UniFinger SFM Series

Packet Protocol Manual

Version 3.1.2

CONTENTS

Revision Notes

V3.1.1   2017-05-02

Protocol interface value was miss-matched – fixed.

V.3.1.0   2017-04-10

Some typos are fixed.

V.3.0.0   2016-12-01

The protocol of SFM6000 series is incorporated.

V.2.9.1   2014-06-18

The protocol of SFM5500 series is incorporated.

Wavelet Scalar Quantization (WSQ) compression is added in RIX command (only available in SFM5500 series).

V.2.9   2013-1-04

The new quality measurement algorithm is added. Detailed description is presented in the page of "Image Quality" parameter.

Since firmware V2.0, OC and TC sensor module also support "Check latent fingerprint" function.

V.2.8.5 2012-7-02   The Appendix D is deleted.

The sensor type information is modified.

Discontinued sensors are deleted and sensor name is modified.

Added comments that the duress finger option is only available with SFM3500 series

Deleted texts related to discontinued products (SFM1000/2000 series)

Added comments which indicate that the commands supported by the Extended Data Transfer Protocol (e.g., ETX, RTX, …) are more

recommended than normal commands (e.g., ET, RT, …)

V2.8.4 2011-6-02   The protocol for SFM 5060 is incorporated.

V2.8.3 2011-5-02   The protocol for SFM 5000 series is incorporated.

All the features of SFM5000 series are compatible with SFM3000 series.

V2.8.2 2010-8-28   ANSI 378 standard format is added in Template Type system parameter.

V2.8.1 2009-4-13   The protocol for SFM 4000 series is incorporated.

Check Latent Fingerprint system parameter is added.

Voltage Warning and PowerOff Timeout parameters are added for

SFM4000 series.

OFF command is added for SFM4000 series.

Appendix A-1. SFM4000 GPIO Configuration is added.

V2.8   2008-5-22   Enhanced Privacy system parameter is added.

Fake Finger Detection system parameter is added.

V2.7   2006-11-13   Template Type system parameter is added to support the standard

template format defined in ISO 19794-2.

UW, UR, UC, UL command added for SFM3500 series.

WME, RME, CME command added for SFM3500 series.

ABL, DBL, RBL, CBL command added for SFM3500 series.

ENTRANCE_LIMIT, REJECTED_ID error code added.

AUTOMATIC fast mode added.

V2.6   2006-03-23   LC command added.

CCL, RCL command added.

WSL, RSL command added. The minimum security level is lowered to

1/1,000 for 1:1 matching.

AUTOMATIC NORMAL, AUTOMATIC SECURE,

AUTOMATIC MORE SECURE security level added.

V2.5   2005-11-15   ETX, RTX command added.

ADD_CHECKSUM option is added to ST command.

DELETE_ONLY_ONE and DELETE_MULTIPLE_ID options are added

to DT command.

RS command added.

System Started output event added.

Watchdog system parameter added.

The default value of Lighting Condition parameter is changed to Outdoor.

The default value of Free Scan Delay parameter is changed to 1 second.

LM, UM, MP command added.

LOCKED error code added.

Appendix D. Packet Protocol for BioEntry™ added.

V2.4   2005-07-11   Broadcast Packet Protocol is changed from 13 bytes to 15 bytes.

In network mode, the modules only respond to 15 byte network packets.

Lighting Condition system parameter added.

Fast Mode system parameter added

ADD_DURESS flag added.

DURESS_FINGER error code added.

Tamper Switch In input function added.

Verify Duress Finger, Identify Duress Finger output event added.

Tamper Switch On, Tamper Switch Off output event added.

UG command added.

LTX command added.

WWX, WRX, WGX, WSX, WFW, WFR, WPW, WPR command added.

V2.3.1　2005-06-01　Free Scan Delay system parameter added.

V2.3　　2005-04-29　Broadcast Packet Protocol added.

ID command added.

CHECK_FINGER and CHECK_FINGER_AUTO_ID flag added.

EXIST_FINGER error code added.

Block index and block size parameters are added to LT command.

Minimum security level is changed to 1/10,000.

Each of system parameter is described in its own sub section.

V2.2.1　2005-02-14　Description of Template Size system parameter added.

V2.2　　2005-01-18　Template Size system parameter added.

Rotation system parameter added.

Enroll commands(ES, EW, ESA, EWA, EI) return image quality score

V2.1　　2004-12-6　BUSY, CANCELED, DATA_ERROR, DATA_OK error code added.

BUSY status code added.

CA command added.

WM, WL, WC command added.

AW, AR, AC command added.

ESA, EWA, DSA, DWA, DAA command added.

Extended Data Transfer Protocol added.

EIX, IIX, VIX, SIX, RIX command added.

(*The changes in V2.1 are only applicable to the SFM3500 series.)

V2.0   2004-11-11   DS command added.

EW, VW, DW command added.

ML, MW, MR command added.

TW, TR, LN, LR, LD command added.

WW, WR, WG, WS command added.

IW, IR, IG command added.

OW, OR, OL, OS command added.

Baudrate2 system parameter added.

NetworkMode system parameter has full duplex mode.

AutoResponse system parameter has auxiliary port.

(*The changes in V2.0 are only applicable to the SFM3500 series.)

V1.9   2004-09-25   CS command added.

EnrollMode system parameter has 2 templates & 2 templates II.

SecurityLevel system parameter has additional levels.

Baudrate system parameter has additional baudrates.

(*The changes in V1.9 are only applicable to the SFM3000/3500 series.)

V1.8   2004-07-02   CHECK_ID flag code for ES, EI, ET command is added.

EnrollDisplacement system parameter is added.

ImageFormat system parameter has 4-bit gray image value.

Number of fingerprints which can be enrolled in the same ID is changed from 2 to 10.

V1.7   2004-05-06   BuildNumber system parameter added.

ImageQuality system parameter has strongest qualification value.

V1.6   2004-04-08   IS, II, IT command support timeout for matching.

MatchingTimeout system parameter added.

TIMEOUT_MATCH error code added.

VH command supports multiple templates.

V1.5   2004-01-15   Network protocol supported.

GPIO configuration (GR, GW, GC, GD command) supported.

SI, FP, DP, KW, KS command added.

ASCIIPacket, RotateImage, Sensitivity, ImageQuality, AutoResponse, NetworkMode, FreeScan, ProvisionalEnroll, PassWhenEmpty, ResponseDelay system parameter added.

IS, II, IT command support group identification.

EI(EP), VI(VP), II(IP), RI(RP), ST(RS) command name changed.

V1.4   2003-03-24   SendScanSuccess system parameter added.

V1.3   2003-02-25   CT, RS command added.

ES, ET, EP command support auto ID.

V1.2   2003-01-14   Minor typo corrected.

V1.1   2002-11-09   VH command added.

V1.0   2002-07-08   Created.

Packet Protocol

In the packet protocol of UniFinger, 1 packet is 13 bytes long and its structure is as follows

Start code	Command	Param	Size	Flag/Error	Checksum	End code
1byte	1byte	4bytes	4bytes	1byte	1byte	1byte

1. Start code: 1 byte. Indicates the beginning of a packet. It always should be 0x40.

2. Command: 1 byte. Refer to the "Command Summary" on page 66.

3. Param: 4 bytes. Indicates user ID or system parameters.

4. Size: 4 bytes. Indicates the size of binary data following the command packet such as fingerprint templates or images.

5. Flag/Error: 1 byte. Indicates flag data in the request command sent to the module, and error code in the response command received from the module, respectively.

6. Checksum: 1 byte. Checks the validity of a packet. Checksum is a remainder of the sum of each field, from the Start code to Flag/Error, divided by 256 (0x100).

7. End code: 1 byte. Indicates the end of a packet. It always should be 0x0A. It is also used as a code indicating the end of a binary data such as fingerprint templates.

- The packet transmitted between the host and the module has the same structures. The commands transmitting from the host to the module are called "request command," and the response transmitting from the module to the hosts, "response command."

- In general, the host receives one response command for one request command. However, it may receive two response commands for some commands such as Enroll by Scan. The first command comes in the intermediate stage, notifying image scanning completed and the other

command notifies process result. If you do not want to receive the intermediate command, you can disable it by changing a system parameter.

- The fingerprint templates vary in size by sensor and firmware version.

- In the following document, # indicates numbers and the number of # specifies the number of digits. N/A indicates that any value can be applied to the field and Null indicates 0x00.

- In the transmission of actual data, the byte order is little endian, the lowest byte is transmitted first. For instance, when transmitting data of 400 (0x190) in the Size field, which is 4 bytes long, the data transmission order is as follows: 0x90, 0x01, 0x00, 0x00. The rule also holds for the data received from the module.

- Take ES command (0x05) as an example, the following is the data transmission order and computation of the checksum of the command:

Start	Command	Param	Size	Flag/Error	Checksum	End
0x40	0x05	0x9929	0x00	0x00	0x07	0x0A

Actual values input in the Param:

1st place	2nd place	3rd place	4th place
0x29	0x99	0x00	0x00

Byte transmission order:

0x40, 0x05,   0x29, 0x99, 0x00, 0x00,   0x00, 0x00, 0x00, 0x00,   0x00, 0x07, 0x0A

To compute the checksum, first compute the sum of each byte of the packet (from start code to flag/error) as demonstrated below:

0x40+0x05+0x29+0x99+0x00+0x00+0x00+0x00+0x00+0x00 = 0x107

Divide the above value by 0x100(256). The remainder of this division is 0x07 and this value is the checksum.

Network Packet Protocol

In order to support RS422 or RS485 network interfaces, UniFinger modules support network packet protocols. Network packet is composed of 15 bytes, whose start code is different from the standard packet, and includes 2 bytes for terminal ID. The terminal ID is correspondent to the lower 2 bytes of Module ID of system parameter.

Field	Start code	Terminal ID	Command	Param	Size	Flag / Error	Checksum	End code
Bytes	1	2	1	4	4	1	1	1
Value	0x41	1 ~ 0xFFFF	Same as standard protocol				Checksum of 13 bytes	0x0A

The contents of the network packet, including command, param, size, and flag are same as those of standard packet. Checksum field is the checksum value of preceding 13 bytes.

Until firmware V1.3, SFM3000/3500 modules respond both standard and network packets regardless of Network Mode system parameter. However, since firmware V1.4, the modules only respond to 15 byte network packets if Network Mode system parameter is on. See Network Mode system parameter for details.

Broadcast Packet Protocol

In RS422 or RS485 network environments, a host can send broadcast packets to all the modules in the network. The only difference between network packets and broadcast packets is that the Terminal ID field of the latter should be 0x00.

Field	Start code	Terminal ID	Command	Param	Size	Flag / Error	Checksum	End code
Bytes	1	2	1	4	4	1	1	1
Value	0x41	0x00	Same as network protocol					

All the modules in the network process the broadcast packet, but do not send response packet to prevent packet collisions. Therefore, if the host wants to confirm that the broadcast request is handled correctly, it should send another request packet to each module using Network Packet Protocol. There is only one exception to this rule. See ID command for details.

Broadcast Packet Protocol is provided for SFM3000/3500/4000/5000/5500/6020/6030/6050 series only. The 13 byte broadcast packet protocol introduced in V1.3 firmware is not supported any longer.

Three types of packet protocol can be summarized as follows:

	Start Code	Packet Length	Communication Type	Operation Mode	Response Packet
Standard	0x40	13	Peer-to-peer	Single	O
Network	0x41	15	Peer-to-peer	Network	O
Broadcast	0x41(Terminal ID: 0x00)	15	1 to N	Network	X

System Parameter Summary

Name	Code	Description	Value (* denotes default value)
Timeout	0x62	Timeout period	0x30 : infinite 0x31 : 1 second … *0x3A : 10 seconds … 0x44 : 20 seconds
Template Size[1]	0x64	Template size. When the Encryption Mode is on, it should be a multiple of 32.	Integer between 256 and *384[4]
Enroll Mode	0x65	Enroll mode	0x30 : 1 time 0x31 : 2 times (1 request command & 2 response commands) 0x32 : 2 times II (2 request commands & 2 response commands) *0x41 : 2 templates (1 request command & 2 response commands) [1] 0x42 : 2 templates II (2 request commands & 2 response commands) [1]
Security Level	0x66	Security level	0x30 : 1/10 FAR(False Acceptance Rate) [1][5] 0x31 : 1/100[5] 0x32 : 1/1,000[5] 0x33 : 1/10,000 0x34 : 1/100,000 0x35 : 1/1,000,000 0x36 : 1/10,000,000 [1] 0x37 : 1/100,000,000 [1] 0x40 : 3/100 [1][5] 0x41 : 3/1,000 [1][5]

			0x42 : 3/10,000 [1] [5]
			0x43 : 3/100,000 [1]
			0x44 : 3/1,000,000 [1]
			0x45 : 3/10,000,000 [1]
			0x46 : 3/100,000,000 [1]
			*0x50 : Automatic Normal[1]
			0x51 : Automatic Secure[1]
			0x52 : Automatic More Secure[1]
Encryption Mode	0x67	Encryption mode	*0x30 : Encryption off 0x31 : Encryption on
Sensor Type	0x68	Sensor type	0x31: FC 0x33 : OP / OP2 / OP3 / OP4 / OP5 / OP6 0x34 : TC1 / TC2 / TC1S / TC2S 0x38 : OC2 / OD/ OC4 / OH / OC6 0x39 : OL 0x3C: TS4
Image Format	0x6C	Image format	0x30 : Gray image *0x31 : Binary image 0x32 : 4 bit gray image 0x33 : WSQ image[9]
Module ID	0x6D	Module ID	Integer 0 ~ 65535
Firmware Version	0x6E	Firmware version	4 bytes character
Serial Number	0x6F	Module serial number	Integer (4 bytes)
Baudrate	0x71	Host baudrate setting	0x31 : 9600 bps 0x32 : 19200 bps 0x33 : 38400 bps 0x34 : 57600 bps *0x35 : 115200 bps 0x36 : 230400 bps 0x37 : 460800 bps

			0x38 : 921600 bps
Baudrate2 [2]	0x72	Auxiliary baudrate setting	0x31 : 9600 bps
			0x32 : 19200 bps
			0x33 : 38400 bps
			0x34 : 57600 bps
			*0x35 : 115200 bps
Enrolled Finger	0x73	Current number of fingerprints enrolled	Integer (4 bytes)
Available Finger	0x74	The available number of fingerprints that can be enrolled	Integer (4 bytes)
Send Scan Success	0x75	Enable sending SCAN_SUCCESS response	0x30 : No SCAN_SUCCESS message
			*0x31 : Send SCAN_SUCCESS message
ASCII Packet	0x76	Flag for packet exchange though HEX-ASCII format	*0x30 : Hexadecimal packet
			0x31 : ASCII packet
Rotate Image	0x77	Flag for rotating sensor image in capture	*0x30 : Upright image
			0x31 : Upside down image
Rotation[1]	0x78	Maximum allowable rotation for matching	0x31: 15 degree
			* 0x32: 30 degree
			0x33: 45 degree
			0x34: 60 degree
			0x35: 75 degree
			0x36: 90 degree
Sensitivity	0x80	Parameter for sensor sensitivity	0x30 : Least sensitive
			…
			*0x37 : Most sensitive
Image Quality	0x81	Parameter for qualifying scanned image	0x30 : Weak qualification
			*0x31 : Moderate qualification
			0x32 : Strong qualification
			0x33 : Strongest qualification
Auto Response	0x82	Flag for sending automatic response as the result of GPIO input or FreeScan	*0x30 : No response command
			0x31 : Send response command (host)

			0x32 : Send response command (aux) [2]
			0x33 : Send response command (both) [2]
Network Mode	0x83	Flag for default operation mode	*0x30 : Single mode 0x31 : Network mode (half duplex) 0x32 : Network mode (full duplex) [2]
Free Scan	0x84	Scan always fingerprint images for identification on idle state	*0x30 : Normal mode 0x31 : Free scan mode
Provisional Enroll	0x85	Save enrolled templates at flash memory permanently or not	*0x30 : Permanent enrollment 0x31 : Provisional enrollment
Pass When Empty	0x86	Pass or fail when fingerprint DB is empty	*0x30 : Fail when DB is empty 0x31 : Pass when DB is empty
Response Delay	0x87	Delay for response command	*0x30 : No delay 0x31 : 20 msec … 0x35 : 100 msec … 0x3A : 200 msec
Matching Timeout	0x88	Timeout period for matching in identification	0x30 : infinite 0x31 : 1 second … *0x33: 3 seconds … 0x3A : 10 seconds … 0x44 : 20 seconds
Build Number	0x89	Build number	4bytes character
Enroll Displacement [3]	0x8A	Displacement between two fingerprints for enrollment in case EnrollMode parameter is 2 times or 2 templates	*0x30 : No check 0x31 : Above 1 mm away … 0x35 : Above 5 mm away

			...
			0x3A : Above 10 mm away
Lighting Condition[1]	0x90	Tune optical sensors based on lighting conditions	*0x30: Outdoor 0x31: Indoor
Free Scan Delay[1]	0x91	Delay between consecutive identification processes in Free Scan Mode.	0x30: No delay *0x31: 1 second ... 0x40: 10 seconds
Fast Mode[1]	0x93	Fast mode for 1:N matching	0x30: Normal 0x31: Fast mode 1 ... 0x35: Fast mode 5(Fastest) *0x36: Automatic
Watchdog[1]	0x94	Watchdog timer	0x30: Don't use Watchdog timer *0x31: Use Watchdog timer
Template Type[1]	0x96	Template type	*0x30: Suprema 0x31: ISO 19794-2 0x32: ANSI 378
Enhanced Privacy[1]	0x97	Enhanced privacy mode	*0x30: Enhanced mode off 0x31: Enhanced mode on
Fake Finger Detection[1]	0x98	Fake finger detection option	*0x30: Fake detection off 0x31: Fake detection on (Weak[8]) 0x32: Normal[8] 0x33: Strong[8]
Check Latent Fingerprint[6]	0x9A	Latent fingerprint detection option	*0x30: Don't check latent fingerprints when enrolling 0x31: Don't check latent fingerprints 0x32: Check latent fingerprints always
Voltage Warning[7]	0x9B	Voltage warning threshold	*0: Don't check voltage 1 ~ 12000: Threshold voltage in mV
PowerOff	0x9C	Timeout for automatic power off	*0: No timeout

Timeout[7]			1000~: Timeout in msec
Factory Reset[10]	0xFA	Factory reset system parameter	
DataBase Raw Format[10]	0xFF	Erase userdb partition	

Table 1   System parameter

(1) SFM3000/3500/4000/5000 only
(2) SFM3500 only
(3) SFM3000/3500/4000/5000 only
(4) Reducing template size might affect authentication performance.
(5) Since firmware V1.3, the minimum security level of SFM3000/3500 series is changed to 1/10,000.
(6) SFM3020-OP, SFM3520-OP, SFM4020-OP, SFM5020-OP only
(7) SFM4000 only
(8) SFM5060-OH only
(9) SFM5500 only
(10) SFM60x0 only

Timeout

Timeout period is commanded by user's input; if the users do not scan fingerprints or Wiegand input isn't received during a certain period of time, TIMEOUT error will be returned.

Configuration

Code	Type	Valid Values	Default Value
0x62	Read/Write	0x30 : infinite 0x31 : 1 second … 0x3A : 10 seconds … 0x44 : 20 seconds	0x3A : 10 seconds

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Template Size

Template size can be specified between 256 and 384 bytes. Template size does not change the template capacity of a module and reducing it might affect the authentication performance.

Configuration

Code	Type	Valid Values	Default Value
0x64	Read/Write	Integer between 256 and 384. When the Encryption Mode(0x67) system parameter is on, it should be a multiple of 32.	384

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Enroll Mode

- One Time(0x30): Enrolls a fingerprint template with one scanned image.

- Two Times(0x31 and 0x32): Enrolls a fingerprint template with two scanned images. In this mode, the two fingerprint images are compared to each other. If two images do not match, they are rejected. If they match, the one with better quality will be enrolled. By enhancing the quality of enrolled templates, the authentication performance will be improved compared to the One Time mode. This mode is also classified into two sub modes according to the way in which the second scanning is initiated. In 0x31, the module will start the second scanning automatically. In 0x32, the second scanning will be started after the host sends another request.

- Two Templates(0x41 and 0x42): Enrolls two fingerprint templates. The enrollment process is identical to the Two Times mode. However, instead of selecting one of the two templates, the module will enroll both of them. By enrolling two templates for each user ID, the authentication performance will be improved further than the Two Times mode. This mode is also classified into two sub modes according to the way in which the second scanning is initiated.

See the ES section for examples of each mode.

Users are strongly advised to choose Two Templates mode. Not only does it show the best authentication performance, it is also adaptable to temporal changes of fingerprints. With Two Templates mode, the module will update one of the enrolled templates automatically when the scanned image has better quality. In this way, it can follow up the changes of fingerprints to a degree.

Since firmware V1.8, if only one template is enrolled in Two Template mode, a new template will be added to the ID automatically when authentication succeeds and the new template is above predefined quality. This feature would be helpful when Two Template mode is set after enrolling only one template per finger.

Configuration

Code	Type	Valid Values	Default Value
0x65	Read/Write	0x30 : 1 time 0x31 : 2 times (1 request command & 2 response commands) 0x32 : 2 times II(2 request commands & 2 response commands) 0x41 : 2 templates (1 request command & 2 response commands) 0x42 : 2 templates II (2 request commands & 2 response commands) * 2 template modes(0x41 and 0x42) are only available for SFM3000/3500/4000/5000/5500/6020/6030/6050	2 templates(0x41) is default.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Security Level

Security level specifies FAR(False Acceptance Ratio). If it is set to 0x34(1/100,000), it means that the probability of accepting false fingerprints is 1/100,000. Since FAR and FRR(False Rejection Ration) is in inverse proportion to each other, FRR will increase with higher security levels.

These FAR values are for 1:1 matching. When identification commands are used for 1:N matching, the FAR would become higher. Therefore, we recommend that users set higher security level – lower FAR value – for 1:N matching, especially when more than hundreds of templates are stored on a module.

Since V1.6 firmware, automatic security levels have been added. With these settings, the module adjusts security level for identification automatically as the number of enrolled templates changes. The following table shows the relationships between the automatic security levels and the number of enrolled templates. For example, when the security level is Automatic Secure(0x51) and the number of enrolled templates is 500, the actual FAR for identification will be 1/10,000,000. The security level for verification is not changed.

Automatic Level	Verification (1:1)	Identification (1:N)			
		1 ~ 9	10 ~ 99	100 ~ 999	1000 ~
Normal(0x50)	1/10,000	1/10,000	1/100,000	1/1,000,000	1/10,000,000
Secure(0x51)	1/100,000	1/100,000	1/1,000,000	1/10,000,000	1/100,000,000
More Secure(0x52)	1/1,000,000	1/1,000,000	1/10,000,000	1/100,000,000	1/100,000,000

Configuration

Code	Type	Valid Values	Default Value
0x66	Read/Write	0x30 : 1/10 FAR(False Acceptance Rate)[1][2]	0x50: Automatic Normal
		0x31 : 1/100[2]	
		0x32 : 1/1,000[2]	
		0x33 : 1/10,000	
		0x34 : 1/100,000	
		0x35 : 1/1,000,000	
		0x36 : 1/10,000,000[1]	
		0x37 : 1/100,000,000[1]	
		0x40 : 3/100[1][2]	
		0x41 : 3/1,000[1][2]	
		0x42 : 3/10,000[1] [2]	
		0x43 : 3/100,000[1]	
		0x44 : 3/1,000,000[1]	
		0x45 : 3/10,000,000[1]	
		0x46 : 3/100,000,000[1]	
		0x50 : Automatic Normal[1]	
		0x51 : Automatic Secure[1]	
		0x52 : Automatic More Secure[1]	
		(1) 0x30, 0x36 ~ 0x52 are only available for SFM3000/3500/4000/5000/5500	
		(2) Since firmware V1.3, the minimum security level of SFM3000/3500 series is changed to 1/10,000(0x33). If users set a lower security level such as 1/100, it will be changed to 1/10,000 automatically.	

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Encryption Mode

UniFinger modules support 256 bit AES encryption algorithm for higher security. When encryption mode is on, all the templates are transferred and saved in encrypted form. See the KW section for setting 256 bit encryption key.

Configuration

Code	Type	Valid Values	Default Value
0x67	Read/Write	0x30 : Encryption off 0x31 : Encryption on	0x30 : Encryption off

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Sensor Type

Specifies the type of sensor connected to the module. Refer to the Datasheet of each model for compatible sensors. Please be reminded that if the sensor type is set incorrectly, module doesn't work or can be damaged. If possible, please do not change the sensor type as it is produced.

Configuration

Code	Type	Valid Values	Description	Connected Platform
0x68	Read/ Write	0x31: FC	Swipe type thermal sensor	SFM3010/SFM3510
		0x33 :OP/OP2/OP3/OP4/OP6	Optical sensor I	SFM3020/SFM3520/
				SFM4020/SFM5020
		0x34 :TC1/TC2/TC1S/TC2S/ T1/T2	Capacitive sensor	SFM3050/SFM3550/
				SFM3050-TC2S
			Optical sensor II	SFM3030/SFM3530/
		0x38 :OC2/OD/OC4/OH/OC 6		SFM5060 (OH only)
			Optical sensor III	SFM3040/SFM3540
		0x39 : OL	Swipe type capacitive sensor	SFM4000
		0x3C : TS4		

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 Series, SFM6020-OP6, SFM6030-OC6, SFM6050-

T1/T2

Image Format

Users can read fingerprint images using SI and RI commands. Image format parameter determines in which format a host receives the scanned image. If it is set to binary or 4 bit gray image, the module will down-convert 8 bit gray image to specified format before sending it. See the RI section for detailed descriptions of image format.

Regardless of this parameter, modules process only 8 bit gray images. Therefore, to enroll, identify, or verify fingerprint images, they should be always in 8 bit gray format.

Also support Wavelet Scalar Quantization (WSQ) : Fingerprint Image Compression Specification.

Configuration

Code	Type	Valid Values	Default Value
0x6C	Read/Write	0x30 : Gray image 0x31 : Binary image 0x32 : 4 bit gray image 0x33 : WSQ	0x31 : Binary image

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Module ID

Specifies the ID of a module which is used in Network Packet Protocol. In Network Packet Protocol, modules respond to requests only if the terminal ID of a request packet is identical to its module ID.

Configuration

Code	Type	Valid Values	Default Value
0x6D	Read/Write	1 ~ 65535	

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Firmware Version

4 byte character which denotes the firmware version of a module. For example, if the version is V1.9A, 0x56313941 – ASCII codes for 'V', '1', '9', and 'A' – will be returned.

Since firmware V1.4, the first character represents the model number of the module.

Series	Model	First character	Last character
SFM3000 series	SFM3020-OP	'A'	'C'
	SFM3030-OD		'D'
	SFM3040-OL		
	SFM3050-TC		'F'
	SFM3050-TC2S		'F'
SFM3500 series	SFM3520-OP	'B'	'C'
	SFM3530-OD		'D'
	SFM3540-OL		
	SFM3550-TC		'F'
SFM4000 series	SFM4000-TS4	'C'	'G'
	SFM4020-OP		'H'
SFM5000 series	SFM5020-OP	'D'	'Z'
	SFM5060-OH		'X'
SFM5500 series	SFM5520-OP5	'E'	'C'
	SFM5530-OC4		'D'
	SFM5550-TC		'F'
SFM6000 series	SFM6020-OP6	'G'	'C'
	SFM6030-OC6		'D'
	SFM6050-T1/T2		'F'

For example, if the firmware version is V1.9 for SFM3020-OP module, 0x41313943 – ASCII codes for 'A', '1', '9', and 'C' – will be returned.

Configuration

Code	Type	Valid Values	Default Value
0x6E	Read Only		

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Serial Number

4 byte integer which uniquely identifies each module.

If module does not have a serial number, it will not function normally.

Configuration

Code	Type	Valid Values	Default Value
0x6F	Read Only	4 byte integer	

Compatibility

SFM 3000 / 3500 / 4000 / 5000 /5500 / 6000 Series

Baudrate

Baudrate setting for host interface. The module should be reset after saving system parameters.

Notice) UART baud rate is dependency on RS232 chip, so be careful if you want to change the baud rate.

Configuration

Code	Type	Valid Values	Default Value
0x71	Read/Write	0x31 : 9600 bps 0x32 : 19200 bps 0x33 : 38400 bps 0x34 : 57600 bps 0x35 : 115200 bps 0x36 : 230400 bps 0x37 : 460800 bps 0x38 : 921600 bps	0x35 : 115200 bps

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Baudrate2

SFM3500 series modules have two serial interfaces, host and auxiliary. This parameter specifies the baudrate setting of auxiliary interface.

Configuration

Code	Type	Valid Values	Default Value
0x72	Read/Write	0x31 : 9600 bps 0x32 : 19200 bps 0x33 : 38400 bps 0x34 : 57600 bps 0x35 : 115200 bps	0x35 : 115200 bps

Compatibility

SFM 3500 / 5500 Series

Enrolled Finger

The number of fingerprint templates enrolled in a module.

Configuration

Code	Type	Valid Values	Default Value
0x73	Read Only		

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Available Finger

The available number of fingerprint templates that can be used for future enrollment. The maximum number of available templates varies according to models. Refer to the Datasheet for template capacity of each model.

Configuration

Code	Type	Valid Values	Default Value
0x74	Read Only		

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Send Scan Success

With this parameter on, the module sends SCAN_SUCCESS message when it scans a fingerprint image or reads a Wiegand input successfully. It also sends SCAN_SUCCESS message when it receives a fingerprint template or a fingerprint image successfully in such commands as ET and EI. See the ES section for usage of SCAN_SUCCESS message.

Configuration

Code	Type	Valid Values	Default Value
0x75	Read/Write	0x30 : No SCAN_SUCCESS message 0x31 : Send SCAN_SUCCESS message	0x31 : Send SCAN_SUCCESS

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

ASCII Packet

Determines the packet translation mode. If it is set to ASCII mode, the binary packet should be converted to ASCII format first before being sent to the module. Response packets are in ASCII format, too.

For example, if changing the baud rate of a module to 19200,

Start	Command	Param	Size	Flag	Checksum	End
0x40	0x01	0x00	0x32	0x71	0xE4	0x0A

Byte transmission order in hexademical mode:

0x40, 0x01, 0x00, 0x00, 0x00, 0x00, 0x32, 0x00, 0x00, 0x00, 0x71, 0xE4, 0x0A

Byte transmission order in ASCII mode:

0x34, 0x30, 0x30, 0x31, 0x30, 0x30, 0x30, 0x30, 0x30, 0x30, 0x30, 0x30, 0x33, 0x32,

0x30 0x30, 0x30, 0x30, 0x30, 0x30, 0x37, 0x31, 0x45, 0x34, 0x30, 0x41

Configuration

Code	Type	Valid Values	Default Value
0x76	Read/Write	0x30 : Hexademical packet 0x31 : ASCII packet	0x30 : Hexademical packet

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Rotate Image

With this parameter on, the module rotates a fingerprint image upside down before processing it. This parameter would be useful when the sensor should be installed upside down.

Configuration

Code	Type	Valid Values	Default Value
0x77	Read/Write	0x30 : Upright image 0x31 : Upside down image	0x30 : Upright image

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Rotation

Specifies the maximum rotation for fingerprint input. If rotation is beyond this limit, matching will fail even if two templates are identical. This parameter also affects matching speed. The wider the maximum rotation is, the slower matching speed is.

Rotation
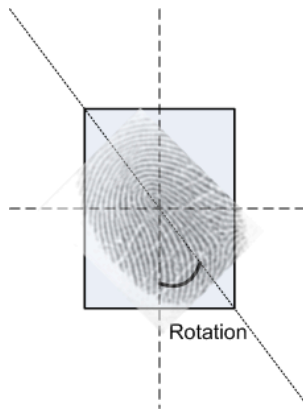
Configuration

Code	Type	Valid Values	Default Value
0x78	Read/Write	0x31: 15 degree 0x32: 30 degree 0x33: 45 degree 0x34: 60 degree 0x35: 75 degree 0x36: 90 degree	0x32: 30 degree

Compatibility

SFM 3000 /3500 / 4000 / 5000 / 5500 / 6000 Series

Sensitivity

Specifies sensor sensitivity to detect a finger. On high sensitivity, the module will accept the finger input more easily. While, by decreasing the sensitivity, the input fingerprint image will be more stabilized. In case of optical models, sensitivity to sunlight is also alleviated by decreasing sensitivity parameter.

Configuration

Code	Type	Valid Values	Default Value
0x80	Read/Write	0x30 : Least sensitive … 0x37 : Most sensitive	0x37 : Most sensitive

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Image Quality

When a fingerprint is scanned, the module will check if the quality of the image is adequate for further processing. If it is poor, the module will send TRY_AGAIN error message. Image quality parameter specifies the strictness of this quality check.

Since firmware V1.8, this parameter applies only when enrolling fingerprints. In other cases such as matching fingerprints, it has no effect.

Since firmware V2.0, new quality measure algorithm is added. The new algorithm provides more realistic score for low quality fingerprints which are expected hard to be recognized; too small size, too narrow valleys, too wet or dry condition, with too many creases, without core, or etc. The new quality measurement algorithm is strongly recommended to be used to decrease the false rejection rate, and can be enabled by setting the "Image Quality" parameter as one of values between 0x34 (Weak (V2)) and 0x37 (Strongest (V2)).

Configuration

Code	Type	Valid Values	Default Value
0x81	Read/Write	0x30 : Weak qualification (V1) 0x31 : Moderate qualification (V1) 0x32 : Strong qualification (V1) 0x33 : Strongest qualification (V1) -------------------------------------- ------ 0x34 : Weak qualification (V2)[1] 0x35 : Moderate qualification (V2)[1] 0x36 : Strong qualification (V2)[1]	0x31 : Moderate qualification

| | | 0x37 : Strongest qualification (V2) [1] | |

(1) Available since firmware V2.0

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Auto Response

If the module processes GPIO inputs or Wiegand* inputs, or works in Free Scan mode, response packets are not sent to serial interface by default. By setting this parameter, a host can receive response packets in those cases, too.

*) SFM6000 series doesn't support.

Configuration

Code	Type	Valid Values	Default Value
0x82	Read/Write	0x30 : No response command 0x31 : Send response command (host) 0x32 : Send response command (aux) 0x33 : Send response command (both)	0x30 : No response command (*0x32 and 0x33 are only available in SFM3500)

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Network Mode

UniFinger modules provide functionality to support RS422/485 network interface.

- SFM3000/4000/5000: To integrate modules into RS422/485 network, the following requirements should be met.

  - External level conversion circuitry between serial port of the module and RS422/485 line. Refer to Application Notes: RS422/RS485 Interface for reference circuitry.

  - Network mode parameter should be set to 0x31. In this case, GPIO7 is automatically allocated as flow control output for external circuitry.

- SFM3500: External level conversion circuitry is not needed and flow control of output signal is handled by firmware itself. Operation mode – full or half duplex – is determined by network mode parameter.

Network mode system parameter also determines which packet protocols are used.

Network Mode	Supported Packet Protocol		
	13 byte Packet Protocol	15 byte Network Packet Protocol	15 byte Broadcast Packet Protocol
Single(0x30)	O	O	O
Network(0x30/0x31)	X	O	O

Configuration

Code	Type	Valid Values		Default Value
0x83	Read/Write	SFM 3000/4000/5000/60x0	SFM3500	0x30 :
		0x30 : Single mode	0x30 : Single mode	Single mode
		0x31: Network mode	0x31 : Half duplex	
			0x32 : Full duplex	

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Free Scan

In normal mode, users have to send a command through serial interface or GPIO to initiate identification process. With Free Scan mode on, however, the module starts identification process automatically on sensing fingerprint input. To receive response packets through serial interface in Free Scan mode, Auto Response parameter should be on. Other commands are handled normally even if Free Scan mode is on.

Configuration

Code	Type	Valid Values	Default Value
0x84	Read/Write	0x30 : Normal mode 0x31 : Free scan mode	0x30 : Normal mode

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Provisional Enroll

Determines if enrolled templates are saved permanently or temporarily. With provisional enroll, enrolled templates will be erased if the module is turned off. To save templates permanently, FP(0x23) command should be executed. DP(0x24) command will erase the provisional templates.

Configuration

Code	Type	Valid Values	Default Value
0x85	Read/Write	0x30 : Permanent enrollment 0x31 : Provisional enrollment	0x30 : Permanent enrollment

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Pass When Empty

Determines if identification succeeds or fails when there is no enrolled template in a module.

Configuration

Code	Type	Valid Values	Default Value
0x86	Read/Write	0x30 : Fail when DB is empty 0x31 : Pass when DB is empty	0x30 : Fail when DB is empty

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Response Delay

Specifies the delay time for which the module should be waiting before sending a response packet. Response delay can be useful when packets are lost due to slow communication channel.

Configuration

Code	Type	Valid Values	Default Value
0x87	Read/Write	0x30 : No delay 0x31 : 20 msec … 0x35 : 100 msec … 0x3A : 200 msec	0x30 : No delay

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Matching Timeout

Timeout period for 1:N matching. If identification process is not finished until this period, MATCH_TIMEOUT error will be returned.

Configuration

Code	Type	Valid Values	Default Value
0x88	Read/Write	0x30 : infinite 0x31 : 1 second … 0x3A : 10 seconds … 0x44 : 20 seconds	0x33 : 3 seconds

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Build Number

4 byte character which denotes the build date of the firmware. For example, if the build date is 2005 April 28, 0x05042800 will be returned. The last 2 number of the build number is the version of customization, but SFM 6000 series use the hour of build time.

Configuration

Code	Type	Valid Values	Default Value
0x89	Read Only		

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Enroll Displacement

Two times and two templates enroll modes are provided to enhance authentication performance. However, if users scan two identical fingerprint images, the purpose of these modes becomes pointless. To prevent these cases, enroll displacement constraint can be imposed. If displacement of two fingerprint images is smaller than this constraint, enroll will fail.

Configuration

Code	Type	Valid Values	Default Value
0x8A	Read/Write	0x30 : No check 0x31 : Above 1 mm away … 0x35 : Above 5 mm away … 0x3A: Above 10 mm away	0x30 : No check

Compatibility

SFM 2000 / 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Lighting Condition

Optical sensors are sensitive to lighting condition. With this parameter, users can tune optical sensors to be adapted for their lighting environment. For example, if a module is installed in outdoor, this parameter should be set to 0x30.

Configuration

Code	Type	Valid Values	Default Value
0x90	Read/Write	0x30 : Outdoor 0x31 : Indoor	0x30 : Outdoor (* Until V1.4 firmware, the default had been Indoor)

Compatibility

SFM 3000 /3500 / 4000 / 5000 / 5500 / 6000 Series

Free Scan Delay

With Free Scan mode on, the module starts identification process automatically on sensing fingerprint input. Using Free Scan Delay parameter, users can specify delay between consecutive identification processes in Free Scan mode.

Configuration

Code	Type	Valid Values	Default Value
0x91	Read/Write	0x30 : No delay 0x31 : 1 second … 0x40 : 10 seconds	0x31 : 1 second (* Until V1.4 firmware, the default had been No delay.)

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Fast Mode

When more than hundreds of templates are stored in a module, the matching time for identification can be very long. Fast Mode parameter can be used to shorten the 1:N matching time with little degradation of authentication performance. The security level - FAR - is not affected by this parameter, but the FRR can be a bit higher than normal mode. In typical cases, Fast Mode 1 is 2 ~ 3 times faster than Normal mode. And Fast Mode 5 is 6 ~ 7 times faster than Normal mode.

If it is set to Automatic(0x36), the fast mode will be adjusted automatically as follows.

Enrolled Templates	Fast Mode
1 ~ 99	Normal
100 ~ 499	Fast Mode 1
500 ~ 999	Fast Mode 2
1000 ~ 1999	Fast Mode 3
2000 ~ 3999	Fast Mode 4
4000 ~	Fast Mode 5

*) Only SFM6000 Series

Enrolled Templates	Fast Mode
1 ~ 699	Normal
700 ~ 2099	Fast Mode 1
2100 ~ 3299	Fast Mode 2
3300 ~ 4999	Fast Mode 3
5000 ~ 7999	Fast Mode 4
8000 ~	Fast Mode 5

Configuration

Code	Type	Valid Values	Default Value
0x93	Read/Write	0x30 : Normal 0x31 : Fast Mode 1	0x36 : Automatic

		…	
		0x35 : Fast Mode 5(Fastest)	
		0x36 : Automatic	

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Watchdog

A watchdog timer is a hardware timing device that triggers a system reset if the main program, due to some fault condition, such as a hang, neglects to regularly service the watchdog. The purpose of watchdog timer is to bring the system back from the hung state into normal operation. It is most useful for mission critical systems that must remain in continuous operation without human intervention.

Configuration

Code	Type	Valid Values	Default Value
0x94	Read/Write	0x30 : Don't use Watchdog timer 0x31 : Use Watchdog timer	0x31 : Use Watchdog timer

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 Series

Template Type

SFM modules basically support Suprema's proprietary template format and additionally two standard template formats - ISO 19794-2 and ANSI 378. ISO 19794-2 format is supported since firmware V1.7, and ANSI 378 format is supported since firmware V1.9. Three template formats are not compatible. Therefore, you can change this parameter only if there is no enrolled template.

Configuration

Code	Type	Valid Values	Default Value
0x96	Read/Write	0x30 : Suprema 0x31 : ISO 19794-2 0x32 : ANSI 378	*0x30 : Suprema

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Enhanced Privacy

When Enhanced Privacy mode is on, Encryption Mode parameter is automatically set and fingerprint images cannot be retrieved from the module. RI, RIX, SI, and SIX commands will return UNSUPPORTED error in this mode. You can change this parameter only if there is no enrolled template. And, you cannot change Encryption Mode parameter when Enhanced Privacy mode is on.

Configuration

Code	Type	Valid Values	Default Value
0x97	Read/Write	0x30 : Enhanced Privacy mode off	*0x30 : Off
		0x31 : Enhanced Privacy mode on	

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Fake Finger Detection

When this parameter is on, the module will try to detect fake fingers. When a scanned fingerprint is suspected as a fake, the module will ignore it. This option enhances security level by detecting fake fingerprint input, but does not guarantee 100% detection. The parameter only applies to optical and TC sensors.

SFM5060 provides enhanced fake finger detection function. When a scanned fingerprint is suspected as a fake, SFM5060 module will returns FAKE_DETECTED (= 0xB0) error code. Also the level of sensitivity for fake finger detection can be adjusted from level 1 to 3 (= Weak, Normal, and Strong).

Configuration

Code	Type	Valid Values	Default Value
0x98	Read/Write	0x30 : Fake detection off 0x31: Fake detection on (= Weak[1]) 0x32: Normal[1] 0x33: Strong[1]	*0x30 : Off

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 Series , (1) = SFM5060 only

Check Latent Fingerprint

With this parameter enabled, the module will try to filter out latent fingerprints automatically.

Since firmware v2.0, this parameter is applicable to the module with OP4, OP6, OC4, OC6, T1, T2, TC1, and TC2 sensor.

Configuration

Code	Type	Valid Values	Default Value
0x9A	Read/Write	0x30: Don't check latent fingerprints when enrolling 0x31: Don't check latent fingerprints 0x32: Check latent fingerprints always	*0x30 : Disabled when enrolling fingerprints. Enabled for the other cases.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Voltage Warning

A SFM4000 module can detect its voltage level. The module will generate VOLTAGE_WARNING output event when the voltage gets lower than the threshold value. See Appendix A-1 for details.

Configuration

Code	Type	Valid Values	Default Value
0x9B	Read/Write	0: Don't check voltage level 1 ~ 12000: Threshold voltage in mV	*0 : No voltage check

Compatibility

SFM4000 Series

PowerOff Timeout

A SFM4000 module can be turned off automatically when there is no interaction during the specified timeout period. For example, if the parameter is set to 5000 and there is no user interaction for 5 seconds, the module will be powered off. The minimum timeout value is 1000 msec.

Configuration

Code	Type	Valid Values	Default Value
0x9C	Read/Write	0: No timeout 1000~: Timeout in msec	*0: No timeout

Compatibility

SFM4000 Series

Protocol Interface

The SFM6000 has two interfaces for protocol communication. It is a basically a UART and USB can be used if necessary.

Configuration

Code	Type	Valid Values	Default Value
0x9E	Read/Write	0x30: UART 0x31: USB	*0x30: UART

Compatibility

SFM6000 Series

Command Summary

Category	Name	Code	Description	3000 / 4000 / 5000	3500 / 5500	6000
System Configuration	SW	0x01	Write system parameter	O	O	O
	SF	0x02	Save system parameter	O	O	O
	SR	0x03	Read system parameter	O	O	O
	CS	0x1A	Calibrate sensor	O	O	O
	SS	0x04	Check system status	O	O	O
	CA	0x60	Cancel	O	O	O
	ID	0x85	Get the module ID	O	O	O
	UG	0x62	Upgrade firmware	O	O	O
	RS	0xD0	Reset the module	O	O	O
	LM	0xB1	Lock the module	X	O	X
	UM	0xB0	Unlock the module	X	O	X
	MP	0xB2	Change the master password	X	O	X
	OFF	0xD2	Turn off the module	O[1]	X	X
Enroll	ES	0x05	Enroll by scan	O	O	O
	ESA	0x70	ES with administrator's verification	O	O	O
	EI	0x06	Enroll by image	O	O	O
	EIX	0x80	EI with extended data transfer protocol	O	O	O
	ET	0x07	Enroll by template	O	O	O
	ETX	0x87	ET with extended data transfer protocol	O	O	O
	EW	0x1C	Enroll by Wiegand ID	X	O	X
	EWA	0x71	EW with administrator's verification	X	O	X
Verify	VS	0x08	Verify by scan	O	O	O
	VI	0x09	Verify by image	O	O	O
	VIX	0x82	VI with extended data transfer protocol	O	O	O

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[1] For SFM4000 only

	VT	0x10	Verify by template	O	O	O
	VW	0x1D	Verify by Wiegand ID	X	O	X
	VH	0x22	Verify host template by scan	O	O	O
	WSL	0x6B	Write security level of a user	O	O	O
	RSL	0x6C	Read security level of a user	O	O	O
Identify	IS	0x11	Identify by scan	O	O	O
	II	0x12	Identify by image	O	O	O
	IIX	0x81	II with extended data transfer protocol	O	O	O
	IT	0x13	Identify by template	O	O	O
Delete	DA	0x17	Delete all templates	O	O	O
	DAA	0x74	DA with administrator's verification	O	O	O
	DT	0x16	Delete template	O	O	O
	DS	0x1E	Delete by scan	O	O	O
	DSA	0x72	DS with administrator's verification	O	O	O
	DW	0x1F	Delete by Wiegand ID	X	O	X
	DWA	0x73	DW with administrator's verification	X	O	X
Template management	LT	0x18	List user ID	O	O	O
	LTX	0x86	List user ID with extended data transfer protocol	O	O	O
	CT	0x19	Check user ID	O	O	O
	FP	0x23	Fix all provisional templates	O	O	O
	DP	0x24	Delete all provisional templates	O	O	O
Get image and template	RI	0x20	Read image	O	O	O
	RIX	0x84	RI with extended data transfer protocol	O	O	O
	SI	0x15	Scan image	O	O	O
	SIX	0x83	SI with extended data transfer protocol	O	O	O
	RT	0x14	Read template	O	O	O
	RTX	0x89	RT with extended data transfer protocol	O	O	O
	ST	0x21	Scan template	O	O	O
	KS	0x35	Scan template with challenge data	O	O	O

	KW	0x34	Write encryption key	O	O	O
User memory management	ML	0x31	Get size of user memory	O	O	O
	MW	0x32	Write to user memory	O	O	O
	MR	0x33	Read from user memory	O	O	O
Time and log management	TW	0x3A	Write current time	X	O	X
	TR	0x3B	Read current time	X	O	X
	LN	0x3C	Get number of log data	X	O	X
	LR	0x3D	Read log data	X	O	X
	LD	0x3E	Delete log data	X	O	X
	LC	0x3F	Set / Get the custom log field	X	O	X
	RCL	0xEC	Read log cache	X	O	X
	CCL	0xEB	Clear log cache	X	O	X
Wiegand configuration	WW	0x41	Write Wiegand configuration	X	O	X
	WR	0x42	Read Wiegand configuration	X	O	X
	WG	0x43	Get Wiegand input	X	O	X
	WS	0x44	Set Wiegand output	X	O	X
	WM	0x68	Map Wiegand ID to input function	X	O	X
	WL	0x69	List Wiegand ID mapping	X	O	X
	WC	0x6A	Clear Wiegand ID mapping	X	O	X
Extended Wiegand configuration	WWX	0xC0	Write Wiegand configuration	X	O	X
	WRX	0xC1	Read Wiegand configuration	X	O	X
	WGX	0xC2	Get Wiegand input	X	O	X
	WSX	0xC3	Set Wiegand output	X	O	X
	WFW	0xC4	Set alternative value of a field	X	O	X
	WFR	0xC5	Get alternative value of a filed	X	O	X
	WPW	0xC6	Write Wiegand I/O settings	X	O	X
	WPR	0xC7	Read Wiegand I/O settings	X	O	X
Input configuration	IW	0x47	Write input configuration	X	O	X
	IR	0x48	Read input configuration	X	O	X
	IG	0x49	Get input state	X	O	X

Output configuration	OW	0x4A	Write output configuration	X	O	X
	OR	0x4B	Read output configuration	X	O	X
	OL	0x4C	Read output configuration partition list	X	O	X
	OS	0x4D	Set output state	X	O	X
GPIO configuration	GW	0x37	Write GPIO configuration	O	X	O
	GR	0x36	Read GPIO configuration	O	X	O
	GC	0x38	Clear GPIO configuration	O	X	O
	GD	0x39	Set default GPIO configuration	O	X	O
Admin level configuration	AW	0x65	Write administration level	O	O	O
	AR	0x66	Read administration level	O	O	O
	AC	0x67	Clear administration level	O	O	O
Auth. mode configuration	UW	0xA3	Write authentication mode	X	O	X
	UR	0xA4	Read authentication mode	X	O	X
	UC	0xA5	Reset authentication mode to default	X	O	X
	UL	0xA6	List user IDs grouped by authentication mode	X	O	X
Blacklist configuration	ABL	0xF3	Add an ID to blacklist	X	O	X
	DBL	0xF4	Delete an ID from blacklist	X	O	X
	RBL	0xF5	Read blacklist	X	O	X
	CBL	0xF6	Clear blacklist	X	O	X
Entrance limit configuration	WME	0xF0	Write entrance limit	X	O	X
	RME	0xF1	Read entrance limit	X	O	X
	CME	0xF2	Clear entrance limit	X	O	X
System Parameter	FR	0xFA	Factory reset by erasing system parameter	X	X	O
File System	FF	0xFF	Raw format userdb partition	X	X	O

Table 2   Command

Flag / Error Code

Name	Code	Description
CHECK_ID	0x70	Check if the requested user ID exists.
ADD_NEW	0x71	Adding more fingerprints to a current existing user ID.
CONTINUE	0x74	There is more data to be sent.
AUTO_ID	0x79	Automatically assign user ID in enrollment.
CHECK_FINGER[1]	0x84	Check if the finger is already enrolled.
CHECK_FINGER_AUTO_ID[1]	0x85	Check if the finger is already enrolled. If not, assign user ID automatically.
ADD_DURESS[2]	0x92	Add duress fingerprints to an existing user ID.

Table 3   Flag code

(1) These flags are available for SFM3000/3500/4000/5000/6000 only.
(2) These flags are available for SFM3500/5500 only.

Name	Code	Description
SUCCESS	0x61	Successfully completed.
SCAN_SUCCESS	0x62	Fingerprint input has succeeded.
SCAN_FAIL	0x63	Sensor or fingerprint input has failed.
NOT_FOUND	0x69	There is no requested data found.
NOT_MATCH	0x6A	Fingerprint does not match.
TRY_AGAIN	0x6B	Fingerprint image is not good.
TIME_OUT	0x6C	Timeout for fingerprint input.
MEM_FULL	0x6D	Maximum template capacity exceeded.
EXIST_ID	0x6E	The requested user ID exists.
FINGER_LIMIT	0x72	The number of fingerprints enrolled in same ID exceeds its limit (10).
CONTINUE	0x74	There is more data to be sent.
UNSUPPORTED	0x75	The command is not supported.
INVALID_ID	0x76	The requested user ID is invalid or missing.

TIMEOUT_MATCH	0x7A	Timeout for matching in identification.
BUSY[1]	0x80	Module is processing another command.
CANCELED[1]	0x81	The command is canceled.
DATA_ERROR[1]	0x82	The checksum of a data packet is incorrect.
DATA_OK[1]	0x83	The checksum of a data packet is correct.
EXIST_FINGER[1]	0x86	The finger is already enrolled.
DURESS_FINGER[2]	0x91	A duress finger is detected.
LOCKED[2]	0xA1	Module is locked.
REJECTED_ID[2]	0x90	Authentication mode of the user is AUTH_REJECT or the ID is in the blacklist.
ENTRANCE_LIMIT[2]	0x94	Authentication fails since the entrance limit is exceeded.
FAKE_DETECTED[3]	0xB0	Scanned fingerprint is determined as a fake finger.

Table 4   Error code

(1) These error codes are available for SFM3000/3500/4000/5000/5500/6000 only.
(2) These error codes are available for SFM3500/5500 only.
(3) These error codes are available for SFM5060 only.

SW : System Parameter Write

Changes the value of system parameters. Since the changed value will be deleted if the module is reset, save the changed value in the flash memory of the module when it is necessary. This can be done by SF command (System parameter save) to be presented next. To validate the modification of SENSOR_INDEX and BAUDRATE, the module should be restarted.

Request Command

Field	Data	Description
Start code	0x40	
Command	0x01	
Param	NULL	
Size	Parameter value	See System Parameter Table
Flag	Parameter ID	See System Parameter Table
Checksum	#	
End code	0x0A	

Response Command

Field	Data	Description
Start code	0x40	
Command	0x01	
Param	Parameter ID	See System Parameter Table
Size	NULL	
Error	0x61	SUCCESS
	0x69	NOT_FOUND
	0x80	BUSY
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Parameter setup is successfully completed.
NOT_FOUND	There is no requested parameter ID found.
BUSY	Module is processing another command.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Example

If the communication baud rate of the module is changed to 19200,

Start	Command	Param	Size	Flag	Checksum	End
0x40	0x01	0x00	0x32	0x71	0xE4	0x0A

the actual values input to the size are as follows:

1st place	2nd place	3rd place	4th place
0x32	0x00	0x00	0x00

Byte transmission order:

0x40, 0x01, 0x00, 0x00, 0x00, 0x00, 0x32, 0x00, 0x00, 0x00, 0x71, 0xE4, 0x0A

SF : System Parameter Save

Stores the system parameter data of the module in the flash memory. SF command is used to store the parameter data in the flash memory so that it can be sustained even when the module is reset.

Request command

Field	Data	Description
Start code	0x40	
Command	0x02	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x02	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
	0x80	BUSY
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Parameter save is successfully completed.
BUSY	Module is processing another command.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

SR : System Parameter Read

Reads the system parameter values that correspond to the ID in the flag field of the request command.

Request command

Field	Data	Description
Start code	0x40	
Command	0x03	
Param	NULL	
Size	NULL	
Flag	Parameter ID	See System Parameter Table
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x03	
Param	Parameter ID	See System Parameter Table
Size	Parameter value	See System Parameter Table
Error	0x61	SUCCESS
	0x69	NOT_FOUND
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	The value of the requested parameter ID has been successfully read.
NOT_FOUND	There is no requested parameter ID found.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

CS : Calibrate Sensor

Calibrate fingerprint sensor. All type of sensors should not be necessarily calibrated. This command is supported for AuthenTec's FingerLoc AF-S2 and STMicro's TouchChip. After using the CS command, the SF command should be used to save calibration result in flash memory.

This command is used with capacitive touch sensor only.

Request command

Field	Data	Description
Start code	0x40	
Command	0x1A	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x1A	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
	0x63	SCAN_FAIL
	0x75	UNSUPPORTED
	0x80	BUSY
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Calibration of sensor is successfully completed.
SCAN_FAIL	Calibration of sensor failed.
UNSUPPORTED	Calibration of sensor is not needed.
BUSY	Module is processing another command.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

SS : System Status Check

Checks the current status of the module.

Request command

Field	Data	Description
Start code	0x40	
Command	0x04	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x04	
Param	Status code	Current status of the module
Size	NULL	
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Status code

Status	Data	Description
ALIVE	0x30	Module is in normal condition

BUSY	0x34	Module is processing a command

Error code

Error code	Description
SUCCESS	System status check is successfully completed.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

CA : Cancel

Cancels the command which is being processed by the module. When the module is executing a command which takes long time to complete or needs user input to proceed, the status of the module will be changed into BUSY. In that case, only SR and SS commands can be processed. All the other commands will fail and BUSY error code will be returned. If users want to execute another command before finishing the current one, they can explicitly cancel it by CA command. Cancelable commands are as follows: ES, ESA, EW, EWA, VS, VW, IS, DS, DSA, DW, DWA, DAA, SI, ST, KS. The following diagram shows one example of CA command. In this example, IS was sent to the module before ES was finished, and failed with BUSY error code. After that, host canceled ES by CA command.

Request command

Field	Data	Description
Start code	0x40	
Command	0x60	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x60	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Cancel is successfully completed.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

ID : Get Module ID

In a network environment, a host needs to know which modules participate in the network. ID is a special command for this purpose. A host sends ID command to all the modules using Broadcast Packet Protocol. Each module returns 4 byte response packet including its module ID. Since packet collision can occur in network environments, the host should repeat this process until no module returns response packets.

The exact procedure is as follows:

1. Host sends ID command and a list of user IDs which were received in previous ID requests. It also specifies maximum delay parameter to minimize the possibility of packet collisions.

2. Each module checks the user ID lists and returns its user ID if it is not included in the list. Before sending a response packet, each module will wait for a random period less than the maximum delay parameter.

3. Host receives response packets and adds new IDs to the list.

4. Repeat 1 ~ 3 until no response packet is received.

Request command

Field	Data	Description
Start code	0x41	
Command	0x85	
Param	Data Size	Number of received user IDs * 2. It would be 0 in the first request.
Size	Maximum Delay in milliseconds	Before sending a response packet, each module will wait for a random period less than this maximum value.
Flag	NULL	
Checksum	#	
End code	0x0A	

First transmit the request command, then the user IDs which were received in previous requests, and finally the 0x0A.

Response command

Data	Description
Start code	1 byte(0x41)
Module ID	2 byte
Checksum	1 byte: checksum of preceding 3 bytes

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Example

There are three modules with ID 1, 2, and 3 respectively. The host sends ID command.

Start	Terminal ID	Command	Data Size	Maximum Delay
0x41	0x00	0x85	0x00	0x3E8

Byte transmission order:

0x41, 0x00, 0x00, 0x85, 0x00, 0x00, 0x00, 0x00, 0xE8, 0x03, 0x00, 0x00, 0x00, 0xB1, 0x0A

Module 1 returns.

0x41, 0x01, 0x00, 0x42

Module 2 returns.

0x41, 0x02, 0x00, 0x43

Module 3 returns.

0x41, 0x03, 0x00, 0x44

The host receives the response packets of Module 1 and Module 2. The response packet of Module 3 is lost due to packet collision. The host sends ID command again with ID lists.

Start	Terminal ID	Command	Data Size	Maximum Delay
0x41	0x00	0x85	0x04	0x3E8

Byte transmission order:

0x41, 0x00, 0x00, 0x85, 0x04, 0x00, 0x00, 0x00, 0xE8, 0x03, 0x00, 0x00, 0x00, 0xB5, 0x0A

0x01, 0x00, 0x02, 0x00, 0x0A

Module 3 returns.

0x41, 0x03, 0x00, 0x44

UG : Upgrade Firmware

Upgrade firmware using Extended Data Transfer Protocol. If upgrade is interrupted by power loss or communication failure, the module will be in unusable state. Therefore, users should use this command with utmost caution.

The sensor LED flashes during firmware upgrade on the SFM6000 with optical sensor. So never turn off the module while the sensor LED is on.

Request command

Field	Data	Description
Start code	0x40	
Command	0x62	
Param	NULL	
Size	Size of firmware	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x62	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
	0x6D	MEM_FULL
	0x82	DATA_ERROR
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Firmware upgrade is successfully completed.
MEM_FULL	Out of memory.
DATA_ERROR	The checksum of a data packet is incorrect.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Example

If the firmware size is 200KB and the data packet size is 16KB, the following packets are transferred between the host and the module.

(1) Request Packet

Start	Command	Param	Size	Flag	Checksum	End
0x40	0x62	0x00	0x32000	0x00	0xC5	0x0A

(2) Response Packet

Start	Command	Param	Size	Flag	Checksum	End
0x40	0x62	0x00	0x00	0x61	0x03	0x0A

(3) Data Packets

Start	Command	Num of Packet	Packet Index	Data Size	Flag	Checksum	End
0x40	0x62	0x0D	0x00	0x4000	0x00	0xEF	0x0A
0x40	0x62	0x0D	0x01	0x4000	0x00	0xF0	0x0A
			...				
0x40	0x62	0x0D	0x0C	0x2000	0x00	0xDB	0x0A

These data packet headers are followed by 16KB data and 4 byte checksum. If the error code of the acknowledge packet is not DATA_OK(0x83), the host should stop the

upgrade process and start it again.

RS : Reset Module

Resets the module. There are two ways to reset the module. One is to use RS command and the other is to use GPIO input function. See GW and IW commands for the latter.

Request command

Field	Data	Description
Start code	0x40	
Command	0xD0	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xD0	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	The module is reset successfully.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

LM : Lock Module

Locks the module. When the module is locked, it returns LOCKED(0xA1) error code. Locking should be used with utmost caution. If users forget the master password after locking a module, it cannot be unlocked.

Request command

Field	Data	Description
Start code	0x40	
Command	0xB1	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xB1	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description

SUCCESS	The module is locked successfully.

Compatibility

SFM 3500 / 5500 Series

UM : Unlock Module

Unlocks the module. To unlock, a 16 byte master password should be sent to the module. The default password is a string of 16 NULL characters.

Request command

Field	Data	Description
Start code	0x40	
Command	0xB0	
Param	NULL	
Size	Data size	16 byte password + 2 byte checksum = 18
Flag	NULL	
Checksum	#	
End code	0x0A	

First transmit the request command, then 16 byte password, 2 byte checksum of the password, and finally the 0x0A.

Response command

Field	Data	Description
Start code	0x40	
Command	0xB0	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
	0x6A	NOT_MATCH
	0x6B	TRY_AGAIN
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	The module is unlocked successfully.
NOT_MATCH	The master password is not correct.
TRY_AGAIN	The checksum of the password is not correct.

Compatibility

SFM 3500 / 5500 Series

MP : Set Master Password

Changes the master password. The password is required for unlocking a locked module. The default password is a string of 16 NULL characters.

Request command

Field	Data	Description
Start code	0x40	
Command	0xB2	
Param	NULL	
Size	Data size	16 byte old password + 2 byte checksum + 16 byte new password + 2 byte checksum = 36
Flag	NULL	
Checksum	#	
End code	0x0A	

First transmit the request command, then 16 byte old password, 2 byte checksum of the old password, 16 byte new password, 2 byte checksum of the new password, and finally the 0x0A.

Response command

Field	Data	Description
Start code	0x40	
Command	0xB2	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
	0x6A	NOT_MATCH
	0x6B	TRY_AGAIN

Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	The password is changed correctly.
NOT_MATCH	The old password is not correct.
TRY_AGAIN	The checksum of the password is not correct.

Compatibility

SFM 3500 / 5500 Series

OFF : Power Off Module

You can turn off a SFM4000 module programmatically with OFF command.

Request command

Field	Data	Description
Start code	0x40	
Command	0xD2	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xD2	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	The module is powered off successfully.

Compatibility

SFM4000 Series

ES : Enroll by Scan

Enrolls a user's fingerprint.

There are three modes of fingerprint enrollment. ENROLL_MODE in system parameters determines which enroll mode is selected. In any modes, the size of fingerprint templates is same.

(1) Enroll Mode

- One Time(0x30): Enrolls a fingerprint template with one scanned image.

- Two Times(0x31 and 0x32): Enrolls a fingerprint template with two scanned images. In this mode, the two fingerprint images are compared to each other. If two images do not match, they are rejected. If they match, the one with better quality will be enrolled. By enhancing the quality of enrolled templates, the authentication performance will be improved compared to the One Time mode. This mode is also classified into two sub modes according to the way in which the second scanning is initiated. In 0x31, the module will start the second scanning automatically. In 0x32, the second scanning will be started after the host sends another request.

- Two Templates(0x41 and 0x42): Enrolls two fingerprint templates. The enrollment process is identical to the Two Times mode. However, instead of selecting one of the two templates, the module will enroll both of them. By enrolling two templates for each user ID, the authentication performance will be improved further than the Two Times mode. In this mode, one of the two stored templates may be automatically updated to reflect dynamical changes of user's finger skin. Each time when a user is verified, module decides if it will replace the existing template with the newly obtained one. For network applications in which a central server manages templates, special attention must be paid. In that case, automatic changes of a template may cause a synchronization problem with the server. This mode is also classified into two sub modes according to the way in which the second scanning is initiated. 0x41 is the default mode for SFM 3000/3500/4000/5000/5500/6000 series.

(2) Enroll Options

Users can specify one of six options for fine tuning the enrollment process. If users do not specify any option – the FLAG field of the packet is NULL, the module does not care about duplication of a user ID and always creates or overwrites with new templates. The user ID "0x0000" is not allowed, since it is pre-assigned for internal use.

- ADD_NEW: Adds another fingerprint to the same user ID. The maximum number of templates per user is 10. By enrolling more templates, users can expect better authentication performance. FINGER_LIMIT error will be returned if the number exceeds the limit.

- CHECK_ID: Before enrolling, checks if the user ID has already some templates. If it does, EXIST_ID will be returned. This option is useful when users do not want to overwrite existing templates.

- CHECK_FINGER: Before enrolling, checks if the same fingerprint is already enrolled. If the identification succeeds, return EXIST_FINGER error. If the identification fails, continue enroll process with ADD_NEW option.

- AUTO_ID: The user ID will be assigned automatically by the module.

- CHECK_FINGER_AUTO_ID: Before enrolling, checks if the same fingerprint is already enrolled. If the identification succeeds, return EXIST_FINGER error. If the identification fails, continue enroll process with AUTO_ID option.

- ADD_DURESS: Adds another fingerprint as duress one to the specified user ID. Under duress, users can authenticate with duress finger to notify the threat. When duress finger is matched, the module will return DURESS_FINGER error code and write a log. Users can also setup output signals for duress events. When enrolling, the duress finger should not match with non-duress fingerprints of the same ID. If it is the case, EXIST_FINGER error code will be returned. This option is valid only for SFM35X0.

Commands like enroll, verify and identify may receive two response commands. The first command comes in the intermediate stage, notifying image scanning completed and

the other command notifies process result. If you do not want to receive the intermediate command, you can disable it by writing '0x30' to the system parameter SEND_SCAN_SUCCESS.

In the process of enrollment, if a user does not put his/her finger on the sensor, the module will send a timeout message and ends the enrollment process.

Timelines of ES:

1. ENROLL_MODE = **0x30**, SEND_SCAN_SUCCESS = **0x31**
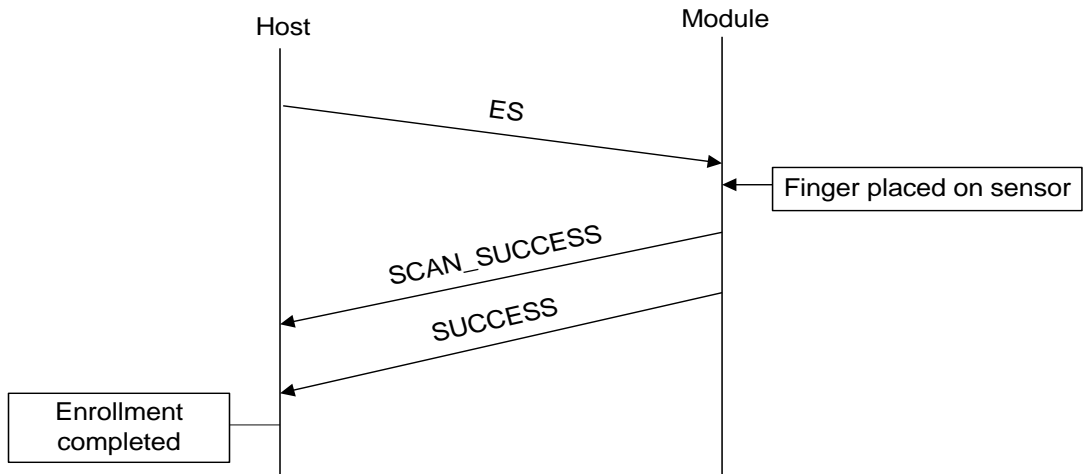
2. ENROLL_MODE = **0x31/0x41**, SEND_SCAN_SUCCESS = **0x31**
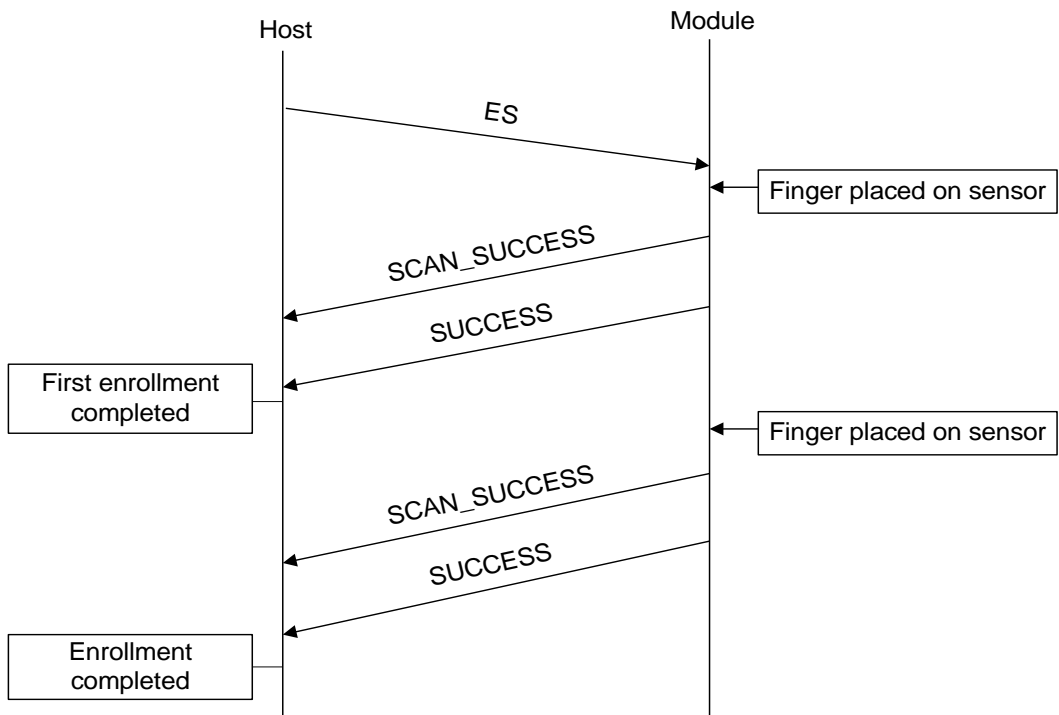
3. ENROLL_MODE = **0x31/0x41**, SEND_SCAN_SUCCESS = **0x30**
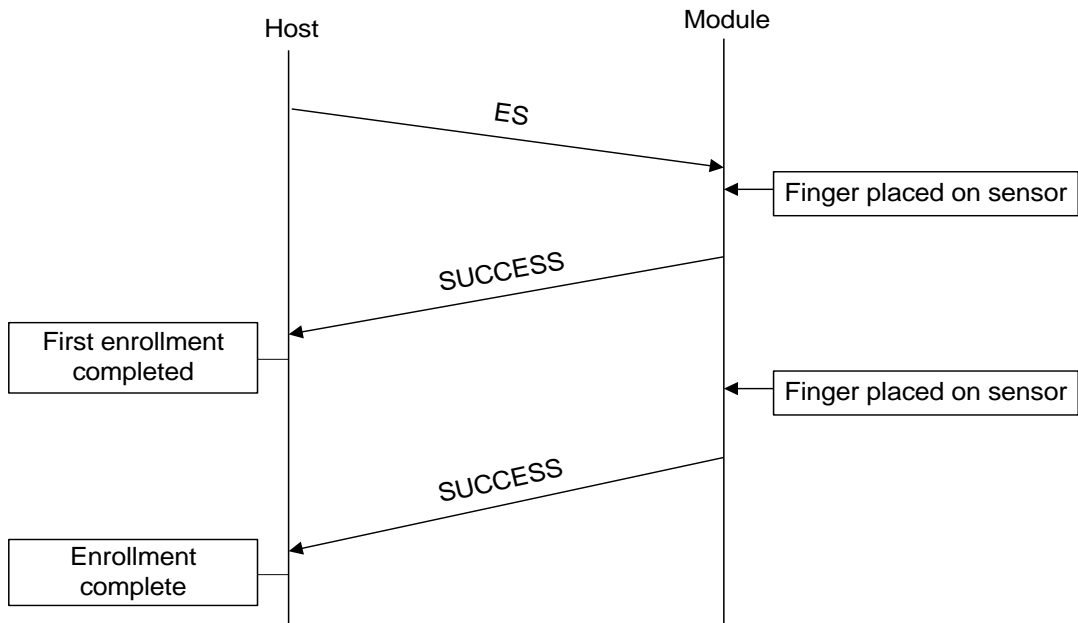
4. ENROLL_MODE = **0x32/0x42**, SEND_SCAN_SUCCESS = **0x30**
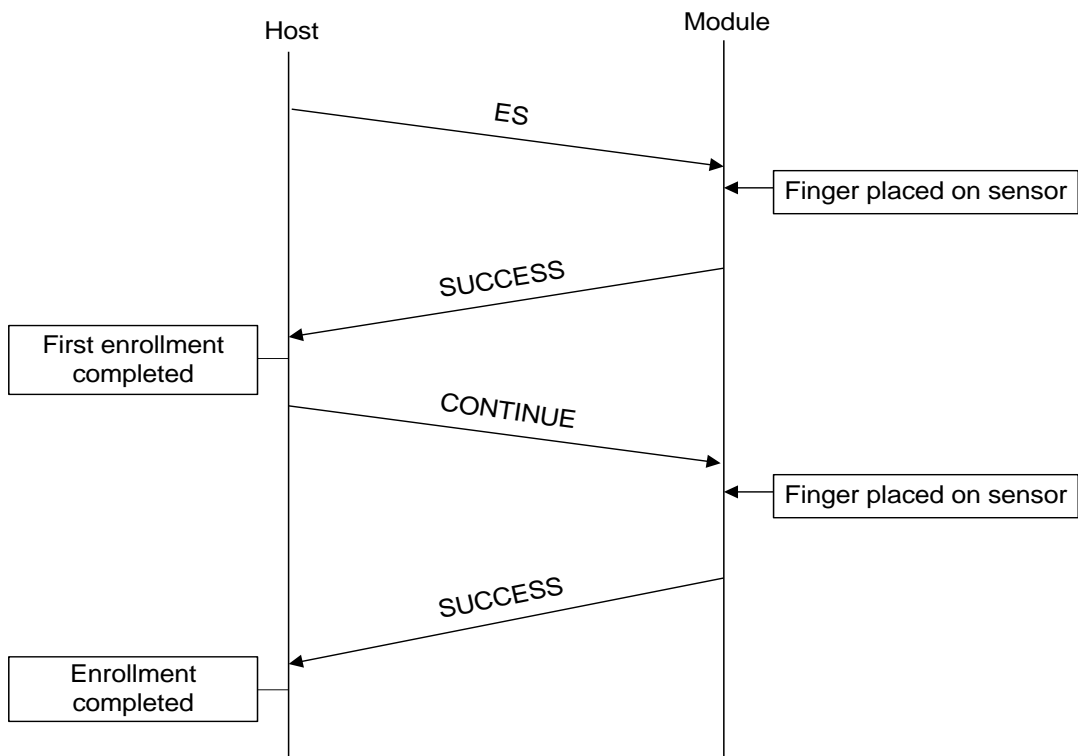
5. Time out occurred in the first enrollment
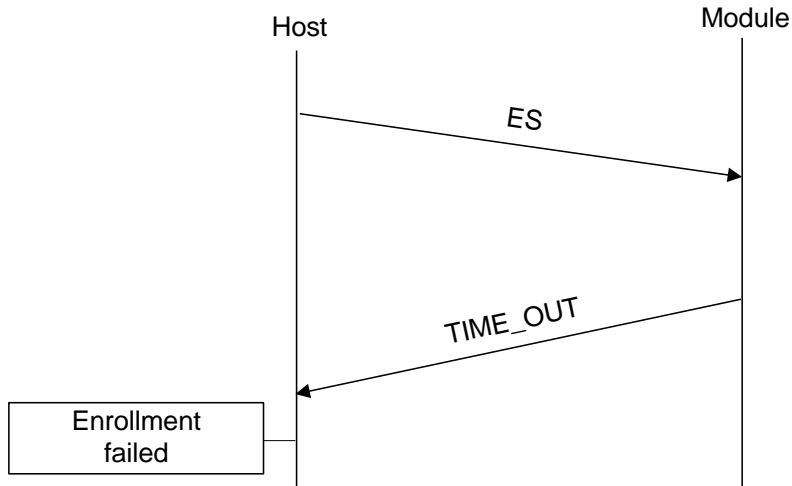
6. Time out occurred in the second enrollment

(When ENROLL_MODE = **0x31/0x41**, SEND_SCAN_SUCCESS = **0x30**)

Request command

Field	Data	Description
Start code	0x40	
Command	0x05	
Param	User ID	
Size	NULL	
Flag	0x71	ADD_NEW
	0x79	AUTO_ID
	0x74	CONTINUE
	0x70	CHECK_ID
	0x84	CHECK_FINGER[1]
	0x85	CHECK_FINGER_AUTO_ID[1]
	0x92	ADD_DURESS[2]
Checksum	#	
End code	0x0A	

(1) These parameters are available for SFM 3000/3500/4000/5000/5500/6000 only.
(2) These parameters are available for SFM 3500 only.

Response command

Field	Data	Description
Start code	0x40	
Command	0x05	
Param	User ID	
Size	Image Quality	Score 0 ~ 100
Error	(0x62)	(SCAN_SUCCESS)
	0x63	SCAN_FAIL
	0x6C	TIME_OUT
	0x61	SUCCESS
	0x6B	TRY_AGAIN
	0x6D	MEM_FULL
	0x72	FINGER_LIMIT

	0x76	INVALID_ID
	0x6E	EXIST_ID
	0x86	EXIST_FINGER
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SCAN_SUCCESS	Fingerprint scanning is successfully completed.
SCAN_FAIL	Sensor or fingerprint input has failed.
TIME_OUT	Timeout for fingerprint input.
SUCCESS	Fingerprint enrollment is successfully completed.
TRY_AGAIN	An error occurred during enrollment process.
MEM_FULL	Flash memory is full.
FINGER_LIMIT	The number of fingerprints enrolled in same ID exceeds its limit (10).
INVALID_ID	The requested user ID is invalid. Note that '0x0000' cannot be used.
EXIST_ID	The requested user ID exists. (In case CHECK_ID flag is used)
EXIST_FINGER	The same finger is already enrolled. (In case CHECK_FINGER or CHECK_FINGER_AUTO_ID is used.)
	The same finger is already enrolled as non-duress.(In case ADD_DURESS option is given.)

All the error codes above are sent at the end of process, except "SCAN_SUCCESS," which appears in an intermediate stage.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 /6000 Series

Example

When enrolling a new fingerprint template with an user ID,'0x0123,'

Start	Command	Param	Size	Flag	Checksum	End
0x40	0x05	0x0123	0x00	0x00	0x69	0x0A

The actual value input in the Param:

1st place	2nd place	3rd place	4th place
0x23	0x01	0x00	0x00

Byte transmission order

0x40, 0x05,　0x23, 0x01, 0x00, 0x00,　0x00, 0x00, 0x00, 0x00,　0x00, 0x69, 0x0A

When adding a fingerprint template with an user ID,'0x0123,'

Start	Command	Param	Size	Flag	Checksum	End
0x40	0x05	0x0123	0x00	0x71	0xDA	0x0A

Byte transmission order

0x40, 0x05,　0x23, 0x01, 0x00, 0x00,　0x00, 0x00, 0x00, 0x00,　0x71, 0xDA, 0x0A

ESA : ES with Administrator's Verification

Enroll and Delete commands can change the fingerprint DB stored in the module. For some applications, it might be necessary to obtain administrator's permission before enrolling or deleting fingerprints. There are 5 commands which need administrator's verification before proceeding: ESA, EWA, DSA, DWA, and DAA. To process these commands, a user with proper administration level should verify himself first. If there is no user with corresponding administration level, these commands will fail with UNSUPPORTED error code. In case the verification fails, NOT_MATCH error code will be returned. The only exception is that ESA and EWA will succeed when the fingerprint DB is empty. In that case, the first user enrolled by ESA or EWA will have ADMIN_ALL level. See AW for details of administration levels.

ESA is equal to ES except that it needs administrator's verification before enrolling a fingerprint. A user with ADMIN_ENROLL or ADMIN_ALL privileges should verify himself first to start the ES processing.

Timelines of ESA:

1. When administrator's verification fails (SEND_SCAN_SUCCESS = **0x31)**
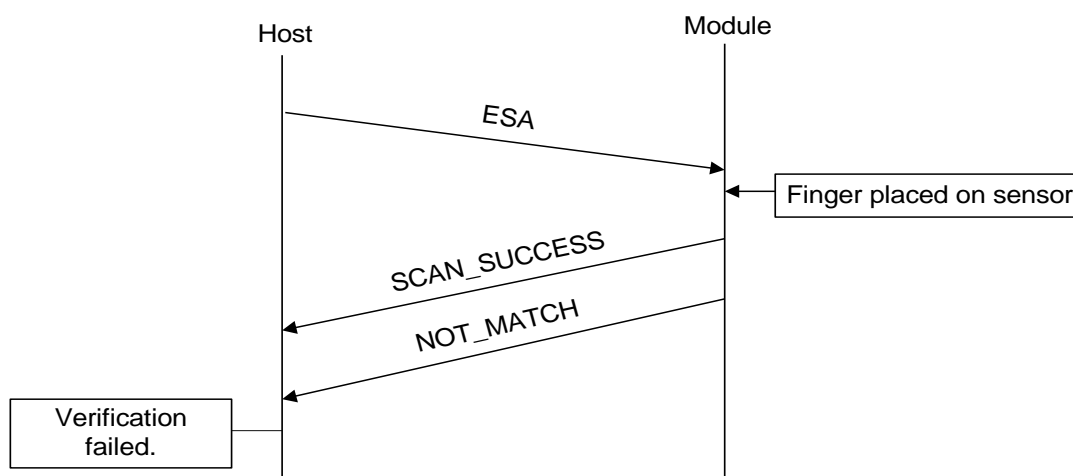
2. When administrator's verification succeeds (SEND_SCAN_SUCCESS = **0x31),**

Host   Module

ESA

Finger placed on sensor

SCAN_SUCCESS

CONTINUE

Verification
succeed

ES processing starts..
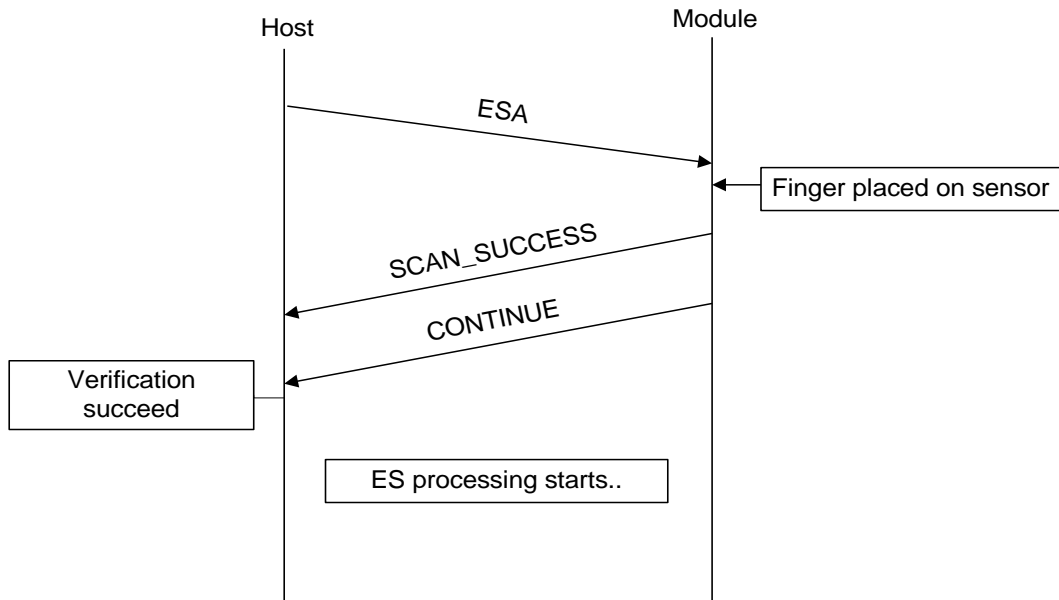
3. When there is no user with corresponding administration levels
(SEND_SCAN_SUCCESS = **0x31),**

Host   Module

ESA

No administrator

UNSUPPORTED

Verification failed
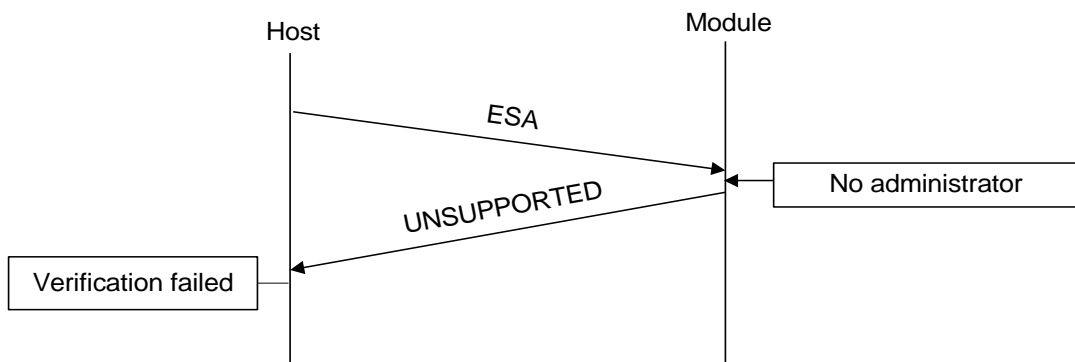
4. When there is no user (SEND_SCAN_SUCCESS = **0x31),**

Request command

Field	Data	Description
Start code	0x40	
Command	0x70	
Param	User ID	
Size	NULL	
Flag	0x71	ADD_NEW
	0x79	AUTO_ID
	0x74	CONTINUE
	0x70	CHECK_ID
	0x84	CHECK_FINGER
	0x85	CHECK_FINGER_AUTO_ID
	0x92	ADD_DURESS
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x70	

Param	User ID	
Size	Image Quality	Score 0 ~ 100
Error	(0x62)	(SCAN_SUCCESS)
	0x63	SCAN_FAIL
	0x74	CONTINUE
	0x6C	TIME_OUT
	0x61	SUCCESS
	0x6B	TRY_AGAIN
	0x6D	MEM_FULL
	0x72	FINGER_LIMIT
	0x76	INVALID_ID
	0x6E	EXIST_ID
	0x6A	NOT_MATCH
	0x75	UNSUPPORTED
	0x86	EXIST_FINGER
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SCAN_SUCCESS	Fingerprint scanning is successfully completed.
SCAN_FAIL	Sensor or fingerprint input has failed.
CONTINUE	Administrator's verification succeeds.
TIME_OUT	Timeout for fingerprint input.
SUCCESS	Fingerprint enrollment is successfully completed.
TRY_AGAIN	An error occurred during enrollment process.
MEM_FULL	Flash memory is full.
FINGER_LIMIT	The number of fingerprints enrolled in same ID exceeds its limit (10).
INVALID_ID	The requested user ID is invalid. Note that '0x0000' cannot be used.
EXIST_ID	The requested user ID exists. (In case CHECK_ID flag is used)

EXIST_FINGER	The same finger is already enrolled. (In case CHECK_FINGER or CHECK_FINGER_AUTO_ID are used.)
NOT_MATCH	Administrator's verification fails.
UNSUPPORTED	There is no user with ADMIN_ALL or ADMIN_ENROLL levels.

All the error codes above are sent at the end of process, except "SCAN_SUCCESS" and "CONTINUE," which appear in an intermediate stage.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

EI : Enroll by Image

Enrolls a user ID by transmitting the fingerprint image from the host. The fingerprint image data can be transmitted following the EI packet. The Enroll Mode for scanning fingerprint 1 or 2 times does not affect for this command and only one image is used for enrollment. Although there is no logical problem in working of the EI command, the EIX command is more recommended because of its higher reliability inherited from the Extended Data Transfer Protocol (Appendix B).

Request command

Field	Data	Description
Start code	0x40	
Command	0x06	
Param	User ID	
Size	Image size	
Flag	0x71	ADD_NEW
	0x79	AUTO_ID
	0x70	CHECK_ID
	0x84	CHECK_FINGER
	0x85	CHECK_FINGER_AUTO_ID
	0x92	ADD_DURESS
Checksum	#	
End code	0x0A	

First transmit the request command, then the raw data (fingerprint image) and finally the 0x0A.

Response command

Field	Data	Description
Start code	0x40	

Command	0x06	
Param	User ID	
Size	Image Quality	Score 0 ~ 100
Error	(0x62)	(SCAN_SUCCESS)
	0x61	SUCCESS
	0x6B	TRY_AGAIN
	0x6D	MEM_FULL
	0x72	FINGER_LIMIT
	0x76	INVALID_ID
	0x6E	EXIST_ID
	0x86	EXIST_FINGER
Checksum	#	
End code	0x0A	

Refer to ES for the error codes.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Example

When enrolling a fingerprint by transmitting image data of 8,000 (0x1F40) bytes with a user ID, '0x0123'

Start	Command	Param	Size	Flag	Checksum	End
0x40	0x06	0x0123	0x1F40	0x00	0xC9	0x0A

+

Fingerprint Image	0x0A

The actual value input in the Param

1st place	2nd place	3rd place	4th place

0x23	0x01	0x00	0x00

The actual value input in the Size

1st place	2nd place	3rd place	4th place
0x40	0x1F	0x00	0x00

Byte transmission order

0x40, 0x06,   0x23, 0x01, 0x00, 0x00,   0x40, 0x1F, 0x00, 0x00,   0x00, 0xC9, 0x0A, 0x**,

0x**,   … , 0x**,   0x0A

EIX : EI with Extended Data Transfer Protocol

Enrolls a user ID by transmitting the fingerprint image from the host. The transfer of image conforms to the Data Transfer Protocol. See Appendix B Extended Data Transfer Protocol.

Request command

Field	Data	Description
Start code	0x40	
Command	0x80	
Param	User ID	
Size	Image size	
Flag	0x71	ADD_NEW
	0x79	AUTO_ID
	0x70	CHECK_ID
	0x84	CHECK_FINGER
	0x85	CHECK_FINGER_AUTO_ID
	0x92	ADD_DURESS
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x80	
Param	User ID	
Size	Image Quality	Score 0 ~ 100
Error	(0x62)	(SCAN_SUCCESS)
	0x61	SUCCESS
	0x6B	TRY_AGAIN

	0x6D	MEM_FULL
	0x72	FINGER_LIMIT
	0x76	INVALID_ID
	0x6E	EXIST_ID
	0x82	DATA_ERROR
	0x83	DATA_OK
	0x86	EXIST_FINGER
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SCAN_SUCCESS	Fingerprint scanning is successfully completed.
SUCCESS	Fingerprint enrollment is successfully completed.
TRY_AGAIN	An error occurred during enrollment process.
MEM_FULL	Flash memory is full.
FINGER_LIMIT	The number of fingerprints enrolled in same ID exceeds its limit (10).
INVALID_ID	The requested user ID is invalid. Note that '0x0000' cannot be used.
EXIST_ID	The requested user ID exists. (In case CHECK_ID flag is used)
DATA_ERROR	The checksum of a data packet is incorrect.
DATA_OK	The checksum of a data packet is correct.
EXIST_FINGER	The same finger is already enrolled. (In case CHECK_FINGER or CHECK_FINGER_AUTO_ID are used.)

All the error codes above are sent at the end of process, except "SCAN_SUCCESS" and "DATA_OK," which appear in an intermediate stage.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

ET : Enroll by Template

Enrolls a user ID by transmitting a fingerprint template from the host. The fingerprint template data can be transmitted following the ET packet. Although there is no logical problem in working of the ET command, the ETX command is more recommended because of its higher reliability inherited from the Extended Data Transfer Protocol (Appendix B).

Request command

Field	Data	Description
Start code	0x40	
Command	0x07	
Param	User ID	
Size	Template size	
Flag	0x71	ADD_NEW
	0x79	AUTO_ID
	0x70	CHECK_ID
	0x84	CHECK_FINGER
	0x85	CHECK_FINGER_AUTO_ID
	0x92	ADD_DURESS(1)
Checksum	#	
End code	0x0A	

First transmit the request command, then the fingerprint template, and finally the 0x0A.

(1) These parameters are available for SFM3500 only.

Response command

Field	Data	Description
Start code	0x40	
Command	0x07	

Param	User ID	
Size	The number of features	The number of features of the enrolled template
Error	(0x62)	(SCAN_SUCCESS)
	0x61	SUCCESS
	0x6B	TRY_AGAIN
	0x6D	MEM_FULL
	0x72	FINGER_LIMIT
	0x76	INVALID_ID
	0x6E	EXIST_ID
	0x86	EXIST_FINGER
Checksum	#	
End code	0x0A	

Refer to ES for the error codes (Page 100).

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Example

When enrolling a fingerprint by transmitting its fingerprint template of 400 (0x190) byte with a user ID,'0x0123':

Start	Command	Param	Size	Flag	Checksum	End
0x40	0x07	0x0123	0x190	0x00	0x8E	0x0A

+

Fingerprint Template	0x0A

The actual value input in the Param

1st place	2nd place	3rd place	4th place

| 0x23 | 0x01 | 0x00 | 0x00 |

The actual value input in the Size

1st place	2nd place	3rd place	4th place
0x90	0x01	0x00	0x00

Byte transmission order

0x40, 0x07,   0x23, 0x01, 0x00, 0x00,   0x90, 0x01, 0x00, 0x00,   0x00, 0x8E, 0x0A, 0x**, 0x**,

… , 0x**,   0x0A

ETX : ET with Extended Data Transfer Protocol

Enrolls a user ID by transmitting fingerprint templates from the host. Users can enroll multiple templates or a template multiple times. The transfer of template data conforms to the Data Transfer Protocol. See Appendix B Extended Data Transfer Protocol.

Request command

Field	Data	Description
Start code	0x40	
Command	0x87	
Param	User ID	
Size	(Number of templates << 24) | (Number of enroll << 16) | Template size	If Number of templates or Number of enroll is 0, it is assumed to be 1.
Flag	0x71 0x79 0x70 0x84 0x85 0x92	ADD_NEW AUTO_ID CHECK_ID CHECK_FINGER CHECK_FINGER_AUTO_ID ADD_DURESS(1)
Checksum	#	
End code	0x0A	

(1) SFM 3500 only

Response command

Field	Data	Description
Start code	0x40	
Command	0x87	

Param	User ID	
Size	Number of enrolled templates	
Error	(0x62)	(SCAN_SUCCESS)
	0x61	SUCCESS
	0x6B	TRY_AGAIN
	0x6D	MEM_FULL
	0x72	FINGER_LIMIT
	0x76	INVALID_ID
	0x6E	EXIST_ID
	0x82	DATA_ERROR
	0x83	DATA_OK
	0x86	EXIST_FINGER
Checksum	#	
End code	0x0A	

Refer to EIX for the error codes (Page 117).

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Example

(1) When enrolling ID 10 which has three 384-byte templates:

Start	Command	Param	Size*	Flag	Checksum	End
0x40	0x87	0x0A	0x3000180	0x00	0x55	0x0A

*Size = (3 << 24) | 384 = 0x3000180

After the request packet, send three 384-byte templates by Extended Data Transfer Protocol. The number of enrolled templates will be 3.

(2) When enrolling a 384-byte template two times to ID 16:

Start	Command	Param	Size*	Flag	Checksum	End
0x40	0x87	0x10	0x20180	0x00	0x5A	0x0A

*Size = (2 << 16) | 384 = 0x20180

After the request packet, send a 384-byte template by Extended Data Transfer Protocol. The number of enrolled templates will be 2.

EW : Enroll by Wiegand ID

Enrolls a user's fingerprint using Wiegand ID.

Request command

Field	Data	Description
Start code	0x40	
Command	0x1C	
Param	NULL	
Size	NULL	
Flag	0x71	ADD_NEW
	0x74	CONTINUE
	0x70	CHECK_ID
	0x84	CHECK_FINGER
	0x85	CHECK_FINGER_AUTO_ID
	0x92	ADD_DURESS
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x1C	
Param	User ID	
Size	Image Quality	Score 0 ~ 100
Error	(0x62)	(SCAN_SUCCESS)
	0x63	SCAN_FAIL
	0x6C	TIME_OUT

	0x61	SUCCESS
	0x6B	TRY_AGAIN
	0x6D	MEM_FULL
	0x72	FINGER_LIMIT
	0x76	INVALID_ID
	0x6E	EXIST_ID
	0x86	EXIST_FINGER
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SCAN_SUCCESS	Fingerprint scanning is successfully completed.
SCAN_FAIL	Sensor or fingerprint input has failed.
TIME_OUT	Timeout for Wiegand input or fingerprint input.
SUCCESS	Fingerprint enrollment is successfully completed.
TRY_AGAIN	An error occurred during enrollment process.
MEM_FULL	Flash memory is full.
FINGER_LIMIT	The number of fingerprints enrolled in same ID exceeds its limit (10).
INVALID_ID	The requested user ID is invalid. Note that '0x0000' cannot be used.
EXIST_ID	The requested user ID exists. (In case CHECK_ID flag is used)
EXIST_FINGER	The same finger is already enrolled. (In case CHECK_FINGER or CHECK_FINGER_AUTO_ID are used.)

All the error codes above are sent at the end of process, except "SCAN_SUCCESS," which appears in an intermediate stage.

Compatibility

SFM 3500 / 5500 Series

EWA : EW with Administrator's Verification

Enrolls a user's fingerprint using Wiegand ID with administrator's verification. See ESA

for details of administrator's verification.

Request command

Field	Data	Description
Start code	0x40	
Command	0x71	
Param	NULL	
Size	NULL	
Flag	0x71	ADD_NEW
	0x74	CONTINUE
	0x70	CHECK_ID
	0x84	CHECK_FINGER
	0x85	CHECK_FINGER_AUTO_ID
	0x92	ADD_DURESS
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x71	
Param	User ID	
Size	Image Quality	Score 0 ~ 100
Error	(0x62)	(SCAN_SUCCESS)
	0x63	SCAN_FAIL

	0x74	CONTINUE
	0x6C	TIME_OUT
	0x61	SUCCESS
	0x6B	TRY_AGAIN
	0x6D	MEM_FULL
	0x72	FINGER_LIMIT
	0x76	INVALID_ID
	0x6E	EXIST_ID
	0x6A	NOT_MATCH
	0x75	UNSUPPORTED
	0x86	EXIST_FINGER
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SCAN_SUCCESS	Fingerprint scanning is successfully completed.
SCAN_FAIL	Sensor or fingerprint input has failed.
CONTINUE	Administrator's verification succeeds.
TIME_OUT	Timeout for Wiegand input or fingerprint input.
SUCCESS	Fingerprint enrollment is successfully completed.
TRY_AGAIN	An error occurred during enrollment process.
MEM_FULL	Flash memory is full.
FINGER_LIMIT	The number of fingerprints enrolled in same ID exceeds its limit (10).
INVALID_ID	The requested user ID is invalid. Note that '0x0000' cannot be used.
EXIST_ID	The requested user ID exists. (In case CHECK_ID flag is used)
NOT_MATCH	Administrator's verification fails.
UNSUPPORTED	There is no user with ADMIN_ALL or ADMIN_ENROLL levels.
EXIST_FINGER	The same finger is already enrolled. (In case CHECK_FINGER or CHECK_FINGER_AUTO_ID are used.)

All the error codes above are sent at the end of process, except "SCAN_SUCCESS" and "CONTINUE," which appear in an intermediate stage.

Compatibility

SFM 3500 / 5500 Series

VS : Verify by Scan

Verifies if a fingerprint input on the sensor matches the enrolled fingerprint of the corresponding user ID.

Request command

Field	Data	Description
Start code	0x40	
Command	0x08	
Param	User ID	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x08	
Param	User ID	
Size	Sub-ID	Order of fingerprints enrolled in the same ID
Error	(0x62)	(SCAN_SUCCESS)
	0x63	SCAN_FAIL
	0x6C	TIME_OUT
	0x61	SUCCESS
	0x6B	TRY_AGAIN
	0x69	NOT_FOUND
	0x6A	NOT_MATCH

	0x90	REJECTED_ID
	0x91	DURESS_FINGER(1)
	0x94	ENTRANCE_LIMIT
	0xB0	FAKE_DETECTED
Checksum	#	
End code	0x0A	

(1) SFM3500 only

Error code

Error code	Description
SCAN_SUCCESS	Fingerprint scanning is successfully completed.
SCAN_FAIL	Sensor or fingerprint input has failed.
TIME_OUT	Timeout for fingerprint input.
SUCCESS	Identification is successfully completed.
TRY_AGAIN	Fingerprint image is not good.
NOT_FOUND	No matching template.
TIMEOUT_MATCH	Timeout for matching.
REJECTED_ID	Authentication mode is AUTH_REJECT or the ID is in the blacklist.
DURESS_FINGER	Duress finger is matched. SFM3500 only.
ENTRANCE_LIMIT	Authentication fails since the entrance limit is exceeded.
FAKE_DETECTED	Scanned fingerprint is determined as fake finger.

All the error codes above are displayed at the end of the process, except "SCAN_SUCCESS," which appears at the intermediate stage.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

VI : Verify by Image

Verifies if the fingerprint image transmitted from the host matches the enrolled fingerprint of the corresponding user ID. The fingerprint image can be transmitted following the VI packet. Although there is no logical problem in working of the VI command, the VIX command is more recommended because of its higher reliability inherited from the Extended Data Transfer Protocol (Appendix B).

Request command

Field	Data	Description
Start code	0x40	
Command	0x09	
Param	User ID	
Size	Image size	
Flag	NULL	
Checksum	#	
End code	0x0A	

First transmit the request command, then the fingerprint image, and finally the 0x0A

Response command

Field	Data	Description
Start code	0x40	
Command	0x09	
Param	User ID	
Size	Sub-ID	Order of fingerprints enrolled in the same ID
Error	(0x62)	(SCAN_SUCCESS)
	0x61	SUCCESS
	0x6B	TRY_AGAIN

	0x69	NOT_FOUND
	0x6A	NOT_MATCH
	0x90	REJECTED_ID
	0x91	DURESS_FINGER(1)
	0x94	ENTRANCE_LIMIT
Checksum	#	
End code	0x0A	

Refer to VS for the error codes (Page 131).

(1) SFM3500 only

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

VIX: VI with Extended Data Transfer Protocol

Verifies if the fingerprint image transmitted from the host matches the enrolled fingerprint of the corresponding user ID. The transfer of image conforms to the Data Transfer Protocol. See Appendix B Extended Data Transfer Protocol.

Request command

Field	Data	Description
Start code	0x40	
Command	0x82	
Param	User ID	
Size	Image size	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x82	
Param	User ID	
Size	Sub-ID	Order of fingerprints enrolled in the same ID
Error	(0x62)	(SCAN_SUCCESS)
	0x61	SUCCESS
	0x6B	TRY_AGAIN
	0x69	NOT_FOUND
	0x6A	NOT_MATCH
	0x82	DATA_ERROR

	0x83	DATA_OK
	0x90	REJECTED_ID
	0x91	DURESS_FINGER(1)
	0x94	ENTRANCE_LIMIT
Checksum	#	
End code	0x0A	

(1) SFM 3500 only

Error code

Error code	Description
SCAN_SUCCESS	Fingerprint scanning is successfully completed.
SUCCESS	Verification is successfully completed.
TRY_AGAIN	Fingerprint image is not good.
NOT_FOUND	Requested user ID is not found.
NOT_MATCH	The input fingerprint does not match the enrolled fingerprint of the corresponding user ID.
DATA_ERROR	The checksum of a data packet is incorrect.
REJECTED_ID	Authentication mode is AUTH_REJECT or the ID is in the blacklist.
DURESS_FINGER	Duress finger is matched. SFM3500 only.
ENTRANCE_LIMIT	Authentication fails since the entrance limit is exceeded.

All the error codes above are displayed at the end of the process, except "SCAN_SUCCESS" and "DATA_OK," which appear at the intermediate stage.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

VT : Verify by Template

Verifies if the fingerprint template transmitted from the host matches the enrolled fingerprint of the corresponding user ID. The fingerprint template can be transmitted following the VT packet.

Request command

Field	Data	Description
Start code	0x40	
Command	0x10	
Param	User ID	
Size	Template size	
Flag	NULL	
Checksum	#	
End code	0x0A	

First transmit the request command, then the fingerprint template, and finally the 0x0A

Response command

Field	Data	Description
Start code	0x40	
Command	0x10	
Param	User ID	
Size	Sub-ID	Order of fingerprints enrolled in the same ID
Error	(0x62)	(SCAN_SUCCESS)
	0x61	SUCCESS
	0x6B	TRY_AGAIN
	0x69	NOT_FOUND
	0x6A	NOT_MATCH

	0x90	REJECTED_ID
	0x91	DURESS_FINGER(1)
	0x94	ENTRANCE_LIMIT
Checksum	#	
End code	0x0A	

Refer to VS for the error codes (Page 131).

(1) SFM 3500 only

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

VW : Verify by Wiegand ID

Verifies if a fingerprint input on the sensor matches the enrolled fingerprint of the corresponding Wiegand ID.

Request command

Field	Data	Description
Start code	0x40	
Command	0x1D	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x1D	
Param	User ID	
Size	Sub-ID	Order of fingerprints enrolled in the same ID
Error	(0x62)	(SCAN_SUCCESS)
	0x63	SCAN_FAIL
	0x6C	TIME_OUT
	0x61	SUCCESS
	0x6B	TRY_AGAIN
	0x69	NOT_FOUND
	0x6A	NOT_MATCH

	0x90	REJECTED_ID
	0x91	DURESS_FINGER(1)
	0x94	ENTRANCE_LIMIT
Checksum	#	
End code	0x0A	

(1) SFM3500 only

Error code

Error code	Description
SCAN_SUCCESS	Fingerprint scanning is successfully completed.
SCAN_FAIL	Sensor or fingerprint input has failed.
TIME_OUT	Timeout for Wiegand input or fingerprint input.
SUCCESS	Verification is successfully completed.
TRY_AGAIN	Fingerprint image is not good.
NOT_FOUND	Requested user ID is not found.
NOT_MATCH	The input fingerprint does not match the enrolled fingerprint of the corresponding user ID.
REJECTED_ID	Authentication mode is AUTH_REJECT or the ID is in the blacklist.
DURESS_FINGER	Duress finger is matched.
ENTRANCE_LIMIT	Authentication fails since the entrance limit is exceeded.

All the error codes above are displayed at the end of the process, except "SCAN_SUCCESS," which appears at the intermediate stage.

Compatibility

SFM 3500 / 5500 Series

VH : Verify Host Template by Scan

Transmits a fingerprint template from the host to the module and verifies if it matches the live fingerprint input from the sensor. As in the Smart Card, the VH command is used when the fingerprint template is not stored in the module but transmitted by the host.

Request command

Field	Data	Description
Start code	0x40	
Command	0x22	
Param	Number of templates	Number of templates verified. Valid value is 0 to 10. 0 means 1 template.
Size	Template size	
Flag	NULL	
Checksum	#	
End code	0x0A	

First transmit the request command, then each fingerprint templates followed by 0x0A.

Response command

Field	Data	Description
Start code	0x40	
Command	0x22	
Param	NULL	
Size	NULL	
Error	(0x62)	(SCAN_SUCCESS)
	0x63	SCAN_FAIL
	0x6C	TIME_OUT
	0x61	SUCCESS

	0x6B	TRY_AGAIN
	0x6A	NOT_MATCH
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SCAN_SUCCESS	Fingerprint template scanning by module is successfully completed.
SCAN_FAIL	Sensor or fingerprint input has failed.
TIME_OUT	Timeout for fingerprint input.
SUCCESS	Fingerprint template matches the input fingerprint.
TRY_AGAIN	Fingerprint image is not good.
NOT_MATCH	Fingerprint template does not match the input fingerprint.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

WSL : Write Security Level of a User

At default, the Security Level parameter is applied both to identification and verification. By using WSL command, different security level can be defined per each user. This security level is used only for verifying the specific user. The security level for identification is not changed by this command.

Request command

Field	Data	Description
Start code	0x40	
Command	0x6B	
Param	User ID	
Size	Security level	0: Same as the Security Level parameter. 1: 1/1,000 2: 3/10,000 3: 1/10,000 4: 3/100,000 5: 1/100,000 6: 3/1,000,000 7: 1/1,000,000 8: 3/10,000,000 9: 1/10,000,000 10: 3/100,000,000 11: 1/100,000,000
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x6B	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
	0x69	NOT_FOUND
	0x75	UNSUPPORTED
	0x76	INVALID_ID
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Security level is written successfully.
NOT_FOUND	There is no such user ID.
UNSUPPORTED	Invalid security level.
INVALID_ID	Invalid user ID.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

RSL : Read Security Level of a User

Reads the security level of a user set by WSL command.

Request command

Field	Data	Description
Start code	0x40	
Command	0x6C	
Param	User ID	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x6C	
Param	NULL	
Size	Security Level	Same as WSL command
Error	0x61	SUCCESS
	0x69	NOT_FOUND
	0x76	INVALID_ID
Checksum	#	
End code	0x0A	

Error code

Error code	Description

SUCCESS	Security level is read successfully.
NOT_FOUND	There is no such user ID.
INVALID_ID	Invalid user ID.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

IS : Identify by Scan

Identifies the user ID among the enrolled fingerprints that matches the input fingerprint from the sensor. While VS verifies the fingerprint of a specific user ID, IS scans all the enrolled fingerprints within designated range of user ID. If no fingerprint is found which matches the input data, an error code, "NOT_FOUND," will appear on the error field.

Request command

Field	Data	Description
Start code	0x40	
Command	0x11	
Param	NULL	Search all enrolled user ID
	Range of user ID	Lower 16 bit value denotes lower limit of user ID, and higher 16 bit value denotes upper limit of user ID.
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x11	
Param	User ID	Identified User ID
Size	Sub-ID	Order of fingerprints enrolled in the same ID
Error	(0x62)	(SCAN_SUCCESS)
	0x63	SCAN_FAIL
	0x6C	TIME_OUT

	0x61	SUCCESS
	0x6B	TRY_AGAIN
	0x69	NOT_FOUND
	0x7A	TIMEOUT_MATCH
	0x90	REJECTED_ID
	0x91	DURESS_FINGER1(1)
	0x94	ENTRANCE_LIMIT
	0xB0	FAKE_DETECTED
Checksum	#	
End code	0x0A	

(1) SFM3500 only

Error code

Error code	Description
SCAN_SUCCESS	Fingerprint scanning is successfully completed.
SCAN_FAIL	Sensor or fingerprint input has failed.
TIME_OUT	Timeout for fingerprint input.
SUCCESS	Identification is successfully completed.
TRY_AGAIN	Fingerprint image is not good.
NOT_FOUND	No matching template.
TIMEOUT_MATCH	Timeout for matching.
REJECTED_ID	Authentication mode is AUTH_REJECT or the ID is in the blacklist.
DURESS_FINGER	Duress finger is matched. SFM3500 only.
ENTRANCE_LIMIT	Authentication fails since the entrance limit is exceeded.
FAKE_DETECTED	Scanned fingerprint is determined as fake finger.

All the error codes above are displayed at the end of the process, except "SCAN_SUCCESS," which appears at the intermediate stage.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

II : Identify by Image

Identifies a corresponding user ID among all the enrolled fingerprints, which matches the transmitted fingerprint image from the host. The fingerprint image can be transmitted following the II packet. Although there is no logical problem in working of the II command, the IIX command is more recommended because of its higher reliability inherited from the Extended Data Transfer Protocol (Appendix B).

Request command

Field	Data	Description
Start code	0x40	
Command	0x12	
Param	NULL	Search all enrolled user ID
	Range of user ID	Lower 16 bit value denotes lower limit of user ID, and higher 16 bit value denotes upper limit of user ID.
Size	Image size	
Flag	NULL	
Checksum	#	
End code	0x0A	

First transmit the request command, then the fingerprint image(RAW data), and finally the 0x0A

Response command

Field	Data	Description
Start code	0x40	
Command	0x12	
Param	User ID	Identified User ID
Size	Sub-ID	Order of fingerprints enrolled

		in the same ID
Error	(0x62)	(SCAN_SUCCESS)
	0x61	SUCCESS
	0x6B	TRY_AGAIN
	0x69	NOT_FOUND
	0x7A	TIMEOUT_MATCH
	0x90	REJECTED_ID
	0x91	DURESS_FINGER(1)
	0x94	ENTRANCE_LIMIT
Checksum	#	
End code	0x0A	

Refer to IS for the error codes.

(1)   SFM3500 only

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

IIX : II with Extended Data Transfer Protocol

Identifies a corresponding user ID among all the enrolled fingerprints, which matches the transmitted fingerprint image from the host. The transfer of image conforms to the Data Transfer Protocol. See Appendix B Extended Data Transfer Protocol.

Request command

Field	Data	Description
Start code	0x40	
Command	0x81	
Param	NULL	Search all enrolled user ID
	Range of user ID	Lower 16 bit value denotes lower limit of user ID, and higher 16 bit value denotes upper limit of user ID.
Size	Image size	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x81	
Param	User ID	Identified User ID
Size	Sub-ID	Order of fingerprints enrolled in the same ID
Error	(0x62)	(SCAN_SUCCESS)
	0x61	SUCCESS
	0x6B	TRY_AGAIN

	0x69	NOT_FOUND
	0x7A	TIMEOUT_MATCH
	0x82	DATA_ERROR
	0x83	DATA_OK
	0x90	REJECTED_ID
	0x91	DURESS_FINGER(1)
	0x94	ENTRANCE_LIMIT
Checksum	#	
End code	0x0A	

(1) SFM 3500 / 5500 only

Error code

Error code	Description
SCAN_SUCCESS	Fingerprint scanning is successfully completed.
SUCCESS	Identification is successfully completed.
TRY_AGAIN	Fingerprint image is not good.
NOT_FOUND	No matching template.
TIMEOUT_MATCH	Timeout for matching.
DATA_ERROR	The checksum of a data packet is incorrect.
DATA_OK	The checksum of a data packet is correct.
REJECTED_ID	Authentication mode is AUTH_REJECT or the ID is in the blacklist.
DURESS_FINGER	Duress finger is matched. SFM3500 only.
ENTRANCE_LIMIT	Authentication fails since the entrance limit is exceeded.

All the error codes above are displayed at the end of the process, except "SCAN_SUCCESS" and "DATA_OK," which appear at the intermediate stage.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

IT : Identify by Template

Identifies a corresponding user ID among all the enrolled fingerprints, which matches the transmitted fingerprint template from the host. The fingerprint template can be transmitted following the IT packet.

Request command

Field	Data	Description
Start code	0x40	
Command	0x13	
Param	NULL	Search all enrolled user ID
	Range of user ID	Lower 16 bit value denotes lower limit of user ID, and higher 16 bit value denotes upper limit of user ID.
Size	Template size	
Flag	NULL	
Checksum	#	
End code	0x0A	

First transmit the request command, then the fingerprint template, and finally the 0x0A

Response command

Field	Data	Description
Start code	0x40	
Command	0x13	
Param	User ID	Identified User ID
Size	Sub-ID	Order of fingerprints enrolled in the same ID
Error	(0x62)	(SCAN_SUCCESS)
	0x61	SUCCESS

	0x6B	TRY_AGAIN
	0x69	NOT_FOUND
	0x7A	TIMEOUT_MATCH
	0x90	REJECTED_ID
	0x91	DURESS_FINGER(1)
	0x94	ENTRANCE_LIMIT
Checksum	#	
End code	0x0A	

Refer to IS for the error codes.

(1) SFM3500 only

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

DA : Delete All Templates

Deletes all user IDs and fingerprint templates stored in the module. Please use carefully this command because it will delete all data.

Request command

Field	Data	Description
Start code	0x40	
Command	0x17	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x17	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Deletion of all templates is successfully completed.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

DAA : DA with Administrator's Verification

Deletes all user IDs and fingerprint templates with administrator's verification. See ESA for details of administrator's verification. When there is no user, SUCCESS will be returned immediately.

Request command

Field	Data	Description
Start code	0x40	
Command	0x74	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x74	
Param	NULL	
Size	NULL	
Error	(0x62)	(SCAN_SUCCESS)
	0x74	CONTINUE
	0x61	SUCCESS
	0x6A	NOT_MATCH
	0x75	UNSUPPORTED
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Deletion of all templates is successfully completed.
CONTINUE	Administrator's verification succeeds.
NOT_MATCH	Administrator's verification fails.
UNSUPPORTED	There is no user with ADMIN_ALL or ADMIN_DELETE levels.

All the error codes above are displayed at the end of the process, except "CONTINUE," which appear at the intermediate stage.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

DT : Delete Template

Deletes a user ID and its fingerprint template stored in the module. Users can also delete just one template by selecting DELETE_ONLY_ONE option. Or, users can delete the enrolled templates of multiple IDs by selecting DELETE_MULTIPLE_ID option.

Request command

Field	Data	Description
Start code	0x40	
Command	0x16	
Param	User ID	
Size	Sub index or Last user ID	Sub index if DELETE_ONLY_ONE option is given. Last user ID if DELETE_MULTIPLE_ID option is given.
Flag	NULL DELETE_ONLY_ONE(0x70)* DELETE_MULTIPLE_ID(0x71)*	
Checksum	#	
End code	0x0A	

*These options have been supported since V1.5 firmware of SFM3000/3500.

Response command

Field	Data	Description
Start code	0x40	
Command	0x16	
Param	N/A	
Size	Number of deleted IDs if	

	DELETE_MULTIPLE_ID option is given	
Error	0x61	SUCCESS
	0x69	NOT_FOUND
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Templates are deleted successfully.
NOT_FOUND	There is no matching user ID found.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Example

(1) To delete user ID 10:

Param	Size	Flag
0x0A	Null	Null

(2) To delete the second template of user ID 10:

Param	Size	Flag
0x0A	1	DELETE_ONLY_ONE(0x70)

(1) To delete user ID 10 ~ 20:

Param	Size	Flag
0x0A	0x14	DELETE_MULTIPLE_ID(0x71)

DS : Delete by Scan

Identifies the user ID among the enrolled fingerprints that matches the input fingerprint from the sensor and deletes found ID and its fingerprint templates stored in the module.

Request command

Field	Data	Description
Start code	0x40	
Command	0x1E	
Param	NULL	Search all enrolled user ID
	Range of user ID	Lower 16 bit value denotes lower limit of user ID, and higher 16 bit value denotes upper limit of user ID.
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x1E	
Param	User ID	Deleted user ID
Size	NULL	
Error	(0x62)	(SCAN_SUCCESS)
	0x63	SCAN_FAIL
	0x6C	TIME_OUT
	0x61	SUCCESS
	0x6B	TRY_AGAIN

	0x69	NOT_FOUND
	0x7A	TIMEOUT_MATCH
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SCAN_SUCCESS	Fingerprint scanning is successfully completed.
SCAN_FAIL	Sensor or fingerprint input has failed.
TIME_OUT	Timeout for fingerprint input.
SUCCESS	Fingerprint enrollment is successfully completed.
TRY_AGAIN	Fingerprint image is not in a good quality.
NOT_FOUND	Requested user ID is not found.
TIMEOUT_MATCH	Timeout for matching.

All the error codes above are displayed at the end of the process, except "SCAN_SUCCESS," which appears at the intermediate stage.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

DSA : DS with Administrator's Verification

Deletes by scan with administrator's verification. See ESA for details of administrator's verification. You cannot delete an administration id using this command.

Request command

Field	Data	Description
Start code	0x40	
Command	0x72	
Param	NULL	Search all enrolled user ID
	Range of user ID	Lower 16 bit value denotes lower limit of user ID, and higher 16 bit value denotes upper limit of user ID.
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x72	
Param	User ID	Deleted user ID
Size	NULL	
Error	(0x62)	(SCAN_SUCCESS)
	0x63	SCAN_FAIL
	0x74	CONTINUE
	0x6C	TIME_OUT
	0x61	SUCCESS

	0x6B	TRY_AGAIN
	0x69	NOT_FOUND
	0x7A	TIMEOUT_MATCH
	0x6A	NOT_MATCH
	0x75	UNSUPPORTED
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SCAN_SUCCESS	Fingerprint scanning is successfully completed.
SCAN_FAIL	Sensor or fingerprint input has failed.
CONTINUE	Administrator's verification succeeds.
TIME_OUT	Timeout for fingerprint input.
SUCCESS	Fingerprint enrollment is successfully completed.
TRY_AGAIN	Fingerprint image is not good.
NOT_FOUND	Requested user ID is not found.
TIMEOUT_MATCH	Timeout for matching.
NOT_MATCH	Administrator's verification fails
UNSUPPORTED	There is no user with ADMIN_ALL or ADMIN_DELETE levels.* Cannot delete an administration id using DSA command.**

* If UNSUPPORTED is returned immediately after DSA command

** If UNSUPPORTED is returned after administrator's verification succeeds.

All the error codes above are displayed at the end of the process, except "SCAN_SUCCESS" and "CONTINUE," which appear at the intermediate stage.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

DW : Delete by Wiegand ID

Deletes Wiegand ID and its fingerprint template stored in the module.

Request command

Field	Data	Description
Start code	0x40	
Command	0x1F	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x1F	
Param	User ID	
Size	NULL	
Error	(0x62)	(SCAN_SUCCESS)
	0x61	SUCCESS
	0x69	NOT_FOUND
	0x6C	TIMEOUT
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Template delete is successfully completed.
NOT_FOUND	There is no matching user ID found.
TIMEOUT	Timeout for Wiegand input.

Compatibility

SFM 3500 / 5500 Series

DWA : DW with Administrator's Verification

Deletes by Wiegand ID with administrator's verification. See ESA for details of administrator's verification. You cannot delete an administration id using this command.

Request command

Field	Data	Description
Start code	0x40	
Command	0x73	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x73	
Param	User ID	
Size	NULL	
Error	(0x62)	(SCAN_SUCCESS)
	0x74	CONTINUE
	0x61	SUCCESS
	0x69	NOT_FOUND
	0x6C	TIMEOUT
	0x6A	NOT_MATCH
	0x75	UNSUPPORTED
Checksum	#	

End code	0x0A	

Error code

Error code	Description
CONTINUE	Administrator's verification succeeds.
SUCCESS	Template delete is successfully completed.
NOT_FOUND	There is no matching user ID found.
TIMEOUT	Timeout for Wiegand input.
NOT_MATCH	Administrator's verification fails.
UNSUPPORTED	There is no user with ADMIN_ALL or ADMIN_DELETE levels.* Cannot delete an administration id using DWA command.**

* If UNSUPPORTED is returned immediately after DSA command

** If UNSUPPORTED is returned after administrator's verification succeeds.

All the error codes above are displayed at the end of the process, except "CONTINUE," which appear at the intermediate stage.

Compatibility

SFM 3500 / 5500 Series

LT : List User ID

Reads the list of user IDs enrolled in the module. With block index and block size parameters, users can receive part of enrolled IDs. For example, assume that there are 490 enrolled templates. If block size is 50 and block index is 0, only the first 50 IDs(1st ~ 50th) will be returned. If block index is 9, the last 40 IDs(451st ~ 490th)   will be returned. If block size is 0, the module ignores block index and returns all the IDs.

Request command

Field	Data	Description
Start code	0x40	
Command	0x18	
Param	Block Index[1]	Starting from 0.
Size	Block Size[1]	If block size is 0, the module ignores the block index and returns all the IDs.
Flag	NULL	
Checksum	#	
End code	0x0A	

(1) These parameters are available SFM3000/3500/4000/5000/5500/6000 only.

Response command

Field	Data	Description
Start code	0x40	
Command	0x18	
Param	Templates count	The number of templates returned
Size	Data size	(The number of templates returned) * 4
Error	0x61	SUCCESS

	0x76	INVALID_ID
Checksum	#	
End code	0x0A	

First transmits the response command and then the user ID.

User ID (4byte)	User ID (4byte)	…	User ID (4byte)	User ID (4byte)	0x0A

Error code

Error code	Description
SUCCESS	Successfully completed.
INVALID_ID	Block index is out of range.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Example

If the user IDs to be returned are 0x0304, 0x0587, 0x8859

Start	Command	Param	Size	Flag	Checksum	End
0x40	0x18	0x03	0x0C	0x61	0xC8	0x0A

The actual value input in the Param

1st place	2nd place	3rd place	4th place
0x03	0x00	0x00	0x00

The actual value input in the Size

1st place	2nd place	3rd place	4th place
0x0C	0x00	0x00	0x00

User ID Data

User ID	User ID	User ID	
0x0304	0x0587	0x8859	0x0A

Byte transmission order

0x40, 0x18,   0x03, 0x00, 0x00, 0x00,   0x0C, 0x00, 0x00, 0x00,   0x61, 0xC8, 0x0A,

0x04, 0x03, 0x00, 0x00, 0x87, 0x05, 0x00, 0x00, 0x59, 0x88, 0x00, 0x00, 0x0A

LTX : LT with Extended Data Transfer Protocol

Reads the list of user IDs enrolled in the module with Extended Data Transfer Protocol. LTX returns 8 byte data for each template. The 2 byte checksum is calculated by summing up all the template data. This checksum can be used to check if two templates are identical.

User ID	(Security Level << 4) | Duress	(Authentication Mode << 6) | (Administration Level << 4) | Sub ID	Checksum
4 bytes	1 byte	1 byte	2 bytes

Request command

Field	Data	Description
Start code	0x40	
Command	0x86	
Param	0	.
Size	Maximum length of data packet size	If 0, it is the total size of data
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x86	
Param	Templates count	The number of templates to be returned
Size	Data size	(The number of templates to be returned) * 8

Error	0x61	SUCCESS
	0x6D	MEM_FULL
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Successfully completed.
MEM_FULL	Out of memory.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Example

For example, Template 1 and Template 2 are enrolled to ID 1 and Template 1 is duress finger. Template 3 and Template 4 are enrolled to ID2 and the administration level of ID2 is ADMIN_ALL (0x03).

(1) Request Packet

Start	Command	Param	Size	Flag	Checksum	End
0x40	0x86	0x00	0x00	0x00	0xC6	0x0A

Since size parameter is 0, the module will send all the data in one data packet.

(2) Response Packet

Start	Command	Param	Size	Flag	Checksum	End
0x40	0x86	0x04	0x20	0x61	0x4B	0x0A

Template Count: 4, Data Size: 32

(3) Data Packet Header

Start	Command	Num of Packet	Packet Index	Data Size	Flag	Checksum	End
0x40	0x86	0x01	0x00	0x20	0x00	0xE7	0x0A

(4) Data Packet Body

	ID	Duress	(Admin Level << 4) | Sub ID	Checksum
Template 1	0x01	0x01	0x00	##
Template 2	0x01	0x00	0x01	##
Template 3	0x02	0x00	0x30	##
Template 4	0x02	0x00	0x31	##

CT : Check User ID

Checks if the user ID exists in the module. Also returns the existing number of enrolled templates for the user ID.

Request command

Field	Data	Description
Start code	0x40	
Command	0x19	
Param	User ID	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x19	
Param	User ID	
Size	Number of Templates	Number of enrolled templates for the user ID
Error	0x6E	EXIST_ID
	0x69	NOT_FOUND
Checksum	#	
End code	0x0A	

Error code

Error code	Description
EXIST_ID	The user ID exists in the module.
NOT_FOUND	The user ID is not found in the module.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

FP : Fix All Provisional Templates

Fix all provisional templates which are enrolled when the Provisional Enroll of system parameter is on.

Request command

Field	Data	Description
Start code	0x40	
Command	0x23	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x23	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
	0x69	NOT_FOUND
Checksum	#	
End code	0x0A	

Error code

Error code	Description

SUCCESS	All provisional templates are fixed.
NOT_FOUND	No provisional template exists.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

DP : Delete All Provisional Templates

Delete all provisional templates which are enrolled when the Provisional Enroll of system parameter is on.

Request command

Field	Data	Description
Start code	0x40	
Command	0x24	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x24	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
	0x69	NOT_FOUND
Checksum	#	
End code	0x0A	

Error code

Error code	Description

SUCCESS	All provisional templates are deleted.
NOT_FOUND	No provisional template exists.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

RI : Read Image

Reads the fingerprint image received from the sensor.

First execute such commands as ES, VS and IS in order to use this command. The fingerprint images in this process are transmitted in a raw data format as SEND_IMAGE structures, of which has a structure as follows. In order to save any fingerprint images in the module, first execute the ES, VS and IS commands. Without executing these commands, the module cannot be updated.

typedef struct SEND_IMAGE {

    int width;

    int height;

    int compressed;

    int encrypted;

    int binary;

    int img_len;

    int template_len;

    char buffer[BUFFER_LENGTH];

} image_t;

Member Variable	Description
Width (4byte)	Width of fingerprint images
Height (4byte)	Height of fingerprint images
Compressed (4byte)	Compression status – Currently not used In case of 4bit gray mode, starting point of actually transmitted image is designated. Lower word is x coordinate and higher word is y coordinate.
Encrypted (4byte)	Encryption status– Currently not used In case of 4bit gray mode, size of actually transmitted image is designated. Lower word is width and higher word is height.

Binary (4byte)	Image Format : 0 – gray, 1 – binary, 2 – 4bit gray
Img_len (4byte)	Size of the fingerprint image received from the sensor = width * height
Template_len (4byte)	Size of the fingerprint template – Currently not used
Buffer (1byte*BUFFER_LENGTH)	Actual raw image data BUFFER_LENGTH=200*1024 (=200Kbyte) max 1) When the image format is binary: 1 byte per 8 pixels Size of data actually transmitted: Img_len/8+1 2) When the image format is gray: 1 byte per 1 pixel Size of data actually transmitted: Img_len (=Width*Height) 3) When the image format is 4bit gray: 1 byte per 2 pixel Size of data actually transmitted: Actual width * height / 2

Request command

Field	Data	Description
Start code	0x40	
Command	0x20	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x20	
Param	NULL	

Size	Data size	When image format is binary: 4*7 + (Img_len/8)+1 When image format is gray: 4*7 + Img_len When image format is 4 bit gray: 4*7 + actual width * actual height / 2
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

First transmits the response command, then the image data, and finally the 0x0A

Error code

Error code	Description
SUCCESS	Fingerprint image reading is successfully completed.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Example

Image reading request command:

Start	Command	Param	Size	Flag	Checksum	End
0x40	0x20	0x00	0x00	0x00	0x60	0x0A

Example of a request command sent from the module:

- Infineon sensor: 224 * 288 pixels = 64512 (= 0xFC00) pixels

- Image format: binary

- Binary image data size: (64512 / 8) + 1 = 8065

- Total data size: (4 byte * 7) + 8065 byte = 8093 (=0x1F9D) byte

Start	Command	Param	Size	Error	Checksum	End
0x40	0x20	0x00	0x1F9D	0x61	0x7D	0x0A

Width	Height	Compressed	Encrypted	Binary	Img_len	Template_len
0xE0	0x120	0x00	0x00	0x01	0xFC00	0x00

Buffer[0]	Buffer[1]	…		Buffer[8063]	Buffer[8064]	End
0xEF	0x2C	…	…	0x1A	0xFE	0x0A

Received data order

0x40, 0x20,   0x00, 0x00, 0x00, 0x00,   0x9D, 0x1F, 0x00, 0x00,   0x61, 0x7D, 0x0A,

0xE0, 0x00, 0x00, 0x00,   0x20, 0x01, 0x00, 0x00,   0x00, 0x00, 0x00, 0x00,

0x00, 0x00, 0x00, 0x00,   0x01, 0x00, 0x00, 0x00,   0x00, 0xFC, 0x00, 0x00,

0x00, 0x00, 0x00, 0x00,   0xEF, 0x2C, …, 0x1A, 0xFE,   0x0A

If the image format is binary, the data in the buffer of the SEND_IMAGE structures will be 1byte data packed from 8 pixels of the image raw data sent by the sensor. Below is an operation example to unpack the binary data with 1byte per 1 pixel.

```
Void img_display_from_buffer()
{
```

```
        unsigned char *uncomp_buffer,*img_buf,*ptr;

        int len,i;

        unsigned long uncomp_len;

        image_t receive_img;


        // g_bin_buffer(buffer with received data inside)
        // total_bin_size(total size of received data) are global variables
        memcpy(&receive_img,(image_t*)g_bin_buffer,total_bin_size);


        img_buf=new unsigned char[receive_img.img_len];

        ptr=img_buf;

        // Check if the image format is binary

        if(receive_img.binary){

                // Data size sent in binary = (Actual image size)/8

                for(i=0;i<receive_img.img_len/8;i++){

                        bit operation to divide 1 byte into 8 bytes

                        *ptr=(receive_img.buffer[i] & 1)?255:0;

                        ptr++;

                        *ptr=(receive_img.buffer[i]>>1 & 1)?255:0;

                        ptr++;

                        *ptr=(receive_img.buffer[i]>>2 & 1)?255:0;

                        ptr++;

                        *ptr=(receive_img.buffer[i]>>3 & 1)?255:0;

                        ptr++;

                        *ptr=(receive_img.buffer[i]>>4 & 1)?255:0;

                        ptr++;

                        *ptr=(receive_img.buffer[i]>>5 & 1)?255:0;

                        ptr++;

                        *ptr=(receive_img.buffer[i]>>6 & 1)?255:0;
```

```
                              ptr++;

                              *ptr=(receive_img.buffer[i]>>7 & 1)?255:0;

                              ptr++;

                      }

              } else {

                      // Put the image into the buffer, for it is not in binary format.

                      memcpy(img_buf,receive_img.buffer,receive_img.img_len);

              }

              // img_buf

      }
```

RIX : RI with Extended Data Transfer Protocol

Reads the fingerprint image received from the sensor. The transfer of image conforms to the Data Transfer Protocol. See Appendix B Extended Data Transfer Protocol.

Request command

Field	Data	Description
Start code	0x40	
Command	0x84	
Param	NULL[1] WSQ compression rate[2]	The value is used to change WSQ compression bit rate. The value is used as type of floating number divided by 100 on firmware. If the value is 0, default value is set to 225. Recommended values are as follow : 225 : High Quality (HQ) 150 : Midium Quality (MQ) 75 : Low Quality (LQ) HQ image is compressed by approx 1/5 compared to gray image. LQ image is approx 1/15.
Size	Maximum length	Maximum length of a data packet body
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x84	
Param	NULL	
Size	Image size	When image format is binary: 4*7 + (Img_len/8)+1 When image format is gray: 4*7 + Img_len When image format is 4 bit gray: 4*7 + actual width * actual height / 2
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Fingerprint image reading is successfully completed.

Compatibility

(1) SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

(2) SFM 5500 only.

SI : Scan Image

Scans a live fingerprint image from the sensor. If the command is successful, captured image data is sent from the module, whose data format is same as that of RI command. Although there is no logical problem in working of the SI command, the SIX command is more recommended because of its higher reliability inherited from the Extended Data Transfer Protocol (Appendix B).

Request command

Field	Data	Description
Start code	0x40	
Command	0x15	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x15	
Param	NULL	
Size	Image size	Size of image data transmitted
Error	(0x62)	(SCAN_SUCCESS)
	0x63	SCAN_FAIL
	0x6C	TIME_OUT
	0x61	SUCCESS
Checksum	#	
End code	0x0A	

First transmits the response command, then the image data, and finally the 0x0A

Error code

Error code	Description
SCAN_SUCCESS	Fingerprint image scanning by module is successfully completed.
SCAN_FAIL	Sensor or fingerprint input has failed.
TIME_OUT	Timeout for fingerprint input.
SUCCESS	Fingerprint image is successfully read.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

SIX : SI with Extended Data Transfer Protocol

Scan live fingerprint image from the sensor. The transfer of image conforms to the Data Transfer Protocol. See Appendix B Extended Data Transfer Protocol.

Request command

Field	Data	Description
Start code	0x40	
Command	0x83	
Param	NULL	
Size	Maximum length	Maximum length of a data packet body
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x83	
Param	NULL	
Size	Image size	Size of image data transmitted
Error	(0x62)	(SCAN_SUCCESS)
	0x63	SCAN_FAIL
	0x6C	TIME_OUT
	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SCAN_SUCCESS	Fingerprint image scanning by module is successfully completed.
SCAN_FAIL	Sensor or fingerprint input has failed.
TIME_OUT	Timeout for fingerprint input.
SUCCESS	Fingerprint image is successfully read.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

RT : Read Template

Reads the fingerprint templates stored in the module. When reading the fingerprint template of a specific user ID, input the user ID in the Param field. Input "NULL" in the Param to read the latest fingerprint template created in the sensor. Although there is no logical problem in working of the RT command, the RTX command is more recommended because of its higher reliability inherited from the Extended Data Transfer Protocol (Appendix B).

Request command

Field	Data	Description
Start code	0x40	
Command	0x14	
Param	NULL User ID	NULL denotes the latest fingerprint template created
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x14	
Param	NULL	
Size	Template size	
Error	0x61 0x69 0x74	SUCCESS NOT_FOUND CONTINUE

Checksum	#	
End code	0x0A	

First transmit the response command, then the fingerprint template, and finally the 0x0A

Error code

Error code	Description
SUCCESS	Fingerprint template reading is successfully completed.
CONTINUE	When there are more users to be enrolled.
NOT_FOUND	There is no fingerprint template or matching user ID found.

If there are more than two fingerprint templates enrolled as one user ID, the host will receive two response commands. If the error code of the first response command is read CONTINUE, it means that there is one more fingerprint enrolled as the corresponding user ID. Then, the host will receive the next packet instantly.

For example, if there are two fingerprint templates enrolled as one user ID, the process order is as follows:

Response command + Template1 + 0x0A + Response command + Template2 + 0x0A

If the error code of the first response command is read "SUCCESS," it means that there are no more fingerprint templates enrolled as the corresponding user ID.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

RTX : RT with Extended Data Transfer Protocol

Reads the fingerprint templates stored in the module. Unlike RT which will read all the templates enrolled to an ID, users can read one template at a time by selecting a sub index. The transfer of template data conforms to Data Transfer Protocol. See Appendix B Extended Data Transfer Protocol.

Request command

Field	Data	Description
Start code	0x40	
Command	0x89	
Param	NULL User ID	NULL denotes the latest fingerprint template created
Size	(Sub index << 16) | Maximum length of a data packet body	Sub index is from 0 to 9.
Flag	0 1	Ignore sub index and reads all the templates of the specified ID. Reads one template of the specified sub index.
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x89	
Param	User ID	
Size	(Number of templates to be returned << 16) |	

	Template size	
Error	0x61	SUCCESS
	0x69	NOT_FOUND
	0x75	UNSUPPORTED
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	The templates are read successfully.
NOT_FOUND	There is no fingerprint template or matching user ID found.
UNSUPPORTED	Invalid parameters.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

ST : Scan Template

This command is used when a host wants to read the fingerprint template of a live fingerprint without enrolling or verifying process. Reads the fingerprint template of a live fingerprint on sensor and does not store in the module.

Request command

Field	Data	Description
Start code	0x40	
Command	0x21	
Param	NULL	
Size	NULL	
Flag	NULL	
	ADD_CHECKSUM(0x70)*	If ADD_CHECKSUM option is given, the module will insert 4 byte checksum before the end code(0x0A).
Checksum	#	
End code	0x0A	

*ADD_CHECKSUM has been supported since V1.5 firmware of SFM3000/3500.

Response command

Field	Data	Description
Start code	0x40	
Command	0x21	
Param	Image quality score	0 ~ 100
Size	Template size	
Error	(0x62)	(SCAN_SUCCESS)
	0x63	SCAN_FAIL

	0x6C	TIME_OUT
	0x61	SUCCESS
	0x6B	TRY_AGAIN
Checksum	#	
End code	0x0A	

First transmit the response command, then the fingerprint template, and finally the 0x0A. If ADD_CHECKSUM option is given, 4 byte checksum will be inserted before 0x0A. The checksum is calculated over the whole template data.

Error code

Error code	Description
SCAN_SUCCESS	Fingerprint template scanning by module is successfully completed.
SCAN_FAIL	Sensor or fingerprint input has failed.
TIME_OUT	Timeout for fingerprint input.
SUCCESS	Fingerprint template is successfully read.
TRY_AGAIN	Fingerprint image is not good.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Example

Refer to ES (Page 100) and RT (Page 196)

KS : Scan Template with Challenge Data

This command is similar to ST, except that 4 bytes of challenge data is provided in the command. Then, the response packet includes the supplementary data, made by encrypting (challenge data + obtained template).

The size of the returned data will be multiple of 32 bytes, since supported AES encryption algorithm processes data based on 32 byte block.

If the module is not in encryption mode, the responding supplementary data will be non-encrypted one of (challenge data + template data). The supplementary data should be followed by EOP.

Request command

Field	Data	Description
Start code	0x40	
Command	0x35	
Param	Challenge data	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x35	
Param	NULL	
Size	Template size	
Error	(0x62)	(SCAN_SUCCESS)

	0x63	SCAN_FAIL
	0x6C	TIME_OUT
	0x61	SUCCESS
	0x6B	TRY_AGAIN
Checksum	#	
End code	0x0A	

First transmit the response command, then the fingerprint template, and finally the 0x0A

Error code

Error code	Description
SCAN_SUCCESS	Fingerprint template scanning by module is successfully completed.
SCAN_FAIL	Sensor or fingerprint input has failed.
TIME_OUT	Timeout for fingerprint input.
SUCCESS	Fingerprint template is successfully read.
TRY_AGAIN	Fingerprint image is not good.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

KW : Write Encryption Key

Changes encryption key, which is 32 bytes. In order to change the key, there should be no stored fingerprint data in the module in order to avoid ambiguity problem. After using the KW command, the SF command should be used to save encryption key in flash memory.

The request command should be followed by new key data of 32 bytes and packet end code. Thus, 33 bytes data (new key (32byte) + EOP(0x0A)) should be provided as the supplementary data.

If the request is unsuccessful, UNSUPPORTED code is returned.

Default encryption key is { 0x01, 0x00, ….. , 0x00 }

Request command

Field	Data	Description
Start code	0x40	
Command	0x34	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

First transmits the request command, then the key data, and finally the 0x0A

Response command

Field	Data	Description
Start code	0x40	
Command	0x34	

Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
	0x75	UNSUPPORTED
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Key is successfully written.
UNSUPPORTED	Enrolled fingerprint exists.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

ML : Get Size of User Memory

Returns size of user memory in Bytes.

Request command

Field	Data	Description
Start code	0x40	
Command	0x31	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x31	
Param	Size of user memory	
Size	NULL	
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Successfully completed.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

MW : Write to User Memory

Writes data to user memory. The SF command should be used to save in flash memory

Request command

Field	Data	Description
Start code	0x40	
Command	0x32	
Param	Offset	First position to be written
Size	Length	Data length
Flag	NULL	
Checksum	#	
End code	0x0A	

First transmits the request command, then user data, and finally the 0x0A

Response command

Field	Data	Description
Start code	0x40	
Command	0x32	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
	0x75	UNSUPPORTED
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	User data is successfully written.
UNSUPPORTED	Offset exceeds size of user memory.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

MR : Read from User Memory

Reads data from user memory.

Request command

Field	Data	Description
Start code	0x40	
Command	0x33	
Param	Offset	First position to be read
Size	Length	Data length
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x33	
Param	NULL	
Size	Size	Actual size to be read
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

First transmits the response command, then user data, and finally the 0x0A

Error code

Error code	Description

SUCCESS	User data is successfully read.
UNSUPPORTED	Offset exceeds size of user memory.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

TW : Write Current Time

Writes current date and time. The year of the date parameter can be from 0 to 89 and will be added to 2000. For example, if the year is 2005, the year field of the date should be 5.

Request command

Field	Data	Description
Start code	0x40	
Command	0x3A	
Param	(DD<<16) | (MM<<8) | YY	Date
Size	(ss<<16) | (mm<<8) | hh	Time
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x3A	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Current time is successfully written.

Compatibility

SFM 3500 / 5500 Series

TR : Read Current Time

Reads current date and time.

Request command

Field	Data	Description
Start code	0x40	
Command	0x3B	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x3B	
Param	(DD<<16) | (MM<<8) | YY	Date
Size	(ss<<16) | (mm<<8) | hh	Time
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Deletion of all templates is successfully completed.

Compatibility

SFM 3500 / 5500 Series

LN : Get Number of Log Data

Returns number of log data.

Request command

Field	Data	Description
Start code	0x40	
Command	0x3C	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x3C	
Param	Number of stored log data	
Size	Number of total log data	Stored + empty
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Successfully completed.

Compatibility

SFM 3500 / 5500 Series

LR : Read Log Data

Reads log data.

The structure of log data is as follows.

Field	Size	Description
Event	1 byte	Output function ID (See OW command)
Source	1 byte	0x01 : Host port 0x02 : Auxiliary port 0x03 : Wiegand input 0x04 : IN0 port 0x05 : IN1 port 0x06 : IN2 port 0x07 : Freescan
Date	3 byte	YY MM DD
Time	3 byte	hh mm ss
User ID	4 byte	User ID
Reserved	4 byte	This field can be set by LC command.

Request command

Field	Data	Description
Start code	0x40	
Command	0x3D	
Param	Start index	
Size	Requested count	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x3D	
Param	NULL	
Size	Actual count	
Error	0x61	SUCCESS
	0x75	UNSUPPORTED
Checksum	#	
End code	0x0A	

First transmits the response command, then log data (actual count x 16 bytes), and finally the 0x0A

Error code

Error code	Description
SUCCESS	Log data is successfully read.
UNSUPPORTED	Start index or requested size is invalid.

Compatibility

SFM 3500 / 5500 Series

LD : Delete Log Data

Deletes log data. The requested count should be a multiple of 256. If it is not a multiple of 256, the next multiple number of logs will be deleted. For example, if the requested count is 300, 512 logs will be deleted.

Request command

Field	Data	Description
Start code	0x40	
Command	0x3E	
Param	Requested count	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x3E	
Param	Actual count to be deleted	
Size	NULL	
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description

SUCCESS	Log data is successfully deleted.

Compatibility

SFM 3500 / 5500 Series

LC : Set/Get the Custom Log Field

There is a 4 byte reserved field in each log record. LC command is used for setting or getting this custom value. If the custom field is not set, the reserved field will be filled with NULL. This command would be most useful for Time & Attendance applications, in which custom log records are necessary.

User can set 4 types of custom log field.

Custom Log Field	Description
0x00: Default	If the log is generated by Packet Protocol commands or freescan, this value will be used.
0x01: IN0	If the log is generated by an Input port, the respective values will be used.
0x02: IN1	
0x03: IN2	

Request command

Field	Data	Description
Start code	0x40	
Command	0x3F	
Param	Custom field value	
Size	Custom field type	0x00: Default 0x01: IN0 0x02: IN1 0x03: IN2
Flag	0	Read custom value
	1	Write custom value
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x3F	
Param	Custom field value	
Size	NULL	
Error	0x61	SUCCESS
	0x75	UNSUPPORTED
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Custom field is read or written successfully.
UNSUPPORTED	Invalid field type.

Compatibility

SFM 3500 / 5500 Series

RCL : Read Current Log in Cache

The module has a 256 byte log cache, which can hold up to 16 recent log records. The log cache is cleared as soon as it is read by RCL command. By using this command, users can monitor the status of the module in real time.

The data transfer conforms to the Extended Data Transfer protocol.

Request command

Field	Data	Description
Start code	0x40	
Command	0xEC	
Param	NULL	
Size	Data packet size	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xEC	
Param	Number of log records	
Size	Log data size	Number of log records * 16
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Log data is successfully read.

Compatibility

SFM 3500 / 5500 Series

CCL : Clear Log Cache

Clears the log cache. This command can be used when starting real time monitoring.

Request command

Field	Data	Description
Start code	0x40	
Command	0xEB	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xEB	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Loc cache is cleared.

Compatibility

SFM 3500 / 5500 Series

WW : Write Wiegand Configuration (Deprecated)

Writes configuration of Wiegand I/O. If Wiegand input is set to a function, the module will start the function automatically on detecting a Wiegand input.

The function for Wiegand I/O is as follows.

Port	Function ID	Function Name
Input	0x00	No action
	0x12	Enroll Given ID
	0x22	Verify Given ID
	0x42	Delete Given ID
Output	0x5A	Output Matched ID

Since firmware V1.4, WW, WR, WG, and WS commands are deprecated. It is highly recommended that extended Wiegand protocol is used in place of these commands. See Appendix C. Extended Wiegand Protocol and WWX, WRX, WGX, WSX, WPW, and WPR commands.

Request command

Field	Data	Description
Start code	0x40	
Command	0x41	
Param	(FC Bits<<16) | (Format<<8) | Function ID	Format is always 0 for Wiegand 26 bits
Size	FC code	
Flag	0x00	Wiegand input port
	0x01	Wiegand output port
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x41	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
	0x75	UNSUPPORTED
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Configuration of Wiegand is successfully written.
UNSUPPORTED	Port or format is invalid.

Compatibility

SFM 3500 / 5500 Series

Example

Set Wiegand input function to Verify Given ID(0x22), FC bits to 8, FC code to 1.

Start	Command	Param	Size	Flag	Checksum	End
0x40	0x41	0x080022	0x01	0x00	0xAC	0x0A

Byte transmission order

0x40, 0x41,   0x22, 0x00, 0x08, 0x00,   0x01, 0x00, 0x00, 0x00,   0x00, 0xAC, 0x0A

WR : Read Wiegand Configuration (Deprecated)

Reads configuration of Wiegand I/O.

Request command

Field	Data	Description
Start code	0x40	
Command	0x42	
Param	NULL	
Size	NULL	
Flag	0x00	Wiegand input port
	0x01	Wiegand output port
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x42	
Param	(FC Bits<<16) | (Format<<8) | Function ID	Format is always 0 for Wiegand 26 bits
Size	FC code	
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description

SUCCESS	Configuration of Wiegand is successfully read.
UNSUPPORTED	Port is invalid.

Compatibility

SFM 3500 / 5500 Series

WG : Get Wiegand Input (Deprecated)

Reads current state of Wiegand input port.

Request command

Field	Data	Description
Start code	0x40	
Command	0x43	
Param	0	Clear state after read
	1	Remain state
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x43	
Param	Wiegand ID	
Size	FC code	
Error	0x61	SUCCESS
	0x69	NOT_FOUND
Checksum	#	
End code	0x0A	

Error code

Error code	Description

SUCCESS	State of Wiegand input port is successfully read.
NOT_FOUND	No Wiegand input.

Compatibility

SFM 3500 / 5500 Series

WS : Set Wiegand Output (Deprecated)

Output specified ID to Wiegand output port.

Request command

Field	Data	Description
Start code	0x40	
Command	0x44	
Param	Wiegand ID	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x44	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Wiegand ID is successfully output.

Compatibility

SFM 3500 / 5500 Series

WM : Map Wiegand ID to Input Function

Maps specified Wiegand ID to an input function. When a Wiegand card reader detects the mapped IDs, the corresponding input function will be executed. For example, if Wiegand ID 10 was mapped to 0x10(Enroll by Scan), ES command will be processed. There can be at most 16 Wiegand mappings. The functions to which Wiegand ID can be mapped are as follows:

Function ID	Function Name
0x10	Enroll by Scan
0x11	Enroll by Wiegand ID
0x40	Delete by Scan
0x41	Delete by Wiegand ID
0x49	Delete All
0x1A	ES with Administrator's Verification
0x1B	EW with Administrator's Verification
0x4A	DS with Administrator's Verification
0x4B	DW with Administrator's Verification
0x4C	DA with Administrator's Verification

Request command

Field	Data	Description
Start code	0x40	
Command	0x68	
Param	Input Function	
Size	Wiegand ID	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x68	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
	0x6D	MEM_FULL
	0x75	UNSUPPORTED
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Wiegand ID is successfully mapped to the function.
MEM_FULL	No more mapping is allowed.
UNSUPPORTED	The input function is not supported.

Compatibility

SFM 3500 / 5500 Series

WL : List Wiegand ID Mapping

Lists Wiegand IDs which are mapped to input functions.

Request command

Field	Data	Description
Start code	0x40	
Command	0x69	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x69	
Param	Number of mapping	
Size	Data size	(Number of mapping) * 5
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

First transmits the response command, then mapping data (number of mapping x 5 bytes), and finally the 0x0A. The mapping data consists of 4 byte Wiegand ID and 1 byte input function. For example, Wiegand ID 0x2450 is mapped to DS(0x40), and Wiegand ID 0x100 is mapped to ES(0x10), the mapping data will be as follows:

0x50 0x24 0x00 0x00 0x40 0x00 0x01 0x00 0x00 0x10

Error code

Error code	Description
SUCCESS	Wiegand mappings are successfully transferred.

Compatibility

SFM 3500 / 5500 Series

WC : Clear Wiegand ID Mapping

Clears all the Wiegand ID mappings to input functions.

Request command

Field	Data	Description
Start code	0x40	
Command	0x6A	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x6A	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	All Wiegand ID mappings are cleared.

Compatibility

SFM 3500 / 5500 Series

WWX : Write Wiegand Configuration

Set Wiegand format. See Appendix C. Extended Wiegand Protocol for details of format definition data.

Request command

Field	Data	Description
Start code	0x40	
Command	0xC0	
Param	(Pulse Width in usec << 16) | (Pulse interval in usec)	If 0, use default values: 50usec width and 2,000usec interval
Size	The size of format definition data	0 if the format is 26 bit standard
Flag	0x01	26 bit standard
	0x02	Pass through format
	0x03	Custom format
Checksum	#	
End code	0x0A	

First transmit the request command, then the format definition data, and finally the 0x0A.

Response command

Field	Data	Description
Start code	0x40	
Command	0xC0	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
	0x75	UNSUPPORTED

Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Wiegand format is successfully written.
UNSUPPORTED	Invalid format data.

Compatibility

SFM 3500 / 5500 Series

WRX : Read Wiegand Configuration

Read Wiegand format definition data. See Appendix C. Extended Wiegand Protocol for details of format definition data.

Request command

Field	Data	Description
Start code	0x40	
Command	0xC1	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xC1	
Param	(Wiegand format << 24) | (Pulse width in usec << 16) | (Pulse interval in usec)	
Size	The size of format definition data	0 if the format is 26 bit standard
Error	0x61	SUCCESS
	0x69	NOT_FOUND
Checksum	#	
End code	0x0A	

First transmits the response command and then the format definition data, and finally 0x0A.

Error code

Error code	Description
SUCCESS	Wiegand format data is successfully read.
NOT_FOUND	Wiegand format is not configured by WWX.

Compatibility

SFM 3500 / 5500 Series

WGX : Get Wiegand Input

Reads Wiegand input string. Wiegand input string is converted to a 64 bit integer with the first bit as the most significant bit. For example, if 26 bit Wiegand input is 00000000 00000000 00110010 00(Site code is 0 and ID is 100), the higher 32 bit is 0x00000000 and the lower 32 bit is 0x000000c8. If flag is set to 0, the module will wait for new Wiegand input. If it is set to 1, the module will read the latched input.

Request command

Field	Data	Description
Start code	0x40	
Command	0xC2	
Param	0	Clear state after read
	1	Remain state
Size	NULL	
Flag	0	Read new Wiegand input
	1	Read latched input
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xC2	
Param	Higher 32 bit of Wiegand input	
Size	Lower 32 bit of Wiegand input	
Error	0x62	(SCAN_SUCCESS)
	0x61	SUCCESS

	0x69	NOT_FOUND
	0x6C	TIMEOUT
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SCAN_SUCCESS	New Wiegand input is detected.
SUCCESS	Wiegand input is successfully read.
NOT_FOUND	Wiegand format is not configured by WWX.
TIMEOUT	Timeout for Wiegand input.

Compatibility

SFM 3500 / 5500 Series

WSX : Set Wiegand Output

Write Wiegand output string. As in WRX, the Wiegand string is represented by a 64 bit integer.

Request command

Field	Data	Description
Start code	0x40	
Command	0xC3	
Param	Higher 32 bit of Wiegand output	
Size	Lower 32 bit of Wiegand output	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xC3	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
	0x6C	NOT_FOUND
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Wiegand output is successfully written.
NOT_FOUND	Wiegand format is not configured by WWX.

Compatibility

SFM 3500 / 5500 Series

WFW : Set Wiegand Field

Set an alternative value for a Wiegand field. If this value is set, the field is always overwritten by this value. For example, this command can be used to set alternative site code for 26 bit standard format. This command is only applicable to 26 bit standard and Custom format.

Request command

Field	Data	Description
Start code	0x40	
Command	0xC4	
Param	Alternative value	
Size	Field index	In 26 bit standard format, site code is index 0. If field index is set to 0xFF, it represents the FAIL ID. See WPW command.
Flag	0	Set alternative value.
	1	Clear the alternative value.
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xC4	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
	0x75	UNSUPPORTED

Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Alternative value is successfully written.
UNSUPPORTED	Invalid index or value.

Compatibility

SFM 3500 / 5500 Series

WFR : Get Wiegand Field

Reads an alternative value of a Wiegand field. This command is only applicable to 26 bit standard and Custom format.

Request command

Field	Data	Description
Start code	0x40	
Command	0xC5	
Param	NULL	
Size	Field index	In 26 bit standard format, site code is index 0. If field index is set to 0xFF, it represents the FAIL ID.
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xC4	
Param	Alternative value	
Size	NULL	
Error	0x61	SUCCESS
	0x69	NOT_FOUND
	0x75	UNSUPPORTED
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Alternative value is successfully read.
NOT_FOUND	Alternative value is not set for the specified field.
UNSUPPORTED	Invalid index.

Compatibility

SFM 3500 / 5500 Series

WPW : Write Wiegand I/O Setting

Set Wiegand input function, output mode, and advanced options. Available values are as follows. Advanced options are not applicable to Pass Through mode.

Input function	
0x00	Disable
0x12	Enroll Given ID
0x22	Verify Given ID
0x42	Delete Given ID

Output mode	
0x00	Disable
0x01	Enable for Wiegand input only
0x02	Enable for all inputs

Advanced options	
0x01	When matching fails, inverse parity bits
0x02	When matching fails, output the fail ID set by WFW command

Request command

Field	Data	Description
Start code	0x40	
Command	0xC6	
Param	(Input function << 16) | (Output mode)	
Size	Advanced options	

	0x01	Inverse parity on fail
	0x02	Fail ID
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xC6	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
	0x75	UNSUPPORTED
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Wiegand I/O is successfully configured..
UNSUPPORTED	Invalid setting value.

Compatibility

SFM 3500 / 5500 Series

WPR : Read Wiegand I/O Setting

Read Wiegand I/O port settings configured by WPW command.

Request command

Field	Data	Description
Start code	0x40	
Command	0xC7	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xC7	
Param	(Input function << 16) | (Output mode)	
Size	Advanced options	
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	I/O settings are successfully read.

Compatibility

SFM 3500 / 5500 Series

IW : Write Input Configuration

SFM3500 series modules provide 3 input ports : IN0, IN1, and IN2. Users can assign an input function to each input port. If an input port is activated, the assigned function will be executed by the module.

Users can also assign tamper switch to an input port. When the tamper switch is on, Tamper Switch On(0x64) event occurred. When it gets off, Tamper Switch Off(0x65) event occurred. Both events are recorded in log, too.

The assignable functions for input ports are as follows.

Function ID	Description
0x00	No action
0x10	Enroll by Scan
0x30	Identify by Scan
0x40	Delete by Scan
0x49	Delete All
0x11	Enroll by Wiegand ID
0x21	Verify by Wiegand ID
0x41	Delete by Wiegand ID
0x1A	ES with Administrator's Verification
0x1B	EW with Administrator's Verification
0x4A	DS with Administrator's Verification
0x4B	DW with Administrator's Verification
0x4C	DA with Administrator's Verification
0x60	Cancel
0x66	Tamper Switch In
0x69	Reset Module

Request command

Field	Data	Description

Start code	0x40	
Command	0x47	
Param	Function ID	
Size	Minimum time	10 ~ 10000 msec If the input signal is shorter than this minimum time, it will be ignored.
Flag	0x00, 0x01, 0x02	IN0, IN1, IN2 port
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x47	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
	0x75	UNSUPPORTED
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Configuration of input port is successfully written.
UNSUPPORTED	Port ID is invalid.

Compatibility

SFM 3500 / 5500 Series

Example

Assign Enroll by Scan(0x10) to IN1 with minimum time 100ms.

Start	Command	Param	Size	Flag	Checksum	End
0x40	0x47	0x10	0x10	0x01	0xA8	0x0A

Byte transmission order

0x40, 0x47,   0x10, 0x00, 0x00, 0x00,   0x10, 0x00, 0x00, 0x00,   0x01, 0xA8, 0x0A

IR : Read Input Configuration

Reads configuration of an input port.

Request command

Field	Data	Description
Start code	0x40	
Command	0x48	
Param	NULL	
Size	NULL	
Flag	0x00, 0x01, 0x02	IN0, IN1, IN2 port
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x48	
Param	Function ID	
Size	Minimum time	10 ~ 10000 msec
Error	0x61	SUCCESS
	0x75	UNSUPPORTED
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Configuration of input port is successfully read.

UNSUPPORTED	Port ID is invalid.

Compatibility

SFM 3500 / 5000 Series

IG : Get Input State

Reads current state of input port.

Request command

Field	Data	Description
Start code	0x40	
Command	0x49	
Param	0	Clear state after read
	1	Remain state
Size	NULL	
Flag	0x00, 0x01, 0x02	IN0, IN1, IN2 port
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x49	
Param	0	Inactive
	1	Active
Size	NULL	
Error	0x61	SUCCESS
	0x75	UNSUPPORTED
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Current state of input port is successfully read.
UNSUPPORTED	Port ID is invalid.

Compatibility

SFM 3500 / 5500 Series

OW : Write Output Configuration

SFM3500 series modules provide 3 output ports and 3 LED ports; OUT0, OUT1, OUT2 and LED0, LED1, LED2 respectively. Users can assign multiple output events to each output or LED port. If one of the given events occurs, the configured signal will be output to the port.

The assignable events for output port are as follows.

Category	Event ID	Description
Clear	0x00	Clear all functions
Enroll	0x13	Enroll Wait Wiegand
	0x14	Enroll Wait Finger
	0x15	Enroll Processing
	0x16	Enroll Bad Finger
	0x17	Enroll Success
	0x18	Enroll Fail
Verify	0x23	Verify Wait Wiegand
	0x24	Verify Wait Finger
	0x25	Verify Processing
	0x26	Verify Bad Finger
	0x27	Verify Success
	0x28	Verify Fail
	0x62	Verify Duress Finger
Identify	0x34	Identify Wait Finger
	0x35	Identify Processing
	0x36	Identify Bad Finger
	0x37	Identify Success
	0x38	Identify Fail
	0x63	Identify Duress Finger
Delete	0x43	Delete Wait Wiegand
	0x44	Delete Wait Finger

	0x45	Delete Processing
	0x46	Delete Bad Finger
	0x47	Delete Success
	0x48	Delete Fail
Detect	0x54	Detect IN0
	0x55	Detect IN1
	0x56	Detect IN2
	0x57	Detect Wiegand input
	0x58	Detect Finger
End	0x59	End Processing
Tamper	0x64	Tamper Switch On
Switch	0x65	Tamper Switch Off
System	0x6A	System Started
	0x6B	Reset by Watchdog Timer

Request command

Field	Data	Description
Start code	0x40	
Command	0x4A	
Param	(T_delay<<16) | (T_count<<8) | Event ID	If T_count is 0, the output signal will be repeated indefinitely until other events occur. If Event ID is 0, all the events assigned to this port will be cleared.
Size	(T_low<<16) | (T_high)	If T_low and T_high are both 0, the specified event will be deleted.
Flag	0x00, 0x01, 0x02 0x03, 0x04, 0x05	OUT0, OUT1, OUT2 port LED0, LED1, LED2 port
Checksum	#	
End code	0x0A	
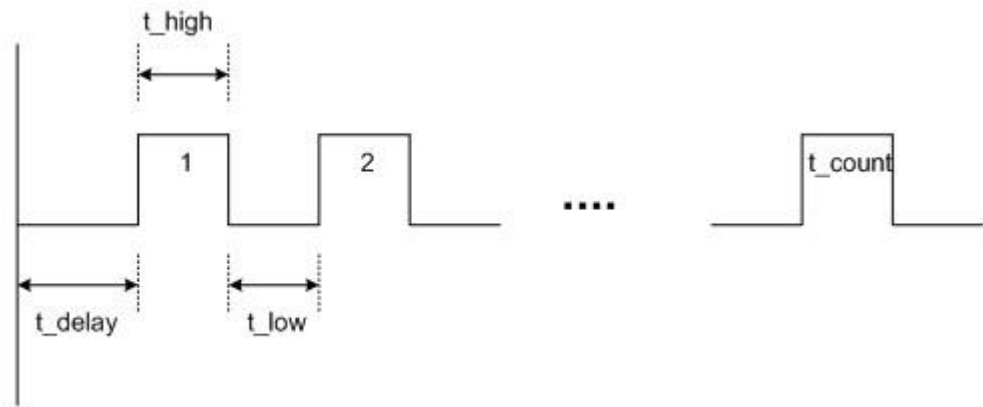
Response command

Field	Data	Description
Start code	0x40	
Command	0x4A	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
	0x6D	MEM_FULL
	0x75	UNSUPPORTED
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Configuration of output port is successfully written.
MEM_FULL	Number of output configuration exceeds its limit (200 configurations).
UNSUPPORTED	Port ID is invalid.

Compatibility

SFM 3500 / 5500 Series

Example

(1) Assign Enroll Wait Finger(0x14) to LED0. The led will blink indefinitely with 500ms period; t_delay(0), t_high(250), t_low(250), t_count(0).

Start	Command	Param	Size	Flag	Checksum	End
0x40	0x4A	0x14	0xFA00FA	0x03	0x95	0x0A

Byte transmission order

0x40, 0x4A,   0x14, 0x00, 0x00, 0x00,   0xFA, 0x00, 0xFA, 0x00,   0x03, 0x95, 0x0A

(2) Assign Enroll Success(0x17) to LED1. The led will be on for 500ms; t_delay(0), t_high(500), t_low(0), t_count(1).

Start	Command	Param	Size	Flag	Checksum	End
0x40	0x4A	0x0117	0x01F4	0x04	0x9B	0x0A

Byte transmission order

0x40, 0x4A,   0x17, 0x01, 0x00, 0x00,   0xF4, 0x01, 0x00, 0x00,   0x04, 0x95B, 0x0A

OR : Read Output Configuration

Reads the configuration of an output event assigned to the given port. Users can get the list of events assigned to an output port using OL command.

Request command

Field	Data	Description
Start code	0x40	
Command	0x4B	
Param	Event ID	
Size	NULL	
Flag	0x00, 0x01, 0x02	OUT0, OUT1, OUT2 port
	0x03, 0x04, 0x05	LED0, LED1, LED2 port
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x4B	
Param	(T_delay<<16) | (T_count<<8)	
Size	(T_low<<16) | (T_high)	
Error	0x61	SUCCESS
	0x69	NOT_FOUND
	0x75	UNSUPPORTED
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Configuration of output port is successfully read.
NOT_FOUND	Specified event is not assigned to the specified port.
UNSUPPORTED	Port ID is invalid.

Compatibility

SFM 3500 / 5500 Series

OL : Read Output Configuration List

Reads the list of events assigned to an output port.

Request command

Field	Data	Description
Start code	0x40	
Command	0x4C	
Param	NULL	
Size	NULL	
Flag	0x00, 0x01, 0x02	OUT0, OUT1, OUT2 port
	0x03, 0x04, 0x05	LED0, LED1, LED2 port
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x4C	
Param	NULL	
Size	Number of enabled events	
Error	0x61	SUCCESS
	0x75	UNSUPPORTED
Checksum	#	
End code	0x0A	

First transmits the response command, then enabled event IDs, and finally the 0x0A

Error code

Error code	Description
SUCCESS	Enabled events of output port are successfully read.
UNSUPPORTED	Port ID is invalid.

Compatibility

SFM 3500 / 5500 Series

OS : Set Output State

Activates or deactivates the specified output ports.

Request command

Field	Data	Description
Start code	0x40	
Command	0x4D	
Param	0x00	Deactivate
	0x01	Activate
Size	NULL	
Flag	0x00, 0x01, 0x02	OUT0, OUT1, OUT2 port
	0x03, 0x04, 0x05	LED0, LED1, LED2 port
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x4D	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
	0x75	UNSUPPORTED
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Output is successfully completed.
UNSUPPORTED	Port ID is invalid.

Compatibility

SFM 3500 / 5500 Series

GW : Write GPIO Configuration

Writes configuration of GPIO ports.

Notice.) SFM6000 doesn't support Wiegand and Shared IO. The reason for not using Shared IO is for stability of I/O.

GW command should be followed by supplementary data and packet end code. Composition of supplementary data should be same as GR's response.

When configuring Wiegand interface, one command for one GPIO among the defined pair is enough for configuration.

In order to transfer the GPIO configuration between the module and the host, 8 byte supplementary data is used for each input function, output function, or Wiegand configurations. 4 words (2 bytes) constitute the GPIO data, whose composition is as follows.[2]

Word	Input	Output	Wiegand
1	Function	Function	Bits
2	Activation	Level	Facility bits
3	0 / interval	Interval	ID bits
4	0	Blink period	Facility code

Third and fourth words in input mode are useless, except the "delete all by confirm" function, which requires the third word for timeout interval.

Refer to Appendix A for detailed description about functions.

For WAIT and PROCESSING output functions; interval and blinking are meaningless, but the interval value should be positive value for effective configuration.

Request command

---

[2] For the buzzer mode of SFM4000, refer to Appendix A-1.

Field	Data	Description
Start code	0x40	
Command	0x37	
Param	GPIO ID | (mode << 16)	
Size	# of supplementary data	
Flag	NULL	
Checksum	#	
End code	0x0A	

First transmits the request command, then supplementary, and finally the 0x0A

Response command

Field	Data	Description
Start code	0x40	
Command	0x37	
Param	GPIO ID	
Size	NULL	
Error	0x61	SUCCESS
	0x75	UNSUPPORTED
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Configuration of GPIO port is successfully written.
UNSUPPORTED	Supplementary data is invalid.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Example

When setting GPIO_0(0x0) as an input port(0x01) for enroll function(0x01) with active high activation(0x01),

Start	Command	Param	Size	Flag	Checksum	End
0x40	0x37	0x010000	0x01	0x00	0x79	0x0A

+

Function(0x01)	Activation(0x01)	0	0	0x0A

The Param(GPIO ID | (mode<<16)):

Upper 16 bit for Mode	Lower 16 bit for GPIO ID
0x0001	0x0000

The 8 byte supplementary data:

1st word for Function	2nd word for Activation	3rd word	4th word
0x0001	0x0001	0x0000	0x0000

Byte transmission order

0x40, 0x37, 0x00, 0x00, 0x01, 0x00, 0x01, 0x00, 0x00, 0x00, 0x00, 0x79, 0x0A

0x01, 0x00, 0x01, 0x00, 0x00, 0x00, 0x00, 0x00, 0x0A

When setting GPIO_7(0x7) as an output port(0x02) for Beep function(0x8D) with active low activation(0x84) and　100ms interval,

Start	Command	Param	Size	Flag	Checksum	End
0x40	0x37	0x020007	0x01	0x00	0x81	0x0A

+

Function(0x8D)	Level(0x84)	Interval(0x0a)	Blink Period(0x0)	0x0A

The Param(GPIO ID | (mode<<16)):

Upper 16 bit for Mode	Lower 16 bit for GPIO ID

0x0002	0x0007

The 8 byte supplementary data:

1st word for Function	2nd word for Level	3rd word for Interval	4th word for Blinking
0x008D	0x0084	0x000a	0x0000

Byte transmission order

0x40, 0x37, 0x07, 0x00, 0x02, 0x00, 0x01, 0x00, 0x00, 0x00, 0x00, 0x81, 0x0A

0x8D, 0x00, 0x84, 0x00, 0x0A, 0x00, 0x00, 0x00, 0x0A

GR : Read GPIO Configuration

Reads configuration of GPIO ports.

The response packet is followed by supplementary data (8 * size) + packet end code (0x0A) if mode is not equal to disabled mode. The number of supplementary data is always 1 for the input mode and it is the number of active output functions for the output mode, respectively. For the shared I/O mode, first supplementary data is input function.

Request command

Field	Data	Description
Start code	0x40	
Command	0x36	
Param	GPIO ID	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x36	
Param	GPIO ID	(mode << 16)	
Size	# of supplementary data	
Error	0x61	SUCCESS
	0x75	UNSUPPORTED
Checksum	#	
End code	0x0A	

First transmits the response command, then supplementary data, and finally the 0x0A.

Error code

Error code	Description
SUCCESS	Configuration of GPIO port is successfully read.
UNSUPPORTED	Supplementary data is invalid.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

GC : Clear GPIO Configuration

Clears all configurations of GPIO ports.

Request command

Field	Data	Description
Start code	0x40	
Command	0x38	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x38	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	All configurations of GPIO is successfully cleared.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

GD : Set Default GPIO Configuration

Sets default of all GPIO ports.

Request command

Field	Data	Description
Start code	0x40	
Command	0x39	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x39	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Successfully completed.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

Default setting (SFM6000 Series)

GPIO #	Direction	Function
GPIO 0	Input	Enroll
GPIO 1	Input	Identify
GPIO 2	Input	Delete All by Confirm
GPIO 3	Output	Beep
GPIO 4	Output	Enroll Success Match Success Delete Success
GPIO 5	Output	Enroll Fail Match Fail Delete Fail
GPIO 6	Output	Enroll Wait Finger Match Wait Finger Delete Wait
GPIO 7	Disable	

AW : Write Administration Level of a User

Assigns an administration level to a user. The default administration level of a user is ADMIN_NONE except when the first user is enrolled by ESA or EWA. In that case, the first user will have ADMIN_ALL level. See ESA for the relationship between administration levels and commands with administrator's verification.

Admin. Level	Value	Commands
ADMIN_NONE	0x00	
ADMIN_ENROLL	0x01	ESA, EWA
ADMIN_DELETE	0x02	DAA, DSA, DWA
ADMIN_ALL	0x03	ESA, EWA, DAA, DSA, DWA

Request command

Field	Data	Description
Start code	0x40	
Command	0x65	
Param	User ID	
Size	Administration Level	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x65	
Param	NULL	

Size	NULL	
Error	0x61	SUCCESS
	0x69	NOT_FOUND
	0x75	UNSUPPORTED
	0x76	INVALID_ID
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Administration level is successfully written.
NOT_FOUND	The user id is not found.
UNSUPPORTED	The administration level is not supported.
INVALID_ID	The user id is invalid.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

AR : Read Administration Level of a User

Reads the administration level of a user.

Request command

Field	Data	Description
Start code	0x40	
Command	0x66	
Param	User ID	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x66	
Param	NULL	
Size	Administration Level	
Error	0x61	SUCCESS
	0x69	NOT_FOUND
	0x76	INVALID_ID
Checksum	#	
End code	0x0A	

Error code

Error code	Description

SUCCESS	Administration level is successfully read.
NOT_FOUND	The user id is not found.
INVALID_ID	The user id is invalid.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

AC : Clear All the Administration Levels

Clears all the administration levels to ADMIN_NONE.

Request command

Field	Data	Description
Start code	0x40	
Command	0x67	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0x67	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Administration levels are successfully cleared.

Compatibility

SFM 3000 / 3500 / 4000 / 5000 / 5500 / 6000 Series

UW: Write Authentication Mode of a User

Specifies the authentication mode of a user. AUTH_BYPASS can be used for 1:1 matching, when it is necessary to allow access without matching fingerprints. AUTH_REJECT can be used for disabling some IDs temporarily. The default authentication mode is AUTH_FINGERPRINT.

Mode	Value	Description
AUTH_FINGERPRINT	0x00	Fingerprint authentication.
AUTH_BYPASS	0x01	Authentication will succeed without matching fingerprints.
AUTH_REJECT	0x03	Authentication will always fail.

Request command

Field	Data	Description
Start code	0x40	
Command	0xA3	
Param	User ID	
Size	Authentication Mode	AUTH_FINGERPRINT AUTH_BYPASS AUTH_REJECT
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xA3	

Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
	0x69	NOT_FOUND
	0x75	UNSUPPORTED
	0x76	INVALID_ID
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Authentication mode is successfully written.
NOT_FOUND	The user id is not found.
UNSUPPORTED	The authentication mode is invalid.
INVALID_ID	The user id is invalid.

Compatibility

SFM 3500 / 5500 Series

UR : Read Authentication Mode of a User

Reads the authentication mode of a user.

Request command

Field	Data	Description
Start code	0x40	
Command	0xA4	
Param	User ID	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xA4	
Param	NULL	
Size	Authentication Mode	
Error	0x61	SUCCESS
	0x69	NOT_FOUND
	0x76	INVALID_ID
Checksum	#	
End code	0x0A	

Error code

Error code	Description

SUCCESS	Authentication mode is successfully read.
NOT_FOUND	The user id is not found.
INVALID_ID	The user id is invalid.

Compatibility

SFM 3500 / 5500 Series

UC : Reset Authentication Modes of All Users

Resets the authentication modes of all users to AUTH_FINGERPRINT.

Request command

Field	Data	Description
Start code	0x40	
Command	0xA5	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xA5	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Authentication modes are successfully reset.

Compatibility

SFM 3500 / 5500 Series

UL : List User ID by Authentication Mode

Reads the user IDs with specified authentication mode.

Request command

Field	Data	Description
Start code	0x40	
Command	0xA6	
Param	NULL	
Size	Authentication mode	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xA6	
Param	Number of user ID	Number of user IDs with the specified authentication mode
Size	Data size	(The number of user ID) * 4
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

First transmits the response command and then the user IDs.

User ID (4byte)	User ID (4byte)	…	User ID (4byte)	User ID (4byte)	0x0A

Error code

Error code	Description
SUCCESS	Successfully completed.

Compatibility

SFM 3500 / 5500 Series

ABL : Add a User to the Blacklist

Adds a user to the blacklist. When a user ID is added to the blacklist, authentication will always fail regardless of fingerprint matching result. The blacklist takes precedence over the authentication mode of a user. For example, though the authentication mode of a user is AUTH_BYPASS, the authentication would fail if it is in the blacklist. The blacklist can store up to 1022 user IDs.

Request command

Field	Data	Description
Start code	0x40	
Command	0xF3	
Param	User ID	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xF3	
Param	User ID	
Size	Number of IDs in the blacklist	
Error	0x61	SUCCESS
	0x6D	MEM_FULL
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	The id is added successfully.
MEM_FULL	The blacklist is full.

Compatibility

SFM 3500 / 5500 Series

DBL : Delete a User ID from the Blacklist

Deletes a user from the blacklist.

Request command

Field	Data	Description
Start code	0x40	
Command	0xF4	
Param	User ID	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xF4	
Param	User ID	
Size	Number of IDs in the blacklist	
Error	0x61	SUCCESS
	0x69	NOT_FOUND
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	The user id is deleted successfully.

NOT_FOUND	The user id is not found in the blacklist.

Compatibility

SFM 3500 / 5500 Series

RBL : Read the Blacklist

Reads the contents of the blacklist.

Request command

Field	Data	Description
Start code	0x40	
Command	0xF5	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xF5	
Param	Number of user ID	Number of user IDs in the blacklist
Size	Data size	(The number of user ID) * 4
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

First transmits the response command and then the user IDs.

User ID (4byte)	User ID (4byte)	…	User ID (4byte)	User ID (4byte)	0x0A

Error code

Error code	Description
SUCCESS	Successfully completed.

Compatibility

SFM3500 / 5500 Series

CBL : Clear the Blacklist

Clears the blacklist.

Request command

Field	Data	Description
Start code	0x40	
Command	0xF6	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xF6	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	The blacklist is cleared successfully.

Compatibility

SFM 3500 / 5500 Series

WME : Write Entrance Limit

Specifies how many times the user is permitted to access per day. The available options are between 0 and 7. The default value is 0, which means that there is no limit. If the user tries to authenticate after the limit is reached, ENTRANCE_LIMIT error will be returned.

To check the limit, the module keeps track of entrance counts of each user. The entrance counts are cleared in the following cases.

(1) At midnight.

(2) When the module is reset.

(3) When new entrance limit is written by WME command.

Request command

Field	Data	Description
Start code	0x40	
Command	0xF0	
Param	User ID	
Size	Entrance limit	0(Infinite) 1 ~ 7
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xF0	
Param	NULL	

Size	NULL	
Error	0x61	SUCCESS
	0x69	NOT_FOUND
	0x75	UNSUPPORTED
	0x76	INVALID_ID
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Entrance limit is successfully written.
NOT_FOUND	The user id is not found.
UNSUPPORTED	The entrance limit is invalid.
INVALID_ID	The user id is invalid.

Compatibility

SFM 3500 / 5500 Series

RME : Read Entrance Limit

Reads the entrance limit of a user.

Request command

Field	Data	Description
Start code	0x40	
Command	0xF1	
Param	User ID	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xF1	
Param	Entrance count	The number of entrances for today
Size	Entrance limit	The entrance limit written by WME
Error	0x61	SUCCESS
	0x69	NOT_FOUND
	0x76	INVALID_ID
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	Entrance limit is successfully read.
NOT_FOUND	The user id is not found.
INVALID_ID	The user id is invalid.

Compatibility

SFM 3500 / 5500 Series

CME : Clear Entrance Limit

Clears the entrance limits of all users.

Request command

Field	Data	Description
Start code	0x40	
Command	0xF2	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xF2	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	The entrance limits of all users are cleared.

Compatibility

SFM 3500 / 5500 Series

FR : Factory reset of system parameter and GPIO

System Parameter and GPIO setting values is in the independent partition.

If any problems happened, such as changing un-support baud rate, use this command.

Request command

Field	Data	Description
Start code	0x40	
Command	0xFA	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xFA	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	System parameter and GPIO settings are reset.

Compatibility

SFM 6000 Series

FF : Format USER Database

Delete the userdb partition that stores the templates by filling it with 0xff.

Request command

Field	Data	Description
Start code	0x40	
Command	0xFF	
Param	NULL	
Size	NULL	
Flag	NULL	
Checksum	#	
End code	0x0A	

Response command

Field	Data	Description
Start code	0x40	
Command	0xFF	
Param	NULL	
Size	NULL	
Error	0x61	SUCCESS
Checksum	#	
End code	0x0A	

Error code

Error code	Description
SUCCESS	The userdb partition is cleared by filling 0xff.

Compatibility

SFM 6000 Series

Appendix A. GPIO Configuration

Overview

On the UniFinger modules; including SFM3000 and SFM5000, there are 8 GPIO's, which are user-configurable for specific functions.[3]

Because all GPIO function can be configured using PC interface program, a general user does not need to know the method stated in this appendix. After GPIO function is tested using PC interface program, the specific configuration can be embedded in the module before delivery for volume order.

GPIO's can be configured as input, output, shared IO, Wiegand input, or Wiegand output. In the input mode, enroll, identify, and delete function are supported. In the output mode, the port can send requested output patterns corresponding to the various events, such as match success, enroll fail, and so on.

(Notice. SFM60x0 don't support Wiegand.)

1. GPIO Index

Eight GPIO's are available on UniFinger modules, which are configurable. Each port is indexed by its ID ranged from 0 to 7 as described in the Table 1.

GPIO Name	ID
GPIO_0	0
GPIO_1	1

---

[3] For SFM4000, you should refer to Appendix A-1, too.

GPIO_2	2
GPIO_3	3
GPIO_4	4
GPIO_5	5
GPIO_6	6
GPIO_7	7

Table 1. GPIO index

Supported pin modes are input, output, shared IO, wiegand input and wiegand output. GPIO of shared IO mode waits input events in normal state and also sends responding output. Input modes, including general input and shared IO, are configurable on GPIO_0 to GPIO_3. Output mode is configurable on any GPIO port. Wiegand modes are restricted on special ports. Wiegand output mode is only configurable on the couple of GPIO_4 and GPIO_5, and wiegand input is configurable on the couple of GPIO_2 and GPIO_3, respectively. Port of lower ID is correspondent to bit 0 and port of higher ID is correspondent to bit 1 for Wiegand interfaces.

When the module is operated in network mode, GPIO_7 is internally controlled to support the network interfaces of RS422 or RS485. So, GPIO_7 is not available for general purpose in network mode.

Supported modes for the GPIO's are summarized in Table 2.

Ports	Output	Input	Shared IO	Wiegand In	Wiegand Out
GPIO_0 ~ 1	O	O	O		
GPIO_2 ~ 3	O	O	O	O	
GPIO_4 ~ 5	O				O
GPIO_6 ~ 7	O				

Table 2. Supported modes

2. GPIO mode

Configured mode of GPIO is identified by its mode value. GPIO mode value is listed in Table 3.

Mode	Value
None(disable)	0
Input	1
Output	2
Shared IO*(SFM60x0 don't support)	3
Wiegand input*(SFM60x0 don't support)	4
Wiegand output*(SFM60x0 don't support)	5
Buzzer[4]	6

Table 3. Gpio mode value

Wiegand modes are enabled for the specific couples. And, if one of Wiegand couple is re-configured as other mode, then the other one is automatically reset to disabled mode.

1) Input mode

Input mode is defined by two factors, function and activation method. GPIO configured as input mode processes one of input functions, enrollment, identification, delete all, and delete all by confirm when the module detects activation at the pin. Four activation methods are selectable including active high, active low, falling edge, and rising edge activations.

Table 4 and 5 shows the index value for input function and activation method.

Input function	Corresponding command	Index value
Enroll	ES	0x01

---

[4] For SFM4000 only.

Identify	IS	0x02
Delete all	DA	0x03
Delete all by confirm	DA	0x04
Cancel	CA	0x06
Enroll with admin's verification	ESA	0x07
Delete with admin's verification	DSA	0x08
Delete all with admin's verification	DAA	0x09
Reset	RS	0x0A

Table 4. Input functions

Activation	Index value
Active high	0x01
Active low	0x02
Rising edge	0x03
Falling edge	0x04

Table 5. Input activation method

"Delete all by confirm" function is for erasing all fingerprint data after confirmation by accepting repeated input within the pre-specified interval. So, this function requires another parameter of maximum waiting interval. This function is also related with a specific output function, named DELETE_WAIT, which sends blinking output in waiting repeated input.

2) Output mode

The GPIO in the output mode can support various output patterns for different functions. For example, GPIO_0 can be configured to send 1 pulse on enroll success and 2 pulses on match success.

There are four issues for output configuration: When, Which level, How long, and steady or

blinking. In order to support these requirements, output function, level, interval, and blinking period can be configured.

There are twelve selectable output functions, which are listed in Table 6.

Event Name	Description	Event ID
ENROLL_WAIT_FINGER	Waiting finger scan on enroll	0x81
ENROLL_PROCESSING	Enroll process is going on	0x82
ENROLL_SUCCESS	Enroll success	0x83
ENROLL_FAIL	Enroll fail	0x84
MATCH_WAIT_FINGER	Waiting finger scan on match	0x85
MATCH_PROCESSING	Match process is going on	0x86
MATCH_SUCCESS	Match success	0x87
MATCH_FAIL	Match fail	0x88
DELETE_WAIT	Waiting confirm on 'delete all by confirm' input	0x89
DELETE_PROCESSING	Delete processing is going on	0x8a
DELETE_SUCCESS	Delete success	0x8b
DELETE_FAIL	Delete fail	0x8c
BEEP	Beep function	0x8d

Table 6 Supported output functions

BEEP function is special function with fixed output pattern on complex output events, which is useful for buzzer control. It will respond on various events with pre-defined patterns as follows:

- End of finger scan : 1 short beep
- Processing success : 1 long beep
- Insufficient fingerprint data : 2 beeps
- Processing failure : 3 beeps

Selectable output levels are listed in Table 7.

Name	Description	Index value
ACTIVE_HIGH	Active high level	0x82
ACTIVE_LOW	Active low level	0x84
HIGH_BLINK	Active high + blinking	0x83
LOW_BLINK	Active low + blinking	0x85

Table 7. Output levels

Notice that all the enabled functions for the same GPIO should have same inactive level, all high or all low. That is, if the inactive level is low, then all should be configured as ACTIVE_HIGH or HIGH_BLINK.

Output interval is also configurable. If the output is blinking mode, blinking period should be specified. Time units for these values are 10ms and the range is 1 to 0xFFFF. Notice that blinking period should not exceed the interval time. Blink count is obtained through dividing interval by blinking period. The following figure shows examples of output signals.
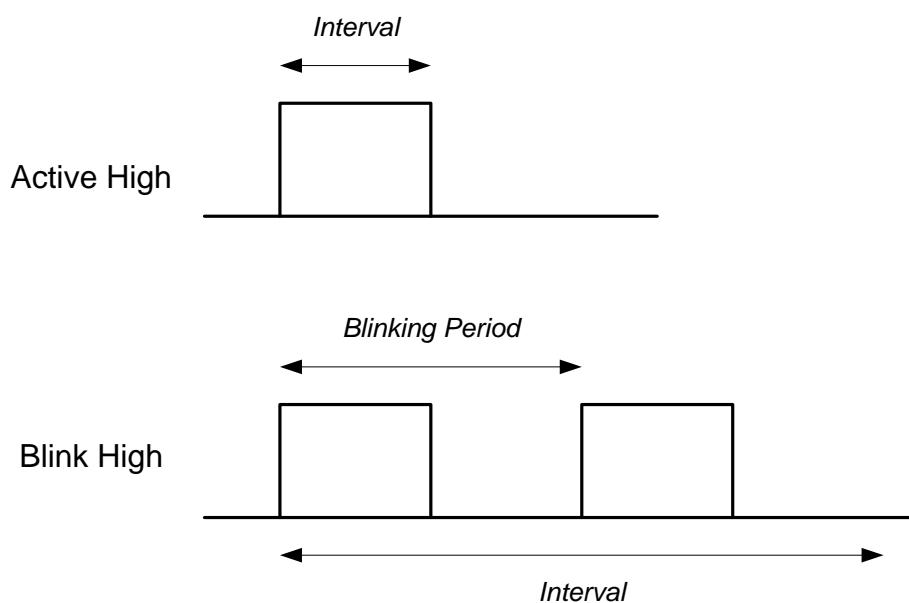
3) Wiegand mode

Wiegand mode requires four configuration parameters: total bits, facility bits, id bits, and facility code. Currently, the firmware only supports standard 26 bit Wiegand interfaces. When identification or verification is successful, Wiegand output is generated combining facility code and user ID. Similarly, Wiegand input is applied, the module carries out verification process (VS) based on the ID code.

Appendix A-1. SFM4000 GPIO Configuration

SFM4000 is based on SFM3000 series modules and shares most of the packet protocol. However, its GPIO configurations are different from those of SFM3000 in some important ways.

(1) General

- Two more ports – GPIO_8 and GPIO_9 – are added. You can configure them as output ports.

- Wiegand I/O is not supported.

- Network mode – RS485 or RS422 communication – is not supported.

- Buzzer mode is added. By configuring this mode, you can customize the buzzer sounds for specific events.

(2) Buzzer Mode

- Buzzer mode(value 6) can be assigned only to GPIO_0.

- There are 8 pre-defined buzzer patterns. And the default settings for output events are as follows;

Buzzer Pattern	Sound Description	Default Output Events
Pattern 0	Single beep	POWER_ON
Pattern 1	Two short beeps	
Pattern 2	Three short beeps	
Pattern 3	Mi-Do-Mi-Do	ENROLL_FAIL MATCH_FAIL DELETE_FAIL
Pattern 4	Do-Mi-Sol-Do	MATCH_SUCCESS
Pattern 5	Do-Sol-Mi-Do	
Pattern 6	Do-Mi-Sol	ENROLL_SUCCESS DELETE_SUCCESS

Pattern 8	Sol-Mi-Do	

- The 8 byte supplementary data for GW command is interpreted as follows;

Word	Buzzer
1	Function
2	0
3	Buzzer Pattern(0~8)
4	0

(3) Output Events

- BEEP(0x8d) event is not supported.

- VOLTAGE_WARNING(0x8e) event is added for Voltage Warning system parameter.

- POWER_UP(0x8f) event is added.

Appendix B. Extended Data Transfer Protocol

Overview

Dividing large data into small blocks can reduce communication errors between the host and the module. It is also suitable for embedded systems with limited resources. Data Transfer Protocol is an extension of Packet Protocol to provide a reliable and customizable communication for large data.

Data Packet Protocol

In Data Transfer Protocol, data is divided into multiple data packets. And a data packet consists of fixed-length header, variable-length data body, and 4 byte checksum. The following figure shows the data packet structure in Packet Protocol. If Network Packet Protocol is used, the start code will be 0x41, and 2 byte terminal ID will be inserted between the start code and the command byte. The checksum field is the sum of each byte in data body.
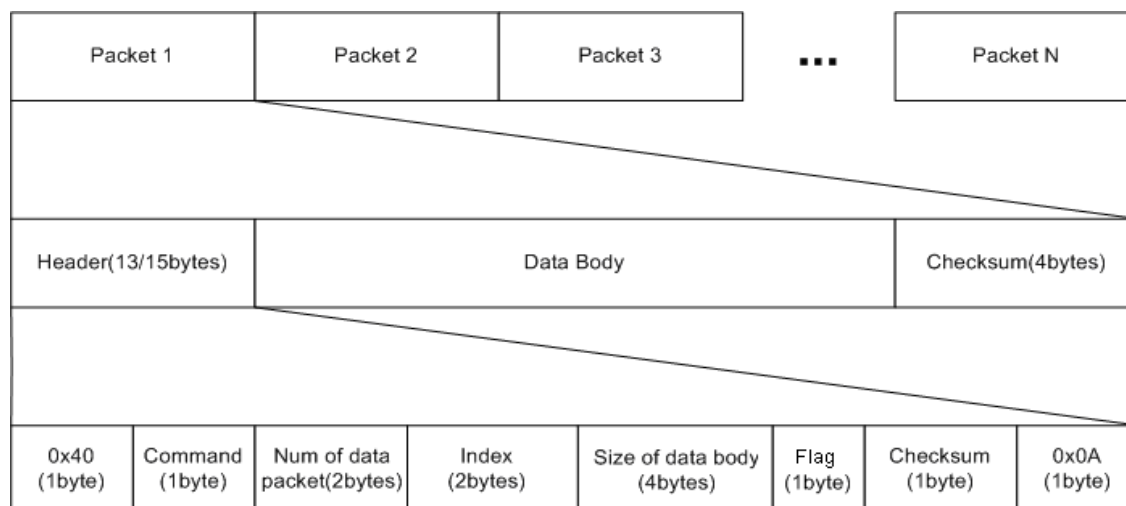
For example, if EIX command sends an image data of 16384 bytes into 3 packets of 4096, 4096, and 8192 bytes, the headers are as follows:

	Start	Command	Num of Packet	Index	Data Size	Flag	Checksum	End
Packet 1	0x40	0x80	0x03	0x00	0x1000	0x00	0xD3	0x0A
Packet 2	0x40	0x80	0x03	0x01	0x1000	0x00	0xD4	0x0A
Packet 3	0x40	0x80	0x03	0x02	0x2000	0x00	0xE5	0x0A

After receiving each data packet, the receiver has to send an acknowledgement packet notifying if the previous transfer is successful. If the received data packet has correct checksum, DATA_OK(0x83) will be returned. Otherwise, DATA_ERROR(0x82) will be returned. If the sender receives DATA_ERROR, it should quit sending the data immediately.
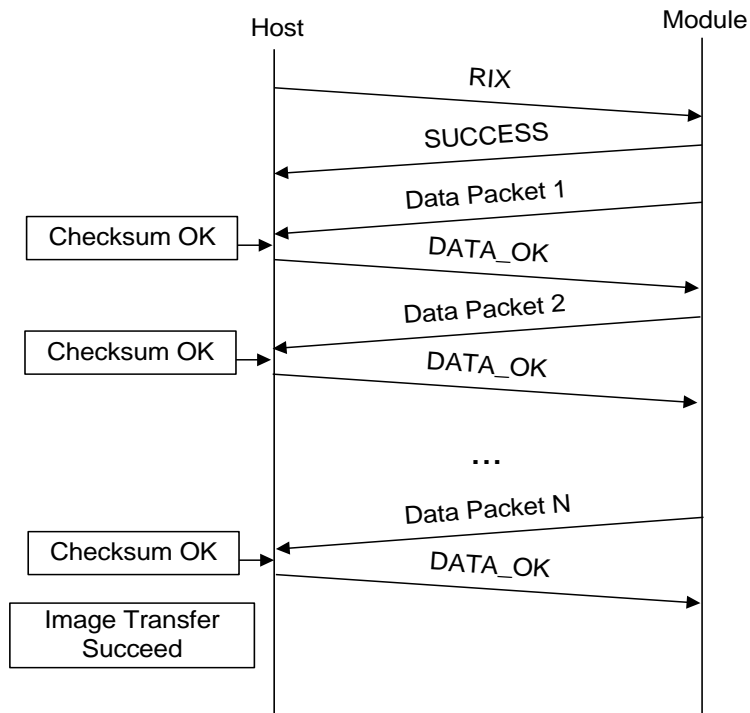
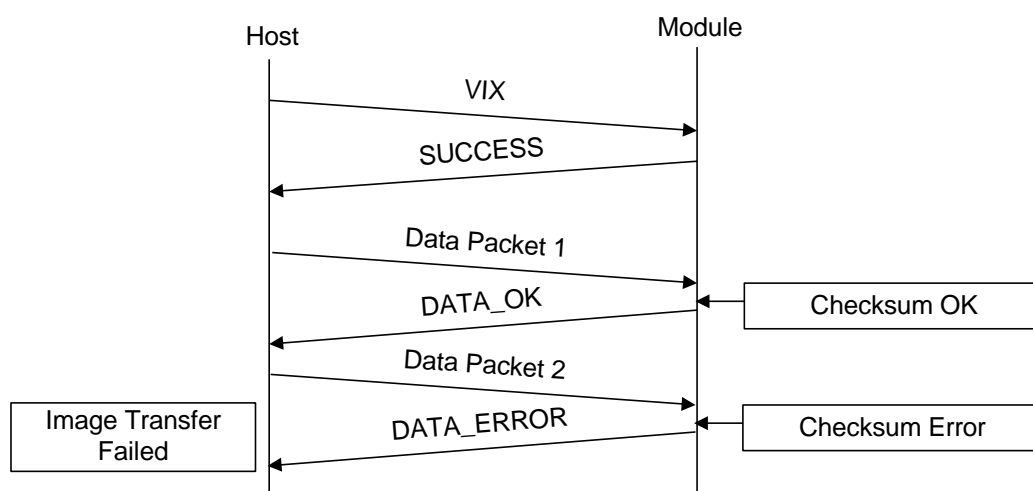**Example**

(1) When EIX succeeds in sending an image,
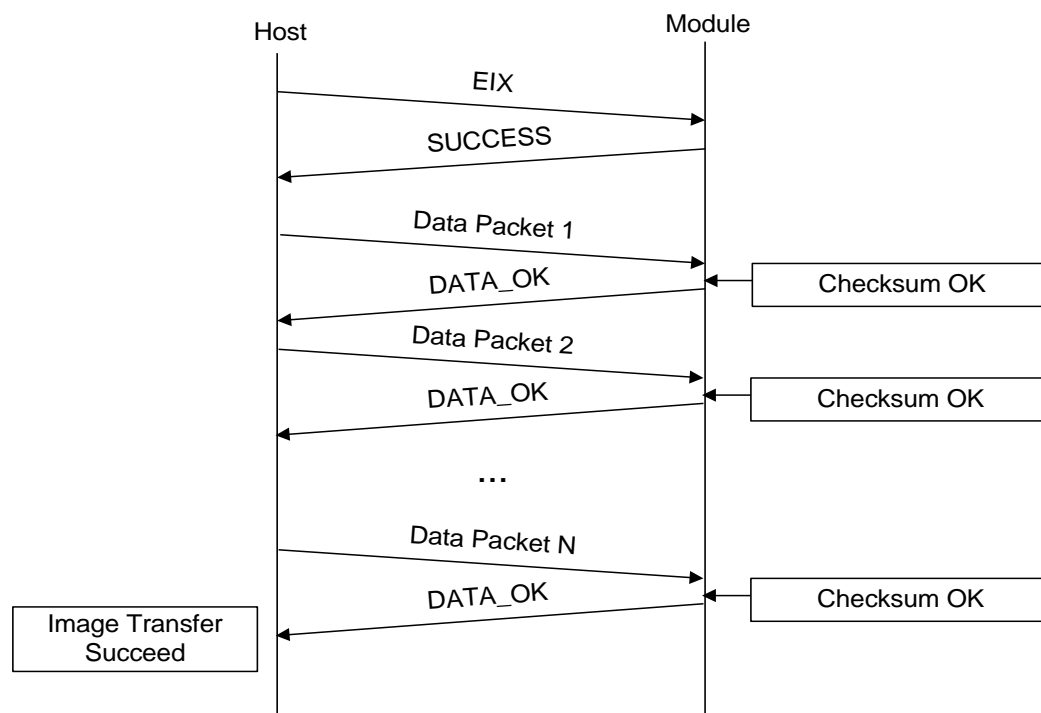
(2) When RIX succeeds in receiving an image,

(3) When VIX fails,

Appendix C. Extended Wiegand Protocol

Overview

Extended Wiegand Protocol supports up to 64 bit Wiegand formats. The only constraint is that the ID field is limited to 32 bits. It also supports advanced options such as Fail ID and Inverse Parity on Fail. There are three ways of configuring Wiegand formats; 26 bit standard, Pass Through, and Custom format.

26 bit standard

The 26 bit standard format is most widely used and consists of 8 bit site code and 16 bit ID. Users can set an alternative site code and enable advanced options.

Pass Through format

Pass Through format is used when only the format of ID field is known. When Wiegand input string is detected, the module extracts ID bits and starts verification with the ID. If the verification succeeds, the module outputs the Wiegand input string as unchanged. Parity check and advanced options are ignored in this format. By definition, Pass Through format is only useful when the matching is initiated by Wiegand input. If the matching is initiated by Packet Protocol or GPIO input, the bits other than ID field are set to 0.

The definition data for Pass Through format is as follows;

Field	Byte	Description
Total bits	1	1 ~ 64
Number of ID fields	1	In most cases, it will be 1. However, if ID bits are composed of several fields, it would be larger than 1.
1st ID field start bit	1	Start bit index of 1st ID field
1st ID field length	1	Number of 1st ID bits

...		
Nth ID field start bit	1	Start bit index of Nth ID field
Nth ID field length	1	Number of Nth ID bits

For example, assume that 32 bit pass through format is composed as follows;

XIIIIIII IIIIIIIX XXXIIIII IIIIIIIX (left most bit is 0th bit, BIT0)

I: Id field, X: Unknown field

The definition data would be,

Total Bits	Num of ID fields	1st ID field start index	1st ID field length	2nd ID field start index	2nd ID field length
0x20	0x02	0x01	0x0E	0x13	0x0C

Custom format

When users know all the information of a Wiegand format, Custom format can be defined. When Wiegand input string is detected, the module checks the parity bits first. If all the parity bits are correct, the module extracts ID bits and starts verification with the ID. Users can also set alternative values of each field and enable advanced options such as Fail ID. If the verification succeeds, the module outputs a Wiegand string. The output string may be different from the input string according to the alternative values and advanced options.

The definition data of Custom format is as follows;

Field		Byte	Description
Total Bits		1	1 ~ 64
Number of fields		1	1 ~ 16
1st Field	Start bit index	1	Start bit index of the field
	Length	1	Number of bits: 1 ~ 32
...			
Nth Field	Start bit index	1	Start bit index of the field
	Length	1	Number of bits: 1 ~ 32

Number of parity bits		1	1 ~ 8
1st Parity	Type	1	0: Even, 1: Odd
	Bit position	1	Bit index of the parity bit
	Bit mask	8	Bit mask for identifying the bits which are included in calculating the parity
...			
Nth Parity	Type	1	0: Even, 1: Odd
	Bit position	1	Bit index of the parity bit
	Bit mask	8	Bit mask for identifying the bits which are included in calculating the parity
Bit mask for ID field		2	Bit mask for identifying the fields which are part of ID

For example, assume that 44 bit custom format is composed as follows;

`EAAAAAAA IIIIIIII IIIIIIII BBBBBBBI IIIIIIII IIIO` (left most bit is 0th bit, BIT0)

E: Even parity for BIT1 ~ BIT22

O: Odd parity for BIT23 ~ BIT42

I: ID bits(Field1 and Field 3), A: Field 0, B: Field 2

The field definition data would be,

Field		Byte	Value
Total Bits		1	0x2C
Number of fields		1	0x04
Field 0	Start bit index	1	0x01
	Length	1	0x07
Field 1	Start bit index	1	0x08
	Length	1	0x10
Field 2	Start bit index	1	0x18
	Length	1	0x07

Field 3	Start bit index	1	0x1F
	Length	1	0x0C
Number of parity bits		1	0x02
1st Parity	Type	1	0x00: Even
	Bit position	1	0x00
	Bit mask	8	0x7FFFFE: Bit1 ~ Bit 22
2nd Parity	Type	1	0x01: Odd
	Bit position	1	0x2B
	Bit mask	8	0x07FFFF800000: Bit 23 ~ Bit 42
Bit mask for ID field		2	0x0A: Field 1 and Field 3

Appendix D. Heating Mode for SFM3X10

In SFM3010FC and SFM3510FC modules, this parameter can be used to turn on the sensor heating mode. When the parameter is set to 0x30, the FC sensor will be heated before sensing fingerprint inputs. In general, the image quality would be better with sensor heating mode. However, this mode consumes more power and users should wait for a few seconds before the sensor gets heated.

Contact Info

- **Headquarters**

  Suprema, Inc. (http://www.supremainc.com)

  15F Parkview Office Tower,

  Jeongja-dong, Bundang-gu,

  Seongnam, Gyeonggi, 463-863 Korea

  Tel: +82-31-783-4505

  Fax:+82-31-783-4506

  Email: sales@supremainc.com, support@supremainc.com