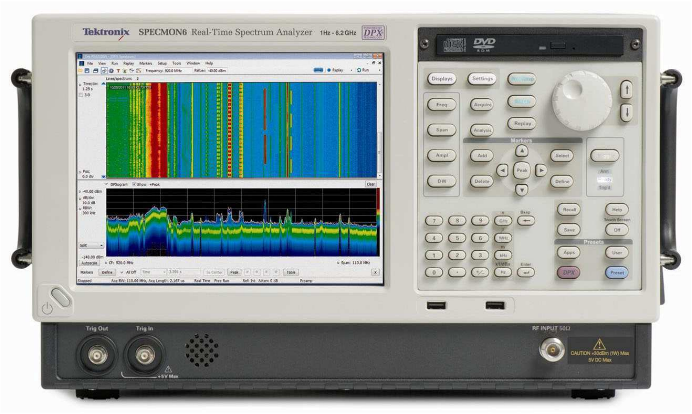
Spectrum Analyzers

SPECMON Series Datasheet



Features & Benefits

SPECMON Series 3.0 and 6.2 GHz Real-time Spectrum Analyzers

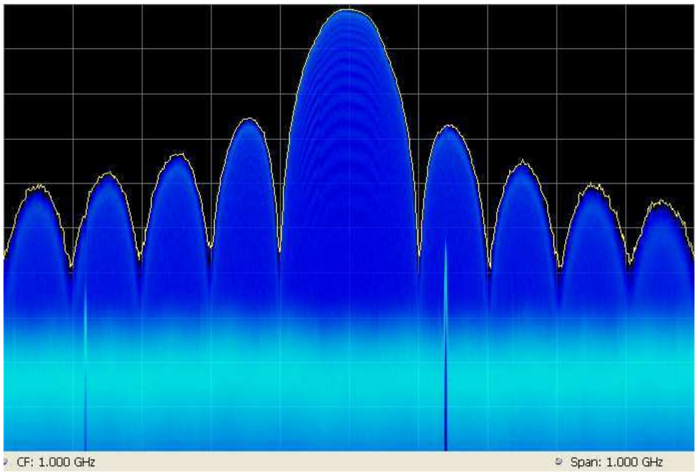
- Leading real time technologies help to troubleshoot the toughest transient interferences in the field
  - Unique Swept DPX ™ enables the customer to “Real-Time Scan” the whole 3/6.2 GHz frequency range for transient interference discovery (Opt. 200)
  - Up to 110 MHz ultra-wide real-time BW for “close-in” signal discovery, capture and real-time demodulation
  - Unmatched ability to discover and capture signals with as short as 3.7 μs duration with 100% Probability of Intercept (POI) (Opt. 200)
  - Exceptional DPX Density Trigger/Trigger on This ™ (Opt. 200), Frequency Mask Trigger (Opt. 52) and other advanced triggering capabilities provide 100% probability of intercept for signals as short as 3.7 μs in the frequency domain and 12 ns in the time domain
  - Save hours of post-capture review time with optional advanced triggering capabilities such as Save-on-Trigger, which intelligently saves events of interest automatically
- Integrated solution design reduces total cost of ownership with lower initial purchase cost and annual maintenance cost
  - Both manual and automatic drive test are supported by built-in mapping software. Commercial off-the-shelf 3rd party GPS receiver supported via USB or Bluetooth connection
  - Field pulse analysis (for example, airport radar) is easier than ever with automated Pulse Analysis suite
  - Save up to 12 years of gap-free DPX Spectrogram/Real-Time Waterfall Traces (Opt. 53) or up to 7 seconds of IQ data at full 110 MHz BW (Opt. 110) with extra-large real-time memory, eliminating the need for an external data recorder in many cases
  - Full 110 MHz bandwidth real-time IQ data can be streamed to external, data recording devices (Opt. 55) for comprehensive post analysis
  - Instrumentation needs for frequency-domain, modulation-domain and time-domain analysis are simplified by native 3-in-1 multiple-domain correlation and analysis capability
  - Modulation analysis for 20+ general purpose analog and digital signal types, including AM/FM demodulation and flexible OFDM signal analysis
  - Built-in versatile field measurement items including Field Strength, Signal Strength, EMI test, Channel Power, ACPR, OBW, and Spurious Search
  - Ruggedness and data security achieved with standard field-removable solid-state drive
- Open data format improves asset utilization through compatibility with industry-standard products
  - Captured IQ data can be saved into Matlab, CSV or other formats for use with third-party software analysis tools
  - RSA MAP supports MapInfo format and scanned version maps, also supports exporting to popular Google Earth and MapInfo map format for post analysis
  - Open interface for integration into customer applications
- Ease-of-use platform improves field-test efficiency and lowers system training cost
  - 10.4 inch ultra-bright touchscreen display
  - Windows 7 Ultimate (64-bit) with support to Microsoft language localization

Applications

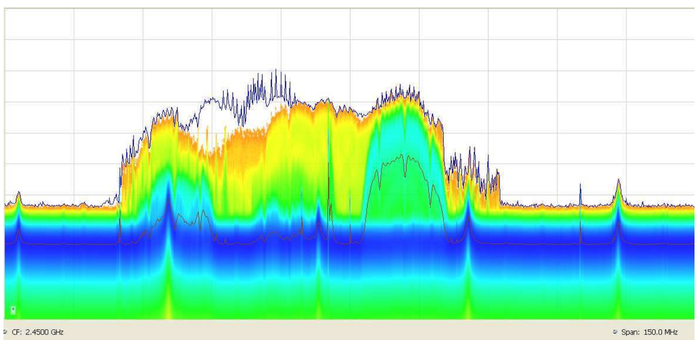
- Spectrum Management – Reduce Time to Intercept and Identify Known and Unknown Signals

Tektronix®

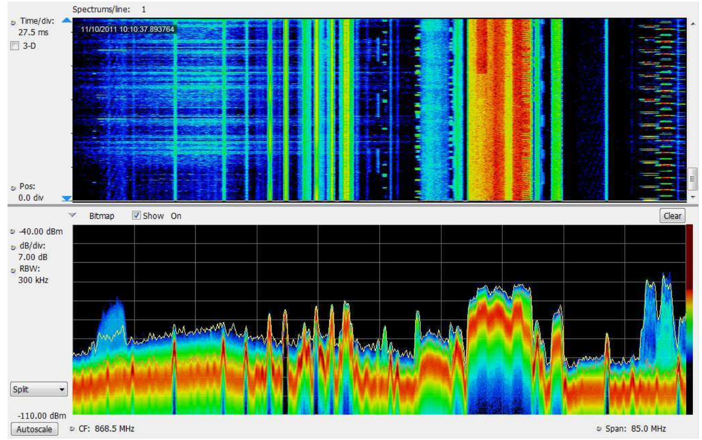
Integrated Real-Time Solution to Your Toughest Field Interference Challenges



Advanced Triggers and Swept DPX 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 sweep the DPX across the full input range of the SPECMON Series, up to 6.2 GHz. In the time a traditional spectrum analyzer has captured one spectrum, the SPECMON 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.



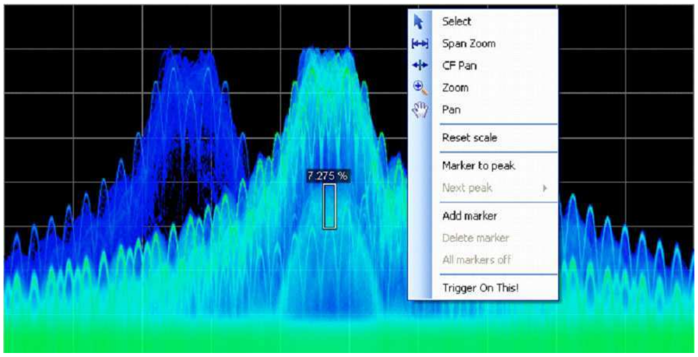
Advanced Triggers, Swept DPX, and Zero Span (Opt. 200) provides superior swept spectrum analysis for transient signals. Here, a 150 MHz swath of spectrum is swept across the ISM band. Multiple WLAN signals are seen, and narrow signals seen in the blue peak-hold trace are Bluetooth access probes. Multiple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



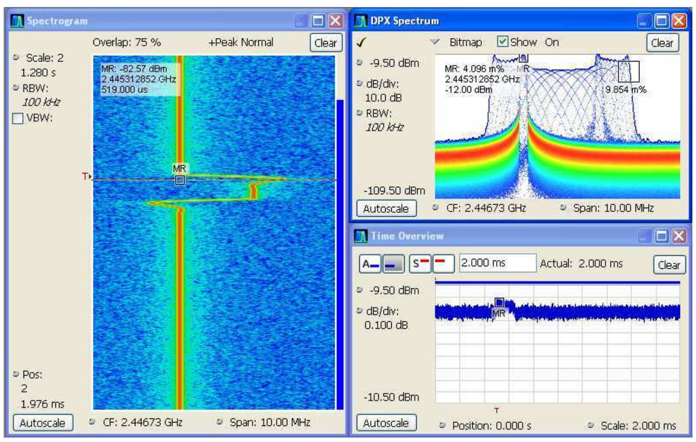
DPX Spectrograms (Opt. 200) provide gap-free spectral monitoring for up to 12 years at a time. 60,000 traces can be recorded and reviewed, with resolution per line adjustable from 110 µs to 6400 s.

Discover

The patented DPX® spectrum processing engine brings live analysis of transient events to spectrum analyzers. Performing up to 292,000 frequency transforms per second, transients of a minimum event duration of 3.7 µs in length are displayed in the frequency domain. This is orders of magnitude faster than swept analysis techniques. Events can be color coded by rate of occurrence onto a bitmapped display, providing unparalleled insight into transient signal behavior. The DPX spectrum processor can be swept over the entire frequency range of the instrument, enabling broadband transient capture previously unavailable in any spectrum analyzer. In applications that require only spectral information, Opt. 200 provides gap-free spectral recording, replay, and analysis of up to 60,000 spectral traces. Spectrum recording resolution is variable from 110 µs to 6400 s per line.



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



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 SPECMON Series spectrum analyzers lead the industry in triggered signal analysis. The SPECMON Series provides unique triggers essential for troubleshooting modern digitally implemented RF systems. Includes time-qualified power, runt, density, frequency, and frequency mask triggers.

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

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

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

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

Capture

Capture once – make multiple measurements without recapturing. All signals in an acquisition bandwidth are recorded into the SPECMON Series deep memory. Record lengths vary depending upon the selected acquisition bandwidth – up to 7 seconds at 110 MHz, 343 seconds at 1 MHz, or 6.1 hours at 10 kHz bandwidth with Memory Extension (Opt. 53). Real-time capture of small signals in the presence of large signals is enabled with 73 dB SFDR in all acquisition bandwidths, even up to 110 MHz (Opt. 110). Acquisitions of any length can stored in MATLAB™ Level 5 format for offline analysis.

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

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

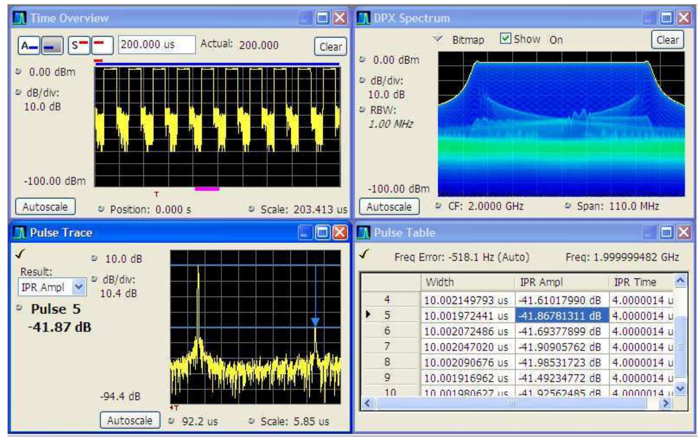
Analyze

The SPECMON 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 SPECMON Series and available options and software packages are summarized below:

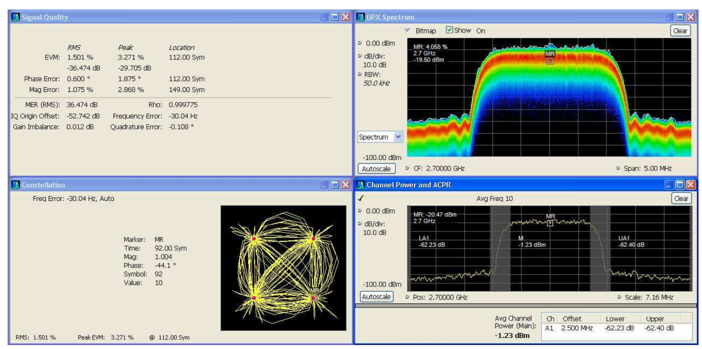
Measurement Functions

Measurements	Description
Spectrum Analyzer Measurements	Channel Power, Adjacent Channel Power, Multicarrier Adjacent Channel Power/Leakage Ratio, Occupied Bandwidth, xdB Down, dBm/Hz Marker, dBc/Hz Marker
Time Domain and Statistical Measurements	RF IQ vs. Time, Power vs. Time, Frequency vs. Time, Phase vs. Time, CCDF, Peak-to-Average Ratio
Spur Search Measurement	Up to 20 frequency ranges, user-selected detectors (Peak, Average, QP), filters (RBW, CISPR, MIL), and VBW in each range. Linear or Log frequency scale. Measurements and violations in absolute power or relative to a carrier. Up to 999 violations identified in tabular form for export in .CSV format
Analog Modulation Analysis Measurement Functions	% Amplitude Modulation (+, –, Total) Frequency Modulation (±Peak, +Peak, –Peak, RMS, Peak-Peak/2, Frequency Error) Phase Modulation (±Peak, RMS, +Peak, –Peak)
AM/FM/PM Modulation and Audio Measurements (Opt. 10)	Carrier Power, Frequency Error, Modulation Frequency, Modulation Parameters (±Peak, Peak-Peak/2, RMS), SINAD, Modulation Distortion, S/N, THD, TNHD
Phase Noise and Jitter Measurements (Opt. 11)	10 Hz to 1 GHz Frequency Offset Range, Log Frequency Scale Traces – 2: ±Peak Trace, Average Trace, Trace Smoothing, and Averaging
Settling Time (Frequency and Phase) (Opt. 12)	Measured Frequency, Settling Time from last settled frequency, Settling Time from last settled phase, Settling Time from Trigger. Automatic or manual reference frequency selection. User-adjustable measurement bandwidth, averaging, and smoothing. Pass/Fail Mask Testing with 3 user-settable zones
Advanced Pulse Measurements Suite	Average On Power, Peak Power, Average Transmitted Power, Pulse Width, Rise Time, Fall Time, Repetition Interval (Seconds), Repetition Interval (Hz), Duty Factor (%), Duty Factor (Ratio), Ripple (dB), Ripple (%), Overshoot (dB), Overshoot (%), Droop (dB), Droop (%), Pulse-Pulse Frequency Difference, Pulse-Pulse Phase Difference, RMS Frequency Error, Max Frequency Error, RMS Phase Error, Max Phase Error, Frequency Deviation, Delta Frequency, Phase Deviation, Impulse Response (dB), Impulse Response (Time), Time Stamp
General Purpose Digital Modulation Analysis (Opt. 21)	Error Vector Magnitude (EVM) (RMS, Peak, EVM vs. Time), Modulation Error Ratio (MER), Magnitude Error (RMS, Peak, Mag Error vs. Time), Phase Error (RMS, Peak, Phase Error vs. Time), Origin Offset, Frequency Error, Gain Imbalance, Quadrature Error, Rho, Constellation, Symbol Table

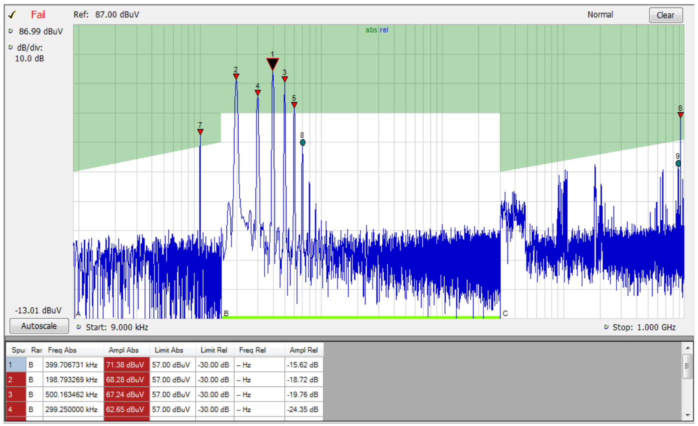


Advanced Signal Analysis package offers over 20 automated pulse parameter calculations on every pulse. Easily validate designs with measurements of peak power, pulse width rise time, ripple, droop, overshoot, and pulse-to-pulse phase. Gain insight into linear FM chirp quality with measurements such as 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.

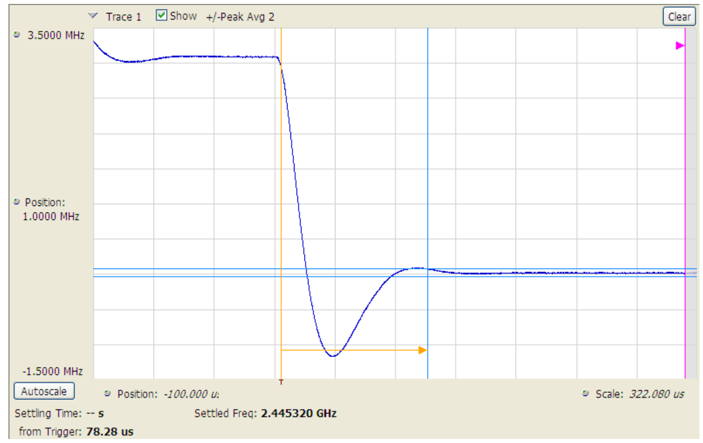
Measurements	Description
Flexible OFDM Analysis (Opt. 22)	OFDM Analysis for WLAN 802.11a/j/g and WiMAX 802.16-2004
DPX Density Measurement (Opt. 200)	Measures % signal density at any location on the DPX spectrum display and triggers on specified signal density
RSAVu Analysis Software	W-CDMA, HSUPA. HSDPA, GSM/EDGE, CDMA2000 1x, CDMA2000 1xEV-DO, RFID, Phase Noise, Jitter, IEEE 802.11 a/b/g/n WLAN, IEEE 802.15.4 OQPSK (Zigbee), Audio Analysis



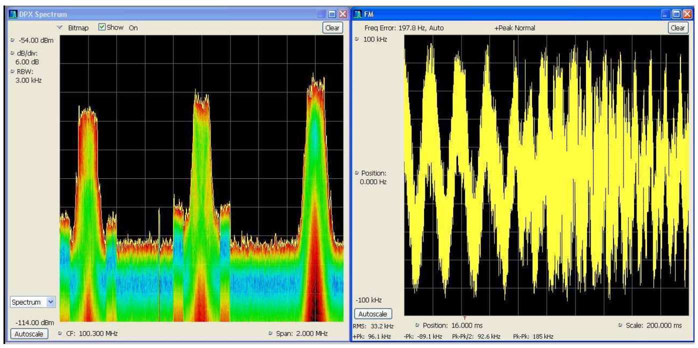
Time-correlated views in multiple domains provide a new level of insight into design problems not possible with conventional analyzers. Here, ACLR and modulation quality are performed simultaneously in a single acquisition, combined with the continuous monitoring of the DPX® spectrum display.



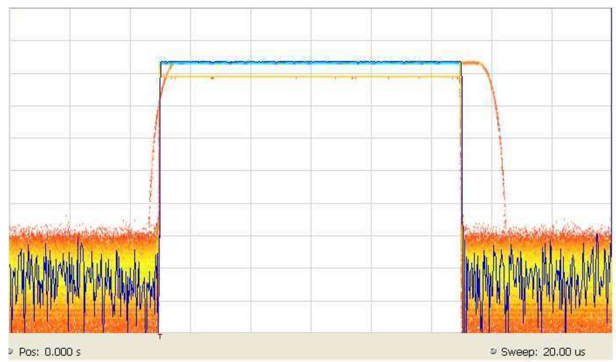
Spurious Search – Up to 20 noncontiguous frequency regions can be defined, each with their own resolution bandwidth, video bandwidth, detector (peak, average, quasi-peak), and limit ranges. Test results can be exported in .CSV format to external programs, with up to 999 violations reported. Spectrum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



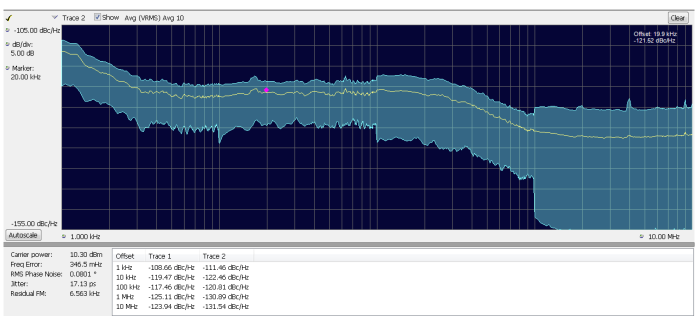
Settling time measurements (Opt. 12) are easy and automated. The user can select measurement bandwidth, tolerance bands, reference frequency (auto or manual), and establish up to 3 tolerance bands vs. time for Pass/Fail testing. Settling time may be referenced to external or internal trigger, and from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



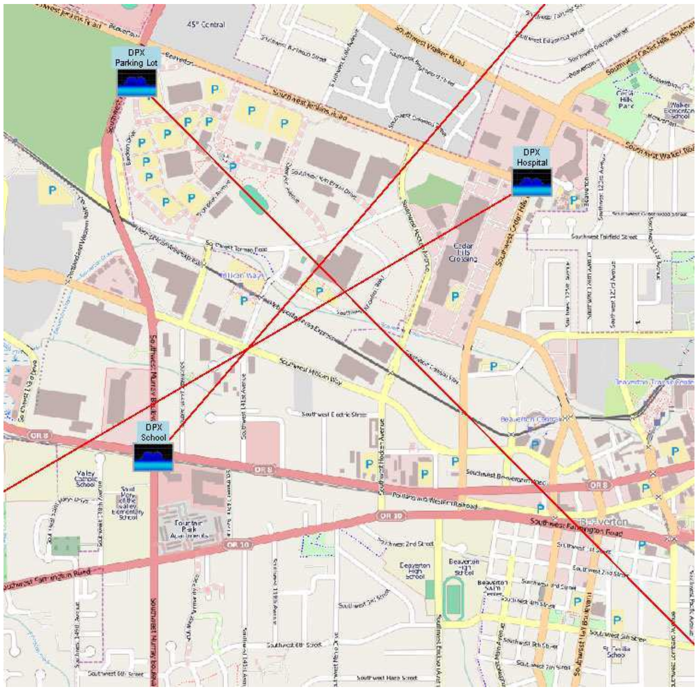
Audio monitoring and modulation measurements simultaneously can make spectrum management an easier, faster task. Here, the DPX spectrum display shows a live spectrum of the signal of interest and simultaneously provides demodulated audio to the internal instrument loudspeaker. FM deviation measurements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



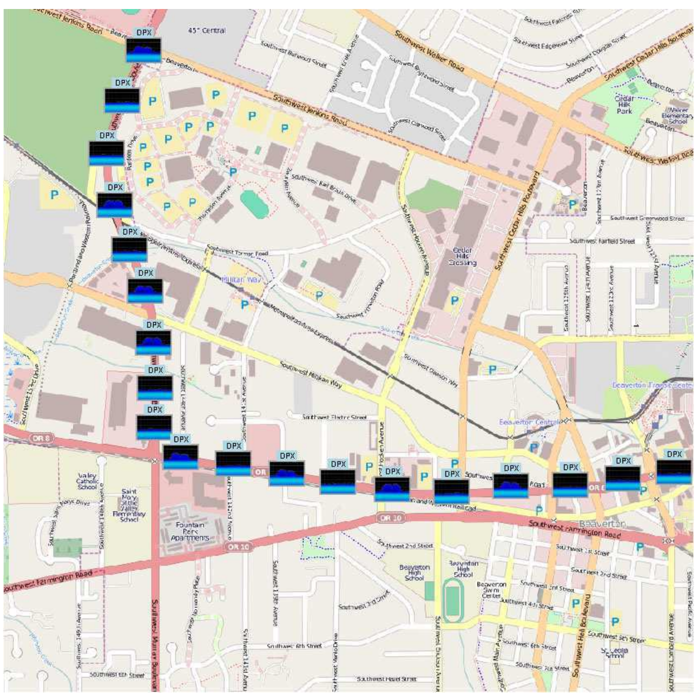
DPX Zero-span produces real-time analysis in amplitude, frequency, or phase vs. time. Up to 50,000 waveforms per second are processed. DPX Zero-span ensures that all time-domain anomalies are immediately found, reducing time-to-fault. Here, three distinct pulse shapes are captured in zero-span amplitude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



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



Locate interference with azimuth direction function. It lets you draw a line or an arrow on a mapped measurement to indicate the direction your antenna was pointing when you take a measurement. User label can also be displayed (this example shows real time DPX measurement taken from Hospital, School and Park Lot)



Both manual and automatic drive test measurements are supported. The Repeat measurements function automatically takes measurements at a user-set time or distance interval.

Integrated Solution for Mapping

SPECMON series Real-Time Spectrum Analyzers provide an integrated solution for field interference and coverage problems. The built-in RSA Map lets you use an on-screen map to record the location and value of SPECMON measurements.

With RSA Map you can do the following:

- Select a measurement and touch the displayed map where you want the measurement to be placed
- Use a GPS receiver (customer supplied) to automatically position measurements at your current location (on maps with geophysical reference information)
- Collect and export measurement data (and position data when using a GPS receiver) to common formats to help analyze measurements (position, value, and direction) and prepare reports to resolve interference problems

RSA Map uses MapInfo format map files (.mif) or Windows bitmap files (.bmp) to indicate location. The .bmp format map files can be either geo-referenced or non-geo-referenced. Saved test results give you complete measurement data along with exporting compatibility to Google Earth (.kmz) and Mapinfo (MIF/MID) formats.

Characteristics

Frequency Related

Characteristic	Description
Frequency Range	1 Hz to 3.0 GHz (SPECMON3) 1 Hz to 6.2 GHz (SPECMON6)
Initial Center Frequency Setting Accuracy	Within 10^{-7} after 10 minute warm-up
Center Frequency Setting Resolution	0.1 Hz
Frequency Marker Readout Accuracy	±(RE × MF + 0.001 × Span + 2) Hz
RE	Reference Frequency Error
MF	Marker Frequency (Hz)
Span Accuracy	±0.3% of Span (Auto mode)
Reference Frequency	
Initial accuracy at cal	1×10^{-7} (after 10 minute warm-up)
Aging per day	1×10^{-9} (after 30 days of operation)
Aging per 10 years	3×10^{-7} (after 10 years of operation)
Temperature drift	2×10^{-8} (5 to 40 °C)
Cumulative error (temperature + aging)	4×10^{-7} (within 10 years after calibration, typical)
Reference Output Level	>0 dBm (internal or external reference selected), +4 dBm, typical
External Reference Input Frequency	10 MHz ±30 Hz
External Reference Input Frequency Requirements	Spurious level on input must be < –80 dBc within 100 kHz offset to avoid on-screen spurs
Spurious	< –80 dBc within 100 kHz offset
Input level range	–10 dBm to +6 dBm

Trigger Related

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

Power Level Trigger

Characteristic	Description
Level Range	0 dB to –100 dB from reference level
Accuracy	
(for trigger levels >30 dB above noise floor, 10% to 90% of signal level)	±0.5 dB (level ≥ –50 dB from reference level)
	±1.5 dB (from < –50 dB to –70 dB from reference level)
Trigger Bandwidth Range	
(at maximum acquisition BW)	4 kHz to 10 MHz + wide open (standard)
	4 kHz to 20 MHz + wide open (Opt. 40)
	11 kHz to 40 MHz + wide open (Opt. 110)
Trigger Position Timing Uncertainty	
25 MHz Acquisition BW, 10 MHz BW (Std.)	Uncertainty = ±15 ns
40 MHz Acquisition BW, 20 MHz BW (Opt. 40)	Uncertainty = ±10 ns
110 MHz Acquisition BW, 40 MHz BW (Opt. 110)	Uncertainty = ±5 ns
Trigger Re-Arm Time, Minimum (Fast Frame 'On')	
10 MHz Acquisition BW	≤25 µs
40 MHz Acquisition BW (Opt. 40)	≤10 µs
110 MHz Acquisition BW (Opt. 110)	≤5 µs
Minimum Event Duration (Filter = Off)	
25 MHz Acquisition BW (Std.)	40 ns
40 MHz Acquisition BW (Opt. 40)	25 ns
110 MHz Acquisition BW (Opt. 110)	12 ns
External Trigger 1	
Level Range	–2.5 V to +2.5 V
Level Setting Resolution	0.01 V
Trigger Position Timing Uncertainty (50 Ω input impedance)	
25 MHz Acquisition BW, 25 MHz Span (Std.)	Uncertainty = ±20 ns
40 MHz Acquisition BW, 40 MHz Span (Opt. 40)	Uncertainty = ±15 ns
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
Advanced trigger specifications are found in sections on Opt. 52 (Frequency Mask Trigger) and Opt. 200 (DPX, Time Qualified, Runt, and Frequency Edge triggers)	

Acquisition Related

Characteristic	Description
Real-time Acquisition Bandwidth	25 MHz (Std.) 40 MHz (Opt. 40) 110 MHz (Opt. 110)
A/D Converter	100 MS/s, 14 bit (optional 300 MS/s, 14 bit, Opt. 40/110)
Acquisition Memory Size	1 GB (4 GB, Opt. 53)
Minimum Acquisition Length	64 Samples
Acquisition Length Setting Resolution	1 Sample
Fast Frame Acquisition Mode	>64,000 records can be stored in a single acquisition (for pulse measurements and spectrogram analysis)

Memory Depth (Time) and Minimum Time Domain Resolution

Acquisition BW	Sample Rate (For I and Q)	Record Length	Record Length (Opt. 53)	Time Resolution
110 MHz (Opt. 110)	150 MS/s	1.79 s	7.15 s	6.6667 ns
40 MHz (Opt. 40)	75 MS/s	3.57 s	14.3 s	13.33 ns
25 MHz	50 MS/s	4.77 s	19.0 s	20 ns
20 MHz	25 MS/s	9.54 s	38.1 s	40 ns
10 MHz	12.5 MS/s	19.0 s	76.3 s	80 ns
5 MHz	6.25 MS/s	38.1 s	152.7 s	160 ns
2 MHz*1	3.125 MS/s	42.9 s	171.7 s	320 ns
1 MHz	1.56 MS/s	85.8 s	343.5 s	640 ns
500 kHz	781 kS/s	171.7 s	687.1 s	1.28 µs
200 kHz	390 kS/s	343.5 s	1347 s	2.56 µs
100 kHz	195 kS/s	687.1 s	2748 s	5.12 µs
50 kHz	97.6 kS/s	1374 s	55497 s	10.24 µs
20 kHz	48.8 kS/s	2748 s	10955 s	20.48 µs
10 kHz	24.4 kS/s	5497 s	21990 s	40.96 µs
5 kHz	12.2 kS/s	10955 s	43980 s	81.92 µs
2 kHz	3.05 kS/s	43980 s	175921 s	328 µs
1 kHz	1.52 kS/s	87960 s	351843 s	655 µs
500 Hz	762 S/s	175921 s	703687 s	1.31 ms
200 Hz	381 S/s	351843 s	1407374 s	2.62 ms
100 Hz	190 S/s	703686 s	2814749 s	5.24 ms

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

Analysis Related

Available Displays	Views
Frequency	Spectrum (Amplitude vs Linear or Log Frequency) DPX® Spectrum Display (Live RF Color-graded Spectrum) Spectrogram (Amplitude vs. Frequency over Time) Spurious (Amplitude vs Linear or Log Frequency) Phase Noise (Phase Noise and Jitter Measurement) (Opt. 11)
Time and Statistics	Amplitude vs. Time Frequency vs. Time Phase vs. Time DPX Amplitude vs. Time (Opt. 200) DPX Frequency vs. Time (Opt. 200) DPX Phase vs. Time (Opt. 200) Amplitude Modulation vs. Time Frequency Modulation vs. Time Phase Modulation vs. Time RF IQ vs. Time Time Overview CCDF Peak-to-Average Ratio
Settling Time, Frequency, and Phase (Opt. 12)	Frequency Settling vs. Time, Phase Settling vs. Time
Advanced Measurements Suite	Pulse Results Table Pulse Trace (selectable by pulse number) Pulse Statistics (Trend of Pulse Results, FFT of Trend, and Histogram)
Digital Demod (Opt. 21)	Constellation Diagram EVM vs. Time Symbol Table (Binary or Hexadecimal) Magnitude and Phase Error versus Time, and Signal Quality Demodulated IQ vs. Time Eye Diagram Trellis Diagram Frequency Deviation vs. Time
Flexible OFDM Analysis (Opt. 22)	Constellation, Scalar Measurement Summary EVM or Power vs. Carrier Symbol Table (Binary or Hexadecimal)
Frequency Offset Measurement	Signal analysis can be performed either at center frequency or the assigned measurement frequency up to the limits of the instrument's acquisition and measurement bandwidths

RF Spectrum and Analysis Performance

Bandwidth Related

Characteristic	Description
Resolution Bandwidth	
Resolution Bandwidth Range (Spectrum Analysis)	0.1 Hz to 5 MHz (10 MHz, Opt. 110) (1, 2, 3, 5 sequence, Auto-coupled), or user selected (arbitrary)
Resolution Bandwidth Shape	Approximately Gaussian, shape factor 4.1:1 (60:3 dB) ±10%, typical
Resolution Bandwidth Accuracy	±1% (Auto-coupled RBW mode)
Alternative Resolution Bandwidth Types	Kaiser window (RBW), –6 dB Mil, CISPR, Blackman-Harris 4B Window, Uniform (none) Window, Flat-top (CW Ampl.) Window, Hanning Window
Video Bandwidth	
Video Bandwidth Range	1 Hz to 5 MHz plus wide open
RBW/VBW Maximum	10,000:1
RBW/VBW Minimum	1:1 plus wide open
Resolution	5% of entered value
Accuracy (Typical, Detector: Average)	±10%
Time Domain Bandwidth (Amplitude vs. Time Display)	
Time Domain Bandwidth Range	At least 1/10 to 1/10,000 of acquisition bandwidth, 1 Hz minimum
Time Domain BW Shape	≤10 MHz, approximately Gaussian, shape factor 4.1:1 (60:3 dB), ±10% typical
	20 MHz (60 MHz, Opt. 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
>1.25 MHz to 10 MHz	10 Hz
≤1 MHz	1 Hz
≤100 kHz	0.1 Hz

Spectrum Display Traces, Detector, and Functions

Characteristic	Description
Traces	Three traces + 1 math waveform + 1 trace from spectrogram for spectrum display
Detector	Peak, –Peak, Average (V_{RMS}), ±Peak, Sample, CISPR (Avg, Peak, Quasi-peak Average (of Logs))
Trace Functions	Normal, Average, Max Hold, Min Hold, Average (of Logs)
Spectrum Trace Length	801, 2401, 4001, 8001, or 10401 points
Sweep Speed (Typical. RBW = Auto, RF/IF Optimization: minimize sweep time)	1500 MHz/s (Std.) 2500 MHz/s (Opt. 40) 6000 MHz/s (Opt. 110)

DPX® Digital Phosphor Spectrum Processing

Characteristic	DPX (Standard)	Advanced DPX (Opt. 200)
Spectrum Processing Rate (RBW = Auto, Trace Length 801)	48,828/s	292,969/s
DPX Bitmap Resolution	201 × 501	201 × 801
DPX Bitmap Color Dynamic Range	64k (48 dB)	8G (99 dB)
Marker Information	Amplitude, frequency, and hit count on the DPX display	Amplitude, frequency, and signal density on the DPX display
Minimum Signal Duration for 100% Probability of Detection (Max-hold On)	31 μs (Std. or Opt. 40) 24 μs (Opt. 110)	See Minimum Signal Duration for 100% Probability of Trigger at 100% Amplitude table
Span Range (Continuous processing)	100 Hz to 25 MHz (40 MHz with Opt. 40) (110 MHz with Opt. 110)	100 Hz to 25 MHz (40 MHz with Opt. 40) (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%	±1%

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

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

Stability

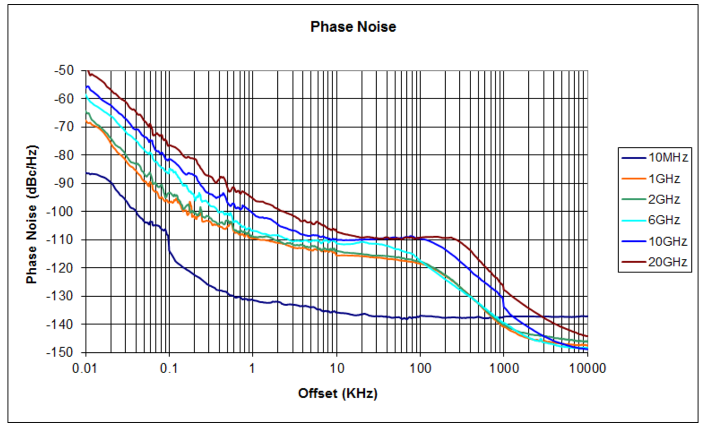
Residual FM – <2 Hz_{p-p} in 1 second (95% confidence, typical).

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

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

Integrated Phase (100 Hz to 100 MHz, typical)

Measurement Frequency	Integrated Phase, Radians
100 MHz	2.51×10^{-3}
1 GHz	3.14×10^{-3}
2 GHz	3.77×10^{-3}
5 GHz	6.28×10^{-3}



Typical phase noise performance as measured by Opt. 11.

Amplitude

(Specifications excluding mismatch error)

Characteristic	Description
Measurement Range	Displayed average noise level to maximum measurable input
Input Attenuator Range	0 dB to 55 dB, 5 dB step
Maximum Safe Input Level	
Average Continuous (RF ATT ≥10 dB, Preamp Off)	+30 dBm
Average Continuous (RF ATT ≥10 dB, Preamp On)	+20 dBm
Pulsed RF (RF ATT ≥30 dB, PW <10 μs, 1% Duty Cycle)	50 W
Maximum Measurable Input Level	
Average Continuous (RF ATT: Auto)	+30 dBm
Pulsed RF (RF ATT: Auto, PW <10 μs, 1% Duty Cycle)	50 W
Max DC Voltage	±5 V
Log Display Range	0.01 dBm/div to 20 dB/div
Display Divisions	10 divisions
Display Units	dBm, dBmV, Watts, Volts, Amps, dBuW, dBuV, dBuA, dBW, dBV, dBV/m, and dBA/m
Marker Readout Resolution, dB Units	0.01 dB
Marker Readout Resolution, Volts Units	Reference-level dependent, as small as 0.001 μV
Reference Level Setting Range	0.1 dB step, –170 dBm to +50 dBm (minimum ref. level –50 dBm at center frequency <80 MHz)
Level Linearity	±0.1 dB (0 to –70 dB from reference level)

Frequency Response

Range	Response
18 °C to 28 °C, Atten. = 10 dB, Preamp Off	
10 MHz to 32 MHz (LF Band)	±0.7 dB
10 MHz to 3 GHz	±0.35 dB
>3 GHz to 6.2 GHz (SPECMON6)	±0.5 dB
5 °C to 40 °C, All Attenuator Settings (Typical, Preamp Off)	
1 Hz to 32 MHz (LF Band)	±0.8 dB
9 kHz to 3 GHz	±0.5 dB
>3 GHz to 6.2 GHz (SPECMON6)	±1.0 dB
Preamp On (Atten. = 10 dB)	
10 MHz to 32 MHz (LF Band)	±0.8 dB
1 MHz to 3 GHz	±0.8 dB
>3 GHz to 6.2 GHz (SPECMON6)	±1.3 dB

Amplitude Accuracy

Characteristic	Description	
Absolute Amplitude Accuracy at Calibration Point (100 MHz, –20 dBm signal, 10 dB ATT, 18 °C to 28 °C)	±0.31 dB	
Input Attenuator Switching Uncertainty	±0.3 dB	
Absolute Amplitude Accuracy at Center Frequency, 95% Confidence*2		
10 MHz to 3 GHz	±0.3 dB	
3 GHz to 6.2 GHz (SPECMON6)	±0.5 dB	
VSWR (Typical) (Atten. = 10 dB, CF set within 200 MHz of VSWR frequency)		
Frequency Range	Preamp OFF	Preamp ON
10 kHz to 10 MHz	<1.6:1	
10 MHz to 2.0 GHz	<1.12:1	<1.6:1
>2.0 GHz to 3.0 GHz	<1.3:1	<1.6:1
>3.0 GHz to 5.0 GHz (SPECMON6)	<1.3:1	<1.6:1
>5.0 GHz to 6.2 GHz (SPECMON6)	<1.45:1	<1.6:1

*2 18 °C to 28 °C, Ref Level ≤ –15 dBm, Attenuator Auto-coupled, Signal Level –15 dBm to –50 dBm. 10 Hz ≤ RBW ≤ 1 MHz, after alignment performed.

Noise and Distortion

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

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

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

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

2nd Harmonic Distortion*4

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

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

Displayed Average Noise Level*5, Preamp Off

Frequency Range	Specification	Typical
LF Band		
1 Hz to 100 Hz		–129 dBm/Hz
>100 Hz to 4 kHz	–124 dBm/Hz	–130 dBm/Hz
>4 kHz to 10 kHz	–141 dBm/Hz	–144 dBm/Hz
>10 kHz to 32 MHz	–150 dBm/Hz	–153 dBm/Hz
RF Band		
9 kHz to 1 MHz	–108 dBm/Hz	–111 dBm/Hz
>1 MHz to 10 MHz	–136 dBm/Hz	–139 dBm/Hz
>10 MHz to 2 GHz	–154 dBm/Hz	–157 dBm/Hz
>2 GHz to 3 GHz	–153 dBm/Hz	–156 dBm/Hz
>3 GHz to 4 GHz (SPECMON6)	–151 dBm/Hz	–154 dBm/Hz
>4 GHz to 6.2 GHz (SPECMON6)	–149 dBm/Hz	–152 dBm/Hz

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

Preamplifier Performance

Characteristic	Description
Frequency Range	1 MHz to 3.0 GHz or 6.2 GHz (SPECMON6)
Noise Figure at 2 GHz	7 dB
Gain at 2 GHz	18 dB (nominal)

Displayed Average Noise Level*5, Preamp On

Frequency Range	Specification	Typical
LF Band		
1 MHz to 32 MHz	–158 dBm/Hz	–160 dBm/Hz
RF Band		
1 MHz to 10 MHz	–158 dBm/Hz	–160 dBm/Hz
>10 MHz to 2 GHz	–164 dBm/Hz	–167 dBm/Hz
>2 GHz to 3 GHz	–163 dBm/Hz	–165 dBm/Hz
>3 GHz to 6.2 GHz (SPECMON6)	–162 dBm/Hz	–164 dBm/Hz

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

Residual Response*6

Frequency Range	Specified	Typical
500 kHz to 32 MHz, LF Band		< –100 dBm
500 kHz to 80 MHz, RF Band		< –75 dBm
80 MHz to 200 MHz		< –95 dBm
200 MHz to 3 GHz	–95 dBm	
3 GHz to 6.2 GHz (SPECMON6)	–95 dBm	

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

Image Response*7

Frequency	Spec
100 Hz to 30 MHz	< –75 dBc
30 MHz to 3 GHz	< –75 dBc
>3 GHz to 6.2 GHz (SPECMON6)	< –65 dBc

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

Spurious Response with Signal, Offset ≥400 kHz*8

	Span ≤25 MHz, Swept Spans >25 MHz		Opt. 40/110 25 MHz < Span ≤ 110 MHz	
Frequency	Specification	Typical	Specification	Typical
10 kHz to 32 MHz (LF Band)	–71 dBc	–75 dBc	NA	NA
30 MHz to 3 GHz	–73 dBc	–78 dBc	–73 dBc	–75 dBc
>3 GHz to 6.2 GHz (SPECMON6)	–73 dBc	–78 dBc	–73 dBc	–75 dBc

*8 RF Input Level = –15 dBm, Attenuator = 10 dB, Mode: Auto. Input signal at center frequency. Center Frequency >90 MHz, Opt. 40/110.

Spurious Response with Signal (10 kHz ≤ offset < 400 kHz), Typical

Frequency	Span ≤ 25 MHz, Swept Spans >25 MHz	Opt. 40/110 25 MHz < Span ≤ 110 MHz
10 kHz to 32 MHz (LF Band)	–71 dBc	NA
30 MHz to 3 GHz	–73 dBc	–73 dBc
3 GHz to 6.2 GHz (SPECMON6)	–73 dBc	–73 dBc

Spurious Response with Signal at 3.5125 GHz <80 dBc (RF input level, –30 dBm)

Local Oscillator Feed-through to Input Connector < –60 dBm (typical, attenuator = 10 dB)

Adjacent Channel Leakage Ratio Dynamic Range*9

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

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

IF Frequency Response and Phase Linearity*10

Frequency Range (GHz)	Acquisition Bandwidth	Amplitude Flatness (Spec)	Amplitude Flatness (Typ, RMS)	Phase Flatness (Typ, RMS)
0.001 to 0.032 (LF Band)	≤20 MHz	±0.50 dB	0.4 dB	1.0°
0.01 to 6.2*11	≤300 kHz	±0.10 dB	0.05 dB	0.1°
0.03 to 6.2	≤25 MHz	±0.30 dB	0.20 dB	0.5°
Opt. 40				
0.03 to 6.2	≤40 MHz	±0.30 dB	0.20 dB	0.5°
Opt. 110				
0.07 to 3.0	≤110 MHz	±0.50 dB	0.30 dB	1.5°
>3.0 to 6.2	≤110 MHz	±0.50 dB	0.40 dB	1.5°

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

*11 High Dynamic Range mode selected.

Frequency Mask Trigger (Opt. 52)

Characteristic	Description
Mask Shape	User Defined
Mask Point Horizontal Resolution	<0.2% of span
Level Range	0 dB to –80 dB from reference level
Level Accuracy*12	
0 to –50 dB from reference level	±(Channel Response Flatness + 1.0 dB)
–50 dB to –70 dB from reference level	±(Channel Response Flatness + 2.5 dB)
Span Range	100 Hz to 25 MHz
	100 Hz to 40 MHz (Opt. 40)
	100 Hz to 110 MHz (Opt. 110)
Trigger Position Uncertainty	Span = 25 MHz: ±15 µs ±9 µs (Opt. 200, RBW = Auto)
	Span = 40 MHz (Opt. 40): ±12.8 µs ±7 µs (Opt. 200, RBW = Auto)
	Span = 110 MHz (Opt. 110): ±5.12 µs ±5 µs (Opt. 200, RBW = Auto)

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

Minimum Signal Duration for 100% Probability of Trigger at 100% Amplitude*13

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

*13 RBW= maximum for FMT with Opt. 200.

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

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

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

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

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

Resolution BW Range vs. Acquisition Bandwidth (DPX®)

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

Zero-span Amplitude, Frequency, Phase Performance (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	±1%
Sweep Time Range	100 ns (minimum) 1 s (maximum, Measurement BW >60 MHz) 2000 s (maximum, Measurement BW ≤60 MHz)
Time Accuracy	±(0.5% + Reference Frequency Accuracy)
Zero-span Trigger Timing Uncertainty (Power trigger)	±(Zero-span Sweep Time/400) at trigger point
DPX Frequency Display Range	±100 MHz maximum
DPX Phase Display Range	±200 Degrees maximum
DPX Waveforms/s	50,000 triggered waveforms/s for sweep time ≤20 µs

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 Trace Length = 2401: 20,000 traces Trace Length = 4001: 12,000 traces
Time Resolution per Line	110 µs to 6400 s, user settable
Maximum Recording Time vs. Line Resolution	6.6 seconds (801 points/trace, 110 µs/line) to 4444 days (801 points/trace, 6400 s/line)

Opt. 200 – Advanced Triggers

Characteristic	Description
DPX Density™ Trigger	
Density Range	0 to 100% density
Horizontal Range	0.25 Hz to 25 MHz (Std.) 0.25 Hz to 40 MHz (Opt. 40) 0.25 Hz to 110 MHz (Opt. 110)
Minimum Signal Duration for 100% Probability of Trigger (at maximum acquisition bandwidth) RBW = Auto, Trace Length 801 Points	See Minimum Signal Duration for 100% Probability of Trigger at 100% Amplitude table
Frequency Edge Trigger	
Range	±(½ × (ACQ BW or TDBW if TDBW is active))
Minimum Event Duration	12 ns (ACQ BW = 110 MHz, no TDBW, Opt. 110) 25 ns (ACQ BW = 40 MHz, no TDBW, Opt. 40) 40 ns (ACQ BW = 25 MHz, no TDBW, Standard)
Timing Uncertainty	Same as Power Trigger Position Timing Uncertainty
Runt Trigger	
Runt Definitions	Positive, Negative
Accuracy	
(for trigger levels >30 dB above noise floor, 10% to 90% of signal level)	±0.5 dB (level ≥ –50 dB from reference level) ±1.5 dB (from < –50 dB to –70 dB from reference level)
Time-qualified Triggering	
Trigger Types and Source	Time qualification may be applied to: Level, Frequency Mask (Opt. 02), DPX Density, Runt, Frequency Edge, Ext. 1, Ext. 2
Time Qualification Range	T1: 0 to 10 seconds T2: 0 to 10 seconds
Time Qualification Definitions	Shorter than T1 Longer than T1 Longer than T1 AND shorter than T2 Shorter than T1 OR longer than T2
Holdoff Trigger	
Range	0 to 10 seconds

Digital IQ Output (Opt. 55)

Characteristic	Description
Connector Type	MDR (3M) 50 pin × 2
Data Output	Data is corrected for amplitude and phase response in real time
Data format	I data: 16 bit LVDS Q data: 16 bit LVDS
Control Output	Clock: LVDS, Max 50 MHz (150 MHz, Opt. 55) DV (Data Valid), MSW (Most Significant Word) indicators, LVDS
Control Input	IQ data output enabled, connecting GND enables output of IQ data
Clock Rising Edge to Data Transition Time (Hold time)	8.4 ns (typical, standard), 1.58 ns (typical, Opt. 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)	(1/2 × Audio Analysis Bandwidth) to maximum input frequency
Maximum Audio Frequency Span	10 MHz
Audio Filters	
Low Pass (kHz)	0.3, 3, 15, 30, 80, 300, and user-entered up to 0.9 × audio bandwidth
High Pass (Hz)	20, 50, 300, 400, and user-entered up to 0.9 × audio bandwidth
Standard	CCITT, C-Message
De-emphasis (μs)	25, 50, 75, 750, and user-entered
File	User-supplied .TXT or .CSV file of amplitude/frequency pairs. Maximum 1000 pairs
FM Modulation Analysis (Modulation Index >0.1)	
FM Measurements	Carrier Power, Carrier Frequency Error, Audio Frequency, Deviation (+Peak, –Peak, Peak-Peak/2, RMS), SINAD, Modulation Distortion, S/N, Total Harmonic Distortion, Total Non-harmonic Distortion, Hum and Noise
Carrier Power Accuracy (10 MHz to 2 GHz, –20 to 0 dBm input power)	±0.85 dB
Carrier Frequency Accuracy (Deviation: 1 to 10 kHz)	±0.5 Hz + (transmitter frequency × reference frequency error)
FM Deviation Accuracy (Rate: 1 kHz to 1 MHz)	±(1% of (rate + deviation) + 50 Hz)
FM Rate Accuracy (Deviation: 1 to 100 kHz)	±0.2 Hz
Residuals (FM) (Rate: 1 to 10 kHz, Deviation: 5 kHz)	
THD	0.10%
Distortion	0.7%
SINAD	43 dB
AM Modulation Analysis	
AM Measurements	Carrier Power, Audio Frequency, Modulation Depth (+Peak, –Peak, Peak-Peak/2, RMS), SINAD, Modulation Distortion, S/N, Total Harmonic Distortion, Total Non-harmonic Distortion, Hum and Noise
Carrier Power Accuracy (10 MHz to 2 GHz, –20 to 0 dBm input power)	±0.85 dB
AM Depth Accuracy (Rate: 1 to 100 kHz, Depth: 10% to 90%)	±0.2% + 0.01 × measured value
AM Rate Accuracy (Rate: 1 kHz to 1 MHz, Depth: 50%)	±0.2 Hz
Residuals (AM)	
THD	0.16%
Distortion	0.13%
SINAD	58 dB
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)	±0.2 Hz + (transmitter frequency × reference frequency error)
PM Deviation Accuracy (Rate: 1 to 20 kHz, Deviation: 0.628 to 6 rad)	±100% × (0.005 + (rate / 1 MHz))
PM Rate Accuracy (Rate: 1 to 10 kHz, Deviation: 0.628 rad)	±0.2 Hz
Residuals (PM) (Rate: 1 to 10 kHz, Deviation: 0.628 rad)	
THD	0.1%
Distortion	1%
SINAD	40 dB
Direct Audio Input	
Audio Measurements	Signal Power, Audio Frequency (+Peak, –Peak, Peak-Peak/2, RMS), SINAD, Modulation Distortion, S/N, Total Harmonic Distortion, Total Non-harmonic Distortion, Hum and Noise
Direct Input Frequency Range (for audio measurements only)	1 Hz to 156 kHz
Maximum Audio Frequency Span	156 kHz
Audio Frequency Accuracy	±0.2 Hz
Signal Power Accuracy	±1.5 dB
Residuals (Rate: 1 to 10 kHz, Input Level: 0.316 V)	
THD	0.1%
Distortion	0.1%
SINAD	60 dB

Phase Noise and Jitter Measurement (Opt. 11)

Characteristic	Description
Carrier Frequency Range	1 MHz to maximum instrument frequency
Measurements	Carrier Power, Frequency Error, RMS Phase Noise, Jitter (Time Interval Error), Residual FM
Residual Phase Noise	See Phase Noise specifications
Phase Noise and Jitter Integration Bandwidth Range	Minimum Offset from Carrier: 10 Hz Maximum Offset from Carrier: 1 GHz
Number of Traces	2
Trace and Measurement Functions	Detection: Average or ±Peak Smoothing Averaging Optimization: Speed or Dynamic Range

Settling Time, Frequency, and Phase (Opt. 12)*14

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°

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

Advanced Measurement Suite

Characteristic	Description
Measurements	Average On Power, Peak Power, Average Transmitted Power, Pulse Width, Rise Time, Fall Time, Repetition Interval (seconds), Repetition Interval (Hz), Duty Factor (%), Duty Factor (Ratio), Ripple (dB), Ripple (%), Droop (dB), Droop (%), Overshoot (dB), Overshoot (%), Pulse-Pulse Frequency Difference, Pulse-Pulse Phase Difference, RMS Frequency Error, Max Frequency Error, RMS Phase Error, Max Phase Error, Frequency Deviation, Phase Deviation, Impulse Response (dB), Impulse Response (Time), Time Stamp
Minimum Pulse Width for Detection	150 ns (standard, Opt. 40), 50 ns (Opt. 110)
Number of Pulses	1 to 10,000
System Rise Time (Typical)	<40 ns (standard), <17 ns (Opt. 40), <12 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 Measurement Accuracy (typical): ±2 dB for a signal 40 dB in amplitude and delayed 1% to 40% of the pulse chirp width*15
Impulse Response Weighting	Taylor Window

*15 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*16	±0.3 dB + Absolute Amplitude Accuracy
Average Transmitted Power*16	±0.4 dB + Absolute Amplitude Accuracy
Peak Power*16	±0.4 dB + Absolute Amplitude Accuracy
Pulse Width	±3% of reading
Duty Factor	±3% of reading

*16 Pulse Width >300 ns (100 ns, Opt. 110) SNR ≥30 dB.

Frequency and Phase Error Referenced to Nonchirped Signal

At stated frequencies and measurement bandwidths*17, typical.

Bandwidth	CF	RMS Freq Err	Pulse to Pulse Freq	Pulse to Pulse Phase
20 MHz	2 GHz	±7 kHz	±12 kHz	±0.3°
	10 GHz	±16 kHz	±40 kHz	±0.75°
	20 GHz	±40 kHz	±110 kHz	±1.8°
60 MHz (Opt. 110)	2 GHz	±26 kHz	±80 kHz	±0.5°
	10 GHz	±55 kHz	±190 kHz	±1.2°
	20 GHz	±200 kHz	±560 kHz	±2.6°

*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.

Frequency and Phase Error Referenced to a Linear Chirp

At stated frequencies and measurement bandwidths*18, typical.

Bandwidth	CF	RMS Freq Err	Pulse to Pulse Freq	Pulse to Pulse Phase
20 MHz	2 GHz	±7 kHz	±16 kHz	±0.3°
	10 GHz	±16 kHz	±40 kHz	±0.95°
	20 GHz	±40 kHz	±110 kHz	±2.25°
60 MHz (Opt. 110)	2 GHz	±26 kHz	±130 kHz	±0.7°
	10 GHz	±55 kHz	±370 kHz	±1.3°
	20 GHz	±200 kHz	±630 kHz	±3.5°

*18 Pulse ON Power ≥ –20 dBm, signal peak at Reference Level, Attenuator = 0 dB, $t_{meas} - t_{reference}$ ≤ 10 ms, Frequency Estimation: Manual. Pulse-to-Pulse Measurement time position excludes the beginning and ending of the pulse extending for a time = (10 / Measurement BW) as measured from 50% of the $t_{(rise)}$ or $t_{(fall)}$. Absolute Frequency Error determined over center 50% of pulse.

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

Digital Modulation Analysis (Opt. 21)

Characteristic	Description
Modulation Formats	π/2DBPSK, BPSK, SBPSK, QPSK, DQPSK, π/4DQPSK, D8PSK, 8PSK, D16PSK, OQPSK, SOQPSK, CPM, 16/32-APSK, 16/32/64/128/256QAM, MSK, 2-FSK, 4-FSK, 8-FSK, 16-FSK, C4FM
Analysis Period	Up to 80,000 Samples
Filter Types	
Measurement filters	Square-root raised cosine, raised cosine, Gaussian, rectangular, IS-95, IS-95 EQ, C4FM-P25, half-sine, None, User Defined
Reference filters	Raised cosine, Gaussian, rectangular, IS-95, SBPSK-MIL, SOQPSK-MIL, SOQPSK-ARTM, None, User Defined
Alpha/B×T Range	0.001 to 1, 0.001 step
Measurements	Constellation, Error Vector Magnitude (EVM) vs. Time, Modulation Error Ratio (MER), Magnitude Error vs. Time, Phase Error vs. Time, Signal Quality, Symbol Table, rho FSK only: Frequency Deviation, Symbol Timing Error
Symbol Rate Range	1 kS/s to 85 MS/s (Modulated signal must be contained entirely within acquisition BW)

Digital (Opt. 21)

Symbol Rate	Residual EVM (Typical)
QPSK Residual EVM*19	
100 kS/s	<0.35%
1 MS/s	<0.35%
10 MS/s	<0.5%
30 MS/s (Opt. 40/110)	<1.5%
60 MS/s (Opt. 110)	<2.0%
256 QAM Residual EVM*20	
10 MS/s	<0.4%
30 MS/s (Opt. 40/110)	<1.0%
60 MS/s (Opt. 110)	<1.5%
Offset QPSK Residual EVM*19	
100 kS/s	<0.4%
1 MS/s	<0.4%
10 MS/s	<1.3%
S-OQPSK (MIL, ARTM) Residual EVM*21	
4 kS/s, CF = 250 MHz	<0.3%
20 kS/s	<0.5%
100 kS/s	<0.5%
1 MS/s	<0.5%
S-BPSK (MIL) Residual EVM*22	
4 kS/s, CF = 250 MHz	<0.2%
20 kS/s	<0.5%
100 kS/s	<0.5%
1 MS/s	<0.5%
CPM (MIL) Residual EVM*22	
4 kS/s, CF = 250 MHz	<0.3%
20 kS/s	<0.5%
100 kS/s	<0.5%
1 MS/s	<0.5%
2/4/8/16 FSK Residual RMS FSK Error*23	
10 kS/s, deviation 10 kHz	<0.5%

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

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

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

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

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

Adaptive Equalizer

Characteristic	Description
Type	Linear, decision-directed, Feed-forward (FIR) equalizer with coefficient adaptation and adjustable convergence rate
Modulation Types Supported	BPSK, QPSK, OQPSK, π/2DBPSK, π/4DQPSK, 8PSK, 8DPSK, 16DPSK, 16/32-APSK, 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 802.11 a/g/j
Parameter settings	Guard Interval, Subcarrier Spacing, Channel Bandwidth
Advanced parameter settings	Carrier Detect: 802.11, 802.16-2004 – Auto-detect; Manual Select BPSK; QPSK, 16QAM, 64QAM Channel Estimation: Preamble, Preamble + Data Pilot Tracking: Phase, Amplitude, Timing Frequency Correction: On, Off
Summary Measurements	Symbol Clock Error, Frequency Error, Average Power, Peak-to-Average, CPE EVM (RMS and Peak) for all carriers, plot carriers, data carriers OFDM Parameters: Number of Carriers, Guard Interval (%), Subcarrier Spacing (Hz), FFT Length Power (Average, Peak-to-Average)
Displays	EVM vs. Symbol, vs. Subcarrier Subcarrier Power vs. Symbol, vs. Subcarrier Mag Error vs. Symbol, vs. Subcarrier Phase Error vs. Symbol, vs. Subcarrier Channel Frequency Response
Residual EVM	–44 dB (WiMAX 802.16-2004, 5 MHz BW) –44 dB (WLAN 802.11g, 20 MHz BW) (Signal input power optimized for best EVM)

Analog Modulation Analysis Accuracy (Typical)

Modulation	Description
AM	±2% (0 dBm Input at Center, Carrier Frequency 1 GHz, 10 to 60% Modulation Depth)
FM	±1% of Span (0 dBm Input at Center) (Carrier Frequency 1 GHz, 400 Hz/1 kHz Input/Modulated Frequency)
PM	±3° (0 dBm Input at Center) (Carrier Frequency 1 GHz, 1 kHz/5 kHz Input/Modulated Frequency)

Inputs And Outputs

Characteristic	Description
Front Panel	
Display	Touch panel, 10.4 in. (264 mm)
RF Input Connector	N-type female, 50 Ω
Trigger Out	BNC, High: >2.0 V, Low: <0.4 V, output current 1 mA (LVTTL)
Trigger In	BNC, 50 Ω/5 kΩ impedance (nominal), ±5 V max input, –2.5 V to +2.5 V trigger level
USB Ports	(2) USB 2.0
Audio	Speaker
Rear Panel	
10 MHz REF OUT	50 Ω, BNC, >0 dBm
External REF IN	50 Ω, 10 MHz, BNC
Trig 2 / Gate IN	BNC, High: 1.6 to 5.0 V, Low: 0 to 0.5 V
GPIB Interface	IEEE 488.2
LAN Interface Ethernet	RJ45, 10/100/1000BASE-T
USB Ports	(2) USB 2.0
VGA Output	VGA compatible, 15 DSUB
Audio Out	3.5 mm headphone jack
Noise Source Drive	BNC, +28 V, 140 mA (nominal)
Digital IQ Out	2 connectors, LVDS (Opt. 55)

RF Field Strength and Mapping

Characteristic	Description
RF Field Strength	
Signal Strength Indicator	Located at right-side of display
Measurement Bandwidth	Up to 110 MHz, dependent on span and RBW setting
Tone Type	Variable frequency
Mapping	
Map Types Directly Supported	Pitney Bowes MapInfo (*.mif), Bitmap (*.bmp)
Saved Measurement Results	Measurement data files (exported results) Map file used for the measurements Google Earth KMZ file Recallable results files (trace and setup files) MapInfo-compatible MIF/MID files

General Characteristics

Characteristic	Description
Temperature Range	
Operating	+5 °C to +40 °C
Storage	–20 °C to +60 °C
Warm-up Time	20 min.
Altitude	
Operating	Up to 3000 m (approximately 10,000 ft.)
Nonoperating	Up to 12,190 m (40,000 ft.)
Relative Humidity	
Operating and nonoperating (80% RH max when accessing DVD)	90% RH at 30 °C (No condensation, max wet bulb, 29 °C)
Vibration	
Operating	0.22 G_{RMS}: Profile = 0.00010 g^2/Hz at 5-350 Hz, –3 dB/octave slope from 350-500 Hz, 0.00007 g^2/Hz at 500 Hz, 3 Axes at 10 min/axis CD/DVD operation not specified under vibration
Nonoperating	2.28 G_{RMS}: Profile = 0.0175 g^2/Hz at 5-100 Hz, –3 dB/octave from 100-200 Hz, 0.00875 g^2/Hz at 200-350 Hz, –3 dB/octave from 350-500 Hz, 0.00613 g^2/Hz at 500 Hz, 3 Axes at 10 min/axis
Shock	
Operating	15 G, half-sine, 11 ms duration. (1 G max when accessing DVD and Opt. 06 Removable HDD)
Nonoperating	30 G, half-sine, 11 ms duration
Safety	UL 61010-1:2004
	CSA C22.2 No.61010-1-04
Electromagnetic Compatibility, Complies with:	EU Council EMC Directive 2004/108/EC
	EN61326, CISPR 11, Class A
Power Requirements	90 V_{AC} to 264 V_{AC}, 50 Hz to 60 Hz
	90 V_{AC} to 132 V_{AC}, 400 Hz
Power Consumption	450 W max
Data Storage	Internal HDD (Opt. 59), USB ports, DVD-R / CD-RW (Opt. 57), Removable HDD (Opt. 56)
Calibration Interval	One year
Warranty	One year
GPIB	SCPI-compatible, IEEE488.2 compliant

Physical Characteristics

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

Note: Physical characteristics, with feet.

Ordering Information

SPECMON3

Real Time Signal Analyzer, 1 Hz to 3 GHz

SPECMON6

Real Time Signal Analyzer, 1 Hz to 6.2 GHz

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

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

Options

Product	Options	Description
SPECMON3		Real Time Spectrum Analyzer, 1 Hz-3 GHz, internal preamplifier, 25 MHz real-time bandwidth, pulse analysis suite, removable solid state drive, 3-year warranty
SPECMON6		Real Time Spectrum Analyzer, 1 Hz-6.2 GHz , internal preamplifier, 40 MHz real-time bandwidth, pulse analysis suite, removable solid state drive, 3-year warranty
	Opt. 52	Frequency Mask Trigger
	Opt. 53	Memory Extension, 4 GB Acquisition Memory Total
	Opt. 55	Digital I and Q output
	Opt. 09	Enhanced Real Time
	Opt. 10	AM/FM/PM Modulation and Audio Measurements
	Opt. 11	Phase Noise / Jitter Measurement
	Opt. 12	Settling Time (Frequency and Phase)
	Opt. 21	General Purpose Modulation Analysis
	Opt. 22	Flexible OFDM Analysis
	Opt. 40	40 MHz Acquisition Bandwidth (SPECMON3 only)
	Opt. 110	110 MHz Acquisition Bandwidth
	Opt. 200	Advanced Triggers, Swept DPX, and DPX Zero Span
RSA56KR		Rackmount for RSA5K, RSA6K, SPECMON Real-Time Analyzers

Accessories

Accessory	Description
RTPA2A Spectrum Analyzer Probe Adapter compatibility	Supports TekConnect® probes P7225, P7240, P7260, P7330, P7313, P7313SMA, P7340A, P7350, P7350SMA, P7360A, P7380A, P7380SMA, P7500 Series
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	Windows 7 and instrument SW preinstalled. 065-0939-xx
Transit Case	016-2026-xx
Rackmount Retrofit	RSA56KR
Additional Quick Start User Manual (Paper)	071-3064-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. A12	Brazil power
Opt. A99	No power cord or AC adapter

Service

Option	Description
Opt. CA1	Single Calibration or Functional Verification
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

Upgrades

SPECMONUP – Upgrade Options for SPECMON3 / SPECMON6

SPECMONUP	Option Description	HW or SW	Factory Calibration Required?
Opt. 52	Frequency Mask Trigger	SW	No
Opt. 53	Memory Extension, 4 GB Acquisition Memory Total	HW	No
Opt. 55	Digital IQ Output	HW	No
Opt. 09	Enhanced Real Time	SW	No
Opt. 10	AM/FM/PM Modulation and Audio Measurements	SW	No
Opt. 11	Phase Noise / Jitter Measurements	SW	No
Opt. 12	Settling Time (Frequency and Phase)	SW	No
Opt. 21	General Purpose Modulation Analysis	SW	No
Opt. 22	Flexible OFDM Analysis	SW	No
Opt. 40	SPECMON3 only: 40 MHz Acquisition Bandwidth	HW	Yes
Opt. 110	110 MHz Acquisition Bandwidth	HW	Yes
Opt. 200	Advanced DPX / Swept DPX with Density, Time Qualified, and Runt Triggers and Zero-span DPX	HW	No

Languages

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.

Contact Tektronix:

ASEAN / Australasia (65) 6356 3900

Austria 00800 2255 4835*

Balkans, Israel, South Africa and other ISE Countries +41 52 675 3777

Belgium 00800 2255 4835*

Brazil +55 (11) 3759 7627

Canada 1 800 833 9200

Central East Europe and the Baltics +41 52 675 3777

Central Europe & Greece +41 52 675 3777

Denmark +45 80 88 1401

Finland +41 52 675 3777

France 00800 2255 4835*

Germany 00800 2255 4835*

Hong Kong 400 820 5835

India 000 800 650 1835

Italy 00800 2255 4835*

Japan 81 (3) 6714 3010

Luxembourg +41 52 675 3777

Mexico, Central/South America & Caribbean 52 (55) 56 04 50 90

Middle East, Asia, and North Africa +41 52 675 3777

The Netherlands 00800 2255 4835*

Norway 800 16098

People's Republic of China 400 820 5835

Poland +41 52 675 3777

Portugal 80 08 12370

Republic of Korea 001 800 8255 2835

Russia & CIS +7 (495) 6647564

South Africa +41 52 675 3777

Spain 00800 2255 4835*

Sweden 00800 2255 4835*

Switzerland 00800 2255 4835*

Taiwan 886 (2) 2722 9622

United Kingdom & Ireland 00800 2255 4835*

USA 1 800 833 9200

* European toll-free number. If not accessible, call: +41 52 675 3777

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