Keysight Z9070B Wideband Signal Analysis Solution

Version 1.1

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Installation and User's Guide

KEYSIGHT TECHNOLOGIES

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Contents:

1.0 Overview

The Z9070B Wideband Signal Analysis solution combines the powerful 89601B VSA software with a wide bandwidth acquisition oscilloscope (DSOS804A) and a N9030A PXA Signal Analyzer to provide up to 50 GHz RF frequency coverage and up to 1.1 GHz of analysis bandwidth for wide bandwidth signal analysis measurements. The Z9070B hardware is controlled by the 89601B VSA Software and within the wideband downconverter control (WBDC) utility, you can control the N9030A PXA Signal Analyzer.

The Z9070B solution further provides magnitude and phase flatness corrections so that the combined system performance is improved over using the instruments individually.

2.0 System Requirements

2.1 Hardware

Z9070B hardware consists of two instruments controlled by two software elements.

1. Wideband Downconverter – N9030A PXA Signal Analyzer

   Required Options:

   – MPB – Microwave Preselector Bypass

   – CR3 – Wideband IF Output

   The Z9070B operates the PXA as a system downconverter for frequency coverage up to 50GHz using the N9030A which performs the RF to IF frequency down-conversion function.

2. Acquisition Digitizer – DSOS804A Infiniium S-Series Oscilloscope

NOTE

Previously the DSO9204H was included in the N9070A system bundle and now the DSOS804A is included in the Z9070B-001 bundle. Any digitizer supported by 89601B VSA may be utilized to provide the acquisition of the IF signal from PXA signal analyzer. Other oscilloscope and digitizer modules are compatible and will work with the WBDC utility and the VSA software. For further information on other VSA compatible hardware devices, go to: http://www.keysight.com/find/89600_hardware.

Hardware Connections

To configure the hardware setup, simply connect an RF cable between the N9030A Aux IF output on the rear panel (SMA) to the Channel 1 input of the oscilloscope (Figure 1). This cable will route the IF signal between the N9030A and the oscilloscope.

LAN – both instruments must be installed on a common Local Area Network (LAN). This can be accomplished using a LAN crossover cable, hub, switch, or by adding both devices to your current network. Configuration of the network is identical to that of a standard PC(s) as both instruments operate on Windows platforms.

RF signals to be measured are then applied to the N9030A RF Input.

Figure 1 Hardware connections

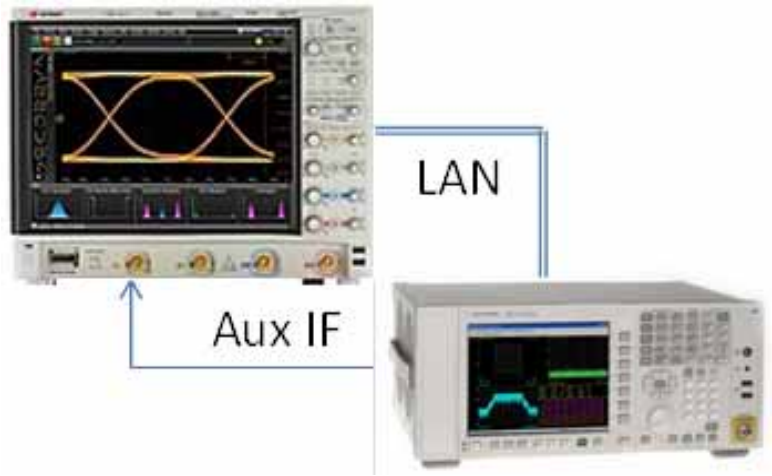


Table 1 Minimum hardware requirements

Z9070B	Options	Description
PXA N9030A	MUST: 508/513/526/544/550	Frequency range
	MUST: CR3	Wideband IF output
	MUST: MPB	Microwave preselector bypass
Infiniium DSOS804A	None	High-Definition Oscilloscope: 8 GHz, 4 Analog Channels
VSA 89601B	200/300	Vector Signal Analysis Software

2.2 Software/Firmware

N9030A Minimum Firmware: A.14.04 or later

89601B VSA Software Version: 18.00 or later

Wideband downconverter control (WBDC) utility Version 1.0 or later

3.0 Z9070B Operation

The 89601B VSA software is the controlling software for the Z9070B bundled solution. Information on operation of the VSA can be found at http://www.keysight.com/find/vsa. A VSA-compatible control utility is also included to configure the VSA software to operate on the N9030A wideband IF output.

3.1 Obtain the Wideband Downconverter Control (WBDC) Utility

To start using the WBDC utility for Z9070B, please use the following instructions.

1. Visit the Keysight.com web page.

   http://www.keysight.com/find/89601B or http://www.keysight.com/find/Z9070B

2. Move to Technical Support
3. Select "Driver, Firmware, & Software" tab

NOTE

If you install (or have installed) the utility and want to re-install or upgrade to a newer version, please delete old files before installing the new version.

4. Click WBDC Utility
5. Click on the Download button
6. Choose to save the zip file to your PC in default download folder or C:\Temp folder.
7. Click on Save
8. Unzip the file to save WBDC_Utility.exe to your favorite folder to use with 89600 VSA.

   Recommendation: C:\Program Files\Agilent\89600 Software 18\89600 VSA Software\Examples

   You can also save the shortcut of .exe file to your desktop if you like.

3.2 Making a Measurement

To make a measurement using the Z9070B setup, begin by launching the 89600 VSA software.

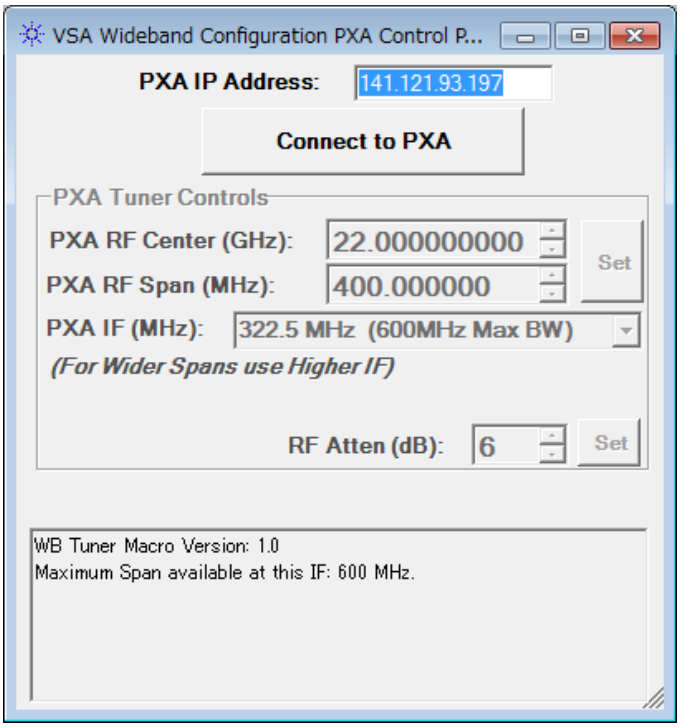
- Start 89600 VSA software on your PC or PC-based instrument
- Configure VSA to read the scope's hardware input: Utilities > Hardware > Configurations.
- Open a folder directly under 89600 VSA menu as Help > Examples
- Find WBDC_Utility folder and run the executable file, WBDC_Utility.exe.

NOTE

All control of the N9030A PXA signal analyzer is accomplished through this utility. The user shouldn't typically need to make any controls from the N9030A front panel. The utility is designed to always be available.

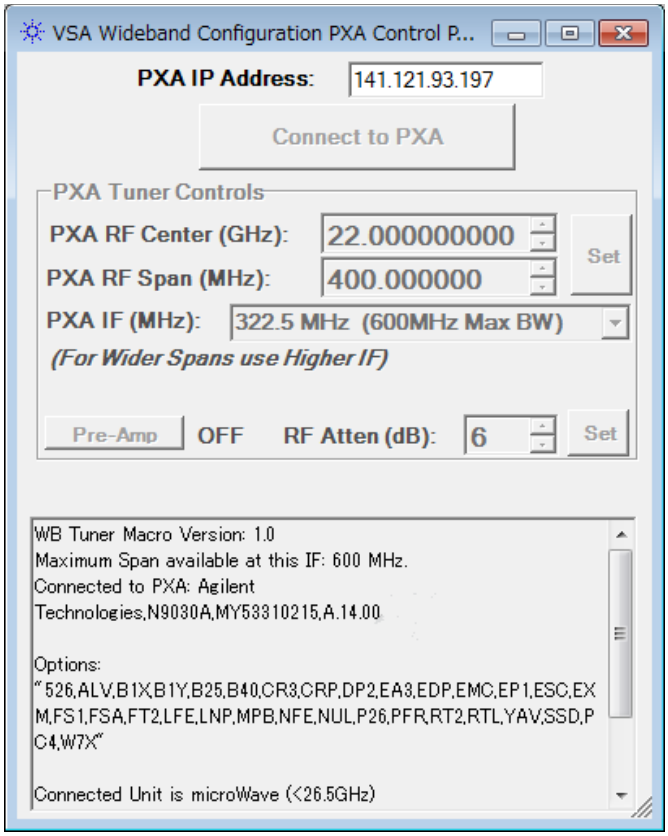
When the WBDC utility runs, you will see a Graphical User Interface (GUI) panel as shown in Figure 2:

Figure 2 WBDC Utility at start-up



Begin by entering in the IP address of the N9030A PXA in the top entry field and click the "Connect to PXA" button. The software will then attempt to make a connection to the N9030A. If the connection succeeds, the remaining controls will be enabled and you will be able to see the status of the connection in the log window at the bottom of the GUI. Figure 3 shows what the GUI looks like immediately upon connection to the analyzer.

Figure 3 WBDC utility after connecting to PXA



IMPORTANT All frequency controls including Center Frequency, Span, and IF are only to be controlled using this utility GUI. When the user makes a change to the utility, it will adjust the N9030A as well as the VSA software frequency controls to appropriate values based on the user's settings into the utility.

CAUTION DO NOT set the frequency using the N9030A or the VSA software directly. Use the utility. Also, do not close the utility after frequency, IF and span has been selected. Minimizing is OK.

All other controls for the measurement are to be accomplished using the VSA software directly.

a. Control the frequency parameters (RF Center, RF Span, IF) using the utility GUI.

b. For Center and Span changes, make the appropriate entry into the GUI numeric control and remember to click the Set button to apply the changes.

c. Selecting the IF of the PXA is done via a drop-down menu selection. By default, the utility will choose the default IF of 322.5MHz for the PXA. To obtain wider Z9070B spans, however, higher IF frequency selections are necessary.

Available Bandwidths Based on IF Selection:

The PXA IF selection lists four possible choices for the IF of the setup.

- 322.5 MHz (600MHz Max BW)
- 400 MHz (760MHz Max BW)
- 500 MHz (960MHz Max BW)
- 600 MHz (1160MHz Max BW)

The higher the IF setting, the wider the maximum bandwidth and therefore span. For example, we can only achieve a 600MHz maximum frequency span using the 322.5MHz IF setting while a 1.16 GHz bandwidth is available when the IF is set to 600MHz.

Refer to section 3.3 Band Edges and Other Precautions below for an explanation of the bandwidth performance based on the various band edge points within the N9030A PXA.

The user may also adjust the RF attenuator and enable/disable the optional RF Pre-amplifier in the N9030A from the control utility. It will be up to the user to verify the proper RF attenuator level setting based on the incoming signal power. Refer to the N9030A data sheet for information on mixer input levels to prevent compressing the N9030A input mixer.

The utility and VSA configure the N9030A PXA to operate as a down-converter. The utility also configures the VSA to compensate for the RF to IF conversion in a way that the VSA frequency readouts match the desired frequency tuning range.

All other Z9070B controls are performed using the VSA software directly; only frequency controls are handled through the utility menus.

3.3 Band Edges and Other Precautions

The table below outlines the different frequency bands within the N9030A PXA. Band 0 for any PXA analyzer covers 3Hz to 3.6 GHz.

NOTE **Band 0 cannot be routed to the Auxiliary IF output. Thus signals below 3.5 GHz need to be analyzed and routed directly to the oscilloscope. The Z9070B covers 3.5 GHz to the top frequency range of the unit.**

Table 2 PXA frequency bands

Band	LO multiple (N)	
0	1	3 Hz to 3.6 GHz (Not covered by Z9070B)
1	1	3.5 to 8.4 GHz
2	2	8.3 to 13.6 GHz
3	2	13.5 to 17.1 GHz
4	4	17 to 26.5 GHz
5	4	26.4 to 34.5 GHz
6	8	34.4 to 50 GHz

The available span for a measurement is dependent on how close to a band edge the measurement is being made. For example, if you wish to make a measurement at 3.7 GHz, you can refer to the table above and note that you would be using Band 1 for this measurement. The low frequency end of band 1 is 3.5 GHz. Your measurement span is limited to 2x the difference between the center frequency and the band edge. In this example, the Center Frequency is 3.7 GHz and the band edge is 3.5 GHz for a difference of 200MHz. Thus, the maximum possible span in this case is 400 MHz.

The Z9070B is nonetheless capable of making measurements >1.1GHz wide, but it is important to note how close you are operating to the band edge to see if this is limiting the frequency span of your measurement. The Z9070B cannot cross spans within a single measurement configuration, resulting in a span limitation near the band edges.

The control utility will configure settings automatically to adjust the span appropriately as you near the band edge. Thus when you see the bandwidth being restricted on the utility log, it means you are nearing a band edge.

4.0 Z9070B IF Flatness Corrections

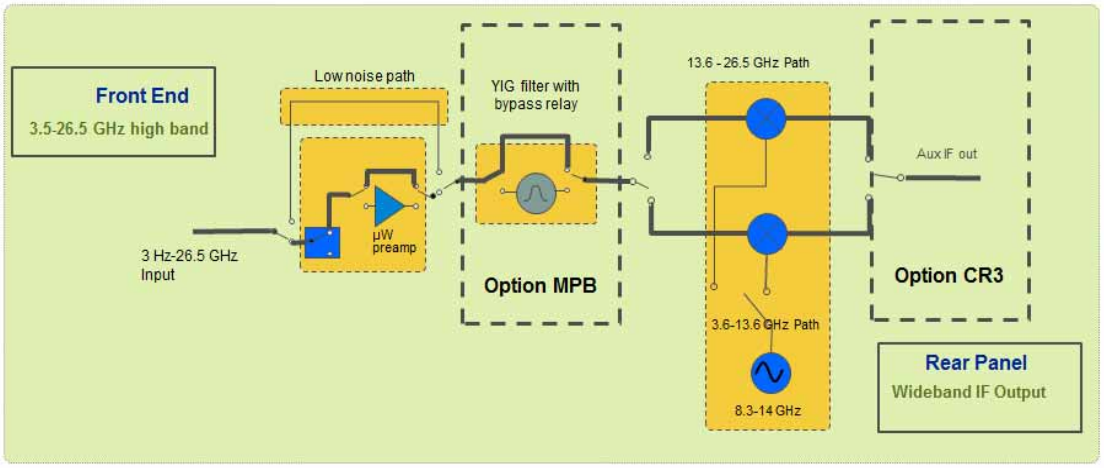
To provide improved measurement capability beyond just connecting instruments together, a set of correction capability was incorporated to the Z9070B Wideband Downconverter Control Utility. These corrections are designed to improve the magnitude and phase response of measurements made using this multi-box configuration.

Absolute Power Measurements: The corrections referred to in this section are span flatness corrections designed to provide as flat of a frequency response as possible given the kind of corrections we are utilizing. These corrections, however, do NOT account for the conversion loss through the N9030A when operating as a down-converter. Therefore, the user would need to note the loss through a given configuration and adjust any absolute power measurements based on this conversion loss factor.

4.1 N9030A PXA Corrections

Corrections are performed to support wideband configurations of the PXA. There are a set of RF and IF corrections that are available to correct and flatten the frequency response (magnitude and phase) of the PXA.

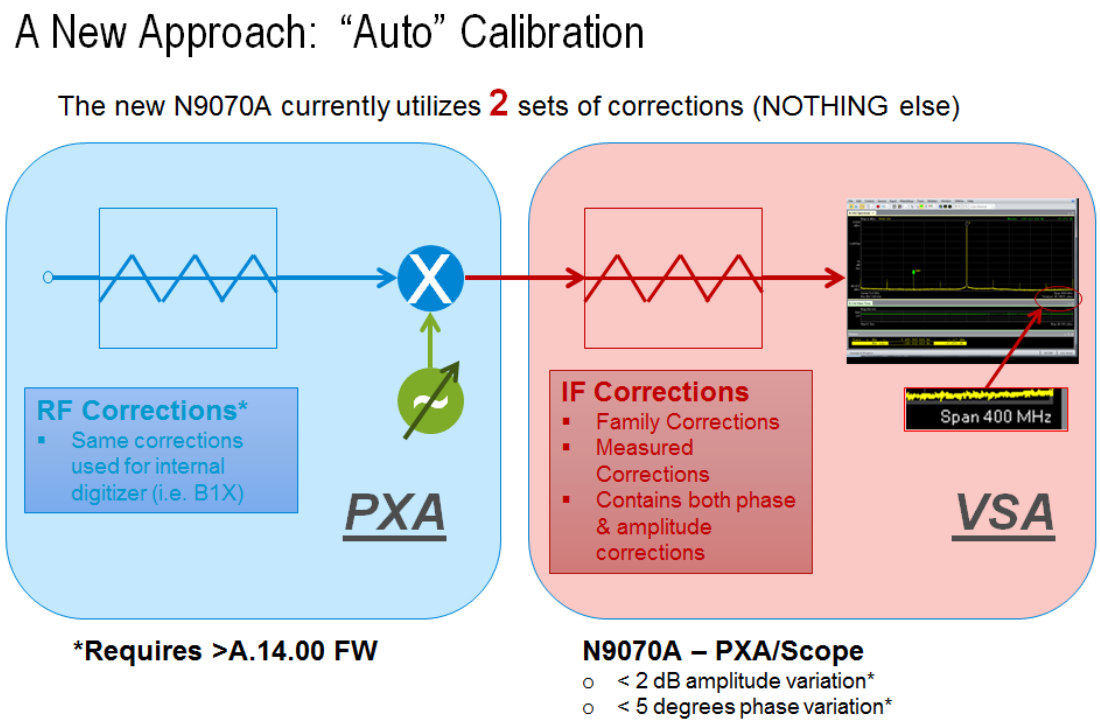
Figure 4 Microwave preselector bypass of PXA signal analyzer



As shown in Figure 4, option CR3 is required for an auxiliary IF output. The other necessary N9030A PXA option is MPB which allows the microwave pre-selector to be bypassed. This allows > 1.1 GHz bandwidth performance and helps provide a flat frequency response when utilized in the Z9070B configuration.

The Z9070B uses an Auto Calibration approach whereby RF correction factors are read out of the N9030A PXA unit. These RF correction factors are magnitude only and are specific to the N9030A used. The utility automatically reads out the correction factors via LAN. At the larger bandwidths, these factors can prove to be less effective due to some higher-order effects manifested in the RF/IF correction technique. This effect is corrected for inside the instrument but has not yet been addressed in the Z9070B. Attempt to deselect the RF measurements in the VSA software by clicking the Input menu and choose -> User corrections and deselecting RF filter. Toggle this parameter off and on to determine if your set-up is affected by this behavior.

Figure 5 Auto calibration in Z9070B wideband signal analyzer



The Z9070B also uses a set of "family" based IF corrections consisting of magnitude and phase characterizations of the IF section of the N9030A. These are not based on an individual N9030A unit but rather on a sample of measured units. A set of common IF magnitude and phase factors are automatically applied by the control utility for the given setup.

The correction scheme of the Z9070B is engineered to provide calibration improvement, ease of use, and flexibility. The anticipated performance for the Z9070B setup is <2 dB of amplitude variation and < 5 degrees of phase variation across a 400 MHz BW in band 1.

4.2 What is Not Corrected

– Conversion loss through the N9030A PXA unit is not accounted for in the Z9070B correction factors. Only RF flatness corrections are implemented with the WBDC utility.

– There are no correction factors for the oscilloscope itself. The oscilloscope is a calibrated instrument on its own. Refer to the Infiniium data sheet for performance specifications for the oscilloscope.

– No temperature compensation is implemented at the system level. Performance may drift with temperature.

Cautions and Reminders:

The Z9070B solution has the following things that should certainly be considered before operation:

– Breadth of product families – The Z9070B bundle uses an average calibration taken from measurements on multiple instruments for the IF correction data. Please consult the technical overview for a review of expected deviation between this and other analyzers (see section 4.3 User Corrections).

– Connections – The Z9070B has corrections for the RF input to the analyzer only. There is no compensation for the cable connections between analyzer and oscilloscope or additional corrections for the oscilloscope. Cabling and connector quality can have an effect on the quality of the measurement.

– Absolute amplitude accuracy – Conversion loss through the N9030A is not compensated by the utility.

– Gain and attenuation changes will change the absolute power measured on the VSA.

– Other platforms - higher end digitizers/scopes can provide better results. Feel free to use any other digitizers that the VSA software supports but please be aware that Keysight has not characterized performance using other digitizers.

– Low Frequency Measurements - Signals below 3.6 GHz will need to be measured directly by the oscilloscope.

4.3 User Corrections

Section 4.1 N9030A PXA Corrections outlines the correction methodology of the Z9070B WBDC utility setup. A compromise was made to achieve good calibration performance without requiring an external source for more detailed calibration. This approach, however, could be improved utilizing a user calibration.

At a high level, there are various approaches to achieve a higher level user characterization or calibration of this setup. Essentially the basic approach would be to connect a calibrated stimulus into the front end of the system and then offset measurement factors vs. frequency could be measured and applied. The techniques are varied and are outside of the scope of this document. Contact Keysight Technologies for questions related to user calibration.

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