

Keysight Technologies

Testing Electromagnetic Compatibility
of Remote Keyless Entry Modules
in Automotive Applications

Application Note

Introduction

The automotive industry continues to embed an increasing amount of electronic content into modern cars. This content supports improvements in safety, performance, and luxury.

One of the most widely used electronic systems is remote keyless entry (RKE). Many manufacturers are expanding the capabilities of the RKE modules being used in the latest automobiles. With increased module functionality, there is also a need for increased test coverage because an RKE module may be used to perform multiple tasks, from unlocking car doors to remotely starting a car's engine.

It is important to ensure that every feature is thoroughly tested. To help ensure customer satisfaction with these features and functions, functional testing of RKE systems is important as well.

One leading global company in the automotive industry is using the Keysight Technologies, Inc. U2353A USB data acquisition (DAQ) module in a system that performs robust electromagnetic compatibility testing of RKE modules. The system also includes a function/arbitrary waveform generator, a spectrum analyzer, and a PC to control the instruments and report the results.

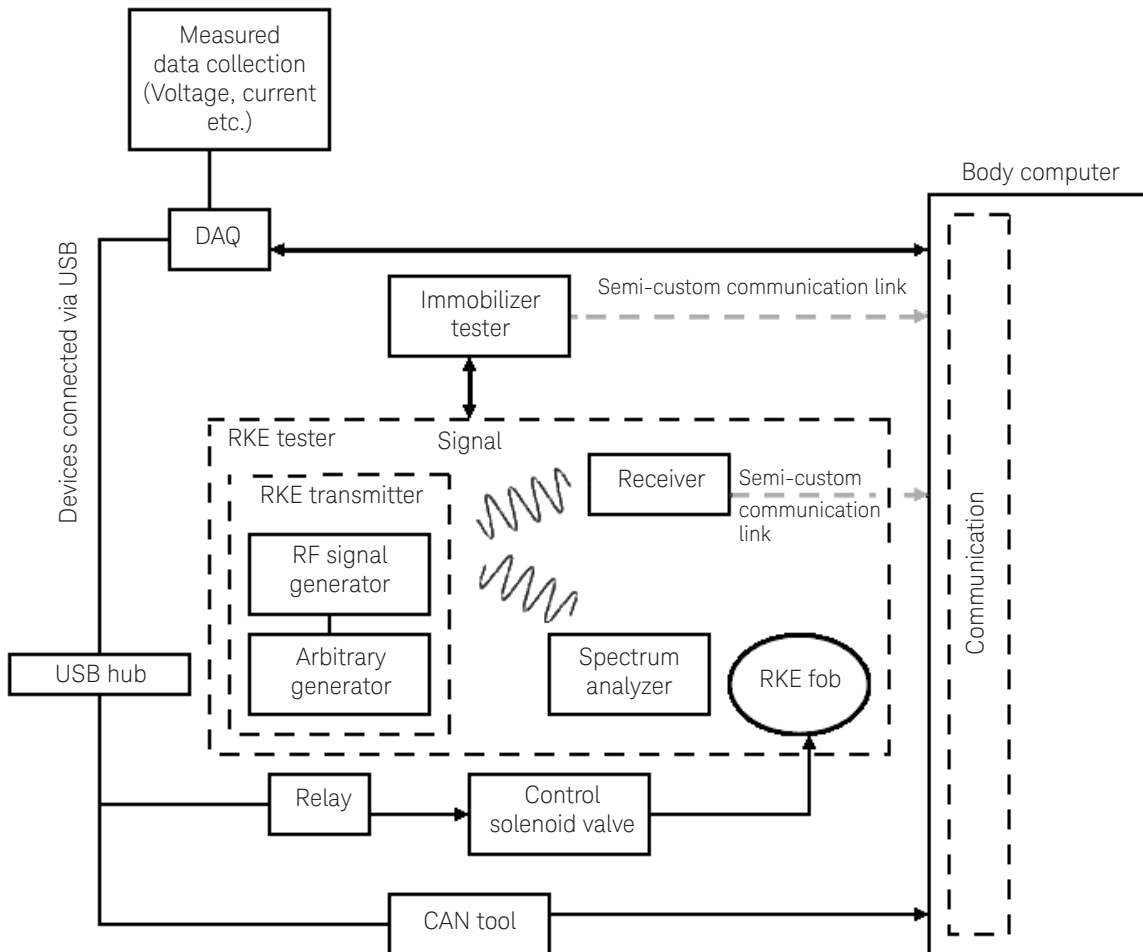


Figure 1. The block diagram of the EMC testing on RKE system

The RKE System

Typically, RKE functionality is embedded in the body control module (BCM) or body computer that controls electromechanical drivers within the automobile. Figure 2 illustrates the components of a BCM that includes both RKE and immobilizer functionality.

Figure 3 illustrates signal flow in an RKE system. When a key is pressed, an identification signal is produced by an RF generator; the signal is modulated before being transmitted to the receiver located in the vehicle. Within the receiver, the typical sequence of activities includes code generation, signal detection and processing, and authentication code verification. If the received signals are verified, then the receiver generates a serial command that controls a driver such as the door locks.

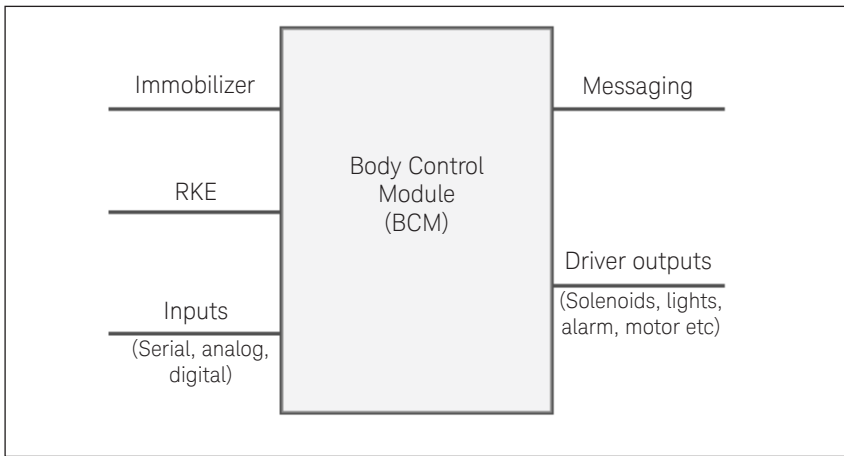


Figure 2. The BCM translates RKE and immobilizer commands into action

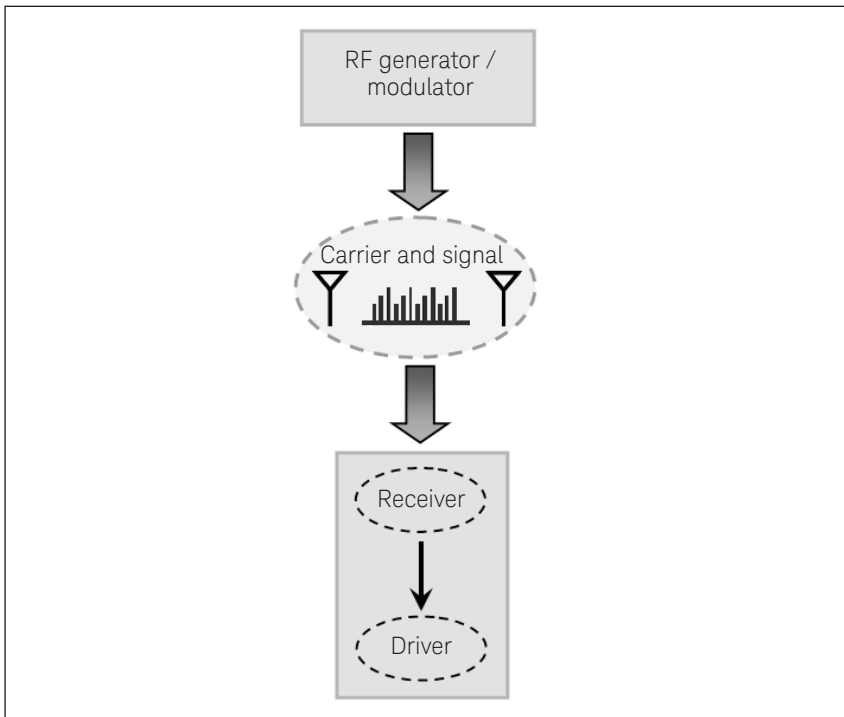


Figure 3. Signal flow and resulting action in an RKE system

RKE Tester

Phase 1: Signal transmitting

The allocated RKE radio frequency (RF) bands are either 315 MHz (United States and Japan) or 434/868 MHz (Europe). At the beginning of the test, the relay is triggered to control the solenoid valves that control small pneumatic actuators to push the key on the RKE fob. After key activation, the tester generates the signal and sends it through the transmitter to the receiver.

In some cases, it may be necessary to check the strength of the transmitted signal. This can be done by using the spectrum analyzer to perform RF output power measurements. Within the system described here, RKE transmitter center frequency and output amplitude are monitored during immunity testing to ensure that interference signals will not corrupt the RKE signals.

Phase 2: Signal receiving

The RKE receiver looks for a valid transmission “message authentication code” (MAC) that includes the transmitter ID, a rolling count, and a command code and status flags. For validity, the transmitted rolling count should be greater than or equal to the count stored in the receiver within a specific count “window.” If the rolling counts do not fall within that count window, the receiver may initiate a re-synchronization. In this example, if the rolling counts match, the electronic control module (ECM) generates a serial command to the drivers controlling the door locks.

Going Beyond the Basics

In addition to the tests mentioned above, it is also important to verify synchronization of the interference signal and the RKE data. To make this measurement, the U2353A DAQ module is connected to the RKE system and immobilizer. One of the module’s digital inputs is used for synchronizing the immunity interference signal with the RKE data between the transmitter (remote key) and the immobilizer/body computer. At the same time, one of the module’s analog inputs is used to measure and verify the sleep current of the receiver during immunity testing. The current test is done at the end of the dwell period after an RF transmit/receive test cycle is completed.

This illustrates how the multifunction capabilities of the USB DAQ module make it very good choice for this application; it can perform synchronization with its digital inputs and measure current with its analog capabilities. The cost effectiveness of the multifunction DAQ module also ensures that it is an effective and efficient component of the overall test solution.

References

[1] Keysight TS-5000 Family of Automotive Electronics Functional Test Systems – Remote Keyless Entry

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