# Bridging the gap for new applications in electronics with interactive Gen2 RFID

NXP's new UCODE I²C integrated circuit (IC) is transforming EPC Gen 2 UHF RFID tags into interactive tools for electronics.


From adding visibility to the production process, through work-in-process manufacturing techniques, to adding accountability and speed to the movement of finished products through the supply chain, RFID has already changed the way manufacturers of electronics operate. But a number of challenges and shortcomings have limited the benefits the technology delivered.

Often, product housings made of metallic or other types of conductive materials, present an obstacle when using off-the-shelf RFID labels, because the surfaces block the RF signal transmitted by readers, making the tags difficult to read. Additionally, an RFID label attached to the exterior surface of a product can easily be found and removed—a weakness that a nefarious party could exploit in order to divert goods to the grey market or disassociate a product from its warranty records.

Moreover, applying RFID tags to the exterior surface of electronic products, after they've already been manufactured, robs the manufacturer of the added visibility and control the technology could provide throughout the entire manufacturing process.

NXP has introduced a new IC platform designed to enhance RFID beyond the traditional track and trace applications. This new product, known as the UCODE I²C boasts a slew of features tailored specifically for the electronics market. The chip provides high memory,

security features, and a variety of packaging options that make it highly versatile. By enabling a bidirectional communication bridge between products' electronic circuitry and a wireless Gen 2 infrastructure, this new introduction offers features never before seen in standard passive UHF RFID tags and opens doors to new applications for wireless sensors, product security, customization and authentication features. NXP's UCODE I²C is a game-changer for RFID and the electronics industry.

Key to these benefits is the addition of NXP's inter-integrated circuit, or I²C, which is a technology that NXP (formerly Phillips) developed more than 30 years ago and which is used widely in electronics today. The UCODE I²C RFID chip comes with a high speed I²C serial bus that enables a wireless link between an RFID reader and the electronic device's microprocessor. Through this interface, users can turn basic EPC Gen 2 tags into communication portals that will allow for unprecedented levels of product interaction, configuration, security and product interactivity for manufacturers, retailers and consumers, alike.

## Case in Point: A Smarter, More Secure Laptop

There are numerous use cases for which using RFID tags based on the UCODE I²C chip would help ensure optimal performance while enhancing tag customization and consumer convenience.

Let's take a laptop as an example where a manufacturer integrates an NXP UCODE I²C RFID chip right into the device's electronics.

### Reliable Track and Trace

The UCODE I²C chip may be integrated within the product's printed circuit board (PCB) using the traces to function as the tag's antenna. The chip may also be coupled to the product chassis to further enhance the tag's performance.

This solves two potential dilemmas. For one, it removes the burden of finding a way to apply an RFID tag to the exterior of the computer while ensuring that the tag doesn't change the laptop's aesthetics. Plus, it protects the tag from damage or tampering. Product aesthetics is a growing concern among manufacturers, as many newer devices, such as smart phones or tablets, are becoming as much a statement of art as of technology. We're seeing this through increasingly streamlined designs that do away with conventional bar-coded labels or printed or etched serial numbers. To accommodate this style, sometimes bar codes are placed inside electronic devices, which means they can only be accessed by opening up the device. An internal, integrated RFID tag removes this hurdle.

The second benefit of an integrated RFID tag is that using the device itself to act as the tag's antenna helps ensure that the tag will be read—in fact it can even increase a tag's read range because integration may help make the antenna relatively large, compared to an off-the-shelf tag. For devices with conductive enclosures, placing a conventional RFID tag inside the laptop often restricts the tag's functionality.

Once the tag is integrated into the device, it can be used to track the laptop throughout the manufacturing process. RFID readers mounted along the production line will collect the unique tag ID encoded within the chip's memory, enabling a work-in-process tracking system that ensures fast, error-free assembly.

### Bi-directional Communication

Integrating the UCODE I²C chip into a laptop opens the doors to many new and exciting applications. By tapping directly into the RFID chip via the I²C serial bus, the electronics manufacturer can establish a link from RFID chip to the laptop's microprocessor. This not only integrates the RFID tag into the device itself—providing the basic tracking benefits described above—but it takes this integration an important step forward, because it paves the way to interactive Gen 2 RFID functionality. It establishes a bidirectional wireless bridge between the electronic device and the manufacturer, the retailer and the consumer.

### Securing Shipments

Integrating the tag into the laptop's main processing unit gives the manufacturer and retailer the power to wirelessly control the device through the RF interface. For example, once the laptop passes its final inspections and is ready for shipment, the manufacturer can disable the unit, through its RFID interface, as a disincentive from theft until ready for purchase. This way, once the laptop is placed into the supply chain, it would be of no use to any nefarious party that might want to divert shipments of the laptops to unintended grey markets.

To disable each laptop, the manufacturer would simply use an RFID reader to send a command, through the laptop's RFID IC, that renders the laptop locked.

Because the embedded RFID tag could still transmit its unique identification number through backscatter, the disabled laptops could still be traced as they move through the supply chain.

Later, once a retailer or distributor receives the laptops, an RFID reader would again be used, this time to send an authentication code, also through the RFID interface, which would unlock the laptops and make them operable again.

And at the retail store, the RFID tag continues its work as a unique identifier, enabling fast, accurate inventory cycles. But its usefulness is far from over.

### Upgraded, Customized Products

At the point of purchase, the integrated, bi-directional RFID tag becomes a tool for product customization. Say, for example, that the laptop is a gift. Upon the consumer's request, the retailer can use the RFID reader to upload, through the IC's I²C bridge, a customized wallpaper backdrop (e.g. a birthday or holiday theme) with a personalized message for the recipient. Using this same technique, the retailer can also preload the laptop with an

online gift certificate, encouraging the recipient to return to the retailer for additional products or services. Plus, the RFID gateway would even allow the retailer to set up the laptop with the user's wireless account credentials or set up an account for downloading music or eBooks for an extra special touch.

Or, say a customer was given a base model laptop as a gift and was interested in upgrading its video graphics quality or increasing its processing speed. If these improvements could be made through software upgrades, a provisioning key may be uploaded through the IC's $I^2C$ bridge. The retailer could make the upgrades without having to swap out any hardware, and the consumer would pay only an upgrade fee.

Through RFID-enabled product customization and software-enabled upgrades, retailers could provide more value to—and earn more loyalty from—their consumers, while also creating new revenue streams through upgrading services.

Plus, all of the wireless services that the $I^2C$ bridge enables—from uploading minor firmware patches, configuring language settings or customizing a laptop for a specific customer—can be done without even removing the laptop from its original packaging.

All of these benefits add up to opportunities for boosting sales, offering customization services and enhancing the customer experience.

### Positive Identity

In addition to all these possibilities, this new chip, through its anti-tampering features, can also be used as a tool for authenticating products, as long as the retailer chooses to keep the embedded RFID tag intact after the point of purchase (rather than decommissioning the tag). Retailers can, thanks to another UCODE $I^2C$ feature, decrease the RFID tag's read range at the point of sale, as a means of addressing privacy concerns the consumer might have about the tag embedded in his new product.

The UCODE $I^2C$ can be configured such that if the device into which it is embedded—say, a motherboard—is tampered with, the chip can report a breach, along with its unique identification during its next RF transmission. This feature would help root out criminal activity such as the practice of purchasing high-value electronics, swapping out the original components for lower-grade versions—or even replacing them with weights rather than electronics—then returning the product while it's under warranty and selling the original, high-value components on the black market. An embedded UCODE $I^2C$ RFID tag would stymie attempts to do this by alerting the retailer to the tampering.

Outside of stemming illegal activities, the technology can also help retailers authenticate legitimate returns, making warranty processing and product returns easier and more accurate. In these scenarios, the retailer would use the embedded RFID tag to identify a product that is returned, either for repair or as a product return or exchange. Once the tag number is captured, the retailer can use it to access the original sales record and warranty, in its back-end records, erasing any doubt as to whether the product was legitimately obtained.

### Diagnostics Duty

In the case of a repair, the bi-directional functionality of the wireless bridge can be used to

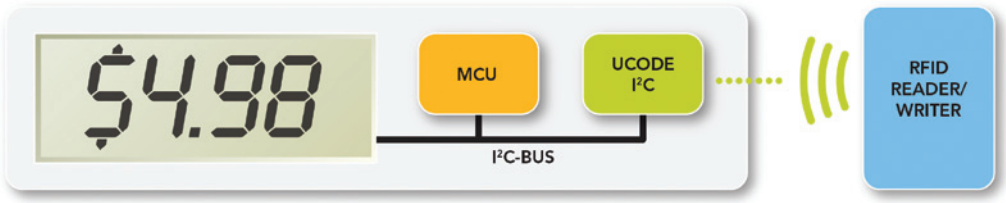
collect any error logs that the computer saved to its memory. This enables access even if the computer ceases to operate.

The 3,328-bit user memory within the UCODE I²C allows adequate space for error logs or other data the stakeholders might want to save to the tag's memory. And embedding the RFID tag into the manufacturing process saves money and time compared to tagging goods as a secondary operation later in the supply chain, where the benefits are less attractive.

All of the above scenarios also play out with a tablet, smart phone or other consumer electronics, as well. In all cases, this new integrated and interactive approach to RFID in electronics opens up many new applications for stakeholders across the consumer electronics industry — from manufacturers to consumers.

## Case in Point: Electronic Shelf Displays

Tagging electronics at the item level using the UCODE I²C chip offers manufacturers and retailers many clear advantages, as we've already outlined. But this chip also opens doors to novel cost-effective applications in the retail environment that can improve inventory control and boost sales.




Printed shelf labels have long been the main medium that retailers use to convey special offers inside stores. But managing these labels, and ensuring that they are placed and removed in accordance to a strict time table, can pull employees away from serving customers. Plus, poorly-managed shelf labels can lead to customer disputes; customers often demand that retailers honor the lower prices if sale prices are not removed from sales in a timely manner.

### Smarter Shelves

But what if switching shelf labels was no longer a concern? What if they changed automatically, always reflecting the accurate prices and terms? The UCODE I²C chip, joined with an inexpensive e-paper display solution, can make this a cost effective reality.

A RFID-enabled dynamic price label can be controlled wirelessly through a nearby RFID reader that is concealed from view—perhaps mounted above ceiling tiles.

Not only does this reduce the labor requirement and complexity of managing shelf tags, it allows retailers to offer many more dynamic sales than they could with paper labels. For example, a retailer might want to dabble with a very short, hour-long sale—perhaps one timed with a special television or radio ad, or to reward shoppers for getting to the store early on a holiday weekend. With a few keystrokes, a store manager can lower the price of specific items,

based on their shelf location, with the UCODE-based electronic shelf labels. As soon as the sale window closes, the labels will automatically revert back to the original retail price. All this would be done using a common, off-the-shelf Gen 2 reader infrastructure.

Electronic shelf displays also help protect revenue by eliminating the need to manually alter the price tags attached to the products—a practice that leads many retailers to having to honor sale prices even after a sale has ended.

And unlike an LCD or LED display, the ePaper can be activated when the tag receives new pricing information from the reader, but does not require energy to sustain the information after the content is adjusted, thereby conserving power.

In instances where batteries are used and where battery life starts to wane, the UCODE I²C may alert the reader of a low power indicator along with its unique ID number, so the retailer can look up its location. Then, the next time the tag is read, the reader detects the status and alerts staff to recharge or replace the battery. Alternatively, power for displays or microprocessors may also be feasible with energy harvesting techniques using the RFID signal, WiFi signals or light, and therefore never need battery replacement.

## In Summary

Aside from all of the features and functions listed here, the UCODE I²C offers all basic EPC Gen 2 capabilities, including password protection and cloaked viewing for instances where data is not intended for public viewing. In addition, it offers added features such as a status flag bit, which can be used in combination with an RFID security system to trigger an item to sound an alarm if it is removed from a store without being purchased.

Best of all, the UCODE I²C chip is the foundation of an EPC Gen 2 / ISO 18000-6c tag, and accepted worldwide, so you'll realize the new benefits that NXP's I²C platform offers by using your existing Gen 2 infrastructure, without having to sacrifice your adherence to industry standards. That's NXP's approach to RFID: Multi-application, without compromise.

So, what's your next step? NXP's RFID Application and System Center and our qualified partners are ready to help you determine the optimal methods for embedding UCODE I²C products into your consumer products.  NXP provides assistance from concept and design to compliance and production, insuring quick and trouble free implementations to maximize your ROI and time to market. Let us know how we can help.

## About NXP

NXP Semiconductors (Nasdaq: NXPI) is the leading global provider of RFID ICs. NXP creates semiconductors, system solutions and software that deliver better sensory experiences in RFID identification applications, eDocuments, mobile phones, TVs, set-top boxes, automobiles and a wide range of other electronic devices. A global semiconductor company with operations in more than 25 countries, NXP posted revenue of $4.4 billion in 2010. For additional information, please visit www.NXP.com or our RFID specific website at www.NXP-RFID.com.





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