

RF Exposure evaluation

FCC ID	2BD95-ZSCYZS1
Product Name	Smart Cylinder
Model/Type reference	S1
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/f ²)*	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/f ²)*	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

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

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:
BT ANT	Ceramic antenna	1.75dBi	2400-2500MHz
NFC ANT	PCB antenna	0dBi	13-14MHz

5. Conducted Peak Output Power

BLE

Mode	Channel	Peak Output Power (dBm)	Peak Output Power (mW)
LE	0	-1.288	0.74
	19	-0.897	0.81
	39	-0.748	0.84

NFC

Mode	Frequency(MHz)	Field Strength(dBuV/m@3m)
ASK	13.56	46.23

Note: NFC: dBuV/m = 20log uV/m

6. Manufacturing Tolerance

BLE

Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	-1.0	-1.0	-1.0
Tolerance \pm (dB)	1.0	1.0	1.0

NFC

TX frequency range: 13.56 MHz

Device category: Mobile device (Distance: 20cm) Max. Field Strength: 46.23dBuV/m @3m

$E(\text{dBuV/m}@0.2\text{m}) = E(\text{dBuV/m}@3\text{m}) + 40\log(3/0.2) = 46.23 + 47.04 = 93.27\text{dBuV/m}$

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, $r = 20\text{cm}$, as well as the gain of the used antenna refer to antenna information, the RF power density can be obtained.

Mode	Channel	Frequency (MHz)	Field strength of fundamental @ 3m		Field strength of fundamental @ 0.2m		Electric Field Strength (V/m)
			(dBuV/m)	V/m	(dBuV/m)	V/m	
ASK	1	13.56	46.23	0.0002	93.27	0.046	60.767

Mode	Output power		Antenna Gain (dBi)	Antenna Gain(linear)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW				
BLE	0	1.0	1.75	1.50	0.0003	1.0000

Remark:

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

Simultaneous Transmission for SAR Exclusion

Support BT and NFC simultaneous transmission, need consider BT and NFC simultaneous transmission.

MPE Ratio _{NFC}	Maximum MPE Ratio _{BT}	Σ MPE Ratio _{NFC} , Maximum MPE Ratio _{BT}	Simultaneous Transmission	Results
0.00076	0.0003	0.00106	1.00	PASS

8. 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-----