2nd Generation Capacitive Fingerprint Recognition Module

BM92S2231-1

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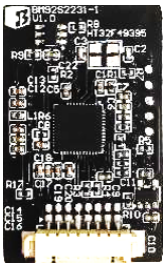
Table of Contents

Features

- Operating voltage: DC 3.3V~5.0V
- Operating current: <60mA
- Standby current: <12μA
- Operating temperature: -20℃~70℃
- Communication interface: UART interface
- Fingerprint collection mode: Capacitive fingerprint collection
- Effective collection area: 9.6×12.8mm
- Image size: 192×256 pixel
- Resolution: 508dpi
- Feature template size: 180×N bytes (N up to 3)
- Storage capacity: 1000 fingerprints
- False acceptance rate (FAR): ≤0.001%
- False rejection rate (FRR): ≤3%
- Power on initialisation time: <100 ms
- Enrollment time: <10 sec
- Recognition time: One-to-one matching time<15ms



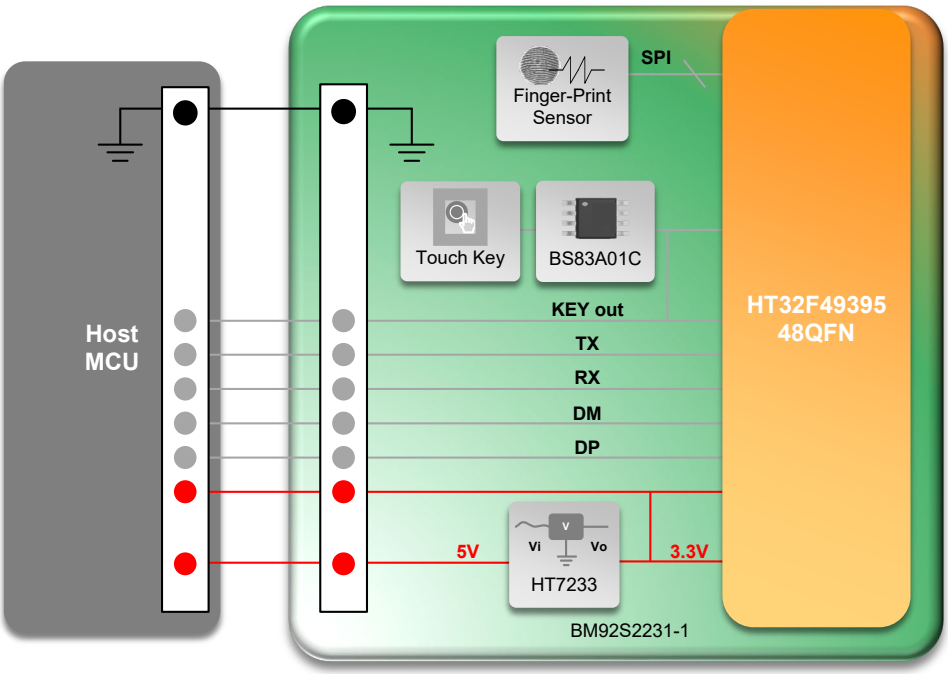
General Description

The BM92S2231-1 is a fingerprint recognition module which is designed using the Holtek HT32F49395 MCU as the host. The device integrates a capacitive fingerprint recognition sensor and supports UART serial communication mode. This module has the advantages of flexible control and accurate recognition, which make the module be mounted on other electronic products flexibly.

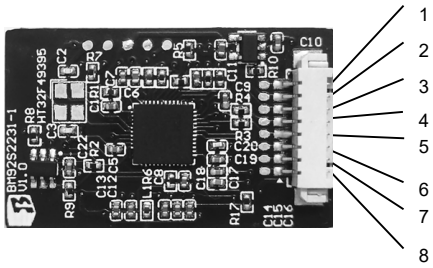
Applications

- Intelligent door locks, etc

Block Diagram



Pin Assignment



Pin Description

Pin	Function	Type	Description
1	KeyOut	DO	Touch signal output pin, high active
2	5.0V	PWR	Module power supply pin
3	3.3V	PWR	Module power supply pin
4	USB_DM	DI/DO	USB_DM reserved pin
5	USB_DP	DI/DO	USB_DP reserved pin
6	UART_RX	DI	UART serial communication transmitting pin
7	UART_TX	DO	UART serial communication receiving pin
8	GND	PWR	Negative power supply, ground

Legend: PWR: Power; DI: Digital input; DO: Digital output

Functional Description

System Description

The BM92S2231-1 is a fingerprint recognition module, which has a fingerprint image collecting sensor as the main sensor. The module has a touch wake-up function, uses the 3.3V or 5V power supply and UART communication. It also has the functions of obtaining image, fingerprint enrolment, fingerprint detection, fingerprint deletion, obtaining enrolled information, setting and so on.

Operating Principle

The module can enroll and matche fingerprints by collecting fingerprint images for image processing. Users can send command packet to the module from the host device using the UART communication method to enter the corresponding function. After the module is powered on or woken up from standby, the baud rate will return to the default value of 115200. The baud rate can be changed by sending instructions.

Standby Mode

To save system power consumption, users can send a standby command to make the module enter the standby mode. Touching the module can wake up the module from standby.

Interface

The BM92S2231-1 supports the UART communication method, the number of data bits are eight. Refer to the UART Interface section for detailed communication method.

UART Interface

UART Communication Protocol

Packet Content

• Command Packet

Order	Content	Bytes	Description
0	0x55	1 Byte	The first byte at the beginning of the command
1	0xAA	1 Byte	The second byte at the beginning of the command
2	Fingerprint Module ID	2 Bytes	Fingerprint Module ID: fixed at 0x0000, the write order is low byte first
4	Parameter	4 Bytes	Input parameter, the write order is low byte first, for example the decimal number 460800 is corresponding to hexadecimal number 70800. The parameter filling order is: 0x00, 0x08, 0x07, 0x00.
8	Command	2 Bytes	Command code, the write order is low byte first. For example 0x12, the parameter filling order is: 0x12, 0x00.
10	Checksum	2 Bytes	Check code (from 0th to 9th) Offset[0]+…+Offset[9]=Checksum

• Feedback Packet

Order	Content	Bytes	Description
0	0x55	1 Byte	The first byte at the beginning of the command
1	0xAA	1 Byte	The second byte at the beginning of the command
2	Fingerprint Module ID	2 Bytes	Fingerprint Module ID: fixed at 0x0000
4	Parameter	4 Bytes	Feedback Parameter

Order	Content	Bytes	Description
8	Response	2 Bytes	0x30: Command received correctly; 0x31: Command received error in the first or second byte; 0x32: Fingerprint module ID received error; 0x33: Received Checksum error; The sending order is low byte first, for example: 0x0030, the parameter sending order is: 0x30, 0x00.
10	Checksum	2 Bytes	Check Code (from 0th to 9th) Offset[0]+… +Offset[9]=Checksum. The sending order is low byte first.

• **Data Packet**

Order	Content	Bytes	Description
0	0x5A	1 Byte	The first byte at the beginning of the command
1	0XA5	1 Byte	The second byte at the beginning of the command
2	Fingerprint Module ID	2 Bytes	Fingerprint Module ID: fixed at 0x0000
4	DATA	N Bytes	N bytes of data, the N value will vary depending on the feedback data from different command code
4+N	Checksum	4 Bytes	Check Code (from 0th to (4+N-1)th) Offset[0]+… +Offset[4+N-1]=Checksum

Instruction Summary

The command code in the command packet is shown as follows:

Value	Command Content
0x01	Fingerprint sensor initialisation
0x02	Change baud rate
0x03	Enroll fingerprint
0x04	Stop enrolling
0x05	Delete the specified ID data
0x06	Delete all fingerprints in the database
0x07	Start obtaining fingerprint image
0x08	Stop obtaining fingerprint image
0x09	Obtain fingerprint image
0x0A	Fingerprint detection
0x0B	Stop fingerprint detection
0x0C	Interrupt
0x0D	Obtain module device information
0x0E	Obtain the enrolled fingerprint information
0x0F	User setting
0x10	Fingerprint image setting
0x11	Enter the fingerprint ID to be enrolled
0x12	Obtain partial fingerprint image
0x13	Standby mode
0x14	Obtain module setting information
0x15	Obtain image setting information
0x16	Firmware update

Command Description:

Fingerprint sensor initialisation

• Command Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Parameter	Instruction	Checksum
0x55	0xAA	0x0000	0x00	0x0001	0x0100

• Feedback Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Feedback Parameter	Response Code	Checksum
0x55	0xAA	0x0000	0x00	0x0030	0x012F

Change baud rate

• Command Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Parameter	Instruction	Checksum
0x55	0xAA	0x0000	Baud Rate	0x0002	Sum

• Feedback Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Feedback Parameter	Response Code	Checksum
0x55	0xAA	0x0000	0x00	0x0030	0x012F

Parameter=Baud Rate (9600, 38400, 56000, 57600, 115200, 128000, 230400, 256000, 460800). The baud rate defaults to be 115200, the baud rate will change to the default baud rate when the module is powered on after powered off or woken up again after entering the standby mode.

Enroll fingerprint

• Command Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Parameter	Instruction	Checksum
0x55	0xAA	0x0000	0x00	0x0003	0x0102

• Feedback Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Feedback Parameter	Response Code	Checksum
0x55	0xAA	0x0000	Enrollment Status	0x0030	Sum

Feedback Parameter=Enrollment Status: 0x01: Keep pressing finger; 0x02: Enrollment succeeded; 0x03: Enrollment failed; 0x05: Too many overlapping areas on the finger, try again with other areas of your finger; 0x06: Please move your finger.

Stop enrolling

• Command Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Parameter	Instruction	Checksum
0x55	0xAA	0x0000	0x00	0x0004	0x0103

• Feedback Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Feedback Parameter	Response Code	Checksum
0x55	0xAA	0x0000	0x00	0x0030	0x012F

Delete specified ID

• Command Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Parameter	Instruction	Checksum
0x55	0xAA	0x0000	ID(1~1000)	0x0005	Sum

Parameter=Fingerprint ID to be deleted (1~1000).

• Feedback Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Feedback Parameter	Response Code	Checksum
0x55	0xAA	0x0000	Delete Status	0x0030	Sum

Feedback Parameter=Delete Status. Delete succeeded: 0x01; Delete failed: 0x02; The ID to be deleted does not exist: 0x03.

Delete all fingerprints in the database

• Command Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Parameter	Instruction	Checksum
0x55	0xAA	0x0000	0x00	0x0006	0x0105

• Feedback Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Feedback Parameter	Response Code	Checksum
0x55	0xAA	0x0000	Delete Status	0x0030	Sum

Feedback Parameter= Delete Status. Delete succeeded: 0x01; Delete failed: 0x02.

Start obtaining fingerprint image

• Command Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Parameter	Instruction	Checksum
0x55	0xAA	0x0000	0x00	0x0007	0x0106

• Feedback Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Feedback Parameter	Response Code	Checksum
0x55	0xAA	0x0000	0x00	0x0030	0x012F

Stop obtaining fingerprint image

• Command Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Parameter	Instruction	Checksum
0x55	0xAA	0x0000	0x00	0x0008	0x0107

• Feedback Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Feedback Parameter	Response Code	Checksum
0x55	0xAA	0x0000	0x00	0x0030	0x012F

Obtain fingerprint image

• Command Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Parameter	Instruction	Checksum
0x55	0xAA	0x0000	0x00	0x0009	0x0108

• Feedback Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Feedback Parameter	Response Code	Checksum
0x55	0xAA	0x0000	0x00	0x0030	0x012F

• Data Packet

1 byte	1 byte	2 bytes	Width*height bytes	2 bytes
Identifier 1	Identifier 2	ID	Data Parameter	Checksum
0x5A	0XA5	0x0000	Image Pixel Matrix	Sum

Data Parameter=Image Pixel Matrix; The data size is image width×heigth in bytes, corresponding to 192×256.

Fingerprint detection

• Command Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Parameter	Instruction	Checksum
0x55	0xAA	0x0000	0x00	0x000A	0x0109

• Feedback Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Feedback Parameter	Response Code	Checksum
0x55	0xAA	0x0000	Detection Result	0x0030	Sum

Feedback Parameter=Fingerprint Detection Result; When the detection has succeeded, the parameter is the corresponding ID number, when the detection has failed, it is 0xFFFF.

Stop fingerprint detection

• Command Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Parameter	Instruction	Checksum
0x55	0xAA	0x0000	0x00	0x000B	0x010A

• Feedback Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Feedback Parameter	Response Code	Checksum
0x55	0xAA	0x0000	0x00	0x0030	0x012F

Interrupt

• Command Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Parameter	Instruction	Checksum
0x55	0xAA	0x0000	0x00	0x000C	0x010B

• Feedback Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Feedback Parameter	Response Code	Checksum
0x55	0xAA	0x0000	0x00	0x0030	0x012F

Obtain module device information

• Command Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Parameter	Instruction	Checksum
0x55	0xAA	0x0000	0x00	0x000D	0x010C

• Feedback Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Feedback Parameter	Response Code	Checksum
0x55	0xAA	0x0000	0x00	0x0030	0x012F

• **Data Packet**

1 byte	1 byte	2 bytes	8 bytes	4 bytes
Identifier 1	Identifier 2	ID	Data Parameter	Checksum
0x5A	0XA5	0x0000	Module Information	Sum

Data Parameter=Module Information; The correctly received data is 0x27, 0x57, 0x00, 0x00, 0xC0, 0x00, 0x00, 0x01; The first four decimal data is 22311, corresponding to the module BM92S2231-1, the last 4 bytes correspond to the module width and height: 192×256.

Obtain the enrolled fingerprint information

• **Command Packet**

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Parameter	Instruction	Checksum
0x55	0xAA	0x0000	0x00	0x000E	0x010D

• **Feedback Packet**

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Feedback Parameter	Response Code	Checksum
0x55	0xAA	0x0000	User Total Number	0x0030	Sum

Feedback Parameter=User Total Number; Number of stored fingerprints.

• **Data Packet**

1 byte	1 byte	2 bytes	N bytes	4 bytes
Identifier 1	Identifier 2	ID	Data Parameter	Checksum
0x55	0xAA	0x0000	User ID	Sum

Data Parameter=All User ID; Stored Fingerprint ID, an ID consists of two bytes, low byte first, the ID ranges from 1 to 1000.

User setting

• **Command Packet**

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Parameter	Instruction	Checksum
0x55	0xAA	0x0000	Setting Parameters	0x000F	Sum

Parameter=Setting Parameters;

Setting Parameters:

Fractional Threshold (2 bytes, low byte first, ranges from 0~100), Detection Angle (1 byte, values: 0, 1, 3, 4), Template Number (1 byte, ranges from 1~3); Default configuration: Fractional Threshold 95, Detection Angle 4, Template Number 3.

Detection Angle:

0x00: Full directions detection method 1, 360 degrees pressing can be recognised;

0x01: Single direction detection, the pressing direction can be recognized within the range of -45 degrees to 45 degrees in the enrolled fingerprint direction;

0x03: Three directions detection, the pressing direction can be recognized within the range of -135 degrees to 135 degrees in the enrolled fingerprint direction;

0x04: Full directions detection method 2, 360 degrees pressing can be recognised;

The difference between the full directions detection method 1 and full directions detection method 2 is that the recognition speed of method 1 is faster than that of method 2, but its recognition reject rate is slightly higher than that of method 2;

Template Number 2:

Fractional Threshold 82, FAR≤0.01%, FRR≤3%;

Fractional Threshold 92, FAR≤0.001%, FRR≤5%;

Template Number 3:

Fractional Threshold 84, FAR≤0.01%, FRR≤2%;

Fractional Threshold 95, FAR≤0.001%, FRR≤3%.

• Feedback Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Feedback Parameter	Response Code	Checksum
0x55	0xAA	0x0000	0x00	0x0030	0x012F

Fingerprint image setting

• Command Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Parameter	Instruction	Checksum
0x55	0xAA	0x0000	Set Parameter	0x0010	Sum

Set Parameter: Image Threshold (2 bytes, low byte first, ranges from 50~1000), Image Percentage (2 bytes, low byte first, ranges from 0~100); Default configuration: Image Threshold 128, Image Percentage 60.

• Feedback Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Feedback Parameter	Response Code	Checksum
0x55	0xAA	0x0000	0x00	0x0030	0x012F

Enter the fingerprint ID to be enrolled

• Command Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Parameter	Instruction	Checksum
0x55	0xAA	0x0000	Fingerprint ID	0x0011	Sum

Fingerprint ID: Ranges from 1~500, low byte first.

• Feedback Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Feedback Parameter	Response Code	Checksum
0x55	0xAA	0x0000	Fingerprint ID Decision	0x0030	Sum

Feedback Parameter=Fingerprint ID Decision; 0x08: The fingerprint ID is out of range; 0x04: The fingerprint ID has been enrolled; 0x00: The fingerprint ID is within range and not enrolled.

Obtain partial fingerprint image

• Command Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Parameter	Instruction	Checksum
0x55	0xAA	0x0000	1/4 Image Range	0x0012	Sum

This instruction is only valid after a fingerprint is enrolled or detected, and the obtained image data will then be selected on the 1/4 of the original image.

Selection Range: Image width start coordinate (1 byte, less then 192/2), image width end coordinate (1 byte, less then 192/2), image heigth start coordinate (1 byte, less then 256/2), image heigth end coordinate (1 byte, less then 256/2). For example: Filling in parameter 0x00, 0x28, 0x00, 0x28 represents on the basis of the 1/4 image of 96×128, with the image top left corner as the origin, select an image range with width of 0 to 40 and heigth of 0 to 40.

• Data Packet

1 byte	1 byte	2 bytes	N bytes	4 bytes
Identifier 1	Identifier 2	ID	Data Parameter	Checksum
0x55	0xAA	0x0000	Image Pixel Matrix	Sum

Data Parameter=Image Pixel Matrix: The size of N is determined by the image selection range in the command packet.

Standby mode

• Command Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Parameter	Instruction	Checksum
0x55	0xAA	0x0000	0x00	0x0013	0x0112

• Feedback Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
0x55	0xAA	0x0000	0x00	0x0030	0x012F

After the command is sent and feedback is received, the module will enter the standby mode, which can be woken up by touching the module. After wake-up, the module communication baud rate will return to 115200. If other baud rates are required, they can be configured by instructions.

Obtain module setting information

• Command Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Parameter	Instruction	Checksum
0x55	0xAA	0x0000	0x00	0x0014	0x0113

• Feedback Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Feedback Parameter	Response Code	Checksum
0x55	0xAA	0x0000	Setting Information	0x0030	Sum

Feedback Parameter=Setting Information: Fractional (2 bytes, low byte first): ranges from 0~100.

Detection angle (1 byte): 0: Full directions detection method 1; 1: Single direction detection; 3: Three directions detection; 4: Full directions detection method 2.

Template Number (1 byte): Number of templates stored for each fingerprint, ranges from 1~3.

Obtain image setting information

• Command Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Parameter	Instruction	Checksum
0x55	0xAA	0x0000	0x00	0x0015	0x0114

• Feedback Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Feedback Parameter	Response Code	Checksum
0x55	0xAA	0x0000	Set Parameters	0x0030	Sum

Feedback Parameter=Setting Parameters: Image threshold (2 bytes, low byte first), Image percentage (2 bytes, low byte first).

Firmware update

• Command Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Parameter	Instruction	Checksum
0x55	0xAA	0x0000	0x00	0x0016	0x0115

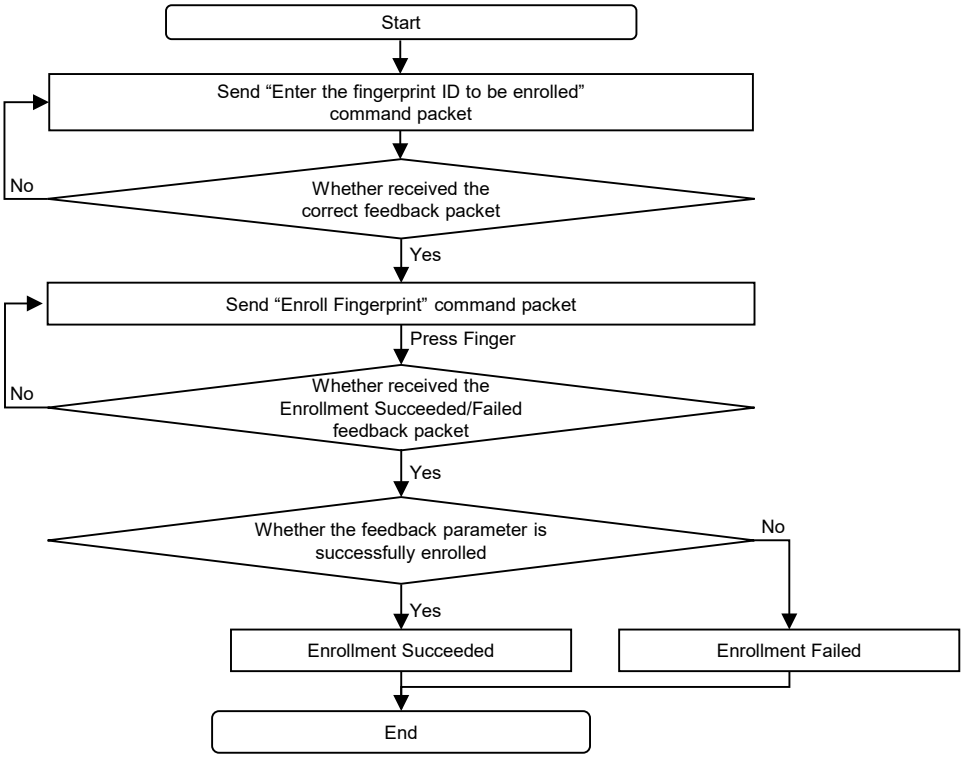
• Feedback Packet

1 byte	1 byte	2 bytes	4 bytes	2 bytes	2 bytes
Identifier 1	Identifier 2	ID	Feedback Parameter	Response Code	Checksum
0x55	0xAA	0x0000	0x00	0x0030	0x012F

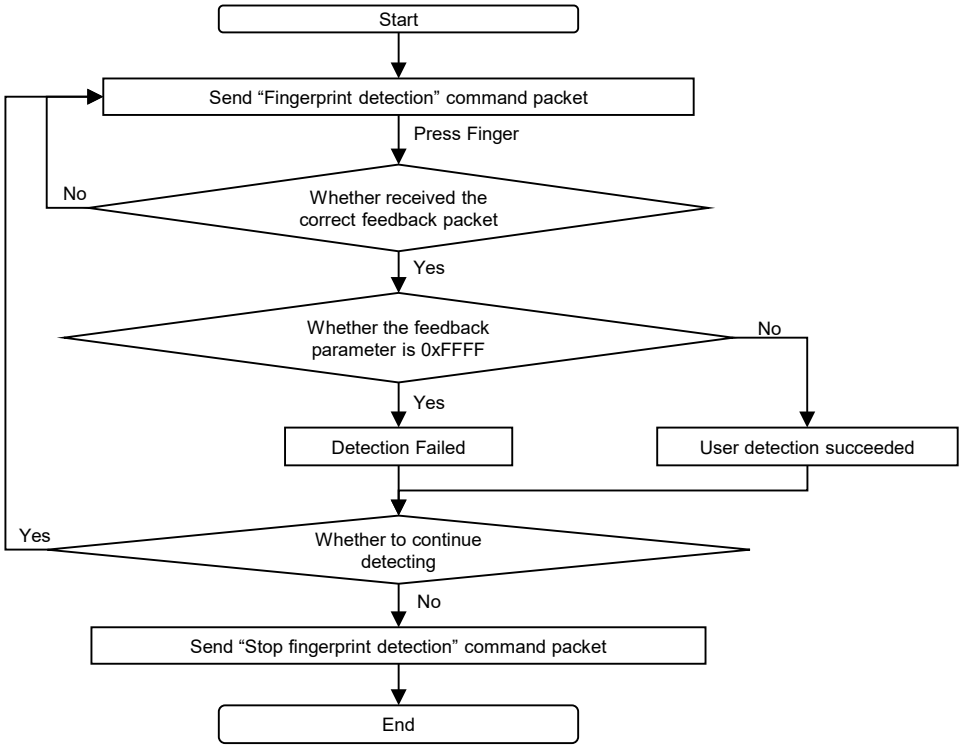
After the module correctly receives the update firmware command, it requires to turn on the update software to update the module program. If it is not updated, it requires to power on again.

Process Description

Enroll fingerprint:

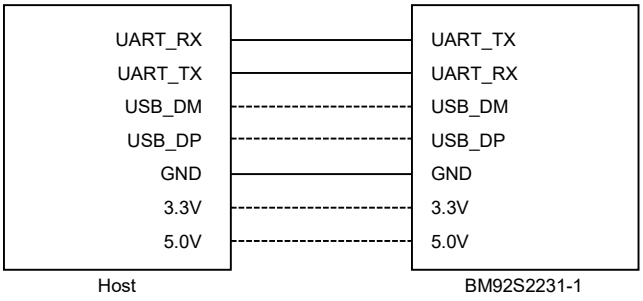


Fingerprint detection:

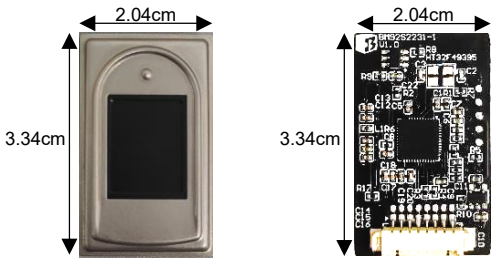


Application Circuits

UART Mode



Dimensions



Reference Information

Modification History

Data	Author	Issue	Modification Information
2023/9/26	黄素贞		First Version

Buy Online

Best Modules