The number of electronic devices in automobiles has increased dramatically in recent years. They have made inroads into virtually all parts of the automobile and are no longer limited to top-of-the-range models as used to be the case. Today electronic fuel injection, airbag and ABS are the standard minimum even in a small car. Considering that some 12 million vehicles are manufactured annually in Western Europe, with about a third coming from German plants, automotive electronic modules generally rank as typical mass products. But in contrast to other mass products, very high requirements are made where functional reliability and quality are concerned. This calls for comprehensive quality assurance in production besides all the necessary measures in design and development.

The German company Kiekert, an automotive electronics supplier, specializes in locking systems and is a market leader in the field, delivering to various car manufacturers. The remote-control locking systems, consisting of a transmitter and receiver, are manufactured on several automatic production lines at the company’s plant in Düsseldorf. The signals from the remote-control unit to the receiver of the central door locking system used to be transmitted by infrared. A new production line was recently set up for units using high frequencies to transmit the signals. The electronic modules are designed in surface-mount technology and produced from panel boards. The small size means that the transmitter can be integrated into the car key.

To ensure high product quality, Kiekert chose a multistage test strategy, despite the enormous cost pressures on suppliers to the automobile industry (FIG 1). Following component insertion and soldering, modules are checked for manufacturing defects and then

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**FIG 1** Multistage test strategy for receiver module

**FIG 2** Radiocommunication Service Monitor CMS54 (bottom left) together with Universal Test System TSU used for functional testing of receivers (in EMC Test Cell S-LINE 700/P) Photo 43 027/2
undergo a functional test. Defective modules are routed to a repair station, where they are corrected and then fed back into the production process. Rohde & Schwarz was responsible for the implementation of all functional testers, repair stations and the integration of these systems into the automatic production line.

**Functional test of transmitters and receivers of remote-control locking systems**

The functional test of the receiver circuit is divided into two separate tests: the digital functional test and the RF test. During the digital functional test, all inputs and outputs at the connector are checked. The tester also downloads data to the DUT’s memory via its interface. The test system consists of Universal Test Station TSU [1] with digital test channels and a power supply for the DUT. A second test system comprising Radiocommunication Service Monitor CMS54 [2] performs the subsequent RF functional test, for which the DUT is placed in a shielded test cell (FIG 2). CMS54 tests the response and sensitivity of the receiver.

The transmitter in the key is only subjected to an RF functional test and a LED check. Again the measurements are performed in a shielded test cell. The measurements are all made within the cycle time of the production line.

**RF measurements in EMC Test Cell S-LINE 700/P**

Accurate and reproducible measurement of transmit and receive parameters is a very important requirement. To exclude interference from other transmitters, the receiver measurement has to be performed in a shielded environment. A conventional in-line fixture station could be modified so that external RFI is sufficiently damped, but the electromagnetic field within the shielded enclosure would not be homogeneous due to reflections from the installations and walls. So accurate and reproducible measurements would hardly be possible. Rohde & Schwarz solved the shielding problem with its S-LINE 700/P (a version of EMC Test Cell S-LINE 700 for use in electronics production [3]). Reproducibility of ±1 dB can thus be achieved in the frequency range 150 kHz to 1 GHz. To enable automated feed and interfacing of the DUTs, the modules are conveyed into the test cell through a bulkhead that opens and closes automatically.

Defective modules are taken to a repair station equipped with a Universal Test System TSU and a spectrum analyzer (FIG 3). This station provides all the facilities required to test transmitter and receiver modules. No parametric measurements are performed here, so a test cell is unnecessary. All functional test systems are linked to Kieker’s quality management system. This means that all data and results generated during tests can be called up at the station to support repairs.

**Ideal partnership**

Rohde & Schwarz’s wealth of experience and competence in production testing and RF measurements was the decisive factor in Kieker’s choice of the company as its partner for this application. It was possible to implement the project almost entirely with standard components from the Rohde & Schwarz product range. In contrast to an individualized solution, the required customer-specific adaptations were therefore reduced to a minimum, so the customer benefited from faster delivery, lower costs and better maintenance.

Klaus Kundinger

**REFERENCES**


Reader service card 158/09