

Maximum Permissible Exposure Evaluation

FCC ID: 2A789-UX33US

1. Client Information

Applicant	:	Ningbo Lingzhu Technology CO., Ltd.
Address	:	No.578, Building 7, No.535 Kangqiao South Road, Jiangbei District, Ningbo, City, Zhejiang Province, China. 315000
Manufacturer	:	Ningbo Lingzhu Technology CO., Ltd.
Address	:	No.578, Building 7, No.535 Kangqiao South Road, Jiangbei District, Ningbo, City, Zhejiang Province, China. 315000

2. General Description of EUT

EUT Name	:	4G multimode engineering gateway
Model(s) No.	:	UX33-US
Model Difference	:	----
Product Description	:	Operation Frequency: ZigBee: 2405MHz~2480MHz Bluetooth 5.0(BLE): 2402MHz~2480MHz 2.4G WiFi: 2412MHz~2462MHz LTE: Band 2/4/12
Power Supply	:	AC Adapter (Model: DCT12W050200US-A0) Input: 100-240V~50/60Hz 0.3A max. Output: 5.0V=2.0A
Software Version	:	1.4.2
Hardware Version	:	V3
Remark: The antenna gain provided by the applicant, the adapter and verified for the RF conduction test and adapter provided by TOBY test lab.		

Note: More test information about the EUT please refer the RF Test Report.

MPE Calculations for WIFI

1. Antenna Gain:

ZigBee Copper tube Antenna: 3dBi
BLE Copper tube Antenna: 3dBi
2.4G WiFi Copper tube Antenna: 3dBi
LTE Copper tube Antenna: 2dBi

2. EUT Operation Condition:

Software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.

3. Exposure Evaluation:

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S=(PG)/4\pi R^2$$

Where

S: power density

P: power input to the antenna

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

4. Test Result:

ZigBee MPE Result								
Mode	N _{TX}	Freq. (MHz)	Conducted Power(max) (dBm)	Turn-up Power (dB)	Max tune up power (dBm) [P]	ANT Gain (dBi) [G]	Distance (cm) [R]	Power Density (mW/ cm ²) [S]
ZigBee	1	2405	5.72	6±1	7	3	20	0.0020
		2445	5.50	6±1	7	3	20	0.0020
		2480	5.42	5±1	6	3	20	0.0016

Note:
 N_{TX}= Number of Transmit Antennas
 RF Output power specifies that Maximum Conducted Peak Output Power.

BLE MPE Result								
Mode	N _{TX}	Freq. (MHz)	Conducted Power(max) (dBm)	Turn-up Power (dB)	Max tune up power (dBm) [P]	ANT Gain (dBi) [G]	Distance (cm) [R]	Power Density (mW/ cm ²) [S]
BLE (1Mbps)	1	2402	6.89	7±1	8	3	20	0.0025
		2440	6.63	7±1	8	3	20	0.0025
		2480	6.54	7±1	8	3	20	0.0025
BLE (2Mbps)	1	2402	6.88	7±1	8	3	20	0.0025
		2440	6.62	7±1	8	3	20	0.0025
		2480	6.53	7±1	8	3	20	0.0025

Note:
 N_{TX}= Number of Transmit Antennas
 RF Output power specifies that Maximum Conducted Peak Output Power.

2.4G WiFi MPE Result Antenna 1								
Mode	N _{TX}	Freq. (MHz)	Conducted Power(max) (dBm)	Turn-up Power (dB)	Max tune up power (dBm) [P]	ANT Gain (dBi) [G]	Distance (cm) [R]	Power Density (mW/ cm ²) [S]
802.11b	1	2412	18.03	18±1	19	3	20	0.0315
		2437	17.81	18±1	19	3	20	0.0315
		2462	17.51	18±1	19	3	20	0.0315
802.11g	1	2412	16.10	16±1	17	3	20	0.0199
		2437	13.66	14±1	15	3	20	0.0126
		2462	13.66	14±1	15	3	20	0.0126
802.11n20	1	2412	14.31	14±1	15	3	20	0.0126
		2437	13.64	14±1	15	3	20	0.0126
		2462	13.34	13±1	14	3	20	0.0100
802.11n40	1	2422	12.17	12±1	13	3	20	0.0079
	1	2437	11.78	12±1	13	3	20	0.0079
	1	2452	12.04	12±1	13	3	20	0.0079

Note:
 N_{TX}= Number of Transmit Antennas
 RF Output power specifies that Maximum Conducted Peak Output Power.

2.4G WiFi MPE Result Antenna 2								
Mode	N _{TX}	Freq. (MHz)	Conducted Power(max) (dBm)	Turn-up Power (dB)	Max tune up power (dBm) [P]	ANT Gain (dBi) [G]	Distance (cm) [R]	Power Density (mW/ cm ²) [S]
802.11b	1	2412	18.64	19±1	20	3	20	0.0397
		2437	17.52	18±1	19	3	20	0.0315
		2462	17.86	18±1	19	3	20	0.0315
802.11g	1	2412	14.51	15±1	16	3	20	0.0158
		2437	14.29	14±1	15	3	20	0.0126
		2462	14.22	14±1	15	3	20	0.0126
802.11n2 0	1	2412	13.35	13±1	14	3	20	0.0100
		2437	12.85	13±1	14	3	20	0.0100
		2462	12.64	13±1	14	3	20	0.0100
802.11n4 0	1	2422	11.5	12±1	13	3	20	0.0079
	1	2437	11.2	11±1	12	3	20	0.0063
	1	2452	10.89	11±1	12	3	20	0.0063

Note:
 N_{TX}= Number of Transmit Antennas
 RF Output power specifies that Maximum Conducted Peak Output Power.

LTE MPE Result Antenna								
Mode	N _{TX}	Freq. (MHz)	Conducted Power(max) (dBm)	Turn-up Power (dB)	Max tune up power (dBm) [P]	ANT Gain (dBi) [G]	Distance (cm) [R]	Power Density (mW/ cm ²) [S]
LTE	1	Band 2	25.31	25±1	26	2	20	0.1255
		Band 4	25.25	25±1	26	2	20	0.1255
		Band 12	24.96	25±1	26	2	20	0.1255

Note:
 N_{TX}= Number of Transmit Antennas
 RF Output power specifies that Maximum Conducted Peak Output Power.

5. Conclusion:

As specified in Table 1B of 47 CFR 1.1310- Limits for Maximum Permissible Exposure (MPE),

Limits for General Population/ Uncontrolled Exposure

Frequency Range (MHz)	Power density (mW/ cm ²)
300-1,500	F/1500
1,500-100,000	1.0

For ZigBee&BLE&2.4G WiFi<E

MPE limit S: 0.466mW/ cm²

6. Summary simultaneous transmission results

ZigBee, Bluetooth, 2.4G WiFi and LTE support simultaneous transmit the

ZigBee MPE (Ratio)	BLE MPE (Ratio)	2.4G WiFi AN1 MPE (Ratio)	2.4G WiFi AN2 MPE (Ratio)	LTE MPE (Ratio)	simultaneous MPE (Ratio)	MPE Limits (Ratio)
0.0020	0.0025	0.0315	0.0397	0.1255	0.2012	0.466

So, RF exposure limit warning or SAR test are not required.

The EUT will only be used with a separation of 20cm or greater between the antenna and nearby persons and can therefore be considered a mobile transmitter per 47 CFR2.1091 (b). The RF Exposure Information page from the manual is included here for reference.

-----END OF REPORT-----