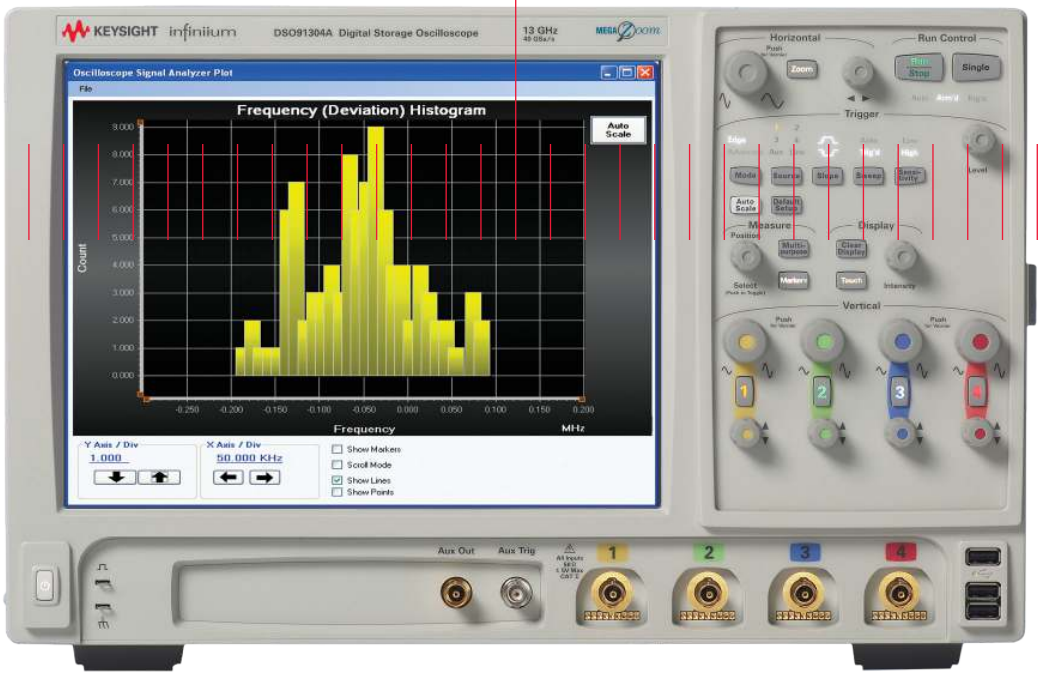
Keysight W2650A Oscilloscope Signal Analyzer

Pulse and Modulation Domain Analysis with the 9000, 90000, and 90000 X-Series Infiniium Oscilloscopes

Data Sheet



KEYSIGHT TECHNOLOGIES

Technical Overview

The Oscilloscope Signal Analyzer (OSA) leverages the powerful Infiniium series oscilloscopes to provide precise, fast and efficient RF analysis for pulsed and CW signals. The OSA provides power and modulation domain (frequency and time interval) analysis measurements for test and verification of CW, Pulsed RF (e.g. RADAR) and Electronic Warfare (EW) systems. The OSA extends the analysis to yield a database of signal parameters that can be searched, filtered, plotted, and exported. Pulse parameters include PW, PRI, PRF, FMOP, Frequency, and Amplitude. Modulation domain parameters include segment timingfrequency dwell time, frequency hopping, frequency deviation and modulation statistics. Extended analysis includes parameter histograms and time domain plots. OSA features and benefits include:

Features and Benefits:

- Extends the powerful Infiniium 9000, 90000, and 90000X oscilloscopes for pulsed and modulation domain signal analysis of Radar and EW waveforms, as well as any time varying signal.
- Performs pulse analysis for signals up to 32 GHz in carrrier frequency with multi-GHz analysis band widths
- Designed to support Aerospace/Defense as well as commercial applications to simplify signal analysis of today's complex waveforms.
- Utilizes the Infiniium oscilloscope's deep memory capture (up to 2 GSa) and optimizes memory usage using the oscilloscope's segmented memory feature
- Analyze a large number of signals- quickly reduce the results, display, and sort through data to gain quick insight into system performance and field test results

Select from a wide range of pulse analysis measurement capabilities, utilizing the segmented memory capability on 9000, 90000, and 90000X series Infiniium oscilloscopes to analyze a large number of pulses.

Pulse Measurements:

- Volts vs. time and Power (dBm) vs. time
- Frequency/phase vs. time, differential frequency/phase vs. time
- PRF (Pulse repetition frequency)
- PRI (Pulse repetition interval)
- Pulse width
- Pulse rise and fall time
- Pulse start and end time
- Pulse frequency- mean, min, max, deviation, excursion
- Pulse modulation- chirp, Barker analysis

In addition to pulsed measurements, the OSA performs a number of CW and modulation measurements:

CW & Modulation Measurements:

- CW main and sub-sampling acquisition
- Frequency vs. time
- Segment duration,
- Frequency statistics and deviation,
- Modulation parameters
- Frequency Hopping signal pattern and duration

Speed Your Time to Gain Insight into System Performance

Electronic warfare, frequency hopping CW, and RADAR design and maintenance engineers can now quickly measure signal characteristics with the W2650A Oscilloscope Signal Analysis (OSA) software. The combination of the W2650A and a Keysight Infiniium oscilloscope performs pulse analysis for signals up to 32 GHz in carrier frequency with multi-GHz analysis bandwidths. Quickly characterize pulse performance using a wide range of measurements including pulse width, rise time, fall time, PRI, PRF, pulse amplitude, pulse frequency, pulse phase, and much more.

View measurement results in a number of different displays such as graphs, tables, and histograms to gain insight into EW, frequency hopping CW, and RADAR transmitter performance. Pulsed RF data can be efficiently captured and stored using the oscilloscopes segmented memory capability, then post-processed to analyze pulse characteristics off-line (e.g. after field testing). Search criteria can be specified to evaluate emitter characteristics from many perspectives to quickly gain insight into events that may have occurred during field testing or gain insight into problematic system issues.

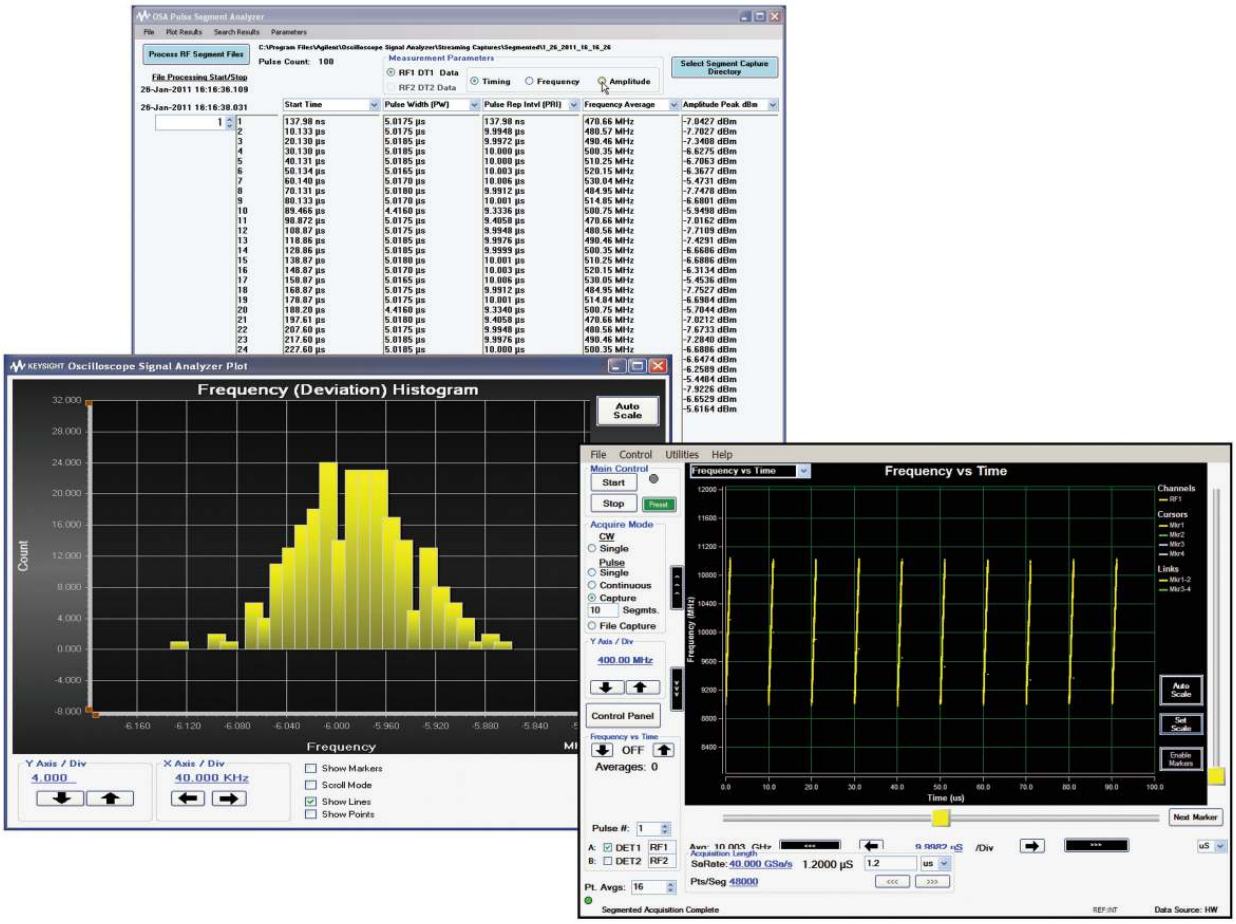
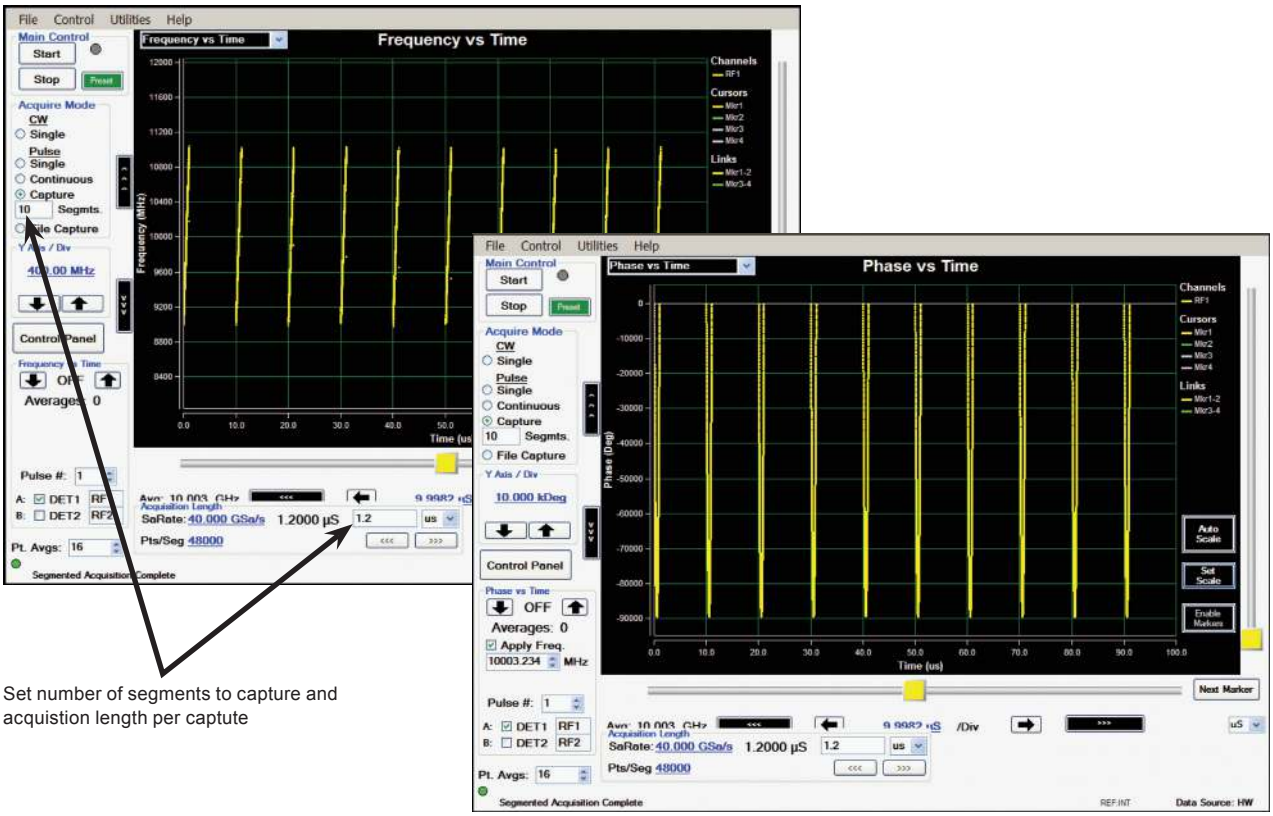


Figure 1. Perform pulse timing measurements (start time, pulse width, PRI), average pulse frequency, frequency deviation. Display frequency vs. time and histograms such as pulse count vs. frequency deviation

Quickly Setup the Oscilloscope's Acquisition for Pulse Characteristics

The oscilloscope's acquisition mode can be easily and quickly setup to acquire data with the continuous acquisition mode or the segmented memory acquisition mode. Continuous acquisition will capture data continuously for the time duration specified, up to the maximum capture time. The Infiniium series oscilloscopes offer memory capture of up to 2 Gsa. Segmented memory enables an acquisition length per capture to be specified, along with the number of segments (or pulses) to be specified. This enables more efficient utilization of the oscilloscopes memory by capturing only the "on" segments of the pulsed waveform with the signal content of interest, without capturing the "off" segments of the waveform.

Figure 2 shows an example of setting up a segmented memory acquisition with the OSA software. The number of segments has been set to 10 segments (RADAR pulses), and the acquisition length has been set to 1.2 µSec to capture pulses with a 1 µSec pulse width and constant PRI. Frequency vs. time and phase vs. time displays have been selected, showing the modulation pulse characteristics of a 2 GHz LFM chirped Radar waveform.



Set number of segments to capture and acquistion length per captute

Figure 2. Frequency vs. time and Phase vs. time of a 2GHz LFM chirped Radar waveform captured with the oscilloscope's segmented memory acquisition mode

Use the “Capture to File Mode” to Capture a Large Number of Pulses and Analyze with the “OSA Pulse Segment Analyzer”

The oscilloscope’s sample rate can be set directly from the OSA software front panel. Consideration should be given to set the sample rate to avoid aliasing (Nyquist). In contrast, consideration should also be given to avoid setting the sample rate excessively high, which can quickly consume the oscilloscope’s memory (up to 2 Gsa). Alternate approaches, such as IF sub-sampling to analyze long waveforms, may also be considered. More information on IF sub-sampling techniques can be found in appendix 1 of this app note: http://cp.literature.keysight.com/litweb/pdf/5990-3276EN.pdf.

For field testing and system-level testing, it is often useful to capture and analyze a large number of pulses to verify operation testing or diagnose an issue or event that occurred. However, graphical displays such as the display shown in Figure 1 can quickly fill up when capturing and analyzing a large number of pulses. The Capture-to-File mode shown in Figure 3 enables segmented acquisition data to be quickly stored as binary files, then automatically invokes the OSA Pulse Segment Analyzer for efficient analysis of the pulse timing, pulse frequency, and pulse amplitude characteristics.

Figure 3 shows an example of setting up the Capture-to-File mode for 200 segments (pulses). The “Auto Analyze Segments” is enabled, which invokes the OSA Pulse Segment Analyzer once the segmented data acquisition has completed. Data is efficiently stored a binary (.bin) files for off-line post-processing and analysis after field testing. Alternatively, it can be stored as .csv files for analysis in other 3rd party tools such as Excel.

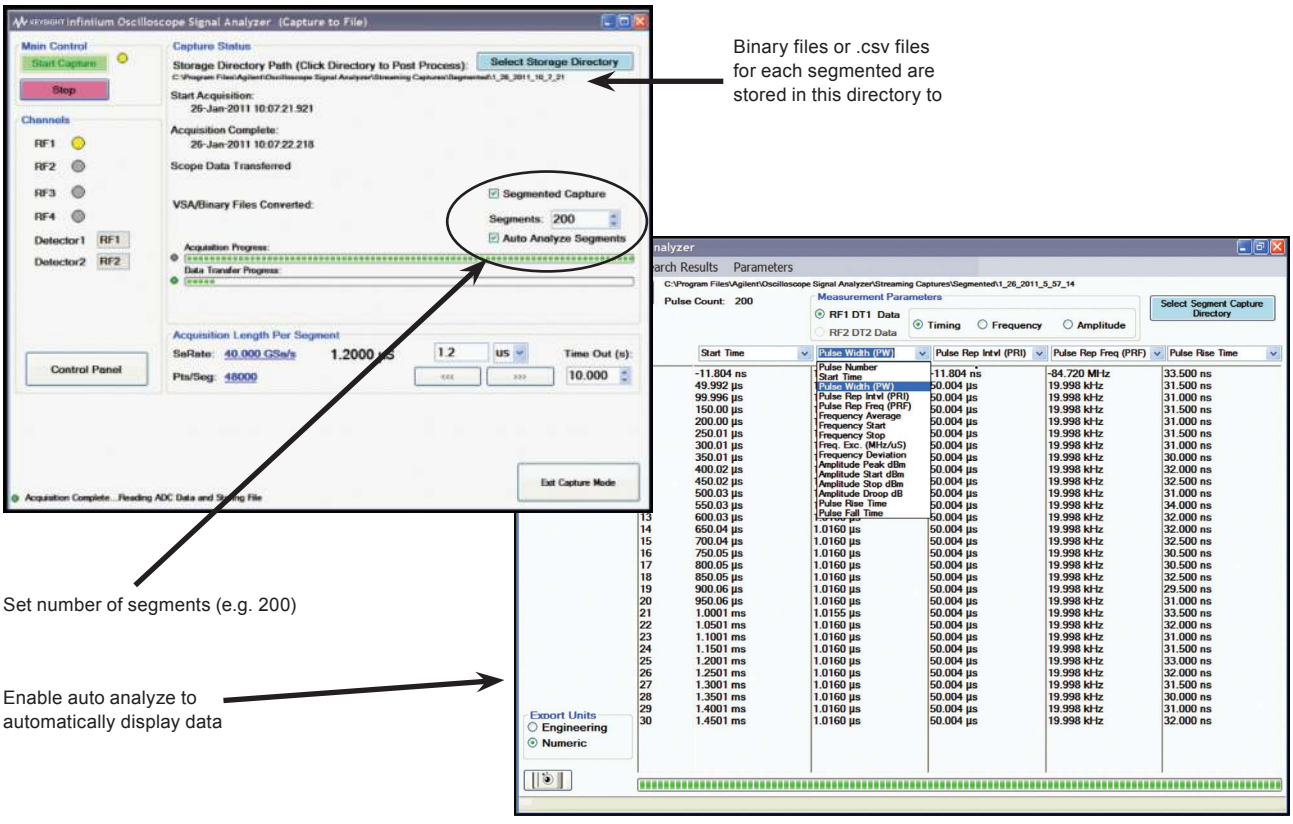


Figure 3. Capture-to-File is setup to capture 200 Radar pulses and then to automatically display and analyze them with the OSA Pulse Segment Analyzer

Quickly Set Up the Oscilloscope's Acquisition for Pulse Characteristics

The OSA's Pulse Segment Analyzer conveniently displays the pulse characteristics in an easy-to-view tabular format. Radio buttons can be selected to display the data with default measurements as listed below, however the default measurements can easily be changed by clicking on the pull-down menu at the top of each table column as shown in Figure 3.

Pulse Timing Measurements (default setup):

- Start time
- Pulse width
- Pulse Repetition Interval (PRI)
- Pulse Repetition Frequency (PRF)
- Rise time

Pulse Frequency Measurements (default setup):

- Average frequency
- Start frequency
- Stop frequency
- Frequency excursion (MHz/uSec)
- Frequency deviation (MHz or GHz)

Pulse Amplitude Measurements (default setup):

- Start time
- Amplitude peak dBm
- Amplitude start dBm
- Amplitude stop dBm
- Amplitude droop dB

Evaluate Long Term Analysis and Zoom into Problem Areas

Long term trend analysis of signals and waveforms can easily be evaluated using the OSA software. The left plot in Figure 4 shows pulse power vs. time measurements being performed on the 1st, 35th, and 50th pulses, and overlaid on the same display so that potential trend analysis issues can easily and quick be identified. Any of the measurements supported by the OSA software can be conveniently displayed in this manner to identify potential long term trend issues.

Figure 4. Left plot shows comparing the pulse power vs. time for the 1st, 35th, and 50th pulses overlaid on same display to identify long term trends. Right plot shows the power (yellow trace), frequency (green trace), and phase (blue trace) of pulse #12 overlaid on same display.

If an issue has been identified, the OSA's powerful display capability can be configured to zoom in and view multiple characteristics of a single pulse overlaid in a single display to diagnose issues. For example, the right plot in Figure 4 has been configured to view the amplitude, frequency, and phase of pulse number 12 with the traces overlaid in a single display

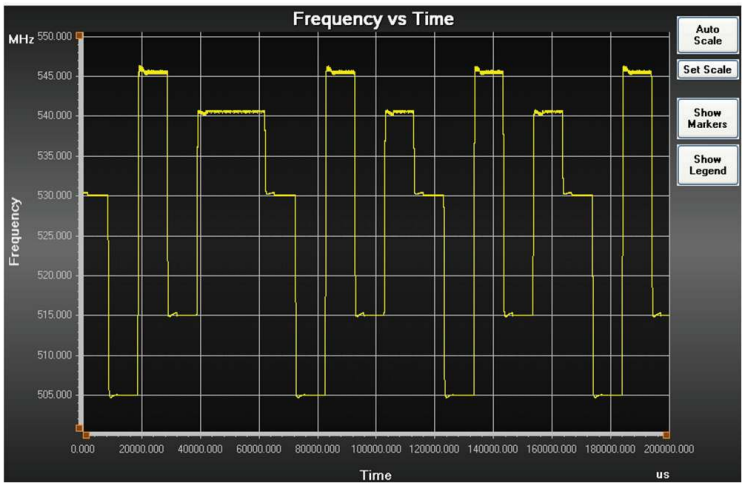
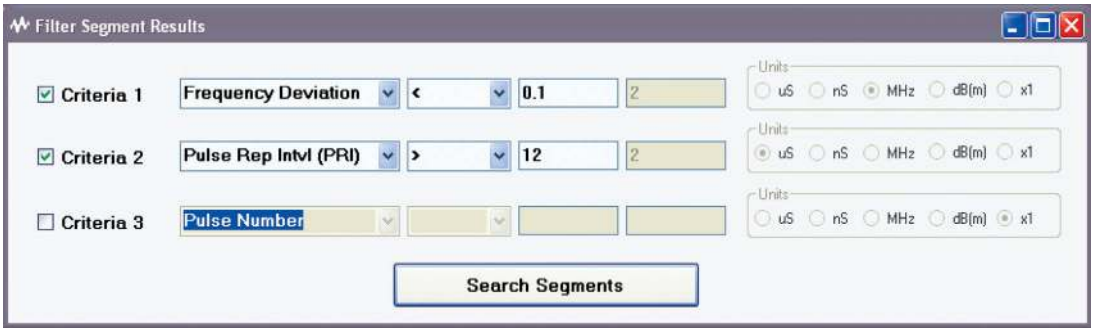


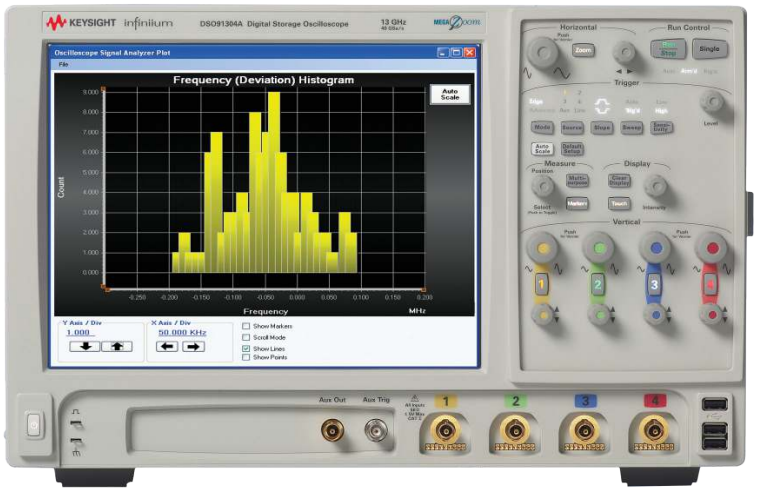
Figure 4a. 200 ms capture of a hopping CW signal. Frequency hop pattern and dwell time can be measured.

Setup Search Criteria and Histograms to Gain Insight into System Performance

Analyzing hundreds or possibly thousands of pulses to gain insight into a system performance issue or an event that may have occurred during field testing can be a challenging and daunting task. The OSA software enables you to quickly operate on the measurement data and display it in a manner that can help you to isolate issues which may have occurred during testing.

Search criteria can be set up with logical Boolean operators to sort and display the data dependent on user-defined characteristics. For example, in Figure 4, search criteria have been set up to only select and display Radar V chirp pulses with a frequency deviation less than 100 KHz and a pulse repetition interval greater than 12 microseconds. A histogram display conveniently shows the frequency deviation of the Radar pulses which met these criteria as the x-axis, and the number of pulses counted for each frequency deviation is displayed as the y-axis.





Sort through and view only pulses with a diviation of <100 KHz and with PRI of >12 µS. Then plot a histogram of filtered results

Instrument Configuration Recommendations

Instrument Model	Bandwidth	Max Sampling Rate	Max Memory Depth	Recommended Options
DSO9404A	4 GHz	20 GS/s	1 Gpts	500
DSO91304A	13 GHz	40 GS/s	1 Gpts	01 G
DSOX91604A	16 GHz	80 GS/s	2 Gpts	02 G
DSOX92004A	20 GHz	80 GS/s	2 Gpts	02 G
DSOX92004A	20 GHz	80 GS/s	2 Gpts	02 G
DSOX92504A	25 GHz	80 GS/s	2 Gpts	02 G
DSOX92804A	28 GHz	80 GS/s	2 Gpts	02 G
DSOX93204A	32 GHz	80 GS/s	2 Gpts	02 G

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