



advanced card systems ltd



# ACSR20

Smart Card Reader Driver Program  
Reference Manual

ACR20 & ACR30 Smart Card Reader

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## 1. INTRODUCTION

This manual describes the use of ACSR20 interface software to program the ACR20 & ACR30 smart card readers. It is a set of library functions implemented for the application programmers to operate the ACR20 & ACR30 smart card readers and the inserted smart cards. Currently, it is supplied in the form of DOS libraries, 16-bit DLL (for Windows3.1) and 32-bit DLL (for Windows 95/98/NT). It can be programmed using the popular development tools like Visual C/C++, Borland C/C++, Visual Basic, Delphi, FoxPro, etc...

Depending on the reader model, ACR20 & ACR30 series of smart card readers can be connected to the PC via the RS/232 interface or USB interface. The connecting interfaces of different model of readers are summarized as follow:

Model Numbers	Connecting interface
ACR20S, ACR20S-S, ACR30S, ACR30S-S	Serial RS/232
ACR20U, ACR20U-S, ACR30U, ACR20S-S	USB interface

Even though the hardware communication interface can be different, application programs can still be using the same API (Application Programming Interface) for operating the smart card readers. Actually, the purpose of using the ACSR20 library is to provide the programmer with a simple and consistent interface over all possible hardware. It is the responsibility of the ACSR20 library to handle the communication details, parameter conversions and error handling. The architecture of the ACSR20 library can be visualized as the following diagram:

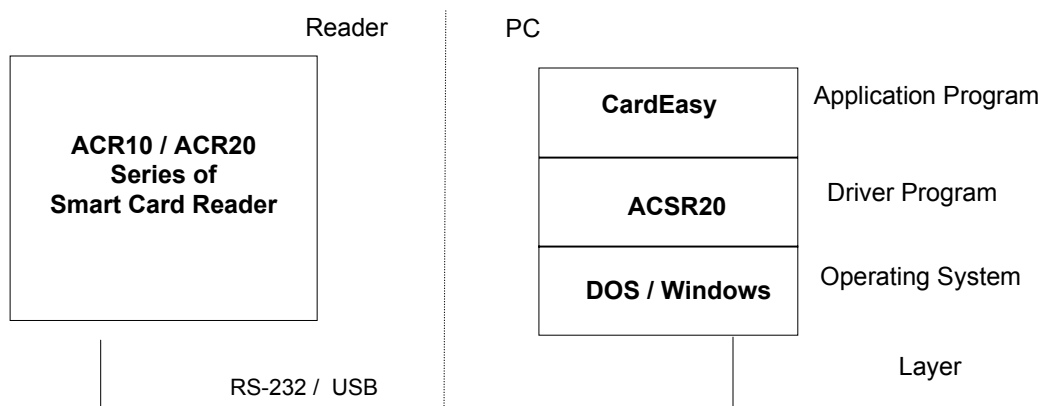


Figure 1.1

## **2. ACSR20**

### **2.1 Overview**

ACSR20 is a set of high level functions provided for the application software to use. It provides a consistent application programming interface (ACSR20 API) for the application to operate on the card reader and the corresponding inserted card. ACSR20 communicates with the ACR10/ACR20 reader via the communication port facilities provided by the operating system. ACSR20 is supposed to be platform independent provided that there is a minor modification on the communication module of the ACSR20 to adapt to different operating environment.

### **2.2 Communication Speed**

The ACSR20 library controls the communication speed between the reader and the PC. For those readers using the serial RS232 connection, the default communication baud rate (factory setting) is 9600bps, no parity, eight bits and one stop bits. A higher speed of 115200bps can be achieved by using software command issuing from the host. If you are not sure about the factory setting of your readers, you can always use the ACR\_AUTODETECT option in your AC\_Open command for the driver to detect the communication speed automatically. Please notice that the above communication speed setting apply only on those readers using the RS232 connection. For the PS/2 type and the USB type of connection, the speed is fixed at 9600bps and 1.5Mbps respectively.

### **2.3 ACSR20 API**

The ACSR20 Application Programming Interface (API) defines a common way of accessing the ACR10/ACR20 reader. Application programs invoke ACSR20 through the interface functions and perform operations on the inserted card through the using of ACI commands. The header file ACSR20.H is available for the program developer which contains all the function prototypes and macros described below.

#### **2.3.1 Interface Data Structure**

The ACSR20 API makes use of several data structures to pass parameters between application programs and the library driver. These data structures are defined in the header file ACSR20.H and they are discussed below:

### 2.3.1.1 AC\_APDU

```

typedef      struct {
    BYTE      CLA;
    BYTE      INS;
    BYTE      P1;
    BYTE      P2;
    INT16     Lc;
    INT16     Le;
    BYTE      DataIn[256];
    BYTE      DataOut[256];
    WORD16    Status;
} AC_APDU;

```

The AC\_APDU data structure is used in the AC\_ExchangeAPDU function for the passing of commands and data information into the smart card. For memory card operation, please refer to section 0 for the definition of fields' value. For MCU card (T=0,T=1) operation, these value are specific to the smart card operating system. You must have the card reference manual before you can perform any valid operations on the card. Please notice that Lc representing the data length going into the card and Le representing the data length expecting from the card.

Name	Input/Output	Description
CLA	I	Instruction Class
INS	I	Instruction Code
P1	I	Parameter 1
P2	I	Parameter 2
Lc	I	Length of command data (DataIn)
Le	I/O	Length of response data (DataOut)
DataIn	I	Command data buffer
DataOut	O	Response data buffer
Status	O	Execution status of the command

### 2.3.1.2 AC\_SESSION

```

typedef      struct {
    BYTE      CardType;    // Card type selected
    BYTE      SCModule;    // Selected security module.
                        //Use only when card type = AC_SCModule
    BYTE      ATRLen;      // Length of the ATR
    BYTE      ATR[128];    // ATR string
    BYTE      HistLen;     // Length of the Historical data
    BYTE      HistOffset;  // Offset of the Historical data
                        // from the beginning of ATR
    INT16     APDULenMax;  // Max. APDU supported
} AC_SESSION;

```

The AC\_SESSION data structure is used in the AC\_StartSession function call for the retrieval of ATR information from the smart card. Before calling AC\_StartSession, the program needs

to specify the value of CardType. After calling the function, the ATR string can be found in ATR field and the length is stored in ATRLen.

Name	Input/Output	Description
CardType	I	The card type selected for operation (refer to Appendix C for CardType)
SCModule	I	The security module selected for operation. (The value is used only when card type = AC_SCModule)
ATRLen	O	Length of the ATR string
ATR	O	Attention to reset (ATR) string
HistLen	O	Obsolete field – not used anymore
HistOffset	O	Obsolete field – not used anymore
APDULenMax	O	Obsolete field - not used anymore

### 2.3.1.3 AC\_INFO

```
typedef struct {
    INT16 nMaxC;      // Maximum number of command data bytes
    INT16 nMaxR;      // Maximum number of data bytes that
                    // can be requested in a response
    INT16 CType;      // The card types supported by the reader
    BYTE  CStat;      // The status of the card reader
    BYTE  CSel;       // The current selection of card type
    BYTE  szRev[10];  // The 10 bytes firmware type and
                    // revision code
    INT16 nLibVer;    // Library version
    Long  lBaudRate;  // Current Running Baud Rate
} AC_INFO;
```

The AC\_INFO data structure is used in the AC\_GetInfo function call for the retrieval of reader related information. Their meaning are described as follow:

Name	Input/Output	Description
nMaxC	O	The maximum number of command data byte (DataIn) that can be accepted in the ExchangeAPDU command
nMaxR	O	The maximum number of response data byte (DataOut) that will be appeared in the ExchangeAPDU command
CType	O	The card types supported by the reader (For details, please look at the ACR20 reference manual)
Cstat	O	The status of the card reader Bit0 = card present (1) or absent (0) Bit1 = card powered up (1) or powered down (0)
szRev[10]	O	The firmware revision code
nLibVer	O	Library version (e.g. 310 is equal to version 3.10)

### 2.3.2 Interface Function Prototypes

Generally, a program is required to call `AC_Open` first to obtain a handle. The handle is required for subsequent calls to `AC_StartSession`, `AC_ExchangeAPDU`, `AC_EndSession` and `AC_Close`. The inserted card can be powered up by using the `AC_StartSession` function and card commands can be exchanged with the inserted card using the `AC_ExchangeAPDU` function. Moreover, `AC_SetOptions` and `AC_GetInfo` are two commands that can be used to set and read the various information of the reader.

#### 2.3.2.1 AC\_Open

This function opens a port and returns a valid reader handle for the application program.

##### Format:

```
INT16 AC_DECL AC_Open (INT16 ReaderType, INT16 ReaderPort);
```

##### Input Parameters:

The table below lists the parameters for this function (you can refer to `ACSR20.H` for the corresponding value):

Parameters	Definition / Values
ReaderType <sup>3</sup>	Reader type and communication speed. <i>ACR10</i> = Target reader is ACR10 (9600bps) <i>ACR20</i> = Target reader is ACR20 (57600bps) <i>ACR20_57600</i> = Target reader is ACR20 (57600bps) <i>ACR20_19200</i> = Target reader is ACR20 (19200bps) <i>ACR20_115200</i> = Target reader is ACR20 (115200bps) <i>ACR20_9600</i> = Target reader is ACR20 (9600bps) <i>ACR_AUTODETECT</i> <sup>1</sup> = Auto detect the target reader
ReaderPort	The port that connected with the reader. <i>AC_COM1</i> = Standard communication port 1 <i>AC_COM2</i> = Standard communication port 2 <i>AC_COM3</i> = Standard communication port 3 (Valid only on the Win32 driver) <i>AC_COM4</i> = Standard communication port 4 (Valid only on the Win32 driver) <i>AC_USB</i> = Using the USB communication port <i>AC_PCSC</i> = Using the PCSC component to access the reader

##### Returns:

The return value is negative and contains the error code when the function encounters an error during operation. Otherwise, it returns a valid reader handle. Please refer to appendix A for the detailed description and meaning of the error codes.

##### Examples:

```
// open a port to a ACR10 reader connected to COM1
INT16 hReader;

hReader = AC_Open (ACR10, AC_COM1);
```

**Remarks:**

1. If the user select ACR\_AUTODETECT to open a reader in the first time, the library will try to reset the reader and wait for the response message from the reader. This may take some time (around 2-3 seconds) for the library to complete this operation.
2. When an ACR20 is reset, the green LED will flash three times. There is no reset for an ACR10 reader.
3. When the application want to access the security module, it needs to open (use the AC\_Open command) the reader for the second time to get a different handler for the handling of the security module session.
4. The option of AC\_USB is available only in the Windows 98 and Windows 2000 platform.  
The option of AC\_PCSC is available only in the platform with the Microsoft PCSC base components installed. The driver will select the first available PCSC reader for operation. In order for the correct operation of the reader, you need to make sure that the first available PCSC reader is a smart card reader from ACS.

**2.3.2.2 AC\_Close**

This function closes a previously opened reader port.

**Format:**

```
INT16 AC_DECL AC_Close (INT16 hReader);
```

**Input Parameters:**

The table below lists the parameters for this function

Parameters	Definition / Values
hReader	A valid reader handle previously opened by AC_Open()

**Returns :**

The return value is zero if the function is successful. Otherwise, it returns a negative value containing the error code. For the detailed meaning of the error code, please refer to appendix A.

**Examples :**

```
// Close a previously opened port
INT16 RtnCode;
RtnCode = AC_Close(hReader);
```

### 2.3.2.3 AC\_StartSession

This function starts a session with a selected card type and updates the session structure with the values returned by the card Answer-To-Reset (ATR). A session is started by a card reset and it is ended by either another card reset, a power down of the card or the removal of a card from the reader. Note that this function will power up the card and perform a card reset.

#### Format:

```
INT16 AC_DECL AC_StartSession (INT16 hReader, AC_SESSION FAR
*Session);
```

#### Input Parameters:

The table below listed the parameters for this function

Parameters	Definition / Values
hReader	A valid reader handle returned by AC_Open()
Session.CardType	The selected card type for this session (please refer to Appendix C for card type selection)
Session.SCModule	The selected security module number (Required only when card type =AC_SCModule)

#### Output Parameters:

The table below listed the parameters returned by this function

Parameters	Definition / Values
Session.ATR	Answer to Reset returned by the card
Session.ATRLen	Length of the answer to reset
Session.HistLen	Length of the historical data
Session.HistOffset	Offset of the historical data
Session.APDULenMax	Maximum length of APDU supported

#### Returns:

The return value is zero if the function is successful. Otherwise, it returns a negative value containing the error code. For the detailed meaning of the error code, please refer to appendix A.

**Examples:**

```
// Prepare Session structure for AM104 memory card
INT16  RtnCode,i;
AC_SESSION Session;

Session.CardType = AC_AM104; // Card type = AM104

//Start a session on previously opened port
RtnCode = AC_StartSession(hReader, &Session);

// Print the card ATR
printf("Card Answer to Reset : ");
for (i = 0; i < (INT16) Session.ATRLen; i++)
    printf(" %02X",Session.ATR[i]);
```

**Remarks:**

1)

When no card type is selected (i.e. Session.CardType = 0), the reader will try to detect the inserted card type automatically. However, while the reader can distinguish the T=0 card, T=1 card and synchronous memory card, it cannot distinguish different types of memory card.

2)

When AM221 card type is selected (i.e. Session.CardType = AC\_AM221), the library will check the backup bits and try to recover the lost token when necessary.

**2.3.2.4 AC\_EndSession**

This function ends a previously started session and powers off the card.

**Format:**

```
INT16 AC_DECL AC_EndSession (INT16 hReader);
```

**Input Parameters:**

The table below lists the parameters for this function

Parameters	Definition / Values
hReader	A valid reader handle returned by AC_Open()

**Returns:**

The return value is zero if the function is successful. Otherwise, it returns a negative value containing the error code. For the detailed meaning of the error code, please refer to appendix A.

**Examples:**

```
//End session on a previously started session
RtnCode = AC_EndSession(hReader);
```

### 2.3.2.5 AC\_ExchangeAPDU

This function sends an APDU command to a card via the opened port and returns the card's response. Please refer Section 2.3.3 ACI Commands for detail description on how to fill in the parameters.

#### Format:

```
INT16 AC_DECL AC_ExchangeAPDU (INT16 hReader, AC_APDU FAR *Apdu);
```

#### Input Parameters:

The table below listed the parameters for this function

Parameters	Definition / Values
hReader	A valid reader handle returned by AC_Open()
Apdu.CLA	Instruction Class (Please refer Section 2.3.3 ACI Commands for detail description)
Apdu.INS	Instruction Code (Please refer Section 2.3.3 ACI Commands for detail description)
Apdu.P1	Parameter 1 (Please refer Section 2.3.3 ACI Commands for detail description)
Apdu.P2	Parameter 2 (Please refer Section 2.3.3 ACI Commands for detail description)
Apdu.DataIn	Data buffer to send
Apdu.Lc	Number of bytes in Apdu.DataIn to be sent
Apdu.Le	Number of bytes expected to receive

#### Output Parameters:

The table below listed the parameters returned by this function

Parameters	Definition / Values
Apdu.DataOut	Data buffer containing the card response
Apdu.Le	Number of bytes received in Apdu.DataOut
Apdu.Status	Status bytes SW1, SW2 returned by the card

#### Returns:

The return value is zero if the function is successful. Otherwise, it returns a negative value containing the error code. For the detailed meaning of the error code, please refer to appendix A.

**Examples:**

```
// Read 8 bytes from AM104 starting from address 0
INT16 RtnCode,i;
AC_APDU Apdu;

Apu.CLA = 0x00; // Instruction Class
Apu.INS = ACI_Read; // Command
Apu.P1 = 0x00; // MSB of starting address
Apu.P2 = 0x00; // LSB of starting address
Apu.Lc = 0x00; // No input data for this command
Apu.Le = 0x08; // Read 8 bytes data

//Exchange APDU with the ACR10 reader
RtnCode = AC_ExchangeAPDU(hReader, &Apu);

if (RtnCode >= 0)
{
    // print the data
    printf("Data : ");
    for (i=0; i < (INT16) Apdu.Le; i++)
        printf(" %02X",Apu.DataOut[i]);
    // print the status bytes
    printf("Card Status(SW1 SW2)=%04X",Apu.Status);
}
```

**2.3.2.6 AC\_GetInfo**

This function retrieve information related to the currently selected reader.

**Format :**

```
INT16 AC_DECL AC_GetInfo (INT16 hReader, AC_INFO FAR *Info);
```

**Input Parameters:**

The table below lists the parameters for this function

Parameters	Definition / Values
hReader	A valid reader handle returned by AC_Open()

**Output Parameters:**

The table below lists the parameters returned by this function

Parameters	Definition / Values
Info.szRev	Revision code for the selected reader.
Info.nMaxC	The maximum number of command data bytes.
Info.nMaxR	The maximum number of data bytes that can be requested to be transmitted in a response
Info.CType	The card types supported by this reader
Info.CStat	The current status of the reader 00 <sub>H</sub> = no card inserted 01 <sub>H</sub> = card inserted, not powered up 03 <sub>H</sub> = card powered up
Info.CSel	The currently selected card type
Info.nLibVer	Current library version (e.g. 310 is equal to version 3.10)

Parameters	Definition / Values
Info.BaudRate	The current running baud rate

**Returns:**

The return value is zero if the function is successful. Otherwise, it returns a negative value containing the error code. For the detailed meaning of the error code, please refer to appendix A.

**Examples:**

```
// Get the revision code of the currently selected reader
INT16 RtnCode;
AC_INFO Info;

RtnCode = AC_GetInfo(hReader, &Info);
printf("Reader Operating System ID : %s", Info.szRev);
```

**2.3.2.7 AC\_SetOptions**

This function set various options for the reader.

**Format:**

INT16 AC\_DECL AC\_SetOptions (INT16 hReader, WORD16 Type, WORD16 Value);

**Input Parameters:**

The table below lists the parameters for this function

Parameters	Definition / Values
hReader	A valid reader handle returned by AC_Open() (except for the ACO_RESET_READER option)
Type	Type of option that is going to set
Value	Value parameter for the selected option type

**Returns:**

The return value is zero if the function is successful. Otherwise, it returns a negative value meaning that the option setting is not available.

**Options :**

Options	Type	Value
Set the communication <u>baud rate</u> between the reader and the host	ACO_SET_BAUD_RATE	ACO_B9600 ACO_B14400 ACO_B19200 ACO_B28800 ACO_B38400 ACO_B57600 ACO_B115200
Set the communication <u>inter</u>	ACO_SET_CHAR_DELAY	0-255

Options	Type	Value
<u>character delay</u> between the reader and the host		
Set the <u>communication</u> to the <u>highest</u> possibility	ACO_SET_BAUD_HIGHEST	0
<u>Reset</u> the <u>reader</u> (hReader is not necessary valid)	ACO_RESET_READER	AC_COM1 AC_COM2
<u>Enable</u> the reader to issue the <u>GET_RESPONSE</u> command <u>automatically</u> (only valid for the MCU card)	ACO_ENABLE_GET_RESPONSE	SW1 + "00" (GET_RESPONSE will be issued automatically when this SW1 is returned from the card)
<u>Disable</u> the <u>automatic</u> issue of the <u>GET_RESPONSE</u> command (this is the default option of the reader)	ACO_DISABLE_GET_RESPONSE	0
Eject card from the card reader (if applicable)	ACO_EJECT_CARD	0
Check the reader is supporting the "eject card" option or not*	ACO_GET_READER_CAPABILITIES	0
Enable / Disable card insertion / removal notification message	ACO_SET_NOTIFICATION	1 =enable notification 2 =disable notification

\* Function return 0 when that option is supported, otherwise it is not supported

#### Examples:

```
// Set the communication baud rate to the highest possible setting
INT16 RtnCode;

RtnCode = AC_SetOption(hReader, ACO_SET_BAUD_HIGHEST, 0);
if (RtnCode < 0)
    printf("Set option failed\n");
```

#### Notes:

Please notice that many options are not available for the ACR10 reader. You will have an error return if you are calling it with the ACR10 reader.

### 2.3.3 ACI Commands

ACI Commands are provided to support the standard operation of a wide range of memory cards. Because of the different nature of different memory cards and their capabilities, not all the commands are available for every card type. Appendix B listed the available ACI commands for different card types.

The ACI Commands described here are used in the AC\_ExchangeAPDU function call. Proper parameter values of different ACI commands should be initialized in the AC\_APDU structure before calling the AC\_ExchangeAPDU function. Upon successful completion of the function, the application program is required to check the card return status (SW1 SW2) in AC\_APDU and retrieve the output result from the DataOut buffer accordingly.

#### 2.3.3.1 ACI\_Read

The ACI\_Read command is available for all types of memory card. The parameter structure is defined as follows:

Field	Value	Description
CLA	0x00	Instruction class
INS	ACI_Read	Instruction code for the read command
P1	Variable	MSB of the starting address to be read
P2	Variable	LSB of the starting address to be read
Lc	0x00	No input data is required for this command
DataIn	-	Don't care
Le	Variable <= 32	The number of bytes to be read from the card For AM256 card, this value will rounded to the next even number

#### 2.3.3.2 ACI\_Write

The ACI\_Write command is available for all types of memory cards. The parameter structure is defined as follows:

Field	Value	Description
CLA	0x00	Instruction class
INS	ACI_Write	Instruction code for the write command
P1	Variable	MSB of the starting address to be written
P2	Variable	LSB of the starting address to be written
Lc	variable <= 32	The number of bytes to be written into the card
DataIn	Variable	Lc bytes of data to be written into the card
Le	0x00	No response data expected from the card. For AM256 card, this value will rounded to the next even number

### 2.3.3.3 ACI\_WriteCarry

The ACI\_WriteCarry command is available for EEPROM non-reloadable token counter cards. The parameter structure is defined as follows:

Name	Value	Description
CLA	0x00	Instruction class
INS	ACI_WriteCarry	Instruction code for the write carry command
P1	0x01,0x02 or 0x03	0x01 = write carry without backup 0x02 = write with backup 0x03 = write carry with backup
P2	Variable	LSB of the starting address to be written
Lc	0x01	Only one byte at a time is allowed for this command
DataIn	Variable	DataIn[0] contains the byte that is to be written into the card
Le	0x00	No response data expected from the card

### 2.3.3.4 ACI\_WritePr

The ACI\_WritePr command is available for some memory cards with protected memory logic. The parameter structure is defined as follows:

Name	Value	Description
CLA	0x00	Instruction class
INS	ACI_WritePr	Instruction code for the write protect command
P1	Variable	MSB of the starting address to be written
P2	Variable	LSB of the starting address to be written
Lc	variable <= 32	The number of bytes to be written into the card
DataIn	Variable	Lc bytes of data to be written into the card
Le	0x00	No response data expected from the card

### 2.3.3.5 ACI\_Erase

The ACI\_Erase command is available for some memory cards with the erasing capability. The parameter structure is defined as follows:

Name	Value	Description
CLA	0x00	Instruction class
INS	ACI_Erase	Instruction code for the erase command
P1	Variable	MSB of the starting address to be erased
P2	Variable	LSB of the starting address to be erased
Lc	variable <= 32	The number of bytes to be erased from the card
DataIn	-	Don't care
Le	0x00	No response data expected from the card

### 2.3.3.6 ACI\_ChangePIN

The ACI\_ChangePIN command is available for the AM2KS / X76F041 / X76F128 / X76F640 card. For the AM8KS, it is required to use the ACI\_Write command to do the change PIN operation. The parameter structure of ACI\_ChangePIN is defined as follows:

Field Name	Value	Description
CLA	0x00	Instruction class
INS	ACI_ChangePIN	Instruction code for the change PIN command
P1	variable	Please refer to the table in command ACI_Verify for the definition of this field
P2	-	Don't Care
Lc	variable	The length of the PIN
DataIn	variable	The new PIN value
Le	0x00	No response data expected from the card

In order for the password (PIN) of X76F041 card can be changed, the application must verify the old password correctly before the ACI\_ChangePIN command can be executed. If the read password is verified, only the read password can be changed. If the write password is verified, only the write password can be changed. However, when the configuration password is verified, all three passwords can be changed.

### 2.3.3.7 ACI\_Verify

The ACI\_Verify command is available for some memory cards with the secret code capability. It is not enough to check alone the code returned from the function AC\_ExchangeAPDU to determine that the verification is successful or not. Application program must check the data returning back from the card for the interpretation of whether the verification is successful or not. Please see the programmer notes for detail.

Field	Value	Description
CLA	0x00	Instruction class
INS	ACI_Verify	Instruction code for the verify command
P1	variable	Key Index, see the table below for the description
P2	-	Don't Care
Lc	variable	Number of bytes of the key
DataIn	variable	Lc bytes of key value to be verified by the card
Le	variable	Case when : - AC_AM2KS : Le = 4 AC_AM8KS : Le = 3 otherwise : Le = 0

Depending on the card type of the current session, Key Index (P1) can contain any of the following values.

Card Type	Key Index	Length (bytes)	Description
AC_AM104	0x00	3	Transport code
AC_AM221	0x00	3	Transport code
AC_SLE4404	0x00	2	Card secure code (GPM416) / security code (SLE4404)
	0x01	4	Erase code (GPM416) / system code (SLE4404)
AC_GPM896	0x00	2	Card secure code
	0x01	6	Erase code 1
	0x02	4	Erase code 2
AC_AT101	0x00	2	Security code
	0x01	4	Zone 1 erase key
AC_AT102	0x00	2	Security code
	0x01	6	Zone 1 erase key
	0x02	4	Zone 2 erase key
AC_AT1604	0x00	2	Security code
	0x01	2	Zone 1 erase key
	0x02	2	Zone 2 erase key
	0x03	2	Zone 3 erase key
	0x04	2	Zone 4 erase key
	0x05	2	Zone 1 security code
	0x06	2	Zone 2 security code
	0x07	2	Zone 3 security code
	0x08	2	Zone 4 security code
AC_AM2KS	0x00	3	Security code
AC_AM8KS	0x00	2	Security code
AC_X76F041	0x00	8	Write password
	0x01	8	Read password
	0x02	8	Configuration password
AC_X76F128 Or AC_X76F640	0x00	8	Read array 0 password
	0x01	8	Read array 1 password
	0x02	8	Write array 0 password
	0x03	8	Write array 1 password
	0x04	8	Reset password
AC_X76F100	0x00	8	Write password
	0x01	8	Read password

### 2.3.3.8 ACI\_Authenticate

The ACI\_Authenticate command is available for some memory cards which can generate a card authentication certificate. The parameter structure is defined as follows:

Field	Value	Description
CLA	0x00	Instruction class
INS	ACI_Authenticate	Instruction code for the authenticate command
P1	variable	Case SLE4436 : 0x00 = Use Key 1 0x01 = Use Key 2 Case ST1333, ST1335: 0x00 always
P2	variable	Case SLE4436: Number of CLK pulses to be supplied to the card for the computation of each bit of the authentication certificate Case ST1333,ST1335 : 0x00 always
Lc	variable	Case SLE4436 : Lc = 0x06 Case ST1333, ST1335 : Lc = 0x04
DataIn	variable	Challenge data to be presented to the card
Le	variable	Authentication certificate Case SLE4436 : Le = 0x02 Case ST1333, ST1335 : Le = 0x01

### 2.3.3.9 ACI\_SetFuse

The ACI\_SetFuse command is available for some memory cards with the set fuse capability. The parameter structure is defined as follow:

Field	Value	Description
CLA	0x00	Instruction class
INS	ACI_SetFuse	Instruction code for the set fuse command
P1	0x00 or 0x01 or 0xFF	0x00 = Set Fuse PIN to "not connected" (high impedance) 0x01 = Set Fuse PIN to high (5V) 0xFF = Set Fuse PIN to low (0V)
P2	-	Don't care
Lc	0x00	No input data for this command
DataIn	-	Don't care
Le	0x00	No output data expected from this command

### 2.3.3.10 ACI\_CardOptions

The ACI\_CardOptions command is available for the IIC card and the XIIC card only. It can be used to change the page size and the chip select address bits. The parameter structure is defined as follow:

Field	Value	Description
CLA	0x00	Instruction class
INS	ACI_CardOptions	Instruction code
P1	Bitmap for this byte is: xAAAxPPP	AAA = Chip select address bits. PPP = Page size where 000 = 4 bytes 001 = 8 bytes 010 = 16 bytes 011 = 32 bytes 100 = 64 bytes 101 = 64 bytes 110 = 64 bytes 111 = 64 bytes
P2	-	Don't care
Lc	0x00	No input data for this command
Dataln	-	No input data
Le	0x00	No output data expected from this command

### 2.3.3.11 ACI\_ReadProtect

The ACI\_ReadProtect command is available for the XIIC card, the AM256 card, the AM2KS, the AM4KP card and the X76F041 card. It can be used to read the block security status and the block number of the high endurance memory block from the XIIC card or it can be used to read the write protection register for the AM256 card and the AM4KP card or it can be used to read the configuration register for the X76F041 card or it can be used to read the security memory for the AM2KS card. The parameter structure is defined as follow:

Field	Value	Description
CLA	0x00	Instruction class
INS	ACI_ReadProtect	Instruction code
P1	-	Don't care
P2	-	Don't care
Lc	0x00	No input data for this command
Dataln	-	No input data
Le	variable	Case when : - XIIC : Le = 3 AM256 : Le = 1 AM4KP : Le = 1 X76F041 : Le = 5 AM2KS : Le=4 AM8KS : Le=3

For XIIC card, this command response with three bytes messages containing the following information.

Byte position	Name	Meaning
1	START	Number of first protected block
2	BLK_CNT	Number of blocks protected from block # start
3	HE_BLK	Block number of the High Endurance memory block

For AM2KS card, this command response with three bytes messages containing security memory of the following information.

Byte position	Name	Meaning
1	ERR_CNT	Error Counter for SC presentation
2-4	SC	Three bytes security code (Visible only after successful security code verification)

For AM8KS card, this command response with three bytes messages containing security memory of the following information.

Byte position	Name	Meaning
1	ERR_CNT	Error Counter for SC presentation
2-3	SC	Two bytes security code (Visible only after successful security code verification)

For X76F041 card, this command response with five bytes messages containing the configuration register information. For the details meaning of each byte, please refer back to the technical specification of the X76F041 chip.

Byte position	Name	Meaning
1	ACR1	Array Control Register 1
2	ACR2	Array Control Register 2
3	CR	Configuration Register
4	RR	Retry Register
5	RC	Retry Counter

### 2.3.3.12 ACI\_SetProtect

The ACI\_SetProtect command is available for the XIIC card, the AM256 card, the AM4KP card and the X76F041 card. For the XIIC, AM256 and the AM4KP card, it can be used to set the starting block of the write-protection memory area and for the case of XIIC card, it can be used to set the number of protection block also. Finally for the X76F041, it can be used to set the configuration register value as described in the ACI\_ChangePIN paragraph. The parameter structure is defined as follow:

Field	Value	Description
CLA	0x00	Instruction class
INS	ACI_SetProtect	Instruction code
P1	variable	Case when : - XIIC : P1 = start protecting block ( $0 \leq P1 \leq 0x0F$ ) AM256 : P1 = start protecting block AM4KP : P1 = start protecting block X76F041 : P1 = 0
P2	variable	Case when : - XIIC : P2 = no of blocks to be protected ( $0 \leq P2 \leq 0x0F$ ) AM256, AM4KP, X76F041 : P2 = 0
Lc	variable	Case when : - XIIC, AM256, AM4KP : Lc = 0 X76F041 : Lc = 5
DataIn	variable	Case when : - XIIC, AM256, AM4KP : No input data X76F041 : Configuration Register
Le	0x00	No output data expected from this command

**2.3.3.13 ACI\_ClearProtect**

The ACI\_ClearProtect command is available for the AM256 card and the AM4KP card only. It can be used to set all memory address to “not write-protected”. The parameter structure is defined as follow:

Field	Value	Description
CLA	0x00	Instruction class
INS	ACI_ClearProtect	Instruction code
P1	0x00	must be zero
P2	0x00	must be zero
Lc	0x00	No input data for this command
DataIn	-	No input data
Le	0x00	No output data expected from this command

**2.3.3.14 ACI\_LockProtect**

The ACI\_LockProtect command is available for the AM256 card and the AM4KP card only. It can be used to disable access to the write-protection register irreversibly. The contents of the write-protection register is not changed and the currently write-protection memory area cannot be modified any more. The parameter structure is defined as follow:

Field	Value	Description
CLA	0x00	Instruction class
INS	ACI_LockProtect	Instruction code
P1	0x00	must be zero
P2	0x00	must be zero
Lc	0x00	No input data for this command
DataIn	-	No input data
Le	0x00	No output data expected from this command

### 2.3.3.15 ACI\_WriteAll

The ACI\_WriteAll command is available for the AM256 / AM4KP / X76F041 / X76F128 / X76F640. For the case of AM256 card and the AM4KP card, it can be used to fill the complete card memory with the specific value. For the X76F041 card, it can be used to fill the complete card with the value 0x00. For the case of X76F128 and X76F640 card, prior to using this command it must have the “Reset Password” being verified OK. The parameter structure is defined as follow:

Field	Value	Description
CLA	0x00	Instruction class
INS	ACI_WriteAll	Instruction code
P1	0x00	must be zero
P2	0x00	must be zero
Lc	variable	Case when : - AM256, AM4KP : Lc = 2 X76FXXX : Lc = 8
DataIn	variable	Case when : - AM256, AM4KP : data to be filled X76F041 : configuration password
Le	0x00	No output data expected from this command

### 2.3.3.16 ACI\_SetHE

The ACI\_SetHE command is available for the XIIC card only. It can be used to relocate the High Endurance memory block to the specified block address. The parameter structure is defined as follow:

Field	Value	Description
CLA	0x00	Instruction class
INS	ACI_SetHE	Instruction code
P1	$0 \leq P1 \leq 0x0F$	New block number of the High Endurance memory block
P2	-	Don't care
Lc	0x00	No input data for this command
DataIn	-	No input data
Le	0x00	No output data expected from this command

**2.3.3.17 ACI\_BlowFuse**

The ACI\_BlowFuse command is available for the AT101, AT102 and AT1604 cards only. It can be used to blow the fuse of a card. The parameter structure is defined as follow:

Field	Value	Description
CLA	0x00	Instruction class
INS	ACI_BlowFuse	Instruction code
P1	variable	MSB of the starting address of the fuse
P2	variable	LSB of the starting address of the fuse
Lc	0x00	No input data for this command
DataIn	-	No input data
Le	0x00	No output data expected from this command

**2.3.3.18 ACI\_EraseAll**

The ACI\_EraseAll command is available for the AM4KP card and the X76F041 card only. It can be used to erase the whole card memory with the value 0xFF. The parameter structure is defined as follow:

Field	Value	Description
CLA	0x00	Instruction class
INS	ACI_WriteAll	Instruction code
P1	0x00	must be zero
P2	0x00	must be zero
Lc	variable	Case when : - X76F041 : Lc = 8 Others : Lc = 0
DataIn	variable	Case when : - X76F041 : configuration password
Le	0x00	No output data expected from this command

### 2.3.3.19 ACI\_Reactivate

The ACI\_Reactivate command is available for the X76F128 card and the X76F640 card only. It can be used to erase the retry counter and reactivate the card. This command is valid only after the "Reset Password" is verified OK. The parameter structure is defined as follow:

Field	Value	Description
CLA	0x00	Instruction class
INS	ACI_Reactivate	Instruction code
P1	0x00	must be zero
P2	0x00	must be zero
Lc	0x00	no input data
DataIn	variable	no input data
Le	0x00	No output data expected from this command

## 2.4 Programmer Notes

Please see the “readme.txt” in the provided diskette for the latest information.

### 2.4.1 The Xicor Card X76F041

According to the technical specification, the X76F041 is organized in four 128 x 8 bit memory array. Each block of memory can be read/write protected by the read password/ write password. The requirement of a password is indicated by the MSB of the address field. If the memory blocks are not password protected, the four blocks of memory are located in addresses 0x0000-0x007F, 0x0080-0x00FF, 0x0100-0x017F and 0x0180-0x01FF. If the memory blocks are password protected, the four blocks of memory are located in addresses 0x8000-0x807F, 0x8080-0x80FF, 0x8100-0x817F and 0x8180-0x81FF. Read / write operation can be performed across the block boundary but it is up to the application to handle the case when the adjacent blocks have different protection attributes (e.g. one block is password protected and the other one is not).

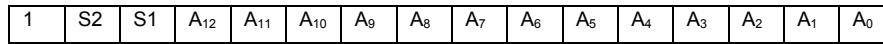
The X76F041 has totally three passwords, namely, the configuration password, the read password and the write password. These passwords can be verified by using the ACI\_Verify command. Once these passwords are verified OK, the library will remember them. Reading of the password protected memory blocks is required to have either the read password or the configuration password. Writing into the password protected memory blocks is required to have either the write password or the configuration password.

The ACI\_ChangePIN command can be used to change the passwords. If the configuration password is verified OK, all three passwords can be changed. If the read password is verified OK, only the read password can be change. If the write password is verified OK, only the write password can be change.

The ACI\_ReadProtect and ACI\_WriteProtect commands can be used to manage the configuration registers after the configuration password is verified OK. The detail meaning of the configuration registers can be found in the X76F041 data book.

### 2.4.2 The Xicor Card X24645 and the IIC card

The operation of the X24645 Xicor card is very similar to the IIC card. It allow only the read and write function. According to the data book of X24645, the chip has two device select inputs (S1, S2) allow up to four devices to share a common two wire bus. In the ACR10/ACR20 reader, these two select inputs are interpret as the two most significant bits of a 15 bit address word. The following diagram illustrate the structure of the address word.

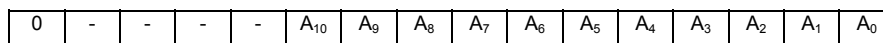


Structure of the address word for the X24645 card

According to the test result of the Xicor sample card, we notice that the values for S1 and S2 are 0 and 1 respectively. As a result, the 8K bytes of memory of a typical X24645 smart card can be found at the address starting from 0xC000 and ending at 0xDFFF. Programmer must bare in mind this special address range for the X24645 smart card. If you have selected the AC\_X24645 card type during the AC\_StartSession, the library will help you to mask on the MSB to "1" automatically. As a result, the address range 0xC000 - 0xDFFF is equal to 0x4000 - 0x5FFF exactly.

Also, the X24645 chip has some kind of protection mechanism that require you to write certain values into the write protect register. The protect register can be accessed by specifying the address at 0xDFFF and a length of 0x01. Please read the X24645 data book for the detail explanation of the protect register.

For the IIC card, the address MSB must be zero. The following diagram illustrate the structure of the address word for the IIC card.



Structure of the address word for the IIC card`

To access the normal IIC, you must have "0" in the MSB, otherwise, you will use the X24645 format to access the card.

### 2.4.3 The AM221 (SLE4436, GAM226) type

The AM221 type of memory card has a counter backup mechanism to prevent the card from being corrupted when the card is torn off from the reader while the reader is erasing the lower counter value of the card. Please refer to the card specification for the full description of the mechanism.

Upon reset (power up) of an AM221 type of card, the library will detect automatically the status of the backup bits (bit 104 to bit 107). If the backup bits indicate that the card has some lost counter values, the library will issue the “write carry with backup” command to reclaim the lost counter values. The correspondence between the backup bit and the counter stages are as follow:

Backup bit (located in byte D)	Counter stage
Bit address 104 (1 <sup>st</sup> bit from the right)	Counter stage 1 (byte 8)
Bit address 105 (2 <sup>nd</sup> bit from the right)	Counter stage 2 (byte 9)
Bit address 106 (3 <sup>rd</sup> bit from the right)	Counter stage 3 (byte A)
Bit address 107 (4 <sup>th</sup> bit from the right)	Counter stage 4 (byte B)

### 2.4.4 Secret code verification

For the secret code verification of memory card, it is done by the ACI\_Verify command using the AC\_ExchangeAPDU function. It is not enough alone to check the code returning from AC\_ExchangeAPDU is equal to zero or not because returning zero means only that the reader have transmitted the command (verify) successfully to the card, it doesn't means that the card itself is accepted such a secret code or not. Depending on the different card types, the returning data has different meaning for the interpretation of the verification operation.

Card Type	Meaning of returning data
AC_AM2KS	byte 0 : error counter (E) byte 1 – byte 3 : secret code (S) < Upon successful verification, E is equal to 0xFF and secret code is echoed in S >
AC_AM8KS	byte 0 : error counter (E) byte 1 – byte 2 : secret code (S) < Upon successful verification, E is equal to 0xFF and secret code is echoed in S >
AC_X76F041 AC_X76F128 AC_X76F640 AC_X76F100	If verification fail, AC_ExchangeAPDU return ERR_INCORRECT_PASSWORD (-1015). For the X76F128 / X76F640 / X76F100, it has a retry counter of 8 attempts.
Others	No direct way to know the verification is successful or not.

#### **2.4.5 The Xicor Card X76F128 / X76F640**

The X76F128 contains one 16K bytes secure EEPROM array (Array0) and one 64 bytes secure EEPROM array (Array1). The X76F640 contains one 8K bytes secure EEPROM array (Array0) and one 32 bytes secure EEPROM array (Array1). A read password and a write password (both are 8 bytes long) are required for the access into each of this memory array. Together with the RESET password which authorize the "ACI\_WriteAll" and the "ACI\_Reactivate" commands, there are totally five passwords for use by this particular card type – namely, "Read Array 0 Password", "Read Array 1 Password", "Write Array 0 Password", "Write Array 1 Password" and "Reset Password".

In order to read (ACI\_Read) the memory content of Array0, the application must have the "Read Array 0 Password" verify (ACI\_Verify) OK. Similarly, for the writing (ACI\_Write) of data into the memory content of Array0, the application must have the "Write Array 0 Password" verify OK. The same restriction is applied also in the case of Array1. For the "Reset Password", once it is verified OK, the command "ACI\_WriteAll" can be used to write the complete card content with zero and the command "ACI\_CardReset" can be used to reset the retry counter and reactive the card. When a password is verified OK, it can be changed using the "ACI\_ChangePIN" command.

For the X76F128, array 0 can be accessed in the address range \$0000 - \$3FFF and array 1 can be accessed in the address range \$8000 - \$803F. For the X76F640, array 0 can be accessed in the address range \$0000 - \$1FFF and array 1 can be accessed in the address range \$8000 - \$801F.

#### **2.4.6 The Xicor Card X76F100**

The X76F100 memory array consists of fourteen 8-byte sectors (total 112 bytes) in which the reading is protected by a 8-byte read password and the writing is protected by a 8-byte write password. Write access to the array always begins at the first address of the sector (i.e. address is a multiple of 8) and the length must be a multiple of 8. The retry counter allows 8 accesses with an invalid password. If the retry counter overflows, the memory area and both of the passwords are cleared to zero. If a correct password is received prior to retry counter overflow, the retry counter is reset and access is granted. For the changing of either one of the password (ACI\_ChangePIN), it is required to have the write password to be verified OK.

**Appendix A : Table of error codes**

<b>Code</b>	<b>Meaning</b>
-603	Error in the reader handle
-600	Session parameter is null
-108	No free handle left for allocation
-100	Selected port is invalid
-101	Selected reader is invalid
-102	Selected port is occupied
-1001	No card type selected
-1002	No card is inserted
-1003	Wrong card type
-1004	Card not powered up
-1005	INS is invalid
-1006	Card failure
-1007	Protocol error
-1008	Card type not supported
-1009	Incompatible command
-1010	Error in address
-1011	Data length error
-1012	Error in response length
-1013	Secret code locked
-1014	Invalid SC module number
-1015	Incorrect password
-1050	Error in CLA
-1051	Error in APDU parameters
-1052	Communication buffer is full
-1053	Address not align with word boundary
-1080	Protocol frame error
-1081	No response from reader
-1082	Error found in the calling function's parameters
-1083	Specified function not supported
-1084	Connector short circuit
-1085	Unexpected internal error
-1086	A required DLL file is missing
-1099	Unknown response
-2000	USB internal error
-2001	Error in memory allocation
-2002	Error in linking USB library
-2003	Error in locating window system directory
-3000	Error found in PCSC smart card manager

## Appendix B : Supporting Memory Card Commands

CardType	ACI_Read	ACI_Write	ACI_SetFuse	ACI_Verify	ACI_WritePr	ACI_ChangePIN	ACI_Erase	ACI_WriteCarry	ACI_Authenticate	ACI_SelfProtect	ACI_ReadProtect	ACI_LockProtect	ACI_SetHE	ACI_ClearProtect	ACI_WriteAll	ACI_EraseAll	ACI_Reactivate	ACI_CardOptions	ACI_BlowFuse
AC_AM104	X	X		X				X											
AC_AM221	X	X		X				X	X										
AC_SLE4404	X	X	X	X			X												
AC_GPM896	X	X	X	X			X												
AC_AT101	X	X	X	X			X												X
AC_AT102	X	X	X	X			X												X
AC_AT8KP	X	X			X														
AC_AT8KS	X	X		X	X					X									
AC_AT2KP	X	X			X														
AC_AT2KS	X	X		X	X	X				X									
AC_IIC	X	X																X	
AC_XIIC	X	X								X	X	X						X	
AC_AT1604	X	X	X	X			X												X
AC_T0																			
AC_T1																			
AC_SCM module																			
AC_AM256	X	X								X	X	X	X	X	X				
AC_AM4KP	X	X					X			X	X	X	X	X	X	X			
AC_X76F041	X	X		X		X				X	X				X	X			
AC_X24645	X	X																	
AC_ST1335	X	X		X			X	X	X										
AC_ST1333	X	X		X			X	X	X										
AC_X76F128	X	X		X		X									X		X		
AC_X76F640	X	X		X		X									X		X		
AC_X76F100	X	X		X		X													

**Appendix C : Table of card types compatibility**

ACSR20 card type	ACS	Atmel	Gemplus	SGS- Thomson	Siemens	Xicor
AC_AM104	AM104	AT88SC06	GPM103	ST1305	SLE4406	-
AC_AM221	AM221	-	GAM226	-	SLE4436	-
AC_SLE4404	AM416	-	GPM416	-	SLE4404	-
AC_GPM896	-	-	GPM896	-	-	-
AC_AT101	-	AT88SC101	-	-	-	-
AC_AT102	-	AT88SC102	-	-	-	-
AC_AM8KP	AM8KP	-	-	-	SLE4418	-
AC_AM8KS	AM8KS	-	-	-	SLE4428	-
AC_AM2KP	AM2KP	-	-	-	SLE4432	-
AC_AM2KS	AM2KS	-	-	-	SLE4442	-
AC_IIC	AM1KF AM2KF AM4KF	AT24C01 AT24C02 AT24C04 AT24C08 AT24C16	GFM1K GFM2K GFM4K GFM8K	ST14C02C ST14C04C	-	X24026 X24165 X24645
AC_XIIC	AM64KP	-	-	-	-	-
AC_AT1604	-	AT88SC1604	-	-	-	-
AC_AM256	AM256	-	-	-	-	-
AC_AM4KP	AM4KP	-	-	-	-	-
AC_X76F041	-	-	-	-	-	X76F041
AC_X24645	-	-	-	-	-	X24645
AC_ST1335	-	-	-	ST1335	-	-
AC_ST1333	-	-	-	ST1333	-	-
AC_X76F128	-	-	-	-	-	X76F128
AC_X76F640	-	-	-	-	-	X76F640
AC_X76F100	-	-	-	-	-	X76F100
AC_T0	All T=0 MCU card					
AC_T1	All T=1 MCU card					
AC_SModule	All T=0 / T=1 security module in SIMM form					

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