Advanced Card Systems Limited

Card and Reader Technologies

# User Manual

## AET62

# Revision History

| Version | Date | Prepared By | Description |
|---|---|---|---|
| 1.00 | 28 Mar 2008 | Jason Ngan | Initial release |
| 1.10 | 24 Aug 2009 | Jason Ngan | Updated Features |
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# 1.0. Introduction

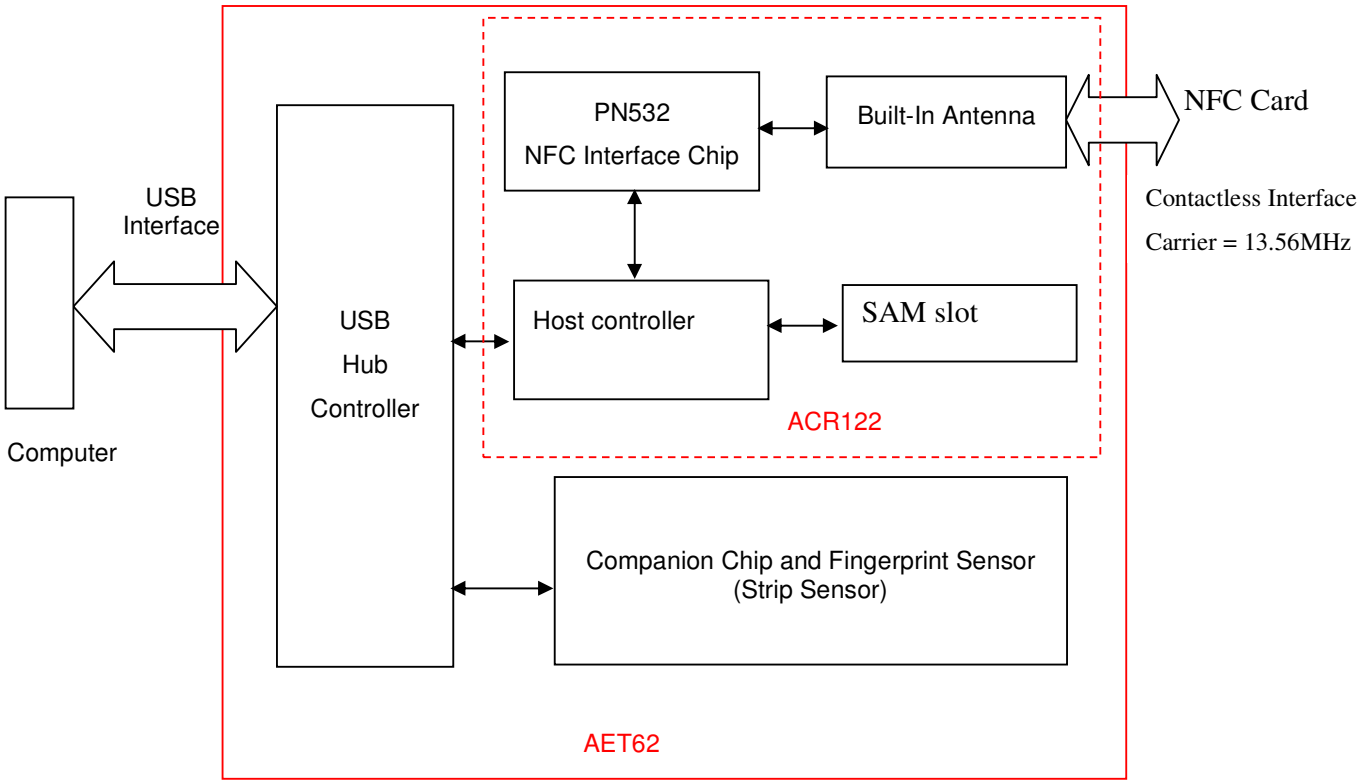
AET62 is a USB 2.0 full speed Contactless card reader, which is the interface for the communication between a computer and a smart card reader. Simultaneously, it is also a fingerprint reader using strip sensor.

# 2.0. FEATURES

- Slope casing for strip sensor for easy finger snapping - as small as possible
- Horizontal card placement
- The card should not cover the strip sensor.
- Add weight to prevent swinging
- Un-detachable USB wire of length same as ACR122
- USB version 1.1 full speed
- A bi-colour LED shows the statues of device power supply and smart card reader
- ISO14443 Parts 1-4 Type A & B, Mifare, Desfire, Topaz, ISO/IEC18092 (NFC) compliant – all 3 modes
- Maxmium smart card operation speed: 424 kbps
- CCID standard,
- PC/SC compliant
- Support anti-collision. Even in the presence of multiple cards, at least 1 tag can be correctly identified.
- (By PC/SC Escape Commands) Allow manual card polling option
- Operating Distance for different Tags ~ 40mm
- Optional: 1 SAM slot (Not changing often)
- Match-on-device
- BioAPI 1.1, Windows Biometric Framework (WBF)
- CE & FCC, RoHS compliant, REACH compliant
- (Optional) VCCI
- OS supported: Windows 2000, 2003, XP 32, XP 64, Vista 32 and Vista 64, Linux, Mac

# 3.0. SYSTEM BLOCK DIAGRAM

AET62 is a merge version with ACR122 and finger print sensor. ACR122 is a contactless reader. The system block of AET62 is shown as follow:




The USB Hub Controller is the communication interface between the PC and the host controller and fingerprint sensor via USB port connection. The companion chip get the fingerprint image form the Strip sensor and contains the fingerprint template extraction and matching algorithms. The template matching can be performed in device. The AET62 is powered from USB port without external power supply.

# 4.0. HARDWARE INTERFACES

## 4.1. Power Supply

The AET62 requires a voltage of 5V DC, 150mA regulated power supply, and gets the power supply from PC.

## 4.2. USB Interface

The AET62 is connected to a computer through USB as specified in the USB Specification 1.1. The AET62 is working in Full speed mode, i.e. 12 Mbps.

| Pin | Signal | Function |
|---|---|---|
| 1 | $V_{BUS}$ | +5V power supply for the reader (Max 200mA, Normal 100mA) |
| 2 | D- | Differential signal transmits data between AET62 and PC. |
| 3 | D+ | Differential signal transmits data between AET62 and PC. |
| 4 | GND | Reference voltage level for power supply |

### 4.2.1. Endpoints

The AET62 uses the following endpoints to communicate with the host computer:

#### 4.2.1.1. Smart Card Reader

| | |
|---|---|
| **Control Endpoint** | For setup and control purpose |
| **Bulk OUT** | For command to sent from host to AET62 (data packet size is 64 bytes) |
| **Bulk IN** | For response to sent from AET62 to host (data packet size is 64 bytes) |
| **Interrupt IN** | For card status message to sent from AET62 to host (data packet size is 8 bytes) |

#### 4.2.1.2. Finger Print Device

| | |
|---|---|
| **Control Endpoint** | For setup and control purpose |
| **Bulk OUT** | For command to sent from host to Device (data packet size is 64 bytes) |
| **Bulk IN** | For response to sent from Device to host (data packet size is 64 bytes) |

## 4.3. Bi-Color LED

- User-controllable Bi-color LED. Red and Green Color.
- The Green Color LED will be blinking if the “Card Interface” is not connected.
- The Green Color LED will be turned on if the “Card Interface” is connected.
- The Green Color LED will be flashing if the “Card Interface” is operating.
- The Red Color LED is controlled by the application only.

## 4.4. Buzzer (optional)

- User-controllable buzzer.
- The default Buzzer State is OFF

## 4.5. SAM Interface (optional)

- One SAM socket is provided.

## 4.6. Built-in Antenna

- 6 turns symmetric loop antenna. Center tapped.
- The estimated size = 50mm x 40mm.
- The loop inductance should be around ~ 1.6uH to 2.5uH
- Operating Distance for different Tags ~ 40mm to 50mm
- No anti-collision. Only one Tag can be accessed at any one time.
- Contactless Interface Carrier = 13.56MHz

## 4.7. FINGERPRINT SCANNNER

AET62 is built around the companion chip and fingerprint sensor.

Fingerprint sensor active capacitive sensing provides a much higher immunity to parasitic effects leading to a higher signal-to-noise ratio and the ability to capture a wider range of fingerprints than competing technologies, such as passive capacitive sensing. The matching algorithm will be stored in the Companion chip. The fingerprint matching will be performed on the device. It can provides “Match on device” feature.

Typically there are two processes involved in a biometric application:

Enrollment:

Before the identity of an individual can be verified via his/her fingerprints, it is necessary to capture one or several fingerprint samples. This process is called enrollment. The samples

are referred to as fingerprint templates and can be stored on a broad range of media such as computer storage devices or smartcards.

Verification:
The verification process requires a user to verify his identity by placing his finger on the fingerprint scanner sensor. The live fingerprint is compared with a stored template using a matching algorithm in order to determine whether they represent the same set of fingerprint. The matching result is then made available to the computer.
When using the fingerprint device, the security level is mainly governed by two parameters:

False Acceptance Rate (FAR):
FAR is the probability that a false sample matches with the original template previously extracted from the subject's fingerprint images during enrollment.

False Rejection Rate (FRR):
FRR is the rate at which the system incorrectly rejects a legitimate attempt to verify.

# 5.0. Commands for Contact and Contactless Interfaces Handling

The contactless interface is operating on the top of contact interface. Some Pseudo APDUs are defined for contactless interface. If the reader finds that the APDUs are for contactless interface, the APDUs will be routed to the contactless interface, otherwise, the APDUs will be routed to contact interface. The Contact and Contactless Interfaces are able to be operating at the same time.

- The Pseudo APDU "Direct Transmit" is used for sending commands to the contactless interface

| Command | Class | INS | P1 | P2 | Lc | Data In |
|---|---|---|---|---|---|---|
| Direct Transmit | 0xFF | 0x00 | 0x00 | 0x00 | Number of Bytes to send | PN532_Contactless Command |

2. The Pseudo APDU "Get Response" is used for retrieving the responses from the contactless interface.

| Command | Class | INS | P1 | P2 | Le |
|---|---|---|---|---|---|
| Get Response | 0xFF | 0xC0 | 0x00 | 0x00 | Number of Bytes to retrieve |

If the reader finds that the APDU is in the form of "FF 00 00 00 Lc XX XX .." or "FF C0 00 00 Le", the APDU will be routed to the contactless interface.

Also, one Pseudo APDU "Bi-Color LED and Buzzer Control" is defined for controlling the LED and Buzzer.

| Command | Class | INS | P1 | P2 | Lc | Data In (4 Bytes) |
|---|---|---|---|---|---|---|
| Bi-Color and Buzzer LED Control | 0xFF | 0x00 | 0x40 | LED State Control | 0x04 | Blinking Duration Control |

Similarly, if the reader finds that the APDU is in the form of "FF 00 40 XX 04 XX XX XX XX", the APDU will be used for setting the LED and Buzzer State.

The contact interface must be activated in order to send commands to the contactless or LED interface.

## 5.1. PSEUDO APDUS IN CONTACTLESS READER

PCSC interface is used for exchanging APDUs and Responses between the PC and Tag. The AET62 will handle the required protocol internally. AET62 comes with two primitive commands for this purpose.

### 5.1.1. Direct Transmit

To send an APDU (PN532 and Contactless Commands), and the length of the Response Data will be returned.

Table 1.0A: Direct Transmit Command Format (Length of the PN532_Contactless Command + 5 Bytes)

| Command | Class | INS | P1 | P2 | Lc | Data In |
|---|---|---|---|---|---|---|
| Direct Transmit | 0xFF | 0x00 | 0x00 | 0x00 | Number of Bytes to send | PN532_Contactless Command |

**Lc: Number of Bytes to Send (1 Byte)**

Maximum 255 bytes

**Data In: PN532_Contactless Command**

The data to be sent to the PN532 and Contactless Tag.

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

| Response | Data Out | |
|---|---|---|
| Result | SW1 | SW2 |

**Data Out: SW1 SW2**

Status Code returned by the reader.

# 6.0. APIs for Fingerprint Sensor

## 6.1. PTOpen

PT_STATUS PTOpen(

IN PT_CHAR *pszDsn

OUT PT_CONNECTION *phConnection

)

Description:

Open a new fingerprint module connection

**Parameters :**

pszDsn :

ASCII string describing the FM connection parameters. Examples: “USB”

phConnection:

Connection handle result.

**Return value:**

PT_STATUS:

Return value.

## 6.2. PTClsoe

PT_STATUS PTClose(

IN PT_CONNECTION hConnection

)

Description:

Close a fingerprint module connection

**Parameters :**

hConnection:

Connection handle to be closed.

**Return value:**

PT_STATUS:

Return value.

## 6.3. PTGrab

PT_STATUS PTGrab(
IN PT_CONNECTION hConnection
IN PT_BYTE byType
IN PT_LONG lTimeout
IN PT_BOOL boWaitForAcceptableFinger
OUT PT_DATA **ppGrabbedData
IN PT_DATA *pSignData
OUT PT_DATA **ppSignature
)

Description:

Scan the finger and return the scanned finger image

hConnection:

FM Handle

byType:

The returned data type

lTimeout:

Timeout value in milliseconds.

boWaitForAcceptableFinger:

| Value: | Description |
|---|---|
| True | Return the finger image if the finger quality would be acceptable |
| False | Always returns the finger image after a single swipe |

ppGrabbedData:

Address of the data pointer,

pSignData:

Reserved, Null value

ppSignature:

Reserved, Null value

For the detail, please you can refer UPEK ESS&TFM Application Communication Layer document.

Table 1.0C: Status Code

| Results | SW1 | SW2 | Meaning |
|---|---|---|---|
| Success | 61 | LEN | The operation is completed successfully. The response data has a length of LEN bytes.<br><br>The APDU "Get Response" should be used to retrieve the response data. |
| Error | 63 | 00 | The operation is failed. |
| Time Out Error | 63 | 01 | The PN532 does not response. |
| Checksum Error | 63 | 27 | The checksum of the Contactless Response is wrong. |
| Parameter Error | 63 | 7F | The PN532_Contactless Command is wrong. |

## 6.4. Get Response

To retrieve the response data after the "Direct Command" is issued.

Table 2.0A: Get Response Command Format (5 Bytes)

| Command | Class | INS | P1 | P2 | Le |
|---|---|---|---|---|---|
| Get Response | 0xFF | 0xC0 | 0x00 | 0x00 | Number of Bytes to retrieve |

**Le: Number of Bytes to Retrieve (1 Byte)**

Maximum 255 bytes

Table 2.0B: Get Response Format (Le bytes, Length of the Response Data)

| Response | Data Out |
|---|---|
| Result | Response Data |

**Data Out: Response Data, or Error Code "63 00" will be given if no response data is available.**

Remark:

In general, the Pseudo APDUs “Direct Transmit” and “Get Response” are used in pairs. Once the APDU “Direct Transmit” is sent, the reader will return the length of the response data. Then, the APDU “Get Response” is immediately used to retrieve the actual response data.

## 6.5. Bi-Color LED and Buzzer Control

This APDU is used to control the states of the Bi-Color LED and Buzzer.

Table 3.0A: Bi-Color LED and Buzzer Control Command Format (9 Bytes)

| Command | Class | INS | P1 | P2 | Lc | Data In (4 Bytes) |
|---|---|---|---|---|---|---|
| Bi-Color and Buzzer LED Control | 0xFF | 0x00 | 0x40 | LED State Control | 0x04 | Blinking Duration Control |

**P2: LED State Control**

Table 3.0B: Bi-Color LED and Buzzer Control Format (1 Byte)

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

**Data In: Blinking Duration Control**

Table 3.0C: Bi-Color LED Blinking Duration Control Format (4 Bytes)

| Byte 0 | Byte 1 | Byte 2 | Byte 3 |
|---|---|---|---|
| T1 Duration<br>Initial Blinking State<br>(Unit = 100ms) | T2 Duration<br>Toggle Blinking State<br>(Unit = 100ms) | Number of repetition | Link to Buzzer |

**Byte 3: Link to Buzzer. Control the buzzer state during the LED Blinking.**

0x00: The buzzer will not turn on

0x01: The buzzer will turn on during the T1 Duration

0x02: The buzzer will turn on during the T2 Duration

0x03: The buzzer will turn on during the T1 and T2 Duration.

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

Table 3.0D: Status Code

| Results | SW1 | SW2 | Meaning |
|---|---|---|---|
| Success | 90 | Current LED State | The operation is completed successfully. |
| Error | 63 | 00 | The operation is failed. |

Table 3.0E: Current LED State (1 Byte)

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

**Remark:**

1. The LED State operation will be performed after the LED Blinking operation is completed.
2. The LED will not be changed if the corresponding LED Mask is not enabled.
3. The LED will not be blinking if the corresponding LED Blinking Mask is not enabled. Also, the number of repetition must be greater than zero.
4. T1 and T2 duration parameters are used for controlling the duty cycle of LED blinking and Buzzer Turn-On duration. For example, if T1=1 and T2=1, the duty cycle = 50%. #Duty Cycle = T1 / (T1 + T2).
5. To control the buzzer only, just set the P2 “LED State Control” to zero.
6. The make the buzzer operating, the “number of repetition” must greater than zero.
7. To control the LED only, just set the parameter “Link to Buzzer” to zero.

## 6.6. Get the Firmware Version of the reader

To retrieve the firmware version of the reader.

Table 4.0A: Get Firmware Version Command Format (5 Bytes)

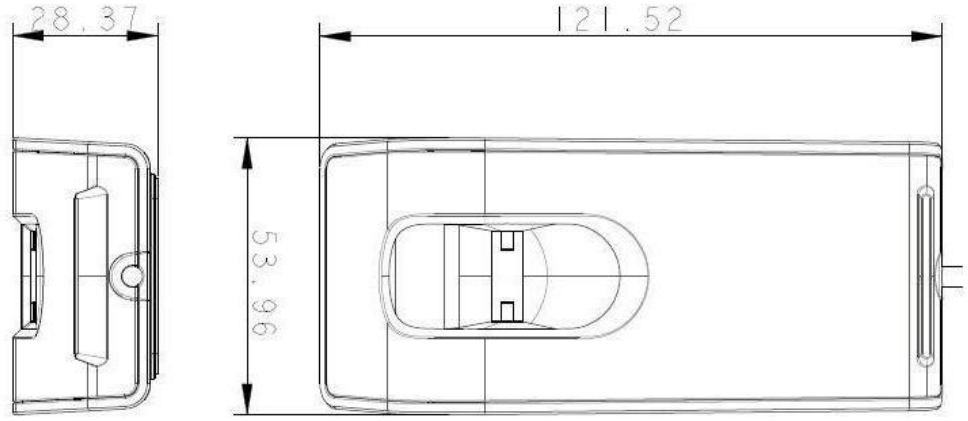
| Command | Class | INS | P1 | P2 | Le |
|---|---|---|---|---|---|
| Get Response | 0xFF | 0x00 | 0x48 | 0x00 | 0x00 |

Table 4.0B: Get Firmware Version Response Format (10 bytes)

| Response | Data Out |
|---|---|
| Result | Firmware Version |

E.g. Response = 41 43 52 31 32 32 55 31 30 31 (Hex) = ACR122U101 (ASCII)

# 7.0. Technical Specification




| | |
|---|---|
| **Universal Serial Bus Interface** | |
| Power source | From USB |
| Speed | 12 Mbps (Full Speed) |
| Supply Voltage | Regulated 5V DC |
| Supply Current | 300mA (maximum); 100mA (standby); 150mA (normal) |
| **Contactless Smart Card Interface** | |
| Standard | MIFARE Classic, ISO14443-4 Type A & B, FeliCa, ISO/IEC 18092 NFC |
| Operating Frequency | 13.56 MHz |
| Smart card read / write speed | 106, 212, 424 kbps |
| **SAM Interface (optional SAM Socket)** | |
| Standard | ISO 7816 |
| Protocol | T=0 protocol |
| Operating Frequency | 4 MHz |
| Smart card read / write speed | 9600 - 115200 bps |
| **Fingerprint Sensor Interface** | |
| Sensor Type | Swipe |
| Image resolution | 508 DPI |
| **Case** | |
| Dimensions | 98 mm (L) x 65 mm (W) x 12.8 mm (H) |
| Material | Polycarbonate (PC) |
| Color | Pearl White |
| Antenna Size | 50mm x 40mm |
| Operating distance | up to 30 mm (depended on tag type) |
| **Built-in peripherals** | |
| Bi-Color LED | Bi-Color LED, Red and Green |
| Buzzer | Monotone (optional) |
| **Operating Conditions** | |
| Temperature | 0 - 50° C |
| Humidity | 10% - 80% |
| **Cable Connector** | |
| Length | 1.5 M (USB) |
| **Standard/Certifications** | |
| CE, FCC | |
| **OS** | |
| Windows 2K, XP, Vista | |
| **OEM** | |
| OEM-Logo possible, customer-specific colors, casing, and card connector | |

Warning:

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

(1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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