MFEV710
Pegoda EV710

1. General description

The new Pegoda is NXP's latest generation of reference designs for secure MIFARE applications. Built around proven, well-established MIFARE solutions and powerful ARM Cortex-M3 processors, these design in kits are available in two evaluation kits: the MFEV710 and the MFEV852.

The MFEV710 design in kit includes the MFRD710 contactless smartcard reader, a design based on the MFRC523 contactless reader IC. The kit supports the entire MIFARE portfolio: MIFARE Classic, MIFARE DESFire, MIFARE Plus, and MIFARE Ultralight C, including SAM AV2 (in x- and non-x modes). The kits also offer full support of MIFARE discover, with a reader library for all the MIFARE card products.

It uses an open software concept and PC-based tools. The software code and hardware architecture are reusable, and each kit includes a sample SAM-based, secure reader architecture that implements multiple protocols. For added flexibility in development, the flash-based microcontroller supports custom application development based on Pegoda hardware. The microcontroller is open for customer code implementations, and the design's hardware interfaces are open for customer extensions.

The kit include native support for USB. An optional hardware extension board, available on request, provides additional support for RS232, RS485, and Ethernet. The extension board also has a JTAG interface, for debugging functionality directly on the microcontroller, and is accompanied by a free embedded toolchain for firmware customization.

The GUI supplied with each kit uses the familiar Windows look and feel and offers a range of features, including history, log, timing profile management, key management, show cards, and installer.

Minimum system requirements The minimum system requirements for running either evaluation kit are as follows: Intel Pentium 166 MHz or equivalent, 32 Mbytes RAM, 20 Mbytes free hard disk space, CD-ROM drive, USB support, and Windows 7, Windows XP, Windows Vista, or Windows Server in 32- or 64-bit version.

2. Features and benefits

2.1 Features

- Multiprotocol ISO/IEC 14443 and MIFARE operation
- PC/SC-based architecture on widely deployed hardware solutions
- Full support for entire MIFARE card portfolio and MIFAREdiscover
- SAM support in standard or x-mode

◼ ARM Cortex-M3 microcontroller with integrated flash memory
◼ Firmware in source code and binaries
◼ USB host interface to PC and Windows-based user interface
◼ Optional support for RS232, RS485, JTAG, Ethernet

2.2 Benefits

◼ Fast, flexible development of SAM-based, secure reader systems
◼ Quick embedded development with portable code
◼ Easy customization with flash-based microcontroller
◼ Custom firmware and JTAG debugging with optional hardware extension board

3. Applications

◼ Public transportation
◼ Access management
◼ PC peripheral terminal

4. Quick reference data

Table 1.   Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DD}	supply voltage	-	4.75	5.0	5.25	V
T_{amb}	ambient temperature	-	−10	+25	70	V

5. Ordering information

Table 2.   Ordering information

Type number	Package		
	Name	**Description**	**Version**
MFEV710	-	Package containing:	-
		MFRD710, Pegoda contactless smartcard reader, based on MFRC523 contactless reader IC	
		USB cable	
		MIFARE sample cards	
		CD with documentation and software	

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6. Block diagram

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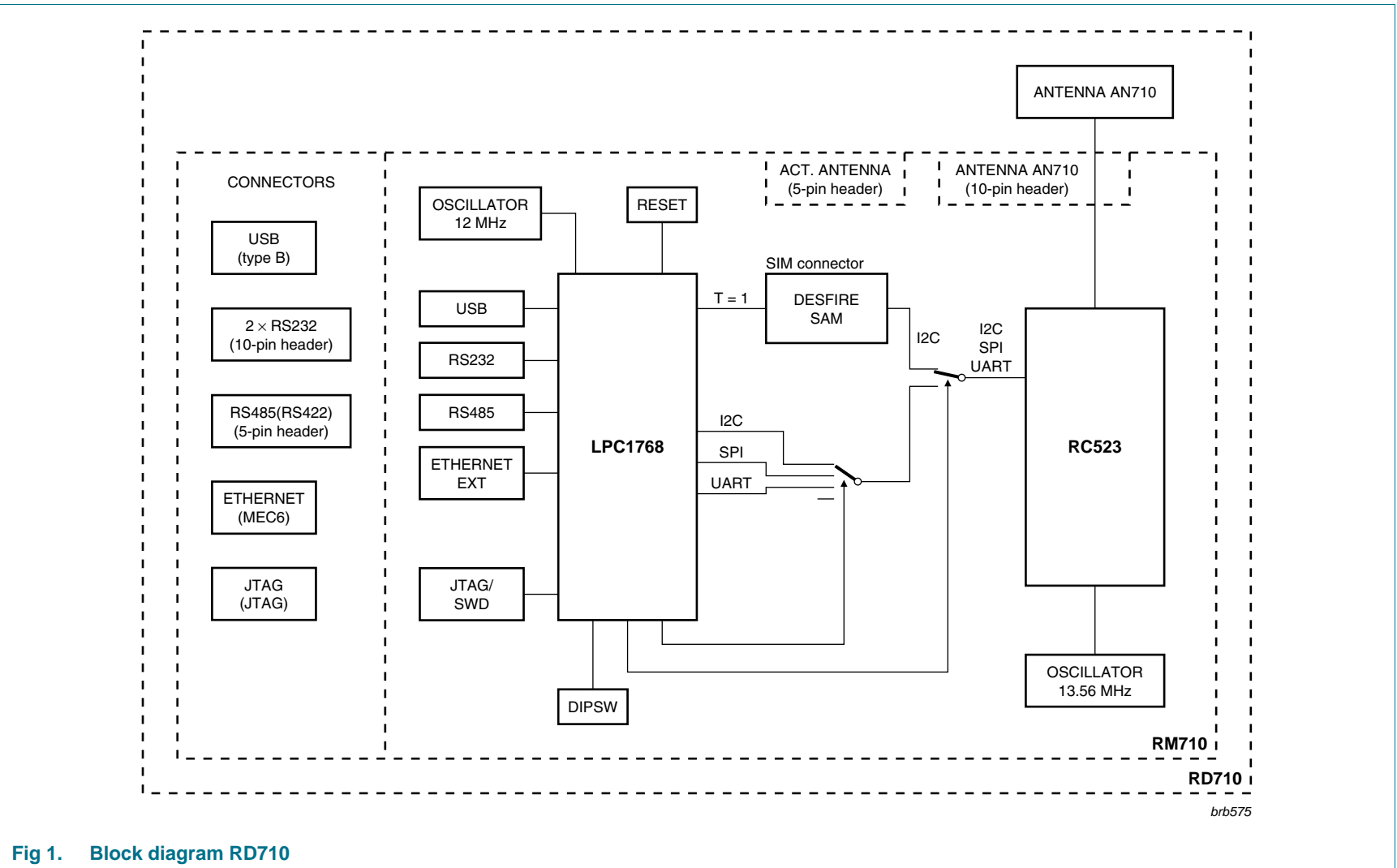© NXP B.V. 2011. All rights reserved.

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Fig 1.   Block diagram RD710

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7. Functional description

7.1 Content

The kit includes the following items:

- MFRD710, Pegoda contactless smartcard reader, based on MFRC523 contactless reader.
- 1 USB cable
- 3 MIFARE sample cards
- CD with documentation and software.

The following paragraphs describe the Hardware and Software Architecture related to the MFRD710.

7.2 Hardware architecture CLRD710

The reader CLRD710 is a contactless Reader/Writer compliant to the ISO/IEC 14443 standard and is able to handle contactless data rates of 106 kBit, 212 kBit, 424 kBit and 848 kBit.

It is based on NXP reader-IC MFRC523, see Ref. 1; which is a highly integrated reader IC solution for contactless communication purposes at 13.56 MHz. The MFRC523 is connected to a LPC1768 µController that executes the firmware. The LPC1768 implements flash memory and allows to download and debug the firmware by means of a JTAG interface.

The CLRD710 implements an external amplifier driven by the MFRC523 which is connected to the antenna to achieve an optimum reader/writer performance for contactless applications.

The MIFARE SAM AV2 module, see Ref. 2; can be used for key storage and enhanced crypto operation to increase the security level.

The reader provides several communication interfaces on board such as: USB, RS232, RS485 (RS422), Ethernet (via LPC_ extension board) and JTAG (a JTAG IEEE 1149.1 compliant interface for debugging).

The Hardware Design is described in more detail in Ref. 4.

7.3 Software architecture

The software of the CLRD710 consist of 3 components.

- CLRD710 firmware based on a ARM CortexM3 implementation as well as the driver
- Reader library
- Graphical User Interface MIFAREdiscover

7.3.1 Firmware and driver

The reader firmware can perform contact and contactless communication.

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The contact part of the reader firmware is used to communicate with a SAM, ideally the MIFARE SAM AV2, see Ref. 2. The contactless part performs the polling and activation sequence according to PC/SC part 2, ISO/IEC 14443-3 and 14443-4 standards.

The polling and activation sequence can be turned off and on with the use of escape (PC/SC part 3) commands. The polling and activation sequence is automatically disabled if escape commands are executed that would interfere with the normal operations. The firmware also interprets the ADPUs for MIFARE which are defined in PC/SC part 3.

The main modes of operation are being set by DIP switches which are located on the reader. Some configuration parameters can be set with the escape commands. The reader will store them in non-violate memory. The user will be able to reset the configuration back to default state.

The firmware will construct the product name – which is returned by USB descriptor – to easily identify the reader/SAM configuration. Depending on the DIP switches, there are three possible configurations:

- No SAM (Pegoda N)
- SAM in X-Mode (Pegoda X)
- SAM in S-Mode (Pegoda S)

The user will be able to flash the board with customized or original firmware with three methods:

- Over USB (IAP)
- Over serial port (ISP)
- Over JTAG with the use of an external program

For more information, please refer to Ref. 6. The implementation of the driver is described in Ref. 9.

7.3.2 NXP Reader Library

The Reader Library is a special build of the functionality provided by the Basic Function library. The desired functionality can be selected by the user and compiled dependent on application requirements. On the CLRD710 the Reader library is implemented to be executed on the Host PC. The library is designed to be portable, it can be ported to any embedded environment if desired. As such it can be also ported to the controller of the CLRD710.

The NXP reader library is encapsulated into Layers and Components written in ANSI C. The library structure provides a modular way of programming and setting up the reader interface.

For easy portability, the reader library consists of 4 layers:

- BAL (Bus Abstraction Layer)
- HAL (Hardware Abstraction Layer)
- PAL (Protocol Abstraction Layer)
- AL (Application Layer)

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The reader library requires a dedicated build for a usage of the CLRD710 functionality in No -SAM, SAM "X-mode" or SAM "Direct-mode".

Building the software stack for a specific reader mode requires therefore different software models to be generated. The three types of operating modes within the PC/SC mode are:

- No SAM mode
  The most important aspect of this mode is performing activation and polling sequence for ISO 14443 A type cards as defined in PC/SC part 3. Selected cards are put in slot manager and notification is sent to PC/SC driver. There can be only one ISO 14443-3 card or multiple (maximum 14) ISO 14443-4 cards in the field.

- SAM in non X-mode
  The most important aspect of this mode is performing activation and polling sequence for ISO 14443 A type cards as defined in PC/SC part 3. Selected cards are put in slot manager and notification is sent to PC/SC driver. There can be only one ISO 14443-3 card or multiple (maximum 14) ISO 14443-4 cards in the field.

- SAM in X-mode
  In this mode communication is only through SAM (slot 0). Only limited number of proprietary commands can be executed

The NXP reader library is available over the NXP BU-ID docu control service, please refer to Ref. 12. An application note, see Ref. 3, gives an overview how to create your on application as a project within the NXP reader library.

7.3.3 MIFAREdiscover

MIFAREdiscover is the Graphical User Interface of the CLRD710 software package. It supports easy and fast application development for ISO/IEC 14443 type Smartcards by providing multiple views to the content and protocols of the cards. It is supplied over our NXP BU-ID docu control service, please refer to Ref. 11. A very first guideline to install all necessary parts and do the first steps with this Graphical User Interface is given in Ref. 5.

7.4 Certification

The CLRD710 went successfully through the following certification processes:

- EMC, certification to comply with EN 301 489-1 V1.6.1 (2005-09); EN 301 489-3 V1.4.1(2002-08); IEC 60950-1:2005; EN 60950-1:2006

- FCC, certification to comply with FCC Part 15, Subpart C

- MIFARE certification institute to comply with Test plan for MIFARE Air-Interface Compatibility Certification of Terminals Qualification of Readers Single and Double UID Version 2.4 Date of Issue: 29.03.2010

- CE

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8. Limiting values

Table 3.   Limiting values [1]

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to VSS (ground = 0 V).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DD}	supply voltage	active reader	4.75	5.00	5.25	V
T_{amb}	ambient temperature	-	−25	+25	+85	°C
I_{DD}	supply current	active, RF on	-	170	-	mA

[1] Stresses beyond those listed may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

9. Abbreviations

Table 4.   Abbreviations

Acronym	Description
AL	Application Layer
APDU	Application Protocol Data Unit
BAL	Bus Abstraction Layer
EEPROM	Electrically Erasable Programmable Read Only Memory
HAL	Hardware Abstraction Layer
IAP	In-Application Programming
ISP	Internet service provider
JTAG	Joint Test Action Group
PAL	Protocol Abstraction Layer
PCD	Proximity Coupling Device
PICC	Proximity Integrated Circuit Card

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10. References

[1]   Data sheet — MFRC523 Contactless reader IC, available on NXP web

[2]   Short data sheet — P5DF081 MIFARE SAM AV2, available on NXP web

[3]   Application Note — Example Project Pegoda, available on NXP web

[4]   Application Note — Hardware Design Guide Pegoda, available on NXP web

[5]   Application Note — Quick Start Up Guide Pegoda, available on NXP web

[6]   Application Note — Software Design Guide Pegoda, available on NXP web

[7]   Application Note — Pegoda Toolchain Information, available on NXP web

[8]   Application Note — Pegoda Amplifier, available on NXP web

[9]   Application Note — Pegoda RD710/RD852 Implementation of the USB drive, available on NXP web

[10] Application Note — MIFARE SAM AV2 Documentation and Sampling, available on NXP web

[11] Software — MIFAREdiscover available over BU-ID docu control, BU-ID Doc. no.: 1866**[1]

[12] Software — NXP Reader library including Sample Projects, available over BU-ID docu control, BU ID Doc.no.: 2003**

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1.   ** ... document version number

11. Revision history

Table 5.   **Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
MFEV710_SDS v3.0	20110214	Product short data sheet	-	-

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12. Legal information

12.1 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.

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

RATP/Innovatron Technology

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13. Contact information

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14. Contents

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