group of keys for defining the values of DC output port, sweep and trigger settings.

Key Name	Description
Start/Center	Displays the data input bar in the upper part of the screen by

Key	which you can specify the start value of the sweep range for the active measurement trace or the time offset value for the transient measurement. It also displays the menu in the right part of the screen that allows you to specify the sweep range. You can use the following menus: • Phase noise measurement Start Menu • Spectrum measurement Start/Center Menu • Frequency power measurement Start/Center Menu • Transient measurement Time Offset Menu • AM noise measurement Start Menu • Baseband noise measurement Start Menu • Segment phase noise measurement Start Menu
Stop/Span Key	Displays the data input bar in the upper part of the screen by which you can specify the stop value of the sweep range for the active measurement trace or the span value for the transient measurement. Also displays the menu in the right part of the screen that allows you to specify the sweep range. You can use the following menus: • Phase noise measurement Stop Menu • Spectrum measurement Stop/Span Menu • Frequency power measurement Stop/Span Menu • Transient measurement Span Menu • AM noise measurement Stop Menu • Baseband noise measurement Stop Menu • Segment phase noise measurement Stop Menu In these menus, the titles are different from those at the start, but the function of the softkey is the same.
DC Control Key	Displays the DC Control Voltage Menu by which you can specify the values of control voltage output for the DC CONTROL port.

DC Power Key	Displays the DC Power Voltage Menu by which you can specify the values of power voltage output for the DC power port.
Setup Key	Displays the Setup Menu on the right side of the screen. Manipulating the Setup Menu enables you to specify the frequency range, *IF* gain, input level etc required for individual measurements.
Trigger Key	Displays the Trigger Menu on the right side of the screen. Manipulating the Trigger Menu enables you to specify the trigger mode and trigger source. You can specify the trigger mode for each measurement window.

6. Hard Disk Drive

The E5052B comes with a removable hard disk drive. For removal procedure, see Removing/Mounting Removable Hard Disk.

7. NAVIGATION Block

The keys and knob in the **NAVIGATION** Block are used to navigate between softkey menus or selected (highlighted) areas in a dialog box and to change a numeric value in the data entry area by stepping up or down. When selecting one of two or more objects (softkey menus, data entry areas, etc.) to manipulate with the **NAVIGATION** Block keys displayed on the screen, first press the **Focus** key in the ENTRY Block to select the object to be manipulated (placing focus on the object) and then manipulate the **NAVIGATION** Block keys (knob) to move among selected (highlighted) objects or change numeric values.

The following descriptions show how the **NAVIGATION** Block keys work both when the focus is on a softkey menu and when the focus is on the data entry area. For more on manipulating tables and dialog boxes, refer to the manipulation procedure for each of these functions.

When the focus is on a softkey menu (softkey menu is selected)

When the focus is placed on a softkey menu (the menu title area in the uppermost part is displayed in blue), the **NAVIGATION** Block keys work as described below.

Key Name	Description
 Knob (turned clockwise or	Moves the softkey selection (highlighted display) up or down.

counterclockwise)	
 Keys	Moves the softkey selection (highlighted display) up or down.
 Key	Displays the softkey menu one layer above.
 Key	Displays the softkey menu one layer below.
 Knob or *Enter* key (pressed)	Executes the function of the selected softkey.

After pressing the data entry softkey, the focus automatically moves to the data entry area.

When the focus is on the data entry area (data entry area is selected)

When the focus is placed on the data entry area (the data entry bar is displayed in blue), the **NAVIGATION** Block keys work as described below.

Key Name	Description
 Knob (turned clockwise or counterclockwise)	Increases or decreases the numeric value in the data entry area in small steps.
 Keys	Increases or decreases the numeric value in the data entry area in large steps.
 Keys	Moves the cursor (|) in the data entry area laterally back and forth. Use it together with the ENTRY Block keys to change data one character at a time.
 Knob or **Enter** key (pressed)	Finishes the entry in the data entry area and moves the focus to the softkey menu.

8. ENTRY Block

A group of keys used for entering numeric data is provided on the front panel of the E5052B.

Key Name	Description
0, 1, 2, 3 ..... 9 , . Keys (numeric keys)	Type numeric characters or a decimal point at the position of the cursor in the data entry area.
+/- & ⬅ Key	**+/-** alternately changes the sign (+, -) of a numeric value in the data entry area. ⬅ is the backspace key. NOTE **+/-** key works only when there are no numerical values in the entry area. When a numerical character is entered in the entry area, the **+/-** key transforms into (⬅) backspace key.
G/n, M/u, k/m, x1 Keys	Adds a prefix to the numeric data typed by using the numeric key and **+/-** key and then enters that data. One of the two prefixes written on the surface of the key is automatically selected depending on the parameter to be entered. **x1** is entered without a prefix.
Softkey On/Off , Entry Off Key	Turns off the data entry bar if it is displayed. If the dialog box is displayed, cancels the entry and closes the dialog box. If the data entry bar and dialog box are not displayed, turns the softkey menu display on/off.
Help Key	Displays SSA help for E5052B.
Focus Key	Changes the selection (focus) among the objects to be manipulated by the **NAVIGATION** Block keys and **ENTRY** Block keys. The objects to be manipulated by the **NAVIGATION** Block keys and **ENTRY** Block keys include softkey menus, data entry areas, dialog boxes, VBA editor, other Window applications and Help window (if they are running). When two or more of these are displayed on the screen and need selecting, use this key to change the selection (focus) among the objects to be manipulated. When a softkey menu is selected, the menu name area at the top of the menu is displayed in blue. When a data entry area is selected, the data entry bar is displayed in blue. When a table is selected, the frame of the table window is displayed in light gray. While a dialog box is displayed, the focus is fixed on the dialog box

	and cannot be changed.

9. INSTR STATE Block

A group of keys related to the macro function, store and call function, control/management function, and the presetting of the E5052B (returning it to the preset state).

Key Name	Description
Macro Setup Key	Displays the Macro Setup Menu on the right side of the screen. Manipulating the Macro Setup Menu enables you to start up the VBA editor or to create, call, or store a VBA project.
Macro Run Key	Executes a VBA procedure called "main" that has a VBA module named Module1.
Macro Break Key	Stops the VBA procedure being executed.
Save/Recall Key	Displays the Save/Recall Menu on the right side of the screen. Manipulating the Save/Recall Menu enables you to store the setup conditions to or read from the storage devices, calibration data, and trace data of the analyzer.
Capture/System Key	First, temporarily saves the data for the image displayed on the LCD screen the moment this key is pressed to the internal memory (clipboard). Immediately after that, displays the System Menu on the right side of the screen. Manipulating the System Menu enables you to define the setup for the limit test and then execute it or to define the setup for the control and management of the analyzer. Using the **Dump Screen Image** option enables you to store the image data in the clipboard to a file on the storage devices. Also, using the **Print** option in the System menu enables you to print the image data in the clipboard to a printer.
Preset Key	Displays the Preset Menu on the right side of the screen. Clicking **Factory** in the Preset Menu enables you to return the analyzer to the initial setup state, called the preset setup.

10. MKR/ANALYSIS Block

A group of keys used for analyzing the measurement results by using the markers, fixture simulator, etc. For more on the functions of the keys in the **MKR/ANALYSIS** Block, see Overview of Functions.

Key Name	Description
Marker Key	Displays the Marker Menu on the right side of the screen. Manipulating the Marker Menu enables you to turn the markers on/off and move them by entering stimulus values. You can place up to 10 markers on each trace.
Marker Search Key	Displays the Marker Search Menu on the right side of the screen. Manipulating the Marker Search Menu enables you to move a marker to a specific point (maximum, minimum, peak,and a point with a target value) on a trace. You can also find and display the bandwidth parameters (up to six).
Marker Fctn Key	Displays the Marker *Function* Menu on the right side of the screen. Manipulating the Marker Function Menu enables you to not only specify the marker sweep range and the coupling of markers on a channel but also to display statistics data on traces.
Marker ➡ Key	Displays the Marker To Menu in the right part of the screen. Manipulating the Marker To Menu enables you to specify the marker sweep range and the coupling of markers within a measurement and to display statistical data on traces.

11. Front USB Port

Two USB (Universal Serial Bus) ports are provided that can be used for connecting to USB, Multiport test set or a printer. Connecting a compatible printer to this port enables screen information on the E5052B to be printed. For more information on printing, see Printing Displayed Screen.

NOTE The specifications of this port are identical to those of the Rear USB port.

12. Optional RF Ports

These ports are used with E5053A otherwise the ports are connected with furnished two short SMA semi-rigid cables.

13. Ground Terminal

Connected to the chassis of the E5052B, a ground terminal is provided with the E5052B. You can connect a banana-type plug to this terminal for grounding.

14. Probe Power

The E5052B comes with one port that can be used to provide power to external probes. See the Data sheet for the voltage and maximum current.

15. DC Control Port

DC Control Port is a *DUT* interface port that can be used to provide control voltage to DUT. For example, this port can be used to provide tuning voltage (V_t) to a VCO.

Connector type: 50Ω, BNC, Female.

16. DC Power Port

DC Power Port is a DUT interface port that can be used to provide power voltage to DUT. For example, this port can be used to provide bias voltage (V_{cc}) to a VCO. Connector type: BNC, Female.

17. Baseband IN Port

This DUT interface port is used for baseband noise measurement and can accept DC voltage up to 35V. To make baseband noise measurement mode useful for power supply noise measurement, this port is well protected for DC voltage application.

Connector type: 50Ω, AC Coupled, BNC, Female.

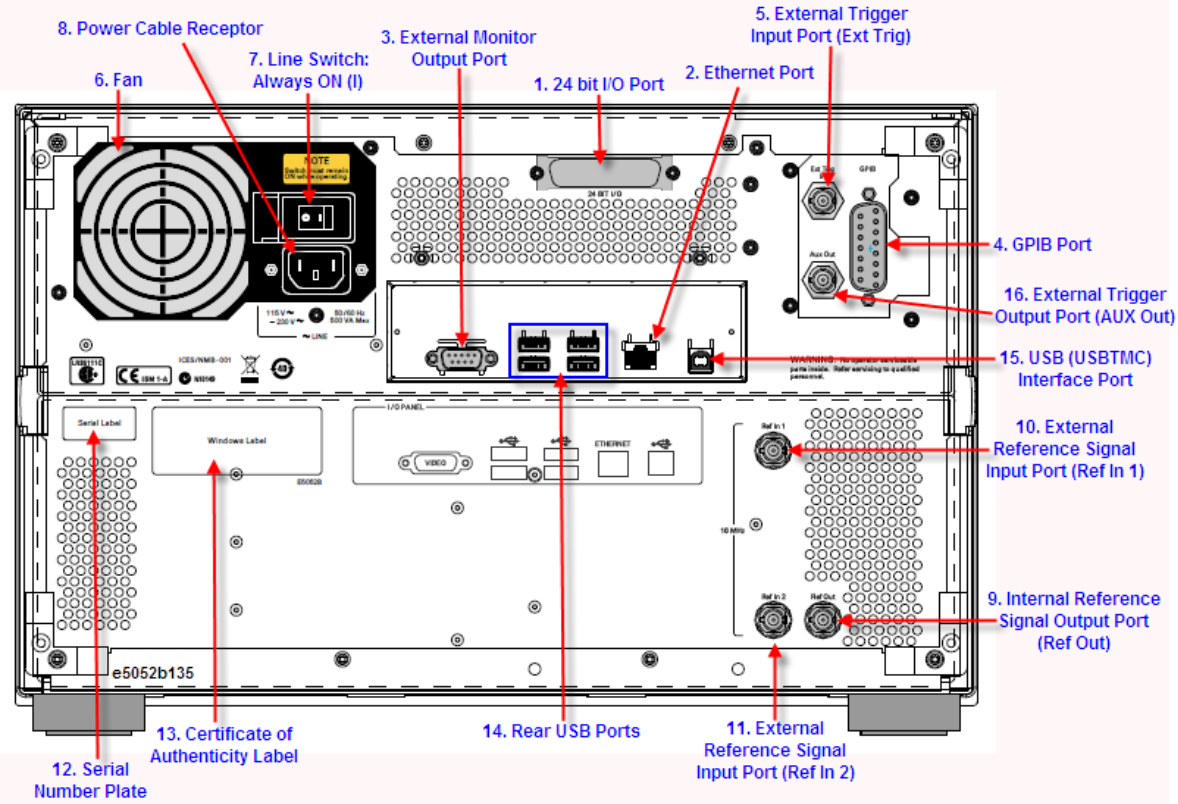
18. RF Port

RF Port is a DUT interface port that gets the RF input generated from the DUT.

Connector type: 50Ω, N-type, Female.

CAUTION Do not apply a DC voltage or current to the individual ports of the DC Control, DC Power and RF Port. Applying a DC voltage or current may lead to the breakdown of this product. In particular, there is the risk of the capacitor remaining charged. Connect the measurement sample (DUT) to the port (or the test fixture, cables, etc. connected to the port) after discharging DUT's electricity enough.

Rear Panel: Names and Functions of Parts



1. 24 bit I/O Port

The terminal to which an automatic machine (handler) used on a production line is connected. See 24 bit I/O Port.

Specification	Value
Connector type	36-pin D-Sub connector, Female
Input Signal Level	TTL level, (0 V to +5 V), Threshold Low: 0.5 V, High: 2.1V
Trigger Pulse Width	> 2 µs
Trigger Polarity	Positive/negative edge selectable

2. Ethernet Port

A terminal for connecting the E5052B to a LAN (Local Area Network). Connecting this instrument to a LAN enables you to access the hard disk drive of this instrument from an external PC or to control this instrument by using SICL-LAN or telnet.

Specification	Value
Connector type	8-pin RJ-45 connector
Base standard	10Base-T/100Base-T Ethernet (automatic data rate selection)

3. External Monitor Output Port

A terminal to which an external color monitor (display device) can be connected. By connecting a color monitor to this terminal, the same information shown on the LCD screen of the main body can be displayed on an external color monitor.

Connector type: 15-pin mini-D sub connector, Female.

4. GPIB Port

The connection of an external controller through General Purpose Interface Bus (GPIB) connector allows you to configure an automatic measurement system.

This GPIB connector is used only for controlling the E5052B from an external controller. Use USB/GPIB interface to control other devices from the E5052B. You cannot control other devices from the E5052B through this GPIB connector.

5. External Trigger Input Port

A connector to which external trigger signals are input. This connector detects the downward transition from the HIGH state in TTL signals as the trigger signal. To use this connector to generate a trigger, you must set the trigger source to the "external" side (key operation: **Trigger** > **Source** > **External**).

Connector type: BNC connector, female

6. Fan

The cooling fan for controlling the temperature inside the E5052B. This fan exhausts heated air from inside the analyzer to the outside.

7. Line Switch: Always ON (I)

Always keep this switch on (|).

CAUTION Do not use this switch to turn off (O) the mains. Doing so may cause the analyzer to fail. For more information, see the description of the Standby Switch.

8. Power Cable Receptor

The receptacle (outlet) to which the power cable is connected.

NOTE To connect the device to a power source (outlet), use the supplied three-prong power cable with a ground conductor. The plug attached to the power cable (on the power outlet side or device side of the cable) serves as the disconnecting device (device that cuts off power supply) of the E5052B. When the power supply must be cut off to avoid such danger as electric shock, pull out the power cable plug (on the power outlet side or device side of the cable). For the procedure for turning off the mains in normal use, see the description in Standby Switch.

For more on the power supply, see the Installation Guide.

9. Internal Reference Signal Output Port (Ref Out)

A connector for outputting the internal frequency reference signal from the E5052B. By connecting this output connector to the external reference signal input connector of another device, the device can be phase-locked to the internal reference signal of the E5052B and used under this condition.

Specification	Value
Connector type	BNC connector, female
Output signal (Typical)	10 MHz ± 5Hz, +2.5 dbm ± 2.5 dBm
Output impedance (Typical)	50 ohm

NOTE When a reference signal is inputted to "Ref In2" and Ch2 is locked with this signal, the "Ref Out" outputs the same signal.

10. External Reference Signal Input Port (Ref In1)

The reference signal input connector for phase-locking the measurement signal from the E5052B to the external frequency reference signal. Inputting the

reference signal to this connector improves the accuracy and frequency stability of the measurement signal from the E5052B.

Specification	Value
Connector type	BNC connector, female
Input signal (Typical)	10 MHz ± 10 Hz, 0 dBm to +10 dBm

NOTE When the frequency reference signal is input to this connector, the measurement signal from the E5052B is automatically phase-locked to the reference signal. When an input signal is not present, the frequency reference signal inside the E5052B is automatically used. The ExtRef1 on the instrument status bar is displayed in blue when the system is phase-locked to the external reference signal and in gray when not phase-locked.

NOTE When Narrow-Narrow mode in the transient measurement is selected, this connector should be connected with the Ref Out connector. The error message of "291 Ref In 1 input not detected" is displayed when the clock signal is not input into this connector.

11. External Reference Signal Input Port (Ref In2)

The reference signal input connector for phase-locking the measurement signal from the E5052B to the external frequency reference signal. Inputting the reference signal to this connector improves the accuracy and frequency stability of the measurement signal from the E5052B.

Specification	Value
Connector type	BNC connector, female
Input signal (Typical)	10 MHz ± 10 Hz, 0 dBm to +10 dBm

NOTE In the Phase Noise Measurement, when the frequency reference signal is input to this connector, the measurement signal from the E5052B is automatically phase-locked to the reference signal. When an input signal is not present, the frequency reference signal inside the E5052B is automatically used. The ExtRef2 on the instrument status bar is displayed in blue when the system is phase-locked to the external reference signal and in gray when not phase-locked.

12. Serial Number Plate

The seal showing the serial number of the product.

13. Certificate of Authenticity Label

The label showing the information of the "Certificate of Authenticity."

14. Rear USB Port

Two USB (Universal Serial Bus) ports are provided specifically for USB/GPIB interface or a printer.

NOTE The specifications of this port are identical to the Front USB Port.

15. USB (USBTMC) Interface Port

Through this port, you can control the E5052B from external controllers. For more information on the measurement system using the USB port, see the USB Remote Control System.

Specification	Value
Connector type	Universal serial bus (USB) jack, type B (4 contact positions), Female
Compliance Standards	USBTMC-USB488 and USB2.0

16. External Trigger Output Port (AUX Out)

External Trigger Output port outputs the pulse of a specified polarity at the end of measurement (EOM).

NOTE This port can handle maximum output current of 50mA.The port outputs to the connector through 24 Ohm resistance and 10k ohm pull-up resistance in series with the output of 74ACT14.

Symbol	Parameter	Typical	*Units*	Condition
	Pulse Width	1	uSec	
VOH	HIGH Level Output Voltage	5	Volt	Iout=-50uA
VOL	LOW Level Output Voltage	0	Volt	Iout=50uA

Screen Area

Screen Area: Names and Functions of Parts

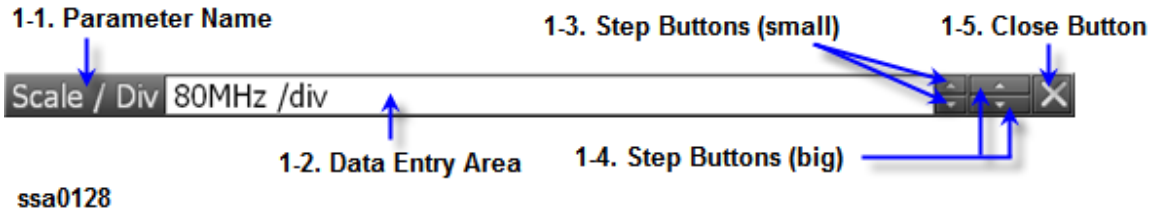
Click on the name or area for details of the topic:

1. Data Entry Bar
2. Softkey Menu Bar
3. Instrument Status Bar
4. Measurement Windows
5. **Windows Status Bar** - Windows Status Bar may or may not appear, depending on the Windows license. Under the same condition, either Windows resize buttons or E5052B resize button will appear. For more information, refer to Windows License.

Data Entry Bar

Used to enter numeric data into the E5052B. Press a hardkey or softkey to enter data, and the data entry bar will appear at the top of the screen. To assign a title to a measurement window, the entry bar also allows you to enter letters and symbols by using the front panel keys or mouse.

Data Entry Bar



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NOTE To manipulate the data entry bar with the front panel keys, it has to be selected as the object to manipulate (focus placed on it). When the focus is placed on the data entry bar, the entire bar is displayed in blue. Pressing or clicking on **Focus** Key in ENTRY Block enables you to move the focus to the desired object.

1-1. Parameter Name

Displays the name of the parameter for which data will be entered.

1-2. Data Entry Area

When the data entry bar is displayed for the first time, the current settings are displayed on it. You can change numeric values by typing from the keyboard or in the ENTRY block on the front panel.

1-3. Step Button (Small)

Increases or decreases the numeric value in the data entry area in small steps. Use the mouse to manipulate this button.

1-4. Step Button (Large)

Increases or decreases the numeric value in the data entry area in large steps. Use the mouse to manipulate this button.

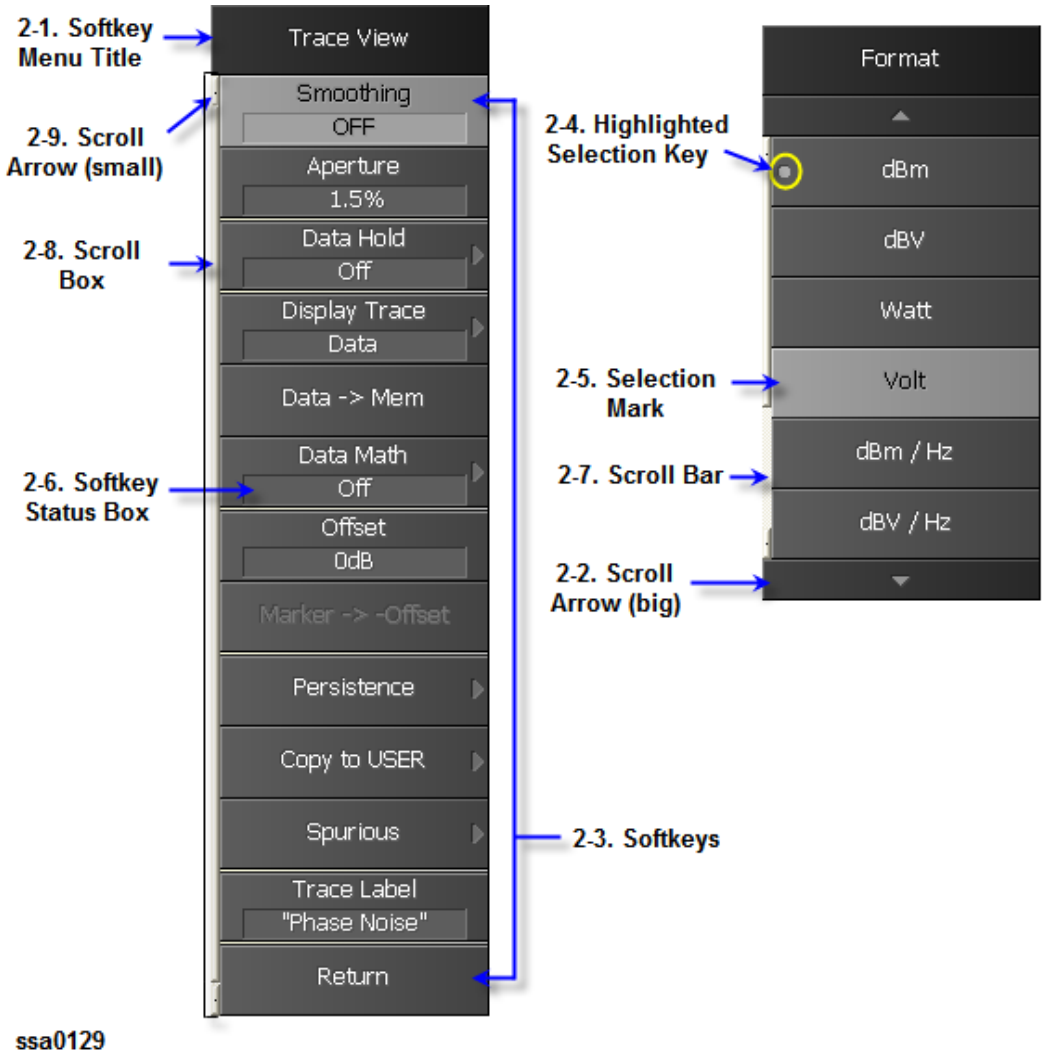
1-5. Close Button

Closes the data entry area (turns off the display). Use mouse to manipulate this button.

Softkey Menu Bar

A group of keys on the screen called by the softkeys and menu bars. You can manipulate these keys by using the **NAVIGATION** Block keys on the front panel, the mouse, or the keyboard. You can perform manipulations by directly touching the screen with your finger instead of using a mouse.

Softkey Menu Bar



NOTE To manipulate a menu bar, it has to be selected as the object to manipulate (with the focus placed on it). When the focus is placed on a menu bar, the menu title area at the top is displayed in blue. Pressing or clicking on **Focus** Key in the ENTRY Block enables you to move the focus to the desired object.

2-1. Softkey Menu Title

The title of the softkey menu is displayed here. Double-clicking on this part of the menu bar displays the top layer of softkeys.

2-2. Scroll Arrow (Large)

When the softkeys in a menu overflow the screen, using this key enables you to scroll the menu page by page. Both upward and downward scroll arrows are available. Use the mouse to manipulate these buttons.

2-3. Softkeys

These are the actual keys you would use to perform setup. A ▶ displayed to the right of a softkey indicates that pressing that softkey will display the lower layer of softkeys.

2-4. Highlighted Softkey

Pressing and ***Enter*** key on the front panel or pressing **Enter** key on the keyboard causes the highlighted (selected) softkey to be executed. You can change which softkey in the menu is highlighted by turning or pressing on the front panel or by pressing on the keyboard. Pressing the key on the front panel or the key on the keyboard brings up the upper level softkey menu, and pressing the key on the front panel or the key on the keyboard brings up the lower level softkey menu.

2-5. Selection Mark

Shows which softkey function is currently selected.

2-6. Softkey Status Display

Displays a softkey's setup status.

2-7. Scroll Bar

When the softkeys in a menu overflow the screen, clicking on the blank part of the scroll bar enables you to scroll the softkey menu up or down.

2-8. Scroll Box

You can scroll the softkey menu up or down by using the mouse to select and drag the scroll box (pressing the button on the object to be moved and then releasing the button at the desired location). The length and position of the scroll box indicate the length and position of the currently displayed part of the softkey menu relative to the entire menu.

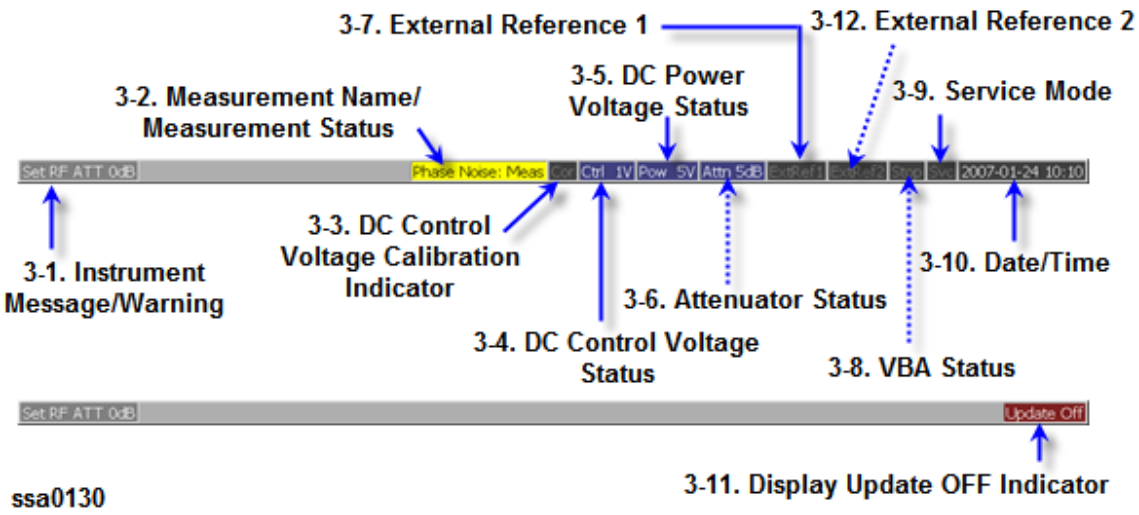
2-9. Scroll Arrow (Small)

Using this button, you can scroll the menu one softkey at a time. Both upward and downward scroll arrows are available. Use the mouse to manipulate these buttons.

Instrument Status Bar

The instrument status bar displays the status of the entire instrument.

Instrument Status Bar



3-1. Instrument Message/Warning

Displays instrument messages and warnings. Instrument messages are displayed in gray and warnings in red. For the meanings of the instrument messages and warnings, see Troubleshooting.

3-2. Measurement Name/Measurement Status

Displays the measurement status of E5052B.

Value	Description
Hold	Measurement on hold (idling).
Man	The trigger source is set to "Manual" and waiting for trigger.
Ext	The trigger source is set to "External" and waiting for trigger.
Bus	The trigger source is set to "Bus" and waiting for trigger.
NVideo	The trigger source is set to "Narrow Video" for transient measurement only and waiting for trigger.

N2Video	The trigger source is set to "Narrow2 Video" for transient measurement only and waiting for trigger.
WVideo	The trigger source is set to "Wide Video" for transient measurement only and waiting for trigger.
Meas	A measurement is in progress.

3-3. DC Control Voltage Calibration Indicator

When DC Control Voltage Calibration is enabled, it is displayed in blue. When disabled, it is displayed in gray.

3-4. DC Control Voltage Status

When the DC control voltage signal output is turned on, the specified voltage is displayed.

3-5. DC Power Voltage Status

When the DC power voltage signal output is turned on, the specified voltage is displayed.

3-6. Attenuator Status

The specified attenuator value is displayed.

3-7. External Reference Signal Phase Lock 1

When the frequency reference signal is input to the External Reference Signal Input Connector (Ref In1) on the rear panel and the measurement signal of the E5052B is phase-locked to the reference signal, ExtRef1 is displayed in blue.

Value	Description
ExtRef1 displayed in blue	Measurement signal is phase-locked to external reference signal.
ExtRef1 displayed in gray	Measurement signal is not phase-locked to external reference signal.

NOTE When the phase lock function is not operated properly, Unlock is displayed in red. Even when High Stability *Frequency* Reference Output Connector (Ref Oven)and External Reference Signal Input Connector (Ref In) are interconnected, the measurement signal may not be phase-locked immediately after powered on under a cool-temperature environment (i.e. the display of "ExtRef1" does not change from gray to blue). In this case, wait a few minutes until the instrument warms-up and "ExtRef1" is displayed in blue.

3-8. VBA Status

Displays the state of the execution of the VBA program in the E5052B.

Value	Description
Run	VBA program is still running
Stop	VBA program has stopped

3-9. Service mode

Indicates the service mode status.

Value	Description
SVC (displayed in red)	An abnormal condition has been detected inside the E5052B. The unit may be damaged. Notify the Customer Contact listed at the end of this brochure or the distributor from whom the unit was purchased.
SVC (displayed in gray)	The E5052B is in normal mode.

3-10. Date and Time

Displays the date and time generated by the internal clock. The display format is as follows:

YYYY-MM-DD HH:MM

Where:

YYYY: Year (AD)
MM: Month
DD: Day
HH: **MM**: Time (0:00 to 23:59)

You can turn the date and time display on/off by: **System** > **Misc Setup** > **Clock Setup** > **Show Clock**.

3-11. Display Update OFF Indicator

When updating of information displayed on the LCD screen is turned off, this indicator is displayed.

3-12. External Reference Signal 2

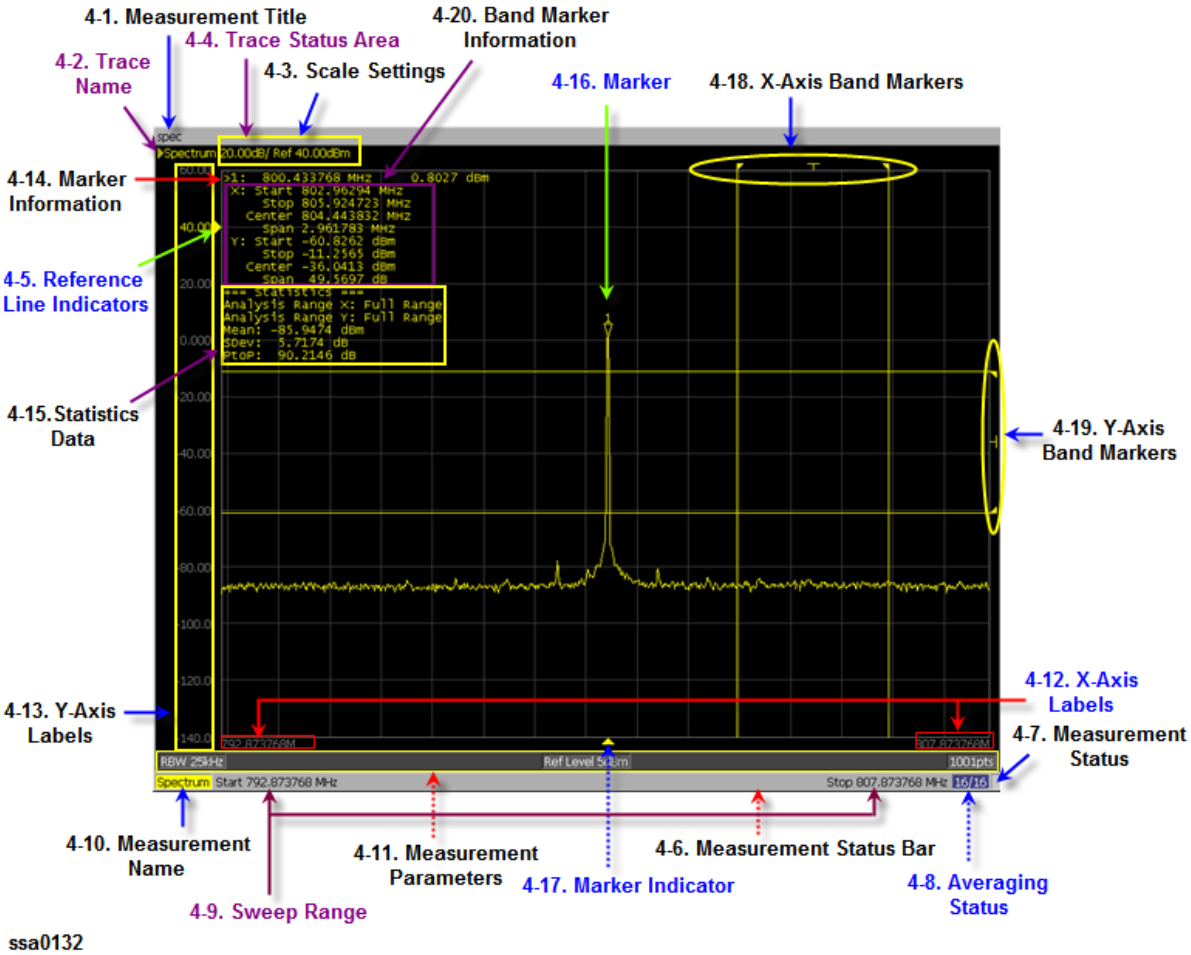
When the frequency reference signal is input to the External Reference Signal Input Connector (Ref In2) on the rear panel and the measurement signal of the E5052B is phase-locked to the reference signal, ExtRef2 is displayed in blue.

Value	Description
ExtRef2 displayed in blue	Measurement signal is phase-locked to external reference signal.
ExtRef2 displayed in gray	Measurement signal is not phase-locked to external reference signal.

Measurement Window

This provides windows for displaying traces. Because a measurement corresponds to a window, it is called a measurement window. When the outer frame of a measurement window is displayed in light gray, the measurement is active (the measurement for which setup is being performed). In Measurement Window spectrum window is active. To make a measurement active, use **Window Next** . Clicking inside a measurement window will also make it active. The following figure shows example of a spectrum measurement displayed in maximum screen by using **Window Max**.

Measurement Window



4-1. Measurement Title

You can assign a title to each channel and have the title displayed in the bar. To set up the measurement title, enter a title in **Display** > **Edit Title Label** and then toggle on/off the title display by using **Display** > **Title Label** .

4-2. Trace Name

The names of the traces on the measurement are displayed here.▶ to the left of the trace name indicates the active trace (the trace for which setup is being performed). To switch over the active trace, use ***Trace*** **Next**. Clicking the graph of the trace will also activate the trace.

4-3. Scale Settings

The scale setting for each trace is displayed here. This example shows that "0.00dB/" corresponds to 10 *dB* per division. "Ref -50.00.000dB" shows that the value of the reference line is -50 dB. To specify the scale settings, use each softkey that can be displayed by pressing the **Scale** hardkey.

4-4. Trace Status Area

The setup for each trace is displayed here.

Trace Status Display

Classification	Contents inside the [ ]	Meaning
Turning on/off traces	Nothing	Data trace: ON, Memory trace: OFF
	M	Data trace: OFF, Memory trace: ON
	D&M	Data trace: ON, Memory trace: ON
	off	Data trace: OFF, Memory trace: OFF
Performing data math: Refer to the indication in parentheses when the memory trace is turned on.	D+M (D+M&M)	Execution of Data+Mem math
	D−M (D-M&M)	Execution of Data−Mem math
	D*M (D*M&M)	Execution of Data*Mem math
	D/M (D/M&M)	Execution of Data/Mem math
Smoothing	Smo	Smoothing: ON

4-5. Reference Line Indicators

These indicate the position of the reference line for the Y-axis scale in the rectangular display format. There is an indicator to the right of the scale (▶). To enter a numeric value for the position of the reference line, open the data entry bar using the keys **Scale** > **Reference Position.** You can also move the position of the reference line by placing the mouse pointer on the reference line indicator (the pointer changes from  to  .), moving the indicator vertically with the left mouse button kept pressed, and then releasing the button at the desired location (i.e., a drag-and-drop operation).

4-6. Measurement Status Bar

The status of each measurement is displayed here.

4-7. Measurement Status

Displays the update status of traces on the measurement.

Status	Description
#	Invalid traces. The measurement conditions have changed, but the traces on the measurement window currently displayed have not been updated to match the new conditions.
(not displayed)	Valid traces.

4-8. Averaging Status

Displays the averaging factor and averaging count when averaging is turned on.

Status	Description
n/m (displayed in blue)	*Averaging* : ON (m: averaging factor; n: averaging count)
(not displayed)	Averaging: OFF

4-9. Sweep Range

Indicates the sweep range by using the start/stop or center/span. This varies depending on the given parameters or measurements.

4-10. Measurement Name

Indicates the measurement name.

4-11. Measurement Parameters

Indicates the parameters specified to perform a measurement sweep at the bottom of each measurement screen. The content may vary depending on the measurement.

4-12. X-axis Labels

X-axis divisions in the rectangular display format. To hide the divisions, select "**OFF**" in -**Y # of Digits**. (The display/nondisplay of the X-axis divisions interlocks with that of the Y-axis divisions.)

4-13. Y-axis Labels

Y-axis divisions in the rectangular display format. The value of the reference line (the division line indicated by ▶) can be entered numerically by opening the data entry bar using the keys: **Scale** > **Reference Value**. You can change values of the reference line in one division intervals by placing the mouse pointer in the area of the graticule label (the pointer changes from to), moving the pointer vertically with the left mouse button pressed, and then releasing the button at the desired location. By using **Display** > **Y # of Digits**, you can select the display format of the graticule label from three options: 4 digits, 12digits, and "not displayed."

4-14. Marker Information

The marker information is displayed in a list. It shows the marker number, marker x-axis value, and marker measurement value from left to right. For the active marker (the one for which setup and analysis are being performed), > is displayed to the left of the marker number. For the reference marker,Δ is displayed instead of the marker number.

4-15. Statistics Data

Turning on the statistics data function displays statistics data here. For more about the statistics data function, see Determining Mean, Standard Deviation, and Peak-to-Peak of the Trace

4-16. Markers

The markers used for reading values on a trace. Up to six markers can be displayed for each trace.

Status	Description
n	Active marker (ready for setup and analysis)
n	Non-active marker

Here, n denotes a marker number. For the reference marker, however, nothing is displayed at the location of n. Clicking the marker or one of the *Marker* Indicators makes the marker active.

4-17. Marker Indicators

These indicate the positions of markers on the x-axis.

Status	Description
▲	Active marker indicator
Δ	Non-active marker indicator

You can also move a marker to desired position by placing the mouse pointer on marker indicator or the position of the marker itself (the pointer changes from to ⟷),moving the indicator vertically with the left mouse button pressed, and then releasing the button at the desired location.

4-18. X-axis Bandmarkers

By turning on the x-axis band marker function, the x-axis band marker is displayed in a specified position.

Status	Description
◤	Indicator of start value of x-axis band marker
◥	Indicator of stop value of x-axis band marker
⊤	Indicator of center value of x-axis band marker

You can also move a marker to the desired position by placing the mouse pointer on the marker indicator or the position of the marker itself (the pointer changes from to ⟷),moving the indicator vertically with the left mouse button pressed, and then releasing the button at the desired location.

4-19. Y-axis Bandmarkers

By turning on the y-axis band marker function, the y-axis band marker is displayed in a specified position

Status	Description
◥	Indicator of start value of y-axis band marker
◢	Indicator of stop value of y-axis band marker

⊣	Indicator of center value of y-axis band marker

You can also move a marker to the desired position by placing the mouse pointer on the marker indicator or the position of the marker itself (the pointer changes from  to ), moving the indicator up or down with the left mouse button pressed, and then releasing the button at the desired location.

4-20. Bandmarker information

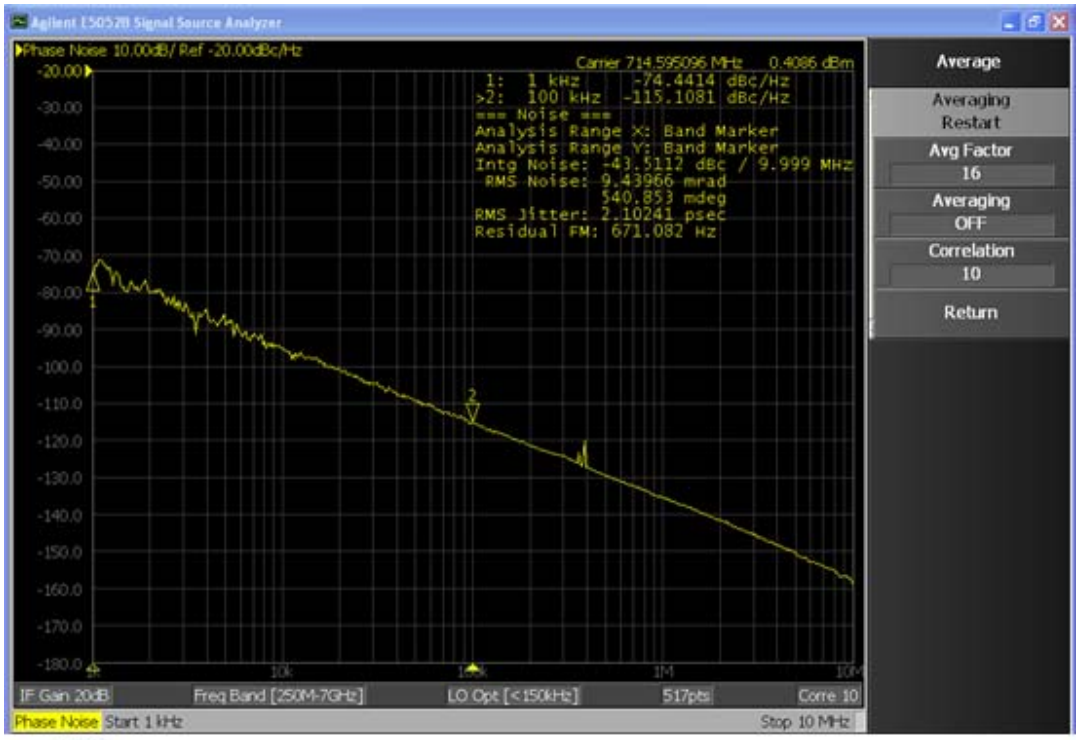
Turning on the x-axis or y-axis band marker function will display the corresponding band marker information on a list in the order of start, stop, center and span.

Three Methods of Operation

You can operate the E5052B using one of three operating methods: using keys on the front panel, using a mouse and keyboard, and using the touch screen.

In the next section and those following it, a series of operations is expressed as follows:

Select **Meas/View** > **Phase Noise** > **Window Max** > **Avg/BW**

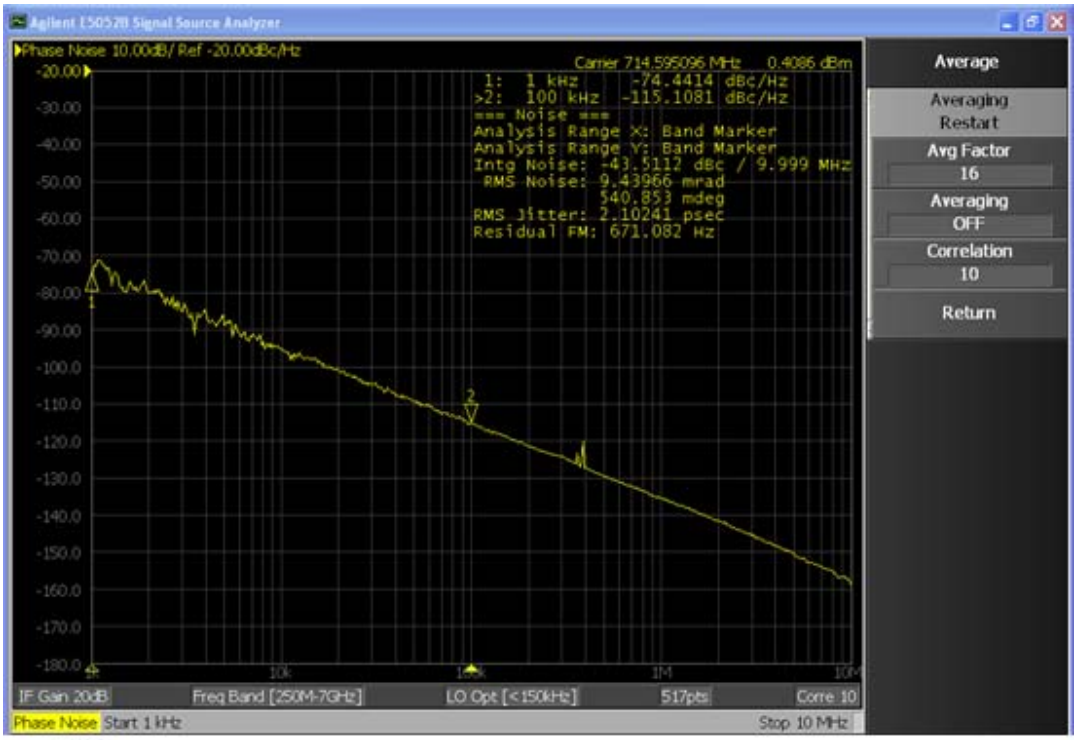


ssa0125

Operating Method Using Keys

1. Press the **Meas/View** key in the **Measurement** Block.
2. Press or key to move the cursor to **Phase Noise**, then press ***Enter*** or ( ) key.

3. Press **Avg/BW**



ssa0125

Operation Method Using a Mouse

1. From the **PN Menu** click **Measurement View**, click **Phase Noise** and then click **Return**

2. Click **Average**

Operation Method Using the Touch Screen

1. Press **Measurement View** > **Phase Noise**

2. Press **Show Window** and set all windows except **Phase Noise** to **OFF** status and then press **Return.**

3. Press **Return** to get back to PN menu.

4. Press **Average**

ssa0126

Measurement Example

VCO Measurement

This section describes the process to evaluate different parameters of a VCO (Voltage Controlled Oscillator) using the E5052B. The VCO used for this example has the following specification:

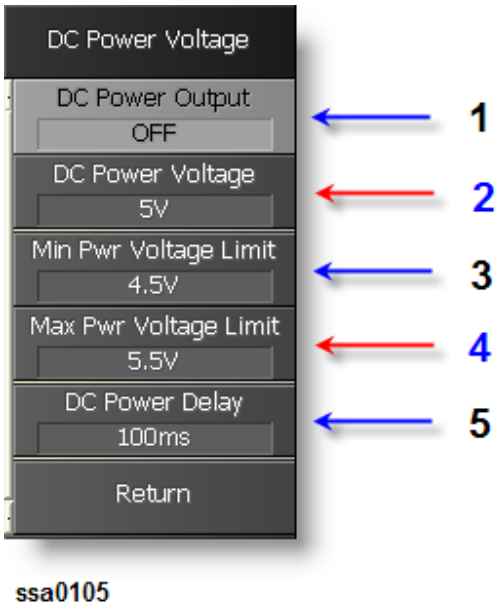
Parameter	Value
V_{cc} (Bias Voltage)	5 ± 0.5 V
V_t (Tuning Voltage)	+1.0 ~ +4.5V
RF Output	800 ± 30 MHz

1. Setting measurement conditions

I. Preset the E5052B to factory settings by **Preset** > **Factory**.

II. Set DUT (VCO) Bias Voltage (V_{cc}) Settings by **DC Power**:

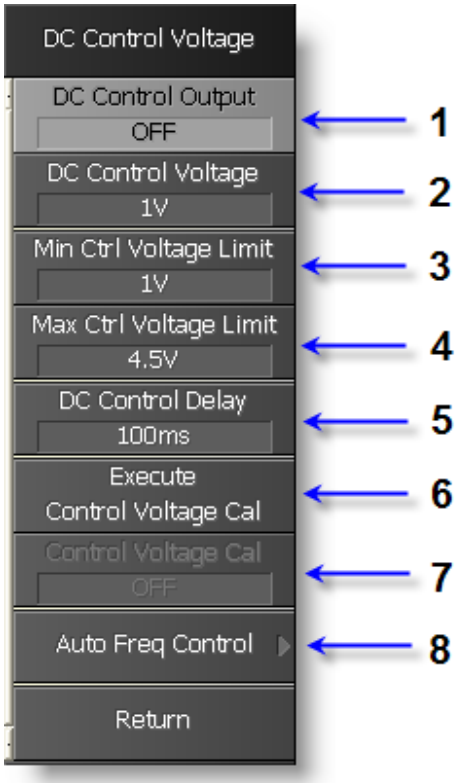
- Set **Min Pwr Voltage Limit** as **4.5 V** (**3** in the figure below).
- Set **Max Pwr Voltage Limit** as **5.5 V** (**4** in the figure below).
- Set **DC Power Delay** as **100ms** (**5** in the figure below).
- Set **DC Power Voltage** as **5V** (**2** in the figure below).



ssa0105

III. Set DUT (VCO) Tuning Voltage (V_t) Settings by **DC Control**:

- Set **Min Ctrl Voltage Limit** as **1.0 V** (**3** in the figure below).
- Set **Max Ctrl Voltage Limit** as **4.5 V** (**4** in the figure below).
- Set **DC Control Delay** as **100ms** (**5** in the figure below).
- Set **DC Control Voltage** as **1V** (**2** in the figure below).


DC Control Voltage
DC Control Output
OFF
1
DC Control Voltage
1V
2
Min Ctrl Voltage Limit
1V
3
Max Ctrl Voltage Limit
4.5V
4
DC Control Delay
100ms
5
Execute
Control Voltage Cal
6
Control Voltage Cal
OFF
7
Auto Freq Control
8
Return

ssa0106

2. Connecting the Device Under Test (DUT)

I. Connect DUT to E5052B.

ssa0107

II. Set **DC Power** > **DC Power Output ON**

III. Set **DC Control** > **DC Control Output ON**

IV. Set **Display** > **Update**

3. Making Measurements

I. Phase Noise

A. Measurement

1. Press **Meas/View** > **Phase Noise** to activate Phase Noise window. Press **Window Max** to maximize the window
2. Press **Setup** > **Frequency Band** > **250M-7GHz**
3. Press **Trigger** > **Trigger to Phase Noise** > **Continuous** to start measurements
4. Press **Start/Center** (**Stop/Span**), set **Start** > **100Hz** and **Stop** > **40MHz**

5. Press **Attn** > **Input Attenuator** 0dB for best dynamic range. Press **Entry Off** to clear the warning message that appears at bottom left
6. Press **Avg/BW** > **Avg factor** 8 > **Averaging** > **ON** to reduce fluctuation
7. Press **Scale** > **Auto Scale**

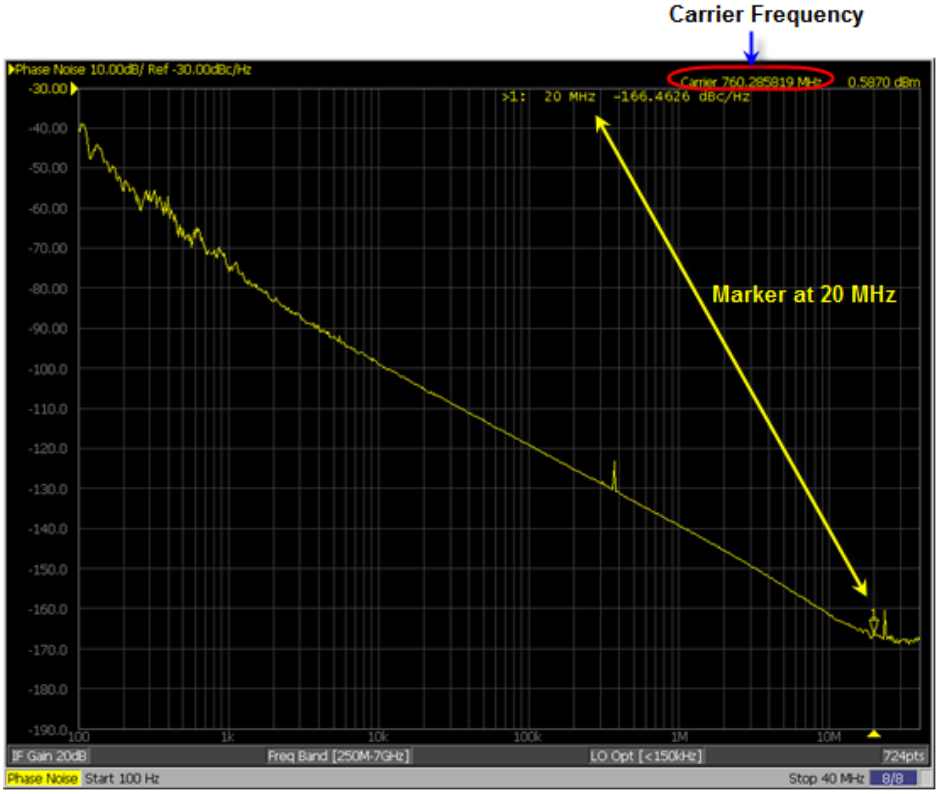
B. Auto Frequency Control

If the 1 GHz signal is a signal of a VCO, you can control the frequency of the signal by using the automatic frequency control (AFC) function.

1. Press **DC Control** > **Auto Freq Control**.
2. Set **Target** > **1GHz**.
3. Set **Tolerance** > **10kHz**.
4. Set **Sensitivity** > **10MHz/V**.
5. Press **AFC Status**, then turn "**ON**" to activate AFC. When "AFC out of loop" message is displayed, change the value for tolerance or sensitivity to a value larger than the current setting.

C. Analysis Using Marker

1. Press **Marker** > **Marker1** > 20 > **x1** to check phase noise at 20MHz offset



ssa0133

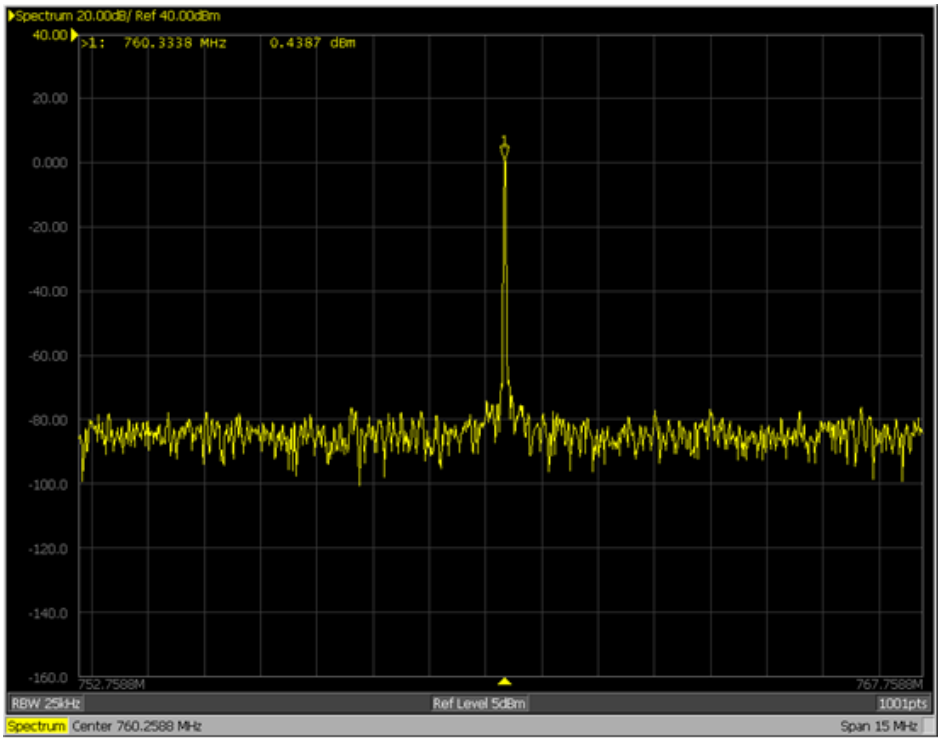
II. Spectrum Monitor

A. Measurement

1. Press **Meas/View** > **Spectrum Monitor** to activate Spectrum window.
2. Press **Window Max** to maximize the window.
3. Press **Trigger** > **Trigger to Spectrum Monitor** > **Continuous** to start measurements
4. Press **Start/Center** (**Stop/Span**), set **Center** to carrier frequency displayed in phase noise window.
5. Press **Setup** > **Reference Level** > **5dBm** to specify maximum input level of the measurement signal that is input from the RF IN port.
6. Press **Scale** > **Auto Scale**

B. Analysis Using Marker

1. Press **Marker Search** > **Search Max**



ssa0134

II. Frequency and Power

A. Measurement

1. Press **Meas/View** > **Freq & Power** to activate Frequency and Power window. Press **Window Max** to maximize the window
2. Press **Setup** > **Frequency Band** > **250M-7GHz**

1.

- **Tester Mode**

3. Press **Setup** > **Frequency Resolution** > **10Hz**
4. Press **Trigger** > **Mode** > **Tester**
5. Press **Trigger** > **Trigger to Freq & Power** > **Continuous** to start measurements

ssa0135

- **Analyzer Mode**

1.

3. Press **Trigger** > **Mode** > **Analyzer**
4. Press **Setup** > **Sweep Parameter** > **Control Voltage**
5. Press **Setup** > **Frequency Resolution** > **10Hz**
6. Press **Setup** > **Points** > **51** to perform tuning selectivity measurement
7. Press **Start/Center** (**Stop/Span**) > **DC Control Start** 1V > **DC Control Stop** 4.5V
8. Press **Scale** > **Auto Scale All**
9. Press **Setup** > **Sweep Parameter** > **Power Voltage** to perform frequency pushing measurement
10. Press **Start/Center** (**Stop/Span**) > **DC Power Start** 4.5V > **DC Power Stop** 5.5V
11. Press **Scale** > **Auto Scale All**

12. Using touch screen touch Frequency screen to activate.
    Press **Format** > **Frequency Format** > **Hz/V**

13. Press **Scale** > **Auto Scale All**

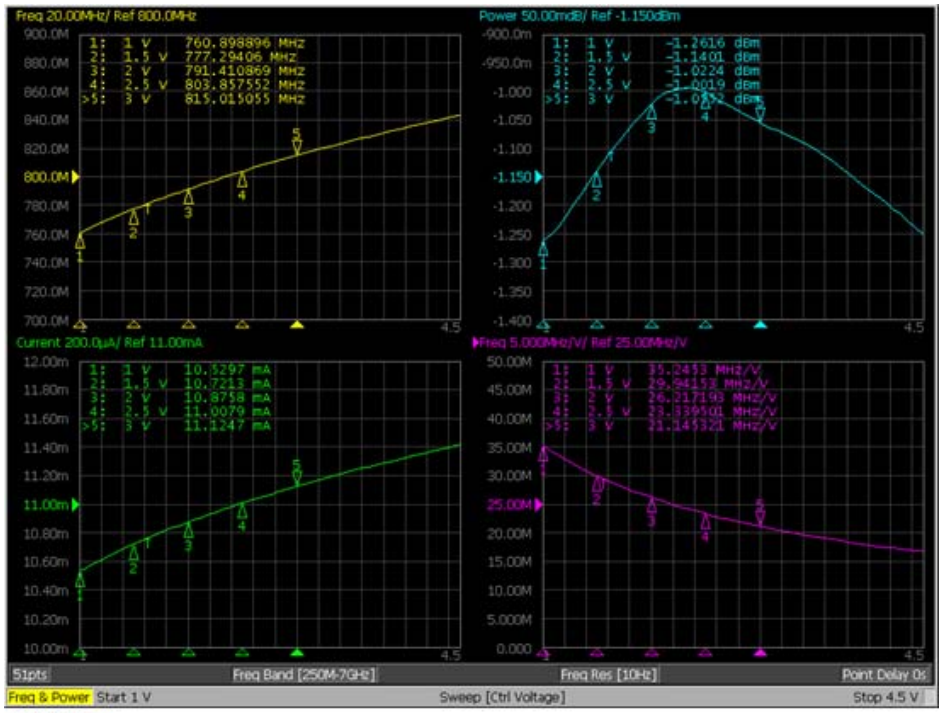
B. Analysis Using Marker

1.

- **Tuning Sensitivity**

1.

1. Press **Marker** > **Marker1** > 1 > **Enter**
2. Press **Marker** > **Marker2** > 1.5 > **Enter**
3. Press **Marker** > **Marker3** > 2 > **Enter**
4. Press **Marker** > **Marker4** > 2.5 > **Enter**
5. Press **Marker** > **Marker5** > 3 > **Enter**
6. Press **Trace Next** to select Power trace in Frequency and Power window and repeat steps 1 to 5.
7. Press **Trace Next** to select Current trace in Frequency and Power window and repeat steps 1 to 5.
8. Press **Trace Next** to select Freq trace in Frequency and Power window and repeat steps 1 to 5.



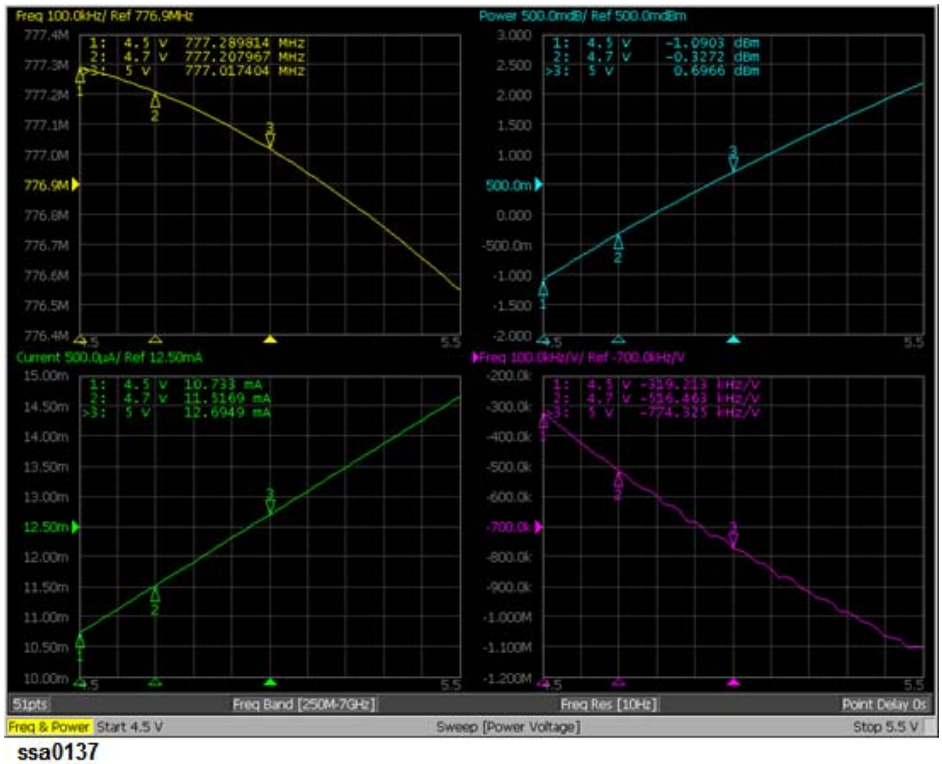
ssa0136

1.

- **Frequency Pushing**

1.

1. Press **Marker** > **Marker1** > 4.5 > **Enter**
2. Press **Marker** > **Marker2** > 4.7 > **Enter**
3. Press **Marker** > **Marker3** > 5 > **Enter**
4. Press **Trace Next** to select Power trace in Frequency and Power window and repeat steps 1 to 3.
5. Press **Trace Next** to select Current trace in Frequency and Power window and repeat steps 1 to 3.
6. Press **Trace Next** to select Freq trace in Frequency and Power window and repeat steps 1 to 3.



ssa0137

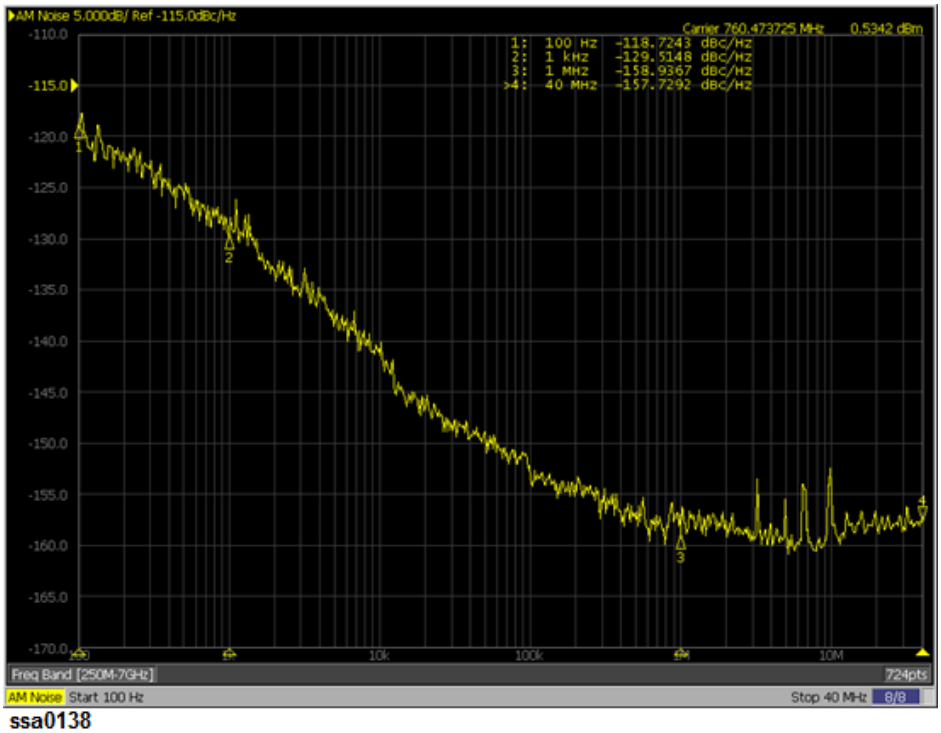
II.AM Noise Measurement

A. Measurement

1. Press **Meas/View** > **AM Noise** to activate AM Noise window. Press **Window Max** to maximize the window
2. Press **Setup** > **Frequency Band** > **250M-7GHz**
3. Press **Trigger** > **Trigger to AM Noise** > **Continuous** to start measurements
4. Press **Start/Center** (**Stop/Span**), set **Start** > **100Hz** and **Stop** > **40MHz**
5. Press **Attn** > **Input Attenuator** 0dB for best dynamic range. Press **Entry Off** to clear the warning message that appears at bottom left
6. Press **Avg/BW** > **Avg factor** 8 > **Averaging** > **ON** to reduce fluctuation
7. Press **Scale** > **Auto Scale**

B. Analysis Using Marker

1. Press **Marker** > **Marker1** > 100 > **x1**
2. Press **Marker** > **Marker2** > 1 > **k/m**
3. Press **Marker** > **Marker3** > 1 > **M/μ**
4. Press **Marker** > **Marker4** > 40 > **M/μ**



ssa0138

3. Outputting measurement results

- Store measurement file to a disk

Phase Noise Measurement for 1GHz signal

Measurement Setup

1. Press **Meas/View** > **Phase Noise** to select the phase noise measurement window. Press **Window Max** to maximize the window
2. Press **Trigger** > **Trigger to Phase Noise** > **Continuous** to start measurements.

3. Press **Trigger** > **Source** > **Internal**.
4. Press **Setup** > **Capture Range** > **Normal** for PLL method.
5. Press **Setup** > **Auto Setting**. When "IF A/D overflow" is displayed, decrease 10 dB from the current IF Gain setting (Press **Setup** > **IF Gain**).
6. Press **Start/Center** (**Stop/Span**), set **Start** > **100Hz** and **Stop** > **40MHz**.
7. Press **Avg/BW** > **Avg factor** > **5** > **Averaging** > **ON** to reduce fluctuation, then press **Averaging Restart**.
8. Press **Scale** > **Auto Scale**.
9. Press **Marker** > **Marker1** > **1** > **M/μ** to check phase noise at 1MHz offset.

The marker value is displayed in the upper part of the trace screen.

ssa0220

Analysis

Correlation

If the 1GHz signal is a clean signal, the correlation function can be used for noise floor reduction.

The following is an example of a 70 MHz clean signal measurement.

1. Press **Avg/BW** > **Correlation** > **1**, then set **Avg factor** > **5** and turn **Averaging** > **ON**, then press **Averaging Restart**.
2. Press **Trace/View** > **Data -> Mem**, then press **Display Trace** > **Data & Mem**.
3. Press **Avg/BW** > **Correlation** and input 100, then press **Averaging Restart**.

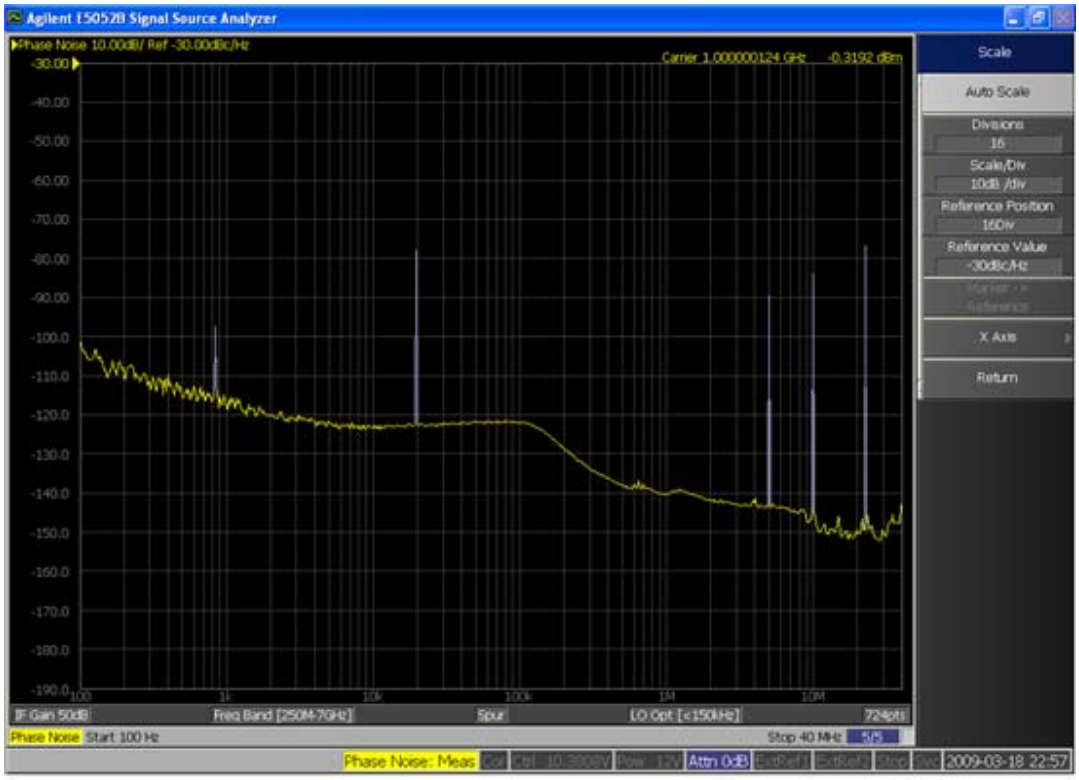
Auto Frequency Control

If the 1 GHz signal is a signal of a VCO, you can control the frequency of the signal by using the automatic frequency control (AFC) function.

1. Press **DC Control** > **Auto Freq Control**.
2. Set **Target** > **1GHz**.
3. Set **Tolerance** > **10kHz**.
4. Set **Sensitivity** > **10MHz/V**.
5. Press **AFC Status**, then turn "**ON**" to activate AFC. When "AFC out of loop" message is displayed, change the value for tolerance or sensitivity to a value larger than the current setting.

Spurious

1. Press **Trace/View** > **Spurious** > **Power (dBc)**. Then set **Spur Sensibility** > **3** and **Minimum Spur Level** > **-100 dBc**.
2. Press **Scale** > **Auto Scale**.
3. Spurious are displayed by high light. Then press **Spurious List**, you can view response values for the spurious in a text file.

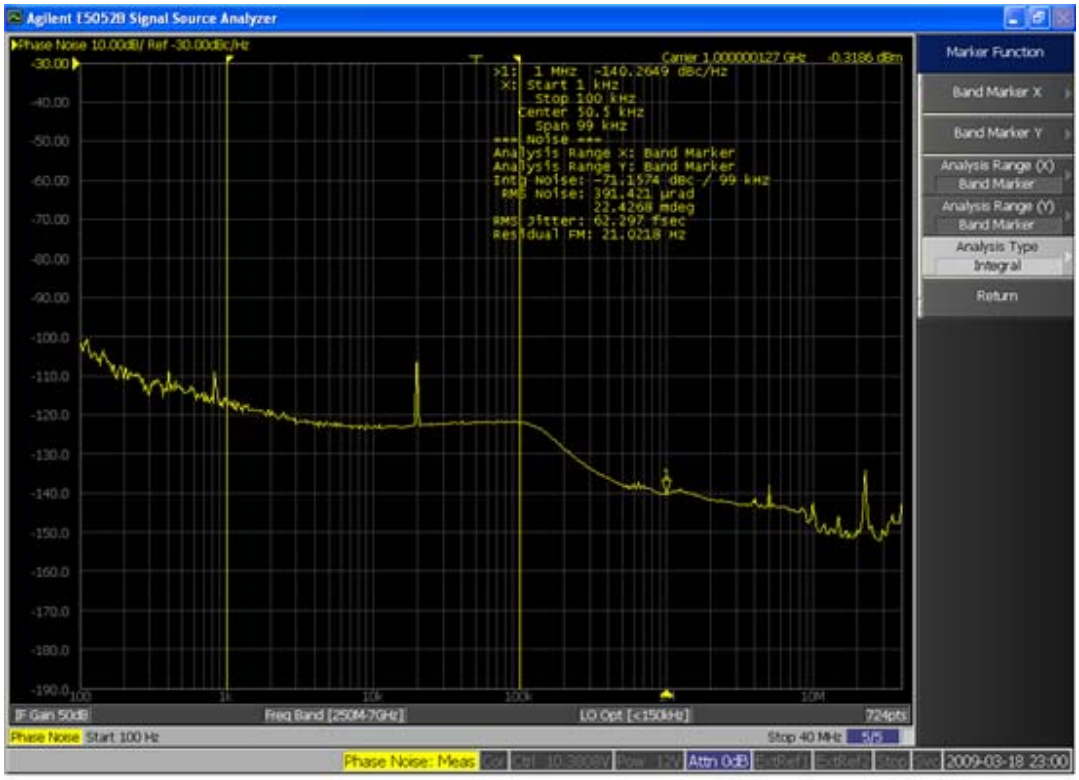


ssa0222

Jitter

1. Press **Marker Fctn**, then **Band Marker** > **ON**
2. Press **Start/Center** (**Stop/Span**), set **Start** > **1kHz** and **Stop** > **100kHz**
3. Press **Marker Fctn**, then **Analysis Type** > **Integral**. In the upper right part of the screen, you can see the Integral Phase Noise value [dBc], the RMS Noise value [rad, deg], the RMS Jitter value [sec] and Residual FM value [Hzrms].

The band marker span is derived from interpolated values (including measurement points). On the other hand the noise span is derived from measurement points directly, so the two data take different values when the band marker is at interpolated points.

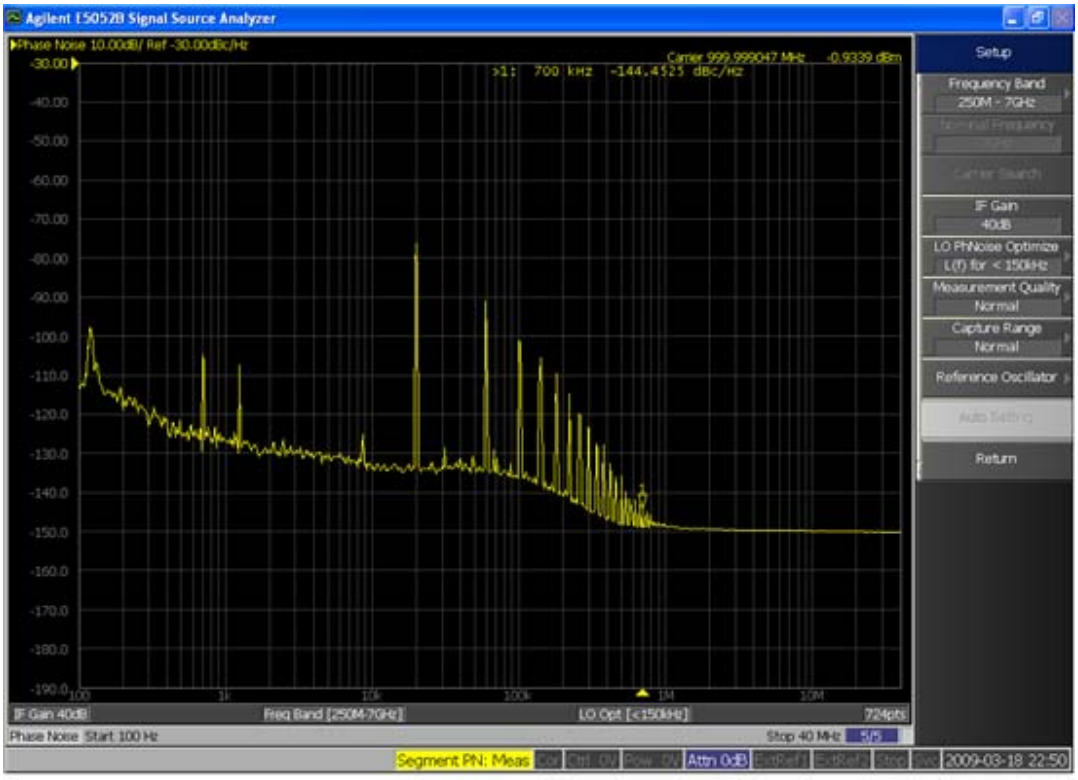


ssa0223

Segment Phase Noise Measurement

The segment phase noise measurement allows you to analyze detail of spurious response with variable RBW setting.

This figure below shows a phase noise measurement.

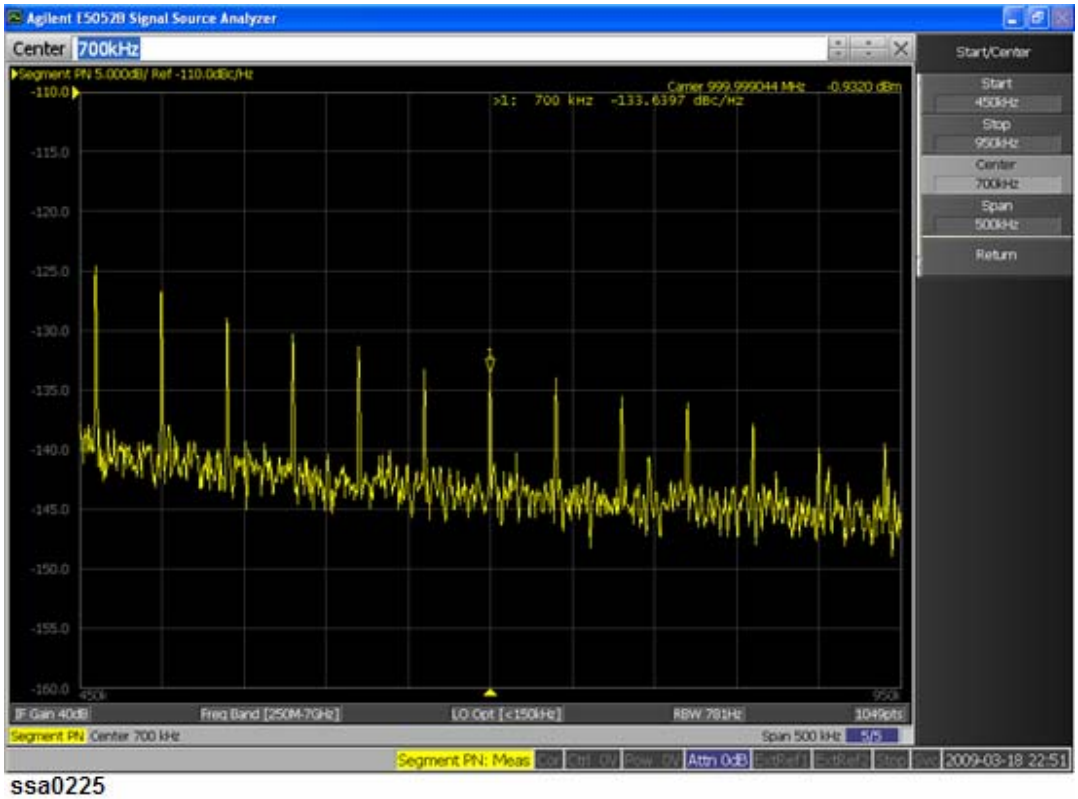


ssa0224

The following steps are for analyzing the spurious around 700kHz frequency offset.

1. Press **Meas/View** > **Show Window** > **Segment PN** to toggle **ON** the segment phase noise measurement.
2. Press **Meas/View** > **Segment PN** to select the segment phase noise measurement window.
3. Press **Trigger** > **Trigger to Segment PN** > **Continuous** to start measurements.

   Press **Trigger** > **Source** > **Internal**
4. Press **Setup** > **Capture Range** > **Normal** for PLL method
5. Press **Setup** > **Auto Setting**
6. Press **Start/Center** (**Stop/Span**), set **Center** > **700kHz** and **Span** > **500kHz**
7. Press **Avg/BW** > **RBW** > **781Hz**
8. Press **Avg/BW** > **Avg factor** 5 > **Averaging** > **ON** to reduce fluctuation, then press **Averaging Restart**
9. Press **Scale** > **Auto Scale**



ssa0225

More Information

For more information about phase noise measurement, see Phase Noise Measurement.

Frequency, power and DC current Measurement for VCO (using built-in DC sources)

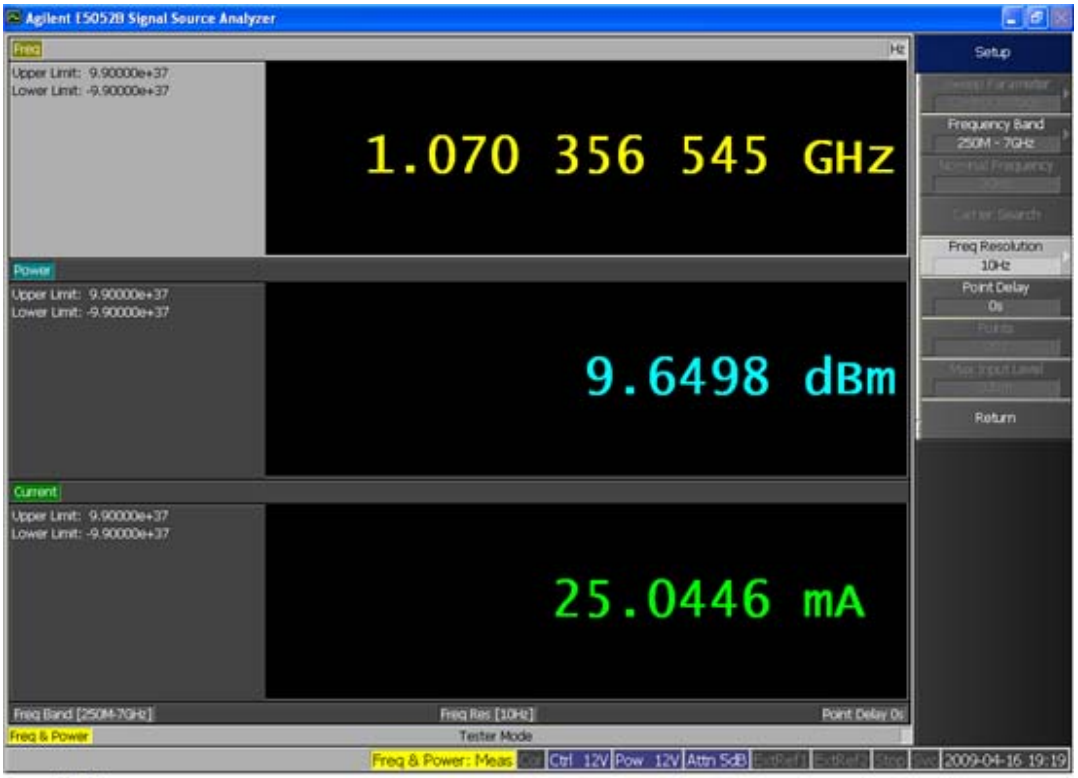
The VCO used for this example has the following specification:

- Vcc (Bias Voltage) : 12V, Vt (Tuning Voltage) : 0.5 to 18 V
- RF Output : 612 to 1200 MHz, Output power: +10 dBm typ.

Measurement Setup

1. Press **DC Power** > **DC Power Voltage** > **12V** and **Max Pwr Voltage Limit** > **13V**, then turn **DC Power Output** to **ON**.
2. Press **DC Control** > **DC Control Voltage** > **12V** and **Max Ctrl Voltage Limit** > **18V**, then turn **DC Control Output** to **ON**.
3. Press **Meas/View** > **Freq & Power** to select the frequency & power measurement window. Press **Window Max** to maximize the window.
4. Press **Att** > **Input Attenuator** > **10dB**.

5. Press **Trigger** > **Mode** > **Tester**. Then, press **Trigger** > **Trigger to Freq & Power** > **Continuous** to start measurements. Press **Trigger** > **Source** > **Internal**.
6. Press **Setup** > **Frequency Band** > **250M - 7GHz**, then press **Freq Resolution** > **10Hz**.



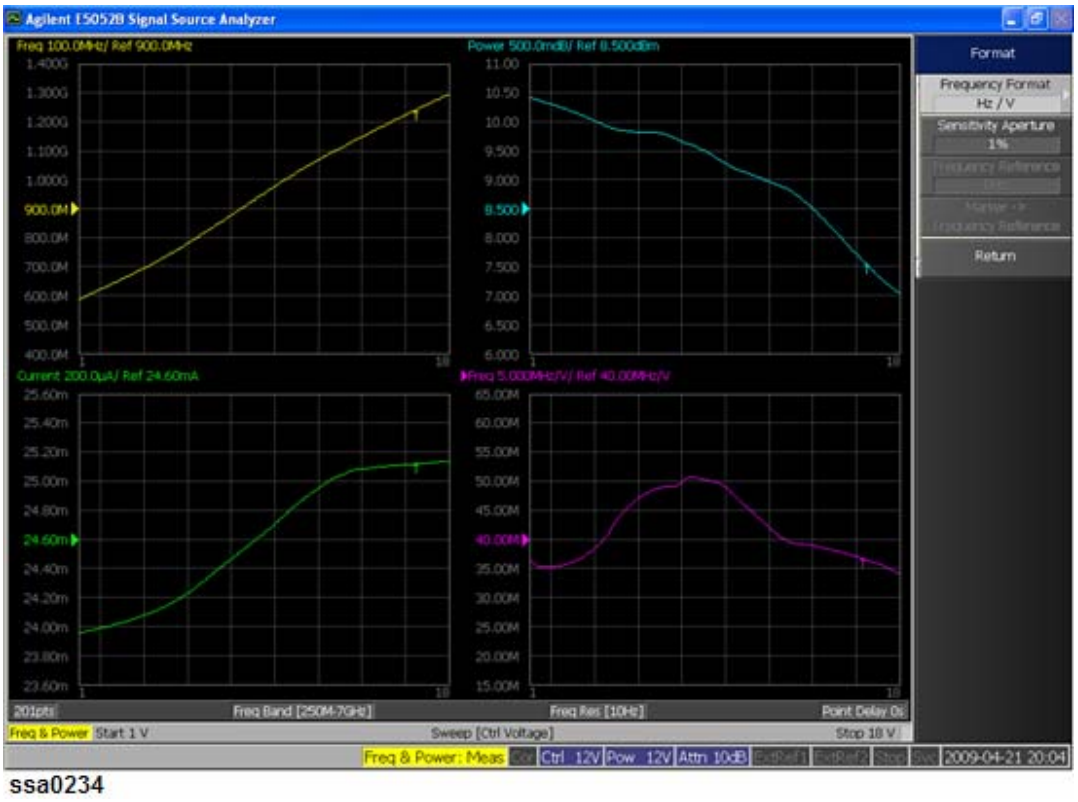
ssa0233

Analysis

Tuning sensitivity measurement

1. Press **Trigger** > **Mode** > **Analyzer**, then press **Source** > **Internal**.
2. Press **Setup** > **Sweep Parameter** > **Control Voltage**, then press **Freq Resolution** > **10Hz** and press **Points** > **201**.
3. Press **Start/Center** (**Stop/Span**) > **DC Control Start** > **1 V** and **DC Control Stop** > **18 V**.
4. Press **Display** > **Allocate** > **x4** to set the trace layout to four-division mode.
5. Press **Trace Next** key to select the frequency measurement trace (lower-right trace), then press **Format** > **Frequency Format** > **Hz/V**.

6. Press **Scale** > **Auto Scale All**.



ssa0234

More Information

For more information about Frequency, power and DC current Measurement, see Frequency/Power Measurement.

Spectrum Monitor for 1 GHz signal

Measurement Setup

1. Press **Meas/View** > **Spectrum Monitor** to select the Spectrum Monitor window. Press **Window Max** to maximize the window.

2. Press **Trigger** > **Trigger to Spectrum Monitor** > **Continuous** to start measurements. Press **Trigger** > **Source** > **Internal**.

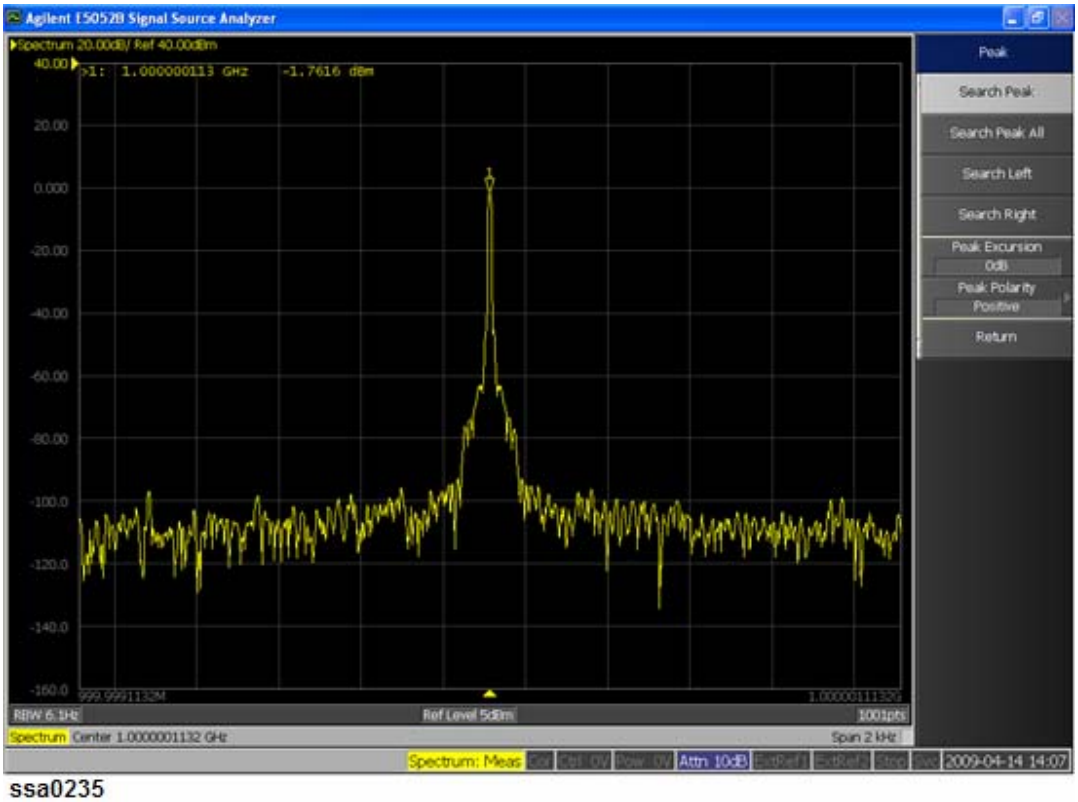
3. Press **Attn** > **Input Attenuator** > **10 dB**, then press **Setup** > **Reference Level** > **5dBm** to specify maximum input level of the measurement signal that is input from the RF IN port.

4. Press **Start/Center** (**Stop/Span**), **Carrier To** > **Frequency Band** > **250MHz – 7GHz**, and press **Return** > **Span** > **2kHz**, then **Carrier To** > **Carrier -> Center**.

5. Press **Avg/BW** > **RBW** > **6.1Hz**.

6. Press **Scale** > **Auto Scale**.
7. Press **Marker Search** > **Peak** > **Search Peak**.

The marker value is displayed in the upper part of the trace screen.

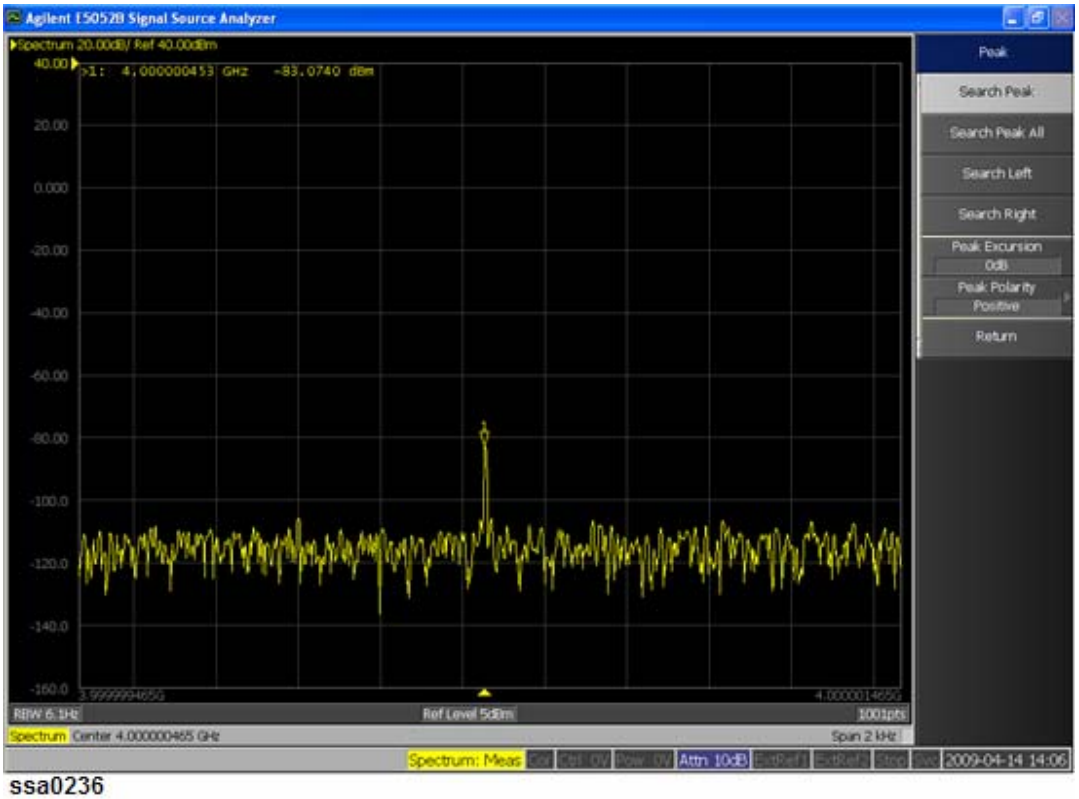


ssa0235

Analysis

Harmonics measurement

1. Press **Start/Center** > **Carrier To** > **Carrier x2 -> Centre**. The center frequency of the sweep range is set at the second harmonic.
2. Press **Marker Search** > **Peak** > **Search Peak**.
3. Press **Start/Center** > **Carrier To** > **Harmonic #** > **4**, then press **Carrier x # -> Center**. The center frequency of the sweep range is set at the fourth harmonic.
4. Press **Marker Search** > **Peak** > **Search Peak**.



ssa0236

More Information

For more information about Spectrum Monitor Measurement, see Spectrum Monitor Measurement.

AM Noise Measurement for 1GHz signal

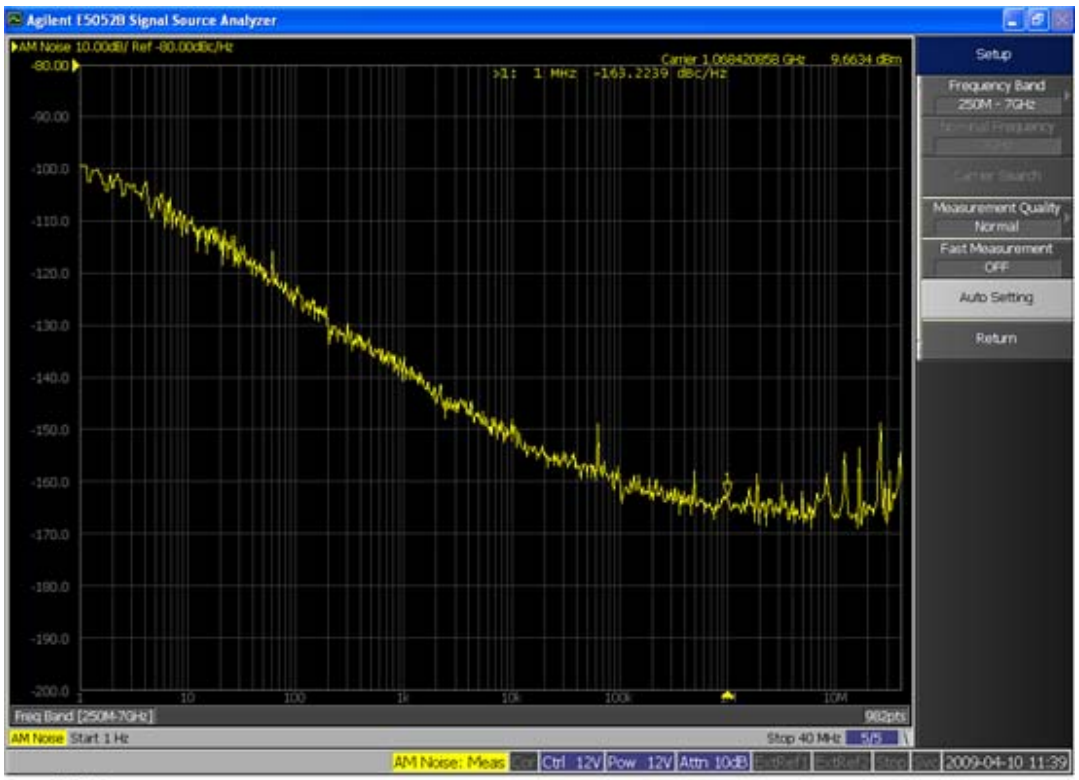
Measurement Setup

1. Press **Meas/View** > **AM Noise** to select the AM noise measurement window. Press **Window Max** to maximize the window.
2. Press **Trigger** > **Trigger to AM Noise** > **Continuous** to start measurements.

   Press **Trigger** > **Source** > **Internal**.
3. Press **Setup** > **Auto Setting**.
4. Press **Start/Center** (**Stop/Span**), set **Start** > **1Hz** and **Stop** > **40MHz**.
5. Press **Avg/BW** > **Avg factor** 5 > **Averaging** > **ON** to reduce fluctuation, then press **Averaging Restart**.
6. Press **Scale** > **Auto Scale**.

7. Press **Marker** > **Marker1** > **1** > **M/u** to check phase noise at 1MHz offset.

   The marker value is displayed in the upper part of the trace screen.



ssa0226

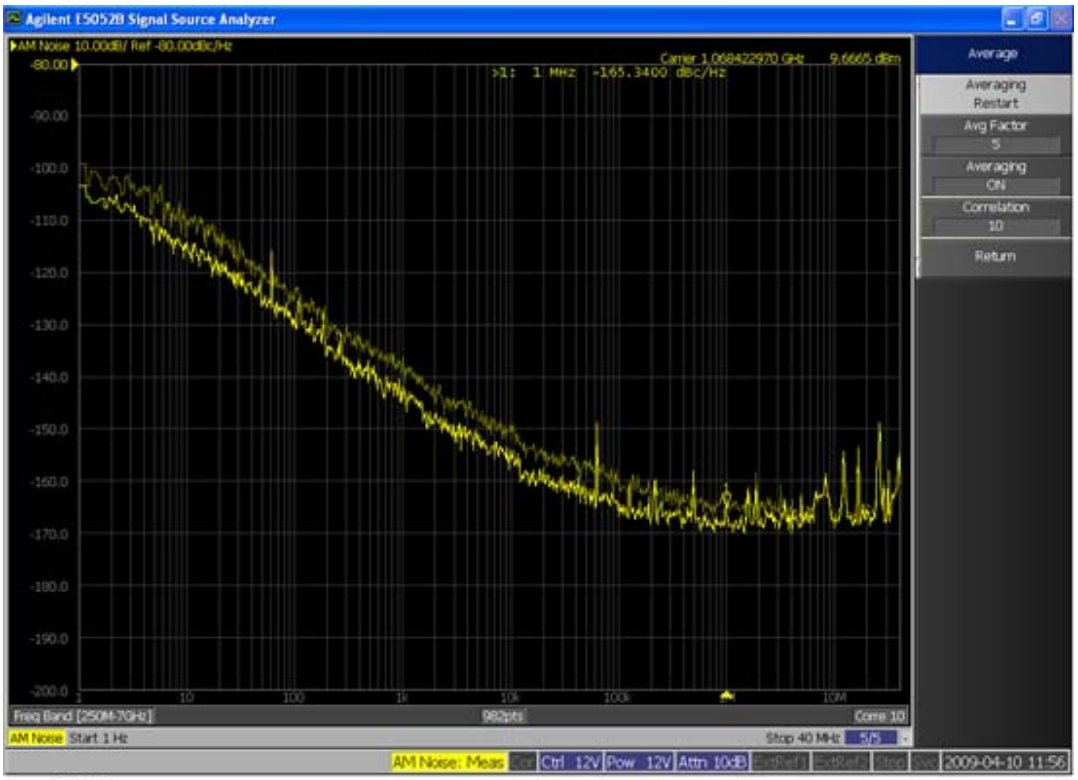
Analysis

Correlation

If the 1GHz signal is a clean signal, the correlation function can be used for noise floor reduction.

1. Press **Avg/BW** > **Correlation** > **1**, then set **Avg factor** > **5** and turn **Averaging** > **ON**, then press **Averaging Restart**.
2. In the bottom right part of screen, Averaging Status n/m is displayed. When the average status becomes "5/5", press **Trigger** > **Hold**.
3. Press **Setup** > **Auto Setting**.
4. Press **Trace/View** > **Data -> Mem**, then press **Display Trace** > **Data & Mem**
5. Press **Avg/BW** > **Correlation** > **10**, then **Averaging Restart**.

   The measurement result (Data trace) is improved about 5dB.

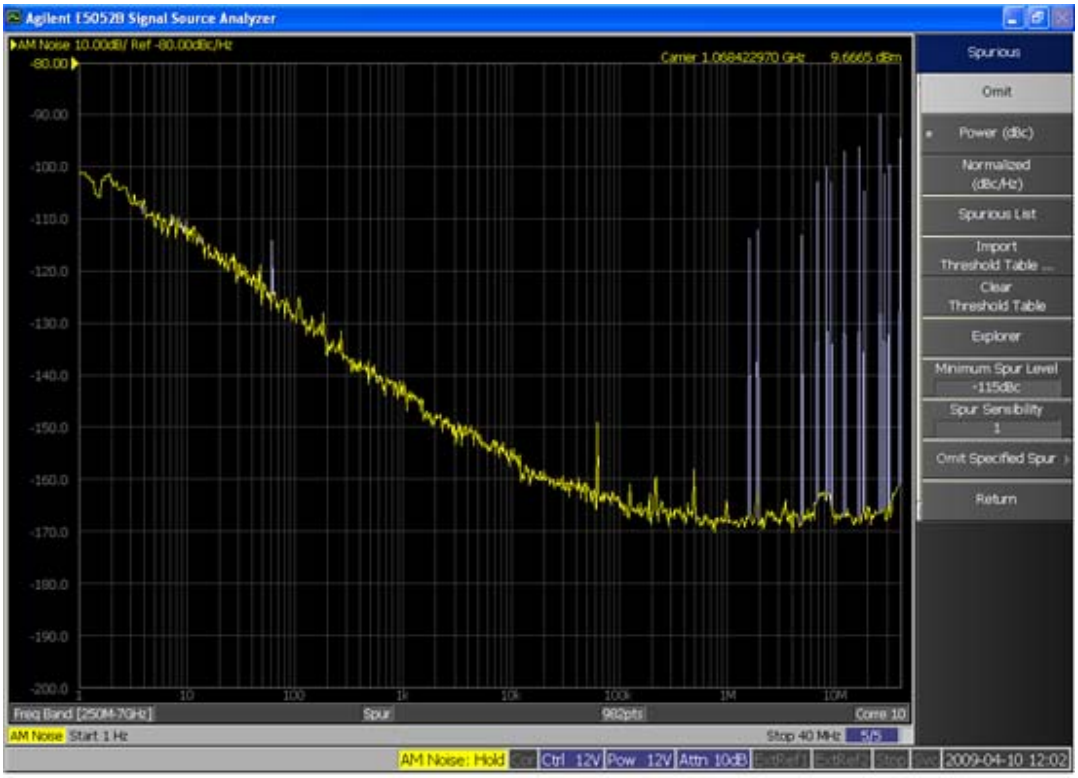


ssa0227

NOTE Generally, the measurement for the AM noise of a VCO requires considerable time because the AM noise level of a VCO is small as compared with its phase noise level.

Spurious

1. Press **Trace/View** > **Spurious** > **Power (dBc)**. Then set **Spur Sensibility** > **1** and **Minimum Spur Level** > **-115 dBc**.
2. Press **Scale** > **Auto Scale**.
3. Spurious are displayed by high light. Then press **Spurious List**, you can view response values for the spurious in a text file.



ssa0228

More Information

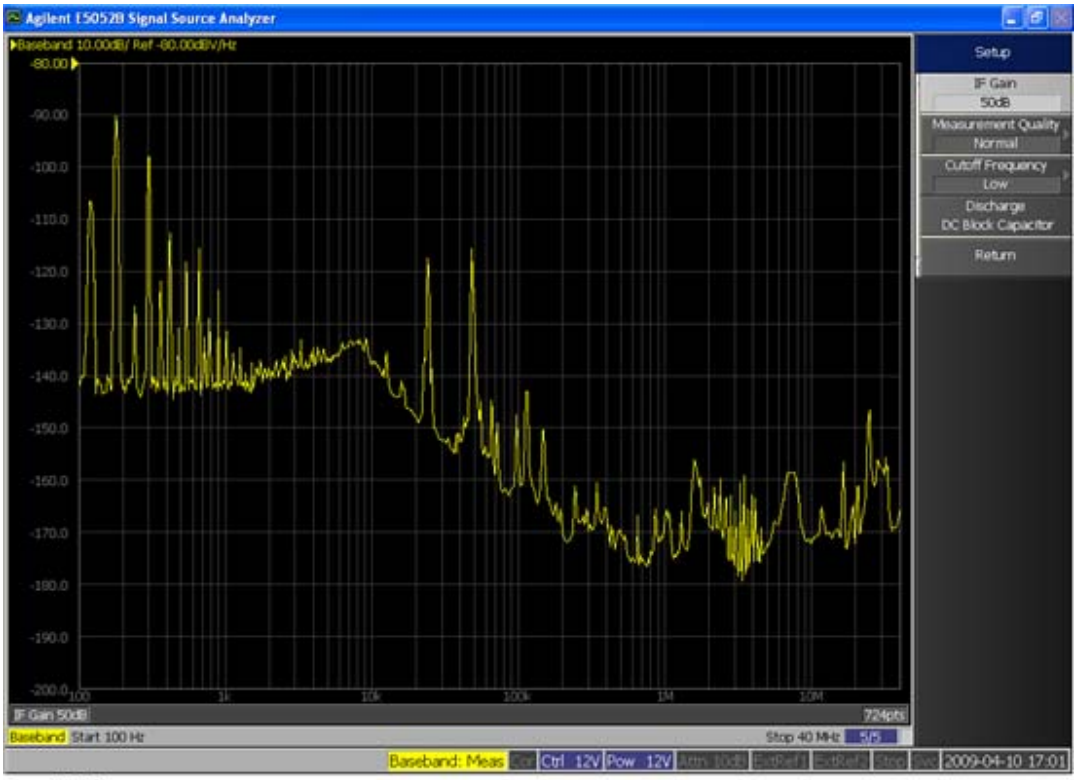
For more information about AM Noise Measurement, see AM Noise Measurement.

Baseband Noise Measurement for DC control source for VCO

Measurement Setup

1. Press **Meas/View** > **Baseband Noise** to select the Baseband noise measurement window. Press **Window Max** to maximize the window.
2. Press **Trigger** > **Trigger to Baseband Noise** > **Continuous** to start measurements.

3. Press **Trigger** > **Source** > **Internal**.
4. Connect the DC source (for a VCO Vtune) to the "BASEBAND IN" port with a BNC cable. Set the DC voltage to a control voltage value (12 V etc.) for the VCO.
5. Press **Start/Center** (**Stop/Span**), set **Start** > **1Hz** and **Stop** > **40MHz**.
6. Press **Setup** > **IF Gain** > **50 dB**. When "IF A/D overflow" is displayed, decrease 10 dB from the current IF Gain setting (Press **Setup** > **IF Gain**).
7. Press **Avg/BW** > **Avg factor** > **5**, and **Averaging** > **ON** to reduce fluctuation, then press **Averaging Restart**.
8. Press **Scale** > **Auto Scale**.



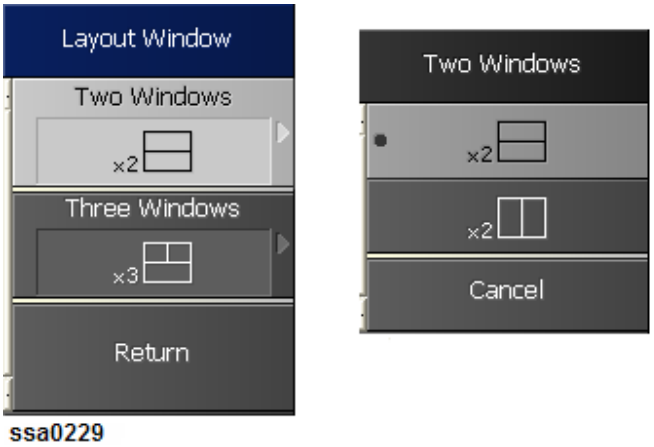
ssa0231

Analysis

Phase Noise vs Baseband Noise

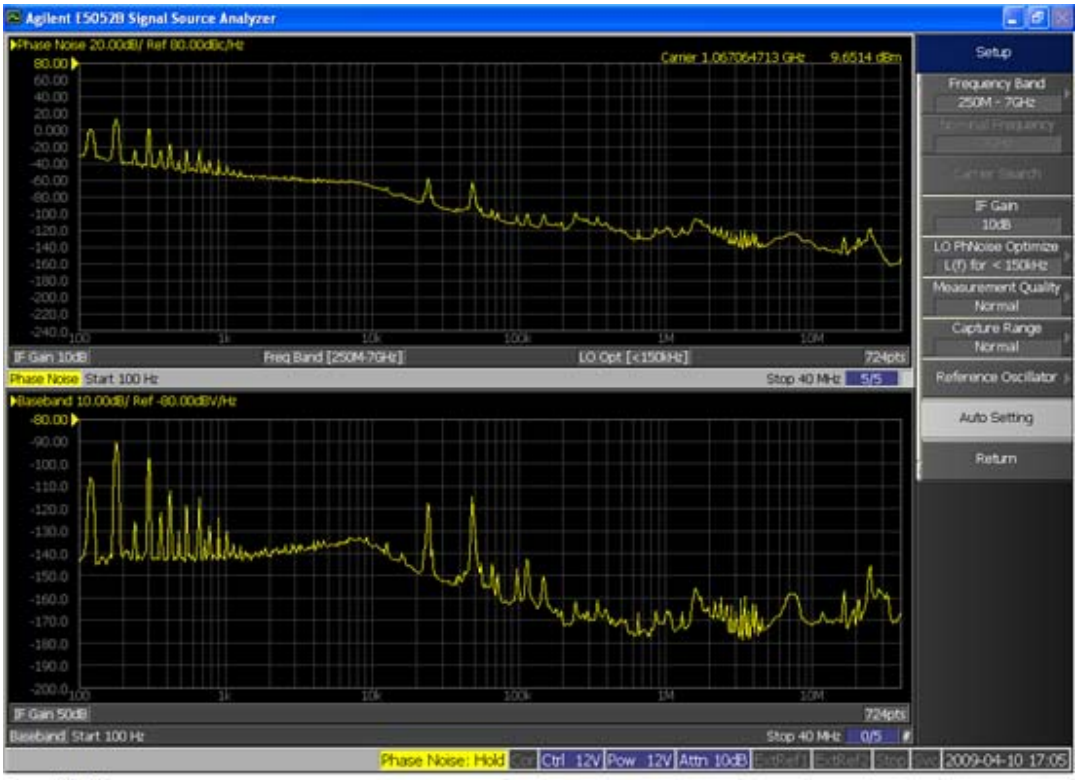
1. Connect the DC source to the VCO (Vtune) and connect the output of the VCO to the "RF IN" port of the E5052B.

2. Press **Meas/View** > **Show Window** > **Layout Window** > **Two Windows** and then press the following screen layout.



ssa0229

3. Press **Meas/View** > **Show Window** > **Spectrum Monitor** to toggle **OFF**, and press **Freq & Power** to toggle **OFF**, **Transient** to toggle **OFF**, **AM Noise** to toggle **OFF**.
4. Press **Window Max** to display two measurement windows (Phase Noise and Baseband Noise) on the screen.
5. Press **Meas/View** > **Phase Noise** to select the phase noise measurement window.
6. Press **Trigger** > **Trigger to Phase Noise** > **Continuous** to start measurements.
7. Press **Trigger** > **Source** > **Internal**.
8. Press **Setup** > **Capture Range** > **Normal** for PLL method.
9. Press **Setup** > **Auto Setting**. When "IF A/D overflow" is displayed, please try to decrease 10 dB from the current IF Gain setting (Press **Setup** > **IF Gain**).
10. Press **Start/Center** (**Stop/Span**), set **Start** > **100Hz** and **Stop** > **40MHz**.
11. Press **Avg/BW** > **Avg factor** > **5**, and **Averaging** > **ON** to reduce fluctuation, then press **Averaging Restart**
12. Press **Scale** > **Auto Scale**



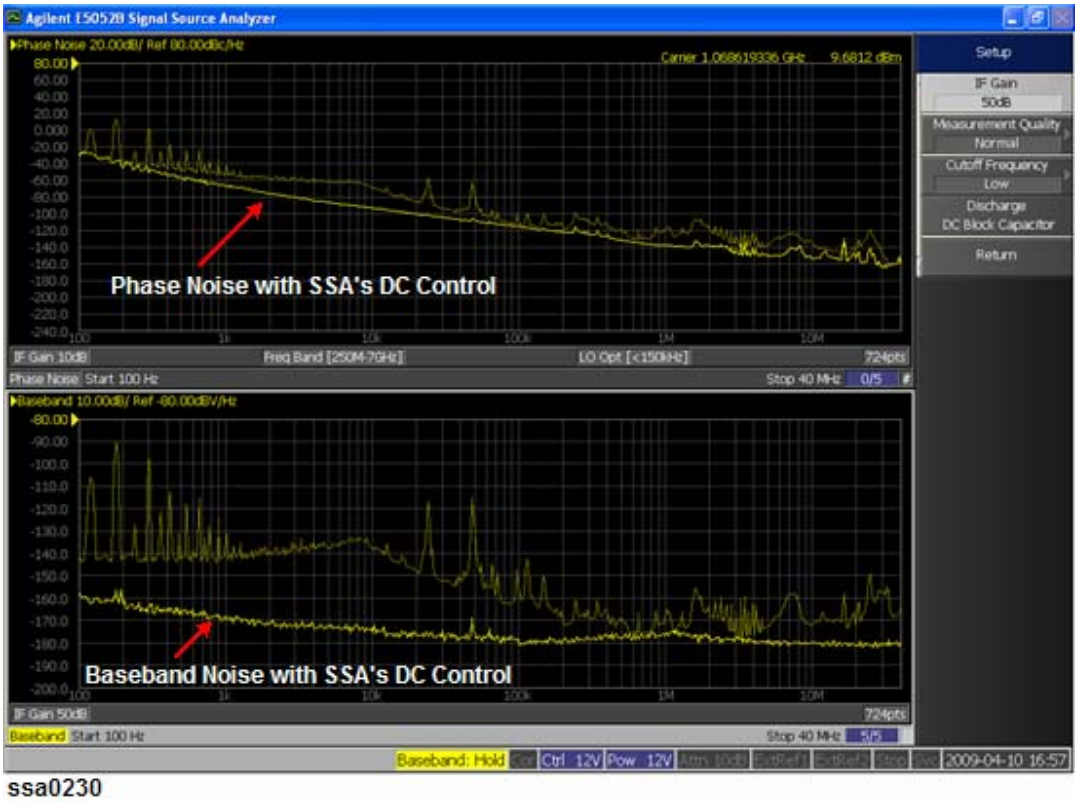
ssa0232

The phase noise of the VCO is highly affected by the noise itself from the DC source.

When a commercial DC source is used, the phase noise of the VCO controlled by the commercial DC source may not be properly measured.

When the DC control of the E5052B is used for the VCO, it enables the very accurate phase noise measurement for the VCO.

The data traces for the phase noise measurement window and baseband noise measurement window are the measurement results when the built-in DC control of the E5052B is used.



ssa0230

More Information

For more information about Baseband Noise Measurement, see Baseband Noise Measurement.

Transient Measurement for a PLL synthesizer (1.75 GHz)

It assumes that this PLL synthesizer has an output signal for frequency change trigger. It can be used for the E5052B as a trigger source (external). Also, it is assumed that the delay of the output for frequency change trigger to the output from the synthesizer's RF port is slight.

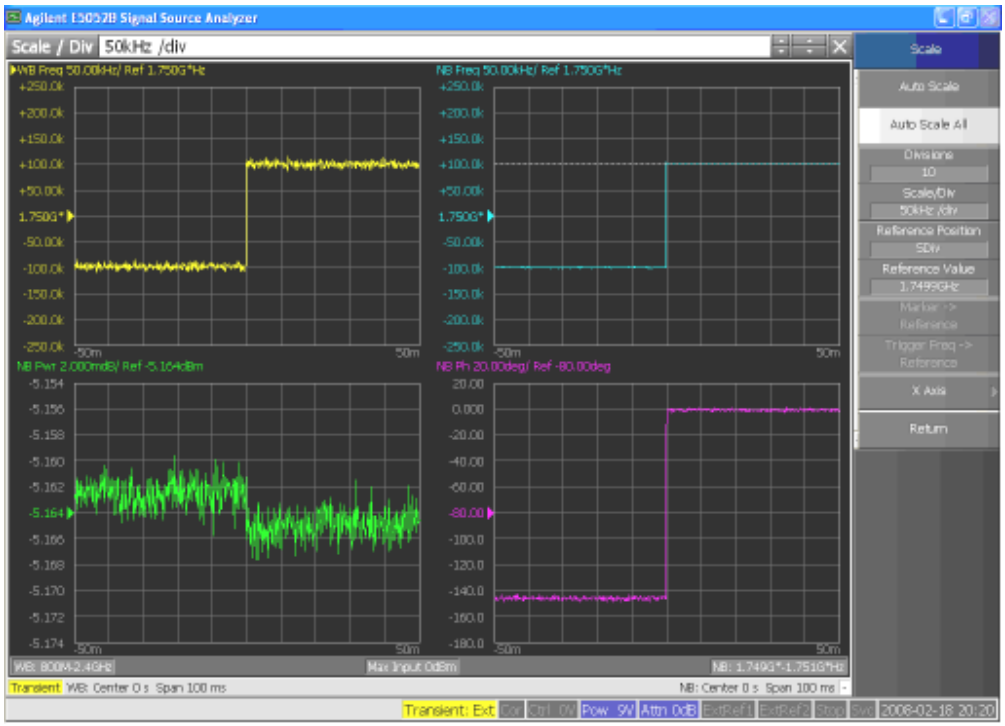
Measurement Setup

1. Press **Meas/View** > **Transient** to select the transient measurement window.
2. Press **Window Max** to maximize the window.
3. Press **Setup** > **Wide Freq Range** > **800 M – 2.4 GHz**, then press **Target requency** > **1.75GHz** and **Freq Range** > **1.6MHz**.
4. Press **Trigger** > **Trigger to Transient** > **Continuous** to start measurements. Then press **Source** > **External**.

5. Change the output frequency of the PLL synthesizer from 1749.8 MHz to 1750.0 MHz.

6. Press **Scale** > **Auto Scale All**.

7. Confirm the display is updated when the output frequency is 1.75 GHz.



Analysis

Frequency Transient (Optimize the E5052B display)

1. Press **Trace Next** key to select the WB Freq trace (upper-left trace), then press **Start/Center** > **Wide Span** > **100 ms**.

2. Press **Trace Next** key to select the NB Freq trace (upper-right trace), then press **Start/Center** > **Narrow Span** > **100 us** and **Narrow Time Offset** > **0 s**. (Span Setting is changed to 100.096 us)

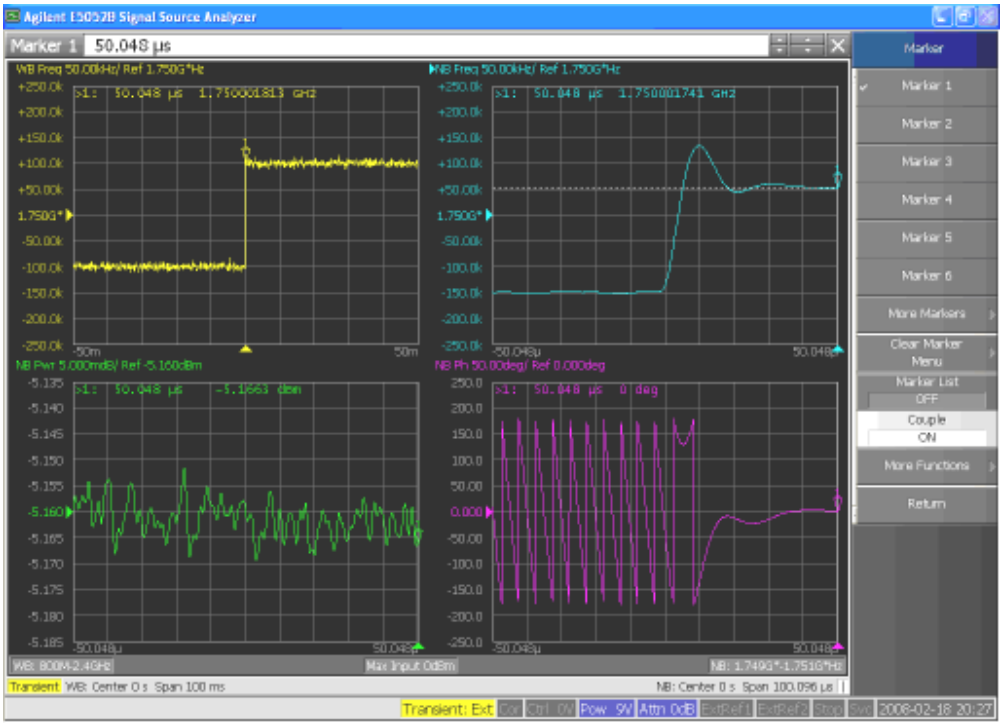
3. Change the output frequency of the PLL synthesizer to 1749.8 MHz, then change to 1750.0 MHz.

4. Press **Scale** > **Auto Scale All**. Confirm the NB Freq trace (frequency transient).

5. Press **Trace Next** key to select the NB Freq trace (upper-right trace), then press **Marker** and move Marker 1 to the right end of the frequency trace.

6. Press **Couple** to turn couple maker ON.

7. Press **Marker ->** > **Marker -> Target Freq** > **Marker -> Phase Reference**, then change the output frequency of the PLL synthesizer to 1749.8 MHz, then to 1750.0 MHz again. Phase trace is calculated from the phase reference frequency on the frequency trace.
8. Confirm that the phase is going to stable (nearly 0 degree) on the NB phase trace.



More Information

For more information about Transient Measurement, See Transient Measurement.

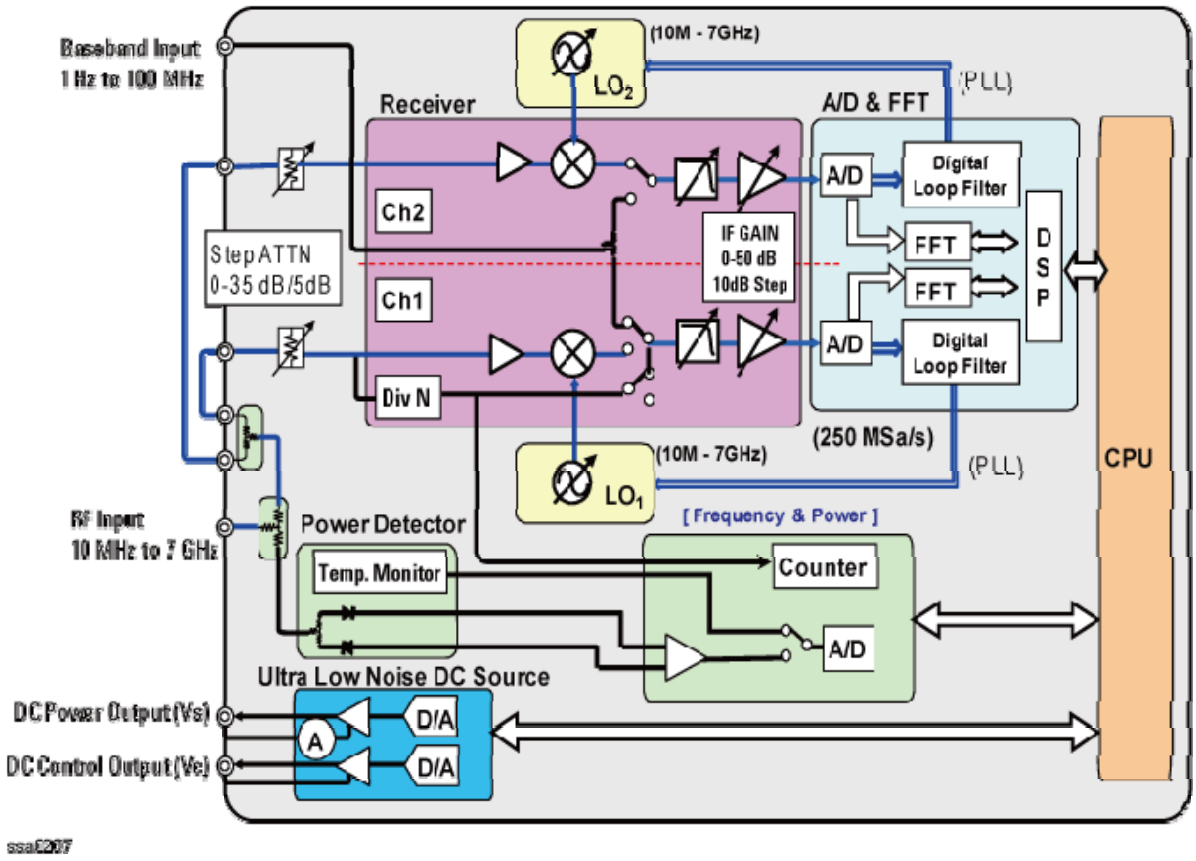
Overall Instrument Operation

- Block_Diagram_of_the_E5052B
- PLL Method for Phase Noise Measurement
- Heterodyne (digital) Discriminator Method for Phase Noise Measurement and AM Noise Measurement
- Cross-Correlation Technique
- Transient Measurement

Block Diagram of the E5052B

The E5052B consists of a DC source, a frequency counter, a power meter, two receivers (down converters and A/D & FFT), two local synthesizers and a digital control (CPU) section as shown in the following figure.

E5052B simplified block diagram



The DC source generates a dc power voltage and a dc control voltage for the DUT. The DC source section also monitors the current of the DC Power output.

The test signal from the DUT flows into the RF IN port. The signal is divided into two signals. One goes to the meter section. The other goes to the receivers section. The power meter section measures the RF input power level for RF power measurement.

The receiver section has two receivers. Each receiver converts the incoming signal into IF signals (or baseband signals) using the local synthesizer, and then digital data for each measurement function. The digital output data of the receiver section is transferred to the digital control section. One receiver also transmits the incoming signal to the frequency counter section. The frequency counter section measures the frequency of the signal.

The digital section controls the analog measurement section as well as calculates the measurement items (parameters) of the DUT from the digital output data of

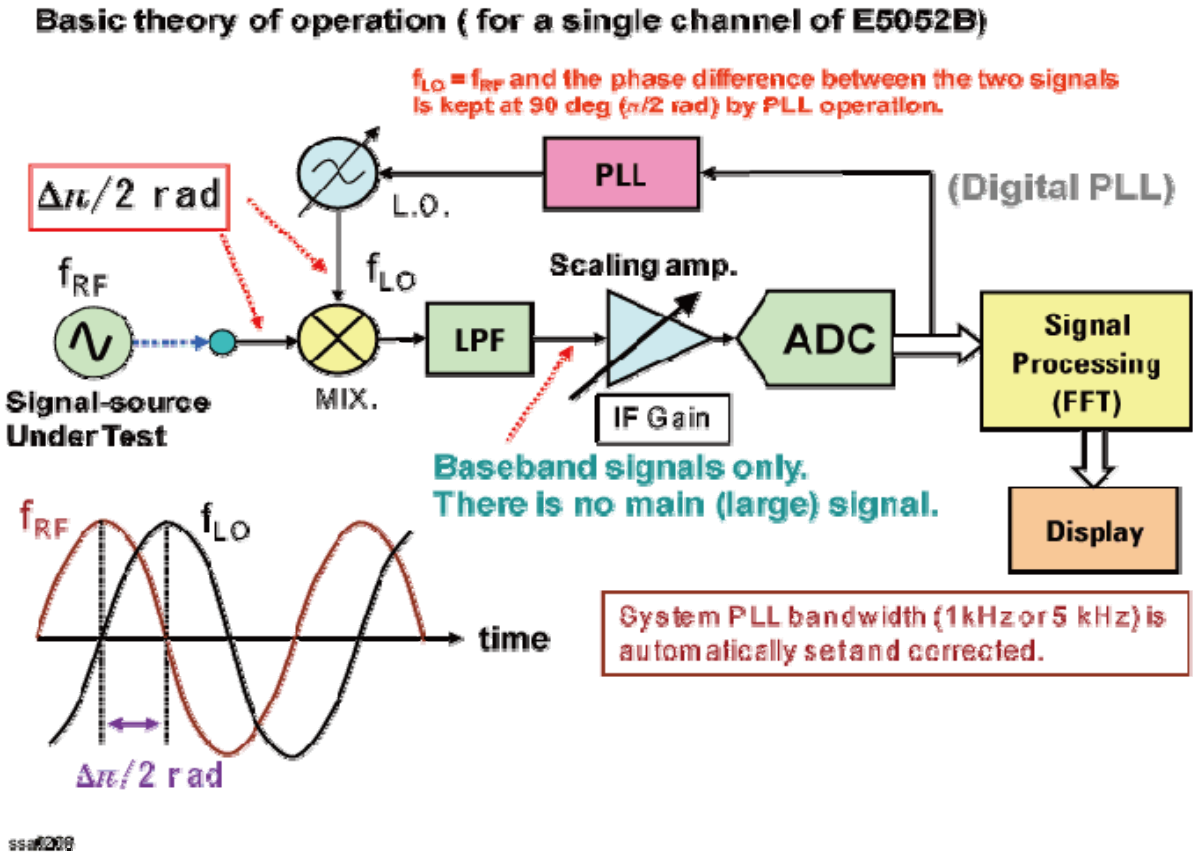
the receivers. The calculated results are transferred to the display section and visualized by means of the color LCD.

PLL Method for Phase Noise Measurement

The E5052B has two phase noise measurement modes, a normal capture range and a wide capture range, and a cross correlation technique with two independent measurement channels is available for both modes.

The normal capture range takes a PLL (direct homodyne) method show in the following figure.

The PLL (direct homodyne) method for PN (Normal)



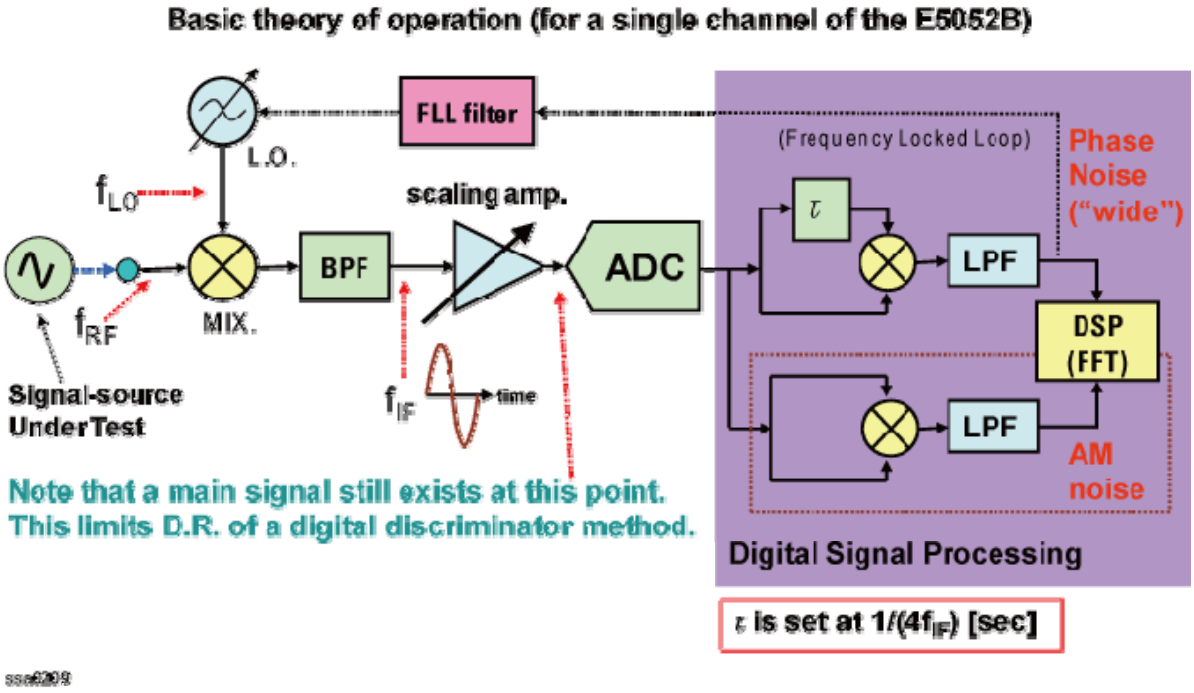
With a PLL method, local oscillator's frequency (f_{LO}) is always same as a frequency (f_{RF}) of signal source under test and the phase difference between the two signals (f_{LO} and f_{RF}) is kept at 90 degree (pi/2 radian) by Digital PLL (Phase Locked Loop) operation. Then, an output of LPF is baseband signals only, there is no main (large) signal. The baseband signals converted into digital data are calculated measured by FFT. For very quiet signal sources, exceptionally stable local reference oscillators, the normal capture range mode can satisfy any requirements of ultra-low phase noise or jitter measurement.

Heterodyne (digital) Discriminator Method for Phase Noise Measurement and AM Noise Measurement

The E5052B has two phase noise measurement modes, a normal capture range and a wide capture range, and a cross correlation technique with two independent measurement channels is available for both modes.

The wide capture range takes a heterodyne (digital) discriminator method shown in the following figure.

The Heterodyne (digital) discriminator method for PN (wide) and AM noise measurements



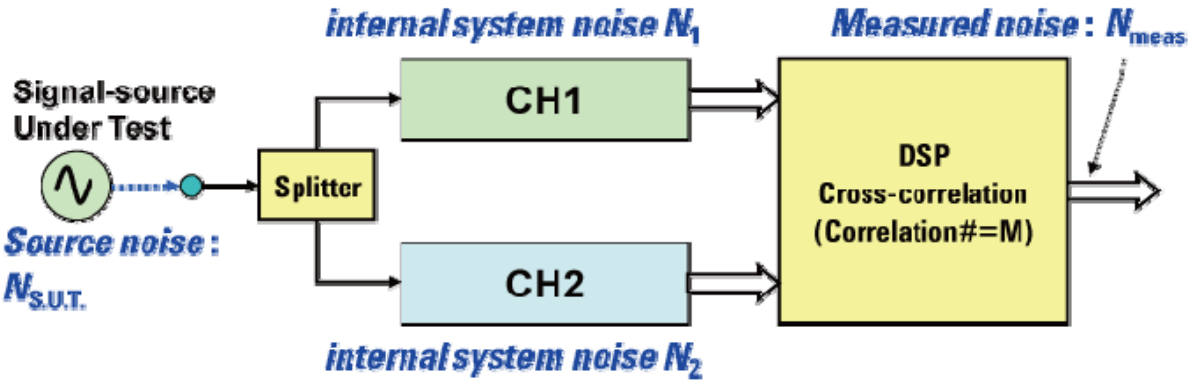
The RF signal of Signal source under test is converted into an IF signal (f_{IF}), then the IF signal leveled properly by the scaling amplifier goes to ADC. The frequency of the IF signal is kept by a FLL (Frequency Locked Loop). In Phase Noise (wide) of purple zoom, Digital Signal Processing separates the captured IF signal by ADC to V1(t) (signal input to mixer directly) and V2(t) (signal delayed in tau). And set delay time (tau) to get the phase difference at 90 degree between V1(t) and V2(t) into the mixer. The delay time is set at $1/(4f_{IF})$. After the LPF, digital signal processing provides the low frequency baseband components of the product of V1(t) and V2(t). The baseband components are calculated by the FFT. For noisy signal sources or drifty oscillators, the wide capture range mode provides reasonable measurement uncertainty and dynamic range in case the normal capture range mode does not work well.

The heterodyne (digital) discriminator method also provides very easy and accurate AM noise measurements (by setting the delay time zero) with the same setup and RF port connection as phase noise measurement.

Cross-Correlation Technique

The cross correlation technique for noise floor reduction is used widely in the E5052B. The basic theory of operation for cross-correlation calculation is traditionally well-known as shown in the following figure. The E5052B implemented this principle by a highly sophisticated manner and enabled its real time operation on display.

Two-channel cross correlation technique



$$N_{meas} = N_{S.U.T.} + (N_1 + N_2)/\sqrt{M}$$ Assuming N_1 and N_2 are uncorrelated.

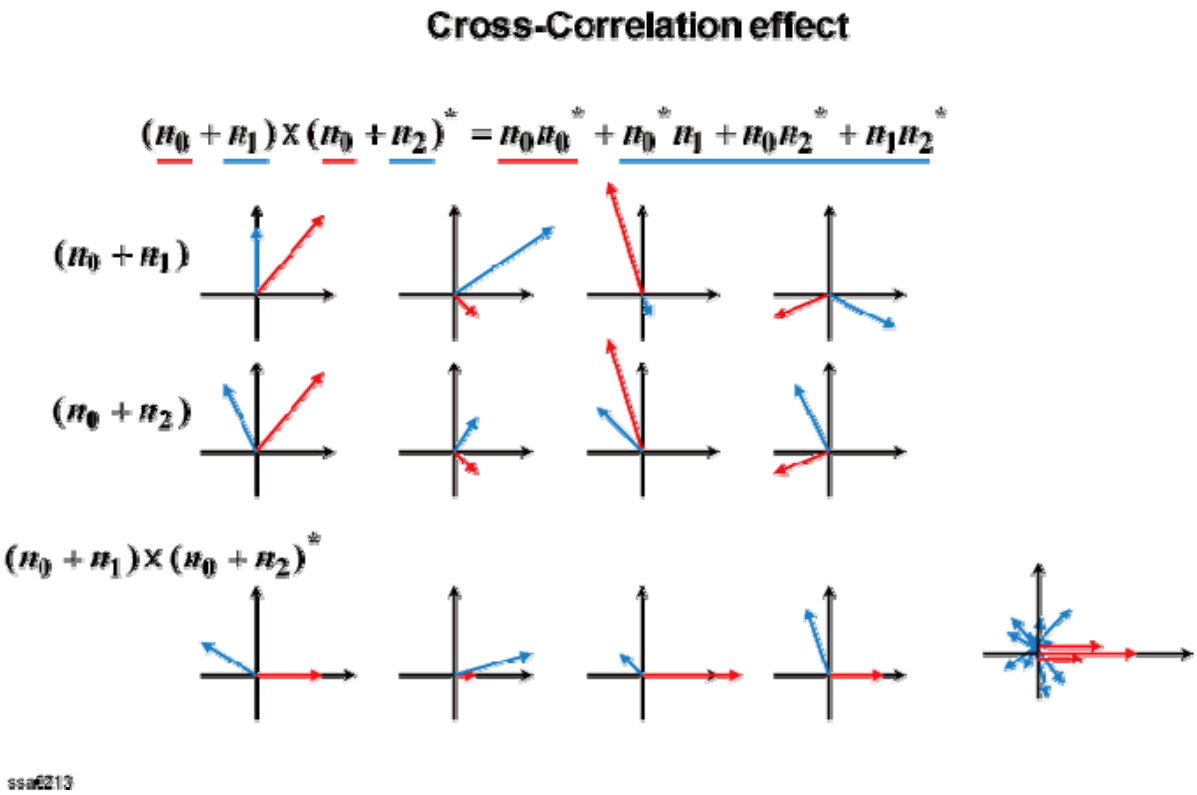
M (number of correlation)	10	100	1,000	10,000
Noise reduction on (N_1+ N_2)	-5dB	-10dB	-15dB	-20dB

ssa0210

The cross correlation technique uses two signal-channel measurement systems. Only the coherent noise present in both channels will average to a finite value. The time average of the incoherent noise will approach zero as $M^{-1/2}$, where M is the number of average. The measured phase noise of the system is represented as the equation shown in the figure.

The diagram in the effect of Cross Correlation is show in the following figure.

Cross-Correlation effect



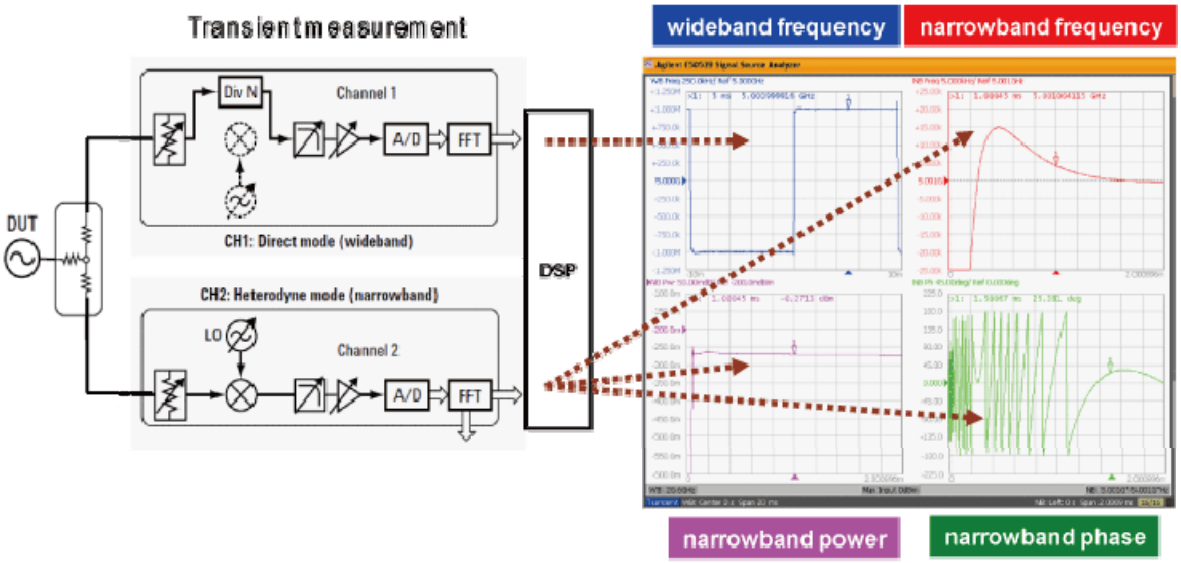
ssa6213

The expression (n_0+n_1) means the noise (source noise n_0 and internal system noise n_1) of the channel 1. The expression (n_0+n_2) means the noise (source noise n_0 and internal system noise n_2) of the channel 2. The mark "*" means complex conjugate and all noise parameters are random complex variables. The red arrows show noise phasors of the source noise. The blue arrows show internal noise phasors and assuming n_1 and n_2 are uncorrelated. After summing up all noise phasors, the internal noise phasors cancel out each other and only the source noise phasors remain.

Transient Measurement

The E5052B has two independent measurement channels for its transient measurement as shown in the following figure. Each channel takes a different method for measuring a signal’s frequency simultaneously.

Wide-Narrow Band Mode

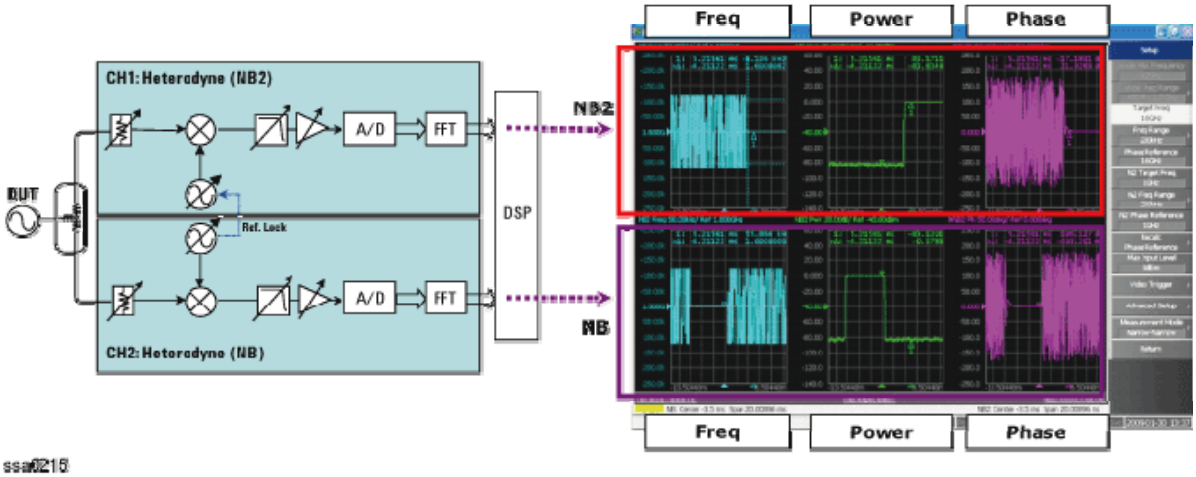


ssa0211

Direct mode (wide band) contains a frequency divider to translate the frequency of signal source under test into a lower frequency, and then it directs to ADC for signal sampling.

In Heterodyne mode (narrow band), the RF signal of the signal source under test is converted into an IF signal and then the IF signal goes to ADC. Both wide band and narrow band modes operate completely in parallel, the E5052B enables observation of the entire picture of frequency changes and detailed transient response in frequency/phase/power at the same time.

Narrow-Narrow Band Mode

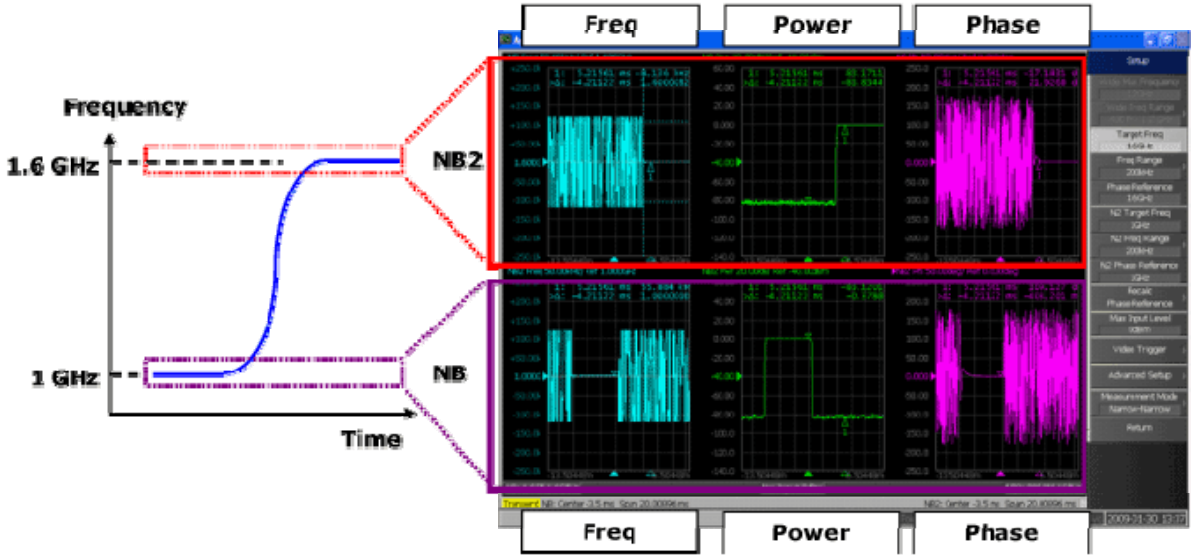


ssa0215

Each channel works in Heterodyne mode as shown in the figure above. The frequency range in both channels can be set as identical or differently. Two LOs

have the same time base as one is locked to another. Both channels operate completely in parallel.

The figure is an example of 600 MHz frequency jump (It hops from 1 GHz to 1.6 GHz in a few milliseconds) measurement using Narrow-Narrow band mode. (See bellow)



ssa0216

Unlike the Wide-Narrow band mode, detailed transient response at the start as well as the stop frequency can be observed. (See bellow)

Zooming traces for the analysis of detailed transient response at start and stop frequency