OBID® *classic-pro*

MANUAL

ID CPR40.xx-Family

Desktop Reader:

ID CPR40.30-USB
ID CPR40.30-SUSB
ID CPR40.30-A

Reader Module:

ID CPR40.00-CD 3.3
ID CPR40.01-CD 3.3
ID CPR40.00-A
ID CPR40.01-A
ID CPR40.00-CDUSB
ID CPR40.01-CDUSB

Up From Firmware Version 01.08.00

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public (B)
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FEIG ELECTRONIC

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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The installation instructions given in this manual are based on advantageous boundary conditions. FEIG ELECTRONIC GmbH does not give any guarantee promise for perfect function in cross environments.

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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.
- #: A command which supports Advanced Protocol-Length is marked with “#”.
  The #-Sign indicates that the location of the first data byte in a protocol, which follows to the STATUS byte could be vary between the 5th and the 7th byte.

Content

Revision History of documentation

Revision	Description
0	Described Firmware: 01.00.00 • First edition
1	Described Firmware: 01.00.00 • Command [0x75] Adjust Antenna added • Parameter CFG3.MIN_LVL redefined • Parameter CFG4.MOD-IDX removed
2	Described Firmware: 01.01.00 • CFG3.ISO14443 STUPT uses 5 ms increments
3	Described Firmware: 01.04.00 • Adding of ANNEX F: Supported SAM Baud Rates • SAM command [0xC0][0x01]: Adding of optional parameter EXT_TA1 • New status byte 0x37: Unsupported SAM Baudrate
4	Described Firmware: 01.05.00 • Revised description of chapter 2.4. Data Format and Protocol Frames for bi-directional communication • Changed naming of reader types with USB interface • Command [0xC0][0x01] SAM Activate / Deactivate: New option GetATR • New parameter CFG3.ISO14443_FTUR.UID_ORDER
5	Described Firmware: 01.07.00 • Support of mifare Ultralight C (MF0ICU2): added • Command [0xA3] Write DES/AES Reader Keys: added • Command [0xA2] Write mifare Keys: maximum number of keys reduced to 8 • Command [0xB2] Authent Mifare Ultralight C: added • New parameter CFG6.SCAN-DATA2.INDPD
6	Described Firmware: 01.08.00 • Command [0xB0][0x25] Select, new option DRV_SEL for explicite Transponder driver selection.

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

Readers of the OBID® *classic-pro* ID CPR40.xx reader family are multi-tag readers which means that they are able to identify transponders of different manufacturers and ISO-standards.

The functionality of the ID CPR40.xx reader family is based on the well known ID CPR-family, like the reader module ID CPR.M02.VP/AB-x and the ID CPR.02.VP/AB-x reader for wall installation and are compatible with them mainly.

The OBID® *classic-pro* ID CPR40.xx reader family is able to process (read and write) Transponders according ISO/IEC 14443 type -A and type -B.

The Readers are supporting also the NXP mifare classic security. Additional some reader models are available with 2 sockets for attachable Security Access Module (SAM), which makes it even suitable for applications such as ticketing, banking, transportation, accounting systems etc.

For data transfer with an host computer the ISO-host mode (polling) or the Scan-mode (uni-directional) are available and can be configured in the reader.

Apart from this, the data-/clock interface of some OBID® *classic-pro* ID CPR40.xx Readers enables them to be used in access control systems.

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 **ISOStart** 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 a easy integration into the customers application.

NOTICE:
The described functionality in this document represents a summary of OBID® classic-pro ID CPR40.xx Family. The table in ANNEX D: Compendium of Supported Commands and Functions ***gives a differentiated overview capabilities of each reader type and the supported functions. Also the separate firmware history file for each reader type informs you about the supported functionality.***

1.1. The OBID® ID CPR40 Family

The following table gives a overview about the hardware similarities and differences within the OBID® ID CPR40.xx-xx reader family.

	ID CPR40.00-CD 3.3	ID CPR40.01-CD 3.3	ID CPR40.00-A	ID CPR40.01-A	ID CPR40.00-CDUSB	ID CPR40.01-CDUSB	ID CPR40.30-USB	ID CPR40.30-SUSB	ID CPR40.30-A
Housing	-						Plastic		
Dimensions (L x D x H)	50 x 50 x 14 mm						144x84x18 mm		
Protection class	-						IP42		
Power supply	3.3 V / DC		5 V / DC		USB				5 V / DC
Antenna:									
internal	●	-	●	-	●	-	●	●	●
external	-	●	-	●	-	●	-	-	-
SAM Socket	-	-	-	-	-	-	-	2	-
Signaler									
• LED	2	2	2	2	2	2	2	2	2
• Buzzer	-	-	-	-	-	-	-	-	-
Digital outputs	-	-	-	-	-	-	-	-	-
Digital inputs	-	-	-	-	-	-	-	-	-
Interface									
• RS232	–	–	●	●	–	–	–	–	●
• RS232-TTL	–	–	–	–	●	●	–	–	–
• RS232-LVTTL	●	●	–	–	–	–	–	–	–
• Data-/Clock (Mag. Stripe)	●	●	–	–	●	●	–	–	–
• Wiegand	●	●	–	–	●	●	–	–	–
• USB full-speed (12Mbit/s)	–	–	–	–	●	●	●	●	–

● included in standard device
○ optional, according to the model
(○) in development
– not available

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

Four different ways of data transmission between OBID® *classic-pro* Readers and host (terminal, PC) are possible. The ISO Host Commands and the Scan-Mode are used for the data exchange between Transponder and host, whereas the Configuration Commands and the Control Commands are for adapting the Reader parameters to the individual range of applications. The following chart shows which method of data transmission is supported by which interface:

	interface		
	asynchronous (RS232 / RS485)	**synchronous Data-/Clock**	**USB**
Configuration and control commands	●	-	●
ISO Host Commands	●	-	●
Scan-Mode	●	●	●

2.1. Configuration Commands and Control Commands

This method of data transmission is used for Reader configuration and the diagnosis via the asynchronous interface.

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 power up the Reader reads the configuration out of the EEPROM.

The Reader control is immediately processed and the answer from the Reader contains status or data information of the control command.

<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 three different 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 protocol “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:

<table>
<tr><td>Host (Terminal / PC / ....)</td><td></td><td colspan="2">Reader</td></tr>
<tr><td rowspan="4">Inventory
to get the UID</td><td>→</td><td colspan="2">Transponder in antenna field ?</td></tr>
<tr><td></td><td>Yes</td><td>No</td></tr>
<tr><td>←</td><td>status /
number of Transponders / UID</td><td>status =
no Transponder</td></tr>
<tr><td>←</td><td colspan="2"></td></tr>
<tr><td rowspan="4">read data from Transponder with UID</td><td>→</td><td colspan="2">Transponder with
correct UID in antenna field ?</td></tr>
<tr><td></td><td>Yes</td><td>No</td></tr>
<tr><td>←</td><td>status /
Transponder read data</td><td>status =
no Transponder
in Reader field</td></tr>
<tr><td>←</td><td colspan="2"></td></tr>
<tr><td rowspan="4">write data to Transponder with UID</td><td>→</td><td colspan="2">Transponder with
correct UID in antenna field ?</td></tr>
<tr><td></td><td>Yes</td><td>No</td></tr>
<tr><td>←</td><td>OK status</td><td>status =
no Transponder
in Reader field</td></tr>
<tr><td>←</td><td colspan="2"></td></tr>
</table>

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. Scan-Mode

In this operation-mode the Reader autonomously sends out data to the host as soon as a Transponder is within the detection range and valid data could be read.

In Scan-Mode the contents of the message block can be adapted to the user-application.

Scan-Mode is available via the asynchronous interface, the Data-/Clock interface or the USB interface depending on the reader hardware. The Scan-Mode interface can be configured by parameters in CFG1 (see chapter 3.2. CFG1: Interface)

Data-/Clock interface:

Scan-Mode can be configured as Magnetic Stripe Emulation and Wiegand Emulation (see chapter 3.2. CFG1: Interface).

Also the kind of data, the data coding and the data volume can configured in a wide range (see 3.7. CFG6: Scan-Mode1 and 3.8. CFG7: Scan-Mode2)).

Asynchronous interface:

The kind of data, the data coding the data volume can be configured (see 3.7. CFG6: Scan-Mode1 and 3.8. CFG7: Scan-Mode2) if the asynchronous interface is used.

USB interface:

If an USB-Reader is used in scan mode, the reader sends its data automatically in HID interface mode (keyboard emulation) to the host. In this case you cannot catch the data with the FEUSB.DLL or any other libraries.

The configuration of the kind of data and the data volume can be done by settings in 3.7. CFG6: Scan-Mode1 and 3.8. CFG7: Scan-Mode2).

NOTICE:

- ***Scan-Mode is only available on readers without SAM.***
- ***If configuration commands shall be sent to the Reader while the Scan-Mode is active, no Transponder should be within the detection range of the Reader during this time.***
- ***Only read operations are available in Scan-Mode.***

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	CONTROL-BYTE	(DATA)	LSB CRC16	MSB CRC16

Host ← Reader

1	2	3	4	(5...n-2)	n-1	n
LENGTH (n)	COM-ADR	CONTROL-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	CONTROL-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	CONTROL-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..253 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

Protocol Start Synchronization Time (PSST):

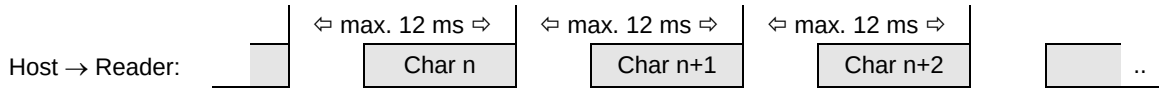
Before starting a new request protocol there must be a gap without any communication of normally 5 ms after the reception of the last byte of the response protocol. The PSST is configurable by the parameter PSST in CFG1.

Block timeout:

Defines the time within the reader response can be expected by the host. The host block timout 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);
  }
}
```

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 5.3. [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	.....

not marked

Changing of this parameter becomes immediately effective after writing / saving this configuration block to RAM

gray marked

Changing of this parameter only becomes effective after writing / saving this configuration block to EEPROM and a Reader reset

marked with “00“

these bits or bytes are reserved for future extensions or for internal testing and manufacturing-functions. These bits or bytes and also any not described bits and bytes **must not be changed**, as this may cause faulty operation of the Reader.

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	COM-ADR	0x00	BAUD	TRANS-FORM	0x00	PSST	TR-RESPONSE-TIME
Default	0x00	0x00	0x08 *38400 Baud*	0x01 *e,8,1*	0x00	0x05 *5 ms*	0x00

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

COM-ADR:

Bus address of the Reader (0 .. 254) for communication via the asynchronous interface, especially for applications with the RS485 interface.

Notes:

- ***Do not configure address 255!***
- ***Via the COM-ADR 255 in the send protocol, the Reader is able to be addressed at any time. It answers then with the configured address.***

BAUD[1]**:**

By means of this byte the baud rate of the asynchronous interface can be defined.

BAUD	ID CPR40.0x- Ax / Cx	
0x05	4.800	bit/s
0x06	9.600	bit/s
0x07	19.200	bit/s
0x08	38.400	bit/s
0x09	57.600	bit/s
0x0B	115.200	bit/s
0x0D	230.400	bit/s
0x80	-	bit/s
0x81	-	bit/s
0x82	-	bit/s
0x83	-	bit/s

NOTICE:

- ***Make sure that your host system supports the selected baud rate. If not it's impossible to communicate with the reader any longer after the baud rate was changed!***
- ***Changing of BAUD only becomes effective after writing / saving configuration block CFG1 to EEPROM and a reset of the Reader.***
- ***The Reader set the baud rate to 38400 bit/s, if the user set an undefined baud rate.***

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

TRANS-FORM[1]**:**

By means of this byte, several parameters for the data transmission format of the asynchronous interface can be defined.

Bit:	7	6	5	4	3	2	1	0
Function:	0	0	0	0	S	D	P	

P: Kind of Parity
- b00: no parity
- b01: even parity
- b10: odd parity
- b11: **- do not use -**

D: Number of data bits
- b0: 8 data bits
- b1: **- do not use -**

S: Number of stop bits
- b0: 1 stop bit
- b1: **- do not use -**

NOTICE:

- ***Changing of TRANS-FORM only becomes effective after writing / saving configuration block CFG1 to EEPROM and reset of the Reader.***
- ***Always 8 Data Bits and 1 Stop Bits should be used***

PSST (Protocol Start Synchronization Time) 0...5 ms

By means of this parameter the duration of the minimum communication gap between the reception of the last byte of the response protocol and the first byte of a new protocol can be defined in 1 ms steps (see also 2.4. Data Format and Protocol Frames)

The parameter could be used to speed up the communication via the asynchronous interface. In case of a RS485 Interface it's not recommended to decrease PSST.

0: The Reader response starts as soon as possible

5: Maximum value for PSST (5 ms)

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

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 with the protocols for Reader Configuration and the protocols for Reader Control.***
- ***The block receive timeout of host computer must set to a value ≥ TR-RESPONSE-TIME.***

READER-MODE:

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

Bit:	7	6	5	4	3	2	1	0
Function:				DC-FORMAT			SCAN-IF	SCAN-E

SCAN-E:

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

b0: **ISO Host Mode** (see chapter 6. ISO Host Commands)
b1: **Scan-Mode** (see chapter 3.7. CFG6: Scan-Mode1)

SCAN-IF:

This bit selects the interface for Scan-Mode

b0: Scan-Mode: via asynchronous or USB interface
b1: Scan-Mode: via data-/clock interface

DC-FORMAT:

By means of this parameter the kind of data transmission via data-/clock interface could by selected:

b000: Wiegand emulation (see 3.2.2. Wiegand Emulation)
data format: binary 1:1, according written to Transponder.

b001: magnetic stripe (see 3.2.1. Magnetic Strip Emulation)
data format: binary 1:1, according written to Transponder.

b010: magnetic stripe (see 3.2.1. Magnetic Strip Emulation)
data format: according ISO 7811-2, track 2+3 (5 Bit)

b011: magnetic stripe (see 3.2.1. Magnetic Strip Emulation)
data format: according ISO 7811-2, track 1 (7 Bit)

b100: Wiegand emulation (see 3.2.2. Wiegand Emulation)
data format: Wiegand formatted protocol frame with start and stop sign.

b101: magnetic stripe (see 3.2.1. Magnetic Strip Emulation)
data format: according ISO 7811-2, track 2+3 (5 Bit)
additional a prefix of 16 leading zero clocks before the start character and additional a trailer of 16 attached zero clocks following to the LRC character.

b110: Wiegand emulation (see 3.2.2. Wiegand Emulation)
data format: Wiegand formatted protocol frame

3.2.1. Magnetic Strip Emulation

Data Format:

The following table shows data coding depending on DC-FORMAT

For cutting the length of data output the parameters D_LGT and D_START (see chapter: 3.7. CFG6: Scan-Mode1) can be use.

DC-FORMAT raw data	b001 binary 1:1 MSB.....LSB	b010 b101 according ISO 7811-2 (5 bit) P / MSB.....LSB	b011 according ISO 7811-2 (7 bit) P / MSB.....LSB
0x0	b 0 0 0 0	b 1 / 0 0 0 0	b 0 / 0 1 0 0 0 0
0x1	b 0 0 0 1	b 0 / 0 0 0 1	b 1 / 0 1 0 0 0 1
0x2	b 0 0 1 0	b 0 / 0 0 1 0	b 1 / 0 1 0 0 1 0
0x3	b 0 0 1 1	b 1 / 0 0 1 1	b 0 / 0 1 0 0 1 1
0x4	b 0 1 0 0	b 0 / 0 1 0 0	b 1 / 0 1 0 1 0 0
0x5	b 0 1 0 1	b 1 / 0 1 0 1	b 0 / 0 1 0 1 0 1
0x6	b 0 1 1 0	b 1 / 0 1 1 0	b 0 / 0 1 0 1 1 0
0x7	b 0 1 1 1	b 0 / 0 1 1 1	b 1 / 0 1 0 1 1 1
0x8	b 1 0 0 0	b 0 / 1 0 0 0	b1 / 0 1 1 0 0 0
0x9	b 1 0 0 1	b 1 / 1 0 0 1	b 0 / 0 1 1 0 0 1
0xA	b 1 0 1 0	b 1 / 1 0 1 0	b 1 / 1 0 0 0 0 1
0xB	b 1 0 1 1	b 0 / 1 0 1 1	b 1 / 1 0 0 0 1 0
0xC	b 1 1 0 0	b 1 / 1 1 0 0	b 0 / 1 0 0 0 1 1
0xD	b 1 1 0 1	b 0 / 1 1 0 1	b 1 / 1 0 0 1 0 0
0xE	b 1 1 1 0	b 0 / 1 1 1 0	b 0 / 1 0 0 1 0 1
0xF	b 1 1 1 1	b 1 / 1 1 1 1	b 0 / 1 0 0 1 1 0
Start „%“	-	b 0 / 1 0 1 1	b 1 / 0 0 0 1 0 1
Stop „?“	-	b 1 / 1 1 1 1	b 0 / 0 1 1 1 1 1

Example: Output of raw data 0x19BF

Sign / DC-FORMAT	prefix (16*0)	Start %	0x1	0x9	0xB	0xF	Stop ?	LRC	trailer (16*0)
b001	-	-	0001	1001	1011	1111	-	-	-
b010	-	1101/0	1000/0	1001/1	1101/0	1111/1	1111/1	0001/0	-
b101	000...000	1101/0	1000/0	1001/1	1101/0	1111/1	1111/1	0001/0	000...000
b011	-	101000/1	100010/1	100110/0	010001/1	011001/0	111110/0	011010/0	-

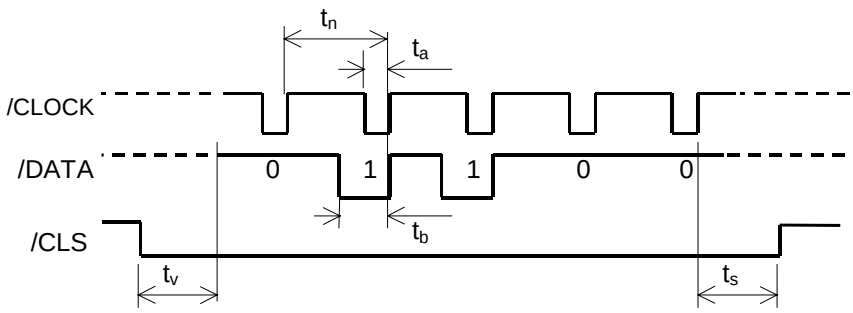
Time →

LRC

XOR operation on Start-, Data and Stop-sign

Timing

The following diagram represents the signal response of the 3 data lines of the data-/clock-interface in magnetic strip emulation.



t_n = 0,5 ms
$t_{a(n)} \approx t_n / 3$
$t_{b(n)} \approx t_n / 2$
$t_v = t_s$ = 10...12 ms

3.2.2. Wiegand Emulation

Data Format:

The following description represents the data coding depending on DC-FORMAT

For cutting the length of data output the parameters D_LGT and D_START (see chapter: 3.7. CFG6: Scan-Mode1) can be use.

DC-FORMAT = b000 ⇒ binary 1:1

In this configuration the output data format is equal to the data coding on the Transponder. The Reader doesn't add a protocol frame e.g. parity Bits or start or stop signs across the data stream.

DC-FORMAT = b100 ⇒ Wiegand formatted protocol frame with start and stop sign

In this configuration the Reader build the protocol frame with one even parity bit at the beginning and one odd parity bit at the end and one start and one stop sign:

4 Bit	1 Bit	n Bit	1 Bit	4 Bit
START	EVEN	DATA	ODD	STOP

START: b1011

EVEN: Even parity bit calculated across the first half DATA bits.

DATA: Data bits as read from the Transponder and defined in scan-mode settings.

ODD: Odd parity bit calculated across the last half DATA bits.

STOP: b1111

DC-FORMAT = b110 ⇒ Wiegand formatted protocol frame

In this configuration the Reader build the protocol frame with one even parity bit at the beginning and one odd parity bit at the end

1 Bit	n Bit	1 Bit
EVEN	DATA	ODD

EVEN: Even parity bit calculated across the first half DATA bits.

DATA: Data bits as read from the Transponder and defined in scan-mode settings.

ODD: Odd parity bit calculated across the last half DATA bits.

Example of parity calculation

Example 1: 18 DATA bit

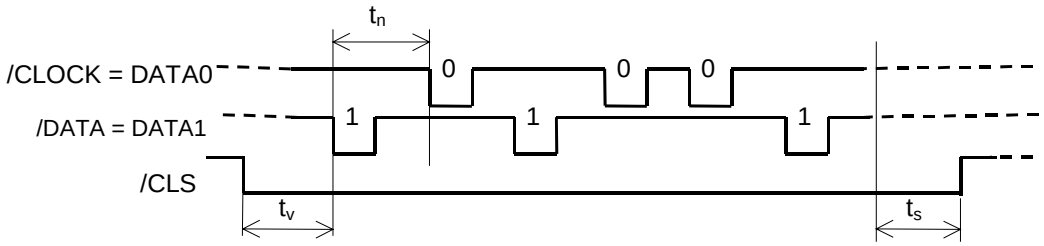
```
DATA bin     011110110010110101101001
                 \_____/ \_____/
                    |       |
                    |       |
OUTPUT     1 011110110010110101101001 0
           `- Even Parity Bit         `- Odd Parity Bit
```

Example 1: 19 DATA bit

```
DATA bin     0111101100101101011010011
                 \_____/ \_____/
                    |       |
                    |       |
OUTPUT     0 0111101100101101011010011 1
           `- Even Parity Bit          `- Odd Parity Bit
```

Timing

The following diagram represents the signal response of the 3 data lines of the data-/clock-interface in Wiegand emulation.



t_n = 0,5 ms
t_v = t_s = 10..12 ms

3.3. CFG2: Inputs / Outputs general

The LED's of ID CPR40.30 and ID CPR40.0x can not be configured by the user.

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	OFFLINE-DLY	0x00	0x00	0x00
Default	0x00	0x00	0x00	0x14	0x00	0x00	0x00

OFFLINE_DLY:

By this parameter the time (100 ms increments) can be configured when the reader starts flashing the green LED after it had received the last command.

NOTICE:

The ID CPR40.30 LED's have the following fix function:

green & blue LED flashing synchronous (approx. 2 Sec)	Reset-Indicator
green LED flashing permanent	• Reader is ready for operation (offline). • Active communication with the host computer (online). • Reader is operating in Scan-Mode
blue LED	Active Communication with a Transponder

The ID CPR40.0x LED's have the following fix function:

green & red LED flashing synchronous (approx. 2 Sec)	Reset-Indicator
green LED flashing permanent	• Reader is ready for operation (offline). • Active communication with the host computer (online). • Reader is operating in Scan-Mode
red LED	Active Communication with a Transponder

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	MIN_LVL
Default	0x0D30		0x000F		0x00	0x00	0x00

Byte	7	8	9	10	11	12	13
Contents	ISO14443 BIT RATE	0x00	0x00	0x00	0x00	ISO14443 STUPT	ISO14443 FTUR
Default	0xF0	0x00	0x00	0x00	0x00	0x03 15 ms	0x1A

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	0	0	0	L	K	0	I	0	G	F	E	0	0	0	0
Default	0	0	0	0	1	1	0	1	0	0	1	1	0	0	0	0

b0: Driver for the Transponder type is disabled

b1: Driver for the Transponder type is activated

- **.E:** Driver for ISO14443A
- **.F:** Driver for ISO14443B
- **.I** Driver for Jewel
- **.K** Driver for SR176
- **.L** Driver for SRIxx

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	B	A

b0: Driver for the Transponder type is disabled

b1: Driver for the Transponder type is activated

- A: Driver for mifare classic
- B: Driver for my-d proximity SLE55Rxx
- C: Driver for mifare Ultralight
- L4 Driver for ISO14443A, Part 4 compatible Transponders

MIN_LVL:

This parameter defines the sensitivity of the RFID receiver. The value depends on the electromagnetic environment noise.

For MIN_LVL evaluation the command 5.8. [0x75] Adjust Antenna can be used.

Bit:	7	6	5	4	3	2	1	0
Function	MAN				LVL			

LVL (0x0...0x0F):

Level which could be set in automatic or manual mode. A low level could increase the reading distance but also the probability of interruptions because of noise.

- 0x0: highest sensitivity (mostly impracticable)
- 0xF: lowest sensitivity

MAN:

b0: default
If this setting is used the reader runs with his default sensitivity.

b1: manual mode
This setting is necessary if the reader should use the setting of LVL.

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 STUPT (1 ... 255 * 5 ms = 5 ms ... 1,275 sec)**:**

The Startup Time defines a delay-time which is required by a ISO14443 Transponder for startup after the RF-Field was switched on (e. g. after a command [0x69] RF Reset).

NOTICE:
The value of ISO14443 STUPT must be considered for calculating the TR-RESPONSE-TIME (see CFG1)

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	0x00	0x00	0x00
Default	0x00	0x00	0x00	0x00	0x00	0x00	0x00

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

ISO14443B-AFI: (only ISO14443B Transponders)

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

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	0x0C	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
Driver	0	0	0	0	AORB_REQ	ACOLL	0	ONT

ONT:

b0: All Transponder in Reader field
The response of the Inventory command [0x01] includes the UID of all detected Transponders in the detection range of the reader.

The Reader performs a RF-Reset before any command reads a UID.

b1: Only new Transponder in Reader field
The response of the Inventory command [0x01] includes only the UID of new detected Transponders.

If the Reader has detected a new Transponder, the Transponder will be automatically set to into the halt state (ISO14443, but not Jewel) by the Reader. In this state the Transponder does not send back a response for the next Inventory command.

The UID of a Transponder will replied only after the Transponder reenters into the detection range of the reader. Otherwise the Reader replies the Status "No Transponder" (0x01).

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.

AORB_REQ:

This parameter defines the abort conditions of the Inventory command [0x01] for ISO14443 Transponder if the ISO14443A and ISO14443B Transponder drivers are activated.

b0: disabled (default)
The Inventory command runs while not all UIDs of ISO14443A and ISO14443B Transponders in the detection range are read.

b1: The Inventory command stops if the UID of all ISO14443A or of all ISO14443B Transponders in the detection range are read. So the Inventory command returns either the presence of ISO14443A or ISO14443B Transponders.

3.7. CFG6: Scan-Mode1

The parameters of the CFG6 configuration block contains Scan-Mode settings. To enable Scan-Mode the SCAN-MODE bit in the configuration block CFG1 (3.2. CFG1: Interface) has to be set.

Byte	0	1	2	3	4	5	6
Contents	0x00	0x00	0x00	SCAN-DATA1	SCAN-DATA2	0x00	SCAN-LOCK-TIME
Default	0x02	0x00	0x00	0x01	0x00	0x00	0x00

Byte	7	8	9	10	11	12	13
Contents	SCAN-LOCK-TIME	MAD_AID		SCAN-KEY_ADR	DB_ADR	D_LGT	D_START
Default	0x0A	0x00	0x00	0x00	0x05	0x04	0x00

SCAN-DATA1

selects the data types to be sent in the Scan Mode.

Bit:	7	6	5	4	3	2	1	0
Function	Byte Order	COM-Prefix	MAD	0	0	BCD_ UID	DB	UID

NOTICE:

- ***If Scan-Mode via data-/clock interface is selected the reader can only transmit the UID or a Data Block. If both options are activated the reader only transmits the UID.***
- ***If Scan-Mode via asynchronous interface is selected reading of UID and Data-Block can be configured at the same time.***

UID = Serial No.

Setting of this bit activates the output of the UID

b0 Output of the UID inactive (inactivates the scan-mode)
b1 Output of the UID active

DB = Data Block

Setting of this bit activates the output of a specified data field (see also parameter DB_ADR, D_LGT and D-START)

b0 Output of a data field inactive
b1 Output of a data field active

NOTICE:

- ***To read a public data block from an ISO 14443 Transponder the driver for mifare classic (see CFG3.*ISO14443-DRV) has to be switched off.**
- ***To read data blocks from mifare classic Transponder see also the parameter SCAN_KEY_ADR, MAD_ID and MAD Bit***

BCD_UID = Serial No. in BCD format

Setting of this bit activates the output of the UID in BCD format if the UID Bit set. In this case the least significant 4 hexadecimal Bytes of the UID are transformed into their 10 digit decimal equivalent value.

b0 Output of the BCD_UID inactive (inactivates the scan-mode)
b1 Output of the BCD_UID active

Depending on the selected scan mode interface (see CFG1) and data format (see CFG7, DB-FORMAT) the output of the BCD transformed UID could be configured in different ways.

Example:
The hexadecimal UID is 0x38 F3 7B 29
The decimal value is: 0955480873

Scan-Mode: via asynchronous interface

unformatted hex data
output 0x09 55 48 08 73

ASCII formatted hex data
output: 0x30 0x39 0x35 0x35 0x34 0x38 0x30 0x38 0x37 0x33

Scan-Mode: via data-/clock interface
If Data-/Clock Interface is used the output data format depends on the setting of the DC-FORMAT parameter.

MAD: (Mifare Application Identifier)

Setting of this bit activates the MAD function for reading data blocks of mifare classic Transponders. It becomes only effect if the DB bit is set to 1.

b0 MAD function is inactive

b1 MAD function is active
In this operation mode the parameter MAD_ID becomes effect and some other scan-mode becomes a different function.

NOTICE
Further details about the MAD functionality are described in Mifare Application Directory documentation issued by NXP Semiconductors.

COM Prefix

When this option is on, the Reader will transmit the COM-ADR before each data set.

b0 COM-ADR of the Reader will not transmit
b1 COM-ADR of the Reader will transmit

Byte Order

Defines the byte Order within frame

b0 MSB first
b1 LSB first

SCAN-DATA2

selects the data types to be sent in the Scan Mode.

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

INDPD

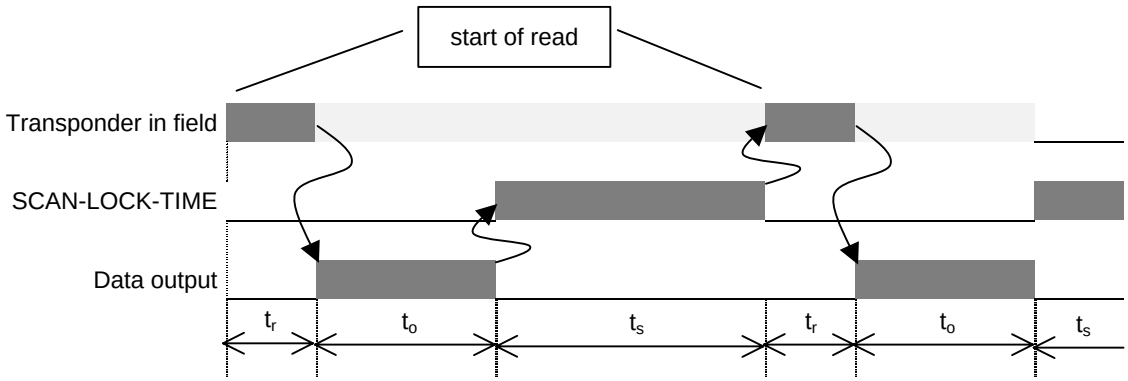
Via this bit an independent transmission of the UID can be configured if the reading of UID and DB is activated.

b0: In this case the reader starts the output of the UID and DB data block as soon as all required data (UID and DB) have been read from the Transponder successful. If the reader can not read the DB data block no UID will be transmitted.

b1: In this case the Reader transmits the UID only independent form a successful reading of the DB data block.

SCAN-LOCK-TIME: (1 ... 65535 * 100 ms = 100 ms ... 6553,5 sec)

The SCAN-LOCK-TIME defines the period in which the Reader does not transmit the Transponder data a second time, after the Reader had transmitted it the first time (regardless whether the Transponder is in the detection range of the reader during SCAN-LOCK-TIME or not). The SCAN-LOCK-TIME starts after the data transmission from the Transponder to the Reader.



t_r: Time to read the Transponder data

t_o: Data Transmission from the Reader to the host

t_s: SCAN-LOCK-TIME
As long as the SCAN-LOCK-TIME is active, the Transponder can be in the detection range of the reader or outside of it.

MAD_AID

Parameter to configure the 2 byte AID (Application Identifier) of the MAD function.

SCAN-KEY_ADR

Defines the mifare key address which will be used for authentication at the mifare block which should be read in scan-mode.

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

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.

DB_ADR (0x00 .... 0xFF):

depending on the setting of the MAD bit in parameter SCAN-DATA this parameter can have two functions

case MAD = 0

DB_ADR defines the absolute Transponder address of the first data block which will be transferred in Scan-Mode. The maximum address depends on the memory size and organization of the respective Transponder (see 9. Supported ISO Host commands

case MAD = 1

DB_ADR defines the relative data block address within one mifare sector which will be transferred in Scan-Mode in MAD function, if a mifare classic Transponder is currently detected by the reader. The maximum address range depends on the memory size and organization of the respective mifare Transponder as displayed in the following table.

	Sector 0...15	Sector 16...31	Sector 32...39
mifare 1k	0...2(3)	-	
mifare 4k	0...2(3)		0...14(15)

Values in brackets () includes the mifare sector trailer block.

D_LGT:

D_LGT defines the length of raw data which are transmitted in the Scan-Mode. Depending on the selected READER-MODE (see: 3.2. CFG1: Interface) D_LGT will be interpreted in different ways. The Parameter D_LGT has only effect to the transmission of a Data Block, defined by DB_ADR.

NOTICE:
In case of a mifare classic Transponder the maximum range of D_LGT and D_START are limited by the end of the mifare sector.

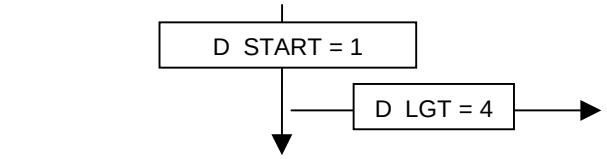
Case Scan-Mode via asynchronous interface:

D_LGT = Number of **data bytes** to be transferred, started with the D_START.

NOTICE:
D_LGT must be less than 128 byte. Otherwise the reader truncates the supernumerary bytes.

Example: Data Block

Byte	0	1	2	3	4	5	6	7
Data	0x01	0x23	0x45	0x67	0x89	0xAB	0xCD	0xEF



Output Data	0x23	0x45	0x67	0x89

Case Scan-Mode via data-/clock interface:

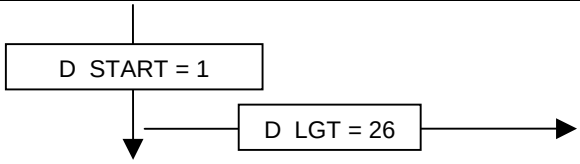
D_LGT = Number of **data bits** to be transferred, started with the D_START.

0: D_LGT = 256 bit.
1...255: D_LGT = Parameter value

In case if DB-FORMAT = ASCII format, the number of D_LGT data bits must be multiplied with 2 to get the whole data block

Example: data block

Byte	0	1	2	3	4	5	6	7
Data	0x01	0x23	0x45	0x67	0x89	0xAB	0xCD	0xEF



Output Data	b0010 0011	b0100 0101	b0110 0111	b10

D_START:

This parameter defines the starting byte in the raw data on which D_LGT starts. The Parameter D_START has only effect to the transmission of a Data Block, defined by DB_ADR.

3.8. CFG7: Scan-Mode2

The CFG7 configuration block contains additional parameters to format the data output in Scan Mode.

NOTICE:
If an USB-Reader is used:

- ***The data are transferred in HID interface mode (keyboard emulation) to the host like an additional keyboard.***
- ***In some cases it might be necessary to switch in the NUM-LOCK function on the host PC to receive the scan-mode data.***
- ***All data's will be transformed into UNICODE format and then transferred with USB-Keycode.***
- ***Independent of any setting the hex raw data of the UID will separated into their nibbles and then transformed into ASCII signs according Table 1: Hex data to ASCII conversion table.***
- ***Special characters like separators or end characters are not influenced by any format setting.***

Byte	0	1	2	3	4	5	6
Contents	DB-USE	SEP-CHAR	SEP-USR	END-CHAR	END-USR	0x00	0x00
Default	0x02	0x20	0x2C	0x01	0x0D	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

DB-USE:

Defines the output data format for scan mode data (Data Block and UID)

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

DB-FORMAT

depending on the SCAN-MODE interface of the kind of data interpretation and the data format can be configured.

USB interface:

b0000 unformatted hex data
In this case the raw data of a data block first are separated into their nibbles and then transformed into ASCII char according Table 1: Hex data to ASCII conversion table and are transmitted in UNICODE format.

This setting is recommended for numeric information's

b0010 ASCII interpreted hex data
In this case each raw data byte is interpreted as an ASCII char and is transformed UNICODE format.

This setting is recommended for alpha-numeric information's

Asynchronous or data-/clock interface

b0000 unformatted hex data
In this case the data are transferred as they were read from the Transponder.

b0010 ASCII formatted hex data
In this case the raw data bytes from the Transponder first are separated into their nibbles and then changed into ASCII chars according Table 1: Hex data to ASCII conversion table.

raw data (hex / binary)		ASCII data (ASCII / hex)	
0x0	b0000	'0'	0x30
0x1	b0001	'1'	0x31
0x2	b0010	'2'	0x32
0x3	b0011	'3'	0x33
0x4	b0100	'4'	0x34
0x5	b0101	'5'	0x35
0x6	b0110	'6'	0x36
0x7	b0111	'7'	0x37
0x8	b1000	'8'	0x38
0x9	b1001	'9'	0x39
0xA	b1010	'A'	0x41
0xB	b1011	'B'	0x42
0xC	b1100	'C'	0x43
0xD	b1101	'D'	0x44
0xE	b1110	'E'	0x45
0xF	b1111	'F'	0x46

Table 1: Hex data to ASCII conversion table

SEP-CHAR:

Selects the separation character between two data types for the send data.

Bit:	7	6	5	4	3	2	1	0
Function	USER	‘ ‘	‘,‘	‘;’	TAB	CR	LF	CR+LF

SEP-CHAR	ASCII	Hex
b0000 0000	none	none
b0000 0001	CR+LF	0x0D and 0x0A
b0000 0010	LF	0x0A
b0000 0100	CR	0x0D
b0000 1000	TAB	0x07
b0001 0000	‘;’	0x3B
b0010 0000	‘,’	0x2C
b0100 0000	‘ ‘	0x20
b1000 0000	USER	user defined in SEP-USR

Note:

Only one option can be selected.

SEP-USR:

User defined separation character.

END-CHAR:

selects the end character between two data types for the send data.

Bit:	7	6	5	4	3	2	1	0
Function	USER	‘ ‘	‘,‘	‘;’	TAB	CR	LF	CR+LF

END-CHAR	ASCII	Hex
b0000 0000	none	none
b0000 0001	CR+LF	0x0D and 0x0A
b0000 0010	LF	0x0A
b0000 0100	CR	0x0D
b0000 1000	TAB	0x07
b0001 0000	‘;’	0x3B
b0010 0000	‘,’	0x2C
b0100 0000	‘ ‘	0x20
b1000 0000	USER	user defined in END-USR

NOTICE:

Only one option could be selected.

END-USR:

User defined end character.

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 classic Transponder (mifare classic mini, 1k, 4k) 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 .... 0x07)

Address where the key is stored in the reader. The address can be any value between 0 and 7.

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 0xFF
  KEY-B: 0xFF 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 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...23	n-1, n
KEY-LEN	KEY (16 Byte)	CRC16

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 reloaded 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 only less protected against hacking it's content.

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

Address where the key is stored in the reader.

AUTH-MODE:

This parameter defines the authentication method which will be performed by the reader with this key

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

AUTH-MODE	authentication method	Key length
1	Standard TDES[1]	16 Byte

KEY-LEN:

This parameter defines the length of the following key (16 byte).

KEY:

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

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

5. Command for Reader Control

5.1. [0x52] Baud Rate Detection

This protocol serves to determine the actual baud rate of the Reader's asynchronous interface.

Host → Reader

1	2	3	4	5...6
6	COM-ADR	[0x52]	0x00	CRC16

Host ← Reader

1	2	3	4	5...6
6	COM-ADR	[0x52]	0x00	CRC16

NOTICE:

- ***The return protocol will only be sent if the inquiry is executed with the baud rate and actual parity of the Reader.***

5.2. [0x55] Start Flash Loader

This protocol starts the Flash Loader inside the Reader. After the reader has received the command, he switches into the Flash-Loader mode. The Flash-Loader mode is signaled by the red LED. For leaving the Flash-Loader mode, the power supply of the Reader must be interrupted.

For more details about the firmware update with the flashloader, please refer to the application note N30201-0e-ID-B.

Host → Reader

1	2	3	4...5
5	COM-ADR	[0x55]	CRC16

Host ← Reader

1	2	3	4	5...6
6	COM-ADR	[0x55]	0x00	CRC16

NOTICE:

- ***COM-ADR = 255 will be ignored by the Reader.***

5.3. [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.

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

5.4. [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
HW-TYPE	SW-TYPE	TR-TYPE	CRC16

SW-REV:

Version of the firmware.

D-REV:

Revision status of the firmware.

HW-TYPE:

Displays options which are supported by the Reader hardware

Bit:	7	6	5	4	3	2	1	0
Function:	ANT	MODEL	-	SD2	HWE		SD1	SE

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

HWE:

RF-Decoder type of the Reader.

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

MODEL:

	b0	b1
ID CPR40.xx	-	-Ax / -Cx / -Ux

ANT:

This bit indicates if the reader is equipped with an internal antenna or it is a model for an external antenna.

b0: external antenna (depending on reader type 1 or more external antennas)

b1: internal antenna

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:	-	-	-	-	SRIx	SR176	-	Jewel

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

5.5. [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.

0x04: Additional firmware functionality.

0x05: Bootloader version information.

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:

MODE = 0x00 (RF Controller Firmware)

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

SW-REV / D-REV / HW-TYPE / SW-TYPE / TR-TYPE:

see: 5.4. [0x65] Get Software Version

RX-BUF:

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

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

MODE = 0x03 (RF-decoder information's)

1	2	3	4	5...9	10
17	COM-ADR	[0x66]	STATUS[1]	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 informations about the self test result, which is performed automativaly 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

MODE = 0x04 (Additional firmware functionality)

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
-	-	-	-	-	CRC16

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	0	0	0	0	0	0	MAD	TCL

TCL:

Indicates the support of the T=CL Function (Command [0xB2][0xBE])

b0: T=CL function is not supported

b1: T=CL function is supported

MAD:

Indicates the support of MAD (Mifare Application Directory) in Scan-Mode

b0: MAD is not supported

b1: MAD is supported

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

MODE = 0x05 (Bootloader version information)

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

MODE = 0x80 (Device_ID)

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

5.6. [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

5.7. [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 2 antenna outputs.

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

ANT_OUT:

This parameter could be used to select one antenna.

b00: switches off RF power at all antennas.

b01: 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

5.8. [0x75] Adjust Antenna

This command can be used to evaluate the absolut minimum for parameter CFG3.MIN_LVL value.

NOTICE:

- ***For a suitable RFID performance the CFG3.MIN_LVL parameter should be set to CFG3.MIN_LVL = MIN_LVLmesured + 2.***
- ***While performing this command it is recommended not to place any Transponder in the detection range of the reader.***

Host → Reader:

1	2	3	4,5
5	COM-ADR	0x75	CRC16

Host ← Reader

1	2	3	4	5	6	7,8
8	COM-ADR	0x75	STATUS[1]	0x00	MIN_LVL	CRC16

MIN_LVL:

MIN_LVL value, which is calculated by the reader for the current antenna configuration and environment.

[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 Scan-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	NTFC_TIME

NOTES:

The operating behavior of the Inventory command depends on some settings in CFG5, parameter ONT and on settings in MODE byte

- ***If the CFG5.ONT Bit ONT = b1 only the response of those Transponders are read which came into the antenna field since the last Inventory command.***

  In this case The Reader sends back a response including an UID only if:

  - ***if the Transponder has left the antenna and reentered the antenna field or***
  - ***the command 5.6. [0x69] RF Reset was send to the Reader meanwhile or***
  - ***the Transponder in the antenna field is a Jewel***
- ***If the CFG5.ONT Bit ONT = b0 a RF-Reset is performed to read the UID of all Transponders inside the antenna field.***
- ***If CFG5.ONT Bit ACOLL = b0 (anticollision function is disabled) the Reader selects the Transponder itself.***
- ***If MODE bit PRESC is set to b1 the response includes the Transponders inside the antenna field without performing a RF-Reset.***

MODE:

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

PRESC:

Settling of this bit activates the presence check mode of the Inventory command. This setting is suitable to perform a presence check of all Transponder in detection range of the reader without influencing the UID of Transponder with a random UID

b0: Presence check is deactivated

b1: The response of the Inventory command [0x01] includes the UID of all detected Transponders in the reader detection range.

NOTICE:
The* PRESC = *b1 can only used if CFG5.ONT, ONT bit and ACOLL bit is set to b1 (see CFG5.ONT)

NTFC:

Settling of this bit activates the notification mode of the Inventory command.

b0: Standard Inventory command

b1: Inventory with notification:
In this case the optional parameter NTFC_TIME must send to the reader.

In notification mode the Inventory command runs internally while one ore more Transponders are detected by the reader or while the time defined by NTFC_TIME elapsed.

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.

NOTICE:
The MORE and NTFC function can be used only exclusive.

NTFC_TIME:

This optional parameter defines the maximum duration of the Inventory command in notification mode (see NTFC bit in MODE Byte).

	max. response duration
NTFC_TIME	0...255 * 100 ms

NOTICE:

- ***The NTFC_TIME overwrites the TR-RESPONSE-TIME which is defined in CFG1. The receive block timeout of the host computer must set to a value ≥ NTFC_TIME.***
- ***A running Inventory command with NTFC option couldn't be interrupted by any other command while NTFC_TIME.***

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.

1	2	3	4
PUPI			
LSByte			MSByte

APP_DATA

4 byte Application Data (according ISO 14443-3:2001).

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

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 - Jewel (TR-TYPE = 0x08)

Response data of Jewel Transponder:

5	6	7	8	9...14					
DATA-SETS	TR-TYPE	0	0	UID					
				HR0	HR1	UID0	UID1	UID2	UID3
	Repeated DATA-SETS times								

UID: Read-only UID of the Transponder.

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

HR0, HR1:

metal-mask data selected. 0x01 0x3C for IRT5001W and IRT5001E.

6.1.1.4. Response-Data - SR176 (TR-TYPE = 0x0A)

Response data of STM SR176 Transponder:

5	6	7	8...15							
DATA-SETS	TR-TYPE	CHIP_ID	UID							
			UID0	UID1	UID2	UID3	UID4	UID5	UID6	UID7
	Repeated DATA-SETS times									

CHIP_ID:

Optional fixed Chip_ID from block address 15.

UID:

64Bit UID of the Transponder.

6.1.1.5. Response-Data - SRIx (TR-TYPE = 0x0B)

Response data of STM SRI512, SRI4K SRIX4k Transponder:

5	6	7	8...15							
DATA-SETS	TR-TYPE	CHIP_ID	UID							
			UID0	UID1	UID2	UID3	UID4	UID5	UID6	UID7
	Repeated DATA-SETS times									

CHIP_ID:

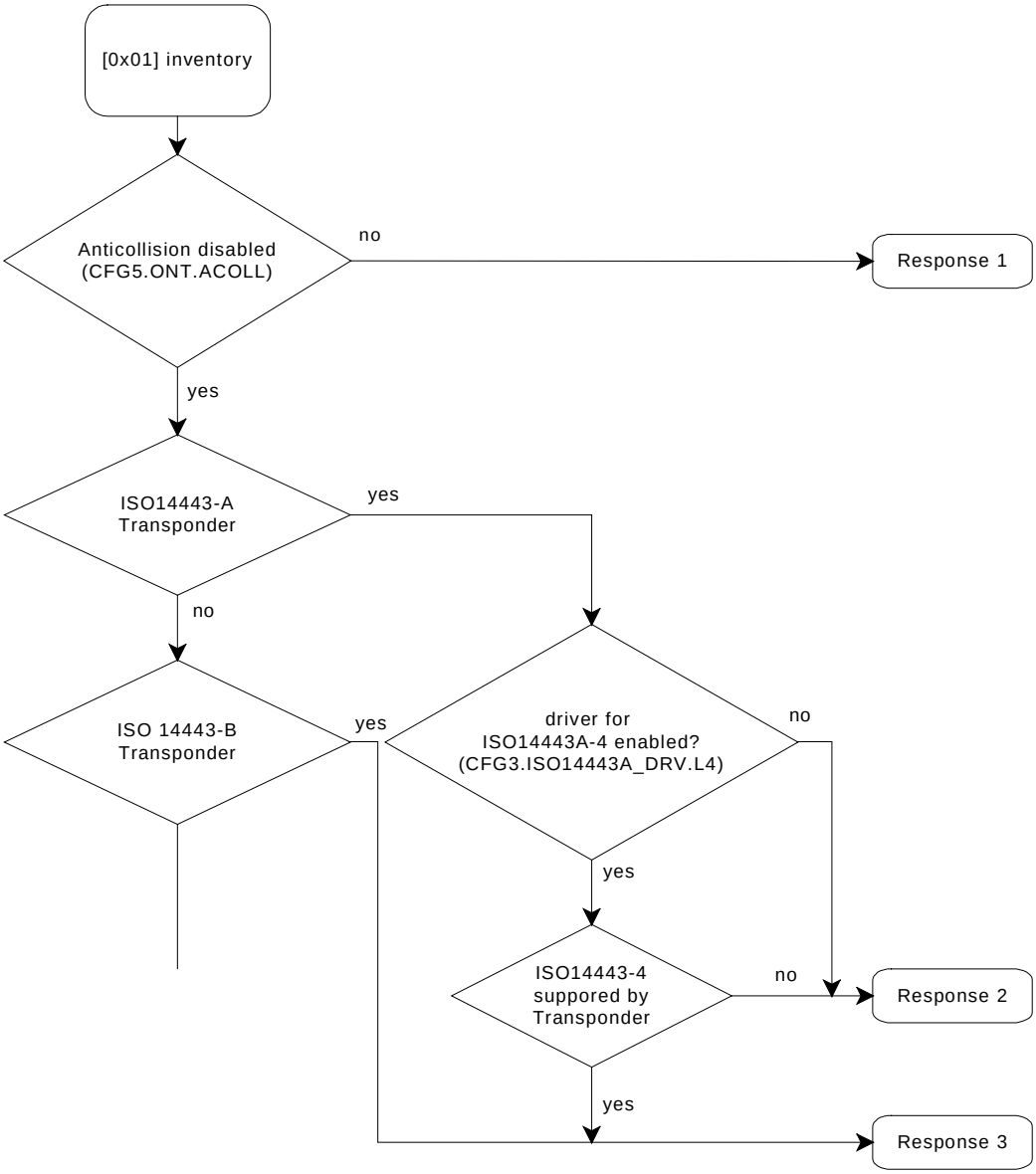
Optional fixed Chip_ID from block address 255.

UID:

64Bit UID of the Transponder.

6.1.1.6. 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 (7) (8)...13 (252) (253)
[0x25]	MODE	TR_DRV	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	DRV_SEL	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.

DRV_SEL:

b0: No extra byte TR-DRV included in request data

b1: Extra byte TR-DRV included in request data

TR_DRV:

This optional extra byte offers the possibility to select explicit a Transponder driver for the current select command.

This option may be helpfull in such cases where the reader can not detect the correct type of the transponder e.g. if a processor card emulates any kind of memory card or if NFC devices are presented.

NOTICE
Make shure that the relevant TAG-DRV and ISO14443-DRV is enabled in CFG3.

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

TR-DRIVER-SELECTION

By means of this parameter the host application explicit selects an internal driver to handle the data exchange with the addressed transponder.

TR-DRIVER-SELECTION	Selected Transponder driver
0x01	ISO 14443-4
0x02	mifare classic
0x03	mifare Ultraligh (e.g. NFC Card Type 2,)
0x04 (*	mifare plus SL1
0x05 (*	mifare plus SL1 - ISO14443-4
0x06 (*	mifare plus SL2
0x07 (*	mifare plus SL2 - ISO14443-4
0x08 (*	mifare plus SL3
0x09 (**	mifare DESFire
0x0A	Infineon my-d proximity

*) Available only with special mifare plus crypto firmware
**) vailable only with special mifare DESFire crypto firmware

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.***
- ***I-Code1 Transponders cannot be read in the selected 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.

NOTICE:
To perform write operation on JEWEL Transponder it is recommended to set MIN_LVL (see 3.4. CFG3: RF-Interface) manual to a value > 8.

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***

6.2. [0xB0] ISO 14443 Standard Host Commands

6.2.1. [0xC0] Halt

This command sets one ISO14443-3 Transponder into Halt State.

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
[0xC0]	MODE

MODE:

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

ADR:

b010 selected

NOTICE:

- ***If anticollision is enabled the Reader sets the Transponder into the Halt status itself.***

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 classic 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 9.2.2. NXP - Mifare classic: mini, 1k, 4k / mifare plus

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 classic 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 9.2.2. NXP - Mifare classic: mini, 1k, 4k / mifare plus

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.

6.3.3. [0xB2] Authent Mifare Ultralight C

Before access is given to the data stored in the secured memory of a mifare Ultralight C transponder, the user have to prove his permission for the requested operation. The key for authentication used by the reader can stored into the readers EEPROM or RAM (see: 4.6. [0xA3] Write DES/AES Reader Keys).

REQUEST-DATA

4	5	6
[0xB2]	MODE	READER-KEY-NDX

MODE:

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

ADR:

b010 selected

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

Only keys with* AUTH-MODE = *1 can be used for mifare Ultralight C.

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 $\Rightarrow$ 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.

7. Special Commands for Transponder Communication

7.1. [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

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:

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

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.

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. The TIMEOUT value can be adjusted in 1ms steps.

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

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.

RSP-BITS:

Number of valid Bits in RESPONSE-DATA

NOTICE:

- ***Data is only transferred if STATUS = 0x00, 0x02, 0x83, 0x84, 0x94.***
- ***The response data ever contains the in RSP-LENGTH defined number of data bytes.***

7.2. [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]	0x00 (reserved)	RSP-LENGTH

7	8	9	10...n-2	n-1,n
TIMEOUT	FRAME	CRC-INFO	REQUEST-DATA	CRC16

Host ← Reader

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

RSP-LENGTH:

Length of the transponder response in bit without SOF, CRC 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. The TIMEOUT value can be adjusted in 1ms steps.

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 lenght 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

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.***
- ***The response data ever contains the in RSP-LENGTH defined number of data bytes.***

7.3. [0xBC] Command Queue (#)

This command can be used for sending multiple commands within one protocol frame to the reader to speed up the total processing time. It is like a container for a queue of different commands which should be processed by the reader sequentially.

Host → Reader

1	2	3	4	5
n	COM-ADR	[0xBC]	MODE	CMD_NO

6....n-2	n-1,n
CMD_QUEUE	CRC16

Host ← Reader

1	2, 3	4	5	6	7
STX	n	COM-ADR	[0xBC]	0x00	CMD_CNT

8....n-2	n-1,n
RESPONSE-DATA	CRC16

NOTICE:
This command can be used only with commands for Transponder communication as described in chapters 6.1. [0xB0] ISO Standard Host Commands, 6.2. [0xB0] ISO 14443 Standard Host Commands and 6.3. [0xB2] ISO14443 Special Host Commands.

MODE:

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

CMD_NO:

Specifies the number of commands which are included in the queue.

CMD_QUEUE:

This field contains the command queue which should be processed by the reader. The structure of a command in queue is identical with the structure of the not queued command, as described in this manual, but without the both CRC16 characters.

CMD.1			
1	2	3	(4...LNG)
CMD_LNG	-	COMMAND BYTE	DATA

...

CMD.CMD_NO			
1	2	3	(4...LNG)
CMD_LNG	-	COMMAND BYTE	DATA

CMD_LNG:

Number of command bytes including CMD_LNG.

COMMAND-BYTE:

Defines the command which the reader should operate.

DATA:

Optional data field with variable length. The number of DATA byte depends on the command.

CMD_CNT:

Indicates the processing step where the reader had stopped the queue processing.

RESPONSE-DATA:

The RESPONSE-DATA field includes the response of the at last operated command of the command queue. This means that the RESPONSE-DATA includes the status and/or data of that command which could be operated at last. If an error occurs while operation of any queued command the queue proceeding will be interrupted and the error status of this last command is send back in the RESPONSE-DATA field.

The structure of the RESPONSE-DATA is identical with the structure of the not queued RESPONSE-DATA as documented in this manual, but without the both CRC16 characters.

1	**2**	3	4	(5...LNG)
RSP_LNG	COM_ADR	COMMAND BYTE	Status[1]	DATA

RSP_LNG:

Number of response bytes including RSP_LNG.

COMMAND-BYTE:

Command which was operated by the reader at least.

DATA:

Optional data field with variable length. The number of DATA byte depends on the command.

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

EXAMPLE:

The commands
1. [0xB0][0x25] select,
2. [0xB2] [0xB0] authent mifare and
3. [0xB0][0x23] read multiple blocks
should be operated within one queue.

Host → Reader

1	2	3	4	5
0x23	COM-ADR	[0xBC]	0x00	0x03

SELECT			
6	7	8	9...18
0x0D	0x00	[0xB0]	[0x25] 0x01 0x00 0x00 0x00 0x00 0x6C 0x29 0xA7 0x62

Authent Mifare, DB_ADR: 4, KEY_TYP: A, KEY_ADR: 0			
19	20	21	22...26
0x08	0x00	[0xB2]	[0xB0] 0x02 0x00 0x00 0x00

Read Multiple Blocks, DB_ADR: 4, DB_N: 1			
27	28	29	30...33
0x07	0x00	[0xB0]	[0x23] 0x02 0x04 0x01

34...35
CRC16

Host ← Reader

1	2, 3	4	5	6	7
STX	n	COM_ADR	COMMAND	STATUS	CMD_CNT
0x02	0x0020	00	[0xBC]	0x00	0x03

8....30
RESPONSE-DATA
0x17 0x00 0x[B0] 0x00 0x01 0x10 0x00 0x74 0x73 0x65 0x54 0x20 0x6E 0x69 0x65 0x20 0x74 0x73 0x69 0x20 0x73 0x61 0x44

31...32
CRC16

8. [0xC0] SAM Commands

The [0xC0] commands are supposed for communication with SAMs (security application modules) which could be installed inside the reader, if the reader type is equipped with a SAM socket. CPU-based SAM with T0= and/or T=1 protocol are supported as defined in ISO7816-4.

The SAM interface has implemented only the common functionality of a smartcard reader. Smartcard functions as WTX handling, chaining and some error recovering proceedings are not implemented into the reader firmware and have do done by the host computer or device driver on host side.

Host → Reader

1	2	3	4	5	6...n-2	n-1,n
n	COM-ADR	[0xC0]	SLOT	SC_TIMEOUT	REQUEST-DATA	CRC16

Host ← Reader

1	2	3	4	5...n-2	n-1,n
n	COM-ADR	[0xC0]	STATUS	RESPONSE-DATA	CRC16

SLOT:

Defines the physical address of the requested smartcard slot.
1: addresses the smartcard in Slot 1 (SD1)
2: addresses the smartcard in Slot 2 (SD2)

SC_TIMEOUT:

Defines the individual timeout for the current command. If the reader can not finish the current command within the defined SC_TIMEOUT it will respond an timeout error.

0: - do not use -

1..255: timeout in 100 ms increments.

The host application has to consider the SC_TIMOUT for setting the timeout on host side.

REQUEST-DATA:

Command specific request (see sub-commands in the following chapters)

RESPONSE-DATA:

Command specific response

8.1. [0x01] SAM Activate / Deactivate

With This command a smartcard can be activated and deactivated and also the protocol selection can be performed.

The activation and protocol selection is the first smartcard command which has to be proceeded in a communication cycle with a smartcard.

Activate / Deactivate

REQUEST-DATA

4	5	(6)
[0x01]	MODE	EXT_TA1

RESPONSE-DATA

4	(5...n-2)
STATUS[1]	ATR

MODE:

Bit:	7	6	5	4	3	2	1	0
Function	0	0	0	0	SET_TA1	0	ACTIVATE	

ACTIVATE

With this parameter the smartcard activation or deactivation and the protocol selection can be done.

In case of an activation command the reader response includes the ATR (Answer to Reset) of the card and/or an error status. The supported baudrates are shown in ANNEX F: Supported SAM Baud Rates.

b00 Deactivation
This setting powers off the addressed smartcard.

b01 T=0 protocol activation
This setting powers up the smartcard and performs a smartcard reset and attempts to activate the T=0 protocol of the card, if this protocol is supported by the card.

b11 T=1 protocol activation
This setting powers up the smartcard and performs a smartcard reset and attempts to activate the T=1 protocol of the card, if this protocol is supported by the card.

b10 GetATR
This setting activates the addressed smartcard temporary and can be used to evaluate ATR string of the inserted smartcard.

Notice:
This mode deactivates an activated smartcard.

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

SET_TA1:

If this bit is set the optional parameter EXT_TA1 must inserted into the command

EXT_TA1:

By using this optional parameter it will be possible for the application to select an explicit SAM Baud Rate. The structure of EXT_TA1 is equal to the TA(1) byte of ISO 7816-3.

The supported baudrates are shown in ANNEX F: Supported SAM Baud Rates

Bit:	7	6	5	4	3	2	1	0
Function	Fi				Di			

Fi:

Indicator value of the clock rate conversion factor according ISO 7816-3.

Di:

Indicator value of the baud rate adjustment factor according ISO 7816-3.

8.2. [0xBD] T=0 Data Exchange

This command is to exchange APDU (Application Protocol Data Unit) command and response pairs with the smartcard by using the T=0 protocol.

Before performing this command the T=0 protocol has to be selected and the smartcard has to activated by using the SAM Activate / Deactivate command (see 8.1. [0x01] SAM Activate / Deactivate).

REQUEST-DATA

4	5	6	7	8	9
[0xBD]	MODE	CLA	INS	P1	P2

10	(11....11+P3-1)
P3	DATA

RESPONSE-DATA

4	(5...5+P3-1)	n-3	n-2
STATUS[1]	DATA	SW1	SW2

MODE:

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

TR_REC:

This bit specifies the data transfer direction of the current command.

b0: Transmit data to SAM

b1: Receive data from SAM

CLA:

APDU instruction class byte.

INS:

APDU instruction

P1:

APDU parameter byte 1

P2:

APDU parameter byte 2

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

P3:

Definition according ISO7816 part 3

>0 Defines the number of bytes to be transferred during the command.

=0 depending on TR_REC:

TR_REC: = b0 (transmit data)
Introduces no data transfer.

TR_REC: = b1 (receive data)
Introduces a 256 byte data transfer from the smartcard.

DATA:

APDU command or response data.

SW1, SW2:

Status Code returned by the card.

8.3. [0xBE] T=1 Data Exchange

This command is to exchange APDU (Application Protocol Data Unit) command and response pairs with the smartcard by using the T=1 protocol.

Before performing this command the T=1 protocol has to be selected and the smartcard has to activated by using the SAM Activate / Deactivate command (see 8.1. [0x01] SAM Activate / Deactivate).

REQUEST-DATA

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

RESPONSE-DATA

4	(5...n-2)
STATUS[1]	(RSP_DATA)

MODE:

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

REQ_DATA:

The REQ_DATA Field could be used to transfer T=1 APDU and has to build by the optional NAD, PCB, LEN, INF Field of the communication protocol.

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

The EDC field is build internally by the reader

RSP_DATA:

Response to the T1 block from the card (if any).

The EDC field is not included in RSP_DATA.

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

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. ISO14443A & B Part 4 compliant Transponder

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	-	-	√	

9.2. ISO14443A Part 3 compliant Transponder

9.2.1. Infineon - my-d proximity SLE55Rxx

Memory organization:

SLE55R04: 616 bytes

Number of blocks	82	max. user area: 5...81 min. user area: 32...81
Block size	8 / (10) byte	

SLE55R08: 1024 bytes

Number of blocks	133	max. user area: 5...132 min. user area: 32...132
Block size	8 / (10) byte	

SLE55R16: 2048 bytes

Number of blocks	261	max. user area: 5...260 min. user area: 32...260
Block size	8 / (10) byte	

Command Code	Function	Mode			Comment
		non-addressed	addressed	selected	
[0xB0] [0x01]	Inventory	-	-	-	
[0xB0] [0x23]	Read Multiple Blocks	-	-	√	DB-Size = 8
[0xB0] [0x24]	Write Multiple Blocks	-	-	√	DB-Size = 8
[0xB0] [0x25]	Select	-	√	-	
[0xB0] [0xC0]	Halt	-	-	√	

9.2.2. NXP - Mifare classic: mini, 1k, 4k / mifare plus (Level 1)

Memory organization:

mifare classic mini (MF1 S20)

Number of blocks	20	user area: 14
Block size	16 byte	

mifare classic 1k (MF1 IC S50)

Number of blocks	64	user area: 47
Block size	16 byte	

mifare classic 4k (MF1 IC S70)

Number of blocks	256	user area: 215
Block size	16 byte	

mifare plus 2k (MF1PLUS60)

Number of blocks	128	user area: 95
Block size	16 byte	

mifare plus 4k (MF1PLUS80)

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.***

DB_ADR calulation methode:

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 **MF1 PLUS 80**	Sector 0 ... 31: DB_ADR = MIFARE_SECTOR * 4 + MIFARE_BLOCK Sector 32 ... 39: DB_ADR = (MIFARE_SECTOR - 32) * 16 + MIFARE_BLOCK + 128
MF1 PLUS 60	Sector 0 ... 31: DB_ADR = MIFARE_SECTOR * 4 + MIFARE_BLOCK

9.2.3. NXP - Mifare Ultralight

Memory organization (MF0U10 / MF0U11): 16 x 4 byte = 64 byte

Number of blocks	16	user area: 12
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	-	-	√	

9.2.4. NXP - Mifare Ultralight C

Mifare Ultralight C (MF0 IC U2): 48 x 4 byte = 192 byte

Number of blocks	48	user area: 36
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	-	-	√	
[0xB2][0xB2]	Authent Mifare Ultralight C	-	-	√	

9.3. ISO14443A Part 2 compliant Transponder

9.3.1. Innovision - Jewel

Memory organization:

IRT5001W / IRT5001E

Number of blocks	120	user area: 8...104; (113...120)
Block size	1 byte	

Command Code	Function	Mode			Comment
		non-addressed	addressed	selected	
[0xB0] [0x01]	Inventory	-	-	-	
[0xB0] [0x23]	Read Multiple Blocks	-	√	-	
[0xB0] [0x24]	Write Multiple Blocks	-	√	-	WRITE-ERASE and WRITE-NO-ERASE

NOTICE:
In case of write operations closely to the reader antenna it could be helpful to increase the MIN_LVL Parameter (see: 3.4. CFG3: RF-Interface).

9.4. ISO14443-B Part 2/ -3 compliant Transponder

9.4.1. STMicroelectronics - SR176

Memory organization:

Number of blocks	16	user area: 4...14; (15)
Block size	2 byte	

Command Code	Function	Mode			Comment
		non-addressed	addressed	selected	
[0xB0] [0x01]	Inventory	-	-	-	
[0xB0] [0x23]	Read Multiple Blocks	-	-	√	
[0xB0] [0x24]	Write Multiple Blocks*	-	-	√	
[0xB0] [0x25]	Select	-	√	-	

* The reader internally performs a read after write before acknowledging the command.

9.4.2. STMicroelectronics - SRIxx

Memory organization:

SRI512 / SRIX512:

Number of blocks	17	user area: 0...15; (255)
Block size	4 byte	

SRI4K / SRIX4K:

Number of blocks	129	user area: 0...127; (255)
Block size	4 byte	

Command Code	Function	Mode			Comment
		non-addressed	addressed	selected	
[0xB0] [0x01]	Inventory	-	-	-	
[0xB0] [0x23]	Read Multiple Blocks	-	-	√	
[0xB0] [0x24]	Write Multiple Blocks*	-	-	√	
[0xB0] [0x25]	Select	-	√	-	

* The reader internally performs a read after write before acknowledging the command.

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)

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.M03 (586/#)
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
0x93	**Data Buffer Overflow:** • There are more Transponders in reader field than could be handled by the reader (refer ANNEX D: Compendium of Supported Commands and Functions).
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)
0x97	**Crypto Processing Error** • An additional code for source and reason of the error is sent with response data (See: ANNEX C1: Crypto Processing Error - ERROR-CODE

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 C1: Crypto Processing Error - ERROR-CODE

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 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 D: Compendium of Supported Commands and Functions

This annex is a short compendium of the supported commands and functions of each type of reader depending on reader hardware and firmware version

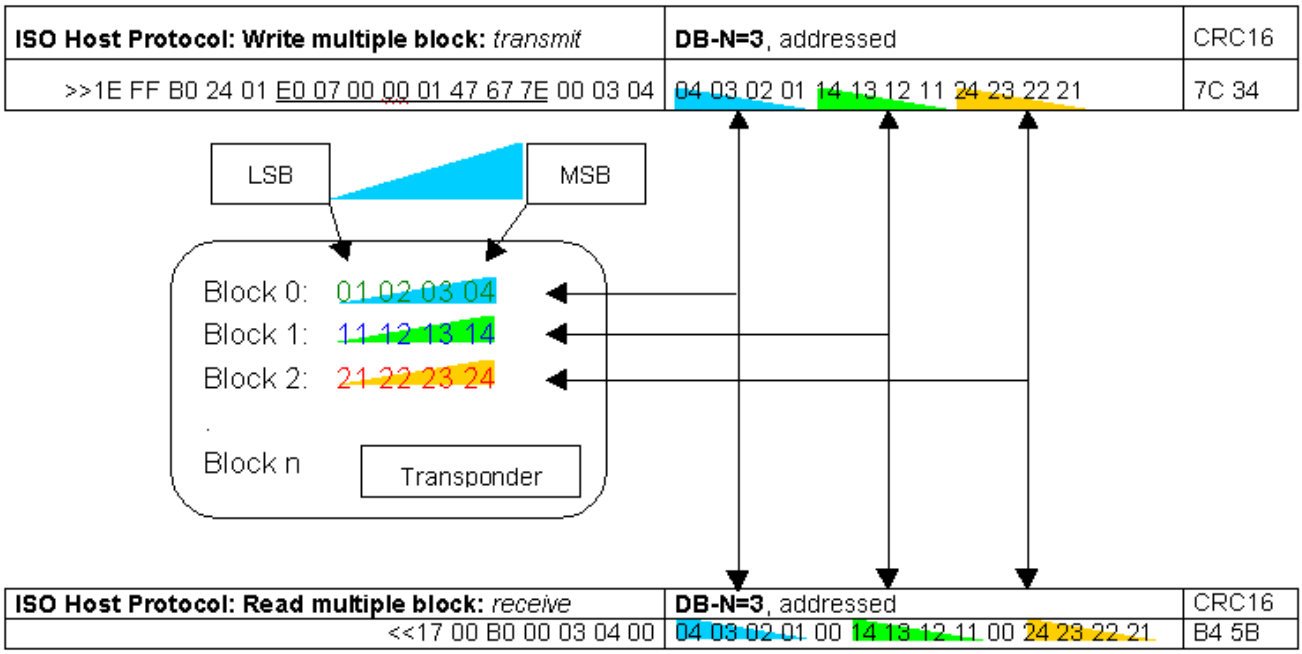
Description	ID CPR40.00-CD	ID CPR40.01-CD	ID CPR40.00-A	ID CPR40.01-A	ID CPR40.00-CS	ID CPR40.01-CS	ID CPR40.00-UCD	ID CPR40.01-CDUSB	ID CPR40.30-USB	ID CPR40.30-SUSB
5.1. [0x52] Baud Rate Detection	●	●	●	●	●	●	●	●	●	●
5.2. [0x55] Start Flash Loader	●	●	●	●	●	●	●	●	●	●
5.3. [0x63] CPU Reset	●	●	●	●	●	●	●	●	●	●
5.4. [0x65] Get Software Version	●	●	●	●	●	●	●	●	●	●
5.5. [0x66] Get Reader Info	●	●	●	●	●	●	●	●	●	●
5.6. [0x69] RF Reset	●	●	●	●	●	●	●	●	●	●
5.7. [0x6A] RF Output ON/OFF	●	●	●	●	●	●	●	●	●	●
4.1. [0x80] Read Configuration	●	●	●	●	●	●	●	●	●	●
4.4. [0x83] Set Default Configuration	●	●	●	●	●	●	●	●	●	●
4.5. [0xA2] Write Mifare Reader Keys	●	●	●	●	●	●	●	●	●	●
4.6. [0xA3] Write DES/AES Reader Keys	●	●	●	●	●	●	●	●	●	●
ISO Host-Mode (see 3.2. CFG1: Interface)	●	●	●	●	●	●	●	●	●	●
Scan-Mode (see 3.2. CFG1: Interface)	●	●	●	●	●	●	●	●	●	●
6.1. [0xB0] ISO Standard Host Commands										
6.1.1. [0x01] Inventory	●	●	●	●	●	●	●	●	●	●
6.1.2. [0x25] Select	●	●	●	●	●	●	●	●	●	●
6.1.3. [0x23] Read Multiple Blocks	●	●	●	●	●	●	●	●	●	●
6.1.4. [0x24] Write Multiple Blocks	●	●	●	●	●	●	●	●	●	●
6.2. [0xB0] ISO 14443 Standard Host Commands										
6.2.1. [0xC0] Halt	●	●	●	●	●	●	●	●	●	●
6.3. [0xB2] ISO14443 Special Host Commands										
6.3.1. [0x30] Mifare Value Commands	●	●	●	●	●	●	●	●	●	●
6.3.2. [0xB0] Authent Mifare	●	●	●	●	●	●	●	●	●	●
6.3.3. [0xB2] Authent Mifare Ultralight C	●	●	●	●	-	-	●	●	●	-
6.3.4. [0xBE] ISO 14443-4 T=CL (#)	●	●	●	●	●	●	●	●	●	●
6.3.5. [0xBF] ISO 14443-4 Container Command (#)	●	●	●	●	●	●	●	●	●	●
6.3.6. [0x2B] ISO14443-4 Transponder-Info	●	●	●	●	●	●	●	●	●	●
7.1. [0xBD] ISO14443A Transparent Command	●	●	●	●	●	●	●	●	●	●
7.2. [0xBE] ISO14443B Transparent Command	●	●	●	●	●	●	●	●	●	●
8. [0xC0] SAM Commands										
8.1. [0x01] SAM Activate / Deactivate	-	-	-	-	●	●	-	-	-	●
8.2. [0xBD] T=0 Data Exchange	-	-	-	-	●	●	-	-	-	●
8.3. [0xBE] T=1 Data Exchange	-	-	-	-	●	●	-	-	-	●

● supported
– not available

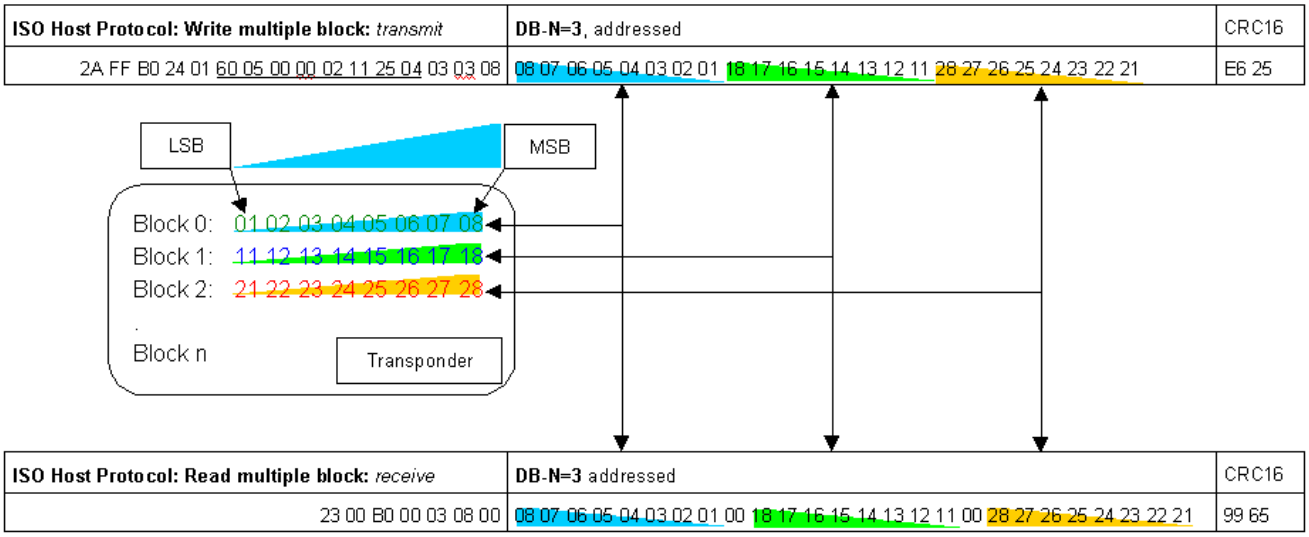
ANNEX E: Examples for Read Data

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)



ANNEX F: Supported SAM Baud Rates

The following baud rates are supported by the reader depending on transmission factors FI and DI of TA(1) parameter according ISO7816-3.

	FI											
DI	**b0000**	**b0001**	**b0010**	**b0011**	**b0100**	**b0101**	**b0110**	**b1001**	**b1010**	**b1011**	**b1100**	**b1101**
b0001	9600	9600	6400	4800	3200	2400	1920	9600	6400	4800	3200	2400
b0010	19200	19200	12800	9600	6400	4800	3840	19200	12800	9600	6400	4800
b0011	38400	38400	25800	19200	12800	9600	7680	38400	25600	19200	12800	9600
b0100	76800	76800	-	38400	25600	19200	15360	76800	51200	38400	25600	19200
b0101	-	-	-	76800	-	38400	-	153600	102400	76800	51200	38400
b0110	-	-	-	-	-	76800	-	307200	-	153600	102400	76800
b1000	115200	115200	-	57600	38400	28800	23040	-	76800	-	38400	-
b1001	-	-	-	-	-	-	38400	-	-	-	-	-

RFU parameters according ISO7816-3 are not shown in the table

Supported SAM Baud Reates:

1920, 2400, 3200; 3840, 4800, 6400, 7680, 9600, 12800, 15360, 19200, 23040, 25600, 28800, 38400, 51200, 57600, 76800, 102400, 115200, 153600, 307200