

CASE STUDY

Automotive Radar Portable RADAR Testing Saves Time on the Assembly Line

Automotive radar technology is an indispensable part of the advanced driver-assistance systems (ADAS) that not only adds convenience but helps save lives. ADAS-connected radar modules must be precisely validated on the assembly line to deliver proper operation.

A major automotive original equipment manufacturer (OEM) faced exactly this challenge: precision validation of radar modules during the assembly line process at one of its high-volume assembly sites in the United States. Integration and testing of radar modules is part of a tightly choreographed assembly process that ensures a high-quality end product. Adding even a single step to an established manufacturing process requires months of preparation to ensure minimal impact on production time.

The OEM currently uses radar modules operating at two different frequencies, adding to the challenge. Some vehicle models utilize 77 GHz units mounted in the front for collision warning and emergency braking, and in the rear for the intelligent parking assistance and near-field navigation. In addition, most models have 24 GHz radar sensors mounted on the sides and towards the rear to provide blind-spot warnings and rear-end collision detection.



Challenge:

- Test radar units on the assembly line more efficiently
- Validating proper transmission of radar units at 24 and 77 GHz
- Eliminate line downtime due to spurious EMI on the plant floor

Solutions:

- Measuring radar and EMI signals with a Keysight FieldFox handheld microwave analyzer, 26.5 GHz (N9918A)
- Downconverting 77 GHz signals with an OML, Inc. WR12 harmonic mixer, 60 to 90 GHz

Results:

- Significant improvement in test time
- Isolated and identified EMI sources, eliminating days of regular downtime

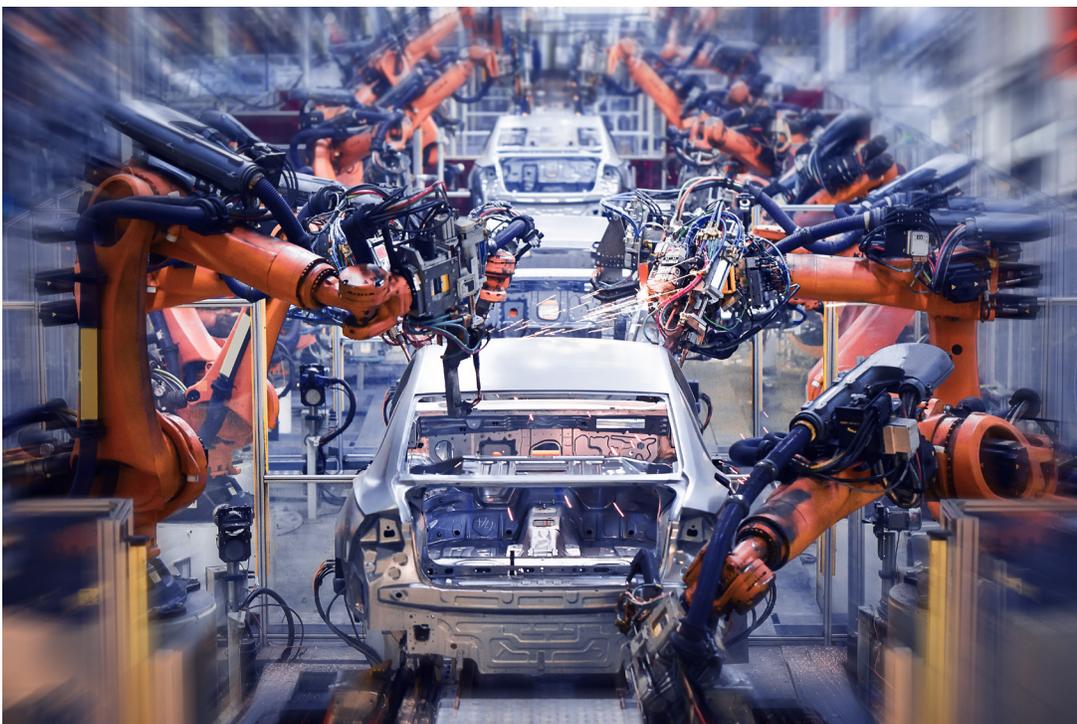


The Challenge: Testing Earlier to Avoid Costly Rework

Automotive radar requires installation of five sensors: four short-range antennas, with one at the corner of each bumper; and one longer-range antenna behind the front bumper. All require testing, and the only way to ensure proper operation is to verify the output of each one at a known distance. Crucial measurements include spectrum flatness, linearity, and phase noise.

Because the OEM uses ultra-sensitive radar sensors, precise measurements are essential to ensure high quality performance. For example, even a small mounting error could result in a 3 dB reduction in sensitivity, causing a radar module to lose 30 percent of its range performance and rendering it useless to the ADAS. Specific to the OEM's situation, the various models produced at the U.S. plant have unique mounting brackets, bumper assemblies and fascia that can adversely affect radar performance.

While trying to implement radar testing, another challenge emerged: the automation technology deployed on the assembly line was both a help and a hindrance. State-of-the-art assembly technology ensures proper and precise installation of the radar sensors. Every robotic system, especially those that weld, is a potential source of electromagnetic interference (EMI) that can affect radar measurements. Previously, quality engineers spent days trying to track down and resolve spurious emissions, slowing the production operation.



Robots and welding stations are potential EMI emitters that can disturb radar measurements

The Solution: Portable Spectrum and EMI Analysis

The OEM knew costly rework would be necessary if faults were found while checking radar functionality after a vehicle has been fully assembled. The OEM needed a new test method that would enable them to efficiently verify radar functionality earlier in the production process. The system had to cover 24 and 77 GHz radar systems as well as the entire spectrum of potential EMI issues.

Keysight engineers proposed a portable solution that is easy to move around the assembly line for verification of radar performance and detection of EMI problems. The solution included three key elements:

- Keysight N9918A FieldFox handheld microwave analyzer (26.5 GHz)
- Keysight N9918A-350 real-time spectrum analyzer (RTSA)
- OML, Inc. WR12 harmonic mixer, 60 to 90 GHz

The OEM selected FieldFox equipped with RTSA (real-time spectrum analyzer) to detect fleeting interference problems and address potential radar issues before the vehicle rolls off the assembly line (Figure 1).



“After our initial discussions with Keysight, it was clear that they shared our passion for safety and had the insight into the RF and microwave technologies we need to troubleshoot on a daily basis. It made them a logical local partner to help us improve quality and productivity.”

*Lead engineer,
OEM team*

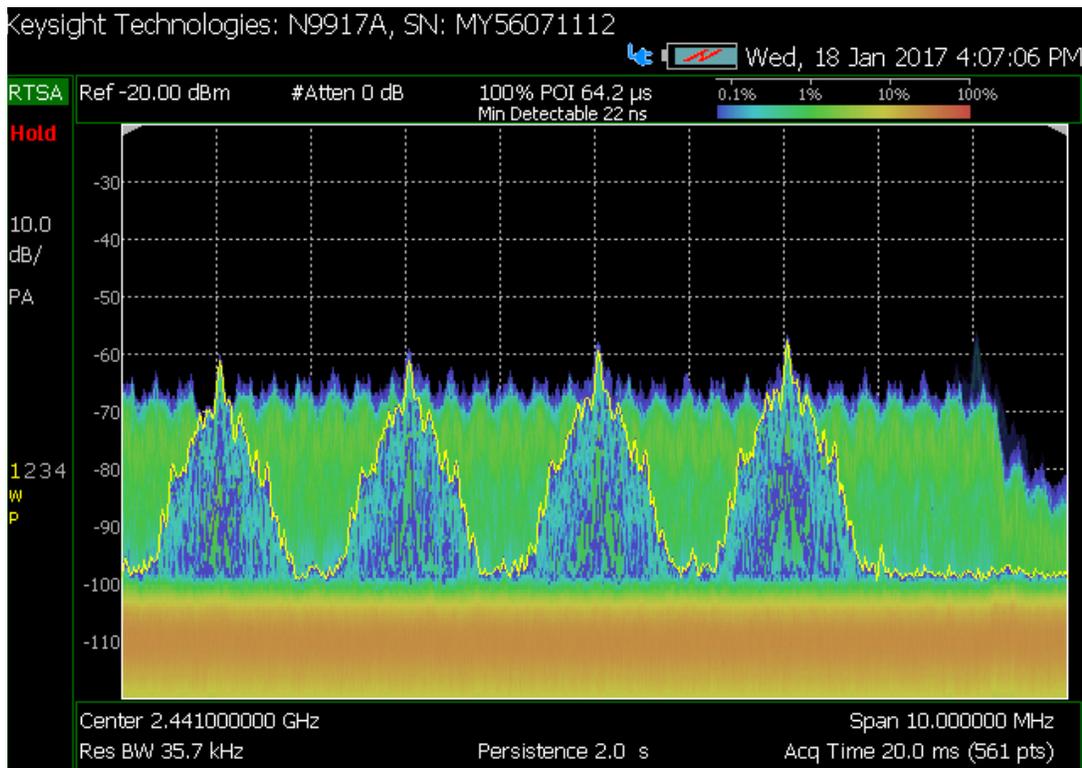


Figure 1. FieldFox real-time density display showing Bluetooth and WiFi signals

The Results: Reducing Test Time and Resolving EMI Issues

Using Keysight's portable solution, the OEM's test engineers were able to isolate RF noise that was affecting radar tests. FieldFox is also enabling technicians to rapidly test all five radar points before and after fascia are installed on each vehicle. They can characterize the effects of different mounting brackets and fascia thicknesses on radar performance.

These new capabilities have helped the OEM reduce test time significantly when characterizing post-assembly radar module performance. With precise fault detection and the ability to solve problems sooner, engineers and technicians can efficiently detect and identify EMI issues on the assembly line and fine-tune the post-assembly performance of their automotive radar modules.



Going forward

The OEM anticipates two new challenges ahead. One is a shift to radar modules that operate at 79 GHz, which can be tested by the FieldFox-based solution. The other change is the inclusion of advanced autonomous-driving features in new models, and the OEM believes it will be able to achieve greater levels of quality and performance thanks to Keysight's innovative solutions. Ultimately, the ability to isolate performance issues earlier in the production process gives the manufacturer greater confidence that it can maximize radar-based performance, enhance safety on the road, and minimize the likelihood of costly product recalls.

Related Information

- Automotive RF/MW System Verification and Troubleshooting Tests Using FieldFox Handheld Analyzers - Application Note, publication **5992-2422EN**
- FieldFox Handheld Analyzers 4/6.5/9/14/18/26.5/32/44/50 GHz - Data Sheet, publication **5990-9783EN**
- Data Sheet: OML M12H6DC Series, WR12 Frequency Converter Extenders, 60 to 90 GHz, available from the **OML website**
- **www.keysight.com/find/automotive**

Learn more at: **www.keysight.com**

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at: www.keysight.com/find/contactus

