GENERAL DESCRIPTION

RhombusMF6800ST is a high performance ISO14443 TYPE B format IC card read/write engine module. It can be applied in RFID system such as office/home security, personal identification, access control, smart card and production control.

FEATURES

- Support external balance drive transceiver antenna
- Maximum effective distance up to 100mm
- Typical R/W operation time less than 2.5ms and 6ms respectively
- Low power dissipation with single power supply;
- Support TTL level serial port
- Support SR176 and its compatible format card of ST company
- Pin description compatible with 40PIN IC socket.
- Very small outline

CHARACTERISTICS

Absolute Maximum Ratings

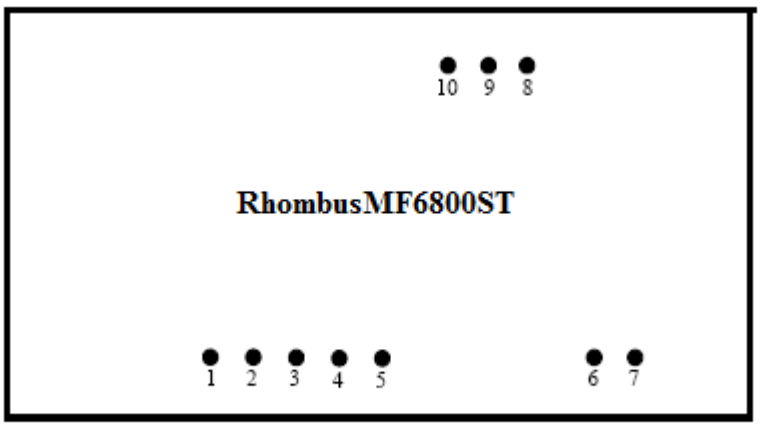
ITEM	SYMBOL	VALUE	UNIT
Power Supply	VCC	6	V
Operating Temp.	T_{OPR}	0~+70	℃
Storage Temp.	T_{STR}	-55~+125	℃

- Electrical and Mechanical Specification
  Under T_A=25℃，VCC=+5V unless specified

ITEM	SYMBOL	MIN	TYP	MAX	UNIT
Power Supply	VCC	3.3	5	5.5	V
Current Supply	I_C（work） $I_{S(standby}$）		100 10	150	mA mA
Operation Freq.	F_{REQ}		13.56		MHz
Effective Distance*	DIS	0	50	100	mm
Read operation Time **	T_{RD}		2.5		ms
Write operation Time**	T_{WR}		6		ms

*Effective Distance depends on tags, antenna design and operating environment.
**Protocol transfer time uncounted.

INTERFACE DESCRIPTION



The bottom view of engine module

NUMBER	SYMBOL	DESCRIPTION
1	TXD	Serial data output
2	RXD	Serial data input
3	LED_DRV	Working state LED output *
4	TX1	Antenna output drive 1
5	TX2	Antenna output drive 2
6	AGND	Simulation GND. Connected with digit GND in the module
7	RX	Receiving signal input, directly received by antenna loop
8	DGND	Digit GND
9	DVCC	+5V Power Supply
10	NRST	Low effective reset * *

*Module working status can be directly connected with LED outside. If the led is on, it indicates normal working state. If the led is off, it indicates the module is in standby state.

** NRST generally need not be connected, could be hung in the air. Connected with low level could reset the interior circuit of the module.

APPLICATION DATA

I. Card data

SR176 follows ISO14443-2&3TYPE B standard.

1. Performance parameter

- Accord with ISO14443-2 TYPE B RF interface criterion
- Accord with ISO14443-3 TYPE B data frames format criterion
- Operating freq. 13.56MHz
- Sub-carrier wave 847KHz
- Data exchange speed 106kbit/s
- 256bit data memory capacity
- The exclusive serial number of 64bit card, 8bit chip code, 8bit protect byte.
- 176bit can lock EEPROM user data section
- Data could be updated more than 1,000 times, could be kept more than 10 years.

2. Memory Structure

256 bit memory section of SR176 card is divided to 8 groups. 16 blocks in all. Every sector consists of 16bit.The basic unit of the access operation to SR176 data is 16bit..The Structure of memory section is as follows:

<table>
<tr><td>Block Address</td><td>Group Number</td><td colspan="3">The highest bit 16bit block data the lowest bit
b15 b8 b7 b0</td><td>Description</td></tr>
<tr><td>0</td><td rowspan="2">0</td><td colspan="3">UID0</td><td rowspan="4">Unchangeable 64bit exclusive serial number</td></tr>
<tr><td>1</td><td colspan="3">UID1</td></tr>
<tr><td>2</td><td rowspan="2">1</td><td colspan="3">UID2</td></tr>
<tr><td>3</td><td colspan="3">UID3</td></tr>
<tr><td>4</td><td rowspan="2">2</td><td colspan="3">User data section</td><td rowspan="2">Can lock EEPROM</td></tr>
<tr><td>5</td><td colspan="3">User data section</td></tr>
<tr><td>6</td><td rowspan="2">3</td><td colspan="3">User data section</td><td rowspan="2">Can lock EEPROM</td></tr>
<tr><td>7</td><td colspan="3">User data section</td></tr>
<tr><td>8</td><td rowspan="2">4</td><td colspan="3">User data section</td><td rowspan="2">Can lock EEPROM</td></tr>
<tr><td>9</td><td colspan="3">User data section</td></tr>
<tr><td>10</td><td rowspan="2">5</td><td colspan="3">User data section</td><td rowspan="2">Can lock EEPROM</td></tr>
<tr><td>11</td><td colspan="3">User data section</td></tr>
<tr><td>12</td><td rowspan="2">6</td><td colspan="3">User data section</td><td rowspan="2">Can lock EEPROM</td></tr>
<tr><td>13</td><td colspan="3">User data section</td></tr>
<tr><td>14</td><td rowspan="2">7</td><td colspan="3">User data section</td><td rowspan="2">Can lock EEPROM</td></tr>
<tr><td>15</td><td>Lock control byte</td><td>reserved</td><td>chip code</td></tr>
</table>

The first 4 blocks of the memory section are to save the exclusive serial number of card of 64bit,where data can not be changed.

From the 4th block to the 14th block are EEPROM user data sections of 176bit for storing data, where data could be rewritten.

The 15th block is the control block. The high 4bit of the low byte are the reserved bits.

The low 4bit are chip codes. In the application process, execute operation to a specified card using chip code. The high byte 8bit are user data section locked state byte. Every bit corresponds with the locked state of a group of memory sections. 0 indicates write operation is allowed to this group.1 indicates write operation is forbidden to this group. The 15th block has one-off programmable characteristic, namely, if a certain bit is set as 1,it is prohibited to be reset as 0. The default of this byte is 0X03, and the serial number of this card is prohibited to be rewritten.

Ⅱ. Serial port protocol

1. Serial port Specification

Data communication could be realized through serial port between RhombusMF6800ST and PC (SCM, MPU, Controller). Corresponding operation is executed according to the command and requirements of PC. The specification of data frames of serial port:1 start bit, 8 data bits , 1 stop bit, but no parity bit .Baud rate:9600. In serial communication, the least significant byte is transferred first, and the least significant bit of every byte is transferred first.

2. Control Character

Four control bytes are defined to describe the start , the end , responsion, and no-responsion of the serial communication. The details are as follows:

Definition	Symbol	Value
Start Symbol	STX	0x02
End Symbol	ETX	0x03
Responsion	ACK	0x06
No Responsion	NAK	0x15

3. Protocol Description

The communication process: First, PC send command and data to RhombusMF6800ST engine, then RhombusMF6800ST send the command execution result state and data back to PC. The communication two parties need a handshake course to start a communication, then data are transferred.

The command of PC are sent as the following form:

PC	**Data Transmission Direction**	**RhombusMF6800ST**	**Specification**
STX	→		If PC receives no ACK or NAK in

	←	ACK	20ms, STX could be re-sent. After PC receives ACK, command data block starts to be sent in 45ms. Every two adjacent byte should be sent less than 15ms one after another. In the process of sending command data block, if PC receives any message that RhombusMF6800ST send, it all indicates lost synchronization of the synchronous communication between PC and RhombusMF6800ST. Then PC could stop sending command, waiting 15ms to re-start handshake process.
command Data Block + ETX	→		

First, after PC send STX and wait for ACK that is sent back by RhombusMF6800ST to start up transferring data block, if ACK and NAK are not received within 20ms,PC could choose to re-send STX or stop communication, and carry out disposal according to communication failure. After PC receives the ACK response of RhombusMF6800ST, it will send command data block including operation command, operation data to RhombusMF6800ST.lastly, PC will send ETX character to end the transmission, and wait for the sent- back command execution result.

RhombusMF6800ST will finish command execution and send back the result in 150ms after it receives the command of PC. The following form is the returning process of the command execution result:

RhombusMF6800ST	**Data Transmission Direction**	**PC**	**SPECIFICATION**
	→		RhombusMF6800ST will end transmission if it does not receive ACK in 45ms. RhombusMF6800ST starts to respond the transmission of data block in 45ms after it receives ACK.
	←	ACK	
response Data Block + ETX	→		

After RhombusMF6800ST send STX and wait for ACK that is sent back by PC to start up transferring data block, if ACK is not received within 45ms, RhombusMF6800ST could stop communication. After RhombusMF6800ST receives the ACK response of PC, it will send response data block including command execution status, execution result data to PC. Lastly, RhombusMF6800ST will send

ETX character to end the transmission.

4. The format of data block

A. Command data block

SeqNo	*Cmd*	*Len*	*Data[]*	*BCC*

SeqNo：Data package of 1 byte exchange serial number, range: 0～255. After one correct data exchange, when PC sends the next command, add 1 to the serial number. RhombusMF6800ST will return the most newly-received data package number in the response data block. The PC program can utilize this number to strengthen the integrality of the communication process, and can also neglect disposal to this number to simplify the communication process.

Cmd: Operating command notation of 1 byte, there are defined 8 commands in all.

Len: the length of command operating data of 1 byte, range:0~3, 0 denotes non operation data.

Data[]: Command operating data of Len bytes, if Len=0,it indicates there is no data.

BCC: Check sum of 1 byte is the XOR byte by byte of all data in the data block(except BCC).

BCC=SeqNo ⊕ *Cmd* ⊕ Len ⊕ Data[]

B. Response data block

SeqNo	*Status*	*Len*	*Data[] BCC*

SeqNo： Most recent-received data package exchange serial number of 1 byte.

Status： command execution result state of 1 byte, o denotes successful command execution. Other value all denote error code.

Error code	Description
0x01	Operating command notation error
0x02	Command operating data length error
0x03	Command data block check sum error
0x04	No card responsion
0x05	Card data flow format error
0x06	Card data flow CRC error
0x07	R/W address violation error(read command operating address should be 0~15;write command operating address should be 4~14)

0x08	RF output not started up(in RF close status,RhombusMF6800ST does not execute any command except start-up or close)
0x09	Write operation failure
0x0A	Lock operation failure

Len： The length of the response data of 1 byte. range:0~2 If error occurs in the command execution, the value is 0.

Data[]：Response data of Len bytes. If Len=o, it means no data.

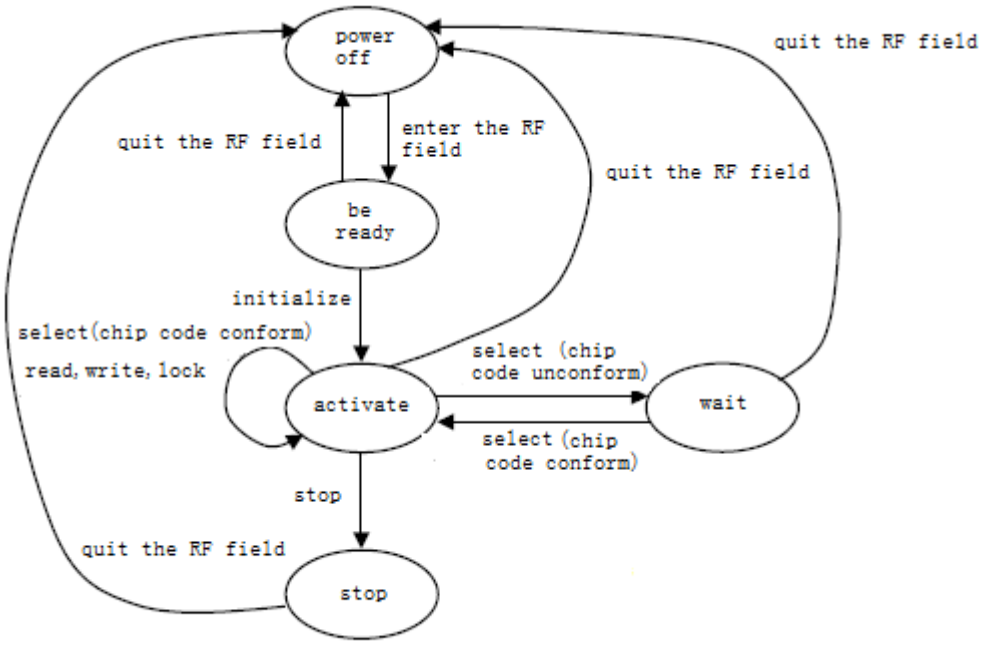
BCC：Check sum of 1 byte is the XOR byte by byte of all data in the data block(except BCC).

BCC=SeqNo ⊕ *Cmd* ⊕ Len ⊕ Data[]

5. Detailed description of operating command

RhombusMF6800ST supports 8 operating commands. They are startup RF, close RF, initialization, choose, read, write, lock, stop. Among them, the first two commands are to control the working state of the internal RF transmission circuit of RhombusMF6800ST.Other commands are for executing card operation.

SR176 Card has 5 operating states. It accepts different operation and carries out corresponding state conversion under different states as follows:



The command format supported by RhombusMF6800ST is as follows:

Command			Response			Description
Command Notation	Data Length	Content	Result State	Data Length	Data Content	
0x41	0	-	0	0	-	Startup RF output, engine enter the normal working state.
			Error Code	0	-	
0x54	0	-	0	0	-	Close RF output, engine enter the standby state.
			Error Code	0	-	
0x49	0	-	0	1	Chip code	Initialization command choose one card from the IC cards in effective RF field and place it in activation state, and return its chip code (low 4bit effective)
			Error Code	0	-	
0x53	1	Chip code(low 4bit effective, high 4bit reserved as 0)	0	1	Chip code	Choose command Choose cards with specified chip code from the IC cards in effective RF field and place it in activation state.
			Error code	0	-	
0x52	1	Block address	0	2	two-byte block data in the front of low byte row	Read command The range of block Address 0~15,the 15th block is the control block of the card
			Error code	0	-	
0x57	3	Block address + two-byte block data in the front of low byte row	0	0	-	Write command The range of block address 4~14
			Error code	0	-	
0x50	2	Two-byte card	0	0		Lock command

		control block data in the front of low byte row	Error code	0	-	The content actually written in is the logic or of the former control block data and the specified data in command
0x48	0	-	0	0	-	Stop command Card will cease all responses after it receives stop command until the card is removed from and reenter the effective RF field
			Error code	0	-	

6. Example

Read the content of the 5th block of one card(If RF output is started, the chip code is 0,and the data of the 5th block inside the card is 0X55AA, the following forms are the content of the communication between PC and RhombusMF6800ST)

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The 1ST step: Initialization

Command	PC	STX		0x00 0x49 0x00 0x49	ETX
		↓	↑	↓	↓
	RhombusMF6800ST		ACK		

Response	PC		ACK		
		↑	↓	↑	↑
	RhombusMF6800ST	STX		0x00 0x00 0x01 0x00 0x01	ETX

The 2nd step: select(If operating directly after initialization, this step could be omitted)

Command	PC	STX		0x01 0x53 0x01 0x00 0x53	ETX
		↓	↑	↓	↓
	RhombusMF6800ST		ACK		

Response	PC		ACK		
		↑	↓	↑	↑
	RhombusMF6800ST	STX		0x01 0x00 0x01 0x00 0x00	ETX

The 3rd step: read

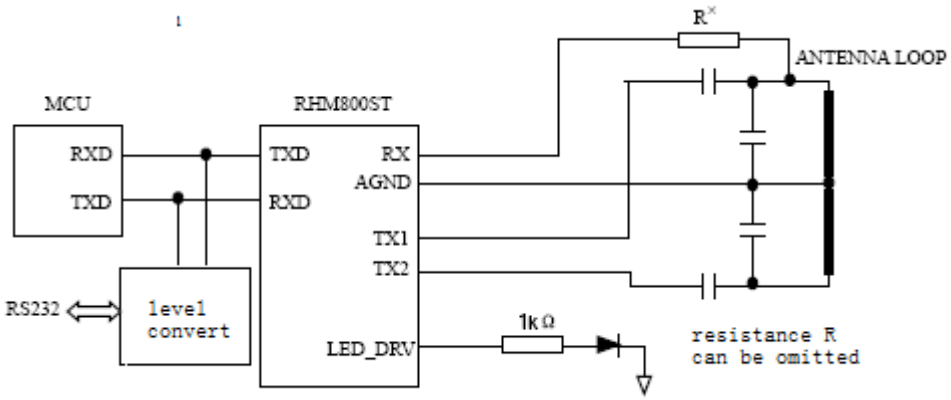
Command	PC	STX		0x02 0x52 0x01 0x05 0x54	ETX

		↓	↑	↓	↓
	RhombusMF6800ST		ACK		

Response	PC		ACK		
		↑	↓	↑	↑
	RhombusMF6800ST	STX		0x02 0x00 0x02 0xAA 0x55 0xFF	ETX

III. Typical application circuit

RhombusMF6800ST supports external balance drive RF antenna. The serial port can be directly connected with SCM serial port or connected with RS232 interface of PC after level transfer. The typical design for reference is as follows:



Note: Rhombus' products must work with linear regulated power supply, and other kinds of power supply are prohibited.