Keysight E5072A ENA Series Network Analyzer

Amplifier Measurement Wizard for E5072A

Operation Manual and Demo Guide

Rev. 01.01

October 2014

Notices

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Sample Program

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Overview of the program

The E5072A Amplifier Measurement Wizard VBA macro assists setting measurement conditions for amplifier tests.
This program has 3 measurement classes; S-parameter and K-factor measurement, Harmonics, and Gain Compression (CW / Swept). Each measurement class has 3 modes; Standard mode, Direct Receiver Access mode, and Advanced mode to simplify the measurement process according to your needs.

Program Description

Program title	Amplifier Measurement Wizard
VBA File Name	E5072AAmplifierWizard_0101.vba
Revision	Rev.01.01

Supported ENA models and firmware

Models	**Firmware**
E5072A	Rev.1.01 or later

Required external instruments

- Power meter and power sensor

Measurements supported in the Wizard

- S-parameter measurements
- Harmonic measurements (E5072A Opt 008 FOM is required)
- Gain compression measurements (CW / Swept)

Starting VBA Program

Step1. Copy VBA file to local drive of E5072A.

Step2. Press Macro Setup on the front panel.

Step3. Press **Load Project** and load VBA file.

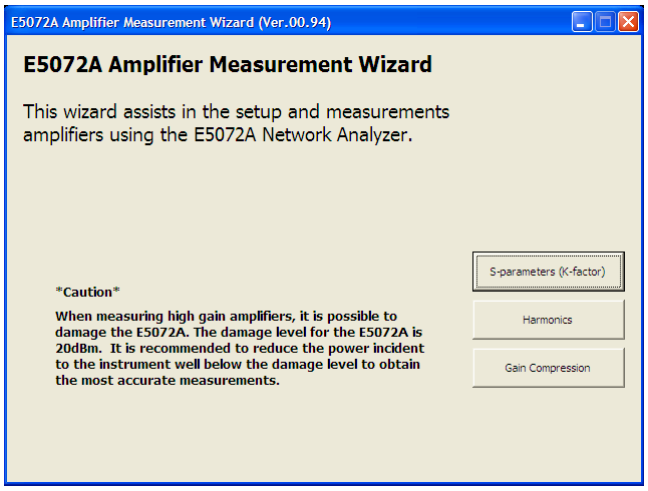
Step4. Press Macro Run on the front panel.

*If you have question on each function of the E5072A, press "?" button on the wizard. Help file will be appeared.

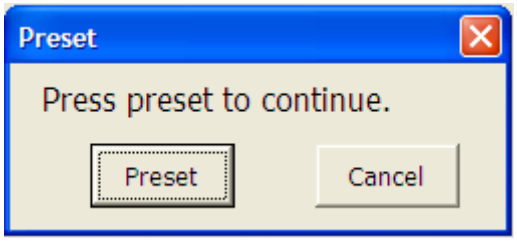
VBA Procedure: Startup Dialogue

The VBA starts with the dialogue shown in right side. The measurement type can be selected with this dialog. The procedure of the wizard and measurement result for each measurement type is described from next page.

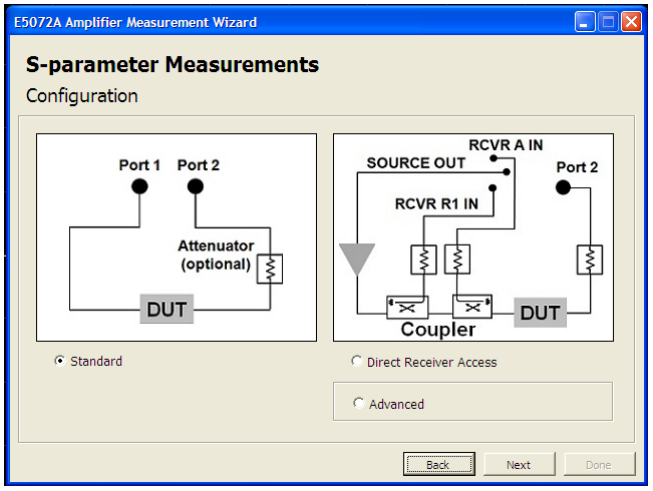
(Note: If the measurement wizard dialogue gets behind the ENA application during the operation, press [Focus] hard key on ENA.)



After you selecting the class, the message box will appear and press OK to proceed.



Select configuration from Standard mode, Direct Receiver Access mode, and Advanced mode. Standard mode supports measurements without direct receiver access. Direct Receiver Access mode supports measurements with configurable test set. And Advanced mode allows you to make measurements with flexible setup.

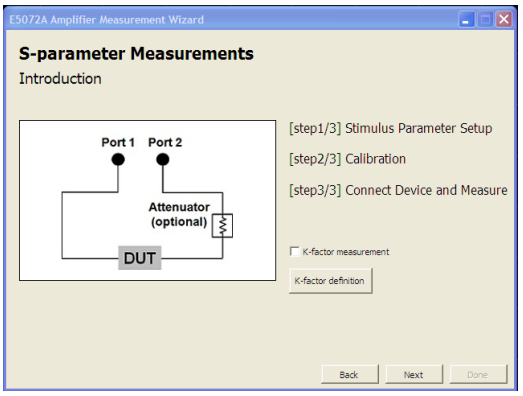


VBA Procedure: S-parameter Measurements

Introduction

If you check “K-factor-measurement” check box, you can measure the K-factor as well as the S-parameters.

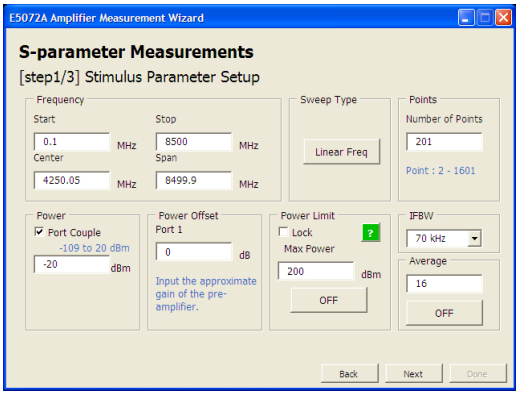
By pressing the “K-factor definition” button, the definition of the K-factor is displayed.



[step1/3] Stimulus Parameter Setup

You can set the following parameters.

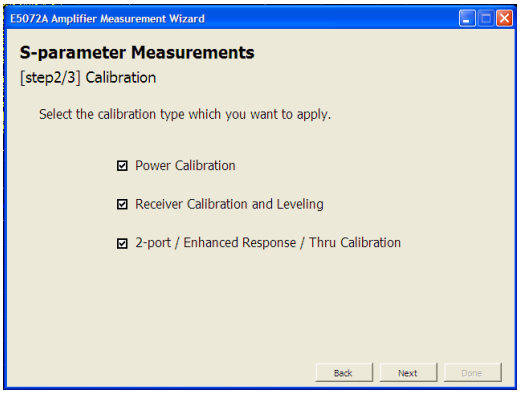
- Frequency
- Sweep type (Lin/Log)
- Number of points
- Power (coupled / uncoupled)
- Power offset (except for standard mode)
- Power Limit
- IFBW
- Averaging



[step2/3] Calibration

You can carry out the following calibrations, and set receiver leveling and fixture simulator.

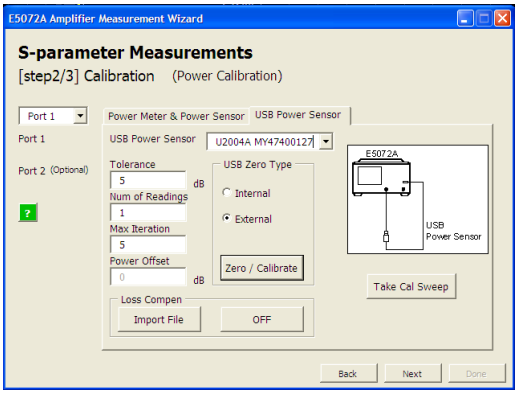
- Power calibration
- Receiver calibration (except for standard mode)
- Receiver leveling (except for standard mode)
- 2-port / Enhanced Response / Thru Calibration and fixture simulator



- Power calibration

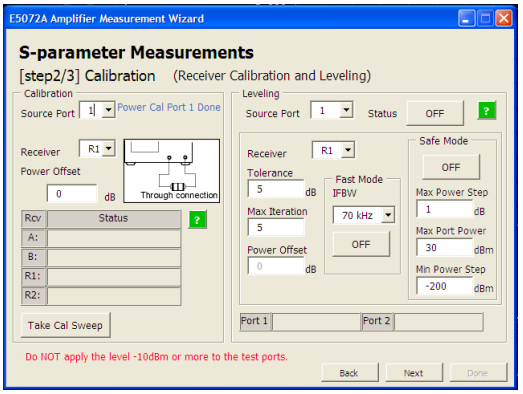
  ➢ You can choose power sensor & power meter or USB power sensor by tab menu.

  ➢ Loss compensation function can be applied in direct receiver access mode and advanced mode.



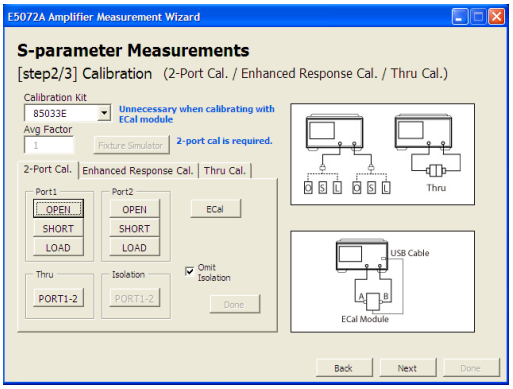
- Receiver calibration and receiver leveling

  ➢ Basically this is for direct receiver access mode. With this receiver leveling function, you can achieve greater source power level accuracy. For accurate leveling, apply receiver calibration.

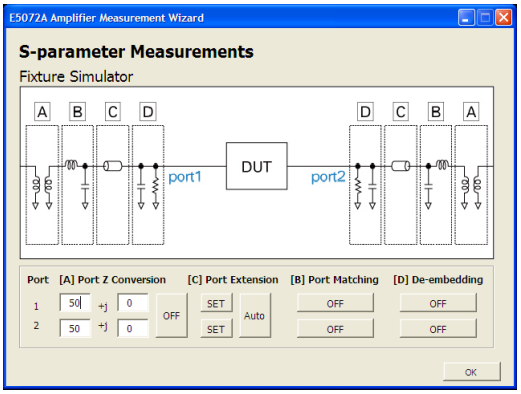


- 2-port / Enhanced Response / Thru Calibration

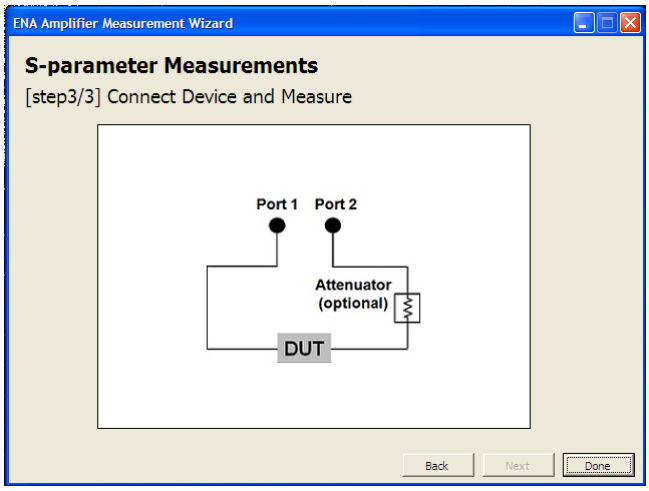
  ➢ You can select the method from full 2-port cal, enhanced response cal, and thru cal by tab menu.



  ➢ Fixture simulator (port Z conversion, port extension, embedding, and de-embedding) can be applied when the full 2-port cal is performed. For de-embedding, the touchstone file (*.s2p) should be prepared beforehand.

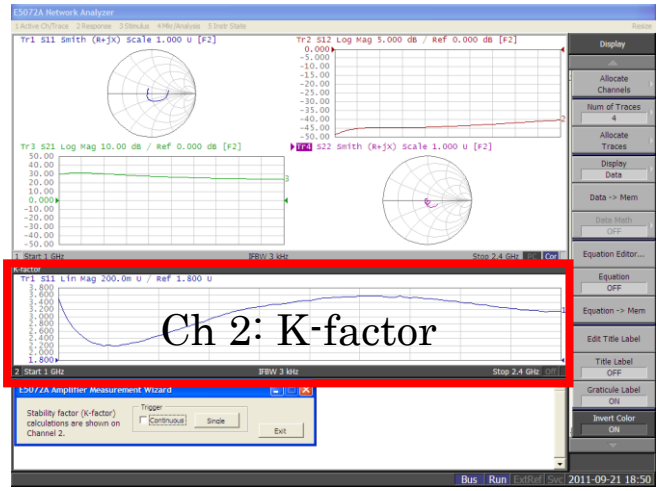


[step3/3] Connect Device and Measure



Measurement result (With K-factor)

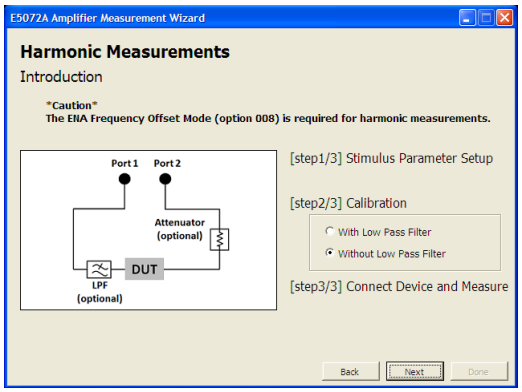
The K-factor measurement is performed every time after the sweep. The K-factor is drawn at Ch2 by the VBA.



VBA Procedure: Harmonics Measurements

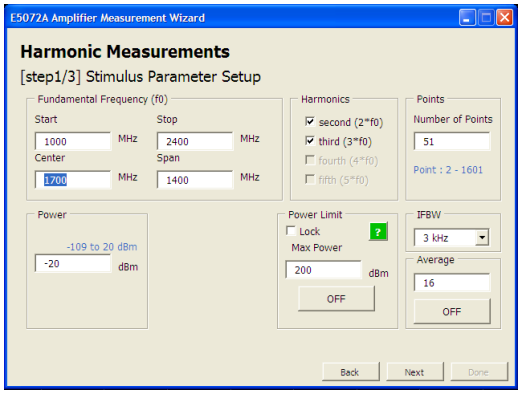
Introduction

You can measure the harmonics of the amplifier with/without low pass filter (LPF) which is used to eliminate the harmonics of the source signal.



[step1/3] Stimulus Parameter Setup

The harmonics of the fundamental frequency can be set with this step. If the frequency for the measurement is not enough, the checkbox for the harmonics will be disabled automatically. And you can set the power, the number of points, IFBW, averaging, power limit, and power offset (except for standard mode).

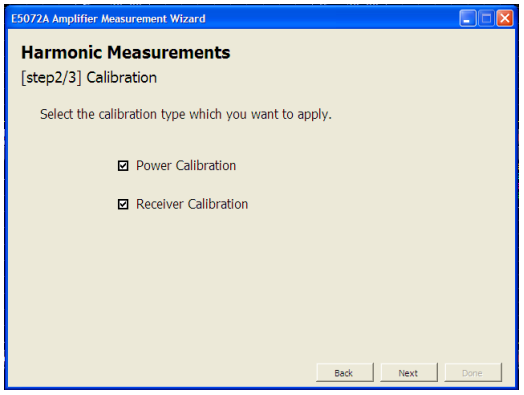


[step2/3] Calibration

You can perform power calibration, receiver calibration, and receiver leveling. The procedure depends on the condition.

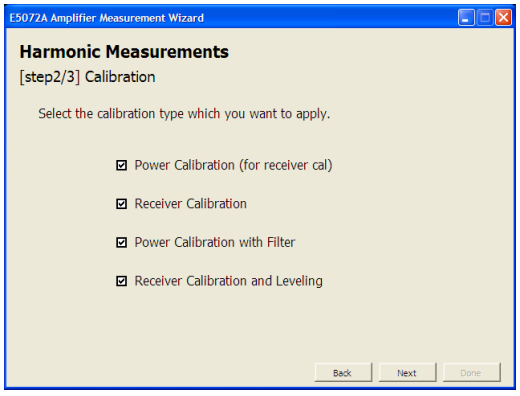
For standard mode, measurement without filter

- Calibration process is as follows:
  - ➢ Power calibration for wide frequency range
  - ➢ Receiver Calibration



For other configuration

- Calibration process is as follows:
  - ➢ Power calibration for receiver calibration
  - ➢ Receiver calibration
  - ➢ Power calibration for input power
  - ➢ Receiver calibration for leveling and setting for receiver leveling. (except for standard mode)

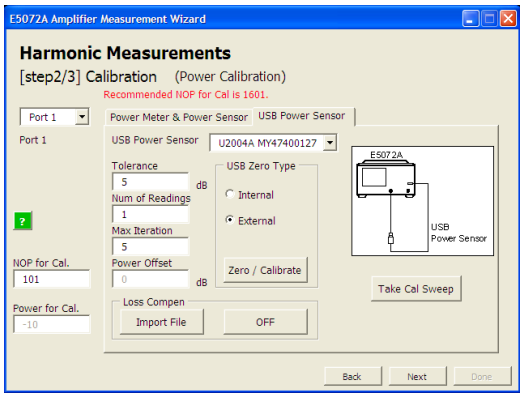


- Calibration for “standard mode without filter” measurement

➢ Power calibration for wide frequency range

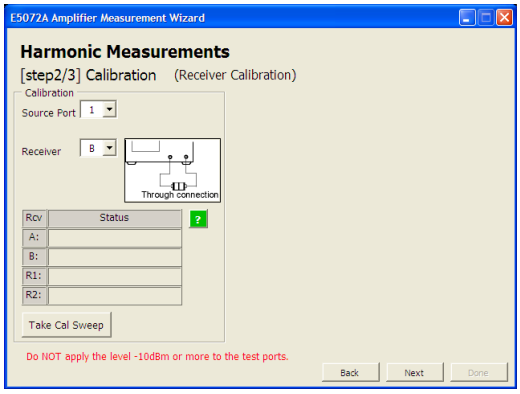
✧Power calibration is carried out from the start frequency of the fundamental to the stop frequency of the harmonics at once.

✧You can set the number of point for this power calibration. For accurate measurement, 1601 points is recommended (but it will take longer time).



➢ Receiver calibration (measurement without filter in standard mode)

✧Receiver calibration is applied for each channel.



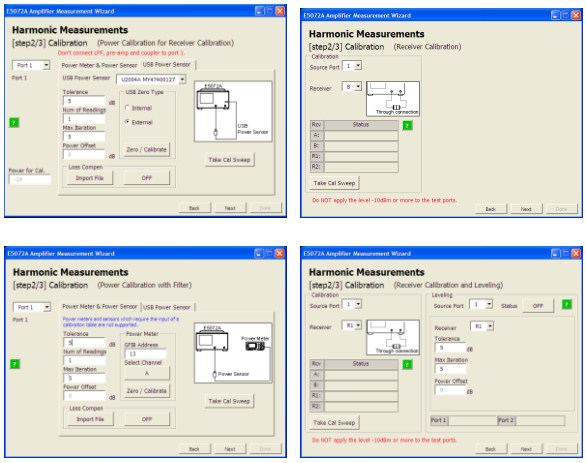
- Calibration for other configuration.

➢ To calibrate the receiver, calibrate the source signal without external parts such as low pass filter, coupler, and pre-amplifier.

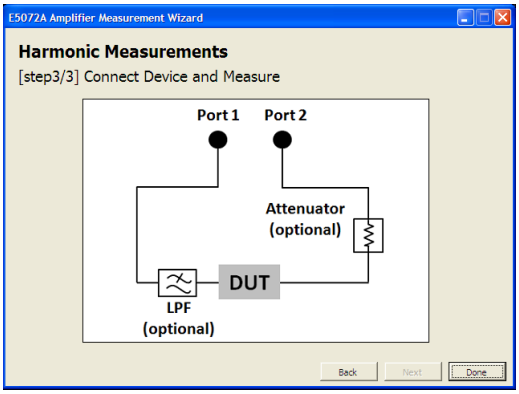
➢ Calibrate the receiver B with calibrated source from port 1.

➢ Re-calibrate the source from port 1 with external parts.

➢ Calibrate the receiver R1 when you want to use receiver leveling function.

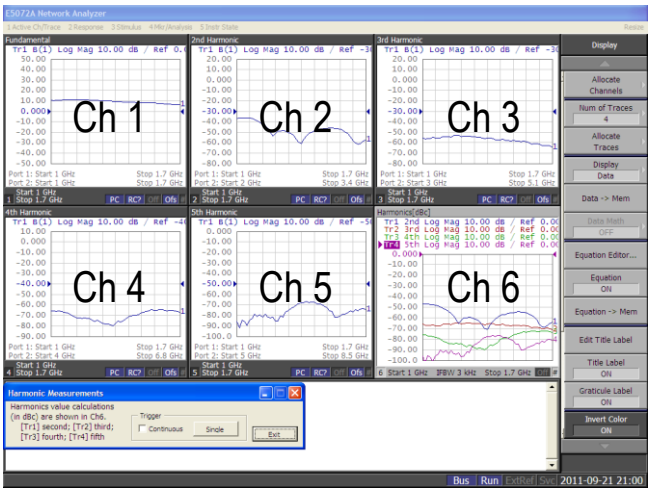


[step3/3] Connect Device and Measure



Measurement result

On CH1, the absolute power [dBm] of the fundamental frequency is displayed. Also, the VBA draws the absolute power [dBm] of each harmonics frequency on Ch2-Ch5. On Ch6, the VBA overlays the harmonics value compared to the fundamental power [dBc].

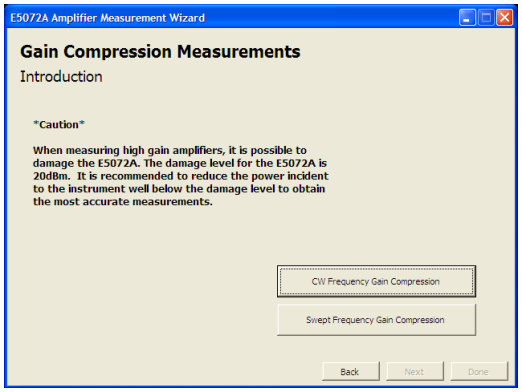


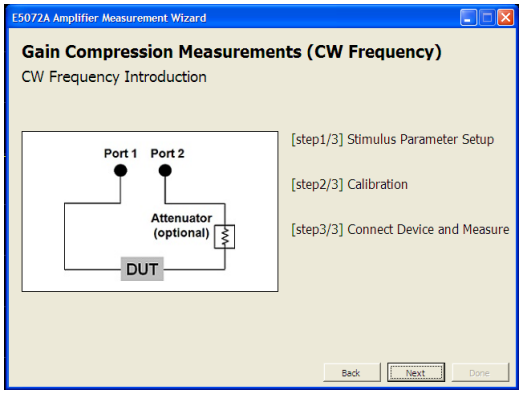
VBA Procedure: Compression Measurements (CW)

Introduction

First of all, you need to select CW frequency on this step. On the CW frequency, the ENA performs power sweep on single frequency, then calculate the gain compression.

Then, select the configuration from standard, direct receiver access, or advanced.

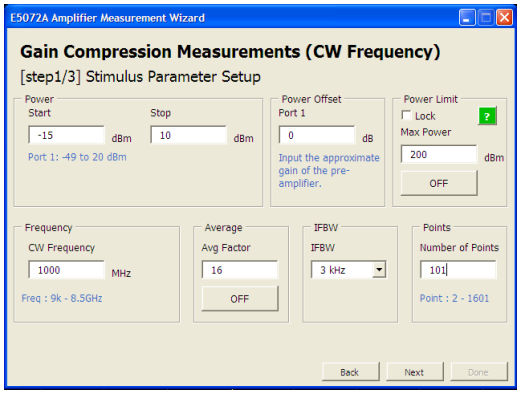




[step1/3] Stimulus parameter setup

You can set the following parameters.

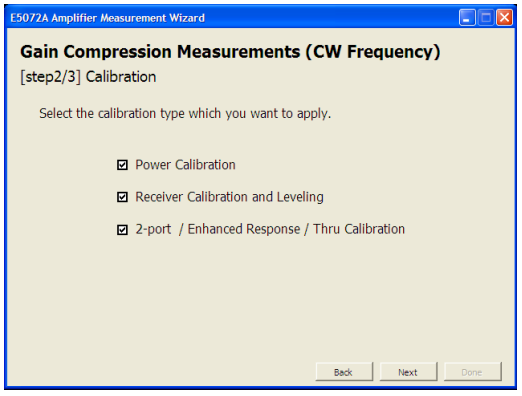
- Power sweep range
- Power offset (except for standard mode)
- Power limit
- CW frequency
- Averaging
- IFBW
- Number of points



[step2/3] Calibration

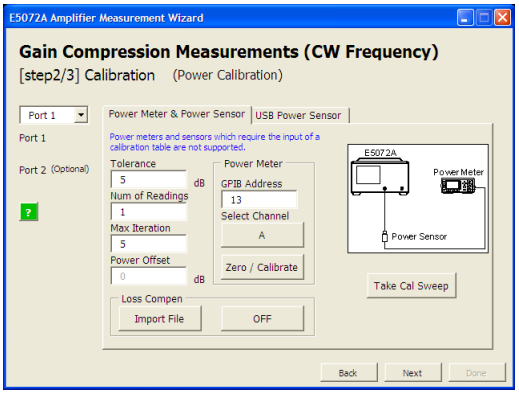
You can carry out the following calibrations and functions:

- Power calibration
- Receiver calibration
- Receiver leveling (except for standard mode)
- 2-port / Enhanced Response / Thru Calibration



- Power calibration

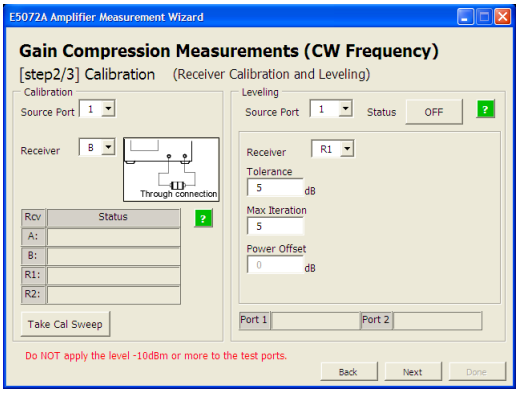
  ➢ Calibrate the source power.



- Receiver calibration and leveling

  ➢ To measure output power with absolute measurement, receiver calibration for B is recommended.

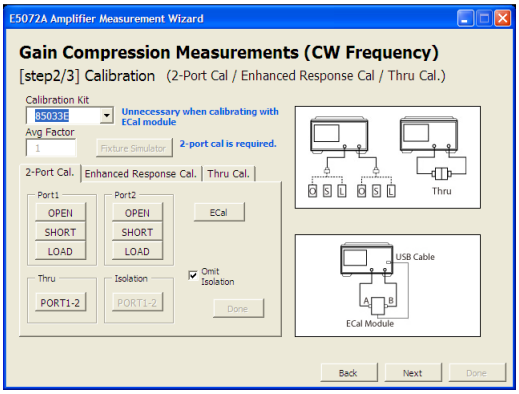
  ➢ When you choose direct receiver access mode and if you want to apply receiver leveling, receiver calibration for R1 is recommended.



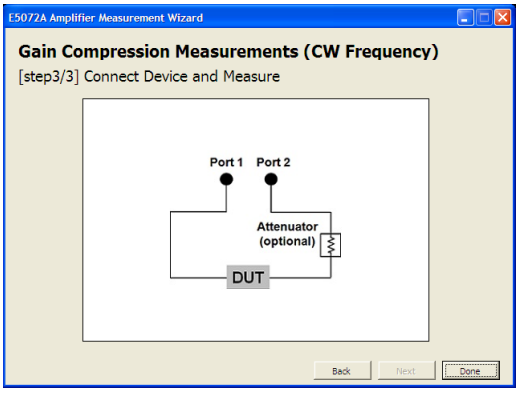
- 2-port / Enhanced Response / Thru Calibration

  ➢ You can select the method from full 2-port cal, enhanced response cal, and thru cal.

  ➢ Fixture simulator (port Z conversion, port extension, embedding, and de-embedding) can be applied when the full 2-port cal is applied. For de-embedding, the touchstone file (*.s2p) should be prepared beforehand.



[step3/3] Connect Device and measure

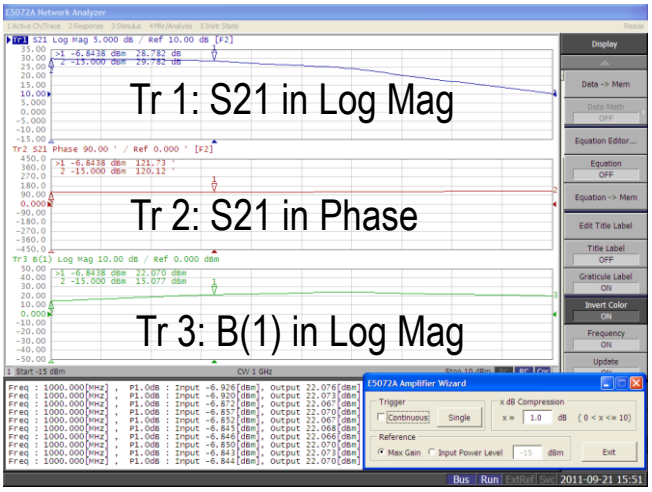


Measurement result

This mode shows the S21 (gain) in Log Mag format as Tr1, phase of the S21 as Tr2, and absolute measurement result (B(1)) as Tr3.

You can check both “input level” and “output level” for the Px dB calculation. You can change the compression value “x” from 0 to 10. The input level simply shows the input power of the DUT (source power of the ENA) where the PxdB compression occurs. The output level shows output power where the Px dB compression occurs.

You can choose the reference value from the “Max Gain” and “Input Power Level”. Max Gain means that VBA uses the max value of the trace as reference. When you choose Input Power Level, you can set the power level of the input power for the DUT and the output value of that is used as reference.



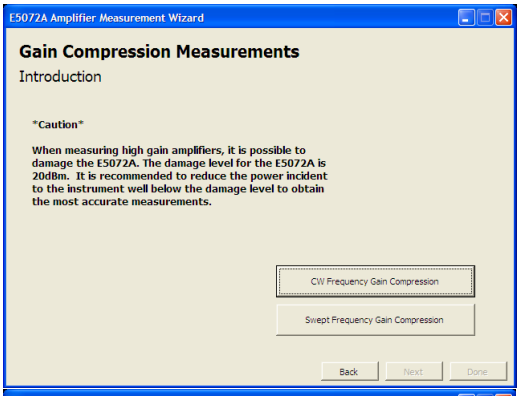
Note that the PxdB calculation uses marker on the Tr1, and the Tr1 should be activated when the VBA calculates the PxdB. If you change the active trace to Tr2, the VBA does not work properly.

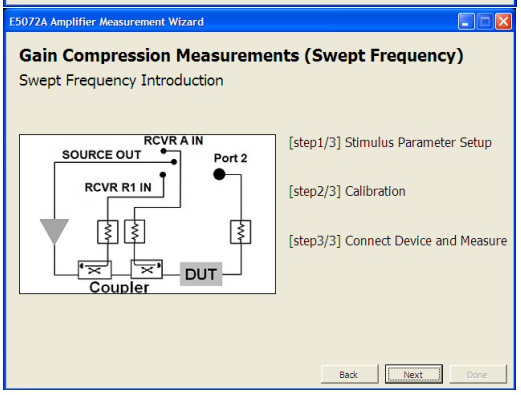
VBA Procedure: Compression Measurements (Swept frequency)

Introduction

You need to select Swept frequency on this step. On the Swept frequency mode, the ENA performs power sweep on single frequency for each frequency point, then calculates the Px dB for each frequency, and then plots the frequency dependency of the Px dB on channel 2.

After selecting the swept frequency, select configuration from standard, direct receiver access, or advanced.

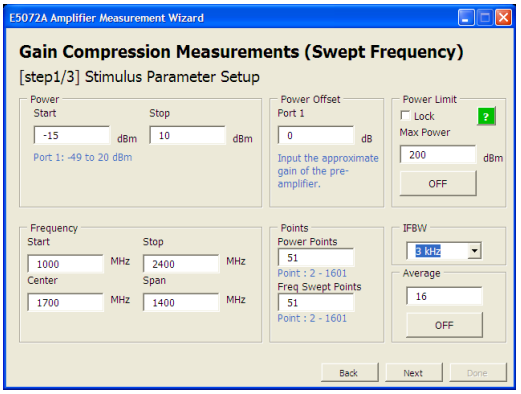




[step1/3] Stimulus parameter setup

You can set the following parameters.

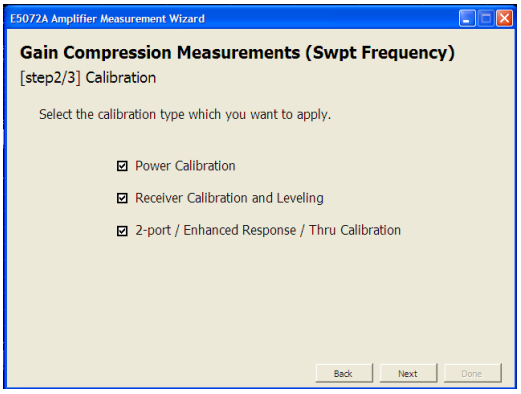
- Power range
- Frequency range
- Power offset (except for standard mode)
- Power Limit
- Points for power sweep and frequency swept
- IFBW
- Averaging



[step2/3] Calibration

You can carry out the following calibrations and functions:

- Power calibration
- Receiver calibration
- Receiver leveling (except for standard mode)
- 2-port / Enhanced Response / Thru Calibration

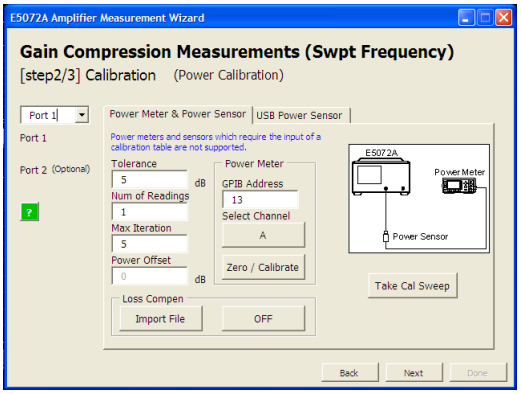


- Power calibration

  ➢ Calibrate the source power.

  ➢ You can choose power sensor & power meter or USB power sensor by tab menu.

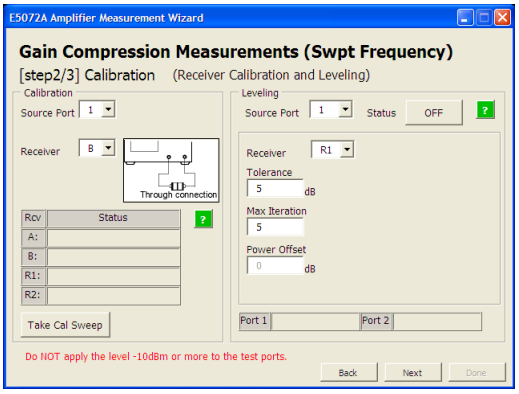
  ➢ Loss compensation function can be applied in direct receiver access mode and advanced mode.



- Receiver calibration and leveling

  ➢ To measure output power with absolute measurement, receiver calibration for B is recommended.

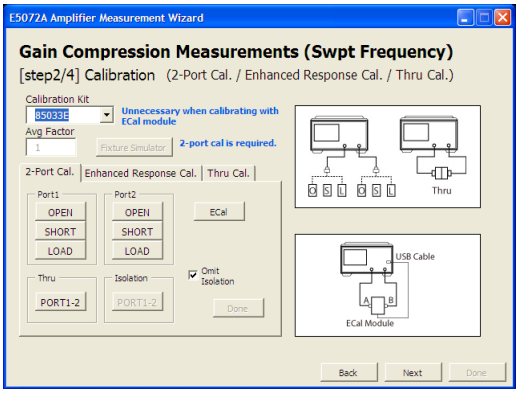
  ➢ When you choose direct receiver access mode and you want to apply receiver leveling, receiver calibration for R1 is recommended.



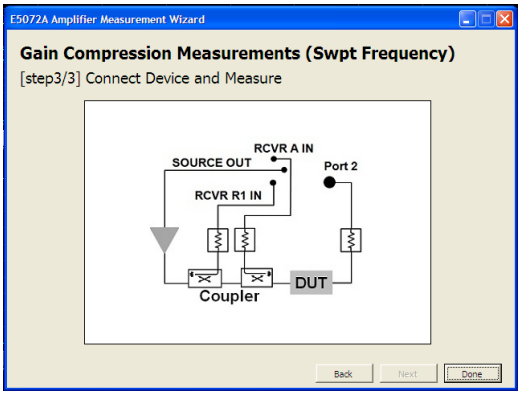
- 2-port / Enhanced Response / Thru Calibration

  ➢ You can select the method from full 2-port cal, enhanced response cal, and thru cal by tab menu.

  ➢ Fixture simulator (port Z conversion, port extension, embedding, and de-embedding) can be applied when the full 2-port cal is performed. For de-embedding, the touchstone file (*.s2p) should be prepared beforehand.



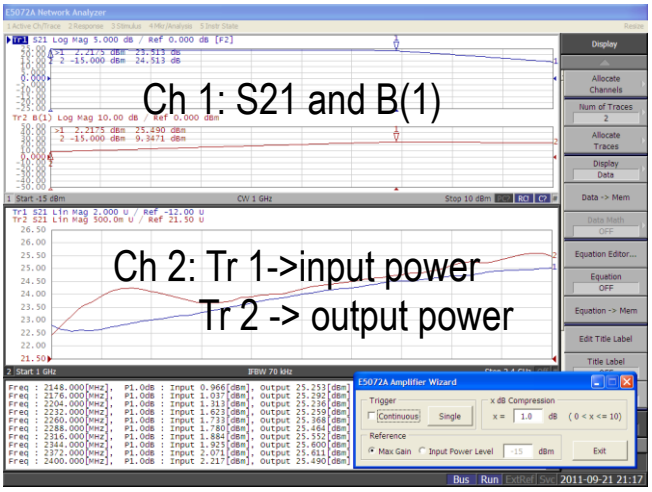
[step3/3] Connect Device and measure



Measurement result

Ch1 shows the power sweep for single frequency. The VBA program performs PxdB search on this measurement. On Ch2, the VBA plots the “input level [dBm]” (Tr1) and “output level [dBm]” (Tr2) of the PxdB over the frequency. Same as the CW mode, the input level simply shows the input power of the DUT (source power of the ENA) where the PxdB compression occurs. Output level shows the output power where the PxdB compression occurs.

You can change the compression value “x” from 0 to 10. And you can choose the reference value from the “Max Gain” and “Input Power Level”. Max Gain means that VBA use the max value of the trace as reference. When you choose Input Power Level, you can set the power level of the input power for the DUT and the output value of that is used as reference.



Revision History

Revision	Date	Description
01.00	Sep 2011	Initial revision
01.01	Oct 2014	Minor bug fix to support Windows 7

Appendix

- Difference among 3 modes.

This wizard has 3 modes, Standard, Direct Receiver Access, and Advanced. To simplify the measurement procedure, the capability of these modes is different.
Following chart shows the differences among 3 modes in each measurement functions.

Note: " - " means the mode does not support this function. "x" means the mode support this function.

S-parameter / k-factor measurement

	S-parameter / k-factor measurement		
Menu	Standard	Direct Receiver Access	Advanced
Setup			
Power Offset	-	Port 1	x
Power Cal			
Power Offset	-	Port 1	x
Loss Compensation	-	x	x
Receiver Cal & Leveling			
Receiver Cal			
Source Port	-	x	x
Power Offset	-	-	x
Receiver	-	x（Src=1→R1、Src=2→R2)	x
Receiver Leveling			
Source Port	-	x	x
Power Offset	-	Port 1	Display only
Fast Mode	-	-	x
Safe Mode	-	-	x
Receiver	-	x（Src=1→R1、Src=2→R2)	x
2-Port Cal	x	x	x
Fixture Simulator	*1	*1	x
Connect	x	x	x

*1 Full 1-port cal is required

Harmonics

	Harmonics measurement			
Menu	Standard		Direct Receiver Access	Advanced
	With Filter	w/o Filter		
Setup				
Power Offset	-	-	Port 1	Port 1
Power Cal				
Source Port	Port 1	Port 1	Port 1	Port 1
Number of point for Cal	N/A	x	N/A	N/A
Power Offset	-	-	Port 1	Port 1
Loss Compensation	-	-	x	x
Receiver Cal & Leveling				
Receiver Cal				
Source Port	Port 1	Port 1	Port 1	Port 1
Power Offset	-	-	-	x
Receiver	B	B	B	B
Power Cal 2nd		N/A		
Source Port	Port 1		Port 1	Port 1
Power Offset	-		Port 1	Port 1
Loss Compensation	-		x	x
Receiver Cal & Leveling 2nd	N/A			
Receiver Cal				
Source Port			Port 1	Port 1
Power Offset			-	x
Receiver			R1 only	R1 only
Receiver Leveling				
Source Port			Port 1	Port 1
Power Offset			Display only	Display only
Fast Mode			-	x
Safe Mode			-	x
Receiver			R1	R1
Connect	x	x	x	x

Gain compression

	Gain compression measurement		
Menu	Standard	Direct Receiver Access	Advanced
Setup			
Power Offset	-	Port 1 only	x
Power Cal			
Power Offset	-	Port 1 only	x
Loss Compensation	-	x	x
Receiver Cal & Leveling			
Receiver Cal			
Source Port	Port1 1	Port 1 only	x
Power Offset	-	-	x
Receiver	B	R1 or B	x
Receiver Leveling			
Source Port	-	Port 1 only	x
Power Offset	-	Port 1 Display only	Display only
Fast Mode	-	-	x
Safe Mode	-	-	x
Receiver	-	R1	x
2-Port Cal	x	x	x
Fixture Simulator	*1	*1	x
Connect	x	x	x

*1 Full 2-port calibration is required.