

Maximum Permissible Exposure Evaluation

The results of power measurement and inclusion of antenna gain are weighed against the requirements for safety of RF exposure.

Criteria

FCC Part 2 excludes RF safety evaluation if the effective radiated power (ERP) is below threshold levels cited in the reference clause as shown below:

Section Reference	Evaluation Threshold Parameter	Date
2.1091(c), OET Bulletin 65	Part 25 Device ¹ : 3 W ERP, Operating Frequency > 1.5 GHz	January 31, 2014

¹This device operates at 1.6 GHz such that the FCC 2.1091(c) criteria for Part 25 devices apply as follows: "... operate at frequencies above 1.5 GHz and their ERP is 3 watts or more."

Procedure

Apply antenna gain to the measured conducted transmit power to determine ERP. Then compare ERP to the threshold parameter. If the calculated ERP is under the threshold then no further action is required. Exceeding the threshold requires additional evaluation or testing as determined by applying the FCC guidance document.

Results

Antennas for this device are located in two basic areas: uplink/outdoors (roof generally), and downlink/indoors (ceiling on lower floors typically). This prevents co-location of the transmit antennas. Outdoors, the uplink transmit antenna is placed for the best sky angle. Indoors, the downlink transmit antenna is located for best area coverage but must be kept at a significant distance from the receive antenna for the uplink amplifier.

This EUT has two transmit ports with a single antenna for each. All transmit and receive ports use the same antenna. The highest output power port frequency for each amplifier is evaluated below. The power is based on each amplifier operating at saturation as worse case.

Iridium uses FDMA/TDMA technology and the design has a limit on transmit duty cycle of 9.2%.¹ Considering the number of users at 3, the factor applied is -5.59 dB.

The uplink antenna requires mounting on the roof by skilled technicians. The evaluation is then for General Public Uncontrolled Exposure and at a distance of 1 m.

¹ <http://www.decodesystems.com/iridium.html> was referenced for technical information on Iridium, which includes the following statement on power: "RF Power Output: Variable range from 0.1 to 0.6 Watts (by control of satellite network via closed loop power control). The transmitter duty cycle allows for bursted transmission every 8.28 ms out of 90 ms, or 9.2%, at a rate of 50 kbps, or 25 k symbols/sec." Assuming 3 concurrent users for each 8.28 ms time slot, total transmit time is 8.28 * 3 or 24.84 ms in 90 ms. When converted to log units as $10 * \log_{10}(24.84/90)$ yields a factor of -5.59 dB.

Uplink				
Conducted Transmit Power Measured Including Antenna Gain	Iridium Maximum Duty Cycle Specification	Power Factoring In Duty Cycle	ERP Threshold Per FCC 2.1091(c)	Excluded From RF Exposure Limitation?
19.1 W	-5.59 dB	5.26 W	3 W	No

The field density limits are determined as:

$$1.0 \text{ mW/cm}^2$$

Ref. FCC Bulletin OET-65 Table 1(B)

The uplink field density is determined at 100 cm:

$$S = \text{EIRP} / (4 \pi 100^2)$$

$$S = 5260.0 \text{ mW} / 125663.7 \text{ cm}^2$$

$$S = 0.042 \text{ mW/cm}^2$$

Ref. FCC Bulletin OET-65 Equation (4)

The uplink field density level is below the respective limit at 100 cm and it therefore meets the criteria for exclusion from SAR testing.

Downlink				
Conducted Transmit Power Measured Including Antenna Gain	Iridium Maximum Duty Cycle Specification	Power Factoring In Duty Cycle	ERP Threshold Per FCC 2.1091(c)	Excluded From RF Exposure Limitation?
0.0676 W	-5.59 dB	0.0187 W	3 W	Yes*

*Regardless, the exposure is calculated below anyway.

The field density limits are determined as:

$$1.0 \text{ mW/cm}^2$$

Ref. FCC Bulletin OET-65 Table 1(B)

The downlink field density is determined at 20 cm:

$$S = \text{EIRP} / (4 \pi 20^2)$$

$$S = 18.7 \text{ mW} / 5026.55 \text{ cm}^2$$

$$S = 0.0173 \text{ mW/cm}^2$$

Ref. FCC Bulletin OET-65 Equation (4)

The downlink field density level is below the respective limit at 20 cm and it therefore meets the criteria for exclusion from SAR testing.
