Agilent
N8211A Analog Upconverter
Synthetic Instrument Module
250 kHz to 20/40 GHz

Data Sheet

The Agilent N8211A is a fully synthesized 20 or 40 GHz analog upconverter synthetic instrument module that converts a baseband signal to a microwave signal. The N8211A is fully LXI class A compliant.

Agilent Technologies

Definitions and Conditions

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All specifications and characteristics apply over a 0 to 55 °C range (unless otherwise stated) and apply after a 45 minute warm-up time. Supplemental characteristics, denoted as typical, nominal, or measured, provide additional (non-warranted) information, which may be useful in the application of the product.

Specifications (spec):
Specifications describe the performance of parameters covered by the product warranty and apply over 0 to 55 °C temperature range unless otherwise noted.

Typical (typ):
Represents characteristic performance which is non-warranted. Describes performance that will be met by a minimum of 80% of all products.

Nominal (nom):
Nominal values indicate expected performance, or describe product performance that is useful in the application of the product, but is not covered by the product warranty. Represents the value of a parameter that is most likely to occur; the expected mean or average.

Measured (meas.):
Measured values represent the value of a parameter measured on an instrument during the design stage. Measured values are non-warranted.

The N8211A 20/40 GHz performance analog upconverter synthetic instrument module will meet its specifications when:

- Stored a minimum of two hours within the operating temperature range and turned on for at least 45 minutes.
- The instrument is within its two-year calibration cycle.

Specifications

Frequency

Range[1]			
Option 520	250 kHz to 20 GHz		
Option 540	250 kHz to 40 GHz		
Resolution			
CW	0.001 Hz		
All sweep modes	0.01 Hz[2]		
Accuracy	Aging rate ± temperature effects ± line voltage effects		
Switching speed[3, 4]	< 11 ms (typical)		
Phase offset	Adjustable in nominal 0.1° increments		
Frequency bands	Band	Frequency range	N #
	1	250 kHz to 250 MHz	1/8
	2	> 250 to 500 MHz	1/16
	3	> 500 MHz to 1 GHz	1/8
	4	> 1 to 2 GHz	1/4
	5	> 2 to 3.2 GHz	1/2
	6	> 3.2 to 10 GHz	1
	7	> 10 to 20 GHz	2
	8	> 20 to 40 GHz	4
Accuracy	Aging rate ± temperature effects ± line voltage effects		
Internal timebase reference oscillator	Standard		Option UNX
Aging rate	< ±1 x 10^{-7}/year or < ±4.5 x 10^{-9}/day after 45 days		< ±3 x10^{-8}/year or < ±2.5 x 10^{-10}/day after 30 days
Temperature effects	Standard		Option UNX
	< ±5 x 10^{-8} 0 to 55 °C (typ)		< ±4.5 x 10^{-9} 0 to 55 °C (typ)
Line voltage effects	Standard		Option UNX
	< ±2 x 10^{-9} for +5% –10% change (typ)		< ±2 x 10^{-10} for ±10% change (typ)
External reference frequency	1, 2, 2.5, 5, 10 MHz		10 MHz only
Lock range	±0.2 ppm		±1.0 ppm
Reference output			
Frequency	10 MHz		
Amplitude	> +4 dBm into 50 Ω load (typ)		
External reference input			
Amplitude	> –3 dBm		
Option UNX	5 dBm ±5 dB[5]		
Input impedance	50 Ω (nom)		

1 Usable, but unspecified, down to 100 kHz.
2 In ramp sweep mode (Option 007), resolution is limited with narrow spans and slow sweep speeds. Refer to ramp sweep specifications for more information.
3 Time from IEEE1588 trigger to within 0.1 ppm of final frequency above 250 MHz or within 100 Hz below 250 MHz.
4 Add 12 ms (typical) when switching from greater than 3.2 GHz to less than 3.2 GHz.
5 To optimize phase noise 5 dBm ± 2 dB.

Specifications (continued)

Step (digital) sweep

Operating modes	Step sweep of frequency or amplitude or both (start to stop) List sweep of frequency or amplitude or both (arbitrary list)
Sweep range	
Frequency sweep	Within instrument frequency range
Amplitude sweep	Within attenuator hold range (see "Output" section)
Dwell time	1 ms to 60 s
Number of points	2 to 65535 (step sweep) 2 to 1601 per table (list sweep)
Triggering	Auto, external, single, or LAN IEEE1588
Settling time[6]	
Frequency	< 8 ms (typ)
Amplitude	< 5 ms (typ)

Ramp (analog) sweep (Option 007)[7, 8]

Operating modes	Synthesized frequency sweep (start/stop), (center/span), (swept CW) Power (amplitude) sweep (start/stop)		
Sweep span range	Settable from minimum[9] to full range		
Maximum sweep rate	Start frequency	Maximum sweep rate	Max span for 100 ms sweep
	250 kHz to < 0.5 GHz	25 MHz/ms	2.5 GHz
	0.5 to < 1 GHz	50 MHz/ms	5 GHz
	1 to < 2 GHz	100 MHz/ms	10 GHz
	2 to < 3.2 GHz	200 MHz/ms	20 GHz
	≥ 3.2 GHz	400 MHz/ms	40 GHz
Frequency accuracy	±0.05% of span ± timebase (at 100 ms sweep time, for sweep spans less than maximum values given above) Accuracy improves proportionally as sweep time increases[10]		
Sweep time	(Forward sweep, not including bandswitch and retrace intervals)		
Resolution	1 ms		
Manual mode settable	10 ms to 200 seconds		
Triggering	Auto, external, single, LAN IEEE1588, or LXI trigger bus		
Markers	10 independent continuously variable frequency markers		
Display	Z-axis intensity or RF amplitude pulse		
Functions	M1 to center, M1/M2 to start/stop, marker delta		

6 19 ms (typical) when stepping from greater than 3.2 GHz to less than 3.2 GHz.

7 During ramp sweep operation, AM, FM, phase modulation, and pulse modulation are usable but performance is not guaranteed.

8 The N8211A does not support operation with swept scalar analyzers, such as the 8757 family.

9 Minimum settable sweep span is proportional to carrier frequency and sweep time. Actual sweep span may be slightly different than desired setting for spans less than [0.00004% of carrier frequency or 140 Hz] x [sweep time in seconds]. Actual span will always be displayed correctly.

10 Typical accuracy for sweep times > 100 ms can be calculated from the equation: [(0.005% of span)/(sweep time in seconds)] ± timebase. Accuracy is not specified for sweep times < 100 ms.

Specifications (continued)

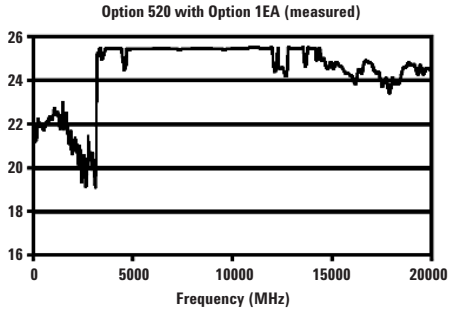
Output

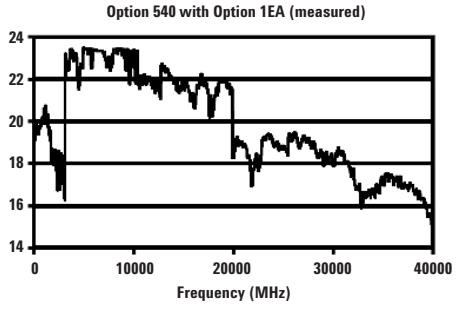
Power[11] (dBm)	Frequency range	Standard	Option 1EA spec. (typ.)
Option 520	250 kHz to 3.2 GHz	–20 to +13	–20 to +16 (+19)
	250 kHz to 3.2 GHz with Option UNW	–20 to +11	–20 to +11 (+14)
	250 kHz to 3.2 GHz with Option 1EH	–20 to +13[12]	–20 to +13 (+16)[12]
	250 kHz to 3.2 GHz with Options UNW and 1EH	–20 to +10[12]	–20 to +10 (+13)[12]
	> 3.2 to 5.2 GHz	–20 to +13	–20 to +22 (+23)
	> 5.2 to 12 GHz	–20 to +13	–20 to +23 (+24)
	> 12 to 20 GHz	–20 to +13	–20 to +21 (+23)
Option 540	250 kHz to 3.2 GHz	–20 to +9	–20 to +15 (+18)
	250 kHz to 3.2 GHz with Option UNW	–20 to +9	–20 to +10 (+13)
	250 kHz to 3.2 GHz with Option 1EH	–20 to +9	–20 to +12 (+15)[12]
	250 kHz to 3.2 GHz with Options UNW and 1EH	–20 to +9[12]	–20 to +9 (+ 12)[12]
	> 3.2 to 17 GHz	–20 to +9	–20 to +17 (+19)
	> 17 to 37 GHz	–20 to +9	–20 to +14 (+17)
	> 37 to 40 GHz	–20 to +9	–20 to +12 (+15)
Option 520 with step attenuator (Option 1E1)	250 kHz to 3.2 GHz	–135 to +11	–135 to +15 (+18)
	250 kHz to 3.2 GHz with Option UNW	–135 to +10	–135 to +10 (+13)
	250 kHz to 3.2 GHz with Option 1EH	–135 to +10[13]	–135 to +12 (+15)[12]
	250 kHz to 3.2 GHz with Options UNW and 1EH	–135 to +9[12]	–135 to +9 (+12)[12]
	> 3.2 to 10 GHz	–135 to +11	–135 to +21 (+22)
	> 10 to 20 GHz	–135 to +11	–135 to +19 (+20)
Option 540 with step attenuator (Option 1E1)	250 kHz to 3.2 GHz	–135 to +7	–135 to +14 (+17)
	250 kHz to 3.2 GHz with Option UNW	–135 to +7	–135 to +9 (+12)
	250 kHz to 3.2 GHz with Option 1EH	–135 to +7	–135 to +11 (+14)[12]
	250 kHz to 3.2 GHz with Options UNW and 1EH	–135 to +7[13]	–135 to +8 (+11)[12]
	3.2 to 17 GHz	–135 to +7	–135 to +15 (+18)
	17 to 37 GHz	–135 to +7	–135 to +12 (+15)
	37 to 40 GHz	–135 to +7	–135 to +10 (+14)

Step attenuator[14] (Option 1E1)

Options 520 and 540: 0 dB and 5 to 115 dB in 10 dB steps

Maximum available power (measured)





11 Maximum power specification is warranted from 15 to 35 °C, and is typical from 0 to 15 °C. Maximum power over the 35 to 55 °C range typically degrades less than 2 dB.

12 With harmonic filters switched off. With filters on, maximum output power is reduced 3 dB for frequencies below 2 GHz.

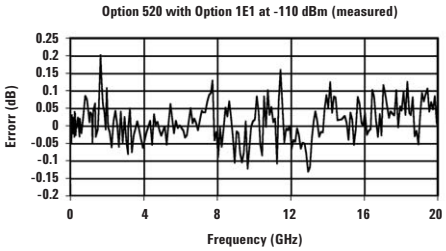
13 With harmonic filters switched off. With filters on, maximum output power is reduced 2 dB for frequencies below 2 GHz.

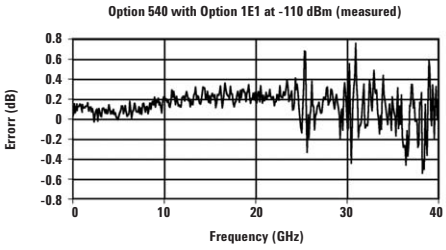
14 The step attenuator provides coarse power attenuation to achieve low power levels. Fine power level adjustment is provided by the ALC (Automatic Level Control) within the attenuator hold range.

Specifications (continued)

Output (continued)

Attenuator hold range minimum	From –20 dBm to maximum specified output power with step attenuator in 0 dB position; can be offset using Option 1E1 attenuator				
Amplitude switching speed[15]					
CW or analog modulation	< 3 ms (typ) with ALC on or off, without power search				
Level accuracy[16] (dB)	Frequency	> +10 dBm	+10 to 0 dBm	0 to –10 dBm	–10 to –20 dBm
	250 kHz to 2 GHz	±0.6	±0.6	±0.6	±1.4
	2 GHz to 20 GHz	±0.8	±0.8	±0.8	±1.2
	> 20 to 40 GHz	±1.0	±0.9	±0.9	±1.3
Level accuracy with step attenuator (Option 1E1)[17] (dB)					
Options 520 and 540	Frequency	> +10 dBm	+10 to –10 dBm	–10 to –70 dBm	–70 to –90 dBm
	250 kHz to 2 GHz	±0.6	±0.6	±0.7	±0.8
	> 2 to 20 GHz	±0.8	±0.8	±0.9	±1.0
	> 20 to 40 GHz	±1.0	±0.9	±1.0	±2.0





Resolution	0.01 dB
Temperature stability	0.01 dB/°C (typ)
User flatness correction	
Number of points	2 to 1601 points/table
Number of tables	Up to 10,000 memory limited
Path loss	Arbitrary, within attenuator range
Entry modes	Remote power meter[18], remote bus, manual (user edit/view)

15 To within 0.1 dB of final amplitude within one attenuator range. Add 10 to 50 ms when using power search.

16 Specifications apply in CW and list/step sweep modes over the 15 to 35 °C temperature range. Degradation outside this range, for power levels > –10 dBm, is typically < 0.3 dB. In ramp sweep mode (with Option 007), specifications are typical. Specifications do not apply above the maximum specified power.

17 Specifications apply in CW and list/step sweep modes over the 15 to 35 °C temperature range, with attenuator hold off (normal operating mode). Degradation outside this range, for ALC power levels > –10 dBm, is typically < 0.3 dB. In ramp sweep mode (with Option 007), specifications are typical. Specifications do not apply above the maximum specified power.

18 Compatible with Agilent N1911A and N1912A power meters as well as EPM Series (E4418B and E4419B) power meters.

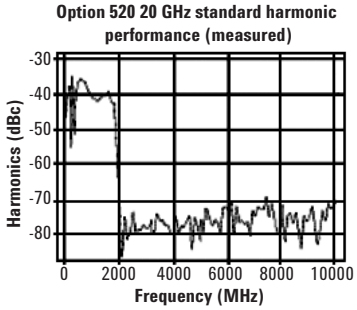
Specifications (continued)

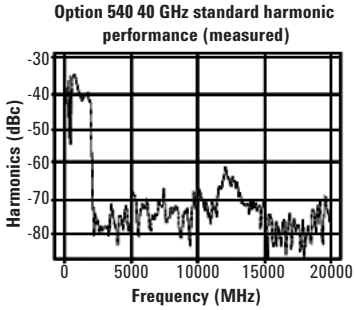
Output (continued)

Output impedance	50 Ω (nom)
SWR (internally leveled) (typ)	
250 kHz to 2 GHz	< 1.4:1
> 2 GHz to 20 GHz	< 1.6:1
> 20 GHz to 40 GHz	< 1.8:1
Leveling modes	Internal leveling, external detector leveling, millimeter source module, ALC off
External detector leveling	
Range	–0.2 mV to –0.5 V (nom) (–36 dBm to +4 dBm using Agilent 33330D/E detector)
Bandwidth	Selectable 0.1 to 100 kHz (nom) (Note: Not intended for pulsed operation)
Maximum reverse power	1/2 Watt, 0 VDC

Spectral purity

Harmonics[19]	(dBc at +10 dBm or maximum specified output power, whichever is lower)
< 10 MHz	–28 dBc (typical below 1 MHz)
10 MHz to 2 GHz	–30 dBc[20]
10 MHz to 2 GHz (with Option 1EH filters on)	–55 dBc[21]
>2 GHz to 20 GHz	–55 dBc
>20 GHz to 40 GHz (Option 540)	–50 dBc (typ)





Sub-harmonics[22]	(dBc at +10 dBm or maximum specified output power, whichever is lower)
250 kHz to 10 GHz	None
> 10 GHz to 20 GHz	< –60 dBc
> 20 GHz	< –50 dBc

19 Specifications are typical for harmonics beyond specified frequency range.
20 Typical below 250 MHz if Option 1EH is installed and the filters are off.
21 In ramp sweep mode (Option 007), harmonics are –28 dBc below 250 MHz.
22 Sub-harmonics are defined as Carrier Freq / N. Specifications are typical for sub-harmonics beyond specified frequency range.

Specifications (continued)

Spectral purity (continued)

Non-harmonics[23]

(dBc at +10 dBm or maximum specified output power, whichever is lower, for offsets > 3 KHz [> 300 Hz with Option UNX])

Frequency	Spec	Typical
250 kHz to 250 MHz	–65	–72 for > 10 kHz offsets
> 250 MHz to 1 GHz	–80	–88
> 1 to 2 GHz	–74	–82
> 2 to 3.2 GHz	–68	–76
> 3.2 to 10 GHz	–62	–70
> 10 to 20 GHz	–56	–64
> 20 to 40 GHz	–50	–58

SSB phase noise (CW)[24]

Offset from carrier (dBc/Hz)

Frequency	20 kHz	20 kHz (typical)
250 kHz to 250 MHz[25]	–130	–134
> 250 to 500 MHz[25]	–134	–138
> 500 MHz to 1 GHz[25]	–130	–134
> 1 to 2 GHz[25]	–124	–128
> 2 to 3.2 GHz	–120	–124
> 3.2 to 10 GHz	–110	–113
> 10 to 20 GHz	–104	–108
> 20 to 40 GHz	–98	–102

Option UNX: Absolute SSB phase noise (dBc/Hz) (CW)[24]

Offset from carrier

Frequency	1 Hz spec (typical)	10 Hz spec (typical)	100 Hz spec (typical)
250 kHz to 250 MHz[25]	–58 (–66)	–87 (–94)	–104 (–120)
> 250 to 500 MHz[25]	–61 (–72)	–88 (–98)	–108 (–118)
> 500 MHz to 1 GHz[25]	–57 (–65)	–84 (–93)	–101 (–111)
> 1 to 2 GHz[25]	–51 (–58)	–79 (–86)	–96 (–106)
> 2 to 3.2 GHz	–46 (–54)	–74 (–82)	–92 (–102)
> 3.2 to 10 GHz	–37 (–44)	–65 (–72)	–81 (–92)
> 10 to 20 GHz	–31 (–38)	–59 (–66)	–75 (–87)
> 20 to 40 GHz	–25 (–32)	–53 (–60)	–69 (–79)

Frequency	1 kHz spec (typical)	10 kHz spec (typical)	100 kHz spec (typical)
250 kHz to 250 MHz[25]	–121 (–128)	–128 (–132)	–130 (–133)
> 250 to 500 MHz[25]	–126 (–132)	–132 (–136)	–136 (–141)
> 500 MHz to 1 GHz[25]	–121 (–130)	–130 (–134)	–130 (–135)
> 1 to 2 GHz[25]	–115 (–124)	–124 (–129)	–124 (–129)
> 2 to 3.2 GHz	–111 (–120)	–120 (–124)	–120 (–124)
> 3.2 to 10 GHz	–101 (–109)	–110 (–114)	–110 (–115)
> 10 to 20 GHz	–95 (–106)	–104 (–107)	–104 (–109)
> 20 to 40 GHz	–89 (–99)	–98 (–101)	–98 (–103)

23 Specifications apply for CW mode, without modulation. In ramp sweep mode (Option 007), performance is typical for offsets > 1 MHz.

24 Phase noise specifications are warranted from 15 to 35 °C.

25 Measured at +10 dBm or maximum specified power, whichever is less.

Specifications (continued)

Spectral purity (continued)

Option UNX: Residual SSB phase noise (dBc/Hz) (CW)[26]	Offset from carrier			
	Frequency	1 Hz spec (typical)	10 Hz spec (typical)	100 Hz spec (typical)
	250 kHz to 250 MHz[27]	(–94)	–100 (–107)	–110 (–118)
	> 250 to 500 MHz[27]	(–101)	–105 (–112)	–115 (–122)
	> 500 MHz to 1 GHz[27]	(–94)	–100 (–107)	–110 (–118)
	> 1 to 2 GHz[27]	(–89)	–96 (–101)	–104 (–112)
	> 2 to 3.2 GHz	(–85)	–92 (–97)	–100 (–108)
	> 3.2 to 10 GHz	(–74)	(–87)	(–98)
	Frequency	1 kHz spec (typical)	10 kHz spec (typical)	100 kHz spec (typical)
	250 kHz to 250 MHz[27]	–120 (–126)	–128 (–132)	–130 (–133)
	> 250 to 500 MHz[27]	–124 (–131)	–132 (–136)	–136 (–141)
	> 500 MHz to 1 GHz[27]	–120 (–126)	–130 (–134)	–130 (–134)
	> 1 to 2 GHz[27]	–114 (–120)	–124 (–129)	–124 (–129)
	> 2 to 3.2 GHz	–110 (–116)	–120 (–124)	–120 (–124)
	> 3.2 to 10 GHz	(–106)	(–114)	(–115)
Residual FM	(rms, 50 Hz to 15 kHz bandwidth)			
CW mode	< N x 6 Hz (typ)			
Option UNX	< N x 4 Hz (typ)			
Ramp sweep mode	< N x 1 kHz (typ)			
Broadband noise	(CW mode at +10 dBm or maximum specified output power, whichever is lower, for offsets > 10 MHz)			
> 2.4 to 20 GHz	< –148 dBc/Hz (typ)			
> 20 to 40 GHz	< –141 dBc/Hz (typ)			

26 Phase noise specifications are warranted from 15 to 35 °C.

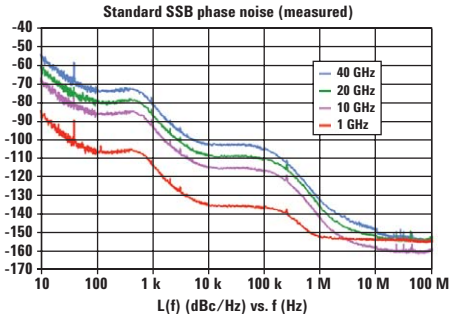
27 Measured at +10 dBm or maximum specified power, whichever is less.

Specifications (continued)

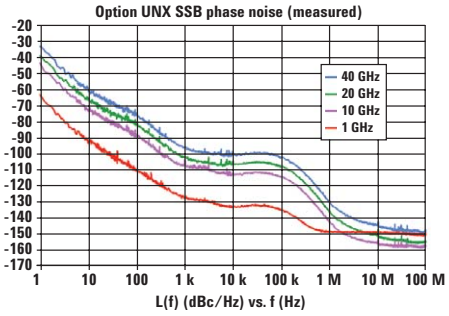
Spectral purity (continued)

Measured phase noise

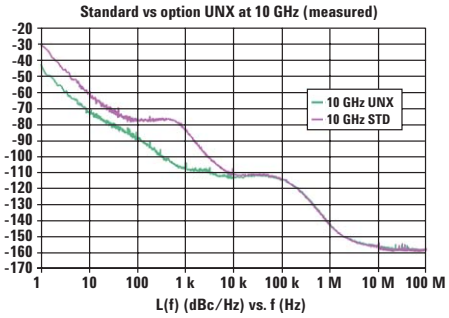
Standard phase noise



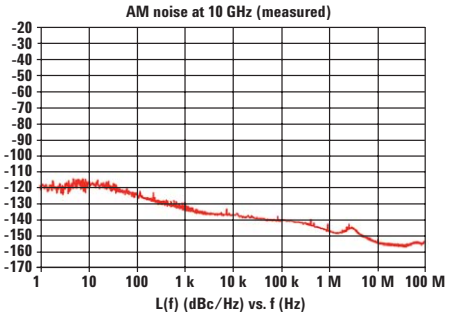
Option UNX phase noise



Standard vs Option UNX phase noise



AM noise at 10 GHz



Measured RMS jitter[28]

Standard	Carrier frequency	SONET/SDH data rates	RMS jitter bandwidth	Unit intervals (µUI)	Time (fs)
	155 MHz	155 MB/s	100 Hz to 1.5 MHz	25	158
	622 MHz	622 MB/s	1 kHz to 5 MHz	21	34
	2.488 GHz	2488 MB/s	5 kHz to 20 MHz	57	23
	9.953 GHz	9953 MB/s	10 kHz to 80 MHz	152	15
	39.812 GHz (with Option 540)	39812 MB/s	40 kHz to 320 MHz	627	16

Option UNX	Carrier frequency	SONET/SDH data rates	RMS jitter bandwidth	Unit intervals (µUI)	Time (fs)
	155 MHz	155 MB/s	100 Hz to 1.5 MHz	23	151
	622 MHz	622 MB/s	1 kHz to 5 MHz	19	30
	2.488 GHz	2488 MB/s	5 kHz to 20 MHz	56	22
	9.953 GHz	9953 MB/s	10 kHz to 80 MHz	152	15
	39.812 GHz (with Option 540)	39812 MB/s	40 kHz to 320 MHz	626	16

28 Calculated from phase noise performance in CW mode only at +10 dBm.

Specifications (continued)

Frequency modulation (Option UNT)

Maximum deviation[29]	Frequency	Maximum deviation	
	250 kHz to 250 MHz	2 MHz	
	> 250 to 500 MHz	1 MHz	
	> 500 MHz to 1 GHz	2 MHz	
	> 1 GHz to 2 GHz	4 MHz	
	> 2 GHz to 3.2 GHz	8 MHz	
	> 3.2 GHz to 10 GHz	16 MHz	
	> 10 GHz to 20 GHz	32 MHz	
	> 20 GHz to 40 GHz	64 MHz	
Resolution	0.1% of deviation or 1 Hz, whichever is greater		
Deviation accuracy	< ± 3.5% of FM deviation + 20 Hz (1 kHz rate, deviations < N x 800 kHz)		
Modulation frequency response[30]		Rates (at 100 kHz deviation)	
	Path [coupling]	1 dB bandwidth	3 dB bandwidth (typical)
	FM path 1 [DC]	DC to 100 kHz	DC to 10 MHz
	FM path 2 [DC]	DC to 100 kHz	DC to 1 MHz
	FM path 1 [AC]	20 Hz to 100 kHz	5 Hz to 10 MHz
	FM path 2 [AC]	20 Hz to 100 kHz	5 Hz to 1 MHz
DC FM[31] carrier offset	±0.1% of set deviation + (N x 8 Hz)		
Distortion	< 1% (1 kHz rate, deviations < N x 800 kHz)		
Sensitivity	±1 V_{peak} for indicated deviation		
Paths	FM1 and FM2 are summed internally for composite modulation. Either path may be switched to any one of the modulation sources: Ext1, Ext2, internal1, internal2. The FM2 path is limited to a maximum rate of 1 MHz. The FM2 path must be set to a deviation less than FM1.		

29 Through any combination of path1, path2, or path1 + path2.

30 Specifications apply in CW and list/step sweep modes. During ramp sweep operation (Option 007), 3 dB bandwidth is typically 50 kHz to 10 MHz (FM1 path), and 50 kHz to 1 MHz (FM2 path).

31 At the calibrated deviation and carrier frequency, within 5 °C of ambient temperature at time of user calibration.

Specifications (continued)

Phase modulation (Option UNT)

Maximum deviation[32]	Frequency	Normal BW mode	High BW mode
	250 kHz to 250 MHz	20 rad	2 rad
	> 250 to 500 MHz	10 rad	1 rad
	> 500 MHz to 1 GHz	20 rad	2 rad
	> 1 GHz to 2 GHz	40 rad	4 rad
	> 2 GHz to 3.2 GHz	80 rad	8 rad
	> 3.2 GHz to 10 GHz	160 rad	16 rad
	> 10 GHz to 20 GHz	320 rad	32 rad
	> 20 GHz to 40 GHz	640 rad	64 rad
Resolution	0.1% of set deviation		
Deviation accuracy	< ±5% of deviation + 0.01 radians (1 kHz rate, normal BW mode)		
Modulation frequency response[33]	Normal BW mode	High BW mode	
Rates (3 dB BW)	DC to 100 kHz	DC to 1MHz (typical)[34]	
Distortion	< 1 % (1 kHz rate, Total Harmonic Distortion (THD), dev < N x 80 rad, normal BW mode)		
Sensitivity	±1 V_{peak} for indicated deviation		
Paths	ΦM1 and ΦM2 are summed internally for composite modulation. Either path may be switched to any one of the modulation sources: Ext1, Ext2, internal1, internal2. The ΦM2 path must be set to a deviation less than ΦM1.		

32 Through any combination of path1, path2, or path1 + path2.

33 Specifications apply in CW and list/step sweep modes. During ramp sweep operation (Option 007), 3 dB bandwidth is typically 50 kHz to 1 MHz (high BW mode).

34 Path 1 is usable to 4 MHz for external inputs less than 0.3 V peak.

Specifications (continued)

Amplitude modulation[35] (Option UNT) (typical)

Depth	Linear mode	Exponential (log) mode (downward modulation only)
Maximum		
ALC on	> 90%	> 20 dB
ALC off or deep AM on[36]	> 95%	> 40 dB[37]
Settable	0 to 100 % (0 to 100%/volt sensitivity)	0 to 40 dB (0 to 40 dB/volt sensitivity)
Resolution	0.1%	0.01 dB
Accuracy (1 kHz rate)	< ±(6 % of setting + 1 %)	< ±(2% of setting + 0.2 dB)
Ext sensitivity	Linear mode	Exponential (log) mode (downward modulation only)
	±1 V_{peak} for indicated depth	–1 V for indicated depth
Rates (3 dB bandwidth, 30% depth)		
DC coupled	0 to 100 kHz	
AC coupled	10 Hz to 100 kHz (usable to 1 MHz)	
Distortion (1 kHz rate, linear mode, total harmonic distortion)		
30% AM	< 1.5%	
60% AM	< 2%	
Paths	AM1 and AM2 are summed internally for composite modulation. Either path may be switched to any one of the modulation sources: Ext1, Ext2, internal1, internal2.	

External modulation inputs (Ext1 & Ext2) (Option UNT)

Modulation types	AM, FM, and ΦM
Input impedance	50 or 600 Ω (nom) switched
High/low indicator (100 Hz to 10 MHz BW, ac coupled inputs only)	Activated when input level error exceeds 3% (nom)

35 AM specifications are typical. For carrier frequencies below 2 MHz AM is usable but not warranted. Unless otherwise stated, specifications apply with ALC on, deep AM off, and envelope peaks within ALC operating range (–20 dBm to maximum specified power, excluding step-attenuator setting).

36 For reduced distortion at high modulation depths, either level hold mode (ALC-off with power search) or deep AM mode should be used. With ALC-On in deep AM mode, waveform peaks are controlled by ALC system, and the lower portion of the waveform (below –10 dBm nominal ALC level) is subject to sample-and-hold drift of approximately 0.25 dB/second.

37 To achieve > 40 dB depth, less than –1 V external input may be required.

Simultaneous modulation (Option UNT)

All modulation types may be simultaneously enabled except: FM with ΦM, and linear AM with exponential AM. AM, FM, and ΦM can sum simultaneous inputs from any two sources (Ext1, Ext2, internal1, or internal2). Any given source (Ext1, Ext2, internal1, or internal2) may be routed to only one activated modulation type.

Internal modulation source (Option UNT)

Dual function generators provide two independent signals (internal1 and internal2) for use with AM, FM, ΦM, or LF Out

Waveforms	Sine, square, positive ramp, negative ramp, triangle, Gaussian noise, uniform noise, swept sine, dual sine[38]
Rate range	
Sine	0.5 Hz to 1 MHz
Square, ramp, triangle	0.5 Hz to 100 kHz
Resolution	0.5 Hz
Accuracy	Same as timebase
LF Out	
Output	Internal1 or internal2; also provides monitoring of internal1 or internal2 when used for AM, FM, or ΦM
Amplitude	0 to 3 V_{peak}, (nom) into 50 Ω
Output impedance	50 Ω (nom)
Swept sine mode (frequency, phase continuous)	
Operating modes	Triggered or continuous sweeps
Frequency range	1 Hz to 1 MHz
Sweep rate	0.5 Hz to 100 kHz sweeps/s, equivalent to sweep times 10 µs to 2 s
Resolution	0.5 Hz (0.5 sweep/s)

38 Internal2 is not available when using swept sine or dual sine modes.

Specifications (continued)

Pulse modulation[39, 40] (Option UNU)	**500 MHz to 3.2 GHz**	**Above 3.2 GHz**
On/Off ratio	80 dB (typ)	80 dB
Rise/Fall times (Tr, Tf)	100 ns (typ)	6 ns (typ)
Minimum pulse width		
Internally leveled	2 µs	1 µs
Level hold (ALC off with power search)	0.5 µs	0.15 µs
Repetition frequency		
Internally leveled	10 Hz to 250 kHz	10 Hz to 500 kHz
Level hold (ALC off with power search)	DC to 1 MHz	DC to 3 MHz
Level accuracy (relative to CW)		
Internally leveled	±0.5 dB	±0.5 dB
Level hold (ALC off with power search)	±0.5 dB (typ)	±0.5 dB (typ)
Width compression (RF width relative to video out)	±50 ns (typ)	±5 ns (typ)
Video feed-through[41]	< 200 mv (typ)	< 2 mv (typ)
Video delay (ext input to video)	40 ns (nom)	40 ns (nom)
RF delay (video to RF output)	280 ns (nom)	35 ns (nom)
Pulse overshoot	< 10% (typ)	< 10% (typ)
Input level	+1 V_{peak} = RF On	+1 V_{peak} = RF On
Input impedance	50 Ω (nom)	50 Ω (nom)

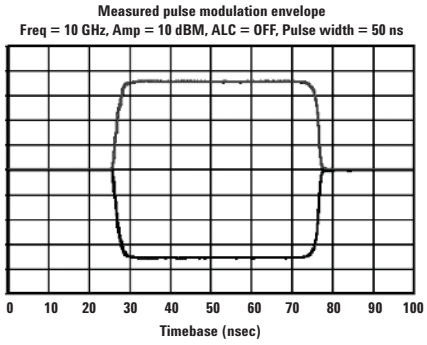
39 With ALC off, specs apply after the execution of power search. Specifications apply with Atten Hold Off (default mode for instruments with attenuator), or ALC level between –5 and 10 dBm or maximum specific power, whichever is lower.

40 Power search is a calibration routine that improves level accuracy with ALC off. The instrument microprocessor momentarily closes the ALC loop to find the modulator drive setting necessary to make the quiescent RF level equal to an entered value, then opens the ALC loop while maintaining that modulator drive setting. When executing power search, RF power will be present for typically 10 to 50 ms; the step attenuator (Option 1E1) can be set to automatically switch to maximum attenuation to protect sensitive devices. Power search can be configured to operate either automatically or manually at the carrier frequency, or over a user-definable frequency range.

41 With attenuator in 0 dB position. Video feed-through decreases with attenuator setting.

Specifications (continued)

Narrow pulse modulation[42, 43] (Option UNW)	**10 MHz to 3.2 GHz**	**Above 3.2 GHz**
On/Off ratio	80 dB	80 dB
Rise/Fall times (Tr, Tf)	10 ns (8 ns typ)	10 ns (6 ns typ)
Minimum pulse width		
Internally leveled:	1 µs	1 µs
Level hold (ALC off with power search)	20 ns	20 ns
Repetition frequency		
Internally leveled	10 Hz to 500 kHz	10 Hz to 500 kHz
Level hold (ALC off with power search)	DC to 5 MHz	DC to 10 MHz
Level accuracy (relative to CW)		
Internally leveled	±0.5 dB	±0.5 dB (0.15 dB typ)
Level hold (ALC off with power search)	±1.3 dB (typ)	≤ 20 GHz: ±0.5 dB (typ)
Width compression (RF width relative to video out)	±5 ns (typ)	±5 ns (typ)
Video feed-through[44]	< 125 mv (typ)	< 2 mv (typ)
Video delay (ext input to video)	50 ns (nom)	50 ns (nom)
RF delay (video to RF output)	45 ns (nom)	35 ns (nom)
Pulse overshoot	< 15% (typ)	< 10% (typ)
Input level	+1 V_{peak} = RF On	+1 V_{peak} = RF On
Input impedance	50 Ω (nom)	50 Ω (nom)



42 With ALC off, specs apply after the execution of power search. Specifications apply with Atten Hold Off (default mode for instruments with attenuator), or ALC level between –5 and 10 dBm or maximum specific power, whichever is lower.

43 Power search is a calibration routine that improves level accuracy with ALC off. The instrument microprocessor momentarily closes the ALC loop to find the modulator drive setting necessary to make the quiescent RF level equal to an entered value, then opens the ALC loop while maintaining that modulator drive setting. When executing power search, RF power will be present for typically 10 to 50 ms; the step attenuator (Option 1E1) can be set to automatically switch to maximum attenuation to protect sensitive devices. Power search can be configured to operate either automatically or manually at the carrier frequency, or over a user-definable frequency range.

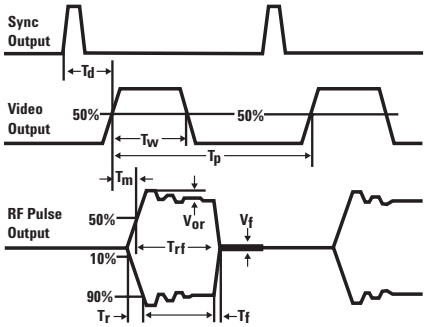
44 With attenuator in 0 dB position. Video feed-through decreases with attenuator setting.

Specifications (continued)

Internal pulse generator (Option UNU or UNW)

Modes	Free-run, triggered, triggered with delay, doublet, and gated. Triggered with delay, doublet, and gated require external trigger source.
Period (PRI) (Tp)	70 ns to 42 s (Repetition frequency: 0.024 Hz to 14.28 MHz)
Pulse width (Tw)	10 ns to 42 s
Delay (Td)	
Free-run mode	0 to ±42 s
Triggered with delay and doublet modes	75 ns to 42s with ±10 ns jitter
Resolution	10 ns (width, delay, and PRI)

Td Video delay (variable)
Tw Video pulse width (variable)
Tp Pulse period (variable)
Tm RF delay
Trf RF pulse width
Tf RF pulse fall time
Tr RF pulse rise time
Vor Pulse overshoot
Vf Video feedthrough



Simultaneous modulation

All modulation types (FM, AM, ΦM, and pulse modulations) may be simultaneously enabled except: FM with ΦM, and linear AM with exponential AM. AM, FM, and ΦM can sum simultaneous inputs from any two sources (Ext1, Ext2, internal1, or internal2). Any given source (Ext1, Ext2, internal1, or internal2) may be routed to only one activated modulation type.

Remote programming

Interfaces	LXI class-A compliant instrument LXI over 100BaseT LAN interface
Triggering	LXI LAN based triggering IEEE 1588 time-based triggering LXI hardware trigger bus
Control languages	IVI-COM - Interchangeable Virtual Instrument Common Object Model IVI-C - Interchangeable Virtual Instrument C (using C programming language)

Specifications (continued)

General specifications

Power requirements	100-240 V, 50/60 Hz (automatically selected)
Power consumption	250 watts (typical), < 300 watts (maximum) Standby: < 20 watts (typical)

Environmental[45]

Samples of this product have been type tested in accordance with the Agilent 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 MIL-PRF-28800F class 3.

Operating temperature range	0 to 55 °C
Storage temperature range[46]	–40 to +70 °C
Relative humidity	Type tested: 0% to 95% at 40 °C, (non-condensing)
Altitude	Type tested: 0 m to 4600 m above mean sea level
Audio noise	L_{NPE} < 70 dB(A), tested according to ISO 7779

Shock and vibration

Operating random vibration	Type tested: 5 to 500 Hz, 0.21 g_{rms}
Survival random vibration	Type tested: 5 to 500 Hz, 2.09 g_{rms}
Survival swept sine vibration	Type tested: 5 to 500 Hz, 0.5 g_{peak}
End use handling shock	Type tested: Half sine, 60 in/sec ΔV, 2-3 msec duration
Transportation shock	Type tested: Trapezoidal, 50 g, 337 in/sec ΔV
Functional shock	Type tested: Half-sine, 30 g, 11 ms
Bench drop test	Type tested: Per MIL-PRF28800F

Electromagnetic compatibility (EMC)

Complies with European EMC Directive 89/336/EEC, amended by 93/68/EEC	IEC/EN 61326 CISPR Pub 11 Group 1, Class A AS/NZS CISPR 11:2002 ICES/NMB-001

Safety

Complies with European Low Voltage Directive 73/23/EEC, amended by 93/68/EEC	IEC/EN 61010 Canada: CSA C22.2 No. 61010 USA: UL 61010B

45 Samples of this product have been type tested in accordance with the Agilent 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 MIL-PRF-28800F Class 3.

46 Storage below –20 °C, instrument states may be lost.

Specifications (continued)

Weight	
Net weight	18.4 kg (40.5 lbs) (nominal)

Dimensions	
4U, 1/2 rack width LXI module	
Height	17.8 cm (7.0 in)
Width	21.3 cm (8.375 in)
Length	64.0 cm (25.2 in)

Recommended calibration cycle

The recommended calibration cycle is 24 months. Calibration services are available through Agilent service centers.

ISO compliance

This product is manufactured in an ISO-9001 registered facility in concurrence with Agilent Technologies, Inc. commitment to quality.

Warranty

This Agilent Technologies product is warranted against defects in materials and workmanship for a period of one year from date of shipment. During the warranty period, Agilent Technologies will, at its option, either repair or replace products that are defective.

Input/Output Descriptions

Front panel connectors (all connectors are SMB male unless otherwise noted)

RF output	RF/microwave output signal from the N8211A; nominal output impedance 50 Ω
Option 520	Precision APC-3.5 male connector
Options 540	Precision APC-2.4 male connector
References	
10 MHz Out	Outputs internal or external reference signal. Nominal output impedance 50 Ω. Nominal output power +8 dBm.
10 MHz In	Accepts an external reference (timebase) input (at 1, 2, 2.5, 5, 10 MHz for standard and 10 MHz only for Option UNX). Nominal input impedance 50 Ω.
10 MHz EFC	(Option UNX only.) Accepts an external DC voltage, ranging from –5 V to +5 V, for electronic frequency control (EFC) of the internal 10 MHz reference oscillator. This voltage inversely tunes the oscillator about its center frequency approximately –0.07 ppm/V. The nominal input impedance is greater than 1 MΩ. Note: A short or 50 Ω termination should be attached to this input connector whenever the EFC port is not used.
Step Sweep	
Settled	Provides an output trigger that indicates when the signal generator has settled to a new frequency or power level. High indicates source not settled; low indicates source settled.
Trig out	Outputs a TTL signal. High at start of dwell, or when waiting for point trigger; low when dwell is over or point trigger is received. In ramp sweep mode, provides 1601 equally-spaced 1 µs pulses (nom) across a ramp sweep. When using LF Out, provides 2 µs pulse at start of LF sweep.
Trig in	Accepts TTL signal for triggering point-to-point in manual sweep mode, or to trigger start of LF sweep. Damage levels ≥ +10 V or ≤ –4 V.
Analog Sweep	
Z/Mkrs	During ramp sweep, supplies +5 V (nom) level during retrace and band-switch intervals. Supplies –5 V (nom) level when the RF frequency is at a marker frequency.
Stop Swp	Open collector, TTL-compatible input/output. In ramp sweep operation, provides low level (nominally 0 V) during sweep retrace and bandcross intervals, and high level during the forward portion of the sweep. Sweep will stop when grounded externally, sweep will resume when allowed to go high.
Sweep Out	Supplies a voltage proportional to the RF power or frequency sweep ranging from 0 V at the start of sweep to +10 V (nominal) at the end of sweep, regardless of sweep width. During CW operation, supplies a voltage proportional to the output frequency, +10 V (nom) corresponding to the maximum specified frequency. Output impedance: < 1 Ω (nominal), can drive 2000 Ω.
LF Output	LF output (Option UNT) is an internal modulation drive and function generator for AM, FM, PM and pulse modulation. Nominal output impedance 50 Ω.
Pulse Modulation	
Pulse In	Accepts input signal for external fast pulse modulation. Also accepts external trigger pulse input for internal pulse modulation. Nominal impedance 50 Ω. Damage levels are 5 V_{rms} and 10 V_{peak}.
Sync Out	Outputs a synchronizing pulse, nominally 50 ns width, during internal and triggered pulse modulation. TTL-level compatible, nominal source impedance 50 Ω.
Video Out	Outputs a signal that follows the RF output in all pulse modes. TTL-level compatible, nominal source impedance 50 Ω.

Input/Output Descriptions (continued)

Front panel connectors (all connectors are SMB male unless otherwise noted) (continued)

Analog Inputs	
Ext 1	Drives either AM, FM, or ΦM. Nominal input impedance 50 or 600 Ω, damage levels are 5 V_{rms} and 10 V_{peak}.
Ext 2	Drives either AM, FM, or ΦM. Nominal input impedance 50 or 600 Ω, damage levels are 5 V_{rms} and 10 V_{peak}.
Automatic Leveling Control (ALC) Input	
ALC Input	Used for negative external detector leveling. Nominal input impedance 120 kΩ, damage level –12 to +0.5 V. Connector type is BNC-female.
ALC Hold	Allows the user to enable or disable the Automatic Leveling Control (ALC) function of the upconverter. A TTL logic '1' signal enables the ALC function, and a TTL logic level '0' signal disables the ALC function of the upconverter. The ALC hold function is useful when pulse modulating the source, so that the ALC circuit does not try to react to the pulsed signal. Typically a marker signal from an external arbitrary waveform generator (AWG) is used to drive the ALC hold.
Coherent Carriers	The coherent carrier In/Out ports are used to allow multiple upconverters to be phase coherent. A common LO signal can be sent to two or more different upconverters, thus allowing their output signals to be phase coherent. In the upconverter, there is a low-band LO, and a high-band LO, thus requiring two different LOs to operate over the entire frequency range of the upconverter. To make the upconverter coherent over its entire frequency range requires having both a low-band and high-band coherent LO signal. When not using the coherent carriers ports for tying multiple upconverter LOs together to make them phase coherent, a jumper cable is required. A jumper cable from 0.25 to 3.2 GHz Out connector to 0.25 to 3.2 GHz In connector, and from 3.2 to 10 GHz Out connector to 3.2 to 10 GHz In connector is required for operation.
0.25 to 3.2 GHz In	Input port for a reference LO signal for the low-band of operation. This port is used when it is desired to make the upconverter phase coherent over the low-band (0.25 to 3.2 GHz) of operation of the upconverter. Connector is SMA female.
3.2 to 10 GHz In	Input port for a reference LO signal for the high-band of operation. This port is used when it is desired to make the upconverter phase coherent over the high-band (3.2 to 20/40 GHz) of operation of the upconverter. The LO signal needs to tune over the range of 3.2 to 10 GHz. There is a frequency doubler or quadrupler to get the upconverter's output signal to either 20 or 40 GHz. Connector is SMA female.
0.25 to 3.2 GHz Out	Output port for the low-band reference LO. Normally this signal is routed back in to the 0.25 to 3.2 GHz In port on the upconverter. If multiple coherent upconverter operation is desired, this output signal can be split into multiple signals, and then routed to several different upconverters to provide a low-band (0.25 to 3.2 GHz) coherent LO signal. Connector is SMA female.
3.2 to 10 GHz Out	Output port for the high-band reference LO. Normally this signal is routed back in to the 3.2 to 10 GHz In port on the upconverter. If multiple coherent upconverter operation is desired, this output signal can be split into multiple signals, and then routed to several different upconverters to provide a high-band (3.2 to 10 GHz) coherent LO signal. The high-band LO must tune over the range 3.2 to 10 GHz; there is a doubler or quadrupler to get the upconverter's output signal up to either 20 or 40 GHz. Connector is SMA female.

Input/Output Descriptions (continued)

Front panel indicator lights

PWR	Indicates when the power switch on the unit is turned to the 'ON' position
LAN	Indicates LAN connection status
1588	Indicates the clock status of the IEEE 1588 time-based trigger
LAN RST	Front panel access hole to reset the LAN to a known default state

Rear panel connectors

Power requirements	100-240 V, 50/60 Hz (automatically selected)
Power consumption	250 watts (typical), < 300 watts (maximum) Standby: < 20 watts (typical)
LAN	Standard LAN connector for 10/100 BaseT LAN communication
LXI trigger bus in	Input for the LXI trigger-bus signals. 25-pin subminiature female connector.
LXI trigger bus out	Output for the LXI trigger-bus signals. 25-pin subminiature female connector.
Diagnostics port (25-pin parallel port)	For internal testing of the instrument in the factory. 25-pin D-subminiature female connector.
Diagnositcs port (9-pin serial port)	For internal testing of the instrument in the factory. 9-pin D-subminiature male connector.

Ordering Information and Options

Model/Option	Description
N8211A	20 or 40 GHz analog upconverter synthetic instrument module
N8211A-520	Frequency range from 250 kHz to 20 GHz
N8211A-540	Frequency range from 250 kHz to 40 GHz
N8211A-007	Fully synthesized analog frequency and power ramp sweep
N8211A-UNT	AM/FM/ΦM modulation and LF output
N8211A-UNU	Standard pulse modulation
N8211A-UNW	Narrow pulse modulation
N8211A-UNX	Enhanced close-in phase noise performance
N8211A-1EA	High output power
N8211A-1E1	Step attenuator
N8211A-1EH	Improved harmonics below 2 GHz

Rack Mounting Options

For complete rack mounting options to meet all of your rack mounting needs for this product, refer to Agilent's Enclosure Solutions Product Catalog (publication number 5980-0450E). This document is available at **http://www.agilent.com** under test accessories, cabinets, cables, then refer to instrument racks and rack accessories.

To mount this product next to a similarly sized unit	To mount this 4U high, 1/2 unit wide instrument module next to a similar sized instrument module, requires a lock link kit (part number 5061-9694) to link the two units together, and a rackmount flange kit 5063-9215 to mount the two instruments into the rack.
To mount this product by itself in a rack	To mount this 4U high, 1/2 unit wide instrument module by itself in a rack requires a rackmount adapter kit, part number 5063-9245.

Resources

Abbreviations used in this data sheet

GS/s	Giga-sample per second
LAN	Local Area Network
MS/s	Mega-sample per second
k	kilo, or 1000
SMB	Sub-miniature bayonet
ps	Pico-seconds
AC	Alternating Current
DC	Direct Current
s	seconds
NA	Not Applicable

Web Resources

For additional information, visit:
www.agilent.com/find/synthetic

For information about renting, leasing, or financing Agilent's latest technology, visit:
www.agilent.com/find/buy/alternatives

For additional accessory information, visit:
www.agilent.com/find/accessories

Related Literature

Publication Title	Publication Type	Publication Number
N8212A Vector Upconverter Synthetic Instrument Module	Data Sheet	5989-2593EN
N8241A 15-bit Arbitrary Waveform Generator Synthetic Instrument Module	Data Sheet	5989-2595EN
N8242A 10-bit Arbitrary Waveform Generator Synthetic Instrument Module	Data Sheet	5989-5010EN
PSG Signal Generator	Brochure	5989-1324EN
E8257D PSG Analog Signal Generator	Data Sheet	5989-0698EN
E8267D PSG Vector Signal Generator	Data Sheet	5989-0697EN
PSG Self Guided Demo		5988-2414EN
E8257D PSG CW and Analog Signal Generators	Configuration Guide	5989-1325EN
E8267D PSG Vector Signal Generator	Configuration Guide	5989-1326EN

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