NITGEN®

RS-232C / LVCMOS serial protocol for Stand-Alone Fingerprint Recognition Device

Protocol Guide

Volume2. Error-codes & Structures

(Supported device: FIM40 Ver. 1.21 or higher,
FIM50 Ver 1.21 or higher,
FIM60 Ver 2.01 or higher)

Version 2.09

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Serial Number:

Specifications can be changed without notice.

Revision Information

Date	Version	Description
2010-05-03	2.0	Release
2010-12-10	2.01	Change Command CMD_DELETE_ALL_FP Add New Command CMD_CTL_IO CMD_CFG_IO Add New Chapter Appendix F
2011-03-21	2.02	Add New Model – FIM5130 New GPIO feature is added – Finger Status Change Command CMD_AUTO_IDENTIFY
2011-04-06	2.03	Add Latent Option – SI_USING_LATENT
2011-05-19	2.04	Change Command CMD_AUTO_IDENTIFY_RESULT
2011-06-27	2.05	Change Description CMD_CHG_EMULMODE (configure only) CMD_CHG_LENGTH_OF_USERID (configure only) SI_LENGTH_OF_USER_ID (read only) SI_EMULATION_MODE (read only)
2011-08-01	2.06	Change Command CMD_GET_TEMPLATE
2011-09-06	2.07	Change Command CMD_GET_DEVICE_INFO (Supported device list) CMD_SET_DEFAULT_SYSINFO (GPIO's default values) CMD_SET_CAPTURE_PERIOD (The unit of tick) CMD_ADD_FP (Description) Change Description FIM40/50 mode → none emulation mode Change Appendix B

		Update commands for each emulation mode. Change Appendix D Description of SI_CAPTURE_TIMEOUT is changed Change Appendix E Typographical and logical errors are fixed
2012-02-24	2.08	Document Renewal Protocol Document is divided into 3 docs Protocol Overview is added Example and Example Condition is added RS232 UART Waveform is added Design alternation
2015-02-23	2.09	Add New Model – FIM60

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1. PACKET ERROR CODES

If the host sends command packet, the device returns acknowledge packet with packet error code. If Error code is not “ERR_NONE”, the previously sent command packet is ignored in the device. The host needs to check the returned error code, and then retry or does something.

ERROR CODE LIST		
ERR_NONE	The command packet successfully executed	0x0
ERR_CHECKSUM_ERROR	There exists checksum error in header or data block.	0x2
ERR_INVALID_CMD	The command sent to the device is invalid.	0x5

2. PACKET RESULT LIST

■ Description

The following table describes result codes in acknowledge packet.

ERROR RESULT LIST		
RESULT_SUCCEEDED	The command is executed successfully	0x01
RESULT_FAILED	The command cannot be executed for unknown reason	0x02
RESULT_NOT_MASTER_MODE	The command that requires the master privilege is executed in normal mode	0x03
RESULT_USED_ID	The ID in command packet is already existed	0x04
RESULT_INVALID_ID	The ID in command packet is invalid	0x05
RESULT_DB_IS_FULL	There is no space for new user	0x06
RESULT_NOT_IN_TIME	The fingerprint image is not captured during pre-configured timeout	0x07
RESULT_INVALID_PARAM	Parameters of command packet are invalid	0x09
RESULT_CANCELED	Cancel command is transferred during executing a previous command	0x0D
RESULT_ANOTHER_FINGER	The second finger is not matched with the first one in registration	0x0E
RESULT_IDLE_STATUS	There is no executed command for the cancel command	0x10
RESULT_TOO_LARGE_DATA	The size of transferred data is larger than the size of pre-defined data structure	0x11
RESULT_IDENTIFY_TIMEOUT	Identification (1:N Matching) cannot be completed during pre-configured identification timeout	0x12
RESUT_DB_ISNOT_EMPTY	User data is existed when the command requires empty DB	0x13
RESULT_INVALID_DATASIZE	The required data size is different with transferred data size	0x15
RESULT_INVALID_DATA	The transferred data cannot be comprehended	0x16
RESULT_EXTRACT_FAIL	The module cannot extract template data from captured fingerprint image. Or identical fingerprint image is inserted sequentially.	0x17
RESULT_NOT_SUPPORTED	The command is not available	0x18
RESULT_AUTO_IDENTIFY_MODE	Command is received in Auto-identification mode	0x19
RESULT_INVALID_SEQUENCE	Wrong parameter is received in sequential commands like CMD_REGISTER_FP and CMD_REGISTER_MULTI_FP	0x20

Troubleshooting

ERROR RESULT LIST	
RESULT_SUCCEEDED	-
RESULT_FAILED	-
RESULT_NOT_MASTER_MODE	Host should obtain master authority to access certain commands. Enter master mode: CMD_ENTER_MATER_MODE2 Leave master model: CMD_LEAVE_MASTER_MODE
RESULT_USED_ID	Same ID is existed in the module; therefore, please remove the ID registered in the module if host wish to replace. Related commands: CMD_DELETE_FP and CMD_DELETE_ALL_FP.
RESULT_INVALID_ID	Transferred ID is not available or wrong-made. Please check the ID again. ID should be finished with NULL byte. For example, firstly, in case of ID = 1234, FPID is composed as below. - 0x31 32 33 34 00 xx xx xx xx xx xx (xx = Do not care) Secondly, in case of ID = 1234567890, FPID is composed as below. - 0x31 32 33 34 35 36 37 38 39 30 00
RESULT_DB_IS_FULL	In order to register/add more users, existed user should be deleted. Related commands: CMD_DELETE_FP and CMD_DELETE_ALL_FP.
RESULT_NOT_IN_TIME	The capture timeout is configured by SI_CAPTURE_TIMEOUT of CMD_SET_SYSINFO. In case of FIM30 mode, CMD_SET_CAPTURE_PERIOD can also be used.
RESULT_INVALID_PARAM	-
RESULT_CANCELED	-
RESULT_ANOTHER_FINGER	Please try registration again. Both fingers should be identical.
RESULT_IDLE_STATUS	-
RESULT_TOO_LARGE_DATA	Total size of multiple packets should be checked again.
RESULT_IDENTIFY_TIMEOUT	The identification timeout is configured by SI_IDENTIFY_TIMEOUT of CMD_SET_SYSINFO.
RESUT_DB_ISNOT_EMPTY	Certain commands require empty DB: CMD_CHG_NUM_OF_TEMP, CMD_CHG_EMULMODE and CMD_CHG_LENGTH_OF_USERID.
RESULT_INVALID_DATASIZE	Please check the parameter of command packet and emulation mode of the module. Required data size can be changed by these factors, especially in

	CMD_ADD_FP.
RESULT_INVALID_DATA	Please check the parameters of command packet and emulation mode of the module. Required data is analyzed based on these factors, especially in CMD_ADD_FP.
RESULT_EXTRACT_FAIL	Main culprit of the error is sequential input of identical fingerprint image when latent option (SI_USING_LATENT) is enabled. User should lift and re-locate the finger in continuous capturing conditions such as registration and auto-identification.
RESULT_NOT_SUPPORTED	Programmable GPIOs cannot be configured in FIM20/30 emulation mode.
RESULT_AUTO_IDENTIFY_MODE	Auto-identification mode blocks most commands. Please release auto-identification mode to use other commands.
RESULT_INVALID_SEQUENCE	Please check registration step.

3. SYSTEM CONFIGURATION LIST

This chapter describes SI_Type, SI_Value and SI_INFO.

■ SI_Type and SI_Value

SI_Type		SI_Value		
Code	Name	Range	Default	Note
	Description			
0x02	SI_USING_LOG	True/False	False	
	Log data is stored into the DB when this option is enabled.			
0x03	SI_NUM_OF_TEMP	2, 4	2	Supported in FIM20 emulation mode only
	Configures template counts of each user. DB has to be empty to change this value.			
0x17	SI_IDENTIFY_TIMEOUT	10 ~ 255	30	100ms tick. 255 = unlimited
	Configures the timeout of identification (1:N Matching).			
0x18	SI_RELAY_TIME	0 or 1~100	10	100ms tick
	Relay is operated as a result in programmable GPIOs when DB/Matching commands are executed. This option specifies the length of relay operation.			
0x19	SI_CAPTURE_TIMEOUT	10~	50	100ms tick (1s tick in FIM30 mode)
	Configures the timeout of fingerprint capturing.			
0x20	SI_IMAGE_BRIGHTNESS	0~100	45	
	Configures the brightness setting of fingerprint sensor. Range is darkness (0) to brightness(100)			
0x21	SI_IMAGE_GAIN	1,2,4,8	2	
	Configures the gain setting of fingerprint sensor.			
0x22	SI_IMAGE_CONTRAST	0~100	20	
	Configures the contrast setting for captured fingerprint image.			
0x28	SI_ADAPTIVE_CAPTURE	True/False	False	
	Adaptive capture is used to improve the recognition ratio for dry/wet fingerprint. Adaptive capture changes sensor's setting values automatically to get better fingerprint image.			
0x30	SI_VERIFY_SECURITY_LEVEL	1~9	5	

	Configures security level for verification (1:1 Matching). High value means high security level.			
0x31	SI_IDENTIFY_SECURITY_LEVEL	6~9	8	
	Configures security level for identification (1:N Matching). High value means high security level.			
0x32	SI_REGISTER_QUALITY	30~100	40	
	This value is used to check the image quality in registration. Higher value than SI_VERIFY_QUALITY is recommended.			
0x33	SI_VERIFY_QUALITY	10~100	30	
	This value is used to check the image quality in matching.			
0x38	SI_USING_LATENT	True/False	False	
	Latent fingerprint image is strongly prevented when this option is enabled.			
0x48	SI_CHANNEL0_BAUDRATE	0 – 115200 1 – 57600 2 – 38400 3 – 19200 4 – 9600	4	
	Configures the baud-rate of UART channel 0.			
0x49	SI_CHANNEL1_BAUDRATE	0 – 115200 1 – 57600 2 – 38400 3 – 19200 4 – 9600	4	
	Configures the baud-rate of UART channel 1.			
0x4A	SI_CURR_CHANNEL_BAUDRATE	0 – 115200 1 – 57600 2 – 38400 3 – 19200 4 – 9600		
	Configures the baud-rate of currently used UART channel.			
0x50	SI_MAX_USER			Read Only Supported in FIM20/30 emulation mode only
	This values means total available user count based on template count of each user; however, this value is not used in NONE emulation mode because variable template count is used.			

0x51	SI_FP_FULL_ROTATION	True/False	False	
	Overturned fingerprint image can be matched when this option is enabled.			
0x52	SI_LENGTH_OF_USER_ID	4~15	10	Read Only
	This value means currently used ID length.			
0x53	SI_NUM_OF_ADAPTIVE_CAP	0~255	5	
	This value means the max number of capturing count in Adaptive capture.			
0x54	SI_MAX_TEMPLATE			Read Only
	This value means total available template count.			
0xF0	SI_EMULATION_MODE	0x01 – FIM20 0x02 – FIM30 0xFF – None	0xFF	Read Only
	This value means currently configured emulation mode.			

If SI_EMULATION_MODE is changed, SI_LENGTH_OF_USER_ID can be changed according to the value of SI_EMULATION_MODE.

■ SI_INFO Structure

SI_INFO	UINT32	SI_Type
	UINT32	SI_Value

4. LOG DATA BLOCK

The log data block consists of index, type, event, result, time and ID. The following table shows the organization of a log data block. The max number of log is different according to devices.

■ Log Data Format

Index (4)	Type (1)	Event (1)	Information (22)		
			ID (10)	Result (2)	Reserved (10)
0 ~ (0xFFFFFFFF – 1)	Command = 0[1)]	0 – Enroll	FPID (10)	RESULT (2)	X
		1 – Delete	FPID (10)	RESULT (2)	X
		2 – Verify	FPID (10)	RESULT (2)	X
		3 – Identify	FPID (10)	RESULT (2)	X
		6 – Instant Match	FPID (10)	RESULT (2)	X
		7 – Enter Master Mode	FPID (10)	RESULT (2)	X
		8 – Set Master	FPID (10)	RESULT (2)	X
		9 – Reset Master	FPID (10)	RESULT (2)	X
		10 – Delete All	X	RESULT (2)	X
		12 – Change Password	FPID (10)	RESULT (2)	X
		13 – Add FP	FPID (10)	RESULT (2)	X
		14 – Instant Verify	FPID (10)	RESULT (2)	X
		15 – Instant Identify	FPID (10)	RESULT (2)	X
		16 – Change User Security	FPID (10)	RESULT (2)	X
	Error = 1	Error String			
	Type (1)	**Event (1)**	**Information (22)**		
			Result (2)	**Time (8)**	**ID (12)**
	Command = 2[2)]	0 – Enroll	RESULT (2)	TIME (8)	FPID (12)
		1 – Delete	RESULT (2)	TIME (8)	FPID (12)
		2 – Verify	RESULT (2)	TIME (8)	FPID (12)
		3 – Identify	RESULT (2)	TIME (8)	FPID (12)
		6 – Instant Match	RESULT (2)	TIME (8)	FPID (12)
		7 – Enter Master Mode	RESULT (2)	TIME (8)	FPID (12)

		8 – Set Master	RESULT (2)	TIME (8)	FPID (12)
		9 – Reset Master	RESULT (2)	TIME (8)	FPID (12)
		10 – Delete All	RESULT (2)	TIME (8)	X
		12 – Change Password	RESULT (2)	TIME (8)	FPID (12)
		13 – Add FP	RESULT (2)	TIME (8)	FPID (12)
		14 – Instant Verify	RESULT (2)	TIME (8)	FPID (12)
		15 – Instant Identify	RESULT (2)	TIME (8)	FPID (12)
		16 – Change User Security	RESULT (2)	TIME (8)	FPID (12)
	Type (1)	**Event (1)**	**Information (26)**		
			Result (2)	**Time (8)**	**ID (16)**
	Command = 3[3)]	0 – Enroll	RESULT (2)	TIME (8)	FPID (16)
		1 – Delete	RESULT (2)	TIME (8)	FPID (16)
		2 – Verify	RESULT (2)	TIME (8)	FPID (16)
		3 – Identify	RESULT (2)	TIME (8)	FPID (16)
		6 – Instant Match	RESULT (2)	TIME (8)	FPID (16)
		7 – Enter Master Mode	RESULT (2)	TIME (8)	FPID (16)
		8 – Set Master	RESULT (2)	TIME (8)	FPID (16)
		9 – Reset Master	RESULT (2)	TIME (8)	FPID (16)
		10 – Delete All	RESULT (2)	TIME (8)	X
		12 – Change Password	RESULT (2)	TIME (8)	FPID (16)
		13 – Add FP	RESULT (2)	TIME (8)	FPID (16)
		14 – Instant Verify	RESULT (2)	TIME (8)	FPID (16)
		15 – Instant Identify	RESULT (2)	TIME (8)	FPID (16)
		16 – Change User Security	RESULT (2)	TIME (8)	FPID (16)

* '()' symbol means number of bytes.

1) This type is supported in FIM30 Emulation Mode.

2) This type is supported in FIM20 Emulation Mode.

3) This type is supported in NONE Emulation Mode.

Log Event List

The following table describes log events.

LOG EVENT LIST	
LOGEVT_ENROLL	0x00
LOGEVT_DELETE	0x01
LOGEVT_VERIFY	0x02
LOGEVT_IDENTIFY	0x03
LOGEVT_INSTANT_MATCH	0x06
LOGEVT_ENTER_MASTERMODE	0x07
LOGEVT_SET_MASTER	0x08
LOGEVT_RESET_MASTER	0x09
LOGEVT_DELETE_ALL	0x0A
LOGEVT_CHANGE_FP	0x0B
LOGEVT_CHANGE_PASSWD	0x0C
LOGEVT_ADD	0x0D
LOGEVT_INSTANT_VERIFY	0x0E
LOGEVT_INSTANT_IDNETIFY	0x0F
LOGEVT_NONE	0xFF

5. DATA STRUCTURE

In this chapter, the structure of data block is explained.

■ Definitions

DEFINITIONS for NONE Emulation Mode		
Name	**Value**	**Note**
LENGTH_OF_FPID	11 (Variable)	Default Value. Can be changed. The available maximum FPID size is 10 if LENGTH_OF_FPID = 11 because NULL byte has to be attached in the last position.
LENGTH_OF_PASSWD	16	The available maximum FPID size is 15 because NULL byte has to be attached in the last position.
LENGTH_OF_TEMPLATE_HEADER	4	Template Header is defined as following. - 0x00 00 00 03: Nitgen Format - 0x00 00 01 00: ISO 19794-2 Format - 0x00 00 02 00: ANSI 378 Format
LENGTH_OF_TEMPLATE_DATA	400	Nitgen format uses fixed length of template data: 400 bytes; however, ISO 19794-2 and ANSI 378 formats are using variable template size.
LENGTH_OF_ISO_DATA	Variable	This value is decided by number of minutiae.

DEFINITIONS for FIM20 Emulation Mode		
Name	**Value**	**Note**
LENGTH_OF_FPID	11	The available maximum FPID size is 10 because NULL byte has to be attached in the last position.
LENGTH_OF_PASSWD	16	The available maximum FPID size is 15 because NULL byte has to be attached in the last position.
LENGTH_OF_TEMPLATE_HEADER	4	Template Header is defined as following. - 0x00 00 00 03: Nitgen Format - 0x00 00 01 00: ISO 19794-2 Format - 0x00 00 02 00: ANSI 378 Format

LENGTH_OF_TEMPLATE_DATA	400	Nitgen format uses fixed length of template data: 400 bytes; however, ISO 19794-2 and ANSI 378 formats are using variable template size.
LENGTH_OF_ISO_DATA	Variable	This value is decided by number of minutiae.

DEFINITIONS for FIM30 Emulation Mode		
Name	**Value**	**Note**
LENGTH_OF_FPID	10	The available maximum FPID size is 9 because NULL byte has to be attached in the last position.
LENGTH_OF_PASSWD	16	The available maximum FPID size is 15 because NULL byte has to be attached in the last position.
LENGTH_OF_TEMPLATE_HEADER	0	-
LENGTH_OF_TEMPLATE_DATA	400	Nitgen format uses fixed length of template data: 400 bytes; however, ISO 19794-2 and ANSI 378 formats are using variable template size.
LENGTH_OF_ISO_DATA	Variable	This value is decided by number of minutiae.

Structures

COMMON		
ID_INFO	UINT8	FPID [LENGTH_OF_FPID]
	Used in: CMD_VERIFY_FP, CMD_IDENTIFY_FP, CMD_IDENTIFY_RID_FP, CMD_INSTANT_IDENTIFY, CMD_AUTO_IDENTIFY_RESULT, CMD_DELETE_FP, CMD_SET_MASTER, CMD_ENTER_MASTER_MODE2 and CMD_CHANGE_FP	
PASSWORD_INFO	UINT8	FPPassword [LENGTH_OF_PASSWD]
	Used in: CMD_SET_MASTER_PASSWORD and CMD_ENTER_MASTER_MODE2	
TEMPLATE_INFO (Nitgen Format)	UINT8	Header [LENGTH_OF_TEMPLATE_HEADER]
	UINT8	Data [LENGTH_OF_TEMPLATE_DATA]
	Used in: CMD_INSTANT_MATCHING, CMD_GET_TEMPLATE and CMD_AUTO_IDENTIFY_RESULT	
TEMPLATE_INFO (ISO/ANSI Format)	UINT8	Header [LENGTH_OF_TEMPLATE_HEADER]
	UINT8	Data [LENGTH_OF_ISO_DATA]
	Used in: CMD_INSTANT_MATCHING, CMD_GET_TEMPLATE and CMD_AUTO_IDENTIFY_RESULT	
SIZE_INFO	UINT8	Size_H (MSB 8 bits)
	UINT8	Size_L (LSB 8 bits)
	Size = (Size_H *256) + Size_L	
AUTHENTICATION		
AUTH_ID_PASSWD	ID_INFO	FPID
	PASSWORD_INFO	FPPassword
	Used in: CMD_VERIFY_FP, CMD_ENTER_MASTER_MODE2, CMD_REGISTER_FP, CMD_CHANGE_FP and CMD_REGISTER_MULTI_FP	
AUTH_ID_TEMPLATE	ID_INFO	FPID
	TEMPLATE_INFO	FPTemplate
	Used in: CMD_INSTANT_VERIFY and CMD_ENTER_MASTER_MODE2	
AUTH_ID_TINDEX	ID_INFO	FPID
	UINT8	Template_Index (0 ~ 9)
	Used in: CMD_IDENTIFY_FP, CMD_IDENTIFY_RID_FP and CMD_INSTANT_IDENTIFY	
AUTH_ID_RIGHT	ID_INFO	FPID

	UINT8	Right (0: Normal, 1: Master)
	Used in: CMD_IDENTIFY_FP, CMD_IDENTIFY_RID_FP and CMD_INSTANT_IDENTIFY	
LIST		
FP_LIST_TYPE0	UINT16	User_Number
	UINT16	ID_Size (FIM30 mode: 10, Otherwise: 11 or N)
	ID_INFO	FPID_1
	ID_INFO	FPID_2
	⋮	⋮
	ID_INFO	FPID_N
	Used in: CMD_GET_FP_LIST2 and CMD_GET_MASTER_LIST2	
FP_LIST_TYPE1	UINT16	User_Number
	Used in: CMD_GET_FP_LIST2 and CMD_GET_MASTER_LIST2	
LOG		
LOG_DATA_BLOCK	UINT16	Log_Number
	UINT16	Log_Size
	LOG_DATA_TYPEx	Log_1
	LOG_DATA_TYPEx	Log_2
	⋮	⋮
	LOG_DATA_TYPEx	Log_n
	Used in: CMD_READ_LOG_DATA2	
LOG_DATA_TYPE0 (FIM30 mode, 28 bytes)	UINT8	Index [4]
	UINT8	Type (0x00)
	UINT8	Event
	UINT8	UserID [10]
	UINT8	Result [2]
	UINT8	Reserved [10]
LOG_DATA_TYPE2 (FIM20 mode, 28bytes)	UINT8	Index [4]
	UINT8	Type (0x02)
	UINT8	Event
	UINT8	Result [2]
	UINT8	TIME [8]

	UINT8	UserID [12]
LOG_DATA_TYPE3 (NONE mode, 32bytes)	UINT8	Index [4]
	UINT8	Type (0x03)
	UINT8	Event
	UINT8	Result [2]
	UINT8	TIME [8]
	UINT8	UserID [16]
FIRMWARE		
FIRMWARE_DATA_BLOCK	UINT32	Firmware_Size (N = M1+M2+…+Mn)
	UINT8	Firmware [Mx] (1 ≤ Mx ≤ 32768)
	Used in: CMD_UPGRADE_FIRMWARE2	
TIME		
TIME_INFO (BCD Code)	UINT8	Hundredth_Year (Hundredth Year)
	UINT8	Year (Remained Year, i.e. 0x20)
	UINT8	Month (1 ~ 12, i.e. 0x12)
	UINT8	Date (1 ~ 31, i.e. 0x31)
	UINT8	Hour (0 ~ 23, i.e. 0x23)
	UINT8	Minute (0 ~ 59, i.e. 0x59)
	UINT8	Second (0 ~ 59, i.e. 0x59)
	UINT8	Reserved
	Used in: CMD_SET_TIME and CMD_GET_TIME	
CONFIGURATION		
SI_INFO	UINT32	SI_Type
	UINT32	SI_Value
	Used in: CMD_SET_SYSINFO and CMD_GET_SYSINFO	
DB		
FIM_OLD_DB_FIM30 (FIM30 mode)	UINT8	Right (0: Normal, 1: Master)
	ID_INFO	FPID
	PASSWORD_INFO	FPPassword
	TEMPLATE_INFO	FPTemplate_1

	TEMPLATE_INFO	FPTemplate_2
	Used in: CMD_ADD_FP and CMD_GET_FP	
FIM_DB_FIM30 (FIM30 mode)	UINT8	Header [4] - 0xC1 00 00 00: Nitgen Format - 0xC1 01 00 00: ISO 19794-2 Format - 0xC1 02 00 00: ANSI 378 Format
	UINT8	Right (0: Normal, 1: Master)
	ID_INFO	FPID
	PASSWORD_INFO	FPPassword
	UINT8	SecuLevelInfo (0xFC: Using personal security level, Otherwise: Not using personal security level)
	UINT8	UserSecuLevel (1 ~ 9, personal verification security level)
	UINT8	Reserved [6]
	SIZE_INFO	FPSize_1
	SIZE_INFO	FPSize_2
	TEMPLATE_INFO	FPTemplate_1
	TEMPLATE_INFO	FPTemplate_2
	Used in: CMD_ADD_FP and CMD_GET_FP	
FIM_OLD_DB2 (FIM20 mode)	UINT8	Right (0: Normal, 1: Master)
	ID_INFO	FPID
	PASSWORD_INFO	FPPassword
	TEMPLATE_INFO	FPTemplate_1
	TEMPLATE_INFO	FPTemplate_2
	TIME_INFO	Time
	Used in: CMD_ADD_FP and CMD_GET_FP	
FIM_OLD_DB4 (FIM20 mode)	UINT8	Right (0: Normal, 1: Master)
	ID_INFO	FPID
	PASSWORD_INFO	FPPassword
	TEMPLATE_INFO	FPTemplate_1
	TEMPLATE_INFO	FPTemplate_2
	TEMPLATE_INFO	FPTemplate_3
	TEMPLATE_INFO	FPTemplate_4

	TIME_INFO	Time
	Used in: CMD_ADD_FP and CMD_GET_FP	
FIM_DB2 (FIM20 mode)	UINT8	Header [4] - 0xC1 00 00 00: Nitgen Format - 0xC1 01 00 00: ISO 19794-2 Format - 0xC1 02 00 00: ANSI 378 Format
	UINT8	Right (0: Normal, 1: Master)
	ID_INFO	FPID
	PASSWORD_INFO	FPPassword
	UINT8	SecuLevelInfo (0xFC: Using personal security level, Otherwise: Not using personal security level)
	UINT8	UserSecuLevel (1 ~ 9, personal verification security level)
	UINT8	Reserved [6]
	TIME_INFO	Time
	SIZE_INFO	FPSize_1
	SIZE_INFO	FPSize_2
	TEMPLATE_INFO	FPTemplate_1
	TEMPLATE_INFO	FPTemplate_2
	Used in: CMD_ADD_FP and CMD_GET_FP	
FIM_DB4 (FIM20 mode)	UINT8	Header [4] - 0xC2 00 00 00: Nitgen Format - 0xC2 01 00 00: ISO 19794-2 Format - 0xC2 02 00 00: ANSI 378 Format
	UINT8	Right (0: Normal, 1: Master)
	ID_INFO	FPID
	PASSWORD_INFO	FPPassword
	UINT8	SecuLevelInfo (0xFC: Using personal security level, Otherwise: Not using personal security level)
	UINT8	UserSecuLevel (1 ~ 9, personal verification security level)
	UINT8	Reserved [6]
	TIME_INFO	Time
	SIZE_INFO	FPSize_1

	SIZE_INFO	FPSize_2
	SIZE_INFO	FPSize_3
	SIZE_INFO	FPSize_4
	TEMPLATE_INFO	FPTemplate_1
	TEMPLATE_INFO	FPTemplate_2
	TEMPLATE_INFO	FPTemplate_3
	TEMPLATE_INFO	FPTemplate_4
	Used in: CMD_ADD_FP and CMD_GET_FP	
FIM_MT_DB (NONE mode)	UINT8	Header [4] - 0xC3 00 00 00: Nitgen Format - 0xC3 01 00 00: ISO 19794-2 Format - 0xC3 02 00 00: ANSI 378 Format
	UINT8	Right (0: Normal, 1: Master)
	ID_INFO	FPID
	PASSWORD_INFO	FPPassword
	UINT8	SecuLevelInfo (0xFC: Using personal security level, Otherwise: Not using personal security level)
	UINT8	UserSecuLevel (1 ~ 9, personal verification security level)
	UINT8	Reserved [6]
	TIME_INFO	Time
	SIZE_INFO	FPSize [10]
	TEMPLATE_INFO	FPTemplate [10]
	FPTemplate [0 ~ 9] exist only when FPSize [0 ~ 9] have non-zero value. For example, FPSize [0] has non-zero value and otherwise is zero, there is only one template data is existed. Used in: CMD_ADD_FP and CMD_GET_FP	

* All data is big-endian format.

* Value for reserved area: 0xFF

* Maximum ISO/ANSI minutiae number is 80.

6. Command List for Emulation mode

This chapter describes commands used in each emulation mode.

■ FIM20 Emulation Command

CATEGORY	COMMANDS
CONNECTION	CMD_REQUEST_CONNECTION (0x01) CMD_GET_FIRMWARE_VERSION2 (0x04) CMD_GET_DEVICE_INFO (0x05)
MATCHING	CMD_VERIFY_FP (0x11) CMD_IDENTIFY_FP (0x12) CMD_IDENTIFY_RID_FP(0x13) CMD_INSTANT_MATCHING (0x15) CMD_GET_TEMPLATE (0x16) CMD_CANCEL (0x17) CMD_INSTNAT_VERIFY (0x18) CMD_INSTNAT_IDENTIFY (0x19) CMD_AUTO_IDENTIFY (0x1A) CMD_AUTO_IDENTIFY_RESULT (0x1B)
DATABASE MANAGEMENT	CMD_DELETE_FP (0x22) CMD_DELETE_ALL_FP (0x23) CMD_SET_MASTER (0x24) CMD_LEAVE_MASTER_MODE (0x26) CMD_SET_MASTER_PASSWORD (0x27) CMD_READ_USER_DATA (0x2B) CMD_WRITE_USER_DATA (0x2C) CMD_ERASE_USER_DATA_BLOCK (0x2D) CMD_DELETE_MASTER_PASSWORD (0x2E) CMD_ENTER_MASTER_MODE2 (0x2F) CMD_GET_FP_LIST2 (0x30) CMD_GET_MASTER_LIST2 (0x31)

	CMD_READ_LOG_DATA 2(0x32) CMD_REGISTER_FP (0x33) CMD_CHANGE_FP (0x34) CMD_ADD_FP (0x35) CMD_GET_FP (0x36) CMD_DELETE_ALL_LOG (0x37)
CONFIGURATION	CMD_SET_SYSINFO (0x4C) CMD_GET_SYSINFO (0x4D) CMD_SAVE_SYSINFO (0x4E) CMD_CHG_NUM_OF_TEMP (0x4F) CMD_SET_DEFAULT_SYSINFO (0x50) CMD_CHG_EMULMODE (0x51) CMD_CHG_LENGTH_OF_USERID (0x52)
SYSTEM MANAGEMENT	CMD_STATUS_CHECK (0x62) CMD_GET_FP_IMAGE2 (0x63) CMD_UPGRADE_FIRMWARE2 (0x64) CMD_SET_TIME (0x65) CMD_GET_TIME (0x66) CMD_CTL_IO (0x67) CMD_GET_IMAGE_QUALITY (0x68)

FIM30 Emulation Command

CATEGORY	COMMANDS
CONNECTION	CMD_REQUEST_CONNECTION (0x01) CMD_SET_BAUDRATE (0x02) CMD_GET_FIRMWARE_VERSION2 (0x04) CMD_GET_DEVICE_INFO (0x05)
MATCHING	CMD_VERIFY_FP (0x11) CMD_IDENTIFY_FP (0x12) CMD_INSTANT_MATCHING (0x15) CMD_GET_TEMPLATE (0x16) CMD_CANCEL (0x17) CMD_AUTO_IDENTIFY (0x1A) CMD_AUTO_IDENTIFY_RESULT (0x1B)
DATABASE MANAGEMENT	CMD_DELETE_FP (0x22) CMD_DELETE_ALL_FP (0x23) CMD_SET_MASTER (0x24) CMD_LEAVE_MASTER_MODE (0x26) CMD_SET_MASTER_PASSWORD (0x27) CMD_READ_USER_DATA (0x2B) CMD_WRITE_USER_DATA (0x2C) CMD_ERASE_USER_DATA_BLOCK (0x2D) CMD_DELETE_MASTER_PASSWORD (0x2E) CMD_ENTER_MASTER_MODE2 (0x2F) CMD_GET_FP_LIST2 (0x30) CMD_GET_MASTER_LIST2 (0x31) CMD_READ_LOG_DATA2 (0x32) CMD_REGISTER_FP (0x33) CMD_ADD_FP (0x35) CMD_GET_FP (0x36) CMD_DELETE_ALL_LOG (0x37)
CONFIGURATION	CMD_SET_OPP_OPTION (0x40)

	CMD_GET_OPP_OPTION (0x41) CMD_SET_SECURITY_LEVEL (0x42) CMD_GET_SECURITY_LEVEL (0x43) CMD_SET_CAPTURE_OPTION (0x44) CMD_GET_CAPTURE_OPTION (0x45) CMD_SET_LOG_OPTION (0x48) CMD_GET_LOG_OPTION (0x49) CMD_SET_CAPTURE_PERIOD (0x4A) CMD_GET_CAPTURE_PERIOD (0x4B) CMD_SET_SYSINFO (0x4C) CMD_GET_SYSINFO (0x4D) CMD_SAVE_SYSINFO (0x4E) CMD_SET_DEFAULT_SYSINFO (0x50) CMD_CHG_EMULMODE (0x51) CMD_CHG_LENGTH_OF_USERID (0x52)
SYSTEM MANAGEMENT	CMD_STATUS_CHECK (0x62) CMD_GET_FP_IMAGE2 (0x63) CMD_UPGRADE_FIRMWARE2 (0x64) CMD_SET_TIME (0x65) CMD_GET_TIME (0x66) CMD_CTL_IO (0x67) CMD_GET_IMAGE_QUALITY (0x68)

7. Programmable GPIOs

This chapter explains 8 programmable GPIOs (General Purpose Input and Output) which are contained in FIM4x and FIM5x devices.

These GPIOs could be configured as the following table by using CMD_CFG_IO (0x69) command and CMD_SAVE_SYSINFO should be executed to preserve changed options.

Default values of all programmable GPIOs are disabled.

Programmable GPIOs are working under LVCMOS (3.3V) level.

Code	Name	Direction	Description
0x00	GPIO_IN_NORMAL	IN	This function is used to read the status of the port by using CMD_CTL_IO (0x67).
0x01	GPIO_IN_ENROLL_HIGH	IN	Registration with automatically created ID is activated when the port level goes from low to high. The finger should be captured twice but it stores only one template. If the module is not master mode and any master is registered, host should be authenticated by fingerprint capturing to obtain master-privilege before registration.
0x02	GPIO_IN_ENROLL_LOW	IN	Registration with automatically created ID is activated when the port level goes from high to low. The finger should be captured twice but it stores only one template. If the module is not master mode and any master is registered, host should be authenticated by fingerprint capturing to obtain master-privilege before registration.
0x03	GPIO_IN_DELETE_HIGH	IN	Deletion by fingerprint capturing is activated when the port level goes from low to high. The step of deletion is: Capturing → Identifying → Deletes matched user. All users can be deleted if high level is maintained over 5 seconds. If the module is not master mode and any master is registered, host should be authenticated by fingerprint

			capturing to obtain master-privilege before deletion.
0x04	GPIO_IN_DELETE_LOW	IN	Deletion by fingerprint capturing is activated when the port level goes from high to low. The step of deletion is: Capturing → Identifying → Deletes matched user. All users can be deleted if high level is maintained over 5 seconds. If the module is not master mode and any master is registered, host should be authenticated by fingerprint capturing to obtain master-privilege before deletion.
0x05	GPIO_IN_IDENTIFY_HIGH	IN	Identification is activated when the port level goes from low to high.
0x06	GPIO_IN_IDENTIFY_LOW	IN	Identification is activated when the port level goes from high to low.
0x80	GPIO_OUT_NORMAL	OUT	This function is used to change the status of the port by using CMD_CTL_IO (0x67).
0x81	GPIO_OUT_SUCCESS_HIGH	OUT	Level of the port is changed to high when certain operations are succeeded. The list of operations is described below.
0x82	GPIO_OUT_SUCCESS_LOW	OUT	Level of the port is changed to low when certain operations are succeeded. The list of operations is described below.
0x83	GPIO_OUT_FAIL_HIGH	OUT	Level of the port is changed to high when certain operations are failed. The list of operations is described below.
0x84	GPIO_OUT_FAIL_LOW	OUT	Level of the port is changed to low when certain operations are failed. The list of operations is described below.
0x85	GPIO_OUT_CAPTURING	OUT	Level of the port goes to high while sensor is capturing.
0x86	GPIO_OUT_FP_STATUS	OUT	Level of the port goes to high when finger is placed on the sensor. This function is only available at optical sensor based products: FIM4060 and FIM5060 and FIM6060.
0xFF	GPIO_DISABLE	-	The port is not used.

GPIO_OUT_SUCCESS/FAIL_HIGH/LOW (0x0A ~ 0x0D) are affected by following operations.

Commands	CMD_VERIFY_FP (0x11)
	CMD_IDENTIFY_FP (0x12)
	CMD_IDENTIFY_RID_FP (0x13)
	CMD_INSTANT_MATCHING (0x15)
	CMD_INSTANT_VERIFY (0x18)
	CMD_INSTANT_IDENTIFY (0x19)
	CMD_AUTO_IDENTIFY_RESULT (0x1B)
	CMD_DELETE_FP (0x22)
	CMD_DELETE_ALL_FP (0x23)
	CMD_REGISTER_FP (0x33)
	CMD_REGISTER_MULTI_FP (0x38)
GPIO Operations	GPIO_IN_ENROLL_HIGH
	GPIO_IN_ENROLL_LOW
	GPIO_IN_DELETE_HIGH
	GPIO_IN_DELETE_LOW
	GPIO_IN_IDENTIFY_HIGH
	GPIO_IN_IDENTIFY_LOW

GPIO_IN_NORMAL (0x00) and GPIO_OUT_NORMAL (0x80) are affected by CMD_CTL_IO (0x67) command.

Appendix A. Support Information

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