Fingerprint Module User's Guide

BM92S2222-A

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General Description

The BM92S2222-A is a fingerprint recognition module, which includes an integrated microcontroller as the master MCU. The device integrates a capacitive fingerprint recognition sensor and supports USART 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.

Communication Protocol: Packet Content

(DWORD WORD Little-Endian Data)

• Command Packet

Order	Content	Bits	Description
0	0x55	BYTE	The first byte of the command beginning
1	0xAA	BYTE	The second byte of the command beginning
2	Fingerprint Module ID	WORD	Fingerprint module ID is fixed at 0x0001, so the filling order is 0x01 first then 0x00
4	Parameter	DWORD	Input parameter
8	Command	WORD	Command code
10	Check Sum	WORD	Checksum code (add from the 0th to the 9th) Offset[0]+…+Offset[9] = Checksum

• Acknowledge Packet

Order	Content	Bits	Description
0	0x55	BYTE	The first byte of the acknowledge beginning
1	0xAA	BYTE	The second byte of the acknowledge beginning
2	Fingerprint module ID	WORD	Fingerprint module ID: fixed at 0x0001, so the filling order is 0x01, 0x00
4	Parameter	DWORD	Response = 0x30: (ACK) output parameter Response = 0x31: (NACK) error code
8	Response	WORD	0x30 : Acknowledge (ACK) 0x32 : Non-acknowledge(NACK)
10	Check Sum	WORD	Check code (add from the 0th to the 9th) Offset[0]+..+Offset[9] = Checksum

• Data Packet

Order	Content	Bits	Description
0	0x5A	BYTE	The first byte of the data beginning
1	0xA5	BYTE	The second byte of the data beginning
2	Fingerprint module ID	WORD	Fingerprint module ID: fixed at 0x0001, so the filling order is 0x01, 0x00
4	DATA	N BYTES	N bytes of data The N value is different according to the acknowledge data of the command code
4+N	Check Sum	WORD	Check code (add from the 0th to the (4+N-1)th) Offset[0]+…+Offset[4+N-1] = Checksum

Communication Protocol: Command Summary

The command code in the command packet is as follows:

Value	Name	Description
0x01	Open	Initialization
0x02	Close	Interrupt
0x04	ChangeBaudrate	Change Baud Rate
0x20	GetEnrollCount	Get the enrolled fingerprint counts
0x21	CheckEnrolled	Check whether the specific ID is enrolled or not
0x22	EnrollStart	Start enrolling
0x23	Enroll1	Enroll for the first time
0x24	Enroll2	Enroll for the second time
0x25	Enroll3	Enroll for the third time, and the contents of the three enrollments will be composed as a group of fingerprint feature and stored into the database
0x26	IsPressFinger	Confirm whether the finger is pressed
0x40	DeleteID	Delete the data with specific ID
0x41	DeleteAll	Delete all database fingerprints
0x50	Verify	Enter the pressed fingerprint and make a one-to-one comparison with the specific ID
0x51	Identify	Enter the pressed fingerprint and make a one-to-many comparison with the database
0x60	CaptureFinger	Capture the fingerprint image from the collection head
0x62	GetImage	Download the captured fingerprint image

Communication Interface: Error Code

When the acknowledge packet has a non-acknowledge, the error code for the parameter is as follows.

NACK Parameter Name	Value	Description
NACK_TIMEOUT	0x1001	Reserved
NACK_INVALID_BAUDRATE	0x1002	Reserved
NACK_INVALID_POS	0x1003	The specific ID is not in the range of 0 to 99
NACK_IS_NOT_USED	0x1004	The specific ID is not in used
NACK_IS_ALREADY_USED	0x1005	The specific ID has been in used
NACK_COMM_ERR	0x1006	Communication error
NACK_VERIFY_FAILED	0x1007	One-to-one comparison is failed
NACK_IDENTIFY_FAILED	0x1008	One-to-many comparison is failed
NACK_DB_IS_FULL	0x1009	Database is full
NACK_DB_IS_EMPTY	0x100A	Database is empty
NACK_TURN_ERR	0x100B	Reserved
NACK_BAD_FINGER	0x100C	Bad fingerprint image
NACK_ENROLL_FAILED	0x100D	Enrollment is failed
NACK_IS_NOT_SUPPORTED	0x100E	The specific command is not supported
NACK_DEV_ERR	0x100F	Reserved
NACK_CAPTURE_CANCELED	0x1010	Reserved
NACK_INVALID_PARAM	0x1011	Invalid parameters
NACK_FINGER_IS_NOT_PRESSED	0x1012	Finger is not pressed
NACK_ENROLL_NOT_ENOUGH	0x1013	Fingerprint area is not enough
NACK_BUSY	0x1014	Device busy
NACK_CMD_ERROR	0x1015	Command error
DuplicatedID	0~99	Database has duplicated fingerprints

Communication Interface: Command Description

Initialization (Open)

Control Terminal

- **Command Packet**

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Command	Checksum
0x55	0xAA	0x0001	0x01	0x01	0x102

Parameter = 0, don't need to get product information, cleared to "0".

Parameter = non-0, get the product information

- **Acknowledge Packet**

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Response Code	Checksum
0x55	0xAA	0x0001	0x01	0x30	0x131

Response Code= 0x30 Acknowledgement

- **Data Packet**

Product Information

1 Byte	1 Byte	2 Bytes	N Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Data	Checksum
0x5A	0xA5	0x0001	devinfo	0x101

```
DATA =
Typedef struct _definfo
{
    DWORD FirwareVersion;
    WORD  Width;
    WORD  Height;
    BYTE  SerialNumber[16];
}devinfo;
```

Commands are executed for module initialization, especially for getting product information.

Devinfo Structure Description

Field	Sample	Description
FirmwareVersion	20120225	Firmware version
Width	160	Sensor sampling width
Height	160	Sensor sampling height
SerialNumber	4653574557494E2D32-30313430333033	The unique serial number of fingerprint module

If the serial number of the fingerprint module is zero, the stability of the module is not guaranteed.

Interrupt (Close)

• Command Packet

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Command	Checksum
0x55	0xAA	0x0001	0x00	0x02	0x102

• Acknowledge Packet

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Response code	Checksum
0x55	0xAA	0x0001	0x02	0x30	0x132

Change Baud Rate (ChangeBaudrate)

• Command Packet

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Command	Checksum
0x55	0xAA	0x0001	9600	0x04	Sum

Parameter = Baud Rate (9600 ~ 115200)

• Acknowledge Packet

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Response code	Checksum
0x55	0xAA	0x0001	0x04	0x30	0x134

Response code = 0x31

Parameter = 0x1011 NACK_INVALID_PARAM

This command should be executed during the module operation. When the power is powered on again, the system will automatically return to the Baud Rate of 57600.

Get the enrolled fingerprint count (GetEnrollCount)

• Command Packet

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Command	Checksum
0x55	0xAA	0x0001	0x00	0x20	0x120

• Acknowledge Packet

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Response code	Checksum
0x55	0xAA	0x0001	xxxx	0x30	Sum

Parameter = the enrolled fingerprint count

Check whether the specific ID is enrolled or not (CheckEnrolled)

• Command Packet

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Command	Checksum
0x55	0xAA	0x0001	ID (0~99)	0x21	Sum

• Acknowledge Packet

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Response code	Checksum
0x55	0xAA	0x0001	0x21	0x30	Sum

Response code = 0x30 This ID has been enrolled.

Response code = 0x31

Parameter = 0x1003 NACK_INVALID_POS

Parameter = 0x1004 NACK_IS_NOT_USED

Start enrollment (EnrollStart)

• Command Packet

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Command	Checksum
0x55	0xAA	0x0001	xxxx	0x22	Sum

Parameter = ID (0~99)

If ID = -1, it means that the enrolled fingerprint was not stored in the database.

• Acknowledge Packet

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Response code	Checksum
0x55	0xAA	0x0001	0x22	0x30	Sum

Response code = 0x30 OK

Response code = 0x31

Parameter = 0x1009 NACK_DB_IS_FULL

Parameter = 0x1003 NACK_INVALID_POS

Parameter = 0x1005 NACK_IS_ALREADY_USED

Enroll for the first time (Enroll1)

• Command Packet

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Command	Checksum
0x55	0XAA	0x0001	0	0x23	0x123

• **Acknowledge Packet**

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Response code	Checksum
0x55	0xAA	0x0001	0x23	0x30	Sum

Response code = 0x30 ACK

Response code = 0x31 NACK

Parameter = 0x100D NACK_ENROLL_FAILED

Parameter = 0x100C NACK_BAD_FINGER

Parameter = 0x1005 NACK_IS_ALREADY_USED

Enroll for the second time (Enroll2)

• **Command Packet**

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Command	Checksum
0x55	0xAA	0x0001	0	0x24	0x124

• **Acknowledge Packet**

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Response code	Checksum
0x55	0xAA	0x0001	0x24	0x30	Sum

Response code = 0x30 ACK

Response code = 0x31 NACK

Parameter = 0x100D NACK_ENROLL_FAILED

Parameter = 0x100C NACK_BAD_FINGER

Parameter = 0x1005 NACK_IS_ALREADY_USED

Enroll for the third time (Enroll3)

• **Command Packet**

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Command	Checksum
0x55	0xAA	0x0001	0	0x25	0x125

• **Acknowledge Packet**

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Response code	Checksum
0x55	0xAA	0x0001	0x25	0x30	Sum

Response code = 0x30 ACK

Response code = 0x31 NACK

Parameter = 0x100D NACK_ENROLL_FAILED

Parameter = 0x100C NACK_BAD_FINGER

Parameter = 0x1005 NACK_IS_ALREADY_USED

• **Data Packet**

1 Byte	1 Byte	2 Bytes	N bytes	2 bytes
Identifier 1	Identifier 2	ID	Data	Checksum
0x5A	0xA5	0x0001	Enrollment feature	Sum

Confirm whether the fingerprint is pressed (IsPressFinger)

• **Command Packet**

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Command	Checksum
0x55	0xAA	0x0001	0	0x26	0x126

• **Acknowledge Packet**

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Response code	Checksum
0x55	0xAA	0x0001	0x26	0x30	0x156

Response code = 0x30 has a fingerprint

Response code = 0x31 no fingerprint

This command is used during enrolling. The control terminal needs to confirm whether the fingerprint is released during each time enrolling.

Delete the data with specific ID (DeleteID)

• **Command Packet**

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Command	Checksum
0x55	0xAA	0x0001	ID (0~99)	0x40	Sum

• **Acknowledge Packet**

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Response code	Checksum
0x55	0xAA	0x0001	0x40	0x30	0x170

Response code = 0x30 ACK

Response code = 0x31 NACK

Parameter = 0x1003 NACK_INVALID_POS

Delete all fingerprints (DeleteAll)

• **Command Packet**

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Command	Checksum
0x55	0xAA	0x0001	0	0x41	0x141

• **Acknowledge Packet**

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Response code	Checksum
0x55	0xAA	0x0001	0x41	0x30	0x171

Response code = 0x30 ACK

Response code = 0x31 NACK

Parameter = 0x100A NACK_DB_IS_EMPTY

One-to-one comparison (Verify)

- **Command Packet**

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Command	Checksum
0x55	0xAA	0x0001	ID (0~99)	0x50	Sum

- **Acknowledge Packet**

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Response code	Checksum
0x55	0xAA	0x0001	0x50	0x30	0x130

Response code = 0x30 ACK
Response code = 0x31 NACK
Parameter = 0x1003 NACK_INVALID_POS
Parameter = 0x1004 NACK_IS_NOT_USED
Parameter = 0x1007 NACK_VERIFY_FAILED

One-to-many comparison (Identify)

- **Command Packet**

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Command	Checksum
0x55	0xAA	0x0001	0	0x51	0x151

- **Acknowledge Packet**

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Response code	Checksum
0x55	0xAA	0x0001	0x51	0x30	Sum

Response code = 0x30 ACK
Parameter = ID(0~99) The correct ID location
Response code = 0x31 NACK
Parameter = 0x100A NACK_DB_IS_EMPTY
Parameter = 0x1008 NACK_IDENTIFY_FAILED

Capture the fingerprint image (CaptureFinger)

- **Command Packet**

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Command	Checksum
0x55	0xAA	0x0001	0	0x60	Sum

- **Acknowledge Packet**

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Response code	Checksum
0x55	0xAA	0x0001	0x60	0x30	Sum

Response code = 0x30 ACK
Response code = 0x31 NACK
Parameter = 0x1012 NACK_FINGER_IS_NOT_PRESSED

Get the fingerprint image (GetImage)

• **Command Packet**

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Command	Checksum
0x55	0xAA	0x0001	0	0x62	0x162

• **Acknowledge Packet**

1 Byte	1 Byte	2 Bytes	4 Bytes	2 Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Parameter	Response code	Checksum
0x55	0xAA	0x0001	0x62	0x30	Sum

• **Data Packet**

Data = (Sensor pixel/4), except for special sizes

1 Byte	1 Byte	2 Bytes	N Bytes	2 Bytes
Identifier 1	Identifier 2	ID	Data	Checksum
0x5A	0xA5	0x0001	Image points	Sum

Judge the sensor pixels to determine the image size.

Communication Interface: Procedure and Description

Get the fingerprint image

IsPressFinger Confirm whether the fingerprint is pressed on the collection head. This command should be used during enrolling.

CapureFinger Capture the fingerprint image. If the finger is not on the collection head, this will return an error code.

GetRawImage Get the raw image. This command is only used to implement capture function and can not judge whether the finger is pressed.

One-to-one comparison and one-to-many comparison

Identify and IdentifyTemplate are used to execute one-to-many comparison.

Verify and VerifyTemplate are used to execute one-to-one comparison.

Before executing "Identify" and "Verify" commands, the control terminal must firstly execute the "CaptureFinger" command.

The procedure is as follows:

1. CaptureFinger
2. Identify/Verify

Enroll

Enrollment procedure is as follows, first select the upper computer language, which can be Chinese or English. Click the open button, and then select the enrollment threshold value, verification threshold value, verification score, which can be set to three levels of high, medium and low according to different requirements. After which, follow the below steps to enroll.

1. EnrollStart with a (not used) ID
2. CaptureFinger

3. Enroll1
4. Execute IsPressFinger to wait finger to move away
5. CaptureFinger
6. Enroll2
7. Execute IsPressFinger to wait finger to move away
8. CaptureFinger
9. Enroll3

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