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Card & Reader Technologies

ACR1251T USB Token NFC Reader II

Reference Manual V1.01

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Revision History

Release Date	Revision Description	Version Number
2018-06-04	• Initial Release	1.00
2020-01-10	• Updated MIFARE Trademarks • Updated Section 2.0 Features • Updated Section 5.1 PCSC API • Updated Section 5.3.6 Set Automatic PICC Polling • Updated Section 5.3.7 Read Automatic PICC Polling • Updated Section 5.3.10 Set Auto PPS • Updated Section 5.3.11 Read Auto PPS • Re-organized Section 5.2	1.01

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1.0. Introduction

The ACR1251T is the token version of the ACR1251U PC-linked NFC smart card reader developed based on the 13.56 MHz contactless technology. Following ACR122T, the token version of the ACR122U, the world's first CCID-compliant contactless reader, the ACR1251T offers more and advanced features. It is designed to support not only ISO 14443 Type A and B cards, but also MIFARE®, FeliCa and all four types of NFC tags and devices.

The ACR1251T acts as the intermediary device between the computer and the card. The reader, which specifically communicates with the contactless tag or the device peripheral (LED), will carry out commands issued from the computer. It has a PICC reader interface that follows the PC/SC specifications. This reference manual will discuss in detail how the PC/SC APDU commands were implemented for the contactless interface and device peripheral of the ACR1251T.

2.0. Features

- USB Full Speed Interface
- CCID-compliant
- Smart Card Reader:
  - Contactless Interface:
    - Read/Write speed of up to 424 Kbps
    - Built-in antenna for contactless tag access, with card reading distance of up to 30 mm (depending on tag type)
    - Supports ISO 14443 Part 4 Type A and B cards, MIFARE Classic®, FeliCa, and all four types of NFC (ISO/IEC 18092 tags)
    - Built-in anti-collision feature (only one tag is accessed at any time)
    - NFC Support:
      - Card Reader/Writer mode
- Built-in Peripherals:
  - User-controllable Bi-color LED
- Application Programming Interface:
  - Supports PC/SC
  - Supports CT-API (through wrapper on top of PC/SC)
- USB Firmware Upgradeability
- Supports Android™ 3.1 and later[1]
- Compliant with the following standards:
  - EN 60950/IEC 60950
  - ISO 14443
  - ISO 18092
  - PC/SC
  - CCID
  - CE
  - FCC
  - RoHS
  - REACH
  - VCCI (Japan)
  - MIC (Japan)
  - Microsoft® WHQL

[1] *Uses an ACS-defined Android Library*

3.0. Acronyms and Abbreviations

Acronym/Abbreviation	Description
ATR	Attribute Request and Attribute Response
DEP	Data Exchange Protocol Request and Data Exchange Protocol Response
DSL	Deselect Request and Deselect Response
PSL	Parameter Selection Request and Parameter Selection Response
RLS	Release Request and Release Response
WUP	Wakeup Request and Wakeup Response
DID	Device ID
BS	Sending bit duration
BR	Receiving bit duration
PP	Protocol Parameters
Gi	Optional information field for Initiator
PFB	Control information for transaction
FSL	maximum value for the Frame Length
LLCP	Logical Link Control Protocol

Table 1: Acronyms and Abbreviations

4.0. Architecture

For communication architecture, the protocol used between the ACR1251T reader and the computer is CCID. All communications between PICC are PCSC-compliant.

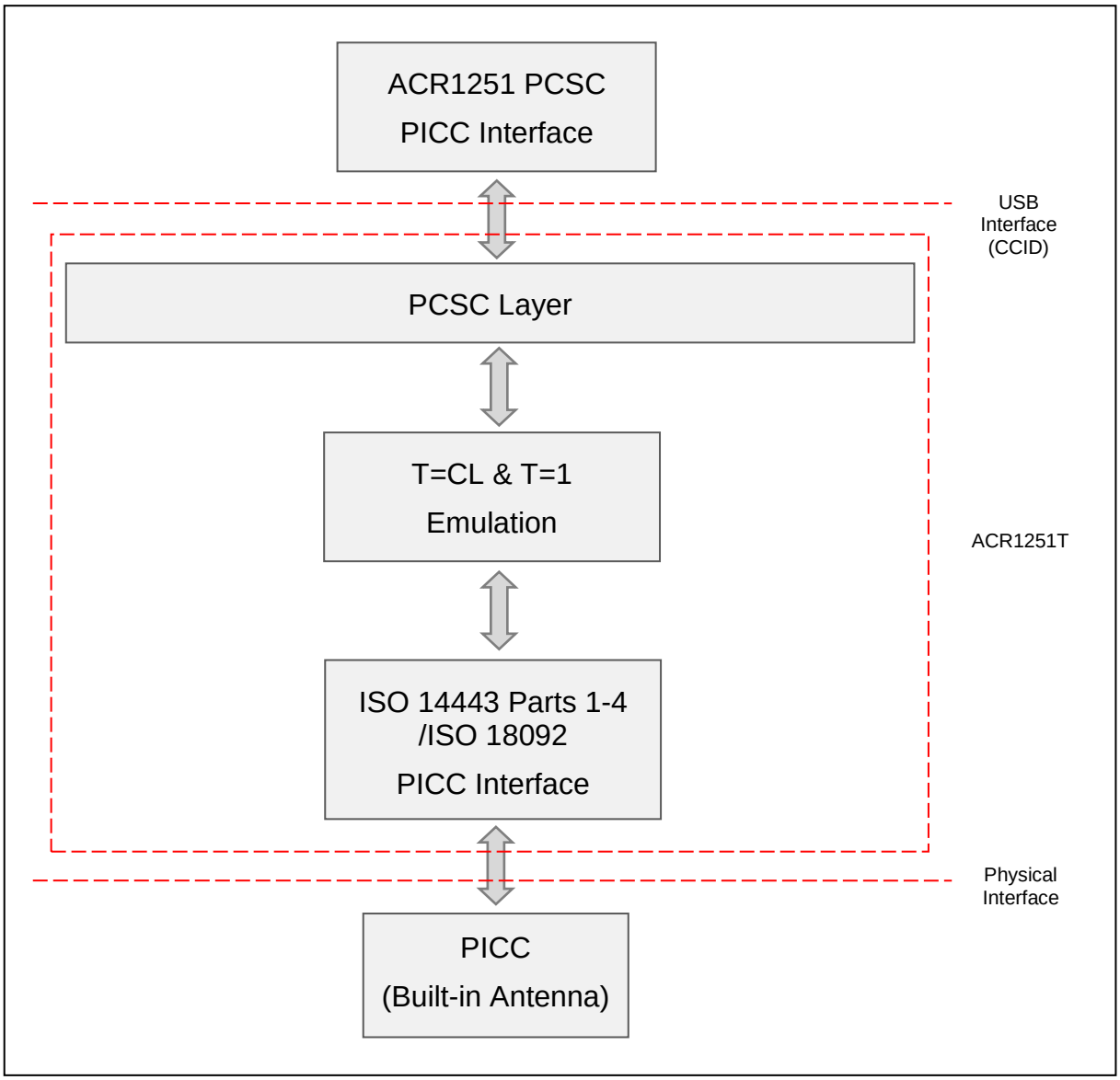


Figure 1: ACR1251T Architecture

5.0. Host Programming (PC-linked) API

5.1. PCSC API

This section will describe some of the PCSC API commands for application programming usage. For more details, please refer to Microsoft MSDN Library or PCSC workgroup.

5.1.1. SCardEstablishContext

The **SCardEstablishContext** function establishes the resource manager context within which database operations are performed.

Refer to: http://msdn.microsoft.com/en-us/library/windows/desktop/aa379479%28v=vs.85%29.aspx

This function should be performed first before any other PCSC operation.

Example:

```
#define SCARD_SCOPE_USER 0

SCARDCONTEXT hContext;
int retCode;
void main ()
{
   // To establish the resource manager context and assign it to “hContext”
   retCode = SCardEstablishContext(SCARD_SCOPE_USER,
                  NULL,
                  NULL,
                  &hContext);
   if (retCode != SCARD_S_SUCCESS)
   {
      // Establishing resource manager context failed
   }
   else
   {
      // Establishing resource manager context successful
      // Further PCSC operation can be performed
   }
}
```

5.1.2. SCardListReaders

The **SCardListReaders** function provides the list of readers within a set of named reader groups, eliminating duplicates.

The caller supplies a list of reader groups, and receives the list of readers within the named groups. Unrecognized group names are ignored. This function only returns readers within the named groups that are currently attached to the system and available for use.

Refer to: http://msdn.microsoft.com/en-us/library/windows/desktop/aa379793%28v=vs.85%29.aspx

Example:

```
#define SCARD_SCOPE_USER 0

SCARDCONTEXT hContext; // Resource manager context
int retCode;
char readerName [256]; // List reader name

void main ()
{
   // To establish the resource manager context and assign to “hContext”
   retCode = SCardEstablishContext(SCARD_SCOPE_USER,
                  NULL,
                  NULL,
                  &hContext);
   if (retCode != SCARD_S_SUCCESS)
   {
      // Establishing resource manager context failed
   }
   else
   {
      // Establishing resource manager context successful
      // List the available reader which can be used in the system
      retCode = SCardListReaders (hContext,
                  NULL,
                  readerName,
                  &size);
      if (retCode != SCARD_S_SUCCESS)
      {
         // Listing reader fail
      }
      if (readerName == NULL)
      {
         // No reader available
      }
      else
      {
         // Reader listed
      }
   }
}
```

5.1.3. SCardConnect

The **SCardConnect** function establishes a connection (using a specific resource manager context) between the calling application and a smart card contained by a specific reader. If no card exists in the specified reader, an error is returned.

Refer to: http://msdn.microsoft.com/en-us/library/windows/desktop/aa379473%28v=vs.85%29.aspx

Example:

```
#define SCARD_SCOPE_USER 0

SCARDCONTEXT      hContext;         // Resource manager context
SCARDHANDLE       hCard;            // Card context handle
unsigned long     dwActProtocol;    // Establish active protocol
int               retCode;
char              readerName [256]; // List reader name
char              rName [256];      // Reader name for connection

void main ()
{
   …
      if (readerName == NULL)
      {
         // No reader available
      }
      else
      {
         // Reader listed
      rName = "ACS ACR1251 CL Reader PICC 0";    // Depends on what
                                                 reader be used
                                                 // Should connect to
                                                 PICC interface

         retCode = SCardConnect(hContext,
               rName,
               SCARD_SHARE_SHARED,
               SCARD_PROTOCOL_T0,
               &hCard,
               &dwActProtocol);
         if (retCode != SCARD_S_SUCCESS)
         {
            // Connection failed (May be because of incorrect reader
         name, or no card was detected)
         }
         else
         {
            // Connection successful
         }
      }
   }
```

5.1.4. SCardControl

The **SCardControl** function gives you direct control of the reader. You can call it any time after a successful call to **SCardConnect** and before a successful call to **SCardDisconnect**. The effect on the state of the reader depends on the control code.

Refer to: http://msdn.microsoft.com/en-us/library/windows/desktop/aa379474%28v=vs.85%29.aspx

Note: *Commands from* ***Peripherals Control*** *use this API for sending.*

Example:

```
#define SCARD_SCOPE_USER    0

#define EscapeCommand 0x310000 + 3500*4
   SCARDCONTEXT          hContext;          // Resource manager context
   SCARDHANDLE           hCard;             // Card context handle
   unsigned long         dwActProtocol;     // Established active protocol
   int                   retCode;
   char                  readerName [256]; // Lists reader name
   char                  rName [256];       // Reader name for connection
   BYTE                  SendBuff[262],     // APDU command buffer
                         RecvBuff[262];     // APDU response buffer
   BYTE                  FWVersion [20],    // For storing firmware
                                               version message
   BYTE                  ResponseData[50]; // For storing card response
   DWORD                 SendLen,           // APDU command length
                         RecvLen;           // APDU response length
void main ()
   {
      …
      rName = "ACS ACR1251 CL Reader PICC 0";       // Depends on what
                                                    reader will be used
                                                    // Should connect to
                                                    PICC interface

         retCode = SCardConnect(hContext,
            rName,
            SCARD_SHARE_DIRECT,
            SCARD_PROTOCOL_T0| SCARD_PROTOCOL_T1,
            &hCard,
            &dwActProtocol);
         if (retCode != SCARD_S_SUCCESS)
         {
            // Connection failed (may be because of incorrect reader
         name, or no card was detected)
         }
         else
         {
            // Connection successful
            RecvLen = 262;
            // Get firmware version
            SendBuff[0] = 0xE0;
            SendBuff[1] = 0x00;
            SendBuff[2] = 0x00;
            SendBuff[3] = 0x18;
            SendBuff[4] = 0x00;
```

```
            SendLen = 5;
            retCode = SCardControl ( hCard,
                     EscapeCommand,
                     SendBuff,
                     SendLen,
                     RecvBuff,
                     RecvLen,
                     &RecvLen);
            if (retCode != SCARD_S_SUCCESS)
            {
               // APDU sending failed
               return;
            }
            else
            {
               // APDU sending successful
               // The RecvBuff stores the firmware version message.
               for (int i=0;i< RecvLen-5;i++)
               {
                  FWVersion[i] = RecvBuff [5+i];
               }
            }
            // Connection successful
            RecvLen = 262;

            // Turn Green LED on, turn Red LED off
            SendBuff[0] = 0xE0;
            SendBuff[1] = 0x00;
            SendBuff[2] = 0x00;
            SendBuff[3] = 0x29;
            SendBuff[4] = 0x01;
            SendBuff[5] = 0x02;  // Green LED On, Red LED off
            SendLen = 6;
            retCode = SCardControl ( hCard,
                     EscapeCommand,
                     SendBuff,
                     SendLen,
                     RecvBuff,
                     RecvLen,
                     &RecvLen);
            if (retCode != SCARD_S_SUCCESS)
            {
               // APDU sending failed
               return;
            }
            else
            {
               // APDU sending success
            }
```

5.1.5. SCardTransmit

The **SCardTransmit** function sends a service request to the smart card and expects to receive data back from the card.

Refer: http://msdn.microsoft.com/en-us/library/windows/desktop/aa379804%28v=vs.85%29.aspx

Note: *APDU Commands (i.e. the command sent to connected card,* ***PICC Commands for MIFARE Classic (1K/4K) memory cards****, and* ***Pseudo APDU for Contactless Interface****) use this API for sending.*

Example:

```
#define SCARD_SCOPE_USER      0

SCARDCONTEXT      hContext;          // Resource manager context
SCARDHANDLE       hCard;             // Card context handle
unsigned long     dwActProtocol;     // Established active protocol
int               retCode;
char              readerName [256]; // List reader name
char              rName [256];       // Reader name for connect
BYTE              SendBuff[262],     // APDU command buffer
                  RecvBuff[262];     // APDU response buffer
BYTE              CardID [8],        // For storing the FeliCa IDM/
                                     MIFARE UID
BYTE              ResponseData[50]; // For storing card response
DWORD             SendLen,           // APDU command length
                  RecvLen;           // APDU response length
SCARD_IO_REQUEST  ioRequest;

void main ()
{
   …
   rName = "ACS ACR1251 CL Reader PICC 0";    // Depends on what reader
                                              should be used
                                              // Should connect to PICC
                                              interface
      retCode = SCardConnect(hContext,
                     rName,
                     SCARD_SHARE_SHARED,
                     SCARD_PROTOCOL_T0,
                     &hCard,
                     &dwActProtocol);
      if (retCode != SCARD_S_SUCCESS)
      {
         // Connection failed (May be because of incorrect reader
         name, or no card was detected)
      }
      else
      {
         // Connection successful
         ioRequest.dwProtocol = dwActProtocol;
         ioRequest.cbPciLength = sizeof(SCARD_IO_REQUEST);
         RecvLen = 262;
```

```
        // Get MIFARE UID/ FeliCa IDM
        SendBuff[0] = 0xFF;
        SendBuff[1] = 0xCA;
        SendBuff[2] = 0x00;
        SendBuff[3] = 0x00;
        SendBuff[4] = 0x00;
        SendLen = 5;
        retCode = SCardTransmit( hCard,
                            &ioRequest,
                            SendBuff,
                            SendLen,
                            NULL,
                            RecvBuff,
                            &RecvLen);

        if (retCode != SCARD_S_SUCCESS)
        {
           // APDU sending failed
           return;
        }
        else
        {
           // APDU sending successful
           // The RecvBuff stores the IDM for FeliCa / the UID for
           MIFARE.
           // Copy the content for further FeliCa access
           for (int i=0;i< RecvLen-2;i++)
           {
              CardID [i] = RecvBuff[i];
           }
        }
```

5.1.6. SCardDisconnect

The **SCardDisconnect** function terminates a connection previously opened between the calling application and a smart card in the target reader.

Refer to: http://msdn.microsoft.com/en-us/library/windows/desktop/aa379475%28v=vs.85%29.aspx

This function is for ending the PCSC Operation.

Example:

```
#define SCARD_SCOPE_USER 0

SCARDCONTEXT      hContext;         // Resource manager context
SCARDHANDLE       hCard;            // Card context handle
unsigned long     dwActProtocol;    // Established active protocol
int               retCode;

void main ()
{
   …
         // Connection successful
      …
      retCode = SCardDisconnect(hCard,SCARD_RESET_CARD);
      if (retCode != SCARD_S_SUCCESS)
      {
         // Disconnection failed
      }
      else
      {
         // Disconnection successful
      }
   }
}
```

5.1.7. APDU Flow

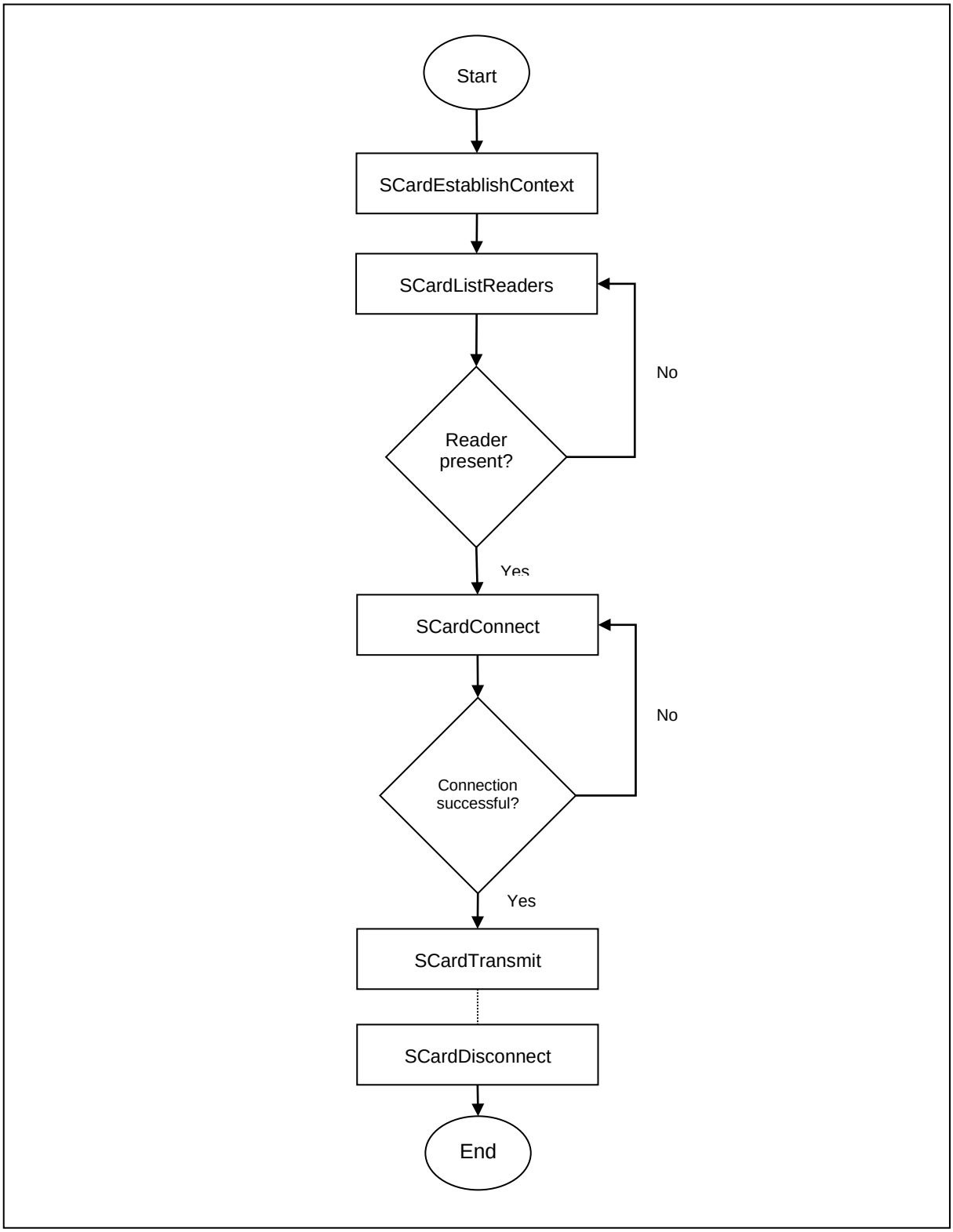


Figure 2: ACR1251T APDU Flow

5.1.8. Escape Command Flow

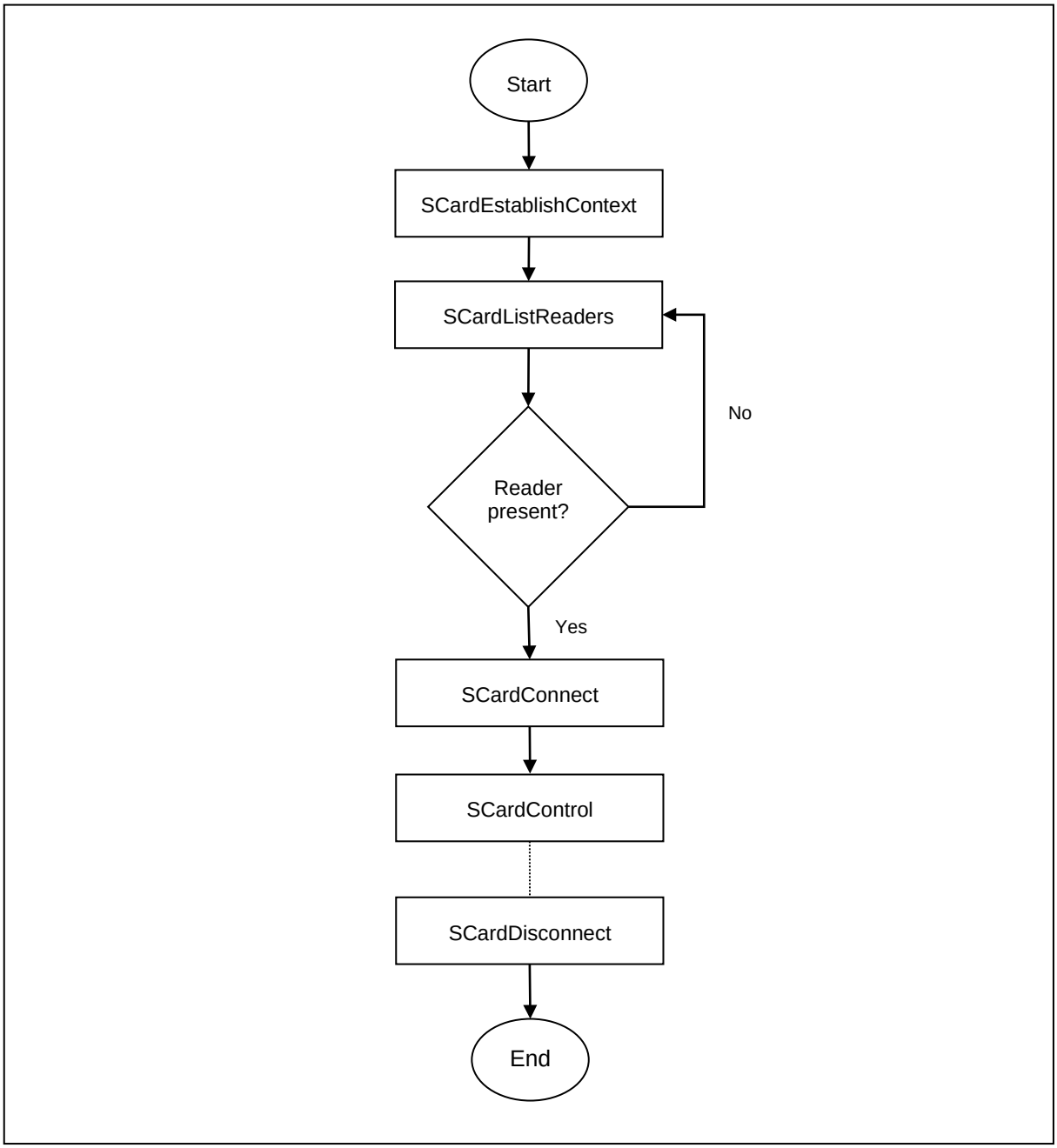


Figure 3: ACR1251T Escape Command Flow

5.2. Contactless Smart Card Protocol

5.2.1. ATR Generation

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

5.2.1.1. ATR Format for ISO 14443 Part 3 PICCs

Byte	Value	Designation	Description
0	3Bh	Initial Header	
1	8Nh	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	80h	TD1	Higher nibble 8 means: no TA2, TB2, TC2 only TD2 is following. Lower nibble 0 means T = 0
3	01h	TD2	Higher nibble 0 means no TA3, TB3, TC3, TD3 following. Lower nibble 1 means T = 1
4 To 3+N	80h	T1	Category indicator byte, 80 means A status indicator may be present in an optional COMPACT-TLV data object.
	4Fh	Tk	Application identifier Presence Indicator.
	0Ch		Length
	RID		Registered Application Provider Identifier (RID) # A0 00 00 03 06
	SS		Byte for standard.
	C0 .. C1h		Bytes for card name.
	00 00 00 00h	RFU	RFU # 00 00 00 00
4+N	UU	TCK	Exclusive-oring of all the bytes T0 to Tk

Example:

ATR for MIFARE Classic 1K = {3B 8F 80 01 80 4F 0C A0 00 00 03 06 03 00 01 00 00 00 00 6Ah}

Where:

Length (YY) = 0Ch

RID = A0 00 00 03 06h (PC/SC Workgroup)

Standard (SS) = 03h (ISO 14443A, Part 3)

Card Name (C0 .. C1) = [00 01h] (MIFARE Classic 1K)

Standard (SS) = 03h: ISO 14443A, Part 3

= 11h: FeliCa

Card Name (C0 .. C1)	00 01: MIFARE Classic 1K	00 38: MIFARE Plus® SL2 2K
	00 02: MIFARE Classic 4K	00 39: MIFARE Plus® SL2 4K
	00 03: MIFARE Ultralight®	00 30: Topaz and Jewel
	00 26: MIFARE Mini®	00 3B: FeliCa
	00 3A: MIFARE Ultralight® C	FF 28: JCOP 30
	00 36: MIFARE Plus® SL1 2K	FF [SAK]: undefined tags
	00 37: MIFARE Plus® SL1 4K	

5.2.1.2. ATR Format for ISO 14443 Part 4 PICCs

<table>
<tr><th>Byte</th><th>Value</th><th>Designation</th><th>Description</th></tr>
<tr><td>0</td><td>3Bh</td><td>Initial Header</td><td></td></tr>
<tr><td>1</td><td>8N</td><td>T0</td><td>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)</td></tr>
<tr><td>2</td><td>80h</td><td>TD1</td><td>Higher nibble 8 means: no TA2, TB2, TC2 only TD2 is following.
Lower nibble 0 means T = 0</td></tr>
<tr><td>3</td><td>01h</td><td>TD2</td><td>Higher nibble 0 means no TA3, TB3, TC3, TD3 following.
Lower nibble 1 means T = 1</td></tr>
<tr><td rowspan="2">4
to
3 + N</td><td>XX</td><td>T1</td><td rowspan="2">Historical Bytes:

ISO 14443-A:
The historical bytes from ATS response. Refer to the ISO 14443-4 specification.

ISO 14443-B:<table><tr><th>Byte1-4</th><th>Byte5-7</th><th>Byte8</th></tr><tr><td>Application Data from ATQB</td><td>Protocol Info Byte from ATQB</td><td>Higher nibble=MBLI from ATTRIB command
Lower nibble (RFU)=0</td></tr></table></td></tr>
<tr><td>XX
XX
XX</td><td>Tk</td></tr>
<tr><td>4+N</td><td>UU</td><td>TCK</td><td>Exclusive-oring of all the bytes T0 to Tk</td></tr>
</table>

Example 1: ATR for MIFARE® DESFire® = {3B 81 80 01 80 80h} // 6 bytes of ATR

Note: *Use the APDU "FF CA 01 00 00h" to distinguish the ISO 14443A-4 and ISO 14443B-4 PICCs, and retrieve the full ATS if available. ISO 14443A-3 or ISO 14443B-3/4 PICCs do have ATS returned.*

APDU Command = FF CA 01 00 00h

APDU Response = 06 75 77 81 02 80 90 00h

ATS = {06 75 77 81 02 80h}

Example 2: ATR for EZ-link = {3B 88 80 01 1C 2D 94 11 F7 71 85 00 BEh}

Application Data of ATQB = 1C 2D 94 11h

Protocol Information of ATQB = F7 71 85h

MBLI of ATTRIB = 00h

5.2.2. Pseudo APDU for Contactless Interface

5.2.2.1. Get Data

This command returns the serial number or ATS of the “connected PICC”.

Get UID APDU Format (5 Bytes)

Command	Class	INS	P1	P2	Le
Get Data	FFh	CAh	00h 01h	00h	00h (Max Length)

If P1 = 00h, Get UID Response Format (UID + 2 Bytes)

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

If P1 = 01h, Get ATS of a ISO 14443 A card (ATS + 2 Bytes)

Response	Data Out		
Result	ATS	SW1	SW2

Response Codes

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

Examples:

To get the serial number of the “connected PICC”:

```
UINT8 GET_UID[5] = {FF, CA, 00, 00, 00};
```

To get the ATS of the “connected ISO 14443 A PICC”:

```
UINT8 GET_ATS[5] = {FF, CA, 01, 00, 00};
```

5.2.3. APDU commands for PCSC 2.0 Part 3 (version 2.02 or above)

PCSC 2.0 Part 3 commands are used to transparently pass data from an application to a contactless tag, return the received data transparently to the application and protocol, and switch the protocol simultaneously.

5.2.3.1. Command and Response APDU Format

Command Format

CLA	INS	P1	P2	Lc	Data In
FFh	C2h	00h	Function	DataLen	Data[DataLen]

Where:

Functions 1 byte.

00h = Manage Session

01h = Transparent Exchange

02h = Switch Protocol

Other = RFU

Response Format

Data Out	SW1	SW2
Data Field BER-TLV encoded		

Every command returns SW1 and SW2 together with the response data field (if available). The SW1 SW2 is based on ISO 7816. SW1 SW2 from the C0 data object below should also be used.

C0 data element Format

Tag	Length (1 byte)	SW2
C0h	03h	Error Status

Error Status Description

Error Status	Description
XX SW1 SW2	XX = number of the bad data object in the APDU 00 = general error of APDU 01 = error in the 1st data object 02 = error in the 2nd data object
00 90 00h	No error occurred
XX 62 82h	Data object XX warning, requested information not available
XX 63 00h	No information
XX 63 01h	Execution stopped due to failure in other data object
XX 6A 81h	Data object XX not supported
XX 67 00h	Data object XX with unexpected length

Error Status	Description
XX 6A 80h	Data object XX with unexpected vale
XX 64 00h	Data Object XX execution error (no response from IFD)
XX 64 01h	Data Object XX execution error (no response from ICC)
XX 6F 00h	Data object XX failed, no precise diagnosis

The first value byte indicates the number of the erroneous data object XX, while the last two bytes indicate the explanation of the error. SW1 SW2 values based on ISO 7816 are allowed.

If there are more than one data objects in the C-APDU field and one data object failed, IFD can process the following data objects if they do not depend on the failed data objects.

5.2.3.2. Manage Session Command

This command is used to manage the transparent session. This includes starting and ending a transparent session. Through this command, you can also manage the operation environment and the capabilities of the IFD within the transparent session.

Manage Session Command

Command	Class	INS	P1	P2	Lc	Data In
Manage Session	FFh	C2h	00h	00h	DataLen	DataObject (N bytes)

Where:

Data Object (1 byte)

Tag	Data Object
80h	Version Data Object
81h	Start Transparent Session
82h	End Transparent Session
83h	Turn Off RF Field
84h	Turn On RF Field
5F 46h	Timer
FF 6Dh	Get Parameter
FF 6Eh	Set Parameter

Manage Session Response Data Object

Tag	Data Object
C0h	Generic Error status
80h	Version data object
FF 6Dh	IFD parameter data object

5.2.3.2.1. Start Session Data Object

This command is used to start a transparent session. Once the session has started, auto-polling will be disabled until the session is ended.

Start Session Data Object

Tag	Length (1 byte)	Value
81h	00h	-

5.2.3.2.2. End Session Data Object

This command ends the transparent session. The auto-polling will be reset to the state before the session has started.

End Session Data Object

Tag	Length (1 byte)	Value
82h	00h	-

5.2.3.2.3. Version Data Object

This command returns the version number of the IFD handler.

Version Data Object

Tag	Length (1 byte)	Value		
80h	03h	Major	Minor	Build

5.2.3.2.4. Turn Off the RF Data Object

This command turns off the antenna field.

Turn off RF Field Data Object

Tag	Length (1 byte)	Value
83h	00h	-

5.2.3.2.5. Turn On the RF Data Object

This command turns on the antenna field.

Turn on the RF Field Data Object

Tag	Length (1 byte)	Value
84h	00h	-

5.2.3.2.6. Timer Data Object

This command creates a 32-bit timer data object in unit of 1 µs.

Example: If there is timer data object with 5000 µs between RF Turn Off Data Object and RF Turn On Data Object, the reader will turn off the RF field for about 5000µs before it is turned on.

Timer Data Object

Tag	Length (1 byte)	Value
5F 46h	04h	Timer (4 bytes)

5.2.3.2.7. Get Parameter Data Object

This command gets the different parameters from the IFD.

Get Parameter Data Object

Tag	Length (1 byte)	Value		
		Tag	Len	Value
FF 6Dh	Var	TLV_Objects		

TLV_Objects

Parameters Requested	Tag	Length
Frame size for IFD integer (FSDI)	01h	00h
Frame size for ICC integer (FSCI)	02h	00h
Frame waiting time integer (FWTI)	03h	00h
Max. Communication Speed supported by the IFD	04h	00h
Communication Speed of the ICC	05h	00h
Modulation Index	06h	00h
PCB for ISO/IEC14443	07h	00h
CID for ISO/IEC14443	08h	00h
NAD for ISO/IEC14443	09h	00h
Param 1 – 4 for for ISO/IEC14443 type B	0Ah	00h

5.2.3.2.8. Set Parameter Data Object

This command sets different parameters from the IFD.

Set Parameter Data Object

Tag	Length (1 byte)	Value		
		Tag	Len	Value
FF 6Eh	Var	TLV_Objects		

TLV_Objects

Parameters Requested	Tag	Length
Frame size for IFD integer (FSDI)	01h	01h
Frame size for ICC integer (FSCI)	02h	01h
Frame waiting time integer (FWTI)	03h	01h
Max. Communication Speed supported by the IFD	04h	01h
Communication Speed of the ICC	05h	01h
Modulation Index	06h	01h
PCB for ISO/IEC14443	07h	01h
CID for ISO/IEC14443	08h	01h
NAD for ISO/IEC14443	09h	01h
Param 1 – 4 for for ISO/IEC14443 type B	0Ah	04h

5.2.3.3. Transparent Exchange Command

This command transmits and receives any bit or bytes from ICC.

Transparent Exchange Command

Command	Class	INS	P1	P2	Lc	Data In
TranspEx	FFh	C2h	00h	01h	DataLen	DataObject (N bytes)

Where:

Data Object (1 byte)

Tag	Data Object
90h	Transmission and Reception Flag
91h	Transmission Bit Framing
92h	Reception Bit Framing
93h	Transmit
94h	Receive
95h	Transceive – Transmit and Receive
FF 6Dh	Get Parameter
FF 6Eh	Set Parameter

Transparent Exchange Response Data Object

Tag	Data Object
C0h	Generic Error status
92h	Number of valid bits in the last byte of received data
96h	Response Status

Tag	Data Object
97h	ICC response
FF 6Dh	IFD parameter data object

5.2.3.3.1. Transmission and Reception Flag Data Object

This command defines the framing and RF parameters for the following transmission.

Transmission and Reception Flag Data Object

Tag	Length (1 byte)	Value	
		bit	Description
90h	02h	0	0 – append CRC in the transmit data 1 – do not append CRC in the transmit data
		1	0 – discard CRC from the received data 1 – do not discard CRC from the received data (i.e. no CRC checking)
		2	0 – insert parity in the transmit data 1 – do not insert parity
		3	0 – expect parity in received date 1 – do not expect parity (i.e. no parity checking)
		4	0 – append protocol prologue in the transmit data or discard from the response 1 – do not append or discard protocol prologue if any (e.g. PCB, CID, NAD)
		5-15	RFU

5.2.3.3.2. Transmission Bit Framing Data Object

This command defines the number of valid bits of the last byte of data to transmit or transceive.

Transmission bit Framing Data Object

Tag	Length (1 byte)	Value	
		bit	Description
91h	01h	0-2	Number of valid bits of the last byte (0 means all bits are valid)
		3-7	RFU

Transmission bit framing data object shall be together with “transmit” or “transceive” data object only.
If this data object does not exist, it means all bits are valid.

5.2.3.3.3. Reception bit Framing Data Object

For the command APDU, this data object defines the number of expected valid bits of the last byte of data received.

For the response APDU, this data object mentions the number of valid bits in the last byte of received data.

Reception bit Framing Data Object

Tag	Length (1 byte)	Value	
		bit	Description
92h	01h	0-2	Number of valid bits of the last byte (0 means all bits are valid)
		3-7	RFU

If this data object does not exist, it means all bits are valid.

5.2.3.3.4. Transmit Data Object

This command transmits the data from IFD to the ICC. No response is expected from the ICC after transmit is complete.

Transmit Data Object

Tag	Length (1 byte)	Value
93h	DataLen	Data (N bytes)

5.2.3.3.5. Receive Data Object

This command forces the reader into receiving mode within the time, given in the following timer object.

Receive Data Object

Tag	Length (1 byte)	Value
94h	00h	-

5.2.3.3.6. Transceive Data Object

This command transmits and receives data from the ICC. After transmission is complete, the reader will wait until the time given in the timer data object.

If no timer data object was defined in the data field, the reader will wait for the duration given in the Set Parameter FWTI Data Object. If no FWTI is set, the reader will wait for about 302 µs.

Transceive Data Object

Tag	Length (1 byte)	Value
95h	DataLen	Data (N Bytes)

5.2.3.3.7. Response Status Data Object

Inside the response, this command is used to notify the received data status.

Response Status Data Object

Tag	Length (1 byte)	Value		
		Byte 0		Byte 1
		Bit	Description	
96h	02h	0	0 – CRC is OK or no checked 1 – CRC check fail	If a collision is detected, these bytes will tell the collision position. Otherwise, "00h" will be shown.
		1	0 – no collision 1 – collision detected	
		2	0 – no parity error 1 – parity error detected	
		3	0 – no framing error 1 – framing error detected	
		4 - 7	RFU	

5.2.3.3.8. Response Data Object

Inside the response, this command is used to notify the received data status.

Response Data Object

Tag	Length (1 byte)	Value
97h	DataLen	ReplyData (N Byte)

5.2.3.4. Switch Protocol Command

This command specifies the protocol and different layers of the standard within the transparent session.

Switch Protocol Command

Command	Class	INS	P1	P2	Lc	Data In
SwProtocol	FFh	C2h	00h	02h	DataLen	DataObject (N bytes)

Where:

Data Object (1 byte)

Tag	Data Object
8Fh	Switch Protocol Data Object
FF 6Dh	Get Parameter
FF 6Eh	Set Parameter

Switch Protocol Response Data Object

Tag	Data Object
C0h	Generic Error status
FF 6Dh	IFD parameter data object

5.2.3.4.1. Switch Protocol Data Object

This command specifies the protocol and different layers of the standard.

Switch Protocol Data Object

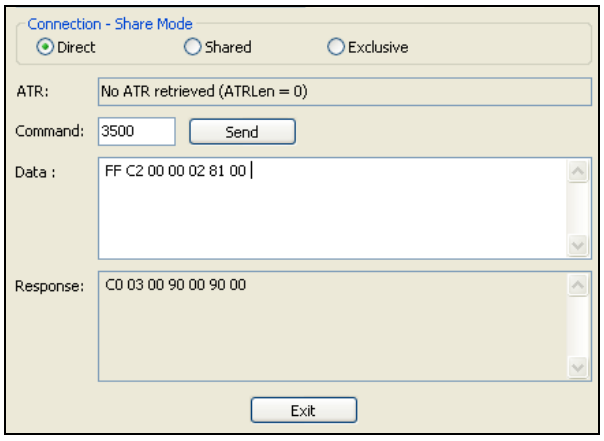
Tag	Length (1 byte)	Value	
		Byte 0	Byte 1
8Fh	02h	00h – ISO/IEC14443 Type A 01h – ISO/IEC14443 Type B 03h – FeliCa Other – RFU	00h – If no layer separation 02h – Switch to Layer 2 03h – Switch or activate to layer 3 04h – Activate to layer 4 Other - RFU

5.2.3.5. PCSC 2.0 Part 3 Example

1. Start Transparent Session.

   Command: **FF C2 00 00 02 81 00**

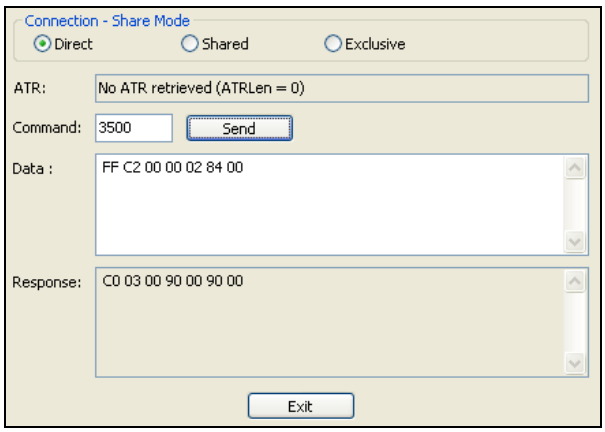
   Response: **C0 03 00 90 00 90 00**



2. Turn the Antenna Field on.

   Command: **FF C2 00 00 02 84 00**

   Response: **C0 03 00 90 00 90 00**

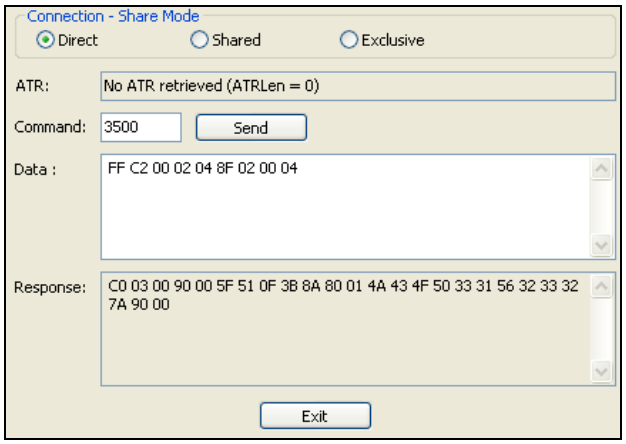


3. ISO 14443-4A Active.

   Command: **FF C2 00 02 04 8F 02 00 04**

   Response: **C0 03 01 64 01 90 00** (if no card present)

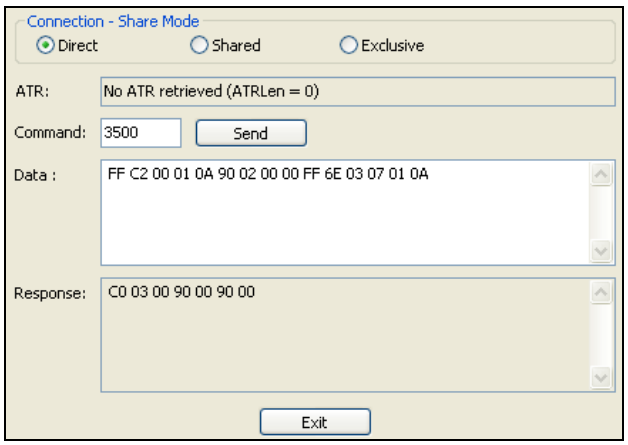
   C0 03 00 90 00 5F 51 [ATR] 90 00



4. Set the PCB to 0Ah and enable the CRC, parity and protocol prologue in the transmit data.

   Command: **FF C2 00 01 0A 90 02 00 00 FF 6E 03 07 01 0A**

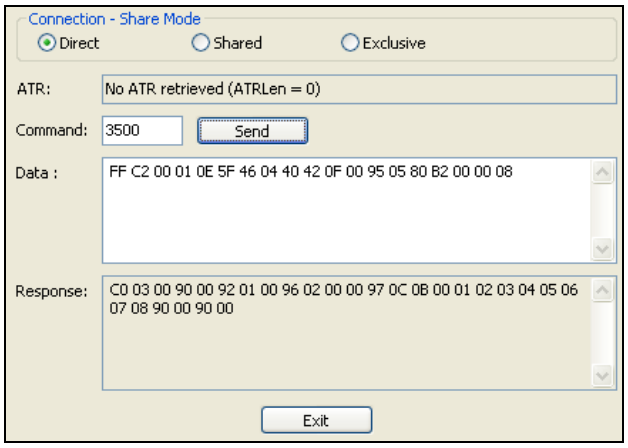
   Response: **C0 03 00 90 00 90 00**



5. Send the APDU “80B2000008” to card and get response.

   Command: **FF C2 00 01 0E 5F 46 04 40 42 0F 00 95 05 80 B2 00 00 08**

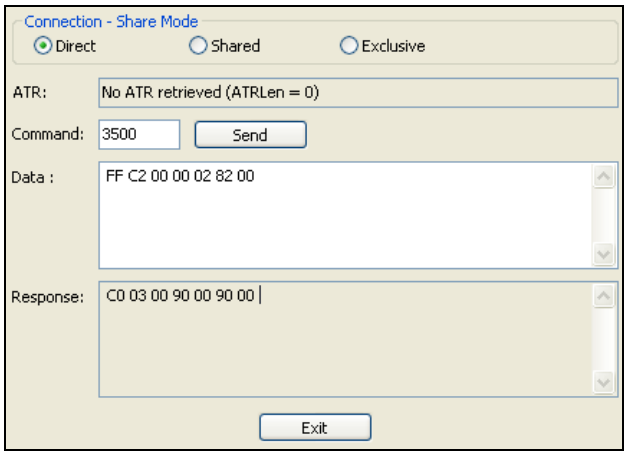
   Response: **C0 03 00 90 00 92 01 00 96 02 00 00 97 0C [Card Response] 90 00**



6. End Transparent Session.

   Command: **FF C2 00 00 02 82 00**

   Response: **C0 03 00 90 00 90 00**



5.2.4. PICC Commands for MIFARE Classic (1K/4K) memory cards

5.2.4.1. Load Authentication Keys

This command loads the authentication keys to the reader. The authentication keys are used to authenticate the particular sector of the MIFARE Classic (1K/4K) memory card.

Load Authentication Keys APDU Format (11 bytes)

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

Where:

Key Structure 1 byte.

00h = Key is loaded into the reader volatile memory.

Other = Reserved.

Key Number 1 byte.

00h ~ 01h = Volatile memory for storing a temporary key. The key will disappear once the reader is disconnected from the computer. Two volatile keys are provided. The volatile key can be used as a session key for different sessions. *Default Value = {FF FF FF FF FF FFh}*

Key 6 bytes.

The key value loaded into the reader. Example: FF FF FF FF FF FFh

Load Authentication Keys Response Format (2 Bytes)

Response	Data Out	
Result	SW1	SW2

Load Authentication Keys Response Codes

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

Example:

// Load a key {FF FF FF FF FF FFh} into the volatile memory location 00h.

APDU = {FF 82 00 00 06 FF FF FF FF FF FFh}

5.2.4.2. Authentication for MIFARE Classic (1K/4K)

This command uses the keys stored in the reader to do authentication with the MIFARE Classic (1K/4K) card (PICC). Two types of authentication keys are used: TYPE_A and TYPE_B.

Load Authentication Keys APDU Format (6 bytes) [Obsolete]

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

Load Authentication Keys APDU Format (10 bytes)

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

Authenticate Data Bytes (5 bytes)

Byte1	Byte 2	Byte 3	Byte 4	Byte 5
Version 01h	00h	Block Number	Key Type	Key Number

Where:

Block Number 1 byte. The memory block to be authenticated.

For MIFARE Classic 1K card, it has totally 16 sectors and each sector consists of four consecutive blocks (e.g., Sector 00h consists of blocks {00h, 01h, 02h and 03h}; sector 01h consists of blocks {04h, 05h, 06h and 07h}; the last sector 0Fh consists of blocks {3Ch, 3Dh, 3Eh and 3Fh}. 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 Classic (1K/4K) specification for more details.

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

Key Type 1 byte.

60h = Key is used as a TYPE A key for authentication.

61h = Key is used as a TYPE B key for authentication.

Key Number 1 byte.

00 ~ 01h = Volatile memory for storing keys. The keys will disappear when the reader is disconnected from the PC. Two volatile keys are provided. The volatile key can be used as a session key for different sessions.

Load Authentication Keys Response Format (2 bytes)

Response	Data Out	
Result	SW1	SW2

Load Authentication Keys Response Codes

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

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	00h – 02h	03h
Sector 1	04h – 06h	07h
..	..	..
..	..	..
Sector 14	38h – 0Ah	3Bh
Sector 15	3Ch – 3Eh	3Fh

1K bytes

Table 2: MIFARE Classic 1K 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	00h ~ 02h	03h
Sector 1	04h ~ 06h	07h
..		
..		
Sector 30	78h ~ 7Ah	7Bh
Sector 31	7Ch ~ 7Eh	7Fh
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	80h ~ 8Eh	8Fh
Sector 33	90h ~ 9Eh	9Fh
..		
..		
Sector 38	E0h ~ EEh	EFh
Sector 39	F0h ~ FEh	FFh

2 KB

2 KB

Table 3: MIFARE Classic 4K 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

Table 4: MIFARE Ultralight Memory Map

Examples:

//Authenticate the Block 04h with a {TYPE A, key number 00h}. For PC/SC V2.01, Obsolete.

APDU = {FF 88 00 04 60 00h};

//Authenticate the Block 04h with a {TYPE A, key number 00h}. For PC/SC V2.07

APDU = {FF 86 00 00 05 01 00 04 60 00h}

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

5.2.4.3. Read Binary Blocks

This command retrieves a multiple of "data blocks" from the PICC. The data block/trailer block must be authenticated first before executing this command.

Read Binary APDU Format (5 bytes)

Command	Class	INS	P1	P2	Le
Read Binary Blocks	FFh	B0h	00h	Block Number	Number of Bytes to Read

Where:

Block Number 1 byte. The starting block.

Number of Bytes to Read 1 byte.

Multiple of 16 bytes for MIFARE Classic (1K/4K) or Multiple of 4 bytes for MIFARE Ultralight

Maximum of 16 bytes for MIFARE Ultralight.

Maximum of 48 bytes for MIFARE Classic 1K. (Multiple Blocks Mode; 3 consecutive blocks)

Maximum of 240 bytes for MIFARE Classic 4K. (Multiple Blocks Mode; 15 consecutive blocks)

Example 1: 10h (16 bytes). The starting block only. (Single Block Mode)

Example 2: 40h (64 bytes). From the starting block to starting block+3. (Multiple Blocks Mode)

Note: *For security reasons, 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.*

Read Binary Block Response Format (Multiply of 4/16 + 2 bytes)

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

Read Binary Block Response Codes

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

Examples:

// Read 16 bytes from the binary block 04h (MIFARE Classic 1K/ 4K)

APDU = FF B0 00 04 10h

// Read 240 bytes starting from the binary block 80h (MIFARE Classic 4K)

// Block 80h to Block 8Eh (15 blocks)

APDU = FF B0 00 80 F0h

5.2.4.4. Update Binary Blocks

This command writes a multiple of "data blocks" into the PICC. The data block/trailer block must be authenticated first before executing this command.

Update Binary APDU Format (Multiple of 16 + 5 bytes)

Command	Class	INS	P1	P2	Lc	Data In
Update Binary Blocks	FFh	D6h	00h	Block Number	Number of bytes to update	Block Data (Multiple of 16 Bytes)

Where:

Block Number — 1 byte. The starting block to be updated.

Number of bytes to update — 1 byte.

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

Block Data — Multiple of 16 + 2 Bytes, or 6 bytes. The data to be written into the binary block/blocks.

Example 1: 10h (16 bytes). The starting block only. (Single Block Mode)

Example 2: 30h (48 bytes). From the starting block to starting block +2. (Multiple Blocks Mode)

Note: *For safety reasons, 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.*

Update Binary Block Response Codes (2 bytes)

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

Examples:

// Update the binary block 04h of MIFARE Classic (1K/4K) with Data {00 01 .. 0Fh}

APDU = {FF D6 00 04 10 00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0Fh}

// Update the binary block 04h of MIFARE Ultralight with Data {00 01 02 03h}

APDU = {FF D6 00 04 04 00 01 02 03h}

5.2.4.5. Value Block Operation (INC, DEC, STORE)

This command is used for manipulating value-based transactions (e.g., increment a value of the value block).

Value Block Operation APDU Format (10 bytes)

Command	Class	INS	P1	P2	Lc	Data In	
Value Block Operation	FFh	D7h	00h	Block Number	05h	VB_OP	VB_Value (4 Bytes) {MSB .. LSB}

Where:

Block Number 1 byte. The value block to be manipulated.

VB_OP 1 byte.

00h = Store the VB_Value into the block. The block will then be converted to a value block.

01h = Increment the value of the value block by the VB_Value. This command is only valid for value block.

02h = 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).

Example 1: Decimal –4 = {FFh, FFh, FFh, FCh}

VB_Value			
MSB			LSB
FFh	FFh	FFh	FCh

Example 2: Decimal 1 = {00h, 00h, 00h, 01h}

VB_Value			
MSB			LSB
00h	00h	00h	01h

Value Block Operation Response Format (2 bytes)

Response	Data Out	
Result	SW1	SW2

Value Block Operation Response Codes

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

5.2.4.6. Read Value Block

This command retrieves the value from the value block. This command is only valid for value block.

Read Value Block APDU Format (5 bytes)

Command	Class	INS	P1	P2	Le
Read Value Block	FFh	B1h	00h	Block Number	04h

Where:

Block Number 1 byte. The value block to be accessed.

Read Value Block Response Format (4 + 2 bytes)

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

Where:

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

Example 1: Decimal –4 = {FFh, FFh, FFh, FCh}

Value			
MSB			LSB
FFh	FFh	FFh	FCh

Example 2: Decimal 1 = {00h, 00h, 00h, 01h}

Value			
MSB			LSB
00h	00h	00h	01h

Read Value Block Response Codes

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

5.2.4.7. Copy Value Block

This command copies a value from a value block to another value block.

Copy Value Block APDU Format (7 bytes)

Command	Class	INS	P1	P2	Lc	Data In	
Copy Value Block	FFh	D7h	00h	Source Block Number	02h	03h	Target Block Number

Where:

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.

Copy Value Block Response Format (2 bytes)

Response	Data Out	
Result	SW1	SW2

Copy Value Block Response Codes

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

Examples:

// Store a value “1” into block 05h

APDU = {FF D7 00 05 05 00 00 00 00 01h}

// Read the value block 05h

APDU = {FF B1 00 05 04h}

// Copy the value from value block 05h to value block 06h

APDU = {FF D7 00 05 02 03 06h}

// Increment the value block 05h by “5”

APDU = {FF D7 00 05 05 01 00 00 00 05h}

5.2.5. Accessing PCSC-compliant tags (ISO 14443-4)

All ISO 14443-4 compliant cards (PICCs) understand the ISO 7816-4 APDUs. The ACR1251T reader just has to communicate with the ISO 14443-4 compliant cards through exchanging ISO 7816-4 APDUs and responses. ACR1251T will handle the ISO 14443 Parts 1-4 Protocols internally.

MIFARE Classic (1K/4K), MIFARE Mini and MIFARE Ultralight tags are supported through the T=CL emulation. Just simply treat the MIFARE tags as standard ISO 14443-4 tags. For more information, please refer to **Section 5.2.2**.

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

ISO 7816-4 Response Format (Data + 2 bytes)

Response	Data Out		
Result	Response Data	SW1	SW2

Common ISO 7816-4 Response Codes

Results	SW1	Meaning
Success	90 00h	The operation was completed successfully.
Error	63 00h	The operation failed.

Typical sequence may be:

1. Present the tag and connect the PICC Interface.
2. Read/Update the memory of the tag.

To do this:

1. Connect the tag.

   The ATR of the tag is 3B 88 80 01 00 00 00 00 33 81 81 00 3Ah.

   In which,

   The Application Data of ATQB = 00 00 00 00, protocol information of ATQB = 33 81 81. It is an ISO 14443-4 Type B tag.

2. Send an APDU, Get Challenge.

   << 00 84 00 00 08h

   >> 1A F7 F3 1B CD 2B A9 58h [90 00h]

   Note: *For ISO 14443-4 Type A tags, the ATS can be obtained by using the APDU "FF CA 01 00 00h."*

Example:

// Read 8 bytes from an ISO 14443-4 Type B PICC (ST19XR08E)

APDU = {80 B2 80 00 08h}

Class = 80h

INS = B2h

P1 = 80h

P2 = 00h

Lc = None

Data In = None

Le = 08h

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

5.2.6. Accessing FeliCa tags

For FeliCa access, the command is different from the one used in PCSC-compliant tags and MIFARE. The command follows the FeliCa specification with an added header.

FeliCa Command Format

Command	Class	INS	P1	P2	Lc	Data In
FeliCa Command	FFh	00h	00h	00h	Length of the Data In	FeliCa Command (start with Length Byte)

FeliCa Response Format (Data + 2 bytes)

Response	Data Out
Result	Response Data

Read Memory Block Example:

1. Connect the FeliCa.

   The ATR = 3B 8F 80 01 80 4F 0C A0 00 00 03 06 11 00 3B 00 00 00 00 42h

   In which, 11 00 3Bh = FeliCa

2. Read FeliCa IDM.

   CMD = FF CA 00 00 00h

   RES = [IDM (8bytes)] 90 00h

   e.g., FeliCa IDM = 01 01 06 01 CB 09 57 03h

3. FeliCa command access.

   Example: “Read” Memory Block.

   CMD = FF 00 00 00 10 10 06 01 01 06 01 CB 09 57 03 01 09 01 01 80 00h

   where:

   Felica Command = 10 06 01 01 06 01 CB 09 57 03 01 09 01 01 80 00h

   IDM = 01 01 06 01 CB 09 57 03h

   RES = Memory Block Data

5.3. Peripherals Control

The reader's peripherals control commands are implemented by using ***SCardControl*** with Control Code ***SCARD_CTL_CODE(3500)***.

5.3.1. Get Firmware Version

This command is used to get the reader's firmware message.

Get Firmware Version Format (5 bytes)

Command	Class	INS	P1	P2	Lc
Get Firmware Version	E0h	00h	00h	18h	00h

Get Firmware Version Response Format (5 bytes + Firmware Message Length)

Response	Class	INS	P1	P2	Le	Data Out
Result	E1h	00h	00h	00h	Number of bytes to receive	Firmware Version

Example:

Response = E1 00 00 00 0F 41 43 52 31 32 35 31 55 5F 56 44 30 21 2E 30

Firmware Version (HEX) = 41 43 52 31 32 35 31 55 5F 56 36 32 31 2E 30

Firmware Version (ASCII) = "ACR1251T_V621.0"

5.3.2. LED Control

This command is used to control the LED's output.

LED Control Format (6 bytes)

Command	Class	INS	P1	P2	Lc	Data In
LED Control	E0h	00h	00h	29h	01h	LED Status

LED Control Response Format (6 bytes)

Response	Class	INS	P1	P2	Le	Data Out
Result	E1h	00h	00h	00h	01h	LED Status

LED Status (1 byte)

LED Status	Description	Description
Bit 0	RED LED	1 = ON; 0 = OFF
Bit 1	GREEN LED	1 = ON; 0 = OFF
Bit 2 - 7	RFU	RFU

5.3.3. LED Status

This command is used to check the existing LED's status.

LED Status Format (5 bytes)

Command	Class	INS	P1	P2	Lc
LED Status	E0h	00h	00h	29h	00h

LED Status Response Format (6 bytes)

Response	Class	INS	P1	P2	Le	Data Out
Result	E1h	00h	00h	00h	01h	LED Status

LED Status (1 byte)

LED Status	Description	Description
Bit 0	RED LED	1 = ON; 0 = OFF
Bit 1	GREEN LED	1 = ON; 0 = OFF
Bit 2 - 7	RFU	RFU

5.3.4. Set LED Status Indicator Behavior

This command sets the behaviors of LEDs as status indicators.

Note: *The setting will be saved into non-volatile memory.*

Set LED Status Indicator Behavior Format (6 bytes)

Command	Class	INS	P1	P2	Lc	Data In
Set LED and Buzzer Status Indicator Behavior	E0h	00h	00h	21h	01h	Behavior

Behavior (1 byte)

Behavior	MODE	Description
Bit 0	Card Operation Blinking LED	To blink the LED whenever the PICC card is being accessed
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 – 5	RFU	RFU
Bit 6	Color Select (GREEN)	GREEN LED for status change 1 = Enable; 0 = Disable
Bit 7	Color Select (RED)	RED LED for status change 1 = Enable; 0 = Disable

Note: *Default value of behavior = 47h.*

Set LED Status Indicator Behaviors Response Format (6 bytes)

Response	Class	INS	P1	P2	Le	Data Out
Result	E1h	00h	00h	00h	01h	Default Behaviors

5.3.5. Read LED Status Indicator Behavior

This command reads the current default behavior of LEDs.

Read LED Status Indicator Behavior Format (5 bytes)

Command	Class	INS	P1	P2	Lc
Read LED Status Indicator Behavior	E0h	00h	00h	21h	00h

Read LED Status Indicator Behavior Response Format (6 bytes)

Response	Class	INS	P1	P2	Le	Data Out
Result	E1h	00h	00h	00h	01h	Behaviors

Behavior (1 byte)

Behavior	MODE	Description
Bit 0	Card Operation Blinking LED	To blink the LED whenever the PICC card is being accessed
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 - 5	RFU	RFU
Bit 6	Color Select (GREEN)	GREEN LED for status change 1 = Enable; 0 = Disable
Bit 7	Color Select (RED)	RED LED for status change 1 = Enable; 0 = Disable

Note: *Default value of Behavior = 47h.*

5.3.6. Set Automatic PICC Polling

This command is used to set the reader's polling mode.

Whenever the reader is connected to a PC, the PICC polling function will start the PICC scanning to determine if a PICC is placed on/removed from the built-antenna.

You can send a command to disable the PICC polling function. The command is sent through the PCSC Escape command interface. To meet the energy saving requirement, special modes are provided for turning off the antenna field whenever the PICC is inactive, or no PICC is found. The reader will consume less current in power saving mode.

Note: *The setting will be saved into non-volatile memory.*

Set Automatic PICC Polling Format (6 bytes)

Command	Class	INS	P1	P2	Lc	Data In
Set Automatic PICC Polling	E0h	00h	00h	23h	01h	Polling Setting

Set Automatic PICC Polling Response Format (6 bytes)

Response	Class	INS	P1	P2	Le	Data Out
Result	E1h	00h	00h	00h	01h	Polling Setting

Polling Setting (1 byte)

Polling Setting	Mode	Description
Bit 0	Auto PICC Polling	1 = Enable; 0 =Disable
Bit 1	Turn off Antenna Field if no PICC is found.	1 = Enable; 0 =Disable
Bit 2	Turn off Antenna Field if the PICC is inactive.	1 = Enable; 0 =Disable
Bit 3	RFU	
Bit 5 .. 4	PICC Poll Interval for PICC	<Bit 5 – Bit 4> <0 – 0> = 250 ms <0 – 1> = 500 ms <1 – 0> = 1000 ms <1 – 1> = 2500 ms
Bit 6	RFU	
Bit 7	Enforce ISO 14443-A Part 4	1= Enable; 0= Disable.

Note: *Default value of Polling Setting = 8Bh.*

Reminders:

1. *It is recommended to enable the option "Turn Off Antenna Field if the PICC is inactive", so that the "Inactive PICC" will not be exposed to the field all the time to prevent the PICC from "warming up".*
2. *The longer the PICC Poll Interval, the more efficient of energy saving. However, the response time of PICC Polling will become longer. The Idle Current Consumption in Power Saving Mode is about 60 mA, while the Idle Current Consumption in Non-Power Saving mode is about 130mA.* ***Note:*** *Idle Current Consumption = PICC is not activated.*
3. *The reader will activate the ISO 14443A-4 mode of the "ISO 14443A-4 compliant PICC" automatically. Type B PICC will not be affected by this option.*
4. *The JCOP30 card comes with two modes: ISO 14443A-3 (MIFARE Classic 1K) and ISO 14443A-4 modes. The application has to decide which mode should be selected once the PICC is activated.*

5.3.7. Read Automatic PICC Polling

This command is used to check the current PICC polling setting.

Read Automatic PICC Polling Format (5 bytes)

Command	Class	INS	P1	P2	Lc
Read Automatic PICC Polling	E0h	00h	00h	23h	00h

Read Automatic PICC Polling Response Format (6 bytes)

Response	Class	INS	P1	P2	Le	Data Out
Result	E1h	00h	00h	00h	01h	Polling Setting

Polling Setting (1 byte)

Polling Setting	Mode	Description
Bit 0	Auto PICC Polling	1 = Enable; 0 =Disable
Bit 1	Turn off Antenna Field if no PICC is found.	1 = Enable; 0 =Disable
Bit 2	Turn off Antenna Field if the PICC is inactive.	1 = Enable; 0 =Disable
Bit 3	RFU	
Bit 5 .. 4	PICC Poll Interval for PICC	<Bit 5 – Bit 4> <0 – 0> = 250 ms <0 – 1> = 500 ms <1 – 0> = 1000 ms <1 – 1> = 2500 ms
Bit 6	RFU	
Bit 7	Enforce ISO 14443-A Part 4	1= Enable; 0= Disable.

Note: *Default value of Polling Setting = 8Bh.*

5.3.8. Set PICC Operating Parameter

This command is used to set the PICC operating parameter.

Note: *The setting will be saved into non-volatile memory.*

Set the PICC Operating Parameter Format (6 bytes)

Command	Class	INS	P1	P2	Lc	Data In
Set the PICC Operating Parameter	E0h	00h	00h	20h	01h	Operation Parameter

Set the PICC Operating Parameter Response Format (6 bytes)

Response	Class	INS	P1	P2	Le	Data Out
Result	E1	00h	00h	00h	01h	Operation Parameter

Operating Parameter (1 byte)

Operating Parameter	Parameter	Description	Option
Bit 0	ISO 14443 Type A	The Tag Types to be detected during PICC Polling.	1 = Detect 0 = Skip
Bit 1	ISO 14443 Type B		1 = Detect 0 = Skip
Bit 2	FeliCa 212 Kbps		1 = Detect 0 = Skip
Bit 3	FeliCa 424 Kbps		1 = Detect 0 = Skip
Bit 4	Topaz		1 = Detect 0 = Skip
Bit 5 - 7	RFU	RFU	RFU

Note: *Default value of Operation Parameter = 1Fh.*

5.3.9. Read PICC Operating Parameter

This command is used to check the current PICC operating parameter.

Read the PICC Operating Parameter Format (5 bytes)

Command	Class	INS	P1	P2	Lc
Read the PICC Operating Parameter	E0h	00h	00h	20h	00h

Read the PICC Operating Parameter Response Format (6 bytes)

Response	Class	INS	P1	P2	Le	Data Out
Result	E1h	00h	00h	00h	01h	Operation Parameter

Operating Parameter (1 byte)

Operating Parameter	Parameter	Description	Option
Bit 0	ISO 14443 Type A	The Tag Types to be detected during PICC polling.	1 = Detect 0 = Skip
Bit 1	ISO 14443 Type B		1 = Detect 0 = Skip
Bit 2	FeliCa 212 Kbps		1 = Detect 0 = Skip
Bit 3	FeliCa 424 Kbps		1 = Detect 0 = Skip
Bit 4	Topaz		1 = Detect 0 = Skip
Bit 5 - 7	RFU	RFU	RFU

Note: *Default value of Operation Parameter = 1Fh.*

5.3.10. Set Auto PPS

Whenever a PICC is recognized, the reader will try to change the communication speed between the PCD and PICC as defined by the maximum connection speed. If the card does not support the proposed connection speed, the reader will try to connect the card with a slower speed setting.

Set Auto PPS Format (7 bytes)

Command	Class	INS	P1	P2	Lc	Data In	
Set Auto PPS	E0h	00h	00h	24h	02h	Max Tx Speed	Max Rx Speed

Set Auto PPS Response Format (9 bytes)

Response	Class	INS	P1	P2	Le	Data Out			
Result	E1h	00h	00h	00h	04h	Max Tx Speed	Current Tx Speed	Max Rx Speed	Current Rx Speed

Where:

Max Tx Speed Maximum Tx Speed (1 Byte)

Current Tx Speed Current Tx Speed (1 Byte)

Max Rx Speed Maximum Rx Speed (1 Byte)

Current Rx Speed Current Rx Speed (1 Byte)

00h = 106 Kbps; default setting, equal to No Auto PPS

01h = 212 Kbps

02h = 424 Kbps

Notes:

1. *Normally, the application should know the maximum connection speed of the PICCs being used. The environment also affects the maximum achievable speed. The reader just uses the proposed communication speed to talk with the PICC. The PICC will become inaccessible is the PICC or environment does not meet the requirement of the proposed communication speed.*
2. *The reader supports different speeds between sending and receiving.*

5.3.11. Read Auto PPS

This command checks the current auto PPS setting.

Read Auto PPS Format (5 bytes)

Command	Class	INS	P1	P2	Lc
Read Auto PPS	E0h	00h	00h	24h	00h

Read Auto PPS Response Format (9 bytes)

Response	Class	INS	P1	P2	Le	Data Out			
Result	E1h	00h	00h	00h	04h	Max Tx Speed	Current Tx Speed	Max Rx Speed	Current Rx Speed

Where:

Max Tx Speed Maximum Tx Speed (1 Byte)

Current Tx Speed Current Tx Speed (1 Byte)

Max Rx Speed Maximum Rx Speed (1 Byte)

Current Rx Speed Current Rx Speed (1 Byte)

00h = 106 Kbps; default setting, equal to No Auto PPS

01h = 212 Kbps

02h = 424 Kbps

5.4. ACR122T Compatible Commands

5.4.1. Bi-color LED Control

This command is used to control the states of the bi-color LED.

Bi-color LED Control Command Format (9 bytes)

Command	Class	INS	P1	P2	Lc	Data In (4 bytes)
Bi-color LED Control	FFh	00h	40h	LED State Control	04h	Blinking Duration Control

P2 LED State Control

Bi-color LED Control Format (1 byte)

CMD	Item	Description
Bit 0	Final Red LED State	1 = On; 0 = Off
Bit 1	Final Green LED State	1 = On; 0 = Off
Bit 2	Red LED State Mask	1 = Update the State 0 = No change
Bit 3	Green LED State Mask	1 = Update the State 0 = No change
Bit 4	Initial Red LED Blinking State	1 = On; 0 = Off
Bit 5	Initial Green LED Blinking State	1 = On; 0 = Off
Bit 6	Red LED Blinking Mask	1 = Blink 0 = Not Blink
Bit 7	Green LED Blinking Mask	1 = Blink 0 = Not Blink

Data In Blinking Duration Control

Bi-color LED Blinking Duration Control Format (4 bytes)

Byte 0	Byte 1	Byte 2	Byte 3
T1 Duration Initial Blinking State (unit = 100 ms)	T2 Duration Toggle Blinking State (unit = 100 ms)	Number of repetition	00h

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

Status Code

Results	SW1	SW2	Meaning
Success	90h	Current LED State	The operation was completed successfully.
Error	63	00h	The operation failed.

Current LED State (1 byte)

Status	Item	Description
Bit 0	Current Red LED	1 = On; 0 = Off
Bit 1	Current Green LED	1 = On; 0 = Off
Bits 2 – 7	Reserved	

Reminders:

1. *The LED State operation will be performed after the LED Blinking operation is completed.*
2. *The LED will not change if the corresponding LED Mask is not enabled.*
3. *The LED will not blink if the corresponding LED Blinking Mask is not enabled. Also, the number of repetition must be greater than zero.*
4. *T1 and T2 duration parameters are used for controlling the duty cycle of LED blinking and Buzzer Turn-On duration. For example, if T1=1 and T2=1, the duty cycle = 50%.*

   Note: *Duty Cycle = T1 / (T1 + T2).*

5.4.2. Get Firmware Version

This command is used to retrieve the firmware version of the reader.

Get Firmware Version Command Format (5 bytes)

Command	Class	INS	P1	P2	Le
Get Firmware	FFh	00h	48h	00h	00h

Get Firmware Version Response Format (X bytes)

Response	Data Out
Result	Firmware Version

Example:

Response = 41 43 52 31 32 35 31 54 5F 56 44 30 30 2E 30h = ACR1251T_VD00.0 (ASCII)

5.4.3. Get PICC Operating Parameter

This command is used to get the PICC operating parameter of the reader.

Get the PICC Operating Parameter Command Format (5 bytes)

Command	Class	INS	P1	P2	Le
Get PICC Operation Parameter	FFh	00h	50h	00h	00h

Get the PICC Operating Parameter Response Format (2 byte)

Response	Data Out	
Result	90h	PICC Operating Parameter

PICC Operating Parameter

Bit	Parameter	Description	Option
7	Auto PICC Polling	To enable the PICC polling.	1 = Enable 0 = Disable
6	Auto ATS Generation	To issue ATS request whenever an ISO 14443-4 Type A tag is activated.	1 = Enable 0 = Disable
5	Polling Interval	To set the time interval between successive PICC polling.	1 = 250 ms 0 = 500 ms
4	FeliCa 424 Kbps	The Tag Types to be detected during PICC polling.	1 = Detect 0 = Skip
3	FeliCa 212 Kbps		1 = Detect 0 = Skip
2	Topaz		1 = Detect 0 = Skip
1	ISO 14443 Type B		1 = Detect 0 = Skip
0	ISO 14443 Type A ***Note:*** *To detect the MIFARE tags, the Auto ATS Generation must be disabled first.*		1 = Detect 0 = Skip

5.4.4. Set PICC Operating Parameter

This command is used to set the PICC operating parameter of the reader.

Set PICC operation Parameter Command Format (5 bytes)

Command	Class	INS	P1	P2	Le
Set PICC Operation Parameter	FFh	00h	51h	PICC Operating Parameter	00h

Set PICC operation Parameter Response Format (2 byte)

Response	Data Out	
Result	90h	PICC Operating Parameter

PICC Operating Parameter

Bit	Parameter	Description	Option
7	Auto PICC Polling	To enable the PICC polling.	1 = Enable 0 = Disable
6	Auto ATS Generation	To issue ATS request whenever an ISO 14443-4 Type A tag is activated.	1 = Enable 0 = Disable
5	Polling Interval	To set the time interval between successive PICC polling.	1 = 250 ms 0 = 500 ms
4	FeliCa 424 Kbps	The Tag Types to be detected during PICC polling.	1 = Detect 0 = Skip
3	FeliCa 212 Kbps		1 = Detect 0 = Skip
2	Topaz		1 = Detect 0 = Skip
1	ISO 14443 Type B		1 = Detect 0 = Skip
0	ISO 14443 Type A ***Note:*** *To detect the MIFARE tags, the Auto ATS Generation must be disabled first.*		1 = Detect 0 = Skip