ST25R95
NFC / RFID Reader IC

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The ST25R95 product is an integrated reader IC for contactless applications with several key features:

- ST25R95 manages frame coding and decoding in Reader / Writer mode and in Card Emulation mode 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
  - 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, ISO14443-B & ISO18092), up to 52.6 Kb/s (ISO15693)
Main ST25R95 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

Activation 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
ST25R95 NFC / RFID Transceiver

Use cases
- Smart Locks, Card Readers, Toys
- Dynamic wireless pairing with hand-over

Key Features
- **Reader-Writer** (R/W) and **Card Emulation** (CE)
- All NFC modes supported (ISO14443, ISO15693, FeliCa)
- Fast data transfer (up to 424kb/s)

Key Benefits
- Simple implementation / limited BOM
- Easy-to-use evaluation / development kits
- Reference designs, application notes
- Cost effective solution
## ST25R95 HF Readers

### Description
- **Entry-Level Reader**

**Reader/Writer mode**
- ISO14443A/B
- ISO15693
- Felica

**Card emulation mode**
- Yes

**P2P mode**
- 

**RF speed**
- 424kbps

**Market certification**
- 

**Advanced features**
- Ind wake-up

**Interface**
- SPI 2Mbps

**Power supply**
- 2.7V - 5.5V

**Output power**
- 0.23W

**Temperature range**
- -25°C to +85°C

**Package**
- 32-pin QFN (5x5mm)
ST25R95: Operating Modes

- ST25R95 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 ST25R95 waits for a command (ProtocolSelect, ...) from external Host
    - Reader: ST25R95 communicates actively with a tag or an external host (an MCU, for example)
    - Card Emulation: The ST25R95 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 ST25R95 via the SPI interface.

- ST25R95 can switch from one mode to another

ST25R95 initialization and operating state change
ST25R95: Startup Sequence

- After the power supply is established at power-on, the ST25R95 waits for a low pulse on the pin IRQ_IN ($t_1$) before automatically selecting the external interface (SPI) 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)
ST25R95: SPI Interface

• 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 ST25R95
      • Poll the ST25R95 until is ready to transmit the response
      • Read the response
    • The application SW should never read data from the ST25R95 without being sure that the ST25R95 is ready to send the response. The maximum allowed SPI communication speed is $f_{\text{clk}}$ (SPI clock frequency)
    • A control byte is used to specify a communication type and direction:
      • 0x00: Send command to the ST25R95
      • 0x03: Poll the ST25R95
      • 0x02: Read data from the ST25R95
      • 0x01: Reset the ST25R95
  • Interrupt mode
    • When the ST25R95 is configure to use the SPI serial interface, pin IRQ_OUT is used to give additional information to user. When the ST25R95 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.
ST25R95: Commands

- **Command format**
  - Frame sent by the Host to the ST25R95: `<CMD><Len><Data>`
  - Frame sent by the ST25R95 to the Host: `<RespCode><Len><Data>`

- **Command list**
  - **IDN**: provides ST25R95 short information and revision
  - **ProtocolSelect**: selects and configure the communication protocol
  - **SendRecv**: sends RF commands and receives tag response
  - **Listen**: Listens for data using previously selected protocol (used in CE mode)
  - **IDL**: sets the ST25R95 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
  - **Echo**: simple serial interface echo command
ST25R95 Package Form

- VFQFPN32 Package – 5.0 x 5.0mm
ST25R95 Support Eco-system

Easy-to-use and customer-oriented

- STM32Nucleo hardware ecosystem
- Discovery kit STM32 based
- Antenna e-design tool
- Schematic, BOM, Gerber
- STM32Cube software ecosystem
- e2e community
- PC software tool ST25 SDK
- Documentation
## ST25R95 Evaluation Boards

### ST25R95 demo board
- CR95HF NFC multi-protocol reader IC
- 47×34 mm 2 turns double layer antenna etched on PCB and associated tuning circuit
- STM32F1 micro-controller
- USB & JTAG connectors

### ST25R95 Nucleo shield board
- CR95HF NFC multi-protocol reader IC
- 47×34mm 4 turns antenna etched on PCB
- SPI (Slave interface) or UART
- Up to 528-byte command/reception buffer
- Optimized power management
- Powered through Arduino™ UNO R3 connector

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**M24LR-DISCOVERY**

**X-NUCLEO-NFC03A1**
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**ST25R Part Numbers**
Thank You!

Solutions for NFC / RFID Tags and Readers
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