SYSTEM LABEL

GUIDE TO RFID / NFC

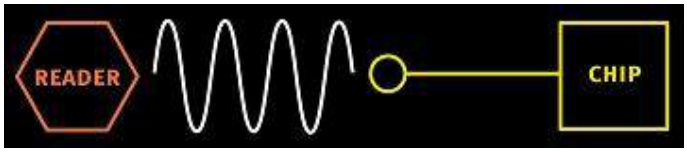
Version 1.0 | 01-SEP-2023

SYSTEM LABEL

What is RFID?

- Radio frequency identification, or RFID, is a generic term for technologies that use radio waves to automatically identify people or objects.
- There are several methods of identification, but the most common is to store a serial number that identifies a person or object, and perhaps other information, on a microchip that is attached to an antenna (the chip and the antenna together are called an RFID transponder or an RFID tag).
- The antenna enables the chip to transmit the identification information to a reader.
- The reader converts the radio waves reflected back from the RFID tag into digital information that can then be passed on to computers that can make use of it.

Step 1:
Communication begins when a reader directs radio waves at a transponder, effectively waking it up.



Step 2:
The transponder responds by returning the data stored on the IC. (example: ePC information).

Carrier Frequencies

- The carrier frequency is an important consideration in both inductive (passive) and propagation (active) RFID systems.
- It distinguishes the vehicle for carrying data across the air interface.
- It also provides a convenient way for distinguishing the spectral regulatory constraints that govern their use in different countries of the world.
- The following table shows 3 major carrier frequencies regions distinguished for RFID for which there is a degree of international harmonization.

Frequency Band	Characteristics
Low 100- 500 kHz (125kHz typical)	• Short to medium read range (10 inches) • Inexpensive • Slow reading speed
High 10- 15 MHz (13.56MHz typical)	• Short to medium read range (3 feet/1 meter) • Potentially inexpensive • Medium reading speed
Ultra-High 850- 950 MHz 2.4- 5.8 GHz	• Long read range (up to 30 feet) • High reading speed • Line of sight required • Expensive

Carrier Frequencies

The choice of carrier frequency and associated bandwidth of RFID systems and tag design is influenced by a number of factors, including:

- Data transfer rate

  (higher the frequency the higher the data rate)

- Propagation capability and associated range

  (higher the frequency the further the range and higher the power needed)

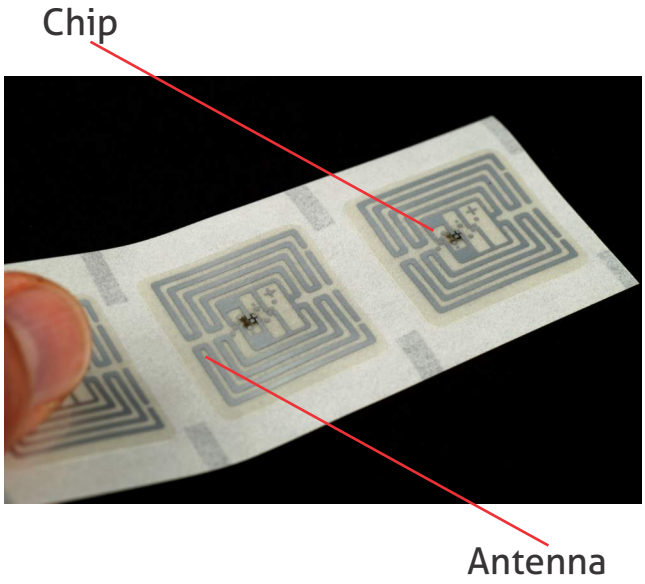
- Size and cost of transponder construction

  (lower the frequency the higher the cost of antenna for inductive coupled systems)

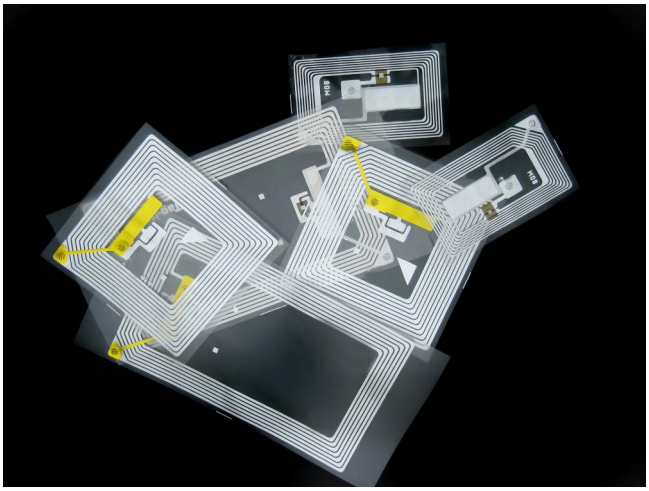
Basic Features of RFID Transponders/Tags

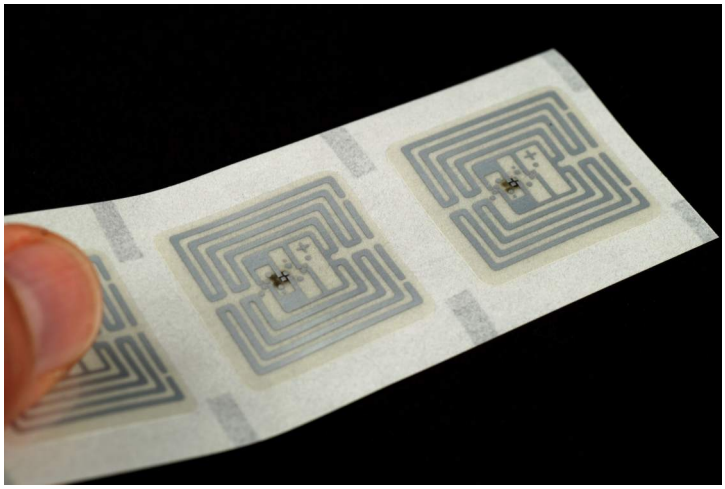
The basic feature of a RFID tag is to detect the interrogation field or transmission in order to affect a response for data transfer. Therefore, the main components in a tag circuitry essentially comprises of the following parts:

- The antenna and radio frequency receiver and transmission circuit.
- Micro -processing circuit for control and data management purpose.
- Memory, appropriate to data carrier and functionality needs.



Basic Features of RFID Transponders/Tags





- One of the most important components of a RFID tag is its memory
- The tag memory can be read only (ROM), random access (RAM) or non-volatile programmable memory for data storage depending upon the type of device.
- ROM -based memory is used to store security data and the transponder operating system instructions which, in conjunction with the processor or processing logic, deals with the internal "housekeeping" functions such as response delay timing, data flow control and power supply switching.
- RAM -based memory is used to facilitate temporary data storage during tag interrogation and response.
- The non-volatile programmable memory may take various forms, electrically erasable programmable read only memory (EEPROM) being typical.
- It is used to store the tag data and needs to be non-volatile to ensure that the data is retained when the device is in its power saving "sleep" mode

Types of RFID transponders

There are basically 3 types of RFID transponders that are most widely used in the world.

They are...

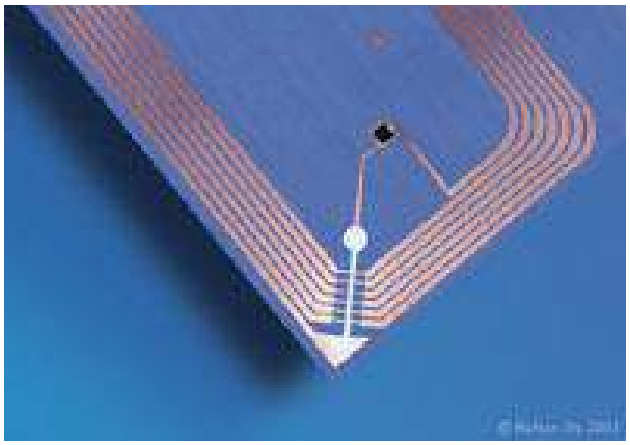
- Contactless Cards
- Contactless Tickets
- Smart Labels

Contactless Cards

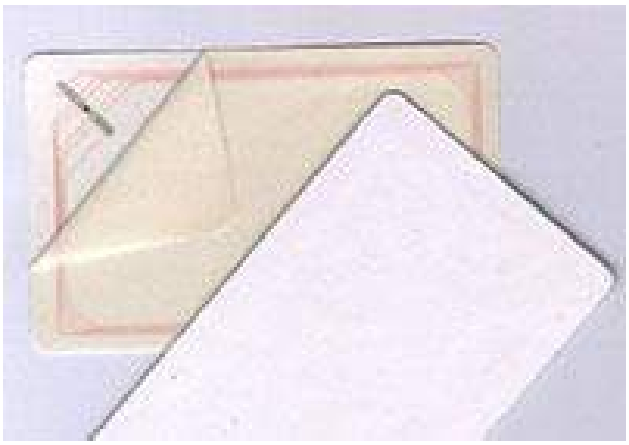
- The most common type of transponder in the market.
- Mainly used in mass transit applications, access control, banks and security applications.
- Their main advantage over their contact variety is their speed control ease of use and low cost of maintenance.
- They are most effective in applications where high speed and accurate identification of people are needed.
- Modern contactless card inlays are based on an etched antenna (rather than the traditional coil antenna) which is much more reliable, lower cost and has a higher performance.
- The flexibility of an etched antenna also allows contactless card inlays to be laminated with cheaper materials like PET that cuts down the cost by almost thirty percent.

Contactless Cards

The differences between the two can be seen in the following pictures...



Etched Antenna



Coil Antenna

Contactless Tickets

- Unlike contactless cards, contactless tickets are made of cheaper materials like PET or paper.
- They cost lessand are useful for temporary applications.
- They have all theadvantages of contactless cards with the added option to be discarded after use.

Applications currently include

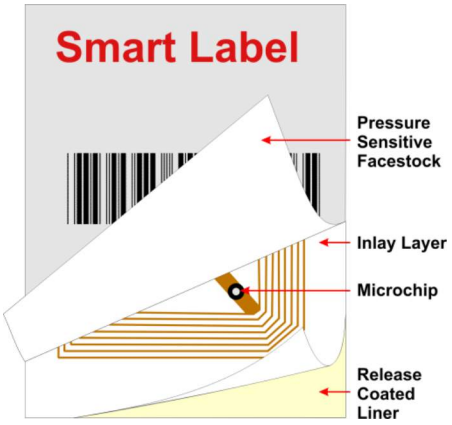
- Contactless travel tickets where season or single trip tickets are needed. This is the case where the high cost of contactless cards is currently prohibitive.
- Access control for temporary employees, club members or visitors where it is not necessary to use a high cost contactless cards.
- Conventions or exhibitions where there is a need to identify and control the visitors. Contactless tickets can be attached to badges or brochures.

Smart Labels

- Unlike both contactless cards and tickets, a smart label transponder is a thin, consumable device with a re-programmable microchip and an antenna.
- Data can be read or written with a reader device, without a direct line of sight.
- Transponders embedded inside paper labels or plastic tags help solve problems in product identification, control, tracking and security and can be used in a wide variety of applications.
- Inlet structures exploit the low cost; low profile etched and printed coil antennas that can be achieved on thin (<0.4mm) flexible substrates.

Smart labels are being seen as a significant driver for RFID usage in a wide range of application areas.

- Airline baggage management.
- Library systems and rental services.
- Retail, including electronic article surveillance
- Supply chain logistics
- Postal and parcel tracking services
- Personnel identification and ticketing
- Animal tagging
- Waste management
- Vehicle identification
- Fraud control and identification



Smart Labels

- Smart labels are also seen as the main RFID market driver for the next 5 years.
- They can be encapsulated in different formats to suit different applications.
- As a replacement for barcodes and other auto identification technologies, smart labels can potentially save companies billions of dollars in labour and logistics costs.
- Potential applications in the retail industry alone can use up to 500 million smart labels a year

Screen Printing Transponder Antennas

- Antennas can be printed using conductive inks
- Printed antennas are recyclable and cost less than solid copper antennas Gillette, for example, says it expects to reduce the cost of RFID tags by 20 to 40 percent by using printed antennas on its packages
- The one drawback of printed antennas is that the performance has not been as good as solid copper antennas, particularly for 13 56 MHz RFID tags, which require highly conductive antennas

International RFID Standards

- International standards have been adopted for some very specific applications, suchas trackinganimals.
- Many other standards initiatives are under way. The International Organization for Standardization (ISO) is working on standards for trackinggoodsin thesupplychain using high-frequency tags (ISO 18000-3) and ultra high frequency tags (ISO 180006)

The Electronic Product Code (ePC)

- The ePC, or Electronic Product Code, is a standard naming scheme for objects.
- It is used for the automatic identification of objects. This is the data typically stored on the IC of a transponder.
- The ePC is the next evolution of the UPC, or Universal Product Code, found as a barcode on most products today.
- The UPC provides a unique identifier for every product The ePC provides a unique identifier for every item This subtle difference provides huge advantages for businesses and consumers.
- There are several standards of ePC. Each relates to the amount of information stored on the IC of the transponder

The Electronic Product Code (ePC)

An example of the ePC- 96 standard or the 96 - bit version:

01. 115A1D7. 28A1E6. 421CBA30A

When each part of the ePC is examined, it becomes apparent how much information can be stored in only 96 bits.

- 01- Version of ePC
- 115A1D7- Manufacturer Identifier
  28 bits (> 268 million possible manufacturers)
- 28A1E6- Product Identifier
  24 bits (> 16 million possible products per manufacturer)
- 421CBA30A- Item Serial Number
  36 bits (> 68 billion possible unique items per product)

NFC

Near-field communication is a set of communication protocols that enables communication between two electronic devices over short distance.
In short, it is a proximity-based wireless communication standard.

Most smartphones now have Near Field Communication, or NFC technology, built in.. Even though NFC may be short-range, it's still a very convenient technology that most of us now take for granted every day.

NFC & RFID DIFFERENCES

NFC is an off-shoot of RFID. The main difference between them is their transmission ranges

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RFID is often used over longer distances. For example, some regions automatically collect road tolls through RFID. Tags are usually affixed to vehicle windshields and you simply have to drive through the toll booth. Communication can take place over even longer distances if the RFID tag is equipped with a power source (Active RFID rather than passive).

NFC, however, only has a maximum range of a few centimeters, at most.
In most smartphone-related applications, you'll find that the software will only initiate communication if there's physical contact. This is to prevent accidental triggers, which is especially important now that the technology is used for transferring sensitive data and payment transactions.

HOW NFC WORKS

The NFC system requires the use of a reader - the terminal, and a receiver - the tag or label.

The terminal and tag communicate with each other through electromagnetic induction.

NFC devices can act as either an NFC reader or tag. This bidirectional capability allows you to use one piece of hardware such as a smartphone for all kinds of different applications.

NFC can only function at very short distances.
The classic example of the benefit of this short range, and associated security, is contactless payment with a bank card.

NFC APPLICATIONS

Unlike Wi-Fi, Bluetooth and UHF RFID, NFC interaction is limited to an extremely short range.

NFC technology is best known in the field of smart phones.
NFC can be used on tablets and other devices such as gaming consoles.
Mobile phone payments apps use NFC technology for contactless payments.
Other uses include as a public transport ticket on a smartphone.
Pairing a smartphone with a external device i.e. speaker, a TV, a router, etc.
Exchanging photos, videos and other files between phones.
Replacing traditional keys with an NFC card for hotel rooms.
Entering restricted access areas of a building with a company ID card.

Conclusion

- RFID and NFC as technologies continues to grow & develope as we gain knowledge, experience and technical capability

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