Pepper C1 User Manual

V1.1
15/03/2019

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1. Introduction

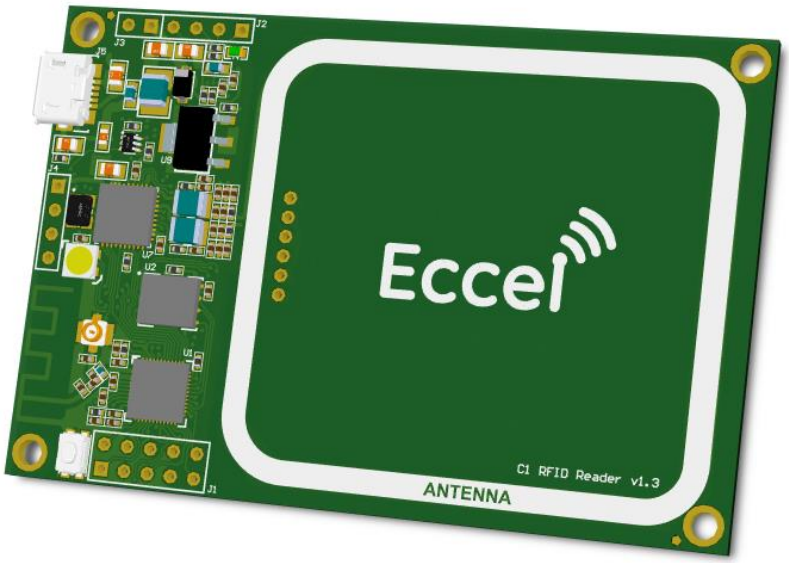
1.1 Device Overview

Features

- Low cost RFID Reader with MIFARE® Classic® in 1K, 4K memory, ICODE, MIFARE Ultralight®, MIFARE DESFire® EV1/EV2, MIFARE Plus® support
- Wireless connectivity:
  - Wi-Fi: 802.11 b/g/n
  - Bluetooth LE coming soon
- Built in WEB interface
- Over-the-Air lifetime updates
- Command interface via UART and TCP sockets with optional AES-128 encryption
- UART baud rate up to 921600 bps
- Configurable RGB LED indicator for RFID or WiFi events
- 6 configurable GPIOs
- Stand-alone mode (polling)
- IoT interfaces: MQTT, WebSocket
- High transponder read and write speed
- -25°C to 85°C operating range
- Multiple internal reference voltages
- RoHS compliant

Applications

- Access control
- Monitoring goods
- Approval and monitoring consumables
- Pre-payment systems
- Managing resources
- Contact-less data storage systems
- Evaluation and development of RFID systems



Description

The Pepper C1 module is the first Eccel Technology Ltd (IB Technology) product with wireless connectivity (Wi-Fi for now and Bluetooth support coming soon). Thanks to this, the customer receives free lifetime Over-the-Air updates, and of course the communication protocol can be used over TCP instead of traditional UART/USB interface. Combining these features with standalone mode provides a ready to use device in many applications “straight out of the box.” In standalone mode, the module can also send a tag UID over MQTT or WebSockets, and so can easily be integrated with IoT systems.

So, this is an ideal design choice if the user wishes to add RFID capability to their design quickly and without requiring extensive RFID and embedded software expertise and time. An advanced and powerful 32-bit microcontroller handles the RFID configuration setup and provides the user with a powerful yet simple command interface to facilitate fast and easy read/write access to the memory and features of the various transponders supported by this module.

2. Electrical specification

2.1 Absolute maximum ratings

Stresses beyond the absolute maximum ratings listed in the table below may cause permanent damage to the device. These are stress ratings only, and do not refer to the functional operation of the device that should follow the recommended operating conditions.

Symbol	Parameter	Min	Max	Unit
T_S	Storage temperature	-40	+125	°C
T_A	Ambient temperature	-40	+85	°C
V_{DDMAX}	Supply voltage (USB or J4 header)	3	5.5	V

Table 2-1. Absolute maximum ratings

2.2 Operating conditions

Symbol	Parameter	Min	Typ	Max	Unit
T_S	Operating temperature	-25	25	+85	°C
H	Humidity	5	60	95	%
V_{DD}	Supply voltage (USB or J4 header)	3	5	5.5	V

Table 2-2. Operating conditions

2.3 DC characteristics (V_{DD} = 5 V, T_S = 25 °C)

Symbol	Parameter	Min	Typ	Max	Unit
V_{OUT}	Output voltage (regulator output, 3V3 pin on the J1 header)	3.23	3.3	3.37	V
V_{IH}	High-level input voltage (J1 header)	0.75 x V_{OUT}	-	V_{OUT} + 0.3	V
V_{IL}	Low-level input voltage (J1 header)	0	-	0.3 x V_{OUT}	V
V_{OH}	High-level output voltage (J1 header)	0.8 x V_{OUT}	-	-	V
V_{OL}	Low-level output voltage (J1 header)	-	-	0.3 x V_{OUT}	V

Table 2-3. DC characteristics

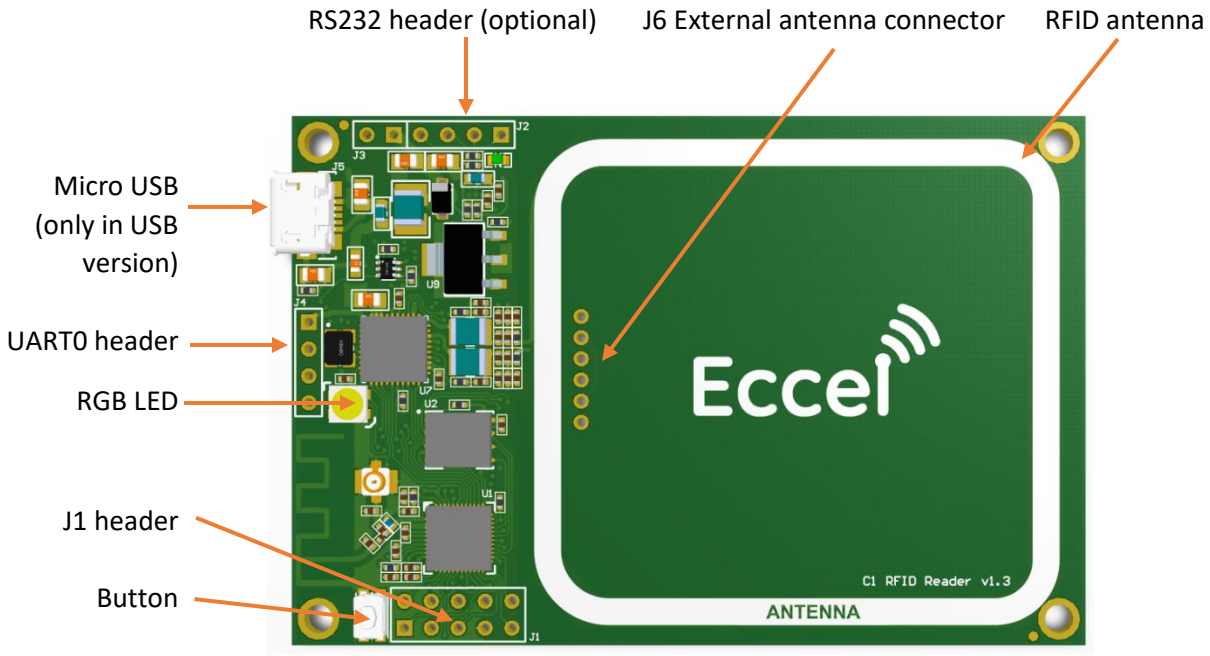
2.4 Current consumption

Symbol			Parameter	Typ	Max	Unit
Wi-Fi enabled	Access Point	$I_{PN\_RFOFF\_AP}$	RF field off (AP)	150	170	mA
		$I_{PN\_RFON\_AP}$	RF field on (AP)	190	210	mA
	Station mode	$I_{PN\_RFOFF\_STA}$	RF field off (STA)	75	95	mA
		$I_{PN\_RFON\_STA}$	RF field on (STA)	130	150	mA
Wi-Fi Off	I_{PN_RFOFF}		RF field off	65	70	mA
	I_{PN_RFON}		RF field on	120	140	mA

Table 2-4. Current consumption

3. Getting started

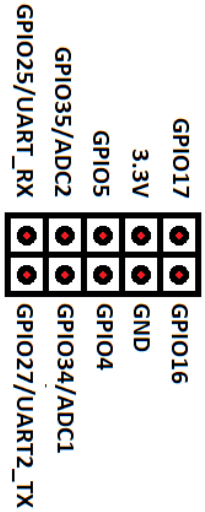
3.1 IO and peripherals



Micro USB – *only in USB version. Connected to the built in USB to TTL converter. This converter is routed to the UART1 header.*
RS232 header – *this connection is for optional built in RS232 converter. This option is available only for custom orders. (Please contact sales@eccel.co.uk for further details if interested)*

3.1.1 J1 header description

- GND – Ground
- 3.3V – Output
- GPIOx - general-purpose input/output. Currently only GPIO4,GPIO5, GPIO16, GPIO17 can be used with polling
- UART2_RX/UART2_TX – UART2 in TTL standard with 3.3V levels



3.1.2 J4 UART0 header

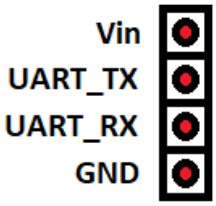
This is the UART0 header in the TTL standard with 3.3V levels. This is the same UART as it available on the USB port in the USB version.

Vin – Power supply, 3-5.5Voltage

UART0 TX – UART TX data from the module

UART0 RX – UART RX data to the module

GND – ground



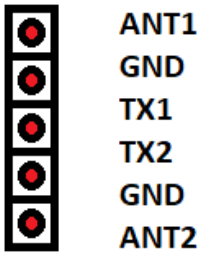
3.1.3 J6 External antenna header

The user has the option to work with an external RFID antenna connected to the Pepper C1 device. Connector J6 is where to plug in an external antenna, but some soldering shown on the pictures below is required to make it work. Eccel Technology Ltd provides a variety of RFID antennas which the user can use together with this device.

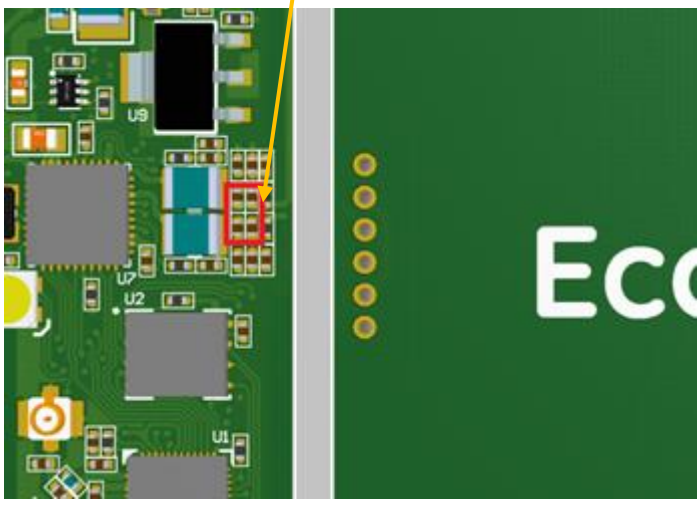
ANT1, ANT2 – for future use with NFC for phone and tablets

TX1, TX2 - Antenna driver output

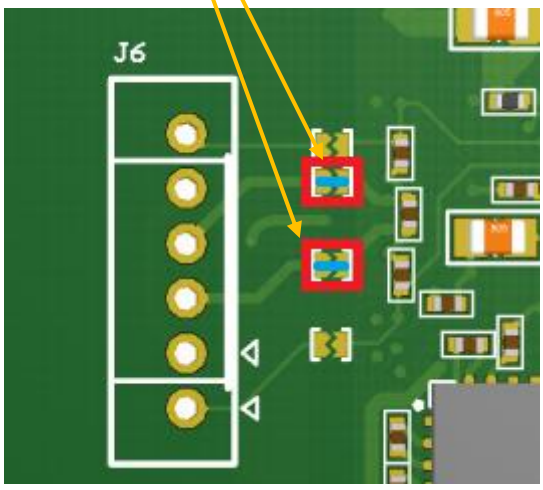
GND – ground



Top view – Remove these four capacitors



Bottom view – Apply solder onto both of these pads to connect to the external antenna connector



3.2 Typical connection

The Pepper C1 device can be connected to a host computer using a standard USB Micro cable. In the same way it can be powered to operate as a standalone device by using power sources such as a USB charger or power bank.

The computer operating system should recognize this device as a USB to TTL bridge or a USB to Serial port converter and it should appear in Windows device manager as a COM port. By default this COM port can be used for communication using the binary protocol described below.

The Reader also has the UART connector (J1 header) where the user can view output logs which contain additional information about temporary executing commands. The default configuration: baud: 115200, Data: 8 bit, Parity: none, Stop bits: 1 bit, Flow Control: none.

Hint – If you don't have your own USB to TTL converter to connect to the log console available on the UART2 header, you can temporary change the communication method in the Communication tab to UART2 or TCP, then console logs should be available on the USB port.

4. Configuration – Web interface

The reader has Wi-Fi functionality and can be configured through the Web interface. The Pepper C1 can work in either station mode or client mode. The default mode is station mode. The user can login using the web interface and set a SSID and a password for their Wi-Fi network.
The Web interface is divided into several sections: The Network configuration, RFID, Communication, IOT, Status and Upgrade. All sections are described below.

4.1 Network Configuration

The very first use of the Pepper C1 Reader Web interface:

1. Connect your PC to the Wi-Fi Access Point named: Pepper_C1-XXXXXX, where XXXXXX is the last three bytes of the MAC address, e.g. Peeper_C1-567801.
2. Open your web browser and enter http://192.168.100.1
3. Enter the default username: admin, and the default password: admin.

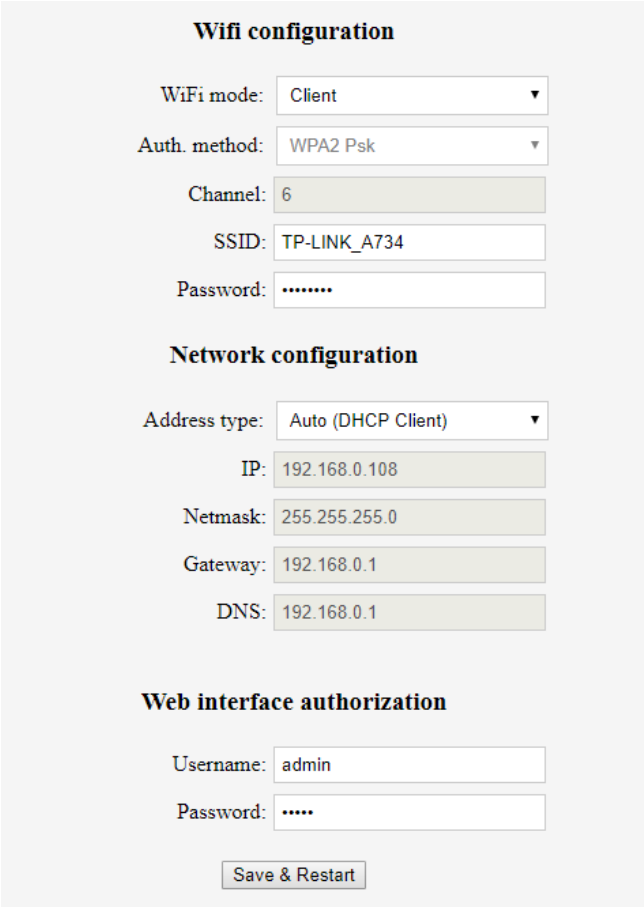


Figure 4-1 Web interface. Network configuration - Access point.

At this stage, change the Wi-Fi mode to Client, enter your SSID and the password. Change the IP, or set the Address type to Auto (DHCP Client). Optionally the user can change the Username and Password for the Web Interface. At the end of this process above, the Save & Restart button should be pressed. If you setup automatic IP and you don't know what IP is assigned by the DHCP server, you can browse the device logs to find this information.

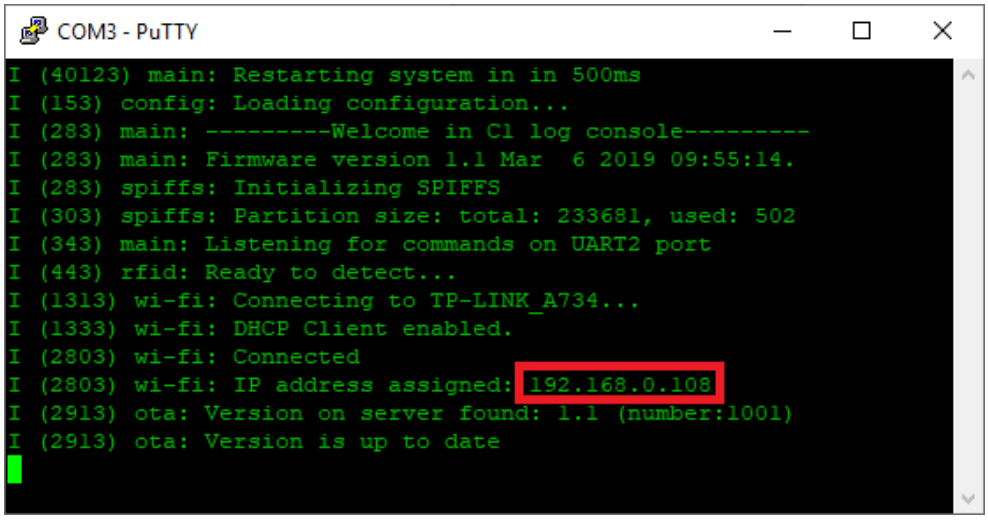


Figure 4-2 Output console. New IP address in the client mode.

The Pepper C1 is now configured as a client, connected to a TP-LINK_A734. The automatic generated IP number is 192.168.0.108.

4.2 RFID

In this tab the user can change configuration for the default RFID behavior. This tab has three subcategories relating to RFID functionality and built in polling options:

- Polling
- Known UIDs
- RFID keys

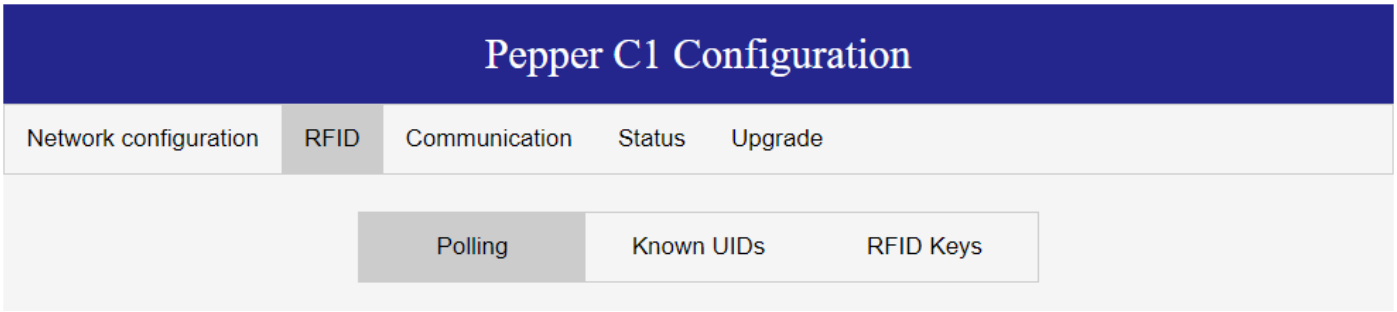


Figure 4-3 Configuration tabs for RFID

More information about this functionality is provided in the Polling modesection in this document.

4.3 Communication

In this tab you can setup parameters for communication.

4.3.1 Communication interface

This tab should be used to setup the communication port for the binary protocol described in the Binary protocol section.

Available options are:

- USB – built in USB to TTL converter. For this port you can change the baud rate from 9600 to 921600.
- UART2 – the UART2 port available on the J1 header. For this port you can change the baud rate from 9600 to 921600.
- TCP server – built in TCP server that can be used to communicate with the device using a Wi-Fi interface. When this port is selected you can change the TCP port used for communication and built in timeout.

When the communication port is changed to UART2 or TCP, the USB port can be used to read logs from the module. The console output always has the same communication parameters: baud: 115200, Data: 8 bit, Parity: none, Stop bits: 1 bit, Flow Control: none.

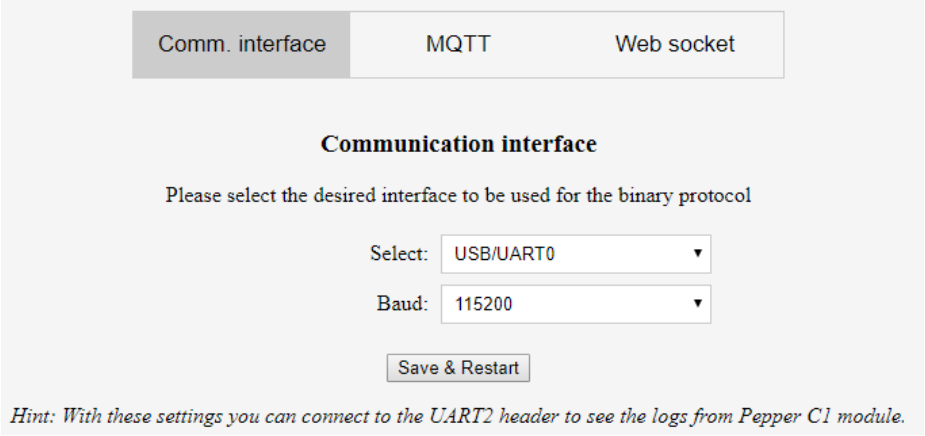


Figure 4-4 Web interface - the Communication interface tab.

4.3.2 MQTT

The device has a built in MQTT client and this tab is used to configure parameters needed for this communication. When the MQTT service is enabled **and the built in polling is enabled,** JSON frames with basic information about the tag is sent to the MQTT server.

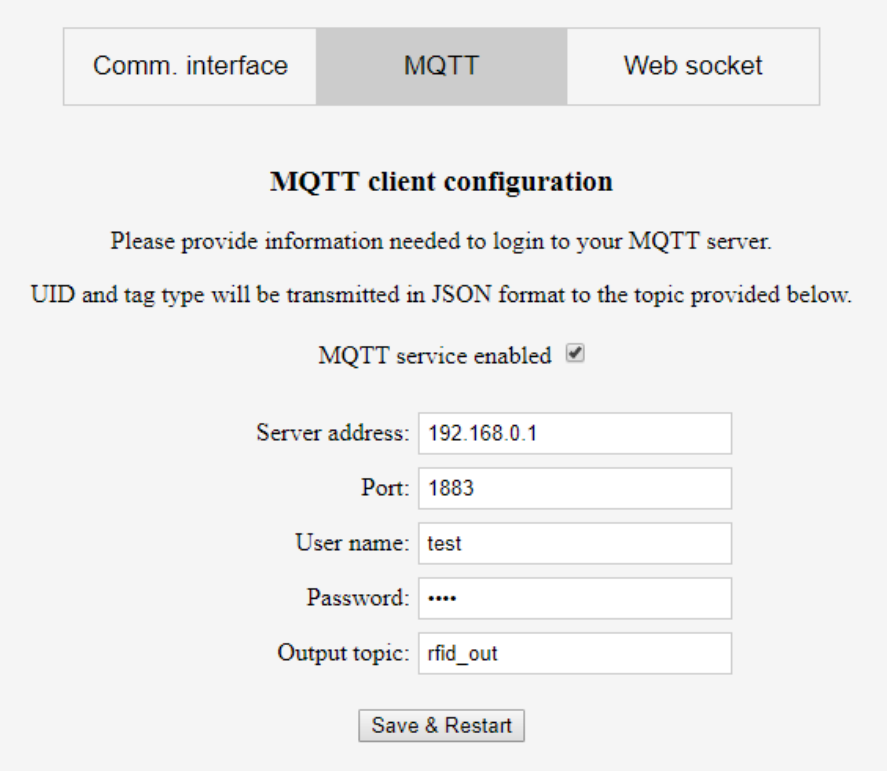


Figure 4-5 Web interface - the MQTT client configuration tab.

The picture below shows an example of a JSON frame received in a Node-RED system.

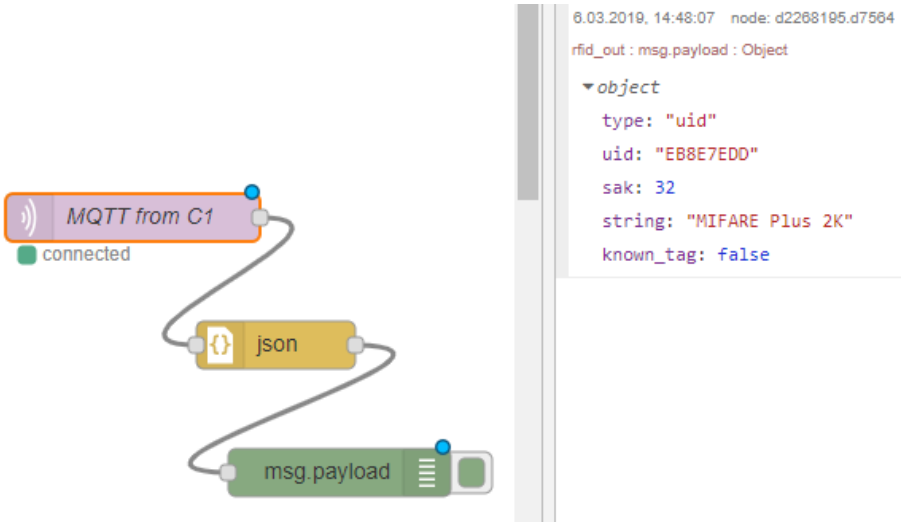


Figure 4-6 Node-Red – the MQTT client + JSON frame example

4.3.3 Web sockets

In a similar way to the MQTT protocol, the device can send JSON messages over Web Sockets. If service is enabled **and built in polling is enabled,** JSON frames can be handled using a Web socket with address ws://<device ip address>/<web socket name> eg. ws://172.16.16.62/wscomm.cgi .

Figure 4-7 Web interface – the Web socket configuration

4.3.4 Status

This page provides information about the current firmware version, and basic information about the TAGs in range of the antenna. Keep in mind that built in polling must be enabled to get information from the tags. The clear page button will clear all readings.

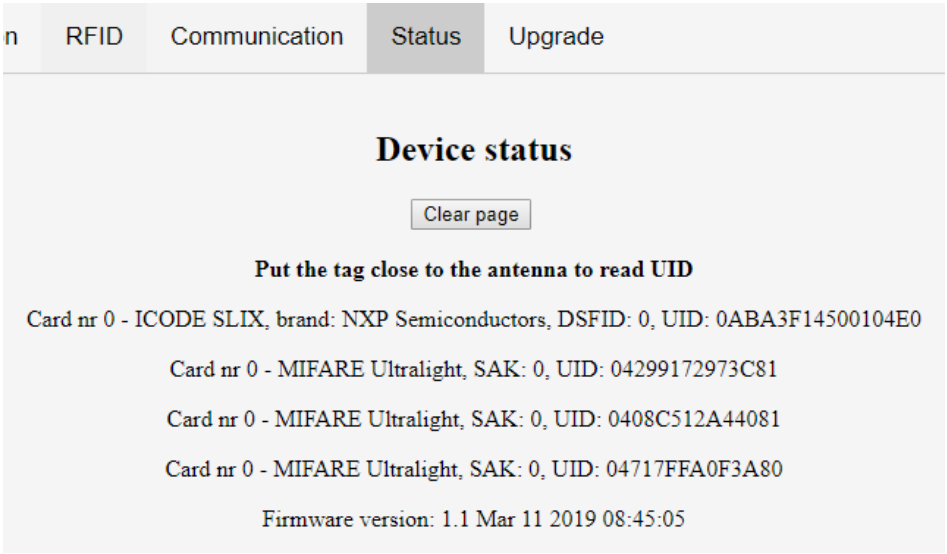


Figure 4-8 Web interface – the Status page

4.4 Firmware upgrade

In the Upgrade tab, the user is able to upgrade the reader firmware. There are two options: select the binary file to upload, or make an OTA Upgrade (Over The Air), which is a powerful feature of the Pepper C1. By clicking the OTA Upgrade button, the firmware file will be downloaded directly from our website www.eccel.co.uk to the reader flash memory and a firmware update will be performed. Each time the user visits the Upgrade tab, they will see information about the availability of the latest firmware version.

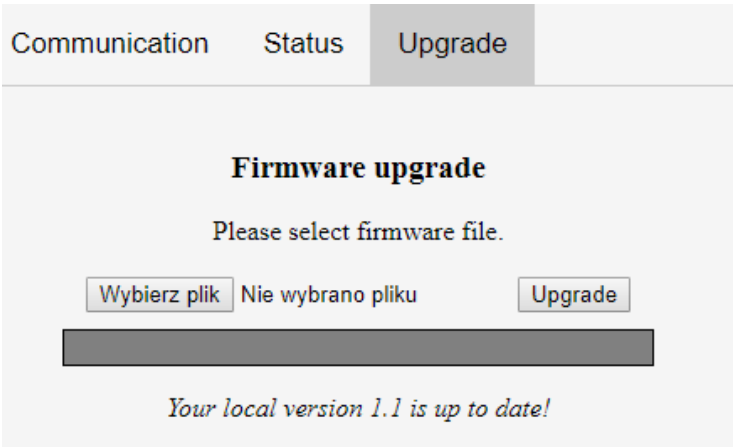


Figure 4-9 Web interface – the Firmware upgrade tab

5. Rescue mode and factory reset

If the user forgets the password to the module or if the settings for the Wi-Fi need to be updated, the Pepper C1 device provides two modes to resolve this situation: the rescue mode and factory defaults reset.

5.1 Rescue mode

This mode is dedicated specifically to update Wi-Fi connection settings or to access the web interface when the Wi-Fi is disabled. To enable this mode please follow this steps:

- Power up device
- Press the button and hold it for about 5 seconds – device blinks red every 1 second, release the button when device blinks white. **Do not hold the button longer if you don't want to perform full factory reset**
- The device should be available as an Access Point with the name Pepper_C1-xxxxxx. If the user has already provided a password for Wi-Fi connection, then this password needs to be entered in order to access the device. If a password has not yet been inputted by the user, then the device will be open and will not require any password for access

5.2 Resetting module to factory defaults

If the user wants to erase all settings stored in the device to factory defaults including Wi-Fi settings, communication settings and known UIDs, then the steps below need to be followed:

- Power up the device
- Press the button and hold it for about 10 seconds
- Release the button when the device blinks green
- The device should reboot itself and should be available for the user with default settings

6. Communication interface

6.1 Overview

The Pepper C1 module can be controlled using a simple binary protocol available over USB (using the built in USB-TTL converter), the UART2 header, or a TCP IP socket. This binary protocol was designed to be as simple as possible to implement on the host side whilst still providing robust communication.

The default configuration provides communication over USB with the following parameters:

- Baud rate: 115200bps
- Data: 8 bit
- Parity: None
- Stop bits: 1 bit
- Flow Control: none

The baud rate can be changed in the Web interface from 9600 up to 921600. The same settings can be applied when communication is switched to UART2.

When communication is set to TCP, the device's built in internet protocol socket module acts as a TCP server and listens for connection by default on port 1234. Only one active TCP connection is allowed to the module. The module has a built in 15 second timeout for connection, so if the host doesn't send any frame for this period, the connection will be closed on the server side. To avoid this, the user should send any frame to the module (e.g. DUMMY_COMMAND).

6.2 Frame structure

Communication with the module is symmetric so frames sent to, and received from the module are coded in the same way. All frames contain fields as described in the table below.

Frame STX	Command length	Command length XOR	Command body		CRC16
1 byte	2-bytes	2-bytes	1-byte	n-bytes	2-bytes
0xF5	Command body length, LSB, maximum value 1024	XOR of command length bytes	Command	Command parameters	Command body CRC

6.3 CRC calculation

CRC is a 16-bit CRC-CCITT with a polynomial equal to 0x1021. The initial value is set to 0xFFFF, the input data and the output CRC is not negated. In addition, no XOR is performed on the output value. Example C code is shown below.

```
static const uint16_t CCITTCRCTable [256] = {
0x0000, 0x1021, 0x2042, 0x3063, 0x4084, 0x50a5,
0x60c6, 0x70e7, 0x8108, 0x9129, 0xa14a, 0xb16b,
0xc18c, 0xd1ad, 0xe1ce, 0xf1ef, 0x1231, 0x0210,
0x3273, 0x2252, 0x52b5, 0x4294, 0x72f7, 0x62d6,
0x9339, 0x8318, 0xb37b, 0xa35a, 0xd3bd, 0xc39c,
0xf3ff, 0xe3de, 0x2462, 0x3443, 0x0420, 0x1401,
0x64e6, 0x74c7, 0x44a4, 0x5485, 0xa56a, 0xb54b,
0x8528, 0x9509, 0xe5ee, 0xf5cf, 0xc5ac, 0xd58d,
0x3653, 0x2672, 0x1611, 0x0630, 0x76d7, 0x66f6,
0x5695, 0x46b4, 0xb75b, 0xa77a, 0x9719, 0x8738,
0xf7df, 0xe7fe, 0xd79d, 0xc7bc, 0x48c4, 0x58e5,
0x6886, 0x78a7, 0x0840, 0x1861, 0x2802, 0x3823,
0xc9cc, 0xd9ed, 0xe98e, 0xf9af, 0x8948, 0x9969,
0xa90a, 0xb92b, 0x5af5, 0x4ad4, 0x7ab7, 0x6a96,
0x1a71, 0x0a50, 0x3a33, 0x2a12, 0xdbfd, 0xcbdc,
0xfbbf, 0xeb9e, 0x9b79, 0x8b58, 0xbb3b, 0xab1a,
0x6ca6, 0x7c87, 0x4ce4, 0x5cc5, 0x2c22, 0x3c03,
0x0c60, 0x1c41, 0xedae, 0xfd8f, 0xcdec, 0xddcd,
0xad2a, 0xbd0b, 0x8d68, 0x9d49, 0x7e97, 0x6eb6,
0x5ed5, 0x4ef4, 0x3e13, 0x2e32, 0x1e51, 0x0e70,
0xff9f, 0xefbe, 0xdfdd, 0xcffc, 0xbf1b, 0xaf3a,
0x9f59, 0x8f78, 0x9188, 0x81a9, 0xb1ca, 0xa1eb,
0xd10c, 0xc12d, 0xf14e, 0xe16f, 0x1080, 0x00a1,
0x30c2, 0x20e3, 0x5004, 0x4025, 0x7046, 0x6067,
0x83b9, 0x9398, 0xa3fb, 0xb3da, 0xc33d, 0xd31c,
0xe37f, 0xf35e, 0x02b1, 0x1290, 0x22f3, 0x32d2,
0x4235, 0x5214, 0x6277, 0x7256, 0xb5ea, 0xa5cb,
```

```
0x95a8, 0x8589, 0xf56e, 0xe54f, 0xd52c, 0xc50d,
0x34e2, 0x24c3, 0x14a0, 0x0481, 0x7466, 0x6447,
0x5424, 0x4405, 0xa7db, 0xb7fa, 0x8799, 0x97b8,
0xe75f, 0xf77e, 0xc71d, 0xd73c, 0x26d3, 0x36f2,
0x0691, 0x16b0, 0x6657, 0x7676, 0x4615, 0x5634,
0xd94c, 0xc96d, 0xf90e, 0xe92f, 0x99c8, 0x89e9,
0xb98a, 0xa9ab, 0x5844, 0x4865, 0x7806, 0x6827,
0x18c0, 0x08e1, 0x3882, 0x28a3, 0xcb7d, 0xdb5c,
0xeb3f, 0xfb1e, 0x8bf9, 0x9bd8, 0xabbb, 0xbb9a,
0x4a75, 0x5a54, 0x6a37, 0x7a16, 0x0af1, 0x1ad0,
0x2ab3, 0x3a92, 0xfd2e, 0xed0f, 0xdd6c, 0xcd4d,
0xbdaa, 0xad8b, 0x9de8, 0x8dc9, 0x7c26, 0x6c07,
0x5c64, 0x4c45, 0x3ca2, 0x2c83, 0x1ce0, 0x0cc1,
0xef1f, 0xff3e, 0xcf5d, 0xdf7c, 0xaf9b, 0xbfba,
0x8fd9, 0x9ff8, 0x6e17, 0x7e36, 0x4e55, 0x5e74,
0x2e93, 0x3eb2, 0x0ed1, 0x1ef0 };

static uint16_t GetCCITTCRC(const uint8_t* Data, uint32_t Size) {
uint16_t CRC;
uint16_t Temp;
uint32_t Index;
if (Size == 0) {
return 0;
}
CRC = 0xFFFF;
for (Index = 0; Index < Size; Index++){
Temp = (uint16_t)( (CRC >> 8) ^ Data[Index] ) & 0x00FF;
CRC = CCITTCRCTable[Temp] ^ (CRC << 8);
}
return CRC;
}
```

7. Key storage

To perform some operations on TAGs authority keys maybe required. The user can set these keys using the SET_KEY command anytime this is required. However it is also possible store up to 5 keys in non-volatile memory and the module will then load these keys after bootup.

Storing keys in memory can be done in two ways: In the HTTP interface on the RFID tab and by using commands.

In the latter scenario, the command SET_KEY needs to be executed to save a KEY in volatile memory temporarily and then execute the SAVE_KEYS command to save these keys to non-volatile memory. Please refer to these commands for full details.

The key storage can be also managed in the web interface under RFID->Key storage tab.

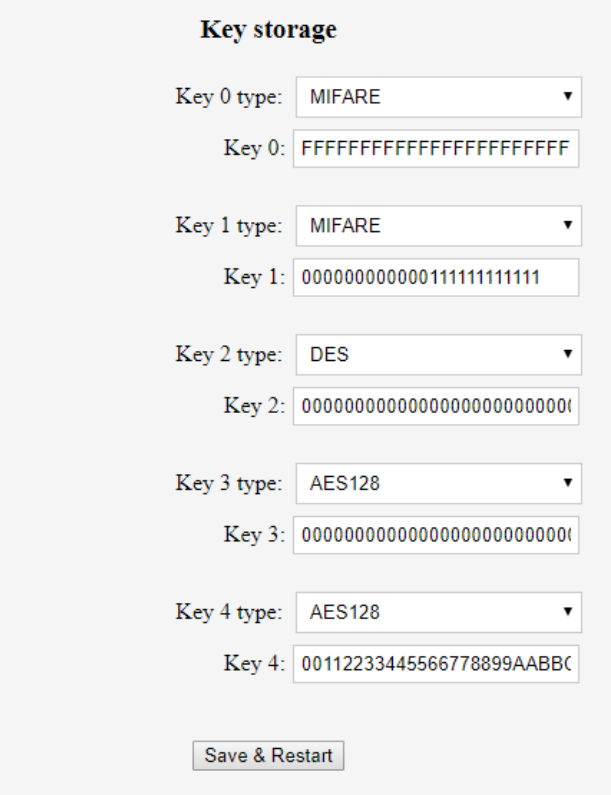


Figure 7-1 Web interface – Key storage TAB

8. Polling mode

In this mode the Pepper C1 device executes the continuous repeated enumerate tags UID command. Depending upon the polling settings in the web interface, the module can execute some actions as described below. Because the module has built in memory, the user can store known UIDs, and polling mode can trigger different actions depending upon whether the UID is stored in the memory or not. (Whitelist)

This mode needs to also be activated in order to send frames using the MQTT client and to the WebSocket interface. These modes are enabled in the Web Interface.

8.1 Web configuration for polling mode

All feature related with polling can be configured in Web interface under RFID->Polling tab.

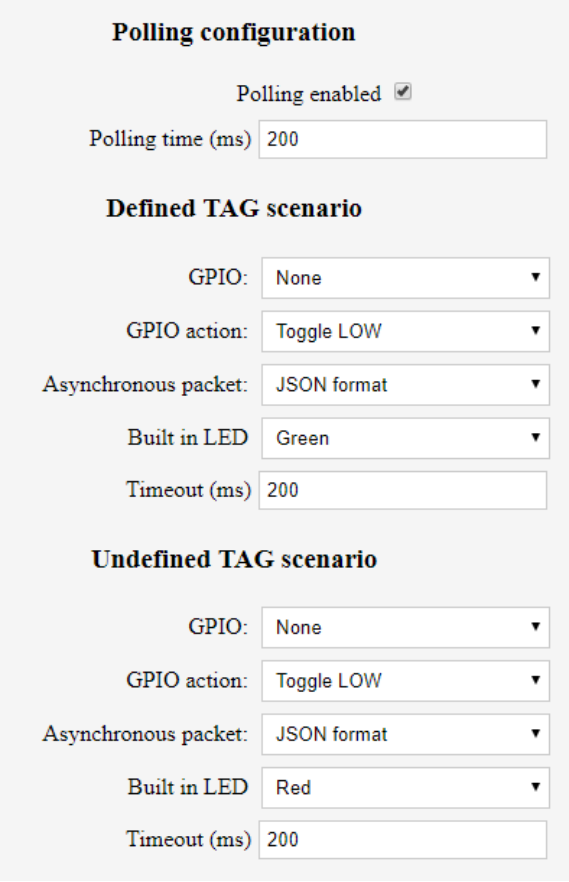


Figure 8-1 Web interface – polling configuration tab

As shown in Figure 8-1 above, you can configure different actions for a defined tag (stored in device memory) and undefined. Both actions have five parameters to configure:

- **GPIO** - user can select one of dedicated GPIO to perform action
- **GPIO action** – there are two options: toggle LOW or HIGH. If the configured action is to toggle HIGH, then the selected GPIO remains LOW until the event occurs and then toggles HIGH for a time defined in the Timeout field. If the selected action is to toggle LOW, then the GPIO remains HIGH until the event occurs and then toggles LOW.
- **Asynchronous packet** – the device can send packets over the communication protocol selected in the communication tab. Three packet options are available:
    - Binary packet format – with these settings, the module sends the Get tag UID (0x03) frame but with ASYNC flag instead of ACK. This is the best method if the user already uses binary protocol as the selected communication method. Here is an example:

```
C1=>HOST: 0xFE - ASYNC byte
          0x03 - related command code GET_TAG_UID
          0x01 – Mifare tag type
          0x20 – tag parameter
          0x74 0x54 0x12 0x65 – tag UID bytes
```

    - Plain text – the device sends text strings with basic information about the TAG eg:

```
Card nr 0 - MIFARE Ultralight, SAK: 0, UID: 0408C512A4408
```

    - JSON frame – the module sends a JSON string using the configured communication method. This is the best option if you want to connect this device to IOT systems. Example below

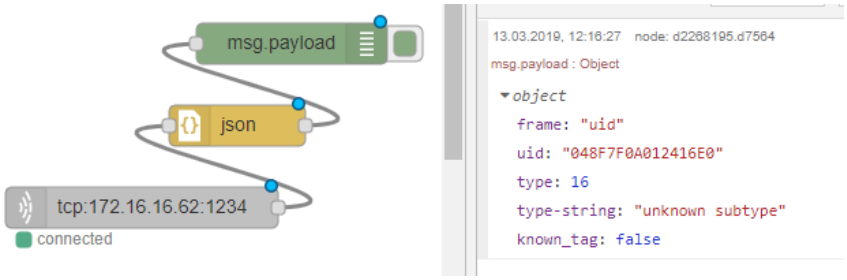


Figure 8-2 JSON frame example

- **Built in LED** – the user can configure the device to toggle the LED in selected colours (RED, Green, Blue, White)
- **Timeout** – time used for toggling the GPIO action and LED

8.2 Known UID list

This tab in the web interface is used to manage known UIDs stored in the device memory. Thanks to this, in standalone mode, the Pepper C1 can perform different actions for known and unknown UIDs.

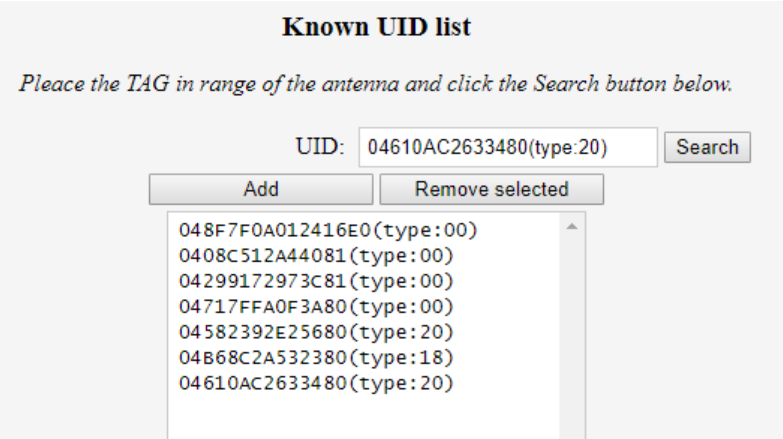


Figure 8-3 Web interface – know UID list

9. Commands list

Commands are exchanged with the module using the protocol described above. All frames contain a command byte and command arguments. Depending upon the command, arguments can be optional, so a command length can be in the range from 1-1024 bytes.

9.1 Generic commands

9.1.1 Acknowledge frame (0x00)

This is the response message from the module to the host. This frame always contains 1-byte with command ID and optional arguments.

Command description:

Argument	Size	Value	Description
Command ID	1	0x00	
Related command ID	1	X	Related command code
Other parameters	n	X	Depending on the requested command this parameter is n-bytes long and contains parameters

Example:

```
HOST=>C1: 0x02 – GET_TAG_COUNT command

C1=>HOST: 0x00 - ACK byte
          0x02 - related command code GET_TAG_COUNT
          0x01 – argument for GET_TAG_COUNT – 0x01 – one tag detected
```

9.1.2 Dummy command (0x01)

This command takes no arguments. It is used to check that the module alive. The module replies to this command with an ACK response and no optional parameters.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x01	DUMMY_COMMAND
Response description			
ACK	1	0x00	
Command ID	1	0x01	DUMMY_COMMAND

Example:

```
HOST=>C1: 0x01 –DUMMY_COMMAND

C1=>HOST: 0x00 - ACK byte
          0x01 - related command code DUMMY_COMMAND
```

9.1.3 Get tag count (0x02)

The command send to the module to read how many TAGS are in range of the antenna no matter which technology of tag, so it returns the total amount present of all supported tag types. The maximum number for this standard discovery loop is 5. If you want to perform a full inventory command for ICODE tag types please refer to ICODE_INVENTORY_xxx commands.

After this command, the module holds all UID's and basic information about TAGs present in volatile memory and the user can read it using the GET_TAG_UID command.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x02	GET_TAG_COUNT
Response description			
ACK	1	0x00	
Command ID	1	0x02	GET_TAG_COUNT
TAG count	1	X	Maximum discovered tags is 5

Example:

```
HOST=>C1: 0x02 – GET_TAG_COUNT

C1=>HOST: 0x00 - ACK byte
          0x02 - related command code GET_TAG_COUNT
          0x01 – number of tags in range
```

9.1.4 Get tag UID (0x03)

This command should be executed after GET_TAG_COUNT frame to read information about the tag.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x03	GET_TAG_UID
TAG idx	1	X	TAG index in module memory, must me less than number of tags reported by GET_TAG_COUNT command
Response description			
ACK	1	0x00	
Command ID	1	0x03	GET_TAG_UID
TAG type	1	X	0x01 - Mifare family tag 0x10 - ICODE family tag
TAG parameter	1	X	SAK - byte for Mifare family tags DSFID - byte for ICODE family tags
UID	N	X	UID bytes. Max length is 8.

Example:

```
HOST=>C1: 0x03 – GET_TAG_UID
          0x00 – TAG idx

C1=>HOST: 0x00 - ACK byte
          0x03 - related command code GET_TAG_UID
          0x01 – Mifare tag type
          0x20 – tag parameter:
                 SAK byte for Mifare family tags
                 DSFID byte for ICODE family tags
          0x74 0x54 0x12 0x65 – tag UID bytes
```

9.1.5 Activate TAG (0x04)

The command executed to activate a TAG after the discovery loop if more than one TAG is detected.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x04	ACTIVATE_TAG
TAG idx	1	X	TAG index in module memory, must me less than number of tags reported by GET_TAG_COUNT command
Response description			
ACK	1	0x00	
Command ID	1	0x04	ACTIVATE_TAG

Example:

```
HOST=>C1: 0x04 – ACTIVATE_TAG
          0x00 – TAG idx

C1=>HOST: 0x00 - ACK byte
          0x04 - related command code ACTIVATE_TAG
```

9.1.6 Halt (0x05)

The Halt command takes no arguments. It halts the tag and turns off the RF field. It must be executed at the end of each operation on a tag to disable the antenna and reduce the power consumption.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x05	HALT
Response description			
ACK	1	0x00	
Command ID	1	0x05	HALT

Example:

```
HOST=>C1: 0x05 – HALT

C1=>HOST: 0x00 - ACK byte
          0x05 - related command code HALT
```

9.1.7 Set polling (0x06)

The module can't perform polling mode and RFID requests over the communication channels simultaneously. When polling is enabled and the host wants to request an RFID command, this command should be executed first with a STOP parameter, and then START again if needed afterwards. This command does not change polling configuration permanently, so after a reset, the module performs polling as configured in the Web interface.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x06	SET_POLLING
Start/Stop	1	X	0x00 – Stop polling 0x01 – Start polling
Response description			
ACK	1	0x00	
Command ID	1	0x06	SET_POLLING

Example:

```
HOST=>C1: 0x06 – SET_POLLING
          0x00 – Stop polling temporary

C1=>HOST: 0x00 - ACK byte
          0x06 - related command code SET_POLLING
```

9.1.8 Set key (0x07)

This command sets a KEY in Key Storage Memory on a selected slot. Set key can be used for all RFID functions needing authorization like e.g. READ/WRITE memory on the TAG etc. This command changes a key in volatile memory, so if the user wants to save it permanently and load automatically after boot-up, then the user should use the CMD_SAVE_KEYS command.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x07	SET_KEY
Key number	1	0-4	Key number in Key Storage Memory.
Key type	1	0 - 6	0x00 - AES 128 Key. (length = 16 bytes) 0x01 - AES 192 Key. (length = 24 bytes) 0x02 - AES 256 Key. (length = 32 bytes) 0x03 - DES Single Key. (length = 16 bytes) 0x04 - 2 Key Triple Des. (length = 16 bytes) 0x05 - 3 Key Triple Des. (length = 24 bytes) 0x06 - MIFARE (R) Key. (length = 12 bytes, key A+B)
Key	12-32	X	Key bytes. Length must match to the type.
Response description			
ACK	1	0x00	
Command ID	1	0x07	SET_KEY

Example:

```
HOST=>C1: 0x07 – SET_KEY
          0x00 – Key number
          0x06 – Mifare key type
          0x00 0x00 0x00 0x00 0x00 0x00
          0xFF 0xFF 0xFF 0xFF 0xFF 0xFF – Key bytes

C1=>HOST: 0x00 - ACK byte
          0x07 - related command code SET_KEY
```

9.1.9 Save keys (0x08)

This command should be called if the user wants to save keys changed using the SET_KEY command in the module non-volatile memory. Saved keys will be automatically loaded after power up or reboot.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x08	SAVE_KEYS
Response description			
ACK	1	0x00	
Command ID	1	0x08	SAVE_KEYS

Example:

```
HOST=>C1: 0x08 – SAVE_KEYS

C1=>HOST: 0x00 - ACK byte
          0x08 - related command code SAVE_KEYS
```

9.1.10 Set network config (0x09)

This command should be used to setup network parameters. Depending upon the second byte of the command, different parameters of the network configuration can be changed. Below is the full list of possible network parameters. Also, the ACK response contains a byte detailing the parameters that have been set.

9.1.10.1 Setting Wi-Fi mode

This command gets one argument to setup Wi-Fi adapter mode to: Access Point, Client or Off. In the case of the Wi-Fi adapter being disabled, the user needs to use this command again with different settings to enable it again or just perform a factory reset.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x09	SET_NET_CFG
Subcommand ID	1	0x00	Wi-Fi mode subcommand
Mode	1	X	0x00 – Access Point 0x01 – Client 0x02 – Wi-Fi adapter off
Response description			
ACK	1	0x00	
Command ID	1	0x09	SET_NET_CFG
Subcommand ID	1	0x00	Wi-Fi mode subcommand

Example:

```
HOST=>C1: 0x09 – SET_NET_CFG
          0x00 – Wi-Fi mode subcommand
          0x01 – Client mode

C1=>HOST: 0x00 - ACK byte
          0x09 - related command code SET_NET_CFG
          0x00 – Wi-Fi mode subcommand
```

9.1.10.2 Wi-Fi authorization mode

This command gets one argument to setup Wi-Fi authorization mode. This setting is only applied in Access Point mode. In client mode authorization is automatically detected.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x09	SET_NET_CFG
Subcommand ID	1	0x01	Wi-Fi authorization mode subcommand
Mode	1	X	0x00 – Open 0x01 – WEP 0x02 – WPA PSK 0x03 – WPA2_PSK 0x04 - WPA_WPA2_PSK 0x05 - WPA2_ENTERPRISE
Response description			
ACK	1	0x00	
Command ID	1	0x09	SET_NET_CFG
Subcommand ID	1	0x01	Wi-Fi authorization mode subcommand

Example:

```
HOST=>C1: 0x09 – SET_NET_CFG
          0x01 – Wi-Fi authorization mode subcommand
          0x03 – WPA2_PSK

C1=>HOST: 0x00 - ACK byte
          0x09 - related command code SET_NET_CFG
          0x01 – Wi-Fi authorization mode subcommand
```

9.1.10.3 Wi-Fi channel

This command gets one argument to setup the Wi-Fi channel. This setting is only applied in Access Point mode. In client mode, the channel is automatically detected.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x09	SET_NET_CFG
Subcommand ID	1	0x02	Wi-Fi channel subcommand
Channel	1	1-13	Channel number
Response description			
ACK	1	0x00	
Command ID	1	0x09	SET_NET_CFG
Subcommand ID	1	0x02	Wi-Fi channel subcommand

Example:

```
HOST=>C1: 0x09 – SET_NET_CFG
          0x02 – Wi-Fi authorization mode
          0x05 – channel number

C1=>HOST: 0x00 - ACK byte
          0x09 - related command code SET_NET_CFG
          0x02 – Wi-Fi authorization mode
```

9.1.10.4 Wi-Fi network SSID

This command sets the SSID for the Wi-Fi adapter. Depending upon mode configuration, this setting will be applied to Access Point or Client.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x09	SET_NET_CFG
Subcommand ID	1	0x03	Wi-Fi SSID subcommand
Channel	1-32	X	SSID - network name
Response description			
ACK	1	0x00	
Command ID	1	0x09	SET_NET_CFG
Subcommand ID	1	0x03	Wi-Fi SSID subcommand

Example:

```
HOST=>C1: 0x09 – SET_NET_CFG
          0x03 – Wi-Fi SSID subcommand
          0x50 0x65 0x65 0x70 0x65 0x72 0x5f 0x43 0x31  - network SSID

C1=>HOST: 0x00 - ACK byte
          0x09 - related command code SET_NET_CFG
          0x03 – Wi-Fi SSID subcommand
```

9.1.10.5 Wi-Fi network password

This command sets the password for the Wi-Fi network. Depending upon mode configuration, this setting will be applied to Access Point or Client.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x09	SET_NET_CFG
Subcommand ID	1	0x04	Wi-Fi SSID network password
Channel	1-32	X	SSID - network name
Response description			
ACK	1	0x00	
Command ID	1	0x09	SET_NET_CFG
Subcommand ID	1	0x04	Wi-Fi SSID network password

Example:

```
HOST=>C1: 0x09 – SET_NET_CFG
          0x04 – Wi-Fi password subcommand
          0x61 0x64 0x6d 0x69 0x6e - network password

C1=>HOST: 0x00 - ACK byte
          0x09 - related command code SET_NET_CFG
          0x04 – Wi-Fi password subcommand
```

9.1.10.6 Network IP address mode

This command gets one argument to setup network address mode: DHCP client or static IP address. In the case of static IP being selected, the user needs to provide IP addresses for the module IP, netmask, gateway and DNS.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x09	SET_NET_CFG
Subcommand ID	1	0x05	IP address mode subcommand
Channel	1	X	0x00 – DHCP client 0x01 – Static IP
Response description			
ACK	1	0x00	
Command ID	1	0x09	SET_NET_CFG
Subcommand ID	1	0x05	IP address mode subcommand

Example:

```
HOST=>C1: 0x09 – SET_NET_CFG
          0x05 – IP address mode subcommand
          0x00 – Static IP address mode

C1=>HOST: 0x00 - ACK byte
          0x09 - related command code SET_NET_CFG
          0x05 – IP address mode subcommand
```

9.1.10.7 Network IP addresses

These four subcommands should be used to setup: IP address, netmask, gateway and DNS. If a DHCP client is enabled with the command described above these settings are ignored.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x09	SET_NET_CFG
Subcommand ID	1	X	0x06 – IP address 0x07 – netmask address 0x08 – gateway address 0x09 – DNS address
Address	4	X	Address bytes

Response description			
ACK	1	0x00	
Command ID	1	0x09	SET_NET_CFG
Subcommand ID	1	0x06-0x09	Address mode subcommand

Example:

```
HOST=>C1: 0x09 – SET_NET_CFG
          0x06 – IP address subcommand
          0xC0 0xA8 0x00 0x02 – IP address 192.168.0.2

C1=>HOST: 0x00 - ACK byte
          0x09 - related command code SET_NET_CFG
          0x06 – IP address subcommand
```

9.1.10.8 Web interface user name and password (0x09)

This command should be used to setup the username and password needed to access the web interface. Default settings for the username and password are admin/admin.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x09	SET_NET_CFG
Subcommand ID	1	X	0x0A – User name subcommand 0x0B – password subcommand
Address	1-32	X	Username/password bytes
Response description			
ACK	1	0x00	
Command ID	1	0x09	SET_NET_CFG
Subcommand ID	1	X	0x0A – User name subcommand 0x0B – password subcommand

Example:

```
HOST=>C1: 0x09 – SET_NET_CFG
          0x0B – Web password subcommand
          0x61 0x64 0x6d 0x69 0x6e – Web interface password

C1=>HOST: 0x00 – ACK byte
          0x09 – related command code SET_NET_CFG
          0x0B – Web password subcommand
```

9.1.11 Reboot (0x0A)

This command requests a software reboot for the Pepper C1 module. After this command the device will not accept any protocol commands for 1 second. In case of communication over WiFi this time can be longer and depends upon network configuration.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x0A	REBOOT
Response description			
ACK	1	0x00	
Command ID	1	0x0A	REBOOT

Example:

```
HOST=>C1: 0x0A – REBOOT

C1=>HOST: 0x00 – ACK byte
          0x0A – related command code REBOOT
```

9.1.12 Get version (0x0B)

This command requests a version string from the device.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x0B	GET_VERSION
Response description			
ACK	1	0x00	
Command ID	1	0x0B	GET_VERSION
Version string	X	X	Version string, contains major and minor version and build data and time e.g.: 1.1 Jan 18 2019 15:35:03

Example:

```
HOST=>C1: 0x0A – GET_VERSION

C1=>HOST: 0x00 – ACK byte
          0x0A – related command code GET_VERSION

          0x31 0x2e 0x31 0x20 0x4a 0x61 0x6e 0x20
          0x31 0x38 0x20 0x32 0x30 0x31 0x39 0x20
          0x31 0x35 0x3a 0x33 0x35 0x3a 0x30 0x33 – version string bytes
```

9.2 Mifare Classics commands

This set of commands should be performed on Mifare Classics tags.

9.2.1 Read block (0x20)

The read block command should be used to read data from the tag. It takes as arguments the block number of the first block to read, the number of blocks to read, the key A or B parameter, and the key number in key storage. The returned ACK answer contains data read from the specified tag memory. The number of bytes of this data is Mifare Classic block size (16) multiplied by the number of blocks to be read.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x20	MF_READ_BLOCK
Block number	1	X	
Number of blocks	1	Y	
Key A/B parameter	1	X	0x0A – Key A should be selected from key storage 0x0B – Key B should be selected from key storage
Key number	1	0-4	Key number in key storage
Response description			
ACK	1	0x00	
Command ID	1	0x20	MF_READ_BLOCK
Read data	Y*16	XXX	Bytes read from the tag. Number of bytes is number of requested blocks multiplied by 16.

Example:

```
HOST=>C1: 0x20 – MF_READ_BLOCK
          0x02 – block number 2
          0x02 – two blocks to read
          0x0A – key A should be selected from key storage
          0x00 – first key should be selected from key storage

C1=>HOST: 0x00 – ACK byte
          0x20 – related command code MF_READ_BLOCK

          0x01 0x2e 0x41 0x22 0x43 0x11 0x8e 0x20
          0x31 0x38 0x20 0x32 0x30 0x31 0x39 0x41
          0x81 0x23 0x42 0x28 0x33 0x01 0x8e 0x72
          0x31 0x35 0x3a 0x33 0x35 0x3a 0x30 0x33 – 32 bytes result
```

9.2.2 Write block (0x21)

The write block command should be used to write data to the tag. It takes as arguments the block number of the first block to write, the number of blocks to write, the key A or B parameter, the key number in key storage, and the bytes to be written. The number of bytes to be written must be exactly the number of blocks to write multiplied by 16.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x21	MF_WRITE_BLOCK
Block number	1	X	
Number of blocks	1	Y	
Key A/B parameter	1	X	0x0A – Key A should be selected from key storage 0x0B – Key B should be selected from key storage
Key number	1	0-4	Key number in key storage
Bytes to write	Y*16	XXX	Bytes to write. Number of this bytes must be number of requested blocks multiplied by 16.
Response description			
ACK	1	0x00	
Command ID	1	0x21	MF_WRITE_BLOCK

Example:

```
HOST=>C1: 0x21 – MF_WRITE_BLOCK
          0x02 – block number 2
          0x02 – two blocks to write
          0x0A – key A should be selected from key storage
          0x00 – first key should be selected from key storage

          0x01 0x2e 0x41 0x22 0x43 0x11 0x8e 0x20
          0x31 0x38 0x20 0x32 0x30 0x31 0x39 0x41
          0x81 0x23 0x42 0x28 0x33 0x01 0x8e 0x72
          0x31 0x35 0x3a 0x33 0x35 0x3a 0x30 0x33 – 32 bytes to write

C1=>HOST: 0x00 – ACK byte
          0x21 – related command code MF_WRITE_BLOCK
```

9.2.3 Read value (0x22)

This command should be used to read a value from the tag. It takes as arguments the block number where the value is stored, the key A or B parameter, and the key number in key storage. The returned ACK response contains a value as a signed 32-bit value (LSB first) and an address byte as an unsigned 8bit value.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x22	MF_READ_VALUE
Block number	1	X	
Key A/B parameter	1	X	0x0A – Key A should be selected from key storage 0x0B – Key B should be selected from key storage
Key number	1	0-4	Key number in key storage

Response description			
ACK	1	0x00	
Command ID	1	0x22	MF_READ_VALUE
Value	4	X	Signed 32-bit value (LSB first)
Address	1	X	Address byte

Example:

```
HOST=>C1: 0x22 – MF_READ_VALUE
          0x02 – block number 2
          0x0A – key A should be selected from key storage
          0x00 – first key should be selected from key storage

C1=>HOST: 0x00 – ACK byte
          0x22 – related command code MF_READ_BLOCK
          0x00 0x00 0x00 0x01 – value
          0x01 – address byte
```

9.2.4 Write value (0x23)

This command should be used to write a value to the tag. It takes as arguments the block number where the value should be stored, the key A or B parameter, the key number in key storage, a value (signed 32-bit LSB first) as 4 bytes, and an address byte (unsigned 8-bit value).

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x23	MF_WRITE_VALUE
Block number	1	X	
Key A/B parameter	1	X	0x0A – Key A should be selected from key storage 0x0B – Key B should be selected from key storage
Key number	1	0-4	Key number in key storage
Value	4	X	Signed 32-bit value (LSB first)
Address	1	X	Address byte
Response description			
ACK	1	0x00	
Command ID	1	0x23	MF_WRITE_VALUE

Example:

```
HOST=>C1: 0x23 – MF_WRITE_VALUE
          0x02 – block number 2
          0x0A – key A should be selected from key storage
          0x00 – first key should be selected from key storage
          0x00 0x00 0x00 0x01 – value
          0x01 – address byte
```

```
C1=>HOST: 0x00 – ACK byte
          0x23 – related command code MF_WRITE_BLOCK
```

9.2.5 Increment/decrement value (0x24)

This command should be used to increment or decrement a value stored in the tag memory. It takes as arguments the block number where the value is stored, the key A or B parameter, the key number in key storage, value (signed 32-bit LSB first) as 4 bytes to increment or decrement, and the increment/decrement flag.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x24	MF_INCREMENT_VALUE
Block number	1	X	
Key A/B parameter	1	X	0x0A – Key A should be selected from key storage 0x0B – Key B should be selected from key storage
Key number	1	0-4	Key number in key storage
Delta value	4	X	Signed 32-bit value (LSB first)
Increment/Decrement	1	X	0x00 – Decrement by delta value 0x01 – Increment by delta value
Response description			
ACK	1	0x00	
Command ID	1	0x24	MF_INCREMENT_VALUE

Example:

```
HOST=>C1: 0x24 – MF_INCREMENT_VALUE
          0x02 – block number 2
          0x0A – key A should be selected from key storage
          0x00 – first key should be selected from key storage
          0x00 0x00 0x00 0x01 – delta value
          0x01 – increment flag

C1=>HOST: 0x00 – ACK byte
          0x24 – related command code MF_INCREMENT_BLOCK
```

9.2.6 Transfer value (0x25)

This command should be used to transfer a value from a volatile register on the tag to the block being addressed. It takes as arguments the block number where the value should be stored, the key A or B parameter, the key number in key storage.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x25	MF_TRANSFER_VALUE
Block number	1	X	
Key A/B parameter	1	X	0x0A – Key A should be selected from key storage 0x0B – Key B should be selected from key storage
Key number	1	0-4	Key number in key storage

Response description			
ACK	1	0x00	
Command ID	1	0x25	MF_TRANSFER_VALUE

Example:

```
HOST=>C1: 0x25 – MF_TRANSFER_VALUE
          0x02 – block number 2
          0x0A – key A should be selected from key storage
          0x00 – first key should be selected from key storage

C1=>HOST: 0x00 – ACK byte
          0x25 – related command code MF_TRANSFER_BLOCK
```

9.2.7 Restore value (0x26)

This command should be used to restore a value to a volatile register on the tag from the block being addressed. It takes as arguments the block number where the value is stored, the key A or B parameter, key number in key storage.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x26	MF_RESTORE_VALUE
Block number	1	X	
Key A/B parameter	1	X	0x0A – Key A should be selected from key storage 0x0B – Key B should be selected from key storage
Key number	1	0-4	Key number in key storage
Response description			
ACK	1	0x00	
Command ID	1	0x26	MF_ RESTORE _VALUE

Example:

```
HOST=>C1: 0x26 – MF_RESTORE_VALUE
          0x02 – block number 2
          0x0A – key A should be selected from key storage
          0x00 – first key should be selected from key storage

C1=>HOST: 0x00 – ACK byte
          0x26 – related command code MF_RESTORE_BLOCK
```

9.2.8 Transfer-Restore value (0x27)

This command performs a Restore-Transfer command sequence on the tag. It takes as arguments the block number to be decremented, the block number to be transferred to, the key A or B parameter, the key number in key storage. This command has the same functionality as the read value command, except that it can be used on a block which is

corrupted – it tries to recover data from a corrupted block. The format of a value-type block allows for some bits to be corrupted and it still be possible to read and recover the proper value

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x27	MF_TRANSFER_RESTORE_VALUE
Source block number	1	X	Block number to be decremented
Destination block number	1	X	Block number to be transferred to
Key A/B parameter	1	X	0x0A – Key A should be selected from key storage 0x0B – Key B should be selected from key storage
Key number	1	0-4	Key number in key storage
Response description			
ACK	1	0x00	
Command ID	1	0x27	MF_ TRANSFER_RESTORE _VALUE

Example:

```
HOST=>C1: 0x27 – MF_TRANSFER_RESTORE_VALUE
          0x02 – source block number 2
          0x03 – destination block number 3
          0x0A – key A should be selected from key storage
          0x00 – first key should be selected from key storage

C1=>HOST: 0x00 – ACK byte
          0x27 – related command code MF_TRANSFER_RESTORE_BLOCK
```

9.3 Mifare Ultralight commands

This set of commands should be performed on Mifare Ultralight tags.

9.3.1 Read page (0x40)

The read page command should be used to read data stored in tag pages. It takes as arguments the page number of the first page to be read, and the number of pages to be read. The returned ACK answer contains data read from the specified tag memory. The number of bytes of this data is Mifare Ultralight page size (4) multiplied by the number of pages to be read.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x40	MFU_READ_PAGE
Page number	1	X	
Number of pages	1	Y	
Response description			
ACK	1	0x00	
Command ID	1	0x40	MFU_READ_PAGE
Read data	Y*4	XXX	Bytes read from the tag. Number of bytes is number of requested pages multiplied by 4.

Example:

```
HOST=>C1: 0x40 – MFU_READ_PAGE
          0x02 – page number 2
          0x02 – two pages to read

C1=>HOST: 0x00 – ACK byte
          0x40 – related command code MFU_READ_PAGE
          0x31 0x35 0x3a 0x33 0x35 0x3a 0x30 0x33 – 8 bytes result
```

9.3.2 Write page (0x41)

The write page command should be used to write data to the tag. It takes as arguments the page number of the first page to write, the number of pages to write, and the bytes to be written. The number of bytes to be written must be exactly the number of pages to write multiplied by 4.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x41	MFU_WRITE_PAGE
Page number	1	X	
Number of pages	1	Y	
Bytes to write	Y*4	XXX	Bytes to write. Number of this bytes must be number of requested pages multiplied by 4.
Response description			
ACK	1	0x00	
Command ID	1	0x41	MFU_WRITE_PAGE

Example:

```
HOST=>C1: 0x41 – MFU_WRITE_PAGE
          0x02 – page number 2
          0x02 – two pages to write
          0x31 0x35 0x3a 0x33 0x35 0x3a 0x30 0x33 – 32 bytes to write

C1=>HOST: 0x00 – ACK byte
          0x41 – related command code MFU_WRITE_PAGE
```

9.3.3 Get version (0x42)

This command requests a version string from the TAG. The returned ACK answer consists of 8-bytes containing the version information defined by the NXP standard. Please refer to the NXP documentation for more information.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x42	MFU_GET_VERSION
Response description			
ACK	1	0x00	
Command ID	1	0x42	MFU_GET_VERSION
Version bytes	8	X	Version bytes from the TAG

Example:

```
HOST=>C1: 0x42 – MFU_GET_VERSION

C1=>HOST: 0x00 – ACK byte
          0x42 – related command code MFU_GET_VERSION
          0x31 0x35 0x3a 0x33 0x35 0x3a 0x30 0x33 – version bytes
```

9.3.4 Read signature (0x43)

This command requests a version string from the device. The returned ACK answer contains 32-bytes with ECC signature defined by the NXP standard. Please refer to the NXP documentation for more information.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x43	MFU_READ_SIGNATURE
Response description			
ACK	1	0x00	
Command ID	1	0x43	MFU_READ_SIGNATURE
Version bytes	32	X	Signature bytes from the TAG

Example:

```
HOST=>C1: 0x43 – MFU_READ_SIGNATURE

C1=>HOST: 0x00 – ACK byte
          0x43 – related command code MFU_READ_SIGNATURE
          0x01 0x2e 0x41 0x22 0x43 0x11 0x8e 0x20
          0x31 0x38 0x20 0x32 0x30 0x31 0x39 0x41
          0x81 0x23 0x42 0x28 0x33 0x01 0x8e 0x72
          0x31 0x35 0x3a 0x33 0x35 0x3a 0x30 0x33 – signature bytes
```

9.3.5 Write signature (0x44)

This command writes the signature information to the Mifare Ultralight Nano TAG. It takes as arguments relative page location of the signature part to be written and four bytes of signature value to be written.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x44	MFU_WRITE_SIGNATURE
Relative page address	1	X	Relative page location of the signature part to be written
Bytes to write	4	XXX	Bytes of signature value to be written to the specified relative page address
Response description			
ACK	1	0x00	
Command ID	1	0x44	MFU_WRITE_ SIGNATURE

Example:

```
HOST=>C1: 0x44 – MFU_WRITE_SIGNATURE
          0x00 – relative page number 0
          0x35 0x3a 0x30 0x33 – 4 bytes to write

C1=>HOST: 0x00 – ACK byte
          0x44 – related command code MFU_WRITE_SIGNATURE
```

9.3.6 Lock signature (0x45)

This command locks the signature temporarily or permanently based on the information provided in the API. The locking and unlocking of the signature can be performed using this command if the signature is not locked or temporary locked. If the signature is permanently locked, then unlocking can't be done.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x45	MFU_LOCK_SIGNATURE
Lock mode	1	X	0x00 – Unlock 0x01 – Lock 0x02 – Permanent lock
Response description			
ACK	1	0x00	
Command ID	1	0x45	MFU_LOCK_SIGNATURE

Example:

```
HOST=>C1: 0x45 – MFU_LOCK_SIGNATURE
          0x02 – permanent lock

C1=>HOST: 0x00 – ACK byte
          0x45 – related command code MFU_LOCK_SIGNATURE
```

9.3.7 Read counter (0x46)

This command should be used to read a counter from the TAG. It takes as arguments the counter number. The returned ACK response contains a value as a signed 24-bit value (LSB first).

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x46	MFU_READ_COUNTER
Counter number	1	0-2	Counter number
Response description			
ACK	1	0x00	
Command ID	1	0x46	MFU_READ_COUNTER
Counter value	3	X	Unsigned 24-bit value, LSB first

Example:

```
HOST=>C1: 0x46 – MFU_READ_COUNTER
          0x01 – counter number

C1=>HOST: 0x00 – ACK byte
          0x46 – related command code MFU_READ_COUNTER
          0x00 0x00 0x01 – value
```

9.3.8 Increment counter (0x47)

This command should be used to increment a counter stored in the tag memory. It takes as arguments the counter number and increment value (24-bit value LSB first) as 3 bytes.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x47	MFU_INCREMENT_COUNTER
Counter number	1	0-2	Counter number
Increment value	3	X	Unsigned 24-bit value (LSB first)
Response description			
ACK	1	0x00	
Command ID	1	0x47	MFU_INCREMENT_COUNTER

Example:

```
HOST=>C1: 0x47 – MFU_INCREMENT_COUNTER
          0x02 – block number 2
          0x00 0x00 0x01 – increment value

C1=>HOST: 0x00 – ACK byte
          0x47 – related command code MFU_INCREMENT_COUNTER
```

9.3.9 Password auth (0x48)

This command tries to authenticate the tag using the chosen password. It takes as an argument a password as four bytes. The returned ACK response contains two bytes of password acknowledge (PACK).

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x48	MFU_PASSWORD_AUTH
Counter number	4	X	4-bytes password
Response description			
ACK	1	0x00	
Command ID	1	0x48	MFU_PASSWORD_AUTH
PACK	2	X	Password acknowledge bytes

Example:

```
HOST=>C1: 0x48 – MFU_PASSWORD_AUTH
          0x00 0x00 0x00 0x00 – password

C1=>HOST: 0x00 – ACK byte
          0x48 – related command code MFU_PASSWORD_AUTH
          0x00 0x00 – password acknowledge bytes
```

9.3.10 Ultralight-C authenticate (0x49)

This command tries to authenticate the Mifare Ultralight-C tag using the password stored in the key storage. It takes as an argument one byte with the key number in the key storage.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x49	MFUC_AUTHENTICATE
Key number	1	0-4	Key number in key storage
Response description			
ACK	1	0x00	
Command ID	1	0x49	MFUC_AUTHENTICATE

Example:

```
HOST=>C1: 0x49 – MFUC_AUTHENTICATE
          0x00 – key number

C1=>HOST: 0x00 – ACK byte
          0x49 – related command code MFUC_AUTHENTICATE
```

9.3.11 Check Tearing Event (0x4A)

The Check Tearing Event command takes as arguments one byte with the counter number. This command checks whether there was a tearing event in the counter. The returned ACK response contains result byte. The value '0x00' is returned if there has been no tearing event, and '0x01' is returned if a tearing event occurred. Please refer to the NXP documentation for more information.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x49	MFU_CHECKEVENT
Key number	1	0-4	Key number in key storage
Response description			
ACK	1	0x00	
Command ID	1	0x49	MFU_CHECKEVENT

Example:

```
HOST=>C1: 0x49 – MFU_CHECKEVENT
          0x00 – counter number

C1=>HOST: 0x00 – ACK byte
          0x49 – related command code MFU_CHECKEVENT
          0x01 – tearing event occurred
```

9.4 Mifare Desfire commands

This set of commands should be performed on Mifare Desfire tags.

9.4.1 Get version (0x60)

This command requests version information from the tag. The returned ACK answer contains 28-bytes with version information.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x60	MFDF_GET_VERSION
Response description			
ACK	1	0x00	
Command ID	1	0x60	MFDF_GET_VERSION
Read data	28	XXX	Version bytes read from the tag

Example:

```
HOST=>C1: 0x60 – MFDF_GET_VERSION

C1=>HOST: 0x00 – ACK byte
          0x60 – related command code MFDF_GET_VERSION

          0x01 0x2e 0x41 0x22 0x43 0x11 0x8e 0x20
          0x31 0x38 0x20 0x32 0x30 0x31 0x39 0x41
          0x81 0x23 0x42 0x28 0x33 0x01 0x8e 0x72
          0x31 0x35 0x3a 0x33 – 28 bytes result
```

9.4.2 Select application (0x61)

This command requests select application operation on the tag. Takes as argument 3-byes containing AID.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x61	MFDF_GET_VERSION
AID	3	X	Application ID
Response description			
ACK	1	0x00	
Command ID	1	0x61	MFDF_GET_VERSION

Example:

```
HOST=>C1: 0x61 – MFDF_SELECT_APP
          0x01 0x02 0x03 – 3 bytes AID

C1=>HOST: 0x00 – ACK byte
          0x61 – related command code MFDF_SELECT_APP
```

9.4.3 List application IDs (0x62)

This command requests lists application IDs from the TAG. The returned ACK answer contains the bytes with application IDs. Every ID is 3-bytes long.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x62	MFDF_LIST_APP_IDS
Response description			
ACK	1	0x00	
Command ID	1	0x62	MFDF_LIST_APP_IDS
Application IDs	X*3	X	Bytes with applications IDs

Example:

```
HOST=>C1: 0x62 – MFDF_LIST_APP_IDS

C1=>HOST: 0x00 – ACK byte
          0x62 – related command code MFDF_LIST_APP_IDS
          0x00 0x00 0x01 – first AID
          0xAA 0xBB 0xCC – second AID
          0x55 0x55 0x55 – third AID
          ...
```

9.4.4 List files IDs (0x63)

This command returns the file IDs of all active files within the currently selected application. The returned ACK answer contains the bytes with file IDs. Every file ID is 3-bytes long.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x63	MFDF_LIST_FILE_IDS
Response description			
ACK	1	0x00	
Command ID	1	0x63	MFDF_LIST_FILE_IDS
Application IDs	X*3	X	Bytes with files IDs

Example:

```
HOST=>C1: 0x63 – MFDF_LIST_FILE_IDS

C1=>HOST: 0x00 – ACK byte
          0x63 – related command code MFDF_LIST_FILE_IDS
          0x00 0x00 0x01 – first file ID
          0xAA 0xBB 0xCC – second file ID
          0x55 0x55 0x55 – third file ID
          ...
```

9.4.5 Authenticate (0x64)

This command tries to authenticate the Mifare Desfire using the password stored in the key storage. It takes as an argument one byte with the key number in the key storage, and one byte with the key number on the card. This command can be used with DES and 2K3DES keys.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x64	MFDF_AUTHENTICATE
Key number in storage	1	0-4	Key number in key storage
Key number on card	1	x	Key number on card
Response description			
ACK	1	0x00	
Command ID	1	0x64	MFDF_AUTHENTICATE

Example:

```
HOST=>C1: 0x64 – MFDF_AUTHENTICATE
          0x00 – key number

C1=>HOST: 0x00 – ACK byte
          0x64 – related command code MFDF_AUTHENTICATE
```

9.4.6 Authenticate ISO (0x65)

This command tries to authenticate the Mifare Desfire tag in ISO CBS send mode using the key stored in the key storage. It takes as an argument one byte with the key number in the key storage, and one byte with the key number on the card. This command can be used with DES, 3DES and 3K3DES keys.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x65	MFDF_AUTHENTICATE_ISO
Key number	1	0-4	Key number in key storage
Key number on card	1	x	Key number on card
Response description			
ACK	1	0x00	
Command ID	1	0x65	MFDF_AUTHENTICATE_ISO

Example:

```
HOST=>C1: 0x65 – MFDF_AUTHENTICATE_ISO
          0x00 – key number

C1=>HOST: 0x00 – ACK byte
          0x65 – related command code MFDF_AUTHENTICATE_ISO
```

9.4.7 Authenticate AES (0x66)

This command tries to authenticate the Mifare Desfire using the key stored in the key storage, and one byte with the key number on the card. It takes as an argument one byte with the key number in the key storage. This command can be used with AES128 keys.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x66	MFDF_AUTHENTICATE_ISO
Key number	1	0-4	Key number in key storage
Response description			
ACK	1	0x00	
Command ID	1	0x66	MFDF_AUTHENTICATE_ISO

Example:

```
HOST=>C1: 0x66 – MFDF_AUTHENTICATE_AES
          0x00 – key number

C1=>HOST: 0x00 – ACK byte
          0x66 – related command code MFDF_AUTHENTICATE_AES
```

9.4.8 Create application (0x67)

This command tries to create application on the tag. It takes three arguments: 3-bytes of application ID, the keySettings1 byte and the keySettings2 byte. Please refer to the NXP documentation for more information about key settings bytes.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x67	MFDF_CREATE_APP
Application ID	3	X	Application ID bytes
Key settings 1	1	X	Please refer to the NXP documentation for more information
Key settings 2	1	X	Please refer to the NXP documentation for more information
Response description			
ACK	1	0x00	
Command ID	1	0x67	MFDF_CREATE_APP

Example:

```
HOST=>C1: 0x67 – MFDF_CREATE_APP
          0x00 – key number
          0x01 0x02 0x03 – application ID
          0xED 0x84 – key settings bytes
C1=>HOST: 0x00 – ACK byte
          0x67 – related command code MFDF_CREATE_APP
```

9.4.9 Delete application (0x68)

This command tries to delete an application from the tag. It takes one argument with the application ID.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x68	MFDF_DELETE_APP
Application ID	3	X	Application ID bytes
Response description			
ACK	1	0x00	
Command ID	1	0x68	MFDF_DELETE_APP

Example:

```
HOST=>C1: 0x68 – MFDF_DELETE_APP
          0x01 0x02 0x03 – application ID

C1=>HOST: 0x00 – ACK byte
          0x68 – related command code MFDF_DELETE_APP
```

9.4.10 Change key (0x69)

This command tries to change the key for the selected application. It takes three arguments: the old key number from key storage, the new key number in the key storage and the key number on the card. The key type of the application keys cannot be changed.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x69	MFDF_CHANGE_KEY
Old key number	1	0-4	Key number in key storage
New key number	1	0-4	Key number in key storage
Key number on card	1	X	Key number on the card
Response description			
ACK	1	0x00	
Command ID	1	0x69	MFDF_CHANGE_KEY

Example:

```
HOST=>C1: 0x69 – MFDF_CHANGE_APP
          0x00 – old key number
          0x01 – new key number
          0x00 – key number

C1=>HOST: 0x00 – ACK byte
          0x69 – related command code MFDF_CHANGE_APP
```

9.4.11 Get key settings (0x6A)

This command gets the key settings bytes from the tag. This command does not require any arguments but an application must be selected and authorized.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x6A	MFDF_GET_KEY_SETTINGS
Response description			
ACK	1	0x00	
Command ID	1	0x6A	MFDF_GET_KEY_SETTINGS
Key settings	2	X	Key settings bytes

Example:

```
HOST=>C1: 0x6A – MFDF_GET_KEY_SETTINGS

C1=>HOST: 0x00 – ACK byte
          0x6A – related command code MFDF_GET_KEY_SETTINGS
          0x01 0x02 – key settings bytes
```

9.4.12 Change key settings (0x6B)

This command changes the key settings bytes for the selected and authorized application. It takes one argument, 2-byes long with key settings.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x6B	MFDF_CHANGE_KEY_SETTINGS
New key settings	2	X	Key settings bytes
Response description			
ACK	1	0x00	
Command ID	1	0x6B	MFDF_CHANGE_KEY_SETTINGS

Example:

```
HOST=>C1: 0x6B – MFDF_GET_KEY_SETTINGS
          0x01 0x02 – key settings bytes

C1=>HOST: 0x00 – ACK byte
          0x6B – related command code MFDF_GET_KEY_SETTINGS
```

9.4.13 Create standard or backup data file (0x6C)

This command creates a file for the storage of plain unformatted user data within the selected application. It takes four arguments listed in the table below.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x6C	MFDF_CREATE_DATA_FILE
File number	1	X	File number inside application
Access rights	2	X	Please refer to the NXP documentation for more information
File size	3	X	file size, LSB first
Backup file	1	X	0x00 – Standard file 0x01 – Backup file
Response description			
ACK	1	0x00	
Command ID	1	0x6B	MFDF_CREATE_DATA_FILE

Example:

```
HOST=>C1: 0x6C – MFDF_CREATE_DATA_FILE
          0x01 – file number
          0xEE 0xEE – access rights
          0x40 0x00 0x00 – file 64-bytes long
          0x01 – backup file

C1=>HOST: 0x00 – ACK byte
          0x6C – related command code MFDF_CREATE_DATA_FILE
```

9.4.14 Write data (0x6D)

This command writes data to standard data files or backup data files. It takes three arguments: the file number, the offset in the file where data should be stored, and the data bytes to be written. To store data on the TAG, a commit transaction command is required.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x6D	MFDF_WRITE_DATA
File number	1	X	File number inside application
File offset	3	X	file offset, 3-bytes LSB value
Data	N	X	Data bytes to write
Response description			
ACK	1	0x00	
Command ID	1	0x6D	MFDF_WRITE_DATA

Example:

```
HOST=>C1: 0x6D – MFDF_WRITE_DATA
          0x01 – file number
          0x00 0x00 0x00 – zero offset
          0x01 0x02 0x03 0x04 0x05 0x06 0x07 - data
C1=>HOST: 0x00 – ACK byte
          0x6D – related command code MFDF_WRITE_DATA
```

9.4.15 Read data (0x6E)

This command reads data from standard data files or backup data files. It takes three arguments: the file number, the offset in the file where data is stored, and the number of bytes to be read. The returned ACK response contains the data that has been read.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x6E	MFDF_READ_DATA
File number	1	X	File number inside application
File offset	3	X	file offset, 3-bytes LSB value
Data length	3	X	Read data length, 3-bytes LSB value
Response description			
ACK	1	0x00	
Command ID	1	0x6E	MFDF_READ_DATA

Example:

```
HOST=>C1: 0x6E – MFDF_READ_DATA
          0x01 – file number
          0x00 0x00 0x00 – zero offset
          0x07 0x00 0x00 – seven bytes to read
C1=>HOST: 0x00 – ACK byte
          0x6E – related command code MFDF_READ_DATA
          0x01 0x02 0x03 0x04 0x05 0x06 0x07 - data
```

9.4.16 Create value file (0x6F)

This command creates files for the storage and manipulation of 32bit signed integer values within an existing application on the TAG. It takes seven arguments listed in the table below.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x6F	MFDF_CREATE_VALUE_FILE
File number	1	X	File number inside application
Access rights	2	X	Please refer to the NXP documentation for more information
Low limit	4	X	Low limit as 4-bytes signed value, LSB first
Up limit	4	X	Up limit as 4-bytes signed value, LSB first
Initial value	4	X	Initial value as 4-bytes signed value, LSB first
Get free enabled	1	X	Please refer to the NXP documentation for more information
Limit credited	1	X	Please refer to the NXP documentation for more information
Response description			
ACK	1	0x00	
Command ID	1	0x6F	MFDF_CREATE_VALUE_FILE

Example:

```
HOST=>C1: 0x6F – MFDF_CREATE_VALUE_FILE
          0x02 – file number
          0xEE 0xEE – access rights
          0x00 0x00 0x00 0x00 – low limit
          0x80 0x00 0x00 0x00 – up limit
          0x00 0x00 0x00 0x00 – initial value
          0x01 – get free enabled
          0x01 – limited credit

C1=>HOST: 0x00 – ACK byte
          0x6F – related command code MFDF_CREATE_VALUE_FILE
```

9.4.17 Get value (0x70)

This command returns the value stored in a value file on the TAG. The returned ACK response contains 4 bytes of signed value, LSB-first.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x70	MFDF_GET_VALUE
File number	1	X	File number inside application
Response description			
ACK	1	0x00	
Command ID	1	0x70	MFDF_GET_VALUE
Value	4	X	4 bytes signed value, LSB first

Example:

```
HOST=>C1: 0x70 – MFDF_GET_VALUE
          0x02 – file number

C1=>HOST: 0x00 – ACK byte
          0x70 – related command code MFDF_GET_VALUE
          0x05 0x00 0x00 0x00 – 4 bytes signed value, LSB first
```

9.4.18 Credit file (0x71)

This command increases a value stored in a value file on the TAG.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x71	MFDF_CREDIT
File number	1	X	File number inside application
Credit value	4	X	4 bytes signed value, LSB first
Response description			
ACK	1	0x00	
Command ID	1	0x71	MFDF_CREDIT

Example:

```
HOST=>C1: 0x71 – MFDF_CREDIT
          0x02 – file number
          0x05 0x00 0x00 0x00 – 4 bytes signed value, LSB first

C1=>HOST: 0x00 – ACK byte
          0x71 – related command code MFDF_CREDIT
```

9.4.19 Credit file (0x72)

This command allows a limited increase of a value stored in a value file without having full credit permissions to the file. Please refer to the NXP documentation for more information.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x72	MFDF_LIMITED_CREDIT
File number	1	X	File number inside application
Credit value	4	X	4 bytes signed value, LSB first
Response description			
ACK	1	0x00	
Command ID	1	0x72	MFDF_ LIMITED_CREDIT

Example:

```
HOST=>C1: 0x72 – MFDF_ LIMITED_CREDIT
          0x02 – file number
          0x05 0x00 0x00 0x00 – 4 bytes signed value, LSB first

C1=>HOST: 0x00 – ACK byte
          0x72 – related command code MFDF_ LIMITED_CREDIT
```

9.4.20 Debit file (0x73)

This command decreases a value stored in a value file on the TAG.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x73	MFDF_DEBIT
File number	1	X	File number inside application
Credit value	4	X	4 bytes signed value, LSB first
Response description			
ACK	1	0x00	
Command ID	1	0x73	MFDF_DEBIT

Example:

```
HOST=>C1: 0x73 – MFDF_DEBIT
          0x02 – file number
          0x05 0x00 0x00 0x00 – 4 bytes signed value, LSB first

C1=>HOST: 0x00 – ACK byte
          0x73 – related command code MFDF_DEBIT
```

9.4.21 Create record file (0x74)

This command creates files for multiple storage of structurally similar data within an existing application. If the cyclic flag is 0x00, then further writing is not possible unless it is cleared. If the cyclic flag is set to 0x01, then the new record overwrites the oldest record.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x74	MFDF_CREATE_RECORD_FILE
File number	1	X	File number inside application
Access rights	2	X	Please refer to the NXP documentation for more information
Record size	2	X	Record size, 16-bits LSB value
Number of records	2	X	Number of records, 16-bits LSB value
Cyclic flag	1	X	If cyclic file is full: 0x00 - further writing is not possible unless it is cleared 0x01 - the new record overwrites oldest record
Response description			
ACK	1	0x00	
Command ID	1	0x74	MFDF_CREATE_RECORD_FILE

Example:

```
HOST=>C1: 0x74 – MFDF_CREATE_RECORD_FILE
          0x03 – file number
          0xEE 0xEE – access rights
          0x08 0x00 – 8-bytes for every record
          0x40 0x00 – 64 records
          0x01 – cyclic flag

C1=>HOST: 0x00 – ACK byte
          0x74 – related command code MFDF_CREATE_VALUE_FILE
```

9.4.22 Write record (0x75)

This command writes data to a record file. It takes two arguments: the file number and the data bytes to be written. To store data on the TAG, a commit transaction command is required.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x75	MFDF_WRITE_RECORD_DATA
File number	1	X	File number inside application
Data	N	X	Data bytes to write
Response description			
ACK	1	0x00	
Command ID	1	0x75	MFDF_WRITE_DATA

Example:

```
HOST=>C1: 0x75 – MFDF_WRITE_DATA
          0x01 – file number
          0x01 0x02 0x03 0x04 0x05 0x06 0x07 - data
C1=>HOST: 0x00 – ACK byte
          0x75 – related command code MFDF_WRITE_RECORD_DATA
```

9.4.23 Read record (0x76)

This command reads data from a record file. It takes three arguments: the file number, the record number, and the number of bytes to be read. The returned ACK response contains the data that has been read.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x76	MFDF_READ_RECORD
File number	1	X	File number inside application
Record number	2	X	Record number, 2-bytes LSB value
Data length	2	X	Read data length, 2-bytes LSB value
Response description			
ACK	1	0x00	
Command ID	1	0x76	MFDF_READ_RECORD

Example:

```
HOST=>C1: 0x76 – MFDF_READ_RECORD
          0x01 – file number
          0x00 0x01 – record number
          0x08 0x00 – eighth bytes to read
C1=>HOST: 0x00 – ACK byte
          0x76 – related command code MFDF_READ_RECORD
          0x00 0x01 0x02 0x03 0x04 0x05 0x06 0x07 - data
```

9.4.24 Clear records (0x77)

This command resets cyclic or lineal record files. It takes as an argument the file number.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x77	MFDF_CLEAR_RECORDS
File number	1	X	File number inside application
Response description			
ACK	1	0x00	
Command ID	1	0x77	MFDF_CLEAR_RECORDS

Example:

```
HOST=>C1: 0x77 – MFDF_CLEAR_RECORDS
          0x01 – file number

C1=>HOST: 0x00 – ACK byte
          0x77 – related command code MFDF_CLEAR_RECORDS
```

9.4.25 Delete file (0x78)

This command permanently deactivates a file within the file directory of the currently selected application. It takes as an argument the file number.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x78	MFDF_DELETE_FILE
File number	1	X	File number inside application
Response description			
ACK	1	0x00	
Command ID	1	0x78	MFDF_DELETE_FILE

Example:

```
HOST=>C1: 0x78 – MFDF_DELETE_FILE
          0x01 – file number

C1=>HOST: 0x00 – ACK byte
          0x78 – related command code MFDF_DELETE_FILE
```

9.4.26 Get free memory (0x79)

This command returns a value corresponding to the amount of free memory available on the TAG. No arguments are required. The available memory is returned as a 4 byte unsigned LSB value.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x79	MFDF_GET_FREE_MEM
Response description			
ACK	1	0x00	
Command ID	1	0x79	MFDF_GET_FREE_MEM
Free memory	4	X	Free memory, 4-bytes, LSB first

Example:

```
HOST=>C1: 0x79 – MFDF_GET_FREE_MEM

C1=>HOST: 0x00 – ACK byte
          0x79 – related command code MFDF_GET_FREE_MEM
          0x00 0x08 0x00 0x00 – free memory
```

9.4.27 Format memory (0x7A)

This command releases user memory in the TAG. No arguments are required.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x7A	MFDF_FORMAT
Response description			
ACK	1	0x00	
Command ID	1	0x7A	MFDF_FORMAT

Example:

```
HOST=>C1: 0x7A – MFDF_FORMAT

C1=>HOST: 0x00 – ACK byte
          0x7A – related command code MFDF_FORMAT
```

9.4.28 Commit transaction (0x7B)

This command validates all previous write access on backup data files, value files and record files within one application. No arguments are required.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x7B	MFDF_COMMIT_TRANSACTION
Response description			
ACK	1	0x00	
Command ID	1	0x7B	MFDF_COMMIT_TRANSACTION

Example:

```
HOST=>C1: 0x7B – MFDF_COMMIT_TRANSACTION

C1=>HOST: 0x00 – ACK byte
          0x7B – related command code MFDF_COMMIT_TRANSACTION
```

9.4.29 Abort transaction (0x7C)

This command invalidates all previous write access on backup data files, value files and record files within one application. No arguments are required.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x7C	MFDF_ABORT_TRANSACTION
Response description			
ACK	1	0x00	
Command ID	1	0x7C	MFDF_ABORT_TRANSACTION

Example:

```
HOST=>C1: 0x7C – MFDF_ABORT_TRANSACTION

C1=>HOST: 0x00 – ACK byte
          0x7C – related command code MFDF_ABORT_TRANSACTION
```

9.5 ICODE (ISO15693) commands

This set of commands should be performed on ICODE (ISO15693) TAGs.

9.5.1 Inventory start (0x90)

This command starts the inventory procedure on ISO 15693 TAGs. It activates the first TAG detected during collision resolution. If no TAGs are detected, then an error with a timeout flag is returned. This command takes one argument AFI - Application Family Identifier. Please refer to the NXP documentation for more information.

If any TAG(s) is/are detected, then the command returns an ACK message containing the UID (8-bytes), a DSFID byte, and 1-byte which contains information about any other tags detected in the field that are available to be read.

Because GET_TAG_COUNT command is limited to 5 tags only, ICODE_INVENTORY_START/ICODE_INVENTORY_NEXT commands should be used to detect all ICODE tags within range of the antenna.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x90	ICODE_INVENTORY_START
AFI	1	X	Application Family Identifier
Response description			
ACK	1	0x00	
Command ID	1	0x90	ICODE_INVENTORY_START
UID	8	XXX	Unique identifier
DSFID	1	X	Data Storage Format Identifier
More cards flag	1	X	0x00 – no more cards in range of antenna 0x01 – more cards in range of antenna

Example:

```
HOST=>C1: 0x90 – ICODE_INVENTORY_START
          0x00 – Application Family Identifier

C1=>HOST: 0x00 – ACK byte
          0x90 – related command code ICODE_INVENTORY_START
          0x04 0x8F 0x7F 0x0A 0x01 0x24 0x16 0xE0 – UID
          0x00 – DSFID
          0x01 – more cards in range of antenna
```

9.5.2 Inventory next (0x91)

This command should be used to continue the inventory procedure on ISO 15693 TAGs. It activates the next TAG that was detected during the collision resolution. It takes one argument, AFI - Application Family Identifier. Please refer to the NXP documentation for more information. If a TAG or multiple tags is/are detected, then this command returns an ACK message containing the UID (8-bytes), a DSFID byte, and 1-byte which contains information about any other tags detected in the field that are available to be read.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x91	ICODE_INVENTORY_NEXT
AFI	1	X	Application Family Identifier
Response description			
ACK	1	0x00	
Command ID	1	0x91	ICODE_INVENTORY_NEXT
UID	8	XXX	Unique identifier
DSFID	1	X	Data Storage Format Identifier
More cards flag	1	X	0x00 – no more cards in range of antenna 0x01 – more cards in range of antenna

Example:

```
HOST=>C1: 0x91 – ICODE_INVENTORY_NEXT
          0x00 – Application Family Identifier

C1=>HOST: 0x00 – ACK byte
          0x91 – related command code ICODE_INVENTORY_NEXT
          0x04 0x8F 0x7F 0x0A 0x01 0x24 0x16 0xE0 – UID
          0x00 – DSFID
          0x00 – no more cards available for reading
```

9.5.3 Stay quiet (0x92)

This command performs an ISO15693 Stay Quiet command to the selected TAG. When the tag receives the Stay quiet command, it enters the quiet state and will not send back a response. The TAG exits the quiet state upon the execution of a reset (power off) or the command ICODE_INVENTORY_START . Please refer to the NXP documentation for more information.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x92	ICODE_STAY_QUIET
Response description			
ACK	1	0x00	
Command ID	1	0x92	ICODE_STAY_QUIET

Example:

```
HOST=>C1: 0x92 – ICODE_STAY_QUIET

C1=>HOST: 0x00 – ACK byte
          0x92 – related command code ICODE_STAY_QUIET
```

9.5.4 Read block (0x93)

The read block command should be used to read data stored in TAG blocks. It takes as arguments the block number of the first block to be read, and the number of blocks to be read. The returned ACK answer contains data read from the specified tag memory. The number of bytes of this data is ICODE block size (4) multiplied by the number of blocks to be read.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x93	ICODE_READ_BLOCK
Block number	1	X	
Block count	1	N	Number of block to read
Response description			
ACK	1	0x00	
Command ID	1	0x93	ICODE_READ_BLOCK
Read data	4*N	XXX	Bytes read from the tag.

Example:

```
HOST=>C1: 0x93 – ICODE_READ_BLOCK
          0x02 – block number 2
          0x01 – 1 block to read

C1=>HOST: 0x00 – ACK byte
          0x93 – related command code ICODE_READ_BLOCK
          0x35 0x3a 0x30 0x33 – 4 bytes block data
```

9.5.5 Write block (0x94)

The write block command should be used to write data to the tag. It takes as arguments the block number of the first block to write, the number of blocks to write, and the bytes to be written. The number of bytes to be written must be exactly the number of blocks to write multiplied by 4.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x94	ICODE_WRITE_BLOCK
Block number	1	X	
Block count	1	N	
Data to write	4*N	X	4-bytes data to write
Response description			
ACK	1	0x00	
Command ID	1	0x94	ICODE_WRITE_BLOCK

Example:

```
HOST=>C1: 0x94 – ICODE_WRITE_BLOCK
          0x02 – block number 2
          0x01 – block count 1
          0x35 0x3a 0x30 0x33 – 4 bytes to write

C1=>HOST: 0x00 – ACK byte
          0x94 – related command code ICODE_WRITE_BLOCK
```

9.5.6 Lock block (0x95)

This command performs a lock block command. Once it receives the lock block command, the TAG permanently locks the requested block. The command takes a one-byte argument representing the block number to be locked.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x95	ICODE_LOCK_BLOCK
Block number	1	X	
Response description			
ACK	1	0x00	
Command ID	1	0x95	ICODE_LOCK_BLOCK

Example:

```
HOST=>C1: 0x95 – ICODE_LOCK_BLOCK
          0x02 – block number 2

C1=>HOST: 0x00 – ACK byte
          0x95 – related command code ICODE_LOCK_BLOCK
```

9.5.7 Write AFI (0x96)

This command performs a write to Application Family Identifier value inside the TAG memory. The command takes a one-byte argument representing the AFI value.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x96	ICODE_WRITE_AFI
AFI value	1	X	
Response description			
ACK	1	0x00	
Command ID	1	0x96	ICODE_WRITE_AFI

Example:

```
HOST=>C1: 0x96 – ICODE_WRITE_AFI
          0xAA – new Application Family Identifier value

C1=>HOST: 0x00 – ACK byte
          0x96 – related command code ICODE_WRITE_AFI
```

9.5.8 Lock AFI (0x97)

This command performs a Lock AFI command on the TAG. When it receives the lock AFI request, the TAG locks the AFI value permanently into its memory.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x97	ICODE_LOCK_AFI
Response description			
ACK	1	0x00	
Command ID	1	0x97	ICODE_LOCK_AFI

Example:

```
HOST=>C1: 0x96 – ICODE_LOCK_AFI

C1=>HOST: 0x00 – ACK byte
          0x96 – related command code ICODE_LOCK_AFI
```

9.5.9 Write DSFID (0x98)

This command performs a write to Data Storage Format Identifier value inside the TAG memory. This command takes a one-byte argument representing the DSFID value.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x98	ICODE_WRITE_DSFID
DSFID value	1	X	
Response description			
ACK	1	0x00	
Command ID	1	0x98	ICODE_WRITE_DSFID

Example:

```
HOST=>C1: 0x98 – ICODE_WRITE_DSFID
          0xAA – new Data Storage Format Identifier value

C1=>HOST: 0x00 – ACK byte
          0x98 – related command code ICODE_WRITE_DSFID
```

9.5.10 Lock DSFID (0x99)

This command performs a Lock DSIFD command on the TAG. When it receives the lock DSFID request, the TAG locks the DSFID value permanently into its memory.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x99	ICODE_LOCK_DSFID
Response description			
ACK	1	0x00	
Command ID	1	0x99	ICODE_LOCK_DSFID

Example:

```
HOST=>C1: 0x99 – ICODE_LOCK_DSFID

C1=>HOST: 0x00 – ACK byte
          0x99 – related command code ICODE_LOCK_DSFID
```

9.5.11 Get System Information (0x9A)

This command performs get system information command on the TAG. No arguments are required. The ACK response contains bytes with system information. Please refer to the NXP documentation for more information.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x9A	ICODE_GET_SYSTEM_INFORMATION
Response description			
ACK	1	0x00	
Command ID	1	0x9A	ICODE_GET_SYSTEM_INFORMATION
System information	X	XXX	System information bytes

Example:

```
HOST=>C1: 0x9A – ICODE_GET_SYSTEM_INFORMATION

C1=>HOST: 0x00 – ACK byte
          0x9A – related command code ICODE_GET_SYSTEM_INFORMATION
          0x0F 0x04 0x8F 0x7F 0x0A 0x01 0x24
          0x16 0xE0 0x00 0x00 0x33 0x03 0x02 – result bytes
```

9.5.12 Get multiple BSS (0x9B)

This command performs get multiple block security status command on the TAG. It takes as arguments the block number for which the status should be returned and the number of blocks to be used for returning the status. The ACK response contains bytes with block security status information. Please refer to the NXP documentation for more information.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x9B	ICODE_GET_MULTIPLE_BSS
First block number	1	X	
Number of blocks	1	N	
Response description			
ACK	1	0x00	
Command ID	1	0x9B	ICODE_GET_MULTIPLE_BSS
BSS information	N	X	Blocks security status information

Example:

```
HOST=>C1: 0x9B – ICODE_GET_MULTIPLE_BSS
          0x00 – starting block number
          0x08 – number of BSS to read

C1=>HOST: 0x00 – ACK byte
          0x9B – related command code ICODE_GET_MULTIPLE_BSS
          0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 – result bytes
```

9.5.13 Password protect AFI (0x9C)

This command enables the password protection for AFI. The AFI password has to be transmitted before with ICODE_SET_PASSWORD command.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x9C	ICODE_PASSWORD_PROTECT_AFI
Response description			
ACK	1	0x00	
Command ID	1	0x9C	ICODE_PASSWORD_PROTECT_AFI

Example:

```
HOST=>C1: 0x9C – ICODE_PASSWORD_PROTECT_AFI

C1=>HOST: 0x00 – ACK byte
          0x9C – related command code ICODE_PASSWORD_PROTECT_AFI
```

9.5.14 Read EPC (0x9D)

This command reads EPC data from the TAG. The ACK response contains 12-bytes of EPC data. Please refer to the NXP documentation for more information.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x9D	ICODE_READ_EPC

Response description			
ACK	1	0x00	
Command ID	1	0x9D	ICODE_READ_EPC
EPC information	12	X	Please refer to the NXP documentation for more information.

Example:

```
HOST=>C1: 0x9D – ICODE_READ_EPC

C1=>HOST: 0x00 – ACK byte
          0x9D – related command code ICODE_READ_EPC
          0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 – result bytes
```

9.5.15 Get NXP System Information (0x9E)

This command retrieves the NXP system information value from the TAG. No arguments are required. The ACK response contains bytes with the NXP system information. Please refer to the NXP documentation for more information.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x9E	ICODE_GET_NXP_SYSTEM_INFORMATION
Response description			
ACK	1	0x00	
Command ID	1	0x9E	ICODE_GET_NXP_SYSTEM_INFORMATION
System information	X	XXX	System information bytes

Example:

```
HOST=>C1: 0x9E – ICODE_GET_NXP_SYSTEM_INFORMATION

C1=>HOST: 0x00 – ACK byte
          0x9E – related command code ICODE_GET_NXP_SYSTEM_INFORMATION
          0x0F 0x04 0x8F 0x7F 0x0A 0x01 0x24
          0x16 0xE0 0x00 0x00 0x33 0x03 0x02 – result bytes
```

9.5.16 Get random number (0x9F)

This command requests a random number from the ICODE TAG. No arguments are required. The ACK response contains a 16-bit random number. This value should be used with ICODE_SET_PASSWORD command.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0x9F	ICODE_GET_RANDOM_NUMBER
Response description			

ACK	1	0x00	
Command ID	1	0x9F	ICODE_GET_RANDOM_NUMBER
Random number	2	XXX	16-bits random number

Example:

```
HOST=>C1: 0x9F – ICODE_GET_RANDOM_NUMBER

C1=>HOST: 0x00 – ACK byte
          0x9F – related command code ICODE_GET_RANDOM_NUMBER
          0x7F 0x14 – result bytes
```

9.5.17 Set password (0xA0)

This command sets the password for the selected identifier. This command has to be executed just once for the related passwords if the TAG is powered. The password is calculated as XOR with the random number returned by the previously executed command ICODE_GET_RANDOM_NUMBER.

Here is an example how to calculate XOR password:

```
xorPassword[0] = password[0] ^ rnd[0];
xorPassword[1] = password[1] ^ rnd[1];
xorPassword[2] = password[2] ^ rnd[0];
xorPassword[3] = password[3] ^ rnd[1];
```

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0xA0	ICODE_SET_PASSWORD
Password Identifier	1	X	0x01 – Read password 0x02 – Write password 0x04 – Privacy password 0x08 – Destroy password
XOR Password	4	X	
Response description			
ACK	1	0x00	
Command ID	1	0xA0	ICODE_SET_PASSWORD

Example:

```
HOST=>C1: 0xA0 – ICODE_SET_PASSWORD
          0x02 – write password
          0x34 0x76 0x39 0x64 – calculated XOR password

C1=>HOST: 0x00 – ACK byte
          0xA0 – related command code ICODE_SET_PASSWORD
```

9.5.18 Write password (0xA1)

This command writes a new password to a selected identifier. With this command, a new password is written into the related memory. Note that the old password has to be transmitted before with ICODE_SET_PASSWORD. The new password takes effect immediately which means that the new password has to be transmitted with ICODE_SET_PASSWORD to get access to the protected blocks/pages. It takes as arguments the password identifier byte and the plain password 4-bytes long.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0xA1	ICODE_WRITE_PASSWORD
Password Identifier	1	X	0x01 – Read password 0x02 – Write password 0x04 – Privacy password 0x08 – Destroy password
Password	4	x	Plain password
Response description			
ACK	1	0x00	
Command ID	1	0xA1	ICODE_WRITE_PASSWORD

Example:

```
HOST=>C1: 0xA1 – ICODE_WRITE_PASSWORD
          0x02 – write password
          0x34 0x76 0x39 0x64 – Plain password

C1=>HOST: 0x00 – ACK byte
          0xA1 – related command code ICODE_WRITE_PASSWORD
```

9.5.19 Lock password (0xA2)

This command locks the addressed password. Note that the addressed password has to be transmitted before with ICODE_SET_PASSWORD. A locked password can no longer be changed.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0xA2	ICODE_LOCK_PASSWORD
Password Identifier	1	X	0x01 – Read password 0x02 – Write password 0x04 – Privacy password 0x08 – Destroy password
Response description			
ACK	1	0x00	
Command ID	1	0xA2	ICODE_LOCK_PASSWORD

Example:

```
HOST=>C1: 0xA2 – ICODE_LOCK_PASSWORD
          0x02 – write password

C1=>HOST: 0x00 – ACK byte
          0xA2 – related command code ICODE_LOCK_PASSWORD
```

9.5.20 Protect page (0xA3)

This command changes the protection status of a page. Note that the related passwords have to be transmitted before with ICODE_SET_PASSWORD if the page is not public. Please refer to the NXP documentation for more information.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0xA3	ICODE_PAGE_PROTECT
Page address	1	X	• Page number to be protected in case of products that do not have pages characterized as high and Low. • Block number to be protected in case of products that have pages characterized as high and Low.
Protection status	1	X	• Protection status options for the products that do not have pages characterized as high and Low: 0x00: ICODE_PROTECT_PAGE_PUBLIC 0x01: ICODE_PROTECT_PAGE_READ_WRITE_READ_PASSWORD 0x10: ICODE_PROTECT_PAGE_WRITE_PASSWORD 0x11: ICODE_PROTECT_PAGE_READ_WRITE_PASSWORD_SEPERATE • Extended Protection status options for the products that have pages characterized as high and Low: 0x01: ICODE_PROTECT_PAGE_READ_LOW 0x02: ICODE_PROTECT_PAGE_WRITE_LOW 0x10: ICODE_PROTECT_PAGE_READ_HIGH 0x20: ICODE_PROTECT_PAGE_WRITE_HIGH
Response description			
ACK	1	0x00	
Command ID	1	0xA2	ICODE_PAGE_PROTECT

Example:

```
HOST=>C1: 0xA3 – ICODE_PAGE_PROTECT
          0x02 – second block selected
          0x01 - ICODE_PROTECT_PAGE_READ_LOW flag selected

C1=>HOST: 0x00 – ACK byte
          0xA3 – related command code ICODE_PAGE_PROTECT
```

9.5.21 Lock page protection (0xA4)

This command permanently locks the protection status of a page. Note that the related passwords have to be transmitted before with ref ICODE_SET_PASSWORD if the page is not public.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0xA4	ICODE_LOCK_PAGE_PROTECTION
Page number	1	X	
Response description			
ACK	1	0x00	
Command ID	1	0xA4	ICODE_LOCK_PAGE_PROTECTION

Example:

```
HOST=>C1: 0xA4 – ICODE_LOCK_PAGE_PROTECTION
          0x02 – page number
C1=>HOST: 0x00 – ACK byte
          0xA4 – related command code ICODE_LOCK_PAGE_PROTECTION
```

9.5.22 Get multiple block protection status (0xA5)

This instructs the label to return the block protection status of the requested blocks. It takes as arguments the first block number to get the block protection status and the number of blocks.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0xA5	ICODE_GET_MULTIPLE_BPS
First block number	1	X	
Number of blocks	1	N	
Response description			
ACK	1	0x00	
Command ID	1	0xA5	ICODE_GET_MULTIPLE_BPS
BSS information	N	X	Blocks protection status information

Example:

```
HOST=>C1: 0xA5 – ICODE_GET_MULTIPLE_BPS
          0x00 – starting block number
          0x08 – number of BSS to read

C1=>HOST: 0x00 – ACK byte
          0xA5 – related command code ICODE_GET_MULTIPLE_BPS
          0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 – result bytes
```

9.5.23 Destroy (0xA6)

This command permanently destroys the label (tag). The destroy password hasto be transmitted before with ICODE_SET_PASSWORD. This command is irreversible and the label will never respond to any command again. This command can take the XOR password argument for the ICODE products that requires this argument. The XOR password calculation method is described in the ICODE_SET_PASSWORD description.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0xA6	ICODE_DESTROY
XOR password	4	X	Optional XOR password
Response description			
ACK	1	0x00	
Command ID	1	0xA6	ICODE_DESTROY

Example:

```
HOST=>C1: 0xA6 – ICODE_DESTROY

C1=>HOST: 0x00 – ACK byte
          0xA6 – related command code ICODE_DESTROY
```

9.5.24 Enable privacy (0xA7)

This command instructs the label to enter privacy mode. In privacy mode, the label will only respond to ICODE_GET_RANDOM_NUMBER and ICODE_SET_PASSWORD commands. To get out of the privacy mode, the Privacy password has to be transmitted before with ICODE_SET_PASSWORD.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0xA7	ICODE_ENABLE_PRIVACY
XOR password	4	X	Optional XOR password
Response description			
ACK	1	0x00	
Command ID	1	0xA7	ICODE_ENABLE_PRIVACY

Example:

```
HOST=>C1: 0xA7 – ICODE_ENABLE_PRIVACY

C1=>HOST: 0x00 – ACK byte
          0xA7 – related command code ICODE_ENABLE_PRIVACY
```

9.5.25 Enable 64-bit password (0xA8)

This instructs the label that both Read and Write passwords are required for protected access. Note that both the Read and Write passwords have to be transmitted before with ICODE_SET_PASSWORD.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0xA8	ICODE_ENABLE_64BIT_PASSWORD
Response description			
ACK	1	0x00	
Command ID	1	0xA8	ICODE_ENABLE_64BIT_PASSWORD

Example:

```
HOST=>C1: 0xA8 – ICODE_ENABLE_64BIT_PASSWORD

C1=>HOST: 0x00 – ACK byte
          0xA8 – related command code ICODE_ENABLE_64BIT_PASSWORD
```

9.5.26 Read signature (0xA9)

This command reads the signature bytes from the TAG. No arguments are required. The ACK response contains bytes containing the signature bytes. Please refer to the NXP documentation for more information.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0xA9	ICODE_READ_SIGNATURE
Response description			
ACK	1	0x00	
Command ID	1	0xA9	ICODE_READ_SIGNATURE
Signature bytes	X	XXX	Signature bytes

Example:

```
HOST=>C1: 0xA9 – ICODE_READ_SIGNATURE

C1=>HOST: 0x00 – ACK byte
          0xA9 – related command code ICODE_READ_SIGNATURE
          0x0F 0x04 0x8F 0x7F 0x0A 0x01 0x24
          0x16 0xE0 0x00 0x00 0x33 0x03 0x02 – result bytes
```

9.5.27 Read config (0xAA)

This command reads multiple 4-byte data chunks from the selected configuration block address. It takes two arguments, the first block number and the number of blocks to read the configuration data.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0xAA	ICODE_READ_CONFIG
First block number	1	X	
Number of blocks	1	N	
Response description			
ACK	1	0x00	
Command ID	1	0xAA	ICODE_READ_CONFIG
Configuration bytes	N*4	X	

Example:

```
HOST=>C1: 0xAA – ICODE_READ_CONFIG
          0x00 – starting block number
          0x02 – number of blocks to read

C1=>HOST: 0x00 – ACK byte
          0xAA – related command code ICODE_READ_CONFIG
          0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 – result bytes
```

9.5.28 Write config (0xAB)

This command writes configuration bytes to addressed block data from the selected configuration block address. It takes three arguments: the option byte, the block number and the configuration bytes. Please refer to the NXP documentation for more information.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0xAB	ICODE_WRITE_CONFIG
Option byte	1	X	0x01 – Enable option 0x00 – Disable option
Block number	1	X	
Configuration bytes	4	X	
Response description			
ACK	1	0x00	
Command ID	1	0xAB	ICODE_WRITE_CONFIG

Example:

```
HOST=>C1: 0xAB – ICODE_WRITE_CONFIG
          0x01 – option byte
          0x00 – block number
          0x00 0x00 0x00 0x00 – config bytes
C1=>HOST: 0x00 – ACK byte
          0xAB – related command code ICODE_WRITE_CONFIG
```

9.5.29 Pick random ID (0xAC)

This command enables the random ID generation in the tag. This interface is used to instruct the tag to generate a random number in privacy mode. Please refer to the NXP documentation for more information.

Command description			
Argument	**Size**	**Value**	**Description**
Command ID	1	0xAC	ICODE_PICK_RANDOM_ID
Response description			
ACK	1	0x00	
Command ID	1	0xAC	ICODE_PICK_RANDOM_ID

Example:

```
HOST=>C1: 0xAB – ICODE_PICK_RANDOM_ID

C1=>HOST: 0x00 – ACK byte
          0xAB – related command code ICODE_PICK_RANDOM_ID
```