4 CHIPLESS Technology

An important emerging area of RFID technology is that of chipless data carriers. These are usually passive devices generally formed from low cost inductive components, magnetic materials and electromagnetic reflective or absorptive materials. These devices are generally low capacity data devices, although marginally higher capacity, two-dimensional data structures are proposed in the future.

Chipless technology devices generally have the characteristics:

- Thin form factor. The devices are realised using thin foil or film materials
- Low data capacity
- Ranges of less than 1 metre
- Wider temperature ranges (-40 to + 200 °C) than chip-based RFID devices
- Lower cost relative than chip-based devices. Prices are eventually projected to be less than 20 cents in volume.

These advantages have to be offset against the limited data capacity and higher reader costs relative projected for chip-based readers.

4.1 Chipless Technologies

4.1.1 Wiegand/Buakhausen Magnetic Technologies.

The Wiegand card technology is comprised of data carrier elements formed from small, specially processed ferromagnetic wire. Sharp reversal of the wire’s magnetic field causes a short duration voltage pulse to be generated; the Buakhausen effect. Bit representation is achieved by the manner in which the data determining wire elements are arranged relative to a defined read line. These devices are low capacity (tens of bits), short range (up to 2.5 cm) storage devices. (reference http://www.hidcorp.com/)
4.2 LC Array, Card-Based Technologies.

LC array technology exploits the resonance of inductor-capacitor circuits as a basis for data encoding. Devices using this approach, otherwise known as Multiple Tuned Circuit Identification (MTCID) tags, are characterised by arrays providing a range of resonant frequencies. The presence or absence of frequencies in a scan across the frequency range defines the code held by the tag. The greater the number of resonant points defined the greater the number of code combinations (or data capacity) can be accommodated. These devices are low capacity (typically 12 digits), short range (up to 1 metre) devices (reference: http://www.cwosrfid.com/)

4.3 Magnetically-Based Chipless Data Carriers

These are non-contact magnetic encoded devices. The three principal technologies are Programmable Magnetic Resonance (PMR), Flying-Null (FN) and Holotag low frequency magnetic (LFM) tag technologies.

4.3.1 Programmable Magnetic Resonance Devices

PMR devices exploit resonance features of magnetically soft magnetostrictive materials in association with data carrying hard magnetic material, to provide tags that can be interrogated using an appropriate low frequency alternating magnetic field. The data is written to the tag using a contact method similar to that used conventionally for magnetic stripe. In response to the reader interrogation field resonances from the PMR tag are detectable that relate to data stored in the hard magnetic material. The particular harmonics can be enabled or disabled to distinguish a bit-string along a magnetically hard coding strip forming an integral part of the tag. 20-bit and 64-bit tags (capable of supporting data encoding schemes with error protection) are available costing in the region of 25 cents and 50 cents respectively.

4.3.2 Flying-Null Data Carriers

Flying-Null technology exploits the properties of very high permeability magnetic materials. The data is defined by a series of simple, passive magnetic structures, analogous in many respects with the bars for conventional linear bar codes. The data is actually stored by reducing or removing the magnetic permeability of selected regions of the high permeability material. FN tags are capable of tolerating a reasonable amount of non-ferrous metal within the interrogation zone.

Read/write tags are simple to implement for FN technology. The writing process requires contact with the write head. However, the tag is read by means of a high-resolution magnetic inductive reader providing read ranges of typically 50 cm and up to 1 m with loop antennas and of the order of few cm for side-scan devices. The interrogation process involves the use of an alternating magnetic field (typically 2 KHz) of intensity sufficient to saturate the high permeability material except in a null or zero region defined by two opposing fields. A scan field is applied to oscillate the null at a frequency that is typically 1/110th. that of the interrogator field. Within the null of the scanning field the data elements can be effectively revealed, the process being somewhat analogous to a scan of a linear bar code. (reference: http://www.flying-null.com/)
4.3.3 Holotag Low Frequency Magnetic Data Carriers

Holotag low frequency magnetic device technology is based upon thin film smart magnetic materials. Tags are made of many layers of metal alloy, each rotationally oriented at a small angle (about 3-4 degrees) and capable of being magnetised in a highly directional manner. The presence or absence of the directional magnetisation in the individual layer determines the data stored. Reading is achieved by a rotating magnetic interrogation field and detection of the magnetic interactions.

The data capacity for presently available tags is limited to less than 50 bits; although higher capacity devices are in prospect. Prices for Holotag devices are in the region of 10 cents for 10,000 off quantities and 8 cents for 1,000,000 off quantities (referenc holotag.co.uk).

4.3.4 Microwave Chipless Technologies

Although still under development, amorphous alloys in the form of small diameter (100-125 microns) glass coated wires are being used to structure tags that can be interrogated by microwave (2.45 GHz) sources to reveal a signature code or data sequence.