MF3D(H)x2

MIFARE DESFire EV2 contactless multi-application IC

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364232 COMPANY PUBLIC

1 General description

1.1 Introduction

MIFARE DESFire EV2 contactless IC (MF3D(H)x2) is the latest addition to the MIFARE DESFire product family introducing new features along with enhanced performance for best user experience. The MIFARE DESFire EV2 is Common Criteria EAL5+ security certified which is the same security certification level as demanded for smart card IC products used e.g. for banking cards or electronic passports. It fully complies with the requirements for fast and highly secure data transmission and flexible application management. This makes it the ideal product for service providers and service operators who want to offer an easy, convenient and secure access to a wide variety of different services.

MIFARE DESFire EV2 offers best flexibility when creating multi-application schemes and features such as MIsmartApp with multiple key sets and Transaction MAC are supporting new business models. Smart Cities services, for example, could be utilized with only one MIFARE DESFire EV2 card by combining services such as public transport, car or bike sharing, access to city attractions with citizen services, closed-loop e-payment applications and local loyalty programs.

MIFARE DESFire EV2 is based on global open standards for both air interface and cryptographic methods. It is compliant to all levels of ISO/IEC 14443A and supports optional ISO/IEC 7816-4 commands (APDU and file structure supported) and is fully interoperable with existing NFC readers for MIFARE products.

Featuring an on-chip backup management system and the mutual three-pass authentication, a MIFARE DESFire EV2 card[1] can hold as many applications as the memory can accommodate. Each application can hold up to 32 files with various data configurations. The size of each file is defined at the moment of its creation, making MIFARE DESFire EV2 a truly flexible and convenient product. An automatic anti-tear mechanism is available for all file types, guaranteeing transaction-oriented data integrity.

The main characteristics of this device are denoted by its name "DESFire": DES indicates the high level of security using a 3DES or AES hardware cryptographic engine for confidentiality and integrity protection of the transmission data. Fire indicates its outstanding position as a Fast, Innovative, Reliable and Secure IC in the contactless proximity transaction market.

MIFARE DESFire EV2 delivers the perfect balance of speed, performance and cost efficiency. Its open concept allows seamless future integration of other ticketing media such as smart paper tickets, banking convergence card, and mobile ticketing based on Near Field Communication (NFC) technology. It is also fully compatible with the existing

1 In this document the term „MIFARE DESFire card“ refers to a MIFARE DESFire IC-based contactless card.

reader hardware platform of MIFARE products. MIFARE DESFire EV2 is your ticket to secure contactless systems worldwide.

1.2 Evolution of MIFARE DESFire products family

MIFARE DESFire has evolved over time, enhancing its security properties to protect against current and future security threats, and adding new features to better suit into new user requirements.

MIFARE DESFire EV2 is the third generation of the MIFARE DESFire products family succeeding MIFARE DESFire EV1 Contactless IC. It is functionally backward compatible with both MIFARE DESFire EV1 and MIFARE DESFire D40 (MF3ICD40).

Figure 1 shows the relationship between the three generations of MIFARE DESFire products. The latest generation encompasses the features from the older generation(s). Therefore, allowing existing users of the older products to adopt the latest product with minimum or no changes to their infrastructures.

MIFARE DESFire EV2 can be used as a MIFARE DESFire EV1 in its default delivery configuration. Every new feature would require an activation and/or the use of new commands.

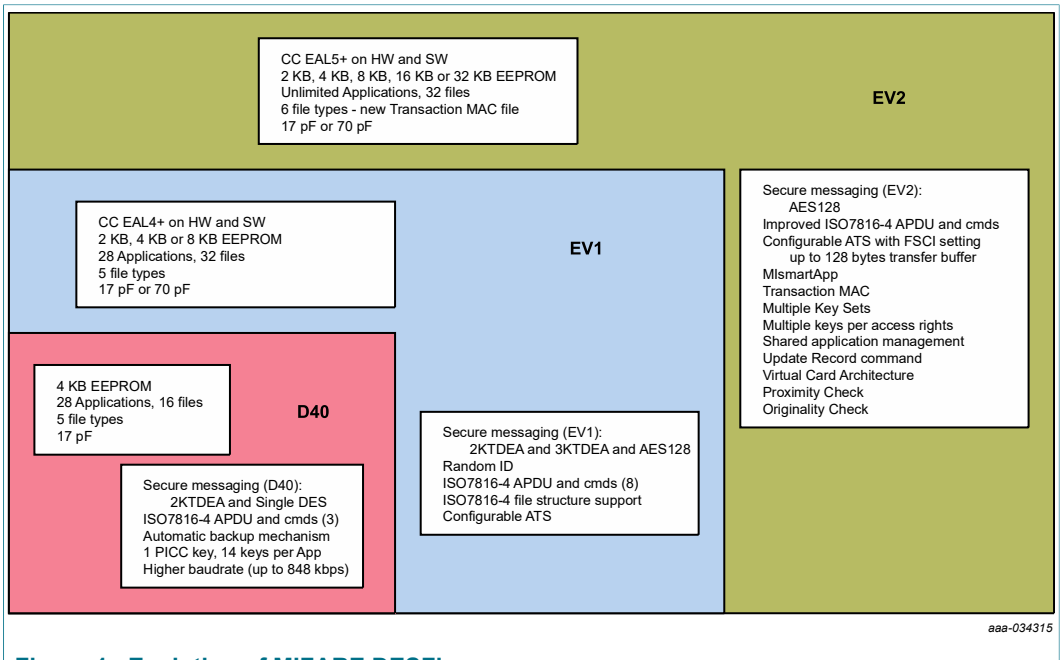

Figure 1. Evolution of MIFARE DESFire

2 Features and benefits

2.1 Features overview

2.1.1 RF interface: ISO/IEC 14443 Type A

- Contactless interface compliant with ISO/IEC 14443-2/3 A
- Low Hmin enabling operating distance up to 100 mm (depending on power provided by the PCD and antenna geometry)
- Fast data transfer: 106 kbit/s, 212 kbit/s, 424 kbit/s, 848 kbit/s
- 7 bytes unique identifier (option for Random ID)
- Uses ISO/IEC 14443-4 transmission protocol
- Configurable FSCI to support up to 128 bytes (256 bytes for 16 and 32 kB) frame size

2.1.2 Non-volatile memory

- 2 kB, 4 kB, 8 kB, 16 kB or 32 kB NV
- Data retention of 25 years
- Write endurance typical 500 000 cycles
- Fast programming cycles (erase/write)

2.1.3 NV-memory organization

- Flexible file system: user can freely define application structures on PICC
- Virtually no limitation on number of applications per PICC *(new)*
- Up to 32 files in each application (6 file types available: Standard Data file, Back-up Data file, Value file, Linear Record file, Cyclic Record file and Transaction MAC file)
- File size is determined during creation (not for Transaction MAC file)

2.1.4 Security

- Common Criteria certification: EAL5+ (Hardware and Software)
- Unique 7 bytes serial number for each device
- Optional "RANDOM" ID for enhance security and privacy
- Mutual three-pass authentication
- Mutual authentication according to ISO/IEC 7816-4
- Flexible key management: 1 card master key and up to 14 keys per application
- Hardware DES using 56/112/168 bit keys featuring key version
- Hardware AES using 128-bit keys featuring key version
- Data authenticity by 8 byte CMAC
- Data encryption on RF-channel
- Authentication on application level
- Hardware exception sensors
- Self-securing file system
- Backward compatibility to MF3ICD40: 4 byte MAC, CRC 16

2.1.5 New features on MIFARE DESFire EV2

- *MIsmartApp* (Delegated Application Management)
- Memory reuse in DAM applications (Format Application)
- Transaction MAC on application level
- Multiple Key Sets per application with fast key rolling mechanism (up to 16 sets)
- Accessing files from any two applications during a single transaction
- Multiple keys assignments for each file access right (up to 8)
- Virtual Card Architecture for enhanced card/application selection on multi-VC devices with privacy protection
- Proximity Check for protection against Relay Attacks
- Originality Check for proof of genuine NXP's product
- New EV2 Secure Messaging based on AES (similar with MIFARE Plus's secure messaging)

2.1.6 ISO/IEC 7816 compatibility

- Supports ISO/IEC 7816-4 file structure (selection by File ID or DF name)
- Supports ISO/IEC 7816-4 APDU message structure
- Supports ISO/IEC 7816-4 APDU wrapper for MIFARE DESFire native commands
- Supports ISO/IEC 7816-4 INS code 'A4' for SELECT FILE
- Supports ISO/IEC 7816-4 INS code 'B0' for READ BINARY
- Supports ISO/IEC 7816-4 INS code 'D6' for UPDATE BINARY
- Supports ISO/IEC 7816-4 INS code 'B2' for READ RECORDS
- Supports ISO/IEC 7816-4 INS code 'E2' for APPEND RECORD
- Supports ISO/IEC 7816-4 INS code '84' for GET CHALLENGE
- Supports ISO/IEC 7816-4 INS code '88' for INTERNAL AUTHENTICATE
- Supports ISO/IEC 7816-4 INS code '82' for EXTERNAL AUTHENTICATE

2.1.7 Special features

- Transaction-oriented automatic anti-tear mechanism
- Configurable ATS information for card personalization
- Backward compatibility mode to MIFARE DESFire EV1 and D40 (MF3ICD40)
- Optional high input capacitance (70 pF) for small form factor designs (MF3DHx2)

2.2 Summary of key differences between MIFARE DESFire generations

Table 1 shows the key differences between each product generation of the MIFARE DESFire family.

Table 1. Key differences between MIFARE DESFire generations

Features	MIFARE DESFire D40	MIFARE DESFire EV1	MIFARE DESFire EV2
Cryptography scheme(s)	*Single DES, 2KTDEA*	*Single DES, 2KTDEA, 3KTDEA, AES128*	*Single DES, 2KTDEA, 3KTDEA, AES128*
Secure messaging(s)	*D40 Native*	*D40 Native, EV1*	*D40 Native, EV1, EV2*
No. of applications	*28*	*28*	*No limit*
No. of files per application	*16*	*32*	*32*
Max. no. of files with backup	*8*	*32*	*32*
ISO/IEC7816-4 commands	*3*	*8*	*8 (refine)*
Random ID	*No*	*Yes*	*Yes*
Configurable ATS	*No*	*Yes, Historical bytes only*	*Yes, all parameters (FSCI supporting up to 256 bytes)*
Max. communication buffer	*64 bytes*	*64 bytes*	*128 bytes (2/4/8kB) or 256 bytes (16/32kB)*
Chaining during data transfer	*Native (AFh)*	*Native (AFh)*	*Native (AFh) or ISO/IEC14443-4*
Multiple Key Sets with rolling	*No*	*No*	*Yes*
MIsmartApp (Delegated Application Management)	*No*	*No*	*Yes*
Shared Application Management	*No*	*No*	*Yes*
Multiple keys per access right	*No*	*No*	*Yes*
UpdateRecord command	*No*	*No*	*Yes*
Transaction MAC	*No*	*No*	*Yes*
Virtual Card Architecture	*No*	*No*	*Yes*
Proximity Check	*No*	*No*	*Yes*
Originality Check	*No*	*No*	*Yes*

3 Applications

- Secure public transport ticketing
- Multi-application smart city and mobility card
- Secure access management
- Micro-payment and Loyalty
- Student ID
- Road tolling and parking
- Hospitality
- Event ticketing

4 Quick reference data

Table 2. Quick reference data [1][2]

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
f_i	input frequency			-	13.56	-	MHz
C_i	input capacitance	MF3Dx2	[3][4]	16.15	17.0	17.85	pF
		MF3DHx2	[3][4]	66.5	70.0	73.5	pF
NV memory characteristics							
t_{ret}	retention time	T_{amb} = 22 °C		25	-	-	year
$N_{endu(W)}$	write endurance	T_{amb} = 22 °C		200 000	500 000	-	cycle

[1] Stresses above one or more of the values may cause permanent damage to the device.
[2] Exposure to limiting values for extended periods may affect device reliability.
[3] Measured with LCR meter.
[4] T_{amb} = 22 °C; f_i = 13.56 MHz; 2 V RMS

5 Ordering information

Table 3. Ordering information

Type number	Package	Description	Version
MF3D8201DUD/01	FFC	8 inch wafer (sawn; 120 µm thickness)[1][2]; 8 K NV, 17 pF input capacitance	-
MF3D4201DUD/01	FFC	8 inch wafer (sawn; 120 µm thickness)[1][2]; 4 K NV, 17 pF input capacitance	-
MF3D2201DUD/01	FFC	8 inch wafer (sawn; 120 µm thickness)[1][2]; 2 K NV, 17 pF input capacitance	-
MF3DH8201DUD/01	FFC	8 inch wafer (sawn; 120 µm thickness)[1][2]; 8 K NV, 70 pF input capacitance	-
MF3DH4201DUD/01	FFC	8 inch wafer (sawn; 120 µm thickness)[1][2]; 4 K NV, 70 pF input capacitance	-
MF3DH2201DUD/01	FFC	8 inch wafer (sawn; 120 µm thickness)[1][2]; 2 K NV 70 pF input capacitance	-
MF3D8201DUF/01	FFC	8 inch wafer (sawn; 75 µm thickness)[1][2]; 8 K NV, 17 pF input capacitance	-
MF3D4201DUF/01	FFC	8 inch wafer (sawn; 75 µm thickness)[1][2]; 4 K NV, 17 pF input capacitance	-
MF3D2201DUF/01	FFC	8 inch wafer (sawn; 75 µm thickness)[1][2]; 2 K NV, 17 pF input capacitance	-
MF3DH8201DUF/01	FFC	8 inch wafer (sawn; 75 µm thickness)[1][2]; 8 K NV, 70 pF input capacitance	-
MF3DH4201DUF/01	FFC	8 inch wafer (sawn; 75 µm thickness)[1][2]; 4 K NV, 70 pF input capacitance	-
MF3DH2201DUF/01	FFC	8 inch wafer (sawn; 75 µm thickness)[1][2]; 2 K NV, 70 pF input capacitance	-
MF3D8200DA4/01	MOA4	plastic leadless module carrier package; 8 K EE, 17 pF input capacitance	SOT500-2
MF3D4200DA4/01	MOA4	plastic leadless module carrier package; 4 K EE, 17 pF input capacitance	SOT500-2
MF3D2200DA4/01	MOA4	plastic leadless module carrier package; 2 K EE, 17 pF input capacitance	SOT500-2
MF3DH8200DA4/01	MOA4	plastic leadless module carrier package; 8 K EE, 70 pF input capacitance	SOT500-2
MF3DH4200DA4/01	MOA4	plastic leadless module carrier package; 4 K EE, 70 pF input capacitance	SOT500-2
MF3DH2200DA4/01	MOA4	plastic leadless module carrier package; 2 K EE, 70 pF input capacitance	SOT500-2
MF3D8200DA6/01	MOB6	plastic leadless module carrier package; 8 K EE, 17 pF input capacitance	SOT500-3
MF3D4200DA6/01	MOB6	plastic leadless module carrier package; 4 K EE, 17 pF input capacitance	SOT500-3
MF3D2200DA6/01	MOB6	plastic leadless module carrier package; 2 K EE, 17 pF input capacitance	SOT500-3
MF3DH8200DA6/01	MOB6	plastic leadless module carrier package; 8 K EE, 70 pF input capacitance	SOT500-3
MF3DH4200DA6/01	MOB6	plastic leadless module carrier package; 4 K EE, 70 pF input capacitance	SOT500-3
MF3DH2200DA6/01	MOB6	plastic leadless module carrier package; 2 K EE, 70 pF input capacitance	SOT500-3
MF3D9200DU15/02	FFC	12 inch wafer (sawn; 150 µm thickness)[1][2]; 16 K NV, 17 pF input capacitance	-

Type number	Package	Description	Version
MF3DA200DU15/02	FFC	12 inch wafer (sawn; 150 µm thickness)[1][2]; 32 K NV, 17 pF input capacitance	-
MF3DH9200DU15/02	FFC	12 inch wafer (sawn; 150 µm thickness)[1][2]; 16 K NV, 70 pF input capacitance	-
MF3DHA200DU15/02	FFC	12 inch wafer (sawn; 150 µm thickness)[1][2]; 32 K NV, 70 pF input capacitance	-
MF3D9200DU75/02	FFC	12 inch wafer (sawn; 75 µm thickness)[1][2]; 16 K NV, 17 pF input capacitance	-
MF3DA200DU75/02	FFC	12 inch wafer (sawn; 75 µm thickness)[1][2]; 32 K NV, 17 pF input capacitance	-
MF3DH9200DU75/02	FFC	12 inch wafer (sawn; 75 µm thickness)[1][2]; 16 K NV, 70 pF input capacitance	-
MF3DHA200DU75/02	FFC	12 inch wafer (sawn; 75 µm thickness)[1][2]; 32 K NV, 70 pF input capacitance	-
MF3D9200DA4/02	MOB4	plastic leadless module carrier package; 16 K NV, 17 pF input capacitance	SOT500-2
MF3DA200DA4/02	MOB4	plastic leadless module carrier package; 32 K NV, 17 pF input capacitance	SOT500-2
MF3DH9200DA4/02	MOB4	plastic leadless module carrier package; 16 K NV, 70 pF input capacitance	SOT500-2
MF3DHA200DA4/02	MOB4	plastic leadless module carrier package; 32 K NV, 70 pF input capacitance	SOT500-2
MF3D9200DA6/02	MOB6	plastic leadless module carrier package; 16 K NV, 17 pF input capacitance	SOT500-3
MF3DA200DA6/02	MOB6	plastic leadless module carrier package; 32 K NV, 17 pF input capacitance	SOT500-3
MF3DH9200DA6/02	MOB6	plastic leadless module carrier package; 16 K NV, 70 pF input capacitance	SOT500-3
MF3DHA200DA6/02	MOB6	plastic leadless module carrier package; 32 K NV, 70 pF input capacitance	SOT500-3

[1] Delivered on film frame carrier with electronic failed die marking according to SECSII format.
[2] See [2]

6 Block diagram

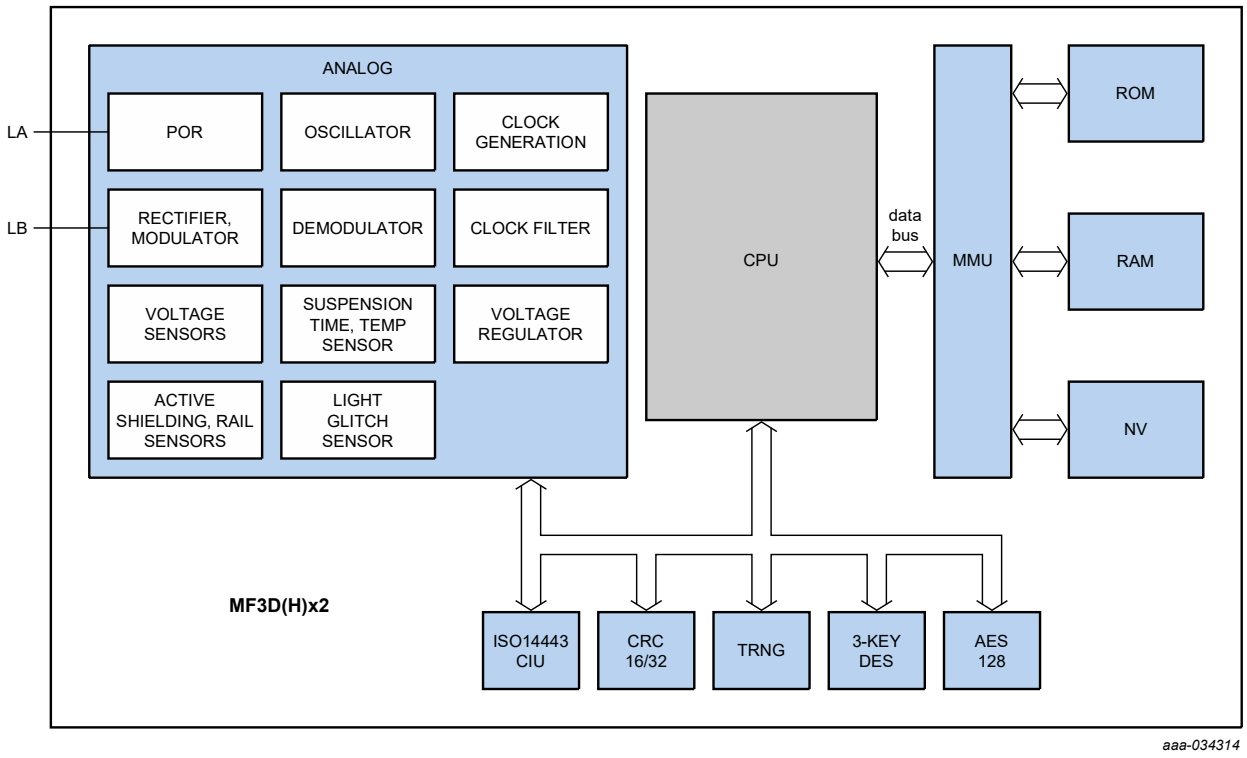

Figure 2. MIFARE DESFire EV2 IC block diagram

7 Functional description

7.1 Introduction

MIFARE DESFire EV2 is a contactless multi-application smart card IC compliant with ISOIEC 14443A (part 1-4). The MIFARE DESFire EV2 operating system provides an off-the-shelf development platform for smart card application providers.

The memory organization of MIFARE DESFire EV2 is flexible and can be dynamically structured to fit into any application requirements. The application and file structure is shown in Figure 3. Each application folder is a container of data files usable within a certain real world application (e.g. Transport ticketing). There are 5 file types available for data storage and 1 file type for storing Transaction MAC as detailed in Section 8.6.

Within the application folder, there is a set of keys and configuration settings dedicated for the application. The application owner can freely organize the file structure and security setting within his application. An adjacent application will not have access to its files as long as they do not possess the correct security rights. MIFARE DESFire EV2 also supports the ISO/IEC 7816-4 file structure and APDU.

At the PICC level, there is another set of keys and security settings for the PICC owner. The PICC owner will have the right to create or delete any application, but he will not have access to the application's files, unless he knows the application keys too.

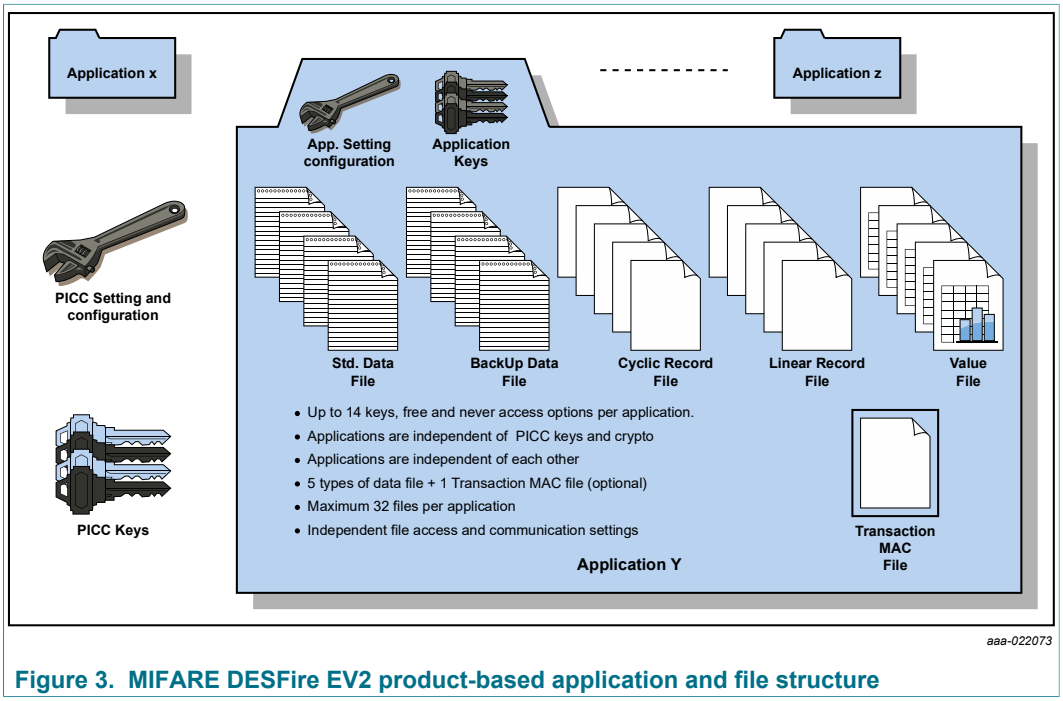

Figure 3. MIFARE DESFire EV2 product-based application and file structure

MIFARE DESFire EV2 supports confidential and integrity protected communication (see Section 7.7). Each MIFARE DESFire EV2 application can have its own cryptographic settings (i.e. 2TDEA, 3TDEA or AES) and secure messaging for communication. The D40 and EV1 secure messaging are included in the product for backward compatible support of existing installations. For new projects, the EV2 secure messaging is recommended.

MIFARE DESFire EV2 offers a transaction-oriented backup mechanism to prevent inconsistent updating of data storage across multiple files during a tearing situation. When transaction tearing occurs, either all data fields are updated or none is altered.

Besides the application file structure support, MIFARE DESFire EV2 offers many optional features such as following:

- Delegated Application Management (*MIsmartApp*) for giving rights to third-party application creation and management.
- Multiple key set within an application with key rolling mechanism and key migration supported.
- Shared files between two applications, supporting a single transaction over two applications at the same time.
- Multiple keys for each access right of files.
- Transaction MAC on application level, MACing the transacted data with a secret key on the card and served as a proof of transaction to the backend system.
- Virtual Card Architecture providing a privacy protecting mechanism during card selection.
- Proximity Check to prevent against relay attacks.
- Originality Check for verification of genuine MIFARE DESFire EV2 product from NXP or its licensees.

The following chapters provide basic description of some functionality on MIFARE DESFire EV2. For a more detailed description of each functionality on MIFARE DESFire EV2, see [1].

7.2 Contactless energy and data transfer

In the MIFARE product-based system, the MIFARE DESFire EV2 is connected to a coil consisting of a few turns embedded in a standard ISO/IEC smart card. A battery is not needed. When the card is positioned in the proximity of the PCD antenna, the high-speed RF communication interface allows data to be transmitted up to 848 kbit/s.

7.3 Anti-collision

An intelligent anti-collision mechanism allows more than one MIFARE DESFire EV2 in the field to be handled simultaneously. The anti-collision algorithm selects each MIFARE DESFire EV2 individually and ensures that the execution of a transaction with a selected MIFARE DESFire EV2 is performed correctly without data corruption resulting from other MIFARE DESFire EV2s in the field.

7.4 UID/serial number

The unique 7 byte (UID) is programmed into a locked part of the NV memory which is reserved for the manufacturer. Due to security and system requirements these bytes are write-protected after being programmed by the IC manufacturer at production time. According to ISO/IEC 14443-3 during the first anti-collision loop the cascade tag returns a value of 88h and also the first 3 bytes of the UID, UID0 to UID2 and BCC. The second anti-collision loop returns bytes UID3 to UID6 and BCC.

UID0 holds the manufacturer ID for NXP (04h) according to ISO/IEC 14443-3 and ISO/IEC 7816-6 AMD 1.

MIFARE DESFire EV2 also allows Random ID to be used. In this case, MIFARE DESFire EV2 only uses a single anti-collision loop. The 3 byte random number is generated after RF reset of the MIFARE DESFire EV2.

7.5 Memory organization

The NV memory is organized using a flexible file system. This file system allows multiple numbers of different applications on one MIFARE DESFire EV2. Each application can have multiple files. Every application is represented by its 3 bytes Application IDentifier (AID) and an optional ISO DF Name.

5 different data file types and 1 Transaction MAC file type are supported; see Section 8.6.

A guideline to assign DESFire AIDs can be found in the application note *MIFARE Application Directory* (MAD); see [3].

Each file can be created either at MIFARE DESFire EV2 initialization (card production/ card printing), at MIFARE DESFire EV2 personalization (vending machine) or in the field.

If a file or application becomes obsolete in operation, it can be permanently invalidated.

Commands which have impact on the file structure itself (e.g. creation or deletion of applications, change of keys) activate an automatic rollback mechanism, which protects the file structure from being corrupted.

If this rollback is necessary, it is done without user interaction before carrying out further commands. To ensure data integrity on application level, a transaction-oriented backup is implemented for all file types with backup. It is possible to mix file types with and without backup within one application.

7.6 Available file types

The files within an application can be any of the following types:

- Standard data files
- Backup data files
- Value files with backup
- Linear record files with backup
- Cyclic record files with backup
- Transaction MAC file

7.7 Security

The 7 byte UID is fixed, programmed into each device during production. It cannot be altered and ensures the uniqueness of each device.

The UID may be used to derive diversified keys for each ticket. Diversified MIFARE DESFire EV2 keys contribute to gain an effective anti-cloning mechanism and increase the security of the original key.

Prior to data transmission a mutual three-pass authentication can be done between MIFARE DESFire EV2 and PCD depending on the configuration employing either 56-bit DES (single DES, DES), 112-bit DES (triple DES, 3DES), 168-bit DES (3 key triple DES, 3K3DES) or AES. During the authentication, the level of security of all further commands during the session is set. In addition, the communication settings of the file/application

result in the following options of secure communication between MIFARE DESFire EV2 and PCD:

- Plain data transfer (only possible within the backwards-compatible mode to MF3ICD40 and EV2 secure messaging)
- Plain data transfer with cryptographic checksum (MAC): Authentication with backwards-compatible mode to MF3ICD40: 4 byte MAC; All other authentications based on DES/3DES/AES: 8 byte CMAC
- Encrypted data transfer (secured by CRC before encryption): Authentication with backwards-compatible mode to MF3ICD40: A 16-bit CRC is calculated over the stream and attached. The resulting stream is encrypted using the chosen cryptographic method. All other authentications-based DES/3DES/AES: A 32-bit CRC is calculated over the stream and attached. The resulting stream is encrypted using the chosen cryptographic method. A cryptographic checksum (CMAC) will also be attached when using EV2 secure messaging.

Find more information on the security concept of the product in [1]. Be aware not all levels of security are recommended. For new design, the EV2 secure messaging is recommended.

8 DESFire command set

This section contains an overview of MF3D(H)x2 command code. A detailed description of all commands is provided in [1].

8.1 Secure Messaging Commands

Table 4. Secure messaging commands overview

Command	Description
Authenticate	Authentication as it was already supported by D40. Only for KeyType.2TDEA keys. Note that the PICC only performs encryption operations. After this authentication, the D40 backwards compatible secure messaging is used.
AuthenticateISO	Authentication as already supported by DESFire EV1. Only for KeyType.2TDEA or KeyType.3TDEA keys. After this authentication, EV1 backwards compatible secure messaging is used.
AuthenticateAES	Authentication as already supported by DESFire EV1. Only for KeyType.AES keys. After this authentication, EV1 backwards compatible secure messaging is used.
AuthenticateEV2First	Authentication for KeyType.AES keys. After this authentication, EV2 secure messaging is used. This authentication is intended to be the first in a transaction.
AuthenticateEV2NonFirst	Authentication for KeyType.AES keys. After this authentication, EV2 secure messaging is used. This authentication is intended for any subsequent authentication after Cmd.AuthenticateEV2First in a transaction.

8.2 Memory and Configuration Management Commands

Table 5. Memory and configuration management commands overview

Command	Description
FreeMem	Returns the free memory available on the card
Format	At PICC level, all applications and files are deleted. At application level (only for delegated applications), all files are deleted. The deleted memory is released and can be reused.
SetConfiguration	Configures the card and pre personalizes the card with a key, defines if the UID or the random ID is sent back during communication setup and configures the ATS string.
GetVersion	Returns manufacturing related data of the PICC.
GetCardUID	Returns the UID.

8.3 Key Management Commands

Table 6. Key management commands overview

Command	Description
ChangeKey	Changes any key stored on the PICC.
ChangeKeyEV2	Depending on the currently selected AID, this command updates a key of the PICC or of one specified application keyset.

Command	Description
InitializeKeySet	Depending on the currently selected application, initialize the key set with specific index.
FinalizeKeySet	Within the currently selected application, finalize the key set with specified number
RollKeySet	Within the currently selected application, roll to the key set with specified number
GetKeySettings	Gets information on the PICC and application master key settings.
ChangeKeySettings	Changes the master key settings on PICC and application level.
GetKeyVersion	Reads out the current key version of any key stored on the PICC.

8.4 Application Management Commands

Table 7. Application management commands overview

Command	Description
CreateApplication	Creates new applications on the PICC. The application is initialized according to the given settings. The application keys of the active key set are initialized with the Default Application Key.
DeleteApplication	Permanently deactivates applications on the PICC.
CreateDelegatedApplication	Creates delegated applications on the PICC with limited memory consumption.
SelectApplication	Selects one specific application for further access.
GetApplicationIDs	Returns the Application IDentifiers of all applications on a PICC.
GetDFNames	Returns the DF names
GetDelegatedInfo	Returns the *DAMSlotVersion* and *QuotaLimit* of a target DAM slot on the card.

8.5 File Management Commands

Table 8. File management commands overview

Command	Description
CreateStdDataFile	Creates files for the storage of plain unformatted user data within an existing application on the PICC.
CreateBackupDataFile	Creates files for the storage of plain unformatted user data within an existing application on the PICC, additionally supporting the feature of an integrated backup mechanism.
CreateValueFile	Creates files for the storage and manipulation of 32bit signed integer values within an existing application on the PICC.
CreateLinearRecordFile	Creates files for multiple storages of structural similar data, for example for loyalty programs, within an existing application on the PICC. Once the file is filled completely with data records, further writing to the file is not possible unless it is cleared.

Command	Description
CreateCyclicRecordFile	Creates files for multiple storages of structural similar data, for example for logging transactions, within an existing application on the PICC. Once the file is filled completely with data records, the PICC automatically overwrites the oldest record with the latest written one. This wrap is fully transparent for the PCD.
CreateTransactionMACFile	Creates a Transaction MAC File and enables the Transaction MAC feature for the targeted application.
DeleteFile	Permanently deactivates a file within the file directory of the currently selected application.
GetFileIDs	Returns the File IDentifiers of all active files within the currently selected application.
GetISOFileIDs	Get back the ISO File ID.
GetFileSettings	Get information on the properties of a specific file.
ChangeFileSettings	Changes the access parameters of an existing file.

8.6 Data Management Commands

Table 9. Data management commands overview

Command	Description
ReadData	Reads data from FileType.StandardData or FileType.BackupData.
WriteData	Writes data to FileType.StandardData or FileType.BackupData
GetValue	Reads the currently stored value from FileType.Value.
Credit	Increases a value stored in a FileType.Value.
Debit	Decreases a value stored in a FileType.Value.
LimitedCredit	Allows a limited increase of a value stored in a FileType.Value without having full Credit permissions to the file.
ReadRecords	Reads out a set of complete records from a FileType.CyclicRecord or FileType.LinearRecord.
WriteRecord	Writes data to a record in a FileType.CyclicRecord or FileType.LinearRecord.
UpdateRecord	Updates data of an existing record in a FileType.LinearRecord or FileType.CyclicRecord file.
ClearRecordFile	Resets a FileType.LinearRecord or FileType.CyclicRecord to empty state.

8.7 Transaction Management Commands

Table 10. Transaction management commands overview

Command	Description
CommitTransaction	Validates all previous write access' on FileType.BackupData, FileType.Value, FileType.LinearRecord and FileType.CyclicRecord within one application.
AbortTransaction	Invalidates all previous write access' on FileType.BackupData, FileType.Value, FileType.LinearRecord and FileType.CyclicRecord within one application.

Command	Description
CommitReaderID	Commits a ReaderID for the ongoing transaction. This will allow a backend to identify the attacking merchant in case of fraud detected.

8.8 ISO/IEC 7816-4 Standard Commands

Table 11. ISO/IEC 7816-4 support commands overview

Command	Description
ISOSelectFile	Selects either the PICC level, a DESFire application or a DESFire file within an application.
ISOReadBinary	Read data from FileType.StandardData and FileType.BackupData files.
ISOUpdateBinary	Write data to FileType.StandardData and FileType.BackupData files.
ISOReadRecord	Read data from FileType.LinearRecord and FileType.CyclicRecord files.
ISOAppendRecord	Write a new record to FileType.LinearRecord and FileType.CyclicRecord files.
ISOGetChallenge	To initiate a ISO/IEC 7816-4 authentication
ISOExternalAutheticate	Authenticate the PCD during a ISO/IEC 7816-4 authentication
ISOInternalAuthenticate	Authenticate the PICC during a ISO/IEC 7816-4 authentication

8.9 Virtual Card Commands

Table 12. Virtual Card commands overview

Command	Description
ISOSelect	Select VC with the given IID.
ISOExternalAuthenticate	Authenticate PCD before accessing the VC.

8.10 Proximity Check Commands

Table 13. Proximity Check commands overview

Command	Description
PreparePC	Prepare for the Proximity Check
ProximityCheck	Perform the precise measurement for the Proximity Check
VerifyPC	Verify the Proximity Check

8.11 Originality Check Commands

Table 14. Originality Check commands overview

Command	Description
Read_Sig	Retrieve the ECC originality check signature

9 Limiting values

Table 15. Limiting values [1][2]

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions		Min	Max	Unit
I_I	input current			-	50	mA
P_{tot}/pack	total power dissipation per package			-	200	mW
T_{stg}	storage temperature			-55	125	°C
T_{amb}	ambient temperature			-25	70	°C
V_{ESD}	electrostatic discharge voltage		[3] [4]	-	2	kV

[1] Stresses above one or more of the limiting values may cause permanent damage to the device.
[2] Exposure to limiting values for extended periods may affect device reliability.
[3] HBM: ANSI/ESDA/JEDEX JS-001
[4] MIL Standard 883-C method 3015; Human Body Model: C = 100 pF, R = 1.5 kΩ.

CAUTION

This device is sensitive to ElectroStatic Discharge (ESD). Observe precautions for handling electrostatic sensitive devices.

Such precautions are described in the *ANSI/ESD S20.20, IEC/ST 61340-5, JESD625-A* or equivalent standards.

10 Abbreviations

Table 16. Abbreviations

Acronym	Description
AES	Advanced Encryption Standard
AID	Application IDentifier
APDU	Application Protocol Data Unit
ATS	Answer to Select
CC	Common Criteria
CMAC	Cryptic Message Authentication Code
CRC	Cyclic Redundancy Check
DES	Digital Encryption Standard
DF	Dedicated File
EAL	Evaluation Assurance Level
EEPROM	Electrically Erasable Programmable Read-Only Memory
FWT	Frame Waiting Time
ID	IDentifier
INS	Instructions
LCR	inductance, Capacitance, Resistance
MAC	Message Authentication Code
MAD	MIFARE Application Directory
NV	Non-Volatile Memory
PCD	Proximity Coupling Device
PPS	Protocol Parameter Selection
RATS	Request Answer To Select
REQA	Request Answer
RF	Radio Frequency
UID	Unique IDentifier
WTX	Waiting Time eXtension
WUPA	Wake Up Protocol A

11 References

[1] Data sheet *MF3Dx2 MIFARE DESFire EV2 Functional specification*, document number: 2260**[2].

[2] Data sheet *MF3D(H)x2 Wafer specification*, document number: 2953**.

[3] Application note *MIFARE Application Directory*, document number: 0018**.

[4] Data sheet *MF3D92/MF3DA2 MIFARE DESFire EV2 16 kB and 32 kB contactless smartcard IC*, document number: 4827**[3].

2 ** ... BU-ID document version number

3 ** ... BU-ID document version number

12 Revision history

Table 17. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
MF3Dx2_MF3DHx2_ SDS v. 3.2	20190612	Product short data sheet	-	MF3Dx2_MF3DHx2_SDS v. 3.1
Modifications:	• Update with 16 kB and 32 kB			
MF3Dx2_MF3DHx2_ SDS v. 3.1	20180517	Product short data sheet	-	MF3Dx2_MF3DHx2_SDS v. 2.0
Modifications:	• Editorial update			
MF3Dx2_MF3DHx2_ SDS v. 2.0	20160224	Preliminary short data sheet	-	-

13 Legal information

13.1 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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