

Officials at Kaohsiung Harbor, Taiwan's busiest port, have introduced the seals with EPC Gen 2 chips to improve security and reduce the need for officers to escort cargo containers.

By Dave Friedlos

Mar. 25, 2009—At Kaohsiung Harbor, one of the 10 largest ports in the world, more than 1 million transit containers are imported and exported annually. To prevent smuggling, Taiwan Customs officers are required to escort some 50,000 unloaded containers each year from the carrier yard, through downtown, to one of the port's five container terminals.

The escorts result in increased expenses for Customs, due to the need for additional employees, and for carrier companies, which must pay an escort fee. In addition, the long inspection times can cause an inconvenience.



The Yeon YTE-100 consists of a bolt with an embedded EPC Gen 2 RFID chip and a body containing an RFID antenna.

In 2004, the Taiwanese Government sought to replace manual escorts with an automated system to improve security and efficiency, as well as cut costs by reducing manned escorts.

Between 2004 and 2006, the Kaohsiung Customs Office called on bidders four times to deliver an automated, RFID-based electronic seal (e-seal) system, says section chief Hai-Hsiao Wang. Each bid, however, failed to meet the department's high standards.

"The bidders could not reach the required criteria of a 95 percent read rate," Wang says, "and the main reason was domestic manufacturers could not control the accuracy of the technology over long distances, or the stability of the electronic seal."

Enter [Yeon Technologies](#), a local hardware supplier that provides both [Impinj's](#) Speedway readers and its own specially designed tamper-proof Yeon YTE-100 e-seal. The

e-seal has a bolt containing a passive ultrahigh-frequency (UHF) chip encoded with a unique ID number.

"The reason a number of readers failed during previous trials is because of environmental conditions at Kaohsiung Harbor," says Yeon Technologies' president, Nancy Tai. "It is in a very tropical area, so the readers must be able to withstand high temperatures, high humidity, salt erosion and even the occasional typhoon."

In early 2008, Yeon Technologies began testing Speedway interrogators in 20 lanes at Kaohsiung Harbor, in order to demonstrate their performance and durability in harsh environments. During trials, Tai says, the YTE-100 outperformed other e-seal designs and Kaohsiung Customs chose to test 4,200 of the e-seals during the pilot.

"The requirements were very simple," Tai explains. "Kaohsiung Customs wanted a secure bolt with a read rate accuracy of 95 percent or higher, and a read range of 7 meters [23 feet] even when trucks are traveling at 60 kilometers [37 miles] per hour or more. Furthermore, once destroyed or cut off, the e-seal must stop functioning to ensure cargo has not been tampered with. If an e-seal could be reused, then there is no guarantee that the container has not been opened at some point during transit."



To seal a container door, the Yeon YTE-100's bolt locks onto the device's body. If the bolt is cut or removed, its RFID chip ceases to function.

The YTE-100 seal's RFID chip complies with the EPC Gen 2 and ISO 18000-6C standards, and operates at a frequency between 860 and 960 MHz. The YTE-100 also complies with the ISO/PAS 17712 standard for mechanical seals used on freight containers.

To seal a container's door, the YTE-100's bolt is inserted into the device's body. This locks the bolt and body together, thereby establishing an electrical connection between the chip embedded in the bolt and an antenna within the body, which enables the chip's encoded ID number to be interrogated. The e-seal can endure a force of up to 200 kilograms (440 pounds), but if broken, it will cease to function.

Impinj's Speedway readers were chosen because they feature high receive sensitivity to increase the effective read range, patented AutoSet functionality to configure the interrogators to deliver the highest read reliability, and dynamic antenna switching to optimize each antenna's read time based on the number of RFID tags within the field of view.

"Customs trialed active e-seals, but cost was an issue," Tai states. "It wanted a low-cost system that still provided the same benefits—passive e-seals have no batteries, but are robust, have a unique ID code and provide security for the containers."

Yeon Technologies initially conducted field tests at a Taiwanese industrial park, where real container trucks traveled past the RFID readers at speeds of up to 80 kilometers (50 miles) per hour. The result during testing was a read rate accuracy of 97 percent, Tai reports, with the read range extending as far

as 18 meters (59 feet) in several cases.

Some 40 Speedway readers were then installed at checkpoints along 20 lanes used for transporting containers. Customs has also purchased 40,000 e-seals, as well as handheld interrogators.

When a transit container is chosen for e-sealing, a notification is sent to the carrier, and an e-seal is used to lock the container at the carrier's yard. A handheld reader is utilized to interrogate the RFID chip's ID number, which is transferred to a secure database, and the information is synchronized with the driver's ID, as well as those of the container and truck, which are printed on the vehicle and container.

"When a truck passes through a checkpoint, an Impinj Speedway reader will read the e-seal on the moving truck," Tai says. "At the same time, the truck driver's ID will be detected through the driver ID system, and an optical character recognition system will pick up the container ID and truck ID. If either does not match, an alarm will be sent out to the harbor police for a physical inspection. When the truck arrives at its destination, a handheld reader will again be used to read the e-seal ID, in order to delete it from the database."

The system was officially rolled out on Feb. 20. According to Tai, the system has an accuracy rate of 97.42 percent at a distance of more than 7 meters (23 feet). That, she says, should result in an annual reduction of 6,000 man-hours for escorts, through the elimination of 10,000 escorts by Customs officers.

The rollout, Wang says, has been a success. "The system is highly reliable and can accurately identify signals no matter how fast the vehicle is traveling, how sharp the curve in the road is, or if the vehicle changes lane," he states. "In addition to the benefits from the reduction of staff time and costs, and improved efficiency, this system is a world first, and helps to improve our competitiveness and image around the world."

The Kaohsiung Customs Office is now working with Yeon Technologies to expand the system to other harbors around the country. Additionally, the agency plans to roll it out at Taichung, Taipei and Keelung Customs in early 2010.