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## Radio Frequency Exposure Evaluation §1.1310

Kind of test item	:	satellite communication device for construction machines
Type identification	:	Komatsu KDTC730
FCC-ID	:	X4QKDTC730
HW hardware status	:	7826-25-890B
SW software status	:	001.IRI.STEP4RC2
Frequency band	:	1616 MHz to 1626.5 MHz
Type of radio transmission	:	TDMA/FDMA
Use of frequency spectrum	:	
Number of channels	:	240
Antenna	:	Hirschmann HIRD-SX-0120x-01 with 3 dBi gain
Power supply	:	24 V DC by lab power supply

### Requirements

FCC: §1.1310	<p><i>The criteria used for the evaluation of human exposure to radio frequency radiation is table 1 according FCC §1.1310 and table chapter 4.2 of RSS-102 standard and it is subject for evaluation of the RF exposure prior to equipment authorization.</i></p> <p><i>As the mobile equipment is authorized under Part 22 (Subpart H) and Part 24 of the FCC Rules, it is subject for evaluation of the RF exposure prior to equipment authorization.</i></p>
FCC § 2.1091	<p><i>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."</i></p> <p><i>For purposes of these requirements mobile devices are defined by the FCC as transmitters designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between radiating structures and the body of the user or nearby persons. These devices are normally evaluated for exposure potential with relation to the MPE limits given in Table 1 of Appendix A.</i></p>

**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 <sup>2</sup> ]	Averaging time [minutes]
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 <sup>2</sup> )	30
30 - 300	27.5	0.073	0.2	30
300 - 1500	-	-	f/1500	30
1500 - 100,00	-	-	1.0	30

For given power density limit at a single frequency (accord. Table 1 Limits) the maximum antenna gain can be calculated.

The used equation to predict the power density in the far-field of one single radiating antenna can be made by following equation:

$$S = \frac{EIRP}{4\pi R^2} = \frac{P * G}{4\pi R^2}$$

$$G_{NUMERIC} = \frac{S * 4\pi R^2}{P}$$

**General Limits:**
**FCC:**

FCC: §1.1307	<i>Cellular Radiotelephone Service (subpart H of part 22)</i> <i>Non-building-mounted antennas: height above ground level to lowest point of antenna &lt; 10 m and total power of all channels &gt; 1000 W ERP (1640 W EIRP)</i>
FCC §1.1307	<i>Personal Communications Services (part 24)</i> <i>Broadband PCS (subpart E): non-building-mounted antennas: height above ground level to lowest point of antenna &lt; 10 m and total power of all channels &gt; 2000 W ERP (3280 W EIRP)</i>
FCC §1.1310	<i>LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)</i> <i>Table 1(B) Limits for General Population/Uncontrolled Exposure</i> <i>300–1500 MHz: f/1500 mW/cm<sup>2</sup></i> <i>1500–100,000 MHz: 1.0 mW/cm<sup>2</sup></i>
FCC §2.1091	<i>Subject to routine evaluation is required when the device operate at frequencies of 1.5 GHz or below and their effective radiated power (ERP) is 1.5 watts or more, or if they operate at frequencies above 1.5 GHz and their ERP is 3 watts or more.</i>
FCC §24.232	<i>(a) Base stations are limited to 1640 watts peak equivalent isotropically radiated power (e.i.r.p.) with an antenna height up to 300 meters HAAT.</i> <i>(b) Mobile/portable stations are limited to 2 watts e.i.r.p. peak power, ...</i>
FCC §22.913	<i>(a) Maximum ERP. The effective radiated power (ERP) of base transmitters and cellular repeaters must not exceed 500 Watts. The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts.</i>
FCC §27.50 (C )(10)	<i>(10) Portable stations (hand-held devices) are limited to 3 watts ERP</i>
FCC §27.50(d)	<i>(4) Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band are limited to 1 watt EIRP.</i>
FCC §27.50(h)	<i>(2) Mobile and other user stations. Mobile stations are limited to 2.0 watts EIRP. All user stations are limited to 2.0 watts transmitter output power.</i>

Also the maximum admissible allowed antenna gain for shown application is calculated not exceeding the MPE limit.

### Minimum Safety distance calculation

Based on valid limits of ERP/EIRP and max. MPE the minimum safety distance which can be used for the specific application is calculated.

#### Iridium Frequency Band (1616 – 1626.5 MHz)

$$S \leq \frac{P \cdot G (EIRP) \cdot t \cdot Dc}{4 \cdot \pi \cdot R^2} = 0.309 \text{ mW/cm}^2$$

$$\frac{S}{S_{lim}} \leq 0.309 \text{ (less than 1, compliant)}$$

Where:

$EIRP (P \cdot G)$	=	38.9 dBm + 3 dBic = 41.9 dBm (15488 mW)
$t$	=	according to CETECOM test report 1-9177/15-33-08-B section 9.2. I.
$Dc$	=	Tune up tolerance (already included in $P \cdot G$ )
$R$	=	Duty cycle 10 % = 0.1 worst case
$S_{lim}$	=	<b>20 cm</b>
	=	10 W/m <sup>2</sup> = 1 mW/cm <sup>2</sup>

Thomas Vogler  
 Lab Manager  
 Radio Communications & EMC