ELECTRONICS
MICROELECTRONICS
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Understand – Analyse – Design - Evolve

BIOMODULE STA-LIGHT

DATASHEET

XSPC6P008
Revision 1.4

Revision History

Revision	Date	Description
1.0	Nov. 29, 2006	Initial release
1.1	Dec. 06, 2006	Added information about communication protocol.
1.2	Jan. 08, 2007	Added VerifyTemplates function. Template size reduced to 256 bytes.
1.3	Jan. 31, 2007	Corrected block diagram and host connector pin assignments (table 8)
1.4	Jan. 04, 2008	New evaluation board

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Contents

1. Overview

BioModule STA-Light is a stand-alone fingerprint module based on a thermal swipe sensor and a dedicated cryptographic and imaging processor designed by id3 Semiconductors. By incorporating powerful embedded fingerprint recognition algorithm, flash memory and advanced database management capabilities, it offers the best possible performance and security for embedded system applications.

In addition to these features, the miniature sized module has a state-of-the-art low power design making it a perfect match in a wide range of applications from battery operated mobile equipments to network based security systems.

Figure 1 : BioModule with flex and fingerprint sensor

The biometric module is used to perform the following main operations:

Enrollment

1. The motherboard sends a request to the module to start the enrollment.
2. The end-user scans his fingerprint by swiping a finger at least 4 times on the sensor.
3. The module extracts a fingerprint signature reference (reference template) from the 4 images.
4. The motherboard sends a request to store the reference template into Flash memory (providing user ID and finger position) or to export the template and save it to an external device (ex: memory card).

Identification

1. The motherboard sends a request to start the acquisition of a fingerprint.
2. The end-user scans his fingerprint by swiping a finger on the sensor.
3. The BioModule extracts a fingerprint signature (candidate template) from the image.
4. The motherboard sends a request to compare the candidate template against the reference templates stored in Flash memory.
5. The BioModule returns the ID of the best matching user.

Verification

1. The motherboard sends a request to start the acquisition of a fingerprint.
2. The end-user scans his fingerprint by swiping a finger on the sensor.
3. The BioModule extracts a fingerprint signature (candidate template) from the image.
4. The motherboard sends a request to compare the candidate template against a reference template stored in Flash memory (providing user ID and finger position), or against a number of transmitted reference template coming from an external device (ex: memory card).

The BioModule Software Development Kit (SDK) provides all the necessary tools and documentation to add these biometric operations to your products in a reduced development time.

2. Features

- Highly secure architecture for code/data storage and processing
- Biometric operation with id3 Semiconductors Match-On-Board technology
- High speed fingerprint identification
- Data storage for up to 1000 fingerprint templates
- Supports fingerprint data encryption (AES 256 bits), with advanced key management
- Secure template exportation/importation for external database management
- Administrator control with PIN or fingerprints
- Duress finger option
- Direct interfacing with Atmel FingerChip® fingerprint sensor
- Asynchronous serial host interface (TTL, 115200 bauds)
- 4 configurable outputs, including a Wiegand output (26-bit or 34-bit format)
- Operates with a single 3.3V DC supply
- Low power consumption (< 130 mA in scanning mode, < 0.5 µA in shutdown mode)
- Operating temperature range : -10°C to +60°C
- Compact size (33mm x 23mm x 4mm)

3. Biometric Specifications

3.1. FINGERPRINT AUTHENTICATION PERFORMANCE

The device's biometric performances are characterized by the following:

- EER (Equal Error Rate) < 0.5%*
- FRR (False Reject Rate) < 2%* (at FAR equal to 0.001%)
- FAR (False Accept Rate) < 0.001%, can be adjusted
- Enrollment time < 10 seconds (including 4 image captures)
- Verification time (1:1) < 1 second
- Identification time (1:N) < 2 seconds (for 200 templates)
- Template size 256 bytes

*EER and FRR are dependent on databases

3.2. FINGERPRINT SENSOR SPECIFICATIONS

BioModule STA-Light uses a thermal swipe sensor. Its small size enables easy integration into the casing of the final product as opposed to rigid and larger sensors. It also ensures maximum reliability and robustness over time. One need not worry about dirt, shocks, humidity or wide operating temperature ranges as with capacitive area sensors, the FingerChip being more highly protected against these stresses than any other sensor.

- Manufacturer Atmel
- Device name Fingerchip® (AT77C101B-CB02 or AT77C102-CB02)
- Sensor technology Thermal, swiping type
- Sensing area 14.0mm x 0.4mm
- Image resolution 500 dpi
- Image size 300 x 428 pixels
- Gray levels 256
- Image distortion < 1%
- Finger swiping speed From 2 to 20 cm/s
- Operating temperature range -40°C to +85°C
- Hard protective coating (made to withstand over 1 million swipes)
- Fully EMI/RFI and ESD protected sensor interface

4. Block Diagram

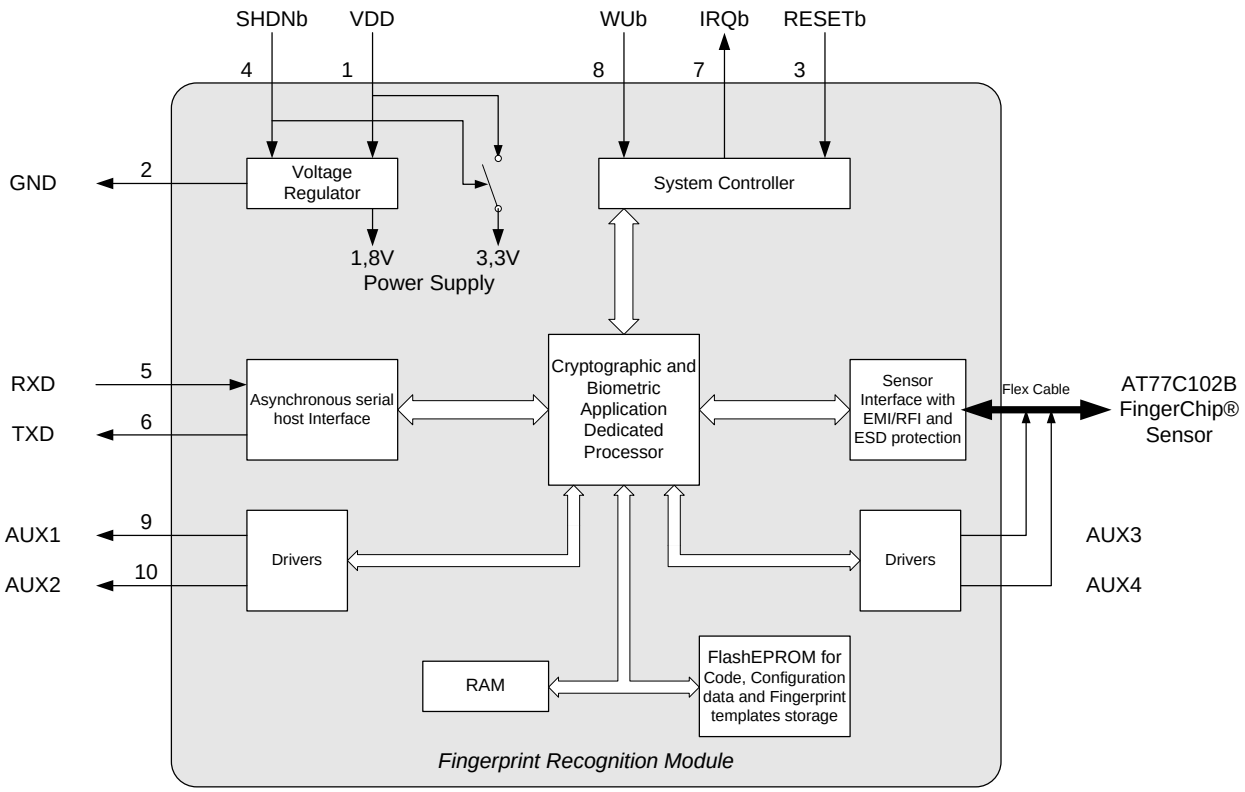

Figure 2 : BioModule STA-Light Block Diagram

5. Electrical Specifications

5.1. Recommended Operating Conditions

Parameter	Test Conditions	Symbol	Min.	Typ	Max	Units
Supply voltage	Operating	V_{DD}	3.0	3.3	3.6	V
High-level input voltage (RXD, RESETb, WUb)		V_{IH}	2		V_{DD} + 0.3	V
Low-level input voltage (RXD, RESETb, WUb, SHDNb)		V_{IL}	-0.3		0.8	V
High-level output current (TXD)	Tested for V_{OH} min	I_{OH}			-2	mA
Low-level output current (TXD)	Tested for V_{OL} max	I_{OL}			2	mA
High-level output current (AUX1, AUX2)	Tested for V_{OH} min	I_{OH}			-4	mA
Low-level output current (AUX1,AUX2,IRQb)	Tested for V_{OL} max	I_{OL}			8	mA
Operating free-air temperature		Ta	-10		+60	°C

Table 1 : Recommended Operating Conditions

5.2. Absolute Maximum Ratings

Stress beyond those listed under Absolute Maximum Rating may cause permanent damage to the device. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability. All voltage values are with respect to GND.

Parameter	Symbol	Min.	Typ	Max	Units
Power supply voltage	V_{DD}	-0.3		4.0	V
Input voltage (RXD, RESETb, WUb)		-0.3		4.5	V
Input voltage range (SHDNb)		-0.5		5.5	V
Output voltage (TXD)		-0.3		4.5	V
Output voltage (IRQb)		-0.5		5.5	V
Output voltage (AUX1, AUX2)		-0.5		5.5	V
Storage temperature		-20		+85	°C

Table 2 : Absolute Maximum Ratings

5.3. ELECTRICAL CHARACTERISTICS

(Over recommended free-air temperature range)

Parameter	Test Conditions	Symbol	Min.	Typ*	Max	Units
Power consumption on VDD	Image acquisition with sensor heating	I_{DD1}		130	180	mA
Power consumption on VDD	Image acquisition with sensor not heating	I_{DD2}		70	90	mA
Power consumption on VDD	Executing command	I_{DD3}		50	70	mA
Power consumption on VDD	Waiting for command	I_{DD4}		35	40	mA
Power consumption on VDD	Standby mode	I_{DDstby}		5	7	mA
Power consumption on VDD	Shutdown mode[1]	I_{DDshdn}		<0.5	2	µA
Input current (RXD, WUb)	GND < V_I < V_{DD}	I_I	-5		5	µA
Input current (RESETb)	GND < V_I < V_{DD}	I_I	-7		7	µA
Pull up current (IRQb)	Open drain IRQb disabled	I_{PU}	-30		-150	µA
High-level output voltage (TXD)	I_{OH} = -2mA	V_{OH}	2.4			V
Low-level output voltage (TXD)	I_{OL} = 2mA	V_{OL}			0.4	V
High-level output voltage (AUX1, AUX2)	I_{OH} = -4mA	V_{OH}	2.4			V
Low-level output voltage (AUX1,AUX2,IRQb)	I_{OL} = 8mA	V_{OL}			0.4	V
Input capacitance (RXD, WUb)		C_I		5		pF
Input capacitance (RESETb)		C_I		20		pF
Output capacitance (TXD)		C_O		5		pF
Output capacitance (IRQb)		C_O		8		pF

Table 3 : Electrical Characteristics

*All typical value are at Ta = 25°C and VDD = +3,3V unless otherwise noted.

[1] Care should be taken to place all device signals at GND level to prevent current flowing through pins.

5.4. RESET TIMING REQUIREMENTS

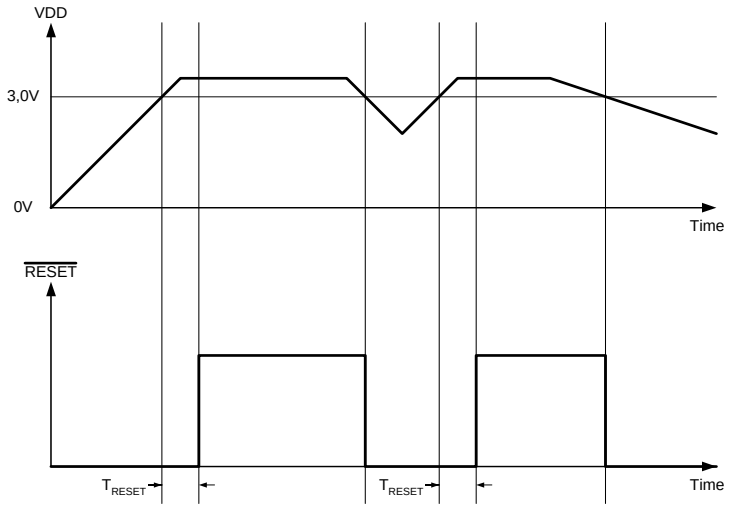

Figure 3 : RESET timing requirements

Parameter	Symbol	Min.	Typ	Max	Units
RESET pulse width	T_{RESET}	40			ms

Table 4 : RESET timing requirement

5.5. SHUTDOWN TIMING REQUIREMENTS

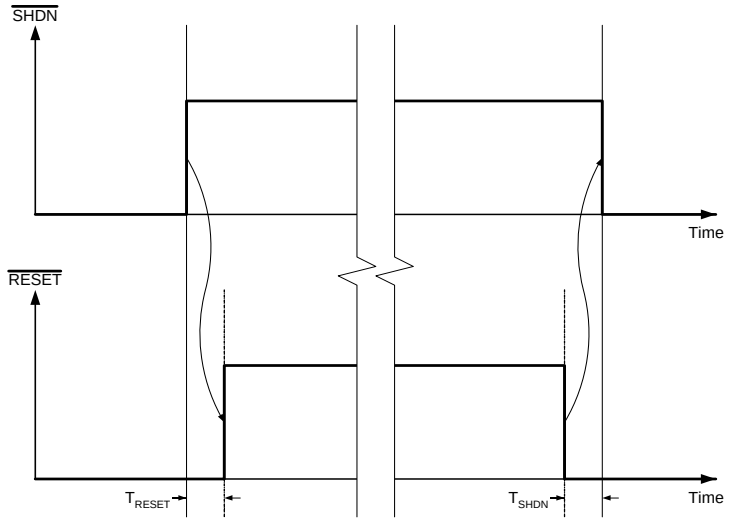

Figure 4 : Shutdown timing requirement

Parameter	Symbol	Min.	Typ	Max	Units
RESET pulse width after SHDN rising edge	T_{RESET}	40			ms
RESET assertion before SHDN falling edge	T_{SHDN}	0			ns

Table 5 : Shutdown timing requirement

5.6. MODULE STANDBY

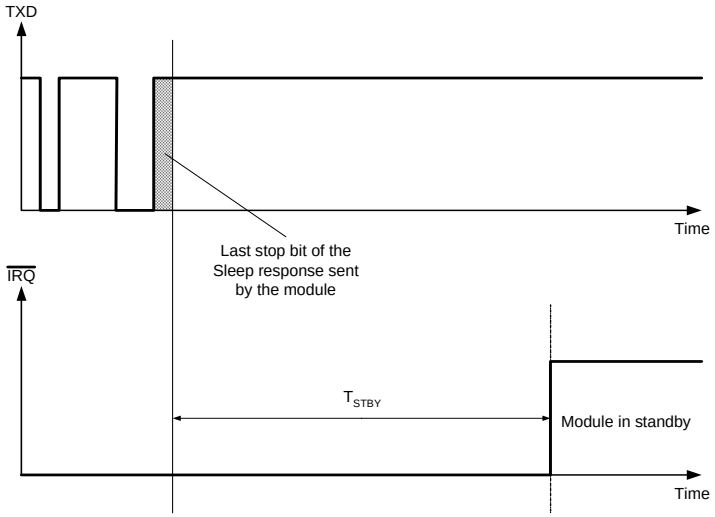

Figure 5 : Placing module in standby mode

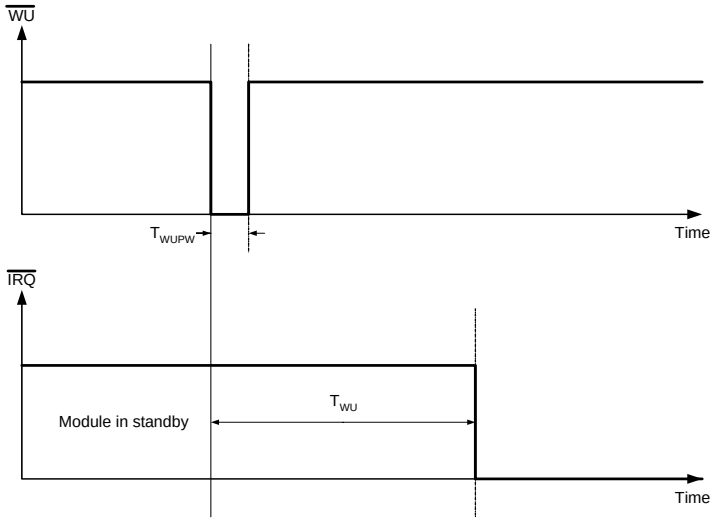

Figure 6 : Resuming operation from standby mode

Parameter	Symbol	Min.	Typ	Max	Units
Module in standby mode from response to Sleep command	T_{STBY}		10	15	ms
WU pulse width	T_{WUPW}	100			ns
Module wake up time from WU falling edge	T_{WU}		400	450	µs

Table 6 : Wake up timing requirement.

5.7. MODULE BOOT SEQUENCE

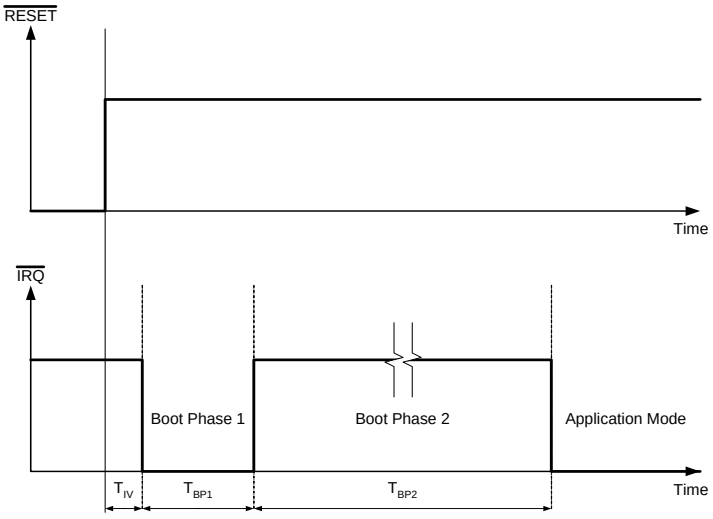

Figure 7 : Module boot sequence

Parameter	Symbol	Min.	Typ	Max	Units
IRQ valid from RESET rising edge	T_{IV}	0	32	40	µs
Module Boot Phase 1	T_{BP1}	0	500	1000	ms
Module Boot Phase 2*	T_{BP2}		3	5	s

Table 7 : Module boot sequence

* Phase 2 may be drastically reduced by issuing a RUN command during this phase. RUN command can be issued immediately after phase 2 rising edge and will force the module to enter application mode immediately.

6. Mechanical Data

6.1. HOST CONNECTOR PIN ASSIGNMENTS

Pin Number	Pin Name	Type	Description
1	VDD	Power	Power supply
2	GND	Power	Ground reference level
3	RESETb	Input	Device reset input
4	SHDNb	Input	Device shutdown
5	RXD	Input	Asynchronous data receive input
6	TXD	Output	Asynchronous data transmit output
7	IRQb	Output	Interrupt request open drain output
8	WUb	Input	Device wake up input (from standby mode)
9	AUX1	Output	Auxiliary 1 output
10	AUX2	Output	Auxiliary 2 output

Table 8 : Host Connector Pin Assignments

6.2. SENSOR CONNECTOR PIN ASSIGNMENTS

Pin Number	Pin Name	Type	Description
1	FPL	Power	Must be tie to GND
2	**AUX3**	**Output**	**Auxiliary 3 output**
3	**AUX4**	**Output**	**Auxiliary 4 output**
4	DE3	Input	Even pixel bit 3 digital output
5	DO3	Input	Odd pixel bit 3 digital output
6	DE2	Input	Even pixel bit 2 digital output
7	DO2	Input	Odd pixel bit 2 digital output
8	DE1	Input	Even pixel bit 1 digital output
9	DO1	Input	Odd pixel bit 1 digital output
10	DE0	Input	Even pixel bit 0 digital output
11	DO0	Input	Odd pixel bit 0 digital output
12	AVE	Input	Even pixel analog output
13	AV0	Input	Odd pixel analog output
14	TPP	Power	Heat resistor power supply
15	TPE	Output	Heat enable input
16	VCC	Power	Power supply
17	GND	Power	Ground

Pin Number	Pin Name	Type	Description
18	RST	Output	RESET input
19	PCLK	Output	Pixel clock input
20	OEb	Output	Digital output enable
21	ACKb	Input	Acknowledge output

Table 9 : Sensor Connector Pin Assignments

6.3. RECOMMENDED PCB LAYOUT

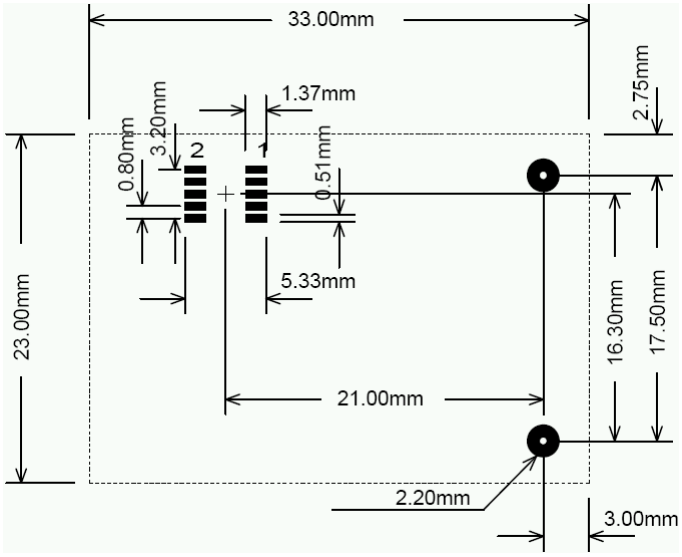

Figure 8 : Recommended PCB Layout

6.4. BOARD TO BOARD MOUNTING

The module features a 10 pins double row 0.8mm pitch male connector from SAMTEC (FTE-105-01-G-DV-A). The host board should feature the following recommended female connector SAMTEC CLE-105-01-G-DV.

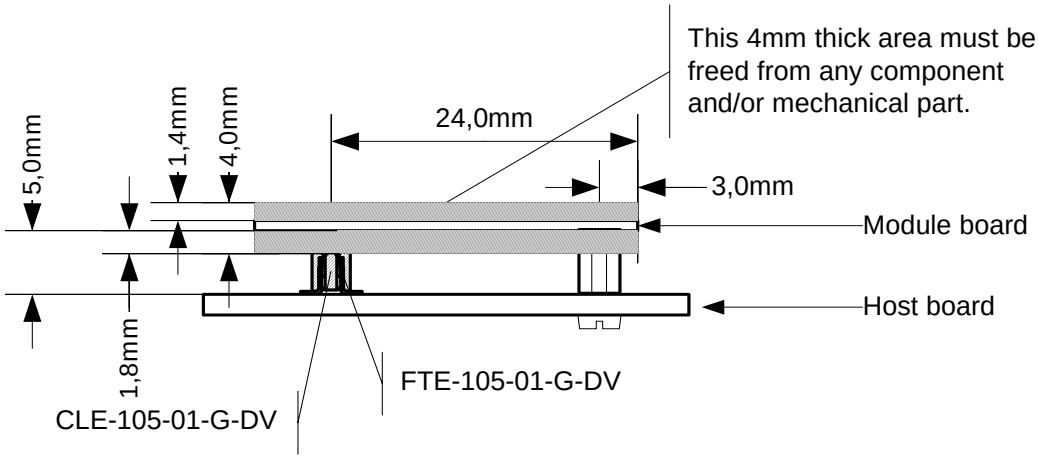

Figure 9 : Board to board mounting

From high density integration, the height of the components under the module is 1,8mm maximum (with the exception of the FTE connector). As the stacking height between the module board and the host board is 5mm high, the host board can have up to 3mm high components placed under the module.

The above figure shows an example of module fixing on a host board. The module board is tight to the host board using two M2 x 5 metallic spacers (SKIFFY PN 301 1050 400 50) and four standard screws M2 x 3. To achieve the best performance of ESD protections and EMI/RFI shielding, designer should take care to provide, on the host board, a fast electrical path to ground using **only metallic spacers**.

6.5. PACKAGE MECHANICAL DATA

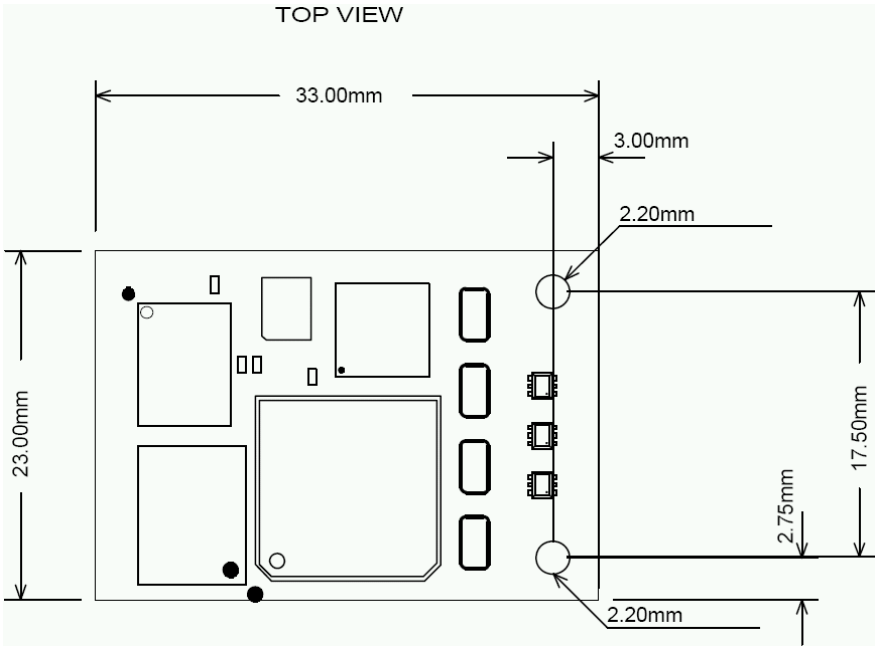

Figure 10 : Package mechanical data (Top View)

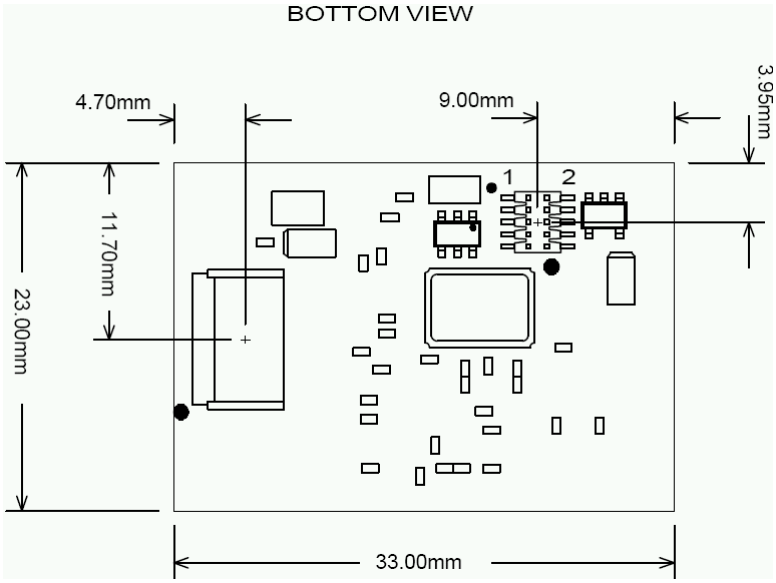

Figure 11 : Package mechanical data (Bottom View)

Dimension	Millimiters
Module width	23 mm
Module length	33 mm
Top Side Components Maximum Height	1.4 mm
Bottom Side Components Maximum Height (Exception for the host connector)	1.8 mm

Table 10 : Mechanical specifications

6.6. FINGERPRINT SENSOR

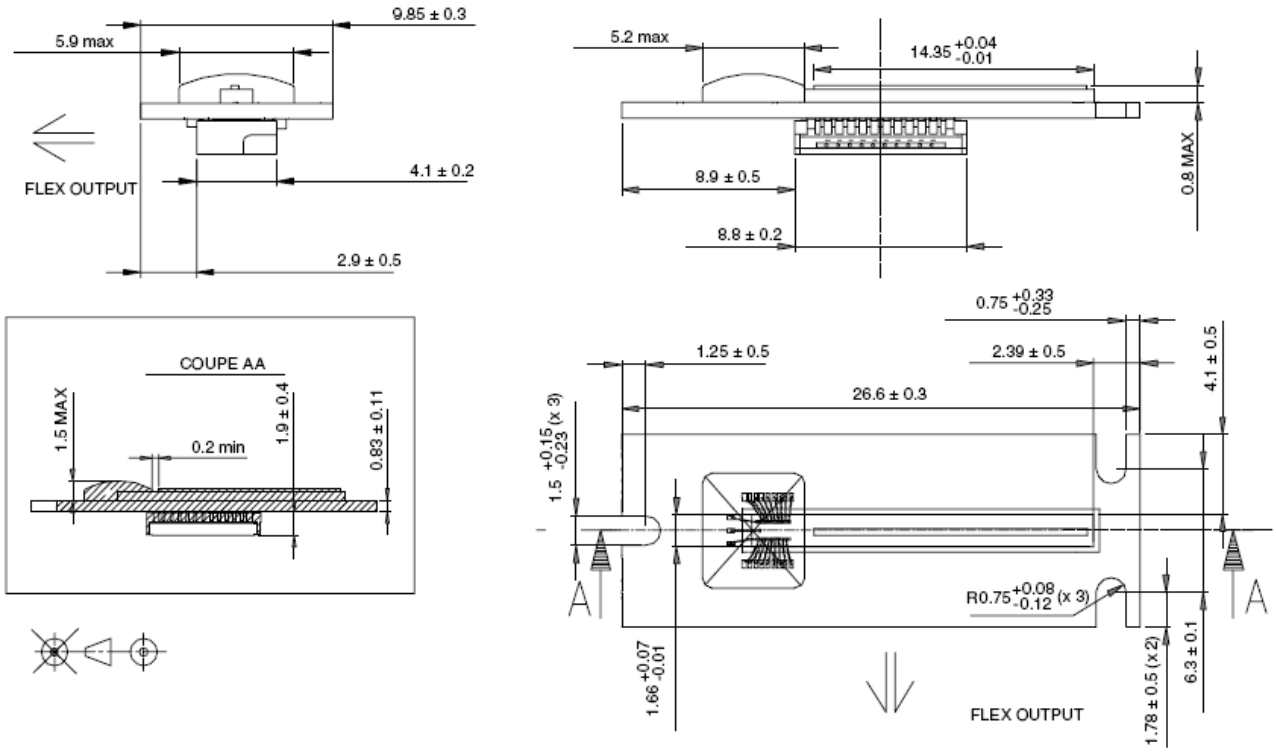

Figure 12 : Fingerprint sensor mechanical data (AT77C102B-CB02)

7. Application Information

7.1. TYPICAL ARCHITECTURE

The BioModule STA-Light may be connected to a motherboard for power supplies and interface connections.

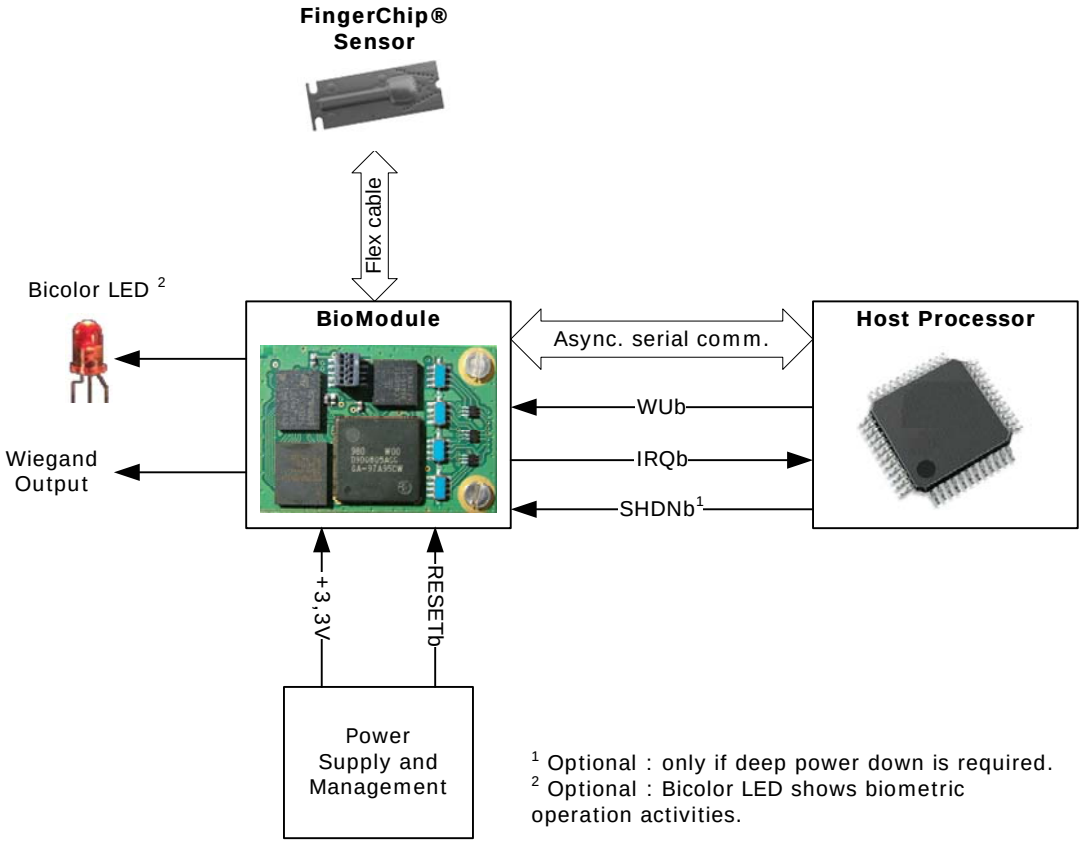

Figure 13 : Typical architecture

7.2. TYPICAL CONNECTION

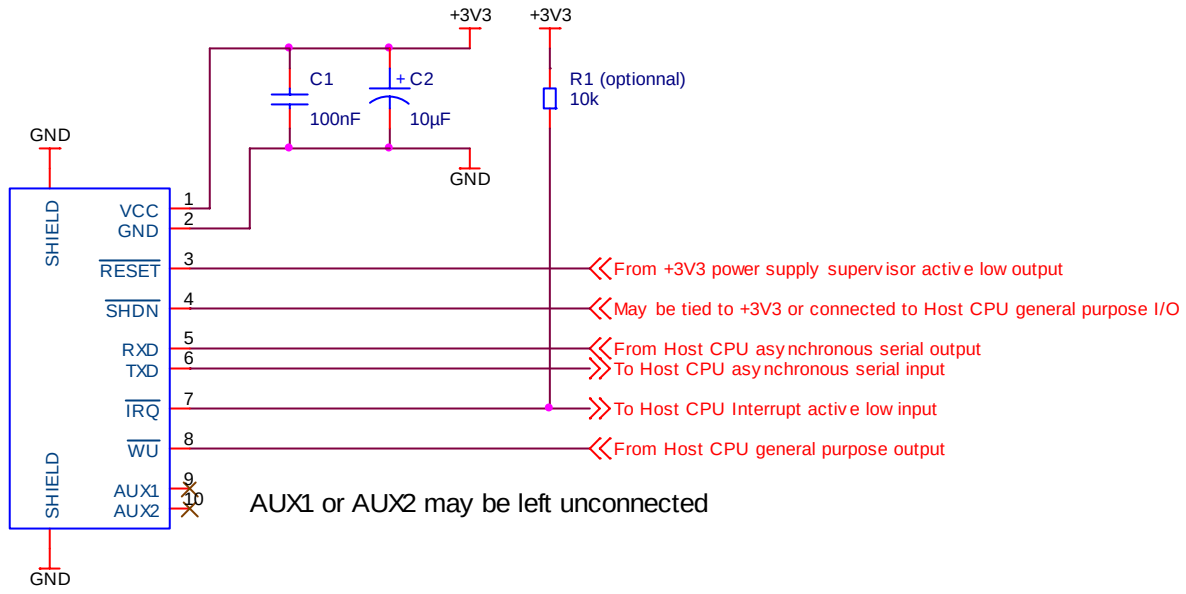

Figure 14 : Typical connection

Power Supply

Module power supply must be carefully decoupled using two capacitors. Recommended decoupling solution is a 100nF ceramic X7R type capacitor in parallel with a 10µF tantalum type capacitor placed as close as possible from the VCC pin of the module. See ***Table 4 : RESET timing requirement***.

Active Low Shutdown input

Shutdown input allows host CPU to completely shutdown the module achieving the lowest module consumption. Putting this pin to low level removes power from internal module components. Therefore, designer must ensure that all others pins (RESET, RXD, TXD, IRQ, WU, AUX1, AUX2, AUX3 and AUX4) are also placed to low level to prevent current flowing through unpowered components. See ***Table 5 : Shutdown timing requirement***.

Shield

The two holes provide also an electrical path to ground used to improve EMI/RFI shielding and ESD protection of the sensor. Designer must ensure the shortest path to ground using metal spacers to mount the module on the host board.

Active Low Reset input

Reset input is used to generate a global module reset. Designer must ensure that module is kept in RESET state whenever power supply voltage is out of specification. See ***Table 4 : RESET timing requirement***.

Active Low Wake Up input

Wake Up input is used to get the module out of standby mode. The module is placed in standby mode by a command from host and is woken up by a low pulse on this pin. See ***Table 6 : Wake up timing requirement***.

Active Low Interrupt output

Interrupt output is used by the module to trigger an interrupt request on the host CPU upon a software dependent event. The host CPU acknowledges the interrupt (the IRQ pin goes back to high level) by sending a command to the module. This pin is open drain and required a pull up. The module features a weak pull up of 47kOhms typical. Therefore, resistor R1 is optional and required only if a stronger pull up resistor is mandatory.

Auxiliary outputs

Depending on module configuration, AUX1, AUX2, AUX3 and AUX4 may be independently configured as open drain output or push/pull output. They may be used for:

- Driving a bicolor LED for biometric activity.
- WIEGAND DATA0/DATA1 or DATA/CLOCK output.

8. Evaluation and Development Kits

8.1. OVERVIEW

Evaluation Kit Contents

This kit is designed to evaluate the BioModule STA-Light stand-alone module. It includes :

- 1 BioModule STA-Light with fingerprint sensor
- 1 evaluation board with mounted BioModule.
- 1 USB cable
- 1 CDROM containing technical documentations and demonstration software for Windows 2000, XP

Development Kit Contents

The BioModule Software Development Kit is designed to minimize development time and costs. It is used to ease the integration of biometric functionalities into an embedded target.

This kit includes:

- 1 BioModule STA-Light with fingerprint sensor
- 1 evaluation board with a mounted BioModule.
- 1 USB cable
- 1 CDROM containing technical documentations, demonstration software for Windows 2000, XP, source codes and examples

BioModule Evaluation Board

This mother board is used for immediate evaluation of the BioModule capabilities.

It features:

- External power supplies possibilities.
- USB bus powered.
- Driver for Windows 2000, XP (The board is seen as a virtual COM port).
- Ergonomical FingerChip case designed for optimal fingerprint acquisition.
- All signals available on test port.
- External connector allowing driving board from an external host-processor.
- Wiegand outputs.
- Relays outputs.

8.2. SOFTWARE DEVELOPMENT KIT

8.2.1. Overview

The BioModule STA-Light provides a proprietary communication protocol (ID3NET) for easy interface with most host systems thanks to an asynchronous serial host interface.

- Host communication Asynchronous serial host interface
- Baud rates 115.2 kbps (optionally 38400 bauds)
- Communication protocol Proprietary (ID3NET)

The Software Development Kit provides all the necessary tools and documentation to implement this communication protocol into an embedded application.

Please refer to *BioModule STA-Light SDK Manual* for detailed information.

8.2.2. Communication Protocol Software Stack

ID3NET protocol stack is organized in software modules for which are provided a header file (.h) and a source file (.c). Source code is written to comply with strict ANSI C.

- Code size < 4700 bytes (based on a x86 implementation)
- Data size < 140 bytes

Please refer to *BioModule Communication Protocol Software Stack Reference Guide* for detailed information.

8.2.3. Command API

The whole implementation of the commands is also provided with complete source code (ANSI C).

- Code size < 5000 bytes (depending the number of functions used)

The following tables show a summary of the API (Application Programming Interface).

Biometric API

Function	Description
id3BM_EnrollByScan	Starts the acquisition of a minimum of 4 fingerprint images and generates a reference template from these images.
id3BM_ExtractTemplateByScan	Starts the acquisition of a fingerprint image and generates a template from this image.
id3BM_GetImage	Starts the acquisition of a fingerprint and returns the pixels of the image.
id3BM_GetSwipeData	Returns information data about the last finger scan.
id3BM_IdentifyUser	Compares the latest fingerrprint template created (or imported) against the whole reference templates contained in the user database.
id3BM_VerifyTemplates	Verifies if one of the transmitted templates matches the latest fingerprint template created (or imported).
id3BM_VerifyUser	Compares the latest fingerprint template created (or imported) against the fingerprints of a specified user stored in the database.

Database Management API

Function	Description
id3BM_ClearDatabase	Deletes all entries from user database.
id3BM_GetTemplateCount	Retrieves the total number of fingerprint templates registered in the module database.

Function	Description
id3BM_GetTemplateList	Returns the list of template IDs registered in the database.
id3BM_RemoveTemplate	Removes a fingerprint template associated with a user registered under specified user ID in the database.
id3BM_RemoveUser	Removes a user registered under specified user ID from the database.
id3BM_StoreTemplate	Stores the latest fingerprint template created (or imported) in the module database.
id3BM_UpdateTemplateAttributes	Updates the attributes of a specified fingerprint template.

Import / Export API

Function	Description
id3BM_ExportDatabase	Exports the full fingerprint database.
id3BM_ExportTemplate	Exports the latest fingerprint template created.
id3BM_ExportTemplateFromDB	Exports a single fingerprint template from the module database.
id3BM_ImportDatabase	Imports a fingerprint database.
id3BM_ImportTemplate	Imports a single fingerprint template into the module.
id3BM_ImportTemplateToDB	Imports and stores a fingerprint template into the module database.

Administrator Control API

Function	Description
id3BM_AdminChangePIN	Changes the administrator PIN.
id3BM_AdminGetStatus	Checks the status of the administrator's credentials.
id3BM_AdminIdentify	Compares the latest fingerprint template created (or imported) against the whole administrator templates contained in the database.
id3BM_AdminResetVerificationFlag	Resets the administrator verification flag.
id3BM_AdminVerifyPIN	Verifies the administrator PIN.

Parameters API

Function	Description
id3BM_ChangeParameters	Changes a parameter set.
id3BM_GetParameters	Returns the specified parameter set.
id3BM_RestoreDefaultParameters	Restores the default module parameters.
id3BM_SaveParameters	Saves current module parameters into persistent storage area.
id3BM_UpdateKeys	Updates the first component used for the generation of the *MAC Key* and the *Template Encryption Key*.

9. Ordering Information

9.1. REFERENCES

Item	Reference
BioModule STA-Light Evaluation Kit	086U3670
BioModule STA-Light Software Development Kit	086U3650
BioModule STA-Light	086U3680
50mm flex cable and AT77C102B-CB02 sensor	086U3960
50mm flex cable and AT77C102B-CB02 sensor with top case	085K3340

For any further information, please contact contact@id3.eu.

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