

Agilent Wide Bandwidth Vector Signal Analysis Measurements



Introduction

300 MHz wide bandwidth vector signal analysis measurements to 50 GHz center frequency can now be realized. The combination of the Agilent PSA Series spectrum analyzer and the Agilent Infiniium Oscilloscope, along with the Agilent 89601A vector signal analysis software, give you the ability to make VSA measurements on signals with up to 300 MHz bandwidth. The E4440A Series PSA is used as the down converter, converting input signals that range from 3.80 GHz to 50 GHz center frequency to an IF output frequency of 321.4 MHz. The IF signal is then applied to an Infiniium Oscilloscope for digitization. The digitized data is then analyzed by the 89601A VSA software, which can either be on a separate PC or reside in the Infiniium Oscilloscope.

In addition to broadband measurements, you can now perform a frequency response calibration over the 300 MHz bandwidth using an external signal generator such as an MXG, PSG or ESG.



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Wideband System Configuration

As shown in the Figure 1, the E4440A Series PSA takes the RF input and down converts to 321.4 MHz IF, which is connected to the 50 ohm channel 1 input of the Infiniium scope. The LAN is used for communication. In this case, the inter-instrument communication is routed through a hub or switch. Depending on what you are measuring, you may or may not need the time bases tied together. If you need to tie the time bases together, use the ESG, PSG, or MXG time base as the master.

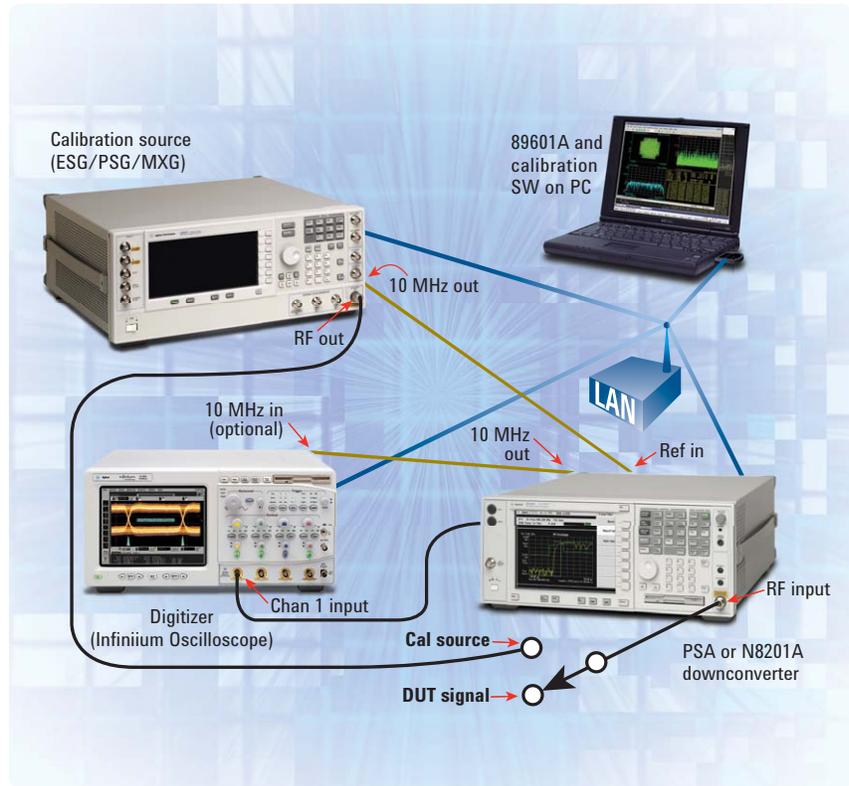


Figure 1. Interconnection diagram

Instrument-PC Communication

Set up the LAN communication using the following suggested process. If you are using your company's site LAN, then each instrument must have an assigned IP address either through DHCP (Dynamic Host Control Protocol), which is supported by the ESG-C, PSG MXG and Infiniium scopes, or directly assigned by IT which is required for the PSA.

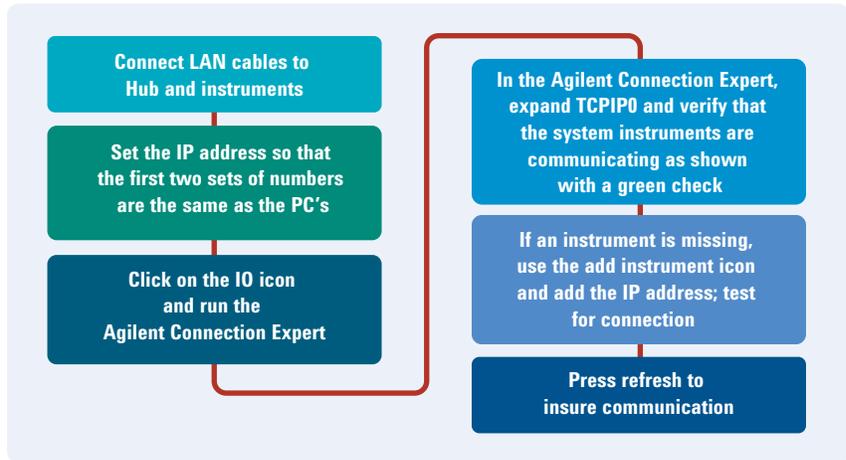


Figure 2. Flow diagram for setting up the IP addresses

Discovering the PC's IP Address Number

On the PC, click on 'START/Run'. On the Run dialog box, type *cmd* then OK. In the Cmd Window, type *ipconfig* then Enter. The PC's IP address is now shown. For example, if the PC's address is 141.121.63.166, set the oscilloscope's IP to 141.121.63.167 and the PSA's address to 141.121.63.168. Reboot the PSA after changing the IP address by cycling its power switch.

The next step is to launch the 89601A VSA. During the initialization phase the software will identify the instruments and the IP addresses. On the tool bar, open the Utilities menu then select 'Hardware'. Click on 'ADC 1' and check 'Infiniium scope'. Click on 'Tuner 1' and check 'PSA Series' then click on 'Source' and check 'source'. While in the source window, click 'Configure' and make sure that 'Restore State' is true. Make sure that 'Default Configuration' and 'Simulation Hardware' are not checked, then click OK.

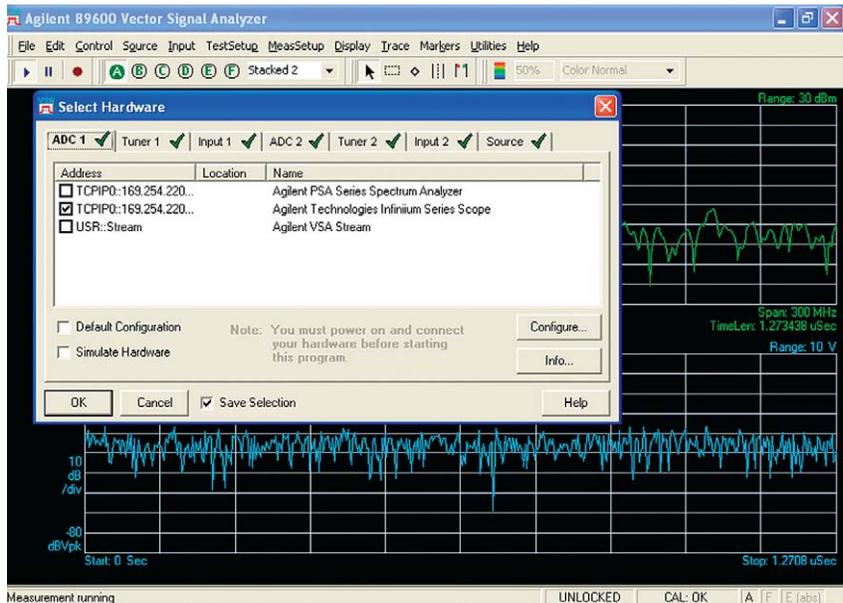


Figure 3. Hardware selection menu

The display shows the center frequency on the left and 300 MHz span on the right, which means that the VSA is set up to do 300 MHz bandwidth measurements.

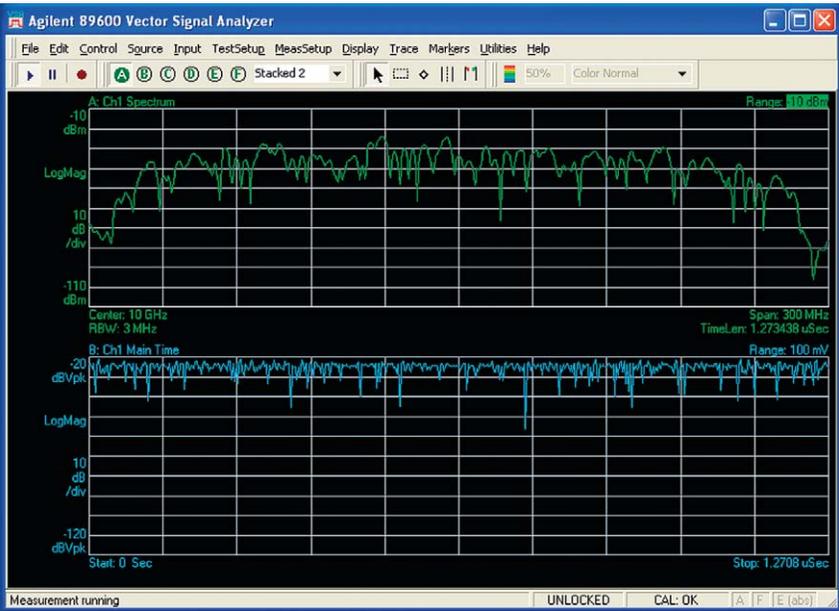


Figure 4. Display after selecting the PSA as the tuner and the Infiniium scope as ADC1

System Calibration

Now you are ready to perform a wideband system calibration. The calibration is completed at the center frequency you plan to make your measurements. Set the center frequency and adjust the range for a good signal-to-noise ratio using the Signal Under Test without going into overload (an OVL will be displayed if the signal is in overload).

Disconnect the Signal Under Test and connect the source to the RF input of the PSA. Open the Utilities menu and click on 'Extended Calibration'. Follow the steps shown.

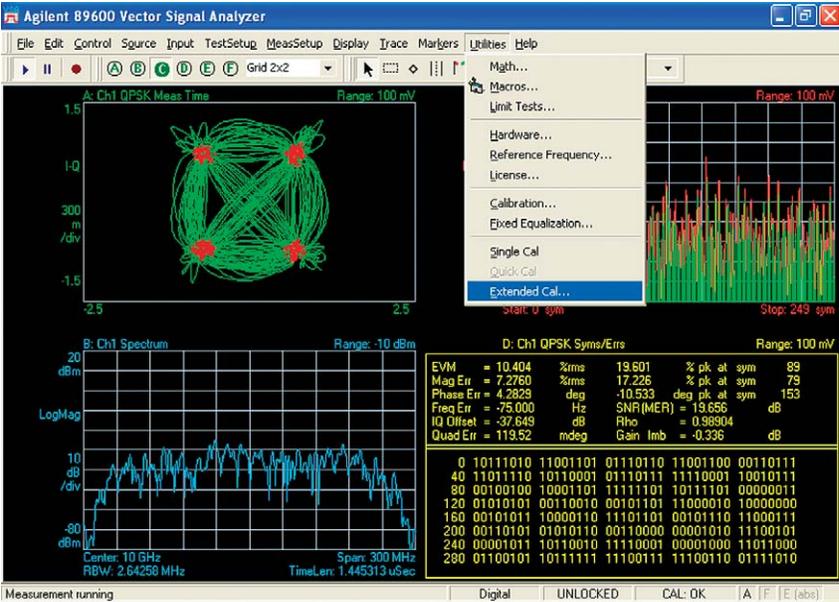


Figure 5. Select 'Extended Calibration' in the utilities menu

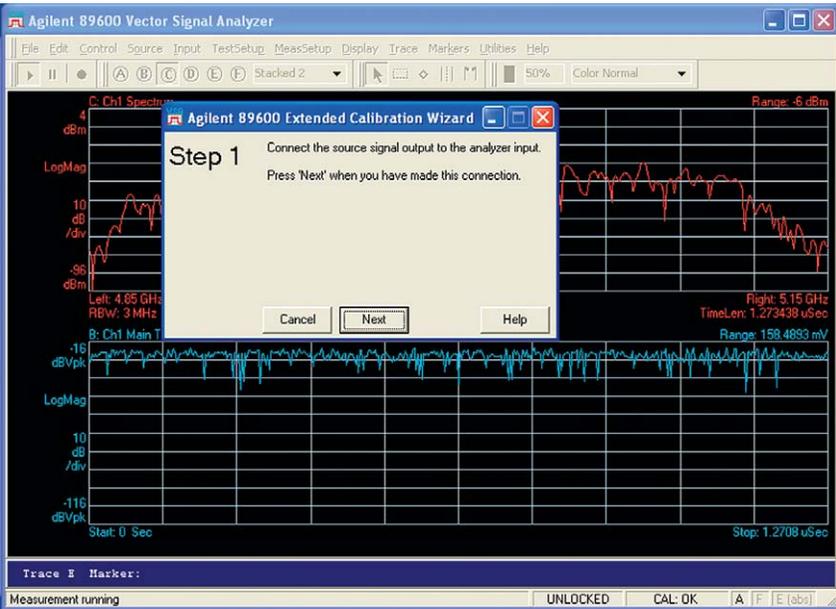


Figure 6. Step 1 in the calibration process

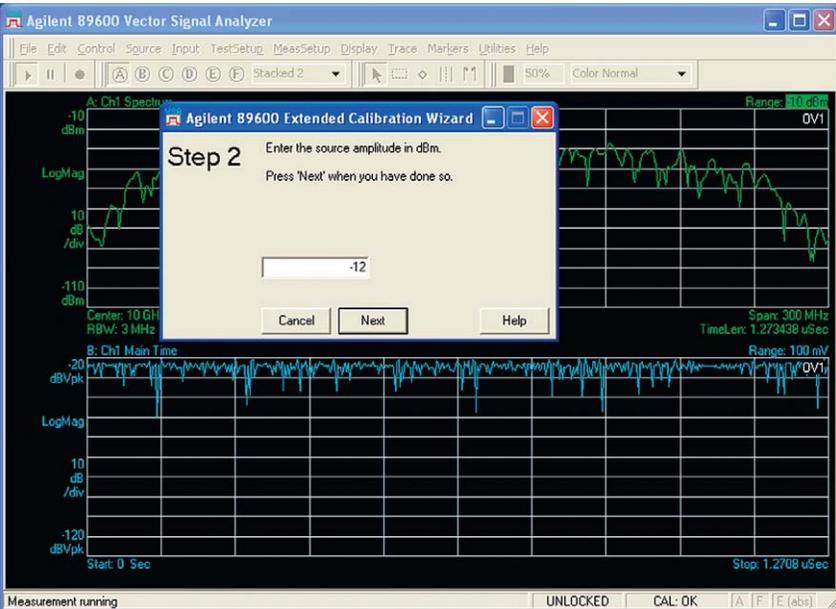


Figure 7. Step 2 in the calibration process — set up source power

In Step 2, the source level should be set so that it is about 2 dB lower than the VSA range setting. The Calibration Wizard chooses this level by default. You can change the source level if necessary.

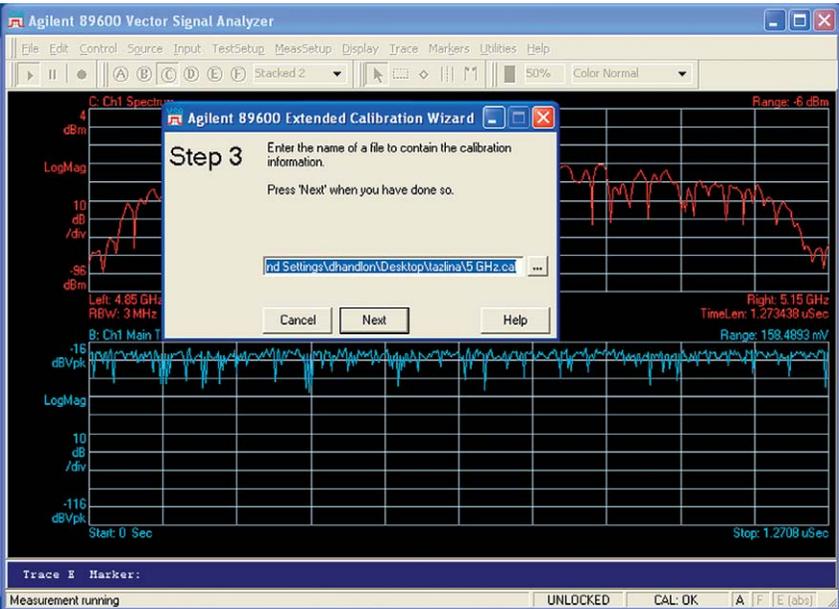


Figure 8. Select the file name to store the corrections

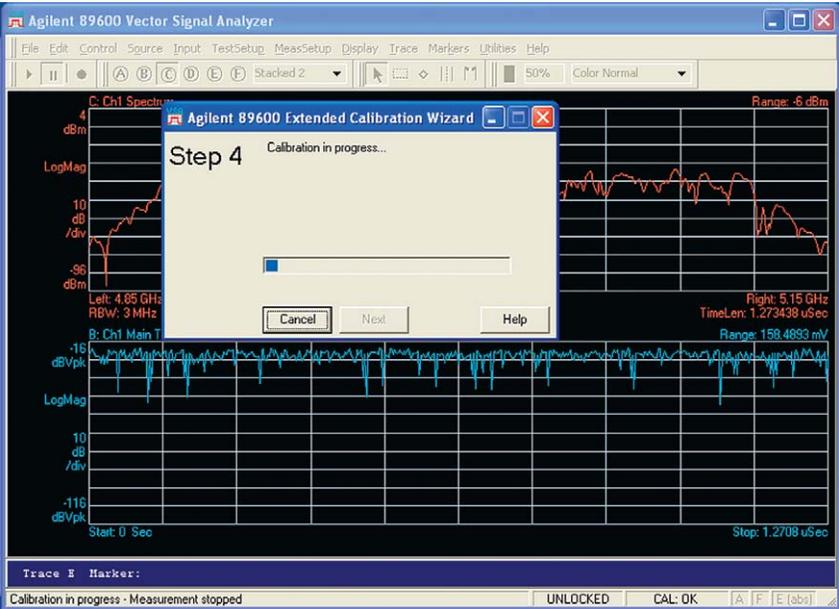


Figure 9. Step 4 shows the calibration in progress

If the calibration fails to complete, reduce the source level and retry the calibration.

After completion of the calibration, the source should return the same settings that it had prior to the calibration process.

Performing Measurements on the Device

Connect your device under test to the input of the E4440A Series PSA. There is some information about your DUT that you will have to know in order to do a complete evaluation: Modulation format, symbol rate, and burst or continuous. The VSA software provides a wide range of preset standards to choose from including cell, wireless standard, and digital video.

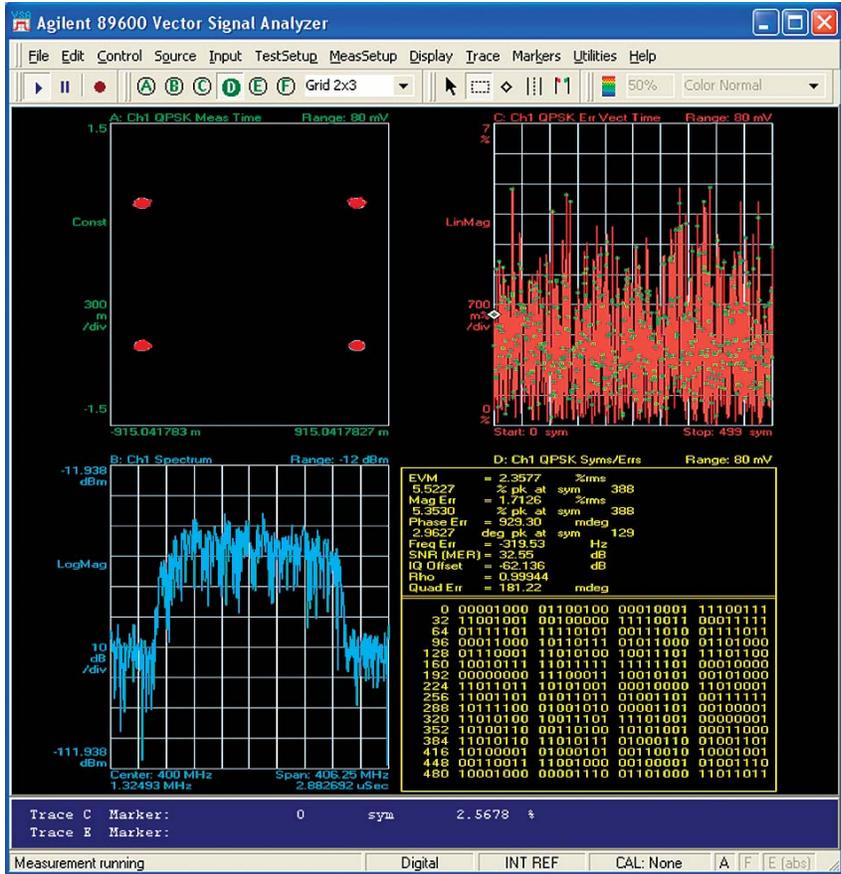


Figure 10. This is an example of a 300 MHz BW satellite signal with 2.4% EVM

PC Requirements to Run 89601A Vector Signal Analysis Software

Microsoft operating system	Window® XP professional	Windows Vista Business, Enterprise or Ultimate
CPU	>1700 MHz Pentium® or AMD-K6 > 2GHz recommended	1 GHz 32-Bit (x86) or 64-bit (x64) > 2GHz recommended
RAM	512 MB; 1 GB for oscilloscopes that have optional memory	1 GB; 2 GB for oscilloscopes that have optional memory
Video RAM	4 MB; 16 MB recommended	128 MB; 512 MB recommended
Additional drivers	CDROM to load SW, 3.5 inch floppy drive, network access or USB for license transfer	CDROM to load SW, 3.5 inch floppy drive, network access or USB for license transfer

Cable Recommendations

LAN cables with a hub are required to interconnect the PSA, Source, Infiniium scope and 89601A software.

- BNC cables to connect references
- BNC (F) to SMA (M) adapter to connect the IF out to Channel A of the scope

Nominal performance summary:

Frequency

Frequency range: 3.80 to 49.85 GHz
 Frequency span¹ : 20 MHz to 300 MHz

Amplitude

Full scale range: -28 to +30 dBm

Performance:

Band [GHz]	Signal-to-noise ratio ²		Total residual EVM ³ (%)
	[dB/BW in MHz]	Noise equiv. %	
3.0 to 6.6	42 / 250	0.8	2.1
6.6 to 13.2	42 / 250	0.8	2.5
13.2 to 19.2	42 / 250	0.8	3.2
19.2 to 26.5	37 / 250	1.4	3.3
26.5 to 31.5	32 / 250	2.5	3.5
31.5 to 49.85	30 / 250	3.1	6.0 ⁴

Frequency response: 300 MHz span, 0.3 dB and 2° peak to peak

1. For information on minimum spans consult application note 5688-4096EN

2. CW signal at 1 dB below overload.

3. 250 MHz BW corrected signal (208 MSymbol/sec QPSK). A bandpass filter may be needed if the DUT has wideband noise. Range: 0 dBm, Source Pwr: -5 dBm Scope model 81204A, Sample Rate 40 GSa/s. (Sample rates lower than the full 40 GSa/s will slightly increase the residual EVM).

4. Limited by noise.

The following is a list of RLC Corporation 325 MHz BW bandpass filters that can be used in the different bands:

- RLC Model F-18199 for the X Band ranges
- RLC Model F-18200 for the Ku Band
- RLC Model F-18201 for the Ka Band
- RLC Model F-18202 for the Q Band

Infiniium oscilloscopes supported by the 89601A VSA software and recording length versus memory configuration at full rate or user rate⁵

Memory		256 k	512 k	2 M	4 M	8 M	16 M	32 M	64 M
Model	Sampling rate [GSa/s]	Max recording length [μs]							
DSO8104	4	–	125	–	1000	2000	4000	8000	16000
DSO80204	4	–	128	–	–	–	–	–	16000
	5		100						400
	10		48						200
DSO80304	4	–	128	–	–	–	–	–	16000
	5		100						400
	10		48						200
DSO80404	4	–	128	–	–	–	–	–	16000
	5		100						400
	20		24						100
DSO80604	4	–	128	–	–	–	–	–	16000
	5		100						400
	20		24						100
DSO80804	4	–	128	–	–	–	–	–	16000
	5		100						400
	40		12						50
DSO81004	4	–	128	–	–	–	–	–	16000
	5		100						400
	40		12						50
DSO81204	4	–	128	–	–	–	–	–	16000
	5		100						400
	40		12						50
DSO81304	4	–	128	–	–	–	–	–	16000
	5		100						400
	40		12						50

Maximum recording lengths at maximum sample rates for Infiniium 90000 Series models with memory as indicated

Memory		10 M	20 M	50 M	100 M	200 M	500 M
Model	Full sample rate [GSa/s]						
DSO90254	20	1 ms	2 ms	5 ms	10 ms	20 ms	50 ms
DSO90404	20	0.5 ms	1 ms	2.5 ms	5 ms	10 ms	25 ms
DSO90604	20	0.5 ms	1 ms	2.5 ms	5 ms	10 ms	25 ms
DSO90804	40	0.25 ms	0.5 ms	1.25 ms	2.5 ms	5 ms	12.5 ms
DSO91204	40	0.25 ms	0.5 ms	1.25 ms	2.5 ms	5 ms	12.5 ms
DSO91304	40	0.25 ms	0.5 ms	1.25 ms	2.5 ms	5 ms	12.5 ms

5. For the 80000 Series Infiniium Oscilloscopes, the maximum memory at sample rates > 4 GS/s is limited to 2 M points regardless of the memory option. There is no restriction for the 90000 Series Infiniium Oscilloscopes. Note: Sample rates lower than the full 40 GSa/s will slightly increase the residual EVM. Furthermore, do not use a sample rate lower than the 4 GSa/s due to aliasing.

Performance spectrum analyzers supported

E4440A 3 Hz to 26.5 GHz

E4443A 3 Hz to 6.7 GHz

E4445A 3 Hz to 13.2 GHz

E4446A 3 Hz to 44 GHz

E4448A 3 Hz to 50 GHz

Note: Option 123 is required. This option bypasses the microwave preselector.

Signal sources supported

E4428C ESG analog signal generator

250 kHz to 6 GHz

E4438C ESG vector signal generator

250 kHz to 6 GHz

E8257D PSG analog signal generator

250 kHz to 70 GHz

E8267C/D vector signal generator

250 kHz to 44 GHz

N5181A MXG analog signal generator

100 kHz to 6 GHz

N5182A MXG vector signal generator

100 kHz to 6 GHz

N5183A MXG vector signal generator

100 kHz to 40 GHz



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Revised: July 17, 2008

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Printed in USA, July 31, 2008
5989-9053EN



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