



Command the EM Spectrum with Design, Simulation, and Test Solutions

Achieve Mission Superiority in the Invisible Battlespace

Controlling the electromagnetic (EM) spectrum is now mission critical. Electronic warfare (EW) systems must operate in congested and contested environments, so the systems must be able to detect, identify, and locate radio-frequency (RF) emitters with speed and precision. Prevailing in EM spectrum operations (EMSO) requires you to confront new challenges, such as the availability and accessibility of sophisticated electronic-warfare (EW) technologies leading to new threats and foes.

The Keysight Electronic Warfare Advanced Simulation Platform (EWASP) enables users to evaluate and enhance defense systems against simulated electronic threats, supporting operations in diverse environments such as research and development (R&D), system integration, hardware in the loop (HIL), open-air ranges, installed system test facilities, and reprogramming and operational verification labs, as shown in Figure 1. By delivering versatile solutions across multiple levels of test, the platform reinforces your systems' ability to identify, defend, and protect your personnel and assets.



Figure 1. Keysight EWASP enables users to evaluate and enhance defense systems against simulated threats, supporting operations in diverse environments such as early integration, open-air ranges, integrated system test facilities, and operational verification centers.

Speed, Scale, and Adapt EW Test

With the rise of machine learning (ML) and artificial intelligence (AI), threats are increasingly dynamic, changing behavior based on scenarios. The spectrum environment also grows increasingly congested, making it more difficult for missions to succeed. As the EW threat environment continues to evolve, confidence and reliability in EW system validation and verification relies on modernizing and enhancing the test and evaluation process.

To adapt to changing demands, such as testing in congested and contested environments, EW simulation and test systems now support complex, high-fidelity models for increased realism. The growing demand for multi-ship/sensor fusion drives the need for open, scalable, and flexible architectures to address multi-domain test requirements. Modern EW test labs also address the problem of costly and complex live fire tests, providing fidelity and accuracy by simulating multiple missions per day.



Built from commercial off the shelf (COTS) components, EWASP delivers flexible, scalable threat simulation and analysis driving realistic, mission-relevant testing. The platform comprises the following:

- SimulationView EW threat simulation software
- RF signal generators (Keysight VXG-C, UXG)
- automated angle of arrival (AoA) normalization
- multi-channel phase-coherent analysis [typically Keysight UXR oscilloscope with Vector Signal Analysis (VSA) 89600 software]

The solution helps you accelerate EW test from digital through RF, testing EW receivers with high-density, complex simulations and stimulating RF front ends with up to 8 pulse on pulse out of a single port. You also can scale from benchtop to integrated, multi-port, high-density AoA threat simulation. At the heart of these capabilities is Keysight's SimulationView EW threat simulation software, shown in Figure 2.



Figure 2. With four ports, this benchtop threat simulation solution can generate up to eight pulse on pulse or other signal types with four AoA ports to 20 GHz.

Start with Software to Create Realistic Threat Environments

You can use the Keysight SimulationView EW threat simulation software to create very complex, high-fidelity threat environments. SimulationView handles scenarios ranging from one versus one to one versus many or many versus many, as shown in Figure 3. Engineers can simulate large, complex, densely populated environments that mimic realistic threat situations. The software provides real-time kinematics modeling, propagation effects, and integration with external interfaces, such as a navigation data bus input.

To build high-impact, real RF testing scenarios for mission success, SimulationView enables you to emulate the complexity of real-world RF environments using the following:

- simple pulse trains to reactive modern threat models
- different depth of pulse-on-pulse cases
- time difference of arrival (TDOA), frequency difference of arrival (FDOA), amplitude, and phase interferometry direction finding (DF)/geolocation high-density environments (millions of pulses per second)
- import of emitter definition from legacy threat databases
- in-phase/quadrature (I/Q) pulse waveform import
- high-fidelity antennas with 360 spherical model

SimulationView is a plugin-based open architecture. Engineers can use plugins for specific test use cases including:

- automated emitter and RF verification
- threat library import
- mission data validation
- open air range test and synchronization
- government-specific use cases
- custom plugins

The SimulationView open architecture enables real-time, dynamic pulse descriptor word (PDW) streaming and control of Keysight RF Stimulus solutions, as well as the ability to time synchronize other test assets for specific mission requirements. The distributed interactive simulation (DIS) protocols enable synchronization with mission planning simulations and third-party test and simulation tools.

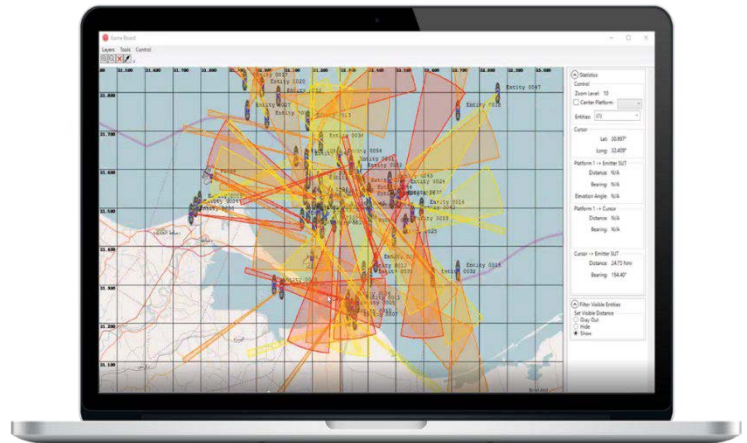


Figure 3. Keysight's Z9500A SimulationView software evolves with the EW development lifecycle, providing a modular, scalable foundation supporting early software-in-the-loop testing through full-scale HIL validation.

Achieve Flexible and Scalable RF Signal Generation

Keysight's COTS RF signal generators integrate seamlessly with the SimulationView software environment, as shown in Figure 4. Users can build, scale, and adapt threat simulations to match program needs, whether supporting lab-based software development, HIL validation, or operational EW system level test and evaluation. In addition, users have the flexibility to integrate EWASP RF signal generator hardware with proprietary or government-owned software, including the U.S. government NEWEG architecture.



Figure 4. By combining Keysight VXG-C and UXG signal generators with UXR oscilloscopes and analysis software, Keysight EWASP provides a synchronized ecosystem combining simulation, stimulus, and verification.

Engineers can easily integrate Keysight RF signal generation solutions into the EWASP platform for scalable and reconfigurable RF stimulus options. For example, the Keysight UXG X-Series and Keysight M9484C VXG-C RF vector signal generators are powerful building blocks addressing all types of EW simulation. Using Keysight proprietary digital-to-analog converters (DACs), they help you do the following:

- Perform direct digital synthesis (DDS) to update frequency, amplitude, and phase in nanoseconds with built-in phase repeatability.
- Create linear and nonlinear chirps with complex pulse modulation.

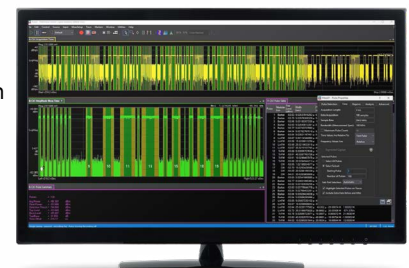
- Generate up to 8 pulse-on-pulse scenarios with one RF output as shown in Figure 5.
- Support frequency agility across operating range/ source.
- Integrate communications, I/Q waveforms, and noise interferers.
- Produce a high-density scenario with millions of pulses per second via PDW streaming.
- Set up multi-box synchronization for AoA simulations.

Figure 6 shows different ways to configure the RF signal generators. Because Keysight's signal generators are all COTS-based, you can use them from benchtop testing through a complete, integrated EW system for challenges like high-density multi-port AoA. These integrated threat simulation solutions can be scaled and reconfigured based on individual test requirements like signal streaming and simulation.

Complex Signal Streaming

With the Keysight M9484C Vector Signal Generator Signal Descriptor Word (SDW) interface, an extension of PDW, users can stream complex signal types to each RF output. Every RF output on the source can generate up to eight simultaneous signals out of one RF output port. These signals are independently controlled within the 2.5-GHz bandwidth. Examples include agile pulsed signals, communication interferers, and continuous wave signals. Engineers can scale this approach to four RF output ports in one instrument and up to 20 GHz for AoA or independently tuned outputs.

Figure 5. By creating configurations for maximum signal generation flexibility, allowing signals to overlap in both time and frequency, engineers can use the same asset for multiple test cases.



Integrated Threat Simulation

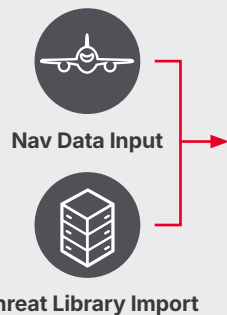
With automated and in-situ normalization, you no longer need to disconnect from the system under test (SUT), enabling accurate, fast, and stable AoA normalization across amplitude, phase, and time. You can use these solutions in distributed environments, such as on various test ranges or across multiple labs. With the same hardware/software EWASP architecture, engineers can address five use cases: R&D, close loop, installed system test facility (ISTF), operational verification, and open air range.

Built on a flexible, modular architecture, each system can be configured to meet a range of mission-specific test needs, from simple emitter emulation to complex multi-port, multithreat scenarios.

Key features for EW threat simulation include:

- modular, scalable design adaptable to evolving mission needs
- multi-port AoA simulation with synchronized phase and timing
- dense, multi-emitter environments with overlapping pulse-on-pulse generation
- hardware-in-the-loop integration for real-time signal injection into the system under test
- seamless interoperability with Keysight EWASP software and VXG-C and UXG signal generators
- proven reliability across laboratory, chamber, and range environments

Test Environment Software



Keysight
SimulationView

Government or Proprietary
Scenario Control Software

Scalable Tx & Reconfigurable Hardware

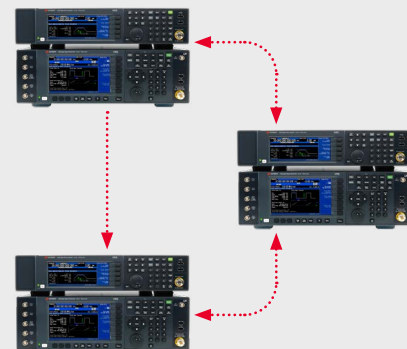


Figure 6. Configurations for Keysight EWASP can scale from software-only environments to high-density, multi-port, RF hardware-driven labs, reusing the same core scenario and data models throughout.

Verify Threat Simulators with RF Pulse Analysis

EWASP supports engineers in verifying proper operation of EW signals. As EW system bandwidths and frequencies continue rising, systems require a solution with ultra-wide bandwidth across the entire EM spectrum of operations. Wider bandwidths increase the amount of data captured, making memory efficiency a priority. Engineers need to quickly validate system performance to lower the time from test to operational readiness. Using a high-bandwidth oscilloscope with a threat simulator, you can look at actual EW signals, such as those from a jammer, to validate operation.

EWASP analysis capabilities enable multichannel phase-coherent measurements for complex pulse analysis, AoA validation, and jammer analysis. An example is testing a radar warning receiver's (RWR) ability to determine the direction of a threat. Engineers can check a threat simulator's output signals with AoA characteristics, such as delta phase between ports, before driving signals into the RWR. This capability leverages the Keysight UXR oscilloscope shown in Figure 7, which also can be used to look at actual EW signals, such as those from a jammer, to verify proper operation.



Figure 7. Using threat simulation software with a high-bandwidth oscilloscope like the UXR provides an effective approach to RF pulse analysis.

With a sample rate to 256 Gsamples/s per channel, engineers can capture ultra-wide bandwidth signals across the entire spectrum of operations simultaneously on all four channels from DC to 110 GHz. To further take advantage of this ultra-wide bandwidth, a multichannel digital downconverter (DDC) is available on each channel to reduce the effective data rate for faster measurements.

Each channel's DDC can have its own independent bandwidth to capture more of the signals of interest and less noise. The multichannel DDC can operate up to 2.16 GHz per channel and is tunable across the entire DC to 110 GHz frequency range. This allows for signal capture and analysis spanning from UHF, L, S, C, X, through K band and beyond.

With segmented memory capture, the EWASP UXR solutions capture "on" time of pulses without wasting memory on deadtime between pulses. Variable-length capture allows you to capture pulses with varying widths and pulse repetition intervals (PRIs). Because the solution is hardware based, it enables virtually zero re-arm time.

The pulse analysis solution supports:

- time/frequency domain measurements
- phase measurements
- automatic pulse parameterization
- modulation on pulse detection
- emitter identification
- pulse train recognition
- statistics

Gain More Insight from Pulse Analysis

Additional measurement features, specifically designed for radar/EW, provide more insight and capabilities for both pulsed and advanced radar. With comprehensive radar analysis of FM linear chirp, frequency hopping, or pulsed RF signals in the time, frequency, and modulation domains, engineers can better assess their system performance against real-world threats.

With pulse modulation analysis and pulse accuracy spanning hundreds of instruments, as shown in Figure 8, engineers can efficiently store RF pulses with variable-length segmented capture and real-time digital downconversion. They can leverage multi-channel and multi-emitter support for further analysis while supporting constant phase, frequency, or chirp rate within an RF burst.



Figure 8. To improve operation planning and support, advanced pulse modulation analysis and comprehensive pulse accuracy can span hundreds of instruments.

Using a “de-interleaving” analysis mode, an EW engineer may add up to 90 emitters and have them color-coded and appropriately labeled in pulse tables, as shown in Figure 9. Once the emitters have been identified, the system recalculates the following from an emitter-centric perspective: pulse-repetition frequency (PRF), PRI, Duty Cycle, and Off Time. This feature allows engineers to gain more insight from timing analysis of the emitters.



Figure 9. De-interleaving analysis mode allows engineers to add up to 90 emitters.

For jammer characterization, engineers benefit from being able to chart the effect of a technique across hundreds or even thousands of pulses. Users achieve this step by measuring the phase of a pulse relative to many more choices than the local-oscillator phase. An example is tabulating phase relative to some reference pulse, which may be specified as any selected pulse on any measurement channel, as shown in Figure 10. All pulse-to-pulse phase and frequency differences may then be tabulated relative to that chosen pulse.



Figure 10. Shown is an example of pulse difference tables for a phase measurement reference selection.

In real-world environments, multiple emitters often operate simultaneously. These overlapping pulses can appear as a single, merged signal or “blob” on an RF magnitude versus time plot. With pulse collision analysis, engineers can accurately identify and differentiate between signals that overlap in time. Using advanced signal processing techniques, engineers can separate these overlapping signals to accurately determine key metrics such as pulse width, PRI, frequency, and amplitude, as shown in Figure 11.



Figure 11. Pulse collision analysis enables users to differentiate between friendly, neutral, and hostile emitters, even when their signals overlap.

With the ability to define and score up to 16 different pulse trains, engineers can define new trains out of existing trains, as shown in Figure 12. This capability greatly increases the flexibility and lengths of trains possible, while the train similarity score enables emitter verification workflows.



Figure 12. With pulse train search, users can define new trains out of existing trains.



CONCLUSION

Prevail Into the Future in Congested, Contested Environments

As threats continue to evolve and the spectrum gets increasingly crowded, uncertainties multiply and escalate. To defend and protect your assets, you need a flexible, scalable approach to EW test. Testing EW systems and components requires simulating real-world threat scenarios. The Keysight EWASP platform enables users to evaluate and enhance defense systems against simulated electronic threats, supporting operations in diverse environments such as open-air ranges, integrated test facilities, and operational verification centers. Defense personnel benefit from realistic training scenarios, ensuring preparedness for live engagements. EWASP ensures adaptability, readiness, and superiority in EW test and evaluation.

By aligning EWASP with broader EMSO capabilities, Keysight provides solutions with higher realism and tighter interoperability. Increase confidence in your ability to detect, classify, defend, and triumph in the electromagnetic battlespace with EWASP.

Additional Resources

For more information on EW solutions:

[EMSO Solutions Page](#)

[Electronic Warfare Advanced Simulation Platform Solution Brief](#)

[Simulation View Software – Technical Overview](#)

[Signal Generator for High Density Electronic Warfare Simulation – Technical Overview](#)

[VSA Radar Pulse Analysis for Electronic Warfare](#)

[X-Series UXG Signal Generators](#)

[Find out more about Keysight's solutions for Aerospace Defense by visiting our site.](#)



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