VXT PXIe Vector Transceiver with Analog BBIQ

330 MHz to 20 GHz

Introduction

The Keysight M9415B VXT PXIe vector transceiver is a multi-functional solution designed for both RF and baseband I/Q (BBIQ) signal analysis. It integrates a 1.2 GHz bandwidth vector RF transceiver and baseband I/Q transceiver into a 4-slot PXIe module, enables the end-to-end design validation and troubleshooting from baseband I/Q to RF thoroughly and cost-effectively.

KEYSIGHT

Technical Specifications

Definitions and Conditions

Specifications

Specifications describe the warranted performance of calibrated instruments. Data represented in this document are specifications under the following conditions unless otherwise noted.

- Specifications are valid from 40 to 65 °C for individual module temperature, as reported by the module, and 20 to 35 °C for environment temperature unless otherwise noted
- The calibrated instrument has been stored for a minimum of 2 hours within the allowed operating range
- If the instrument has previously been stored at a temperature range inside the allowed storage range, but outside the allowed operating range, instrument must have been stored for a minimum of 2 hours within the allowed operating range before turn-on
- 45-minute warm-up time with the Modular TRX application running
- Calibration cycle maintained
- When used with Keysight M9300A frequency reference and Keysight interconnect cables
- An “All Alignment” has been run within the previous 7 days
- A “Align Fast Amplitude” has been run:
  - Within the previous 8 hours
  - If the environmental temperature has changed more than 5°C from the previous Fast Alignment

Typical

Typical values describe additional product performance information that is not covered by the product warranty. It is performance beyond specifications that 95 percent of the units exhibit with a 95 percent confidence level. This data does not include measurement uncertainty and is valid only at room temperature (approximately 25 °C) after alignment within the stated alignment time and temperature limits.

Nominal

Nominal values indicate expected performance or describe product performance that is useful in the application of the product but are not covered by the product warranty.

Recommended Best Practices in Use

- Use slot blockers and EMC filler panels in empty module slots to ensure proper operating temperatures. Keysight chassis and slot blockers optimize module temperature performance and reliability of test
- Set chassis fan to high at environmental temperatures above 35 °C

Vector Signal Analyzer

Performance

Capture Depth		
Standard (Option M02)	256 MSa of IQ data	
Option M05	512 MSa of IQ data	
Frequency		
Frequency Range (CW)		
Standard (Option F08)	330 MHz to 8.5 GHz	lower edge to upper edge
Option F13	330 MHz to 13.5 GHz	
Option F20	330 MHz to 20 GHz	
Frequency Reference		
Accuracy, aging rate, stability	Refer to M9300A specifications	
Frequency Readout Accuracy		
CW	± (marker frequency x frequency reference accuracy + 0.10% x span + 5% x RBW + 2 Hz + 0.5 x horizontal resolution)	
Demodulation	± (center frequency × frequency reference accuracy + 1 Hz)	
Resolution	1 Hz	
Analysis Bandwidth		
	Center frequency	Bandwidth
Standard (400 MHz bandwidth, licensed as Option B4X)	330 to 380 MHz	(Center Frequency – 330 MHz) × 2
	380 to 550 MHz	100 MHz
	550 MHz to 1.31 GHz	200 MHz
	1.31 to 19.8 GHz	400 MHz
	>19.8 GHz	(20 GHz – Center Frequency) × 2
800 MHz bandwidth (Requires Option B8X)	330 to 380 MHz	(Center Frequency – 330 MHz) × 2
	380 to 550 MHz	100 MHz
	550 MHz to 1.31 GHz	200 MHz
	1.31 to 2 GHz	600 MHz
	2 to 19.6 GHz	800 MHz
	>19.6 GHz	(20 GHz – Center Frequency) × 2
1.2 GHz bandwidth (Requires Option B12)	330 to 380 MHz	(Center Frequency – 330 MHz) × 2
	380 to 550 MHz	100 MHz
	550 MHz to 1.31 GHz	200 MHz
	1.31 to 2 GHz	600 MHz
	2 to 19.4 GHz	1.2 GHz
	>19.4 GHz	(20 GHz – Center Frequency) × 2
Trigger		
IQ analyzer	Free run, External 1, External 2, RF burst, Video, Periodic, PXI, Internal	
Trigger delay range	–150 to 500 ms	
Resolution	1/sample rate	
Maximum Safe Input Level		
	Average power input	DC volts
RF input port	+27 dBm	30 Vdc

Absolute Amplitude Accuracy (CW Mode)

RF Input Port	
Frequency range	–70 dBm ≤ Input level < 0 dBm
330 MHz to 1.31 GHz	< ±0.55 dB, < ±0.35 dB typical
1.31 to 4.3 GHz	< ±0.50 dB, < ±0.25 dB typical
4.3 to 8.4 GHz	< ±0.65 dB, < ±0.30 dB typical
8.4 to 12 GHz	< ±0.75 dB, < ±0.40 dB typical
12 to 20 GHz	< ±0.95 dB, < ±0.55 dB typical
Input Voltage Standing Wave Ratio (VSWR), Nominal	
Frequency range	RF input port
380 MHz to 4 GHz	1.5
4 to 8 GHz	1.7
8 to 11 GHz	2
11 to 12.2 GHz	2.1
12.2 to 19.6 GHz	1.8
19.6 to 20 GHz	1.9

IF Flatness

RF Input Port, –25 dBm ≤ Input Level ≤ +10 dBm, Nominal						
Center frequency	100 MHz BW	200 MHz BW	400 MHz BW	600 MHz BW	800 MHz BW	1.2 GHz BW
380 to 550 MHz	±0.60 dB					
550 MHz to 1.31 GHz	±0.20 dB	±0.35 dB				
1.31 to 1.62 GHz	±0.15 dB	±0.20 dB	±0.10 dB	±0.15 dB		
1.62 to 2 GHz	±0.15 dB	±0.30 dB	±0.20 dB	±0.20 dB		
2 to 3.5 GHz	±0.25 dB	±0.50 dB	±0.50 dB	±0.50 dB	±0.20 dB	±0.20 dB
3.5 to 4.3 GHz	±0.10 dB	±0.10 dB	±0.15 dB	±0.15 dB	±0. 15 dB	±0.55 dB
4.3 to 6.2 GHz	±0.15 dB	±0.15 dB	±0.20 dB	±0.20 dB	±0.25 dB	±0.35 dB
6.2 to 18 GHz	±0.20 dB	±0.20 dB	±0.30 dB	±0.45 dB	±0.50 dB	±0.55 dB
18 to 19.4 GHz	±0.10 dB	±0.10 dB	±0.20 dB	±0.5 dB	±0.30 dB	±0.40 dB

Dynamic Range

Displayed Average Noise Floor (DANL) , Input Terminated, LNA On, Log Power Average, and Normalized to 1 Hz Bandwidth	
Center frequency	RF input port, with analyzer ranged to -70 dBm
330 MHz to 14 GHz	-166 dBm typical
14 to 19 GHz	-162 dBm typical
19 to 20 GHz	-160 dBm typical
Third-Order Intermodulation Distortion (TOI, with Analyzer Ranged to +10 dBm), Nominal	
380 to 500 MHz	+22 dBm
500 MHz to 10 GHz	+28 dBm
10 to 12 GHz	+25 dBm
12 to 18.2 GHz	+25 dBm
18.2 to 19.4 GHz	+24 dBm

Spurious Responses

Residual Responses						
RF input port, with analyzer ranged to +10 dBm; offset from 10 MHz to 1/2 × analysis bandwidth, nominal						
380 MHz to 4.5 GHz	< -87 dBm					
4.5 to 6.4 GHz	<-69 dBm					
6.4 to 8 GHz	<-88 dBm					
8 to 11.2 GHz	<-63 dBm					
11.2 to 13.7 GHz	<-85 dBm					
13.7 to 14.5 GHz	<-63 dBm					
14.5 to 18.5 GHz	<-85 dBm					
18.5 to 19.4 GHz	<-75 dBm					
Image Responses						
RF input port, with analyzer ranged from -30 to +27 dBm, nominal						
Center frequency	100 MHz BW	200 MHz BW	400 MHz BW	600 MHz BW	800 MHz BW	1.2 GHz BW
380 to 550 MHz	-62 dBc					
550 MHz to 1.31 GHz	-62 dBc	-62 dBc				
1.31 to 2 GHz	-64 dBc	-64 dBc	-62 dBc	-62 dBc		
2 to 4.3 GHz	-62 dBc	-61 dBc	-60 dBc	-60 dBc	-60 dBc	-58 dBc
4.3 to 4.6 GHz	-64 dBc	-64 dBc	-62 dBc	-62 dBc	-62 dBc	-58 dBc
4.6 to 12 GHz	-60 dBc	-60 dBc	-59 dBc	-58 dBc	-58 dBc	-54 dBc
12 to 19.4 GHz	-61 dBc	-61 dBc	-60 dBc	-58 dBc	-58 dBc	-54 dBc
Sideband Spurs						
1 kHz to 10 MHz offset	-85 dBc, nominal					
LO Feedthrough (dBr)						
Center frequency	RF input port, with analyzer ranged from 0 to +27 dBm, nominal					
380 MHz to 1.3 GHz	–62 dBr					
1.3 to 4.3 GHz	–64 dBr					
4.3 to 19.4 GHz	–64 dBr					
Phase Noise (Nominal)						
Offset	CF=2.4 GHz	CF=4.8 GHz	CF=9.6 GHz	CF=19.2 GHz		
1 kHz	-121 dBc/Hz	-118 dBc/Hz	-112 dBc/Hz	-109 dBc/Hz		
10 kHz	-130 dBc/Hz	-126 dBc/Hz	-120 dBc/Hz	-116 dBc/Hz		
100 kHz	-133 dBc/Hz	-130 dBc/Hz	-125 dBc/Hz	-119 dBc/Hz		
1 MHz	-138 dBc/Hz	-138 dBc/Hz	-136 dBc/Hz	-136 dBc/Hz		
10 MHz	-142 dBc/Hz	-142 dBc/Hz	-141 dBc/Hz	-141 dBc/Hz		

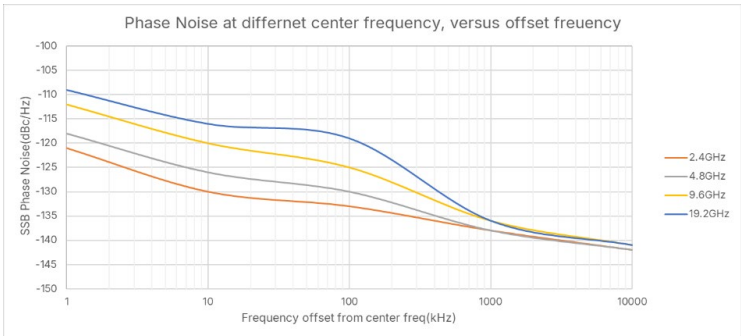

Figure 1. Measured phase noise at 2.4/4.8/9.6/19.2 GHz, with 1 kHz to 10 MHz

Vector Signal Generator

Performance

Capture Depth		
Standard (Option M02)	256 MSa of IQ data	
Option M05	512 MSa of IQ data	
Frequency Range (CW)		
Standard (Option F08)	330 MHz to 8.5 GHz	Lower edge to upper edge
Option F13	330 MHz to 13.5 GHz	
Option F20	330 MHz to 20 GHz	
Frequency Reference		
Accuracy, aging rate, stability	Refer to M9300A specifications	
Frequency readout accuracy	± (output frequency × frequency reference accuracy + 0.001 Hz)	
Frequency switching speed		
SCPI mode	≤ 14 ms nominal	
IVI mode	≤ 6 ms nominal	
Signal Generation Bandwidth		
	Center frequency	Bandwidth
Standard (400 MHz bandwidth, licensed as Option B4X)	330 to 380 MHz	(Center Frequency – 330 MHz) × 2
	380 to 550 MHz	100 MHz
	550 MHz to 1.31 GHz	200 MHz
	1.31 to 19.8 GHz	400 MHz
	>19.8 GHz	(20 GHz – Center Frequency) × 2
800 MHz bandwidth (Requires Option B8X)	330 to 380 MHz	(Center Frequency – 330 MHz) × 2
	380 to 550 MHz	100 MHz
	550 MHz to 1.31 GHz	200 MHz
	1.31 to 2 GHz	600 MHz
	2 to 19.6 GHz	800 MHz
	>19.6 GHz	(20 GHz – Center Frequency) × 2
1.2 GHz bandwidth (Requires Option B12)	330 to 380 MHz	(Center Frequency – 330 MHz) × 2
	380 to 550 MHz	100 MHz
	550 MHz to 1.31 GHz	200 MHz
	1.31 to 2 GHz	600 MHz
	2 to 19.4 GHz	1.2 GHz
	>19.4 GHz	(20 GHz – Center Frequency) × 2
Output Level Range (CW Mode)		
380 MHz to 20 GHz	RF output port	RF output port with option 1EA
	–120 to +5 dBm	–120 to +20 dBm, +25 dBm settable
Maximum Reverse Power		
Average power input	+27 dBm	
DC volts	30 Vdc	
Amplitude Switching Speed		
SCPI mode	≤ 10 ms nominal	
IVI mode	≤ 5 ms nominal	

Absolute Amplitude Accuracy (CW Mode)

RF Output Port					
	380MHz to 4.3 GHz	4.3 to 10.2 GHz	10.2 to 12.3 GHz	12.3 to 19.4 GHz	19.4 to 20 GHz
+10 dBm< Level ≤ +20 dBm	< ± 0.5 dB typical	< ±0.65 dB typical	< ±0.6 dB typical	< ±1 dB typical	< ± 1 dB typical
0 dBm<Level ≤ +10 dBm	< ± 0.6 dB, < ± 0.35 dB typical	< ±0.75 dB, < ±0.35 dB typical	< ±0.85 dB, < ±0.45 dB typical	< ±0.85 dB, < ±0.6 dB typical	< ± 1.8 dB, < ± 0.7 dB typical
-50 dBm≤ Level ≤ 0 dBm	< ± 0.6 dB, < ± 0.35 dB typical	< ±0.9 dB, < ±0.55 dB typical	< ± 1 dB, < ±0.65 dB typical	< ± 1 dB, < ±0.65 dB typical	< ±1.9 dB, < ±0.9 dB typical
-90 dBm≤ Level < –50 dBm	< ± 0.4 dB typical	< ±0.55 dB typical	< ±0.65 dB typical	< ±0.7 dB typical	< ± 1.1 dB typical
-100dBm≤Level < –90dBm	< ± 0.6 dB typical	< ±0.65 dB typical	< ±0.65 dB typical	< ±0.75 dB typical	< ± 1.1 dB typical
-110dBm≤ Level < –100 dBm	< ± 0.65 dB typical	< ±0.85 dB typical	< ±0.85 dB typical	< ±0.85 dB typical	< ± 1.1 dB typical

Output Voltage Standing Wave Radio (VSWR)	
RF output port	
380 MHz to 4.3 GHz	1.6 nominal
4.3 to 10.2 GHz	1.5 nominal
10.2 to 12.3 GHz	1.55 nominal
12.3 to 14.4 GHz	1.6 nominal
14.4 to 19.4 GHz	1.7 nominal

Setting Resolution
0.01 dB

Harmonics		
RF output port	With 0 dBm output power	With 10 dBm output power
380 MHz to 2 GHz	< -54 dBc nominal	< -39 dBc nominal
2 to 4.7 GHz	<-42 dBc nominal	<-37 dBc nominal
4.7 to 6.4 GHz	< -51 dBc nominal	< -42 dBc nominal
6.4 to 13.2 GHz	< -39 dBc nominal	< -32 dBc nominal

Non-Harmonics (CW Mode)	
RF output port, with 0 dBm output power	
380 MHz to 4.3 GHz	< -67 dBc nominal
4.3 to 9 GHz	< -59 dBc nominal
9 to 10.2 GHz	<-41 dBc nominal
10.2 to 15.7 GHz	< -57 dBc nominal
15.7 to 17 GHz	< -44 dBc nominal
17 to 19.4 GHz	< -63 dBc nominal

LO Feedthrough	
RF output port, with 0 dBm output power	
380 to 550 MHz	-53 dBc nominal
550 MHz to 4.3 GHz	-50 dBc nominal
4.3 to 10.2 GHz	-60 dBc nominal
10.2 to 19.4 GHz	-58 dBc nominal

Image Response						
RF output port, 0 dBm output power						
Center frequency	100 MHz BW	200 MHz BW	400 MHz BW	600 MHz BW	800 MHz BW	1.2 GHz BW
380 to 550 MHz	-66 dBc nominal					
550 MHz to 2 GHz	-65 dBc nominal	-65 dBc nominal				
1.31 to 3.5 GHz	-64 dBc nominal	-62 dBc nominal	-61 dBc nominal	-59 dBc nominal		
2 to 4.3 GHz	-61 dBc nominal	-61 dBc nominal	-61 dBc nominal	-60 dBc nominal	-60 dBc nominal	-58 dBc nominal
4.3 to 19.4 GHz	-61 dBc nominal	-61 dBc nominal	-57 dBc nominal	-57 dBc nominal	-57 dBc nominal	-54 dBc nominal

Sideband Spurious			
RF output port, 0 dBm output power			
	1 to 100 kHz offset	100 kHz to 1 MHz offset	1 to 10 MHz offset
380 MHz to 4.3 GHz	-90 dBc nominal	-99 dBc nominal	-83 dBc nominal
4.3 to 10.2 GHz	-82 dBc nominal	-97 dBc nominal	-83 dBc nominal
10.2 to 12.3 GHz	-82 dBc nominal	-97 dBc nominal	-82 dBc nominal
12.3 to 19.4 GHz	-78 dBc nominal	-91 dBc nominal	-82 dBc nominal

Third-Order Intermodulation Distortion (TOI)	
RF output port, 0 dBm output power	
380 MHz to 4.3 GHz	+29 dBm typical
4.3 to 6.5 GHz	+27 dBm typical
6.5 to 13.1 GHz	+26 dBm typical
13.1 to 15.7 GHz	+25 dBm typical
15.7 to 19.4 GHz	+24 dBm typical

Broadband Noise Floor	
RF output port, 0 dBm output power	
380 MHz to 4.3 GHz	-142 dBm/Hz nominal
4.3 to 10.2 GHz	-140 dBm/Hz nominal
10.2 to 13 GHz	-139 dBm/Hz nominal
13 to 19.4 GHz	-140 dBm/Hz nominal

IF Flatness

RF Output Port, –25 dBm ≤ Input Level ≤ +10 dBm, Nominal						
Center frequency	100 MHz BW	200 MHz BW	400 MHz BW	600 MHz BW	800 MHz BW	1.2 GHz BW
380 to 550 MHz	±1.2 dB nominal					
550 MHz to 2 GHz	±0.9 dB nominal	±0.9 dB nominal				
1.31 to 3.5 GHz	±0.4 dB nominal	±0.4 dB nominal	±0.55 dB nominal	±0.7 dB nominal		
3.5 to 4.3 GHz	±0.4 dB nominal	±0.5 dB nominal	±0.6 dB nominal	±0.6 dB nominal	±0.6 dB nominal	±0.65 dB nominal
4.3 to 19.4 GHz	±0.8 dB nominal	±0.95 dB nominal	±1 dB nominal	±1 dB nominal	±1 dB nominal	±1.1 dB nominal

Phase Noise	
RF output port, 0 dBm output power, center frequency = 1 GHz	
1 kHz offset	-117 dBm/Hz nominal
10 kHz offset	-135 dBm/Hz nominal
100 kHz offset	-140 dBm/Hz nominal
1 MHz offset	-145 dBm/Hz nominal
10 MHz offset	-145 dBm/Hz nominal

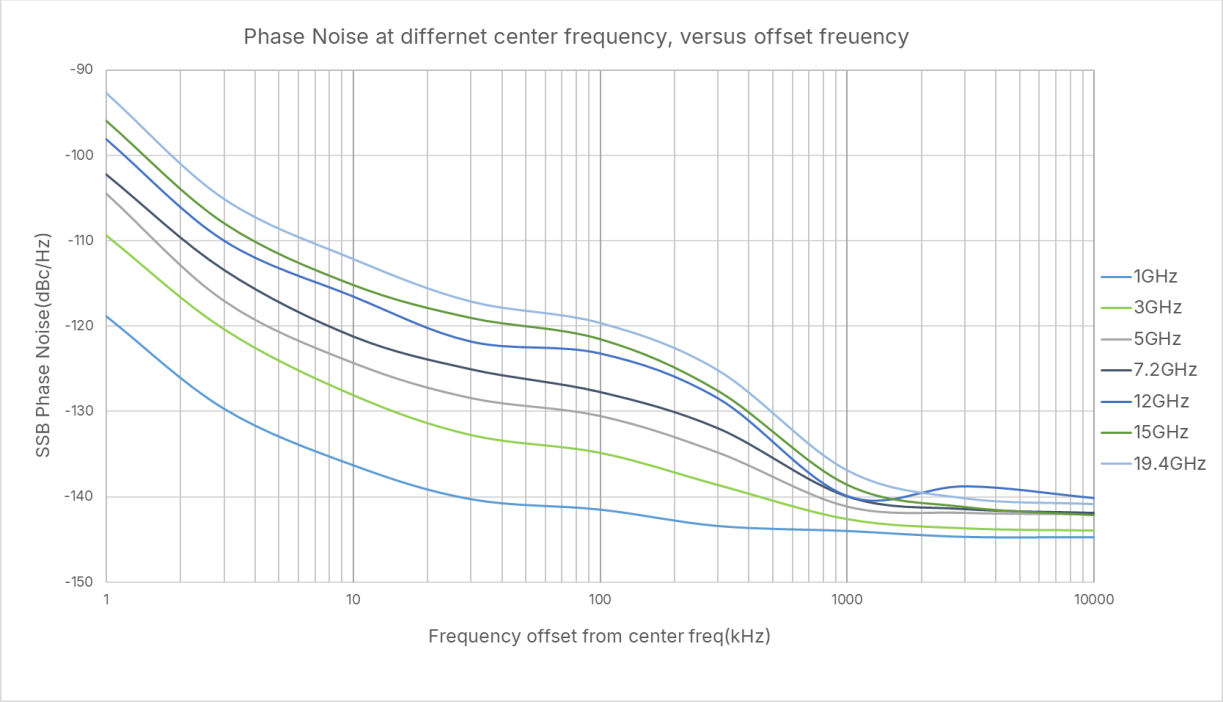

Figure 2. Measured phase noise at 1/3/5/7.2/12/15/19.4 GHz, with 1 kHz to 10 MHz offset

Analog Baseband I/Q

Processing a calibration for BBIQ with Y1823A kit is required to meet the following specifications.

Frequency Range			
I only, Q only		DC to 600 MHz per channel	
I+jQ		-600 MHz to 600 MHz	
Frequency resolution		1 Hz	
General Specification			
Input channels		4 (I+, I-, Q+, Q-)	
Output channels		4 (I+, I-, Q+, Q-)	
Connector type		SMB male	
Differential impedance		100 Ω nominal	
Input/Output Common voltage range		-0.25 to 2.5 V	
Output peak voltage range		0 to 3 Vpp	I/Q output differential-mode
Input peak voltage range		0.2 to 4 Vpp	I/Q input differential-mode
Baseband I/Q Input			
Input Common Voltage accuracy		±1.2 mV nominal	
Input AC flatness		±0.18 dB nominal	
Input AC accuracy		±0.2 dB nominal	
Input noise density		-134 dBm/Hz nominal, at 2 V	
		-140 dBm/Hz nominal, at 1 V	
		-150 dBm/Hz nominal, at 0.39V	
		-157 dBm/Hz nominal, at 0.1 V	
Non-input related spurious		-70 dBm nominal	
Spurious response		-71 dBc nominal	
Maximum safe input voltage		Vcom ±2.5 V	
Baseband I/Q Output			
Output Common Voltage accuracy		±3 mV	With 0 Vcom
Output AC flatness		±0.2 dB nominal	DC to 200 MHz
		±0.4 dB nominal	DC to 600 MHz
Output AC accuracy		±0.18 dB nominal	
Output noise density		-150 dBm/Hz nominal	at CF 10 MHz with offset 1.1 MHz
Maximum reverse input voltage		Vcom ±2.5 V	
Baseband I/Q Loopback Performance			
Loopback flatness		±0.6 dB nominal	
Loopback image response	At 400 MHz BW	-56 dBc nominal	With 0 Vcom, baseband generator leveled to -6 dB of baseband analyzer's range
	At 1.2 GHz BW	-54 dBc nominal	
Loopback DC leakage	With CF=10 MHz	-55 dBr nominal	
Loopback harmonics	With CF=10 MHz	-75 dBc nominal	With 0 Vcom, baseband analyzer ranged to 1 V, baseband generator leveled to -6 dB of baseband analyzer
	With CF=100 MHz	-73 dBc nominal	
Loopback DC offset accuracy		±4 mV nominal, source level <0.5V	With 0 Vcom
		±10 mV nominal, source level <1 V	With 0 Vcom
		±45 mV nominal, 1V <source level <2V	With 0 Vcom
Loopback IMD3		-77 dBc, 0.2V < source level< 2V	With 0 Vcom

General Specifications

Environmental Characteristics		
Operating temperature	+5 to +45 °C	
Storage temperature	–40 to +65 °C	
EMC	Complies with European EMC Directive 2014/30/EU IEC/EN 61326-1 CISPR 11, Group 1, Class A AS/NZS CISPR 11 ICES/NMB-001 This ISM device complies with Canadian ICES-001 Cet appareil ISM est conforme a la norme NMB-001 du Canada	
Environmental stress	Samples of this product have been type tested in accordance with the Keysight Environmental Test Manual and verified to be robust against the environmental stresses of storage, transportation, and end-use; those stresses include, but are not limited to, temperature, humidity, shock, vibration, altitude, and power line conditions; test methods are aligned with IEC 60068-2 and levels are similar to MILPRF-28800F Class 3.	
Maximum power consumption	155 W nominal	
Weight Net	2.18 kg (4.81 lbs)	
Dimension (H*W*D)	128.6 mm x 80.8 mm x 209.3 mm	
Calibration cycle	1-year, calibration services available through Keysight service center	
Warranty	1-year standard	
Front Panel		
Reference	Ref In, Ref Out	Frequency: 100 MHz
		Connector: SMP male, 50 Ω nominal
		Lock range: ± 1 ppm, nominal
		Input amplitude: >+10 dBm, nominal
		Output amplitude: >+10 dBm, nominal
LO reference	2.4 GHz In, 2.4 GHz Out	Connector: SMP male, 50 Ω nominal
		Input amplitude: >+10 dBm, nominal
		Output amplitude: >+12 dBm, nominal
RF connections	RF Input	Connector: 3.5 mm female, 50 Ω nominal
	RF Output	Connector: 3.5 mm female, 50 Ω nominal
	Half Duplex	Connector: 3.5 mm female, 50 Ω nominal
Trigger connections	Trigger 1, Trigger 2 (input/output selectable)	Connector: SMP male
		Input impedance: 1 kΩ or 50 Ω nominal
		Input level range: -3.3 V to +3.3 V
		Output impedance: 50 Ω nominal
		Output level range: 3.3 V LVTTL
DIO connections	Ctrl M, Ctrl S	Connector: Micro-HDMI female
		Level range: 3.3 V LVTTL, LVDS
BBIQ Input and Output	BBIQ Input	SMB male, differential 100 ohm
	BBIQ Output	SMB male, differential 100 ohm

WLAN Measurement Key Specification

RF Path

Error Vector Magnitude (EVM)		
EVM floor conditions Phase Tracking on, Eq Smoothing on, Eq Training Seq only, RF output loopback to RF input, at –20 dBm input power, optimized range, rms-EVM, nominal		
802.11ac 5.8 GHz 80 MHz	< –50.5 dB	
802.11ac 5.8 GHz 160 MHz	< –48.5 dB	
802.11ax 5.8 GHz 80 MHz	< –51.5 dB	
802.11ax 5.8 GHz 160 MHz	< –49 dB	
802.11ax 7 GHz 80 MHz	< –52.5 dB	
802.11ax 7 GHz 160 MHz	< –50 dB	
EVM floor conditions Phase Tracking on, Eq Smoothing on, Eq Training Seq only, RF output loopback to RF input, at –15 dBm input power, optimized range, nominal		
	rms-EVM	nc-EVM [1]
802.11be, 5 GHz, 160 MHz, 1024 QAM	< –50 dB	
802.11be, 5.8 GHz, 160 MHz, 1024 QAM	< –50.5 dB	
802.11be, 7 GHz, 160 MHz, 1024 QAM	< –50 dB	
802.11be, 5 GHz, 320 MHz, 4096 QAM	< –47 dB	< –49.5 dB
802.11be, 5.8 GHz, 320 MHz, 4096 QAM	< –47.5 dB	< –50 dB
802.11be, 7 GHz, 320 MHz, 4096 QAM	< –47 dB	< –49 dB

BBIQ Path

Error Vector Magnitude (EVM)			
EVM floor conditions Phase Tracking on, Eq Smoothing on, Eq Training Seq only, BBIQ output loopback to BBIQ input, optimized IQ output level, rms-EVM, nominal			
Format / Bandwidth	**I/Q Output Level**	**rms-EVM**	
802.11ax, 80 MHz	0.1 to 0.2 V	<-48 dB	
	0.2 to 0.4 V	<-53 dB	
	0.4 to 0.6 V	<-52.5 dB	
	0.6 to 1.5 V	<-53.5 dB	
802.11ax, 160 MHz	0.1 to 0.2 V	<-45 dB	
	0.2 to 0.3 V	<-50.5 dB	
	0.3 to 0.6 V	<-51 dB	
	0.6 to 1.2 V	<-52 dB	
	1.2 to 1.5 V	<-51 dB	
Format / Bandwidth	**I/Q Output Level**	**rms-EVM**	**nc-EVM [1]**
802.11be, 160 MHz	0.1 to 0.3 V	<-47 dB	<-47.5 dB
	0.3 to 0.4 V	<-52.5 dB	<-53 dB
	0.4 to 0.6 V	<-52 dB	<-53 dB
	0.6 to 1.2 V	<-52 dB	<-54 dB
	1.2 to 1.5 V	<-51.5 dB	<-55.5 dB
802.11be, 320 MHz	0.1 to 0.2 V	<-41.5 dB	<-42 dB
	0.2 to 0.6 V	<-47.5 dB	<-49.5 dB
	0.6 to 1.2 V	<-49 dB	<-53 dB
	1.2 to 1.5 V	<-48 dB	<-53.5 dB

1. nc-EVM: noise corrected EVM, is a technique to improve EVM by compensating analyzer's noise in EVM domain.

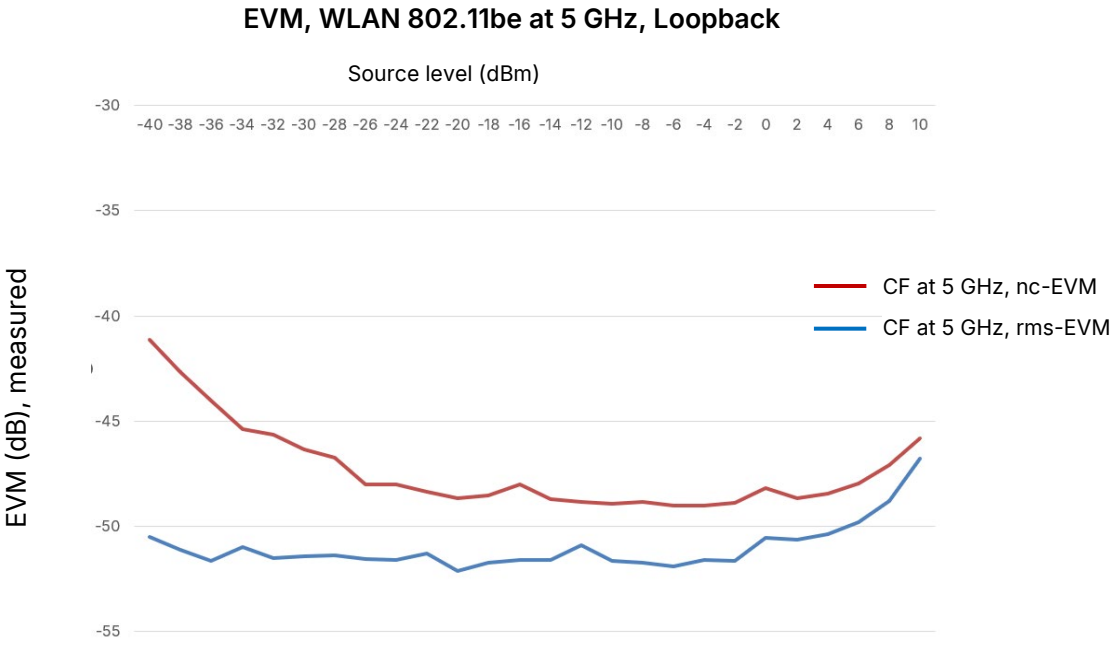

Figure 3. Measured WLAN 802.11be EVM vs. source level in RF path, at 5 GHz, 320 MHz BW, loopback

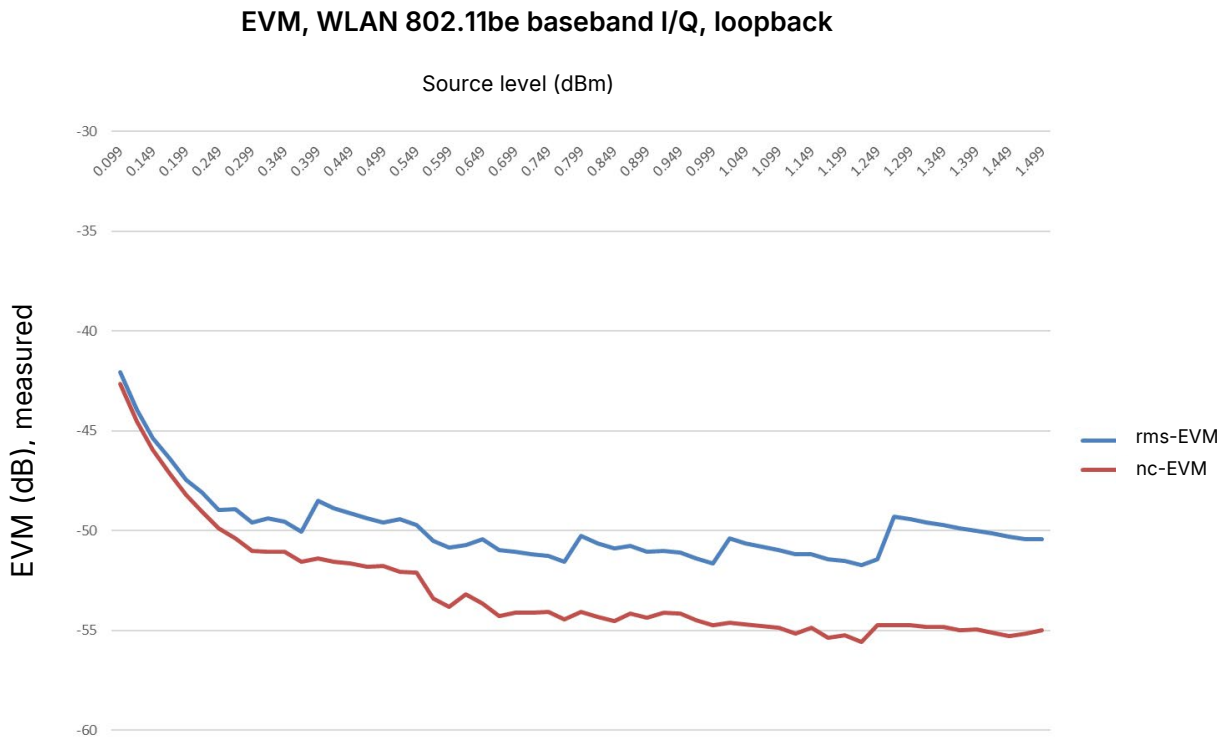

Figure 4. Measured WLAN 802.11be EVM vs. source level in BBIQ path, 320 MHz BW, loopback

5G NR Measurement Specifications

RF Path	
Error Vector Magnitude (EVM)	
Residual EVM, RF output loopback to RF input, at –10 dBm or 0 dBm input power, nominal	
30 kHz SCS, 4 GHz, 100 MHz (256QAM)	0.24%
30 kHz SCS, 5 GHz, 100 MHz (256QAM)	0.34%
30 kHz SCS, 7 GHz, 100 MHz (256QAM)	0.38%
30 kHz SCS, 12 GHz, 100 MHz (256QAM)	0.34%
30 kHz SCS, 15 GHz, 100 MHz (256QAM)	0.45%
30 kHz SCS, 18 GHz, 100 MHz (256QAM)	0.67%
Residual EVM, RF output loopback to RF input, at –5 dBm input power, nominal	
120 kHz SCS, 4 GHz, 200 MHz (256QAM)	0.29%
120 kHz SCS, 5 GHz, 200 MHz (256QAM)	0.38%
120 kHz SCS, 7 GHz, 200 MHz (256QAM)	0.34%
120 kHz SCS, 12.3 GHz, 200 MHz (256QAM)	0.45%
120 kHz SCS, 15 GHz, 200 MHz (256QAM)	0.51%
120 kHz SCS, 18 GHz, 200 MHz (256QAM)	0.71%
Residual EVM, RF output loopback to RF input, at –10 dBm input power, nominal	
120 kHz SCS, 4 GHz, 400 MHz (256QAM)	0.43%
120 kHz SCS, 5 GHz, 400 MHz (256QAM)	0.45%
120 kHz SCS, 7 GHz, 400 MHz (256QAM)	0.4%
120 kHz SCS, 11 GHz, 400 MHz (256QAM)	0.45%
120 kHz SCS, 12.3 GHz, 400 MHz (256QAM)	0.51%
120 kHz SCS, 15 GHz, 400 MHz (256QAM)	0.54%
120 kHz SCS, 18 GHz, 400 MHz (256QAM)	0.6%
120 kHz SCS, 7 GHz, 100 MHz 8CC (256QAM)	0.64%
120 kHz SCS, 12.3 GHz, 100 MHz 8CC (256QAM)	0.8%
120 kHz SCS, 15 GHz, 100 MHz 8CC (256QAM)	0.8%
120 kHz SCS, 18 GHz, 100 MHz 8CC (256QAM)	0.85%
Adjacent Channel Power	
RF output loopback to RF input, at –10 dBm input power, LNA off, noise correction on	
30 kHz SCS, 4 GHz, 100 MHz (256QAM)	-62 dBc
30 kHz SCS, 5 GHz, 100 MHz (256QAM)	-61 dBc
30 kHz SCS, 7 GHz, 100 MHz (256QAM)	-53.5 dBc
30 kHz SCS, 12 GHz, 100 MHz (256QAM)	-50.5 dBc
30 kHz SCS, 15 GHz, 100 MHz (256QAM)	-52 dBc
30 kHz SCS, 18 GHz, 100 MHz (256QAM)	-57 dBc

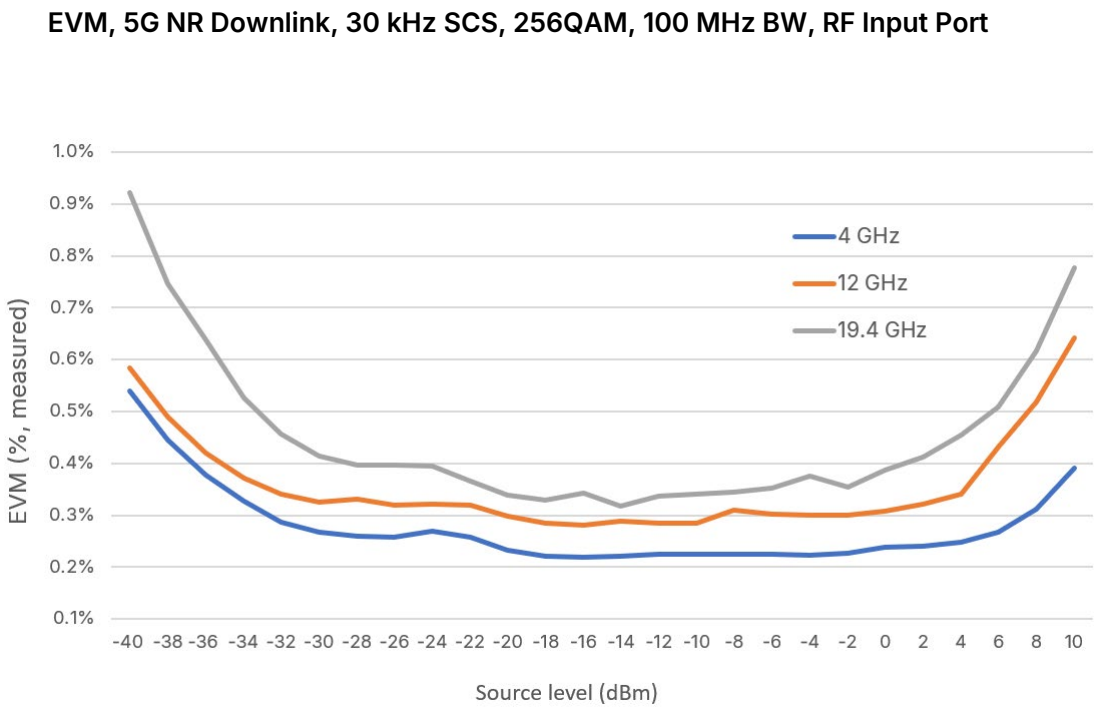

Figure 5. Measured 5G NR EVM vs. source level, with 30 kHz SCS, 256QAM, 100 MHz BW, loopback

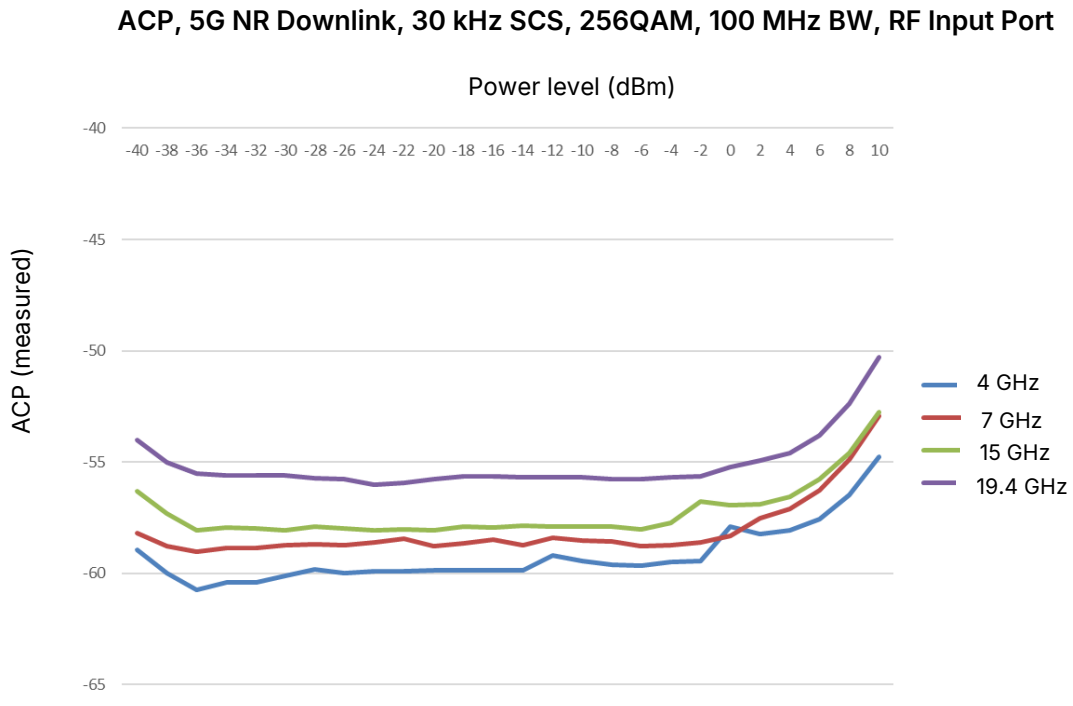

Figure 6. Measured 5G NR ACP vs. source level, with 30 kHz SCS, 256QAM, 100 MHz BW, loopback

LTE/LTE-Advanced FDD and TDD Measurement Specifications [1]

RF Path

Error Vector Magnitude (EVM)				
Residual EVM, RF Output Loopback to RF Input, at –10 dBm or 0 dBm Input Power, Nominal				
Frequency		Bandwidth	Downlink	Uplink
900 MHz		5 MHz	0.32%	0.36%
		20 MHz	0.16%	0.18%
2000 MHz		5 MHz	0.32%	0.34%
		20 MHz	0.16%	0.18%
Adjacent Channel Power				
RF Output Loopback to RF Iinput, at –10 dBm or 0 dBm Input Power, Nominal				
FDD	E-UTRA (Uplink and downlink)	900 MHz, 2000 MHz	5 MHz bandwidth, 20 MHz bandwidth	-62 dBc
FDD	UTRA (Uplink and downlink)	900 MHz, 2000 MHz	5 MHz bandwidth, 20 MHz bandwidth	-67.5 dBc
TDD	E-UTRA (Uplink and downlink)	900 MHz, 2000 MHz	5 MHz bandwidth, 20 MHz bandwidth	-58 dBc
TDD	UTRA (Uplink and downlink)	900 MHz, 2000 MHz	5 MHz bandwidth, 20 MHz bandwidth	-64.5 dBc

W-CDMA/HSPA+ Measurement Application Key Specifications [2]

RF Path

QPSK Error Vector Magnitude (EVM)	
RF output loopback to RF input, at -10 dBm input power, nominal	
Residual EVM	0.7%
Adjacent Channel Power Ratio (ACPR)	
Residual relative power in 3.84 MHz BW, nominal	
5 MHz offset	-65 dBc
Spectrum Emission Mask (SEM)	
Residual relative power (offset), at 0 dBm input power, nominal	
Downlink	
2.515 to 2.715 MHz	–81.5 dBc in a 30 kHz BW
2.715 to 3.515 MHz	–83.5 dBc in a 1 MHz BW
3.515 to 4 MHz	–83.5 dBc in a 1 MHz BW
4 to 8 MHz	–69.5 dBc in a 1 MHz BW
8 to 12.5 MHz	–70.5 dBc in a 1 MHz BW
Uplink	
2.515 to 3.485 MHz	–76.5 dBc in a 1 MHz BW
4 to 7.5 MHz	–67 dBc in a 1 MHz BW
7.5 to 8.5 MHz	–74 dBc in a 1 MHz BW
8.5 to 12 MHz	–73.5 dBc in a 1 MHz BW

1. For frequencies from 695 to 3800 MHz.
2. For frequencies from 730 MHz to 2650 MHz.

GSM/EDGE/Evo Measurement Key Specifications [1]

RF Path	
EDGE Error Vector Magnitude (EVM)	
RF output loopback to RF input, at 0 dBm input power, nominal	
RMS floor	0.1%
Output RF Spectrum (ORFS for GMSK and 8PSK Modulation)	
Residual relative power, spectrum due to modulation, at 0 dBm input power, nominal	
Offset frequency	
600 kHz	-76 dBc
1.2 MHz	-76 dBc
1.8 MHz	-72 dBc
Residual relative power, spectrum due to switching, at 0 dBm input power	
600 kHz	-66 dBc
1.2 MHz	-73 dBc
1.8 MHz	-73 dBc
Phase Eror (GMSK Modulation), at 0 dBm Input Power, Nominal	
Average floor	0.3°

1. For frequencies from 380 to 490 MHz, 695 to 960 MHz, 1425 to 2180 MHz; 450 to 490 MHz, 820 to 920 MHz, and 1710 to 1790 MHz.

Related Literature

For more detailed product and specification information refer to the following literature and web pages:

- M9415B VXT PXIe Vector Transceiver Configuration Guide (literature no. 3126-1059EN)
- M9019B PXIe 18 slot Chassis Data Sheet (literature no. 5992-1481EN)
- M9038A PXIe High Performance Embedded Controller Data Sheet (literature no. 3122-1717EN)
- M9300A PXIe Frequency Reference Data Sheet (literature no. 5991-0898EN)
- X-Series Measurement Applications Brochure (literature no. 5989-8019EN)
- Signal Studio Software Brochure (literature no. 5989-6448EN)