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## **Aimgene BioFlex IV**

### **Fingerprint Recognition Embedded System**

**Version 1.03**

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## **Release Note 2005/09/02**

### **I. Firmware v1.12 2005/08/31**

- A) Add a new command “F” to change UART baud rate and control LED on/off.
- B) fix the bug :command “DEL” not work if “E” in the upper case.

### **II. Documents**

- A) Newest release version: V1.03
- B) Update:
  - 1. Add a new command “F “to change UART baud rate and control LED on/off.
  - 2 .fix the bug: command “DEL” not work if “E” in the upper case.

### **III. Tools**

- A) Testing tool version for newest module: 1.0.0.3.  
Support 115200/57600/19200/9600 bps communication speed.
- B) Release: Firmware update tool V1.0.02 with new firmware v1.12  
Support 115200/57600/19200/9600 bps communication speed.

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**Release Note 2005/08/15****IV. Firmware**

- A) 1. Add a new command “ J ” to upload a condensed fingerprint image(52\*48 pixel)
- B) 2. Change “D” command to “DEL” command.

**V. Documents**

- A) Newest release version: V1.02
- B) Update:
  - 1. Add a new command “ J “
  - 2. Change “D” command to “DEL” command

**VI. Tools**

- A) Testing tool version for newest module: 940815.
- B) Release: Firmware update tool with new firmware v1.11

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**Release Note 2005/07/16****VII. Firmware**

A) Newest release version: V1.10

B) Update:

1. Enhance reliability
2. T commend instead of U and ignore U commend

**VIII. Documents**

A) Newest release version: V1.01

B) Update:

1. T commend instead of U and ignore U commend
2. Modify uP communication schematic " add start" on page 14.
3. Add 2.1.0 firmware upgrade and 2.2.0 how to use testing tools.

**IX. Tools**

A) Testing tool version for newest module: 940713 V3.

B) Release: Firmware update tool with new firmware v1.10

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The BioFlex IV is an embedded system solution for doing biometric fingerprint verification / identification. The system consists of the powerful processor and a capacitive fingerprint sensor. The BioFlex IV executes the algorithm for doing fingerprint verification / identification, communication with host, and also interfaces to fingerprint sensor. Fingerprint templates can be stored in 999 memory slots in flash memory and non-volatile after power off. It is possible to upload/download template via serial communication for external storage. User can change the security level for different application.

■ **Features :**    **MODEL NO: BFS-4A**

1. Compact size, embedded system design principle.
2. Easy integrate biometric security function into any product.
3. High C/P value, provide 1:1, 1:N fingerprint matching.
4. Semiconductor chip sensor, anti-stain, 3-D image capture.
5. Standalone system, low power consumption.



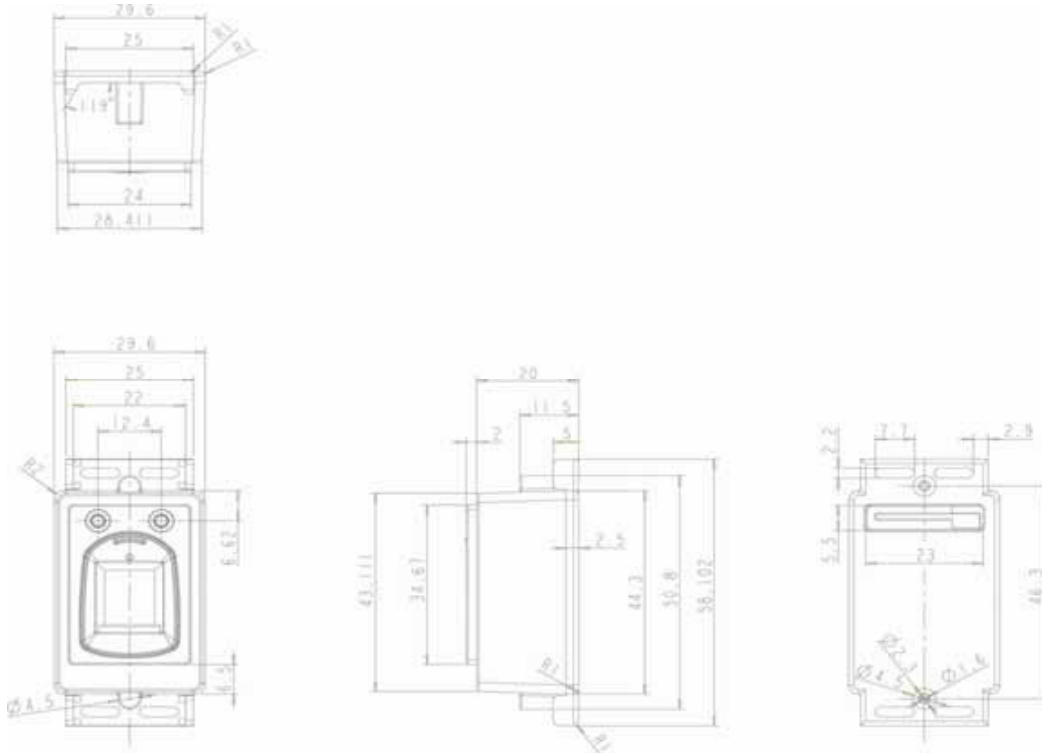
■ **Application :**

1. Electronics Commerce \ ATM / E-bank system access control.
2. Personal handheld device security, personal preference.
3. Equipment Rack, Gun Box, Safe Box, Door Lock...etc.
4. Time Attendance, Access control system. Vehicle security control
5. Integrate with Contact / Contactless Smart card system.
6. MIS / ERP security.

**Specification: Aimgene BioFlex IV Model No: BFS-4A**

Fingerprints Store Capacity	1:1 / 1:N Mode - 999 / 99 fingerprints
Sensor	Semiconductor
Hardware Interface	RS-232 (TTL), SIO
Fingerprint Sensor Resolution	508 DPI
Sensor Chip Size	12.8 mm X 10 mm
Sensor Area	11.8 mm x 9.6 mm
Pixels Numbers	236 x 192 Pixels
Gray Level	256 levels (8 bits/pixel)
Minutia Size	512 bytes
False Rejection Rate	1/100
False Acceptance Rate	1/1,000,000
Allowable Rotation	± 15°
ESD	18-20 KV Air Contact mode
Scanning / Matching Speed	0.2 Second / 0.1 Second
Recognition Response time 1:1	Max : < 2 Second
Module Dimension	20(D) X58 (H) X30 (W) mm
Weight	Under 300g
Sensor Temperature	-40°C~70°C
Allowable Voltage	5V DC
Power consumption (Wattage)	Idle: 165 mA, Capture: 250 mA, Enrollment: 280 mA, Sleep mode: 50 mA
MMI	2 DUO-LED'S red/green/orange

## ■ Dimension: Aimgene BioFlex IV Model No: BFS-4A



## ■ Pin assignment & Protocols:

Communication speed: 115200 bps

Format: 8 data bits, no parity, one stop bit, flow control set to NONE.

JP1 connector pin assignment:

Pin No.	Pin Name	Type	Definition	Wire Cable Color
1	VIN	PWR	Power supply, 5V	Red
2	RXD	IN	Asynchronous communication interface receiver data, TTL level 3.3V	Black
3	TXD	OUT	Asynchronous communication interface receiver data, TTL level 3.3V	Black
4	GND	GND	Ground for power and signals	Black
5	START#	Out	Indicate finger is press, indication from module to host, external pull up resistor is recommended	Black

## ■ Overviews of Commands :

Command	Description
A	Device version identification
B	Upload fingerprint raw image to host
C	Capture fingerprint
DEL	Delete all templates in flash memory slot
E	Capture and enroll into flash memory slot (ID)
I	Identify against in flash memory slot 001 to 099
K	Write RAM data to flash memory slot location (ID)
L1 to L9	Security level setup
M	Download template to RAM
O	Verify against in flash memory slot in location (ID)
R	Capture and enroll template into RAM
S	Upload the enrollment table to host
T	Upload the template from flash memory slot (ID)to host
V	Verify against in RAM
X	Delete template (ID) in flash memory slot
Y	Delete template in RAM
0001 to 0999	Change template identity ID
J	Upload a condensed fingerprint raw image to host
F	Change UART baud rate and control LED on/off

### 1.1 Command description

Commands sent to the BioFlex IV system can be in either lower or upper case. BioFlex IV responds to all commands with a text string followed by carriage return <CR> and line feed <LF> (see below).

Commands C,R returns a response message in the following format in which the sb and rb value varies depending on the result (note. In the tables below the symbol \* means “don't care”):

Start mb : sb <CR> <LF>

Result mb : rb <CR> <LF>



<b>1.1.1</b>	<b>Command</b>	<b>A</b>	<b>Device identification</b>
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Show device identification and software version. This command is suitable for communication start-up test.

Response:

Aimgene Co., Ltd , BioFlex IV, v1.01,VIP100 ,@400Mhz,D-date 2005.05.16r  
<CR> <LF>

<b>1.1.2</b>	<b>Command</b>	<b>C</b>	<b>Capture fingerprint</b>
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Capture fingerprint from the sensor and store in RAM.

Read Sensor	Sb	rb	Response example
TRUE	00	*	Start mb : 00 <CR> <LF> Result mb : 08 <CR> <LF>
FALSE	>00	*	Start mb : 02 <CR> <LF> Result mb : 09 <CR> <LF>

Left orange LED is flashing while capturing fingerprint image.

<b>1.1.3</b>	<b>Command</b>	<b>R</b>	<b>Enroll fingerprint into RAM</b>
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Capture fingerprint and enroll fingerprint into RAM. It will take approx 2 seconds.

Enrolment OK ?	sb	Rb	Response example
SUCCESS	00	10	Start mb : 00 <CR> <LF> Result mb : 10 <CR> <LF>
FAIL	>00	00	Start mb : 0F <CR> <LF> Result mb : 00 <CR> <LF>

Left orange LED will be flashing while capturing fingerprint image.

<b>1.1.4</b>	<b>Command</b>	<b>V</b>	<b>Verify with the RAM</b>
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Verify the fingerprint against the template that stored in RAM.

Verification OK ?	sb	Rb	Response example
SUCCESS	00	10	Start mb : 00 <CR> <LF> Result mb : 10 <CR> <LF>
FAIL	OF	*	Start mb : OF <CR> <LF> Result mb : 00 <CR> <LF>

Left orange LED will be flashing while capturing fingerprint image.

If verification success, left green LED will be flashing, otherwise showing red light.

<b>1.1.5</b>	<b>Command</b>	<b>Y</b>	<b>Delete template in RAM</b>
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Erase the template from RAM.

Response :

<CR> <LF>

<b>1.1.6</b>	<b>Command</b>	<b>0001 to 0999</b>	<b>Change template storage number &lt;ID&gt;</b>
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Number specified a template storage slot in flash, it must be sent before command E and X. Templates stored on 0001 to 0099 will identify in 1:N command “ I ”.

Response :

id=<ID>

<CR> <LF>

for example:

id=011<CR> <LF>

<b>1.1.7</b>	<b>Command</b>	<b>E</b>	<b>Capture and Enroll fingerprint into flash</b>
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Capture fingerprint and enroll fingerprint into flash memory where at the storage slot defined by <ID> number 0001 to 0999. After enrollment the number of the storage slot, the response will also return at the end of the text string (see example below). It will take approx. 2 seconds to enroll fingerprint.

Enrolment OK ?	sb	rb	Response example
SUCCESS	00	10	Start mb : 00 <CR> <LF> Result mb : 10 <CR> <LF> 05
FAIL	>00	*	Start mb : 02 <CR> <LF> Result mb : 00 <CR> <LF> 05

Left orange LED will be flashing while capturing fingerprint image.

If verification success, left green LED will be flashing, otherwise showing red light.

### 1.1.8 Command I 1:N Identification

Capture fingerprint and identify against templates (0001 to 0099) that are stored in the flash memory. On success the template storage slot ID is returned.

Identification OK ?	sb	rb	Response example
SUCCESS	00	match score	Start mb : 00 <CR> <LF> Result mb : 10 <CR> <LF> ID<CR><CB>
FAIL	0F	*	Start mb : 02 <CR> <LF> Result mb : 00 <CR> <LF> 000<CR><CB>

Left orange LED will be flashing while capturing fingerprint image.

If verification success, left green LED will be flashing, otherwise showing red light.

### 1.1.9 Command X Delete a specify template

Delete a pre-defined template in flash. The selected template storage slot must be specified by a slot number (0001 to 0999). After completed deletion, the number of the deleted slot is returned.

Response:

<CR> <LF>

<b>1.1.10</b>	<b>Command</b>	<b>DEL</b>	<b>Delete all templates</b>
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All templates stored in flash memory are deleted

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Response:

<b>DEL OK?</b>	<b>sb</b>	<b>rb</b>	<b>Response example</b>
SUCCESS	00	match score	Start mb : 00 <CR> <LF> Result mb : 10 <CR> <LF>

<b>1.1.11</b>	<b>Command</b>	<b>M</b>	<b>Download template to RAM</b>
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Download template to RAM from host. The command must start with M and then a binary sequence of 512 byte values. When the download is completed, BioFlex IV returns. <CR> <LF>

Response:

<CR> <LF>

<b>1.1.12</b>	<b>Command</b>	<b>B</b>	<b>Upload fingerprint raw image to host</b>
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Upload fingerprint raw image that captured from sensor. The raw image is uploaded as a binary sequence of 45312 byte values. The image has 192columns (x) and 236 rows (y).The first byte in the sequence is the upper left pixel and continues in column-direction.

Response:

*Binary sequence of 45312 bytes* <CR> <LF>

<b>1.1.13</b>	<b>Command</b>	<b>T</b>	<b>Upload template from flash memory slot to host</b>
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Upload template that stored in flash slot(ID) to host. The template is uploaded as a binary sequence of 512 byte values.

Response:

*Binary sequence of 512 bytes* <CR> <LF>

<b>1.1.14</b>	<b>Command</b>	<b>S</b>	<b>Upload the enrollment table to host</b>
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Upload the enrollment table to host. In the enrollment table, ‘f’: enrolled, ‘e’: empty

Response:

*Binary sequence of 999 bytes <CR> <LF>*

*Example:*

feeeefeeceeeceeeceeeceeeffceeeceee...eeceef<CR><LF>

<b>1.1.15</b>	<b>Command</b>	<b>L</b>	<b>Security level setup</b>
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The default security level is ‘L1’ after power on. The user can setup the fingerprint match threshold from ‘L1’ to ‘L9’.

Response:

<CR> <LF>

<b>1.1.16</b>	<b>Command</b>	<b>O</b>	<b>1:1 Verification</b>
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Capture fingerprint and verify against the template (ID) that stored in the flash memory. On success the template storage slot ID is returned.

Identification OK ?	sb	rb	Response example
SUCCESS	00	match score	Start mb : 00 <CR> <LF> Result mb : 10 <CR> <LF> ID<CR><CB>
FAIL	0F	*	Start mb : 02 <CR> <LF> Result mb : 00 <CR> <LF>

<b>1.1.17</b>	<b>Command</b>	<b>K</b>	<b>Move template from RAM to flash memory</b>
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Move template from RAM to flash memory slot. The selected template storage slot must be specified by a slot number (0001 to 0999 ).

Command complete	sb	rb	Response example
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SUCCESS	00	10	Start mb : 00 <CR> <LF> Result mb : 10 <CR> <LF>
FAIL	0F	*	Start mb : 02 <CR> <LF> Result mb : 00 <CR> <LF>

### 1.1.18 Command J Upload condensed fingerprint raw image to host

Upload a condensed fingerprint raw image that captured from sensor. The raw image is uploaded as a binary sequence of 2496 byte values. The image has 48columns (x) and 52 rows (y).The first byte in the sequence is the upper left pixel and continues in column-direction.

Response:

*Binary sequence of 2496 bytes <CR> <LF>*

### 1.1.19 Command F Change UART baud rate and Control LED on/off

Users can use “F” command to change UART baud rate and control LED on/off. The default baud rate is 115200 bps in factory. The new baud rate will be available after reset the power.”FB1” “FB2” “FB2” & “FB3” functions will be activated after reset the power.

The “F” command can control LED on/off too.

If users want to control LED, please send “FE1” command first.

“FL1” “FL2” “FR1”.....functions will be activated right away.

Command	Function
<b>FB1</b>	Change UART Baud Rate to 9600 bps and store a flag in Flash
<b>FB2</b>	Change UART Baud Rate to 19200 bps and store a flag in Flash
<b>FB3</b>	Change UART Baud Rate to 57600 bps and store a flag in Flash
<b>FB4</b>	Change UART Baud Rate to 115200 bps and store a flag in Flash
<b>FE1</b>	Change LED control by external command and store a flag in Flash
<b>FE2</b>	Change LED control by BioFlex itself and store a flag in Flash
	Control Left LED
<b>FL1</b>	left orange LED on

<b>FL2</b>	left red LED on
<b>FL3</b>	left green LED on
<b>FL4</b>	left orange LED off
<b>FL5</b>	left red LED off
<b>FL6</b>	left green LED off
	<b>Control Right LED</b>
<b>FR1</b>	right orange LED on
<b>FR2</b>	right red LED on
<b>FR3</b>	right green LED on
<b>FR4</b>	right orange LED off
<b>FR5</b>	right red LED off
<b>FR6</b>	right green LED off

Response:

<b>Execute</b>	<b>OK ?</b>	<b>sb</b>	<b>rb</b>	<b>Response example</b>
SUCCESS		00	10	Start mb : 00 <CR> <LF> Result mb : 10 <CR> <LF>

## **1.2 Command mode operation example:**

Connect a PC using the serial interface and use a standard terminal program, for example HyperTerminal in Windows. Please setup the software in 115200bps, 8 data bits, 1 stop bit, none parity, none Flow control, to send commands to BioFlex IV.

### **1.2.1 Enrollment**

- Step1. Place finger on the sensor.
- Step2. RAM enrollment, issue the command 'R'. Proceed to Step4.
- Step3. Flash memory enrollment, issue the number of the template storage slot (0001 To 0999), for example "0001". Issue the 'E' commands for enrollment. Proceed to step5.
- Step4. To finish enrollment, please wait for approx. 2 seconds.
- Step5. If the enrolment is successful, the created template is stored for future verifications, otherwise the above sequence has to be repeated until a successfully enrolment is achieved.

### **1.2.2 1: N Identification / 1:1 Verification with the template stored in slot 0001 to 0099**

- Step 1. Place finger on the sensor.
- Step 2. For RAM verification, issue the 'V' commands. Proceed to Step 4
- Step 3. For flash memory identification, issue the 'I' command.
- Step 4. If the identification/verification is successful, a message might be given to the user.

### **1.2.3 1:1 Verification**

- Step 1. Place finger on the sensor.
- Step 2 Issue command <ID> to point the template in flash memory.
- Step 4. Issue command 'O' for flash memory verification.
- Step 5. If the verification is successful, a message might be given to the user.



### 1.2.4 Delete templates

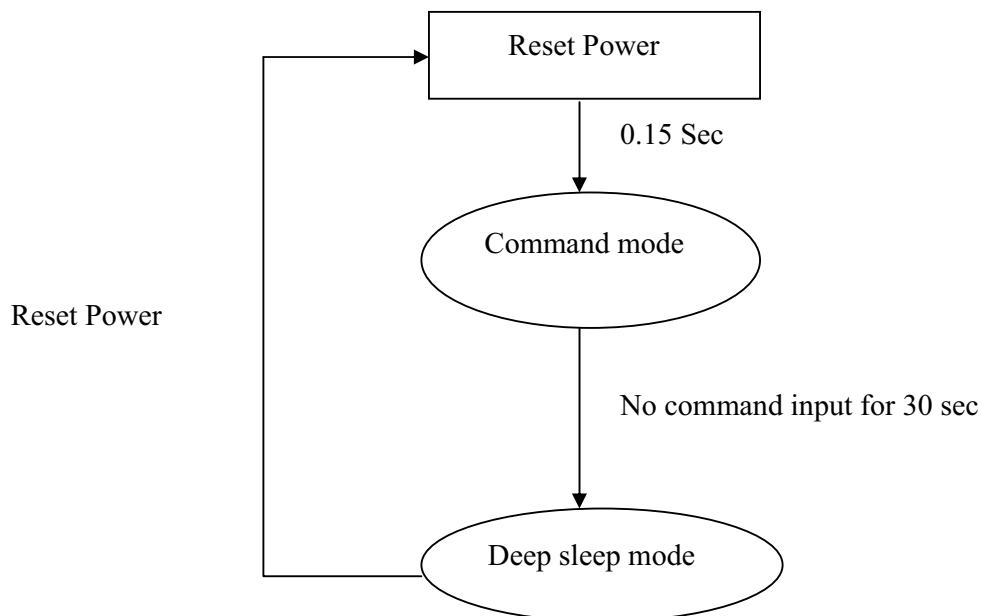
- There are two different ways of deleting templates:
- Issue the ‘D’ command, and all templates are deleted from flash memory.
- If require to erase a specify template from flash memory, issue the slot number followed by the ‘X’ command.

### 1.2.5 Download a template to Flash ROM <ID>

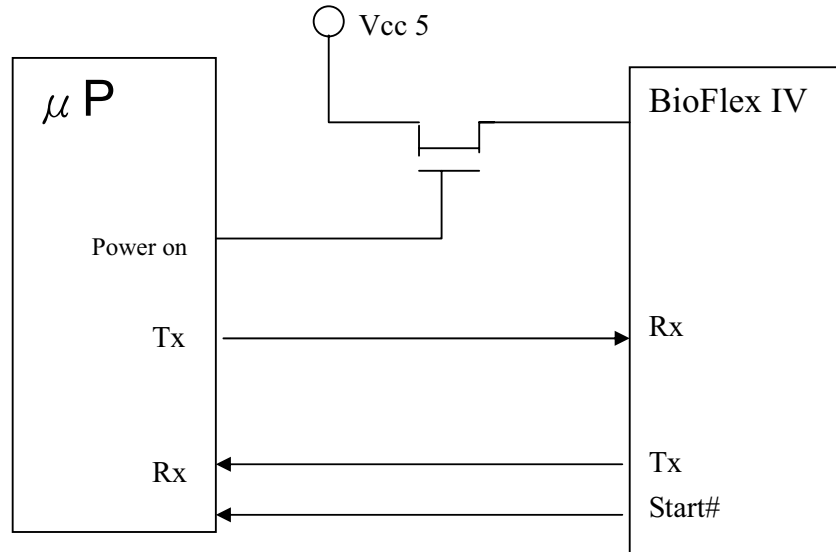
- Step 1 change <ID> to where the template will be stored.
- Step 2 Issue ‘M ‘command and 512 bytes template data.
- Step 3 Issue ‘K’ command to write the template data to flash memory <ID>.

### 2.0.0 Deep sleep mode

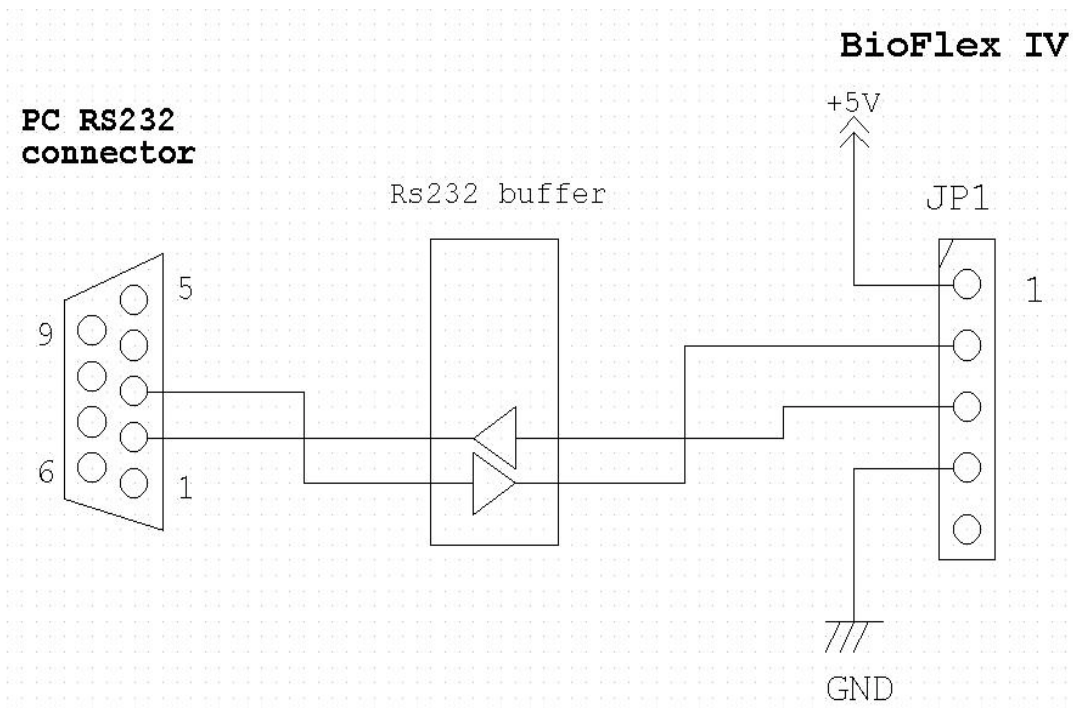
The BioFlex IV module will enter deep sleep mode automatically after 30 sec if no command input. Deep sleep mode can be terminated only by reset power. As a result, suggest adding a circuit to control module’s power (VCC5) on/off.



**Figure: Microprocessor Serial Communication Schematics**



■ **Serial Communication Schematics :**



- \* Power supply to the BioFlex IV pin1 is +5 V.
- \* The BioFlex IV uses RX, TX and GND for serial communication in JP1. These signals must be converted if they are connected to a PC for example.