OBID® *classic-pro*

MANUAL

ID CPR50.10-Ex
ID MAX50.10-Ex

RFID Reader for ISO/IEC14443-A & -B, NFC and ISO/IEC15693
with Ethernet Interface for
Access Control and General-Purpose Applications

Up From Firmware Version 01.01.00

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Note

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With the edition of this manual, all previous editions become void. Indications made in this manual may be changed without previous notice.

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General information's regarding this manual

- If bits within one byte are filled with "-", these bit spaces are reserved for future extensions or for internal testing- and manufacturing-functions. These bit spaces must not be changed, as this may cause faulty operation of the Reader.
- The following figure formats are used:
  0...9: for decimal figures
  0x00...0xFF: for hexadecimal figures,
  b0...1 for binary figures.
- The hexadecimal value in brackets "[ ]" indicates a command.

Content

Revision History of this documentation

Revision	Description
0	Desciped Firmware: 01.00.00 • Preliminary Version - Changes are not separate recorded.
1	Descriped Firmware: 01.01.00 • Parameter CFG11.D-OFFSET and CFG11.D-LENGTH added (Access Mode only). • Parameter CFG14.ACCESS-MODE added (Access Mode only). • Parameter CFG14.ACCESS-STATE, CFG14.ACCESS-ACTIVATIOn-TIME, CFG14.ACCESS-DENIED-STATE and CFG14.ACCESS-DENIED-ACTIVATIOn-TIME redefined (Access Mode only). • ISO Host Commands for mifare DESFire Communication [0xC1]. • ISO Host Commands for mifare Plus Communication [0xC2].

Abbreviations

ADR	Address
AFI	Application Family Identifier
ASK	Amplitude Shift Keying
CFG	Configuration Parameter Block
CRC	Cyclic Redundancy Check
DB	data block
frq	Frequency
FSK	Frequency Shift Keying
h	Hour
Hz	Hertz
ID	Identification
IN	Input
LEN	Length
LOC	Location
LSB	Least Significant Byte
min	Minutes
ms	Milliseconds
MSB	Most Significant Byte
N	Number
OUT	Output
R/W	Read / Write Access
RD	Read
REL	Relay
RF	Radio Frequency
TR	Transponder
TS	Timeslot
UID	Unique Identifier (read only Serial Number)
WO	Write Only Access
WR	Write

1. Introduction

The readers of ID CPR50.10-xE and ID MAX50.10-xE family are members of the OBID® *classic-pro* reader family and are supporting passive transponder chips according ISO/IEC 14443 type A and type B as well as transponder chips according ISO/IEC 15693 and are able to communicate with NFC devices according ISO/IEC 18092.

The Readers are supporting the security functions of NXP mifare classic, mifare DESFire, and mifare PLUS transponder chips whereby the security algorithms like DES, TDES, 3KTDES and AES are integrated into the reader firmware and can be used wihtout addional SAM modules.

Beneath the mentioned transponder chips the firmware gives access to ISO14443 part 4 compliant contactless smart cards als well as to a couple of different ISO 14443 Type B memory chips.

Additional some reader models are available with 1 socket for attachable Security Access Module (SAM), which makes it even suitable for applications with high security requirements.

Because of it's Ethernet interface according 10BASE-T / 100BASE-T standard the readers are well suited for easy integration in an existing LAN environment. The integrated power over Ethernet (PoE) power supply guaranties a maximum on reliability and easy installation with standardized PoE power supply's. If no PoE infrastructure is available, the ID CPR50.10-Ex can be powered also form an external power supply

This manual describes the functionality of the ID CPR50.10-Ex reader family as well as the functionality of the access controller ID MAX50.10-Ex which is bases on the main functionality of ID CPR50.10-Ex but offers complex access control functions and has extended hardware features.

1.1. ID CPR50.10-xE

The functionality of the ID CPR50.10-xE readers based on the well known ID CPR-family, like the reader module ID CPR.M02.VP/AB-x and the reader for wall installation ID CPR.02.VP/AB-x and are compatible with them mainly.

The ID CPR50.10-xE can work in polling mode or in notification mode. Notification mode reduces the necessary data traffic between reader and host to a minimum. In notification mode the host will be informed by a notification message if a transponder was detected by the reader and can start the further data exchange with this transponder if required.

The use of OBID® ISO-host commands guarantees a easy creation of user software as well as the module's compatibility with OBID *i-scan*® Reader family.

Beside the **CPRStart** software for demonstration and configuration the reader capabilities and the **OBID® Firmware Update Tool** a lot of different **Software Development Kits** (SDK) and drivers are available to support an easy integration into the customers application.

NOTICE:
The described functionality in this document represents a summary of OBID® classic-pro ID CPR50.10-Ex reader family.

1.2. ID MAX50.10-xE

The ID MAX50.10-xE based upon the ID CPR50.10-xE but has additional functionality which gives the device the ability of a complete stand alone access controller which can decide offline and without a permanent connected host computer about the permission of presented Transponders.

Therefore the MAX50.10-xE hardware is equipped with a non non-volatile storage to store a large number of permitted access data sets and can handle a configurable number of logging records. Further the hardware is equipped with a power fail buffered real-time clock to supply the possibility of user individual time restricted access.

A power fail buffered real-time clock guarantees the possibility of individual time restricted access. ID MAX50.10-xE offers 15 time zones and the possibility to define additional holidays which are handled like Sundays. Each access entry can be connected to various time zones which guarantees a flexible time limitation concept for each user.

The following table gives an overview about the possible number of Access Entries (Users) that can be handled by MAX50.10-Ex together with 10 Timezones Entries and 40 Holiday Entries depending on the data length of user data (Identifier Data: IDD) which shall be checked.

IDD length	Number of Access Entries	max. number of buffered Events
16 Byte	1000	1651 Events
	2000	972 Events
	3300	90 Events
7 Byte	1000	1972 Events
	3000	1258 Events
	5000	543 Events
	6300	79 Events
4 Byte	1000	2079 Events
	3000	1579 Events
	5000	1079 Events
	7000	579 Events
	9000	79 Events

To identify a user MAX50.10-xE can either read the UID or a configurable data segment of the presented Transponder. The configuration of the data which shall be evaluated to decide about the permission of the presented Transponder can be configured in the notification mode settings of MAX50.10-xE.

2. Data Transmission between OBID® ID CPR-Reader and Host

Different ways of data transmission between OBID® *classic-pro* Readers and host (terminal, PC) are possible. The ISO Host Commands and the Notification-Mode are used for the data exchange between Transponder and host, whereas the Configuration and Control Commands are for adapting the Reader parameters to the individual requirements of the applications.

2.1. Configuration and Control Commands

This method of data transmission is used for Reader configuration and diagnostics.

The Reader-configuration parameters will be stored in the Reader memory. To store the current configuration during a power down of the Reader the Reader configuration has to be stored in the EEPROM. After the Reader was powered up the configuration out of the EEPROM is used.

<table>
<tr><th>Host (Terminal / PC / ....)</th><th></th><th colspan="2">Reader</th></tr>
<tr><td rowspan="2">parameter- / control command</td><td rowspan="2">→</td><td colspan="2">parameter received and stored / control command processed</td></tr>
<tr><td>yes</td><td>no</td></tr>
<tr><td rowspan="2"></td><td>←</td><td>status / data</td><td rowspan="2">error status</td></tr>
<tr><td>←</td><td colspan="2"></td></tr>
</table>

2.2. ISO Host Commands

The ISO Host Commands provide the exchange of data between a host and Transponders via the Reader as long as the Transponder remains in the detection range of the Reader.

NOTICE:
During the writing of data on a Transponder, it must be ensured that the Transponder is located within the detection range of the Reader during the entire process. If the Transponder is removed from detection range of the Reader during a writing process, this will cause a loss of data.

The Reader distinguishes between the following different addressing modes:

Addressed mode:

Before reading or writing data in addressed mode, the UID of the Transponder has to be known. This is executed by sending the command "6.1.1. [0x01] Inventory". If a Transponder is located within the detection range of the Reader at that time, it answers with its UID. For all following read- / write orders the Transponder must be addressed with its correct UID.

The following chart will show the necessary steps for the communication with a Transponder in addressed mode:

Host (Terminal / PC / ....)		Reader	
Inventory to get the UID	→	Transponder in antenna field ?	
		Yes	No
	←	status / number of Transponders / UID	status = no Transponder
	←		
read data from Transponder with UID	→	Transponder with correct UID in antenna field ?	
		Yes	No
	←	status / Transponder read data	status = no Transponder in Reader field
	←		
write data to Transponder with UID	→	Transponder with correct UID in antenna field ?	
		Yes	No
	←	OK status	status = no Transponder in Reader field
	←		

Selected:

In this mode the Reader communicates only with the one, selected Transponder.

Before reading or writing data in selected mode, the UID of the Transponder has to be known. This is executed by sending at first the protocol "6.1.1. [0x01] Inventory". In a second step the Transponder must be selected with the select command (see: 6.1.2. [0x25] Select) which must include its UID.

The following chart will show the necessary steps for the communication with a Transponder in selected mode:

Host (Terminal / PC / ....)		Reader	
Inventory to get the UID	→	Transponder in antenna field ?	
		Yes	No
	←	status / number of Transponders / UID	status = no Transponder
	←		
select Transponder with UID	→	Transponder with the correct UID in antenna field ?	
		Yes	No
	←	status / Transponder read data	status = no Transponder in Reader field
	←		
read data	→	selected Transponder in antenna field ?	
		Yes	No
	←	status / Transponder read data	status = no Transponder in Reader field
	←		
write data	→	selected Transponder in antenna field ?	
		Yes	No
	←	OK status	status = no Transponder in Reader field
	←		

2.3. Notification Mode

In notification mode the reader self initiated reads predefined data from Transponders which get inside the antenna field and transmits a notification message to the host if a transponder was detected by the reader.

After power up or a *5.1.* [0x63] CPU Reset command the notification mode starts with transponder reading according it's configuration (see 3.8. CFG11: Read Mode – Read Data 1, 3.9. CFG12: Read Mode - Filter and 3.11. CFG15: Read Mode – Read Data 2).

Queued Transponder data and optionally Input/Status events are notified automatically and asynchronously to a host with the 7.2. [0x22] Read Buffer response command. The destination address and the notification conditions can be set in 3.18. CFG49: Notification Channel configuration block. In general, the notification channel can be used simultaneously with the host interface.

A notification is normally not acknowledged by the host. Thus, the deletion of the transferred data with the 7.4. [0x32] Clear Data Buffer command is not necessary. As an option, this acknowledgement can be enabled to synchronize the notifications with the host to prevent notification overflow in the host application.

The notification message format depends on settings for the read mode in 3.8. CFG11: Read Mode – Read Data and 3.9. CFG12: Read Mode - Filter as well as settings for the notification trigger in 3.18. CFG49: Notification Channel.

An additional option of the Notification Mode is the Keepalive message, which can be sent periodically to the host. The Keepalive message transports valuable information about the reader hardware. Keepalive messages are always never acknowledged by the host. The Keepalive message should not be mistaken with the keepalive option (s. CFG41/CFG43) of a LAN-Connection initiated by a host.

2.4. Data Format and Protocol Frames for bi-directional communication

The communication between Reader and connected host (terminal, PC, etc.) is executed by means of fixed protocols. The used protocol is intended for data bus use and is equipped with an individual bus address for each device.

During data transfer the Reader supplies the required data or a status byte. The reply contains the transmitted command byte.

There is no reply from the Reader in case of a protocol frame failure.

The Reader supports two different Protocol frames which are the standard and the advanced protocol frame. The Host Application can chose which protocol frame shall used.

- If the host application chose advanced protocol frame the Reader will always response with advanced protocol frame.
- If the host application chose the standard protocol frame the Reader's response will depend on the length of the response data.
- If the response data will result a protocol frame with more than 255 Byte the Reader chose the advanced protocol frame otherwise the Reader chose the standard protocol frame.

2.4.1. Standard Protocol Frame (up to 255 Byte)

Host → Reader

1	2	3	4...n-2	n-1	n
LENGTH (n)	COM-ADR	COMMAND - BYTE	(DATA)	LSB CRC16	MSB CRC16

Host ← Reader

1	2	3	4	(5...n-2)	n-1	n
LENGTH (n)	COM-ADR	COMMAND - BYTE	STATUS	(DATA)	LSB CRC16	MSB CRC16

2.4.2. Advanced Protocol Frame

Reader ← Host

1	2	3	4	5	(6...n-2)
STX (0x02)	MSB ALENGTH	LSB ALENGTH	COM-ADR	COMMAND - BYTE	(DATA)

n-1	n
LSB CRC16	MSB CRC16

Host ← Reader

1	2	3	4	5	6	(7...n-2)
STX (0x02)	MSB ALENGTH	LSB ALENGTH	COM-ADR	COMMAND - BYTE	STATUS	(DATA)

n-1	n
LSB CRC16	MSB CRC16

2.4.3. Protocol Elements

LENGTH (n = 6...255):

Number of protocol bytes including LENGTH and CRC16.

COM-ADR:

0..254 address of device in bus mode

NOTICE:

The Reader can be addressed via COM-ADR 255 at any time!

COMMAND-BYTE:

Defines the Command which the Reader should operate.

STATUS [1]:

Includes the status message or protocol data from or to the Reader.

DATA:

Is a optional data field with variable length. The number of DATA byte depends on the command. The data will be sent always as MSB first if the Reader is in the ISO-Host Command Mode.

CRC16:

Cyclic redundancy check of the protocol bytes from 1 to n-2, as specified by CCITT-CRC16

Polynom $x^{16} + x^{12} + x^5 + 1$

Start Value 0xFFFF

In case of USB communication the CRC16 value is not checked by the reader.

STX:

The STX sign (0x02) at the start of protocol indicates an Advanced Protocol-Frame.

ALENGTH (n = 8...65535):

Number of protocol bytes including STX, ALENGTH and CRC16

Data format:

Start bits:	1
Data bits:	8
Stop bits:	1
Parity:	even (default) odd none

[1] see ANNEX C: Index of Status Bytes

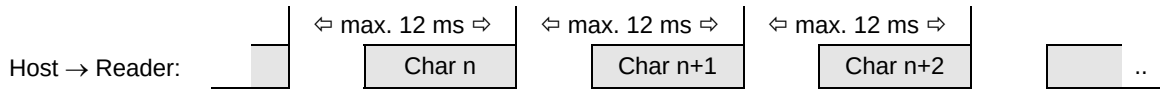
2.4.4. Timing Conditions

Block timeout:

Defines the time within the reader response can be expected by the host. The host block timeout shall be set to value longer than the time configured in CFG1.TR-RESPONSE-TIME.

Character timeout:

Within one protocol, the characters have to follow each other in intervals of maximum 12 ms.



2.4.5. CRC16 Calculation Algorithm

Polynom: $x^{16} + x^{12} + x^5 + 1$ ⇒ CRC_POLYNOM = 0x8408;

Start Value: 0xFFFF ⇒ CRC_PRESET = 0xFFFF;

C-Example:

```
unsigned int crc = CRC_PRESET;

for (i = 0; i < cnt; i++)  // cnt = number of protocol bytes without CRC
{
  crc ^= DATA[i];
  for (j = 0; j < 8; j++)
  {
    if (crc & 0x0001)
      crc = (crc >> 1) ^ CRC_POLYNOM;
    else
      crc = (crc >> 1);
  }
}
```

2.5. Characteristics of TCP/IP protocol

In case of LAN interfaces the data are packaged into TCP/IP protocol frames. This means the whole data format and protocol frame which is described in 2.4.2. Advanced Protocol Frame is packaged as the data of TCP/IP protocol frames.

LAN sockets on the reader side uses the **keepalive option** for detecting interrupted connections. The default parameters for keepalive are initialized as listed in the table:

Parameter	default Value	Note
INTERVAL-TIME	5 seconds	The reader sends every 5 seconds a keepalive probe which has to be acknowledged by the client
RETIRES	2	If a keepalive probe is not acknowledged, the reader repeats the probe only two times with an interval of 5 seconds each.

If the 15 second time span is expired and no keepalive probe response is obtained from the client the connection is closed and the client application must enable a new connection. The keepalive parameters can be modified in the configuration pages for LAN (see 3.17. CFG41: LAN Settings, Part 2).

3. Configuration Parameters (CFG)

The configuration memory of the Reader is organized in configuration blocks of 16 byte each. These are divided into 14-byte configuration parameters and a 2-byte CRC16 checksum. Each of these configuration blocks takes a number (CFG 0...CFG n).

Structure of a configuration block in Reader configuration memory and Reader EEPROM (CFG):

Byte	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Contents	PARAMETER														CRC16	

The parameters are stored in two different configuration memory locations:

- Reader RAM
- Backup EEPROM (used for storing parameter over power down)

Multiple configuration memory locations can be addressed by the value of the parameter CFG-ADR used in chapter 4. Commands for Reader Configuration

CFG-ADR:

CFGn: memory-address of the required configuration block
LOC: specifies the location of the configuration block (RAM / EEPROM)
MODE: specifies one or all configuration blocks

Bit:	7	6	5	4	3	2	1	0
Function	LOC	MODE	CFGn: address of configuration block					

The EEPROM configuration blocks are protected by a 16 bit CRC-checksum. The examination of these checksums is executed after each reset of the Reader. If an faulty checksum is found, the Reader goes into an error status "EE-Init-Mode" and sets the configuration block which is faulty to the default values.

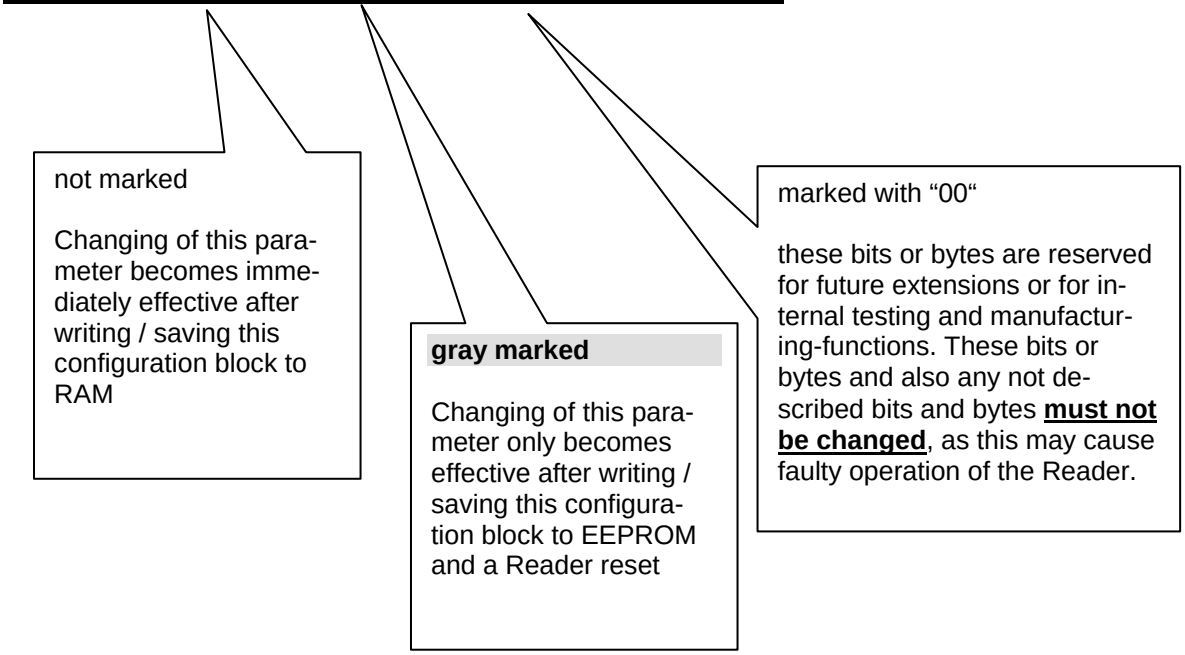
While the EE-Init-Mode is active, the LED blinks alternately red and green and the Reader answers external commands with the status "0x10 EEPROM Failure". The "EE-Init-Mode" can be exited now by a new reset (cold start or 5.1. [0x63] CPU Reset command). If after this the checksums of all data records are correct, the Reader shifts to the configured operation mode.

Notes:

- ***Malfunctions may occur if parameters are configured outside their described range or if unspecified parameters have been changed!***
- ***A firmware update resets the EEPROM to default settings and the Reader goes into the error status "EE-Init-mode".***

Structure of configuration parameter description.

Byte	0	1	2	.....n
contents	RAM-eff.	EEPROM-eff.	00 res	.....



3.1. CFG0: Reserved

The configuration block CFG0 is reserved for future use.

Byte	0	1	2	3	4	5	6
Contents	0x00	0x00	0x00	0x00	0x00	0x00	0x00
Default	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Byte	7	8	9	10	11	12	13
Contents	0x00	0x00	0x00	0x00	0x00	0x00	0x00
Default	0x00	0x00	0x00	0x00	0x00	0x00	0x00

3.2. CFG1: Interface

The parameters of the CFG1 configuration block contain the data communication settings.

Byte	0	1	2	3	4	5	6
Contents	0x00	0x00	0x00	0x00	0x00	0x00	TR-RESPONSE-TIME
Default	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Byte	7	8	9	10	11	12	13
Contents	TR-RESPONSE-TIME	0x00	0x00	0x00	0x00	INTERFACE	READER - MODE
Default	0x0A *1 sec.*	0x00	0x00	0x00	0x00	0x80	0x00

TR-RESPONSE-TIME:

By means of this parameter the maximum duration for the Transponder command can be defined.

The TR-RESPONSE-TIME starts after the Reader has received a new command. At the latest after the TR-RESPONSE-TIME elapsed the Reader will be sent an answer protocol. In this case, the current commands between Reader and Transponder are aborted.

	max. response duration
TR-RESPONSE-TIME	0...65535 * 100 ms

NOTICE:

- ***TR-RESPONSE-TIME has no effect for commands for Reader Configuration and Reader Control.***
- ***The block receive timeout of host computer must set to a value ≥ TR-RESPONSE-TIME.***

INTERFACE:

By setting of this parameter the Network-Discovery can be enabled

0x00: Network-Discovery disabled.

0x80: Network-Discovery enabled.

The Network-Discovery is the functionality that allows to discover an to setup the network configuration of the FEIG-Network-Reader with UDP commands (UDP = User Data Protocol).

READER-MODE:

By means of this byte, the Reader mode can be defined.

Bit:	7	6	5	4	3	2	1	0
Function:	0	NTF-E	0	0	0	0	0	0

NTF-E:

By setting of this bit the Notification-Mode can be enabled

b0: **Notification Mode disabled**

b1: **Notification Mode enabled**

The following table lists the bit combinations for the reader modes:

Reader Mode	Bit							
	7	6	5	4	3	2	1	0
Host-Mode	0	0	0	0	0	0	0	0
Notification Mode	0	**1**	0	0	0	0	0	0

3.3. CFG2: Inputs / Outputs general

Via the following parameters the operation mode of the LED and the Buzzer can be configured individual separate for offline, online and tag-detect conditions.

Byte	0	1	2	3	4	5	6
Contents	0x00	0x00	ONLINE-STATE		INPUT-EVENT		0x00
Default	0x00	0x00	0x0004		0x0000		0x00

Byte	7	8	9	10	11	12	13
Contents	OFFLINE-STATE		OFFLINE-DELAY	TAGDETECT-STATE		TAGDETECT ACTIVATION TIME	CPRIO ENABLE
Default	0x0008		0x64 10 sec.	0x0040		0x04 400 ms	0x00

ONLINE-STATE

This Parameter defines the behavior of the signal transmitters if they are not activated by any other event.

Bit:	15	14	13	12	11	10	9	8
Function:	-		-		-		RELAY	

Bit:	7	6	5	4	3	2	1	0
Function:	BUZZER		RED		BLUE		GRN	

GRN / BLUE / RED / BUZZER / RELAY

The bit combination defines the behavior of the signal transmitter

b00: OFF
b01: ON
b10: FLASHING SLOW
b11: FLASHING FAST

INPUT-EVENT

This parameter defines which digital input will activate a signal transmitter.

Bit:	15	14	13	12	11	10	9	8
Function:	-	-	-	-	-	-	-	-

Bit:	7	6	5	4	3	2	1	0
Function:	IN_MSG		-	-	-	-	-	-

IN_MSG:

By setting of this bits the input message function can be configured. message function generates a "Get Input" response protocol (see:5.8. [0x74] Get Input) via the host interface if a change at any digital input of the reader occurs.

b00 Input message function is deactivated.

b01 An get input response protocol is transmitted if a digital input changes form the inactive to the active state.

b10 An get input response protocol is transmitted if a digital input changes form the active to the inactive state.

b11 An get input response protocol is transmitted if any status change occurs at a digital input.

NOTICE:
This function is only available in the notification mode.

OFFLINE-STATE

This parameter defines the behavior of the signal transmitter, in case of a the reader has detected an offline state. The following cases are possible:

Polling-Mode:

In case of polling mode the reader starts to signalize the offline state if it has received no command from the host for more than the time defined by the parameter OFFLINE-TIME.

Notification-Mode:

In case of notification mode the reader starts to signalize the offline state if it can not establish a socket connection with it's configured communication partner.

Bit:	15	14	13	12	11	10	9	8
Function:	-		-		-		RELAY	

Bit:	7	6	5	4	3	2	1	0
Function:	BUZZER		RED		BLUE		GRN	

GRN / BLUE / RED / BUZZER / RELAY

The bit combination defines the behavior of the signal transmitter

b00: OFF
b01: ON
b10: FLASHING SLOW
b11: FLASHING FAST

OFFLINE-DELAY

This parameter defines the delay in 100 ms increments, after the Reader will signalize the offline state if he had not received a command via his asynchronous interface.

0 ... 255 x 100 ms ⇒ 0 ... 25,5 sec

TAGDETECT-STATE:

This parameter defines the behavior of the signal transmitter if a new transponder was detected by the reader

Bit:	15	14	13	12	11	10	9	8
Function:	-		-		-		RELAY	

Bit:	7	6	5	4	3	2	1	0
Function:	BUZZER		RED		BLUE		GRN	

GRN / BLUE / RED / BUZZER / RELAY

The bit combination defines the behavior of the signal transmitter

b00: OFF
b01: ON
b10: FLASHING SLOW
b11: FLASHING FAST

TAGDETECT-ACTIVATION-TIME

This parameter defines the duration in 100 ms increments, the Reader signalize a transponder was detected.

0 ... 255 x 100 ms ⇒ 0 ... 25,5 sec

CPRIO ENABLE

This parameter enables the communication to the CPRIO.

b00: OFF
b01: ON

3.4. CFG3: RF-Interface

The parameters of the CFG3 configuration block contain global Transponder driver and Reader settings.

Byte	0	1	2	3	4	5	6
Contents	TAG-DRV		ISO14443-DRV		0x00	0x00	0x00
Default	0x0038		0x000F		0x00	0x00	0x00

Byte	7	8	9	10	11	12	13
Contents	ISO14443 BIT RATE	0x00	0x00	0x00	0x00	0x00	ISO14443 FTUR
Default	0x00	0x00	0x00	0x00	0x00	0x03	0x00

TAG-DRV[1]:

Defines the Transponder types that are operated by the Reader.

Byte:	0								1							
Bit:	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Driver	0	O	0	0	L	K	0	I	0	G	F	E	D	0	0	0
Default	0	1	0	0	1	1	0	1	0	0	1	1	1	0	0	0

b0: Driver for the Transponder type is disabled

b1: Driver for the Transponder type is activated

.D: Driver for ISO15693

.E: Driver for ISO14443A

.F: Driver for ISO14443B

Only those Transponder drivers should be active that are used in the current application. Thus, the reaction time of the Reader for Transponder read- / write-operations is reduced and the danger of a parasitic Transponder access is minimized.

[1] A plausibility check is performed by writing this parameter to the Reader. If an error occurs the Reader answers with STATUS = 0x11.

ISO14443-DRV:

Defines the ISO 14443 Transponder types that are read/write operated by the Reader. Reading of the UID is also possible if the driver is inactive, because of the standardized ISO14443 access conditions.

If more than one Transponder driver is activated The Reader attempted by means of some indications to decide about the Transponder type.

To guarantee that the Reader only processes the correct Transponder type the not required drivers should be disabled.

Byte:	2								3							
Bit:	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Driver	0	0	0	0	0	0	0	0	0	0	0	0	L4	C	0	A

b0: Driver for the Transponder type is disabled

b1: Driver for the Transponder type is activated

- A: Driver for mifare classic
- C: Driver for mifare Ultralight
- L4 Driver for ISO14443A, Part 4 compatible Transponders

ISO14443 BIT RATE:

This parameter defines the highest Bit-Rate which should be used by the Reader. The actual used Bit-Rate depends on the capabilities of the present Transponder. If the adjusted Bit-Rate is not support by the Transponder the Reader select the highest supported Bit-Rate of the Transponder.

Bit:	7	6	5	4	3	2	1	0
Function	Tx BIT RATE		Rx BIT RATE		-	-	-	-

TX BIT RATE

Used for bit rate selection from Reader to Transponder

b00: 106 kbit / s
b01: 212 kbit / s
b10: 424 kbit / s
b11: 848 kbit / s

RX BIT RATE

Used for bit rate selection from Transponder to Reader

b00: 106 kbit / s
b01: 212 kbit / s
b10: 424 kbit / s
b11: 848 kbit / s

NOTICE:

- ***A high Bit-Rate could effect a reduction of the reading distance and the data stream between Reader and Transponder could be interrupted by noisy environments.***

ISO14443 FTUR:

In this parameter byte are some special features combined.

Bit:	7	6	5	4	3	2	1	0
Function	UID-ORDER			OPTI	ERROR_RETRY		PLIC	BSLCT

BSLCT (only ISO 14443B Transponder)

This bit selects the response behavior for ISO 14443B Transponder with Bit-Rates above 106 kBit / s.

The Reader principally use 106 kBit / for the first communication cycle. If the Transponder supports a higher Bit-Rate and this is configured by the parameter ISO14443 BIT RATE the Reader selects the highest possible Bit-Rate.

Unfortunately the reception from the Transponder could be on 106 kBit / s ore on the new higher Bit-Rate.

b0: The first reception after a Bit-Rate change is expected with 106 kBit / s.

b1: The first reception after a Bit-Rate change is expected with the selected higher Bit-Rate.

PLIC (only ISO 14443-4 Transponder)

This bit enables the power level indicator check function of the Reader.

b0: Power level check is disabled.

b1: Power level check is enabled.
The power level indicator of ISO 14443-4 Transponders will be interpreted by the Reader if it is supported by the Transponder.

If a Transponder response indicates insufficient power the reader breaks the present command and send an error status.

ERROR_RETRY (only ISO 14443-4 Transponder)

This parameter defines the maximum number of automatic retry loops in case of transmission or protocol errors as described in ISO 14443-4.

b00: disables retry loop

b01: 1 retry loop

b10 2 retry loops

b11: 3 retry loops

OPTI (only ISO14443A Transponder)

By means of this bit some optional information's could be displayed for ISO14443A in the [0x01] inventory response byte OPT_INFO (see also 6.1.1. [0x01] Inventory)

b0: The OPT_INFO byte in [0x01] inventory response is always set to 0.

b1: The OPT_INFO byte in [0x01] inventory response includes further Information's.

UID_ORDER (only ISO14443A Transponder)

By means of this bit the byte order of the UID of ISO14443A Transponder can be swapped.

b0: The UID will be transferred as described in 6.1.1.1. Response-Data - ISO 14443A (TR-TYPE = 0x04).

b1: The byte order of the transferred UID will be swapped (UID transfer will be carried out like described in ISO14443).

3.5. CFG4: Transponder Parameters

The parameters of the CFG4 configuration block contain general Transponder settings.

Byte	0	1	2	3	4	5	6
Contents	0x00	0x00	0x00	0x00	ISO15693-MODE	ISO15693-AFI	ISO15693-OPTION
Default	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Byte	7	8	9	10	11	12	13
Contents	0x00	ISO14443B-AFI	0x00	0x00	0x00	0x00	ISO15693 BLOCKSIZE
Default	0x00	0x00	0x00	0x00	0x00	0x00	0x04

ISO15693-MODE: (only ISO15693 Transponders)

Bit:	7	6	5	4	3	2	1	0
Function	0	0	AFI	NO-TS	0	0	0	0

NO-TS

b0: 16 timeslots
b1: 1 timeslot

NOTICE:
Anticollision is only possible if NO-TS=16.

AFI

b0: disabled
b1: enabled

ISO15693-AFI: (only ISO15693 Transponders)
Application Family Identifier to select a Transponder

ISO15693-OPTION: (only ISO15693 Transponder)

Bit:	7	6	5	4	3	2	1	0
Function	0	0	0	0	WR-OPTION		0	0

WR-OPTION:

b00: automatically set
b10: Tag Option = 0
b11: Tag Option = 1

NOTICE:

- ***If WR-OPTION is automatically set, the Reader sets the WR-OPTION to 0, if the ISO-Host Command is in non-addressed mode.***

ISO14443B-AFI: (only ISO14443B Transponders)

Application Family Identifier for ISO14443 type B Transponder. For more information's refer to ISO14443-3.

ISO15693-BLOCKSIZE

Bit:	7	6	5	4	3	2	1	0
Function	Read Mode		Blocksize	DB-Blocksize				

DB-Blocksize:

Defines the block size of an ISO-transponder which is not listed chapter 9. Supported ISO Host commandsor if the transponder is used in the non-addressed mode.

Range: 0x01 ... 0x1F
A value of 0x00 will be automatically set to a block size of 4byte.

Blocksize:

b0: Automatic (If transponder is known)
b1: Manuel (As specified in DB-Blocksize)

Read Mode:

b00: Automatic Mode (If transponder is known)
b01 Single Read
b10 Multiple Read

3.6. CFG5: Anticollision

The parameters of the CFG5 configuration block contain anticollision settings.

Byte	0	1	2	3	4	5	6
Contents	0x00	0x00	0x00	0x00	0x00	0x00	0x00
Default	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Byte	7	8	9	10	11	12	13
Contents	0x00	0x00	0x00	0x00	ONT	0x00	0x00
Default	0x00	0x00	0x00	0x00	0x04	0x00	0x00

ONT:

This parameter configures the reply behavior of the Inventory command [0x01]. It defines which Transponder will reply to the host.

Bit:	7	6	5	4	3	2	1	0
Function	0	0	0	0	0	ACOLL	0	0

ACOLL:

This bit activates Anticollision Mode. In Anticollision Mode the Reader automatically sets Transponder-specific communication parameters.

b0: disabled
In this case the Reader doesn't processes any anticollision procedure with the Transponders inside the antenna field.

If anticollision is disabled, the Reader automatically selects the Transponder. The Select command [0x25] is not necessary for further communication with the Transponder.

If more than one Transponder of the same type is in the detection range the Reader replies an error status.

b1: enabled (default)
In this case the Reader processes the anticollision procedure with the Transponders inside of the antenna field and replies the UID of all detected Transponder's.

3.7. CFG6 .. 10: Reserved

3.8. CFG11: Read Mode – Read Data 1

The parameters of the CFG11 configuration block contain Notification Mode settings. The Notification Mode can be enabled by setting the READER-MODE register of the configuration block 3.2. CFG1: Interface. It may be useful to enable “Anticollision Select Mode” in 3.6. CFG5: Anticollision if there is a large or unknown number of Transponders expected in the antenna field.

Byte	0	1	2	3	4	5	6
Contents	TR-DATA-1	0x00	0x00	0x00	DB-ADR [1]		0x00
Default	0x01	0x00	0x00	0x00	0x0000		0x00

Byte	7	8	9	10	11	12	13
Contents	0x00	DB-N [2]		0x00	0x00	0x00	0x00
Default	0x00	0x0001		0x00	0x00	0x00	0x00

TR-DATA-1:

Selects the data types for read operation.

Bit:	7	6	5	4	3	2	1	0
Function	0	0	0	0	Byte Order	0	DB	SNR

SNR

b0: no Serial Number will be transmitted
b1: Serial Number will be transmitted

DB

b0: no data block will be transmitted
b1: data block will be transmitted

Byte Order

By this bit the byte order of the data block can be swapped.
b0: MSB first
b1: LSB first

DB-ADR:

0x00...0xFF
Address of first data block. Range: 0x00...0xFF.

DB-N:

Number of data blocks. Range: 0x01...0x20.

[1] A reasonableness check is performed by writing this parameter to the Reader. If an error occurs the Reader answers with STATUS = [0x11].
[2] A plausibility check is performed by writing this parameter to the Reader. If an error occurs the Reader

3.9. CFG12: Read Mode - Filter

Byte	0	1	2	3	4	5	6
0x00	VALID-TIME[1]						0x00
Default	0x0037 5,5 sec.		0x01	0x00	0x00	0x00	0x00

Byte	7	8	9	10	11	12	13
Contents	0x00	0x00	0x00	0x00	0x00	0x00	0x00
Default	0x00	0x00	0x00	0x00	0x00	0x00	0x00

VALID-TIME: (0...65535 x 100 ms = 0 ms ... 6553,5 sec)

The period of time during which a Transponder can't be read a 2nd time.

Note:

- ***Changing of VALID-TIME only becomes effective after writing / saving configuration block CFG12 to EEPROM and reset of the RFC-Controller with 5.2. [0x64] System Reset in mode 0x00.***
-

3.10. CFG13 .. 14: Reserved

3.11. CFG15: Read Mode – Read Data 2

The parameters of the CFG15 configuration block contain some additional Notification Mode settings for Mifare Classic Transponder.

Byte	0	1	2	3	4	5	6
Contents	MIFARE-KEY_ADR	0x00	0x00	0x00	0x00	0x00	0x00
Default	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Byte	7	8	9	10	11	12	13
Contents	0x00	0x00	0x00	0x00	0x00	0x00	0x00
Default	0x00	0x00	0x00	0x00	0x00	0x00	0x00

[1] DB-ADR, DB-N of CFG11

MIFARE-KEY_ADR

Defines the mifare key address which will be used for authentication at the mifare block which should be read in Notification Mode.

This parameter is designed to be used if the mifare block is directly addressed via DB_ADR .

The command 4.5. [0xA2] Write Mifare Reader Keys describes how to store a key in the reader.

Bit:	7	6	5	4	3	2	1	0
Function	KEY-TYPE	0	0	0	KEY-ADR			

KEY-TYPE:

Defines how the key should be used in authentication process.

0 KEY-A
1 KEY-B

KEY-ADR: (0x0 .... 0xF)

Address of the Key which should be used for authentication.

3.12. CFG16: Persistence Reset

The parameters in CFG16 are used to configure the timing conditions when the Reader performs self initiated a reset of the RF antenna field.

Byte	0	1	2	3	4	5	6
Contents	0x00	0x00	PER-RESET-TIME-ANT		0x00	0x00	0x00
Default	0x00	0x00	0x0028		0x00	0x00	0x00
			40 x 5ms = 200ms				

Byte	7	8	9	10	11	12	13
Contents	0x00	0x00	0x00	0x00	0x00	0x00	0x00
Default	0x00	0x00	0x00	0x00	0x00	0x00	0x00

PER-RESET-TIME-ANT:

The timer value specifies a time which determines the reset of the RF filed by the Reader. The timer PER-RESET-TIME-ANT starts after the Reader gets a response at the antenna. After this time has expired the Reader resets the RF-Field.
Timer ticks = 5ms

Maximum timer value = 5ms x 65534[0xFFFE] = 5,46125 min.
The value 65535 [0xFFFF] indicates that no RF-Reset is performed by the Reader

3.13. CFG17 .. 19: Reserved

3.15. CFG20 .. 39: Reserved

3.16. CFG40: LAN Settings, Part 1

Byte	0	1	2	3	4	5	6
Contents	IP-ADDRESS-LAN				0x00	0x00	0x00
Default	0xC0	0xA8	0x0A	0x0A	0x00	0x00	0x00
	192	*168*	*10*	*10*			

Byte	7	8	9	10	11	12	13
Contents	0x00	IP-PORT-NUMBER-LAN		0x00	0x00	0x00	0x00
Default	0x00	0x27	0x11	0x00	0x00	0x00	0x00
		10001					

IP-ADDRESS-LAN:

Defines the IP address for wired LAN connection.

IP-PORT-NUMBER-LAN:

Defines the port number for wired LAN connection.

Note:

- ***The command 4.4. [0x83] Set Default Configuration has no effect on this setting***
- ***Changing of this parameter only becomes effective after writing / saving this configuration block to EEPROM and a [0x64] System Reset of the RFC.***

3.17. CFG41: LAN Settings, Part 2

Byte	0	1	2	3	4	5	6
Contents	SUBNET-MASK-LAN				LAN-OPTIONS	RETRIES	GW-ADDRES-LAN
Default	0xFF *255*	0xFF *255*	0xFF *255*	0x00 *0*	0x00 *disabled*	0x02 *2*	0x00

Byte	7	8	9	10	11	12	13
Contents	GW-ADDRES-LAN			0x00	0x00	INTERVAL-TIME	
Default	0x00	0x00	0x00	0x00	0x00	0x00	0x05 *5 sec.*

SUBNET-MASK-LAN:

Defines the subnet mask for wired TCP/IP connection.

GW-ADDRESS-LAN:

Defines the gateway address for TCP/IP connection.

LAN-OPTIONS:

Bit:	7	6	5	4	3	2	1	0
Function:	DHCP	0	0	0	0	0	0	KEEP-ALIVE

KEEP-ALIVE:

b0: Keep-Alive option disabled.

b1: Keep-Alive option enabled.

DHCP:

b0: dhcp-client disabled.

b1: dhcp-client enabled.

RETIRES:

Specify the maximum number of retransmissions. This is the number of times that the reader re-transmits a keepalive packet to the host to check for connectivity. The valid range is 1..255.

INTERVAL-TIME:

Set the Keepalive Interval. This is the polling frequency used to determine if a keepalive exchange is needed. This interval is used when the connection failed. The valid range is 1..255 sec.

Note:

- ***The command 4.4. [0x83] Set Default Configuration has no effect on this setting***
- ***Changing of this parameter only becomes effective after writing / saving this configuration block to EEPROM and a [0x64] System Reset of the RFC.***

3.18. CFG49: Notification Channel

Byte	0	1	2	3	4	5	6
Contents	0x00	0x00	0x00	0x00	KEEP-ALIVE	KEEP-ALIVE-TIME	
Default	0x00	0x00	0x00	0x00	0x00 *off*	0x00	0x00

Byte	7	8	9	10	11	12	13
Contents	DEST-IP-ADDRESS				DEST-IP-PORT		HOLD-TIME
Default	0x00	0x00	0x00	0x00	0x00	0x00	0x01

KEEP-ALIVE:

Mode for keep alive notification.

Bit:	7	6	5	4	3	2	1	0
Function	0	0	0	0	0	0	0	EN

EN:

b0: disabled
b1: enabled

KEEP-ALIVE-TIME:

Defines the cycle time for keep alive notification.

	max. time period
KEEP-ALIVE-TIME	0...65535 * 1s

DEST-IP-ADDRESS:

Defines the destination IP address.

DEST-IP-PORT-NUMBER

Defines the destination port number.

HOLD-TIME:

Defines the hold time of the TCP/IP connection after sent of a notification. The time will be retriggered with every new notification

4. Commands for Reader Configuration

Via the command protocols for the Reader configuration, the Reader may be adapted to individual conditions of application within wide limits.

4.1. [0x80] Read Configuration

By using the Read Configuration the actual configuration of the Reader can be detected. In order to do this, the configuration is read in blocks of 14 bytes each and addressed by CFGn in the byte CFG-ADR.

Host → Reader

1	2	3	4	5...6
6	COM-ADR	[0x80]	CFG-ADR	CRC16

Host ← Reader

1	2	3	4	5...18	19...20
20	COM-ADR	[0x80]	STATUS[1]	CFG-REC	CRC16

CFG-ADR[2]:

Bit:	7	6	5	4	3	2	1	0
Function	LOC	0	CFGn: Address of Configuration Block					

CFGn:

Memory-address of the required configuration block.

LOC:

Specifies the location of the configuration block.

b0: RAM

b1: EEPROM

CFG-REC:

14-byte configuration block read from address CFGn in CFG-ADR.

NOTICE:

- ***A read configuration from EEPROM with reserved configuration blocks will cause an 0x15 error code.***

[1] see: ANNEX C: Index of Status Bytes

[2] see Chapter 3. Configuration Parameters (CFG)

4.2. [0x81] Write Configuration

Via the command Write Configuration the configuration of the Reader can be changed. In order to do this, the configuration memory is written on with 14 bytes long blocks and addressed by CFGn in the byte CFG-ADR. The description of parameters can be taken from chapter 3. Configuration Parameters (CFG)

Host → Reader

1	2	3	4	5...18	19...20
20	COM-ADR	[0x81]	CFG-ADR	CFG-REC	CRC16

Host ← Reader

1	2	3	4	5...6
6	COM-ADR	[0x81]	STATUS[1]	CRC16

CFG-ADR[2]:

Bit:	7	6	5	4	3	2	1	0
Function	LOC	0	CFGn: Address of Configuration Block					

CFGn: Memory-address of the required configuration block.

LOC: Specifies the location of the configuration block.
b0 RAM
b1 EEPROM and RAM

CFG-REC:

14-byte configuration block stored in the configuration memory of the Reader at address CFGn.

NOTICE:
A write configuration to EEPROM with reserved configuration blocks will cause an 0x16 error code.

[1] see: ANNEX C: Index of Status Bytes
[2] see chapter 3. Configuration Parameters (CFG)

4.3. [0x82] Save Configuration

By the command Save Configuration each configuration block of the RAM can be stored in EEPROM.

Host → Reader

1	2	3	4	5...6
6	COM-ADR	[0x82]	CFG-ADR	CRC16

Host ← Reader

1	2	3	4	5...6
6	COM-ADR	[0x82]	STATUS[1]	CRC16

CFG-ADR[2]:

Bit:	7	6	5	4	3	2	1	0
Function	0	MODE	CFGn					

CFGn: Memory-address of the required configuration block.

MODE: Specifies one or all configuration blocks.
b0: configuration block specified by CFGn
b1: all configuration blocks

NOTICE:

- ***To store RAM configuration over power down use 4.3. [0x82] Save Configuration***
- ***A save configuration to EEPROM with reserved configuration blocks will cause an 0x16 error code.***

[1] see: ANNEX C: Index of Status Bytes
[2] see chapter 3. Configuration Parameters (CFG)

4.4. [0x83] Set Default Configuration

Using the command Set Default Configuration each configuration block can be reset to the manufacturer's setting.

Host → Reader

1	2	3	4	5...6
6	COM-ADR	[0x83]	CFG-ADR	CRC16

Host ← Reader

1	2	3	4	5...6
6	COM-ADR	[0x83]	STATUS	CRC16

CFG-ADR:

Bit:	7	6	5	4	3	2	1	0
Function	LOC	MODE	CFGn					

CFGn: Memory-address of the required configuration block.

MODE: Specifies one or all configuration blocks.
b0: configuration block specified by CFGn
b1: all configuration blocks

LOC: Specifies the location of the configuration block.
b0: RAM
b1: EEPROM

Notes:

- ***To store RAM configuration over power down use 4.3. [0x82] Save Configuration***
- ***A set default configuration with reserved configuration blocks will cause an error code.***

4.5. [0xA2] Write Mifare Reader Keys

The keys which are required by the Reader in order to authentify itself to a Mifare ISO14443A Transponder, will be stored by this command. Only if the keys of the Reader and of the Transponder correspond, the data exchange between Reader and Transponder can be effected.

Host → Reader

1	2	3	4	5	6...11	12...13
13	COM-ADR	0xA2	KEY-TYPE	KEY-ADR	KEY	CRC16

Host ← Reader

1	2	3	4	5...6
6	COM-ADR	0xA2	STATUS	CRC16

KEY-TYPE:

Defines the key for the authentication.

0x00 KEY-A
0x01 KEY-B

KEY-ADR: (0x00 .... 0x0F)

Address where the key is stored in the reader. The address can be any value between 0 and 15.

KEY:

Mifare: 6 byte Key

Notes:

- ***It is not possible to read back the keys off the Reader. After having changed the keys these should be stored at a secured place.***
- ***The factory adjustment of the keys on KEY-ADR 0x00 is:***
  KEY-A: 0xFF 0xFF 0xFF 0xFF 0xFF 0xFF
  KEY-B: 0xFF 0xFF 0xFF 0xFF 0xFF 0xFF

4.6. [0xA3] Write DES/AES Reader Keys

The keys which are required by the Reader in order to authentify itself to a Mifare DESFire or mifare Ultralight C, will be stored in the reader by this command. Only if the keys of the reader and of the transponder correspond, the data exchange between reader and transponder can be effected.

Host → Reader

1	2	3	4	5	6
n	COM-ADR	0xA3	MODE	READER-KEY-NDX	AUTH-MODE

7	8...15, 23 or 31	n-1, n
KEY-LEN	KEY (8, 16 or 24 Byte)	CRC16
	7... 14 (8 Byte KEY)	
	7...22. (16 Byte KEY)	
	7...30 (24 Byte KEY)	

Host ← Reader

1	2	3	4	5...6
6	COM-ADR	0xA3	STATUS[1]	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	0	0	0	0	0			LOC

LOC:

Specifies the location where the KEY should be stored in the reader

b0: RAM
The KEY will be stored only temporary in the RAM of the reader. After the supply power was interrupted the keys has to be loaded once again into the RAM. This option is recommended, if the reader is used on a public place, if anybody can to take the reader away easily.

b1: EEPROM
The KEY will be stored in the EEPROM and in the RAM of the reader. The key can be used also after the supply power was interrupted. This option can used, if the reader is used on a secured place.

NOTICE:
The key's in the EEPROM are more or less unprotected against hacking it's content.

[1] see: ANNEX C: Index of Status Bytes

READER-KEY-NDX (0...3)

Address where the key is stored in the reader.

AUTH-MODE:

This parameter defines the authentication mode DESFire Command which will be performed by the reader with this key

AUTH-MODE	authentication method	DESFire Command	mifare PLUS command	KEY-LEN
0	DESFire Native - TDES	[0x0A]	-	16 Byte
1	Standard TDES	[0x1A]	-	16 Byte
2	DESFire Native – DES	[0x0A]	-	8 Byte
3	Standard DES	[0x1A]	-	8 Byte
4	3KTDES	[0x1A]	-	24 Byte
5	AES	[0xAA]	[0x70] [0x76]	16 Byte

KEY-LEN:

This parameter defines the length of the following key (8,16 or 24 byte).

KEY:

Key which has to be used for authentication and encryption. The number of bytes depends on the authentication mode and .

[1] This **AUTH-MODE can used for mifare DESFire and mifare ultralight C**

5. Command for Reader Control

5.1. [0x63] CPU Reset

This protocol allows you to reset the CPU on the Reader.

Host → Reader

1	2	3	4...5
5	COM-ADR	[0x63]	CRC16

Host ← Reader

1	2	3	4	5...6
6	COM-ADR	[0x63]	STATUS[1]	CRC16

NOTICE:

- ***The RF-field will be switched off while a CPU Reset.***
- ***"RF Controller Reset" over LAN is only a soft-reset***

5.2. [0x64] System Reset

This protocol allows you to reset the RF-Decoder and the RF Controller.

Host → Reader

1	2	3	4	5,6
6	COM-ADR	[0x64]	Mode	CRC16

Host ← Reader

1	2	3	4	5,6
6	COM-ADR	[0x64]	STATUS[2]	CRC16

MODE:

Defines Controller which will be reset.

MODE	Controller
0	RF Controller
3	RF Decoder

Note:

- ***The TCP/IP-Connection will be released after the RF-Controller runs a start up process.***

[1] see: ANNEX C: Index of Status Bytes
[2] see ANNEX C: Index of Status Bytes

5.3. [0x65] Get Software Version

This protocol allows you to determine the software version of the Reader, its type and the types of the Transponders which are supported by the software.

Host → Reader

1	2	3	4...5
5	COM-ADR	[0x65]	CRC16

Host ← Reader

1	2	3	4	5...6	7
13	COM-ADR	[0x65]	STATUS[1]	SW-REV	D-REV

8	9	10...11	12...13	14...15	16...17
HW-TYPE	SW-TYPE	TR-TYPE	RX-BUF	TX-BUF	CRC16

SW-REV:

Version of the firmware.

D-REV:

Revision status of the firmware.

HW-TYPE:

Displays options configuration pin value (internal use).

SW-TYPE:

Displays the type / model of the Reader
(see: ANNEX B: Codes of Reader Types)

TR-TYPE:

Displays the Transponders supported by the Reader.

Bit:	15	14	13	12	11	10	9	8
Function:	-	-	-	-	-	-	-	-

Bit:	7	6	5	4	3	2	1	0
Function:	-	-	ISO 14443B	ISO 14443A	ISO 15693	-	-	-

RX-BUF:

RX-BUF is the maximum receive buffer size of the Reader. If a protocol from the host ex-

[1] see: ANNEX C: Index of Status Bytes

ceed the RX-BUF size the Reader response with error code 0x81 PROTOCOL LENGTH ERROR.

TX-BUF:

TX-BUF is the maximum transmit buffer size of the Reader. The host has to take in to account that a response protocol of the Reader can have this length.

5.4. [0x66] Get Reader Info

This protocol allows you to determine, a lot of Firmware and hardware options and version from the reader. Most information's are only required for service and support questions.

Host → Reader

1	2	3	4	5...6
6	COM-ADR	[0x66]	MODE	CRC16

MODE:

Via the Parameter MODE different information could requested from the Reader.

0x00: General hard- and firmware information's

0x01: AC controller firmware - not supported -

0x02: USB controller - not supported -

0x03: RF-decoder information's for factory diagnostic.

0x05: Bootloader version information.

0x10: Hardware Information

0x50: Mac-address

0x80: Device-ID: Necessary Information's for firmware updates and firmware upgrades.

Host ← Reader

Depending on the MODE Parameter the reader response has a differing structure with several information's:

5.4.1. Mode = 0x00 (RF Controller Firmware)

Host ← Reader

1	2	3	4	5...6	7
17	COM-ADR	[0x66]	STATUS[1]	SW-REV	D-REV

8	9	10...11	12...13	14...15	16...17
HW-TYPE	SW-TYPE	TR-TYPE	RX-BUF	TX-BUF	CRC16

see: 5.3. [0x65] Get Software Version

5.4.2. Mode = 0x03 (RF-decoder information's)

Host ← Reader

1	2	3	4	5...9	10
17	COM-ADR	[0x66]	STATUS[2]	DEC_TYPE	SELF_TST

11	12	13	14	15	16...17
-	-	-	-	-	CRC16

DEC_TYPE

Information's about the functionality and revision of the RF-decoder for service and support.

SELF_TST

This byte gives information about the self test result, which is performed automatically by the reader after a power on reset.

0x00: Self test not OK
The reader has detected an internal failure.

0x01: Self test OK.

[1] see: ANNEX C: Index of Status Bytes
[2] see: ANNEX C: Index of Status Bytes

5.4.4. Mode = 0x05 (Bootloader version information)

Host ← Reader

1	2	3	4	5	6
17	COM-ADR	[0x66]	STATUS[1]	BL_VERSION	BL_REF

7...8	8...10	1...12	13...14	15	16...17
-	-	-	-	-	CRC16

BL_VERSION:

Bootloader Version

BL_REV:

Revision of Bootloader Version

[1] see: ANNEX C: Index of Status Bytes

5.4.6. Mode = 0x07 (CPRIO-INFO)

Host ← Reader

1	2	3	4	5...6	7
13	COM-ADR	[0x66]	STATUS[1]	SW-REV	HW-REV

9	10	11	12	13...14
NO-INPUTS	NO-OUTPUTS	NO-RELAYS	NO-SIGNALER	CRC16

SW-REV:

Version of the CPRIO-Software.

HW-REV:

Version of the CPRIO-Hardware.

NO-INPUTS:

Number of inputs.

NO-OUTPUTS:

Number of outputs.

NO-RELAYS:

Number of relays.

NO-SIGNALER:

Number of signaler.

[1] see: ANNEX C: Index of Status Bytes

5.4.7. Mode = 0x10 (Hardware Information)

Host ← Reader

1	2	3	4	5	6	7…8
0x02	19		COM-ADR	[0x66]	STATUS	HW-INFO

9…10	11…12	13	14	15	16
D_HW	A_HW	FREQUENCY	PORT_TYPE	reserved	RFC-INFO

17	18,19
reserved	CRC16

HW-INFO:

Hardware Information

Bit:	15	14	13	12	11	10	9	8
Function:	-	-	-	-	-	SD2	SD1	SE

Bit:	7	6	5	4	3	2	1	0
Function:	ANT	ACM	-	-	-	-	-	-

SE:

b0: The Reader is not equipped with any SAM socket.
b1: The Reader is equipped with one ore more SAM sockets.

SD1:

This bit indicates if a SAM is inserted into SAM socket 1.
b0: No SAM inserted.
b1: SAM inserted

SD2:

This bit indicates if a SAM is inserted into SAM socket 2.
b0: No SAM inserted.
b1: SAM inserted

ACM:

b0: The Reader is not equipped with Access-Control-Hardware.
b1: The Reader is equipped with Access-Control-Hardware

ANT:

b0: External antenna.
b1: Internal antenna.

D-HW:

internal use

A-HW:

internal use

FREQUENCY:

Flags for supported frequencies

Bit:	7	6	5	4	3	2	1	0
Function:	HF	UHF	-	-	-	-	FCC	EU

EU: b0: EU frequencies not supported
b1: EU frequencies supported

FCC: b0: FCC frequencies not supported
b1: FCC frequencies supported

UHF: b0: UHF not supported
b1: UHF supported

HF: b0: HF not supported
b1: HF supported

PORT_TYPE:

Flags for supported communication ports

Bit:	7	6	5	4	3	2	1	0
Function:	-	-	BT	USB	WLAN	LAN	RS4xx	RS232

RS232: b0: not supported
b1: supported

RS4xx: b0: not supported
b1: supported

LAN: b0: not supported
b1: supported

WLAN: b0: not supported

b1: supported

USB: b0: not supported

b1: supported

BT: b0: not supported
b1: supported

RFC-INFO: (Reserved for future use)

Displays options which are supported by the RFC

Bit:	7	6	5	4	3	2	1	0
Function:	-	-	-	-	-	-	-	-

5.4.8. Mode = 0x50 (MAC-address)

Host ← Reader

1	2	3	4	5	6..11
13	COM-ADR	[0x66]	STATUS[1]	FLAGS	MAC

12...13
CRC16

FLAGS:

indicates additional settings

Byte	5							
Bit:	7	6	5	4	3	2	1	0
	0	0	0	0	0	0	IP V4	0

IP V4:

b0: disabled

b1: enabled

MAC:

Mac-address of the Reader.

[1] see: ANNEX C: Index of Status Bytes

5.4.9. Mode = 0x80 (Device_ID)

Host ← Reader

1	2	3	4	5...8	9..12
22	COM-ADR	[0x66]	STATUS[1]	DEV_ID	CUSTOM_L

13...14	15...16	17...18	19...20	21...22
FW_L	TR_DRV_L	FNC_L	-	CRC16

DEV_ID:

Individual device identifier of the Reader.

CUSTOM_L:

Indicates which customer firmware is licensed on the Reader.

FW_L:

Indicates which Firmware version is licensed on the Reader.

TR_DRV_L:

Indicates which Transponder drivers are licensed on the Reader.

FNC_L:

Indicates which optional functions are licensed on the Reader.

[1] see: ANNEX C: Index of Status Bytes

5.5. [0x69] RF Reset

The RF-field of the Reader antenna can be switched off for **t_{rf} = 15 ms** by the command RF Reset. Thus, all Transponders which are within the antenna field of the Reader will be reset to their base setting.

Host → Reader

1	2	3	4,5
5	COM-ADR	[0x69]	CRC16

Host ← Reader

1	2	3	4	5,6
6	COM-ADR	[0x69]	STATUS[1]	CRC16

NOTES:

- ***After the RF Reset command the Reader is not able to receive any new Transponder before expiration of t_{rf} .***
- ***After a RF Reset a Transponder which is located within the field has to be re-selected.***

[1] see: ANNEX C: Index of Status Bytes

5.6. [0x6A] RF Output ON/OFF

The command RF ON/OFF switches the RF field of the Reader antenna ON or OFF.

Host → Reader

1	2	3	4	5,6
6	COM-ADR	[0x6A]	RF_OUTPUT	CRC16

Host ← Reader

1	2	3	4	5,6
6	COM-ADR	[0x6A]	STATUS[1]	CRC16

RF_OUTPUT:

Set on of the antenna outputs.

Bit:	7	6	5	4	3	2	1	0
Function	SNFM	0	0	0	0	ANT		

SNFM:

With this bit the notification mode can be suspended temporary, e.g. to exchange data with a transponder in polling mode. This bit has only effect if the notification mode is enabled (see: 3.2. CFG1: Interface, READER-MODE)

b0: Reactivates the suspended notification mode

b1 Suspends the notification mode while it is reactivated by setting NFM = b0

NOTICE:
In each case the ANT has to be set to b001 otherwise the antenna will be switches off!

ANT:

This parameter could be used to select one antenna.

b000: switches off RF power at all antennas.

b001: switches on the RF power at antenna 1.
This setting is to use, if the reader has only one internal or one external antenna.

[1] see ANNEX C: Index of Status Bytes

5.7. [0x72] Set Output

The command Set Output serves temporary limited or unlimited activation of the outputs of the Reader.

Each output takes on the state defined by the byte OUTx-mode for the period of time (OUT-TIME) included in the protocol. Via this protocol the outputs can be switched on or off for the indicated period of time. If the Reader receives a command Set Output, all times that have been active until then are being overwritten by the new times included in the protocol if they are > 0.

Host → Reader

1	2	3	4	5	6	7	8-9	n-1...n
n	COM-ADR	[0x72]	Mode	OUT-N	OUT-NR	OUT-S	OUT-TIME	CRC16
					Repeated OUT-N times			

Host ← Reader

1	2	3	4	5...6
6	COM-ADR	[0x71]	STATUS[1]	CRC16

Mode: 0x00

OUT-N:

Defines the number of output records.

OUT-NR:

Defines the type and the number of the output

Bit:	7	6	5	4	3	2	1	0
Function:	OUT-typ			0	OUT-Number			

OUT-typ:

- b000 Digital Output
- b001 LED
- b010 Buzzer
- b100 Relays..... - any other bit configuration is reserved

OUT-S:

OUT-S (Output State) defines the status of the output during the time defined in OUT-TIME and provides the possibility to allocate its own flashing-frequency to each output.

Bit:	7	6	5	4	3	2	1	0
Function:	0	0	0	0	0	0	OUTx-mode	

OUTx-mode:

b00: OFF
b01: ON
b10: FLASHING SLOW
b11: FLASHING FAST

OUT-TIME:

By the values defined by “OUT-TIME”, the outputs can be activated temporary limited or un-limited.
An exception are the time values 0 and 65535 (0xFFFF) (see following table).

0x0001	1 x 100ms	-> 100ms
...	...	
0xFFFE	65534 x 100ms	-> 1:49:13 h
0xFFFF	continuously active	

Notes:

- ***In order to reset a continuously active time, OUT-TIME = 1 has to be sent to the Reader, which effects a change to the idle status after 100 ms.***
- ***The continuous activation is being set back after a reset or a power failure.***

5.7.1. Set Output Examples

Example No. 1:

LED1 is alternating fast for 500 ms.
LED2 is not activated for 200 ms.
BUZZER is activated for 1000ms
LED3 and RELAY are unchanged

OUT-N	OUT-NR	OUT-S	OUT-TIME	
0x0003	*0x21*	*0x03*	*0x0005*	↴
↳	OUT-NR	OUT-S	OUT-TIME	
	0x22	*0x00*	*0x0002*	↴
↳	OUT-NR	OUT-S	OUT-TIME	
	0x41	*0x01*	*0x000A*	

5.8. [0x74] Get Input

With this command the actual status of the digital inputs can be inquired at any time. Because of the different number of digital inputs, this command is not supported from all Readers of the CPR-Family in the same way.

Host → Reader:

1	2	3	4,5
5	COM-ADR	[0x74]	CRC16

Host ← Reader

1	2	3	4	5	6,7
7	COM-ADR	[0x74]	STATUS[1]	INPUTS	CRC16

INPUTS:

Bit:	7	6	5	4	3	2	1	0
Function:	-	-	IN2_CNG	IN1_CNG	-	-	IN 2	IN 1

IN1 / IN2:

b0: Indicates that the digital input IN# is currently inactive.

b1: Indicates that the digital input IN# is currently activated.

IN1_CNG / IN2_CNG:

b1: Indicates that one or more state change had occurred at the digital input IN# in the meantime while the last Get Input command was proceeded.

[1] see: ANNEX C: Index of Status Bytes

6. ISO Host Commands for Transponder Communication

In the following chapters the Host commands for communication with a Transponder according are described. Notice that not all commands are available for each Transponder type. Detailed information about the supported ISO Host commands are described in chapter 9. Supported ISO Host commands. for each Transponder type separate.

6.1. [0xB0] ISO Standard Host Commands

This command sends standard RF commands to the Transponder.

Host → Reader

1	2	3	4...n-2	n-1,n
n	COM-ADR	[0xB0]	REQUEST-DATA	CRC16

Host ← Reader

1	2	3	4	5...n-2	n-1,n
n	COM-ADR	[0xB0]	STATUS	RESPONSE-DATA	CRC16

REQUEST-DATA:

Command specific request

RESPONSE-DATA:

Command specific response

Notes:

- ***Data are only transferred if STATUS = 0x00, 0x83, 0x94, 0x95.***
- ***These commands are not available if Notification-Mode is active.***

6.1.1. [0x01] Inventory

This command reads the UID of all Transponders inside the detection range. The reply behavior of this command can be configured by the ONT parameter of configuration block 3.6. CFG5: Anticollision.

REQUEST-DATA

4	5	6
[0x01]	MODE	[0x00]

RESPONSE-DATA see: 6.1.1.1. Response-Data - ISO 14443A (TR-TYPE = 0x04)
6.1.1.2. Response-Data - ISO 14443B (TR-TYPE = 0x05)
6.1.1.3. Response-Data – ISO15693 (TR-TYPE = 0x03)
6.1.1.4. Response-Data – KEYBOARD-PIN (TR-TYPE = 0x0E)

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	MORE	-	-	-	-	-	-	-

MORE:

this bit can be used, to read out the whole UIDs, after the Reader had signalized more data sets with status 0x94 (see: ANNEX C: Index of Status Bytes)**.**

b0: new Inventory requested
The reader carries out a new inquiry, which Transponder are in his detection range.

b1: more data requested
The reader response contain the UIDs which are not transferred with the last response because of the status 0x94.

DATA-SETS:

Number of Transponder data sets to be transferred in this reader response.

TR-TYPE:

Bit:	7	6	5	4	3	2	1	0
Function	RF_TEC		-	-	TYPE_NO			

RF_TEC:

Indicates the RFID - Technology of the present Transponder:
b00: 13,56 MHz Transponder
b10: UHF Transponder

TYPE_NO

Displays the Transponder type of the present Transponder
(see: ANNEX A: Codes of Transponder Types).

RESPONSE-DATA:

Depending on the Transponder type the response data of the Reader are different as described in the following chapters.

6.1.1.1. Response-Data - ISO 14443A (TR-TYPE = 0x04)

Response data of ISO 14443 Type A compliant Transponder:

Case CFG3. ISO14443 FTUR.OPTI = b0 ⇒ OPT_INFO is disabled

5	6	7	8	9...15 (18)
DATA-SETS	TR-TYPE	TR_INFO	0	UID
	Repeated DATA-SETS times			

Case CFG3. ISO14443 FTUR.OPTI = b1 ⇒ OPT_INFO is enabled

5	6	7	8	9...15 (18)
DATA-SETS	TR-TYPE	TR_INFO	OPT_INFO	UID
	Repeated DATA-SETS times			

TR_INFO (only ISO 14443A Transponder)**:**

This byte represent some information's from the SAK byte as described in ISO14443-3 ([1].

Bit:	7	6	5	4	3	2	1	0
Function	-	-	L4	-	-	CL3	-	-

CL3: Displays the UID length of the present Transponder.

b0 The UID is transmitted as a 7 byte field
(Transponder with Cascade Level 1 or Level 2)

b1 The UID is transmitted as a 10 byte field
(Transponder with Cascade Level 3)

L4: Displays the compliance of the Transponder with ISO 14443-4 according ISO 14443-3, SAK, b6

b0 Not compliant with ISO 14443-4

b1 Compliant with ISO 14443-4

[1] In case of NXP mifare chips this byte also indicates the chip type. Further information's are given in the NXP Application Note "mifare Interface Platform, Type Identification Procedure" M018412.

OPT_INFO (only ISO 14443A Transponder)**:**

Depending on the setting of CFG3.ISO14443 FTUR.OPTI this byte could optional display further information's about the present Transponder.

It's recommend to use this information if ISO14443-4 Transponder or Transponder with more the 4 byte UID length should be handled by the reader.

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	L4_SLCT	C_LEVEL	

C_LEVEL:

This 2 bits displays the Cascade Level of the Transponder UID

b00: Cascade Level 1 (4 byte UID)

b01: Cascade Level 2 (7 byte UID)

b10: Cascade Level 3 (10 byte UID)

L4_SLCT:

This bit displays the select status of the present Transponder.

b0: The Transponder is not selected in ISO14443-4 level.

b1: The Transponder is selected on ISO14443-4 level by the reader now. A further select command is not necessary for data exchange with this Transponder.

UID:

ISO 14443A UID could have different lengths. This depends on the Cascade Level of the Transponder (see also TR_INFO byte). It is transmitted by the reader with a length of 7 or 10 byte.

The following table shows the structure of the UID in relation to ISO14443-3

transmitted byte	9	10	11	12	13	14	15	16	17	18
Cascade-Level 1	0	0	0	UID3	UID2	UID1	UID0	-	-	-
Cascade-Level 2	UID6	UID5	UID4	UID3	UID2	UID1	UID0(*	-	-	-
Cascade-Level 3	UID9	UID8	UID7	UID6	UID5	UID4	UID3	UID2	UID1	UID0(*

* UID0: Manufacturer ID according ISO/IEC7816-6/AM1

In case of a shorter UID the redundant bytes are filled with 0 at the most significant digits.

Notice:

The UID byte order can be swapped by using the parameter CFG3.ISO14443 FTUR.UID_ORDER

6.1.1.2. Response-Data - ISO 14443B (TR-TYPE = 0x05)

Response data of ISO 14443 Type B compliant Transponder:

5	6	7	8...11	12...15
DATA-SETS	TR-TYPE	PROTO INFO.	APP DATA	PUPI
	Repeated DATA-SETS times			

PUPI

4 byte Pseudo-Unique PICC Identifier, according ISO 14443-3:2001.

This information is required to select the Transponder.

APP_DATA

4 byte Application Date according ISO 14443-3:2001.

1	2	3	4
AFI	CRC_B (AID)		Number of Applications

PROTO_INFO

This parameter is extracted from the protocol Info bytes as described in ISO14443-3.

Bit:	7	6	5	4	3	2	1	0
Function	Max_Frame_Size				Protocol_Type			

Max_Frame_Size (according ISO14443-3:2001)

Value	0	1	2	3	4	5	6	7	8	9-F
Frame Size (Byte)	16	24	32	40	48	64	96	128	256	RFU > 256

Protocol_Type (according ISO14443-3:2001)

7	6	5	4	Meaning
0	0	0	1	PICC compliant with ISO/IEC 14443-4
0	0	0	0	PICC not compliant with ISO/IEC 14443-4

6.1.1.3. Response-Data – ISO15693 (TR-TYPE = 0x03)

Response data of ISO 15693 compliant Transponder:

RESPONSE-DATA **(standard)**

5	6	7	8...15
DATA-SETS	TR-TYPE	DSFID	UID
	Repeated DATA-SETS times		

DATA-SETS:

Number of Transponder data sets to be transferred in this Reader response.

TR-TYPE:

Bit:	7	6	5	4	3	2	1	0
Function	RF_TEC		-	-	TYPE_NO			

RF_TEC:

Indicates the RFID - Technology of the present Transponder:
b00: 13,56 MHz Transponder

TYPE_NO

Displays the Transponder type of the present Transponder
(see: **ANNEX A: Codes of Transponder Types**).

DSFID: (only ISO15693Transponders)

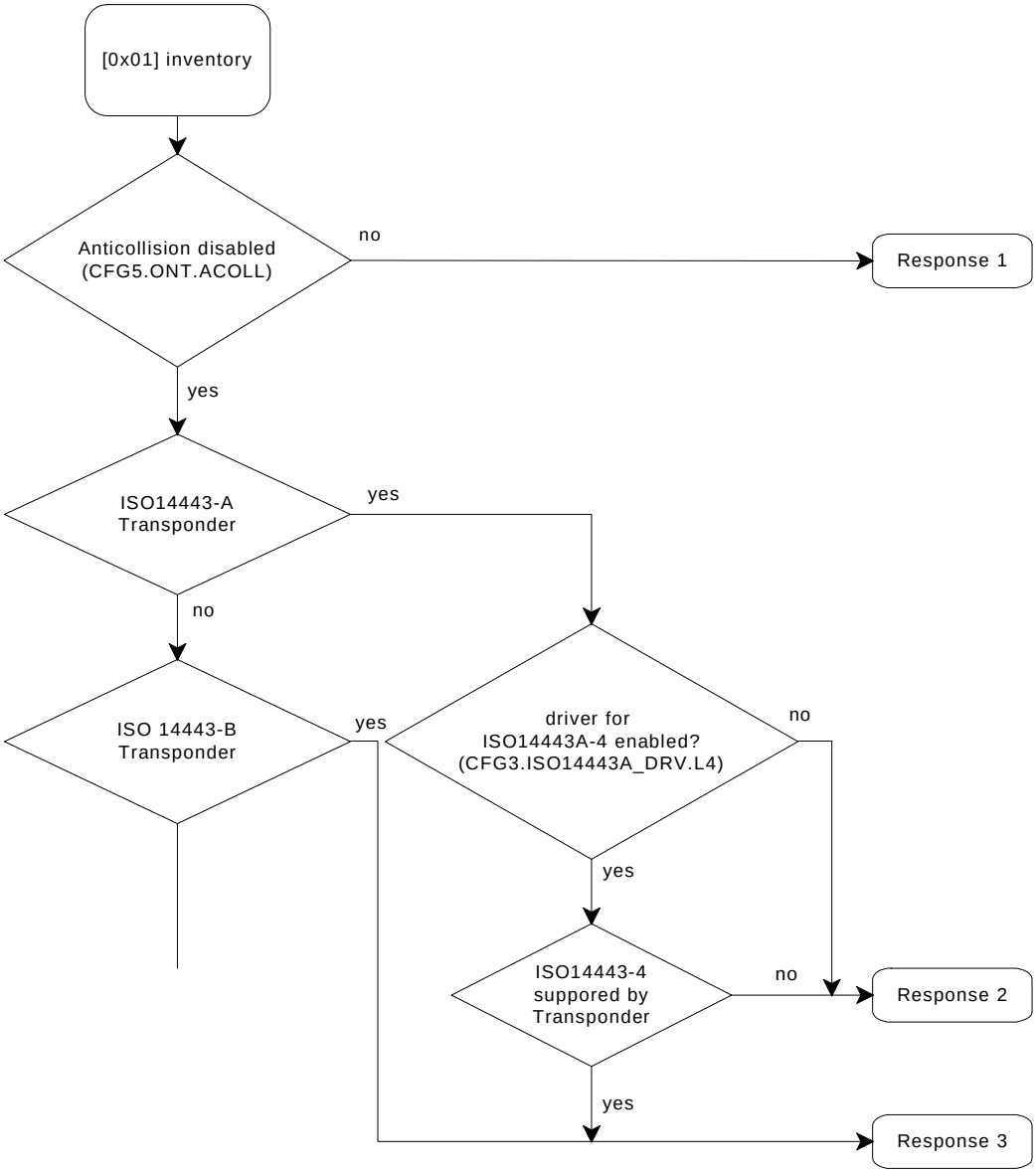
Data Storage Family Identifier.

UID:

ISO 156963 UID. It is transmitted by the reader with a length of 8 byte.

6.1.1.5. Sequences of Inventory Command and ISO14443 Transponder

The following chart displays the sequences and effects after a Inventory command depending on the Transponder type and the Reader configurations.



	Transponder(s) are selected	**No of announced Transponder**	**next possible commands**
Response 1	no	> 1 (possibly)	6.1.2. [0x25] Select
Response 2	yes one Transponder on ISO14443-3 level	1	Proprietary or standard commands for ISO14443 Transponders (see 6.3. [0xB2] ISO14443 Special Host Commands)
Response 3	yes one Transponder on ISO14443-4 level	1	ISO14443-4 Commands (see 6.3. [0xB2] ISO14443 Special Host Commands

6.1.2. [0x25] Select

This command sets one Transponder to the Select State. Only one ISO Transponder can be selected at once.

The supported ISO Host commands depends on the Transponder types, they are described in chapter 9. Supported ISO Host commands.

REQUEST-DATA

4	5	(6)	(7) 6...13 (253)
[0x25]	MODE	UID_LEN	UID

RESPONSE-DATA (only if STATUS = 0x95)

(5)
ISO-ERROR

RESPONSE-DATA (only if the MODE-bit CINF was set in the request and STATUS = 0x00)

(5)	(6)..n
FORMAT	CARD_INFO

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	0	0	CINF	UID_LF	0	ADR		

ADR:

b001 addressed

UID_LF:

If this bit is set the parameter UID_LEN must inserted into the command.

b0: The protocol UID_LEN doesn't include the UID_LEN byte and the UID field has a fixed length of 8 byte, from byte 6 to byte 13.

b1: The protocol includes the parameter UID_LEN. The UID has a variable length as defined in UID_LEN.

CINF:

b0 don't return card-information

b1 return the card-information within the select response.

UID_LEN:

Is an optional parameter and depends on the setting of UID_LF (see MODE). UID_LEN defines the length of the following UID field.

NOTICE:

The maximum UID_LEN is limited depending on the reader type. If UID_LEN exceeds the internal buffer size the reader responses a error massage.

UID:

UID, Serial-Number or pseudo unique identifier of the Transponder.

Depending on the UID_LF and UID_LEN the UID field could have a fixed ore a variable length and a variable position in the protocol.

case UID_LF = 0:

If UID_LEN is not used, the following definitions are mandatory depending on the Transponder type.

ISO 14443A

4	5	6	8...13
[0x25]	b000 0001	0x00	UID

ISO 14443B

4	5	6...9	10...13
[0x25]	b000 0001	0x00	PUPI

case : UID_LF = 1

If UID_LEN is activated the specific UID length of the Transponder should be used in the protocol.

4	5	6	7... 7+UID_LEN
[0x25]	MODE	UID_LEN	UID

ISO-ERROR:

Additional error code if STATUS = 0x95.

FORMAT:

Indicates the format of the CARD_INFO field:

0x00: No further CARD_INFO field available.

0x01: CARD_INFO of an ISO14443-4 Type-A Transponder.

0x02: CARD_INFO of an ISO14443-4 Type-B Transponder.

0x03: CARD_INFO of an ISO14443-3 Type-A Transponder.

CARD_INFO:

Depending on the FORMAT parameter this data field contains different data's

case FORMAT = 0x01

CARD_INFO contains the ATQA and SAK and parts of the Answer to select (ATS) of the ISO14443 Type-A Transponder as defined in ISO14443-4. The length of CARD_INFO depends on the TL parameter. The response length depends on the TL parameter of the Transponder ATS.

6		7		
ATQA				
RFU	Proprietary coding	UID size	RFU	Bit frame anticollision

8	9
SAK	TL

(10....10+TL-2)
T0, TA(1), TB(1), TC(1) T1, Tk

case FORMAT = 0x02

CARD_INFO contains parts of the answer ATQB response ATTRIB response of the ISO14443 Type-B Transponder as defined in ISO14443-3.

6	7		8		
ATQB Response Protocol Info					
Bit_Rate_capability	Max_Frame_ Size	Protocol_Type	FWI	ADC	F0

9	
1 th Byte of Answer to ATTRIB	
MBLI	CID

case FORMAT = 0x03

CARD_INFO contains the ATQA and SAK parameter after the anticollision loop has finished of ISO14443 Type-A Transponder as defined in ISO14443-3.

6		7		
ATQA				
RFU	Proprietary coding	UID size	RFU	Bit frame anticollision

8
SAK

6.1.3. [0x23] Read Multiple Blocks

This command reads one or more data blocks.

The supported ISO Host commands depends on the different Transponder types, they are described in chapter 9. Supported ISO Host commands.

REQUEST-DATA

4	5	(6...13)	6 / (14)	7 / (15)
[0x23]	MODE	UID	DB_ADR	DB-N

RESPONSE-DATA (STATUS = 0x95)

5
ISO-ERROR

RESPONSE-DATA

5	6	7	8...n
DB-N	DB-SIZE	SEC-STATUS	DB
		Repeated DB-N times	

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	0	0	0	0	SEC	ADR		

ADR:

b000 non-addressed
b001 addressed
b010 selected

SEC:

Requests optional the security status of the followed data block
b0 security status not requested (SEC-STATUS always = 0x00)
b1 security status is requested

UID:

Read-only UID of the Transponder. The UID is required only in the addressed mode.

DB_ADR:

First block number to be read. First block can be any value between 0 and 255.

DB-N:

Number of data blocks to be read from the Transponder, starting at DB_ADR. The maximum number of DB-N, depends on DB-Size. The maximum number of bytes is 128 byte.

DB-Size	Max. DB-N
1	128
4	32
8	16
x	= 128 / x

ISO-ERROR:

Additional error code if STATUS = 0x95.

DB-SIZE:

Number of bytes of one data block. This value depends on the specification of the Transponder manufacturer, see chapter 9. Supported ISO Host commands.

SEC-STATUS:

Block security status of followed data block.
If SEC-STATUS is not requested or not supported, this value will return 0x00.

DB:

Requested data block. The block size is defined by DB-SIZE.

Notes:

- ***A read from 1 block uses a Read Single Block command to the Transponder.***
- ***If a Transponder does not support Read Multiple Blocks commands several Read Single Block commands are used for this Transponder.***
- ***Only one Transponder can be read in the non-addressed mode.***
- ***Jewel Transponders are only supported in Addressed Mode***
- ***A read of 1 byte from a JEWEL Transponder uses the JEWEL READ Instruction***
  A read of more than 1 byte from a JEWEL Transponder uses the JEWEL READ-ALL instruction

6.1.4. [0x24] Write Multiple Blocks

This command writes one or more data blocks.

The supported ISO Host commands depends on the different Transponder types, which are described in chapter 9. Supported ISO Host commands.

REQUEST-DATA

4	5	(6...13)	6 / (14)	7 / (15)	8 / (16)	9...n / (17...n)
[0x24]	MODE	UID	DB_ADR	DB-N	DB-SIZE	DB
						Repeated DB-N times

RESPONSE-DATA (STATUS = 0x03)

5
DB_ADR-E

RESPONSE-DATA (STATUS = 0x95)

5	6
ISO-ERROR	DB_ADR-E

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	0	0	0	0	WR-NE	ADR		

ADR:

b000 non-addressed
b001 addressed
b010 selected

WR-NE (Only JEWEL):

b0 JEWEL Write-Erase
b1 JEWEL Write-No-Erase
This settling is necessary for write operations on OTP Bytes.

UID:

Read-only UID of the Transponder. The UID is required only in the addressed mode.

DB_ADR:

Address of the first data block to be written to the Transponder. First block can be any value between 0 and 255.

DB-N:

Number of data blocks to be written to the Transponder, starting at DB_ADR. The maximum number of DB-N, depends on DB-Size. The maximum number of bytes is 128 byte.

DB-Size	Max. DB-N
1	128
4	32
8	16
x	= 128 / x

DB-SIZE:

Number of bytes of one data block. This value depends on the specification of the Transponder manufacturer, see chapter 9. Supported ISO Host commands.

DB:

Data of the data block to be written to the Transponder. The required block size is defined by DB-SIZE. The number of the expected bytes are DB-N * DB-SIZE.

ISO-ERROR:

Additional error code if STATUS = 0x95.

DB_ADR-E:

Block number where the error occurred.

Notes:

- ***If a Transponder does not support Write Multiple Blocks commands several Write Single Block commands are used for this Transponder.***
- ***If an error occurred during a write command, the number of the block were the error occurred will be send to host***

•

6.3. [0xB2] ISO14443 Special Host Commands

The [0xB2] commands are supposed to send special ISO14443 defined commands and proprietary ISO14443 RF commands to the Transponder.

Host → Reader

1	2	3	4...n-2	n-1,n
n	COM-ADR	[0xB2]	REQUEST-DATA	CRC16

Host ← Reader

1	2	3	4	5...n-2	n-1,n
n	COM-ADR	[0xB2]	STATUS	RESPONSE-DATA	CRC16

REQUEST-DATA:

Command specific request

RESPONSE-DATA:

Command specific response

Notes:

- ***This command isn't available if the scan mode is switched on.***

6.3.1. [0x30] Mifare Value Commands

This command provides the Mifare value functions INCREMENT, DECREMENT, TRANSFER and RESTORE of an value formatted Mifare sector block. The command returns an error if the block is not in value block format (details about the Mifare value block format are described in Mifare standard data sheet provided by NXP). The command loads the value from a source address (DB_ADR), operates the value function and stores the result at the destination address (DESTIN_ADR).

NOTICE:

- ***A previous authentication (see:*** 6.3.2. [0xB0] Authent Mifare***) is needed to process the command.***
- ***The Mifare value block format could be written with the reader command*** 6.1.4. [0x24] Write Multiple Blocks

REQUEST-DATA

4	5	6	7	8...11	12
[0x30]	MODE	MF_CMD	DB_ADR	OP_VALUE	DEST_ADR
				MSB ... LSB	

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	0	0	0	0	0	ADR		

ADR:

b010 selected

MF_CMD

This parameter defines the value operation which should be done on the Mifare Transponder.

0x01 INCREMENT
Adds the value OP_VALUE to the value specified by address DB_ADR.

0x02 DECREMENT
Subtracts the value OP_VALUE from the value specified by address DB_ADR.

0x03 COPY
Transfers the value structure from address DB_ADR to address DESTIN_ADR without changing the value.

DB_ADR:

Source Mifare block address of the value formatted data. A formula to calculate DB_ADR could be found in Chapter 9.2.1. NXP - Mifare classic

NOTICE:
The specified Mifare block must have been formatted as a Mifare value block.

OP_VALUE:

This parameter contains the 32 Bit value which should be calculated with the value at DB_ADR.

NOTICE:
In case of the COPY function the content of OP_VALUE has no effect.

DEST_ADR:

Destination address where the result of the value operation should be stored.

NOTICE:
DEST_ADR and DB_ADR must be in the same Mifare sector.

Example:

- *Formatting of Mifare Sector 2, Block 1 in Mifare value block format with Value = 2 and Adr = 5 by using the command [0x24] Write Multiple Blocks.*

6	*7*	*8*	*9....24*						
		mifare Byte:	15	14	13	12	11 10 9 8	7 6 5 4	3 2 1 0
DB_ADR	*DB-N*	*DB-SIZE*	*DB*						
0x09	*0x01*	*0x10*	*0xFA 0x05 0xFA 0x05 0x00000002 0xFFFFFFFD 0x00000002*						
			$\overline{Adr.}$ Adr. $\overline{Adr.}$ Adr Value $\overline{Value}$ Value						

NOTICE:
make sure that the access conditions in the Mifare Sector Trailer for this block are also configured as value block.

- *Formatting of Mifare Sector Trailer by using the command [0x24] Write Multiple Blocks*

6	*7*	*8*	*9....24*													
		mifare Byte:	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DB_ADR	*DB-N*	*DB-SIZE*	*Key A*						*Access Bits*				*Key B*					
0x0B	*0x01*	*0x10*	*0xFFFFFFFFFFFF*						*0x69 8F 77 08*				*0xFFFFFFFFFFFF*					

- *Increment Value at Mifare Sector 2, Block 1 with OP_VALUE = 3*

6	*7*	*8....11*	*12*
MF_CMD	*DB_ADR*	*OP_VALUE*	*DEST_ADR*
0x01	*0x09*	*0x00000003*	*0x05*

6.3.2. [0xB0] Authent Mifare

Before access is given to the data stored in the memory of a mifare standard Transponder, the user have to prove his permission for the requested operation. Depending on the MODE.KL bit this command offers to possibilities for key handling. It is possible to use a key which is stored into the readers EERPOM (see: 4.5. [0xA2] Write Mifare Reader Keys) or a temporary key can transferred within the request data.

REQUEST-DATA

MODE: bxxxx 0010

4	5	6	7	8
[0xB0]	MODE	DB_ADR	KEY-TYPE	KEY-ADR

MODE: bxxxx 1010

4	5	6	7	8...13
[0xB0]	MODE	DB_ADR	KEY-TYPE	KEY

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	KL	ADR		

ADR:

b010 selected

KL:

This bit indicates the key location

b0: EEPROM Key, defined by KEY-TYPE and KEY-ADR is used for authentication process .

b1: KEY-TYPE and temporary KEY which are transferred within the request data are used for authentication process.

DB_ADR:

Address of the first data block on which an access is requested .

NOTICE:
The Reader uses a linear addressing mode. For calculating the block address (DB_ADR) the expected mifare Sector and the mifare Block in this sector must be known. A formula to calculate DB_ADR could be found in Chapter 9.2.1. NXP - Mifare classic

An authentication to one mifare Block inside a sector have effect to the whole sector.

KEY-TYPE:

Defines the key for the authentication.
0x00: KEY A
0x01 KEY B

KEY-ADR:

EEPROM Address (0x00 ... 0x0F) where the key is stored in the Reader (see: 4.5. [0xA2] Write Mifare Reader Keys).

KEY:

6 byte Mifare Key which should used for the current authentication process.

6.3.4. [0xBE] ISO 14443-4 T=CL (#)

This command provides the data exchange between a host and the Transponder on ISO 14443-4 layer. It is special designed for easy APDU data exchange.

NOTICE:

- ***The maximum buffer size of the Reader for data exchange is.***
  - 128 byte for data sending from Host to Reader (downlink)
  - 256 byte (FSDI = 8) for data sending from Reader to Host (uplink).

REQUEST-DATA

4	5	(6...n-2)
[0xBE]	MODE	(DATA)

RESPONSE-DATA

4	(5)	(6...7)	(8...n-2)
STATUS	(PSTAT)	(BLK_CNT)	(DATA)

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	FIRST	MORE	-	-	PING	NAD_E	CID_E	INF

MODE bit setting rules

MODE	DATA			
	6	7	8...n-2	
b1000 0001	(INF)			APDU without CID or NAD (single block)
b1100 0001	(INF)			APDU without CID or NAD (first chained block)
b0100 0001	(INF)			APDU without CID or NAD (further chained block)
b0000 0001	(INF)			APDU without CID or NAD (last chained block)
b1000 0011	CID	(INF)		APDU with CID (single block)
b1100 0011	CID	(INF)		APDU with CID (first chained block)
b1000 0101	NAD	(INF)		APDU with NAD (single block)
b1100 0101	NAD	(INF)		APDU with NAD (first chained block)
b1000 0111	CID	NAD	(INF)	APDU with CID and NAD (single block)
b1100 0111	CID	NAD	(INF)	APDU with CID and NAD (first chained block)
b1000 0000	-			DESLECT without CID or NAD
b1000 0010	CID	-		DESLECT with CID
b1000 100x	-			PING without CID or NAD
b1000 101x	CID	-		PING with CID

INF:

b0 "DESELECT"
Sends the S-block command "DESELECT" to the present Transponder.

b1 "APDU"
Instructs the Reader to send the INF Block (APDU) which is included in the DATA Block to the Transponder.

CID_E:

b0 The DATA Block includes no CID

b1: The DATA Block includes an optional 1 byte CID Parameter
The CID has to be placed in DATA directly behind the MODE Parameter

NOTICE:
In case of command chaining (see Bit "MORE") only the CID in the first command block is accepted by the Reader.

NAD_E:

b0 The DATA Block includes no NAD

b1: The DATA Block includes an optional 1 byte NAD Parameter
The NAD parameter is only supported in conjunction with INF = b1

NOTICE:
In case of command chaining (see Bit "MORE") only the NAD in the first command block is accepted by the Reader.

PING:

By means of this bit a presence check to the current Transponder can be operated by the host. The response includes only a status message.

b0: PING will not be operated

b1: PING will be operated by the Reader.

NOTICE:
PING is an exclusive function and can not combined with an APDU command. It can used with or without CID.

FIRST:

This bit indicates the first protocol of a new command. It is necessary for single commands and chained commands.

b0: The present protocol block is the second or further part of a chained command.

b1: The present protocol block is a single command or the first part of a chained command.

MORE:

By means of this bit a data chaining from the host to the Reader could realized if the number of data bytes which should be send beyond the receive buffer size of the Reader.

b0 **No downlink chaining (Host ⇒ Reader)**
The present protocol block includes the complete command.

b1 **downlink chaining (Host ⇒ Reader)**
The present protocol block includes not the complete command.
After the reader has acknowledged the protocol block the host can send further parts of the command.

NOTICE:

- ***If an error status is responded by the Reader the downlink chaining should stopped by the host.***
- ***If a MORE status (0x94) is responded by the Reader the host have to handle this message.***

Protocol examples for Error-free operation with 3 blocks and 1 MORE response

	DATA	
MODE: b11xx 0xx1	(CID), (NAD), INF	Host ⇒ Reader (1. protocol block)
STATUS: 0x94 (MORE)		Host ⇐ Reader
STATUS: 0x00 (OK)		Host ⇐ Reader
b01xx 0001	INF	Host ⇒ Reader (2. protocol block)
STATUS: 0x00 (OK)		Host ⇐ Reader
b00xx 0001	INF	Host ⇒ Reader (last protocol block)
STATUS: 0x00 (OK)		Host ⇐ Reader

DATA:

The DATA Field could be used to transfer the optional CID, NAD and INF Field of the ISO14443-4 communication protocol.

In most cases the INF Field carries an APDU to the Transponder.

PSTAT

This parameter represents the processing status of the present command. PSTAT must be evaluated in conjunction with the STATUS byte of the Reader response.

Depending on PSTAT and STATUS the response data of the Reader are different.

0x01 WTXM

This response is given by the Reader if the Transponder needs more time than defined in parameter TR-RESPONSE-TIME (see CFG1) to proceed the present command.

After receiving this response the host shall align his receive timeout to a value grater than indicated by WTXM.

4	5	6	7	8	9
STATUS	PSTAT	BLK_CNT		WTXM	FWI
0x94	0x01	0xXX		0xXX	0xXX

WTXM and FWI:

refer to ISO 14443-4

The minimum receive timeout could calculated by the following formula:

TIMEOUT = 302µsec * 2^{FWI} * WTXM

WTXM: 1...59
FWI: 0...14

0x02 INF

This response is given by the Reader if the protocol includes data's from the Transponder.

4	5	6	7	8...n-2
STATUS	PSTAT	BLK_CNT		DATA
0x94	0x02	0xXX		0xXX
0x00	0x02	0xXX		0xXX

0xFF BUSY

This response is given by the Reader to re-trigger the receive timeout of the host. This response could occur if an error in data exchange between Transponder and Reader had happened and the Reader retries the process by it self.

4	5	6	7
STATUS	PSTAT	BLK_CNT	
0x94	0xFF	0xXX	

STATUS = ERROR (STATUS not 0x00 or 0x94)

This response is given by the Reader if the present command could not be finished, because of transmission errors.

4	5
STATUS	(ISO14443-ERROR)

STATUS:

see ANNEX C: Index of Status Bytes.

ISO14443-ERROR

Additional error code if STATUS = 0x96 (see ANNEX C2: ISO14443-Error, Error-Codes)

BLK_CNT

The BLK_CNT is a block counter which indexes each transmission from the Reader to the Host. On basis of the BLK_CNT the host could proof and sort the received protocols.

6.3.5. [0xBF] ISO 14443-4 Container Command (#)

This command encapsulates and transports the ISO 14443-4 commands to the Transponder. The Command enables the transparent data exchange between host and Transponder as described in ISO 14443-4.

REQUEST-DATA

4	5	6	7...n-2
[0xBF]	RSP	TIMEOUT (FWI)	REQUEST-BLOCK

RESPONSE-DATA

#..n-2
RESPONSE-DATA

NOTICE:
The maximum buffer for the RESPOSE-DATA is 256 byte (FSDI = 8).

RSP:

0 The Reader will send the command to the Transponder but do not wait for any response from the Transponder. Is option should only used if the command doesn't have any response.

> 0 The Reader will send the command and is waiting for a response form the Transponder while the time period defined in TIMEOUT is running or the Transponder had send a response.

TIMEOUT (FWI):

With this parameter the Frame waiting time (FWT) according ISO14443-4 could be select by the user

TIMEOUT (FWI)	approx. Frame waiting time (FWT)
0	1 ms
1	1 ms
2	2 ms
3	3 ms
4	5 ms
5	10 ms
6	20 ms
7	39 ms
8	78 ms
9	155 ms
10	310 ms
11	619 ms
12	1237 ms
13	2474 ms
14	4948 ms
15..254	- not allowed -
255	automatically

NOTICE:

- ***If TIMEOUT = 255 is chosen the Reader used the FWI as transmitted from the Transponder.***
- ***The value of TIMEOUT must be considered for calculating the TR-RESPONSE-TIME (see CFG1)***

REQUEST-BLOCK

This Parameter with variable length is provided for the transparent data transfer to the Transponder. Refer to ISO 14443-4, chapter "Block Format"

Prologue filed			Information field	Epilogue field
PCB	[CID]	[NAD]	[INF]	EDC
1 Byte	1 Byte	1 Byte	x Byte	2 Byte

NOTICE:
PCB is mandatory for each command whereas the parameters in [ ] brackets are optional. For further Information please see ISO/IEC ISO14443-4

***The max. size of a* REQUEST-BLOCK is 64 byte.**

6.3.6. [0x2B] ISO14443-4 Transponder-Info

This command could be helpful to get further information's about the capabilities of the present ISO14443-4 Transponder. The included information are transferred from the Transponder. (For further Information please see ISO/IEC ISO14443-4)

NOTICE:

- ***This command could be used only after the Transponder was selected (see*** 6.1.2. [0x25] Select***).***

REQUEST-DATA

4
[0x2B]

RESPONSE-DATA

5	6	7	8	9	10
FSCI	FWI	DSI	DRI	NAD	CID

FSCI:

Transponder Frame-Size

FSCI	0	1	2	3	4	5	6	7	8	9..255
Bytes	16	24	32	40	48	64	96	128	256	RFU

FWI:

Frame Waiting Time Integer of the Transponder.

Frame Waiting Time (FWT) = 302µsec * 2^{FWI} (FWI_{max} = 14 ⇒ 4949 ms)

DSI (Divisor send Integer)**:**

Displays the present supported data transfer rate from Reader to Transponder.

DSI	**b00**	**b01**	**b10**	**b11**
kBit / s	106	212	424	847

DRI (Divisor receive Integer)**:**

Displays the present supported data transfer rate from Transponder to Reader.

DRI	**b00**	**b01**	**b10**	**b11**
kBit / s	106	212	424	847

NAD:

b1: NAD (Node Address) supported, if bit is set to 1.

CID:

b1: CID (Card Identifier) supported, if bit is set to 1.

6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

In the following chapters the Host commands for communication with a DESFire Transponder are described. Most of the commands have the same structure. Only the content of REQUEST-DATA can vary depending on DESFIRE-COMMAND.

The firmware supports authentication, ciphering and deciphering and supports security functions of mifare DESFire, like DES, TDES, 3KTDES and AES algorithms for fully enciphered and CMAC protected files as well as it supports read and write operations on plain files.

NOTICE:

- ***This manual do not and shall not explain the functionality of mifare DESFire. For a better understanding of this manual the mifare DESFire documentation from NXP has to be present to get background knowledge.***
- ***DESFire commands which are not explicit described in the following chapters are not implemented in firmware. This DESFire commands can be processed by using the ISO Host Command [0xB2][0xBE] ISO14443-4 T=CL command and inserted DESFire ADPUs.***
- ***The ISO Host Commands for mifare DESFire Communication can be performed only if the mifare Plus Transponder is selected by the standard ISO Host Command [0x25] Select.***

Host → Reader

1	2	3	4	5	6...8
n	COM-ADR	[0xC1]	DESFire-COMMAND	MODE	AID (LSB … MSB)

9	(10 ... n-2)	n-1, n
READER-KEY-NDX	REQUEST-DATA	CRC16

Host ← Reader

Depending on the DESFIRE-COMMAND and the success of the command the structure of the reader response can vary:

STATUS = 0x00 - successful operation

1	2	3	4	(5...n-2)	n-1, n
n	COM-ADR	[0xC1]	STATUS[1]	(RESPONSE-DATA)	CRC16

STATUS = 0x97 (Crypto Processing Error) - failed operation

1	2	3	4	5	7...8	9, 10
10	COM-ADR	[0xC1]	STATUS[2]	ERROR SOURCE	ERROR CODE	CRC16

STATUS = all other values - failed operation

1	2	3	4	5, 6
6	COM-ADR	[0xC1]	STATUS[3]	CRC16

DESFIRE-COMMAND

This Sub-Command specifics the operation which shall be performed by the reader for data exchange.

The command bytes are in most cases similar to the original DESFire commands.

MODE:

The content of the mode byte my vary depending on the DESFIRE-COMMAND.

AID

3 byte DESFire Application ID.

READER-KEY-NDX (0...3)

Index of the key which is stored in the reader (see: 4.6. [0xA3] Write DES/AES Reader Keys) and which shall be used for authentication for the current command.

Notice

The key which is addressed with READER-KEY-NDX defines the authentication command and method. The addressed file has to configured in the same way.

[1] see: ANNEX C: Index of Status Bytes
[2] see: ANNEX C: Index of Status Bytes
[3] see: ANNEX C: Index of Status Bytes

REQUEST-DATA

The content of the REQUEST-DATA field may vary depending on the DESFIRE-COMMAND and is described for each DESFIRE-COMMAND separate.

The following fields are part of REQUEST-DATA of many commands and are not separate described for each command.

(10)	(11)	(12)
DESFire KEY-NO	FILE-NO	FILE-COMM-SETTINGS

DESFire KEY-NO (0x0...0xE)

Defines the number of the key to which the authentication shall be processed on the DESFire to get access to the data. The KEY-No on DESFire is specified in the access rights for each file.

0x0....0xD:

DESFire Key no for enciphered access
If a data exchange with a enciphered or MACed file shall be processed the respective KEY-NO has to used here

0xE:

DESFire Key No for free access.

This setting is possible for "read", "write" and "read&write" access rights for each file on the card. If this setting is used for "read&write" access rights a different key setting for "read" access rights or "write" access rights becomes obsolete.

NOTICE:
Depending on the DESFire KEY-NO and FILE-COMM-SETTINGS different security conditions can be configured. The following table shows the possible combinations and how the security functions are influenced by this settings.

DESFire KEY-NO	FILE-COMM-SETTINGS	file access conditions	
		valid authentication required	data exchange
0x0...0xD	0x00	yes	plain
	0x01		plain + MAC
	0x03		enciphered
0xE	0x00 0x01 0x03	no	plain

FILE-NO:

No of the file which should be read, written or otherwise manipulated.

FILE-COMM-SETTINGS

coding of the communication mode of the dedicated file.
0x00: plain communication
0x01: plain communication secured by MACing
0x03: fully enciphered communication

RESPONSE-DATA

The content and length of RESPONSE-DATA are varying depending on the DESFIRE-COMMAND.

In case of read commands from ciphered files the response data are deciphered data without padding bytes or CRC.

In case of MACed data the MAC is checked by the firmware. The response data doesn't include the MAC value.

ERROR-SOURCE

This byte displays the reason where a error occurred while command processing

1: Transponder:
The recognized error occurred while transponder communication.

3: Algorithm:
The recognized error occurred while data processing in the reader.

ERROR-CODE:

see ## ANNEX C3: Crypto Processing Error

6.4.1. [0xC1] [0xFA] DESFire Authent

This command can be used to process an explicit authentication. For data exchange commands like read and write data, value or record files this command is not necessary, because an authentication processed is included in this commands.

Host → Reader

1	2	3, 4	5	6...8	9
12	COM-ADR	[0xC1][0xFA]	MODE	AID	READER-KEY-NDX
				LSB MSB	

10	11, 12
DESFire KEY-NO	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

AID

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

READER-KEY-NDX

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

DESFire KEY-NO

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

6.4.2. [0xC1] [0xBD] DESFire Read Standard Data

The DESFire Read Standard Data command allows the read form DESFire standard data files or backup data files. Depending on the used parameters the reader performs an authentication, CRC and CMAC checking and deciphering of the data to be read as well as chaining.

Host → Reader

1	2	3, 4	5	6...8	9
20	COM-ADR	[0xC1][0xBD]	MODE	AID LSB MSB	READER-KEY-NDX

10	11	12	13...15	16....18	19, 20
DESFire KEY-NO	FILE-NO	FILE-COMM-SETTINGS	FILE-OFFSET LSB MSB	DATA-LEN LSB MSB	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

AID

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

READER-KEY-NDX

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

DESFire KEY-NO

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

FILE-NO:

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

FILE-COMM-SETTTINGS

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

FILE-OFFSET

Defines the byte position within the file where the read process shall start.

DATA-LEN (1 ... 1024 Byte):

Defines the number of bytes which shall be read.

6.4.3. [0xC1] [0x3B] DESFire Write Standard Data

The DESFire Write Standard Data command allows to write to DESFire standard data files or back-up data files. Depending on the used parameters the reader performs the authentication, ciphering, padding and all further calculations which are necessary to write ciphered or MACed data as well as chaining.

To write data to a backup data file the APDU commit transaction has to be performed by the user application after DESFire Write Standard Data command.

Host → Reader

1	2	3, 4	5	6...8	9
n	COM-ADR	[0xC1][0x3B]	MODE	AID	READER-KEY-NDX
				LSB MSB	

10	11	12	13...15	16....18
DESFire KEY-NO	FILE-NO	FILE-COMM-SETTINGS	FILE-OFFSET	DATA-LEN
			LSB MSB	LSB MSB

19.... 19 + DATA-LEN - 1	n- 1, n
DATA	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

AID

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

READER-KEY-NDX

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

DESFire KEY-NO

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

FILE-NO:

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

FILE-COMM-SETTTINGS

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

FILE-OFFSET

Defines the byte position within the file where the write process shall start.

DATA-LEN (0...1024)

Defines the number of bytes which shall be written.

DATA:

Data to be written.

NOTICE:
The no of data bytes to be written shall correspond with DATA-LEN.

6.4.4. [0xC1] [0x6C] DESFire Get Value

The DESFire Get Value command allows to read the currently stored value from a value file. Depending on the used parameters the reader performs an authentication, CRC and CMAC checking and deciphering of the data to be read.

Host → Reader

1	2	3, 4	5	6...8	9
14	COM-ADR	[0xC1][0x6C]	MODE	AID	READER-KEY-NDX
				LSB MSB	

10	11	12	13, 14
DESFire KEY-NO	FILE-NO	FILE-COMM-SETTINGS	CRC16

Host ← Reader

5...n-2
RESPONSE-DATA
LSB MSB

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

AID

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

READER-KEY-NDX

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

DESFire KEY-NO

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

FILE-NO:

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

FILE-COMM-SETTTINGS

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

6.4.5. [0xC1] [0x0C] DESFire Credit

The DESFire Credit command allows to increase the value stored in a value file. Depending on the used parameters the reader performs the authentication, ciphering, padding and all further calculations which are necessary to write ciphered or MACed data.

Host → Reader

1	2	3, 4	5	6...8	9
18	COM-ADR	[0xC1][0x0C]	MODE	AID LSB MSB	READER-KEY-NDX

10	11	12	13...16	17, 18
DESFire KEY-NO	FILE-NO	FILE-COMM-SETTINGS	CREDIT-VALUE LSB MSB	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

AID

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

READER-KEY-NDX

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

DESFire KEY-NO

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

FILE-NO:

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

FILE-COMM-SETTTINGS

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

CREDIT-VALUE

Value which shall added to the value stored in the value file.

6.4.6. [0xC1] [0xDC] DESFire Debit

The DESFire DEbit command allows to decrease the value stored in a value file. Depending on the used parameters the reader performs the authentication, ciphering, padding and all further calculations which are necessary to write ciphered or MACed data.

Host → Reader

1	2	3, 4	5	6...8	9
18	COM-ADR	[0xC1][0xDC]	MODE	AID LSB MSB	READER-KEY-NDX

10	11	12	13...16	17, 18
DESFire KEY-NO	FILE-NO	FILE-COMM-SETTINGS	DEBIT-VALUE LSB MSB	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

AID

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

READER-KEY-NDX

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

DESFire KEY-NO

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

FILE-NO:

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

FILE-COMM-SETTTINGS

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

DEBIT-VALUE

Value which shall subtracted from the value stored in the value file.

6.4.7. [0xC1] [0x1C] DESFire Limited Credit

The DESFire Credit command allows a limited increase of a value stored in a value file without having full Read&Write permissions to the file. Depending on the used parameters the reader performs the authentication, ciphering, padding and all further calculations which are necessary to write ciphered or MACed data.

Host → Reader

1	2	3, 4	5	6...8	9
18	COM-ADR	[0xC1][0x1C]	MODE	AID	READER-KEY-NDX
				LSB MSB	

10	11	12	13...16	17, 18
DESFire KEY-NO	FILE-NO	FILE-COMM-SETTINGS	CREDIT-VALUE	CRC16
			LSB MSB	

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

AID

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

READER-KEY-NDX

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

DESFire KEY-NO

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

FILE-NO:

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

FILE-COMM-SETTTINGS

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

CREDIT-VALUE

Value which shall added to the value stored in the value file.

6.4.8. [0xC1] [0x3B] DESFire Write Records

The DESFire Write Records command allows to write data to a record in a cyclic or linear record file. Depending on the used parameters the reader performs the authentication, ciphering, padding and all further calculations which are necessary to write ciphered or MACed data.

Host → Reader

1	2	3, 4	5	6...8	9
n	COM-ADR	[0xC1][0x3B]	MODE	AID LSB MSB	READER-KEY-NDX

10	11	12	13...15	16....18
DESFire KEY-NO	FILE-NO	FILE-COMM-SETTINGS	FILE-OFFSET LSB MSB	DATA-LEN LSB MSB

17.... 17+ DATA-LEN - 1	n- 1, n
DATA	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

AID

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

READER-KEY-NDX

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

DESFire KEY-NO

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

FILE-NO:

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

FILE-COMM-SETTTINGS

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

FILE-OFFSET

Defines the byte position within the file where the write process shall start.

DATA-LEN (0...1024)

Defines the number of bytes which shall be written.

DATA:

Data to be written.

NOTICE:
The no of data bytes to be written shall correspond with DATA-LEN.

6.4.9. [0xC1] [0xBB] DESFire Read Records

The DESFire Read Read Records command allows the read out a set of complete records form cyclic or linear record file. Depending on the used parameters the reader performs an authentication, CRC and CMAC checking and deciphering of the data to be read as well as chaining.

Host → Reader

1	2	3, 4	5	6...8	9
23	COM-ADR	[0xC1][0xBB]	MODE	AID LSB MSB	READER-KEY-NDX

10	11	12	13...15	16....18
DESFire KEY-NO	FILE-NO	FILE-COMM-SETTINGS	RECORD-OFFSET	NO- OF-RECORDS
			LSB MSB	LSB MSB

19....21	22, 23
RECORD-SIZE	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

AID

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

READER-KEY-NDX

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

DESFire KEY-NO

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

FILE-NO:

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

FILE-COMM-SETTTINGS

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

RECORD-OFFSET

Defines the record number within the file where the read process shall start.

NO-OF-RECORDS:

Defines the number of records which shall be read.

RECORD-SIZE

Defines the number of byte of one record which shall be read.

NOTICE:
The NO-OF-RECORDS multiplied with RECORD-SIZE shall be less than 1024 Byte.
(NO-OF-RECORDS * RECORD-SIZE ≤1024)

6.4.10. [0xC1] [0xEB] DESFire Clear Record File

The DESFire Clear Record File command allows to reset a cyclic or linear record file to the empty state.

Host → Reader

1	2	3, 4	5	6...8	9
14	COM-ADR	[0xC1][0xEB]	MODE	AID LSB MSB	READER-KEY-NDX

10	11	12	13, 14
DESFire KEY-NO	FILE-NO	FILE-COMM-SETTINGS	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

AID

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

READER-KEY-NDX

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

DESFire KEY-NO

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

FILE-NO:

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

FILE-COMM-SETTTINGS

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

6.4.11. [0xC1] [0x5F] DESFire Change File Settings

The DESFire Change File Settings command changes the access rights to an existing file. Depending on the used parameters the reader performs the authentication, ciphering, padding and all further calculations which are necessary to write ciphered or MACed data.

Host → Reader

1	2	3, 4	5	6...8	9
16	COM-ADR	[0xC1][0x5F]	MODE	AID LSB MSB	READER-KEY-NDX

10	11	12	13...14	15, 16
DESFire KEY-NO	FILE-NO	NEW-FILE-COMM-SETTINGS	NEW-FILE-ACCESS-RIGHTS	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

AID

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

READER-KEY-NDX

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

DESFire KEY-NO

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

FILE-NO:

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

NEW-FILE-COMM-SETTINGS

New coding of the communication mode of the dedicated file

0x00: plain communication

0x01: plain communication secured by MACing

0x03: Fully enciphered communication

NEW-FILE-ACCESS-RIGHTS

Byte	13		14	
Bit:	7.....4	3.....0	7.....4	3.....0
KEY-NO	Read&Write Access Rights	Change Access Rights	Read Access Rights	Write Access Rights

KEY-NO (0x0...0xF)

Assigns the key with which an access to the dedicated operation shall permitted.

0x0....0xD:
Key no which shall used for authentication to get the respective access.

0xE free access (no authentication is necessary to get access)

0xF: deny access (the access in denied)

6.4.12. [0xC1] [0x54] DESFire Change Key Settings

The DESFire Change Key Settings command changes the master key configuration settings depending on the addressed AID. Depending on the used parameters the reader performs the authentication, ciphering, padding and all further calculations which are necessary to write ciphered or MACed data.

Host → Reader

1	2	3, 4	5	6...8	9
12	COM-ADR	[0xC1][0x54]	MODE	AID LSB MSB	READER-KEY-NDX

10	11, 12
NEW-KEY-SETTINGS	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

AID

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

READER-KEY-NDX

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

NEW-KEY-SETTINGS

This parameter contains the new key settings of the via AID addressed application.

Depending on the AID value the PICC master key setting or the application master key settings can be changed.

AID = 0 The PICC Masterkey can changed.

AID > 0 The address application master key settings can changed.

6.4.13. [0xC1] [0xC4] DESFire Change Key

The DESFire Change Key command allows to change any key stored on the DESFire. Depending on the used parameters the reader performs the authentication, ciphering, padding and all further calculations which are necessary to write ciphered or MACed data.

Host → Reader

1	2	3, 4	5	6...8	9
63	COM-ADR	[0xC1][0xC4]	MODE	AID LSB MSB	READER-KEY-NDX

10	11	12	13...36
DESFire KEY-NO	KEY-NO-TB-CHANGED	KEY-LEN	OLD-KEY

37....60	61	62, 63
NEW-KEY	AES NEW KEY VERSION	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

AID

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

READER-KEY-NDX

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

DESFire KEY-NO

see chapter 6.4. [0xC1] ISO Host Commands for mifare DESFire Communication

DESFire KEY-NO:

Defines the key number which shall used for authentication to change a key. This key number depends on application master key settings (see also 6.4.12. [0xC1] [0x54] DESFire Change Key Settings).

0....D: DESFire Key No for enciphered access

KEY-NO-TB-CHANGED:

Number of key which shall be changed with the change key command.

KEY-LEN:

This parameter defines the length of the following keys (8,16 or 24 byte).

OLD-KEY:

Value of the current valid key which shall be changed. Depending on the settings of key which is stored in the reader (see: 4.6. [0xA3] Write DES/AES Reader Keys) the length of OLD-KEY varies between 8, 16 or 24 byte

<table>
<tr><th rowspan="2">AUTH-MODE</th><th colspan="3">Byte</th></tr>
<tr><th>12...19</th><th>20...27</th><th>28...35</th></tr>
<tr><td>2 (DESFire Native - DES)
3 (Standard DES)</td><td>OLD-KEY</td><td>-</td><td>-</td></tr>
<tr><td>0 (DESFire Native - TDES)
1 (Standard TDES)
5 (AES)</td><td colspan="2">OLD-KEY</td><td>-</td></tr>
<tr><td>4 (3KTDES)</td><td colspan="3">OLD-KEY</td></tr>
</table>

NEW-KEY:

Value of the new key which shall replace the OLD-KEY. Depending on the settings of key which is stored in the reader (see: 4.6. [0xA3] Write DES/AES Reader Keys) the length of NEW-KEY varies between 8, 16 or 24 byte

<table>
<tr><th rowspan="2">AUTH-MODE</th><th colspan="3">Byte</th></tr>
<tr><th>36...43</th><th>44..51</th><th>52...59</th></tr>
<tr><td>2 (DESFire Native - DES)
3 (Standard DES)</td><td>NEW-KEY</td><td>-</td><td>-</td></tr>
<tr><td>0 (DESFire Native - TDES)
1 (Standard TDES)
5 (AES)</td><td colspan="2">NEW-KEY</td><td>-</td></tr>
<tr><td>4 (3KTDES)</td><td colspan="3">NEW-KEY</td></tr>
</table>

AES NEW KEY VERSION:

Optional key version parameter if the key which shall be changed is a key for AES encryption.

6.5. [0xC2] ISO Host Commands for mifare Plus Communication

In the following chapters the Host commands for communication with a mifare Plus Transponder are described. Most of the commands have the same structure. Only the content of REQUEST-DATA can vary depending on MFP-COMMAND.

NOTICE:

- ***This manual do not and shall not explain the functionality of mifare Plus. For a better understanding of this manual the mifare Plus documentation from NXP has to be present to get background knowledge.***
- ***mifare Plus commands which are not explicit described in the following chapters are not implemented in firmware. This mifare Plus commands can be processed by using the ISO Host Command [0xB2][0xBE] ISO14443-4 T=CL command and inserted mifare Plus ADPUs.***
- ***The ISO Host Commands for mifare Plus Communication can be performed only if the mifare Plus Transponder is selected by the standard ISO Host Command [0x25] Select.***

Host → Reader

1	2	3	4	5	
n	COM-ADR	[0xC2]	MFP-COMMAND	MODE	↵

	(6 ... n-2)	n-1, n
↳	REQUEST-DATA	CRC16

Host ← Reader
Depending on the MFP-COMMAND and the success of the command the structure of the reader response can vary:

STATUS = 0x00 - successful operation

1	2	3	4	(5...n-2)	n-1, n
n	COM-ADR	[0xC2]	STATUS[1]	(RESPONSE-DATA)	CRC16

STATUS = 0x97 (Crypto Processing Error) - failed operation

1	2	3	4	5	6, 7	8, 9
9	COM-ADR	[0xC2]	STATUS[2]	ERROR SOURCE	ERROR CODE	CRC16

STATUS = all other values - failed operation

1	2	3	4	5, 6
6	COM-ADR	[0xC2]	STATUS[3]	CRC16

MFP-COMMAND

This Sub-Command specifics the operation which shall be performed by the reader for data exchange.

The command bytes are in most cases similar to the original mifare Plus commands.

MODE:

The content of the mode byte my vary depending on the MFP-COMMAND.

REQUEST-DATA

The content of the REQUEST-DATA field may vary depending on the MFP-COMMAND and is described for each MFP-COMMAND separate.

RESPONSE-DATA

The content and length of RESPONSE-DATA are varying depending on the MFP-COMMAND.

In case of read commands from ciphered files the response data are deciphered data without padding bytes or CRC.

In case of MACed data the MAC is checked by the firmware. The response data doesn't include the MAC value.

[1] see: ANNEX C: Index of Status Bytes
[2] see: ANNEX C: Index of Status Bytes
[3] see: ANNEX C: Index of Status Bytes

ERROR-SOURCE

This byte displays the reason where an error occurred while command processing

1: Transponder:
The recognized error occurred while transponder communication.

3: Algorithm:
The recognized error occurred while data processing in the reader.

ERROR-CODE:

see ## ANNEX C3: Crypto Processing Error

6.5.1. Commands for all Security Levels

This chapter describes commands which can be used independent on the current security level of mifare Plus. This commands can be different used depending on the current mifare plus security level.

Case mifare Plus is in SL1:

This command is necessary to switch to an higher security level. Process the following steps to switch to an higher security:

- Process the select [0x25] command with MODE.DRV_SEL = b1 and TR-DRIVER-SELECTION = 0x05 to switch the mifare Plus to ISO14443 Level 4 layer.
- Process the command MFP_FirstAuthentication or MFP_FollowingAuthentication with KeyBNr = 0x02, 0x90 to switch to security level 2 or with KeyBNr = 0x03, 0x90 to switch to security level 3.
- Process a RF-Reset.

Case mifare Plus is in SL3

This command allows the authentication in SL3.

6.5.1.1. [0xC2] [0x70] MFP_FirstAuthentication

The mifare Plus First Authentication command allows an initial authentication on a Block in SL3. This command could also perform an authentication to switch to SL2 or SL3 too.

Host → Reader

1	2	3, 4	5	6,7
11+ LEN-CAP	COM-ADR	[0xC2][0x70]	MODE	KeyBNr
				LSB MSB

8	9...(n-3)	n-2	n-1,n
LEN-CAP	PCDcap2	READER-KEY-NDX	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

KeyBNr

AES Key-Block-Number to be authenticated with**.**

LEN-CAP

Length of the PCD capabilities.
0x00 (for future use)

PCDcap2

The capabilities of the PCD, which define what is the PCD capable to do.
If used set to 0x00 (for future use)

READER-KEY-NDX (0...3)

Index of the key which is stored in the reader (see:4.6. [0xA3] Write DES/AES Reader Keys) and which shall be used for authentication for the current command.

6.5.1.2. [0xC2] [0x76] MFP_FollowingAuthentication

The mifare Plus Following Authentication command allows a following authentication on another Block in SL3 after a First Authentication was done. This command could also perform an authentication to switch to SL2 or SL3 too.

Host → Reader

1	2	3, 4	5	6,7	8	n- 1, n
10	COM-ADR	[0xC2][0x76]	MODE	KeyBNr LSB MSB	READER-KEY-NDX	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

KeyBNr

AES Key-Block-Number to be authenticated with**.**

READER-KEY-NDX (0...3)

Index of the key which is stored in the reader (see:4.6. [0xA3] Write DES/AES Reader Keys) and which shall be used for authentication for the current command.

6.5.2. Securtiy Level 1 commands

6.5.2.1. [0xC2] [0x77] MFP_SL1_AESAuthent

This command can be used to process an explicit authentication. For data exchange commands like read and write data, value or record files this command is not necessary.

Host → Reader

1	2	3, 4	5	6	7, 8
8	COM-ADR	[0xC2][0x77]	MODE	READER-KEY-NDX	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

READER-KEY-NDX (0...3)

Index of the key which is stored in the reader (see:4.6. [0xA3] Write DES/AES Reader Keys) and which shall be used for authentication for the current command.

NOTICE:
After processing the command [0xC2] [0x77] MFP_SL1_AESAuthent an additional [0xB2][0xB0] Authent Mifare command is necessary before a data exchange can be processed.

6.5.3. Securtiy Level 3 commands

This chapter describes command which can be processed only on mifare PLUS in security level 3 (SL3).

In SL3 the mifare plus supports plain, MAC, encrypted and mixtures of this security algorithms. A new authentication is necessary if a read command with MAC in response ([0x31], [0x33] ,[0x35] or [0x37]) shall be processed after a read command without MAC in response ([0x30], [0x32], [0x34] and [0x36]) was processed before.

If unMACed commands [0x34], [0x35], [0x36] or [0x37] shall be used, be aware the setting of MFP Configuration Block for the maximum number of unmaced read command!

In MFP Configuration Block can be configured:

- 00h MAC on Read Mandatory (default value)
- ##h number of read commands, which can be conducted within one transaction, where MAC on command sent is optional.

6.5.3.1. [0xC2] [0x78] MFP_SL3_ResetAuthentication

This command is used to reset a valid authentication.

Host → Reader

1	2	3, 4	5	6,7
7	COM-ADR	[0xC2][0x78]	MODE	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

6.5.3.2. [0xC2] [0x30] MFP_SL3_ReadEncrypted

This command offers the possibility to read the data from one or multiple blocks in an encrypted way. A MAC is only used on the command sent to the PICC, no MAC is attached to the response.

Host → Reader

1	2	3, 4	5	6,7	8	9,10
10	COM-ADR	[0xC2][0x30]	MODE	BNr	Ext	CRC16
				LSB MSB		

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

BNr:

Block number of the first block to be read

Ext:

Number of blocks to be read (limited to 64)

6.5.3.3. [0xC2] [0x31] MFP_SL3_ReadEncryptedMaced

This command offers the possibility to read the data from one or multiple blocks in an encrypted way. A MAC is only used on the command sent to the PICC and on the reponse received.

Host → Reader

1	2	3, 4	5	6,7	8	9,10
10	COM-ADR	[0xC2][0x31]	MODE	BNr	Ext	CRC16
				LSB MSB		

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

BNr:

Block number of the first block to be read

Ext:

Number of blocks to be read (limited to 64)

6.5.3.4. [0xC2] [0x32] MFP_SL3_ReadPlain

This command offers the possibility to read the data in plain from one or multiple blocks. A MAC is used on the command and not on the response.

Host → Reader

1	2	3, 4	5	6,7	8	9,10
10	COM-ADR	[0xC2][0x32]	MODE	BNr	Ext	CRC16
				LSB MSB		

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

BNr:

Block number of the first block to be read

Ext:

Number of blocks to be read (limited to 64)

6.5.3.5. [0xC2] [0x33] MFP_SL3_ReadPlainMaced

This command offers the possibility to read the data in plain from one or multiple blocks. A MAC is only used on the command and the response.

Host → Reader

1	2	3, 4	5	6,7	8	9,10
10	COM-ADR	[0xC2][0x33]	MODE	BNr	Ext	CRC16
				LSB MSB		

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

BNr:

Block number of the first block to be read

Ext:

Number of blocks to be read (limited to 64)

6.5.3.6. [0xC2] [0x34] MFP_SL3_ReadEncryptedUnmaced

This command offers the possibility to read the data from one or multiple blocks in an encrypted way.

Host → Reader

1	2	3, 4	5	6,7	8	9,10
10	COM-ADR	[0xC2][0x34]	MODE	BNr	Ext	CRC16
				LSB MSB		

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

BNr:

Block number of the first block to be read

Ext:

Number of blocks to be read (limited to 64)

6.5.3.7. [0xC2] [0x35] MFP_SL3_ReadEncryptedUnmacedRespMaced

This command offers the possibility to read the data from one or multiple blocks in an encrypted way. A MAC is only used only on the response received.

Host → Reader

1	2	3, 4	5	6,7	8	9,10
10	COM-ADR	[0xC2][0x35]	MODE	BNr	Ext	CRC16
				LSB MSB		

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

BNr:

Block number of the first block to be read

Ext:

Number of blocks to be read (limited to 64)

6.5.3.8. [0xC2] [0x36] MFP_SL3_ReadPlainUnmaced

This command offers the possibility to read the data in plain from one or multiple blocks. A MAC is not used on the response and not on the command.

Host → Reader

1	2	3, 4	5	6,7	8	9,10
10	COM-ADR	[0xC2][0x36]	MODE	BNr	Ext	CRC16
				LSB MSB		

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

BNr:

Block number of the first block to be read

Ext:

Number of blocks to be read (limited to 64)

6.5.3.9. [0xC2] [0x37] MFP_SL3_ReadPlainUnmacedRespMaced

This command offers the possibility to read the data in plain from one or multiple. A MAC is used on the response and not on the command.

Host → Reader

1	2	3, 4	5	6,7	8	9,10
10	COM-ADR	[0xC2][0x37]	MODE	BNr	Ext	CRC16
				LSB MSB		

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

BNr:

Block number of the first block to be read

Ext:

Number of blocks to be read (limited to 64)

6.5.3.10. [0xC2] [0xA0] MFP_SL3_WriteEncrypted

This command offers the possibility to write the data to up to three blocks in an encrypted way. A MAC is only used on the command sent to the PICC.

Host → Reader

1	2	3, 4	5	6,7	8
n	COM-ADR	[0xC2][0xA0]	MODE	BNr	Length
				LSB MSB	

9...(24)(40)(56)	n- 1, n
DATA	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

BNr:

Block number of the first block to be written

Length:

No of blocks to write (1...3)

DATA:

16,32 or 48 bytes of data

6.5.3.11. [0xC2] [0xA1] MFP_SL3_WriteEncryptedMaced

This command offers the possibility to write the data to up to three blocks in an encrypted way. A MAC is only used on the command sent to the PICC and on the response received from the PICC.

Host → Reader

1	2	3, 4	5	6,7	8
n	COM-ADR	[0xC2][0xA0]	MODE	BNr	Length
				LSB MSB	

9...(24)(40)(56)	n- 1, n
DATA	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

BNr:

Block number of the first block to be written

Length:

No of blocks to write (1...3)

DATA:

16,32 or 48 bytes of data

6.5.3.12. [0xC2] [0xA2] MFP_SL3_WritePlain

This command offers the possibility to write the data to up to three blocks in plain. A MAC is only used on the command sent to the PICC.

Host → Reader

1	2	3, 4	5	6,7	8
n	COM-ADR	[0xC2][0xA0]	MODE	BNr LSB MSB	Length

9...(24)(40)(56)	n- 1, n
DATA	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

BNr:

Block number of the first block to be written

Length:

No of blocks to write (1...3)

DATA:

16,32 or 48 bytes of data

6.5.3.13. [0xC2] [0xA3] MFP_SL3_WritePlainMaced

This command offers the possibility to write the data to up to three blocks in plain. A MAC is used on the command sent to the PICC as well as on the response from the PICC.

Host → Reader

1	2	3, 4	5	6,7	8
n	COM-ADR	[0xC2][0xA0]	MODE	BNr	Length
				LSB MSB	

9...(24)(40)(56)	n- 1, n
DATA	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

BNr:

Block number of the first block to be written

Length:

No of blocks to write (1...3)

DATA:

16,32 or 48 bytes of data

6.5.3.14. [0xC2] [0xB0] MFP_SL3_IncrementEncrypted

This command offers the possibility to increment a value block where the command is secured by a MAC calculated, but not on the response.

Host → Reader

1	2	3, 4	5	6,7	8...11	12,13
13	COM-ADR	[0xC2][0xB0]	MODE	SourceBNr	DATA	CRC16
				LSB MSB		

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

SourceBNr:

Block number of the value to be incremented

DATA:

4 bytes value

6.5.3.15. [0xC2] [0xB1] MFP_SL3_IncrementEncryptedMaced

This command offers the possibility to increment a value block where the command is secured by a MAC calculated, as well as on the response.

Host → Reader

1	2	3, 4	5	6,7	8...11	12,13
13	COM-ADR	[0xC2][0xB1]	MODE	SourceBNr	DATA	CRC16
				LSB MSB		

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

SourceBNr:

see chapter 6.5.3.14. [0xC2] [0xB0] MFP_SL3_IncrementEncrypted

DATA:

see chapter 6.5.3.14. [0xC2] [0xB0] MFP_SL3_IncrementEncrypted

6.5.3.16. [0xC2] [0xB2] MFP_SL3_DecrementEncrypted

This command offers the possibility to decrement a value block where the command is secured by a MAC calculated, but not on the response.

Host → Reader

1	2	3, 4	5	6,7	8...11	12,13
13	COM-ADR	[0xC2][0xB2]	MODE	SourceBNr	DATA	CRC16
				LSB MSB		

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

SourceBNr:

Block number of the value to be decremented

DATA:

see chapter 6.5.3.14. [0xC2] [0xB0] MFP_SL3_IncrementEncrypted

6.5.3.17. [0xC2] [0xB3] MFP_SL3_DecrementEncryptedMaced

This command offers the possibility to decrement a value block where the command is secured by a MAC calculated, as well as on the response.

Host → Reader

1	2	3, 4	5	6,7	8...11	12,13
13	COM-ADR	[0xC2][0xB3]	MODE	SourceBNr	DATA	CRC16
				LSB MSB		

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

SourceBNr:

see chapter 6.5.3.16. [0xC2] [0xB2] MFP_SL3_DecrementEncrypted

DATA:

see chapter 6.5.3.16. [0xC2] [0xB2] MFP_SL3_DecrementEncrypted

6.5.3.18. [0xC2] [0xB4] MFP_SL3_Transfer

The Transfer command stores the content of the Transfer Buffer to the specified address. The Transfer command can be applied to any block. The Transfer command ca only be executed after an Increment, Decrement, IncrementTransfer, DecrementTransfer or Restore command has been successfully executed since the latest authentication. The command is secured by a MAC on command. No MAC is calculated on the response.

Host → Reader

1	2	3, 4	5	6,7	8,9
9	COM-ADR	[0xC2][0xB4]	MODE	DestBNr	CRC16
				LSB MSB	

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

DestBNr:

Block number of the destination block

6.5.3.19. [0xC2] [0xB5] MFP_SL3_TransferMaced

The Transfer command stores the content of the Transfer Buffer to the specified address. The Transfer command can be applied to any block. The Transfer command ca only be executed after an Increment, Decrement, IncrementTransfer, DecrementTransfer or Restore command has been successfully executed since the latest authentication. The command is secured by a MAC on a command. A MAC is calculated on the response.

Host → Reader

1	2	3, 4	5	6,7	8,9
9	COM-ADR	[0xC2][0xB5]	MODE	DestBNr	CRC16
				LSB MSB	

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

DestBNr:

see chapter 6.5.3.18. [0xC2] [0xB4] MFP_SL3_Transfer

6.5.3.20. [0xC2] [0xB6] MFP_SL3_IncrementTransferEncrypted

This command offers the possibility to make a combined increment and transfer within one command on a value block where the command is secured by a MAC calculated, no MAC on the response.

Host → Reader

1	2	3, 4	5	6,7	8,9
15	COM-ADR	[0xC2][0xB6]	MODE	SourceBNr	DestBNr
				LSB MSB	LSB MSB

10...13	14,15
DATA	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

SourceBNr:

Block number of the source block

DestBNr:

Block number of the destination block

DATA:

4 bytes value

6.5.3.21. [0xC2] [0xB7] MFP_SL3_IncrementTransferEncryptedMaced

This command offers the possibility to make a combined increment and transfer within one command on a value block where the command is secured by a MAC calculated, and as well as a MAC on the response.

Host → Reader

1	2	3, 4	5	6,7	8,9
15	COM-ADR	[0xC2][0xB7]	MODE	SourceBNr	DestBNr
				LSB MSB	LSB MSB

10...13	14,15
DATA	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

SourceBNr:

see chapter 6.5.3.20. [0xC2] [0xB6] MFP_SL3_IncrementTransferEncrypted

DestBNr:

see chapter 6.5.3.20. [0xC2] [0xB6] MFP_SL3_IncrementTransferEncrypted

DATA:

see chapter 6.5.3.20. [0xC2] [0xB6] MFP_SL3_IncrementTransferEncrypted

6.5.3.22. [0xC2] [0xB8] MFP_SL3_DecrementTransferEncrypted

This command offers the possibility to make a combined decrement and transfer within one command on a value block where both the the command and the response are secured by a MAC.

Host → Reader

1	2	3, 4	5	6,7	8,9
15	COM-ADR	[0xC2][0xB8]	MODE	SourceBNr	DestBNr
				LSB MSB	LSB MSB

10...13	14,15
DATA	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

SourceBNr:

see chapter 6.5.3.20. [0xC2] [0xB6] MFP_SL3_IncrementTransferEncrypted

DestBNr:

see chapter 6.5.3.20. [0xC2] [0xB6] MFP_SL3_IncrementTransferEncrypted

DATA:

see chapter 6.5.3.20. [0xC2] [0xB6] MFP_SL3_IncrementTransferEncrypted

6.5.3.23. [0xC2] [0xB9] MFP_SL3_DecrementTransferEncryptedMaced

This command offers the possibility to make a combined decrement and transfer within one command on a value block where the command is secured by a MAC calculated, and as wells as a MAC on the response.

Host → Reader

1	2	3, 4	5	6,7		8,9	
15	COM-ADR	[0xC2][0xB9]	MODE	SourceBNr		DestBNr	
				LSB	MSB	LSB	MSB

10...13	14,15
DATA	CRC16

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

SourceBNr:

see chapter 6.5.3.20. [0xC2] [0xB6] MFP_SL3_IncrementTransferEncrypted

DestBNr:

see chapter 6.5.3.20. [0xC2] [0xB6] MFP_SL3_IncrementTransferEncrypted

DATA:

see chapter 6.5.3.20. [0xC2] [0xB6] MFP_SL3_IncrementTransferEncrypted

6.5.3.24. [0xC2] [0xC2] MFP_SL3_Restore

The Restore command copies the Content found in the Value Block at the given address to the Transfer Buffer. The Restore command can only be applied to value blocks. The command is secured by a MAC on a command, no MAC is calculated on the response.

Host → Reader

1	2	3, 4	5	6,7	8,9
9	COM-ADR	[0xC2][0xC2]	MODE	SourceBNr	CRC16
				LSB MSB	

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

SourceBNr:

see chapter 6.5.3.20. [0xC2] [0xB6] MFP_SL3_IncrementTransferEncrypted

6.5.3.25. [0xC2] [0xC2] MFP_SL3_RestoreMaced

The Restore command copies the Content found in the Value Block at the given address to the Transfer Buffer. The Restore command can only be applied to value blocks. The command is secured by a MAC on a command and a MAC is calculated on the response.

Host → Reader

1	2	3, 4	5	6,7	8,9
9	COM-ADR	[0xC2][0xC2]	MODE	SourceBNr	CRC16
				LSB MSB	

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	-

SourceBNr:

see chapter 6.5.3.20. [0xC2] [0xB6] MFP_SL3_IncrementTransferEncrypted

6.6. Special Commands for Transponder Communication

6.6.1. [0xBD] ISO14443A Transparent Command

This command sends user transparent commands to ISO14443A transponder.

Host → Reader

1	2	3	4	5-6
n	COM-ADR	[0xBD]	MODE	RSP-LENGTH

Mode 0 +1

7	8	9...n-2	n-1,n
TIMEOUT	CRC-INFO	REQUEST-DATA	CRC16

Mode 2

7	8	9	10...n-2	n-1,n
TIMEOUT	CRC-INFO	REQ-BITS	REQUEST-DATA	CRC16

Mode 3

7	8	9	10
TIMEOUT	CRC-INFO	TX-SETTINGS	RX-SETTINGS

11,12	13...n-2	n-1,n
REQ-BITS	REQUEST-DATA	CRC16

Host ← Reader

1	2	3	4
n	COM-ADR	[0xBD]	STATUS

Mode 0 +1

5...n-2	n-1,n
RESPONSE-DATA	CRC16

Mode 2

5	6...n-2	n-1,n
RSP-BITS	RESPONSE-DATA	CRC16

Mode 3

5,6	7...n-2	n-1,n
RSP-BITS	RESPONSE-DATA	CRC16

MODE:

Options for frame format request.

The following frame types are defined:
- short frames for commands like REQA, WUPA, ...
- standard frames for regular commands;
- bit oriented anticollision frame for anticollision command
- bit oriented frame with variable bitrates

0 = short frame

A short frame is used to initiate communication and consists of, in the following order:

- start of communication;
- 7 data bits transmitted LSB first
- end of communication.
- No parity bit is added.

1 = standard frame

Standard frames are used for data exchange and consist of:

- start of communication;
  - n * (8 data bits + odd parity bit), with n _ 1. The LSB of each byte is transmitted first. Each byte is followed by an odd parity bit. The parity bit P is set such that the number of 1s is odd in (b1 to b8, P);
  - end of communication.

2 = bit oriented frame

Bit oriented Frames are used for anticollision.

3 = bit oriented frame with variable bitrates

Bit oriented frames with variable Tx- and Rx-Bitrates

RSP-LENGTH

If RSP-LENGTH is set to “0” the Reader will send the command but not wait for any response. If RSP-LENGTH is not equal to “0” the Reader will send the command and return the response data of the Transponder without SOF and EOF.

TIMEOUT:

The TIMEOUT value defines the time for receiving the whole Transponder response. If the TIMEOUT it exceeded the command will be abort and the Status “NO TRANSPONDER” is returned.

Bit:	7	6	5	4	3	2	1	0
Function	FWI-VALUE	Timeout-Value						

FWI-VALUE: b0: The Timeout-Value can be adjusted in 1ms steps. (0ms ...127ms)

b1: The Timeout Value is equivalent to the FWI value according to ISO14443-4. (0...14)

With this parameter the Frame waiting time (FWT) according ISO14443-4 could be select by the user

TIMEOUT (FWI)	**approx. Frame waiting time (FWT)**
0	1 ms
1	1 ms
2	2 ms
3	3 ms
4	5 ms
5	10 ms
6	20 ms
7	39 ms
8	78 ms
9	155 ms
10	310 ms
11	619 ms
12	1237 ms
13	2474 ms
14	4948 ms
15..254	- not allowed -

NOTICE:

- ***The value of TIMEOUT must be considered for calculating the HOST-TIMEOUT.***
- ***The value of TIMEOUT must be considered for calculating the TR-RESPONSE-TIME (see CFG1).***

CRC-INFO:

Selects kind and mode of checking the data integrity of the RF-channel.

Bit:	7	6	5	4	3	2	1	0
Function	-	CRC MSB First	-	-	RxCRC En	TXCRC En	-	Parity En

ParityEn

b0: No parity bit is inserted or expected

b1: An odd parity bit is inserted in the transmitted data stream after each byte and expected in the received data stream after each byte (standard ISO14443A)

TxCRCEn

b0: No CRC is inserted/transmitted

b1: A CRC is calculated over the transmitted data and the CRC byte(s) are appended to the data stream

RxCRCEn

b0: No CRC is checked

b1: The last byte(s) of a received frame is/are interpreted as CRC byte/s

CRCMSBFirst

b0: CRC-calculation starts with the LSB bit (standard ISO14443A)

b1: CRC-calculation starts with the MSB bit

TX-SETTINGS:

Selects kind and mode of transmission settings.

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	BAUDRATE	

BAUDRATE

b00: 106 kBaud

b01: 212 kBaud

b10: 424 kBaud

b11: 848 kBaud

RX-SETTINGS:

Selects kind and mode of reception settings.

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	BAUDRATE	

BAUDRATE

b00: 106 kBaud

b01: 212 kBaud

b10: 424 kBaud

b11: 848 kBaud

REQ-BITS:

Number of valid Bits in REQUEST-DATA

REQUEST-DATA:

Complete transponder request without SOF and EOF. If "**TxCRCEn"** is "1" the reader appended a calculated CRC to the date stream. If "**TxCRCEn"** is "0" the application should send the CRC within the **Request-Data**, if the CRC is needed.

RESPONSE-DATA:

Complete transponder response without SOF and EOF. A CRC check is performed inside the reader if "**RxCRCEn"** is "1". However if "**RxCRCEn"** is "0"the transponder CRC is transferred with the response data.

RSP-BITS:

Number of valid Bits in RESPONSE-DATA

NOTICE:

- ***Data is only transferred if STATUS = 0x00, 0x02, 0x83, 0x84, 0x94.***

6.6.2. [0xBE] ISO14443B Transparent Command

This command sends user transparent commands to ISO14443B transponder.

Host → Reader

1	2	3	4	5-6
n	COM-ADR	[0xBE]	MODE	RSP-LENGTH

Mode 0

7	8	9	10...n-2	n-1,n
TIMEOUT	FRAME	CRC-INFO	REQUEST-DATA	CRC16

Mode 1

7	8	9	10
TIMEOUT	FRAME	CRC-INFO	TX-SETTINGS

11	12,13	14...n-2	n-1,n
RX-SETTINGS	REQ-BITS	REQUEST-DATA	CRC16

Host ← Reader

1	2	3	4	5...n-2	n-1,n
n	COM-ADR	[0xBE]	STATUS	RESPONSE-DATA	CRC16

MODE:

Options for frame format request.

The following frame types are defined:
- standard frames for regular commands;
- bit oriented frame

0 = standard frame

Standard frames are used for data exchange and consist of:

- start of communication
- n * (8 data bits). The LSB of each byte is transmitted first.
- end of communication

1 = bit oriented frame with variable bitrates

Bit oriented frames with variable Tx- and Rx-Bitrates

RSP-LENGTH:

If RSP-LENGTH is set to “0” the Reader will send the command but not wait for any re-

sponse. If RSP-LENGTH is not equal to “0” the Reader will send the command and return the response data of the Transponder without SOF and EOF.

TIMEOUT:

The TIMEOUT value defines the time for receiving the whole Transponder response. If the TIMEOUT it exceeded the command will be abort and the Status “NO TRANSPONDER” is returned.

Bit:	7	6	5	4	3	2	1	0
Function	FWI-VALUE	Timeout-Value						

FWI-VALUE: b0: The Timeout-Value can be adjusted in 1ms steps. (0ms ...127ms)

b1: The Timeout Value is equivalent to the FWI value according to ISO14443-4. (0...14)

With this parameter the Frame waiting time (FWT) according ISO14443-4 could be select by the user

TIMEOUT (FWI)	**approx. Frame waiting time (FWT)**
0	1 ms
1	1 ms
2	2 ms
3	3 ms
4	5 ms
5	10 ms
6	20 ms
7	39 ms
8	78 ms
9	155 ms
10	310 ms
11	619 ms
12	1237 ms
13	2474 ms
14	4948 ms
15..254	- not allowed -

NOTICE:

- ***The value of TIMEOUT must be considered for calculating the HOST-TIMEOUT.***
- ***The value of TIMEOUT must be considered for calculating the TR-RESPONSE-TIME (see CFG1).***

FRAME:

Defines the framing for ISO 14443B transponders.

Bit:	7	6	5	4	3	2	1	0
Function	RxSOF Req	RxEOF Req	-	EOFSOF Width	No TxSOF	No TxEOF	TxEGT	

TxEGT:

These bits define the length of the EGT

b00: 0 Bit
b01: 1 Bit
b10: 2 Bit
b11: 3 Bit

NoTxEOF

b0: The frame includes EOF
b1: TxCoder suppresses the EOF

NoTxSOF

b0: The frame includes SOF
b1: TxCoder suppresses the SOF

EOFSOFWidth

b0: Set the SOF to a length of 10 ETU Low and 2 ETU High
Set the EOF to a length of 10 ETU

b1: Set the SOF to a length of 11 ETU Low and 3 ETU High
Set the EOF to a length of 11 ETU

RxEOF Req:

b0: A data stream with and without EOF is accepted
b1: A EOF is required in data stream

RxSOF Req:

b0: A data stream with and without SOF is accepted
b1: A SOF is required in data stream

CRC-INFO:

Selects kind and mode of checking the data integrity of the RF-channel.

Bit:	7	6	5	4	3	2	1	0
Function	-	CRC MSB First	-	-	RxCRC En	TXCRC En	-	Parity En

ParityEn

b0: No parity bit is inserted or expected (standard ISO14443B)

b1: A parity bit is inserted in the transmitted data stream after each byte and expected in the received data stream after each byte

TxCRCEn

b0: No CRC is inserted

b1: A CRC is calculated over the transmitted data and the CRC byte(s) are appended to the data stream

RxCRCEn

b0: No CRC is checked

b1: The last byte(s) of a received frame is/are interpreted as CRC byte/s

CRCMSBFirst

b0: CRC-calculation starts with the LSB bit (standard ISO14443B)

b1: CRC-calculation starts with the MSB bit

TX-SETTINGS:

Selects kind and mode of transmission settings.

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	BAUDRATE	

BAUDRATE

b00: 106 kBaud

b01: 212 kBaud

b10: 424 kBaud

b11: 848 kBaud

RX-SETTINGS:

Selects kind and mode of reception settings.

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	BAUDRATE	

BAUDRATE

b00: 106 kBaud

b01: 212 kBaud

b10: 424 kBaud

b11: 848 kBaud

REQ-BITS:

Number of valid bits in REQUEST-DATA.

REQUEST-DATA:

Complete transponder request without SOF and EOF. If "**TxCRCEn"** is "1" the reader appended a calculated CRC to the date stream. If "**TxCRCEn"** is "0" the application should send the CRC within the **Request-Data**, if the CRC is needed.

NOTICE:

The max. size of REQUEST-DATA is 64 Byte

RESPONSE-DATA:

Complete transponder response without SOF and EOF. A CRC check is performed inside the reader if "**RxCRCEn"** is "1". However if "**RxCRCEn"** is "0" the transponder CRC is transferred with the response data.

NOTICE:

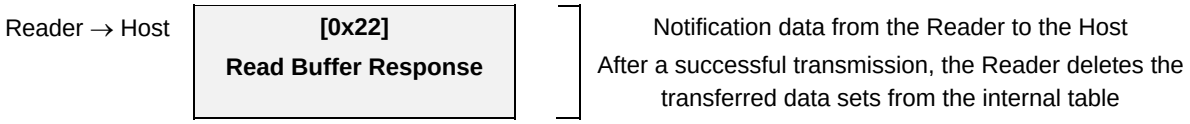
- ***Data is only transferred if STATUS = 0x00, 0x02, 0x83, 0x84, 0x94.***

7. Commands for Notification Mode

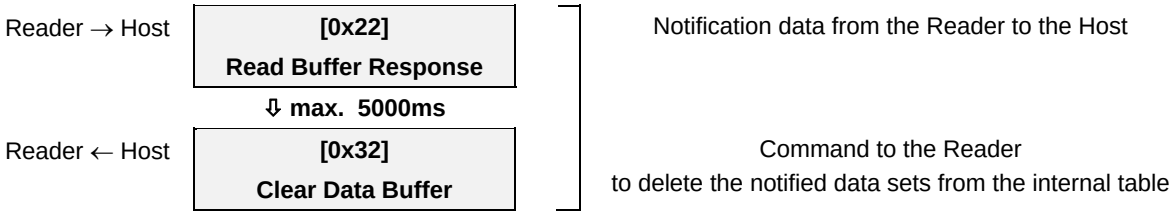
7.1. The Notification Mode Procedure

By using Notification Mode the Reader itself reads data from every Transponder which is inside the antenna field **and** tries to establish a connection to a host to send the queued data asynchronously. Notification mode can be enabled and configured in a wide range via parameters (see 3.2. CFG1: Interface configuration and 3.18. CFG49: Notification Channel). The settings for the Read Mode defines the notification information sent to the host.

Only one command is necessary to send sampled Transponder data sets. The figure below illustrates the Notification Mode procedure:



The reader sends notifications as fast as possible, if the notification trigger is set to continuously or a very short cycle time in time-triggered mode is defined. To prevent a notification overflow at the host application the acknowledgement option can be set. In this case the notification must be acknowledged by the host with an response protocol to synchronize the notification process with the host application. The figure below illustrates this procedure:



The acknowledge command [0x32] Clear Data Buffer must be in the time frame of 5 seconds. If no acknowledge is received the Reader repeats the notification as configured.

Additional information about the capacity of the data buffer can be determined with the 7.3. [0x31] Read Data Buffer Info command.

In Notification Mode the 7.2. [0x22] Read Buffer is not applicable.

As an additional option Keepalive messages can be sent periodically to a host. Keepalive notifications are always never acknowledged.

7.2. [0x22] Read Buffer

The Read Buffer Command has two functions. It can be used to poll data sets from the internal notification data buffer.

In notification mode the reader transmits the data self initialized by using the response of the Read Buffer command.

Host → Reader

1	2	3	4 .. 5	6...7
7	COM-ADR	[0x22]	DATA-SETS	CRC16

Host ← Reader

1	2	3	4	5	(6)	6, 7 (7, 8)
n	COM-ADR	[0x22]	STATUS[1]	TR-DATA1	TR-DATA2	DATA-SETS

(8 or 9 ... n-2)	n-1, n
DATA	CRC16

DATA-SETS:

Number of data sets to be transferred from the data buffer. If the data buffer does not contain the requested number of data sets, the Reader responds with all available data sets and an error will occur.

TR-DATA1:

Indicates the content of the following data.

Bit:	7	6	5	4	3	2	1	0
Function					Byte Order	-	DB	UID

UID

Transponder serial number

DB:

data block

Byte Order

b0:MSB first, b1:LSB first

[1] see ANNEX C: Index of Status Bytes

DATA:

Requested number of data sets from the data buffer. Only selected data will be transferred to the host. See chapter 3.8. CFG11: Read Mode for details. Each data set has the following structure:

Data Type		**DATA**			
Record Length	byte no.	1	2		
		MSB RecLen	LSB RecLen		
Serial Number	byte no.	1	2	3	3+LEN
		TR-TYP	-rfu-	UID-LEN	UID
data blocks	byte no.	1	2	3	4…4+DB-N*DB-SIZE
		DB-N		DB-SIZE	DB

7.3. [0x31] Read Data Buffer Info

The command Read Data Buffer Info reads the actual parameters of the data buffer.

Host → Reader

1	2	3	4...5
5	COM-ADR	[0x31]	CRC16

Host ← Reader

1	2	3	4	5...6	7,8
12	COM-ADR	[0x31]	STATUS[1]	TAB-SIZE	TAB-START

9,10	11,12
TAB-LEN	CRC16

TAB-SIZE:

Maximum count of Transponder data sets in the data buffer.

TAB-START:

Address of first Data Set in the data buffer.

TAB-LEN:

Number of Transponder data sets reserved in the data buffer.

Notes:

- ***Additional information about the data table status is transferred if STATUS = 0x00, 0x84, 0x85, 0x93.***

7.4. [0x32] Clear Data Buffer

The command Clear Data Buffer clears the data sets from the data buffer which were transferred with the 7.2. [0x22] Read Buffer command.

Host → Reader

1	2	3	4...5
5	COM-ADR	[0x32]	CRC16

Host ← Reader

1	2	3	4	5...6
6	COM-ADR	[0x32]	STATUS[2]	CRC16

[1] see ANNEX C: Index of Status Bytes
[2] see ANNEX C: Index of Status Bytes

7.5. [0x33] Initialize Buffer

The command Initialize Buffer clears the data buffer to an initial state. It does not matter if the data sets in the data buffer were read or not.

Host → Reader

1	2	3	4...5
5	COM-ADR	[0x33]	CRC16

Host ← Reader

1	2	3	4	5...6
6	COM-ADR	[0x33]	STATUS[1]	CRC16

8. Access Mode (ID MAX50.10-Ex only)

The following chapters describes the access control functionality of ID MAX50.10-Ex which is based on the common functionality of ID CPR50.10-E described in the previous chapters.

8.1. The Access Data Structure

By using Access Mode ID MAX50.10-Ex reads data from transponders which get inside the antenna field self initiated **and** permits or denies access by verifying the received transponder data with internal data.

Therefor MAX Data is stored inside the Reader in the following structure:

CRC LIST	read/ write
METADATA	read/ write
TIMEZONE TABLE (0...15 Timezone Entries)	read/ write
HOLIDAY TABLE (0...n Holiday Entries)	read/ write
ACCESS TABLE (0...n Access Entries)	read/ write
EVENT TABLE (0...n Event datasets)	read only

8.1.1. CRC List

The CRC List contains CRC data for internal verification. The structure is described with the command 8.3.2. [0x02] EndUpdate.

8.1.2. Metadata

The Metadata contains general information concerning the Timezone Table, Holiday Table and Access Table. The structure is described with the command 8.3.1. [0x01] StartUpdate.

8.1.3. Timezone Table

The Timezone Table is a list of Timezone Entries to permit access during the user defined timezone. The entries are callable by their index starting with 0. The timezone table index 15 is not user definable and permits permanent access.

TIMEZONE TABE INDEX	
0...14	TIMEZONE ENTRY

TIMEZONE TABLE ENTRY:

Byte	0...3	3...5	6	7+8	9+10
Content	STARTDATE OF VALIDITY	ENDDATE OF VALIDITY	DAYS OF VALIDITY	STARTTIME OF VALIDITY	ENDTIME OF VALIDITY

STARTDATE OF VALIDITY:

Byte	0	1	2
Content	STARTDAY OF VALIDITY	STARTMONTH OF VALIDITY	STARTYEAR OF VALIDITY
	1...31	1...12	00...99

ENDDATE OF VALIDITY:

Byte	0	1	2
Content	ENDDAY OF VALIDITY	ENDMONTH OF VALIDITY	ENDYEAR OF VALIDITY
	1...31	1...12	00...99

DAYS OF VALIDITY:

Bit:	7	6	5	4	3	2	1	0
Function	0b0	Sa	Fr	Th	We	Tu	Mo	Su

0b0: Access denied for the specific day

0b1: Access permitted for the specific day

STARTTIME OF VALIDITY:

Byte	0	1
Content	STARTHOUR OF VALIDITY	STARTMINUTE OF VALIDITY
	0...23	0...59

ENDTIME OF VALIDITY:

Byte	0	1
Content	ENDHOUR OF VALIDITY	ENDMINUTE OF VALIDITY
	0...23	0...59

Notes:

- ***A value of 0xFF in any Byte of the Timezone Entry is treaded as don't care for the specific field.***
- ***The paramters STARTDATE OF VALIDITY and ENDDATE OF VALIDITY define the dates for possible access.***
- ***The paramter DAYS OF VALIDITY define the weekdays for possible access.***
- ***The paramter STARTTIME OF VALIDITY and ENDTIME OF VALIDITY define the daily time-span for possible access.***

8.1.4. Holiday Table

A list of Holidays that should have the same access permission as Sundays. The first entry has the index 0.

HOLIDAY TABLE ENTRY:

Byte	0	1	2
Contents	DAY OF HOLIDAY	MONTH OF HOLIDAY	YEAR OF HOLIDAY
	1...31	1...12	00...99

8.1.5. Access Table

A list of Access Entries to permit access for a user defined Identifier Data during the selected Time-zones.

ACCESS ENTRY:

Byte	0...n	2 byte	1 byte
Contents	IDD	Timezones	Reseved

IDD:

Identifier Data (max. 16 byte - LSB first)

TIMEZONES:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Function																

Each bit represents an index into the Timezone Table. To permit access during a specified time the bit must be set. If bit 15 is set permanent access is permitted.

Reserved:

Reserved for future use.

Notes:

- ***All Identifier Data must have the same length defined in the Metadata***
- ***The access table has to be sorted by the Identifier Data starting with the lowest value. Therefor the Identifier Data is interpreted as a numeric data.***
- ***It is possible to use serial number or data blocks as Identifier Data. For Configuration see*** 8.4.2. CFG11: Read Mode – Read Data 1***.***

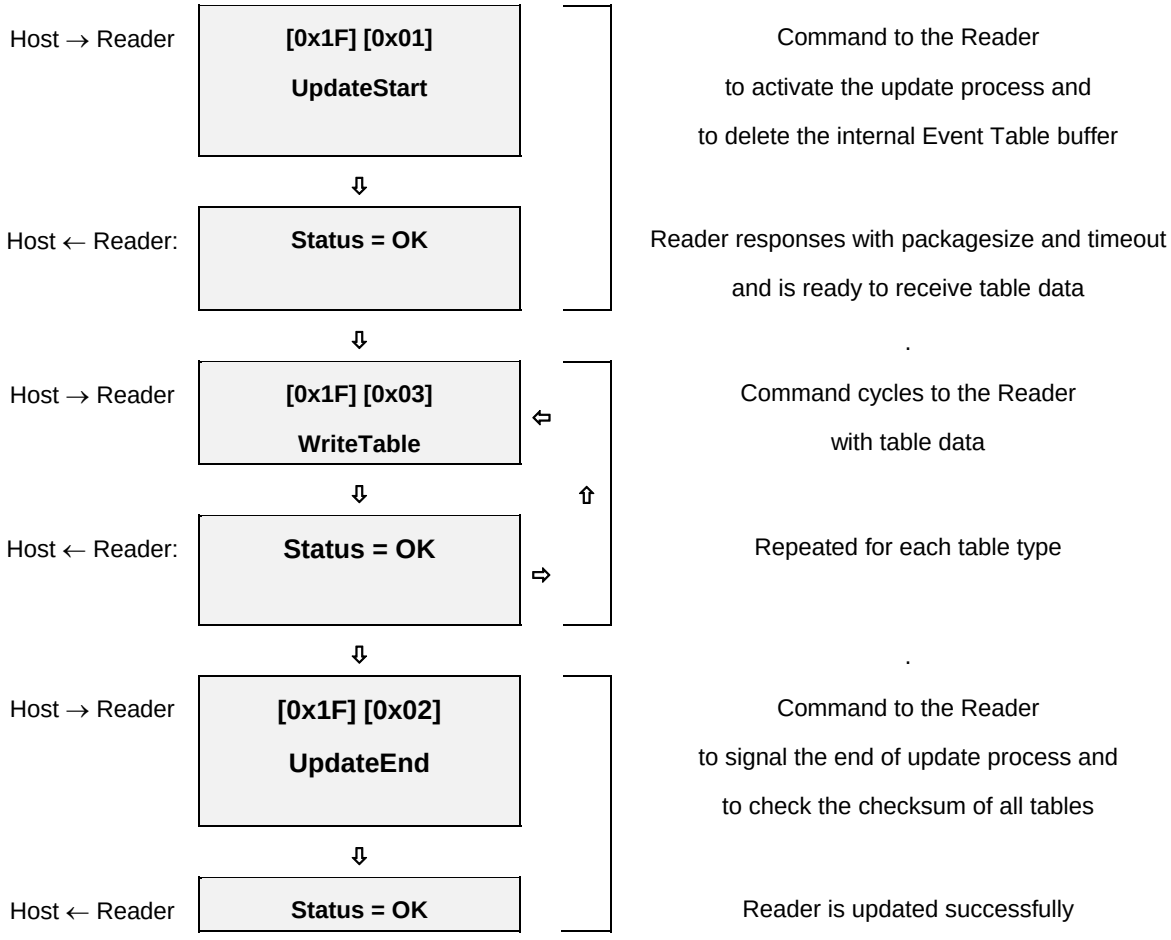
8.1.6. Event Table

The Event Table contains the event datasets. The structure is described with the command 8.3.4. [0x05] Read Table.

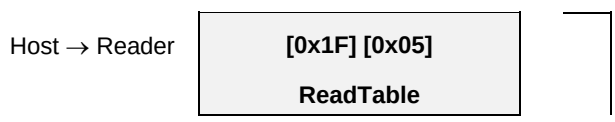
8.2. The Access Mode Procedure

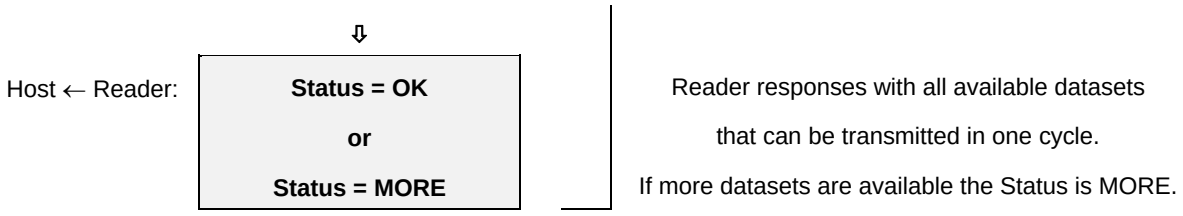
To Exchange Access data with the Reader the MAX Data Exchange Protocol is used. This Protocol is defined for transfer of block oriented data from host to a device or device to host.

The main task of the protocol is the update process of table data.



A second task is the read of MAX Data .





8.3. [0x01] MAX Data Exchange Protocol

This Protocol allows to exchange MAX Data with the Reader.

Host → Reader:

1	2 + 3	4	5	6	…
0x02	LENGTH	COM-ADR	[0x1F]	CMD	

…	7	8	9...n	2 byte
	MODE	TABLE-ID	DATA	CRC16

Host ← Reader

1	2+3	4	5	6	7...n	2 byte
0x02	LENGTH	COM-ADR	[0x1F]	STATUS	DATA	CRC16

CMD:

The CMD controls the command. The following commands are defined:

CMD	Value	Note
UpdateStart	0x01	
UpdateEnd	0x02	
WriteTable	0x03	
ReadTable	0x05	

MODE:

The MODE controls the transfer. The following flags are defined:

7	6	5	4	3	2	1	0
MORE	0	0	0	0	0	0	0

MORE:

The MORE flag indicates a following Data Exchange Protocol. The flag must be zero in the last protocol to indicate the end of transmission.

TABLE-ID:

Identifier of table.

Table	TableID
CRC List	0x00
Metadata	0x01
Timezone Table	0x02
Holiday Table	0x03
Access Table	0x04
Event Table	0x05

DATA:

Data to transfer as specified in the following chapters.

8.3.1. [0x01] StartUpdate

This command activates the update table process and must be therefore the first command in the command sequence. With this command the internal Event Table is deleted if the responded Status from the Reader is OK.

Host → Reader:

1	2 + 3	4	5	6
0x02	LENGTH	COM-ADR	[0x1F]	0x01

…

…

7	8	9...n	2 byte
0x00	0x01	METADATA	CRC16

Host ← Reader

1	2+3	4	5	6	7...	2 byte
0x02	LENGTH	COM-ADR	[0x1F]	STATUS	RSP-DATA	CRC16

METADATA:

General information concerning the a Timezone Table, Holiday Table and an Access Table:

Byte	0+1	2	3	4+5	6	7
Content	TABLE-VERSION	TIMEZONE-ENTRIES	HOLIDAY-ENTRIES	ACCESS-ENTRIES	IDD-LENGTH	IDD-FORMAT
		0...15	0...255	0...65535	1...16	

Byte	8...15
Content	reserved

TABLE-VERSION:

Defines the Table-Version. Only Version 0x00 defined.

TIMEZONE-ENTRIES:

Defines the number of valid Timezone Entries inside the Timezone Table. The maximum value is 15.

HOLIDAY-ENTRIES:

Defines the number of valid Holiday Entries inside the Holiday Table. The maximum value is 255.

ACCESS-ENTRIES:

Defines the number of Access Entries inside the Access Table. The maximum value is 65535.

IDD-LENGTH:

Defines the length of the Identifier Data inside the Access Table.

IDD-FORMAT:

Defines the format for the PC.

RSP-DATA:

Response Data from the Reader:

Byte	0+1	2+3
Content	PACKET-LEN	MAX TIMEOUT

PACKET-LEN:

Maximum Packet Length in Byte.

MAX TIMEOUT:

Maximum Timeout in millisecond.

8.3.2. [0x02] EndUpdate

This command signals the end of the update table process and must be therefore the last command in the command sequence.

The protocol transfers the CRC of each table and the Reader compares them with the internal calculated CRC. If any error in a table is detected the dedicated flag in the response byte ERROR-FLAGS is set.

Host → Reader:

1	2 + 3	4	5	6
0x02	LENGTH	COM-ADR	[0x1F]	0x02

…

…

7	8	9...n	2 byte
0x00	0x00	CRC-LIST	CRC16

Host ← Reader

1	2+3	4	5	6	7	2 byte
0x02	LENGTH	COM-ADR	[0x1F]	STATUS	CRC-FLAGS	CRC16

CRC-LIST:

Byte	0+1	2+3	4+5	6+7
Content	CRC of METADATA	CRC of TIMEZONE-TABLE	CRC of HOLIDAY-TABLE	CRC of ACCESS-TABLE

CRC-FLAGS:

Each FLAG represents a Table Error. The bit number correlates with the Table-ID.

Bit	7	6	5	4	3	2	1	0
	0	0	0	ACCESS	HOLIDAY	TIMEZONE	METADATA	0

8.3.3. [0x03] Write Table

This command transfers in one or multiple steps table data to the Reader. Multiple steps must be signaled with the MORE flag in the MODE byte. The last protocol must not have set the MORE flag.

Host → Reader:

1	2 + 3	4	5	6	…
0x02	LENGTH	COM-ADR	[0x1F]	0x03	

…	7	8	9...n	2 byte
	MODE	TABLE-ID	DATA	CRC16

Host ← Reader

1	2+3	4	5	6	2 byte
0x02	LENGTH	COM-ADR	[0x1F]	STATUS	CRC16

DATA:

Byte	0 + 1	2	3...n
Content	DATA-SETS	DATA-SIZE	TABLE RECORD
			repeated DATA-SETS times

DATA-SETS:

Number of records in the protocol.

DATA-SIZE:

Number of bytes in each record.

TABLE-RECORD:

Data structure according the table record specification of each table.

Notes:

- ***Only Table-ID 0x02, 0x03 or 0x04 are possible for Write Table.***

8.3.4. [0x05] Read Table

This command reads in one or multiple steps table data from the Reader. If multiple steps are available the Reader signals this with the MORE status.

Host → Reader:

1	2 + 3	4	5	6
0x02	LENGTH	COM-ADR	[0x1F]	0x05

…

…

7	8	9 + 10	2 byte
0x00	TABLE-ID	REQ-INFO	CRC16

Host ← Reader

1	2+3	4	5	6	7...	
0x02	LENGTH	COM-ADR	[0x1F]	STATUS	DATA	CRC16

REQ-INFO:

Contains information of requested data depending on the TABLE-ID:

Table	Table-ID	REQ-INFO
CRC List	0x00	0x00 0x00
Metadata	0x01	0x00 0x00
Timezone Table	0x02	TABLE-IDX
Holiday Table	0x03	TABLE-IDX
Access Table	0x04	TABLE-IDX
Event Table	0x05	DATA-SETS

TABLE-IDX:

Index of the first requested table record.

To read a complete table the TABLE-IDX is set to the last value of TABLE-IDX plus the responded DATA-SETS value of the last response. This procedure is repeated as long as the Reader response the status 0x94 (MORE).

If TABLE-IDX is out of range the Reader respond the status 0x11 (PARAMETER RANGE ERROR).

DATA-SETS:

Number of datasets to be transferred from the Event Table. If the Event Table does not contain any dataset the Reader responds with status 0x92 (NO VALID DATA).

If the Event Table does not contain the requested number of datasets, the Reader responds with all available datasets. If more datasets are available, the Reader responds with status 0x94 (MORE). The read datasets of the Event Table are deleted.

DATA:

TABLE-ID = {0x00, 0x01, 0x02, 0x03, 0x04}

Byte	0 + 1	2	3...n
Content	DATA-SETS	DATA-SIZE	TABLE RECORD
			repeated DATA-SETS times

DATA-SETS:

Number of records in the protocol.

DATA-SIZE:

Number of bytes in each record.

TABLE-RECORD:

Data structure according the table Record specification of each table.

DATA:

TABLE-ID = {0x05}

Byte	0	1 + 2	3...n
Content	DATA-LAYOUT	DATA-SETS	EVENT RECORD
			repeated DATA-SETS times

DATA-LAYOUT:

Defines the layout of each event record. Each flag signals the inclusion of the data section selected by the parameter EVENT-OPT in 8.4.3. CFG14: Access Control.

Bit:	7	6	5	4	3	2	1	0
Function	0	0	0	0	INPUT DATA	EVENT STATUS	TIME-STAMP	IDD SET

IDD SET: Identifier Data Set

TIMESTAMP: internal system date and time

EVENT STATUS: Access action and additional error code

INPUT DATA: Input status

DATA-SETS:

Number of records in the protocol.

EVENT RECORD:

Event record with different data sections:

Data Section		**DATA**	
Record Length	byte no.	1	2
		MSB RecLen	LSB RecLen
EVENT-ID	byte no.	1	
		EVENT-ID	
IDD SET	byte no.	1	2..2+IDD-LEN
		IDD-LEN	IDD
TIMESTAMP	byte no.	1...3	4...6
		DATE	TIME
EVENT STATUS	byte no.	1	2...3
		ACTION	ERROR
INPUT DATA	byte no.	1	
		INPUT	

EVENT-ID:

Number of Event type:

Event Type	Event-ID
Access event	0x01
Input event	0x02

IDD-LENGTH:

Length of the Identifier Data in byte (max. 16 byte)

IDD:

Identifier Data (max. 16 byte)

DATE:

Byte	0	1	3
Contents	DAY	MONTH	YEAR
	1...31	1...12	0...99

TIME:

Byte	0	1	2
Contents	HOUR	MINUTE	SECOND
	0...23	0...59	0...59

ACTION:

Bit	7	6	5	4	3	2	1	0

Function	0	0	0	0	0	0	0	Access

Access:

0b0: Denied access
0b1: Permitted access

ERROR:

Each FLAG represents a an Error.

Bit	15	14	13	12	11	10	9	8
Function	OVERFLOW	0	0	0	0	0	0	0

Bit	7	6	5	4	3	2	1	0
Function	TABLE UPDATE BUSY	READER CONFIG	0	ACCESS	HOLIDAY	TIMEZONE	METADATA	RTC

INPUT:

Bit	7	6	5	4	3	2	1	0
Function	0	0	0	0	IN3	IN3	IN2	IN1

8.3.5. [0x06] Notify Event

This command transfers Event datasets to a host to send. This mode must be enabled in the 8.4.3. CFG14: Access Control configuration block by the parameter EVENT-NOTI and configured in 3.18. CFG49: Notification Channel configuration block.

Reader → Host:

1	2 + 3	4	5	6
0x02	LENGTH	COM-ADR	[0x1F]	0x06

…

…

7	8	9...n	2 byte
0x00	0x00	EVENT-DATA	CRC16

EVENT-DATA:

Byte	0	1 + 2	3...n
Content	DATA-LAYOUT	DATA-SETS	EVENT RECORD
			repeated DATA-SETS times

For detailed information see the response from the reader on the command 8.3.4. [0x05] Read Table for TABLE-ID 0x05 (Event table).

8.4. Additional Configuration Parameters (CFG)

This chapter describes additional configuration parameters for the Access Mode.

8.4.1. CFG1: Interface

The parameters of the CFG1 configuration block contain the data communication settings.

Byte	0	1	2	3	4	5	6
Contents	0x00	0x00	0x00	0x00	0x00	0x00	TR-RESPONSE-TIME
Default	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Byte	7	8	9	10	11	12	13
Contents	TR-RESPONSE-TIME	0x00	0x00	0x00	0x00	INTERFACE	READER - MODE
Default	0x0A *1 sec.*	0x00	0x00	0x00	0x00	0x80	0x00

Reader Mode:

By means of this byte, the Reader mode can be defined.

Bit:	7	6	5	4	3	2	1	0
Function:	0	NTF-E	ACM-E	0	0	0	0	0

NTF-E:

By setting of this bit the Notification-Mode can be enabled

b0: Notification Mode disabled
b1: Notification Mode enabled

ACM-E:

By setting of this bit the Access Mode can be enabled

b0: Access Mode disabled
b1: Access Mode enabled

The following table lists the bit combinations for the reader modes:

Reader Mode	Bit							
	7	6	5	4	3	2	1	0
Host-Mode	0	0	0	0	0	0	0	0
Notification Mode	0	**1**	0	0	0	0	0	0
Access Mode	0	0	**1**	0	0	0	0	0

Notes:

- ***It is not possible to activate Notification Mode and Access Mode.***

8.4.2. CFG11: Read Mode – Read Data 1

The parameters of the CFG11 configuration block contain Access Mode settings.

Byte	0	1	2	3	4	5	6
Contents	TR-DATA-1	0x00	0x00	0x00	DB-ADR [1]		0x00
Default	0x01	0x00	0x00	0x00	0x0000		0x00

Byte	7	8	9	10	11	12	13
Contents	0x00	DB-N [1]		0x00	D-OFFSET	D-LENGTH	
Default	0x00	0x0001		0x00	0x00	0x04	

TR-DATA-1:

Selects the data types for read operation.

Bit:	7	6	5	4	3	2	1	0
Function	0	0	0	0	Byte Order	0	DB	SNR

SNR:

b0: no Serial Number for identification
b1: use Serial Number for identification

DB:

b0: no data block for identification
b1: use data block for identification

Byte Order

By this bit the byte order of the data block can be swapped.
b0: MSB first
b1: LSB first

Notes:

- ***If SNR and DB are set only the Serial Number is used for identification.***

DB-ADR:

0x00...0xFF
Address of first data block. Range: 0x00...0xFF.

DB-N:

Number of data blocks. Range: 0x01...0x20. **D-OFFSET:**

[1] A reasonableness check is performed by writing this parameter to the Reader. If an error occurs the Reader answers with STATUS = [0x11].

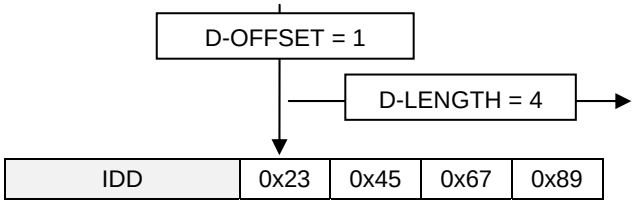
This parameter defines the first byte in the raw data (defined by DB-ADR and DB-N), which will is used for identification in Access Mode.

D-LENGTH:

D-LENGTH defines the length of data which is used for identification in Access Mode.

Example:
data block

Byte	0	1	2	3	4	5	6	7
Data	0x01	0x23	0x45	0x67	0x89	0xAB	0xCD	0xEF



Notes:

- ***If data blocks of Mifare Classic are read the configuration of 3.11. CFG15: Read Mode – Read Data 2 configuration block is also used.***

8.4.3. CFG14: Access Control

The parameters of the CFG14 configuration block contain Access Control settings.

Byte	0	1	2	3	4	5	6
Contents	ACCESS-MODE	EVENT-NOTI	EVENT-OPT	EVENT-LAYOUT	0x00	0x00	0x00
Default	0x00	0x00	0x01	0x0F	0x00	0x00	0x00

Byte	7	8	9	10	11	12	13
Contents	ACCESS-STATE	ACCESS-ACTIVATION TIME LED	ACCESS-ACTIVATION TIME BUZZER	ACCESS-ACTIVATION TIME RELAY	ACCESS-DENIED-STATE	ACCESS-DENIED-ACTIVATION TIME LED	ACCESS-DENIED-ACTIVATION TIME BUZZER
Default	0x41	0x0A 1 sec.	0x0A 1 sec.	0x14 2 sec.	0x50	0x0A 1 sec.	0x0A 1 sec.

ACCESS-MODE:

Configuration of event notifications:

Bit:	7	6	5	4	3	2	1	0

[1] A plausibility check is performed by writing this parameter to the Reader. If an error occurs the Reader

Function	0	0	0	0	0	0	0	TIME-ERROR

TIME-ERROR:

By setting of this bit access is never permitted if an error occures with the realtime clock, the holiday table or the timezone table inside the Reader.

b0: Access is permitted if the identifier data is found is the access table but an error occures with the realtime clock, the holiday table or the timezone table.

b1: Access is denied if the idenfierter data found is the access table that has not permanent access and an error occured with the realtime clock, the holiday table or the timezone table.

Note:

- ***The error source can be read out with the command 8.6.2. [0x6E] Reader Diagnostic Mode = 0x06 (MAX Status).***
- ***If the erorr occured with the realtime clock the command 8.5.1. [0x87] Set System Time and Date has to be used to set the realtime clock to the correct time and date.***
- ***If an error occured the holiday table or the timezone table the corresponding table has to be updated (see 8.2. The Access Mode Procedure).***

EVENT-NOTI:

Configuration of event notifications:

Bit:	7	6	5	4	3	2	1	0
Function	0	0	0	0	0	0	0	EN

EN:

By setting of this bit the notification of events defined in EVENT-OPT can be enabled or disabled.

b0: Event notifications are disabled. Events are internally recorded and can be read out by using the command 8.3.4. [0x05] Read Table.

b1: Event notifications are enabled and the reader tries to establish a host connection immediately otherwise they are recorded internally. The host connection is configured in 3.18. CFG49: Notification Channel configuration block.

EVENT-OPT:

Different for events can be enabled:

Bit:	7	6	5	4	3	2	1	0
Function	0	0	0	0	0	0	0	ACCESS-EVENT

ACCESS-EVENT:

By setting of this bit access events (permissions and denials) can be activated

b0: access events disabled
b1: access events enabled

Notes:

- ***Input Events can be enabled by the parameter INPUT-EVENT in 3.3. CFG2: Inputs / Outputs general configuration block.***

EVENT-LAYOUT:

By means of this parameter the structure of an event record can be configured.

Layout for events:

Bit:	7	6	5	4	3	2	1	0
Function	0	0	0	0	INPUT DATA	EVENT STATUS	TIME-STAMP	IDD SET

IDD SET:

Identifier Data Set

b0: Identifier Data Set present in events
b1: Identifier Data Set in events

TIME-STAMP:

Identifier Data Set

b0: Timestamp present in events
b1: Timestamp Data Set in events

EVENT STATUS:

Identifier Data Set

b0: Event Status present in events
b1: Event Status in events

INPUT DATA:

Identifier Data Set

b0: Input Data present in events
b1: Input Data in events

ACCESS-STATE:

This parameter defines the behavior of the signal transmitter if access is permitted by the Reader in Access Mode.

Bit:	7	6	5	4	3	2	1	0
Function:	BUZZER		RED		BLUE		GRN	

GRN / BLUE / RED / BUZZER

The bit combination defines the behavior of the signal transmitter

b00: OFF
b01: ON
b10: FLASHING SLOW
b11: FLASHING FAST

ACCESS-ACTIVATION-TIME LED:

This parameter defines the duration in 100 ms increments, the Reader signalize permitted access on the LEDs defined by the parameter ACCESS-STATE.

0 ... 255 x 100 ms ⇒ 0 ... 25,5 sec

ACCESS-ACTIVATION-TIME BUZZER:

This parameter defines the duration in 100 ms increments, the Reader signalize permitted access on the buzzer by the parameter ACCESS-STATE.

ACCESS-ACTIVATION-TIME RELAY:

This parameter defines the duration in 100 ms increments, the Reader signalize permitted access on the relay.

ACCESS-DENIED-STATE:

This parameter defines the behavior of the signal transmitter if access is denied by the Reader in Access Mode.

Bit:	7	6	5	4	3	2	1	0
Function:	BUZZER		RED		BLUE		GRN	

GRN / BLUE / RED / BUZZER

The bit combination defines the behavior of the signal transmitter

b00: OFF
b01: ON
b10: FLASHING SLOW
b11: FLASHING FAST

ACCESS- DENIED-ACTIVATION-TIME LED:

This parameter defines the duration in 100 ms increments, the Reader signalize denied access on the LEDs by the parameter ACCESS-DENIED-STATE.

ACCESS- DENIED-ACTIVATION-TIME BUZZER:

This parameter defines the duration in 100 ms increments, the Reader signalize denied access on the buzzer by the parameter ACCESS-DENIED-STATE.

Notes:

- ***The states ONLINE-STATE and OFFLINE-STATE configured in 3.3. CFG2: Inputs / Outputs general are still available.***
- ***The state TAGDETECT-STATE is replaced by the states* ACCESS-STATE and ACCESS-DENIED-STATE.**
- ***In Access Mode the relay can only be activated by the parameter* ACCESS-ACTIVATION-TIME RELAY.**

8.5. Additional Commands for Reader Configuration

Via the command for the Reader configuration, the Reader may be adapted to individual conditions of application within wide limits.

8.5.1. [0x87] Set System Time and Date

The Set System Time and Date command sets the internal RTC.

Host → Reader

1	2	3	4...8	8..12	12...13
13	COM-ADR	[0x87]	DATE	TIMER	CRC16

Host ← Reader

1	2	3	4	5...6
6	COM-ADR	[0x87]	STATUS	CRC16

DATE:

Byte	4	5
TIME	century	year
	20	0...99

6	7	8
month	day	time zone
1...12	1...31	0

TIMER:

Byte	9	10	11...12
TIME	h	min	ms
	0...23	0...59	0...59999

Notes:

- ***The weekday is calculated automatically inside the Reader.***

8.5.2. [0x88] Get System Time and Date

The Get System Time and Date command reads the internal RTC.

Host → Reader

1	2	3	4...5
5	COM-ADR	[0x88]	CRC16

Host ← Reader

1	2	3	4	5..9	9...12	13...14
14	COM-ADR	[0x88]	STATUS	DATE	TIMER	CRC16

Notes:

- ***If clock integrity is not guaranteed the Status Hardware Warning [0xF1] is sent with the Time and Date.***

8.6. Additional Commands for Reader Control

8.6.1. [0x66] Get Reader Info Mode = 0x04 (Additional firmware functionality)

This protocol allows you to determine Additional firmware functionality.

Host → Reader

1	2	3	4	5...6
6	COM-ADR	[0x66]	MODE	CRC16

Host ← Reader

1	2	3	4	5	6
17	COM-ADR	[0x66]	STATUS[1]	TEMPLATE	FNC_LST0

7...8	8...10	1...12	13...14	15	16...17
EVENT_BUF_SIZE	EVENT_BUF_LEN	-	-	-	CRC16

MODE:

0x04: Additional firmware functionality. (to be done)

TEMPLATE:

Indicates how to interpret the following content depending on the reader type

0x01: ID CPR-Family

FNC_LST0:

Each bit represents a firmware functionality.

Bit:	7	6	5	4	3	2	1	0
Function	MAX	0	0	0	0	0	0	0

MAX:

Indicates the support of MAX (Access Control)

b0: MAX is not supported

b1: MAX is supported

8.6.2. [0x6E] Reader Diagnostic Mode = 0x06 (MAX Status)

The command Reader Diagnostic displays several hardware diagnostics on the Reader.

Host → Reader

1	2	3	4	5...6

[1] see: ANNEX C: Index of Status Bytes

6	COM-ADR	[0x6E]	MODE	CRC16

Host ← Reader

1	2	3	4	5...n-2	n-1...n
n	COM-ADR	[0x6E]	STATUS	DATA	CRC16

DATA:

Response for MAX Status (MODE = 0x06)

5..6	7..8	9..10
ERROR_FLAGS	EVENT_TAB_SIZE	EVENT_TAB_LEN

ERROR_FLAGS:

Bit	15	14	13	12	11	10	9	8
Function	0	0	0	0	0	0	0	0

Bit	7	6	5	4	3	2	1	0
Function	UPDATE BUSY	READER CONFIG	0	ACCESS	HOLIDAY	TIMEZONE	METADATA	RTC

EVENT_TAB_SIZE

Maximum count of Event data sets in the event table

EVENT_TAB_LEN

Number of Event data sets reserved in the event table

9. Supported ISO Host commands

The command codes listed in the following chapters gives an overview of the various Transponder commands and operations that are available for each Transponder type.

NOTICE:

Detailed data sheets and information's about the functions and capabilities of each Transponder type are not supplied by FEIG ELECTRONIC. For detailed information's we refer to the original data sheets of the chip manufacturer.

9.1. ISO14443-A & -B Part 4 compatible Transponder

9.1.1. Common Processorcards

Memory organization:
Depends on the type and implementation of the used Transponder.

Command Code	Function	Mode			Comment
		non-addressed	addressed	selected	
[0xB0] [0x01]	Inventory	-	-	-	
[0xB0] [0x25]	Select	-	√	-	
[0xB2] [0xBE]	ISO14443-4 T=CL	-	-	√	
[0xB2] [0xBF]	ISO14443-4 Container	-	-	√	
[0xB2] [0x2B]	ISO14443-4 Transponder-Info	-	-	√	

9.1.2. NXP - mifare DESFire

mifare DESFire (MF3 IC D40)

mifare DESFire EV1 (2k: MF3 IC D21, 4k: MF3 IC D41, 8k: MF3 IC D81)

Command Code	Function	Mode			Comment
		non-addressed	addressed	selected	
[0xB0] [0x01]	Inventory	-	-	-	
[0xB0] [0x25]	Select	-	√	-	
[0xB2] [0xBE]	ISO14443-4 T=CL	-	-	√	
[0xB2] [0xBF]	ISO14443-4 Container	-	-	√	
[0xB2] [0x2B]	ISO14443-4 Transponder-Info	-	-	√	
[0xC1] [0xFA]	DESFire Authent	-	-	√	
[0xC1] [0xBD]	DESFire Read Standard Data	-	-	√	
[0xC1] [0x3B]	DESFire Write Standard Data	-	-	√	
[0xC1] [0x6C]	DESFire Get Value	-	-	√	
[0xC1] [0x0C]	DESFire Credit	-	-	√	
[0xC1] [0xDC]	DESFire Debit	-	-	√	
[0xC1] [0x1C]	DESFire Limited Credit	-	-	√	
[0xC1] [0x3B]	DESFire Write Records	-	-	√	
[0xC1] [0xBB]	DESFire Read Records	-	-	√	
[0xC1] [0xEB]	DESFire Clear Record File	-	-	√	
[0xC1] [0x5F]	DESFire Change File Settings	-	-	√	
[0xC1] [0x54]	DESFire Change Key Settings	-	-	√	
[0xC1] [0xC4]	DESFire Change Key	-	-	√	

9.2. ISO14443-A Part 3 compatible Transponder

9.2.1. NXP - Mifare classic

Memory organization:

mifare mini (MF1 S20)

Number of blocks	20	user area: 14
Block size	16 byte	

mifare classic 1k (MF1 S50)

Number of blocks	64	user area: 47
Block size	16 byte	

mifare classic 4k (MF1 S70)

Number of blocks	256	user area: 215
Block size	16 byte	

Command Code	Function	Mode			Comment
		non-addressed	addressed	selected	
[0xB0] [0x01]	Inventory	-	-	-	
[0xB0] [0x23]	Read Multiple Blocks*	-	-	√	Security Status is always 0x00
[0xB0] [0x24]	Write Multiple Blocks*	-	-	√	
[0xB0] [0x25]	Select	-	√	-	
[0xB0] [0xC0]	Halt	-	-	√	
[0xB2] [0x30]	Mifare value Commands*			√	
[0xB2] [0xB0]	Authent Mifare*	-	-	√	

* ***The Reader uses a linear addressing mode. To calculate the Data-Block-Address (DB_ADR) the expected mifare Sector and the mifare Block in the sector must be known.***

MF1 IC S20

Sector 0 ... 4: DB_ADR = MIFARE_SECTOR * 4 + MIFARE_BLOCK

MF1 IC S50

Sector 0 ... 15: DB_ADR = MIFARE_SECTOR * 4 + MIFARE_BLOCK

MF1 IC S70

Sector 0 ... 31: DB_ADR = MIFARE_SECTOR * 4 + MIFARE_BLOCK

Sector 32 ... 39: DB_ADR = (MIFARE_SECTOR - 32) * 16 + MIFARE_BLOCK + 128

9.2.2. NXP - Mifare UltraLight

Memory organization (MF0U10 / MF0U11): 16 x 4 byte = 64 byte

Number of blocks	16	user area: 4...15; (2...3)
Block size	4 byte	

Command Code	Function	Mode			Comment
		non-addressed	addressed	selected	
[0xB0] [0x01]	Inventory	-	-	-	
[0xB0] [0x23]	Read Multiple Blocks	-	-	√	Security Status is always 0x00
[0xB0] [0x24]	Write Multiple Blocks	-	-	√	
[0xB0] [0x25]	Select	-	√	-	
[0xB0] [0xC0]	Halt	-	-	√	

9.2.3. NXP - mifare Plus

Memory organization:

mifare Plus 2k (MF1SPLUS60, MF1PLUS60)

Number of blocks	64	user area: 47
Block size	16 byte	

mifare Plus 4k (MF1SPLUS80, MF1PLUS80)

Number of blocks	256	user area: 215
Block size	16 byte	

- **mifare Plus (MF1SPLUS60, MF1SPLUS80)**

Command Code	Function	ISO14443 Level	Mode		Comment
			addressed	selected	
[0xB0] [0x01]	Inventory	-	-	-	
[0xB0] [0x25]	Select	-	√	-	
[0xB2] [0xBE]	ISO14443-4 T=CL	-4	-	√	
[0xB2] [0xBF]	ISO14443-4 Container	-4	-	√	
[0xB2] [0x2B]	ISO14443-4 Transponder-Info	-4	-	√	
[0xC2] [0x77]	MFP_SL1_Authent	-3	-	√	
[0xC2] [0x70]	MFP_FirstAuthentication	-4	-	√	
[0xC2] [0x76]	MFP_FollowingAuthentication	-4	-	√	
[0xC2] [0x78]	MFP_SL3_ResetAuthnetication	-4	-	√	
[0xC2] [0x33]	MFP_SL3_ReadPlainMaced	-4	-	√	
[0xC2] [0xA1]	MFP_SL3_WriteEncryptedMaced	-4	-	√	AES Keys only
[0xC2] [0xA3]	MFP_SL3_WritePlainMaced	-4	-	√	

- **mifare Plus (MF1PLUS60, MF1PLUS80)**

Command Code	Function	ISO14443 Level	Mode		Comment
			addressed	selected	
[0xB0] [0x01]	Inventory	-	-	-	
[0xB0] [0x25]	Select	-	√	-	
[0xB2] [0xBE]	ISO14443-4 T=CL	-4	-	√	
[0xB2] [0xBF]	ISO14443-4 Container	-4	-	√	
[0xB2] [0x2B]	ISO14443-4 Transponder-Info	-4	-	√	
[0xC2] [0x77]	MFP_SL1_Authent	-3	-	√	
[0xC2] [0x70]	MFP_FirstAuthentication	-4	-	√	
[0xC2] [0x76]	MFP_FollowingAuthentication	-4	-	√	
[0xC2] [0x78]	MFP_SL3_ResetAuthnetication	-4	-	√	
[0xC2] [0x30]	MFP_SL3_ReadEncrypted	-4	-	√	
[0xC2] [0x31]	MFP_SL3_ReadEncryptedMaced	-4	-	√	
[0xC2] [0x32]	MFP_SL3_ReadPlain	-4	-	√	
[0xC2] [0x33]	MFP_SL3_ReadPlainMaced	-4	-	√	
[0xC2] [0x34]	MFP_SL3_ReadEncryptedUnmaced	-4	-	√	

Command	Function	ISO14443	Mode		Comment
[0xC2] [0x35]	MFP_SL3_ReadEncryptedUnmacedRespMaced	-4	-	√	
[0xC2] [0x36]	MFP_SL3_ReadPlainUnmaced	-4	-	√	
[0xC2] [0x37]	MFP_SL3_ReadPlainUnmacedRespMaced	-4	-	√	
[0xC2] [0xA0]	MFP_SL3_WriteEncrypted	-4	-	√	
[0xC2] [0xA1]	MFP_SL3_WriteEncryptedMaced	-4	-	√	
[0xC2] [0xA2]	MFP_SL3_WritePlain	-4	-	√	
[0xC2] [0xA3]	MFP_SL3_WritePlainMaced	-4	-	√	
[0xC2] [0xB0]	MFP_SL3_IncrementEnrypted	-4	-	√	
[0xC2] [0xB1]	MFP_SL3_IncrementEnryptedMaced	-4	-	√	
[0xC2] [0xB2]	MFP_SL3_DecrementEnrypted	-4	-	√	
[0xC2] [0xB3]	MFP_SL3_DecrementEnryptedMaced	-4	-	√	
[0xC2] [0xB4]	MFP_SL3_Transfer	-4	-	√	
[0xC2] [0xB5]	MFP_SL3_TransferMaced	-4	-	√	
[0xC2] [0xB6]	MFP_SL3_IncrementTransferEncrypted	-4	-	√	
[0xC2] [0xB7]	MFP_SL3_IncrementTransferEncryptedMaced	-4	-	√	
[0xC2] [0xB8]	MFP_SL3_DecrementTransferEncrypted	-4	-	√	
[0xC2] [0xB9]	MFP_SL3_DecrementTransferEncryptedMaced	-4	-	√	
[0xC2] [0xC1]	MFP_SL3_Restore	-4	-	√	
[0xC2] [0xC2]	MFP_SL3_RestoreMaced	-4	-	√	

* ***The Reader uses a linear addressing mode in SL1 and SL2. To calculate the Data-Block-Address (DB_ADR) the expected mifare Sector and the mifare Block in the sector must be known.***

MF1SPLUS60, MF1PLUS60

Sector 0 ... 31: DB_ADR = MIFARE_SECTOR * 4 + MIFARE_BLOCK

MF1SPLUS80, MF1PLUS80

Sector 0 ... 31: DB_ADR = MIFARE_SECTOR * 4 + MIFARE_BLOCK

Sector 32 ... 39: DB_ADR = (MIFARE_SECTOR - 32) * 16 + MIFARE_BLOCK + 128

If you want to find the right AES Key to the chosen Data-Block you have to use the following calculation:

AES Sector Keys for sector 0 to 39 (40 00h to 40 4Fh)

Key A = sector number multiplied by 2

Key B = sector number multiplied by 2 +1

E.g. Key A for sector 2 has number: 40 04

ANNEX

ANNEX A: Codes of Transponder Types

TYPE_NO	Transponder Type
0x00	NXP I-Code1
0x01	-
0x03	Transponder according ISO15693
0x04	Transponder according ISO14443A
0x05	Transponder according ISO14443B
0x06	NXP I-Code EPC
0x08	Innovision Jewel
0x0A	STMicroelectronics SR176
0x0B	STMicroelectronics SRIxx (SRI512, SRIX512, SRI4K, SRIX4K)
0x0E	Keyboard

ANNEX B: Codes of Reader Types

No.	Reader Type
30	ID ISC.M01
31	ID ISC.M02
40	ID ISC.LR100
41	ID ISC.LR200
71	ID ISC.PRH100–U (USB-Version)
72	ID ISC.PRH100
73	ID ISC.MR100–U (USB-Version)
74	ID ISC.MR100 / .PR100
75	ID ISC.MR200-A / -E
80	ID CPR.M02
81	ID CPR.02
82*	ID CPR40.xx-U with USB interface
83*	ID CPR40.xx- with asynchronous (RS232) interface
84	ID CPR.50.xx
87	ID CPR.04 / ID CPR.M04 (596/#)
88	ID CPR.04-USB (USB-Version; 596/#)
91	ID ISC.LRU1000

* if a reader is equipped with both interfaces the reader type is switched dynamical depending on the currently used interface.

ANNEX C: Index of Status Bytes

Hex-value	General
0x00	**OK:** • Data / parameters have been read or stored without error • Control command has been executed

Hex-value	Transponder Status
0x01	**No Transponder:** • No Transponder is located within the detection range of the Reader. • The Transponder in the detection range has been switched to mute. • The communication between Reader and Transponder has been interfered and the Reader is not able to read the Transponder anymore.
0x02	**Data False:** • CRC, parity or framing error at received data.
0x03	**Write-Error:** Negative plausibility check of the written data: • Attempt to write on a read-only storing-area. • Too much distance between Transponder and Reader antenna. • Attempt to write in a noise area.
0x04	**Address-Error:** The required data are outside of the logical or physical Transponder-address area: • The address is beyond the max. address space of the Transponder. • The address is beyond the configured address space of the Transponder.
0x05	**Wrong Transponder-Type:** This command is not applicable at the Transponder: • Attempt to write on or read from a Transponder. • A special command is not applicable to the Transponder.
0x08	**Authent-Error** The reader could not identify itself to the transponder as authorized: • reader- and transponder Keys do not correspond
0x0E	**General-Error** • The Transponder answered with an undefined or general error code
0x83	**RF Communication Error:** • Anticollision could not be finished by the reader. • Corrupted or faulty data exchange between reader and Transponder
0x92	**No valid Data:** • There is no valid data in the buffer. • There is no Transponder in the antenna field.
0x93	**Data Buffer Overflow:** • A data buffer overflow occurred.
0x94	**More Data:** • There are more Transponder data sets requested than the response protocol can transfer at once.
0x95	**ISO15693-Error:** • An additional error code for ISO15693 Transponders is sent with response data.
0x96	**ISO14443-Error:** • An additional error code for ISO14443 Transponders is sent with response data. (see: ANNEX C2: ISO14443-Error, Error-Codes)

Hex-value	Parameter Status
0x10	**EEPROM-failure:** • The EEPROM of the Reader is not able to be written on. • Before writing onto the EEPROM a faulty checksum of parameters has been detected.
0x11	**Parameter-Range-Error:** • The value range of the parameters was exceeded.

Hex-value	Interface Status
0x80	**Unknown Command:** • The Reader does not support the selected function.
0x81	**Length-Error:** • The received protocol contains not the expected content.
0x82	**Command (currently) not available:** • The reader is configured in scan-mode and had received an ISO Host-mode command.

Hex-value	Reader Status
0xF1	**Hardware Warning:** • The Firmware is incompatible with the hardware

Hex-value	SAM Status
0x31	**No SAM detected** • The reader get no response from the Smart Card
0x32	**Requested SAM is not activated** • The requested SAM is not activated by the SAM Activate command
0x33	**Requested SAM is already activated**
0x34	**Requested protocol is not supported by the SAM** • Check if T=0 or T=1 protocol is supported by the SAM
0x35	**SAM communication error** • A data transmission error occurred while communication with the SAM
0x36	**Timeout** • The Reader got no response from SAM within the defined timout
0x37	**Unsupported SAM Baudrate** • The used parameter of Fi and/or Di are not supported by the reader

ANNEX C2: ISO14443-Error, Error-Codes

Hex-value	Response error code definition
0x01	Lowlevel Error: CRC, Framing or EGT error
0x02	Timeout
0x03	Protocol error
0x04	block-no error (Chaining)
0x05	**Insufficient power: The present Transponder indicates** insufficient power • Maybe is distance between reader antenna and Transponder is high. • To many Transponders in the detection range of the Reader. • The power consumption of the Transponder exceed the antenna power of the Reader.

ANNEX C3: Crypto Processing Error - ERROR-CODE

ERROR-SOURCE = 1:

ERROR-CODE	Status
0x96xx	• ISO14443-Error: An additional error code for ISO14443 Transponders is sent with response data. (ANNEX C2: ISO14433-Error, Error-Codes)
0x6581	• Buffer Overflow, because the received data volume exceeds the reader internal buffer size
0x00##	• MFP Error The ERROR-CODE was received form the mifare Plus Card (see NXP mifare Plus functional specification)
0x00##	• DESFire Error The ERROR-CODE was received form the DESFire Card (see NXP mifare DESFire functional specification)

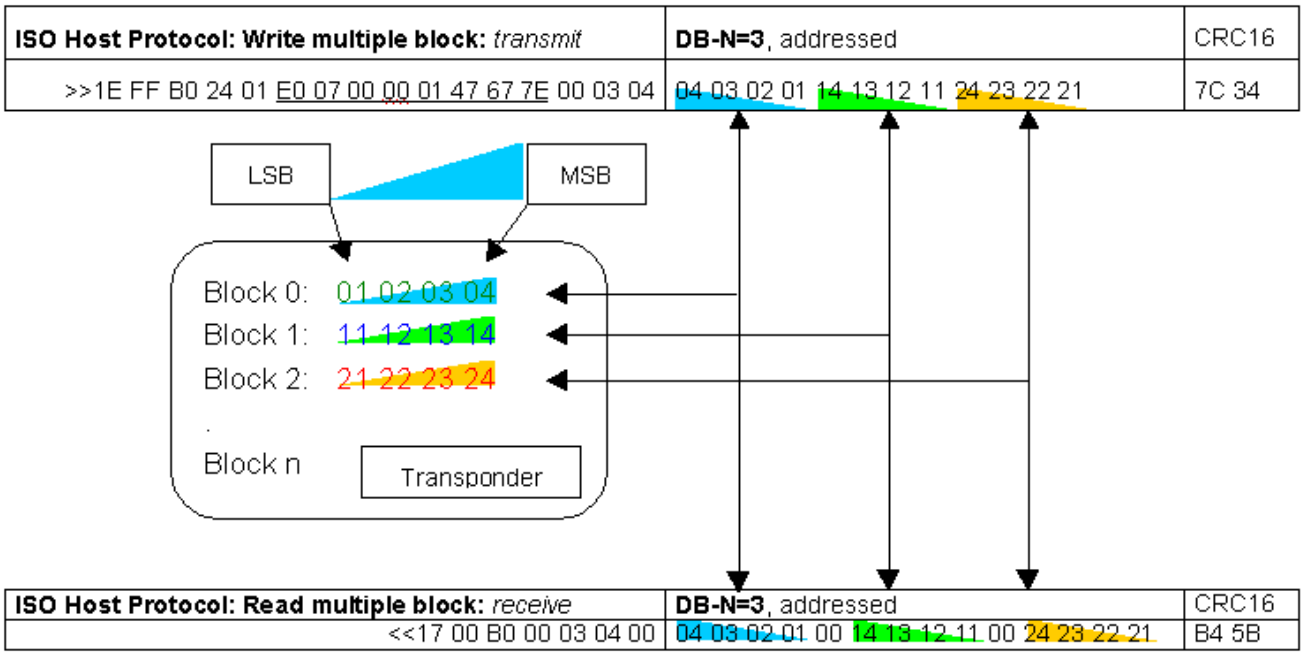
ERROR-SOURCE = 3:

ERROR-CODE	Status
0x901E	• an error occurs while authentication, MAC calculation or CRC calculation. The reason can be a not satisfied security status or any kind of transmission errors.

ANNEX D: Examples for Read Data

The setting "**LSB first**" and "**MSB first**" gives the direction of the received data bytes

ISO-Host Command (DB-Size of the Transponder = 4Byte)



ISO-Host Command (DB-Size of the Transponder = 8Byte)