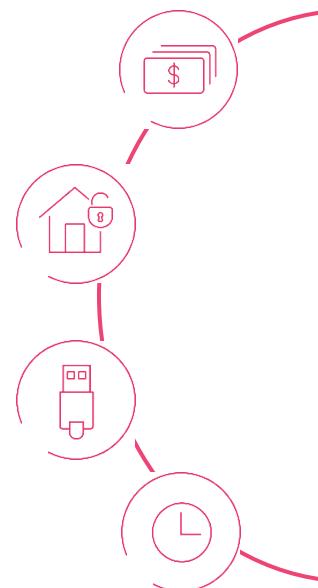


Features

- ⌚ Compact biometric system
- ⌚ Onboard authentication software
- ⌚ Navigation support
- ⌚ Encrypted template storage
- ⌚ Multiple interfaces SPI/UART/USB/I²C
- ⌚ Single 3,3V power supply
- ⌚ Support for GPIO ports
- ⌚ Black matt protective sensor coating
- ⌚ All-in-one package and/or flex module
- ⌚ Feather wing and Arduino shield support
- ⌚ RoHS and REACH compliant

Applications

- ⌚ Access control, door locks
- ⌚ Crypto wallets
- ⌚ Fido authenticators, tokens
- ⌚ Digital access devices
- ⌚ Time and attendance



General description

The AllKey Biometric System family FPC2530 offers a proven, robust fingerprint sensor solution that can easily be integrated into virtually any application. Fingerprint templates are automatically created and stored in the internal flash memory. The device can be controlled from any host with basic commands for enrollment and verification, or be customized for stand-alone operation without external components. The AllKey is provided with several different host interfaces, pre-loaded software and is ready to use on delivery. The AllKey also features an attractive black coating, that together with a built-in hidden discharge node (bezel) offers protection against ESD, scratches, impact, and everyday wear and tear.

 FPC2532AP
AllKey LGA

 FPC2532AM
AllKey Module

 FPC2534AP
AllKey Pro LGA

 FPC2534AM
AllKey Pro Module

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1 INTRODUCTION

1.1 Document content

This specification outlines the general features and functionalities of the FPC AllKey Biometric System. It includes mechanical and environmental information, integration guidelines as well as packing and ordering information for all versions. Regarding more advanced features like Secure Host Interface, and additional interface options like USB, I²C and GPIO use, we also refer to dedicated supplements, describing each feature set.

1.2 FPC2530 device family

The FPC AllKey Biometric System device family includes several biometric system devices, with different interface configurations and system functionalities. Most versions are available with a hardware compatible electrical and mechanical interface, allowing for future upgrades without the need for redesign.

Versions within the FPC2530 AllKey family at present date:

| PRODUCT | DESCRIPTION | PRODUCT SPECIFICATION | FEATURE SUPPLEMENT |
|-----------|------------------------------------|--------------------------|--------------------|
| FPC2532AP | AllKey Biometric System LGA | SPC27317 (this document) | |
| FPC2532AM | AllKey Biometric System Module | SPC27317 (this document) | |
| FPC2534AP | AllKey Pro Biometric System LGA | SPC27317 (this document) | SPC27387 |
| FPC2534AM | AllKey Pro Biometric System Module | SPC27317 (this document) | SPC27387 |
| | | | |

1.2.1 FPC2532 AllKey

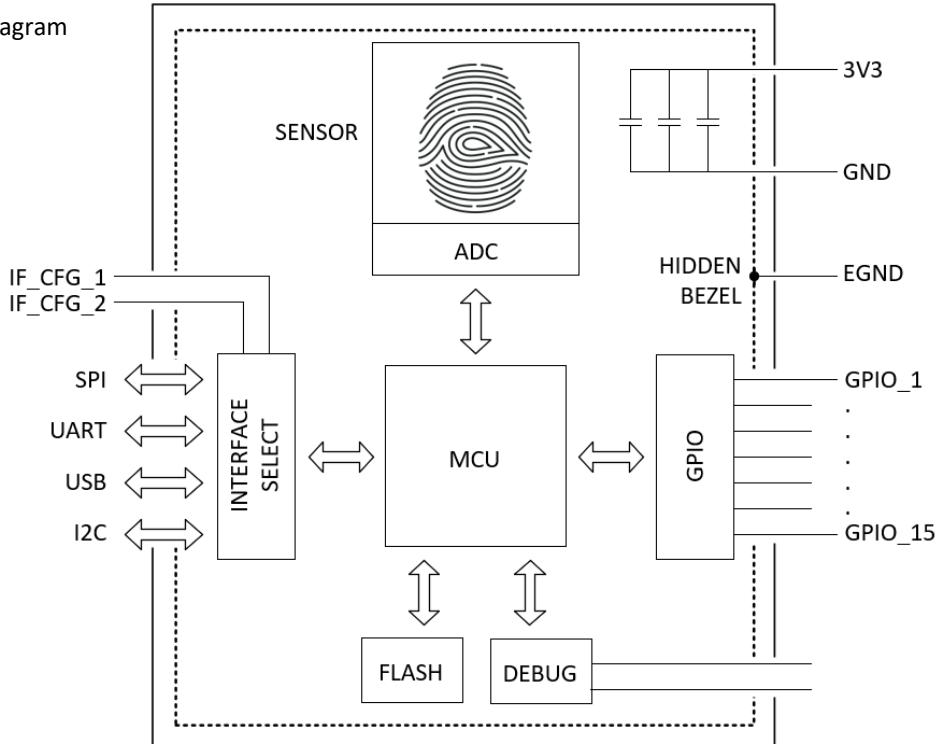
FPC2532 standard version is fully covered in this document and target applications where fingerprint is used to increase convenience by adding Identification, Personalization and Navigation. The FPC2532 is available both in an LGA package FPC2532AP, and a versatile flex module assembly FPC2532AM.

1.2.2 FPC2534 AllKey Pro

FPC2534 high security version target applications where fingerprint is used for Authentication and where Protection for Tampering is priority. The FPC2534 is available both in an LGA package FPC2534AP, and a versatile flex module assembly FPC2534AM.

2 FUNCTIONAL DESCRIPTION

2.1 Block diagram



2.2 Product features

| PARAMETER | DESCRIPTION | VALUE | UNIT |
|---------------------|---|-------------|-------|
| Dimension | Sensor body ($\varnothing \times T$), nominal | 11,0 x 0,83 | mm |
| Active sensing area | Pixel matrix | 5,0 x 4,8 | mm |
| | | 100 x 96 | pixel |
| Pixel resolution | 256 gray scale values | 8 | bit |
| Spatial resolution | | 508 | dpi |
| Package type | 47 pin LGA, 8x8 matrix with 1,0 mm pitch | 47 | pin |

2.3 Operating conditions

| PARAMETER | CONDITION / DESCRIPTION | VALUE | UNIT |
|-----------------------------|---|-------------|-------|
| Operating temperature (max) | Ambient temperature, power applied | -40 ... 125 | °C |
| Storage temperature (max) | Long term storage above RT will decrease shelf life (30 years shelf life is expected @ 25 °C) | -40 ... 85 | °C |
| Floor life (out of bag) | JEDEC MSL Level 3 Compliant | 168 | hours |
| IP classification | Supported water and dust proof level | IP67 | - |

2.4 Electrical characteristics

| SYMBOL | PARAMETER | CONDITION | MIN | TYP | MAX | UNIT |
|------------------------|-----------------------------|---|-------------|---------|-------------|--------|
| V_{DD} | Voltage supply (total) * | All interfaces incl USB | 3,0 | 3,3 | 3,6 | V |
| I_{DD} | Current supply, active ** | | - | - | - | - |
| | High-performance mode | Processing biometrics (Enroll & Identify) | | 17 | 21 | mA |
| | Active mode | Processing commands e.g. navigational swipes. | | 5.2 | | mA |
| | Finger detect mode *** | Waiting for finger | 14.3 | 22 | 78 | uA |
| | Deep sleep mode | | | 14 | | uA |
| <i>Digital inputs</i> | | | | | | |
| V_{IL} | Logic '0' voltage | | N/A | N/A | $0,3V_{DD}$ | V |
| V_{IH} | Logic '1' voltage | | $0,7V_{DD}$ | N/A | N/A | V |
| <i>Digital outputs</i> | | | | | | |
| V_{OL} | Logic '0' output voltage | | - | - | 0,4 | V |
| V_{OH} | Logic '1' output voltage | | 2,4 | - | - | V |
| <i>Interfaces</i> | | | | | | |
| SPI Clock frequency | SPI mode 0 (CPOL=0, CPHA=0) | | | 10 | 10 | MHz |
| UART baud rate | Default rate 921 600 | 9 600 | | 921 600 | | baud |
| USB specification 2.0 | Full-speed compliant | - | - | 12 | | Mbit/s |
| I^2C standard | Fast mode compliant | - | - | 400 | | kbit/s |

(*) NOTE: Power supply levels apply regardless of the selected interface. This is especially important in USB mode where the standard VBUS level is 5V. Supplying power directly to the FPC2530 from the USB bus will damage the device.

(**) NOTE: All power consumption measurements are made with $VDD = 3,3V$.

(***) NOTE: Depends on polling rate, which is configurable. Typical value is for default polling rate (34 ms). Min and Max are the respective edges of valid polling rates.

2.5 Secure package layout

Extra precaution is taken to not expose critical signals on the outside of the SiP. Internal communication lines between the sensor, flash and MCU are all hidden inside the molded package body. To maintain integrity, signals cannot be accessed from the outside.

2.6 Signal configuration overview

Not all signals are available in all Biometric System devices. Refer to the section on “Customization” for more details on optional signals. Below is an overview of available signals (X) and interfaces in different product versions. Signals marked (-) are not available and should be left open (not connected).

| PIN NAME | DESCRIPTION (default) | FPC2532AP | FPC2534AP | FPC2532AM | FPC2534AM |
|--------------|-----------------------------------|-----------|-----------|-----------------|-----------------|
| IF_CFG_1 | Interface selection | X | X | X | X |
| IF_CFG_2 | Interface selection | X | X | - | - |
| RST_N | System reset, active low | X | X | X | X |
| IRQ | Interrupt request | X | X | IRQ / HOST_WU * | IRQ / HOST_WU * |
| SPI_MOSI | SPI master out, slave in | X | X | X | X |
| SPI_MISO | SPI master in, slave out | X | X | X | X |
| SPI_SCK | SPI clock | X | X | X | X |
| SPI_CS_N | SPI chip select, active low | X | X | CS_N / SYS_WU * | CS_N / SYS_WU * |
| UART_TX | Serial interface, transmit | X | X | X | X |
| UART_RX | Serial interface, receive | X | X | X | X |
| USB_DP | USB data + (Optional) | - | X | - | - |
| USB_DM | USB data - (Optional) | - | X | - | - |
| I2C_SDA | I ² C Data (Optional) | - | X | - | - |
| I2C_SCL | I ² C Clock (Optional) | - | X | - | - |
| GPIO_1 | General purpose IO | X | X | - | - |
| GPIO_2 | General purpose IO | X | X | - | - |
| GPIO_3 | General purpose IO | X | X | - | - |
| GPIO_4 | General purpose IO | X | X | - | - |
| GPIO_5 | General purpose IO | X | X | - | - |
| GPIO_6 | General purpose IO | X | X | - | - |
| GPIO_7 | General purpose IO | X | X | - | - |
| GPIO_8 | General purpose IO | X | X | - | - |
| GPIO_9 | General purpose IO | X | X | - | - |
| GPIO_10 | General purpose IO | X | X | - | - |
| GPIO_11 | General purpose IO | X | X | - | - |
| GPIO_12 | General purpose IO | X | X | - | - |
| GPIO_13 | General purpose IO | X | X | - | - |
| GPIO_14 | General purpose IO | X | X | - | - |
| GPIO_15 | General purpose IO | X | X | - | - |
| BOOT0 | Do not connect | X | X | - | - |
| DBG_(prefix) | Do not connect | - | - | - | - |
| 3V3 | Power supply | X | X | X | X |
| GND | Signal ground | X | X | X | X |
| EGND | Hidden bezel, ESD node | X | X | X | X |
| NO PAD | Pin ONE indication | - | - | - | - |
| NO PAD | Laser marking area | - | - | - | - |

(*) NOTE: Dual functionality depending on SPI or UART interface selection, i.e. functionality in SPI mode (default) / UART mode.
See more under FLEX MODULE section.

3 SOFTWARE

3.1 Overview

The software configuration on the device will depend on the feature set supported by the product variant. In this chapter is a summary of the common parts. For details on commands implementations, data types, and various defines, refer to the provided API header file (fpc_api.h) and sample code.

3.2 States

The internal state of the device is defined by a 2-byte bitmap. The table below gives an overview of the possible states. Note that some are mutually exclusive. For example, only one of Enroll, Identify, Navigation, and Capture can be active at a time. Attempting to enter multiple of these states simultaneously yields an error response.

| STATE ID | NAME | CLEARED ON ABORT | DESCRIPTION |
|----------|-----------------|------------------|--|
| 0x0001 | App FW Ready | No | Application is ready to receive commands. |
| 0x0004 | Capture | Yes | Sensor is armed for a single touch. Transitions to <i>Image Available</i> state on capture. Note that the image cannot be used for biometric operations; this state is intended for debugging purposes and evaluating image quality. |
| 0x0010 | Image Available | Yes | A captured fingerprint image is available for readout. No biometrics can be performed on the image. State is cleared upon readout. |
| 0x0040 | Data Transfer | Yes | Data transfer session is ongoing. |
| 0x0080 | Finger Down | No | A finger is touching the sensor. Can only be entered if the sensor is actively searching for a finger (i.e. during Enroll, Identify, Navigation, or Capture). |
| 0x0400 | System Error | No | A system error has occurred. State will clear itself once the error code has been read out. |
| 0x1000 | Enroll | Yes | Enrollment of a new user is ongoing, and the sensor is armed for multiple touches. State will clear itself once enrollment finishes. |
| 0x2000 | Identify | Yes | Identification/Verification of user is ongoing, and the sensor is armed for a single touch. State will clear itself once the match result is reported. |
| 0x4000 | Navigation | Yes | Sensor is primed for detection and classification of navigation gestures. |

3.3 Events

A change in the internal state is communicated as an *event*. They can occur as a response to a request (e.g. an enrollment request), a touch of the sensor, or the outcome of some internal operation (e.g. fingerprint matching). All events are reported to the host as part of a status response, which also contains the current state. A status response will always be sent in response to any command, and in case there is no special event which occurred, it is seen as an “empty” event. Below is a list of possible events, which are also defined in the API header file.

| EVENT ID | NAME | DESCRIPTION |
|----------|--------------------|---|
| 0 | None / Empty event | No special event occurred. |
| 1 | Idle | Triggers on device startup. |
| 2 | Armed | Not in use. |
| 3 | Finger Detect | Triggers on touch if the sensor is searching for a finger. The device enters “Finger Down” state on this event. |
| 4 | Finger Lost | Triggers if a finger leaves the sensor area. The device exits “Finger Down” state on this event. |
| 5 | Image Ready | Sensor has captured an image. |
| 6 | Command Failed | The requested command failed. Typically accompanied by an error code. |

3.4 Communication Protocol

All data transfers have a *Frame Header*, *Command Header* and, where applicable, *Command Payload Data*. This applies to all messages in both directions.

| FRAME HEADER | COMMAND HEADER | COMMAND DATA (PAYLOAD) |
|--------------|----------------|------------------------|
| 8 bytes | 4 bytes | Variable |

All structs and defines described in this document can be found in the API header files and sample code. The data fields in the API header files use size-specific datatypes defined in stdint.h (e.g., uint16_t, etc.).

All fields are in little endian format.

3.4.1 *Frame Header*

All Requests, Responses and Events start with a Frame Header.

The header contains information on what version of the protocol and what type of message it is, and the length of the following payload. The size of the frame header is 8 bytes.

If the VERSION field does not match between device and host, the frame will be discarded.

| VERSION | TYPE | FLAGS | PAYLOAD SIZE |
|---------|---------|---------|--------------|
| 2 bytes | 2 bytes | 2 bytes | 2 bytes |

3.4.2 *Command Header*

All commands have a common command header. The payload depends on the command. The size of the command header is 4 bytes.

| COMMAND ID | TYPE | COMMAND DATA (PAYLOAD) |
|------------|---------|------------------------|
| 2 bytes | 2 bytes | Variable |

3.5 Commands

This table below contains all common commands supported by the FPC2530 device family. “Command” and “Request” are used interchangeably, and both refer to a data transfer initiated by the host.

| ID | NAME | DESCRIPTION |
|--------|---------------------------|---|
| 0x0040 | Status | Get the status of device. |
| 0x0041 | Version | Get FW version and unique HW ID. |
| 0x0044 | Built-in Self-Test (BIST) | Run internal test for defects on the fingerprint sensor. Test verdict 1 = PASS, 0 = FAIL |
| 0x0050 | Capture | Arm the sensor to capture a single image on touch. |
| 0x0052 | Abort | Abort active state(s). See Section 3.2 for which states can be aborted. |
| 0x0053 | Image Data | Request readout of fingerprint image collected in <i>Capture</i> mode. |
| 0x0054 | Enroll | Start enrollment of a new finger, see Section 3.7 for details. A maximum of 30 fingers can be saved on the device |
| 0x0055 | Identify | Put device in Identify state (one touch) to perform matching against saved templates on touch. |
| 0x0060 | List Templates | List enrolled templates. |
| 0x0061 | Delete Template(s) | Delete one or all enrolled templates. |
| 0x006A | Get System Configuration | Get active or default system configuration settings. |
| 0x006B | Set System Configuration | Set system configuration settings. |
| 0x0072 | Reset | Reset device. |
| 0x0080 | Set Debug Log Level | Not supported. Only Critical logs can be read out. |
| 0x0101 | Data Get | Read out one chunk of requested data from buffer. A data request, such as <i>Image Data</i> , must be sent prior. |
| 0x0200 | Navigation | Put the device in Navigation mode. |
| 0x0300 | GPIO Control | Set or get configuration for GPIO pins. Refer to Section 6.6 for details. |

3.6 Timings

Below are timing and performance values for FPC AllKey. Note that a response is always sent from the device once an operation finishes, such as *identify*. Measurements are independent of the communication interface used.

| USE CASE | VALUE | COMMENT |
|------------------------|---------------|--|
| Power up / Boot | 150 ms | Status is sent from device to host when finished. This can be disabled in System Configuration. Timing is identical for a SW reset. |
| Wakeup from deep sleep | 500 us | The device typically wakes up faster; this is the lowest recommended delay between sending a wakeup signal and data. |
| Enrollment | 130 ms | - |
| Identify | 140 - 1400 ms | Depends based on number of fingers enrolled and the match ID; it goes through all registered ID:s in ascending order and stops on the first match. Specifying an ID in the verify request will always yield the best-case scenario. Max value is worst case scenario with 30 enrolled fingers, matching on the last. |

3.7 Enrollment mode

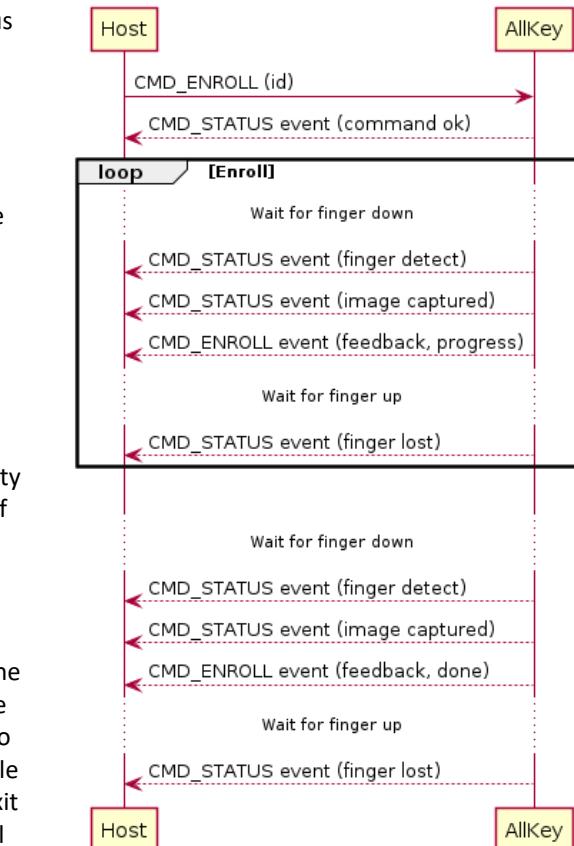
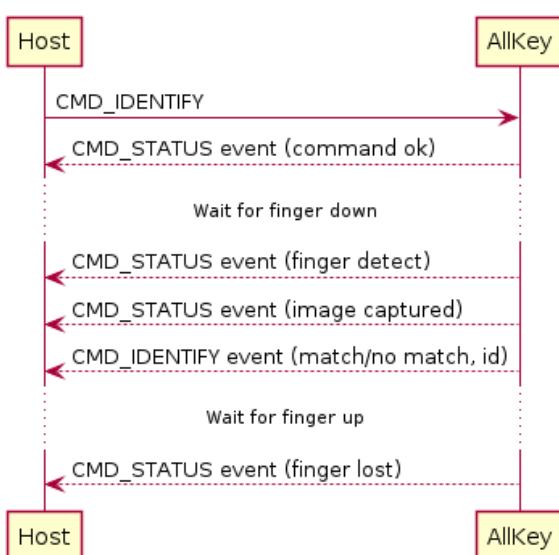
Enrollment mode consists of the full enrollment of a new fingerprint, from capturing images, providing continuous feedback, and saving the template to the internal flash. An overview of the enrollment is displayed to the right.

It is initiated by the Enroll command, with the optional argument of an ID to register the template under. If no ID is specified, it will use the next number available. The enroll request is validated by a status event, signaling that enrollment successfully started. Note that if the maximum number of fingers (30) are already enrolled, new ones cannot be registered.

Once enrollment starts, the device continuously checks for a finger on its sensor to enroll. Each touch is registered, and feedback is provided on the image quality and remaining touches. The loop continues for a total of 12-16 accepted touches, depending on finger mobility. When enrollment finishes the device returns to its idle state.

The enrollment can be cancelled either by the host or the device. From the host side, it is cancelled by sending the abort command at any point which returns the device to its idle state. The device may abort enrollment if multiple images in a row are of insufficient quality. It will then exit with the appropriate error code. If either side aborts, all registered data so far is discarded – nothing is saved until the full enrollment finishes successfully.

3.8 Identify mode



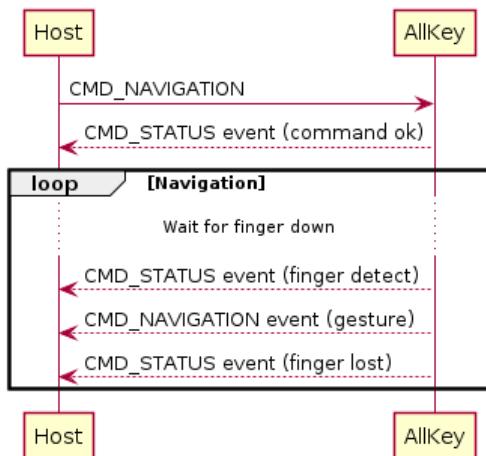
When identify mode is entered, the sensor is armed to capture a single image on touch. The device will try to match the image against *any* template on the device, or a specific one (i.e. verify), if specified in the Identify command payload. The outcome and the match ID are returned as an event, and the device returns to its idle state once the finger is lifted.

Note that identify mode consists of a *single* attempt. The mode must be re-entered again after the match response is given and the finger is lifted.

If too many unsuccessful attempts are made, the device will be locked out from identify for some time, preventing further attempts. The number of fails, and the lockout time can be changed via the system configuration (see Section 3.10).

3.9 Navigation mode

The device also provides the possibility of performing simple navigational gestures, such as traversing a menu. This is handled in *navigation mode*, which continuously checks for a finger on the sensor. Instead of capturing and processing an image, the device tracks and categorizes any gestures performed. It may either be classified as a swipe in one of the four cardinal directions (up, down, left, right), a press, or a long press. Navigation events are sent to the host on any gesture, as seen in the diagram below. To exit navigation, an abort request must be sent from the host.



3.10 System configuration

A few parameters for the software can be configured by the host. The table below lists all available settings and their default values. These are FPC recommended settings, and do not need to be changed. The exception is “Stop mode for UART” flag which should be enabled in the final integration if power consumption is a restriction. See sections 4.3 and 5 for details.

| CONFIG | | DEFAULT | DESCRIPTION |
|------------------------|-----------------------|----------|--|
| Version | | 1 | Version of system configuration structure. Shall not be changed. |
| Finger Scan interval | | 34 ms | Sleep time between each finger presence check. A higher value will decrease power consumption in Finger Detect Mode, but also increase response time. |
| System Flags | Status event at boot | Enabled | Send Status event after system boot. |
| | Stop mode for UART | Disabled | Let system go into deep sleep when using UART interface. This requires the system to be woken via the wake-up pin (CS) before sending any UART data to host. |
| | UART IRQ before TX | Enabled | Set IRQ pin before SiP sends UART data. The delay between the IRQ and start of data transfer is configurable via “UART delay before TX” below. |
| UART delay before TX | | 1 ms | Delay between the IRQ pin is set, and UART TX is started. |
| Idle time before sleep | | 0 ms | Idle time after last command before entering deep sleep. |
| Identify lockout | Max consecutive fails | 5 | Number of consecutive fails to trigger a lockout. The lockout is activated on the next failure i.e. 6 th no-match for default setting. |
| | Lockout time | 15 s | Lockout time. The lockout is cleared upon FW reset. |

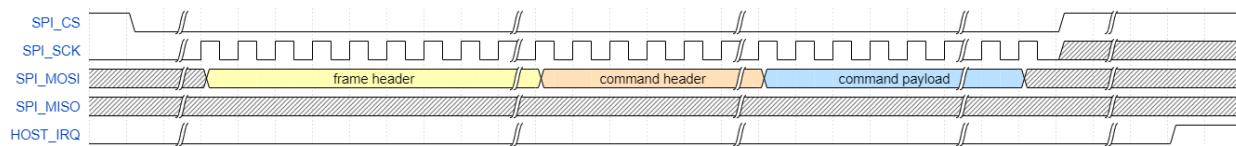
4 INTERFACES

4.1 Interface overview

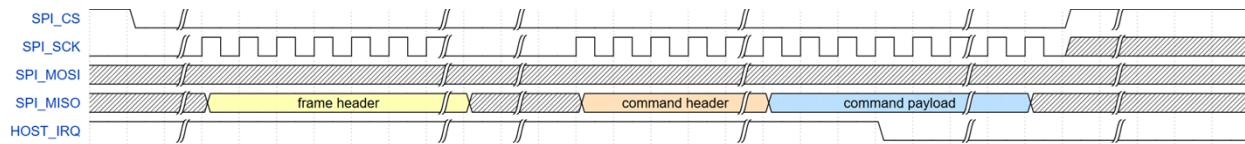
The FPC2530 module supports a variety of HW interfaces. SPI and UART are supported in all SW variants. Other interfaces may be supported depending on SW. The interface selection will adhere to the table in the section "Interface selection pins (IF CONFIG)".

4.2 SPI communication

SPI Host to Device



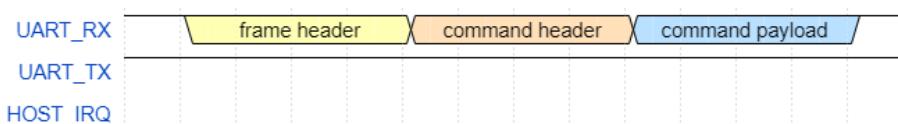
SPI Device to Host



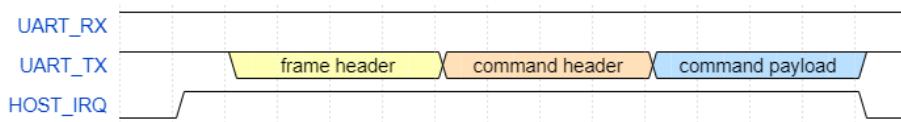
Time between chip select low and first clock flank must be > 500 us to let the MCU wake from sleep state. Frames must be sent without toggling the chip select during the transfer. For frames read by the host, the frame header is usually read first and then the rest of the frame. The HOST_IRQ goes high when the device has something to send. Product use SPI mode 0 (CPOL=0, CPHA=0).

4.3 UART communication

UART Host to Device



UART Device to Host



Transfer from device to host will be sent 1ms after HOST_IRQ goes high (this value is configurable, see Section 3.10). The HOST_IRQ is used to let the host device wake from sleep if needed.

To wake the device from sleep, the HOST_CS_N line must be toggled. If fewer pins are needed, the HOST_CS_N line can be connected to HOST_UART_RX instead and a break character can be sent before sending the normal frame. The break length must be > 1 character in length (baud rate dependent, ~10us at 921600 baud).

4.4 USB and I²C communication

Only supported for FPC2534. See feature supplement for additional details.

5 MODES OF OPERATION

This product has 4 different power modes. In most cases, the software automatically defaults to the lowest applicable mode to minimize power consumption. The subsections below describe each mode, when its used, and ways of minimizing consumption.

5.1 Deep sleep mode

Deep sleep mode refers to the lowest power state when the fingerprint sensor is also in deep sleep. This mode may also be referred to as Stop mode interchangeably. For SPI interface, this is automatically entered when the device is idle.

5.2 Finger detect mode

Finger detect mode refers to when the device is waiting for a finger to touch the sensor or waiting for a finger to leave the sensor area (enroll/identify/navigation states). No other data is being processed by the device during finger detect mode. It is activated during Enroll, Identify, Navigation, and Finger Down states.

5.3 Active mode

Active mode refers to when the device is fully awake and processing data or communicating with internal hardware. Any requests and communication with the device will put it in active mode, as well as processing navigation gestures. Based on the system configuration it will re-enter deep sleep or finger detect after a while.

5.4 Active mode, high performance

High performance mode is only activated in short periods when greater processing power is required. It is automatically entered or exited by the device; it cannot be controlled by the host. The high-performance mode is only used for processing a captured fingerprint image for enrollment or identification purposes, as well as listing all templates.

5.5 Reducing power consumption.

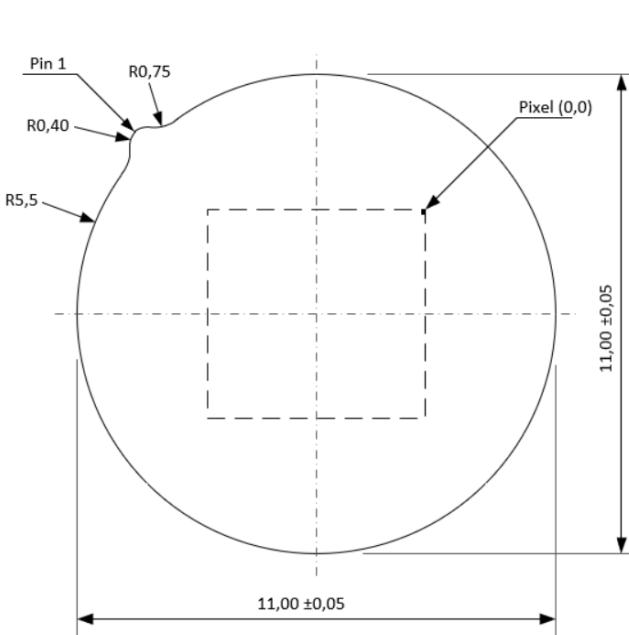
Below are a few suggestions on how to reduce power consumption in the software implementation. Note that these are dependent on the end use case and may not be applicable in all situations.

- ② If using UART mode, make sure to enable “Stop mode for UART” flag in the system configuration for the final product. Note that it requires the device to be woken via CS pin before sending any data.
- ② If the end solution allows it, avoid idling in Finger detect mode. Scanning for a finger on the sensor slightly increases power consumption (see Section 2.4). Instead, only enter these modes when needed.
 - If this is not possible, e.g. if the system is intended to wake up on a finger detect, consider increasing the finger scan interval in the system configuration.
- ② If the purpose is only to verify the identity of a known user, consider specifying their ID in the Identify command. Matching is done in high performance mode, and it is faster to match against a single template, rather than the entire database.

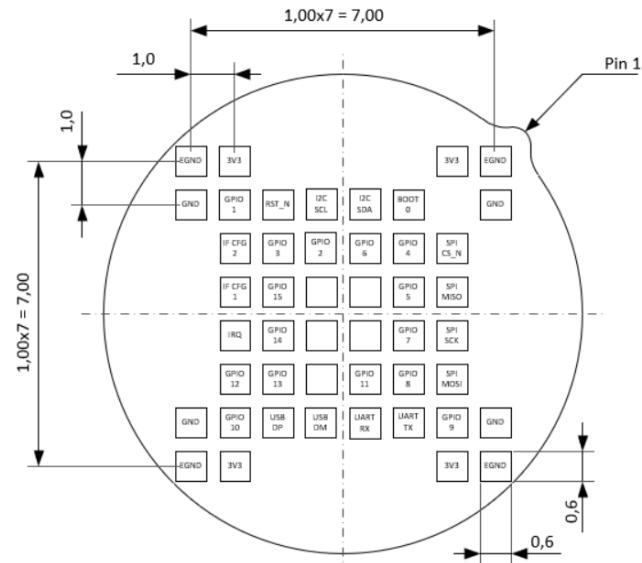
6 LGA INTEGRATION GUIDELINE

6.1 Package outline

The standard package within the FPC2530 device family is a round LGA (land grid array) with a small notch as pin one indication. Top side is coated black and bottom side gives access to all signals.



TOP VIEW



BOTTOM VIEW

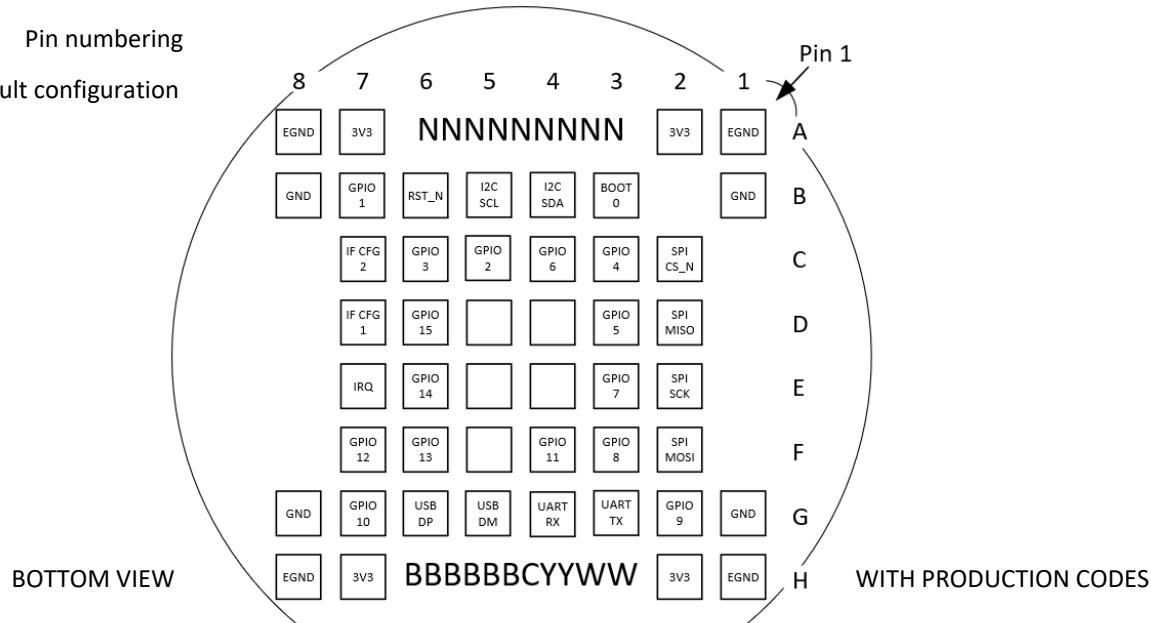


SIDE VIEW

[mm]

6.2 Pin numbering

Default configuration



BOTTOM VIEW

WITH PRODUCTION CODES

| PIN | NAME | DESCRIPTION | PIN | NAME | DESCRIPTION |
|-----|-----------|-----------------------------------|-----|-------------|----------------------------|
| A1 | EGND | Hidden bezel, ESD node | E1 | NO PAD | Laser marking area |
| A2 | 3V3 | Power supply | E2 | SPI_SCK | SPI clock |
| A3 | NO PAD | Laser marking area | E3 | GPIO_7 | General purpose IO |
| A4 | NO PAD | Laser marking area | E4 | DBG_UART_RX | Do not connect |
| A5 | NO PAD | Laser marking area | E5 | DBG_SWDIO | Do not connect |
| A6 | NO PAD | Laser marking area | E6 | GPIO_14 | General purpose IO |
| A7 | 3V3 | Power supply | E7 | IRQ | Interrupt request |
| A8 | EGND | Hidden bezel, ESD node | E8 | NO PAD | Laser marking area |
| B1 | GND | Common ground | F1 | NO PAD | Laser marking area |
| B2 | NO PAD | Pin ONE indication | F2 | SPI_MOSI | SPI master out, slave in |
| B3 | BOOT0 | Do not connect | F3 | GPIO_8 | General purpose IO |
| B4 | I2C_SDA | I ² C Data | F4 | GPIO_11 | General purpose IO |
| B5 | I2C_SCL | I ² C Clock | F5 | DBG_UART_TX | Do not connect |
| B6 | RST_N | System reset, active low | F6 | GPIO_13 | General purpose IO |
| B7 | GPIO_1 | General purpose IO | F7 | GPIO_12 | General purpose IO |
| B8 | GND | Common ground | F8 | NO PAD | Laser marking area |
| C1 | NO PAD | Laser marking area | G1 | GND | Common ground |
| C2 | SPI_CS_N | SPI chip select, active low | G2 | GPIO_9 | General purpose IO |
| C3 | GPIO_4 | General purpose IO | G3 | UART_TX | Serial interface, transmit |
| C4 | GPIO_6 | General purpose IO | G4 | UART_RX | Serial interface, receive |
| C5 | GPIO_2 | General purpose IO | G5 | USB_DM | USB data - |
| C6 | GPIO_3 | General purpose IO | G6 | USB_DP | USB data + |
| C7 | IF_CFG_2 | Interface selection, config pin 2 | G7 | GPIO_10 | General purpose IO |
| C8 | NO PAD | Laser marking area | G8 | GND | Common ground |
| D1 | NO PAD | Laser marking area | H1 | EGND | Hidden bezel, ESD node |
| D2 | SPI_MISO | SPI master in, slave out | H2 | 3V3 | Power supply |
| D3 | GPIO_5 | General purpose IO | H3 | NO PAD | Laser marking area |
| D4 | DBG_SWO | Do not connect | H4 | NO PAD | Laser marking area |
| D5 | DBG_SWCLK | Do not connect | H5 | NO PAD | Laser marking area |
| D6 | GPIO_15 | General purpose IO | H6 | NO PAD | Laser marking area |
| D7 | IF_CFG_1 | Interface selection, config pin 1 | H7 | 3V3 | Power supply |
| D8 | NO PAD | Laser marking area | H8 | EGND | Hidden bezel, ESD node |

6.3 Power supply and ground pins

The LGA package is provided with four pins for power supply, and four ground pins. Even if it may be enough to connect only two of these pins, it is recommended to connect all eight pins for optimal power supply stability. Package is equipped with internal decoupling and hence the need for external decoupling is limited in most applications. If space is limited, connections are short (< 30 mm), and power supply can be considered stable, omitting external decoupling capacitors can be evaluated.

Pay attention the required voltage supply levels specified in 2.4. These levels are applicable regardless of selected communication interface. This is especially important in USB mode, where the standard VBUS level is 5V. Supplying power directly to the FPC2530 will damage the device. Instead a step-down voltage regulator (LDO) should be inserted in between.

6.4 Interface selection pins

Different product versions of the FPC2530, offers a choice of up to four interfaces. In order to select the desired interface, two configuration pins are used. These pins can be hard wired high (3V3) or low (GND) in the final application, when the final interface is selected, assuming only one interface is used.

| INTERFACE | IF_CFG_1 | IF_CFG_2 | COMMENT |
|------------------|----------|----------|--|
| SPI | LOW | LOW | Standard interface, available on FPC2532 |
| UART | HIGH | LOW | Standard interface, available on FPC2532 |
| USB | LOW | HIGH | Optional interface, available on FPC2534 |
| I ² C | HIGH | HIGH | Optional interface, available on FPC2534 |

6.5 Interface pins

The functionality of all interface pins are described in previous section "Interfaces".

Since multiple interfaces are supported, some pins have dual use depending on IF CONFIG selection. This implementation is also described more in the "Module integration guideline" section.

| PIN NAME | DESCRIPTION (SPI/default) | DESCRIPTION (UART mode) | SPI mode | UART mode |
|----------|-----------------------------------|-----------------------------------|----------|-----------|
| IF_CFG_1 | Interface selection, config pin 1 | Interface selection, config pin 1 | LOW | HIGH |
| IF_CFG_2 | Interface selection, config pin 2 | Interface selection, config pin 2 | LOW | LOW |
| IRQ | Interrupt request / Host wakeup | Host wakeup | IRQ | HOST_WU |
| SPI_MOSI | SPI master out, slave in | General purpose IO | MOSI | GPIO_31 |
| SPI_MISO | SPI master in, slave out | General purpose IO | MISO | GPIO_32 |
| SPI_SCK | SPI clock | General purpose IO | SCK | GPIO_33 |
| SPI_CS_N | SPI chip select, active low | System wakeup | CS_N | SYS_WU |
| UART_TX | General purpose IO | Serial interface, transmit | GPIO_21 | TX |
| UART_RX | General purpose IO | Serial interface, receive | GPIO_22 | RX |

6.5.1 SPI_CS_N/SYS_WU termination in UART mode

The SYS_WU in UART mode can be connected in three different ways depending on the application.

- ① Assigning a separate Host IO to control SYS_WO provides full flexibility, including controlling wakeup in DEEP SLEEP mode.
- ② If the DEEP SLEEP feature is used and no Host IO is assigned to SYS_WU, it's recommended to connect SYS_WU directly to UART_RX. This will allow the system to wake up using only the UART_RX signal by sending a break character.
- ③ If DEEP SLEEP is not used and no Host IO is assigned, the SYS_WU pin need to be set high (3V3).

In USB or I²C mode the CS_N/SYS_WU pin can be left not connected (NC) since its internally pulled high.

6.5.2 I²C interface termination

Note that both I²C pins (SDA, SCL) should be properly terminated in I²C mode (pull up resistors). Typical values range from 2-10 kohm depending on application.

Please refer to commonly available I²C termination guidelines for more details.

6.5.3 USB impedance matching

Pay attention to the differential impedance when connecting to the USB pins (DM, PD). The trace lines geometrical properties (connecting wires) have to be considered when tuning for optimal performance.

Please refer to commonly available USB impedance matching guidelines for more details.

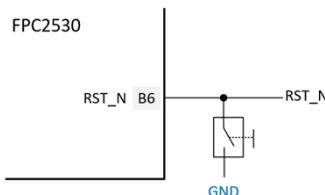
6.6 General purpose I/O pins (GPIO)

Different versions of the FPC2530 incorporates different functionalities on the available GPIO pins (see below). In fact each of the GPIO pins can be configured as output (push-pull or open-drain), as input (with or without pull-up or pull-down) or as peripheral alternate function. Most of the GPIO pins are shared with digital or analog alternate functions. Refer to the applicable feature supplement or section about "Customization" for more details on specific GPIO signals and how they can be customized for different applications.

| GPIO pin | FPC2532 | FPC2534 | COMMENT |
|--------------------|------------------|------------------|-------------------------------|
| 1 to 15 | Configured in SW | Configured in SW | Not available on module level |
| 21, 22, 31, 32, 33 | Configured in SW | Configured in SW | Depend on interface selection |

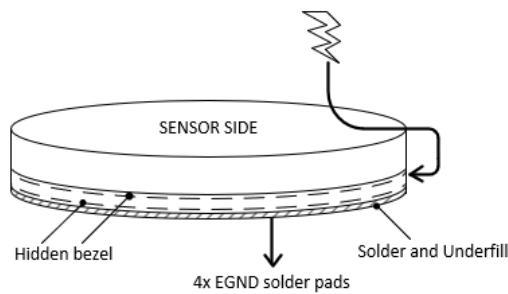
6.7 RST_N

The RST_N pin on the LGA is connected to the MCU reset input which has a built-in pull-up resistor. During different reset stages of the MCU, the MCU will ground this pin for a duration. Use a tristate / open-drain IO to assert it (=‘0’) and let the internal pull up pull it high when de-asserting. If a button is used as the reset source, use a similar approach as seen below.



6.8 ESD protection (EGND)

All LGAs are equipped with a built in ESD drain node, a so-called hidden bezel. Purpose with this feature is to redirect a potential high voltage discharge to the local ESD drain node (EGND). This drain feature works in combination with the durable sensor surface coating, that will safely deflect potential ESD discharges to the hidden bezel structure, and hence providing a robust protection against a surface breakdown.



It is recommended to connect all four EGND pins directly to protective ground for best performance.

6.9 Pins not used

The LGA implements an 8x8 pin matrix pattern, but some locations are not used. Especially B2 is left blank to provide a “pin one” indication for easy orientation of the package back side. This blank pin also coincides with the package notch. Four positions on each side, are left blank to offer space for device marking.

Five pins in the center region with DBG prefix are shown as “do not connect. They are only intended for manufacturing.

6.10 Underfill

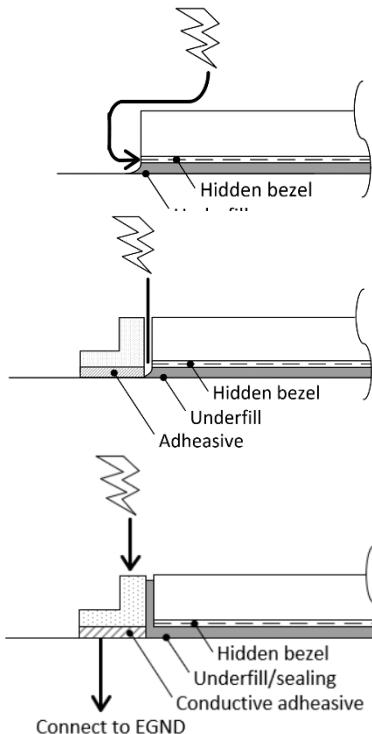
It is recommended to seal the solder joints by means of underfill to improve environmental durability and/or to meet a specific IP classification (water proofing). However, pay attention to not cover the hidden bezel structure embedded in the LGA package. Covering the hidden bezel structure will reduce the tolerance to external ESD discharges.

6.11 Adding a customized bezel

A customized bezel can be added to enhance the visual appearance in the end user application. Regardless, proper access to an ESD discharge node (hidden bezel or EGND) is required to maintain the ESD resistance.

When applying underfill as described above, extra precaution needs to be taken not to cover the hidden bezel pattern on the package sides. Metal bezels should be grounded (EGND), and hence access to the hidden bezel is of less importance. The electrical connection between the bezel and ground level on the receiving board/flex, should ideally be low ohmic, to provide a good ESD discharge node. Higher DC values may also work but it depends on the geometry and existing physical gaps.

When adding a non-conductive bezel or casing in combination with underfill, the same requirement for hidden bezel access applies.

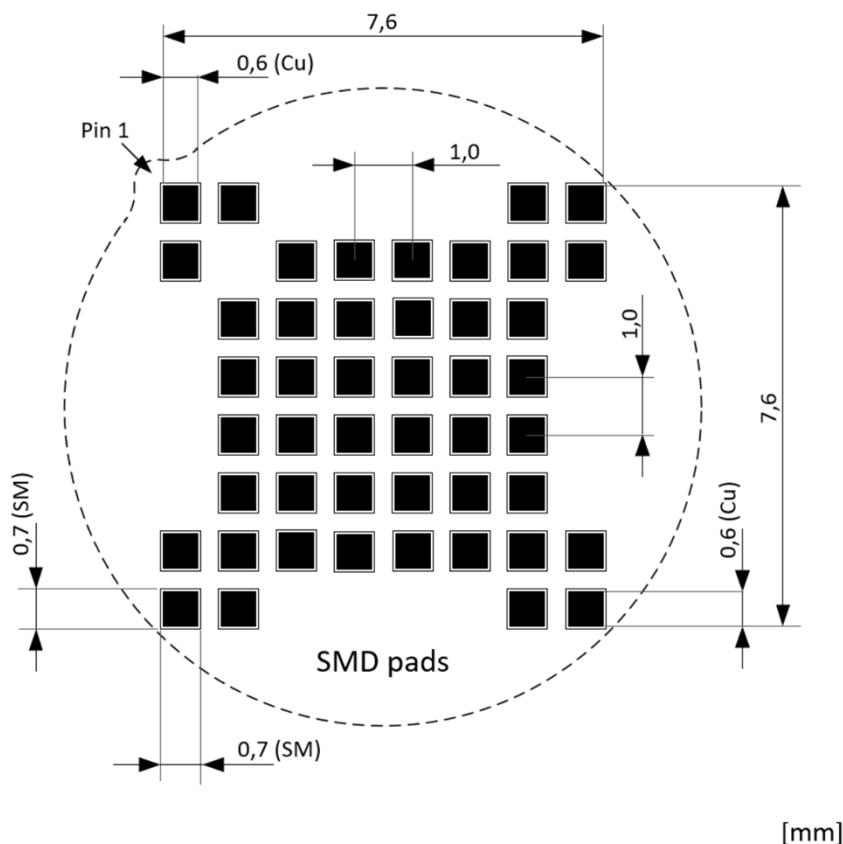


6.12 Recommended solder pattern

The FPC2530 family LGAs are provided with squared 0,6 mm solder-mask-defined (SMD) pads. It is recommended to use a mirrored pad pattern on the receiver PCB as shown below. On FPCs Development boards, 0,6 mm NSMD pads with a 0,7 mm solder mask opening are used (see below), but other designs may be possible. Stencil openings are the same as the exposed Cu.

Solder profile according to JEDEC J-STD-020D.

TOP VIEW (receiver PCB)

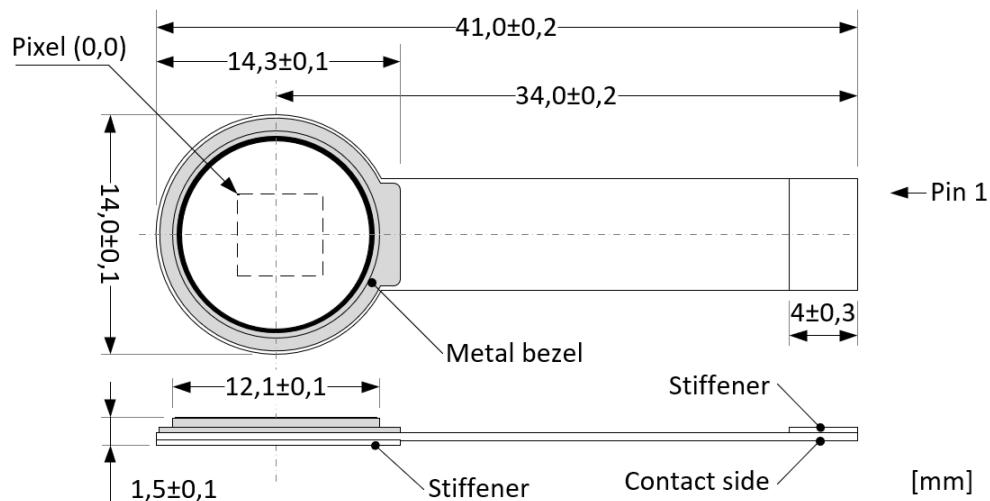


[mm]

7 MODULE INTEGRATION GUIDELINE

7.1 Module outline

The Biometric Systems module has an integrated bezel in stainless steel. The bezel is grounded and operates together with the integrated ESD protection system for optimal performance. On the flex side there is a 12 pin ZIF (zero insertion force) connector pattern. Sensor facing up, connectors facing down. This allows for a low-cost connection to the host system. One recommended connector, used on FPCs development boards, is provided below in the "Mating connector section".



7.2 Pin numbering

| PIN | NAME | DESCRIPTION | CONFIG = low | CONFIG = high |
|-----|----------|-----------------------------|----------------------|------------------------|
| 1 | CONFIG * | Interface select | SPI interface active | UART interface active |
| 2 | TX | UART TX | GPIO_21 | TX |
| 3 | RX | UART RX | GPIO_22 | RX |
| 4 | IRQ | Interrupt request | IRQ | HOST_WU (host wakeup) |
| 5 | MOSI | SPI master out slave in | MOSI | GPIO_31 |
| 6 | MISO | SPI master in slave out | MISO | GPIO_32 |
| 7 | SCK | SPI serial clock | SCK | GPIO_33 |
| 8 | CS_N | SPI chip select, active low | CS_N | SYS_WU (system wakeup) |
| 9 | RST_N | System reset, active low | RST_N | RST_N |
| 10 | 3V3 | Power supply | 3V3 | 3V3 |
| 11 | GND | Internal use | GND | GND |
| 12 | EGND | ESD ground node, bezel | EGND | EGND |

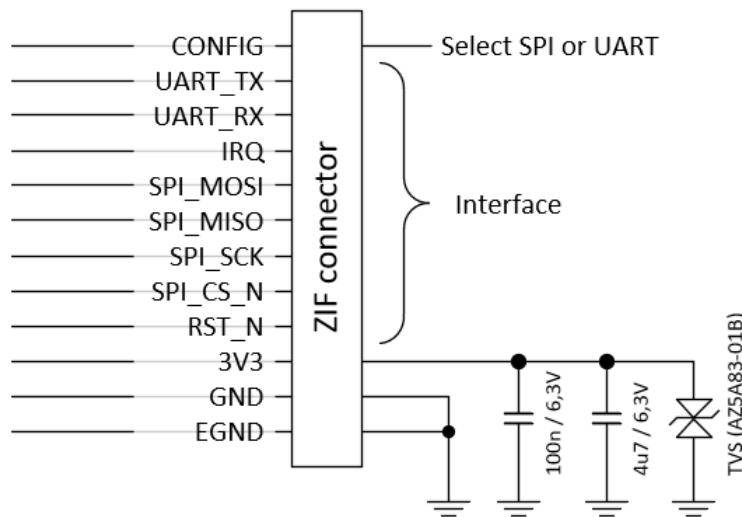
(*) NOTE: CONFIG is identical with IF_CFG_1, and IF_CFG_2 is internally hard wired to limit interfaces to SPI and UART

7.3 Power supply and ground

The flex module use one single power line and one ground connection. The module is further equipped with internal decoupling and hence the need for external decoupling is limited in most applications. If space is limited, additional connections are short (< 30 mm), and power supply can be considered stable, omitting dedicated external decoupling capacitors may be evaluated.

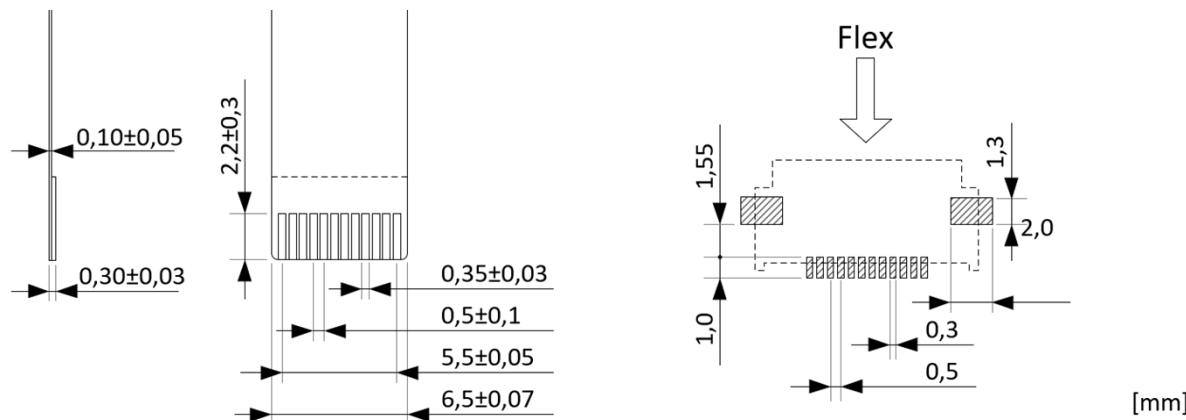
7.4 ESD protection (EGND)

The AllKey flex module is fitted with a conductive external bezel for improved appearance. The bezel is directly connected to the ESD drain node (EGND). The EGND and hidden bezel operation is described more in detail in the “LGA integration guideline” where both the use of underfill, and other things so consider when attaching an external bezel, are described. General reference schematic below.



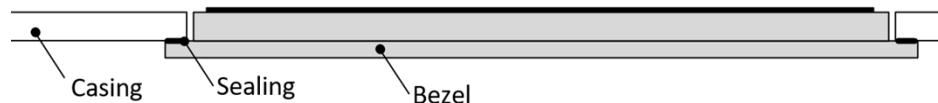
7.5 Mating connector

Several brands of flex connectors will successfully fit with the Biometric Systems module. On FPCs development boards, Molex 505110-1292 is used. Flex dimensions and connector solder pattern for this combination is shown below. Please refer to Molex data sheets for additional information.



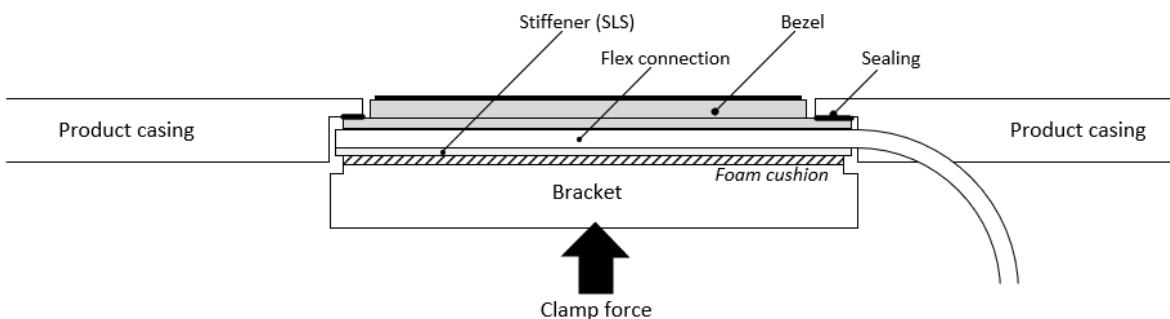
7.6 Water and dust proof

The AllKey module complies with the IP67 standard which means it is water and dust proof, and is not damaged by rain or splashing water. The internal sealing is accomplished by a sealing agent, filling the entire gap between solder joints and around the bezel. In order to create a water and dust proof end user product, the bezel flange needs to be fully sealed towards the product casing/enclosure, e.g. using Tesa 62625 or similar, to make a complete ring all around the bezel. Alternatively a full backside potting can be applied.

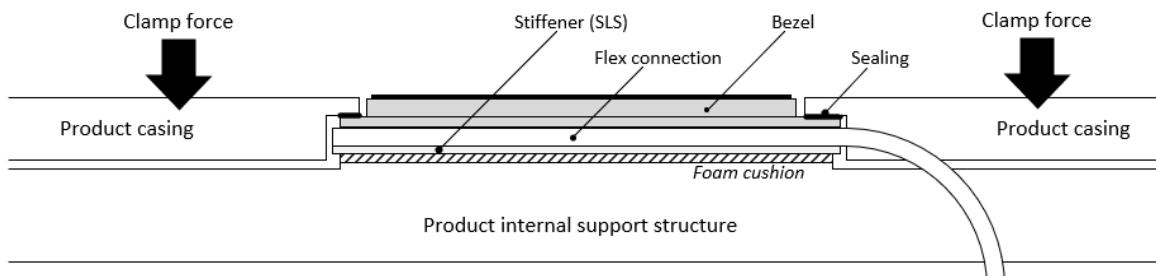


7.7 Mechanical support

It is recommended to provide a mechanical support to the module backside, and not to only rely on the sealing adhesive to keep it in place. A separate support structure will offload any stress generated from fingers pressing down on the sensor surface. Support can for example be provided by adding a separate clamp (plastic/rubber part), pushing the module towards the opening in the casing. This will require a method of fixing the bracket towards the product casing, using screws or fasteners (clips).



Since the module backside consists of a flat stainless-steel stiffener, another option would be to fix the sensor module between the inner mechanical structure, and the outer product casing. This approach will allow the module to be sealed towards the casing and be mechanically supported from the backside. And as above, this will require a method of fixing the product casing towards the internal support structure, using screws or fasteners (clips).



8 USER GUIDELINE

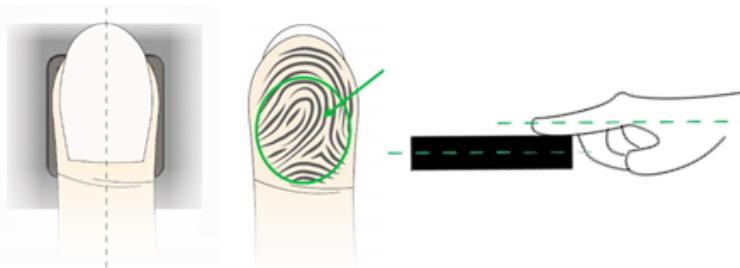
8.1 Introduction

Biometric systems are built to cope with variations in user behavior and different conditions. Understanding the basics of what will impact biometric performance, will help to improve product integration and system design. The coming sections describes the fundamentals of a biometric system. It's strongly recommended to avoid a product integration that impairs users' possibility to interact with the biometric system in an optimal way. Allowing for, or even encouraging correct finger placement, will in the end result in a stable high performing system.

8.2 Finger placement

Below is some general information on how to properly put a finger on a sensor. This behavior can be emphasized in the product design with a user-friendly approach angle, finger guidance, or symbols and signs.

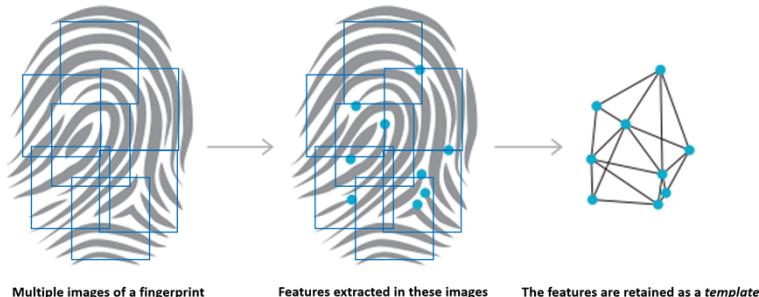
- ⌚ The lower part of the fingertip should be exposed to the sensor
- ⌚ The sensor needs to be fully covered by the finger
- ⌚ Keep the finger straight and fully parallel to the sensor



8.3 Enroll

Before being able to use a fingerprint for verification/identification it needs to be *enrolled*. During enrollment the fingerprint is imaged by the sensor and salient information, i.e. features, are extracted from the image data. This data is stored on the device and is referred to as the *template* corresponding to that fingerprint. As the sensor area is significantly smaller than a fingerprint the enrollment is carried out over multiple touches. Any part of the fingerprint skin not "seen" during enrollment cannot contribute to the matching process so it is important that during the enrollment as large a part of the fingerprint as possible is shown to the sensor, thus the finger should be moved around from touch to touch. Moreover, the design and placement of a device will influence the position of hand and finger and thus what parts of a fingerprint will be more likely to end up on the sensor during usage, this makes it important to carry out the enrolment in the same manner as the device is going to be used. In summary, the enroll process is as follows:

- ⌚ Until the feedback of that the enrollment is completed is received, repeat:
 - ⌚ Touch the sensor as you would when using it (i.e. same placement, direction, grip).
 - ⌚ Lift the finger from the sensor and move it slightly to a new position, but not so much that the sensor surface isn't completely covered.
- ⌚ When all the required touches have been made, the template data representing the fingerprint will be stored and the enrollment is finished.
- ⌚ To enroll additional fingers, restart the enrollment and repeat the process with another finger.



8.4 Verify/Authenticate

When the sensor is used to verify a user, features on the fingerprint presented are compared to features in the stored template. If there are enough similar features, it is considered a match. Once again, user repeatability should be encouraged by the design to maximize biometric performance.

- ⌚ Make sure you use the same finger as when you enrolled
- ⌚ And that preferably the same part of the fingertip is exposed to the sensor.



8.5 Template update

Template updating adapts the template information to better match seasonal variations and/or damages to the enrolled fingertip. Template updating is only activated for strong successful verifications.

Template updating enables:

- ⌚ Increased template information (template growing) to mitigate low initial fingerprint coverage
- ⌚ Increased quality score of already covered parts with successful matching
- ⌚ Adapting template information to variations in user behavior (new grip or approach)
- ⌚ Adapting template information to seasonal variations (e.g. humidity)
- ⌚ Adapting template information to fingertip degradation/improvement (e.g. worn or dry fingertip)

Template update use acquired template information to continuously improve the match score.

8.6 Biometric performance

An estimate on the biometric performance is given in the table below. Values are measured on a reference dataset. Individual performance may vary depending on user mobility, skin conditions, etc.

| PARAMETER | USE CASE | VALUE | COMMENT |
|-------------------------|-----------------------|-----------|--|
| FRR (False Reject Rate) | After Enrollment | < 3.5 % | Normal dataset, measured directly after enrollment |
| | After Template Update | < 1.5 % | Normal dataset, measured after multiple updates |
| | Wet Fingers | < 8.0 % | Dataset with wet fingers, measured against normally enrolled fingers |
| FAR (False Accept Rate) | - | 1 / 100 K | False Accept Rate is given per finger |

8.6.1 Abbreviations

FAR (False Accept Rate): the probability that the system incorrectly matches the input pattern to a non-matching template in the database. It measures the percent of invalid inputs that are incorrectly accepted. In case of similarity scale, if the person is an imposter, but the matching score is higher than the threshold, then he is treated as genuine. This increases the FAR, which thus also depends upon the threshold value. FAR also increases with increased number of enrolled templates. In summary, FAR is a measurement on security.

FRR (False Reject Rate): the probability that the system fails to detect a match between the input pattern and a matching template in the database. It measures the percent of valid inputs that are incorrectly rejected. In summary, FRR is a measurement on convenience or user friendliness.

The errors that are observed in FRR are typically not evenly distributed between the users, most of the users have good biometric performance but few users might have an observed high FRR. The reason for this is that the fingers of the users with high FRR might have features that are hard to capture e.g. from worn fingers, dry skin, or damages

8.7 Navigation

The navigational gesture detection is designed to handle variations in user motion and classifying them accordingly. Just like biometrics, understanding how the system operates helps improve the performance even further.

The detection of gestures is primarily done through how the finger *leaves* the sensor. For example, if the top part of the sensor loses connection to the finger first, it is likely to be detected as a swipe downwards. If the finger is lifted straight from the sensor, it is considered a short press. If it stays on the sensor for longer, it is a long press.

The following guidelines helps achieve the best possible performance:

- ⌚ The sensor should be fully covered by the finger at some point during the gesture.
- ⌚ Keep the finger straight and fully parallel to the sensor.
- ⌚ For presses, lift the finger straight from the sensor.
- ⌚ For swipes, make a clear sweeping motion in the intended direction.
- ⌚ Sweep across the entire sensor, starting at one edge and ending past the opposite edge.

9 PRODUCT STRESS TESTING

9.1 Standard compliance - LGA package

The FPC2530 LGA package is tested according to the JEDEC standard. Below performed tests are listed.

| TEST ITEM | CONDITION | RESULT |
|---------------------------|-------------------------------------|--------|
| Preconditioning (PC) | MSL3 | PASS |
| Temperature cycling (TCT) | -55°C to 125°C, 700x, 2 cycles/hour | PASS |
| Unbiased HAST | 130°C, 85% RH, 96 hours | PASS |
| High temp storage (HTSL) | 150°C, 1000 hours | PASS |
| | | |

9.2 Standard compliance - Flex module

The FPC2530 module is tested according to applicable standards. Below performed tests are listed.

| TEST ITEM | CONDITION | RESULT |
|--------------------------------|---|--------|
| IP67 | SS-EN 60529, IP6X and IPX7 | PASS |
| Thermal shock | 30 cycles (-40°C 2 hours ~85°C 2 hours, 5 min duration at 20°C between), 4 hours at room temperature | PASS |
| High temperature high humidity | T85°C/RH85%/120 hours, 4 hours at room temperature | PASS |
| Low temperature storage | 120 hours, -40°C | PASS |
| Ball drop test | Basic requirement: 18mm stainless steel ball, minimum 5cm height | PASS |
| Static load | 3mm round tip (material SUS), increased load up to 13 kgf, Speed 5mm/min, hold 10sec, repeat 10 times | PASS |
| Flex bending Test | Bending fixture: R=0.8mm, thickness= 1mm, bending 180° for 20 times | PASS |
| ESD contact discharge | IEC61000-4-2, 8 kV | PASS |
| ESD air discharge | IEC61000-4-2, 15 kV | PASS |
| | | |

9.3 Sensor surface properties

The FPC2530 surface coating is tested according to FPC internal test methods. No formal standard applies but the listed test items below have proven to be adequate to guarantee good biometric performance.

| TEST ITEM | DESCRIPTION | RESULT |
|-------------------------|--|--------|
| Coating thickness | Manual thickness measurement before and after coating | PASS |
| Coating adhesion | 1mm cut, 3 times tape, classification: max 2 (ISO 2409) | PASS |
| Coating WCA | Water Contact Angle > 75° | PASS |
| Pencil hardness | ISO 15184-2012 classifications: 4H | PASS |
| UV resistance | Distance between Lamp and Samples: 200mm, test UVB only, Lux value 15W for 72 hours | PASS |
| RCA paper abrasion test | 175g load, 80 times, 17cycles/min | PASS |
| Hot water resistance | 30 min 80°C, wipe dry | PASS |
| Salt spray resistance | Surface continuous sprayed with salt solution, 35°C, 72h 5%±1% Na Cl, PH=6.5~7.2 | PASS |
| Alcohol resistance | 500g load, 250 strokes (40 strokes/min), alcohol input: 1 ml/50 strokes and then perform cross-cutting | PASS |
| Ink resistance | Pen lines on surface T85 °C/RH 85%/60 min, room temperature 60 min, cleaning 15 times, 2 kg load using 99.3% alcohol cloth | PASS |
| Artificial sweat test | SHINYO BUFFER STD SOLUTION pH4, pH7(48 hours), wash with water, wipe dry, 4 hours in room temperature | PASS |
| Cosmetics resistance | Sunblock cream on surface, T85°C/RH85%/24h, wash with water, wipe with cloth | PASS |
| | | |

10 ENVIRONMENTAL COMPLIANCE

10.1 Environmental regulations

The FPC2530 device family all comply with the necessary regulations.

| TEST ITEM | CONDITION | RESULT |
|-------------------|-----------------------------------|--------|
| RoHS EU | Compliant to requirement standard | PASS |
| RoHS China | Compliant to requirement standard | PASS |
| REACH | Compliant to requirement standard | PASS |
| Halogen free | Compliant to requirement standard | PASS |
| ODS | Compliant to requirement standard | PASS |
| POP | Compliant to requirement standard | PASS |
| Conflict minerals | Compliant to requirement standard | PASS |
| | | |

11 CUSTOMIZATION (ON REQUEST)

11.1 Customization project

The FPC2530 can be customized in many ways to fit specific target applications. Both host-controlled systems, as well as stand-alone operation mode without external components can be supported. Depending on the level of customization different MOQ (minimum order quantity), NRE (non-refundable engineering fee) and lead time will apply. Reach out to your FPC sales contact for more information on customization projects.

11.2 Device geometry

FPC2530 is available off-the-shelf in a standard sized LGA. On request other dimensions, colors and/or shapes can be provided.

Available size ranges that can be supported on request:

- ⌚ Round 11,0 to 13,2 mm
- ⌚ Square 9,0 to 13,2 mm
- ⌚ Larger sizes are also possible but with longer lead time

11.3 General purpose IO

The FPC2530 family are equipped with multiple GPIO signals for controlling peripherals or communicating with external host systems. In some product versions the GPIOs have dedicated functionality, in others they are not used. Due to the vast number of interfaces and onboard GPIO possibilities, the FPC2530 device can be customized to fit into numerous target applications.

Example of functionalities that can be supported on request:

- ⌚ Additional SPI busses or UART communication
- ⌚ LED control (RGB/PWM)
- ⌚ External oscillator
- ⌚ ADC and/or DAC
- ⌚ Digital audio
- ⌚ SD memory cards

12 KNOWN LIMITATIONS

12.1 Large templates

| REPORT DATE | IMPACTED ITEM | REFERENCE |
|---|---------------|--|
| 2025-01-12 | Firmware | SW release version 2024.3.0.026 (FPC2532) SW release version 2024.4.0.029 (FPC2534) |
| DESCRIPTION | | |
| ID numbers above 9999 will not work. | | |
| WORK AROUND | | |
| Always select low ID numbers at enrollment, or let the device select automatically. | | |

13 ORDERING INFORMATION

13.1 Device name and Part numbers

| PRODUCT | PART # | DESCRIPTION |
|-----------|-----------|---|
| FPC2532AP | 100026222 | 47 pin LGA, FPC AllKey package (generic laser mark 100026206) |
| FPC2534AP | 100026223 | 47 pin LGA, FPC AllKey Pro package (generic laser mark 100026206) |
| FPC2532AM | 100026207 | 12 pin AllKey flex module including FPC2532AP (UART and SPI, black bezel) |
| FPC2534AM | 100026230 | 12 pin AllKey Pro module including FPC2534AP (UART and SPI, black bezel) |
| | | |

13.2 Production codes

All LGA parts are laser marked on the backside with a unique production code. This code comprises information about part number, production batch and date.

| ITEM | REFERENCE DESIGNATION | LENGTH |
|-----------------------|------------------------------|--------------|
| Part number | NNNNNNNNNN (FPC part number) | 9 characters |
| Supplier batch number | BBBBBB (example S29227) | 6 characters |
| Lot number | C | 1 character |
| Manufacturing year | YY | 2 characters |
| Manufacturing week | WW | 2 characters |

Other devices are labeled with a QR code instead.

| ITEM | REFERENCE DESIGNATION | LENGTH |
|-----------------------|------------------------------|---------------|
| Part number | NNNNNNNNNN (FPC part number) | 9 characters |
| Hardware revision | 1A | 2 characters |
| Supplier batch number | DDDDDDDDDDDD (up to) | 12 characters |
| Manufacturing year | YY | 2 characters |
| Manufacturing week | WW | 2 characters |

Example QR code string: 100026224-1A-DDDDDDDD-2418



13.3 Shipping format

AllKey LGA parts are supplied face up in standard ESD safe JEDEC trays, 144 sensor units per tray. Products are arranged in trays to match standard industry; pin 1 at the tray chamfered corner. 10 trays and one lid are stacked, wrapped, and dry packed in one ESD safe bag, i.e. 1440 parts per full stack/box, all placed in a standard cardboard box (tray box).

AllKey modules are supplied in ESD safe vacuum trays, 60 units per tray, 10 trays per box. Boxes are marked with necessary product information, both text and barcode.

13.4 ESD sensitive device

Although the component provides a rigorous ESD protection when connected in the final application, proper handling shall be ensured during device assembly.

14 REVISION HISTORY

14.1 Product specification (this document)

| REVISION | DESCRIPTION | RELEASE DATE |
|----------|---|--------------|
| 1 | Initial release (draft) to support early engineering samples (ES) | Aug 2024 |
| 2 | Final release (CS) | Nov 2024 |
| 3 | Minor corrections | Nov 2024 |
| 4 | USB standard compliance added (2.0 full-speed compliant) I2C standard compliance added (Fast mode) SYS_WU termination in UART mode, I ² C/USB pin termination added Updated "Enrollment" section of user guidelines Info added on timings for boot, enrollment, identify, and wakeup | Dec 2024 |
| 5 | Module mechanical support section added Product revisions list removed Info on max number of templates (30) added "Known limitations" section added | Feb 2025 |
| 6 | Part numbers for Devkit contents added Additional info on BIST and Version commands added | April 2025 |
| 7 | New logo/domain Clarified current consumption use cases Flex connector removed on updated FingerWing Shield and flex breakout description moved to separate document SPC27462 | Aug 2025 |
| 8 | All development board are moved to separate document SPC27462 Note on what to consider when adding an external metal bezel added SPI Device to Host wave forms updated, info on SPI mode added | Dec 2025 |
| | | |
| | | |
| | | |

15 CONTACT INFORMATION

Fingerprint Cards AB (FPC)

Main office
P.O. Box 2412
SE-403 16, Gothenburg
Sweden

Web site
www.fpc.com

Sales contact information: sales@fpc.com