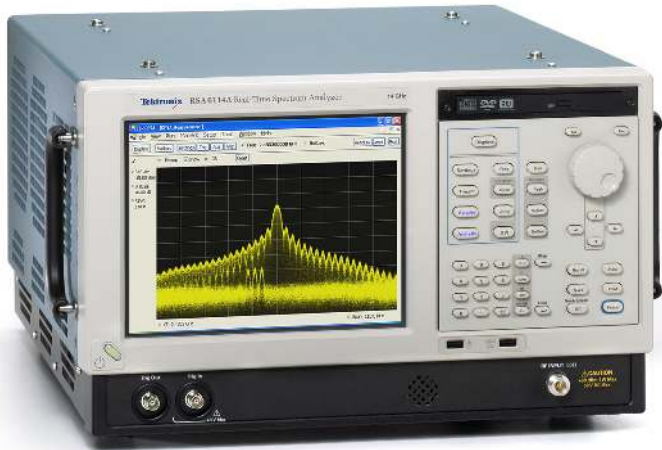


# Spectrum Analyzers

## RSA6000 Series Data Sheet



### Features & Benefits

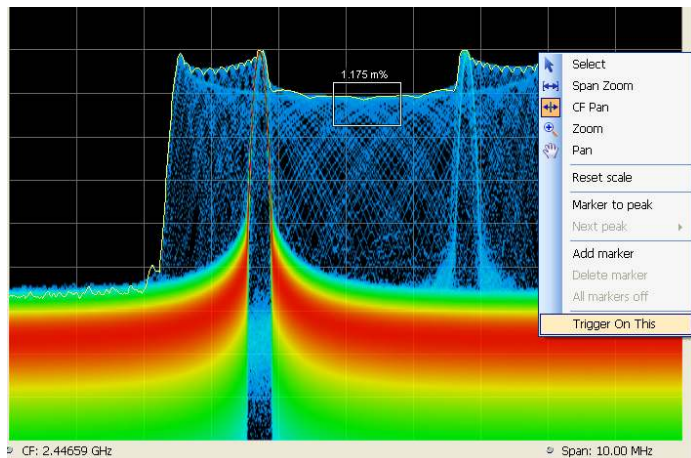
#### RSA6000 Series 6.2, 14, and 20 GHz Spectrum Analyzers

- High-performance Spectrum Analysis
  - 20 dBm 3<sup>rd</sup> Order Intercept at 2 GHz, Typical
  - Displayed Average Noise Level -151 dBm/Hz at 2 GHz (-170 dBm/Hz, Preamp On, typical) enables Low-level Signal Search
  - $\pm 0.5$  dB Absolute Amplitude Accuracy to 3 GHz for High Measurement Confidence
  - Fully Preselected and Image Free at All Times for Maximum Dynamic Range at Any Acquisition Bandwidth
  - Fastest High-resolution Sweep Speed: 1 GHz sweep in 10 kHz RBW in less than 1 second
- Discover
  - DPX<sup>®</sup> Spectrum Processing provides an Intuitive Understanding of Time-varying RF Signals with Color-graded Displays based on Frequency of Occurrence
  - Revolutionary DPX Displays Transients with a Minimum Event Duration of 3.7  $\mu$ s
  - Swept DPX Spectrum enables Unprecedented Signal Discovery over Full Instrument Span

- Trigger
  - Trigger on Frequency Edge or Power Level Transients with a Minimum Event Duration of 3.8  $\mu$ s in the Frequency Domain, 9.1 ns in Time Domain
  - DPX Density<sup>™</sup> Trigger Activated Directly from DPX Display
  - Time-qualified and Runt Triggers Trap Elusive Transients
  - Frequency Mask Trigger Captures Any Change in Frequency Domain
- Capture
  - Up to 1.7 s Acquisitions at 110 MHz Bandwidth can be Directly Stored as MATLAB<sup>™</sup> Compatible Files
  - Gap-free Spectrogram Records up to 4444 Days of Spectral Information for Analysis and Replay
  - Interfaces with TekConnect<sup>®</sup> Probes for RF Probing
- Analyze
  - Time-correlated Multidomain Displays for Quicker Understanding of Cause and Effect when Troubleshooting
  - Power, Spectrum, and Statistics Measurements help you Characterize Components and Systems: Channel Power, ACLR, Power vs. Time, CCDF, OBW/EBW, and Spur Search
  - AM/FM/PM Modulation and Audio Measurements (Opt. 10)
  - Phase Noise and Jitter Measurements (Opt. 11)
  - Settling Time Measurements, Frequency, and Phase (Opt. 12)
  - Pulse Measurements (Opt. 20) – Over 20 Vector and Scalar Parameters including Rise Time, Pulse Width, Pulse-to-Pulse Phase provide Deep Insight into Pulse Train Behavior
  - General Purpose Digital Modulation Analysis (Opt. 21) provides Vector Signal Analyzer Functionality for Over 20 Modulation Types
  - Flexible OFDM analysis of 802.11a/g/j and WiMAX 802.16-2004

### Applications

- Spectrum Management – Find Interference and Unknown Signals
- Radar/EW – Full Characterization of Pulsed and Hopping Systems Characterize Radar and Pulsed RF Signals
- RF Debug – Components, Modules, and Systems
- Radio/Satellite Communications – Analyze Time-variant Behavior of Cognitive Radio and Software-defined Radio Systems
- EMI Diagnostics – Increase Confidence that Designs will Pass Compliance Testing



Revolutionary DPX<sup>®</sup> spectrum display reveals transient signal behavior that helps you discover instability, glitches, and interference. Here, an infrequently occurring transient is seen in detail. The frequency of occurrence is color-graded, indicating the infrequent transient event in blue and the noise background in red. The DPX Density™ Trigger is activated, seen in the measurement box at the center of the screen, and Trigger On This™ has been activated. Any signal density greater than the selected level causes a trigger event.

## High-performance Spectrum and Vector Signal Analysis, and a Lot More

The RSA6000 Series replaces conventional high-performance signal analyzers, offering the measurement confidence and functionality you demand for everyday tasks. A typical 20 dBm TOI and -151 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. The RSA6000 Series uses broadband preselection filters that are always in the signal path. 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 is standard, including Channel Power, ACLR, CCDF, Occupied Bandwidth, AM/FM/PM,

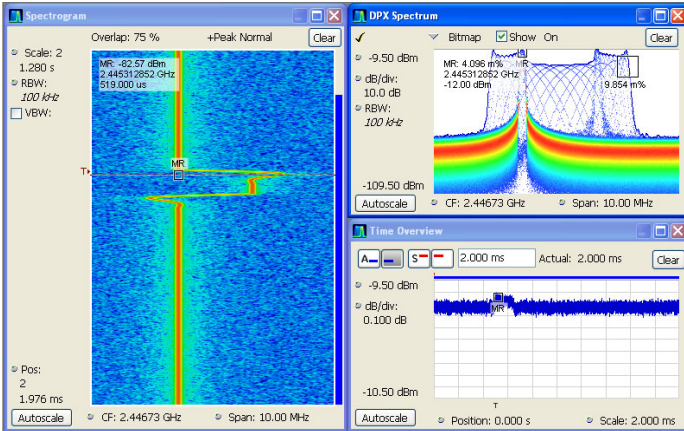
and Spurious measurements. Available Phase Noise and General Purpose Modulation Analysis measurements round out the expected set of high-performance analysis tools.

But, just being a high-performance signal analyzer is not sufficient to meet the demands of today's hopping, transient signals.

The RSA6000 Series will help you to easily discover design issues that other signal analyzers may miss. The revolutionary DPX<sup>®</sup> 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<sup>®</sup>, the RSA6000 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<sup>®</sup> spectrum processing engine brings live analysis of transient events to spectrum analyzers. Performing up to 292,968 frequency transforms per second, transients of a minimum event duration of 3.7  $\mu$ s 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  $\mu$ s to 6400 s per line.



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 RSA6000 Series provides unique triggers essential for troubleshooting modern digitally implemented RF systems. Trigger types include time-qualified power, runt, density, and frequency mask.

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 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 RSA6000 Series deep memory. Record lengths vary depending upon the selected acquisition bandwidth – up to 1.7 seconds at 110 MHz, 81.9 seconds at 1 MHz, or 1.46 hours at 10 kHz bandwidth with FMT / Deep Memory (Opt. 02). 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 be stored in MATLAB™ Level 5 format for offline analysis.

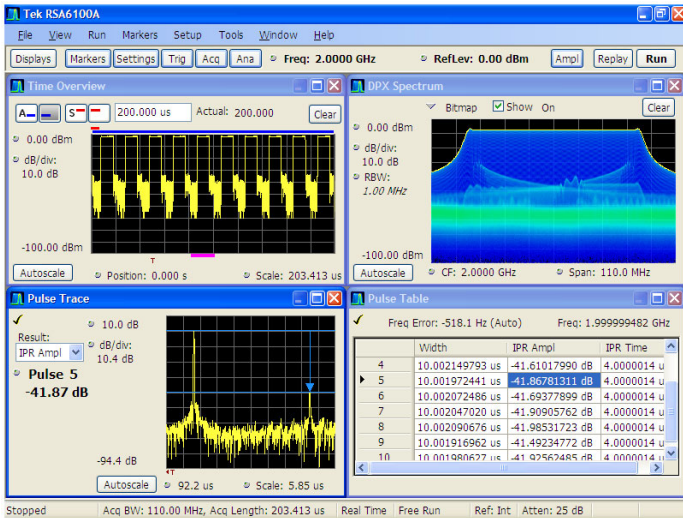
## Analyze

The RSA6000 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.

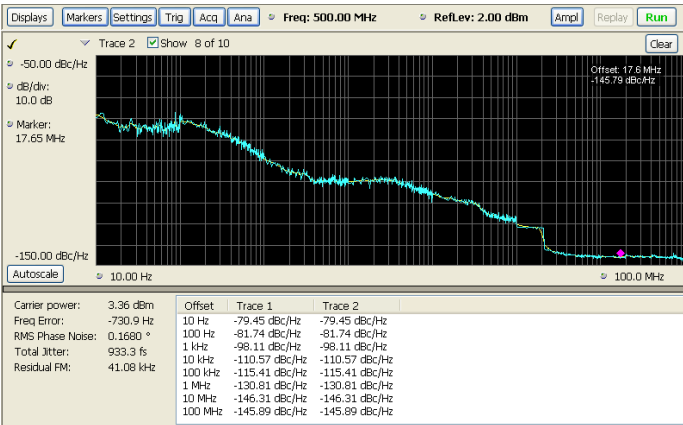
The measurement capabilities of the RSA6000 Series and available options and software packages are summarized below:

## Measurement Functions

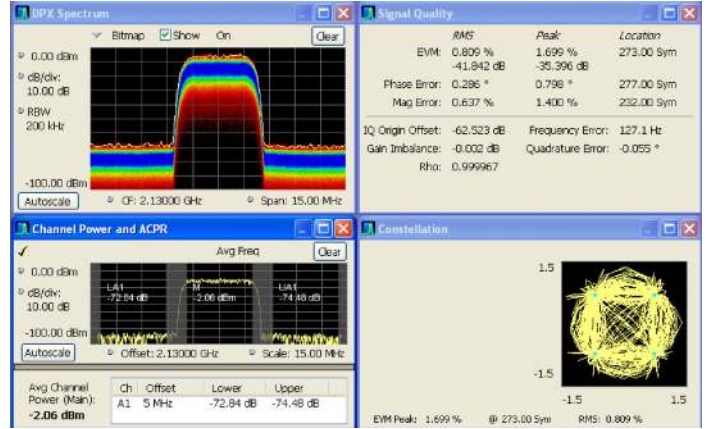
| Measurements  | Description  |
|---|--|
| Spectrum Analyzer Measurements                        | Channel Power, Adjacent Channel Power, Multicarrier Adjacent Channel Power/Leakage Ratio, Occupied Bandwidth, xdB Bandwidth, dBm/Hz Marker, dBc/Hz Marker, Spectrum Emissions Mask   |
| Time Domain and 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 Measurements (Standard)             | % Amplitude Modulation (+Peak, -Peak, RMS, Mod. Depth)<br>Frequency Modulation ( $\pm$ Peak, +Peak to -Peak, RMS, Peak-Peak/2, Frequency Error)<br>Phase Modulation ( $\pm$ Peak, RMS, +Peak to -Peak)   |
| AM/FM/PM Modulation and Audio Measurements (Opt. 10)  | Carrier Power, Frequency Error, Modulation Frequency, Modulation Parameters ( $\pm$ Peak, Peak-Peak/2, RMS), SINAD, Modulation Distortion, S/N, THD, TNHD  |
| Phase Noise and Jitter Measurements (Opt. 11)         | Phase Noise vs. Frequency Offset<br>Offset range 10 Hz to 1 GHz. Measures Carrier Power, Frequency Error, RMS Phase Noise, Integrated Jitter, Residual FM  |
| 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   |
| 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   |
| Flexible OFDM Analysis (Opt. 22)                      | OFDM Analysis for WLAN 802.11a/g/j and WiMAX 802.16-2004   |



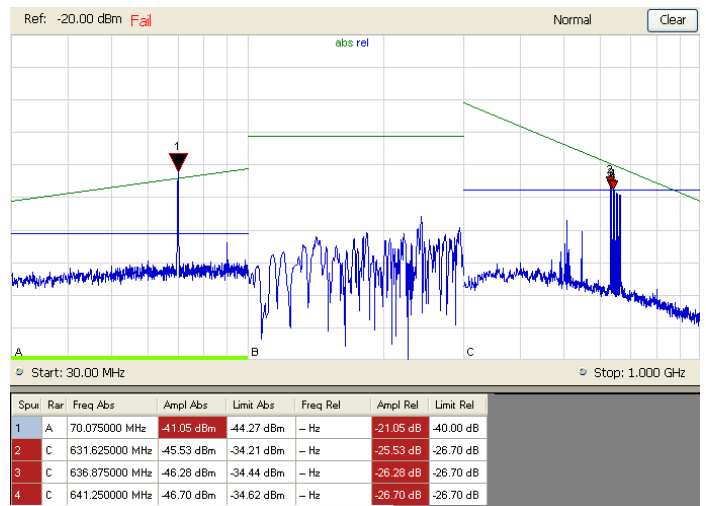
Advanced Signal Analysis package (Opt. 20) offers over 20 automated pulse parameter calculations on every pulse. Easily validate designs with measurements of peak power, pulse width rise time, ripple, droop, overshoot, and pulse-to-pulse phase. Gain insight into linear FM chirp quality with measurements such as Impulse Response and Phase Error. A pulse train (upper left) is seen with automatic calculation of pulse width and impulse response (lower right). A detailed view of the Impulse Response is seen in the lower left, and a DPX® display monitors the spectrum on the upper right.



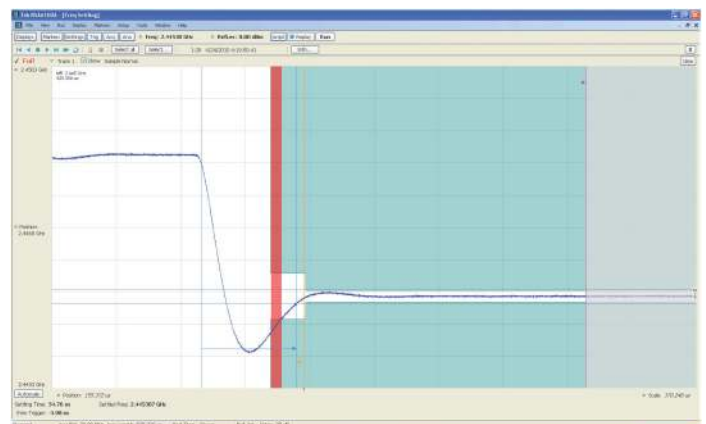
Phase noise and jitter measurements (Opt. 11) adds value to your RSA6000 Series by replacing a conventional phase noise tester for many applications. Phase noise can be measured at carrier offsets up to 1 GHz, and internal phase noise is automatically reduced by optimizing acquisition bandwidths and attenuator settings for each carrier offset for maximum dynamic range. For less critical measurements, speed optimization may be applied for faster results. Typical residual phase noise of -132 dBc/Hz at 1 MHz offset, 0 GHz carrier frequency gives sufficient measurement margin for many applications.



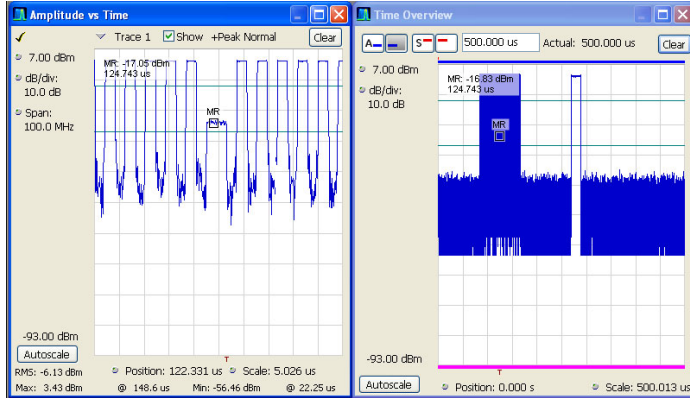
Time-correlated, multidomain views provide a new level of insight into design or operational problems not possible with conventional analysis solutions. Here, ACLR and Vector Modulation Quality (Opt. 21) are performed on a single acquisition, combined with the continuous monitoring of the DPX® spectrum display.



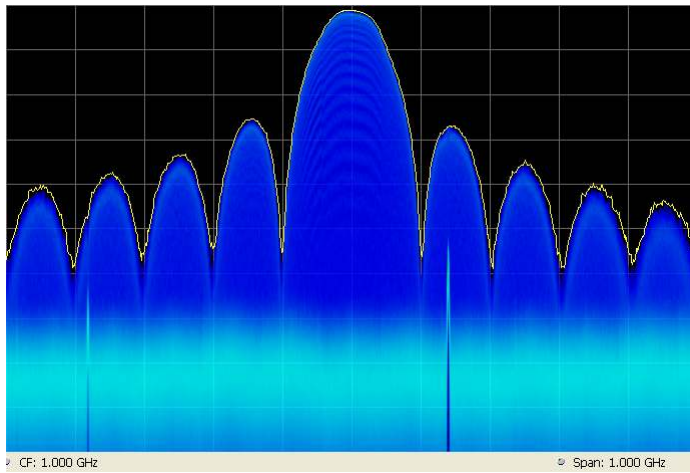
Spurious Search – Up to 20 noncontiguous frequency regions can be defined, each with their own resolution bandwidth, video bandwidth, detector (peak, average, quasi-peak), and limit ranges. Test results can be exported in .CSV format to external programs, with up to 999 violations reported. Spectrum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



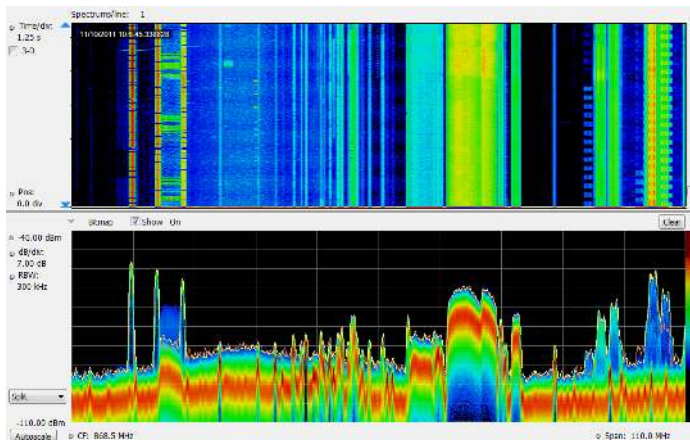
Settling time measurements (Opt. 12) are easy and automated. The user can select measurement bandwidth, tolerance bands, reference frequency (auto or manual), and establish up to 3 tolerance bands vs. time for Pass/Fail testing. Settling time may be referenced to external or internal trigger, and from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



Advanced Triggers and Swept DPX (Opt. 200) combines the revolutionary DPX Density™ Trigger with the ability to trigger on runt pulses and apply time qualification to any trigger. The runt trigger seen here can be used to track down nonconforming pulses in a pulse train, greatly reducing time to insight. Time qualification can be used to separate ranging pulses from higher resolution pulses in a radar signal, or trigger only on signals that remain on longer than a specified time.



Advanced Triggers and Swept DPX (Opt. 200) re-invents the way swept spectrum analysis is done. The DPX engine collects hundreds of thousands of spectrums per second over a 110 MHz bandwidth. Users can now sweep the DPX across the full input range of the RSA6000 Series, up to 20 GHz. In the time a traditional spectrum analyzer has captured one spectrum, the RSA6000 Series has captured orders of magnitude more spectrums. This new level of performance reduces the chance of missing time-interleaved and transient signals during broadband searches.



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.

## Performance You Can Count On

Depend on Tektronix to provide you with performance you can count on. In addition to industry-leading service and support, this product comes backed by a one-year warranty as standard.

## Characteristics

### Frequency Related

| Characteristic                              | Description   |
|---|---|
| Frequency Range                             | 9 kHz to 20 GHz (RSA6120A)<br>9 kHz to 14 GHz (RSA6114A)<br>9 kHz to 6.2 GHz (RSA6106A) |
| Center Frequency Setting Resolution         | 0.1 Hz  |
| Frequency Marker                            | $\pm(RE \times MF + 0.001 \times \text{Span} + 2)$ Hz                                   |
| Readout Accuracy                            |   |
| RE  | Reference Frequency Error   |
| MF  | Marker Frequency (Hz)   |
| Span Accuracy                               | $\pm 0.3\%$ (Auto mode)   |
| Reference Frequency                         |   |
| Initial accuracy at cal                     | $1 \times 10^{-7}$ (after 10 minute warm-up)  |
| Aging per day                               | $1 \times 10^{-9}$ (after 30 days of operation)   |
| Aging per 10 years                          | $3 \times 10^{-7}$ (after 10 years of operation)  |
| Temperature drift                           | $2 \times 10^{-8}$ (0 to 50 °C)   |
| Cumulative error (temperature + aging)      | $4 \times 10^{-7}$ (within 10 years after calibration, typical)                         |
| Reference Output Level                      | >0 dBm (internal reference selected)  |
| Reference Output Level (Loopthrough)        | 0 dB nominal gain from Ext Ref In to Ref Output, +15 dBm max output                     |
| External Reference Input Frequencies        | 1 to 25 MHz (1 MHz steps) + 1.2288 MHz, 4.8 MHz, 19.6608 MHz, 31.07 MHz                 |
| External Reference Input Frequency Accuracy | Must be within $\pm 3 \times 10^{-7}$ of a valid listed input frequency                 |
| Spurious                                    | < -80 dBc within 100 kHz offset to avoid on-screen spurious                             |
| 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. 02), 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 | 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**

| 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) | $\pm 0.5$ dB (level $\geq -50$ dB from reference level)<br>$\pm 1.5$ dB (from $< -50$ dB to $-70$ dB from reference level) |
| Trigger Bandwidth Range   |  |
| (at maximum acquisition BW)   | 4 kHz to 20 MHz + wide open (standard)<br>11 kHz to 60 MHz + wide open (Opt. 110)  |
| Trigger Position Timing Uncertainty                                       |  |
| 40 MHz Acquisition BW, 20 MHz BW  | Uncertainty = $\pm 15$ ns  |
| 110 MHz Acquisition BW, 60 MHz BW (Opt. 110)                              | Uncertainty = $\pm 5$ ns   |
| Trigger Re-Arm Time, Minimum (Fast Frame 'On')                            |  |
| 10 MHz Acquisition BW   | $\leq 25$ $\mu$ s  |
| 40 MHz Acquisition BW   | $\leq 10$ $\mu$ s  |
| 110 MHz Acquisition BW (Opt. 110)   | $\leq 5$ $\mu$ s   |

**Frequency Mask Trigger (Opt. 02)**

| 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*1  |  |
| 0 to $-50$ dB from reference level  | $\pm$ (Channel Response + 1.0 dB)  |
| $-50$ dB to $-70$ dB from reference level   | $\pm$ (Channel Response + 2.5 dB)  |
| Span Range  | 100 Hz to 40 MHz<br>100 Hz to 110 MHz (Opt. 110)   |
| Minimum Event Duration for 100% Probability of Trigger (at maximum acquisition bandwidth, RBW = Auto). Events lasting less than minimum event duration specification will result in degraded Frequency Mask Trigger accuracy. |  |
| Acq. BW 40 MHz  |  |
| Opt. 02 (fixed FFT length)  | 30.7 $\mu$ s   |
| Opt. 02 plus<br>Opt. 200 at<br>specified resolution<br>bandwidths   | 10 MHz: 3.9 $\mu$ s<br>1 MHz: 5.8 $\mu$ s<br>100 kHz: 30.9 $\mu$ s   |
| Acq. BW 110 MHz (Opt. 110)  |  |
| Opt. 02 (fixed FFT length)  | 10.3 $\mu$ s   |
| Opt. 02 plus<br>Opt. 200 at<br>specified resolution<br>bandwidths   | 10 MHz: 3.7 $\mu$ s<br>1 MHz: 5.8 $\mu$ s<br>100 kHz: 37.6 $\mu$ s   |
| Trigger Position Uncertainty  | Span = 40 MHz:<br>$\pm 12.8$ $\mu$ s<br>$\pm 2$ $\mu$ s (Opt. 200, RBW = Auto)<br><br>Span = 110 MHz:<br>$\pm 5.12$ $\mu$ s (Opt. 110)<br>$\pm 2$ $\mu$ s (Opt. 200, RBW = Auto) |

\*1 For masks &gt;30 dB above noise floor.

**Opt. 200 – Advanced Triggers**

| Characteristic   | Description  |
|--|--|
| <b>DPX Density Trigger</b>   |  |
| Density Range  | 0 to 100% density  |
| Horizontal Range   | 0.25 Hz to 40 MHz<br>0.25 Hz to 110 MHz (Opt. 110)   |
| Minimum Signal Duration for 100% Probability of Trigger (at maximum acquisition bandwidth and RBW) | 3.9 $\mu$ s<br>3.7 $\mu$ s (Opt. 110)  |
| Trace Length   | 801 Points   |
| <b>Runt Trigger</b>  |  |
| Runt Definitions   | Positive, Negative   |
| Accuracy   |  |
| (for trigger levels >30 dB above noise floor, 10% to 90% of signal level)                          | $\pm 0.5$ dB (level $\geq -50$ dB from reference level)<br>$\pm 1.5$ 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, Ext. 1, Ext. 2     |
| Time Qualification Range       | T1: 0 to 10 seconds<br>T2: 0 to 10 seconds   |
| Time Qualification Definitions | Shorter than T1<br>Longer than T1<br>Longer than T1 AND shorter than T2<br>Shorter than T1 OR longer than T2 |

**Frequency Edge Trigger**

|                        |   |
|------------------------|---|
| Range                  | $\pm(1/2 \times (\text{Acq. BW or TDBW if active}))$  |
| Minimum Event Duration | 25 ns for 40 MHz Acq. BW using no trigger RBW<br>50 ns for 40 MHz Acq. BW using 20 MHz trigger RBW<br>9.1 ns for 110 MHz Acq. BW using no RBW<br>16.7 ns for 110 MHz Acq. BW using 60 MHz trigger RBW |
| Timing Uncertainty     | Same as Power Trigger Position Timing Uncertainty   |

**Holdoff Trigger**

|       |                     |
|-------|---------------------|
| Range | 20 ns to 10 seconds |
|-------|---------------------|

**External Trigger 1**

| Characteristic  | Description  |
|---|--|
| Level Range   | $-2.5$ V to $+2.5$ V                                     |
| Level Setting Resolution  | 0.01 V   |
| Trigger Position Timing Uncertainty (50 $\Omega$ input impedance) |  |
| 40 MHz Acquisition BW, 40 MHz Span                                | Uncertainty = $\pm 20$ ns                                |
| 110 MHz Acquisition BW, 110 MHz Span (Opt. 110)                   | Uncertainty = $\pm 12$ ns                                |
| Input Impedance   | Selectable 50 $\Omega$ /5 k $\Omega$ impedance (nominal) |

**External Trigger 2**

| Characteristic       | Description     |
|----------------------|-----------------|
| Threshold Voltage    | Fixed, TTL      |
| Input Impedance      | 10 kΩ (nominal) |
| Trigger State Select | High, Low       |

**Trigger Output**

| Characteristic   | Description          |
|------------------|----------------------|
| Voltage          | Output Current <1 mA |
| High             | >2.0 V               |
| Low              | <0.4 V (LVTTTL)      |
| Output impedance | 50 Ω (nominal)       |

**Acquisition Related**

| Characteristic                        | Description   |
|---------------------------------------|---|
| Real-time Acquisition Bandwidth       | 40 MHz (110 MHz, Opt. 110)  |
| A/D Converter                         | 100 MS/s 14 bit (optional 300 MS/s, 14 bit, Opt. 110)   |
| Acquisition Memory Size               | 256 MB (1 GB, Opt. 02)  |
| 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 IQ) | Max Acquisition Time | Max Acquisition Time (Opt. 02) | Time Resolution |
|--------------------|----------------------|----------------------|--------------------------------|-----------------|
| 110 MHz (Opt. 110) | 150 MS/s             | 0.426 s              | 1.706 s                        | 6.6667 ns       |
| 60 MHz (Opt. 110)  | 75 MS/s              | 0.852                | 3.413                          | 13.33 ns        |
| 40 MHz             | 50 MS/s              | 1.28 s               | 5.12 s                         | 20 ns           |
| 20 MHz             | 25 MS/s              | 2.56 s               | 10.2 s                         | 40 ns           |
| 10 MHz             | 12.5 MS/s            | 5.12 s               | 20.5 s                         | 80 ns           |
| 5 MHz              | 6.25 MS/s            | 10.2 s               | 41.0 s                         | 160 ns          |
| 2 MHz*2            | 3.125 MS/s           | 10.2 s               | 41.0 s                         | 320 ns          |
| 1 MHz              | 1.56 MS/s            | 20.5 s               | 81.9 s                         | 640 ns          |
| 500 kHz            | 781 kS/s             | 41.0 s               | 164 s                          | 1.28 μs         |
| 200 kHz            | 390 kS/s             | 81.9 s               | 328 s                          | 2.56 μs         |
| 100 kHz            | 195 kS/s             | 164 s                | 655 s                          | 5.12 μs         |
| 50 kHz             | 97.6 kS/s            | 328 s                | 1310 s                         | 10.24 μs        |
| 20 kHz             | 48.8 kS/s            | 655 s                | 2620 s                         | 20.48 μs        |
| 10 kHz             | 24.4 kS/s            | 1310 s               | 5240 s                         | 40.96 μs        |
| 5 kHz              | 12.2 kS/s            | 2620 s               | 10500 s                        | 81.92 μs        |
| 2 kHz              | 3.05 kS/s            | 10500 s              | 41900 s                        | 328 μs          |
| 1 kHz              | 1.52 kS/s            | 21000 s              | 83900 s                        | 655 μs          |
| 500 Hz             | 762 S/s              | 41900 s              | 168000 s                       | 1.31 ms         |
| 200 Hz             | 381 S/s              | 83900 s              | 336000 s                       | 2.62 ms         |
| 100 Hz             | 190 S/s              | 168300 s             | 671000 s                       | 5.24 ms         |

\*2 In spans ≤2 MHz, higher resolution data is stored, reducing maximum acquisition time.

**Analysis Related**

| Displays by Domain                            | Views  |
|---|--|
| Frequency                                     | Spectrum (Amplitude vs Linear or Log Frequency)<br>DPX® Spectrum Display (Live RF Color-graded Spectrum)<br>Spectrogram (Amplitude vs. Frequency over Time)<br>Spurious (Amplitude vs Linear or Log Frequency)<br>Phase Noise (Phase Noise and Jitter Measurement) (Opt. 11)   |
| Time and Statistics                           | Amplitude vs. Time<br>Frequency vs. Time<br>Phase vs. Time<br>DPX Amplitude vs. Time (Opt. 200)<br>DPX Frequency vs. Time (Opt. 200)<br>DPX Phase vs. Time (Opt. 200)<br>Amplitude Modulation vs. Time<br>Frequency Modulation vs. Time<br>Phase Modulation vs. Time<br>RF IQ vs. Time<br>Time Overview<br>CCDF<br>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<br>Pulse Trace (selectable by pulse number)<br>Pulse Statistics (Trend of Pulse Results, FFT of Trend, and Histogram)  |
| Digital Demod (Opt. 21)                       | Constellation Diagram<br>EVM vs. Time<br>Symbol Table (Binary or Hexadecimal)<br>Magnitude and Phase Error versus Time, and Signal Quality<br>Demodulated IQ vs. Time<br>Eye Diagram<br>Trellis Diagram<br>Frequency Deviation vs. Time  |
| 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  |
| Flexible OFDM Analysis (Opt. 22)              | Constellation, Scalar Measurement Summary, EVM or Power vs. Carrier, Symbol Table (Binary or Hexadecimal)  |
| Acquisition Replay                            | Replay entire contents of acquisition memory or subset of acquisitions and frames. History can collect up to 64,000 acquisitions (each containing one or more frames) or 1 GB of sample data, whichever limit is reached first   |

## RF Spectrum and Analysis Performance

### Bandwidth Related

| Characteristic  | Description   |
|---|---|
| <b>Resolution Bandwidth</b>                               |   |
| Resolution Bandwidth Range (Spectrum Analysis)            | 0.1 Hz to 8 MHz<br>0.1 Hz to 10 MHz (Opt. 110)  |
| Resolution Bandwidth Shape                                | Approximately Gaussian, shape factor 4.1:1 (60:3 dB) $\pm 10\%$ , typical   |
| Resolution Bandwidth Accuracy                             | $\pm 1\%$ (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               |
| <b>Video Bandwidth</b>                                    |   |
| 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)  | $\pm 10\%$  |
| <b>Time Domain Bandwidth (Amplitude vs. Time Display)</b> |   |
| Time Domain Bandwidth Range                               | At least 1/10 to 1/10,000 of acquisition bandwidth, 1 Hz minimum  |
| Time Domain BW Shape                                      | $\leq 10$ MHz, approximately Gaussian, shape factor 4.1:1 (60:3 dB), typical<br>20 MHz (60 MHz, Opt. 110), shape factor $< 2.5:1$ (60:3 dB) typical |
| Time Domain Bandwidth Accuracy                            | 1 Hz to 10 MHz = 1% (Auto-coupled)<br>20 MHz and 60 MHz = 10%   |

### Minimum Settable Spectrum Analysis RBW vs. Span

| Frequency Span      | RBW    |
|---------------------|--------|
| $> 10$ MHz          | 100 Hz |
| $> 1$ MHz to 10 MHz | 10 Hz  |
| $> 5$ kHz to 1 MHz  | 1 Hz   |
| $\leq 5$ 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, $\pm$ 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  |

## DPX® Digital Phosphor Spectrum Processing

| Characteristic  | DPX (Standard)   | Advanced DPX (Opt. 200)                                     |
|---|--|---|
| Spectrum Processing Rate (RBW = Auto, Trace Length 801)                 | 48,828/s   | 292,968/s   |
| DPX Bitmap Resolution   | 201 $\times$ 501                                       | 201 $\times$ 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 $\mu$ s (24 $\mu$ s, Opt. 110)                      | 5.8 $\mu$ s (3.7 $\mu$ s, Opt. 110)                         |
| Span Range (Continuous processing)                                      | 100 Hz to 40 MHz (110 MHz with Opt. 110)               | 100 Hz to 40 MHz (110 MHz with Opt. 110)                    |
| 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%   | 7%  |

### DPX® Zero-span Amplitude, Frequency, Phase Performance, Opt. 200 (Nominal)

| Characteristic                                       | Description  |
|--|--|
| 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                       | $\pm 1\%$  |
| Sweep Time Range                                     | 100 ns (minimum)<br>1 s (maximum, measurement BW $> 60$ MHz)<br>2000 s (maximum, measurement BW $\leq 60$ MHz) |
| Time Accuracy  | $\pm (0.5\% + \text{Reference Frequency Accuracy})$  |
| Zero-span Trigger Timing Uncertainty (Power trigger) | $\pm (\text{Zero-span Sweep Time} / 400)$ at trigger point   |
| DPX Frequency Display Range                          | $\pm 100$ MHz maximum  |
| DPX Phase Display Range                              | $\pm 200$ degrees maximum, phase-wrapped<br>$\pm 500G$ degrees, phase-unwrapped                                |

### DPX® Spectrogram Performance

| Characteristic                             | Description   |
|--|---|
| 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<br>Trace Length = 2401: 20,000 traces<br>Trace Length = 4001: 12,000 traces |
| Time Resolution per Line                   | 110 $\mu$ s to 6400 s, user settable  |
| Maximum Recording Time vs. Line Resolution | 6.6 seconds (801 points/trace, 110 $\mu$ s/line) to 4444 days (801 points/trace, 6400 s/line)                 |

**Minimum Signal Duration vs. RBW, Opt. 200  
(Trace Length, 801 Points)**

| Span    | RBW (kHz) | FFT Length | Spectrums/sec | Minimum Signal Duration for 100% POI, $\mu$ s |
|---------|-----------|------------|---------------|---|
| 110 MHz | 10,000    | 1024       | 292,968       | 3.7   |
|         | 1000      | 1024       | 292,968       | 5.8   |
|         | 300       | 2048       | 146,484       | 14.8  |
|         | 100       | 4096       | 73,242        | 37.7  |
|         | 30        | 16384      | 18,311        | 134.7   |
|         | 20        | 32768      | 9,155         | 229.3   |
| 40 MHz  | 10,000    | 1024       | 292,968       | 3.9   |
|         | 1000      | 1024       | 292,968       | 5.8   |
|         | 300       | 1024       | 292,968       | 11.4  |
|         | 100       | 2048       | 146,484       | 30.9  |
|         | 30        | 4096       | 73,242        | 93.8  |
|         | 20        | 8192       | 36,621        | 147.5   |
|         | 10        | 16384      | 18,311        | 295.0   |

**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. Span (DPX®)**

| Acquisition Bandwidth | RBW (Min) | RBW (Min) (Opt. 200) | RBW (Max) (Opt. 200) |
|-----------------------|-----------|----------------------|----------------------|
| 110 MHz               | 640 kHz   | 20 kHz               | 10 MHz               |
| 55 MHz                | 320 kHz   | 10 kHz               | 5 MHz                |
| 40 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                |

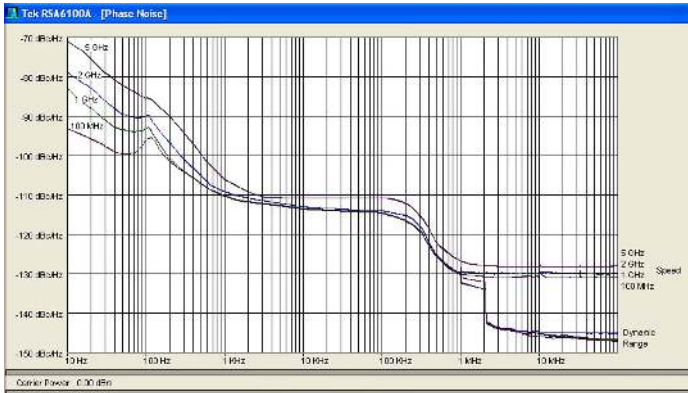
Minimum RBW, Swept Spans (Opt. 200) – 10 kHz.

**Stability**

Residual FM –  $< 2 \text{ Hz}_{p-p}$  in 1 second (95% confidence, typical).

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

| Offset  | CF = 1 GHz |         | CF = 2 GHz | CF = 6 GHz | CF = 10 GHz (RSA6114A) | CF = 10 GHz (RSA6120A) | CF = 18 GHz (RSA6120A) |
|---------|------------|---------|------------|------------|------------------------|------------------------|------------------------|
|         | Spec       | Typical | Typical    | Typical    | Typical                | Typical                | Typical                |
| 100 Hz  | -80        | -86     | -80        | -70        | -64                    | -77                    | -70                    |
| 1 kHz   | -100       | -106    | -106       | -96        | -91                    | -95                    | -93                    |
| 10 kHz  | -106       | -110    | -110       | -107       | -106                   | -111                   | -108                   |
| 100 kHz | -107       | -113    | -111       | -107       | -106                   | -112                   | -111                   |
| 1 MHz   | -128       | -134    | -133       | -132       | -132                   | -130                   | -130                   |
| 6 MHz   | -134       | -142    | -142       | -142       | -142                   | -142                   | -142                   |
| 10 MHz  | -134       | -142    | -142       | -142       | -142                   | -142                   | -142                   |



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 75 dB, 5 dB step   |
| Maximum Safe Input Level   |  |
| Average Continuous (RF ATT $\geq$ 10 dB, Preamp Off)               | +30 dBm  |
| Average Continuous (RF ATT $\geq$ 10 dB, Preamp On)                | +20 dBm  |
| Pulsed RF (RF ATT $\geq$ 30 dB, PW $<$ 5 $\mu$ s, 0.5% Duty Cycle) | 75 W   |
| Maximum Measurable Input Level                                     |  |
| Average Continuous (RF ATT: Auto)                                  | +30 dBm  |
| Pulsed RF (RF ATT: Auto, PW $<$ 5 $\mu$ s, 0.5% Duty Cycle)        | 75 W   |
| Max DC Voltage   | $\pm$ 40 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 $\mu$ V   |
| 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  | $\pm$ 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 - 3 GHz                  | $\pm$ 0.5 dB |
| $>$ 3 GHz - 6.2 GHz             | $\pm$ 0.8 dB |
| $>$ 6.2 GHz - 14 GHz (RSA6114A) | $\pm$ 1.0 dB |
| $>$ 6.2 GHz - 20 GHz (RSA6120A) | $\pm$ 1.0 dB |

### 5 °C to 50 °C, All Attenuator Settings (Typical)

|                                 |              |
|---------------------------------|--------------|
| 9 kHz - 3 GHz                   | $\pm$ 0.7 dB |
| $>$ 3 GHz - 6.2 GHz             | $\pm$ 0.8 dB |
| $>$ 6.2 GHz - 14 GHz (RSA6114A) | $\pm$ 2.0 dB |
| $>$ 6.2 GHz - 20 GHz (RSA6120A) | $\pm$ 2.0 dB |

### Preamp (Opt. 01) On (Atten. = 10 dB)

|                |              |
|----------------|--------------|
| 10 MHz - 3 GHz | $\pm$ 0.7 dB |
|----------------|--------------|

## Amplitude Accuracy

| Characteristic | Description |
|----------------|-------------|
|----------------|-------------|

|   |               |
|---|---------------|
| Absolute Amplitude Accuracy at Calibration Point (100 MHz, -20 dBm signal, 10 dB ATT, 18 °C to 28 °C) | $\pm$ 0.31 dB |
| Input Attenuator Switching Uncertainty  | $\pm$ 0.2 dB  |

### Absolute Amplitude Accuracy at Center Frequency, 95% Confidence\*3

|                   |              |
|-------------------|--------------|
| 10 MHz to 3 GHz   | $\pm$ 0.5 dB |
| 3 GHz to 6.2 GHz  | $\pm$ 0.8 dB |
| 6.2 GHz to 20 GHz | $\pm$ 1.5 dB |

### VSWR (Typical)

(Atten. = 10 dB, Preamp Off, CF set within 200 MHz of VSWR Test Frequency)

|                                   |           |
|-----------------------------------|-----------|
| 10 MHz to 4 GHz                   | $<$ 1.6:1 |
| 4 GHz to 6.2 GHz                  | $<$ 1.8:1 |
| 6.2 GHz to 20 GHz (RSA6114A only) | $<$ 1.9:1 |

### VSWR with Preamp (Typical)

(Atten. = 10 dB, Preamp On, CF set within 200 MHz of VSWR Test Frequency)

|                 |           |
|-----------------|-----------|
| 10 MHz to 3 GHz | $<$ 1.9:1 |
|-----------------|-----------|

\*3 18 °C to 28 °C, Ref Level  $\leq$  -15 dBm, Attenuator Auto-coupled, Signal Level -15 dBm to -50 dBm. 10 Hz  $\leq$  RBW  $\leq$  1 MHz, after alignment performed.

## Noise and Distortion

### 3rd Order Intermodulation Distortion\*4 (Typical)

| Frequency                 | 3rd Order Intermodulation Distortion, dBc | 3rd Order Intercept, dBm |
|---------------------------|---|--------------------------|
| <b>RSA6106A, RSA6114A</b> |   |                          |
| 9 kHz to 100 MHz          | -77                                       | 13.5                     |
| 100 MHz to 3 GHz          | -80                                       | 15                       |
| 3 GHz to 6.2 GHz          | -84                                       | 17                       |
| 6.2 GHz to 14 GHz         | -84                                       | 17                       |
| <b>RSA6120A</b>           |   |                          |
| 9 kHz to 100 MHz          | -79                                       | 14.5                     |
| 100 MHz to 3 GHz          | -90                                       | 20                       |
| 3 GHz to 6.2 GHz          | -88                                       | 19                       |
| 6.2 GHz to 20 GHz         | -88                                       | 19                       |

\*4 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\*5

| Frequency                       | 2nd Harmonic Distortion, Typical |
|---------------------------------|----------------------------------|
| 10 MHz to 3.1 GHz*5             | < -80 dBc                        |
| >3.1 GHz to 7 GHz*5 (RSA6114)   | < -80 dBc                        |
| >3.1 GHz to 10 GHz*6 (RSA6120A) | < -80 dBc                        |

\*5 -40 dBm at RF input, Attenuator = 0, Preamp Off, typical.

\*6 < -80 dBc, -25 dBm at RF input, Atten = 0, Preamp OFF, Maximize Dynamic Range "RF & IF Optimization" mode.

### Displayed Average Noise Level\*7, Preamp Off

| Frequency            | Specification | Typical     |
|----------------------|---------------|-------------|
| 9 kHz to 10 MHz      | -99 dBm/Hz    | -102 dBm/Hz |
| >10 MHz to 100 MHz   | -149 dBm/Hz   | -151 dBm/Hz |
| >100 MHz to 2.3 GHz  | -151 dBm/Hz   | -153 dBm/Hz |
| >2.3 GHz to 4 GHz    | -149 dBm/Hz   | -151 dBm/Hz |
| >4 GHz to 6.2 GHz    | -145 dBm/Hz   | -147 dBm/Hz |
| <b>RSA6114A Only</b> |               |             |
| 4 GHz to 7 GHz       | -145 dBm/Hz   | -147 dBm/Hz |
| >7 GHz to 14 GHz     | -137 dBm/Hz   | -139 dBm/Hz |
| <b>RSA6120A Only</b> |               |             |
| >6.2 GHz to 8.2 GHz  | -145 dBm/Hz   | -147 dBm/Hz |
| >8.2 GHz to 15 GHz   | -149 dBm/Hz   | -152 dBm/Hz |
| >15 GHz to 17.5 GHz  | -145 dBm/Hz   | -147 dBm/Hz |
| >17.5 GHz to 20 GHz  | -143 dBm/Hz   | -145 dBm/Hz |

\*7 Measured using 1 kHz RBW, 100 kHz span, 100 averages, Best Noise mode, input terminated, Average of Logs detection.

### Preamplifier Performance (Opt. 01)

| Characteristic        | Description   |
|-----------------------|---|
| Frequency Range       | 10 MHz to 3.0 GHz   |
| Noise Figure at 2 GHz | 4 dB  |
| Gain                  | 30 dB   |
| ESD Protection Level  | 1 kV (Human Body Model)<br>RSA6106A Serial Number ≥ B020241<br>RSA6114A Serial Number ≥ B020759<br>RSA6120A Serial Number ≥ B010173 |

### Displayed Average Noise Level\*7, Preamp On (Opt. 01)

| Frequency        | Specification | Typical     |
|------------------|---------------|-------------|
| 10 MHz to 50 MHz | -162 dBm/Hz   | -170 dBm/Hz |
| >50 MHz to 1 GHz | -167 dBm/Hz   | -170 dBm/Hz |
| 1 GHz to 2 GHz   | -168 dBm/Hz   | -170 dBm/Hz |
| 2 GHz to 3 GHz   | -166 dBm/Hz   | -170 dBm/Hz |

\*7 Measured using 1 kHz RBW, 100 kHz span, 100 averages, Best Noise mode, input terminated, Average of Log detection.

### Residual Response\*8

| Frequency                    | Spec              |
|------------------------------|-------------------|
| 40 MHz to 200 MHz            | -90 dBm           |
| >200 MHz to 6.2 GHz          | -95 dBm           |
| 6.2 GHz to 14 GHz (RSA6114A) | -95 dBm (typical) |
| 6.2 GHz to 20 GHz (RSA6120A) | -95 dBm (typical) |

\*8 Input terminated, RBW = 1 kHz, Attenuator = 0 dB.

### Image Response\*9

| Frequency                            | Spec      |
|--------------------------------------|-----------|
| 9 kHz to 6.2 GHz                     | < -80 dBc |
| 6.2 GHz to 8 GHz (RSA6114A/RSA6120A) | < -80 dBc |
| >8 GHz to 14 GHz (RSA6114A)          | < -76 dBc |
| >6.2 GHz to 20 GHz (RSA6120A)        | < -76 dBc |

\*9 Ref = -30 dBm, Attenuator = 10 dB, RF Input Level = -30 dBm, RBW = 10 Hz.

### Spurious Response with Signal\*10

| Frequency                     | Span ≤40 MHz, Swept Spans >40 MHz |         | Opt. 110 40 MHz < Span ≤ 110 MHz |         |
|-------------------------------|-----------------------------------|---------|----------------------------------|---------|
|                               | Specification                     | Typical | Specification                    | Typical |
| 30 MHz to 6.2 GHz             | -73 dBc                           | -78 dBc | -73 dBc                          | -75 dBc |
| ≥6.2 GHz to 14 GHz (RSA6114A) | -70 dBc                           | -75 dBc | -70 dBc                          | -75 dBc |
| >6.2 GHz to 20 GHz (RSA6120A) | -70 dBc                           | -75 dBc | -70 dBc                          | -75 dBc |

\*10 RF Input Level = -15 dBm, Attenuator = 10 dB, Offset ≥400 kHz, Mode: Auto. Input signal at center frequency. Performance level for signals offset from center frequency typically the same.

### Spurious response with signal at 4.75 GHz: < 62 dBc

(CF 9 kHz to 8 GHz, Ref = -30 dBm, Atten = 10 dB, RBW = 1 kHz)

Signal Frequency Range = 4.7225 to 4.7775 GHz, RF Input Level = -30 dBm

### Local Oscillator Feed-through to Input Connector < -65 dBm

(typical, attenuator = 10 dB)

**Adjacent Channel Leakage Ratio Dynamic Range\*11**

| Signal Type,<br>Measurement Mode | ACLR, Typical |           |
|----------------------------------|---------------|-----------|
|                                  | Adjacent      | Alternate |
| 3GPP Downlink, 1 DPCH            |               |           |
| Uncorrected                      | -70 dB        | -70 dB    |
| Noise Corrected                  | -79 dB        | -79 dB    |
| 3GPP TM1 64 Channel              |               |           |
| Uncorrected                      | -69 dB        | -69 dB    |
| Noise Corrected                  | -78 dB        | -78 dB    |

\*11 Measured with test signal amplitude adjusted for optimum performance. (CF = 2.13 GHz)

**IF Frequency Response and Phase Linearity\*12**

| Frequency<br>Range       | Specification     |               | Typical (RMS)<br>Amplitude/Phase |
|--------------------------|-------------------|---------------|----------------------------------|
|                          | Acq.<br>Bandwidth | Specification |                                  |
| 0.01 to 6.2*13           | ≤300 kHz          | ±0.10 dB      | 0.05 dB/0.1°                     |
| 0.03 to 6.2              | ≤40 MHz           | ±0.30 dB      | 0.20 dB/0.5°                     |
| >6.2 to 14<br>(RSA6114A) | ≤300 kHz          | ±0.10 dB      | 0.05 dB/0.1°                     |
| >6.2 to 14<br>(RSA6114A) | ≤40 MHz           | ±0.50 dB      | 0.40 dB/1.0°                     |
| >6.2 to 20<br>(RSA6120A) | ≤300 kHz          | ±0.10 dB      | 0.05 dB/0.1°                     |
| >6.2 to 20<br>(RSA6120A) | ≤40 MHz           | ±0.50 dB      | 0.40 dB/1.0°                     |
| <b>Opt. 110</b>          |                   |               |                                  |
| 0.07 to 3.0              | ≤110 MHz          | ±0.50 dB      | 0.30 dB/1.0°                     |
| >3 to 6.2                | ≤110 MHz          | ±0.50 dB      | 0.40 dB/1.0°                     |
| >6.2 to 14<br>(RSA6114A) | ≤80 MHz           | ±0.75 dB      | 0.70 dB/1.5°                     |
| >6.2 to 14<br>(RSA6114A) | ≤110 MHz          | ±1.0 dB       | 0.70 dB/1.5°                     |
| >6.2 to 20<br>(RSA6120A) | ≤80 MHz           | ±0.75 dB      | 0.70 dB/1.5°                     |
| >6.2 to 20<br>(RSA6120A) | ≤110 MHz          | ±1.0 dB       | 0.70 dB/1.5°                     |

\*12 Amplitude flatness and phase deviation over the acquisition BW, includes RF frequency response. Attenuator Setting: 10 dB. For RSA6106A S/N ≥ B020214 and RSA6114A S/N ≥ B020630.

\*13 High Dynamic Range mode selected.

**Analog IF and Digital IQ Output (Opt. 05)**

| Characteristic  | Description   |
|---|---|
| <b>Analog IF Output</b>                               |   |
| Frequency   | 500 MHz<br>Output frequency varies ±1 MHz with changes in center frequency. Sidebands may be frequency inverted from input, depending on center frequency   |
| Output Level  | +3 to -10 dBm for peak signal level of -20 dBm at RF mixer (typical)  |
| Filter control  | Wide open (square top) or 60 MHz Gaussian   |
| Bandwidth (wide open)                                 | >150 MHz (typical)  |
| Bandwidth (Gaussian)                                  | 60 MHz, Gaussian to -12 dB  |
| <b>Digital IQ Output</b>                              |   |
| 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<br>Q data: 16 bit LVDS  |
| Control Output  | Clock: LVDS, 150 MHz – Acquisition Bandwidth >40 MHz, 50 MHz – Acquisition Bandwidth ≤40 MHz, 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. 110)   |
| Data Transition to Clock Rising Edge (Setup time)     | 8.2 ns (typical, standard), 1.54 ns (typical, Opt. 110)   |

**AM/FM/PM and Direct Audio Measurement (Opt. 10)**

Characteristics (typical) for input frequencies <2 GHz, RBW: Auto, Averaging: Off, Filters: Off

| Characteristic | Description |
|----------------|-------------|
|----------------|-------------|

**Analog Demodulation**

|   |   |
|---|---|
| Carrier Frequency Range (for modulation and audio measurements) | 9 kHz or (1/2 × Audio Analysis Bandwidth) to maximum input frequency. Distortion and noise performance reduced below 30 MHz |
|---|---|

|                              |        |
|------------------------------|--------|
| 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) (Rate: 1 to 100 kHz, Depth: 50%)**

|     |       |
|-----|-------|
| THD | 0.16% |
|-----|-------|

|            |       |
|------------|-------|
| Distortion | 0.13% |
|------------|-------|

|       |       |
|-------|-------|
| SINAD | 58 dB |
|-------|-------|

**Characteristic Description****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**

**Note:** Direct input (unmodulated) audio measurements are limited by the low-frequency input range of 9 kHz in the RSA6000 Series.

|                    |  |
|--------------------|--|
| 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) | 9 kHz to 10 MHz |
|--|-----------------|

|                              |        |
|------------------------------|--------|
| Maximum Audio Frequency Span | 10 MHz |
|------------------------------|--------|

|                          |         |
|--------------------------|---------|
| Audio Frequency Accuracy | ±0.2 Hz |
|--------------------------|---------|

|                       |         |
|-----------------------|---------|
| Signal Power Accuracy | ±1.5 dB |
|-----------------------|---------|

**Residuals (Rate: 10 kHz, Input Level: 1.0 V)**

|     |      |
|-----|------|
| THD | 0.1% |
|-----|------|

|            |      |
|------------|------|
| Distortion | 0.8% |
|------------|------|

|       |       |
|-------|-------|
| SINAD | 42 dB |
|-------|-------|

**Phase Noise and Jitter Measurement (Opt. 11)****Characteristic Description**

|                         |   |
|-------------------------|---|
| Carrier Frequency Range | 30 MHz to Maximum Instrument Frequency – Less selected Frequency Offset Range |
|-------------------------|---|

|              |  |
|--------------|--|
| 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<br>Maximum Offset from Carrier: 1 GHz |
|--|--|

|                  |   |
|------------------|---|
| Number of Traces | 2 |
|------------------|---|

|                                 |   |
|---------------------------------|---|
| Trace and Measurement Functions | Detection: Average or ±Peak<br>Smoothing: Averaging<br>Optimization: Speed or Dynamic Range |
|---------------------------------|---|

**Settling Time, Frequency, and Phase (Opt. 12)\*<sup>14</sup>****Settled Frequency Uncertainty, 95% Confidence (Typical), at Stated Measurement Frequencies, Bandwidths, and # of Averages**

| Measurement Frequency, Averages | Frequency Uncertainty at Stated Measurement Bandwidth |        |        |         |
|---------------------------------|---|--------|--------|---------|
|                                 | 110 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 |        |       |
|---------------------------------|---|--------|-------|
|                                 | 110 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° |

\*<sup>14</sup> Measured input signal level > -20 dBm, Attenuator: Auto.**Frequency and Phase Error Referenced to Nonchirped Signal**At stated frequencies and measurement bandwidths\*<sup>17</sup>, 95% confidence.

| Bandwidth          | CF: 2 GHz           |                  |                   | CF: 10 GHz          |                  |                   | CF: 20 GHz          |                  |                   |
|--------------------|---------------------|------------------|-------------------|---------------------|------------------|-------------------|---------------------|------------------|-------------------|
|                    | Abs. Freq Err (RMS) | Pulse-Pulse Freq | Pulse-Pulse Phase | Abs. Freq Err (RMS) | Pulse-Pulse Freq | Pulse-Pulse Phase | Abs. Freq Err (RMS) | Pulse-Pulse Freq | Pulse-Pulse Phase |
| 20 MHz             | ±5 kHz              | ±13 kHz          | ±0.3°             | ±5 kHz              | ±40 kHz          | ±0.6°             | ±8 kHz              | ±60 kHz          | ±1.3°             |
| 40 MHz             | ±10 kHz             | ±30 kHz          | ±0.35°            | ±10 kHz             | ±50 kHz          | ±0.75°            | ±20 kHz             | ±60 kHz          | ±1.3°             |
| 60 MHz (Opt. 110)  | ±30 kHz             | ±70 kHz          | ±0.5°             | ±30 kHz             | ±150 kHz         | ±0.75°            | ±50 kHz             | ±275 kHz         | ±1.5°             |
| 110 MHz (Opt. 110) | ±50 kHz             | ±170 kHz         | ±0.6°             | ±50 kHz             | ±150 kHz         | ±0.75°            | ±100 kHz            | ±300 kHz         | ±1.5°             |

\*<sup>17</sup> Pulse ON Power ≥ -20 dBm, signal peak at Reference Level, Attenuator = Auto,  $t_{\text{meas}} - t_{\text{reference}} \leq 10$  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  $t_{\text{rise}}$  or  $t_{\text{fall}}$ . Absolute Frequency Error determined over center 50% of pulse. For RSA6106A S/N ≥ B020214 and RSA6114A S/N ≥ B020630.**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 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), 50 ns (Opt. 110)  |
| Number of Pulses                  | 1 to 10,000  |
| System Rise Time (Typical)        | <25 ns (standard), <10 ns (Opt. 110)   |
| Pulse Measurement Accuracy        | Signal Conditions: Unless otherwise stated, Pulse Width >450 ns (150 ns, Opt. 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<br>Measurement Accuracy (typical): ±2 dB for a signal 40 dB in amplitude and delayed 1% to 40% of the pulse chirp width* <sup>15</sup>  |
| Impulse Response Weighting        | Taylor Window  |

\*<sup>15</sup> 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* <sup>16</sup>          | ±0.3 dB + Absolute Amplitude Accuracy |
| Average Transmitted Power* <sup>16</sup> | ±0.4 dB + Absolute Amplitude Accuracy |
| Peak Power* <sup>16</sup>                | ±0.4 dB + Absolute Amplitude Accuracy |
| Pulse Width                              | ±3% of reading                        |
| Duty Factor                              | ±3% of reading                        |

\*<sup>16</sup> Pulse Width >300 ns (100 ns, Opt. 110).

### Frequency and Phase Error Referenced to a Linear Chirp

At stated frequencies and measurement bandwidths\*17, 95% confidence.

| Bandwidth          | CF: 2 GHz           |                  |                   | CF: 10 GHz          |                  |                   | CF: 20 GHz          |                  |                   |
|--------------------|---------------------|------------------|-------------------|---------------------|------------------|-------------------|---------------------|------------------|-------------------|
|                    | Abs. Freq Err (RMS) | Pulse-Pulse Freq | Pulse-Pulse Phase | Abs. Freq Err (RMS) | Pulse-Pulse Freq | Pulse-Pulse Phase | Abs. Freq Err (RMS) | Pulse-Pulse Freq | Pulse-Pulse Phase |
| 20 MHz             | ±10 kHz             | ±25 kHz          | ±0.4°             | ±15 kHz             | ±30 kHz          | ±0.9°             | ±25 kHz             | ±50 kHz          | ±1.8°             |
| 40 MHz             | ±12 kHz             | ±40 kHz          | ±0.4°             | ±15 kHz             | ±50 kHz          | ±1.0°             | ±30 kHz             | ±130 kHz         | ±2.0°             |
| 60 MHz (Opt. 110)  | ±60 kHz             | ±130 kHz         | ±0.5°             | ±60 kHz             | ±150 kHz         | ±1.0°             | ±75 kHz             | ±200 kHz         | ±2.0°             |
| 110 MHz (Opt. 110) | ±75 kHz             | ±275 kHz         | ±0.6°             | ±75 kHz             | ±300 kHz         | ±1.0°             | ±125 kHz            | ±500 kHz         | ±2.0°             |

\*17 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. For RSA6106A S/N ≥ B020214 and RSA6114A S/N ≥ B020630.

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

### Digital Modulation Analysis (Opt. 21)

| Characteristic      | Description   |
|---------------------|---|
| Modulation Formats  | $\pi/2$ DBPSK, BPSK, SBPSK, QPSK, DQPSK, $\pi/4$ DQPSK, D8PSK, D16PSK, 8PSK, OQPSK, SOQPSK, CPM, 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<br>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 RSA6000 Series)  |

### Digital (Opt. 21)

| Symbol Rate                                   | Residual EVM (Typical) |
|---|------------------------|
| <b>QPSK Residual EVM*18</b>                   |                        |
| 100 kS/s                                      | <0.35%                 |
| 1 MS/s  | <0.35%                 |
| 10 MS/s                                       | <0.6%                  |
| 30 MS/s                                       | <1.5%                  |
| 80 MS/s (Opt. 110)                            | <2.0%                  |
| <b>256 QAM Residual EVM*19</b>                |                        |
| 10 MS/s                                       | <0.4%                  |
| 30 MS/s                                       | <0.8%                  |
| 80 MS/s (Opt. 110)                            | <0.8%                  |
| <b>Offset QPSK Residual EVM*18</b>            |                        |
| 100 kS/s                                      | <0.5%                  |
| 1 MS/s  | <0.5%                  |
| 10 MS/s                                       | <1.4%                  |
| <b>S-QQPSK (MIL, ARTM) Residual EVM*20</b>    |                        |
| 4 kS/s, CF = 250 MHz                          | <0.3%                  |
| 20 kS/s                                       | <0.5%                  |
| 100 kS/s                                      | <0.5%                  |
| 1 MS/s  | <0.5%                  |
| <b>S-BPSK (MIL) Residual EVM*21</b>           |                        |
| 4 kS/s, CF = 250 MHz                          | <0.2%                  |
| 20 kS/s                                       | <0.5%                  |
| 100 kS/s                                      | <0.5%                  |
| 1 MS/s  | <0.5%                  |
| <b>CPM (MIL) Residual EVM*21</b>              |                        |
| 4 kS/s, CF = 250 MHz                          | <0.3%                  |
| 20 kS/s                                       | <0.5%                  |
| 100 kS/s                                      | <0.5%                  |
| 1 MS/s  | <0.5%                  |
| <b>2/4/8/16 FSK Residual RMS FSK Error*22</b> |                        |
| 10 kS/s, deviation 10 kHz                     | <0.6%                  |

\*18 CF = 2 GHz, Measurement Filter = root raised cosine, Reference Filter = raised cosine, Analysis Length = 200 symbols.

\*19 CF = 2 GHz, Measurement Filter = root raised cosine, Reference Filter = raised cosine, Analysis Length = 400 symbols.

\*20 CF = 2 GHz unless otherwise noted. Reference Filters: MIL STD, ARTM, Measurement Filter: none.

\*21 CF = 2 GHz unless otherwise noted. Reference Filter: MIL STD.

\*22 CF = 2 GHz. Reference Filter: None, Measurement Filter: None.

**Adaptive Equalizer**

| Characteristic  | Description  |
|---|--|
| Type  | Linear, decision-directed, feed-forward (FIR) equalizer with co-efficient adaptation and adjustable convergence rate |
| Modulation Types Supported                              | BPSK, QPSK, OQPSK, $\pi/2$ DBPSK, $\pi/4$ DQPSK, 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   | 1 to 128 taps  |
| Taps/Symbol: Raised Cosine, Half Sine, No Filter        | 1, 2, 4, 8   |
| Taps/Symbol: Rectangular Filter                         | 1  |
| Equalizer Controls                                      | Off, Train, Hold, Reset  |

**Flexible OFDM Characteristics (Opt. 22)**

| Characteristic              | Description   |
|-----------------------------|---|
| Recallable Standards        | WiMAX 802.16-2004, WLAN 802.11a/g/j   |
| Parameter Settings          | Guard Interval, Subcarrier Spacing, Channel Bandwidth   |
| Advanced Parameter Settings | Constellation Detect: Auto; Manual Select (BPSK, QPSK, 16QAM, 64QAM)<br>Symbol Analysis Offset: (-100% to 0%)<br>Pilot Tracking: Phase, Amplitude, Timing<br>Swap I and Q: Enable/Disable   |
| Summary Measurements        | Symbol Clock Error, Frequency Error, Average Power, Peak-to-Average, CPE<br>EVM (RMS and Peak) for all carriers, pilot carriers, data carriers<br>OFDM Parameters: Number of Symbols, Frequency Error, Symbol Clock Error, IQ Origin Offset, CPE, Average Power, Peak-to-Average Power<br>EVM (RMS and Peak) for all subcarriers, pilot subcarriers, data subcarriers |
| Displays                    | EVM vs. Symbol, vs. Subcarrier<br>Subcarrier Power vs. Symbol, vs. Subcarrier<br>Subcarrier Constellation<br>Symbol Data Table<br>Mag Error vs. Symbol, vs. Subcarrier<br>Phase Error vs. Symbol, vs. Subcarrier<br>Channel Frequency Response  |
| Residual EVM                | -44 dB (WiMAX 802.16-2004, 5 MHz BW)<br>-44 dB (WLAN 802.11g, 20 MHz BW)<br>Signal input power optimized for best EVM   |

**Modulation Analysis Accuracy****Analog (Typical)**

| Modulation               | Description  |
|--------------------------|--|
| AM Demodulation Accuracy | $\pm 2\%$<br>0 dBm input at center<br>Carrier Frequency 1 GHz, 10 to 60% Modulation Depth, 1 kHz/5 kHz Input/Modulated Frequency |
| PM Demodulation Accuracy | $\pm 3^\circ$<br>0 dBm input at center<br>Carrier Frequency 1 GHz, 400 Hz/1 kHz Input/Modulated Frequency                        |
| FM Demodulation Accuracy | $\pm 1\%$ of Span<br>0 dBm input at center<br>Carrier Frequency 1 GHz, 1 kHz/5 kHz Input/Modulated Frequency                     |

**Inputs and Outputs**

| Characteristic                              | Description   |
|---|---|
| <b>Front Panel</b>                          |   |
| Display                                     | Touch panel, 10.4 in. (264 mm)  |
| RF Input Connector                          | N-type female, 50 $\Omega$ (RSA6106A/RSA6114A)<br>3.5 mm male, ruggedized, 50 $\Omega$ (RSA6120A)         |
| Trigger Out                                 | BNC, High: >2.0 V, Low: <0.4 V, output current 1 mA (LVTTTL), 50 $\Omega$                                 |
| Trigger In                                  | BNC, 50 $\Omega/5$ k $\Omega$ impedance (nominal), $\pm 5$ V max input, -2.5 V to +2.5 V trigger level    |
| USB Ports                                   | 1 USB 2.0, 1 USB 1.1  |
| Audio                                       | Speaker   |
| <b>Rear Panel</b>                           |   |
| 10 MHz REF OUT                              | 50 $\Omega$ , BNC, >0 dBm   |
| External REF IN                             | 50 $\Omega$ , BNC, -10 dBm - +6 dBm, 1 to 25 MHz in 1 MHz steps, plus 1.2288, 4.8, 19.6608, and 31.07 MHz |
| External REF IN Frequency Accuracy Required | $\leq \pm 0.3$ ppm  |
| Trig 2 / Gate IN                            | BNC, High: 1.6 to 5.0 V, Low: 0 to 0.5 V  |
| GPIO 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)  |

**General Characteristics**

| Characteristic  | Description  |
|---|--|
| <b>Temperature Range</b>  |  |
| Operating   | +5 °C to +50 °C.<br>(+5 °C to +40 °C when accessing DVD)   |
| Storage   | -20 °C to +60 °C   |
| Warm-up Time  | 20 min.  |
| <b>Altitude</b>   |  |
| Operating   | Up to 3000 m (approximately 10,000 ft.)  |
| Nonoperating  | Up to 12,190 m (40,000 ft.)  |
| <b>Relative Humidity</b>  |  |
| Operating and nonoperating (80% RH max when accessing DVD)                              | 90% RH at 30 °C<br>(No condensation, max wet bulb, 29 °C)  |
| <b>Vibration</b>  |  |
| Operating (except when equipped with Option 06 Removable HDD, or when accessing DVD/CD) | 0.22G <sub>RMS</sub> . Profile = 0.00010 g <sup>2</sup> /Hz at 5-350 Hz, -3 dB/Octave slope from 350-500 Hz, 0.00007 g <sup>2</sup> /Hz at 500 Hz, 3 Axes at 10 min/axis.  |
| Nonoperating  | 2.28G <sub>RMS</sub> . Profile = 0.0175 g <sup>2</sup> /Hz at 5-100 Hz, -3 dB/Octave slope from 100-200 Hz, 0.00875 g <sup>2</sup> /Hz at 200-350 Hz, -3 dB/Octave slope from 350-500 Hz, 0.006132 g <sup>2</sup> /Hz at 500 Hz, 3 Axes at 10 min/axis |
| <b>Shock</b>  |  |
| 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  |
| <b>Safety</b>   |  |
|   | UL 61010-1:2004<br>CSA C22.2 No.61010-1-04   |
| <b>Electromagnetic Compatibility, Complies with:</b>                                    |  |
|   | EU Council EMC Directive 2004/108/EC<br>EN61326, Class A   |
| <b>Power Requirements</b>   |  |
|   | 90 V AC to 240 V AC, 50 Hz to 60 Hz<br>90 V AC to 132 V AC, 400 Hz   |
| Power Consumption   | 450 W max  |
| Data Storage  | Internal HDD, USB ports, DVD±RW (Opt. 07), Removable HDD (Opt. 06)   |
| Calibration Interval  | One year   |
| Warranty  | One year   |
| GPIO  | 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 | 26.4 | 58   |

Note: Physical characteristics, with feet, without accessory pouch.

**Ordering Information****RSA6106A**

Spectrum Analyzer, 9 kHz to 6.2 GHz

**RSA6114A**

Spectrum Analyzer, 9 kHz to 14 GHz

**RSA6120A**

Spectrum Analyzer, 9 kHz to 20 GHz

**All Include:** Quick-start Manual (Printed), Application Guide (Printed), Printable Online Help File, Programmer's manual (on CD), power cord, BNC-N adapter (RSA6106A/RSA6114), SMA Female barrel (RSA6120A), USB Keyboard, USB Mouse, Front Cover, One-year Warranty.

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

**Options**

| Option     | Description   |
|------------|---|
| Opt. 01    | Internal Preamp, 10 MHz to 3 GHz, 30 dB gain, 4 dB Noise Figure at 2 GHz, typical |
| Opt. 02    | 1 GB Acquisition Memory Total, Frequency Mask Trigger                             |
| Opt. 05    | Digital IQ Output and 500 MHz Analog IF Output                                    |
| Opt. 06*23 | ≥80 GB Removable HDD. This removes the internal HDD                               |
| Opt. 07*23 | CD R/W, DVD-R. Includes internal HDD  |
| Opt. 10    | AM/FM/PM Modulation and Audio Measurements  |
| Opt. 11    | Phase Noise and Jitter Measurement  |
| Opt. 12    | Settling Time Measurements (Frequency and Phase)                                  |
| Opt. 20    | Advanced Signal Analysis (including pulse measurements)                           |
| Opt. 21    | General Purpose Digital Modulation Analysis                                       |
| Opt. 22    | Flexible OFDM   |
| Opt. 110   | 110 MHz Real-time Acquisition BW  |
| Opt. 200   | Advanced Triggers and Swept DPX   |
| Opt. 1R    | Rackmount   |

\*23 One of the following mutually exclusive options must be ordered: 06 or 07.

**Accessories**

| Accessory                                     | Description  |
|---|--|
| RTPA2A Spectrum Analyzer Probe Adapter        | Supports TekConnect probe series P7200, P7300, P7300SMA, P7500 compatibility   |
| 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 |
| E and H Near-field Probes                     | For EMI troubleshooting. 119-4146-xx   |
| Additional Removable Hard Drive               | For use with Opt. 06 (Windows XP and instrument SW preinstalled). 065-0751-xx  |
| Additional Removable Hard Drive (Solid State) | For use with Opt. 08 (Windows XP and instrument SW preinstalled). 065-0765-xx  |
| Transit Case                                  | 016-2026-xx  |
| Rackmount Retrofit                            | 016-1962-xx  |
| 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**

| Option   | Description                 |
|----------|-----------------------------|
| 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. A99 | No power cord or AC adapter |

**Service**

| Option   | Description   |
|----------|---|
| 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 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  |
| Opt. R5  | Repair Service 5 Years  |
| Opt. CA1 | Single Calibration or Functional Verification                           |

**Upgrades – RSA6UP**

| Option    | Description  | For Serial Numbers  | HW or SW | Factory Calibration Required? |
|-----------|--|---|----------|-------------------------------|
| Opt. 01   | Internal Preamp, 10 MHz to 3 GHz   | All   | HW       | Yes                           |
| Opt. 02   | 1 GB Memory, Frequency Mask Trigger for S/N  | S/N ≥ B020212 (RSA6106A)<br>S/N ≥ B020603 (RSA6114A)<br>All RSA6120 | SW       | No                            |
| Opt. 2L   | 1 GB Memory, Frequency Mask Trigger for S/N  | S/N < B020212 (RSA6106A)<br>S/N < B020603 (RSA6114A)                | HW       | No                            |
| Opt. 05   | Digital IQ Output and 500 MHz Analog IF Output   | All   | HW       | No                            |
| Opt. 06   | 80 GB Removable HDD. This removes the internal HDD, and is not compatible with Opt. 07 | All   | HW       | No                            |
| Opt. 07   | CD R/W, DVD-R. Includes internal HDD, and is not compatible with Opt. 06               | All   | HW       | No                            |
| Opt. 10   | AM/FM/PM Modulation and Audio Measurements   | All   | SW       | No                            |
| Opt. 11   | Phase Noise and Jitter Measurements  | All   | SW       | No                            |
| Opt. 12   | Settling Time Measurements (Frequency and Phase)                                       | All   | SW       | No                            |
| Opt. 20   | Advanced Signal Analysis (including pulse measurements)                                | All   | SW       | No                            |
| Opt. 21   | General Purpose Digital Modulation Analysis  | All   | SW       | No                            |
| Opt. 22   | Flexible OFDM  | All   | SW       | No                            |
| Opt. 110  | 110 MHz Real-time Acquisition BW   | All S/N ≥ B02xxxx   | SW       | No                            |
| Opt. 110L | 110 MHz Real-time Acquisition BW   | All S/N B01xxxx   | HW       | Yes                           |
| Opt. 200  | Advanced Triggers and Swept DPX (Tektronix installation recommended, add Opt. IF)      | All   | HW       | No                            |
| Opt. IF   | Installation Labor for all purchased options   | All   | —        | —                             |
| Opt. IFC  | Installation Labor + Calibration   | All   | —        | —                             |

**Languages**

| Option   | Description               |
|----------|---------------------------|
| Opt. L0  | English Manual            |
| Opt. L5  | Japanese Manual           |
| Opt. L7  | Simplified Chinese Manual |
| Opt. L10 | Russian Manual            |



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](http://www.tektronix.com)



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