FPM10A Fingerprint Module
User's Guide

V1.3

Features :

Power supply voltage: 3.6 V– 6.0V
Power supply current (operating): 120mA
Scan fingerprint image time: < 0.5s
Window size: 14mm * 18mm
Verify mode:
1:1
1:N

FAR: < 0.008%
FRR: < 0.008%
Interface : UART
Size(L x W x H):
28 x 19 x 8.5mm

Hardware:

PIN1:VCC(3.5V -6V)
PIN2:GND
PIN3:RXD(TTL)
PIN4:TXD(TTL)

4. Instruction Set

4.1 PS_GetImage

- Instruction Code: 01H
- Function: Reading images from sensor and store them in the image buffer

4.2 PS_GenChar

- Instruction Code: 02H
- Function: Generating fingerprint characters according to original images and store them in CharBuffer1 or CharBuffer2

4.3 PS_Match

- Instruction Code: 03H
- Function: Pattern-matching the character file in CharBuffer1 and CharBuffer2

4.4 PS_Search

- Instruction Code: 04H
- Function: Using the character files in CharBuffer1 or CharBuffer2 to search the whole or part of fingerprint database

4.5 PS_RegModel

- Instruction Code: 05H
- Function: Merging the character files in CharBuffer1 and CharBuffer2 and generate them into template to store in CharBuffer2

4.6 PS_StoreChar

- Instruction Code: 06H
- Function: Storing files in the character buffer to FLASH fingerprint database

4.7 PS_LoadChar

- Instruction Code: 07H
- Function: Reading a template from FLASH fingerprint database to character buffer

4.8 PS_UpChar

- Instruction Code: 08H
- Function: Uploading files in the character buffer to the host

4.9 PS_DownChar

- Instruction Code: 09H
- Function: Downloading a character file from the host to the character buffer

4.10 PS_UpImage

- Instruction Code: 0AH
- Function: Uploading original image

4.11 PS_DownImage

- Instruction Code: 0BH
- Function: Downloading original image

4.12 PS_DeletChar

- Instruction Code: 0CH
- Function: Deleting a character file of the FLASH fingerprint database

4.13 PS_Empty

- Instruction Code: 0DH
- Function: Clearing FLASH fingerprint database

4.14 PS_WriteReg

- Instruction Code: 0EH
- Function: Writing SOC system register

4.15 PS_ReadSysPara

- Instruction Code: 0FH
- Function: Reading system basic parameter

4.16 PS_EnrolI

- Instruction Code: 10H
- Function: Enrolling template

4.17 PS_ Identify

- Instruction Code: 11H
- Function: Verifying fingerprint

4.18 PS_SetPwd

- Instruction Code: 12H
- Function: Setting device handshake passwords

4.19 PS_VfyPwd

- Instruction Code: 13H
- Function: Verifying device handshake passwords

4.20 PS_GetRandomCode

- Instruction Code: 14H
- Function: Sampling random code

4.21 PS_SetChipAddr

- Instruction Code: 15H
- Function: Setting chip address

4.22 PS_ReadINFpage

- Instruction Code: 16H
- Function: Reading contents of FLASH Information Page

4.23 PS_Port_Control

- Instruction Code: 17H
- Function: Communication port（UART/USB） switch control

4.24 PS_WriteNotepad

- Instruction Code: 18H
- Function: Writing notepad

4.25 PS_ReadNotepad

- Instruction Code: 19H
- Function: Reading notepad

4.26 PS_BurnCode（in FPM10A this instruction used for burning external FLASH code）

- Instruction code: 1AH
- Function: Burning on-chip FLASH

4.27 PS_HighSpeedSearch

- Instruction Code: 1BH
- Function: Fast-classifying FLASH

4.28 PS_GenBinImage

- Instruction Code: 1CH
- Function: Generating to binary fingerprint image

4.29 PS_ValidTempleteNum

- Instruction Code: 1DH
- Function: reading the number of valid templates.

4.30 PS_UserGPIOCommand (for FPM10A-3 and versions hereafter)

- Instruction Code: 1EH
- Function: Independent GPIO control command

4.31 PS_ReadIndexTable

- Instruction Code: 1FH
- Function: Reading Index table

5. Instruction Form specification

FPM10A can form complete fingerprint identification module with several necessary periphery circuit （sensor, flash, power supply, etc.）. The module is in Slave mode all the time. The host can issue different instructions to the module, for various functions. The host instruction, modules ACK and data exchanges are all work according to given format data packet. The host should packet instructions and data which need transmitting as well as analyze received data packets based-on the following format. For multi-byte data, the high byte is in front, low byte retro, e.g. two-byte data 00 60 should be expressed as 0060, not 0600.

5.1 Data packet Form

Instruction /data packet altogether be classified into three categories:

Packet flag=01 Command packet

Packet flag=02 Data packet, and with continue packet

Packet flag=08 The last data packet, i.e. end packet

All data packets should be with packet header: 0xEF01

01 Command packet format:

Byte NO.	2bytes	4bytes	1 byte	2 bytes	1byte	… …			2 bytes
Name	Packet header	Chip address	Packet flag	Packet length	Instruction	Para-meter 1	…	Para-meter n	Check sum
Content	0xEF01	xxxx	01	N=					

02 Data packet format:

Byte NO.	2bytes	4bytes	1 byte	2 bytes	N bytes…	2 bytes
Name	Packet header	Chip address	Packet flag	Packet length	Data	Check sum
Content	0xEF01	xxxx	02			

08 End packet format:

Byte NO.	2bytes	4bytes	1 byte	2 bytes	N bytes…	2 bytes

Name	Packet header	Chip address	Packet flag	Packet length	Data	Check sum
Content	0xEF01	xxxx	08			

- The data packet should not enter implement flow respectively, but behind the instruction packet or ACK packet;
- Downloaded or uploaded data packet are in the same format ;
- Packet length= The total byte number from packet length to Sum（instruction, parameter or data）, including Sum, but not the byte number of packet length itself;
- Sum is the total bytes from packet flag to Sum, the carry will be ignored if it exceed 2 bytes;
- The default chip address is 0xFFFFFFFF before its issue. Once the host issues chip address by instruction, all data packets should receive and transmit according to the address. Chip will reject packets with wrong address.
- For multi-byte, low byte in the post, big endian (for example, 00 06(2 bytes)denotes for 0006 not 0600)

5.2 Instruction ACK

ACK is to report relevant command running condition and result to the host, the ACK packet contains parameter and can be with continue data packet. Only when the host received the ACK packet of SOC can it confirm the condition of SOC packet receiving and instruction implementing.

ACK packet format:

2 bytes	4bytes	1 byte	2 byte	1 bytes	N bytes	2 bytes
0xEF01	Chip address	Packet flag 07	Packet length	Confirm code	Return value	Check sum

Definition of Confirm codes:

1. 00h: Indicates instruction implementing end or OK;
2. 01h: Indicates data packet receiving error;
3. 02h: Indicates no finger on the sensor;
4. 03h: Indicates getting fingerprint image failed;
5. 04h: Indicates the fingerprint image is too dry or too light to generate character;
6. 05h: Indicates the fingerprint image is too humid or too blurry to generate character;
7. 06h: Indicates the fingerprint image is too amorphous to generate character;
8. 07h: Indicates the fingerprint image is in order, but with too little minutiaes（or too small area）to generate character;
9. 08h: Indicates the fingerprint unmatched;
10. 09h: Indicates no fingerprint searched;
11. 0ah: Indicates the character merging failed;
12. 0bh: Indicates the address SN exceeding the range of fingerprint database

when accessing to it;

13. 0ch: Indicates template reading error or invalid from the fingerprint database;
14. 0dh: Indicates character uploading failed;
15. 0eh: Indicates the module cannot receive continue data packet;
16. 0fh: Indicates image uploading failed;
17. 10h: Indicates module deleting failed;
18. 11h: Indicates the fingerprint database clearing failed;
19. 12h: Indicates cannot be in low power consumption;
20. 13h: Indicates the password incorrect;
21. 14h: Indicates the system reset failed;
22. 15H: Indicates there is no valid original image in buffer to generate image;
23. 16H: Indicates on-line upgrading failed;
24. 17H: Indicates there are incomplete fingerprint or finger stay still between twice image capturing;
25. 18H: Indicates read-write FLASH error;
26. 0xf0: Existing instruction of continue data packet, ACK with 0xf0 after receiving correctly;
27. 0xf1: Existing instruction of continue data packet, the command packet ACK with 0xf1;
28. 0xf2: Indicates Sum error when burning internal FLASH;
29. 0xf3: Indicates packet flag error when burning internal FLASH;
30. 0xf4: Indicates packet length error when burning internal FLASH;
31. 0xf5: Indicates the code length too long when burning internal FLASH;
32. 0xf6: Indicates burning FLASH failed when burning internal FLASH;
33. 0x19: Non-defined error;
34. 0x1a: Invalid register number;
35. 0x1b: Register distributing content wrong number;
36. 0x1c: Notepad page number appointing error;
37. 0x1d: Port operation failed;
38. 0x1e: Automatic enroll failed;
39. 0x1f: Fingerprint database is full;
40. 0x20—0xefh: Reserved.

Instructions can only be transmitted from the host to the module, and the module ACK to the host.

After the system power on reset, it will first check whether the default device handshake passwords have been modified or not. If not, the system will ensure the host no passwords verification, then SOC enters into normal work directly; if yes, should first verify the device handshake passwords, SOC enters into normal work after passing passwords.

5.3 Detail Instruction

5.3.1 Get Image PS_GetImage

- Function description: Detecting finger, then get the fingerprint image and store it in ImageBuffer. Returning to confirm code to show: getting success, no finger, etc.
- Input parameter: none
- Return value: Confirm words
- Instruction Code: 01H

Instruction packet format:2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Check sum
0xEF01	xxxx	01H	03H	01H	05H

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm Code	Check sum
0xEF01	xxxx	07H	03H	xxH	sum

Comment: Confirm Code=00H: getting success;
Confirm Code=01H: receiving packet error;
Confirm Code=02H: no finger on the sensor;
Confirm Code=03H: getting failed;
Sum=Check sum.

5.3.2 Generate character file PS_GenChar

- Function description: To generate character file according to the original image in ImageBuffer and store the character file in CharBuffer1 or CharBuffer2
- Input parameter: BufferID(character buffer number)
- Return value: Confirm words
- Instruction Code: 02H
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Buffer number	Check sum
0xEF01	xxxx	01H	04H	02H	BufferID	sum

Comment: The BufferID in CharBuffer1 and CharBuffer2 are 1h and 2h, if appoints other values, then process according to CharBuffer2.

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Check sum
0xEF01	xxxx	07H	03H	XxH	sum

Comment: Confirm Code=00H: generating success;
Confirm Code=01H: receiving packet error;
Confirm Code=06H: the fingerprint image is too amorphous to generate character;
Confirm Code=07H: the fingerprint image is in order, but with too little minutiaes to generate character;
Confirm Code=15H: there is no valid original image in buffer to generate image;
Sum=Check sum.

5.3.3 Compare Two Fingerprint Character files PS_Match

- Function description: Conduct comparison between character files from CharBuffer1 and CharBuffer2
- Input parameter: none
- Return value: Confirm words, match scores
- Instruction code: 03H
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Check sum
0xEF01	xxxx	01H	03H	03H	07H

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Score	Check sum
0xEF01	xxxx	07H	05H	XxH	XxH	sum

Comment: Confirm Code=00H: fingerprint matched;
Confirm Code=01H: receiving packet error;
Confirm Code=08H: fingerprint unmatched;
Sum=Check sum.

5.3.4 Search a Fingerprint PS_Search

- Function description: To search the whole or part of fingerprint database with character files in CharBuffer1 or CharBuffer2. If got, return

the right page number.

- Input parameter: BufferID, StartPage, PageNum
- Return value: Confirm words, page number（Matched fingerprint template）
- Instruction code: 04H
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1 byte	2 bytes	2 bytes	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Buffer number	parameter	parameter	Check sum
0xEF01	xxxx	01H	08H	04H	BufferID	StartPage	PageNum	sum

Comment: The BufferID in CharBuffer1 and CharBuffer2 are 1h and 2h.

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes	2 bytes	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	page number	Score	Check sum
0xEF01	xxxx	07H	7	xxH	PageID	MatchScore	sum

Comment: Confirm Code=00H: searching success;
Confirm Code=01H: receiving packet error;
Confirm Code=09H: unsearched, here the page number and score are “0”;
Sum=Check sum.

5.3.5 Combine Character files (Generating one Template) PS_RegModel

- Function description: Combine the character files from CharBuffer1 and CharBuffer2 to generate the finger template, and store the template in CharBuffer1.
- Input parameter: none
- Return value: Confirm words
- Instruction code: 05H
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Check sum
0xEF01	xxxx	01H	03H	05H	09H

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Check sum
0xEF01	xxxx	07H	03H	xxH	sum

Comment: Confirm Code=00H: combining success;
Confirm Code=01H: receiving packet error;
Confirm Code=0aH: combining failed（two fingerprints are not from the same finger）;
Sum=Check sum.

5.3.6 Store Templates PS_StoreChar

- Function description: Storing the template files in CharBuffer1 or CharBuffer2 to the location of PageIDNum flash database.
- Input parameter: BufferID(buffer number), PageID （ fingerprint database location number）
- Return value: Confirm words
- Instruction code: 06H
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1 byte	2 bytes	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Buffer number	Location number	Check sum
0xEF01	xxxx	01H	06H	06H	BufferID	PageID	sum

Comment: The BufferID in CharBuffer1 and CharBuffer2 are 1h and 2h.

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Check sum
0xEF01	xxxx	07H	03H	xxH	sum

Comment: Confirm Code=00H: storing success;
Confirm Code=01H: receiving packet error;
Confirm Code=0bH: PageID exceeded the range of fingerprint database;
Confirm Code=18H: writing FLASH error;
Sum=Check sum.

5.3.7 Load Template PS_LoadChar

- Function description: Readin the fingerprint templates which appointed IDNum in flash database to template buffer CharBuffer1 or CharBuffer2
- Input parameter: BufferID(buffer number), PageID （ fingerprint database template number）
- Return value: Confirm words
- Instruction code: 07H
- Instruction packet format:

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

Packet header	Chip address	Packet flag	Packet length	Instruction code	Buffer number	Page number	Check sum
0xEF01	xxxx	01H	06H	07H	BufferID	PageID	sum

Comment: The BufferID in CharBuffer1 and CharBuffer2 are 1h and 2h.

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Check sum
0xEF01	xxxx	07H	03H	XxH	sum

Comment: Confirm Code=00H: reading success;
Confirm Code=01H: receiving packet error;
Confirm Code=0cH: reading error or template invalid;
Confirm Code=0bH: PageID exceeded the range of fingerprint database;
Sum=Check sum.

5.3.8 upload character file or templates PS_UpChar

- Function description: Uploading the character files in character buffer to the host.
- Input parameter: BufferID(buffer number)
- Return value: Confirm words
- Instruction code: 08H
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Buffer number	Check sum
0xEF01	xxxx	01H	04H	08H	BufferID	sum

Comment: The BufferID in CharBuffer1 and CharBuffer2 are 1h and 2h.

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Packet length	Check sum
0xEF01	xxxx	07H	03H	xxH	sum

Comment: Confirm Code=00H: transmitting data packet later;
Confirm Code=01H: receiving packet error;
Confirm Code=01H: instruction running error;
Sum=Check sum.

- Transmitting continue data packet after ACK

5.3.9 Transfer a Character file or Template from PC to DSP PS_DownChar

- Function description: Transfer a Character file or Template from PC to character buffer in DSP
- Input parameter: BufferID(buffer number)
- Return value: Confirm words
- Instruction code: 09H
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Buffer number	Check sum
0xEF01	xxxx	01H	04H	09H	BufferID	sum

Comment: The BufferID in CharBuffer1 and CharBuffer2 are 1h and 2h.

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Check sum
0xEF01	xxxx	07H	03H	xxH	sum

Comment: Confirm Code=00H: can receive continue data packet;
Confirm Code=01H: receiving packet error;
Confirm Code=0eH: cannot receive continue data packet;
Sum=Check sum.

- Receiving continue data packet after ACK

5.3.10 Upload Image PS_UpImage

- Function description: Uploading data in image buffer to the host
- Input parameter: none
- Return value: Confirm words
- Instruction code: 0aH
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Check sum
0xEF01	xxxx	01H	03H	0aH	000eH

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Check sum
0xEF01	xxxx	07H	03H	xxH	sum

Comment: Confirm Code=00H: going on transmitting continue data packet;
Confirm Code=01H: receiving packet error;

Confirm Code=0fH: cannot transmit continue data packet;
Sum=Check sum.

- Transmitting continue data packet after ACK
- When using UART communication， one byte contains two pixels, each pixel with 4bits

5.3.11 Download Image PS_DownImage

- Function description: The host download image data to the module
- Input parameter: none
- Return value: Confirm words
- Instruction code: 0bH
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Check sum
0xEF01	xxxx	01H	03H	0bH	000fH

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Check sum
0xEF01	xxxx	07H	03H	xxH	sum

Comment: Confirm Code=00H: can receive continue data packet;
Confirm Code=01H: receiving packet error;
Confirm Code=0eH: cannot receive continue data packet;
Sum=Check sum.

- Receiving continue data packet after ACK, the data packet length should be 64, 128 or 256
- A byte contains two pixels, each pixel with 4bits

5.3.12 Delete Template PS_DeletChar

- Function description: Deleting *N* fingerprint templates starting from *IDNum* in the flash database
- Input parameter: PageID(template ID in the database), N: number of templates to be deleted
- Return value: Confirm words
- Instruction code: 0cH
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes	2bytes	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Page number	Delete number	Check sum

0xEF01	xxxx	01H	07H	0cH	PageID	N	sum

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Check sum
0xEF01	xxxx	07H	03H	xxH	sum

Comment: Confirm Code=00H: deleting module success;
Confirm Code=01H: receiving packet error;
Confirm Code=10H: deleting module failed;
Sum=Check sum.

5.3.13 Clear Fingerprint Database PS_Empty

- Function description: Deleting all fingerprint modules in flash database
- Input parameter: none
- Return value: Confirm words
- Instruction code: 0dH
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Check sum
0xEF01	xxxx	01H	03H	0dH	0011H

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Check sum
0xEF01	xxxx	07H	03H	xxH	sum

Comment: Confirm Code=00H: clearing success;
Confirm Code=01H: receiving packet error;
Confirm Code=11H: clearing failed;
Sum=Check sum.

5.3.14 Write System Registers PS_WriteReg

- Function description: Writing module registers
- Input parameter: Register SN
- Return value: Confirm words
- Instruction code: 0eH
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1byte	1byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	SN of registers	Content	Check sum

0xEF01	xxxx	01H	05H	0eH	4/5/6	xx	sum

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Check sum
0xEF01	xxxx	07H	03H	xxH	sum

Register NO.	Register Name	Content description
4	Baudrate control register	9600 * N
5	Match threshold register	1: level1 2: level2 3: level3 4: level4 5: level5
6	Packet size register	0: 32bytes 1: 64bytes 2: 128bytes 3: 256bytes

Comment1: Confirm code=00H: OK;
Confirm Code=01H: receiving packet error;
Confirm Code=1aH: register SN error;
Sum=Check sum.

Comment2: When write the instruction implementing of system register （PS_WriteReg）, first ACK with the original configuration, after that modify the system configuration and record it to FLASH. At next power on, the system will work with new configuration.

5.3.15 Read System Basic Parameter PS_ReadSysPara

- Function description:
  - Read the module's basic parameter（baudrate, packet size etc.）.
  - The former 16 bytes of **Parameter Table** stores module's basic information of communication and configuration, which are module's basic parameters.
- Input parameter: none
  - Return value: Confirm words + basic parameter（16bytes）
- Instruction code: 0fH
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Check sum

0xEF01	xxxx	01H	03H	0fH	0013H

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	16 bytes	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Basic **parameter table**	Check sum
0xEF01	xxxx	07H	3+16	xxH	Refer to the following table	sum

Comment: Confirm code=00H: OK;
Confirm Code=01H: receiving packet error;
Sum=check sum.

Name	Content description	Offset(word)	Size（word）
State register	Content of system's state registers	0	1
Sensor type	Sensor type code: 0: fpc1011c； 2: Ligh Tuning c500； 3: Ligh Tuning s500 strip； 7: Shenzhen Micro-chip strip； 9: User-defined sensor； Others: reserved	1	1
Fingerprint database size	Fingerprint database capacity	2	1
Security rank	Security level code（1/2/3/4/5）	3	1
Device address	32 bits device address	4	2
Data packet size	Data packet size code: 0: 32bytes 1: 62bytes 2: 128bytes 3: 256bytes	6	1
Baudrate configuration	N (Baudrate=9600*N bps)	7	1

5.3.16 Auto-Enroll Template PS_Enroll

- Function description: Capturing fingerprint enroll template for once, and search for empty space in the fingerprint database and store it, finally jump to memory ID
- Input parameter: none
- Return value: Confirm words, page number（matched fingerprint template）

- Instruction code: 10H
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Check sum
0xEF01	xxxx	01H	0003H	10H	0014H

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Page number	Check sum
0xEF01	xxxx	07H	5	xxH	PageID	sum

Comment: Confirm Code=00H: enrolling success;
Confirm Code=01H: receiving packet error;
Confirm Code=1eH: enrolling failed;
Sum==check sum.

5.3.17 Auto-Identify Fingerprint PS_Identify

- Function description:
  - Capturing fingerprint automatically, search target module in fingerprint database and return to searching result.
  - If the match score of target module with current captured fingerprint is higher than the maximum threshold value and the target module is incomplete character, then update the blank area of target module with captured character.
- Input parameter: none
- Return value: Confirm words, page number（matched fingerprint template）
- Instruction code: 11H
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Check sum
0xEF01	xxxx	01H	0003H	11H	0015H

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes	2 bytes	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Page number	Score	Check sum
0xEF01	xxxx	07H	7	xxH	PageID	MatchScore	sum

Comment: Confirm Code=00H: searching success;
Confirm Code=01H: receiving packet error;

Confirm Code=09H: searching failed, here the page number and score are “0”;
Sum==check sum.

5.3.18 Set Password PS_SetPwd

- Function description: Setting module handshake password
- Input parameter: Password
- Return value: Confirm words
- Instruction code: 12H
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	4 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Password	Check sum
0xEF01	xxxx	01H	07H	12H	Password	sum

Comment: The default value of module address is “0”

- ACK packet format:

2 bytes	4 byte	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Check sum
0xEF01	xxxx	07H	03H	xxH	sum

Comment: Confirm code=00H: OK;
Confirm Code=01H: receiving packet error;
Sum=check sum.

5.3.19 Verify Password PS_VfyPwd

- Function description: Verifying module handshake passwords
- Input parameter: Password
- Return value: Confirm words
- Instruction code: 13H
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	4 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Password	Check sum
0xEF01	xxxx	01H	07H	13H	PassWord	sum

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Check sum
0xEF01	xxxx	07H	03H	xxH	sum

Comment: Confirm code=00H: password correct;
Confirm Code=01H: receiving packet error;
Confirm Code=13H: password incorrect;
Sum=check sum.

5.3.20 Get Random Code PS_GetRandomCode

- Function description: Making chip generate a random code and return to the host
- Input parameter: none
- Return value: Confirm words
- Instruction code: 14H
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Check sum
0xEF01	xxxx	01H	03H	14H	0018H

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	4 bytes	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Random code	Check sum
0xEF01	xxxx	07H	07H	xxH	xxxx	sum

Comment: Confirm Code=00H: generating success;
Confirm Code=01H: receiving packet error;
Sum=check sum.

5.3.21 Set Chip Address PS_SetChipAddr

- Function description: Setting chip address
- Input parameter: none
- Return value: Confirm words
- Instruction code: 15H
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	4 bytes	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Chip address	Check sum
0xEF01	xxxx	01H	07H	15H	xxxx	sum

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Check sum
0xEF01	xxxx	07H	07H	xxH	sum

Comment: Confirm Code=00H: generating address success;
Confirm Code=01H: receiving packet error;
Sum=check sum.

- When the host download instruction packet, the chip address adopts default address: 0xffffffff; the ACK packet address space adopts the newly generated address;
- After running the instruction, the chip address be fixed, remains no change. Only to clear FLASH can you change it;
- After running the instruction, all data packets should apply the generated address.

5.3.22 Read Flash Info Page PS_ReadINFpage

- Function description: Reading the information page in FLASH (512bytes)
- Input parameter: none
- Return value: Confirm words
- Instruction code: 16H
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Check sum
0xEF01	xxxx	01H	03H	16H	001aH

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Check sum
0xEF01	xxxx	07H	03H	xxH	sum

Comment: Confirm Code=00H: transmitting data packet later;
Confirm Code=01H: receiving packet error;
Confirm Code=0dH: instruction running failed;
Sum=check sum.

- Transmitting continue data packet after ACK

5.3.23 Port Control PS_Port_Control

- Function description:
  - To UART protocol, this command control the switch of USB communication port;
  - To USB protocol, this command control the switch of UART port.
- Input parameter: Control code
  - Control code 0 means to close the port

■ Control code 1 means to open the port

- Return value: Confirm words
- Instruction code: 17H
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Control code	Check sum
0xEF01	xxxx	01H	04H	17H	0/1	sum

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Check sum
0xEF01	xxxx	07H	03H	xxH	sum

Comment: Confirm Code=00H: port operating success;
Confirm Code=01H: receiving packet error;
Confirm Code=1dH: port operating failed;
Sum=check sum.

5.3.24 Write Notepad PS_WriteNotepad

- Function description: Distributing a-256-bytes FLASH space for storing user's data in the module, named as user notepad. The pad is divided into 16 pages logically. To write the notepad command --- for read-in user's 32 bytes data to appointed notepad page.
- Input parameter: NotePageNum, user content
- Return value: Confirm words
- Instruction code: 18H
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1byte	32 bytes	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Page number	User information	Check sum
0xEF01	xxxx	01H	36	18H	0~15	content	sum

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Check sum
0xEF01	xxxx	07H	03H	xxH	sum

Comment: Confirm code=00H: OK;
Confirm Code=01H: receiving packet error;
Sum=check sum.

5.3.25 Read Notepad PS_ReadNotepad

- Function description: Reading 128bytes data in FLASH user field
- Input parameter: none
- Return value: Confirm words + User information
- Instruction code: 19H
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Page number	Check sum
0xEF01	xxxx	01H	04H	19H	0~15	xxH

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	32bytes	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	User information	Check sum
0xEF01	xxxx	07H	3+32	xxH	User content	sum

Comment: Confirm code=00H: OK;
Confirm Code=01H: receiving packet error;
Sum=check sum.

5.3.26 Burn on-chip FLASH PS_ BurnCode

- Function description: The host download code data and write in FLASH
- Input parameter: none
- Return value: Confirm words
- Instruction code: 01AH
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1 bytes	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Upgrade mode	Check sum
0xEF01	xxxx	01H	04H	1AH	0/1	sum

Upgrade mode 0: Only upgrade information page
Upgrade mode 1: Complete upgrading
Others: Error

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Check sum
0xEF01	xxxx	07H	03H	xxH	sum

Comment: Confirm Code=00H: can receive continue data packet;
Confirm Code=01H: receiving packet error;

Confirm Code=0eH: cannot receive continue data packet;
Sum=Check sum.

- Receiving continue data packet after ACK, the data packet length should be 64, 128 or 256

5.3.27 High Speed Search PS_HighSpeedSearch

- Function description:
  - High-speed searching the whole or part of fingerprint database with the character files in CharBuffer1 or CharBuffer2.If get, jump to the original page.
  - The instruction will soon work out the searching result if the fingerprint really be in the database and with good quality.
- Input parameter: BufferID, StartPage, PageNum
- Return value: Confirm words, Page number（matched fingerprint template）
- Instruction code: 1bH
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1 byte	2 bytes	2 bytes	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Buffer number	Parameter	Parameter	Check sum
0xEF01	xxxx	01H	08H	1bH	BufferID	StartPage	PageNum	sum

Comment: The BufferID in CharBuffer1 and CharBuffer2 are 1h and 2h.

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes	2 bytes	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Page number	Score	Check sum
0xEF01	xxxx	07H	7	xxH	PageID	MatchScore	sum

Comment: Confirm Code=00H: searching success;
Confirm Code=01H: receiving packet error;
Confirm Code=09H: searching failed, here the page number and score are “0”;
Sum=check sum.

5.3.28 Generate to Minutiae Fingerprint Image PS_GenBinImage

- Function description: Processing the fingerprint image in image buffer and generate it to minutiae fingerprint image
- Input parameter: BinImgTpye
  - 0: Binary images

- 1: Minutiae images without minutiae flag
- 2 or others: Minutiae images with minutiae flag

➢ Return value: Confirm words

➢ Instruction code: 1cH

➢ Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1 bytes	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Target type	Check sum
0xEF01	xxxx	01H	04H	1cH	0/1/2	sum

➢ ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Check sum
0xEF01	xxxx	07H	03H	xxH	sum

Comment: Confirm Code=01H: receiving packet error;
Confirm Code=15H: invalid fingerprint images;
Confirm Code=07H: without enough character information;
Confirm Code=06H: images with too low quality;
Sum=check sum.

5.3.29 Read valid template number PS_ValidTemplateeNum

➢ Function description: Reading valid template number

➢ Input parameter: none

➢ Return value: Confirm words, valid template number (ValidN)

➢ Instruction code: 1dH

➢ Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Check sum
0xEF01	xxxx	01H	0003H	1dH	0021H

➢ ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	2 bytes	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	valid template number	Check sum
0xEF01	xxxx	07H	5	xxH	ValidN	sum

Comment: Confirm Code=00H indicates reading success;
Confirm Code=01H indicates receiving packet error;
Sum=check sum

5.3.30 Independent GPIO control command PS_UserCommand

- Function description: Conduct control of GPIO
- Input parameter: GPIOx (GPIO left for use depends on the sensor type, for detail please refer to the schmetics);
  Status: 0, low level output; 1, high level output.
- Return value: confirm code, status
- Instruction code: 1eH
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1byte	1byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	GPIOx	Status	Check sum
0xEF01	xxxx	01H	05H	1eH	0--7	0/1	Sum

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1byte	1bytes	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Status	Check sum
0xEF01	xxxx	07H	04H	xx	0/1	Sum

Comment: Confirm Code=00H: operating success;
Confirm Code=1AH: Input parameter error;
Sum=check sum

5.3.31 Read Index Table

- **Function description:** Read the index table for fingerprint templates.
- **Input parameter:** page ID of index table. Page 0 corresponds to templates 0~255; Page 1 corresponds to templates 256~511; Page 2 corresponds to templates 512~767; Page 3 corresponds to templates 768~1023.
- **Index info:** Or template info, 32 bytes. Each bit represents a template; bit 0 of the first byte corresponds to template 0, and so on. 1 means there is a template in that specific memory, 0 means none.
- **Return value:** confirm code, index info
- Instruction code: 1FH
- Instruction packet format:

2 bytes	4bytes	1 byte	2 bytes	1 byte	1byte	2 bytes
Packet header	Chip address	Packet flag	Packet length	Instruction code	Page ID	Check sum

0xEF01	xxxx	01H	04H	1FH	0~3	xxH

- ACK packet format:

2 bytes	4bytes	1 byte	2 bytes	1byte	32bytes	2 bytes
Packet header	Chip address	Packet flag	Packet length	Confirm code	Index Info	Check sum
0xEF01	xxxx	07H	3+32	xx	Index info	Sum

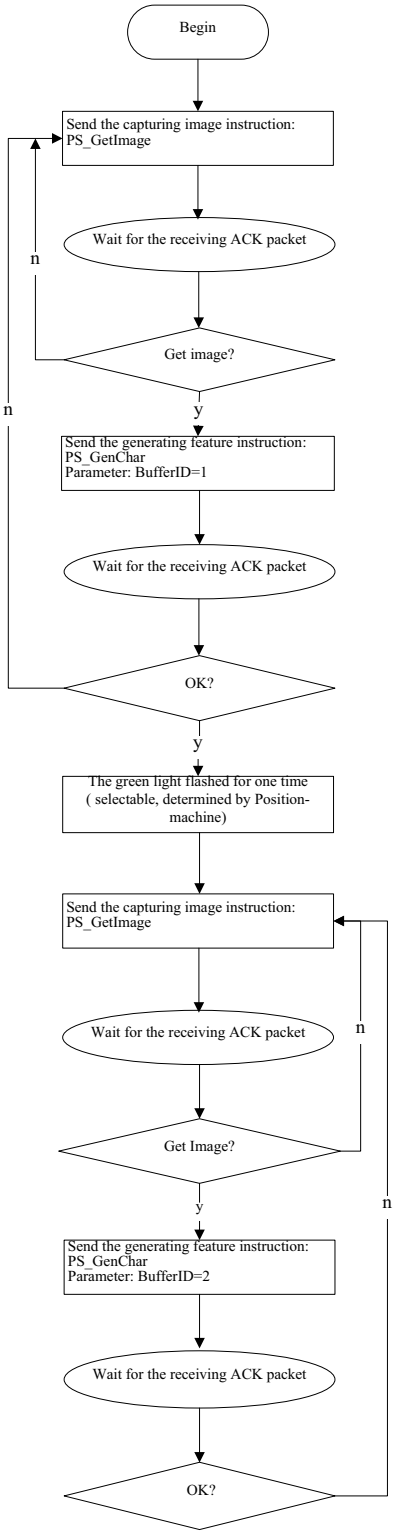
Comment: Confirm Code=00H: operating success;

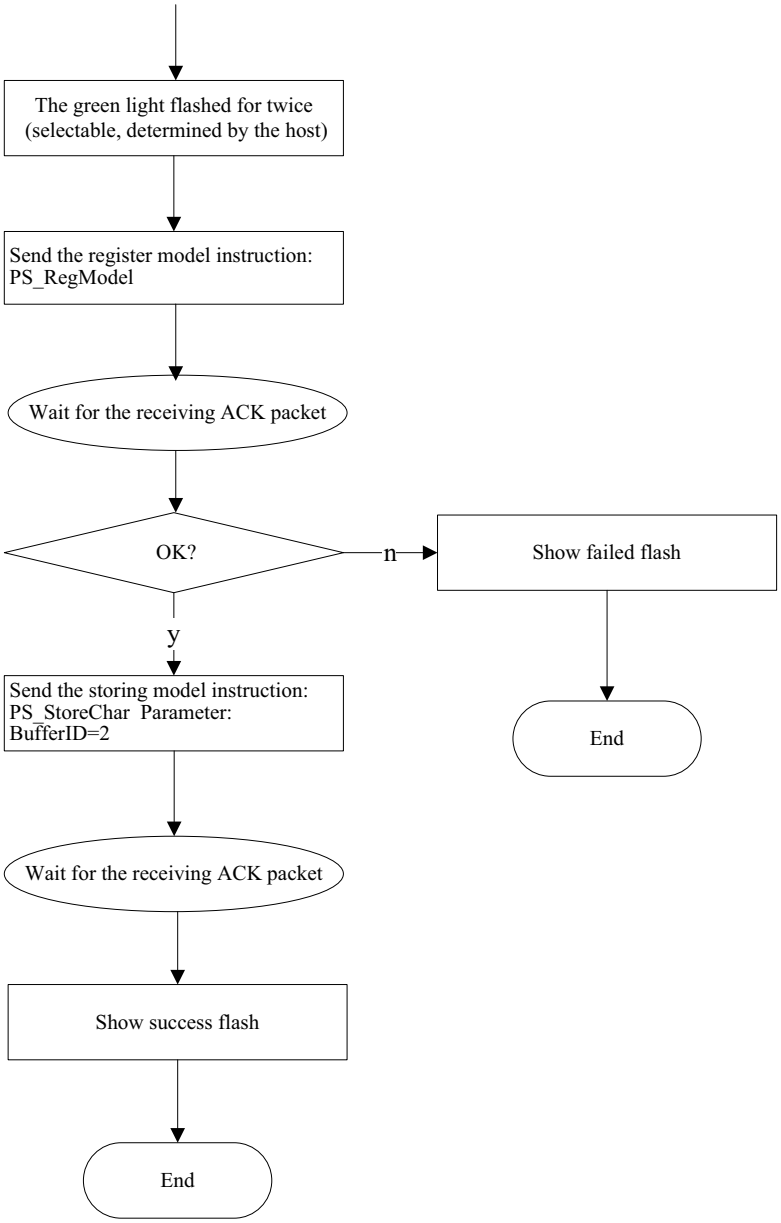
Confirm Code=01H: Receive package error;

Sum=check sum

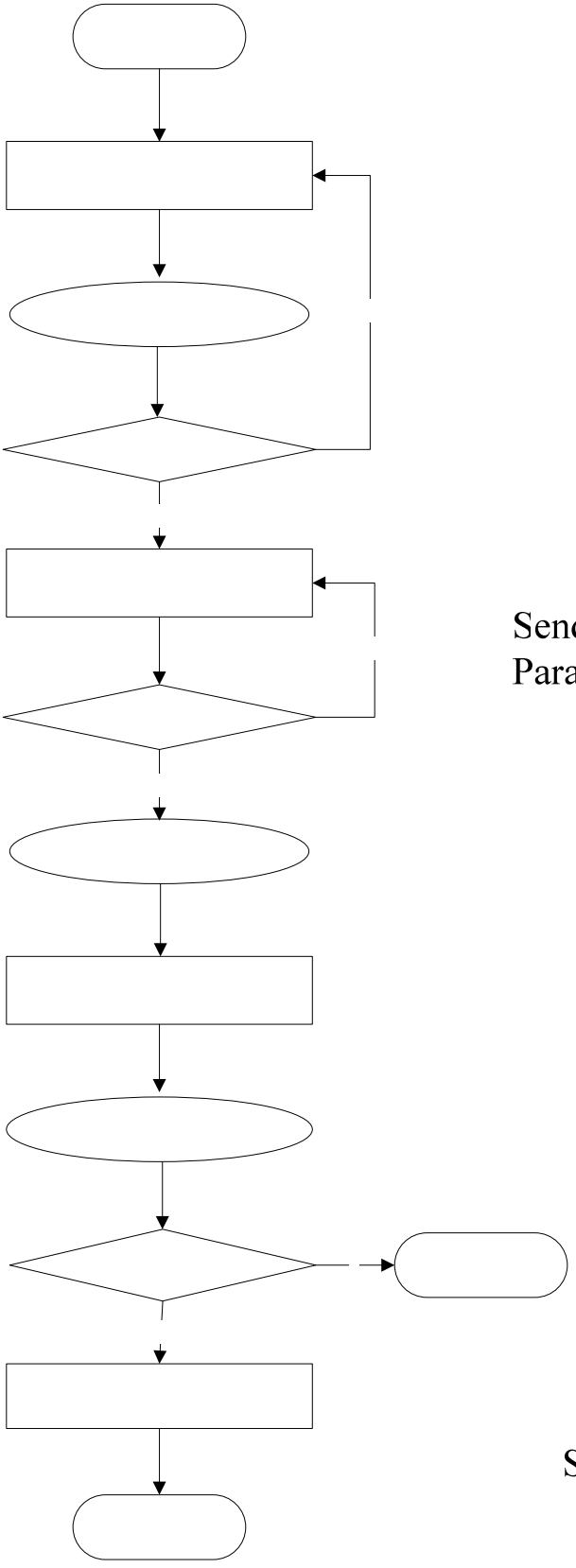
6. Function Implement Illustration

a) Pressing fingerprint twice to record a template and store in flash fingerprint database;

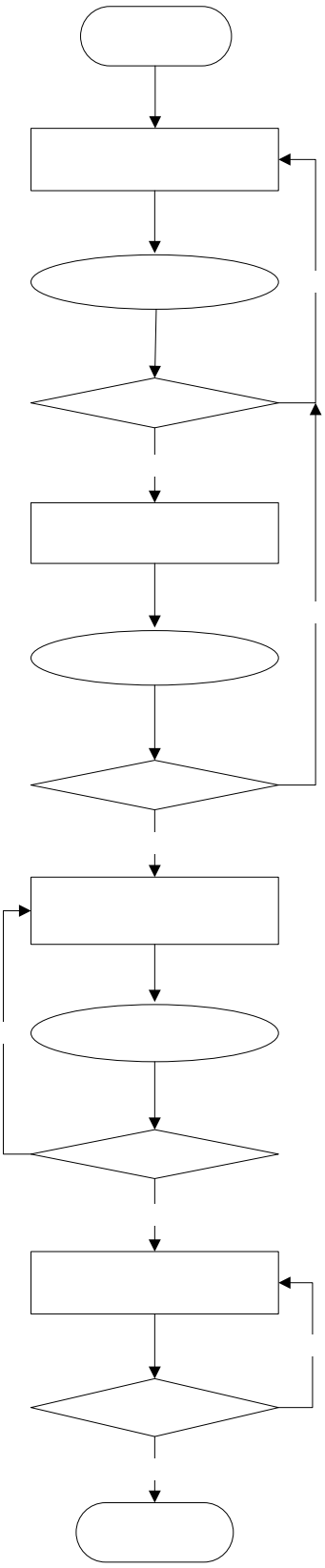



The green light flashed for twice (selectable, determined by the host)
Send the register model instruction: PS_RegModel
Wait for the receiving ACK packet
OK?
n
Show failed flash
End
y
Send the storing model instruction: PS_StoreChar Parameter: BufferID=2
Wait for the receiving ACK packet
Show success flash
End

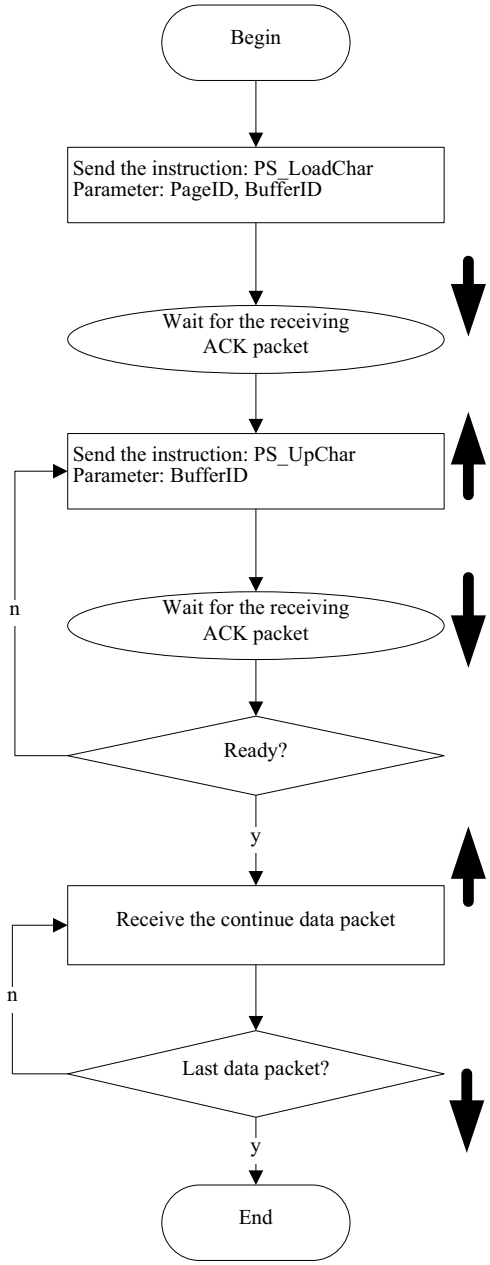
b) Downloading a fingerprint character from the host and searching the fingerprint database with it;



c) Capturing a fingerprint image from sensor and generating the character file, then upload to the host;



d) Reading a appointed template from flash fingerprint database and uploading;



e) Reading an image from sensor and searching the database field from 10—100.