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RFID MODULE

Mifare Reader / Writer

SL031
User Manual

Version 2.7
Nov 2012
StrongLink

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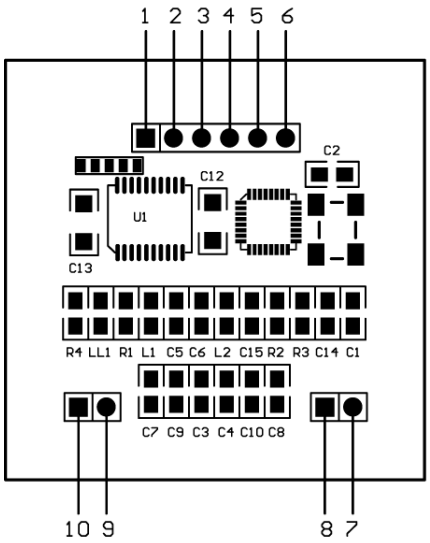
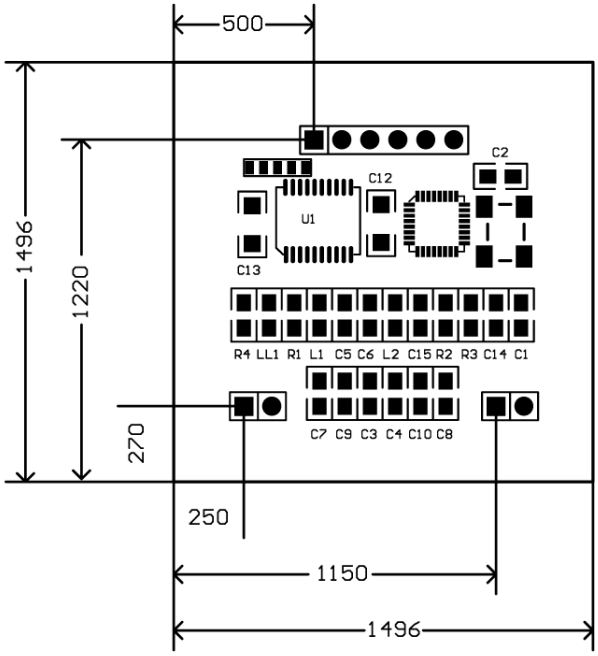
1. MAIN FEATURES

- Tags supported: Mifare 1k, Mifare 4k, Mifare UltraLight and NFC NTAG203
- Auto-detecting tag
- 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 ºC ~ +85 ºC
- Operating temperature: -25 ºC ~ +70 ºC
- Dimension: 38 × 38 × 3 mm
- The OUT pin at low level indicates tag in detective range, and high level indicating tag out

2. PINNING INFORMATION





Uint: 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		
8	NC		
9	NC		
10	NC		

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
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
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
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
0xF0: Checksum error
UID: The uniquely serial number of Mifare card,
Type: 0x01: Mifare 1k, 4 byte UID
0x02: Mifare 1k, 7 byte UID [1]
0x03: Mifare UltraLight or NATG203[2], 7 byte UID
0x04: Mifare 4k, 4 byte UID
0x05: Mifare 4k, 7 byte UID [1]
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: [3]

0xBD	Len	0xF0	Status	Data	Checksum

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

Data: firmware version.

Remark

[1] 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.

[2] 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.

[3] One sample of SL031 response

	Preamble	Len	Command	Status	Data (Firmware version)	Checksum
HEX	BD	0C	F0	00	53 4C 30 33 31 2D 33 2E 32	6E
ASCII					"SL031-3.2"	