MFRX852
Secure contactless reader solution

1. General description

The MFRX852 is a new highly integrated security reader module for contactless communication at 13.56 MHz. It combines a completely integrated Secure Application Module (SAM), data processing and modulation/demodulation for high security passive contactless communication methods and protocols at 13.56 MHz.

The MFRX852 supports the following contactless protocols and features:

- all layers of the ISO/IEC 14443 including the type A and type B communication scheme
- contactless T=CL protocol for MIFARE DESFire communication
- contactless communication using higher baud rates

The MFRX852 is primarily designed for secure transport applications and related loyalty programs. Other possible applications are for example, general secure reader applications, Automatic Fare Collection (AFC) terminals, value checkers, ePassport readers and security handheld readers.

It supports the MIFARE Mini, MIFARE 1K, MIFARE 4K security algorithm to authenticate MIFARE Mini, MIFARE 1K, MIFARE 4K products. In addition, DES/3DES and AES security algorithms are supported to authenticate NXP MIFARE DESFire and MIFARE DESFire EV1 products. Additional immunity against security attacks is provided by the high integration of security processor and contactless interface into a single module package.

Reduced complexity of security reader design, hardware and software development is achieved by high integration of several hardware components into one small module package of 7 mm × 7 mm.

2. Features

2.1 General

- Hard reset with low power function
- User-programmable reader start-up configuration
- Power-down mode per software
- Integrated oscillator to connect 13.56 MHz
- 3.3 V to 5 V operation power supply
- CRC coprocessor
- Internal self-test

2.1.1 Contactless interface

- Highly integrated analog circuitry to demodulate and decode responses
- Buffered output drivers for connecting to an antenna with the minimum number of external components
- Supports ISO/IEC 14443A/MIFARE and ISO/IEC 14443B
- Supports contactless communication with higher baud rates up to 848 kbaud
- Support of MFIN/MFOUT
- Internal power supply for the smart card IC connected via MFIN/MFOUT
- Bit- and byte-oriented framing

2.2 Host interface

- T=1 communication protocol as defined in ISO/IEC 7816-3
- Automatic detection of host processor interface type

2.3 Key storage memory

- 10 years data retention
- Write endurance of 100 000 cycles
- 128 key entries (1 SAM master key entry)
- Up to 3 key versions for each entry
- Key cache (8 entries) for accelerating key access

2.4 Security

- Unique serial number for each SAM device
- Hardware (3)DES coprocessor
- Hardware AES coprocessor
- Hardware MIFARE Mini, MIFARE 1K, MIFARE 4K crypto coprocessor

2.5 SAM functions

- Support of multiple CIDs/logical channels in parallel, separated by hardware firewall
- Generate session key to support DESFire "Authenticate" commands
- Generate session key to support secured host communication
- Verify (3)DES generated 4 byte and 8 byte MACs based on session key (optional)
- Create (3)DES generated 4 byte and 8 byte MACs based on session key (optional)
- Verify AES generated 8 byte MACs based on session key (optional)
- Create AES generated 8 byte MACs based on session key (optional)
- Decipher and verify (3)DES or AES enciphered data based on session key (optional)
- Encipher plain data using (3)DES or AES based on session key (optional)
- Secure update of all keys stored in the SAM
- Mutual three pass authentication between SAM and SAM controller
- Key usage counters
- (3)DES or AES based key diversification

3. Quick reference data

Table 1.   Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DD}	supply voltage			3	-	5.5	V
$V_{DD(CVDD)}$	CVDD supply voltage	GND = 0 V		2.7	2.8	3.3	V
$V_{DD(PVDD)}$	PVDD supply voltage	$V_{DD(PVDD)} \leq V_{DDA} = V_{DDD} = V_{DD(TVDD)}$; $V_{SSA} = V_{SSD} = V_{SS(PVSS)} = V_{SS(TVSS)} = 0$ V; GND = 0 V	[1]	1.6	-	3.6	V
$V_{DD(SVDD)}$	SVDD supply voltage	$V_{SSA} = V_{SSD} = V_{SS(PVSS)} = V_{SS(TVSS)} = 0$ V; GND = 0 V		1.6	-	3.6	V
I_{pd}	power-down current	hard power-down; $V_{DD(PVDD)} = 2.8$ V	[2]	-	-	10.5	µA
		soft power-down; $V_{DD(VDDCO)} = 0$ V; $V_{DD(CVDD)} = 2.8$ V; RF level detector on	[2]	-	-	10	µA
$I_{DD(SVDD)}$	SVDD supply current	$V_{DD(SVDD)} = 2.8$ V		-	6.5	30	mA
I_{CC}	supply current		[3]	-	-	40	mA
$I_{DD(VIN)}$	VIN supply current	$T_{amb} = -30$ °C to +80 °C, 40 Ω typical TX load impedance	[4][5][6]	-	70	120	mA
T_{amb}	ambient temperature	HLQFN48R	[7]	−25	-	+85	°C

[1] $V_{DD(PVDD)}$ must always be the same or lower voltage than $V_{DD(CVDD)}$.

[2] I_{pd} soft power-down and I_{pd} hard power-down are the total currents for all supplies.

[3] I_{CC} depends on the overall load at the digital pins.

[4] $I_{DD(VIN)}$ depends on the external circuit connected to pins TX1 and TX2.

[5]   During typical circuit operation the overall current is below 100 mA.

[6]   Typical value using a complementary driver configuration and an antenna matched to 40 Ω between TX1 and TX2 at 13.56 MHz.

[7]   In still air with exposed pad soldered on a 4-layer JEDEC printed-circuit board.

4. Ordering information

Table 2.   Ordering information

Type number	Package		
	Name	**Description**	**Version**
MFRX85201HD/rrffo[1]	HLQFN48R	plastic thermal enhanced low profile quad flat package; no leads; 48 terminals; resin based; body 7 × 7 × 1.2 mm	SOT995-1

[1]   rr = ROM code, ff = fab. key, o = MIFARE option.

5. Block diagram

The MFRX852 main components are the SAM: P5DF072, and the MFRC523 reader IC; see Figure 1. The P5DF072 contains software to directly control the MFRC523 reader IC and a command set for acting, beside the classic SAM functionality, as a contactless security reader module.

The MFRX852 also provides the functionality to connect an external analog front-end based on the MFIN/MFOUT protocol pins.
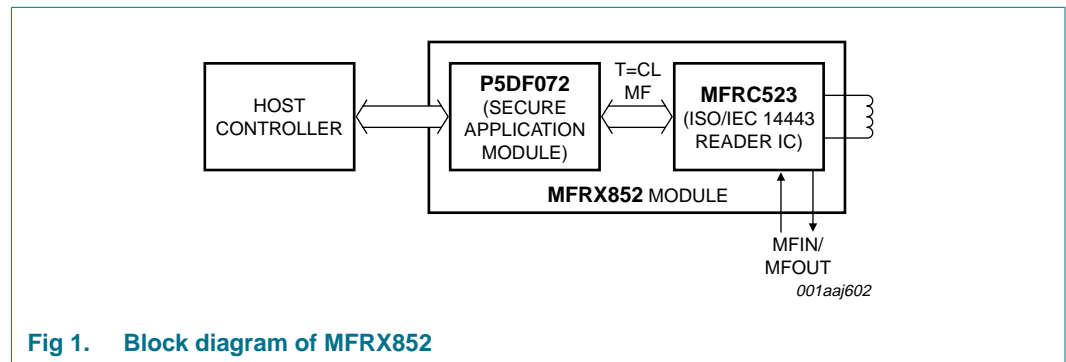

Fig 1. **Block diagram of MFRX852**

6. Limiting values

Table 3. **Limiting values**
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DD}	supply voltage		−0.3	+6.5	V
$V_{DD(PVDD)}$	PVDD supply voltage		−0.5	+4.0	V
$V_{DD(CVDD)}$	CVDD supply voltage		−0.5	+4.0	V
$V_{DD(SVDD)}$	SVDD supply voltage		−0.5	+4.0	V
$V_{DD(VDDCO)}$	VDDCO supply voltage		−0.5	+6.0	V
P_{tot}	total power dissipation	per package; V_{DDD} in shortcut mode	-	700	mW
I_O	output current	maximum current at TX1 and TX2	−100	100	mA
T_j	junction temperature		-	100	°C
T_{stg}	storage temperature		+5	+45	°C
V_{ESD}	electrostatic discharge voltage	HBM; 1500 Ω, 100 pF; JESD22-A114-B	-	2000	V
		MM; 0.75 µH, 200 pF; JESD22-A114-A	-	200	V

7. Revision history

Table 4. **Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
MFRX852_SDS_30	20091113	Product short data sheet	-	-

8. Legal information

8.1 Data sheet status

Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

8.2 Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local NXP Semiconductors sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

8.3 Disclaimers

General — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

Right to make changes — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in medical, military, aircraft, space or life support equipment, nor in applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors accepts no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) may cause permanent damage to the device. Limiting values are stress ratings only and operation of the device at these or any other conditions above those given in the Characteristics sections of this document is not implied. Exposure to limiting values for extended periods may affect device reliability.

Terms and conditions of sale — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at http://www.nxp.com/profile/terms, including those pertaining to warranty, intellectual property rights infringement and limitation of liability, unless explicitly otherwise agreed to in writing by NXP Semiconductors. In case of any inconsistency or conflict between information in this document and such terms and conditions, the latter will prevail.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from national authorities.

Quick reference data — The Quick reference data is an extract of the product data given in the Limiting values and Characteristics sections of this document, and as such is not complete, exhaustive or legally binding.

8.4 Licenses

Purchase of NXP ICs with ISO/IEC 14443 type B functionality

RATP/Innovatron Technology

This NXP Semiconductors IC is ISO/IEC 14443 Type B software enabled and is licensed under Innovatron's Contactless Card patents license for ISO/IEC 14443 B.

The license includes the right to use the IC in systems and/or end-user equipment.

8.5 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

I²C-bus — logo is a trademark of NXP B.V.

MIFARE — is a trademark of NXP B.V.

DESFire — is a trademark of NXP B.V.

MFRX852_SDS_30

© NXP B.V. 2009. All rights reserved.

Product short data sheet
PUBLIC

Rev. 3 — 13 November 2009
181530

6 of 8

9. Contact information

For more information, please visit: **http://www.nxp.com**

For sales office addresses, please send an email to: **salesaddresses@nxp.com**

10. Contents