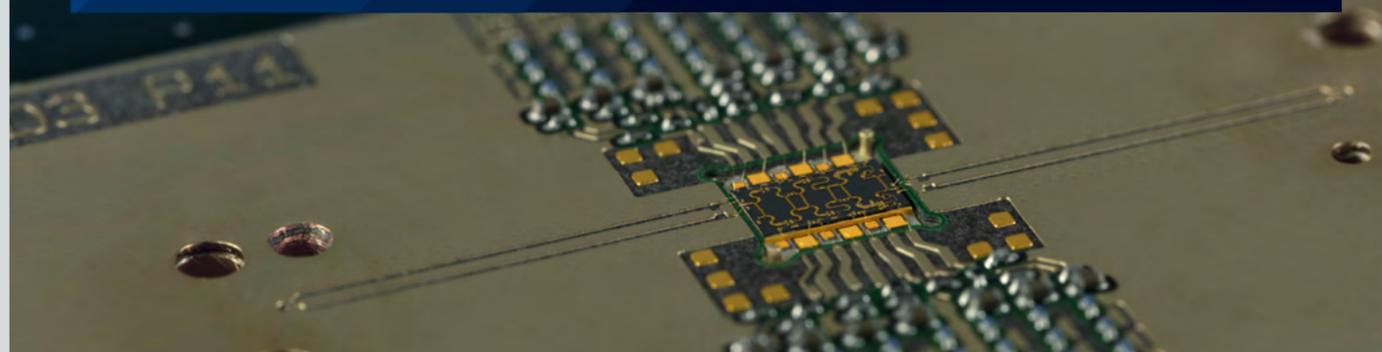


# FLEXIBLE DEBUGGING OF MODERN RADAR AND EW SYSTEMS.

Improving measurement flexibility to address evolving test challenges



Modern radar and electronic warfare (EW) architectures are showing a multitude of technological advancements that raise the need for more flexible testing approaches. Originally a purely analog domain, radar and EW modules are getting more and more integrated and exhibit a variety of digital interfaces, especially with the extensive adoption of advanced digital signal processing (DSP) techniques for a fast and accurate signal analysis.

When characterizing and debugging their designs, developers of such systems often look for versatile instruments that can handle both their RF and digital test requirements and reduce the test effort and costs. In this context, the R&S®RTP high-performance oscilloscope represents a good fit by combining powerful RF signal analysis capabilities with a large set of features for signal integrity and digital interface test.

## Precise characterization of multi-antenna designs

Sophisticated radar systems are increasingly relying on electronically steered phased array antennas. To characterize these types of systems, test equipment must exhibit multichannel capabilities and ensure that all channels are constantly phase-coherent. Rohde&Schwarz oscilloscopes are very well suited in this case since they provide multiple channels that are by design tightly aligned and do not need any additional calibration before performing multichannel phase-coherent measurements. The R&S®RTP oscilloscope can fully address this kind of measurement. In order to achieve the best possible phase accuracy, the R&S®RTP oscilloscope is also capable of measuring the channel-to-channel skew and compensating it across the entire signal path between the device under test (DUT) and the oscilloscope channel inputs by using the R&S®RTP-B7 high-accuracy differential pulse source option to generate the calibration signals.



## Leading-edge multichannel pulse analysis capabilities

Besides the characterization of multi-antenna designs, phase coherence has a crucial role when modulated pulsed signals have to be analyzed in relation to each other.

Figure 1: The R&S®RTP oscilloscope

One of the most prominent examples is the digital radio frequency memory (DRFM) jamming technique, where the jammer is capable of receiving the original radar signal and creating a fake radar echo representing a false target that the transmitting radar cannot distinguish from other legitimate signals. For this purpose, the retransmitted false targets have to maintain coherence with the original signal. This can only be validated when both the original and retransmitted pulses are analyzed in relation to each other. The R&S®RTP oscilloscope allows a phase-coherent analysis of both signals in time and frequency domains. With an internal analysis bandwidth up to 16 GHz, it even offers the RF hopper analysis for frequency-agile radars over a relatively wide bandwidth, to verify if the DRFM is following that agility.



Figure 2: Analysis of retransmitted echo in relation to the original pulse with the R&S®RTP oscilloscope onboard-tools. Changes over time can be tracked in both time and frequency domain

The detection accuracy of the pulses is greatly improved by the advanced trigger system of the R&S®RTP oscilloscope. All Rohde&Schwarz oscilloscopes have the particularity, that their trigger system is fully digital so that it operates directly on the samples of the A/D converter. The measurement signal is not split up into two paths as for conventional analog triggers. Therefore, the impairments of an analog trigger system are eliminated by design. This results in a lower trigger jitter and a flexible trigger sensitivity that can be optimized depending on the actual needs.

For a more in-depth analysis of the pulses, The R&S®RTP oscilloscope can be combined with the R&S®VSE vector signal explorer software, a powerful analysis tool for a variety of signals. The R&S®VSE software has the unique capability of providing the R&S®RTP oscilloscope trigger system full support without any limitations regarding the trigger types or parameters. This allows for a flexible optimization of the trigger settings to get a stable and reliable trigger condition of the signal of interest, and leads to a better measurement performance, especially when irrelevant signal portions, such as off-times, have a significantly larger duration than the pulses/pulse sequences.

Considering the DRFM example, the R&S®VSE-K6A multichannel pulse analysis option delivers a comparison of pulse parameters and statistics over multiple channels. This allows a comprehensive analysis of the DRFM retransmitted pulse changes over time with respect to the original signal.

## A single solution for all digital design test needs

Current digital testing needs (including signal integrity, high-speed digital interface and memory tests) are gaining more importance for the prototyping and validation of radar and EW designs. This is increased by the intensive use of DSP blocks for real-time signal processing and the current trend that is going towards the deployment of wideband converters as close as possible to the antennas and relying on advanced digital technologies for beamforming and beam steering. Oscilloscopes represent the tool of choice for such measurements. For example, the R&S®RTP offers a wide range of signal integrity functions (such as eye diagram and jitter analysis). Additionally, it provides a variety of digital interface and memory test solutions for multiple standards (e.g. PCIe and DDR) and for aerospace and defense specific buses (e.g. MIL-STD-1553, ARINC 429 and SpaceWire).

Combined with its RF multichannel analysis capabilities, it becomes clear that the R&S®RTP oscilloscope represents a general-purpose solution that is best suited for debugging complex systems by providing research and development and validation engineers with an all-in-one solution to help characterize their prototypes from the RF frontend up to the bitstream.



Figure 3: In-depth analysis of the retransmitted pulse echo (channel 3) in relation to the original pulse (channel 1) with the R&S®VSE-K6A multichannel pulse analysis option

## Rohde & Schwarz offers:

- ▶ Analysis bandwidth up to 16 GHz
- ▶ Advanced fully digital trigger system supporting the full instrument bandwidth
- ▶ Dedicated multichannel pulse analysis tool
- ▶ Wide range of digital design measurement functions
- ▶ Unrivaled update rate of 750000 waveforms/s

- ▶ Versatile solution than can handle both RF and digital test requirements

For latest information on Rohde&Schwarz solutions, visit: [www.rohde-schwarz.com/aerospace-defense/radar-component-testing](http://www.rohde-schwarz.com/aerospace-defense/radar-component-testing)



## Webinar: Analyzing multichannel phase-coherent radar signals

This webinar explains the importance of phase-coherent measurements in a variety of real-world use cases and presents relevant Rohde&Schwarz solutions needed to perform them.

Watch our webinar at:

[www.rohde-schwarz.com/aerospace-defense/multichannel-pulse-webinar](http://www.rohde-schwarz.com/aerospace-defense/multichannel-pulse-webinar)