

# AC8401

Embedded Wi Fi module

Manual

Version: 1.0

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## Module characteristics

- Support IEEE 802.11a/b/g/n wireless standard
- Support WEP, WPA and WPA2 encryption
- Support UART / PWM / ADC / GPIO / I2C / SPI interface
- Support STA / AP and other working modes
- Support Amazon FFS distribution network
- Support TLS / SSL Protocol
- Support PCB antenna
- 3.3V power supply
- Peripheral equipment:
  - 2x UART
  - 1x I2C
  - 1x SPI
  - 5x PWM
  - 4x ADC
  - Up to 14GPIOs

- Working environment temperature: -20 °C to +85 °C
- Half hole SMT package supporting SMT

## Application

- Electrical lighting
- smart home / home appliances
- instrumentation
- health care
- Industrial automation
- smart energy

## MODEL

Model	Antenna type	explain
AC8401	PCB Antenna	Default

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## 1. Product introduction

AC8401 is a high cost-effective embedded WiFi module introduced by Asean that supports 802.11a/b/g/n and can communicate with other devices via UART port. The module integrates RF transceiver, MAC, baseband processing, all WiFi protocols and configuration information, and network protocol stack. It can be widely used in smart home devices, remote monitoring devices, medical devices and other fields.

The module integrates Andes Technology N10 processors with a maximum primary frequency of 160MHz, 192KB of SRAM, and a built-in 2MB Flash.

## 2. Electrical parameters

### 2.1 Power consumption parameters

The power consumption parameters are detailed in Table 1.

Table 1 AC8401 Power consumption parameters

Specifications	Min.	Typ.	Max.	Units
VDD <sup>1</sup>	3.1		3.6	V
VIL(input low voltage)	0		0.8	V
VIH(input high voltage)	2		3.6	V
VOL(output low voltage)			0.4	V
VOH(output high voltage)	2.4			V
Io			12	mA
Standby (SP mini)		80	85	mA
pulse current @TX 11b @17dBm 11Mbps			305	mA
pulse current @TX 11g @15dBm 54Mbps			250	mA
pulse current @TX 11n @14dBm 65Mbps			225	mA
networking			305	mA

**Note: It is important to ensure that VDD is not less than 3.3V**

## 2.2 work environment

The working environment is detailed in Table 2

Table 2 AC8401 Work Environment

Symbol	Description	Min.	Max.	Units
Ts	Storage temperature	-40	125	°C
TA	Ambient operating temperature	-20	85	°C
Vdd	Supply voltage	3.1	3.6	V
Vio	Voltage on IO pin	0	VDD	V
ESD	HBM	1000	2000	V

## 3. Radio Frequency Parameters

### 3.1 Basic Radio Frequency Parameters

RF parameters are detailed in Table 3

Table 3 AC8401 RF parameter

frequency range	2.412GHz-2.464GHz 5.15GHz-5.25GHz
Wireless Standard Support	IEEE 802.11 a/b/g/n
RF power	802.11b:17dBm±1dBm 802.11g:14dBm±1dBm 802.11n:14dBm±1dBm 5G 802.11a/n:12.5dBm±1dBm
antenna	Built in: PCB antenna/ Add in: not supported
Receive Sensitivity	802.11b<-85dBm@11Mbps 802.11a/g<-72dBm@54Mbps 802.11n<-69dBm@MCS7
Protocol stack support	IPv4, TCP/UDP/FTP/HTTP/HTTPS/TLS/mDNS
Data rate (Max)	11M@802.11b, 54M@802.11g, MCS7@802.11n
Security support	Encryption Standard:Open/WEP-Open/WPA/WPA2 Encryption algorithm:WEP64/WEP128/TKIP/AES
Network type	STA/AP/STA+AP

## 3.2 TX、RX performance

### 3.2.1 IEEE802.11b Mode

Table 4 3.2.1 basic parameters of IEEE802.11b mode

ITEM	Specification
Modulation Type	DSSS / CCK
Frequency range	2412MHz~2462MHz
Channel	CH1 to CH11
Data rate	1, 2, 5.5, 11Mbps

Table 4 transmitting performance parameters in IEEE802.11b mode

TX Characteristics	Min	Typical	Max.	Unit
Power@11Mbps		17		dBm
Frequency Error	-10		+10	ppm
EVM@11Mbps			-30	dB
Transmit spectrum mask				
Pass				

Table 5 receiving performance parameters in IEEE802.11b mode

RX Characteristics	Min	Typical	Max.	Unit
<b>Minimum Input Level Sensitivity</b>				
11Mbps (FER $\leq$ 8%)			<b>-87</b>	dBm
Maximum Input Level (FER $\leq$ 8%)			<b>-3</b>	dBm

### 3.2.2 IEEE802.11g Mode

Table 6 basic parameters in IEEE802.11g mode

ITEM	Specification
Modulation Type	OFDM
Frequency range	2412MHz~2462MHz
Channel	CH1 to CH11
Data rate	6, 9, 12, 18, 24, 36, 48, 54Mbps

Table 7 transmitting performance parameters in IEEE802.11g mode

TX Characteristics	Min	Typical	Max.	Unit
<b>Power@54Mbps</b>		<b>14</b>		dBm
<b>Frequency Error</b>	<b>-10</b>		<b>+10</b>	ppm
<b>EVM@54Mbps</b>			-34	dB
<b>Transmit spectrum mask</b>				
Pass				

Table 8 receiving performance parameters in IEEE802.11g mode

RX Characteristics	Min	Typical	Max.	Unit
<b>Minimum Input Level Sensitivity</b>				
54Mbps			-71	dBm
Maximum Input Level (FER $\leq$ 10%)			-8	dBm

### 3.2.3 IEEE802.11n Mode

Table 9 basic parameters of ieee802.11n in 20MHz mode

ITEM	Specification
Modulation Type	OFDM
Frequency range	2412MHz~2462MHz
Channel	CH1 to CH11
Data rate	MCS0/1/2/3/4/5/6/7

Table 10 transmission performance parameters of ieee802.11n in 20MHz mode

TX Characteristics	Min	Typical	Max.	Unit
<b>Power@HT20, MCS7</b>		<b>14</b>		dBm
<b>Frequency Error</b>	<b>-10</b>		<b>+10</b>	ppm
<b>EVM@HT20, MCS7</b>			<b>-30.5</b>	dB
<b>Transmit spectrum mask</b>				
<b>Pass</b>				

Table 11 receiving performance parameters of ieee802.11n in 20MHz mode

RX Characteristics	Min	Typical	Max.	Unit
<b>Minimum Input Level Sensitivity</b>				
MCS7			-69	dBm
Maximum Input Level (FER $\leq$ 10%)			-8	dBm

Table 12 basic parameters of ieee802.11n 5g 20MHz mode

ITEM	Specification
Modulation Type	OFDM
Frequency range	5.15GHz-5.25GHz
Channel	CH36 to CH48
Data rate	MCS0/1/2/3/4/5/6/7

Table 14 transmission performance parameters in ieee802.11n 5g 20MHz mode

TX Characteristics	Min	Typical	Max.	Unit
<b>Power@HT20, MCS7</b>		<b>12.5</b>		dBm
<b>Frequency Error</b>	<b>-10</b>		<b>+10</b>	ppm
<b>EVM@HT20, MCS7</b>			<b>-30.5</b>	dB
<b>Transmit spectrum mask</b>				
<b>Pass</b>				

Table 15 receiving performance parameters in ieee802.11n 5g 20MHz mode

RX Characteristics	Min	Typical	Max.	Unit
<b>Minimum Input Level Sensitivity</b>				
MCS7			-69	dBm
Maximum Input Level (FER $\leq$ 10%)			-8	dBm

Table 16 basic parameters of ieee802.11n in 40MHz mode

ITEM	Specification
Modulation Type	OFDM
Frequency range	2422MHz~2452MHz
Channel	CH3 to CH9
Data rate	MCS0/1/2/3/4/5/6/7

Table 17 transmission performance parameters of ieee802.11n in 40MHz mode

TX Characteristics	Min	Typical	Max.	Unit
<b>Power@HT40, MCS7</b>		<b>14</b>		dBm
<b>Frequency Error</b>	<b>-10</b>		<b>+10</b>	ppm
<b>EVM@HT40, MCS7</b>			<b>-29</b>	dB
<b>Transmit spectrum mask</b>				
<b>Pass</b>				



Table 18 receiving performance parameters of ieee802.11n in 40MHz mode

RX Characteristics	Min	Typical	Max.	Unit
<b>Minimum Input Level Sensitivity</b>				
MCS7			-68	dBm
Maximum Input Level (FER $\leq$ 10%)			-8	dBm

Table 19 basic parameters of ieee802.11n 5g 40MHz mode

ITEM	Specification
Modulation Type	OFDM
Frequency range	5.15GHz-5.25GHz
Channel	CH38 to CH46
Data rate	MCS0/1/2/3/4/5/6/7

Table 20 transmission performance parameters of ieee802.11n 5g 40MHz mode

TX Characteristics	Min	Typical	Max.	Unit
<b>Power@HT20, MCS7</b>		<b>12.5</b>		dBm
<b>Frequency Error</b>	<b>-10</b>		<b>+10</b>	ppm
<b>EVM@HT20, MCS7</b>			<b>-30</b>	dB
<b>Transmit spectrum mask</b>				
<b>Pass</b>				

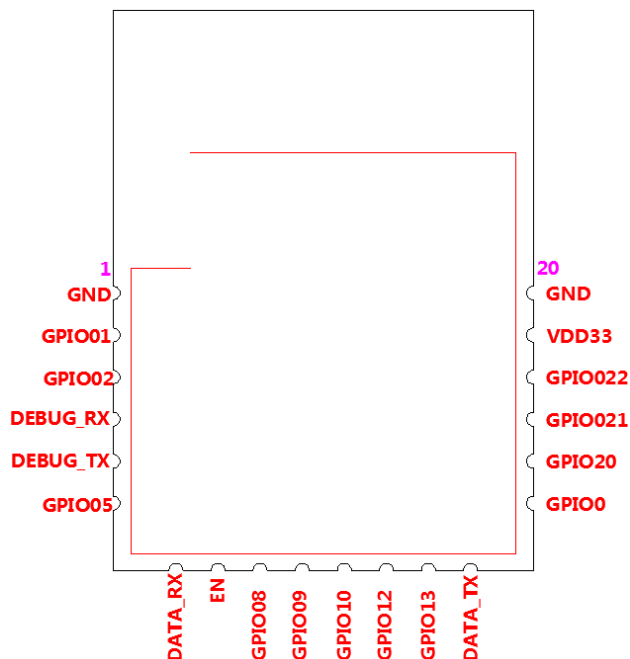
Table 21 receiving performance parameters in ieee802.11n 5g 40MHz mode

RX Characteristics	Min	Typical	Max.	Unit
<b>Minimum Input Level Sensitivity</b>				
MCS7			-67	dBm
Maximum Input Level (FER $\leq$ 10%)			-8	dBm

## 4. AC8401 essential information

### 4.1 Pin arrangement

AC8401 pin arrangement is shown in Figure 1.



### 4.2 Pin definition

#### 4.2.1 Module hardware pin definition

Table 15 for the definition of module hardware pins

Table 14 for AC8401 pin definition annotation

Pin number	Pin definition	Pin function	Configurable function		
1	GND	Ground			
2	GPIO01			PWM1	
3	GPIO02			PWM2	
4	GPIO03		Debug_UART_RX	PWM3	

5	GPIO04		Debug_UART_TX	PWM4	
6	GPIO05		UART1_RTS		
7	GPIO06		UART1_RXD		
8	EN	Enable pin			
9	GPIO08		SPI_M_CLK		
10	GPIO09		UART1_CTS		
11	GPIO10		SPI_M_MISO		
12	GPIO12		SPI_M_MOSI		
13	GPIO13		SPI_M_CS		
14	GPIO07		UART1_TXD		
15	GPIO00			PWM0	ADC
16	GPIO20				ADC
17	GPIO21		I2C_SCL	Debug_UART_RX	ADC
18	GPIO22		I2C_SDA	Debug_UART_TX	ADC
19	VDD33	Power supply 3.3V			
20	GND	Ground			

Note:

1. By default, uart1 (pin7, PIN14) is used for general transparent transmission, UART0 (pin4, pin5) is used for debug information output and firmware upgrade, and the serial port output level is described by DC characteristics.
2. En is the module hardware reset, the low level is valid, and the module will be restarted after reset to retain the original configuration information. The EN has been pulled up in the module itself.
3. Reset button and LED indicator control pin need to be selected and designed according to the actual firmware.
4. The ADC is a 10 bit ADC with an input voltage range of 0 ~ 1V.

### 4.3 Built in antenna

See Figure 2 for the built-in antenna. The PCB board in the area should be cut directly directly, and the ground laying, wiring and metal components should be avoided directly under the antenna and in the two directions indicated by the arrow.

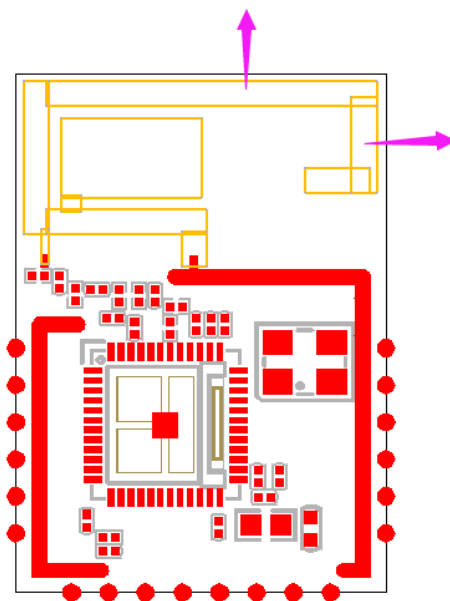


图 2 AC8401 Antenna diagram

The gain of PCB antenna of this module is about 0dB, as shown in Figure 3.

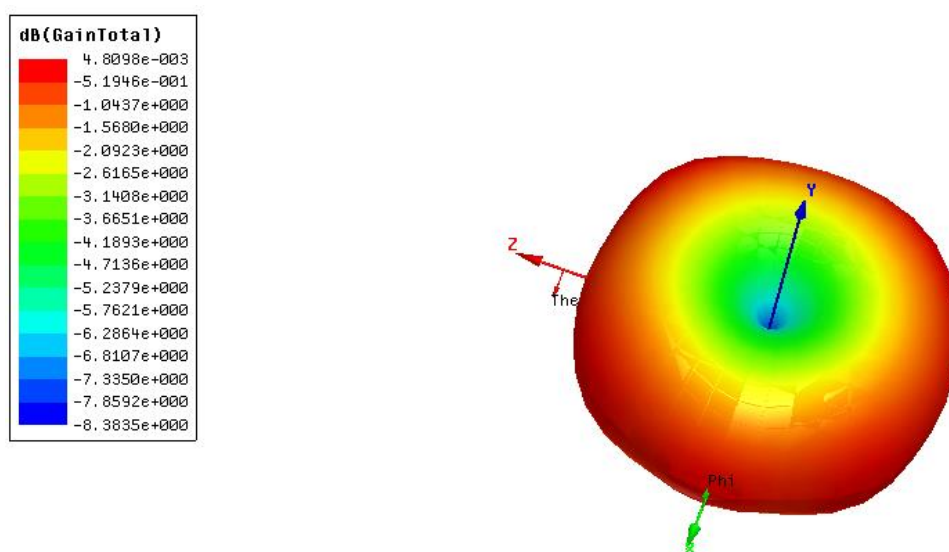


Figure 3 simulation radiation diagram of antenna gain

When selecting PCB antenna, the following points should be paid attention to when placing the module:

1. Users can't place components and pave the floor in the area corresponding to PCB base plate and module antenna. It's better to hollow out the PCB in this area.
2. It is suggested that no components should be placed within 30mm of the module antenna area, and the wiring of the module bottom plate should be avoided as far as possible in this area, and copper deposition is prohibited.
3. Do not place the module in the metal shell or the mold with metal spray paint.
4. It is strongly recommended that the antenna of the WiFi module should be close to the edge of the bottom plate as far as possible in PCB layout, as shown in the figure below, so as to ensure the good performance of the antenna.

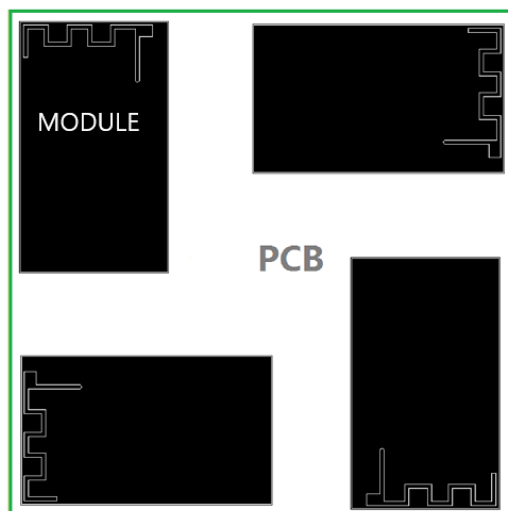


Figure 4 AC8401 Recommended PCB layout

## 4.4 Mechanical dimension

The dimensions of AC8401 module are shown in Figure 5.

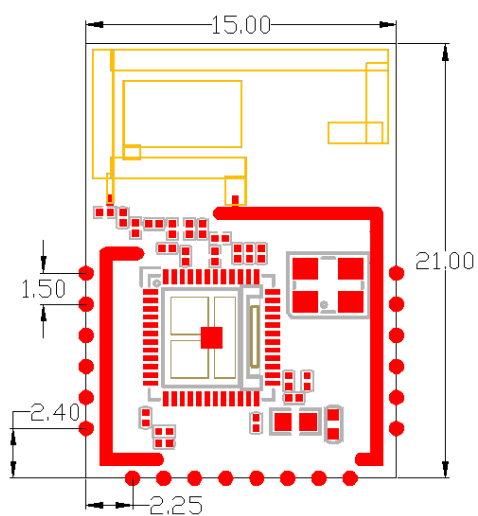


Figure 5 AC8401 Module dimension drawing

a. Description: dimension  $(15 \pm 0.2) \text{ mm} * (21 \pm 0.2) \text{ mm} * (2.6 \pm 0.2) \text{ mm}$  (with shield)

## 4.5 Recommended package size

See Figure 6 for the recommended package dimensions of AC8401.

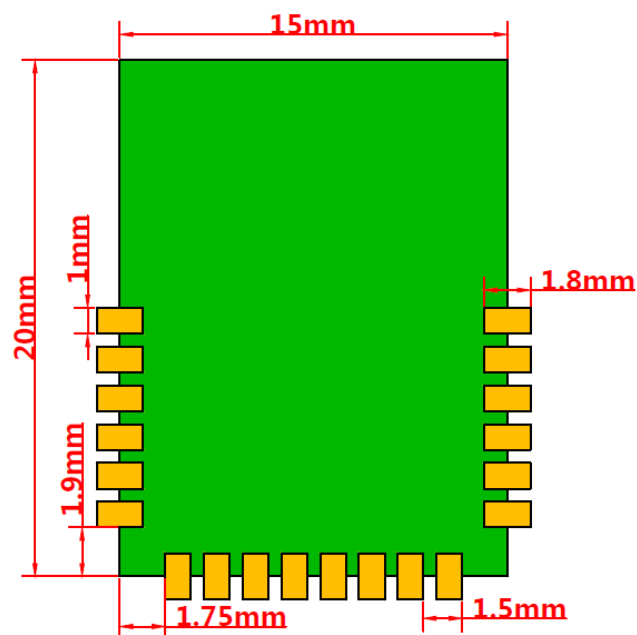


图 3 AC8401 recommended package dimensions

## 5. Reference design

### 5.1 UARTinterface design

For 3.3V power supply equipment, the serial port of equipment and module can be directly connected to complete communication according to the circuit shown in Figure 7.

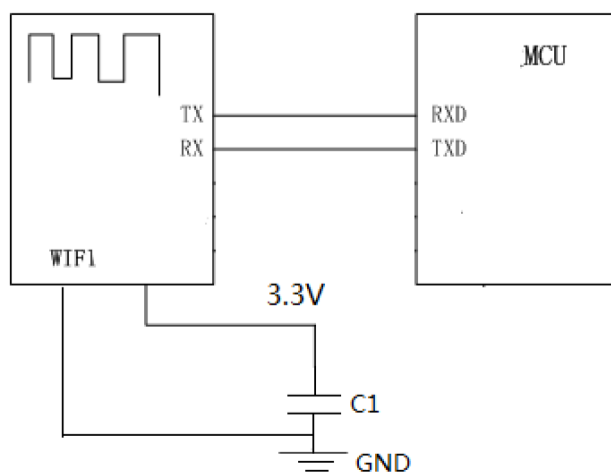
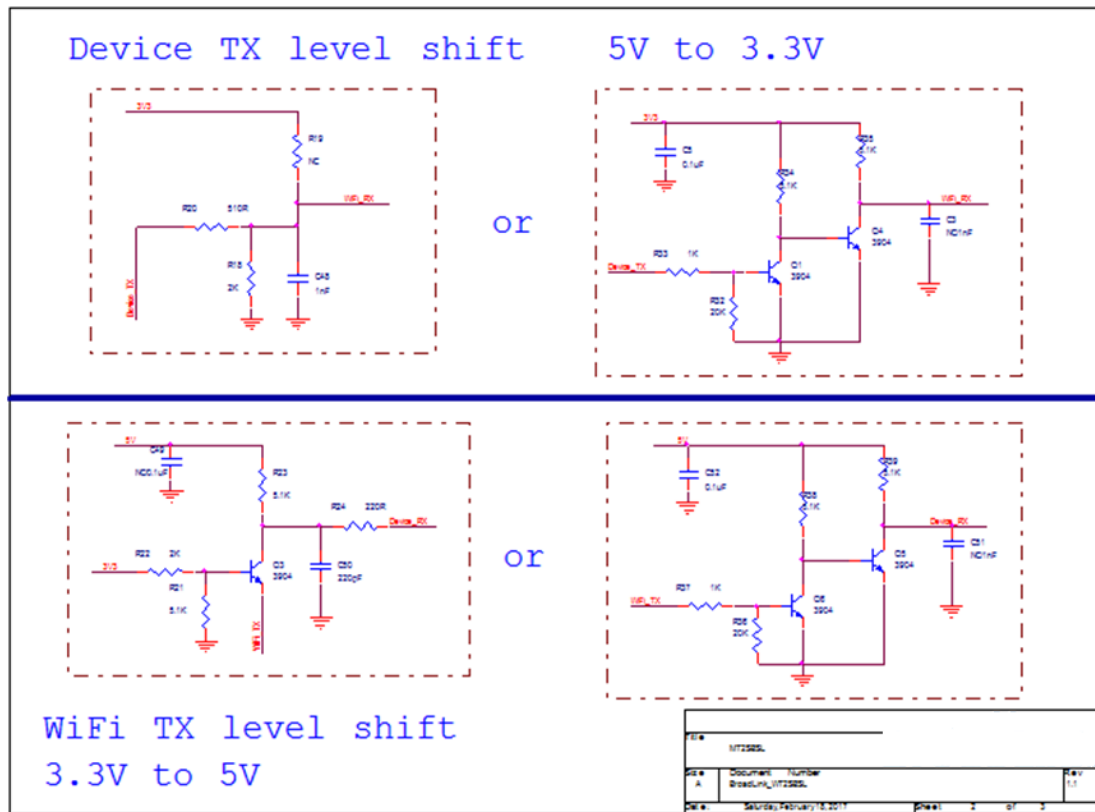


Table 4 Circuit diagram (3.3V)

For 5V power supply equipment, refer to the circuit shown in Figure 8 or design relevant level conversion circuit. The resistance value can be adjusted according to the actual circuit.



## 5.2 Power supply requirements

Power supply requirements: if 3.3V voltage is generated by LDO to supply power to the module, the capacitance value of C1 can be considered as 10uF ~ 22uF; if 3.3V voltage is generated by DCDC power supply to supply power to the module, the capacitance value of C1 can be considered as 22uF.

Please ensure that the power supply can provide enough current to avoid power failure when the module sends data. It is recommended that the maximum input current of the module is greater than 400mA.



## 6. Certification instructions

### 6.1 Label diagram



Note: in addition to the icon, some other information, such as version number, may be added to the label.

### 6.2 FCC instructions

#### 2.2 List of applicable FCC rules

FCC Part 15.247, FCC Part 15.407

#### 2.6 RF exposure considerations

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

#### 2.8 Label and compliance information

FCC ID label on the final system must be labeled with “Contains FCC ID: 2AY4V-AC8401” or “Contains transmitter module FCC ID: 2AY4V-AC8401”.

#### 2.9 Information on test modes and additional testing requirements

Contact Asiacom Technology Ltd. will provide stand-alone modular transmitter test mode. Additional testing and certification may be necessary when multiple modules are used in a host.

#### 2.10 Additional testing, Part 15 Subpart B disclaimer

To ensure compliance with all non-transmitter functions the host manufacturer is responsible for

ensuring compliance with the module(s) installed and fully operational. For example, if a host was previously authorized as an unintentional radiator under the Supplier's Declaration of Conformity procedure without a transmitter certified module and a module is added, the host manufacturer is responsible for ensuring that after the module is installed and operational the host continues to be compliant with the Part 15B unintentional radiator requirements. Since this may depend on the details of how the module is integrated with the host, Asiacom Technology Ltd. shall provide guidance to the host manufacturer for compliance with the Part 15B requirements.

**FCC Warning**

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.

NOTE 1: Any changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

**FCC Radiation Exposure Statement:**

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance.

**Note 1:** This module certified that complies with RF exposure requirement under mobile or fixed condition, this module is to be installed only in mobile or fixed applications.

A mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons. Transmitting devices designed to be used by consumers or workers that can be easily re-located, such as wireless devices associated with a personal computer, are considered to be mobile devices if they meet the 20 centimeter separation requirement.

A fixed device is defined as a device is physically secured at one location and is not able to be easily moved to another location.

**Note 2:** Any modifications made to the module will void the Grant of Certification, this module is limited to OEM installation only and must not be sold to end-users, end-user has no manual instructions to remove or install the device, only software or operating procedure shall be placed

in the end-user operating manual of final products.

**Note 3:** The module may be operated only with the antenna with which it is authorized. Any antenna that is of the same type and of equal or less directional gain as an antenna that is authorized with the intentional radiator may be marketed with, and used with, that intentional radiator.

**Note 4:** For all products market in US, OEM has to limit the operation channels in CH1 to CH11 for 2.4G band by supplied firmware programming tool. OEM shall not supply any tool or info to the end-user regarding to Regulatory Domain change.