

Fingerprint Module User's Guide
(Ver 1.2)

ShenZhen ISUN technology Co., LTD

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(I) Overview

This document describes the parameters, communication process, command and data formats of the HA1210 fingerprint recognition module manufactured by Shenzhen ISUN Technology Co., LTD. Please read this manual carefully.

Communication Rules

All command transmission and reception must follow the send-then-receive rule. The Host shall not send new commands to the Target module before receiving a complete response.

Data Transmission Rules

Data is transmitted in asynchronous serial mode with one start bit preceding data bits.

- Byte transmission: Least Significant Bit (LSB) first
- Word transmission: Low byte sent prior to high byte

Serial Communication Parameters

- Start bit: 1 bit
- Data bit: 8 bits
- Stop bit: 1 bit
- Parity bit: None
- Baud rate: 9600 / 19200 / 38400 / 57600 / 115200 / 230400 / 460800 / 921600; Default: 115200 BPS

Core Functions:

Besides standard functions including live fingerprint enrollment (library capacity: 1700 / 2000 / 3000), fingerprint 1:1 verification, 1:N identification and batch deletion of fingerprints, the module supports extended functions as below:

1. Upload / download fingerprint template data between Host and module for enrollment, verification and identification
2. Upload / download fingerprint images between Host and module for template generation, live fingerprint matching
3. Detect corrupted fingerprint templates stored in module Flash within specified ID range
4. Set and read module serial number

(II) Communication Protocol

2.1 Communication Flow

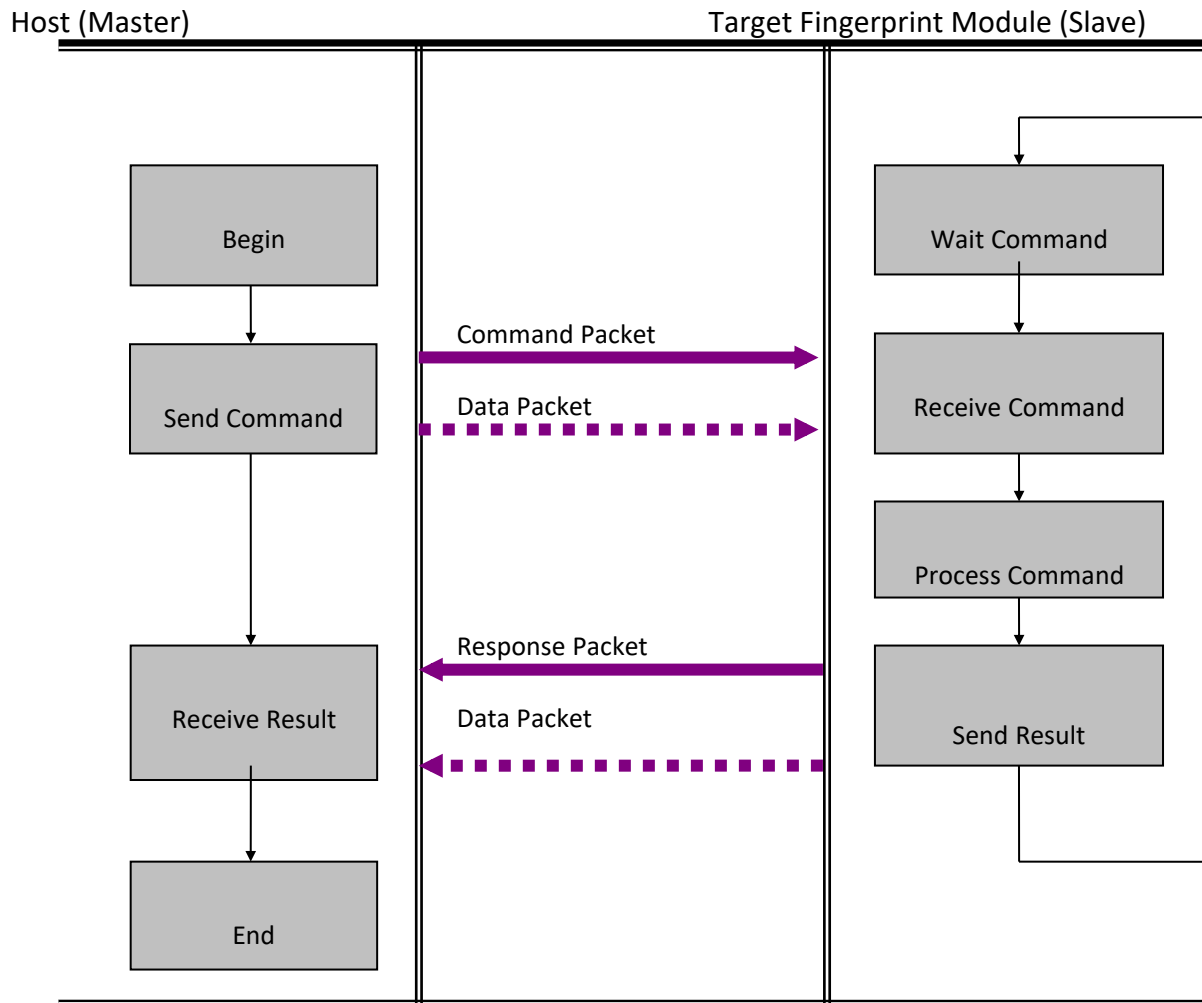


Figure 2-1 Communication process

Note:

The one-send-one-receive rule must be strictly followed. No new command shall be sent before response arrival.

2.2 Classification of Communication Packets

2.2.1 Command packet

- Carries instruction data transmitted from Host to Target.
- All Host instructions are encapsulated in Command Packets.
- Command Packets of fixed length: 26 bytes.

2.2.2 Response packet

- Carries reply data transmitted from Target to Host.
- A command session terminates after receiving the corresponding Response Packet.
- Response packet of fixed length: 26 bytes

2.2.3 Command / Response Data Packet

- Used when command parameters or response data exceed 16 bytes.
- Host must notify the module of total data length via a Command Packet before sending Data Packets.
- Command / Response Data Packet of Maximum payload length: 500 bytes

2.3 Frame Structure of Communication Packets

2.3.1 Packet Identification Code

The first 2 bytes of each packet serve as identification headers:

Packet Type	Identification Code
Command packet	0xAA55
Response packet	0x55AA
Command Data Packet	0xA55A
Response Data Packet	0x5AA5

Table 2-1 Packet identification code

2.3.2 Frame Structure of Command Packet

PREFIX		SID	DID	CMD		LEN		DATA				CKS	
0x55	0xAA	Source ID	Destination ID	L	H	L	H	D0	D1	...	D15	L	H
0	1	2	3	4	5	6	7	8	9	...	23	24	25

Table 2-2 Command packet

OFFSET	FIELD	Data TYPE	Byte SIZE	DESCRIPTION
0	PREFIX	WORD	2byte	Packet Identify code
2	SID	BYTE	1byte	Soruce Device ID
3	DID	BYTE	1byte	Destination Device ID

4	CMD	WORD	2byte	Command Code
6	LEN	WORD	2byte (=n, n < 16)	Length of DATA
8	DATA	Byte Array	16byte	Command Parameter (only first n bytes valid)
24	CKS	WORD	2byte	Check Sum: Lower 2 bytes of arithmetic sum from PREFIX to DATA field

2.3.3 Frame Structure of Response Packet

PREFIX		SID	DID	RCM		LEN		RET		DATA				CKS	
0x55	0xAA	Source ID	Destination ID	L	H	L	H	L	H	D0	D1	...	D15	L	H
0	1	2	3	4	5	6	7	8	9	10	11	...	24	25	26

Table 2-3 Response packet

OFFSET	FIELD	Data TYPE	Byte SIZE	DESCRIPTION
0	PREFIX	WORD	2byte	Packet Identify code
2	SID	BYTE	1byte	Source Device ID
3	DID	BYTE	1byte	Destination Device ID
4	RCM	WORD	2byte	Response Code
6	LEN	WORD	2byte(=n, n < 16)	Length of RET and DATA
8	RET	WORD	2byte	Result Code(0 :Pass, 1 :Fail)
10	DATA	Byte Array	14byte	Response Data(valid length = n - 2)
24	CKS	WORD	2byte	Check Sum: Lower 2 bytes of arithmetic sum from PREFIX to DATA field

2.3.4 Command Data Packet

PREFIX		SID	DID	CMD		LEN		DATA				CKS	
0x5A	0xA5	Source ID	Destination ID	L	H	L	H	D0	D1	...	Dn-1	L	H
0	1	2	3	4	5	6	7	8	9	...	8+n-1	8+n	8+n+1

Table 2-4 Command Data Packet:

OFFSET	FIELD	Data TYPE	Byte SIZE	DESCRIPTION
0	PREFIX	WORD	2byte	Packet Identify code
2	SID	BYTE	1byte	Source Device ID
3	DID	BYTE	1byte	Destination Device ID
4	CMD	WORD	2byte	Command Code
6	LEN	WORD	2byte(=n , n <500)	Length of DATA

8	DATA	Byte Array	nbyte	Command parameter
8+n	CKS	WORD	2byte	Check Sum: Lower 2 bytes of arithmetic sum from PREFIX to DATA field

Rules: Host sends Command Packet first to inform module of pending data length; module enters data receiving state after replying success response, then Host transmits Command Data Packet.

2.3.5 Frame Structure of Response Data Packet

PREFIX		SID		DID	RCM		LEN		RET		DATA				CKS	
0xA5	0x5A	Source ID		Destination ID	L	H	L	H	L	H	D0	D1	...	Dn-3	L	H
0	1	2		3	4	5	6	7	8	9	10	11	...	8+n-1	8+n	8+n+1

Table 2-5 Response Data Packet:

OFFSET	FIELD	Data TYPE	Byte SIZE	DESCRIPTION
0	PREFIX	WORD	2byte	Packet Identify code
2	SID	BYTE	1byte	Soruce Device ID
3	DID	BYTE	1byte	Destination Device ID
4	CMD	WORD	2byte	Response Code
6	LEN	WORD	2byte(=n, n <500)	Length of result data (RET + DATA)
8	RET	WORD	2byte	Result code(0 : Pass, 1 : Fail)
10	DATA	Byte Array	n-2 byte	Response data
8+n	CKS	WORD	2byte	Check Sum: Lower 2 bytes of arithmetic sum from PREFIX to DATA field

Note: Response Data Packet is used when module needs to transmit more than 14 bytes data to Host.

(III) Overview of Communication Commands

3.1 Data Structure of Fingerprint Template Record

Template Data	Checksum
496 byte	2 byte
Template Data	Minimum 2 bytes of arithmetic sum of each byte of Template Data.

Table 3-1 Template Record

Note: CheckSum = Lower 2 bytes of arithmetic sum of all bytes in Template Data
Total template record size = 498 Bytes

3.2 Command List

No	Command Name	Code	Function
1	CMD_TEST_CONNECTION	0x0001	Test communication connection with device
2	CMD_SET_PARAM	0x0002	Device ID, Security Level, Baudrate, Duplication Check, Auto Learn
3	CMD_GET_PARAM	0x0003	Device ID, Security Level, Baudrate, Duplication Check, Auto Learn
4	CMD_GET_DEVICE_INFO	0x0004	Read current device parameters
5	CMD_ENTER_IAP_MODE	0x0005	Switch module to IAP firmware upgrade mode
6	CMD_GET_IMAGE	0x0020	Capture fingerprint image and store to ImageBuffer
7	CMD_FINGER_DETECT	0x0021	Detect whether finger is placed on sensor
8	CMD_UP_IMAGE	0x0022	Upload image stored in ImageBuffer to Host
9	CMD_DOWN_IMAGE	0x0023	Download fingerprint image from Host to module ImageBuffer
10	CMD_SLED_CTRL	0x0024	Turn collector backlight ON/OFF (Not applicable to semiconductor sensors)
11	CMD_STORE_CHAR	0x0040	Save template from specified RamBuffer to designated library ID
12	CMD_LOAD_CHAR	0x0041	Read template from specified library ID into designated RamBuffer
13	CMD_UP_CHAR	0x0042	Upload template in RamBuffer to Host
14	CMD_DOWN_CHAR	0x0043	Download template from Host to designated RamBuffer
15	CMD_DEL_CHAR	0x0044	Delete all templates within specified ID range
16	CMD_GET_EMPTY_ID	0x0045	Get first unused registration ID in specified range
17	CMD_GET_STATUS	0x0046	Check if specific ID is occupied by registered template
18	CMD_GET_BROKEN_ID	0x0047	Scan specified ID range to detect corrupted templates
19	CMD_GET_ENROLL_COUNT	0x0048	Count total registered templates in specified ID range
20	CMD_GENERATE	0x0060	Generate template from image in ImageBuffer and save to RamBuffer

No	Command Name	Code	Function
21	CMD_MERGE	0x0061	Merge 2 or 3 templates stored in RamBuffers into one complete enrollment template
22	CMD_MATCH	0x0062	1:1 matching between two templates in RamBuffers
23	CMD_SEARCH	0x0063	1:N matching: RamBuffer template vs all templates in specified library ID range
24	CMD_VERIFY	0x0064	1:1 matching: RamBuffer template vs single designated library ID template
25	CMD_SET_MODULE_SN	0x0008	Write unique serial number into module
26	CMD_GET_MODULE_SN	0x0009	Read stored module serial number
27	CMD_FP_CANCEL	0x0025	Abort ongoing fingerprint capture (sliding sensor only)
28	CMD_GET_ENROLLED_ID_LIST	0x0049	Upload full bitmap list of all registered IDs
29	CMD_ENTER_STANDY_STATE	0x000C	Put module into low-power standby mode

(IV) Detailed Description of Each Communication Command

Module memory buffer(ImageBuffer & Ram Buffer) definition:

ImageBuffer: Use to save the image.

Ram Buffer Used to temporarily store fingerprint template data,

There are 3 Ram Buffer :

Ram Buffer0, Ram Buffer1 and Ram Buffer2 .

Note: Data in ImageBuffer and Ram Buffer will be lost in case of power failure.

4.1 Connection Test(CMD_TEST_CONNECTION)

[Function]

Verify physical and communication link between Host and Target. This command shall be sent first before all other operations. If response fails, troubleshoot wiring, baud rate mismatch or module power supply.

[Sequence]

Return ERR_SUCCESS when communication link is normal.

[Command and Response]

PREFIX	0xAA55
SID	Source Device ID
DID	Destination Device ID
CMD	0x0001
LEN	0
DATA	No Data
PREFIX	0x55AA
SID	Source Device ID
DID	Destination Device ID
RCM	0x0001
LEN	2
RET	Result Code
DATA	No Data

Table 4-1 CMD_TEST_CONNECTION command

Example: HOST sends CMD _ TEST _ CONNECTION command and module respond

HOST command: 55 AA 00 00 0100 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 01

Target response: AA 55 01 00 010002000000 00 00 00 00 00 00 00 00 00 00 00 00 03 01

4.2 Set Parameters (CMD_SET_PARAM)

[Function]

Configure module working parameters including Device ID, Security Level, Baud Rate, Duplicate Check, Auto Learn and Finger Capture Timeout, then return operation result.

[Sequence]

- ① If the specified Parameter Type is invalid, the ERR _ INVALID _ PARAM is returned.
- ② If the specified Parameter Value is invalid, the ERR _ INVALID _ PARAM is returned.
- ③ Sets the Parameter Value and returns its result according to the Parameter Type.

[Command and Response]

PREFIX	0xAA55	
SID	Source Device ID	
DID	Destination Device ID	
CMD	0x0002	
LEN	5	
DATA	1bytes	Parameter Type
	4bytes	Parameter Value
PREFIX	0x55AA	
SID	Source Device ID	
DID	Destination Device ID	
RCM	0x0002	
LEN	2	
RET	Result Code	
DATA	No Data	

Table4-2 CMD_SET_PARAM command

[Parameter Type]

Parameter Type	Parameter ValueDescription
0	Indicates the Device ID. Can be set from 1 to 255.

1	Security Level: 1~5 。 Default:3 Security Level: <table><tr><th>Security Level</th><th colspan="2">Recognition rate</th></tr><tr><td rowspan="2">Level 1</td><td>FAR （ False Acceptance Rate ）</td><td>0.1%</td></tr><tr><td>FRR （ False Rejection Rate ）</td><td>0.005%</td></tr><tr><td rowspan="2">Level 2</td><td>FAR （ False Acceptance Rate ）</td><td>0.003%</td></tr><tr><td>FRR （ False Rejection Rate ）</td><td>0.01%</td></tr><tr><td rowspan="2">Level 3</td><td>FAR （ False Acceptance Rate ）</td><td>0.001 %</td></tr><tr><td>FRR （ False Rejection Rate ）</td><td>0.1 %</td></tr><tr><td rowspan="2">Level 4</td><td>FAR （ False Acceptance Rate ）</td><td>0.003%</td></tr><tr><td>FRR （ False Rejection Rate ）</td><td>0.5%</td></tr><tr><td rowspan="2">Level 5</td><td>FAR （ False Acceptance Rate ）</td><td>0.0001%</td></tr><tr><td>FRR （ False Rejection Rate ）</td><td>1%</td></tr></table>	Security Level	Recognition rate		Level 1	FAR （ False Acceptance Rate ）	0.1%	FRR （ False Rejection Rate ）	0.005%	Level 2	FAR （ False Acceptance Rate ）	0.003%	FRR （ False Rejection Rate ）	0.01%	Level 3	FAR （ False Acceptance Rate ）	0.001 %	FRR （ False Rejection Rate ）	0.1 %	Level 4	FAR （ False Acceptance Rate ）	0.003%	FRR （ False Rejection Rate ）	0.5%	Level 5	FAR （ False Acceptance Rate ）	0.0001%	FRR （ False Rejection Rate ）	1%
Security Level	Recognition rate																												
Level 1	FAR （ False Acceptance Rate ）	0.1%																											
	FRR （ False Rejection Rate ）	0.005%																											
Level 2	FAR （ False Acceptance Rate ）	0.003%																											
	FRR （ False Rejection Rate ）	0.01%																											
Level 3	FAR （ False Acceptance Rate ）	0.001 %																											
	FRR （ False Rejection Rate ）	0.1 %																											
Level 4	FAR （ False Acceptance Rate ）	0.003%																											
	FRR （ False Rejection Rate ）	0.5%																											
Level 5	FAR （ False Acceptance Rate ）	0.0001%																											
	FRR （ False Rejection Rate ）	1%																											
2	Duplication Check: 0 = Disable / 1 = Enable 1 :Duplicate detection is performed when the CMD _ STORE _ CHAR instruction is processed. 0 :Duplicate detection is not performed.																												
3	Baudrate Setup: 1 ~ 8. 1:9600bps, 2:19200bps, 3:38400bps, 4:57600bps, 5:115200bps 6:230400bps, 7:460800bps, 8:921600bps																												
4	Auto Learn Disable/Enable: 0/1。 1 : Then the CMD _ SEARCH is processed, and the intelligent update is carried out when the instruction is CMD _ VERIFY. 0 : The Smart Update is not performed.																												
5	Indicates the fingerprint collection timeout (Fp TimeOut) parameter, which can be set from 1 second to 60 seconds. This parameter is used in the CMD _ GET _ IMAGE command to wait for the input of the fingerprint during the FP TimeOUT time. Note: This parameter is only used for sliding the fingerprint sensor module, and the default value is 5S.																												

Example: Set the baud rate to 921600 BPS

HOST command: 55 AA 00 00 020005000308000000 00 00 00 00 00 00 00 00 00 00 00 00 11 01

Target response: AA 55 01 00 020002000000 00 00 00 00 00 00 00 00 00 00 00 00 00 04 01

4.3 Read parameters (CMD_GET_PARAM)

[Function]

Obtain the device parameter according to the specified Parameter Type(Device ID, Security Level, Baud rate, Duplication Check, Auto Learn, FP TimeOut).

About Parameter Type , Please refer to above CMD_SET_PARAM.

[Sequence]

- ① If the specified Parameter Type is invalid, the ERR_INVALID_PARAM is returned.
- ② Returns the device parameter corresponding to the specified Parameter Type.

[Command and Response]

PREFIX	0xAA55	
SID	Source Device ID	
DID	Destination Device ID	
CMD	0x0003	
LEN	1	
DATA	1byte	Parameter Type

PREFIX	0x55AA	
SID	Source Device ID	
DID	Destination Device ID	
RCM	0x0003	
LEN	Success : 6, failed : 2	
RET	Result Code	
DATA	4bytes	On success: Parameter Value

Table 4-3 CMD_GET_PARAM Command

Example 1: Read the current security level (return security level = 3)

Host command: 55 AA 00 00 0300010001 00 00 00 00 00 00 00 00 00 00 00 00 04 01

Target response: AA 55 01 00 03000600000003000000 00 00 00 00 00 00 00 00 00 0C 01

Example 2: Read the current TimeOut value (TimeOut = 5S); used to slide the fingerprint module

Host command: 55 AA 00 00 0300010005 00 00 00 00 00 00 00 00 00 00 00 00 08 01

Target response: AA 55 01 00 03000600000005000000 00 00 00 00 00 00 00 00 00 0E 01

4.4 Read the device information (CMD_DEVICE_INFO)

[Function] Get device information such as module version (Device Information of Target)。

The format of the device information is as follows: "SEON _ GD _ FPC1020 (xfp) Vy. Y". And X represent that number of fingerprint that can be registered.

The Y. Y indicates the firmware version (F/W Version).

[Sequence]

- 1) Firstly, the data length of the response data packet sent next time is sent to the HOST by using the command response packet.
- 2) Use the reply packet to send Device Information.

[Command and Response]

PREFIX	0xAA55	
SID	Source Device ID	
DID	Destination Device ID	
CMD	0x0004	
LEN	0	
DATA	No data	
PREFIX	0x55AA	
SID	Source Device ID	
DID	Destination Device ID	
RCM	0x0004	
LEN	4	
RET	ERR_SUCCESS	
DATA	2bytes	Data length of data response packet
When SUCCESS		
PREFIX	0x5AA5	
SID	Source Device ID	
DID	Destination Device ID	
RCM	0x0004	
LEN	2 + Device Information length	
RET	ERR_SUCCESS	
DATA	Device Information	

Table 4-4 CMD_DEVICE_INFO command

Host command: 55 AA 00 00 0400 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 03 01

Target response: AA 55 01 00 0400040000001A00 00 00 00 00 00 00 00 00 00 00 00 00 22 01

Response packet: A55A010004001F00000053 454F4E5F47445F465043313032

3028323030306670292056312E30002B08; The gray data is the ASCII code of the equipment information
"SEON _ GD _ FPC1020 (2000fp) V1.0"

4.5 Put the module into IAP mode (CMD_ENTER_IAP_MODE)

[Function]

Set the device to the IAP state.

[Sequence]

After receiving the command packet, set the device to the IAP state.

[Command and Response]

PREFIX	0xAA55
SID	Source Device ID
DID	Destination Device ID
CMD	0x0005
LEN	0
DATA	No data
PREFIX	0x55AA
SID	Source Device ID
DID	Destination Device ID
RCM	0x0005
LEN	2
RET	Result Code
DATA	No data

Table 4-5 CMD_ENTER_IAP_MODE command

Note: The CMD _ ENTER _ IAP _ MODE command will clear the firmware program and will only be executed if the firmware needs to be upgraded. Firmware must be reprogrammed with USB after this command is executed. Please use this command with caution!!

4.6 Get a fingerprint image (CMD_GET_IMAGE)

[Function]

Get the fingerprint image from the collector and save it in the ImageBuffer.

[Sequence]

Get a fingerprint image from a collector. And if that acquire image is correct, returning to the ERR _ SUCCESS. Otherwise, an error code is returned.

For the slide-type semiconductor fingerprint sensor:

- ① If the fingerprint is not detected within the Fp TimeOut time, the ERR _ TIME _ OUT is returned.
- ② If a CMD _ FP _ CANCEL command is received during the acquisition process or during the fingerprint input waiting process, the operation of the command is canceled and the ERR _ FP _ CANCEL is returned.

[Command and Response]

PREFIX	0xAA55
SID	Source Device ID
DID	Destination Device ID
CMD	0x0020
LEN	0
DATA	No data

PREFIX	0x55AA
SID	Source Device ID
DID	Destination Device ID
RCM	0x0020
LEN	2
RET	Result Code
DATA	0

Table 4-6CMD_IMAGE command

Example 1: Command and response of the module detecting the finger after sending the collected fingerprint image

Host command: 55 AA 00 00 2000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 1F 01

Target response: AA 55 01 00 2000 0200 0000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 22 01

Example2: Send the command and response of FP TimeOut after collecting the sliding fingerprint image

[illegible]

4.7 Detect the finger (CMD_FINGER_DETECT)

[Function]

Check that fingerprint input state at the time of receiving the instruction and return the result.

[Sequence]

Return to the fingerprint input status of the Sensor at the time of receiving the command.

[Command and Response]

PREFIX	0xAA55
SID	Source Device ID
DID	Destination Device ID
CMD	0x0021
LEN	0
DATA	No data

PREFIX	0x55AA	
SID	Source Device ID	
DID	Destination Device ID	
RCM	0x0021	
LEN	Success : 3, Fail: 2	
RET	Result Code	
DATA	1byte	Success: fingerprint input status (1: Fingerprint input, 0: No fingerprint input)

Table 4-7CMD_FINGER_DETECT Command

Example1: No fingerprints detected.

Host command: 55 AA 00 00 2100 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 20 01

Target response: AA 55 01 00 21000300000000 00 00 00 00 00 00 00 00 00 00 00 00 24 01

Example2: fingerprints detected

Host command: 55 AA 00 00 2100 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 20 01

Target response: AA 55 01 00 21000300000001 00 00 00 00 00 00 00 00 00 00 00 00 25 01

4.8 Upload fingerprint image to the host (CMD_UP_IMAGE_CODE)

[Function]

The image saved in the ImageBuffer is sent to the Host according to the specified Image Type.

If the Image Type is 0: send the full image:

(Optical collector and press-type semiconductor collector: 242 * 266 (202 * 258), FPC1080: 128 * 436).

If the Image Type is 1 : A 1/4 image is sent (1 point out of 4 points).

(Optical harvester and press-type semiconductor harvester: 121 * 133 (101 * 129), FPC1080: 64 * 218).

[Sequence]

- 1) Returns an ERR_INVALID_PARAM if the specified Image Type is invalid.
- 2) The size of the image to be received by the HOST is sent to the HOST using the command response packet.
- 3) According to the Image Type, the image is divided into 496 bytes and sent to the HOST using the response packet.

[Command and Response]

PREFIX	0xAA55	
SID	Source Device ID	
DID	Destination Device ID	
CMD	0x0022	
LEN	1	
DATA	1byte	Image Type (0: Full, 1: Quarter)

PREFIX	0x55AA	
SID	Source Device ID	
DID	Destination Device ID	
RCM	0x0022	
LEN	6/2	
RET	Result Code	
DATA	2bytes	Success: image of width
		Full image (242/202/128)
		Quarter image (121/101/64)
	2bytes	Success: image of height
Success: Target sends reply packet to HOST		
PREFIX	0x5AA5	
SID	Source Device ID	
DID	Destination Device ID	
RCM	0x0022	
LEN	4+ Image data length	
RET	ERR_SUCCESS	
DATA	Image data length(2bytes) + Image data	

...

Resume sending reply packet

Table 4-8CMD_UP_IMAGE command

Note:

1. Before calling this instruction, you must first call the CMD_GET_IMAGE to save the fingerprint image in the Image Buffer.
2. Full Mode Width * Height: 242*266/202*258/128*436
3. Quarter Mode Width * Height: 121*133/101*129/64*218

Example1: Upload full-resolution optical fingerprint image

Host command: 55 AA 00 00 2200010000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 22 01

Target response: AA 55 01 00 2200060000000CA000201 00 00 00 00 00 00 00 00 00 00 00 00 F5 01

Note: Full image width=0xCA=202, Full image height=0x102=258

Target response packet: Image data size: 202*258=52116 bytes, 105*496 bytes+1*36bytes

A5 5A 01 00 2200F4010000F001496 bytes of data for this frame 2-byte check code

...

105 total response packets containing 496 bytes of image data

A5 5A 01 00 2200280000002400Last frame 36 bytes of data 2-byte check code

Last response packet containing 36 bytes of image data

Example2: Upload optical fingerprint image at 1/4 image resolution

Host command: 55 AA 00 00 2200010001 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 23 01

Target response: AA 55 01 00 22000600000065008100 00 00 00 00 00 00 00 00 00 00 00 0E 02

Note: 1/4image width=0x65=101, full image height=0x81=129

Target response data packet: image data size:202*258/4=13029 bytes, 26*496 bytes+1*133 bytes

A5 5A 01 00 2200F4010000F001496 bytes of data for this frame 2-byte check code

...

26 total response packets containing 496 bytes of image data

A5 5A 01 00 2200890000008500Last frame 133 bytes of data 2-byte check code

Last response packet containing 133 bytes of image data

4.9 Download fingerprint image to module (CMD_DOWN_IMAGE)

[Function]

The image data received from the Host is saved in the ImageBuffer.

Host sends images to Target in units of 496 bytes. At this time, the image data number is transmitted at the same time.

Note: Fingerprint image requirements: resolution: 500DPI, grayscale: 8-bit grayscale

Pixel size: optical collector: 242 * 266;

Press-type semiconductor collector (such as FPC1011): 202 * 258;

[Sequence]

- 1) If the image height or image width is not correct, the ERR _ INVALID _ PARAM is returned.
- 2) The reply packet is used to return the ERR _ SUCCESS.
- 3) Receive the command packet to save the image in the ImageBuffer.

[Command and Response]

Command package		
PREFIX	0xAA55	
SID	Source Device ID	
DID	Destination Device ID	
CMD	0x0023	
LEN	4	
DATA	2bytes	Image width: 242/202/128
	2bytes	Image height: 266/258/436
PREFIX	0x55AA	
SID	Source Device ID	
DID	Destination Device ID	
RCM	0x0023	
LEN	2	
RET	Result Code	

DATA	0
command data package	
PREFIX	0xA55A
SID	Source Device ID
DID	Destination Device ID
CMD	0x0023
LEN	2 + image data size
DATA	Image data number(2bytes) + Image data
Response data packet	
PREFIX	0x5AA5
SID	Source Device ID
DID	Destination Device ID
RCM	0x0023
LEN	2
RET	Result Code
DATA	0

...

Command data package	
PREFIX	0xA55A
SID	Source Device ID
DID	Destination Device ID
CMD	0x0023
LEN	2 + image data size
DATA	Image data number(2bytes) + Image data
Response data packet	
PREFIX	0x5AA5
SID	Source Device ID
DID	Destination Device ID
RCM	0x0023
LEN	2
RET	Result Code
DATA	0

Table 4-9 CMD_DOWN_IMAGE command

Example: Download fingerprint image to ImageBuffer

Host command: 55 AA 00 00 23000400CA000201 00 00 00 00 00 00 00 00 00 00 00 00 F3 01

Target response: AA 55 01 00 230002000000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 25 01

HOST command data packet: 5A A5 00 002300F20100 00 2-byte check code of 496-byte data of this block

Target response data packet: A5 5A 01 00 2300020000 00 25 01; The length of the data reply packet is 12 bytes because there is no data

。 。 。 105 command packets and response packets containing 496 bytes of image data

Host command data packet: 5A A5 00 00230026006900 Contains a 2-byte check code for the last block of 36-byte image data

Target response data packet: A5 5A 01 00 230002000000 25 01; The length of the data reply packet is 12 bytes because there is no data.

4.10 Controls on/off of the collector backlight (CMD _ SLED _ CTRL)

[Function]

Controls on/off of the collector backlight.

[Sequence]

Return without any operation ERR_SUCCESS 。

[Command and Response]

PREFIX	0xAA55
SID	Source Device ID
DID	Destination Device ID
CMD	0x0024
LEN	2
DATA	LED status (1: ON, 0: OFF)
PREFIX	0x55AA
SID	Source Device ID
DID	Destination Device ID
RCM	0x0024
LEN	2
RET	ERR_SUCCESS
DATA	0

Table4-10 CMD_SLED_CTRL command

Example: Backlight LED On

Host command: 55 AA 00 00 240002000100 00 00 00 00 00 00 00 00 00 00 00 00 00 00 26 01

Target response: AA 55 01 00 240002000000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 26 01

4.11 Save fingerprint template data to the module fingerprint database (CMD_STORE_CHAR)

[Function]

The template saved in the specified Ram Buffer is saved in the module fingerprint library with the specified number.

[Sequence]

- 1) If the specified Template number is invalid, the error code ERR _ INVALID _ TMPL _ NO will be returned.
- 2) If the specified Ram Buffer number is invalid, an error code ERR _ INVALID _ BUFFER _ ID is returned.
- 3) If Duplication Check is set to OFF, the fingerprint template data in the specified Ram Buffer is directly registered in the fingerprint database with the specified number and the result is returned.
- 4) If Duplication Check is set to ON, a 1: N comparison is performed between the Template in the specified Ram Buffer and all the Templates in the registered fingerprint library.
- 5) If there is a template successfully compared, it indicates that the fingerprint has been registered, then return (RET): ERR _ DUPLICATION _ ID, and DATA returns the number of the Template successfully compared.
- 6) Otherwise, the template is registered in the fingerprint database of the specified Template number and the result is returned.

[Command and Response]

PREFIX	0xAA55	
SID	Source Device ID	
DID	Destination Device ID	
CMD	0x0040	
LEN	4	
DATA	2bytes	Template number
	2bytes	Ram Buffer number

PREFIX	0x55AA	
SID	Source Device ID	
DID	Destination Device ID	
RCM	0x0040	
LEN	Result Code is For ERR_DUPLICATION_ID: 4; otherwise: 2	
RET	Result Code	
DATA	2bytes	Result Code is For ERR_DUPLICATION_ID is: Template number; otherwise: 0

Table 4-11 CMD STORE CHAR command

Example: Save the template data in Ram Buffer0 to the module database with the specified number 1

Host command packet: 55 AA 00 00 4000040001000000 00 00 00 00 00 00 00 00 00 00 00 00 44 01

Target response packet: AA 55 01 00 400002000000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 42 01

4.12 Read the fingerprint in the fingerprint database and temporarily store it in the specified RamBuffer (CMD LOAD CHAR)

[Function]

Take out the fingerprint Template in the specified number in the fingerprint database and temporarily store it in the specified Ram Buffer.

[Sequence]

- 1) If the specified Template number is invalid, the ERR _ INVALID _ TMPL _ NO is returned.
- 2) If no Template is registered in the specified Template number, an error code ERR _ TMPL _ EMPY will be returned.
- 3) If the specified Ram Buffer number is invalid, an error code ERR _ INVALID _ BUFFER _ ID is returned.
- 4) Saves the Template in the specified number in the specified Ram Buffer and returns the ERR _ SUCCESS.

[Command and Response]

PREFIX	0xAA55	
SID	Source Device ID	
DID	Destination Device ID	
CMD	0x0041	
LEN	4	
DATA	2bytes	Template number
	2bytes	Ram Buffer number

PREFIX	0x55AA	
SID	Source Device ID	
DID	Destination Device ID	
RCM	0x0041	
LEN	2	
RET	Result Code	
DATA	0	

Table 4-12 CMD_LOAD_CHAR command

Example : The template data with the reading number of 1 is temporarily stored in RamBuffer0

Host command packet: 55 AA 00 00 41 00 04 00 01 00 00 00 00 00 00 00 00 00 00 00 00 00 45 01

Target response packet: AA 55 01 00 41 00 02 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 43 01

4.13 Upload the fingerprint template temporarily stored in RamBuffer to the host (CMD_UP_CHAR)**[Function]**

Send the Template in the specified Ram Buffer to the Host.

[Sequence]

- 1) If the specified Ram Buffer number is invalid, an ERR _ INVALID _ BUFFER _ ID is returned.
- 2) The size of the Template data to be received by the HOST is sent to the HOST by using the command response packet.
- 3) Use the reply packet to send the Template data in the specified number to HOST.

[Command and Response]

PREFIX	0xAA55	
SID	Source Device ID	

DID	Destination Device ID
CMD	0x0042
LEN	2
DATA	Ram Buffer ID
PREFIX	0x55AA
SID	Source Device ID
DID	Destination Device ID
RCM	0x0042
LEN	4
RET	ERR_SUCCESS or ERR_FAIL
DATA	Success: Data length of the next data response packet (Template Record Size + 2), Failed: Error code
On success, the module sends a response packet	
PREFIX	0x5AA5
SID	Source Device ID
DID	Destination Device ID
RCM	0x0042
LEN	Template Record Size + 2
RET	ERR_SUCCESS
DATA	Template Record Data

Table4-13 CMD_UP_CHAR command

Note: Before calling this instruction, you must first call an instruction in the CMD_GENERATE, CMD_DOWN_CHAR, and CMD_LOAD_CHAR to save the Template in the Ram Buffer.

Example: Upload the template data in RamBuffer0 to HOST

Host command packet: 55 AA 00 00 420002000000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 43 01

Target response packet: AA 55 01 00 420004000000F201 00 00 00 00 00 00 00 00 00 00 00 00 00 00 39 02

Target response data packet: A5 5A 01 00 4200F4010000 498 bytes of this fingerprint template data 2-byte check code

4.14 Download fingerprint template data to the RamBuffer specified by the module (CMD_DOWN_CHAR)

[Function]

Receive the fingerprint template data (Template Data) from the Host and save it in the specified Ram Buffer.

[Sequence]

- 1) The Host sends a command packet to make the Target enter the data (Ram Buffer + Template) receive wait state.
- 2) The length of the next command packet to be sent has been set in the data field of the command packet.
- 3) Target checks the accuracy of the received command packet.
If not, an error code is returned and processing is ended.

If the size of the data to be received is incorrect, the ERR _ INVALID _ PARAM is returned.

If it is correct, the module sends a response packet to the HOST to indicate that the module has entered the data (Ram Buffer No. + Template data) receiving waiting state, and has entered the data (Ram Buffer No. + Template data) receiving waiting state.

- 4) When the Host receives the response packet that the Target has entered the data receiving waiting state, it uses the command packet to set the RamBuffer number and Template data and sends them to the Target.

After receiving the command packet, the Target returns the ERR _ INVALID _ BUFFER _ ID if the Ram Buffer ID is invalid.

- 5) Check the CheckSum of the received Template. If not, the ERR _ INVALID _ TMPL _ DATA is returned.
6) Save the received Template in the specified Ram Buffer and return the ERR _ SUCCESS.

[Command and Response]

Command packet	
PREFIX	0xAA55
SID	Source Device ID
DID	Destination Device ID
CMD	0x0043
LEN	2
DATA	2 + Template Record Size
PREFIX	0x55AA
SID	Source Device ID
DID	Destination Device ID
RCM	0x0043
LEN	4
RET	Result Code
DATA	0
Command data packet	
PREFIX	0xA55A
SID	Source Device ID
DID	Destination Device ID
CMD	0x0043
LEN	2 + Template size(498)
DATA	Ram Buffer number(2byte) + Template data
PREFIX	0x5AA5
SID	Source Device ID
DID	Destination Device ID
RCM	0x0043
LEN	4

RET	Result Code
DATA	0

Table4-14 CMD_DOWN_CHAR command

Note: Template saved in Ram Buffer2, If (CMD _ SEARCH, CMD _ VERIFY, CMD _ GENERATE, CMD _ STORE _ CHAR, CMD _ DEL _ CHAR, CMD _ GET _ EMPTY _ ID, CMD _ GET _ STATUS, GET _ BROKEN _ ID, CMD _ GETN _ ENROLL _ COUNT), it will be cleared. It is recommended not to use Ram Buffer2.

Example: Download the fingerprint template data to Rambuffer0 of the module

Host command: 55 AA 00 00 43000200F401 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 39 02

Target response: AA 55 01 00 430002000000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 45 01

Host command packet: 5A A5 00 004300F4010000498 bytes of fingerprint template data 2-byte check code

Target response packet: A5 5A 01 00 430002000000 45 01 ; The length of the data reply packet is 12 bytes because there is no data

4. 15 Deletes fingerprints within the specified number range (CMD_DEL_CHAR)

[Function]

Delete all registered templates in the specified number range (from the starting Template number to the ending Template number).

[Sequence]

- 1) If the specified range is invalid, the ERR _ INVALID _ PARAM is returned.
- 2) If no Template is registered in the specified range, the ERR _ TMPL _ EMPTY is returned.
- 3) Delete all registered Templates in the specified range and return the results.

[Command and Response]

PREFIX	0xAA55	
SID	Source Device ID	
DID	Destination Device ID	
CMD	0x0044	
LEN	4	
DATA	2bytes	Start Template number
	2bytes	End Template number
PREFIX	0x55AA	
SID	Source Device ID	
DID	Destination Device ID	
RCM	0x0044	
LEN	2	
RET	Result Code	
DATA	0	

Table 4-15 CMD_DEL_CHAR command

Example: Delete all fingerprints numbered 1-2000 in the database

Host command: 55 AA 00 00 440004000100D007 00 00 00 00 00 00 00 00 00 00 00 00 00 00 1F 02

Target response: AA 55 01 00 440002000000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 46 01

4.16 Get the first registrable number in the specified number range (CMD_GET_EMPTY_ID)

[Function]

Gets the first Template number that can be registered (without a registered Template) in the specified range (starting Template number to ending Template number).

[Sequence]

① If the specified range is invalid, the ERR_INVALID_PARAM is returned.

② Search for the first ID that can be registered in the specified range.

If it exists, return its value. Otherwise, the ERR_EMPTY_ID_NOEXIST is returned.

[Command and Response]

PREFIX	0xAA55	
SID	Source Device ID	
DID	Destination Device ID	
CMD	0x0045	
LEN	4	
DATA	2bytes	Start Template number
	2bytes	End Template number
PREFIX	0x55AA	
SID	Source Device ID	
DID	Destination Device ID	
RCM	0x0045	
LEN	success : 4, fail : 2	
RET	Result Code	
DATA	2bytes	On success: the first Template number that can be registered

Table 4-16 CMD_GET_EMPTY_ID command

Example: Get the first registration number in the 1-2000 number range (0x0001-0x07D0), which turns out to be 11

Host command: 55 AA 00 00 450004000100D007 00 00 00 00 00 00 00 00 00 00 00 00 00 00 20 02

Target response: AA 55 01 00 4500040000000B00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 54 01

4.17 Check if the specified number is already registered (CMD_GET_STATUS)

[Function]

Gets the registration status of the Template in the specified number.

[Sequence]

If the specified Template number is invalid, the ERR _ INVALID _ TMPL _ NO is returned.

If there is already a Template registered in the specified number, Returns 1, Otherwise 0 .

[Command and Response]

PREFIX	0xAA55	
SID	Source Device ID	
DID	Destination Device ID	
CMD	0x0046	
LEN	2	
DATA	Template number	
PREFIX	0x55AA	
SID	Source Device ID	
DID	Destination Device ID	
RCM	0x0046	
LEN	Success : 4, Fail : 2	
RET	Result Code	
DATA	1byte	Success: Registration status (1: Registered, 0: Not registered)

Table 4-17 CMD_GET_STATUS command

Example1: Obtain the registration status of ID number = 1, which can be registered

Host command packet: 55 AA 00 00 46 00 02 00 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 48 01

Target response packet: AA 55 01 00 46 00 03 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 49 01

Example2: Get the registration status of ID number = 1, registered

Host command packet: 55 AA 00 00 46 00 02 00 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 48 01

Target response packet: AA 55 01 00 46 00 03 00 00 00 01 00 00 00 00 00 00 00 00 00 00 00 00 00 4A 01

4. 18 Check the fingerprint library within the specified number range for data corruption (CMD_GET_BROKEN_ID)

[Function]

Check whether the registered templates in the specified range (starting Template number to ending Template number) are damaged.

In the Write operation of Flash, the template may be damaged due to sudden power failure and other reasons.

HOST uses this command to check the template for damage at any time (for example, the initial startup of Target).

Damaged templates need to be deleted and re-registered.

[Sequence]

- 1) If the specified range is invalid, the ERR _ INVALID _ PARAM is returned.
- 2) Check all registered templates in the specified range for damage.

If there are broken templates, the number of broken templates and the number of the first broken template are returned.

Otherwise, the number of templates and the template number are both 0.

[Command and Response]

PREFIX	0xAA55	
SID	Source Device ID	
DID	Destination Device ID	
CMD	0x0047	
LEN	4	
DATA	2bytes	start Template number
	2bytes	End Template number
PREFIX	0x55AA	
SID	Source Device ID	
DID	Destination Device ID	
RCM	0x0047	
LEN	Success : 6, Fail : 2	
RET	Result Code	
DATA	2byte	On success: number of broken Templates
	2byte	On success: the first broken Template number

Table 4-18 CMD_GET_BROKEN_ID command

Example : Obtain the ID number of the fingerprint damage in the range of 1-2000

Host command: 55 AA 00 00 47 00 04 00 01 00 D0 07 00 00 00 00 00 00 00 00 00 00 00 00 22 02

Target response: AA 55 01 00 47 00 06 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 4D 01

4.19 Gets the total number of registered fingerprints in the specified number range (CMD_GET_ENROLL_COUNT)

[Function]

Gets the total number of registered fingerprints in the specified range (starting Template number to ending Template number).

[Sequence]

- 1) If the specified range is invalid, the ERR_INVALID_PARAM is returned.
- 2) Returns the number of fingerprints registered in the module.

[Command and Response]

PREFIX	0xAA55	
SID	Source Device ID	
DID	Destination Device ID	

CMD	0x0048	
LEN	4	
DATA	2bytes	Start Template number
	2bytes	End Template number
PREFIX	0x55AA	
SID	Source Device ID	
DID	Destination Device ID	
RCM	0x0048	
LEN	Success : 4, Fail : 2	
RET	Result Code	
DATA	2bytes	Number of registered Templates

Table 5-19 CMD_GET_ENROLL_COUNT command

Example: Get the total number of registered users in the range of 1-2000 (0 x0001 ~ 0 x07D0), totaling 10 (0 x000A)

Host command: 55 AA 00 00 48 00 04 00 01 00 D0 07 00 00 00 00 00 00 00 00 00 00 00 00 00 00 23 02

Target response: AA 55 01 00 48 00 04 00 00 00 00 0A 00 00 00 00 00 00 00 00 00 00 00 00 00 00 56 01

4. 20 **Generate a template from the fingerprint image temporarily stored in the ImageBuffer (CMD_GENERATE)**

[Function]

A fingerprint template Template is generated from the fingerprint image in the ImageBuffer and is stored in the specified Ram Buffer.

[Sequence]

- 1) If the specified Ram Buffer number is invalid, an error code `ERR_INVALID_BUFFER_ID` is returned.
- 2) Check the correctness of the image in the `ImageBuffer`. If not, the `ERR_BAD_QUALITY` is returned.
- 3) Saves the generated Template in the specified Ram Buffer and returns the `ERR_SUCCESS`.

[Command and Response]

PREFIX	0xAA55	
SID	Source Device ID	
DID	Destination Device ID	
CMD	0x0060	
LEN	2	
DATA	2bytes	Ram Buffer number

PREFIX	0x55AA	
SID	Source Device ID	
DID	Destination Device ID	
RCM	0x0060	
LEN	2	
RET	Result Code	
DATA	0	

Table 4-20 CMD GENERATE command

Example1: Template data generated from ImageBuffer is saved in RamBuffer0

[illegible]

Target response packet: AA 55 01 00 60 00 02 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 62 01

Example2: Template data generated from ImageBuffer is saved in RamBuffer1

Host command packet: 55 AA 00 00 60 00 02 00 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 62 01

Target response packet: AA 55 01 00 60 00 02 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 62 01

Example3: Template data generated from ImageBuffer is saved in RamBuffer2

Host command packet: 55 AA 00 00 60 00 02 00 02 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 63 01

Target response packet: AA 55 01 00 60 00 02 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 62 01

4.21 Synthesize fingerprint template data for storage (CMD_MERGE)

[Function]

Merge the templates temporarily stored in the Ram Buffer to generate template data and save it in the specified Ram Buffer.

The synthesis number can be 2 or 3:

If for 2 : Synthesize templates for Ram Buffer0 and Ram Buffer1.

If for 3 : Synthesize templates for Ram Buffer0, Ram Buffer1, and Ram Buffer2.

[Sequence]

- 1) If the specified Ram Buffer number is invalid, an error code ERR-INVALIDUUFFER-ID will be returned.
- 2) If the synthesized number is invalid, return ERR_CEN-COUNT.
- 3) Synthesize templates based on the number of compositions and generate a template. If synthesis fails, return an error code.
- 4) Save the generated Template in the specified Ram Buffer and return ERR_SUCCESS.

[Command and Response]

PREFIX	0xAA55	
SID	Source Device ID	
DID	Destination Device ID	
CMD	0x0061	
LEN	3	
DATA	2bytes	Ram Buffer number
	1byte	synthesis number(2/3)
PREFIX	0x55AA	
SID	Source Device ID	
DID	Destination Device ID	
RCM	0x0061	
LEN	2	
RET	Result Code	
DATA	0	

Table 4-21 CMD_MERGE command

Example: Merge 3 temporarily stored fingerprint templates in RamBuffer into 1 fingerprint template data

Host command packet: 55 AA 00 00 61 00 03 00 00 00 03 00 00 00 00 00 00 00 00 00 00 00 00 00 66 01

Target response packet: AA 55 01 00 61 00 02 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 63 01

4.22 Specify the template between 2 RamBuffer for comparison (CMD_MATCH)

[Function]

Compare the templates in the two specified Ram buffers.

[Sequence]

- 1) If the specified Ram Buffer number is invalid, an error code ERR-INVALIDUUFFFER-ID will be returned.
- 2) Compare two templates in the specified Ram Buffer and return their results.
If the comparison is successful, RET returns ERR_SUCCESS and DATA returns the intelligent update result.
Otherwise, RET returns ERR_VERIFY.

[Command and Response]

PREFIX	0xAA55	
SID	Source Device ID	
DID	Destination Device ID	
CMD	0x0062	
LEN	4	
DATA	2bytes	The first Ram Buffer number to be compared
	2bytes	The second Ram Buffer number to be compared

PREFIX	0x55AA	
SID	Source Device ID	
DID	Destination Device ID	
RCM	0x0062	
LEN	2	
RET	Result Code	
DATA	No data	

Table 4-22 CMD MATCH command

Example: Compare the fingerprint templates in RamBuffer0 and RamBuffer1 in a 1:1 ratio

[illegible]

Target response packet: AA 55 01 00 62 00 02 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 64 01

4.23 1: N identification within a specified number range (CMD_SEARCH)

[Function]

Perform a 1:N comparison between the template in the specified Ram Buffer and all registered fingerprint templates within the specified search range (starting template number~ending template number), and return the result.

[Sequence]

- 1) If the specified Ram Buffer number is invalid, an error code ERR-INVALIDUUFFER-ID will be returned.

- 2) If the specified search range is invalid, an error code ERR-INVALIDUUFFER-ID will be returned.
- 3) If there is no registered Template, an error code ERR_LAL_TMPL-EMPTY will be returned.
- 4) Compare the Template in the Ram Buffer with all registered templates and return the result.

If the search is successful, RET returns ERR_SUCCESS and returns the template number and intelligent update result found in the DATA field.

Otherwise, RET returns ERR-IDENTIFY.

[Command and Response]

PREFIX	0xAA55	
SID	Source Device ID	
DID	Destination Device ID	
CMD	0x0063	
LEN	6	
DATA	2bytes	Ram Buffer number
	2bytes	The starting template number to be searched
	2bytes	End Template Number to be Searched
PREFIX	0x55AA	
SID	Source Device ID	
DID	Destination Device ID	
RCM	0x0063	
LEN	Success : 5, Fail : 2	
RET	Result Code	
DATA	3bytes	On success : Template number(2bytes) + Intelligent update results(1byte)

Table 4-23 CMD_SEARCH command

Example: Compare the fingerprint template temporarily stored in RamBuffer0 with fingerprints within the range of 1-2000, and return the comparison result

Host command: 55 AA 00 00 63 0006 0000 0001 00D0 07 00 00 00 00 00 00 00 00 00 00 00 40 02

Target response: AA 55 01 00 63 0005 0000 0008 0001 00 00 00 00 00 00 00 00 00 00 00 00 00 71 01

4.24 Compare RamBuffer with the template with the specified number in the fingerprint library (CMD_VERIFY)

[Function]

Compare the template in Ram Buffer with the template with the specified number in the database at a 1:1 ratio and return the result.

[Sequence]

- 1) If the specified Template number is invalid, an error code ERR-INVALID_TMPL-∞ will be returned.
- 2) If the specified Ram Buffer number is invalid, an error code ERR-INVALIDUUFFER-ID will be returned.

- 3) If there is no template registered with the specified number, an error code ERR_TMPL-EMPTY will be returned.
- 4) Compare the template in the specified Ram Buffer with the template in the specified number and return the result.

If the comparison is successful: RET returns ERR_SUCCESS and DATA returns Template number and intelligent update result.

Otherwise: RET returns ERR_VERIFY.

[Command and Response]

PREFIX	0xAA55	
SID	Source Device ID	
DID	Destination Device ID	
CMD	0x0064	
LEN	4	
DATA	2bytes	Template number to be compared
	2bytes	Ram Buffer number

PREFIX	0x55AA	
SID	Source Device ID	
DID	Destination Device ID	
RCM	0x0064	
LEN	Success : 5, Fail : 2	
RET	Result Code	
DATA	3bytes	On success: Template number (2 bytes)+ Intelligent update result (1: Intelligent update has been performed, 0: No update)

Table 4-24 CMD_VERIFY command

Example: 1:1 verification between the fingerprint template in RamBuffer0 and the fingerprint with ID 8 in the database

Host command packet: 55 AA 00 00 64 0004 0008 0000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 6F 01

Target response packet: AA 55 01 00 64 0005 0000 0008 0001 00 00 00 00 00 00 00 00 00 00 00 00 00 72 01

4.25 Set module serial number (CMD_SET_MODULE_SN)

[Function]

Receive the module serial number (Module SN) from the Host and save it in the module. The Module SN is 16 bytes.

[Sequence]

- 1) Host sends a command packet to put Target into a data (Module SN) reception waiting state.

The length of the next instruction packet has been set in the DATA field of the instruction packet.

- 2) Target detects the correctness of the received instruction packet:

If not correct: return an error code and end processing.

If the size of the data to be received is incorrect: return ERR-INVALID-PAM.

If correct: In order to inform that the data (Module SN) reception waiting state has been entered, send a response packet to the HOST and enter the data (Module SN) reception waiting state.

- 3) After receiving the response packet, the Host sets the Module SN in the instruction packet and sends it to the Target.
- 4) After receiving the instruction packet, Target sets the Module SN to the module and returns its result.

[Command and Response]

Command packet	
PREFIX	0xAA55
SID	Source Device ID
DID	Destination Device ID
CMD	0x0008
LEN	2
DATA	16(Module SN Size)
PREFIX	0x55AA
SID	Source Device ID
DID	Destination Device ID
RCM	0x0008
LEN	2
RET	Result Code
DATA	No
Command data packet	
PREFIX	0xA55A
SID	Source Device ID
DID	Destination Device ID
CMD	0x0008
LEN	16(Module SN Size)
PREFIX	0x5AA5
SID	Source Device ID
DID	Destination Device ID
RCM	0x0008
LEN	2
RET	Result Code
DATA	No

Table 4-27 CMD_SET_MODULE_SN command

4.26 Read module serial number (CMD_GET_MODULE_SN)

[Function]

Send the Module SN saved in the module to the Host.

[Sequence]

- 1) In the form of an instruction response packet, specify the size of the Module SN to be received by the HOST as the response data and respond.
- 2) Save the Module SN in the module and send it using a response packet.

[Command and Response]

PREFIX	0xAA55
SID	Source Device ID
DID	Destination Device ID
CMD	0x0009
LEN	0
DATA	No
PREFIX	0x55AA
SID	Source Device ID
DID	Destination Device ID
RCM	0x0009
LEN	4
RET	Result Code
DATA	Success: Data length of the next data response packet (Module SN Size (16)) Fail: Error code
Response packet upon success	
PREFIX	0x5AA5
SID	Source Device ID
DID	Destination Device ID
RCM	0x0009
LEN	Module SN Size(16)
RET	ERR_SUCCESS
DATA	Module SN(16bytes)

Table 4-28 CMD_GET_MODULE_SN command

4.27 Cancel fingerprint collection (CMD_FP_CANCEL)

Note: The CMD_fp_Cancel command is only applicable to the module of the sliding collector

[Function]

- 1) Cancel the instruction for fingerprint collection process.
- 2) If you receive the CMD_SP_CANCEL command during the process of processing the CMD_FP_SMAGE command:
- 3) The processing of the CMD_GET_IMAGE instruction is aborted and the error code is returned with the ERR_FP_CANCEL as the return value of the CMD_GET_IMAGE instruction.

Note: The CMD_SP_CANCEL command has no response packet.

[Command and Response]

PREFIX	0xAA55
SID	Source Device ID
DID	Destination Device ID
CMD	0x0049
LEN	0
DATA	No
PREFIX	0x55AA
SID	Source Device ID
DID	Destination Device ID
RCM	0x0049
LEN	4
RET	Result Code
DATA	Success: Data length of the next response packet (ID List Information Size) Fail: Error code
Response packet upon success	
PREFIX	0x5AA5
SID	Source Device ID
DID	Destination Device ID
RCM	0x0049
LEN	ID List Information Size
RET	ERR_SUCCESS
DATA	ID List Information

Table 4-28 CMD_GET_ENROLLED_ID_LIST command

4.29 Enter sleep mode (CMD_ENTER_STANDBY_STATE)**[Function]**

Put the module into sleep mode.

[Sequence]

After receiving the instruction packet, the module returns ERR_SUCCESS and enters sleep mode.

[Command and Response]

PREFIX	0xAA55
SID	Source Device ID
DID	Destination Device ID
CMD	0x000C

LEN	0
DATA	No data
PREFIX	0x55AA
SID	Source Device ID
DID	Destination Device ID
RCM	0x000C
LEN	Success: 2
RET	0
DATA	No data

Table 4-29 CMD_ENTER_STANDBY_STATE

4.30 Communication error returned (Incorrect Command)

[Function]

If the module receives incorrect instructions due to communication errors, interference caused errors, or other reasons, it sends this response to the HOST.

[Command and Response]

PREFIX	0x55AA
SID	Source Device ID
DID	Destination Device ID
RCM	0x00FF
LEN	2
RET	ERR_SUCCESS
DATA	-

Table 4-31 Incorrect Command return

4.31 Note:

- 1) The CMD _ GENERATE instruction is to generate Template Data from ImageBuffer. Therefore, before calling this instruction, it is necessary to call the CMD _ GET _ IMAGE instruction in advance to save the image in the ImageBuffer.
- 2) Call the commands of CMD _ VERIFY, CMD _ SEARCH, CMD _ GENERATE, CMD _ MERGE, CMD _ MATCH, and the image saved in ImageBuffer will be cleared.
- 3) Template saved in Ram Buffer2, Call CMD _ SEARCH, CMD _ VERIFY, CMD _ GENERATE, CMD _ STORE _ CHAR, CMD _ DEL _ CHAR, CMD _ GET _ EMPTY _ ID, CMD _ GET _ STATUS, GET _ BROKEN _ ID, CMD _ GETN _ ENROLL _ COUNT command will be cleared.

Therefore, do not use Ram Buffer2 except for registration.

(V). Response and error code table (Error Code)

No	Response and error code	value	Explain
1	ERR_SUCCESS	0x00	Command processing succeeded.
2	ERR_FAIL	0x01	Command processing failed.
3	ERR_VERIFY	0x10	1:1 comparison with Template in the specified number failed.
4	ERR_IDENTIFY	0x11	1: N alignment has been performed, but the same Template does not exist.
5	ERR_TMPL_EMPTY	0x12	There is no registered Template in the specified number.
6	ERR_TMPL_NOT_EMPTY	0x13	Template already exists in the specified number.
7	ERR_ALL_TMPL_EMPTY	0x14	There is no registered Template.
8	ERR_EMPTY_ID_NOEXIST	0x15	There is no registered Template ID.
9	ERR_BROKEN_ID_NOEXIST	0x16	There is no damaged template.
10	ERR_INVALID_TMPL_DATA	0x17	The specified Template Data is invalid.
11	ERR_DUPLICATION_ID	0x18	This fingerprint has already been registered.
12	ERR_BAD_QUALITY	0x19	The fingerprint image quality is poor.
13	ERR_MERGE_FAIL	0x1A	Template synthesis failed.
14	ERR_NOT_AUTHORIZED	0x1B	No communication password confirmation has been conducted. Note: 1) If a communication password has been set but CMD_VERIFY_DEVPASS has not been called for confirmation, all commands except CMD_TEST_CONNECTION and CMD_VERIFY_DEVPASS will return this error code. 2) If no communication password is set, all commands can be used without confirming the password.
15	ERR_MEMORY	0x1C	External Flash programming error.
16	ERR_INVALID_TMPL_NO	0x1D	The specified Template number is invalid.
17	ERR_INVALID_PARAM	0x22	An incorrect parameter was used.
18	ERR_GEN_COUNT	0x25	Invalid number of fingerprint composites.
19	ERR_TIME_OUT	0x23	Fingerprint was not entered during TimeOut.
20	ERR_INVALID_BUFFER_ID	0x26	Buffer ID value is incorrect.
21	ERR_FP_NOT_DETECTED	0x28	There is no fingerprint input on the collector.
22	ERR_FP_CANCEL	0x41	The order was cancelled.

(VI). Flow chart of registration and comparison

6.1 Registration Process of Fingerprint Collector Module (Enroll Process)

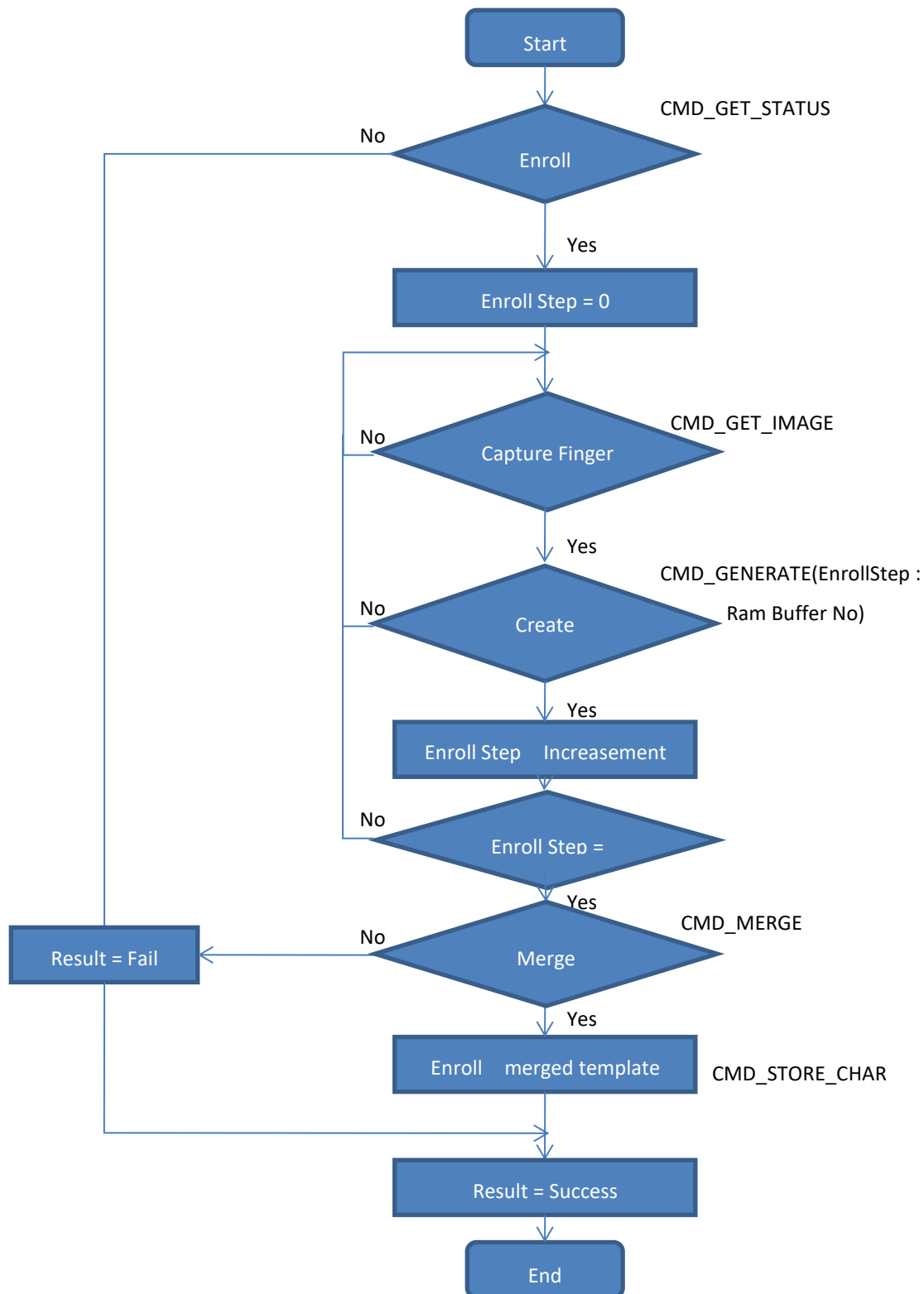


Figure 6-1 Registration Flow of Area Array Semiconductor Fingerprint Collector Module

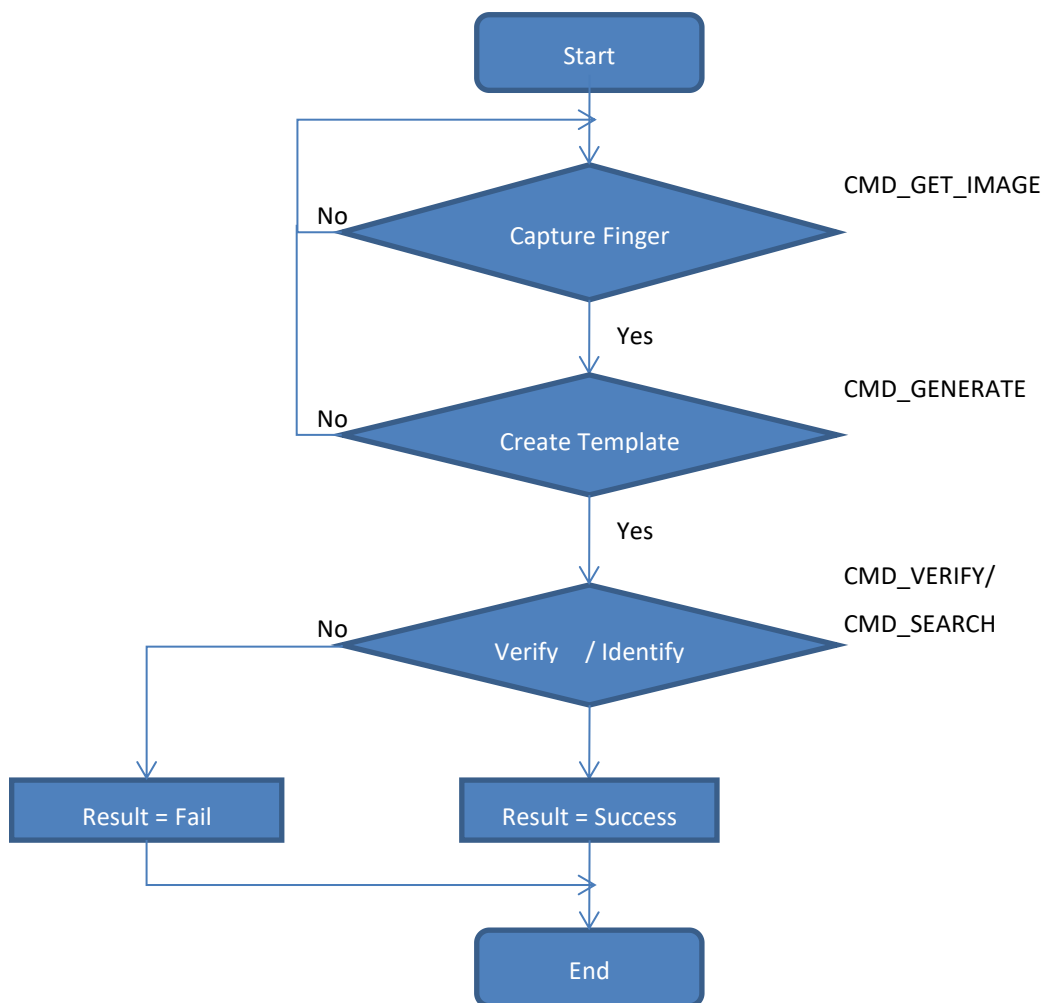
6.2 Verification and Identification Flow of Fingerprint Collector Module (Verify & Identify)

Figure 6-2 Verification and Identification Process of Area Array Semiconductor Collector Module

(VII).Hardware description

7.1 Fingerprint module interface signal definition (Connectors are 1.25 mm apart)

PIN	PIN name	PIN description	Note
1	Wakeup	Finger signal output detected	It can be used as the sleep wake-up signal of the application MCU, and the high level is valid.
2	Tx	UART of data out	UART serial communication 3.3 V TTL level
3	Rx	UART of data input	
4	GND	Ground	Input voltage range: DC3.3V
5	VIN	Power input(Power-on for operation, power-off for non-operation)	
6	VTOUCH	Power input of touch sensing IC(Keep the power on)	Input voltage range: DC3.3V
7	USB-DN	USB D-	USB communication
8	USB-DP	USB D+	

7.2 Technical parameters of fingerprint identification module

Item	Parameter	Note
CPU	Core: 32-bit ARM Cortex-M3, 108MHz, RAM:96KB,Flash memory:1MB	
Fingerprint capacity	500/1700/2000/3000 Optional,The default is 1700.	
FAR	< 0.001 % (Security Level: 3)	
FRR	< 0.1 % (Security Level: 3)	
Comparison mode	1:N Identification/ 1:1 Validate	
Fingerprint template data size	498 Bytes	
Security level	1-5 can be set, default: 3	
Response time	Fingerprint preprocessing< 0.45 s	
	1:N Recognition time (3000 full capacity registrations)< 1.5s	
Communication interface	USB2.0 or UART (3.3V-TTL logic)	
Serial port communication parameters	Start bit: 1, stop bit: 1, parity: none, support the following baud rates: 9600/19200/38400/57600/115200/230400/460800/921600 Default: 115200	
Work environment	Temperature: -20℃- 70℃ Humidity: 20%– 80%	
Operating Systems	Windows or Android	

