Agilent V2820A RF Vector Signal Analyzer

400 MHz to 4 or 6 GHz

Technical Overview

Applications

- MIMO derived research
- Commercial OFDM development and verification
- 802.11n WLAN design validation

The V2820A RF vector signal analyzer provides extensive and unique capabilities for signal analysis of devices that use both existing wireless standards and new wide bandwidth, complex modulation, high throughput wireless communication standards. The V2820A's wide signal capture bandwidth enables measurements of wideband signals such as 802.11n 40 MHz WLAN, and a DSP-based software-defined radio (SDR) architecture gives it the flexibility to easily adapt to new wireless technologies. The SDR-based design maximizes the life of the V2820A and provides an ongoing return on investment compared with more traditional signal analysis instruments.

Agilent Technologies

Unique capabilities substantially reduce signal acquisition and measurement times.

In addition to allowing both manual and automated control through the traditional built-in microprocessor instrument controller, the V2820A offers the ability to bypass the internal controller and permits a PC to act as the instrument controller. This enables transfer of IQ data over USB at data rates exceeding 100 Mbits/second and is essential for high speed data acquisition and measurement of wireless devices such as femtocells.

High-quality measurements not compromised by high-speed testing

While the V2820A has been optimized for high-speed test performance, it also delivers excellent measurement performance. Superior phase noise performance with the V2820A-UPN ultra low phase noise option provides a –42 dB EVM floor for a 40 MHz bandwidth 802.11n signal at 5.6 GHz. Even without the enhanced phase noise option, the EVM floor is –40 dB. Similarly, WiMAX™ relative constellation error (RCE) floor levels exceed –42 dB to 3.5 GHz. The dynamic range of EDGE Evolution Output RF Frequency Spectrum (ORFS) due to switching is 80 dBc at a 1800 kHz offset from the carrier.

The wide bandwidth of the V2820A can capture a complete 40 MHz WLAN or WiMAX signal in a single acquisition, eliminating any need to make multiple signal captures and to concatenate signal segments, therefore avoiding the resulting degradation in measurement accuracy. Also included as a standard part of the signal analyzer is the pre-amp, which lowers the V2820A's noise floor by as much as 15 dB.

The V2820A measures channel power on single-carrier standards with ±0.6 dB typical accuracy and multi-carrier standards signals, such as WLAN and WiMAX™, with ±0.85 dB typical accuracy. These accuracy levels combined with ±0.15 dB amplitude repeatability enable test engineers to design test protocols with the tight tolerances needed to ship the highest quality products.

Test MIMO devices with low instrument uncertainty

Each V2820A is designed to be synchronized to other V2820As, enabling the capture of multiple transmission streams with an extremely high level of synchronization. Signal acquisition synchronization jitter is ≤250 ps, ensuring that time delays between signal streams are due to transmitter issues or channel conditions and not due to instrument latency. MIMO device designs can be tested during development with a high degree of confidence that the V2820A is not contributing offset errors to the multiple signal stream acquisitions. Agilent MIMO configurations that include V2820A instruments can test MIMO devices with up to eight antennas. System synchronization is ensured by the V2895A MIMO synchronization unit. This instrument distributes a common local oscillator, a common clock signal, and precise trigger signals to all the system's signal analyzers.

Using the V2901A SignalMeister integrated RF signal analysis and generation toolkit software and V2920A RF vector signal generators, MIMO signals can be both easily generated and analyzed. Furthermore, all the synchronization, designation of master and slave units, and control of multiple instruments is managed by the SignalMeister software and transparent to the user. SignalMeister allows the generation of MIMO WLAN, WiMAX, and HSPA+ signals for testing MIMO receivers as well as for analysis of MIMO transmitters. An Agilent MIMO system with SignalMeister software makes it very easy to conduct multi-antenna research and test MIMO device designs.

Agilent MIMO test systems provide superior test performance, system flexibility, and unparalleled ease of use that are unmatched in the industry. Refer to the MIMO technical overview, literature number 5990-5493EN for further information.

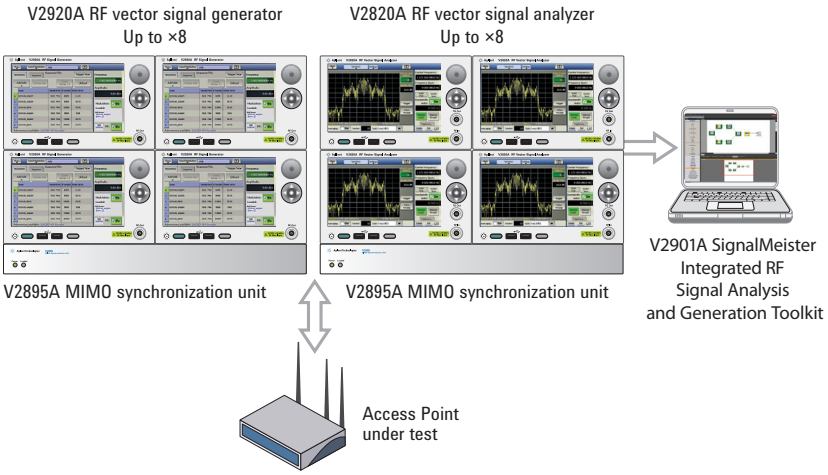


Figure 1. Easily configure a 2x2 to an 8x8 MIMO system and obtain excellent signal sourcing synchronization and signal acquisition synchronization for testing MIMO devices. SignalMeister software makes creating a MIMO test protocol.

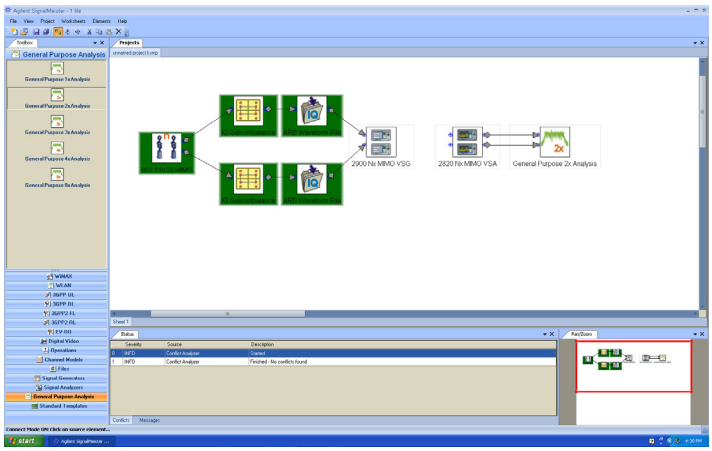


Figure 2. Use SignalMeister software to create two signal streams with transmitter impairments to test a 802.11n WLAN MIMO receiver. Similarly, SignalMeister can program two analyzers to acquire output streams from a MIMO transmitter.

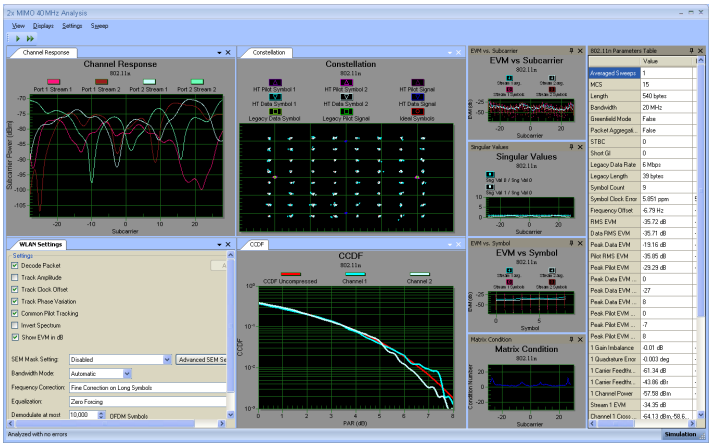


Figure 3. SignalMeister software creates a wide range of computations and plots for MIMO analyses. Display selections are easily arranged to create a desired presentation. The analysis shown is on an 802.11n transmission.

Fast, accurate and flexible for femtocell applications

Production test engineers have the option of using a number of configurations of the instrument to optimize test system performance and simplify test system connections. In addition to front and rear panel configurations, the single port input option, V2820A-SPI, allows the analyzer to connect directly with a single port wireless device such as femtocells, to provide both RF sourcing and RF measurement without requiring switching between the measurement devices and the device-under-test. The single port input option includes a broadband coupler integrated into the V2820A. An RF source connects to the V2820A and the V2820A connects directly to the DUT. The integrated coupler's path losses are fully calibrated as part of the V2820A's factory calibration so that additional test system calibration procedures, required if an external coupler is used, are not needed.

The V2820A RF vector signal analyzer enables fast switching between multiple standards and can perform an extensive set of RF measurements, including power calibration measurements, as required for femtocell testing. Channel power list mode allows setting up a pre-defined list of frequencies, measurement bandwidths, and measurement times, enabling fast transmitter output power measurements.

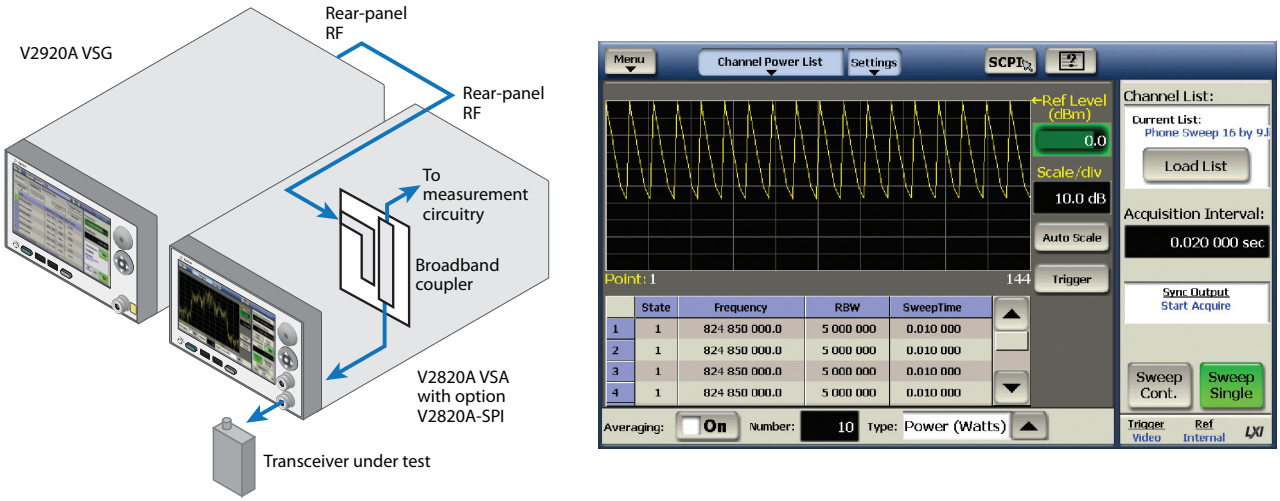


Figure 4. (Left) Connect directly to a transceiver or mobile handset without switching using the single port input option, V2820A-SPI of the V2820A, which features a built–in broadband coupler that is fully calibrated at the V2820A's input terminal. (Right) The channel power list mode captures transmitter declining-power ramps at multiple frequencies for fast transmitter calibrations of femtocells.

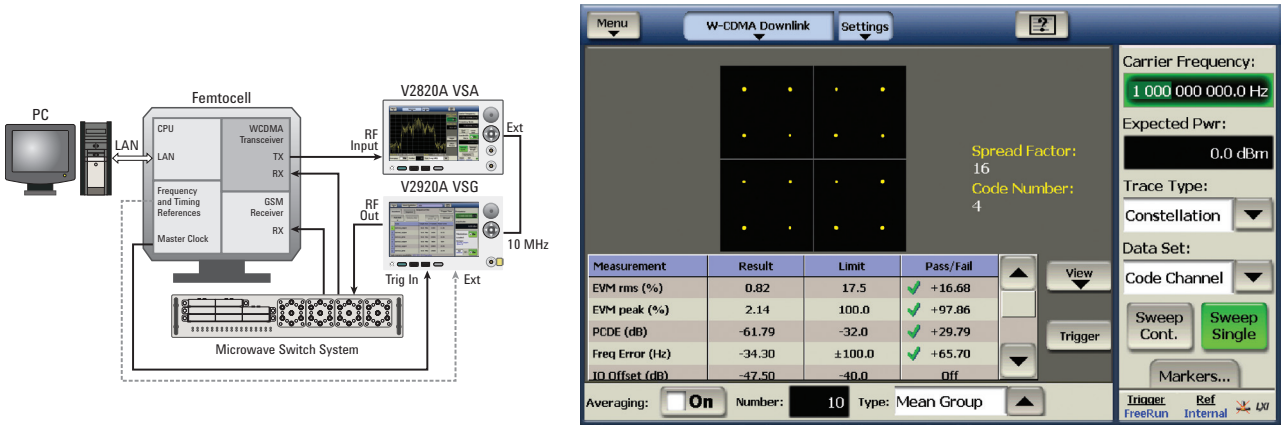


Figure 5. (Left) Test femtocells and access points that operate on multiple standards. Agilent vector signal analyzers and vector signal generators can quickly switch between standards for fast testing of all access point functionality. (Right) Example analysis of an access point transmitting an HSPA+ signal.

Product Specifications

Specification definitions and conditions

Specifications (warranted performance):
Specifications describe the instrument's warranted performance. All units are warranted to meet performance specifications under the following conditions:

- Ambient operating temperature of 18 to 28 °C, unless otherwise noted
- After specified warm-up time of 30 minutes and self calibration at ambient temperature

Note: All items are specifications unless otherwise noted.

Typical (mean +3 standard deviations):
Typical indicates performance that units will meet under the following conditions:

- Ambient operating temperature of 23 °C, unless otherwise noted
- After specified warm-up time of 30 minutes and self calibration at ambient temperature

This performance is not warranted.

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.

This performance is not warranted.

Modes of operation

Standard spectrum analysis modes and measurements

- Spectrum analyzer (power envelope amplitude versus frequency spectrum)
- Zero span (power envelope amplitude versus time)
- ACPR (adjacent channel power ratio bar chart)
- Channel power list
- Spectrum Emissions Mask (SEM)

Optional vector signal analysis modes

- GSM-GPRS-EDGE
- EDGE Evolution
- cdmaOne–cdma2000®
- W-CDMA FDD uplink (mobile phone transmitter signals)
- W-CDMA FDD downlink (base station transmitter signals)
- 802.11a, b, g, j, and n WLAN (SISO signals)
- 802.16e-2005 WiMAX (SISO signals)
- Generic FSK and PSK signals
- HSPA and HSPA+

Note: All items are specifications unless otherwise noted.

Frequency

Frequency range:	
V2820A-504:	400 MHz to 4.0 GHz[1]
V2820A-506:	400 MHz to 6.0 GHz[2]
Frequency setting resolution:	0.1 Hz
Frequency accuracy:	Same as frequency reference + synthesizer resolution term[3]
Frequency switching speed[4]:	250 µs
V2820A-UPN:	1.05 ms

Internal frequency reference

Aging rate:	≤1 ppm/year
Temperature stability:	≤0.2 ppm[5] (nominal)

Frequency reference output

Impedance:	50 W (nominal), AC coupled
Reference output signal:	10 MHz, +7 dBm ±3 dB (nominal)

External frequency reference input

Frequency lock range:	
Hardware lock mode[6]:	10 MHz ±10 Hz (1 ppm) input frequency lock range
Variable input frequency mode:	1 to 60 MHz[7]
Amplitude lock range:	-3 to +15 dBm[9]
Impedance:	50 Ω (nominal)

Spectrum analysis controls and parameters

Frequency span:	
V2820A-504:	200 Hz to 3.6 GHz[8]
V2820A-506:	200 Hz to 5.6 GHz[9]
Zero span mode available	
Sweep time settings in zero span mode:	1 µs to 30 s[10]
Sweep modes:	Continuous, single
IF bandwidth[11]:	
Relative flatness over 20 MHz:	±1.0 dB (typical)
Relative flatness over 4 MHz:	±0.5 dB (typical)
3 dB BW:	>30 MHz (typical)
6 dB BW:	>38 MHz (typical)
Resolution bandwidths:	1 Hz to 3 MHz (ENBW) with 1 Hz resolution for spans >0 Hz[12]
Resolution bandwidth filters (1 Hz resolution)[13]	
Brickwall:	10 Hz to 35 MHz, flat BW[14]
Root raised cosine α = 0.22:	10 Hz to 28 MHz, 3 dB BW
Gaussian:	10 Hz to 7 MHz, 3 dB BW
5 pole synchronously tuned:	10 Hz to 2.3 MHz, 3 dB BW
4 pole synchronously tuned:	10 Hz to 1.75 MHz, 3 dB BW
Amplitude:	
Reference level range setting:	+40 dBm to –170 dBm
Scale settings: Manual:	0.1 dB/division to 40 dB/division

Pre-amplifier: On, off
- 400 MHz to 2.5 GHz (nominal gain 15 dB)
- 2.5 GHz to 4.0 GHz (nominal gain 20 dB)
- 4.0 GHz to 6.0 GHz (nominal gain 18 dB)

Display:	
Detection modes:	normal, maximum, minimum, sample, power average, power average + noise correction
Trace hold displays:	normal, max hold, min hold, min/max hold
Averaging:	1 to 1,000 traces[15]
Modes:	Log, power, log group, power group, max group, min group, min/max group
Markers:	4 independent markers, each with a delta marker, normal and peak modes
Marker amplitude resolution:	0.01 dB from front panel, 0.001 dB via remote interface
Channel power list:	single command to execute up to 501 power measurements

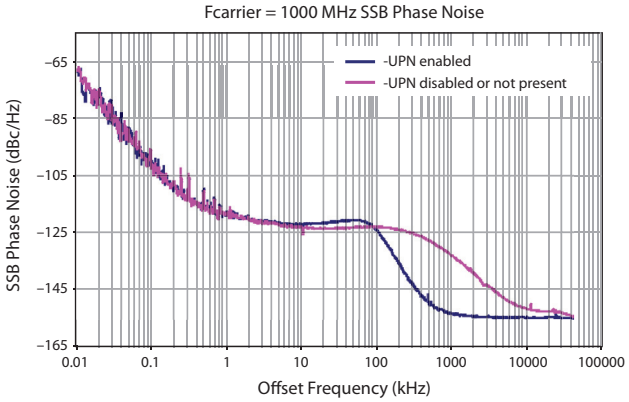
Spectrum analysis amplitude[16]

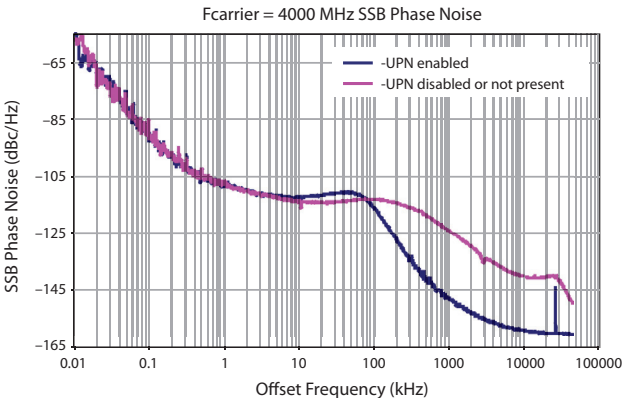
Maximum safe input power:	+35 dBm
Maximum safe voltage DC voltage:	±50 VDC
Absolute accuracy (typical)[17]	
325 MHz to 400 MHz:	0.2 dB (nominal)
400 MHz ≤Freq ≤2000 MHz:	±0.6 (±0.2) dB
2,000 MHz <Freq ≤6,000 MHz:	± 0.8 (±0.3) dB
6,000 MHz <Freq ≤6,500 MHz:	±5.0 dB (nominal)
Ref level accuracy (referenced to 0 dBm):	
+10 to –75 dBm:	±0.2 dB
–75 to –100 dBm:	±0.6 dB
Display scale fidelity[18]:	±0.2 dB
Attenuator accuracy[19]:	
Frequency <2.5 GHz:	±0.1 dB for 5 through 20 dB attenuator settings ±0.15 dB for >20 dB attenuator setting.
Frequency ≥2.5 GHz:	±0.1 dB for 5 through 10 dB attenuator settings ±0.2 dB for 15 through 25 dB attenuator settings ±0.25 dB for 30 dB attenuator setting
Amplitude repeatability[20]:	±0.15 dB (±0.07 dB typical)
Amplitude change due to preamp on:	±0.2 dB (±0.15 dB typical)
Displayed average noise level[21]:	≤–140 dBm/Hz, pre-amp off (F ≤2500 MHz) ≤–138 dBm/Hz, pre-amp off (2500 MHz <F ≤4000 MHz) ≤–128 dBm/Hz, pre-amp off (4000 MHz <F ≤6000 MHz) ≤–150 dBm/Hz, pre-amp on (F ≤2500 MHz) ≤ –148 dBm/Hz, pre-amp on (2500 MHz <F ≤4000 MHz) ≤–143 dBm/Hz, pre-amp on (4000 MHz <F ≤6000 MHz)
VSWR:	≤1.4:1 (nominal)

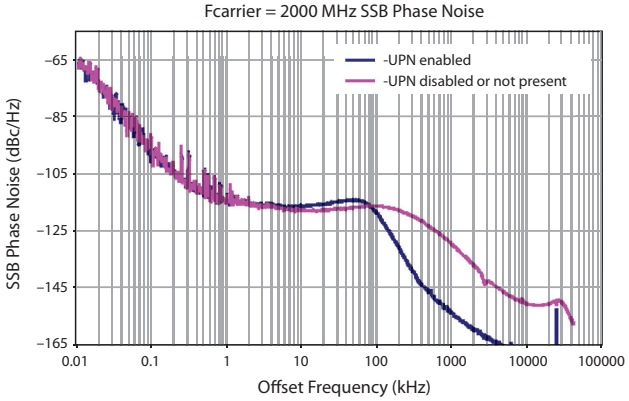
Spurious and residual responses

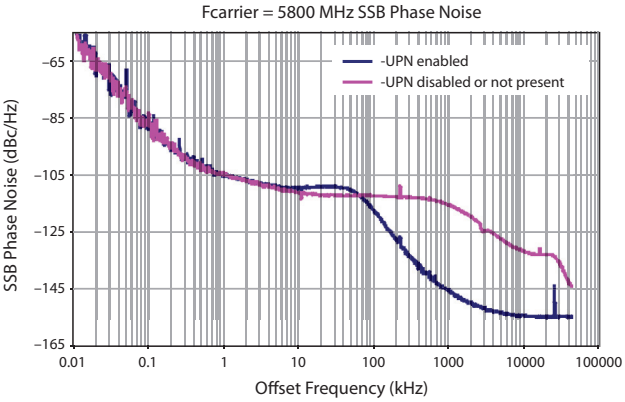
TOI (referred to the RF input, two 0 dBm input signals and reference level = 0 dBm):	F <2325 MHz = +35 dBm (nominal) F ≥2325 MHz = +34 dBm (nominal)
SOI (referred to the RF input, 0 dBm input signals and reference level = 0 dBm):	+50 dBm (nominal)
Residuals (reference level setting ≤–40 dBm), pre-amp on:	≤–95 dBm
LO related spurs:	≤–65 dBc

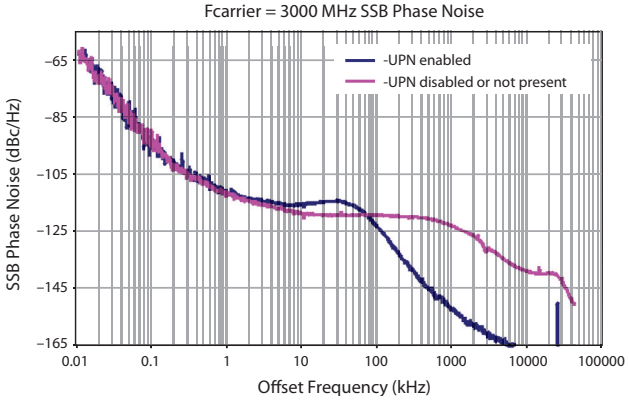
Standard and option V2820A-UPN phase noise







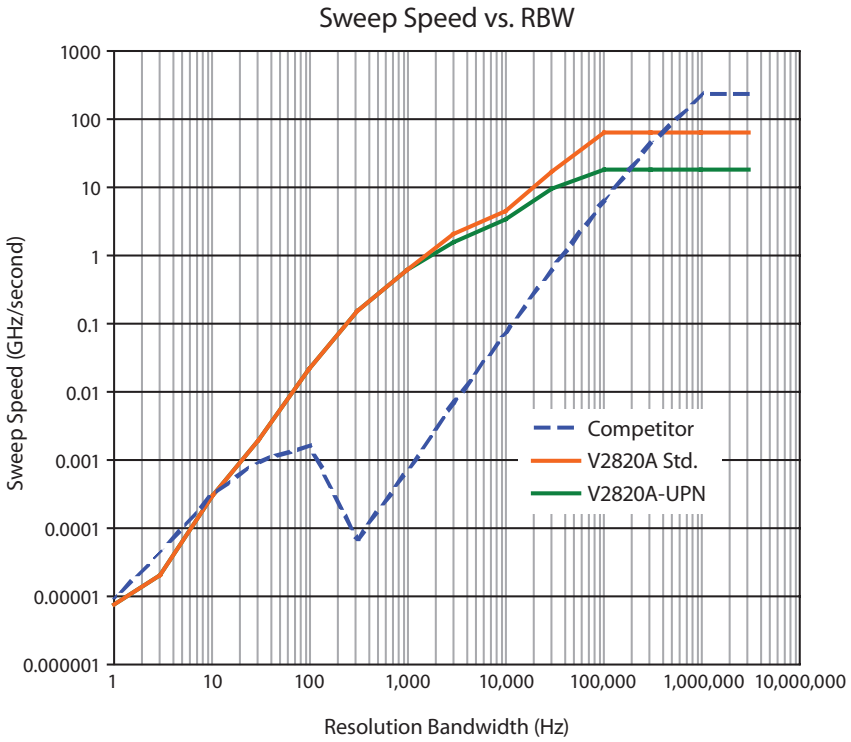




Generator output

Frequency range[22]: 400 to 2500 MHz
Sweep span[23]: 0 to 2100 MHz
Sweep points: 1 to 501
Dwell setting: 1 ms to 1 s in 1 ms increments
Amplitude: fixed: -18 dBm +5.0 dB (typical)

Supplemental speed information



Measurement speed characteristics[24, 25]

Measurement speed parameter	Nominal value	Remote front panel performance[26]
General purpose mode		
Spectrum or zero span[27]	16.0 ms	7.29 ms
ACPR/ACLR[28]		
Center, upper and lower adj, upper and lower alt	5.0 ms (V2820A-UPN: 13.0 ms)	1.93 ms (V2820A-UPN: 6.5 ms)
Center channel only (measurement of adj and alt off)	4.0 ms	0.9 ms
Channel power list mode[29]		
Single frequency	600 µs per point	590 µs per point
With any frequency change	720 µs per point (V2820A-UPN: 1500 µs per point)	670 µs per point (V2820A-UPN: 1500 µs per point)
Maximum reading rate (minimum step width)[30]	100 µs per point	100 µs per point
GSM mode[31]		
Phase error, channel power and time mask	22.4 ms	8.4 ms
Phase error and channel power free run trigger (burst measurement 100 averages)	15.5 ms (6.3 ms/burst)	8.1 ms (6.2 ms/burst)
Phase error and channel power video trigger (burst measurement 100 averages)	14 ms (4.7 ms/burst)	4.7 ms (4.6 ms/burst)
ORFS due to modulation or switching	17.5 ms	9.4 ms
EDGE mode[32]		
EVM, channel power and time mask	22.0 ms	10.3 ms
EVM and channel power (burst measurement 100 averages)	18.7 ms (6.4 ms/burst)	9.9 ms (6.3 ms/burst)
ORFS due to modulation or switching	20.7 ms	9.4 ms
EDGE 2.0		
EVM, channel power and time mask	22.9 ms	9.2 ms
EVM and channel power (burst measurement 100 averages)	14.2 ms (5.0 ms/burst)	9.2 ms (4.9 ms/burst)
ORFS due to modulation or switching	19 ms	9.4 ms
cdma2000 mode		
Demodulation measurement[33]	46 ms	41 ms
ACPR method 1[34]	4.6 ms (V2820A-UPN: 29.5 ms)	21.8 ms (V2820A-UPN: 26.4 ms)
ACPR method 2[35]	223 ms (V2820A-UPN: 232 ms)	219.3 ms (V2820A-UPN: 228.5 ms)
Spectrum emissions mask and occupied bandwidth[36]	37 ms	16 ms
W-CDMA DL mode		
Demodulation measurement[37]	117.5 ms	108.6 ms
ACLR method 1[38]	5.4 ms (V2820A-UPN: 10 ms)	2.3 ms (V2820A-UPN: 6.8 ms)
ACLR method 2[39]	208 ms (V2820A-UPN: 218 ms)	205 ms (V2820A-UPN: 214 ms)
Spectrum emissions mask and occupied bandwidth[40]	49 ms	27 ms

Measurement speed parameter	Nominal value	Remote front panel performance[26]
W-CDMA UL mode		
Demodulation measurement[41]	69 ms	62 ms
ACLR method 1[42]	5.1 ms (V2820A-UPN: 10 ms)	2.3 ms (V2820A-UPN: 6.8 ms)
ACLR method 2[43]	209 ms (V2820A-UPN: 218 ms)	204 ms (V2820A-UPN: 214 ms)
Spectrum emissions mask and occupied bandwidth[44]	56 ms	34 ms
HSDPA		
Demodulation measurement[45]	130.5 ms	121.3 ms
WLAN mode[46]		
802.11a	14.4 ms (V2820A-UPN: 20.8 ms)	21.5 ms (V2820A-UPN: 23.6 ms)
802.11b	34.6 ms (V2820A-UPN: 34.6 ms)	37 ms (V2820A-UPN: 37 ms)
802.11j	15.8 ms (V2820A-UPN: 22.1 ms)	21.5 ms (V2820A-UPN: 25 ms)
802.11n 20 MHz signal bandwidth	20.7 ms (V2820A-UPN: 23.2 ms)	21.5 ms (V2820A-UPN: 25.4 ms)
802.11n 40 MHz signal bandwidth	17.2 ms (V2820A-UPN: 23.6 ms)	21.5 ms (V2820A-UPN: 28 ms)
WiMAX mode[47]		
802.16e 10 MHz signal bandwidth	164.8 ms	99 ms
802.16e 20 MHz signal bandwidth	148.0 ms	80 ms
Maximum display refresh rate for a complete update of a 640 × 480 pixel VGA screen: internal display	30 sweeps/s (33 ms/sweep)	(PC dependent)
Data transfer over LAN/TCP/IP	Up to 0.4 MByte/s	Up to 10 MByte/s[48]
Remote trace data transfer[49]		
LAN	3.7 ms	0.9 ms
USB	13 ms	
GPIB	24 ms	
Time to switch between measurements[50]		
Within general purpose mode	5.5 ms	2.0. ms
From digital to general purpose mode	10.7 ms	3.5 ms
From general purpose to digital mode	12.4 ms	3.6 ms
Within GSM or EDGE mode	9.4 ms	3.6 ms
From cdma2000 or W-CDMA non-demodulate to demodulate	15.9 ms	4.4 ms
From cdma2000 or W-CDMA demodulate to non-demodulate	11.8 ms	6.4 ms

V2800A-102 GSM/GPRS/EDGE signal analysis personality license

GSM/GPRS power and modulation quality (carrier ≤2.5 GHz)

Channel power:

Measurement range:	+33 dBm to –30 dBm (typical)
Accuracy:	±0.6 dB (typical)

Phase and frequency error:

Frequency error measurement range:	±50 kHz (typical)
Frequency error accuracy:	±10 Hz (typical)
RMS phase error measurement range:	0 to 10° (typical)
RMS phase error accuracy:	<±1°
Peak phase error measurement range[51]:	0 to 25° (typical)
Peak phase error accuracy[52]:	±2°
Phase error floor:	RMS: 0.35°, Peak: 1.0°

Time mask conformance:

Sampling resolution:	0.615 µs (1/6 bit)
Accuracy along burst peak:	±0.25 dB
Outputs:	pass/fail, complete burst with upper and lower mask limit lines

Output RF spectrum[53]:

Relative accuracy:	±0.7 dB (typical)

ORFS due to modulation:

	Dynamic range (dBc)	
Offset frequency (kHz)	Carrier frequency (F_C) (typical in parentheses)	
	400 MHz ≤F_C ≤1 GHz	1 GHz <F_C ≤2 GHz
200	35	35
250	40	40
400	68	67
600	73 (76)	72 (74)
1200	77 (80)	77 (79)
1800[54]	75 (77)	74 (77)

V2820A-UPN: ORFS due to modulation:

	Dynamic range (dBc)	
Offset frequency (kHz)	Carrier frequency (F_C) (typical in parentheses)	
	400 MHz ≤F_C ≤1 GHz	1 GHz <F_C ≤2 GHz
200	35	35
250	40	40
400	70	69
600	81 (82)	79 (81)
1200	82 (84)	82 (83)
1800[55]	77 (79)	77 (79)

ORFS due to switching:

	Dynamic range (dBc)	
Offset frequency (kHz)	Carrier frequency (F_C) (typical in parentheses)	
	400 MHz ≤F_C ≤1 GHz	1 GHz <F_C ≤2 GHz
400	67 (68)	66 (67)
600	73 (74)	70.5 (72)
1200	77 (79)	76 (78)
1800	80 (81)	80 (81)

V2820A-UPN: ORFS due to switching:

	Dynamic range (dBc)	
Offset frequency (kHz)	Carrier frequency (F_C) (typical in parentheses)	
	400 MHz ≤F_C ≤1 GHz	1 GHz <F_C ≤2 GHz
400	69 (70)	69 (70)
600	78 (80)	77 (79)
1200	82 (84)	82 (84)
1800	83 (85)	81 (83)

Displays: Power versus Time with Time Mask, ORFS due to Modulation, ORFS due to Switching, EVM versus Time, Symbols versus Time, Constellation.

EDGE power and modulation quality (carrier ≤2.5 GHz)

Channel power:

- Measurement range: +33 dBm to –30 dBm (typical)
- Accuracy: ±0.6 dB (typical)

Frequency error:

- Frequency error measurement offset: ±50 kHz (typical)
- Frequency error accuracy: ±10 Hz (typical)

EVM:

- RMS measurement range: 0 to 15% (typical)
- RMS floor: ≤0.6%
- Origin offset range: –20 dBc maximum (typical)
- RMS accuracy: ±0.5%

Time mask conformance:

- Sampling resolution: 0.615 µs (1/6 bit) (typical)
- Accuracy along burst peak[56]: ±0.25 dB (typical)

Output RF spectrum[57]:

- Relative accuracy: ±0.7 dB (typical)

ORFS due to modulation:

	Dynamic range (dBc)	
Offset frequency (kHz)	Carrier frequency (F_C) (typical in parentheses)	
	400 MHz ≤F_C ≤1 GHz	1 GHz <F_C ≤2 GHz
200	37	37
250	41	41
400	68	67
600	73 (74)	71 (73)
1200	78 (79)	77 (78)
1800[58]	75 (77)	75 (77)

V2820A-UPN: ORFS due to modulation:

	Dynamic range (dBc)	
Offset frequency (kHz)	Carrier frequency (F_C) (typical in parentheses)	
	400 MHz ≤F_C ≤1 GHz	1 GHz <F_C ≤2 GHz
200	37	37
250	41	41
400	70	70
600	80 (81)	79 (80)
1200	81 (83)	80 (82)
1800[59]	77 (79)	77 (79)

ORFS due to switching:

	Dynamic range (dBc)	
Offset frequency (kHz)	Carrier frequency (F_C) (typical in parentheses)	
	400 MHz ≤F_C ≤1 GHz	1 GHz <F_C ≤2 GHz
400	67 (68)	66 (67)
600	72 (73)	70 (72)
1200	77 (78)	76 (77)
1800	80 (81)	80 (81)

V2820A-UPN: ORFS due to switching:

	Dynamic range (dBc)	
Offset frequency (kHz)	Carrier frequency (F_C) (typical in parentheses)	
	400 MHz ≤F_C ≤1 GHz	1 GHz <F_C ≤2 GHz
400	67 (68)	68 (69)
600	78 (79)	78 (79)
1200	80 (82)	79 (81)
1800	80 (82)	81 (83)

Displays: Power versus Time with Time Mask, ORFS due to Modulation, ORFS due to Switching, EVM versus Time, Symbols versus Time, Constellation.

V2800A-103 EDGE Evolution signal analysis personality license

EDGE Evolution power and modulation quality (carrier ≤2.5 GHz)

Channel power:
- Measurement range: +33 dBm to –30 dBm (typical)
- Accuracy: ±0.6 dB (typical)

Frequency error:
- Frequency error measurement offset: ±50 kHz (typical)
- Frequency error accuracy: ±10 Hz (typical)

EVM:
- RMS measurement range: 0 to 15% (typical)
- RMS floor: ≤0.50%
- Origin offset range: –20 dBc maximum (typical)
- RMS accuracy: ±0.5%

Time mask conformance:
- Sampling resolution: 0.615 µs (1/6 bit) (typical)
- Accuracy along burst peak: ±0.25 dB (typical)
- Outputs: pass/fail, complete burst with upper and lower mask limit lines

Displays: Power versus Time with Time Mask, ORFS due to Modulation, ORFS due to Switching, EVM versus Time, Symbols versus Time, Constellation

Output RF spectrum[60]:
- Relative accuracy: ±0.7 dB (typical)

ORFS due to modulation:

	Dynamic range (dBc)	
Offset frequency (kHz)	Carrier frequency (F_C) (typical in parentheses)	
	400 MHz ≤F_C ≤1 GHz	1 GHz <F_C ≤2 GHz
200	36	36
250	39	39
400	68 (69)	64 (66)
600	74 (75)	69 (70.5)
1200	77.5 (78.5)	75 (77)
1800[61]	74 (75)	72 (75)

V2820A-UPN: ORFS due to modulation:

	Dynamic range (dBc)	
Offset frequency (kHz)	Carrier frequency (F_C) (typical in parentheses)	
	400 MHz ≤F_C ≤1 GHz	1 GHz <F_C ≤2 GHz
200	36	36
250	39	39
400	69	69
600	77 (78)	77 (78)
1200	79 (80)	79 (80)
1800[62]	75 (76)	76 (77)

ORFS due to switching:

Dynamic range (dBc)		
Offset frequency (kHz)	Carrier frequency (F_C) (typical in parentheses)	
	400 MHz ≤F_C ≤1 GHz	1 GHz <F_C ≤2 GHz
400	67 (68)	64 (65)
600	74 (75)	69 (70)
1200	78 (79)	74.5 (77)
1800	79 (82)	77 (80)

V2820A-UPN: ORFS due to switching:

Dynamic range (dBc)		
Offset frequency (kHz)	Carrier frequency (F_C) (typical in parentheses)	
	400 MHz ≤F_C ≤1 GHz	1 GHz <F_C ≤2 GHz
400	70	69 (70)
600	78 (79)	77.5 (78.5)
1200	80 (81)	79 (80)
1800	80 (81)	80.5 (81.5)

Displays: Power versus Time with Time Mask, ORFS due to Modulation, ORFS due to Switching, EVM versus Time, Symbols versus Time, Constellation.

V2800A-104 cdma2000 and IS-95A reverse link signal analysis personality license

cdma2000 power and modulation quality (carrier ≤2.5 GHz)

Channel power:	
Measurement range:	+33 dBm to –70 dBm (typical)
Accuracy (1.2288 MHz BW):	±0.6 dB (typical)
Frequency error:	
Frequency error measurement range:	±3 kHz (typical)
Frequency error accuracy:	±10 Hz (typical)
RHO (ρ):	
Range:	0.7 to 10 (typical)
Ceiling:	>0.9995
Accuracy:	±0.005 (for ρ values >0.9)
Code domain power:	
Relative accuracy, for code channels[3]	
–20 dB of total power:	±0.3 dB (typical)
Adjacent channel power[63]:	
Dynamic range:	74 dBc @ 885 kHz offset (typical) 86 dBc @ 1980 kHz offset (typical)
V2820A-UPN:	79 dBc @ 885 kHz offset (typical) 88.5 dBc @ 1980 kHz offset (typical)
Relative accuracy:	±0.5 dB (typical)
Occupied bandwidth:	
Frequency accuracy:	±5 kHz (typical)
Spectrum emissions mask[64]:	
Accuracy relative to carrier power:	<0.5 dB
Displays:	Code Domain Power, Adjacent Channel Power with limits, Occupied Bandwidth with limit lines, Conducted Spurious Emissions with limits

V2800A-106 W-CDMA FDD uplink signal analysis personality license

W-CDMA power and modulation quality (carrier frequency = 1800 to 2200 MHz)

Channel power:	
Measurement range:	+33 dBm to –60 dBm (typical)
Accuracy (3.84 MHz BW):	±0.6 dB (typical)
Frequency error:	
Frequency error measurement range:	±3 kHz (typical)
Frequency error accuracy:	±10 Hz (typical)
RMS EVM:	
Range:	0 to 25% (typical)
Floor:	1.8% (typical)
Accuracy:	±2%
Code domain power:	
Relative accuracy, for code channels[3]	
–20 dB of total power:	±0.3 dB
Adjacent channel power[65]:	
Dynamic range:	67 dBc @ 5 MHz offset (typical) 69 dBc @ 10 MHz offset (typical)
V2820A-UPN:	68 dBc @ 5 MHz offset (typical) 70 dBc @ 10 MHz offset (typical)
Relative accuracy:	±0.5 dB (typical)
Occupied bandwidth:	
Frequency accuracy:	±20 kHz (nominal)
Spectrum emissions mask[66]:	
Accuracy relative to carrier power:	<1.5 dB (nominal)
Displays:	Code Domain Power, Adjacent Channel Power with limits, Occupied Bandwidth with limit lines, Spectrum Emissions with limits

V2800A-105 W-CDMA FDD downlink signal analysis personality license

W-CDMA power and modulation quality (carrier frequency = 1800 to 2200 MHz)

Channel power:	
Measurement range:	+33 dBm to –60 dBm (typical)
Accuracy (3.84 MHz BW):	±0.6 dB (typical)
Frequency error:	
Frequency error measurement range:	±3 kHz (typical)
Frequency error accuracy:	± 10 Hz (typical)
RMS EVM:	
Range:	0 to 25% (typical)
Floor:	1.8% (typical)
Accuracy:	±2%
Symbol EVM[67]:	0.5%
Code domain power:	
Relative accuracy, for code channels[3] –20 dB of total power:	±0.3 dB
Adjacent channel power[68]:	
Dynamic range:	67 dBc @ 5 MHz offset (typical) 69 dBc @ 10 MHz offset (typical)
V2820A-UPN:	68 dBc @ 5 MHz offset (typical) 70 dBc @ 10 MHz offset (typical)
Relative accuracy:	±0.5 dB (typical)
Occupied bandwidth:	
Frequency accuracy:	±20 kHz (nominal)
Spectrum emissions mask[69]:	
Accuracy relative to carrier power:	<1.5 dB (nominal)
Displays:	Code Domain Power, Adjacent Channel Power with limits, Occupied Bandwidth with limit lines, Spectrum Emissions with limits

V2800A-107 W-CDMA HSPA downlink signal analysis personality license
V2800A-108 W-CDMA HSPA uplink signal analysis personality license

HSPA power and modulation quality (carrier frequency = 1800 to 2200 MHz)

Channel power:	
Measurement range:	+33 dBm to –60 dBm (typical)
Accuracy (3.84 MHz BW):	±0.6 dB (typical)
Frequency error:	
Frequency error measurement range:	±3 kHz (typical)
Frequency error accuracy:	±10 Hz (typical)
RMS EVM:	
Range:	0 to 25% (typical)
Floor[70]:	2.25% (typical)[71] QPSK: 1.25% (nominal) 16QAM: 1.30% (nominal) 64QAM: 1.35% (nominal)
Accuracy:	±2%
Code domain power:	
Relative accuracy, for code channels[3] –20 dB of total power:	±0.3 dB
Adjacent channel power[72]:	
Dynamic range:	–66 dBc @ 5 MHz offset (typical) –68 dBc @ 10 MHz offset (typical)
Relative accuracy:	±0.5 dB (typical)
Occupied bandwidth:	
Frequency accuracy:	±20 kHz (nominal)
Spectrum emissions mask[73]:	
Accuracy relative to carrier power:	<1.5 dB (nominal)
Displays:	Code Domain Power, Adjacent Channel Power with limits, Occupied Bandwidth with limit lines, Spectrum Emissions with limits

V2800A-110 WLAN 802.11 a-b-g-j-n SISO signal analysis personality license

WLAN power and modulation quality

Channel power measurement range:

Carrier frequency 2.4 GHz:	+33 dBm to –60 dBm (typical)
Carrier frequency 4.9 and 5.8 GHz:	+15 dBm to –60 dBm (typical)

Accuracy:

OFDM 20 MHz signal bandwidth:	±0.85 dB (typical)
OFDM 40 MHz signal bandwidth:	±0.85 dB (typical)
DSSS/CCK:	±0.85 dB (typical)

Frequency error:

Measurement range:

OFDM:	±312 kHz
DSSS/CCK:	±100 kHz
Accuracy:	±10 Hz (typical)

RMS EVM floor[74] characteristic:

	Standard phase noise	V2820A–UPN
802.11a	–42.5 dB @ 4.9 to 5.8 GHz	–44 dB @ 4.9 to 5.8 GHz
802.11b	–49 dB @ 2.4 GHz	–50.5 dB @ 2.4 GHz
802.11g	–47 dB @ 2.4 GHz	–50.5 dB @ 2.4 GHz
802.11j	–44 dB @ 4.9 GHz	–45 dB @ 4.9 GHz
802.11n 20 MHz signal bandwidth[75]	–46 dB @ 2.4 GHz –42 dB @ 5.1 to 5.8 GHz	–48 dB @ 2.4 GHz –44 dB @ 5.1 to 5.8 GHz
802.11n 40 MHz signal bandwidth[76]	–40 dB @ 5.1 to 5.8 GHz	–42 dB @ 5.1 to 5.8 GHz

Channel flatness mask margin:

OFDM 20 MHz signal bandwidth:	1.4 dB (typical) at 2.4 and 5.8 GHz
OFDM 40 MHz signal bandwidth:	1.0 dB (typical) at 5.8 GHz

V2800A-111 802.16e WiMAX and WiBro SISO signal analysis personality license

WiMAX power and modulation quality

Channel power:	
Measurement range, carrier frequency <3.6 GHz:	+33 dBm to –60 dBm (typical)
Accuracy:	
10 MHz signal bandwidth:	±0.85 dB (typical)
20 MHz signal bandwidth:	±0.85 dB (typical)
Frequency error:	
Measurement range:	
10 MHz BW signal bandwidth[77]:	±60 kHz
20 MHz BW signal bandwidth[78]:	±120 kHz
Accuracy:	±10 Hz (nominal)
RCE floor[79], typical (nominal):	
10 MHz signal bandwidth[80]:	–47 dB (–48 dB) @ 700 MHz –45.5 dB (–47 dB) @ 2.5 GHz –44 dB (–46 dB) @ 3.5 GHz
20 MHz signal bandwidth[81]:	–44 dB (–46 dB) @ 700 MHz –43 dB (–45 dB) @ 2.5 GHz –42 dB (–44 dB) @ 3.5 GHz
Channel flatness mask margin:	
10 MHz signal bandwidth:	1.8 dB (nominal)
20 MHz signal bandwidth:	1.7 dB (nominal)
Spectrum emissions mask[82]:	
Accuracy relative to carrier power:	<2.0 dB swept mode (nominal) <1.0 dB step mode (nominal)

V2800A-101 flexible digital modulation signal analysis personality license

FSK parameters

Modulation type:	FSK2
Filters:	
Filter types:	Rectangular, RC, RRC, Gaussian, NRZ Gauss
Filter factor:	
RC, RRC:	ratio is 0.2 to 1.0
Gaussian, NRZ Gauss:	ratio is 0.2 to 3.0
Symbol rate:	
Symbol rate resolution:	1 Symbol/s
Minimum symbol rate:	10K Symbols/s
Maximum symbol rate:	
Gaussian, NRZ Gauss:	3.125 MSps (factor <0.5) 2.5 MSps (0.5 ≤factor <1.0) 1.25 MSps (factor ≥1.0)
RC, RRC, rectangular:	1.25 MSps
Frequency separation:	
Range:	
Gaussian, NRZ Gauss, Rectangular:	2 × symbol rate
RC, RRC:	1 × symbol rate

PSK parameters

Modulation types:	BPSK, QPSK, pi/4 QPSK, 3pi/4 QPSK, 8PSK
Filters: Filter types:	NRZ, RC, RRC, Gaussian, NRZ Gauss, Wideband
Filter factor:	
RC, RRC:	ratio is 0.2 to 1.0
Gaussian, NRZ Gauss:	ratio is 0.3 to 3.0
Symbol rate:	
Symbol rate resolution:	1 Symbol/s
Minimum symbol rate:	10 KSymbols/s
Maximum symbol rate:	
Gaussian, NRZ Gauss:	3.125 MSps (factor <0.5) 2.5 MSps (0.5 ≤factor <1.0) 1.25 MSps (factor ≥1.0)
NRZ, Wideband:	1.25 MSps
RC, RRC:	6.25 MSps

EVM characteristics

Modulation	Filter type	RMS EVM, %
All PSK	NRZ, Wideband	<0.2%
FSK	NRZ	<0.3%

Trigger and synchronization inputs and outputs

Trigger sources[83]:
- Free run
- External
- Video
- Bus
- External arm using video trigger
- Bus arm using external or video trigger
- Latched external

Trigger delay range:	–30 to +30 seconds
Trigger modes:	On measurement On acquire

External trigger:
- Selectable on rising or falling edge of external input
- Input level TTL
- Minimum input pulse width required 50 ns (nominal)

Video trigger modes:
- Selectable on rising or falling signal edge
- Video level
- Pre-qualification mode level and time settings

Sync output modes:
- Generate a sync pulse:
  - Off
  - Begin measurement
  - Start tune
  - Ready acquire
  - Start acquire
  - End acquire
  - End measurement

Sync output polarity select:	Sync out is on the falling or rising edge
Sync output:	TTL level; minimum pulse width 200 ns (nominal)
Even second clock input:	external even second clock (TTL)
Even second clock output:	external even second clock (TTL)

General specifications

Power: 100 VAC to 240 VAC; 50/60 Hz (automatically detected); 150 VA max

CE EMC compliance: compliant with the European Union EMC Directive

CE safety compliance: compliant with the European Union Low Voltage Directive

Calibration: Annual calibration cycle in system

Environment (for indoor use only):

18 to 28 °C specified operating, unless otherwise noted
0 to 50 °C operating survival, non-specified operation
–25 to 65 °C non-operating (AC power off) storage

Altitude: 2000 meters above sea level maximum specified operating

Cooling: Forced air top, bottom, and side intakes and rear exhaust. For proper cooling in a rack, use rack mount kit V2820A-1CM

Digital inputs/outputs: 4 bits, TTL-compatible

Interfaces: IEEE-488.1 compliant. Supports IEEE-488.2 common commands and status model topology

LAN: 10/100BT Ethernet, RJ45, LXI class C, no auto MDIX
IVI-COM
USB: USB full speed
RF in/TG out: Type N connector

Mechanical vibration and shock:

MIL-PRF-28800F CL3 random vibration, 3 axes
Sine-sweep test for resonances, 3 axes
MIL-STD-810F 516.5 paragraph 4.5.7, procedure VI, bench handling

General mechanical characteristics:

Height: 3 U, 133 mm (5.25″)
Width: Half-rack 213 mm (8.4″)
Depth: 464 mm (18.25″)
Weight: 7.5 kg (16.5 lbs)
Warranty: 1 year

Notes

1. Over range operation provided: 325 MHz to 4.0 GHz. Performance below 400 MHz is not specified.
2. Over range operation provided: 325 MHz to 6.5 GHz. Performance below 400 MHz and above 6.0 GHz is not specified.
3. Synthesizer resolution term: ≤20 µHz.
4. From sync out on start tune to within 0.1 ppm of final value.
5. Total variation from 0° to 50 °C ambient temperature range.
6. Factory preset setting.
7. On 10 Hz boundaries Freq = 1 MHz + n * 10 Hz. Reference accuracy: ≤±1 ppm. Sine or square wave inputs acceptable. Lock time may be up to 30 seconds.
8. Over range operation provided: Maximum span is 3.675 GHz. Performance below 400 MHz is not specified.
9. Over range operation provided: Maximum span is 6.175 GHz. Performance below 400 MHz and above 6.0 GHz is not specified.
10. Maximum sweep time is limited to 32 MS data points.
11. Flatness across a given measurement span is the sum of IF flatness and RF flatness.
12. RBW accuracy <1% nominal.
13. Filter types are settable in zero span, channel power list, and ACPR modes.
14. Filter is raised-cosine type, alpha = 0.091. ENBW and 6 dB BW is 1.1 * RBW setting.
15. CDMA and W-CDMA measurement personalities limit number of trace averages to 100.
16. Specifications apply when autocoupled unless otherwise stated.
17. Input power at 0 dBm, span = 1 MHz and RBW = 100 Hz.
18. Signal level within 60 dB of top of screen, reference level 0 dBm, no change in instrument state.
19. Applies only if input attenuator is changed from auto-coupled setting.
20. For repetitive CW power readings with read signal removed then reapplied for signals: >40 dB above noise floor within 5 minutes.
21. For option V2820A-SPI, 1 dB degradation of performance across all frequency bands with preamp on and off.
22. Over range operation provided: 325 MHz to 2.7 GHz. Performance below 400 MHz and above 2.5 GHz is not specified.
23. Over range operation provided: Maximum span: 2.375 GHz. Performance below 400 MHz and above 2.5 GHz is not specified.
24. General test conditions: fast mode on, noise correction off, range check off, randomize start off, background tasks off, display off.
25. Except where noted, GPIB is used.
26. Using the V2820A Desktop Control Panel software running on a Windows® XP, 3.4 GHz, IBM-compatible desktop PC.
27. Instrument preset, all settings auto coupled: 300 kHz ≤span ≤300 MHz. In zero span, sweep time ≤5 ms and 1 MHz BW. Time is trigger to data available.
28. 100 µs sweep time, 3.84 MHz BW, RRC filter.
29. 101 point list, 400 µs acquisition time, ≥1 MHz BW, brickwall.
30. ≤50 µs acquisition time, ≥1 MHz BW, brickwall.
31. Single burst, no averaging.
32. Single burst, no averaging.
33. Parameters measured: Rho, code domain power, RMS EVM, peak EVM, peak code domain error, frequency error, IQ offset, and total channel power.
34. 500 µs sweep.
35. To preset condition accuracy, display off.
36. Measured with general purpose SEM measurement, channel sweep time = 100 µs, number of averages = 1, measurement mode = sweep.
37. Parameters measured: Code domain power, RMS EVM, peak EVM, peak code domain error, frequency error, IQ offset, and total channel power.
38. 100 µs sweep.
39. To preset condition accuracy, display off.
40. Measured with general purpose SEM measurement, channel sweep time = 100 µs, number of averages = 1, measurement mode = sweep.
41. Parameters measured: Code domain power, RMS EVM, peak EVM, peak code domain error, frequency error, IQ offset and total channel power.

Notes (continued)
42. 100 µs sweep.
43. 100 averages.
44. Measured with general purpose SEM measurement, channel sweep time = 100 µs, number of averages = 1, measurement mode = sweep.
45. Parameters measured: Code domain power, RMS EVM, peak EVM, peak code domain error, frequency error, IQ offset, and total channel power.
46. 802.11b waveform with 504 chips, mean of 100 iterations, plots turned off, no frequency change, measurements include 4 EVM values, channel power, and 4 additional parametric measurements.
47. FFT Size: 1024, channel equalization: Chan Est Seq+Pilots, mean of 100 iterations, plots turned off, no frequency change, measurements include 4 RCE values, channel power, and 5 additional parametric measurements.
48. Using PC socket connection.
49. Zero span, sweep time 100 µs, binary data transfer, 501 data points.
50. Display off, MEAS1;INIT;IMM;*WAI;;MEAS2;INIT;IMM;*OPC.
51. Average of peak from each burst.
52. Average of peak from each burst.
53. Nominal carrier power at RF input ≥–10 dBm. Does not include level uncertainty due to inherent noise.
54. 1800 kHz offset measured using 100 kHz RBW. All other offsets measured using 30 kHz RBW.
55. 1800 kHz offset measured using 100 kHz RBW. All other offsets measured using 30 kHz RBW.
56. Pass/fail, complete burst with upper and lower mask limit lines.
57. Nominal carrier power at RF input ≥–10 dBm. Does not include level uncertainty due to inherent noise.
58. 1800 kHz offset measured using 100 kHz RBW. All other offsets measured using 30 kHz RBW.
59. 1800 kHz offset measured using 100 kHz RBW. All other offsets measured using 30 kHz RBW.
60. Nominal carrier power at RF input ≥–10 dBm. 32QAM R325 Normal. Does not include level uncertainty due to inherent noise.
61. 1800 kHz offset measured using 100 kHz RBW. All other offsets measured using 30 kHz RBW.
62. 1800 kHz offset measured using 100 kHz RBW. All other offsets measured using 30 kHz RBW.
63. Carrier power at RF input ≥–10 dBm. Does not include level uncertainty due to inherent noise.
64. Carrier power at RF input ≥–10 dBm. Does not include level uncertainty due to inherent noise.
65. Carrier power at RF input ≥–10 dBm. Does not include level uncertainty due to inherent noise.
66. Carrier power at RF input ≥–10 dBm. Does not include level uncertainty due to inherent noise.
67. Valid for CPICH only signal.
68. Carrier power at RF input ≥–10 dBm. Does not include level uncertainty due to inherent noise.
69. Carrier power at RF input ≥–10 dBm. Does not include level uncertainty due to inherent noise.
70. Test model 5 with 2 HS-PDSCH channels (HS channels are QPSK, 16QAM, or 64QAM).
71. Test model 5 with 2 HS-PDSCH channels (HS channels using 16QAM).
72. Carrier power at RF input ≥–10 dBm. Does not include level uncertainty due to inherent noise.
73. Carrier power at RF input ≥–10 dBm. Does not include level uncertainty due to inherent noise.
74. Applies when input signal is above –20 dBm, with Expected Channel Power set equal to input power.
75. Measuring 802.11n SISO signals when configured as the Master in a MIMO system configuration can degrade the EVM floor up to 3 dB.
76. Measuring 802.11n SISO signals when configured as the master in a MIMO system configuration can degrade the EVM floor up to 3 dB.
77. FFT Size: 1024. Channel equalization: Chan Est Seq + Pilots.
78. FFT Size: 1024. Channel equalization: Chan Est Seq + Pilots.
79. Applies when input signal is above –20 dBm, with Expected Channel Power set equal to input power.
80. FFT Size: 1024. Channel equalization: Chan Est Seq + Pilots.
81. FFT Size: 1024. Channel equalization: Chan Est Seq + Pilots.
82. Carrier power at RF input ≥–20 dBm. Does not include level uncertainty due to inherent noise.
83. Bus trigger and bus arm available only in channel power mode.

Ordering Information

V2820A RF vector signal analyzer

V2820A-504 RF vector signal analyzer 400 MHz to 4 GHz
V2820A-506 RF vector signal analyzer 400 MHz to 6 GHz

RF connector options

V2820A-FPC front RF input connector
V2820A-RPC rear RF input connector
V2820A-SPI single port input connector

Performance improvement options

V2820A-UPN analyzer ultra low phase noise option

Signal analysis personality options

V2800A-101: Flexible digital modulation
V2800A-102: GSM, GPRS, and EDGE
V2800A-103: EDGE Evolution
V2800A-104: cdma2000 and IS-95A reverse link
V2800A-105: W-CDMA FDD downlink
V2800A-106: W-CDMA FDD uplink
V2800A-107: W-CDMA HSPA downlink
V2800A-108: W-CDMA HSPA uplink
V2800A-110: WLAN 802.11a-b-g-j-n SISO
V2800A-111: 802.16e WiMAX and WiBro SISO

Contact your local Agilent sales representative for the latest information on new personalities and software.

Optional software

V2901A: SignalMeister integrated RF signal analysis and generation toolkit
V2901A-WMX: WiMAX signal analysis SignalMeister license
V2901A-WLN: WLAN signal analysis SignalMeister license

Accessories supplied

AC power cable, printed quick start guide, CD-ROM containing V2820A desktop control panel software, V2820A VSA system help, utility programs, and PDF files (also available online at **www.agilent.com/find/V2820A**)

Accessories available

V2999A-BTK additional benchtop kit, handle and front-rear sleeve
V2999A-1CM additional rack mount kit for 1 or 2 instruments
V2999A-ADK RF cable and adapter accessory kit
V2999A-DCB external RF-DC block module

Services available

R-51B-001-C return to Agilent warranty – 1 year (standard)
R51B-001-3C return to Agilent warranty – 3 years
R51B-001-5C return to Agilent warranty – 5 years
R-50C-001-3 Agilent calibration – 3 years

For more information about the V2820A, visit the website at: **www.agilent.com/find/V2820A**

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