Au-delà de l'identification par radiofréquence, la RFID sans puce

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1. Principle of operation

Introduction to chipless RFID

The RFID is one of the major technologies in the field of identification. Its field of application is expanding rapidly.

More than 3000 application cases are known (Logistics, Item, Pallet, Animal, ID paper, Toll road, pharmacy...)

Variety of applications

lot of constraints:

Size, Cost, Reliability (vibration, temperature ...), Data security

Different classes of tags for different applications.
1. Principle of operation

“Classical” RFID Application
1. Principle of operation

Chipless RFID

Chipless approach
2. Comparison between barcode & RFID

**Chipless RFID**

**Barcode**

- Easy to use
- Universal
- Low cost
- Short range, direct line of sight

‘Personal’ software, printer to generate printable barcode labels

**RFID**

- RF communication
  - Flexibility for placement, orientation, direct line of sight is not necessary,
  - Extensive read ranges, multi-read,

- More complex solution
  - Not universal, lack of security,
  - Cost,
  - With a chip, more or less robust.
2. Comparison between barcode & RFID

Chipless RFID

Barcode

Chipless RFID

RFID
RFID offers a rich spectrum of services.

**Functions**

- Item-level tagging
- Multi-read / large reading area
- Discretion
- Writing capability
- Product integrity

**RFID**

- (*) 2D barcodes only

**Barcode**

- (*) 2D barcodes only
Barcode is overtaken?

And yet barcode is still used ….

Barcode:

- 70% of the Manufactured Products
- +/- 15 000 billions individual products yearly
- works very well

(*) 2D barcodes only
What about chipless RFID?

Positioning of Chipless RFID

Functions

- Item-level tagging
- Multi-read / large reading area
- Discretion
- Writing capability
- Product integrity
- Sensing
- Cout

RFID

Chipless RFID

Barcode

(*) 2D barcodes only

(*)
Classification for chipless RFID tags

- **Conductive materials**
  - RF Dielectric
  - Plastic film
  - Paper
  - Piezoelectric

- **Non-conductive materials**
  - Paper
  - Plastic film

**Encoding techniques**

**Materials**

**General design approach**
A. Vena, E. Perret, S. Tedjini, ‘High-Capacity Chipless RFID Tag Insensitive to the Polarization’. 

Gap-coupled Microstrip dipoles: Half-wave resonator 

Source: O. Rance
Today, the demonstration of the practical and economic potential of chipless need to be done.

The feasibility of large scale chipless tags production + a unit cost of about € 0.4 cents

New functionalities regarding barcodes.

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2. Comparison between barcode & RFID

Chipless RFID issues

- Encoding capacity
- Tag cost
- Sensing
- Reader cost
- Orientation of reading
- Robustness of detection
- Compliance with RF emission regulations
- Reader cost

49 bit > EAN13 barcode
Chipless RFID issues

- Encoding capacity
- Tag cost
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- Orientation of reading
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- Reader cost
- Compliance with RF emission regulations
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Box full of paper:

\[ f_{\text{res}}^0 = \frac{f_{\text{res}} n \cdot f_{\text{sens}}^0}{f_{\text{sens}} n} \]
2. Comparison between barcode & RFID

Chipless RFID issues

Telecommunications Standards
- UWB (3 - 10 GHz)

M. Garbati, « Contribution au développement d’un lecteur RFID sans puce basé sur l’approche ultra large bande impulsionnelle ».

FCC and ETSI mask for communication application
Chipless RFID issues

- Reader cost
- Compliance with RF emission regulations
- Encoding capacity
- Orientation of reading
- Robustness of detection
- Sensing
- Tag cost

1. Oscilloscope
2. Homemade UWB radar

Signal [V] vs. Time [ns] (Graph a)
2. Comparison between barcode & RFID

Chipless RFID issues

Flexography

reader cost

Compliance with RF emission regulations

Encoding capacity

Tag cost

Sensing

65mm

50mm

€ 0.4 cents

Encoding capacity

robustness of detection

orientatiion of reading

Reader cost

Chipless RFID issues

Barcode & RFID

Comparison between barcode & RFID

Tag cost

Sensing

€ 0.4 cents

Encoding capacity

robustness of detection

orientatiion of reading

Reader cost
Chipless RFID issues

Deformation sensor

Encoding capacity

Tag cost

Sensing

Compliance with RF emission regulations

Reader cost

Robustness of detection

Orientation of reading

Tag chipless double « L » inversé

Tag cost

Reference plane '0'

Deformation sensor

Polarization V

Polarization H

Antenna

Object

VNA

Fixed tag 2
Mobile tag 1

Emission/reception antenna

Emission/reception antenna

Reference plane '0'

L

w

g

Tag

Reference plane '0'

Parameter "dc"

Frequency (GHz)

Frequency (GHz)

Parameter "dc"
Background removal: Time separation

Cross-Polarization

\[ i_{vh}(t) \]

\[ a_{vh}(t) \]

\[ c_{vh}(t) \]

Obj. 1, Obj. 2, Time

Tag, Time

Window

NEW INSIGHTS

(1) RF switch based on CBRAM - Reconfigurable chipless - writing

(2) Remote sensor based on Chipless label

(3) Gesture recognition
(1) RF switch based on CBRAM - Reconfigurable chipless - writing
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