FCC ID: LNQSBWD960A

RF EXPOSURE EVALUATION

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency(RF) Radiation as specified in §1.1307(b)

Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*100	6
3.0-30	1842/f	4.89/f	$*900/f^2$	6
30-300	61.4	0.163	1.0	6
300-1,500			f/300	6
1,500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*100	30
1.34-30	824/f	2.19/f	$*180/f^2$	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
1,500-100,000			1.0	30

f = frequency in MHz * = Plane-wave equivalent power density

MPE Calculation Method

E (V/m) = $\frac{\sqrt{30 * P * G}}{d}$ Power Density: *Pd* (W/m²) = $\frac{E^2}{377}$

E = Electric field (V/m)

P = Average RF output power (W)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

Pd = $\frac{30 * P * G}{377 * D^2}$

From the EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the gain of the used antenna, the RF power density can be obtained.

Module& antenna

WIFI:

Frequency	ANT1 max Gain(dBi)	ANT2 max Gain(dBi)	ANT3 max Gain(dBi)	ANT4 max Gain(dBi)
2400MHz-2500MHz	2.80	2.91	3.47	2.52
5150MHz-5250MHz	4.86	4.40	5.22	4.83
5725MHz-5850Mhz	3.36	4.30	5.11	4.93

BLE antenna Gain: -0.64 dBi

The Control software(tool_WIFI.exe) can control Modules 8812/8192 antenna 1, 2,3,4 ,
For 2.4GHz mode, antenna 1, 2, 3, 4, are transmitting, antenna 1 and 2 or antenna 3 and 4 May simultaneously transmit.
And the data is recorded for radiated emission and band edge.
Modules 8812 For MIMO mode:
Directional gain= 10log(antenna 1 + antenna 2) dbi =5.86dbi in 2.4GHz
802.11 n 2.4GHz has MIMO mode.
Modules 8192 For MIMO mode:
Directional gain=10log(antenna 3 + antenna 4) dbi =6.03dbi in 2.4GHz
802.11/n 2.4GHz has MIMO mode.
Modules 8812 For MIMO mode: Directional gain
= 10log(antenna 1 + antenna 2) dbi =7.65dbi in 5.2GHz
= 10log(antenna 1 + antenna 2) dbi =8.04dbi in 5.8GHz
802.11 n/ac 5.0GHz has MIMO mode.
Modules 8192 For MIMO mode: Directional gain
=10log(antenna 3 + antenna 4) dbi =6.86dbi in 5.2GHz
= 10log(antenna 3 + antenna 4) dbi =8.03dbi in 5.8GHz
802.11n/ac 5.0GHz has MIMO mode.

MAX OUTPUT POWER

BLE:

Test Channel	Frequency (MHz)	Power Setting	Peak Output Power (dBm)	LIMIT (dBm)	Verdict
1Mbps					
00	2402	Default	3.52	30	PASS
19	2440	Default	3.09	30	PASS
39	2480	Default	3.22	30	PASS

WIFI:

RF Module 8812

Test Channel	Frequenc (MHz)	Conducted Output Power(dBm)		Total Power (dBm)		LIMIT (dBm)	Verdict
		ANT 1	ANT 2	ANT 1	ANT 2		
802.11b							
1	2412	17.24	17.15	-	-	30	PASS
6	2437	17.16	17.03	-	-	30	PASS
11	2462	17.21	17.07	-	-	30	PASS
802.11g							
1	2412	17.29	17.01	-	-	30	PASS
6	2437	17.15	17.33	-	-	30	PASS
11	2462	17.22	17.22	-	-	30	PASS
802.11n HT20							
1	2412	17.16	17.11	20.15		29.97	PASS
6	2437	17.23	17.08	20.17		29.97	PASS
11	2462	17.18	17.24	20.22		29.97	PASS
802.11n HT40							
3	2422	17.36	17.15	20.27		29.97	PASS
6	2437	17.29	17.24	20.28		29.97	PASS
9	2452	17.58	17.36	20.48		29.97	PASS

RF Module 8192

Test Channel	Frequenc (MHz)	Conducted Output Power(dBm)		Total Power (dBm)		LIMIT (dBm)	Verdict
		ANT 3	ANT 4	ANT 3	ANT 4		
802.11b							
1	2412	17.14	17.11	-	-	30	PASS
6	2437	17.18	17.04	-	-	30	PASS
11	2462	17.01	17.13	-	-	30	PASS
802.11g							
1	2412	17.16	17.64	-	-	30	PASS
6	2437	17.29	17.28	-	-	30	PASS
11	2462	17.29	17.43	-	-	30	PASS
802.11n HT20							
1	2412	17.31	17.24	20.29		29.97	PASS
6	2437	17.28	17.15	20.23		29.97	PASS
11	2462	17.29	17.09	20.20		29.97	PASS
802.11n HT40							
3	2422	17.19	17.05	20.13		29.97	PASS
6	2437	17.27	17.11	20.20		29.97	PASS
9	2452	17.22	17.13	20.19		29.97	PASS

RF Module 8812

Test Channel	Frequency	Maximum output power. (AV) (dBm)		Total Power (AV)	LIMIT	Result
	(MHz)	ANT 1	ANT 2	dBm	dBm	
TX 802.11a Mode						
CH36	5180	15.72	15.27	–	23.97	Pass
CH40	5200	15.69	15.12	–	23.97	Pass
CH48	5240	15.35	15.18	–	23.97	Pass
TX 802.11 n20M Mode						
CH36	5180	14.570	14.280	17.438	22.35	Pass
CH40	5200	14.760	14.170	17.485	22.35	Pass
CH48	5240	14.080	14.070	17.085	22.35	Pass
TX 802.11 n40M Mode						
CH38	5190	14.870	14.150	17.535	22.35	Pass
CH46	5230	14.570	14.070	17.337	22.35	Pass
TX 802.11 AC20M Mode						
CH36	5180	14.840	14.270	17.575	22.35	Pass
CH40	5200	14.540	14.060	17.317	22.35	Pass
CH48	5240	14.250	14.110	17.191	22.35	Pass
TX 802.11 AC40M Mode						
CH38	5190	14.140	14.010	17.086	22.35	Pass
CH46	5230	14.110	14.100	17.115	22.35	Pass
TX 802.11 AC80M Mode						
CH42	5210	14.530	14.420	17.486	22.35	Pass

RF Module 8192

Test Channel	Frequency	Maximum output power. (AV) (dBm)		Total Power (AV)	LIMIT	Result
	(MHz)	ANT 3	ANT 4	dBm	dBm	
TX 802.11a Mode						
CH36	5180	15.680	15.210	–	23.97	Pass
CH40	5200	15.660	15.080	–	23.97	Pass
CH48	5240	15.530	15.120	–	23.97	Pass
TX 802.11 n20M Mode						
CH36	5180	14.490	14.250	17.382	23.12	Pass
CH40	5200	14.260	14.170	17.226	23.12	Pass
CH48	5240	14.540	14.140	17.355	23.12	Pass
TX 802.11 n40M Mode						
CH38	5190	14.480	14.160	17.333	23.12	Pass
CH46	5230	14.640	14.110	17.393	23.12	Pass

RF Module 8812

Test Channel	Frequency	Maximum output power. (AV) (dBm)		Total (AV)	LIMIT
	(MHz)	ANT 1	ANT 2	dBm	dBm
TX 802.11a Mode					
CH 149	5745	17.15	17.36	–	30
CH 157	5785	17.29	17.11	–	30
CH 165	5825	17.38	17.37	–	30
TX 802.11 n20M Mode					
CH 149	5745	17.31	17.13	20.231	27.96
CH 157	5785	17.37	17.23	20.311	27.96
CH 165	5825	17.22	17.44	20.342	27.96
TX 802.11 n40M Mode					
CH 151	5755	17.28	17.14	20.221	27.96
CH 159	5795	17.16	17.03	20.106	27.96
TX 802.11 AC20M Mode					
CH 149	5745	17.14	17.05	20.106	27.96
CH 157	5785	17.21	17.09	20.161	27.96
CH 165	5825	17.22	17.15	20.195	27.96
TX 802.11 AC40M Mode					
CH 151	5755	17.58	17.25	20.428	27.96
CH 159	5795	17.34	17.28	20.320	27.96
TX 802.11 AC80M Mode					
CH 155	5775	17.02	17.1	20.070	27.96

RF Module 8192

Test Channel	Frequency	Maximum output power. (AV) (dBm)		Total (AV)	LIMIT
	(MHz)	ANT 3	ANT 4	dBm	dBm
TX 802.11a Mode					
CH 149	5745	17.08	17.14	–	30
CH 157	5785	17.46	17.25	–	30
CH 165	5825	17.34	17.07	–	30
TX 802.11 n20M Mode					
CH 149	5745	17.25	17.11	20.191	27.97
CH 157	5785	17.15	17.07	20.120	27.97
CH 165	5825	17.08	17.16	20.130	27.97
TX 802.11 n40M Mode					
CH 151	5755	17.27	17.09	20.191	27.97
CH 159	5795	17.26	17.00	20.142	27.97

11.2 Measurement Result

Exposure Environment: General Population / Uncontrolled Exposure

For 2.4GHz Band:
For WLAN
Antenna Type : PCB Antenna
For 2.4GHz mode, Module 8812, antenna 1/2 are transmitting, four antennas simultaneously transmit. And the data is recorded for radiated emission and band edge.
Modules 8812 For MIMO mode:
Directional gain= 10log(antenna 1 + antenna 2) dbi =5.86dbi in 2.4GHz
802.11 n 2.4GHz has MIMO mode.
Conducted Power for IEEE 802.11n40: 20.48 dBm

Distance (cm)	DirectionalGain	Antenna Gain (numeric)	The maximum combined Distance Average Output Power		Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
			dBm	mW			
20	5.86	3.855	20.48	111.6863	0.0856	1	Complies

$$DirectionalGain = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{ANT}}\left\{\sum_{k=1}^{N_{SS}} g_{j,k}\right\}^2}{N_{ANT}}\right]$$

For 2.4GHz Band:
For WLAN
Antenna Type : PCB Antenna
For 2.4GHz mode, Module 8192, antenna 3/4 are transmitting, four antennas simultaneously transmit. And the data is recorded for radiated emission and band edge.
Modules 8192 For MIMO mode:
Directional gain=10log(antenna 3 + antenna 4) dbi =6.03dbi in 2.4GHz
802.11/n 2.4GHz has MIMO mode.
Conducted Power for IEEE 802.11n20: 20.29 dBm

Distance (cm)	DirectionalGain	Antenna Gain (numeric)	The maximum combined Distance Average Output Power		Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
			dBm	mW			
20	6.03	4.009	20.29	106.9055	0.0853	1	Complies

$$DirectionalGain = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{ANT}}\left\{\sum_{k=1}^{N_{SS}} g_{j,k}\right\}^2}{N_{ANT}}\right]$$

For 5GHz ISM Band:
Antenna Type : PCB Antenna
For 5GHz mode, Module 8812, antenna 1/2 are transmitting, four antennas simultaneously transmit. And the data is recorded for radiated emission and band edge.
Modules 8812 For MIMO mode: Directional gain
= 10log(antenna 1 + antenna 2) dbi =8.04dbi in 5.8GHz
802.11 n/ac 5.0GHz has MIMO mode.
Conducted Power for IEEE 802.11ac 40: 20.428dBm

Distance (cm)	DirectionalGain	Antenna Gain (numeric)	The maximum combined Distance Average Output Power		Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
			dBm	mW			
20	8.04	6.368	20.428	110.357	0.1398	1	Complies

$$DirectionalGain = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{ANT}}\left\{\sum_{k=1}^{N_{SS}} g_{j,k}\right\}^2}{N_{ANT}}\right]$$

For 5GHz ISM Band:
Antenna Type : PCB Antenna
For 5GHz mode, Module 8192, antenna 3/4 are transmitting, four antennas simultaneously transmit. And the data is recorded for radiated emission and band edge.
Modules 8192 For MIMO mode: Directional gain
= 10log(antenna 3 + antenna 4) dbi =8.03dbi in 5.8GHz
802.11n/ac 5.0GHz has MIMO mode.
Conducted Power for IEEE 802.11n 40: 20.20.191dBm

Distance (cm)	DirectionalGain	Antenna Gain (numeric)	The maximum combined Distance Average Output Power		Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
			dBm	mW			
20	8.03	6.353	20.191	104.4961	0.1321	1	Complies

$$DirectionalGain = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{ANT}}\left\{\sum_{k=1}^{N_{SS}} g_{j,k}\right\}^2}{N_{ANT}}\right]$$

For 5GHz UNII Band:
Antenna Type : PIFA Antenna
For 5GHz mode, Module 8812, antenna 1/2 are transmitting, four antennas simultaneously transmit. And the data is recorded for radiated emission and band edge.
Modules 8812 For MIMO mode: Directional gain
= 10log(antenna 1 + antenna 2) dbi =7.65dbi in 5.2GHz
802.11 n/ac 5.0GHz has MIMO mode.
Conducted Power for IEEE 802.11ac 20 : 17.575dBm

Distance (cm)	DirectionalGain	Antenna Gain (numeric)	The maximum combined Distance Average Output Power		Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
			dBm	mW			
20	7.65	5.821	17.575	57.2137	0.0663	1	Complies

$$DirectionalGain = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{ANT}}\left\{\sum_{k=1}^{N_{SS}} g_{j,k}\right\}^2}{N_{ANT}}\right]$$

For 5GHz UNII Band:
Antenna Type : PIFA Antenna
For 5GHz mode, Module 8192, antenna 3/4 are transmitting, four antennas simultaneously transmit. And the data is recorded for radiated emission and band edge.
Modules 8192 For MIMO mode: Directional gain
=10log(antenna 3 + antenna 4) dbi =6.86dbi in 5.2GHz
802.11n/ac 5.0GHz has MIMO mode.
Conducted Power for IEEE 802.11n 40 : 17.393dBm

Distance (cm)	DirectionalGain	Antenna Gain (numeric)	The maximum combined Distance Average Output Power		Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
			dBm	mW			
20	6.86	4.853	17.393	54.86558	0.0530	1	Complies

$$DirectionalGain = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{ANT}}\left\{\sum_{k=1}^{N_{ANT}} g_{j,k}\right\}^2}{N_{ANT}}\right]$$

For Bluetooth
Antenna Type : PCB Antenna
Antenna Gain: -0.64dBi
Max Conducted Power for Bluetooth 4.0 : 3.52 dBm

Distance (cm)	DirectionalGain	Antenna Gain (numeric)	The maximum combined Distance PK Output Power		Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
			dBm	mW			
20	-0.64	0.863	3.52	2.249055	0.0004	1	Complies

CONCULSION:
Both of the WLAN 5GHz Band and Bluetooth and WLAN 2.4GHz can transmit simultaneously, the formula of calculatedthe MPE is:
CPD1 / LPD1 + CPD2 / LPD2 + CPD3 / LPD3 ……etc. < 1
CPD = Calculation power density
LPD = Limit of power density
Therefore, the worst-case situation is 0.1398/1+ 0.0004/1+0.0856/1=0.2258, which is less than "1".

This confirmed that the device comply with FCC 1.1310 MPE limit.

Jason chen

Signature: **Date:** 2016-6-28

NAME AND TITLE (Please print or type): Jason Chen/Manager

COMPANY (Please print or type): Shenzhen NTEK Testing Technology Co., Ltd./ 1/F, Building E, Fenda Science Park, Sanwei Community, Xixiang Street Bao'an District, Shenzhen P.R. China.