RFID MODULE

Mifare Reader / Writer

SL032
User Manual

Version 3.1
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StrongLink

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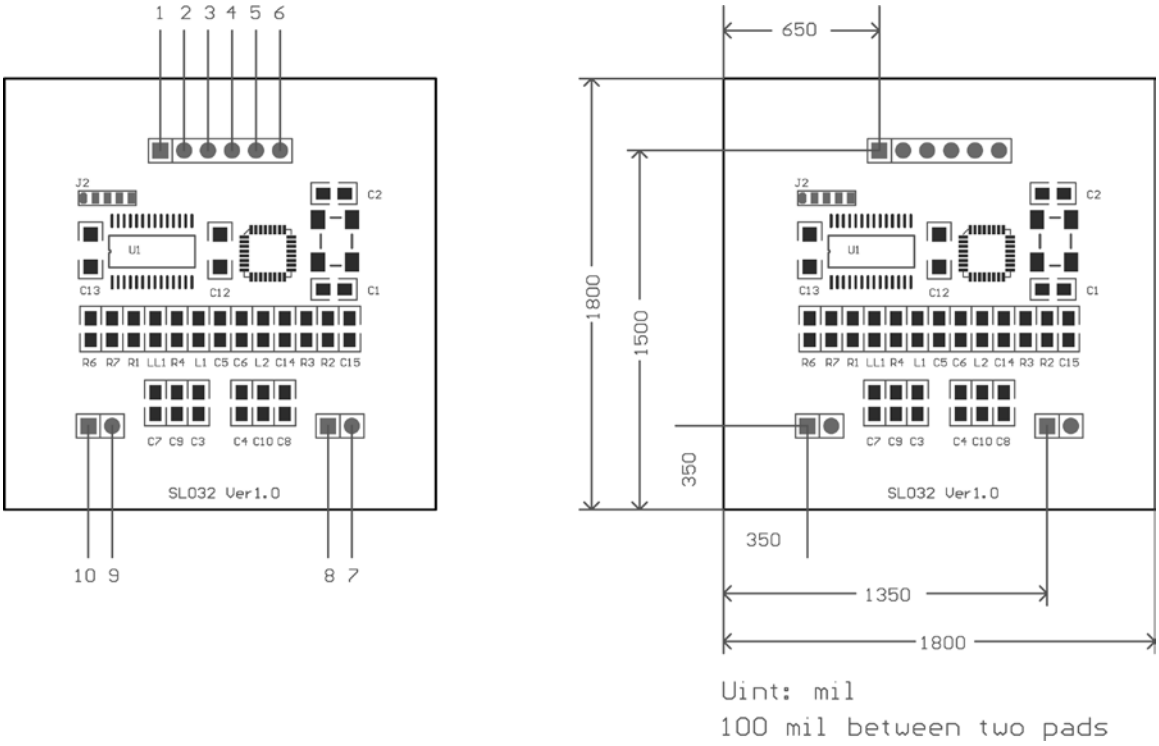
1. MAIN FEATURES

*This picture may not be exactly the same as real object.

- Tags supported: Mifare 1k, Mifare 4k, Mifare UltraLight, Mifare UltraLight C, NTAG203, DESFire, DESFire EV1 and Mifare Plus 2K/4K
- Built-in antenna
- UART interface, baud rate 9,600 ~ 115,200 bps
- 2.7 ~ 3.6V VDC operating, 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 ºC ~ +85 ºC
- Operating temperature: -25 ºC ~ +55 ºC
- Dimension: 46 × 46 × 3 mm
- The OUT pin at low level indicates tag in detective range, and high level indicating tag out
- Auto-detection: LED is on when card is in the detection range[1]

[1] Suppots all cards above except ISO14443-4 cards like DESFire/DESFire EV1 and MifarePlus L0/L2/L3. There is

2. PINNING INFORMATION



PIN	SYMBOL	TYPE	DESCRIPTION
1	VDD	PWR	Power supply, 2.7 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	OUT	Output	Tag auto-detection signal low level indicating tag in high level indicating tag out
6	GND	PWR	Ground
7	NC		
8	NC		
9	NC		
10	NC		

Attention: Pin IN must be connected HIGH voltage when working, so SL032 can enter power down mode properly.

Auto-detection command to control its on/off.

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
	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 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 & NTAG203)
0x11	Write a data page (Ultralight & NATG203)
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	LED control
0x50	Go to Power Down mode
0x60	3Des Authentication(Ultralight C)
0x61	Update Key(Ultralight C)
0x80	MFP WritePerso
0x81	MFP CommitPerso
0xF0	Get firmware version
0xFE	Turn on/off Auto-detection

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
0x0A	Collision occur
0x0C	Load key fail
0x0D	Not authenticate
0x0E	Not a value block
0x0F	Input len invalid

0x12	MFP WritePerso fail
0x13	MFP CommitPerso fail
0x14	Ulralight c authenticate fail

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:

MFMini_4B	0x01
MFMini_7B	0x02
MF1K_4B UID/ MFPLUS2K SL1_4B UID	0x03
MF1K_7B UID/ MFPLUS2K SL1_7B UID	0x04
MF4K_4B UID/ MFPLUS4K SL1_4B UID	0x05
MF4K_7B UID/ MFPLUS4K SL1_7B UID	0x06
MF Ultralight/MF Ultralight C/Ntag 203	0x07
MF DESFire/MF DESFire EV1	0x09
MF PROX	0x0B
MFPLUS2K SL2_4B UID	0x21
MFPLUS4K SL2_4B UID	0x22
MFPLUS2K SL2_7B UID	0x23
MFPLUS4K SL2_7B UID	0x24
MFPLUS2K SL0/SL3_4B UID[2]	0x31
MFPLUS4K SL0/SL3_4B UID	0x32
MFPLUS2K SL0/SL3_7B UID	0x33
MFPLUS4K SL0/SL3_7B UID	0x34
Other	0x00

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

[2] Mifare Plus SL0 and SL3 can tell differences via ATS(ISO14443-4). Before ATS, they have the same ATQA and SAK(ISO14443-3). SL032 judges card type only via ISO14443-3 layer for the compatibility.

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 & NTAG203)

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 & NTAG203)

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. LED Control

0xBA	Len	0x40	Data	Checksum

Data: 0x00: LED off
0x01: LED on

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. 3Des Authentication(Utralight C)

0xBA	Len	0x60	Key	Checksum

Key: 16 bytes

Response:

0xBD	Len	0x60	Status	Checksum

Status: 0x00: Operation succeed
0x14: Authenticate failed
0xF0: Checksum error

4-4-20. Update Key(Utralight C)

0xBA	Len	0x61	Key	Checksum

Key: 16 bytes

Response:

0xBD	Len	0x61	Status	Checksum

Status: 0x00: Operation succeed
0x05: Write fail
0xF0: Checksum error

4-4-21. Write Perso

0xBA	Len	0x80	Bnr	Data	Checksum

Bnr: 2Byte Block or Key Address to be written, MSB first.
For example,
Master Key Address is 0x9000, and write it as 0xFFFF..FF(16Bytes)
BA14809000FFFFFFFFFFFFFFFFFFFFFFFFFFFFBEh
Configuration Key Address is 0x9001, and write it as 0xFFFF..FF(16Bytes)
BA14809001FFFFFFFFFFFFFFFFFFFFFFFFFFFFBFh
Switch to Level 2 Key Address is 0x9002, and write it as 0xFFFF..FF(16Bytes)
BA14809002FFFFFFFFFFFFFFFFFFFFFFFFFFFFBCh
Switch to Level 3 Key Address is 0x9003, and write it as 0xFFFF..FF(16Bytes)
BA14809003FFFFFFFFFFFFFFFFFFFFFFFFFFFFBDh

Data: Value of the key or data

Response:

0xBD	Len	0x80	Status	Checksum

Status: 0x00: Operation succeed
0x11: Communicate with card failed
0x12: Card Write Perso failed

0xF0: Checksum error

4-4-22. Commit Perso

0xBA	Len	0x81	Checksum

This command commit the Write Perso and switch the card to security level 1(SL1 card) or level 3(SL3 card).

Response:

0xBD	Len	0x81	Status	Checksum

Status: 0x00: Operation succeed
0x11: Communicate with card failed
0x13: Card Commit Perso failed
0xF0: Checksum error

Attention: According to NXP MifarePlus card document, Commit Perso will make effect after you have “Write Perso” the Master KEY, Configuration KEY and SWL3 KEY.
If your card is L1 card, after Commit Perso, the card will switch L0 to L1;
If your card is L3 card, after Commit Perso, the card will switch L0 to L3.

4-4-23. Get firmware version

0xBA	Len	0xF0	Checksum

Response:

0xBD	Len	0xF0	Status	Data	Checksum

Status: 0x00: Operation success
0xF0: Checksum error
Data: firmware version.

4-4-24. Turn on/off Auto-detection

0xBA	Len	0xFE	Data	Checksum

Data: 0x00: Turn off Auto-detection
0x01: Turn on Auto-detection

For example,
02FE00h // Turn off Auto-detection
02FE01h // Turn on Auto-detection

Response:

0xBD	Len	0xFE	Status	Checksum

Status: 0x00: Operation succeed

5. DIFFERENCES FROM PREVIOUS VERSION

Although we make efforts on the compatibility between the new SL032 V3.1and the old SL032, there are still some differences you need to know.

1. New SL032 has the auto-detection function which can close automatically when there is a DESFire or MifarePlus L0/L2/L3 card coming into the detection range. By the way, we also offer you the Turn On/Off Auto-detection command.
2. New SL032 supports nearly all cards of NXP Mifare series now and we rebuilt the card type characters.(Details see to Command Select Mifare Card Description)
3. New SL032 also has PIN OUT function indicating tag auto-detection status like SL025 and SL031 now.
4. New SL032 has the 3des authentication and update key function for ulralight c.