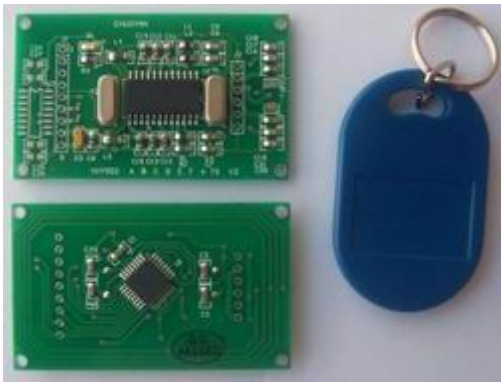
YHY502CTG

13.56MHz RFID Mifare® Read/Write Module



- ▲ Complete Read/Write module with built-in transceiver antenna
- ▲ Auto checks for presence of a tag and upload ID need no command
- ▲ Contactless operating frequency 13.56 MHz
- ▲ Supports ISO14443A /MIFARE® ,Mifare® Classic1K,Mifare® Classic 4K
- ▲ TTL RS232 Interface, baud rate19200bps
- ▲ Fast data transfer Contactless communication up to 106KHz
- ▲ Secure Encrypted contactless communication
- ▲ Ideal for emoney,secure access and fast data collection applications
- ▲ Typical Operating Distance: 0 – 60 mm
- ▲ Operating Voltage ： DC 3.0-5.5V
- ▲ Watchdog timer
- ▲ 1 LED indicator, 3 I/O pins for external use
- ▲ 512 bytes eeprom
- ▲ Unique serial number on each device
- ▲ Size: 58mm × 35mm × 6mm
- ▲ Weight:10g

Scope

This document describes the basic functionality and the electric specifications of the YHY502CTG read/write module.

This contactless module is designed for an easy reader adaptation to a host to use this device for test and application purpose.

There is need only one command to finish one action, such as read or write card data. It needs no request, anticoll or selection.The module will do it for you automatically. What you need is just send one command to the module. Then it will send back what you want. Anything is just so **simple** and so **easy**.

Also, if there is any card go into the rf field, the red led on the module will light and the SIG pin will change from “1” to “0” to indicate the event.

1. Pin Information

YHY502CTG is a module that is integrated with 8bit microcontroller, analog&digital signal processor and necessary passive components on both top layer to complete a fully functional Mifare® read/write module.

Figure 1 *– YHY502CTG J1 PinOut TOPView*

J1 Interface:

Pin	Symbol	IO Type	Description
J1-1	RXD	I/O	Uart Receiver
J1-2	TXD	I/O	Uart Transmitter
J1-3	OUT1	I/O	Output 1
J1-4	OUT2	I	Output 2
J1-5	RST	I	Reset, active-low, floating for power-on reset by default
J1-6	BUZ	I	Buzzer output, high level drive
J1-7	SIG	O	Interrupt output, LOW level indicates card in the field
J1-8	VCC	Power	Power positive
J1-9	GND	GND	Power Negative

Table1 *– J1 Pin information*

2. Introduction

YHY502CTG is a compact 13.56MHz RFID Read / Write module designed for ISO14443A standard and supports Mifare® Classic 1K, Mifare® Classic 4K transponders. It is controlled by external device over UART with simple protocols defined in this sheet.

YHY502CTG can be easily and quickly integrated into RFID applications with very less effort. Mifare® Classic is a secure memory (1Kbyte, 4KByte) chip/card often called contactless smart card. The reason it is called smartcard is because it has increment and decrement functions designed for especially payment systems. Mifare® Classic family of tags is being used in RFID applications where very high security and fast data collection systems are required. This family of tags has contactless communication speed up to 106 KHz and uses very strong encryption techniques. If the user want to copy or modify the content of the Mifare®Classic family of tags then he needs the correct key(s) when it is protected. As a result Mifare® become ideal for e-money applications, secure access, data storage and fast data collection systems. Not only limited with these applications but printed antenna technology makes possible to find very thin and low cost Mifare® tags (e.g. labels,stickers) so that extending the field of RFID applications.

3. Mifare® Brief Technical Information

For Mifare® tag memory organization and communication principles please refer to Mifare® S50 en.pdf document (Standard Card IC MF1 IC S50) of NXP. Mentioned document gives functional specification of the IC used in Mifare® 1K tags. Same communication principles are valid for Mifare® 4K (MF1 IC S70) tags. Documents can be downloaded at http://www.nxp.com. Communication principles are greatly simplified by YHY502CTG module. When read or write the card, it just need to send one read/write command with keyA/B for authenticate, the module would perform request, anticoll and select card itself.

4. Communication Protocols

4.1 Command lists:

This chapter describes the protocol and commands which is used by the YHY502CTG to communication with host.

Code	Command	Description
0x01	Module Type	Read Module Type
0x02	Module Serial Number	Read Module Serial Number
0x03	Power Down	Set Module Power Down
0x10	Firmware Version	Read Module Firmware Version
0x11	Antenna control	Set Module Antenna on or off
0x12	Card IDLE	Set Card IDLE
0x13	Seek	Set Auto-Search Card
0x14	Beep	Set Buzzer ON/OFF
0x15	Beep interval	Set buzzer beep interval time
0x16	Output1	Set Output 1
0x17	Output2	Set Output 2
0x19	Card type	Read Card Type
0x20	Card serial number	Read card serial number
0x21	Block Read	Read Card Block data, 16 bytes
0x22	Block Write	Write Card Block data, 16 bytes
0x23	Initialize epurse	Initialize one block into epurse value
0x24	Value read	Read ePurse Value, 4 bytes
0x25	Increment	Increase ePurse Value, 4 bytes
0x26	Decrement	Decrease Purse Value, 4 bytes
0x30	Read E^2	Read Module's EEPROM
0x31	Write E^2	Write Module's EEPROM

Table2 – Command list

4.2 Protocol

UART:（default：19200bps,N,8,1 ）

The communication between the host and the module communicates at 19200bps, N, 8, 1.

The host first sends the command and the module executes the operation and replies with a response to the command. The host can analyze the reply to check if the operation was successful or if any error occurred during the operation.

Following is the UART frame for the commands sent by the host:

Header	Length	Command	Data	CSUM
2 Byte	1 Byte	1 Byte	N Bytes	1 Byte

Table 4.2-1 *– UART frame send by Host*

1. Header: This header has 2 bytes that indicates the beginning of a frame. These 2 bytes should be always 0xAA 0xBB.

2. Length: This byte is used to indicate the length of the payload data. This includes the Length, Command and the Data bytes

3. Command: This byte is used to instruct the module on what operation to perform

4. Data: These are parameters for the module to execute the command. For example, for a Read command, the data will be the block number to be read and the authenticated key. For a Write command, this will be the block number and the authenticated key and 16

bytes data to write into the block. For other command,it maybe empty.

5. CSUM: This is the checksum byte. This byte is used on the host as well as the module to check the validity of the packet and to trap any data corruption. This is calculated by **XOR** all the bytes in the packet except the Header and CSUM byte.

CSUM=Length ⊕ Command ⊕ Data[0] ⊕ Data[1]… ⊕ Data[n-1]

Note: If there is one byte "0xAA" in the packet data from Length to CSUM，please insert one byte "0x00" after "0xAA",but the Length need not change.

Code example:

```
//-------------------------------------------------
if (cSendBuffer[i] == 0xAA)
{
        TI = 0;
        SBUF = 0;
        while (!TI);
}
//-------------------------------------------------
```

Following is the UART frame for the response packets sent by YHY502CTG module in response to the commands:

Header	Length	Status	Response	CSUM
2 Byte	1 Byte	1 Byte	N Bytes	1 Byte

Table 4 – UART frame send by YHY502CTG module

1. Header: This header has 2 bytes that indicates the beginning of a frame. These 2 bytes should be always 0xAA 0xBB.

2. Length: This byte is used to indicate the length of the payload data. This includes the Length, Command and the Data bytes

3. Status: This is the status for which the response is being sent back. If ok then the module return the command which host has sent, else it return the ones-complement code. For example, the command is 0x19, then the ones-complement code is 0xe6.

4. **Response**: This contains the result data if an operation was successful. It may be empty.

5. CSUM: This is the checksum byte. This byte is used on the host as well as the module to check the validity of the packet and to trap any data corruption. This is calculated by **XOR** all the bytes in the packet except the Header and CSUM byte.

CSUM=Length ⊕ Command ⊕ Response[0] ⊕ Response[1] ⊕ … ⊕ Response[n-1]

5. Commands & Respones

In this chapter detailed information and UART frame examples are given for command and

responses.

After power on the module, the red led will flash one time.

If a Mifare® tag detected by the module, it will read out the card ID and upload to host ,at the same time the red led on board will light and the “SIG” pin will change from “1” to “0” till the tag moves out of field.

For example:

AA BB 06 20 E2 90 B3 55 B2

Below is showing the detail about the command sent and return.

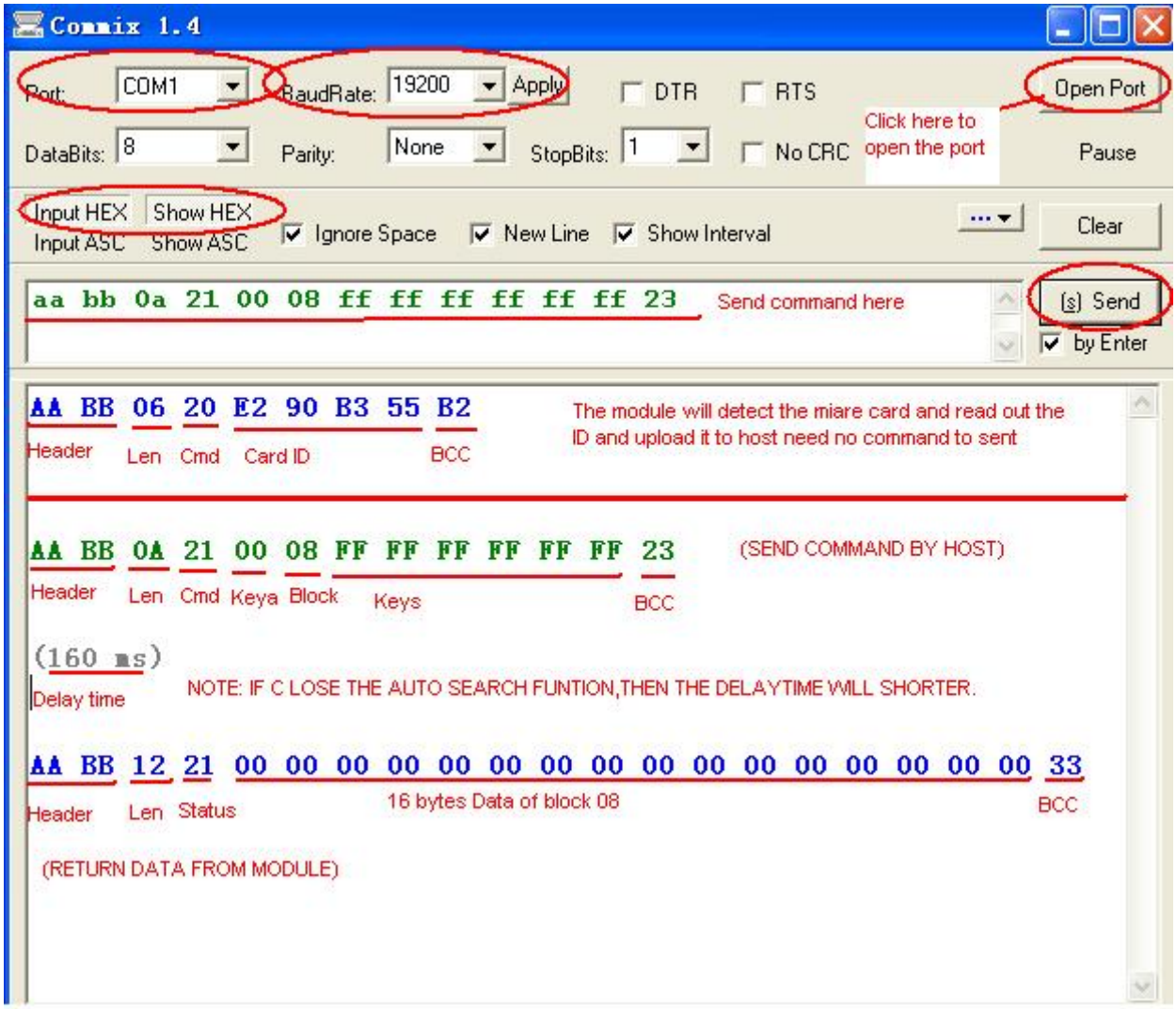


Figure 4 *–1 Command sent and return explain*

（The following data are not specified is in hexadecimal）

5.1 Module Type

Command description: Read module type

Data Frame Format:

Send	Head	Length	Command	XOR Checksum
	AA BB	02	01	03

Receive	Head	Length	Command	Module Type	XOR Checksum
Success	AA BB	0A	01	8Bytes	XOR Checksum
Failure	AA BB	02	FE	-	FC

Example:

Send	**AA BB 02 01 *03***	
Description	AA BB	*Head of this COMMAND*
	02	*Length of this COMMAND*
	01	*COMMAND*
	03	*02 ⊕01*
Receive(Success)	**AA BB 0A 01 *48 59 35 30 32 43 20 20* *6E***	
Description	AA BB	*Head of this DATA*
	0A	*Length of this DATA*
	01	*COMMAND*
	48 59 35 30 32 43 20 20	*Module TYPE*
	6E	*0A ⊕01 ⊕48 ⊕59 ⊕35 ⊕30 ⊕32 ⊕43 ⊕20 ⊕20*
Receive(Failure)	**AA BB 02 FE *E***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	FE	*One's complement of COMMAND*
	FC	*02 ⊕FE*

5.2 Module Serial Number

Command description: Read Module Serial Number

Note: Each module has it's unique serial number.(NOT card serial number)

Data Frame Format:

Send	Head	Length	Command	XOR Checksum
	AA BB	02	02	00

Receive	Head	Length	Command	Module SN	XOR Checksum
Success	AA BB	06	02	4Bytes	XOR Checksum
Failure	AA BB	02	FD	-	FF

Example:

Send	**AA BB 02 02 *00***	
Description	AA BB	*Head of this COMMAND*
	02	*Length of this COMMAND*
	02	*COMMAND*
	00	*02 ⊕02*
Receive(Success)	**AA BB 06 02 *00 00 00 01* *05***	
Description	AA BB	*Head of this DATA*
	06	*Length of this DATA*
	02	*COMMAND*
	00 00 00 01	*Module SN*
	05	*06 ⊕02 ⊕00 ⊕00 ⊕00 ⊕01*
Receive(Failure)	**AA BB 02 FD *F***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	FD	*One's complement of COMMAND*
	FF	*02 ⊕FD*

5.3 Power Down

Command description: After execute this Command the module will power down , To wake up the module need to give the RST pin a low-level pulse or Re-power on.

Data Frame Format:

Send	Head	Length	Command	XOR Checksum
	AA BB	02	03	01

Receive	Head	Length	Command	XOR Checksum
Success	AA BB	02	03	01
Failure	AA BB	02	FC	FE

Example:

Send	**AA BB 02 03 *01***	
Description	AA BB	*Head of this COMMAND*
	02	*Length of this COMMAND*
	03	*COMMAND*
	01	*02 ⊕03*
Receive(Success)	**AA BB 02 03 *01***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	03	*COMMAND*
	01	*02 ⊕03*
Receive(Failure)	**AA BB 02 FC *E***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	FC	*One's complement of COMMAND*
	FE	*02 ⊕FC*

5.4 Module Firmware Version

Command description: Read Module Firmware Version

Data Frame Format:

Send	Head	Length	Command	XOR Checksum
	AA BB	02	10	12

Receive	Head	Length	Command	Module Firmware Version	XOR Checksum
Success	AA BB	06	10	4Bytes	XOR Checksum
Failure	AA BB	02	EF	-	ED

Example:

Send	**AA BB 02 10 *12***	
Description	AA BB	*Head of this COMMAND*
	02	*Length of this COMMAND*
	10	*COMMAND*
	12	*02 ⊕10*
Receive(Success)	**AA BB 06 10 *00 00 02 01* *15***	
Description	AA BB	*Head of this DATA*
	06	*Length of this DATA*
	10	*COMMAND*
	00 00 02 01	*Module SN*
	15	*06 ⊕10 ⊕00 ⊕00 ⊕02 ⊕01*
Receive(Failure)	**AA BB 02 EF *ED***	

Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	EF	*One's complement of COMMAND*
	ED	*02 ⊕EF*

5.5 Antenna control

Command description: Set the Module antenna power on or off .This command will switch RF field.

Data Frame Format:

Send	Head	Length	Command	Data	XOR Checksum
	AA BB	03	11	1Byte *'00'*: antenna off *'01'*: antenna on	XOR Checksum

Receive	Head	Length	Command	XOR Checksum
Success	AA BB	02	11	13
Failure	AA BB	02	EE	EC

Example:

Send	**AA BB 03 11 00 *12***	
Description	AA BB	*Head of this COMMAND*
	03	*Length of this COMMAND*
	11	*COMMAND*
	00	*00:* antenna off
	12	*03 ⊕11 ⊕00*
Receive(Success)	**AA BB 02 11 *13***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	11	*COMMAND*
	13	*02 ⊕11*
Receive(Failure)	**AA BB 02 EE *EC***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	EE	*One's complement of COMMAND*
	EC	*02 ⊕EE*

5.6 Card IDLE

Command description: Set the Card into IDLE . After successfully operation the card will be idle. Reactivate the card need to remove the card from antenna area and put the card into antenna area again.

Data Frame Format:

Send	Head	Length	Command	XOR Checksum
	AA BB	02	12	10

Receive	Head	Length	Command	XOR Checksum
Success	AA BB	02	12	10
Failure	AA BB	02	ED	EF

Example:

Send	**AA BB 02 12 *10***

Description	AA BB	*Head of this COMMAND*
	02	*Length of this COMMAND*
	12	*COMMAND*
	10	*02 ⊕12*
Receive(Success)	**AA BB 02 12 *10***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	12	*COMMAND*
	10	*02 ⊕12*
Receive(Failure)	**AA BB 02 ED *EF***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	ED	*One's complement of COMMAND*
	EF	*02 ⊕ED*

5.7 Seek

Command description: Set the module automatic search cards, 1 byte of data, 0x01 open automatic search cards, 0x00 closed. SIG pin active low when find a card untill remove the card or card idle.

Data Frame Format:

Send	Head	Length	Command	Data	XOR Checksum
	AA BB	03	13	1Byte *'01'*: seek on *'00'*: seek off	XOR Checksum

Receive	Head	Length	Command	XOR Checksum
Success	AA BB	02	13	11
Failure	AA BB	02	EC	EE

Example:

Send	**AA BB 03 13 00 *10***	
Description	AA BB	*Head of this COMMAND*
	03	*Length of this COMMAND*
	13	*COMMAND*
	00	*00: auto off*
	10	*03 ⊕13 ⊕00*
Receive(Success)	**AA BB 02 13 *11***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	13	*COMMAND*
	11	*02 ⊕13*
Receive(Failure)	**AA BB 02 EC *EE***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	EC	*One's complement of COMMAND*
	EE	*02 ⊕EC*

5.8 Set Buzzer ON/OFF

Command description: Set the buzzer ON or OFF, and control the buzzer beep times.

Data Frame Format:

Send	Head	Length	Command	Data	XOR Checksum
	AA BB	03	14	1Byte	XOR Checksum

				'1y': Buzzer ON and sound *y* times *'0F'*: Buzzer OFF	

Receive	Head	Length	Command	XOR Checksum
Success	AA BB	02	14	16
Failure	AA BB	02	EB	E9

Example:

Send	**AA BB 03 14 13 *04***	
Description	AA BB	*Head of this COMMAND*
	03	*Length of this COMMAND*
	14	*COMMAND*
	13	*beep 3 times*
	04	*03 ⊕14 ⊕13*
Receive(Success)	**AA BB 02 14 *16***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	14	*COMMAND*
	16	*02 ⊕14*
Receive(Failure)	**AA BB 02 EB *E9***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	EB	*One's complement of COMMAND*
	E9	*02 ⊕EB*

5.9 Set buzzer beep time interval

Command description: Set buzzer beep time interval .

Data Frame Format:

Send	Head	Length	Command	Ringing Interval	XOR Checksum
	AA BB	03	15	1Byte	XOR Checksum

Receive	Head	Length	Command	XOR Checksum
Success	AA BB	02	15	17
Failure	AA BB	02	EA	E8

Example:

Send	**AA BB 03 15 10 *06***	
Description	AA BB	*Head of this COMMAND*
	03	*Length of this COMMAND*
	15	*COMMAND*
	10	*Beep time Interval*
	06	*03 ⊕15 ⊕10*
Receive(Success)	**AA BB 02 15 *17***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	15	*COMMAND*
	17	*02 ⊕17*
Receive(Failure)	**AA BB 02 EA *E8***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	EA	*One's complement of COMMAND*
	E8	*02 ⊕EA*

5.10 Output 1

Command description: Set Output1

Data Frame Format:

Send	Head	Length	Command	Data	XOR Checksum
	AA BB	03	16	1Byte *'00'*: Output *'0'* *'01'*: Output *'1'*	XOR Checksum

Receive	Head	Length	Command	XOR Checksum
Success	AA BB	02	16	14
Failure	AA BB	02	E9	EB

Example:

Send	**AA BB 03 16 01 *04***	
Description	AA BB	*Head of this COMMAND*
	03	*Length of this COMMAND*
	16	*COMMAND*
	01	*Output 1*
	04	*03 ⊕16 ⊕01*
Receive(Success)	**AA BB 02 16 *14***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	15	*COMMAND*
	17	*02 ⊕17*
Receive(Failure)	**AA BB 02 E9 *EB***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	E9	*One's complement of COMMAND*
	EB	*02 ⊕E9*

5.11 Output 2

Command description: Set Output2

Data Frame Format:

Send	Head	Length	Command	Data	XOR Checksum
	AA BB	03	17	1Byte *'00'*: Output *'0'* *'01'*: Output *'1'*	XOR Checksum

Receive	Head	Length	Command	XOR Checksum
Success	AA BB	02	17	15
Failure	AA BB	02	E8	EA

Example:

Send	**AA BB 03 17 01 *05***	
Description	AA BB	*Head of this COMMAND*
	03	*Length of this COMMAND*
	17	*COMMAND*
	01	*Output 1*
	05	*03 ⊕17 ⊕01*
Receive(Success)	**AA BB 02 17 *15***	

Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	17	*COMMAND*
	15	*02 ⊕17*
Receive(Failure)	**AA BB 02 E8 *EA***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	E8	*One's complement of COMMAND*
	EA	*02 ⊕E8*

5.12 Card Type

Command description: Read card type. S50 card is *'0x0400'*，S70 card is *'0x0200'*，the others can refer to card datasheet.

Data Frame Format:

Send	Head	Length	Command	XOR Checksum
	AA BB	02	19	1B

Receive	Head	Length	Command	Card Type	XOR Checksum
Success	AA BB	04	19	2Bytes	XOR Checksum
Failure	AA BB	02	E6	-	E4

Example:

Send	**AA BB 02 19 *1B***	
Description	AA BB	*Head of this COMMAND*
	02	*Length of this COMMAND*
	19	*COMMAND*
	1B	*02 ⊕19*
Receive(Success)	**AA BB 04 19 04 00 *19***	
Description	AA BB	*Head of this DATA*
	04	*Length of this DATA*
	19	*COMMAND*
	04 00	*Card TYPE 04 00: S50 Card; 02 00: S70 Card*
	19	*02 ⊕19 ⊕04 ⊕00*
Receive(Failure)	**AA BB 02 E6 *E4***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	E6	*One's complement of COMMAND*
	E4	*02 ⊕E6*

5.13 Card serial number

Command description: This command reads card serial number

Data Frame Format:

Send	Head	Length	Command	XOR Checksum
	AA BB	02	20	22

Receive	Head	Length	Command	Card SN	XOR Checksum
Success	AA BB	06	20	4Bytes	XOR Checksum
Failure	AA BB	02	DF	-	DD

Example:

Send	**AA BB 02 20 *22***

Description	AA BB	*Head of this COMMAND*
	02	*Length of this COMMAND*
	20	*COMMAND*
	22	*02 ⊕20*
Receive(Success)	**AA BB 06 20 *92 BF72 59* *20***	
Description	AA BB	*Head of this DATA*
	06	*Length of this DATA*
	20	*COMMAND*
	92 BF 72 59	*Card SN*
	20	*06 ⊕20 ⊕92 ⊕BF ⊕72 ⊕59*
Receive(Failure)	**AA BB 02 DF *DD***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	DF	*One's complement of COMMAND*
	DD	*02 ⊕DF*

5.14 Block read

Command description: Read data from appointed card's block.

Data Frame Format:

Send	Head	Length	Command	Key A or Key B	Block Number	Key	XOR Checksum
	AA BB	0A	21	1Byte *'00'*: Key A *'01'*: Key B	1Byte	6 Bytes	XOR Checksum

Receive	Head	Length	Command	Block Data	XOR Checksum
Success	AA BB	12	21	16Bytes	XOR Checksum
Failure	AA BB	02	DE	-	DC

Example:

Send	**AA BB 0A 21 00 08 *FFFFFF* *23***	
Description	AA BB	*Head of this COMMAND*
	0A	*Length of this COMMAND*
	21	*COMMAND*
	00	*Authenticate with A Key*
	08	*Read Block 08*
	FF FF FF FF FF FF	*Keys*
	23	*0A ⊕21 ⊕00 ⊕08 ⊕FF ⊕FF ⊕FF ⊕FF ⊕FF ⊕FF*
Receive(Success)	**AA BB 12 21 *00 11 22 33 44 55 66 77 88 99 AA BB CC DD EE F* *23***	
Description	AA BB	*Head of this DATA*
	12	*Length of this DATA*
	21	*COMMAND*
	00 11 22 33 44 55 66 77	*16 Bytes Data of Block 08*
	88 99 AA BB CC DD EE	
	FF	
	23	*12 ⊕21 ⊕00 ⊕11 ⊕22 ⊕33 ⊕44 ⊕55 ⊕66 ⊕77 ⊕88 ⊕99 ⊕AA ⊕BB ⊕CC ⊕DD ⊕EE ⊕FF*
Receive(Failure)	**AA BB 02 DE *DC***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	DE	*One's complement of COMMAND*
	DC	*02 ⊕DE*

5.15 Block Write

Command description: Write data to appointed card's block.

Data Frame Format:

Send	Head	Length	Command	Key A or Key B	Block Number	Key	Data want to write	XOR Checksum
	AA BB	1A	22	1Byte *'00'*: Key A *'01'*: Key B	1Byte	6 Bytes	16Bytes	XOR Checksum

Receive	Head	Length	Command	XOR Checksum
Success	AA BB	02	22	20
Failure	AA BB	02	DD	DF

Example:

Send	**AA BB 1A 22 00 08 *FFFFFF* *00 11 22 33 44 55 66 77* *88 99 AA BB CC DD EE F* *30***	
Description	AA BB	*Head of this COMMAND*
	1A	*Length of this COMMAND*
	22	*COMMAND*
	00	*Authenticate with A Key*
	08	*Read Block 08*
	FF FF FF FF FF FF	*Keys*
	00 11 22 33 44 55 66 77	*16 Bytes Data want to Write*
	88 99 AA BB CC DD EE	
	FF	
	30	*1A ⊕21 ⊕00 ⊕08 ⊕FF ⊕FF ⊕FF ⊕FF ⊕FF ⊕FF ⊕00 ⊕11 ⊕22 ⊕33 ⊕44 ⊕55 ⊕66 ⊕77 ⊕88 ⊕99 ⊕AA ⊕BB ⊕CC ⊕DD ⊕EE ⊕FF*
Receive(Success)	**AA BB 02 22 *20***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	22	*COMMAND*
	20	*02 ⊕22*
Receive(Failure)	**AA BB 02 DD *DF***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	DD	*One's complement of COMMAND*
	DF	*02 ⊕DD*

5.16 Initialize ePurse

Command description: Initialize block as epurse value, the 4-byte purse value of command related to purse operation is low byte first, and the purse value is 4 bytes signed.

Data Frame Format:

Send	Head	Length	Command	Key A or Key B	Block Number	Key	Purse Value	XOR Checksum
	AA BB	0E	23	1Byte *'00'*: Key A *'01'*: Key B	1Byte	6 Bytes	4Bytes (LSB⋯MSB)	XOR Checksum

Receive	Head	Length	Command	XOR Checksum
Success	AA BB	02	23	21
Failure	AA BB	02	DC	DE

Example:

Send	AA BB 0E 23 00 09 FFFFFF 11 11 00 00 24	
Description	AA BB	*Head of this COMMAND*
	0E	*Length of this COMMAND*
	23	*COMMAND*
	00	*Authenticate with A Key*
	09	*Initialize Block 09 as a Purse*
	FF FF FF FF FF FF	*Keys*
	11 11 00 00	*4 Bytes Value of Purse*
	24	*0E ⊕23 ⊕00 ⊕09 ⊕FF ⊕FF ⊕FF ⊕FF ⊕FF ⊕FF ⊕11 ⊕11 ⊕00 ⊕00*
Receive(Success)	AA BB 02 23 21	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	23	*COMMAND*
	21	*02 ⊕23*
Receive(Failure)	AA BB 02 DC DE	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	DC	*One's complement of COMMAND*
	DE	*02 ⊕DC*

5.17 Read Purse Value

Command description: Read purse value.

Data Frame Format:

Send	Head	Length	Command	Key A or Key B	Block Number	Key	XOR Checksum
	AA BB	0A	24	1Byte *'00'*: Key A *'01'*: Key B	1Byte	6Bytes	XOR Checksum

Receive	Head	Length	Command	Purse Value	XOR Checksum
Success	AA BB	06	24	4Bytes (LSB⋯MSB)	XOR Checksum
Failure	AA BB	02	DB	-	D9

Example:

Send	AA BB 0A 24 00 09 FFFFFF 27	
Description	AA BB	*Head of this COMMAND*
	0A	*Length of this COMMAND*
	24	*COMMAND*
	00	*Authenticate with A Key*
	09	*Block 09 is a Purse*
	FF FF FF FF FF FF	*Keys*
	27	*0A ⊕24 ⊕00 ⊕09 ⊕FF ⊕FF ⊕FF ⊕FF ⊕FF ⊕FF*
Receive(Success)	AA BB 06 24 11 11 00 00 22	
Description	AA BB	*Head of this DATA*
	06	*Length of this DATA*
	24	*COMMAND*
	11 11 00 00	*Value of Purse*
	22	*06 ⊕24 ⊕11 ⊕11 ⊕00 ⊕00*
Receive(Failure)	AA BB 02 DB D9	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	DB	*One's complement of COMMAND*

	D9	*02 ⊕DB*

5.18 Increase Purse Value

Command description: Increase purse value

Data Frame Format:

Send	Head	Length	Command	Key A or Key B	Block Number	Key	Increase Value	XOR Checksum
	AA BB	0E	25	1Byte *'00'*: Key A *'01'*: Key B	1Byte	6 Bytes	4Bytes (LSB⋯MSB)	XOR Checksum

Receive	Head	Length	Command	XOR Checksum
Success	AA BB	02	25	27
Failure	AA BB	02	DA	D8

Example:

Send	**AA BB 0E 25 00 09 *FFFFFF* *11 11 00 00* *22***	
Description	AA BB	*Head of this COMMAND*
	0E	*Length of this COMMAND*
	25	*COMMAND*
	00	*Authenticate with A Key*
	09	*Block 09 is a Purse*
	FF FF FF FF FF FF	*Keys*
	11 11 00 00	*Vlaue of Increase*
	22	*0E ⊕25 ⊕00 ⊕09 ⊕FF ⊕FF ⊕FF ⊕FF ⊕FF ⊕FF ⊕11 ⊕11 ⊕00 ⊕00*
Receive(Success)	**AA BB 02 25 *27***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	25	*COMMAND*
	27	*02 ⊕25*
Receive(Failure)	**AA BB 02 DA *D8***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	DA	*One's complement of COMMAND*
	D8	*02 ⊕DA*

5.19 Decrease Purse Value

Command description: Decrease purse value

Data Frame Format:

Send	Head	Length	Command	Key A or Key B	Block Number	Key	Decrease Value	XOR Checksum
	AA BB	0E	26	1Byte *'00'*: Key A *'01'*: Key B	1Byte	6 Bytes	4Bytes (LSB⋯MSB)	XOR Checksum

Receive	Head	Length	Command	XOR Checksum
Success	AA BB	02	26	24
Failure	AA BB	02	D9	DB

Example:

Send	**AA BB 0E 26 00 09 *FFFFFF* *11 11 00 00* *21***

Description	AA BB	*Head of this COMMAND*
	0E	*Length of this COMMAND*
	26	*COMMAND*
	00	*Authenticate with A Key*
	09	*Block 09 is a Purse*
	FF FF FF FF FF FF	*Keys*
	11 11 00 00	*Vlaue of Decrease*
	21	*0E ⊕26 ⊕00 ⊕09 ⊕FF ⊕FF ⊕FF ⊕FF ⊕FF ⊕FF ⊕11 ⊕11 ⊕00 ⊕00*
Receive(Success)	**AA BB 02 26 24**	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	26	*COMMAND*
	24	*02 ⊕26*
Receive(Failure)	**AA BB 02 D9 *DB***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	D9	*One's complement of COMMAND*
	DB	*02 ⊕D9*

5.20 Read Module's EEPROM

Command description: Read data from module's EEPROM

Data Frame Format:

Send	Head	Length	Command	Address LSB	Address MSB	Length	XOR Checksum
	AA BB	05	30	1Byte	1Byte	1Byte	XOR Checksum

Receive	Head	Length	Command	EEPROM Data	XOR Checksum
Success	AA BB	02+n(n=Length)	30	n Bytes(n=Length)	XOR Checksum
Failure	AA BB	02	CF	-	CD

Example:

Send	**AA BB 05 30 00 00 04 *02***	
Description	AA BB	*Head of this COMMAND*
	05	*Length of this COMMAND*
	30	*COMMAND*
	00	*EEPROM Address LSB*
	00	*EEPROM Address MSB*
	04	*Length*
	02	*05 ⊕30 ⊕00 ⊕00 ⊕04*
Receive(Success)	**AA BB 06 30 *00 00 02 01* *35***	
Description	AA BB	*Head of this DATA*
	06	*Length of this DATA*
	30	*COMMAND*
	00 00 02 01	*EEPROM Data*
	35	*06 ⊕30 ⊕00 ⊕00 ⊕02 ⊕01*
Receive(Failure)	**AA BB 02 CF *CD***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	CF	*One's complement of COMMAND*
	CD	*02 ⊕CF*

5.21 Write Module's EEPROM

Command description: Write data to module's EEPROM

Data Frame Format:

Send	Head	Length	Command	Address LSB	Address MSB	Length (<16)	Data	XOR Checksum
	AA BB	05+n (n=Length)	31	1Byte	1Byte	1Byte	n Bytes (n=Length)	XOR Checksum

Receive	Head	Length	Command	XOR Checksum
Success	AA BB	02	31	33
Failure	AA BB	02	CE	CC

Example:

Send	**AA BB 09 31 00 00 04 *00 11 22 33* *3C***	
Description	AA BB	*Head of this COMMAND*
	09	*Length of this COMMAND*
	31	*COMMAND*
	00	*EEPROM Address LSB*
	00	*EEPROM Address MSB*
	04	*Length*
	00 11 22 33	*Data to Write*
	3C	*09 ⊕31 ⊕00 ⊕00 ⊕04 ⊕00 ⊕11 ⊕22 ⊕33*
Receive(Success)	**AA BB 02 31 *33***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	31	*COMMAND*
	33	*02 ⊕31*
Receive(Failure)	**AA BB 02 CE *CC***	
Description	AA BB	*Head of this DATA*
	02	*Length of this DATA*
	CE	*One's complement of COMMAND*
	CC	*02 ⊕CE*

6. ELECTRICAL CHARACTERISTICS

6.1 ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	MIN	MAX	UNIT
Tamb,abs	Ambient or Storage Temperature Range	-40	+150	°C
VDD	DC Supply Voltages	-0.5	6	V
Vin,abs	Absolute voltage on any digital pin to GND	-0.5	VDD +0.5	V

Table 6-1: Absolute Maximum Ratings

6.2 **Operating Condition Range**

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT

Tamb	Ambient Temperature	-	-25	+25	+85	°C
VDD	DC Supply Voltages	GND = 0V	3.0	3.3	3.6	V
			4.5	5.0	5.5	V
RD	Reading Distance	VDD=5.0V	0	50	60	mm
		VDD=3.3V	0	35	50	
WD	Writing Distance	VDD=5.0V	0	45	55	mm
		VDD=3.3V	0	30	45	

Table 6-2: Operating Condition Range

6.3 Current Consumption

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
IVDD1	Supply Current 1 VDD=4.5V-5.5V	Continuous read or write		70	150	mA
		Antenna Soft Power Down		11	20	mA
		Module Hard Power Down		70	160	µA
IVDD2	Supply Current 2 VDD=3.0V-3.6V	Continuous read or write		45	120	mA
		Antenna Soft Power Down		8	16	mA
		Module Hard Power Down		65	150	µA

Table 6-3: Current Consumption

6.4 E²PROM CHARACTERISTICS

The E²PROM has a size of 512x8 = 4.096 bit.

SYMBOL	PARAMETER	CONDITIONS	MIN	MAX	UNIT
$t_{EEEndurance}$	Data Endurance		100.000		erase/write cycles
$t_{EERetention}$	Data Retention	Tamb ≤55°C	10		years
$t_{EEErase}$	Erase Time			4	ms
$t_{EEWrite}$	Write Time			4	ms

Table 6-4:E²PROM Characteristics

7. Packaging Information

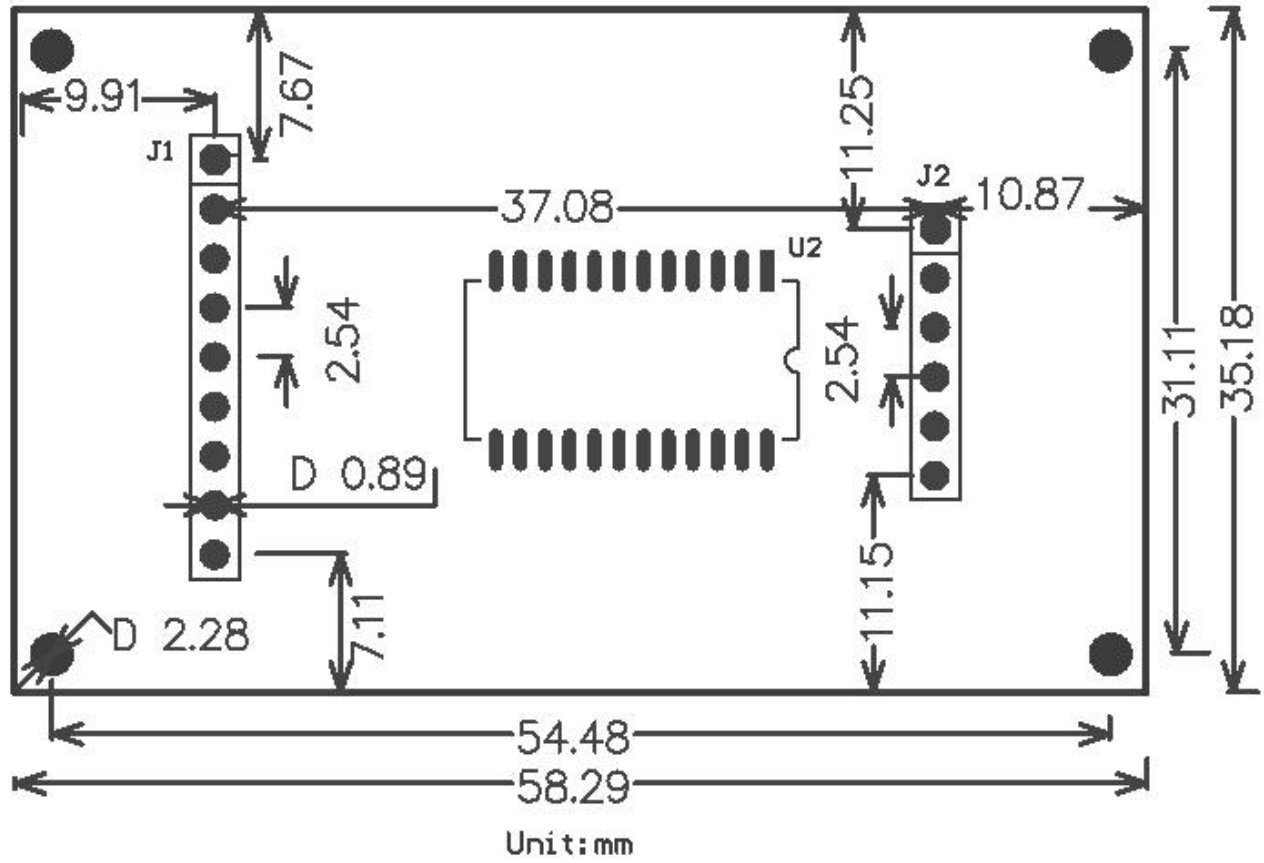


Figure 7-1 – Top View

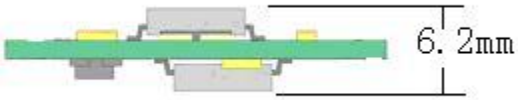


Figure 7-2 – Side View