

1. Communication Interface Specification

Data communication could be realized through RS232 serial communication interface between RR9001Lite reader/writer and epigyny computer (SCM, MPU, Controller and so on). Corresponding operation is executed according to the command and requirements of epigyny computer. The specification of data frames of serial communication interface: 1 start bit, 8 data bits, 1 stop bit, but no parity bit. Baud rate: 19200. In serial communication process, the least significant byte is transferred first, and the least significant bit of every byte is transferred first.

2. Protocol Description

The communication process: First, epigyny computer send command and data to the reader/writer, then the reader/writer send the command execution result state and data back to epigyny computer.

When reader/writer is powered up, it will send a data of 4-byte to the serial port to check if loop is formed between the sending end of the receiving end (pin 2,3) of the serial port. If loop is formed, reader/writer will enter into "demo mode"

Epigyny Computer	Data Transmission Direction	Reader/Writer	Specification
Command Data Block	→		In the data string which epigyny computer sent, every two adjacent byte should be sent less than 15ms one after another. In the process of sending command data block of the epigyny computer, if hypogyny computer receives any message that reader/writer send, it all indicates lost synchronization between the communication of epigyny computer and hypogyny computer. Then epigyny computer stop sending data, waiting 15ms to re-start sending command data block when data of the reader/writer is not received.

The command data block that epigyny computer send to reader/writer should accord with the requirement of this protocol, the epigyny computer send command data block such as reader/writer address, operating command notation, operating control notation, command operating data, CRC-16 to reader/writer, and wait for reader/writer to return the command execution result.

Reader/writer will finish command execution in 1s (The time reader/writer send data to epigyny computer is not included) after receiving the command of PC. In this period, reader/writer will not deal with the data that epigyny computer send.

The following form is the returning process of the command execution result:

Reader/writer	Data Transmission Direction	PC	Specification
Response Data Block	→		Every two adjacent byte should be sent less than 15ms one after another.

After reader/writer execute command and get the result, it will send response data block including reader/writer address, command execution result status value, response data to epigyny computer. Then a complete communication process has been finished.

3. Data Block Format

A. Command Data Block

Len	Com_adr	Cmd	State	Data[]	LSB-CRC16	MSB-CRC16
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Len: The length of command data block of 1 byte(the self byte not included),value ranges from 5~25. The length of Len equals the length of (5+Data[]). Notice: the value of Len should be the same with the number of data which is followed by Len.

Com_adr: The reader/writer address of length of 1 byte. When the value range is: 0~254,only reader/writer that match this address could have response to this command data block. When the value is 255 (the broadcast address), all the reader/writer will have response to the command data block.

Cmd: Operating command notation of length of 1 byte. 4 commands has been defined in all.

State: Operating control notation of length of 1 byte. Low 4 bit control operating mode(the value is selected according to every command) high 4 bit are control operating type. When the value is 0,it indicates ISO/IEC 15693 protocol command. When the value is F, it indicates command can be self-defined by reader/writer . Other value are ineffective.

Data[]: Command operating data. Give necessary data to run commands. If Len=5,it means no data.

CRC16: CRC-16 check sum of length of 2 bytes. The low byte lined afore.

B. Response Data Block

Len	Com_adr	Cmd	Status	Data[]	LSB-CRC16	MSB-CRC16
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Len : the length of response data block of 1 byte ,value ranges from 4~28.If the value is 4,it means no operating data. The length of Len equals the length of(4+Data[]).

Com_adr: reader/writer address of length of 1 byte, range: 0~254.

Status: The command execution result status value of length of 1 byte,?

Data[]: Response data. Tags information got after running commands. If Len=4,it means no data.

CRC16: CRC-16 check sum of length of 2 bytes. The low byte lined afore.

Notice: when command data does not meets the requirements; reader/writer will not have any response.

The default config of reader/writer address Com-adr is 0x00.

Calculation of Cyclic Redundancy Code (CRC) includes all data starting from Len. Low byte of CRC lined afore in transmission. Multinomial got from CRC calculation should be the same with that defined in ISO/IEC 15693 protocol. But note that the calculation result does not negate. For example: if we calculate data block 0x05,0xFF,0x01,0x00,LSBCRC, MSB-CRC, after CRC Calculation, data LSB-CRC=0x5D, MSB-CRC=0xB2 is got.

So, when data block such as 0x05, 0xFF, 0x01, 0x00, 0x5D, 0xB2 is received, carry calculation to them (all 6 bytes), if the value which is got is 0x00 and 0x00,it means checkout has been passed. The following is a CRC calculation program of C language for reference.

Polynomial: POLYNOMIAL=0x8408;

Start Value: PRESET_VALUE=0xffff;

C-Example:

```
int i,j;
unsigned int current_crc_value=PRESET_VALUE;
for(i=0;i<len;i++) /*len=number of protocol bytes without CRC*/
{
current_crc_value=current_crc_value^((unsigned int)pData[i]);
for(j=0;j<8;j++)
{
if(current_crc_value&0x0001)
{
current_crc_value=(current_crc_value>>1)^POLYNOMIAL;
}
}
else
```

```

{
current_crc_value=(current_crc_value>>1);
}
}
}
}
pData[i++]=((unsigned char)(current_crc_value&0x00ff));
pData[i]=((unsigned char)((current_crc_value>>8)&0x00ff));

```

4. Command execution result status value list

The high 4 bits and low 4 bits of command execution result status value denote different meanings respectively. Among them, the low 4 bits are the command execution result status value. The high 4 bits are protocol type codes. In ISO/IEC 15693 protocol, All of the high 4 bits are 0. The following form shows the response data block, their meaning and description in different status value under ISO/IEC15693 protocol.

Response data block					Status meaning	Description
Len	Com_adr	Status	Data[]	CRC-16		
4+Data[] Part of byte	0xXX	0x00	LSM+MS B	Operation succeed	The status value returned to Epigyny computer after command execution succeeds. Data block includes the necessary information.
4	0xXX	0x01	No this item	LSM+MS B	The length of command operating data error	Status value returned to Epigyny computer when the length of command operating data in command data block sent by the epigyny computer does not meet the requirement of this command.
4	0xXX	0x02	No this item	LSM+MS B	Operating command do not support	Status value returned to epigyny computer when operating command of command data block sent by epigyny computer is not supported by reader/writer.
4	0xXX	0x05	No this	LSM+MS B	Induction field in closed status	Epigyny computer send command data block, execute ISO/IEC 15693 command.

			item			Status value returned to epigyny computer when induction field is in close status.
4	0xXX	0x0A	No this item	LSM+MS B	Specified Inventory-scan -Time overflow	When epigyny computer send command data block, and reader/writer execute Inventory, status value returned to epigyny computer when smart tag is not received before user's specified time Inventory-Scan-Time overflow.
4	0xXX	0x0B	No this item	LSM+MS B	The ULD of all Smart tags has not been received. But the specified Inventory-scan -Time overflow	When epigyny computer send command data block, and reader/writer execute Inventory-scan, status value returned to epigyny computer when all the UID are not received before user's specified time Inventory-Scan-Time overflow.
4	0xXX	0x0C	No this item	LSM+MS B	ISO error	When epigyny computer send command data block, and reader/writer execute the corresponding commands , status value returned to epigyny computer if phenomenon which does not accord with ISO/IEC 15693 protocol requirements occurs.
4	0xXX	0x0E	No this item	LSM+MS B	No smart tag could be operated	When epigyny computer send command data block, and reader/writer execute the corresponding commands , status value returned to epigyny computer if no smart tag

						could be operated in the induction field.
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- ◆ Note:, The length of response data block(Len) and response data(data[]) of status “0x00” could be different as the commands are different. We will give details in the detailed introduction of every command.
- ◆ Note: When status is being other value, the content and the length of response data block are fixed. So, we will not give explanation of these response data blocks in the detailed introduction of every command.

5 Operation Order Detailed Description

RR9001Lite reader supports 4 items of orders. Every order has multi run mode. The follows are descriptions of orders that RR9001Lite reader supports.

5.1 ISO/IEC15693 Protocol Order

When Epigyny computer sends ISO/IEC15693 Protocol Order, the highest 4 digits of operation control symbol (State) must be 0.

ISO/IEC15693 Protocol Order can run as long as reader’s inductive field is open. Otherwise reader needs to open inductive field by his self-defining order (OPEN RF). When reader connects to power, the inductive field is open.

5.1.1 Inventory

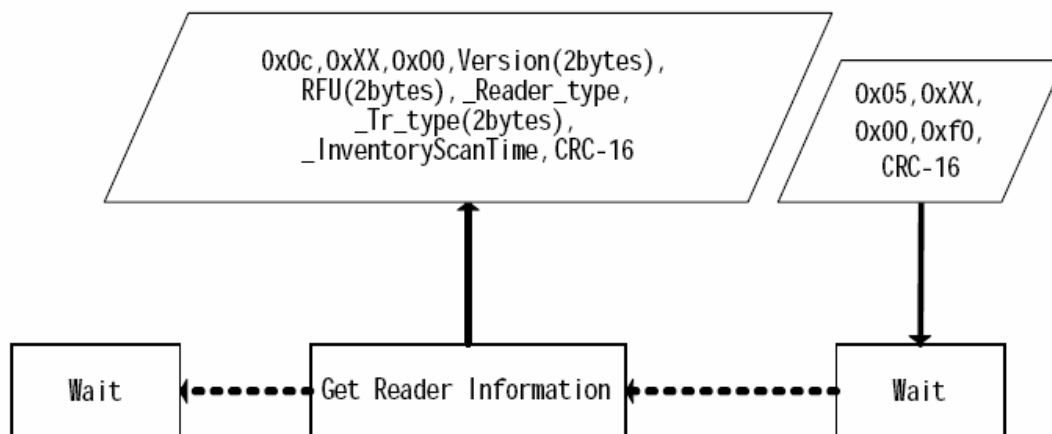
The role of Inventory is to check whether there are cards during its effective range. If reader wants to run other operations to unknown UID of new smart labels, reader should get label’s UID through Inventory first. When the reader comes out of the factory, it has been set the Inventory-Scan-Time 3s.

Model	State	Data[]	Description
Inventory-scan	0x06	NO item	Before running inventory, reader will run CLOSE RF and OPEN RF automatically. Thus, the entire smart labels match with the protocol in the inductive field can answer it, and then reader will return all the UID that it got.
	0x02	NO item	Because reader can not handle inductive field, only smart labels coming into the inductive field newly or that ones whose inventory order don’t get UID will answer, and then reader will return UID it gets.

Format of Order Data Block and Response Data Block are as follows:

Len	Com_adr	Cmd	State	Data[]	CRC-16	
0x05	0xXX	0x01	0x06(new inventory)	—	LSB	MSB
0x05	0xXX	0x01	0x02(continuing inventory)	—	LSB	MSB
Len	Com_adr	Status	Data[]		CRC-16	
0x0d	0xXX	0x00	DSFID, UID-1		LSB	MSB
0x0d	0xXX	0x00	DSFID, UID-2		LSB	MSB

Len	Com adr	Cmd	State	Data[]	CRC-16	
0x05	0xXX	0x00	0xf0	—	LSB	MSB
Len	Com adr	Status	Data[]		CRC-16	
0x0c	0xXX	0x00	Version(2bytes), RFU(2bytes) _Reader_type, _Tr_type(2bytes), _InventoryScanTime		LSB	MSB

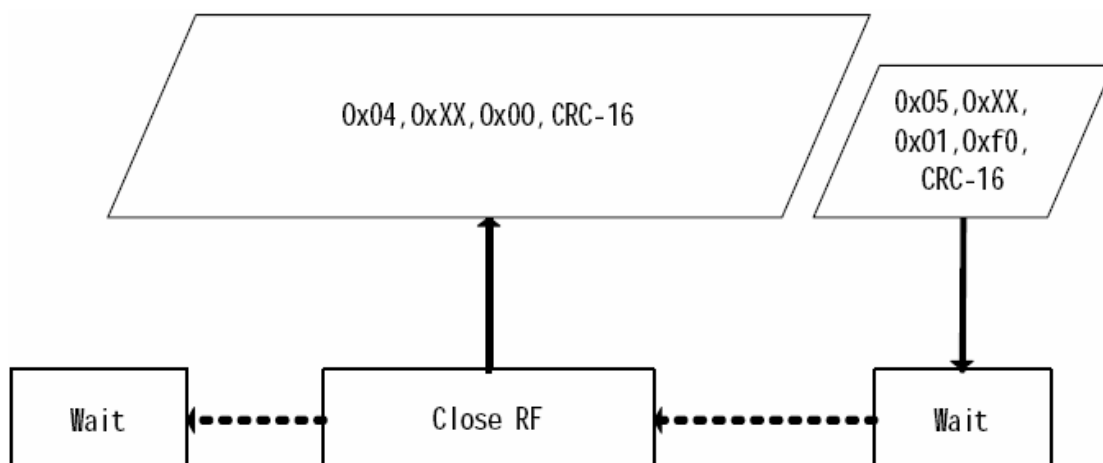


Notes: arrowed broken line stands for reader's inner flow; arrowed real line stands for the communication between reader and epigyny computer.

5.2.2 Close RF

After Epigyny computer makes reader/writer carry out this order though sending order data block, reader's inductive field will be closed. At this time, if Epigyny computer sends order data block to make reader carry out ISO/IEC15693 order, reader will do nothing except returning to the fixed response data block to inform that inductive field is closed.

Len	Com adr	Cmd	State	Data[]	CRC-16	
0x05	0xXX	0x01	0xf0	—	LSB	MSB
Len	Com adr	Status	Data[]		CRC-16	
0x04	0xXX	0x00	—		LSB	MSB



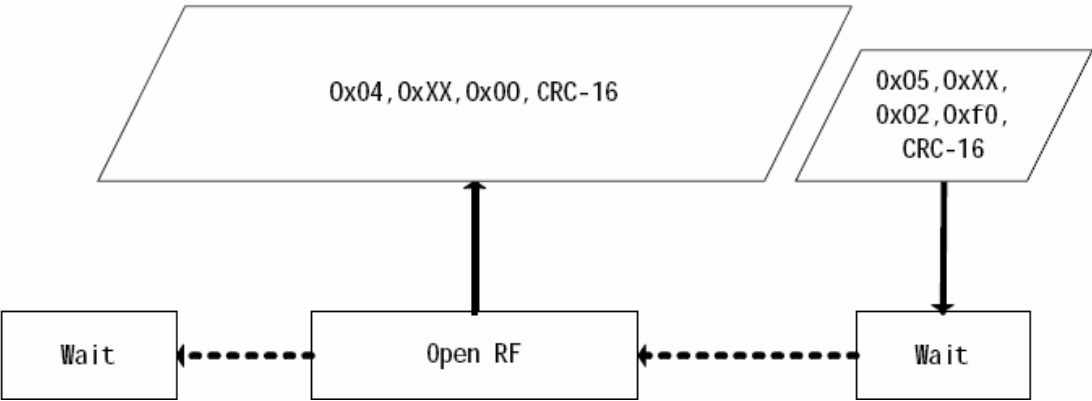
Notes: arrowed broken line stands for reader's inner flow; arrowed real line stands for the communication between reader and Epigyny computer.

5.2.3 Open RF

After Epigyny computer makes reader/writer carry out this order though sending order data block, reader's inductive field will be open. ISO/IEC15693 protocol order can be carried out as long as inductive field is open.

When reader connects to power, inductive field is open.

Len	Com_adr	Cmd	State	Data[]	CRC-16	
0x05	0xXX	0x02	0xf0	—	LSB	MSB
Len	Com_adr	Status	Data[]		CRC-16	
0x04	0xXX	0x00	—		LSB	MSB



Notes: arrowed broken line stands for reader's inner flow; arrowed real line stands for the communication between reader and Epigyny computer.