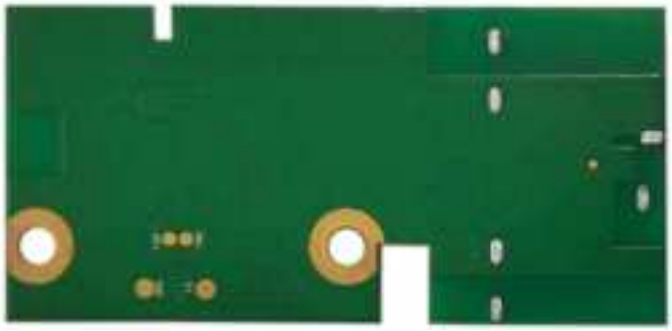
FRX-WIFI 7988AP&Sta&BT

802.11ax 1201Mbps WLAN + BT5.2 USB2.0 Combo Module Specification

Top View



Bottom View

Module Name:FRX-WIFI 7988AP&Sta&BT	
Module Type: 802.11ax 1201Mbps WLAN + BT5.2 USB2.0 Combo Module Specification	
Revision: V1.0	
Customer Approval:	
Company:	
Title:	
Signature:	Date:
Title:	
Signature:	Date:

Revision History

Revision	Summary	Release Date
0.1	Initial release	2022-07-03
1.0	Official version	2022-09-01

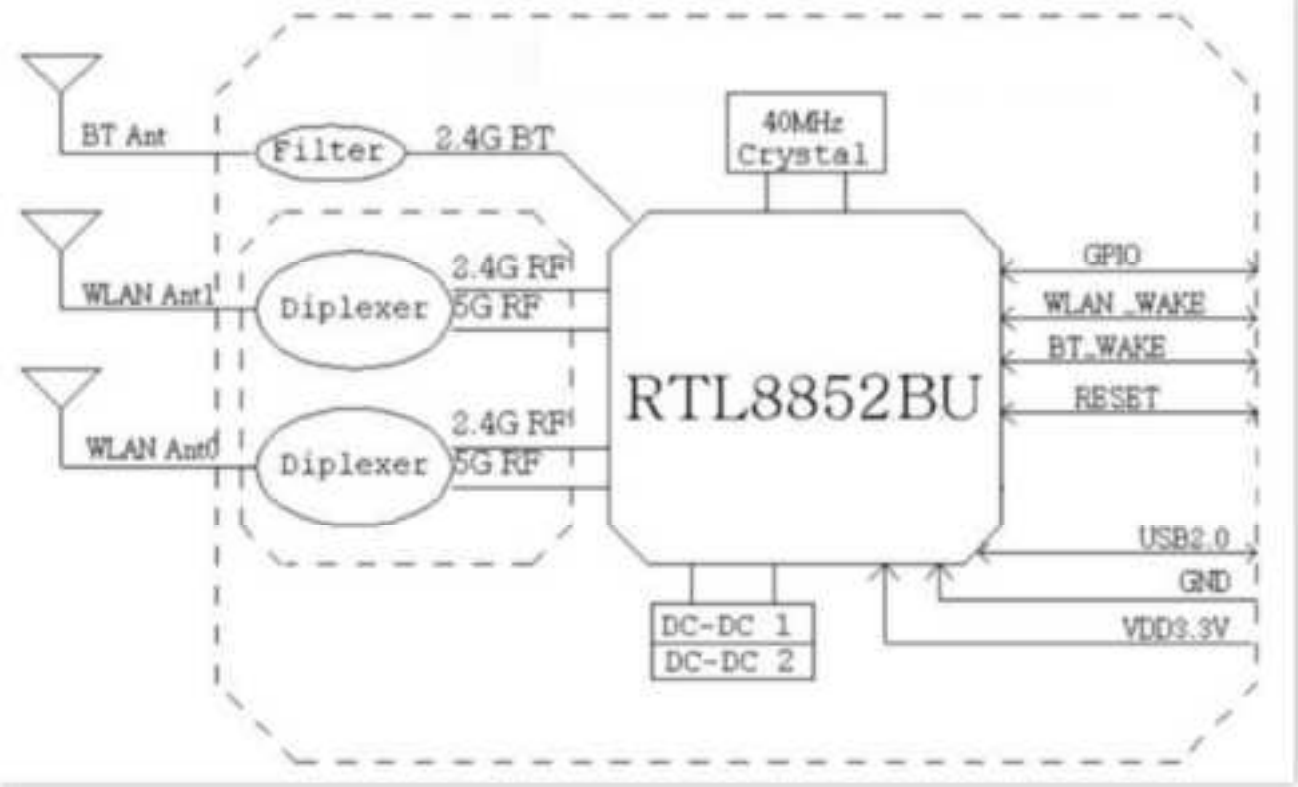
1. Introduction

FRX-WIFI 7988AP&Sta&BT is a highly integrated Dual-band WLAN + Bluetooth v5.2 Combo module. It combines a 2T2R Dual-band WLAN subsystem and a Bluetooth v5.2 subsystem. This module compatible IEEE 802.11 a/b/g/n/ac/ax standard and provides the maximum PHY rate up to 1201Mbps, it supports BT dual mode with BT v5.2 compliant, offering feature-rich wireless connectivity at high standards, and delivering reliable, cost-effective, high throughput from an extended distance.

1.1 Features

. Operating Frequency: 2.4~2.4835GHz or 5.15~5.85GHz
. Host interface: Complies with USB2.0 for WLAN and BT controller
. IEEE Standards: IEEE 802.11a/b/g/n/ac/ax
. Wireless data rate can reach up to 573.5Mbps or 1201Mbps
. VDD5V±0.3V main power supply

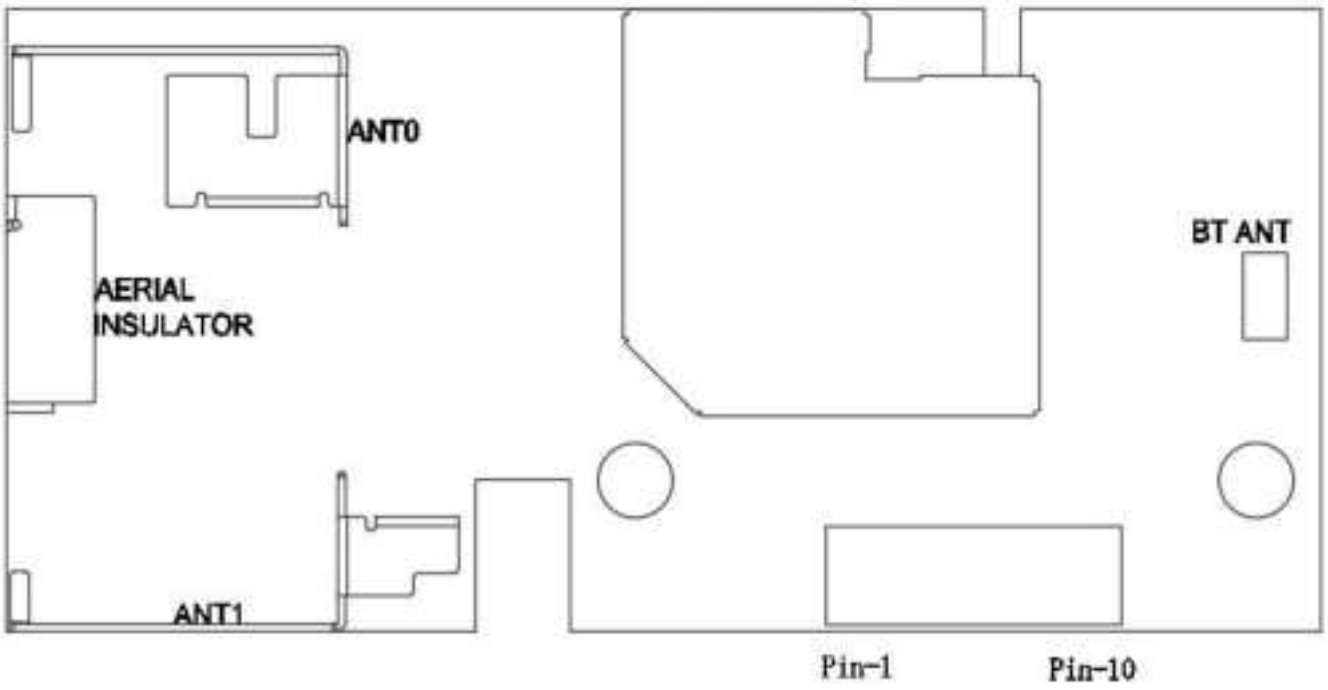
1.2 Block Diagram



1.3 General Specifications

Module Name	FRX-WIFI 7988AP&Sta&BT
Chipset	RTL8852BU-CG
WLAN Standards	IEEE802.11a/b/g/n/ac
Host Interface	USB2.0 for WLAN & BT
Antenna	Built-in antennas
Dimension	70.0mm x 33.0mm x 6.0mm (L*W*H) ,Tolerance: ±0.15mm
Power Supply	DC 5V±0.3V 1500mA (Max)
Operation Temperature	-20℃ to +70℃
Operation Humidity	10% to 95% RH (Non-Condensing)

2. Pin Assignments



TOP View

2.1 Pin Definition

No.	Pin Name	Type	I/O Level	Module Pin Description
1	DC_EN	I	5V	The board DC / DC enable active high input,Internal pull high by 10K resistor to 5V.
2	BT_WAKE	O	3.3V	Bluetooth wake up host, internal pull high by 10K resistor
3	VDD5V	P		DC 5.0V Main power supply
4	USB 2.0 -DM	A I/O		USB Transmitter/Receiver Differential Pair
5	USB 2.0 -DP	A I/O		USB Transmitter/Receiver Differential Pair
6	GND	P		GND for power
7	GND	P		GND for power
8	3D_SYNC	O	3.3V	Synchronization function, internal pull high by 10K resistor
9	RESET	I	3.3V	System reset Input, active low, internal pull high by 10K resistor
10	WLAN_WAKE	O	3.3V	WLAN_wake up host, internal pull high by 10K resistor
	ANT0	RF		Built-in antennas for 2.4G / 5G RF ANT0
	ANT1	RF		Built-in antennas for 2.4G / 5G RF ANT1
	BT ANT	RF		Built-in antennas for BT RF
	Aerial Insulator	RF		Aerial Insulator，used to increase the isolation between ANT0 and ANT1

P: Power or Ground; I/O: In/Output; I: Input; A I/O: Analog In/Output; AI: Analog Input; AO: Analog Output; RF: Analog RF Port or RF Ground;

3. Electrical and Thermal Specification

3.1 Recommended Operating Conditions

Parameters		Min	Typ	Max	Units
Ambient Operating Temperature		-20	25	70	℃
External Antenna VSWR		/	1.7	1.92	/
Supply Voltage	VDD5V	4.7	5	5.3	V

3.2 Current Consumption

Conditions : VDD5V ; Ta:25℃ .

Use Case	VDD5V Current		
	Typ ($_{RMS}$)	Max (I_{pp})	Units
WLAN Unassociated (Linux Driver, BT disable)	266	340	mA
WLAN 2.4G TRX Throughput 160Mbps(Linux Driver, BT disable)	266	740	mA
WLAN 5G TRX Throughput 240Mbps(Linux Driver, BT disable)	352	1020	mA
BTO LE 1Mbps MP3 playback (Linux Driver, WLAN disable)	218	235	mA
2.4G 11b 1Mbps TX @ 19dBm (1TX RF test)	344	416	mA
2.4G 11g 6Mbps TX @ 18dBm (1TX RF test)	278	440	mA
2.4G HE_SU 20MHz MCS15 TX@15dBm (2TX RF test)	201	560	mA
2.4G HE_SU 40MHz MCS0 TX@16dBm (2TX RF test)	267	720	mA
2.4G HE_SU 40MHz MCS11 TX@15dBm (2TX RF test)	202	704	mA
2.4G HE_SU 40MHz MCS11 RX (2RX RF test)	169	216	mA
5G 11a 6Mbps TX @ 18dBm (1TX RF test)	441	800	mA
5G 11n HT20Mbps MCS7 TX @ 16dBm (1TX RF test)	200	688	mA
5G VHT80 MCS0 TX@17dBm (2TX RF test)	313	1160	mA
5G VHT80 MCS9 TX@15dBm (2TX RF test)	240	1120	mA
5G HE_SU 80MHz MCS0 TX@16dBm (2TX RF test)	336	1160	mA
5G HE_SU 80MHz MCS11 TX@15dBm (2TX RF test)	263	1110	mA
5G HE_SU 80MHz MCS11 RX(2TX RF test)	202	260	mA
BT BR_ 1M TX@5dBm (BTO RF test, WLAN disable)	236	286	mA
BT BR_ 1M RX Active (BTO RF test, WLAN disable)	193	248	mA
BT EDR_3M TX@5dBm (BTO RF test, WLAN disable)	238	279	mA
BT LE_ 1M TX@5dBm (BTO RF test, WLAN disable)	218	268	mA

4. WLAN & Bluetooth RF Specifications

4.1 2.4G WLAN RF Specification

Conditions : VDD5V ; Ta:25℃	
Features	Description
WLAN Standard	IEEE 802.11b/g/n/ac/ax
Frequency Range	2.4~2.4835GHz (2.4GHz ISM Band)
Channels	Ch1~Ch14 (For 20MHz Channels)
Modulation	802.11b (DSSS): CCK, DQPSK, DBPSK; 802.11g (OFDM): BPSK, QPSK, QAM16, QAM64; 802.11n (OFDM): BPSK, QPSK, QAM16, QAM64; 802.11ac (OFDM): BPSK, QPSK, QAM16, QAM64, QAM256; 802.11ax (OFDMA): BPSK, BPSK_DCM, QPSK, QPSK_DCM, QAM16, QAM16_DCM, QAM64, QAM256, QAM1024;
Date Rate	802.11b: 1, 2, 5.5, 11Mbps; 802.11g: 6, 9, 12, 18, 24, 36, 48, 54Mbps; 802.11n (HT20): MCS0~MCS7(1T1R_SISO) 6.5~72.2Mbps; 802.11n (HT20): MCS8~MCS15(2T2R_MIMO) 13~144.4Mbps; 802.11n (HT40): MCS0~MCS7(1T1R) 13.5~150Mbps; 802.11n (HT40): MCS8~MCS15(2T2R) 27~300Mbps; 802.11ac (VHT20): MCS0~MCS8(1T1R) 6.5~86.7Mbps; 802.11ac (VHT20): MCS0~MCS8(2T2R) 13~173.3Mbps; 802.11ac (VHT40): MCS0~MCS9(1T1R)13.5~200Mbps; 802.11ac (VHT40): MCS0~MCS9(2T2R)27~400Mbps; 802.11ax (HE_MU,26~242RU): MCS0~MCS11(1T1R) 0.4~143.4Mbps; 802.11ax (HE_MU,26~242RU): MCS0~MCS11(2T2R) 0.8~286.8Mbps; 802.11ax (HE_SU, non-OFDMA 20MHz): MCS0~MCS11(1T1R) 3.6~143.4Mbps; 802.11ax (HE_SU, non-OFDMA 20MHz): MCS0~MCS11(2T2R) 7.3~286.8Mbps; 802.11ax (HE_SU, non-OFDMA 40MHz): MCS0~MCS11(1T1R) 7.3~286.8Mbps; 802.11ax (HE_SU,non-OFDMA 40MHz): MCS0~MCS11(2T2R) 14.6~573.5Mbps;
Frequency Tolerance	≦±20ppm

2.4G Receiver Specifications（WLAN_ANT0 & WLAN_ANT1）			
RX Rate	Min Input Level（dBm）	Max Input Level（dBm）	PER
802.11b@1Mbps	-95	-5	< 8%
802.11b@11Mbps	-88	-5	< 8%
802.11g@6Mbps	-93	-5	< 10%
802.11g@54Mbps	-75	-5	< 10%
802.11n@HT20_MCS0	-93	-5	< 10%
802.11n@HT20_MCS7	-73	-5	< 10%
802.11n@HT40_MCS0	-89	-5	< 10%
802.11n@HT40_MCS7	-70	-5	< 10%
802.11ac@VHT40_MCS9	-65	-5	< 10%
802.11ax@HE_SU 20M_MCS0	-94	-5	< 10%
802.11ax@HE_SU 20M_MCS11	-63	-5	< 10%
802.11ax@HE_SU 40M_MCS0	-88	-5	< 10%
802.11ax@HE_SU 40M_MCS11	-61	-5	< 10%

4.2 5G WLAN RF Specification

Conditions: VDD5V; Ta:25℃	
Features	Description
WLAN Standard	IEEE 802.11a/n/ac/ax
Frequency Range	5.15~5.25GHz; 5.735~5.835GHz (5GHz ISM Band)
Channels	Ch36, Ch40, Ch44, Ch48; Ch149~Ch165 (For 20MHz Channels)
Modulation	802.11a (OFDM): BPSK, QPSK, QAM16, QAM64; 802.11n (OFDM): BPSK, QPSK, QAM16, QAM64; 802.11ac (OFDM): BPSK, QPSK, QAM16, QAM64, QAM256; 802.11ax (OFDMA): BPSK, BPSK_DCM, QPSK, QPSK_DCM, QAM16, QAM16_DCM, QAM64, QAM256, QAM1024;
Date Rate	802.11a: 6, 9, 12, 18, 24, 36, 48, 54Mbps; 802.11n (HT20): MCS0~MCS7(1T1R_SISO) 6.5~72.2Mbps; 802.11n (HT20): MCS8~MCS15(2T2R_MIMO) 13~144.4Mbps; 802.11n (HT40): MCS0~MCS7(1T1R) 13.5~150Mbps; 802.11n (HT40): MCS8~MCS15(2T2R) 27~300Mbps; 802.11ac (VHT20): MCS0~MCS8(1T1R) 6.5~86.7Mbps; 802.11ac (VHT20): MCS0~MCS8(2T2R) 13~173.3Mbps; 802.11ac (VHT40): MCS0~MCS9(1T1R)13.5~200Mbps; 802.11ac (VHT40): MCS0~MCS9(2T2R)27~400Mbps; 802.11ac (VHT80): MCS0~MCS9(1T1R)29.3~433.3Mbps; 802.11ac (VHT80): MCS0~MCS9(2T2R)58.5~866.7Mbps; 802.11ax (HE_MU,26~484RU): MCS0~MCS11(1T1R) 0.4~286.8Mbps; 802.11ax (HE_MU,26~484RU): MCS0~MCS11(2T2R) 0.8~573.5Mbps; 802.11ax (HE_SU, non-OFDMA 20MHz): MCS0~MCS11(1T1R) 3.6~143.4Mbps; 802.11ax (HE_SU, non-OFDMA 20MHz): MCS0~MCS11(2T2R) 7.3~286.8Mbps; 802.11ax (HE_SU, non-OFDMA 40MHz): MCS0~MCS11(1T1R) 7.3~286.8Mbps;
	802.11ax (HE_SU,non-OFDMA 40MHz): MCS0~MCS11(2T2R) 14.6~573.5Mbps; 802.11ax (HE_SU,non-OFDMA 80MHz): MCS0~MCS11(1T1R) 15.3~600.4Mbps; 802.11ax (HE_SU, non-OFDMA 80MHz): MCS0~MCS11(2T2R) 30.6~1201Mbps;
Frequency Tolerance	≦ ±20ppm

5G Receiver Specifications（WLAN_ANT0 & WLAN_ANT1）			
RX Rate	Min Input Level（dBm）	Max Input Level（dBm）	PER
802.11a@6Mbps	-93	-5	< 10%
802.11a@54Mbps	-73	-5	< 10%
802.11n@HT20_MCS0	-92	-5	< 10%
802.11n@HT20_MCS7	-73	-5	< 10%
802.11n@HT40_MCS0	-86	-5	< 10%
802.11n@HT40_MCS7	-70	-5	< 10%
802.11ac@VHT80_MCS0	-86	-5	< 10%
802.11ac@VHT80_MCS9	-59	-5	< 10%
802.11ax@HE_SU 20M_MCS0	-93	-5	< 10%
802.11ax@HE_SU 20M_MCS11	-63	-5	< 10%
802.11ax@HE_SU 80M_MCS0	-87	-5	< 10%
802.11ax@HE_SU 80M_MCS11	-59	-5	< 10%

4.3 Bluetooth RF Specification

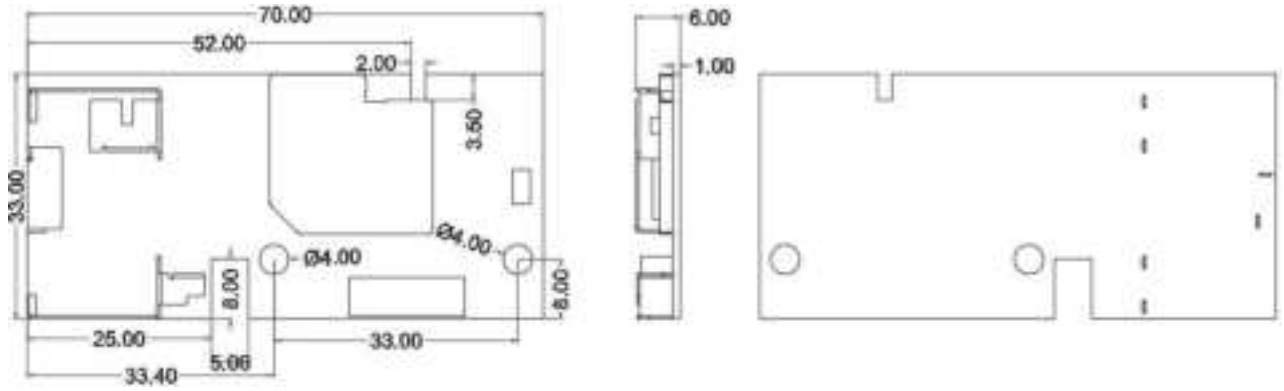
Conditions: VDD5V; Ta:25℃			
Features	Description		
Bluetooth Specification	Bluetooth Core Specification v5.2/4.2/2.1		
Frequency Range	2.4~2.4835GHz (2.4GHz ISM Band)		
Channels	Bluetooth Classic: Ch0~Ch78 (For 1MHz Channels); Bluetooth Low Energy: Ch0~Ch39 (For 2MHz Channels);		
Power Classes	Bluetooth Classic: Class1; Bluetooth Low Energy: Class1.5;		
Date Rate & Modulation	BR_ 1Mbps: GFSK; EDR_2Mbps: π/4-DQPSK; EDR_3Mbps: 8DPSK; LE_ 1Mbps: GFSK (Uncoded);		
BR_1M (DH1) Modulation Characteristics			
Δf1avg	140KHz	164.8KHz	175KHz
Δf2avg	140KHz	151.2KHz	175KHz
Δf2max	115KHz	139.9KHz	/
Δf2avg/Δf1avg	0.8	0.91	/
Items	Min	Typ	Max
EDR_3M(3DH5) EDR Carrier Frequency Stability and Modulation Accuracy			
ωi	-75KHz	2.69KHz	+75KHz
ωi+ωo	-75KHz	2.74KHz	+75KHz
ωo	-10KHz	-0.4KHz	+10KHz
8DPSK RMS DEVM	/	0.044	0.13
8DPSK DEVM	/	0.093	0.25

Items	Min	Typ	Max
LE_1M Modulation Characteristics			
Δf1avg	225KHz	249.8KHz	275KHz
Δf2avg	225KHz	239.4KHz	275KHz
Δf2max	185KHz	243.6KHz	/
Δf2avg/Δf1avg	0.8	0.96	/
Items	Min	Typ	Max
LE_1M Modulation Characteristics			
Δf1avg	450KHz	499.64KHz	550KHz
Δf2avg	450KHz	505.55KHz	550KHz
Δf2max	370KHz	498.78KHz	/
Δf2avg/Δf1avg	0.8	1	/
Bluetooth Receiver Specifications			

Items	Sensitivity		Maximum Input Level	
	Input Level(Typ)	BER	Input Level(Typ)	BER
BR_1M (DH1)	-90 dBm	≦ 0.1%	-5 dBm	≦ 0.1%
EDR_3M (3DH5)	-80 dBm	≦ 0.01%	-5 dBm	≦ 0.1%
	Input Level (Typ)	PER	Input Level (Typ)	PER
LE_1M	-92 dBm	≦ 5%	-5 dBm	≦ 5%

5. Mechanical Specifications

5.1 Module Outline Drawing

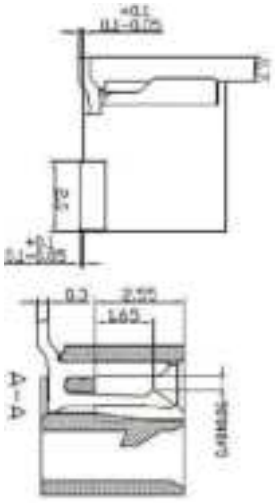


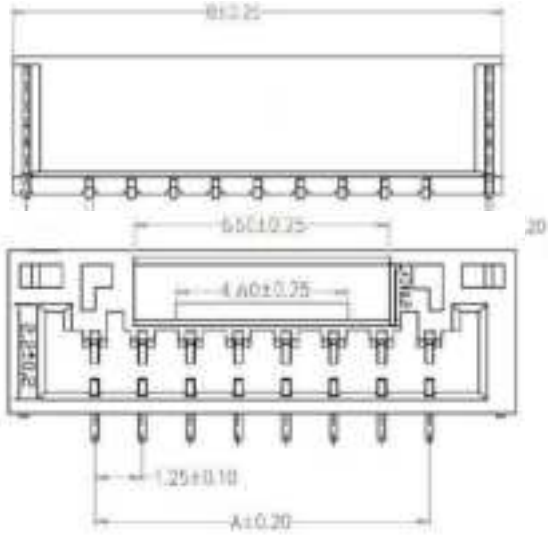
(Top View) (Side View) (Bottom View)

Module dimension: 70.0*33.0*6.0mm (L*W*H; Tolerance: ±0.15mm)

5.2 Connector Specification

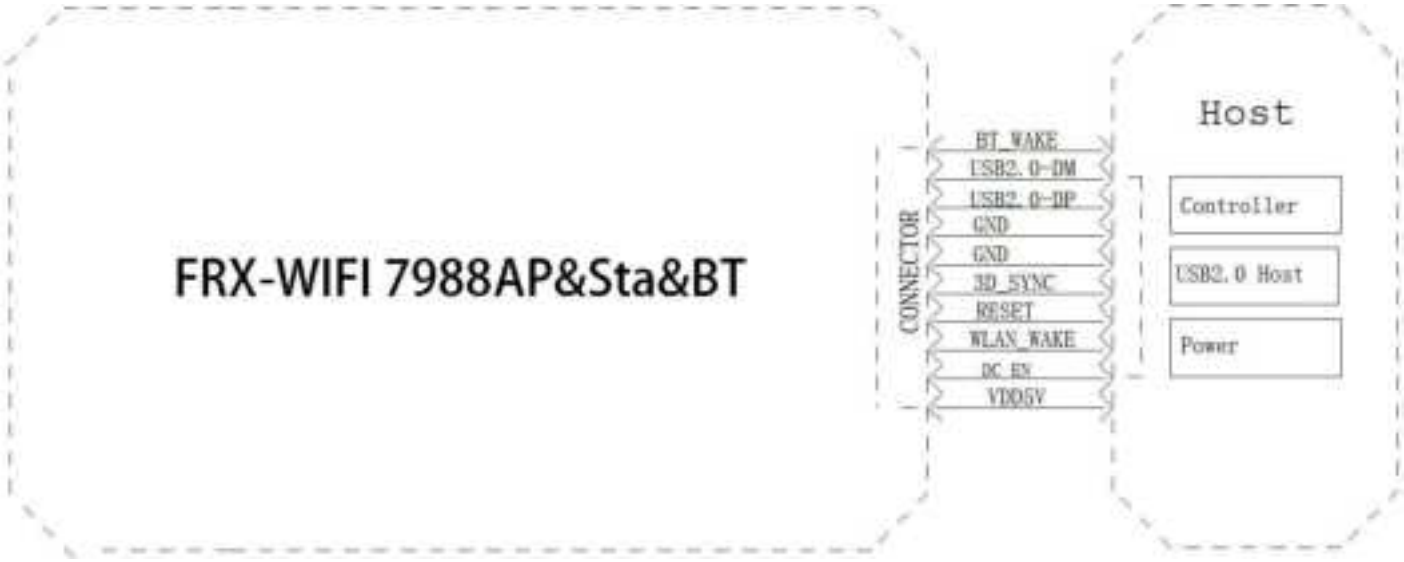
Poles	DIM.A	DIM.B
2P	1.25	5.75
3P	2.50	7.00
4P	3.75	8.25
5P	5.00	9.50
6P	6.25	10.75
7P	7.50	12.00
8P	8.75	13.25
9P	10.00	14.50
10P	11.25	15.75
11P	12.50	17.00
12P	13.75	18.25
13P	15.00	19.50
14P	16.25	20.75
15P	17.50	22.00





6. Application Information

6.1 Typical Application Circuit



7. Key Components Of Module

No.	Parts	Specification	Manufacturer	Note
1	Chipset	RTL8852BU-CG	MediaTek Inc.	
2	PCB	FRX-WIFI 7988AP&Sta&BT	ShenZhen Tie Fa Technology Limited	
			MILLION SOURCE PRINTED CIRCUIT BOARD CO.,LTD	
			SHEN ZHEN QILI ELECTRON CO.,LTD	
3	Crystal	40MHz-3225	LUCKI CM ELECTRONICS CO.,LTD	
			Chengde oscillator Electronic Technology CO.,LTD	
			JinHua East Crystal Electronic CO.,LTD	
4	Diplexer	DP1608	Advanced Ceramic X Corp.	
			Dongguan Hekang Electronics Co.,LTD	
			Walsin Technology Corporation	

1. Package and Storage Information

1.1 Package Dimensions

Package specification:

1. 16 modules per blister plate and 416 modules per box.
2. The blister is bound with wire membrane and put into anti-static vacuum bag.
3. Put 1 bag of dry beads (20g) in each anti-static vacuum bag. 1 pcs 3 point humidity card.
4. The outer box size is 43*35*16cm.

1.2 Storage Conditions

Absolute Maximum Ratings:

Storage temperature: -40℃ to +85℃,
Storage humidity: 10% to 95
（Non-Condensing）

Recommended Storage Conditions:

Storage temperature:
5℃ to +40℃, Storage
humidity: 20% to 90%
RH

Please use this Module within 12month after vacuum-packaged. The Module shall be stored without opening the packing. After the packing opened, the Module shall be used within 72hours. When the color of the humidity indicator in the packing changed, The Module shall be baked before use.

Baking condition: 60℃, 24hours, 1time.

Note: Applicable to SMT patch modules

ESD Sensitivity：

ESD Protection: 4KV(HBM ,Maximum rating)

The Module is a static-sensitive electronic device. Do not operate or store near strong electrostatic fields. Take proper ESD precautions!

ESD CAUTION

FCC Statement

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.

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 modular has been tested and found to comply with part 15 requirements for Modular Approval.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01r01

2.2 List of applicable FCC rules

CFR 47 FCC Part 15 Subpart C and Subpart F has been investigated. It is applicable to the modular transmitter

2.3 Specific Operational Use Conditions - Antenna Placement Within the Host Platform

The module is tested for standalone mobile RF exposure use condition.

- The antenna must be installed such that 20cm is maintained between the antenna and users,
- The transmitter module may not be co-located with any other transmitter or antenna.

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

2.4 Limited Module Procedures

Not applicable

2.5 Trace Antenna Designs

Not applicable

2.6 RF Exposure Considerations

This device 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.

2.7 Antenna Type and Gain

The following antennas have been certified for use with this module.

Only antennas of the same type with equal or lower gain may also be used with this module.

Other types of antennas and/or higher gain antennas may require the additional authorization for operation.

Antenna Specification list below:

Model	Type	Connector	Peak gain (dBi)				
			2400-2483.5 MHz	5150-5250 MHz	5250-5350 MHz	5470-5725 MHz	5725-5850 MHz
A99052A	External Antenna	/	2.30dBi	2.86dBi	/	/	2.86dBi
A99054A	External Antenna	/	2.30dBi	2.86dBi	/	/	2.86dBi
RFECA3216060A1T	External Antenna	/	2.00dBi	/	/	/	/

2.8 End Product Labelling Compliance Information

When the module is installed in the host device, the FCC ID label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily removed. If not, a second label must be placed on the outside of the final device that contains the following text: “Contains FCC ID: **2AVED-FRXWIFI7988AP**”. The FCC ID can be used only when all FCC compliance requirements are met.

2.9 Information on Test Modes and Additional Testing Requirements

This transmitter is tested in a standalone mobile RF exposure condition and any co-located or simultaneous transmission with other transmitter(s) class II permissive change re-evaluation or new FCC authorization.
Host manufacturer installed this modular with single modular approval should perform the test of radiated emission and spurious emission according to FCC part 15C, Part 15E, 15.209, 15.207 requirement, only if the test result comply with FCC part 15C, Part 15E, 15.209, 15.207 requirement, then the host can be sold legally.

2.10 Additional testing, Part 15 Subpart B Disclaimer

This transmitter modular us tested as a subsystem and its certification does not cover the FCC Part 15 Subpart B rules requirement applicable to the final host. The final host will still need to be reassessed for compliance to this portion of rules 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 modular installed.

2.11 Manual Information to The End User

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 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 Publication 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 RF Exposure essential requirements of the FCC rules.

2.12 How to Make Changes - Important Note

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.