MPE Calculation

Product:	Infotainment head unit
Model no.:	CTR
FCC ID:	2ACRLCTR
Rating:	DC 12V
RF Transmission Frequency:	Bluetooth:2402-2480MHz For Wi-Fi 2.4G: 2412~2462 MHz For Wi-Fi 5GHz: 5.180GHz~5.240GHz; 5.260GHz~5.320GHz; 5.500GHz~5.700GHz; 5.745GHz~5.825GHz
Modulation:	DSSS, OFDM
Antenna Type:	Internal Antenna
Max Antenna Gain:	Bluetooth: 0dBi Wi-Fi 2.4GHz: 4.7dBi Wi-Fi 5GHz: 3.7dBi
Description of the EUT:	CTR is Infotainment head unit with AM, FM, DAB, Bluetooth, Wi-Fi function.

According to subpart 15.247(i)and subpart §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm2)	Averaging Time (minutes)
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f²)	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;

According to §1.1310 and §2.1091 RF exposure is calculated.

Calculated Formulary:
Predication of MPE limit at a given distance
$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm2);
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, the power gain factor, is normally numeric gain;
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

Calculated Data:

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for 5G Wi-Fi

Maximum peak output power at antenna input terminal (dBm):	**8.1**
Maximum peak output power at antenna input terminal (mW):	**6.46**
Prediction distance (cm):	**20**
Antenna Gain, typical (dBi):	**3.7**
Maximum Antenna Gain (numeric):	**3.7**
The worst case is power density at predication frequency at 20 cm (mW/cm2):	**0.003**
MPE limit for general population exposure at prediction frequency (mW/cm2):	1.0

For 2.4G Wi-Fi

Maximum peak output power at antenna input terminal (dBm):	**13.7**
Maximum peak output power at antenna input terminal (mW):	**23.44**
Prediction distance (cm):	**20**
Antenna Gain, typical (dBi):	**4.7**
Maximum Antenna Gain (numeric):	**4.7**
The worst case is power density at predication frequency at 20 cm (mW/cm2):	**0.1376**
MPE limit for general population exposure at prediction frequency (mW/cm2):	1.0

For Bluetooth

Maximum peak output power at antenna input terminal (dBm):	**0.23**
Maximum peak output power at antenna input terminal (mW):	**1.05439**
Prediction distance (cm):	**20**
Antenna Gain, typical (dBi):	**0**
Maximum Antenna Gain (numeric):	**0**
The worst case is power density at predication frequency at 20 cm (mW/cm2):	**0.00021**
MPE limit for general population exposure at prediction frequency (mW/cm2):	1.0

For simultaneous transmission (Bluetooth+2.4G WIFI)

The Max case is power density at predication frequency at 20 cm for WIFI 2.4G (mW/cm2):	**0.1376**
The Max case is power density at predication frequency at 20 cm for BLE (mW/cm2):	**0.00021**
Prediction distance (cm):	**20**
The worst case is power density at predication frequency at 20 cm (mW/cm2):	0.13781
MPE limit for general population exposure at prediction frequency (mW/cm2):	1.0

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The max power density 0.13781 (mW/cm^2) < 1 (mW/cm^2)

Result: Compliant

TUV SUD China, Shenzhen Branch

Reviewed by: Prepared By:

John Zhi/ Project Manager   Moon Xiong/Project Engineer
Date: 2019-05-17   Date: 2019-05-17

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