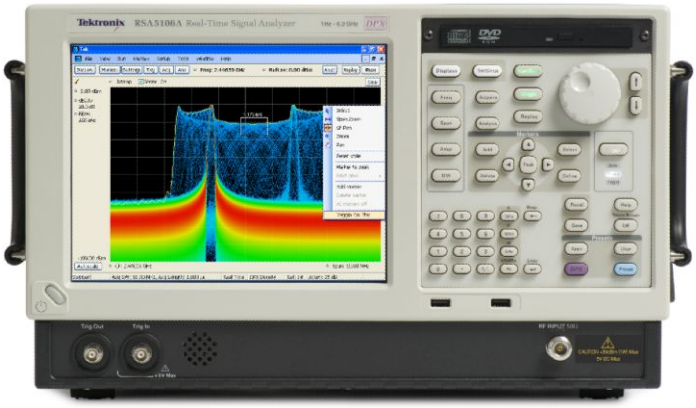
Spectrum Analyzers Datasheet

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 292,000 spectrums per second, 50,000 time domain (Zero span) waveforms per second
  - Swept DPX spectrum enables unprecedented signal discovery over full frequency range
- Triggers zero in on the Problem
  - DPX density™ trigger on single occurrences as brief as 3.7 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 110 MHz acquisition bandwidths
  - Acquire more than 7 seconds at 110 MHz bandwidth
- Wideband preselection filter provides image free measurements in entire analysis bandwidth up to 110 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
  - Advanced DPX including swept DPX, gap-free DPX spectrograms, and DPX zero span with real-time amplitude, frequency, or phase
  - Advanced triggers DPX density, time qualified, runt, frequency edge, and frequency mask
  - 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

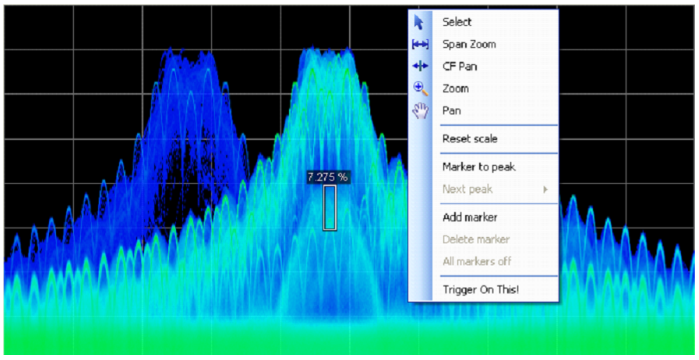
High performance spectrum and vector signal ananlysis, and much more

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 292,000 frequency transforms per second, transients of a minimum event duration of 3.7 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, Opt. 200 provides gap-free spectral recording, replay, and analysis of up to 60,000 spectral traces. Spectrum recording resolution is variable from 110 µs to 6400 s per line.

Trigger

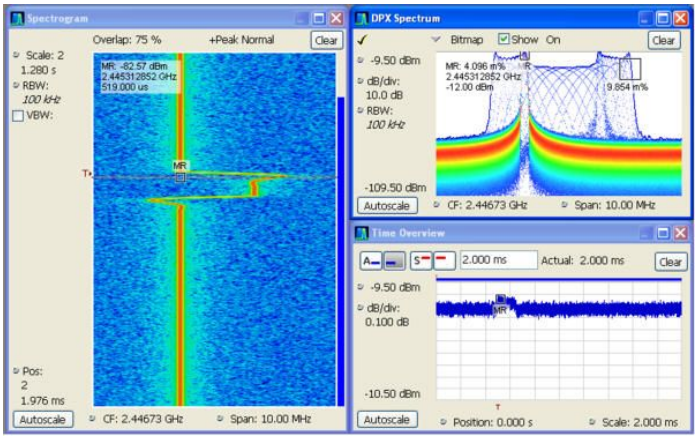
Tektronix has a long history of innovative triggering capability, and the RSA Series spectrum analyzers lead the industry in triggered signal analysis. The RSA5000 Series provides unique triggers essential for troubleshooting modern digitally implemented RF systems. Includes time-qualified power, runt, 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 7.15 seconds at 110 MHz, 343 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 73 dB SFDR in all acquisition bandwidths, even up to 110 MHz (Opt. 110). Acquisitions of any length can 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

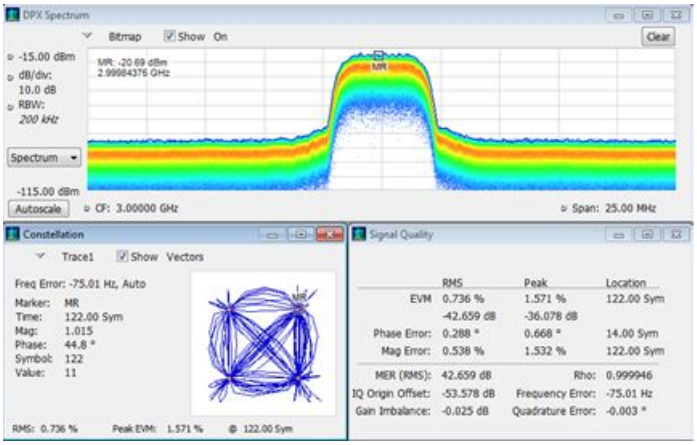
The RSA5000 Series offers analysis capabilities that advance productivity for engineers working on components or in RF system design, integration, and performance verification, or operations engineers working in networks, or spectrum management. In addition to spectrum analysis, spectrograms display 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.

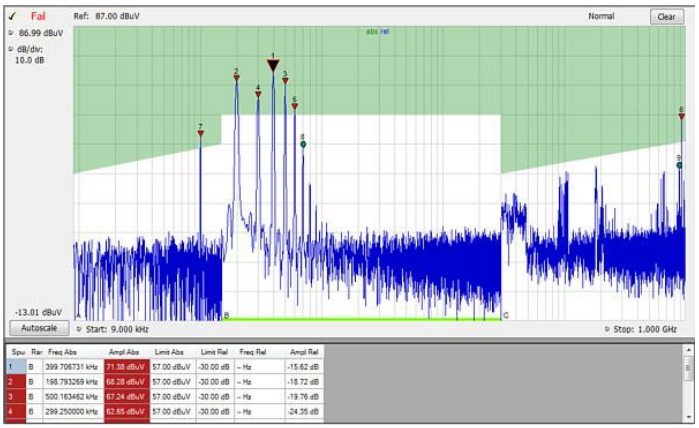
Measurement functions

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

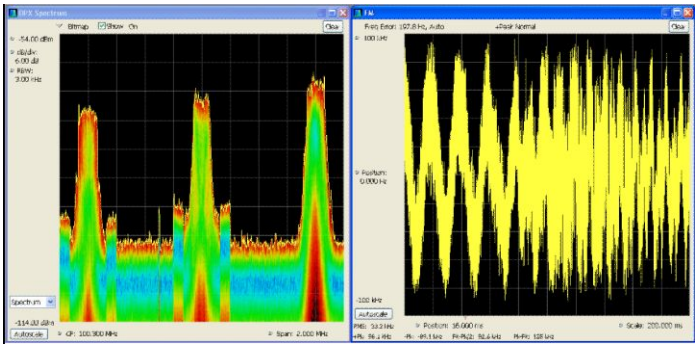
Measurements	Description
Advanced pulse measurements suite (Opt. 20)	Average on power, Peak power, Average transmitted power, Pulse width, Rise time, Fall time, Repetition interval (seconds), Repetition interval (Hz), Duty factor (%), Duty factor (ratio), Ripple (dB), Ripple (%), Overshoot (dB), Overshoot (%), 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 (Opt. 200)	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



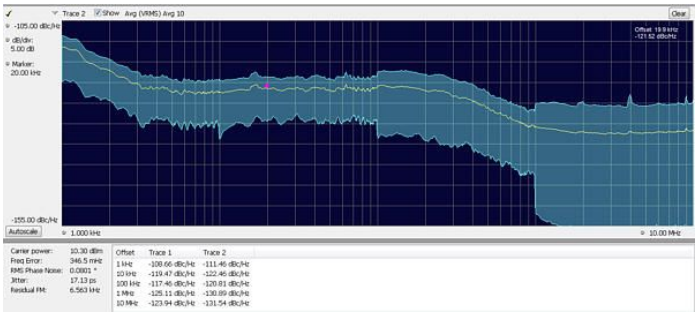
Time-correlated views in multiple domains provide a new level of insight into design problems not possible with conventional analyzers. Here, modulation quality and the constellation measurements are combined with the continuous monitoring of the DPX ® spectrum display.



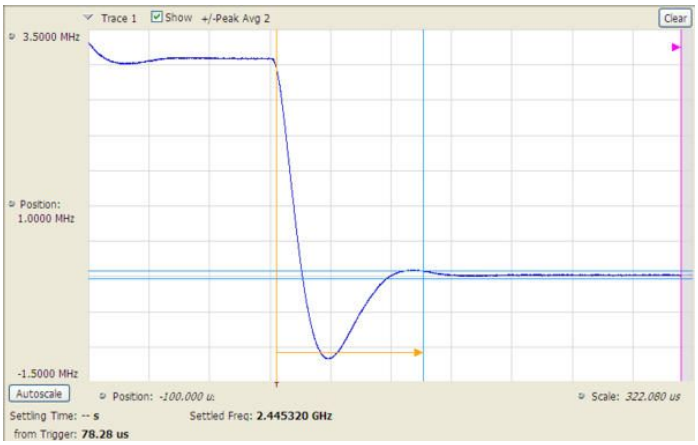
Spurious Search - Up to 20 noncontiguous frequency regions can be defined, each with their own resolution bandwidth, video bandwidth, detector (peak, average, quasi-peak), and limit ranges. Test results can be exported in .CSV format to external programs, with up to 999 violations reported. Spectrum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



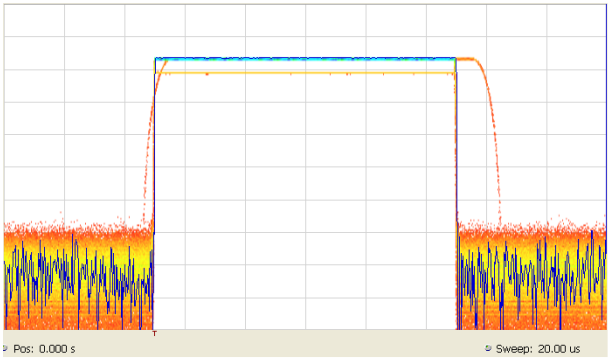
Audio monitoring and modulation measurements simultaneously can make spectrum management an easier, faster task. Here, the DPX spectrum display shows a live spectrum of the signal of interest and simultaneously provides demodulated audio to the internal instrument loudspeaker. FM deviation measurements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



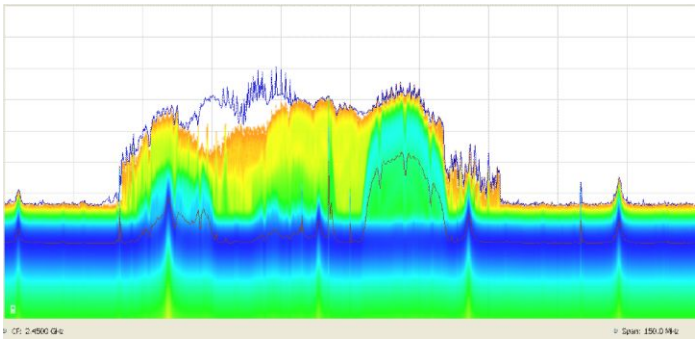
Phase noise and jitter measurements (Opt. 11) on the RSA5000 Series may reduce the cost of your measurements by reducing the need for a dedicated phase noise tester. Outstanding phase noise across the operating range provides margin for many applications. Here, phase noise on a 13 MHz carrier is measured 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.



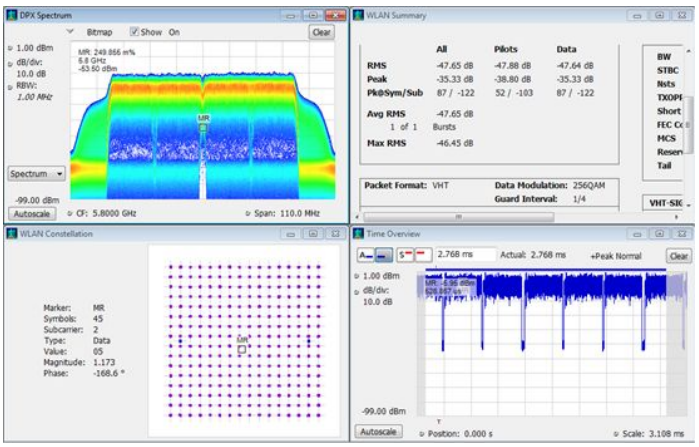
Settling time measurements (Opt. 12) are easy and automated. The user can select measurement bandwidth, tolerance bands, reference frequency (auto or manual), and establish up to 3 tolerance bands vs. time for Pass/Fail testing. Settling time may be referenced to external or internal trigger, and from 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.



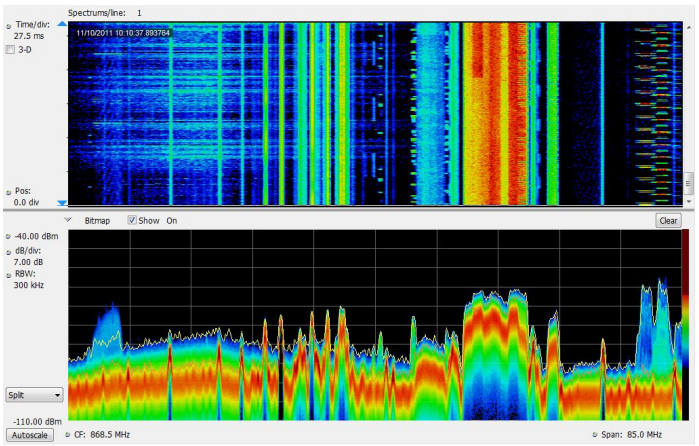
DPX Zero-span produces real-time analysis in amplitude, frequency, or phase vs. time. Up to 50,000 waveforms per second are processed. DPX Zero-span ensures that all time-domain anomalies are immediately found, reducing time-to-fault. Here, three distinct pulse shapes are captured in zero-span amplitude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



Advanced Triggers, Swept DPX, and Zero Span (Opt. 200) provides superior swept spectrum analysis for transient signals. Here, a 150 MHz swath of spectrum is swept across the ISM band. Multiple WLAN signals are seen, and narrow signals seen in the blue peak-hold trace are Bluetooth access probes. Multiple interfering signals are seen below the analyzers noise level in the multi-color DPX display.



Analysis options for 802.11 standards are available. Here, an 802.11ac 80 MHz signal is analyzed, with displays of constellation, amplitude vs. time, summary of WLAN measurements, and the DPX spectrum of the analyzed signal. The density of the 'shoulders' of the WLAN signal are clearly seen in the DPX display, and a marker has been placed on the suppressed center carrier of the signal. An EVM of -47.65 dB and other signal measurements are seen in the summary panel.



DPX Spectrograms (Opt. 200) 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 110 µs to 6400 s.

Specifications

Model overview

	RSA5103A	RSA5106A	RSA5115A	RSA5126A
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, 110 MHz	25 MHz, 40 MHz, 85 MHz, 110 MHz	25 MHz, 40 MHz, 85 MHz, 110 MHz	25 MHz, 40 MHz, 85 MHz, 110 MHz
Minimum Event Duration for 100% POI	3.7 µs	3.7 µs	3.7 µs	3.7 µs
SFDR (typical)	75 dBc	75 dBc	75 dBc	75 dBc
Trigger modes	Free run, Triggered, FastFrame	Free run, Triggered, FastFrame	Free run, Triggered, FastFrame	Free run, Triggered, FastFrame
Trigger types	Power (Std), Frequency mask (Opt. 52), Frequency edge, DPX density, Runt, Time qualified (Opt. 200)	Power (Std), Frequency mask (Opt. 52), Frequency edge, DPX density, Runt, Time qualified (Opt. 200)	Power (Std), Frequency mask (Opt. 52), Frequency edge, DPX density, Runt, Time qualified (Opt. 200)	Power (Std), Frequency mask (Opt. 52), Frequency edge, DPX density, Runt, Time qualified (Opt. 200)

Frequency related

Initial center frequency setting accuracy	Within 10^{-7} after 10 minute warm-up
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)
Reference frequency	
Initial accuracy at cal	1×10^{-7} (after 10 minute warm-up)
Aging per day	1×10^{-9} (after 30 days of operation)
Aging per year	7.5×10^{-8} (After 1 year of operation)
Aging per 10 years	3×10^{-7} (after 10 years of operation)
Temperature drift	2×10^{-8} (5 to 40 °C)
Cumulative error (temperature + aging)	4×10^{-7} (within 10 years after calibration, typical)
Reference output level	>0 dBm (internal or external reference selected), +4 dBm, typical
External reference input frequency	10 MHz ±30 Hz
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

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	4 kHz to 10 MHz + wide open
Opt. 40	4 kHz to 20 MHz + wide open
Opt. 85/110	11 kHz to 40 MHz + wide open
Trigger position timing uncertainty	
25 MHz acquisition BW, 10 MHz BW (Std.)	Uncertainty = ±15 ns
40 MHz acquisition BW, 20 MHz BW (Opt. 40)	Uncertainty = ±10 ns
85 MHz acquisition BW, 40 MHz BW (Opt. 85)	Uncertainty = ±5 ns
110 MHz acquisition BW (Opt 110)	Uncertainty = ±5 ns
Trigger re-arm time, minimum (fast frame on)	
10 MHz acquisition BW	≤25 µs
40 MHz acquisition BW (Opt. 40)	≤10 µs
85 MHz acquisition BW (Opt. 85)	≤5 µs
110 MHz acquisition BW (Opt 110)	≤5 µs
Minimum event duration	
25 MHz acquisition BW (Std.)	40 ns
40 MHz acquisition BW (Opt. 40)	25 ns
85 MHz acquisition BW (Opt. 85)	12 ns
110 MHz acquisition BW (Opt 110)	12 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 (Std.)	Uncertainty = ±20 ns
40 MHz acquisition BW, 40 MHz span (Opt. 40)	Uncertainty = ±15 ns
85 MHz acquisition BW, 85 MHz span (Opt. 85)	Uncertainty = ±12 ns
110 MHz acquisition BW, 110 MHz span (Opt. 110)	Uncertainty = ±12 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
	Advanced trigger specifications are found in sections on Opt. 52 (Frequency mask rrigger) and Opt. 200 (DPX, Time qualified, Runt, and Frequency edge triggers)
High	>2.0 v
Low	<0.4 v

Acquisition related

A/D converter	100 MS/s, 14 bit (optional 300 MS/s, 14 bit, opt. 40/85/110)
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

Acquisition BW	Sample rate (for I and Q)	Record length	Record length (Opt. 53)	Time resolution
110 MHz (Opt. 110)	150 MS/s	1.79 s	7.15 s	6.6667 ns
85 MHz (Opt. 85)	150 MS/s	1.79 s	7.15 s	6.6667 ns
40 MHz (Opt. 40)	75 MS/s	3.57 s	14.3 s	13.33 ns
25 MHz	50 MS/s	4.77 s	19.0 s	20 ns
20 MHz	25 MS/s	9.54 s	38.1 s	40 ns
10 MHz	12.5 MS/s	19.0 s	76.3 s	80 ns
5 MHz	6.25 MS/s	38.1 s	152.7 s	160 ns
2 MHz [1]	3.125 MS/s	42.9 s	171.7 s	320 ns
1 MHz	1.56 MS/s	85.8 s	343.5 s	640 ns
500 kHz	781 kS/s	171.7 s	687.1 s	1.28 µs
200 kHz	390 kS/s	343.5 s	1347 s	2.56 µs
100 kHz	195 kS/s	687.1 s	2748 s	5.12 µs
50 kHz	97.6 kS/s	1374 s	5497 s	10.24 µs
20 kHz	48.8 kS/s	2748 s	10955 s	20.48 µs
10 kHz	24.4 kS/s	5497 s	21990 s	40.96 µs
5 kHz	12.2 kS/s	10955 s	43980 s	81.92 µs
2 kHz	3.05 kS/s	43980 s	175921 s	328 µs
1 kHz	1.52 kS/s	87960 s	351843 s	655 µs
500 Hz	762 S/s	175921 s	703687 s	1.31 ms
200 Hz	381 S/s	351843 s	1407374 s	2.62 ms
100 Hz	190 S/s	703686 s	2814749 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)

1 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 (Opt. 200)
	DPX frequency vs time (Opt. 200)
	DPX phase vs time (Opt. 200)
	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, Opt. 85, Opt. 110) (1, 2, 3, 5 sequence, Auto-coupled), or user selected (arbitrary)
Resolution bandwidth shape	Approximately gaussian, shape factor 4.1:1 (60:3 dB) ±10%, typical
Resolution bandwidth accuracy	±1% (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. 85/110), 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. 85/110), ±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

Bandwidth related

Spectrum display traces, detector, and functions

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)	1500 MHz/s (Std.) 2500 MHz/s (Opt. 40) 6000 MHz/s (Opt. 85) 6000 MHz/s (Opt. 110)

Minimum FFT Length vs. Trace Length(Independent of Span and RBW), Opt. 200

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

Resolution BW Range vs. Acquisition Bandwidth (DPX®) [2]

	Standard	Opt. 200	
Acquisition bandwidth	**RBW (Min)**	**RBW (Min)**	**RBW (Max)**
110 MHz (Opt. 110)	640 kHz	20 kHz	10 MHz
85 MHz (Opt. 85)	640 kHz	20 kHz	10 MHz
55 MHz (Opt. 85)	320 kHz	10 kHz	5 MHz
40 MHz (Opt. 40/85/110)	320 kHz	10 kHz	5 MHz
25 MHz	214 kHz	10 kHz	3 MHz
20 MHz	107 kHz	5 kHz	2 MHz
10 MHz	53.3 kHz	2 kHz	1 MHz
5 MHz	26.7 kHz	1 kHz	500 kHz
2 MHz	13.4 kHz	500 Hz	200 kHz
1 MHz	6.66 kHz	200 Hz	100 kHz
500 kHz	3.33 kHz	100 Hz	50 kHz
200 kHz	1.67 kHz	50 Hz	20 kHz
100 kHz	833 Hz	20 Hz	10 kHz
50 kHz	417 Hz	10 Hz	5 kHz
20 kHz	209 Hz	5 Hz	2 kHz
10 kHz	105 Hz	2 Hz	1 kHz
5 kHz	52 Hz	0.1 Hz	500 Hz
2 kHz	13.1 Hz	0.1 Hz	200 Hz
1 kHz	6.51 Hz	0.1 Hz	100 Hz
500 Hz	3.26 Hz	0.1 Hz	50 Hz
200 Hz	1.63 Hz	0.1 Hz	20 Hz
100 Hz	0.819 Hz	0.1 Hz	10 Hz

2 Minimum RBW, Swept spans (Opt. 200) - 10 kHz

DPX® digital phosphor spectrum processing [3]

Characteristic	DPX (standard)	Advanced DPX (Opt. 200)
Spectrum processing rate (RBW = auto, trace length 801)	48,828/s	292,969/s
DPX bitmap resolution	201 × 501	201 × 801
DPX bitmap color dynamic range	64k (48 dB)	8G (99 dB)
Marker information	Amplitude, frequency, and hit count on the DPX display	Amplitude, frequency, and signal density on the DPX display
Minimum signal duration for 100% probability of detection (Max-hold on)	31 µs (Std. or Opt. 40) 24 µs (Opt. 85 or Opt. 110)	See minimum signal duration for 100% probability of trigger at 100% amplitude table
Span Range (Continuous processing)	100 Hz to 25 MHz (40 MHz with Opt. 40) (85 MHz with Opt. 85) (110 MHz with Opt. 110	100 Hz to 25 MHz (40 MHz with Opt. 40) (85 MHz with Opt. 85) (110 MHz with Opt. 110)
Span range (Swept)	Not available	Up to instrument frequency range
Dwell time per step [4]	Not available	50 ms to 100 s
Trace processing	Color-graded bitmap, +Peak, –Peak, average	Color-graded bitmap, +Peak, –Peak, average
Trace length	501	801, 2401, 4001, 10401
Resolution BW accuracy	7%	±1%

Stability

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

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/–116	–115	–114	–108	–108
1 MHz	–135	–130/–139	–137	–135	–132	–126
6 MHz	–140	–137/–144	–142	–141	–145	–140
10 MHz	NA	–137/–144	–142	–14	–146	–142

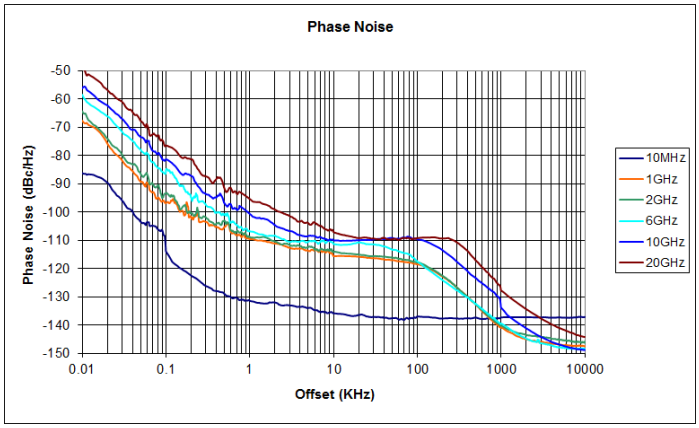
3 For complete Advanced DPX specifications, see the Opt. 200 section of this data sheet.

4 Minimum RBW, swept spans (Opt. 200) – 10 kHz

Integrated phase (100 Hz to 100 MHz, typical)

Measurement frequency	Integrated phase, radians
100 MHz	2.51×10^{-3}
1 GHz	3.14×10^{-3}
2 GHz	3.77×10^{-3}
5 GHz	6.28×10^{-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 75 dB, 5 dB step
Maximum safe input level	
Average continuous (RF ATT ≥10 dB, preamp off)	+30 dBm
Average continuous (RF ATT ≥10 dB, preamp on)	+20 dBm
Pulsed RF (RF ATT ≥30 dB, PW <10 µs, 1% duty cycle)	50 w
Maximum measureable input level	
Average continuous (RF ATT: auto)	+30 dBm
Pulsed RF (RF ATT: auto, PW <5 µs, 0.5% duty cycle)	75 W
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

Amplitude

Marker readout resolution, dB units	0.01 dB
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 (100 MHz, –20 dBm signal, 10 dB ATT, 18 °C to 28 °C)	±0.31 dB
Input attenuator switching uncertainty	±0.3 dB
Absolute amplitude accuracy at center frequency, 95% confidence [5]	
10 MHz to 3 GHz	±0.3 dB
3 GHz to 6.2 GHz (RSA5106A/15A/26A)	±0.5 dB
6.2 GHz to 15 GHz (RSA5115A/26A)	±0.75 dB
15 GHz to 26.5 GHz (RSA5126A)	±0.9 dB

VSWR (typical)

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

	RSA5103A / RSA5106		RSA5115A / RSA5126A	
Frequency range	**Preamp OFF**	**Preamp ON**	**Preamp OFF**	**Preamp ON**
10 kHz to 10 MHz	<1.6:1		<1.6:1	
>10 MHz to 2.0 GHz	<1.12:1	<1.6:1	<1.3:1	<1.3:1
>2.0 GHz to 3.0 GHz	<1.3:1	<1.6:1	<1.3:1	<1.3:1
>3.0 GHz to 5.0 GHz	<1.3:1	<1.6:1	<1.4:1	<1.5:1
>5.0 GHz to 6.2 GHz	<1.45:1	<1.6:1	<1.4:1	<1.5:1
>6.2 GHz to 15 GHz			<1.8:1	<1.8:1
>15 GHz to 22 GHz (RSA5126A)			<1.8:1	<1.8:1
>22 GHz to 26.5 GHz (RSA5126A)			<2.0:1	<2.0:1

5 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.

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 (RSA5106A)	±0.5 dB
>6.2 GHz to 15 GHz (RSA5115A)	±1.0 dB
>15 GHz to 26.5 GHz (RSA5115A)	±1.2 dB

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 (RSA5115A/ 26A)	±0.5 dB
>3 GHz to 6.2 GHz (RSA5106A)	±1.0 dB
>6.2 GHz to 15 GHz (RSA5115A/26A)	±1.0 dB
>15 GHz to 26.5 GHz (RSA5126A)	±1.5 dB

5 °C to 40 °C, (RSA5103A / RSA5106A Opt. 50) (typical, preamp on, atten.=10 dB)

10 MHz to 32 MHz (LF band)	±0.8 dB
1 MHz to 3 GHz	±0.8 dB
>3 GHz to 6.2 GHz (RSA5106A)	±1.3 dB

5 °C to 40 °C, (RSA5115A / RSA5126A Opt. 51) (typical, preamp on, atten.=10 dB)

10 MHz to 32 MHz, LF band	±0.8 dB
10 MHz to 3 GHz	±0.8 dB
>3 GHz to 6.2 GHz	±0.8 dB
>6.2 GHz to 15 GHz	±1.5 dB
>15 GHz to 26.5 GHz (RSA5126A)	±2.0 dB

Noise and distortion

3rd order intermodulation distortion at 2.13 GHz [6]

RSA5103A / RSA5106	–84
RSA5115A / RSA5126A	–80

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)
10 kHz to 32 MHz (LF band)	–75	+12.5
1 MHz to 80 MHz	–72	+11
>80 MHz to 300 MHz	–76	+13
>300 MHz to 6.2 GHz	–84	+17
>6.2 GHz to 15 GHz	–72	+11
15 GHz to 26.5 GHz	–66	+8

RSA5103A / RSA5106A 2nd harmonic distortion [8]

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

RSA5115A / RSA5126A 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

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

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

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

Noise and distortion

RSA5103A / RSA5106A 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	–157
>2 GHz to 3 GHz	–152	–155
>3 GHz to 4 GHz (R5106A)	–152	–155
>4 GHz to 6.2 GHz (R5106A)	–149	–152

RSA5115A / RSA5126A displayed average noise level [11], 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		
>1 MHz to 10 MHz	–136	–139
>10 MHz to 4 GHz	–152	–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	–140	–143

Preamplifier performance (Opt. 50)

Frequency range	1 MHz to 3.0 GHz or 6.2 GHz (RSA5106A)
Noise figure at 2 GHz	7 dB
Gain at 2 GHz	18 dB (nominal)

Preamplifier performance (Opt. 51)

Frequency range	1 MHz to 15 GHz or 26.5 GHz (RSA5115A or 5126A)
Noise figure at 15 GHz	<10 dB
Noise figure at 26.5 GHz	<13 dB
Gain at 10 GHz	20 dB (nominal)

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

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

Noise and distortion

Preamplifier performance (Opt. 51)

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 (RSA5106A)	–162 dBm/Hz	–164 dBm/Hz

Displayed average noise level[12], 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	–160 dBm/Hz
>13 GHz to 23 GHz	–157 dBm/Hz	–160 dBm/Hz
>23 GHz to 26.5 GHz	–153 dBm/Hz	–155 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)
- **500 kHz 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 (RSA5106A / RSA5115A / RSA5126A)** –95 dBm
- **6.2 GHz to 15 GHz (RSA5115A / RSA5126A)** –95 dBm
- **15 GHz to 26.5 GHz (RSA5126A)** –95 dBm

Image response, up to 110 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 (RSA5106A)** < –70 dBc
- **6.2 GHz to 15 GHz (RSA5115A / RSA5126A)** < –76 dBc
- **15 GHz to 26.5 GHz (RSA5126A)** < –72 dBc

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

Spurious response with signal, offset ≥400 kHz [13]

	Span ≤25 MHz		Opt. 40/85/110	
	Swept spans >25 MHz		25 MHz < span ≤ 110 MHz	
Frequency	**Specification**	**Typical**	**Specification**	**Typical**
10 kHz to 32 MHz (LF band)	–71 dBc	–75dBc		
30 MHz to 3 GHz	–73 dBc	–78 dBc	–73 dBc	–75 dBc
>3 GHz to 6.2 GHz (RSA5106A / RSA5115A / RSA5126A)	–73 dBc	–78 dBc	–73 dBc	–75 dBc
6.2 GHz to 15 GHz (RSA5115A / RSA5126A)	–70 dBc	–73 dBc	–70 dBc	–73 dBc
15 GHz to 26.5 GHz (RSA5126A)	–66 dBc	–69 dBc	–66 dBc	–69 dBc

Spurious response with signal (10 kHz ≤ offset < 400 kHz), typical [14]

Frequency	Span ≤ 25 MHz, swept spans >25 MHz	Opt. 40/85/110 25 MHz < span ≤ 110 MHz
10 kHz to 32 MHz (LF band)	–71 dBc	NA
30 MHz to 3 GHz	–73 dBc	–73 dBc
3 GHz to 6.2 GHz (RSA5106A)	–73 dBc	–73 dBc
6.2 GHz to 15 GHz (RSA5115A / RSA5126A)	–70 dBc	–70 dBc
15 GHz to 26.5 GHz (RSA5126A)	–66 dBc	–66 dBc

Spurious response with signal at 3.5125 GHz

<80 dBc (RF input level, –30 dBm)

Local oscillator feed-through to input connector

< –60 dBm (RSA5103A / RSA5106A), <-90 dbm (RSA5115A>

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

13 RF input level = -15 dBm, Attenuator = 10 dB, Mode: Auto. Input signal at center frequency. Center Frequency >90 MHz, Opt. 40/85/110. For acquisition bandwidth 15 - 25 MHz with signals at center frequency and at ± (37.5 MHz to 42.5 MHz): 65 dBc.

14 RF Input Level = -15 dBm, Attenuator = 10 dB, Mode: Auto. Input signal at center frequency. Center frequency >90 MHz, Opt. 40/85/110. For acquisition bandwidth 15 - 25 MHz with signals at center frequency and at ± (37.5 MHz to 42.5 MHz): 65 dBc.

Noise and distortion

IF frequency response and phase linearity, includes all preselection and image rejection filters [15]

Measurement frequency (GHz)	Acquisition bandwidth	Amplitude flatness (Spec)	Amplitude flatness (Typ, RMS)	Phase flatness (Typ, RMS)
0.001 to 0.032 (LF band)	≤20 MHz	±0.50 dB	0.4 dB	1.0°
0.01 to 6.2 [16]	≤300 kHz	±0.10 dB	0.05 dB	0.1°
0.03 to 6.2	≤25 MHz	±0.30 dB	0.20 dB	0.5°
Opt. 40				
0.03 to 6.2	≤40 MHz	±0.30 dB	0.20 dB	0.5°
Opt. 85				
0.07 to 3.0	≤85 MHz	±0.50 dB	0.30 dB	1.5°
>3.0 to 6.2	≤85 MHz	±0.50 dB	0.40 dB	1.5°
Opt. 110				
0.07 to 6.2	≤110 MHz	±0.50 dB	0.40 dB	1.5°

RSA5115A / RSA5126A IF frequency response and phase linearity

Includes all preselection and image rejection filters [17]

Measurement frequency (GHz)	Span	Amplitude flatness (Spec)	Amplitude flatness (Typ, RMS)	Phase flatness (Typ, RMS)
6.2 to 26.5	≤300 kHz	±0.10 dB [18]	0.05 dB	0.2°
6.2 to 26.5	≤20/40 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	≤110 MHz	±1.0 dB	0.70 dB	1.5°

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 [19]

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

100 Hz to 40 MHz (Opt. 40)

100 Hz to 85 MHz (Opt. 85)

100 Hz to 110 MHz (Opt. 110)

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

16 High dynamic range mode selected.

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

18 High dynamic range mode selected

19 For masks >30 dB above noise floor

Frequency mask trigger

Trigger position uncertainty

Span = 25 MHz	±15 µs
	±9 µs (Opt. 200, RBW = auto)
Span = 40 MHz (Opt. 40)	±12.8 µs
	±7 µs (Opt. 200, RBW = Auto)
Span = 85 MHz (Opt. 85)	±5.12 µs
	±5 µs (Opt. 200, RBW = Auto)
Span = 110 MHz (Opt. 110)	±5.12 µs
	±5 µs (Opt. 200, RBW = Auto)

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

RBW= maximum for FMT with Opt. 200

Acquisition BW	Opt. 52	Opt. 52 plus Opt. 09	Opt. 52 plus Opt. 200	Opt. 52 plus Opt. 200 plus Opt. 09
25 MHz	35.9 µs	25.6 µs	17.7 µs	4 µs
40 MHz	27.3 µs	15.4 µs	17.5 µs	3.9 µs
85 MHz	23.9 µs	10.3 µs	17.3 µs	3.7 µs
110 MHz	23.9 µs	10.3 µs	17.3 µs	3.7 µs

Opt. 200: Advanced triggers, Swept DPX, and DPX zero span

				Minimum event duration 100% POI (µs)	
Span	RBW (kHz)	FFT Length	Spectrums / sec	Opt. 200	Opt. 200 plus Opt. 09
110 MHz	10000	1024	292,969	17.3	3.7
	1000	1024	292,969	19.5	5.8
	300	2048	146,484	28.5	14.8
	100	4096	73,242	37.6	37.6
	30	16384	18,311	134.6	134.6
	20	32768	9,155	229.2	229.2
85 MHz	10000	1024	292,969	17.3	3.7
	1000	1024	292,969	19.5	5.8
	500	1024	292,969	21.9	8.2
	300	1024	292,969	25.1	11.4
	100	4096	73,242	37.6	37.6
	30	16384	18,311	134.6	134.6
	20	16384	18,311	174.6	174.6
40 MHz	5000	1024	292,969	17.5	3.9
	1000	1024	292,969	19.4	5.8
	300	1024	292,968	25	11.4
	100	2048	146,484	37.6	30.8
	30	4096	73,242	93.6	93.6
	20	8192	36,621	147.3	147.3
	10	16384	18,311	194.5	194.5
25 MHz	3800	1024	292,969	17.4	4
	1000	1024	292,969	19.4	5.8
	300	1024	292,969	25.1	11.4
	200	1024	292,969	25.7	15.4

DPX 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)
	1 s (maximum, Measurement BW >60 MHz)
	2000 s (maximum, Measurement BW ≤60 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
Span range	100 Hz to maximum acquisition bandwidth
DPX spectrogram trace detection	+Peak, –Peak, avg (V_{RMS})
DPX spectrogram trace length	801 to 4001
DPX spectrogram memory depth	Trace length = 801: 60,000 traces
	Trace length = 2401: 20,000 traces
	Trace length = 4001: 12,000 traces
Time resolution per line	110 µs to 6400 s, user settable
Maximum recording time vs line resolution	6.6 seconds (801 points/trace, 110 µs/line) to 4444 days (801 points/trace, 6400 s/line)

Advanced triggers

DPX density trigger	
Density range	0 to 100% density
Horizontal range	0.25 Hz to 25 MHz (Std.)
	0.25 Hz to 40 MHz (Opt. 40)
	0.25 Hz to 85 MHz (Opt. 85)
	0.25 Hz to 110 MHz (Opt. 110)
Minimum signal duration for 100% probability of trigger (at maximum acquisition bandwidth) RBW = auto, trace length 801 points	See minimum signal duration for 100% probability of trigger at 100% amplitude table

Advanced triggers

Frequency edge trigger

Range	±(½ × (ACQ BW or TDBW if TDBW is active))
Minimum event duration	9.1 ns (ACQ BW = 110 MHz, no TDBW, Opt. 110)
	12 ns (ACQ BW = 85 MHz, no TDBW, Opt. 85)
	25 ns (ACQ BW = 40 MHz, no TDBW, Opt. 40)
	40 ns (ACQ BW = 25 MHz, no TDBW, Standard)
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 (Opt. 02), 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

Digital IQ Output (Opt. 55)

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 (150 MHz, Opt. 55) 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, standard), 1.58 ns (typical, Opt. 85 or Opt. 110)
Data transition to clock rising edge (Setup time)	8.2 ns (typical, standard), 1.54 ns (typical, Opt. 85 or Opt. 110)

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

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

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

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

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) [20]

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°

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

Advanced measurement suite (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 (standard, Opt. 40), 50 ns (Opt. 85/110)
Number of pulses	1 to 10,000
System rise time (typical)	<40 ns (standard), <17 ns (Opt. 40), <12 ns (Opt. 85/110)
Pulse measurement accuracy	Signal conditions: Unless otherwise stated, Pulse width >450 ns (150 ns, Opt. 85/110), 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 [21]
Impulse response waiting	Taylor window

Pulse measurement performance

Pulse amplitude and timing (typical)

Average on power [22]	±0.3 dB + Absolute amplitude accuracy
Average transmitted power [22]	±0.4 dB + Absolute amplitude accuracy
Peak power [22]	±0.4 dB + Absolute amplitude accuracy
Pulse width	±3% of reading
Duty factor	±3% of reading

Frequency and phase error referenced to nonchirped signal

At stated frequencies and measurement bandwidths [23], typical

Bandwidth	CF	RMS frequency error	Pulse to pulse frequency	Pulse to pulse phase
20 MHz	2 GHz	±7 kHz	±12 kHz	±0.3°
	10 GHz	±16 kHz	±40 kHz	±0.75°
	20 GHz	±40 kHz	±110 kHz	±1.8°
60 MHz	2 GHz	±26 kHz	±80 kHz	±0.5°
	10 GHz	±55 kHz	±190 kHz	±1.2°
	20 GHz	±200 kHz	±560 kHz	±2.6°
85/110 MHz	2 GHz	±65 kHz	±25 kHz	±0.5°
	10 GHz	±125 kHz	±530 kHz	±1.4°
	20 GHz	±400 kHz	±1.7 MHz	±3.6°

21 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.

22 Pulse width >300 ns (100 ns, opt. 85/110) SNR ≥30 dB

23 Pulse ON Power ≥ -20 dBm, Signal peak at reference Level, Attenuator = Auto, $t_{meas} - t_{reference} \leq 10$ 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.

Pulse measurement performance

Frequency and phase error referenced to a linear chirp

At stated frequencies and measurement bandwidths [24], typical

Bandwidth	CF	RMS frequency error	Pulse to pulse frequency	Pulse to pulse phase
20 MHz	2 GHz	±7 kHz	±16 kHz	±0.3°
	10 GHz	±16 kHz	±40 kHz	±0.95°
	20 GHz	±40 kHz	±110 kHz	±2.25°
60 MHz	2 GHz	±26 kHz	±130 kHz	±0.7°
	10 GHz	±55 kHz	±370 kHz	±1.3°
	20 GHz	±200 kHz	±630 kHz	±3.5°
85/110 MHz	2 GHz	±65 kHz	±200 kHz	±0.72°
	10 GHz	±125 kHz	±510 kHz	±1.8°
	20 GHz	±400 kHz	±1.5 MHz	±5.5°

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 80,000 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)

[24] 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 (Opt 21)

QPSK residual EVM [25]

100 kS/s	<0.35%
1 MS/s	<0.35%
10 MS/s	<0.5%
30 MS/s (Opt. 40/85/110)	<1.5%
60 MS/s (Opt. 85/110)	<2.0%

256 QAM residual EVM [26]

10 MS/s	<0.4%
30 MS/s (Opt. 40/85/110)	<1.0%
60 MS/s (Opt. 85/110)	<1.5%

Offset QPSK residual EVM [27]

100 kS/s	<0.4%
1 MS/s	<0.4%
10 MS/s	<1.3%

S-OQPSK (MIL, ARTM) residual EVM [28]

4 kS/s, CF = 250 MHz	<0.3%
20 kS/s	<0.5%
100 kS/s	<0.5%
1 MS/s	<0.5%

S-BPSK (MIL) residual EVM [29]

4 kS/s, CF = 250 MHz	<0.2%
20 kS/s	<0.5%
100 kS/s	<0.5%
1 MS/s	<0.5%

CPM (MIL) residual EVM [30]

4 kS/s, CF = 250 MHz	<0.3%
20 kS/s	<0.5%
100 kS/s	<0.5%
1 MS/s	<0.5%

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

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

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

28 CF = 2 GHz unless otherwise noted. Reference Filters: MIL STD, ARTM, Measurement Filter: none.

29 CF = 2 GHz unless otherwise noted. Reference Filter: MIL STD.

30 CF = 2 GHz unless otherwise noted. Reference Filter: MIL STD.

Digital (Opt 21)

2/4/8/16 FSK residual RMS FSK error[31]	
10 kS/s, deviation 10 kHz	<0.5%

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
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)

31 CF = 2 GHz. Reference filter: None, Measurement filter: None.

Flexible OFDM (Opt. 22)

Displays	EVM vs symbol, vs subcarrier
	Subcarrier power vs Ssymbol, vs subcarrier
	Mag error vs symbol, vs subcarrier
	Phase error vs symbol, vs subcarrier
	Channel frequency response
Residual EVM	-44 dB (WiMAX 802.16-2004, 5 MHz BW)
	-44 dB (WLAN 802.11g, 20 MHz BW)
	Signal input power optimized for best EVM

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

General characteristics

Modulation formats	DBPSK (DSSS1M), DQPSK (DSSS2M), CCK5.5M, CCK11M , 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 EVM – 802.11b (CCK-11Mbps)	RMS-EVM over 1000 chips, EQ On
	2.4 GHz: 1.1%(–39.3 dB) typical, 0.95% (–40.5 dB) typical-mean
	Signal input power optimized for best EVM
Residual EVM – 802.11a/g/j (OFDM, 20 MHz, 64-QAM)	RMS-EVM averaged over 20 bursts, 16 symbols each
	2.4 GHz: –49 dB typical, –51 dB typical-mean;
	5.8 GHz: –48 dB typical, –49 dB typical-mean ; (RMS-EVM averaged over 20 bursts, 16 symbols each)
	Signal input power optimized for best EVM

WLAN IEEE802.11n (Opt. 24)

General characteristics

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 EVM - 802.11n (802.11ac EVM (40 MHz, 64-QAM))	(RMS-EVM averaged over 20 bursts, 16 symbols each)
	5.8 GHz: –45 dB typical, –47 dB typical-mean
	Signal input power optimized for best EVM

WLAN IEEE802.11ac (Opt. 25)

General characteristics

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 EVM - 802.11ac (80 MHz, 256-QAM)	(RMS-EVM averaged over 20 bursts, 16 symbols each)
	5.8 GHz –42 dB typical, –44.6 typical-mean
	Signal input power optimized for best EVM

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 (RSA5103A, RSA5106A) N-Type Female Planar Crown (RSA5115A) 3.5mm Female Planar Crown (RSA5126A)
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)
Digital IQ 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	90% RH at 30 °C
80% RH max when accessing DVD	No condensation, max wet bulb, 29 °C

Vibration

Operating (except when equipped with option 56 removable HDD, or when accessing DVD/CD)	$0.22G_{RMS}$. 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. (1 G max when accessing DVD and Opt. 06 removable HDD)
Nonoperating	30 g, half-sine, 11 ms duration

Data storage	Internal HDD (Opt. 59), USB ports, DVD-R / CD-RW (Opt. 57), removable HDD (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	450 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

Physical characteristics

With feet

Dimensions

	mm	in
Height	282	11.1
Width	473	18.6
Depth	531	20.9

Weight With all options

kg	lb
29	64.7

Ordering information

Models

RSA5103A	Real Time Signal Analyzer, 1 Hz to 3 GHz
RSA5106A	Real Time Signal Analyzer, 1 Hz to 6.2 GHz
RSA5115A	Real Time Signal Analyzer, 1 Hz to 15 GHz
RSA5126A	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.

5115A also includes: Planar Crown RF Input Connector - Type N Female PN 131-4329-00

5126A 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
RSA5103A		Real Time Signal Analyzer, 1 Hz to 3 GHz, 25 MHz Acquisition BW
RSA5106A		Real Time Signal Analyzer, 1 Hz to 6.2 GHz, 25 MHz Acquisition BW
RSA5115A		Real Time Signal Analyzer, 1 Hz to 15 GHz, 25 MHz Acquisition BW
RSA5126A		Real Time Signal Analyzer, 1 Hz to 26.5 GHz, 25 MHz Acquisition BW
	Opt. 50	Internal Preamp, 1 MHz to 3/6.2 GHz, RSA5103A/06A only
	Opt. 51	Internal Preamp, 1 MHz to 15/26.5 GHz, RSA5115A/26A only
	Opt. 52	Frequency Mask Trigger (no cost option)
	Opt. 53	Memory Extension, 4 GB Acquisition Memory Total
	Opt. 55	Digital I and Q output
	Opt. 56 [32]	Removable 160 GB Storage Drive, incompatible with Opt. 57 or 59
	Opt. 57 [32]	Internal HDD and DVD-R / CD-RW, incompatible with Opt. 56 or 59
	Opt. 59 [32]	Internal 160 GB HDD, incompatible with Opt. 56 or 57 (no cost option)
	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	Advanced Signal Analysis (including 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)

[32] Must order either Opt. 56, 57, or 59.

Product	Options	Description
	Opt. 25	WLAN 802.11ac measurement application (requires opt 24)
	Opt. 40	40 MHz Acquisition Bandwidth
	Opt. 85	85 MHz Acquisition Bandwidth
	Opt. 110	110 MHz Acquisition Bandwidth
	Opt. 200	Advanced Triggers, Swept DPX, and DPX Zero Span
	Opt. 5040	Combines Opt. 50 (Preamp) and Opt. 40 (40 MHz Acquisition BW). Mutually exclusive to Opt. 50 and 40. RSA5103A/06A only.
	Opt. 5085	Combines Opt. 50 (Preamp) and Opt. 85 (85 MHz Acquisition BW). Mutually exclusive to Opt. 50 and 85. RSA5103A/06A only.
	Opt. 50110	Combines Opt. 50 (Preamp) and Opt. 110 (110 MHz Acquisition BW). Mutually exclusive to Opt. 50 and 110. RSA5103A/06A only.
RSA56KR		Rackmount for RSA5K, RSA6K Real Time Signal Analyzers

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)

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	For RSA5103A/06A only. This is a solid state drive with a minimum capacity of 160 GB. For use with Opt. 56 (Windows 7 and instrument SW preinstalled). 065-0937-xx
	For RSA5115A/26A only. This is a solid state drive with a minimum capacity of 160 GB. For use with Opt. 56 (Windows 7 and instrument SW preinstalled). 065-0938-xx
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
Rackmount Retrofit	RSA56KR

Accessory	Description
Additional Quick-start Manual (Paper)	071-2838-xx
Additional Application Examples Manual (Paper)	071-2834-xx

RSA5UP – Upgrade options for the RSA5100A series

RSA5UP	Option description	HW or SW	Factory calibration required?
Opt. 50	Internal Preamp 1 MHz to 3 GHz (RSA5103A) or 1 MHz to 6.2 GHz (RSA5106A)	HW	Yes
Opt. 51	Internal Preamp 1 MHz to 15 GHz (RSA5115A) or 1 MHz to 26.5 GHz (RSA5126A)	SW	No
Opt. 52	Frequency Mask Trigger	SW	No
Opt. 53	Memory Extension, 4 GB Acquisition Memory Total	HW	No
Opt. 55	Digital IQ Output	HW	No
Opt. 56	Removable Drive (160 GB), incompatible with Opt. 57 or 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 or 57	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	Advanced Signal Analysis (including 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. 40	40 MHz Acquisition Bandwidth (from 25 MHz BW)	HW	Yes
Opt. 85	85 MHz Acquisition Bandwidth (from 25 MHz BW)	HW	Yes
Opt. 110	110 MHz Acquisition Bandwidth (from 25 MHz)	HW	Yes
Opt. 110E	110 MHz Acquisition Bandwidth (from 40 MHz)	SW	No
Opt. 110H	110 MHz Acquisition Bandwidth (from 85 MHz)	SW	No
Opt. 200	Advanced DPX / Swept DPX with Density, Time Qualified, and Runt Triggers and Zero-span DPX	HW	No

CE

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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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.

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