VERSION： V1.0

NAME： WLC ECU Product Specification

PRODUCT MODEL： WLC ECU

PRODUCTCODE： 21532

CUSTOMER NAME： VINFAST

FILE TYPE： ☐HW ☐SW ☐STRU■OTHER

☐TEST DOCUMENT ☐DESIGN DOCUMENT

SECRECY： ☐INTERNAL ■EXTERNAL ☐NO ALL

WRITE BY：CHUN ZHANG 日期： 2023-03-02

CHECK BY：LAIJIAFU 日期： 2023-03-02

APPROVE BY：ZHANGJUNYONG 日期： 2023-03-02

Document revision of resume

Num.	Ver.	Content	Date	Make BY	Remark
1	V1.0	first edition	2023-03-02	CHUN ZHANG	

目录

1 Overview

1.1 background

The content described in this document applies to VINFAST Automobile VFe34S project。

1.2 Product function description

This product can provide charging service for wireless charger receiver that supports QI standard.

1.3 Product index function parameter

Num.	Technical index function	Design parameter value identification	Remark
1	input voltage	9-16V	
2	Input current	2A@12V	
3	output voltage	12V/5V	Output voltage: The output voltage at the receiving end
4	output current	1.25A（12V）	input voltage>11V
		1A（5V）	input voltage≤11V
5	output power	15W(max)	Compatible with 5 w
6	Standby current	≦50mA(average current)	
7	Sleep current	NA	Not a normal power supply does not do the requirement
8	static current	NA	Not a normal power supply does not do the requirement
9	System conversion efficiency	≥60%@5W	Coil distance 4mm test
10	Effective charging distance	3～8mm	The distance is the distance between the transmitter coil and the receiver coil
11	Effective charging range	60*20mm	（Distance between transmitting and receiving coils7mm）
12	Working frequency	127±10KHz	
13	Working temperature	-30℃～+80℃	
14	Storage temperature	-40℃～+90℃	
15	Protection grade	IP52	
16	Qi certification	QI 1.2.4	
17	Protection function	Overtemperature protection, overcurrent protection, overvoltage protection and undervoltage	

		protection and other protection functions	

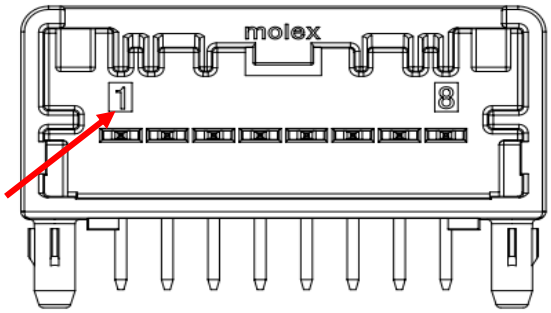
1.4 Connector model and interface definition

PCBConnector model	brand	Type of wire end connector	Brand
34793-0080	Molex	34791-0080	Molex

Socket Number	Pin Number	I/O Type	Clamp Definition	Signal Definition (TTE)
34793-0080(PIN)	1	POWER_GND	Clamp 31	Ground
	2			
	3	-	-	-
	4	-	-	-
	5	BUS	-	LIN Comminication
	6	-	-	-
	7			
	8	POWER_VCC	KL 15	Ignition ON Input

Connector diagram

PIN 1



2 Product function description

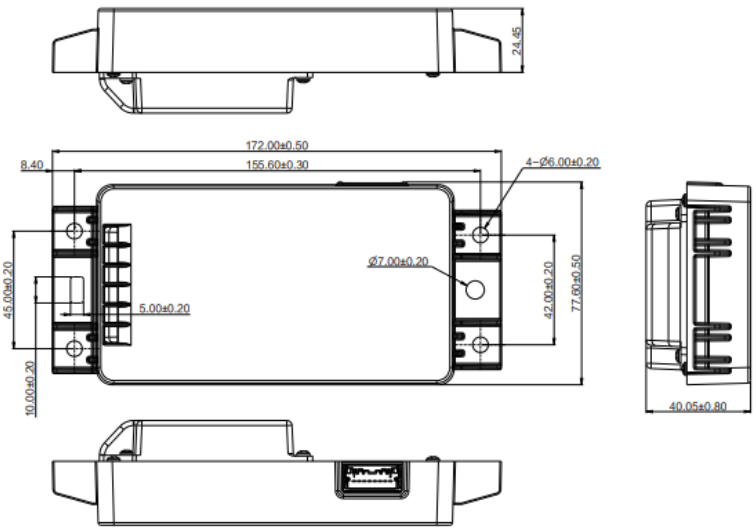
2.1 Description of product structure

2.1.1 Appearance and requirements

The appearance should be clean and tidy, and there should be no dents, obvious scratches, cracks, deformations, burrs, mildew and other defects on the surface. Surface coating should not bubble, crack, fall off; Parts should be fastened without looseness.

2.1.2 Structural dimension/material/weight composition

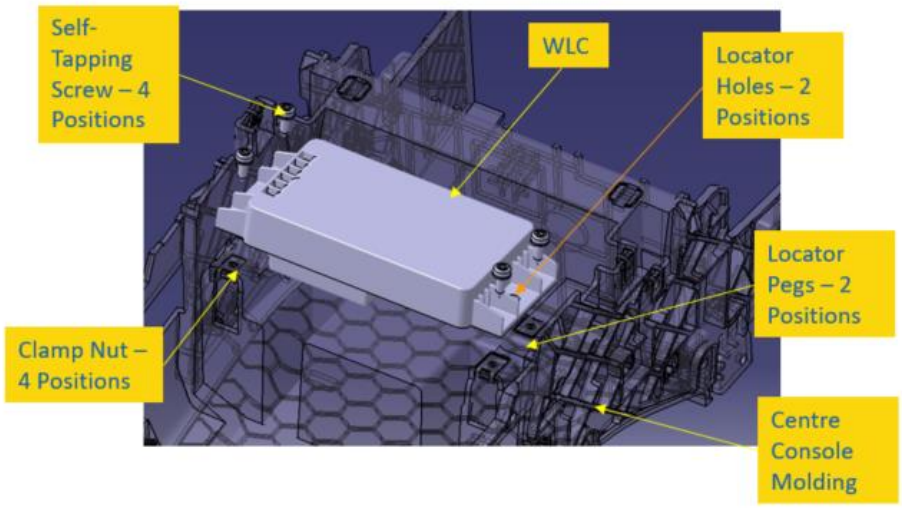
Size：



The material, weight and quantity of materials used in the structure are shown in the following table:

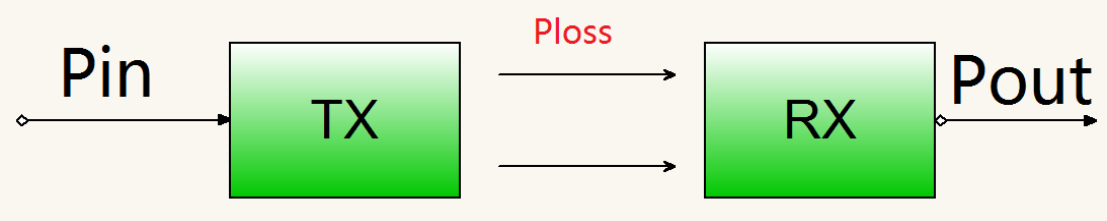
NO.	name	material	weight (g)	quantity
1	On the cover	PC+ABS		1
2	The shell	ADC12		1
3	PCBA component	component		1
4	shield	AL5052		1
5	Cross grooved countersunk head screw	C1018		4
Total weight	About300g			

2.1.3 Module installation instructions



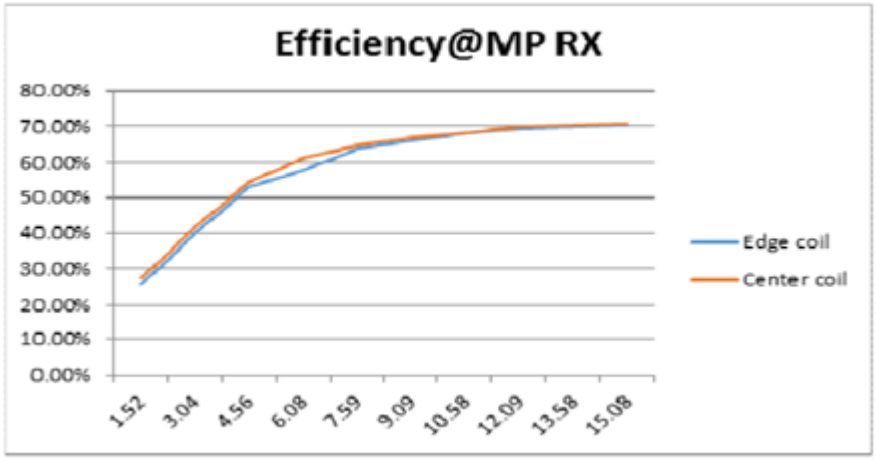
2.1.4 Efficiency test results of the whole machine

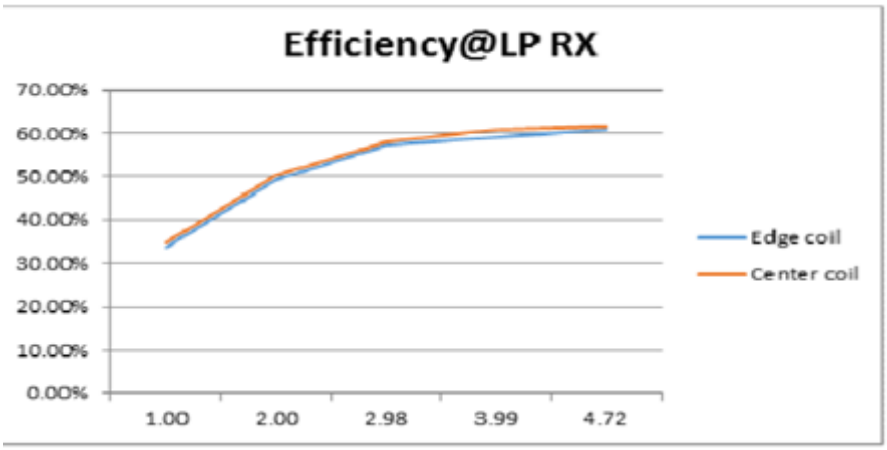
15W/MP-A13 Scheme test efficiency



Efficiency test method: efficiency η=Pout/Pin

Test results:





2.2　Detailed description of product software

Software Overview:

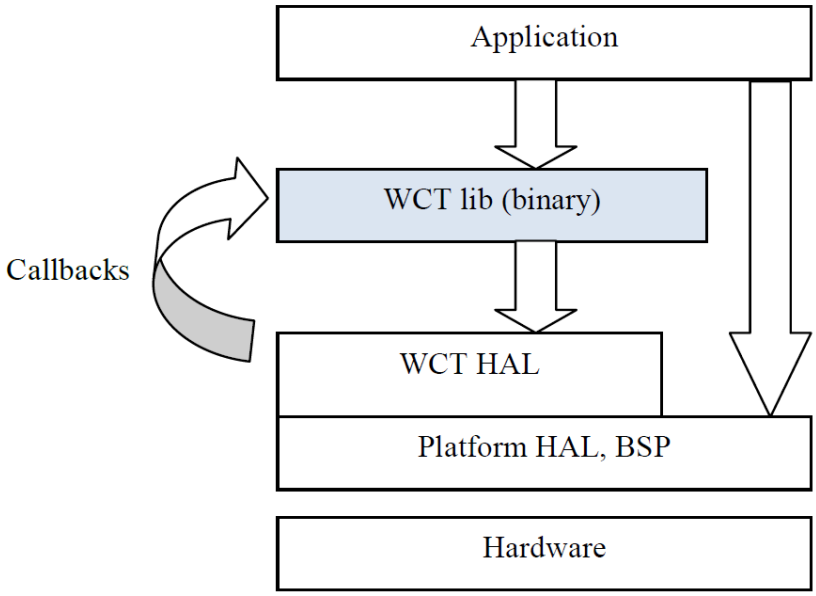
1．This product software solution is a reference platform for 15W multi-coil transmitter and is designed for wireless charging application of vehicles based on KF32A140 sending controller IC.

2．The controller IC manages and performs all the control functions required to implement the wireless charging transmitter solution.

3．The solution provides a high-performance wireless charging system that also takes into account the complex working environment of the vehicle.

4．The design conforms to the latest Qi specification of wireless charging Alliance and has been certified by MP-A13 transmitter.

NUV provides a set of WCT Library for wireless charging transmission of 15W series wireless charging IC, and encapsulates the wireless charging function, so that the development of wireless charging function does not have to pay too much attention to the specific hardware implementation. Therefore, the software operation hierarchy of the whole system is as follows:



Software is layered from bottom to top as follows:

1． Kernel and peripheral driver layer: this layer realizes the underlying hardware configuration and initializes the operation parameters of the MCU system.

2．Driver interface layer: this layer realizes the interaction between the driver layer and other levels, which is conducive to the migration of the chip platform.

3．Hardware abstraction layer: This layer is the WCT Library hardware abstraction layer (WCT HAL) API, and the WCT library API, providing the following functions:库函数的初始化

- library version number query
- library function main entry function
- the declaration of all kinds of the callback function
- coil operation related definitions
- timer related definitions
- voltage, electric current sensor is defined

interrupts enabled definition, etc

4. WCT library: This layer realizes the control algorithm of wirelessly charged invert full bridge, the control algorithm of lift-voltage transform circuit, and the detection algorithm of FOD, including the following main modules:

- WPC Qi Or PMA state machine
- coil selection
- Qi or PMA communication decoding

- PID power transmission control

foreign body detection

5. Application layer: This layer realizes the interactive processing of external information, the state transition mechanism of wireless charging, and the fault diagnosis of LIN.

Software features of this product:

The system is developed on the basis of the on-board wireless charging platform scheme developed by NUV for many years, taking into account charging efficiency, structural optimization and other factors.Scenario, the power transform part is mainly composed of DCDC buck step-down module and A full bridge inverter resonant DC module, DC part adopts DCDC buck regulating chip automatically adjust the output voltage, the MCU is according to the power error at the receiving end, output A D/A conversion of the output of the reference voltage as the voltage regulator chip reference level, eventually adjusted the DC output voltage of inverter part as input, and the control of inverter part work for fixed fixed frequency and duty ratio (50%), so that you can adjust the DCDC output voltage to adjust output power.

By using the above control mode, our actual test results show that the inverter has obvious advantages over the inverter in EMC performance.

- based WPC MP – A13 (grace wisdom pu topology);
- free wireless charging platform more than 10 w coil position, has a fixed frequency;
- integrated on a chip digital demodulation;
- support based on the quality factor (Q factor) change in power loss calculation and calibration;
- support multiple types of RX modulation signal (ac capacitance, ac resistance and dc resistance).
- support low standby function and ignition control logic;
- support other functions, such as the LIN communication, over voltage, over current, over temperature protection, etc.;

2.2.1 Communication method and Protocol Description

LIN communication:

- support LIN V2.1 agreement;
- support based on UDS diagnosis LIN online diagnosis, upgrade function;

transfer rate of up to 20 kbit/s;

The list of communication matrix can be prepared by referring to LIN Communication Matrix Template. AN diagnostic questionnaire can be compiled by referring to the TEMPLATE of LIN Diagnostic Questionnaire.

2.2.2 Description of realization method of product software protection function.

Various protection functions and methods implemented by the software are as follows:

1. Overvoltage protection: Stop charging when the input voltage of the power supply is greater than

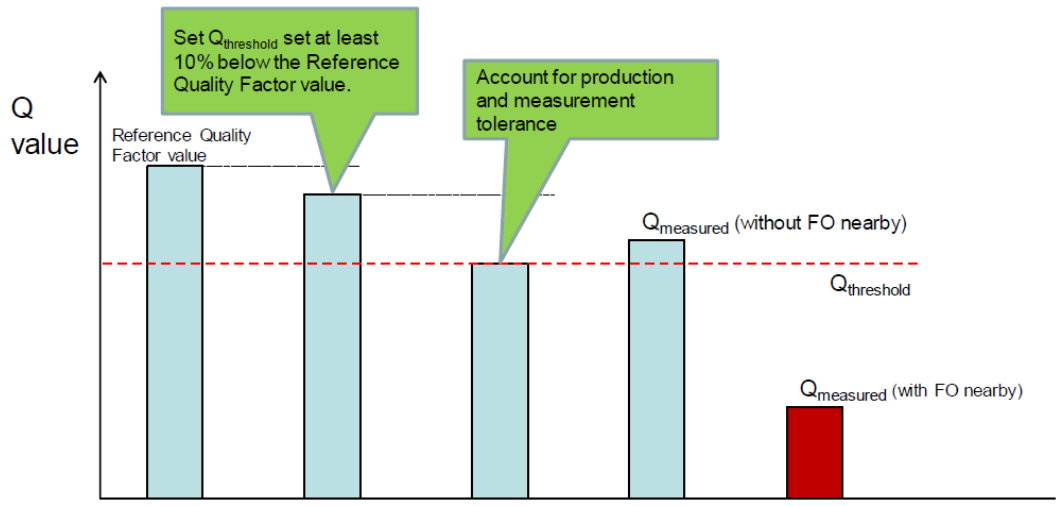
the over voltage threshold set in the software;

2. Over voltage recovery: when the power supply voltage returns to the normal working voltage set in the software from the over voltage state, restart the wireless charging;
3. Under voltage protection: Stop charging when the input voltage of the power supply is less than the under voltage threshold set in the software;
4. Under voltage recovery: when the power supply voltage returns to the normal operating voltage set in the software from the under voltage state, restart the wireless charging;
5. Over temperature protection: When it is detected that the temperature of the temperature sensor on the PCB board is higher than the threshold temperature set in the software, stop charging;
6. Over temperature recovery: when it is detected that the temperature of the temperature sensor on the PCB board is restored to the normal working temperature set in the software, wireless charging can be started again;
7. Over current protection: When the power input current or coil output current is detected to be greater than the threshold current set in the software, the wireless charging shall be stopped;
8. Overpower protection: When it is detected that the input power of the power supply is greater than the threshold power set in the software, stop the wireless charging;
9. FOD (Metal foreign body) detection protection:

The wireless charging Qi standard does not specify the detection of foreign matter on the charging plate. With the increase of wireless devices compatible with this international standard, the problem of system application security is becoming more and more serious. The purpose of foreign body detection (FOD) is to prevent metal and other objects from being heated near the launching platform and causing personal and property safety. At present, we carry out FOD detection in the following two ways:

Method 1: Q factor change is detected. The formula of Q factor algorithm is as follows:

$$Q = 2\pi \times \frac{\text{Energy Stored}}{\text{Energy dissipated per cycle}} = 2\pi f_r \times \frac{\text{Energy Stored}}{\text{Power Loss}}.$$



The steps based on this method can be divided into:

1. When a foreign object is detected near the upper part of the transmitting end, the quality factor of the transmitting end coil, namely the Qmea value, is detected;
2. The receiving end will send a reference Q value (see QI Protocol 1.2.2 for specific definition) to the transmitting end during the negotiation stage of communication with the transmitting end;
3. After receiving the reference Q value transmitted by the receiving end, the transmitter will calculate a threshold Qth value, which is at least 10% lower than the reference Q value. In addition, considering component error and measurement error, the threshold Qth value will be lower than 90% of the reference Q value;
4. If the quality factor Qmea of the transmitter coil is greater than the threshold Qth, then it is considered that there is no foreign body; If the Qmea is less than Qth, the foreign body is considered to be present and the power conversion is terminated simultaneously.

Method 2: Detect the difference of power loss

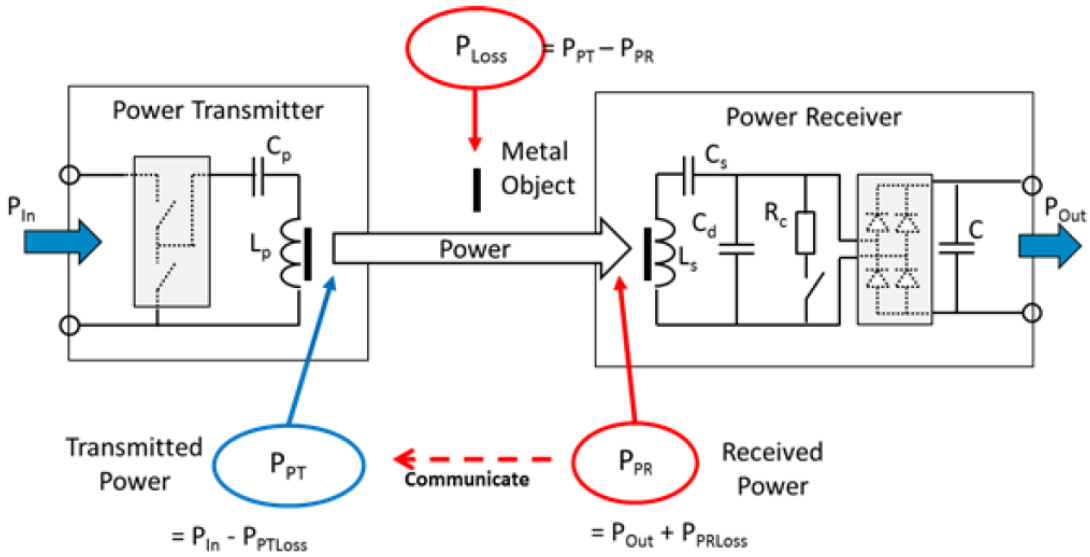


Table 61. Maximum P_Δ

Maximum Power [W]*	Maximum P_Δ [mW]
0...5	350
5...10	500
10...15	750
* The lower limit is not included in the range.	

As shown in Figure 1, the schematic diagram of power loss difference to detect foreign bodies:

The definition in figure 1 is as follows:

P_{PT}define：The net output power of the emitter is equal to the input power of the emitterPinMinus the loss of the transmitter itselfP_{PTLOSS}；

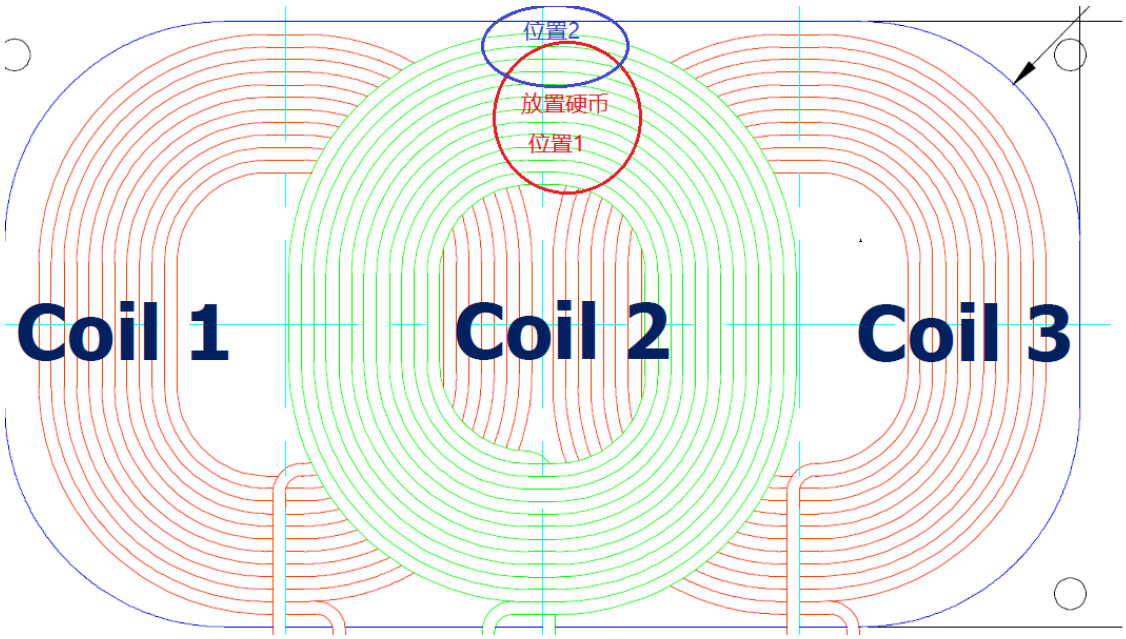
P_{PR} define：The total power received by the receiver is equal to the net output power of the receiverPoutPlus the loss of the receiving end itselfP_{PRLOSS}

PLossIs the net output power of the transmitterP_{PT}And the total power received by the receiverP_{PR}

The definition in figure 2 is as follows:

MaximunP_{delta}Is the calibration value of the receiving end, and its size definition is shown in the table 2 above

This method is to judge whether there is foreign matter by the difference of power loss between the transmitter and the receiver,ifPLossLess than or equal toMaximunP_{delta}， No foreign body was believed to exist; ifPLoss is greater than MaximunP_{delta}， It is considered that the power conversion is terminated simultaneously in the presence of foreign bodies.



Schematic diagram of placing coins

The foreign body recognition function is tested by placing coins

Test method: put the receiving end on the transmitting end first, and put the coin after the receiving end works stably

COINS	TXvoltage (V)	TX(current) (A)	TX input power (W)	RX voltage (V)	RX(current) (A)	RX output power (W)	Power loss (W)	FOD Whether recognitio	FODIdentify time(S)

								n	
NO	12.26	1.695	20.78	11.9	1.27	15.11	5.67	NO	-
Position 2	12.26	1.812	22.22	11.9	1.27	15.11	7.1	NO	-
Position 1	12.26	1.982	24.3	11.9	1.27	15.11	9.19	YES	1.5S

Warning：

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
- This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.

This equipment complies with FCC and IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

This device complies with part 15 of the FCC rules and RSS-216 of Industry Canada. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne

doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This Class B digital apparatus complies with Canadian ICES-001.
Cet appareil numérique de la classe B est conforme à la norme NMB-001 du Canada.