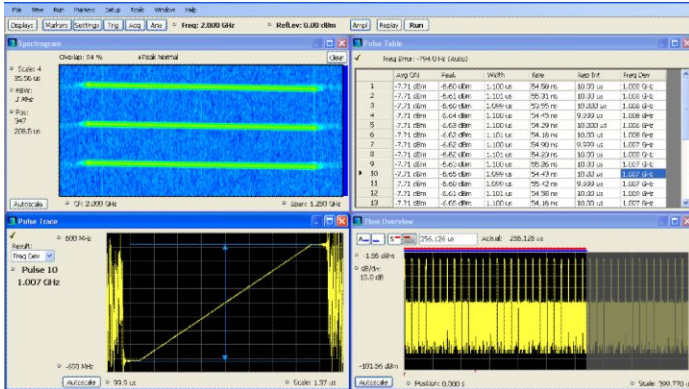


# Vector and RF Suite of Signal Analysis Software for PC

## 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 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 signal analysis suite - automated pulse measurements including rise time, pulse width, and pulse-to-pulse phase provide deep insight into pulse train behavior
  - 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

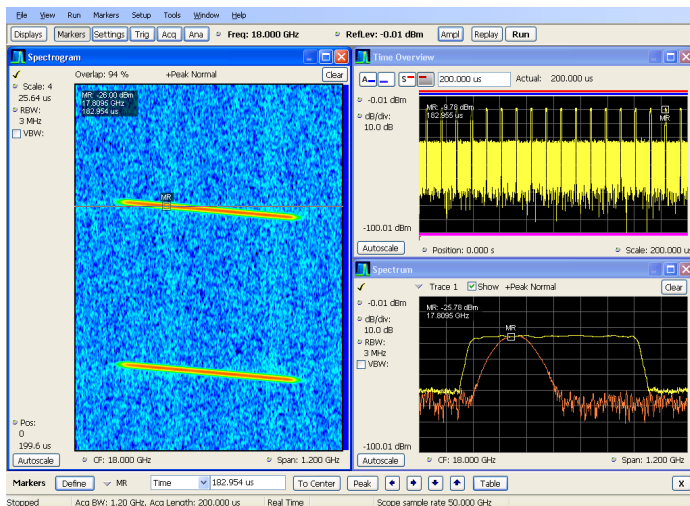
- Wideband radar and pulsed RF signals
- Frequency agile communications
- Broadband satellite and microwave backhaul links
- Wireless LAN, Bluetooth, Commercial Wireless
- Land Mobile Radio (LMR), APCO P25



- 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

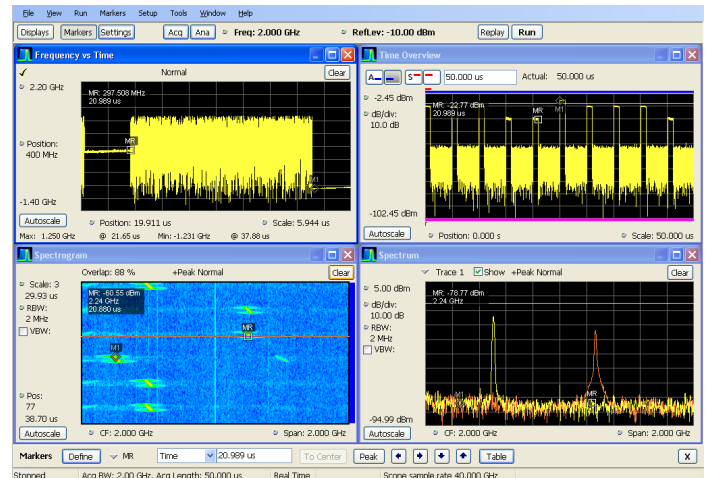
With SignalVu-PC Connect (CON-SVPC), SignalVu-PC extends the functionality of the Mixed Domain Oscilloscope MDO4000B/C Series and turns it into the industry's only 1 GHz Vector Signal Analyzer. SignalVu-PC controls the MDO4000B/C RF section, acquires the vector-calibrated I/Q data, and makes wide-band, 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.

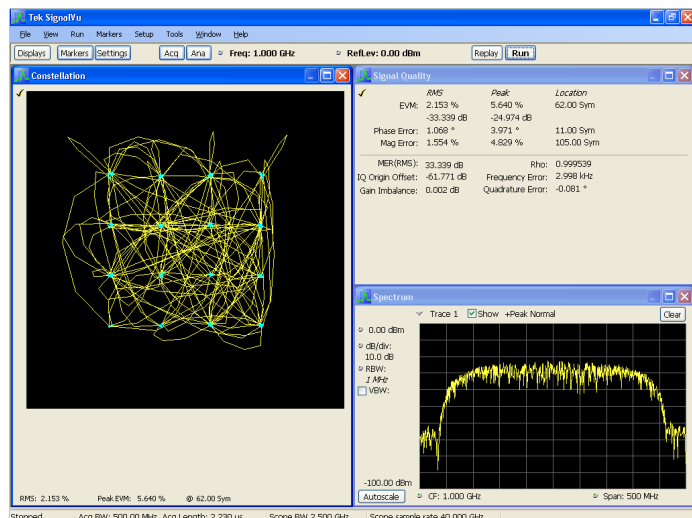
Acquisitions from the USB Spectrum Analyzers and all Tektronix MDO/MSO/DPO Series oscilloscopes, including the spectrum analyzer in the Mixed Domain Oscilloscope can be analyzed with SignalVu-PC, adding deep analysis capabilities to these broadband acquisition systems. Signals acquired with RSAs and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



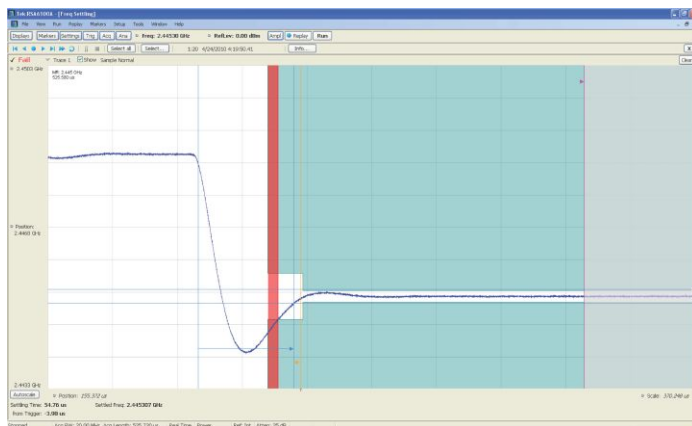
Time-correlated, multi-domain view provides a new level of insight into design or operational problems not possible with conventional analysis solutions. Here, the hop patterns of a narrowband signal can be observed using Spectrogram (lower left) and its hop characteristics can be precisely measured 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.

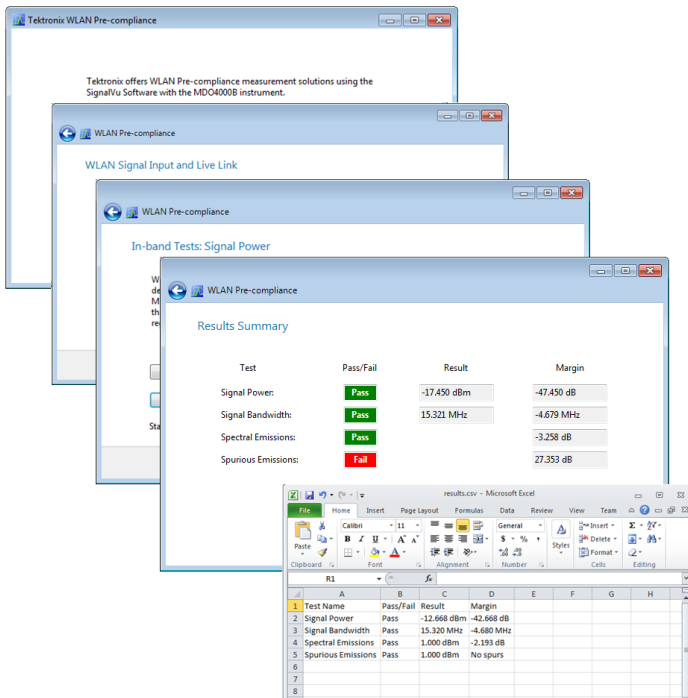
## WLAN transmitter testing

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
Transmit Power On/Off Ramp	20.3.20.3 ("n")	country dependent
	16.4.7.8 (DSSS)	(10%-90%) 2 usec
Transmit Spectrum mask	17.4.7.7 ("b")	(10%-90%) 2 usec
	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
RF Carrier suppression	20.3.20.1 ("n")	Std mask
	22.3.18.1 ("ac")	Std mask
	16.4.7.9 ("DSSS")	-15dB
Center frequency leakage	17.4.7.8 ("b")	-15dB
	18.3.9.7.2 ("a")	-15 dBc or +2 dB w.r.t. average subcarrier power
Transmit Spectral flatness	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
	18.3.9.7.3 ("a")	+/- 4 dB (SC = -16...16), +/-6 dB (other)
	20.3.20.2 ("n")	+/- 4 dB, +/-6 dB
Transmission spurious	22.3.18.2 ("ac")	+/- 4 dB, +/-6 dB (various BWs, 20-160 MHz)
	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)
Symbol clock frequency tolerance	22.3.18.3 ("ac")	+/-20 ppm
	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
Transmit Modulation accuracy	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		
Transmitter Constellation Error	18.3.9.7.4 ("a")	Modulation	Coding rate (R)	Relative constellation error (dB)
		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
	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		

## Bluetooth transmitter testing

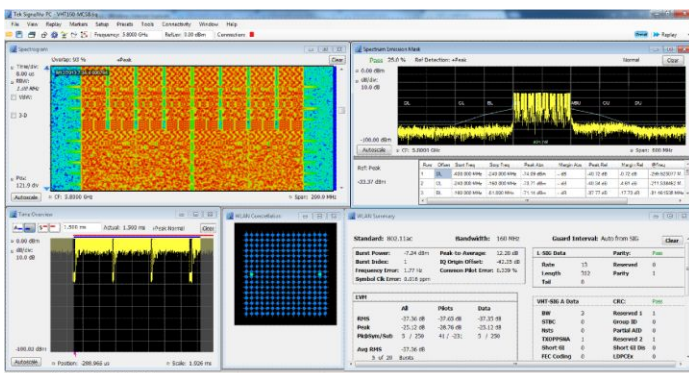
With SV27, you can perform Bluetooth SIG standard-based transmitter RF measurements in the time, frequency, and modulation domains. SV27 supports Basic Rate and Low Energy Transmitter measurements defined by Bluetooth SIG Test Specification RF.TS.4.2 for Basic Rate and RF-PHY.TS.4.2 for Bluetooth Low Energy. 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.

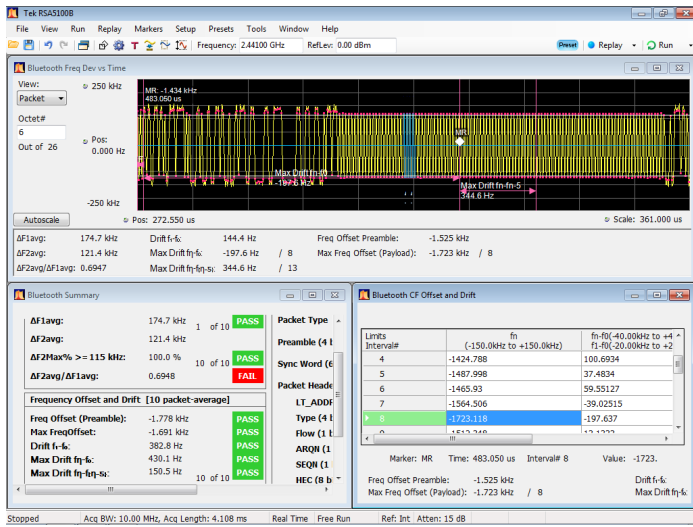
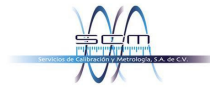
Below is a summary of the measurements that are automated with SV27 (unless noted):

- 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.



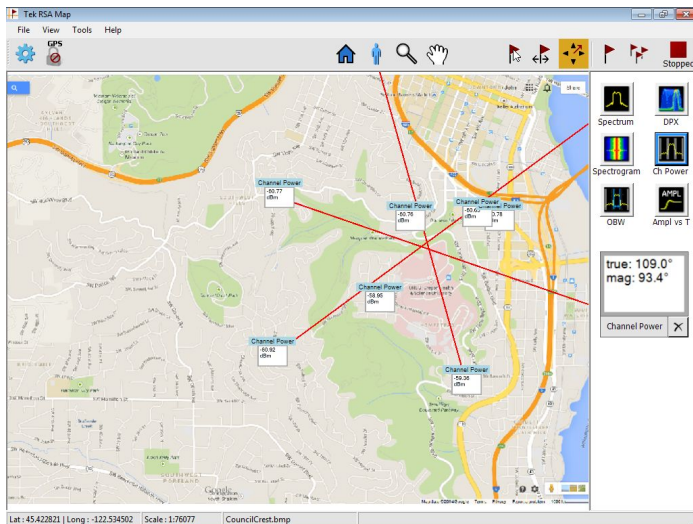
Easy analysis of WLAN 802.11ac transmitter with a WLAN preset that provides spectral emission mask, constellation diagram, and decoded burst information.



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

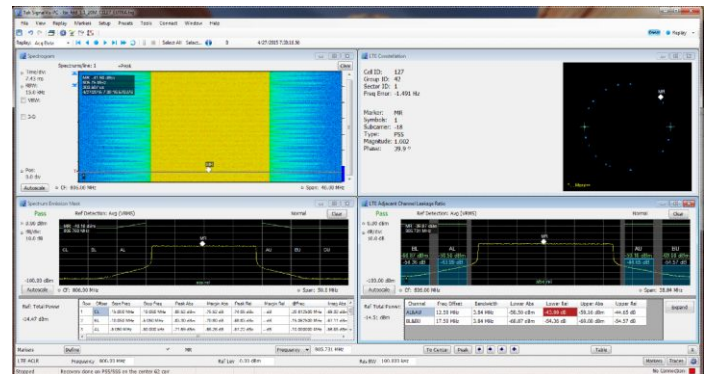
SV28 enables the following LTE measurements:

- 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.

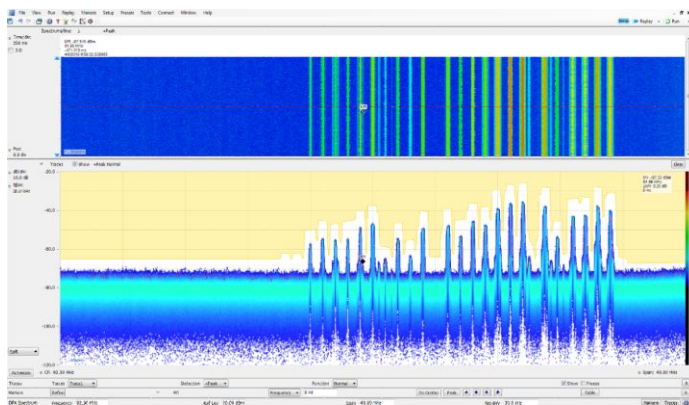
The ACLR preset measures the E-UTRA and the UTRA adjacent channels, with different chip rates for UTRA. ACLR also supports Noise Correction based on the noise measured when there is no input. Both ACLR and SEM will operate in swept mode (default) or in faster single acquisition if the instrument has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



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

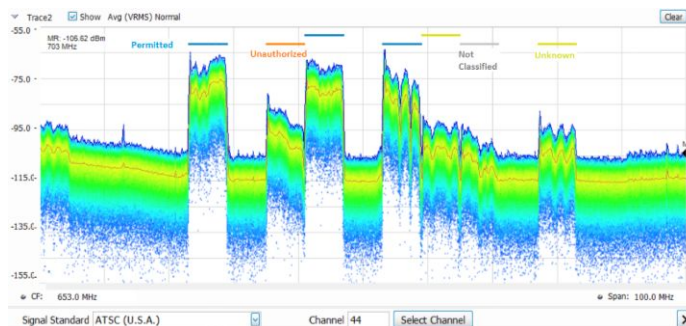
## Playback of recorded files

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.

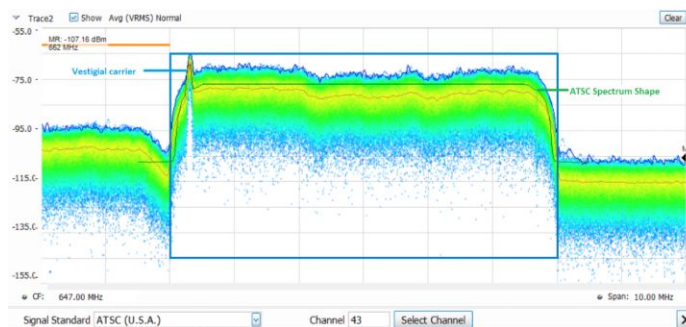


## Signal survey

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.



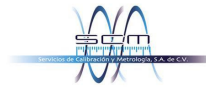
Above is a typical signal survey. This survey is of a portion of the TV broadcast band, and 7 regions have been declared as either Permitted, Unknown, or Unauthorized, as indicated by the color bars for each region.



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. The signal is a close match to the spectrum mask, including the vestigial carrier at the lower side of the signal, characteristic of ATSC broadcasts.

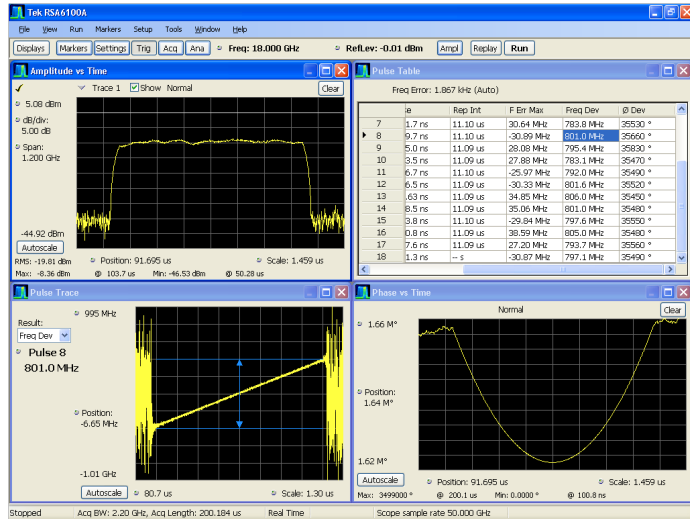
SignalVu-PC with mapping can be used to manually indicate the azimuth of a measurement made in the field, greatly aiding in triangulation efforts. The addition of a smart antenna able to report its direction to SignalVu-PC automates this process. Automatically plotting the azimuth/bearing of a measurement 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](http://www.Tektronix.com).





## Advanced signal analysis

The Advanced Signal Analysis package (SVP) provides 27 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.



## 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 ( $\pm$ 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 signal analysis (SVP)	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.



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.



## 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

<b>Frequency range</b>	See appropriate oscilloscope data sheet
<b>Initial center frequency setting accuracy</b>	Equal to time-base accuracy of oscilloscope
<b>Center frequency setting resolution</b>	0.1 Hz
<b>Frequency offset range</b>	0 Hz to the maximum bandwidth of the oscilloscope
<b>Frequency marker readout accuracy</b>	$\pm(\text{Reference Frequency Error} \times \text{Marker Frequency} + 0.001 \times \text{Span} + 2)$ Hz
<b>Span accuracy</b>	$\pm 0.3\%$
<b>Reference frequency error</b>	Equal to oscilloscope reference frequency accuracy, aging, and drift. Refer to appropriate DPO/DSA/MSO data sheet.
<b>Tuning Tables</b>	<p>Tables that present frequency selection in the form of standards-based channels are available for the following.</p> <p>Cellular standards families: AMPS, NADC, NMT-450, PDC, GSM, CDMA, CDMA-2000, 1xEV-DO WCDMA, TD-SCDMA, LTE, WiMax</p> <p>Unlicensed short range: 802.11a/b/j/g/p/n/ac, Bluetooth</p> <p>Cordless phone: DECT, PHS</p> <p>Broadcast: AM, FM, ATSC, DVBT/H, NTSC</p> <p>Mobile radio, pagers, other: GMRS/FRS, iDEN, FLEX, P25, PWT, SMR, WiMax</p>

#### 3rd order inter-modulation distortion<sup>1</sup>

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<sup>2</sup>

<b>DPO/DSA/ MSO70000 series (all spans)</b>	-60 dBm
<b>DPO7000C series (all spans)</b>	-65 dBm
<b>MSO/DPO5000 series (all spans)</b>	-70 dBm

<sup>1</sup> 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.

<sup>2</sup> 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<sup>3</sup>

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

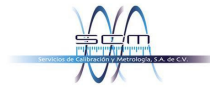
Maximum acquisition time will vary based on the oscilloscope available memory and analog bandwidth. The following table highlights the single-channel capabilities for each model given maximum available memory configuration.

Model <sup>4</sup>	Max span	Max acquisition time at max sample rate	Min RBW at max sample rate	Min IQ time resolution	Max number of FastFrames <sup>5</sup>
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			100 ps	
DPO7104C	1 GHz				
DPO7054C	500 MHz				
MSO/DPO5204/B	2 GHz	25 ms	100 Hz	200 ps	
MSO/DPO5104/B	1 GHz			400 ps	
MSO/DPO5054/B	500 MHz				
MSO/DPO5034/B	350 MHz				
MDO4000B/C Spectrum Analyzer	3 GHz or 6 GHz <sup>4</sup>	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	

<sup>3</sup> 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.

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

<sup>5</sup> 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 measurements suite (SVP)**      Pulse results table  
    Pulse trace (selectable by pulse number)  
    Pulse statistics (trend of pulse results, FFT of trend, and histogram)

**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

**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



**Performance (typical)**

**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

**Bluetooth Basic LE Tx Measurements (SV27)**

- Peak Power, Average Power, Adjacent Channel Power or InBand Emission mask, -20dB Bandwidth, Frequency Error, Modulation Characteristics including  $\Delta F1_{avg}$  (11110000),  $\Delta F2_{avg}$  (10101010),  $\Delta F2 > 115$  kHz,  $\Delta F2/\Delta F1$  ratio, frequency deviation vs. time with packet and octet level measurement information, Carrier Frequency  $f_0$ , 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

<b>Resolution bandwidth (spectrum analysis)</b>	1, 2, 3, 5 sequence, auto-coupled, or user selected (arbitrary)
<b>Resolution bandwidth shape</b>	Approximately Gaussian, shape factor 4.1:1 (60:3 dB) $\pm 10\%$ , typical
<b>Resolution bandwidth accuracy</b>	$\pm 1\%$ (auto-coupled RBW mode)
<b>Alternative resolution bandwidth types</b>	Kaiser window (RBW), -6 dB Mil, CISPR, Blackman-Harris 4B window, Uniform window (none), flat-top window (CW ampl.), Hanning window

### Video bandwidth

<b>Video bandwidth range</b>	Dependent on oscilloscope record length setting. approximately 500 Hz to 5 MHz
<b>RBW/VBW maximum</b>	10,000:1
<b>RBW/VBW minimum</b>	1:1
<b>Resolution</b>	5% of entered value
<b>Accuracy (typical)</b>	$\pm 10\%$

### Time domain bandwidth (amplitude vs. time display)

<b>Time domain bandwidth range</b>	At least 1/2 to 1/10,000 of acquisition bandwidth
<b>Time domain bandwidth shape</b>	Approximately Gaussian, shape factor 4.1:1(60:3 dB), $\pm 10\%$ typical Shape factor <2.5:1 (60:3 dB) typical for all bandwidths
<b>Time domain bandwidth accuracy</b>	$\pm 10\%$

### Spectrum display traces, detectors, and functions

<b>Traces</b>	Three traces + 1 math trace + 1 trace from spectrogram for spectrum display
<b>Detector</b>	Peak, -peak, average, CISPR peak
<b>Trace functions</b>	Normal, Average, Max Hold, Min Hold
<b>Spectrum trace length</b>	801, 2401, 4001, 8001, or 10401 points

## Signal strength

### Signal Strength display

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

## AM/FM/PM modulation and audio measurements (SVA)<sup>7</sup>

### Analog demodulation<sup>7</sup>

<b>Carrier frequency range</b>	1 kHz or (1/2 × audio analysis bandwidth) to maximum input frequency
<b>Maximum audio frequency span</b>	10 MHz

### Audio filters

<b>Low pass (kHz)</b>	0.3, 3, 15, 30, 80, 300, and user-entered up to 0.9 × audio bandwidth
<b>High pass (Hz)</b>	20, 50, 300, 400, and user-entered up to 0.9 × audio bandwidth
<b>Standard</b>	CCITT, C-Message
<b>De-emphasis (μs)</b>	25, 50, 75, 750, and user-entered
<b>File</b>	User-supplied .TXT or .CSV file of amplitude/frequency pairs. Maximum 1000 pairs.

### FM modulation analysis

<b>FM measurements,</b>	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
<b>FM deviation accuracy</b>	±1.5% of deviation
<b>FM rate accuracy</b>	±1.0 Hz
<b>Carrier frequency accuracy</b>	±1 Hz + (transmitter frequency × reference frequency error)

### Residuals (FM) (rate: 1 kHz to 10 kHz, deviation: 5 kHz)

<b>THD</b>	0.2% (MSO/DPO70000, DPO7000 Series)
	1.0% (MSO/DPO5000 Series)
	1.0% (MDO4000B Series)
<b>SINAD</b>	44 dB (MSO/DPO70000, DPO7000 Series)
	38 dB (MSO/DPO5000 Series)
	38 dB (MDO4000B Series)

### AM modulation analysis

<b>AM measurements</b>	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
<b>AM depth accuracy (rate: 1 kHz, depth: 50%)</b>	±1% + 0.01 × measured value
<b>AM rate accuracy (rate: 1 kHz, depth: 50%)</b>	±1.0 Hz

### Residuals (AM)

<b>THD</b>	0.3% (MSO/DPO70000, MDO7000 Series)
	1.0% (MSO/DPO5000 Series)
	1.0% (MDO4000B Series)
<b>SINAD</b>	48 dB (MSO/DPO70000, MDO7000 Series)
	43 dB (MSO/DPO5000 Series)
	43 dB (MDO4000B Series)

<sup>6</sup> 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.

<sup>7</sup> 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)

### PM modulation analysis

<b>PM measurement</b>	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
<b>PM deviation accuracy (rate: 1 kHz, deviation: 0.628 rad)</b>	$\pm 100\% \times (0.01 + (\text{rate} / 1 \text{ MHz}))$
<b>PM rate accuracy (rate: 1 kHz, deviation: 0.628 rad)</b>	$\pm 1 \text{ Hz}$

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### Residuals (PM)

<b>THD</b>	0.1% (MSO/DPO70000, MDO7000 Series)
	0.5% (MSO/DPO5000 Series)
	0.5% (MDO4000B Series)
<b>SINAD</b>	48 dB (MSO/DPO70000, MDO7000 Series)
	43 dB (MSO/DPO5000 Series)
	43 dB (MDO4000B Series)

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### Direct audio input

<b>Audio measurements</b>	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
<b>Direct input frequency range (for audio measurements only)</b>	1 Hz to 10 MHz
<b>Maximum audio frequency span</b>	10 MHz
<b>Audio frequency accuracy</b>	$\pm 1 \text{ Hz}$

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### Residuals (PM)

<b>THD</b>	1.5%
<b>SINAD</b>	38 dB

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### 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 recommended	>4 kHz	1 MHz	2 kHz
DPO/DSA/MSO 70000 <12.5 GHz BW	200 kHz	400 Hz	20 kHz	40 Hz	not recommended	>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)<sup>8</sup>

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

<sup>8</sup> 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 measurement suite (SVP)

General characteristics

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

Number of pulses

1 to 10,000

System rise time (typical)

Equal to oscilloscope rise time

Minimum pulse width for detection<sup>9</sup>

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

<sup>9</sup> 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 measurement suite (SVP)

**Pulse measurement accuracy (typical)<sup>10</sup>**

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

### Digital modulation analysis (SVM)

**Modulation formats**  $\pi/2$ DBPSK, BPSK, SBPSK, QPSK, DQPSK,  $\pi/4$ DQPSK, 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**

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

**16QAM Residual EVM (typical) for DPO7000 and DPO/DSA/MSO70000 series<sup>11</sup>**

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

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

<sup>11</sup> 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<sup>12</sup>

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<sup>13</sup>

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

<b>Modulation formats</b>	DBPSK (DSSS1M), DQPSK (DSSS2M), CCK5.5M, CCK11M , OFDM (BPSK, QPSK, 16 or 64QAM)
<b>Measurements and displays</b>	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 <sup>14</sup> , 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)
<b>Typical residual EVM - 802.11b (CCK-11Mbps) with MDO4000B<sup>15</sup></b>	RMS-EVM over 1000 chips, EQ On 1.04% (2.4 GHz)
<b>Typical residual EVM - 802.11a/g/j (OFDM, 20 MHz, 64-QAM), with MDO4000B<sup>15</sup></b>	-44 dB (2.4 GHz) -43 dB (5.8 GHz)  (RMS-EVM averaged over 20 bursts, 16 symbols each)

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

<sup>13</sup> Measurement filter = root raised cosine, reference filter = raised cosine, analysis Length = 400 symbols, 20 averages

<sup>14</sup> 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

<sup>15</sup> 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 <sup>16</sup>, 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 <sup>17</sup>

-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 <sup>18</sup>, 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 <sup>19</sup>

-37.3 dB (5.8 GHz), RMS-EVM averaged over 20 bursts, 16 symbols each

<sup>16</sup> 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

<sup>17</sup> Signal input power optimized for best EVM

<sup>18</sup> 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

<sup>19</sup> Signal input power optimized for best EVM



## APCO P25 (SV26)

<b>Modulation formats</b>	Phase 1 (C4FM), Phase 2 (HCPM, HDQPSK)
<b>Measurements and displays</b>	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
<b>Residual modulation fidelity (with MDO4000B)</b>	
Phase 1 (C4FM)	≤1.0% typical
Phase 2 (HCPM)	≤0.5% typical
Phase 2 (HDQPSK)	≤0.5% typical
<b>Adjacent channel power ratio</b>	
<b>25 kHz offset from the center and bandwidth of 6 kHz<sup>20</sup></b>	Phase 1 (C4FM): -76 dBc typical Phase 2 (HCPM): -74 dBc typical Phase 2 (HDQPSK): -74 dBc typical
<b>62.5 kHz offset from the center and bandwidth of 6 kHz</b>	Phase 1 (C4FM): -77 dBc typical Phase 2 (HCPM): -78 dBc typical Phase 2 (HDQPSK): -76 dBc typical

## Bluetooth (SV27)

<b>Modulation formats</b>	Basic Rate, Bluetooth Low Energy, Enhanced Data Rate - Revision 4.2
<b>Measurements and displays</b>	Peak Power, Average Power, Adjacent Channel Power or InBand Emission mask, -20 dB Bandwidth, Frequency Error, Modulation Characteristics including $\Delta F_{1avg}$ (11110000), $\Delta F_{2avg}$ (10101010), $\Delta F_2 > 115$ kHz, $\Delta F_2/\Delta F_1$ ratio, frequency deviation vs. time with packet and octet level measurement information, Carrier Frequency $f_0$ , 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
<b>Output power (Average and Peak Power)</b>	
Level uncertainty	Refer to instrument amplitude and flatness specification
Measurement range	Signal level > -70 dBm (for USB Spectrum Analyzers) and -60 dBm (for MDO4000B)
<b>Modulation Characteristics</b> ( $\Delta F_{1avg}$ , $\Delta F_{2avg}$ , $\Delta F_{2avg}/\Delta F_{1avg}$ , $\Delta F_{2max} \geq 115$ 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)

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



<b>Measurement resolution</b>	10 Hz
<b>Measurement range</b>	Nominal channel frequency $\pm 100$ kHz

**Initial Carrier Frequency Tolerance (ICFT)**

<b>Measurement uncertainty (at 0 dBm)</b>	< 1 kHz + instrument frequency uncertainty (for USB Spectrum Analyzers) < 1.5 kHz + MDO4000B frequency uncertainty (for MDO4000B)
<b>Measurement resolution</b>	10 Hz
<b>Measurement range</b>	Nominal channel frequency $\pm 100$ 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  $\mu$ s))**

<b>Measurement uncertainty</b>	< 2 kHz + instrument frequency uncertainty (for RSA306 and MDO4000B) < 1 kHz + instrument frequency uncertainty (for RSA600 and RSA500)
<b>Measurement resolution</b>	10 Hz
<b>Measurement range</b>	Nominal channel frequency $\pm 100$ kHz

**In-band Emissions and ACP**

<b>Level uncertainty</b>	Refer to instrument amplitude and flatness specification
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**LTE Downlink RF measurements (SV28)**

<b>Standard Supported</b>	3GPP TS 36.141 Version 12.5
<b>Frame Format supported</b>	FDD and TDD
<b>Measurements and Displays Supported</b>	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.
<b>ACLR with E-UTRA bands (Typical Mean, with Noise Correction)</b>	
<b>1st Adjacent Channel</b>	60 dB (MDO4000B); 61 dB (RSA600/RSA500); 65 dB (RSA306/B)
<b>2nd Adjacent Channel</b>	65 dB (MDO4000B); 63 dB (RSA600/RSA500); 66 dB (RSA306/B)

**Mapping (MAP)**

**Mapping**

<b>Map types directly supported</b>	Pitney Bowes MapInfo (*.mif), Bitmap (*.bmp), Open Street Maps (.osm)
<b>Saved measurement results</b>	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

**Playback of recorded signals (SV56)**

<b>Playback file type</b>	R3F recorded by RSA306, RSA500, or RSA600
<b>Recorded file bandwidth</b>	40 MHz



<b>File playback controls</b>	<p>General: Play, stop, exit playback</p> <p>Location: Begin/end points of playback settable from 0-100%</p> <p>Skip: Defined skip size from 73 <math>\mu</math>s up to 99% of file size</p> <p>Live rate: Plays back at 1:1 rate to recording time</p> <p>Loop control: Play once, or loop continuously</p>
<b>Memory requirement</b>	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.

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## General characteristics

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

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## System requirements

<b>Operating systems</b>	<p>Windows 10 x64</p> <p>Windows 8 x64</p> <p>Windows 7 Service Pack 1 x64</p>
<b>Disk space</b>	6 GB free on C: drive
<b>RAM</b>	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.

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## Instruments and file types supported

### Instrument family Oscilloscopes

	File type				
	.WFM	.ISF	.TIQ	.IQT	.MAT
Performance: MSO/DPO5000 DPO7000C DPO/DSA/ MSO70000	X		X <sup>21</sup>		
Mixed-domain: MDO4000 & MDO4000B/C		X	X <sup>22</sup>		
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.

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

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



## Ordering information

### Purchasing, licensing, and activation

SignalVu-PC and its applications are available for download at [www.tektronix.com/downloads](http://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.

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 $\leq 40$ MHz and MDO4000B/C
	SVMFL-SVPC	FL	
SVP	SVPNL-SVPC	NL	Pulse Analysis to work with analyzer of acquisition bandwidth $\leq 40$ 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/l/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 $\leq 40$ 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 $\leq 40$ 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	
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/l/j/p/n/ac and Connect to MDO4000B/C to work with MDO4000B/C or analyzer of acquisition bandwidth $\leq 40$ MHz
	SV2CFL-SVPC	FL	
SV28	SV28NL-SVPC	NL	LTE Downlink RF measurement to work with analyzer of acquisition bandwidth $\leq 40$ MHz and MDO4000B/C
	SV28FL-SVPC	FL	



Legacy SignalVu-PC option	New application license	License type	Description
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

## 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.



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**For Further Information.** Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit [www.tek.com](http://www.tek.com).

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