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ACR83 PINeasy

Reference Manual V1.06

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1.0. Introduction

The ACR83, a cost-effective PC-linked PIN-pad reader, serves as an interface for the communication between a computer (for example, a PC) and a smart card. Different types of smart cards have different commands and communication protocols, and the ACR83 PINeasy establishes a uniform interface from the computer to the smart card for a wide variety of cards.

The ACR83 is connected to the computer through a USB interface and uses the CCID interface to communicate with the USB port. CCID is the Device Class Specification for USB chip/Smart Card Interface Devices, and defines the communication protocol and commands for the USB chip-card interface devices.

Furthermore, the ACR83 supports CCID Secure PIN Entry (SPE) functionality which provides a secure user interface for PIN entry without the danger of the PIN being observed by a third party. ACR83 is a specific smart card reader which can do the PIN verification and modification in the card reader.

This Reference Manual will provide the PC/SC APDU commands that are used to control the built-in peripherals of the ACR83 device, and the data structures for secure PIN verification and modification.

1.1. Reference Documents

The following related documents are available from WWW.USB.ORG

- Universal Serial Bus Specification 2.0 (also referred to as the USB specification), April 27, 2000
- Universal Serial Bus Common Class Specification 1.0, December 16, 1997
- Universal Serial Bus Device Class: Smart Card CCID Specification for Integrated Circuit(s) Cards Interface Devices, Revision 1.1, April 22, 2005

The following related documents can be ordered through WWW.ANSI.ORG

- ISO/IEC 7816-1; Identification Cards – Integrated circuit(s) cards with contacts - Part 1: Physical Characteristics
- ISO/IEC 7816-2; Identification Cards – Integrated circuit(s) cards with contacts - Part 2: Dimensions and Locations of the contacts
- ISO/IEC 7816-3; Identification Cards – Integrated circuit(s) cards with contacts - Part 3: Electronic signals and transmission protocols

1.2. Symbols and Abbreviations

Symbol	Abbreviation
ATR	Answer-to-Reset
EMV	Europay MasterCard VISA
PPS	Protocol and Parameters Selection
SPE	Secure PIN Entry
USB	Universal Serial Bus

2.0. Features

- 14-key keypad
- 2 rows x 16 characters dot matrix LCD, each character has 5x8 dots
- Supports ISO 7816 Microprocessor Smart Cards with the following features:
  - Class A, B, C (5 V, 3 V and 1.8 V respectively)
  - T=0 and/or T=1 protocol
- Supports Secure PIN Entry (SPE)
- EMV Level 1 Certified
- Full-speed USB Interface (12 Mbps)
- Compliant to the following standards:
  - PC/SC
  - Microsoft® WHQL
  - CCID
  - CE/FCC
  - RoHS 2

3.0. Supported Card Types

The ACR83 supports MCU cards with either T=0 or T=1 protocol. The card ATR indicates the specific operation mode (TA2 present; bit b5 of TA2 must be 0) and when that the particular mode is not supported by the ACR83 PINeasy, the reader will reset the card to a negotiable mode. If the card cannot be set to negotiable mode, the reader will then reject the card.

When the card ATR indicates the negotiable mode (TA2 not present) and communication parameters other than the default parameters, the ACR83 will execute the PPS and try to use the communication parameters that the card suggested in its ATR. If the card does not accept the PPS, the reader will use the default parameters (F=372, D=1).

For the meaning of the aforementioned parameters, please refer to ISO 7816 Part 3.

4.0. Smart Card Interface

ACR83 PINeasy Smart Card Reader has a 14-key keypad and LCD display consisting of 2 rows with 16 characters dot matrix.

4.1. Smart Card Power Supply VCC (C1)

The current consumption of the inserted card must not be higher than 100 mA.

4.2. Programming Voltage VPP C6

According to ISO 7816-3, the smart card contact C6 (VPP) supplies the programming voltage to the smart card. Since all common smart cards in the market are EEPROM-based and do not require the provision of an external programming voltage, the contact C6 (VPP) has been implemented as a normal control signal in the ACR83 (CCID). The electrical specifications of this contact are identical to those of the signal RST (at contact C2).

4.3. Card Type Selection

The controlling PC always has to select the card type through the proper command sent to the ACR83 prior to activation the inserted card.

For MCU-based cards the reader allows to select the preferred protocol, T=0 or T=1. However, this selection is only accepted and carried out by the reader through the PPS when the card inserted in the reader supports both protocol types. Whenever an MCU-based card supports only one protocol type, T=0 or T=1, the reader automatically uses that protocol type, regardless of the protocol type selected by the application.

4.4. Interface for Microcontroller-based Cards

For microcontroller-based smart cards only the contacts C1 (VCC), C2 (RST), C3 (CLK), C5 (GND) and C7 (I/O) are used. A frequency of 4 MHz is applied to the CLK signal (C3).

4.5. Card Tearing Protection

The ACR83 (CCID) provides a mechanism to protect the inserted card when it is suddenly withdrawn while it is powered up. The power supply to the card and the signal lines between the ACR83 (CCID) and the card are immediately deactivated when the card is being removed. As a general rule, however, to avoid any electrical damage, a card should only be removed from the reader while it is powered down.

***Note**: The ACR83 (CCID) does never, by itself, switch on the power supply to the inserted card. This must be explicitly done by the controlling computer through the proper command sent to the reader.*

5.0. Power Supply

The ACR83 (CCID) requires a voltage of 5 V DC, 100 mA regulated power supply. The ACR83 (CCID) gets the power from PC through the cable supplied along with each type of reader.

6.0. USB Interface

The ACR83 (CCID) is connected to a computer through a USB port following the USB standard.

6.1. Communication Parameters

The ACR83 (CCID) is connected to a computer through USB as specified in the USB Specification 1.1. The ACR83 (CCID) is working in full-speed mode, i.e. 12 Mbps.

Pin	Signal	Function
1	**VBUS**	+5 V power supply for the reader
2	**D-**	Differential signal transmits data between ACR83 and PC
3	**D+**	Differential signal transmits data between ACR83 and PC
4	**GND**	Reference voltage level for power supply

Table 1: USB Interface Wiring

Note*: *ACR83 PINeasy is a* PC/SC Device*. In order for the ACR83 (CCID) to function properly through USB interface, an* ACS PC/SC driver *has to be installed. Please refer to the Device Driver Installation Guide for more details.

6.2. Endpoints

The ACR83 (CCID) uses the following endpoints to communicate with the host computer:

Control Endpoint	For setup and control purpose
Bulk OUT	For command to sent from host to ACR83 (CCID) (data packet size is 64 bytes)
Bulk IN	For response to sent from ACR83 (CCID) to host (data packet size is 64 bytes)
Interrupt IN	For card status message to sent from ACR83 (CCID) to host (data packet size is 8 bytes)

7.0. Communication Protocol

ACR83 (CCID) shall interface with the host with USB connection. A specification, namely CCID, has been released within the industry defining such a protocol for the USB chip-card interface devices. CCID covers all the protocols required for operating smart cards and PIN.

The configurations and usage of USB endpoints on ACR83 (CCID) shall follow CCID Section 3. An overview is summarized below:

- **Control Commands** are sent on control pipe (default pipe). These include class-specific requests and USB standard requests. Commands that are sent on the default pipe report information back to the host on the default pipe.
- **CCID Events** are sent on the interrupt pipe.
- **CCID Commands** are sent on BULK-OUT endpoint. Each command sent to ACR83 (CCID) has an associated ending response. Some commands can also have intermediate responses.
- **CCID Responses** are sent on BULK-IN endpoint. All commands sent to ACR83 (CCID) have to be sent synchronously. (i.e. *bMaxCCIDBusySlots* is equal to 1 for ACR83 (CCID)).

The supported CCID features by ACR83 (CCID) are indicated in its Class Descriptor:

Offset	Field	Size	Value	Description
0	*bLength*	1	36h	Size of this descriptor (in bytes)
1	*bDescriptorType*	1	21h	CCID Functional Descriptor type
2	*bcdCCID*	2	0100h	CCID Specification Release Number in Binary-coded decimal
4	*bMaxSlotIndex*	1	00h	One slot is available on ACR83 (CCID)
5	*bVoltageSupport*	1	07h	ACR83 (CCID) can supply 1.8 V, 3.0 V and 5.0 V to its slot
6	*dwProtocols*	4	00000003h	ACR83 (CCID) supports T=0 and T=1 Protocol
10	*dwDefaultClock*	4	00000FA0h	Default ICC clock frequency is 4 MHz
14	*dwMaximumClock*	4	00000FA0h	Maximum supported ICC clock frequency is 4 MHz
18	*bNumClockSupported*	1	00h	Does not support manual setting of clock frequency
19	*dwDataRate*	4	00002A00h	Default ICC I/O data rate is 10752 bps
23	*dwMaxDataRate*	4	0001F808h	Maximum supported ICC I/O data rate is 250000 bps
27	*bNumDataRatesSupported*	1	00h	Does not support manual setting of data rates
28	*dwMaxIFSD*	4	00000Feh	Maximum IFSD supported by ACR83 (CCID) for protocol T=1 is 254
32	*dwSynchProtocols*	4	00000000h	ACR83 (CCID) does not support synchronous card

Offset	Field	Size	Value	Description
36	*dwMechanical*	4	00000000h	ACR83 (CCID) does not support special mechanical characteristics
40	*dwFeatures*	4	00010030h	ACR83 (CCID) supports the following features: • Automatic ICC clock frequency change according to parameters • Automatic baud rate change according to frequency and FI,DI parameters • TPDU level exchange with ACR83 (CCID)
44	*dwMaxCCIDMessageLength*	4	0000010Fh	Maximum message length accepted by ACR83 (CCID) is 271 bytes
48	*bClassGetResponse*	1	00h	Insignificant for TPDU level exchanges
49	*bClassEnvelope*	1	00h	Insignificant for TPDU level exchanges
50	*wLCDLayout*	2	0000h	No LCD
52	*bPINSupport*	1	00h	No PIN Verification
53	*bMaxCCIDBusySlots*	1	01h	Only one slot can be simultaneously busy

8.0. PC/SC SCardControl Application Programming Interface

8.1. Specific ScardControl

```
LONG SCardControl(
SCARDHANDLE hCard,
DWORD dwControlCode,
LPCVOID lpInBuffer,
DWORD nInBufferSize,
LPVOID lpOutBuffer,
DWORD nOutBufferSize,
LPDWORD lpBytesReturned
);
#define IOCTL_SMARTCARD_GET_FIRMWARE_VERSION SCARD_CTL_CODE(2078)
#define IOCTL_SMARTCARD_DISPLAY_LCD_MESSAGE SCARD_CTL_CODE(2079)
#define IOCTL_SMARTCARD_READ_KEY SCARD_CTL_CODE(2080
// PC/SC 2.0 Part 10
#define CM_IOCTL_GET_FEATURE_REQUEST SCARD_CTL_CODE(3400)
```

***Note**: Data is stored in little-endian form in which the LSB (Least Significant Byte) is first. Furthermore, SCardControl command must be declared in the source code.*

8.2. Smart Card Device IOCTLs

The following sections discuss the defined smart card device Input/Output Controls (IOCTL).

8.2.1. CM_IOCTL_GET_FEATURE_REQUEST

The CM_IOCTL_GET_FEATURE_REQUEST returns a list of supported features from the reader.

hCard	Reference value returned from *SCardConnect*
dwControlCode	CM_IOCTL_GET_FEATURE_REQUEST
lpInBuffer	NULL
nInBufferSize	Must be the **sizeof**(ULONG) of *lpInBuffer*
lpOutBuffer	According to PC/SC 2.0 Specification Part 10, the following features had been defined:

```
#define FEATURE_VERIFY_PIN_START 0x01
#define FEATURE_VERIFY_PIN_FINISH 0x02
#define FEATURE_MODIFY_PIN_START 0x03
#define FEATURE_MODIFY_PIN_FINISH 0x04
#define FEATURE_GET_KEY_PRESSED 0x05
#define FEATURE_VERIFY_PIN_DIRECT 0x06
#define FEATURE_MODIFY_PIN_DIRECT 0x07
#define FEATURE_MCT_READERDIRECT 0x08
#define FEATURE_MCT_UNIVERSAL 0x09
#define FEATURE_IFD_PIN_PROP 0x0A
#define FEATURE_ABORT 0x0B
```

In ACR83, the following features are supported:

```
#define FEATURE_VERIFY_PIN_DIRECT 0x06
#define FEATURE_MODIFY_PIN_DIRECT 0x07
#define FEATURE_IFD_PIN_PROP 0x0A
```

If the ACR83 reader used supports PC/SC 2.0 Part 10, you will get the following data:

06 04 XX XX XX XX 07 04 XX XX XX XX 0A 04 XX XX XX XXh

where, XX XX XX XXh is the control code for the feature.

nOutBufferSize	**sizeof**(ULONG) of *lpOutBuffer*
lpBytesReturned	pointer to a DWORD that receives the size, in bytes, of the data stored into the buffer pointed to by *lpOutBuffer*

8.2.2. FEATURE_VERIFY_PIN_DIRECT

hCard Reference value returned from *SCardConnect*

dwControlCode CM_IOCTL_GET_FEATURE_REQUEST

lpInBuffer

Offset	Field	Size	Value	Description
0	*bTimeOut*	1	-	Number of seconds. If the value is equal to 00h, then default value is used.
1	*bTimeOut2*	1	00h	Not supported. Number of seconds after first key stroke.
2	*bmFormatString*	1	-	Several parameters for the PIN format options. For more information, please refer to **Appendix A**.
3	*bmPINBlockString*	1	-	Defines the length in bytes of the PIN block to present in the APDU command. For more information, please refer to **Appendix B**.
4	*bmPINLengthFormat*	1	-	Allows the insertion of the PIN length in the APDU command. For more information, please refer to **Appendix C**.
5	*wPINMaxExtraDigit*	2	XXYYh	XXh: Maximum PIN size in digit YYh: Minimum PIN size in digit
7	*bEntryValidationCondition*	1	-	The value is a bit wise OR operation. 01h = Maximum size reached 02h = Validation key pressed 04h = Timeout occurred
8	*bNumberMessage*	1	FFh	Number of messages to display for PIN verification
9	*wLangId*	2	0409h	Language for messages
11	*bMsgIndex*	1	00h	Message index (should be 00h)
12	*bTeoPrologue*	3	000000h	T=1 I-block prologue field to use (fill with 00h)
15	*ulDataLength*	4	-	Length of data to be sent to the ICC
19	*abData*	-	-	Data to send to the ICC

nInBufferSize 19 + uLDataLength

lpOutBuffer

Offset	Field	Size	Value	Description
0	*abStatus*	2	-	6400h: SPE operation timed out 6401h: SPE operation was cancelled by the "Cancel" button 6402h: Modify PIN operation failed because two "New PIN" entries do not match 6403h: User entered too short or too long PIN regarding MIN/MAX PIN Length. ***Note*****:** *ACR83 will not return this status because it checks the PIN length during input.* 6B80h: Invalid parameter in passed structure SW1SW2: Result from the card

nOutBufferSize 2

lpBytesReturned Pointer to a DWORD that receives the size, in bytes, of the data stored into the buffer pointed to by *lpOutBuffer*.

8.2.3. FEATURE_MODIFY_PIN_DIRECT

hCard Reference value returned from *SCardConnect*

dwControlCode CM_IOCTL_GET_FEATURE_REQUEST

lpInBuffer

Offset	Field	Size	Value	Description
0	*bTimeOut*	1	-	Number of seconds. If value is equal to 00h, then default value is used.
1	*bTimeOut2*	1	00h	Not supported. Number of seconds after first key stroke.
2	*bmFormatString*	1	-	Several parameters for the PIN format options. For more information, please refer to **Appendix A**.
3	*bmPINBlockString*	1	-	Defines the length in bytes of the PIN block to present in the APDU command. For more information, please refer to **Appendix B**.
4	*bmPINLengthFormat*	1	-	Allows the insertion of the PIN length in the APDU command. For more information, please refer to **Appendix C**.
5	*bInsertionOffsetOld*	1	-	Insertion position offset in byte for the current PIN
6	*bInsertionOffsetNew*	1	-	Insertion position offset in byte for the new PIN
7	*wPINMaxExtraDigit*	2	XXYYh	XXh: Maximum PIN size in digit YYh: Minimum PIN size in digit
9	*bConfirmPIN*	1	00h, 01h, 02h, 03h	Indicates if a confirmation is requested before acceptance of a new PIN (meaning that the user has to enter this new PIN twice before it is accepted) Indicates if the current PIN must be entered and set in the same APDU field of not. b0: (0/1) If 0 = No confirmation requested If 1 = Confirmation requested b1: (0/1) If 0 = No current PIN entry requested. (In this case, the *bInsertinoOffsetOld* value must not be taken into account.) If 1 = Current PIN entry requested b2 – b7: RFU

Offset	Field	Size	Value	Description
10	*bEntryValidationCondition*	1	-	The value is a bit wise OR operation. 01h = Maximum size reached 02h = Validation key pressed 04h = Timeout occurred
11	*bNumberMessage*	1	FFh	Number of messages to display for PIN verification
12	*wLangId*	2	0409h	Language for message
14	*bMsgIndex1*	1	00h	Index of 1st prompting message
15	*bMsgIndex2*	1	01h	Index of 2nd prompting message
16	*bMsgIndex3*	1	02h	Index of 3rd prompting message
17	*bTeoPrologue*	3	000000h	T=1 I-block prologue field to use (fill with 00h).
20	*ulDataLength*	4	-	Length of Data to be sent to the ICC
24	*abData*		-	Data to send to the ICC

nInBufferSize 24 + ulDataLength

lpOutBuffer

Offset	Field	Size	Value	Description
0	*abStatus*	2	-	6400h: SPE operation timed out 6401h: SPE operation was cancelled using the “Cancel” button 6402h: Modify PIN operation failed because two “New PIN” entries do not match 6403h: User entered too short or too long PIN regarding MIN/MAX PIN Length. ***Note*****:** *ACR83 will not return this status because it checks the PIN length during input.* 6B80h: Invalid parameter in passed structure SW1SW2: Result from the card

nOutBufferSize 2

lpBytesReturned Pointer to a DWORD that receives the size, in bytes, of the data stored into the buffer pointed to by *lpOutBuffer*.

8.2.4. FEATURE_IFD_PIN_PROP

hCard Reference value returned from *SCardConnect*.

dwControlCode Return from CM_IOCTL_GET_FEATURE_REQUEST.

lpInBuffer NULL

LpOutBuffer

Offset	Field	Size	Value	Description
0	*wLcdLayout*	2	0210h	Display characteristics: 2 lines, 16 characters per line
2	*bEntryValidationCondition*	1	07h	Support timeout reached, maximum PIN size reached, validation key pressed
3	*bTimeOut2*	1	00h	0 = IFD does not distinguish *bTimeOut* from *bTimeOut2* 1 = IFD distinguishes *bTimeOut* from *bTimeOut2*

nOutBufferSize 4

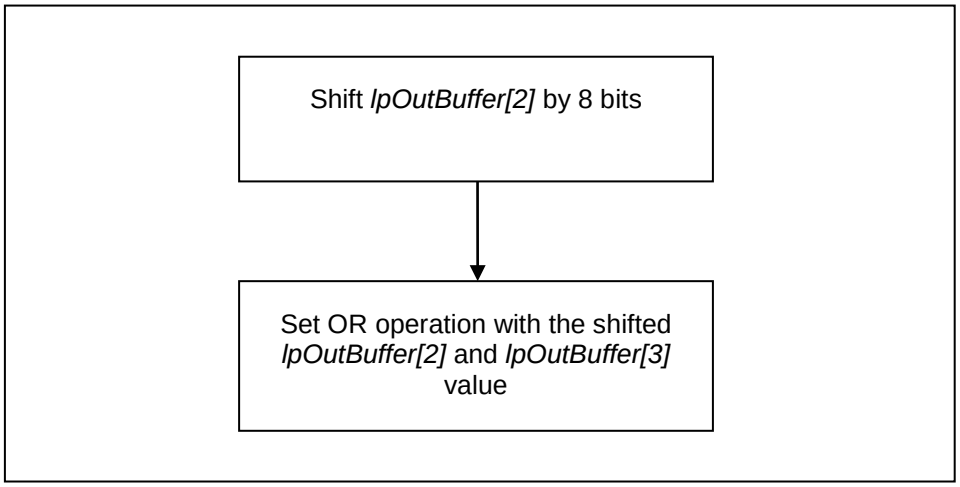
lpBytesReturned Pointer to a DWORD that receives the size, in bytes, of the data stored into the buffer pointed to by *lpOutBuffer*.

8.2.5. IOCTL_SMARTCARD_GET_FIRMWARE_VERSION

The IOCTL_SMARTCARD_GET_FIRMWARE_VERSION enables *Get Firmware Version* command.

8.2.5.1. Firmware Version

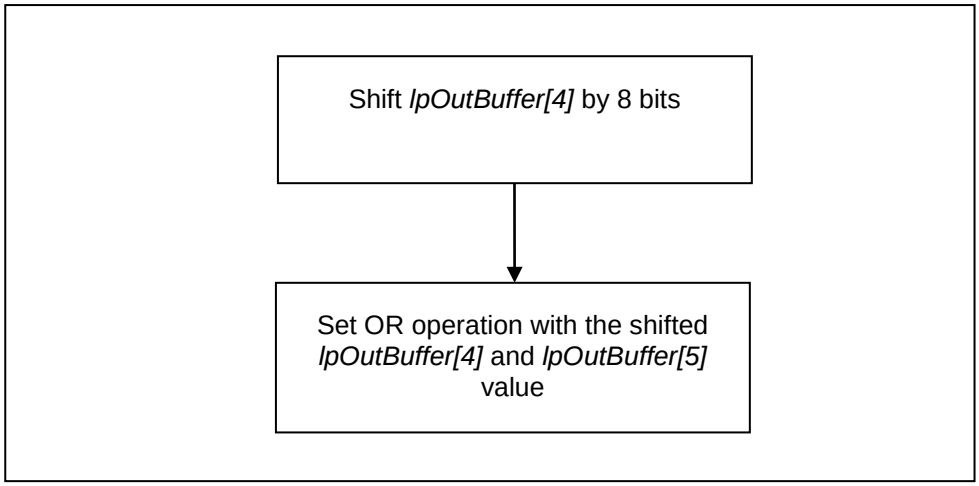
To acquire device firmware version, take the third element of the received buffer and shift it by 8 bits. Set the result to an OR operation together with the fourth element of the received buffer.



Example: Firmware_Version = (Common.RecvBuff[2] << 8) | Common.RecvBuff[3]);

8.2.5.2. LCD

To acquire the device's LCD, take the fifth element of the received buffer and shift it by 8 bits. Set the result to an OR operation together with the sixth element of the received buffer.



Input:

hCard	Reference value returned from *SCardConnect*
dwControlCode	IOCTL_SMARTCARD_GET_FIRMWARE_VERSION

Output:

lpOutBuffer	Output value of command

nOutBufferSize **sizeof**(ULONG) of l*pOutBuffer*

lpBytesReturned Pointer to a DWORD that receives the size, in bytes, of the data stored into the buffer pointed to by *lpOutBuffer*

Offset	Field	Size	Value	Description
0	*abStatus*	2	0000h	SUCCESS
2	*wACR83Firmware*	2		-
4	*LCD*	2		-

8.2.6. IOCTL_SMARTCARD_DISPLAY_LCD_MESSAGE

The IOCTL_SMARTCARD_DISPLAY_LCD_MESSAGE enables display LCD message command.

hCard Reference value returned from *SCardConnect*

dwControlCode IOCTL_SMARTCARD_DISPLAY_LCD_MESSAGE

lpInBuffer Set value for Display LCD message option

nInBufferSize **sizeof**(ULONG) of *lpInBuffer*

Offset	Field	Size	Value	Description
0	*abLCDmessage*	0-32	-	LCD message (maximum 32 characters)

Output:

lpOutBuffer Output value of command

nOutBufferSize **sizeof**(ULONG) of *lpOutBuffer*

lpBytesReturned Pointer to a DWORD that receives the size, in bytes, of the data stored into the buffer pointed to by *lpOutBuffer*

Offset	Field	Size	Value	Description
0	*abStatus*	2	0000h 0001h	SUCCESS BAD_PARAMETER

8.2.7. IOCTL_SMARTCARD_READ_KEY

The IOCTL_SMARTCARD_READ_KEY enables *Read Key* command.

Input:

hCard Reference value returned from *SCardConnect*

dwControlCode IOCTL_SMARTCARD_READ_KEY

lpInBuffer Set value for Display LCD message option

nInBufferSize **sizeof**(ULONG) of *lpInBuffer*

Offset	Field	Size	Value	Description
0	*bTimeOut*	1	-	Number of seconds. If value is equal to 00h, then the default value is used.
1	*wPINMaxExtraDigit*	2	XXYYh	XXh: Maximum PIN size in digit YYh: Minimum PIN size in digit
3	*bKeyReturnCondition*	1	-	The value is a bit wise OR operation. 01h: Maximum size reached 02h: Key [E] pressed 04h: Timeout occurred 08h: Key [C] pressed
4	*bEchoLCDStartPosition*	1	-	Starting position (0 – 31)
5	*bEchoLCDMode*	1	-	00h: Echo key press data ASCII representation to LCD 01h: Display all key presses as asterisks “*” on LCD

Output:

lpOutBuffer Output value of command

nOutBufferSize **sizeof**(ULONG) of *lpOutBuffer*

lpBytesReturned Pointer to a *DWORD* that receives the size, in bytes, of the data stored into the buffer pointed to by *lpOutBuffer*.

Offset	Field	Size	Value	Description
0	*abStatus*	2	0000h 0001h	SUCCESS BAD_PARAMETER
2	*bKeyReturnCondition*	1	31h 32h 33h 34h	Maximum size reached Key [E] pressed Timeout occurred Key [C] pressed
3	*abNumericInputKeys*	0-32	-	-

9.0. Operation Flow for PIN Verification and Modification (PC/SC 2.0 Part 10)

ACR83 reader supports **PC/SC 2.0 Part 10**. The flowchart below shows the PIN verification and modification operation.

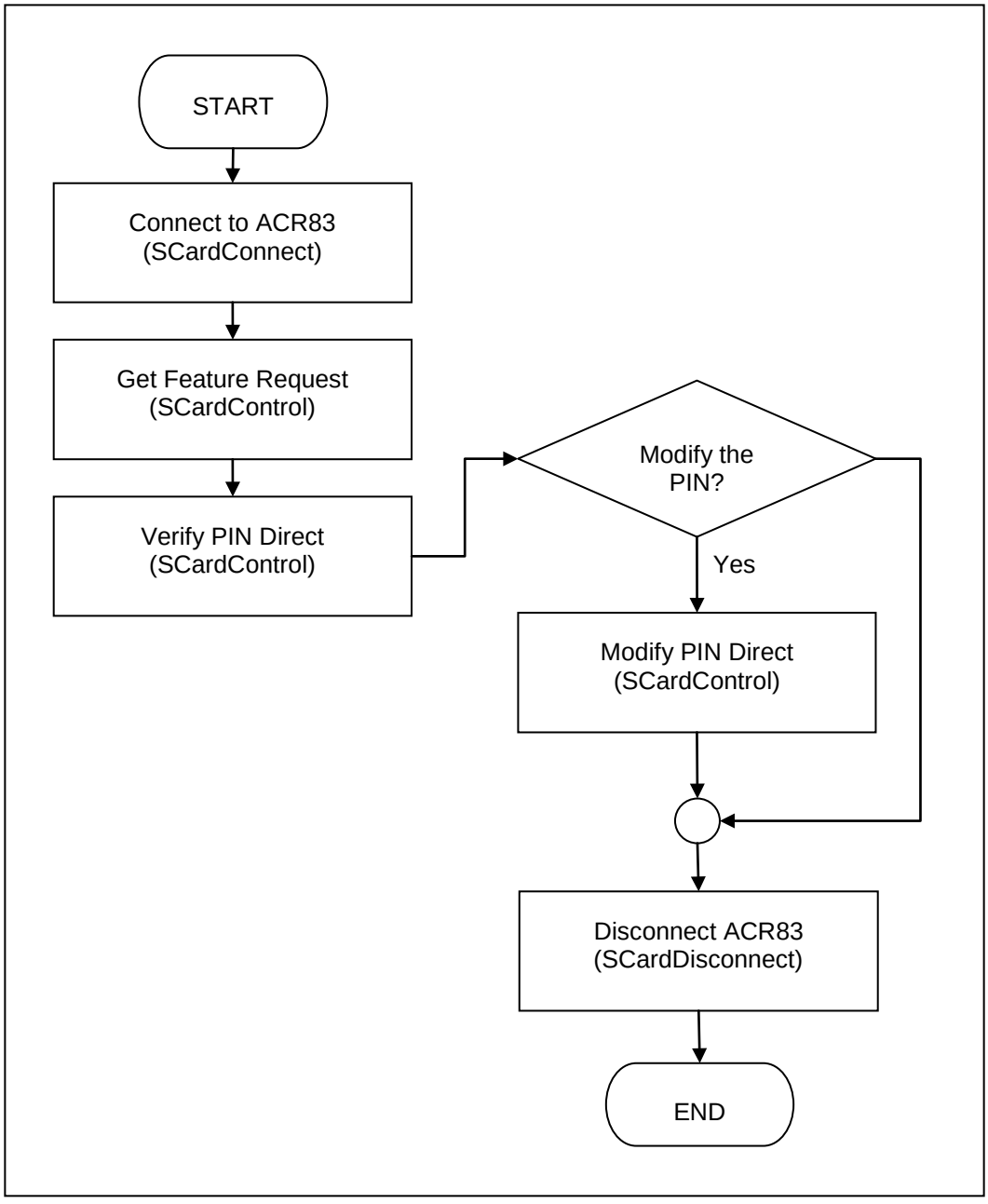


Figure 1: PIN Verification and Modification Operation Flowchart

To use the PIN verification and modification, the *SCardControl* API must be called with the Get Feature Request control code. This API will return a list of supported features from the reader.

In ACR83, only *Verify PIN Direct*, *Modify PIN Direct* and *IFD PIN Properties* are supported. To use these features, you can get the control codes from the list. For more information, please refer to PC/SC 2.0 Specification Part 10.

10.0.CCID SPE Data Structure

The ACR83 SPE is based on the CCID SPE which is fully compatible to CCOD SPE.

If the application uses the CCID SPE, it must use the CCID *PC_to_RDR_Secure* to send the APDU.

According to CCID specification, the SPE has two modes:

1. PIN Verification
2. PIN Modification

The Modes setting is based on CCID *abPINOperationDataStructure.* For more information, please refer to CCID specification 6.1.11.1.

bPINOperation:

00h: PIN Verification

01h: PIN Modification

Any other values will not be supported by ACR83.

11.0.PIN Verification Data Structure

bTimeOut Number of seconds for key press (00h: default value = 60 seconds)

abPINApdu *CLA INS P1 P2* Lc XX XX XX XX …

Example *abPINApdu* = 00 20 00 01 08 FF FF FF FF FF FF FF FFh

bmFormatString (Bit 7) 0h: means the system units is bit

1h: means the system units is byte

Bit 6~3 (*SpePinPos)*: PIN position after format in the APDU command

Bit2 (*SpeLeftRight*): 0=Left, 1=Right

Bit1~0 (*SpePINTyp*):

00h: Binary ex: 01 02 03 04 05 06

01h: BCD ex: 12 34 56

10h: ASCII ex: 31 32 33 34 35 36

bmPINBlockString:

Bit7~4 (*SpePINSize*):

Ex: 2 means 2*2 -1 = 4 - 1 allow maximum 3 digits PIN

If *SpePINSize* = 0, it means no PIN management.

Bit3~0 (*SpePINLen*): PIN block size in bytes after justification and formatting

bmPINLengthFormat:

Bit3~0 (*SpePINLenPos*): Indicate the PIN length position in the APDU command

If *SpePINLenPos* =0, it means no PIN management.

Bit4: 0: indicates if the *SpePINLenPos* is in bit or byte unit

wPINMaxExtraDigit:

XX: *(SpePinMin)* Minimum PIN Size

YY: *(SpePinMax)* Maximum PIN Size

bNumberMessage:

00h: No message display in LCD

01h: Display one message: LCD will display “Enter PIN:”

FFh: Default value equal to 01h

bMsgIndex:

00h: LCD will display “Enter PIN:”

Any other values will raise an error.

If the data structure format error, the ACR83 will give “6B 80h.”

For the system unit is bit (*bmFormatString* bit 7=0). The APDU formatting is total different with system unit is byte (*bmFormatString* bit 7=1).

11.1. Error Checking (Bit)

Verification system unit is bit.

Command Header		SpePINLen			
APDU Command Header	APDU Length	Offset *SpePINPos*			PIN
CLA INS P1 P2	*Lc*	Offset *SpePINLenPos*	*SpePINSize*	Not used field/may not exist	PIN

Check points in implementing the PIN Verification Data Structure:

- *SpePINLen* must be equal to *Lc*
- *SpePINPos* must be equal or larger than *SpePINLenPos* + *SpePINSize*
- *SpePINLen* – *SpePINPos* must be larger or equal to *SpePinMax* (if BCD, need multiple 4)
- *SpePinMax* must be equal or larger than *SpePinMin*
- *SpePinMax* cannot be larger than 16 digits because LCD one row only have 16 digits
- *SpePinMin* must be equal or larger than 1

11.2. Error Checking (Byte)

Check points in implementing the PIN Verification Data Structure:

- *Lc* must equal to *SpePINLen* + *SpePINPos*
- *SpePINPos* must be equal or larger than *SpePINLenPos* + *SpePINSize*
- *SpePINLen* – *SpePINPos* must be larger or equal to *SpePinMax* (if BCD, need multiple 4)
- *SpePinMax* must be equal or larger than *SpePinMin*
- *SpePinMax* cannot be larger than 16 digits because LCD one row only have 16 digits
- *SpePinMin* must be equal or larger than 1

Verification system unit is byte.

Command Header		Offset SpePINPos			SpePINLen
APDU Command Header	APDU Length	Offset *SpePINPos*			PIN
CLA INS P1 P2	Lc	Offset *SpePINLenPos*	*SpePINSize*	Not used field	PIN

11.3. Verification Example 1

System unit is bit.

Command Header		SpePINLen			
APDU Command Header	APDU Length	Offset *SpePINPos*			PIN
CLA INS P1 P2	*Lc*	Offset *SpePINLenPos*	*SpePINSize*	Not used field/may not exist	PIN

Check points in implementing the PIN Verification Data Structure:

- *SpePINLen* must be equal to *Lc*
- *SpePINPos* must be equal or larger than *SpePINLenPos* + *SpePINSize*
- *SpePINLen* – *SpePINPos* must be larger or equal to *SpePinMax* (if BCD, need multiple 4)
- *SpePinMax* must be equal or larger than *SpePinMin*
- *SpePinMax* cannot be larger than 16 digits because LCD one row only have 16 digits
- *SpePinMin* must be equal or larger than 1

abPINApdu = 00 20 00 01 09 57 30 30 30 30 30 30 30 30h

After *Lc* (09h), the first 7 bits (0101011) is control character.

bmFormatString=39h

SpePinPos=7 bits because *bmFormatString* bit 7 = 0

SpeLeftRight=Left

SpePINTyp=BCD

bmPINBlockString=49h

SpePINSize=4 bits

SpePINLen=9 bytes

bmPINLengthFormat=02h

SpePINLenPos=2 bits

wPINMaxExtraDigit=010Ah

SpePinMax=0Ah

SpePinMin=01h

PIN Input = 1 2 3 4 5 6 7 8 0

Error checks points:

- Point 1: *SpePINLen* (9h) equal to *Lc* (9h)
- Point 2: *SpePINPos* (7 bits) >= *SpePinLenPos* (2 bits) + *SpePINSize* (4 bits)
- Point 3: *SpePINLen* (9h) – *SpePinPos* (7 bits)[act as 1 byte] >=[*SpePinMax* (0Ah) * 4bits (BCD)] = 5 bytes

  : 8 bytes >=5 bytes
- Point 4: *SpePinMax* (0Ah) > *SpePinMin* (01h)
- Point 5: *SpePinMax* (0Ah)< =10h
- Point 6: *SpePinMin* (01h) >= 01h

Command Header		SpePINLen			
APDU Command Header	APDU Length	Offset *SpePINPos* 7 bits			PIN
00 20 00 01	09	Offset 2bits	*SpePINSize* (4 bits)	Not used field/may not exist	PIN
00 20 00 01	09	01	Input 9 digits	Offset 6 bit relative to *Lc*	PIN
00 20 00 01	09	**01**=**01**01011	**1001** (bits)	**1** (bit)=0101011	PIN
00 20 00 01	09	**0110011** (**1001** replace original 01**0101**1)			PIN

The PIN management is BCD and left arrangement.

	PIN (bits)
Original	1 0011 0000 0011 0000 0011 0000 0011 0000 0011 0000 0011 0000 0011 0000 1100 0000
Input 12 34 56 78 0 (change to bit format)	0001 0010 0011 0100 0101 0110 0111 1000 0000
Original	1 0011 0000 0011 0000 0011 0000 0011 0000 0011 0000 0011 0000 0011 0000 1100 0000
Input PIN	0 0010 0100 0110 1000 1010 1100 1111 0000 000
Result PIN	0 0010 0100 0110 1000 1010 1100 1111 0000 0001 0000 0011 0000 0011 0000 1100 0000
Result APDU in bit format	0110 0110 0010 0100 0110 1000 1010 1100 1111 0000 0001 0000 0011 0000 0011 0000 0011 0000
Result APDU in byte format	66 24 68 ac f0 10 30 30 30

The whole APDU in byte format will be:

00 20 00 01 09 66 24 68 AC F0 10 30 30 30h

If arrangement is Right:

bmFormatString change to=3Dh

00 20 00 01 09 67 30 30 30 31 23 45 67 80h

11.4. Verification Example 2

System unit is bit.

abPINApdu = 00 20 00 01 08 57 A5 30 30 30 30 30 30h

After *Lc* (08h), the first 11 bits (01010111 101) is control character.

bmFormatString=59h

SpePinPos=11 bits because *bmFormatString* bit 7 = 0

SpeLeftRight=Left

SpePINTyp=BCD

bmPINBlockString=48h

SpePINSize=4 bits

SpePINLen=8 bytes

bmPINLengthFormat=06h

SpePINLenPos=6 bits

wPINMaxExtraDigit=0108h

SpePinMax=08h

SpePinMin=01h

PIN Input = 1 2 3 4 5

Command Header		**SpePINLen**			
APDU Command Header	APDU Length	Offset *SpePINPos* 7 bits			PIN
00 20 00 01	08	Offset 6 bits	*SpePINSize* (4bits)	Not used field/may not exist	PIN
00 20 00 01	08	01010111 101	Input 5 digits	Offset 6 bit relative to *Lc*	PIN
00 20 00 01	08	010101	0101 (bits)	1 (bit)= 01010111 101	PIN
00 20 00 01	08	01010101 011 (0101 replace original 01010111 1011)			PIN

The PIN management is BCD and left arrangement.

	PIN (bits)
Original	0 0101 0011 0000 0011 0000 0011 0000 0011 0000 0011 0000 0011 0000
Input 12 34 5 (change to bit format)	0001 0010 0011 0100 0101
Original	0 0101 0011 0000 0011 0000 0011 0000 0011 0000 0011 0000 0011 0000
Input PIN	0 0010 0100 0110 1000 101

	PIN (bits)
Result PIN	0 0010 0100 0110 1000 1010 0011 0000 0011 0000 0011 0000 0011 0000
Result APDU in bit format	0101 0101 0110 0010 0100 0110 1000 1010 0011 0000 0011 0000 0011 0000 0011 0000
Result APDU in byte format	55 62 46 8A 30 30 30 30

The whole APDU in byte format will be:

00 20 00 01 08 55 62 46 8A 30 30 30 30h

If arrangement is Right:

bmFormatString change to=5Dh

00 20 00 01 08 55 65 30 30 30 31 23 45h

11.5. Verification Example 3

System unit is Byte.

Command Header		Offset SpePINPos			SpePINLen
APDU Command Header	APDU Length	Offset *SpePINPos*			PIN
CLA INS P1 P2	*Lc*	Offset *SpePINLenPos*	*SpePINSize*	Not used field	PIN

Check points in implementing the PIN Verification Data Structure:

- *Lc* must be equal to *SpePINLen* + *SpePINPos*
- *SpePINPos* must be equal or larger than *SpePINLenPos* + *SpePINSize*
- *SpePINLen* – *SpePINPos* must be larger or equal to *SpePinMax*(if BCD, need multiple 4)
- *SpePinMax* must be equal or larger than *SpePinMin*
- *SpePinMax* cannot be larger than 16 digits because LCD one row only have 16 digits
- *SpePinMin* must be equal or larger than 1

Example1:

abPINApdu = 00 20 00 01 09 57 30 30 30 30 30 30 30 30h

After *Lc* (09h), the first 1 byte 57h is control character.

bmFormatString = 89h

SpePinPos = 1 byte because *bmFormatString* bit 7 = 1

SpeLeftRight = Left

SpePINTyp = BCD

bmPINBlockString = 48h

SpePINSize = 4 bits

SpePINLen = 8 bytes

bmPINLengthFormat = 04h

SpePINLenPos = 4 bits

wPINMaxExtraDigit = 010ah

SpePinMax = 0ah

SpePinMin = 01h

PIN Input = 1 2 3 4 5 6 7 8 0

- Point 1: *SpePINLen* (9) equal to *SpePINLen* (8) + *SpePinPos* (1)
- Point 2: *SpePINPos* (1 Byte) >= *SpePinLenPos* (4 bits) + *SpePINSize* (4 bits)
- Point 3: *SpePINLen* (9) – *SpePinPos* (1 Byte) >=[*SpePinMax* (0Ah) * 4bits(BCD)] = 5 Bytes
  : 8 Bytes >=5 Bytes
- Point 4: *SpePinMax* (0Ah) > *SpePinMin* (01h)
- Point 5: *SpePinMax* (0Ah) < =10h
- Point 6: *SpePinMin* (01h) >= 01h

Command Header		SpePINPos			SpePINLen
APDU Command Header	*Lc*	Offset *SpePINPos* (1 Byte)			PIN
00 20 00 01	09	Offset (4 bits)	*SpePINSize* (4 bits)	Not used field	PIN
00 20 00 01	09	57h	Input 9 digits	Does not exist	PIN
00 20 00 01	09	**0101**=**0101**0111	**1001** (bits)	Does not exist	PIN
00 20 00 01	09	**01011001** (59h) (**1001** replace original 0101**0111**)			PIN

The PIN management is BCD and left arrangement.

	PIN (Byte)
Original	00 20 00 01 09 57 30 30 30 30 30 30 30 30
Input	12 34 56 78 0
Result PIN	00 20 00 01 09 59 12 34 56 78 00 30 30 30

The whole APDU in byte format will be:

00 20 00 01 09 59 12 34 56 78 00 30 30 30h

If arrangement is Right:

bmFormatString change to = 8Dh

00 20 00 01 08 59 30 30 30 31 23 45 67 80h

12.0.PIN Modification Data Structure

The following subsections will discuss the PIN Modification Data Structure.

bTimeOut: Number of seconds for key press (00h: default value = 60 seconds)

abPINApdu = CLA INS P1 P2 Lc XX XX XX XXh …

For *bConfirmPIN* bit1 =0

Ex: *abPINApdu* = 00 24 00 01 08 FF FF FF FF FF FF FF FFh
(New PIN)

For *bConfirmPIN* bit1 =1

Ex: *abPINApdu* = 00 24 00 01 10 20 FF FF FF FF FF FF FF 20 FF FF FF FF FF FF FFh
(Old/Current PIN) (New PIN)

bmFormatString (Bit 7):

0: means the system units is bit

1: means the system units is byte

Bit 6~3 (*SpePinPos*): PIN position after format in the APDU command

Bit2 (*SpeLeftRight*): 0=Left, 1=Right

Bit1~0 (*SpePINTyp*):

00h: Binary ex: 01 02 03 04 05 06

01h: BCD ex: 12 34 56

10h: ASCII ex: 31 32 33 34 35 36

bmPINBlockString:

Bit7~4 (*SpePINSize*):

Ex: 2 means 2*2 -1 = 4 - 1 allow maximum 3 digits PIN

If *SpePINSize* = 0, it means no PIN management.

Bit3~0 (*SpePINLen*): PIN block size in bytes after justification and formatting

bmPINLengthFormat:

Bit3~0 (*SpePINLenPos*): indicates the PIN length position in the APDU command

If *SpePINLenPos* =0, it means no PIN management.

Bit4: 0: indicates if the *SpePINLenPos* is in bit or byte unit

bInsertionOffsetOld (*SpeOffsetOld*): insertion position offset in byte for the current PIN

bInsertionOffsetNew (*SpeOffsetNew*): insertion position offset in byte for the new PIN

bConfirmPIN:

Bit 0: 0=no confirmation of New PIN request 1: Confirmation of New PIN request

Bit 1: 0=no Old (current) PIN entry request 2: Old (current) PIN entry request

00h: *bNumberMessage* must be equal to 00h or 01h

01h: *bNumberMessage* must be equal to 02h

02h: *bNumberMessage* must be equal to 02h

03h: *bNumberMessage* must be equal to 03h

Otherwise, it will raise an error.

wPINMaxExtraDigit:

XX: (*SpePinMin*) Minimum PIN Size

YY: (*SpePinMax*) Maximum PIN Size

bMsgIndex1:

00h: LCD will display “Enter PIN:”

Any other values will raise an error.

bMsgIndex2:

01h: LCD will display “Enter New PIN:”

Any other values will raise an error.

bMsgIndex3:

02h: LCD will display “Enter Confirm PIN:”

Any other values will raise an error.

12.1. Modification (Bit) bConfirmPIN Bit1=0

Modification *bConfirmPIN* Bit1 = 0

(No current/Old PIN entry requested)

System unit is bit.

APDU Command		SpeOffsetNew	SpePINLen			
APDU Header	APDU Lc	Maybe not	Offset *SpePINPos*			PIN
CLA INS P1 P2	Lc	Exists	Offset *SpePINLenPos*	*SpePINSize*	Not used field/Does not exist	PIN

12.2. Modification (Bit) bConfirmPIN Bit1=0 Data Structure Error Checking

Check points in implementing the PIN Modification Data Structure:

- *SpePINLen* + *SpeOffsetNew* must be equal to Lc
- *SpePINPos* must be equal or larger than *SpePINLenPos* + *SpePINSize*
- *SpePINLen* – *SpePINPos* must be larger or equal to *SpePinMax*(if BCD, need multiple 4)
- *SpePinMax* must be equal or larger than *SpePinMin*
- *SpePinMax* cannot be larger than 16 digits because LCD one row only have 16 digits
- *SpePinMin* must be equal or larger than 1

12.3. Modification (Byte) bConfirmPIN Bit1=0

Modification *bConfirmPIN* Bit1 = 0

(No current/Old PIN entry requested)

System unit is byte.

Command Header		OffsetNew	Offset SpePINPos			SpePINLen
APDU Command Header	APDU Lc	*OffsetNew*	Offset *SpePINPos*			PIN
CLA INS P1 P2	Lc	*OffsetNew*	Offset *SpePINLenPos*	*SpePINSize*	Not used field	PIN

12.4. Modification (Byte) bConfirmPIN Bit1=0 Data Structure Error Checking

Check points in implementing the PIN Modification Data Structure:

- Lc must be equal to *SpePINLen* + *SpePINPos* + *SpeOffsetNew*
- *SpePINPos* must be equal or larger than SpePINLenPos + SpePINSize
- *SpePINLen* – *SpePINPos* must be larger or equal to *SpePinMax*(if BCD, need multiple 4)
- *SpePinMax* must be equal or larger than *SpePinMin*
- *SpePinMax* cannot be larger than 16 digits because LCD one row only have 16 digits
- *SpePinMin* must be equal or larger than 1

12.5. Modification (Bit) bConfirmPIN Bit1=1

bConfirmPIN Bit1 = 1

(Current/Old PIN entry requested)

System unit is bit.

APDU Command		SpeOffsetOld	SpePINLen			
APDU Header	APDU Lc	Maybe not	Offset *SpePINPos*			Old PIN
CLA INS P1 P2	Lc	Exist	Offset *SpePINLenPos*	*SpePINSize*	Not used field	Old PIN

SpeOffsetNew	SpePINLen			
Maybe not	Offset *SpePINPos*			New PIN
Exist	Offset *SpePINLenPos*	*SpePINSize*	Not used field	New PIN

12.6. Modification (Bit) bConfirmPIN Bit1=1 Data Structure Error Checking

Check points in implementing the PIN Modification Data Structure:

- *SpePINLen* + *SpeOffsetNew* must equal to Lc
- *SpeOffsetNew* >= *SpeOffsetOld* + *SpePINLen*
- *SpePINPos* must be equal or larger than *SpePINLenPos* + *SpePINSize*
- *SpePINLen* – *SpePINPos* must be larger or equal to *SpePinMax* (if BCD, need multiple 4)
- *SpePinMax* must be equal or larger than *SpePinMin*
- *SpePinMax* cannot be larger than 16 digits because LCD one row only have 16 digits
- *PinMin* must be equal or larger than 1

12.7. Modification (Byte) bConfirmPIN Bit1=1

bConfirmPIN Bit1 = 1

(Current/Old PIN entry requested)

System unit is byte.

APDU Command		SpeOffsetOld	Offset SpePINPos			SpePINLen
APDU Header	APDU Lc	Maybe not	Offset *SpePINPos*			Old PIN
CLA INS P1 P2	Lc	Exist	Offset *SpePINLenPos*	*SpePINSize*	Not used field	Old PIN

SpeOffsetNew	Offset SpePINPos			SpePINLen
Maybe not	Offset *SpePINPos*			New PIN
Exists	Offset *SpePINLenPos*	*SpePINSize*	Not used field	New PIN

12.8. Modification (Byte) bConfirmPIN Bit1=1 Data Structure Error Checking

Check points in implementing the PIN Modification Data Structure:

- *SpePINLen* + *SpeOffsetNew* + *SpePINPos* must equal to Lc
- *SpeOffsetNew* >= *SpeOffsetOld* + *SpePINPos* + *SpePINLen*
- *SpePINPos* must be equal or larger than *SpePINLenPos* + *SpePINSize*
- *SpePINLen* – *SpePINPos* must be larger or equal to *SpePinMax*(if BCD, need multiple 4)
- *SpePinMax* must be equal or larger than *SpePinMin*
- *SpePinMax* cannot be larger than 16 digits because LCD one row only have 16 digits
- *SpePinMin* must be equal or larger than 1

12.9. Modification Example 1

Modification *bConfirmPIN* Bit1 = 0

(No current/Old PIN entry requested)

System unit is bit.

APDU Command		SpeOffsetNew	SpePINLen			
APDU Header	APDU Lc	Maybe not	Offset *SpePINPos*			PIN
CLA INS P1 P2	Lc	Exists	Offset *SpePINLenPos*	*SpePINSize*	Not used field/Does not exist	PIN

Check points in implementing the PIN Modification Data Structure:

- *SpePINLen* + *SpeOffsetNew* must be equal to Lc
- *SpePINPos* must be equal or larger than *SpePINLenPos* + *SpePINSize*
- *SpePINLen* – *SpePINPos* must be larger or equal to *SpePinMax*(if BCD, need multiple 4)
- *SpePinMax* must be equal or larger than *SpePinMin*
- *SpePinMax* cannot be larger than 16 digits because LCD one row only have 16 digits
- *SpePinMin* must be equal or larger than 1

abPINApdu = 00 24 00 01 0A 20 57 30 30 30 30 30 30 30 30h

bConfirmPIN = 00h (if *bConfirmPIN* = 00h, the *bNumberMessage* must equal to 01h, 00h)

Enter the New PIN once.

bmFormatString = 39h

SpePinPos = 7 bits because *bmFormatString* bit 7 = 0

SpeLeftRight = Left

SpePINTyp = BCD

bmPINBlockString = 49h

SpePINSize = 4 bits

SpePINLen = 9 bytes

bmPINLengthFormat = 02h

SpePINLenPos = 2 bits

wPINMaxExtraDigit = 010Ah

SpePinMax = 0Ah

SpePinMin = 0Ah

bInsertionOffsetNew(SpeOffsetNew)=01h

SpeOffsetNew =1 byte

bNumberMessage = 01h

Show “Enter New PIN:”

If *bNumberMessage* = 00h

No message will be shown, but user needs to input the PIN.

New PIN Input = 1 2 3 4 5 6 7 8 0

- Point 1: Lc (0A) equal to *SpePINLen* (09) + *SpeOffsetNew* (01h)
- Point 2: *SpePINPos* (7 bits) >= *SpePinLenPos* (2 bits) + *SpePINSize* (4 bits)
- Point 3: *SpePINLen* (9) – *SpePinPos* (7 bits)[act as 1 byte] >= [*SpePinMax* (0Ah) * 4 bits (BCD)] = 5 bytes

  : 8 bytes >=5 bytes
- Point 4: *SpePinMax* (0Ah) > *SpePinMin* (01h)
- Point 5: *SpePinMax* (0Ah) < =10h
- Point 6: *SpePinMin* (01h) >= 01h

Command Header		OffsetNew	SpePINLen			
APDU Header	APDU *Lc*	*OffsetNew*	Offset *SpePINPos* 7 bits			PIN
00 24 00 01	09	Offset	Offset (2 bits)	*SpePINSize* (4 bits)	Not used field/Does not exist	PIN
00 24 00 01	09	1 byte	01	Input 9 digits	Offset 6 bit relative to *Lc*	PIN
00 24 00 01	09	20	**01**=**01**01011	**1001** (bits)	**1** (bit)=0101011	PIN
00 24 00 01	09	20	**0110011** (**1001** replace original 01**01011**)			PIN

The PIN management is BCD and left arrangement.

	PIN (bits)
Original	1 0011 0000 0011 0000 0011 0000 0011 0000 0011 0000 0011 0000 1100 0000
Input 12 34 56 78 0 (change to bit format)	0001 0010 0011 0100 0101 0110 0111 1000 0000
Original	1 0011 0000 0011 0000 0011 0000 0011 0000 0011 0000 0011 0000 1100 0000
Input New PIN	0 0010 0100 0110 1000 1010 1100 1111 0000 000
Result PIN	0 0010 0100 0110 1000 1010 1100 1111 0000 0001 0000 0011 0000 0011 0000 1100 0000
Result APDU in bit format	0110 0110 0010 0100 0110 1000 1010 1100 1111 0000 0001 0000 0011 0000 0011 0000 0011 0000
Result APDU in byte format	66 24 68 ac f0 10 30 30 30

The whole APDU in byte format will be:

00 24 00 01 0A 20 66 24 68 ac f0 10 30 30 30h

If arrangement is Right:

bmFormatString change to = 3Dh

00 24 00 01 0A 20 67 30 30 30 31 23 45 67 80h

If *SpeOffsetNew* = 00h and *abPINApdu* = 00 24 00 01 09 57 30 30 30 30 30 30 30 30h

bmFormatString change to = 39h

The result formatting APDU = 00 24 00 01 09 66 24 68 AC F0 10 30 30 30h

12.10. Modification Example 2

It is the same as example 1, only *bConfirmPIN* is changed to 01h.

abPINApdu = 00 24 00 01 0A 20 57 30 30 30 30 30 30 30 30h

bConfirmPIN = 01h (If bConfirmPIN=01h, *bNumberMessage* must equal to 02h)

Enter the New PIN and confirm the New PIN.

bmFormatString = 39h

SpePinPos = 7 bits because *bmFormatString* bit 7 = 0

SpeLeftRight = Left

SpePINTyp = BCD

bmPINBlockString = 49h

SpePINSize = 4 bits

SpePINLen = 9 bytes

bmPINLengthFormat = 02h

SpePINLenPos = 2 bits

wPINMaxExtraDigit = 010Ah

SpePinMax = 0Ah

SpePinMin = 01h

bInsertionOffsetNew (SpeOffsetNew) = 01h

SpeOffsetNew = 1 byte

bNumberMessage = 02h

Show “Enter New PIN:” and

Show “Enter Confirm PIN”

New PIN Input = 1 2 3 4 5 6 7 8 0

- Point 1: Lc (0Ah) equal to *SpePINLen* (09) + *SpeOffsetNew* (01h)
- Point 2: *SpePINPos* (7 bits) >= *SpePinLenPos* (2 bits) + *SpePINSize* (4 bits)
- Point 3: *SpePINLen* (9) – *SpePinPos* (7 bits) [act as 1 byte] >= [*SpePinMax* (0Ah) * 4 bits (BCD)] = 5 bytes

  : 8 bytes >=5 bytes
- Point 4: *SpePinMax* (0Ah) > *SpePinMin* (01h)
- Point 5: *SpePinMax* (0Ah) < 10h
- Point 6: *SpePinMin* (01h) >= 01h

Command Header		**OffsetNew**	**SpePINLen**			
APDU Header	APDU *Lc*	*OffsetNew*	Offset *SpePINPos* 7 bits			PIN
00 24 00 01	09	Offset	Offset (2 bits)	*SpePINSize* (4 bits)	Not used field/Does not exist	PIN
00 24 00 01	09	1 byte	01	Input 9 digits	Offset 6 bit relative to *Lc*	PIN
00 24 00 01	09	20	**01**=**01**01011	**1001**(bits)	**1** (bit)=0101011	PIN
00 24 00 01	09	20	**0110011** (**1001** replace original 0101011)			PIN

The PIN management is BCD and left arrangement.

	PIN (bits)
Original	1 0011 0000 0011 0000 0011 0000 0011 0000 0011 0000 0011 0000 0011 0000 1100 0000
Input 12 34 56 78 0 (change to bit format)	0001 0010 0011 0100 0101 0110 0111 1000 0000
Original	1 0011 0000 0011 0000 0011 0000 0011 0000 0011 0000 0011 0000 0011 0000 1100 0000
Input New PIN	0 0010 0100 0110 1000 1010 1100 1111 0000 000
Result PIN	0 0010 0100 0110 1000 1010 1100 1111 0000 0001 0000 0011 0000 0011 0000 1100 0000
Result APDU in bit format	0110 0110 0010 0100 0110 1000 1010 1100 1111 0000 0001 0000 0011 0000 0011 0000 0011 0000
Result APDU in byte format	66 24 68 AC F0 10 30 30 30

The whole APDU in byte format will be:

00 24 00 01 0A 20 66 24 68 ac f0 10 30 30 30h

If arrangement is Right:

bmFormatString change to=3Dh

00 24 00 01 0A 20 67 30 30 30 31 23 45 67 80h

If *SpeOffsetNew* = 00h and *abPINApdu* = 00 24 00 01 09 57 30 30 30 30 30 30 30 30h

bmFormatString change to=39h

The result formatting APDU = 00 24 00 01 09 66 24 68 ac f0 10 30 30 30h

12.11. Modification Example 3

bConfirmPIN Bit1 = 0

(No current/Old PIN entry requested)

System unit is Byte.

Command Header		OffsetNew	Offset SpePINPos			SpePINLen
APDU Command Header	APDU *Lc*	*OffsetNew*	Offset *SpePINPos*			PIN
CLA INS P1 P2	*Lc*	*OffsetNew*	Offset *SpePINLenPos*	*SpePINSize*	Not used field	PIN

Check points in implementing the PIN Modification Data Structure:

1. *Lc* must be equal to *SpePINLen* + *SpePINPos* + SpeOffsetNew
2. *SpePINPos* must be equal or larger than *SpePINLenPos* + *SpePINSize*
3. *SpePINLen* – *SpePINPos* must be larger or equal to *SpePinMax* (if BCD, need multiple 4)

4. *SpePinMax* must be equal or larger than *SpePinMin*
5. *SpePinMax* cannot be larger than 16 digits because LCD one row only have 16 digits
6. *SpePinMin* must be equal or larger than 1

abPINApdu = 00 24 00 01 09 57 30 30 30 30 30 30 30 30h
After *Lc* (09h), the first 1 byte 57h is control character

bConfirmPIN = 01h (If *bConfirmPIN*=01h, *bNumberMessage* must equal to 02h)
Enter the New Pin and confirm the New Pin

bmFormatString = 89h
SpePinPos = 1 byte because *bmFormatString* bit 7 = 1
SpeLeftRight = Left
SpePINTyp = BCD

bmPINBlockString = 48h
SpePINSize = 4 bits
SpePINLen = 8 bytes

bmPINLengthFormat = 04h
SpePINLenPos = 4 bits

wPINMaxExtraDigit = 010Ah
SpePinMax = 0Ah
SpePinMin = 01h

bInsertionOffsetNew (*SpeOffsetNew*)=00h
SpeOffsetNew =00 byte

bNumberMessage=02h
Show “Enter New PIN:” and
Show “Enter Confirm PIN”

PIN Input = 1 2 3 4 5 6 7 8 0

- Point 1: *Lc* (*9*) equal to *SpeOffsetNew* (0) + *SpePINLen* (*8*) + *SpePinPos* (*1*)
- Point 2: *SpePINPos* (1 Byte) >= *SpePinLenPos* (4 bits) + *SpePINSize* (4 bits)
- Point 3: *SpePINLen* (9) – *SpePinPos* (1 Byte) >=[*SpePinMax* (0Ah*)* * 4 bits(BCD)] = 5 bytes
  : 8 bytes >=5 bytes

- Point 4: *SpePinMax* (0Ah) > *SpePinMin* (01h)
- Point 5: *SpePinMax* (0Ah) < =10h
- Point 6: *SpePinMin* (01h) >= 01h

Command Header		SpePINPos			SpePINLen
APDU Command Header	*Lc*	Offset *SpePINPos* 1 Byte			PIN
00 24 00 01	09	Offset (4 bits)	*SpePINSize* (4bits)	Not used field	PIN
00 24 00 01	09	57h	Input 9 digits	Does not exist	PIN
00 24 00 01	09	**0101**=**0101**0111	**1001**(bits)	Does not exist	PIN
00 24 00 01	09	**01011001** (59h) (**1001** replace original 0101**0111**)		-	PIN

The PIN management is BCD and left arrangement.

	PIN (Byte)
Original	00 24 00 01 09 57 30 30 30 30 30 30 30 30h
Input	12 34 56 78 0h
Result PIN	00 24 00 01 09 59 12 34 56 78 00 30 30 30h

The whole APDU in byte format will be:

00 24 00 01 09 59 12 34 56 78 00 30 30 30h

If arrangement is Right:

bmFormatString change to = 8Dh

00 24 00 01 08 59 30 30 30 31 23 45 67 80h

12.12. Modification Example 4

bConfirmPIN Bit1 = 1

(Current/Old PIN entry requested)

System unit is bit.

APDU Command		SpeOffsetOld	SpePINLen			
APDU Header	APDU Lc	Maybe not	Offset *SpePINPos*			Old PIN
CLA INS P1 P2	Lc	Exists	Offset *SpePINLenPos*	*SpePINSize*	Not used field	Old PIN

SpeOffsetNew	SpePINLen			
Maybe not	Offset *SpePINPos*			New PIN
Exists	Offset *SpePINLenPos*	*SpePINSize*	Not used field	New PIN

Check points in implementing the PIN Modification Data Structure:

- *SpePINLen* + *SpeOffsetNew* must be equal to Lc
- *SpeOffsetNew* > = *SpeOffsetOld* + *SpePINLen*
- *SpePINPos* must be equal or larger than *SpePINLenPos* + *SpePINSize*
- *SpePINLen* – *SpePINPos* must be larger or equal to *SpePinMax* (if BCD, need multiple 4)
- *SpePinMax* must be equal or larger than *SpePinMin*
- *SpePinMax* cannot be larger than 16 digits because LCD one row only have 16 digits
- *SpePinMin* must be equal or larger than 1

abPINApdu = 00 24 00 01 12 08 02 30 30 30 30 30 30 30 09 03 30 30 30 30 30 30 30h

bConfirmPIN = 02h (if *bConfirmPIN* =02h , *bNumberMessage* must equal to 02h)

bmFormatString = 41h

SpePinPos = 8 bit because *bmFormatString* bit 7 = 0

SpeLeftRight = Left

SpePINTyp = BCD

bmPINBlockString = 48h

SpePINSize = 4 bits

SpePINLen = 8 bytes

bmPINLengthFormat = 04h

SpePINLenPos = 4 bits

wPINMaxExtraDigit = 010Ah

SpePinMax = 0Ah

SpePinMin = 01h

bInsertionOffsetNew(SpeOffsetNew) = 0Ah

SpeOffsetNew = 0Ah byte

bInsertionOffsetOld (SpeOffsetOld) = 01h

SpeOffsetOld = 01h byte

PIN Input (Old/Current PIN) = 1 2 3 4 5 6

PIN Input (New PIN) = 1 2 3 4 5 6 7 8 9 0

bNumberMessage = 02h

Show “Enter PIN:” means enter the old/current PIN and

Show “Enter New PIN”

- Point 1: Lc (12h) equal to *SpeOffsetNew* (0Ah) + *SpePINLen* (8)
- Point 2: *SpeOffsetNew* (0Ah) >= *SpeOffsetOld* (1) + *SpePINLen* (8)
- Point 3: *SpePINPos* (8 bits) >= *SpePinLenPos* (4 bits) + *SpePINSize* (4 bits)
- Point 4: *SpePINLen* (8) – *SpePinPos* (4 bits) >=[*SpePinMax* (0Ah) * 4bits(BCD)] = 5 bytes
  : 7.5 bytes >=5 bytes
- Point 5: *SpePinMax* (0Ah) > *SpePinMin* (01h)
- Point 6: *SpePinMax* (0Ah) < =10h
- Point 7: *SpePinMin* (01h) > = 01h

Command Header		**OffsetOld**	**SpePINLen**			
APDU Header	APDU Lc	OffsetOld	Offset *SpePINPos* 8 bits = 1byte			Old PIN
00 24 00 01	12	Offset	Offset (4 bits)	*SpePINSize* (4 bits)	Not used field	Old PIN
00 24 00 01	12	1 byte	02	Input 6 digits	-	Old PIN
00 24 00 01	12	08	**0000**=0000**0010**	**0110** (bits)	-	Old PIN
00 24 00 01	12	08	**00000110** (**0110** replace original 0000**0010**)		-	Old PIN

OffsetNew	**SpePINLen**			
OffsetNew	Offset *SpePINPos* 8 bits = 1byte			New PIN
Offset	Offset (4 bits)	*SpePINSize* (4 bits)	Not used field	New PIN
0A bytes	03	Input 10 digits	-	New PIN
relative to Lc	**00**=**0000**0011	**1010** (bits)	-	New PIN
09	**00001010** (**1010** replace original 0000**0011**)		-	New PIN

First, handle the old PIN.

	Old PIN (Byte)

	Old PIN (Byte)
Original	00 24 00 01 12 08 02 30 30 30 30 30 30 30 09 03 30 30 30 30 30 30 30
Input	12 34 56
Result PIN	00 24 00 01 12 08 06 12 34 56 30 30 30 30 09 03 30 30 30 30 30 30 30

And then, handle the New PIN.

	New PIN (Byte)
Original	00 24 00 01 12 08 06 12 34 56 30 30 30 30 09 03 30 30 30 30 30 30 30h
Input	12 34 56 78 90h
Result PIN	00 24 00 01 12 08 06 12 34 56 30 30 30 30 09 0A 12 34 56 78 90 30 30h

The whole APDU after the format will be:

00 24 00 01 12 08 06 12 34 56 30 30 30 30 09 0A 12 34 56 78 90 30 30h

12.13. Modification Example 5

BConfirmPIN Bit1 = 1

(Current/Old PIN entry requested)

System unit is byte.

APDU Command		SpeOffsetOld	Offset SpePINPos			SpePINLen
APDU Header	APDU Lc	Maybe not	Offset *SpePINPos*			Old PIN
CLA INS P1 P2	Lc	Exists	Offset *SpePINLenPos*	*SpePINSize*	Not used field	Old PIN

SpeOffsetNew	Offset SpePINPos			SpePINLen
Maybe not	Offset *SpePINPos*			New PIN
Exists	Offset *SpePINLenPos*	*SpePINSize*	Not used field	New PIN

Check points in implementing the PIN Modification Data Structure:

- *SpePINLen* + *SpeOffsetNew* + *SpePINPos* must be equal to Lc
- *SpeOffsetNew* >= *SpeOffsetOld* + *SpePINPos* + *SpePINLen*
- *SpePINPos* must be equal or larger than *SpePINLenPos* + *SpePINSize*
- *SpePINLen* – *SpePINPos* must be larger or equal to *SpePinMax* (if BCD, need multiple 4)
- *SpePinMax* must be equal or larger than *SpePinMin*
- *SpePinMax* cannot be larger than 16 digits because LCD one row only have 16 digits

- *SpePinMin* must be equal or larger than 1

abPINApdu = 00 24 00 01 12 2F 0A A6 30 30 30 30 30 30 2E FB C7 30 30 30 30 30 30h

bConfirmPIN = 03h (if *bConfirmPIN* = 03h, *bNumberMessage* must equal to 03h or FFh)

bmFormatString = 91h

SpePinPos = 2 bytes because *bmFormatString* bit 7 = 1

SpeLeftRight = Left

SpePINTyp = BCD

bmPINBlockString = 46h

SpePINSize = 4 bits

SpePINLen = 6 bytes

bmPINLengthFormat = 11h

SpePINLenPos = 1 byte

wPINMaxExtraDigit = 010Ah

SpePinMax = 0Ah

SpePinMin = 01h

bInsertionOffsetNew (SpeOffsetNew)=0Ah

SpeOffsetNew =0Ah byte

bInsertionOffsetOld (SpeOffsetOld)=01h

SpeOffsetOld =00h byte

PIN Input(Old/Current Pin) = 1 2 3 4 5 6

PIN Input(New Pin) = 1 2 3 4 5 6 7 8 9 0

bNumberMessage=03h or FFh

Show “Enter PIN:” means enter the old/current PIN and

Show “Enter New PIN”

Show “Confirm New PIN”

- Point 1: Lc (12h) equal to *SpeOffsetNew* (0Ah) + *SpePINLen* (6) + *SpePinPos* (2)
- Point 2: *SpeOffsetNew* (0Ah) >= *SpeOffsetOld* (1) + *SpePINLen* (6) + *SpePinPos* (2)
- Point 3: *SpePINPos* (2 Bytes) >= *SpePinLenPos* (1 Byte) + *SpePINSize* (4 bits)

- Point 4: *SpePINLen* (6) = [*SpePinMax* (0Ah) * 4bits(BCD)] = 5 bytes
  : 6 bytes >=5 bytes
- Point 5: *SpePinMax* (0Ah) > *SpePinMin* (01h)
- Point 6: *SpePinMax* (0Ah) <=10h
- Point 7: *SpePinMin* (01h) >= 01h

Command Header		OffsetOld	SpePINLen			
APDU Header	APDU Lc	*OffsetOld*	Offset *SpePINPos* = 2 bytes			Old PIN
00 24 00 01	12	Offset	Offset (1 Byte)	*SpePINSize* (4 bits)	Not used field	Old PIN
00 24 00 01	12	1 byte	0A	Input 6 digits	0110	Old PIN
00 24 00 01	12	2F	0A	**0110** (bits)	0110	Old PIN
00 24 00 01	12	2F	0A	**6**6 replace **A**6	0110	Old PIN

OffsetNew	SpePINLen			
OffsetNew	Offset *SpePINPos* 8 bits = 1 byte			New PIN
Offset	Offset (1 Byte)	*SpePINSize* (4 bits)	Not used field	New PIN
0A bytes	FB	Input 10 digits	0111	New PIN
relative to Lc	FB	**1010** (bits)	0111	New PIN
2E	FB	**1010** (**1010** replace original **C**7)	0111	New PIN

First, handle the Old PIN.

	Old PIN (Byte)
Original	00 24 00 01 12 2F 0A A6 30 30 30 30 30 30 2E FB C7 30 30 30 30 30 30
Input	12 34 56
Result PIN	00 24 00 01 12 2F 0A 66 12 34 56 30 30 30 2E FB C7 30 30 30 30 30 30

And then handle the New PIN.

	New PIN (Byte)
Original	00 24 00 01 12 2F 0A 66 12 34 56 30 30 30 2E FB C7 30 30 30 30 30 30
Input	12 34 56 78 90
Result PIN	00 24 00 01 12 2F 0A 66 12 34 56 30 30 30 2E FB A7 12 34 56 78 90 30

The whole APDU after the format will be:

00 24 00 01 12 2F 0A 66 12 34 56 30 30 30 2E FB A7 12 34 56 78 90 30h

Appendix A. bmFormatString Description

Bit Number	Description
Bit 7	The system units' type indicator: If 0h: the system units are bits If 1h: the system units are bytes This bit quantifies the next parameter (unit moving).
Bit 6 – 3	Define the PIN position after format in the APDU command (relative to the first data after *Lc*). The position is based on the system units' type indicator (maximum 1111 for 15 system units).
Bit 2	Bit mask for the PIN justification: If 0h: Left justify data If 1h: Right justify data
Bit 1-0	Bit wise for the PIN format type: 00h: binary 01h: BCD 10h: ASCII

Appendix B. bmPINBlockString Description

Bit Number	Description
Bit 7 - 4	Size in bits of the PIN length inserted in the APDU command. (If 0h, then the effective pin length is not inserted in the APDU command)
Bit 3 - 0	PIN length information: PIN block size in bytes after justification and formatting

Appendix C. bmPINLengthFormat

Bit Number	Description
Bit 7-5	RFU
Bit 4	The system units' type indicator: If 0h: the system units are bits If 1h: the system units are bytes
Bit 3 - 0	Indicates the PIN length position in the APDU command according to the previous parameters (maximum 1111 for 15 system units)

Appendix D. Sample Code (PC/SC 2.0 Part 10)

```
#include <stdio.h>
#include <stdlib.h>
#include <windows.h>
#include <winscard.h>

#define FEATURE_VERIFY_PIN_START    0x01
#define FEATURE_VERIFY_PIN_FINISH   0x02
#define FEATURE_MODIFY_PIN_START    0x03
#define FEATURE_MODIFY_PIN_FINISH   0x04
#define FEATURE_GET_KEY_PRESSED     0x05
#define FEATURE_VERIFY_PIN_DIRECT   0x06
#define FEATURE_MODIFY_PIN_DIRECT   0x07
#define FEATURE_MCT_READERDIRECT    0x08
#define FEATURE_MCT_UNIVERSAL       0x09
#define FEATURE_IFD_PIN_PROP        0x0A
#define FEATURE_ABORT               0x0B

#define FEATURE_SIZE                (FEATURE_ABORT + 1)

#define IOCTL_SMARTCARD_GET_FIRMWARE_VERSION    SCARD_CTL_CODE(2078)
#define IOCTL_SMARTCARD_DISPLAY_LCD_MESSAGE     SCARD_CTL_CODE(2079)
#define IOCTL_SMARTCARD_READ_KEY                SCARD_CTL_CODE(2080)
#define CM_IOCTL_GET_FEATURE_REQUEST            SCARD_CTL_CODE(3400)

#pragma pack(push, 1)
typedef struct _PIN_VERIFY_STRUCTURE {
    BYTE bTimeOut;
    BYTE bTimeOut2;
    BYTE bmFormatString;
    BYTE bmPINBlockString;
    BYTE bmPINLengthFormat;
    USHORT wPINMaxExtraDigit;
    BYTE bEntryValidationCondition;
    BYTE bNumberMessage;
    USHORT wLangId;
    BYTE bMsgIndex;
    BYTE bTeoPrologue[3];
    ULONG ulDataLength;
    BYTE abData[1];
} PIN_VERIFY_STRUCTURE, *PPIN_VERIFY_STRUCTURE;

typedef struct _PIN_MODIFY_STRUCTURE {
    BYTE bTimeOut;
    BYTE bTimeOut2;
    BYTE bmFormatString;
    BYTE bmPINBlockString;
    BYTE bmPINLengthFormat;
    BYTE bInsertionOffsetOld;
    BYTE bInsertionOffsetNew;
    USHORT wPINMaxExtraDigit;
    BYTE bConfirmPIN;
    BYTE bEntryValidationCondition;
    BYTE bNumberMessage;
    USHORT wLangId;
    BYTE bMsgIndex1;
    BYTE bMsgIndex2;
    BYTE bMsgIndex3;
    BYTE bTeoPrologue[3];
    ULONG ulDataLength;
```

```
    BYTE abData[1];
} PIN_MODIFY_STRUCTURE, *PPIN_MODIFY_STRUCTURE;

typedef struct _PIN_PROPERTIES_STRUCTURE {
    USHORT wLcdLayout;
    BYTE bEntryValidationCondition;
    BYTE bTimeOut2;
} PIN_PROPERTIES_STRUCTURE, *PPIN_PROPERTIES_STRUCTURE;

typedef struct _READ_KEY_OPTION {
    BYTE bTimeOut;
    WORD wPINMaxExtraDigit;
    BYTE bKeyReturnCondition;
    BYTE bEchoLCDStartPosition;
    BYTE bEchoLCDMode;
} READ_KEY_OPTION;
#pragma pack(pop)

int main(int argc, char *argv[])
{
    SCARDCONTEXT hSCardContext;
    LONG lReturn;

    lReturn    =    SCardEstablishContext(SCARD_SCOPE_USER,    NULL,    NULL,
&hSCardContext);
    if (lReturn != SCARD_S_SUCCESS)
    {
        printf("Error: SCardEstablishContext failed with error 0x%08x\n",
lReturn);
        return 1;
    }

    char **readerName = NULL;
    int numReaders = 0;
    int i;

    LPTSTR pmszReaders = NULL;
    LPTSTR pReader;
    DWORD cch = SCARD_AUTOALLOCATE;

    lReturn = SCardListReaders(hSCardContext, NULL, (LPTSTR) &pmszReaders,
&cch);
    if (lReturn == SCARD_S_SUCCESS)
    {
        pReader = pmszReaders;
        while (*pReader != '\0')

        {
            printf("Reader: %s\n", pReader);

            // Advance to the next value
            pReader = pReader + strlen(pReader) + 1;

            numReaders++;
        }

        // Allocate reader name
        readerName = new char*[numReaders];
        if (readerName == NULL)
        {
            printf("Error: not enough memory\n");
```

```
            exit(1);
        }

        i = 0;
        pReader = pmszReaders;
        while (*pReader != '\0')
        {
            readerName[i] = new char[strlen(pReader) + 1];
            if (readerName[i] == NULL)
            {
                printf("Error: not enough memory\n");
                exit(1);
            }
            strcpy(readerName[i], pReader);
            i++;

            // Advance to the next value
            pReader = pReader + strlen(pReader) + 1;
        }

        // Free the memory
        SCardFreeMemory(hSCardContext, pmszReaders);
    }

    if (numReaders == 0)
    {
        printf("Error: cannot find reader in the system\n");
        return 1;
    }

    SCARDHANDLE hCard;
    DWORD dwAP;

    const int BUFFER_SIZE = 300;
    BYTE bSendBuffer[BUFFER_SIZE];
    DWORD dwSendBufferLen;
    BYTE bRecvBuffer[BUFFER_SIZE];
    DWORD dwRecvBufferLen;

    BYTE bOutputBuffer[100];

    DWORD dwNumBytesReturned;

    DWORD featureControlCodes[FEATURE_SIZE];
    DWORD controlCode;

    // Connect to the first reader
    printf("Connecting to %s...\n", readerName[0]);
    lReturn       =       SCardConnect(hSCardContext,       readerName[0],
SCARD_SHARE_SHARED,
        SCARD_PROTOCOL_T0 | SCARD_PROTOCOL_T1, &hCard, &dwAP);
    if (lReturn != SCARD_S_SUCCESS)
        printf("Error: SCardConnect failed with error 0x%08x\n", lReturn);
    else
    {
        // Get feature request
        printf("Getting feature request...\n");
        dwRecvBufferLen = sizeof(bRecvBuffer);
        lReturn = SCardControl(hCard, CM_IOCTL_GET_FEATURE_REQUEST,
            NULL, 0,
            bRecvBuffer, dwRecvBufferLen, &dwRecvBufferLen);
```

```
        if (lReturn != SCARD_S_SUCCESS)
            printf("Error:  SCardControl  failed  with  error  0x%08x\n",
lReturn);
        else
        {
            printf("Response: ");
            for (i = 0; i < dwRecvBufferLen; i++)
                printf("%02X ", bRecvBuffer[i]);
            printf("\n");

            memset(featureControlCodes, 0, sizeof(featureControlCodes));

            i = 0;
            while (i < dwRecvBufferLen)
            {
                // Get the feature
                if ((bRecvBuffer[i] >= FEATURE_VERIFY_PIN_START) &&
                    (bRecvBuffer[i] <= FEATURE_ABORT))
                {
                    // Get the TLV
                    if (i + 1 + 4 < dwRecvBufferLen)
                    {
                        // Get the length field
                        if (bRecvBuffer[i + 1] == 4)
                        {
                            controlCode  = bRecvBuffer[i + 2] << 24;
                            controlCode |= bRecvBuffer[i + 3] << 16;
                            controlCode |= bRecvBuffer[i + 4] << 8;
                            controlCode |= bRecvBuffer[i + 5];

                            featureControlCodes[bRecvBuffer[i]]          =
controlCode;
                        }

                    }
                }

                // Get the next feature
                if (i + 1 < dwRecvBufferLen)
                    i += bRecvBuffer[i + 1] + 2;
                else
                    break;
            }
        }

        printf("Beginning transaction...\n");
        lReturn = SCardBeginTransaction(hCard);
        if (lReturn != SCARD_S_SUCCESS)
            printf("Error:   SCardBeginTransaction   failed   with   error
0x%08x\n", lReturn);

        // Send card command for PIN verification (ACOS3)
        dwSendBufferLen = 13;
        memcpy(bSendBuffer,
"\x80\x20\x06\x00\x08\xFF\xFF\xFF\xFF\xFF\xFF\xFF\xFF", dwSendBufferLen);

        // Create PIN verify structure
        PPIN_VERIFY_STRUCTURE  pPinVerify  =  (PPIN_VERIFY_STRUCTURE)  new
BYTE[sizeof(PIN_VERIFY_STRUCTURE) - 1 + dwSendBufferLen];
        if (pPinVerify == NULL)
        {
```

```
            printf("Error: not enough memory\n");
            exit(1);
        }

        // Initialize PIN verify structure (ACOS3)
        pPinVerify->bTimeOut                  = 0;
        pPinVerify->bTimeOut2                 = 0;
        pPinVerify->bmFormatString            = 0;
        pPinVerify->bmPINBlockString          = 0x08;
        pPinVerify->bmPINLengthFormat         = 0;
        pPinVerify->wPINMaxExtraDigit         = 0x0408;
        pPinVerify->bEntryValidationCondition = 0x03;
        pPinVerify->bNumberMessage            = 0x01;
        pPinVerify->wLangId                   = 0x0409;
        pPinVerify->bMsgIndex                 = 0;
        pPinVerify->bTeoPrologue[0]           = 0;
        pPinVerify->bTeoPrologue[1]           = 0;
        pPinVerify->bTeoPrologue[2]           = 0;
        pPinVerify->ulDataLength = dwSendBufferLen;
        memcpy(pPinVerify->abData, bSendBuffer, dwSendBufferLen);

        // Verify PIN
        printf("Verifying PIN using VERIFY_PIN_DIRECT...\n");
        dwRecvBufferLen = sizeof(bRecvBuffer);
        lReturn                    =                    SCardControl(hCard,
featureControlCodes[FEATURE_VERIFY_PIN_DIRECT],

            pPinVerify, sizeof(PIN_VERIFY_STRUCTURE) - 1 + dwSendBufferLen,
            bRecvBuffer, dwRecvBufferLen, &dwRecvBufferLen);
        if (lReturn != SCARD_S_SUCCESS)
            printf("Error:  SCardControl  failed  with  error  0x%08x\n",
lReturn);
        else
        {
            printf("Response: ");
            for (i = 0; i < dwRecvBufferLen; i++)
                printf("%02X ", bRecvBuffer[i]);
            printf("\n");
        }

        delete [] ((BYTE*) pPinVerify);

        // Send card command for PIN modification (ACOS3)
        dwSendBufferLen = 13;
        memcpy(bSendBuffer,
"\x80\x24\x00\x00\x08\xFF\xFF\xFF\xFF\xFF\xFF\xFF\xFF", dwSendBufferLen);

        // Create PIN modify structure
        PPIN_MODIFY_STRUCTURE  pPinModify  =  (PPIN_MODIFY_STRUCTURE)  new
BYTE[sizeof(PIN_MODIFY_STRUCTURE) - 1 + dwSendBufferLen];
        if (pPinModify == NULL)
        {
            printf("Error: not enough memory\n");
            exit(1);
        }

        // Initialize PIN modify structure (ACOS3)
        pPinModify->bTimeOut                  = 0;
        pPinModify->bTimeOut2                 = 0;
        pPinModify->bmFormatString            = 0;
        pPinModify->bmPINBlockString          = 0x08;
```

```
        pPinModify->bmPINLengthFormat         = 0;
        pPinModify->bInsertionOffsetOld       = 0;
        pPinModify->bInsertionOffsetNew       = 0;
        pPinModify->wPINMaxExtraDigit         = 0x0408;
        pPinModify->bConfirmPIN               = 0x01;
        pPinModify->bEntryValidationCondition = 0x03;
        pPinModify->bNumberMessage            = 0x02;
        pPinModify->wLangId                   = 0x0409;
        pPinModify->bMsgIndex1                = 0;
        pPinModify->bMsgIndex2                = 1;
        pPinModify->bMsgIndex3                = 0;
        pPinModify->bTeoPrologue[0]           = 0;
        pPinModify->bTeoPrologue[1]           = 0;
        pPinModify->bTeoPrologue[2]           = 0;
        pPinModify->ulDataLength = dwSendBufferLen;
        memcpy(pPinModify->abData, bSendBuffer, dwSendBufferLen);

        // Modify PIN

        printf("Modifying PIN using MODIFY_PIN_DIRECT...\n");
        dwRecvBufferLen = sizeof(bRecvBuffer);
        lReturn                    =                    SCardControl(hCard,
featureControlCodes[FEATURE_MODIFY_PIN_DIRECT],
            pPinModify, sizeof(PIN_MODIFY_STRUCTURE) - 1 + dwSendBufferLen,
            bRecvBuffer, dwRecvBufferLen, &dwRecvBufferLen);
        if (lReturn != SCARD_S_SUCCESS)
            printf("Error:  SCardControl  failed  with  error  0x%08x\n",
lReturn);
        else
        {
            printf("Response: ");
            for (i = 0; i < dwRecvBufferLen; i++)
                printf("%02X ", bRecvBuffer[i]);
            printf("\n");
        }

        delete [] ((BYTE*) pPinModify);

        printf("Ending transaction...\n");
        lReturn = SCardEndTransaction(hCard, SCARD_LEAVE_CARD);
        if (lReturn != SCARD_S_SUCCESS)
            printf("Error: SCardEndTransaction failed with error 0x%08x\n",
lReturn);

        // Get IFD PIN properties
        printf("Getting IFD PIN properties...\n");
        dwRecvBufferLen = sizeof(bRecvBuffer);
        lReturn                    =                    SCardControl(hCard,
featureControlCodes[FEATURE_IFD_PIN_PROP],
            NULL, 0,
            bRecvBuffer, dwRecvBufferLen, &dwRecvBufferLen);
        if (lReturn != SCARD_S_SUCCESS)
            printf("Error:  SCardControl  failed  with  error  0x%08x\n",
lReturn);
        else
        {
            printf("Response: ");
            for (i = 0; i < dwRecvBufferLen; i++)
                printf("%02X ", bRecvBuffer[i]);
            printf("\n");
        }
```

```
        // Display LCD message to ACR83
        char *msg = "Hello";
        printf("Displaying message (%s) to LCD...\n", msg);
        lReturn = SCardControl(hCard, IOCTL_SMARTCARD_DISPLAY_LCD_MESSAGE,
            msg, strlen(msg),
            bOutputBuffer, sizeof(bOutputBuffer), &dwNumBytesReturned);
        if (lReturn != SCARD_S_SUCCESS)
            printf("Error:  SCardControl  failed  with  error  0x%08x\n",
lReturn);

        else
        {
            // Check status
            if ((dwNumBytesReturned >= 2) &&
                (bOutputBuffer[0] == 0) && (bOutputBuffer[1] == 0))
                printf("The message is displayed successfully\n");
            else
                printf("Error: cannot display LCD message\n");
        }

        // Read key from ACR83
        READ_KEY_OPTION readKeyOption;
        char keyString[100];
        DWORD len;
        BYTE keyReturnCondition;

        // Initialize read key option
        readKeyOption.bTimeOut = 0;
        readKeyOption.wPINMaxExtraDigit = 0x0408;
        readKeyOption.bKeyReturnCondition = 0x01;
        readKeyOption.bEchoLCDStartPosition = 0;
        readKeyOption.bEchoLCDMode = 0x01;

        printf("Reading key...\n");
        lReturn = SCardControl(hCard, IOCTL_SMARTCARD_READ_KEY,
            &readKeyOption, sizeof(READ_KEY_OPTION),
            bOutputBuffer, sizeof(bOutputBuffer), &dwNumBytesReturned);
        if (lReturn != SCARD_S_SUCCESS)
            printf("Error:  SCardControl  failed  with  error  0x%08x\n",
lReturn);
        else
        {
            // Check status
            if ((dwNumBytesReturned >= 2) &&
                (bOutputBuffer[0] == 0) && (bOutputBuffer[1] == 0))
            {
                if (dwNumBytesReturned >= 3)
                    keyReturnCondition = bOutputBuffer[2];
                else
                    keyReturnCondition = 0;

                len = 0;
                if (dwNumBytesReturned >= 4)
                {
                    len = dwNumBytesReturned - 3;
                    memcpy(keyString, bOutputBuffer + 3, len);
                }

                // Set the last NULL character
                keyString[len] = '\0';
```

```
                printf("Key Return Condition: 0x%02x, Key String: %s\n",
keyReturnCondition, keyString);
            }

            else
                printf("Error: cannot read key\n");
        }

        lReturn = SCardDisconnect(hCard, SCARD_LEAVE_CARD);
        if (lReturn != SCARD_S_SUCCESS)
            printf("Error: SCardDisconnect failed with error 0x%08x\n",
lReturn);
    }

    lReturn = SCardReleaseContext(hSCardContext);
    if (lReturn != SCARD_S_SUCCESS)
        printf("Error: SCardReleaseContext failed with error 0x%08x\n",
lReturn);

    // Deallocate reader name
    for (i = 0; i < numReaders; i++)
        delete [] readerName[i];
    delete readerName;

    return 0;}
```

Appendix E. Set bKeyReturnCondition

bKeyReturnCondition	OR Operand
If Maximum PIN size is reached	01h
If ACR83 device KEY_E is pressed	02
If ACR83 session TIMEOUT has reached	04h
If ACR83 device KEY_C is pressed	08h
If ACR83 device KEY_BACK is pressed	10h
If ACR83 device KEY_FN is pressed	20h

***Note**: Set value to an OR Operation again the specific OR Operand.*

Appendix F. Response Error Codes

The following table summarizes the possible error code returned by the ACR83 (CCID).

Error Code	Status
0001h	BAD_PARAMETER
0083h	SLOTERROR_LCDCOMMANDERROR
0084h	SLOTERROR_WRONGCONFIRMPIN
0085h	SLOTERROR_UNKNOWN_LCD
0086h	SLOTERROR_MAXPINSIZE_EQUAL_ZERO
00EFh	SLOTERROR_PIN_CANCELLED
00F0h	SLOTERROR_PIN_TIMEOUT