ST25R3920
product presentation

MMY Division
May 2020
ST25R3920 use cases

**Car access**
Compliant to CCC DK2.0 specs

**NFC card protection**
Protects NFC cards like creditcard, access cards from powerful Qi field

**Car start**
Compliant to CCC DK2.0 specs

**Car sharing**
Allows shared key with preference settings

**Consumable authentication**
Increases safety, traceability and convenience of replacement parts

**Payment**
In-car or external payment for electric charge
ST25R3920 benefits

**Outstanding analog performance**
- No external amplifier required to achieve high field strength
- Excellent P2P interoperability
- Low power wakeup

**Advanced Features**
- Noise suppression receivers
- Automatic antenna tuning
- Active waveshaping

**Fast time to market**
- ISO, MISRA compliant SW library
- Single SW library for all products
- Full integration into STM32 eco system

**Proven solution**
- Market proven solution in the consumer and automotive space
- Ensures best customer experience
## ST25R NFC / HF readers product family

### Description

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Card emulation mode</td>
<td>Yes</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Initiator &amp; Target</td>
<td>Initiator &amp; Target</td>
<td>Initiator &amp; Target</td>
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<tr>
<td>AP2P mode</td>
<td>Initiator &amp; Target</td>
<td>Initiator &amp; Target</td>
<td>Initiator &amp; Target</td>
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<td>Initiator &amp; Target</td>
<td>Initiator &amp; Target</td>
<td>Initiator &amp; Target</td>
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<tr>
<td>PP2P mode</td>
<td>Initiator</td>
<td>Initiator</td>
<td>Initiator</td>
<td>Initiator</td>
<td>Initiator</td>
<td>Initiator</td>
<td>Initiator</td>
</tr>
<tr>
<td>RF speed</td>
<td>424kbps</td>
<td>6.8Mbps</td>
<td>848kbps</td>
<td>848kbps</td>
<td>848kbps</td>
<td>848kbps</td>
<td>848kbps</td>
</tr>
<tr>
<td>Market</td>
<td>Consumer</td>
<td>Payment EMVCo 2.6, Industrial</td>
<td>Access control, Metering, Consumer</td>
<td>Automotive AEC-Q100 grade 1</td>
<td>Payment EMVCo 3.0, Industrial, Consumer</td>
<td>Payment EMVCo 3.0, Industrial, Consumer</td>
<td>Automotive AEC-Q100 grade 1</td>
</tr>
<tr>
<td>Advanced features</td>
<td>IWU</td>
<td>AAT, DPO, CIWU</td>
<td>DPO, IWU</td>
<td>AAT (3914), DPO, CIWU</td>
<td>AAT, DPO, NSR, DSA, AWS, CIWU, EMD</td>
<td>AAT, DPO, NSR, DSA, AWS, IWU, EMD</td>
<td>AAT, DPO, NSR, DSA, AWS, CIWU, EMD</td>
</tr>
<tr>
<td>HW interface</td>
<td>SPI 2Mbps</td>
<td>SPI 6Mbps</td>
<td>SPI 6Mbps</td>
<td>SPI 6Mbps</td>
<td>I²C // SPI 10Mbps</td>
<td>I²C // SPI 10Mbps</td>
<td>I²C // SPI 5Mbps</td>
</tr>
<tr>
<td>SW interface</td>
<td>SPI 6Mbps</td>
<td>SPI 6Mbps</td>
<td>SPI 6Mbps</td>
<td>SPI 6Mbps</td>
<td>I²C // SPI 10Mbps</td>
<td>I²C // SPI 10Mbps</td>
<td>I²C // SPI 5Mbps</td>
</tr>
<tr>
<td>Power supply</td>
<td>2.7V - 5.5V</td>
<td>2.4V – 5.5V</td>
<td>2.4V – 5.5V</td>
<td>2.4V – 5.5V</td>
<td>2.4V – 5.5V</td>
<td>2.4V – 5.5V</td>
<td>2.4V – 5.5V</td>
</tr>
<tr>
<td>Output power</td>
<td>0.23W</td>
<td>1.4W</td>
<td>1.0W</td>
<td>1.0W</td>
<td>1.6W</td>
<td>1.6W</td>
<td>1.6W</td>
</tr>
<tr>
<td>Temperature range</td>
<td>-25°C to +85°C</td>
<td>-40°C to +125°C</td>
<td>-40°C to +125°C</td>
<td>-40°C to +125°C</td>
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</tbody>
</table>

**Notes:**
- **VHBR:** Very High Baud Rate
- **EMD:** Automatic EMD suppression
- **DSA:** Drive Slope Adjustment
- **NSR:** Noise Suppression Receiver
- **IWU:** Inductive Wakeup
- **CIWU:** Capacitive & Inductive Wakeup
- **P2P:** Peer to Peer mode
- **AAT:** Automatic Antenna Tuning
- **AWS:** Active Wave Shaping
- **HBR:** Very High Baud Rate
- **DPO:** Dynamic Power Output
ST25R3920 high-perf. reader for CCC digital key and car center console

**Use cases**
- Ideal for Car Consortium Consortium Digital Key (CCC DK) applications
- IoT and pairing in the car (center console)

**Key Features**
- NFC Forum Device
- AEC-Q100 grade 1
- 1.6W output power at 5V with 2.5W peak current
- Active Waveshaping
- Automatic Antenna Tuning
- Noise Suppression Receiver
- -40°C to 105°C ambient temperature range

**Key Benefits**
- Low power operation & Standby mode (capacitive wake-up)
- Works in challenging environment like small antennas
<table>
<thead>
<tr>
<th>NSR: Noise Suppression Receiver</th>
<th>AAT: Automatic Antenna Tuning</th>
<th>DSA: Driver Slope Adjustment</th>
<th>AWS: Active Waveshaping</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Decoding at high noise level with up to 19.3dB better SNR</td>
<td>• Easiest environmental/lifetime compensation:</td>
<td>• Easier FCC approval</td>
<td>• Faster/easier NFC Forum/ EMVCo analog approval</td>
</tr>
<tr>
<td>• increases immunity to interference from noise sources and therefore simplifies electromagnetic immunity and eases certification.</td>
<td>• Automatic adjustment of the tuning resonance and matching impedance driving adjustable capacitors</td>
<td>• Programmable Push/Pull driver slope, minimizes high frequency EMC noise</td>
<td>• Under/Overshoot can be reduced to achieve required wave shaping easily and fast</td>
</tr>
</tbody>
</table>
### ST25R3920 benefits

<table>
<thead>
<tr>
<th>Large FIFO, Automatic EMD</th>
<th>Improved RF Performance</th>
<th>CIWU: Capacitive &amp; Inductive Wakeup</th>
<th>DPO: Dynamic Power Output</th>
</tr>
</thead>
</table>
| • Reduced/faster SW integration effort:  
  • Complete frames can be transmitted and received without SW interaction  
  • Time critical EMD suppression is handled automatically | • Larger operating volume/ smaller antenna  
• Unrivaled RX sensitivity with high output power delivers maximum margin for challenging antenna designs. | • Low power consumption in card detection mode  
• Capacitive and Inductive wakeup allow for low power consumption while in card detection mode. | • Increase Efficiency and achieve min/max Limits  
• The output power is adjusted automatically to reduce power and stay within certification limits. |
DPO: dynamic power output tweaks the power to your needs

DPO will keep power levels within requirements & limits

- **Field Strength**
- **Danger Zone**
- **NFC Forum**
  - Damage Limit: 12A/m
  - Maximum Limit: 7.5A/m
  - Minimum Limit: 1.5A/m
- **Variable EMVCo Limits**

**Upper Limit**

**Lower Limit**

**without DPO**

**Increase Power**

**Reduce Power**

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**NFC Forum**

- Minimum Limit: 1.5A/m
- Maximum Limit: 7.5A/m
- Damage Limit: 12A/m

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**Increase Power**

**Reduce Power**

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**Variable EMVCo Limits**

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**Without DPO**

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**Increase Power**

**Reduce Power**
DPO Working Principle

- The ST25R family is able to measure the antenna amplitude via Register 0x20 with the direct command “Measure amplitude”.
- The antenna amplitude can be used to define certain levels/distances in which the power output defined in Register 0x27 can be changed via the driver resistance.
- Thresholds can be set to decrease or to increase power output.
Match the antenna well and make sure it stays tuned.

Placement, mounting and outside factors can detune and reduce performance.
AAT: automatic antenna tuning
be sure your antenna stays tuned

AAT will help to maximize performance in different situations

- Algorithm is based on antenna amplitude and phase measurement
- On 3914 tuning is possible on the parallel path of the antenna
- On 3920 tuning is possible in parallel and/or in series
- Ideal for center console applications
Reduce power consumption while offering good detection range

Consider reaction time/sensitivity of the system

Card Polling
Can be set

System time
Varies on application

Time to action
Usually expected to be <500ms for human interaction

Sensitivity
Distance of detection
Reduce power consumption while offering good detection range

Consider reaction time/sensitivity of the system

**Timer period**
- Time in which the IC stays in Sleep mode before checking if a card is present.
- Can be set from 10 to 800ms in 16 steps.

**System time**
- Varies on application.

**Time to action**
- Usually expected to be <500ms for human interaction.

**Card Polling**
- Can be set.

**Sensitivity**
- Distance of detection.

**Delta (window size)**
- Set the sensitivity of the wakeup in 256 steps.

**Auto averaging**
- Higher noise immune or to compensate for slow environmental changes.
- Can be set to average over the last 4/8/16/32 cycles.

**Automatic reference measurement**
- Measure the environmental influence to the capacitive sensor or the antenna.
- Used to calibrate the wakeup system at system start or at any required time.
Low Power Wakeup will maximize your application lifetime

- Supply current in Wakeup Mode: 3.6µA
- XTAL Startup: 5.4mA

Inductive

- Amplitude or Phase measurement: 8.7mA + I_TX
- Startup: 20µs
- 10-800ms
- 1ms

Fully programmable wakeup scheme.
All relevant parameters like cycle time & sensitivity can be programmed and do not need MCU interaction.
• Proper decoding
  • Proper decoding still possible even though LCD noise level exceeds card signal strength
  • ANS jumps in as soon as the receiver locks on a card response.

• Noise immunity compared to non NSR
  • Type A 106 display noise immunity improved by a factor of 3.3 vs ST25R3914
  • Type B 106 display noise immunity improved by a factor of 9.2 vs ST25R3914
• Traditional A 106 modulation pulse

• Improved A106 modulation pulse with Over/Undershoot Protection

Over/Undershoots can be solved with register settings
No rematching of antenna required
• Automatic PCD EMD handling
  • When the ST25R3920 receives a PICC frame it is checked for transmission errors. Transmission errors are detected in real time and if the number of received bytes when a transmission error is detected is less than 4, then the PCD shall ignore the transmission and be ready to receive a new PICC frame.

• Increased Robustness
  • EMD handling enhances the robustness of the contactless communication between ST25R3920 and the PICC against PICC generated electromagnetic disturbance (EMD)
Evaluation boards & ecosystem
ST25R3920 vs. Competition

Output Power
- ST25R3920: 500mA
- Competition: 170mA

Standby Power
- ST25R3920: 30µA
- Competition: 200µA

Features
- AAT (Automatic Antenna Tuning): Compensates temperature, production drift; Improves communication with metal phones/watch
- NSR (Noise Supression Receiver): Improves immunity against external noise sources; Improves communication with phones/watch
- AWS (Active Waveshaping): Improves waveshapes and communication with phones/watch
- DPO (Dynamic Power Output): Dynamically adjusts output power to requirements

More Range: ST25R3920
Lower consumption: ST25R3920
ST25R3920 rich eco-system

- Discovery kits based on STM32 MCU
- STM32 Nucleo boards ecosystem
- STM32Cube software ecosystem

- Antenna e-design tool
  - Schematic, BOM
  - Gerber files

- PC software tool ST25
  - MCU drivers firmware

- Documentation
  - e2e community
  - Webinar / MOOC
  - Training
The ST25R3916-DISCO consists of the ST25R3916 high performance NFC universal device controlled by a STM32L476 ultra-low-power ARM Cortex-M4 MCU with 512Kbytes flash. It can be operated in stand alone mode via the LCD display or can be connected via USB to a Windows PC and controlled via the ST25R3916 GUI.

- Onboard 66x66mm, two turns, 13.56 MHz inductive antenna and possibility for external antenna

- RF Operation
  - NFC-A/B / ISO14443A/B up to 848 kbit/s
  - NFC-F / Felica™ up to 424 kbit/s
  - NFC-V / ISO15693 up to 53 kbit/s
  - NFC-A / ISO14443A and NFC-F / FeliCa™ card emulation
  - Active & passive peer to peer initiator and target modes, up to 424 kbit/s

- Free comprehensive development library and schematics / Gerber files available
The X-NUCLEO-NFC06 is a Nucleo shield based on the ST25R3916 high performance Universal HF/NFC & EMVCo frontend. With its Arduino U3 connector it fits to the STM32 Nucleo, Raspberry Pi and other platforms.

- Onboard 47mm x 34mm, four turns antenna with connection point for external antennas

- RF Operation
  - NFC-A/B / ISO14443A/B up to 848 kbit/s
  - NFC-F / Felica™ up to 424 kbit/s
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  - NFC-A / ISO14443A and NFC-F / FeliCa™ card emulation
  - Active and passive peer to peer initiator and target modes, up to 424 kbit/s

- Free comprehensive development library and schematics/Gerber files available.
  Free Raspberry Pi Linux driver
Solutions for NFC / RFID Tags & Readers

ST25 SIMPLY MORE CONNECTED
Thank you