OMRON Uses Real-Time Spectrum Analysis to Monitor RFID Communications between Tags and Reader/Writer

Problems occurring in the air are clearly identified, helping to accelerate development

Solution Summary	
Challenge	Signal changes over time between RFID tags and the reader/writer could not be measured dynamically in the air, which made it difficult to identify where problems in communications were occurring.
Solution	Instead of steady state measurements using a swept spectrum analyzer, signal changes over time measurement is conducted with a Real-Time Spectrum Analyzer. An antenna is placed between the tags and reader/writer.
Benefits	By understanding how the RF modulated signal changes over time, errors and their causes can be quickly identified, which successfully leads to accelerated development cycle..

RFID Applications Spreading from Factory Automation to Distribution

OMRON Corporation (headquartered in Kyoto) is a major Japanese company in the area of sensing and controls. OMRON offers products ranging from relays and sensors to factory automation, control systems, and public transportation systems. The company also manufactures medical equipment such as blood pressure gauges and low frequency therapy devices. OMRON has been one of the early entrants in the market of RFID (Radio Frequency Identification) applications offering a broad lineup of products used in distribution and factory automation.

The company is known as one of the few manufacturers providing comprehensive support for both tags and reader/writers. In addition, OMRON possesses many different proprietary technologies such as the use of ultrasound to fuse the chip and antenna within a tag, thus minimizing changes in impedance of the power source caused by thermal shock when laminating the inlet into a card.

Communication System Difficult to Measure

RFID is used in systems for communication between tags, which can come in different forms such as a card, and a reader/writer. In such systems, it is necessary to be able to make measurements between communicating devices in both the transmission and receiving directions. While it is necessary to make measurements to determine connectivity and data reliability, measurements are also required to determine conformance with the laws and regulations in different countries governing the use of electromagnetic waves. RFID systems are difficult to measure due to several reasons. One reason is that in an RFID system, the reader not only supplies power to the tag but also conducts signal polling, to which the tag responds. Because communications are established as such in this integrated system, it is difficult to make measurements isolating just the tag or reader/writer. In addition, because most tags are about the size of a sesame seed with an integrated chip and antenna, they do not allow access to a measuring point within the circuit of tag which contributes to the difficulty in measurement.

Problems Caused in Air

The carrier frequency and modulation method used in RFID systems are defined by the type of application. There are a variety of different frequencies and modulation methods, and each of these requires a specific type of measurement technology. For situations where signals can change instantaneously such as pulsed RF signals or carrier frequency in a frequency hopping systems, accurate meaningful measurements using conventional swept spectrum analyzer are not possible.

Mr. Kazuhiro Kudoh
OMRON Manager of
RFID Business Development

Tektronix

According to Kazuhiro Kudoh, technical manager of the development group, RFID business development department at OMRON, “we were forced to make steady state measurements using conventional swept spectrum analyzers. We also had to base analysis of communication protocol using output signals from the reader/writer. When a problem arose, we faced the difficulty of being unable to specify where the problem was occurring, whether it was in the air, antenna, RF circuit, baseband, or protocol.” Furthermore, in distribution applications, the distance between the tags and reader/writer becomes large. This can lead to noise or interference from other tags becoming a problem, which must be overcome. Given situations such as the use of sub-carriers that are particularly sensitive to interference, it is necessary to be able to determine dynamic changes in communication status during actual operation.

Only Solution

To address this, Kudoh searched for “a spectrum analyzer that could dynamically measure in real time the phenomenon actually occurring in the air to determine what was going on.” He began inquiring to several companies that specialized in radio frequency measurement. The result was that “the only company to possess an analyzer that fulfilled our requirements and responded to our inquiry was Tektronix.” The RSA Series of Real Time Spectrum Analyzers from Tektronix perfectly met Kudoh’s needs.

An RSA is not only able to capture the real-time instantaneous changes in the signal into its memory; it also enables simultaneous time-correlated analysis of the frequency, time, and modulation domains. Kudoh selected it thinking, “This is the one.” Real Time Spectrum Analyzers from Tektronix enable acquisition of detailed information from the reader/writer polling signal and tag response. This is because it is able to clearly identify instantaneously occurring spurious noise or interference from other devices. The ability to capture and directly measure ASK (Amplitude Shift Keying) modulation signals as waveforms are particularly effective for polling analysis, an important feature that Kudoh had desired. “We are also thinking of using this feature in an RFID evaluation system in which the Real-Time Spectrum Analyzer acts as a modulation signal decoder in real space.”

Measurement example that uses RSA

The development of RFID technology at OMRON has evolved from the use of a conventional swept spectrum analyzer capable of steady state signal analysis to a Real-Time Spectrum Analyzer from Tektronix capable of analyzing time-varying RF signals. According to Kudoh, “The ability of the RSA series of Real-Time Spectrum Analyzers to pinpoint the problems occurring during the communications between tag and reader/writer has led to accelerated RFID product development at OMRON.“

OMRON V720 Series RFID System

■Tag Inlet – V720S-D13P01

■Reader Writer – V720S-BC5D4

■Aerial – V720-HS03