High-capacity Memory RF Tag by FRAM

In January, FUJITSU released the RF tag with high-capacity memory for the aviation industry. This article introduces its applications and innovativeness. This memory adopts FRAM, which offers high-speed reading and writing to realize a high-capacity of 64Kbytes for the first time in the world on a practical level.

Introduction

FUJITSU has released a UHF band RF tag with 64Kbytes user memory. This RF tag fully conforms to the required specifications for parts life-cycle control in the aviation industry. It is a product with a new concept, "writable and readable memory with contactless+RF tag"—it can offer a completely different solution from the conventional RF tag that has only about 100-bit ID.

RF tag originally played the same role as conventional barcodes: determining the unique identification code system within the subject system using a small 64-bit or 96-bit memory. Tags inside boxes and so forth may be used as a new medium that can be read in bulk from remote locations. They can also hold identification key information to track the location of the object with the tag and search the database for the object.

We expect that the solutions that can be developed will change dramatically with the utilization of this newly released high-capacity memory.

Main Specifications

In UHF band frequencies with which reading and writing is expected at a relatively long distance, EPC global[1] C1G2 specification[2] is recognized as a global standard for the communication protocol (air interface) with reader-writer systems and is rapidly becoming popular. This product is capable of reading and writing via an interface whose basic components conform to the C1G2 world standard. It requires no special reader-writer system and so forth in adoption. This means that worldwide operation is possible because it adopts the global standard specification.

The main features of this product are listed as follows:

- **Air interface conforms to EPC global C1G2 and ISO/IEC 18000-6 Type C**[3]
- **User memory area is 64Kbytes and high-speed reading and writing by FRAM**[4] **is possible**
- **Security functions such as password writing lock added as original specifications by FUJITSU**
- **Tag clears the airworthiness standard SAE AS5678**[5]**—it can thus be affixed to an aircraft**

Photo 1 External View

- Antenna specifications support different frequency bands by region such as Japan, Europe, and the U.S. (860 to 960MHz)

This product permits reading and writing without contacting the reading system and is portable like the widely popular USB memories. In short, it is a "wireless memory" product.

Examination of Utilization in the Aviation Industry

This article briefly examines how the aviation industry, which is currently researching the utilization of this memory, plans to use it.

Aircraft (commercial aircraft) have many loaded systems (parts). There is a parts supply chain for some parts in which they are repaired or modified after certain periods of use and are reused or sold among companies as parts (**Figure 1**). Parts are distributed through different organizations including parts manufacturers (suppliers), aircraft manufacturers, airlines operating aircraft, and MRO (Maintenance Repair Overhaul) to repair the parts.

The goal is to standardize the operation for the entire aviation industry by affixing this high-capacity memory to individual parts as a medium to record the service and repair history. In the memory of this tag, they will record the information that had conventionally been controlled separately on paper or in the database of each company. This will prevent the loss of necessary technical information for servicing and improve the accuracy and efficiency of work to lead to higher parts quality and safety. Expectations have recently been growing in the highly competitive aviation industry to use this as a solution and technology to realize safe and efficient aircraft operation by reducing the turnaround period for various processes.

According to the released Aerospace Standard AS5678, which leads the industry, the required specifications for high-capacity memory RF demanded in the aviation industry are as follows:
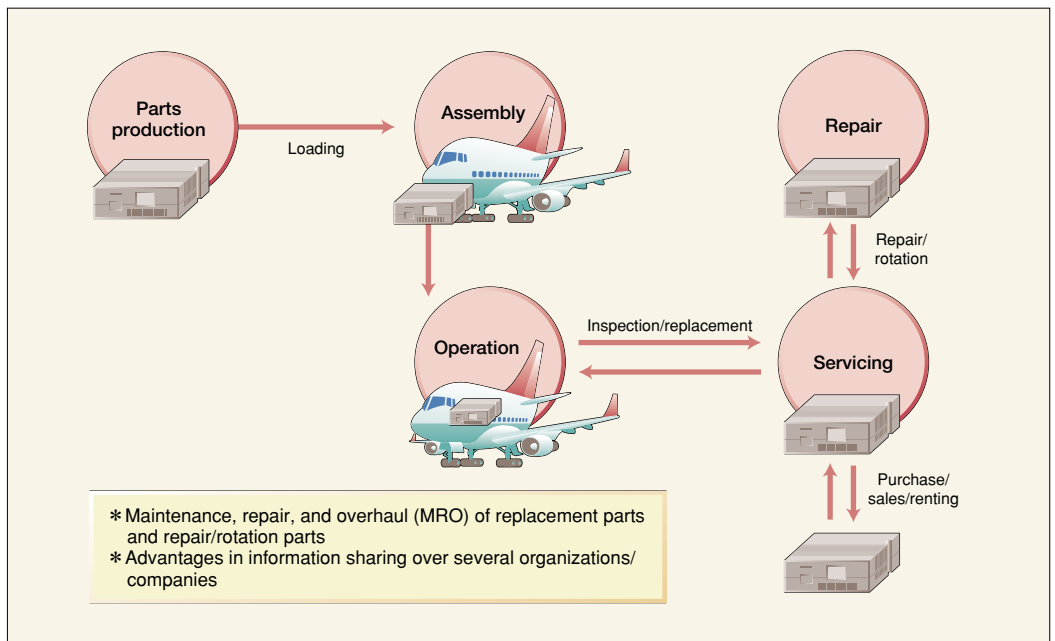
- It should be a passive, high-speed protocol RF that does not transmit radio waves from itself
- It should support the 860 to 960MHz frequency band that covers Japan, Europe, and the U.S.
- It should have memory security measures for reading and writing (overwriting prohibition, etc.)
- It should conform to ATA[*6] SPEC Chapter 9
- It should satisfy the airworthiness specifications of RTCA DO160E/SAE AS5678
- It should have a package structure well suited for metals and should have surface protection
- It should have durability of 20 years
- It should conform to the FAA memorandum announced on May 15, 2005
- The air interface should conform to EPC global C1G2 (ISO 18000-6C)

When an RF tag product of specifications that realize the highest requirements in the world is released into the market, it is expected to be applied in various areas such as production control, product life-cycle recording, and so forth.

Features and Future Issues

This product adopts the EPC global C1G2 specification, which is expected to become the practical global standard for air interfaces. The purpose of this is to minimize the facility

Figure 1 Aviation Industry Product Supply Chain

Parts production → Loading → Assembly

Assembly ↓

Operation — Inspection/replacement → Servicing

Servicing ← Operation

Repair ↕ Repair/rotation Servicing

Servicing ↕ Purchase/sales/renting

∗ Maintenance, repair, and overhaul (MRO) of replacement parts and repair/rotation parts
∗ Advantages in information sharing over several organizations/companies

investment by our customers by allowing reading and writing from the many existing reader-writer systems purchased for other purposes. It also means that this equipment can be used in other applications as well. We believe that its utilization will be mainly in handy reader-writer systems to read or write by bringing it close to each tag under such access to read or write the information in memory unlike the conventional use of RF tags to read in bulk when they pass the gate.

The advantages of FUJITSU's FRAM-RF tag compared to the conventional E^2PROM-RF tags are that its speed and necessary distance are identical for reading and writing. There is a difference of several minutes to fully write the 64Kbytes. Furthermore, it overcomes the operational weakness of E^2PROM-RF tags that need to come closer to the tag to write than to read.

ATA SPEC2000 is a document that specifies various procedures for commercial aircraft. There is a description on barcodes in Chapter 9. This chapter is currently being revised to describe the standardization of information written in high-capacity memories and its format. Once it is completed, it will be possible to develop reader-writer system software programs and applications that meet industry standards—the users benefits will be immense.

Problems that remain in this industry include the following:
- **Unification and standardization of original security specifications by each manufacturer outside the EPC global C1G2 specification**
- **Short memory lifetime compared to aircraft parts that are used for long periods**
- **Tags are easily damaged under high-temperature environments and tend to generate data errors**

If these issues are resolved, the range of tag application may expand even further. In fact, EPC global is working on the above issues as "Class 2" regarding the standardization of security specifications. As for the short memory lifetime issue, we are considering solving the problem in operations by replacing the tag after a certain period of use during regular servicing and so forth.

Application Points and the Future

As discussed above, it is anticipated that this high-capacity memory, which allows the reading and writing without contact, will be applied in various different ways than the conventional RF tags that solely serve as IDs. Its memory can be used locally in addition to the identification process. Future applications can be expected from the following viewpoints:
- **Capable of constructing a system to read and write the minimum necessary information other than ID using a user memory without connection to the network**
- **Capable of constructing a system to transmit information among multiple users with different systems with an image like a signboard**
- **Enables the pursuit of security, safety, and cost reduction by forming a worldwide traceability system for important components**

In the future, it may be applied in information management at various production sites and "charts" to maintain product life-cycle records. It is also expected to be applied in common supply chains for various industries in a similar fashion to the business model for this aviation industry.

It may also be utilized in the automatic writing of log information in combination with various sensors to detect the temperatures, impact, and so forth, as well as in the analysis of the progress information after pickup. We invite you to join us in thinking about how applications could expand as memory capacity increases in the future. ✱

NOTES

✱1: EPCglobal: EPCglobal is a non-profit organization established by GS1 (formerly known as EAN International), which promotes the international standardization of barcodes, and GS1 US™ (formerly the Uniform Code Council, Inc.).

✱2: CIG2 (Class 1 Generation 2) : Communication protocol between the UHF band RF tag and the reader-writer developed by EPC global and the standard specifications for the 2nd generation that has improved performance over EPC Class1.

✱3: ISO/IEC 18000-6 Type C: Communication standard for UHF band RF tags, which was internationally standardized by ISO based on EPC global Class1 Generation2.

✱4: FRAM: Ferroelectric Random Access Memory (also referred to as FeRAM). Memory that uses ferroelectric film as a capacitor for storing data. Featuring advantages of both ROM and RAM devices, FRAM features high-speed access, low power consumption, and high endurance for numerous rewrites.

✱5: SAE AS5678: Issued by the SAE (Society of Automotive Engineers) in December 2006, SAE AS5678 is a standard defining environmental specifications and test methods for passive RF tags used in aviation applications. SAE has categorized and defined environmental specifications for RF tag use, for the three environmental categories of "Standard," "Robust" and "Harsh."

✱6: ATA: The ATA (Air Transport Association) provides various standards for the operation of commercial aircraft including SPEC2000 for procedures of aircraft servicing and operation.