

## RF-URDZ100LReader technical manual



## catalogue

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## 1. Brief introduction

### 1.1 Appoint

The following terms/abbreviations are used synonymously throughout this document:

Reader, equivalent to "read/write device", "read/write device", "read head",

Electronic tag, equivalent to "code carrier", "responder";

This device, equivalent to "this product", refers to the product model or series Described in this manual.

### 1.2 Purpose of this document

This manual contains all the information required for proper use of the device, including the necessary functions, performance, and use methods. It is intended for Both programmers and test/debuggers who debug the system themselves and connect It to other units (automation systems, other programming equipment), and service and Maintenance personnel who install extensions or perform fault/error analysis.

Please read this manual carefully before installing the equipment and putting it Into operation. This manual contains instructions and comments to help you step Through installation and commissioning. This ensures trouble-free use of the product. Familiarizing yourself with this manual will give you the following benefits:

- ✓ Ensure the safe operation of the device
- ✓ Helps you take advantage of the full capabilities of your device
- ✓ Avoid errors and related failures
- ✓ Reduce maintenance and avoid cost wastage

### 1.3 The valid scope of the document

The description of this document applies to the UHF reader products of the RF-U series.

### 1.4 Declaration of conformity

This product has been developed and manufactured in compliance with Applicable North American standards and guidelines. You can request these Certificates of conformity from the manufacturer or your local sales Representative.

## 1.5 Revision history

Table 1.1 Document Version information

| versions | Revision date | Reason for modification |
|----------|---------------|-------------------------|
| V1.0     | 2017.10.20    | Editio princeps         |
|          |               |                         |
|          |               |                         |
|          |               |                         |

## 2. Safety instructions

### 2.1 Safety symbol specification

Read these instructions carefully and look at the equipment carefully before Attempting to install, operate, repair, or maintain it. The following special messages May appear in this document or on the device to prompt status information or warn of Potential hazards.

We divide the safety information into four levels: "danger", "Warning", "Attention" and "warning".

|                  |                                                                                                      |
|------------------|------------------------------------------------------------------------------------------------------|
| RiskDANGER       | Indicates a serious danger condition that, if not avoided, will<br>Result in death or serious injury |
| WarnWARNING      | Indicates a dangerous situation that, if not avoided, could result<br>in death or serious injury     |
| AttentionCAUTION | Indicates a dangerous condition that, if not avoided, may result<br>in mild or moderate injury       |
| Hint NOTICE      | Indicates information that is not related to personal injury                                         |



This is a "danger" or "warning" sign that indicates an electrical hazard  
That will result in personal injury if the instructions are not followed.



This is the "attention" symbol. Used to warn you of potential personal  
Injury. Please follow all safety tips after this symbol to avoid injury or  
death.



This is the "tip" symbol, which is used to alert the user to possible risks.  
Failure to comply with this regulation may result in equipment errors or  
Even complete failure.

### 2.2 General safety specification

This equipment can only be installed, operated, repaired and maintained by Qualified personnel. A qualified person is a person who has the skills and knowledge Related to the construction and operation of electrical equipment and its installation, And has received safety training to identify and avoid the hazards involved.



User modifications and/or repairs are dangerous and will void the Warranty and exonerate the manufacturer from any liability.



Product maintenance can only be carried out by our personnel.  
Unauthorized opening and improper servicing of the product may Result in extensive equipment damage or possible personal injury to the user.

If a serious fault occurs, stop using the device. Prevent accidental operation of The device. If repairs are required, please return the equipment to our local Representative or sales office.

The operating company is responsible for complying with applicable local safety Regulations.

Store unused equipment in its original packaging. This provides the best impact And moisture protection for the equipment. Please ensure that environmental Conditions comply with these regulations.

## 2.3 Special safety instructions



The process of starting in an uncontrolled manner may harm other Equipment or be exposed to other risky equipment, so before Commissioning, ensure that the use of the equipment does not involve Risks that may harm other equipment or is free from risks that may Harm other equipment.

### **power supply**

According to the European safety standard EN 60950, the equipment can only be Operated with limited power current sources, that is, the power supply must have Overvoltage and overcurrent protection. To prevent the power failure of this Equipment, affecting the safety of other equipment; Or an external device is faulty, Which affects the security of the device.

## 3. Product overview

The RF-URDZ100L is an industrial-grade UHF RFID read/write head that supports RS485 and Ethernet communication using the standard MODBUS communication protocol. The product is small in size, low power consumption, stable and reliable, coupled with easy installation, Especially suitable for assembly line, warehousing logistics, AGV vehicle Identification and other application scenarios. The communication Modes supported by each read head are described in Chapter 4. This Series of reading and writing devices has the following notable features:

- ✓ Designed for industrial environment, can be used in automatic line body Induction identification system.
- ✓ Is compact and suitable for use where installation conditions are limited.
- ✓ IP65 High protection level, anti-interference design, suitable for demanding RFID application environment.

## 4. Technical parameters

### 4.1 List of general technical parameters

The general technical specifications of RF-URD series read-write heads are shown in The following table:

|                               |                                      |                                                                                            |
|-------------------------------|--------------------------------------|--------------------------------------------------------------------------------------------|
| RF parameter                  | Wireless protocol                    | ISO 18000-6C (Class 1 Gen 2)                                                               |
|                               | Working frequency                    | China Frequency: 920-925 MHz (SRRC)<br>North American Frequency: 902-928 MHz (FCC Part 15) |
|                               | Output power                         | 5-27 DBM adjustable, step by 1dbm                                                          |
| Application Environment       | Operating Temperature                | -25°C ~ +60°C                                                                              |
|                               | Storage temperature                  | -40°C ~ +85°C                                                                              |
|                               | Humidity                             | 5% ~ 95%RH (without condensation)                                                          |
|                               | Waterproof and Dustproof grade       | IP65, EN 60529                                                                             |
|                               | Vibration resistance                 | 2 mm (f= 5...29.5 Hz) , EN 60068-2-6<br>7 gn (f= 29.5...150 Hz) , EN 60068-2-6             |
|                               | Rf field conducted Immunity test CS  | 3V, pass class A                                                                           |
|                               | Electrostatic Discharge immunity ESD | Contact discharge, 8KV, over class A<br>Air discharge, 15KV, over Class A<br>IEC 61000-4-2 |
| Certification and Declaration | FCC                                  | FCC PART 15C                                                                               |
|                               | RoHS instruct                        | 2011/65/EU, 2015/863/EU                                                                    |

## 4.2 RF-URDZ100L



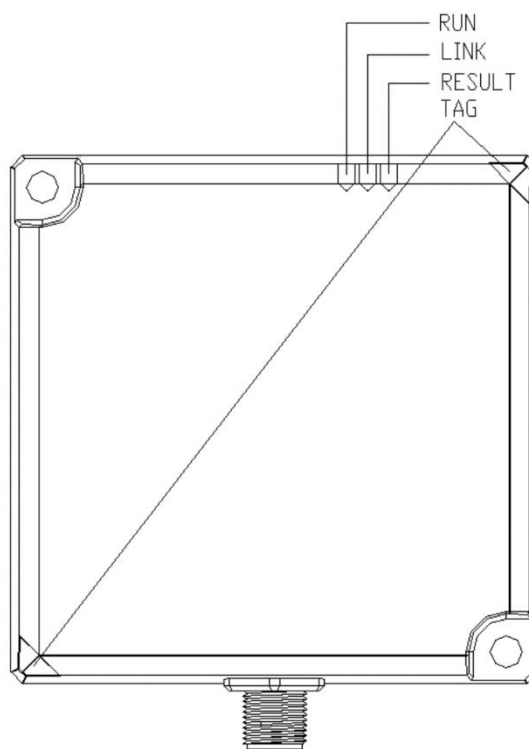
### 4.2.1 RF-URDZ100L Specification

RF-URDZ100L The technical specifications are as follows:

|                         |                         |                             |                        |
|-------------------------|-------------------------|-----------------------------|------------------------|
| Specification parameter | Product model           | RF-URDZ100L-R4              | RF-URDZ100L-TP         |
|                         | Antenna gain            | 3 dBi                       |                        |
|                         | Read distance           | 0~1.5 米 (Related to labels) |                        |
|                         | Communication Interface | RS485                       | TCP Ethernet           |
|                         | Communication rate      | 9600 ~ 115200bit/s          | 10M/100M Self-adaption |
|                         | Supply voltage          | 9~30VDC                     |                        |
|                         | Average current         | <0.2A@24VDC                 |                        |
|                         | Indicator light         | 5 LEDIndicator              |                        |
| physical parameter      | Boundary dimension      | 100×100×41.5mm              |                        |
|                         | Fixture type            | 2 ↑ M6Threaded hole         |                        |
|                         | Sheating material       | Aluminium alloy, PC+ABS     |                        |
|                         | Shell color             | Black                       |                        |
|                         | Total weight            | 280g                        |                        |

### 4.2.2 RF-URDZ100L LED Definition

RF-URDZ100L Reader provides 5 leds, namely RUN, LINK, RESULT and 2 TAG, of which 2 TAG LED display is synchronized. The distribution of leds is shown in the figure below.



The specific definition of each LED lamp is as follows:

| Name | Colour                                                                                                                | State                                                                                                       | Describe                                                                            |
|------|-----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| RUN  | Green-red<br>Two-tone<br>Light<br> | Steady on                | System power supply is normal.                                                      |
|      |                                                                                                                       | Steady on                | System exception                                                                    |
|      |                                                                                                                       | Red long blink once<br>  | The RF module is abnormal. The Indicator blinks red for 1000ms each Time            |
|      |                                                                                                                       | Red long blink twice<br> | The network module is abnormal. The Indicator is steady red for 1000ms each Time    |
|      |                                                                                                                       | Blinking red twice<br>   | If the MAC address is not initialized, The indicator blinks red for 100ms each Time |
|      |                                                                                                                       | Extinguish               | The system is not powered on or the Power supply is abnormal                        |
| LINK | Green light<br>                    | Steady on                | A TCP connection has been established Between the host and the reader.<br>Procedure |

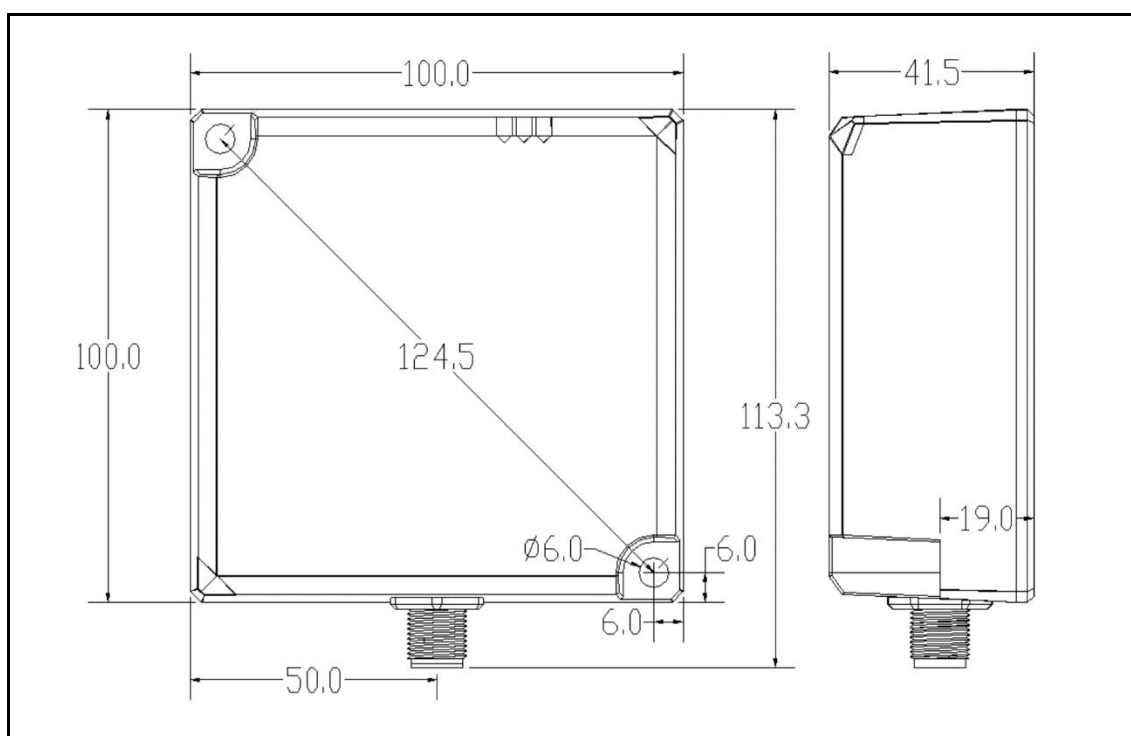


|        |                          |              |                                                     |
|--------|--------------------------|--------------|-----------------------------------------------------|
|        |                          | Flicker ●●●  | Communicating, currently using TCP                  |
|        |                          | Flicker ●●●  | Communicating using RS485                           |
|        |                          | Extinguish ● | Connectionless                                      |
| RESULT | Green light<br>●         | Steady on ●  | Instruction executed successfully                   |
|        |                          | Extinguish ● | Command execution failed or no Command was executed |
| TAG    | Green-orange light<br>●● | Steady on ●  | Excellent TAG signal                                |
|        |                          | Steady on ●  | Good TAG signal                                     |
|        |                          | Flicker ●●●  | TAG threshold                                       |
|        |                          | Extinguish ● | TAG free signal                                     |

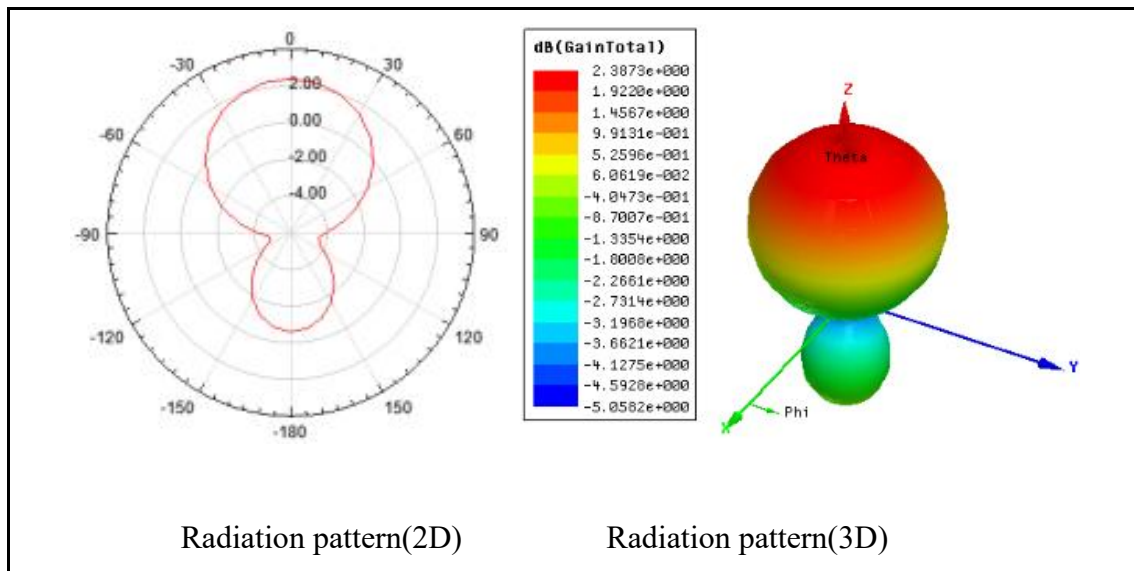
**Note:** When a red light appears on the RUN, the surface product works abnormally. If The fault persists, contact the manufacturer for technical assistance.

#### 4.2.3 RF-URDZ100L Mounting dimension

The size of the RF-URDZ100L is 100x100x41.5mm, including 2 M6 mounting Holes, and the depth of the mounting holes is 19mm, as shown in the following Figure.



#### 4.2.4 Antenna pattern



## 5. product setup

### 5.1 installation precautions

To prevent improper operation, misoperation, or negative impact on performance And equipment, please comply with the following.

#### 5.1.1 About installation site



Do not install it near devices with high heat dissipation, such as heaters, Transformers, and large-capacity resistors.

Do not install it near devices with severe electromagnetic interference, Such as large motors, transformers, transceivers, frequency converters, And switching power supplies.



When multiple readers are installed close to each other, use the sensor To trigger reading to avoid interference when multiple readers work at The same time.

If multiple labels are installed in close proximity and need to be read Accurately, it is recommended that the label spacing be at least three Times the application read distance.

#### 5.1.2 On application matters

Do not use AC power. Otherwise, there is a risk of rupture, which seriously affects the safety of people and equipment.



Use a current source with limited power to operate the device, that is, The power supply must have overvoltage and overcurrent protection. To prevent the power failure of this equipment, affecting the safety of other Equipment; Or an external device is faulty, which affects the security of The device.



Avoid incorrect wiring. Otherwise, there is the danger of cracking and burning out. Personal and device safety may be affected.



When the antenna plane of the reader is parallel to the label plane, the Identification distance is the longest. The communication distance is Shortened when the label is mounted at an Angle. Please consider the Tilt effect before installing the label.

### 5.1.3 About the use



Do not bend the cable within a radius of 40mm. Otherwise, there is the Danger of breaking the line.



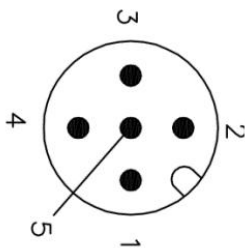
If the product is abnormal, please stop using it immediately and Contact our sales representative after cutting off the power supply.

## 5.2 Hardware interface description

The M12 connector provides both power and communication interfaces. The Communication interfaces can be RS485 or Ethernet.

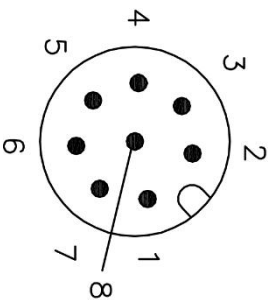
### RS-485 communication interface

RS-485 Interface adopts A-CODE M12 male head, 5-pin connector, pin defined As follows:

| Male connector                                                                                            | Pin                                                                                                                                                         | Symbol  | Describe             |
|-----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|----------------------|
|                          | Pin1                                                                                                                                                        | 24V     | Positive pole        |
|                                                                                                           | Pin2                                                                                                                                                        | RS485_A | RS-485 Signal Line A |
|                                                                                                           | Pin3                                                                                                                                                        | 0V      | Negative pole        |
|                                                                                                           | Pin4                                                                                                                                                        | RS485_B | RS-485Signal line B  |
|                                                                                                           | Pin5                                                                                                                                                        | NC      | /                    |
|  Matters need attention | 1) Shielded twisted pair is recommended for communication lines;<br>2) Communication cable length: Max<=50m;<br>3) The cable core should be 24AWG or higher |         |                      |

### Ethernet communication interface

The Ethernet interface adopts A-CODE M12 male head, 8-pin connector, and the pins are defined as follows:

| Male connector                                                                                            | Pin                                                        | Symbol | Describe                |
|-----------------------------------------------------------------------------------------------------------|------------------------------------------------------------|--------|-------------------------|
|                        | Pin1                                                       | 24V    | Positive pole           |
|                                                                                                           | Pin2                                                       | NC     | /                       |
|                                                                                                           | Pin3                                                       | 0V     | Negative pole           |
|                                                                                                           | Pin4                                                       | NC     | /                       |
|                                                                                                           | Pin5                                                       | TD+    | Ethernet data sending + |
|                                                                                                           | Pin6                                                       | TD-    | Ethernet data sending - |
|                                                                                                           | Pin7                                                       | RD+    | Ethernet data sending + |
|                                                                                                           | Pin8                                                       | RD-    | Ethernet data sending - |
|  Matters need attention | 1) The cable used is CAT5E or above, and the cable core is |        |                         |

|  |                                                             |
|--|-------------------------------------------------------------|
|  | 24AWG or above;<br>2) Communication cable length: Max≤100m. |
|--|-------------------------------------------------------------|

## 6. Product operation

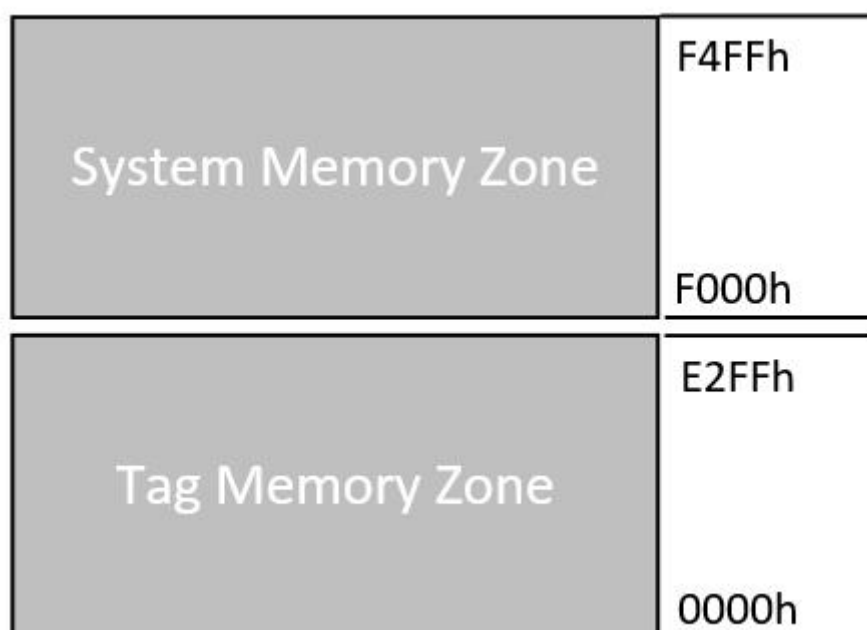
### 6.1 Register definition

- The read and write operation of the carrier and the configuration of the read Head are accomplished by accessing the register, which is mainly divided into four areas:

- label memory area

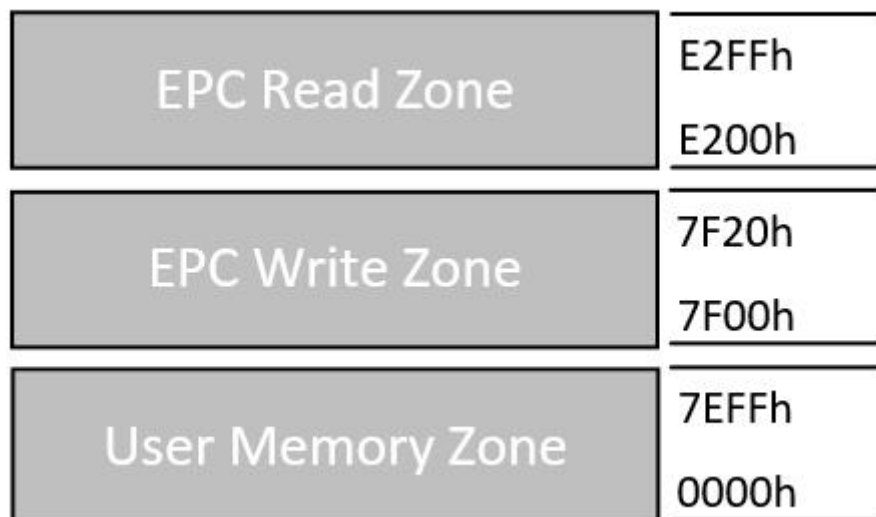
System memory area

The specific address ranges for each region are set as follows:



### 6.1.1 Label memory area

The label memory area is divided into three parts: the EPC read area, the EPC Write area, and the user memory area.



#### EPC Read area

The EPC read area is a mapping of the label EPC read result. This area is Read-only. The specific mapping relationship is as follows:

| Initial Address | End address | Number of Registers | Operation Type | Explain                                                      |
|-----------------|-------------|---------------------|----------------|--------------------------------------------------------------|
| E200 H          | E200 H      | 1                   | R <sup>①</sup> | Read trigger <sup>②</sup>                                    |
| E201 H          | E201 H      | 1                   | R              | Number of labels                                             |
| E202 H          | E202 H      | 1                   | R              | The total number of bytes for all tags                       |
| E203 H          | E203 H      | 1                   | R              | The first TAB, PC                                            |
| E204 H          | E204+x1     | x1                  | R              | The first tag, EPC, is the actual EPC length of the tag      |
| E205+x1         | E205+x1     | 1                   | R              | The first label, RSSI <sup>③</sup>                           |
| E206+x1         | E206+x1     | 1                   | R              | The second TAB, PC                                           |
| E207+x1         | E207+x1+x2  | x2                  | R              | The second label, EPC, is the actual EPC length of the label |
| E208+x1+x2      | E208+x1+x2  | 1                   | R              | The second label, RSSI                                       |
| .....           |             |                     |                | And so on, up to 32 labels can be stored                     |

注① Note 1: R is the abbreviation for Readable, indicating that the register can be

Read; W is the abbreviation of Writable, indicating that the register can be Written.

注②：The E200H register needs to be read to trigger the re-read EPC, otherwise The read is the result of the last read EPC;

注③：To obtain the power value, you need to calculate the formula:

$-39.9 + 6\log_2(Y/190)$ . You can also query the corresponding value from the Attachment.



Use suggestion

In formal use, first confirm the EPC length of a single label N words, Read N+5 registers, you can just read a label.

## EPC Write area

The EPC read area is a mapping of the label EPC read result. This area is Read-only. The specific mapping relationship is as follows:

| Initial address | End address | Number of Registers | Operation Type | Explain         |
|-----------------|-------------|---------------------|----------------|-----------------|
| 7F00 H          | 7F00 H      | 1                   | W              | PC <sup>①</sup> |
| 7F01 H          | 7F20 H      | 32                  | W              | EPC             |

注①：Note 1 The top 5 bits of PC are used to define the length of the EPC, and the

Value of the top 5 bits is the number of registers accounted for by the EPC. If The PC is 0x3000 and the high 5 bits are "00110 B", the length of the EPC is 6 registers, that is, 12 bytes. The maximum length of the EPC depends on the Tag chip, see the tag's technical manual for details.

## TID Read area

The TID read area maps the read result of the tag TID. This area is read-only. The specific mapping relationship is as follows:

| Initial address | End address | Number of registers | operation type | Explain |
|-----------------|-------------|---------------------|----------------|---------|
|-----------------|-------------|---------------------|----------------|---------|

|        |   |   |   |  |
|--------|---|---|---|--|
| E300 H | * | * | R |  |
|--------|---|---|---|--|

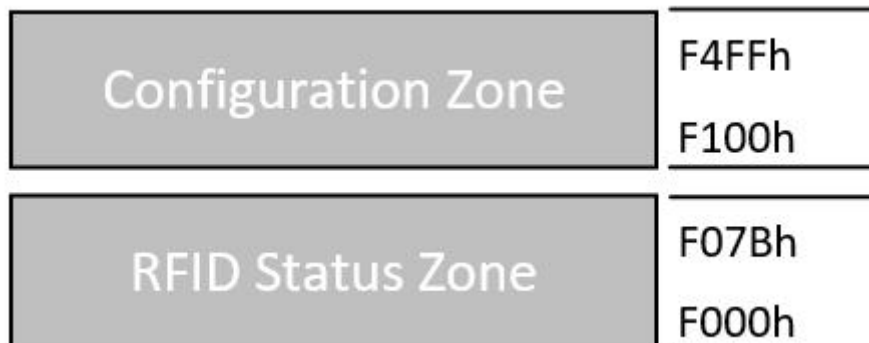
Note: The size of the TID read area is related to the size of the actual TID Memory area of the label. Different labels may have different TID sizes.

## User memory area

The definition of the user memory area is based on the size of the label user Memory, mapped to the user memory area inside the read header, to access the label, Read and write. The Alien H3 chip, for example, has 64 bytes of user memory and Maps to a user memory area with a minimum address of 0 and a maximum address of 31 (1FH). If access exceeds the label's maximum memory address, an error is Returned.

### 6.1.2 System memory area

The system memory area is divided into two parts: the RFID status area and The configuration area, where the configuration area includes the basic Configuration area, the working mode configuration area and the UHF parameter Configuration area.



## Basic configuration area

Basic configuration mainly includes device information and connection-related Parameter configurations. The registers in this part can be saved after power failure. After configuration, power off and restart take effect. The specific registers and Assigned addresses are as follows:

| Field             | Initial Address | End address | Number of Registers | Operation Type | Explain |
|-------------------|-----------------|-------------|---------------------|----------------|---------|
| Manufacturer Name | F100 H          | F109 H      | 10                  | R              |         |

|                |        |        |    |    |                                                                                                                                                                |
|----------------|--------|--------|----|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product code   | F10A H | F113 H | 10 | R  |                                                                                                                                                                |
| Version Number | F114 H | F115 H | 2  | R  |                                                                                                                                                                |
| Serial number  | F116 H | F11B H | 6  | R  |                                                                                                                                                                |
| MAC site       | F11C H | F11E H | 3  | R  |                                                                                                                                                                |
| Port number    | F11F H | F11F H | 1  | R  | Fixed value 502                                                                                                                                                |
| IP site        | F120 H | F121 H | 2  | RW | Default: 192.168.0.10                                                                                                                                          |
| Subnet mask    | F122 H | F123 H | 2  | RW | Default: 255.255.255.0                                                                                                                                         |
| Gateway        | F124 H | F125 H | 2  | RW | Default: 192.168.0.1                                                                                                                                           |
| Device address | F126 H | F126 H | 1  | RW | MODBUS secondary station address.<br>The value is [1,16]. The default value<br>Is 1,0 indicates the broadcast address                                          |
| Baud rate      | F127 H | F127 H | 1  | RW | Slave station baud rate, serial port<br>configuration using N, 8,1;<br>0:115200[Default];<br>1:57 600;<br>400 instant;<br>And 200;<br>For 600;<br>ELSE: 115200 |

### Working mode Configures the area

The working mode configuration is mainly used to configure the working mode And parameters of RFID, and the register of this part can be saved when the power is Off. RFID has active working mode and passive working mode. In active operation Mode, RFID will automatically read the tag EPC that enters the readable area. In Passive mode, the reader is idle by default and performs the work according to the Received instructions. Specific registers are defined as follows:

| Field          | Start address | End Address | Number of Registers | Operation type | Explain                                                                                                                                      |
|----------------|---------------|-------------|---------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| Operating Mode | F200 H        | F200 H      | 1                   | RW             | Working mode:<br>0: passive working mode;<br>1: Active working mode [default],<br>F201~F204H valid (need to set the<br>Address and quantity) |

|            |        |        |   |    |                                                                                            |
|------------|--------|--------|---|----|--------------------------------------------------------------------------------------------|
| Cache Time | F201 H | F201 H | 1 | RW | Set the storage time of automatically read Data after the label leaves, in ms[default 100] |
|------------|--------|--------|---|----|--------------------------------------------------------------------------------------------|

## RFID Protocol configuration area

The RFID protocol configuration area is used to configure protocols supported by RFID. Specific registers are defined as follows:

| Field                          | Start address | End Address | Number of Registers | Operation type | Explain                                                                                                                                                                                                   |
|--------------------------------|---------------|-------------|---------------------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RFID Agreement                 | F300 H        | F300 H      | 1                   | R              | Protocols supported by RFID:<br>3: ISO 18000-6C                                                                                                                                                           |
| Read power                     | F301 H        | F301 H      | 1                   | RW             | The read power of the reader is 12dBm by default. The value ranges from 5 to 27dBm                                                                                                                        |
| Write power                    | F302 H        | F302 H      | 1                   | RW             | The write power of the reader, default 18dBm. The value ranges from 5 to 27dBm                                                                                                                            |
| Frequency Band                 | F303 H        | F303 H      | 1                   | RW             | The current frequency band of the reader:<br>0: PRC (920 ~ 925MHz) [Default]<br>3: FCC (902 ~ 928MHz)                                                                                                     |
| Number of Channel <sup>①</sup> | F304 H        | F304 H      | 1                   | RW             | Number of channels used by readers:<br>The maximum number of PRC is 16 and<br>The maximum number of FCC is 50<br>If the number of channels is set to 0, Automatic frequency hopping is used.<br>Default 0 |
| Frequency point <sup>①</sup>   | F305 H        | F31D H      | 25                  | RW             | The channel number used by the reader, Where each register occupies 2 channels, is filled with high bytes first. This Parameter is valid when the number of Channels is not 0                             |
| Air parameter <sup>①</sup>     | F31E H        | F31E H      | 1                   | RW             | 0:40K, tari 25us, FM0 code<br><br>1:250K, tari 25us, M4 encoding [default]                                                                                                                                |

|                                         |        |        |   |    |                                                                                                                                                                      |
|-----------------------------------------|--------|--------|---|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                         |        |        |   |    | 2:300K, Tari 25us, M4 code<br><br>3:400K, Tari6.25us, FM0 code<br><br>4:320 k, Tari25us, M4 code                                                                     |
| Q value <sup>①</sup>                    | F31F H | F31F H | 1 | RW | Q Value used for inventory. The value Ranges from 0 to 15. The default value is 0. When Q=0, reading EPC (E200H Register trigger) will only read 1 label.            |
| Session layer <sup>①</sup><br>(Session) | F320 H | F320 H | 1 | RW | 0: Session_0<br>1: Session_1[Default]<br>2: Session_2<br>3: Session_3                                                                                                |
| Inventory Mark <sup>①</sup>             | F321 H | F321 H | 1 | RW | 0: A<br>1: B<br>2: A and B[default]                                                                                                                                  |
| Repeat the label filtering Time         | F322 H | F322 H | 1 | RW | It indicates that within a cycle of a card Read command, the same label content is Uploaded only once within the specified Repeat filtering period (time unit: 10ms) |
| RSSI <sup>①</sup>                       | F323 H | F323 H | 1 | RW | If the label RSSI value is lower than the Threshold, label data will not be uploaded And discarded.                                                                  |

- a) This section is not recommended for users unfamiliar with RF or ISO 18000-6C.

## RFID status area

The RFID status area is mainly used to record the current working status of The device, and the control system can diagnose the device and application Environment through the status. The specific registers in the RFID status area are Defined as follows:

| Field       | Initial Address | End Address | Number of Registers | Operation Type | Explain                                |
|-------------|-----------------|-------------|---------------------|----------------|----------------------------------------|
| RFID status | F000 H          | F000 H      | 1                   | R              | Indicates the current status of RFID   |
| error code  | F001 H          | F001 H      | 1                   | R              | See the following section for specific |

|         |        |        |    |   | Definitions                          |
|---------|--------|--------|----|---|--------------------------------------|
| RFU     | F002 H | F002 H | 1  | R |                                      |
| EPC_LEN | F003H  | F003 H | 1  | R | The amount of memory taken up by EPC |
| EPC     | F004 H | F023 H | 32 | R | Label EPC                            |

The RFID status (F000 H) is defined in detail as follows:

| Bit address | Identification | Definition                                                                                                                                                                                                                                                                                                                                                              |
|-------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| bit0        | Ready          | Running status: The reader is running properly                                                                                                                                                                                                                                                                                                                          |
| bit1-2      | Mode           | Working mode, same as register F200 H:<br>0: passive working mode;<br>1: Active working mode                                                                                                                                                                                                                                                                            |
| bit3        | RFU            | The value is 0                                                                                                                                                                                                                                                                                                                                                          |
| bit4        | TP             | Tag Present, indicating whether a tag is in the read area:<br>0: No label<br>1: indicates that labels exist, but does not mean that the specified label memory has been read.                                                                                                                                                                                           |
| bit5        | Cached         | Indicates whether there is currently a cache label:<br>0: Not cached<br>1: Cached, indicating that the label memory read is complete, and this Signal disappears at the end of the cache time (F201 H register) after The label leaves                                                                                                                                  |
| bit6        | Busy           | Indicates the task status of the current device:<br>0: idle<br>1: indicates that a task is being executed, including the command sent By the upper computer in active and passive working modes                                                                                                                                                                         |
| bit7        | Done           | Set indicates that the command is executed successfully                                                                                                                                                                                                                                                                                                                 |
| bit8        | Error          | Set indicates command execution error [non-product fault]                                                                                                                                                                                                                                                                                                               |
| bit9-10     | RssiLevel      | Label signal strength level:<br>0: No label signal is displayed<br>1: The label signal is weak, which generally occurs in the critical area<br><br>2: The label signal is general, and it can work at rest when the Electromagnetic interference is not serious<br>3: The label signals are strong. You are advised to install the label in an Area with strong signals |
| bit11-14    | RFU            | The value is 0                                                                                                                                                                                                                                                                                                                                                          |

|       |              |                                                 |
|-------|--------------|-------------------------------------------------|
| bit15 | RFIDProtocol | RFID protocol:<br>0: ISO 15693<br>1: ISO 14443A |
|-------|--------------|-------------------------------------------------|

The memory mapped area is mainly used in active mode. It is a memory mapped To read parameters and read results in active mode. When the Cached signal (F000H,bit5) is set, the data in the memory mapped area is valid.

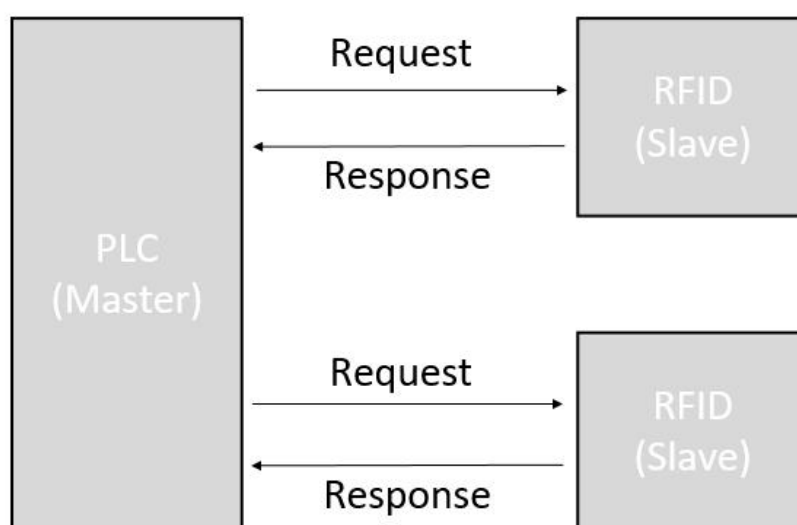
## 6.2 MODBUS Protocol support

Devices using different communication modes use different communication Orotocols. Before using the devices, check the communication modes supported by The devices. For serial communication devices, including RS485 and RS232, MODBUS RTU is supported. The MODBUS TCP protocol is supported for network Port devices.

|                        |                    |            |
|------------------------|--------------------|------------|
| Communication Mode     | Serial port(RS485) | Ethernet   |
| Communication Protocol | MODBUS RTU         | MODBUS TCP |

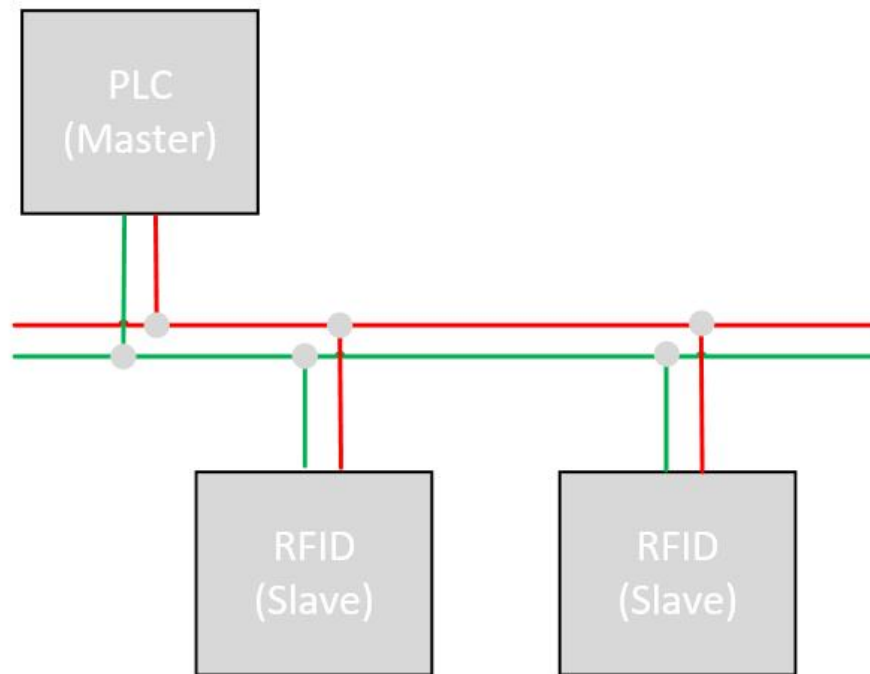
### 6.2.1 MODBUS RTU layout of equipment

In a serial communication network, RFID devices are used as slave stations. When communicating with the main equipment such as PLC, the method of question And answer is adopted and initiated by the main equipment.



Note the device address and serial port configuration parameters when setting up Communication. The default device address is 1. You can set the device address based

On the actual situation. When multiple devices exist on the network, each slave device Must be configured with a different address. The master device controls each slave Device based on the address in turn. Multiple devices are connected to the serial Network in parallel.

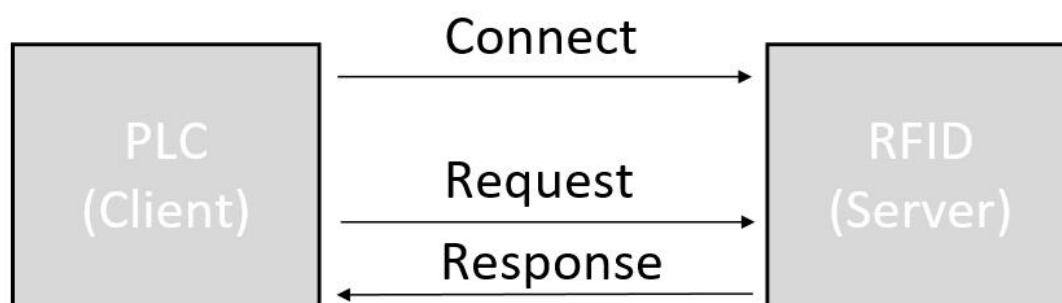


The default serial port configurations of the slave device are as follows:

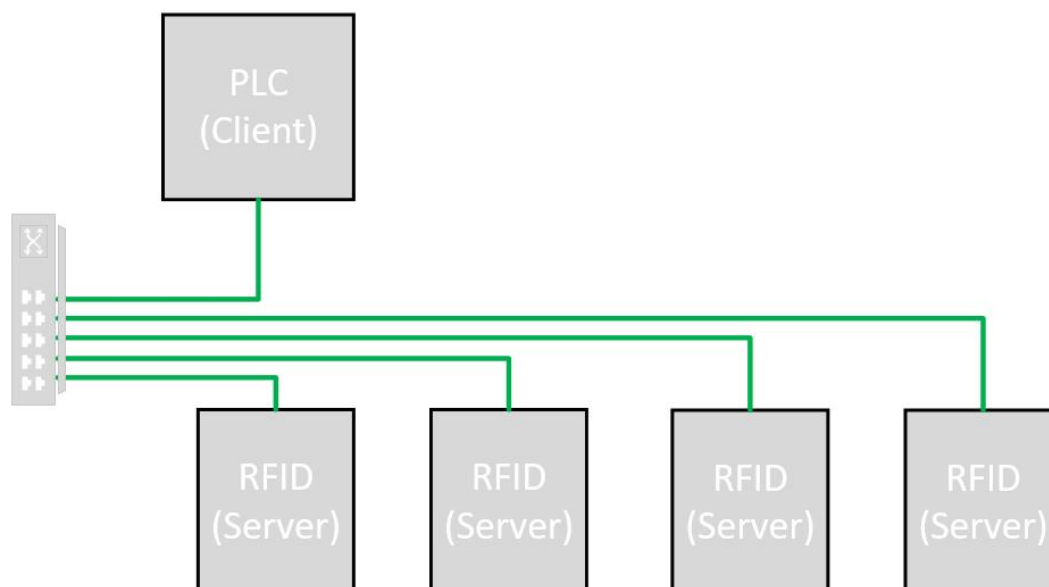
| Index      | Value                                                     |
|------------|-----------------------------------------------------------|
| Baud rate  | The default value is 115200.<br>The value is configurable |
| Parity bit | NONE                                                      |
| Data bits  | 8-bit                                                     |
| Stop bit   | one-bit                                                   |

### 6.2.2 MODBUS TCP layout of equipment

In an Ethernet communication network, the RFID device acts as the server and The PLC acts as the client. A connection must be established before the Communication. The connection is initiated by the client. The communication is by Question and answer method and is initiated by PLC.



The IP address needs to be configured to establish communication. The default IP Address of RFID is 192.168.0.10, and the fixed port number of MODBUS TCP is 502. Before establishing a connection, it is necessary to confirm that the PLC and RFID are In the same network segment. When multiple devices are connected to the network, Each RFID needs to be configured with a different IP address, and multiple devices Can be connected together through a switch.

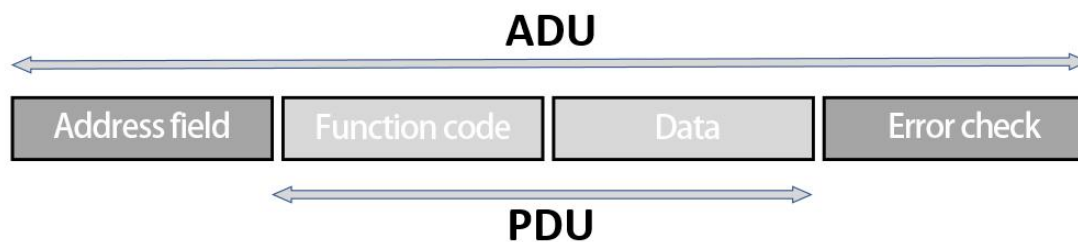


### 6.2.3 Commands supported by the device

The following MODBUS instructions are supported by this device:

| cmdcode     |            | Explain                  |
|-------------|------------|--------------------------|
| hexadecimal | decimalism |                          |
| 03          | 3          | Read multiple registers  |
| 06          | 6          | Write a single register  |
| 10          | 16         | Write multiple registers |
| 5           | 5          | Write a single coil      |

The MODBUS protocol defines a simple protocol data unit (PDU) that is Independent of the underlying communication layer. MODBUS protocol mapping on A particular bus or network can introduce additional domains on the application data Unit (ADU).



#### MODBUS RTU ADU

The MODBUS RTU ADU consists of the address domain, PDU, and error check. The address domain is the device address, and the error check bit is CRC check.

| device<br>address | function<br>code | data    | CRC verify            |    |
|-------------------|------------------|---------|-----------------------|----|
|                   |                  |         | Lo                    | Hi |
| 1byte             | 1byte            | N bytes | 2 bytes<br>MODBUS RTU |    |

- Device address: slave device address, networking application 1-16, Point-to-point communication 0
- CRC check: CRC16-MODBUS: verifies all previous data

#### MODBUS TCP ADU

The ADU of MODBUS RTU consists of an address domain and a PDU. The Address domain is the MBAP packet header

| MBAP packet header             |                        |                 |            | Function | Data    |
|--------------------------------|------------------------|-----------------|------------|----------|---------|
| Transaction<br>Meta identifier | Protocol<br>identifier | length<br>Hi Lo | Element ID | Code     |         |
| Hi Lo                          | Hi Lo                  |                 |            |          |         |
| 2 bytes                        | 2bytes                 | 2bytes          | 1byte      | 1byte    | N bytes |

- Transaction meta identifier: identifies the transaction
- Protocol identifier: MODBUS = 0
- Length: Number of the following bytes
- Unit identifier: Default FFH

## 1、Read multiple registers

The request ADU for reading multiple registers is as follows:

| Agreement | Address field               |                     |        |            |                | Function code | Data       |                | Error check |
|-----------|-----------------------------|---------------------|--------|------------|----------------|---------------|------------|----------------|-------------|
|           | Transaction meta identifier | Protocol Identifier | length | Element ID | Device address | Cmdcode 3H    | Site Hi Lo | Quantity Hi Lo | CRC Lo Hi   |
| RTU       | ——                          | ——                  | ——     | ——         | 1byte          | 1byte         | 2 bytes    | 2 bytes        | 2 bytes     |
| TCP       | 2bytes                      | 2bytes              | 2bytes | 1byte      | ——             |               |            |                | ——          |

- Transaction meta identifier: identifies the transaction
- Protocol identifier: MODBUS = 0
- Length: The number of the following bytes, in this case 6
- Unit identifier: Default FFH
- Address: Device address of the slave station, networking application 1-16, Point-to-point communication 0
- Command code: The command code for reading multiple registers is fixed to 3
- First register address: address of the first register to be read

Register quantity: indicates the number of registers to be read. If the area to be read

Is the label memory area, the value can be  $1 \leq N \leq 120$ . In other cases, the value can be

$1 \leq N \leq 123$

The normal response ADU for reading multiple registers is as follows:

| Agreement | Address field               |                     |        |            |                | Function code | Data            |                              | Error check     |
|-----------|-----------------------------|---------------------|--------|------------|----------------|---------------|-----------------|------------------------------|-----------------|
|           | Transaction meta identifier | Protocol identifier | length | Element ID | Device address | Cmdcode 3H    | Number of bytes | Register value<br>Hi      Lo | CRC<br>Lo    Hi |
| RTU       | ——                          | ——                  | ——     | ——         | 1Byte          | 1Byte         | 1 Bytes         | 2Bytes<br>(Register 1)       | 2 Bytes         |
| TCP       | 2Bytes                      | 2Bytes              | 2Bytes | 1Byte      | ——             |               |                 |                              | ——              |
|           |                             |                     |        |            |                |               |                 | .....                        |                 |

|                        |
|------------------------|
| 2Bytes<br>(Register N) |
|------------------------|

- Command code: This is the same as the request
- Number of bytes read: twice the number of registers

Register value: The value of the register to be read

The abnormal response ADU for reading multiple registers is as follows:

|           | Address field               |                     |        |            |                | Function code | Data       | Error check |
|-----------|-----------------------------|---------------------|--------|------------|----------------|---------------|------------|-------------|
| Agreement | Transaction meta identifier | protocol identifier | length | Element ID | Device address | Cmdcode 83H   | Error code | CRC Lo Hi   |
| RTU       | ——                          | ——                  | ——     | ——         | 1Byte          | 1Byte         | 1Byte      | 2 Bytes     |
| TCP       | 2Bytes                      | 2Bytes              | 2Bytes | 1Byte      | ——             |               |            | ——          |

2、Write a single register

3、Write a single register request ADU is as follows:

| Agreement | Address field               |                     |        |            |                | Function code | Data       |                      | Error check |
|-----------|-----------------------------|---------------------|--------|------------|----------------|---------------|------------|----------------------|-------------|
|           | Transaction meta identifier | Protocol identifier | length | Element ID | Device address | Cmdcode 6H    | site Hi Lo | Register value Hi Lo | CRC Lo Hi   |
| RTU       | ——                          | ——                  | ——     | ——         | 1Byte          | 1Byte         | 2 Bytes    | 2 Bytes              | 2 Bytes     |
| TCP       | 2Bytes                      | 2bytes              | 2Bytes | 1byte      | ——             |               |            |                      | ——          |

- Command code: The command code for reading multiple registers is 6
- Register address: address of the register to be operated
- Register value: The value of the register to be operated

The normal response ADU for writing a single register is as follows:

| agreement | Address field               |                     |        |            |                | Function code | Data       |                      | Error check |
|-----------|-----------------------------|---------------------|--------|------------|----------------|---------------|------------|----------------------|-------------|
|           | Transaction meta identifier | Protocol identifier | length | Element ID | device address | Cmdcode 6H    | Site Hi Lo | Register value Hi Lo | CRC Lo Hi   |
| RTU       | ——                          | ——                  | ——     | ——         | 1Byte          | 1Byte         | 2 Bytes    | 2 Bytes              | 2 Bytes     |
| TCP       | 2Bytes                      | 2Bytes              | 2Bytes | 1Byte      | ——             |               |            |                      | ——          |

- Address: As requested
- Command code: This is the same as the request
- Register address: As requested
- Register value: as requested

The exception response ADU for writing a single register is as follows:

| Agreement | Address field | Function code | Data | Error check |
|-----------|---------------|---------------|------|-------------|
|-----------|---------------|---------------|------|-------------|

|     | Transac<br>tion<br>meta<br>identifi<br>er | protocol<br>identifier | length | Element<br>ID | Devi<br>ce<br>addre<br>ss | Cmdcod<br>e<br>86H | Error<br>code | CRC<br>Lo    Hi |
|-----|-------------------------------------------|------------------------|--------|---------------|---------------------------|--------------------|---------------|-----------------|
| RTU | ——                                        | ——                     | ——     | ——            | 1Byt<br>e                 | 1Byte              | 1Byte         | 2 Bytes         |
| TCP | 2Bytes                                    | 2Bytes                 | 2Bytes | 1Byte         | ——                        |                    |               | ——              |

## 4、Write multiple registers

The request ADU for writing multiple registers is as follows:

| Agreement | Address field               |                     |        |            |                | Function code | Data                   |                        |                 |                             |           | Error check |
|-----------|-----------------------------|---------------------|--------|------------|----------------|---------------|------------------------|------------------------|-----------------|-----------------------------|-----------|-------------|
|           | Transaction meta identifier | protocol identifier | length | Element ID | Device address | Cmdcode 10H   | Register Address Hi Lo | Register Address Hi Lo | Number of bytes | Register value Hi Lo        | CRC Lo Hi |             |
| RTU       | ——                          | ——                  | ——     | ——         | 1byte          | 1Byte         | 2 Bytes                | 2 Bytes                | 1Byte           | 2Bytes (The first register) | 2 Bytes   |             |
| TCP       | 2Bytes                      | 2Bytes              | 2Bytes | 1Byte      | ——             |               |                        |                        |                 | ——                          |           |             |
|           |                             |                     |        |            |                |               |                        |                        |                 | .....                       |           |             |
|           |                             |                     |        |            |                |               |                        |                        |                 | 2Bytes (The first register) |           |             |

- Command code: The command code for reading multiple registers is 10H
- Register address: address of the first register to be operated
- Register quantity: indicates the number of registers to be operated. If the Operation area is the label memory area, the value can be  $1 \leq N \leq 120$ . In other Cases, the value can be  $1 \leq N \leq 121$
- Bytes: The total number of bytes occupied by the register value, 2\* the number of Registers
- Register value: The value of the register to be operated

The normal response ADU for writing multiple registers is as follows:

| Agreement | Address field               |                     |        |            |                | Function code | Data                   |                           | Error check |
|-----------|-----------------------------|---------------------|--------|------------|----------------|---------------|------------------------|---------------------------|-------------|
|           | Transaction meta identifier | Protocol identifier | length | Element ID | Device address | Cmdcode 10H   | Register Address Hi Lo | Number of Registers Hi Lo | CRC Lo Hi   |

|     |        |        |        |       |       |       |         |         |         |
|-----|--------|--------|--------|-------|-------|-------|---------|---------|---------|
|     | r      |        |        |       | ss    |       |         |         |         |
| RTU | —      | —      | —      | —     | 1Byte | 1Byte | 2 Bytes | 2 Bytes | 2 Bytes |
| TCP | 2Bytes | 2Bytes | 2Bytes | 1Byte | —     |       |         |         | —       |

- Command code: This is the same as the request
- Register address: As requested
- Number of registers: as requested

The exception response ADU for writing multiple registers is as follows:

| Agreement | Address field               |                     |        |            |                | Function code | Data       | Error check |
|-----------|-----------------------------|---------------------|--------|------------|----------------|---------------|------------|-------------|
|           | Transaction Meta identifier | Protocol identifier | length | Element ID | Device address | Cmdcode 90H   | Error code | CRC Lo Hi   |
| RTU       | —                           | —                   | —      | —          | 1Byte          | 1Byte         | 1Byte      | 2 Bytes     |
| TCP       | 2Bytes                      | 2Bytes              | 2Bytes | 1Byte      | —              |               |            | —           |

## 5、Write a single coil

The request ADU for writing a single coil is as follows:

| Agreement | Address field               |                     |        |            |                | Function code | Data               |                  | Error check |
|-----------|-----------------------------|---------------------|--------|------------|----------------|---------------|--------------------|------------------|-------------|
|           | Transaction Meta identifier | Protocol identifier | length | Element ID | Device address | Cmdcode 5H    | Coil Address Hi Lo | Coil Value Hi Lo | CRC Lo Hi   |
| RTU       | ——                          | ——                  | ——     | ——         | 1Byte          | 1Byte         | 2 Bytes            | 2 Bytes          | 2 Bytes     |
| TCP       | 2Bytes                      | 2Bytes              | 2Bytes | 1Byte      | ——             |               |                    |                  | ——          |

- Address: Device address of the slave station, networking application 1-16, Point-to-point communication 0
- Command code: The command code for reading multiple registers is fixed at 5
- Coil address: specifies the address of the coil to be operated
- Coil value: The value of the coil to be operated, 0 or 1

Write the normal response ADU of a single coil as follows:

| Agreement | Address field               |                     |        |            |                | Function code | Data               |                  | Error Check |
|-----------|-----------------------------|---------------------|--------|------------|----------------|---------------|--------------------|------------------|-------------|
|           | Transaction meta identifier | protocol identifier | length | element ID | device address | Cmdcode 5H    | Coil Address Hi Lo | Coil value Hi Lo | CRC Lo Hi   |
| RTU       | ——                          | ——                  | ——     | ——         | 1Byte          | 1Byte         | 2 Bytes            | 2 Bytes          | 2 Bytes     |
| TCP       | 2Bytes                      | 2Bytes              | 2Bytes | 1Byte      | ——             |               |                    |                  | ——          |

- Command code: This is the same as the request
- Coil address: As requested
- Coil value: as requested

Write the abnormal response ADU of a single coil as follows:

| Agreement | Address field               |                     |        |            |                | Function code | Data       | Error check |
|-----------|-----------------------------|---------------------|--------|------------|----------------|---------------|------------|-------------|
|           | Transaction meta identifier | protocol identifier | length | Element ID | Device address | Cmdcode 85H   | Error code | CRC Lo Hi   |
| RTU       | ——                          | ——                  | ——     | ——         | 1Byte          | 1Byte         | 1Byte      | 2 Bytes     |
| TCP       | 2Bytes                      | 2Bytes              | 2Bytes | 1Byte      | ——             |               |            | ——          |

### 6.3 Product reset

The reader uses a coil to simulate the reset foot of the RFID device, pulls the coil Down, and the RFID immediately restarts the software.

| Coil address | Operating mode | Operating command                           |
|--------------|----------------|---------------------------------------------|
| 0xFFFF       | Buy 0          | Write a single coil. The Command value is 5 |



Note: The reader will not respond to the reset operation.

## 6.4 error code

The error code consists of two parts: The error code returned by the MODBUS Command. This part is a custom error code that is stored in the F001H register for compatibility with the MODBUS protocol. The MODBUS error code is defined as Follows:

| Error code | Definition         | Explain                                                                                                                                                                                                          |
|------------|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 00H        | inerrancy          |                                                                                                                                                                                                                  |
| 01H        | Command Code error | The used command code is not supported                                                                                                                                                                           |
| 02H        | Address error      | A nonexistent address was used, or a read - only address was Written                                                                                                                                             |
| 03H        | Error in data      | The system configuration register is written using non-legal Method                                                                                                                                              |
| 04H        | Unit Exception     | Equipment failure                                                                                                                                                                                                |
| 0BH        | No response        | This error occurs when the label is not in the read area or when The label does not respond correctly to the instruction. In this Case, you can obtain more details from the custom error code (F001H register). |

Custom error codes are as follows:

| error code |             | Definition         | Explain                                                                                                                                           |
|------------|-------------|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Decimalism | Hexadecimal |                    |                                                                                                                                                   |
| 144        | 90H         | Unlabeled Response | The label may be out of read range                                                                                                                |
| 145        | 91H         | Rf data error      | At this time, strong electromagnetic Interference may cause data Transmission errors, or half of the data Transmission label leaves the read area |
| 147        | 93H         | Label memory lock  | The label memory is locked and cannot Be written. Procedure                                                                                       |
| 149        | 95H         | Label off          | Halfway through reading the data, the label leaves                                                                                                |
| 150        | 96H         | Label off          | Write half the data, label away                                                                                                                   |
| 161        | A1H         | The RF data        | Rf data cannot be sent                                                                                                                            |

|     |     |                             |  |
|-----|-----|-----------------------------|--|
|     |     | Transmission is<br>Abnormal |  |
| 176 | B0H | Parameter error             |  |

## 7. Appendix

### 7.1 Communication cable Description

#### 1、RS485 Communication cable Description

RS485 communication cable: A CODE M12 female head (5 pins), internal thread

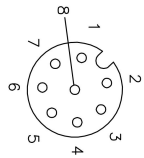
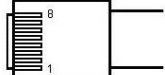
Inner hole -- bare wire, cable pin definition is as follows:

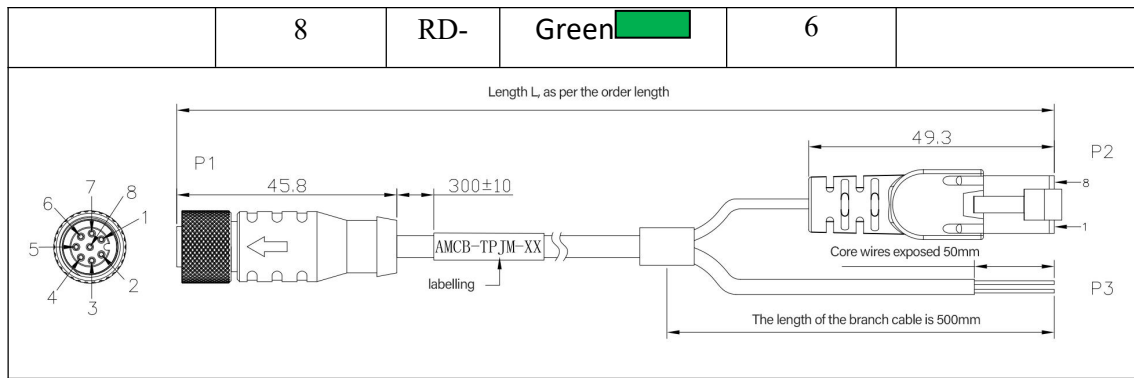
|  | PIN pin | Definition | Matching wire color |
|-----------------------------------------------------------------------------------|---------|------------|---------------------|
|                                                                                   | 1       | 24V        | Brown/              |
|                                                                                   | 2       | RS485_A    | White/              |
|                                                                                   | 3       | 0V         | Kohlrabiblue/       |
|                                                                                   | 4       | RS485_B    | Black/              |
|                                                                                   | 5       | PE         | Shielding layer     |

#### 2、Ethernet communication cable description

Ethernet communication cable: A CODE M12 female head (8 pins), internal thread

Inner hole - bare wire +RJ45 male head, cable pin definition is as follows:

|  | M12splice<br>PIN pin | Defini<br>tion | Matching wire<br>color                                                                                                                                                                         | RJ45splice<br>PIN pin |  |
|-------------------------------------------------------------------------------------|----------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|
|                                                                                     | 1                    | 24V            | Red <br>(Brown           | OPEN                  |                                                                                       |
|                                                                                     | 2                    | NC             | ---                                                                                                                                                                                            |                       |                                                                                       |
|                                                                                     | 3                    | 0V             | Black <br>(Kohlrabiblue  | OPEN                  |                                                                                       |
|                                                                                     | 4                    | NC             | ---                                                                                                                                                                                            |                       |                                                                                       |
|                                                                                     | 5                    | TD+            | Orange white                                                                                                | 1                     |                                                                                       |
|                                                                                     | 6                    | TD-            | Orange                                                                                                      | 2                     |                                                                                       |
|                                                                                     | 7                    | RD+            | Greenish<br>White                                                                                           | 3                     |                                                                                       |



## 7.2 RSSI Value correspondence table

| value | RSSI (dBm)   | value | RSSI (dBm)   | value | RSSI (dBm)   | value | RSSI (dBm)   |
|-------|--------------|-------|--------------|-------|--------------|-------|--------------|
| 1     | -85.31913365 | 65    | -49.18492677 | 129   | -43.25177012 | 193   | -39.76439143 |
| 2     | -79.31913365 | 66    | -49.05276893 | 130   | -43.18492677 | 194   | -39.7196566  |
| 3     | -75.80935865 | 67    | -48.92259851 | 131   | -43.11859564 | 195   | -39.67515177 |
| 4     | -73.31913365 | 68    | -48.7943566  | 132   | -43.05276893 | 196   | -39.63087459 |
| 5     | -71.38756508 | 69    | -48.66798691 | 133   | -42.98743904 | 197   | -39.58682273 |
| 6     | -69.80935865 | 70    | -48.54343555 | 134   | -42.92259851 | 198   | -39.54299393 |
| 7     | -68.47500412 | 71    | -48.42065093 | 135   | -42.85824007 | 199   | -39.49938593 |
| 8     | -67.31913365 | 72    | -48.29958364 | 136   | -42.7943566  | 200   | -39.45599651 |
| 9     | -66.29958364 | 73    | -48.1801863  | 137   | -42.73094115 | 201   | -39.4128235  |
| 10    | -65.38756508 | 74    | -48.06241346 | 138   | -42.66798691 | 202   | -39.36986475 |
| 11    | -64.56254394 | 75    | -47.94622151 | 139   | -42.60548721 | 203   | -39.32711815 |
| 12    | -63.80935865 | 76    | -47.83156857 | 140   | -42.54343555 | 204   | -39.2845816  |
| 13    | -63.11649534 | 77    | -47.71841441 | 141   | -42.48182554 | 205   | -39.24225305 |
| 14    | -62.47500412 | 78    | -47.60672034 | 142   | -42.42065093 | 206   | -39.20013049 |
| 15    | -61.87779008 | 79    | -47.49644916 | 143   | -42.35990563 | 207   | -39.1582119  |
| 16    | -61.31913365 | 80    | -47.38756508 | 144   | -42.29958364 | 208   | -39.11649534 |
| 17    | -60.7943566  | 81    | -47.28003363 | 145   | -42.23967911 | 209   | -39.07497886 |
| 18    | -60.29958364 | 82    | -47.17382162 | 146   | -42.1801863  | 210   | -39.03366054 |
| 19    | -59.83156857 | 83    | -47.06889706 | 147   | -42.12109958 | 211   | -38.99253852 |
| 20    | -59.38756508 | 84    | -46.96522911 | 148   | -42.06241346 | 212   | -38.95161092 |
| 21    | -58.96522911 | 85    | -46.86278803 | 149   | -42.00412253 | 213   | -38.91087593 |
| 22    | -58.56254394 | 86    | -46.76154512 | 150   | -41.94622151 | 214   | -38.87033173 |
| 23    | -58.17776191 | 87    | -46.66147267 | 151   | -41.88870521 | 215   | -38.82997655 |
| 24    | -57.80935865 | 88    | -46.56254394 | 152   | -41.83156857 | 216   | -38.78980864 |
| 25    | -57.45599651 | 89    | -46.46473306 | 153   | -41.77480659 | 217   | -38.74982626 |
| 26    | -57.11649534 | 90    | -46.36801507 | 154   | -41.71841441 | 218   | -38.7100277  |
| 27    | -56.78980864 | 91    | -46.27236581 | 155   | -41.66238722 | 219   | -38.67041129 |
| 28    | -56.47500412 | 92    | -46.17776191 | 156   | -41.60672034 | 220   | -38.63097537 |
| 29    | -56.17124768 | 93    | -46.08418078 | 157   | -41.55140916 | 221   | -38.59171829 |
| 30    | -55.87779008 | 94    | -45.99160054 | 158   | -41.49644916 | 222   | -38.55263845 |
| 31    | -55.59395579 | 95    | -45.9        | 159   | -41.44183592 | 223   | -38.51373425 |
| 32    | -55.31913365 | 96    | -45.80935865 | 160   | -41.38756508 | 224   | -38.47500412 |
| 33    | -55.05276893 | 97    | -45.7196566  | 161   | -41.33363238 | 225   | -38.4364465  |
| 34    | -54.7943566  | 98    | -45.63087459 | 162   | -41.28003363 | 226   | -38.39805988 |
| 35    | -54.54343555 | 99    | -45.54299393 | 163   | -41.22676472 | 227   | -38.35984273 |
| 36    | -54.29958364 | 100   | -45.45599651 | 164   | -41.17382162 | 228   | -38.32179356 |
| 37    | -54.06241346 | 101   | -45.36986475 | 165   | -41.12120036 | 229   | -38.28391092 |
| 38    | -53.83156857 | 102   | -45.2845816  | 166   | -41.06889706 | 230   | -38.24619334 |

|    |              |     |              |     |              |     |              |
|----|--------------|-----|--------------|-----|--------------|-----|--------------|
| 39 | -53.60672034 | 103 | -45.20013049 | 167 | -41.0169079  | 231 | -38.2086394  |
| 40 | -53.38756508 | 104 | -45.11649534 | 168 | -40.96522911 | 232 | -38.17124768 |
| 41 | -53.17382162 | 105 | -45.03366054 | 169 | -40.91385703 | 233 | -38.13401678 |
| 42 | -52.96522911 | 106 | -44.95161092 | 170 | -40.86278803 | 234 | -38.09694533 |
| 43 | -52.76154512 | 107 | -44.87033173 | 171 | -40.81201856 | 235 | -38.06003197 |
| 44 | -52.56254394 | 108 | -44.78980864 | 172 | -40.76154512 | 236 | -38.02327535 |
| 45 | -52.36801507 | 109 | -44.7100277  | 173 | -40.71136428 | 237 | -37.98667416 |
| 46 | -52.17776191 | 110 | -44.63097537 | 174 | -40.66147267 | 238 | -37.95022707 |
| 47 | -51.99160054 | 111 | -44.55263845 | 175 | -40.61186698 | 239 | -37.9139328  |
| 48 | -51.80935865 | 112 | -44.47500412 | 176 | -40.56254394 | 240 | -37.87779008 |
| 49 | -51.63087459 | 113 | -44.39805988 | 177 | -40.51350035 | 241 | -37.84179763 |
| 50 | -51.45599651 | 114 | -44.32179356 | 178 | -40.46473306 | 242 | -37.80595423 |
| 51 | -51.2845816  | 115 | -44.24619334 | 179 | -40.41623899 | 243 | -37.77025863 |
| 52 | -51.11649534 | 116 | -44.17124768 | 180 | -40.36801507 | 244 | -37.73470962 |
| 53 | -50.95161092 | 117 | -44.09694533 | 181 | -40.32005833 | 245 | -37.69930602 |
| 54 | -50.78980864 | 118 | -44.02327535 | 182 | -40.27236581 | 246 | -37.66404662 |
| 55 | -50.63097537 | 119 | -43.95022707 | 183 | -40.22493462 | 247 | -37.62893026 |
| 56 | -50.47500412 | 120 | -43.87779008 | 184 | -40.17776191 | 248 | -37.59395579 |
| 57 | -50.32179356 | 121 | -43.80595423 | 185 | -40.13084489 | 249 | -37.55912206 |
| 58 | -50.17124768 | 122 | -43.73470962 | 186 | -40.08418078 | 250 | -37.52442794 |
| 59 | -50.02327535 | 123 | -43.66404662 | 187 | -40.03776689 | 251 | -37.48987233 |
| 60 | -49.87779008 | 124 | -43.59395579 | 188 | -39.99160054 | 252 | -37.45545411 |
| 61 | -49.73470962 | 125 | -43.52442794 | 189 | -39.9456791  | 253 | -37.4211722  |
| 62 | -49.59395579 | 126 | -43.45545411 | 190 | -39.9        | 254 | -37.38702553 |
| 63 | -49.45545411 | 127 | -43.38702553 | 191 | -39.85456068 | 255 | -37.35301303 |
| 64 | -49.31913365 | 128 | -43.31913365 | 192 | -39.80935865 |     |              |

### 7.3 Channel frequency mapping table

| PRC   |                    | FCC   |                    |       |                    |       |                    |
|-------|--------------------|-------|--------------------|-------|--------------------|-------|--------------------|
| route | frequency<br>(KHz) | route | frequency<br>(KHz) | route | frequency<br>(KHz) | route | frequency<br>(KHz) |
| 0     | 920625             | 0     | 902750             | 17    | 911250             | 34    | 919750             |
| 1     | 920875             | 1     | 903250             | 18    | 911750             | 35    | 920250             |
| 2     | 921125             | 2     | 903750             | 19    | 912250             | 36    | 920750             |
| 3     | 921375             | 3     | 904250             | 20    | 912750             | 37    | 921250             |
| 4     | 921625             | 4     | 904750             | 21    | 913250             | 38    | 921750             |
| 5     | 921875             | 5     | 905250             | 22    | 913750             | 39    | 922250             |
| 6     | 922125             | 6     | 905750             | 23    | 914250             | 40    | 922750             |
| 7     | 922375             | 7     | 906250             | 24    | 914750             | 41    | 923250             |
| 8     | 922625             | 8     | 906750             | 25    | 915250             | 42    | 923750             |
| 9     | 922875             | 9     | 907250             | 26    | 915750             | 43    | 924250             |
| 10    | 923125             | 10    | 907750             | 27    | 916250             | 44    | 924750             |
| 11    | 923375             | 11    | 908250             | 28    | 916750             | 45    | 925250             |
| 12    | 923625             | 12    | 908750             | 29    | 917250             | 46    | 925750             |
| 13    | 923875             | 13    | 909250             | 30    | 917750             | 47    | 926250             |
| 14    | 924125             | 14    | 909750             | 31    | 918250             | 48    | 926750             |
| 15    | 924375             | 15    | 910250             | 32    | 918750             | 49    | 927250             |
|       |                    | 16    | 910750             | 33    | 919250             |       |                    |