Radio Frequency Exposure

1.1 Radio Frequency Exposure Compliance

1.1.1 Electromagnetic Fields

RESULT: **Pass**

Test Specification

Test item	:	WiFi+BT USB2.0 Module
Identification / Type No.	:	NTUD-T12
FCC ID	:	2ANM3NTUDT12
IC	:	23165-NTUDT12
HVIN	:	NTUD-T12
Test standard	:	CFR47 FCC Part 2: Section 2.1093 CFR47 FCC Part 1: Section 1.1310 FCC KDB Publication 447498 v06 RSS-102 Issue 5 February 2021

Product Classification

This device 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 20 cm is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons.

1.1.2 Radio Frequency Exposure Limit

For FCC:

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)
300-1,500	--	--	f/1500
1,500-100,000	--	--	1.0

For IC:

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
0.003-10[21]	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142f^{0.3417}$	$0.008335f^{0.3417}$	$0.02619f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
*Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

1.1.3 Radio Frequency Exposure Calculation Formula

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density (in appropriate units, e.g. mW/cm^2)
P = power input to the antenna (in appropriate units, e.g., mW)
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

or:

$$S = \frac{EIRP}{4\pi R^2}$$

where: EIRP = equivalent (or effective) isotropically radiated power

1.1.4 Calculation Result

1) Stand-alone transmission MPE

Mode	*Measured RF Output Power (dBm)	Antenna Gain (dBi)	Distance (cm)	Power Density (mW/cm²)	FCC Limit (mW/cm²)	Power Density (W/m²)	IC Limit (W/m²)
Bluetooth	12.24	2.85	20	0.006	1.0	0.061	5.3
2.4GHz Wi-Fi	21.076	2.72	20	0.048	1.0	0.477	5.3
5GHz Wi-Fi	17.239	2.89	20	0.021	1.0	0.201	9.0

Note:
1. Bluetooth Output Power: Refer to test report CN231C12 001, CN231C12 002
2. 2.4GHz Wi-Fi RF Output Power: Refer to test report CN231C12 003
3. 5GHz Wi-Fi RF Output Power: Refer to test report CN231C12 004

2) Simultaneous transmission MPE

The product has multiple transmitters, the Simultaneous Transmission possibilities are listing below:

Simultaneous Tx Combination	Configuration
1	Bluetooth + 2.4GHz Wi-Fi
2	Bluetooth + 5GHz Wi-Fi

Per KDB 447498 D01 v06, simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on calculated or measured field strengths or power density, is ≤ 1.0.

For FCC

No.	Test Mode	Calculation (mW/cm²)	Limit (mW/cm²)	Calculation	Limit	Result
1	Bluetooth + 2.4GHz Wi-Fi	0.006	1	0.054	1	Pass
		0.048	1			
2	Bluetooth + 5GHz Wi-Fi	0.006	1	0.027	1	Pass
		0.021	1			

For IC

No.	Test Mode	Calculation (W/m^2)	Limit (W/m^2)	Calculation	Limit	Result
1	Bluetooth + 2.4GHz Wi-Fi	0.061	5.3	0.102	1	Pass
		0.477	5.3			
2	Bluetooth + 5GHz Wi-Fi	0.061	5.3	0.034	1	Pass
		0.201	9.0			

1.1.5 Conclusion

Therefore the maximum calculations result of above are meet the requirement of Radio Frequency Exposure (MPE) limit.