



## Getting a Read on Embedded UHF RFID:

Why RFID Modules are the Smart Choice for Developing Next-Generation Solutions

UHF RFID technology continues to travel down the road toward becoming ubiquitous. As the technology becomes more mature, it is being deployed in more industries each day, with applications growing in sectors like medical and healthcare, pharmaceutical, retail, hospitality, automotive and general manufacturing.

What's driving adoption? Users are embracing the fact that the read range of passive UHF RFID has quadrupled in the past few years, meaning that UHF devices can now "see" objects up to tens of meters away. Read rates have increased from 200 tags per second to 1,200, and read accuracy is near 100 percent.

As the use of UHF RFID (860 to 960 MHz frequency range) becomes more commonplace, the focus on the technology is clearly shifting from that of an add-on technology to something that is being increasingly included in original product specs and embedded into products at the point of manufacture.

In digesting this trend, original equipment manufacturers (OEMs) are placing greater emphasis on determining the best path to take when it comes to embedding RFID into their products. Some are still taking the complex road of buying the components needed to build their own reader modules. Others are purchasing an RFID reader chip and reference design, a somewhat simpler, but still very challenging approach.

A more common and efficient option is to purchase a fully functional reader module that can be easily integrated into a wide range of products.

This white paper offers some key examples of how RFID readers are being embedded into equipment, examines the pros and cons of each option, and looks at how embedded UHF RFID is creating new applications that are expected to drive rapid growth.

## **Embedded RFID – enabling new apps around the globe**

Increasingly, companies are moving well beyond inserting modules into dedicated finished readers and handheld readers, opting to embed RFID into devices like rugged mobile computers, retail kiosks, forklifts, autos, appliances, vending machines and refrigerated cabinets and storage chests, just to name a few. Clearly, embedded UHF RFID is enabling new and highly innovative use cases for the technology, both for indoor use and for extreme rugged outdoor applications.

In doing so, these RFID enabled products become real-time data collection tools capable of transmitting highly accurate data in a digital form that previously was available only by manual means – or in many cases not at all.

For example, hospitals and labs are embracing refrigerated cabinets with embedded RFID systems that are capable of tracking highly expensive inventories of drugs, and send events to warn if an expiration date is about to be violated, or if the storage temperature deviates from a pre-determined level. RFID-enabled emergency rooms and patient care apps are evolving rapidly. Aside from using RFID to track patients and healthcare providers, the vision of some in the healthcare community is to create entirely wired hospital rooms -- an RF bubble around the bed -- to provide a higher level of care and to seamlessly make the association between caregiver and the patient.

Aside from numerous applications that improve business operations, safety and inventory control, consumer-facing RFID use cases continue to explode. There is heavy activity on the retail front, where RFID enabled printers and handhelds are a key part of the ongoing inventory management revolution powered by RFID. But innovation is also occurring with retail floor applications like smart shelving, “magic mirrors” in dressing rooms, and self-service payment kiosks, all of which rely on embedded UHF RFID. Desktop USB pads for initiating POS apps and EAS gates assembled with reader modules are also expected to see rapid growth in retail.

Digital signage manufacturers are relying on embedded RFID systems to message and interact with consumers at storefronts, universities and at sporting events, as well as in

hospitals and hotel lobbies. Transportation is another example of the endless vertical markets adopting RFID enabled digital signage. Car dealers rely on RFID-based digital signs to welcome car owners when they show up for service calls, and to alert dealer representatives when repeat customers are on the premise.

Another fast growing application involves using RFID technology to interact with social media sites like Facebook and Twitter. Increasingly, RFID-enabled kiosks at theme parks, concerts and sporting events allow guests -- usually wearing RFID-enabled lanyards or bracelets -- to post pictures to their social media accounts in real time. This market is expected to explode in the near-term, as adoption by soccer stadiums in Europe and pro sports teams in the U.S. could result in hundreds of millions of users. The National Hockey League (NHL) and the National Basketball Association (NBA) are already studying the technology for social media interaction with their fan base.

So, what is the best path to take when it comes to RFID-enabling your product line in order to compete in the above-mentioned markets? The three most common approaches are outlined below.

#### **Discrete components: high cost, high risk**

In the early days of RFID, many OEMs opted to build their own reader devices by purchasing their own components and hiring a full team of engineers. However, OEMs are migrating away from that path for many reasons. Our research shows that even manufacturers in Asia are backing away from building their own systems from scratch, choosing not to re-invent the wheel when proven chip sets and modules are readily available.

Starting from scratch with discrete components requires the OEM to create a textbook communication system with great attention to detail. Engineering a system that can handle hundreds of tag reads per second is a complex and timely process and will require major commitment to a development team.

In addition, compliance and certification represent additional roadblocks. Consider that each reader product must receive regulatory certification for RF emissions. The process can be time consuming and expensive, considering that individual countries all have their own set of rules

to follow. Generally speaking, regional certification can take four or more weeks per region. In addition, testing sites can be costly, and that expense adds up when you multiply the number of countries you must be certified in to market your products.

However, the biggest issue -- and one that could damage a product line by jacking up the final cost -- is the process to procure individual components. A high quality reader will likely require 1,000 or more parts, probably purchased initially in small lots from a wide range of manufacturers. It is prohibitively expensive for an OEM to source all of its own original components to build a reader. The final cost skyrockets further when you consider certification and added overhead and development costs.

### **Reader chip/reference design: still a costly and laborious option**

Using an RFID reader chip and reference design can simplify things quite a bit by removing about 70 percent of the development costs and time from the equation. By traveling this route, OEMs can simplify the task of getting data out of the air and delivering it to a digital sub-system, and they eliminate the complexity of generating RF, receiving the signal, and turning it into bits.

Even with those advantages, OEMs should be aware that they still need a team in place that possesses a deep understanding of RFID protocols. Additionally, a reader chip and reference design does not eliminate the need for significant development, testing and certification resources and associated costs.

If your primary goal for RFID is simply harvesting the data to improve operations or retail sales, then there is really no need to consider these two options, since companies like ThingMagic have already completed the work needed by developing a fully certified set of RFID modules.

### **Reader modules: a commercially viable and proven path to adoption**

By deploying ThingMagic's line of embedded RFID modules, OEMs can seamlessly incorporate RFID into handhelds, printers, vehicles, retail floor devices and much more. As time to market becomes more critical for manufacturers and retailers, OEMs are embracing ThingMagic modules that are available in a variety of form factors and performance

characteristics. ThingMagic modules offer more custom commands for RFID tags than other alternatives, and, to some degree, these modules can be customized with features required for specific markets.

Further, ThingMagic's line of UHF RFID modules and finished RFID readers are all supported by the same application-programming interface, and are designed to meet specific market needs. RF performance, optimization, and certification for various countries – a long process to undertake on your own - have already been addressed by the ThingMagic team, resulting in speedier time to market and further cost savings.

For example, The 4-port Mercury6e (M6e) embedded UHF RFID reader module offers world leading performance, form factor, and time-to-market advantages to OEM, Value Added Reseller, and Solution Provider customers. It is designed to incorporate the performance standards of full size readers, but is small and efficient enough to be used in mobile applications.

ThingMagic's newest and smallest embedded UHF RFID reader modules, the Micro and Micro-LTE offer the high-performance capabilities of the M6e in a small form factor. Only 46 mm long and 26 mm wide, these modules offer two antenna ports and support the ability to transmit up to +30 dBm (1 Watt) of power for the most demanding applications. The Micro has a read rate of 750 tags/second and is designed for applications where high performance in a wide range of operating conditions is required. The Micro-LTE has a read rate of 50 tags/second and is optimized for devices, device accessories and applications that require reading small tag populations. Exceptionally small size and powerful performance yield increased efficiency, reduced development costs and time-to-market advantages for a wide variety of handheld, portable and stationary devices and solutions.

ThingMagic's 2-port Mercury5e reader module, about the same size as a PCMCIA Type II PC card, is designed for adding UHF RFID read/write capabilities to a wide range of devices, from high-speed label printing to inline testing to mobile and handheld computers.

For the size matters crowd, ThingMagic also offers the single-port M5e-Compact embedded UHF RFID reader - about the same size as a compact flash card. This RFID reader module is

ideal for adding UHF RFID read/write capabilities to mobile printers and hand-held readers, where small size and low power consumption are essential.

As technology evolves, RFID-enabled products like hand-held readers become smaller and smaller in form factor, with the ultimate form factor representing something like a mobile phone device. It's crucial for manufacturers of these devices to understand the relationship and the tradeoff between the options available to them.

Although size is an important factor, it should not be the primary decision in the product engineering process. By emphasizing size as the primary factor instead of looking at the entire equation, OEMs run the risk of added costs – not to mention a longer cycle – to bring product to market. In a day and age where product obsolescence is a major concern, this point cannot be stressed enough when it comes to considering reader modules versus building from scratch.

While the read range of passive UHF RFIDS tags has quadrupled in past few years, imagine the technology innovation that is possible during the next 12 to 24 months. Read rates will surely advance, and the cost of passive RFID tags -- which have already decreased by a factor of five over three years -- will continue to decline, making for an even stronger ROI for the technology.

Functionality is also expanding. In addition to reading a unique ID, UHF devices can remotely query the temperature of an object, determine its direction of travel and velocity, measure impact and storage conditions, and can even turn on and off devices connected to the tag.

That represents some incredible innovation over a short period of time. The gains in the next several years are bound to be even more dramatic, launching UHF RFID into ubiquitous status in commerce and society.

### The ThingMagic RFID Module Advantage

- **Breadth of Product Offering** - ThingMagic RFID modules are available in multiple configurations, providing the greatest number of options for adding RFID to your product or solution.
- **Ease of Use** - Our development tools include Developer Kits, a common API across all products, and a Universal Reader Assistant utility for advanced demo, testing, and tuning of all ThingMagic readers.
- **ThingMagic Firmware** - ThingMagic firmware adds valuable real-world features to the primary functions delivered by RF chips, giving customers an enhanced set of tools to develop innovative and customized RFID solutions for worldwide deployment.
- **Faster Time to Market at a Lower Cost** - Using an RFID module, as opposed to discrete components or a chip and reference design, reduces time to market and overall system costs.
- **Manufacturing Strength** - As a Division of Trimble, ThingMagic is capable of producing high volumes of product with highly predictable quality.



ABI Research studied 9 different UHF RFID module providers and ranked ThingMagic #1 in Innovation and #1 in Implementation in their Embedded Passive UHF Reader Module Vendor Matrix.

Contact us to learn more.

For more information, visit [www.thingmagic.com](http://www.thingmagic.com)

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