FINGERPRINTS

Product Specification

FPC-BM

Biometric Module

Revision B

Contents

1 Overview

The FPC-BM module is a biometric fingerprint system, including a robust fingerprint sensor solution and on-board template storage. It can be used standalone, ready to use out-of-the-box at delivery, or connected to a host CPU over UART or SPI. Simple serial commands are used to enrol and verify.

Application examples

- Access control systems
- Time & Attendance
- Locks, safes
- POS terminals

1.1 General Description

The FPC-BM can be used in conjunction with either an FPC1020AM touch fingerprint sensor, or an FPC1011F3 area fingerprint sensor, depending on which is deemed most suitable for the intended application. Each FPC sensor has a protective coating which helps to protect the biometric module against ESD, scratches, impact and everyday wear-and-tear. All FPC sensors feature 3D pixel sensing technology that can read virtually any finger; dry or wet.

The FPC-BM includes the following features:

- Embedded / stand-alone fingerprint identification system
- Compact sensor module package
- Protective sensor coating: scratch and ESD resistant
- One-to-one verification mode
  - Matching against 1 multi-template
- Identify (Few) verification mode
  - 50 multi-templates
- On-board template storage
  - Max. 50 multi-templates
- Straightforward serial command interface
- Finger detect & FPC OneTouch™ wake-up functionality (with FPC1020)
- EU RoHS compliant
- Easy to integrate and minimize time-to-market

The FPC-BM can be integrated into virtually any application and controlled by a host sending basic commands for enrolment and verification via the serial interface. Fingerprint templates are automatically created and stored in the internal flash memory. Templates used for verification can also be imported from an external storage source, including a central database, smartcard, or portable flash memory.

1.2 Technical Features – Biometric Module

An overview of the technical features of the FPC-BM biometric module is shown in Table 1.

Parameter		Description	Value	Unit
Processor board dimension		(W x L x H)	40 x 20 x 2.6	mm
Supply voltage		Regulated	3.3	V
		Unregulated	5	V
Current consumption (3.3 V)	Active capture mode	Full Speed	<70	mA
		Half Speed	25	
	Idle mode (default)	Typical	10	mA
	Sleep mode	Finger detection active	35	µA
	Deep Sleep mode	Finger detection not active	3.3	µA
ESD*		IEC61000-4-2, level X, air discharge	> ± 30	kV

**With proper integration as recommended in this specification*

Table 1: Technical features overview

1.3 Technical Features – Fingerprint Sensors

An overview of the fingerprint sensors which are compatible with the FPC-BM is shown in Table 2.

		
SENSOR / FEATURE	FPC1020AM-CM03 FPC1020AM-CM04 (IP67)	FPC1011F3
Sensor matrix	192 x 192 pixels	152 x 200 pixels
Number of pixels	36 864 pixels	30 400 pixels
Active sensing area	9.6 x 9.6 mm 92.2 mm²	10.6 x 14.0 mm 148.4 mm²
Spatial resolution	508 DPI	363 DPI
Durability	10 million finger placements	
Scratch resistance	Pencil hardness: 4H	
Resistance to household substances	Water, Carbonated soft drinks, coffee, oil, petrol, soap, artificial sweat, orange juice	
RoHS / ACPEIP	EU RoHS 2 / China RoHS	

Table 2: Overview of the FPC1020AM and FPC1011F3 sensors.

See section 11.2 for information on the mechanical properties of the sensors in Table 2.

1.4 China RoHS

Based on the information from our suppliers FPC-BM has an Environment Friendly Use Period (EFUP) of 50 years.

Part Name	Toxic and Harmful Substances					
	Pb	Hg	Cd	Cr (VI)	PBB	PBDE
Resistors	X*	O*	O*	O*	O*	O*

** O: All homogenous materials in the part are under the limits set out in standard GB/T 26572-2011.*
** X: In at least one homogenous material in the part the substance exceeds the limits set out in standard GB/T 26572-2011.*

Table 3: Toxic and harmful substances

2 Functional Description

The FPC-BM biometric module is a versatile stand-alone fingerprint verification system which consists of two main components - a fingerprint sensor and a processor board.

The FPC-BM can also be used as a slave towards a host CPU. In this case, a host CPU - selected and provided by the customer - executes the main application which interfaces with the FPC-BM module. Requirements on the host processor associated with the module communication are extremely low. Hence the host processor can be selected entirely to suit the main application at hand.

2.1 System overview

FPC-BM can be run in true standalone mode or connected to a host by soldering. See the illustration in Figure 1 for a system overview.

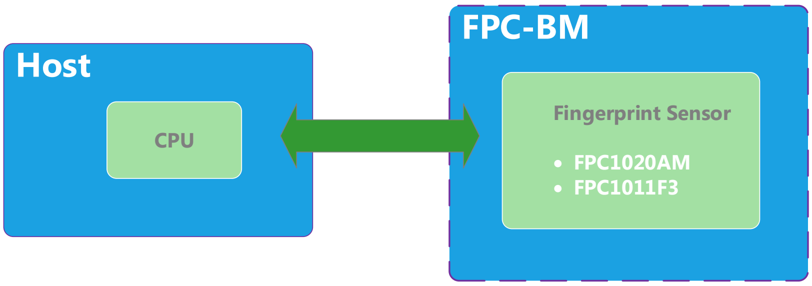

Figure 1: System Overview

2.1.1 FPC-BM

The FPC-BM processor board acquires the fingerprint image from the fingerprint sensor. The flash memory on the FPC-BM is pre-loaded with firmware from FPC and is used for all biometric operations and template storage.

Side solder edge pads

The FPC-BM is mounted in the customer application using 36 side solder edge pads on the PCB. There are 18 side solder edge pads on each long side of the PCB. Three connector pins are used for GND. See section 11 for more information on integration and the pin-pad configuration for the side solder edge pads.

Host Connection

There is no direct interaction between the host processor and the fingerprint sensor. The interface between the host processor and the processor board is based on a simple-to-use serial UART or a 20 MHz SPI command interface.

2.1.2 Fingerprint Sensors

The fingerprint sensors incorporated into the FPC-BM are based on capacitive technology and utilize a reflective measurement method. This method requires a galvanic contact point outside the sensor chip; a conductive bezel which is integrated into the sensor package.

In order to obtain good quality images it is important that the sensor is correctly mounted in an enclosure. See section 11 Integration for more information.

2.2 Absolute Maximum Ratings

Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Stress beyond the values listed in Table 4 may cause permanent damage to the device. Operation of the device in conditions beyond those indicated as normal operation in this specification is not implied or supported.

Parameter	Absolute maximum value	Unit
VDD	-0.5 to +2.5	V
VDDIO	-0.5 to +4.8	V
VDDA	-0.5 to +2.5	V
Operating temperature	- 20 to + 60	˚C
Storage temperature	- 45 to + 85	˚C

Table 4: Absolute maximum ratings

2.3 Performance Characteristics

This section describes the performance characteristics for the sensors that are compatible with the FPC-BM. The FPC-BM has three operation levels which directly affect performance characteristics:

- High Convenience (Default)
- Normal
- High Security

The level that is selected determines the level of convenience and security - FRR and FAR – in any given implementation. The FRR and FAR values for the one-to-one verification mode is shown in Table 5. For applications that handle more than 25 users it is recommended to use the Normal or High Security level.

PARAMETER	CONDITION	1 USER	UNIT
FRR (False-rejection-rate)	High Convenience (Default)	2,5	%
	Normal	3	%
	High Security	4	%
FAR (False-acceptance-rate)	High Convenience (Default)	0.01	%
	Normal	0.002	%
	High Security	0.001	%

Table 5: Performance characteristics – FRR / FAR.

2.4 Verification Times

Typical processing times for the biometric verification process in both full- and half-speed configuration modes are shown is Table 6.

Process	Full Speed			Half speed			Unit
	Min	Typical	Max	Min	Typical	Max	
Verification 1:1	-	400	-	-	800	-	ms
Identify (Few) 1:50	400	500	600	800	900	1000	ms

Table 6 : Biometric processing times

2.5 Template Updates and Limitations

A maximum limit of 70,000 user updates can be performed throughout the lifecycle of the FPC-BM. Each of the 7 data sectors is capable of 10k erases per sector (assuming optimal flash usage spread possible through algorithm use). Each multi-template for can be updated a maximum of 20 times (per enrolled finger).

As an example, over a 3 year period, this equates to a maximum of approximately 1165 user changes or updates per year. [*70k / 20 = 3500 user changes. 3500 / 3 years ~= 1165 user changes / year.*]

3 Signal List

This section gives an overview of the signals sent between the FPC-BM and a host.

3.1 Sensor Signals

This section gives an overview of the signals sent between the FPC-BM and the sensor.

Name	ID	Signal type (relative to FPC-BM)	Min. voltage [V]	Max. voltage [V]	Max. current [mA]	Max. frequency [MHz]
GND	GND	Output	0	0	24	DC
Reset (active low)	RST	Output	GND	3V3	~ 0	~ 0
SPI clock	SCLK	Output	GND	3V3	~ 0	20
SPI MOSI	MOSI	Output	GND	3V3	~ 0	SCLK
SPI chip select	SCS	Output	GND	3V3	~ 0	~ 0
SPI MISO	MISO	Input	GND	3V3	~ 0	SCLK
Interrupt*	INT	Input	GND	3V3	~ 0	~ 0
VDD (1.8 V)	1V8	Output	1.64	1.96	7	DC
Sensor reset (active low)	RST_N	Output	GND	3V3	~ 0	~ 0
Sensor SPI clock	SPICLK	Output	GND	3V3	~ 0	~ 0
Sensor SPI MOSI	MOSI	Output	GND	3V3	~ 0	SCLK
Sensor SPI C.S.	CS_N	Output	GND	3V3	~ 0	~ 0
Sensor SPI MISO	MISO	Input	GND	3V3	~ 0	SCLK
Sensor interrupt	INT	Input	GND	3V3	~ 0	~ 0
ESD FPC1011F3	ESD_DRAIN	Input	ESD_ GND	n/a	n/a	n/a

**not applicable for FPC-BM1011*

Table 7: Sensor signals

3.2 Host Signals

This section gives an overview of the signals sent between the FPC-BM and a host.

Name	ID	Signal type (relative to FPC-BM)	Min. voltage [V]	Max. voltage [V]	Design current [mA]	Max. frequency [MHz]
VDD (unreg.)	5V_IN	Input	4.18	6.00	135	DC
VDD (3.3V in)	3V3_IN	Input	3.01	3.59	135	DC
VDD (3.3V Out)	3V3_OUT	Output	3.01	3.59	135	DC
GND	GND	Input	0	0	135	DC
GPIO1	GPIO1	Bidirectional	GND	3V3	8	-
GPIO2	GPIO2	Bidirectional	GND	3V3	8	-
GPIO3	GPIO3	Bidirectional	GND	3V3	8	-
TX	TXD_UART	Output	GND	3V3	~ 0	0.1152
RX	RXD_UART	Input	GND	3V3	~ 0	0.1152
SPI clock host	SPICLK_HOST	Input	GND	3V3	~ 0	20
SPI MOSI host	MOSI_HOST	Input	GND	3V3	~ 0	SCLK
SPI chip select host	CS_N_HOST	Input	GND	3V3	~ 0	~ 0
SPI MISO host	MISO_HOST	Output	GND	3V3	~ 0	SCLK
JTAG state machine control	JTAG_TMS	Input	GND	3V3	~ 0	-
JTAG clock input	JTAG_TCK	Input	GND	3V3	~ 0	-
JTAG data input	JTAG_TDI	Input	GND	3V3	~ 0	-
JTAG data output	JTAG_TDO	Output	GND	3V3	~ 0	-

Name	ID	Signal type (relative to FPC-BM)	Min. voltage [V]	Max. voltage [V]	Design current [mA]	Max. frequency [MHz]
JTAG test reset	JTAG_TRST	Input	GND	3V3	~ 0	n/a
Verified OK	Verified OK	Output	GND	3V3	8	~ 0
Reset FTDI	Reset FTDI	Output	GND	3V3	~ 0	~ 0
BOOT0 SET	BOOT0 SET	Input	GND	3V3	8	~ 0
Switch #1	SWITCH1_WAKE_UP	Input	GND	3V3	~ 0	~ 0
Switch #2	SWITCH2_ENROLL	Input	GND	3V3	~ 0	~ 0
Switch #3	SWiTCH3_RESET	Input	GND	3V3	~ 0	~ 0

Table 8: Host signals

GPIO Pins

Some GPIO pins may be dedicated to driving a LED direction indicator for guidance use with multi-enrolment.

Switches

The host system is responsible for handling any ESD events that may happen via the external switches.

3.3 LED Indicators

An LED indicates the current state of the FPC-BM. An overview of the LED behaviour including colour and LED state (solid or blinking) during biometric procedures is shown in Table 9.

Function	Procedure	Colour	LED State
Power On	-	Blue	Solid
Identify (Few)	Wait for Finger	Yellow	Blinking
	Processing captured image	Yellow	Solid
	Identify (Few) Successful	Green	Solid
	Identify (Few) Failed	Red	Solid
Enrol	Wait for Finger	Yellow	Blinking
	Processing captured image	Yellow	Solid
	Enrol Successful	Green	Solid
	Enrol Failed	Red	Solid
Delete All templates in FLASH	Processing	Red	Blinking
	Done	Green	Solid

Table 9: LED indicator status

4 Electrical Characteristics

The electrical characteristics of the FPC-BM are described in this chapter. All signals except the power supply rails and ground are 3.3 V or unregulated 5 V.

4.1 Supply Voltage

Supply voltage for the FPC-BM is shown in Table 10.

Symbol	Parameter	Minimum	Typical	Maximum	Unit
VDD	Unregulated, input 5 V	4.18	5	6	V
VDD	Core supply, input 3.3 V	3.01	3.3	3.59	V

Table 10: Supply Voltage

For more details on power supply modes, see section 4.6.

4.2 Supply Current

Supply current for the FPC-BM is shown in Table 11. The FPC1011F3 sensor does not go into idle mode.

SYMBOL	PARAMETER	CONDITION	MIN	TYP	MAX	UNIT
IDD	Supply current	Idle*	-	10	-	mA
		Active full speed	-	70	-	mA
		Active half speed	-	25	-	mA
		Sleep	-	30	-	µA
		Deep Sleep	-	3.3	-	µA

**not applicable for the FPC-BM1011F3*

Table 11: Supply Current

4.3 Maximum Current Consumption and Power Dissipation

Current consumption and power dissipation for FPC-BM components is shown in Table 12. This does not include the power dissipation of the linear regulators.

Source	Typical voltage	Max. current	Duty cycle	Average power dissipation
Sensor FPC1020AM	1.8 V	5.6 mA	50 %	5 mW
	3.3 V	0.5 mA	50 %	1 mW
Sensor FPC1011F3	3.3 V	24 mA	50 %	40 mW
Microcontroller	3.3 V	51 mA	50 %	84 mW
LED	3.3 V	10 mA	50 %	17 mW

Table 12: Maximum Current and power consumption

4.4 Digital Inputs

Digital inputs for the FPC-BM are shown in Table 13.

SYMBOL	PRAMETER	MIN	TYP	MAX	UNIT
V_{IL}	Logic '0' voltage	0	-	0.8	V
V_{IH}	Logic '1' voltage	0.7 V_{DD}	-	V_{DD}+0.3	V
I_{IL}	Logic '0' current (V_I = GND)	-	-	±10	µA
I_{IH}	Logic '1' current (V_I = V_{DD})	-	-	±10	µA

Table 13: Digital Inputs

4.5 Digital Outputs

Digital outputs for the FPC-BM are shown in Table 14.

SYMBOL	PRAMETER	MIN	TYP	MAX	UNIT
V_{OL}	Logic '0' output voltage	-	-	0.45	V
V_{OH}	Logic '1' output voltage	0.85 V_{DD}	-	-	V

Table 14: Digital Outputs

4.6 Power Supply Modes

FPC-BM has two supply modes: 3.3 V (regulated) and 5 V (unregulated).

In the 3.3 V regulated power supply mode the supply voltage is connected directly to MCU and sensor. In the 5 V unregulated supply mode the supply voltage is regulated down to 3V3 through a linear regulator before connection to MCU and sensor.

4.6.1 3.3 V Supply Mode

The supply voltage shall be connected to 3V3_IN at contact J4, Pin 3 of the biometric module. No supply voltage should be connected to the 5V_IN at contact J4, Pin1 of the biometric module, see Figure 2 for details. Ripple and noise level must be ≤ 20 mVpp with 20MHz bandwidth.

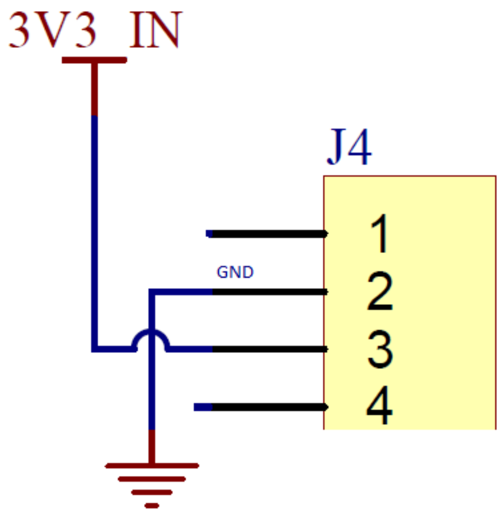

Figure 2: *Power connections in 3V3 supply mode*

The rise and fall time of the host power interface must be slower than 20µs/V at power-up and power-down to ensure MCU startup integrity.

4.6.2 5 V Supply Mode

The 5V power supply shall be connected to *5V_IN* at contact J4, Pin 1 of the biometric module. In this mode, the regulated *3V3_OUT* must be bridged to *3V3_IN*. No other connection to the *3V3_IN* than the bridge from *3V3_OUT* should be connected. See Figure 3 for details. Ripple and noise level must be ≤ 80 mVpp with 20 MHz bandwidth.

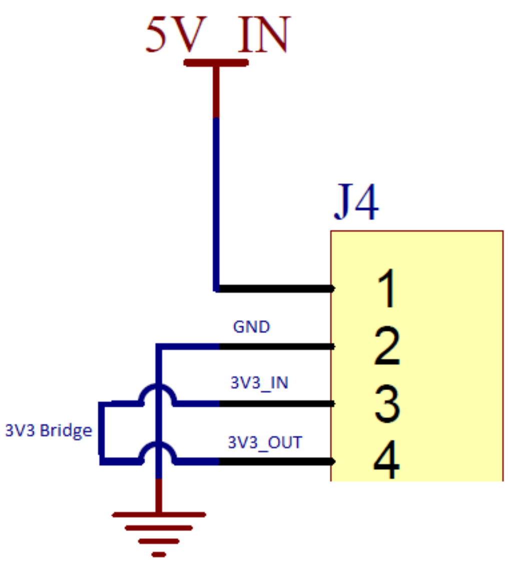

Figure 3: 3V3_IN to 3V3_OUT bridge in 5V supply mode

5 Software Command Interface

To communicate with the sensor module, a serial command interface is used between a host processor and the processor board. This interface is designed to be easy to use and performs the basic biometric functions needed in a fingerprint authentication system.

5.1 UART Serial Interface Settings

The software settings for the serial protocol using UART are outlined in Table 15.

Parameter	Value
Communication speed	Factory default baud rate set to 9600 baud (range from 9600 to 115200 baud)
Format	8 data bits, odd parity, one stop bit.
Bit order	least significant bit first

Table 15: Serial UART interface settings

5.2 SPI Interface Settings

The software settings for using SPI commands are outlined in Table 16.

Parameter	Value
Communication speed	Guaranteed maximum speed: 20 MHz. For details, see SPI timing requirements, in section 5.5.
SPI Mode	Mode 3, Clock Polarity High and Clock Phase Rising
Chip Select	Active Low

Table 16: SPI interface settings

5.3 Command Send Structure

The structure of commands sent from a host are shown in Table 17 and described in this section:

0	1	2	3	4	5
STX	IDX-LSB	IDX-MSB	COMMAND	PAYLOAD-LSB	PAYLOAD-MSB

Table 17: Structure of commands sent from the host

STX
Start byte, should be 0x02.

IDX-LSB:

Index value, least significant byte.

IDX-MSB:

Index value, most significant byte.

COMMAND:

Command byte.

PAYLOAD-LSB:

If any additional data is sent, the payload is a counter of how many bytes that will be sent (not including the CRC-code), otherwise zero.

PAYLOAD-MSB:

Payload most significant byte, if no data, set to zero.

5.3.1 Additional Payload Data

If PAYLOAD != 0, then additional data should follow in the stream according to Table 18:

6	…	n	n+1	n+2	n+3	n+4
DATA	DATA-…	DATA-n	CRC-LSB	CRC-BYTE2	CRC-BYTE3	CRC-MSB

Table 18: Command Send - Additional Payload Data

The CRC size (4 bytes) is not included in the payload counter. Its value is calculated from all the data bytes, and is used for checking if an error occurred during the transmission. The default for IDX-LSB and IDX-MSB is 0x00, if nothing else is stated.

A new command cannot be sent before a response has been received from the previous command. An exception is when using the API_CANCEL command. See section 7.30 for more information on the cancel command.

5.4 Response structure

The structure of the response from the FPC-BM is given in Table 19:

0	1	2	3
STX	RESULT	PAYLOAD-LSB	PAYLOAD-MSB

Table 19: Structure of response from the FPC-BM

STX: Start byte: 0x02

RESULT: Result byte

PAYLOAD-LSB: If any additional data is sent, the payload is a counter of how many bytes that will be sent (not including the CRC-code), otherwise zero.

PAYLOAD-MSB: Payload most significant byte, if no data, set to zero. If PAYLOAD != 0, then additional data should follow in the stream according to Table 20.

4	…	n	n+1	n+2	n+3	n+4
DATA-1	DATA-…	DATA-n	CRC-LSB	CRC-BYTE2	CRC-BYTE3	CRC-MSB

Table 20: Response Structure Additional Data

The CRC size (4 bytes) is not included in the payload counter. Its value is calculated from all the data bytes, and is used for checking if an error occurred during the transmission.

5.5 SPI Timing Requirements

The SPI interface of the FPC-BM is a slave interface, implying that the host (the master) determines when data is sent to and from the FPC-BM. Since the host cannot know when the FPC-BM has completed processing a given command, a polling process is implemented by the host when trying to read the response for a given command request.

The required implementation of the Request/Response process is as follows:

1. Let the host send the 6 command bytes
2. Wait a minimum of 20 ms for possible payload and CRC
3. Let the host send a byte with value 0x52 to the slave. The host asks the FPC-BM if it is ready to send the response back to the host.
4. Wait a minimum of 20 ms
5. Check that the received byte is 0x02. If not, the slave is not ready, and requires more time to complete processing the command. Alternatively, the FPC-BM returns 0x52 to indicate that it is busy.
6. Repeat steps 4-6 until a 0x02 byte is received as response.
7. The 0x02 value is the first byte in the regular response consisting of 4 bytes (plus a possible payload and CRC).

The SPI data transfer speed is up to 20 MHz for all single -byte transmission.

UART Interface

The requirements outlined in this section do not apply for the UART interface, where the host is aware that the received response is the correct response.

6 Command Tables

This section gives an overview of the available commands that can be used with the FPC-BM.

6.1 Biometric Commands

This section describes the biometric commands for the FPC-BM.

Command	HEX	Description
API_CAPTURE_IMAGE	0x80	Capture image from sensor (before enrol).
API_CAPTURE_AND_ENROL_RAM	0x81	Enrol into RAM (includes Capture Image)
API_CAPTURE_AND_VERIFY_RAM	0x82	Verify against RAM (includes Capture Image)
API_CAPTURE_AND_VERIFY_FLASH	0x83	Verify against single FLASH slot (includes Capture Image) Set slot number (0 – 49) in IDX
API_CAPTURE_AND_IDENTIFY_FLASH	0x84	Identify (Few) against all FLASH slots (includes Capture Image)
API_ENROL_RAM	0x85	Enrol into RAM
API_VERIFY_RAM	0x86	Verify against RAM
API_VERIFY_FLASH	0x87	Verify against single FLASH slot. Set slot number (0 – 49) in IDX
API_IDENTIFY_FLASH	0x88	Identify (Few) against all FLASH slots
API_CAPTURE_IMAGE_FINGERPRESENT	0x89	Capture Image from sensor (once a finger is present)
API_ENROL_FLASH	0x92	Enrol into FLASH memory
API_CAPTURE_AND_ENROL_FLASH	0x93	Enrol into FLASH memory (includes Capture Image)

Table 21: Biometric Commands

6.2 Image transfer

This section describes the image transfer commands for the FPC-BM.

Command	HEX	Description
API_UPLOAD_IMAGE	0x90	Upload image from RAM to Host
API_DOWNLOAD_IMAGE	0x91	Download image to RAM to Host

Table 22: Image transfer commands

6.3 Template Handling

This section describes the template handling commands for the FPC-BM.

Command	HEX	Descriptions
API_UPLOAD_TEMPLATE	0xA0	Upload template from RAM to host
API_DOWNLOAD_TEMPLATE	0xA1	Download template to RAM to host
API_COPY_TEMPLATE_RAM_TO_FLASH	0xA2	Copy template from RAM to permanent FLASH storage Set slot number (0 to 49) in IDX
API_UPLOAD_TEMPLATE_FROM_FLASH	0xA3	Upload template from single FLASH slot to host. Set slot number (0 to 49) in IDX
API_DELETE_TEMPLATE_RAM	0xA4	Erase template from RAM
API_DELETE_SLOT_IN_FLASH	0xA5	Delete single slot in FLASH Set slot number (0 to 49) in IDX
API_DELETE_ALL_IN_FLASH	0xA6	Delete all FLASH slots
API_DOWNLOAD_TEMPLATE_TO_FLASH	0xA7	Download a template from host to FLASH

Table 23: Template handling commands

6.4 Algorithm Settings

This section describes the algorithm settings commands for the FPC-BM.

Command	HEX	Description
API_SECURITY_LEVEL_RAM	0xB0	Set security level, setting saved in RAM IDX-LSB: 0x04 = high convenience 0x05 = standard 0x06 = high security
API_SECURITY_LEVEL_STATIC	0xB1	Set security level, setting saved in non-volatile (static) memory.
API_GET_SECURITY_LEVEL	0xB2	Returns the current security level, value sent as payload data.
API_GET_DYNAMIC_UPDATE	0xB3	Returns the current dynamic update setting.
API_SET_DYNAMIC_UPDATE	0xB4	Sets the dynamic update IDX-LSB: 0x00 = Off 0x01 = On

Table 24: Commands for algorithm settings

6.5 Firmware Commands

This section describes the firmware commands for the FPC-BM.

Command	HEX	Description
API_FIRMWARE_VERSION	0xC0	Upload the version string for this device

Table 25: Firmware commands

6.6 Communication Commands

This section describes the communication commands for the FPC-BM.

Command	HEX	Description
API_SET_BAUD_RATE_RAM	0xD0	Set baud rate, setting saved in RAM. See section 7.27
API_SET_BAUD_RATE_STATIC	0xD1	Set baud rate, setting saved in non-volatile static Flash memory. See section 7.28
API_TEST_HARDWARE	0xD2	Test hardware components

Table 26: Communication commands

6.7 Power Commands

This section describes the commands for power settings for the FPC-BM.

Command	HEX	Description
API_ENTER_SLEEP_MODE	0xE1	Enter sleep mode (wake up by activating proper pin)
API_GET_POWER_SAVE_MODE	0xE5	Get current power save mode, value sent as payload data: IDX-MSB: 0x00 = Frequency 0x01 = LED 0x02 = Sleep Mode 0x03 = Sensor wake up (detection frequency)
API_POWER_SAVE_MODE_RAM	0xE2	Set power save mode, setting saved in RAM IDX-MSB: 0x00 = Frequency 0x01 = LED 0x02 = Sleep Mode 0x03 = Sensor wake up (detection frequency) IDX-LSB (frequency): 0x00 = Half 0x01 = Full IDX-LSB (LED): 0x00 = On 0x01 = Mode 0x02 = Off IDX-LSB (sleep mode): 0x00 = Run 0x01 = Standby 0x02 = Sleep 0x03 Deep Sleep IDX-LSB (sensor wake up): 0x00 = Min (always active) … up to 0xFF = 2000 ms (each step = 7.8 ms)
API_POWER_SAVE_MODE_STATIC	0xE3	Set power save mode, setting saved in non-volatile (static) memory IDX-MSB: 0x00 = Frequency 0x01 = LED 0x02 = Sleep Mode 0x03 = Sensor wake up (detection frequency) IDX-LSB (frequency): 0x00 = Half 0x01 = Full IDX-LSB (LED): 0x00 = On 0x01 = Mode 0x02 = Off IDX-LSB (sleep mode): 0x00 = Run 0x01 = Standby 0x02 = Sleep 0x03 Deep Sleep IDX-LSB (sensor wake up): 0x00 = Min (always active) … up to 0xFF = 2000 ms (each step = 7.8 ms)

Table 27: Power commands

6.8 Miscellaneous Commands

This section describes other miscellaneous commands for the FPC-BM.

Command	HEX	Description
API_CANCEL	0xE0	Cancel ongoing command, only valid for the following commands: API_CAPTURE_AND_ENROL_RAM, API_CAPTURE_AND_VERIFY_RAM, API_CAPTURE_AND_VERIFY_AGAINST_FLASH, API_CAPTURE_AND_IDENTIFY_AGAINST_FLASH
API_ADVANCED_SETTINGS	0xE8	Managing advanced settings, see section 7.36
API_STAND_ALONE	0xEF	Toggle stand-alone functionality IDX-LSB: 0x00 = Off 0x01 = On

Table 28: Miscellaneous commands

6.9 Response Bytes

This section describes the possible response bytes from the FPC-BM to the host.

Command	HEX
API_FAILURE	0x00
API_SUCCESS	0x01
API_NO_FINGER_PRESENT	0x02
API_FINGER_PRESENT	0x03
API_VERIFICATION_OK	0x04
API_VERIFICATION_FAIL	0x05
API_ENROL_OK	0x06
API_ENROL_FAIL	0x07
API_HW_TEST_OK	0x08
API_HW_TEST_FAIL	0x09
API_CRC_FAIL	0x0A
API_PAYLOAD_TOO_LONG	0x0B
API_PAYLOAD_TOO_SHORT	0x0C
API_UNKNOWN_COMMAND	0x0D
API_NO_TEMPLATE_PRESENT	0x0E
API_IDENTIFY_OK	0x0F
API_IDENTIFY_FAIL	0x10
API_INVALID_SLOT_NR	0x11
API_CANCEL_SUCCESS	0x12
API_APPL_CRC_FAIL	0x14
API_SYS_CRC_FAILED	0x16
API_LOW_VOLTAGE	0x17
API_NO_SENSOR	0x18
API_BROKEN_SENSOR	0x19

Table 29: Response Bytes

6.10 No sensor: API_NO_SENSOR

The response API_NO_SENSOR is sent for all commands if there is no active sensor present in the system.

6.11 Broken sensor: API_BROKEN_SENSOR

The response API_BROKEN_SENSOR is sent for the following commands if an improper or corrupted response is received from the sensor:

- API_TEST_HARDWARE
- API_CAPTURE_IMAGE
- API_CAPTURE_AND_VERIFY_RAM
- API_CAPTURE_IMAGE_FINGERPRESENT
- API_CAPTURE_AND_VERIFY_FLASH
- API_CAPTURE_AND_IDENTIFY_FLASH
- API_CAPTURE_AND_ENROL_FLASH

7 Command Descriptions

This chapter describes the individual commands of the main application, along with their parameters, and responses.

7.1 Capture image: API_CAPTURE_IMAGE

An image is captured from the fingerprint sensor. The fingerprint image is placed in RAM and can be uploaded by the command API_UPLOAD_IMAGE. Calculation is done on the image to determine if a finger is present or not present on the sensor. No payload is sent with this command.

Response command

- API_NO_FINGER_PRESENT = No finger present on sensor
- API_FINGER_PRESENT = Finger present on sensor
- API_BROKEN_SENSOR = Improper or corrupted response from sensor

No payload is received with the response from this command.

7.2 Capture and Enrol (RAM): API_CAPTURE_AND_ENROL_RAM

An image is captured from the fingerprint sensor and enrolment of the image is performed. See Table 30 for the number of finger placements required during enrol.

Sensor	Number of finger placements during enrol
FPC1011	1
FPC1020	8

Table 30: Finger placements during enrolment

Images are captured in a loop from the sensor until a finger is present. The command waits for “finger present” before it starts enrolment. No payload is sent with this command.

The command returns with response when the enrolment is complete or if the enrolment fails for any reason. After enrolment the template is stored in RAM and can be uploaded or moved to FLASH storage.

Response command

- API_ENROL_OK = Enrolment successful
- API_ENROL_FAIL = Enrolment failed
- API_CANCEL_SUCCESS = API_CANCEL successful, or timeout of 6 seconds per finger placement.

No payload is received with the response from this command.

Cancel operation

It is possible to cancel the current enrol operation by sending the command API_CANCEL. This cancels the enrolment and the device returns to its normal command loop.

See Section 7.30 for more information on the cancel command.

7.3 Capture and verify (RAM): API_CAPTURE_AND_VERIFY_RAM

A template must be present in RAM before starting the verification, (use one of the following commands: API_DOWNLOAD_TEMPLATE, API_CAPTURE_ENROL_RAM). Thereafter the verification can be started. This command also captures an image from the fingerprint sensor. The command waits for "finger present" before it starts the verification. This means that images are captured in a loop from the sensor until a finger is present. The command returns with response when the verification is complete or if the verification fails for any reason. No payload is sent with this command.

Response command

- API_VERIFICATION_OK = Verification successful
- API_VERIFICATION_FAIL = Verification failed
- API_NO_TEMPLATE_PRESENT = No template present
- API_BROKEN_SENSOR = Improper or corrupted response from sensor
- API_CANCEL_SUCCESS = API_CANCEL successful, or timeout of 6 seconds per finger placement.

No payload is received with the response from this command. It is possible to cancel the current verification operation by sending the command API_CANCEL. This returns the device to its normal command loop.

See Section 7.30 for more information on the cancel command.

7.4 Capture and identify (FLASH): API_CAPTURE_ AND _IDENTIFY_FLASH

Identification is made against all FLASH slots. This command first captures an image from the fingerprint sensor. The command waits for "finger present" before it starts the identification. This means that images are captured in a loop from the sensor until a finger is present. The command returns with response when the identification is complete or if the identification fails for any reason. No payload is sent with this command.

Response command

- API_ IDENTIFY _OK = Identification successful
- API_ IDENTIFY _FAIL = Identification fails
- API_BROKEN_SENSOR = Improper or corrupted response from sensor
- API_CANCEL_SUCCESS = API_CANCEL successful, or timeout of 6 seconds per finger placement.

In a successful identification, the slot index is received as payload in two bytes (LSB first) plus the 4 CRC bytes. Maximum number of templates during identification is 50.

It is possible to cancel the current identification operation by sending the API_CANCEL command. The device returns to its normal command loop. See Section 7.30 for more information on the cancel command.

7.5 Enrol (RAM): API_ENROL_RAM

A fingerprint image must be present in RAM before starting the enrolment, either by capturing an image from the fingerprint sensor using the API_CAPTURE_IMAGE command, or the API_DOWNLOAD_IMAGE. The command returns with response when the enrolment is complete or if the enrolment fails for any reason. After enrolment the template is stored in RAM and can be uploaded or moved to FLASH storage. No payload is sent with this command.

Response command

- API_ENROL_OK = Enrolment successful
- API_ENROL_FAIL = Enrolment failed

No payload is received with the response from this command.

7.6 Verify (RAM): API_VERIFY_RAM

A template and a fingerprint image must both be present in RAM before verification starts; use the API_DOWNLOAD_TEMPLATE command, or the API_CAPTURE_ENROL_RAM command.

To process the image use the API_DOWNLOAD_IMAGE command, or the API_CAPTURE_IMAGE command. The verification can be started after one of these commands has been sent.

The command returns with a response when the verification is complete or if the verification fails for any reason. No payload is sent with this command.

Response command

- API_VERIFICATION_OK = Verification successful
- API_VERIFICATION_FAIL = Verification failed
- API_NO_TEMPLATE_PRESENT = No template present

No payload is received with the response from this command.

7.7 Verify (FLASH): API_VERIFY_FLASH

A fingerprint image must be present in RAM before starting the verification, (use one of the following commands: API_DOWNLOAD_IMAGE, API_CAPTURE_IMAGE. The FLASH slot number must be given in the IDX bytes. The command returns with response when the verification is complete or if the verification fails for any reason. No payload is sent with this command.

Response command:

- API_VERIFICATION_OK = Verification successful
- API_VERIFICATION_FAIL = Verification failed
- API_NO_TEMPLATE_PRESENT = No template in given FLASH slot
- API_INVALID_SLOT_NR = Wrong slot number

No payload is received with the response from this command.

7.8 Identify (Few) (FLASH): API_IDENTIFY_FLASH

A fingerprint image must be present in RAM before starting the verification using either the API_DOWNLOAD_IMAGE or API_CAPTURE_IMAGE command.

Identification is performed against all FLASH slots. The command returns with response when the identification is complete or if the identification fails for any reason. No payload is sent with this command.

Response command

- API_ IDENTIFY _OK = Identification successful
- API_ IDENTIFY _FAIL = Identification failed
- API_NO_TEMPLATE_PRESENT = All FLASH slots are empty

In a successful identification, the slot index is received as payload in two bytes (LSB first), plus the 4 CRC bytes.

Maximum number of templates

The FPC-BM has integral support for a maximum of 50 templates.

7.9 Capture image (Finger present): API_CAPTURE_IMAGE_FINGERPRESENT

An image is captured from the fingerprint sensor once the system detects a finger on the sensor. The fingerprint image is placed in RAM and can be uploaded by the command API_UPLOAD_IMAGE. No payload is sent with this command. The system waits until a finger is detected, and can only be terminated with the API_CANCEL command.

Response command

- API_FINGER_PRESENT = Finger present on sensor
- API_CANCEL_SUCCESS = API_CANCEL successful, or timeout of 6 seconds
- API_BROKEN_SENSOR = Improper or corrupted response from sensor

No payload is received with the response from this command.

7.10 Enrol (FLASH): API_ENROL_FLASH

A fingerprint image must be present in RAM before starting the enrolment, either by capturing an image from the fingerprint sensor using the command API_CAPTURE_IMAGE OR by using the Download Image Command (API_DOWNLOAD_IMAGE). The command returns with response when the enrolment is complete or if the enrolment fails for any reason.

After enrolment the template is stored in FLASH and can be uploaded or moved to FLASH storage. The desired FLASH slot number must be given in the IDX bytes. No payload is sent with this command.

Response command

- API_ENROL_OK = Enrolment successful
- API_ENROL_FAIL = Enrolment failed
- API_INVALID_SLOT_NR = Incorrect FLASH slot number

No payload is received with the response from this command.

7.11 Capture Enrol (FLASH): API_CAPTURE_AND_ENROL_FLASH

This command first captures an image from the fingerprint sensor. The command waits for "finger present" before it starts the verification. This means that images are captured in a loop from the sensor until a finger is present. The command then returns with a response when the enrolment is complete or if the enrolment fails for any reason.

After enrolment the template is stored in FLASH and can be uploaded or moved to FLASH storage. The desired FLASH slot number must be given in the IDX bytes. No payload is sent with this command.

Response command

- API_ENROL_OK = Enrolment successful
- API_ENROL_FAIL = Enrolment failed
- API_INVALID_SLOT_NR = Incorrect FLASH slot number
- API_BROKEN_SENSOR = Improper or corrupted response from sensor
- API_CANCEL_SUCCESS = API_CANCEL successful, or timeout of 6 seconds per finger placement.

No payload is received with the response from this command.

7.12 Upload image: API_UPLOAD_IMAGE

By using this command it is possible to upload the fingerprint image present in RAM. The response is the API_SUCCESS command followed by the image data. The first byte is the upper left pixel and then data follows row-wise (X-direction). Each pixel has one byte value (256 grey scales). There is no image header.

Response command

- API_ SUCCESS = Upload successful
- API_ FAILURE = Upload failed

7.13 Download image: API_DOWNLOAD_IMAGE

By using this command it is possible to download a fingerprint image to RAM. The first byte is the upper left pixel and then data follows row-wise (X-direction). Each pixel has one byte value (256 grey scales).

Response command

- API_ SUCCESS = Download successful
- API_ FAILURE = Download failed

No payload is received with the response from this command.

7.14 Upload template: API_UPLOAD_TEMPLATE

After a successful enrolment a template is uploaded from RAM using the (API_UPLOAD_TEMPLATE command. The response is the API_SUCCESS command followed by the template data. No payload is sent with this command.

Response command

- API_ SUCCESS = Upload successful
- API_ FAILURE = Upload failed

7.15 Download template: API_DOWNLOAD_TEMPLATE

Before verification, a template is downloaded to RAM using the API_DOWNLOAD_TEMPLATE command.

Response command

- API_ SUCCESS = Download successful
- API_ FAILURE = Download failed

No payload is received with the response from this command.

7.16 Copy template from RAM to FLASH: API_COPY_TEMPLATE_FROM_RAM_TO_FLASH

This command copies the template currently in RAM to FLASH. The FLASH slot number must be given in the IDX bytes. No payload is sent with this command.

Response command

- API_ SUCCESS = Template storage successful
- API_ FAILURE = Template storage failed
- API_INVALID_SLOT_NR = Wrong slot number

No payload is received with the response from this command.

7.17 Upload template from FLASH: API_UPLOAD_TEMPLATE_FROM_FLASH

This command uploads the template from FLASH. The FLASH slot number must be given in the IDX bytes. No payload is sent with this command.

Response command

- API_ SUCCESS = Upload successful
- API_ FAILURE = Upload failed
- API_INVALID_SLOT_NR = Wrong slot number

7.18 Delete template in RAM: API_DELETE_TEMPLATE_RAM

This command deletes the template currently stored in RAM. No payload is sent with this command.

Response command

- API_ SUCCESS = Template removal successful
- API_ FAILURE = Template removal failed

No payload is received with the response from this command.

7.19 Delete single template in FLASH: API_DELETE_SLOT_IN_FLASH

By using the command Delete slot in FLASH one can choose which slot to delete (include slot number in index value of command). No payload is sent with this command.

Response command

- API_ SUCCESS = Template removal successful
- API_ FAILURE = Template removal failed
- API_INVALID_SLOT_NR = Wrong slot number

No payload is received with the response from this command.

7.20 Delete all templates in FLASH: API_DELETE_ALL_IN_FLASH

It is possible to delete all templates in FLASH by issuing the command Delete all in FLASH. No payload is sent with this command.

Response command

- API_ SUCCESS = Template removal successful
- API_ FAILURE = Template removal failed

No payload is received with the response from this command.

7.21 Download template to FLASH: API_DOWNLOAD_TEMPLATE_TO_FLASH

This command downloads a template from the host directly into the FLASH memory (and into RAM). The FLASH slot number must be given in the IDX bytes. The size of the template is 938 bytes.

Response command

- API_ SUCCESS = Download successful
- API_ FAILURE = Download failed
- API_INVALID_SLOT_NR = Wrong slot number

No payload is received with the response from this command.

7.22 Security level (STATIC): API_SECURITY_LEVEL_STATIC

The security level to be used during verification and identification can be set by the Set Security Level command. The value of the security level should be set in the index value (IDX-LSB) of the command as seen in Table 31. The factory default security level is set to value 0x04. The value is stored in non-volatile memory and the setting is saved even after reset. The factory default value will be changed.

VALUE (IDXLSB)	SECURITY LEVEL
0x04	High convenience (factory default)
0x05	Standard
0x06	High security

Table 31: Security Level Settings

The security level is not stored together with the template. During enrolment there is no effect when changing the security threshold. The created template will support all security settings. No payload is sent with this command.

Response command

- API_ SUCCESS = New security level set
- API_ FAILURE = Security level out of range

No payload is received with the response from this command.

7.23 Get current security level: API_GET_SECURITY_LEVEL

The API_GET_SECURITY_LEVEL command returns the value of the current security level setting that the FPC-BM is using. No payload is sent with this command.

Response command

The response command is the API_SUCCESS command plus the security level string as payload.

- API_ SUCCESS = Command successful, followed by the security level string
- API_ FAILURE = Command fail

A payload + 4 CRC bytes is received if the request is successful. The payload value, which always is 1 byte corresponds to one of the security levels in Table 32.

VALUE	SECURITY LEVEL
0x00	High convenience (factory default)
0x01	Standard
0x06	High security

Table 32: Current security level values

7.24 Get dynamic update: API_GET_DYNAMIC_UPDATE

The API_GET_DYNAMIC_UPDATE command returns the value of the current dynamic update setting that the module FPC-BM is using. No payload is sent with this command.

Response command

- API_ SUCCESS = Request accepted, dynamic update setting string follows
- API_ FAILURE = Request failed

A payload + 4 CRC bytes will be received in a successful request. The payload value, which always is 1 byte corresponds to one of the update settings in Table 33.

VALUE (IDXLSB)	Dynamic update
0x00	Deactivated
0x01	Activated

Table 33: Dynamic update status

7.25 Set dynamic update: API_SET_DYNAMIC_UPDATE

To activate or deactivate dynamic update, issue the command **API_SET_DYNAMIC_UPDATE**. No payload is sent with this command.

VALUE (IDXLSB)	Dynamic update
0x00	Deactivate
0x01	Activate

Table 34: Standalone Mode setting

Response command

- API_ SUCCESS = Request accepted, dynamic update activated or deactivated
- API_ FAILURE = Request failed

No payload is received with the response from this command.

7.26 Get firmware version: API_FIRMWARE_VERSION

The **API_FIRMWARE_VERSION** command returns the firmware version of the main application. No payload is sent with this command.

The response is the **API_SUCCESS** command followed by the firmware version string.

Response command

- API_ SUCCESS = Request successful, firmware version string follows as payload
- API_ FAILURE = Request failed

A payload + 4 CRC bytes will be received in a successful request. The size of this payload could vary with the version of the firmware.

7.27 Set baud rate (RAM): API_SET_BAUD_RATE RAM

It is possible to change the baud rate for the serial communication between host and FPC-BM. The default baud rate is 9600. The available baud rates are shown in Table 35.

VALUE (IDXLSB)	BAUD RATE
0x00	Currently active baud rate
0x10	9600 (factory default)
0x20	14400
0x30	19200
0x40	28800
0x50	38400
0x60	57600
0x70	76800
0x80	115200

Table 35: Baud Rate values for RAM

The selected value should be set in the IDX-LSB byte of the command. The value is stored in RAM and is not saved after a reset. This means that the factory default value will not be changed until the FPC-BM is reset. Index 0 is the recommended option in order to ensure that a non-compatible UART speed is not selected. No payload is sent with this command.

Response command

- API_ SUCCESS = Baud rate change accepted
- API_ FAILURE = Baud rate out of range

No payload is received with the response from this command.

Once a baud rate change has been accepted, the next command must be sent with a new baud rate. However the response command above is sent with the previous (old) baud rate.

7.28 Set baud rate (STATIC): API_SET_BAUD_RATE_STATIC

It is possible to change baud rate for the serial communication between host and FPC-BM. The table below shows the available baud rates. The default baud rate is 9600.

The available baud rates are shown in Table 35.

The selected baud rate value should be set in the IDX-LSB byte of the command. The value is stored in non-volatile memory and the setting is saved even after reset. This means that the factory default value will be changed.

Note that if the index 0 is used, the currently active baud rate will be stored. This is the recommended option, since it will ensure that a non-compatible UART speed not is permanently selected. No payload is sent with this command.

Response command:

- API_ SUCCESS = Baud rate change accepted
- API_ FAILURE = Baud rate out of range

No payload is received with the response from this command. Once a baud rate change has been accepted, the next command must be sent with a new baud rate. However the response command above is sent with the previous (old) baud rate.

7.29 Test hardware: API_TEST_HARDWARE

The API_TEST_HARDWARE command initiates a test of the FPC-BM hardware. No payload is sent with this command.

Response command

- API_HW_TEST_OK = Hardware check successful
- API_HW_TEST_FAIL = Hardware check failed, contact technical support
- API_BROKEN_SENSOR = Improper or corrupted response from sensor

No payload is received with the response from this command.

7.30 Cancel current command: API_CANCEL

It is possible to cancel the following ongoing commands:

- API_CAPTURE_IMAGE_FINGERPRESENT
- API_CAPTURE_AND_ENROL_RAM
- API_CAPTURE_AND_ENROL_FLASH
- API_CAPTURE_AND_VERIFY_RAM
- API_CAPTURE_AND_VERIFY_FLASH
- API_CAPTURE_AND_IDENTIFY_ FLASH

Important - When the cancel command is sent over SPI, only the following command byte shall be sent: 0xE0. The module will respond with API_CANCEL_SUCCESS and the return to normal command loop. No payload is sent with this command.

Response command

- API_ CANCEL_SUCCESS = Cancel successful
- API_ FAILURE = Cancel failed

No payload is received with the response from this command.

7.31 Set Standalone mode: API_STAND_ALONE

Standalone mode is toggled by sending the **API_STAND_ALONE** command. See Table 36 for details. No payload is sent with this command. No payload is received with the response from this command.

VALUE (IDX-LSB)	STANDALONE MODE
0x00	Deactivate
0x01	Activate

Table 36: Standalone Mode setting

When setting standalone mode, the save location can be set using IDX-MSB. See Table 37 for more information.

VALUE (IDX-MSB)	STANDALONE MODE- SAVE LOCATION
0x00	RAM
0x01	STATIC

Table 37: Standalone mode save location

Response command

- API_ SUCCESS = Request accepted, standalone mode activated or deactivated
- API_ FAILURE = Request failed

7.32 Enter sleep mode: API_ENTER_SLEEP_MODE

To enter SLEEP MODE, issue the **API_ENTER_SLEEP_MODE** command. To wake up the device, a wakeup interrupt must occur. The wakeup interrupt is triggered by the following signal: SWITCH1_WAKEUP (active high).

Before the device enters SLEEP MODE it responds with one of the following:

Response command

- API_ SUCCESS = Request accepted, entering SLEEP MODE
- API_ FAILURE = Request failed

No payload is received with the response from this command.

7.33 Enter power save mode: API_ENTER_POWER_SAVE_MODE_RAM

In POWER SAVE MODE the device reduces the clock frequency of the processor by half to lower power consumption. To enter POWER SAVE MODE, issue the API_ENTER_POWER_SAVE_MODE_RAM command. No payload is sent with this command.

Response command

- API_ SUCCESS = Request accepted, entering POWER SAVE MODE
- API_ FAILURE = Request failed

No payload is received with the response from this command.

7.34 Power save mode: (STATIC) API_POWER_SAVE_MODE_STATIC

In POWER SAVE MODE the module reduces the clock frequency of the processor by half to lower power consumption.

Enter power save mode

To enter POWER SAVE MODE, issue the command Power Save Mode with the value 0 in the IDX-LSB bytes, as shown in Table 38.

Exit power save mode

To exit POWER SAVE MODE, issue the command Power Save Mode with the value 1 in the IDX-LSB byte, as shown in Table 38.

The setting is stored in non-volatile memory and the setting is saved even after reset. This means that the factory default setting (value=1) will be changed. No payload is sent with this command.

VALUE (IDX-LSB)	POWER SAVE MODE
0	Half Speed
1	Full Speed (factory default)

Table 38: Power save mode setting

Response command

- API_ SUCCESS = Request accepted, entering POWER SAVE MODE
- API_ FAILURE = Request failed

No payload is received with the response from this command.

7.35 Get current power save mode: API_GET_POWER_SAVE_MODE

This command returns the value of the current setting of power save mode. See Table 39 for details. The value is received as payload data. No payload is sent with this command.

VALUE (IDX-LSB)	POWER SAVE MODE
0	Half Speed
1	Full Speed (factory default)

Table 39: Current Power Save mode setting

Response command

- API_ SUCCESS = Command OK
- API_ FAILURE = Command fail

The received payload in a successful upload consists of 1 byte plus the 4 CRC bytes.

7.36 Manage Advance Settings: API_ADVANCED_SETTINGS

This command is used both to get current, and to set advanced current settings. The advanced settings presently supported include Supply Voltage Control, and disabling the UART host interface.

See Table 40 for command payload values.

7.36.1 Supply Voltage Control

The Supply Voltage Control monitors the supply voltage to ensure that it is at a proper level. The supply voltage threshold is > 2.93 V.

The Supply Voltage Control can be enabled temporarily (in RAM) or statically (in non-volatile Flash memory). If enabled in Flash memory, the setting will remain after a system reset.

Low supply voltage

If Supply Voltage Control is enabled and the supply voltage falls below the specified level, the system will respond to any command with the response code API_LOW_VOLTAGE.

Default setting

The default factory setting for Supply Voltage Control is *enabled*.

7.36.2 Disable UART

UART can be disabled using the API_ADVANCED_SETTINGS command. The setting can be stored in RAM or in the static Flash memory. The UART interface can only be disabled if the command is sent using an SPI host interface, otherwise the command will fail.

When issuing this command, the host is forced to set the values of both the advanced settings with the same payload byte.

7.36.3 Command with one-byte Payload

When the API_ADVANCED_SETTINGS command is sent with a one-byte payload, it is used to put the system in the desired mode, by turning on/off individual bits in the payload byte, as seen in Table 40.

COMMAND PAYLOAD VALUE	DESCRIPTION
Bit 0 (LSB) = 0	Disable Supply Voltage Control
Bit 0 (LSB) = 1	Enable Supply Voltage Control
Bit 1 = 0	Do not store bit 0 setting statically
Bit 1 = 1	Store bit 0 setting statically
Bit 2 = 0	Enable both UART and SPI
Bit 2 = 1	Disable UART
Bit 3 = 0	Do not store bit 2 setting statically
Bit 3 = 1	Store bit 2 setting statically

Table 40: With one-byte payload

7.36.4 Command with no payload

When the API_ADVANCED_SETTINGS command is sent with no payload, it will return a response including a one byte payload, which represents the state that the system is currently as seen in Table 41.

RESPONSE PAYLOAD VALUE	DESCRIPTION
Bit 0 (LSB) = 0	Supply Voltage Control disabled
Bit 0 (LSB) = 1	Supply Voltage Control enabled
Bit 1	Not used
Bit 2 = 0	Both UART and SPI active
Bit 2 = 1	Only SPI active

Table 41: With no payload

Response command

- API_SCUCCESS = Command OK
- API_FAILURE = Command Fail

The CRC of 4 bytes are always added to the 1 byte payload, and the index bytes of the command structure are not used with this command.

8 CRC Calculation

The CRC calculation can be implemented as a table of pre-computed effects to ensure efficiency. The CRC value is 32 bits long. The table is indexed by the byte to be encoded and thus the table contains 256 double words (256 x 32 bits).

The CRC algorithm implementation was initially developed by the University of California, Berkeley and its contributors, but has been changed and somewhat simplified to fit the embedded nature of FPC-BM. The algorithm uses the CCITT-32 CRC Polynomial.

The source code for the CRC implementation is available from FPC and can be compiled with limited impact in most environments.

9 Power Management

The FPC-BM uses an external crystal with a frequency of 25 MHz, and uses this clock to internally generate specific frequencies, depending on the current state of the system.

Two separate commands (API_POWER_SAVE_MODE_RAM, and API_POWER_SAVE_MODE_STATIC) allow the user to set the system in two different power management modes:

- Full Speed (Power Save Mode=disabled)
- Half Speed (Power Save Mode=enabled).

Full Speed Mode

In Full Speed Mode, the processor speed is 168 MHz

Half Speed Mode

In Half Speed Mode, the processor speed is 84 MHz

10 Product Identification

The FPC-BM is delivered with device name, revision, and manufacturing date marked on the surface of the processor chip to allow for visual recognition and traceability as shown in Figure 4.

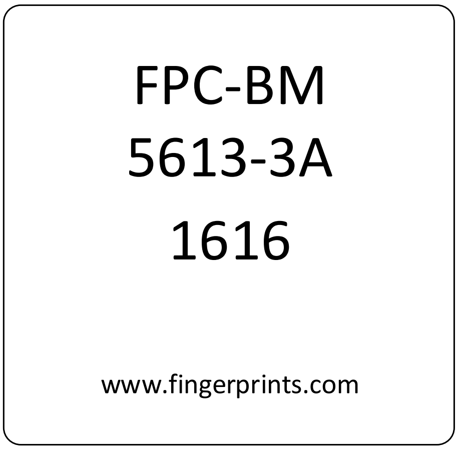

Figure 4: FPC-BM marking

The designation used for the labelling in Figure 4 is described in Table 42.

Row	Reference label	Name	Length (# of characters)	Example
1	nnn-nn	Device Name	6	FPC-BM
2	rrrr-rr	Part number - HW Revision	7	5613-3A
3	yyww	Manufacturing Date (year and week)	4	1616

Table 42: Marking designation

11 Integration

This chapter gives an overview of the application information relevant to the FPC-BM biometric module.

11.1 Mounting the FPC-BM

Solder height is kept to a minimum due to the positioning of the solder pads on the side edge of the FPC-BM Printed Board Assembly (PBA). The relative position of J4 and J5 is indicated in Figure 5.

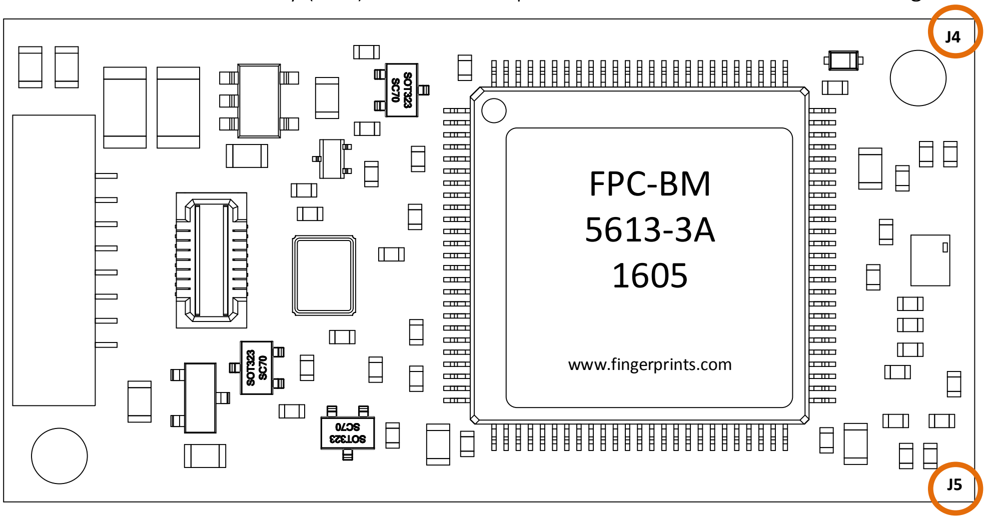

Figure 5: J4 and J5 positioning

J4 and J5 contacts

- Contact **J4** is right (east) of the connectors when the processor is at the bottom (south)).
- Contact **J5** is left (west) of the connectors when the processor is at the bottom (south)).

11.1.1 Pin-Pad configuration

The side solder pin configuration for the FPC-BM processor card is outlined in Table 43.

Pin number	Pad Name [contact J4]	Pad Name [contact J5]
1	5V_IN	ESD_DRAIN
2	GND	GND
3	3V3_IN	1V8
4	3V3_OUT	RESET_FTDI
5	CS_N	GPIO1
6	MOSI	GPIO2
7	SPICLK	GPIO3
8	RST_N	MOSI_HOST
9	MISO	MISO_HOST
10	INT	CS_N_HOST
11	JTAG_TRST	SPICLK_HOST
12	JTAG_TDO	Verified_OK
13	JTAG_TMS	TXD_UART
14	JTAG_TDI	RXD_UART
15	JTAG_TCK	BOOT0_SET
16	SWITCH1_WAKE_UP	GND
17	SWITCH2_ENROLL	USB1_N
18	SWITCH_RESET	USB1_P

Table 43: Pin-pad configuration

11.2 Mechanical Drawings – Sensors

This section gives an overview of the mechanical properties of the sensors that are compatible with the FPC-BM.

- All measurements are in millimetres.
- Dimensional data is based on nominal values.

11.2.1 Part Drawings - FPC1020AM CM03

The FPC1020AM CM03 configuration is illustrated as schematic part drawings in this section.

Top View - FPC1020AM CM03

A part drawing for the top view of the FPC1020AM CM03 sensor is shown in Figure 6.

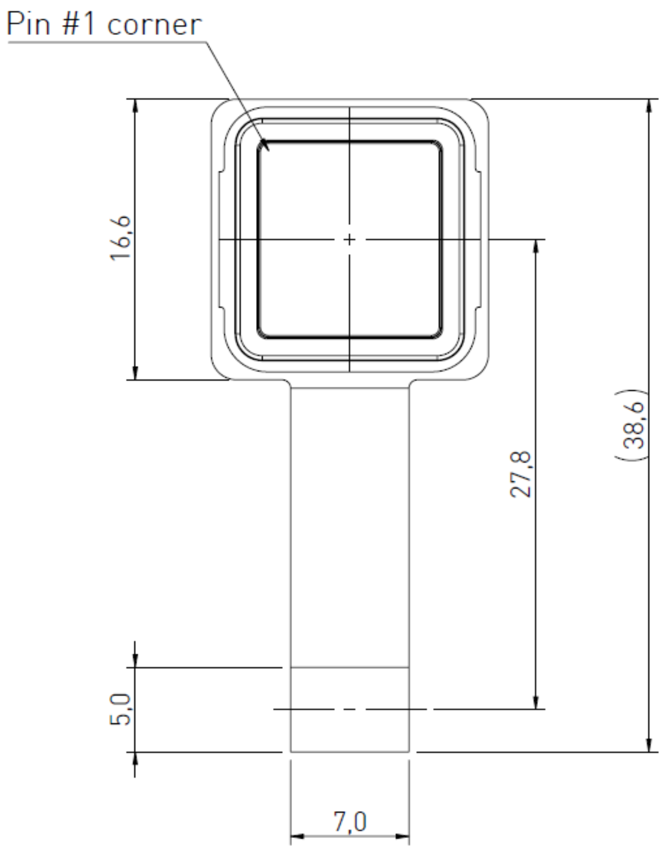

Figure 6: Part Drawing FPC1020AM CM03 – top view

Bottom View - FPC1020AM CM03

A part drawing for the top view of the FPC1020AM CM03 sensor is shown in Figure 7.

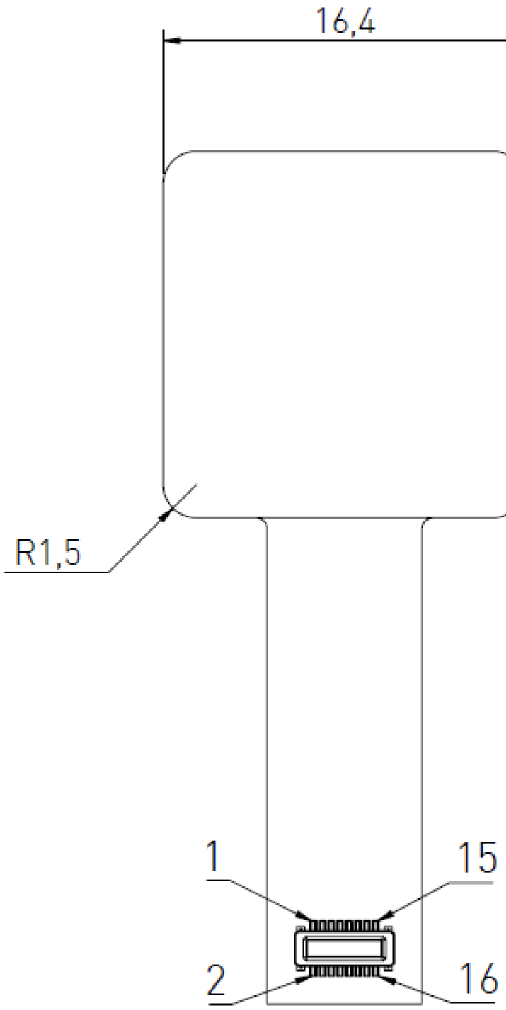

Figure 7: Part Drawing FPC1020AM CM03 – bottom view

Side View - FPC1020AM CM03

A part drawing for the side view of the FPC1020AM CM03 sensor is shown in Figure 8.

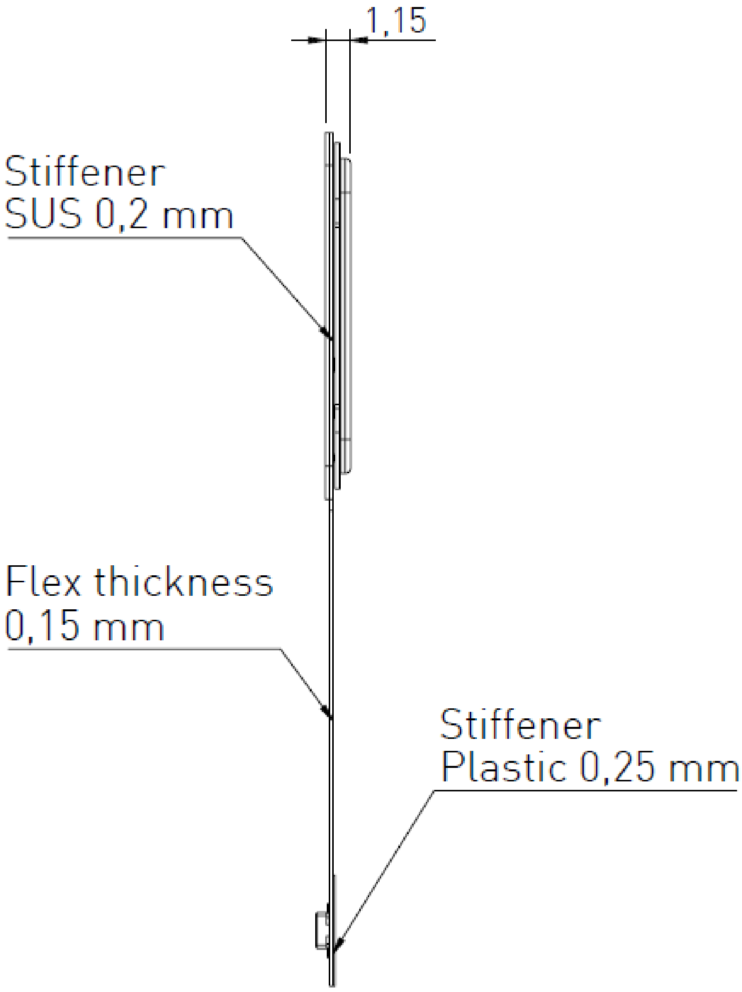

Figure 8: Part Drawing FPC1020AM CM03 – side view

11.2.2 Mechanical Drawings – FPC1020AM CM04

The FPC1020AM CM04 configuration is illustrated as schematic part drawings in this section.

Top View - FPC1020AM CM04

A part drawing for the top view of the FPC1020AM CM04 sensor is shown in Figure 9.

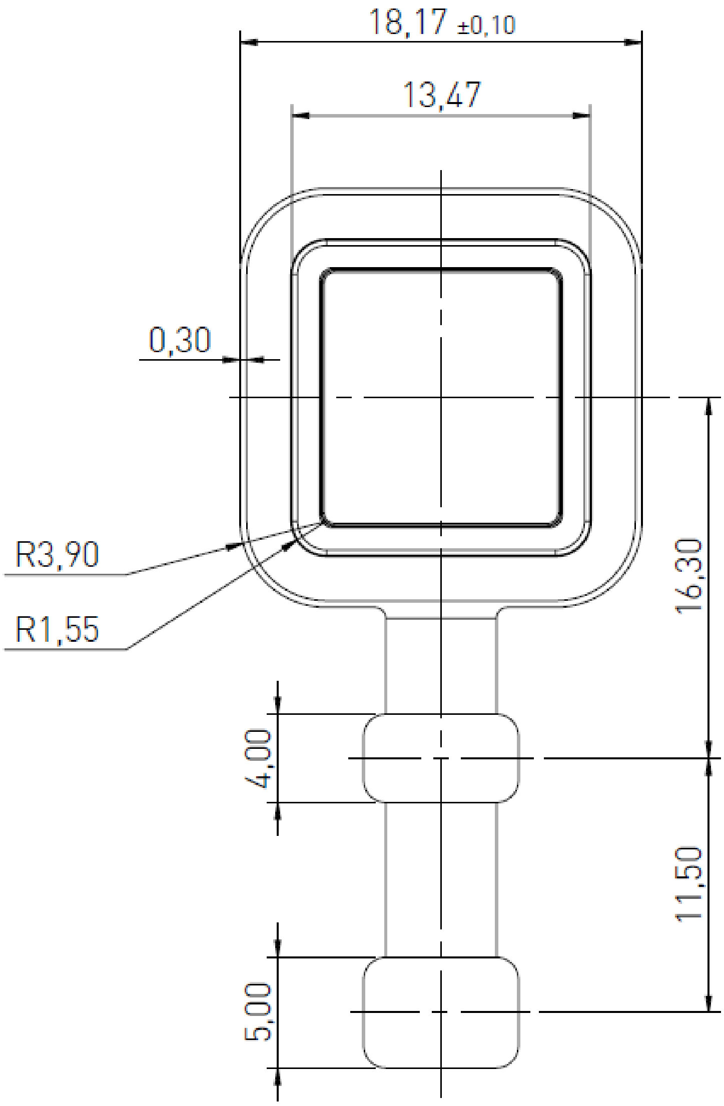

Figure 9: Part Drawing FPC1020AM CM04 – top view

Bottom View - FPC1020AM CM04

A part drawing for the top view of the FPC1020AM CM04 sensor is shown in Figure 10.

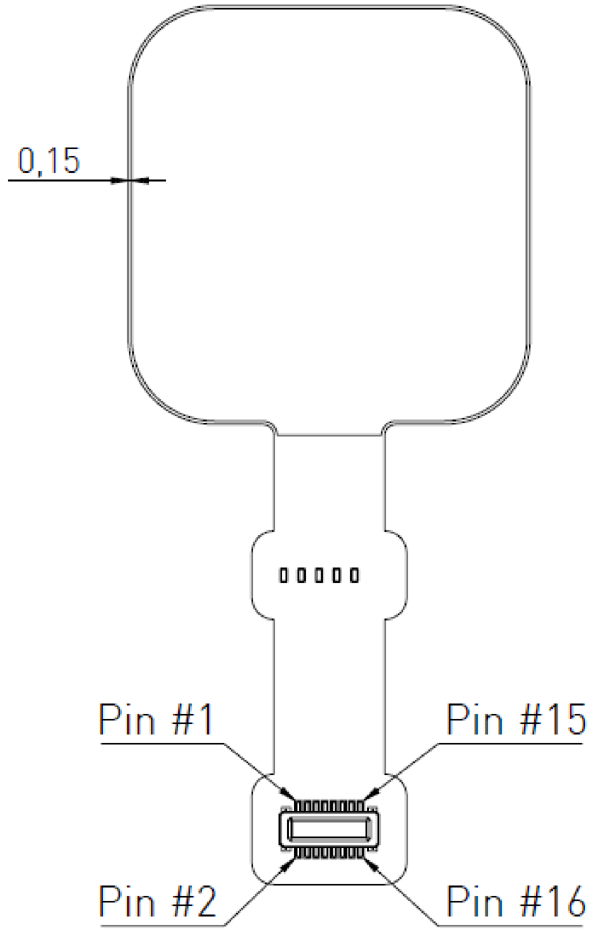

Figure 10: Part Drawing FPC1020AM CM04 – bottom view

Side View – FPC1020AM CM04

A part drawing for the top view of the FPC1020AM CM04 sensor is shown in Figure 11.

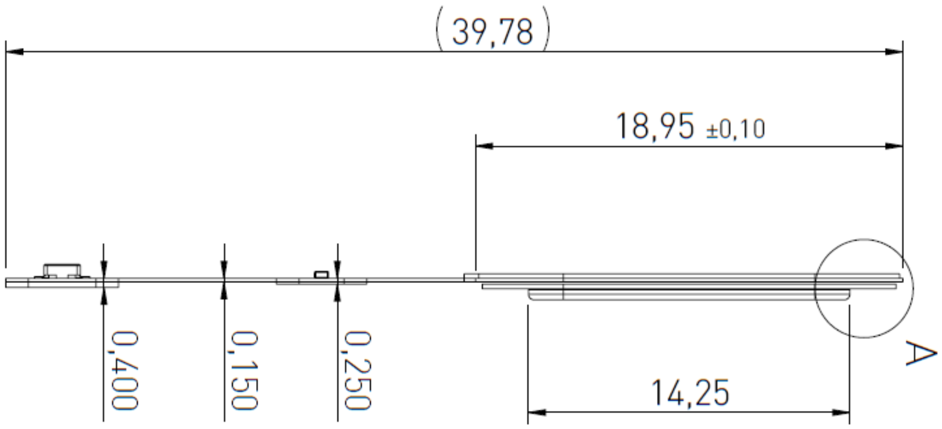

Figure 11: Part Drawing FPC1020AM CM04 – side view

11.2.3 Mechanical Drawings – FPC1011F3

The FPC1011F3 sensor is illustrated as schematic part drawings in this section.

Top View – FPC1011F3

A part drawing for the top view of the FPC1011F3 sensor is shown in Figure 12.

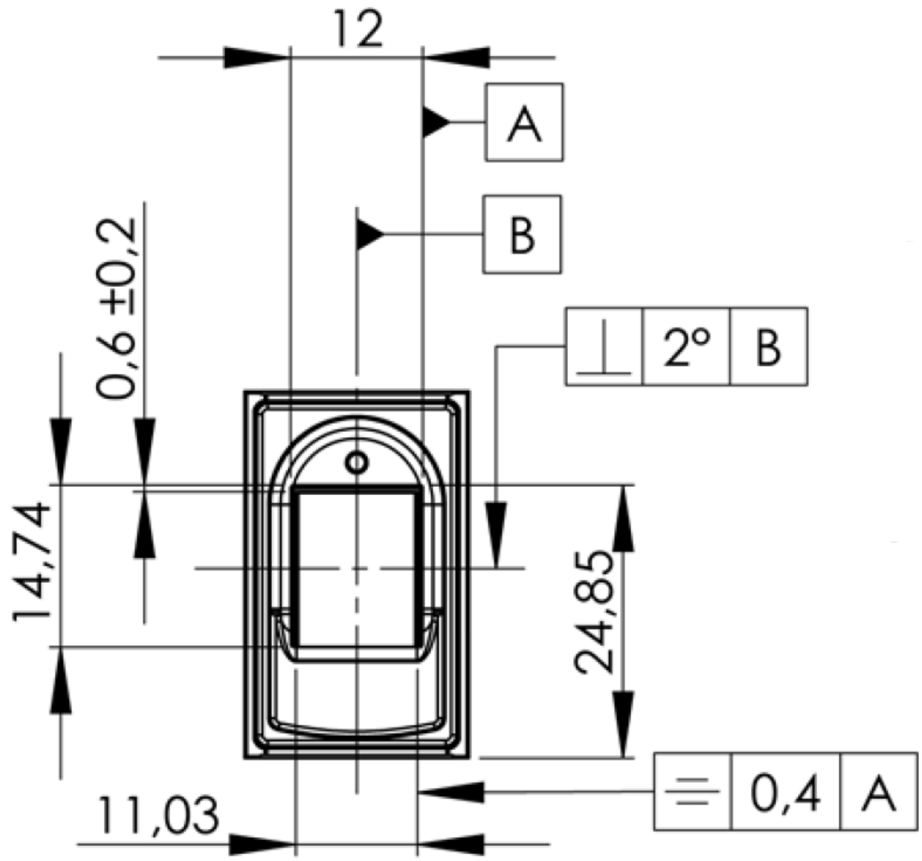

Figure 12: Part Drawing FPC1011F3 – top view

Bottom View - FPC1011F3

A part drawing for the top view of the FPC1011F3 sensor is shown in Figure 13.

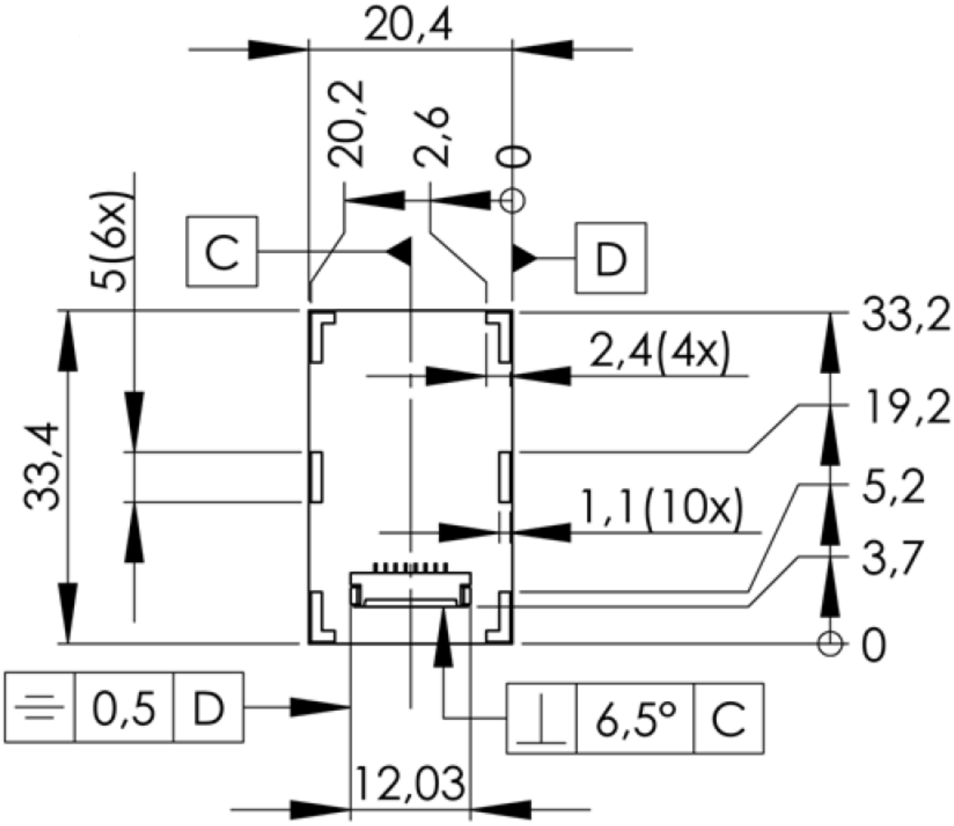

Figure 13: Part Drawing FPC1011F3 – bottom view

Side View - FPC1011F3

A part drawing for the top view of the FPC1011F3 sensor is shown in Figure 14

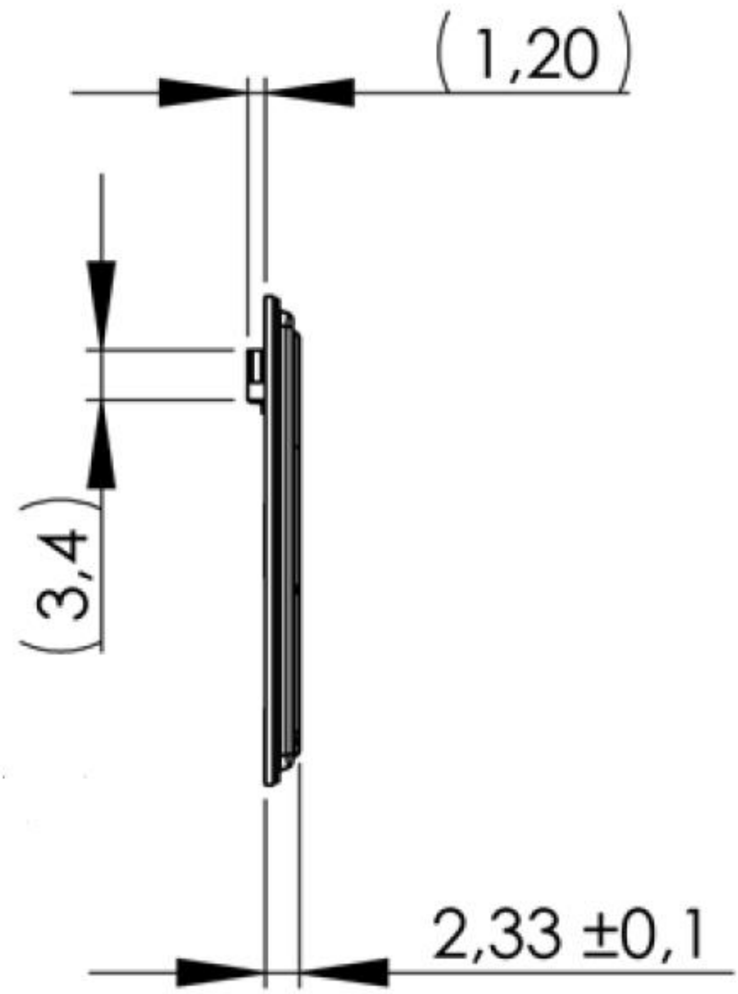

Figure 14: Part Drawing FPC1011F3 – side view

11.3 Sensor Module Integration

In order to maintain biometric performance the FPC-BM should be mounted or integrated according to the guidelines outlined in this section.

11.3.1 Mechanical Support – Sensor Modules

The best way to ensure a solid mount is to apply a stable, non-conductive, support to the back side of the sensor module. This non-conductive support can preferably be attached to the entire back side area.

Important! Mechanical force outside the maximum rating may cause permanent damage to the sensor.

11.4 Galvanic Contact – Sensor Modules

Due to the conductive bezel on the sensor module, a smooth transition to exterior mechanics can easily be obtained.

Important! Ensure galvanic isolation!

The sensor must be mounted in such way that electrical insulation to adjacent conductive surfaces is achieved. It is also recommended to avoid grounded surfaces nearby the bezel, as this may interfere with sensor operation. Contact Fingerprint Cards for details on the mechanical reference design. 2D and 3D drawings are available.

11.5 ESD Protection

The FPC-BM module has integrated ESD protection.

11.5.1 ESD - Module

ESD current is deflected across a protective coating on the sensor surface to the bezel surrounding the sensor. From the bezel, the discharged current is conducted via the Transient Voltage Suppressor (TVS) to the local ESD drain node ground pin (GND) on the PCB.

11.5.2 ESD - Power Supply Rails

The power supply rails do not need to be protected with an ESD device as they have bulk capacitors that will efficiently store any charge delivered by the ESD.

11.6 Moisture Sensitivity Level

The FPC-BM sensor is a moisture-sensitive device and should be handled in accordance with IPC/JEDEC guidelines in order to avoid damage from moisture absorption and exposure to solder reflow temperatures, which may cause yield and reliability degradation.

The FPC-BM module is delivered with a MSL level 3 guarantee (168 hours) based on J-STD-20A. Once soldering has been performed and the FPC-BM module has been mounted, there is reduced risk of degradation from moisture absorption to the device throughout its lifecycle.

11.6.1 Solder Reflow Profile

The solder reflow curve as illustrated in Figure 15 is based on IPC/JEDEC J-STD-020D.

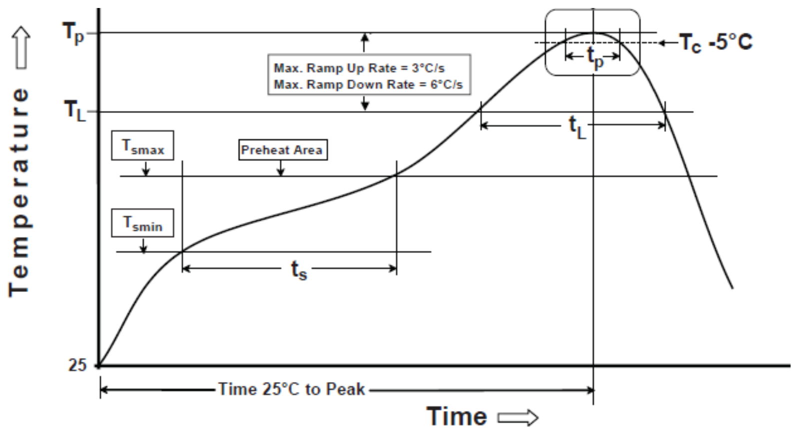

Figure 15: FPC-BM solder reflow curve.

12 Product Updates

An overview of the latest updates to the FPC-BM can be found in this section.

12.1 Product Configurations

An overview of the available product configurations for the FPC-BM is shown in Table 44.

Article Number	Description
FPC-BM-3A-CM01	FPC Biometric Module
FPC-BM1020-3A-CM01	FPC Biometric Module with FPC1020AM
FPC-BM1020-3A-CM02	FPC Biometric Module with FPC1020AM IP67
FPC-BM1011F3-3A-CM01	FPC Biometric Module with FPC1011F3

Table 44: Product Configurations

12.2 Document History

The updates and changes between the previous versions of this specification are outlined in Table 45.

Revision	Changes
B	Initiate Firmware and Firmware Update commands are removed. Performance Characteristics updated. Document filename changed. RoHS and REACH information added.
A	New document. CS release FPC-BM.

Table 45: Document History