

RF Exposure (SAR)

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| Test Date | May 10, 2011 |
| Sample Number | 884753 |
| Tested By | Jeremy Lee |

Test Limits

FCC15.247(i)

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 levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this chapter.

FCC1.1310

The criteria listed in table 1 shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in § 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of § 2.1093 of this chapter. Further information on evaluating compliance with these limits can be found in the FCC's OST/OET Bulletin Number 65, "Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radiofrequency Radiation."

TABLE 1—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 | *(900/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 | *(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

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

Included are calculations that determine the minimum distance from the transmitter antenna that will ensure an exposure limit at or below the guidelines given in Table 1 of Section 1.1310 for the general population. The formula for these calculations are taken from OET Bulletin 65, edition 97-01, August 1997; "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields".

KDB 447498

2) Transmitters and modules for use in portable exposure conditions that do not require SAR evaluation for simultaneous transmission

a) Unlicensed intentional radiators and licensed devices can be approved as either a transmitter or a module for use in stand-alone portable exposure conditions that do not allow simultaneous transmission. Based on the SAR or output power level, the following three conditions may be applied; otherwise, the provisions of item 2) c) should be considered. When SAR is evaluated using the procedures in item 2) b), additional stand-alone SAR evaluation is not required to incorporate the transmitter into final products based on procedures contained herein, or in KDB 616217 and its supplement or KDB 648474, when simultaneous transmission SAR evaluation is not required for the transmitter

i) A device may be used in portable exposure conditions with no restrictions on host platforms when either the source-based time-averaged output power is $\leq 60/f(\text{GHz})$ mW or all measured 1-g SAR are < 0.4 W/kg.¹¹ When SAR evaluation is required, the most conservative exposure conditions for all expected operating configurations must be tested.

Calculations

The source based, time-averaged power was less than 60/f mW.

| Channel Frequency(MHz) | Power Limit (mW) | Output Power (mW) | Margin |
|------------------------|------------------|-------------------|----------|
| 2403.1 | 60/f GHz | 24.96775 | 19.11042 |
| 2441.7 | | 24.57304 | 18.70626 |
| 2478.5 | | 24.20819 | 18.99504 |

Therefore, the EUT does not require SAR evaluation.

Per Table 1 of Section 1.1310, the limit for General Population/Uncontrolled Exposure at 2400 to 2483.5MHz is 1 mW/cm².

Per OET Bulletin 65, Edition 97-01, the formula for calculating power density is: $S=P*G/4\pi d^2$ with:

Given

$$E=\sqrt{(30*P*G)/d}$$

and

$$S=E^2/3770$$

where

E=Field Strength in Volts/meter

P=Power in Watts

G=Numeric antenna gain

D=Distance in meters

S=Power Density in milliwatts/square centimeter

Combining equations and rearranging the terms to express the distance as a function of the remaining variables yields:

$$d=\sqrt{((30*P*G)/(3770*S))}$$

Changing to units of Power to mW and Distance to cm, using:

$$P(\text{mW})=P(\text{W})/1000 \text{ and}$$

$$D(\text{cm})=100*d(\text{m})$$

yields

$$d=100*\sqrt{30*(P/1000)*G}/(3770*S)$$

$$d=0.282*\sqrt{P*G/S}$$

where

d=distance in cm

P=Power in mW

G=Numeric antenna gain

S=Power Density in mW/cm²

Substituting the logarithmic form of power and gain using:

$$P(\text{mW})=10^{(P(\text{dBm})/10)} \text{ and}$$

$$G(\text{numeric})=10^{(G(\text{dBi})/10)}$$

yields

$$d=0.282*10^{((P+G)/20)} / \sqrt{S} \quad \text{Equation(1)}$$

where

d=MPE distance in cm

P=Power in dBm

G=Antenna Gain in dBi

S=Power Density Limit in mW/cm²

Equation (1) and the measured peak power is used to calculate the MPE distance.

Limits

From §1.1310 Table 1 (B), S= 1 mW/cm²

Results

No non-compliance noted:

| Channel Frequency(MHz) | Power Density Limit (mW/cm ²) | Output Power (dBm) | Gain of Antenna (dBi) | MPE distance (cm) |
|------------------------|---|--------------------|-----------------------|-------------------|
| 2403.1 | 1 | 7.677 | 1.76 | 0.836 |
| 2441.7 | 1 | 7.684 | 1.76 | 0.836 |
| 2478.5 | 1 | 7.171 | 1.76 | 0.788 |

Conclusion

The minimum safe distance has to be inserted in the EUT's User Manual.