

QUALIFICATION OF MULTI-CHANNEL DIRECTION FINDING RADAR RECEIVERS IN THE LAB



Kongsberg Defence & Aerospace selects a radar test setup from Rohde & Schwarz based on the R&S®SMW200A vector signal generator for high-performance multi-channel, phase-coherent radar signal generation.

At a glance

Kongsberg Defence & Aerospace AS is Norway's premier supplier of defense and aerospace-related solutions. The joint strike missile (JSM) is a 5th generation long-range precision strike missile. Using advanced sensors, the JSM can locate targets based on their electronic signature. Kongsberg selected Rohde & Schwarz as a radar test equipment vendor because of their proven high quality instrumentation, hands-on customer support and flexible solutions to unique test and measurement challenges.

Summary

- ▶ **Customer:** Kongsberg Defence & Aerospace, Kongsberg, Norway
- ▶ **Task:** Testing direction finding radar receivers on highly dynamic platforms
- ▶ **Challenge:** Phase-coherent radar signal generation for multiple RF channels based on pulse descriptor words (PDWs)
- ▶ **Solution:** Test system based on the R&S®SMW200A vector signal generator
- ▶ **Benefits:** High-speed PDW streaming, automated amplitude, delay and phase calibration, excellent price/performance ratio and product support

Case Study | Version 01.00

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Application description

Kongsberg's Joint Strike Missile must operate autonomously in highly contested environments. To increase mission success, the missile has a passive RF sensor that can locate and identify radio frequency emitters. To test and verify this RF direction finding capability in a laboratory, Kongsberg required a multi-channel phase coherent vector signal generator that could be linked to existing test environments.

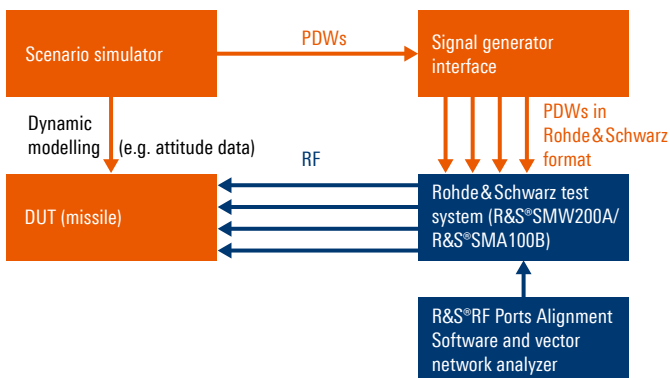
The Rohde&Schwarz test system can simulate multiple emitters in a dynamic environment in real time, enabling Kongsberg to perform closed-loop testing of the missile system with the passive RF sensor and enabling massive amounts of integrated system testing on the host hardware, without costly flight tests and with a high level of repeatability.

Test tasks, challenges and requirements

To test direction finding receivers effectively and efficiently, the test system must meet the following requirements:

- ▶ Test system RF outputs must be connected to the receiver antenna inputs; a separate signal must be provided for each input, so the test system has an independent signal source for each simulated antenna.
- ▶ The test system must be calibrated at the RF interface for exact adherence to the relative amplitudes and phases between the channels.
- ▶ The phase relationships between the simulated signals must remain stable during simulation (phase coherence).
- ▶ Test systems for multichannel applications are often operated in a hardware-in-the-loop (HIL) environment; high update rates and low latencies are essential, because a computer feeds signal data into the test system at high speeds.

Overview of a closed-loop simulation environment for testing direction finding radar receivers on a highly dynamic platform



Test solution

Test system overview

The test system includes a scenario simulator that generates pulse descriptor words (PDWs). The PDWs are the basis for generating corresponding RF signals that are then fed to the device under test (DUT).

Scenario simulator

Kongsberg developed an in-house real-time simulation environment that can accurately replicate all aspects of a missile flight. The simulator can generate PDWs for a large number of simultaneous emitters, taking into account positions, attitudes, antenna patterns and propagation. Integration of the Rohde&Schwarz test system closes the loop by generating accurate RF incident signals identical to those at the receiver inputs.

Signal generator interface

Time-synchronized PDWs are sent to the Rohde&Schwarz test system. The PDWs include the phase and amplitude response of the antennas along with other parameters.

Multi-channel radar simulation

The main components of the Rohde&Schwarz test system include two coupled R&S®SMW200A vector signal generators (VSG) and an analog R&S®SMA100B signal generator for the local oscillator (LO) signal. Using a common LO source together with the advanced clock distribution concept of the VSGs ensures accurate, stable and repeatable simulations of relative amplitude, phase and group delay offsets between the RF ports at the reference plane for the DUT input, as required for precise AOA simulations.

RF port alignment

R&S®RF Ports Alignment Software runs predefined and optimized alignment routines for RF signals at the reference plane. RF frequencies, used bandwidth and level range for alignment are configured for the test case. The software together with a network analyzer automatically determines the correction coefficients for all RF ports and loads the data to the Rohde&Schwarz test system.

DUT

The DUT may be the RF sensor or a portion of the sub-system running true operational software on real flight hardware.

“Rohde & Schwarz was able to offer a system that not only has excellent phase coherence, but also provided a flexible and scalable solution where Kongsberg was able to integrate the signal generator in an existing closed-loop simulation environment.

Erik Narverud, Team Manager Passive RF Sensor System Integration at Kongsberg

Integrated test solution

The multi-channel radar test system used by Kongsberg is a four RF channel system. It has two general-purpose, high-end R&S®SMW200A vector signal generators providing radar signals to the DUT, an analog R&S®SMA100B signal generator for LO distribution and a Rohde & Schwarz vector network analyzer (VNA) for measuring the required corrections for the RF port alignment process. All instruments are integrated into a rack for a compact and transportable advanced testing solution when phase-coherent radar signals are required.



Four-channel radar test system consisting of two R&S®SMW200A vector signal generators, an analog R&S®SMA100B signal generator providing the LO signal and a Rohde & Schwarz vector network analyzer for the automated RF port alignment.

Customer benefits

Upgradability

Additional RF channels or simulation features can easily be retrofitted with purchased hardware components or software licenses.

Long-term phase stability

Thanks to the advanced clock distribution and LO coupling mechanism, the relative phase between multiple RF ports remains stable not just for hours, but days.

Repeatable scenarios

Predefined, optimized and automated calibration routines ensure highly repeatable scenarios independent of frequency bands, signal power levels and bandwidths.

Commercial-off-the-shelf hardware

Since the RF hardware is based on general purpose vector signal generators, users have fast delivery times and worldwide service support.

Reusability

Since the equipment is commercial off-the-shelf, all instruments can be used for other applications, testing and projects by extending their signal generation capabilities with application-specific software licenses.

About Kongsberg Defence & Aerospace

Kongsberg Defence & Aerospace is Norway's premier supplier of defense and aerospace systems and solutions. The company is a leading supplier of defense products and systems for command and control, surveillance, space, tactical communications, remote weapon stations and missiles systems. Kongsberg Defence & Aerospace also has extensive capabilities in advanced composite manufacturing and maintenance, repair and overhaul for the aircraft and helicopter markets. Kongsberg Defence & Aerospace has a long and proud history – from its founding in Norway in 1814, to the international corporation of today, the company has always provided innovative technology.



KONGSBERG

Service that adds value

- ▶ Worldwide
- ▶ Local and personalized
- ▶ Customized and flexible
- ▶ Uncompromising quality
- ▶ Long-term dependability

Rohde & Schwarz

The Rohde&Schwarz technology group is among the trailblazers when it comes to paving the way for a safer and connected world with its leading solutions in test & measurement, technology systems and networks&cybersecurity. Founded more than 85 years ago, the group is a reliable partner for industry and government customers around the globe. The independent company is headquartered in Munich, Germany and has an extensive sales and service network with locations in more than 70 countries.

www.rohde-schwarz.com

Sustainable product design

- ▶ Environmental compatibility and eco-footprint
- ▶ Energy efficiency and low emissions
- ▶ Longevity and optimized total cost of ownership

Certified Quality Management
ISO 9001

Certified Environmental Management
ISO 14001

Rohde & Schwarz training

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