FERROX TAG

RFID introduction

SMART ON METAL | SMART ON LIQUID | SMART AT SPEED

What is RFID?

RFID stands for Radio Frequency IDentification. It is an automatic identification method that uses radio waves to transmit the data between the reader and the tag that contains the item data.

The tag is an electronic device with an integrated circuit and an antenna. We can distinguish between active and passive tags: Active tags have a built-in battery whereas passive tags do not. This application note refers to passive RFID systems. The integrated circuit contains a unique serial number, some read/write memory used to identify the item, and handles the communications protocol between the tag and reader.

The reader collects the information from the tags. The reader sends commands, data and energy to the tags by means of an antenna that can be external to the reader (conveyors, dock doors) or built in (hand held, desktop). The reader can be connected to the company Local Area Network (LAN) to exchange information among the different information systems through the middleware. This middleware defines how and what information is shared between RFID and the local databases including item reference and description, batch number, expiry date, process status.

What are the benefits of using RFID in your business?

RFID is not intended to substitute bar codes, in fact both are complimentary identification technologies, and in some cases they can exist together. The determination of when to use RFID technologies instead of bar coding should be driven by whether RFID can improve an existing business process. There are some powerful features that make of RFID a real breakthrough in the automatic identification technology:

Bar code deficiency	RFID improved solution
Line of sight technology	Able to read hidden items out of the line of sight, even inside a box or pallet without the need to open it
Only identifies items generically and not as unique objects. Limited storage capacity	Read and write information unique to each item, like serial and batch number, process conditions, user data. Larger storage capacity.
Label must be clean and not deformed. Cannot withstand harsh conditions like humidity, high temperature, corrosive liquids, harsh material handling	Works effectively even in harsh environments: Insensitivity to dirt, humidity, can even read through liquids or high temperature
Slow reading and labor intensive	Fast reading: possibility to read many tags simultaneously in just one second.
Poor tracking technology	Possible to program the reader to track a specific item, i.e. a certain model and size of a shirt on the shelf
Open information, no protection possible	Encrypted data with passwords for reading and writing.
No potential for further technology development	This technology can be improved due to new chip and other innovations

What is RFID used for?

There is no specific application area for RFID, but some identification needs that RFID make very easy:

- Asset tracking: for each asset the tag contains information like inventory number, description, user, maintenance situation.
- Food traceability: each SKU (stock keeping unit) has the reference and batch numbers, expiration date, producer, customer reference...
- Process control: each manufacturing unit holds a tag with information about the process parameters and completed steps.
- Personal identification: new passports make use of RFID chips to keep secure identity information.
- Counterfeiting prevention: original products have the serial number stored into the chip.
- Luggage tracking in airports, such as Las Vegas or Hong Kong.
- Animal identification.

And any other object that moves or can be hidden!

What are the limitations of RFID?

Although it has many advantages, there are some limitations from different points of view:

- Technical limitations intrinsic to the technology:

  – Limited read range from 10 cm to 10 m, depending on the reader power and tag sensitivity.

  – Radio frequency waves are absorbed by liquids and reflected by metals, greatly reducing the reading distance. This means that identification of items containing or surrounded by metal and liquids is difficult.

- Return of investment: before implementing this technology one should study what benefits the user will get out of it, and when possible, study what savings will be achieved. In some cases RFID is simply needed to comply with certain mandates, like batch tracing or asset control improvement, so a ROI would not be needed.

- Users have to get used to it. Though it is a very friendly and reliable technology, people will have to change their way of working, and rely on a device (the tag) that keeps their information but can only be read with the reader.

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How does RFID work? What is needed?

Four components are needed for RFID deployment: tags, readers, air protocol and middleware. Now let's see how do they interact with each other:

The reader sends out a carrier frequency using its transmitting antenna. This wave is powerful enough to wake up the tags in the interrogation zone; its properties (frequency, amplitude, baud rates and commands) are defined by the air protocol. In other words, the air protocol defines the language between the reader and the tag, so both components should support the same air protocol to establish the communication.

When the tag receives the carrier wave, the IC is activated and responds with the UID (Unique Identification number). The tag has no battery, so the only way to transmit the information is to reflect the carrier wave (similar to a transponder) back to the reader.

Once the communication is established, the reader can send commands to write to the tag memory, retrieve part of the information or even destroy the tag.

And finally the middleware links the IT infrastructure with the reader, supplying the information to be written to the tag and collecting the information read.

Choosing properly each component is essential to achieve optimal performance of the installation:

There are many different types of readers. Industrial long range readers for transport conveyors, forklifts and dock doors, hand held readers for manual reading, desktop readers for document. Industrial readers support operating with several multiplexed antennas to ensure proper coverage of the interrogation zone. The readers can be linked to the LAN directly (using wired or wireless Ethernet) or through a bridge computer.

With respect to tags, again, there are many different options from very simple and cheap inlays (a PET foil with the antenna and IC unprotected on top), to the printable labels and robust encapsulated industrial tags. Special features are also available in the market, like protection against chemicals, high temperature operation and storage and operation in metal environments, ending up in a more professional and expensive tag.

The air protocol has to fulfil the application requirements in terms of read/write speed,

Passive RFID technologies

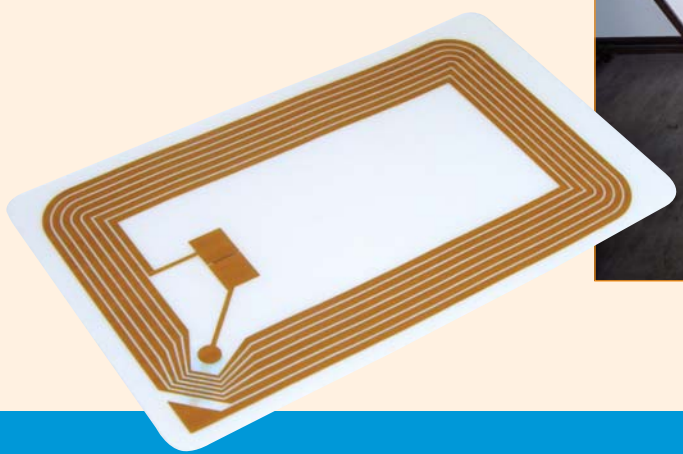
There are 3 main technologies optimized for different environments, each of them with advantages and drawbacks:

	Reading range	Problems with liquids and metals	Installation	Speed	Tag price
Low freq (125-134 kHz)	0 to 10 cm	Less	Easy	Slow	High
High freq (13.56 MHz)	0 to 1 m	Difficult	Easy	Fast	Medium
UHF (860-960 MHz)	10 cm to 10 m	Very difficult	Difficult	Very fast	Low

Low and High frequency communicate by inductive coupling (magnetic field) between the reader and the tag. The frequencies used for communication are standard all over the world, so the same reader and tag can be used in every country.

UHF tags communicate with the reader by backscatter electric field, thus enabling longer reading range. However, each region (Europe, Asia, Japan, USA, Australia...) allows different frequency bands and transmitting power, in such a way that the readers have to be configured properly to the country where they will be installed.

We will now focus in High Frequency ISO15693 technology. This standard defines the air interface between the reader and the tag in the same way as any other communication protocol is defined, Ethernet networking or wireless communications will make it possible to use different brands of readers and tags, meaning that you are not tied to a certain manufacturer. ISO15693 is the most extended protocol and it is also compatible with Electronic Product Code EPC ISO18000, although not with Gen2 tags (they work in UHF band!)



What is Ferroxtag?

Ferroxtag is a high frequency (13.56 MHz) tag ISO15693 compliant, with a ceramic magnetic antenna. This special antenna provides excellent performance in difficult environments such as METALS and LIQUIDS. Remember that typically when RFID tags are placed on or near metal or liquids, performance degrades to the point where they are no longer usable, or have a very poor performance as metals and water interfere with the operation of the RFID tag antenna.

Why is Ferroxtag different compared to other tags?

The orientation of the antenna parallel to the item prevents reflection of the reader wave in the metallic item, while the magnetic antenna attracts the magnetic field enabling operation in field absorbent environments like liquids, papers, cellulose, wood (including pallets), food or any other item with high moisture content. FERROXTAG is the perfect solution if there is a requirement to read and identify items containing metal and/ or liquids.

Ferroxtag, like any other ISO15693 tag, can be read with standard readers from most of the vendors.

Depending on the reader power and the size of the tag antenna the reading range can go as far as 1.5 m, but typical values of 40 cm can be achieved with a small tag 15 x 8 x 2 mm and a 4 watts reader.

Encapsulated tags are resistant to harsh environments, surviving and operating at high temperature, high humidity (even inside the liquid), and mechanical stress.

Customers can also encapsulate the tags themselves, in such a way that the can be molded inside a plastic box, mounted on a printed circuit board, or mounted inside the item housing.

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Ferroxtag memory

One of the key features of RFID tags is their memory. Each tag has a read only unique identification number (UID) and some bytes of read write memory. Depending on the IC used to build the tag, the size and characteristics of the memory may vary; Ferroxtag preferred partner is NXP Semiconductors, but other IC's can be used upon request.
With standard NXP ICode SLI, the tag has the memory map shown in the figure.

Block -3	UID 4	UID 5	UID 6	UID 7
Block -2	Control bytes			
Block -1	Write acces condition			
Block 00	R/W	R/W	R/W	R/W
Block 01	R/W	R/W	R/W	R/W
Block 02	R/W	R/W	R/W	R/W
Block 03	R/W	R/W	R/W	R/W
Block 04	R/W	R/W	R/W	R/W
Block 23	R/W	R/W	R/W	R/W
Block 24	R/W	R/W	R/W	R/W
Block 25	R/W	R/W	R/W	R/W
Block 26	R/W	R/W	R/W	R/W
Block 27	R/W	R/W	R/W	R/W

There are many options to get the best functionality of the memory, depending on the application:

- Food industry: it is possible to record the EAN128 label content directly on the R/W memory of the tag in the pallet.
- Process control: make use of the UID to create a relation between a production lot and the tag, in this case the UID will behave as an index in a database. The advantage is that the UID is read in a very short time (just a few milliseconds), so fast moving items in front of antenna can be read.
- Asset tracking: Inventory number as well as product description can be recorded and locked in the memory and variable values, such as user or maintenance information and can be reprogrammed as many times as needed.

FERROXCUBE —your global partner

Australia: Contact Ferroxcube Taiwan
Tel. +886 2 86650099, Fax: +886 2 86650145
Austria: Contact Ferroxcube Germany
Tel: +49 (040) 527 28 305, Fax: +49 (040) 527 28 306
Benelux: Contact Ferroxcube Germany
Tel: +49 (040) 527 28 302, Fax: +49 (040) 527 28 306
Bosnia: Contact Ferroxcube Italy
Tel: +39 02 241131 1 , Fax: +39 02 241131 11
Brazil: Richardson Electronics, Sao Paulo
Tel: +55 11 3845 6199, Fax: +55 11 3845 6199
Richardson Electronics, Rio de Janeiro
Tel: +55 21 521 4004, Fax: +55 21 521 5193
Canada east: Contact Ferroxcube USA
Tel: +1 978 579 7932, Fax: +1 978 579 9457
China: Ferroxcube Hong Kong
Tel: +852 2319 2740, Fax: +852 2319 2757
Ferroxcube South of China
Tel: +86 769 7382420, Fax: +86 769 7339561
Ferroxcube Suzhou
Tel: +86 512 68095048, Fax: +86 512 68097128
Colombia: Richardson Electronics
Tel: +57 1 636 1028, Fax: +57 1 636 1005
Croatia: Contact Ferroxcube Italy
Tel: +39 02 241131 1 , Fax: +39 02 241131 11
Czech Republic: Contact Ferroxcube Poland
Tel: +48 46 834 00 07, Fax: +48 46 834 00 35
Denmark: Contact Ferroxcube Sweden
Tel: +46 8 580 119 74, Fax: +46 8 580 121 60
Finland: Contact Ferroxcube Sweden
Tel: +46 8 580 119 74, Fax: +46 8 580 121 60
France: Ferroxcube France, NANTERRE
Tel: +33 (01) 5551 8422, Fax: +33 (01) 5551 8423
Germany: Ferroxcube Germany, HAMBURG
Tel: +49 (040) 527 28 302, Fax: +49 (040) 527 28 306
Greece: Contact Ferroxcube Italy
Tel: +39 02 241131 1 , Fax: +39 02 241131 11
Hungary: Contact Ferroxcube Poland
Tel: +48 46 834 00 07, Fax: +48 46 834 00 35
Indonesia: Contact Ferroxcube Singapore
Tel: +65 6244 7815, Fax: +65 6449 0446
Ireland: Contact Ferroxcube UK
Tel: +44 1706 830723, Fax: +44 1706 222638
Israel: Arrow\Rapac Ltd., PETACH TIKVA
Tel: +972 3 9203480, Fax: +972 3 9203443
Italy: Ferroxcube Italy, SESTO S. GIOVANNI (MI)
Tel: +39 02 241131 1 , Fax: +39 02 241131 11
Korea: Contact Ferroxcube Taiwan
Tel. +886 2 86650099, Fax: +886 2 86650145
Malaysia: Contact Ferroxcube Singapore
Tel: +65 6244 7815, Fax: +65 6449 0446
Mexico (excl. Baja): R.V. Componentes, Guadalajara, MX
Tel: +52 33 3641 9595, Fax: +52 33 3641 9898
Mexico (Baja): Contact Ferroxcube USA
Tel: +1 619 207 0061, Fax: +1 619 207 0062
New Zealand: Contact Ferroxcube Taiwan
Tel. +886 2 86650099, Fax: +886 2 86650145
Norway: Contact Ferroxcube Sweden
Tel: +46 8 580 119 74, Fax: +46 8 580 121 60
Philippines: Contact Ferroxcube Singapore
Tel: +65 6244 7815, Fax: +65 6449 0446
Poland: Ferroxcube Polska, SKIERNIEWICE
Tel: +48 46 834 00 07, Fax: +48 46 834 00 35
Portugal: Contact Hispano Ferritas, Spain
Tel: +34 (949) 247 153, Fax: +34 (949) 247 146
Serbia and Montenegro: Contact Ferroxcube Italy
Tel: +39 02 241131 1 , Fax: +39 02 241131 11
Singapore: Ferroxcube Singapore, SINGAPORE
Tel: +65 6244 7815, Fax: +65 6449 0446
Slovak Republic: Contact Ferroxcube Poland
Tel: +48 46 834 00 07, Fax: +48 46 834 00 35
Slovenia: Contact Ferroxcube Italy
Tel: +39 02 241131 1 , Fax: +39 02 241131 11
South-Africa: Contact Ferroxcube UK
Tel: +44 1706 830723, Fax: +44 1706 222638
Spain: Hispano Ferritas, GUADALAJARA
Tel: +34 (949) 247 153, Fax: +34 (949) 247 146
Sweden: Ferroxcube Sweden, JÄRFÄLLA
Tel: +46 8 580 119 74, Fax: +46 8 580 121 60
Switzerland: Contact Ferroxcube Germany
Tel: +49 (040) 527 28 305, Fax: +49 (040) 527 28 306
Taiwan: Ferroxcube Taiwan, TAIPEI
Tel. +886 2 86650099, Fax: +886 2 86650145
Turkey: Contact Ferroxcube Italy
Tel: +39 02 241131 1 , Fax: +39 02 241131 11
United Kingdom: Ferroxcube UK, CROYDON
Tel: +44 870 2418759, Fax: +44 870 2418761
United States: Ferroxcube USA, EL PASO (TX)
Tel: +1 915 599 2513/2328, Fax: +1 915 599 2555

For all other countries apply to closest regional sales office:
• HAMBURG, Germany
Tel: +49 (040) 527 28 302, Fax: +49 (040) 527 28 306
e-mail: saleseurope@ferroxcube.com
• EL PASO (TX), USA
Tel: +1 915 599 2513/2328, Fax: +1 915 599 2555
e-mail: salesusa@ferroxcube.com
• TAIPEI, Taiwan
Tel. +886 2 86650099, Fax: +886 2 86650145
e-mail: salesasia@ferroxcube.com

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