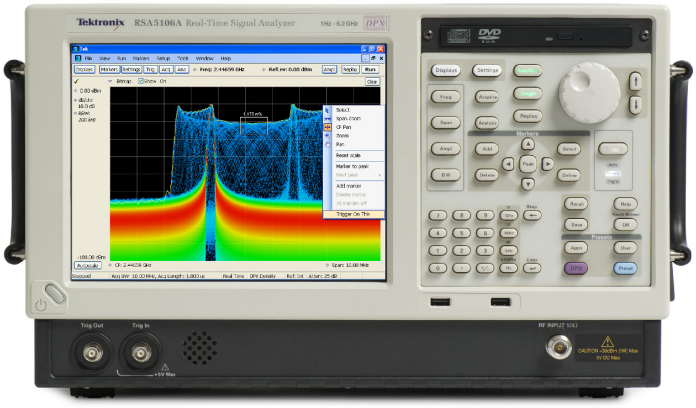
Spectrum Analyzers

RSA5000 Series Data Sheet



Features & Benefits

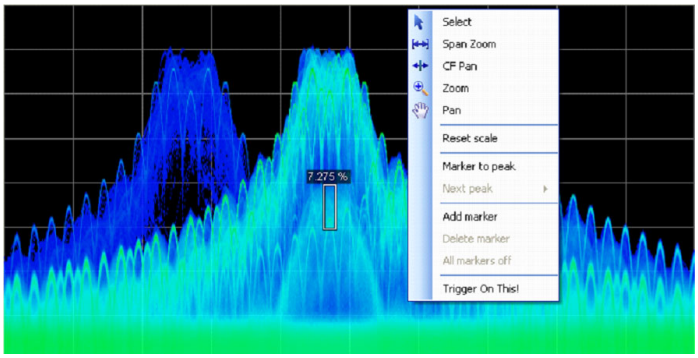
RSA5000 Series 3.0 and 6.2 GHz Real Time Signal Analyzers

- Outstanding Mid-Range Spectrum Analysis
  - +17 dBm 3rd Order Intercept at 2 GHz
  - ±0.5 dB Absolute Amplitude Accuracy to 3 GHz
  - Displayed Average Noise Level –154 dBm/Hz at 2 GHz and –150 dBm/Hz at 10 kHz
  - Phase noise –109 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
- 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 5.8 µs in frequency domain and distinguish between continuous signals vs infrequent event
  - 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 or 85 MHz acquisition bandwidths
  - Acquire more than 7 seconds at 85 MHz bandwidth
- 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, DPX Zero Span with real time amplitude, frequency, or phase
  - Advanced Triggers DPX density, time-qualified, runt, frequency edge, and frequency mask
  - 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
  - Flexible OFDM analysis of 802.11a/g/j and WiMax 802.16-2004

Applications

- RF Debug and design of components, modules and systems of all types
- Spectrum Management – reduce time to intercept and identify known and unknown signals
- Radio/Satellite Communications – Analyze complex behavior of new designs
- EMI Diagnostics – Increase confidence that designs will pass compliance testing
- Radar/EW – Complete analysis of pulsed, hopping signals of all types

Tektronix®



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.

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 –154 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'.

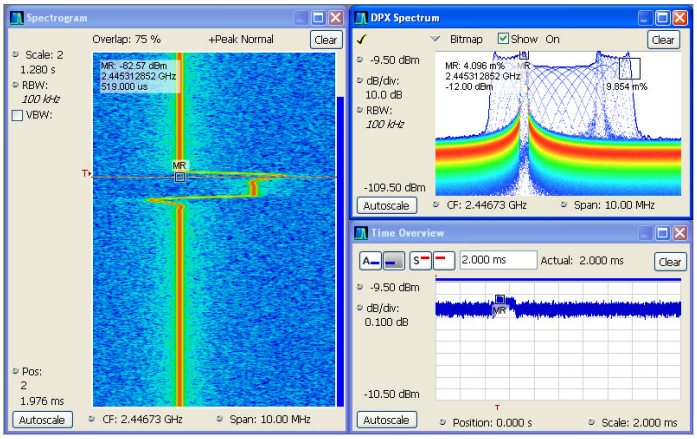
A complete toolset of power and signal statistics measurements are standard, including Channel Power, ACLR, CCDF, Occupied Bandwidth, AM/FM/PM, and Spurious measurements. Available Phase Noise and General Purpose Modulation Analysis measurements round out the expected set of high-performance analysis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

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 5.8 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.



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.

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.

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 seconds at 85 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 85 MHz (Opt. 85). Acquisitions of any length can stored in Matlab™ Level 5 format for offline analysis.

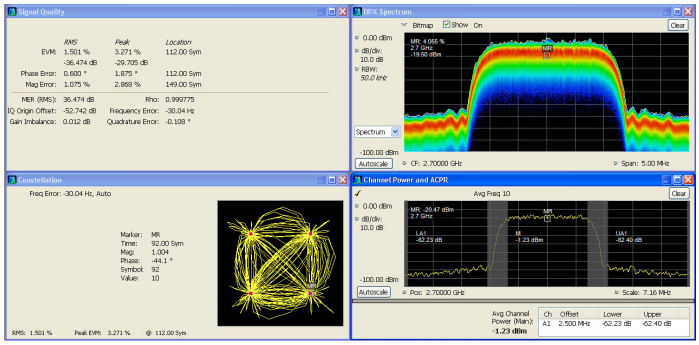
Analyze

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.

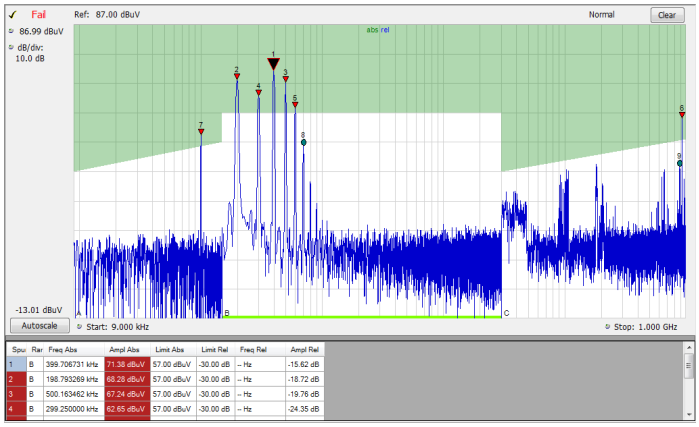
The measurement capabilities of the RSA5000 Series and available options and software packages are summarized below:

Measurement Functions

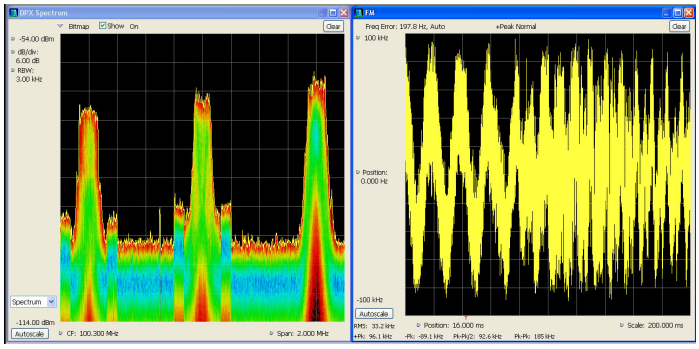
Measurements	Description
Spectrum Analyzer Measurements	Channel Power, Adjacent Channel Power, Multicarrier Adjacent Channel Power/Leakage Ratio, Occupied Bandwidth, xdB Down, dBm/Hz Marker, dBc/Hz Marker
Time Domain and Statistical Measurements	RF IQ vs. Time, Power vs. Time, Frequency vs. Time, Phase 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	% Amplitude Modulation (+, –, Total) Frequency Modulation (±peak, +peak, –peak, RMS, peak-peak/2, Frequency Error) Phase Modulation (±peak, RMS, +peak, –peak)
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
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, 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
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
Analysis SW (RSA-IQWIMAX)	WiMAX 802.16-2004 and 802.16e standards support
Analysis Software (RSALTE)	3GPP Release 8 LTE standards support



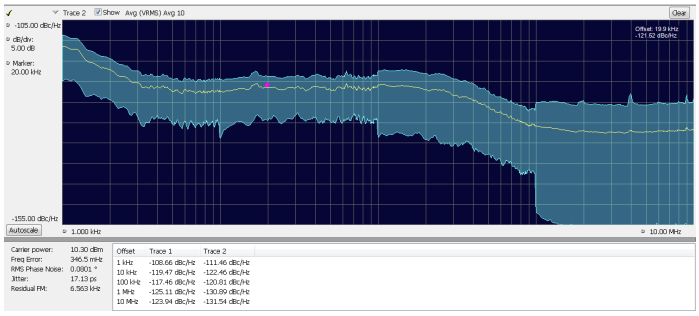
Time-correlated views in multiple domains provide a new level of insight into design problems not possible with conventional analyzers. Here, ACLR and modulation quality are performed simultaneously in a single acquisition, combined with the continuous monitoring of the DPX® spectrum display.



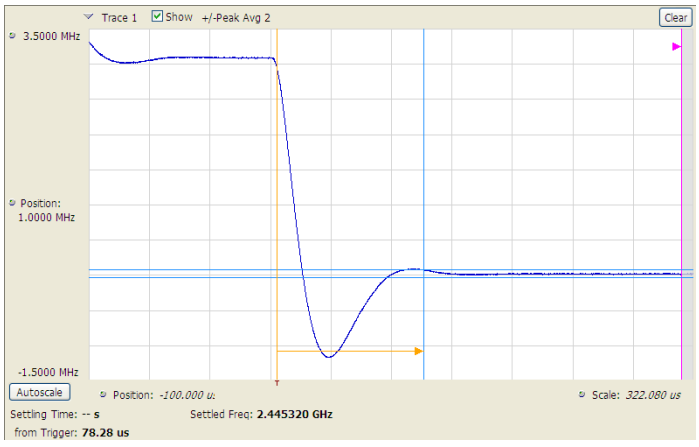
Spurious Search – Up to 20 noncontiguous frequency regions can be defined, each with their own resolution bandwidth, video bandwidth, detector (peak, average, quasi-peak), and limit ranges. Test results can be exported in CSV format to external programs, with up to 999 violations reported. Spectrum results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



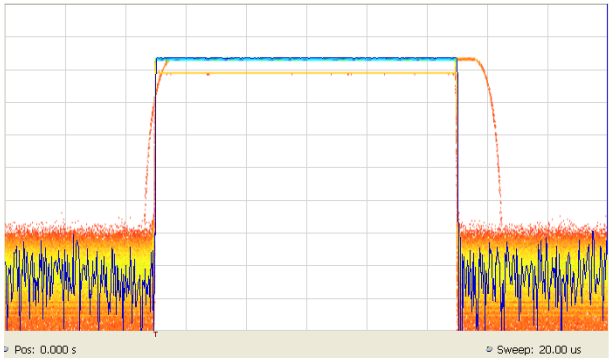
Audio monitoring and modulation measurements simultaneously can make spectrum management an easier, faster task. Here, the DPX spectrum display shows a live spectrum of the signal of interest and simultaneously provides demodulated audio to the internal instrument loudspeaker. FM deviation measurements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



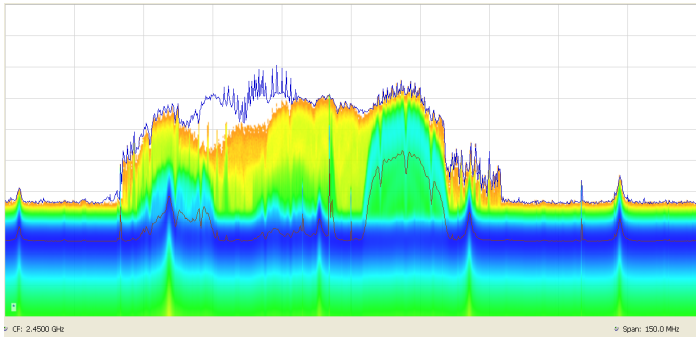
Phase noise and jitter measurements (Opt. 11) on the RSA5000 series may reduce the cost of your measurements by reducing the need for a dedicated phase noise tester. Outstanding phase noise across the operating range provides margin for many applications. Here, phase noise on a 13 MHz carrier is measured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

Characteristics

Frequency Related

Characteristic	Description
Frequency Range	1 Hz to 3.0 GHz (RSA5103A) 1 Hz to 6.2 GHz (RSA5106A)
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 min. warm-up)
Aging per day	1×10^{-9} (after 30 days 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

Characteristic	Description
Trigger Modes	Free Run, Triggered, FastFrame
Trigger Event Source	RF Input, Trigger 1 (Front Panel), Trigger 2 (Rear Panel), Gated, Line
Trigger Types	Power (Std), Frequency Mask (Opt. 52), Frequency Edge, DPX Density, Runt, Time-Qualified (Opt. 200)
Trigger Setting	Trigger position settable from 1 to 99% of total acquisition length
Trigger Combinational Logic	Trig 1 AND Trig 2 / Gate may be defined as a trigger event
Trigger Actions	Save acquisition and/or save picture on Trigger

Power Level Trigger

Characteristic	Description
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)	±0.5 dB (level ≥ –50 dB from reference level)
	±1.5 dB (from < –50 dB to –70 dB from reference level)
Trigger Bandwidth Range	
(at maximum acquisition BW)	4 kHz to 10 MHz + wide open (standard)
	4 kHz to 20 MHz + wide open (Opt. 40)
	11 kHz to 40 MHz + wide open (Opt. 85)
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
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
Minimum Event Duration (Filter = Off)	
25 MHz Acquisition BW (Std.)	40 ns
40 MHz Acquisition BW (Opt. 40)	25 ns
85 MHz Acquisition BW(Opt. 85)	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
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
Advanced trigger specifications are found in sections on Opt 52 (Frequency Mask Trigger) and Opt. 200 (DPX, Time Qualified, Runt, and Frequency Edge triggers)	

Acquisition Related

Characteristic	Description
Real-time Acquisition Bandwidth	25 MHz (Std.) 40 MHz (Opt. 40) 85 MHz (Opt. 85)
A/D Converter	100 MS/s 14 bit (optional 300 MS/s, 14 bit, Opts. 40/85)
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)

Memory Depth (Time) and Minimum Time Domain Resolution

Acquisition BW	Sample Rate (For I and Q)	Record Length	Record Length (Opt. 53)	Time Resolution
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	5.28 s	21.1 s	20 ns
20 MHz	25 MS/s	10.5 s	42.2 s	40 ns
10 MHz	12.5 MS/s	21.1 s	84.5 s	80 ns
5 MHz	6.25 MS/s	42.2 s	169.1 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	55497 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

*[1] In spans ≤2 MHz, higher resolution data is stored.

Analysis Related

Available Displays	Views
Frequency	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)
Time and Statistics	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 Phase Modulation vs. Time RF IQ vs. Time Time Overview CCDF Peak-to-Average Ratio
Settling Time, Frequency, and Phase (Opt. 12)	Frequency Settling vs. Time, Phase Settling vs. Time
Advanced Measurements Suite (Opt. 20)	Pulse Results Table Pulse Trace (selectable by pulse number) Pulse Statistics (Trend of Pulse Results, FFT of Trend, and Histogram)
Digital Demod (Opt. 21)	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)	Constellation, Scalar Measurement summary, EVM or Power vs. Carrier Symbol Table (Binary or Hexadecimal)
Frequency Offset Measurement	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

RF Spectrum and Analysis Performance

Bandwidth Related

Characteristic	Description
Resolution Bandwidth	
Resolution Bandwidth Range (Spectrum Analysis)	0.1 Hz to 5 MHz (10 MHz, Opt 85) (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), –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 5 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, Detector: Average)	±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	≤10 MHz, approximately Gaussian, shape factor 4.1:1 (60:3 dB), ±10% typical
	20 MHz (60 MHz, Opt. 85), shape factor <2.5:1 (60:3 dB) typical
Time Domain Bandwidth Accuracy	1 Hz to 20 MHz, and (>20 MHz to 60 MHz Opt. 85), ±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, Detector, and Functions

Characteristic	Description
Traces	Three traces + 1 math waveform + 1 trace from spectrogram for spectrum display
Detector	Peak, –Peak, Average (V_{RMS}), ±Peak, Sample, CISPR (Ave, 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/sec (Std.) 2500 MHz/sec (Opt. 40) 6000 MHz/sec (Opt. 85)

DPX® Digital Phosphor Spectrum Processing

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)	5.8 µs (Std., or Opts. 40/85, RBW = 1 MHz)
Span Range (Continuous processing)	100 Hz to 25 MHz (40 MHz with Opt. 40) (85 MHz with Opt. 85)	100 Hz to 25 MHz (40 MHz with Opt. 40) (85 MHz with Opt. 85)
Span Range (Swept)	Not Available	Up to instrument frequency range
Dwell Time per Step	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%

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

Minimum RBW, Swept Spans (Opt. 200) – 10 kHz.

Stability

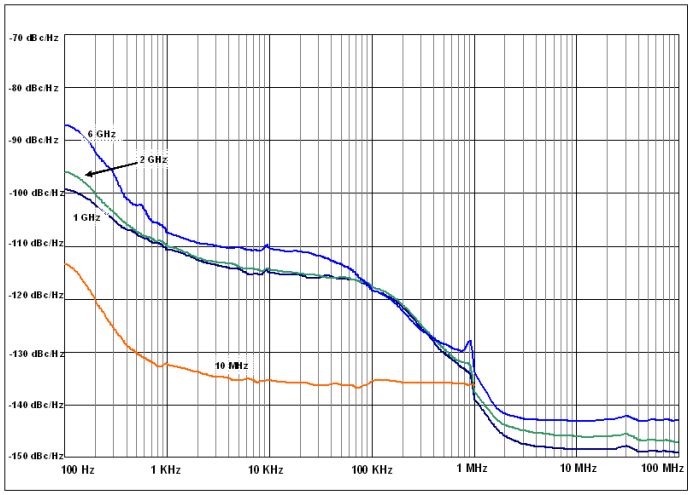
Residual FM – <2 Hz_{p-p} in 1 second (95% confidence, typical).

Phase Noise Sidebands, dBc/Hz at Specified Center Frequency (CF)

Offset	CF= 10 MHz	CF = 1 GHz		CF = 2 GHz	CF = 6 GHz
	Typical	Spec	Typical	Typical	Typical
1 kHz	–128	–103	–107	–107	–104
10 kHz	–134	–109	–113	–112	–109
100 kHz	–134	–112	–116	–115	–114
1 MHz	–135	–130	–139	–137	–135
6 MHz	–140	–134	–144	–142	–141
10 MHz	NA	–135	–144	–142	–141

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)

Characteristic	Description
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 (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 Measurable Input Level	
Average Continuous (RF ATT: Auto)	+30 dBm
Pulsed RF (RF ATT: Auto, PW <10 µs, 1% Duty Cycle)	50 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
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)

Frequency Response

Range	Response
18 °C to 28 °C, Atten. = 10 dB, Preamp Off	
10 MHz - 32 MHz (LF Band)	±0.7 dB
10 MHz - 3 GHz	±0.5 dB
>3 GHz - 6.2 GHz (RSA5106A)	±1.0 dB
5 °C to 40 °C, All Attenuator Settings (Typical, Preamp Off)	
1 Hz - 32 MHz (LF Band)	±0.8 dB
9 kHz - 3 GHz	±0.5 dB
>3 GHz - 6.2 GHz (RSA5106A)	±1.0 dB
Preamp (Opt. 50) On (Atten. = 10 dB)	
10 MHz - 32 MHz (LF Band)	±1.0 dB
10 MHz - 3.0 GHz	±0.7 dB
>3 GHz - 6.2 GHz (RSA5106A)	±1.3 dB

Amplitude Accuracy

Characteristic	Description
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*2	
10 MHz to 3 GHz	±0.5 dB
3 GHz to 6.2 GHz(RSA5106A)	±0.8 dB
VSWR (Atten. = 10 dB, Preamp Off, CF set within 200 MHz of VSWR Test Frequency)	
10 kHz to 30 MHz	<1.6:1 (Typical)
10 MHz to 3 GHz	<1.4:1
>3 GHz to 6.2 GHz (RSA5106A)	<1.6:1
VSWR with Preamp (Atten. = 10 dB, Preamp On, CF set within 200 MHz of VSWR Test Frequency	
10 MHz to 3/6.2 GHz	<1.6:1

*2 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.

Noise and Distortion

3rd Order Intermodulation Distortion: –84 dBc at 2.13 GHz (Specified)*3

Frequency Range	3rd Order Intermodulation Distortion, dBc (Typical)	3rd Order Intercept, dBm (Typical)
10 kHz - 32 MHz (LF Band)	–75	+12.5
9 kHz - 80 MHz	–72	+11
>80 MHz - 300 MHz	–76	+13
>300 MHz - 3 GHz	–84	+17
>3 GHz - 6.2 GHz	–84	+17

*3 Each Signal Level –25 dBm, Ref Level –20 dBm, Attenuator = 0 dB, 1 MHz tone separation.

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

2nd Harmonic Distortion*4

Frequency	2nd Harmonic Distortion, Typical
10 MHz -1 GHz	< –80 dBc
>1 GHz – 3.1 GHz	< –83 dBc

*4 –40 dBm at RF input, Attenuator = 0, Preamp Off, typical.

Displayed Average Noise Level*5, Preamp Off

Frequency Range	Specification	Typical
LF Band		
1 Hz - 100 Hz		–129 dBm/Hz
>100 Hz - 2 kHz	–124 dBm/Hz	–130 dBm/Hz
>2 kHz - 10 kHz	–141 dBm/Hz	–144 dBm/Hz
>10 kHz - 32 MHz	–150 dBm/Hz	–153 dBm/Hz
RF Band		
9 kHz - 1 MHz	–108 dBm/Hz	–111 dBm/Hz
>1 MHz - 10 MHz	–136 dBm/Hz	–139 dBm/Hz
>10 MHz - 2 GHz	–154 dBm/Hz	–157 dBm/Hz
>2 GHz - 3 GHz	–153 dBm/Hz	–156 dBm/Hz
>3 GHz - 4 GHz (R5106A)	–151 dBm/Hz	–154 dBm/Hz
>4 GHz - 6.2 GHz (R5106A)	–149 dBm/Hz	–152 dBm/Hz

*5 Measured using 1 kHz RBW, 100 kHz span, 100 averages, Minimum Noise mode, input terminated, log-average detector and trace function.

Preamplifier Performance (Opt. 50)

Characteristic	Description
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)

Displayed Average Noise Level*5, Preamp On (Opt. 50)

Frequency Range	Specification	Typical
LF Band		
1 MHz - 32 MHz	–158 dBm/Hz	–160 dBm/Hz
RF Band		
1 MHz - 10 MHz	–158 dBm/Hz	–160 dBm/Hz
>10 MHz - 2 GHz	–164 dBm/Hz	–167 dBm/Hz
>2 GHz - 3 GHz	–163 dBm/Hz	–165 dBm/Hz
>3 GHz - 6.2 GHz (RSA5106A)	–161 dBm/Hz	–164 dBm/Hz

*5 Measured using 1 kHz RBW, 100 kHz span, 100 averages, Minimum Noise mode, input terminated, log-average trace detector and function.

Residual Response*6

Frequency Range	Specified	Typical
500 kHz - 32 MHz, LF Band		<–100 dBm
500 kHz - 80 MHz, RF Band		<–75 dBm
80 MHz - 200 MHz		<–95 dBm
200 MHz - 3 GHz	–95 dBm	
3 GHz – 6.2 GHz (RSA5106A)	–95 dBm	

*6 Input terminated, RBW = 1 kHz, Attenuator = 0 dB, Reference Level –30 dBm.

Image Response*7

Frequency	Spec
100 Hz – 30 MHz	< –75 dBc
30 MHz – 3 GHz	< –75 dBc
>3 GHz to 6.2 GHz (RSA5106A)	< –65 dBc

*7 Ref = –30 dBm, Attenuator = 10 dB, RF Input Level = –30 dBm, RBW = 10 Hz.

Spurious Response with Signal, Offset ≥400 kHz*8

	Span ≤25 MHz, Swept Spans >25 MHz		Opt. 40/85 25 MHz < Span ≤ 85 MHz	
Frequency	Specification	Typical	Specification	Typical
1 MHz – 32 MHz (LF Band)	–71 dBc	–75 dBc	NA	NA
30 MHz – 3 GHz	–73 dBc	–78 dBc	–73 dBc	–75 dBc
>3 GHz - 6.2 GHz (RSA5106A)	–73 dBc	–78 dBc	–73 dBc	–75 dBc

*8 RF Input Level = –15 dBm, Attenuator = 10 dB, Mode: Auto. Input signal at center frequency. Center Frequency >90 MHz, Opts. 40/85.

Spurious response with signal (10 kHz ≤ offset < 400 kHz), Typical

Frequency	Span ≤ 25 MHz, Swept Spans >25 MHz	For Opts. 40/85, 25 MHz < Span ≤ 85 MHz
1 MHz – 32 MHz (LF Band)	–71 dBc	NA
30 MHz – 3 GHz	–73 dBc	–73 dBc
3 GHz – 6.2 GHz (RSA5106A)	–73 dBc	–73 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 (typical, attenuator = 10 dB)

Adjacent Channel Leakage Ratio Dynamic Range*9

Signal Type, Measurement Mode	ACLR, Typical	
	Adjacent	Alternate
3GPP Downlink, 1 DPCH		
Uncorrected	–70 dB	–70 dB
Noise Corrected	–79 dB	–79 dB

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

IF Frequency Response and Phase Linearity*[10]

Frequency Range (GHz)	Acquisition Bandwidth	Amplitude Flatness (Spec)	Amplitude Flatness (Typ, RMS)	Phase Flatness (Typ, RMS)
0.001 - 0.032 (LF Band)	≤20 MHz	±0.50 dB	0.4 dB	1.0°
0.01 - 6.2*[11]	≤300 kHz	±0.10 dB	0.05 dB	0.1°
0.03 - 6.2	≤25 MHz	±0.30 dB	0.20 dB	0.5°
Option 40				
0.03 – 6.2	≤40 MHz	±0.30 dB	0.20 dB	0.5°
Option 85				
0.07 - 3.0	≤85 MHz	±0.50 dB	0.30 dB	1.5°
>3 - 6.2	≤85 MHz	±0.50 dB	0.40 dB	1.5°

*[10] Amplitude flatness and phase deviation over the acquisition BW, includes RF frequency response. Attenuator Setting: 10 dB.

*[11] High Dynamic Range mode selected.

Frequency Mask Trigger (Opt. 52)

Characteristic	Description
Mask Shape	User Defined
Mask Point Horizontal Resolution	<0.2% of span
Level Range	0 dB to –80 dB from reference level
Level Accuracy*[12]	
0 to –50 dB from reference level	±(Channel Response Flatness + 1.0 dB)
–50 dB to –70 dB from reference level	±(Channel Response Flatness + 2.5 dB)
Span Range	100 Hz to 25 MHz
	100 Hz to 40 MHz (Opt. 40)
	100 Hz to 85 MHz (Opt. 85)
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)

*[12] For masks >30 dB above noise floor, Center Frequency ≥50 MHz.

Opt. 200: Advanced Triggers, Swept DPX, and DPX Zero Span

Span	RBW (kHz)	FFT Length	Spectrums/sec	Minimum Signal Duration, 100% Probability of Intercept (µs)
85 MHz	1000	1024	292,969	5.8
	300	2048	146,484	11.4
	100	4096	73,242	37.6
	30	16384	18,311	134.6
	20	16384	18,311	174.6
40 MHz	1000	1024	292,969	5.8
	300	1024	292,969	11.4
	100	2048	146,484	30.8
	30	4096	73,242	93.6
	20	8192	36,621	147.3
	10	16384	18,311	294.5
25 MHz	300	1024	292,969	11.4
	100	1024	292,969	27.5
	30	4096	73,242	93.8
	20	4096	73,242	133.9
	10	8192	36,621	267.8

Minimum RBW, Swept Spans (Opt. 200) – 10 kHz.

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

Trace Length (Points)	Minimum FFT Length
801	1024
2401	4096
4001	8192
10401	16384

Resolution BW Range vs. Acquisition Bandwidth (DPX®)

Acquisition Bandwidth	Standard	Opt. 200	
	RBW (Min)	RBW (Min)	RBW (Max)
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)	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

Zero-span Amplitude, Frequency, Phase Performance (Nominal)

General Characteristics, Zero span Amplitude, Frequency, Phase	
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 sec (maximum, Measurement BW > 60 MHz) 2000 sec (maximum, Measurement BW ≤ 60 MHz)
Time Accuracy	±(0.5% + Reference Frequency Accuracy)
Zerospan Trigger Timing Uncertainty (power trigger)	±(Zerospan Sweep Time/800) at trigger point
DPX Frequency Display Range	±100 MHz maximum
DPX Phase Display Range	±200 Degrees maximum
DPX Waveforms/sec	50,000 triggered waveforms/sec for sweep time ≤20 µs

Opt. 200 – Advanced Triggers

Characteristic	Description
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)
Minimum Signal Duration for 100% Probability of Trigger (at maximum acquisition bandwidth) RBW = Auto, Trace Length 801 Points	30.7 µs (Standard) 20.5 µs (Opt. 40) 11.4 µs (Opt. 40 and Opt. 200) 8.2 µs (Opt. 85 and Opt. 200) 5.8 µs (Opt. 85 and Opt. 200, RBW = 1 MHz) Events lasting less than minimum event duration specification will result in degraded Frequency Mask Trigger accuracy
Frequency Edge Trigger	
Range	±(½ × (ACQ BW or TDBW if TDBW is active))
Minimum Event Duration	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)

Characteristic	Description
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. 110) 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)
Data Transition to Clock Rising Edge (Setup time)	8.2 ns (typical, standard), 1.54 ns (typical, Opt. 85)

Phase Noise and Jitter Measurement (Opt. 11)

Characteristic	Description
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)*[13]

Settled Frequency Uncertainty, 95% Confidence (Typical), at Stated Measurement Frequencies, Bandwidths, and # of Averages

Measurement Frequency, Averages	Frequency Uncertainty at Stated Measurement Bandwidth			
	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

Measurement Frequency, Averages	Phase Uncertainty at Stated Measurement Bandwidth		
	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°

*[13] Measured input signal level > –20 dBm, Attenuator: Auto.

Advanced Measurement Suite (Opt. 20)

Characteristic	Description
Measurements	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 (%), 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)
Number of Pulses	1 to 10,000
System Rise Time (Typical)	<40 ns (standard), <17 ns (Opt. 40), <12 ns (Opt. 85)
Pulse Measurement Accuracy	Signal Conditions: Unless otherwise stated, Pulse Width >450 ns (150 ns, Opt. 85), 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*[14]
Impulse Response Weighting	Taylor Window

*[14] 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.

Pulse Measurement Performance

Pulse Amplitude and Timing

Measurement	Accuracy (Typical)
Average On Power*[15]	±0.3 dB + Absolute Amplitude Accuracy
Average Transmitted Power*[15]	±0.4 dB + Absolute Amplitude Accuracy
Peak Power*[15]	±0.4 dB + Absolute Amplitude Accuracy
Pulse Width	±3% of reading
Duty Factor	±3% of reading

*[15] Pulse Width >300 ns (100 ns, Opt. 85) SNR ≥30 dB.

Frequency and Phase Error Referenced to Nonchirped Signal

At stated frequencies and measurement bandwidths*[16], 95% confidence.

Bandwidth	CF: 2 GHz		
	Abs. Freq Err (RMS)	Pulse-to-Pulse Freq	Pulse-to-Pulse Phase
20 MHz	±10 kHz	±30 kHz	±0.3°
60 MHz (Opt. 85)	±26 kHz	±80 kHz	±0.7°

*[16] 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.

Frequency and Phase Error Referenced to a Linear Chirp

At stated frequencies and measurement bandwidths*16, 95% confidence.

Bandwidth	CF 2 GHz		
	Abs. Freq Err (RMS)	Pulse-Pulse Freq	Pulse-Pulse Phase
20 MHz	±17 kHz	±12 kHz	±0.3°
60 MHz (Opt. 85)	±30 kHz	±130 kHz	±0.5°

*16 Pulse ON Power ≥ –20 dBm, signal peak at Reference Level, Attenuator = 0 dB, $t_{meas} - t_{reference} \leq 10$ 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.

Note: Signal type: Linear Chirp, Peak-to-Peak Chirp Deviation: ≤0.8 Measurement BW.

Digital Modulation Analysis (Opt. 21)

Characteristic	Description
Modulation Formats	π/2DBPSK, BPSK, SBPSK, QPSK, DQPSK, π/4DQPSK, D8PSK, 8PSK, OQPSK, SOQPSK, CPM, 16/32/64/128/256QAM, MSK, 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 85 MS/s (Modulated signal must be contained entirely within acquisition BW)

Digital (Opt. 21)

Symbol Rate	Residual EVM (Typical)
QPSK Residual EVM*17	
100 kS/s	<0.35%
1 MS/s	<0.35%
10 MS/s	<0.5%
30 MS/s (Opts. 40/85)	<1.5%
60 MS/s (Opt. 85)	<2.0%
256 QAM Residual EVM*18	
10 MS/s	<0.4%
30 MS/s (Opts. 40/85)	<1.0%
60 MS/s (Opt. 85)	<1.5%
Offset QPSK Residual EVM*17	
100 kS/s	<0.4%
1 MS/s	<0.4%
10 MS/s	<1.3%
S-OQPSK (MIL, ARTM) Residual EVM*19	
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*20	
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*20	
4 kS/s, CF = 250 MHz	<0.3%
20 kS/s	<0.5%
100 kS/s	<0.5%
1 MS/s	<0.5%
2/4/8/16 FSK Residual RMS FSK Error*21	
10 kS/s, deviation 10 kHz	<0.5%

*17 CF = 2 GHz, Measurement Filter = root raised cosine, Reference Filter = raised cosine, Analysis Length = 200 symbols.

*18 CF = 2 GHz, Measurement Filter = root raised cosine, Reference Filter = raised cosine, Analysis Length = 400 symbols.

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

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

*21 CF = 2 GHz. Reference Filter: None, Measurement Filter: None.

Flexible OFDM Characteristics (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: # 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	–44 dB (WiMax 802.16-2004, 5 MHz BW) –44 dB (WLAN 802.11g, 20 MHz BW) (Signal input power optimized for best EVM)

Analog Modulation Analysis Accuracy (Typical)

Modulation	Description
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

Characteristic	Description
Front Panel	
Display	Touch panel, 10.4 in. (264 mm)
RF Input Connector	N-type female, 50 Ω
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	USB 2.0, two ports
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

Characteristic	Description
Temperature Range	
Operating	+5 °C to +40 °C. (+5 °C to +40 °C when accessing DVD)
Storage	–20 °C to +60 °C
Warm-up Time	20 min.
Altitude	
Operating	Up to 3000 m (approximately 10,000 ft.)
Nonoperating	Up to 12,190 m (40,000 ft.)
Relative Humidity	
Operating and nonoperating (80% RH max when accessing DVD)	90% RH at 30 °C (No condensation, max wet bulb, 29 °C)
Vibration	
Operating	0.22 G_{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	2.28 G_{RMS}: Profile = 0.0175 g^2/Hz at 5-100 Hz, –3 dB/octave from 100-200 Hz, 0.00875 g^2/Hz at 200-350 Hz, –3 dB/octave from 350-500 Hz, 0.00613 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
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
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
Data Storage	Internal HDD (Opt. 59), USB ports, DVD±RW (Opt. 57), Removable HDD (Opt. 56)
Calibration Interval	One year
Warranty	One year
GPIB	SCPI-compatible, IEEE488.2 compliant

Physical Characteristics

Dimensions	mm	in.
Height	282	11.1
Width	473	18.6
Depth	531	20.9
Weight	**kg**	**lb.**
With All Options	24.6	54

Note: Physical characteristics, with feet.

Ordering Information

RSA5103A
Real Time Signal Analyzer, 1 Hz - 3 GHz

RSA5106A
Real Time Signal Analyzer, 1 Hz – 6.2 GHz

All Include: Quick-start Manual (Printed), Application Guide (Printed), Printable Online Help File, Programmer's manual (on CD), power cord, BNC-N adapter, USB Keyboard, USB Mouse, Front Cover.
Note: Please specify power plug and language options when ordering.

Options

Product	Options	Description
RSA5103A		Real Time Signal Analyzer 1 Hz – 3 GHz 25 MHz Acquisition BW
RSA5106A		Real Time Signal Analyzer 1 Hz – 6.2 GHz 25 MHz Acquisition BW
	Opt. 50	Internal Preamp, 1 MHz - 3/6.2 GHz
	Opt. 52	Frequency Mask Trigger
	Opt. 53	Memory Extension, 4 GB Acquisition Memory Total
	Opt. 55	Digital I and Q output
	Opt. 56*[22]	Removable HDD (160 GB), incompatible with Options 57 or 59
	Opt. 57*[22]	CD/DVD-RW incompatible with Option 56
	Opt. 59*[22]	Internal HDD (160 GB), incompatible with Option 56 (no cost option)
	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. 40	40 MHz Acquisition Bandwidth
	Opt. 85	85 MHz Acquisition Bandwidth
	Opt. 200	Advanced Triggers, Swept DPX, and DPX Zero Span
	Opt. 5040	Combines Option 50 (Preamp) and Option 40 (40 MHz Acquisition BW). Mutually exclusive to Options 50 and 40
	Opt. 5085	Combines Option 50 (Preamp) and Option 85 (85 MHz Acquisition BW). Mutually exclusive to Options 50 and 85
RSA56KR		Rackmount for RSA5K, RSA6K Real Time Signal Analyzers

*[22] Must order one of either Option 56 (removable HDD) or Option 59 (Internal HDD). Removable HDD (Opt. 56) is not compatible with DVD/CD (Opt. 57) or Internal HDD (Opt. 59). Internal HDD (Opt. 59) is not compatible with Removable HDD (Opt. 56)

Accessories

Accessories	Description
RTPA2A Spectrum Analyzer Probe Adapter compatibility	Supports TekConnect probes P7225, P7240, P7260, P7330, P7313, P7350, P7350SMA, P7380, P7380SMA
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
RSA-IQWIMAX	WiMAX 802.16-2004 and 802.16.e standards support
RSALTE	3GPP Release 8 LTE standards support
Additional Removable Hard Drive	For use with Opt. 56 (Windows 7 and instrument SW preinstalled). 065-0852-xx
Transit Case	016-2026-xx
Rackmount Retrofit	RSA56KR
Additional Quick-start Manual (Paper)	071-1909-xx
Service Manual (Paper)	071-1914-xx
SMA (Male) to SMA (Male) 36 in. Cable	174-5706-xx
SMA Female to Female Barrel	131-8508-xx

International Power Plugs
Opt. A0 – North America power.
Opt. A1 – Universal EURO power.
Opt. A2 – United Kingdom power.
Opt. A3 – Australia power.
Opt. A4 – 240 V, North America power.
Opt. A5 – Switzerland power.
Opt. A6 – Japan power.
Opt. A10 – China power.
Opt. A11 – India power.
Opt. A12 – Brazil power.
Opt. A99 – No power cord or AC adapter.

Service
Opt. C3 – Calibration Service 3 Years
Opt. C5 – Calibration Service 5 Years
Opt. D1 – Calibration Data Report
Opt. D3 – Calibration Data Report 3 Years (with Option C3)
Opt. D5 – Calibration Data Report 5 Years (with Option C5)
Opt. G3 – Complete Care 3 Years (includes loaner, scheduled calibration and more)
Opt. G5 – Complete Care 5Years (includes loaner, scheduled calibration and more)
Opt. R3 – Repair Service 3 Years
Opt. R5 – Repair Service 5 Years
Opt. CA1 – Single calibration or coverage for the designated calibration interval, whichever comes first

Upgrades

RSA5UP – Upgrade Options for RSA5103A / RSA5106A

RSA5UP	Option Description	HW or SW	Factory Calibration Required?
Opt. 50	Internal Preamp 1 MHz – 3 GHz (5103) or 1 MHz – 6.2 GHz (5106)	HW	Yes
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 HDD, incompatible with Options 57 or 59	HW	No
Opt. 57	CD/DVD-RW, incompatible with Option 56	HW	No
Opt. 59	Internal HDD, incompatible with Option 56	HW	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. 40	RSA5106A: 40 MHz Acquisition Bandwidth	HW	Yes
Opt. 85	RSA5106A: 85 MHz Acquisition Bandwidth	HW	Yes
Opt. 403	RSA5103A: 40 MHz Acquisition Bandwidth	HW	Yes
Opt. 853	RSA5103A: 85 MHz Acquisition Bandwidth	HW	Yes
Opt. 200	Advanced DPX/swept DPX with Density, Time Qualified, and Runt Triggers and Zero-Span DPX	HW	No

Languages

Options	Description
Opt. L0	English Manual
Opt. L5	Japanese Manual
Opt. L7	Simplified Chinese Manual
Opt. L10	Russian Manual

CE

ISO 9001

Product(s) are manufactured in ISO registered facilities.

GPIB IEEE-488

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

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Updated 25 May 2010

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**

10 Dec 2010 37W-26274-0