

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HID GLOBAL CORPORATION,
Petitioner,

v.

DATAMARS SA,
Patent Owner.

Case IPR2023-01445
Patent No. 11,128,027

**PETITION FOR *INTER PARTES REVIEW*
OF U.S. PATENT NO. 11,128,027**

Declaration of Kelley M. Hayes Greenhill Regarding Exhibit 1016 (“*Moraru*”)

I, Kelley M. Hayes Greenhill, state and declare as follows:

I. Introduction

1. I have prepared this Declaration in connection with the Petition for *Inter Partes* Review of U.S. Patent No. 11,128,027, which I understand will be filed concurrently with this Declaration.

2. I am currently a Senior Manager with the Research & Information Services team at Finnegan, Henderson, Farabow, Garrett & Dunner, LLP, located at 901 New York Avenue, NW, Washington, DC 20001-4413.

3. I am over eighteen years of age, and I am competent to make this Declaration. I make this Declaration based on my own personal knowledge, and my knowledge of library science practices.

4. I earned a Master of Science in Library Science from the Catholic University of America in 1995, and a Bachelor of Arts in Political Science from Duquesne University in 1989. I have work as a librarian for over twenty-five years. I have been employed at Finnegan, Henderson, Farabow, Garrett & Dunner, LLP since 2019. Before that, from 1995–2015, I was employed in the Library Department of Sterne, Kessler, Goldstein & Fox, PLLC. And from 2015–2019, I was employed in the Knowledge and Research Service Group (formerly, Information Research Service) at Northrop Grumman Corporation.

5. I am a member of the American Association of Law Libraries.

II. Standard Library Practices for Receiving, Cataloging, and Making Materials, Including Serial Publications, Publicly Available

6. I have knowledge of and experience with standard library practices regarding the receipt, cataloging, shelving, and making materials, including serial publications, available to the public. I have knowledge of and experience with the Machine-Readable Cataloging (MARC) system, an industry-wide standard that libraries use to catalog materials.

7. The MARC system was developed during the 1960s to standardize bibliographic records so they could be read by computers and shared among libraries. By the mid-1970s, MARC had become the international standards for bibliographic data and cataloguing. It still used today. Many libraries provide public access to their MARC records via the Internet and/or their electronic cataloging systems at the library.

III. MARC Records

5. The MARC record system uses a specific three-digit numeric code (from 001-999) to identify each field in a catalog record. For example, field tag 008 provides the six-digit date the item was catalogued (*Date entered on file*). The first six characters of field tag 008 are always in the “**YYMMDD**” format. Descriptions and definitions of all of the character positions of field tag 008 are outlined here: <https://www.loc.gov/marc/bibliographic/bd008a.html>

8. As is relevant to this Declaration, MARC field tag 245 identifies the full title statement for the work; field tag 264 identifies the place of publication, name of publisher, and copyright date of the publication.

9. Based on standard library practice, when a library receives an item, including a serial, it generally stamps (and/or labels) the item with the library name, barcode, often with a date that is within a few days or weeks of receipt. Next, the library will catalog the item within a matter of a few days or weeks of receiving it. As a general practice, cataloguing is centralized and performed by a cataloguing department within a library or university setting. In certain circumstances the catalogued item may be subsequently sent to a library location within the library or university setting where it may be stamped and/or labeled after it has been catalogued.

10. Generally, after an item is cataloged, the public may access the item by searching a catalog, browsing the library shelves, and either requesting or electronically accessing the item from the library. Standard library practice is to make the item available to the public within a few days or weeks of cataloging it.

IV. Serial Publications

11. A serial publication, often known as a “journal,” is a resource that is issued in successive parts and has no predetermined conclusion. These successive parts are commonly referred to as “issues,” and each issue is usually

chronologically numbered and dated. The presence of enumeration, years of coverage, and/or other chronological information also indicates a serial publication.

12. There are significant differences between cataloging finite resources (books/monographs) and continuing resources (serials). For serials, the catalog record provides information about the serial as a whole, including the first or earliest available issue. It also provides information as to holdings – the volumes and issues, with dates, received by the library and made available to the public. In serials cataloging, there are identifying characteristics unique to serials that are slightly different from monographs (books). The issue date for a print serial publication, for example, generally appears on the cover (front or back), the masthead page, the title page (if any), the table of contents page(s), or on the pages of the individual articles contained in the issue. More information regarding the unique aspects of cataloguing serials can be found at this link:

<https://www.loc.gov/aba/pcc/conser/scctppt/Basic-2014/Basic-Trainee-Mannual.pdf>.

V. Cataloguing of Conference Proceedings (Monographs v. Serial Treatment)

13. Conference proceedings often consist of collections of papers presented at a meeting, program, symposium or conference held during a specific time-period in a designated geographic place. Bibliographic control of

conference proceedings to promote public discovery and access has long been a priority of catalogers. Although some ongoing conference publications are catalogued as serials (if a conference publication exhibits continuity, regularity, and evidence of seriality), cataloguing a conference publication as a monograph is preferred for public retrieval purposes. Cataloguing a conference publication as a monograph is an optimal way for the public to easily access the conference resource, and its papers, by searching for a unique title and other descriptive data elements added by the cataloger. Monographs are efficient for public searching and offer the public an easier way to discover what an institution holds, while changes to the record (unlike serials) are not an issue. However, sometimes conference proceeding cataloging is done serially, and the MARC record will be updated after each serial publication is received.

VI. IEEE Xplore

14. The IEEE *Xplore* digital library is a powerful resource for discovery of scientific and technical content published by the Institute of Electrical and Electronics Engineers (IEEE) and its publishing partners. IEEE *Xplore* provides web access to more than 6 million full-text documents from some of the world's most highly cited publications in electrical engineering, computer science and electronics. Approximately 25,000 new documents are added to IEEE *Xplore* each month. Access to full-text documents in IEEE *Xplore* can be obtained from:

institutional subscriptions, exclusive subscription available to IEEE member and IEEE society members, and online purchase of individual documents.

15. The date of publication for journals and standards on IEEE *Xplore* represents the very first instance of dissemination. IEEE *Xplore* previously made distinctions between the online publication date, print publication date, etc. This was simplified to reflect a single publication date of record as defined above.

16. IEEE publishes more than 1,700 leading-edge conference proceedings every year, which are recognized by academia and industry worldwide as the most vital collection of consolidated publisher papers in electrical engineering, computer science and related fields.

17. Conference publications appear in IEEE *Xplore* about 30–60 days following IEEE’s receipt of the printed conference proceedings. It is worth noting that conference proceedings often arrive at IEEE several weeks after the conference date.

18. Conference proceedings in IEEE *Xplore* show “Date of Conference” which is the date of the event, and “Date Added to IEEE *Xplore*” which is the date proceedings were first published.

VII. Public Availability of *Moraru* (Exhibit 1016)

6. This Declaration relates to the dates of receipt and public availability of the following reference: Aurelian Moraru, Elena Helerea,

Corneliu Ursachi, Marius Daniel Calin, "RFID System with Passive RFID Tags For Textiles," (*"Moraru"*) found within the *2017 10th International Symposium on Advanced Topics in Electrical Engineering (ATEE)*, Bucharest, Romania, 2017, pp. 410–415. I understand that *Moraru* has been submitted as **Exhibit 1016** in this proceeding. That same reference is appended to my Declaration as **Appendix A**.

7. As detailed below, I have reviewed the reference, public holdings information and University of Wisconsin – Madison Libraries MARC record for *Moraru* to determine the date of public availability for this reference.

8. **Appendix A** to this declaration is a true and accurate copy of the cover page, title page, front matter, table of contents for the copy of the *2017 10th International Symposium on Advanced Topics in Electrical Engineering (ATEE)* containing *Moraru* held by the University of Wisconsin – Madison Libraries. **Appendix A** also include pages 410–415, which comprises the publication, "RFID System with Passive RFID Tags for Textiles," *i.e. Moraru*.

19. The University of Wisconsin – Madison Libraries public catalog record (**Appendix B**) sets forth the public holdings information for members of the public seeking a physical copy of *2017 10th International Symposium on Advanced Topics in Electrical Engineering (ATEE)* containing *Moraru*. The public catalog record indicates it is a "books" record and, specifically, identifies

the title name as “*2017 10th International Symposium on Advanced Topics in Electrical Engineering (ATEE)*.” The public catalog record also notes a publication location in Piscataway, NJ, and IEEE as the publisher. Based on my experience as a librarian, the public catalog record (**Appendix B**) references the *2017 10th International Symposium on Advanced Topics in Electrical Engineering (ATEE)* that containing *Moraru* (**Appendix A**).

20. **Appendix C** to this declaration is a true and correct copy of the University of Wisconsin – Madison Libraries public catalog and MARC for its copy of the publication *2017 10th International Symposium on Advanced Topics in Electrical Engineering (ATEE)*, containing *Moraru*, which was downloaded from: <https://search.library.wisc.edu/external/oclc987911355> and <https://search.library.wisc.edu/external/oclc987911355/staff>.

21. The University of Wisconsin – Madison Libraries MARC record for *Moraru* identifies the fixed data elements of MARC field tag 008 as 170524t20172017njua ob 101 0 eng d. This indicates that the record for *2017 10th International Symposium on Advanced Topics in Electrical Engineering (ATEE)* was catalogued by the Library of Congress on May 24, 2017. The publication status code “t” appearing in MARC field tag 008 refers to “publication date and copyright date” indicating that this item published and copyrighted in 2017. Based on this MARC record, *2017 10th International Symposium on*

Advanced Topics in Electrical Engineering (ATEE) containing, *Moraru* would have been catalogued and made available to the public within a few days and weeks of May 24, 2017.

22. The Library of Congress MARC record for *2017 10th International Symposium on Advanced Topics in Electrical Engineering (ATEE)* containing *Moraru* includes field tag 245, which denotes the title and statement of responsibility for the work as “2017 10th International Symposium on Advanced Topics in Electrical Engineering (ATEE).”

23. In the Library of Congress MARC record, field tag 264 denotes information relating to the place of publication, name of publisher, and date of publication of *2017 10th International Symposium on Advanced Topics in Electrical Engineering (ATEE)* as “.| Piscataway, NJ b. IEEE an c. [2017?].” Subfield code “a” refers to the place of publication. Subfield code “b” refers to the name of the publisher and “c” refers to the date of publication or copyright.

24. Based on the information in **Appendices B and C**, it is clear that the MARC record (**Appendix C**) references *2017 10th International Symposium on Advanced Topics in Electrical Engineering (ATEE)* containing *Moraru*.

25. **Appendix D** to this declaration is a true and accurate copy of the IEEE *Xplore* record for *Moraru*. This record indicates the article entitled “*RFID System with Passive RFID Tags for Textiles*” was published *2017 10th*

International Symposium on Advanced Topics in Electrical Engineering (ATEE). Further, this record indicates Date of Conference: 23-25 March 2017 and Date Added to IEEE *Xplore*: 24 April 2017.

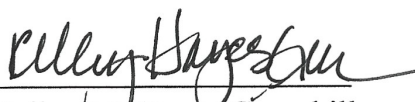
26. Based on the information in **Appendix D**, it is clear that the issue of *2017 10th International Symposium on Advanced Topics in Electrical Engineering (ATEE)* containing *Moraru* was published by IEEE *Xplore* on April 24, 2017. *Moradi* would have been available to the public within a matter of a few days or weeks of receipt of April 24, 2017.

VIII. Conclusion

27. In signing this Declaration, I understand it will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I understand I may be subject to cross-examination in this case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

28. I declare that all statements made herein of my knowledge are true, that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed on September 28, 2023, in Washington, DC.


Kelley M. Hayes Greenhill

APPENDIX A

**2017 — 10TH INTERNATIONAL SYMPOSIUM ON
ADVANCED TOPICS IN ELECTRICAL ENGINEERING
(ATEE)**

2017 — 10TH INTERNATIONAL SYMPOSIUM ON ADVANCED TOPICS IN ELECTRICAL ENGINEERING (ATEE)

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The 10th International Symposium on ADVANCED TOPICS IN ELECTRICAL ENGINEERING Bucharest, March 23-25, 2017

The Faculty of Electrical Engineering , University POLITEHNICA of Bucharest

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RFID System with Passive RFID Tags for Textiles

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Abstract- Radio Frequency Identification (RFID) technology, by assigning a unique identifier to each product allowed spectacular development of wireless monitoring and control applications. With the advances of tags with passive integrated circuits, operating without a self-contained energy source, extracting the needed energy from the energy of electromagnetic waves generated by an interrogator, RFID applications extended to processes held in harsh industrial environments. For textile articles, in industrial laundries, the RFID system with passive RFID tags involves specific architectures and building solutions. The paper analyses the weak points of actual passive UHF RFID tags and proposes solutions regarding the architecture and the materials used in construction of tags suitable for laundry applications. Thus, new requirements have been established to design passive RFID tags: they should be washable and wearable, robustness enough to operate in harsh environments, with a sufficiently long lifetime, and cost-efficient.

Keywords: passive RFID tag, RFID system, UHF, harsh environment, weak points, textiles, laundry application.

I. INTRODUCTION

In 1873 Maxwell in his famous treaty [1], for the beauty of mathematical equations symmetry, introduced in Ampere's Law, the term:

$$\int_{\text{sr}} \frac{\partial \vec{D}}{\partial t} \cdot d\vec{S}$$

advancing the theoretical hypothesis of the possibility on electromagnetic field propagation.

After a few years, in 1887, Hertz [2] demonstrated, experimentally, the validity of this hypothesis. The way to the transfer, via electromagnetic field, of energy and especially of information was open. Regarding the transfer of energy through electromagnetic field without electrical wires, wirelessly, the beginning binds the name of Tesla [3,4] and it has become a hot topic nowadays. The wireless transfer of analogue or digital information has begun with Marconi patent in 1896, and continued with a long line of scientists and engineers, leading to ubiquitous and fabulous applications of wireless communications technologies [5].

Radio Frequency Identification (RFID) is one of these wireless technologies which use the property of electromagnetic field to propagate in a complete manner, both in the transmission of information and the transmission of energy.

The theoretical foundation of the process of communication in an RFID system, using the phenomenon of

backscattering has been described in [6]. This operating principle allows RFID systems to be used effectively in tracking and monitoring physical objects [7,8].

A generic RFID system consists of an RFID tag fixed on the object it identifies, a RFID reader and a software application. The reader sends a radio signal to the RFID tag, which, after receiving the signal, responds with a signal containing the tag identifier and other data regarding the identified object [9-11].

The successes in achieving RFID integrated circuits and software development, have led to lower prices, increase performances and RFID systems. As a result, RFID systems are widely used in logistics, defence, space, health [12-14].

Thus, the RFID system for supply chain management applications allows:

- substantiation consumption by analysing the use of objects before they become waste,
- analysis of energy use efficiency for production of goods,
- inventory, objectively and in real time, of monitored goods,
- reducing of consumer or industrial goods by inventory management.

There are still many RFID issues in actual researches: RFID tags miniaturization, reduction of energy consumption required for the activation of RFID tags, the integrity of Reader-Tag communication, possibility to use the tags in harsh environments, mitigation of the susceptibility to electromagnetic disturbances [15-19].

Introduction of the RFID systems in textile articles management raises specific issues related to the wash ability and endurance of RFID tags to harsh environmental conditions and repeated washing, the ways of fixing the RFID tag on the textile support, and the effective reading [20].

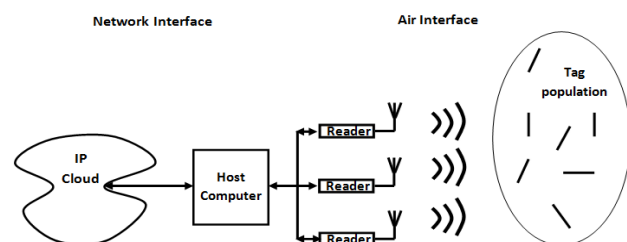


Fig. 1. General structure of a RFID system.

II. RFID TAGS PERFORMANCES

An RFID system includes RFID readers connected to a computer and a population of RFID tags, each tag identifying uniquely an entity (person, place or object) monitored via an inventory, monitoring or security software.

The RFID tag contains a digital electronic device capable of communicating according to the "Air Interface" protocol, by radio frequency electromagnetic waves, with RFID reader. Typically a software application manages several readers (Fig. 1).

Depending on how it is designed the software that controls the RFID system, access to the system can be limited to the local server (Host Computer), or can be allowed from any location with Internet access by Internet Protocols. Different RFID applications establish specific performance levels in terms of communication between RFID reader and RFID tag, and therefore the radio frequency should be specifically established. Ultra High Frequency (UHF) or Super High Frequency (SHF) are used when a high-speed communication and a greater reading distance are needed.

Depending on how extract their power to run, RFID tags are active, passive and semi-passive.

Active RFID tags use energy from their own internal battery, both for the reception of signals from the RFID reader and for the emission of signals from RFID tag, by backscatter, to the Reader. These tags are often compared with minicomputers being able to control proximity sensors, to perform logical operations and even make decisions. RFID systems with active tags operate over long distances. Usually, a RFID system is able to manage a population of thousands of active RFID tags with several RFID readers.

Semi-passive RFID tags, called Battery Assisted Tags, do not need its own power supply for receiving electromagnetic waves emitted by the reader. The formation of the reflected wave (backscatter waves) needs its own power supply.

Passive RFID tags do not use external power from batteries or accumulators. The passive RFID tag power is extracted from the electromagnetic field generated by the RFID reader antenna. Passive RFID tags advantages are directly related to their low cost of production and to the possibility of their easy attaching to the identified objects. These types of systems are widely used in supply chain systems due to low price and a form factor that does not depend on power source. Specific performance of RFID tags are given in Table I.

Applications that need a greater distance of communication is more efficient to work at high frequencies of the order 900 MHz (UHF), considering that with the increase of the frequency, length required for RFID antenna decreases and also increases the directivity of RFID reader antenna.

Thus, for the same RF power radiated by the RFID reader, RFID tag available power at high frequency is higher [10, 21, 22, 23]. However, increased to GHz, increase the complexity of RFID tag design and as a consequence, the price.

TABLE I
CHARACTERISTICS AND PERFORMANCE OF RFID TAGS

Types of RFID tag	Active RFID tag	Semi-active RFID tag	Passive RFID tag
Frequency	433 MHz	860-950 MHz	860 – 950 MHz.
Coupling	Radiation	Radiation	Electromagnetic field; Backscatter
Read rate, tags/second	500 – 1500	500 – 1500	500 – 1500
Read distance	1000-3000 m	100 m	10 m
Storage capacity	+60 kB	+60 kB	+100 B
Battery Lifetime	3 - 5 years	3 - 5 years	-
Cost	10\$ - 100\$	0.1\$ - 30\$.	0.10\$ - 20\$.

A specificity of UHF passive tags is that they transmit information only when they are in the reader electromagnetic field.

Further, efforts are made to improve the structure and functional characteristics of the passive RFID tags.

For communication over distances of several meters, passive RFID tag comprises a UHF antenna and an integrated circuit IC, tiny size, which, in its internal memory, stores the unique identifier of the object to which it is attached, and other information required by the concrete application.

The two fundamental components of the RFID tag are connected via an adaptive impedance structures. This allows resonance between IC and UHF antenna, which provide, on the one hand, a maximum transfer of electromagnetic energy from the reader to tag, and on the other hand, the integrity of transmitted / received data.

There are different various geometries and shapes of passive UHF RFID tags (Fig. 2)

From the constructive point of view (Fig. 2a), the core of the RFID tag is a the so-called "inlay" which comprises an electrically insulating substrate (1) (plastic, paper, fabric) on which there are placed UHF antenna (2) and adaptive impedance structure (3), made from electrically conductive materials (metallic wire, textile electroconductive yarn, nanowires).

Integrated circuit (4) is then bonded with a conductive adhesive to the adaptive impedance structure. Additionally, the "inlay" can be coated with textile or plastics.

Commercial passive UHF RFID tags, shown in Fig. 2b and Fig. 2c, include typical passive tags structure: integrated circuit, adaptive impedance structure and UHF antenna. The differences are given by the UHF antenna geometry (form factor, shape and number of meanders, shape of the tips).

An analysis of power levels handled in a RFID system with passive tags is shown in Fig. 3 [24]. Reader emission signal has a level of 30 dBm / 1W, and only -10 dBm / 0,1mW at 6 m distance, where we assume that passive RFID tag is.

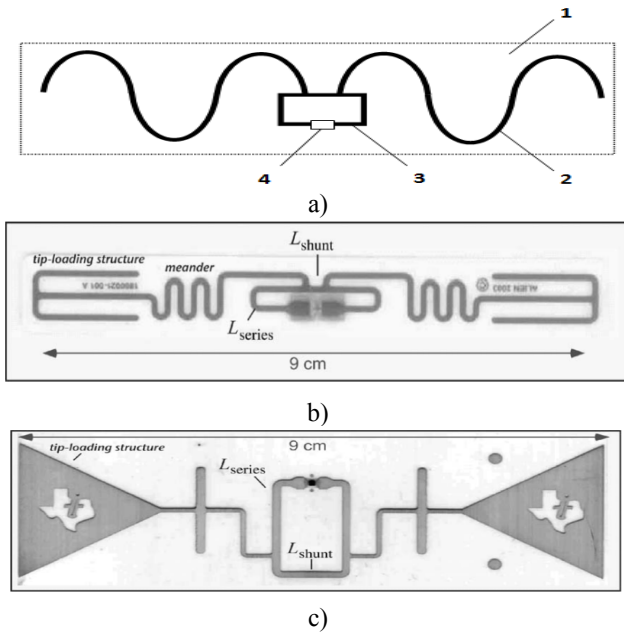


Fig. 2. Structures of passive RFID UHF tags:
a) generic structure; b) with meanders; c) with different shape of the tips.

After reflection (backscattering) on RFID tag, the signal will have the level of -60 dBm / 1nW to the RFID reader entry.

Thus, the main requirements that are taken into account in passive RFID tag designing are the reducing power consumption and the increasing degree of workability (constructive forms, increase rectifying efficiency, optimal choice of communication protocols, etc.).

To meet these functional requirements, advanced design and execution procedures of the tags must be correlated with the specific applications and environments where RFID tags will work.

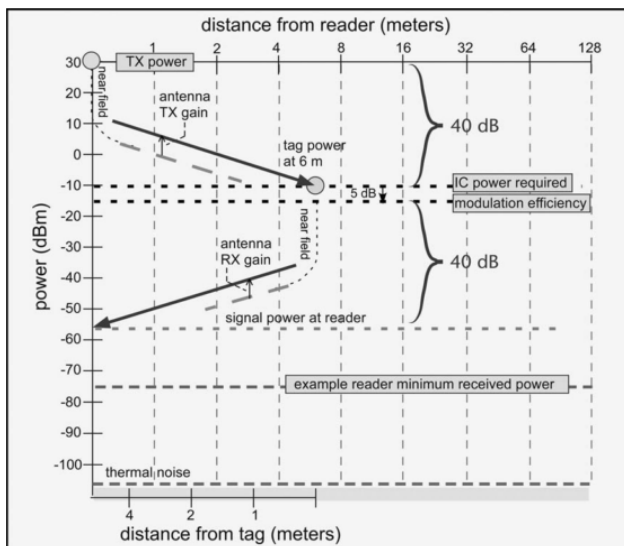


Fig. 3. Power levels in a RFID system with passive RFID tags [24].

III. ASSESSMENT OF WASHABLE PASSIVE RFID TAGS

A. RFID system and work environment description

In the area of Brasov town, an industrial laundry was equipped with a RFID monitoring system of textile objects, which consists in passive RFID tags, RFID readers and the RFID application that uses RFID data.

Readers are mounted in specific interrogation areas, called the read gates, in which are introduced trolleys filled with textiles RFID tagged, at the entry and the exit of laundry. It includes an interface that communicates with the articles monitoring software application that controls the washing procedures, distribution and use to the customer (Fig. 4).

RFID data is processed by operational management system, to fulfil its current tasks (good delivery, packaging, etc.), for data analysis applications, and for top level strategic management decision (Fig. 5).

The working environment for RFID tags embedded in textiles is complex in this case. Textiles, along with RFID tags, are subject to cyclic stress, on the supply chain, to the end user, and then the stage they reach the laundry.

RFID tags are stressed with specific industrial laundry environmental factors:

- washing temperatures of up to 90°C, more than 20 minutes,
- high temperature variations – cold/warm (8°C/90°C),
- chemical agents included in washing procedures,
- squeezing pressure of 40-60 bars,
- finishing / ironing temperatures of 200°C, tens of seconds.

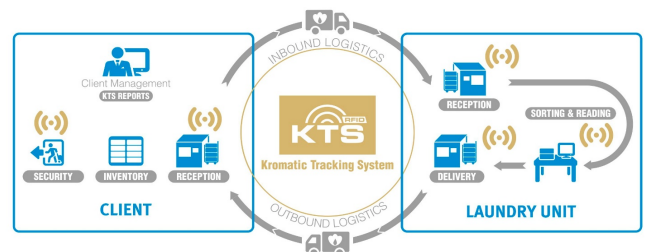


Fig. 4. Flow of information between client and laundry.

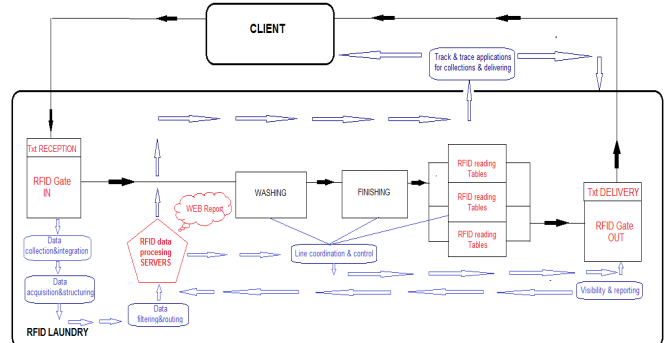


Fig. 5. Scheme of RFID data processed by operational management system.

Contact with water and other substances as detergents, temperature variations and mechanical stresses in the steps of washing, squeezing and ironing, are physical deteriorating RFID tags and decrease the efficiency of communication between reader and tag, but mostly destroy the galvanic connection between the integrated circuit and the adapting impedance structure.

B. The effects of washing cycles on RFID tags

To increase RFID technology efficiency, an analysis of the specific industrial laundries environment impact has been conducted to determine the causes of RFID tags deterioration and to identify optimal constructive/ functional solutions.

A first experiment was done on the samples of passive RFID tags, Fujitsu type, with adaptation impedance structure, which has been subjected to several washing cycles [25].

The inlay is done on a plastic substrate, which were made, by aluminium printed circuit structure, adapting impedance structure common with UHF.

The chip is glued fixed with conductive adhesive on the adapting structure impedance structure (Fig. 6, Fig. 7).

Fig. 6 shows the sample of UHF RFID tag view after the applied stresses, and when the protective silicone coating was removed.

Fig. 7 shows that the insulating substrate, the adapting impedance structure and the UHF antenna are in good state, the samples have resisted to the environmental stress conditions specific to industrial laundries.

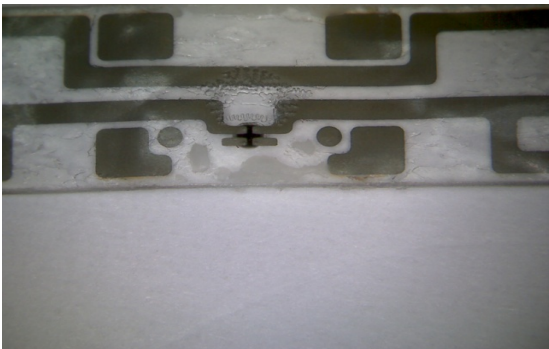


Fig. 6. UHF RFID passive tag - back view.

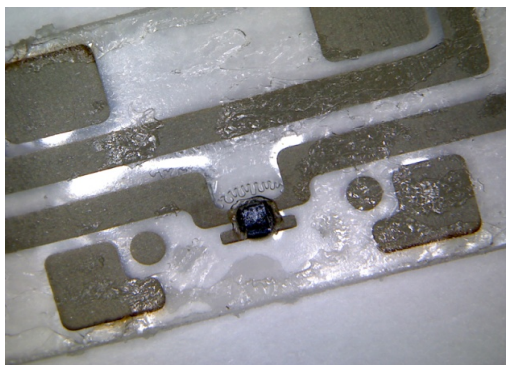


Fig. 7. UHF RFID passive tag - front view.

But the galvanic contact, made of conductive adhesive, between integrated circuit pins and the adapting impedance structure felt to the test. It follows that galvanic contact between integrated circuit pins and the adapting impedance structure have to be much better protected.

In order to establish relevant solutions for increasing the wash ability of passive RFID tags, new tests have been made to establish the impact of washing procedure and laundry environment on RFID tags integrated in textile articles.

In Table II, are summarized the stresses encountered by tagged textiles in different stages of laundry process, and the effects on tags integrity. In the worst case, the tag become no longer functional, the textile item lose its identity and the RFID monitoring system is useless.

The weak points of actual passive UHF RFID tags were analyzed and solutions regarding the architecture and the materials the tags are proposed:

- to develop adequate materials to protect "inlay" support,
- for RFID tag components, to use materials with the same thermal dilatation coefficient,
- for UHF antennas, to use electrical conducting materials with mechanical strength closed with textile article,
- optimization of the design of the UHF antenna,
- establishing new methods for electrical contact between CI pins and UHF antenna.

Regarding the galvanic connection points, there are specific solutions, as:

- reduction to minimum the galvanic contacts of tag architecture, and removal, as it is possible, of galvanic contact with the inductive coupling,
- protection of galvanic contacts,
- achieving more robust galvanic contacts,
- use of materials with flexibility close to the textiles ones when building the UHF antennas. Nowadays, there are related the uses of electrically conductive textile yarns [22] or conductive inks [23].

The result of analysis certified the main way for the passive RFID tags with adaptation impedance structure to withstand the stress specific to industrial laundries is a well protection of the galvanic connection points of integrated circuit pins.

Indeed, the solution that has been imposed for RFID tags used in industrial laundries was to create a small transponder, centimetre range, inductive coupled with the UHF antenna (Fig. 8).

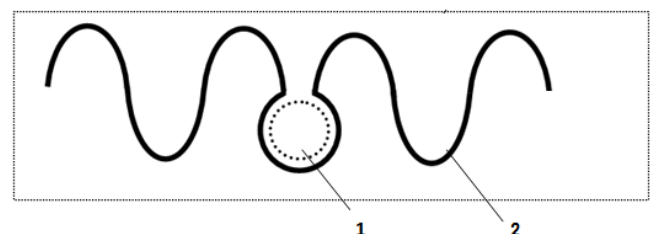


Fig. 8. The structure of a RFID tag with an encapsulated transponder (1) inductively coupled with the UHF antenna (2).

TABLE II
STAGES, STRESS CYCLES AND EFFECTS ON RFID TAGGED TEXTILES IN THE INDUSTRIAL LAUNDRY

No.	Stage	Tag stress	Aspect	Effects
1	Textile reception	- Mixing of textiles results in folding, creasing and random position UHF antennas of RFID tags.		- Transfer of energy RFID tag – reader, and data integrity is seriously affected.
2	Washing procedures	- RFID tag contact with water, detergents, industrial chemicals class. - Washing temperatures up to 90°C, more than 20 min. - Repetitive cold-warm variations (8°C-90°C). - Stress to mechanical forces specifically for the washing process.		Textile article loss of identity due to: - stitches weakening or tearing of the textile material, - breaking in the contact area of the various components (IC, adapting impedance structure, conductive adhesive) which make the galvanic electrical contact.
3	Squeezing procedures	- Stress with pressure of 40-60bars.		- Encapsulated transponder from the RFID tag breaking or its separation from the textile cover.
4	Finishing procedures	- Tens of seconds at about 200°C temperatures, - High pressure.		- Breaking the encapsulated transponder of the RFID tag due to the effect of the pressure, - Destruction in the encapsulated transponder of the textile support, followed by its loss.

The micro-transponder is well protected in a capsule that isolate it electrical, mechanical, thermal and chemical from the environment of the laundry.

Electromagnetic performances are satisfactory, the reading range is 3-5 meters.

Although surpass in reliability tags with adapting impedance structure, in aggressive environments, specific to industrial laundries, even passive RFID tags with encapsulated transponders are destroyed at 15-25% rates.

The weak point, this time, is transferred to the encapsulated transponder, where the galvanic connections between the integrated circuit pins and the conductive loop could be interrupted, leading to loss of textile article identity.

An evaluation of the galvanic connection between the integrated circuit pins and the loop wire, analysis methods of making such connections and materials used, premise

solutions that will lead to the development of even more robust and reliable passive RFID tags.

IV CONCLUSIONS

RFID technology is widely applied in the tracing items throughout their lifetime, being a valuable tool in supply chain management and strategic decisions in energy and materials savings, safety and security.

Effective monitoring process is closely link to keeping the identity of products that can be lost if the tag is no longer functional, either by physical destruction of some of its components or by interruption of electrical contact between them.

This paper identifies the weak points of actual passive UHF RFID tags, and proposes solutions to have passive UHF tags, robust enough to operate in harsh environments specific to

industrial laundries, with a lifetime sufficiently long, and cost-efficient, at the parameters set by the laundry application.

The tag architecture design must minimise the number of galvanic contacts, by removal, as it is possible, of galvanic contact with the non-contact inductive coupling. Passive UHF RFID tags with encapsulated transponders are recommended in textile logistics in aggressive washing processes.

The materials for the tag components have to resist to the industrial laundries harsh conditions, with mechanical and thermal properties close to those of textile materials.

This research was carried for sustaining the implementation of a RFID monitoring system in a modern industrial laundry, built in 2011 within the company PROMAR in industrial park Prejmer, from Brasov County.

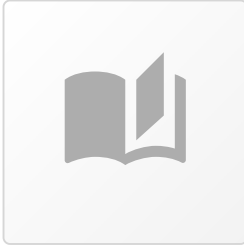
Implementing a RFID monitoring system operating in the field of UHF has enabled rapid reading of hundreds of textile articles and formed the basis for the development of high performance computing applications in one of the most modern industrial laundries in the world.

Accumulation of knowledge related to tags for harsh environments made possible the development of the specific passive RFID UHF tags for the laundry.

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APPENDIX B



Books

2017-10th International Symposium on Advanced Topics in Electrical Engineering (ATEE)

SUMMARY

ATEE is the forum that stimulates the active and effective exchange of information between researchers in various areas of theoretical and applied electrical engineering. Key leaders from private and state owned companies involved in will also be in attendance.

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FORMAT

Books

LANGUAGE

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[Piscataway, New Jersey] : IEEE, [2017?]

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Subjects

Electrical engineering--Congresses

Génie électrique--Congrès

Electrical engineering

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Conference papers and proceedings

Actes de congrès

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APPENDIX C

Staff view for 2017-10th International Symposium on Advanced Topics in Electrical Engineering (ATEE)

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APPENDIX D

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Abstract

Document Sections

I. Introduction

II. RFID Tags Performances

III. Assessment of Washable Passive Rfid Tags

IV Conclusions

Authors

Figures

References

Citations

Keywords

Metrics

Abstract:

Radio Frequency Identification (RFID) technology, by assigning a unique identifier to each product allowed spectacular development of wireless monitoring and control applications. With the advances of tags with passive integrated circuits, operating without a self-contained energy source, extracting the needed energy from the energy of electromagnetic waves generated by an interrogator, RFID applications extended to processes held in harsh industrial environments. For textile articles, in industrial laundries, the RFID system with passive RFID tags involves specific architectures and building solutions. The paper analyses the weak points of actual passive UHF RFID tags and proposes solutions regarding the architecture and the materials used in construction of tags suitable for laundry applications. Thus, new requirements have been established to design passive RFID tags: they should be washable and wearable, robustness enough to operate in harsh environments, with a sufficiently long lifetime, and cost-efficient.

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Publisher: IEEE

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I. Introduction

In 1873 Maxwell in his famous treaty [1], for the beauty of mathematical equations symmetry, introduced in Ampere's Law, the term:

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