95HF series
NFC / RFID Reader IC

April 2017
The 95HF product is an integrated reader IC for contactless applications with several key features:

- The 95HF series manages frame coding and decoding in Reader / Writer mode (CR95HF / ST95HF) and in Card Emulation mode (only ST95HF) for standard applications such as near field communication (NFC), proximity and vicinity standards (RFID).

- Multiprotocol support @13.56MHz
  - ISO/IEC 14443 Type A and B
  - ISO/IEC 15693
  - ISO/IEC 18092
  - MIFARE® Classic compatible

- Communication interfaces with a Host Controller
  - Serial Peripheral Interface (SPI) Slave Interface 2MHz
  - Universal Asynchronous Receiver/Transmitter (UART) (only for CR95HF)
  - Up to 528-Byte RAM buffer for Reader / Writer & 256-Byte RAM buffer for Card Emulation

- Fast data transfer speed
  - Up to 424 Kb/s (ISO14443-A / ISO18092)
  - Up to 848 Kb/s (ISO14443-B)
  - Up to 52.6 Kb/s (ISO15693)
Main 95HF market segments

Smart Industry
- Maintenance, Factory Automation

Smart Home
- Home Gateway, Gaming

Smart City
- Lighting, Access lock
Key use cases

Access control / data reading
- Activate / Deactivate access
- Data programming

Commissioning for Wireless industrial network
- ID Activation
- Parameter settings

Device programming in production
- In-the-box programming
- Simple and flexible

Servicing & Maintenance
- Download records history with contactless
- Update parameters
95HF NFC / RFID reader

**CR95HF NFC reader / writer**
- Reader / Writer
- ISO14443, ISO15693, Felica (848kb/s)
- RAM: 528B
- SPI: 2.7/5.5V - 2Mb/s
- UART: 2.7/5.5V - 2Mb/s
- Digital output

**ST95HF NFC reader / writer & Card emulation**
- Reader / Writer & Card Emulation
- ISO14443, ISO15693, Felica (848kb/s)
- RAM: 528B
- SPI: 2.7/5.5V - 2Mb/s
- Digital output

**Use cases**
- RFID / NFC reader
  - Product identification or authentication
  - Product configuration (parameter settings)
  - Access Control, Digital Door Locks
  - Medical, industrial & production reader equipment

**Key benefits**
- All NFC modes supported (ISO14443, ISO15693, Felica)
- Reader-Writer (R/W) and Card Emulation (CE) modes supported
- Fast data transfer (up to 848kb/s)
- Low power modes

**ST's competitive advantage**
- Simple implementation / limited BOM
- Easy-to-use evaluation / development kits
- Reference designs, application notes
- Cost effective solution
<table>
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<tr>
<th>Feature</th>
<th>CR95HF</th>
<th>ST95HF</th>
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<td><strong>Operating Mode</strong></td>
<td>Reader &amp; Writer</td>
<td>Reader / Writer &amp; Card Emulation (ISO/IEC 14443-3 Type A)</td>
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<tr>
<td><strong>Contactless Interface</strong></td>
<td>ISO14443A/B</td>
<td>ISO14443A/B</td>
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<td>ISO15693</td>
<td>ISO15693</td>
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<td></td>
<td>Felica</td>
<td>Felica</td>
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<td></td>
<td>NFC Forum type 1,2,3,4,5</td>
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<td><strong>RF speed</strong></td>
<td>Up to 848kbps</td>
<td>Up to 848kbps</td>
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<tr>
<td><strong>Serial Interface</strong></td>
<td>SPI @2MHz</td>
<td>SPI @2MHz</td>
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<tr>
<td></td>
<td>UART @2MHz</td>
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<td><strong>Extra features</strong></td>
<td>Host wake-up</td>
<td>Host wake-up</td>
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<td><strong>RAM buffer</strong></td>
<td>528-Byte</td>
<td>528-Byte</td>
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<tr>
<td></td>
<td></td>
<td>(256-Byte for Card Emulation)</td>
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<tr>
<td><strong>Digital power supply</strong></td>
<td>2.7 to 5.5V</td>
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</tr>
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<td><strong>RF output power</strong></td>
<td>230mW</td>
<td>230mW</td>
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<tr>
<td><strong>Temperature range</strong></td>
<td>-25°C to +85°C</td>
<td>-25°C to +85°C</td>
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<tr>
<td><strong>Package</strong></td>
<td>VFQFPN32 5x5</td>
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The CR95HF has 2 modes operating modes:
- **Wait for Event (WFE):**
  - This mode includes four low consumption states:
    - Power-up
    - Hibernate
    - Sleep
    - Tag detector
- **Active mode:**
  - Ready: RF is OFF and the CR95HF waits for a command (ProtocolSelect, ...) from external Host
  - Reader: CR95HF communicates actively with a tag or an external host (an MCU, for example)
- The CR95HF can switch from one mode to another
The ST95HF has 2 modes operating modes:

- **Wait for Event (WFE):**
  - This mode includes four low consumption states:
    - Power-up
    - Hibernate
    - Sleep / Field Detector
    - Tag detector

- **Active mode:**
  - **Ready:** RF is OFF and the ST95HF waits for a command (ProtocolSelect, ...) from external Host
  - **Reader:** ST95HF communicates actively with a tag or an external host (an MCU, for example)
  - **Card Emulation:** The ST95HF can communicate as a Card or Tag with an external reader. The Card or Tag application is located in the Host and communicates with the ST95HF via the SPI interface.

The ST95HF can switch from one mode to another.
After the power supply is established at power-on, the 95HF waits for a low pulse on the pin IRQ_IN ($t_1$) before automatically selecting the external interface (SPI) or (UART in case of CR95HF) and entering Ready state after a delay ($t_3$).

- $t_0$: initial wake-up delay - 100µs (min)
- $t_1$: minimum interrupt width - 10µs (min)
- $t_2$: delay for the serial interface selection – 250ns (typ)
- $t_3$: High Frequency Oscillator setup time – 10ms (max)
- $t_4$: VPS ramp-up time from 0V to VPS - 10ms (max)
CR95HF / ST95HF: SPI communication protocol

• Serial Peripheral Interface (SPI)
  • Polling mode:
    • In order to send commands and receive replies, the application SW has to perform 3 steps:
      • Send the command to the 95HF
      • Poll the 95HF until is ready to transmit the response
      • Read the response
    • The application SW should never read data from the 95HF without being sure that the 95HF is ready to send the response. The maximum allowed SPI communication speed is $f_{\text{clock}}$ (SPI clock frequency)
  • A control byte is used to specify a communication type and direction:
    • 0x00: Send command to the 95HF
    • 0x03: Poll the 95HF
    • 0x02: Read data from the 95HF
    • 0x01: Reset the 95HF

• Interrupt mode
  • When the 95HF is configure to use the SPI serial interface, pin IRQ_OUT is used to give additional information to user. When the 95HF is ready to send back a reply, it sends an Interrupt Request by setting a low level on pin IRQ_OUT, which remains low until the host reads the data.
  • The application can use the Interrupt mode to skip the polling stage.
CR95HF: UART communication protocol

- Universal Asynchronous Receiver/Transmitter (UART)
  - The host sends commands to the CR95HF and waits for replies. Polling for readiness is not necessary. The default baud rate is 57600 baud. The maximum baud rate is 2Mbps

Sending commands to the CR95HF

```
| CMD | LEN | DATA | DATA |
```

- Several data bytes

Receiving data from the CR95HF

```
| Resp Code | LEN | DATA | DATA |
```

- Several data bytes

- When sending commands, no data must be sent if the LEN field is zero
- When receiving data from the CR95HF, no data will be received if the LEN field is zero
CR95HF / ST95HF : Commands

• Command format
  • Frame sent by the Host to the 95HF: <CMD><Len><Data>
  • Frame sent by the 95HF to the Host: <RespCode><Len><Data>

  ➢ These 2 formats are available either in both UART and SPI modes.

• Commands list
  • IDN: provides 95HF short information and revision
  • ProtocolSelect: selects and configure the communication protocol
  • SendRecv: sends RF commands and receives tag response
  • Listen (ST95HF used): Listens for data using previously selected protocol (used in Card Emulation mode).
  • IDLE: sets the 95HF in a low power consumption mode “Wait for Event mode” (Power-up, Hibernate, Sleep or tag detection) and specifies the wake-up source.
  • RDREG: allows to read the Wake-up register and the Analog configuration register
  • WRREG: allows to write the Analog configuration register
  • BaudRate: sets the UART baud rate.
  • Echo: simple serial interface echo command
95HF support eco-system

- Antenna Design suite
- Eval Board
- Schematic, BOM, Gerber
- Documentation
- e2e community
- PC SW tools
- MCU drivers (FW)
CR95HF / ST95HF package form

- VFQFPN32 Package – 5.0 x 5.0mm
Evaluation boards
M24LR Discovery Kit

- M24LR board
  - M24LR04E-R Dynamic NFC tag IC Dual Interface EEPROM with I2C and ISO/IEC 15693 RF interfaces
  - STM8L152C6T6 8-bit microcontroller, with 8 Kbytes of Flash memory
  - STTS751-0WB3F, low-voltage digital temperature sensor
  - 20 x 40 mm inductive antenna etched on the PCB
  - I²C connectors & SWIM connector for programming and debugging
  - Two function buttons (User and Reset)
  - LCD (24 segments, 4 commons)

- RF transceiver board
  - CR95HF-VMD5T 13.56 MHz multi-protocol contactless transceiver IC with SPI and UART serial access
  - STM32F103CB 32-bit microcontroller, with 128 Kbytes of Flash memory
  - 47 x 34 mm 13.56 MHz inductive antenna etched on PCB and associated circuitry
  - USB connector for communication with host PC and demonstration board powering

http://www.st.com/m24lr-discovery
CR95HF Nucleo shield

- CR95HF Nucleo board
  - NFC (Near Field Communication) card reader evaluation board based on CR95HF, designed for expansion of STM32 Nucleo boards
  - 47 mm x 34 mm, four turns, 13.56 MHz inductive antenna etched on PCB, and associated tuning circuit
  - Reader/Writer modes supported
  - RF communication
    - ISO/IEC 14443 (A and B)
    - ISO/IEC 15693
    - ISO/IEC 18092
    - MIFARE® Classic compatible
  - Equipped with Arduino™ UNO R3 connector
  - Four general purpose LEDs
  - Scalable solution, capable of cascading multiple boards for larger systems
  - Free comprehensive development firmware library and examples for CR95HF, compatible with STM32Cube firmware
  - FCC certified
  - RoHS compliant

- Reference: X-NUCLEO-NFC03A1

EVAL-ST95HF

- **EVAL-ST95HF**
  - Ready to use printed circuit board with ST95HF 13.56 MHz transceiver (32 leads, 5x5 mm VFQFPN package):
    - Reader mode: ISO/IEC 14443 Type A
    - ISO/IEC 15693; ISO/IEC 18092
    - Card Emulation mode: ISO/IEC 14443 Type A
  - The ST95HF also supports the detection, reading and writing of NFC Forum Type 1, 2, 3 and 4 tags.
  - STM32F103RGT6, an STM32 32-bit ARM® Cortex® microcontroller in LQFP64 package, with 1 Mbyte of Flash memory
  - 47 mm x 34 mm, four turns, 13.56 MHz inductive antenna etched on PCB, and associated tuning circuit
  - Mini USB connector for board powering
  - Five different color LEDs, indicating the presence of RF field and protocol used to communicate
  - JTAG connector for microcontroller firmware download and debug
  - Joystick for menu selection
  - LCD color screen (320 x 200 pixels)
  - USB cable: Type A / mini B
- **Reference:** EVAL-ST95HF

Thank You!