

**RFID MODULE**

**Mifare Reader / Writer**

**SL032**  
**User Manual**

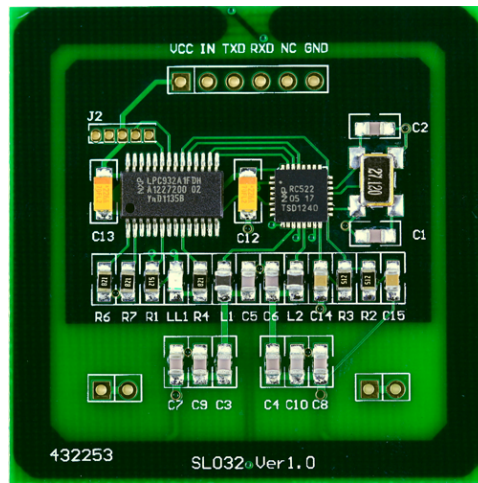


**Version 1.4**  
**Nov 2011**  
**StrongLink**

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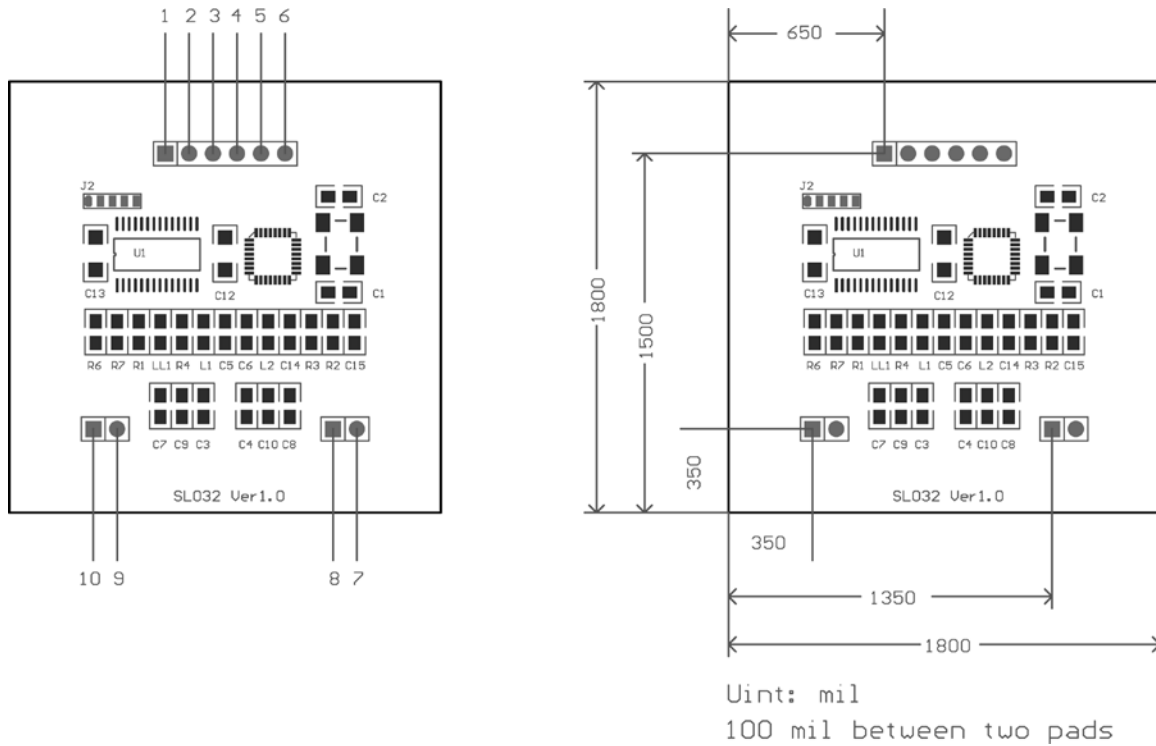
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## 1. MAIN FEATURES



- Tags supported: Mifare 1k, Mifare 4k, UltraLight, DesFire
- Built-in antenna
- UART interface, baud rate 9,600 ~ 115,200 bps
- 2.5V to 3.6VDC power supply, I/O pins are 5V 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: 46 × 46 × 3 mm

## 2. PINNING INFORMATION



PIN	SYMBOL	TYPE	DESCRIPTION
1	VDD	PWR	Power supply, 2.5 to 3.6VDC
2	IN	Input	Falling edge wake up SL032 from power down mode
3	TXD	Output	Serial output port
4	RXD	Input	Serial input port
5	NC		
6	GND	PWR	Ground
7	NC		
8	NC		
9	NC		
10	NC		

### 3. BAUD RATE SETTING

R6 & R7 are used for setting baud rate as follows sheet

	R6	R7	Baud rate bps
Assembled	no	no	9,600
	no	yes	19,200
	yes	no	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 Reader:

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

##### Reader 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
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)
0x11	Write a data page (UltraLight)
0x12	Download Key
0x13	Login sector via stored Key
0x20	Request for Answer to Select (ISO14443-4)
0x21	Exchange Transparent Data according to T = CL
0x40	Manage LED
0x50	Go to Power Down mode
0xF0	Get firmware version

### Status Overview

**Table 4**

Status	Description
0x00	Operation success
0x01	No tag
0x02	Login success
0x03	Login fail
0x04	Read fail
0x05	Write fail
0x06	Unable to read after write
0x08	Address overflow
0x10	ATS failed
0x11	T = CL communication failed
0x0A	Collision occur
0x0D	Not authenticate
0x0E	Not a value block
0xF0	Checksum error
0xF1	Command code error

## 4-4. Command List

### 4-4-1. Select Mifare card

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

#### Response:

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

Status: 0x00: Operation succeed  
 0x01: No tag  
 0x0A: Collision occur  
 0xF0: Checksum error

UID: The uniquely serial number of Mifare carde

Type: 0x01: Mifare 1k, 4 byte UID  
 0x02: Mifare Pro  
 0x03: Mifare UltraLight  
 0x04: Mifare 4k, 4 byte UID  
 0x05: Mifare ProX  
 0x06: Mifare DesFire  
 0x07: Mifare 1k, 7 byte UID <sup>[1]</sup>  
 0x08: Mifare 4k, 7 byte UID <sup>[1]</sup>  
 0x0A: Other

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

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

Sector: Sector need to login

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  
 0x03: Login fail  
 0xF0: Checksum error

### 4-4-3. Read a data block

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

Block: The block number to be read, 1 byte

#### Response:

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

Status: 0x00: Operation succeed  
 0x04: Read fail  
 0x0D: Not authenticate  
 0xF0: Checksum error

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

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

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

Block: The block number to be written, 1 byte.

Data: The data to write, 16 bytes.

**Response:**

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

Status: 0x00: Operation succeed

0x05: Write fail

0x06: Unable to read after write

0x0D: Not authenticate

0xF0: Checksum error

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

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

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

Block: The block number to be read, 1 byte.

**Response:**

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

Status: 0x00: Operation succeed

0x04: Read fail

0x0D: Not authenticate

0x0E: Not a value block

0xF0: Checksum error

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

**4-4-6. Initialize a value block**

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

Block: The block number to be initialized, 1 byte.

Value: The value to be written, 4 bytes.

**Response:**

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

Status: 0x00: Operation succeed

0x05: Write fail

0x06: Unable to read after write

0x0D: Not authenticate

0xF0: Checksum error

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

**4-4-7. Write master key (key A)**

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

Sector: The sector number to be written, 1 byte.

Key: Authentication key, 6 bytes

**Response:**

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

Status: 0x00: Operation succeed

0x05: Write fail

0x0D: Not authenticate

0xF0: Checksum error

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

#### 4-4-8. Increment value

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

Block: The block number 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

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

#### 4-4-9. Decrement value

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

Block: The block number 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

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

#### 4-4-10. Copy value

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

Source: The source block copy from, 1 byte

Destination: The destination copy to, 1 byte

The source and destination must in the same sector

#### Response:

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

Status: 0x00: Operation succeed

- 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

#### 4-4-11. Read a data page (UltraLight)

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

Page: The page number to be read, 1 byte

##### Response:

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

Status: 0x00: Operation succeed

0x04: Read fail

0xF0: Checksum error

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

#### 4-4-12. Write a data Page (UltraLight)

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

Page: The page number to be written, 1 byte.

Data: The data to write, 4 bytes.

##### Response:

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

Status: 0x00: Operation succeed

0x05: Write fail

0x06: Unable to read after write

0xF0: Checksum error

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

#### 4-4-13. Download Key

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

Sector: 0 - 39

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

Key: 6 bytes, stored in SL032

##### Response:

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

Status: 0x00: Operation succeed

0x08: Address overflow

0xF0: Checksum error

**4-4-14. Login sector via stored key**

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

Sector: 0 - 39

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

**4-4-15. Request for Answer to Select (ISO14443-4)**

0xBA	Len	0x20	Checksum
------	-----	------	----------

**Response:**

0xBD	Len	0x20	Status	ATS	Checksum
------	-----	------	--------	-----	----------

Status: 0x00: Operation succeed

0x10: Address overflow

0xF0: Checksum error

ATS: According to ISO14443-4 protocol

 $Len + T_0 + TA_1 + TB_1 + TC_1 + A_1 + A_K$ **4-4-16. Exchange Transparent Data (T = CL)**

0xBA	Len	0x21	Data	Checksum
------	-----	------	------	----------

Data: COS command

**Response:**

0xBD	Len	0x21	Status	Data	Checksum
------	-----	------	--------	------	----------

Status: 0x00: Operation succeed

0x11: Communicate with card failed

0xF0: Checksum error

Data: Response data from card

**4-4-17. Manage Led**

0xBA	Len	0x40	Code	Checksum
------	-----	------	------	----------

Code: 0 command red led turn off , other red led turn on, 1 byte

**Return:**

0xBD	Len	0x40	Status	Checksum
------	-----	------	--------	----------

Status: 0x00: Operation succeed

0xF0: Checksum error

**4-4-18. Power Down**

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

**Response:**

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

Status: 0x00: Operation succeed

0xF0: Checksum error

**4-4-19. Get firmware version**

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

**Response:** <sup>[2]</sup>

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

Status: 0x00: Operation success

0xF0: Checksum error

Data: firmware version.

**Remark**

<sup>[1]</sup> In order to supports 7 byte UID Mifare class, the firmware of SL032 has been updated to Ver1.9 in Mar 2011.

And older firmware version (such as Ver1.0, 1.5, 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> One sample of SL032 response

	Preamble	Len	Command	Status	Data (Firmware version)	Checksum
HEX	BD	0C	F0	00	53 4C 30 33 32 2D 312E 39	64
ASCII					"SL032-1.9"	