



Security & Chip Card ICs

SLE 44R35S / Mifare[©]

Intelligent 1-Kbyte EEPROM
with Interface for Contactless Transmission, Security Logic
and Anticollision according to the MIFARE[®]-System

Revision History: Current Version 07.99

Previous Releases: 11.97 Version 1.0

Page	Subjects (changes since last revision)
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	Layout change
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Intelligent 1–Kbyte EEPROM with Interface for Contactless Transmission, Security Logic and Anticollision according to the MIFARE[®]-System

Features

EEPROM

- 1 Kbyte, organised in 16 sectors with 4 blocks of 16 bytes each
- User definable access conditions for each memory block
- Erasing and writing of one block (16 bytes) in one shot at 5 ms
- Endurance minimum 10⁵ write/erase cycles ¹⁾
- Data retention for minimum of 10 years¹⁾

Contactless Interface (complying to the Mifare[®] System)

- Contactless transmission of data and supply energy (battery-less operation)
- Read and write distance from 0 cm up to 10 cm (with Mifare[®] Read/Write Device))
- Fast data transfer (106 Kbit/s)
- Anticollision logic: Several cards may be operated in the field simultaneously
- Operating frequency 13.56 MHz
- Short transaction times: Typical ticketing transaction < 100 ms (including backup); transaction possible with moving card

Security

- Mutual three pass authentication between card and reader
- Data encryption for RF channel
- Data integrity supported by several mechanisms: Anticollision, 16 bit CRC, parity check, bit count checking and channel monitoring
- Access to EEPROM protected by transport code on chip delivery
- Unique serial number for each circuit
- Suited for multifunctional applications by individual key sets per each EEPROM sector

Ambient temperature –25 ... +70°C

Table 1 Ordering Information

Type	Package ²⁾
SLE 44R35S C	C
SLE 44R35S MCC2-2-1	MCC2-2-1 (without solder holes)
SLE 44R35S MCC2-2-2	MCC2-2-2 (with two solder holes)

¹⁾ Values are temperature dependent

²⁾ Available as a Module Contactless Card (MCC) for embedding in plastic cards or as a die (C) for customer packaging

1 Pin Description

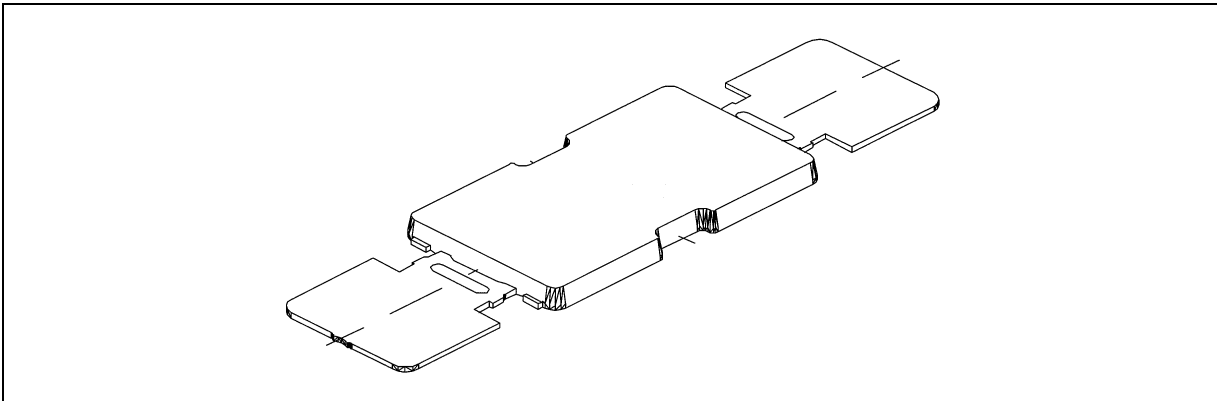


Figure 1 Pin Configuration Module Contactless Card (top view)

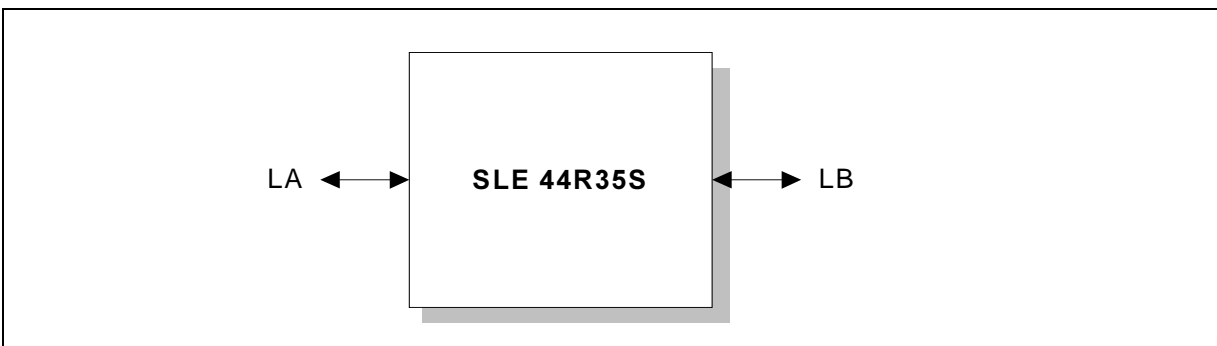


Figure 2 Pad Configuration Die

Table 2 Pin Definitions and Functions

Symbol	Function
LA	Antenna connection
LB	Antenna connection

2 Circuit Description

SLE 44R35S is designed for single applications (e.g. access control or electronic tickets) with small memory requirements. SLE 44R35S consists of an EEPROM memory of 1 Kbyte organised in 16 sectors with 4 blocks each containing 16 bytes, an analogue interface for contactless energy and data transmission and a control unit. The power supply and data are transferred to SLE 44R35S via an antenna which consists of a coil with a few turns directly connected to the chip. No further external components are necessary. The circuit is designed to communicate with a card reader at an operating distance between 0 cm and 10.0 cm.

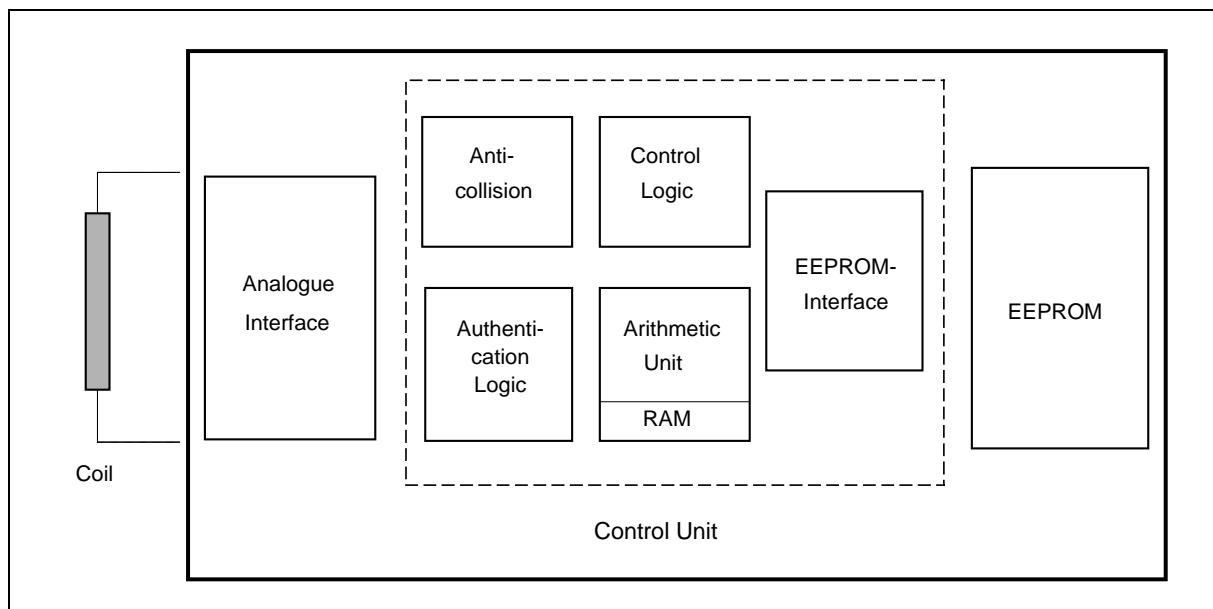


Figure 3 Block diagram

- **Analogue Interface**
 - Modulator / Demodulator
 - Rectifier
 - Clock Separator
 - Power on Reset
 - Voltage Regulator
- **Anticollision**

The internal logic ensures the recognition of several cards in the field which may be selected and operated simultaneously
- **Authentication Logic**

Preceding any memory operation the authentication procedure with secret keys for the single sector ensures permitted memory access only
- **Control Logic**

The memory can only be accessed according to the access conditions programmed for every block
- **Arithmetic Unit / RAM**

Arithmetic capability: Increase and decrease of values. Values are stored in a special redundant format
- **EEPROM:** 16 sectors with 4 blocks each containing 16 bytes. The last block of each sector is called "trailer" and stores a pair of secret keys and programmable access conditions for each block

3 Mifare® Contactless Remote Coupling Smart Card System Overview

SLE 44R35S is designed to operate in the Mifare® system, a contactless proximity smart card system. The system consists of a smart card on the one hand and a card reader together with an antenna on the other hand.

Contactless Energy and Data Transfer

In the Mifare® system, the operating distance between card and reader antenna can vary from 0 cm up to 10 cm. The card's antenna consists of a simple coil with a few turns embedded in plastic. Mifare® cards are passive and work batteryless. The high speed RF communication interface allows to transmit data with 106 Kbit/s.

Mifare® – The User-Friendly Contactless System

The Mifare® system is designed for optimal user-friendliness. The high data transmission rate permits short transaction times. For example, a ticketing transaction can be handled in less than 100 ms so that the Mifare® card user does not need to stop at the reader target (antenna). The Mifare® card may remain in the wallet of the user even if there are coins in it.

An intelligent anticollision function allows to operate more than one card in the field simultaneously. The anticollision algorithm selects each card individually and ensures that the execution of a transaction with a selected card is performed correctly without data corruption resulting from other cards in the field.

Multi-Application Functionality

The Mifare® system is especially suited as well for the use in payment systems as in ticketing systems, e.g. public transport applications. Both kinds of applications can be performed with the same card. The Mifare® system offers real multi-functionality comparable to the features of the processor card. Two different key sets for each memory sector support systems using key hierarchies.

High System Security

In the Mifare® system design, special emphasis has been placed on security against fraud. An access to the card memory is only possible after a three pass authentication. The serial number is unique for each card and can never be changed. Each data transmission is enciphered. Configurable access conditions protected by secret keys for memory operations as read or write protect from misuse.

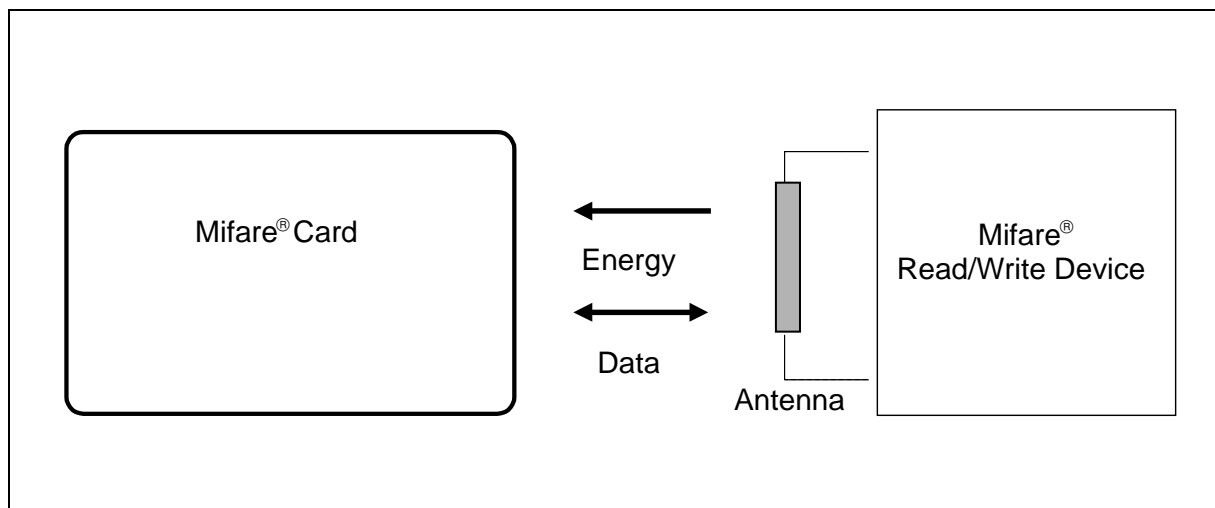


Figure 4 Mifare® System Overview

4 Mifare® Core Module (MCM) – The Kernel of a Mifare® Reader

The Mifare® Core Module (MCM) is the kernel of Mifare® read/write units which covers all the necessary functions to access Mifare® cards. The MCM offers the versatility to be applied in Mifare® card readers installed in a lot of different systems such as bus terminals, metro gate controllers, handheld devices or even PCs.

The Mifare® Core Module consists of two circuits, a RF circuit and an interface circuit, which are mounted on a PCB. The RF circuit which is shielded by metal housing performs energy and data transmission to the card and receives the card's responses. The security management for the data communication, the anticollision logic and the 16 byte receive/transmit buffer are part of the interface circuit. It offers furthermore an interface for controlling the MCM with a standard microprocessor via a parallel 8 bit bus.

Table 3 Features of the Mifare® Core Module

	Mifare® Core Module
Power supply	5 V / 15 mA and 12 V / 180 mA ¹⁾
Mechanical dimensions	54 x 100 x 19 mm as 52 pin-plug in module
Interface MCM-Host	CMOS parallel μ P bus
Interface MCM-Antenna	Triax cable

¹⁾ A special handheld version of the MCM operated with only 5V supply voltage is available

5 Tool Overview

For evaluating the performance of the Mifare[®] system, a demonstration kit is available. It operates with the serial PC port and via parallel control by a PC. The demonstration kit makes it possible to

- demonstrate the Mifare[®] system with the supplied demonstration software
- get familiar with the Mifare[®] system in order to shorten the phase for system integration
- start the system integration
- develop applications based on the supplied libraries

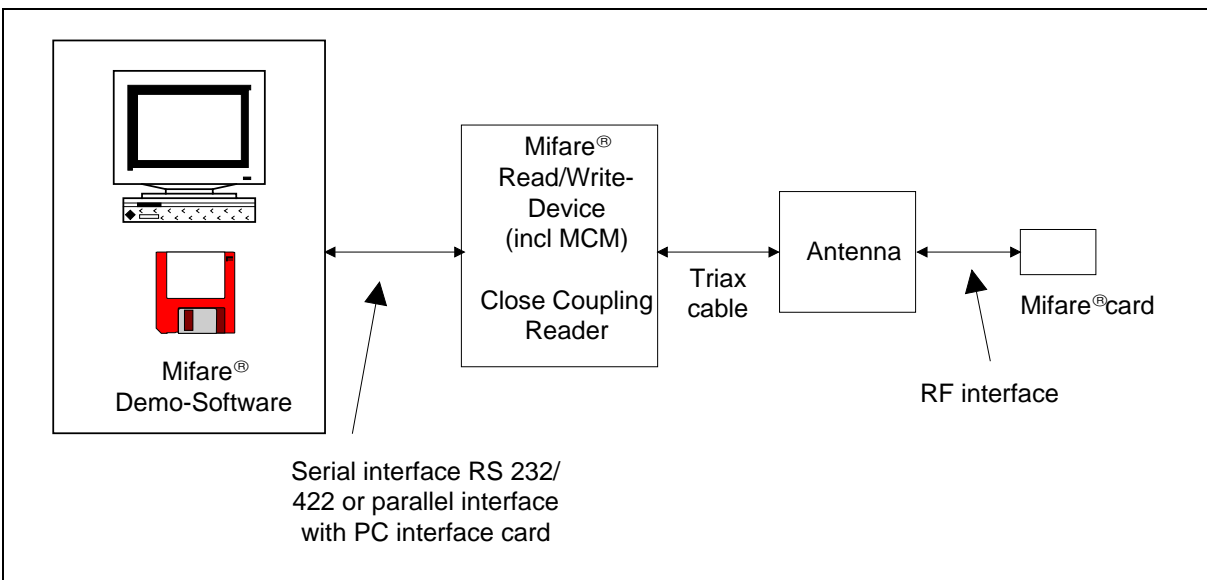


Figure 5 Mifare[®] Demonstration System

The demonstration system can be used in two modes:

Serial mode: Default mode where the Read/Write Device can be accessed via a RS232 or RS422 serial interface. An internal microprocessor converts the serial bit protocol to the parallel MCM interface. In this mode a 12 V (300 mA) external power supply is necessary.

Parallel mode: In this mode, a PC plug-in board is used for controlling the parallel interface of the MCM directly with the μ P bus of a PC. The RWD is connected with a parallel 37 pin flat cable. No external power supply is needed.

The Mifare[®] Demonstration Kit package includes

- Mifare[®] Read/Write Device based on a standard Mifare[®] Core Module (MCM)
- Antenna (+ cable)
- PC plug-in board for controlling the parallel interface of the MCM directly with the μ P bus of a PC. The RWD is connected with a parallel 37 pin flat cable in this operation mode.
- Mifare[®] cards according to ISO dimensions
- Software on 3.5" diskette
- Documentation set