Vector Signal Analysis Software for Oscilloscopes
SignalVu™ Datasheet

SignalVu vector signal analysis software combines the signal analysis engine of the RSA5000 and RSA6000 Series real-time spectrum analyzer with that of the industry’s leading digital oscilloscopes, making it possible for designers to evaluate complex signals without an external down converter. You get the functionality of a vector signal analyzer, a spectrum analyzer, and the powerful trigger capabilities of a digital oscilloscope - all in a single package. You can use SignalVu with an MSO/DPO5000, DPO7000, or DPO/DSA/MSO7000 Series digital oscilloscope to easily validate wideband designs and characterize wideband spectral events. Whether your design validation needs include wideband radar, high data rate satellite links, wireless LAN, or frequency-hopping communications, SignalVu can speed your time-to-insight by showing you the time-variant behavior of these wideband signals.

Key features
- **Trigger**
  - Integrated RF signal analysis package lets you take full advantage of oscilloscope settings
  - Pinpoint™ triggering offers over 1400 combinations to address virtually any triggering situation
- **Capture**
  - Direct observation of microwave signals without need of an external down converter
  - All signals up to the analog bandwidth of oscilloscope are captured into memory
  - Customize oscilloscope acquisition parameters for effective use of capture memory
  - FastFrame segmented memory captures signal bursts without storing the signal's off time
  - Supports RF, I and Q, and differential I and Q signals using the oscilloscope’s 4 analog inputs

- **Analyze**
  - Extensive time-correlated, multidomain 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, OBW/EBW, and Spur Search
  - WLAN spectrum and modulation transmitter measurements based on IEEE 802.11 a/b/g/j/p/n/ac standards (Opt. SV23, SV24, and SV25)
  - Bluetooth® Transmitter Measurements based on Bluetooth SIG RF Specifications for Basic Rate and Low Energy. Some support of Enhanced Data Rate. (Option SV27)
  - Simple and complete APCO Project 25 transmitter compliance testing and analysis for Phase 1 (C4FM) and Phase 2 (TDMA) (Opt. SV26)
  - AM/FM/PM Modulation and Audio Measurements (Opt. SVA) for characterization of analog transmitters and audio signals
  - Settling Time Measurements, Frequency, and Phase (Opt. SVT) for characterization of wideband frequency-agile oscillators
  - Advanced Signal Analysis Suite (Opt. SVP) - 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 (Opt. SVM) provides vector signal analyzer functionality
  - Flexible OFDM analysis (Opt. SVO) with support for 802.11a/g/j and WiMAX 802.16-2004 signals
  - Frequency offset control for analyzing baseband signals with near-zero intermediate frequencies (IF)
  - Tektronix OpenChoice® makes for easy transfer to a variety of analysis programs such as Excel and Matlab

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

www.tektronix.com
Wideband signal characterization

SignalVu helps you easily validate wideband designs and characterize wideband spectral events using an MSO/DPO5000, DPO7000, or DPO/DSA/MSO7000 Series digital oscilloscope. Users can easily switch between the SignalVu application and the oscilloscope’s user interface to optimize the collection of wideband signals.

Trigger

SignalVu software works seamlessly with the oscilloscope allowing users to utilize all of its powerful triggering capabilities. The ability to trigger on time- and amplitude-varying events of interest is paramount in wideband system design, debug, and validation. The Tektronix oscilloscopes’ trigger systems allow selection of virtually all trigger types on both A and B trigger events whether they be transition, state, time, or logic qualified triggers. Once triggered, SignalVu processes the acquisition for analysis in multiple domains.

Capture

Capture once - make multiple measurements without recapturing. All signals in an acquisition bandwidth are recorded into the oscilloscope’s deep memory. Up to four channels can be captured simultaneously; each of which can be independently analyzed by SignalVu software. Channels can be RF, I and Q, or differential inputs. Users can also apply math functions to the acquisition prior to analysis by SignalVu. Acquisition lengths vary depending upon the selected capture bandwidth - up to 25 ms can be captured on a single channel with the MSO/DPO5000 Series, up to 12.5 ms can be acquired on a single channel with the DPO7000 Series, and up to 2.5 ms can be captured on a single channel with the DPO/DSA/MSO70000 Series. Significantly longer capture times can be realized with lower oscilloscope sample rates.

Using the FastFrame segmented memory feature in SignalVu enables you to capture events of interest, such as low duty cycle pulsed signals, while conserving acquisition memory. Using multiple trigger events, FastFrame captures and stores short-duration, bursty signals and passes them to SignalVu vector signal analysis functions. Capturing thousands of frames is possible, so long-term trends and changes in the bursty signal can be analyzed.

Once captured into memory, SignalVu 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).
Analyze

SignalVu vector signal analysis software utilizes the same analysis capabilities found in the RSA5000 and RSA6000 Series real-time spectrum analyzers. SignalVu advances productivity for engineers working on components in wideband RF system design, integration, and performance verification, or operations engineers working in networks, or spectrum management. In addition to spectrum analysis, spectrograms display both frequency and amplitude changes over time. Time-correlated measurements can be made across the frequency, phase, amplitude, and modulation domains. This is ideal for signal analysis that includes frequency hopping, pulse characteristics, modulation switching, settling time, bandwidth changes, and intermittent signals.

SignalVu can process RF, I and Q, and differential I and Q signals from any one of the four available oscilloscope inputs. Math functions applied by the oscilloscope are also utilized by SignalVu allowing users to apply custom filtering prior to vector signal analysis.

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

Options tailored for your wideband applications

SignalVu vector signal analysis software is available for all MSO/DPO5000, DPO7000, and DPO/DSA/MSO7000 Series oscilloscopes and offers options to meet your specific application, whether it be wideband radar characterization, broadband satellite, or spectrum management. SignalVu Essentials (Opt. SVE) provides the fundamental capability for all measurements and is required for pulse analysis (Opt. SVP), settling time (Opt. SVT), digital modulation analysis (Opt. SVM), flexible OFDM analysis (Opt. SVO), and AM/FM/PM Modulation and Audio Measurements (Opt. SVA).

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

Settling time measurements (Opt. 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 options, you can perform standards-based transmitter measurements in the time, frequency, and modulation domains.

- Option SV23 supports IEEE 802.11a, b, g, j and p signals
- Option SV24 supports IEEE 802.11n 20 MHz and 40 MHz SISO signals
- Option SV25 supports IEEE 802.11ac 20/40/80/160 MHz SISO signals

The table below describes the modulation formats and frequency bands of IEEE 802.11 WLAN signals:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Std PHY</th>
<th>Freq band(s)</th>
<th>Signal</th>
<th>Modulation formats</th>
<th>Bandwidth (max)</th>
<th>802.11-2012 section</th>
</tr>
</thead>
<tbody>
<tr>
<td>802.11b</td>
<td>DSSS HR/DSSS</td>
<td>2.4 GHz</td>
<td>DSSS/CCK 1-11 Mbps</td>
<td>DBSK, DQPSK, CCK5.5M, CCK11M</td>
<td>20 MHz</td>
<td>16 &amp; 17</td>
</tr>
<tr>
<td>802.11g</td>
<td>ERP</td>
<td>2.4 GHz</td>
<td>DSSS/CCK/PCBCC 1-33 Mbps</td>
<td>BPSK DQPSK</td>
<td>20 MHz</td>
<td>17</td>
</tr>
<tr>
<td>802.11a</td>
<td>OFDM</td>
<td>5 GHz</td>
<td>OFDM 64&lt;54 Mbps</td>
<td>BPSK QPSK 16QAM 64QAM</td>
<td>20 MHz</td>
<td>18</td>
</tr>
<tr>
<td>802.11n</td>
<td>HT</td>
<td>2.4 GHz &amp; 5 GHz</td>
<td>OFDM 64, 128, 256, 512 ≤ 867 Mbps</td>
<td>BPSK QPSK 16QAM 64QAM 256QAM</td>
<td>20, 40, 80, 160 MHz</td>
<td>20</td>
</tr>
<tr>
<td>802.11ac</td>
<td>VHT</td>
<td>5 GHz</td>
<td>OFDM 64, 128, 256, 512 ≤ 867 Mbps</td>
<td>BPSK QPSK 16QAM 64QAM 256QAM</td>
<td>20, 40, 80, 160 MHz</td>
<td>22</td>
</tr>
</tbody>
</table>

The Frequency Band (Freq Band(s)) provides the minimum requirement for the bandwidth of the oscilloscope to use.

Inside SignalVu, the WLAN presets make the EVM, Constellation and SEM measurements push-button. The WLAN RF transmitter measurements are defined by the IEEE 802.11- 2012 revision of the standard and listed below with the reference to the section and the limit to reach.
**IEEE 802.11 WLAN transmitter test summary**

<table>
<thead>
<tr>
<th>IEEE 802.11 RF layer test</th>
<th>IEEE reference 802.11-2012</th>
<th>Limit tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modulation</td>
<td>Coding rate (R)</td>
<td>Relative constellation error (dB)</td>
</tr>
<tr>
<td>BPSK</td>
<td>1/2</td>
<td>-5</td>
</tr>
<tr>
<td>BPSK</td>
<td>3/4</td>
<td>-8</td>
</tr>
<tr>
<td>QPSK</td>
<td>1/2</td>
<td>-10</td>
</tr>
<tr>
<td>QPSK</td>
<td>3/4</td>
<td>-13</td>
</tr>
<tr>
<td>16-QAM</td>
<td>1/2</td>
<td>-16</td>
</tr>
<tr>
<td>16-QAM</td>
<td>3/4</td>
<td>-19</td>
</tr>
<tr>
<td>64-QAM</td>
<td>2/3</td>
<td>-22</td>
</tr>
<tr>
<td>64-QAM</td>
<td>3/4</td>
<td>-25</td>
</tr>
<tr>
<td>64-QAM</td>
<td>5/6</td>
<td>-27</td>
</tr>
</tbody>
</table>

**Transmitter Constellation Error**

<table>
<thead>
<tr>
<th>18.3.9.7.4 (&quot;a&quot;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPSK</td>
</tr>
<tr>
<td>QPSK</td>
</tr>
<tr>
<td>QPSK</td>
</tr>
<tr>
<td>16-QAM</td>
</tr>
<tr>
<td>16-QAM</td>
</tr>
<tr>
<td>64-QAM</td>
</tr>
<tr>
<td>64-QAM</td>
</tr>
<tr>
<td>64-QAM</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>20.3.20.7.3 (&quot;n&quot;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPSK</td>
</tr>
<tr>
<td>QPSK</td>
</tr>
<tr>
<td>QPSK</td>
</tr>
<tr>
<td>16-QAM</td>
</tr>
<tr>
<td>16-QAM</td>
</tr>
<tr>
<td>64-QAM</td>
</tr>
<tr>
<td>64-QAM</td>
</tr>
<tr>
<td>64-QAM</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>22.3.18.4.3 (&quot;ac&quot;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPSK</td>
</tr>
<tr>
<td>QPSK</td>
</tr>
<tr>
<td>QPSK</td>
</tr>
<tr>
<td>16-QAM</td>
</tr>
<tr>
<td>16-QAM</td>
</tr>
<tr>
<td>64-QAM</td>
</tr>
<tr>
<td>64-QAM</td>
</tr>
<tr>
<td>64-QAM</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Out-of-band spurious emission</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.4.6.6 (&quot;DSSS&quot;)</td>
</tr>
<tr>
<td>17.4.6.9 (&quot;b&quot;)</td>
</tr>
<tr>
<td>18.3.8.5 (&quot;a&quot;)</td>
</tr>
<tr>
<td>19.4.4 (&quot;g&quot;)</td>
</tr>
</tbody>
</table>

**BluetoothTransmitterTesting**

With Option SV27, you can perform Bluetooth SIG standard-based transmitter RF measurements in the time, frequency, and modulation domains. This option supports Basic Rate and Low Energy Transmitter measurements defined by Bluetooth SIG Test Specification RF.TS.4.1.1 for Basic Rate and RF-PHY.TS.4.1.1 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 Option 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.

**Measurement functions**

<table>
<thead>
<tr>
<th>Spectrum analyzer measurements (Opt. SVE)</th>
<th>Channel Power, Adjacent Channel Power, Multicarrier Adjacent Channel Power/Leakage Ratio, Occupied Bandwidth, dxB Down, dBm/Hz Marker, dBc/Hz Marker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time domain and statistical measurements (Opt. SVE)</td>
<td>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</td>
</tr>
<tr>
<td>Spur search measurements (Opt. SVE)</td>
<td>Up to 20 ranges, user-selected detectors (peak, average, CISPR peak), filters (RBW, CISPR, MIL) and VBW in each range. Linear or Log frequency scale. Measurements and violations in absolute power or relative to a carrier. Up to 999 violations identified in tabular form for export in CSV format</td>
</tr>
<tr>
<td>WLAN 802.11a/b/g/i/j/p measurement application (Opt. SV23)</td>
<td>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.</td>
</tr>
<tr>
<td>WLAN 802.11n measurement application (Opt. SV24)</td>
<td></td>
</tr>
<tr>
<td>WLAN 802.11ac measurement application (Opt. SV25)</td>
<td></td>
</tr>
</tbody>
</table>

**APCO P25 compliance testing and analysis application (Opt. 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.

Option SV26 requires Option SVE

**Bluetooth Basic LE TX SIG measurements (Opt. 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 (Opt. 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) (Opt. 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 (Opt. 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

**Option SV23 requires Option SVE**

**Option SV24 requires Option SV23**

**Option SV25 requires Option SV24**
Flexible OFDM analysis  
(Opt. 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  
(Opt. 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

The Advanced Signal Analysis package (Opt. 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.

Settling time measurements (Opt. 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.
Specifications

Performance (typical)
The following is typical performance of SignalVu™ running on any MSO/DPO5000, DPO7000, or DPO/DSA/MSO70000 Series oscilloscopes.

Frequency-related

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial center frequency setting</td>
<td>Accuracy equal to time-base accuracy of oscilloscope</td>
</tr>
<tr>
<td>Frequency offset range</td>
<td>0 Hz to the maximum bandwidth of the oscilloscope</td>
</tr>
<tr>
<td>Frequency marker readout accuracy</td>
<td>±(Reference Frequency Error × Marker Frequency + 0.001 × Span + 2) Hz</td>
</tr>
<tr>
<td>Span accuracy</td>
<td>±0.3%</td>
</tr>
</tbody>
</table>

3rd order inter-modulation distortion

<table>
<thead>
<tr>
<th>Frequency</th>
<th>MSO/DPO5000</th>
<th>DPO7000</th>
<th>DPO/DSA/MSO70000</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 GHz</td>
<td>-38 dBc</td>
<td>-40 dBc</td>
<td>-55 dBc</td>
</tr>
<tr>
<td>10 GHz</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>18 GHz</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
</tbody>
</table>

Residual responses

<table>
<thead>
<tr>
<th>Series</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPO/DSA/MSO70000 series</td>
<td>-60 dBm</td>
</tr>
<tr>
<td>DPO7000 series (all spans)</td>
<td>-65 dBm</td>
</tr>
<tr>
<td>MSO/DPO5000 series (all spans)</td>
<td>-70 dBm</td>
</tr>
</tbody>
</table>

Displayed average noise level

<table>
<thead>
<tr>
<th>Span</th>
<th>MSO/DPO5000</th>
<th>DPO7000</th>
<th>DPO/DSA/MSO70000</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC - 500 MHz</td>
<td>-94 dBm</td>
<td>-100 dBm</td>
<td>-103 dBm</td>
</tr>
<tr>
<td>&gt;500 MHz - 3.5 GHz</td>
<td>-</td>
<td>-102 dBm</td>
<td>-103 dBm</td>
</tr>
<tr>
<td>&gt;3.5 GHz - 14 GHz</td>
<td>-</td>
<td>-</td>
<td>-101 dBm</td>
</tr>
<tr>
<td>&gt;14 GHz - 20 GHz</td>
<td>-</td>
<td>-</td>
<td>-88 dBm</td>
</tr>
<tr>
<td>&gt;20 GHz - 25 GHz</td>
<td>-</td>
<td>-</td>
<td>-87 dBm</td>
</tr>
<tr>
<td>&gt;25 GHz - 33 GHz</td>
<td>-</td>
<td>-</td>
<td>-85 dBm</td>
</tr>
</tbody>
</table>

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.

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/DPO5064 performance not listed.
### Performance (typical)

<table>
<thead>
<tr>
<th>Input-related</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of inputs</td>
<td>4</td>
</tr>
<tr>
<td>Input signal types</td>
<td>RF, I and Q (single ended), I and Q (differential)</td>
</tr>
<tr>
<td>Maximum input level</td>
<td>+26 dBm for 50 Ω input (5 VRMS)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trigger-related</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Trigger modes</td>
<td>Free Run and Triggered. Trigger sensitivity and characteristics can be found in the appropriate oscilloscope data sheet.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Acquisition-related</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SignalVu provides long acquisitions of waveform captures with high time and frequency resolution. Maximum acquisition time will vary based on the oscilloscope's available memory and analog bandwidth. The following table highlights each model's single-channel capabilities given its maximum available memory configuration.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>Max span</th>
<th>Max acquisition time at max sample rate</th>
<th>Min RBW at max sample rate</th>
<th>Min IQ time resolution</th>
<th>Max number of FastFrames</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPO/DSA73304D</td>
<td>33 GHz</td>
<td>2.5 ms</td>
<td>1.2 kHz</td>
<td>20 ps</td>
<td>65,535</td>
</tr>
<tr>
<td>DPO/DSA72504D</td>
<td>25 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DPO/DSA/MSO72004C</td>
<td>20 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DPO/DSA/MSO71604C</td>
<td>16 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DPO/DSA/MSO71254C</td>
<td>12.5 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DPO/DSA/MSO70804C</td>
<td>8 GHz</td>
<td>5 ms</td>
<td>600 Hz</td>
<td>80 ps</td>
<td></td>
</tr>
<tr>
<td>DPO/DSA/MSO70604C</td>
<td>6 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DPO/DSA/MSO70404C</td>
<td>4 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DPO7354C</td>
<td>3.5 GHz</td>
<td>12.5 ms</td>
<td>300 Hz</td>
<td>50 ps</td>
<td></td>
</tr>
<tr>
<td>DPO7254C</td>
<td>2.5 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DPO7104C</td>
<td>1 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DPO7054C</td>
<td>500 MHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSO/DPO5204</td>
<td>2 GHz</td>
<td>25 ms</td>
<td>100 Hz</td>
<td>200 ps</td>
<td></td>
</tr>
<tr>
<td>MSO/DPO5104</td>
<td>1 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSO/DPO5054</td>
<td>500 MHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSO/DPO5034</td>
<td>350 MHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

4 SignalVu can process acquisitions from any one of the oscilloscope channels. Users can also apply custom math and filter functions to each of the oscilloscope's acquisition channels. The resulting Math channel can then be selected by SignalVu for signal processing.

5 With maximum available record length option and maximum sample rate.

6 Maximum number of frames available will depend upon the oscilloscope's record length, sample rate, and the acquisition length settings.
## Performance (typical)

### Analysis-related

- **Frequency (Opt. SVE)**
  - Spectrum (Amplitude vs. Linear or Log Frequency)
  - Spectrogram (Amplitude vs. Frequency over Time)
  - Spurious (Amplitude vs. Linear or Log Frequency)

- **Time and statistics (Opt. SVE)**
  - 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

- **Settling time, frequency, and phase (Opt. SVT)**
  - Frequency Settling vs. Time
  - Phase Settling vs. Time

- **Advanced measurements suite (Opt. SVP)**
  - Pulse results Table
  - Pulse trace (Selectable by pulse number)
  - Pulse statistics (Trend of pulse results, FFT of trend, and histogram)

- **Digital demod (Opt. 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 (Opt. 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

### Supported file formats

SignalVu can recall saved acquisitions from MSO/DPO5000, DPO7000, DPO/DSA/MSO70000, RSA5000, and RSA6000 Series instruments. Both WFM and TIQ file extensions can be recalled for postprocessing by SignalVu.

### RF and spectrum analysis performance

<table>
<thead>
<tr>
<th>Resolution bandwidth</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution bandwidth (spectrum analysis)</td>
<td>1, 2, 3, 5 sequence, auto-coupled, or user selected (arbitrary)</td>
</tr>
<tr>
<td>Resolution bandwidth shape</td>
<td>Approximately Gaussian, shape factor 4.1:1 (60:3 dB) ±10%, typical</td>
</tr>
<tr>
<td>Resolution bandwidth accuracy</td>
<td>±1% (auto-coupled RBW mode)</td>
</tr>
<tr>
<td>Alternative resolution bandwidth types</td>
<td>Kaiser window (RBW), –6 dB Mil, CISPR, Blackman-Harris 4B window, Uniform window (none), flat-top window (CW ampl.), Hanning window</td>
</tr>
</tbody>
</table>
# RF and spectrum analysis performance

<table>
<thead>
<tr>
<th>Video bandwidth</th>
<th>Video bandwidth range</th>
<th>Dependent on oscilloscope record length setting, approximately 500 Hz to 5 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBW/VBW maximum</td>
<td>10,000:1</td>
<td></td>
</tr>
<tr>
<td>RBW/VBW minimum</td>
<td>1:1</td>
<td></td>
</tr>
<tr>
<td>Resolution</td>
<td>5% of entered value</td>
<td></td>
</tr>
<tr>
<td>Accuracy (typical)</td>
<td>±10%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time domain bandwidth</th>
<th>Time domain bandwidth range</th>
<th>At least 1/2 to 1/10,000 of acquisition bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time domain bandwidth shape</td>
<td>Approximately Gaussian, shape factor 4:1:1 (60:3 dB), ±10% typical</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shape factor &lt;2:5:1 (60:3 dB) typical for all bandwidths</td>
<td></td>
</tr>
<tr>
<td>Time domain bandwidth accuracy</td>
<td>±10%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spectrum display traces, detectors, and functions</th>
<th>Traces</th>
<th>Three traces + 1 math trace + 1 trace from spectrogram for spectrum display</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detector</td>
<td>Peak, –peak, average, CISPR peak</td>
<td></td>
</tr>
<tr>
<td>Trace functions</td>
<td>Normal, Average, Max Hold, Min Hold</td>
<td></td>
</tr>
<tr>
<td>Spectrum trace length</td>
<td>801, 2401, 4001, 8001, or 10401 points</td>
<td></td>
</tr>
</tbody>
</table>

## AM/FM/PM modulation and audio measurements (Opt. SVA)  

<table>
<thead>
<tr>
<th>Analog demodulation</th>
<th>Carrier frequency range</th>
<th>1 kHz or (1/2 × audio analysis bandwidth) to maximum input frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum audio frequency span</td>
<td>10 MHz</td>
<td></td>
</tr>
</tbody>
</table>

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

## FM modulation analysis

<table>
<thead>
<tr>
<th>FM measurements,</th>
<th>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</th>
</tr>
</thead>
<tbody>
<tr>
<td>FM deviation accuracy</td>
<td>±1.5% of deviation</td>
</tr>
<tr>
<td>FM rate accuracy</td>
<td>±1.0 Hz</td>
</tr>
<tr>
<td>Carrier frequency accuracy</td>
<td>±1 Hz + (transmitter frequency × reference frequency error)</td>
</tr>
</tbody>
</table>

---

7 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.

8 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 (Opt. SVA)

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

<table>
<thead>
<tr>
<th></th>
<th>THD</th>
<th>SINAD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.2% (MSO/DPO7000, 70000 Series)</td>
<td>44 dB (MSO/DPO7000, 70000 Series)</td>
</tr>
<tr>
<td></td>
<td>1.0% (MSO/DPO5000 Series)</td>
<td>38 dB (MSO/DPO5000 Series)</td>
</tr>
</tbody>
</table>

#### AM modulation analysis

<table>
<thead>
<tr>
<th>AM measurements</th>
<th>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</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM depth accuracy (rate: 1 kHz, depth: 50%)</td>
<td>±1% + 0.01 × measured value</td>
</tr>
<tr>
<td>AM rate accuracy (rate: 1 kHz, depth: 50%)</td>
<td>±1.0 Hz</td>
</tr>
</tbody>
</table>

#### Residuals (AM)

<table>
<thead>
<tr>
<th></th>
<th>THD</th>
<th>SINAD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.3% (MSO/DPO7000, 70000 Series)</td>
<td>48 dB (MSO/DPO7000, 70000 Series)</td>
</tr>
<tr>
<td></td>
<td>1.0% (MSO/DPO5000 Series)</td>
<td>43 dB (MSO/DPO5000 Series)</td>
</tr>
</tbody>
</table>

#### PM modulation analysis

<table>
<thead>
<tr>
<th>PM measurement</th>
<th>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</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM deviation accuracy (rate: 1 kHz, deviation: 0.628 rad)</td>
<td>±100% × (0.01 + (rate / 1 MHz))</td>
</tr>
<tr>
<td>PM rate accuracy (rate: 1 kHz, deviation: 0.628 rad)</td>
<td>±1 Hz</td>
</tr>
</tbody>
</table>

#### Residuals (PM)

<table>
<thead>
<tr>
<th></th>
<th>THD</th>
<th>SINAD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.1% (MSO/DPO7000, 70000 Series)</td>
<td>48 dB (MSO/DPO7000, 70000 Series)</td>
</tr>
<tr>
<td></td>
<td>0.5% (MSO/DPO5000 Series)</td>
<td>43 dB (MSO/DPO5000 Series)</td>
</tr>
</tbody>
</table>

#### Direct audio input

<table>
<thead>
<tr>
<th>Audio measurements</th>
<th>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</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct input frequency range (for audio measurements only)</td>
<td>1 Hz to 10 MHz</td>
</tr>
<tr>
<td>Maximum audio frequency span</td>
<td>10 MHz</td>
</tr>
<tr>
<td>Audio frequency accuracy</td>
<td>±1 Hz</td>
</tr>
</tbody>
</table>

#### Residuals (PM)

<table>
<thead>
<tr>
<th></th>
<th>THD</th>
<th>SINAD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.5%</td>
<td>38 dB</td>
</tr>
</tbody>
</table>
### AM/FM/PM modulation and audio measurements (Opt. SVA)

<table>
<thead>
<tr>
<th>Model</th>
<th>Sample rate: 1 GS/s</th>
<th>Sample rate: maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard memory</td>
<td>Maximum memory</td>
</tr>
<tr>
<td></td>
<td>Min. Aud. BW</td>
<td>RBW (Auto)</td>
</tr>
<tr>
<td></td>
<td>Min. Aud. BW</td>
<td>RBW (Auto)</td>
</tr>
<tr>
<td></td>
<td>Min. Aud. BW</td>
<td>RBW (Auto)</td>
</tr>
<tr>
<td></td>
<td>Min. Aud. BW</td>
<td>RBW (Auto)</td>
</tr>
<tr>
<td>MSO/DPO 5034</td>
<td>200 kHz</td>
<td>400 Hz</td>
</tr>
<tr>
<td>MSO/DPO 5054</td>
<td>100 kHz</td>
<td>200 Hz</td>
</tr>
<tr>
<td></td>
<td>50 kHz</td>
<td>100 Hz</td>
</tr>
<tr>
<td></td>
<td>200 kHz</td>
<td>400 Hz</td>
</tr>
<tr>
<td></td>
<td>100 kHz</td>
<td>200 Hz</td>
</tr>
<tr>
<td></td>
<td>1 MHz</td>
<td>2 kHz</td>
</tr>
<tr>
<td></td>
<td>100 kHz</td>
<td>20 kHz</td>
</tr>
<tr>
<td></td>
<td>200 Hz</td>
<td>2 kHz</td>
</tr>
<tr>
<td></td>
<td>1 MHz</td>
<td>2 kHz</td>
</tr>
<tr>
<td></td>
<td>100 kHz</td>
<td>2 kHz</td>
</tr>
<tr>
<td></td>
<td>200 Hz</td>
<td>2 kHz</td>
</tr>
<tr>
<td></td>
<td>1 MHz</td>
<td>2 kHz</td>
</tr>
<tr>
<td>MSO/DPO 5104</td>
<td>50 kHz</td>
<td>100 Hz</td>
</tr>
<tr>
<td>MSO/DPO 5204</td>
<td>50 kHz</td>
<td>100 Hz</td>
</tr>
<tr>
<td></td>
<td>2 MHz</td>
<td>4 kHz</td>
</tr>
<tr>
<td></td>
<td>2 MHz</td>
<td>4 kHz</td>
</tr>
<tr>
<td>DPO 7000</td>
<td>50 kHz</td>
<td>100 Hz</td>
</tr>
<tr>
<td></td>
<td>100 Hz</td>
<td>10 kHz</td>
</tr>
<tr>
<td>DPO/DSA/MSO 70000 ≥12.5 GHz BW</td>
<td>200 kHz</td>
<td>400 Hz</td>
</tr>
<tr>
<td>DPO/DSA/MSO 70000 &lt;12.5 GHz BW</td>
<td>200 kHz</td>
<td>400 Hz</td>
</tr>
</tbody>
</table>

### Settling time, frequency, and phase (Opt. SVT)\(^9\)

<table>
<thead>
<tr>
<th>Measurement frequency: 1 GHz</th>
<th>Frequency uncertainty at stated measurement bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Averages</td>
<td>1 GHz</td>
</tr>
<tr>
<td>Single measurement</td>
<td>20 kHz</td>
</tr>
<tr>
<td>100 averages</td>
<td>10 kHz</td>
</tr>
<tr>
<td>1000 averages</td>
<td>2 kHz</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measurement frequency: 9 GHz</th>
<th>Frequency uncertainty at stated measurement bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Averages</td>
<td>1 GHz</td>
</tr>
<tr>
<td>Single Measurement</td>
<td>20 kHz</td>
</tr>
<tr>
<td>100 Averages</td>
<td>10 kHz</td>
</tr>
<tr>
<td>1000 Averages</td>
<td>2 kHz</td>
</tr>
</tbody>
</table>

\(^9\) Settled Frequency or Phase at the measurement frequency. Measured signal level > -20 dBm, Attenuator: Auto.
Settled phase uncertainty,

<table>
<thead>
<tr>
<th>Measurement frequency: 1 GHz</th>
<th>Averages</th>
<th>Phase uncertainty at stated measurement bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 GHz</td>
</tr>
<tr>
<td>Single measurement</td>
<td>2°</td>
<td>2°</td>
</tr>
<tr>
<td>100 averages</td>
<td>0.5°</td>
<td>0.5°</td>
</tr>
<tr>
<td>1000 averages</td>
<td>0.2°</td>
<td>0.2°</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measurement frequency: 9 GHz</th>
<th>Averages</th>
<th>Phase uncertainty at stated measurement bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 GHz</td>
</tr>
<tr>
<td>Single measurement</td>
<td>5°</td>
<td>5°</td>
</tr>
<tr>
<td>100 averages</td>
<td>2°</td>
<td>2°</td>
</tr>
<tr>
<td>1000 averages</td>
<td>0.5°</td>
<td>0.5°</td>
</tr>
</tbody>
</table>

Advanced measurement suite (Opt. 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

<table>
<thead>
<tr>
<th>Model</th>
<th>Minimum PW</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPO/DSA72004B MSO72004</td>
<td>400 ps</td>
</tr>
<tr>
<td>DPO/DSA71604B MSO71604</td>
<td>500 ps</td>
</tr>
<tr>
<td>DPO/DSA71254B MSO71254</td>
<td>640 ps</td>
</tr>
<tr>
<td>DPO/DSA70804B MSO70804</td>
<td>1 ns</td>
</tr>
<tr>
<td>DPO/DSA70604B MSO70604</td>
<td>1.3 ns</td>
</tr>
<tr>
<td>DPO/DSA70404B MSO70404</td>
<td>2 ns</td>
</tr>
<tr>
<td>DPO7354</td>
<td>2.25 ns</td>
</tr>
<tr>
<td>DPO7254</td>
<td>3 ns</td>
</tr>
<tr>
<td>DPO7104</td>
<td>8 ns</td>
</tr>
<tr>
<td>DPO7054</td>
<td>16 ns</td>
</tr>
<tr>
<td>MSO/DPO5204</td>
<td>4 ns</td>
</tr>
<tr>
<td>MSO/DPO5104</td>
<td>8 ns</td>
</tr>
<tr>
<td>MSO/DPO5054</td>
<td>16 ns</td>
</tr>
<tr>
<td>MSO/DPO5034</td>
<td>25 ns</td>
</tr>
</tbody>
</table>

10 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 (Opt. SVP)

Pulse measurement accuracy

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average on power</td>
<td>±0.3 dB + Absolute Amplitude Accuracy of oscilloscope</td>
</tr>
<tr>
<td>Average transmitted power</td>
<td>±0.4 dB + Absolute Amplitude Accuracy of oscilloscope</td>
</tr>
<tr>
<td>Peak power</td>
<td>±0.4 dB + Absolute Amplitude Accuracy of oscilloscope</td>
</tr>
<tr>
<td>Pulse width</td>
<td>±(3% of reading + 0.5 × sample period)</td>
</tr>
<tr>
<td>Pulse repetition rate</td>
<td>±(3% of reading + 0.5 × sample period)</td>
</tr>
</tbody>
</table>

Digital modulation analysis (Opt. SVM)

Modulation formats

<table>
<thead>
<tr>
<th>Format</th>
<th>Supported Modulations</th>
</tr>
</thead>
<tbody>
<tr>
<td>π/2DBPSK</td>
<td>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</td>
</tr>
</tbody>
</table>

Analysis period

- Up to 80,000 samples

Measurement filters

- Square-root raised cosine, raised cosine, Gaussian, rectangular, IS-95, IS-95 EQ, 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

- BPSK, QPSK, OQPSK π/2 DQPSK, π/4 DQPSK, 8PSK, D8PSK, D16PSK, 16/32/64/128/256QAM

Reference filters for all modulation types except OQPSK

- Raised cosine, Rectangular, None

Reference filters for OQPSK

- Raised cosine, Half sine

Filter length

- 1-128 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 DPO70000 and DPO/DSA/MSO70000 series

<table>
<thead>
<tr>
<th>Symbol Rate</th>
<th>RF</th>
<th>IQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 MS/s</td>
<td>&lt;2.0%</td>
<td>&lt;2.0%</td>
</tr>
<tr>
<td>312.5 MS/s</td>
<td>&lt;3.0%</td>
<td>&lt;3.0%</td>
</tr>
</tbody>
</table>

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

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

### Digital modulation analysis (Opt. SVM)

<table>
<thead>
<tr>
<th>16QAM Residual EVM (typical) for MSO/DPO5000 series</th>
<th>Symbol Rate</th>
<th>RF</th>
<th>IQ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10 MS/s</td>
<td>1.5%</td>
<td>1.0%</td>
</tr>
<tr>
<td></td>
<td>100 MS/s</td>
<td>4.0%</td>
<td>2.0%</td>
</tr>
</tbody>
</table>

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

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

- **General characteristics**
- **Modulation formats**: DBPSK (DSSS1M), DQPSK (DSSS2M), CCK5.5M, CCK11M, OFDM (BPSK, QPSK, 16 or 64QAM)
- **Measurements**
  - 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, 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)

### WLAN IEEE802.11n (Opt. SV24)

- **General characteristics**
- **Modulation formats**: OFDM (BPSK, QPSK, 16 or 64 QAM), SISO
- **Measurements**
  - 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, 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)

---

13 Carrier frequency 700 MHz. MSO/DPO5054 and MSO/DPO5034 performance not listed. Use of external reference will degrade EVM performance.
### WLAN IEEE802.11ac (Opt. SV25)

**General characteristics**

- **Modulation formats**
  - OFDM (BPSK, QPSK, 16 QAM, 64 QAM, 256 QAM), SISO

- **Measurements**
  - 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, 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)

### APCO P25 (Opt. 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

### Bluetooth (Opt. SV27)

**Modulation formats**

- Basic Rate, Bluetooth Low Energy, Enhanced Data Rate - Revision 4.1.1

**Measurements and displays**

- Peak Power, Average Power, Adjacent Channel Power or InBand Emission mask, -20 dB Bandwidth, Frequency Error, Modulation Characteristics including \( \Delta F_{1\text{avg}} \) \( \{01110000\} \), \( \Delta F_{2\text{avg}} \) \( \{10101010\} \), \( \Delta F_2 > 115 \text{ kHz} \), \( \Delta F_2/\Delta F_1 \) 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 \( f_n - f_0 \), Max Drift Rate \( f_n - f_0 \), Center Frequency Offset Table and Frequency Drift table, color-coded Symbol table, Packet header decoding information, eye diagram, constellation diagram

**General characteristics**

- **GPIB**
  - SCPI-compatible, see programmer manual for exceptions
Ordering information

SignalVu™ Vector Signal Analysis software is compatible with all DPO/MSO5000 Series digital oscilloscopes with firmware version 6.1.1 and DPO7000, DPO/DSA/MSO70000 Series digital oscilloscopes with firmware version V5.1.0 or higher. SignalVu Essentials (Opt. SVE) provides basic vector signal analysis and is required for all other analysis options.

Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
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<tr>
<td>Opt. SVE</td>
<td>SignalVu Essentials - Vector Signal Analysis Software</td>
</tr>
<tr>
<td>Opt. SV23</td>
<td>WLAN 802.11a/b/g/j/p measurement application (requires opt. SVE, requires oscilloscope of bandwidth of 2.5 GHz or above)</td>
</tr>
<tr>
<td>Opt. SV24</td>
<td>WLAN 802.11n measurement application (requires opt SV23, requires oscilloscope of bandwidth of 2.5 GHz or above)</td>
</tr>
<tr>
<td>Opt. SV25</td>
<td>WLAN 802.11ac measurement application (requires opt SV24, requires oscilloscope of bandwidth of 6.0 GHz or above)</td>
</tr>
<tr>
<td>Opt. SV26</td>
<td>APCO P25 measurement application</td>
</tr>
<tr>
<td>Opt. SV27</td>
<td>Bluetooth Basic LE Tx Measurements (requires Opt. SVE, requires oscilloscope of bandwidth of 2.5 GHz or above)</td>
</tr>
<tr>
<td>Opt. SVP</td>
<td>Advanced Signal Analysis, including pulse measurements (requires opt. SVE)</td>
</tr>
<tr>
<td>Opt. SVM</td>
<td>General Purpose Digital Modulation Analysis (requires opt. SVE)</td>
</tr>
<tr>
<td>Opt. SVT</td>
<td>Settling Time, Frequency, and Phase (requires opt. SVE)</td>
</tr>
<tr>
<td>Opt. SVO</td>
<td>Flexible OFDM with support for 802.11a/j/g and 802.16-2044 (fixed WiMAX) modulation types. Not available on the MSO/DPO5000 Series (requires instruments with Windows 7 operating system)</td>
</tr>
<tr>
<td>Opt. SVA</td>
<td>AM/FM/PM Modulation and Audio Measurements. Requires Opt. SVE (requires instruments with Windows 7 operating system)</td>
</tr>
</tbody>
</table>

SignalVu ordering and upgrade guide for new and existing instruments

Option ordering nomenclature for all oscilloscopes. Option SVE is required for all other options listed. Option SVO is not available on MSO/DPO5000 models.

For information on analysis software that runs on your personal computer, please see the SignalVu-PC datasheet.

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<th>Ordering on new instrument</th>
<th>Upgrade existing instrument</th>
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<td>MSO/DPO5000 Series</td>
<td>Opt. SVE (Essentials)</td>
<td>DPO-UP Opt. SVEE</td>
</tr>
<tr>
<td>DPO7000 Series</td>
<td>Opt. SVE (Essentials)</td>
<td>DPO-UP Opt. SVM</td>
</tr>
<tr>
<td>DPO/DSA/MSO7000 Series ≤8 GHz</td>
<td>Opt. SVE (Essentials)</td>
<td>DPO-UP Opt. SVEH</td>
</tr>
<tr>
<td>DPO/DSA/MSO7000 Series &gt;8 GHz</td>
<td>Opt. SVE (Essentials)</td>
<td>DPO-UP Opt. SVEU</td>
</tr>
<tr>
<td>Option SVE required for all other options listed</td>
<td>Opt. SVT (Settling time)</td>
<td>DPO-UP Opt. SVT</td>
</tr>
<tr>
<td></td>
<td>Opt. SVP (Pulse measurements)</td>
<td>DPO-UP Opt. SVP</td>
</tr>
<tr>
<td></td>
<td>Opt. SVM (GP modulation analysis)</td>
<td>DPO-UP Opt. SVM</td>
</tr>
<tr>
<td></td>
<td>Opt. SVO (OFDM)</td>
<td>DPO-UP Opt. SVO</td>
</tr>
<tr>
<td></td>
<td>Opt. SVA (AM/FM/PM Audio)</td>
<td>DPO-UP Opt. SVA</td>
</tr>
<tr>
<td>DPO7000 and DPO/DSA/MSO7000 Series ≥2.5 GHz</td>
<td>Opt. SV23 (IEEE802.11a/b/g/j/p)</td>
<td>DPO-UP Opt. SV23</td>
</tr>
<tr>
<td>Option SV23 required for SV24</td>
<td>Opt. SV24 (IEEE802.11n)</td>
<td>DPO-UP Opt. SV24</td>
</tr>
<tr>
<td>DPO7000 and DPO/DSA/MSO7000 Series ≥2.5 GHz</td>
<td>Opt. SV27 (Bluetooth)</td>
<td>DPO-UP Opt. SV27</td>
</tr>
</tbody>
</table>
Legacy models

DPO7000 Series, DPO/DSA/MSO70000 Series

Earlier DPO7000 and DPO/DSA/MSO70000 Series oscilloscopes may be retrofitted with SignalVu. These instruments use a Microsoft Windows XP operating system, have oscilloscope firmware version 5.1 or above, and are compatible with SignalVu version 2.3.0072. See upgrade nomenclature table above for ordering information. Option SVO (OFDM), Option SVA (AM/FM/PM Audio), and Options SV23, SV23, SV25, SV26 (WLAN and P25) are not available on instruments with Microsoft Windows XP.

Standard accessories

- Reference Manual (PDF)
- Printable Help (PDF)
- Programmer Manual (PDF)

Tektronix is registered to ISO 9001 and ISO 14001 by SRI Quality System Registrar.
