

Electronic Toll Collection (ETC) Equipment  
(Model: DP268)

User Manual



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## Introduction

This part of the content serves as reference manual for system installation personnel, mainly introducing basic functions, installation and debugging approaches of DP268 microwave read-write controller provided by the Company. The manual aims at providing correct approaches of installation and debugging.

## Relevant document

In the process of product design, installation and debugging, the relevant standards are referred as follows:

1. JGJT16-92: *Code for Electric Designing of Civil Building*
2. CNYGBJ54-83: *Code for Design of Low Voltage Power Distribution Installations and Wiring Systems*
3. CNYGB9254-88: *Radio Disturbance and Test Methods of Information Technological Equipment*
4. CECS72-95 *Code for Design of Integrative Wiring Standard Engineering of Buildings and Architectural Complex*
5. China Highway [2000] No. 463 *Temporary Technical Requirements of Networked Expressway Toll Collection*
6. *Code for Networked Expressway Toll Collection in Guangdong Province*: DB44/127-2002

## Announcements

To ensure that the equipment can work properly, in the process of the installation of our products, please follow the following explanations correctly:

- ① Guard against damp in the process of transport, installation and application of equipment.
- ② Guard against vibration and extrusion in the process of transport, installation and application of equipment.
- ③ Guard against the coating of corrosive or dirty things on equipment.
- ④ The equipment can not be separated and fixing screws must be tightened up.
- ⑤ Prevention of the interference of strong electromagnetic waves around the location of device installation.
- ⑥ Management of the power of equipment should be centralized; power switches must be labeled with clear instructions.
- ⑦ Equipment must be connected with protective earth wire.

## Packing box list

Table 1

Item	Name	Model	Amount
1	microwave read-write controller	<u>DP268</u>	1 set
2	power controller	Supporting microwave read-write controller	1 set
3	fixation support	Upper support; lower support	1 set
4	power line	10A 250V 1.5 m	1 unit
5	serial port cable (RS232)	9-core 1.5 m	1 unit
6	16-core communication cable	RVVP shield line 50m	1 roll
7	set screws		1 pack
8	User manual(see the attached disk)		1
9	test program(see the attached disk)		1
10	product warranty card		1
11	product certification		1
12	packing list		1

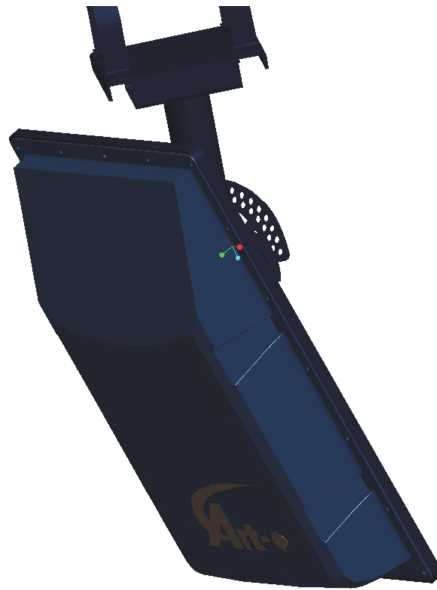
## 1 Equipment Introduction

### 1.1 microwave read-write controller

#### 1.1.1 Brief Introduction

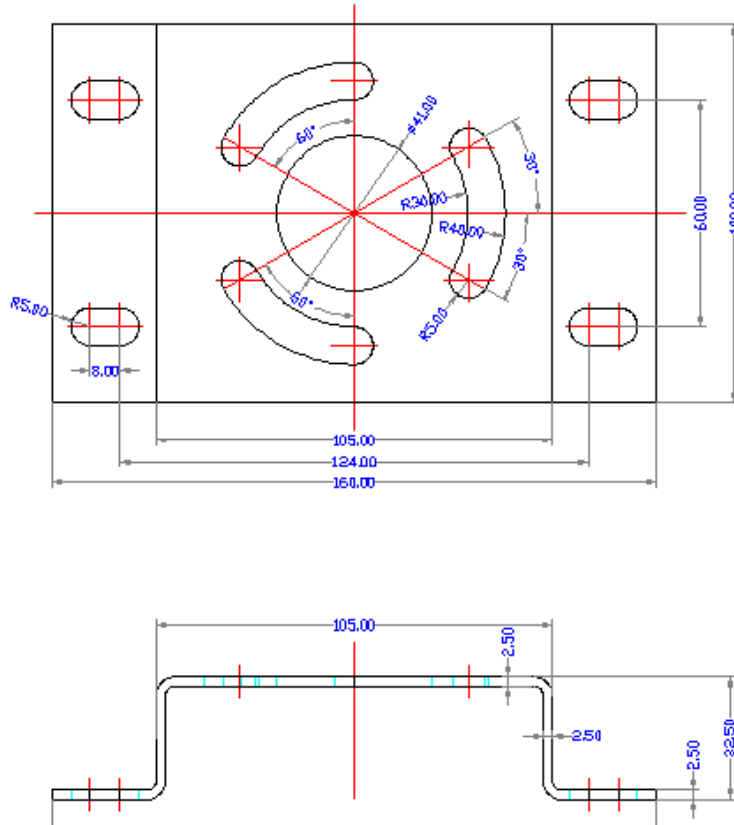
DP268 microwave read-write controller complies with DSRC and *Code for Networked Expressway Toll Collection in Guangdong Province: DB44/127-2002*.

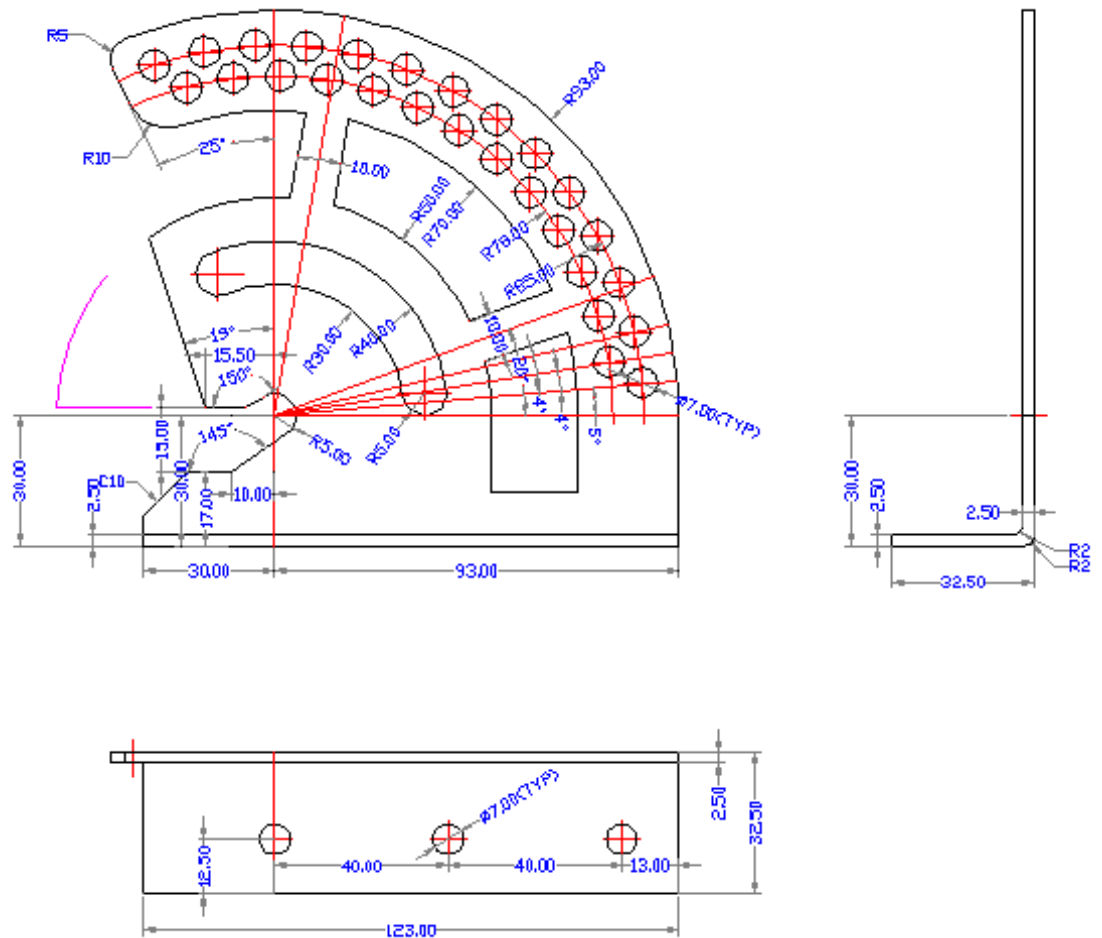
DP268 microwave read-write controller is a DAE (Data Acquisition Equipment), achieving data exchange through wireless communication with RFID (radio frequency identification). It collects and updates information in RFID, and communicates with computers through serial port.



### 1.1.2 Dimension figure of fixed support

As shown in the figure: fixation support is a crucial device for the installation and fixation of microwave read-write controller, which is equipped with four fixed orifices of M10. Through four fixed orifices, fixation support is set on the portal frame or rain-shed. Meanwhile, with the hung microwave read-write controller by fixation support, the M8 fixed orifices as shown in the figure and fine tuning rotation fixed orifices can be applied for fine tuning. An appropriate angle is first selected. Then set screws of M8 fixed orifices and three fine tuning rotation fixed orifices shall be applied.





### 1.1.3 Technical Parameters

#### Mechanical properties

parameter	specification
overall dimensions	492mm × 302mm × 95mm
weight	6.9 kg
canning material	Pedestal: galvanized steel plain sheet + spraying plastics Antenna fairing: PC material modified in high temperature
color	pedestal: Dark Blue/Dark Gray      Antenna fairing: Dark Blue/Dark Gray
installation location	Portal frame: overhead installation or roadside installation

#### Electric and application properties

parameter	specification	
power	+ 24Vdc(MAX 1300mA)power; the adapter adopts 220V/50Hz AC power source	
communication interface	RS232/422	115200 Baud
	communication error detection	BCC (exclusive OR inclusive)
typical exchange time	≤230ms (PBOC e-wallet)	
lightning protection	discharge tube + voltage regulator protection	
average MTBF (mean time before failure)	MTBF > 70000 h	

failure)	
working life	≥15 years

Microwave link properties

parameter	specification	
signal modulation approach	AM(downward)	AM(upward)
coding scheme(national standard)	FM0(downward)	FM0(upward)
frequency(national standard)	5.830/5.840GHz	5.790/5.800GHz
radiated power EIRP	≤33dBm, adjustable by software applications	
antenna polarization	right-handed circular polarization	
beam width of antenna	Half-Power Beam Width (HPBW)<20°(X-axis), <40°(Y-axis)	
microwave communication scope	0-20m	
scope adjustment of microwave communication	With adjustment of installation angle, at the height of 5.5m, a communication zone wide 3.0m and high 8.0m will be formed on the ground.	
microwave communication error detection	CRC 16 Cyclic Redundancy Check	
communication encryption	TDES encryption algorithm	
Bit-Error Rate B.E.R	1 X 10 <sup>-6</sup>	

Environmental properties

parameter	specification
working temperature	-20°C~+75°C
storage temperature	-40°C~+85°C
relative humidity	10%~95%
static electricity	8Kv
vibration	To meet CNYGB/T 2434.13
impact	To meet CNYGB/T 2434.6 test Eb and guide rule
salt atmosphere	To meet CNYGB/T 2434.18
lightning stroke	4kV 10/200 μS

## 1.2 Power controller

### 1.2.1 Brief introduction

Power controller is the power supply equipment for microwave read-write controller, providing required power for microwave read-write controller.

Meanwhile, the power controller is the conversion module of RS-422/RS-232. Microwave read-write

controller sends the RS-422serial communication signal which is converted to RS-232communication signal output through RS-422/RS-232 conversion module, and communicates with serial port of IPC. IPC outputs RS-232 signal which is then converted to microwave reader-writer as RS-422 signal converted by the module.

In addition, the power controller is also the interface module of external input (wayside inductor) and output (fence).

External view of power controller is shown as Figure 5:



front



back



bottom



### 1.2.2 The front of power controller

Power input of power controller is controlled by the host power switch of front panel. Under normal circumstances, information of indicator panel is as follows:

name of indicator light	display status	display status information
Vcc	constant lighting	+ 5V power indicator light, power on constant lighting( backup)
Vdd	constant lighting	+24V power indicator light, power on constant lighting
232T	depends on conditions	communication between PC and power controller
232R	depends on conditions	communication between power controller and PC
422TA	depends on conditions	communication between microwave read-write controller and power controller
422TB	depends on conditions	communication between microwave read-write controller and power controller
422RA	depends on conditions	communication between power controller and microwave read-write controller
422RB	depends on conditions	communication between power controller and microwave read-write controller
VD1	depends on conditions	wayside inductor coil1 outputs signals to power controller
SLT1	depends on conditions	PSAM card selection wire1
SLT2	depends on conditions	PSAM card selection wire2
RTCTL	depends on conditions	PSAM card: control of receive and send
DAT1	depends on conditions	PSAM card data link1
DAT2	depends on conditions	PSAM card data link2
RST	no light on	PSAM card reset line

### 1.2.3 The bottom of power controller

A. the bottom has 4 pedestals for PSAM card: CK1.CK2.CK3 and CK4, in which CK4 is used for national standard PSAM card, CK3 for standard PSAM card for the Guangdong Province.

### 1.2.4 The back of power controller

A. RS-232 is a serial socket for IPC serial port. The selection of the specific serial port shall be based on the settings.

B. RJ45 is Ethernet interface with functions equivalent to a RS-232 interface and faster than it.

C. Antenna port is 16-pin plug socket, connecting the input of 16-core communication cable of the microwave read-write controller.

D. AC plug can be connected to the power plug, and the AC voltage is 220V/5Hz.

### 1.2.5 Voltage Test

1. Power controller provides two kinds of DC voltage: +24 V and +5 V. +5 V power provides the power controller's own circuit and microwave read-write controller (as backup), and +24 V power is provided to the microwave read-write controller.

2. Voltage provided by power controller can be tested via a digital multimeter. Testing methods are as follows:

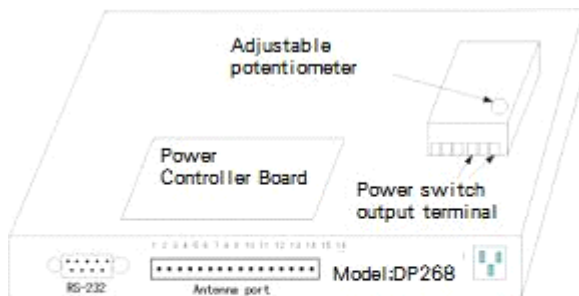
Power controller's terminal is No. 1 to 16, where No.16 is public ground wire of the power, and No.15 is for the positive of +24 V, while No. 14 is the positive for the +5 V. By testing two sets of power terminal of No. 14 and No.16 as well as and No.15 and No.1 can be applied for testing power voltage.

3. Since +24 V power voltage is sent to the microwave read-write controller through No15 and No.16 lines of 16-core communication cable transmission lines, there is resistance in wires. The voltage line will see pressure drop. After the pressure drop, the voltage arriving at microwave read-write controller should be +20 V ~ +24 V , otherwise the equipment cannot work properly.

4. +24 V voltage provided to the microwave read-write controller can be adjusted.

Adjustment method is as follows: (Note: If communication cable length is within 100 meters, adjustment of the voltage value is not recommended.)

Open the shell of power controller, with appropriate phillips screwdriver, adjustable potentiometer of switch power can be adjusted. Meanwhile the multimeter is used to test the output terminal of switch power (or use the multimeter for measuring No.15 and No.16 16-core communication cable lines), adjusting the voltage at the proper value.



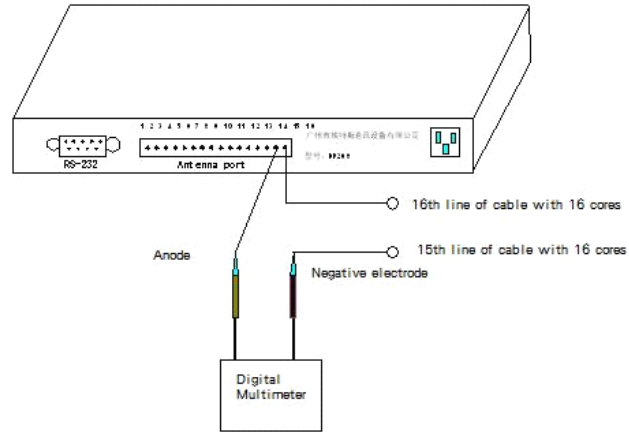
### 1.2.6 Current Test

1. Under normal circumstances, operating current of microwave read-write controller should be 400 ~ 600mA and the current in fact is provided by the power. The too high or too low current is not normal.

2. Under normal circumstances, the current size can not be debugged, but can be tested.

Testing methods are as follows:

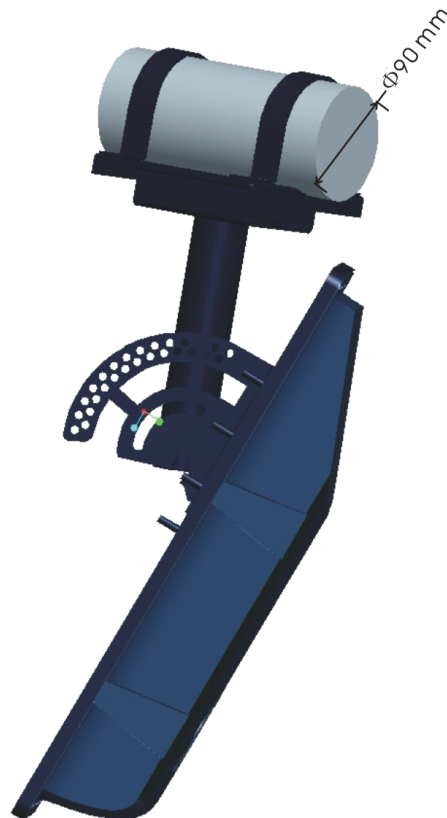
At the location of No.15 and No.16 of terminals of the power controller, the multimeter shall be appropriated for "10A", and the multimeter shall be connected in series in the loop to test the current size.



## 2 Equipment installation

### 2.1 Mechanism installation

#### 2.1.1 Guide of the installation (for reference)



(Figure 2)

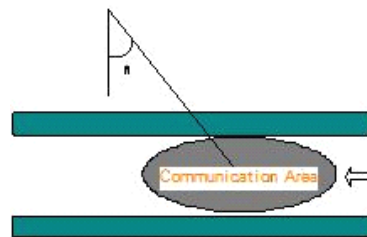
#### 2.1.2 Installation procedures

- ① 4 M8X30 bolts shall be applied to fix the fixation support of the microwave read-write controller to portal frame or rain-shed.
- ② The microwave read-write controller shall be installed in the fixation support with the screws, and height from the ground of the installation of microwave read-write controller

should be maintained at 5.5-6.0 meters, and the horizontal position should generally be in the center of the portal frame (according to the actual situation, horizontal translation is allowed).

- ③ By adjusting the position of the limiting screw holes, the vertical installation angle of the microwave read-write controller can be adjusted. By adjusting fine tuning rotating set screws of the fixation support, the mounting angle can be adjusted as well as the communication area.
- ④ Meanwhile, software can also be applied to adjust the size of the communication area.
- ⑤ Finally, required 16-core communication cable of installation of electrical connections can be installed through the steel portal frame or rain-shed, and be connected to the power controller terminals.

### 2.1.3 Adjustment of communication range



#### Adjustment Description

1, the center of the device launch axis and the vertical angle (M) ranges from  $5 \pm 109^\circ$ , and can adjust the limit screws to choose the right angle. The upper and lower rounds are staggered. For every adjustment of hole site, the angle is decreased or increased by  $4^\circ$ . Specifically as the following table:

Hole Site ( From upward to downward)	Angle(M)
1	5°
2	14°
3	18°
4	22°
5	26°
6	30°
7	34°
8	38°
9	42°
10	46°
11	50°
12	54°
13	58°
14	62°
...	...

25	109°
----	------

2. Communication range forms an irregular oval on the ground.
3. As angle value increases, the oval communication area shifts forward, and the communication area is even greater. Corresponding communication intensity is weakened in the communication area (mainly to adjust the horizontal position of the short-axis of communication distance.)
4. The horizontal position of microwave read-write controller can be used to adjust communication zone in the portal frame (to adjust the horizontal position of the short-axis of communication zone)
5. The horizontal position of microwave read-write controller can be used to adjust communication zone. The horizontal angle is adjusted with the fine tuning screws (mainly to adjust the shape of communication zone to comply with the drive lane).
6. In the condition of fixed angle, the size of the communication area and the intensity of communication strength are related with the power intensity of the microwave read-write controller. Power intensity can be set by software. The value range shall be set between 0 and 31, and the greater the value is, the more communication intensity and communication range will be increased (mainly to adjust the size of the entire communication zone.)

#### 2.1.4 Reference value

Vertical height of installation: 5.5 meters

Horizontal position of installation: 30m right of the center of portal frame (left hand of driver)

Horizontal angle of installation: 0 ° (over against the Drive)

Vertical angle of installation: 30 ° or 35 °

Power settings: 31

Communication zone value: long-axis for 8.0 meters and short-axis for 3.0 m

#### 2.1.5 Notes

1. In the adjustment process of communication range, RFID will be used. As angle and height of RFID in the debugging process and the position of hand holding RFID are different, it will produce relatively large deviations for the results for debugging. Thus, it is needed to regulate the consistency of RFID debugging:

- A. In the debugging process, the back of RFID faces microwave read-write controller, and the typical direction of installation of the vehicle can be available.
- B. In the debugging process, RFID should be consistent with the height of the proposed 1.2 meters.
- C. In the debugging process, angle of RFID should be consistent with the proposed direction perpendicular to the ground.
- D. In the debugging process, the hand holding position of RFID should be consistent and try to hold close to the IC card insertion place (upper and lower edges of RFID).

2. In the debugging process, one item is the detection of transport speed. For the transport speed, it shall be concerned for the Drive system. Yet, the transport speed of the Drive system shall include conditions of many aspects, such as the reaction time of wayside inductor coil, exchange time of microwave read-write controller, rising time of fences, and exchange procedures and so on. As for the detection of exchange time of microwave read-write controller, it can be displayed by testing software and be analyzed through referring to LOG files.

- A. For the microwave read-write controller, reference value of the exchange time shall be 0.25 seconds.
  - B. For Drive systems, it is completed through exchange and the determination of the horizontal distance the vehicle away from the microwave read-write controller of the projection point in the horizontal plane when open railings.
3. In the debugging process, for the definition of communication range, people shall judge that by the actual application condition of project. Under the premise of the current installation reference value and Drive structure, the range of communication shall satisfy the reference values of long-axis (7.5m) and short-axis (3.3m).
- For example: sometimes the range of communication shall meet the long –axis requirements and short-axis, and also demand the communication zone to get closer to the below of the antenna. But in practice, the world has not yet reached the technological level. The recommendation is only an ideal state, and impossible to achieve
4. In addition, as the external and internal testing condition of cars is different, it is used inside of the car in the actual use so that testers should understand some situations.
- For example: the free test in the car may be bypass interference, but when used in the car it actually does not exist. By the understanding of the situation, it should be determined according to actual situation.
5. Special note: Because of different ways in different places lane trigger, and different structures of the same trigger approaches of one location of the Drive System, it is necessary to adjust according to the scene.

## 2.2 Electrical installation

### 2.2.1 Device attachment chart

As shown in the figure: connection of the whole system shall include IPC and power controller, microwave read-write controller and power controller as well as power controller and AC power.

### 2.2.2 Wiring introduction

- 1. The connection between IPC and power controller shall be achieved through the specifically configured 9-pin RS232 serial port cable, and one end shall be connected with the serial terminal of IPC (the selection of the serial terminal is set by users) and the other end shall be connected with the serial terminal “RS-232”.
- 2. The exchange voltage of power controller shall be provided by specifically configured power line, and the voltage shall be exchange 220V/50HZ.
- 3. The connection between microwave read-write controller and power controller shall be achieved through the specifically configured 16-core communication cable, and one end is connected through 16-core circular connector to connect with the 16-core circular socket of microwave read-write controller, and the other end shall be controlled by 16-pin serial socket with 16-pin serial socket on the power controller.
- 4. The connection between wayside inductor signal and power controller shall be achieved by the connection of the output of power controller to 16-pin terminal of socket.

### 2.2.3 Mapping Table of equipment wiring

16-core circular socket	16-core communication cable	power controller connecting ter	power controller indicator light	indicator light significance
-------------------------	-----------------------------	---------------------------------	----------------------------------	------------------------------

		minal		
1	1	1	RS422T+	PC send
2	2	2	RS422T-	PC send
3	3	3		serial port ground wire
4	4	4	RS422R+	RSU send
5	5	5	RS422R-	RSU send
6	6	6	VD1	input interface
7	7	7	SLT1	PSAM CARD selection wire1
8	8	8	SLT2	PSAM CARD selection wire2
9	9	9		backup
10	10	10	RTCTL	PSAM CARD transceiver
11	11	11	RST	PSAM CARD reset line
12	12	12	DAT1	PSAM CARD data link1
13	13	13	DAT2	PSAM CARD data link2
14	14	14	VCC	+5V
15	15	15	VDD	+24 V
16	16	16	GND	GND

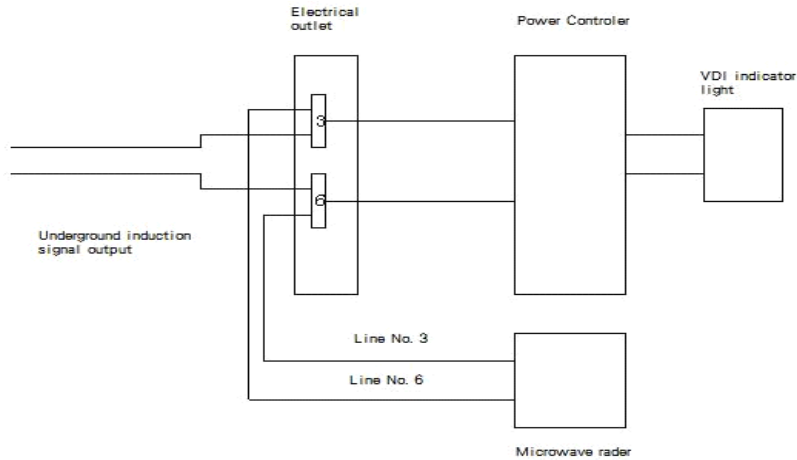
The following points should be noted in wiring process:

1. The connection of circular socket and microwave read-write controller must cut the power or the socket with power will damage the communication interface.
2. Circular socket shall be inserted in a fixed position on the plug, otherwise it cannot be inserted; when it is normally inserted, you must tighten the fixed screw sets on the air plug. If the screw sets cannot be tightened, it cannot be used for future operation.
3. The connection of the other end of 16-core communication cable and 16-pin socket shall notice the corresponding matching of 16-core cable number and terminal of sockets; 16-core communication cable shall apply the pump to fix the connection line and avoid short circuit; 16-core communication cable and terminals of sockets shall be in good contact and fixed connection to prevent the accident of "false connection"; in the wiring and debugging process, it is forbidden to use any hard things to insert into the terminal or the terminal will be damaged.
4. In the 16-pin plugging process, it is necessary to ensure the plug is fully inserted into the socket in order to ensure the firmly plugging. Because the plug has fixation grommet, in the inserting process, set screws must be tightened.
5. RS—232serial port cable must use specially configured serial port cable. In the inserting process, set screws must be tightened.
6. Power line must use specially configured power line, and tightened.
7. The output line of wayside inductor coil is the No.2 line, in which i unit is connected to No.3 of 16-pin

plug terminal, and the other i unit is connected to No.6 of 16-pin plug terminal.

### 2.2.4 Principle of wayside inductor coil signal

Lines of wayside inductor coil signal are as follows:



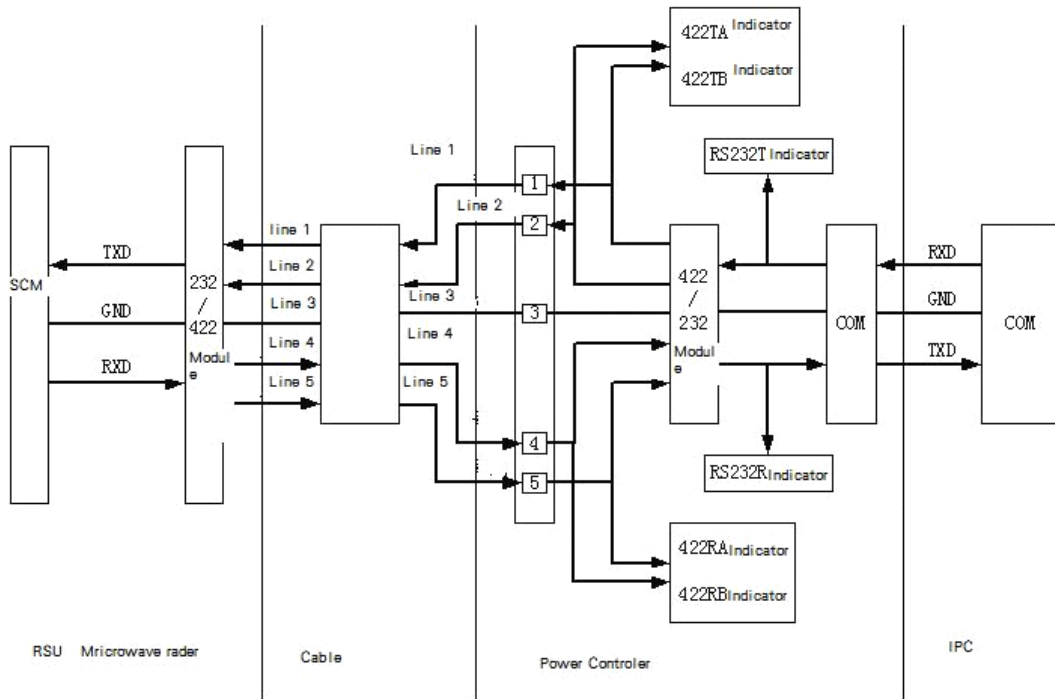
A. The signals from the wayside inductor coil are sent to 16-pin plug socket terminal No. 3 and No.6 by vehicle detector. Signals in No.3 and No.6 lines are divided into two parts: the first is sent to microwave read-write controller through 16-core communication cable No.3 and No.6 lines, and controls switches of microwave read-write controller ;the other is sent to the circuit of power controller through 16-pin power socket, which controls the on and off of VD1 indicator light.

B. signal transmission and signal directions in fact can be independent, of course, with certain links (under normal circumstances, signal transmission and the indicator light display should exist simultaneously). When any part of it has a problem, it will not affect the other part. For example: VD1 indicator light is on, which could not indicate that the line transporting signals to the microwave read-write controller will be certainly normal; if the condition is not normal. The light can still be on; indicator light off cannot verify the signals are not sent to microwave read-write controller, as the broken light does not affect signal transmission.

### 2.2.5 Principle of communication signal transmission

Principle diagram of communication signal transmission is as follows:





- A. RS 232 is imbalanced transmission approach, and the transmission distance is short, prone to interference. RS422 is a differential signal and the transmission distance is long, less susceptible to interference.
- B. The signal transmission process is divided into sending (RXD) and receiving (TXD) (RSU indicates the main body of sending and receiving). Two parts are separately carried out simultaneously, and are relatively independent, so there may be able to send but cannot receive, otherwise the same.
- C. In addition to sending and receiving signal for the signal transmission, indicator light is controlled, but the communication and instruction is independent. Under normal circumstances, the instructions of indicator light can be used to determine the normal communication or abnormal operation. But if the indicator light display is incorrect, it can not fully indicate the abnormal communication (if the indicator light is broken), whereas the same.
- D. RS 232 serial port cable must use the special configured serial port cable, and common serial port cable cannot support the working properly.
- E. In addition, due to RS422 differential mode, when one or part of No.1, 2, 3, 4 and 5 lines have bad contacts or the failure of formation of access, or the possibility of available communication with unstable process, the line shall be carefully checked and the reason shall be found.

### 3 Debugging information display

1. To connect the 16-core communication cable (no serial port, or Startup Program is not launched with serial port connected. No wayside inductor signal. No RFID test); to provide correct AC power voltage for power controller; to turn on power switch, and the power controller indicator light as:

name of indicator light	display status	name of indicator light	display status
-------------------------	----------------	-------------------------	----------------

Vcc	constant lighting	422BR	interval flash
Vdd	constant lighting	VD1	no light on
232T	one flash	VD2	no light on
232R	interval flash	VD3	no light on
422TA	one flash	L-UP	light on
422TB	one flash	RED	light on
422RA	interval flash	GREEN	light on

(1) If the power controller's indicator light VD1, VD2 and VD3 constantly flashing, it indicates +30 V power is not normally available to the RSU. There may be three problems:

- A. power controller through 16-core communication cable sends +30 V to the RSU, but inside the RSU equipment, the power plug is loosened, resulting in the situation that the power does not reach the circuit board.
- B. Power controller itself does not provide voltage of +30 V.
- C. Power controller provides normal voltage, and RSU equipment power plugs are working normally, but trouble emerges in the course of power going through 16-core communication cable, such as the terminals are not tightened enough; different kinds of cables and so on.

(2) If the wayside inductor indicator light VD1 constantly flashes, it indicates that VD1 (terminal No. 6) and GND (terminal No. 3) has short circuit, and short circuit is caused by 2 main reasons:

- A. internal wiring short circuit of RSU equipment, that is, No. 6 line (VD1) and No. 3 line (GND) short circuit of 16-core communication cable causes short circuit of the system. (In this state, DSRC devices can not communicate.)
- B. the output short circuit of wayside inductor coil results in the VD1 and the GND short-circuit of 16-pin terminal block. (In this state, DSRC devices can communicate and there will be reaction with RFID testing.)

2. To connect 16corecommunication cable and have wayside inductor signal (no serial port, or Startup Program is not launched with serial port connected. No wayside inductor signal. No RFID test); to provide correct AC power voltage for power controller; to turn on power switch, and the power controller indicator light as:

name of indicator light	display status	name of indicator light	display status
Vcc	constant lighting	422BR	interval flash
Vdd	constant lighting	VD1	light on
232T	one flash	VD2	no light on
232R	interval flash	VD3	no light on
422TA	one flash	L-UP	light on
422TB	one flash	RED	light on
422RA	interval flash	GREEN	light on

3. To connect 16corecommunication cable and test with RFID (no serial port, or Startup Program is not launched with serial port connected); to provide correct AC power voltage for power controller; to turn on power switch, and the power controller indicator light as:

name of indicator light	display status	name of indicator light	display status
Vcc	constant lighting	422BR	interval flash
Vdd	constant lighting	VD1	light on
232T	one flash	VD2	no light on
232R	interval flash	VD3	no light on
422TA	one flash	L-UP	light on
422TB	one flash	RED	light on
422RA	interval flash	GREEN	light on

RFID instructions:

- A. If there is no card inserted, the RFID "red indicator light" will flash, and LCD interface alternately displays "no card".
- B. If the account card is inserted, the red indicator light flashes, and LCD interface alternately displays "account cards."
- C. If the value card is inserted, the red indicator light flashes, and LCD interface alternately displays "amount".
- ★ IN the test process, if the red indicator light does not flash and LCD interface does not display information, it indicates the downward chain of RSU equipment has malfunction;
- ★ In the test process, if the red indicator light flashes while LCD interface does not display information, it indicates the upward chain of RSU equipment has malfunction.

3. To connect 16corecommunication cable and launch the program (no serial port, or Startup Program is not launched with serial port connected; no RFID test); to provide correct AC power voltage for power controller; to turn on power switch, and the power controller indicator light as:

Name of indicator light	Display status	Name of indicator light	Display status
Vcc	constant lighting	422BR	one flash
Vdd	constant lighting	VD1	no light on
232T	one flash	VD2	no light on
232R	one flash	VD3	no light on
422TA	one flash	L-UP	light on
422TB	one flash	RED	light on
422RA	one flash	GREEN	light on

- ★ In this state, DSRC devices can not communicate, and provide no reaction even tested by RFID.

4. To connect 16corecommunication cable and the serial port; to launch the program. The VD1 wayside inductor has signals (no RFID test); to provide correct AC power voltage for power controller; to turn on power switch, and the power controller indicator light as:

Name of indicator light	Display status	Name of indicator light	Display status
Vcc	constant lighting	422BR	one flash
Vdd	constant lighting	VD1	constant lighting
232T	one flash	VD2	no light on
232R	one flash	VD3	no light on
422TA	one flash	L-UP	light on
422TB	one flash	RED	light on
422RA	one flash	GREEN	light on

5. To connect 16corecommunication cable and the serial port; to launch the program. The VD1 wayside inductor has signals; to test with RFID; to provide correct AC power voltage for power controller; to turn on power switch, and the power controller indicator light as:

Name of indicator light	Display status	Name of indicator light	Display status
Vcc	constant lighting	422BR	interval flash during exchange
Vdd	constant lighting	VD1	constant lighting
232T	interval flash during exchange	VD2	no light on
232R	interval flash during exchange	VD3	no light on
422TA	interval flash during exchange	L-UP	light on
422TB	interval flash during exchange	RED	light on
422RA	interval flash during exchange	GREEN	light on

## 4 Maintenance and Training

### 4.1 Maintenance

- ☆ Since the date of purchase (subject to the official purchase invoice date), under normal use, one year free replacement is provided. The whole three-year warranty is provided as well as lifetime maintenance.
- ☆ Damage caused by improper application, maintenance and storage or force majeure is not in the scope of warranty.
- ☆ As warranty expires, paid maintenance service is provided.
- ☆ Free technical upgrade consulting services are provided.

### 4.2 Training

Application of RSU does not need training and only requires the installation guide, that is, detailed RSU

Installation Guide shall be provided to any ETC user. RSU's maintenance training program must include:

1. Equipment Description
2. Test Software Description

## 5 FCC STATEMENT

1. This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference.
  - (2) This device must accept any interference received, including interference that may cause undesired operation.
2. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

### FCC Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body

### Company Information

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