FUJITSU FRAM RFID

開啟物聯網被動裝置新紀元

July. 2017

Fujitsu Electronics Pacific Asia Ltd. Taiwan Branch
Fujitsu Semiconductor Limited
Fujitsu Semiconductor Group

High Quality and High Performance Memory
- FUJITSU SEMICONDUCTOR LTD.

High Reliable Technology and Services
- MIE FUJITSU SEMICONDUCTOR LTD.
- AIZU FUJITSU SEMICONDUCTOR LTD.
- AIZU FUJITSU SEMICONDUCTOR WAFER SOLUTION LTD.
- AIZU FUJITSU SEMICONDUCTOR MANUFACTURING LTD.

Global support
- FUJITSU ELECTRONICS INC.
- Fujitsu Electronics(Shanghai) Co.,Ltd.
- Fujitsu Electronics Pacific Asia Ltd. Taiwan Branch
Fujitsu FRAM Products

**Standalone**
More than 1,000 customers mainly for Industrial automation

**RFID**
Working closely with Global leading Tag/Inlay manufactures

**Authentication**
Customized chip Shipping 250Mpcs/y
Agenda

- Company Introduction
- Introduction of Battery-less RF solution
- Benefits of Battery-less RF solution
- Applications
- Products Lineup
Can you imagine a IoT embedded device **without battery and MCU**?
Battery-less RF solutions

Feature of Battery-less RF solutions
1. No MCU
2. No Battery

- **Existing system**
  - Antenna
  - Reader/Writer
  - MCU
  - Dual I/F RFID
  - Battery
  - LED
  - E-Paper

- **New system**
  - Antenna
  - Reader/Writer
  - Battery-less RF
  - LED
  - E-Paper

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The concept of Battery-less RF solutions

Conventional wireless system

- RF Device
  - Wi-Fi
  - BLE
  - ZigBee
- DC/DC
- MCU
  - GPIO
  - I2C, SPI
- External Device
  - Sensor
  - Key PAD
  - EPD
- Memory
- F/W

Battery-less RF solution

- RF Device
- UHF RFID
- DC/DC
- MCU
  - GPIO
  - I2C, SPI
- External Device
  - Sensor
  - Key PAD
  - EPD
- Memory
- App. Specific Logic
- New RFID LSI

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Company Introduction

Introduction of Battery-less RF solution

Benefits of Battery-less RF solution

Applications

Products Lineup
FRAM RFID Benefits

1. Battery-less solution
   ✓ Enable to control sensor devices
   ✓ Enable to supply power to sensor devices
   ✓ Enable to connect to embedded devices through SPI I/F

2. Built-in FRAM
   ✓ Fast Writing Speed
   ✓ Strong Radiation Tolerance
   ✓ High Density Memory
Benefit 1: Battery-less RF solutions

Feature: Control and Supply Power to Sensor Devices
Benefits: Reduce BOM, reduce PCB physical size, and ECO friendly

- Application: Environment Monitoring, Metering, Data Recording

Battery-less RF

Commands:
- Checking sensor data
- Changing display
- Changing MCU setting

Data:
- Sensor data
- Measurement Data
Benefit 1: Example of Battery-less E-Paper

- **Antenna**
- **Battery-less RF**
- **E-Paper Module**
- **Supply Power**
- **Control E-Paper**
- **Reader/Writer**

**Applications**
- Electronic Shelf Label
- Distribution Food Tray
Benefit 1: Example of Battery-less Key Board

- **Applications**
  - Key Board
  - Remote Controller
  - Key PAD
  - Door Lock System

- **Antenna**

- **Fujitsu Battery-less RF**

- **Key Scan**

- **16 x 8 (max) Key Matrix**
Benefit 1: Battery-less Key Board Demo

Battery-less RF

TEST Circuit

FPGA

TEST Circuit

UHF R/W and antenna

Demo-Board

Store-bought Keyboard

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Benefit 1 : Battery-less Key Board Demo
Benefit 2: Built-in FRAM

Three big advantages of FRAM:

- High Endurance
- High Speed Writing
- Radiation Tolerance
### Benefit 2: Built-in FRAM

<table>
<thead>
<tr>
<th></th>
<th>FRAM</th>
<th>EEPROM</th>
<th>Flash</th>
<th>SRAM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Write cycle time</strong></td>
<td>![Checkmark] 150ns</td>
<td>5,000,000ns (5ms)</td>
<td>10,000ns (10μs)</td>
<td>![Checkmark] 55ns</td>
</tr>
<tr>
<td><strong>Write Endurance</strong></td>
<td>![Checkmark] 10,000,000,000,000</td>
<td>1,000,000</td>
<td>100,000</td>
<td>![Checkmark] Unlimited</td>
</tr>
<tr>
<td><strong>Back up Battery</strong></td>
<td>![Checkmark] No</td>
<td>![Checkmark] No</td>
<td>![Checkmark] No</td>
<td>![Checkmark] Yes</td>
</tr>
<tr>
<td><strong>Rewriting method</strong></td>
<td><strong>Overwrite</strong></td>
<td><strong>Erase + Write</strong></td>
<td><strong>Sector Erase + Write</strong></td>
<td><strong>Overwrite</strong></td>
</tr>
</tbody>
</table>

#### Write cycle time comparison

![Graph showing 33,333 times faster:](image)

#### Write Endurance comparison

![Graph showing 10,000,000 times more:](image)
Benefit 2: FRAM, High Speed Writing

FRAM RFID vs. EEPROM RFID

Conditions: 32 tags Inventory, 112 Bytes Writing and Reading Speed comparison

3X faster!
Benefit 2: FRAM, Radiation Tolerance

RFID tag data affection by Gamma-ray/E-beam radiation

**FRAM RFID TAG**
- Part No.: AB00298
- Lot No.: 1247738

**Data retention!!**
- Part No.: AB00298
- Lot No.: 1247738

**Gamma-ray/E-beam Sterilization**
- Part No.: AB00298
- Lot No.: 1247738

**Data lost!!**
- Part No.: oiejoifj
- Lot No.: k39fk2dk

**Difference mechanism of data store**

<table>
<thead>
<tr>
<th></th>
<th>FRAM</th>
<th>EEPROM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FRAM</strong></td>
<td>polarization of the ferroelectric material</td>
<td>charge carriers in a “floating gate”</td>
</tr>
<tr>
<td><strong>EEPROM</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Applications: FA and Maintenance

Features: High density Memory and Fast Write/Read
Benefits: High Quality Management and High Operational Efficiency

Factory Automation
- History Record
- Products Information
- Instruction manual and Condition etc.

Airplane Maintenance
- History Record
- Parts Management
- Life Cycle Management etc.
FRAM RFID Applications : Medical, Bio, Pharmacy

Feature : **Strong Radiation tolerance**

Benefits : Traceability including radiation sterilization process
FRAM RFID Product Lineup

**HF (ISO/IEC 15693, 13.56MHz)**
- MB89R119B - FRAM 2kbit
- MB89R118C - FRAM 16kbit

**Medical Sterilization**
- MB97R8050 - No User memory

**UHF (EPC global C1G2, 860 - 960MHz)**
- MB97R8110 - FRAM 64kbit
  - Dual IF (RF/Master Slave SPI/Key scan)
  - APP: Keyboard, EPD, Sensor tag...
- MB97R8130 - FRAM 64kbit
  - Dual IF (RF/Slave SPI)
  - APP: Meter, Data logger...
- MB97R8120 - FRAM 64kbit
  - Dual IF (RF/Slave SPI)
  - APP: Data carrier tag

**Embedded/IoT FA**
- MB89R112A - FRAM 64kbit

Density
- None to 512bit
- 2kbit to 16kbit
- 64kbit

As of Jun 2017

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1. Fujitsu Semiconductor is a leading company of outstanding non-volatile memory FRAM.

2. Battery-less solution can control and supply power to sensor devices and connect to embedded devices.

3. Battery-less solution provide benefits such as BOM reduction, PCB Physical size reduction, Eco-Friendly devices.

4. FRAM RFID battery-less solution could be used widely in many kinds of embedded applications.
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