Better than real life: radar echoes from a target simulator

Until recently, radar sensor development was one of the automotive industry's last remaining electronics fields without realistic lab and production testing. It was simply not feasible to simulate reproducible scenarios with multiple moving and static targets at greatly varying distances in the confines of a building. With the ARTS9510 automotive radar target simulator, these tests are simplicity itself.

Radar sensors are key components in advanced driver assistance systems (ADAS) and have made possible an entirely new class of in-vehicle comfort and safety functions within just a few years. ADAS applications such as brake and lane change assistants and adaptive cruise control take an active role in vehicle guidance and therefore play a major role in safety. The reliability requirements for these systems are correspondingly strict, and thorough field testing is required before they are launched on the market. Lab testing, however, should be conducted prior to field testing in order to anticipate all critical situations using realistic test scenarios. There is an economic reason behind this approach: test drives are costly and time-consuming, while lab tests are relatively cost-efficient, can be quickly executed and – always desirable

Fig. 1: Radar sensors are currently used in all types of vehicles. The ARTS9510 radar target simulator is the first instrument to enable flexible test setups to verify these sensors under lab conditions.

in T&M applications – can be repeated and varied under defined conditions (field-to-lab testing, FTL). The ARTS9510 radar target simulator now opens up these advantages for testing in-vehicle systems equipped with radar sensors.

For all application and radar scenarios

The ARTS9510 family was developed specifically for the automotive industry, i. e. for radars operating in the 24 GHz and 77 GHz frequency bands. Their flexible, future-ready architecture enables these instruments to do more than just handle FMCW signals. They can deal with the entire spectrum of radar technologies. Versatility is a key advantage in every respect. The instrument platform can be custom configured to match the specific use case and the radar characteristics to be covered. Variations of the simulator include both design (desktop instrument with integrated computer and graphical user interface or remotely controlled system instrument) and module configuration (frequency ranges, bandwidths, optional extensions) options. The ARTS meets all current and future requirements for simulated distances, variable target sizes (radar cross section, RCS), resolutions and object speeds. It delivers the same precision for near-range radars such as those used for parking assistants as it does for long-range systems, for which it can simulate an object at up to 2.4 km traveling at radial velocities of up to 700 km/h. Optionally it can even display the angle of arrival of moving objects.

The ARTS is right for the lab and the production line. The horn antenna (optionally, bistatic operation is possible with two antennas for greater dynamic range) can be placed on the rear, side or bottom panel of the instrument, making it possible to configure convenient desktop test setups as well as horizontal and vertical assemblies in test chambers (Fig. 2). Installing a microwave transceiver for either horizontal or vertical signal polarization creates an additional degree of freedom. And if these options are not enough, the highly compact (approx. the size of a matchbox) transceiver module can be detached from the simulator for remote operation. This dramatically expands its range of applications, for example, in EMC chambers.

Holistic approach: the ARTS as a component of HIL systems

The trend toward autonomous vehicles will continue to generate increasingly more and demanding test cases to cover the complexity of real-life situations in the most comprehensive way possible. It is no longer enough to generate and analyze signal traffic via wired bus systems (CAN, FlexRay, LIN, etc.). On the contrary, realistic system simulation requires all control loops to be closed via the RF connections involved (GPS, radar, C2C, eCall, etc.). Hardware-in-the-loop (HIL) systems for these simulations must also be outfitted with various

Fig. 2: ARTS9510 designs and operating modes: desktop model with touchscreen user interface and rear-mounted antenna; system instrument with side or floor-mounted antenna.

Sample automotive radar test setup

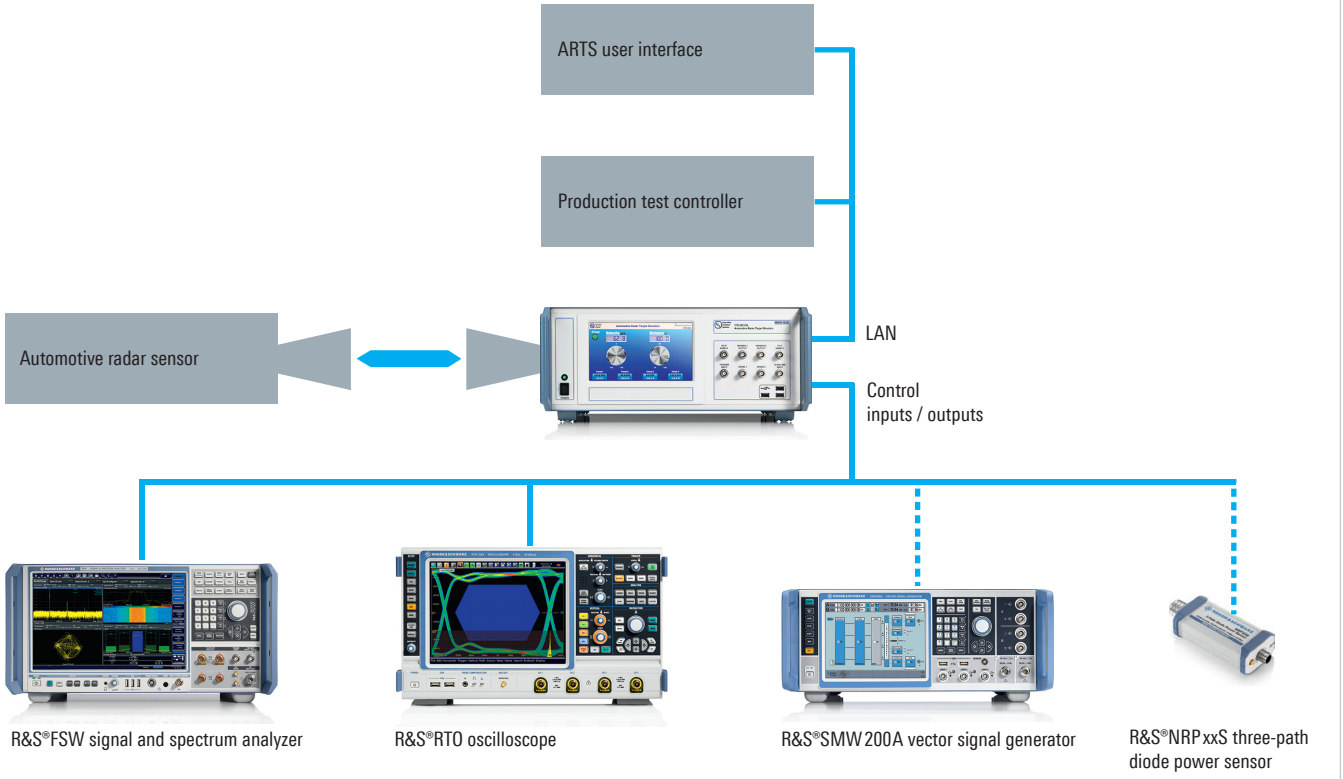

Fig. 3: The ARTS9510 target simulator in a sample setup with additional test instruments: signal and spectrum analyzer with radar analysis software, oscilloscope for signal visualization, signal generator for signal effects, power sensor for precise measurement of transmit power.

air (wireless) interfaces, and the ARTS offers such a realtime-capable interface. All other interfaces are available from the Rohde&Schwarz T&M instrument portfolio. The radar target simulator itself is a compact, modular and flexible toolbox enabling test engineers to use the included DLL/API libraries to develop their own signal and control routines and generate, for example, nonlinear velocity profiles. As an additional feature, test engineers may use the simulator's large memory depth to program long-time (20 to 30 minutes, depending on the number of target parameters and their rate of change), multitarget scenarios and assign individual dynamic ranges to each target.

An IF control output allows users to analyze the received signal with external test instruments. Fig. 3 shows possible extensions for examining radar signals more thoroughly. The combination with the R&S®FSW signal and spectrum analyzer provides an especially comprehensive image. While the ARTS is used primarily to assess the functionality of radar sensors and to close signal paths in HIL scenarios, the R&S®FSW enables exact, automatic measurements of the signals themselves. This makes it possible to quickly identify possible trouble spots and optimization potential in sensors (see article on page 30).

Summary

The ARTS9510 represents another important developmental step in the effort to use sophisticated T&M equipment to control functionalities and comply with safety standards for increasingly complex automotive systems. Automobile manufacturers, tier 1 suppliers as well as sensor and chipset manufacturers can now use this instrument to create reproducible, reliable test conditions in every phase of the development and production process, while drastically reducing test drive costs and development times. The ARTS9510 can be upgraded to a fully configured radar technology test environment by adding other RF T&M equipment from the Rohde & Schwarz portfolio.

Udo Reil; Lutz Fischer; Volker Bach