

Maximum Permissible Exposure (MPE)

Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended to comply with Section Part 22, subpart H and Part 24, subpart E of the FCC CFR 47 Rules 1.1310 Radio frequency, and RSS-102 issue 4 of radiation exposure requirement.

Special Accessories

Not available for this EUT intended for grant.

Equipment Modifications

Not available for this EUT intended for grant.

Limitation

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minute)
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
1500-15000	/	/	1.0	30

F = frequency in MHz

* = Plane-wave equipment power density

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Averaging Time (minutes)
0.003-1	280	2.19	-	6
1-10	280/f	2.19/f	-	6
10-30	28	2.19/f	-	6
30-300	28	0.073	2*	6
300-1500	1.585 f ^{0.5}	0.0042 f ^{0.5}	f/150	6
1500-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/f ^{1.2}
150000-300000	0.158 f ^{0.5}	4.21 x 10 ⁻⁴ f ^{0.5}	6.67 x 10 ⁻⁵ f	616000/f ^{1.2}

Note: f is frequency in MHz.

* Power density limit is applicable at frequencies greater than 100 MHz.

Maximum Permissible Exposure (MPE) Evaluation

In this application we seek approval to the LISA-U120. Based on the FCC OET Bulletin 65 Supplement C and 47 CFR §2.1091, we have concluded that the LISA-U120, LISA-U100 module will comply with the FCC rules on RF exposure for mobile devices in cellular band and PCS band. The following analysis will demonstrate such compliance. The analysis will be done in two US bands.

Operation in cellular band (824 – 849 MHz)

The ERP of LISA-U120 in cellular band is 25.84dBm max at GPRS 850 mode. The resulted power density at a distance of 20 cm can be deducted as follows:

EUT Mode	Frequency (MHz)	CH	EUT Pol.	Antenna Pol.	SPA Reading (dBuV)	S.G. Output (dBm)	Antenna Gain (dBi)	Cable Loss (dB)	ERP (dBm)	Limit (dBm)
GPRS 850	824.20	128	E2	V	122.42	36.03	-7.87	3.62	24.53	38.45
				H	120.56	34.29	-7.87	3.62	22.79	38.45
	836.60	190	E2	V	121.63	35.38	-7.88	3.65	23.85	38.45
				H	121.60	35.37	-7.88	3.65	23.84	38.45
	848.80	251	E2	V	123.52	37.40	-7.88	3.68	25.84	38.45
				H	120.85	34.66	-7.88	3.68	23.10	38.45

$$\text{ERP} = 25.84\text{dBm} = 383.71 \text{ mW}$$

$$\text{Power Density} = \text{ERP} * \text{Duty Cycle} / (4 \pi R^2)$$

$$= 383.71 * 0.50 / (4 * \pi * 20^2) = 0.0382 \text{ mW/cm}^2$$

where Duty Cycle is 0.50 for GPRS operation (class 12) and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and RSS-102 Issue.4, and it can be calculated as follows:

$$\text{MPE limit} = 824/1500 = 0.55 \text{ mW/cm}^2$$

As we can see the resulted power density is below the MPE limit, therefore LISA-U120 in cellular band is compliant with the FCC / RSS rules on RF exposure.

Operation in PCS band (1850 – 1910 MHz)

The EIRP of LISA-U120 in PCS band is 24.30 dBm. max. The resulted EIRP can be expressed as follows:

EUT Mode	Frequency (MHz)	CH	EUT Pol.	Antenna Pol.	SPA Reading (dBuV)	S.G. Output (dBm)	Antenna Gain (dBi)	Cable Loss (dB)	ERP (dBm)	Limit (dBm)
PCS 1900	1850.20	512	E2	V	123.75	19.36	9.90	5.56	23.70	33.00
				H	115.72	11.54	9.90	5.84	15.60	33.00
	1880.00	661	E2	V	124.78	20.42	9.99	5.61	24.80	33.00
				H	114.87	10.73	9.99	5.61	15.10	33.00
	1909.80	810	E2	V	123.96	19.63	10.08	5.66	24.05	33.00
				H	113.85	9.74	10.08	5.66	14.16	33.00

$$\text{EIRP} = 24.80 \text{ dBm} = 301.995 \text{ mW}$$

$$\text{Power Density} = \text{EIRP} \cdot \text{Duty Cycle} / (4 \pi R^2)$$

$$= 301.994 \cdot 0.50 / (4 \cdot \pi \cdot 20^2) = 0.03004 \text{ mW/cm}^2$$

where Duty Cycle is 0.50 for GPRS operation (class 12) and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and RSS-102 Issue.4, and it can be calculated as follows:

$$\text{MPE limit} = 1.0 \text{ mW/cm}^2$$

As we can see the resulted power density is below the MPE limit, therefore LISA-U120 in PCS band is compliant with the FCC rules on RF exposure.

Operation in EDGE 850 (824.2~848.8 MHz)

The EIRP of LISA-U120 in EDGE 850 band is 23.29 dBm. max. The resulted EIRP can be expressed as follows:

EUT Mode	Frequency (MHz)	CH	EUT Pol.	Antenna Pol.	SPA Reading (dBuV)	S.G. Output (dBm)	Antenna Gain (dBi)	Cable Loss (dB)	ERP (dBm)	Limit (dBm)
EDGE 850	824.20	128	E2	V	120.17	33.78	-7.87	3.62	22.28	38.45
				H	118.14	31.87	-7.87	3.62	20.37	38.45
	836.60	190	E2	V	121.04	34.79	-7.88	3.65	23.26	38.45
				H	118.41	32.18	-7.88	3.65	20.65	38.45
	848.80	251	E2	V	120.97	34.85	-7.88	3.68	23.29	38.45
				H	118.08	31.89	-7.88	3.68	20.33	38.45

$$\text{EIRP} = 23.29 \text{ dBm} = 213.30 \text{ mW}$$

$$\text{Power Density} = \text{EIRP} \cdot \text{Duty Cycle} / (4 \pi R^2)$$

$$= 213.30 \cdot 0.50 / (4 \cdot \pi \cdot 20^2) = 0.0212 \text{ mW/cm}^2$$

where Duty Cycle is 0.50 for Edge 850 operation (class 12) and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and RSS-102 Issue.4, and it can be calculated as follows:

$$\text{MPE limit} = 824/1500 = 0.55 \text{ mW/cm}^2$$

As we can see the resulted power density is below the MPE limit, therefore LISA-U120 while in Edge 850 mode is compliant with the FCC / RSS rules on RF exposure.

Operation in Edge 1900 (1850 – 1910 MHz)

The EIRP of LISA-U120 in Edge 1900 band is 24.70 dBm. max. The resulted EIRP can be expressed as follows:

EUT Mode	Frequency (MHz)	CH	EUT Pol.	Antenna Pol.	SPA Reading (dBuV)	S.G. Output (dBm)	Antenna Gain (dBi)	Cable Loss (dB)	ERP (dBm)	Limit (dBm)
EDGE 1900	1850.20	512	E2	V	124.75	20.36	9.90	5.56	24.70	33.00
				H	114.98	10.80	9.90	5.84	14.86	33.00
	1880.00	661	E2	V	124.26	19.90	9.99	5.61	24.28	33.00
				H	114.71	10.57	9.99	5.61	14.94	33.00
	1909.80	810	E2	V	124.42	20.09	10.08	5.66	24.51	33.00
				H	113.83	9.72	10.08	5.66	14.14	33.00

$$\text{EIRP} = 24.70 \text{ dBm} = 295.12 \text{ mW}$$

$$\text{Power Density} = \text{EIRP} \cdot \text{Duty Cycle} / (4 \pi R^2)$$

$$= 295.12 \cdot 0.50 / (4 \cdot \pi \cdot 20^2) = 0.0294 \text{ mW/cm}^2$$

where Duty Cycle is 0.50 for Edge 1900 operation (class 12) and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and RSS-102 Issue.4, and it can be calculated as follows:

$$\text{MPE limit} = 1.0 \text{ mW/cm}^2$$

As we can see the resulted power density is below the MPE limit, therefore LISA-U120 while in Edge 1900 mode is compliant with the FCC / RSS rules on RF exposure.

Operation in WCDMA Band V (826.4~846.6 MHz)

The EIRP of LISA-U120 in WCDMA Band V is 21.95 dBm. max. The resulted EIRP can be expressed as follows:

EUT Mode	Frequency (MHz)	CH	EUT Pol.	Antenna Pol.	SPA Reading (dBuV)	S.G. Output (dBm)	Antenna Gain (dBi)	Cable Loss (dB)	ERP (dBm)	Limit (dBm)
WCDMA Band V	826.40	4132	E2	V	118.93	32.57	-7.88	3.63	21.06	38.45
				H	117.60	31.34	-7.88	3.63	19.84	38.45
	1880.00	600	E2	V	119.67	33.41	-7.88	3.65	21.88	38.45
				H	118.04	31.81	-7.88	3.65	20.28	38.45
	1908.75	1175	E2	V	119.65	33.50	-7.88	3.67	21.95	38.45
				H	118.09	31.89	-7.88	3.67	20.34	38.45

$$\text{EIRP} = 21.95 \text{ dBm} = 156.68 \text{ mW}$$

$$\text{Power Density} = \text{EIRP} * \text{Duty Cycle} / (4 \pi R^2)$$

$$= 156.68 * 1.00 / (4 * \pi * 20^2) = 0.0312 \text{ mW/cm}^2$$

where Duty Cycle is 1.00 for WCDMA Band V operation and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and RSS-102 Issue.4, and it can be calculated as follows:

$$\text{MPE limit} = 826.4 / 1500 = 0.55 \text{ mW/cm}^2$$

As we can see the resulted power density is below the MPE limit, therefore LISA-U120 while in WCDMA Band V mode is compliant with the FCC / RSS rules on RF exposure.

Operation in WCDMA BII (1852.4 – 1907.6 MHz)

The EIRP of LISA-U120 in WCDMA BII is 24.53 dBm. max. The resulted EIRP can be expressed as follows:

EUT Mode	Frequency (MHz)	CH	EUT Pol.	Antenna Pol.	SPA Reading (dBuV)	S.G. Output (dBm)	Antenna Gain (dBi)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)
WCDMA II	1852.40	9262	E2	V	122.93	18.41	9.48	5.33	22.55	33.00
				H	112.59	8.26	9.90	5.84	12.32	33.00
	1880.00	600	E2	V	123.99	19.49	9.54	5.36	23.66	33.00
				H	114.11	9.80	9.54	5.36	13.97	33.00
	1908.75	1175	E2	V	124.81	20.33	9.61	5.40	24.53	33.00
				H	113.64	9.35	9.61	5.40	13.56	33.00

$$\text{EIRP} = 24.70 \text{ dBm} = 283.79 \text{ mW}$$

$$\text{Power Density} = \text{EIRP} \cdot \text{Duty Cycle} / (4 \pi R^2)$$

$$= 283.79 \cdot 1.00 / (4 \cdot \pi \cdot 20^2) = 0.0565 \text{ mW/cm}^2$$

where Duty Cycle is 1.00 for WCDMA Band II operation and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and RSS-102 Issue.4, and it can be calculated as follows:

$$\text{MPE limit} = 1.0 \text{ mW/cm}^2$$

As we can see the resulted power density is below the MPE limit, therefore LISA-U120 while in WCDMA BII mode is compliant with the FCC / RSS rules on RF exposure.