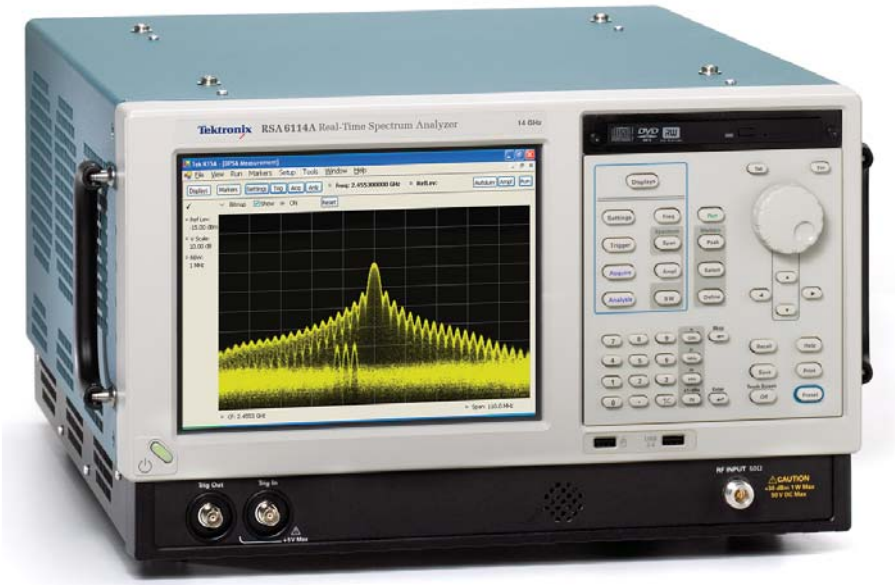
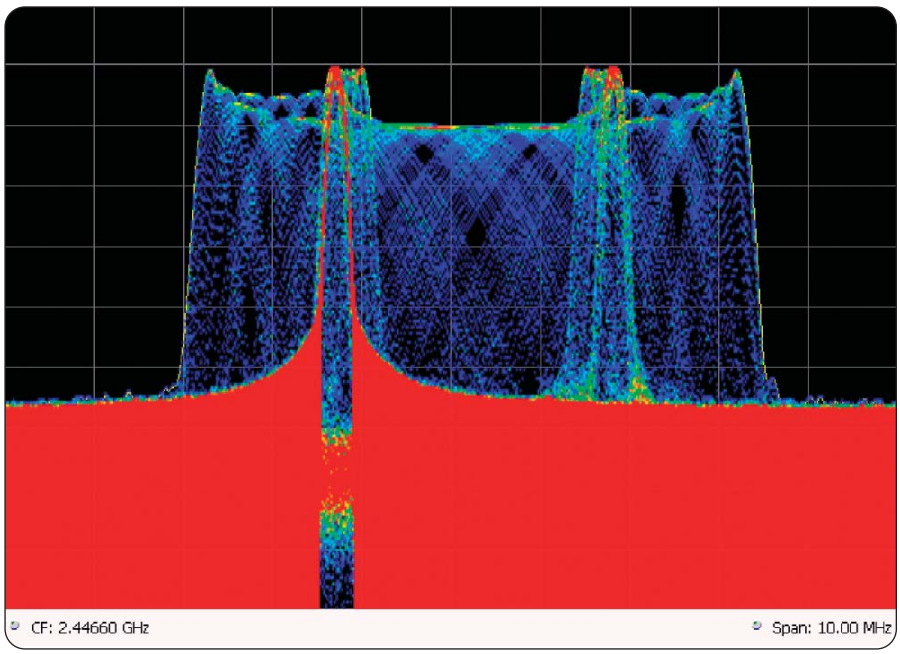
# Real-Time Spectrum Analyzers

## ▶ RSA6100A Series 6.2 GHz and 14 GHz Real-Time Spectrum Analyzers




### Completely Characterize Time-Varying RF Signals

The RSA6100A 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 RSA6100A Series of Real-Time Spectrum Analyzers (RTSA) 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 wide-band vector signal analyzer, a spectrum analyzer and the unique trigger-capture-analyze capability of a Real-Time Spectrum Analyzer — all in a single package.




▶ Revolutionary DPX spectrum display reveals transient signal behavior that helps you discover instability, glitches and interference. Here, 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.

## ▶ Features & Benefits

Discover
- DPX 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 over 48,000 spectrum measurements per second

Trigger
- Tektronix exclusive 40 MHz and 110 MHz frequency mask triggers (FMT) offer easy event-based capture of transient RF signals by triggering on any change in the frequency domain

Capture
- All signals in up to 110 MHz spans are captured into memory
- Up to 1.7 s acquisition length at 110 MHz bandwidth provides complete analysis over time without making multiple acquisitions
- 6.2 GHz and 14 GHz models available
- Fully pre-selected and image-free at all times for full dynamic range at any capture bandwidth
- Interfaces with TekConnect® probes for RF probing

Analyze
- Extensive time-correlated multi-domain displays connect problems in time, frequency, phase and amplitude for quicker understanding of cause and effect when troubleshooting
- Power measurements and signal statistics help you characterize components and systems: ACLR, multi-carrier ACLR, power vs. Time, CCDF, OBW/EBW and spur search
- EMI diagnostics with CISPR and Mil/–6dB filters and CISPR quasi peak average and peak detectors
- Phase noise and jitter measurements (Opt. 11)
- Advanced measurement suite (Opt. 20) – pulse measurements including rise time, pulse width and pulse-to-pulse phase provide deep insight into pulse train behavior
- General purpose digital modulation analysis (Opt. 21) provides vector signal analyzer functionality
- Tektronix OpenChoice® makes for easy transfer to a variety of analysis programs such as Excel and Matlab

## ▶ Applications

- Find interference and unknown signals in spectrum monitoring and management
- Characterize radar and pulsed RF signals
- RF debug components, modules, or systems
- Analyze time variant behavior of cognitive radio and software defined radio systems
- EMI Diagnostics – increase confidence that designs will pass compliance testing
- Capture vector signal parameters of multi-carrier 3G and 4G systems for offline analysis

Tektronix®

### Discover

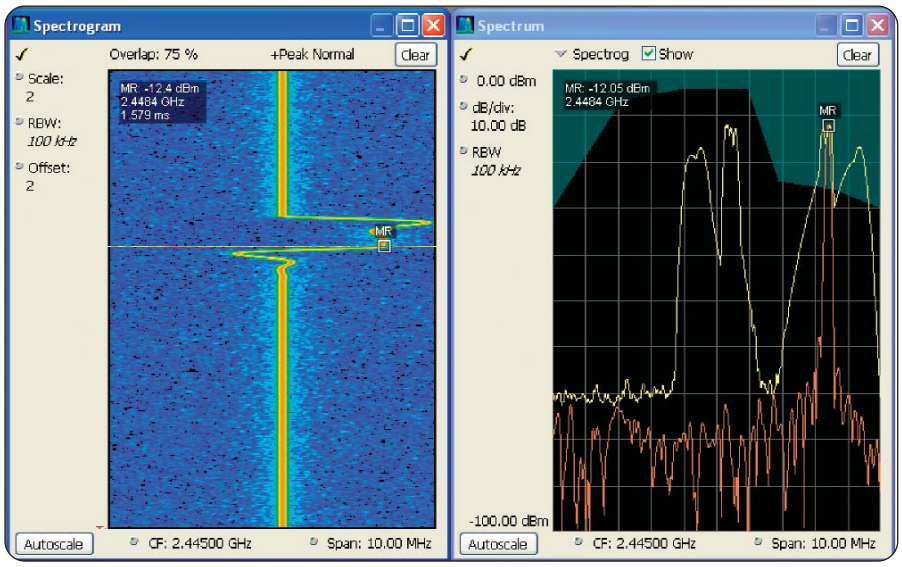
The patented DPX™ spectrum processing engine brings live analysis of transient events to spectrum analyzers. Performing > 48,000 frequency transforms per second, transients as brief as 24 µs in length are displayed in the frequency domain. This is a 500-fold improvement over swept analysis techniques. Events can be color coded by rate of occurrence onto a bit-mapped display, providing unparalleled insight into transient signal behavior.

### Trigger

The patented Tektronix Frequency Mask Trigger (FMT) Opt. 02 makes it easy to capture transient signals in up to a 110 MHz bandwidth. An FMT is simply configured to monitor all changes in frequency occupancy within the capture bandwidth. A Power Trigger, working in the time domain and in any capture bandwidth, can be armed to monitor for a user-set power threshold to be crossed during a moment in time. 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 a capture bandwidth are recorded into the RSA6100A Series deep memory. Record lengths vary depending upon the selected capture 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 Option 02. Real-Time capture of small signals in the presence of large signals is enabled with 73 dB SFDR in all capture bandwidths, even up to 110 MHz (Opt. 110).




► Trigger and Capture: The frequency mask 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 FMT, the frequency domain view (right panel) automatically updates to show the detailed spectrum view at that precise moment in time.

### Analyze

The RSA6100A Series introduces 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. 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.

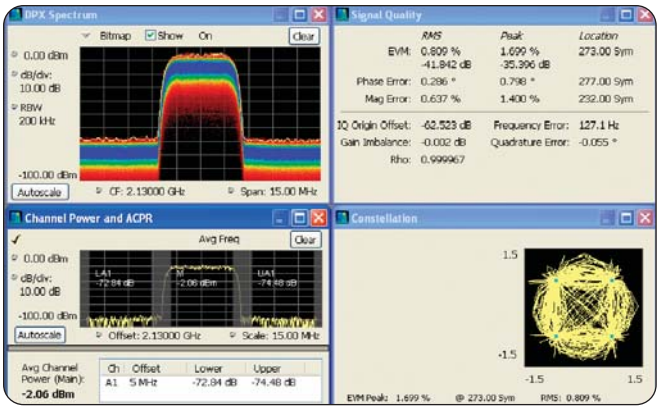
The Windows XP environment makes this multi-domain analysis even easier with an unlimited number of analysis windows, all time-correlated, to provide deeper insight into signal behavior. A user interface that adapts to your preferences (keyboard, front-panel, touchscreen and mouse) makes learning the RSA6100A Series easy for both first time users and experienced hands.

### Options Tailor Your RSA for Specific Applications

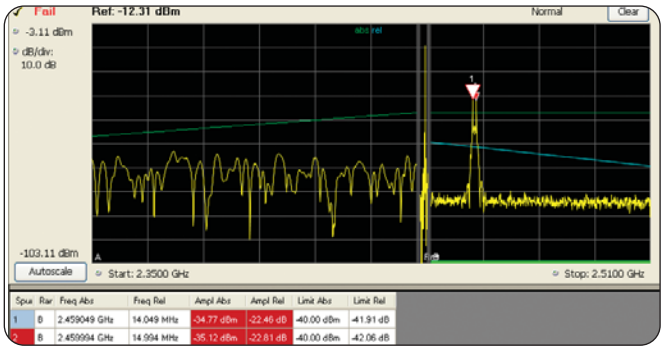
The RSA6100A Series offers options to meet your specific application, whether it be Radar characterization, communications system design, cognitive or software-defined radio research or spectrum management.

## ▶ Example Applications Benefiting from Key RSA61000A Series Standard Capabilities and Options

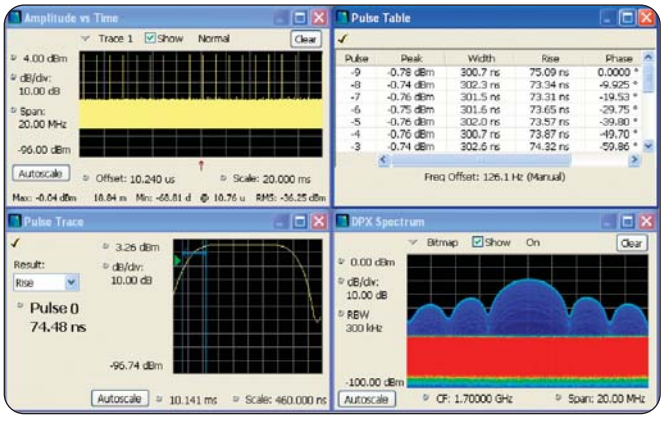
| Analysis Feature | RF Debug | Cellular, WLAN, General Comms | Radar, Pulsed Signals | Spectrum Management |
|---|---|---|---|---|
| DPX™ Spectrum Processing | X | X | X | X |
| Frequency Mask Trigger (Opt. 02) | X | X | X | X |
| 110 MHz Capture Bandwidth (Opt. 110) | X | X | X | X |
| Spectrogram | X | X | X | X |
| Multi-domain Correlation | X | X | X | X |
| Spurious Search with User-Defined Frequency Zones, Filter Types, Limits | X | X | X | X |
| Quasi–Peak Detectors, CISPR and –6 dB Filters for EMI Diagnostics and Troubleshooting | X | X | X | X |
| Phase Noise and Jitter Measurements (Opt. 11) | X | X | X | X |
| Internal Preamplifier (Opt. 01) | X | X | X | X |
| Digital IQ and Analog IF Output (Opt. 05) | X | X | X | X |
| Removable HDD (Opt. 06) | | | X | X |
| General Purpose Digital Modulation Analysis (Opt. 21) | X | X | X | X |
| Advanced (Pulsed) Signal Analysis (Opt. 20) | | | X | X |
| RSAVu Analysis Software | X | X | | X |




▶ Time-correlated, multi-domain view provides 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 – user configurable spur search measurement marks up to 999 limit lines violations.




▶ Pulse measurements, available in the Advanced Signal Analysis package (Opt. 20): A pulse train (upper left) is seen with measurements of peak power, pulse width, rise time and pulse-to-pulse phase (upper right). A detailed view of the pulse rise time is seen in the lower left and a DPX display monitors the spectrum on the lower right.

# ▸ Characteristics

### Trigger-related

**Acquisition Mode –** Single or Continuous, Free Run or Triggered.

**Trigger Event Source –** Trigger 1 (front), Trigger 2/Gate (rear), Line.

**Trigger Types –** Level or Frequency Mask.

**Trigger Setting –** Trigger position settable from 0 to 100% of total acquisition length.

**Trigger Combinational Logic –** Trig 1 AND Trig 2/Gate may be defined as a trigger event.

**Trigger Delay –**
Range: 20 ns to 60 s.
Resolution: 20 ns.
Uncertainty: ±20 ns.

### Power Level Trigger

**Level Range –** 0 dB to –100 dB from reference level.

**Accuracy –** (for trigger levels >30 dB above noise floor, 10% to 90% of signal level).
±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 20 MHz + wide open (standard).
11 kHz to 60 MHz + wide open (Option 110).

**Trigger Position Timing Uncertainty –** 40 MHz Acquisition BW, 20 MHz BW: Uncertainty = ±10 ns.
110 MHz Acquisition BW, 60 MHz BW (Opt. 110): Uncertainty = ±3.3 ns.
Trigger Re-Arm Time, Minimum (Fast-Frame 'On').
10 MHz Acquisition BW ≤ 25 µS.
40 MHz Acquisition BW ≤10 µS.
110 MHz Acquisition BW (Opt. 110) ≤ 5 µS.

### Frequency Mask Trigger (Opt. 02)

**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: ±(IF Frequency Response + 1.0 dB). –50 dB to –70 dB from reference level: ±(IF Frequency Response + 2.5 dB).

**Span Range –** 100 Hz to 40 MHz (Option 02).
100 Hz to 110 MHz (Option 02 + Option 110).

**Minimum Event Duration for 100% Probability of Trigger –** (at maximum acquisition bandwidth).
30.7 µSec (10.3 µSec, Opt. 02 + Opt. 110).
Events lasting less than minimum event duration specification will result in degraded Frequency Mask Trigger accuracy.

**Trigger Position Uncertainty –**
**Span =** 40 MHz – ±12.8 µS.
**Span =** 110 MHz – ±5.12 µS
(Option 02 + Option 110).

*[1] for masks >30 dB above noise floor.

### 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). 40 MHz acquisition BW, 40 MHz.
Span: Uncertainty = ±20 ns.
110 MHz acquisition BW, 110 MHz Span (Opt 110): Uncertainty = ±12 ns.

**Input Impedance –** Selectable 50 Ω/5 kΩ Impedance (nominal).

### External Trigger 2

**Threshold Voltage –** Fixed, TTL.

**Input Impedance –** 10 kΩ (nominal).

**Trigger State Select –** High, low.

### Trigger Output

**Voltage (Output Current <1 mA) –** High: >2.0 V; Low: <0.4 V (LVTTL).

### Capture-related

**Real-Time Capture Bandwidth –** 40 MHz (110 MHz, Opt. 110).

**A/D Converter –** 100 MS/s 14 bit (Optional 300 MS/s, 12 bit, Opt. 110).

**Acquisition Memory Size –** 256 MB (1 GB, Opt. 02).

**Minimum Acquisition Length –** 2 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) | Acquisition Time | Acquisition Time (Option 02) | Min 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*[1] | 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 |

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

## ▸ Analysis-related

| Measurement Functions | Measurements |
|---|---|
| Power and Frequency Measurements | Channel Power, Adjacent Channel Power, Multi Carrier Adjacent Channel Power/Leakage Ratio, Occupied Bandwidth, xdB Down, dBm/Hz Marker, dBc/Hz Marker |
| Time Domain and Statistical Measurements | RF I/Q vs. Time, Power vs. Time, Frequency vs. Time, Phase vs. Time, CCDF, Peak-to-Average Ratio |
| 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 |
| Spur Search Measurement | Up to 20 ranges, User-selected detectors (peak, average, QP), filters (RBW, CISPR, MIL) and VBW in each range. Measurements and violations in absolute power or relative to a carrier. Up to 999 violations identified in tabular form for export in CSV format |
| Advanced Measurements Suite (Option 20) | Rise Time, Fall Time, Pulse Width, Pulse Peak Power, Average Power, Ripple, Pulse Repetition Interval, Duty Cycle, Pulse-Pulse Phase, Pulse-Pulse Frequency, Pulse Frequency Deviation, Pulse Frequency Error, Pulse Phase Deviation, Pulse Phase Error, Droop, Trend, FFT of Trend |
| General Purpose Digital Modulation Analysis (Option 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 |
| 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) |
| Analysis SW (RSAIQWIMAX) | WiMAX 802.16-2004 and 802.16.e standards support |
| Analysis Software (RSALTE) | 3GPP Release 8 LTE standards support |

| Displays by Domain | Views |
|---|---|
| Frequency | Spectrum (Amplitude vs. Frequency)<br>DPX™ Spectrum Display (Live RF Color-Graded Spectrum)<br>Spectrogram (Amplitude vs. Frequency over Time)<br>Phase Noise (Phase Noise and Jitter Measurement) (Opt. 11) |
| Time and Statistics | Frequency vs. Time<br>Amplitude vs. Time<br>Phase vs. Time<br>RF I&Q vs. Time<br>Time Overview<br>CCDF<br>Peak-to-Average-Ratio |
| Advanced Measurements Suite (opt. 20) | Pulse Results Table<br>Pulse Trace (Selectable by pulse number)<br>Pulse Statistics (Trend of Pulse Results and FFT of Trend) |
| Digital Demod (Option 21) | Constellation diagram<br>EVM vs. Time<br>Symbol Table (Binary or Hexadecimal<br>Magnitude and Phase error versus time and signal quality |

### Spectrum Display Traces, Detectors and Functions

**Traces –** Three traces + 1 math waveform + 1 trace from spectrogram for spectrum display.

**Detector –** Peak, - peak, average.

**Trace Functions –** Normal, Average, Max Hold, Min Hold.

**Spectrum Trace Length –** 801, 2401, 4001, 8001 or 10401 points.

### RF Performance

### Frequency

**Frequency Range –** 9 kHz to 6.2/14 GHz (RSA6106A/RSA6114A).

**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 x MF + 0.001 x Span + 2) Hz.
**RE –** Reference Frequency Error.
**MF –** Marker Frequency (Hz).

**Span Accuracy –** ±0.3% (Auto mode).

**Reference Frequency** .
**Initial Accuracy at Cal –** 1 x $10^{-7}$ (after 10 min. warmup).
**Aging per Day –** 1 x $10^{-9}$ (after 30 days of operation).
**Aging per 10 Years –** 3 x $10^{-7}$ (after 10 years of operation).
**Temperature Drift –** 2 x $10^{-8}$ (0 to 50 ºC).
**Cumulative Error (Temperature + Aging) –** 4 x $10^{-7}$ (within 10 years after calibration, typical).

**Reference Output Level –** >0 dBm (internal reference selected).

**Reference Output Level (Loop-through) –** 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.

**External Reference Input Frequency Requirements –** Must be within ±3 x $10^{-7}$ of stated frequency input.

**Spurious –** < –80 dBc within 100 kHz offset.

**Input Level Range –** –10 dBm to +6 dBm.

### Bandwidth

### Resolution Bandwidth

**Resolution Bandwidth Range (Spectrum Analysis) –** 1 Hz to 5 MHz (1, 2, 3, 5 sequence, auto-coupled) or user-selected (arbitrary).

**Resolution Bandwidth Shape –** 1 Hz to 5 MHz – Approximately Gaussian, shape factor 4.1:1 (60:3 dB) ±10%, typical.

**Resolution Bandwidth Accuracy –** 1 Hz to 5 MHz ±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 (auto coupled)

**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) –** ±10%.

### Time Domain Bandwidth

**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 110), 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 110), ±10%.

▶ Minimum Settable Spectrum Analysis RBW vs. Span

| Frequency Span | RBW |
|---|---|
| >10 MHz | 100 Hz |
| >1 MHz to 10 MHz | 10 Hz |
| ≤1 MHz | 1 Hz |

### DPX™ Digital Phosphor Spectrum Processing

**Spectrum Processing Rate –** >48,828/s.

**Trace Processing –** Color-graded bit map, +Peak, –Peak, Average.

**Minimum Signal Duration for 100% Probability of Detection (Max-hold On) –** 31 µs (24 µs Opt. 110).

**Span Range –** 100 Hz to 40 MHz (110 MHz with Opt. 110).

**Resolution BW Accuracy –** 7%.

▶ Resolution BW Range vs. Span (DPX)

| Span | RBW (Min) |
|---|---|
| 110 MHz | 600 kHz |
| 55 MHz | 300 kHz |
| 40 MHz | 200 kHz |
| 20 MHz | 100 kHz |
| 10 MHz | 50 kHz |
| 5 MHz | 25 kHz |
| 2 MHz | 13 kHz |
| 1 MHz | 7 kHz |
| 500 kHz | 4 kHz |
| 200 kHz | 2 kHz |
| 100 kHz | 800 Hz |
| 50 kHz | 400 Hz |
| 20 kHz | 200 Hz |
| 10 kHz | 100 Hz |
| 5 kHz | 50 Hz |
| 2 kHz | 13 Hz |
| 1 kHz | 7 Hz |
| 500 Hz | 4 Hz |
| 200 Hz | 2 Hz |
| 100 Hz | 1 Hz |

# It's Time to Get
## Completely Characterize

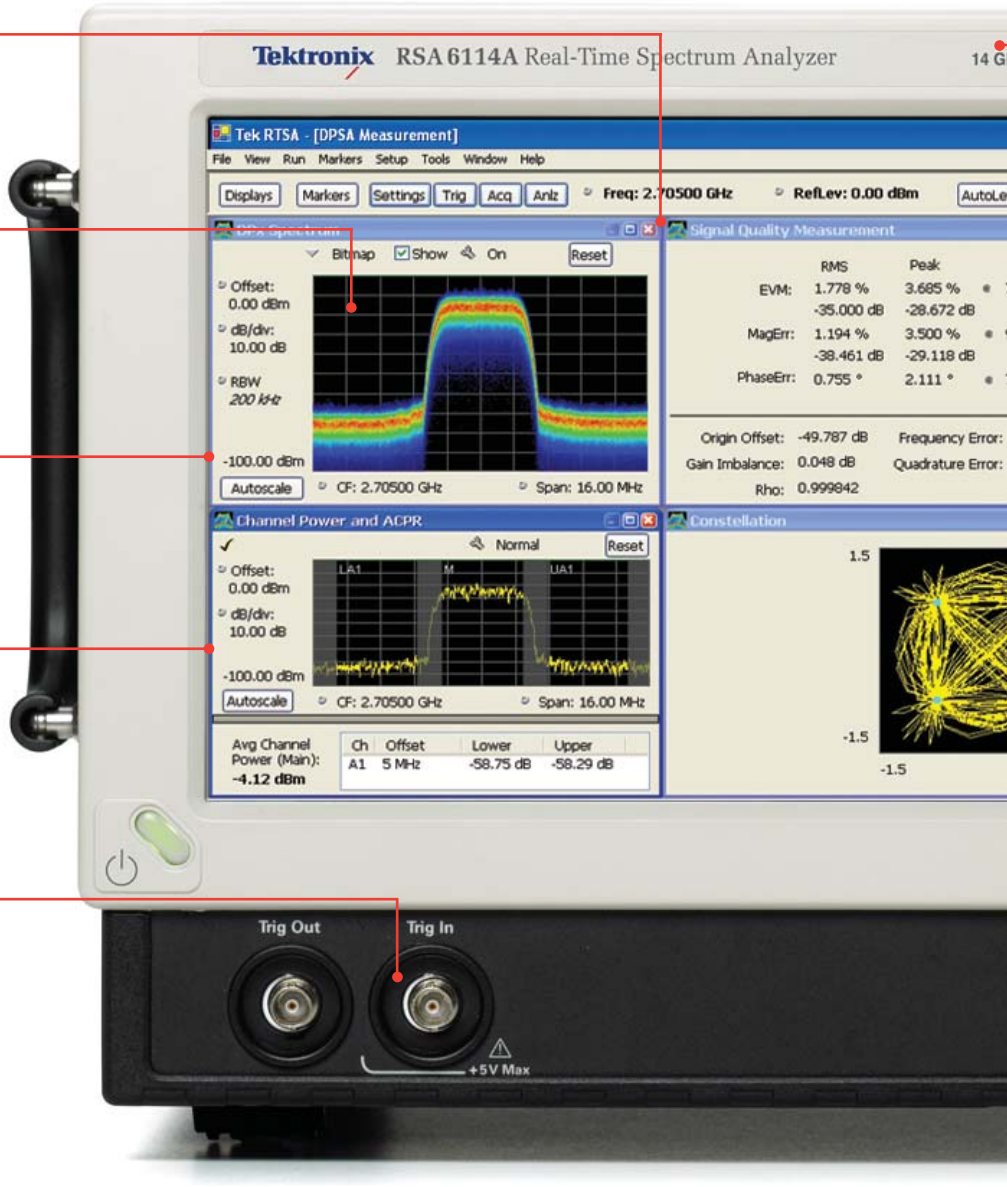
**Multiple correlated views** in all domains (Frequency, Time, Amplitude, Phase, Modulation) with intuitive user interface.

**Revolutionary DPX™ spectrum processing** for unmatched troubleshooting and live transient analysis.

**Touch screen, mouse and front panel controls** directly adjust settings in the views.

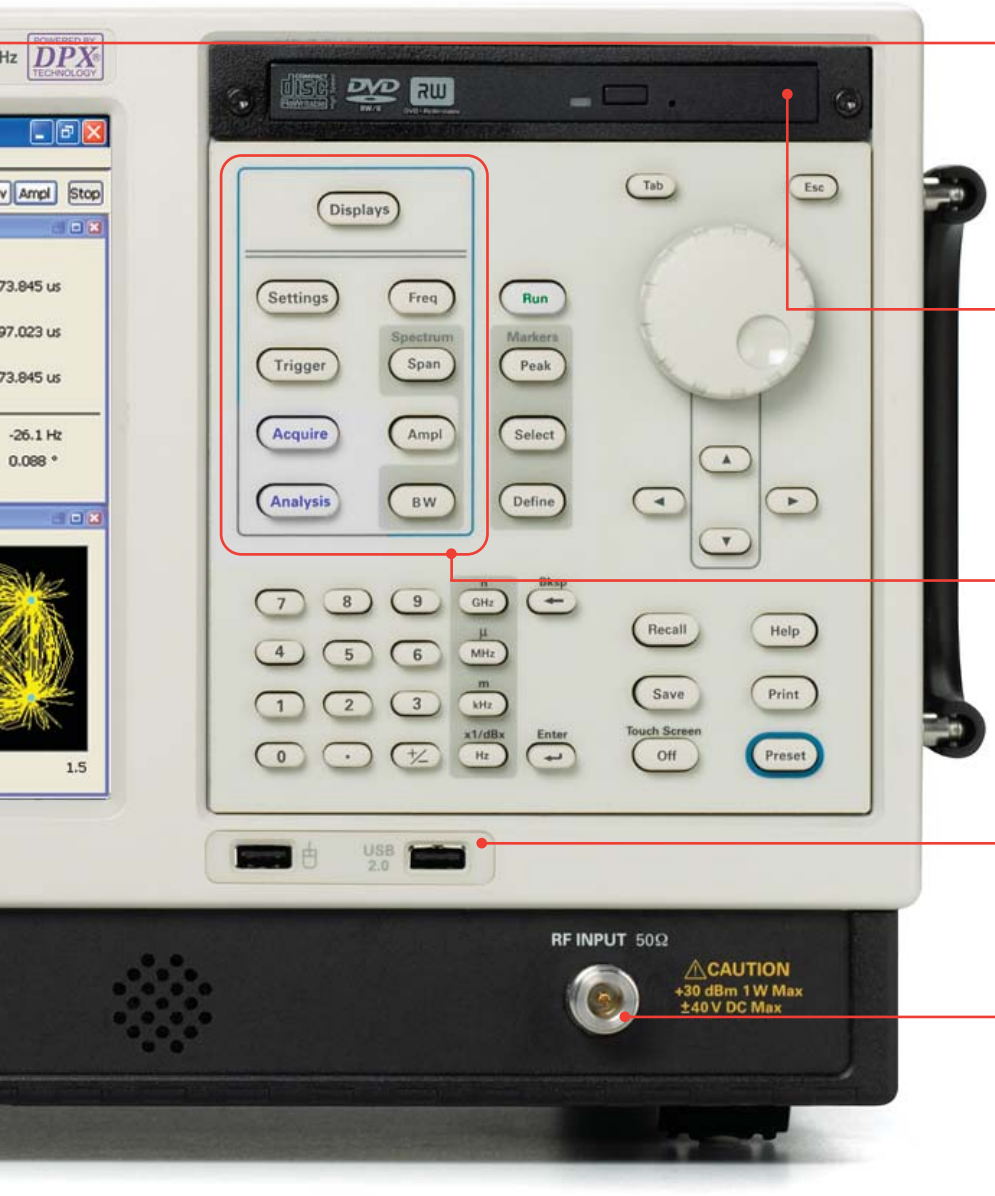
**Windows XP Operating System** with Tek OpenChoice® for easy file operations, printing, Ethernet and GPIB control, remote connections and more.

**Two external triggers** to capture key event information (1 front, 1 rear).



# Real.

## Time-varying RF Signals




**Two frequency ranges:**
9 kHz to 6.2 GHz (RSA6106A) or
9 kHz to 14 GHz (RSA6114A).

**DVD ±RW (standard)** for waveform storage. Removable HDD (optional) for data security.

**Familiar spectrum analyzer controls** plus fast access to all acquisition and measurement settings.

**USB connections** (2 front, 2 rear), for mouse, keyboard and memory.

**DC-Protected Input**
±40 V DC, over entire frequency range, +30 dBm CW, 75 W Pulse Maximum.

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

| Offset | CF = 1 GHz | | CF = 2 GHz | CF = 6 GHz | CF = 10 GHz (RSA6114A) |
|---|---|---|---|---|---|
| | Spec | Typical | Typical | Typical | Typical |
| 100 Hz | –80 | –86 | –80 | –70 | –64 |
| 1 kHz | –100 | –106 | –106 | –96 | –91 |
| 10 kHz | –106 | –110 | –110 | –107 | –106 |
| 100 kHz | –107 | –113 | –111 | –107 | –106 |
| 1 MHz | –128 | –134 | –133 | –132 | –132 |
| 6 MHz | –134 | –142 | –142 | –142 | –142 |
| 10 MHz | –134 | –142 | –142 | –142 | –142 |

### Stability

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

### Amplitude

(Specifications excluding mismatch error).

**Measurement Range –** Displayed average noise level to maximum measurable input.

**Input Attenuator Range –** 0 dB to 75 dB, 5 dB step.

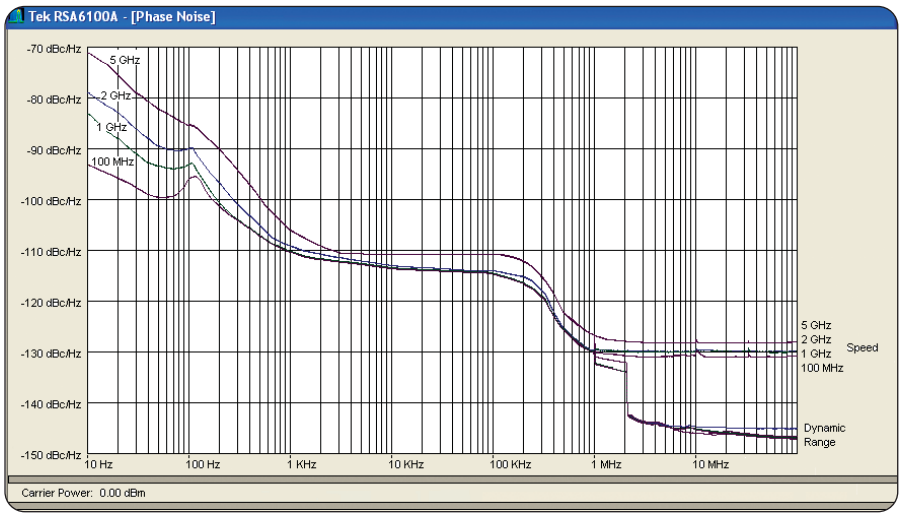
**Maximum Safe Input Level –**
Average Continuous (RF ATT ≥10 dB, Pre-amp OFF): +30 dBm.
Average Continuous (RF ATT ≥10 dB, Pre-amp ON): +20 dBm.
Pulsed RF (RF ATT ≥ 30 dB, PW <5 µs, 0.5% Duty Cycle): 75 W.

**Maximum Measurable Input Level –**
Average Continuous (RF ATT: Auto): +30 dBm
Pulsed RF (RF ATT: Auto, PW <5 µs, 0.5% Duty Cycle): 75 W.

**MAX DC Voltage –** ±40 V.

**Log Display Range –** 0.01 dBm/div to 20 dB/div.

**Display Divisions –** 10 divisions.




▶ Typical phase noise performance as measured by Opt. 11.

**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

| 18 °C to 28 °C, Atten.= 10 dB, Preamp Off | |
|---|---|
| 10 MHz to 3 GHz | ±0.5 dB |
| >3 GHz to 6.2 GHz | ±0.8 dB |
| > 6.2 GHz to 14 GHz (RSA6114A) | ±1.0 dB |
| **5 °C to 50 °C, All Attenuator settings (typical)** | |
| 9 kHz to 3 GHz | ±0.7 dB |
| >3 GHz to 6.2 GHz | ±0.8 dB |
| > 6.2 GHz to 14 GHz (RSA6114A) | ±2.0 dB |
| **Preamp (Opt. 01) ON (Att.= 10 dB)** | |
| 10 MHz to 3 GHz | ±0.7 dB |

**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 –** ±0.2 dB.

**Absolute Amplitude Accuracy at Center Frequency, 95% confidence*[1] (typical) –**
10 MHz to 3 GHz: ±0.5 dB.
3 GHz to 6.2 GHz: ±0.8 dB.
6.2 GHz to 14 GHz: ±1.5 dB.

*[1] 18 °C to 28 °C, Reference level ≤–15 dBm, Attenuator Auto-Coupled, signal level –15 dBm to –50 dBm. 10 Hz ≤ RBW ≤ 1 MHz, after Alignment performed.

**VSWR (typical) –** (Att = 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 14 GHz (RSA6114A only): <1.9:1.

**VSWR with Preamp (typical) –** (Att = 10 dB, Preamp ON, CF set within 200 MHz of VSWR test frequency.
10 MHz to 3 GHz: <1.9:1.

### Noise and Distortion

## ▶ 3rd Order Inter-modulation Distortion*[2]

| Frequency | 3rd order IM | 3rd Order Intercept | 3rd Order Intercept (typical) |
|---|---|---|---|
| 2.130 GHz | <–80 dBc | +15 dBm | +17 dBm |

*[2] 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*[3]

| Frequency | 2nd Harmonic Distortion, Typical |
|---|---|
| 10 MHz to 3.1 GHz | <–80 dBc |
| >3.1 GHz to 7 GHz (RSA6114 Only) | <–80 dBc |

*[3] –40 dBm at RF input, Attenuator = 0, Preamp Off, typical.

## ▶ Displayed Average Noise Level*[1], Preamp OFF

| Frequency | Specification | Typical |
|---|---|---|
| 9 kHz to 10 MHz | –97 dBm/Hz | –100 dBm/Hz |
| >10 MHz to 100 MHz | –147 dBm/Hz | –149 dBm/Hz |
| >100 MHz to 2.3 GHz | –149 dBm/Hz | –151 dBm/Hz |
| >2.3 GHz to 4 GHz | –147 dBm/Hz | –149 dBm/Hz |
| >4 GHz to 6.2 GHz | –143 dBm/Hz | –145 dBm/Hz |
| **RSA6114A Only** | | |
| 4 GHz to 7 GHz | –143 dBm/Hz | –145 dBm/Hz |
| >7 GHz to 14 GHz | –135 dBm/Hz | –137 dBm/Hz |

*[1] Measured using 1 kHz RBW, 100 kHz Span, 100 Averages, Minimum Noise Mode, Input terminated.

## ▶ Displayed Average Noise Level*[2], Preamp ON (Opt. 01)

| Frequency | Specification | Typical |
|---|---|---|
| 10 MHz to 80 MHz | –160 dBm/Hz | –170 dBm/Hz |
| >80 MHz to 1 GHz | –165 dBm/Hz | –170 dBm/Hz |
| 1 GHz to 2 GHz | –166 dBm/Hz | –170 dBm/Hz |
| 2 GHz to 3 GHz | –164 dBm/Hz | –170 dBm/Hz |

*[6] Measured using 1 kHz RBW, 100 kHz Span, 100 Averages, Minimum Noise Mode, Input terminated.

## ▶ Residual Response*[3]

| 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) |

*[3] Input Terminated, RBW = 1 kHz, Atten = 0 dB.

## ▶ Image Response*[4]

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

*[4] Ref = –30 dBm, Atten = 10 dB, RF input Level = –30 dBm, RBW = 10 Hz.

## ▶ Spurious Response with Signal*1

| Frequency | Span ≤40 MHz, swept spans >40 MHz | | Option 110 40 MHz < span ≤ 110 MHz | |
|---|---|---|---|---|
| | Specification | Typical | Specification | Typical |
| 10 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 |

*1 RF input level, –15 dBm, Atten = 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 –** <–57 dBc (RF input level, –30 dBm).

## ▶ Adjacent Channel Leakage Ratio Dynamic Range*2

| Signal Type, 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 |

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

## ▶ IF Frequency Response and Phase Linearity*3

| Frequency Range | Specification | | Typical (rms) |
|---|---|---|---|
| Freq. (GHz) | Acq. Bandwidth | Specification | Amplitude/Phase |
| 0.01 to 3.0*4 | ≤300 kHz | ±0.20 dB | 0.05 dB/0.5º |
| 0.03 to 3.0 | ≤40 MHz | ±0.50 dB | 0.18 dB/1.0º |
| >3 to 6.2*4 | ≤300 kHz | ±0.20 dB | 0.05 dB/0.5º |
| >3 to 6.2 | ≤40 MHz | ±0.50 dB | 0.26 dB/1.0º |
| >6.2 to 14 (RSA6114A) | ≤300 kHz | ±0.20 dB | 0.05 dB/1.0º |
| >6.2 to 14 (RSA6114A) | ≤40 MHz | ±0.80 dB | 0.40 dB/1.0º |
| **Option 110** | | | |
| 0.07 to 3.0 | ≤80 MHz | ±0.90 dB | 0.40 dB/1.5º |
| 0.07 to 3.0 | ≤110 MHz | ±0.90 dB | 0.40 dB/2.0º |
| >3 to 6.2 | ≤80 MHz | ±0.90 dB | 0.60 dB/1.5º |
| >3 to 6.2 | ≤110 MHz | ±0.90 dB | 0.60 dB/2.0º |
| >6.2 to 14 (RSA6114A) | ≤80 MHz | ±1.5 dB | 0.70 dB/1.5º |
| >6.2 to 14 (RSA6114A) | ≤110 MHz | ±1.5 dB | 1.0 dB/2.25º |

*3 Amplitude flatness and phase deviation over the capture BW, includes RF frequency response. Attenuator setting: 10 dB.

*4 High Dynamic Range Mode Selected.

### Advanced Measurement Suite (Opt. 20)

**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, 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, Timestamp.

**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 ºC to 28 ºC.

| Measurement | Accuracy (Typical) |
|---|---|
| Average ON Power*1 | ±0.3 dB + Absolute Amplitude Accuracy |
| Average Transmitted Power*1 | ±0.4 dB + Absolute Amplitude Accuracy |
| Peak Power*1 | ±0.4 dB + Absolute Amplitude Accuracy |
| Pulse Width | ±3% of reading |
| Duty Factor | ±3% of reading |

### ▶ Frequency and Phase Error Referenced to Non-chirped Signal

At stated frequencies and measurement bandwidths*2, 95% confidence.

| | CF 2 GHz | | | CF: 10 GHz | | |
|---|---|---|---|---|---|---|
| | Abs. Freq. Err. (rms) | Pulse-Pulse Freq. | Pulse-Pulse Phase | Abs. Freq. Err. (rms) | Pulse-Pulse Freq. | Pulse-Pulse Phase |
| BW: 20 MHz | ± 50 kHz | ± 100 kHz | ± 1.7 ◦ | ± 100 kHz | ± 200 kHz | ± 3.2 ◦ |
| BW: 40 MHz | ± 50 kHz | ± 100 kHz | ± 1.7 ◦ | ± 125 kHz | ± 200 kHz | ± 3.7 ◦ |
| BW: 60 MHz (Opt. 110) | ± 200 kHz | ± 350 kHz | ± 1.9 ◦ | ± 450 kHz | ± 1.0 MHz | ± 4 ◦ |
| BW: 110 MHz (Opt. 110) | ± 300 kHz | ± 550 kHz | ± 2 ◦ | ± 700 kHz | ± 1.3 MHz | ± 5 ◦ |

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

At stated frequencies and measurement bandwidths*2, 95% confidence.

| | CF 2 GHz | | | CF: 10 GHz | | |
|---|---|---|---|---|---|---|
| | Abs. Freq. Err. (rms) | Pulse-Pulse Freq. | Pulse-Pulse Phase | Abs. Freq. Err. (rms) | Pulse-Pulse Freq. | Pulse-Pulse Phase |
| BW: 20 MHz | ± 200 kHz | ± 100 kHz | ± 2.2 ◦ | ± 300 kHz | ± 200 kHz | ± 4 ◦ |
| BW: 40 MHz | ± 300 kHz | ± 100 kHz | ± 2.2 ◦ | ± 400 kHz | ± 250 kHz | ± 5 ◦ |
| BW: 60 MHz (Opt. 110) | ± 900 kHz | ± 550 kHz | ± 2.4 ◦ | ± 1.3 MHz | ± 1.1 MHz | ± 6.5 ◦ |
| BW: 110 MHz (Opt. 110) | ± 1.9 MHz | ± 650 kHz | ± 2.5 ◦ | ± 2.0 MHz | ± 1.6 MHz | ± 7.0 ◦ |

*1 Pulse width >300 ns (100 ns, Opt. 110).

*2 Pulse ON power ≥ –20 dBm, signal peak at Reference Level, Attenuator = Auto, $t_{meas}$ - $t_{reference}$ ≤10 ms, Frequency Estimation: Manual. Pulse-to-Pulse Measurement time position excludes the beginning and ending of the pulse extending for a time = (10/Measurement BW) as measured from 50% of the $t_{(rise)}$ or $t_{(fall)}$. Absolute Frequency Error determined over center 50% of pulse.

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

### Digital Modulation Analysis (Option 21)

**Modulation Formats –** BPSK, QPSK, 8PSK, 16QAM, 32 QAM, 64QAM, 128 QAM, 256QAM, MSK, GMSK, π/4DQPSK, DQPSK, D8PSK.

**Analysis Period –** Up to 80,000 Samples.

**Filter Types –**

**Measurement filters:** Square root raised cosine, raised cosine, Gaussian, rectangular, IS-95, IS-95 EQ, none.

**Reference filters:** Raised cosine, Gaussian, rectangular, IS-95, none.

**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.

**Symbol Rate Rang –** 1 k Symbols/s to 100 M Symbols/s (Modulated signal must be contained entirely within acquisition BW of RSA6100A).

### Demodulation Accuracy

#### Digital (Option 21)

#### QPSK Residual EVM (Typical)*3

| Symbol Rate | Residual EVM |
|---|---|
| 100 kSymbols/s | <0.6% |
| 1 MSymbol/s | <0.7% |
| 10 MSymbol/s | <1.0% |
| 30 MSymbol/s | <3.0% |
| 80 MSymbols/s (Opt. 110) | <3.0% |

*3 CF = 2 GHz, Measurement Filter = root raised cosine, reference filter = raised cosine, analysis length = 200 symbols.

#### 256 QAM Residual EVM (Typical)*4

| Symbol Rate | Residual EVM |
|---|---|
| 10 MSymbol/s | <1.0% |
| 30 MSymbol/s | <3.0% |
| 80 MSymbols/s (Opt. 110) | <3.0% |

*4 CF = 2 GHz, Measurement Filter = root raised cosine, reference filter = raised cosine, analysis length = 400 symbols.

### Inputs and Outputs

#### Front Panel

**RF Input Connector –** N type, 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 –** 1 USB 2.0, 1 USB 1.1.
**Audio –** Speaker.

#### Rear Panel

**Analog IF and Digital IQ Output (Opt. 05).**
**Analog IF Output (Opt. 05)**.
**Frequency –** 500 MHz (±1 MHz based on center frequency selection).
**Output Level –** 0 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.
**Digital IQ Output (Opt. 05).**
**Connector Type –** MDR (3M) 50 pin x 2.
**Data Output –** Data is corrected for amplitude and phase response in real time.
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. 110).
**Data Transition to Clock Rising Edge (setup time) –** 8.2 ns (typical, standard), 1.54 ns (typical, Opt. 110).
**10 MHz REF OUT –** 50 Ω, BNC, >0 dBm.
**External REF IN –** 50 Ω, BNC, –10 dBm – +6 dBm, 1 MHz to 25 MHz in 1 MHz steps, plus 1.2288 MHz, 4.8 MHz and 19.6608 MHz.
**External REF IN Frequency Accuracy Required –** ≤ ±0.3 ppm.
**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, 10/100/1000 Base-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

**Temperature Range**
Operating: +5 ºC to +50 ºC. (+5 ºC to +40 ºC when accessing DVD).
Storage: –20 ºC to +60 ºC.
Warm-up Time: 20 min.
**Altitude**
Operating: up to 3000 m (Approximately 10,000 ft.).
Non-operating: up to 12,190 m (40,000 ft.).
**Relative Humidity**
Operating and Non-operating: 90% RH at 30 ºC (No condensation, Max. wet bulb, 29 ºC). (80% RH max when accessing DVD).
**Vibration**
Operating: 0.22 Grms, 5 Hz to 500 Hz (except when accessing DVD and Opt. 06 Removable HDD).
Non-operating: 2.28 Grms, 5 Hz to 500 Hz.
**Shock**
Operating – 15 G, half-sine, 11 ms duration. (1 G max when accessing DVD and Opt. 06 Removable HDD).
Non-operating – 30 G, half-sine, 11 ms duration.
**Safety –** UL 61010-1:2004, CSA C22.2 No.61010-1-04.
**Electromagnetic Compatibility, Complies with –**
EC Council EMC Directive 89/336/EEC, amended by 93/68/EEC.
EN61326, Class A.
AS/NZS CISPR 11, Class A (Australia).
**Power Requirements –**
90 VAC to 240 VAC, 50 Hz to 60 Hz.
90 VAC to 132 VAC, 400 Hz.
**Power Consumption –** 600 W max.
**Data Storage –** Internal HDD, USB ports, DVD±RW (Opt. 07), Removable HDD (Opt. 06).
**Calibration Interval –** One year.
**Warranty –** One year.
**GPIB –** SCPI-compatible, IEEE488.2 compliant.

### Physical Characteristics

| Weight | kg | lb. |
|---|---|---|
| With All Options | 26.4 | 58 |

| Dimensions | mm | in. |
|---|---|---|
| Height | 282 | 11.1 |
| Width | 473 | 18.6 |
| Depth | 531 | 20.9 |

**Note**: Physical Characteristics, with feet, without accessory pouch.

## ▸ Ordering Information

### RSA6106A

Real-Time Spectrum Analyzer, 9 kHz to 6.2 GHz.

### RSA6114A

Real-Time Spectrum Analyzer, 9 kHz to 14 GHz.

**Both Include:** Quick Start Manual (Printed), User manual, Programmer's manual (on CD), power cord, BNC-N adapter, USB Keyboard, USB Mouse, Pouch, Front Cover.

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

### Options

**Opt. 01 –** Internal Preamp, 10 MHz to 3 GHz, 30 dB gain, 4 dB Noise Figure at 2 GHz, typical.
**Opt. 02 –** 1 GB Memory, Frequency Mask Trigger.
**Opt. 05 –** Digital IQ Output and 500 MHz Analog IF output.
**Opt. 06 –** Removable HDD.
**Opt. 07 –** DVD-RW, Required option, no-cost (not compatible with Opt. 06 or Opt. 08).
**Opt. 08 –** Removable Solid-State Hard Drive.
**Opt. 11 –** Phase Noise and Jitter Measurement.
**Opt. 20 –** Advanced Signal Analysis (including pulse measurements).
**Opt. 21 –** General Purpose Modulation Analysis.
**Opt. 110 –** 110 MHz Real Time Capture BW.
**Opt. 1R –** Rackmount.

### Accessories

**RTPA2A Real-Time Spectrum Analyzer Probe Adapter Compatibility –** Supports TekConnect® probes P7225, P7240, P7260, P7330, P7313, P7350, P7350SMA, P7380, P7380SMA.

**RSAVu –** SW based on the RSA3000 platform for analysis supporting 3G wireless standards, WLAN (IEEE 802.11a/b/g/n) phase noise measurements and more measurements.

**RSAIQWIMAX –** 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. 06 (Windows XP and instrument SW pre-installed). – 065-0751-00.

**Additional Removable Hard Drive (Solid State) –** For use with Opt. 08 (Windows XP and instrument SW pre-installed). 065-0765-00.

**Transit Case –** 016-1963-00.

**Rackmount Retrofit –** 016-1962-00.

**Additional Quick Start Manual (Paper) –** 071-1909-xx.

**Service Manual (Paper) –** 071-1914-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. A99 –** No power cord or AC adapter.

### Service

**Opt. C3 –** Calibration Service Three Years.

**Opt. C5 –** Calibration Service Five Years.

**Opt. D1 –** Calibration Data Report.

**Opt. D3 –** Calibration Data Report Three Years (with Option C3).

**Opt. D5 –** Calibration Data Report Five Years (with Option C5).

**Opt. R3 –** Repair Service Three Years.

**Opt. R5 –** Repair Service Five Years.

**Opt. CA1 –** Single calibration or coverage for the designated calibration interval, whichever comes first.

### Upgrades

### RSA61UP

### International Power Plugs

**Opt. 01 –** Internal Preamp, 10 MHz to 3 GHz, 30 dB gain, 4 dB Noise Figure at 2 GHz, Typical.

**Opt. 02 –** 1 GB Memory, Frequency Mask Trigger.

**Opt. 05 –** Digital IQ Output and 500 MHz Analog IF Output.

**Opt. 11 –** Phase Noise and Jitter Measurement.

**Opt. 20 –** Advanced Signal Analysis (Including Pulse Measurements).

**Opt. 21 –** General Purpose Modulation Analysis.

**Opt. 110 –** 110 MHz Real Time Capture BW.

**Opt. IF –** Installation Labor.

**Opt. IFC –** Installation Labor + Calibration.

### Languages

**Opt. L0 –** English Manual.

**Opt. L5 –** Japanese Manual.

**Opt. L7 –** Simplified Chinese Manual.

**Opt. L10 –** Russian Manual.

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


04/08 HB/WOW 37W-19513-5

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