SIGMATEK

HF-RFID

Reader Module

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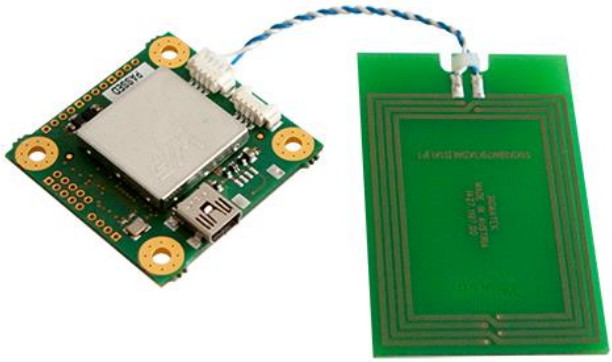
HF-RFID Reader



Contents

1 Technical Data

1.1 RFID Specification

Protocol	ISO15693 ISO14443A ISO14443B B3
Supported cards	Mifare Ultralight / Ultralight C Mifare Classic Mini / 1K / 4K Mifare Desfire EV1 2K, 4K 8K Mifare Pro, Plus ISO15693 NXP ICOD SLI, TI TagIT, standard cards
RF power	100 mW
Operating frequency	13.56 MHz
Reading distance	up to 12 cm (depending on the tag, antenna and ambient conditions)
Write distance	circa 70 % or the read distance
Host interface	USB CDC (Virtual Serial Port) Default 57600 Baud
IO pins	3 software controllable GPIO pins
Antenna	external via Molex Pico Blade article No. 0532610471
Driver	Windows
Dimensions	41.00 mm x 37.70 mm x 6.50 mm (W x H x D)

1.2 Electrical Requirements

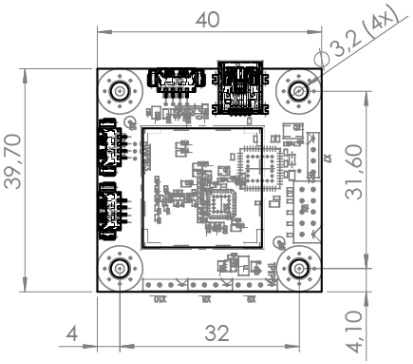
Supply voltage	5 V DC ±5 % (via USB)
Current consumption	maximum 100 mA

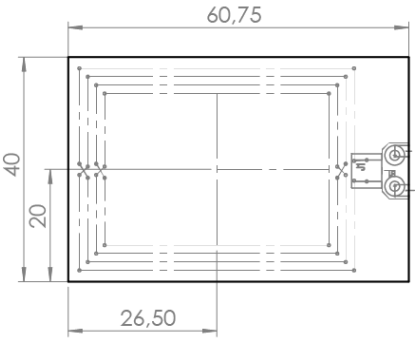
1.3 Environmental Conditions

Storage temperature	-20 ... +85 °C
Operating temperature	0 ... +55 °C
Humidity	0 - 95 %, non-condensing
EMV resistance	in accordance with EN 61000-6-2 (industrial area)
EMC - noise generation	in accordance with EN 61000-6-4 (industrial area)
Radio Communication Conformity Europe	ETSI EN 302 291
Radio Communication Conformity USA	FCC CFR 47 Part 15

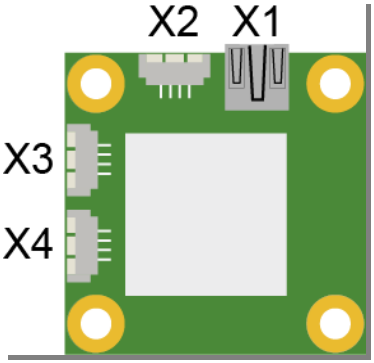
Product safety	EN 60950-1:2006

2 Mechanical Dimensions





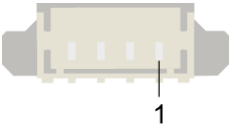
3 Connector Layout



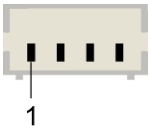
X1: USB-Device 2.0 (Type Mini-B)

Pin	Function
1	+5 V
2	D-
3	D+
4	n.c.
5	GND

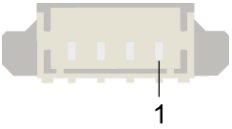
X2: USB Device 2.0 (4-pin Molex Pico Blade)



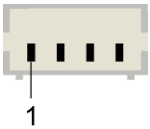
Pin	Function
1	GND
2	D+
3	D-
4	+5 V



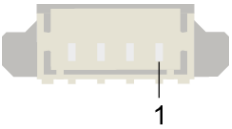
X3: UART (4-pin Molex Pico Blade)



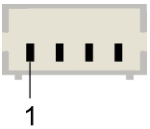
Pin	Function
1	+5 V
2	TXD
3	RXD
4	GND



X4: Antenna (4-pin Molex Pico Blade)



Pin	Function
1	RFO 2
2	GND
3	GND
4	RFO 1



3.1.1 Applicable Connectors

X1: USB 2.0 (Type A) (not included in delivery)
X2: 4-pin Molex Pico Blade - 51021-0400
X3: 4-pin Molex Pico Blade - 51021-0400
X4: 4-pin Molex Pico Blade - 51021-0400

4 Protocol Description

The protocol is always the same and independent of the interface used.

4.1 Structure Packet

All packets between the reader and host have the same structure and must be interpreted the same.

Description	Number	Short description	Color
Instruction	1 byte	CMD	Blue
status	1 byte	STC	red
Data length	2 bytes	DLI	Orange
DATA	variable	Data	green
Checksum	1 byte	CS	Black

Instruction The field command describes which command should be run. This is described in chapter 5.

Status: This byte is always 0x00 for commands from the host to the RFIE reader. The status is used exclusively as a return value for the reader and indexes the status of the currently executed commands.

Data Length: The "Data length" indicates how much payload data is transferred after this byte.

Data: The payload data to evaluate.

Checksum: The checksum is used to verify the transferred data. More information can be found in chapter 4.4.

4.2 Example of Communication

As an example, the command 0x02 – Get Software-Revision is used here.

4.2.1 From Host to RFID Reader

Byte No.	Number	Contents	Data Sent	Value	Description
0	1 byte	CMD	0x02		Command 0x02 "Get Software Revision"
1	1 byte	STC	0x00		Status code for read always 0x00
2 – 3	2 bytes	DLI	0x00, 0x00		Data length
4	1 byte	CS	0x02		Data checksum

4.2.2 From RFID Reader to Host

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x02	Command 0x02 "Get Software Revision"
1	1 byte	STC	0x00	status code from the host to the reader
2 – 3	2 bytes	DLI	0x00, 0x00	Data length
4 – 7	4 bytes	Data	0x00, 0x01, 0x00, 0x06	Software Revision 01.06
8	1 byte	CS	0x3D	Checksum

4.3 Breakdown of the Status Bytes

Here, the status bytes and there meanings are explained.

Name	Value	Description
ERR_RET_SUCCESS	0x00	The command was successfully executed
ERR_ET_PARM	0x01	The wrong parameter was sent
ERR_RET_DATA_PUSH	0x02	The wrong data were sent
ERR_RET_CMD_INVALID	0x03	The command used does not exist
ERR_RET_CRC_ERR	0x04	The Checksum is defective
ERR_RET_LENGTH	0x05	The wrong data length was entered
ERR_RET_CMD_DATA	0x06	The data length and transmitted data do not match
ERR_RET_CALIBRATE_ANT	0x0F	The antenna could not be calibrated
ERR_RET_TIMEOUT	0x10	A time out event has occurred
ERR_RET_FIFO_DATA	0x11	No data in FIFO
ERR_RET_COLLISION	0x12	Card collision
ERR_RET_EXEC_CMD	0x13	Error while executing a command

ERR_RET_CARD_NOT_SUPPORTED	0x14	The RFID card is not supported
ERR_RET_AUTH	0x15	Login with card failed

4.4 Card Types for Protocol Handling

4.4.1 Protocol

See Enumerators Table, Chapter 4.6

Norm	Value	Example	Version
ISO14443A	0x00	Mifare Classic 1K	
ISO14443B	0x01	NFC Label such as SRI512	
ISO15693	0x02	NXP ICode SLI	
Unknown card	0xFF	unidentified card	

4.4.2 Card type

See Enumerators Table, Chapter 4.6

Card type	Value	Example	Version
Mifare Ultralight	0x00	NXP MF0ICU1	
Mifare Mini	0x01	NXP MF1ICS20	
Mifare Classic 1K	0x02	NXP MF1S503	
Mifare Classic 4K	0x03	NXP MF1S70	
Mifare Plus	0x04	MF1 S PLUS60	
Mifare DESFire	0x05	MF3 IC D41	
Mifare ISO14443A-4	0x06		
ISO14443B Srix	0x07		
ISO14443B Srix 176	0x08		
ISO15693 (default)	0x09	NXP ICode SLI, TI TagIT	
Unknown card	0xFF	unidentified card	

4.5 Checksum

The checksum is an XOR from all bytes. This is calculated as follows:

Example command "Scan Tags – 0x06"

4.5.1 Data Configuration Example

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x06	Command "Scan Tags"
1	1 byte	STC	0x00	Status code for read always 0x00
2 – 3	2 bytes	DLI	0x01, 0x00	Data length
4	1 byte	Data	0x00	Card type
5	1 byte	CS	0x07	Data checksum

Below the data (0x06 0x00 0x01 0x00 0x02) that should be sent to the reader can be seen. Before the data are sent, the checksum (byte 5) must be formed.

The checksum in an XOR or each subsequent byte.

Bytes	Number
0x06 0x00 0x01 0x00 0x02	data to send (command, status...)
0x06 ⊻ 0x00 ⊻ 0x01 ⊻ 0x00 ⊻ 0x02	XOR calculation
0x05	Checksum
0x06 0x00 0x01 0x00 0x02 **0x05**	data to send including the checksum

$\veebar = \mathrm{XOR}$

5 Overview of the Available Commands

5.1 General Reader Commands

Instruction	Value	Description	Version
GET-Reader Name	0x00	Calls the reader name	
GET-Product Name	0x01	Calls the product name	
GET-Software Rev.	0x02	Calls the software version	
GET-Hardware Rev.	0x03	Calls the hardware version	
GET-Bootloader Rev.	0x04	Calls the booloader version	
Calibrate_Antenna	0x05	Calibrates the antenna	
GET-Feature	0x10	Calls the available functions	
SET-RSSI	0x11	Activates the RSSI value transition	
GPIO_Commands	0x0F	Enables the control of GPIOs	

5.2 General Transponder Commands

General commands that can be used in all tags.

Instruction	Value	Description	Version
Scan_Tags	0x06	Searches for tags that are in range.	
Select_Tag	0x07	Selects a tag	
Deslect_Tag	0x08	Deselects a tag	
Read_From_Tag	0x09	Reads data from a tag	
Write_To_Tag	0x0A	Writes data to a tag	

5.3 Tag-specific Commands

The tag-specific commands are limited to a tag group or type.

Instruction	Value	Description	Version
Option_Tag	0x0B	See chapter 7.9 (ISO15693 only)	

5.4 DESFire-Commands

This command is used with Mifare DESFire cards. More information can be found in the DESFire standards documentation.

Please reference the NXP documentation for the DESFire standard

Instruction	Value	Description	Version
Get ATS	0x0C	Call answer from the card for select	
Set PPC	0x0D	Sets communication parameters	
Execute Command	0x0E	Executes a command on a DESFire card	

6 Detailed Description of the Commands

6.1 Get-Reader Name – 0x00

The command returns the reader name.

6.1.1 From Host to RFID Reader

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x00	Command "Get-Reader Name"
1	1 byte	STC	0x00	Status code for read always 0x00
2 – 3	2 bytes	DLI	0x00, 0x00	Data length
4	1 byte	CS	0x00	Data checksum

6.1.2 From RFID Reader to Host

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x00	Command "Get-Reader Name"
1	1 byte	STC	0x00	status code from reader, see chapter 4.3
2 – 3	2 bytes	DLI	0x00, 0x00	Data length
x	x byte	Data	0xFF, 0xFF, 0xFF	Reader name as ASCII string
X + 1	1 byte	CS	0x3D	Checksum

6.1.3 Example

Host to Reader: 0x00 0x00 0x00 0x00 0x00
Reader to Host: 0x00 0x00 0x05 0x00 0x52 0x2D 0x4F 0x45 0x4D 0x3D

Command = 0x00 => Command "Get-Reader Name"
Status = 0x00 => action error-free
Data length = 0x05 0x00 => 5 bytes
Data = 0x52 0x2D 0x4F 0x45 0x4D => ASCII „R-OEM“
Checksum = 0x3D

Sent: 5 bytes
Received: 10 bytes

6.2 Get-Product Name – 0x01

The command returns the product name of the reader.

6.2.1 From Host to RFID Reader

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x01	Command "Get-Product Name"
1	1 byte	STC	0x00	Status code for read always 0x00
2 – 3	2 bytes	DLI	0x00, 0x00	Data length
4	1 byte	CS	0x01	Data checksum

6.2.2 From RFID Reader to Host

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x01	Command "Get-Product Name"
1	1 byte	STC	0x00	status code from reader, see chapter 4.3
2 – 3	2 bytes	DLI	0x00, 0x00	Data length
x	x byte	Data	0xFF, 0xFF, 0xFF	Product name as ASCII string
X + 1	1 byte	CS	0x3D	Checksum

6.2.3 Example

Host to Reader: 0x01 0x00 0x00 0x00 0x01

Reader to Host: 0x01 0x00 0x0D 0x00 data: 0x39 0x30 0x30 0x2D 0x4D 0x54 0x2D 0x53 0x65 0x72 0x69 0x61 0x6C 0x0C

Command = 0x01 => Command "Get-Product Name"
Status = 0x00 => action error-free
Data length = 0x0D 0x00=> 13 bytes
Data = data => ASCII String "900-MT-Serial"
Checksum = 0x0C

Sent: 5 bytes
Received: 18 bytes

6.3 Get-Software Revision – 0x02

The command returns the name of the software version found on the reader.

6.3.1 From Host to RFID Reader

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x02	Command "Get-Software Revision"
1	1 byte	STC	0x00	Status code for read always 0x00
2 – 3	2 bytes	DLI	0x00, 0x00	Data length
4	1 byte	CS	0x02	Data checksum

6.3.2 From RFID Reader to Host

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x02	Command "Get-Software Revision"
1	1 byte	STC	0x00	status code from reader, see chapter 4.3
2 – 3	2 bytes	DLI	0x04, 0x00	Data length
4 – 7	4 bytes	Data	0x00, 0x02, 0x00, 0x09	Software version (02.09)
8	1 byte	CS	0x0D	Checksum

6.3.3 Example

Host to Reader: 0x02 0x00 0x00 0x00 0x02

Reader to Host: 0x02 0x00 0x04 0x00 0x00 0x02 0x00 0x09 0x0D

Command = 0x02 => Command "Get-Software Revision"
Status = 0x00 => action error-free
Data length = 0x0D 0x00 => 4 bytes
Data = 0x00 0x02 0x00 0x09 => Software Revision 02.09
Checksum = 0x0D

Sent: 5 bytes
Received: 9 bytes

6.4 Get-Hardware Revision – 0x03

The command returns the hardware version of the reader.

6.4.1 From Host to RFID Reader

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x03	Command "Get-Hardware Revision"
1	1 byte	STC	0x00	Status code for read always 0x00
2 – 3	2 bytes	DLI	0x00, 0x00	Data length
4	1 byte	CS	0x03	Data checksum

6.4.2 From RFID Reader to Host

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x03	Command "Get-Hardware Revision"
1	1 byte	STC	0x00	status code from reader, see chapter 4.3
2 – 3	2 bytes	DLI	0x04, 0x00	Data length
4 – 7	4 bytes	Data	0x00, 0x01, 0x00, 0x00	Hardware version (01.00)
8	1 byte	CS	0x06	Checksum

6.4.3 Example

Host to Reader: 0x03 0x00 0x00 0x00 0x03

Reader to Host: 0x03 0x00 0x04 0x00 0x00 0x01 0x00 0x00 0x06

Command = 0x03 => Command "Get-Hardware Revision"
Status = 0x00 => action error-free
Data length = 0x04 0x00 => 4 bytes
Data = 0x00 0x01 0x00 0x00 => Hardware Revision 01.00
Checksum = 0x06

Sent: 5 bytes
Received: 9 bytes

6.5 Get-Bootloader Revision – 0x04

The command returns the bootloader revision on the reader.

6.5.1 From Host to RFID Reader

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x04	Command "Get-Bootloader Revision"
1	1 byte	STC	0x00	Status code for read always 0x00
2 – 3	2 bytes	DLI	0x00, 0x00	Data length
4	1 byte	CS	0x04	Data checksum

6.5.2 From RFID Reader to Host

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x04	Command "Get-Bootloader Revision"
1	1 byte	STC	0x00	Status code from reader, see chapter 4.3
2 – 3	2 bytes	DLI	0x04, 0x00	Data length
4 – 7	4 bytes	Data	0x00, 0x01, 0x00, 0x00	Bootloader version (01.00)
8	1 byte	CS	0x01	Checksum

6.5.3 Example

Host to Reader: 0x04 0x00 0x00 0x00 0x04

Reader to Host: 0x04 0x00 0x04 0x00 0x00 0x01 0x00 0x00 0x01

Command = 0x04 => Command "Get-BootloaderRevision"
Status = 0x00 => action error-free
Data length = 0x04 0x00 => 4 bytes
Data = 0x00 0x01 0x00 0x00 => Bootloader Revision 01.00
Checksum = 0x01

Sent: 5 bytes
Received: 9 bytes

6.6 Calibrate Antenna – 0x05

Calibrates the antenna within the range of the system limits. If the calibration fails, a specific error code is returned.

6.6.1 From Host to RFID Reader

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x05	Command "Calibrate Antenna"
1	1 byte	STC	0x00	Status code for read always 0x00
2 – 3	2 bytes	DLI	0x00, 0x00	Data length
4	1 byte	CS	0x05	Data checksum

6.6.2 From RFID Reader to Host

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x05	Command "Calibrate Antenna"
1	1 byte	STC	0x00	Status code from reader, see chapter 4.3
2 – 3	2 bytes	DLI	0x00, 0x00	Data length
4	1 byte	CS	0x05	Checksum

6.6.3 Example

Host to Reader: 0x05 0x00 0x00 0x00 0x05

Reader to Host: 0x05 0x00 0x00 0x00 0x05

Command = 0x05 => Command "Calibrate Antenna"
Status = 0x00 => action error-free
Data length = 0x00 0x00 => 4 bytes
Checksum = 0x05

Sent: 5 bytes
Received: 9 bytes

6.7 Scan Tags – 0x06

With the Scan Tags command, all available tags with the reading range of the RFID reader listed.

6.7.1 From Host to RFID Reader

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x06	command "Scan Tags"
1	1 byte	STC	0x00	Status code for read always 0x00
2 – 3	2 bytes	DLI	0x01, 0x00	Data length
4	1 byte	Data	0x00	Card type, see chapter 4.4.2!
5	1 byte	CS	0x07	Data checksum

6.7.2 From RFID Reader to Host

Byte No.	Number	Con-tents	Data Sent	Description
0	1 byte	CMD	0x06	Command "Scan Tags"
1	1 byte	STC	0x00	Status code from reader, see chapter 4.3
2 – 3	2 bytes	DLI	0xFF, 0xFF	Data length
x	x byte	Data	0xFF, 0xFF, 0xFF 0xFF	Card information
x +1	1 byte	CS	0xFF	Checksum

7 Configuration of Card Data

Block	Name		Description
0	Number of tags	1 byte	Returns the number of tags found
1	Card data length	1 byte	Returns the number of bytes contained in the card data.
2	Card type	1 byte	Indicates the card type, e.g. 0x02 = ISO15693
3	Card subtype	1 byte	Indicates the exact type of card 0x09 = ISO15693 standard
4	RSSI value	1 byte	Indicates the RSSI value of the card (receiver field strength)
5	UID length	1 byte	Indicates the UID length as follows
6	UID	X bytes	The UID

The fields marked in grey repeat for each recognized RFID card.

RSSI value: The RSSI value represents the Receiver field data

7.1 Example for 1 Card

Host to Reader: 0x06 0x00 0x01 0x00 0x02 0x07

Reader to Host: 0x06 0x00 0x0E 0x00 0x01 0x0D 0x02 0x09 0x50 0x08 UID:0xEA 0xAA 0xD9 0x7F 0x00 0x01 0x04 0xE0 0x54

Command = 0x06 => Command "Scan Tags"
Status = 0x00 => action error-free
Data length = 0x0E 0x00=> 14 bytes
Data = 0x01 => number of cards found
0x0D => card data length 12 bytes
0x02 => card **type ISO15693**
0x09 => Cards SubType ISO15693 Standard
0x50 => RSSI (If not activated, the value is 0x00)
0x08 => UID length 8 bytes
UID => EA-AA-D9-7F-00-01-04-E0
Checksum = 0x54

Sent: 6 bytes
Received: 19 bytes

7.2 Example for 2 Cards

Host to Reader: 0x06 0x00 0x01 0x00 0x02 0x07

Reader to Host: 0x06 0x00 0x1B 0x00 0x02
0x0D 0x02 0x09 0x94 0x08 UID:0x50 0x72 0xD9 0x7F 0x00 0x01 0x04 0xE0
0x0D 0x02 0x09 0x84 0x08 UID:0xEA 0xAA 0xAD 0x97 0xF0 0x01 0x04 0xE0 0x6D

Command = 0x06 => Command "Scan Tags"
Status = 0x00 => action error-free
Data length = 0x1B 0x00=> 27 bytes
Dat = 0x02 => number of cards found 2
Data card 1:
0x0D => card data length 12 bytes
0x02 => card **type ISO15693**
0x09 => Cards **SubType ISO15693 Standard**
0x50 => RSSI (If not activated, the value is 0x00)
0x08 => UID length (8 bytes)
UID => EA-AA-D9-7F-00-01-04-E0
Data card 2:
0x0D => card data length 12 bytes
0x02 => card **type ISO15693**

0x09 => Cards **SubType ISO15693 Standard**
0x84 => RSSI (If not activated, the value is 0x00)
0x08 => UID length (8 bytes)
UID => EA-AA-D9-7F-00-01-04-E0

Checksum = 0x6D

7.3 Select Tag – 0x07

This command selects the card for further operations such as read or write. As soon as a tag is selected, the HF field is active and communication with the card can be established.

7.3.1 From Host to RFID Reader

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x07	Command "Select Tag"
1	1 byte	STC	0x00	Status code for read always 0x00
2 – 3	2 bytes	DLI	0x00, 0x00	Data length
4	1 byte	Data	0x00	Length of the card data
5	1 byte	Data	0x00	Card type
6	1 byte	Data	0x00	Card subtype
7	1 byte	Data	0x00	Dummy byte with content 0x00
8 –x	Variable	Data	0x00, 0x00, 0x00, 0x00	UID of the card to select
x +1	1 byte	CS	0x00	Checksum

7.3.2 From RFID Reader to Host

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x07	Command "Select Tag"
1	1 byte	STC	0x00	Status code from reader, see chapter 4.3
2 – 3	2 bytes	DLI	0x00, 0x00	Data length
4	1 byte	CS	0x07	Checksum

7.3.3 Example

Host to Reader: 0x070x00 0x0D 0x00 0x0D 0x02 0x09 0x00 0x08 UID: 0xD5 0x4C 0xD8 0x7F 0x00 0x01 0x04 0xE0 0xDF

Command	= 0x07 => Command "Select Tag"
Status	= 0x00 => dummy byte 0x00
Data length	= 0x0D 0x00=> 14 bytes
Data	= 0x0D => card data length 12 bytes 0x02 => card **type ISO15693** 0x09 => Cards SubType ISO15693 Standard 0x00 => dummy byte with 0x00 0x08 => UID length 8 bytes UID => D5-4C-D8-7F-00-01-04-E0
Checksum	= 0xDF

Reader to Host: 0x07 0x00 0x00 0x00 0x07 = card selected successfully

7.4 DeSelect Tag – 0x08

This command deselects the previously selected card. After running, the HF field is deactivated and communication with the card is ended.

7.4.1 From Host to RFID Reader

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x08	Command "DeSelect Tag"
1	1 byte	STC	0x00	Status code for read always 0x00
2 – 3	2 bytes	DLI	0x00, 0x00	Data length
4	1 byte	CS	0x08	Data checksum

7.4.2 From RFID Reader to Host

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x08	Command "DeSelect Tag"
1	1 byte	STC	0x00	Status code from reader, see chapter 4.3
2 – 3	2 bytes	DLI	0x00, 0x00	Data length
4	1 byte	CS	0x08	Checksum

7.4.2.1 Example

Host to Reader: 0x08 0x00 0x00 0x00 0x08

Reader to Host: 0x08 0x00 0x00 0x00 0x08

Command = 0x08 => Command "DeSelect Tag"
Status = 0x00 => action error-free
Data length = 0x00 0x00 => 0 bytes
Checksum = 0x08

Sent: 5 bytes
Received: 5 bytes

7.5 Read-From Tag – 0x09

With this command, data can be read from the card. Hereby, it must be ensured that the correct communication variant is selected. This varies between in protocol between "encrypted cards" and "non-encrypted cards"

7.5.1 Description of Non-encrypted Cards

Non-encrypted cards are for example, ISO15693, Mifare Ultralight and others. The description can be found in the card specifications.

7.5.2 From Host to RFID Reader

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x09	Command "Read-From Tag"
1	1 byte	STC	0x00	Status code for read always 0x00
2 – 3	2 bytes	DLI	0x08, 0x00	Data length
4, -7	4 bytes	Data	0x04, 0x00, 0x00, 0x00	Start sector as UINT (here start sector 4)
9 - 10	4 bytes	Data	0x01, 0x00, 0x00, 0x00	Number of sectors (here 1 sector) 1 as UINT
12	1 byte	CS	0x00	Checksum

7.5.3 From RFID Reader to Host

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x07	Command "Read-From Tag"
1	1 byte	STC	0x00	Status code from reader, see chapter 4.3
2 – 3	2 bytes	DLI	0x00, 0x00	Data length
4 - X	Variable	Data	0xFF, 0xFF, 0xFF, 0xFF	the date required from the card
X +1	1 byte	CS	0x07	Checksum

7.5.4 Example of Reading Non-encrypted Cards:

Host to Reader: 0x09 0x00 0x08 0x00 Start: 0x04 0x00 0x00 0x00 Count: 0x01 0x00 0x00 0x00 0x04

Command	= 0x09=> Command "Read-From Tag"
Status	= 0x00 => dummy byte 0x00
Data length	= 0x08 0x00 => 8 bytes
Data	= Start => start reading data from sector 4
	= Count => 1 sector is read
Checksum	= 0x04

Reader to Host: 0x09 0x00 0x04 0x00 Data: 0x73 0x69 0x67 0x6D 0x1D

Command	= 0x09=> Command "Read-From Tag"
Status	= 0x00 => action error-free
Data length	= 0x04 0x00 => 4 bytes
Data	= Data => 4-byte data
Checksum	= 0x04

7.6 Description of Encrypted Cards

With this sequence of the protocol, data is read from cards with encrypted content. Example of such cards are Mifare 1K or similar. Further information on handling can be found in the data sheet of the RFID transponder.

7.6.1 From Host to RFID Reader

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x09	Command "Read-From Tag"
1	1 byte	STC	0x00	Status code for read always 0x00
2 – 3	2 bytes	DLI	0x10, 0x00	Data length
4, -7	4 bytes	Data	0x04, 0x00, 0x00, 0x00	Start sector as UINT (here start sector 4)
9 - 10	4 bytes	Data	0x01, 0x00, 0x00, 0x00	Number of sectors (here 1 sector) 1 as UINT
12	1 byte	Data	0x00	KeyType (0x00 = KeyA, 0x01 = KeyB)
13	1 byte	Data	0x06	Length of the keys (here 6 bytes)
14 -19	6 bytes	Data	0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF	key
20	1 byte	CS	0x1A	Checksum

7.6.2 From RFID Reader to Host

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x07	Command "Read-From Tag"
1	1 byte	STC	0x00	Status code from reader, see chapter 4.3
2 – 3	2 bytes	DLI	0x00, 0x00	Data length
4 - X	Variable	Data	0xFF, 0xFF, 0xFF, 0xFF	the date required from the card
X +1	1 byte	CS	0x07	Checksum

7.6.3 Examples of Reading Encrypted Cards:

Host to Reader: 0x09 0x00 0x10 0x00 Start: 0x04 0x00 0x00 0x00 Count: 0x01 0x00 0x00 0x00 0x00 0x06 Key: 0xFF 0xFF 0xFF 0xFF 0xFF 0xFF 0x1A

Command	= 0x09=> Command "Read-From Tag"
Status	= 0x00 => dummy byte 0x00
Data length	= 0x08 0x00 => 8 bytes
Data	= Start => start reading data from sector 4
	= Count => 1 sector is read
	= 0x00 => Key Type (0x00 = KeyA, 0x01 = KeyB)
	= 0x06 => Key length 6 bytes
	= Key => FF-FF-FF-FF-FF-FF
Checksum	= 0x1A

Reader to Host: 0x09 0x00 0x10 0x00 Data: 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x19

Command	= 0x09=> Command "Read-From Tag"
Status	= 0x00 => action error-free
Data length	= 0x10 0x00=> 16 bytes
Data	= Data => 16-byte data
Checksum	= 0x04

With a Mifare 1K tag, 16 bytes are returned due to the memory organization per sector (4 bytes).

Sector	Block	Byte Number within a Block 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Description
15	3	Key A						Access Bits				Key B						Sector Trailer 15
	2																	Data
	1																	Data
	0																	Data
14	3	Key A						Access Bits				Key B						Sector Trailer 14
	2																	Data
	1																	Data
	0																	Data
:	:																	
:	:																	
:	:																	
1	3	Key A						Access Bits				Key B						Sector Trailer 1
	2																	Data
	1																	Data
	0																	Data
0	3	Key A						Access Bits				Key B						Sector Trailer 0
	2																	Data
	1																	Data
	0	Manufacturer Data																Manufacturer Block

Excerpt from the data sheet for the Mifare 1K Tag MF1S503x from NXP.

7.7 Write-To Tag – 0x0A

This instruction writes to the specified areas of the card data. Here, it must be ensured that the right communication variant is used. This varies between in protocol between "encrypted cards" and "non-encrypted cards"

7.7.1 Description of Non-encrypted Cards

Non-encrypted cards are for example, ISO15693, Mifare Ultralight and others. The description can be found in the card specifications.

7.7.2 From Host to RFID Reader

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x0A	Command "Write-to Tag"
1	1 byte	STC	0x00	Status code for read always 0x00
2 – 3	2 bytes	DLI	0x10, 0x00	Data length
4, -7	4 bytes	Data	0x04, 0x00, 0x00, 0x00	Start sector as UINT (here start sector 4)
9 - 10	4 bytes	Data	0x01, 0x00, 0x00, 0x00	Number of sectors (here 1 sector) 1 as UINT
12 – 15	4 bytes	Data	0x04, 0x00, 0x00, 0x00	Length of the following data as UINT
15 - x	Variable	Data	0x00, 0x01, 0x02, 0x03	Date that should be written
X + 1	1 byte	CS	0x1F	Checksum

7.7.3 From RFID Reader to Host

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x0A	Command "Write-to Tag"
1	1 byte	STC	0x00	Status code from reader, see chapter 4.3
2 – 3	2 bytes	DLI	0x00, 0x00	Data length
4	1 byte	CS	0x0A	Checksum

7.7.4 Example of Writing to Non-encrypted Cards:

Host to Reader: 0x0A 0x00 0x10 0x00 Start: 0x04 0x00 0x00 0x00 Count: 0x01 0x00 0x00 0x00 length: 0x04 0x00 0x00 0x00 Data: 0x01 0x02 0x03 0x04 0x1F

Command	= 0x0A=> Command "Write-To Tag"
Status	= 0x00 => dummy byte 0x00
Data length	= 0x10 0x00=> 16 bytes
Data	= Start => start reading data from sector 4
	= Count => 1 sector is read
	= Data length => 4 bytes are written to the card
	= Data => The data that should be written in the tag
Checksum	= 0x1F

Reader to Host: 0x0A 0x00 0x00 0x00 0x0A

Command	= 0x0A=> Command "Write-To Tag"
Status	= 0x00 => action error-free
Data length	= 0x00 0x00 => 0 bytes
Checksum	= 0x0A

7.8 Description of Encrypted Cards

With this sequence of the protocol, data is read from cards with encrypted content. Example of such cards are Mifare 1K or similar. Further information on handling can be found in the data sheet of the RFID transponder.

7.8.1 From Host to RFID Reader

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x0A	Command "Write-to Tag"
1	1 byte	STC	0x00	Status code for read always 0x00
2 – 3	2 bytes	DLI	0x29, 0x00	Data length
4, -7	4 bytes	Data	0x04, 0x00, 0x00, 0x00	Start sector as UINT (here start sector 4)
9 - 10	4 bytes	Data	0x01, 0x00, 0x00, 0x00	Number of sectors (here 1 sector) 1 as UINT
	4 bytes	Data	0x10, 0x00, 0x00, 0x00	Length of the following data as UINT
16	1 byte	Data	0x00	KeyType (0x00 = KeyA, 0x01 = KeyB)
17	1 byte	Data	0x06	Length of the keys (here 6 bytes)
18 – 23	6 bytes	Data	0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF	key
23 – X	Variable	Data	0x01, 0x02, 0x03, 0x04	Date that should be written
20	1 byte	CS	0x30	Checksum

7.8.2 From RFID Reader to Host

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x0A	Command "Write-to Tag"
1	1 byte	STC	0x00	Status code from reader, see chapter 4.3
2 – 3	2 bytes	DLI	0x00, 0x00	Data length
4	1 byte	CS	0x0A	Checksum

7.8.3 Examples of Reading Encrypted Cards:

Host to Reader: 0x0A 0x00 0x29 0x00 Start: 0x04 0x00 0x00 0x00 Count: 0x01 0x00 0x00 0x00 length: 0x04 0x00 0x00 0x00 0x00 0x06 Key: 0xFF 0xFF 0xFF 0xFF 0xFF 0xFF Data: 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x30

Command	= 0x0A=> Command "Write-To Tag"
Status	= 0x00 => dummy byte 0x00
Data length	= 0x29 0x00 => 8 byte
Data	= Start => start reading data from sector 4
	= Count => 1 sector is read
	= Data length => 16 bytes should be written
	= 0x00 => Key Type (0x00 = KeyA, 0x01 = KeyB)
	= 0x06 => Key length 6 bytes
	= Key => FF-FF-FF-FF-FF-FF
	= Data => Data that should be written to the card
Checksum	= 0x30

Reader to Host: 0x0A 0x00 0x00 0x00 0x0A

Command	= 0x0A=> Command "Write-To Tag"
Status	= 0x00 => action error-free
Data length	= 0x00 0x00 => 0 bytes
Checksum	= 0x0A

7.9 Option Tag Commands – 0x0B

Running Option Tags Commands allows ISO15693-specific and special instructions to be run in the tag.

7.9.1 Commands

The following instructions are available as additional commands:

Instruction	Value	Description	Version
CMD_OPT_READ_AFI	0x00	Returns the value of the AFI register	
CMD_OPT_WRITE_AFI	0x01	Writes the AFI	
CMD_LOCK_AFI	0x02	Sets the AFI to Read Only	
CMD_READ_DSFID	0x03	Returns the value of the DSFID register	
CMD_WRITE_DSFID	0x04	Writes the DSFID	
CMD_LOCK_DSFID	0x05	Sets the AFI to Read Only	
CMD_OPT_LOCK_BLOCK	0x06	Sets a block to Read Only	
reserved	0x07	reserved	
reserved	0x08	reserved	
reserved	0x09	reserved	
CMD_SYS_INFO	0x0A	Reads card information	

7.9.2 From Host to RFID Reader

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x0B	Command "Option Tag Command"
1	1 byte	STC	0x00	Status code for read always 0x00
2 – 3	2 bytes	DLI	0x00, 0x00	Data length
4	1 byte	OCMD	0x00	Option Tag Command
5 - x	Variable	DATA	0x00 0x00 0x00 0x00	Data / parameters for option commands
x +1	1 byte	CS	0x04	Data checksum

Data are optional and must be implemented depending on the Option Tag Command used. This is explained in the following examples.

7.9.3 From RFID Reader to Host

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x0B	Command "Option Tag Command"
1	1 byte	STC	0x00	Status code for read always 0x00
2 – 3	2 bytes	DLI	0x00, 0x00	Data length
4 - x	Variable	DATA	0x00 0x00 0x00 0x00	Return data from the card
x +1	1 byte	CS	0x00	Data checksum

Whether data are sent or only a confirmation of the action is explained in this example.

7.9.4 Example Read AFI – 0x00

The AFI register sets the "Application Family identifier" according to ISO15693-3. With this command, the value of this register is read.

Host to Reader: 0x0B 0x00 0x01 0x00 0x00 0x04

Command = 0x0B => Command "Option Tag Command"
Status = 0x00 => dummy byte 0x00
Data length = 0x01 0x00 => 1 byte
Opt_Command = 0x01 => Read AFI
Checksum = 0x0B

Reader to Host: 0x0B 0x00 0x01 0x00 0x01 0x0B

Command = 0x0B => Command "Option Tag Command"
Status = 0x00 => action error-free
Data length = 0x01 0x00 => 1 byte
Data = 0x01 => value of the AFI register
Checksum = 0x0B

7.9.5 Example Write AFI – 0x01

The AFI register sets the "Application Family identifier" according to ISO15693-3. With this command, the value of this register is written.

Host to Reader: 0x0B 0x00 0x02 0x00 0x01 0x01 0x09

Command	= 0x0B => Command "Option Tag Command"
Status	= 0x00 => dummy byte 0x00
Data length	= 0x02 0x00 => 2 bytes
Opt_Command	= 0x01 => Write AFI
Data	= 0x01 => Value that should be written to the AFI register
Checksum	= 0x0B

Reader to Host: 0x0B 0x00 0x00 0x00 0x0B

Command	= 0x0B => Command "Option Tag Command"
Status	= 0x00 => action error-free
Data length	= 0x01 0x00 => 1 byte
Checksum	= 0x0B

7.9.6 Example LOCK AFI – 0x02

The AFI register sets the "Application Family identifier" according to ISO15693-3. With this command, the AFI register is set to "Read Only". After executing this command, the value can no longer be changed.

Host to Reader: 0x0B 0x00 0x01 0x00 0x02 0x08

Command	= 0x0B => Command "Option Tag Command"
Status	= 0x00 => dummy byte 0x00
Data length	= 0x01 0x00 => 1 byte
Opt_Command	= 0x02 => Lock AFI
Checksum	= 0x0B

Reader to Host: 0x0B 0x00 0x00 0x00 0x0B

Command	= 0x0B => Command "Option Tag Command"
Status	= 0x00 => action error-free
Data length	= 0x00 0x00 => 0 bytes
Checksum	= 0x0B

7.9.7 Example READ DSFID – 0x03

The DSFID register sets the "Data storage format identifier" according to ISO15693-3. With this command, the value of this register is read.

Host to Reader: 0x0B 0x00 0x01 0x00 0x03 0x09

Command	= 0x0B => Command "Option Tag Command"
Status	= 0x00 => dummy byte 0x00
Data length	= 0x01 0x00 => 1 byte
Opt_Command	= 0x03 => Read DSFID
Checksum	= 0x09

Reader to Host: 0x0B 0x00 0x01 0x00 0x02 0x0B

Command	= 0x0B => Command "Option Tag Command"
Status	= 0x00 => action error-free
Data length	= 0x01 0x00 => 1 byte
Data	= 0x02 => Value of the DSFID register
Checksum	= 0x0C

7.9.8 Example WRITE DSFID – 0x04

The DSFID register sets the "Data storage format identifier" according to ISO15693-3. With this command, the value of this register is written.

Host to Reader: 0x0B 0x00 0x02 0x00 0x04 0x02 0x0F

Command	= 0x0B => Command "Option Tag Command"
Status	= 0x00 => dummy byte 0x00
Data length	= 0x02 0x00 => 2 bytes
Opt_Command	= 0x01 => Write DSFID
Data	= 0x01 => Value that should be written to the DSFID register
Checksum	= 0x0F

Reader to Host: 0x0B 0x00 0x00 0x00 0x0B

Command	= 0x0B => Command "Option Tag Command"
Status	= 0x00 => action error-free
Data length	= 0x00 0x00 => 1 byte
Checksum	= 0x0B

7.9.9 Example LOCK DSFID – 0x05

The DSFID register sets the "Data storage format identifier" according to ISO15693-3. With this command, the DSFID register is set to "Read Only". After executing this command, the value can no longer be changed

Host to Reader: 0x0B 0x00 0x01 0x00 0x05 0x0F

Command	= 0x0B => Command "Option Tag Command"
Status	= 0x00 => dummy byte 0x00
Data length	= 0x01 0x00 => 1 byte
Opt_Command	= 0x05 => Lock DSFID
Checksum	= 0x0F

Reader to Host: 0x0B 0x00 0x00 0x00 0x0B

Command	= 0x0B => Command "Option Tag Command"
Status	= 0x00 => action error-free
Data length	= 0x00 0x00 => 0 bytes
Checksum	= 0x0B

7.9.10 LOCK BLOCK – 0x06

With the Lock Block command, the selected sectors are locked and are then read only.

To set a sector or multiple sectors to Read Only, the following input is required:

Start sector: Start from this sector (sector index)
Sectors: The number of sectors to lock beginning with the start sector

Example: Start" 0x06 0x00 0x00 0x00 (Sector 6 is start sector)
Sectors: 0x02 0x00 0x00 0x00 (starting from sector 6, two sectors should be locked.)

Result: After successfully executing the command, the sectors 06 and 07 are now read only.

Host to Reader: 0x0B 0x00 0x09 0x00 0x06 Start: 0x00 0x00 0x00 0x00 Sectors: 0x01 0x00 0x00 0x00 0x05

Command	= 0x0B => Command "Option Tag Command"
Status	= 0x00 => dummy byte 0x00
Data length	= 0x01 0x00 => 1 byte
Opt_Command	= 0x06 => Lock Block
Data	= Start => Start sector from which Read Only should be set
	= Sectors => Number of sectors to lock
Checksum	= 0x05

Reader to Host: 0x0B 0x00 0x00 0x00 0x0B

Command	= 0x0B => Command "Option Tag Command"
Status	= 0x00 => action error-free
Data length	= 0x00 0x00 => 0 bytes
Checksum	= 0x0B

7.9.11 SYS-INFO – 0x0A

With SYS command, card-specific information such as size, number of blocks and additional information is read.

Host to Reader: 0x0B 0x00 0x01 0x00 0x0A 0x00

Command	= 0x0B => Command "Option Tag Command"
Status	= 0x00 => dummy byte 0x00
Data length	= 0x01 0x00 => 1 byte
Opt_Command	= 0x0A => SYS-INFO
Checksum	= 0x00

Reader to Host: 0x0B 0x00 0x06 0x00 0x01 0x00 0x1C 0x00 0x04 0x00 0x14

Command	= 0x0B => Command "Option Tag Command"
Status	= 0x00 => action error-free
Data length	= 0x00 0x00 => 0 bytes
Data	= 0x01 => Chip ID (0x01 = iCode SLI SL2 ICS20) = 0x00 0x1C => number of sectors, here there are 28 sectors = 0x00 0x04 => Indicates the size of the sectors, here the size is 4 bytes per sectors = 0x00 => Reserved
Checksum	= 0x14

This results in the following data for the tag:

- Number of sectors: 28 sectors
- Sectors size: 4 bytes
- User memory on card: 28 sectors *4 bytes per sector = 112 bytes
- Manufacturer: The manufacturer can be determined from the UID, UID byte 6
- Chip ID: Indicates the type of tag 0x01 = iCode SLI ICS20

7.10 Get-ATS – 0x0C

The command returns the ATS (Answer to Select) of a DESFire card.

7.10.1 From Host to RFID Reader

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x0C	command "Get-ATS"
1	1 byte	STC	0x00	Status code for read always 0x00
2 – 3	2 bytes	DLI	0x01, 0x00	Data length
4	1 byte	Data	0x04	Frame Size, conform to DESFire spec.
5	1 byte	CS	0x3E	Data checksum

7.10.2 From RFID Reader to Host

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x0C	command "Get-ATS"
1	1 byte	STC	0x00	Status code from reader, see chapter 4.3
2 – 3	2 bytes	DLI	0x07, 0x00	Data length
4 - X	Variable	Data	0x00, 0x01, 0x00, 0x00	ATS
X +1	1 byte	CS	0xFF	Checksum

7.10.3 Example

Host to Reader: 0x0C 0x00 0x01 0x00 0x04 0x04

Reader to Host: 0x0C 0x00 0x07 0x00 0x06 0x04 0x94 0x32 0x15 0x43 0x87 0x78

Command = 0x0C => Command "Get-ATS"
Status = 0x00 => action error-free
Data length = 0x07 0x00 => 7 bytes
Data = 0x06 0x04 0x94 0x32 0x15 0x43 0x87 => ATS
Checksum = 0x78

7.11 SET-PPS – 0x0D

The command indicates the ATS of a DESFire card.

7.11.1 From Host to RFID Reader

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x0D	command "Set PPS"
1	1 byte	STC	0x00	Status code for read always 0x00
2 – 3	2 bytes	DLI	0x02, 0x00	Data length
4	1 byte	Data	0x00	Logic card ID
5	1 byte	Data	0x00	Communication speed*
6	1 byte	CS	0x3E	Data checksum

7.11.2 From RFID Reader to Host

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x0D	command "Set PPS"
1	1 byte	STC	0x00	Status code from reader, see chapter 4.3
2 – 3	2 bytes	DLI	0x00, 0x00	Data length
4	1 byte	CS	0x0D	Checksum

"Currently 0x00 (106kbs) supported only

7.11.3 Example

Host to Reader: 0x0D 0x00 0x02 0x00 0x00 0x00 0x0A

Command = 0x0D => Command "Set PPS"
Status = 0x00 => action error-free
Data length = 0x07 0x00 => 7 bytes
Data = 0x00 => Card ID
= 0x00 => Communication speed
Checksum = 0x0A

Reader to Host: 0x0D 0x00 0x00 0x00 0x0D

Command = 0x0D => Command "Set PPS"
Status = 0x00 => action error-free
Data length = 0x00 0x00 => 0 bytes
Checksum = 0x0D

7.12 Execute Command – 0x0E

The command outputs the DESFire-conforming commands on the card

7.12.1 From Host to RFID Reader

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x0E	Command "Execute Command"
1	1 byte	STC	0x00	Status code for read always 0x00
2 – 3	2 bytes	DLI	0x03, 0x00	Data length
4	1 byte	Data	0x0A	Header (DESFire standard)
5	1 byte	Data	0x00	Logic card ID
6	1 byte	Data	0x60	CMD (0x60 = Get Version)
7	1 byte	CS	0x67	Data checksum

7.12.2 From RFID Reader to Host

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x0E	Command "Execute Command"
1	1 byte	STC	0x00	Status code from reader, see chapter 4.3
2 – 3	2 bytes	DLI	0x08, 0x00	Data length
4 - x	Variable	Data	0xAF 0x04 0x01 0x01	Data return from command
X +1	1 byte	CS	0x0D	Checksum

"Currently 0x00 (106kbs) supported only

7.12.3 Example

Host to Reader: 0x0E 0x00 0x03 0x00 0x0A 0x00 0x60 0x67

Command	= 0x0D => Command "Execute Command"
Status	= 0x00 => action error-free
Data length	= 0x03 0x00 => 3 bytes
Data	= 0x0A => Header according to DESFire standard
	= 0x00 => Card ID
	= 0x60 => Command (0x60 = Get Version)
Checksum	= 0x67

Reader to Host: 0x0D 0x00 0x08 0x00 Data: 0xAF 0x04 0x01 0x01 0x00 0x02 0x18 0x05 0x0D

Command	= 0x0D => Command "Execute Command"
Status	= 0x00 => action error-free
Data length	= 0x08 0x00 => 8 bytes
Data	= Data returned from the executed command.
Checksum	= 0x0D

7.13 SET RSSI – 0x11

Activates the return of the RSSI value. The RSSI value indicates the receiving strength of the card. During a "Scan Tag" command, the RSSI value is returned for each card.

7.13.1 From Host to RFID Reader

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x11	Command "Set RSSI"
1	1 byte	STC	0x00	Status code for read always 0x00
2 – 3	2 bytes	DLI	0x01, 0x00	Data length
4	1 byte	Data	0x00	0x00 = RSSI off, 0x01 = RSSI on
5	1 byte	CS	0x11	Data checksum

7.13.2 From RFID Reader to Host

Byte No.	Number	Contents	Data Sent	Description
0	1 byte	CMD	0x11	Command "Set RSSI"
1	1 byte	STC	0x00	Status code from reader, see chapter 4.3
2 – 3	2 bytes	DLI	0x00, 0x00	Data length
4	1 byte	CS	0x11	Checksum

7.13.3 Example

Host to Reader: 0x11 0x00 0x01 0x00 0x01 0x11

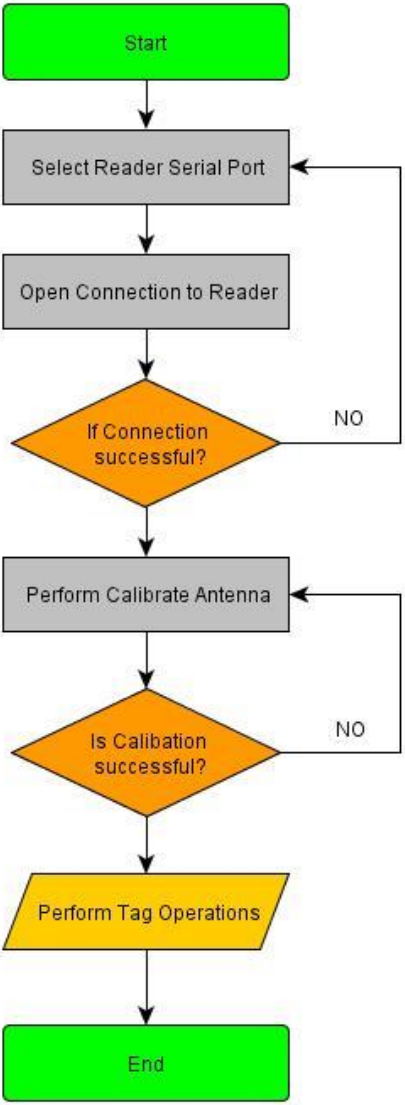
Command = 0x11 => Command "Set RSSI"
Status = 0x00 => action error-free
Data length = 0x00 0x00 => 7 bytes
Data = 0x01 => Set RSSI ON
Checksum = 0x11

Reader to Host: 0x11 0x00 0x00 0x00 0x11

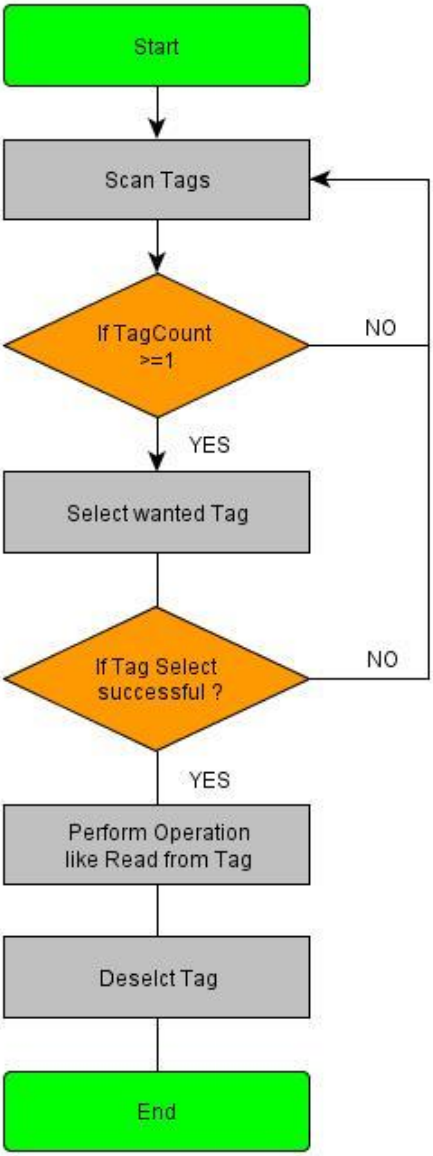
Command = 0x11 => Command "Set RSSI"
Status = 0x00 => action error-free
Data length = 0x00 0x00 => 0 bytes
Checksum = 0x11

8 Communication Process Diagram

8.1 Connecting with the Reader



8.2 With Tag Communication



9 Enumerators C

```
enum RFE_RET_VALUE
{
ERR_RET_SUCCESS = 0x00,
ERR_RET_PARAM,
ERR_RET_DATA_PUSH,
ERR_RET_CMD_INVALID,
ERR_RET_CRC,
ERR_RET_LENGTH,
ERR_RET_CMD_DATA,
ERR_RET_CALIBRATE_ANENA = 0x0F,
ERR_RET_TIMEOUT,
ERR_RET_FIFO,
ERR_RET_COLLISION,
ERR_RET_EXEC_CMD,
ERR_RET_CARD_NOT_SUPPORTED,
ERR_RET_AUTH,
};

enum ECMD
{
CMD_READER_NAME = 0x00,
CMD_PRODUCT_NAME,
CMD_SOFT_VERSION,
CMD_HARD_VERSION,
CMD_BOOT_VERSION,
CMD_CALIBRATE_ANTENNA,
CMD_SCAN_CARDS,
CMD_SELECT_CARD,
CMD_DESELECT_CARD,
CMD_READ_CARD,
CMD_WRITE_CARD,
CMD_OPTION_CARD,
CMD_GET_ATS,
CMD_SET_PPS,
CMD_EXEC_DESFIRE,
CMD_GPIO = 0x0F,
CMD_GET_FEATURE = 0x10,
CMD_SET_RSSI = 0x11,
};

enum ECMD
{
CMD_OPT_READ_AFI = 0x00,
CMD_OPT_WRITE_AFI,
CMD_OPT_LOCK_AFI,
CMD_OPT_READ_DSFID,
CMD_OPT_WRITE_DSFID,
CMD_OPT_LOCK_DSFID,
CMD_OPT_LOCK,
CMD_OPT_WRITE_KILL,
CMD_OPT_KILL,
CMD_OPT_LOCK_KILL,
CMD_OPT_SYS_INFO
};
```

```
enum CARD_TYPE
{
	CARD_ISO14443A = 0x00,
	CARD_ISO14443B,
	CARD_ISO15693,
	CARD_UNKNOWN = 0xFF,
};

enum CARD_SUBTYPE
{
	MIFARE_ULTRALIGHT = 0x00,
	MIFARE_MINI,
	MIFARE_1K,
	MIFARE_4K,
	MIFARE_PLUS,
	MIFARE_DES_FIRE,
	MIFARE_ISO14443A_4,
	ISO14443B_SRIX,
	ISO14443B_SRIX176,
	ISO15693_STANDARD,
	CARD_SUBTYPE_UNKNOW = 0xFF,
};
```

10 Declaration of Conformity

10.1 FCC Statement

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Section 15.21 Information to user

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Section 15.105 (b)

Note: This equipment has been tested and found to comply with the Limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television Reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Documentation Changes

Change date	Affected page(s)	Chapter	Note