NFC frontend CLRC663 _plus_
push your design further – best performance at lowest power consumption

LAURENT DARDÉ  NEXT GENERATION HIGH-PERFORMANCE
JÜRGEN SCHRODER  MULTI-PROTOCOL NFC FRONTEND
NFC product portfolio

**Connected NFC tag solutions**

Our connected NFC tag solutions include a NFC Forum RF interface, an EEPROM, and a field-detection function (NTAG F) or a field-detection function with an I²C interface (NTAG I²C plus).

**NFC frontend solutions**

Our standalone frontends, which work seamlessly with the NFC Reader Library, are the most flexible way to add NFC to a system.

**NFC controller solutions**

Our NFC controller solutions enable higher integration with fewer components combining an NFC frontend with an advanced 32-bit microcontroller.

Options include integrated firmware, for an easy, standardized interface, or a freely programmable microcontroller with the ability to load fully-custom applications.
CLRC663 plus – push your design further

**best performance at lowest power consumption**
- extended Low Power Card Detection range with new configuration options
- low supply voltage for battery support down to 2.5V

**design flexibility**
- max. operating transmitter current of 350mA with limiting value of 500mA
- broad temperature range from -40°C to +105°C

**backward compatibility**
- pin-to-pin and software compatible to CLRC663

**faster time-to-market**
- complete support package including EMVCo compliant NFC SW library and NFC Cockpit with VCOM interface and easy antenna configuration
## CLRC663 plus – product features

### Characteristics
- 350mA maximum operating transmitter current with limiting value of 500mA
- Power supply voltage: 2.5 to 5.5V
- Extended operating temperature range: -40 to +105°C
- 512byte FIFO buffer for highest transaction performance
- Flexible and efficient power saving modes including hard power down, standby and low-power card detection
- Integrated PLL provides external system clock from 27.12MHz RF crystal

### Supported RF protocols
**Reader and Writer mode**
- ISO/IEC 14443A/MIFARE
- ISO/IEC 14443B
- JIS X 6319-4 (comparable with FeliCa1 scheme)
- ISO/IEC 15693 (ICODE-SLIX, ICODE-DNA)
- ISO/IEC 18000-3 mode 3/ EPC Class-1 HF (ICODE-ILT)

**Peer to Peer mode**
- Passive-Initiator according to ISO/IEC 14443A (106kbit/s) and FeliCa (212 and 424kbit/s)

**Allows to read and write**
- All MIFARE® family: Ultralight, Classic 1K & 4K, DESFire EV1 & EV2 and Plus EV1
- All NTAG® family incl. NTAG I²C plus
- All SmartMX® family incl. SmartMX2 P40 & P60

### Licenses and supported standards
- Includes NXP ISO/IEC14443-A, NXP MIFARE® and Innovatron ISO/IEC14443-B licenses
- Crypto 1 intellectual property licensing rights
- Hardware supports for MIFARE Classic encryption
- EMVCo 2.6 L1 analog compliancy on RF level and digital compliancy with NXP NFC reader library

### Interfaces
- Host interfaces: SPI (10Mbit/s), I²C (1000kbit/s) and UART (1228.8kbit/s)
- SAM interface in X-mode
- Up-to 8 general purpose inputs/outputs

### Packages
- HVQFN32
- Wettable flanks
CLRC663 plus – target markets

- **ACCESS CONTROL**
  - broad temperature range from -40°C to +105°C
  - pin-to-pin and software compatible to CLRC663

- **GAMING**
  - extended Low Power Card Detection range with new configuration options
  - low supply voltage for battery support down to 2.5V

- **PAYMENT TERMINAL**
  - highest transmitter current
  - EMVCo 2.6 L1 analog and digital compliant
POSITIONING
## CLRC663 plus vs. other NXP NFC frontends

<table>
<thead>
<tr>
<th>Reader Writer</th>
<th>NFC tag type emulation</th>
<th>ISO/IEC 18092 Target</th>
<th>ISO/IEC 18092 Initiator</th>
<th>Output Power (TX current)</th>
<th>EMVCo RF</th>
<th>Dynamic Power Control</th>
<th>SW stack</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PN512</strong></td>
<td>ISO14443(1) Mifare, FeliCa</td>
<td>2, 3, 4A(3)</td>
<td>Active &amp; Passive</td>
<td>Active &amp; Passive</td>
<td>3.6V output stage (100mA)</td>
<td>L1 with booster</td>
<td>No</td>
</tr>
<tr>
<td><strong>CLRC663 plus</strong></td>
<td>ISO14443(1) Mifare, FeliCa ISO15693(2)</td>
<td>Passive</td>
<td>Passive</td>
<td>5V output stage (350mA)</td>
<td>L1</td>
<td>No</td>
<td>NFC &amp; EMVCo</td>
</tr>
<tr>
<td><strong>PN5180</strong></td>
<td>ISO14443(1) Mifare, FeliCa ISO15693(2)</td>
<td>4A</td>
<td>Active &amp; Passive</td>
<td>Active &amp; Passive</td>
<td>5V output stage (250mA)</td>
<td>L1</td>
<td>Yes</td>
</tr>
</tbody>
</table>

1. ISO/IEC14443
2. ISO/IEC15693
3. No software available for NFC tag type 2 and 3 emulation
<table>
<thead>
<tr>
<th>Feature</th>
<th>CLRC663 plus</th>
<th>PN5180</th>
<th>PN7462</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>HVQFN32</td>
<td>HVQFN40</td>
<td>HVQFN64</td>
<td>CLRC663 plus is pin-to-pin compatible with CLRC663</td>
</tr>
<tr>
<td>RF transmitter supply voltage</td>
<td>2.5 to 5.5V</td>
<td>2.7 to 5.5V</td>
<td>3 to 5.5V</td>
<td>CLRC663 plus enables better support for battery powered systems</td>
</tr>
<tr>
<td>General Purpose Input/Output pins (e.g. to drive LEDs)</td>
<td>4</td>
<td>up-to 7</td>
<td>12</td>
<td>PN5180 has up-to 7 general purpose outputs on TFBGA64 package only</td>
</tr>
<tr>
<td>Max. operating transmitter current</td>
<td>350mA</td>
<td>250mA</td>
<td>250mA</td>
<td>CLRC663 plus enables more flexibility in the antenna design</td>
</tr>
<tr>
<td>Temperature range</td>
<td>-40 to +105°C</td>
<td>-30 to +85°C</td>
<td>-40 to +85°C</td>
<td>CLRC663 plus has an automotive or industrial temperature range</td>
</tr>
<tr>
<td>Low power card detection</td>
<td>range: very good power: best</td>
<td>range: best power: good</td>
<td>range: best power: good</td>
<td>CLRC663 plus offers the lowest power consumption</td>
</tr>
<tr>
<td>Complete set of field proven software libraries</td>
<td>NFC &amp; EMVCo</td>
<td>Full NFC &amp; EMVCo</td>
<td>Full NFC &amp; EMVCo</td>
<td>Full NFC forum certified library; EMVCo 2.6</td>
</tr>
<tr>
<td>Waveform Control</td>
<td>Yes</td>
<td>Yes (adaptive)</td>
<td>Yes (adaptive)</td>
<td>Adaptive Waveform Control improves wave shape stability under detuned conditions</td>
</tr>
<tr>
<td>Adaptive Range Control</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Adaptive Range Control increases sensibility and robustness under detuned conditions</td>
</tr>
<tr>
<td>Freely programmable MCU (flash)</td>
<td>No</td>
<td>No</td>
<td>Cortex M0 (160kB)</td>
<td>PN7462 enables an 1-chip reader solution</td>
</tr>
<tr>
<td>Host interfaces</td>
<td>SPI, I²C, UART</td>
<td>SPI</td>
<td>USB, HSUART, SPI, I²C</td>
<td>PN7462 has also two master interfaces (SPI, I²C) and one contact reader interface</td>
</tr>
<tr>
<td>SAM Interface</td>
<td>Yes with X-mode</td>
<td>No</td>
<td>Yes</td>
<td>The SAM interface allows to store keys in a secure container</td>
</tr>
</tbody>
</table>
CLRC663 plus vs. CLRC663
CLRC663 $plus$ vs. CLRC663

Maximum operating transmitter current increases by 40% for CLRC663 $plus$ with 2x the limiting value of the CLRC663

CLRC663 $plus$ has new configuration options\(^{(2)}\) enabling up-to 2.5x the detection range in LPCD\(^{(1)}\) mode

CLRC663 $plus$ has an automotive or industrial operating temperature range: -40 to +105°C

CLRC663 $plus$ enables better support for battery powered systems

1. Low Power Card Detection
2. New LPCD configuration options are Charge Pump (enabled/disabled) and LPCD Filter (enabled/disabled)
CLRC663 *plus* – LPCD in details

<table>
<thead>
<tr>
<th>Card type</th>
<th>Standard (CLRC663)</th>
<th>Charge pump enabled</th>
<th>LPCD_FILTER enabled</th>
<th>Charge pump + LPCD_FILTER enabled</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIFARE® Ultralight</td>
<td>11 mm(^{(2)})</td>
<td>16 mm</td>
<td>29 mm</td>
<td>25 mm</td>
</tr>
<tr>
<td>NTAG</td>
<td>19 mm</td>
<td>24 mm</td>
<td>37 mm</td>
<td>33 mm</td>
</tr>
<tr>
<td>MIFARE DESFire® EV2</td>
<td>19 mm</td>
<td>24 mm</td>
<td>39 mm</td>
<td>35 mm</td>
</tr>
<tr>
<td>JCOP DIF</td>
<td>12 mm</td>
<td>17 mm</td>
<td>30 mm</td>
<td>27 mm</td>
</tr>
<tr>
<td>ISO RefPICC Class 6</td>
<td>4 mm</td>
<td>7 mm</td>
<td>18 mm</td>
<td>23 mm</td>
</tr>
<tr>
<td>EMVCo RefPICC</td>
<td>26 mm</td>
<td>29 mm</td>
<td>57 mm</td>
<td>66 mm</td>
</tr>
</tbody>
</table>

- The basic idea of the LPCD\(^{(1)}\) is to provide a function that turns off the RF field when no card is used. This saves energy and allows battery powered NFC Reader designs.
- The CLRC663 and CLRC663 *plus* offer a standalone LPCD function, which replaces the normal active card polling that is triggered by the host µController.
- CLRC663 *plus* offers additional features to extend the LPCD performance:
  - **Charge Pump** increases the RF field strength during the RF-on time.
  - **LPCD Filter** reduces the risk of fail detections especially in case of spike noise.

\(^{(1)}\) Low Power Card Detection
\(^{(2)}\) All detection ranges measured using the standard CLRC663 *plus* development board (CLEV6630B) operated with external power supply at room temperature.
CLRC663 plus – wettable flank package

- In the case of standard HVQFN packages (e.g. CLRC663 family), there is no exposed pin to visually determine whether or not the package is successfully soldered onto the PCB. The package edge has exposed copper for the terminals, these are prone to oxidation, making sidewall solder wetting difficult
- The CLRC663 plus, with wettable flank HVQFN package, enables 100% automatic visual inspection post-assembly ensuring higher quality of assembly
TECHNICAL OVERVIEW
CLRC663 plus – quick references

- The **analog interface** handles the modulation and demodulation of the antenna signals for the contactless interface.
- The **contactless UART** manage the protocol dependency of the contactless interface settings managed by the host.
- The **FIFO buffer** ensures fast and convenient data transfer between host and the contactless UART.
- The **register bank** contains the settings for the analog and digital functionality.

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**Table of Parameters**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDD</td>
<td>supply voltage</td>
<td></td>
<td>2.5</td>
<td>5.0</td>
<td>5.5</td>
<td>V</td>
</tr>
<tr>
<td>VDD(PVDD)</td>
<td>PVDD supply voltage</td>
<td></td>
<td>2.5</td>
<td>5.0</td>
<td>VDD</td>
<td>V</td>
</tr>
<tr>
<td>VDD(TVDD)</td>
<td>TVDD supply voltage</td>
<td></td>
<td>2.5</td>
<td>5.0</td>
<td>5.5</td>
<td>V</td>
</tr>
<tr>
<td>Ipd</td>
<td>power-down current</td>
<td>PDOWN pin pulled HIGH</td>
<td>8</td>
<td>40</td>
<td></td>
<td>nA</td>
</tr>
<tr>
<td>IOD</td>
<td>supply current</td>
<td></td>
<td>-</td>
<td>17</td>
<td>20</td>
<td>mA</td>
</tr>
<tr>
<td>IOD(TVDD)</td>
<td>TVDD supply current</td>
<td>transmitter permanent active</td>
<td>180</td>
<td>350</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Tamb</td>
<td>ambient temperature</td>
<td>device mounted on PCB which allows sufficient heat dissipation</td>
<td>-40</td>
<td>25</td>
<td>105</td>
<td>°C</td>
</tr>
<tr>
<td>Tstg</td>
<td>storage temperature</td>
<td>no supply voltage applied</td>
<td>-55</td>
<td>25</td>
<td>150</td>
<td>°C</td>
</tr>
</tbody>
</table>

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1. V_{DD(PVDD)} must always be the same or lower voltage than V_{DD}.
2. I_{pd} is the sum of all supply currents.
CLRC663 plus – block diagram
CLRC663 plus – pinning

This pin is used for connection of a buffer capacitor. Connection of a supply voltage might damage the device.
PRODUCT SUPPORT PACKAGE
CLRC663 plus – development kit and board

- The OM26630FDK is a flexible and easy to use frontend development kit for CLRC663 plus
- It contains a CLEV6630B board fully supported by the NFC Cockpit and the NFC Reader Library with a 65*65mm² antenna optimized for EMVCo applications and a 30*50mm² antenna with matching components optimized for Access Management applications
- It also includes, 3 small antenna matching PCBs for implementation of custom antenna matching circuit, NFC sample cards based on NTAG216F (NFC Forum type 2 tag) and DESFire® EV2, and 10 CLRC663 plus samples in HVQFN package
**CLRC663 plus – NFC Cockpit**

- **NFC Cockpit** is an intuitive GUI that lets you configure and adapt CLRC663 plus settings without writing a single line of software code.
- This Windows tool features:
  - direct register/EPPROM read/write access and backup of EEPROM settings
  - RF field control and card operation (Type A, Type B, Type F, ISO15693)
  - control of test applications like EMVCo Loopback and test signal configuration
  - LPCD configuration
**CLRC663 plus – NFC Reader library**

- **Scalability** – enable only required components and protocol implementations
- **Optimum performance** – built-in MCU support, interrupt-based event handling, free RTOS support and compilers that produce highly compact and efficient code
- **Faster development** – save time and effort by using the APIs and the rich set of sample applications for most common functions
- **Simpler certification** – get ready for certification with test applications for EMVCO L1, NFC Forum and ISO/IEC10373-6 PICC/PCD
Find your NFC toolkit at [www.nxp.com](http://www.nxp.com)
CLRC663 plus – best performance at lowest power consumption

- Max. operating transmitter current: 350mA (lim. 500mA)
- Enhanced LPCD performance and options
- Broad temperature range from -40°C to +105°C
- Low supply voltage for battery support down to 2.5V

<table>
<thead>
<tr>
<th>Item</th>
<th>12NC</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLRC66303HN, 551</td>
<td>9353 062 08551</td>
<td>CLRC663 plus on single tray</td>
</tr>
<tr>
<td>CLRC66303HN, 518</td>
<td>9353 062 08518</td>
<td>CLRC663 plus on reel</td>
</tr>
<tr>
<td>OM26630FDK</td>
<td>9353 391 51699</td>
<td>CLRC663 plus frontend development kit containing a CLEV6630B development board and - an 30*50mm² antenna with matching components and 3 PCBs for individual antenna matching - NTAG216F and MIFARE DESFire EV2 sample cards and 10 CLRC663 plus samples</td>
</tr>
<tr>
<td>CLEV6630B</td>
<td>9353 391 49699</td>
<td>CLRC663 plus frontend development board with 65*65mm² antenna</td>
</tr>
</tbody>
</table>

www.nxp.com/products/:CLRC66303HN
www.nxp.com/products/:OM26630FDK
SECURE CONNECTIONS FOR A SMARTER WORLD