Radar sensors on the test bench

Proper operation of radar sensors used in driver assistance systems is a safety-critical issue. Each sensor needs to be tested during manufacturing and when installed in the vehicle. A new radar echo generator plays a key role.

Radar sensor tests call for echo simulators

Radar based driver assistance systems, e.g. collision avoidance systems, rely on proper operation of their radar sensors. Whether a specific sensor in the fully assembled vehicle will correctly measure the distance, size, direction and speed of an object depends on the sensor's performance and quality and on its mounting position in the vehicle. Both aspects are relevant to safety, making functional tests necessary in sensor production at the supplier and on the vehicle manufacturer's assembly line. To assess the performance and radar compatibility of sensor radomes, Rohde&Schwarz recently launched the R&S®QAR automotive radome tester (see NEWS No. 219, pp. 24 to 29). In addition, the digital ARTS9510C automotive radar test system has been available for some time for thoroughly testing radar sensors during development, simulating in particular moving targets. Once the sensor and radome for a given vehicle model have reached the stage of production maturity with the aid of the above test equipment, all that needs to be done during series production is to verify that key parameters comply with predefined limit values.

The new R&S®AREG100A automotive radar echo generator performs these production tests conveniently and reliably (Figs. 1 and 2).

The R&S®AREG100A provides reliable testing of current and future radar sensors both in the 24 GHz ISM band and in the 77 GHz/79 GHz E band. It is made up of two components to provide a high degree of flexibility and ease of use:

1. The base unit includes all components necessary to simulate up to four objects at fixed distances, with user-definable values for radar cross section and radial velocity. When placing the order, customers can specify any four fixed distances for the simulated objects to obtain a solution matched to their test scenarios.

Fig. 1: The R&S®AREG100A automotive radar echo generator consists of a base unit and a remote frontend, which can be selected to match the radar band used.

Fig. 2: The R&S®AREG100A and the R&S®ATS1500A shielded chamber form a system solution for testing radar sensors, in particular during series production.

2. The remote frontend converts the signal emitted by the radar sensor to a lower, intermediate frequency (IF) band. The base unit generates the echoes. The signal is then converted back into the radar band and retransmitted to the radar sensor.

In the E band, the R&S®AREG100A already supports bandwidths up to 4 GHz and can simulate object distances as short as 4 meters when the user chooses an air gap of 0.8 meters between the frontend and the DUT. These capabilities make the instrument a future-proof solution for testing short range and long range radars.

Radar sensors must be resistant to interference

Until recently, mutual interference between automotive radar sensors was not considered a serious issue since only very few luxury cars were equipped with radar based driver assistance systems. Now that these systems are becoming increasingly popular in mid-size and compact cars, the situation is changing. In addition, the number of radar based systems and sensors per vehicle is growing. Both trends increase the probability of mutual interference between radar sensors. As a consequence, appropriate immunity tests need to be performed. The European Radio Equipment Directive (RED), which became effective in June 2017, and associated standards such as ETSI EN 303396 define performance requirements that need to be demonstrably complied with. To verify the robustness of radar sensors against interference, Rohde&Schwarz offers a reference solution based on the R&S®AREG100A (Fig. 3). The R&S®AREG100A frontend converts the generated echo signals, together with an interfering signal supplied by a signal generator, up into the radar band. A signal generator with an upper frequency limit of 6 GHz is adequate for this purpose.

Since RED stipulates tests with CW interfering signals only, an analog signal generator such as the R&S®SMB100B is sufficient to deliver RED-compliant signals. It is also possible to simulate more challenging interference scenarios, e.g. with FM chirp sequences, which are typically encountered in radar applications. Using simulation software such as R&S®Pulse Sequencer in combination with a vector signal generator such as the R&S®SMW200A is a good choice. Together with the R&S®AREG100A, a test setup is obtained that allows even very complex interference scenarios to be simulated.

RED-compliant characterization of radar sensors during final functional testing in production

RED also specifies an upper limit for the transmit power. The calibrated receive paths of the R&S®AREG100A make it possible to verify compliance with this limit during final functional sensor testing in production. Conversion of the radar signal from the ISM band or E band to an IF band in the R&S®AREG100A frontend considerably simplifies the test setup. To measure the equivalent isotropic radiated power (EIRP), the user simply connects an R&S®NRP8S power meter to the calibrated IF output of the R&S®AREG100A. A signal and spectrum analyzer, such as the R&S®FSW8, can be connected to another IF output of the R&S®AREG100A to simultaneously measure key parameters such as occupied bandwidth, chirp linearity and chirp duration.

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Reference solution for RED-compliant testing of automotive radar sensors

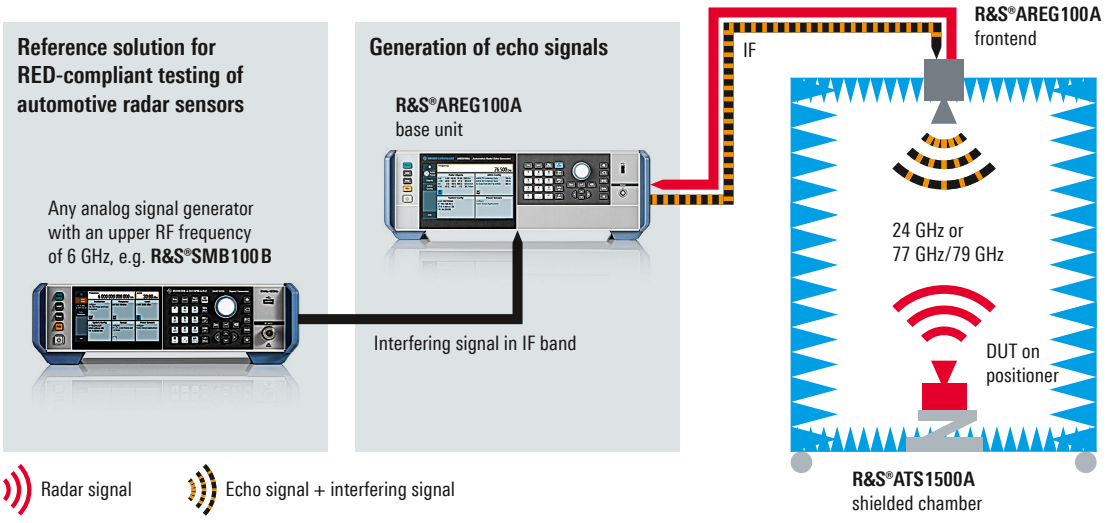

Fig. 3: RED-compliant sensor interference immunity tests can easily be performed using a setup with the R&S®AREG100A, the R&S®ATS1500A shielded chamber and an analog RF signal generator such as the R&S®SMB100B.