R30X Series
Fingerprint Identification Module

User Manual

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Preface & Declaration

Thank you for you selection of R30x series Fingerprint Identification Module (Module) of SFG.

The Manual is targeted for hardware & software developing engineer, covering hardware interface, system resource, instruction system, installment information, etc. To ensure the developing process goes smoothly, it is highly recommended the Manual is read through carefully.

We will try our best to assure you the correctness of the Manual. However, should you find any problem or error with it, feel free to contact us or the sales representative of us. We would be very grateful.

Holding the principle of constantly improving and perfecting products, so both the module and contents of the Manual might subject to changes. Sorry for separate notice. You may visit our website or call us for the latest information.

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I Introduction

Power	DC 3.6V-6.0V	**Interface**	UART(TTL logical level)/ USB 1.1
Working current	Typical: 100mA Peak: 150mA	**Matching Mode**	1:1 and 1:N
Baud rate	(9600*N)bps, N=1～12 (default N=6）	**Character file size**	256 bytes
Image acquiring time	<0.5s	**Template size**	512 bytes
Storage capacity	256	**Security level**	5 (1, 2, 3, 4, 5(highest))
FAR	<0.001%	**FRR**	<0.1%
Average searching time	< 1s (1:1000)	**Window dimension**	18mm*22mm
Working environment	Temp: -10℃- +40℃	**Storage environment**	Temp: -40℃- +85℃
	RH: 40%-85%		RH: <85%
Outline Dimention	Split type	Module: 32*23*7mm Sensor:56*20*21.5mm	
	Integral type	54.5*20.6*23.8mm	

Operation Principle

Fingerprint processing includes two parts: fingerprint enrollment and fingerprint matching (the matching can be 1:1 or 1:N).

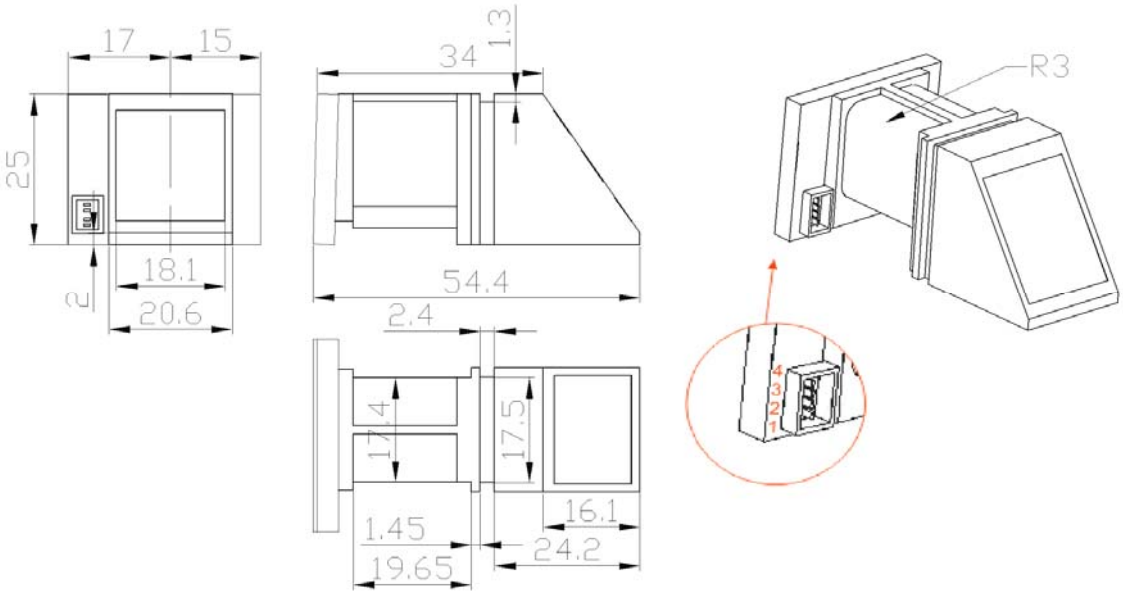
When enrolling, user needs to enter the finger two times. The system will process the two time finger images, generate a template of the finger based on processing results and store the template. When matching, user enters the finger through optical sensor and system will generate a template of the finger and compare it with templates of the finger library. For 1:1 matching, system will compare the live finger with specific template designated in the Module; for 1:N matching, or searching, system will search the whole finger library for the matching finger. In both circumstances, system will return the matching result, success or failure.

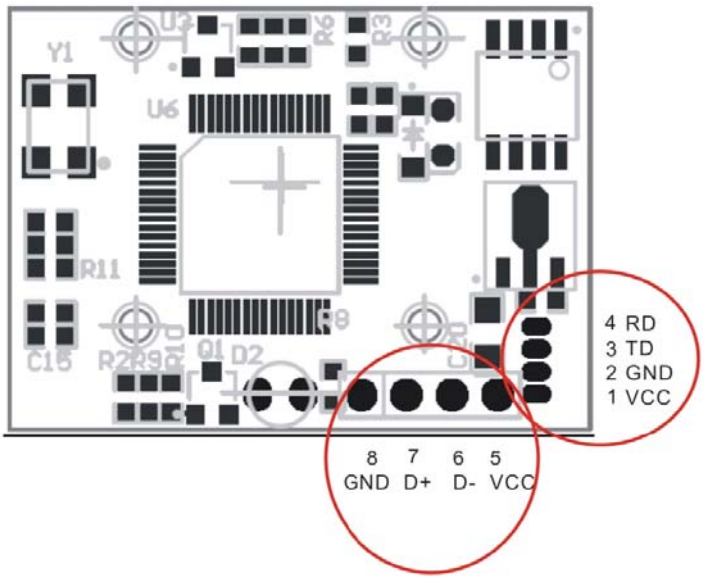
II Main Parameters

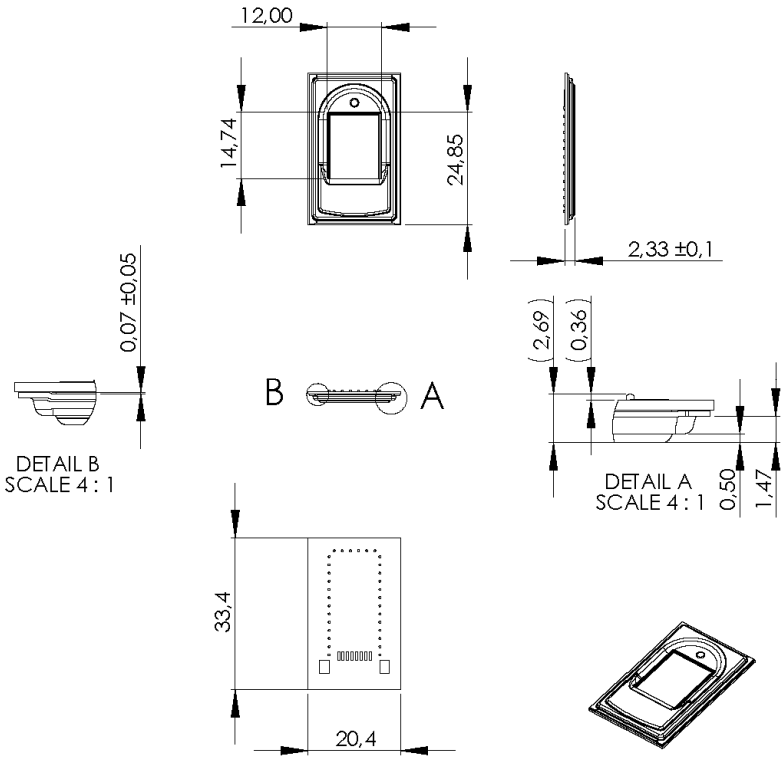
III Hardware Interface

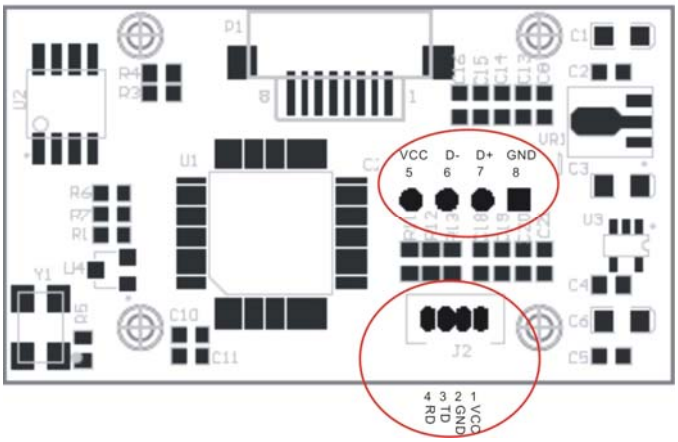
Exterior Interface

R305 (All in one)









Connecting with PC (P1/P2 on board)

Serial Communication(P1)

When the FP module communicates with user device, definition of J1 is as follows:

Pin Nmuber	Name	Type	Function Description
1	Vin	in	Power input
2	GND	—	Signal ground. Connected to power ground (color: black）
3	TD	in	Data output. TTL logical level
4	RD	out	Data input. TTL logical level

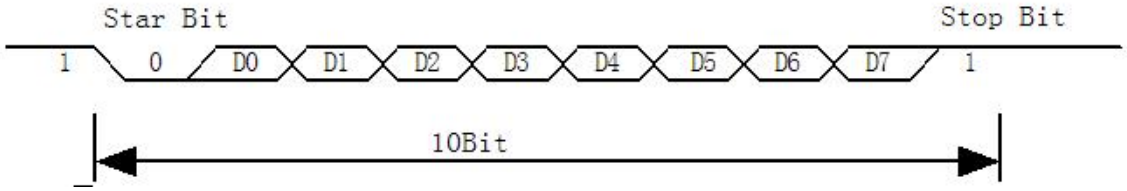
Hardware connection

Via serial interface, the Module may communicate with MCU of 3.3V or 5V power: TD (pin 3 of P1) connects with RXD (receiving pin of MCU), RD (pin 4 of P1) connects with TXD (transferring pin of MCU). Should the upper computer (PC) be in RS-232 mode, please add level converting circuit, like MAX232, between the Module and PC.

Serial communication protocol

The mode is semiduplex asychronism serial communication. And the default baud rate is 57600bps. User may set the baud rate in 9600～115200bps。

Transferring frame format is 10 bit: the low-level starting bit, 8-bit data with the LSB first, and an ending bit. There is no check bit.



Reset time

At power on, it takes about 500ms for initialization. During this period, the Module can't accept commands for upper computer.

Electrical paramenter (All electrical level takes GND as reference)

Power supply

Item	Parameter			Unit	Note
	Min	Typ	Max		
Power Voltage (Vin)	3.6		6.0	V	Normal working value.
Maximum Voltage (Vin_{max})	－0.3		7.0	V	**Exceeding the Maximum rating may cause permant harm to the Module.**
Operation Current (Icc)	90	100	110	mA	
Peak Current (Ipeak)			150	mA	

TD（output, TTL logic level）

Item	Condition	Parameter			Unit	Note
		Min	Typ	Max		
V_{OL}	I_{OL}=－4mA			0.4	V	Logic 0
V_{OH}	I_{OH}= 4mA	2.4		**3.3**	V	Logic 1

RD（input, TTL logic level）

Item	Condition	Parameter			Unit	Note
		Min	Typ	Max		
V_{IL}				0.6	V	Loigc 0

V_{IH}		2.4			V	Logic 1
I_{IH}	V_{IH} =5V		1		mA	
	V_{IH} =3.3V		30		uA	
V_{Imax}		－0.3		5.5	V	**Maximum input voltage**

IV System Resources

To address demands of different customer, Module system provides abundant resources at user's use.

Notepad

The system sets aside a 512-bytes memory (16 pages* 32 bytes) for user's notepad, where data requiring power-off protection can be stored. The host can access the page by instructions of PS_WriteNotepad and PS_Read Notepad.

Note: when write on one page of the pad, the entire 32 bytes will be written in wholly covering the original contents.

Buffer

There are an image buffer and two 512-byte-character-file buffer within the RAM space of the module. Users can read & write any of the buffers by instructions.

Note: Contents of the above buffers will be lost at power-off.

Image buffer

ImageBuffer serves for image storage and the image format is 256*288 pixels.

When transferring through UART, to quicken speed, only the upper 4 bits of the pixel is transferred (that is 16 grey degrees). And two adjacent pixels of the same row will form a byte before the transferring. When uploaded to PC, the 16-grey-degree image will be extended to 256-grey-degree format. That's 8-bit BMP format.

When transferring through USB, the image is 8-bit pixel, that's 256 grey degrees.

Character file buffer

Character file buffer, CharBuffer1, CharBuffer2, can be used to store both character file and template file.

4.3Fingerprint Library

Synstem sets aside a certain space within Flash for fingerprint template storage, that's fingerprint library. Contents of the library remain at power off.

Capacity of the library changes with the capacity of Flash, system will recognize the latter automatically. Fingerprint template's storage in Flash is in sequential order. Assume the fingerprint capacity N, then the serial number of template in library is 0, 1, 2, 3 … N. User can only access library by template number.

System Confiuration Parameter

To facilitate user's developing, Module opens part system parameters for use. And the basic instructions are SetSysPara & ReadSysPara. Both instructions take Parameter Number as parameter.

When upper computer sends command to modify parameter, Module first responses with original configurations, then performs the parameter modification and writes configuration record into Flash. At the next startup, system will run with the new configurations.

Baud rate control (Parameter Number: 4)

The Parameter controls the UART communication speed of the Modul. Its value is an integer N, N= [1, 12]. Cooresponding baud rate is 9600*N bps。

Security Level (Parameter Number: 5)

The Parameter controls the matching threshold value of fingerprint searching and matching. Security level is divided into 5 grades, and cooresponding value is 1, 2, 3, 4, 5. At level 1, FAR is the highest and FRR is the lowest; however at level 5, FAR is the lowest and FRR is the highest.

Data package length (Parameter Number: 6)

The parameter decides the max length of the transferring data package when communicating with upper computer. Its value is 0, 1, 2, 3, corresponding to 32 bytes, 64 bytes, 128 bytes, 256 bytes respectively.

System status register

System status register indicates the current operation status of the Module. Its length is 1 word, and can be read via instruction *ReadSysPara*. Definition of the register is as follows:

Bit Num	15 4	3	2	1	0
Description	Reserved	ImgBufStat	PWD	Pass	Busy

Note:

Busy：1 bit. 1: system is executing commands; 0: system is free;

Pass：1 bit. 1: find the matching finger; 0: wrong finger;

PWD：1 bit. 1: Verified device's handshaking password.

ImgBufStat：1 bit. 1: image buffer contains valid image.

Module password

At power-on reset, system first checks whether the handshaking password has been modified. If not, system deems upper computer has no requirement of verifying password and will enter into normal operation mode. That's, when Module password remains the default, verifying process can be jumped. The password length is 4 bytes, and its default factory value is 0FFH, 0FFH, 0FFH, 0FFH. Should the password have be modified, *refer to instruction SetPwd*, then Module (or device) handshaking password must be verified before the system enter into normal operation mode. Or else, system will refuse to execute and command.

The new modified password is stored in Flash and remains at power off.

Module address

Each module has an identifying address. When communicating with upper computer, each instruction/data is transferred in data package form, which contains the address item. Module system only responds to data package whose address item value is the same with its identifying address.

The address length is 4 bytes, and its default factory value is 0xFFFFFFFF. User may modify the address via instruction *SetAdder.* The new modified address remains at power off.

Random number generator

Module integrates a hardware 32-bit random number generator (RNG) (without seed). Via instruction *GetRandomCode*, system will generate a random number and upload it.

V Communication Protocol

The protocol defines the data exchanging format when ZFM-20 series communicates with upper computer. The protocol and instruction sets apples for both UART and USB communication mode. For PC, USB interface is strongly recommended to improve the exchanging speed, especially in fingerprint scanning device.

5.1 Data package format

When communicating, the transferring and receiving of command/data/result are all wrapped in data package format.

Data package format

Header	Adder	Package identifier	Package length	Package content (instuction/data/Parameter）	Checksum

Definition of Data package

Name	Symbol	Length	Description	
Header	Start	2 bytes	Fixed value of 0xEF01; High byte transferred first.	
Adder	ADDER	4 bytes	Default value is 0xFFFFFFFF, which can be modified by command. High byte transferred first and at wrong adder value, module will reject to transfer.	
Package identifier	PID	1 byte	01H	Command packet;
			02H	Data packet; Data packet shall not appear alone in executing processs, must follow command packet or acknowledge packet.
			07H	Acknowledge packet;

			08H	End of Data packet.
Package length	LENGTH	2 bytes	Refers to the length of package content (command packets and data packets) plus the length of Checksum(2 bytes). Unit is byte. Max length is 256 bytes. And high byte is transferred first.	
Package contents	DATA	—	It can be commands, data, command's parameters, acknowledge result, etc. (fingerprint character value, template are all deemed as data);	
Checksum	SUM	2 bytes	The arithmetic sum of package identifier, package length and all package contens. Overflowing bits are omitted. high byte is transferred first.	

Check and acknowledgement of data package

Note: Commands shall only be sent from upper computer to the Module, and the Module acknowledges the commands.

Upon receipt of commands, Module will report the commands execution status and results to upper computer through acknowledge packet. Acknowledge packet has parameters and may also have following data packet. Upper computer can't ascertain Module's package receiving status or command execution results unless through acknowledge packet sent from Module. Acknowledge packet includes 1 byte confirmation code and maybe also the returned parameter.

Confirmation code's definition is :

00h: commad execution complete;

01h: error when receiving data package;

02h: no finger on the sensor;

03h: fail to enroll the finger;

06h: fail to generate character file due to the over-disorderly fingerprint image;

07h: fail to generate character file due to lackness of character point or over-smallness of fingerprint image

08h: finger doesn't match;

09h: fail to find the matching finger;

0Ah: fail to combine the character files;

0Bh: addressing PageID is beyond the finger library;

0Ch: error when reading template from library or the template is invalid;

0Dh: error when uploading template;

0Eh: Module can't receive the following data packages.

0Fh: error when uploading image;

10h: fail to delete the template;

11h: fail to clear finger library;

13h: wrong password!

15h: fail to generate the image for the lackness of valid primary image;

18h: error when writing flash;

19h: No definition error;

1Ah: invalid register number;

1Bh: incorrect configuration of register;

1Ch: wrong notepad page number;
1Dh: fail to operate the communication port;
others: system reserved;

VI Module Instruction System

R303A series provide 23 instructions. Through combination of different instructions, application program may realize muti finger authentication functions. All commands/data are transferred in package format. *Refer to 5.1 for the detailed information of package.*

System-related instructions

Verify passwoard VfyPwd

Description: Verify Module's handshaking password. (Refer to 4.6 for details)
Input Parameter: PassWord (4 bytes)
Return Parameter: Confirmation code (1 byte)
Instruction code: 13H
Command (or instruction) package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	4 byte	2 bytes
Header	Module address	Package identifier		Instruction code	Password	Checksum
0xEF01	xxxx	01H	07H	13H	PassWord	sum

Acknowledge package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Header	Module address	Package identifier	Package Length	Confirmation code	Checksum
0xEF01	xxxx	07H	03H	xxH	sum

Note: Confirmation code = 00H: Correct password;
Confirmation code = 01H: error when receiving package;
Confirmation code = 13H: Wrong password;

Set password SetPwd

Description: Set Module's handshaking password. (Refer to 4.6 for details)
Input Parameter: PassWord (4 bytes)
Return Parameter: Confirmation code (1 byte)
Instruction code: 12H
Command (or instruction) package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	4 byte	2 bytes
Header	Module address	Package identifier	Package length	Instruction code	Password	Checksum
0xEF01	xxxx	01H	07H	12H	PassWord	sum

Acknowledge package format:

2 bytes	4 byte	2 bytes	1 byte	2 bytes
Header	Module address	Package length	Confirmation code	Checksum
0xEF01	xxxx	03H	xxH	Sum

Note: Confirmation code=00H: password setting complete;
Confirmation code=01H: error when receiving package;

Set Module address SetAdder

Description: Set Module address. (Refer to 4.7 for adderss information)
Input Parameter: None;
Return Parameter: Confirmation code (1 byte)
Instruction code: 15H
Command (or instruction) package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	4 bytes	2 bytes
Header	Original Module address	Package identifier	Package length	Instruction code	New Module address	Checksum
0xEF01	xxxx	01H	07H	15H	xxxx	sum

Acknowledge package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Header	New Module address	Package identifier	Package length	Confirmation code	Checksum
0xEF01	xxxx	07H	07H	xxH	Sum

Note: Confirmation code=00H: address setting complete;
Confirmation code=01H: error when receiving package;

Set module system's basic parameter SetSysPara

Description: Operation parameter settings. (Refer to 4.4 for more information)
Input Parameter: Parameter number;
Return Parameter: Confirmation code (1 byte)
Instruction code: 0eH
Command (or instruction) package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1byte	1byte	2 bytes
Header	Module address	Package identifier	Package length	Instruction code	Parameter number	Contents	Checksum
0xEF01	Xxxx	01H	05H	0eH	4/5/6	xx	sum

Acknowledge package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Header	Module address	Package identifier	Package length	Confirmation code	Checksum
0xEF01	Xxxx	07H	03H	xxH	Sum

Note: Confirmation code=00H: parameter setting complete;
Confirmation code=01H: error when receiving package;

Confirmation code=1aH: wrong register number;

Port Control　Control

Description:

For UART protocol, it control the “on/off” of USB port;

For USB protocol, it control the “on/off” of UART port;

Input Parameter: control code

Control code ”0” means turns off the port;

Control code ”1” means turns on the port;

Return Parameter: confirmation code;

Instruction code: 17H

Command (or instruction) package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1byte	2 bytes
Header	Chip address	Package identifier	Package length	Instruction code	Control code	Checksum
0xEF01	xxxx	01H	04H	17H	0/1	sum

Acknowledge package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Header	Chip address	Package identifier	Package length	Confirmation code	Checksum
0xEF01	xxxx	07H	03H	xxH	sum

Note: Confirmation code=00H: Port operation complete;

Confirmation code=01H: error when receiving package;

Confirmation code=1dH: fail to operate the communication port;

Read system Parameter　ReadSysPara

Description: Read Module’s status register and system basic configuration parameters;（Refer to 4.4 for system configuration parameter and 4.5 for system status register）.

Input Parameter：none

Return Parameter：Confirmation code (1 byte) + basic parameter（16bytes）

Instuction code: 0fH

Command (or instruction) package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Header	Module address	Package identifier	Package length	Instruction code	Checksum
0xEF01	Xxxx	01H	03H	0fH	sum

Acknowledge package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	16 bytes	2 bytes
Header	Module address	Package identifier	Package length	Confirmation code	Basic parameter list	Checksum
0xEF01	xxxx	07H	3+16	xxH	See following table	sum

Note: Confirmation code=00H: read complete;

Confirmation code=01H: error when receiving package;

Name	Description	Offset (word)	Size (word)
Status register	Contents of system status register	0	1
System identifier code	Fixed value: 0x0009	1	1
Finger library size	Finger library size	2	1
Security level	Security level (1, 2, 3, 4, 5)	3	1
Device address	32-bit device address	4	2
Data packet size	Size code (0, 1, 2, 3)	6	1
Baud settings	N (baud = 9600*N bps)	7	1

Read valid template number TempleteNum

Description: read the current valid template number of the Module

Input Parameter: none

Return Parameter: Confirmation code (1 byte)，template number:N

Instuction code: 1dH

Command (or instruction) package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Header	Module address	Package identifier	Package length	Instruction code	Checksum
0xEF01	xxxx	01H	0003H	1dH	0021H

Acknowledge package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes	2 bytes
Header	Module address	Package identifier	Package length	Confirmation code	Template number	Checksum
0xEF01	xxxx	07H	5	xxH	N	sum

Note: Confirmation code=00H: read complete;

Confirmation code=01H: error when receiving package;

Fingerprint-processing instructions

To collect finger image GenImg

Description: detecting finger and store the detected finger image in ImageBuffer while returning successfull confirmation code; If there is no finger, returned confirmation code would be “can’t detect finger”.

Input Parameter: none

Return Parameter: Confirmation code (1 byte)

Instuction code: 01H

Command (or instruction) package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Header	Module address	Package identifier	Package length	Instruction code	Checksum
0xEF01	Xxxx	01H	03H	01H	05H

Acknowledge package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes

Header	Module address	Package identifier	Package length	Confirmation code	Checksum
0xEF01	Xxxx	07H	03H	xxH	Sum

Note: Confirmation code=00H: finger collection successs;
Confirmation code=01H: error when receiving package;
Confirmation code=02H: can't detect finger;
Confirmation code=03H: fail to collect finger;

Upload image UpImage

Description: to upload the image in Img_Buffer to upper computer. Refer to 1.1.1 for more about image buffer.

Input Parameter: none

Return Parameter: Confirmation code (1 byte)

Instuction code: 0aH

Command (or instruction) package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Header	Module address	Package identifier	Package length	Instruction code	Checksum
0xEF01	Xxxx	01H	03H	0aH	000eH

Acknowledge package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Header	Module address	Package identifier	Package length	Confirmation code	Checksum
0xEF01	Xxxx	07H	03H	xxH	sum

Note 1： Confirmation code=00H: ready to transfer the following data packet;
Confirmation code=01H: error when receiving package;
Confirmation code=0fH: fail to transfer the following data packet;
2：Module shall transfer the following data packet after responding to the upper computer.

Download the image DownImage

Description: to download image from upper computer to Img_Buffer. Refer to 1.1.1 for more about the image buffer.

Input Parameter: none

Return Parameter: Confirmation code (1 byte)

Instuction code: 0bH

Command (or instruction) package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Header	Module address	Package identifier	Package length	Instruction code	Checksum
0xEF01	Xxxx	01H	03H	0bH	000fH

Acknowledge package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Header	Module	Package	Package	Confirmation	Checksum

	address	identifier	length	code	
0xEF01	Xxxx	07H	03H	xxH	sum

Note: 1：Confirmation code=00H: ready to transfer the following data packet;
Confirmation code=01H: error when receiving package;
Confirmation code=0eH: fail to transfer the following data packet;
2：Module shall transfer the following data packet after responding to the upper computer. Data package length must be 64, 128, or 256。

To generate character file from image Img2Tz

Description: to generate character file from the original finger image in ImageBuffer and store the file in CharBuffer1 or CharBuffer2.

Input Parameter: BufferID (character file buffer number)

Return Parameter: Confirmation code (1 byte)

Instuction code: 02H

Command (or instruction) package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1 byte	2 bytes
Header	Module address	Package identifier	Package length	Instruction code	Buffer number	Checksum
0xEF01	xxxx	01H	04H	02H	BufferID	sum

Note: BufferID of CharBuffer1 and CharBuffer2 are 1h and 2h respectively. Other values (except 1h, 2h) would be processed as CharBuffer2.

Acknowledge package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Header	Module address	Package identifier	Package length	Confirmation code	Checksum
0xEF01	xxxx	07H	03H	XxH	sum

Note: Confirmation code=00H: generate character file complete;
Confirmation code=01H: error when receiving package;
Confirmation code=06H: fail to generate character file due to the over-disorderly fingerprint image;
Confirmation code=07H: fail to generate character file due to lackness of character point or over-smallness of fingerprint image;
Confirmation code=15H: fail to generate the image for the lackness of valid primary image;

To generate template RegModel

Description: To combine information of character files from CharBuffer1 and CharBuffer2 and generate a template which is stroed back in both CharBuffer1 and CharBuffer2.

Input Parameter：none

Return Parameter：Confirmation code (1 byte)

Instuction code: 05H

Command (or instruction) package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes

Header	Module address	Package identifier	Package length	Instruction code	Checksum
0xEF01	xxxx	01H	03H	05H	09H

Acknowledge package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Header	Module address	Package identifier	Package length	Confirmation code	Checksum
0xEF01	xxxx	07H	03H	xxH	sum

Note: Confirmation code=00H: operation success;

Confirmation code=01H: error when receiving package;

Confirmation code=0aH: fail to combine the character files. That's, the character files don't belong to one finger.

To upload character or template UpChar

Description: to upload the character file or template of CharBuffer1/CharBuffer2 to upper computer;

Input Parameter: BufferID (Buffer number)

Return Parameter: Confirmation code (1 byte)

Instuction code: 08H

Command (or instruction) package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1 byte	2 bytes
Header	Module address	Package identifier	Package length	Instruction code	Buffer number	Checksum
0xEF01	xxxx	01H	04H	08H	BufferID	sum

Note: BufferID of CharBuffer1 and CharBuffer2 are 1h and 2h respectively. Other values (except 1h, 2h) would be processed as CharBuffer2.

Acknowledge package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Header	Module address	Package identifier	Package length	Confirmation code	Checksum
0xEF01	xxxx	07H	03H	xxH	sum

Note 1: Confirmation code=00H: ready to transfer the following data packet;

Confirmation code=01H: error when receiving package;

Confirmation code=0dH: error when uploading template;

2: Module shall transfer following data packet after responding to the upper computer.;

3: The instruction doesn't affect buffer contents.

To download character file or template DownChar

Description: to download character file or template from upper computer to the specified buffer of Module;

Input Parameter: BufferID (buffer number)

Return Parameter: Confirmation code (1 byte)

Instuction code: 09H

Command (or instruction) package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1 byte	2 bytes
Header	Module address	Package identifier	Package length	Instruction code	buffer number	Checksum
0xEF01	xxxx	01H	04H	09H	BufferID	sum

Note: BufferID of CharBuffer1 and CharBuffer2 are 1h and 2h respectively. Other values (except 1h, 2h) would be processed as CharBuffer2.

Acknowledge package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Header	Module address	Package identifier	Package length	Confirmation code	Checksum
0xEF01	xxxx	07H	03H	xxH	sum

Note 1: Confirmation code=00H: ready to transfer the following data packet;
Confirmation code=01H: error when receiving package;
Confirmation code=0eH: fail to receive the following data packages.

2: Module shall transfer the following data packet after responding to the upper computer.

To store template Store

Description: to store the template of specified buffer (Buffer1/Buffer2) at the designated location of Flash library.

Input Parameter: BufferID(buffer number), PageID（Flash location of the template, two bytes with high byte front and low byte behind）

Return Parameter: Confirmation code (1 byte)

Instuction code: 06H

Command (or instruction) package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1 byte	2 bytes	2 bytes
Header	Module address	Package identifier	Package length	Instruction code	buffer number	Location number	Checksum
0xEF01	xxxx	01H	06H	06H	BufferID	PageID	sum

Note: BufferID of CharBuffer1 and CharBuffer2 are 1h and 2h respectively. Other values (except 1h, 2h) would be processed as CharBuffer2.

Acknowledge package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Header	Module address	Package identifier	Package length	Confirmation code	Checksum
0xEF01	Xxxx	07H	03H	xxH	sum

Note: Confirmation code=00H: storage success;
Confirmation code=01H: error when receiving package;
Confirmation code=0bH: addressing PageID is beyond the finger library;
Confirmation code=18H: error when writing Flash.

To read template from Flash library LoadChar

Description: to load template at the specified location (PageID) of Flash library to template buffer CharBuffer1/CharBuffer2

Input Parameter: BufferID(buffer number), PageID (Flash location of the template, two bytes with high byte front and low byte behind)。

Return Parameter: Confirmation code (1 byte)

Instuction code: 07H

Command (or instruction) package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1 byte	2 bytes	2 bytes
Header	Module address	Package identifier	Package length	Instruction code	buffer number	Page number	Checksum
0xEF01	xxxx	01H	06H	07H	BufferID	PageID	sum

Note: BufferID of CharBuffer1 and CharBuffer2 are 1h and 2h respectively. Other values (except 1h, 2h) would be processed as CharBuffer2.

Acknowledge package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Header	Module address	Package identifier	Package length	Confirmation code	Checksum
0xEF01	xxxx	07H	03H	XxH	sum

Note: Confirmation code=00H: load success;

Confirmation code=01H: error when receiving package;

Confirmation code=0cH: error when reading template from library or the readout template is invalid;

Confirmation code=0BH: addressing PageID is beyond the finger library;

To delete template DeletChar

Description: to delete a segment (N) of templates of Flash library started from the specified location (or PageID);

Input Parameter: PageID (template number in Flash), N (number of templates to be deleted)

Return Parameter: Confirmation code (1 byte)

Instuction code: 0cH

Command (or instruction) package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes	2bytes	2 bytes
Header	Module address	Package identifier	Package length	Instruction code	Page number	number of templates to be deleted	Checksum
0xEF01	Xxxx	01H	07H	0cH	PageID	N	sum

Acknowledge package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Header	Module address	Package identifier	Package length	Confirmation code	Checksum
0xEF01	Xxxx	07H	03H	xxH	sum

Note: Confirmation code=00H: delete success;

Confirmation code=01H: error when receiving package;

Confirmation code=10H: faile to delete templates;

To empty finger library Empty

Description: to delete all the templates in the Flash library

Input Parameter: none

Return Parameter: Confirmation code (1 byte)

Instuction code: 0dH

Command (or instruction) package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Header	Module address	Package identifier	Package length	Instruction code	Checksum
0xEF01	Xxxx	01H	03H	0dH	0011H

Acknowledge package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Header	Module address	Package identifier	Package length	Confirmation code	Checksum
0xEF01	Xxxx	07H	03H	xxH	sum

Note: Confirmation code=00H: empty success;

Confirmation code=01H: error when receiving package;

Confirmation code=11H: fail to clear finger library;

To carry out precise matching of two finger templates Match

Description: to carry out precise matching of templates from CharBuffer1 and CharBuffer2, providing matching results.

Input Parameter: none

Return Parameter: Confirmation code (1 byte)， matching score.

Instuction code: 03H

Command (or instruction) package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Header	Module address	Package identifier	Package length	Instruction code	Checksum
0xEF01	Xxxx	01H	03H	03H	07H

Acknowledge package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes	2 bytes
Header	Module address	Package identifier	Package length	Confirmation code	Matching score	Checksum
0xEF01	Xxxx	07H	05H	XxH	XxH	sum

Note 1: Confirmation code=00H: templates of the two buffers are matching!

Confirmation code=01H: error when receiving package;

Confirmation code=08H: templates of the two buffers aren’t matching;

2: The instruction doesn’t affect the contents of the buffers.

To search finger library Search

Description: to search the whole finger library for the template that matches the one in CharBuffer1 or CharBuffer2. When found, PageID will be returned.

Input Parameter: BufferID, StartPage (searching start address), PageNum（searching numbers）

Return Parameter: Confirmation code (1 byte), PageID (matching templates location）

Instuction code: 04H

Command (or instruction) package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1 byte	2 bytes	2 bytes	2 bytes
Header	Module address	Package identifier	Package length	Instruction code	buffer number	Parameter	Parameter	Checksum
0xEF01	xxxx	01H	08H	04H	BufferID	StartPage	PageNum	sum

Note: BufferID of CharBuffer1 and CharBuffer2 are 1h and 2h respectively. Other values (except 1h, 2h) would be processed as CharBuffer2.

Acknowledge package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes	2 bytes	2 bytes
Header	Module address	Package identifier	Package length	Confirmation code	页码	得分	Checksum
0xEF01	xxxx	07H	7	xxH	PageID	MatchScore	sum

Note 1: Confirmation code=00H: found the matching finer;

Confirmation code=01H: error when receiving package;

Confirmation code=09H: No matching in the library (both the PageID and matching score are 0);

2: The instruction doesn't affect the contents of the buffers.

Other instructions

To generate a random code GetRandomCode

Description: to command the Module to generate a random number and return it to upper computer;Refer to 4.8 for more about Random Number Generator;

Input Parameter: none

Return Parameter: Confirmation code (1 byte)

Instuction code: 14H

Command (or instruction) package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Header	Module address	Package identifier	Package length	Instruction code	Checksum
0xEF01	xxxx	01H	03H	14H	0018H

Acknowledge package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	4 bytes	2 bytes
Header	Module address	Package identifier	Package length	Confirmation code	Random number	Checksum
0xEF01	xxxx	07H	07H	xxH	xxxx	sum

Note: Confirmation code=00H: generation success;

Confirmation code=01H: error when receiving package;

To write note pad WriteNotepad

Description: for upper computer to write data to the specified Flash page (refer to 4.1 for more about Note pad). Also see R**eadNotepad;**

Input Parameter: NotePageNum, user content (or data content)

Return Parameter: Confirmation code (1 byte)

Instuction code: 18H

Command (or instruction) package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1byte	32 bytes	2 bytes
Header	Module address	Package identifier	Package length	Instruction code	Page number	Data content	Checksum
0xEF01	xxxx	01H	36	18H	0~15	content	sum

Acknowledge package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Header	Module address	Package identifier	Package length	Confirmation code	Checksum
0xEF01	xxxx	07H	03H	xxH	sum

Note: Confirmation code=00H: write success;

Confirmation code=01H: error when receiving package;

To read note pad ReadNotepad

Description: to read the specified page's data content; Refer to 4.1 for more about user note pad. Also see **WriteNotepad**.

Input Parameter: none

Return Parameter: Confirmation code (1 byte) + data content

Instuction code: 19H

Command (or instruction) package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1byte	2 bytes
Header	Module address	Package identifier	Package length	Instruction code	Page number	Checksum
0xEF01	xxxx	01H	04H	19H	0~15	xxH

Acknowledge package format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	32bytes	2 bytes
Header	Module address	Package identifier	Package length	Confirmation code	User content	Checksum
0xEF01	xxxx	07H	3+32	xxH	User content	sum

Note: Confirmation code=00H: read success;

Confirmation code=01H: error when receiving package;

Instruction Table

Classified by functions

type	num	code	description	Type	num	Code	description
System-related	1	13H	To verify password	Finerprint processing	13	08H	to upload template
	2	12H	To set password		14	09H	To download template
	3	15H	To set device address		15	06H	To store template;
	4	0EH	To set system Parameter		16	07H	to read/load template
	5	17H	Port control		17	0CH	to delete tempates
	6	0FH	To read system Parameter		18	0DH	to empty the library
	7	1DH	To read finger template numbers		19	03H	Carry out precise matching of two templates;
Finerprint processing	8	01H	Collect finger image		20	04H	Search the finger library
	9	0AH	To upload image				
	10	0BH	To download image	others	21	14H	to get random code
	11	02H	To generate character file from image		22	18H	to write note pad
	12	05H	To combine character files and generate template		23	19H	To read note pad

Classified by instruction code

code	identifier	Description	Code	Identifier	Description
01H	GenImg	Collect finger image	0DH	Empty	to empty the library
02H	Img2Tz	To generate character file from image	0EH	SetSysPara	To set system Parameter
03H	Match	Carry out precise matching of two templates;	0FH	ReadSysPara	To read system Parameter
04H	Serach	Search the finger library	12H	SetPwd	To set password
05H	RegModel	To combine character files and generate template	13H	VfyPwd	To verify password
06H	Store	To store template;	14H	GetRandomCode	to get random code
07H	LoadChar	to read/load template	15H	SetAdder	To set device address
08H	UpChar	to upload template	17H	Control	Port control
09H	DownChr	to download template	18H	WriteNotepad	to write note pad
0AH	UpImage	To upload image	19H	ReadNotepad	To read note pad

0BH	DownImage	To download image	1BH	HiSpeedSearch	Search the library fastly
0CH	DeletChar	to delete tempates	1DH	TempleteNum	To read finger template numbers