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PRG_22-14 IDTRONIC LEUZE RFID SYSTEMS HF TCP COMMUNICATION PROTOCOL AND DEVICE CONFIGURATION

RDH 308i 00

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Version	Date	Author	Changelist
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2 Scope

This document refers to the Leuze RDH 308i 00 device and describes in detail the communication protocol and the configuration parameters.

3 Field of Application

This document applies to the Leuze RDH 308i 00 device with firmware version v1.0.0.

4 Definitions and Abbreviations

Term / Abbreviation	Definition
TBD	To Be Determined
UID	Unique Identifier

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5 Device Description

The device object of this manual is a mid-range RFID read/write device operating at 13.56MHz with integrated antenna and suitable for industrial application. It communicates with a 'host' system (typically a PC or a PLC) through an Ethernet TCP/IP connection. The device acts as a joint through a set of commands between the host system and the RFID tag/s (or transponder/s) present near the antenna/s. For this purposes it is equipped with an integrated decoder for the identification of standard transponders (data carriers) acc. to ISO/IEC 15693 and ISO/IEC 14443 A. An USB connection, working as Virtual COM, is also available and is used as service port to configure the functional parameters and to update the firmware of the device.

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6 Transponder (Tag) Types

In many commands and acknowledgements, the transponder type (tag type) is also transmitted. Listed in the following table are the supported transponder types.

Tag Type	Transponder Type	Number of Bytes	Start Block / Pages (when Writing)	Number of Blocks / Pages	Block / Page Size
01h	NXP I-CODE 1	44	5	11	4
02h	STM LRI 512	60	0	16	4
03h	Reserved	-	-	-	-
04h	NXP I-CODE SLI	112	0	28	4
	NXP I-CODE SLI-S	160	0	40	4
	NXP I-CODE SLI-L	32	0	8	4
05h	Infineon my-d (02P)	224	0	56	4
	Infineon my-d (10P)	992	0	248	4
06h	EM EM4135	288	13	36	8
07h	TI Tag-it HF-I Standard	32	0	8	4
	TI Tag-it HF-I Plus	256	0	64	4
	TI Tag-it HF-I Pro	32	0	8	4
08h	NXP I-CODE SLIX	112	0	28	4
	NXP I-CODE SLIX-S	160	0	40	4
	NXP I-CODE SLIX-L	32	0	8	4
09h	NXP I-CODE SLIX2	320	0	80	4
0Ah	Fujitsu MB89R118C	2000	0	250	8
0Bh	NXP MIFARE Classic 1k	1024	0	64	16
	NXP MIFARE Classic 4k	4096	0	256	16
0Ch	NXP MIFARE Ultralight C	144	4	36	4
	NXP NTAG 210	48	4	12	4
	NXP NTAG 212	128	4	32	4
	NXP NTAG 213	144	4	36	4
	NXP NTAG 215	504	4	126	4
	NXP NTAG 216	888	4	222	4
...
FEh	Reserved	-	-	-	-
FFh	Reserved	-	-	-	-

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7 Configuration of the Device

The setting parameters of the device are stored in different registers that can be accessed in read and write. The following table shows a list of the configuration registers:

Address	Parameters / Function	Default settings
00h	AFI (Application Family Identifier) filter	00h
01h	Functions register 1	71h
02h	Functions register 2	50h
03h	Transponder type High byte	12h
04h	Transponder type Low byte	00h
05h	Reserved	20h
06h	Trigger pulse time (ms) High byte	00h
07h	Trigger pulse time (ms) Low byte	00h
08h	Output pulse time (ms) High byte	01h
09h	Output pulse time (ms) Low byte	2Ch
0Ah	Start address Read High byte	00h
0Bh	Start address Read Low byte	00h
0Ch	Read operation Number of blocks	01h
0Dh	Start address Write High byte	00h
0Eh	Start address Write Low byte	05h
0Fh	Write operation Number of blocks	01h
10h-57h	Write data (max. 9 x 8 bytes)	00h
58h-FFh	Reserved	00h

7.1 Configuration AFI (Application Family Identifier) Filter (Address 00h)

The AFI filter is a legitimization for the ISO15693 transponder in this application: only if the AFI on the transponder and the data stored in this register are the same, the transponder can be read or written. The AFI filter can be enabled setting to 1 the bit 3 of Functions Register 2 (address 02h).

Default setting: 00h

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7.2 Configuration Functions Register 1 (Address 01h)

Bit	Function	Level	Description
0...1	Operation mode	00	Write Mode
		01	Read Mode
		10	Multiple Read
2	Reserved	0	
3	Reserved	0	
4	Trigger	0	Permanent ready for read
		1	Read on trigger pulse
5	Read mode	0	Permanent read and data output
		1	Single shot. Read once while in field
6	Write forward	0	Not active, a write command must be sent with the tag in the reading field
		1	Active, a write command can be sent before the tag enters the field
7	Reserved	0	

The parameter to set is combined via Bit column. The MSB (most significant Bit) is Bit 7 on first position.

Default setting: 71h

The operation mode defines, what function a trigger pulse (or '+' command) causes. The factory setting is "Read", that means after a trigger the serial no. or data blocks is read: if the parameter Start Address Read (addresses 0Ah-0Bh) is set to 4000h the device reads the serial no., if not the device reads blocks of data from transponder. The number of blocks and the starting block to read are defined by Read operation Number Of Blocks (address 0Ch) and Start Address Read (address 0A-0Bh) parameters. The response is the same as after an "N" command: state, block no. (or @0), tag type, data. With operation mode "Write" the stored data (address 10h following) is written into every tag after trigger, answer is "Q5". In this case the number of blocks and the starting block to write are defined by Write operation Number Of Blocks (address 0Fh) and Start Address Write (address 0Dh-0Eh) parameters. The operation mode "Multiple read" delivers the whole tag data on trigger pulse. Note that this operation takes more time (about double the time) than a read operation for one block.

7.3 Configuration Functions Register 2 (Address 02h)

Bit	Function	Level	Description
0	Serial number	0	Not active, no transmission

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Bit	Function	Level	Description
	(W and N command)	1	Active, serial number must be transmitted
1	Anticollision	0	Not active, only one tag in field
		1	Active, several tags in field
2	Reserved	0	
3	Filter (AFI)	0	Not active
		1	Active, AFI code in address 00h
4	Switching output	0	Not active
		1	Automatically activated, address 05h
5	Data block size	0	4 Byte
		1	8 Byte
6	Large data	1	Further data is sent automatically (> 256 bytes)
7	Reserved	0	


The parameter to set is combined via Bit column. The MSB (most significant Bit) is Bit 7 on first position.

Default setting: 50h

7.4 Configuration Transponder Type (Addresses 03h-04h)

Address 03h:

Bit	Description
0	Reserved
1	NXP I-CODE 1
2	STM LRI 512
3	Reserved
4	NXP I-CODE SLI NXP I-CODE SLI-S NXP I-CODE SLI-L
5	Infineon my-d (02P) Infineon my-d (10P)
6	EM EM4135
7	Tag-It HF-I Standard Tag-It HF-I Plus

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The parameter to set is combined via Bit column. The MSB (most significant Bit) is Bit 7 on first position.

If the bit level is 1, the device operations are enabled for the corresponding transponder type.

Default setting: 12h

Address 04h:

Bit	Description
0	NXP I-CODE SLIX NXP I-CODE SLIX-S NXP I-CODE SLIX-S
1	NXP I-CODE SLIX2
2	Fujitsu MB89R118C
3	NXP MIFARE Classic 1k NXP MIFARE Classic 4k
4	NXP MIFARE Ultralight C NXP NTAG 210 NXP NTAG 212 NXP NTAG 213 NXP NTAG 215 NXP NTAG 216
5	Reserved
6	Reserved
7	Reserved


The parameter to set is combined via Bit column. The MSB (most significant Bit) is Bit 7 on first position.

If the bit level is 1, the device operations are enabled for the corresponding transponder type.

Default setting: 00h

7.5 Configuration Trigger / Output Switch (Addresses 05h-09h)

The trigger is a combination of the trigger functionality and the trigger pulse time. For the output it is similar: the functionality and the output pulse time. In the address 05h the functionality for both output and trigger is combined. The trigger pulse time is in address 06/07h and the output pulse time in 08/09h.

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7.5.1 Configuration Trigger Mode (Address 05h)

Only the bits 0/1 of this byte are used for trigger and the Bits 3-5 for the output functionality. Other Bits are set to "0". Therefore the possible combinations are as follows:

Value	Description
00	Trigger: read as long high level at input Output: good read signal on low level
01	Trigger: read for time after positive slope Output: good read signal on low level
02	Trigger: read after positive slope, time counts after negative slope Output: good read signal on low level
08	Trigger: read as long high level on input Output: no read signal on low level
09	Trigger: read for time after positive slope Output: no read signal on low level
0A	Trigger: read after positive slope, time counts after negative slope Output: no read signal on low level
20	Trigger: read as long high level at input Output: good read signal on high level
21	Trigger: read for time after positive slope Output: good read signal on high level
22	Trigger: read after positive slope, time counts after negative slope Output: good read signal on high level
28	Trigger: read as long high level on input Output: no read signal on high level
29	Trigger: read for time after positive slope Output: no read signal on high level
2A	Trigger: read after positive slope, time counts after negative slope Output: no read signal on high level
03	Trigger: read in multi tag mode Output: good read signal on low level
0B	Trigger: read in multi tag mode Output: no read signal on low level
23	Trigger: read in multi tag mode Output: good read signal on high level

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Value	Description
2B	Trigger: read in multi tag mode Output: no read signal on high level

Default setting: 20h

7.5.2 Configuration Trigger Pulse Time (Addresses 06h-07h)

These registers store the value of the time after the trigger pulse, represented in hexadecimal numeric system. The time can be set in a range from 0 to 9000 ms.

Default setting: 0000h

Examples:

- 500 ms 01F4h
- 1000 ms 03E8h

7.5.3 Configuration Output Pulse Time (Addresses 08h-09h)

These registers store the value of activation time for 'good read' or 'no read', represented in hexadecimal numeric system. The time can be set in a range from 30 to 9000 ms.

Default setting: 33 (300 ms)

Examples:

- 500 ms 01F4h
- 1000 ms 03E8h

7.6 Configuration Start Address Read (Addresses 0Ah-0Bh)

These registers store the address of the first block read from the transponder after trigger in the operation mode 'Read'.

Default setting: 0000h

Example:

- Block 05 0005h

7.7 Configuration Read Number of Blocks (Address 0Ch)


This register stores the number of data blocks read from the transponder after trigger in the operation mode 'Read'. The number of blocks can be set from 1 to 9.

Default setting: 01h (1 block)

Examples:

- 5 blocks 05h
- 9 blocks 09h

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7.8 Configuration Start Address Write (Addresses 0D-0Eh)

These registers store the address of the first block written into the transponder after trigger in the operation 'Write'.

Default settings: 0005h

Example:

- Block 10 00A0h

7.9 Configuration Write Number of Blocks (Address 0Fh)

This register stores the number of data blocks written into the transponder after trigger in the operation 'Write'. The number of blocks can be set from 1 to 9.

Default setting: 01h

Examples:

- 5 blocks 05h
- 9 blocks 09h

7.10 Configuration Write data (Addresses 10h-57h)

These registers store the data that is written into the transponder data blocks after trigger in the operation 'Write'.

7.11 Configuration dependencies


Some configuration settings are mutually exclusive because of the dependence on other setting parameters.

Setting	Dependencies
Anticollision = Active (Address 02h, Bit 1)	Seral Number transmission = Active (Address 02h, Bit 0) Trigger Mode = Read in multi tag mode (Address 05h) Write forward = Not Active (Address 01h, Bit 6)
Write forward = Active (Address 01h, Bit 6)	Trigger = Read on trigger pulse (Address 01h, Bit 4)
Operation mode = Multiple Read (Address 01h, Bit 0-1)	Anticollision = Not Active (Address 02h, Bit 1)
Read mode = Permanent read (Address 01h, Bit 5)	Trigger = Permanent ready for read (Address 01h, Bit 4) Write forward = Not Active (Address 01h, Bit 6)

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Before setting one of this four parameters all the dependencies must be set correctly, otherwise the device responds with error code 'E10'

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8 Ethernet TCP/IP Communication Interface

The device is designed as an Ethernet device (acc. To IEEE 802.3) with a standard baud rate of 10/100Mbit/s. A fixed MAC-ID is assigned to each device by the manufacturer; this ID cannot be changed. The device automatically supports the transmission rates of 10 Mbit/s (10Base T) and 100 Mbit/s (10Base TX), as well as auto-negotiation and auto-crossover.

The device features multiple M12 connectors/sockets for the electrical connection of the supply voltage, the interface and the switching inputs and outputs. Further information can be found in the data sheet of the device.

The device supports:

- TCP/IP
- UDP
- ARP
- PING

8.1 Ethernet Start Topology

The device can be operated as a single device (standalone) in an Ethernet star topology with individual IP address.

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9 Structure of the Ethernet TCP/IP Telegrams

The following telegram structure is used between **host -> device**:

STX	Data	CR LF
-----	------	-------

Where:

STX	=0x02, start of the message
Data	Data of the message
CR LF	=0x0D 0x0A, end of the message

The following telegram structure is used between **device -> host**:

STX	Data	CR LF
-----	------	-------


Where:

STX	=0x02, start of the message
Data	Data of the message
CR LF	=0x0D 0x0A, end of the message

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10 USB Virtual COM Service Interface

TBD

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11 Structure of the USB Virtual COM Telegrams

The following telegram structure is used between **host -> device**:

STX	Data	CR LF
-----	------	-------

Where:

STX	=0x02, start of the message
Data	Data of the message
CR LF	=0x0D 0x0A, end of the message

The following telegram structure is used between **device -> host**:

STX	Data	CR LF
-----	------	-------

Where:

STX	=0x02, start of the message
Data	Data of the message
CR LF	=0x0D 0x0A, end of the message

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12 Messages Definitions of the Device

The data from and to the device is always coded in ASCII-Hex coding and always read out or written in complete data blocks. Usable as data are all characters of the ASCII table.

Messages are recognized in capital letters as well as in small letters. To address the device several commands codes are defined. Then, to receive acknowledgment to specific commands and to recognize transmission errors, several acknowledgment and error codes (in the standard response structure specified above) are defined.

Command Code	Description/meaning	Ethernet TCP/IP	USB Virtual COM
'V/v'	Get Firmware Version	✓	✓
'R/r'	Reset to Default	✓	✓
'H/h'	Reset Software	✓	✓
'+'	Set Trigger On	✓	
'-'	Set Trigger Off	✓	
'I/i'	Inventory	✓	✓
'P/p'	Get Input	✓	✓
'A/a'	Set Output	✓	✓
'F/f'	Switch Field	✓	✓
'G/g'	Read Configuration	✓	✓
'C/c'	Write Configuration	✓	✓
'N/n'	Read Blocks Data	✓	✓
'M/m'	Read Transponder	✓	✓
'W/w'	Write Blocks Data	✓	✓
'D/d'	Firmware Upgrade	✓	✓

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Acknowledgement Code	Description/meaning
'Q0'	Command could not be carried out
'Q1'	Configuration change carried out
'Q2'	Action carried out
'Q4'	Write command understood
'Q5'	Data successfully written

Error Code	Description/meaning
'E01'	Invalid command
'E02'	Invalid parameter
'E04'	Data frame error
'E08'	CRC checksum error
'E10'	Controvert configuration settings
'E20'	Firmware not valid

12.1 Get Firmware Version

This command is used to get the current version of the firmware installed in the device.

Command:

V

Where:

Designation	Bytes	Description
V	1	Command code

Response:

RDH 308i 00 V x.y.z yyyy-mm-dd

Where:

Designation	Bytes	Description
RDH 308i 00	11	Device name, it is a fixed field
V x.y.z	8	Version of release in the format major.minor.release, for example V 1.0.0
yyyy-mm-dd	10	Date of release, for example 2024-02-16

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12.2 Reset to Default

This command is used perform a restart and to set the device to factory configuration.

Command:

R

Where:

Designation	Bytes	Description
R	1	Command code

Response:

Q2

Where:

Designation	Bytes	Description
Q2	2	Action carried out

12.3 Reset Software

This command is used to perform a software restart maintaining all the current settings.

Command:

H

Where:

Designation	Bytes	Description
H	1	Command code

Response:

Q2

Where:

Designation	Bytes	Description
Q2	2	Action carried out

12.4 Set Trigger On

This command is used to turn the trigger on, activating a read or write operation depending on the configuration. Using only the command itself does not get a response from the device. The device sends a response when a transponder enters in the device

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reading/writing field and the operation is completed. Once the transponder enters the reading/writing field and the operation is completed the trigger turns off.



This command works with MIFARE Classic only in Read Mode (Serial Number). If the configuration is set to Read Mode (Block Data), Multiple Read, Write Mode, when a MIFARE Classic enters in reading/writing field the device behaves like that transponder is not present.

Command:

+

Where:

Designation	Bytes	Description
+	1	Command code

Response, Read Mode, Serial Number:

F@0TagtypeSNR

Where:

Designation	Bytes	Description
F	1	Telegram flag: =0: only 1 telegram is output =1: multiple telegrams are output (for more than 256 bytes out)
@0	2	The designator for following serial number
Tagtype	2	The transponder type
SNR	...	The serial number of the transponder

Response, Read Mode, Block Data

FB#TagtypeData

Where:

Designation	Bytes	Description
F	1	Telegram flag: =0: only 1 telegram is output =1: multiple telegrams are output (for more than 256 bytes of data)

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Designation	Bytes	Description
B#	2	Number of the first block read
Tagtype	2	The transponder type
Data	...	1 to 9 blocks of the transponder starting from the first block read

Response, Read Mode, Multiple Read

FB#TagtypeData

Where:

Designation	Bytes	Description
F	1	Telegram flag: =0: only 1 telegram is output =1: multiple telegrams are output (for more than 256 bytes of data)
B#	2	Number of the first block read
Tagtype	2	The transponder type
Data	...	All blocks of the transponder starting from the first block read

Response, Write Mode with Write Forward

Q5

Where:

Designation	Bytes	Description
Q5	2	Data successfully written

12.5 Set Trigger Off

This command is used to terminate the read process.

Command:

-

Where:

Designation	Bytes	Description
-	1	Command code

Response:

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No answer. If no transponder was read, a NO READ (0x18) is output.

12.6 Inventory

This command is used to get the serial number of the tags in the reading field of the device. It normally detects just one tag at every use of the command. If it's needed to detect multiple tags in the reading field is necessary to activate the anticollision mode.

Command:

I

Where:

Designation	Bytes	Description
I	1	Command code

Response:

F@0TagtypeSNR

Where:

Designation	Bytes	Description
F	1	Telegram flag: =0: only 1 telegram is output =1: multiple telegrams are output (for more than 256 bytes out)
@0	2	The designator for following serial number
Tagtype	2	The transponder type
SNR	...	The serial number of the transponder

Or if no transponder was read, a NO READ (0x18) is output.

12.7 Get Input

This command is used to read the input status.

Command:

Pn

Where:

Designation	Bytes	Description
P	1	Command code

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Designation	Bytes	Description
n	1	=0, input 1 =1, input 2

Response:

nxx

Where:

Designation	Bytes	Description
n	1	=0, input 1 =1, input 2
xx	2	=FF, input on =00, input off

12.8 Set Output

This command is used to permanently set the output.

Command:

Anxx

Where:

Designation	Bytes	Description
A	1	Command code
n	1	=0, output 1 =1, output 2
xx	2	=FF, output on =00, output off

Response:

None.

12.9 Switch Field

This command is used to switch on/off the RF field. The RF field is generally off. It is automatically switched on after a new trigger.

Command:

Fx

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Where:

Designation	Bytes	Description
F	1	Command code
x	1	=1, field on =2, field off =3, reset field

Response:

Q2

Where:

Designation	Bytes	Description
Q2	2	Action carried out

12.10 Read Configuration

This command is used to read the content of the configuration registers.

Command:

Gxxxx

Where:

Designation	Bytes	Description
G	1	Command code
xxxx	4	=FF00: completely read out the configuration =1000: only addresses 00 ... 0Fh =01xx: only one address

Response:

0Gxxyy

Where:

Designation	Bytes	Description
xx	2	The register (if only one address requested)
yy	2	The configuration read from the device

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12.11 Write Configuration

This command is used to write the configuration data of the device.

Command:

Cyyzz

Where:

Designation	Bytes	Description
C	1	Command code
yy	2	Address of the first configuration register to write
zz	...	Configuration data to write to the device

Response:

Q1

Where:

Designation	Bytes	Description
Q1	2	Configuration change carried out



This command allows to write every contiguous register after the specified first one. The number of the register to be written depends on the length of field 'zz' (2 bytes for every register).

12.12 Read Block

This command is used to read one or several blocks of data of a transponder.

Command:

NB#TagtypeNOBSNR

Where:

Designation	Bytes	Description
N	1	Command code
B#	2	Number of the first block to read
Tagtype	2	The transponder type

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Designation	Bytes	Description
NOB	1	Number of blocks to read, from 1 to 9
SNR	...	<i>Optional</i> Serial number of the transponder to be read. It is necessary if multiple transponders are in the field

Response:

FB#TagtypeData

Where:

Designation	Bytes	Description
F	1	Telegram flag: =0: only 1 telegram is output =1: multiple telegrams are output (for more than 256 bytes of data)
B#	2	Number of the first block to read
Tagtype	2	The transponder type
Data	...	Content of the blocks of data specified by the command



It is absolutely necessary that a read process first be performed by means of trigger and that the transponder remains in the field




If anticollision is active, serial number transmission must be activated and the serial number of the desired transponder must be specified in the command. An average answer time of 50 ms can be assumed per data block

12.13 Read Transponder

This command is used to read the entire blocks of data of a transponder.

Command:

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MTagtypeSNR

Where:

Designation	Bytes	Description
M	1	Command code
Tagtype	2	The transponder type
SNR	...	<i>Optional</i> Serial number of the transponder to be read. It is necessary if multiple transponders are in the field

Response:

FTagtypeData

Where:

Designation	Bytes	Description
F	1	Telegram flag: =0: only 1 telegram is output =1: multiple telegrams are output (for more than 256 bytes of data)
Tagtype	2	The transponder type
Data	...	All data beginning with block 0



It is absolutely necessary that a read process first be performed by means of trigger and that the transponder remains in the field




This command works only with one transponder simultaneously in the reading field. If the transponder has more than 256 byte of data then the answer will be splitted. This command is not provided with the EM4135

12.14 Write Block

This command is used to write one or several blocks of data of the transponder.

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Command:

WB#TagtypeNOBSNRData

Where:

Designation	Bytes	Description
W	1	Command code
B#	2	Number of the first block to write
Tagtype	2	The transponder type
NOB	1	Number of blocks to write, from 1 to 9
SNR	...	<i>Optional</i> Serial number of the transponder to be written. It is necessary if multiple transponders are in the field
Data	...	Data to be written (hexadecimal) for 1 block

Response:

yy

Designation	Bytes	Description
yy	2	=Q4: command understood (if write forward activated) =Q5: write operation successful (after trigger) =Q0: write operation failed



If write forward is disabled in the configuration registers, it is necessary to have a trigger operation before and the transponder must stay in the writing field. If write forward is enabled, the command is received even if the transponder is not in the writing field and the data is written after a trigger

12.15 Firmware Download

This command is used to download the firmware to the device.

Command:

DBlockData

Where:

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Designation	Bytes	Description
D	1	Command code
Block	4	The block number of firmware image (0000h for the first block of firmware image, 0001h for the second block, ..., FFFFh to start the firmware upgrade).
Data	64	<i>Optional</i> The data of the block (64 bytes). It is necessary for every block of firmware image to transmit

Response:

yy

Where:

Designation	Bytes	Description
yy	2	=Q2: Action carried out =Q0: Command could not be carried out
	3	=E02: Invalid parameter =E20: Firmware not valid

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13 Transponder (Tag) Specific Information

13.1 Memory Organization NXP I-CODE 1

Block	Byte 0	Byte 1	Byte 2	Byte 3	Description
0	SNR0	SNR1	SNR2	SNR3	Serial number (low)
1	SNR4	SNR5	SNR6	SNR7	Serial number (high)
2	F0	FF	FF	FF	Write access
3	x	x	x	x	Special functions
4	x	x	x	x	Filter code / App Id / User data
5	x	x	x	x	User data
6	x	x	x	x	User data
...
14	x	x	x	x	User data
15	x	x	x	x	User data

13.2 Memory Organization NXP I-CODE SLI

Block	Bits	Description
UID	64	Fixed serial number
0	32	User data
1	32	User data
...
26	32	User data
27	32	User data

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13.2.1 Unique Identifier (UID) NXP I-CODE SLI

64	57	56	49	48	41	40										1
E0	04	01	IC manufacturer serial number													
UID 7	UID 6	UID 5	UID 4	UID 3	UID 2	UID 1	UID 0									

To differentiate it from the other I-CODE types of transponder bits 37 and 36 are programmed to '00'.

13.3 Memory Organization NXP I-CODE SLI-S

Block	Bits	Description
UID	64	Fixed serial number
0	32	User data
1	32	User data
...
38	32	User data
39	32	User data

13.3.1 Unique Identifier (UID) NXP I-CODE SLI-S

64	57	56	49	48	41	40										1
E0	04	02	IC manufacturer serial number													
UID 7	UID 6	UID 5	UID 4	UID 3	UID 2	UID 1	UID 0									

To differentiate it from the other I-CODE types of transponder bits 37 and 36 are programmed to '00'.

13.4 Memory Organization NXP I-CODE SLI-L

Block	Bits	Description
UID	64	Fixed serial number

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Block	Bits	Description
0	32	User data
1	32	User data
...
7	32	User data
8	32	User data

13.4.1 Unique Identifier (UID) NXP I-CODE SLI-L

64	57	56	49	48	41	40									1
E0	04	03	IC manufacturer serial number												
UID 7	UID 6	UID 5	UID 4	UID 3	UID 2	UID 1	UID 0								

To differentiate it from the other I-CODE types of transponder bits 37 and 36 are programmed to '00'.

13.5 Memory Organization NXP I-CODE SLIX

Block	Bits	Description
UID	64	Fixed serial number
0	32	User data
1	32	User data
...
26	32	User data
27	32	User data

13.5.1 Unique Identifier (UID) NXP I-CODE SLIX

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64	57	56	49	48	41	40									1
E0	04	01	IC manufacturer serial number												
UID 7	UID 6	UID 5	UID 4	UID 3	UID 2	UID 1	UID 0								

To differentiate it from the other I-CODE types of transponder bits 37 and 36 are programmed to '10'.

13.6 Memory Organization NXP I-CODE SLIX-S

Block	Bits	Description
UID	64	Fixed serial number
0	32	User data
1	32	User data
...
38	32	User data
39	32	User data

13.6.1 Unique Identifier (UID) NXP I-CODE SLIX-S

64	57	56	49	48	41	40									1
E0	04	02	IC manufacturer serial number												
UID 7	UID 6	UID 5	UID 4	UID 3	UID 2	UID 1	UID 0								

To differentiate it from the other I-CODE types of transponder bits 37 and 36 are programmed to '10'.

13.7 Memory Organization NXP I-CODE SLIX-L

Block	Bits	Description
UID	64	Fixed serial number
0	32	User data

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Block	Bits	Description
1	32	User data
...
6	32	User data
7	32	User data

13.7.1 Unique Identifier (UID) NXP I-CODE SLIX-L

64	57	56	49	48	41	40										1
E0	04	03	IC manufacturer serial number													
UID 7	UID 6	UID 5	UID 4	UID 3	UID 2	UID 1	UID 0									

To differentiate it from the other I-CODE types of transponder bits 37 and 36 are programmed to '10'.

13.8 Memory Organization NXP I-CODE SLIX2

Block	Bits	Description
UID	64	Fixed serial number
0	32	User data
1	32	User data
...
77	32	User Data
78	32	User data
79	32	Counter

13.8.1 Unique Identifier (UID) NXP I-CODE SLIX2

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64	57	56	49	48	41	40									1
E0	04	03	IC manufacturer serial number												
UID 7	UID 6	UID 5	UID 4	UID 3	UID 2	UID 1	UID 0								

To differentiate it from the other I-CODE types of transponder bits 37 and 36 are programmed to '01'.

13.9 Memory Organization TI Tag-it HF-I Standard

Block	Bits	Description
UID	64	Fixed serial number
0	32	User data
1	32	User data
...
6	32	User Data
7	32	User data

13.9.1 Unique Identifier (UID) TI Tag-it HF-I Standard

64	57	56	49	48	41	40									1
E0	07	C0 / C1	IC manufacturer serial number												
UID 7	UID 6	UID 5	UID 4	UID 3	UID 2	UID 1	UID 0								

13.10 Memory Organization TI Tag-it HF-I Plus

Block	Bits	Description
UID	64	Fixed serial number
0	32	User data
1	32	User data

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Block	Bits	Description
...
62	32	User Data
63	32	User data

13.10.1 Unique Identifier (UID) TI Tag-it HF-I Plus

64	57	56	49	48	41	40										1
E0	07	00 / 01 / 80 / 81		IC manufacturer serial number												
UID 7	UID 6	UID 5	UID 4	UID 3	UID 2	UID 1	UID 0									

13.11 Memory Organization TI Tag-it HF-I Pro

Block	Bits	Description
UID	64	Fixed serial number
0	32	User data
1	32	User data
...
6	32	User Data
7	32	User data

13.11.1 Unique Identifier (UID) TI Tag-it HF-I Pro

64	57	56	49	48	41	40										1
E0	07	C4 / C5		IC manufacturer serial number												
UID 7	UID 6	UID 5	UID 4	UID 3	UID 2	UID 1	UID 0									

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13.12 Memory Organization STM LRI 512

Block	Bits	Description
UID	64	Fixed serial number
0	32	User data
1	32	User data
...
14	32	User Data
15	32	User data

13.12.1 Unique Identifier (UID) STM LRI 512

64	57	56	49	48											1
E0	02	IC manufacturer serial number													
UID 7	UID 6	UID 5	UID 4	UID 3	UID 2	UID 1	UID 0								

13.13 Memory Organization Infineon my-d (02P)

Block	Bits	Description
UID	64	Fixed serial number
0	32	User data
1	32	User data
...
54	32	User Data
55	32	User data

13.13.1 Unique Identifier (UID) Infineon my-d (02P)

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64	57	56	49	48	41	40									1
E0	05	40	IC manufacturer serial number												
UID 7	UID 6	UID 5	UID 4	UID 3	UID 2	UID 1	UID 0								

13.14 Memory Organization Infineon my-d (10P)

Block	Bits	Description
UID	64	Fixed serial number
0	32	User data
1	32	User data
...
246	32	User Data
247	32	User data

13.14.1 Unique Identifier (UID) Infineon my-d (10P)

64	57	56	49	48	41	40									1
E0	05	00	IC manufacturer serial number												
UID 7	UID 6	UID 5	UID 4	UID 3	UID 2	UID 1	UID 0								

13.15 Memory Organization EM EM4135

Block	Bits	Description
UID	64	Fixed serial number
13	64	User data
14	64	User data
...

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Block	Bits	Description
47	64	User Data
48	64	User data

13.15.1 Unique Identifier (UID) EM EM4135

64	57	56	49	48											1
E0	16	IC manufacturer serial number													
UID 7	UID 6	UID 5	UID 4	UID 3	UID 2	UID 1	UID 0								

13.16 Memory Organization Fujitsu MB89R118C

Block	Bits	Description
UID	64	Fixed serial number
0	64	User data
1	64	User data
...
248	64	User Data
249	64	User data

13.16.1 Unique Identifier (UID) Fujitsu MB89R118C

64	57	56	49	48	41	40									1
E0	08	01	IC manufacturer serial number												
UID 7	UID 6	UID 5	UID 4	UID 3	UID 2	UID 1	UID 0								

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13.17 Memory Organization NXP MIFARE Classic 1k

Sector	Block	Bits	Description
0	0	128	Manufacturer Block
	1	128	User Data
	2	128	User Data
	3	128	Sector Trailer
1	0	128	User Data
	1	128	User Data
	2	128	User Data
	3	128	Sector Trailer

15	0	128	User Data
	1	128	User Data
	2	128	User Data
	3	128	Sector Trailer

13.18 Memory Organization NXP MIFARE Classic 4k

Sector	Block	Bits	Description
0	0	128	Manufacturer Block
	1	128	User Data
	2	128	User Data
	3	128	Sector Trailer
...

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Sector	Block	Bits	Description
31	0	128	User Data
	1	128	User Data
	2	128	User Data
	3	128	Sector Trailer
32	0	128	User Data
	1	128	User Data
	2	128	User Data
	3	128	User Data

	13	128	User Data
	14	128	User Data
	15	128	Sector Trailer
...
39	0	128	User Data
	1	128	User Data
	2	128	User Data
	3	128	User Data

	13	128	User Data
	14	128	User Data
	15	128	Sector Trailer

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13.18.1 Manufacturer block NXP MIFARE Classic 1k / 4k

128	49	48	1
Manufacturer Data		UID (32 bits if NUID)	

13.18.2 Sector trailer NXP MIFARE Classic 1k / 4k

128	81	80	49	48	1
Key B (optional)		Access Bits		UID (32 bits if NUID)	

13.19 Memory Organization NXP MIFARE Ultralight C

Pages	Byte	Bits	Description
0	0 – 3	32	Serial Number
1	0 – 3	32	Serial Number
2	0	8	Serial Number
	1	8	Internal
	2 – 3	16 - 31	Lock Bytes
3	0 – 3	32	One Time Programmable
4	0 – 3	32	User Memory
...
39	0 – 3	32	User Memory
40	0 – 1	16	Lock Bytes
	2 – 3	16	Reserved
41	0 – 1	16	16-bit Counter
42	0 – 4	32	Authentication Configuration

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Pages	Byte	Bits	Description
43	0 – 4	32	Authentication Configuration
44	0 – 4	32	Authentication Key
45	0 – 4	32	Authentication Key
46	0 – 4	32	Authentication Key
47	0 – 4	32	Authentication Key

13.19.1 Unique Identifier NXP MIFARE Ultralight C

Page	Byte 3	Byte 2	Byte 1	Byte 0
0	Check Byte 0	Serial Number part 1		
1	Serial Number part 2			
2	Lock Bytes		Internal	Check Byte 1

13.20 Memory Organization NXP NTAG 210

Pages	Bytes	Bits	Description
0	0 – 3	32	Serial Number
1	0 – 3	32	Serial Number
2	0	8	Serial Number
	1	8	Internal
	2 – 3	16	Lock Bytes
3	0 – 3	32	Capability Container
4	0 – 3	32	User Memory
...	
15	0 – 3	32	User Memory

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Pages	Bytes	Bits	Description
16	0 – 3	32	Configuration page CFG 0
17	0 – 3	32	Configuration page CFG 1
18	0 – 3	32	Configuration page PWD
19	0 – 1	16	Configuration page PACK
	2 – 3	16	Configuration page RFUI

13.20.1 Unique Identifier NXP NTAG 210

Pages	Byte 3	Byte 2	Byte 1	Byte 0
0	Check byte 0	Serial number part 1		
1	Serial number part 2			
2	Lock Bytes		Internal	Check byte 1

13.21 Memory Organization NXP NTAG 212

Pages	Bytes	Bits	Description
0	0 – 3	32	Serial Number
1	0 – 3	32	Serial Number
2	0	8	Serial Number
	1	8	Internal
	2 – 3	16	Lock Bytes
3	0 – 3	32	Capability Container
4	0 – 3	32	User Memory
...
35	0 – 3	32	User Memory

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Pages	Bytes	Bits	Description
36	0 - 2	24	Dynamic Lock Bytes
	3	8	Dynamic Lock Bytes RFUI
37	0 - 3	32	Configuration page CFG 0
38	0 - 3	32	Configuration page CFG 1
39	0 - 3	32	Configuration page PWD
40	0 - 1	16	Configuration page PACK
	2 - 3	16	Configuration page RFUI

13.21.1 Unique Identifier NXP NTAG 212

Pages	Byte 3	Byte 2	Byte 1	Byte 0
0	Check byte 0	Serial number part 1		
1	Serial number part 2			
2	Lock Bytes		Internal	Check byte 1

13.22 Memory Organization NXP NTAG 213

Pages	Bytes	Bits	Description
0	0 - 3	32	Serial Number
1	0 - 3	32	Serial Number
2	0	8	Serial Number
	1	8	Internal
	2 - 3	16	Lock Bytes
3	0 - 3	32	Capability Container
4	0 - 3	32	User Memory

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Pages	Bytes	Bits	Description
...	
39	0 – 3	32	User Memory
40	0 - 2	24	Dynamic Lock Bytes
	3	8	Dynamic Lock Bytes RFUI
41	0 – 3	32	Configuration page CFG 0
42	0 – 3	32	Configuration page CFG 1
43	0 – 3	32	Configuration page PWD
44	0 – 1	16	Configuration page PACK
	2 – 3	16	Configuration page RFUI

13.22.1 Unique Identifier NXP NTAG 213

Pages	Byte 3	Byte 2	Byte 1	Byte 0
0	Check byte 0	Serial number part 1		
1	Serial number part 2			
2	Lock Bytes		Internal	Check byte 1

13.23 Memory Organization NXP NTAG 215

Pages	Bytes	Bits	Description
0	0 – 3	32	Serial Number
1	0 – 3	32	Serial Number
2	0	8	Serial Number
	1	8	Internal
	2 – 3	16	Lock Bytes

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Pages	Bytes	Bits	Description
3	0 – 3	32	Capability Container
4	0 – 3	32	User Memory
...	
129	0 – 3	32	User Memory
130	0 - 2	24	Dynamic Lock Bytes
	3	8	Dynamic Lock Bytes RFUI
131	0 – 3	32	Configuration page CFG 0
132	0 – 3	32	Configuration page CFG 1
133	0 – 3	32	Configuration page PWD
134	0 – 1	16	Configuration page PACK
	2 – 3	16	Configuration page RFUI

13.23.1 Unique Identifier NXP NTAG 215

Pages	Byte 3	Byte 2	Byte 1	Byte 0
0	Check byte 0	Serial number part 1		
1	Serial number part 2			
2	Lock Bytes		Internal	Check byte 1

13.24 Memory Organization NXP NTAG 216

Pages	Bytes	Bits	Description
0	0 – 3	32	Serial Number
1	0 – 3	32	Serial Number
2	0	8	Serial Number

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Pages	Bytes	Bits	Description
	1	8	Internal
	2 – 3	16	Lock Bytes
3	0 – 3	32	Capability Container
4	0 – 3	32	User Memory
...	
225	0 – 3	32	User Memory
226	0 - 2	24	Dynamic Lock Bytes
	3	8	Dynamic Lock Bytes RFUI
227	0 – 3	32	Configuration page CFG 0
228	0 – 3	32	Configuration page CFG 1
229	0 – 3	32	Configuration page PWD
230	0 – 1	16	Configuration page PACK
	2 – 3	16	Configuration page RFUI

13.24.1 Unique Identifier NXP NTAG 216

Pages	Byte 3	Byte 2	Byte 1	Byte 0
0	Check byte 0	Serial number part 1		
1	Serial number part 2			
2	Lock Bytes		Internal	Check byte 1