

RF Exposure Evaluation

1 TEST CONDITIONS AND RESULTS

1.1. Limit

KDB 447498 D04 Interim General RF Exposure Guidance v01

Appendix B Exemptions for Single RF Sources

B.3 MPE-based Exemption and B.4 SAR-based Exemption:

$$P_{th} \text{ (mW)} = ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases} \quad \text{(B.1)}$$

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}}(d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases} \quad \text{(B.2)}$$

where

$$x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right)$$

f is in GHz, d is the separation distance (cm), and $ERP_{20 \text{ cm}}$ is per Formula (B.1).

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 Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	2	6
30–300	61.4	0.163	1.0	6
300–1500	-	-	f/300	6
1500–100,000	-	-	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	2	30
30–300	27.5	0.073	0.2	30
300–1500	-	-	f/1500	30
1500–100,000	-	-	1.0	30

Note: f = frequency in MHz

EVALUATION METHOD

Transmission formula: $Pd = (Pout \cdot G) / (4 \cdot \pi \cdot r^2)$

Where

Pd = power density in mW/cm², **Pout** = output power to antenna in mW, **G** = gain of antenna in linear scale;

Pi = 3.1416, **R** = distance between observation point and center of the radiator in cm

TEST RESULT

Passed **Not Applicable**

Radio Type	Frequency (MHz)	Conducted Power(dBm)*	Conducted Maximum Tune-up(dBm)	Ant Gain(dBi)	Maximum ERP/EIRP (dBm)	Maximum ERP/EIRP (mW)	Minimum Separation Distance(cm)	Pth (mW)
Bluetooth	2480	7.75	8.00	2.00	10.00	10.00	1.0	10.39

Radio Type	Frequency (MHz)	Conducted Average Power (dBm)*	Maximum Tune-up (dBm)	r (m)	Power Density (mW/cm2)	Limit (mW/cm2)	Result
PMR	400.025	44.3	44.5	0.42	1.271	1.333	Pass
PMR	435.000	44.4	44.5	0.40	1.402	1.450	Pass
PMR	469.975	44.3	44.5	0.38	1.553	1.567	Pass

Note:

- 1) r is the distance from observation point to the antenna which is declared by the applicant.
- 2) *: refer to the RF report.
- 3) Antenna Gain is 0dBi.

If the gain of the antenna is 0dBi, the separation distance is at least 0.42m from body and the antenna, so meet this standard requirement.

1.2. Measurement Procedure

1. Polarization of the EUT's antenna was vertical, which is its polarization in actual use.
2. The EUT at the chosen modulation was set to transmit at the chosen frequency at maximum RF power and at 50% duty cycle (50% duty cycle is simulated either by lowering the radio's power by 3dB or by using a 3 dB pad on the output of the radio). During preliminary measurements, we set the distance between the power density probe and the investigated EUT's antenna equal to the average calculated R_{safe} applicable either for controlled or uncontrolled environments.
3. Power density measurements were taken at different heights of the probe from the ground (0.1 to 2 meters) while rotating versus azimuth (from 0° to 360°) the antenna.
4. The azimuth between the probe and the antenna position corresponding to the highest MPE level was chosen as the "worst case" position for the final measurements.
5. For the final measurements, we adjusted the distance between the test probe and the tested antenna to the real safe distance, R_{real} , such that the measured highest power density in the "worst case" position was the same or slightly less than the test limit.
6. The measurement results of final measurements conducted at the chosen azimuth and different heights of the probe above the ground.
7. Average values of power density were calculated for the imaginary whole human body (0.1–2.0 m), for the lower part of the body (0.1–0.9 m) and for the upper part of the body (1.0–2.0 m).

1.3. Test Results

EME Data:

Measuring Antenna Height(cm)	FCC Part 2.1091		
	Controlled RF Exposure(mW/cm ²)		
	0dBi Antenna 42.00cm	0dBi Antenna 52.00cm	0dBi Antenna 62.00cm
10	0.21	0.18	0.16
20	0.40	0.28	0.23
30	0.62	0.53	0.42
40	0.80	0.64	0.55
50	0.90	0.70	0.61
60	0.94	0.92	0.78
70	0.98	0.97	0.85
80	0.95	0.90	0.72
90	0.93	0.86	0.74
100	0.91	0.80	0.77
110	0.82	0.77	0.72
120	0.78	0.75	0.67
130	0.73	0.62	0.50
140	0.62	0.50	0.38
150	0.50	0.46	0.34
160	0.42	0.30	0.28
170	0.30	0.24	0.23
180	0.27	0.20	0.18
190	0.24	0.16	0.14
200	0.18	0.14	0.12

EME for Body Parts:

Part of the body/averaging points(m)	FCC Part 2.1091
	Controlled RF Exposure
	0dBi Antenna 42.00cm (mW/cm ²)
Whole body (0.1 to 2.0)	0.98
Lower body (0.1 to 0.9)	0.98
Upper body (1.0 to 2.0)	0.91

1.4. Conclusion

The User Manual shall include RF radiation safety warnings:

The antenna of this device must be installed on the roof or trunk of the vehicle. If the gain of the used antenna is 0dBi, the minimum mobile separation distance $R_{safe} = 42.00\text{cm}$.

2 TEST SETUP PHOTOS OF THE EUT

