UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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HID GLOBAL CORPORATION,
Petitioner,

v.

DATAMARS SA,
Patent Owner.

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

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

**Declaration of Kelley M. Hayes Greenhill Regarding Exhibit 1012 ("*Guibert*")**

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; and field tag 588 includes the general and specific source of description notes.

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. Public Availability of *Guibert* (Exhibit 1012)

14. This Declaration relates to the dates of receipt and public availability of the following reference: Maxime Guibert, Alexandre Masslcar, Xiaochen Chen, Han He, Jeremie Torres, Leena Ukkonen and Johanna Virkki,

"Washing Reliability of Painted, Embroidered, and Electro-textile Wearable RFID Tags," *("Guibert")* found within the 2017 Progress in Electromagnetics Research Symposium – Fall, Singapore, 19 -22 November 19 -22, pp. 828 - 831. I understand that *Guibert* has been submitted as Exhibit 1012 in this proceeding. That same reference is appended to my Declaration as **Appendix A**.

15. As detailed below, I have reviewed the reference, public holdings information and Stanford University Library MARC record for *Guibert* to determine the date of public availability for this reference.

16. **Appendix B** to this declaration is a true and correct copy of the Stanford University library public catalog and MARC for its copy of the publication *2017 Progress in Electromagnetics Research Symposium – Fall (PIERS – FALL) : PIERS 2017 Singapore: proceedings: 19-22 November 2017, Singapore*, containing *Guibert*, which was downloaded from: https://searchworks.stanford.edu/view/13252333.

17. The Stanford University MARC record for *Guibert* identifies the fixed data elements of MARC field tag 008 as 180408t20171017njua ob 101 0 eng d. This indicates that the record for *2017 Progress in Electromagnetics Research Symposium – Fall (PIERS – FALL): PIERS 2017 Singapore: proceedings: 19-22 November 2017* was last

catalogued by Stanford University on April 8, 2018. The publication status code "t" appearing in MARC field tag 008 refers to "publication date and copyright date" indicating that this item has a publication date of 2017 and a copyright date of 2017. Based on this MARC record, and the receipt and processing of *Progress in Electromagnetics Research Symposium – Fall (PIERS – FALL): PIERS 2017 Singapore: proceedings: 19-22 November 2017* by Stanford University Library, *Guibert* would have been catalogued and made available to the public in 2017.

18. The Stanford University Library MARC record for Progress in Electromagnetics Research Symposium – Fall (PIERS – FALL): PIERS 2017 Singapore: proceedings: 19-22 November 2017 containing *Guibert* includes field tag 245, which denotes the title and statement of responsibility for the work as "a| 2017 Progress In Electromagnetics Research Symposium – Fall (PIERS-FALL) :b| PIERS 2017 Singapore : proceedings: 19-22 November 2017, Singapore."

19. In the Stanford University Library MARC catalog record, field tag 264 denotes information relating to the place of publication, name of publisher, and date of publication of *Progress in Electromagnetics Research Symposium – Fall (PIERS – FALL): PIERS 2017 Singapore: proceedings: 19-22 November 2017* as "a| Piscataway, NJ :b| IEEE, c| 2017. Subfield code "a"

refers to the place of publication. Subfield code "b" refers to the name of the publisher. Subfield code "c" refers to date of publication, which for this record is 2017.

20. In the Stanford University MARC catalog record, field tag 588 includes the general and specific source of description notes. In this record for *Guibert*, the "Description based on online resource; title from PDF title page (IEEE Xplore, viewed May 16, 2018).

21. The Stanford University public catalog record for Progress in Electromagnetics Research Symposium – Fall (PIERS – FALL): PIERS 2017 Singapore: proceedings: 19-22 November 2017 sets forth the holdings information for members of the public seeking *Guibert*. The public catalog record indicates that the *Guibert* is available online through IEEE Xplore Digital Library.

22. Based on the information in **Appendices A and B**, it is clear that the issue of Progress in Electromagnetics Research Symposium – Fall (PIERS – FALL): PIERS 2017 Singapore: proceedings: 19-22 November 2017 containing *Guibert* was available in 2017.

## VII. Conclusion

23. 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.

24. 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 Progress In Electromagnetics Research Symposium — Fall (PIERS — FALL)

PIERS 2017 Singapore

www.emacademy.org
www.piers.org

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# Washing Reliability of Painted, Embroidered, and Electro-textile Wearable RFID Tags

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**Abstract**— In this paper, we present textile antennas fabricated for wearable RFID applications by cutting from commercially available electro-textile, by sewing with conductive thread, and by painting with conductive paint on a 100% cotton fabric. The ready tags with attached ICs are coated with a protective encapsulant. The wireless performance of the tags is evaluated initially, after moisture testing in tap water, and after five washing cycles in a household washing machine. The initial read ranges of the electro-textile, embroidered, and painted tags are around 10, 6, and 4 meters, respectively. Based on the reliability testing results, the coating protects the components from moisture but the mechanical stress during washing cycles has a major effect on the tags' reliability.

## 1. INTRODUCTION

A passive RFID (radio frequency identification) tag consists only of an antenna and an IC (integrated circuit), and it uses the power from the reader to energize itself and backscatter its data. As no onboard power sources or complex systems are needed, these wireless platforms offer versatile possibilities when embedded into clothing. In addition to light and conformal wearable identification and tracking applications, RFID technology could be utilized in healthcare and sports related wireless systems, such as in passive on-body sensors [1–3].

Conductive fabrics, i.e., electro-textiles, are a great example technology, which can be used to utilize cost-effective antennas for wearable solutions [4, 5]. Electro-textile materials are easy to cut and can be unnoticeably embedded into traditional textiles. Sewing with conductive thread is a versatile manufacturing method, which has great possibilities in textile antennas, due to its compatibility with various textile materials and easily modified conductive patterns [6, 7]. Further, conductive paint, which can be brush-painted like a traditional paint, and requires no post-processing, has been found to be a potential new approach for fabricating antenna structures [8, 9]. In many applications, the reliability of textile-integrated wireless components is critical, and especially moisture and washing are among the key reliability challenges [10, 11].

In this paper, we present textile RFID tag antennas, fabricated by cutting from commercially available electro-textile, as well as by embroidering with conductive thread and painting with conductive paint on a cotton substrate. The ready tags equipped with ICs are coated with a protective encapsulant and the wireless performance of the tags is evaluated after coating, after one hour in tap water, and after five washing cycles in a household washing machine.

## 2. TAG FABRICATION

The tag antennas used in this study were T-matched dipoles with the structure shown in Figure 1. The electro-textile tag antennas were cut with scissors from Less EMF Pure Copper Polyester Taffeta Fabric (Cat. #A1212), which is a thin and lightweight conductive textile material. The painted tags were fabricated on a thin 100% cotton fabric. We chose to coat the fabric with the protective encapsulant first, and then paint the antennas on the coated substrate. The selected coating, DuPont PE772 stretchable encapsulant, was applied on the fabric, and the substrate was dried in 100°C for 60 minutes. The used conductive paint was Bare Conductive's nontoxic, solvent free, and water soluble Electric Paint. The tag antennas were brush-painted on the coated fabric through a stencil cut from plastic, by using one layer of paint. Then, the painted antennas were dried in 70°C for 30 minutes to maximize their conductivity. Finally, the embroidered antenna contours were sewed on the same cotton fabric with Husqvarna Viking embroidery machine. The used conductive yarn was Shieldex multifilament thread 110f34 dtex 2-ply HC.

The tag IC was NXP UCODE G2iL series RFID IC, which has a wake-up power of −18 dBm (15.8 μW). The IC is attached by the manufacturer in a strap. The strap copper pads were attached

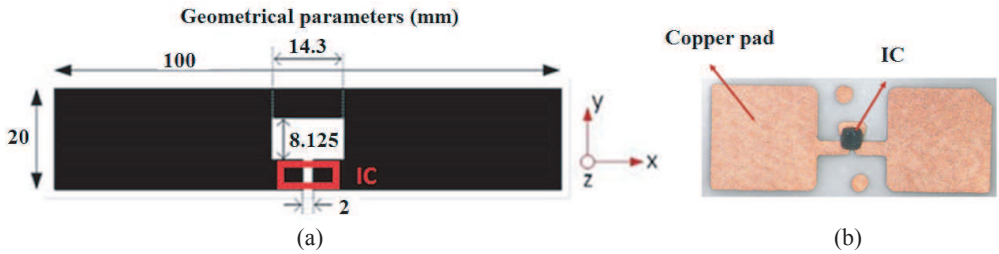


Figure 1: (a) The used tag antenna design and (b) IC strap.

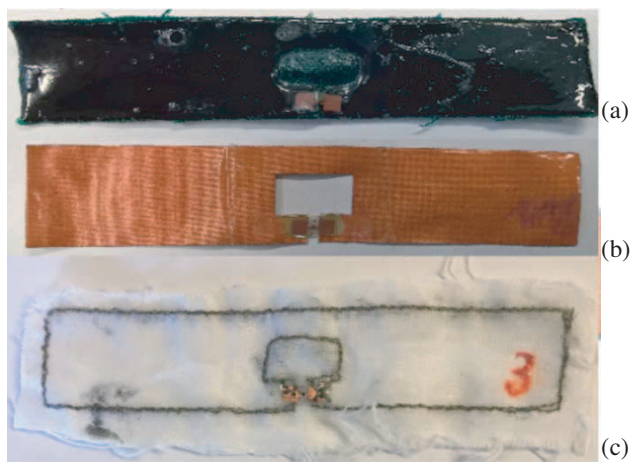


Figure 2: Ready tags with (a) painted, (b) electro-textile, and (c) embroidered antennas.

to the fabricated antennas using Circuit Works CW2400 conductive silver epoxy. For comparison, in case of the painted tags, the IC strap pads were also attached directly to the paint, when it was still wet. Also, in case of the embroidered tags, the attachment was also fabricated by sewing a cross over the IC pads with conductive thread, as shown in Figure 2.

Following the attachment of ICs, the coating material was applied on both sides of the electro-textile and embroidered tags, by dip coating. The coating was also brush-painted on top of the painted antennas. Next, all tags were dried in 100°C for 30 minutes. The extended drying time and the low drying temperature (recommendation from the coating manufacturer was 100–160°C for 2–10 minutes) were chosen because of the low temperature endurance of the IC component and the relatively thick coating layer protecting the IC. For each tag type, four tags were fabricated and these ready tags are presented in Figure 2.

## 3. MEASUREMENTS AND RELIABILITY TESTING

The wireless performance of the fabricated and coated textile tags was evaluated in an anechoic chamber, using Voyantic Tagformance RFID measurement system. The system contains an RFID reader with an adjustable transmission frequency (0.8 . . . 1 GHz) and output power (up to 30 dBm), and the recording of the backscattered signal strength (down to −80 dBm) from the tag under test is provided.

First, the wireless channel from the reader antenna to the location of the tag under test was characterized using a system reference tag with known properties When evaluating the tags, the lowest continuous-wave transmission power (threshold power: $P_{th}$) at which the tag remained responsive, was recorded. $P_{th}$ is defined as the lowest power at which a valid 16-bit random number from the tag is received as a response to the *query* command in ISO 18000-6C communication standard. The attainable read range of the tag ($d_{tag}$) versus frequency can be calculated from

$$d_{tag} = \frac{\lambda}{4\pi}\sqrt{\frac{EIRP}{\Lambda}\frac{P_{th*}}{P_{th}}}, \tag{1}$$

where $P_{th}$ is the measured threshold power of the tag, $\Lambda$ is a known constant describing the sensitivity of the system reference tag, $P_{th*}$ is the measured threshold power of the system reference

tag, and *EIRP* is the emission limit of an RFID reader given as equivalent isotropic radiated power. All the results are corresponding to $EIRP = 3.28\,\mathrm{W}$, which is the emission limit in European countries.

The reliability of the tags was evaluated with a moisture test, where the tags were placed into room temperature tap water for 1 hour. After the moisture test, the same tags were washed in a household washing machine, by using a normal 40°C washing cycle with detergent and spinning. The tags were measured after the moisture test and after each washing cycle. Altogether five washing cycles were done.

## 4. RESULTS

The read ranges of the coated electro-textile, embroidered, and painted tags were around 10, 6, and 4 meters, respectively. All the read range results are presented in Figure 3. The IC attachment method (glued compared to painted/sewed) in case of the painted and embroidered tags did not have an effect on the read range results. As can be seen from the results, all types of tags were able to maintain their read ranges after the moisture test. Thus, the protective coating was very effectively protecting the tags from moisture.

However, washing was found to be detrimental for the tags: The painted conductor was found to crack because of the mechanical stress during washing, and thus the painted tags cannot be considered suitable for wearable applications requiring washing in a washing machine. Figure 3 shows the wireless performance of a painted tag: after the first washing cycle, the read range was slightly decreased and there were some cracks on the tag antenna. However, already after the second washing cycle, the tag did not respond at all, and the surface of the antenna showed serious cracking.

The electro-textile tags and the embroidered tags survived all five washing cycles, but also their read ranges slightly decreased after each washing cycle. Also, in further washing tests, some of the tested electro-textile and embroidered tags broke due to the mechanical stress harming the antenna-IC joint. Tags with both types of IC attachment method were found to break during washing. Thus, based on the results, the tested encapsulant can be considered a potential protective coating for textile-integrated wireless components, as they were able to maintain the excellent read ranges after 1 hour in water. The coating seems to also protect the components during washing, to a certain

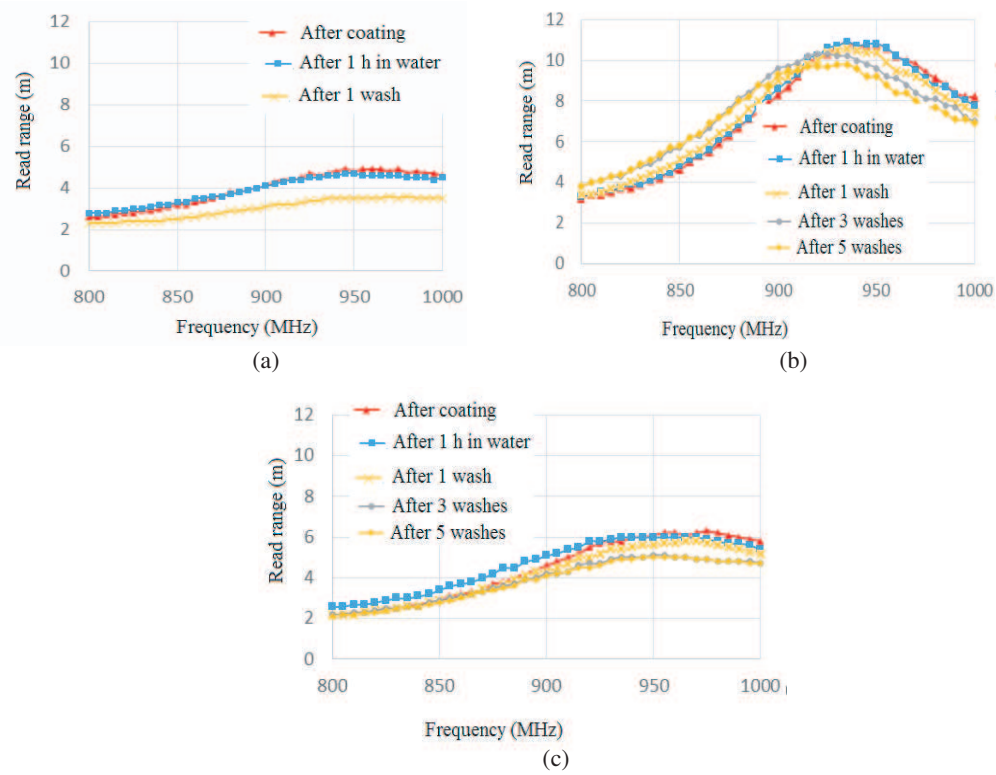


Figure 3: The read range results of (a) painted, (b) electro-textile, and (c) embroidered tags.

degree, but the mechanical stress has a major effect on the tags' reliability.

In the next step of this research, further support material is needed around the antenna-IC attachments, in order to make these tags truly washable. Further work also includes studying different textile substrates and conducting washing tests with more washing cycles.

## 5. CONCLUSIONS

RFID-based wearable platforms are among the key technologies to build the future of wearable wireless networks. We studied the fabrication and washing reliability of RFID tags with painted, embroidered, and electro-textile antennas. The fabricated tags were coated with a protective, flexible encapsulant, and their reliability was studied in tap water, as well as after five washing cycles. The initial read ranges of the electro-textile tags, embroidered tags, and the painted tags were around 10, 6, and 4 meters, respectively. The encapsulant was found to be a potential protective coating for these textile tags, as they were able to maintain the excellent read ranges after the moisture test. However, washing in a washing machine was found to be damaging for the tags. The painted antennas were found to crack and break due to the mechanical stress. In addition, the antenna-IC interconnections were found to be easily breakable in a normal household washing machine.

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# APPENDIX B

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▶ Holdings JSON

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