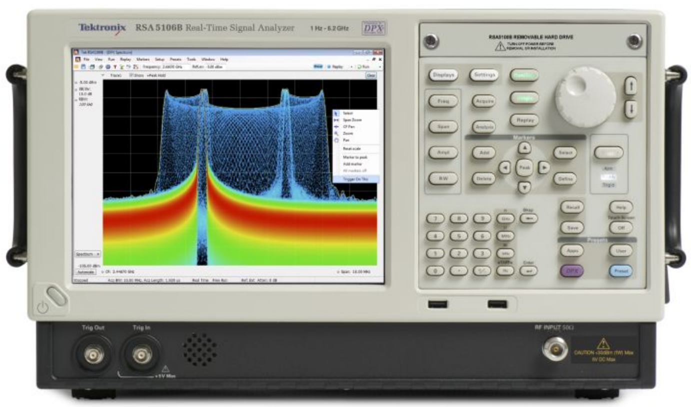
Tektronix

Spectrum Analyzers Datasheet

RSA5000 Series



The RSA5000 Series replaces conventional high-performance signal analyzers, offering the measurement confidence and functionality you demand for everyday tasks. A complete toolset of power and signal statistics measurements are standard. With the RSA5000 Series instruments, you get the functionality of a high-performance spectrum analyzer, wideband vector signal analyzer, and the unique trigger-capture-analyze capability of a real-time spectrum analyzer – all in a single package.

Key performance specifications

- +17 dBm 3rd order intercept at 2 GHz
- ±0.3 dB absolute amplitude accuracy to 3 GHz
- Displayed average noise level: –142 dBm/Hz at 26.5 GHz, –155 dBm/Hz at 2 GHz and –150 dBm/Hz at 10 kHz
- Phase noise: –113 dBc/Hz at 1 GHz and –134 dBc/Hz at 10 MHz carrier frequency, 10 kHz offset
- High-speed sweeps with high resolution and low noise: 1 GHz sweeps at 10 kHz RBW in <1 second
- 26.5 GHz internal preamp available: DANL of –167 dBm/Hz at 1 GHz, –156 dBm/Hz at 26.5 GHz

Key features

- Reduce Time-to-Fault and increase design confidence with Real-time Signal Processing
  - Up to 390,625 spectrums per second, 50,000 time domain (Zero span) waveforms per second
  - Swept DPX spectrum enables unprecedented signal discovery over full frequency range
  - Advanced DPX including swept DPX, gap-free DPX spectrograms, and DPX zero span with real-time amplitude, frequency, or phase
- Triggers zero in on the Problem
  - DPX density™ trigger on single occurrences as brief as 2.7 μs in frequency domain and distinguish between continuous signals vs infrequent events
  - Advanced time-qualified, runt, and frequency-edge triggers act on complex signals as brief as 20 ns
- Capture the widest and deepest signals
  - 25, 40, 85, or 165 MHz acquisition bandwidths
  - Acquire more than 5 seconds at 165 MHz bandwidth
- Wideband preselection filter provides image free measurements in entire analysis bandwidth up to 165 MHz
- More standard analysis than you expect in an everyday tool
  - Measurements including channel power, ACLR, CCDF, OBW/EBW, spur search, EMI detectors
  - Amplitude, frequency, phase vs. time, DPX spectrum, and spectrograms
  - Correlated multi-domain displays
- Optional performance offers added value
  - AM/FM/PM modulation and audio measurements
  - Phase noise and jitter
  - Automated settling time measurements (frequency and phase)
  - More than 20 pulse measurements including rise time, pulse width, Pulse-to-Pulse phase, impulse response
  - General purpose modulation analysis of more than 20 modulation types
  - WLAN analysis for 802.11 a/b/g/j/p, 802.11n, and 802.11ac

Applications

- Wideband radar and pulsed RF signals
- Frequency agile communications
- Broadband satellite and microwave backhaul links
- Education

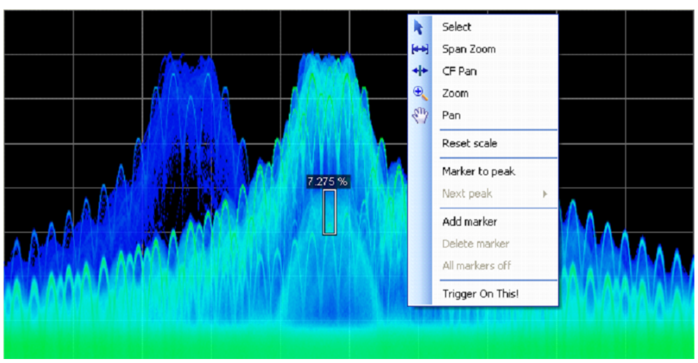
High performance spectrum and vector signal analysis, and much more

The RSA5000 Series replaces conventional high-performance signal analyzers, offering the measurement confidence and functionality you demand for everyday tasks. A +17 dBm TOI and -155 dBm/Hz DANL at 2 GHz gives you the dynamic range you expect for challenging spectrum analysis measurements. All analysis is fully preselected and image free. You never have to compromise between dynamic range and analysis bandwidth by 'switching out the preselector'.

A complete toolset of power and signal statistics measurements are standard, including Channel Power, ACLR, CCDF, Occupied Bandwidth, AM/FM/PM, and Spurious measurements. Available Phase Noise and General Purpose Modulation Analysis measurements round out the expected set of high-performance analysis tools.

But, just being an excellent mid-range signal analyzer is not sufficient to meet the demands of today's hopping, transient signals.

The RSA5000 Series will help you to easily discover design issues that other signal analyzers may miss. The revolutionary DPX® spectrum display offers an intuitive live color view of signal transients changing over time in the frequency domain, giving you immediate confidence in the stability of your design, or instantly displaying a fault when it occurs. Once a problem is discovered with DPX®, the RSA5000 Series spectrum analyzers can be set to trigger on the event, capture a contiguous time record of changing RF events, and perform time-correlated analysis in all domains. You get the functionality of a high-performance spectrum analyzer, wideband vector signal analyzer, and the unique trigger-capture-analyze capability of a real-time spectrum analyzer - all in a single package.



Revolutionary DPX ® spectrum display reveals transient signal behavior that helps you discover instability, glitches, and interference. Here, three distinct signals can be seen. Two high-level signals of different frequency-of-occurrence are seen in light and dark blue, and a third signal beneath the center signal can also be discerned. The DPX Density™ trigger allows the user to acquire signals for analysis only when this third signal is present. Trigger On This™ has been activated, and a density measurement box is automatically opened, measuring a signal density 7.275%. Any signal density greater than the measured value will cause a trigger event.

Discover

The patented DPX® spectrum processing engine brings live analysis of transient events to spectrum analyzers. Performing up to 390,625 frequency transforms per second, transients of a minimum event duration of 2.7 μs in length are displayed in the frequency domain. This is orders of magnitude faster than swept analysis techniques. Events can be color coded by rate of occurrence onto a bitmapped display, providing unparalleled insight into transient signal behavior. The DPX spectrum processor can be swept over the entire frequency range of the instrument, enabling broadband transient capture previously unavailable in any spectrum analyzer. In applications that require only spectral information, DPX provides gap-free spectral recording, replay, and analysis of up to 60,000 spectral traces. Spectrum recording resolution is variable from 5.12 μs to 6400 s per line.

Trigger

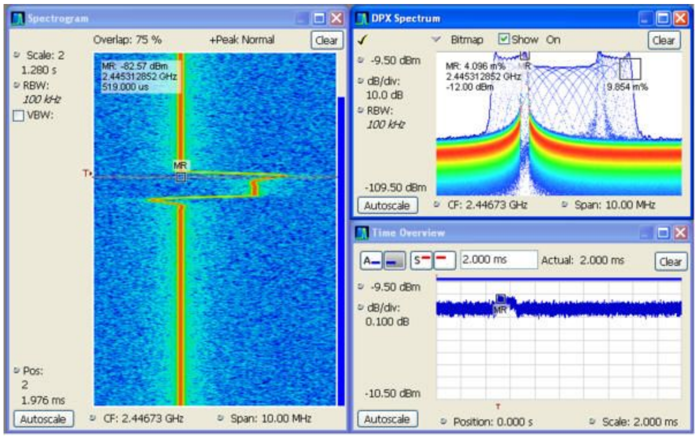
Tektronix has a long history of innovative triggering capability, and the RSA Series spectrum analyzers lead the industry in triggered signal analysis. The RSA5000 Series provides unique triggers essential for troubleshooting modern digitally implemented RF systems, including time-qualified power, runt, density, frequency, and frequency mask triggers.

Time qualification can be applied to any internal trigger source, enabling capture of 'the short pulse' or 'the long pulse' in a pulse train, or, when applied to the Frequency Mask Trigger, only triggering when a frequency domain event lasts for a specified time. Runt triggers capture troublesome infrequent pulses that either turn on or turn off to an incorrect level, greatly reducing time to fault.

DPX Density™ Trigger works on the measured frequency of occurrence or density of the DPX display. The unique Trigger On This™ function allows the user to simply point at the signal of interest on the DPX display, and a trigger level is automatically set to trigger slightly below the measured density level. You can capture low-level signals in the presence of high-level signals at the click of a button.

The Frequency Mask Trigger (FMT) is easily configured to monitor all changes in frequency occupancy within the acquisition bandwidth.

A Power Trigger working in the time domain can be armed to monitor for a user-set power threshold. Resolution bandwidths may be used with the power trigger for band limiting and noise reduction. Two external triggers are available for synchronization to test system events.



Trigger and Capture: The DPX Density™ Trigger monitors for changes in the frequency domain, and captures any violations into memory. The spectrogram display (left panel) shows frequency and amplitude changing over time. By selecting the point in time in the spectrogram where the spectrum violation triggered the DPX Density™ Trigger, the frequency domain view (right panel) automatically updates to show the detailed spectrum view at that precise moment in time.

Capture

Capture once - make multiple measurements without recapturing. All signals in an acquisition bandwidth are recorded into the RSA5000 Series deep memory. Record lengths vary depending upon the selected acquisition bandwidth - up to 5.36 seconds at 165 MHz, 343.5 seconds at 1 MHz, or 6.1 hours at 10 kHz bandwidth with Memory Extension (Opt. 53). Real-time capture of small signals in the presence of large signals is enabled with greater than 70 dB SFDR in all acquisition bandwidths, even up to 165 MHz (Opt. B16x). Acquisitions of any length can be stored in MATLAB™ Level 5 format for offline analysis.

Most spectrum analyzers in the market utilize narrowband tunable band pass filters, often YIG tuned filters (YTF) to serve as a preselector. These filters provide image rejection and improve spurious performance in swept applications by limiting the number of signals present at the first mixing stage. YTF's are narrow band devices by nature and are usually limited to bandwidths less than 50 MHz. These analyzers bypass the input filter when performing wideband analysis, leaving them susceptible to image responses when operating in modes where wideband analysis is required such as for real time signal analysis.

Unlike spectrum analyzers with YTF's, Tektronix Real Time Signal Analyzers use a wideband image-free architecture guaranteeing that signals at frequencies outside of the band to which the instrument is tuned don't create spurious or image responses. This image-free response is achieved with a series of input filters designed such that all image responses are suppressed. The input filters are overlapped by greater than the widest acquisition bandwidth, ensuring that full-bandwidth acquisitions are always available. This series of filters serves the purpose of the preselector used by other spectrum analyzers, but has the benefit of always being on while still providing the image-free response in all instrument bandwidth settings and at all frequencies.

Analyze

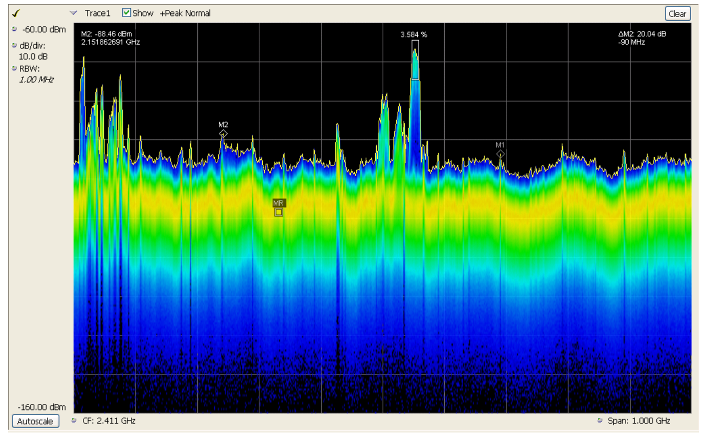
The RSA5000 Series offers analysis capabilities that advance productivity for engineers working on components or in RF system design, integration, and performance verification, or operations engineers working in networks, or spectrum management. In addition to spectrum analysis, spectrograms display both frequency and amplitude changes over time. Time-correlated measurements can be made across the frequency, phase, amplitude, and modulation domains. This is ideal for signal analysis that includes frequency hopping, pulse characteristics, modulation switching, settling time, bandwidth changes, and intermittent signals.

The measurement capabilities of the RSA5000 Series and available options and software packages are summarized in the following section.

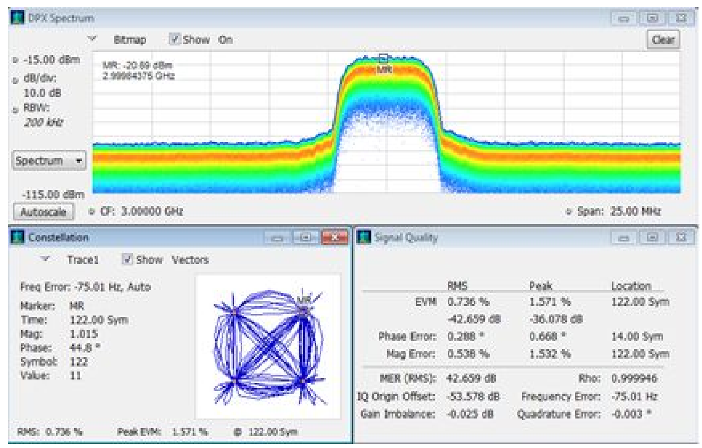
Measurement functions

Measurements	Description
Spectrum analyzer measurements	Channel power, Adjacent channel power, Multicarrier adjacent channel power/leakage ratio, Spectrum emissions mask, Occupied bandwidth, xdB down, dBm/Hz marker, dBc/Hz marker
Time domain and statistical measurements	RF IQ vs Time, Power vs Time, Frequency vs Time, Phase vs Time, CCDF, Peak-to-Average Ratio
Spur search measurement	Up to 20 frequency ranges, user-selected detectors (Peak, Average, QP), filters (RBW, CISPR, MIL), and VBW in each range. Linear or log frequency scale. Measurements and violations in absolute power or relative to a carrier. Up to 999 violations identified in tabular form for export in .CSV format
Analog modulation analysis measurement functions (standard)	% amplitude modulation (+, -, total) frequency modulation (±Peak, +Peak, -Peak, RMS, Peak-Peak/2, frequency error) phase modulation (±Peak, RMS, +Peak, -Peak)
AM/FM/PM modulation and audio measurements (Opt. 10)	carrier power, frequency error, modulation frequency, modulation parameters (±Peak, Peak-Peak/2, RMS), SINAD, modulation distortion, S/N, THD, TNHD
Phase noise and jitter measurements (Opt. 11)	10 Hz to 1 GHz frequency offset range, log frequency scale traces - 2: ±Peak trace, average trace, trace smoothing, and averaging
Settling Time (Frequency and Phase) (Opt. 12)	Measured frequency, Settling time from last settled frequency, Settling time from last settled phase, Settling time from trigger. Automatic or manual reference frequency selection. User-adjustable measurement bandwidth, averaging, and smoothing. Pass/Fail mask testing with 3 user-settable zones

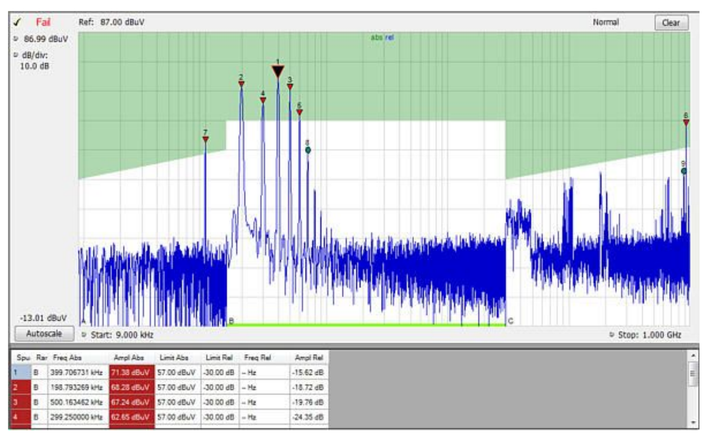
Measurements	Description
Advanced pulse measurements suite (Opt. 20)	Average on power, Peak power, Average transmitted power, Pulse width, Rise time, Fall time, Repetition interval (seconds), Repetition interval (Hz), Duty factor (%), Duty factor (ratio), Ripple (dB), Ripple (%), Overshoot (dB), Overshoot (%), Droop (dB), Droop (%), Pulse-pulse frequency difference, Pulse-pulse phase difference, RMS frequency error, Max frequency error, RMS phase error, Max phase error, frequency deviation, delta frequency, Phase deviation, Impulse response (dB), Impulse response (time), Time stamp
General Purpose Digital Modulation Analysis (Opt. 21)	Error vector magnitude (EVM) (RMS, Peak, EVM vs time), Modulation error ratio (MER), Magnitude error (RMS, Peak, Mag error vs time), Phase error (RMS, Peak, Phase error vs time), Origin offset, Frequency error, Gain imbalance, Quadrature error, Rho, Constellation, Symbol table
Flexible OFDM Analysis (Opt.`22)	OFDM analysis for WLAN 802.11a/j/g and WiMAX 802.16-2004
WLAN 802.11a/b/g/j/p measurement application (Opt. 23)	All of the RF transmitter measurements as defined in the IEEE standard, as well as a wide range of additional measurements including Carrier Frequency error, Symbol Timing error, Average/peak burst power, IQ Origin Offset, RMS/Peak EVM, and analysis displays, such as EVM and Phase/Magnitude Error vs. time/ frequency or vs. symbols/ subcarriers, as well as packet header decoded information and symbol table. Option 24 requires option 23. Option 25 requires option 24.
WLAN 802.11n measurement application (Opt. 24)	
WLAN 802.11ac measurement application (Opt. 25)	
DPX density measurement	Measures % signal density at any location on the DPX spectrum display and triggers on specified signal density
RSAVu Analysis Software	W-CDMA, HSUPA. HSDPA, GSM/EDGE, CDMA2000 1x, CDMA2000 1xEV-DO, RFID, Phase noise, Jitter, IEEE 802.11 a/b/g/n WLAN, IEEE 802.15.4 OQPSK (Zigbee), Audio analysis



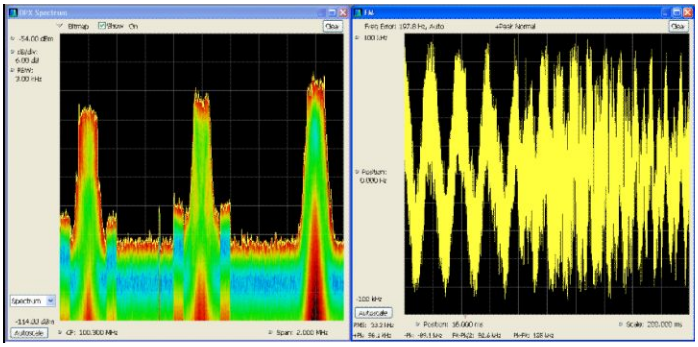
Swept DPX can capture low-probability events across spans greater than the real time bandwidth. Here, a 1 GHz sweep views the activity form 1.9 GHz to 2.9 GHz from an off-air antenna. Number signals in the 1.9 GHz cell band are seen, and significant activity in the 2.4 GHz ISM band is apparent. The density measurement both has been used on the largest signal near the center, displaying approximately 3.5% occupancy.



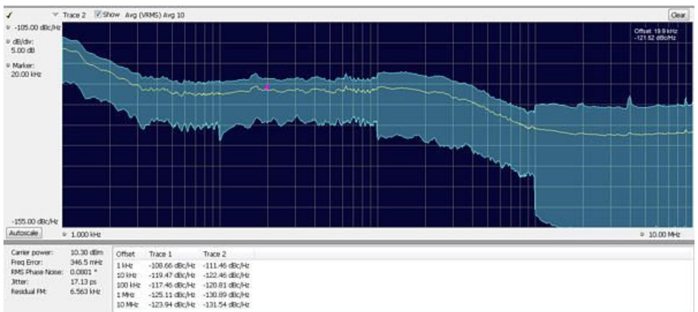
Time-correlated views in multiple domains provide a new level of insight into design problems not possible with conventional analyzers. Here, modulation quality and the constellation measurements are combined with the continuous monitoring of the DPX ® spectrum display.



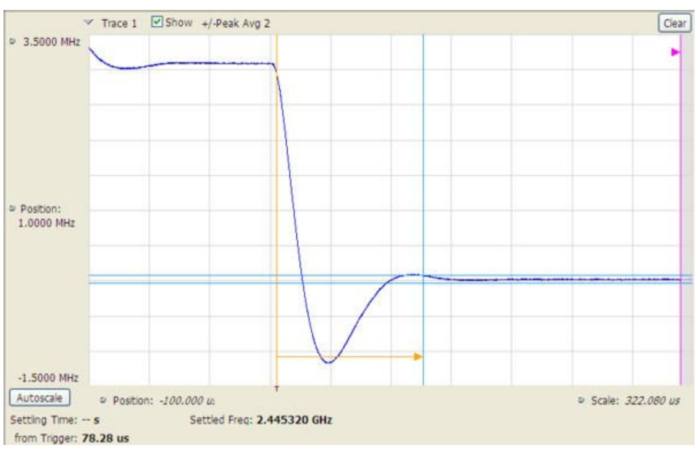
Spurious Search - Up to 20 noncontiguous frequency regions can be defined, each with their own resolution bandwidth, video bandwidth, detector (peak, average, quasi-peak), and limit ranges. Test results can be exported in .CSV format to external programs, with up to 999 violations reported. Spectrum results are available in linear or log scale.



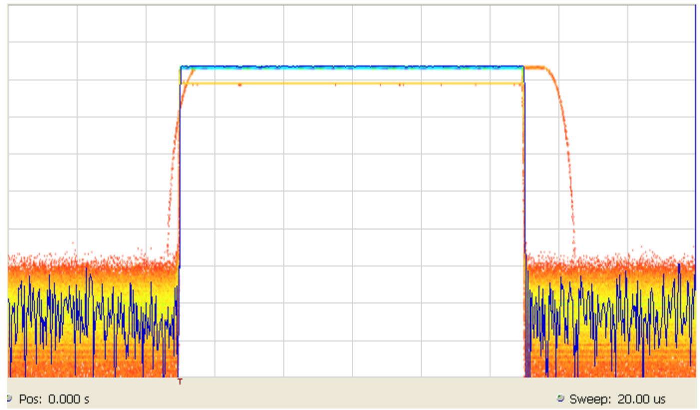
Audio monitoring and modulation measurements simultaneously can make spectrum management an easier, faster task. Here, the DPX spectrum display shows a live spectrum of the signal of interest and simultaneously provides demodulated audio to the internal instrument loudspeaker. FM deviation measurements are seen in the right side of the display for the same signal.



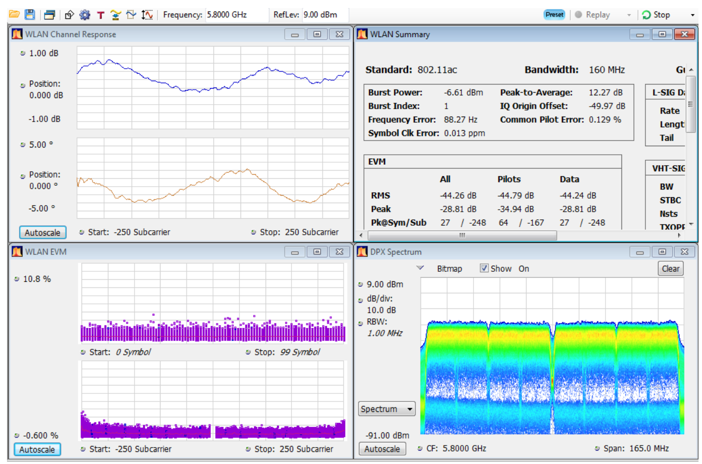
Phase noise and jitter measurements (Opt. 11) on the RSA5000 Series may reduce the cost of your measurements by reducing the need for a dedicated phase noise tester. Outstanding phase noise across the operating range provides margin for many applications. Here, phase noise on a 13 MHz carrier is measured at -119 dBc/Hz at 10 kHz offset. The instrument phase noise of < -134 dBc/Hz at this frequency provides ample measurement margin for the task.



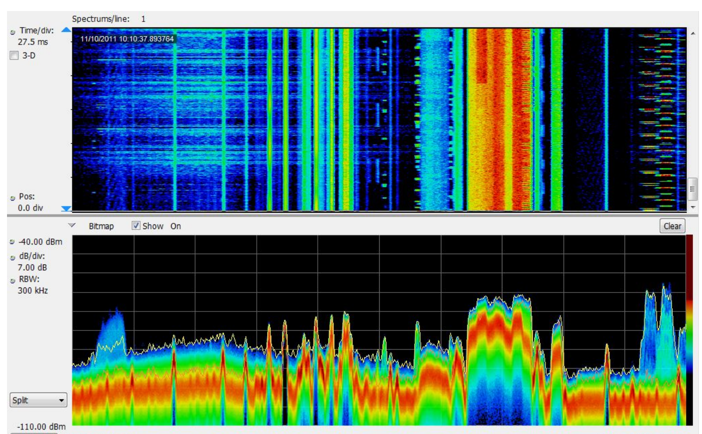
Settling time measurements (Opt. 12) are easy and automated. The user can select measurement bandwidth, tolerance bands, reference frequency (auto or manual), and establish up to 3 tolerance bands vs. time for Pass/Fail testing. Settling time may be referenced to external or internal trigger, and from the last settled frequency or phase. In the illustration, frequency settling time for a hopped oscillator is measured from an external trigger point from the device under test.



DPX Zero-span produces real-time analysis in amplitude, frequency, or phase vs. time. Up to 50,000 waveforms per second are processed. DPX Zero-span ensures that all time-domain anomalies are immediately found, reducing time-to-fault. Here, three distinct pulse shapes are captured in zero-span amplitude vs. time. Two of the three waveforms occur only once in 10,000 pulses, but all are displayed with DPX.



Analysis options for 802.11 standards are available. Here, an 802.11ac 80 MHz signal is analyzed, with displays of EVM vs. subcarrier number and symbol number, channel response vs subcarrier with a summary of WLAN measurements, and the DPX spectrum of the analyzed signal. An EVM of -44.26 dB and other signal measurements are seen in the summary panel.



DPX Spectrograms provide gap-free spectral monitoring for up to days at a time. 60,000 traces can be recorded and reviewed, with resolution per line adjustable from 5.12 µs to 6400 s.

Specifications

Model overview

	RSA5103B	RSA5106B	RSA5115B	RSA5126B
Frequency range	1 Hz - 3 GHz	1 Hz - 6.2 GHz	1 Hz - 15 GHz	1 Hz - 26.5 GHz
Real-time acquisition bandwidth	25 MHz, 40 MHz, 85 MHz, 165 MHz			
Minimum Event Duration for 100% POI at 100% amplitude	2.7 μs at 165 MHz BW 2.8 μs at 85 MHz BW 3.0 μs at 40 MHz BW 3.2 μs at 25 MHz BW			
SFDR (typical)	>75 dBc (25/40 MHz) >73 dBc (85/165 MHz)			
Trigger modes	Free run, Triggered, FastFrame			
Trigger types	Power, Frequency mask, Frequency edge, DPX density, Runt, Time qualified			

Frequency related

Reference frequency

Specification	Standard	Option PFR	Conditions
Initial accuracy at cal	$\pm 1 \times 10^{-6}$	$\pm 1 \times 10^{-7}$	After 10 minute warm-up
Aging per day	1×10^{-8}	1×10^{-9}	After 30 days of operation
First year aging (typical)	1×10^{-6}	7.5×10^{-8}	After 1 year of operation
Aging per 10 years		3×10^{-7}	After 10 years of operation
Temperature drift per °C	2×10^{-6}	1×10^{-7}	From 5 to 40 °C
Cumulative error (temperature + aging, typical)	3×10^{-6}	4×10^{-7}	Within 10 years after calibration

Reference output level >0 dBm (internal or external reference selected), +4 dBm, typical

External reference input frequency Every 1 MHz from 1 to 100 MHz plus 1.2288 MHz, 4.8 MHz, and 19.6608 MHz.

External input must be within $\pm 1 \times 10^{-6}$ (Std), $\pm 3 \times 10^{-7}$ (Opt PFR) to stated input

External reference input frequency requirements Spurious level on input must be < –80 dBc within 100 kHz offset to avoid on-screen spurs

- **Spurious** < –80 dBc within 100 kHz offset
- **Input level range** –10 dBm to +6 dBm

Center frequency setting resolution 0.1 Hz

Frequency marker readout accuracy ±(RE × MF + 0.001 × Span + 2) Hz

- **RE** Reference frequency error
- **MF** Marker frequency (Hz)

Span accuracy ±0.3% of span (Auto mode)

Trigger related

Trigger event source	RF input, Trigger 1 (front panel), Trigger 2 (rear panel), Gated, Line
Trigger setting	Trigger position settable from 1 to 99% of total acquisition length
Trigger combinatorial logic	Trigger 1 AND trigger 2 / gate may be defined as a trigger event
Trigger actions	Save acquisition and/or save picture on trigger

Power level trigger

Level range	0 dB to –100 dB from reference level
Accuracy	For trigger levels >30 dB above noise floor, 10% to 90% of signal level
Level ≥ –50 dB from reference level	±0.5 dB
From < –50 dB to –70 dB from reference level	±1.5 dB
Trigger bandwidth range	At maximum acquisition bandwidth
Standard (Opt. B25)	4 kHz to 10 MHz + wide open
Opt. B40	4 kHz to 20 MHz + wide open
Opt. B85/B16x	11 kHz to 40 MHz + wide open
Trigger position timing uncertainty	
25 MHz acquisition BW, 20 MHz BW (Opt. B25)	Uncertainty = ±15 ns
40 MHz acquisition BW, 20 MHz BW (Opt. B40)	Uncertainty = ±12 ns
85 MHz acquisition BW, 60 MHz BW (Opt. B85)	Uncertainty = ±5 ns
165 MHz acquisition BW (Opt B16x)	Uncertainty = ±4 ns
Trigger re-arm time, minimum (fast frame on)	
10 MHz acquisition BW	≤25 µs
40 MHz acquisition BW (Opt. B40)	≤10 µs
85 MHz acquisition BW (Opt. B85)	≤5 µs
165 MHz acquisition BW (Opt B16x)	≤5 µs
Minimum event duration	
25 MHz acquisition BW (Opt. B25)	25 ns
40 MHz acquisition BW (Opt. B40)	25 ns
85 MHz acquisition BW (Opt. B85)	6.2 ns
165 MHz acquisition BW (Opt B16x)	6.2 ns

External trigger 1

Level range	-2.5 V to +2.5 V
Level setting resolution	0.01 V
Trigger position timing uncertainty	50 Ω input impedance
25 MHz acquisition BW, 25 MHz span (Opt. B25)	Uncertainty = ±20 ns
40 MHz acquisition BW, 40 MHz span (Opt. B40)	Uncertainty = ±20 ns
85 MHz acquisition BW, 85 MHz span (Opt. B85)	Uncertainty = ±11 ns
165 MHz acquisition BW, 165 MHz span (Opt. B16x)	Uncertainty = ±11 ns
Input impedance	Selectable 50 Ω/5 kΩ impedance (nominal)

External trigger 2

Threshold voltage	Fixed, TTL
Input impedance	10 kΩ (nominal)
Trigger state select	High, Low

Trigger output

Voltage	Output current <1 mA
High	>2.0 V
Low	<0.4 V

Frequency mask trigger

Mask shape	User defined
Mask point horizontal resolution	<2% of span
Level range	0 dB to –80 dB from reference level
Level accuracy [1]	
0 to –50 dB from reference level	±(Channel response + 1.0 dB)
–50 dB to –70 dB from reference level	±(Channel response + 2.5 dB)
Span range	100 Hz to 25 MHz (Opt. B25) 100 Hz to 40 MHz (Opt. B40) 100 Hz to 85 MHz (Opt. B85) 100 Hz to 165 MHz (Opt. B16x)

1 For masks >30 dB above noise floor

Frequency mask trigger

Trigger position uncertainty

Span = 25 MHz (Opt. B25)	±13 μs (RBW ≥ 300 kHz) ±7 μs (Opt. 09)
Span = 40 MHz (Opt. B40)	±13 μs (RBW ≥ 300 kHz) ±6 μs (Opt. 09)
Span = 85 MHz (Opt. B85)	±10 μs (RBW ≥ 1 MHz) ±3 μs (Opt. 09)
Span = 165 MHz (Opt. B16x)	±9 μs (RBW ≥ 1 MHz) ±3 μs (Opt. 09)

Minimum signal duration for 100% probability of trigger at 100% amplitude

Frequency-Mask and DPX signal processing				**Minimum signal duration, 100% probability of intercept, Frequency-Mask and DPX density trigger (μs) [2]**			
Span (MHz)	**RBW (kHz)**	**FFT Length (points)**	**Spectrums / sec**	**Standard**		**Opt. 09**	
				Full amplitude	**-3 dB**	**Full amplitude**	**-3 dB**
165 MHz	20000	1024	390,625	15.5	15.4	2.7	2.6
	10000	1024	390,625	15.6	15.4	2.8	2.6
	1000	1024	390,625	17.8	15.7	5.0	2.9
	300	2048	195,313	23.4	16.3	13.1	6.1
	100	8192	48,828	44.5	23.4	44.5	23.4
	30	32768	12,207	161.9	91.7	161.9	91.7
85 MHz	10000	1024	390,625	15.6	15.4	2.8	2.6
	1000	1024	390,625	17.8	15.7	5.0	2.9
	500	1024	390,625	20.2	15.9	7.4	3.1
	300	1024	390,625	23.4	16.3	10.6	3.5
	100	4096	97,656	44.5	23.4	34.2	13.2
	30	16384	24,414	121.0	50.7	121.0	50.7
	20	16384	24,414	161.0	55.6	161.0	55.6
40 MHz	5000	1024	390,625	15.8	15.4	3.0	2.6
	1000	1024	390,625	17.8	15.7	5.0	2.9
	300	1024	390,625	23.3	16.3	10.5	3.5
	100	2048	195,313	39.4	18.3	29.1	8.1
	30	4096	97,656	90.4	21.8	90.4	21.8
	20	8192	48,828	140.7	36.3	140.7	36.3
	10	16384	24,414	281.3	72.6	281.3	72.6
25 MHz	3800	1024	390,625	16.0	15.4	3.2	2.6
	1000	1024	390,625	17.7	15.7	4.9	2.9
	300	1024	390,625	23.4	16.3	10.6	3.5
	200	1024	390,625	27.4	16.8	14.6	4.1

2 Values displayed by the instrument may differ by 0.1μs

Advanced triggers

DPX density trigger	
Density range	0 to 100% density
Horizontal range	0.25 Hz to 25 MHz (Opt. B25)
	0.25 Hz to 40 MHz (Opt. B40)
	0.25 Hz to 85 MHz (Opt. B85)
	0.25 Hz to 165 MHz (Opt. B16x)
Minimum signal duration for 100% probability of trigger	See minimum signal duration for 100% probability of trigger at 100% amplitude table
Frequency edge trigger	
Range	±(½ × (ACQ BW or TDBW if TDBW is active))
Minimum event duration	6.2 ns (ACQ BW = 165 MHz, no TDBW, Opt. 16x)
	6.2 ns (ACQ BW = 85 MHz, no TDBW, Opt. B85)
	25 ns (ACQ BW = 40 MHz, no TDBW, Opt. B40)
	25 ns (ACQ BW = 25 MHz, no TDBW, Opt. B25)
Timing uncertainty	Same as power trigger position timing uncertainty
Runt trigger	
Runt definitions	Positive, Negative
Accuracy (for trigger levels >30 dB above noise floor, 10% to 90% of signal level)	±0.5 dB (level ≥ -50 dB from reference level)
	±1.5 dB (from < -50 dB to -70 dB from reference level)
Time qualified triggering	
Trigger types and source	Time qualification may be applied to: Level, Frequency mask, DPX Density, Runt, Frequency edge, Ext. 1, Ext. 2
Time qualification range	T1: 0 to 10 seconds
	T2: 0 to 10 seconds
Time qualification definitions	Shorter than T1
	Longer than T1
	Longer than T1 AND shorter than T2
	Shorter than T1 OR longer than T2
Holdoff trigger	
Range	0 to 10 seconds

Acquisition related

A/D converter	200 MS/s, 16 bit (Option B25, B40, B85, B16x), 400 MS/s, 14 bit (Option B85, B16x)
Acquisition memory size	1 GB (4 GB, opt. 53)
Minimum acquisition length	64 samples
Acquisition length setting resolution	1 sample
Fast frame acquisition mode	>64,000 records can be stored in a single acquisition (for pulse measurements and spectrogram analysis)

Acquisition related

Memory depth (time) and minimum time domain resolution

Acq. BW (max span)	Sample rate (for I and Q)	Record length (Std.)	Record length (Opt. 53)	Time resolution
165 MHz	200 MS/s	1.34 s	5.37 s	5 ns
85 MHz	200 MS/s	1.34 s	5.37 s	5 ns
80 MHz	100 MS/s	2.68 s	10.74 s	10 ns
40 MHz	50 MS/s	4.77 s	19.09 s	20 ns
25 MHz	50 MS/s	4.77 s	19.09 s	20 ns
20 MHz	25 MS/s	4.77 s	38.18 s	20 ns
10 MHz	12.5 MS/s	19.09 s	76.35 s	80 ns
5 MHz	6.25 MS/s	38.18 s	152.71 s	160 ns
2 MHz [3]	3.125 MS/s	42.9 s	171.8 s	320 ns
1 MHz	1.563 MS/s	85.9 s	343.6 s	640 ns
500 kHz	781.25 kS/s	171.8 s	687.2 s	1.28 µs
200 kHz	390.625 kS/s	343.6 s	1374.4 s	2.56 µs
100 kHz	195.313 kS/s	687.2 s	2748.8 s	5.12 µs
50 kHz	97.656 kS/s	1374.4 s	5497.6 s	10.24 µs
20 kHz	48.828 kS/s	2748.8 s	10955.1 s	20.48 µs
10 kHz	24.414 kS/s	5497.6 s	21990.2 s	40.96 µs
5 kHz	12.207 kS/s	10955.1 s	43980.5 s	81.92 µs
2 kHz	3.052 kS/s	43980.4 s	175921.8 s	328 µs
1 kHz	1.526 kS/s	87960.8 s	351843.6 s	655 µs
500 Hz	762.9 S/s	175921.7 s	703687.3 s	1.31 ms
200 Hz	381.5 S/s	351843.4 s	1407374.5 s	2.62 ms
100 Hz	190.7 S/s	703686.8 s	2814749.1 s	5.24 ms

Displays and measurements

Frequency views

Spectrum (amplitude vs linear or log frequency)

DPX® spectrum display (live RF color-graded spectrum)

Spectrogram (amplitude vs frequency over time)

Spurious (amplitude vs linear or log frequency)

Phase noise (phase noise and Jitter measurement) (Opt. 11)

3 In spans ≤2 MHz, higher resolution data is stored.

Displays and measurements

Time and statistics views	Amplitude vs time Frequency vs time Phase vs time DPX amplitude vs time DPX frequency vs time DPX phase vs time Amplitude modulation vs time Frequency modulation vs time RF IQ vs time Time overview CCDF Peak-to-Average ratio
Settling time, frequency, and phase (Opt. 12) views	Frequency settling vs time, Phase settling vs time
Advanced measurements (Opt. 20) views	Pulse results table Pulse trace (selectable by pulse number) Pulse statistics (trend of pulse results, FFT of trend, and histogram)
Digital demod (Opt. 21) views	Constellation diagram EVM vs time Symbol table (binary or hexadecimal) Magnitude and phase error versus time, and signal quality Demodulated IQ vs time Eye diagram Trellis diagram Frequency deviation vs time
Flexible OFDM analysis (Opt. 22) views	Constellation, scalar measurement summary EVM or power vs carrier Symbol table (binary or hexadecimal)
Frequency offset analysis	Signal analysis can be performed either at center frequency or the assigned measurement frequency up to the limits of the instrument's acquisition and measurement bandwidths.
WLAN 802.11a/b/g/j/p measurement application (Opt. 23)	WLAN Power vs time, WLAN symbol table, WLAN constellation, Spectrum emission mask Error vector magnitude (EVM) vs symbol (or time), vs subcarrier (or frequency) Mag error vs symbol (or time), vs subcarrier (or frequency) Phase error vs symbol (or time), vs subcarrier (or frequency) Channel frequency response vs symbol (or time), vs subcarrier (or frequency) Spectral flatness vs symbol (or time), vs subcarrier (or frequency)

Displays and measurements

WLAN 802.11n measurement application (Opt. 24)	WLAN Power vs time, WLAN symbol table, WLAN constellation, Spectrum emission mask Error vector magnitude (EVM) vs symbol (or time), vs subcarrier (or frequency) Mag error vs symbol (or time), vs subcarrier (or frequency) Phase error vs symbol (or time), vs subcarrier (or frequency) Channel frequency response vs symbol (or time), vs subcarrier (or frequency) Spectral flatness vs symbol (or time), vs subcarrier (or frequency)
WLAN 802.11ac measurement application (Opt. 25)	WLAN Power vs time, WLAN symbol table, WLAN constellation, Spectrum emission mask Error vector magnitude (EVM) vs symbol (or time), vs subcarrier (or frequency) Mag error vs symbol (or time), vs subcarrier (or frequency) Phase error vs symbol (or time), vs subcarrier (or frequency) Channel frequency response vs symbol (or time), vs subcarrier (or frequency) Spectral flatness vs symbol (or time), vs subcarrier (or frequency)

Bandwidth related

Resolution bandwidth

Resolution bandwidth range (spectrum analysis)	0.1 Hz to 5 MHz (10 MHz with Opt. B85, 20 MHz with Opt. B16x) (1, 2, 3, 5 sequence, Auto-coupled), or user selected (arbitrary)
Resolution bandwidth shape	Approximately Gaussian, shape factor 4.1:1 (60:3 dB) ±3%, typical
Resolution bandwidth accuracy	±0.5% (Auto-coupled RBW mode)
Alternative resolution bandwidth types	Kaiser window (RBW, Gaussian), –6 dB mil, CISPR, Blackman-Harris 4B window, Uniform (none) window, Flat-top (CW ampl.) window, Hanning window

Video bandwidth

Video bandwidth range	1 Hz to 10 MHz plus wide open
RBW/VBW maximum	10,000:1
RBW/VBW minimum	1:1 plus wide open
Resolution	5% of entered value
Accuracy (typical)	±10%

Time domain bandwidth (amplitude vs time display)

Time domain bandwidth range	At least 1/10 to 1/10,000 of acquisition bandwidth, 1 Hz minimum
Time domain BW shape	20 MHz (60 MHz, Opt. B85/B16x), shape factor <2.5:1 (60:3 dB) typical
Time domain bandwidth accuracy	≤10 MHz, approximately Gaussian, shape factor 4.1:1 (60:3 dB), ±10% typical 1 Hz to 20 MHz, and (>20 MHz to 60 MHz Opt. B85/B16x), ±10%

Minimum settable spectrum analysis RBW vs. span

Frequency span	RBW
>10 MHz	100 Hz
>1.25 MHz to 10 MHz	10 Hz
≤1 MHz	1 Hz
≤100 kHz	0.1 Hz

Spectrum display

Traces	Three traces + 1 math waveform + 1 trace from spectrogram for spectrum display
Detector	Peak, –Peak, Average (VRMS), ±Peak, Sample, CISPR (Avg, Peak, Quasi-peak average (of logs))
Trace functions	Normal, Average, Max hold, Min hold, Average (of logs)
Spectrum trace length	801, 2401, 4001, 8001, or 10401 points
Sweep speed (typical)	RBW = auto, RF/IF optimization: minimize sweep time
Opt. B25	2000 MHz/s
Opt. B40	3300 MHz/s
Opt. B85	8000 MHz/s (RSA5103B/RSA5106B)
	6000 MHz/s (RSA5115B/RSA5126B)
Opt. B16x	11000 MHz/s (RSA5103B/RSA5106B)
	8000 MHz/s (RSA5115B/RSA5126B)

Minimum FFT Length vs. Trace Length (Independent of Span and RBW)

Trace length (points)	Minimum FFT length
801	4001
1024	8192
2401	10401
4096	16384

DPX related

DPX® digital phosphor spectrum processing

Characteristic	Performance
Spectrum processing rate (RBW = auto, trace length 801)	390,625/s
DPX bitmap resolution	201 × 801
DPX bitmap color dynamic range	2^{33} levels
Marker information	Amplitude, frequency, and signal density on the DPX display
Minimum signal duration for 100% probability of detection (Max-hold on)	See minimum signal duration for 100% probability of trigger at 100% amplitude table
Span Range (Continuous processing)	100 Hz to 25 MHz (Opt. B25) (40 MHz with Opt. B40) (85 MHz with Opt. B85) (165 MHz with Opt. B16x)
Span range (Swept)	Up to instrument frequency range
Dwell time per step	50 ms to 100 s
Trace processing	Color-graded bitmap, +Peak, –Peak, average
Trace length	801, 2401, 4001, 10401
Resolution BW accuracy	±1%

DPX related

Resolution BW Range vs. Acquisition Bandwidth (DPX®)

Acquisition bandwidth	RBW (Min)	RBW (Max)
165 MHz (Opt. B16x)	25 kHz	20 MHz
85 MHz (Opt. B85)	12.9 kHz	10 MHz
40 MHz (Opt. B40)	6.06 kHz	10 MHz
25 MHz	3.79 kHz	3.8 MHz
20 MHz	3.04 kHz	3.04 MHz
10 MHz	1.52 kHz	1.52 MHz
5 MHz	758 Hz	760 kHz
2 MHz	303 Hz	304 kHz
1 MHz	152 Hz	152 kHz
500 kHz	75.8 Hz	76 kHz
200 kHz	30.3 Hz	30.4 kHz
100 kHz	15.2 Hz	15.2 kHz
50 kHz	7.58 Hz	7.6 kHz
20 kHz	3.03 Hz	3.04 kHz
10 kHz	1.52 Hz	1.52 kHz
5 kHz	758 Hz	760 Hz
2 kHz	0.303 Hz	304 Hz
1 kHz	0.152 Hz	152 Hz
500 Hz	0.1 Hz	76 Hz
200 Hz	0.1 Hz	30.4 Hz
100 Hz	0.1 Hz	15.2 Hz

Stability

Residual FM

<2 Hz_{p-p} in 1 second (95% confidence, typical).

Phase related

Phase noise sidebands

dBc/Hz at specified center frequency (CF)

	CF = 10 MHz	CF = 1 GHz	CF = 2 GHz	CF = 6 GHz	CF = 10 GHz	CF = 20 GHz
Offset	**Typical**	**Spec/Typical**	**Typical**	**Typical**	**Typical**	**Typical**
1 kHz	–128	–103/–107	–107	–104	–99	–95
10 kHz	–134	–109/–113	–112	–108	–108	–106
100 kHz	–134	–112/–117	–115	–114	–108	–106
1 MHz	–135	–130/–139	–137	–135	–128	–125
6 MHz	–140	–137/–146	–142	–147	–145	–140
10 MHz	NA	–137/–146	–142	–147	–147	–144

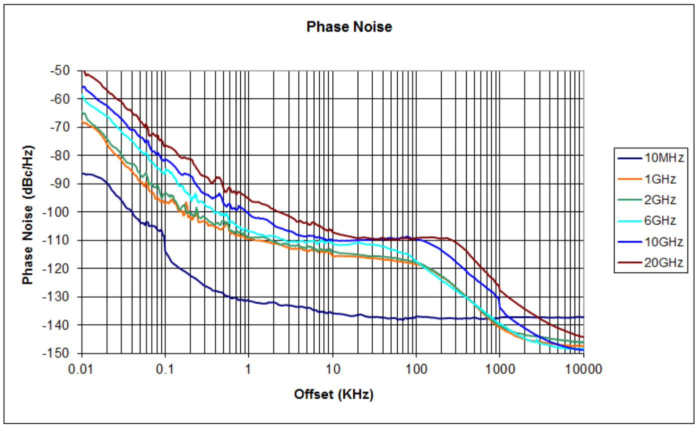
Phase related

Integrated phase (RMS), typical

Integrated from 1 kHz to 10 MHz.

Measurement frequency	Integrated phase, radians
1 GHz	1.01×10^{-3}
2 GHz	1.23×10^{-3}
6 GHz	1.51×10^{-3}
10 GHz	2.51×10^{-3}
20 GHz	3.27×10^{-3}

Typical phase noise performance as measured by Opt. 11.



Amplitude

Specifications excluding mismatch error

Measurement range — Displayed average noise level to maximum measurable input

Input attenuator range — 0 dB to 55 dB, 5 dB step

Maximum safe input level

- **Average continuous** — +30 dBm (RF ATT ≥10 dB, preamp off)
- **Average continuous** — +20 dBm (RF ATT ≥10 dB, preamp on)
- **Pulsed RF** — 50 W (RF ATT ≥30 dB, PW <10 μs, 1% duty cycle)

Maximum measurable input level

- **Average continuous** — +30 dBm (RF ATT: Auto)
- **Pulsed RF** — 10 W (RF Input, RF ATT: Auto, PW <10 μs, 1% duty cycle repetitive pulses)

Max DC voltage — ±5 V

Log display range — 0.01 dBm/div to 20 dB/div

Display divisions — 10 divisions

Display units — dBm, dBmV, Watts, Volts, Amps, dBuW, dBuV, dBuA, dBW, dBV, dBV/m, and dBA/m

Marker readout resolution, dB units — 0.01 dB

Amplitude

Marker readout resolution, Volts units	Reference-level dependent, as small as 0.001 µV
Reference level setting range	0.1 dB step, -170 dBm to +50 dBm (minimum ref. level -50 dBm at center frequency <80 MHz)
Level linearity	±0.1 dB (0 to –70 dB from reference level)

Amplitude accuracy

Absolute amplitude accuracy at calibration point	±0.31 dB (100 MHz, –10 dBm signal, 10 dB ATT, 18 °C to 28 °C)
Input attenuator switching uncertainty	±0.3 dB (RSA5103B/RSA5106B) ±0.15 dB (RSA5115B/RSA5126B)
Absolute amplitude accuracy at center frequency, 95% confidence [4]	
10 MHz to 3 GHz	±0.3 dB
3 GHz to 6.2 GHz (RSA5106B/15B/26B)	±0.5 dB
6.2 GHz to 15 GHz (RSA5115B/26B)	±0.75 dB
15 GHz to 26.5 GHz (RSA5126B)	±0.9 dB

4 18 °C to 28 °C, Ref Level ≤ -15 dBm, Attenuator Auto-coupled, Signal Level -15 dBm to -50 dBm. 10 Hz ≤ RBW ≤ 1 MHz, after alignment performed.

Amplitude accuracy

VSWR

Typical		
RSA5103B / RSA5106B		
Frequency range	**Preamp OFF**	**Preamp ON**
10 kHz to 10 MHz [5]	<1.6	--
>10 MHz to 2.0 GHz	--	<1.2
>2.0 GHz to 6.2 GHz	--	<1.4

Typical		
RSA5115B / RSA5126B		
Frequency range	**Preamp OFF**	**Preamp ON**
10 kHz to 10 MHz [5]	<1.6	--
>10 MHz to 3.0 GHz	--	<1.4
>3.0 GHz to 6.2 GHz	--	<1.5
>6.2 GHz to 15 GHz	--	<1.8
>15 GHz to 22 GHz	--	<1.8
>22 GHz to 26.5 GHz	--	<2.0

Typical, 95% confidence	
RSA5103B / RSA5106B	
Frequency range	**Preamp OFF**
>10 MHz to 2.0 GHz	<1.25
>2.0 GHz to 5.0 GHz	<1.25
>5.0 GHz to 6.2 GHz	<1.3

Typical, 95% confidence	
RSA5115B / RSA5126B	
Frequency range	**Preamp OFF**
>10 MHz to 3.0 GHz	<1.3
>3.0 GHz to 6.2 GHz	<1.3
>6.2 GHz to 15 GHz	<1.5
>15 GHz to 22 GHz	<1.5
>22 GHz to 26.5 GHz	<1.7

Frequency response

18 °C to 28 °C, atten. = 10 dB, preamp off

10 MHz to 32 MHz (LF band)	±0.2 dB
10 MHz to 3 GHz	±0.35 dB
>3 GHz to 6.2 GHz (RSA5106B)	±0.5 dB
>6.2 GHz to 15 GHz (RSA5115B)	±1.0 dB
>15 GHz to 26.5 GHz (RSA5115B)	±1.2 dB

5 Atten. = 10 dB, CF set within 200 MHz of VSWR frequency

Frequency response

5 °C to 40 °C, all attenuator settings (typical, preamp off)	
100 Hz to 32 MHz (LF band)	±0.8 dB
9 kHz to 3 GHz	±0.5 dB
1 MHz to 3 GHz (RSA5115B/ 26B)	±0.5 dB
>3 GHz to 6.2 GHz (RSA5106B)	±1.0 dB
>6.2 GHz to 15 GHz (RSA5115B/26B)	±1.0 dB
>15 GHz to 26.5 GHz (RSA5126B)	±1.5 dB
5 °C to 40 °C, (RSA5103B/ RSA5106B Opt. 50) (typical, preamp on, atten.=10 dB)	
1 MHz to 32 MHz (LF band)	±0.8 dB
1 MHz to 3 GHz	±0.8 dB
>3 GHz to 6.2 GHz (RSA5106B)	±1.3 dB
5 °C to 40 °C, (RSA5115B / RSA5126B Opt. 51) (typical, preamp on, atten.=10 dB)	
1 MHz to 3 GHz	±0.8 dB
>3 GHz to 6.2 GHz	±1.3 dB
>6.2 GHz to 15 GHz	±1.5 dB
>15 GHz to 26.5 GHz (RSA5126B)	±2.0 dB

Noise and distortion

3rd order intermodulation distortion at 2.13 GHz [6]	
RSA5103B / RSA5106B	–84 dBc
RSA5115B / RSA5126B	–80 dBc

3rd order intermodulation distortion – typical [7]

Note: 3rd order intercept point is calculated from 3rd order intermodulation performance.

Frequency range	3rd order intermodulation distortion, dBc (typical)		3rd order intercept, dBm (typical)	
	RSA5103B/5106B	RSA5115B/5126B	RSA5103B/5106B	RSA5115B/5126B
10 kHz to 32 MHz (LF band)	–75	–75	+12.5	+12.5
1 MHz to 120 MHz	–70	–70	+10	+10
>80 MHz to 300 MHz	–76	–76	+13	+13
>300 MHz to 6.2 GHz	–84	–82	+17	+16
>6.2 GHz to 15 GHz	--	–72	--	+11
15 GHz to 26.5 GHz	--	–72	--	+11

6 Each signal level –25 dBm, Ref level –20 dBm, Attenuator = 0 dB, 1 MHz tone separation.

7 Each signal level –25 dBm, Ref level –20 dBm, Attenuator = 0 dB, 1 MHz tone separation.

Noise and distortion

RSA5103B / RSA5106B 2nd harmonic distortion [8]

10 MHz to 1 GHz	< –80 dBc
>1 GHz to 3.1 GHz	< –83 dBc

RSA5115B / RSA5126B 2nd harmonic distortion [9]

10 MHz to 500 MHz	< –80 dBc
>500 MHz to 1 GHz	< –74 dBc
>1 GHz to 3.1 GHz	< –74 dBc
>3.1 GHz to 7.5 GHz	< –85 dBc
>7.5 GHz to 13.25 GHz	< –85 dBc

RSA5103B / RSA5106B displayed average noise level [10], preamp off

Frequency range	Spec, dBm/Hz	Typical , dBm/Hz
LF Band (all models)		
1 Hz to 100 Hz	--	–129
>100 Hz to 2 kHz	–124	–143
>2 kHz to 10 kHz	–141	–152
>10 kHz to 32 MHz	–150	–153
RF band		
9 kHz to 1 MHz	–108	–111
>1 MHz to 10 MHz	–136	–139
>10 MHz to 2 GHz	–154	–155
>2 GHz to 3 GHz	–152	–155
>3 GHz to 4 GHz (RSA5106B)	–151	–155
>4 GHz to 6.2 GHz (RSA5106B)	–149	–152

8 –40 dBm at RF input, attenuator = 0, preamp off, typical

9 –40 dBm at RF input, attenuator = 0, preamp off, typical

10 Measured using 1 kHz RBW, 100 kHz span, 100 averages, minimum noise mode, input terminated, log-average detector and trace function.

Noise and distortion

RSA5115B / RSA5126B displayed average noise level, preamp off [11]

Frequency range	Spec, dBm/Hz	Typical , dBm/Hz
LF Band (all models)		
1 Hz to 100 Hz		–129
>100 Hz to 2 kHz	–124	–143
>2 kHz to 10 kHz	–141	–152
>10 kHz to 32 MHz	–150	–153
RF band		
>1 MHz to 10 MHz	–136	–139
>10 MHz to 3 GHz	–152	–155
>3 GHz to 4 GHz	–151	–155
>4 GHz to 6.2 GHz	–149	–152
>6.2 GHz to 13 GHz	–146	–149
>13 GHz to 23 GHz	–144	–147
>23 GHz to 26.5 GHz (RSA5126B)	–140	–143

Preamplifier performance (Opt. 50)

Frequency range 1 MHz to 3.0 GHz or 6.2 GHz (RSA5106B)

Noise figure at 2 GHz 7 dB

Gain at 2 GHz 20 dB (nominal)

Preamplifier performance (Opt. 51)

Frequency range 1 MHz to 15 GHz or 26.5 GHz (RSA5115B or RSA5126B)

Noise figure at 15 GHz <10 dB

Noise figure at 26.5 GHz <13 dB

Gain at 10 GHz 20 dB (nominal)

Displayed Average Noise Level [12]**, preamp on (Opt. 50)**

Frequency range	Specification	Typical
LF band		
1 MHz to 32 MHz	–158 dBm/Hz	–160 dBm/Hz
RF band		
1 MHz to 10 MHz	–158 dBm/Hz	–160 dBm/Hz
>10 MHz to 2 GHz	–164 dBm/Hz	–167 dBm/Hz
>2 GHz to 3 GHz	–163 dBm/Hz	–165 dBm/Hz
>3 GHz to 6.2 GHz (RSA5106B)	–162 dBm/Hz	–164 dBm/Hz

11 Measured using 1 kHz RBW, 100 kHz span, 100 averages, minimum noise mode, input terminated, log-average detector and trace function.

12 Measured using 1 kHz RBW, 100 kHz span, 100 averages, minimum noise mode, input terminated, log-average trace detector and function.

Noise and distortion

Displayed average noise level [13], preamp on (Opt. 51)

Frequency range	Specification	Typical
RF band		
1 MHz to 10 MHz	–158 dBm/Hz	–160 dBm/Hz
>10 MHz to 2 GHz	–164 dBm/Hz	–167 dBm/Hz
>2 GHz to 3 GHz	–163 dBm/Hz	–165 dBm/Hz
>3 GHz to 4 GHz	–160 dBm/Hz	–163 dBm/Hz
>4 GHz to 6.2 GHz	–159 dBm/Hz	–162 dBm/Hz
>6.2 GHz to 13 GHz	–159 dBm/Hz	–162 dBm/Hz
>13 GHz to 23 GHz	–157 dBm/Hz	–160 dBm/Hz
>23 GHz to 26.5 GHz	–153 dBm/Hz	–156 dBm/Hz

Residual response	Input terminated, RBW = 1 kHz, attenuator = 0 dB, reference level –30 dBm
500 kHz to 32 MHz, LF band	< –100 dBm (typical)
1 MHz to 80 MHz, RF band	< –75 dBm (typical)
>80 MHz to 200 MHz	< –95 dBm (typical)
>200 MHz to 3 GHz	–95 dBm
>3 GHz to 6.2 GHz (RSA5106B / RSA5115B / RSA5126B)	–95 dBm
>6.2 GHz to 15 GHz (RSA5115B / RSA5126B)	–95 dBm
>15 GHz to 26.5 GHz (RSA5126B)	–95 dBm

Image response, up to 165 MHz bandwidth	Ref = –30 dBm, attenuator = 10 dB, RF input level = –30 dBm, RBW = 10 Hz.
100 Hz to 30 MHz	< –75 dBc
30 MHz to 3 GHz	< –75 dBc
>3 GHz to 6.2 GHz (RSA5106B)	< –70 dBc
>6.2 GHz to 15 GHz (RSA5115B / RSA5126B)	< –76 dBc
>15 GHz to 26.5 GHz (RSA5126B)	< –72 dBc

13 Measured using 1 kHz RBW, 100 kHz span, 100 averages, minimum noise mode, input terminated, log-average trace detector and function.

Noise and distortion

Spurious response with signal at CF, offset ≥400 kHz [14]

	Span ≤25 MHz (Opt. B25)		Span ≤40 MHz (Opt. B40) [15]		Opt. B85/B16x [15]	
	Swept spans >25 MHz		Swept spans >40 MHz		40 MHz < span ≤ 160 MHz	
Frequency	Specification	Typical	Specification	Typical	Specification	Typical
10 kHz to 32 MHz (LF band)	–80 dBc	–85 dBc	--	--	--	--
30 MHz to 3 GHz	–73 dBc	–80 dBc	–73 dBc	–80 dBc	–73 dBc	–75 dBc
>3 GHz to 6.2 GHz (RSA5106B / RSA5115B / RSA5126B)	–73 dBc	–80 dBc	–73 dBc	–80 dBc	–73 dBc	–75 dBc
6.2 GHz to 15 GHz (RSA5115B / RSA5126B)	–70 dBc	–80 dBc	–70 dBc	–80 dBc	–70 dBc	–73 dBc
15 GHz to 26.5 GHz (RSA5126B)	–66 dBc	–76 dBc	–66 dBc	–76 dBc	–66 dBc	–73 dBc

Spurious response with signal at CF (10 kHz ≤ offset < 400 kHz, Span = 1 MHz) [16]

Frequency	Typical
10 kHz to 32 MHz (LF band)	–75 dBc
30 MHz to 3 GHz	–75 dBc
3 GHz to 6.2 GHz (RSA5106B)	–75 dBc
6.2 GHz to 15 GHz (RSA5115B / RSA5126B)	–75 dBc
15 GHz to 26.5 GHz (RSA5126B)	–68 dBc

Spurious response with signal at Half-IF (3.532.75 GHz)

<–80 dBc (RF input level, –30 dBm)

Spurious response with signal, other than CF (typical)

Frequency	Span ≤25MHz, swept spans >25MHz	Opt. B40, Span ≤40MHz, swept spans >40 MHz [17]	Opt. B85, 40MHz < Span ≤ 85 MHz [17]	Opt. B16x, 85MHz < Span ≤ 165 MHz [17], [18]
1 MHz - 32 MHz (LF Band)	–80 dBc	--	--	--
30 MHz - 3 GHz	–80 dBc	–80 dBc	–76 dBc	–73 dBc
3 GHz - 6.2 GHz (RSA5106B)	–80 dBc	–80 dBc	–76 dBc	–73 dBc
6.2 GHz - 15 GHz (RSA5115B)	–80 dBc	–80 dBc	–73 dBc	–73 dBc
15 GHz - 26.5 GHz (RSA5126B)	–76 dBc	–76 dBc	–73 dBc	–73 dBc

14 RF input level = –15 dBm, Attenuator = 10 dB, Mode: Auto. Input signal at center frequency. Center Frequency > 90 MHz, Opt. B40/B85/B16x. For acquisition bandwidth 15 - 25 MHz with signals at center frequency and at ±(37.5 MHz to 42.5 MHz): 65 dBc.

15 CF> 150 MHz

16 RF Input Level = –15 dBm, Attenuator = 10 dB, Mode: Auto. Input signal at center frequency. Center frequency > 90 MHz, Opt. B40/B85/B16x. For acquisition bandwidth 15 - 25 MHz with signals at center frequency and at ±(37.5 MHz to 42.5 MHz): 65 dBc.

17 CF ≥ 150 MHZ for Opt. B40/B85/B16x.

18 -70 dBc for input signals 20 MHz above or below instrument center frequency.

Noise and distortion

Local oscillator feed-through to input connector (attenuator = 10 dB)

< –60 dBm (RSA5103B / RSA5106B)

< –90 dbm (RSA5115B / RSA5126B)

Adjacent channel leakage ratio dynamic range

Measured with test signal amplitude adjusted for optimum performance (CF = 2.13 GHz)

		ACLR, typical	
Signal type, measurement mode		**Adjacent**	**Alternate**
3GPP downlink, 1 DPCH			
	Uncorrected	–69 dB	–70 dB
	Noise corrected	–80 dB	–82 dB

IF frequency response and phase linearity, includes all preselection and image rejection filters [19]

Measurement frequency (GHz)	Acquisition bandwidth	Amplitude flatness (Spec)	Amplitude flatness (Typ, RMS)	Phase linearity (Typ, RMS)
0.001 to 0.032 (LF band)	≤20 MHz	±0.4 dB	0.3 dB	0.5°
Opt. B25				
0.01 to 6.2 [20]	≤300 kHz	±0.1 dB	0.05 dB	0.1°
0.03 to 6.2	≤25 MHz	±0.3 dB	0.2 dB	0.5°
Opt. B40				
0.03 to 6.2	≤40 MHz	±0.3 dB	0.2 dB	0.5°
Opt. B85				
0.07 to 3.0	≤85 MHz	±0.5 dB	0.3 dB	1.5°
>3.0 to 6.2	≤85 MHz	±0.5 dB	0.4 dB	1.5°
Opt. B16x				
0.07 to 6.2	≤165 MHz	±0.5 dB	0.4 dB	1.5°

RSA5115B / RSA5126B IF frequency response and phase linearity

Includes all preselection and image rejection filters [21]

Measurement frequency (GHz)	Span	Amplitude flatness (Spec)	Amplitude flatness (Typ, RMS)	Phase linearity (Typ, RMS)
6.2 to 26.5	≤300 kHz	±0.10 dB [22]	0.05 dB	0.2°
6.2 to 26.5	≤25/40 MHz	±0.50 dB	0.40 dB	1.0°
6.2 to 26.5	≤80 MHz	±0.75 dB	0.70 dB	1.5°
6.2 to 26.5	≤165 MHz	±1.0 dB	0.70 dB	1.5°

19 Amplitude flatness and phase deviation over the acquisition BW, includes RF frequency response. Attenuator setting: 10 dB.

20 High dynamic range mode selected.

21 Amplitude flatness and phase deviation over the acquisition BW, includes RF frequency response. Attenuator setting: 10 dB.

22 High dynamic range mode selected

DPX zero-span performance

Zero-span amplitude, frequency, phase performance (nominal)	
Measurement BW range	100 Hz to maximum acquisition bandwidth of instrument
Time domain BW (TDBW) range	At least 1/10 to 1/10,000 of acquisition bandwidth, 1 Hz minimum
Time domain BW (TDBW) accuracy	±1%
Sweep time range	100 ns (minimum) 2000 s (maximum, Measurement BW >80 MHz)
Time accuracy	±(0.5% + Reference frequency accuracy)
Zero-span trigger timing uncertainty (Power trigger)	±(Zero-span sweep time/400) at trigger point
DPX frequency display range	±100 MHz maximum
DPX phase display range	±200 degrees maximum
DPX waveforms/s	50,000 triggered waveforms/s for sweep time ≤20 µs
DPX spectrogram trace detection	+Peak, –Peak, Avg (V_{RMS})
DPX spectrogram trace length	801 to 10401
DPX spectrogram memory depth	Trace length = 801: 60,000 traces Trace length = 2401: 20,000 traces Trace length = 4001: 12,000 traces Trace length = 10401: 4,600 traces
Time resolution per line	User settable. 25.6 µs to 6400 s (std.) 5.12 µs to 6400 s (Opt. 09)
Maximum recording time vs line resolution	1.54 seconds (801 points/trace, 25.6 µs/line) to 4444 days (801 points/trace, 6400 s/line) 0.31 seconds (801 points/trace, 5.12 µs/line) to 4444 days (801 points/trace, 6400 s/line), Opt. 09

Digital IQ Output (Opt. 65)

Connector type	MDR (3M) 50 pin × 2
Data output	Data is corrected for amplitude and phase response in real time
Data format	I data: 16 bit LVDS Q data: 16 bit LVDS
Control output	Clock: LVDS, Max 50 MHz (200 MHz, Opt. B85, B16x) DV (Data valid), MSW (Most significant word) indicators, LVDS
Control input	IQ data output enabled, connecting GND enables output of IQ data
Clock rising edge to data transition time (Hold time)	8.4 ns (typical, Opt. B25 or B40), 1.58 ns (typical, Opt. B85 or B16x)
Data transition to clock rising edge (Setup time)	8.2 ns (typical, Opt. B25 or B40), 1.54 ns (typical, Opt. B85 or Opt. B16x)

Zero-span analog output (Opt. 66)

General information	Option 66 provides for a real-time analog representation of the detected output of the analyzer. This output is available when either the DPX spectrum or DPX zero span function is used in spans up to the maximum acquisition bandwidth. The bandwidth of the analog output is adjustable using the resolution bandwidth control of the DPX spectrum analyzer, or can be made independent of the spectrum analyzer. The output is "OFF" when the instrument is in swept spectrum analyzer mode, as it does not correspond to the output of the swept output
Connector type	BNC - Female
Output impedance	On: 50 Ω, Off: 5 kΩ
Output voltage	
Typical	1.0V @ 0 dBm input
	0 dBm reference level, 10 dB/div vertical scale, measured into a 50 Ω load. Full-scale voltage is relative to reference level.
Maximum	1.25 V
Accuracy	± 5% of full-scale voltage
Slope	10 mV/dB
	10 dB/div vertical scale, measured into a 50 Ω load. Slope will vary with vertical scale setting.
Output range log fidelity	> 60 dB @ 1 GHz CF
Output log accuracy	± 0.75 dB within range
Output delay accuracy	
RF Input to Analog Out	± (1 µs + 10%)
Output bandwidth	Up to maximum RBW
Continuous output	Continuous output for spans up to the maximum real-time acquisition bandwidth of the instrument. Output is disabled for swept spans.
Output reverse power protection	±20 V

AM/FM/PM and direct audio measurement (Opt. 10)

Analog demodulation	
Carrier frequency range (for modulation and audio measurements)	(1/2 × audio analysis bandwidth) to maximum input frequency
Maximum audio frequency span	10 MHz
Audio filters	
Low pass (kHz)	0.3, 3, 15, 30, 80, 300, and user-entered up to 0.9 × audio bandwidth
High pass (Hz)	20, 50, 300, 400, and user-entered up to 0.9 × audio bandwidth
Standard	CCITT, C-Message
De-emphasis (µs)	25, 50, 75, 750, and user-entered
File	User-supplied .TXT or .CSV file of amplitude/frequency pairs. Maximum 1000 pairs

AM/FM/PM and direct audio measurement (Opt. 10)

FM Modulation Analysis (Modulation Index >0.1)	
FM measurements	Carrier Power, Carrier Frequency Error, Audio Frequency, Deviation (+Peak, -Peak, Peak-Peak/2, RMS), SINAD, Modulation Distortion, S/N, Total Harmonic Distortion, Total Non-harmonic Distortion, Hum and Noise
Carrier power accuracy (10 MHz to 2 GHz, -20 to 0 dBm input power)	±0.85 dB
Carrier frequency accuracy (deviation: 1 to 10 kHz)	±0.5 Hz + (transmitter frequency × reference frequency error)
FM deviation accuracy (rate: 1 kHz to 1 MHz)	±(1% of (rate + deviation) + 50 Hz)
FM rate accuracy (deviation: 1 to 100 kHz)	±0.2 Hz
Residuals (FM) (rate: 1 to 10 kHz, deviation: 5 kHz)	
THD	0.10%
Distortion	0.7%
SINAD	43 dB
AM modulation analysis	
AM measurements	Carrier Power, Audio Frequency, Modulation Depth (+Peak, –Peak, Peak-Peak/2, RMS), SINAD, Modulation Distortion, S/N, Total Harmonic Distortion, Total Non-harmonic Distortion, Hum and Noise
Carrier power accuracy (10 MHz to 2 GHz, –20 to 0 dBm input power)	±0.85 dB
AM depth accuracy (rate: 1 to 100 kHz, depth: 10% to 90%)	±0.2% + 0.01 × measured value
AM rate accuracy (rate: 1 kHz to 1 MHz, depth: 50%)	±0.2 Hz
Residuals (AM)	
THD	0.16%
Distortion	0.13%
SINAD	58 dB
PM modulation analysis	
PM measurements	Carrier Power, Carrier Frequency Error, Audio Frequency, Deviation (+Peak, -Peak, Peak-Peak/2, RMS), SINAD, Modulation Distortion, S/N, Total Harmonic Distortion, Total Non-harmonic Distortion, Hum and Noise
Carrier power accuracy (10 MHz to 2 GHz, -20 to 0 dBm input power)	±0.85 dB
Carrier frequency accuracy (deviation: 0.628 rad)	±0.02 Hz + (transmitter frequency × reference frequency error)
PM deviation accuracy (rate: 10 to 20 kHz, deviation: 0.628 to 6 rad)	±100% × (0.005 + (rate / 1 MHz))
PM rate accuracy (rate: 1 to 10 kHz, deviation: 0.628 rad)	±0.2 Hz

AM/FM/PM and direct audio measurement (Opt. 10)

Residuals (PM) (rate: 1 to 10 kHz, deviation: 0.628 rad)	
THD	0.1%
Distortion	1%
SINAD	40 dB
Direct audio input	
Audio measurements	Signal power, Audio frequency (+Peak, –Peak, Peak-Peak/2, RMS), SINAD, Modulation distortion, S/N, Total harmonic distortion, Total non-harmonic distortion, Hum and Noise
Direct input frequency range (for audio measurements only)	1 Hz to 156 kHz
Maximum audio frequency span	156 kHz
Audio frequency accuracy	±0.2 Hz
Signal power accuracy	±1.5 dB
Residuals (Rate: 1 to 10 kHz, Input level: 0.316 V)	
THD	0.1%
Distortion	0.1%
SINAD	60 dB

Phase noise and jitter measurement (Opt. 11)

Carrier frequency range	1 MHz to maximum instrument frequency
Measurements	Carrier power, Frequency error, RMS phase noise, Jitter (time interval error), Residual FM
Residual Phase Noise	See Phase noise specifications
Phase noise and jitter integration bandwidth range	Minimum offset from carrier: 10 Hz Maximum offset from carrier: 1 GHz
Number of traces	2
Trace and measurement functions	Detection: average or ±Peak Smoothing Averaging Optimization: speed or dynamic range

Settling time, frequency, and phase (Opt. 12) [23]

Settled frequency uncertainty

95% confidence (typical), at stated measurement frequencies, bandwidths, and # of averages

	Frequency uncertainty at stated measurement bandwidth			
Measurement frequency, averages	**85 MHz**	**10 MHz**	**1 MHz**	**100 kHz**
1 GHz				
Single measurement	2 kHz	100 Hz	10 Hz	1 Hz
100 averages	200 Hz	10 Hz	1 Hz	0.1 Hz
1000 averages	50 Hz	2 Hz	1 Hz	0.05 Hz
10 GHz				
Single measurement	5 kHz	100 Hz	10 Hz	5 Hz
100 averages	300 Hz	10 Hz	1 Hz	0.5 Hz
1000 averages	100 Hz	5 Hz	0.5 Hz	0.1 Hz
20 GHz				
Single measurement	2 kHz	100 Hz	10 Hz	5 Hz
100 averages	200 Hz	10 Hz	1 Hz	0.5 Hz
1000 averages	100 Hz	5 Hz	0.5 Hz	0.2 Hz

Settled phase uncertainty

95% confidence (Typical), at stated measurement frequencies, bandwidths, and # of averages

	Frequency uncertainty at stated measurement bandwidth		
Measurement frequency, averages	**85 MHz**	**10 MHz**	**1 MHz**
1 GHz			
Single measurement	1.00°	0.50°	0.50°
100 averages	0.10°	0.05°	0.05°
1000 averages	0.05°	0.01°	0.01°
10 GHz			
Single measurement	1.50°	1.00°	0.50°
100 averages	0.20°	0.10°	0.05°
1000 averages	0.10°	0.05°	0.02°
20 GHz			
Single measurement	1.00°	0.50°	0.50°
100 averages	0.10°	0.05°	0.05°
1000 averages	0.05°	0.02°	0.02°

23 Measured input signal level > –20 dBm, Attenuator: Auto

Pulse measurements (Opt. 20)

Measurements	Average on power, Peak power, Average transmitted power, Pulse width, Rise time, Fall time, Repetition interval (seconds), Repetition rate (Hz), Duty factor (%), Duty factor (ratio), Ripple (dB), Ripple (%), Droop (dB), Droop (%), Overshoot (dB), Overshoot (%), Pulse-Pulse frequency difference, Pulse-Pulse phase difference, RMS frequency error, Max frequency error, RMS phase error, Max phase error, Frequency deviation, Phase deviation, Impulse response (dB), Impulse response (time), Time stamp
Minimum pulse width for detection	150 ns (Opt. B25/B40), 50 ns (Opt. B85/B16x)
Number of pulses	1 to 10,000
System rise time (typical)	<40 ns (Opt. B25), <25 ns (Opt. B40), <12 ns (Opt. B85), <7 ns (Opt. B16x)
Pulse measurement accuracy	Signal conditions: Unless otherwise stated, Pulse width >450 ns (150 ns, Opt. B85/B16x), S/N Ratio ≥30 dB, Duty cycle 0.5 to 0.001, Temperature 18 °C to 28 °C
Impulse response	Measurement range: 15 to 40 dB across the width of the chirp Measurement accuracy (typical): ±2 dB for a signal 40 dB in amplitude and delayed 1% to 40% of the pulse chirp width [24]
Impulse response weighting	Taylor window

Pulse measurement performance

Pulse amplitude and timing (typical)	
Average on power [25]	±0.3 dB + Absolute amplitude accuracy
Average transmitted power [25]	±0.4 dB + Absolute amplitude accuracy
Peak power [25]	±0.4 dB + Absolute amplitude accuracy
Pulse width	±0.25% of reading
Duty factor	±0.2% of reading

24 Chirp width 100 MHz, pulse width 10 μs, minimum signal delay 1% of pulse width or 10/(chirp bandwidth), whichever is greater, and minimum 2000 sample points during pulse on-time.

25 Pulse width >300 ns (100 ns, Opt. B85/B16x) SNR ≥30 dB

Pulse measurement performance

Frequency and phase error referenced to nonchirped signal

At stated frequencies and measurement bandwidths [26], typical, 95% confidence

Bandwidth	CF	RMS frequency error	Pulse to pulse frequency	Pulse to pulse delta frequency	Pulse to pulse phase
25 MHz	2 GHz	±2.5 kHz	±15 kHz	±500 Hz	±0.2°
	10 GHz	±2.5 kHz	±20 kHz	±1.5 kHz	±0.5°
	20 GHz	±3.5 kHz	±25 kHz	±2 kHz	±0.8°
40 MHz	2 GHz	±3.5 kHz	±20 kHz	±1 kHz	±0.2°
	10 GHz	±5 kHz	±30 kHz	±2 kHz	±0.5°
	20 GHz	±7.5 kHz	±40 kHz	±3 kHz	±0.8°
60 MHz	2 GHz	±8 kHz	±50 kHz	±1.5 kHz	±0.3°
	10 GHz	±15 kHz	±75 kHz	±3 kHz	±0.5°
	20 GHz	±20 kHz	±100 kHz	±4 kHz	±0.8°
85 MHz	2 GHz	±15 kHz	±100 kHz	±2 kHz	±0.3°
	10 GHz	±20 kHz	±125 kHz	±3 kHz	±0.5°
	20 GHz	±25 kHz	±175 kHz	±4 kHz	±0.8°
160 MHz	2 GHz	±20 kHz	±100 kHz	±4.5 kHz	±0.3°
	10 GHz	±25 kHz	±125 kHz	±6 kHz	±0.5°
	20 GHz	±40 kHz	±175 kHz	±8 kHz	±0.8°

Frequency and phase error referenced to a linear chirp

At stated frequencies and measurement bandwidths [27], typical

Bandwidth	CF	RMS frequency error	Pulse to pulse frequency	Pulse to pulse phase
25 MHz	2 GHz	±5 kHz	±15 kHz	±0.25°
	10 GHz	±8 kHz	±20 kHz	±0.5°
	20 GHz	±10 kHz	±25 kHz	±0.8°
40 MHz	2 GHz	±5 kHz	±20 kHz	±0.25°
	10 GHz	±8 kHz	±30 kHz	±0.5°
	20 GHz	±10 kHz	±50 kHz	±0.8°
60 MHz	2 GHz	±25 kHz	±125 kHz	±0.3°
	10 GHz	±30 kHz	±150 kHz	±0.5°
	20 GHz	±30 kHz	±150 kHz	±0.8°
85 MHz	2 GHz	±25 kHz	±125 kHz	±0.3°
	10 GHz	±30 kHz	±150 kHz	±0.5°
	20 GHz	±30 kHz	±175 kHz	±0.8°
160 MHz	2 GHz	±35 kHz	±125 kHz	±0.3°
	10 GHz	±40 kHz	±150 kHz	±0.5°
	20 GHz	±40 kHz	±200 kHz	±0.8°

26 Pulse ON Power ≥ -20 dBm, Signal peak at reference Level, Attenuator = Auto, $t_{meas} - t_{reference}$ ≤ 10 ms, Frequency estimation: Manual. Pulse-to-Pulse measurement time position excludes the beginning and ending of the pulse extending for a time = (10 / Measurement BW) as measured from 50% of the $t_{(rise)}$ or $t_{(fall)}$. Absolute frequency error determined over center 50% of pulse.

27 Signal type: Linear chirp, Peak-to-Peak chirp deviation: ≤0.8 Measurement BW, Pulse ON Power ≥ -20 dBm, Signal peak at reference Level, Attenuator = 0 dB, $t_{meas} - t_{reference}$ ≤ 10 ms, Frequency estimation: Manual. Pulse-to-Pulse measurement time position excludes the beginning and ending of the pulse extending for a time = (10 / Measurement BW) as measured from 50% of the $t_{(rise)}$ or $t_{(fall)}$. Absolute frequency error determined over center 50% of pulse.

Digital modulation analysis (Opt. 21)

Modulation formats	π/2DBPSK, BPSK, SBPSK, QPSK, DQPSK, π/4DQPSK, D8PSK, D16PSK, 8PSK, OQPSK, SOQPSK, CPM, 16/32-APSK, 16/32/64/128/256QAM, MSK, GMSK, 2-FSK, 4-FSK, 8-FSK, 16-FSK, C4FM
Analysis period	Up to 81,000 samples
Filter types	
Measurement filters	Square-root raised cosine, Raised cosine, Gaussian, Rectangular, IS-95, IS-95 EQ, C4FM-P25, Half-sine, None, User defined
Reference filters	Raised cosine, Gaussian, Rectangular, IS-95, SBPSK-MIL, SOQPSK-MIL, SOQPSK-ARTM, none, user defined
Alpha/B*T range	0.001 to 1, 0.001 step
Measurements	Constellation, Error vector magnitude (EVM) vs. Time, Modulation error ratio (MER), Magnitude error vs. Time, Phase error vs. Time, Signal quality, Symbol table, Rho FSK only: Frequency deviation, Symbol timing error
Symbol rate range	1 kS/s to 100 MS/s (modulated signal must be contained entirely within acquisition BW of the instrument)
QPSK residual EVM [28]	
100 kHz symbol rate	<0.35%
1 MHz symbol rate	<0.35%
10 MHz symbol rate	<0.4%
30 MHz symbol rate (Opt. B40/B85/B16x)	<0.75%
60 MHz symbol rate (Opt. B85/B16x)	<1.0%
120 MHz symbol rate (Opt. B16x)	<1.5%
Offset QPSK residual EVM [29]	
100 kHz symbol rate, 200 kHz measurement BW	<0.5%
1 MHz symbol rate, 2 MHz measurement BW	<0.5%
10 MHz symbol rate, 20 MHz measurement BW	<1.1%
256 QAM residual EVM [30]	
10 MHz symbol rate	<0.4%
30 MHz symbol rate (Opt. B40/B85/B16x)	<0.6%
60 MHz symbol rate (Opt. B85/B16x)	<0.6%
120 MHz symbol rate (Opt. B16x)	<1.0%

28 CF = 2 GHz, Measurement filter = Root raised cosine, Reference filter = Raised cosine, Analysis length = 200 symbols.

29 CF = 2 GHz, Measurement filter = Root raised cosine, Reference filter = Raised cosine, Analysis length = 200 symbols.

30 CF = 2 GHz, Measurement filter = Root raised cosine, Reference filter = Raised cosine, Analysis length = 400 symbols 20 averages.

Digital modulation analysis (Opt. 21)

S-OQPSK (MIL) residual EVM [31]

4 kHz symbol rate, 64 kHz measurement bandwidth, CF = 250 MHz	<0.3%
20 kHz symbol rate, 320 kHz measurement bandwidth, CF = 2 GHz	<0.5%
100 kHz symbol rate, 1.6 MHz measurement bandwidth, CF = 2 GHz	<0.5%
1 MHz symbol rate, 16 MHz measurement bandwidth, CF = 2 GHz	<0.5%

S-OQPSK (ARTM) residual EVM [32]

4 kHz symbol rate, 64 kHz measurement bandwidth, CF = 250 MHz	<0.3%
20 kHz symbol rate, 320 kHz measurement bandwidth, CF = 2 GHz	<0.4%
100 kHz symbol rate, 1.6 MHz measurement bandwidth, CF = 2 GHz	<0.4%
1 MHz symbol rate, 16 MHz measurement bandwidth, CF = 2 GHz	<0.4%

S-BPSK (MIL) residual EVM [33]

4 kHz symbol rate, 64 kHz measurement bandwidth, CF = 250 MHz	<0.25%
20 kHz symbol rate, 320 kHz measurement bandwidth, CF = 2 GHz	<0.5%
100 kHz symbol rate, 1.6 MHz measurement bandwidth, CF = 2 GHz	<0.5%
1 MHz symbol rate, 1.6 MHz measurement bandwidth, CF = 2 GHz	<0.5%

CPM (MIL) residual EVM [34]

4 kHz symbol rate, 64 kHz measurement bandwidth, CF = 250 MHz	<0.3%
20 kHz symbol rate, 320 kHz measurement bandwidth, CF = 2 GHz	<0.4%

31 Reference Filter: MIL STD Measurement Filter: none.

32 Reference Filter: MIL STD Measurement Filter: none.

33 Reference Filter: MIL STD.

34 Reference Filter: MIL STD.

Digital modulation analysis (Opt. 21)

100 kHz symbol rate, 1.6 MHz measurement bandwidth, CF = 2 GHz	<0.4%
1 MHz symbol rate, 16 MHz measurement bandwidth, CF = 2 GHz	<0.4%
2/4/8/16 FSK residual RMS FSK error [35]	
2FSK, 10 kHz symbol rate, 10 kHz frequency deviation, CF = 2 GHz	<0.3%
4/8/16FSK, 10 kHz symbol rate, 10 kHz frequency deviation, CF = 2 GHz	<0.4%

Adaptive equalizer

Type	Linear, decision-directed, feed-forward (FIR) equalizer with co-efficient adaptation and adjustable convergence rate
Modulation types supported	BPSK, QPSK, OQPSK, π/2DBPSK, π/4DQPSK, 8PSK, 8DPSK, 16DPSK, 16/32/64/128/256QAM
Reference filters for all modulation types except OQPSK	Raised cosine, rectangular, none
Reference filters for OQPSK	Raised cosine, half sine
Filter length	3 to 2001 taps
Taps/Symbol: raised cosine, half sine	1, 2, 4, 8
Taps/Symbol: rectangular filter, no filter	1
Equalizer controls	Off, train, hold, reset

Flexible OFDM (Opt. 22)

Recallable standards	WiMAX 802.16-2004, WLAN 802.11 a/g/j
Parameter settings	Guard interval, subcarrier spacing, channel bandwidth
Advanced parameter settings	Carrier detect: 802.11, 802.16-2004 - Auto-detect; Manual select BPSK; QPSK, 16QAM, 64QAM Channel estimation: Preamble, Preamble + Data Pilot tracking: Phase, Amplitude, Timing Frequency correction: On, Off

35 Reference filter: None, Measurement filter: None.

Flexible OFDM (Opt. 22)

Summary measurements	Symbol clock error, Frequency error, Average power, Peak-to-Average, CPE EVM (RMS and peak) for all carriers, plot carriers, data carriers OFDM parameters: Number of carriers, Guard interval (%), Subcarrier spacing (Hz), FFT Length Power (Average, Peak-to-Average)
Displays	EVM vs symbol, vs subcarrier Subcarrier power vs symbol, vs subcarrier Mag error vs symbol, vs subcarrier Phase error vs symbol, vs subcarrier Channel frequency response
Residual EVM	-49 dB (WiMAX 802.16-2004, 5 MHz BW) -49 dB (WLAN 802.11g, 20 MHz BW) Signal input power optimized for best EVM

WLAN IEEE802.11a/b/g/j/p (Opt. 23)

Modulation formats	DBPSK (DSSS1M), DQPSK (DSSS2M), CCK5.5M, CCK11M , OFDM (BPSK, QPSK, 16QAM, 64QAM)
Measurements and displays	Burst index, Burst power, Peak to average burst power, IQ origin offset, Frequency error, Common pilot error, Symbol clock error RMS and Peak EVM for Pilots/Data, Peak EVM located per symbol and subcarrier Packet header format information Average power and RMS EVM per section of the header WLAN power vs time, WLAN symbol table, WLAN constellation Spectrum emission mask, spurious Error vector magnitude (EVM) vs symbol (or time), vs subcarrier (or frequency) Mag error vs symbol (or time), vs subcarrier (or frequency) Phase error vs symbol (or time), vs subcarrier (or frequency) WLAN channel frequency response vs symbol (or time), vs subcarrier (or frequency) WLAN spectral flatness vs symbol (or time), vs subcarrier (or frequency)
Residual EVE - 802.11b (CCK-11 Mbps)	RMS-EVM over 1000 chips, EQ On Signal input power optimized for best EVM
2.4 GHz:	1%(–40 dB) typical, 0.9% (–40.9 dB) typical-mean
Residual EVE - 802.11a/g/j (OFDM, 20 MHz, 64-QAM)	RMS-EVM averaged over 20 bursts, 16 symbols each Signal input power optimized for best EVM
2.4 GHz	–49 dB typical, –50 dB typical-mean
5.8 GHz	–49 dB typical, –50 dB typical-mean

WLAN IEEE802.11n (Opt. 24)

Modulation formats	OFDM (BPSK, QPSK, 16 or 64QAM)
Measurements and displays	Burst index, Burst power, Peak to average burst power, IQ origin offset, Frequency error, Common pilot error, Symbol clock error RMS and Peak EVM for Pilots/Data, Peak EVM located per symbol and subcarrier Packet header format information Average power and RMS EVM per section of the header WLAN power vs time, WLAN symbol table, WLAN constellation Spectrum emission mask, spurious Error vector magnitude (EVM) vs symbol (or time), vs subcarrier (or frequency) Mag error vs symbol (or time), vs subcarrier (or frequency) Phase error vs symbol (or time), vs subcarrier (or frequency) WLAN channel frequency response vs symbol (or time), vs subcarrier (or frequency) WLAN spectral flatness vs symbol (or time), vs subcarrier (or frequency)
Residual EVE - 802.11n (CCK-11 Mbps), (802.11ac EVM (40 MHz, 64-QAM))	RMS-EVM over 1000 chips, EQ On Signal input power optimized for best EVM
5.8 GHz	–48 dB typical, –48.5 dB typical-mean

WLAN IEEE802.11ac (Opt. 25)

Modulation formats	OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM)
Measurements and displays	Burst index, Burst power, Peak to average burst power, IQ origin offset, Frequency error, Common pilot error, Symbol clock error RMS and Peak EVM for Pilots/Data, Peak EVM located per symbol and subcarrier Packet header format information Average power and RMS EVM per section of the header WLAN power vs time, WLAN symbol table, WLAN constellation Spectrum emission mask, spurious Error vector magnitude (EVM) vs symbol (or time), vs subcarrier (or frequency) Mag error vs symbol (or time), vs subcarrier (or frequency) Phase error vs symbol (or time), vs subcarrier (or frequency) WLAN channel frequency response vs symbol (or time), vs subcarrier (or frequency) WLAN spectral flatness vs symbol (or time), vs subcarrier (or frequency)
Residual EVE - 802.11ac	RMS-EVM averaged over 20 bursts, 16 symbols each Signal input power optimized for best EVM
5.8 GHz (80 MHz, 256-QAM)	–48 dB typical, –48.5 dB typical-mean
5.8 GHz (160 MHz, 256-QAM)	–45 dB typical, –45.5 dB typical-mean

Analog modulation analysis accuracy (typical)

AM	±2% (0 dBm input at center, carrier frequency 1 GHz, 10 to 60% modulation depth)
FM	±1% of span (0 dBm input at center) (Carrier frequency 1 GHz, 400 Hz/1 kHz Input/Modulated frequency)
PM	±3° (0 dBm input at center) (Carrier frequency 1 GHz, 1 kHz/5 kHz Input/Modulated frequency)

Inputs and outputs

Front panel	
Display	Touch panel, 10.4 in. (264 mm)
RF input connector	N-type female, 50 Ω (RSA5103B, RSA5106B) N-Type Female Planar Crown (RSA5115B) 3.5mm Female Planar Crown (RSA5126B)
Trigger out	BNC, High: >2.0 V, Low: <0.4 V, Output current 1 mA (LVTTL)
Trigger in	BNC, 50 Ω/5 kΩ impedance (nominal), ±5 V max input, -2.5 V to +2.5 V trigger level
USB ports	(2) USB 2.0
Audio	Speaker
Rear panel	
10 MHz REF OUT	50 Ω, BNC, >0 dBm
External REF IN	50 Ω, 10 MHz, BNC
Trig 2 / gate IN	BNC, High: 1.6 to 5.0 V, Low: 0 to 0.5 V
GPIB interface	IEEE 488.2
LAN interface ethernet	RJ45, 10/100/1000BASE-T
USB ports	(2) USB 2.0
VGA output	VGA compatible, 15 DSUB
Audio out	3.5 mm headphone jack
Noise source drive	BNC, +28 V, 140 mA (nominal) Turn ON time: 100 µs, Turn OFF time: 500 µs
Digital I and Q out	2 connectors, LVDS (Opt. 55)

General characteristics

Temperature range	
Operating	+5 °C to +40 °C
Storage	–20 °C to +60 °C
Warm-up time	20 minutes
Altitude	
Operating	Up to 3000 m (approximately 10,000 ft.)
Nonoperating	Up to 12,190 m (40,000 ft.)

General characteristics

Relative humidity	
Operating and nonoperating	+40 °C at 95% relative humidity, meets intent of EN 60068-2-30. [36]
Vibration	
Operating (except when equipped with option 56 removable SSD)	$0.22G_{RMS}$. Profile = 0.00010 g^2 /Hz at 5-350 Hz, -3 dB/Octave slope from 350-500 Hz, 0.00007 g^2 /Hz at 500 Hz, 3 Axes at 10 min/axis
Nonoperating	$2.28G_{RMS}$. Profile = 0.0175 g^2 /Hz at 5-100 Hz, -3 dB/Octave slope from 100-200 Hz, 0.00875 g^2 /Hz at 200-350 Hz,-3 dB/Octave slope from 350-500 Hz, 0.006132 g^2 /Hz at 500 Hz, 3 Axes at 10 min/axis
Shock	
Operating	15 G, half-sine, 11 ms duration, three shocks per axis in each direction (18 shocks total)
Nonoperating	30 G, half-sine, 11 ms duration, three shocks per axis in each direction (18 shocks total)
Data storage	Internal HDD (Opt. 59), USB ports, removable SSD (Opt. 56)

Power

Power requirements	90 V_{AC} to 264 V_{AC}, 50 Hz to 60 Hz 90 V_{AC} to 132 V_{AC}, 400 Hz
Power consumption	400 W max

EMC and safety compliance

Safety	UL 61010-1:2004 CSA C22.2 No.61010-1-04
Electromagnetic compatibility, complies with	EU council EMC Directive 2004/108/EC EN61326, CISPR 11, Class A ACMA (Australia/New Zealand) FCC 47CFR, Part 15, Subpart B, Class A (USA)

Physical characteristics

With feet

Dimensions	
Height	282 mm (11.1 in.)
Width	473 mm (18.6 in.)
Depth	531 mm (20.9 in.)
Weight	29 kg (64.7 lb.) With all options.

36 Frequency amplitude response may vary up to ±3 dB at +40 °C and greater than 45% relative humidity.

Ordering information

Models

RSA5103B	Real Time Signal Analyzer, 1 Hz to 3 GHz
RSA5106B	Real Time Signal Analyzer, 1 Hz to 6.2 GHz
RSA5115B	Real Time Signal Analyzer, 1 Hz to 15 GHz
RSA5126B	Real Time Signal Analyzer, 1 Hz to 26.5 GHz

All Include: Quick-start Manual (Printed), Application Guide, Printable Online Help File, Programmer's manual (on CD), power cord, BNC-N adapter, USB Keyboard, USB Mouse, Front Cover.

RSA5115B also includes: Planar Crown RF Input Connector - Type N Female PN 131-4329-00

RSA5126B also includes: Planar Crown RF Input Connector - 3.5 mm Female

Note: Please specify power plug and language options when ordering.

Warranty

One year

Options, accessories, and upgrades

Options

Product	Options	Description
RSA5103B		Real Time Signal Analyzer, 1 Hz to 3 GHz
RSA5106B		Real Time Signal Analyzer, 1 Hz to 6.2 GHz
RSA5115B		Real Time Signal Analyzer, 1 Hz to 15 GHz
RSA5126B		Real Time Signal Analyzer, 1 Hz to 26.5 GHz
	Opt. B25	25 MHz Acquisition Bandwidth (no-cost option)
	Opt. B40	40 MHz Acquisition Bandwidth
	Opt. B85	85 MHz Acquisition Bandwidth
	Opt. B16x	165 MHz Acquisition Bandwidth
	Opt. 09	Enhanced Real Time
	Opt. 10	AM/FM/PM Modulation and Audio Measurements
	Opt. 11	Phase Noise / Jitter Measurement
	Opt. 12	Settling Time (Frequency and Phase)
	Opt. 20	Pulse Measurements
	Opt. 21	General Purpose Modulation Analysis
	Opt. 22	Flexible OFDM Analysis
	Opt. 23	WLAN 802.11a/b/g/j/p measurement application
	Opt. 24	WLAN 802.11n measurement application (requires opt 23)
	Opt. 25	WLAN 802.11ac measurement application (requires opt 24)
	Opt. 50	Internal Preamp, 1 MHz to 3/6.2 GHz, RSA5103B/5106B only
	Opt. 51	Internal Preamp, 1 MHz to 15/26.5 GHz, RSA5115B/5126B only
	Opt. 53	Memory Extension, 4 GB Acquisition Memory Total
	Opt. 56 [37]	Removable 480 GB Storage Drive, incompatible with Opt. 59
	Opt. 59 [37]	Internal HDD, incompatible with Opt. 56 (no cost option)

Product	Options	Description
	Opt. 65	Digital I and Q outputs
	Opt. 66	Zero-span analog output
	Opt. 6566	Digital I and Q outputs and Zero-span analog output
	Opt. PFR	Precision Frequency Reference
	Opt. PFR50	Precision Frequency Reference and Internal Preamp, RSA5103B/5106B only

International power plugs

Opt. A0	North America power plug (115 V, 60 Hz)
Opt. A1	Universal Euro power plug (220 V, 50 Hz)
Opt. A2	United Kingdom power plug (240 V, 50 Hz)
Opt. A3	Australia power plug (240 V, 50 Hz)
Opt. A4	North America power plug (240 V, 50 Hz)
Opt. A5	Switzerland power plug (220 V, 50 Hz)
Opt. A6	Japan power plug (100 V, 110/120 V, 60 Hz)
Opt. A10	China power plug (50 Hz)
Opt. A11	India power plug (50 Hz)
Opt. A12	Brazil power plug (60 Hz)
Opt. A99	No power cord

Language options

Opt. L0	English manual
Opt. L5	Japanese manual
Opt. L7	Simplified Chinese manual
Opt. L10	Russian manual

Service options

Opt. C3	Calibration Service 3 Years
Opt. C5	Calibration Service 5 Years
Opt. CA1	Single Calibration or Functional Verification
Opt. D1	Calibration Data Report
Opt. D3	Calibration Data Report 3 Years (with Opt. C3)
Opt. D5	Calibration Data Report 5 Years (with Opt. C5)
Opt. G3	Complete Care 3 Years (includes loaner, scheduled calibration, and more)
Opt. G5	Complete Care 5 Years (includes loaner, scheduled calibration, and more)
Opt. R3	Repair Service 3 Years (including warranty)
Opt. R5	Repair Service 5 Years (including warranty)

[37] Must order either Opt. 56 or 59.

Recommended accessories

Accessory	Description
RTPA2A Spectrum Analyzer Probe Adapter compatibility	Supports TekConnect® probes. **Compatibility** P7225 - 2.5 GHz Active Probe, P7240 - 4 GHz Active Probe, P7260 - 6 GHz Active Probe, P7330 - 3.5 GHz Differential Probe, P7350 - 5 GHz Differential Probe, P7350SMA - 5 GHz Differential SMA Probe, P7340A - 4 GHz Z-Active Differential Probe, P7360A - 6 GHz Z-Active Differential Probe, P7380A - 8 GHz Z-Active Differential Probe, P7380SMA - 8 GHz Differential Signal Acquisition System, P7313 - >12.5 GHz Z-Active Differential Probe, P7313SMA - 13 GHz Differential SMA Probe, P7500 Series - 4 GHz to 20 GHz TriMode Probes
RSAVu	Software based on the RSA3000 Series platform for analysis supporting 3G wireless standards, WLAN (IEEE802.11a/b/g/n), RFID, Audio Demodulation, and more measurements.
SignalVu-PC	Software based on the RSA5000/6000 Series Real Time Signal Analyzers puts the power of your RTSA signal analysis tools on your Windows XP or Windows 7 PC. Performs measurements on stored signals from RSA3/5/6K series, MDO oscilloscope RF captures.
E and H Near-field Probes	For EMI troubleshooting. 119-4146-xx
Additional Removable Hard Drive	Order RSA5BUP Opt. SSD. This is an additional solid-state drive for instrument with Option 56 installed. (Windows 7 and instrument software preinstalled).
DC Block	Order 119-7902-00. 9 kHz-18 GHz. Type N Male to Type N Female. Voltage Rating: 50 V DC Max. Insertion Loss 0.9 dB. Aeroflex model 7003.
101A EMC Probe Set	RF Probes. Contact Beehive Electronics to order: http://beehive-electronics.com/probes.html
150A EMC Probe Amplifier	
110A Probe Cable	
SMA Probe Adapter	
BNC Probe Adapter	
131-4329-xx	Planar Crown RF Input Connector - 7005A-3 Type-N Female
131-9062-xx	Planar Crown RF Input Connector - 7005A-6 3.5 mm Female
131-8822-xx	Planar Crown RF Input Connector - 7005A-7 3.5 mm Male
131-8689-xx	Planar Crown RF Input Connector – 7005A-1 SMA Female
015-0369-xx	RF Adapter – N (male) to SMA (male)
119-6599-xx	Power Attenuator – 20 dB, 50 W, 5 GHz
Transit Case	016-2026-xx
RSA56KR	Rackmount Retrofit
Additional Quick-start Manual (Paper)	071-3224-xx
Additional Application Examples Manual (Paper)	071-3283-xx

RSA5BUP – Upgrade options for the RSA5100B series

RSA5BUP	Option description	HW or SW	Factory calibration required?
Opt. PFR	Precision Frequency Reference	HW	Yes
Opt. SSD	Additional removable solid-state drive for units equipped with Option 56. Minimum capacity 480 GB. Windows 7 and instrument software preinstalled.	HW	No
Opt. PFR50	Precision Frequency Reference and Internal Preamp, RSA5103B/RSA5106B	HW	Yes
Opt. 50	Internal Preamp 1 MHz to 3 GHz (RSA5103B) or 1 MHz to 6.2 GHz (RSA5106B)	HW	Yes

RSA5BUP	Option description	HW or SW	Factory calibration required?
Opt. 51	Internal Preamp 1 MHz to 15 GHz (RSA5115B) or 1 MHz to 26.5 GHz (RSA5126B)	SW	No
Opt. 53	Memory Extension, 4 GB Acquisition Memory total	HW	No
Opt. 65	Digital I and Q outputs	HW	No
Opt. 66	Zero-span analog output	HW	No
Opt. 6566	Digital I and Q outputs and Zero-span analog output	HW	No
Opt. 56	Removable Solid-State Drive (460 GB), incompatible with Opt. 59	HW	No
Opt. 57	CD/DVD-RW, incompatible with Opt. 56 or 59	HW	No
Opt. 59	Internal HDD (160 GB), incompatible with Opt. 56	HW	No
Opt. 09	Enhanced Real Time	SW	No
Opt. 10	AM/FM/PM Modulation and Audio Measurements	SW	No
Opt. 11	Phase Noise / Jitter Measurements	SW	No
Opt. 12	Settling Time (Frequency and Phase)	SW	No
Opt. 20	Pulse Measurements	SW	No
Opt. 21	General Purpose Modulation Analysis	SW	No
Opt. 22	Flexible OFDM Analysis	SW	No
Opt. 23	WLAN 802.11a/b/g/j/p measurement application	SW	No
Opt. 24	WLAN 802.11n measurement application (requires opt 23)	SW	No
Opt. 25	WLAN 802.11ac measurement application (requires opt 24)	SW	No
Opt. B40	40 MHz Acquisition Bandwidth (from 25 MHz BW)	HW	Yes
Opt. B85	85 MHz Acquisition Bandwidth (from 25 MHz BW)	HW	Yes
Opt. B85E	85 MHz Acquisition Bandwidth (from 40 MHz BW)	SW	No
Opt. 16x	165 MHz Acquisition Bandwidth (from 25 MHz BW)	HW	Yes
Opt. 16xE	165 MHz Acquisition Bandwidth (from 40 MHz BW)	SW	No
Opt. 16xH	165 MHz Acquisition Bandwidth (from 85 MHz BW)	SW	No

Tektronix is registered to ISO 9001 and ISO 14001 by SRI Quality System Registrar.

Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.

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Updated 10 April 2013

For Further Information. Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit www.tektronix.com.

07 Mar 2014

37W-26274-10