

**RFID MODULE**

**Mifare Reader / Writer**

**SL031**

**User Manual**

**Version 3.0**

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**StrongLink**

# CONTENT

<b>1. MAIN FEATURES</b> .....	3
<b>2. PINNING INFORMATION</b> .....	5
<b>3. BAUD RATE SETTING</b> .....	6
<b>4. COMMUNICATION PROTOCOL</b> .....	6
<b>4-1. COMMUNICATION SETTING</b> .....	6
<b>4-2. COMMUNICATION FORMAT</b> .....	6
<b>4-3. COMMAND OVERVIEW</b> .....	7
<b>4-4. COMMAND LIST</b> .....	8
<b>4-4-1. Select Mifare card</b> .....	8
<b>4-4-2. Login to a sector</b> .....	8
<b>4-4-3. Download Key into SL031</b> .....	8
<b>4-4-4. Login sector via stored key</b> .....	9
<b>4-4-5. Read a data block</b> .....	9
<b>4-4-6. Write a data block</b> .....	9
<b>4-4-7. Read a value block</b> .....	9
<b>4-4-8. Initialize a value block</b> .....	10
<b>4-4-9. Write master key (key A)</b> .....	10
<b>4-4-10. Increment value</b> .....	10
<b>4-4-11. Decrement value</b> .....	11
<b>4-4-12. Copy value</b> .....	11
<b>4-4-13. Read a data page (Ultralight &amp; NTAG203)</b> .....	11
<b>4-4-14. Write a data Page (Ultralight &amp; NTAG203)</b> .....	12
<b>4-4-15. Power Down</b> .....	12
<b>4-4-16. Get firmware version</b> .....	12
<b>4-4-17. Halt selected card</b> .....	12
<b>4-4-17. Select Mifare card(not including halt card)</b> .....	13

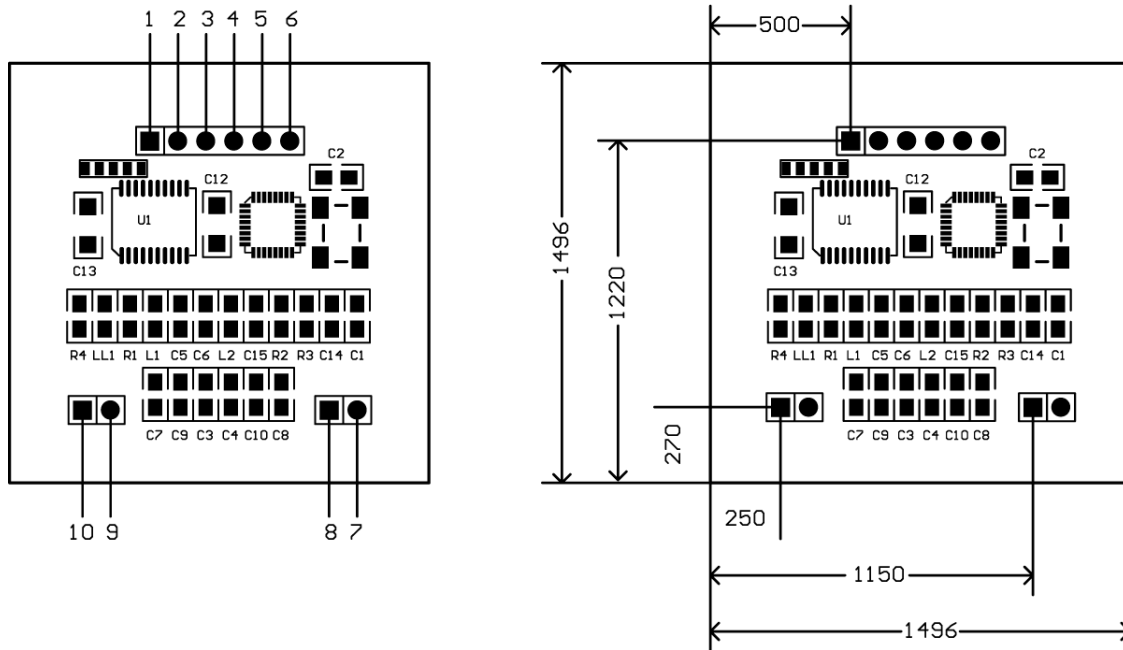
## 1. MAIN FEATURES



- Tags supported: Mifare 1k, Mifare 4k, Mifare UltraLight and NFC NTAG203
- Auto-detecting tag(not compatible with anti-collision version)
- Built-in antenna
- UART interface on CMOS level, baud rate 9,600 ~ 115,200 bps
- 2.5 ~ 3.6VDC power supply, I/O pins are 5VDC tolerant
- Work current less than 45mA @3.3V
- Power down current less than 10uA
- Operating distance: Up to 50mm, depending on tag
- Storage temperature: -40 °C ~ +85 °C
- Operating temperature: -25 °C ~ +70 °C
- Dimension: 38 × 38 × 3 mm
- The OUT pin at low level indicates tag in detective range, and high level indicating tag out
- Support IAP Firmware update



## 2. PINNING INFORMATION



Unit: mil

100 mil between two pads

PIN	SYMBOL	TYPE	DESCRIPTION
1	VDD	PWR	Power supply, 2.5 ~ 3.6VDC
2	IN	Input	Falling edge wake up SL031 from power down mode
3	TXD	Output	Serial output port
4	RXD	Input	Serial input port
5	Out	Output	Tag detective signal low level indicating tag in high level indicating tag out
6	GND	PWR	Ground
7	NC	NA	Location via
8	NC	NA	Location via
9	NC	NA	Location via
10	NC	NA	Location via

### 3. BAUD RATE SETTING

JP1 & JP2 are used for setting baud rate as follows Table

	JP1	JP2	Baud rate bps
Shorted	no	no	9,600
	yes	no	19,200
	no	yes	57,600
	yes	yes	115,200 ( default )

## 4. COMMUNICATION PROTOCOL

### 4-1. Communication Setting

The communication protocol is byte oriented. Both sending and receiving bytes are in hexadecimal format. The communication parameters are as follows

Baud rate: 9,600 ~ 115,200 bps

Data: 8 bits

Stop: 1 bit

Parity: None

Flow control: None

### 4-2. Communication Format

#### Host to SL031:

Preamble	Len	Command	Data	Checksum
----------	-----	---------	------	----------

Preamble: 1 byte equal to 0xBA

Len: 1 byte indicating the number of bytes from Command to Checksum

Command: 1 byte Command code, see Table 3

Data: Variable length depends on the command type

Checksum: 1 byte XOR of all the bytes from Preamble to Data

#### SL031 to Host:

Preamble	Len	Command	Status	Data	Checksum
----------	-----	---------	--------	------	----------

Preamble: 1 byte equal to 0xBD

Len: 1 byte indicating the number of bytes from Command to Checksum

Command: 1 byte Command code, see Table 3

Status: 1 byte Command status, see Table 4

Data: Variable length depends on the command type.

Checksum: 1 byte XOR of all the bytes from Preamble to Data

### 4-3. Command Overview

Table 3

Command	Description
0x01	Select Mifare card(all cards including halt cards)
0x02	Login to a sector
0x03	Read a data block
0x04	Write a data block
0x05	Read a value block
0x06	Initialize a value block
0x07	Write master key (key A)
0x08	Increment value
0x09	Decrement value
0x0A	Copy value
0x10	Read a data page (UltraLight & NTAG203)
0x11	Write a data page (UltraLight & NTAG203)
0x12	Download Key
0x13	Login sector via stored Key
0x50	Go to Power Down mode
0xA0	Halt selected card(unsupported in standard version, only available in ant-collision version)
0xA1	Select Mifare card but not including halt cards(unsupported in standard version, only available in ant-collision version)
0xF0	Get firmware version

### Status Overview

Table 4

Status	Description
0x00	Operation succeed
0x01	No tag
0x02	Login succeed
0x03	Login fail
0x04	Read fail
0x05	Write fail
0x06	Unable to read after write
0x08	Address overflow
0x09	Download Key fail
0x0D	Not authenticate
0x0E	Not a value block or Halt selected card fail
0x0F	Invalid command length parameter
0xF0	Checksum error
0xF1	Command code error

## 4-4. Command List

### 4-4-1. Select Mifare card(all cards including halt cards)

0xBA	Len	0x01	Checksum
------	-----	------	----------

#### Response:

0xBD	Len	0x01	Status	UID	Type	Checksum
------	-----	------	--------	-----	------	----------

Status: 0x00: Operation succeed  
 0x01: No tag  
 0xF0: Checksum error

UID: The uniquely serial number of Mifare card,

Type: 0x01: Mifare 1k, 4 byte UID  
 0x02: Mifare 1k, 7 byte UID <sup>[1]</sup>  
 0x03: Mifare UltraLight or NATG203<sup>[2]</sup>, 7 byte UID  
 0x04: Mifare 4k, 4 byte UID  
 0x05: Mifare 4k, 7 byte UID <sup>[1]</sup>  
 0x06: Mifare DesFire, 7 byte UID  
 0x0A: Other

### 4-4-2. Login to a sector

0xBA	Len	0x02	Sector	Type	Key	Checksum
------	-----	------	--------	------	-----	----------

Sector: Sector need to login, 0x00 – 0x27  
 Type: Key type (0xAA: authenticate with KeyA, 0xBB: authenticate with KeyB)  
 Key: Authenticate key, 6 bytes

#### Response:

0xBD	Len	0x02	Status	Checksum
------	-----	------	--------	----------

Status: 0x02: Login succeed  
 0x01: No tag  
 0x03: Login fail  
 0x08: Address overflow  
 0xF0: Checksum error

### 4-4-3. Download Key into SL031

0xBA	Len	0x12	Sector	Type	Key	Checksum
------	-----	------	--------	------	-----	----------

Sector: 0x00 – 0x27  
 Type: Key type (0xAA: KeyA, 0xBB: KeyB)  
 Key: 6 bytes, stored into SL031

#### Response:

0xBD	Len	0x12	Status	Checksum
------	-----	------	--------	----------

Status: 0x00: Operation succeed  
 0x08: Address overflow  
 0x09: Download fail  
 0xF0: Checksum error



**4-4-4. Login sector via stored key**

0xBA	Len	0x13	Sector	Type	Checksum
------	-----	------	--------	------	----------

Sector: Sector need to login, 0x00 – 0x27

Type: Key type (0xAA: KeyA, 0xBB: KeyB)

**Response:**

0xBD	Len	0x13	Status	Checksum
------	-----	------	--------	----------

Status: 0x02: Login succeed

0x03: Login fail

0x08: Address overflow

0xF0: Checksum error

**4-4-5. Read a data block**

0xBA	Len	0x03	Block	Checksum
------	-----	------	-------	----------

Block: The absolute address of block to be read, 1 byte

**Response:**

0xBD	Len	0x03	Status	Data	Checksum
------	-----	------	--------	------	----------

Status: 0x00: Operation succeed

0x01: No tag

0x04: Read fail

0x0D: Not authenticate

0xF0: Checksum error

Data: Block data returned if operation succeeds, 16 bytes.

**4-4-6. Write a data block**

0xBA	Len	0x04	Block	Data	Checksum
------	-----	------	-------	------	----------

Block: The absolute address of block to be written, 1 byte.

Data: The data to write, 16 bytes.

**Response:**

0xBD	Len	0x04	Status	Data	Checksum
------	-----	------	--------	------	----------

Status: 0x00: Operation succeed

0x01: No tag

0x05: Write fail

0x06: Unable to read after write

0x0D: Not authenticate

0xF0: Checksum error

Data: Block data written if operation succeeds, 16 bytes.

**4-4-7. Read a value block**

0xBA	Len	0x05	Block	Checksum
------	-----	------	-------	----------

Block: The absolute address of block to be read, 1 byte.

**Response:**

0xBD	Len	0x05	Status	Value	Checksum
------	-----	------	--------	-------	----------

Status: 0x00: Operation succeed

0x01: No tag  
 0x04: Read fail  
 0x0D: Not authenticate  
 0x0E: Not a value block  
 0xF0: Checksum error

Value: Value returned if the operation succeeds, 4 bytes.

#### 4-4-8. Initialize a value block

0xBA	Len	0x06	Block	Value	Checksum
------	-----	------	-------	-------	----------

Block: The absolute address of block to be initialized, 1 byte.

Value: The value to be written, 4 bytes.

#### Response:

0xBD	Len	0x06	Status	Value	Checksum
------	-----	------	--------	-------	----------

Status: 0x00: Operation succeed  
 0x01: No tag  
 0x05: Write fail  
 0x06: Unable to read after write  
 0x0D: Not authenticate  
 0xF0: Checksum error

Value: Value written if the operation succeeds, 4 bytes.

#### 4-4-9. Write master key (key A)

0xBA	Len	0x07	Sector	Key	Checksum
------	-----	------	--------	-----	----------

Sector: The sector number to be written, 0x00 – 0x27

Key: Authentication key, 6 bytes

#### Response:

0xBD	Len	0x07	Status	Key	Checksum
------	-----	------	--------	-----	----------

Status: 0x00: Operation succeed  
 0x01: No tag  
 0x05: Write fail  
 0x08: Address overflow  
 0x0D: Not authenticate  
 0xF0: Checksum error

Key: Authentication key written if the operation succeeds, 6 bytes.

Attention: Be sure KeyB is readable, otherwise KeyB will be change to 000000000000 after this command.

#### 4-4-10. Increment value

0xBA	Len	0x08	Block	Value	Checksum
------	-----	------	-------	-------	----------

Block: The absolute address of block to be increased, 1 byte.

Value: The value to be increased by, 4 bytes.

#### Response:

0xBD	Len	0x08	Status	Value	Checksum
------	-----	------	--------	-------	----------

Status: 0x00: Operation succeed  
 0x01: No tag  
 0x05: Write fail  
 0x06: Unable to read after write  
 0x0D: Not authenticate  
 0x0E: Not a value block  
 0xF0: Checksum error  
 Value: The value after increment if the operation succeeds, 4 bytes

#### 4-4-11. Decrement value

0xBA	Len	0x09	Block	Value	Checksum
------	-----	------	-------	-------	----------

Block: The absolute address of block to be decreased, 1 byte  
 Value: The value to be decreased by, 4 bytes

#### Response:

0xBD	Len	0x09	Status	Value	Checksum
------	-----	------	--------	-------	----------

Status: 0x00: Operation succeed  
 0x01: No tag  
 0x05: Write fail  
 0x06: Unable to read after write  
 0x0D: Not authenticate  
 0x0E: Not a value block  
 0xF0: Checksum error  
 Value: The value after decrement if the operation succeeds, 4 bytes

#### 4-4-12. Copy value

0xBA	Len	0x0A	Source	Destination	Checksum
------	-----	------	--------	-------------	----------

Source: The source block copy from, 1 byte  
 Destination: The destination copy to, 1 byte  
 Attention: The source and destination must in the same sector

#### Response:

0xBD	Len	0x0A	Status	Value	Checksum
------	-----	------	--------	-------	----------

Status: 0x00: Operation succeed  
 0x01: No tag  
 0x05: Write fail  
 0x06: Unable to read after write  
 0x0D: Not authenticate  
 0x0E: Not a value block (Source)  
 0xF0: Checksum error  
 Value: The value after copy if the operation succeeds, 4 bytes

#### 4-4-13. Read a data page (Ultralight & NTAG203)

0xBA	Len	0x10	Page	Checksum
------	-----	------	------	----------

Page: The page number to be read, 0x00 – 0x0F

**Response:**

0xBD	Len	0x10	Status	Data	Checksum
------	-----	------	--------	------	----------

Status: 0x00: Operation succeed  
 0x01: No tag  
 0x04: Read fail  
 0x08: Address overflow  
 0xF0: Checksum error

Data: Block data returned if operation succeeds, 4 bytes.

**4-4-14. Write a data Page (Ultralight & NTAG203)**

0xBA	Len	0x11	Page	Data	Checksum
------	-----	------	------	------	----------

Page: The page number to be written, 0x00 – 0x0F

Data: The data to write, 4 bytes.

**Response:**

0xBD	Len	0x11	Status	Data	Checksum
------	-----	------	--------	------	----------

Status: 0x00: Operation succeed  
 0x01: No tag  
 0x05: Write fail  
 0x06: Unable to read after write  
 0x08: Address overflow  
 0xF0: Checksum error

Data: Page data written if operation succeeds, 4 bytes.

**4-4-15. Power Down**

0xBA	Len	0x50	Checksum
------	-----	------	----------

**Response:**

0xBD	Len	0x50	Status	Checksum
------	-----	------	--------	----------

Status: 0x00: Operation success  
 0xF0: Checksum error

**4-4-16. Get firmware version**

0xBA	Len	0xF0	Checksum
------	-----	------	----------

**Response:** <sup>[3]</sup>

0xBD	Len	0xF0	Status	Data	Checksum
------	-----	------	--------	------	----------

Status: 0x00: Operation success  
 0xF0: Checksum error

Data: firmware version.

**4-4-17. Halt selected card**

0xBA	Len	0xA0	Checksum
------	-----	------	----------

**Response:** <sup>[3]</sup>

0xBD	Len	0xA0	Status	Checksum
------	-----	------	--------	----------

Status: 0x00: Operation success

0x0E: Operation fail  
 0xF0: Checksum error

#### 4-4-18. Select Mifare card(not including halt cards)

0xBA	Len	0xA1	Checksum
------	-----	------	----------

##### Response:

0xBD	Len	0xA1	Status	UID	Type	Checksum
------	-----	------	--------	-----	------	----------

Status: 0x00: Operation succeed  
 0x01: No tag  
 0xF0: Checksum error

UID: The uniquely serial number of Mifare card,

Type: 0x01: Mifare 1k, 4 byte UID  
 0x02: Mifare 1k, 7 byte UID <sup>[1]</sup>  
 0x03: Mifare UltraLight or NATG203<sup>[2]</sup>, 7 byte UID  
 0x04: Mifare 4k, 4 byte UID  
 0x05: Mifare 4k, 7 byte UID <sup>[1]</sup>  
 0x06: Mifare DesFire, 7 byte UID  
 0x0A: Other

**Remark**

<sup>[1]</sup> In order to support 7 byte UID Mifare class, the firmware of SL031 has been updated to Ver3.2 in Mar 2011.

And older firmware version (such as Ver1.0, 2.0, 2.2, etc) only supports 4 byte UID. Please refer to NXP [Customer Letter UID](#) for detailed information of 4 byte & 7 byte UID of Mifare products.

<sup>[2]</sup> To support NATG203, the firmware of SL031 has been updated to Ver3.6 in Mar 2012. The older firmware version only supports reading/writing data page address less than 16.

<sup>[3]</sup> One sample of SL031 response

	Preamble	Len	Command	Status	Data (Firmware version)	Checksum
HEX	BD	16	F0	00	53 4C 30 33 31 2D 33 2E 30 2D 32 30 31 36 31 32 30 31 00	5C
ASCII					“SL031-3.0-20161 201”	