RF Exposure evaluation

FCC ID	2BE3U-C6
Product Name	Encoder
Model/Type reference	C6
Exposure category	General population/uncontrolled environment
EUT Type	Production Unit
Device Type	Mobile Device

1. Reference

ANSI C95.1–1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

FCC KDB publication 447498 D01 General 1 RF Exposure Guidance v06: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

FCC CFR 47 part1 1.1310: Radio frequency radiation exposure limits.

FCC CFR 47 part2 2.1091: Radio frequency radiation exposure evaluation: mobile devices

2. Limit

Limits for Maximum Permissible Exposure (MPE)/Controlled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	(100) *	6
3.0 – 30	1842/f	4.89/f	(900/f2)*	6
30 – 300	61.4	0.163	1.0	6
300 – 1500	/	/	f/300	6
1500 – 100,000	/	/	5	6

Limits for Maximum Permissible Exposure (MPE)/Uncontrolled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	(100) *	30
3.0 – 30	824/f	2.19/f	(180/f2)*	30
30 – 300	27.5	0.073	0.2	30
300 – 1500	/	/	f/1500	30
1500 – 100,000	/	/	1.0	30

F=frequency in MHz

*=Plane-wave equivalent power density

3. MPE Calculation Method

Predication of MPE limit at a given distance

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 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. Antenna Information

405-ECO-WiFi can only use antennas certificated as follows provided by manufacturer;

Antenna No.	Type of antenna:	Gain of the antenna (Max.)	Frequency range:
2.4G ANT	External Antenna	1.4dBi	5150-5850MHz
5G ANT	External Antenna	2.8dBi for 5.2GWIFI 0.2dBi for 5.8GWIFI	5150-5850MHz

5. Conducted Peak Output Power

2.4G WIFI

Mode	Channel	Power(dBm)
IEEE 802.11b	1	13.15
	6	12.80
	11	11.05
IEEE 802.11g	1	11.20
	6	11.57
	11	11.06
IEEE 802.11n_20	1	10.51
	6	10.66
	11	10.20
IEEE 802.11n_40	3	10.73
	6	11.03
	9	10.71
IEEE 802.11ax_20	1	12.97
	6	14.20
	11	12.90
IEEE 802.11ax_40	3	14.07
	6	13.95
	9	13.54

5.2G WIFI

Mode	Channel	Power(dBm)
IEEE 802.11a	36	12.03
	40	12.03
	48	11.92
IEEE 802.11n_20	36	11.86
	40	11.83
	48	11.73
IEEE 802.11n_40	38	11.32
	46	11.18
IEEE 802.11ac_20	36	11.93
	40	11.97
	48	11.77
IEEE 802.11ac_40	38	11.49
	46	11.33
IEEE 802.11ac_80	42	10.42
IEEE 802.11ax_20	36	15.89
	40	15.24
	48	13.62
IEEE 802.11ax_40	38	15.5
	46	13.55
IEEE 802.11ax_80	42	15.18

5.8G WIFI

Mode	Channel	Power(dBm)
IEEE 802.11a	149	11.34
	157	11.86
	165	12.48
IEEE 802.11n_20	149	11.75
	157	11.83
	165	12.33
IEEE 802.11n_40	151	11.51
	159	11.82
IEEE 802.11ac_20	149	11.78
	157	11.6
	165	12.12
IEEE 802.11ac_40	151	11.35
	159	11.85
IEEE 802.11ac_80	155	9.74
IEEE 802.11ax_20	149	14.26
	157	12.98
	165	14.36
IEEE 802.11ax_40	151	15.76
	159	14.04

IEEE 802.11ax_80	155	13.43

6. Manufacturing Tolerance

2.4G WIFI

Mode	11b		
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	12.0	12.0	12.0
Tolerance ± (dB)	1.0	1.0	1.0
Mode	11g		
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	11.0	11.0	11.0
Tolerance ± (dB)	1.0	1.0	1.0
Mode	11n(HT20)		
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	11.0	11.0	11.0
Tolerance ± (dB)	1.0	1.0	1.0
Mode	11n(HT40)		
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	11.0	11.0	11.0
Tolerance ± (dB)	1.0	1.0	1.0
Mode	11ax(HT20)		
Channel	11.0	11.0	11.0
Target (dBm)	12.0	14.0	12.0
Tolerance ± (dB)	1.0	1.0	1.0
Mode	11ax(HT40)		
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	14.0	14.0	14.0
Tolerance ± (dB)	1.0	1.0	1.0

5.2G WIFI

Mode	11a		
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	12.0	12.0	12.0
Tolerance ± (dB)	1.0	1.0	1.0
Mode	11n(HT20)		
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	11.0	11.0	11.0
Tolerance ± (dB)	1.0	1.0	1.0
Mode	11n(HT40)		
Channel	Channel 38	Channel 46	
Target (dBm)	11.0	11.0	
Tolerance ± (dB)	1.0	1.0	
Mode	11ac(HT20)		
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	11.0	11.0	11.0
Tolerance ± (dB)	1.0	1.0	1.0
Mode	11ac(HT40)		
Channel	Channel 38	Channel 46	
Target (dBm)	11.0	11.0	
Tolerance ± (dB)	1.0	1.0	
Mode	11ac(HT80)		
Channel	Channel 42		
Target (dBm)	11.0		
Tolerance ± (dB)	1.0		
Mode	11ax(HT20)		
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	15.0	15.0	14.0
Tolerance ± (dB)	1.0	1.0	1.0
Mode	11ax(HT40)		
Channel	Channel 38	Channel 46	
Target (dBm)	15.0	13.0	
Tolerance ± (dB)	1.0	1.0	
Mode	11ax(HT80)		
Channel	Channel 42		
Target (dBm)	15.0		
Tolerance ± (dB)	1.0		

5.8G WIFI

Mode	11a		
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	11.0	11.0	12.0
Tolerance ± (dB)	1.0	1.0	1.0
Mode	11n(HT20)		
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	11.0	11.0	11.0
Tolerance ± (dB)	1.0	1.0	1.0
Mode	11n(HT40)		
Channel	Channel 151	Channel 159	
Target (dBm)	11.0	11.0	
Tolerance ± (dB)	1.0	1.0	
Mode	11ac(HT20)		
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	11.0	11.0	12.0
Tolerance ± (dB)	1.0	1.0	1.0
Mode	11ac(HT40)		
Channel	Channel 151	Channel 159	
Target (dBm)	11.0	11.0	
Tolerance ± (dB)	1.0	1.0	
Mode	11ac(HT80)		
Channel	Channel 155		
Target (dBm)	10.0		
Tolerance ± (dB)	1.0		
Mode	11ax(HT20)		
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	14.0	13.0	14.0
Tolerance ± (dB)	1.0	1.0	1.0
Mode	11ax(HT40)		
Channel	Channel 151	Channel 159	
Target (dBm)	15.0	14.0	
Tolerance ± (dB)	1.0	1.0	
Mode	11ax(HT80)		
Channel	Channel 155		
Target (dBm)	13.0		
Tolerance ± (dB)	1.0		

7. Standalone MPE Result

As declared by the Applicant, the EUT is a wireless device used in a fix application, at least 20 cm from any body part of the user or nearby persons; from the maximum EUT RF output power, the minimum separation distance, r =20cm, as well as the gain of the used antenna is 2.8dBi(Max), the RF power density can be obtained.

Mode	Output power		Antenna Gain (dBi)	Antenna Gain(linear)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW				
2.4GWIFI	15	31.62	1.4	1.38	0.00868	1.0000
5.2GWIFI	16	39.81	2.8	1.91	0.01509	1.0000
5.8GWIFI	16	39.81	0.2	1.05	0.00829	1.0000

Remark:

1. Output power (Peak) including turn-up tolerance;
2. MPE evaluate distance is 20cm from user manual provide by manufacturer.

8. Simultaneous Transmission MPE Evaluation

The EUT equiped with one 2.4GWIFI antenna and one 5.2G WIFI/5.8GWIFI antenna. so need consider simultaneous transmission;

According to KDB447498 for Transmitters used in mobile exposure conditions for simultaneous transmission operations;

$\sum\sum$ of MPE ratios $\leqslant$ 1.0

Ant0: 2.4GWIFI MPE ratios	Ant1: 5.2GWIFI MPE ratios	Ant1: 5.8GWIFI MPE ratios	$\sum$ MPE ratios	Limit	Results
0.00868	0.01509	/	0.02377	1.0	Pass
0.00868	/	0.00829	0.01697	1.0	Pass

9. Conclusion

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure of mobile device.

------End of the report------