

**\*\*\* Caution \*\*\***

Changes of modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

# Operation Manual

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## XCRF-500 Reader Series



**Shenzhen Yuanwanggu Information Technology Co., Ltd.**



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## **Chapter 1: Introduction**

The XCRF-500 reader series are electronic tag readers developed by Shenzhen Yuanwanggu Information Technology Co., Ltd. These readers are applicable to reading/writing XCTF-5000 tag series that satisfies NCITS256-1999 protocol and works within UHF frequency range, as well as compatibly reading AMTECH's UHF tag used in vehicle identification.

With its compatible electronic tags, XCRF-500 reader series could be widely deployed in the areas like custom vehicle automatic identification, urban vehicle automatic identification management, highway non-stop toll, etc.

XCRF-600 reader can only read the tags that meet the proposal of EM4223. XCRF-600 reader needs only to send RF power to tags, one tag will send its ID information. XCRF-600 reader can be widely deployed in the doorway management, etc.

XCRF-500 reader series includes 4 reader models: XCRF-500W, XCRF-501W, XCRF-502W and XCRF-504W.

XCRF-500W is single-ported reader where only antenna 1 can be connected with external antenna. XCRF-501W is antenna-built-in reader, XCRF-502W is dual-ported reader,



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both antenna 1 and antenna 2 of which can be connected with external antenna. XCRF-504W is four-ported reader, antenna 1, antenna 2, antenna 3 and antenna 4 of which can be connected with external antenna. In the case that the reader you ordered is multi-ported, it is necessary to connect the unused antenna ports to 50  $\Omega$ /20W dummy load in order to protect the reader.

## 1.1 System Advantage

From the point of data collection, radio frequency identification system completely resembles bar code system. In the course of data collection, bar code system adopts one-way communication, i.e., bar code sensor (reader) reads information from bar code in non-touch way. During such information flowing, bar code is totally in a passive and subordinate position and the communication is one-way, i.e., information is transmitted to bar code sensor from bar code tag.

The shortcoming of bar code system is that, if damaged, polluted, damped or located inside an article, the bar code couldn't acquire data because the reading range of sensor is too short.

Data collection system composed of XCRF-500 reader series and their compatible electronic tags, fundamentally overcomes the above shortcoming of bar code system. The communication between reader and tag is two-way, in which the tag makes



relevant response to reader's demand. With two-way communication, system could realize the function of reading multiple tags within reading area.

Matched with appropriate antenna, the reading range of XCRF-500 reader series could be over 7 meters.

## **1.2 System Capability Characteristics**

- ✧ Ability to read part of or all the data information of a single tag;
- ✧ Ability to read part of or all the data information of multiple tags under the circumstance of no unpacking and ordering;
- ✧ Ability to screen specific electronic tag according to the user-defined rules;

The super inquiry protocol followed by reader and electronic tag enables reader to unerringly identify every electronic tag within reading area and read each tag only once.

The unique protocol between reader and electronic tag decides that when multiple tags are read, every tag spends the same reading time, independent of tag quantity within reading area (regarding XCTF-5000 electronic tag).





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## 1.3 XCRF-500 reader series

XCRF-500 reader series are designed for reading and writing UHF tag of XCTF-5000, while keeping compatible with AMTECH vehicle tag.

XCRF-500 reader series provides 1 to 4 radio frequency interfaces for external radio frequency antennas. Radio frequency cable should employ low loss cable, and the length of radio frequency cable equipped with reader is 10 meters. Lengthening the radio frequency cable or using general radio frequency cable will affect the reading/writing range of reader.

### **Note:**

(1) Joint between radio frequency cable and reader is N-type joint, connection of which should be tight and reliable. Over-tight joint connection would damage the joint socket, while a loose one would cause system performance decline (reading/writing distance).

(2) Switching on the power and transmitting microwave prior to disconnecting antenna might cause serious damage to the system.

(3) Unused antenna port should be connected to 50  $\Omega$  20W load.



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## 1.4 Other Required Accessories

Besides reader and tag, IBM-compatible personal computer system and interface software for reader are also needed to build a integrated radio frequency identification system and data collection system.

The minimum requirement for personal computer system is:

- ✧ 9-firing pin RS-232 serial port;
- ✧ Well adaptive to Windows 98/2000/XP;

Interface software for reader includes:

- ✧ API Dynamic-Link Library for XCRF-500W reader series;
- ✧ API and demo software V1.1 for XCRF-500W reader series;

## Chapter 2: Installation

In this chapter we introduce the installation and testing of XCRF-500 reader series. Before installation and testing, operator should read the article of “radio frequency (RF) radiation” (Section 6.1) of this handbook.

### 2.1 Appearance of XCRF-500 reader series

Appearance of XCRF-500 reader series is shown as figure 2-1 (a) and figure 2-1 (b). There are power switch , interface of power supply, an serial interface, a 10M network interface and a control interface on the front panels of XCRF-500 reader series. There are 5 LED indicators for working status of reader on the upper panels of XCRF-500 reader series. There are 2 N-joints which connect transmitting and receiving antenna of reader, except that there are also 2 extend N-joints on the back panels of XCRF-500 reader series.



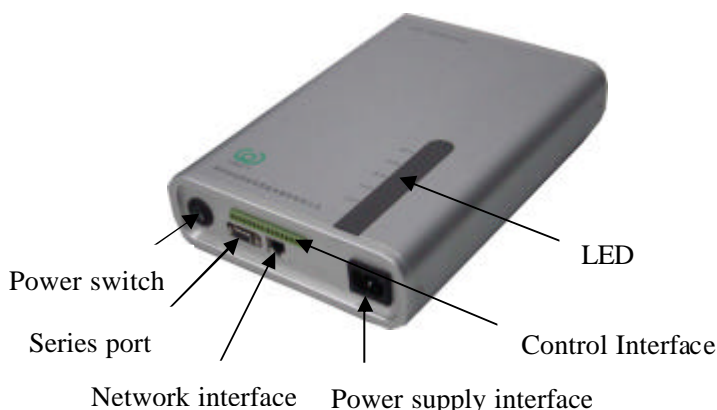
**Figure 2-1(a) Appearance of XCRF-500 reader series (front right)**



**Figure 2-1(b) Appearance of XCRF-500 reader series (right back)**

## 2.2 Front Panel and Upper Panel

On the upper panel of XCRF-500W reader series there are 5 LED indicating the working status of reader. The indicators of “Power supply” and “Power amplifier” are bicolour (red and green), shown as figure 2-2.



**Figure 2-2 Top panel of XCRF-500 reader series**

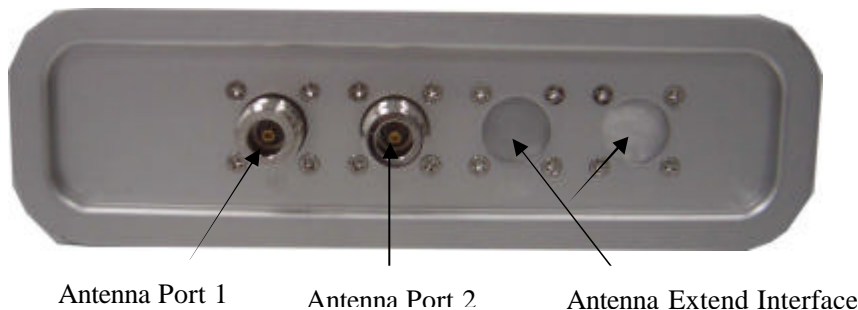
The 5 LED on the front upper panel of reader indicates the current status of power supply, power amplifier, connection, communication and receiving. The meaning of each LED indicator is detailed in table 2-1.

Table 2-1    Meaning of each indicator light on the front panels of XCRF-500 reader series

LED indicator	Colour	Status
Power Supply	Green or red	Light-up means reader start-up.
Power Amplifier	Green or red	Light-up means that power amplifier of radio frequency works.
Link	Green	Light-up means that network interface connects correctly.
Activity	Blue	Light-up means exchanging data by network interface.
Receive	Green	Light-up means receiving correct tag information.
“Power supply” and “power amplifier” light combination indicated function		Working status indication of multiple antennas
Light status of “power supply”	Light status of “power amplifier”	Status indication
Green	Green	Mean that antenna 1 is working
Green	Red	Mean that antenna 2 is working
Red	Green	Mean that antenna 3 is working
Red	Red	Mean that antenna 4 is working

## 2.3 Back Panel

There are 2 radio frequency (RF) interfaces (N (Female)) which connect reader antenna, and two extend RF interface. Only port 1 can be used for XCRF-500 reader, both port 1 and 2 can be used for XCRF-502W reader (see figure 2-3). The two separated ports provide the same function, they are worked time-devided. In a period time only one port can transmit and receive information simultaneously.



**Figure 2-3 Back panel of XCRF-500 reader series**

## 2.4 Installation steps

Installation steps of XCRF-500 reader series are as follows:

- (1) Reader installation: choose a position closer to antenna. If located outdoor, the reader should be installed in a water-proof case;
- (2) Connect external antenna (see page 21);
- (3) Install the antenna and make reader in the best working status for reading/writing electronic tag (see page 23);
- (4) Connect serial communication cable to the serial port of personal computer (see page 25);
- (5) Connect power supply (see page 26);
- (6) Configure reader (see reader API interface and demo software specification);
- (7) Adjust antenna's position (see page 31)





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## 2.5 Connect external antenna

There are 2 N-type coaxial cable joints (Female) on the back panels of XCRF-500 reader series to connect the external antenna. **Be sure that the installation of the antenna must be performed by professional installers authorized by the provider.** Sketch map of connection between reader and external antenna is shown in figure 2-4.

Low loss radio frequency cable with a standard length of 10 meters is recommended for the connection between reader and antenna. **Insert loss of the Low loss radio frequency cable must be at least 1 dB and less than 2dB.** When connecting with antenna and reader, the cable joint should be tightly screwed. In practical installation, a heat-contracted pipe should be used to airproof the cable joint for protection once it is screwed.



**Figure 2-4 Connexion between XCRF-500 reader series and antenna**  
**(Sketch map)**

## **2.6 Install external antenna**

External antennas of XCRF-500 reader series are usually installed outdoors. The area that its wave beam covers is the valid area for system reading/writing electronic tag.

Depending on the specific requirement on the application spot, external antenna of reader could be either horizontal-top-mounted or vertical-side-mounted . The angle of inclination or rotation of antenna could be adjusted to enable



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the best reading/writing performance.

Usually XCRF-500 reader series should be used with linear-polarized antenna (to avoid antenna loss). In a on-spot installation, do pay attention to the polarization matching between reader antenna and tag antenna, otherwise the reading/writing range might be seriously affected.

## **2.7 Connect to PC serial port**

XCRF-500 reader series provides RS232 serial interface. The 9th foot of the serial interface provides an output power of +5V DC, which meets standard RS232 transmission, easily connects to expanded USB interface module, connects to standard radio communication module of WLAN802.11b protocol to meet the requirement of radio data transmission within 10m, or connects special radio communication module to meet the requirement of radio data transmission within 200m.

In addition, XCRF-500 series readers also provide a 10M network interface to meet the requirement of high-speed data transmission.

## **2.8 Connect to external AC power supply**

Follow the below steps to connect to AC power supply of



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XCRF-500 reader:

- (1) Make sure that the voltage is AC100V ~ 240V and working frequency is 50Hz;
- (2) Make sure that the switch of XCRF-500 reader series is off;
- (3) Plug one end of the power line into the socket of AC power supply, and another end into the triple-cored-cassette AC power input of XCRF-500 reader series
- (4) Turn on the switch on the front panel of XCRF-500 reader series. After a beep, power supply indicator lights up, then the reader is initialising, and the system is standby after finishing initialising process.

**Note:**

When XCRF-500 reader is in default status, the system is in standby status after start-up. The reader does not transmit radio wave when it is initialising or standby (radio power amplifier is off). Only after connected to antenna or load and receiving 'Read/Write tag' command from PC or 'Enable Power Amplifier' command, Power Amplifier of reader turns to working status.

**Caution:** It is harmful for readers to enable the Power Amplifier with the absence of the connection to antenna or



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dummy load.

## **2.9 Reader Test**

Testing for XCRF-500 reader series includes:

- (1) Power Amplifier enable test: the indicator “PA” on the front panel of reader lights up after the Power Amplifier is

enabled.

(2) Power Amplifier disable test: Power Amplifier is off after the system start-up and initialisation. Power Amplifier could be disabled by “Disable Power Amplifier” command. The indicator “PA” on front panel of reader will be off after Power Amplifier is disabled.

(3) Electronic tag reading test:

- ✧ Single tag reading test: test reading the tag ID number, partial or entire data in designated electronic tag;
- ✧ Multi-tag reading test: test reading multi-tag ID number, and the memory data of the designated electronic tags among multiple.

(4) Electronic tag write test:

- ✧ Single tag writing test: read tag ID number; update the data in designated position or total data in tag memory; writing-protection test.
- ✧ Multi-tag writing test: read multi-tag ID number, read or update the data in designated tag memory; writing-protection test.

(5) Read-range test: Read single tag to test its read-range, and



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adjust the position and inclination/rotation angle of antenna.

This test could be done from near to far or reversely;

- (6) Write-range test: A signal-tag test usually done after read test. It should be conducted from far to near.

The equipments and software required for read test are :

- (1) XCRF-500 reader series
- (2) Antenna : XCAF-11, YWGIT, 6dBi
- (3) RF cable:  $1\text{dB} < \text{Insert loss} < 2\text{dB}$
- (4) AC power supply and power socket;
- (5) PC with WINDOWS98/2000 and 9Pin Serial Port;

Test software for XCRF-500 reader series: XCRF-500 reader series API and demo software V1.1.

- (6) Attached CD.



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## **2.10 Adjust antenna position**

Determine a rough read-range on the application spot, then locate and fix the antenna. Follow the procedure of reading test for XCRF-500 reader series to adjust the inclination /rotation angle of antenna to get an optimal read-range.

Last, fix the installation position and antenna angle.

## **2.11 Test for reading tag information**

Fulfilled by “XCRF-500 reader series API and demo software.

## **2.12 Test for writing tag information**

Fulfilled by “XCRF-500 reader series API and demo software”.



## Chapter 3: RF Communication

Generally, the system performance of the devices employing radio communication technology is very sensitive to signal interference and attenuation. This chapter addresses the optimisation issue of radio frequency communication between XCRF-500 reader series and electronic tag, which includes:

- ( 1 ) Signal interference
- ( 2 ) Signal attenuation
- ( 3 ) Optimisation of system performance

### 3.1 Signal interference

Signal interference is the radio frequency (RF) signal caused by the information exchange between reader and electronic tag. Signal interference might seriously impair reader's ability to read the data of electronic tag. The flashing of receiver indicator indicates the existence of interference signal, and the flashing frequency represents the extent of signal interference.

The sources of interference signal include:

- ✧ Radio frequency (RF) system, e.g., RF local-area network, nearby interactive identification system;
- ✧ RF signal radiated from security gate, garage door or

other devices;

✧ Radiation source of other radio frequency (RF);

The influence of these interference sources can be eliminated or reduced by adjusting the installation position and direction of the reader and antenna.

When radio frequency (RF) interference or noise exists, the performance of reader system (exchange data with electronic tag) will dramatically decline. The reader can only “receive” one signal at any time, not able to differentiate the unexpected “noise” and expected “useful RF signal”.

### 3.2 Signal attenuation/reflection

Signal attenuation refers to the natural attenuation of signal strength with the distance increasing. Meeting blocks during signal transmission might also cause attenuation.

The blocks probably affecting the transmission of radio frequency signal include:

- ✧ Close-ended space comprised of concrete wall, floor and ceiling;
- ✧ Metal surface surrounding antenna or tag;
- ✧ Water or other liquids surrounding antenna or tag;

Almost every object (furniture or blocks) in the path of transmitting radio frequency signal will cause attenuation to different extent. With an elaborate adjustment to the installation position, the attenuation of radio frequency caused by blocks can be lessened to possible least.

The reflection from the metal or metalized surface back close to the electronic tag can affect the signal attenuation. In some situation, this could be solved by slightly increasing reading distance, but at the same time some ‘dead corners’ will appear

within reading area. When the electronic tag is positioned in dead corners, the communication between reader and tag will be very poor.

### 3.3 Optimisation of system performance

Generally, it is impossible to precisely predict the system performance of the reader under any given circumstance (the root is the complexity of electromagnetic radiation, including the frequency stability of signal source, the direction of antenna, antenna side-lobes and the environment). However, the suggestions below are instructive to optimising the system performance in practice.

- ✧ Elaborately design and install the antenna of reader. The standard length of radio frequency cable between antenna and reader is 10 meters. Over-lengthy radio frequency cable will bring about attenuation of both transmitted signal and received echo signal, which will shorten the reading range.
- ✧ Change in antenna connection or antenna type will significantly affect the system performance.
- ✧ Take the surrounding into consideration: construction materials, office hours, windows and pipe configuration, etc. Radio frequency field mode and

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- ✧ reading range could be affected by the nearby metal articles like the household appliance, equipments, metal frames, etc.
  - ✧ Make sure that the objects attached with the electronic tags to be identified stay within the valid reading area for longer than 10 milli-second (regarding XCTF-5000 electronic tag).
  - ✧ The polarization direction of the reader antenna shall be the same as that of the electronic tag antenna. If the reader antenna is linearly polarized, the electronic tag could be rotated by 90 degree to find out minimum and maximum reading range.
  - ✧ If the reader antenna is round polarized, the electronic tag may be rotated by 360 degrees in the plane facing the reader antenna without affecting the reading range.
  - ✧ In the case that the electronic tag is vertical to the reader antenna, the reader-writer antenna can't communicate with the electronic tag however it is polarized.
  - ✧ The optimal length of electronic tag antenna is related to the non-conduct material in which the antenna is packed or embedded. The basic idea is: for the
  - ✧ electronic tag packed in non-conductor (its dielectric

constant is usually larger than that of the air, and thus its effective wave length is shorter than that in the air), if its effective electrical length is adjusted to the optimal length in the air (the corresponding reading distance to the reader-writer is the longest), and when the antenna is packed in the non-conduct material, the electrical length of the antenna should be shortened to parallel the optimal effect in the air. On the contrary, if the electrical length of the antenna is adjusted to the optimal, then its optimal electric length in air should be increased.

- ✧ To avoid the mutual interference between multiple electronic tags installed on one object, any two electronic tags should keep enough distance to each other. The interference between multiple electronic tags will occur when the distance between two electronic tags is less than 10cm and their distances to the antenna are equal.
- ✧ Keep the bare or unpacked electronic tags away from chemicals. Some chemicals, such as alcohol, will not affect electronic tags in the normal temperature, but will somewhat cause corrosion when the temperature gets higher,





## Chapter 4: Fault Diagnosis

This chapter introduces the solutions, service information and repair issue of devices malfunction and abnormal situation.

### 4.1 User-solvable Problem

Table 4-1 lists some user-solvable problems regarding the radio frequency identification system composed of reader and electronic tag.

Table 4-1 Fault diagnosis for XCRF-500 reader series

Problem	Likely cause	Solution
The power supply indicator doesn't light up after the reader is switched on.	The socket of AC junction box malfunction.	Apply another AC electrical appliance such as a bulb to the socket to see if it works. If not, please check out the power supply or replace the socket.

	The AC junction box may be controlled by one switch	Connect to control switch, or select one junction box with control switch  Power on the control switch or select a junction with control switch
The power amplifier indicator of doesn't light up.	The power amplifier of reader is not enabled.	Enable the radio frequency power amplifier with the 'Enable power amplifier' command of the test software
The indicator of Power amplifier doesn't light up	Disconnection between reader and PC.	Connect the reader with PC using serial port or network cable.
	Reader isn't switched on	Switch on the reader.



The indicator “Receive” doesn’t light up	The power amplifier disabled, no RF power output.	Enable the power amplifier with the ‘Enable power amplifier’ command of the test software
	No tag in the reading area of reader.	Make the tested tag closer to the reader antenna.
	The tags in the reading area of the reader are damaged.	Replace the damaged tags and retry.
	The direction of electronic tag in reading area doesn’t match the polarization direction of the reader’s antenna	Make the electronic tag face the reader’s antenna and turn it.
The indicator of power supply doesn’t light up	No AC power output	Check the external AC power supply

## 4.2 Contact customer service

Please contact the company's customer service centre in case users get any problems beyond those in section 4.1 and can't figure out solutions.

Before contacting our client service centre, please make following information available:

### **Information of Reader**

- ✧ Model of the reader;
- ✧ Serial number of reader (at the bottom of the reader);
- ✧ Any alterations to the reader or tag;
- ✧ Position of reader;
- ✧ Information about the application software of reader.

### **Information about Computer**

- ✧ Brand and model of computer;
- ✧ Processing speed and available RAM;



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- ✧ COM interface used;
  - ✧ Operating system.

**Contact our client service centre:**

Shenzhen Yuanwanggu Information Technology Co., Ltd.

Free Telephone Call : 800-891-0036

Email: sales@ywgite.cn

## 4.3 Device Return

If the client service staff decides that user should return the reader for reparation, the client service representative will give user a RMA ( Return Merchandise Authorization). Please record this RMA number on the packaging outside and meanwhile place a note bearing this number inside the packaging so that the returned merchandise could be promptly handled.

Please follow the steps below to return the reader for reparation:

- (1) Pack the reader and its accessories carefully and then put them into the original static-proof foam packing case. If the original packing case is missing, please use a protective packing case.
- (2) Use filling materials to cover the content in the case;



- 
- a) Put a note bearing the RMA number in the case;
  - b) Write the RMB number and the word “FRAGILE” on the outer surface of the case;
  - c) Mail the returned merchandise to the following address:

Postal Code: 518057

3/F, Building T2-B, High-Tech Industrial Park South,  
Shennan Road, Shenzhen

Shenzhen Yuanwanggu Information Technology Co.,  
Ltd





## Chapter 5: Performance Index

Performance indexes of XCRF-500W reader series are as follows:

- ✧ Reading and Writing Performance:
  - The reading and writing range is related to the output power of reader, antenna and electronic tag;
  - Under regular configuration: EIRP=36dBm
    - ✧ Maximum Reading Range=7m ;
    - ✧ Maximum Writing Range=5m ;
  - Single Character ( 16bits ) Reading Time: 10ms ;
  - Single Character ( 16bits ) Writing Time: 30ms ;
  - GPRS Module Interface
- ✧ Lighting Emitting Diode (LED): Power Supply indicator ( red or green ) , Power Amplifier indicator (red or green), Link indicator (green), Activity indicator(blue), Receive indicator (green);
- ✧ Communication Interface : RS232 or 10M network ;
- ✧ Serial Transmission Rate : 19200bps ;
- ✧ Regulation on DB9 Pin: standard RS232 definition , the 9<sup>th</sup> pin for +5V output ;

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- ✧ Voltage : 100V ~ 240V/50Hz
  - ✧ RF Output Power : less than 1W
  - ✧ Power Consumption : less than 30W
  - ✧ Maximum Length of Serial Port Cable : 10m
  - ✧ Dimension : 296 × 200 × 65mm(L\*W\*H)
  - ✧ Weight: less than 2.5 kg
  - ✧ Operating Temperature: -10 ~ +50
  - ✧ Storage Temperature: -20 ~ +70

## **Chapter 6: Other Items**

### **6.1 Radio frequency (RF) radiation**

When reader is working (radiating microwave power), the engaged people should keep at least 30cm away from the antenna to meet the requirement stipulated by the US FCC clause for the allowable radio frequency (RF) radiation that human body is exposed to.

This item aims at the on-spot installation and debugging of the equipment.

### **6.2 Non-promissory articles**

Any radio-emitting devices including this device may cause interference to the operation of medical device without appropriate protection. In this case, please consult the relevant medical equipments vendor for solution. The operation of this device may also affect other electronic equipments.

### **6.3 Marketed method**

The device is not available in the general public at the typical retail stores and not available on the web. The device is custom-built, so it is only available if customers purchase.



**Shenzhen Yuanwanggu Information Technology Co., Ltd.**

**Address:** Floor 3, Building T2-B, High-Tech Industrial Park  
South, Shennan Road, Shenzhen



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