N5186A MXG

Vector Signal Generator

Introduction

This data sheet provides key features and specifications for the N5186A MXG vector signal generator.

KEYSIGHT

Table of Contents

Definitions and Conditions

Specifications represent warranted performance of a calibrated instrument that has been stored for a minimum of 2 hours within the operating temperature of 0 to 55 °C, unless otherwise stated, and after a 45 minute warm-up period. The specifications include measurement uncertainty. Data represented in this document are specifications unless otherwise noted.

Typical (typ) describes additional product performance information that is not covered by the product warranty. It is performance beyond specifications that 80 percent of the units exhibit with a 90 percent confidence level at room temperature (approximately 25 °C). Typical performance does not include measurement uncertainty.

Nominal (nom) values indicate the expected mean or average performance, or an attribute whose performance is by design, such as the 50 ohm connector. This data is not warranted and is measured at room temperature (approximately 25 °C).

Measured (meas) describes an attribute measured during the design phase for purposes of communicating expected performance, such as amplitude drift vs. time. This data is not warranted and is measured at room temperature (approximately 25 °C).

Frequency

Frequency options

Option	CW frequency range
N5186A-503	9 kHz to 3 GHz
N5186A-506	9 kHz to 6 GHz
N5186A-508	9 kHz to 8.5 GHz

Frequency resolution

CW	0.00001 Hz

Phase adjustments

Adjustable in nominal 0.1° increments

Frequency switching speed [1]

CW mode	
SCPI mode	≤ 9 ms (meas)
Digital modulation	
SCPI mode	≤ 15 ms (meas)

[1] Time from receipt of SCPI command or trigger signal to within 0.1 ppm of final frequency or within 100 Hz, whichever is greater.

Frequency Reference

Frequency resolution

Internal time base reference oscillator aging rate [2]	< ± 3 x 10^{-8}/year or ± 30 ppb/year after 30 days
	< ± 5 x 10^{-10}/year or ± 0.5 ppb/day after 30 days
Initial achievable calibration accuracy	± 4 x 10^{-8} or ± 40 ppb
Adjustment resolution	< 1.3 x 10^{-11}
Temperature effects	< ± 1 x 10^{-8}, nominal
Line voltage effects	< ± 1 x 10^{-9} for ± 5% change, nominal

Reference output

Frequency	10 MHz or 100 MHz, user selectable
Amplitude	≥ +6 dBm, nominal into 50 Ω load at 10 MHz reference output
	≥ +8 dBm, nominal into 50 Ω load at 100 MHz reference output

External reference input

Input frequency, standard	10 MHz
Stability	Follows stability of external reference input signal
Lock range	± 1 ppm
Amplitude	–3 dBm to +20 dBm, nominal
Impedance	50 Ω, nominal
Waveform	Sine or square

[2] Not verified by Keysight N7800A TME Calibration and Adjustments Software. Daily aging rate may be verified as a supplementary chargeable service, on request.

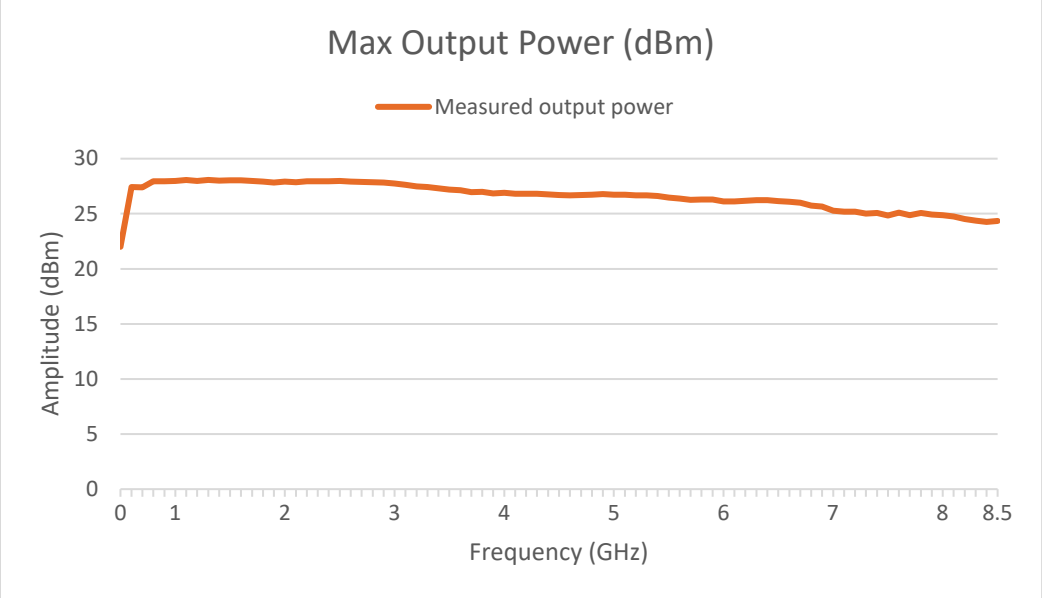
Output Power

Output parameters

Settable range	+20 to -144 dBm (std)
	+30 to -144 dBm (option 1EA)
Resolution	0.01 dB
Connector [3]	Type N 50 Ω, nominal
Maximum revers power	20 W, 50 VDC (nom)
Attenuator type	Electronic

Maximum output power

Frequency range	Standard	Option 1EA
9 kHz to 10 MHz	+13 dBm (meas)	+18 dBm (meas)
> 10 MHz to 3 GHz	+20 dBm (meas)	+27 dBm (meas)
> 3 to 6 GHz	+20 dBm (meas)	+26 dBm (meas)
> 6 to 8.5 GHz	+18 dBm (meas)	+24 dBm (meas)



[3] Connector type for configurations with options 1EM, 001, 002, 003, and 004 is 3.5 mm.

Absolute level accuracy (CW) [4], typical

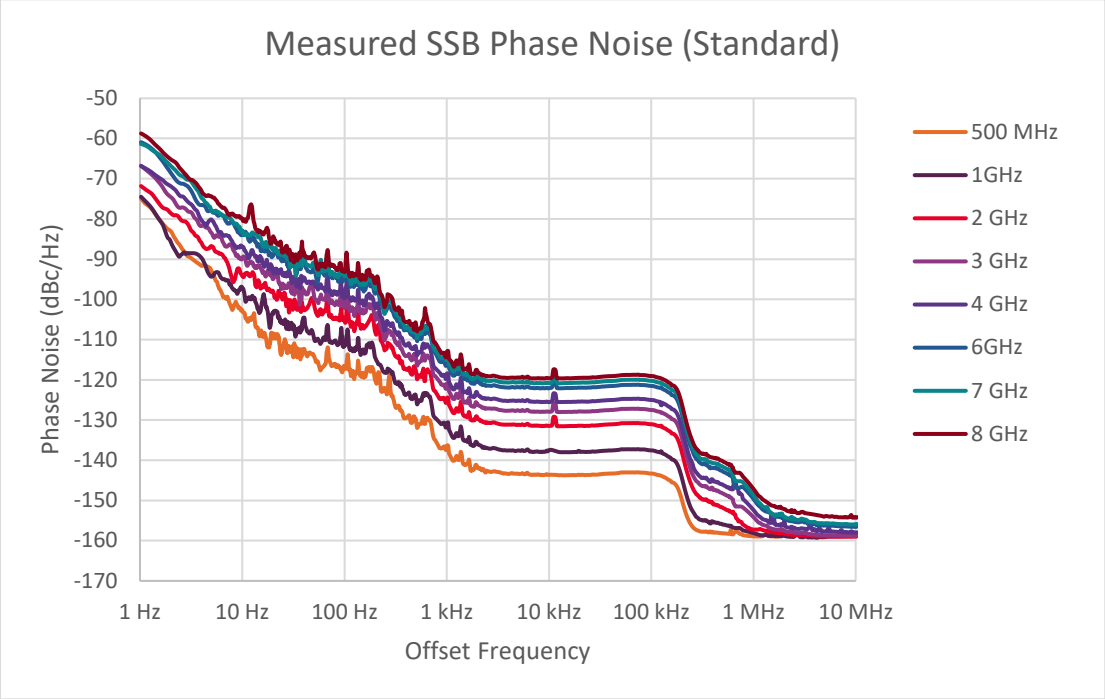
Frequency range	+20 dBm to +15 dBm (option 1EA)	< +15 dBm to +5 dBm	< +5 dBm to -60 dBm	< -60 dBm to -110 dBm [5]	< -110 dBm to -127 dBm (option 1EQ)
9 to 20 kHz	-	-	± 1.2 dB	± 2 dB	-
> 20 kHz to 10 MHz	-	-	± 0.5 dB	± 2 dB	-
> 10 MHz to 1 GHz	± 1 dB	± 0.85 dB	± 0.85 dB	± 0.7 dB	± 0.7 dB
> 1 to 5 GHz	± 0.5 dB	± 0.5 dB	± 0.5 dB	± 0.6 dB	± 0.6 dB
> 5 to 7 GHz	± 0.6 dB	± 0.6 dB	± 0.6 dB	± 0.8 dB	± 1 dB
> 7 to 8.5 GHz	± 0.8 dB	± 0.8 dB	± 0.8 dB	± 0.9 dB	± 0.9 dB

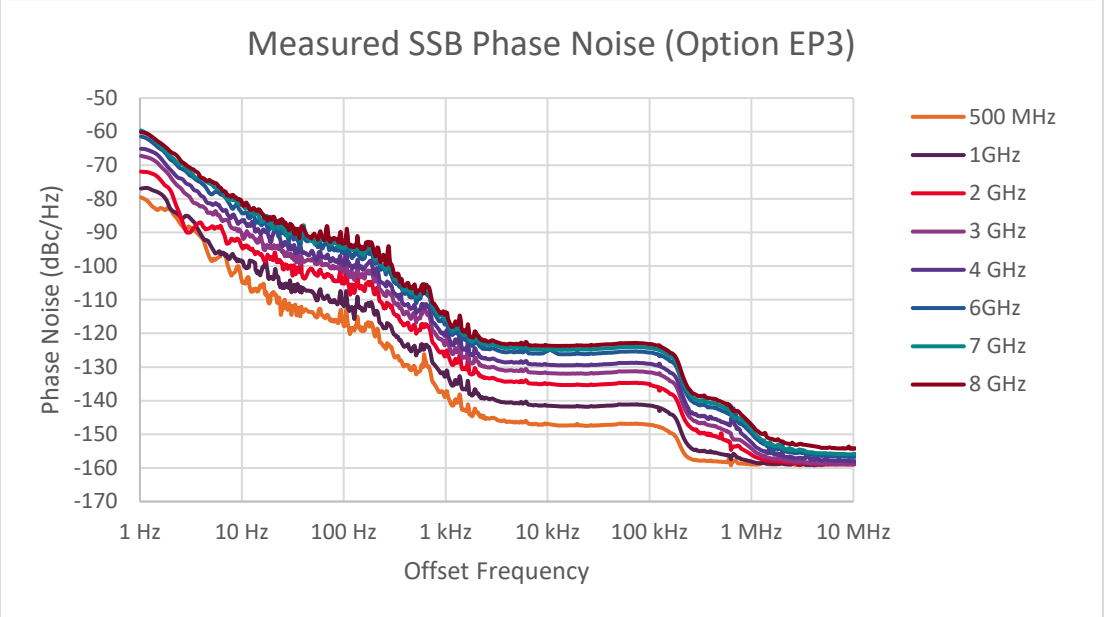
Amplitude switching speed [6]

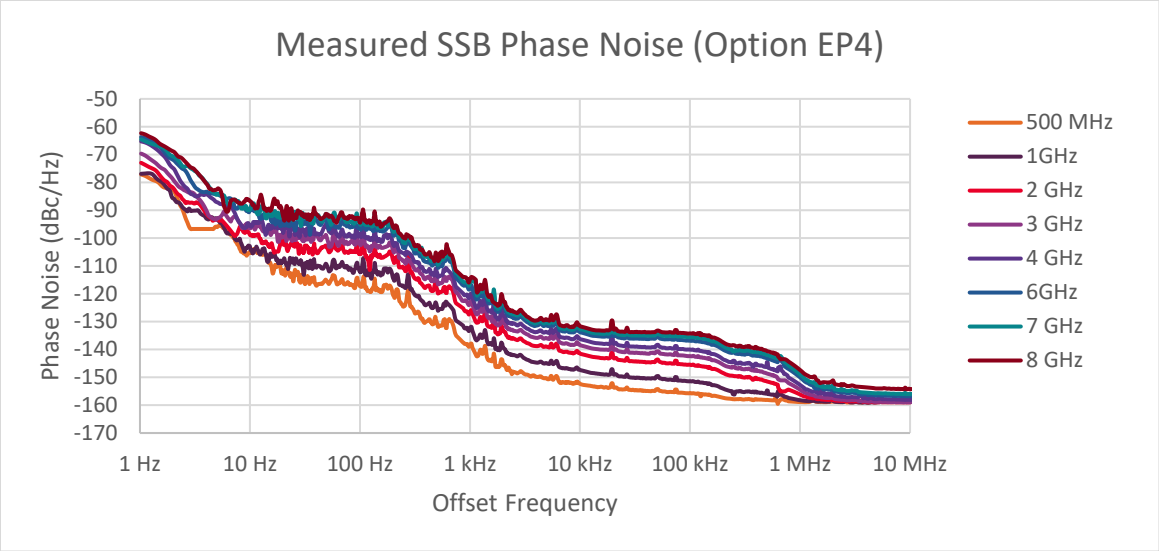
CW mode	
SCPI mode	≤ 9 ms (meas)
Digital modulation on	
SCPI mode	≤ 15 ms (meas)

[4] Applies after power alignments ± 5 °C of previous alignment (full-band power alignment).
[5] Performance operating below 20 kHz frequency is not warranted if the power level is set below -85 dBm.
[6] Time from receipt of SCPI command or trigger signal to amplitude settled within 0.2 dB. Switching speed specifications apply when status register updates are off.

Phase Noise


Measured SSB Phase Noise (Standard)
Phase Noise (dBc/Hz)
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
1 Hz
10 Hz
100 Hz
1 kHz
10 kHz
100 kHz
1 MHz
10 MHz
Offset Frequency
500 MHz
1GHz
2 GHz
3 GHz
4 GHz
6GHz
7 GHz
8 GHz


Measured SSB Phase Noise (Option EP3)
Phase Noise (dBc/Hz)
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
1 Hz
10 Hz
100 Hz
1 kHz
10 kHz
100 kHz
1 MHz
10 MHz
Offset Frequency
500 MHz
1GHz
2 GHz
3 GHz
4 GHz
6GHz
7 GHz
8 GHz



Spectral Purity

Harmonics (CW), measured

Frequency range	< +10 dBm	< +12 dBm
9 kHz to 100 kHz	< -30 dBc	n/a
> 100 kHz to 3 GHz	< -35 dBc	< -30 dBc
> 3 GHz to 4.25 GHz	< -30 dBc	< -28 dBc
> 4.25 GHz to 8.5 GHz	< -34 dBc	< -33 dBc

Non-harmonics (CW), > 10 kHz offset, +10 dBm, measured

Frequency range	Standard (+10 dBm)	Option EP3 / EP4
10 kHz to < 5 MHz	-57 dBc	-57 dBc
5 MHz to < 10 MHz	-62 dBc	-62 dBc
10 MHz to < 8.5 GHz	-75 dBc (nom)	-85 dBc

Fixed spurs, +10 dBm

Frequency range	Standard	Option EP3 / EP4
300 MHz	-75 dBc (nom)	-78 dBc (meas)
1.2 GHz	-75 dBc (nom)	-84 dBc (meas)
1.8 GHz	-75 dBc (nom)	-96 dBc (meas)
2.4 GHz	-75 dBc (nom)	-92 dBc (meas)
4.375 GHz	-72 dBc (nom)	-72 dBc (meas)
DAC spur (19.2 GHz – $2f_{out}$)	-75 dBc (nom)	-76 dBc (meas)

Analog Modulation

I/Q based analog modulation (E7642APPC)

This section describes the functionality provided by E7642APPC PathWave Signal Generation for I/Q based amplitude modulation. External inputs are not supported.

Amplitude modulation		
Waveform	Sine, dual-sine, triangle, ramp up, ramp down, square	
AM rate	Sine	1 Hz to (maximum baseband bandwidth / 2) [7]
	All other waveforms	1 Hz to (maximum baseband bandwidth / 16) [7]
AM depth	0 to 100%	
Frequency modulation		
Waveform	Sine, dual-sine, triangle, ramp up, ramp down, square	
FM rate	Sine	1 Hz to (maximum baseband bandwidth / 4) [7]
	All other waveforms	1 Hz to (maximum baseband bandwidth / 16) [7]
FM depth	0 Hz to 50 MHz	
Phase modulation		
Waveform	Sine, dual-sine, triangle, ramp up, ramp down, square	
PM rate	Sine	1 Hz to (maximum baseband bandwidth / 4) [7]
	All other waveforms	1 Hz to (maximum baseband bandwidth / 16) [7]
PM depth	0 to 10 radians	

[7] See RF (I+Q) bandwidth table for available modulation bandwidth.

Vector Modulation Specifications

Internal I/Q baseband generator adjustments [8]

Internal I/Q offset	Separate I and Q offsets, ± 20%
Internal I/Q quadrature angle	± 20°
Internal I/Q gain balance	± 10 dB
Internal I/Q time skew	± 83.3333 ns
I/Q common delay range	0 to 41.6667 ns
I/Q common delay resolution	250 fs

Frequency response over modulation bandwidth, measured

	Amplitude	Phase
400 MHz to 8.5 GHz	± 0.6 dB	± 2°

User defined automatic channel response correction and S-parameter de-embedding (E7653APPC)

Methods for fixture error removal	
Scatter parameters de-embedding/embedding files generated by a network analyzer or simulation	
Automatic channel response correction using a power sensor or spectrum analyzer (amplitude and phase correction)	
Scalar user flatness (absolute power correction)	
Scatter parameters	
File format	.s2p, .csv
Number of cascadable calibration sets	4
Automated channel response correction (256 taps) [9]	
Recommended maximum amplitude for error correction	± 5 dB across modulation bandwidth
User flatness	
File format	.uflat, .csv
Entry modes	USB or LAN direct power meter control

[8] I/Q adjustments represent user interface nominal parameter ranges and not specifications.
[9] Automated routine uses power sensor to correct for linear amplitude response of DUT (equalizer). See User Documentation for more details.

Internal Baseband Generator (Options BxX)

Definitions

Channel or port	The number of physical RF outputs
Signal	Each channel can generate one signal (ex: one waveform file).

Internal baseband generator (Options BxX)

I/Q file resolution	16 bits
Waveform granularity	1 sample
Frequency offset	+/- half maximum bandwidth
Signal attenuation	0 to -100 dB
Sample rate resolution	1 Hz
Interpolated I/Q rate	1.2 GHz

RF (I + Q) bandwidth[10] and sample rate

Option	RF (I + Q) bandwidth (nom)	Sample rate (nom)
Option B2X	250 MHz	312.5 MHz
Option B5X	500 MHz	625 MHz
Option B9X	960 MHz	1.2 GHz

Arbitrary waveform memory

Maximum arbitrary waveform playback memory	Standard	256 MSa
	Option M05	512 MSa
	Option M10	1024 MSa
	Option M20	2048 MSa
Maximum storage capacity	256 GB (nom)	

Waveform segments

Segment length	Minimum: 128
	Maximum: See Maximum arbitrary waveform playback memory
	Quantum: See waveform granularity
Minimum memory allocation blocking factor	64 Bytes or 16 samples
Maximum number of waveform files	> 1000, depending on available memory

[10] Lower edge of modulated signal is not recommended to extend below 10 MHz. Upper edge of modulated signal is not recommended to extend above 8.5 GHz.

Waveform sequences

Maximum number of segments per sequences	65,280
Maximum number of repetitions	2^{32} -1

Triggers

Types	Continuous, single, gated, segment advance	
Source	Trigger key, external, bus (GPIB, LAN, USB)	
Modes	Continuous	Free run, trigger and run, reset and run
	Single	Buffered trigger, no retrigger, restart on trigger
	Gated	Negative polarity or positive polarity
	Segment advance	Not supported
External coarse delay time	0 to 41s (nom)	
External coarse delay resolution	833 ps (nom)	
I/Q delay range	See Internal I/Q baseband adjustment generator adjustments section	
I/Q delay resolution	See Internal I/Q baseband adjustment generator adjustments section	

Markers

Markers are defined in a segment during the waveform generation process, or from the front panel; see User Documentation or Online Help for more information.	
Marker polarity	Positive, negative
Number of markers	3

AWGN (option 403)

Type	Real-time
Modes of operation	Standalone signal or digitally added to signals
Crest factor	12.9 dB (nom)
Randomness	16.3 hours (nom)
Carrier-to-noise ratio	± 100 dB when added to signal
Carrier-to-noise ratio formats	C/N, Eb/No

CW interferer (option 403)

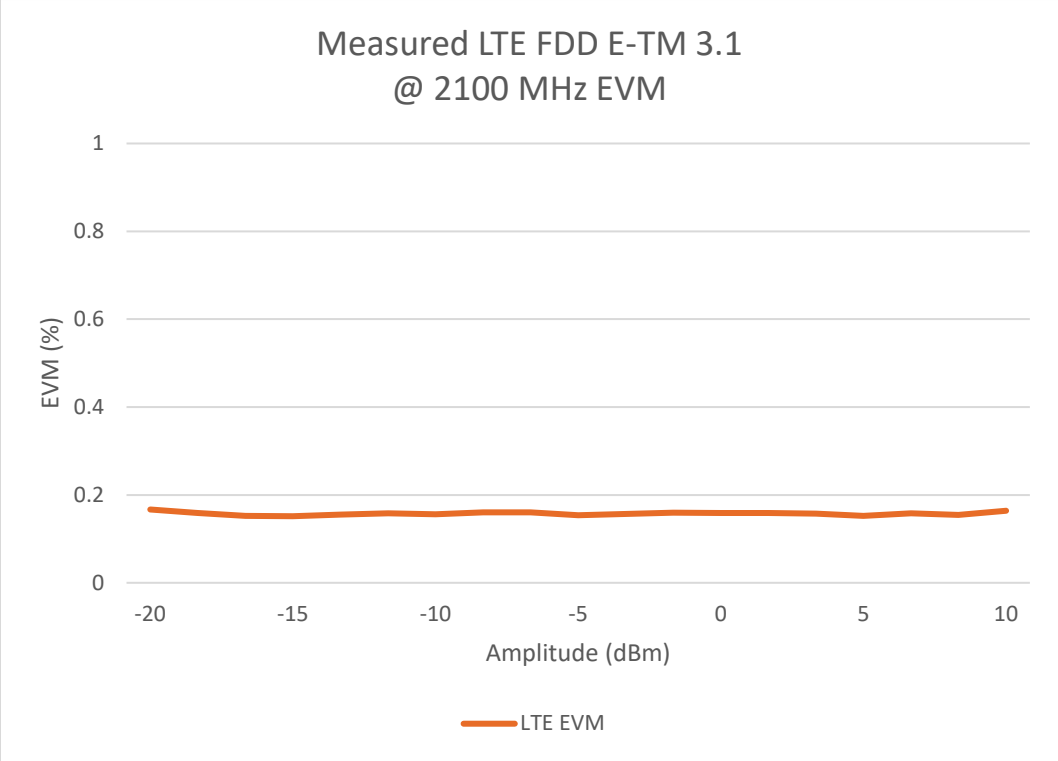
Type	Real-time
Modes of operation	Standalone signal or digitally added to signals
Power control	Absolute, relative to signal power
Frequency offset	± half of maximum baseband bandwidth[11]

[11] For maximum baseband bandwidth and sample rate, see RF (I + Q) bandwidth and sample rate.

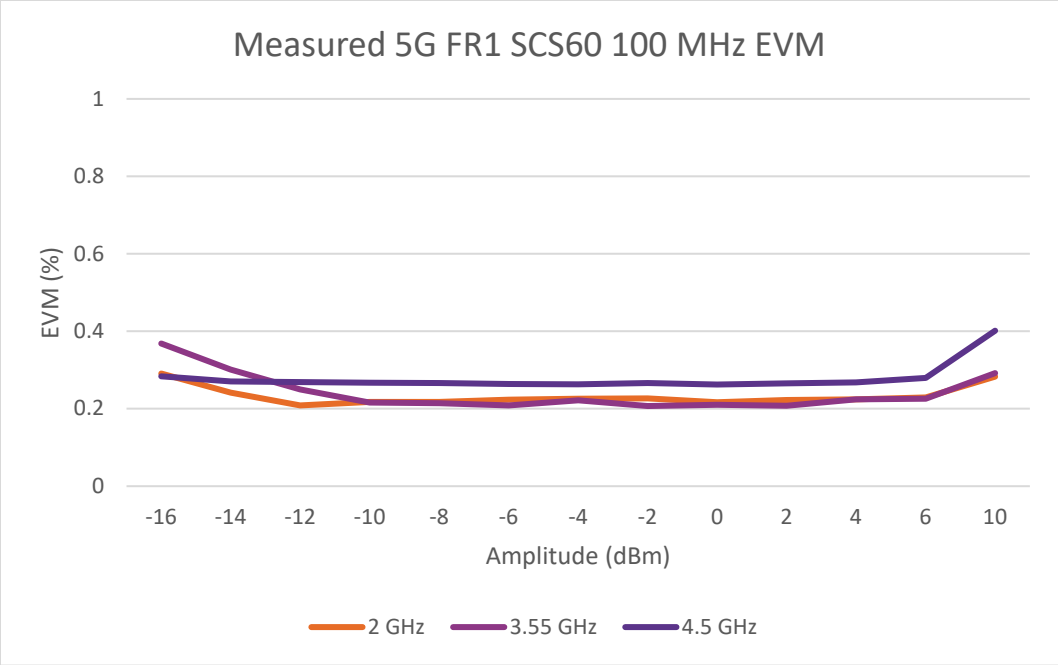
Multitone and single tone (E7621APPC)

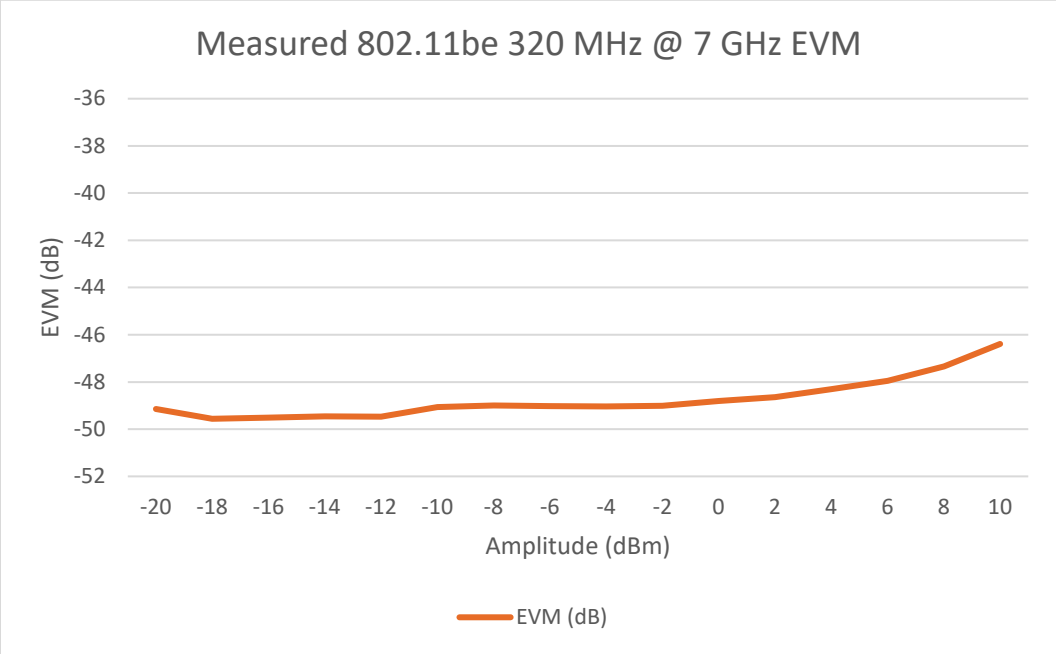
Type	Arbitrary waveform file	
Number of tones	Multitone mode	2 to 200,001
	Single tone mode [12]	1
Tone spacing	100 Hz to Floor [(maximum baseband bandwidth [13])/((number of tones) - 1)/100] * 100	
Phase (per tone)	Random, fixed (remote command only)	

Error Vector Magnitude (EVM)

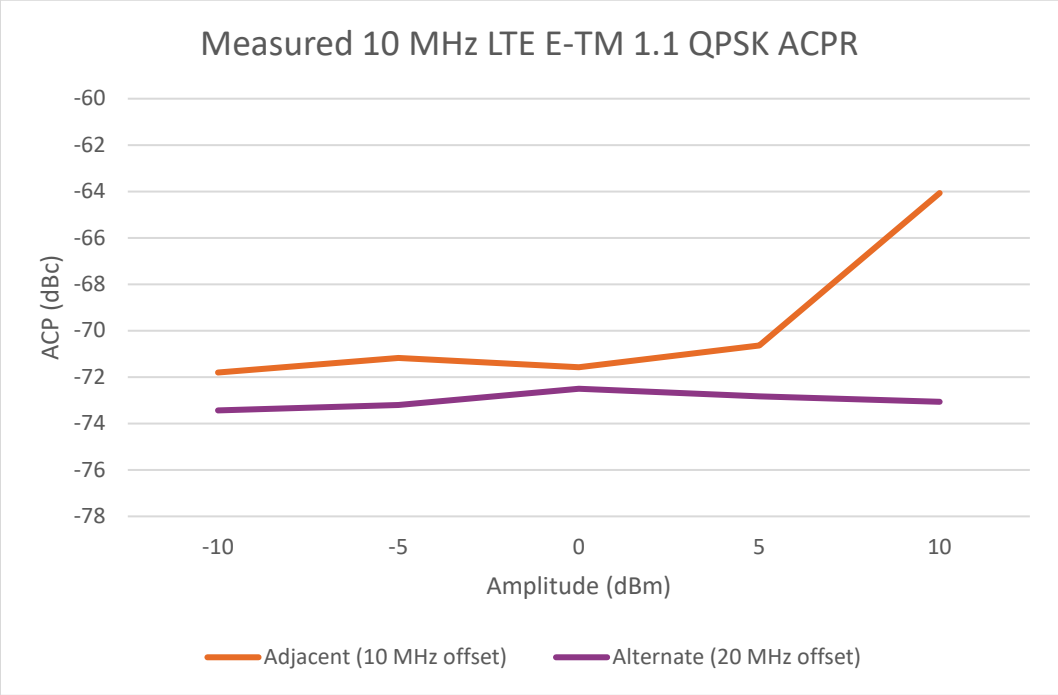


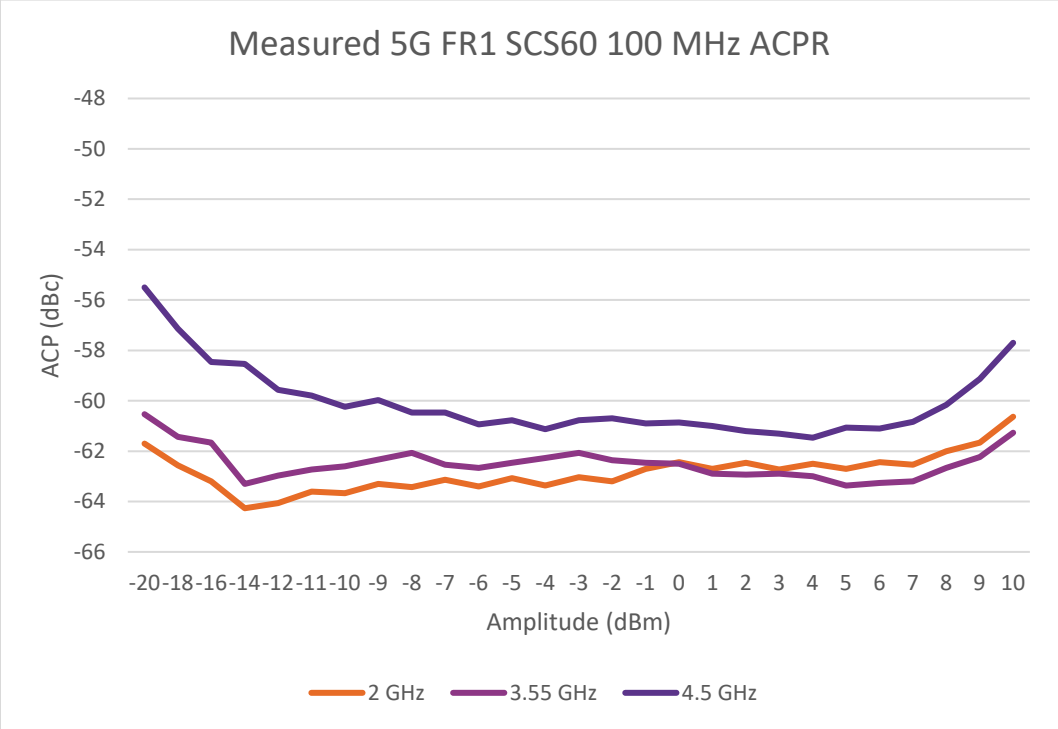
[12] Single tone generates a single CW tone at a specified offset to the channel's RF frequency.
[13] For maximum baseband bandwidth and sample rate, see RF (I+Q) bandwidth and sample rate.


Measured 5G FR1 SCS60 100 MHz EVM
1
0.8
0.6
0.4
0.2
0
EVM (%)
-16 -14 -12 -10 -8 -6 -4 -2 0 2 4 6 10
Amplitude (dBm)
2 GHz
3.55 GHz
4.5 GHz


Measured 802.11be 320 MHz @ 7 GHz EVM
-36
-38
-40
-42
-44
-46
-48
-50
-52
EVM (dB)
-20 -18 -16 -14 -12 -10 -8 -6 -4 -2 0 2 4 6 8 10
Amplitude (dBm)
EVM (dB)

Distortion Performance (ACPR)





Inputs and Outputs

Front panel connectors

RF output	Outputs the RF signal via a precision Type-N female connector; see output section for reverse power protection information
USB 2.0	Type-A connector used with a memory stick for transferring instrument states, licenses and other files into or out of the instrument.
USB 3.0	Outputs 2 A at 15 V.

Rear panel connectors

Rear panel inputs and outputs are 3.3 V CMOS, unless indicated otherwise; CMOS inputs will accept 5 V CMOS, 3 V CMOS, or TTL voltage levels.		
RF output (Option 1EM)	1 channel configuration	Outputs the RF signal via a precision Type-N female connector
	4 channel configuration	Outupts the RF signal via a 3.5 mm female connector
EXT1/EXT2	BNC, nominal input impedance is 50 Ω; damage levels are 1 V_{rms} and 5 V_{peak}.	
Event 1-3	Channel 1	BNC connector outputs the programmable timing signal generated by marker 1. The marker signal can also be routed internally to control the RF blanking and damage levels are > +8 V and < –4 V.
	Channels 2-4	SMB connector, only events 1-2. The marker signal can also be routed internally to control the RF blanking and damage levels are > +8 V and < –4 V.
Trigger 1-6	Channel 1	BNC accepts signal to trigger internal pattern generator to start single pattern output, for use with the internal baseband generators Accepts CMOS signal with minimum pulse width of 10 ns. Damage levels are > +8 V and < –4 V.
	Channels 2-4	SMB connector, only triggers 1-5. Accepts signal to trigger internal pattern generator to start single pattern output, for use with the internal baseband generators Accepts CMOS signal with minimum pulse width of 10 ns. Damage levels are > +8 V and < –4 V.
Sweep out/LF out	Reserved for future use.	
Pulse	Reserved for future use.	
10 MHz out (Ref Out)	BNC connectors outputs the 10 MHz reference signal used by internal timebase; level nominally +3.9 dBm; nominal output impedance 50 Ω; input damage level is +16 dBm.	
USB 2.0	The USB connector provides remote programming functions via SCPI with 2 Type-A ports and 1 Type-B port.	
LAN (1000 BaseT)	The LAN connector provides the same SCPI remote programming functionality as the GPIB connector and is also used to access the internal Web server and FTP server. Supports DHCP, sockets SCPI, VXI-11 SCPI, connection monitoring, dynamic hostname services, TCP keep alive. LXI class C compliant	
GPIB	The micro GPIB connector provides remote programming functionality via SCPI.	

Remote Programming

Remote programming

Interfaces	VXI-11 HiSlip SOCKET USB-488
	GPIB
	USB Version-488
Control languages	Control languages SCPI Version 1997.0
Keysight IO libraries	Keysight's IO Library Suite helps you quickly establish an error-free connection between your PC and instruments – regardless of the vendor. It provides robust instrument control and works with the software development environment you choose.

General Specifications

Environmental specifications and regulatory compliance

Temperature	Operating	1 channel	0 to 55 °C
		4 channel	0 to 50 °C
	Storage	-40 to +70 °C	
Maximum relative humidity (non-condensing)		95%RH up to 40 °C, decreases linearly to 45%RH at 55 °C	
Operating and storage altitude		Up to 4,600 meters	
Indoor use		For indoor use only	
Environmental testing		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 enduse; 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 MILPRF28800F Class 3	
Safety	Complies with European Low Voltage Directive 2006/95/EC	IEC/EN 61010-1 [14] Canada: CSA C22.2 No. 61010-1 USA: UL std no. 61010-1 German Acoustic statement	
		Acoustic noise emission LpA < 77.5 dB Operator position Normal position Per ISO 7779	
		Geraeuschemission LpA < 77.5 dB Am Arbeitsplatz Normaler Betrieb Nach DIN 45635 t.19	
	Complies with European EMC Directive 2004/108/EC	IEC/EN 61326-1or IEC/EN 61326-2-1 CISPR Pub 11 Group 1, class A AS/NZS CISPR 11 ICES/NMB-001 2This ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme a la norme NMB-001 du Canada.	

Power requirements

Number of channels	Maximum frequency	Power requirements
1 (opt. 001)	3/6/8.5 GHz (opt. 503/506/508)	100/120 VAC, 50/60/400 Hz
		220/240 VAC, 50/60/400 Hz
		650 W Max
4 (opt. 001, 002, 003, and 004)	3/6/8.5 GHz (opt. 503/506/508)	100/120 VAC, 50/60/400 Hz
		220/240 VAC, 50/60 Hz
		650 W Max

[14] AC line voltage dropouts (IEC 61000-4-11) of duration greater than 5 ms will cause the RF output to turn off until it is re-enabled by the operator, in order to protect internal hardware.

Physical specifications

Configuration		One channel (001)	Four channels (001, 002, 003, 004)
Weight		16.09 kg (or 35.47 lbs)	21.73 kg (or 47.91 lbs)
Dimensions	Height	88.25 mm (without feet)	
		102 mm (with feet)	
	Width with handles	474.7 mm	
	Width without handles	425.5 mm	
	Length with handles (including connectors)	591.1 mm	
	Length without handles (including connectors)	501.9 mm	
Display	Resolution	1280 x 400	
	Size	190.08 mm x 59.44 mm	

Data storage

Internal	Removable solid-state drive (256 GB)
External	Supports USB 3.0/2.0 compatible memory devices

Self-test

Internal diagnostic routines test most modules in a preset condition; for each module, if its node voltages are within acceptable limits, the module passes the test.

Recommended calibration cycle

1 year

Related Literature

Publication title	Publication number
N5186A MXG Configuration Guide	3123-1623.EN