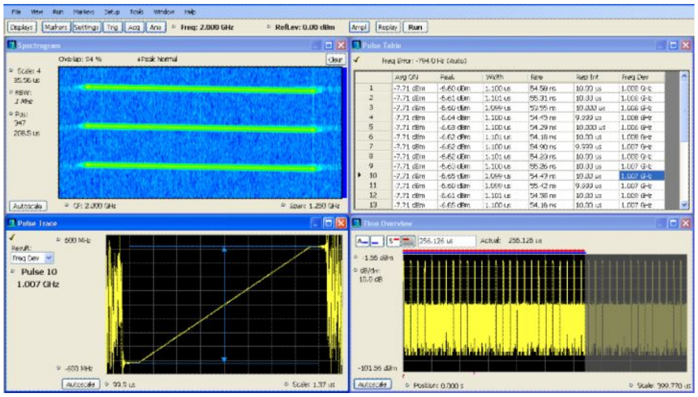
Vector and RF Suite of Signal Analysis Software for PC

SignalVu-PC-SVE Applications Datasheet



SignalVu-PC is the foundation of RF and vector signal analysis software that helps you easily validate RF designs. It is based on the signal analysis engine of the RSA5000 Series real-time signal analyzers and runs on your computer or Windows tablet. You can now move your analysis of acquisitions off the instrument and anywhere. SignalVu-PC is also the companion software that runs the analysis for the Tektronix USB real-time spectrum analyzers. Whether your design validation needs include wideband radar, high data rate satellite links, wireless LAN or frequency-hopping communications, the SignalVu-PC comprehensive suite of tools and application software can speed your time-to-insight by showing you the time-variant behavior of these signals.

Key features

- Analyzes waveforms acquired by Tektronix real-time signal analyzers and oscilloscopes, including:
  - Tektronix real-time and mixed-domain oscilloscopes (MDO/MSO/ DPO3000, MDO/MSO/DPO4000, MSO/DPO5000, DPO7000C, DPO/ DSA/MSO70000 Series)
  - Tektronix real-time signal analyzers (RSA3000, RSA5000, RSA6000, SPECMON Series, RSA500, RSA600, and RSA306 Series)
  - Turn the MDO4000B/C Series into the industry's only 1 GHz Vector Signal Analyzer using Connect (CON-SVPC)
- Analyze without acquisition hardware present
- Analyze wideband designs
- Free up instruments for further use while analysis occurs offline
- Enable analysis at multiple sites without purchasing additional hardware
- Use your Windows tablet or your powerful PC workstation
  - Windows 7 (64 bit), Windows 8 (64 bit), and Windows 10 compatible
- Node Locked and Floating License available for each SignalVu-PC optional application
- 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, Multicarrier ACLR, Power vs. Time, CCDF, and OBW/EBW
  - WLAN spectrum and modulation transmitter measurements based on IEEE 802.11 a/b/g/j/p/n/ac/ad standards
  - Bluetooth® Transmitter Measurements based on Bluetooth SIG RF specifications for Basic Rate and Low Energy. Some support of Enhanced Data Rate.
  - Settling time measurements, frequency, and phase for characterization of wideband frequency-agile oscillators
  - Advanced Pulse analysis suite - automated pulse measurements provide deep insight into pulse train behavior. Measurement pulse statistics over many acquisitions (millions of pulses).
  - General purpose digital modulation analysis provides modulation analysis of 23 modulation types
  - Flexible OFDM analysis of custom OFDM signals
  - Frequency offset control for analyzing baseband signals with near-zero intermediate frequencies (IF)
  - AM/FM/PM modulation and audio measurements for characterization of analog transmitters and audio signals
  - Simple and complete APCO Project 25 transmitter compliance testing and analysis for Phase 1 (C4FM) and Phase 2 (TDMA)
  - Playback of recorded files from the USB spectrum analyzers (RSA306, RSA500, and RSA600)
  - LTE™ FDD and TDD Base Station (eNB) Transmitter RF measurements
  - Signal Classification and Survey
  - Mapping

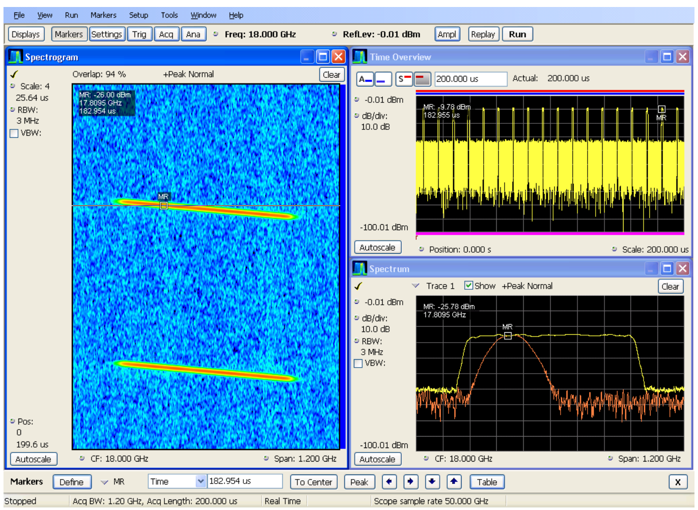
Applications

- Wideband radar and pulsed RF signals
- Frequency agile communications
- Broadband satellite and microwave backhaul links
- Wireless LAN, Bluetooth, Commercial Wireless
- Land Mobile Radio (LMR), APCO P25

- Education
- Long Term Evolution (LTE), Cellular

Capture with a variety of tools

Capture once - make multiple measurements without recapturing. Using oscilloscopes, up to four channels can be captured simultaneously; each of which can be independently analyzed by SignalVu-PC software. Channels can be RF, I and Q, or differential inputs. You can also apply math functions to the acquisition before analysis by SignalVu-PC. Acquisition lengths vary depending upon the selected capture bandwidth: full-bandwidth acquisitions can range from 1 ms to 25 ms depending upon model and option selections. Real-time signal analyzer captures range from up to 7.15 seconds at maximum acquisition bandwidth to several hours at reduced bandwidths.



Once captured into memory, SignalVu-PC provides detailed analysis in multiple domains. The spectrogram display (left panel) shows the frequency of an 800 MHz wide LFM pulse changing over time. By selecting the point in time in the spectrogram during the On time of the pulse, the chirp behavior can be seen as it sweeps from low to high (lower right panel).

Connect with the MDO4000B/C Series

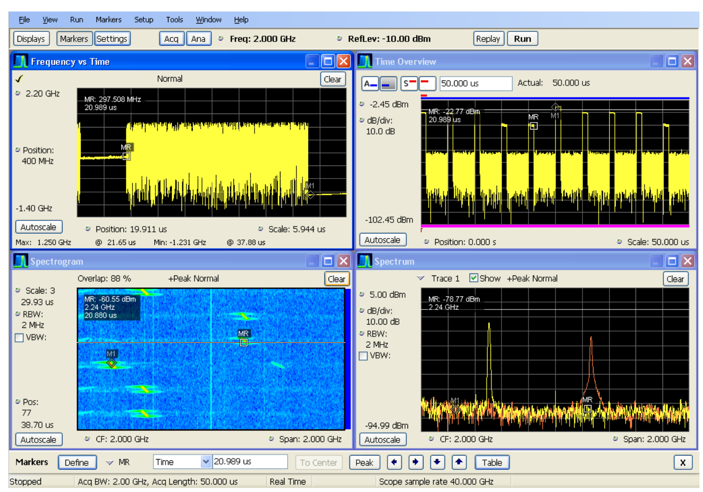
With SignalVu-PC Connect (CON-SVPC), SignalVu-PC extends the functionality of the Mixed Domain Oscilloscope MDO4000B/C Series and turns it into the industry's only 1 GHz Vector Signal Analyzer. SignalVu-PC controls the MDO4000B/C RF section, acquires the vector-calibrated I/Q data, and makes wide-band, time-correlated, multi-domain measurements. You can analyze, correlate and troubleshoot issues in time, frequency, phase, amplitude, and even modulation, since you can acquire up to 1 GHz of bandwidth in one shot. You can leverage the MDO4000B/C triggering capability and extend your debugging work into system-level troubleshooting of your embedded RF devices.

Analyze

SignalVu-PC vector signal analysis software uses the same analysis capabilities found in the RSA5000 and RSA6000 Series real-time signal analyzers.

Time-correlated measurements can be made of frequency, phase, amplitude, and modulation versus time. This is ideal for signal analysis that includes frequency hopping, pulse characteristics, modulation switching, settling time, bandwidth changes, and intermittent signals.

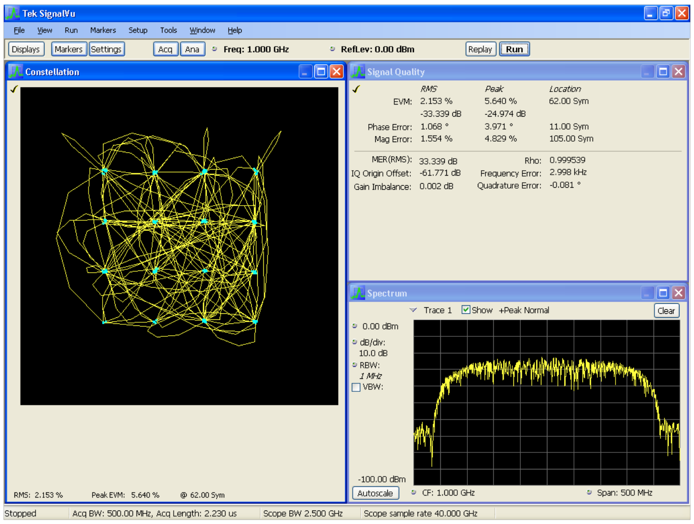
Acquisitions from the USB Spectrum Analyzers and all Tektronix MDO/MSO/DPO Series oscilloscopes, including the spectrum analyzer in the Mixed Domain Oscilloscope can be analyzed with SignalVu-PC, adding deep analysis capabilities to these broadband acquisition systems. Signals acquired with RSAs and Specmon can also be analyzed with all of the post-acquisition analysis capabilities of those instruments.



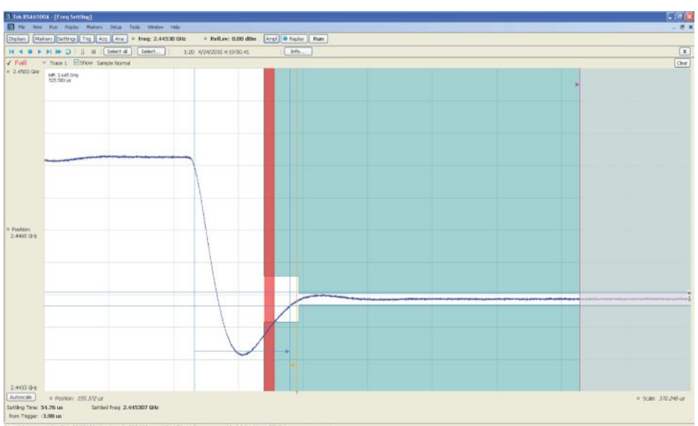
Time-correlated, multi-domain view provides a new level of insight into design or operational problems not possible with conventional analysis solutions. Here, the hop patterns of a narrowband signal can be observed using Spectrogram (lower left) and its hop characteristics can be precisely measured with Frequency vs Time display (upper left). The time and frequency responses can be observed in the two views on the right as the signal hops from one frequency to the next. All of the analysis shown above is available in the free base version of SignalVu-PC.

Optional applications tailored for your RF applications

The basic SignalVu-PC enables spectrum analysis, RF power and statistics, spectrograms, amplitude, frequency and phase vs. time, and analog modulation measurements. Applications are available for P25, Bluetooth, LTE, Mapping, Playback of recorded files, WLAN, settling time, audio, modulation, pulse, and OFDM analysis.



Wideband satellite and point-to-point microwave links can be directly observed with SignalVu-PC analysis software. Here, general purpose Digital Modulation Analysis (SVM) is demodulating a 16QAM backhaul link running at 312.5 MS/s.



Settling time measurements (SVT) 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.

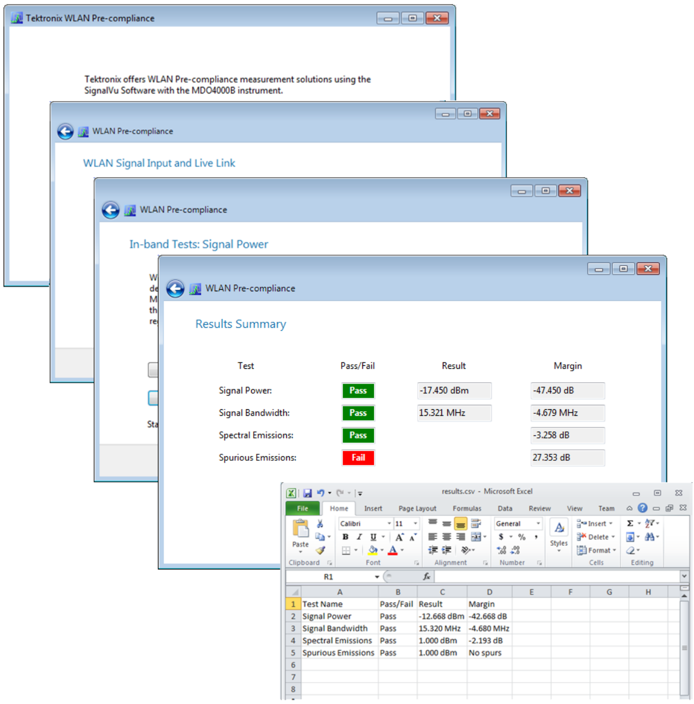
WLAN transmitter testing

With the WLAN measurement applications, you can perform standards-based transmitter measurements in the time, frequency, and modulation domains.

- SV23 supports IEEE 802.11a, b, g, j and p signals
- SV24 supports 802.11n 20 MHz and 40 MHz SISO signals
- SV25 802.11ac 20/40/80/160 MHz SISO signals
- SV2C is a bundle of Connect (CON) to MDO4000B/C Series and all the WLAN measurement applications described above (SV23, SV24 and SV25)

All modulation formats, as shown in the following table can be measured.

Standard	Std PHY	Freq band(s)	Signal	Modulation formats	Bandwidth (max)	802.11-2012 section
802.11b	DSSS HR/ DSSS	2.4 GHz	DSSS/ CCK 1 - 11 Mbps	DBSK, DQPSK CCK5.5M, CCK11M	20 MHz	16 & 17
802.11g	ERP	2.4 GHz	DSSS/ CCK/ PBCC 1 - 33 Mbps	BPSK DQPSK	20 MHz	17
802.11a	OFDM	5 GHz	OFDM 64 <54 Mbps	BPSK QPSK 16QAM 64QAM	20 MHz	18
802.11g		2.4 GHz			20 MHz	19
802.11j/p		5 GHz			5, 10, 20 MHz	18
802.11n	HT	2.4 GHz & 5 GHz	OFDM 64, 128 ≤ 150 Mbps	BPSK QPSK 16QAM 64QAM	20 , 40 MHz	20
802.11ac	VHT	5 GHz	OFDM 64, 128, 256, 512 ≤ 867 Mbps	BPSK QPSK 16QAM 64QAM 256QAM	20, 40, 80, 160 MHz	22

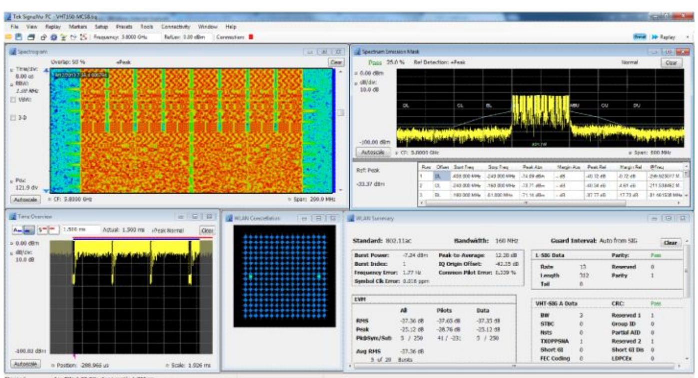


The WLAN presets make the Error Vector Magnitude (EVM), Constellation, and Spectral Emission Mask (SEM) measurements push-button. In addition, you can download the WLAN pre-compliance wizard to easily and quickly prepare for compliance regulatory tests. The Wizard automatically measures Transmit Power, Occupied Bandwidth, Spectral Power Density, Spectral Emission Mask and Spurious Emission Mask.

The WLAN RF transmitter measurements are defined by the IEEE 802.11-2012 revision of the standard.

IEEE 802.11 RF layer test	IEEE reference 802.11-2012	Limit tested
Transmit power	16.4.7.2 (DSSS)	country dependent
	17.4.7.2 ("b")	country dependent
	18.3.9.2("a")	country dependent
	19.4.8.2 ("g")	country dependent
	20.3.20.3 ("n")	country dependent
Transmit Power On/Off Ramp	16.4.7.8 (DSSS)	(10%-90%) 2 usec
	17.4.7.7 ("b")	(10%-90%) 2 usec
Transmit Spectrum mask	16.4.7.5 (DSSS)	Std mask
	17.4.7.4 ("b")	Std mask
	18.3.9.3 ("a")	Std mask
	19.5.5 ("g")	Std mask
	20.3.20.1 ("n")	Std mask
	22.3.18.1 ("ac")	Std mask
RF Carrier suppression	16.4.7.9 ("DSSS")	-15dB
	17.4.7.8 ("b")	-15dB
Center frequency leakage	18.3.9.7.2 ("a")	-15 dBc or +2 dB w.r.t. average subcarrier power
	20.3.20.7.2 ("n")	20 MHz: follow 18.3.9.7.2
		40 MHz: -20 dBc or 0 dB w.r.t. average subcarrier power
Transmit Spectral flatness	18.3.9.7.3 ("a")	+/- 4 dB (SC = -16…16), +4/-6 dB (other)
	20.3.20.2 ("n")	+/- 4 dB, +4/-6 dB
	22.3.18.2 ("ac")	+/- 4 dB, +4/-6 dB (various BWs, 20-160 MHz)
Transmission spurious	18.3.9.4 ("a")	country dependent
Transmit Center frequency tolerance	16.4.7.6 ("DSSS")	+/-25 ppm
	17.4.7.5 ("b")	+/-25 ppm
	18.3.9.5 ("a")	+/-20 ppm (20 MHz and 10 MHz), +/-10 ppm (5 MHz)
	19.4.8.3 ("g")	+/-25 ppm
	20.3.20.4 ("n")	+/-20 ppm (5 GHz band), +/-25 ppm (2.4 GHz band)
	22.3.18.3 ("ac")	+/-20 ppm
Symbol clock frequency tolerance	16.4.7.7 ("DSSS")	+/-25 ppm
	17.4.7.6 ("b")	+/-25 ppm
	18.3.9.6 ("a")	+/-20 ppm (20 MHz and 10 MHz), +/-10 ppm (5 MHz)
	19.4.8.4 ("g")	+/-25 ppm
	20.3.20.6 ("n")	+/-20 ppm (5 GHz band), +/-25 ppm (2.4 GHz band)
	22.3.18.3 ("ac")	+/-20 ppm
Transmit Modulation accuracy	16.4.7.10 ("DSSS")	Peak EVM < 0.35
	17.4.7.9 ("b")	Peak EVM < 0.36

IEEE 802.11 WLAN transmitter test summary				
IEEE 802.11 RF layer test	IEEE reference 802.11-2012	Limit tested		
		Modulation	Coding rate (R	Relative constellation error (dB)
Transmitter Constellation Error	18.3.9.7.4 ("a")	BPSK	1/2	-5
		BPSK	3/4	-8
		QPSK	1/2	-10
		QPSK	3/4	-13
		16-QAM	1/2	-16
		16-QAM	3/4	-19
		64-QAM	2/3	-22
		64-QAM	3/4	-25
	20.3.20.7.3 ("n")	BPSK	1/2	–5
		QPSK	1/2	–10
		QPSK	3/4	–13
		16-QAM	1/2	–16
		16-QAM	3/4	–19
		64-QAM	2/3	–22
		64-QAM	3/4	–25
		64-QAM	5/6	–27
	22.3.18.4.3 ("ac")	BPSK	1/2	-5
		QPSK	1/2	-10
		QPSK	3/4	-13
		16-QAM	1/2	-16
		16-QAM	3/4	-19
		64-QAM	2/3	-22
		64-QAM	3/4	-25
		64-QAM	5/6	-27
		256-QAM	3/4	-30
		256-QAM	5/6	-32
Out-of-band spurious emission	16.4.6.6 ("DSSS")	country dependent		
	17.4.6.9 ("b")	country dependent		
	18.3.8.5 ("a")	country dependent		
	19.4.4 ("g")	country dependent		



Easy analysis of WLAN 802.11ac transmitter with a WLAN preset that provides spectral emission mask, constellation diagram, and decoded burst information.

Bluetooth transmitter testing

With option SV27, you can perform Bluetooth SIG standard-based transmitter RF measurements in the time, frequency, and modulation domains. Option SV27 supports Basic Rate and Low Energy Transmitter measurements defined by Bluetooth SIG Test Specification RF.TS.4.2 for Basic Rate and RF-PHY.TS.4.2 for Bluetooth Low Energy. Option SV27 also automatically detects Enhanced Data Rate packets, demodulates them and provides symbol information.

Pass/Fail results are provided with customizable limits and the Bluetooth presets make the different test set-ups push-button.

Below is a summary of the measurements that are automated with option SV27 (unless noted):

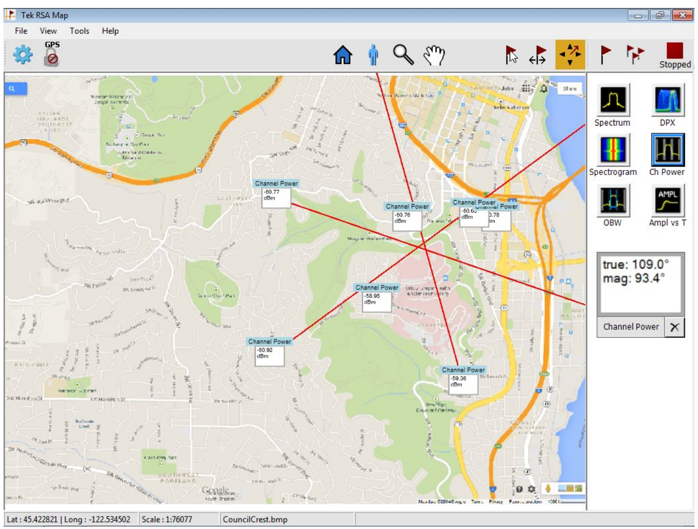
- Bluetooth Low Energy Transmitter Measurements
  - Output power at NOC TRM-LE/CA/01/C and at EOC TRM-LE/CA/02/C
  - In-band emission at NOC TRM-LE/CA/03/C and at EOC TRM-LE/CA/04/C
  - Modulation characteristics TRM-LE/CA/05/C
  - Carrier frequency offset and drift at NOC TRM-LE/CA/06/C and at EOC TRM-LE/CA/07/C
- Basic Rate Transmitter Measurements
  - Output power TRM/CA/01/C
  - Power Density TRM/CA/02/C (no preset)
  - Power Control TRM/CA/03/C (no preset)
  - Tx output Spectrum – Frequency Range TRM/CA/04/C (no preset)
  - Tx output spectrum - 20dB Bandwidth TRM/CA/05/C
  - Tx output spectrum - Adjacent Channel Power TRM/CA/06/C
  - Modulation characteristics TRM/CA/07/C
  - Initial carrier frequency tolerance TRM/CA/08/C
  - Carrier frequency-drift TRM/CA/09/C

The following additional information is also available with SV27: symbol table with color coded field information, constellation, eye diagram, frequency deviation vs time with highlighted packet and octet, frequency offset and drift detailed table as well as packet header field decoding. Markers can be used to cross-correlate the time, vector and frequency information.

Easy validation of Bluetooth transmitter with push button preset, pass/fail information and clear correlation between displays.

Mapping

The MAP application enables interference hunting and location analysis. Locate interference with an azimuth function that lets you draw a line or an arrow on a mapped measurement to indicate the direction your antenna was pointing when you took a measurement. You can also create and display measurement labels.



Mapped channel power readings using the azimuth function.

LTE FDD and TDD base station transmitter RF testing

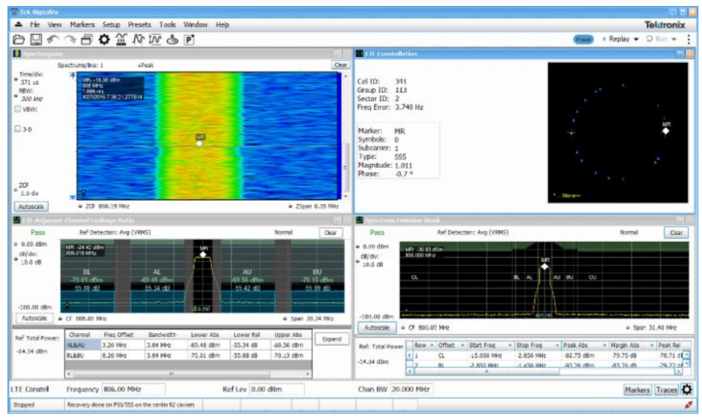
Option SV28 enables the following LTE measurements:

- Cell ID
- Channel Power
- Occupied Bandwidth
- Adjacent Channel Leakage Ratio (ACLR)
- Spectrum Emission Mask (SEM)
- Transmitter Off Power for TDD

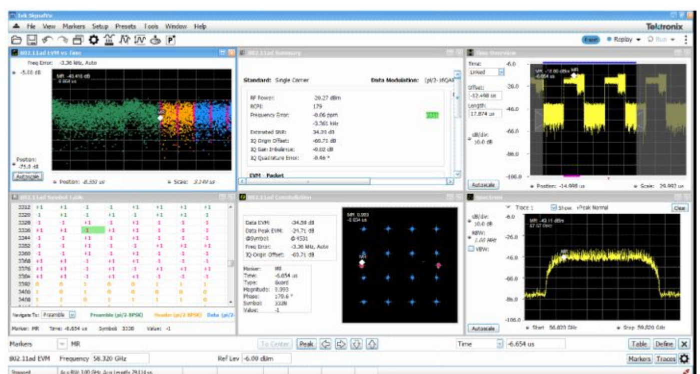
There are four presets to accelerate pre-compliance testing and determine the Cell ID. These presets are defined as Cell ID, ACLR, SEM, Channel Power and TDD Toff Power. The measurements follow the definition in 3GPP TS Version 12.5 and support all base station categories, including picocells and femtocells. Pass/Fail information is reported and all channel bandwidths are supported.

The Cell ID preset displays the Primary Synchronization Signal (PSS) and the Secondary Synchronization Signal (SSS) in a Constellation diagram. It also provides Frequency Error.

The ACLR preset measures the E-UTRA and the UTRA adjacent channels, with different chip rates for UTRA. ACLR also supports Noise Correction based on the noise measured when there is no input. Both ACLR and SEM will operate in swept mode (default) or in faster single acquisition if the instrument has enough acquisition bandwidth.



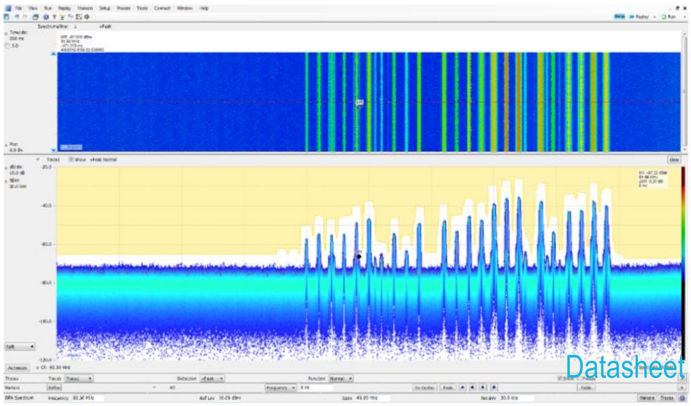
Fast validation of LTE base station transmitter with push button preset, and pass/fail information



WiGig IEEE802.11ad transmitter testing

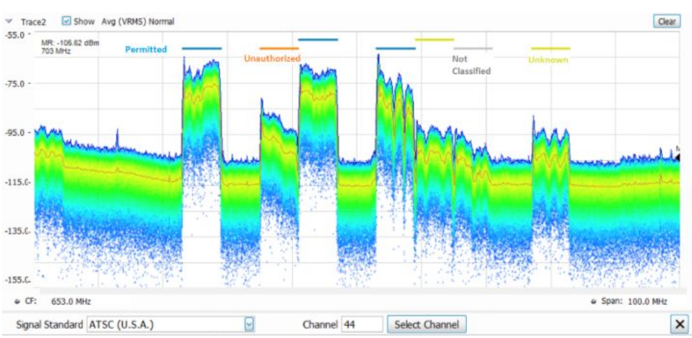
Playback of recorded files

With SV56, playback of recorded files from one of the USB spectrum analyzers is possible. Playback of recorded signals can reduce hours of watching and waiting for a spectral violation to minutes at your desk reviewing recorded data. Recording length is limited only by storage media size and recording is a basic feature included in SignalVu-PC. SignalVu-PC SV56 Playback allows for complete analysis by all SignalVu-PC measurements, including DPX Spectrogram. Minimum signal duration specifications are maintained during playback. AM/FM audio demodulation can be performed. Variable span, resolution bandwidth, analysis length, and bandwidth are all available. Frequency mask testing can be performed on recorded signals up to 40 MHz in span, with actions on mask violation including beep, stop, save trace, save picture, and save data. Portions of the playback can be selected and looped for repeat examination of signals of interest. Playback can be skip-free, or time gaps can be inserted to reduce review time. A Live Rate playback ensures fidelity of AM/FM demodulation and provides a 1:1 playback vs. actual time. Clock time of the recording is displayed in the spectrogram markers for correlation to real world events. In the illustration below, the FM band is being replayed, with a mask applied to detect spectral violations, simultaneous with listening to the FM signal at the center frequency of 92.3 MHz.

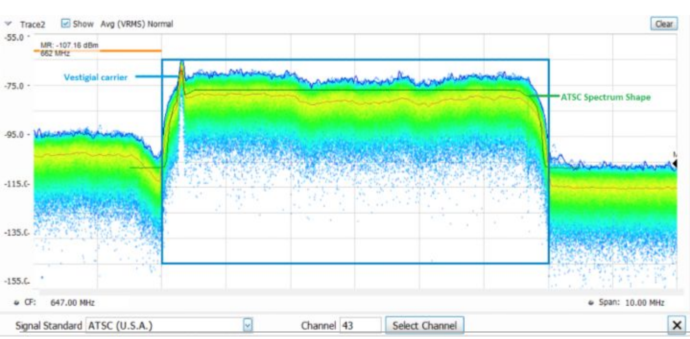


Signal survey

The signal classification application (SV54) enables expert systems guidance to aid the user in classifying signals. It provides graphical tools that allow you to quickly create a spectral region of interest, enabling you to classify and sort signals efficiently. The spectral profile mask, when overlaid on top of a trace, provides signal shape guidance, while frequency, bandwidth, channel number, and location are displayed allowing for quick checks. WLAN, GSM, W-CDMA, CDMA, Bluetooth standard and enhanced data rate, LTE FDD and TDD, and ATSC signals can be quickly and simply classified. Databases can be imported from your H500/RSA2500 signal database library for easy transition to the new software base.



Above is a typical signal survey. This survey is of a portion of the TV broadcast band, and 7 regions have been declared as either Permitted, Unknown, or Unauthorized, as indicated by the color bars for each region.



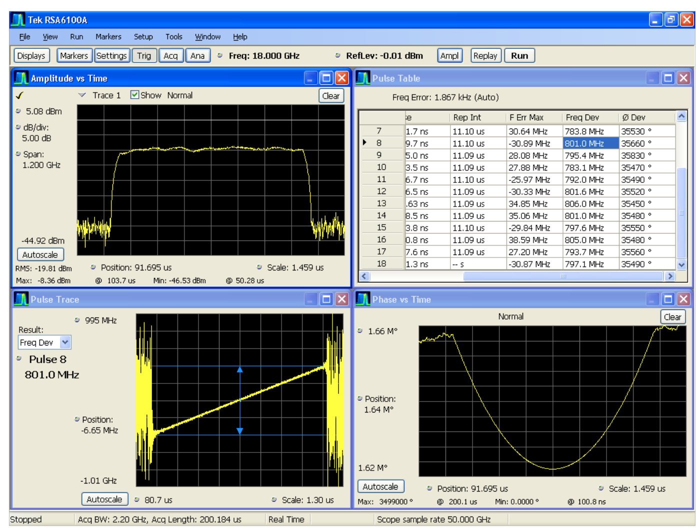
In this illustration, a single region has been selected. Since we have declared this to be an ATSC video signal, the spectrum mask for the ATSC signal is shown overlaid in the region. he signal is a close match to the spectrum mask, including the vestigial carrier at the lower side of the signal, characteristic of ATSC broadcasts.

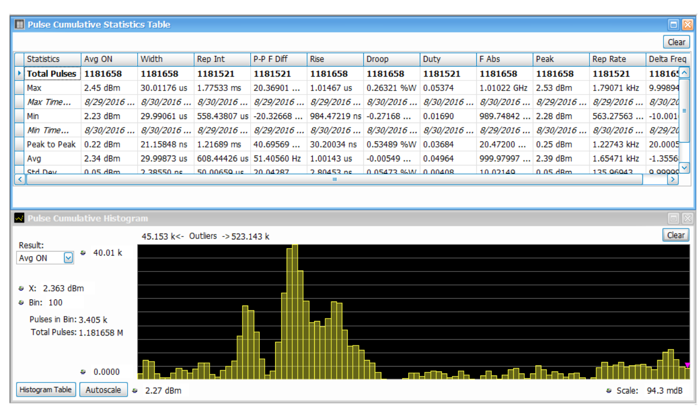
SignalVu-PC with mapping can be used to manually indicate the azimuth of a measurement made in the field, greatly aiding in triangulation efforts. The addition of a smart antenna able to report its direction to SignalVu-PC automates this process. Automatically plotting the azimuth/bearing of a measurement during interference hunting can greatly speed the time spent searching for the source of interference. Tektronix offers the Alaris DF-A0047 handheld direction finding antenna with frequency coverage from 20 MHz -8.5 GHz (optional 9 kHz-20 MHz) as part of a complete interference hunting solution. Azimuth information and the selected measurement is automatically recorded on the SignalVu-PC Map just by releasing the control button on the antenna. Full specifications for the DF-A0047 antenna are available in a separate antenna datasheet available on www.Tektronix.com.

SignalVu-PC-SVE Vector Signal Analysis Software

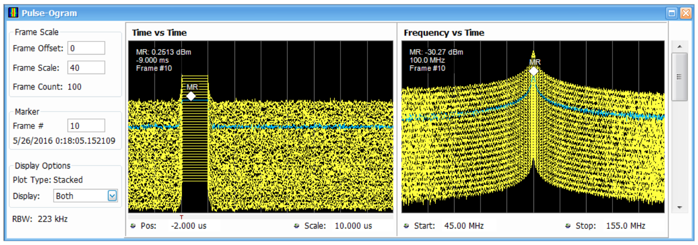
Advanced Pulse analysis

The Advanced Pulse Analysis package (SVP) provides 31 individual measurements to automatically characterize long pulse trains. An 800 MHz wide LFM chirp centered at 18 GHz is seen here with measurements for pulses 7 through 18 (upper right). The shape of the pulse can be seen in the Amplitude vs Time plot shown in the upper left. Detailed views of pulse #8's frequency deviation and parabolic phase trajectory are shown in the lower two views.





Cumulative statistics provides timestamps for Min, Max values as well as Peak to Peak, Average and Standard deviation over multiple acquisitions, further extending the analysis. Histogram shows you outliers on the right and left.



Pulse-Ogram displays a waterfall of multiple segmented captures, with correlated amplitude vs time and spectrum of each pulse. Can be used with an external trigger to show target range and speed.

Education license

Qualified educational facilities can cost-effectively use SignalVu-PC in teaching environments. The specially priced education version includes all available analysis standard and provides results watermarked 'Education Version'.

Measurement functions

Spectrum analyzer measurements (base software)	Channel power, Adjacent channel power, Multicarrier adjacent channel Power/Leakage ratio, Occupied bandwidth, xdB down, Marker measurements of power, delta power, integrated power, power density, dBm/Hz, and dBc/Hz, Signal strength with audible feedback.
Time domain and statistical measurements (base software)	RF IQ vs time, Amplitude vs time, Power vs time, Frequency vs time, Phase vs time, CCDF, Peak-to-Average ratio, Amplitude, Frequency, and Phase modulation analysis.
WLAN 802.11a/b/g/j/p measurement application (SV23)	All of the RF transmitter measurements as defined in the IEEE standard, and a wide range of additional scalar measurements such as Carrier Frequency error, Symbol Timing error, Average/peak burst power, IQ Origin Offset, RMS/Peak EVM, and analysis displays, such as EVM and Phase/ Magnitude Error vs time/frequency or vs symbols/ subcarriers, as well as packet header decoded information and symbol table. SV24 requires SV23. SV25 requires SV24.
WLAN 802.11n measurement application (SV24)	
WLAN 802.11ac measurement application (SV25)	
APCO P25 compliance testing and analysis application (SV26)	Complete set of push-button TIA-102 standard-based transmitter measurements with pass/fail results including ACPR, transmitter power and encoder attack times, transmitter throughput delay, frequency deviation, modulation fidelity, symbol rate accuracy, and transient frequency behavior, as well as HCPM transmitter logical channel peak ACPR, off slot power, power envelope, and time alignment.
Bluetooth Basic LE TX SIG measurements (SV27)	Presets for transmitter measurements defined by Bluetooth SIG for Basic Rate and Bluetooth Low Energy. Results also include Pass/Fail information. Application also provides Packet Header Field Decoding and can automatically detect the standard including Enhanced Data Rate.
AM/FM/PM modulation and audio measurements (SVA)	Carrier power, frequency error, modulation frequency, modulation parameters (±peak, peak-peak/2, RMS), SINAD, modulation distortion, S/N, THD, TNHD, hum and noise.
Settling time (frequency and phase) (SVT)	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 analysis (SVP)	Pulse-Ogram™ waterfall display of multiple segmented captures, with amplitude vs time and spectrum of each pulse. Pulse frequency, Delta Frequency, 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- Ref Pulse frequency difference, Pulse- Ref Pulse phase difference, 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.
Flexible OFDM analysis (SVO)	OFDM analysis with support for WLAN 802.11a/g/j and WiMAX 802.16-2004. Constellation, Scalar measurement summary, EVM or power vs carrier, Symbol table (Binary or Hexadecimal).

General purpose digital modulation analysis (SVM)	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. FSK only: Frequency deviation, Symbol timing error.
Playback of recorded files (SV56)	Playback of files recorded with one of the USB spectrum analyzers (RSA306, RSA500, or RSA600). Controls for file selection, begin/end points. Rate controls for skip-free or live-rate playback.
LTE Downlink RF measurements (SV28)	Presets for Cell ID, ACLR, SEM, Channel Power and TDD Toff Power. Supports TDD and FDD frame format and all base stations defined by 3GPP TS version 12.5. Results include Pass/ Fail information. Real-Time settings make the ACLR and the SEM measurements fast, if the connected instrument has required bandwidth.
WiGig IEEE 802.11ad (Opt. SV30)	Presets for Control PHY and Single Carrier PHY. Measures EVM in each of the packet fields per the standard, and decodes the header packet information.RF power, Received Channel Power Indicator, Frequency error, IQ DC origin offset, IQ Gain and Phase imbalance are reported in the Summary display. Pass/Fail results are reported using customizable limits.

Specifications

Performance (typical)

The following is typical performance of SignalVu-PC analyzing acquisitions from any MSO/DPO5000, DPO7000, or DPO/DSA/MSO70000 Series oscilloscopes. Vector modulation analysis is provided for the MDO4000B spectrum analyzer acquisitions. All other MDO spectrum analysis specifications are available in the MDO4000 Series datasheet. No published performance is available for MSO/DPO2000, MDO/MSO/DPO3000, and MDO4000 Series oscilloscope acquisitions. Performance for SignalVu-PC when used with the RSA306, RSA500, or RSA600 USB real time spectrum analyzers are shown respectively in the RSA306, RSA500, and RSA600 datasheets.

Frequency-related

Frequency range: See appropriate oscilloscope data sheet

Initial center frequency setting accuracy: Equal to time-base accuracy of oscilloscope

Center frequency setting resolution: 0.1 Hz

Frequency offset range: 0 Hz to the maximum bandwidth of the oscilloscope

Frequency marker readout accuracy: ±(Reference Frequency Error × Marker Frequency + 0.001 × Span + 2) Hz

Span accuracy: ±0.3%

Reference frequency error: Equal to oscilloscope reference frequency accuracy, aging, and drift. Refer to appropriate DPO/DSA/MSO data sheet.

Tuning Tables: Tables that present frequency selection in the form of standards-based channels are available for the following.

Cellular standards families: AMPS, NADC, NMT-450, PDC, GSM, CDMA, CDMA-2000, 1xEV-DO WCDMA, TD-SCDMA, LTE, WiMax

Unlicensed short range: 802.11a/b/j/g/p/n/ac, Bluetooth

Cordless phone: DECT, PHS

Broadcast: AM, FM, ATSC, DVBT/H, NTSC

Mobile radio, pagers, other: GMRS/FRS, iDEN, FLEX, P25, PWT, SMR, WiMax

3rd order inter-modulation distortion [1]

Center frequency	MSO/DPO5000	DPO7000	DPO/DSA/MSO70000
2 GHz	-38 dBc	-40 dBc	-55 dBc
10 GHz	--	--	-48 dBc
18 GHz	--	--	-50 dBc

Residual responses [2]

DPO/DSA/ MSO70000 series (all spans): –60 dBm

DPO7000C series (all spans): –65 dBm

MSO/DPO5000 series (all spans): –70 dBm

1 Conditions: Each signal level -5 dBm, reference level 0 dBm, 1 MHz tone separation. Math traces off. DPO7054/7104 and MSO/DPO5034/5054/5104 performance not listed.

2 Conditions: RF input terminated, reference level 0 dBm, measurements made after specified oscilloscope warm-up and SPC calibration. Does not include zero Hz spur.

Performance (typical)

Displayed average noise level [3]

Span	MSO/DPO5000	DPO7000C	DPO/DSA/MSO70000
DC - 500 MHz	-94 dBm	-100 dBm	-103 dBm
>500 MHz - 3.5 GHz	-	-102 dBm	-103 dBm
>3.5 GHz - 14 GHz	-	-	-101 dBm
>14 GHz - 20 GHz	-	-	-88 dBm
>20 GHz - 25 GHz	-	-	-87 dBm
>25 GHz - 33 GHz	-	-	-85 dBm

Acquisition-related

Maximum acquisition time will vary based on the oscilloscope available memory and analog bandwidth. The following table highlights the single-channel capabilities for each model given maximum available memory configuration.

Model [4]	Max span	Max acquisition time at max sample rate	Min RBW at max sample rate	Min IQ time resolution	Max number of FastFrames [5]
DPO/DSA73304D	33 GHz	2.5 ms	1.2 kHz	20 ps	65,535
DPO/DSA72504D	25 GHz				
DPO/DSA/ MSO72004C	20 GHz				
DPO/DSA/ MSO71604C	16 GHz				
DPO/DSA/ MSO71254C	12.5 GHz				
DPO/DSA/ MSO70804C	8 GHz	5 ms	600 Hz	80 ps	
DPO/DSA/ MSO70604C	6 GHz				
DPO/DSA/ MSO70404C	4 GHz				
DPO7354C	3.5 GHz	12.5 ms	300 Hz	50 ps	
DPO7254C	2.5 GHz				
DPO7104C	1 GHz			100 ps	
DPO7054C	500 MHz				
MSO/DPO5204/B	2 GHz	25 ms	100 Hz	200 ps	
MSO/DPO5104/B	1 GHz				
MSO/DPO5054/B	500 MHz			400 ps	
MSO/DPO5034/B	350 MHz				
MDO4000B/C Spectrum Analyzer	3 GHz or 6 GHz [4]	20 ms	111 Hz	200 ps	Not available
MSO/DPO/ MDO4000/B/C	1 GHz	4 ms	557 Hz	2 ns	
MSO/DPO2000	200 MHz	1 ms	2.23 kHz	2 ns	
MSO/ DPO/ MDO3000	500 MHz	2 ms	1.11 kHz	800 ps	

3 Conditions: RF input terminated, 10 kHz RBW, 100 averages, reference level -10 dBm, trace detection average. Measurements made after specified oscilloscope warm-up and SPC calibration. MSO/DPO5034 and MSO/DPO5054 performance not listed.

4 Maximum span when used as a spectrum analyzer is the entire frequency range of the instrument.

5 Maximum number of frames available will depend upon the oscilloscope record length, sample rate, and the acquisition length settings.

Performance (typical)

Analysis-related

Frequency (base software)	Spectrum (amplitude vs linear or log frequency) Spectrogram (amplitude vs frequency over time)
Time and statistics (base software)	Amplitude vs time Frequency vs time Phase vs time 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 (SVT)	Frequency settling vs time Phase settling vs time
Advanced Pulse measurements suite (SVP)	Pulse results table Pulse trace (selectable by pulse number) Pulse statistics (trend of pulse results, FFT of time trend, and histogram) Cumulative statistics Cumulative histogram Pulse-Ogram
Digital demod (SVM)	Constellation diagram EVM vs Time Symbol table (binary or hexadecimal) Magnitude and phase error vs time, and signal quality Demodulated IQ vs time Eye diagram Trellis diagram Frequency deviation vs time

Performance (typical)

Flexible OFDM (SVO)	EVM vs Symbol, vs Subcarrier Subcarrier power vs symbol, vs subcarrier Subcarrier constellation Symbol data table Mag error vs Symbol, vs Subcarrier Phase error vs Symbol, vs Subcarrier Channel frequency response
WLAN measurements (SV23, SV24, SV25 or SV2C)	Burst index Burst power Peak to average burst power IQ origin offset Frequency error Common pilot error Symbol clock error RMS and Peak EVM for Pilots/Data Peak EVM located per symbol and subcarrier Packet header format information Average power and RMS EVM per section of the header WLAN power vs Time or vs Symbol Burst Width WLAN symbol table WLAN Constellation Spectrum emission mask Spurious EVM vs symbol (or time), vs subcarrier (or frequency) Mag error vs symbol (or time), vs subcarrier (or frequency) Phase error vs symbol (or time), vs subcarrier (or frequency) WLAN channel frequency response vs symbol (or time), vs subcarrier (or frequency) WLAN spectral flatness vs symbol (or time), vs subcarrier (or frequency)
APCO P25 measurement application (SV26)	RF output power, operating frequency accuracy, modulation emission spectrum, unwanted emissions spurious, adjacent channel power ratio, frequency deviation, modulation fidelity, frequency error, eye diagram, symbol table, symbol rate accuracy, transmitter power and encoder attack time, transmitter throughput delay, frequency deviation vs. time, power vs. time, transient frequency behavior, HCPM transmitter logical channel peak adjacent channel power ratio, HCPM transmitter logical channel off slot power, HCPM transmitter logical channel power envelope, HCPM transmitter logical channel time alignment, cross-correlated markers

Performance (typical)

Bluetooth Basic LE Tx Measurements (SV27)	Peak Power, Average Power, Adjacent Channel Power or InBand Emission mask, -20dB Bandwidth, Frequency Error, Modulation Characteristics including ΔF1avg (11110000), ΔF2avg (10101010), ΔF2 > 115 kHz, ΔF2/ΔF1 ratio, frequency deviation vs. time with packet and octet level measurement information, Carrier Frequency f0, Frequency Offset (Preamble and Payload), Max Frequency Offset, Frequency Drift f_1-f_0, Max Drift Rate f_n-f_0 and f_n-f_{n-5}, Center Frequency Offset Table and Frequency Drift table, color-coded Symbol table, Packet header decoding information, eye diagram, constellation diagram, editable limits
LTE Downlink RF measurements (SV28)	Adjacent Channel Leakage Ratio (ACLR), Spectrum Emission Mask (SEM), Channel Power, Occupied Bandwidth, Power vs. Time displaying Transmitter OFF power for TDD signals and LTE constellation diagram for PSS, SSS with Cell ID, Group ID, Sector ID and Frequency Error.

RF and spectrum analysis performance

Resolution bandwidth	
Resolution bandwidth (spectrum analysis)	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 window (none), flat-top window (CW ampl.), Hanning window
Video bandwidth	
Video bandwidth range	Dependent on oscilloscope record length setting. approximately 500 Hz to 5 MHz
RBW/VBW maximum	10,000:1
RBW/VBW minimum	1:1
Resolution	5% of entered value
Accuracy (typical)	±10%
Time domain bandwidth (amplitude vs. time display)	
Time domain bandwidth range	At least 1/2 to 1/10,000 of acquisition bandwidth
Time domain bandwidth shape	Approximately Gaussian, shape factor 4.1:1(60:3 dB), ±10% typical
	Shape factor <2.5:1 (60:3 dB) typical for all bandwidths
Time domain bandwidth accuracy	±10%
Spectrum display traces, detectors, and functions	
Traces	Three traces + 1 math trace + 1 trace from spectrogram for spectrum display
Detector	Peak, –peak, average, CISPR peak
Trace functions	Normal, Average, Max Hold, Min Hold
Spectrum trace length	801, 2401, 4001, 8001, or 10401 points

Signal strength

Signal Strength display	
Signal strength indicator	Located at right side of display
Measurement bandwidth	Up to 40 MHz, dependent on span and RBW setting
Tone type	Variable frequency based on received signal strength

AM/FM/PM modulation and audio measurements (SVA) [6]

Analog demodulation [7]	
Carrier frequency range	1 kHz or (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	
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
FM deviation accuracy	±1.5% of deviation
FM rate accuracy	±1.0 Hz
Carrier frequency accuracy	±1 Hz + (transmitter frequency × reference frequency error)
Residuals (FM) (rate: 1 kHz to 10 kHz, deviation: 5 kHz)	
THD	0.2% (MSO/DPO70000, DPO7000 Series)
	1.0% (MSO/DPO5000 Series)
	1.0% (MDO4000B Series)
SINAD	44 dB (MSO/DPO70000, DPO7000 Series)
	38 dB (MSO/DPO5000 Series)
	38 dB (MDO4000B Series)
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
AM depth accuracy (rate: 1 kHz, depth: 50%)	±1% + 0.01 × measured value
AM rate accuracy (rate: 1 kHz, depth: 50%)	±1.0 Hz

6 All published performance based on conditions of Input Signal: 0 dBm, Input Frequency: 100 MHz, RBW: Auto, Averaging: Off, Filters: Off. Sampling and input parameters optimized for best results.

7 Sampling rates of the oscilloscope are recommended to be adjusted to no more than 10X the audio carrier frequency for modulated signals, and 10X the audio analysis bandwidth for direct input audio. This reduces the length of acquisition required for narrow-band audio analysis.

AM/FM/PM modulation and audio measurements (SVA)

Residuals (AM)	
THD	0.3% (MSO/DPO70000, MDO7000 Series) 1.0% (MSO/DPO5000 Series) 1.0% (MDO4000B Series)
SINAD	48 dB (MSO/DPO70000, MDO7000 Series) 43 dB (MSO/DPO5000 Series) 43 dB (MDO4000B Series)
PM modulation analysis	
PM measurement	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
PM deviation accuracy (rate: 1 kHz, deviation: 0.628 rad)	±100% × (0.01 + (rate / 1 MHz))
PM rate accuracy (rate: 1 kHz, deviation: 0.628 rad)	±1 Hz
Residuals (PM)	
THD	0.1% (MSO/DPO70000, MDO7000 Series) 0.5% (MSO/DPO5000 Series) 0.5% (MDO4000B Series)
SINAD	48 dB (MSO/DPO70000, MDO7000 Series) 43 dB (MSO/DPO5000 Series) 43 dB (MDO4000B Series)
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 10 MHz
Maximum audio frequency span	10 MHz
Audio frequency accuracy	±1 Hz
Residuals (PM)	
THD	1.5%
SINAD	38 dB

AM/FM/PM modulation and audio measurements (SVA)

Minimum audio analysis bandwidth and RBW vs. oscilloscope memory and sample rate (SVA)

Model	Sample rate: 1 GS/s				Sample rate: maximum			
	Standard memory		Maximum memory		Standard memory		Maximum memory	
	Min. Aud. BW	RBW (Auto)	Min. Aud. BW	RBW (Auto)	Min. Aud. BW	RBW (Auto)	Min. Aud. BW	RBW (Auto)
MSO/ DPO 5034 MSO/DPO 5054	200 kHz	400 Hz	20 kHz	40 Hz	1 MHz	2 kHz	100 kHz	200 hz
MSO/DPO 5104 MSO/DPO 5204	100 kHz	200 Hz	10 kHz	20 hz	1 MHz	2 kHz	100 kHz	200 Hz
DPO 7000	50 kHz	100 Hz	50 kHz	100 Hz	2 MHz	4 kHz	2 MHz	4 kHz
DPO/DSA/ MSO 70000 ≥12.5 GHz BW	200 kHz	400 Hz	10 kHz	20 Hz	not recom-mended	>4 kHz	1 MHz	2 kHz
DPO/DSA/ MSO 70000 <12.5 GHz BW	200 kHz	400 Hz	20 kHz	40 Hz	not recom-mended	>4 kHz	500 kHz	1 kHz

Minimum audio analysis bandwidth for MDO4000B RF input 7.8 kHz

Minimum audio analysis RBW for MDO4000B RF input ≥ 15 Hz (Span set to minimum 1 kHz)

Settling time, frequency, and phase (SVT) [8]

Settled frequency uncertainty,

Measurement frequency: 1 GHz

Averages	Frequency uncertainty at stated measurement bandwidth			
	1 GHz	100 MHz	10 MHz	1 MHz
Single measurement	20 kHz	2 kHz	500 Hz	100 Hz
100 averages	10 kHz	500 Hz	200 Hz	50 Hz
1000 averages	2 kHz	200 Hz	50 Hz	10 Hz

Measurement frequency: 9 GHz

Averages	Frequency uncertainty at stated measurement bandwidth			
	1 GHz	100 MHz	10 MHz	1 MHz
Single Measurement	20 kHz	5 kHz	2 kHz	200 Hz
100 Averages	10 kHz	2 kHz	500 Hz	50 Hz
1000 Averages	2 kHz	500 Hz	200 Hz	20 Hz

8 Settled Frequency or Phase at the measurement frequency. Measured signal level > -20 dBm, Attenuator: Auto.

Settling time, frequency, and phase (SVT)

Settled phase uncertainty,

Measurement frequency: 1 GHz

Averages	Phase uncertainty at stated measurement bandwidth			
	1 GHz	100 MHz	10 MHz	1 MHz
Single measurement	2°	2°	2°	2°
100 averages	0.5°	0.5°	0.5°	0.5°
1000 averages	0.2°	0.2°	0.2°	0.2°

Measurement frequency: 9 GHz

Averages	Phase uncertainty at stated measurement bandwidth			
	1 GHz	100 MHz	10 MHz	1 MHz
Single measurement	5°	5°	5°	5°
100 averages	2°	2°	2°	2°
1000 averages	0.5°	0.5°	0.5°	0.5°

Advanced Pulse measurement suite (SVP)

General characteristics

Measurements

Pulse-Ogram™ waterfall display of multiple segmented captures, with amplitude vs time and spectrum of each pulse. Pulse frequency, Delta Frequency, 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- Ref Pulse frequency difference, Pulse- Ref Pulse phase difference, 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.

System rise time (typical)

Equal to oscilloscope rise time

Minimum pulse width for detection [9]

Model	Minimum PW
DPO/DSA72004B MSO72004	400 ps
DPO/DSA71604B MSO71604	500 ps
DPO/DSA71254B MSO71254	640 ps
DPO/DSA70804B MSO70804	1 ns
DPO/DSA70604B MSO70604	1.3 ns
DPO/DSA70404B MSO70404	2 ns
DPO7354	2.25 ns
DPO7254	3 ns
DPO7104	8 ns
DPO7054	16 ns
MSO/DPO5204	4 ns
MSO/DPO5104	8 ns
MSO/DPO5054	16 ns
MSO/DPO5034	25 ns
MDO4000B	≥5 ns

9 Conditions: Approximately equal to 10/(IQ sampling rate). IQ sampling rate is the final sample rate after digital down conversion from the oscilloscope. Pulse measurement filter set to max bandwidth.

Advanced Pulse measurement suite (SVP)

Pulse measurement accuracy (typical) [10]

Average on power	±0.3 dB + Absolute Amplitude Accuracy of oscilloscope
Average transmitted power	±0.4 dB + Absolute Amplitude Accuracy of oscilloscope
Peak power	±0.4 dB + Absolute Amplitude Accuracy of oscilloscope
Pulse width	±(3% of reading + 0.5 × sample period)
Pulse repetition rate	±(3% of reading + 0.5 × sample period)

Digital modulation analysis (SVM)

Modulation formats	π/2DBPSK, BPSK, SBPSK, QPSK, DQPSK, π/4DQPSK, D8PSK, 8PSK, OQPSK, SOQPSK, CPM, 16/32/64/128/256QAM, MSK, GMSK, GFSK, 2-FSK, 4-FSK, 8-FSK, 16-FSK, C4FM, D16PSK, 16APSK, and 32APSK
Analysis period	Up to 80,000 samples
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 x T range	0.001 to 1, 0.001 step
	Constellation, Error vector magnitude (EVM) vs time, Modulation error ratio (MER), Magnitude error vs time, Phase error vs time, Signal quality, Symbol table rhoFSK only: Frequency deviation, Symbol timing error
Symbol rate range	1 kS/s to (0.4 * Sample Rate) GS/s (modulated signal must be contained entirely within the acquisition bandwidth)

Adaptive equalizer

Type	Linear, decision-directed, feed-forward (FIR) equalizer with coefficient adaptation and adjustable convergence rate
Modulation types supported	π/2 DBPSK, BPSK, SBPSK, QPSK, DQPSK, π/4 DQPSK, D8PSK, 8PSK, D16PSK, OQPSK, SOQPSK, CPM, 16/32/64/128/256QAM, MSK, 2-FSK, 4-FSK, 8-FSK, 16-FSK, C4FM
Reference filters for all modulation types except OQPSK	Raised Cosine, Rectangular, None
Reference filters for OQPSK	Raised Cosine, Half Sine
Filter length	1-128 taps
Taps/symbol: raised cosine, half sine, no filter	1, 2, 4, 8
Taps/symbol: rectangular filter	1
Equalizer controls	Off, Train, Hold, Reset

16QAM Residual EVM (typical) for DPO7000 and DPO/DSA/MSO70000 series [11]

Symbol Rate	RF	IQ
100 MS/s	<2.0%	<2.0%
312.5 MS/s	<3.0%	<3.0%

10 Conditions: Pulse Width > 450 ns, S/N Ratio ≥30 dB, Duty Cycle 0.5 to 0.001, Temperature 18 °C to 28 °C.

11 CF = 1 GHz, Measurement Filter = root raised cosine, Reference Filter = raised cosine, Analysis Length = 200 symbols.

Digital modulation analysis (SVM)

16QAM Residual EVM (typical) for MSO/DPO5000 series [12]

Symbol Rate	RF	IQ
10 MS/s	1.5%	1.0%
100 MS/s	4.0%	2.0%

OFDM residual EVM, 802.11g Signal at 2.4 GHz, input level optimized for best performance

DPO7000 Series	–33 dB
DPO/DSA/MSO70000 Series	–38 dB

QPSK Residual EVM (typical) for MDO4000B RF Input [13] — Single Carrier, measured at 1GHz

0.1 MSymbols/sec rate	0.26%
10 MSymbols/sec rate	0.28 %
100 MSymbols/sec rate	1.0 %
312.5 MSymbols/sec rate	3.0 %

WLAN IEEE802.11a/b/g/j/p (SV23)

General characteristics

Modulation formats
DBPSK (DSSS1M), DQPSK (DSSS2M), CCK5.5M, CCK11M , OFDM (BPSK, QPSK, 16 or 64QAM)

Measurements and displays
Burst Index, Burst Power, Peak to Average Burst Power, IQ Origin Offset, Frequency Error, Common Pilot Error, Symbol Clock Error

RMS and Peak EVM for Pilots/Data, Peak EVM located per Symbol and Subcarrier

Packet Header Format Information

Average Power and RMS EVM per section of the header

WLAN Power vs Time, WLAN Symbol Table, WLAN Constellation

Spectrum Emission Mask [14], Spurious

Error Vector Magnitude (EVM) vs Symbol (or Time), vs Subcarrier (or Frequency)

Mag Error vs Symbol (or Time), vs Subcarrier (or Frequency)

Phase Error vs Symbol (or Time), vs Subcarrier (or Frequency)

WLAN Channel Frequency Response vs Symbol (or Time), vs Subcarrier (or Frequency)

WLAN Spectral Flatness vs Symbol (or Time), vs Subcarrier (or Frequency)

Typical residual EVM - 802.11b (CCK-11Mbps) with MDO4000B [15]
RMS-EVM over 1000 chips, EQ On

1.04% (2.4 GHz)

Typical residual EVM - 802.11a/g/j (OFDM, 20 MHz, 64-QAM), with MDO4000B [15]
-44 dB (2.4 GHz)

–43 dB (5.8 GHz)

(RMS-EVM averaged over 20 bursts, 16 symbols each)

12 Carrier frequency 700 MHz. MSO/DPO5054 and MSO/DPO5034 performance not listed. Use of external reference will degrade EVM performance.

13 Measurement filter = root raised cosine, reference filter = raised cosine, analysis Length = 400 symbols, 20 averages

14 SEM is specified with noise reduction and at least 30 averages for 802.11a/n/ac signals in 5 GHz band. Residual noise performance of the MDO4000B may exceed SEM mask at frequency above 5.85 GHz

15 Signal input power optimized for best EVM

WLAN IEEE802.11n (SV24)

General characteristics

Modulation formats	SISO, OFDM (BPSK, QPSK, 16 or 64QAM)
Measurements and displays	Burst Index, Burst Power, Peak to Average Burst Power, IQ Origin Offset, Frequency Error, Common Pilot Error, Symbol Clock Error, RMS and Peak EVM for Pilots/Data, Peak EVM located per Symbol and Subcarrier Packet Header Format Information Average Power and RMS EVM per section of the header WLAN Power vs Time, WLAN Symbol Table, WLAN Constellation Spectrum Emission Mask [16], Spurious Error Vector Magnitude (EVM) vs Symbol (or Time), vs Subcarrier (or Frequency) Mag Error vs Symbol (or Time), vs Subcarrier (or Frequency) Phase Error vs Symbol (or Time), vs Subcarrier (or Frequency) WLAN Channel Frequency Response vs Symbol (or Time), vs Subcarrier (or Frequency) WLAN Spectral Flatness vs Symbol (or Time), vs Subcarrier (or Frequency)
Typical residual EVM - 802.11n (40 MHz QAM) with MDO4000B [17]	–41 dB typical (5.8 GHz) -42 dB (2.4 GHz) (RMS-EVM averaged over 20 bursts, 16 symbols each)

WLAN IEEE802.11ac (SV25)

General characteristics

Modulation formats	SISO, OFDM (BPSK, QPSK, 16/64/256QAM)
Measurements and displays	Burst Index, Burst Power, Peak to Average Burst Power, IQ Origin Offset, Frequency Error, Common Pilot Error, Symbol Clock Error, RMS and Peak EVM for Pilots/Data, Peak EVM located per Symbol and Subcarrier Packet Header Format Information Average Power and RMS EVM per section of the header WLAN Power vs Time, WLAN Symbol Table, WLAN Constellation Spectrum Emission Mask [18], Spurious Error Vector Magnitude (EVM) vs Symbol (or Time), vs Subcarrier (or Frequency) Mag Error vs Symbol (or Time), vs Subcarrier (or Frequency) Phase Error vs Symbol (or Time), vs Subcarrier (or Frequency) WLAN Channel Frequency Response vs Symbol (or Time), vs Subcarrier (or Frequency) WLAN Spectral Flatness vs Symbol (or Time), vs Subcarrier (or Frequency)
Typical residual EVM - 802.11ac (160 MHz 256-QAM) with MDO4000B [19]	–37.3 dB (5.8 GHz), RMS-EVM averaged over 20 bursts, 16 symbols each

16 SEM is specified with noise reduction and at least 30 averages for 802.11a/n/ac signals in 5 GHz band. Residual noise performance of the instrument may exceed SEM mask at frequency above 5.85 GHz

17 Signal input power optimized for best EVM

18 SEM is specified with noise reduction and at least 30 averages for 802.11a/n/ac signals in 5 GHz band. Residual noise performance of the instrument may exceed SEM mask at frequency above 5.85 GHz

19 Signal input power optimized for best EVM

APCO P25 (SV26)

Modulation formats	Phase 1 (C4FM), Phase 2 (HCPM, HDQPSK)
Measurements and displays	RF output power, operating frequency accuracy, modulation emission spectrum, unwanted emissions spurious, adjacent channel power ratio, frequency deviation, modulation fidelity, frequency error, eye diagram, symbol table, symbol rate accuracy, transmitter power and encoder attack time, transmitter throughput delay, frequency deviation vs. time, power vs. time, transient frequency behavior, HCPM transmitter logical channel peak adjacent channel power ratio, HCPM transmitter logical channel off slot power, HCPM transmitter logical channel power envelope, HCPM transmitter logical channel time alignment
Residual modulation fidelity (with MDO4000B)	
Phase 1 (C4FM)	≤1.0% typical
Phase 2 (HCPM)	≤0.5% typical
Phase 2 (HDQPSK)	≤0.5% typical
Adjacent channel power ratio	
25 kHz offset from the center and bandwidth of 6 kHz [20]	Phase 1 (C4FM): -76 dBc typical Phase 2 (HCPM): -74 dBc typical Phase 2 (HDQPSK): -74 dBc typical
62.5 kHz offset from the center and bandwidth of 6 kHz	Phase 1 (C4FM): -77 dBc typical Phase 2 (HCPM): -78 dBc typical Phase 2 (HDQPSK): -76 dBc typical

Bluetooth (SV27)

Modulation formats	Basic Rate, Bluetooth Low Energy, Enhanced Data Rate - Revision 4.2
Measurements and displays	Peak Power, Average Power, Adjacent Channel Power or InBand Emission mask, -20 dB Bandwidth, Frequency Error, Modulation Characteristics including ΔF1avg (11110000), ΔF2avg (10101010), ΔF2 > 115 kHz, ΔF2/ΔF1 ratio, frequency deviation vs. time with packet and octet level measurement information, Carrier Frequency f0, Frequency Offset (Preamble and Payload), Max Frequency Offset, Frequency Drift f_1-f_0, Max Drift Rate f_n-f_0 and f_n-f_{n-5}, Center Frequency Offset Table and Frequency Drift table, color-coded Symbol table, Packet header decoding information, eye diagram, constellation diagram
Output power (Average and Peak Power)	
Level uncertainty	Refer to instrument amplitude and flatness specification
Measurement range	Signal level > -70 dBm (for USB Spectrum Analyzers) and -60 dBm (for MDO4000B)
Modulation Characteristics (ΔF_1avg, ΔF_2avg, ΔF_2avg/ΔF_1avg, ΔF_2max ≥115 kHz)	
Deviation range	± 280 kHz
Deviation uncertainty (at 0 dBm)	< 2 kHz + instrument frequency uncertainty (Basic Rate) < 3 kHz + instrument frequency uncertainty (for USB spectrum analyzers and Low Energy) < 4 kHz + MDO4000B frequency uncertainty (for MDO4000B and Low Energy)

20 Measured with test signal amplitude adjusted for optimum performance if necessary. Measured with Averaging, 10 waveforms.

Measurement resolution	10 Hz
Measurement range	Nominal channel frequency ±100 kHz

Initial Carrier Frequency Tolerance (ICFT)	
Measurement uncertainty (at 0 dBm)	< 1 kHz + instrument frequency uncertainty (for USB Spectrum Analyzers)
	< 1.5 kHz + MDO4000B frequency uncertainty (for MDO4000B)
Measurement resolution	10 Hz
Measurement range	Nominal channel frequency ±100 kHz

Carrier Frequency Drift (Max freq. offset, drift f_1- f_0, max drift f_n-f_0, max drift f_n-f_{n-5} (50 µs))	
Measurement uncertainty	< 2 kHz + instrument frequency uncertainty (for RSA306 and MDO4000B)
	< 1 kHz + instrument frequency uncertainty (for RSA600 and RSA500)
Measurement resolution	10 Hz
Measurement range	Nominal channel frequency ±100 kHz

In-band Emissions and ACP	
Level uncertainty	Refer to instrument amplitude and flatness specification

LTE Downlink RF measurements (SV28)

Standard Supported	3GPP TS 36.141 Version 12.5
Frame Format supported	FDD and TDD
Measurements and Displays Supported	Adjacent Channel Leakage Ratio (ACLR), Spectrum Emission Mask (SEM), Channel Power, Occupied Bandwidth, Power vs. Time showing Transmitter OFF power for TDD signals and LTE constellation diagram for PSS, SSS with Cell ID, Group ID, Sector ID and Frequency Error.
ACLR with E-UTRA bands (Typical Mean, with Noise Correction)	
1st Adjacent Channel	60 dB (MDO4000B); 61 dB (RSA600/RSA500); 65 dB (RSA306/B)
2nd Adjacent Channel	65 dB (MDO4000B); 63 dB (RSA600/RSA500); 66 dB (RSA306/B)

Mapping (MAP)

Mapping	
Map types directly supported	Pitney Bowes MapInfo (*.mif), Bitmap (*.bmp), Open Street Maps (.osm)
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

WiGig 802.11ad (SV30) Measurements

WiGig 802.11ad (SV30) Measurements	RF output power, Received Channel Power Indicator (RCPI), Frequency Error, Symbol Rate Error, IQ Origin Offset, IQ Gain Imbalance, IQ Quadrature Error, EVM results for each packet region (STF, CEF, Header and Data), Packet information includes the Packet type, Preamble, Synchronization Word or Access Code, Packet Header, Payload length and CRC details.

Playback of recorded signals (SV56)

Playback file type	R3F recorded by RSA306, RSA500, or RSA600
Recorded file bandwidth	40 MHz
File playback controls	General: Play, stop, exit playback Location: Begin/end points of playback settable from 0-100% Skip: Defined skip size from 73 µs up to 99% of file size Live rate: Plays back at 1:1 rate to recording time Loop control: Play once, or loop continuously
Memory requirement	Recording of signals requires storage with write rates of 300 MB/sec. Playback of recorded files at live rates requires storage with read rates of 300 MB/sec.

General characteristics

CON	Provides Connect to the MDO4000B/C
Update rate	< 0.2 /sec (802.11ac EVM, acq BW: 200 MHz, record length: 400 µs)
Programmatic interface	SCPI-compliant command set. Requires installation of Tektronix Virtual Instrument Software Architecture (VISA) drivers

System requirements

Operating systems	Windows 10 x64 Windows 8 x64 Windows 7 Service Pack 1 x64
Disk space	6 GB free on C: drive
RAM	1 GB (4 GB recommended) Operation with one of the USB real-time spectrum analyzers has additional requirements. See the related instrument data sheet for details.

Instruments and file types supported

Instrument family

Oscilloscopes

	File type				
	.WFM	.ISF	.TIQ	.IQT	.MAT
Performance: MSO/DPO5000 DPO7000C DPO/DSA/ MSO70000	X		X [21]		
Mixed-domain: MDO4000 & MDO4000B/C		X	X [22]		
Bench: MSO/DPO2000 MDO/MSO/ DPO4000		X			

Real-time signal analyzers

	File type				
	.WFM	.ISF	.TIQ	.IQT	.MAT
RSA3000				X	
RSA5000/ 6000			X		X

Other

	File type				
	.WFM	.ISF	.TIQ	.IQT	.MAT
3rd party waveforms in MATLAB Level 5 format					X

SignalVu-PC vs. SignalVu

SignalVu for oscilloscopes is a separate product made to run directly on Tektronix performance oscilloscopes. SignalVu directly controls the acquisition settings of the oscilloscopes and automatically transfers data from the oscilloscope acquisition channel to the SignalVu software.

SignalVu-PC runs on a separate PC. Files from oscilloscopes and signal analyzers can be opened and analyzed. SignalVu-PC does not communicate with the acquisition instrument or control its acquisition settings.

SignalVu-PC-SVE Vector Signal Analysis Software

Ordering information

Purchasing, licensing, and activation

SignalVu-PC and its applications are available for download at www.tektronix.com/downloads. SignalVu-PCEDU is a bundle version of SignalVu-PC that includes all analysis applications for educational institutions. Licenses are granted to a single PC.

In December 2015, the license policy and nomenclature was changed for SignalVu-PC and its options. This will be a gradual change with systems running in parallel for both ordering new capabilities and accessing trial versions of optional licenses.

The legacy system, with SignalVu-PC and its associated options, will continue to be supported in the software, so there is no need to change your current licenses. You will also be able to use the trial options present in the legacy system for several months after the transition.

The new application licenses offer standard node-locked (NL) licenses, plus new floating licenses (FL) that can be checked in and out of the Tektronix Asset Management System (Tek AMS) on the Tektronix.com Web site. Trial licenses are also available in the new system on the ordering pages for SignalVu-PC on Tektronix.com.

The new license structure and the old options are shown below.

21 .TIQ files can be created on performance oscilloscopes with SignalVu installed. SignalVu is a separate product from SignalVu-PC.

22 The MDO RF channel saves waveforms in the .TIQ format. MDO oscilloscope waveforms are stored in .ISF format.

Legacy SignalVu-PC option	New application license	License type	Description
SVA	SVANL-SVPC	NL	AM/FM/PM/Direct Audio analysis
	SVAFL-SVPC	FL	
SVT	SVTNL-SVPC	NL	Settling Time (frequency and phase) measurements
	SVTFL-SVPC	FL	
SVM	SVMNL-SVPC	NL	General Purpose Modulation analysis to work with analyzer of acquisition bandwidth ≤40 MHz and MDO4000B/C
	SVMFL-SVPC	FL	
SVP	SVPNL-SVPC	NL	Pulse Analysis to work with analyzer of acquisition bandwidth ≤40 MHz and MDO4000B/C
	SVPFL-SVPC	FL	
SVO	SVONL-SVPC	NL	Flexible OFD analysis
	SVOFL-SVPC	FL	
SV23	SV23NL-SVPC	NL	WLAN 802.11a/b/g/j/p measurement to work with analyzer
	SV23FL-SVPC	FL	
SV24	SV24NL-SVPC	NL	WLAN 802.11n measurement (requires SV23)
	SV24FL-SVPC	FL	
SV25	SV25NL-SVPC	NL	WLAN 802.11ac measurement to work with analyzer of acquisition bandwidth ≤40 MHz and MDO4000B/C (requires SV23 and SV24)
	SV25FL-SVPC	FL	
SV26	SV26NL-SVPC	NL	APCO P25 measurement
	SV26FL-SVPC	FL	
SV27	SV27NL-SVPC	NL	Bluetooth measurement to work with analyzer of acquisition bandwidth ≤40 MHz and MDO4000B/C
	SV27FL-SVPC	FL	
MAP	MAPNL-SVPC	NL	Mapping
	MAPFL-SVPC	FL	
SV56	SV56NL-SVPC	NL	Playback of recorded files
	SV56FL-SVPC	FL	
SV60	SV60NL-SVPC	NL	Return loss, VSWR, cable loss, and distance to fault (requires option 04 on RSA500A/600A)
	SV60FL-SVPC	FL	
CON	CONNL-SVPC	NL	SignalVu-PC Connect to the MDO4000B/C series mixed-domain oscilloscopes
	CONFL-SVPC	FL	
SV2C	SV2CNL-SVPC	NL	WLAN 802.11a/b/g/j/p/n/ac and Connect to MDO4000B/C to work with MDO4000B/C or analyzer of acquisition bandwidth ≤40 MHz
	SV2CFL-SVPC	FL	
Legacy SignalVu-PC option	New application license	License type	Description
SV28	SV28NL-SVPC	NL	LTE Downlink RF measurement to work with analyzer of acquisition bandwidth ≤40 MHz and MDO4000B/C
	SV28FL-SVPC	FL	
Not available in legacy license	SV54NL-SVPC	NL	Signal survey and classification
	SV54FL-SVPC	FL	
SignalVu-PCEDU	EDUFL-SVPC	FL	Education-only version of all modules for SignalVu-PC
Not available in legacy license	SV30NL-SVPC	NL	WiGig 802.11ad measurements (only for offline analysis)
	SV30FL-SVPC	FL	

SignalVu-PC application upgrades

Owners of SignalVu-PC applications can download any bug fixes or enhancements to existing products free of charge. New applications with new measurements may become available and upgrades can be purchased to add the new functionality using the ordering information described above.