13. Maximum Permissible Exposure (MPE)

13.1. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended to comply with § 2.1091 Radiofrequency radiation exposure evaluation: mobile devices of the FCC CFR 47 Rules, CFR 1.1310 (b) Radio frequency Radiation Exposure Requirement.

13.2. Special Accessories

Not available for this EUT intended for grant.

13.3. Equipment Modifications

Not available for this EUT intended for grant.

13.4. 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

13.5. Exposure (MPE) Evaluation

The evaluation and calculation as deduces below presents only worst-case that produces highest value of the result:

Operation Configuration of the Worst-Case picked up to evaluate:

LTE Band 2 / 4 / 13

Operation in LTE band 2 (1850 – 1910 MHz) *Int. Antenna

BAND 2 / BW: 15M / 16QAM / RB: 1, 0

EUT			Measurement					
Operation Band	Fundamental Frequency	CH	Antenna Pol.	S.G. Output	Antenna Gain	Cable Loss	EIRP	Limit
	MHz		V/H	dBm	dBi	dB	dBm	dBm
LTE BAND 2 BW: 15M 16QAM RB: 1,0	1857.5	18675	V	18.66	9.95	-4.47	24.14	33.01
			H	16.26	9.95	-4.47	21.74	33.01
	1880.0	18900	V	20.11	10.02	-4.5	25.63	33.01
			H	17.33	10.02	-4.5	22.85	33.01
	1902.5	19125	V	19.34	10.09	-4.54	24.89	33.01
			H	16.16	10.08	-4.53	21.71	33.01

Power Density = EIRP*Duty Cycle/(4πR^2)
Duty Cycle is 1 for LTE band operation and R is 20cm.

EIRP	25.63	(dBm)
EIRP	365.595	(mW)
Duty cycle:	1	(%)
Maximum Pav :	3.65594792	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	1880	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1.0000	(mW/cm^2)
Power density at predication frequency at 20 (cm) distance	0.00073	(mW/cm^2)

Measurement Result

The predicted power density level at 20 cm is 0.00073 mW/cm2.

This is below the uncontrolled exposure limit of 1 mW/cm2 at 1880MHz.

Operation in LTE band 4 (1710 to 1755 MHz) *Int. Antenna

BAND 4 / BW: 10M / 16QAM / RB: 1,49

EUT			Measurement					
Operation Band	Fundamental Frequency	CH	Antenna Pol.	S.G. Output	Antenna Gain	Cable Loss	EIRP	Limit
	MHz		V/H	dBm	dBi	dB	dBm	dBm
LTE BAND 4 BW: 10M 16QAM RB: 1,49	1715.0	20000	V	16.57	9.5	-4.31	21.76	30.00
			H	20.54	9.5	-4.31	25.73	30.00
	1732.0	20175	V	15.11	9.56	-4.31	20.35	30.00
			H	18.5	9.56	-4.31	23.75	30.00
	1750.0	20350	V	15.61	9.62	-4.33	20.89	30.00
			H	19.22	9.62	-4.33	24.51	30.00

Power Density = EIRP*Duty Cycle/(4πR^2)
Duty Cycle is 1 for LTE band operation and R is 20cm.

EIRP	25.73	(dBm)
EIRP	374.111	(mW)
Duty cycle:	1	(%)
Maximum Pav :	3.74110588	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	1715	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1.0000	(mW/cm^2)
Power density at predication frequency at 20 (cm) distance	0.00074	(mW/cm^2)

Measurement Result
The predicted power density level at 20 cm is 0.00074 mW/cm2.
This is below the uncontrolled exposure limit of 1 mW/cm2 at 1715MHz.

Operation in LTE band 13 (777 to 787 MHz) * Int. Antenna

BAND 13 / BW: 5M / QPSK / RB: 1, 0

EUT			Measurement					
Operation Band	Fundamental Frequency	CH	Antenna Pol.	S.G. Output	Antenna Gain	Cable Loss	ERP	Limit
	MHz		V/H	dBm	dBd	dB	dBm	dBm
LTE BAND 13 BW: 5M QPSK RB: 1,0	779.5	23205	V	13.16	3.27	-2.91	13.52	34.77
			H	19.78	3.28	-2.91	20.15	34.77
	782.0	23230	V	14.25	3.29	-2.91	14.63	34.77
			H	21.33	3.29	-2.91	21.71	34.77
	784.5	23255	V	12.17	3.29	-2.91	12.55	34.77
			H	19.9	3.29	-2.91	20.29	34.77

Power Density = EIRP*Duty Cycle/(4πR^2)
Duty Cycle is 1 for LTE band operation and R is 20cm.

ERP	21.71	(dBm)
ERP	148.252	(mW)
Duty cycle:	1	(%)
Maximum Pav :	1.48251809	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	782	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	0.5213	(mW/cm^2)
Power density at predication frequency at 20 (cm) distance	0.00030	(mW/cm^2)

Measurement Result

The predicted power density level at 20 cm is 0.0003 mW/cm2.
This is below the uncontrolled exposure limit of 0.5213 mW/cm2 at 782MHz.

Operation in LTE band 2 (1850 – 1910 MHz) *Ext. Antenna

BAND 2 / BW: 15M / QPSK / RB: 1, 0

EUT			Measurement					
Operation Band	Fundamental Frequency	CH	Antenna Pol.	S.G. Output	Antenna Gain	Cable Loss	EIRP	Limit
	MHz		V/H	dBm	dBi	dB	dBm	dBm
LTE BAND 2 BW: 15M QPSK RB: 1,0	1857.5	18675	V	11.45	9.95	-4.47	16.93	33.01
			H	20.1	9.95	-4.47	25.59	33.01
	1880.0	18900	V	11.97	10.02	-4.5	17.49	33.01
			H	21.06	10.02	-4.5	26.58	33.01
	1902.5	19125	V	11.23	10.09	-4.54	16.79	33.01
			H	20.31	10.08	-4.53	25.86	33.01

Power Density = EIRP*Duty Cycle/(4πR^2)
Duty Cycle is 1 for LTE band operation and R is 20cm.

EIRP	26.58	(dBm)
EIRP	454.988	(mW)
Duty cycle:	1	(%)
Maximum Pav :	4.5498806	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	1880	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1.0000	(mW/cm^2)
Power density at predication frequency at 20 (cm) distance	0.00091	(mW/cm^2)

Measurement Result

The predicted power density level at 20 cm is 0.00091 mW/cm2.

This is below the uncontrolled exposure limit of 1 mW/cm2 at 1880MHz.

Operation in LTE band 4 (1710 to 1755 MHz) *Ext. Antenna

BAND 4 / BW: 20M / 16QAM / RB: 1, 0

EUT			Measurement					
Operation Band	Fundamental Frequency	CH	Antenna Pol.	S.G. Output	Antenna Gain	Cable Loss	EIRP	Limit
	MHz		V/H	dBm	dBi	dB	dBm	dBm
LTE BAND 4 BW: 20M 16QAM RB: 1,0	1720.0	20050	V	22.58	9.48	-4.31	27.75	30.00
			H	15.3	9.49	-4.31	20.48	30.00
	1732.5	20175	V	23.54	9.53	-4.31	28.76	30.00
			H	15.68	9.53	-4.31	20.9	30.00
	1745.0	20300	V	21.38	9.57	-4.31	26.64	30.00
			H	14.08	9.57	-4.31	19.34	30.00

Power Density = EIRP*Duty Cycle/(4πR^2)
Duty Cycle is 1 for LTE band operation and R is 20cm.

EIRP	28.76	(dBm)
EIRP	751.623	(mW)
Duty cycle:	1	(%)
Maximum Pav :	7.51622894	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	1832.5	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1.0000	(mW/cm^2)
Power density at predication frequency at 20 (cm) distance	0.00150	(mW/cm^2)

Measurement Result

The predicted power density level at 20 cm is 0.0015 mW/cm2.

This is below the uncontrolled exposure limit of 1 mW/cm2 at 1832.5MHz.

Operation in LTE band 13 (777 to 787 MHz) *Ext. Antenna

BAND 13 / BW: 5M / QPSK / RB: 1, 0

EUT			Measurement					
Operation Band	Fundamental Frequency	CH	Antenna Pol.	S.G. Output	Antenna Gain	Cable Loss	ERP	Limit
	MHz		V/H	dBm	dBd	dB	dBm	dBm
LTE BAND 13 BW: 5M QPSK RB: 1,0	779.5	23205	V	14.35	3.27	-2.91	14.71	34.77
			H	21.18	3.28	-2.91	21.55	34.77
	782.0	23230	V	15.61	3.29	-2.91	15.99	34.77
			H	23.16	3.29	-2.91	23.54	34.77
	784.5	23255	V	14.17	3.29	-2.91	14.55	34.77
			H	20.92	3.29	-2.91	21.3	34.77

Power Density = EIRP*Duty Cycle/($4\pi R^2$)
Duty Cycle is 1 for LTE band operation and R is 20cm.

ERP	23.54	(dBm)
ERP	225.944	(mW)
Duty cycle:	1	(%)
Maximum Pav :	2.25943577	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	782	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	0.5213	(mW/cm^2)
Power density at predication frequency at 20 (cm) distance	0.00045	(mW/cm^2)

Measurement Result

The predicted power density level at 20 cm is 0.00045 mW/cm2.

This is below the uncontrolled exposure limit of 0.5213 mW/cm2 at 782MHz.