W82
Hardware Design

WIFI Module

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Version History

Date	Version	Description of change	Author
2021-11-12	1.00	First edition	Zhengyin Wang
2022-06-13	1.01	1.change Table 4 Power on timing and electronic characteristic 2.change Table 6 Sleep clock 3.change Figure2 and Table2 PIN67 to RESERVED 4.change Figure15 5.Modify the content of baking in chapter 5.7 6.Update some RF parameters in Table14,Table15, Table16	Wangyaling Rui.Chen
2022-12-07	1.02	1.Add VPH shutdown leakage current 2.Change the power supply pin name and typical values 3.Add the test report to the list of appendix documents 4.Update some RF parameters in Table14,Table15, Table16,Table17 5.Change Table1 Transmitting power 6.Add power supply, PCIe and RF layout guidelines	Zhongxi.Xiang Rui Chen

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1 Introduction

This document describes the electronic specifications, RF specifications, interfaces, mechanical characteristics and testing results of the W82 module. With the help of this document, in combination with our application manual and user guide, customers can quickly apply W82 module into wireless applications.

1.1 Product Outline

The W82 is a small, low-power, low-cost Wi-Fi and Bluetooth module based on Qualcomm WCN6856 chipset. The module can be used in wireless routing, and other wireless terminals. The module is designed to be used together with SIMCom SIM8260 Series modules to establish WLAN and Bluetooth connections.

1.2 WCN Key features

WCN Key features

- Compliant with IEEE 802.11a/b/g/n/ac/ax
- Supports 2x2 Multi-User Multiple-Input Multiple-Output (MU-MIMO)
- Dual Band Simultaneous (DBS), up to 3.6 Gbps data rate (2x2+2x2 11ax DBS)
- Tri-band 2.4 GHz/5 GHz/6 GHz support
- 20 MHz/40 MHz channel bandwidth for 2.4 GHz and 20 MHz/40 MHz/80 MHz/160 MHz channel bandwidth for 5 GHz/6 GHz
- Dynamic Frequency Selection (DFS, radar detection)
- Offloading traffic for minimal host utilization at 802.11ac/ax speeds
- Low-power PCIe (with L1 substate) interface
- Integrated close-loop power detector

1.3 Hardware Interface Overview

W82 support the following interfaces:

- Power supply
- One I2S interface
- One PCIe *1 lane interface

- One COEX_UART interface
- One 32KHz clock input interface
- Two WLAN antenna interfaces
- LAA/N79 control interfaces
- GPIOs

NOTE

1. If unused I2S feature, please keep open.

1.4 Hardware Block Diagram

The following figure shows the hardware block diagram of W82:

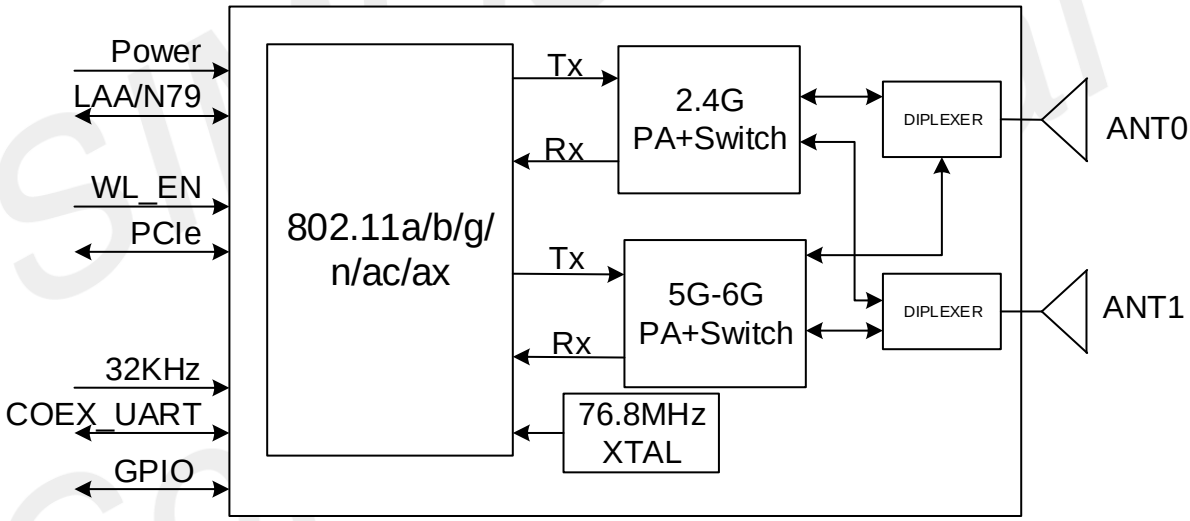

Figure 1：W82 hardware block diagram

1.5 Feature Overview

Table 1：Key features

Feature	Implementation
Power Supply	VPH : 3.3~4.4 V VDD_VM: 1.22~1.42 V VDD_VL: 0.82~1.0 V VDD_VH: 1.8~2.1 V

	VDD_IO : 1.71~2.0 V
Date Rate	802.11b：1,2,5.5,11Mbps 802.11g\a：6,9,12,18,24,36,48,54Mbps 802.11n_HT20：MCS0~MCS7 802.11n_HT40：MCS0~MCS7 802.11ac_HT20: MCS0~MCS8 802.11ac_HT40: MCS0~MCS9 802.11ac_HT80: MCS0~MCS9 802.11ax_HT20: MCS0~MCS11 802.11ax_HT40: MCS0~MCS11 802.11ax_HT80: MCS0~MCS11 802.11ax_HT160:MCS0~MCS11
Transmitting power	802.11b/11Mbps：17dBm 802.11a/g/54Mbps：17dBm 802.11n_HT20/MCS7：17dBm 802.11n_HT40/MCS7：17dBm 802.11ac_HT20/MCS8：17dBm 802.11ac_HT40/MCS9：17dBm 802.11ac_HT80/MCS9：17dBm 802.11ax_HT20/MCS11：14dBm 802.11ax_HT40/MCS11：14dBm 802.11ax_HT80/MCS11：14dBm 802.11ax_HT160/MCS11：14dBm
WLAN Standard	IEEE 802.11a/b/g/n/ac/ax
Modulation Method	DSSS (1/2Mbps)，CCK(1/2/5.5/11Mbps)，OFDMA,OFDM（6/9/12/18/24/36/48/54Mbps）,OFDM technology combined with BPSK, QPSK, 16-qam , 64-qam, 256-qam, 1024-qam; 4k-qam 820.11b adopts CCK and DSSS modulation technology
PCIe Interface	One lane PCIe interface, support PCIe Gen 3.0
UART Interface	● One UART interface ● Data rate up to 3.2 Mbps
I2S Interface	One I2S interface, the I2S also can be configured as PCM
Antenna Interface	2X2+2X2
Physical characteristics	Size：24.0mm*17.0mm*2.6mm Weight：2.1g
Temperature range	Normal operation：-30°C ~ +70°C Storage temperature：-40°C ~ +90°C

NOTE

1. For detailed data, please refer to the test report in the related documents in the appendix
2. I2S Interface default software does not support

1.6 W82 and SIM8260 Series Connect Diagram

The following figure shows the connect diagram of W82 and SIM8260 Series, the details please refer the SIM8260 Series reference design.

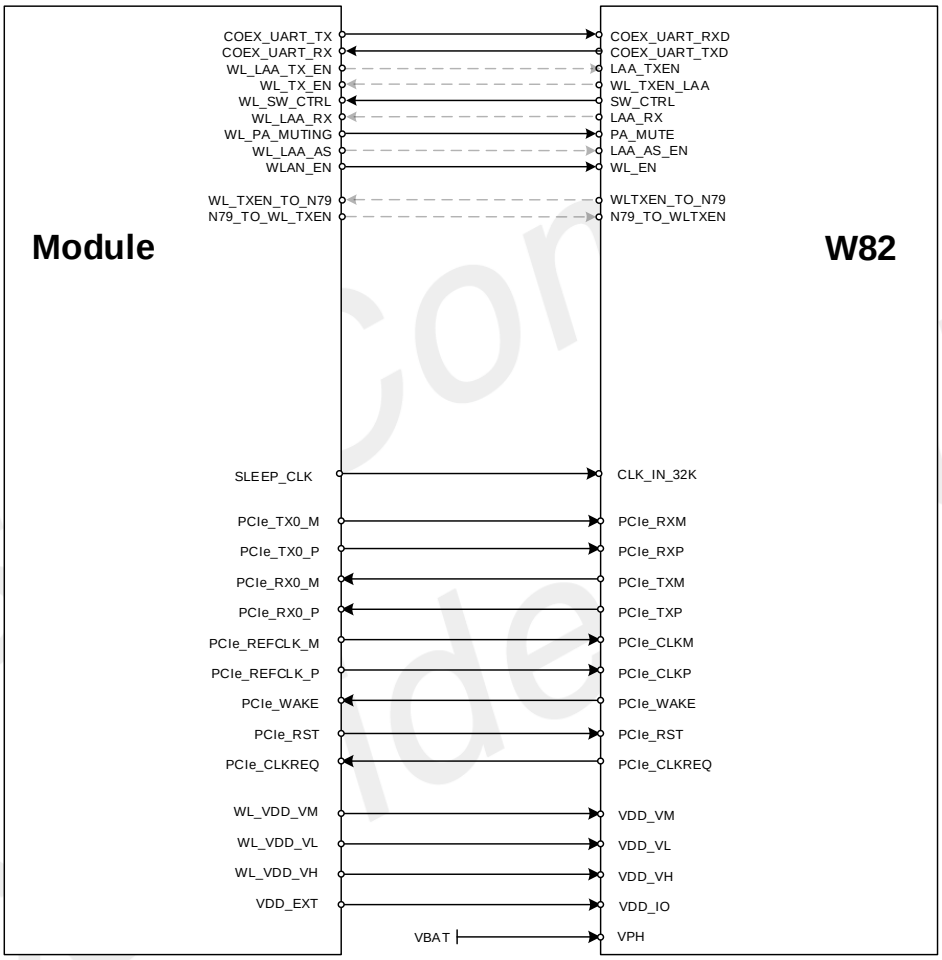

Figure 2：W82 and SIM8260 Series connect diagram

NOTE

1. Gray network to be confirmed after debugging

2 Package Information

2.1 Pin Assignment Overview

All functions of the W82 will be provided through 90 pins that will be connected to the customer's platform. The following figure the pin assignment of the W82.

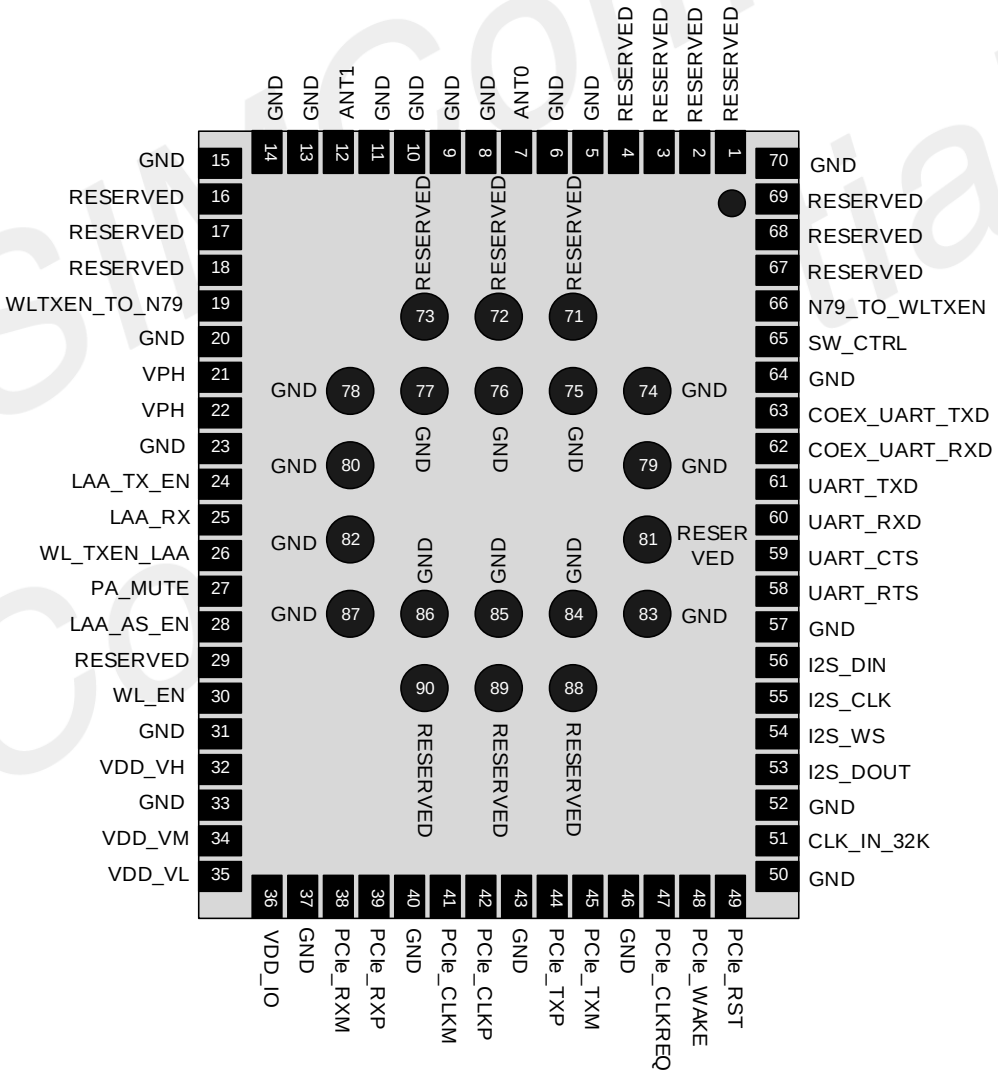

Figure 3：Pin assignment

2.2 Mechanical Dimensions

The following figure shows the mechanical dimensions of W82.

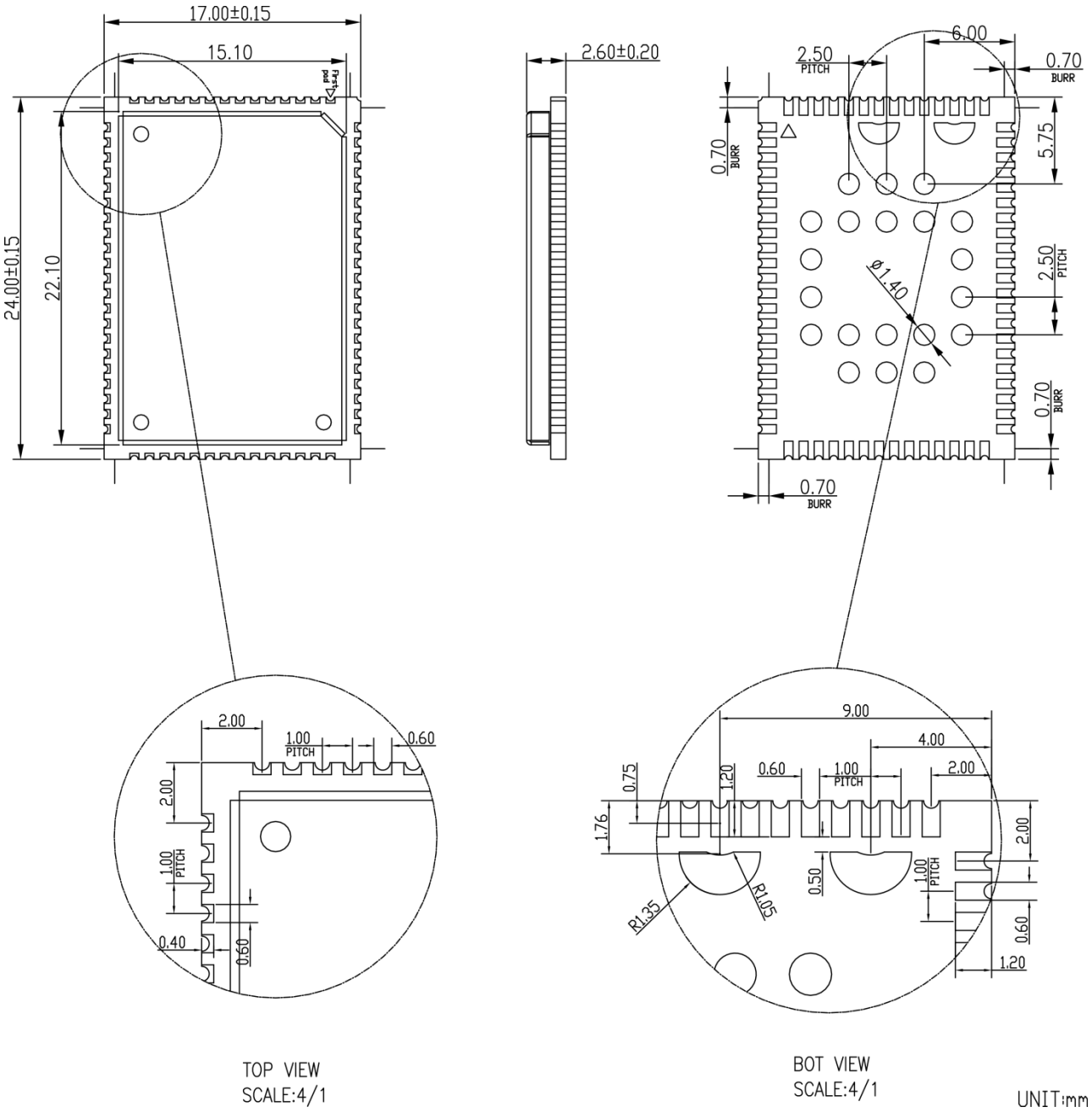

Figure 4：Dimensions of W82 (Unit: mm)

3 Interface Application

3.1 Power Supply

Ensure the module works properly, all power and GND pins should be connected; when all powers are supplied W82 will work well together with SIM8260 Series modules.
When W82 and SIM8260 Series modules are actually used together, the following current consumption data in Table 3 is measured:

Table 2: Power electronic characteristics

Symbol	Description	Min.	Typ.	Max.	Unit
VPH	Module VPH power supply voltage.	3.3	3.8	4.4	V
	Module VPH current in power off mode	-	55	-	uA
	Module VPH peak current.	-	-	1.2	A
VDD_VM	Module VDD_VM power supply voltage.	1.22	1.35	1.42	V
	Module VDD_VM peak current.	-	-	0.6	A
VDD_VL	Module VDD_VL power supply voltage.	0.82	0.95	1.0	V
	Module VDD_VL peak current.	-	-	1.7	A
VDD_VH	Module VDD_VH power supply voltage.	1.8	1.95	2.1	V
	Module VDD_VH peak current.	-	-	0.6	A
VDD_IO	Module VDD_IO power supply voltage.	1.71	1.8	2.0	V
	Module VDD_IO peak current.	-	-	10	mA

NOTE

Test conditions:
1. The mounting capacitance on the VPH network is 10uF+100nF+33pF.
2. The mounting capacitance on the VDD_VM network is 10uF+1uF +100nF.
3. The mounting capacitance on the VDD_VL network is 10uF+1uF +100nF.
4. The mounting capacitance on the VDD_VH network is 10uF+1uF+100nF.
5. The mounting capacitance on the VDD_IO network is 1uF +100nF.
6. VDD_VL layout PCB ESR<5mΩ

Power supply layout guidelines:

- The closer the WIFI module and 5G module are placed, the shorter the power be route, the smaller the DC ESR and DC voltage drop of the power will be. At the same time, the influence of the close distance between WIFI module and 5G module on the thermal design should also be considered.
- The width of the VPH power supply trace of the WIFI module needs to be greater than 1.5MM.
- The VDD_VM (10uF+1uF +100nF) capacitor are placed close to the WIFI module, and the trace width is greater than 0.6mm.
- The VDD_VL (10uF+1uF +100nF) capacitors are placed close to the WIFI module, the trace width is greater than 2mm, PCB_route requires DC ESR<5mΩ.
- The VDD_VH (10uF+1uF +100nF) capacitor are placed close to the WIFI module, and the trace width is greater than 0.6mm.

Timing of power on ：

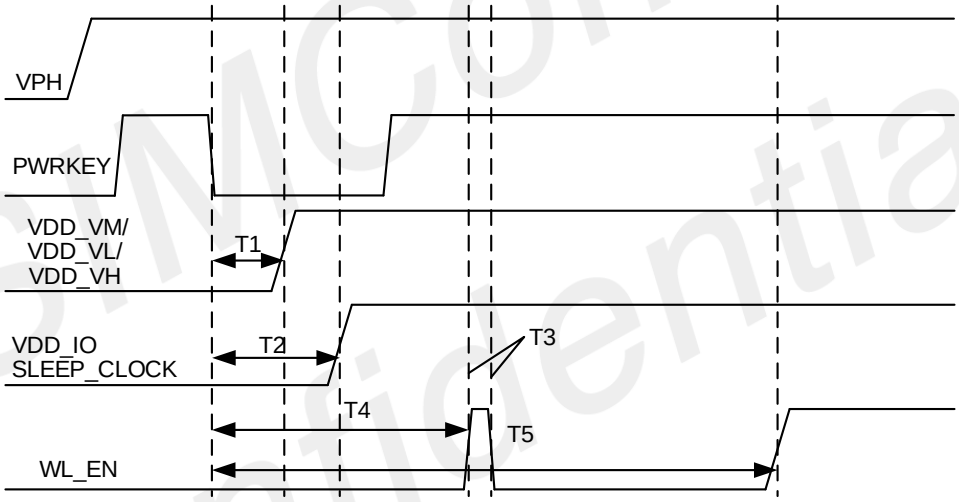

Figure 5：Timing of power on

Table 3: Power on timing and electronic characteristic

Symbol	Parameter	Min	Typ	Max	Unit
T_1	The time from power-on action to VDD_VH,	-	-	8.40	ms
	The time from power-on action to VDD_VM ready.	-	-	9.48	ms
	The time from power-on action to VDD_VL ready.	-	-	9.80	ms
T_2	The time from power-on action to VDD_IO,	-	-	11.45	ms
	The time from power-on action to SLEEP_CLOCK ready.		-	16.00	ms
T_3	The time of W82 initialize.		13		ms
T_4	The time from power-on action to W82 initialize.	-	6.6	-	s
T_5	The time from power-on action to WLAN enable.		7.3		s

NOTE

1.The PWRKEY is the control signal of SIM8260 Series series modules.
2. The T3, T4 and T5 time sequence are based on the data tested by the SIM8260C standard software version. The time sequence may vary with different software versions.

Timing of power off ：

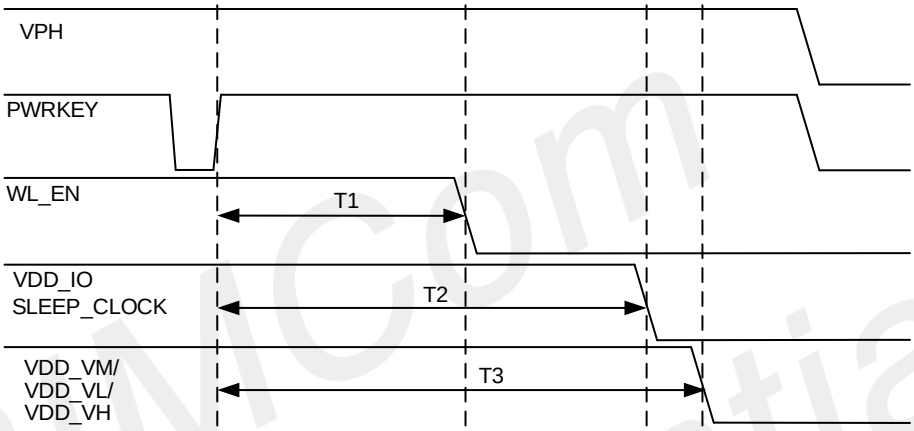

Figure 6：Timing of power off

Table 4: Power off timing and electronic characteristic

Symbol	Parameter	Min.	Typ.	Max.	Unit
T_1	The time from power-off action to W82 disable.	-	3.5	-	s
T_2	The time from power-off action to VDD_IO, SLEEP_CLOCK close.	-	6	-	s
T_3	The time from power-off action to VDD_VH, VDD_VL, VDD_VM close.	-	6.2	-	s

NOTE

1. The PWRKEY is the control of SIM8260 Series series modules.
2. The T1, T2, T3 time sequence are based on the data tested by the SIM8260C standard software version. The time sequence may vary with different software versions.

3.2 Clock Interface

The 32KHz clock is for sleep mode of Bluetooth, the routing line of it should be as short as possible and also need GND protection, and keep it away from interference sources such as power, RF and high-speed signals.

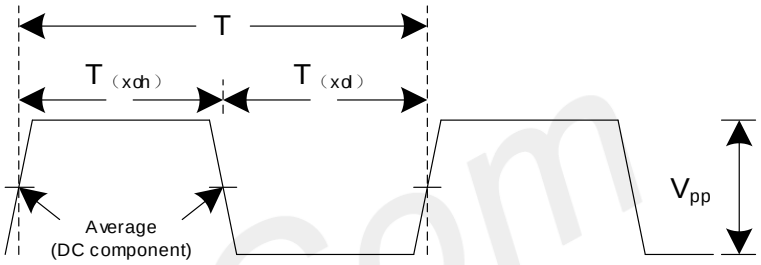

Figure 7：Timing of 32KHz

Table 5：Sleep clock

Symbol	Parameter	Min.	Typ.	Max.	Unit
T(xoh)	Sleep clock logic high	4.58	15.259	25.94	us
T(xol)	Sleep clock logic low	4.58	15.259	25.94	us
T	Sleep clock period	30.508	30.518	30.527	us
F	Sleep clock frequency	32.758	32.768	32.778	KHz
Vpp	Peak-to-peak voltage	1.7	1.8	1.95	V

3.3 PCIe Interface

PCIe is for communication with SIM8260 Series modules, which required differential trace impedance is 85±10%Ω, and the following figure is the PCIe reference circuit:

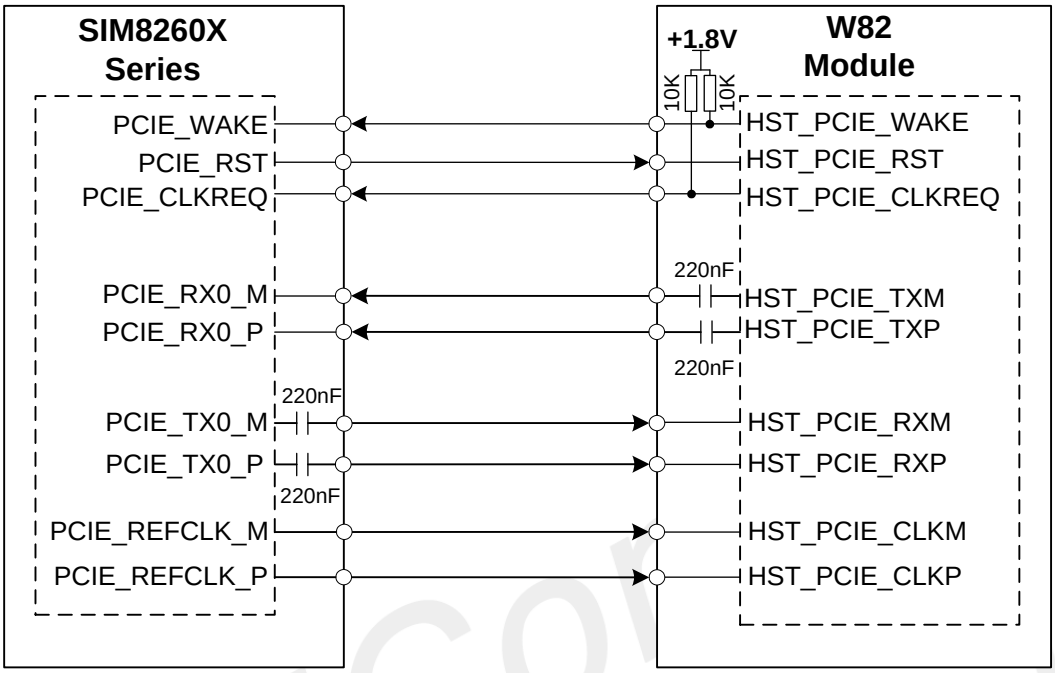

Figure 8：PCIe interface reference circuit

Table 6：PCIe Interface

Pin name	Pin number	I/O	Description	Comment
PCIe_RXM	38	-	PCIe receive minus	Required 85Ω differential impedance
PCIe_RXP	39	-	PCIe receive plus	
PCIe_CLKM	41	-	PCIe reference clock minus	
PCIe_CLKP	42	-	PCIe reference clock plus	
PCIe_TXM	44	-	PCIe transmit minus	
PCIe_TXP	45	-	PCIe transmit plus	
PCIe_RST	49	DI	PCIe reset.	
PCIe_CLKREQ	47	DO	PCIe clock request.	These pins have been pulled up to 1.8V internally
PCIe_WAKE	48	DO	PCIe wake-up	

The PCIe layout guidelines:

- All high-speed or sensitive signals shall be far away from PCIE to prevent interference.
- PCIE_RX0_P/M, PCIE_RX1_P/M, PCIE_TX0_P/M, PCIE_TX1_P/M, PCIE_REFCLK_P/M 5 groups of respective difference 85Ω impedance control, and the differential line intralane match is less than 0.5mm, trace length <200mm. In the case of serpentines, one line of a differential pair must be routed to make up a length delta, then it must be routed at the source (breakout) – this ensures that lines stay differential thereafter.
- PCIE_RX0_P/M, PCIE_RX1_P/M, equal-length control is required only for 2 groups to use at the same time, the intra-lane length mismatch is less than 1mm; PCIE_TX0_P/M, PCIE_TX1_P/M, equal-length control is required only for 2 groups to use at the same time, the intra-lane length

mismatch is less than 1mm. Equal length control is not required between PCIE_TX, PCIE_RX PCIE_REFCLK groups.

- The AC capacitor of PCIE in series shall be close to the output terminal to ensure signal integrity. The two AC capacitors on the same pair of differential lines should be placed in close parallel, otherwise it may affect the signal integrity and cause EMI problems.
- The line distance between PCIE differential pairs and other signal lines shall not be less than 4x line width.
- The differential signal shall first route in the inner layer and be surrounded by GND to ensure continuous reference plane and avoid impedance discontinuity. To maintain impedance balance, maintain positive and negative traces as balanced as possible in terms of the signal and its return path.

3.4 Antenna Interface

Pin7 and pin12 are for antenna, the characteristic impedance is 50Ω.

3.4.1 Frequency band

Table 7：Frequency band

Parameter	Value	Unit
Frequency range	2412~2462	MHz
	5180~5320	MHz
	5500~5700	MHz
	5745~5825	MHz
	5995~7115	MHz

3.4.2 Reference design for RF

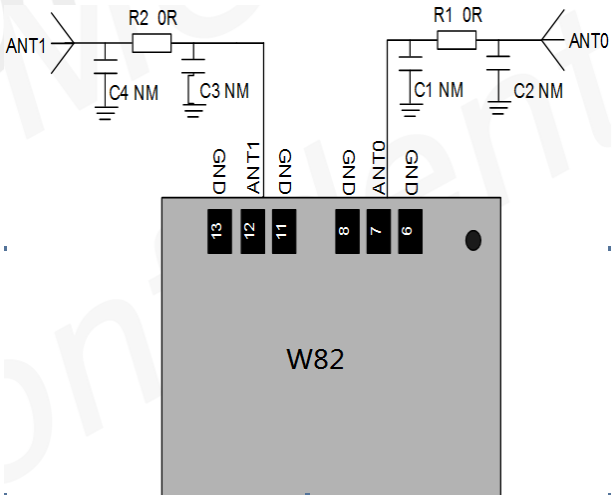

Figure 9：Reference design of RF

W82 provides two RF welding disc interfaces for connecting external antennas. The RF wiring connected to the module RF antenna welding disc is made with a micro-strip line or other type impedance line. The impedance must be controlled at about 50Ω, and the routing line is as short as possible. In order to obtain better RF performance, two GND pads on each side of the RF interface are needed.

Figure 10 ： Impedance Calculation

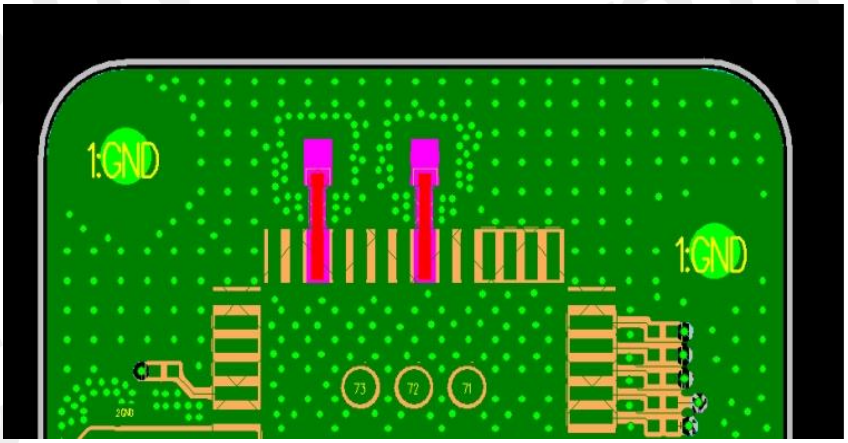

Figure 11：50ohm impedance line

- Use an impedance simulation tool to accurately control the characteristic impedance of RF traces to 50Ω
- GND pins adjacent to RF pins should not be designed as thermal relief pads, and should be fully connected to ground.
- Clearance between RF pins and RF connector should be as short as possible, and all right-angle (90°) traces should be changed to the ones with the angle of 135°.
- There should be clearance under the signal pin of the antenna connector or solder joint.
- The reference ground of RF traces should be complete. Meanwhile, ground vias around RF traces and the reference ground can improve RF performance. The clearance between ground vias and R traces should be at least twice the width of RF signal traces (2 x W).
- Keep RF traces away from interference sources, and avoid intersection and paralleling between any traces on adjacent layers.

3.4.3 Requirement for antenna installation

Table 8：Requirement for antenna installation

Parameter	Requirement
Frequency range	2412~2462MHz
	5180~5320MHz
	5500~5700MHz
	5745~5825MHz
	5995~7115MHz
SWR	≤2:1
Line loss	<1dB
Gain（dBi）	3.99
Input impedance（Ω）	50
Direction	Vertical

The EUT have two RF welding disc interfaces for connecting external antennas and contain the two unique antenna connectors. Antenna type is Sector Glue Stick Antenna; Two antenna ports use same antennas. The max antenna gain is 2.4G: 2.97dBi, UNII 1: 3.50dBi, UNII 2C: 3.94dBi, UNII 3: 3.52dBi, UNII 5: 3.99dBi, UNII 6: 3.29dBi, UNII 7: 3.95dBi, UNII 8: 3.82dBi.

4 Electrical Specifications

4.1 Absolute Maximum Ratings

Table 9：Absolute maximum ratings

Parameter	Description	Min	Type	Max	Unit
VPH	Power for PA	-	-	4.8	V
VDD_VM	Power for PCIe and RFA	-	-	1.5	V
VDD_VL	Power for RFA and others	-	-	1.1	V
VDD_VH	Power for PCIe and RFA	-	-	2.1	V
VDD_IO	Power for IO	-	-	2.0	V

4.2 Operating Conditions

Table 10：Power recommended operating ratings

Parameter	Description	Min	Type	Max	Unit
VPH	Power for PA	3.3	3.8	4.4	V
VDD_VM	Power for PCIe and RFA	1.22	1.35	1.42	V
VDD_VL	Power for RFA and others	0.82	0.95	1.0	V
VDD_VH	Power for PCIe and RFA	1.8	1.95	2.1	V
VDD_IO	Power for IO	1.71	1.8	2.0	V

Table 11：1.8V digital I/O characteristics

Parameter	Description	Min	Type	Max	Unit
VIH	Input high level	1.26	-	2.1	V
VIL	Input low level	0	-	0.54	V
VOH	Output high level	1.35	-	1.8	V
VOL	Output low level	0	-	0.45	V

4.3 RF Characteristics

Table 12：Receive Sensitivity at 2.4G for 1X1 configuration

Band	Type	Unit
2.4G 11b@11 Mbps	-89.4	dBm
2.4G 11g@6Mbps	-93.6	dBm
2.4G 11g@54Mbps	-75.8	dBm
2.4G 11n/ac@HT20-MCS0	-93.7	dBm
2.4G 11n/ac@HT20-MCS7	-74.6	dBm
2.4G 11n/ac@HT40-MCS0	-89.7	dBm
2.4G 11n/ac@HT40-MCS7	-70.2	dBm
2.4G 11ax@HE20-MCS0	-96.7	dBm
2.4G 11ax@HE20-MCS11	-65.4	dBm
2.4G 11ax@HE40-MCS0	-93.6	dBm
2.4G 11ax@HE40-MCS11	-63.4	dBm

Table 13：Receive Sensitivity at 5G for 1X1 configuration

Band	Type	Unit
5G 11a@6Mbps	-96.3	dBm
5G 11a@54Mbps	-78.8	dBm

5G 11n@HT20-MCS0	-95.7	dBm
5G 11n@HT20-MCS7	-76.7	dBm
5G 11n@HT40-MCS0	-92	dBm
5G 11n@HT40-MCS7	-73.5	dBm
5G 11ac@VHT20-MCS8	-72.5	dBm
5G 11ac@VHT40-MCS9	-67.9	dBm
5G 11ac@VHT80-MCS9	-68	dBm
5G 11ax@HE20-MCS0	-97	dBm
5G 11ax@HE20-MCS11	-65	dBm
5G 11ax@HE40-MCS0	-93	dBm
5G 11ax@HE40-MCS11	-63	dBm
5G 11ax@HE80-MCS0	-90	dBm
5G 11ax@HE80-MCS11	-61	dBm
5G 11ax@HE160-MCS0	-89	dBm
5G 11ax@HE160-MCS11	-59	dBm

Table 14：Receive Sensitivity at 6G for 1X1 configuration

Band	Type	Unit
6G 11ax@HE20-MCS0	-97.4	dBm
6G 11ax@HE20-MCS11	-65.4	dBm
6G 11ax@HE40-MCS0	-93	dBm
6G 11ax@HE40-MCS11	-65.1	dBm
6G 11ax@HE80-MCS0	-89.5	dBm
6G 11ax@HE80-MCS11	-65.3	dBm
6G 11ax@HE160-MCS0	-87	dBm
6G 11ax@HE160-MCS11	-56.2	dBm

4.4 ESD

Module is sensitive to ESD in the process of storage, transporting, and assembling. When Module is mounted on the customers' main board, the ESD components should be placed beside the connectors which human body may touch, such as switches, USB interface, etc. The following table shows the Module ESD measurement performance.

Table 15：The ESD performance measurement table (Temperature：25℃，humidity：45%)

Parameter	Connect（±kv）	Air（±kv）
GND	±3	±6
Power	±2	±5
Antenna	±2	±5
PCIe	±2	±4

I2S	±2	±4
UART	±2	±4
Other PADs	±2	±4

NOTE

Test conditions:
1. Test conditions: the external of the module has surge protection diodes and ESD protection diodes
2. The data in Table 18 were tested using SIMCom EVB.

5 Manufacturing

5.1 Top and Bottom View of W82

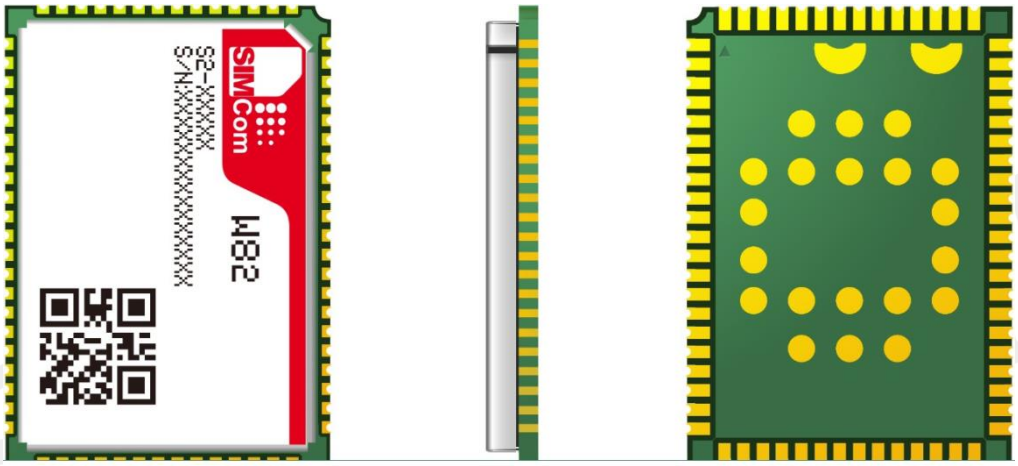

Figure 10：Top and bottom view of W82

5.2 Label Description Information

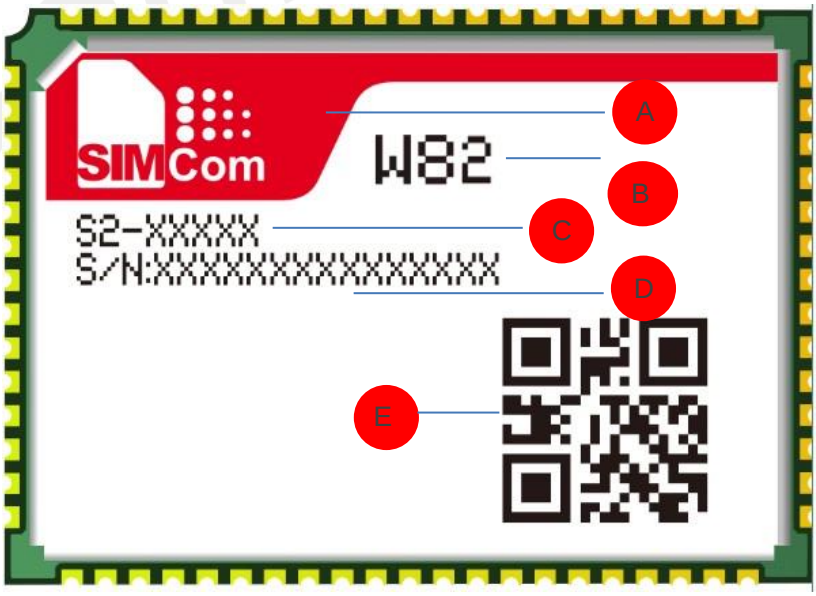

Figure 11：Label description of module

Table 16：Label description of module information

No.	Description
A	LOGO
B	Project name
C	Product code
D	Serial number
E	QR code

NOTE

Figure 11 and Figure 12 are the effect diagrams of the module, for reference only. Please refer to the actual product for appearance.

5.3 Recommended PCB Footprint

The following figure shows the PCB footprint of W82.

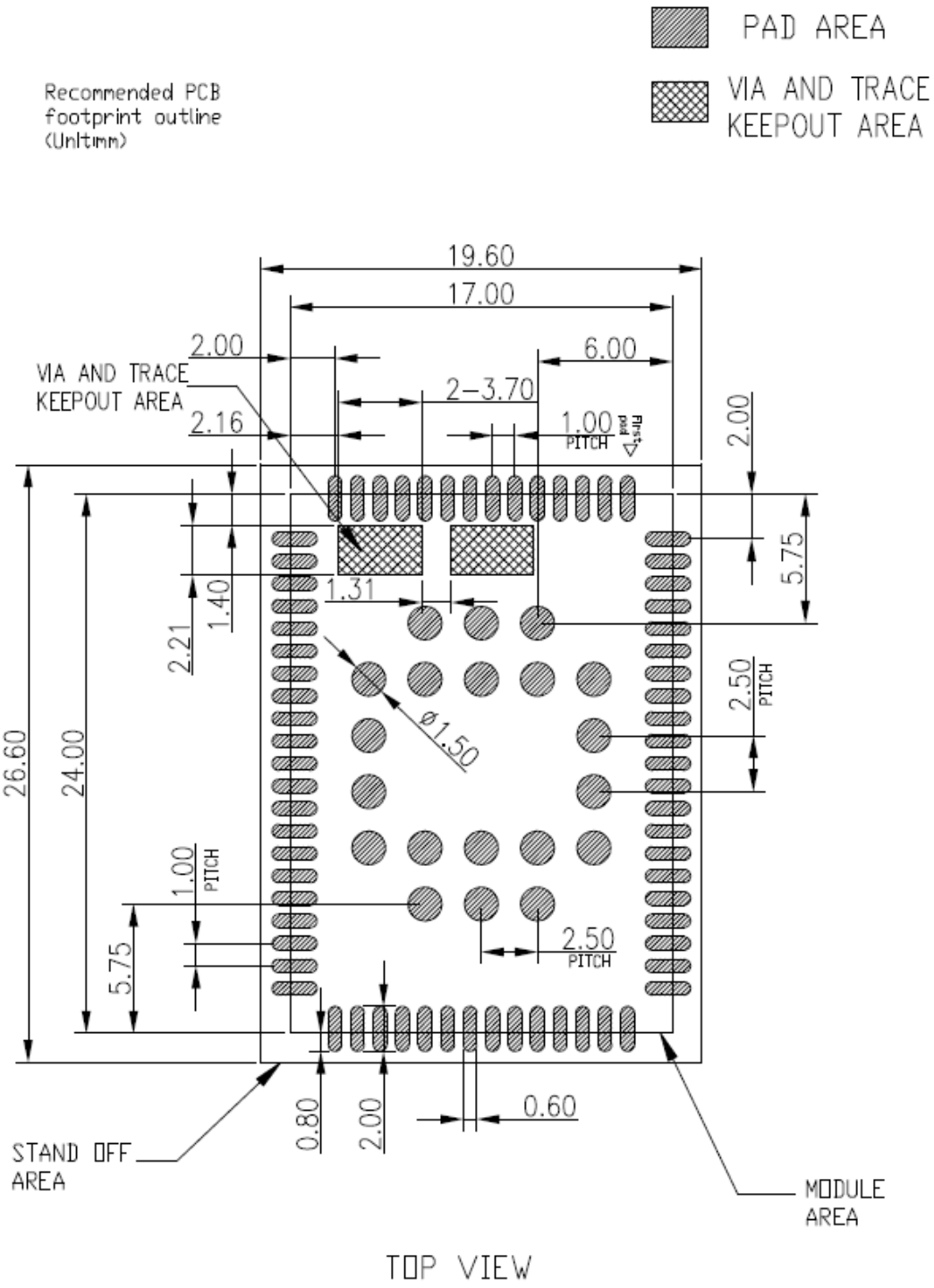

Figure 12：Recommended PCB footprint

NOTE

FDRBIDDEN AREA requires that the TOP layer cannot be layout. See W82 module recommended package for details

5.4 Recommended SMT Stencil

The following figure shows the SMT stencil of W82.

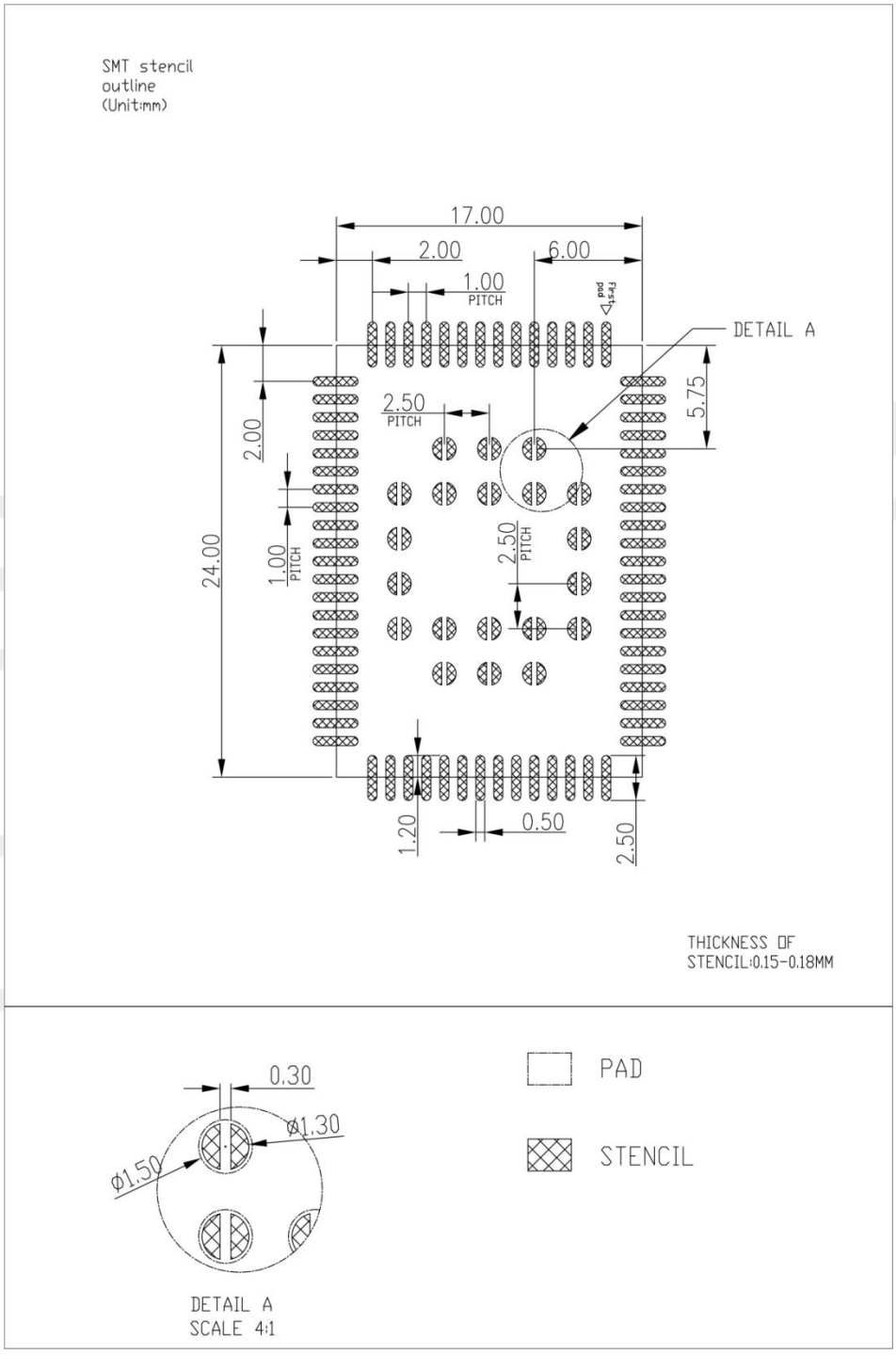

Figure 13：Recommended SMT stenci

5.5 Recommended SMT Reflow Profile

SIMCom provides a typical soldering profile. Therefore, the soldering profile shown below is only a generic recommendation and should be adjusted to the specific application and manufacturing constraints.

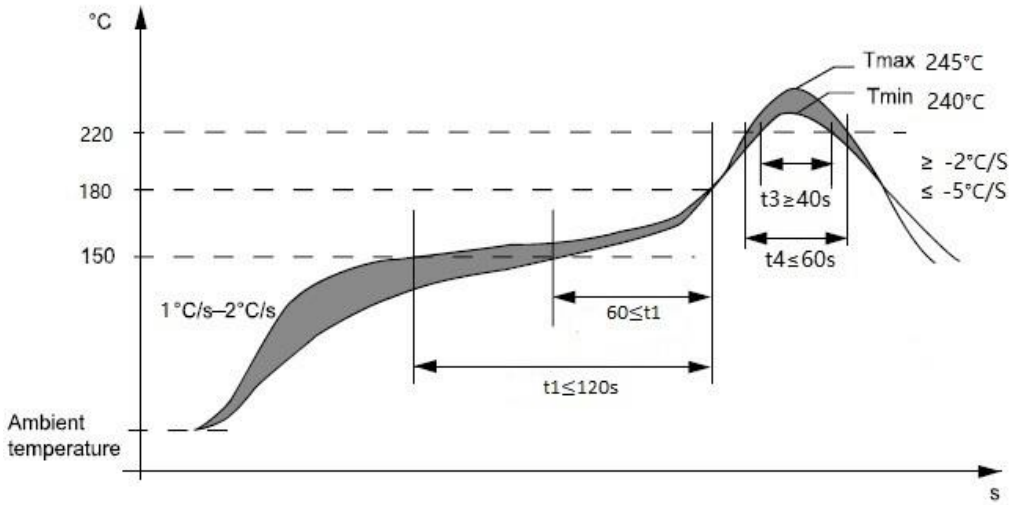

Figure 14：The ramp-soak-spike reflow profile of module

5.6 Moisture Sensitivity Level (MSL)

Module is susceptible to damage induced by absorbed moisture and high temperature. A package's moisture-sensitivity level (MSL) indicates its ability to withstand exposure after it is removed from its shipment bag, while it is on the factory floor awaiting PCB installation. A low MSL rating is better than a high rating; a low MSL device can be exposed on the factory floor longer than a high MSL device. All pertinent MSL ratings are summarized in Table 20.

Table 17：MSL ratings summary

MSL	Out-of-bag floor life	Comments
1	Unlimited	≤+30 /85% RH
2	1 year	≤+30 /60% RH
2a	4 weeks	≤+30 /60% RH
3	168 hours	≤+30 /60% RH
4	72 hours	≤+30 /60% RH
5	48 hours	≤+30 /60% RH
5a	24 hours	≤+30 /60% RH

6	Mandatory bake before use. After bake, it must be reflowed within the time limit specified on the label.	≤+30 /60% RH

Module is qualified to Moisture Sensitivity Level (MSL) 3 in accordance with JEDEC J-STD-033.

NOTE

IPC / JEDEC J-STD-033 standard must be followed for production and storage.

5.7 Baking Requirements

Module is vacuum packed. Under ambient conditions of temperature <40 degrees and relative humidity <90%. Shelf life is 6 months when unopened and the vacuum bag is not leaking.

If any of the following three conditions are met, the module should be fully baked before reflow soldering, otherwise the module may cause permanent damage during the reflow soldering process.

●The vacuum packaging is damaged or leaked

●In the case of vacuum packaging in good condition. When the vacuum packaging is opened, the storage time has exceeded 6 months (from the date of packaging)

●In the case of vacuum packaging in good condition. When the vacuum packaging is opened, the storage time does not exceed 6 months (calculated from the date of packaging), but after opening the packaging, the storage time in the workshop with temperature <30 degrees and relative humidity <60% exceeds 168 hours.

If the module exceeds the specified time limit, it must be baked. The baking conditions are as follows Table 21. Special attention that plastic tray is not heat-resistant, and only can be baked at 45° C. When the baking temperature is 120 degrees, the original tray of the module cannot be used, otherwise baking will damage the tray.

Table 18：Baking requirements

Baking conditions options	Duration	Remark
40°C±5°C, <5% RH	192 hours	
120°C±5°C, <5% RH	8 hours	The original tray cannot be used

6 Packaging

Module support tray packaging. The packaging process is shown in the following figures.

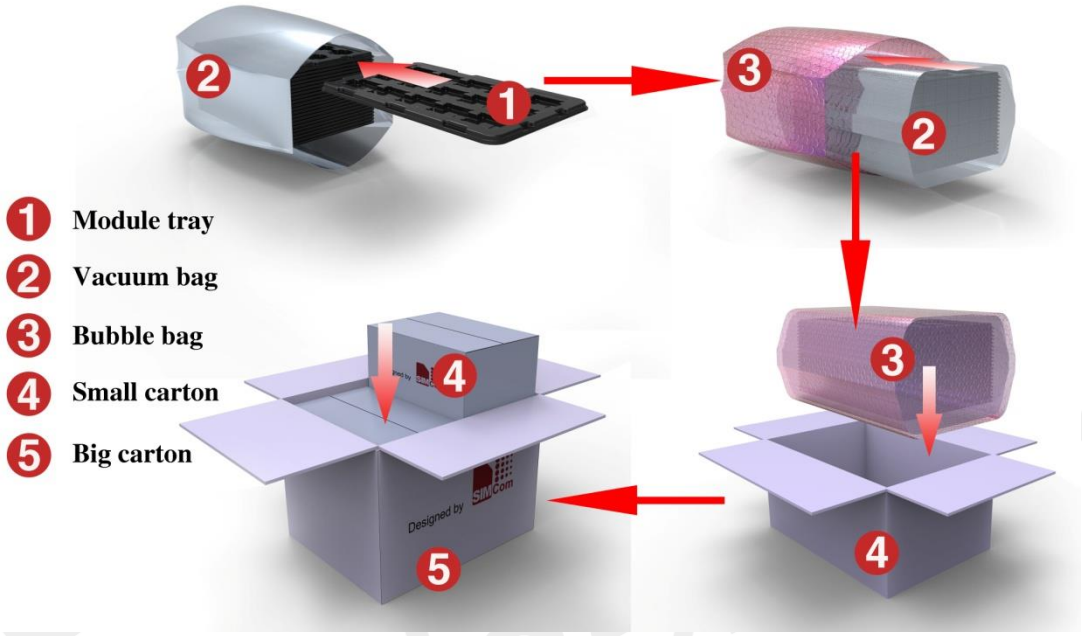

Figure 15：Packaging diagram

Module tray drawing：

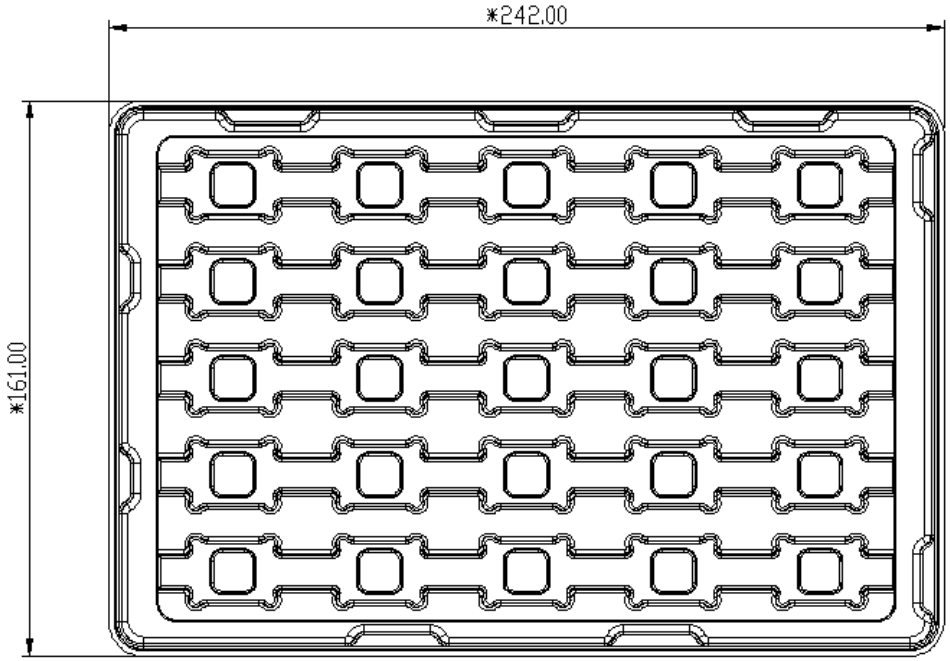

Figure 16：Tray drawing

Table 19：Tray size

Length（±3mm）	Width（±3mm）	Number
242.0	161.0	25

Small carton drawing：

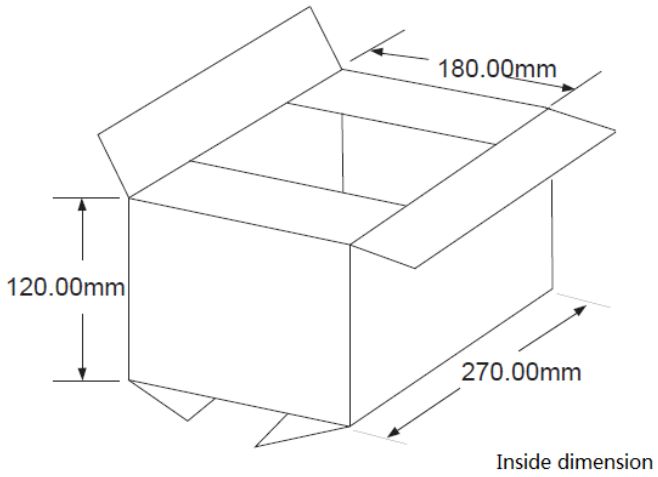

Figure 17：Small carton drawing

Table 20：Small carton size

Length（±10mm）	Width（±10mm）	Height（±10mm）	Number
270	180	120	25*20=500

Big carton drawing：

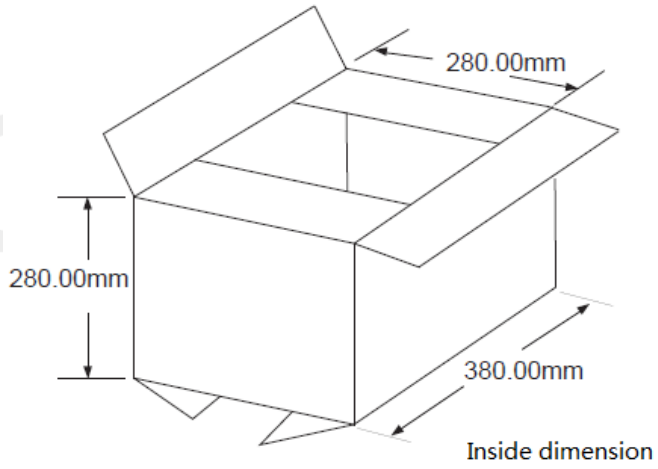

Figure 18：Big carton drawing

Table 21：Big carton size

Length（±10mm）	Width（±10mm）	Height（±10mm）	Number
380	280	280	500*4=2000

7 Appendix

7.1 Related Documents

Table 22：Related documents

NO	Title	Description
[1]	SIM8260 Series-LGA_KDL	W82 and SIM8260 Series reference design
[2]	W82 Hardware Baseband Test Report	W82 Hardware Baseband Test Report
[3]	W82 Hardware RF Test Report	W82 Hardware RF Test Report
[4]	W82 Hardware Data Transmission Test Report	W82 Hardware Data Transmission Test Report

7.2 Terms and Abbreviations

Table 23：Terms and abbreviations

Abbreviation	Description
BPSK	Binary Phase Shift Keying
B	Bidirectional digital input
CCK	Complementary Code Keying
DSSS	Direct Sequence Spread Spectrum
NC	Not connect
ESD	Electrostatic Discharge
I/O	Input/Output
Mbps	Million Bits Per Second
MCS	Modulation and Coding Scheme
OFDM	Orthogonal Frequency Division Multiplexing
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RX	Receive Direction
TX	Transmitting Direction
VSWR	Voltage Standing Wave Ratio

WLAN	Wireless Local Area Networks
LAA	Limited Access Authorization
MIMO	Multiple Input Multiple Output
I2S	Inter-IC Sound
PCIe	Peripheral Component Interface Express
UART	Universal Asynchronous Receiver Transmitter

7.3 Safety Caution

Table 24: Safety caution

Marks	Requirements
	When in a hospital or other health care facility, observe the restrictions about the use of mobiles. Switch the cellular terminal or mobile off, medical equipment may be sensitive and not operate normally due to RF energy interference.
	Switch off the cellular terminal or mobile before boarding an aircraft. Make sure it is switched off. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communication systems. Forgetting to think much of these instructions may impact the flight safety, or offend local legal action, or both.
	Do not operate the cellular terminal or mobile in the presence of flammable gases or fumes. Switch off the cellular terminal when you are near petrol stations, fuel depots, chemical plants or where blasting operations are in progress. Operation of any electrical equipment in potentially explosive atmospheres can constitute a safety hazard.
	Your cellular terminal or mobile receives and transmits radio frequency energy while switched on. RF interference can occur if it is used close to TV sets, radios, computers or other electric equipment.
	Road safety comes first! Do not use a hand-held cellular terminal or mobile when driving a vehicle, unless it is securely mounted in a holder for hands free operation. Before making a call with a hand-held terminal or mobile, park the vehicle.
	GSM cellular terminals or mobiles operate over radio frequency signals and cellular networks and cannot be guaranteed to connect in all conditions, especially with a mobile fee or an invalid SIM card. While you are in this condition and need emergent help, please remember to use emergency calls. In order to make or receive calls, the cellular terminal or mobile must be switched on and in a service area with adequate cellular signal strength. Some networks do not allow for emergency call if certain network services or phone features are in use (e.g. lock functions, fixed dialing etc.). You may have to deactivate those features before you can make an emergency call. Also, some networks require that a valid SIM card be properly inserted in the cellular terminal or mobile.

The following warning statements:

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, and

(2) this device must accept any interference received, including interference that may cause undesired operation.

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 regulations restricted the operation of this device to indoor use only. List of applicable FCC rules.

This module has been tested for compliance with FCC Part 15 Subpart C (15.247) and Subpart E (15.407).

Limited module procedures

This device is only authorized for use with the specific antennas used for the DFS compliance tests. The antennas information, see the section 3.4.3.

Exposure to Radio Frequency Radiation. This equipment must be installed and operated in accordance with provided instructions, and the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be collocated or operating in conjunction with any other antenna or transmitter. End-users and installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance.

This Modular Approval is limited to OEM installation for mobile and fixed applications only.

The antenna installation and operating configurations of this Modular, including any applicable source-based time averaging duty factor, antenna gain and cable loss must satisfy MPE categorical Exclusion Requirements of 2.1091.

if the host is marketed so that end users do not have straight forward commonly used methods for access to remove the module so that the FCC ID of the module is visible; then an additional permanent label referring to the enclosed module: Contains Transmitter Module FCC ID: 2AJYU-8XN0002 or Contains FCC ID: 2AJYU-8XN0002 must be used.

Operation of transmitter is in the 5925-7125MHz band is prohibited for control of or communications with unmanned aircraft systems.

Operation of device is prohibited on oil platforms, cars, trans, boats and aircraft except that operation of this device is permitted in large aircraft while flying above 10,000 feet.

RF Soft restrictions for UNII 5/6/7/8

a. Contention-Based Protocol, as demonstrated in the test report, is permanently embedded in the module and is not host-dependent.

b. The device will only associate and connect with a low-power indoor access point or subordinate device and never directly connect to other client devices.

c. This device will always initiate transmission under the control of a low-power indoor AP or subordinate except for brief transmissions before joining a network. These short messages will only occur if the client has detected an indoor AP or subordinate operating on a channel. These brief messages will have a time-out mechanism such that if it does not receive a response from an AP it will not continually repeat the request.

d. Transmissions will be lower or equal to the power advertised by the indoor low-power access point or subordinate and never above the maximum output power allowed by the FCC grant for equipment class 6XD.

Part 15 Subpart B disclaimer

This transmitter module is tested as a subsystem and its certification does not cover the FCC Part 15 Subpart B rule requirement applicable to the final host. The final host will still need to be reassessed for compliance to this portion of rule requirements if applicable.

As long as all conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Manual Information to the End User

The end user manual shall include all required regulatory information/warning as shown in this document.

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as

show in this manual.

The host integrator must follow the integration instructions provided in this document and ensure that the composite-system end product complies with the requirements by a technical assessment or evaluation to the rules and to KDB Publication 996369.

The host integrator installing this module into their product must ensure that the final composite product complies with the requirements by a technical assessment or evaluation to the rules, including the transmitter operation and should refer to guidance in KDB 996369.

OEM/Host manufacturer responsibilities

OEM/Host manufacturers are ultimately responsible for the compliance of the Host and Module. The final product must be reassessed against all the essential requirements of the FCC rule such as FCC Part 15 Subpart B before it can be placed on the US market. This includes reassessing the transmitter module for compliance with the Radio and EMF essential requirements of the FCC rules. This module must not be incorporated into any other device or system without retesting for compliance as multi-radio and combined equipment.