LSI for NFC Tag
Connectivity expansion between Virtual and Real

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Automotive & Industrial Systems Company
Panasonic Corporation
Outline of NFC
What is NFC

Near Field Communication of utilizing RFID (no contact IC card/RF tag) technology

- Communication distance: below around 10cm
- Communication speed: 106 / 212 / 424 / (848)kbps
- Carrier frequency: 13.56MHz

Application for "Touch/Tap/close on" specialized with close communication (not applicable for fast/long distanced communication)

China, London, Korea Subway
Credit card etc.

Paris subway
Driver's license, passport, etc.

Tokyo subway etc.
Electronic money (Edy etc.)

Non contact IC card Standard

ISO14443 TypeA
China, London, Korea Subway
Credit card etc.

ISO14443 TypeB
Paris subway
Driver's license, passport, etc.

FeliCa
Tokyo subway etc.
Electronic money (Edy etc.)

RFID tag standard

ISO15693

Communication method

- NFC IP-1 (ISO/IEC18092)
- NFC IP-2 (ISO/IEC21481)

NFC is standard for communication layer. Upper level for application on each IC card is defined individually. Devices (SE: secure element) for application should be prepared separately.
How RFID (RF Tag/Contactless IC card) works?

- By magnetic coupling of R/W and RFID, R/W generates 13.56MHz alternating field, which can supply electric power and clock to RFID.
- Using the alternating field as carrier, transmit data from R/W to RFID by amplitude modulation of the magnetic field strength. (uplink).
- To transmit data from RFID to R/W, RFID turns ON/OFF the antenna load to change the magnetic field strength, (down-link).

NFC controller has both function of reader/writer and RFID.
3 basic NFC function and Hand-Over

- **Peer to Peer mode**

  ![Peer to Peer mode Diagram](image)

- **Reader/Writer mode**

  ![Reader/Writer mode Diagram](image)

- **Card emulation mode**

  ![Card emulation mode Diagram](image)

- **Hand over**

  ![Hand over Diagram](image)
NFC equipped mobile phone (mainly smart phone) is increasing among the world.
Ratio of NFC equip base becomes 30% in W.W at 2015.

(source: NFC Saizensen (Frontline) 2012)
Panasonic RFID deployment and NFC application

- Apply contactless communication and security technology cultivated by IC card
- Stable communication technology, security ISO15408(EAL4+) technology is applied
- Nonvolatile memory technology which precedes the industry
  1) FeRAM (Ferroelectric memory): High speed R/W
  2) ReRAM: Large / high speed / low power consumption

- For printer cartridge
- ID card
- Transport card
- Smart Battery

2000～

2001～

2002～

2003～

2004～

2005～

2006～

2007～

2008～

2009～

2010～

2011～

2012～

NFC

2000～

2001～

2002～

2003～

2004～

2005～

2006～

2007～

2008～

2009～

2010～

2011～

2012～

Accumulated Sales Q’ty

2000

2005

2010

2012

2000

2005

2010

2012

Total over 600 million has been shipped out!
NFC Tag
● **4 Kbit FeRAM** (Non-volatile memory) is accessible from NFC and Host processor
● **Works by power from R/W** and can be used as independent RF tag.

◆ **Block diagram**

![Block diagram](image)

◆ **Function**

<table>
<thead>
<tr>
<th>Function</th>
<th>MN63Y1210A</th>
<th>MN63Y1208</th>
<th>MN63Y1212</th>
<th>MN63Y1213</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reader / Writer function</td>
<td>non</td>
<td>non</td>
<td>non</td>
<td>non</td>
</tr>
<tr>
<td>RF Interface</td>
<td>ISO/IEC14443 TypeB, JIS X 6319-4 (FeliCa)</td>
<td>ISO/IEC14443 TypeB, JIS X 6319-4 (FeliCa)</td>
<td>ISO/IEC14443 TypeB, JIS X 6319-4 (FeliCa)</td>
<td>ISO/IEC14443 TypeB, JIS X 6319-4 (FeliCa)</td>
</tr>
<tr>
<td>NFC Forum tag</td>
<td>Type3</td>
<td>Type4B, Type3</td>
<td>Type4B, Type3</td>
<td>Type4B, Type3</td>
</tr>
<tr>
<td>Power-off mode (Powered by field)</td>
<td>possible</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encryption</td>
<td>non</td>
<td></td>
<td>AES128</td>
<td>AES128</td>
</tr>
<tr>
<td>HOST Interface</td>
<td>UART &amp; Synchronized serial</td>
<td>I2C</td>
<td>non</td>
<td>I2C</td>
</tr>
<tr>
<td>User data memory (non-volatile)</td>
<td>432Bytes (FeRAM)</td>
<td>432Bytes (FeRAM)</td>
<td>432Bytes (FeRAM)</td>
<td>432Bytes (FeRAM)</td>
</tr>
</tbody>
</table>
Example of the use of NFC

◆ Handover (Bluetooth simple pairing, Wi-Fi Protected set-up)
◆ Read/Write the information of Set device
  (For example, Home appliances and AV equipment can be operated by mobile phone)
◆ Set Device at the power OFF, Read/Write the information of FeRAM
  (For example, If the Set device gets error, notify the details on the information of FeRAM)
Use case of NFC-Tag

◆ White goods
- Customer information registration linked with set ID
- Operation by smart phone (New recipe, timer reservation)
- View ECO info (Power consumption, etc.) at smart phone and register to server
- Display error/defect info at smart phone, asking repair

◆ Health care goods
- Customer information registration linked with set ID
- Operation by smart phone (setting, etc.)
- View checked health data by smart phone and register to server
- Display error/defect info at smart phone, asking repair

◆ Audio/Visual
- Customer information registration linked with set ID
- Touch smart phone onto DSC or camcorder to send pictures and movies via WiFi or Bluetooth at handover mode
- Check battery and set and confirm exposure parameter
- Display error/defect info at smart phone, asking repair

◆ Office machine
- Customer information registration linked with set ID
- Touch smart phone onto printer or projector to print or display the contents at handover mode
- Check ink status, exposure parameter and picture setting
- Display error/defect info at smart phone, asking repair
Basic operation of NFC Tag

Three basic modes of operation

(1) RF Communication Mode
Communication between NFC equipment and NFC tag (Also operate in power-off)

(2) Serial Communication Mode
Communication between Host processor and NFC tag

(3) Tunnel Communication Mode
Communication between NFC equipment and Host processor via NFC tag

Host processor

NFC equipment (Mobile phone, etc.)

LSI for NFC Tag

TypeB FeliCa

Area of virtual memory

(Master) (Slave)
Power-off mode

● When no power supply from the host side, this LSI works with power from the NFC equipment (Reader/Writer)

(1) Operation of the wireless tag
Even when the host power-off, can access the FeRAM

(2) Drive of the host
Even when the host power OFF, IRQ signal can be output

IRQ signal output conditions
- When the LSI has received the tunnel communication mode command
- When the LSI has detected a carrier

Because operating conditions fluctuate by an antenna shape and magnetic field strength of leader writer, the power off mode needs the operation check with the actual machine.
# Overview Specifications

## Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>MN63Y1210A</th>
<th>MN63Y1208</th>
<th>MN63Y1212</th>
<th>MN63Y1213</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>1.8V ~ 3.6V or 4.5V ~ 5.5V</td>
<td>1.7V ~ 3.6V</td>
<td>non</td>
<td>1.7V ~ 3.6V</td>
</tr>
<tr>
<td>Ambient operating temperature</td>
<td>-20℃ ~ 85℃</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40℃ ~ 85℃</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FeRAM (Non-volatile memory)</td>
<td>Memory size : 4Kbit / Write endurance : 100 million cycle Retention time : 10 year</td>
<td>ISO/IEC14443 TypeB: 106, 212Kbps JISX6319-4 (FeliCa): 212,424Kbps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RF Interface</td>
<td>UART (~38.4kbps), Synchronized serial (~1Mbps)</td>
<td>I2C (~100Kbps)</td>
<td>non</td>
<td>I2C (~100Kbps)</td>
</tr>
<tr>
<td>Host Interface</td>
<td>~ 1mW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Consumption when RF Comm.</td>
<td>~ 500μA</td>
<td></td>
<td></td>
<td>~ 500μA</td>
</tr>
<tr>
<td>External Operating current</td>
<td>SSOP 16pin 5.0 × 6.4 × 1.3mm</td>
<td>QFN 16pin 3.2 × 4.2 × 0.77mm</td>
<td>SON 8pin 2.0 × 2.0 × 0.45mm</td>
<td></td>
</tr>
<tr>
<td>Package</td>
<td>QFN 16pin</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Connection Example of LSI

- **LSI for NFC Tag**
  - **VDD:** 1.7 ~ 3.6V
  - **HOST interface (I2C):** IRQ-output (Open-drain)
  - **Internal power supply:**
  - **GND:**

- **antenna**
  - **VA:**
  - **VB:**

- **Host processor**
Thank you!!