Specialists in Card Readers

ACR1222U
Technical Specification
V1.02

Revision History

Rev Number	Date	Author	Notes
V1.01	17/12/2009	Vincent Zhong Teddy Liu	Preliminary specification for ACR1222U
V1.02	30/09/2010	Vincent Zhong Kit Au	Added Remark on “Refresh the interface status” command

INDEX

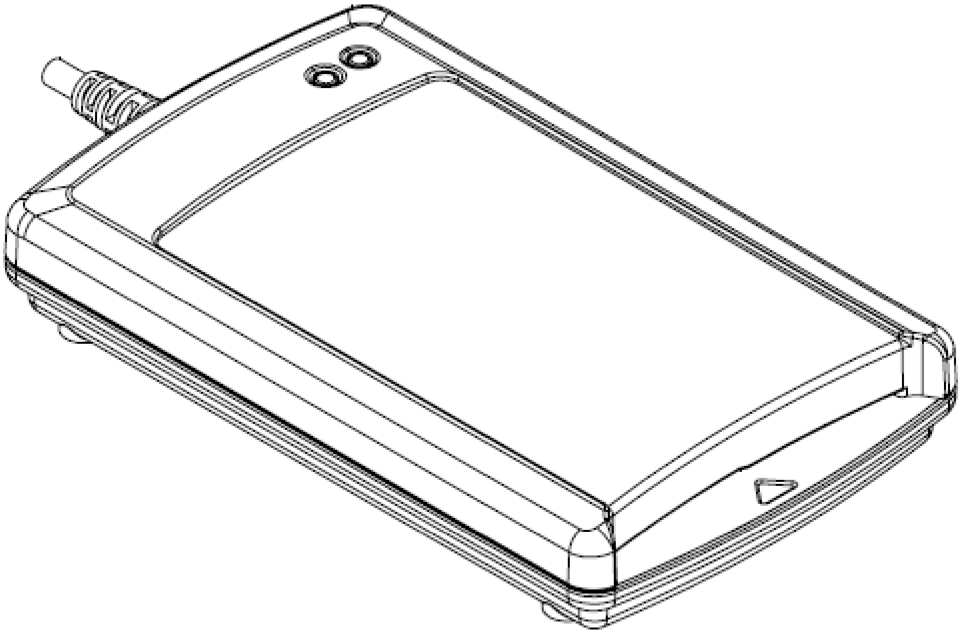
SCOPES

This document describes the contactless part (PICC & PCD) of the ACR1222U reader only.

HIGHTLIGHTS

The ACR1222U is a dual-interface reader (IFD and PCD) that supports both contact (ICC) and contactless (PICC) smart cards.

- One standard ICC landing type card acceptor.
- One SAM socket is provided for highly secure applications.
- A built-in antenna for PICC contactless access applications.
- ISO 7816 Parts 1-4 Compliant for Contact Smart Card Interface.
- Intelligent Support for Hybrid Cards and Combi Cards.
- Energy saving modes for turning off the antenna field whenever the PICC is inactive, or no PICC is found. It prevents the PICC from exposing to the field all the time.
- Contactless interface Support ISO14443 Part 4 Type A & B, MIFARE, FeliCa and NFC-1 tags.
- User-Controllable Peripherals. E.g. LED, Buzzer.
- CCID Compliant.
- PCSC Compliant for Contact, Contactless and SAM Interfaces.
- USB V2.0 Interface. (12M bps)
- Device Firmware Upgradeable through the USB Interface.

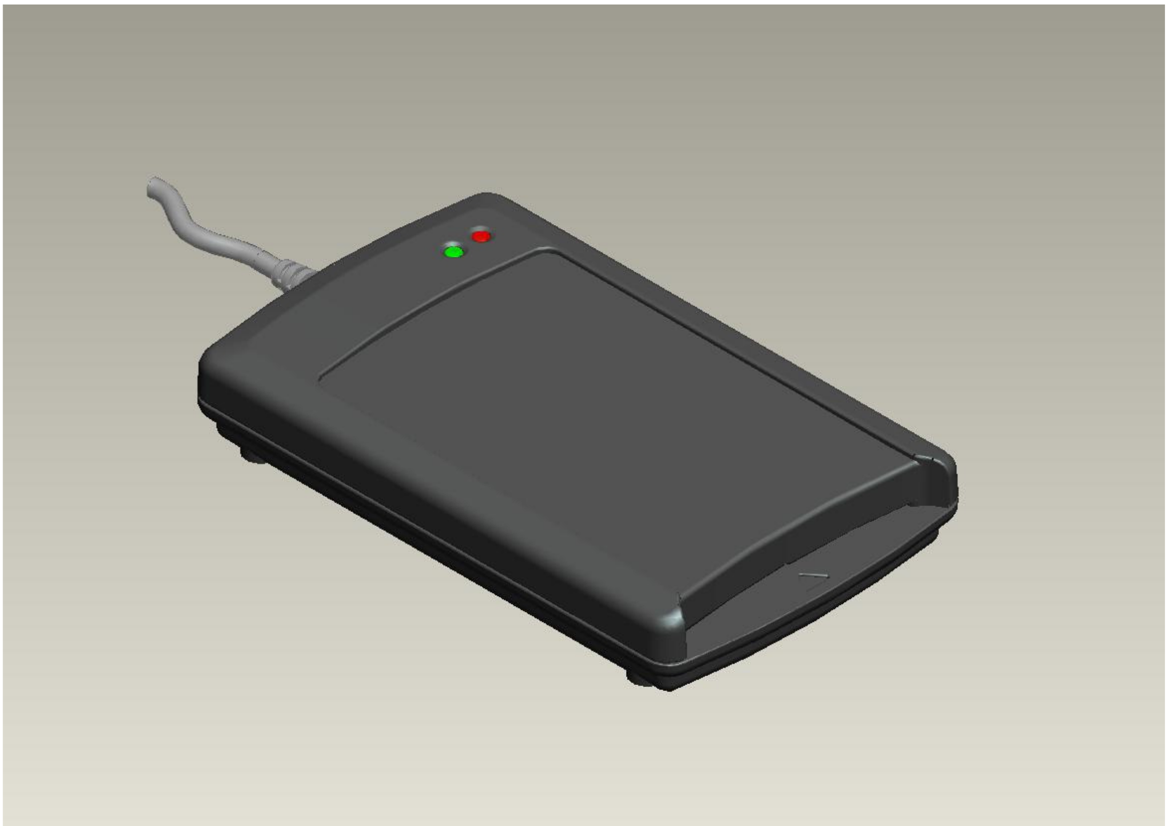


TERMS

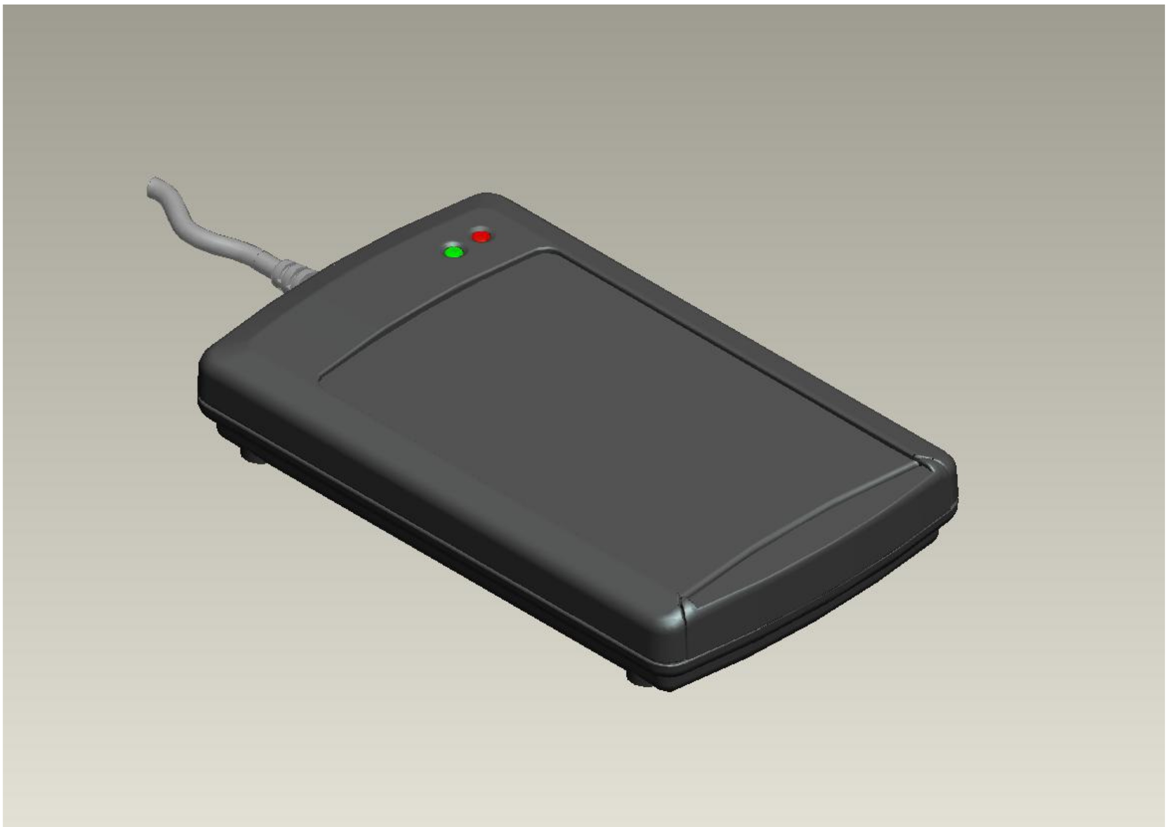
- **IFD**: Interface Device. A terminal, communication device, or machine to which the integrated circuit(s) card is electrically connected during operation.
- **PCD**: Proximity Coupling Device. ISO 14443 Contactless Reader.
- **ICC**: Integrated Circuit(s) Card. Refer to a plastic card containing an integrated circuit, which is compatible with ISO 7816.
- **SAM**: Security Access Module, similar to ICC but in smaller size.
- **PICC**: Proximity Integrated Circuit(s) Card. Contactless Cards operating without mechanical contact to the IFD, using magnetic coupling.
- **Combi-Card**: A smart card that supports both ICC and PICC Interfaces. But only one interface can be operating at any one time.
- **Hybrid-Card**: A smart card that consists of both ICC and PICC cards. Both ICC and PICC cards can be operating at the same time.
- **USB**: Universal Serial Bus, a common device interface used in PC environment.
- **CCID**: The specifications for USB devices that interface with ICC or act as interfaces with ICC/PICC.
- **PCSC**: Personal Computer Smart Card, a specification that can facilitate the interoperability necessary to allow ICC/PICC technology to be effectively utilized in the PC environment.
- **ISO 7816**: A standard for contact smart cards (ICC).
- **T=0**: Character-oriented asynchronous half duplex transmission protocol for ICCs (ISO 7816).
- **T=1**: Block-oriented asynchronous half duplex transmission protocol for ICCs (ISO 7816).
- **ISO 14443**: A standard for contactless smart cards (PICC)
- **T=CL**: Block-oriented asynchronous half duplex transmission protocol for PICCs (ISO 14443).
- **APDU**: Application Protocol Data Unit.
- **ATR**: Answer-to-Reset. The transmission sent by an ICC to the reader (IFD) in response to a RESET condition.
- **ATS**: Answer-to-Select. The transmission sent by a PICC Type A to the reader (PCD) in response to a SELECT condition.
- **ATQB**: Answer-to-Request. The transmission sent by a PICC Type B to the reader (PCD) in response to a REQUEST condition.
- **Card Insertion Event**: Either an ICC or a PICC is just appeared to the reader.
- **Card Removal Event**: Either an ICC or a PICC is removed from the reader.

QUICK OVERVIEW OF THE ACR1222U READER

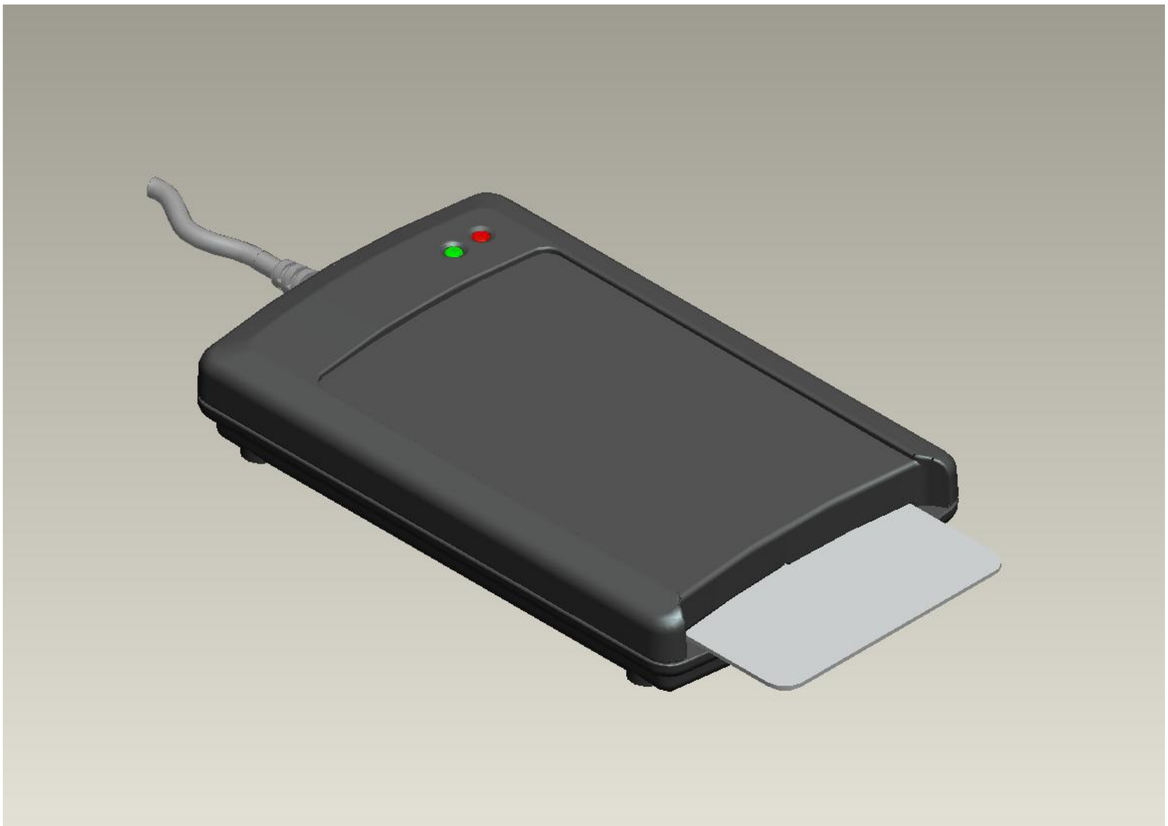
1. ACR1222U (with Contact Card Option)



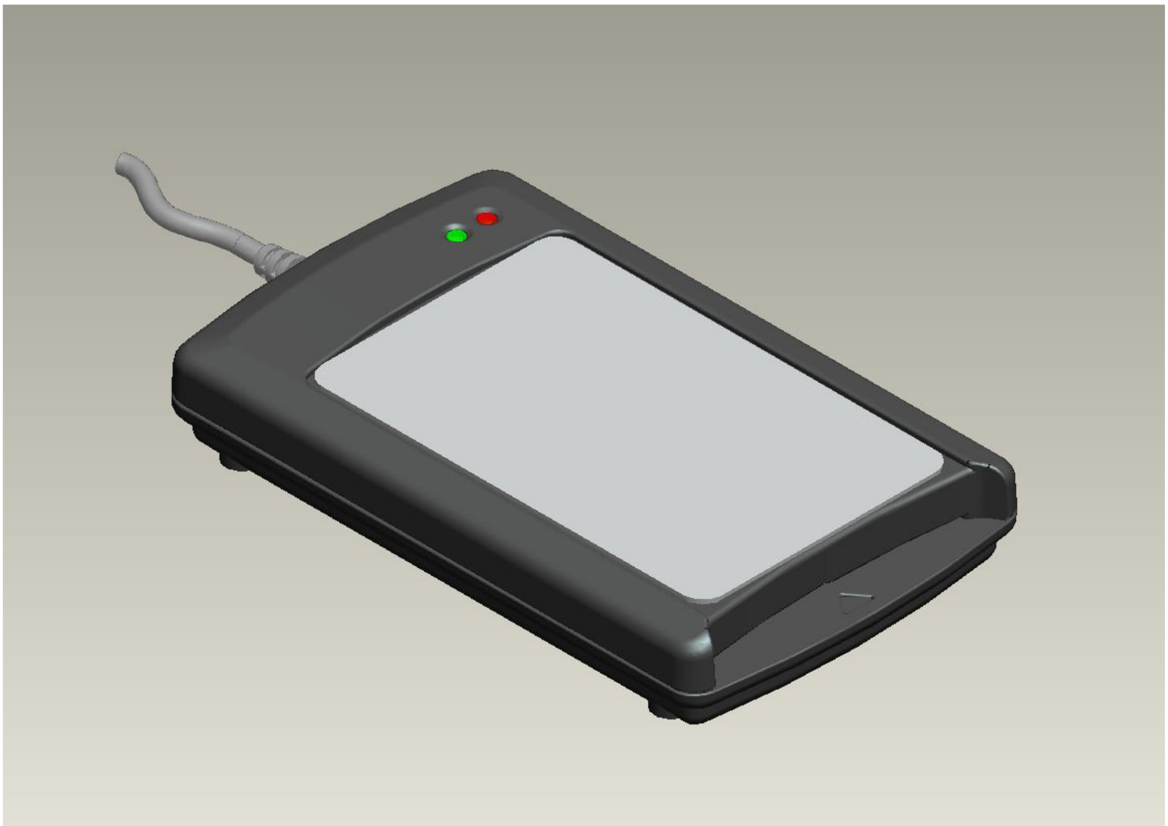
2. ACR1222U (without Contact Card Option)



3. ACR1222U ICC Interface

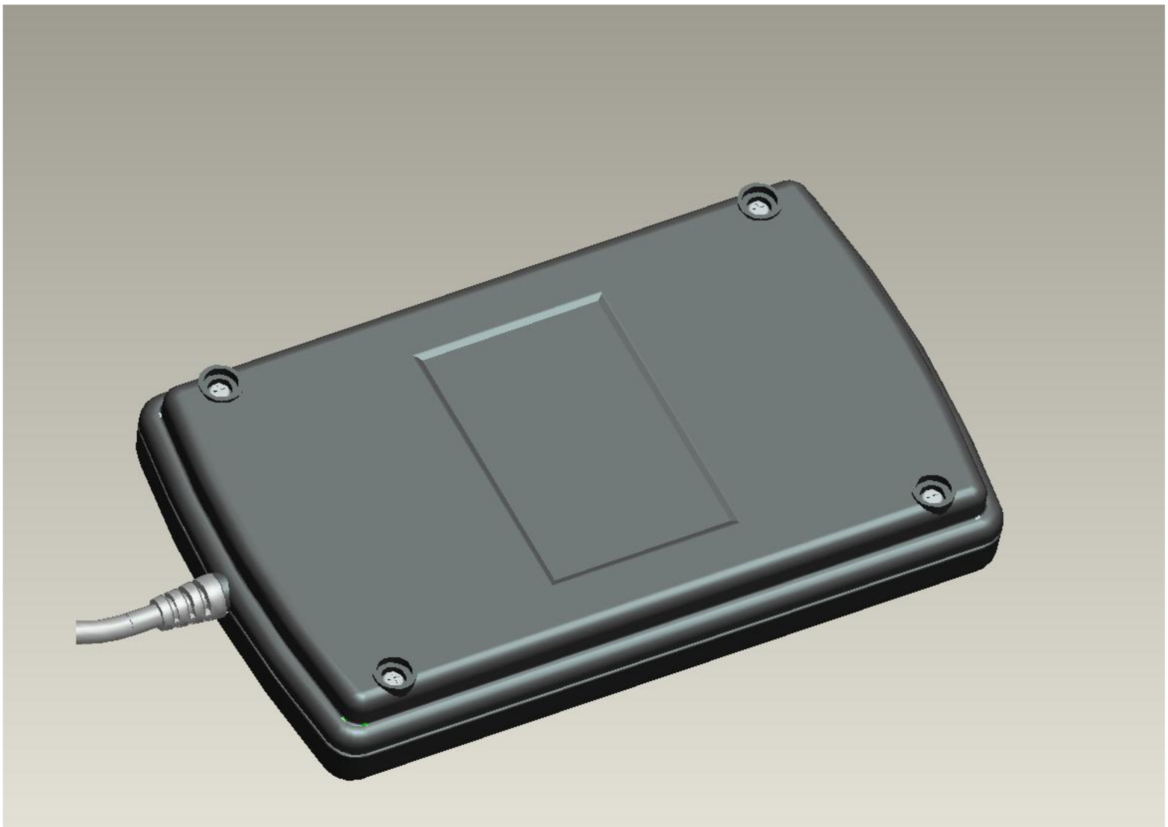


4. ACR1222U PICC Interface

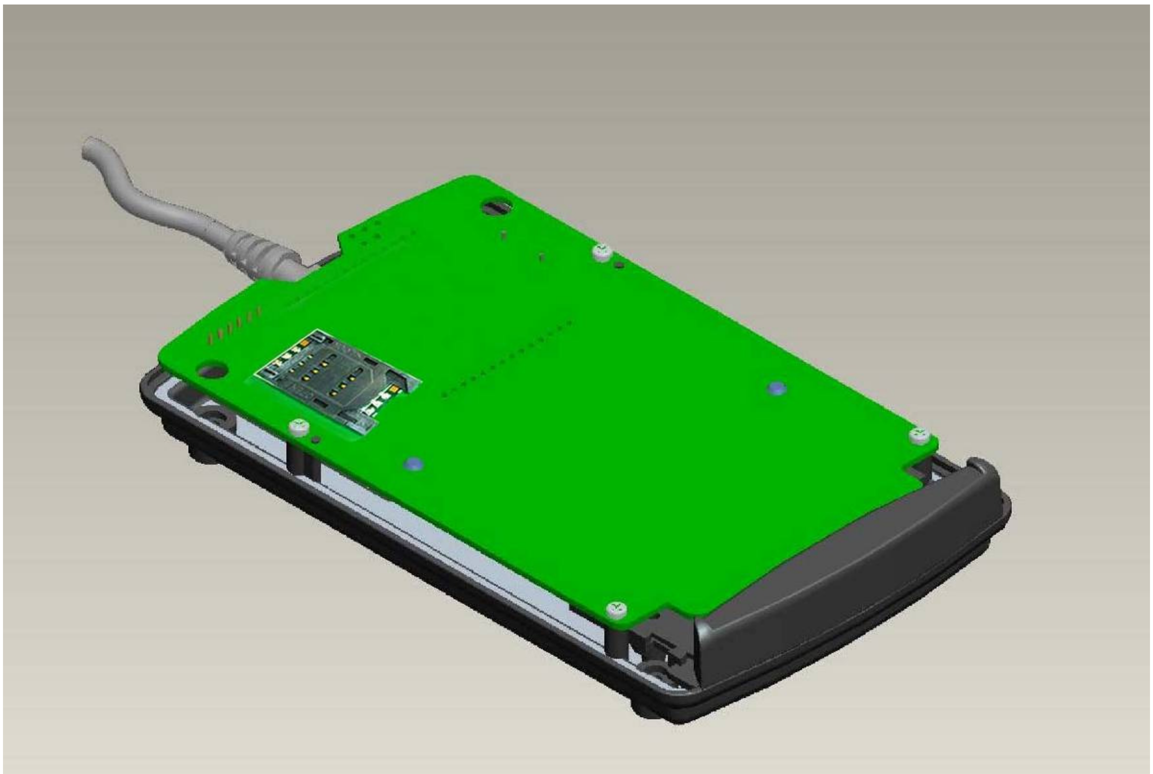


5. ACR1222U SAM Interface

Step 1: Open the plastic covers by unscrewing the four screws first

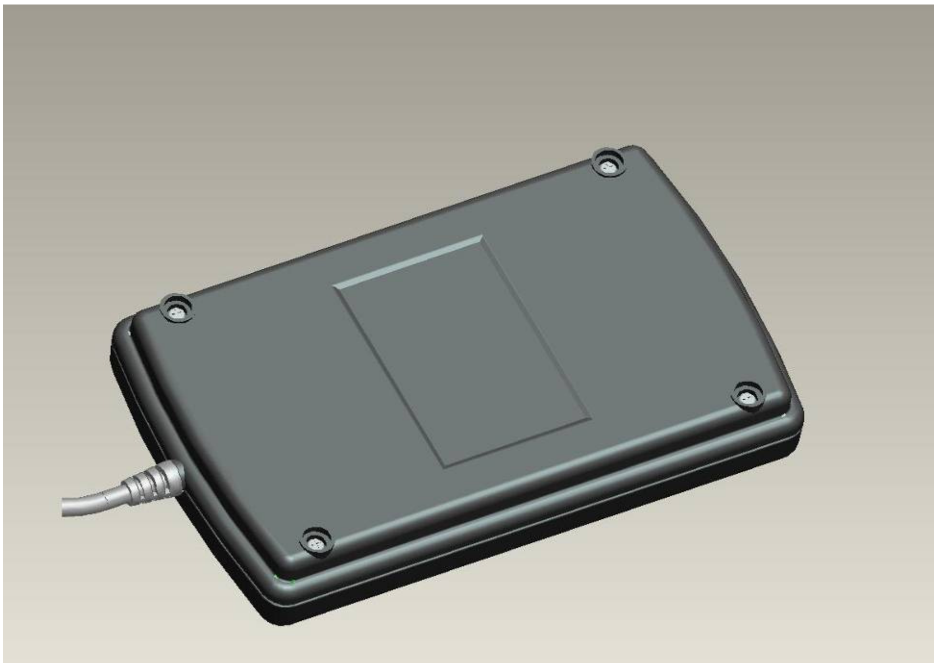


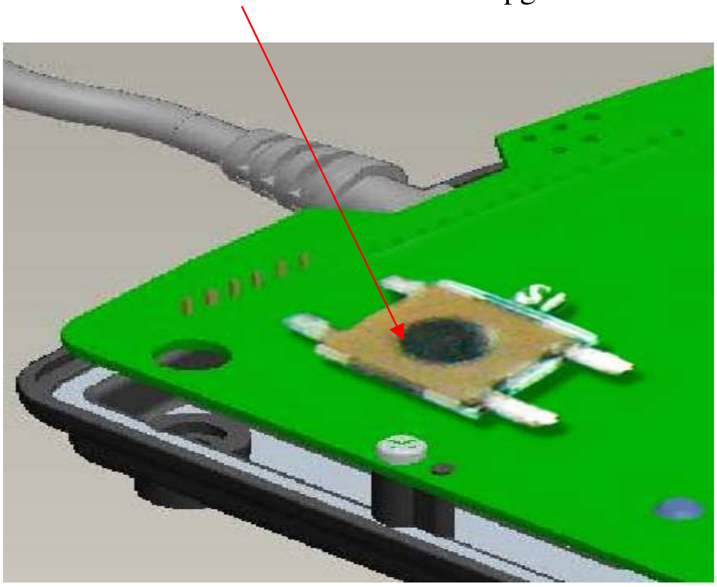
Step 2: The SAM socket is inside the reader.



6. ACR1222U Firmware Upgrade Procedure

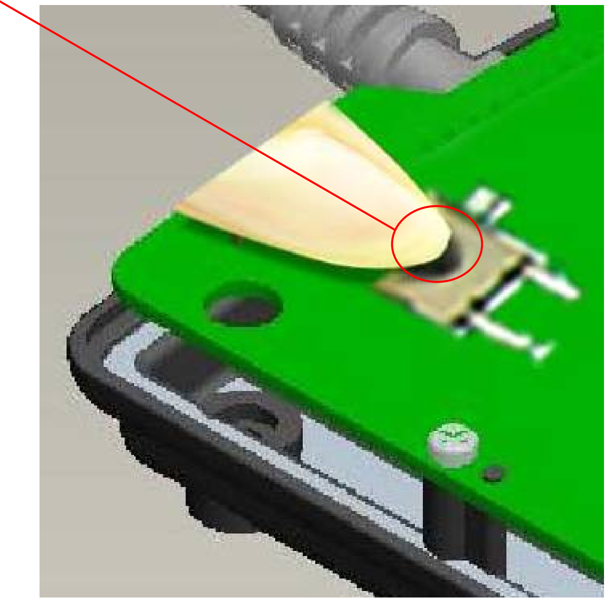
Step 1: Unplug the USB Cable from the PC.
Step 2: Open the plastic covers by unscrewing the four screws first.



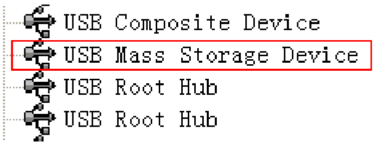


The Button Used For Firmware Upgrade

Step 3: Insert the USB plug to USB Port before pressing the button.



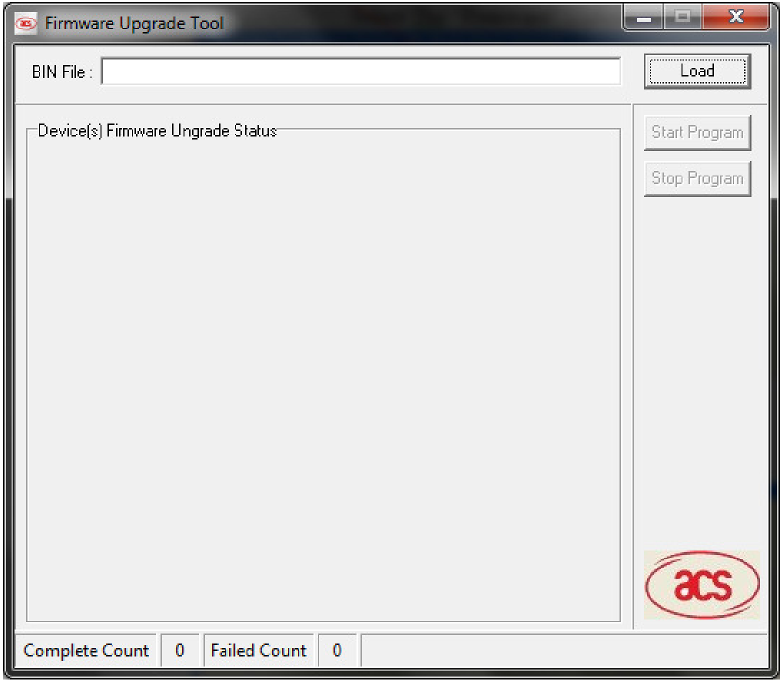
Step 4: The USB Mass Storage Device can be found in Device Manager.



USB Composite Device
USB Mass Storage Device
USB Root Hub
USB Root Hub

Step 5: Execute the Firmware Upgrade Program:

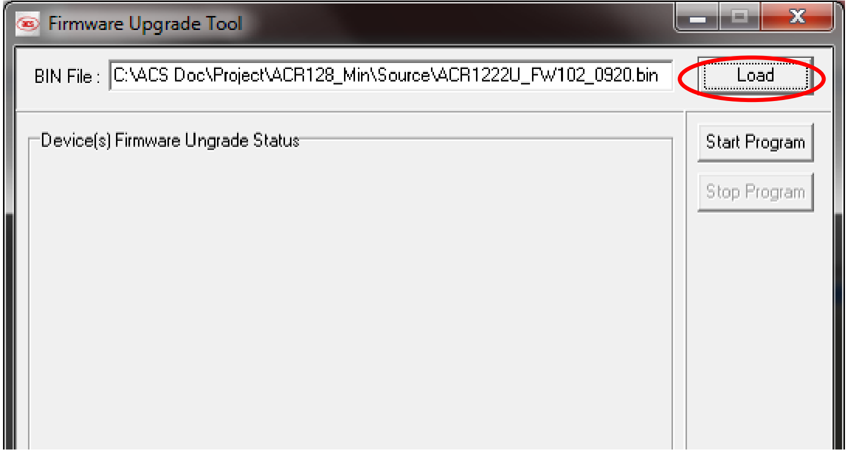
“FW Upgrade Tool.exe”



Complete Count 0 Failed Count 0

Step 6: Pressing the “Load BIN” Button.

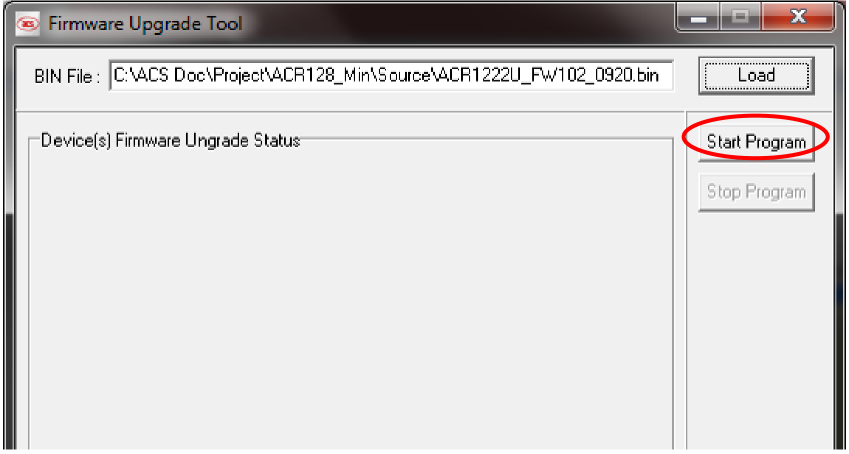
Select the “Firmware” file for Upload to the Reader



BIN File : C:\ACS Doc\Project\ACR128_Min\Source\ACR1222U_FW102_0920.bin

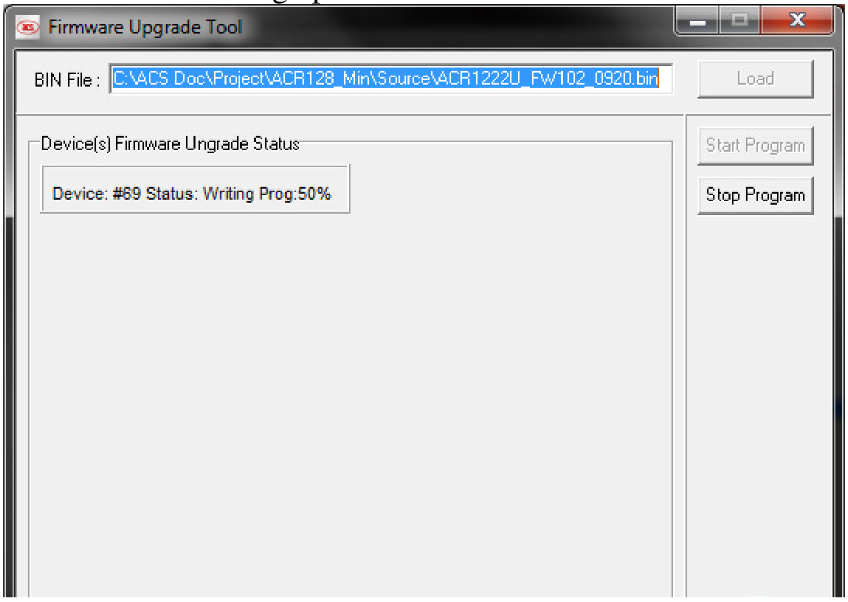
Step 7: Pressing the “Start Program” Button.

Start Program



BIN File : C:\ACS Doc\Project\ACR128_Min\Source\ACR1222U_FW102_0920.bin

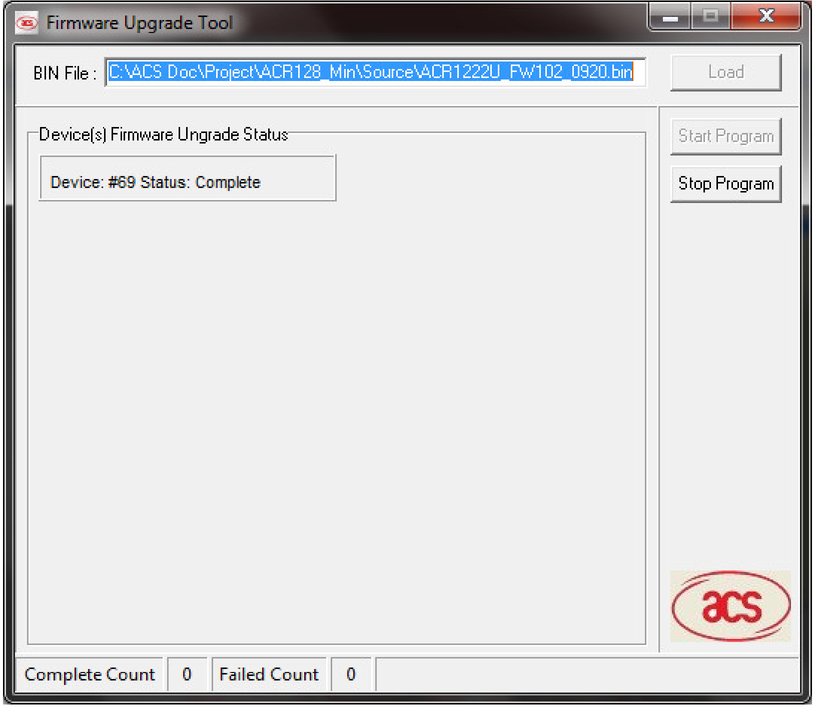
The firmware is being uploaded to the reader



BIN File : C:\ACS Doc\Project\ACR128_Min\Source\ACR1222U_FW102_0920.bin

Device: #69 Status: Writing Prog:50%

The firmware upgrade is completed.



Firmware Upgrade Tool

BIN File : C:\ACS Doc\Project\ACR128_Min\Source\ACR1222U_FW102_0920.bin

Device(s) Firmware Ungrade Status

Device: #69 Status: Complete

Complete Count 0 Failed Count 0

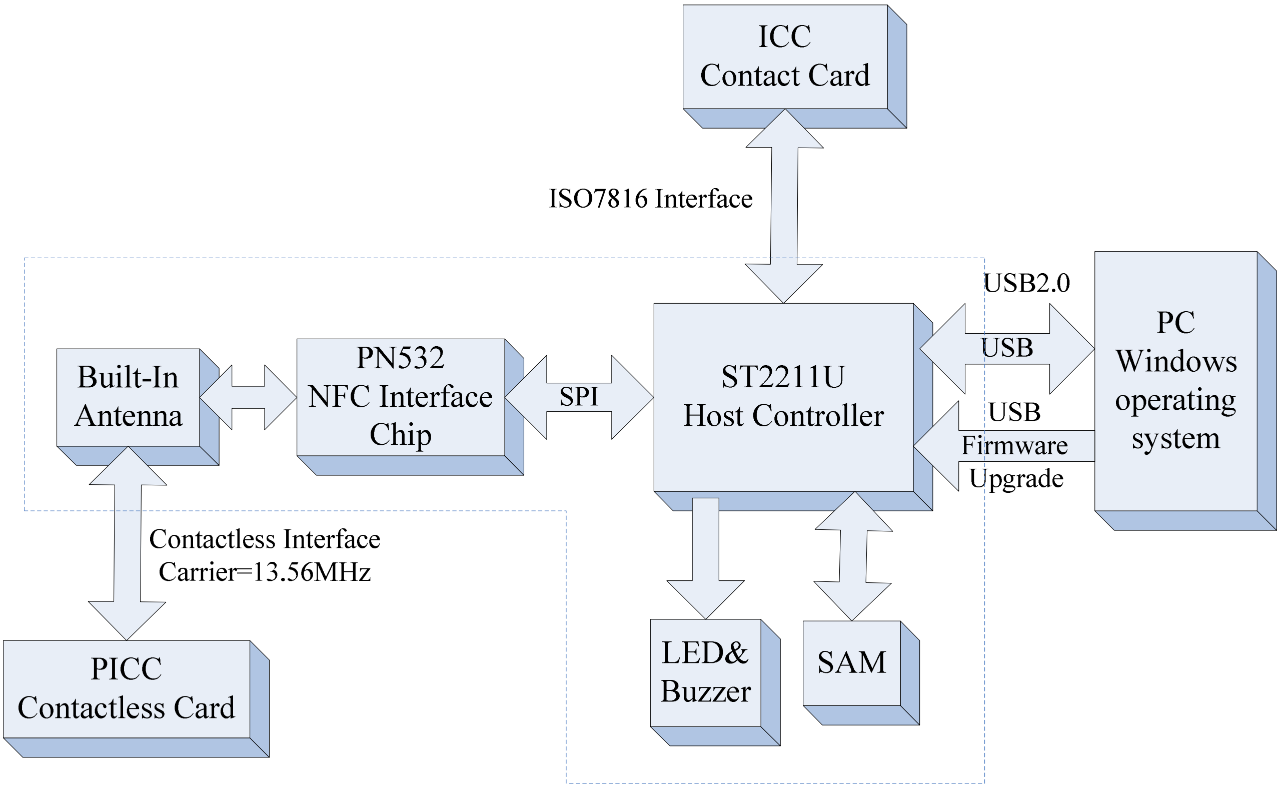
Step 8: Close the plastic covers. After that, reconnect the USB cord.

Noted:

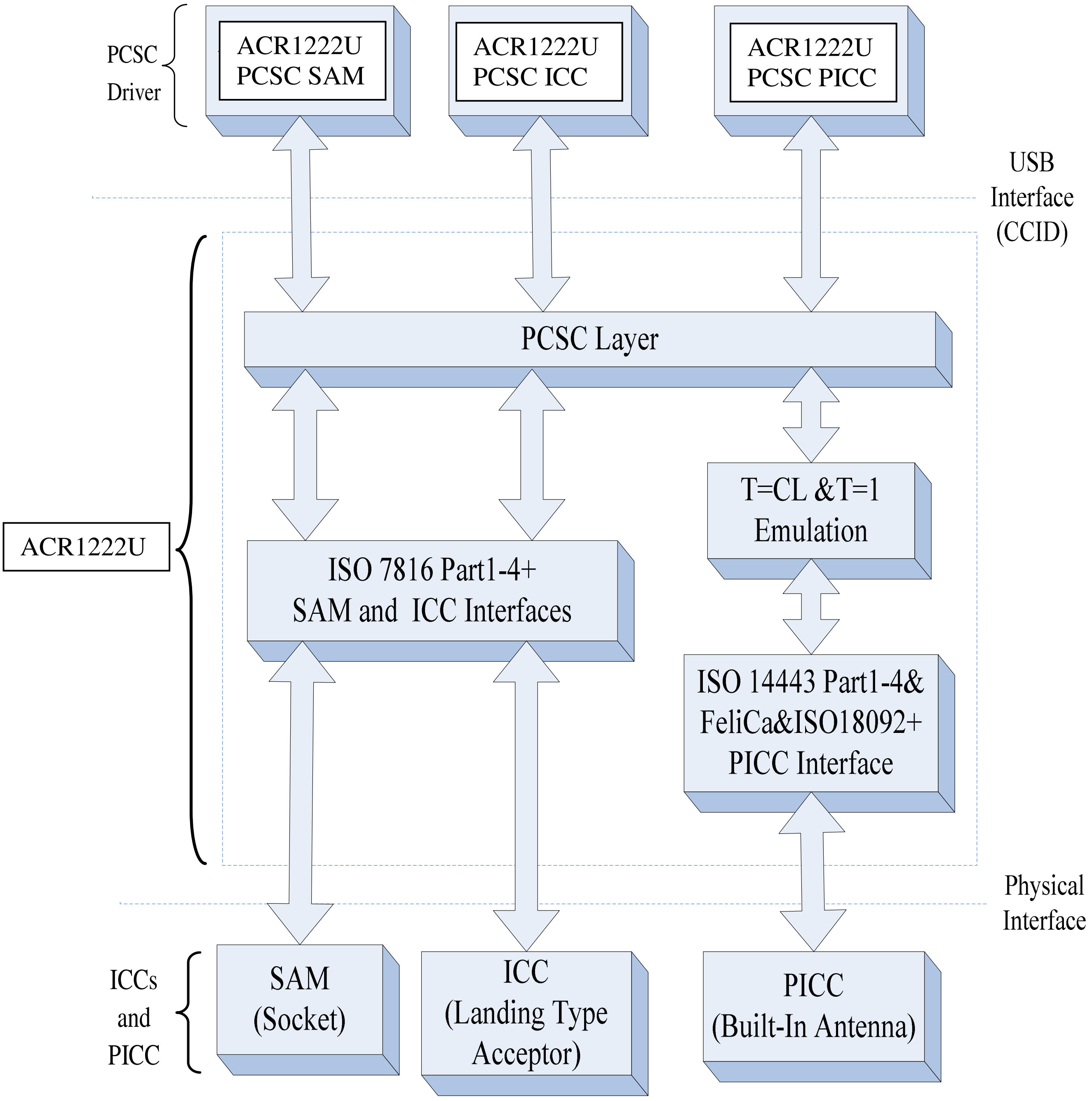
If the upgrade firmware “fail”, please repeat do from steps 3 to 7.

SYSTEM DESCRIPTION

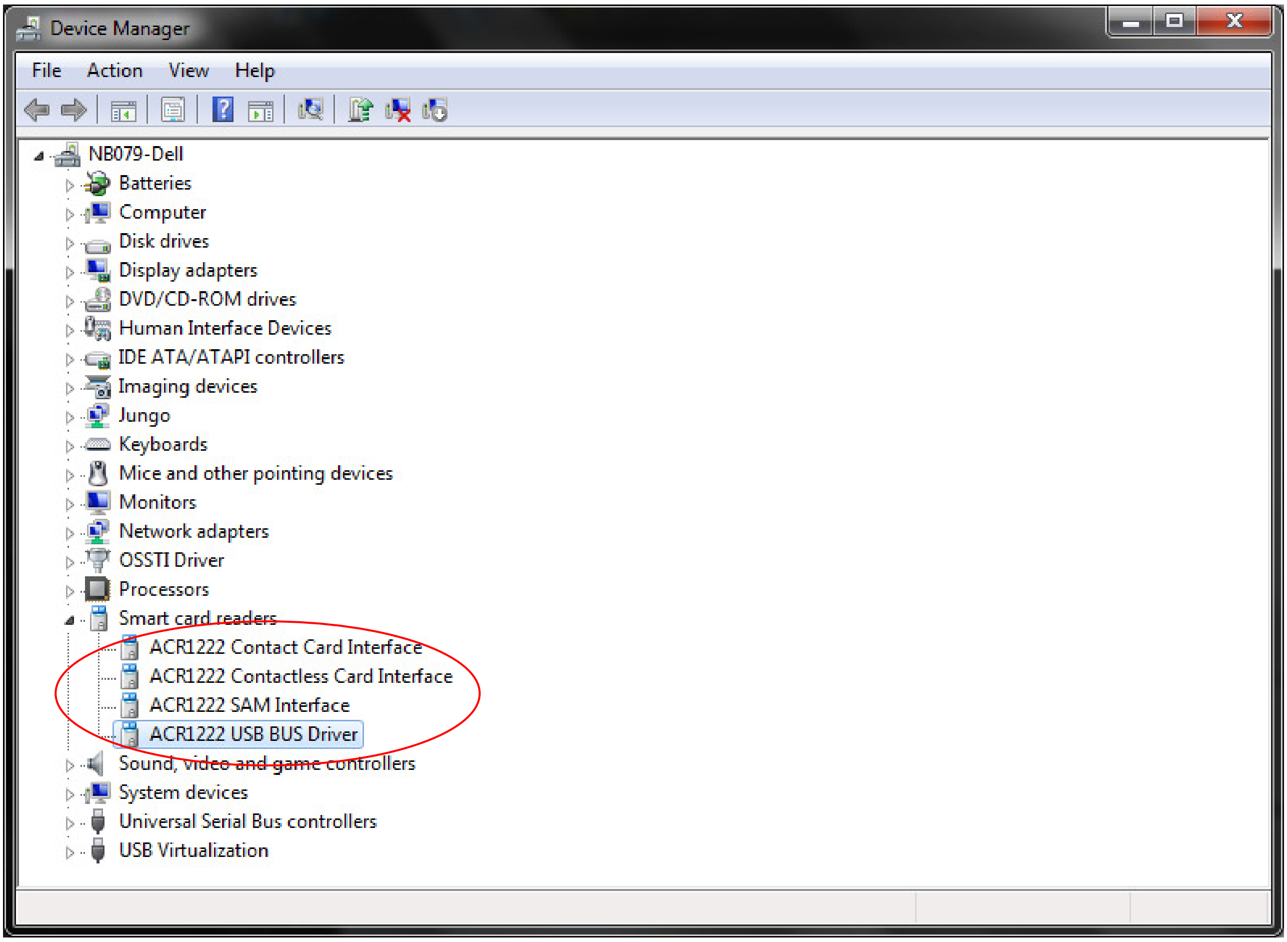
1. The Reader Block Diagram



2. Communication between the PCSC Driver and the ICC, PICC & SAM



3. Smart Card Readers Interfaces Overview.

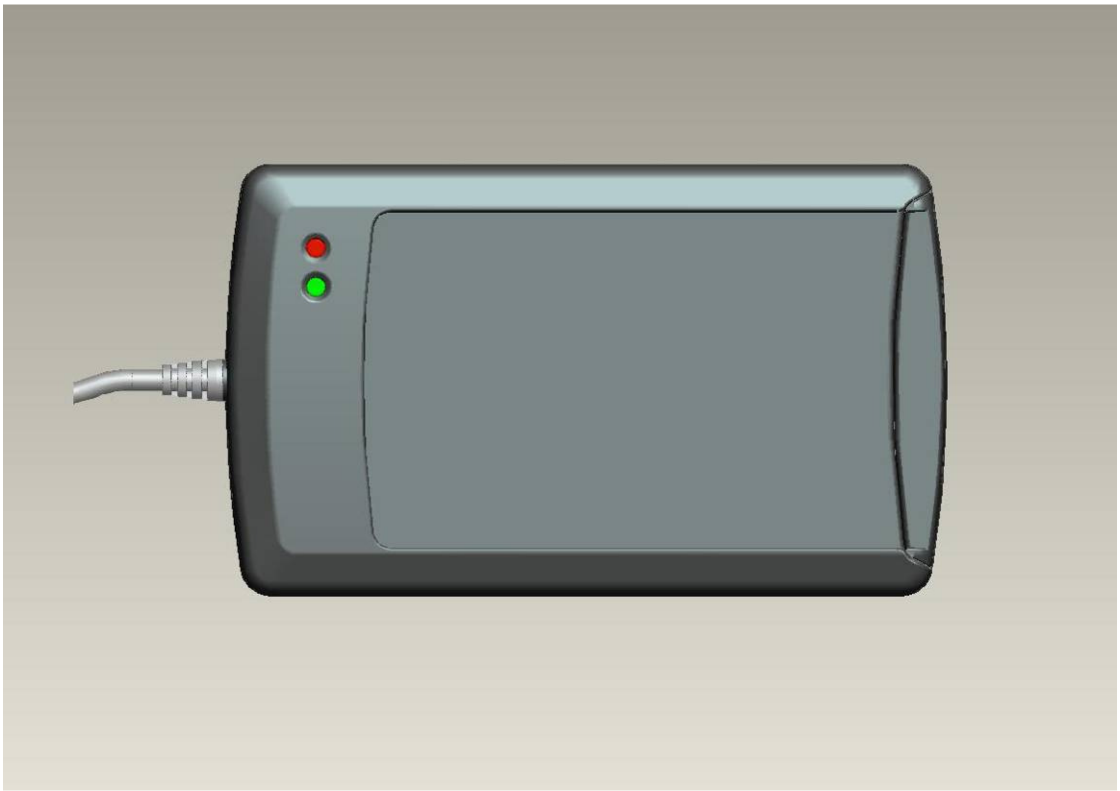


- NB079-Dell
  - Batteries
  - Computer
  - Disk drives
  - Display adapters
  - DVD/CD-ROM drives
  - Human Interface Devices
  - IDE ATA/ATAPI controllers
  - Imaging devices
  - Jungo
  - Keyboards
  - Mice and other pointing devices
  - Monitors
  - Network adapters
  - OSSTI Driver
  - Processors
  - Smart card readers
    - ACR1222 Contact Card Interface
    - ACR1222 Contactless Card Interface
    - ACR1222 SAM Interface
    - ACR1222 USB BUS Driver
  - Sound, video and game controllers
  - System devices
  - Universal Serial Bus controllers
  - USB Virtualization

HARDWARE DESCRIPTION

1. LED Indicatior

The LEDs are used for showing the state of the contact and contactless interfaces.The Red LED is used for showing PICC status and Green LED for ICC.



Reader States	Red LED PICC Indicator	Green LED ICC Indicator
1. No PICC Found or PICC present but not activated.	A single pulse per ~ 5 seconds	
2. PICC is present and activated	ON	
3. PICC is operating	Blinking	
4. ICC is present and activated		ON
5. ICC is absent or not activated		OFF
6. ICC is operating		Blinking

2. Buzzer

A monotone buzzer is used to show the "Card Insertion" and "Card Removal" events.

Events	Buzzer
1. The reader powered up and initialization success.	Beep
2. Card Insertion Event (ICC or PICC)	Beep
3. Card Removal Event (ICC or PICC)	Beep

3. USB Interface

The ACR1222U is connected to a computer through USB interface as specified in the USB Specification 2.0. The ACR1222U is working in full speed mode, i.e. 12 Mbps.

USB Interface Wiring

Pin	Signal	Function
1	**V_{BUS}**	+5V power supply for the reader (~200mA)
2	**D-**	Differential signal transmits data between ACR1222U and PC.
3	**D+**	Differential signal transmits data between ACR1222U and PC.
4	**GND**	Reference voltage level for power supply

NOTE - In order for the ACR1222U functioning properly through USB interface, ACS proprietary device drive has to be installed. Please refer to the Device Driver Installation Guide for more details. {VID = 0x072F; PID = 0x1280}

4. ICC Interface (Contact Smart Card)

A landing type Smart Card Acceptor is used for providing reliable operations. The minimum life cycle of the acceptor is about 300K times of card insertion and removal.

5. SAM Interface (Contact Smart Card)

One SAM socket is provided for highly secure application requirement.

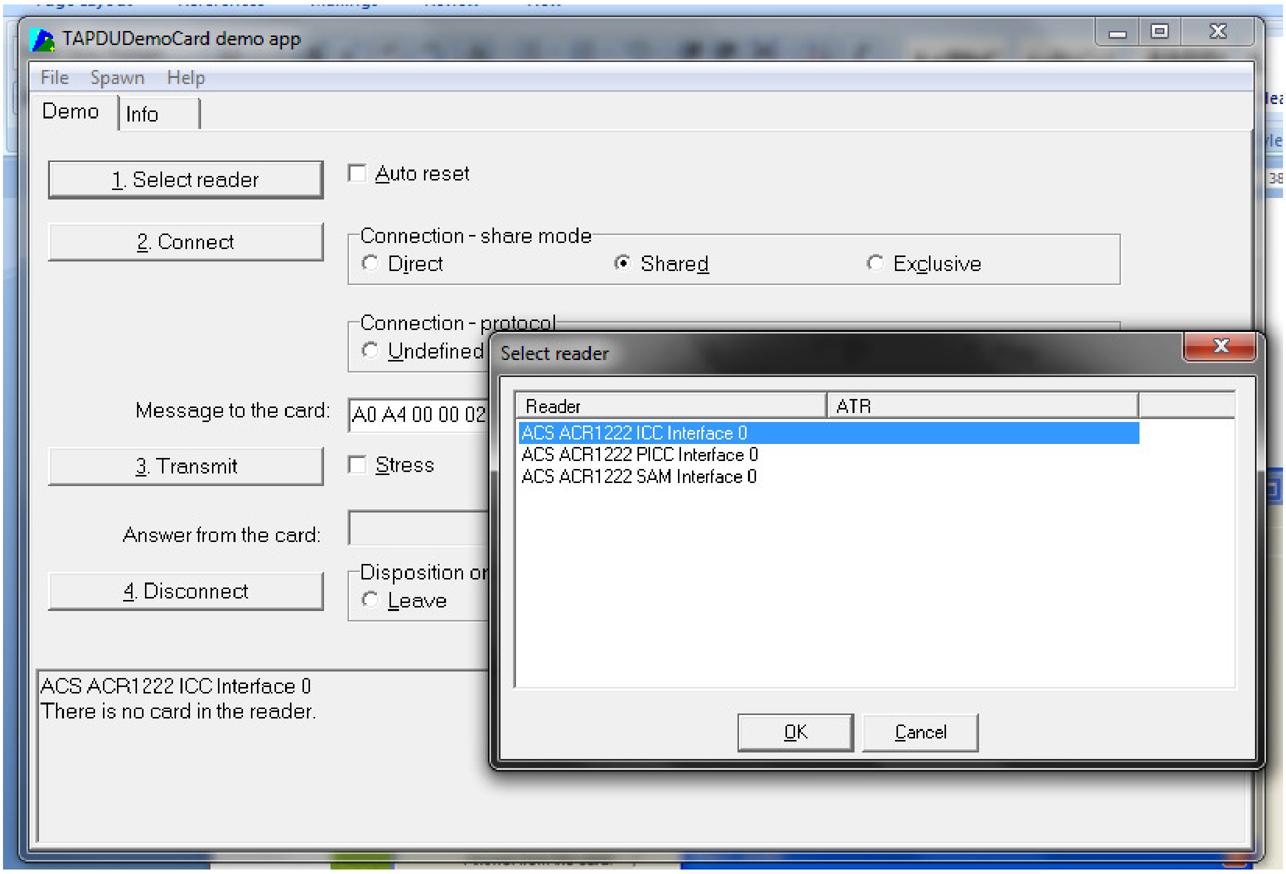
6. PICC Interface (Contactless Smart Card)

A built-in antenna is used for communication between the PCD and PICC.

SOFTWARE DESCRIPTION

1. TAPDUDemoCard Demo App

This program is used to demonstrate the PCSC functions of the ACR1222U readers.



☐ Auto reset

Connection - share mode: ○ Direct ● Shared ○ Exclusive

Connection - protocol: ○ Undefined

Message to the card: A0 A4 00 00 02

☐ Stress

Answer from the card:

Disposition or: ○ Leave

Reader	ATR
ACS ACR1222 ICC Interface 0	
ACS ACR1222 PICC Interface 0	
ACS ACR1222 SAM Interface 0	

```
ACS ACR1222 ICC Interface 0
There is no card in the reader.
```

Operating Procedures:

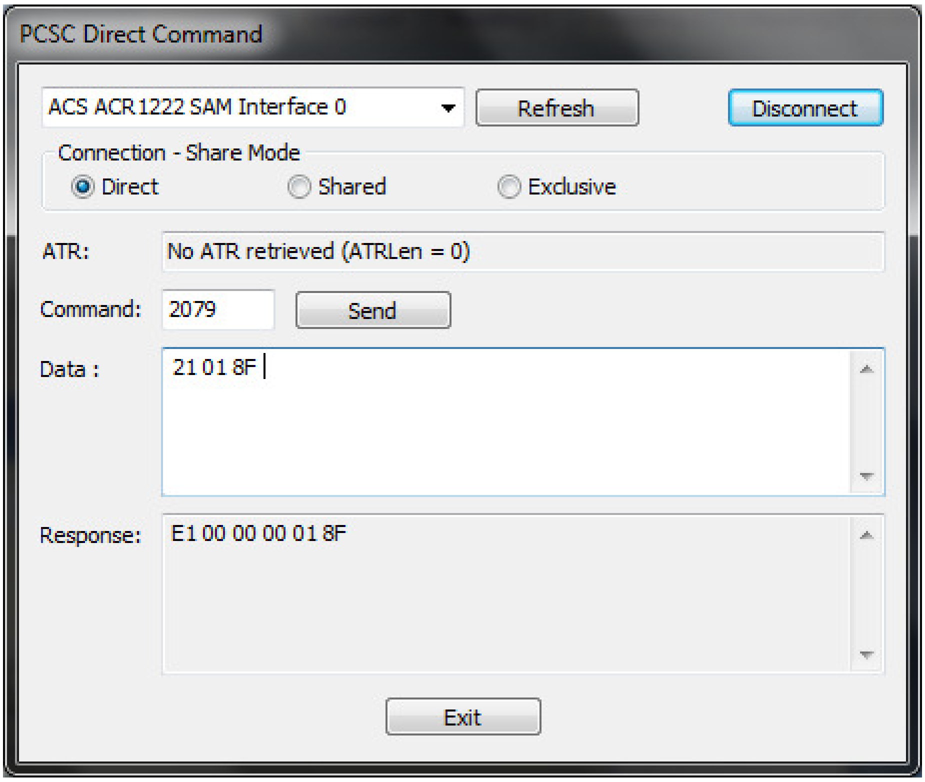
1) Place a PICC on the top of the ACR1222U reader.
2) Press “1. Select Reader” and select the “ACR1222 PICC Interface”
3) Select “T1” in the connection-protocol. Press “2. Connect “to establish a connection between the card and reader.
4) Enter the APDU in text box “Message to the card”
5) Press “3. Transmit” to send the APDU to the card.
6) Press “4. Disconnect” to terminate the connection between the card and reader.

Remarks:

The program can be used to test all the PCSC interfaces. E.g. ACR1222U ICC or SAM Interface.

2. ACR1222U PCSC Direct Command Test

This program is used to demonstrate the PCSC Escape functions of the ACR1222U readers.



ACS ACR1222 SAM Interface 0

Connection - Share Mode

● Direct ○ Shared ○ Exclusive

ATR: No ATR retrieved (ATRLen = 0)

Command: 2079

Data : 21 01 8F

Response: E1 00 00 00 01 8F

Operating Procedures:

1. Select the "ACS ACR1222 SAM Interface 0".
2. Select the "Shared Mode" if a SAM is inserted or "Direct Mode if no Sam is inserted.
3. Press the button "Connect" to establish a connection between the PC and the ACR1222U reader.
4. Enter "2079" in the Command Text Box.
5. Enter the PCSC Escape Command, e.g. "21 01 8F" and press the button "Send" to send the command to the reader.
6. Press the button "Disconnect" to break the connection.

Hints: "21 01 8F" is used for setting the LED and Buzzer Behaviors.

Remarks:

The program can be used to test all the PCSC interfaces. E.g. ACR1222U ICC or PICC Interface.

PERIPHERALS CONTROL

The reader's peripherals control is implemented by Escape Command.

1. Get Firmware Version

Command = {18 00}
Response = {E1 00 00 00 "Frame Length" {Firmware Version} }

In which, Firmware Version = 20 bytes; RFU = 10 bytes
e.g. Response = E1 00 00 00 0D 41 43 52 31 32 32 32 55 5F 56 31 30 32

Firmware Version (HEX) = 41 43 52 31 32 32 32 55 5F 56 31 30 32
Firmware Version (ASCII) = "ACR1222U_V102"

2. LED Control

- **Setting the LED State:**

Command = {29 01 "CMD"}.
Response = {E1 00 00 00 01 "Status"}

- **Reading the existing LED State:**

Command = {29 00}.
Response = {E1 00 00 00 01 "Status"}

CMD Bit Map

CMD	Description	Description
Bit 0	RED LED	1 = ON; 0 = OFF
Bit 1	GREEN LED	1 = ON; 0 = OFF
Bit 2	RFU	RFU
Bit 3	RFU	RFU
Bit 4	RFU	RFU
Bit 5	RFU	RFU
Bit 6	RFU	RFU
Bit 7	RFU	RFU

The "Status" bit map is the same as "CMD".

3. Buzzer Control

- **Setting the Buzzer State:**

Command = {28 01 “Duration”} Unit = 10mS

00 = Turn off
01 – FE = Duration
FF = Turn on

Response = {E1 00 00 00 01 “Status”}

- **Reading the existing Buzzer State:**

Command = {28 00}
Response = {E1 00 00 00 01 “Status”}

4. Default LED and Buzzer Behaviors

CMD	MODE	Description
Bit 0	ICC Activation Status LED	To show the activation status of the ICC interface. 1 = Enable; 0 =Disable
Bit 1	PICC Polling Status LED	To show the PICC Polling Status. 1 = Enable; 0 =Disable
Bit 2	PICC Activation Status LED	To show the activation status of the PICC interface 1 = Enable; 0 =Disable
Bit 3	Card Insertion and Removal Events Buzzer	To make a beep whenever a card insertion or removal event is detected. (For both ICC and PICC) 1 = Enable; 0 =Disabled
Bit 4	RFU	RFU
Bit 5	RFU	RFU
Bit 6	RFU	RFU
Bit 7	Card Operation Blinking LED	To blink the LED whenever the card (PICC or ICC) is being accessed.

- **Setting the LED and Buzzer behaviors:**

Command = {21 01 “CMD”}. Default value of CMD = 8F;
Response = {E1 00 00 00 01 “Status”}

- **Reading the existing behaviors of the LED and Buzzer:**

Command = {21 00}
Response = {E1 00 00 00 01 “Status”}

Hints:
If you want to enjoy the silent environment, just set the CMD value to “87”.

5. Refresh the Interface Status

- **Read the existing status:**
  Command = {2D 00}
  Response = {E1 00 00 00 01 “Interfaces refreshed”}

- **Refresh Interface:**
  Command = {2D 01 “Interfaces to be refreshed”}
  Response = {E1 00 00 00 01 “Interfaces refreshed”}

<Interface No>
Bit 0 = ICC Interface
Bit 1 = PICC Interface
Bit 2 = SAM Interface

Hints: This command is useful for refreshing the SAM status after a new SAM is inserted.
(* Only Can Use if have SAM inserted before Power-up the reader*)

Example 1. Refresh the SAM status after a new SAM is inserted
Step 1. Connect the “SAM Interface” in “Direct” connection mode.
Step 2. Send the direct command “2D 01 04”
Step 3. Disconnect the “SAM Interface”
Step 4. Connect the “SAM Interface: again in either “Direct” or “Shared” connection mode.

Example 2. Refresh the ICC status (Reset the ICC)
Step 1. Connect the “SAM Interface” in “Direct” or “Shared” connection mode.
Step 2. Send the direct command “2D 01 01”

6. Set the Configure Mode

- **Read the existing status:**
  Command = {2B 00}
  Response = {E1 00 00 00 01 “Configure Mode”}

- **Set Configure Mode:**
  Command = {2B 01 “Configure Mode”}
  Response = {E1 00 00 00 01 “Configure Mode”}

“Configure Mode” = 00: Default Mode, enable auto antenna off when ICC reset fail even at the same time reader access PICC with APDU exchange.
“Configure Mode” = 01: Manual Mode, disable auto antenna off when ICC reset fail when reader access PICC with APDU exchange.

7. Set the PICC Operating Parameter

This command is used to control the PICC Operating Parameter of the reader.

- **Read the existing status:**

Command = {20 00}
Response = {E1 00 00 00 01 "PICC Operating Parameter"}

- Setting the PICC Operating Parameter:

Command = {20 01 "CMD"}
Response = {E1 00 00 00 01 "PICC Operating Parameter"}

PICC Operating Parameter. Default Value = FF

CMD	Parameter	Description	Option
Bit0	ISO14443 Type A #To detect the MIFARE Tags, the Auto ATS Generation must be disabled first.	The Tag Types to be detected during PICC Polling.	1 = Detect 0 = Skip
Bit1	ISO14443 Type B		1 = Detect 0 = Skip
Bit2	Topaz		1 = Detect 0 = Skip
Bit3	FeliCa 212K		1 = Detect 0 = Skip
Bit4	FeliCa 424K		1 = Detect 0 = Skip
Bit5	Polling Interval	To set the time interval between successive PICC Polling.	1 = 250 ms 0 = 500 ms
Bit6	Auto ATS Generation	To issue ATS Request whenever an ISO14443-4 Type A tag is activated	1 = Enable 0 = Disable
Bit7	Auto PICC Polling	To enable the PICC Polling	1 = Enable 0 = Disable

PICC INTERFACE DESCRIPTION

1. ATR Generation

If the reader detects a PICC, an ATR will be sent to the PCSC driver for identifying the PICC.

1.1 ATR format for ISO 14443 Part 3 PICCs.

Byte	Value (Hex)	Designation	Description
0	3B	Initial Header	
1	8N	T0	Higher nibble 8 means: no TA1, TB1, TC1 only TD1 is following. Lower nibble N is the number of historical bytes (HistByte 0 to HistByte N-1)
2	80	TD1	Higher nibble 8 means: no TA2, TB2, TC2 only TD2 is following. Lower nibble 0 means T = 0
3	01	TD2	Higher nibble 0 means no TA3, TB3, TC3, TD3 following. Lower nibble 1 means T = 1
4 To 3+N	80	T1	Category indicator byte, 80 means A status indicator may be present in an optional COMPACT-TLV data object
	4F	Tk	Application identifier Presence Indicator
	0C		Length
	RID		Registered Application Provider Identifier (RID) # A0 00 00 03 06
	SS		Byte for standard
	C0 .. C1		Bytes for card name
	00 00 00 00	RFU	RFU # 00 00 00 00
4+N	UU	TCK	Exclusive-oring of all the bytes T0 to Tk

e.g. ATR for MIFare 1K = {3B 8F 80 01 80 4F 0C A0 00 00 03 06 03 00 01 00 00 00 00 6A}

Length (YY) = 0x0C
RID = {A0 00 00 03 06} (PC/SC Workgroup)
Standard (SS) = 03 (ISO14443A, Part 3)
Card Name (C0 .. C1) = {00 01} (MIFare 1K)

Card Name (C0 .. C1)
00 01: Mifare 1K
00 02: Mifare 4K
00 03: Mifare Ultralight
00 26: Mifare Mini

F0 04: Topaz and Jewel
F0 11: FeliCa 212K
F0 12: FeliCa 424K
FF 28: JCOP 30
FF [SAK]: undefined tags

1.2 ATR format for ISO 14443 Part 4 PICCs.

Byte	Value (Hex)	Designation	Description
0	3B	Initial Header	
1	8N	T0	Higher nibble 8 means: no TA1, TB1, TC1 only TD1 is following. Lower nibble N is the number of historical bytes (HistByte 0 to HistByte N-1)
2	80	TD1	Higher nibble 8 means: no TA2, TB2, TC2 only TD2 is following. Lower nibble 0 means T = 0
3	01	TD2	Higher nibble 0 means no TA3, TB3, TC3, TD3 following. Lower nibble 1 means T = 1
4 to 3 + N	XX	T1	Historical Bytes: ISO14443A: The historical bytes from ATS response. Refer to the ISO14443-4 specification. ISO14443B: The higher layer response from the ATTRIB response (ATQB). Refer to the ISO14443-3 specification.
	XX XX XX	Tk	
4+N	UU	TCK	Exclusive-oring of all the bytes T0 to Tk

E.g 1. ATR for DESFire = { 3B 81 80 01 80 80 } // 6 bytes of ATR

Hint: Use the APDU "FF CA 01 00 00" to distinguish the ISO14443A-4 and ISO14443B-4 PICCs, and retrieve the full ATS if available. ISO14443A-3 or ISO14443B-3/4 PICCs do have ATS returned.

APDU Command = FF CA 01 00 00
APDU Response = 06 75 77 81 02 80 90 00
ATS = {06 75 77 81 02 80}

E.g 2. ATR for ST19XRC8E = { 3B 8C 80 01 50 12 23 45 56 12 53 54 4E 33 81 C3 55}
// 12 bytes of ATQB, No CRC-B

ATQB = {50 12 23 45 56 12 53 54 4E 33 81 C3}

PSEUDO APDUS FOR CONTACTLESS INTERFACE

ACR1222U comes with two primitive commands for this purpose. <Class 0xFF>

1. Direct Transmit

To send a Pseudo APDU (PN532 and TAG Commands), and the Response Data will be returned.

Table 1.0A: Direct Transmit Command Format (Length of the PN532_TAG Command + 5 Bytes)

Command	Class	INS	P1	P2	Lc	Data In
Direct Transmit	0xFF	0x00	0x00	0x00	Number of Bytes to send	PN532_TAG Command

Lc: Number of Bytes to Send (1 Byte)
Maximum 255 bytes.

Data In: PN532_TAG Command
The data to be sent to the PN532 and Tag.

Table 1.0B: Direct Transmit Response Format (Response Length + 2 Bytes)

Response	Data Out	
Result	PN532_TAG Response	SW1 SW2

Data Out: PN532_TAG Response
PN532_TAG Response returned by the reader.

Data Out: SW1 SW2
Status Code returned by the reader.

Table 1.0C: Status Code

Results	SW1	SW2	Meaning
Success	90	00	The operation is completed successfully.
Error	63	00	The operation is failed.
Checksum Error	63	27	The checksum of the Response is wrong.

PICC COMMANDS FOR GENERAL PURPOSES

1. Get Data

The “Get Data command” will return the serial number or ATS of the “connected PICC”.

Table 1.1-1a: Get UID APDU Format (5 Bytes)

Command	Class	INS	P1	P2	Le
Get Data	FF	CA	00 01	00	00 (Max Length)

Table 2.1-1b: Get UID Response Format (UID + 2 Bytes) if P1 = 0x00

Response	Data Out					
Result	UID (LSB)			UID (MSB)	SW1	SW2

Table 2.1-1c: Get ATS of a ISO 14443 A card (ATS + 2 Bytes) if P1 = 0x01

Response	Data Out		
Result	ATS	SW1	SW2

Table 2.1-1d: Response Codes

Results	SW1	SW2	Meaning
Success	90	00	The operation is completed successfully.
Warning	62	82	End of UID/ATS reached before Le bytes (Le is greater than UID Length).
Error	6C	XX	Wrong length (wrong number Le: ‘XX’ encodes the exact number) if Le is less than the available UID length.
Error	63	00	The operation is failed.
Error	6A	81	Function not supported

Examples:

```
// To get the serial number of the “connected PICC”
UINT8 GET_UID[5]={0xFF, 0xCA, 0x00, 0x00, 0x00};

// To get the ATS of the “connected ISO 14443 A PICC”
UINT8 GET_ATS[5]={0xFF, 0xCA, 0x01, 0x00, 0x00};
```

2.1 Load Authentication Keys

The "Load Authentication Keys command" will load the authentication keys into the reader. The authentication keys are used to authenticate the particular sector of the Mifare 1K/4K Memory Card. Two kinds of authentication key locations are provided, volatile and non-volatile key locations respectively.

Table 2.1-1a: Load Authentication Keys APDU Format (11 Bytes)

Command	Class	INS	P1	P2	Lc	Data In
Load Authentication Keys	FF	82	Key Structure	Key Number	06	Key (6 bytes)

Key Structure (1 Byte):
0x00 = Key is loaded into the reader volatile memory.
Other = Reserved.

Key Number (1 Byte):
0x00 ~ 0x01 = Key Location. The keys will be disappeared once the reader is disconnected from the PC.

Key (6 Bytes):
The key value loaded into the reader. E.g. {FF FF FF FF FF FF}

Table 2.1-1b: Load Authentication Keys Response Format (2 Bytes)

Response	Data Out	
Result	SW1	SW2

Table 2.1-1c: Load Authentication Keys Response Codes

Results	SW1	SW2	Meaning
Success	90	00	The operation is completed successfully.
Error	63	00	The operation is failed.

Examples:

// Load a key {FF FF FF FF FF FF} into the key location 0x00.
APDU = {FF 82 00 00 06 FF FF FF FF FF FF}

2.2 Authentication for MIFARE 1K/4K

The "Authentication command" uses the keys stored in the reader to do authentication with the MIFARE 1K/4K card (PICC). Two types of authentication keys are used, TYPE_A and TYPE_B respectively.

Table 2.2-1a: Load Authentication Keys APDU Format (6 Bytes) #Obsolete

Command	Class	INS	P1	P2	P3	Data In
Authentication	FF	88	00	Block Number	Key Type	Key Number

Table 2.2-1b: Load Authentication Keys APDU Format (10 Bytes)

Command	Class	INS	P1	P2	Lc	Data In
Authentication	FF	86	00	00	05	Authenticate Data Bytes

Authenticate Data Bytes (5 Byte):

Byte1	Byte 2	Byte 3	Byte 4	Byte 5
Version 0x01	0x00	Block Number	Key Type	Key Number

Block Number (1 Byte):
The memory block to be authenticated.

For MIFARE 1K Card, it has totally 16 sectors and each sector consists of 4 consecutive blocks. E.g. Sector 0x00 consists of Blocks {0x00, 0x01, 0x02 and 0x03}; Sector 0x01 consists of Blocks {0x04, 0x05, 0x06 and 0x07}; the last sector 0x0F consists of Blocks {0x3C, 0x3D, 0x3E and 0x3F}. Once the authentication is done successfully, there is no need to do the authentication again provided that the blocks to be accessed are belonging to the same sector. Please refer to the MIFARE 1K/4K specification for more details.

#Once the block is authenticated successfully, all the blocks belonging to the same sector are accessible.

Key Type (1 Byte):
0x60 = Key is used as a TYPE A key for authentication.
0x61 = Key is used as a TYPE B key for authentication.

0x00 ~ 0x01 = Key Location.

Table 2.2-1b: Load Authentication Keys Response Format (2 Bytes)

Response	Data Out	
Result	SW1	SW2

Table 2.2-1c: Load Authentication Keys Response Codes

Results	SW1	SW2	Meaning
Success	90	00	The operation is completed successfully.
Error	63	00	The operation is failed.

MIFARE 1K Memory Map.

Sectors (Total 16 sectors. Each sector consists of 4 consecutive blocks)	**Data Blocks** (3 blocks, 16 bytes per block)	**Trailer Block** (1 block, 16 bytes)
Sector 0	0x00 ~ 0x02	0x03
Sector 1	0x04 ~ 0x06	0x07
..		
..		
Sector 14	0x38 ~ 0x0A	0x3B
Sector 15	0x3C ~ 0x3E	0x3F

1K Bytes

MIFARE 4K Memory Map.

Sectors (Total 32 sectors. Each sector consists of 4 consecutive blocks)	**Data Blocks** (3 blocks, 16 bytes per block)	**Trailer Block** (1 block, 16 bytes)
Sector 0	0x00 ~ 0x02	0x03
Sector 1	0x04 ~ 0x06	0x07
..		
..		
Sector 30	0x78 ~ 0x7A	0x7B
Sector 31	0x7C ~ 0x7E	0x7F

2K Bytes

Sectors (Total 8 sectors. Each sector consists of 16 consecutive blocks)	**Data Blocks** (15 blocks, 16 bytes per block)	**Trailer Block** (1 block, 16 bytes)
Sector 32	0x80 ~ 0x8E	0x8F
Sector 33	0x90 ~ 0x9E	0x9F
..		
..		
Sector 38	0xE0 ~ 0xEE	0xEF
Sector 39	0xF0 ~ 0xFE	0xFF

2K Bytes

Examples:
// To authenticate the Block 0x04 with a {TYPE A, key number 0x00}.
// PC/SC V2.01, Obsolete
APDU = {FF 88 00 04 60 00};

<Similarly>
// To authenticate the Block 0x04 with a {TYPE A, key number 0x00}.
// PC/SC V2.07
APDU = {FF 86 00 00 05 01 00 04 60 00}

Hints:

MIFARE Ultralight does not need to do any authentication. The memory is free to access.

MIFARE Ultralight Memory Map.

Byte Number	**0**	**1**	**2**	**3**	**Page**
Serial Number	SN0	SN1	SN2	BCC0	0
Serial Number	SN3	SN4	SN5	SN6	1
Internal / Lock	BCC1	Internal	Lock0	Lock1	2
OTP	OPT0	OPT1	OTP2	OTP3	3
Data read/write	Data0	Data1	Data2	Data3	4
Data read/write	Data4	Data5	Data6	Data7	5
Data read/write	Data8	Data9	Data10	Data11	6
Data read/write	Data12	Data13	Data14	Data15	7
Data read/write	Data16	Data17	Data18	Data19	8
Data read/write	Data20	Data21	Data22	Data23	9
Data read/write	Data24	Data25	Data26	Data27	10
Data read/write	Data28	Data29	Data30	Data31	11
Data read/write	Data32	Data33	Data34	Data35	12
Data read/write	Data36	Data37	Data38	Data39	13
Data read/write	Data40	Data41	Data42	Data43	14
Data read/write	Data44	Data45	Data46	Data47	15

512 bits
Or
64 bytes

2.3 Read Binary Blocks

The "Read Binary Blocks command" is used for retrieving a multiple of "data blocks" from the PICC. The data block/trailer block must be authenticated first before executing the "Read Binary Blocks command".

Table 2.3-1a: Read Binary APDU Format (5 Bytes)

Command	Class	INS	P1	P2	Le
Read Binary Blocks	FF	B0	00	Block Number	Number of Bytes to Read

Block Number (1 Byte):
The starting block.

Number of Bytes to Read (1 Byte):
Multiply of 16 bytes for MIFARE 1K/4K or Multiply of 4 bytes for MIFARE Ultralight

- Maximum 16 bytes for MIFARE Ultralight.
- Maximum 48 bytes for MIFARE 1K. (Multiple Blocks Mode; 3 consecutive blocks)
- Maximum 240 bytes for MIFARE 4K. (Multiple Blocks Mode; 15 consecutive blocks)

Example 1: 0x10 (16 bytes). The starting block only. (Single Block Mode)
Example 2: 0x40 (64 bytes). From the starting block to starting block+3. (Multiple Blocks Mode)

#For safety reason, the Multiple Block Mode is used for accessing Data Blocks only. The Trailer Block is not supposed to be accessed in Multiple Blocks Mode. Please use Single Block Mode to access the Trailer Block.

Table 2.3-1b: Read Binary Block Response Format (Multiply of 4/16 + 2 Bytes)

Response	Data Out		
Result	Data (Multiply of 4/16 Bytes)	SW1	SW2

Table 2.3-1c: Read Binary Block Response Codes

Results	SW1	SW2	Meaning
Success	90	00	The operation is completed successfully.
Error	63	00	The operation is failed.

Examples:
// Read 16 bytes from the binary block 0x04 (MIFARE 1K or 4K)
APDU = {FF B0 00 04 10}

// Read 240 bytes starting from the binary block 0x80 (MIFARE 4K)
// Block 0x80 to Block 0x8E (15 blocks)
APDU = {FF B0 00 80 F0}

2.4 Update Binary Blocks

The “Update Binary Blocks command” is used for writing a multiple of “data blocks” into the PICC. The data block/trailer block must be authenticated first before executing the “Update Binary Blocks command”.

Table 2.3-1a: Update Binary APDU Format (Multiple of 16 + 5 Bytes)

Command	Class	INS	P1	P2	Lc	Data In
Update Binary Blocks	FF	D6	00	Block Number	Number of Bytes to Update	Block Data (Multiple of 16 Bytes)

Block Number (1 Byte):
The starting block to be updated.

Number of Bytes to Update (1 Byte):

- Multiply of 16 bytes for MIFARE 1K/4K or 4 bytes for MIFARE Ultralight.
- Maximum 48 bytes for MIFARE 1K. (Multiple Blocks Mode; 3 consecutive blocks)
- Maximum 240 bytes for MIFARE 4K. (Multiple Blocks Mode; 15 consecutive blocks)

Example 1: 0x10 (16 bytes). The starting block only. (Single Block Mode)
Example 2: 0x30 (48 bytes). From the starting block to starting block+2. (Multiple Blocks Mode)

#For safety reason, the Multiple Block Mode is used for accessing Data Blocks only. The Trailer Block is not supposed to be accessed in Multiple Blocks Mode. Please use Single Block Mode to access the Trailer Block.

Block Data (Multiply of 16 + 2 Bytes, or 6 bytes):
The data to be written into the binary block/blocks.

Table 2.3-1b: Update Binary Block Response Codes (2 Bytes)

Results	SW1	SW2	Meaning
Success	90	00	The operation is completed successfully.
Error	63	00	The operation is failed.

Examples:

// Update the binary block 0x04 of MIFARE 1K/4K with Data {00 01 .. 0F}
APDU = {FF D6 00 04 10 00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F}

// Update the binary block 0x04 of MIFARE Ultralight with Data {00 01 02 03}
APDU = {FF D6 00 04 04 00 01 02 03}

2.5 Value Block Related Commands

The data block can be used as value block for implementing value-based applications.

2.5.1 Value Block Operation

The "Value Block Operation command" is used for manipulating value-based transactions. E.g. Increment a value of the value block etc.

Table 2.5.1-1a: Value Block Operation APDU Format (10 Bytes)

Command	Class	INS	P1	P2	Lc	Data In	
Value Block Operation	FF	D7	00	Block Number	05	VB_OP	VB_Value (4 Bytes) {MSB .. LSB}

Block Number (1 Byte):
The value block to be manipulated.

VB_OP (1 Byte):
0x00 = Store the VB_Value into the block. The block will then be converted to a value block.
0x01 = Increment the value of the value block by the VB_Value. This command is only valid for value block.
0x02 = Decrement the value of the value block by the VB_Value. This command is only valid for value block.

VB_Value (4 Bytes):
The value used for value manipulation. The value is a signed long integer (4 bytes).

E.g. 1: Decimal –4 = {0xFF, 0xFF, 0xFF, 0xFC}

VB_Value			
MSB			LSB
FF	FF	FF	FC

E.g. 2: Decimal 1 = {0x00, 0x00, 0x00, 0x01}

VB_Value			
MSB			LSB
00	00	00	01

Table 2.5.1-1b: Value Block Operation Response Format (2 Bytes)

Response	Data Out	
Result	SW1	SW2

Table 2.5.1-1c: Value Block Operation Response Codes

Results	SW1	SW2	Meaning
Success	90	00	The operation is completed successfully.
Error	63	00	The operation is failed.

2.5.2 Read Value Block

The “Read Value Block command” is used for retrieving the value from the value block. This command is only valid for value block.

Table 2.5.2-1a: Read Value Block APDU Format (5 Bytes)

Command	Class	INS	P1	P2	Le
Read Value Block	FF	B1	00	Block Number	00

Block Number (1 Byte):
The value block to be accessed.

Table 2.5.2-1b: Read Value Block Response Format (4 + 2 Bytes)

Response	Data Out		
Result	Value {MSB .. LSB}	SW1	SW2

Value (4 Bytes):
The value returned from the card. The value is a signed long integer (4 bytes).

E.g. 1: Decimal –4 = {0xFF, 0xFF, 0xFF, 0xFC}

Value			
MSB			LSB
FF	FF	FF	FC

E.g. 2: Decimal 1 = {0x00, 0x00, 0x00, 0x01}

Value			
MSB			LSB
00	00	00	01

Table 2.5.3-1c: Read Value Block Response Codes

Results	SW1	SW2	Meaning
Success	90	00	The operation is completed successfully.
Error	63	00	The operation is failed.

2.5.3 Restore Value Block

The “Restore Value Block command” is used to copy a value from a value block to another value block.

Table 2.5.3-1a: Restore Value Block APDU Format (7 Bytes)

Command	Class	INS	P1	P2	Lc	Data In	
Value Block Operation	FF	D7	00	Source Block Number	02	03	Target Block Number

Source Block Number (1 Byte): The value of the source value block will be copied to the target value block.

Target Block Number (1 Byte): The value block to be restored. The source and target value blocks must be in the same sector.

Table 2.5.3-1b: Restore Value Block Response Format (2 Bytes)

Response	Data Out	
Result	SW1	SW2

Table 2.5.3-1c: Restore Value Block Response Codes

Results	SW1	SW2	Meaning
Success	90	00	The operation is completed successfully.
Error	63	00	The operation is failed.

Examples:

// Store a value "1" into block 0x05
APDU = {FF D7 00 05 05 00 00 00 00 01}

// Read the value block 0x05
APDU = {FF B1 00 05 00}

// Copy the value from value block 0x05 to value block 0x06
APDU = {FF D7 00 05 02 03 06}

// Increment the value block 0x05 by "5"
APDU = {FF D7 00 05 05 01 00 00 00 05}

BASIC PROGRAM FLOW FOR CONTACTLESS APPLICATIONS

Step 0. Start the application. The reader will do the PICC Polling and scan for tags continuously. Once the tag is found and detected, the corresponding ATR will be sent to the PC.

Step 1. Connect the "ACR1222U PICC Interface" with T=1 protocol.

Step 2. Access the PICC by exchanging APDUs.

Step 2. Access the PICC by exchanging APDUs.

..

Step N. Disconnect the "ACR1222U PICC Interface". Shut down the application.

Remarks:

1) The antenna can be switched off in order to save the power.

- Turn off the antenna power: FF 00 00 00 04 D4 32 01 00
- Turn on the antenna power: FF 00 00 00 04 D4 32 01 01

1. How to access PCSC Compliant Tags (ISO14443-4)?

Basically, all ISO 14443-4 complaint cards (PICCs) would understand the ISO 7816-4 APDUs. The ACR1222U Reader just has to communicate with the ISO 14443-4 complaint cards through exchanging ISO 7816-4 APDUs and Responses. ACR1222U will handle the ISO 14443 Parts 1-4 Protocols internally.

MIFARE 1K, 4K, MINI and Ultralight tags are supported through the T=CL emulation. Just simply treat the MIFARE tags as standard ISO14443-4 tags. For more information, please refer to topic "PICC Commands for MIFARE Classic Memory Tags"

Table 3.1-1a: ISO 7816-4 APDU Format

Command	Class	INS	P1	P2	Lc	Data In	Le
ISO 7816 Part 4 Command					Length of the Data In		Expected length of the Response Data

Table 3.1-1b: ISO 7816-4 Response Format (Data + 2 Bytes)

Response	Data Out		
Result	Response Data	SW1	SW2

Table 3.1-1c: Common ISO 7816-4 Response Codes

Results	SW1	SW2	Meaning
Success	90	00	The operation is completed successfully.
Error	63	00	The operation is failed.

Typical sequence may be:

- Present the Tag and Connect the PICC Interface
- Read / Update the memory of the tag

Step 1) **Connect the Tag**

The ATR of the tag is 3B 8C 80 01 50 00 05 70 3B 00 00 00 00 33 81 81 20

In which,

The ATQB = 50 00 05 70 3B 00 00 00 00 33 81 81. It is an ISO14443-4 Type B tag.

Step 2) **Send an APDU, Get Challenge.**

```
<< 00 84 00 00 08
>> 1A F7 F3 1B CD 2B A9 58 [90 00]
```

Hint:
For ISO14443-4 Type A tags, the ATS can be obtained by using the APDU “FF CA 01 00 00”

For Example: ISO7816-4 APDU
// To read 8 bytes from an ISO 14443-4 Type B PICC (ST19XR08E)
APDU ={80 B2 80 00 08}

Class = 0x80
INS = 0xB2
P1 = 0x80
P2 = 0x00
Lc = None
Data In = None
Le = 0x08

Answer: 00 01 02 03 04 05 06 07 [$9000]

2. How to access DESFIRE Tags (ISO14443-4)?

The DESFIRE supports ISO7816-4 APDU Wrapping and Native modes. Once the DESFire Tag is activated, the first APDU sent to the DESFire Tag will determine the “Command Mode”. If the first APDU is “Native Mode”, the rest of the APDUs must be in “Native Mode” format. Similarly, If the first APDU is “ISO7816-4 APDU Wrapping Mode”, the rest of the APDUs must be in “ISO7816-4 APDU Wrapping Mode” format.

Example 1: DESFIRE ISO7816-4 APDU Wrapping.
// To read 8 bytes random number from an ISO 14443-4 Type A PICC (DESFIRE)
APDU = {90 0A 00 00 01 00 00}

Class = 0x90; INS = 0x0A (DESFire Instruction); P1 = 0x00; P2 = 0x00
Lc = 0x01; Data In = 0x00; Le = 0x00 (Le = 0x00 for maximum length)

Answer: 7B 18 92 9D 9A 25 05 21 [$91AF]

# Status Code{91 AF} is defined in DESFIRE specification. Please refer to the DESFIRE specification for more details.

Example 2: DESFIRE Frame Level Chaining (ISO 7816 wrapping mode)
// In this example, the application has to do the “Frame Level Chaining”.
// To get the version of the DESFIRE card.

Step 1: Send an APDU {90 60 00 00 00} to get the first frame. INS=0x60
Answer: 04 01 01 00 02 18 05 91 AF [$91AF]

Step 2: Send an APDU {90 AF 00 00 00} to get the second frame. INS=0xAF
Answer: 04 01 01 00 06 18 05 91 AF [$91AF]

Step 3: Send an APDU {90 AF 00 00 00} to get the last frame. INS=0xAF
Answer: 04 52 5A 19 B2 1B 80 8E 36 54 4D 40 26 04 91 00 [$9100]

Example 3: DESFIRE Native Command.
// We can send Native DESFire Commands to the reader without ISO7816 wrapping if we find that the Native DESFire Commands are more easier to handle.

// To read 8 bytes random number from an ISO 14443-4 Type A PICC (DESFIRE)
APDU = {0A 00}

Answer: AF 25 9C 65 0C 87 65 1D D7[$1DD7]

In which, the first byte "AF" is the status code returned by the DESFire Card.
The Data inside the blanket [$1DD7] can simply be ignored by the application.

Example 4: DESFIRE Frame Level Chaining (Native Mode)
// In this example, the application has to do the "Frame Level Chaining".
// To get the version of the DESFIRE card.

Step 1: Send an APDU {60} to get the first frame. INS=0x60
Answer: AF 04 01 01 00 02 18 05[$1805]

Step 2: Send an APDU {AF} to get the second frame. INS=0xAF
Answer: AF 04 01 01 00 06 18 05[$1805]

Step 3: Send an APDU {AF} to get the last frame. INS=0xAF
Answer: 00 04 52 5A 19 B2 1B 80 8E 36 54 4D 40 26 04[$2604]

Hints:
In DESFIRE Native Mode, the status code [90 00] will not be added to the response if the response length is greater than 1. If the response length is less than 2, the status code [90 00] will be added in order to meet the requirement of PCSC. The minimum response length is 2.

3. How to access FeliCa Tags (ISO18092)?

Typical sequence may be:

- Present the FeliCa Tag and Connect the PICC Interface
- Read / Update the memory of the tag

```
Step 1) Connect the Tag

The ATR = 3B 8F 80 01 80 4F 0C A0 00 00 03 06 03 F0 11 00 00 00 00 8A

In which,
F0 11 = FeliCa 212K


Step 2) Read the memory block without using Pseudo APDU.
<< 10 06 [8-byte NFC ID] 01 09 01 01 80 00
>> 1D 07 [8-byte NFC ID] 00 00 01 00 AA 55 AA 55 AA 55 AA 55 AA 55 AA 55 AA 55
   AA [90 00]
```

Or

```
Step 2) Read the memory block using Pseudo APDU.
<< FF 00 00 00 [13] D4 40 01 10 06 [8-byte NFC ID] 01 09 01 01 80 00
```

In which,

[13] is the length of the Pseudo Data “D4 40 01.. 80 00”

```
D4 40 01 is the Data Exchange Command

>> D5 41 00 1D 07 [8-byte NFC ID] 00 00 01 00 AA 55 AA 55 AA 55 AA 55 AA 55 AA
   55 AA 55 AA [90 00]
```

In which, `D5 41 00 is the Data Exchange Response`

Hint:
The NFC ID can be obtained by using the APDU “FF CA 00 00 00”

#please refer to the FeliCa specification for more detailed information.

4. How to access NFC Forum Type 1 Tags (ISO18092)? E.g. Jewel and Topaz Tags

Typical sequence may be:

- Present the Topaz Tag and Connect the PICC Interface
- Read / Update the memory of the tag

```
Step 1) Connect the Tag

The ATR = 3B 8F 80 01 80 4F 0C A0 00 00 03 06 03 F0 04 00 00 00 00 9F

In which,
F0 04 = Topaz

Step 2) Read the memory address 08 (Block 1: Byte-0) without using Pseudo APDU
<< 01 08
>> 18 [90 00]
In which, Response Data = 18
```

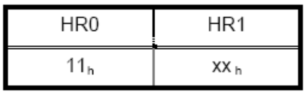
Or

```
Step 2) Read the memory address 08 (Block 1: Byte-0) using Pseudo APDU
<< FF 00 00 00 [05] D4 40 01 01 08
In which,
[05] is the length of the Pseudo APDU Data “D4 40 01 01 08”
D4 40 01 is the DataExchange Command.
01 08 is the data to be sent to the tag.

>> D5 41 00 18 [90 00]
In which, Response Data = 18

Tip: To read all the memory content of the tag
<< 00
>> 11 48 18 26 .. 00 [90 00]

Step 3) Update the memory address 08(Block 1: Byte-0)with the data FF
<< 53 08 FF
>> FF [90 00]
In which, Response Data = FF
```

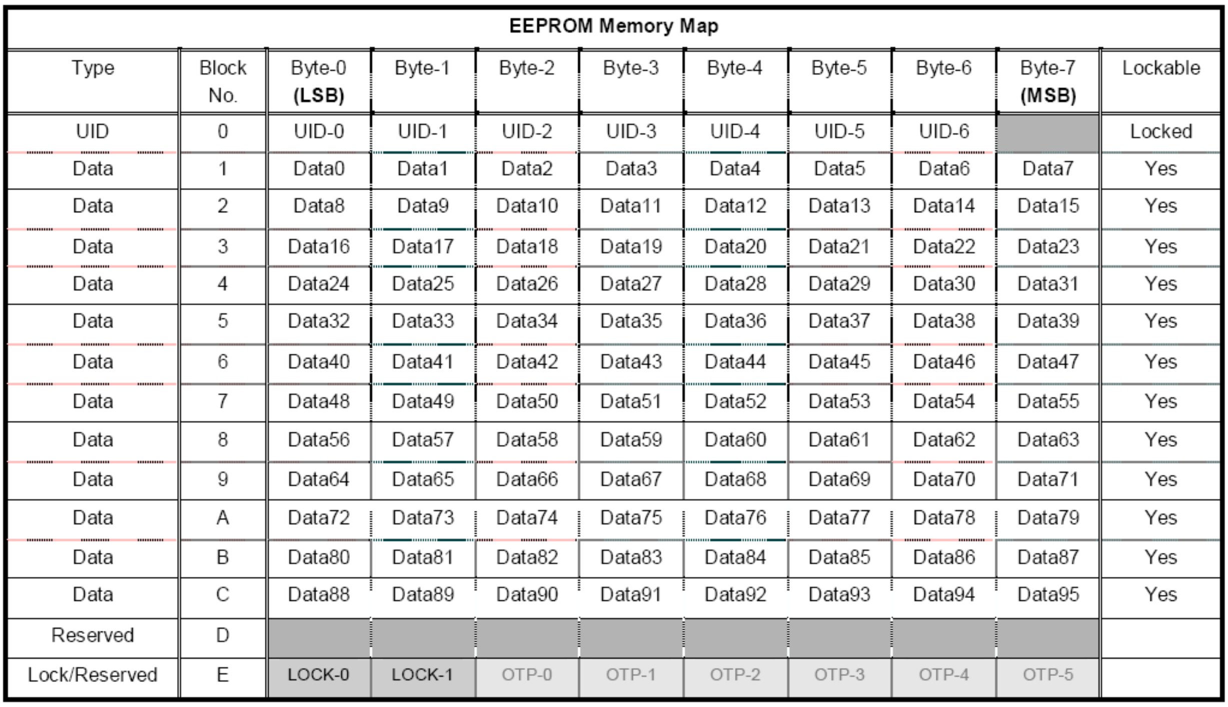
Topaz Memory Map.

Memory Address = Block No * 8 + Byte No

e.g. Memory Address 08 (hex) = 1 x 8 + 0 = Block 1: Byte-0 = Data0
e.g. Memory Address 10 (hex) = 2 x 8 + 0 = Block 2: Byte-0 = Data8



HR0	HR1
11ₕ	xx ₕ



EEPROM Memory Map										
Type	Block No.	Byte-0 **(LSB)**	Byte-1	Byte-2	Byte-3	Byte-4	Byte-5	Byte-6	Byte-7 **(MSB)**	Lockable
UID	0	UID-0	UID-1	UID-2	UID-3	UID-4	UID-5	UID-6	▨	Locked
Data	1	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Yes
Data	2	Data8	Data9	Data10	Data11	Data12	Data13	Data14	Data15	Yes
Data	3	Data16	Data17	Data18	Data19	Data20	Data21	Data22	Data23	Yes
Data	4	Data24	Data25	Data26	Data27	Data28	Data29	Data30	Data31	Yes
Data	5	Data32	Data33	Data34	Data35	Data36	Data37	Data38	Data39	Yes
Data	6	Data40	Data41	Data42	Data43	Data44	Data45	Data46	Data47	Yes
Data	7	Data48	Data49	Data50	Data51	Data52	Data53	Data54	Data55	Yes
Data	8	Data56	Data57	Data58	Data59	Data60	Data61	Data62	Data63	Yes
Data	9	Data64	Data65	Data66	Data67	Data68	Data69	Data70	Data71	Yes
Data	A	Data72	Data73	Data74	Data75	Data76	Data77	Data78	Data79	Yes
Data	B	Data80	Data81	Data82	Data83	Data84	Data85	Data86	Data87	Yes
Data	C	Data88	Data89	Data90	Data91	Data92	Data93	Data94	Data95	Yes
Reserved	D	▨	▨	▨	▨	▨	▨	▨	▨	
Lock/Reserved	E	LOCK-0	LOCK-1	OTP-0	OTP-1	OTP-2	OTP-3	OTP-4	OTP-5	

▨	Reserved for internal use
▨	User Block Lock & Status
▨	OTP bits

#please refer to the Jewel and Topaz specification for more detailed information.

FCC Warning:

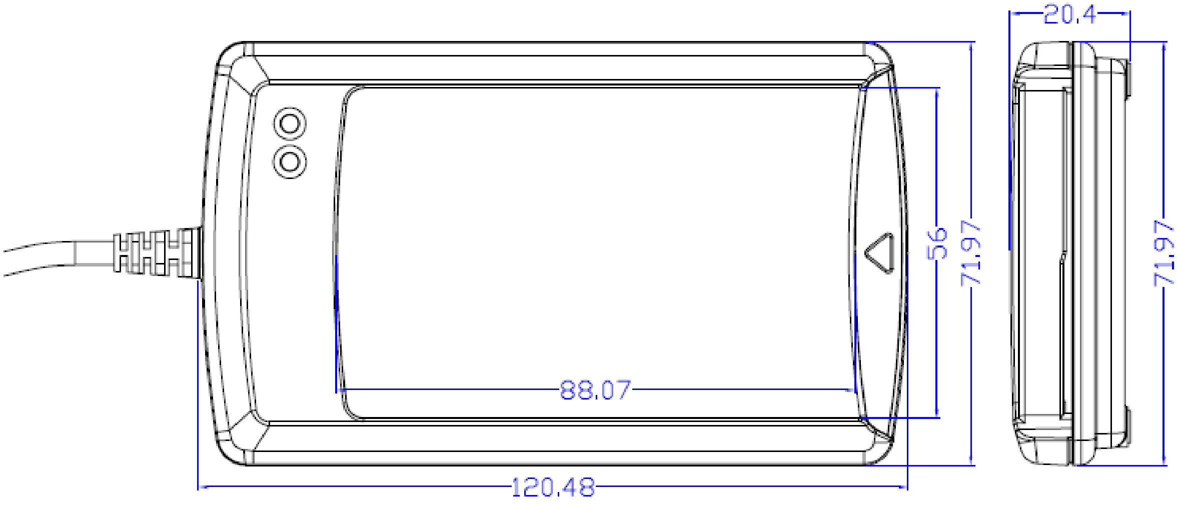
Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) this device must accept any interference received, including interference that may cause undesired operation.

TECHNICAL SPECIFICATION



Universal Serial Bus Interface

Power source	From USB
Speed	12 Mbps (Full Speed)
Supply Voltage	Regulated 5V DC
Supply Current	200mA (max); 100mA (normal)

Contactless Smart Card Interface

Standard	ISO 14443 A & B Parts 1-4
Protocol	ISO14443 T=CL for ISO14443-4 compliant cards and T=CL Emulation for MIFARE 1K/4K, FeliCa, ISO18092.
Smart card read / write speed	106 kbps for ISO14443 Type A & Type B, 212 kbps and 424 kbps for FeliCa,

Contact Smart Card Interface

Standard	ISO 7816 1/2/3, Class A, B (5V, 3V), T=0 and T=1
Supply current	max. 60mA
Smart card read / write speed	9,600 – 115,200 bps
Short circuit protection	+5V / GND on all pins
CLK frequency	3.58 MHz
Card connector	Landing
Card insertion cycles	min. 300,000

SAM Card Interface

Standard SAM Socket

Case

Dimensions	120.48 mm (L) x 71.97 mm (W) x 20.4 mm (H)
Material	ABS
Color	Metallic Silver Grey ■

Antenna

Antenna Size	65mm x 60mm
Operating distance	up to 50 mm

Operating Frequency for Contactless Cards Access

Operating Frequency	13.56 MHz

Built-in peripherals

Monotone buzzer
Dual-Color LED

Operating Conditions

Temperature	0 - 50° C
Humidity	10% - 80%

Cable Connector

Length	1m (USB)

Standard/Certifications

CE, FCC

OS

Windows 98, ME, 2K, XP

OEM

OEM-Logo possible, customer-specific colors, casing, and card connector