RAK475/477 Instruction
Hardware Design Considerations

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1. Overview

Precautions in each phase of product designing with utilization of RAM 475/477 WiFi modules are listed in the document. Please be sure to be familiar with this document and consider beforehand and effectively avoid issues that might be occurred in the hardware design, so as to achieve the goal of rapid production.

1.1 Model of the modules used

- RAK475 and RAK477 modules

Table 1-1: 475/477 model list

Series	Module	Model	Antenna	Communication interface	Note:
475/477	RAK475	RAK475AS	Onboard antenna	UART	Package of stamp hole
		RAK475BS	External connection of antenna with IPEX interface	UART	Package of stamp hole
		RAK475CS	RF-OUT	UART	Package of stamp hole
	RAK477	RAK477AS	Onboard antenna	UART	Package of stamp hole
		RAK477BS	External connection of antenna with IPEX interface	UART	Package of stamp hole
		RAK477CS	RF-OUT	UART	Package of stamp hole

1.1 Basic characteristics of module hardware

- Each module has the only MAC ID in the world
- Onboard ceramic antenna or U.FL antenna connector
- Modules are conducted reflow soldering twice in SMT.
- Average current 80mA@3.3V
- Package dimension: 21 mm x 18 mm x 3.15 mm

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2. Precautions regarding hardware design

2.1 Physical Map of Module

Figure 2-1 RAK475/477 Front View

Figure 2-2 RAK475/477 Back View

2.2 Referred package design

Figure 2-3 is a referred package dimension diagram we suggested for the modules when designing the motherboard of PCB. Sizes of solder mask opening and pad are consistent.

Tip: There are several test points on the back of modules. Please preventing test points from contacting pad or metal objects when designing the motherboard of PCB.

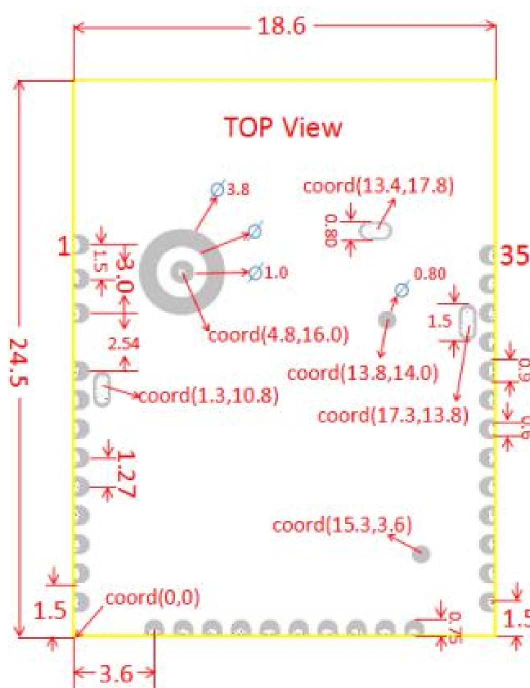

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Figure 2-3 RAK475/477 Package Dimension Diagram

2.3 RF Design

If onboard module of PCB antenna is adopted, it shall consider lowering the intervention of external factors on module signals as much as possible during hardware design.

2.3.1 There are two methods to lower intervention of PCB antenna signals.

1.The bottom plate sheet in PCB antenna area can be cut if possible. By doing so, influence of the bottom plate on performance of PCB antenna can be lowered to the maximum.
2.If the first method is limited and unable to use, please ensure that the module is prohibited to be coated with shell containing mental. Cooper layout, wiringc and element placement are prohibited in the module PCB antenna area and within 15 mm areas extended from the antenna area. Schematic diagram is as shown in figure 2-4.

Figure 2-4 Clearance Schematic Diagram of PCB antenna area

2.3.2 Explanation of recommended position for the module on the base plate.

We suggest that the antenna part of the module can be extended out of the base plate when putting the module on the plate. If not, it'd better to clear the overlapping area between the base plate and the antenna according to figure 2-4, so as to lower its influence on PCB antenna and wireless signal.

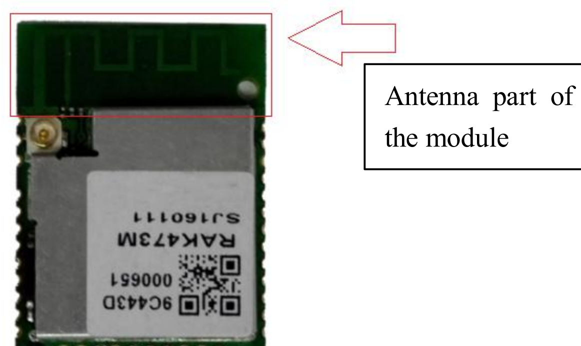

Figure 2-5 Sketch Map of Module Drop Place

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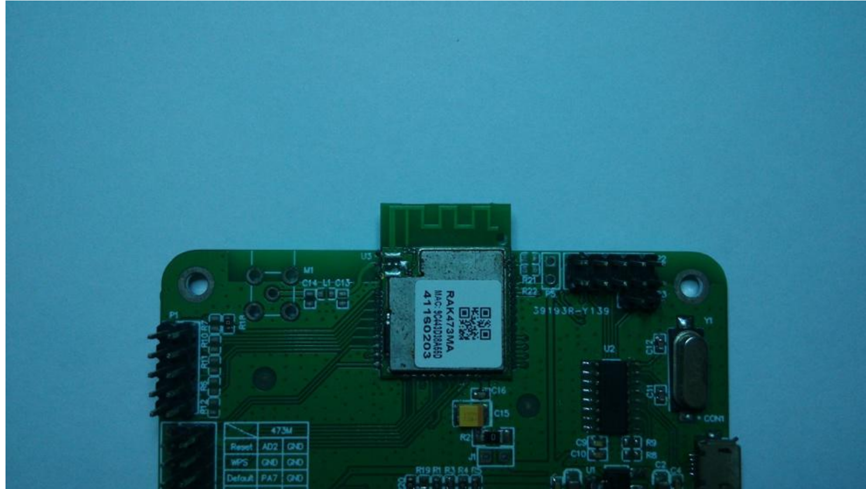

Figure 2-6 Sketch Map of Module Drop Place

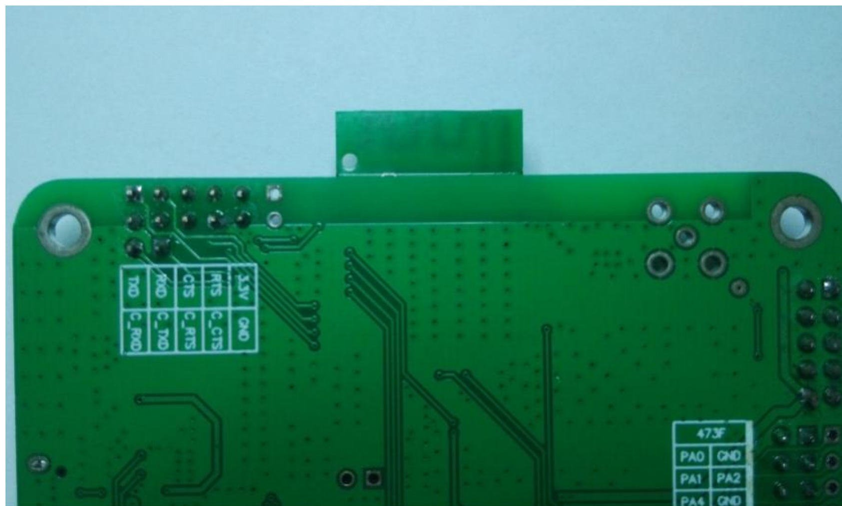

Figure 2-7 Sketch Map of Clearance on Base Plate

2.3.3 Selection of antenna connector for external antenna modules

Figure 2-6 is presented the dimension of IPEX antenna connector. When selecting the connector, it shall confirm whether it It shall confirm with the supplier about the fitting dimension.

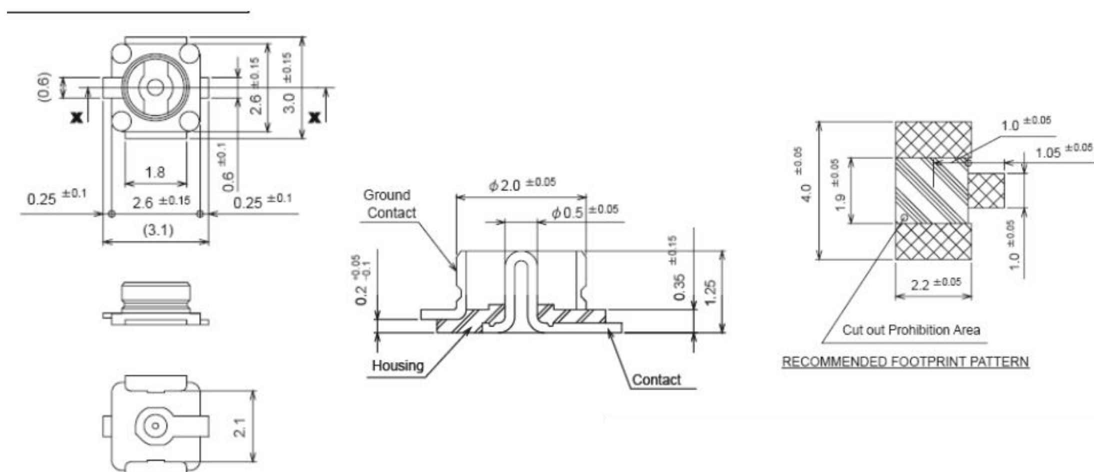

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Figure 2-8 Dimension of IPEX Antenna Connector

2.4 DC Power Design

In order to reduce the probability of the end products going wrong in the actual test, following aspects should be considered in power supply design:

1.Peak current of the module is around 230 mA. DC/DC power supply chip with maximum output current above 600 mA is recommended, as DC/ DC can reflect low-energy advantage of the module with a comparison of LDO.

2.When using DC/DC, it shall pay attention to wiring; Components should be compact as much as possible; Input and output should be well-grounded; Feedback signals should be away from inductance and schottky barrier diode, specific requirements of which can refer to corresponding Datasheet of DC/DC power supply chip.

3.When using LDO, it shall notice the maximum output current and heat dissipation. For example, voltage is decreased from 5 V to 3.3 V with a drop of 1.7 V; If the current is 320 mA, then thermal power consumption converted on the LDO is 1.7V x 230mA = 391mW. Power Dissipation parameters on the LDO Datasheet must be greater than 391 mW (other input voltages are calculated based on this method).

2.5 ESD Design

Module ESD level: human body model (HBM) is 2000 V, while the component device model (CDM) is 500 V.

2.5.1 The module is welded directly to the board.

It shall specially note all pins that might have a chance to contact with the outside world if there is a higher ESD demand in a product. If connection to connectors like USB and SD card slot, etc. is needed, position of ESD protective device shall be reserved.

2.5.2 The module isn't welded directly to the board.

If the module operates through jump wire, EMI problems should be noticed. It'd better connect with the shielded wire or reserve a position of common mode choke on the board.

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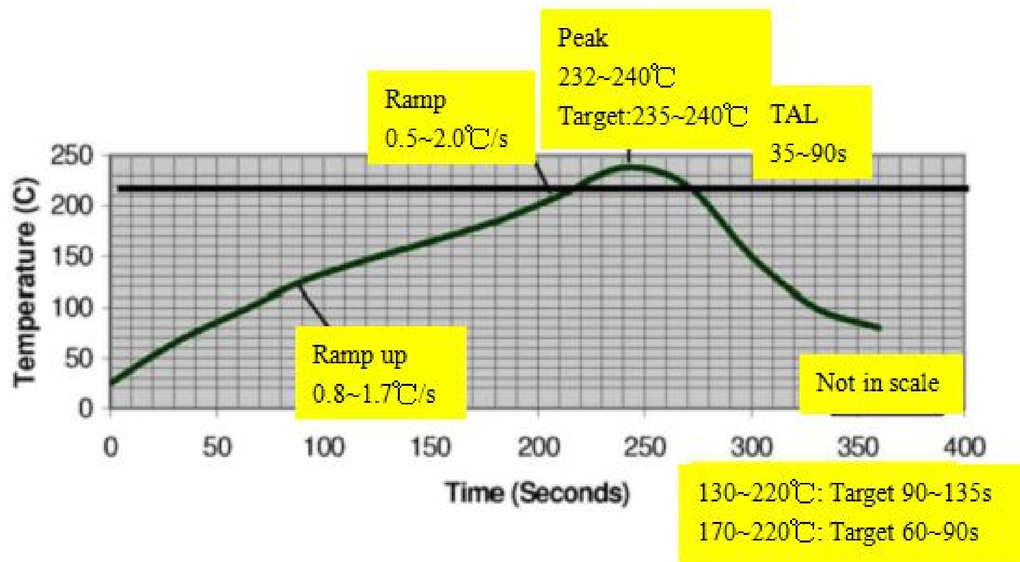
3. SMT Precautions

3.1 Precautions of steel mesh making

1.Suggested thickness of the steel mesh: 0.12 mm (0.1 ~ 0.15 mm); The hold is opened with laser grinding.
2.Suggested solder paste: lead-free solder paste SAC305

3.2 Temperature Curve of Reflow Soldering



Temperature Curve of Reflow Soldering

Notes:

SAC305-based lead-free (3% silver and 0.5% copper) solder paste is presented in figure 3-1. It is recommended to use reflowing temperature curve of Alpha OM-338 lead-free no-wash flux. The diagram is mainly used for reference. Time of the whole reflowing process is determined on the basis of numbers of pads of assembled plate and device density.

3.3 Roasting explanation

RAK475/ 477 modules are sensitive to moisture. Module roasting shall be handled carefully. PCB must be assembled via reflow soldering within 168 hours at room temperature upon taking out from the vacuum package or stored in an environment with relative humidity below 10%. If the above conditions are dissatisfied, RAK475/477 modules must be roasted at 125 ℃ for 9 hours before reflow soldering.

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4. Version

Version	Author	Date	Content modification
V1.0	Wenyong Tang	2016/09/23	Create a document

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