

### 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 <sup>2</sup> )	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 <sup>2</sup> )	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**

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SGS Taiwan Ltd.

台灣檢驗科技股份有限公司

No.134,WuKungRoad,NewTaipeiIndustrialPark,WukuDistrict,NewTaipeiCity,Taiwan24803/新北市五股區新北產業園區五工路 134 號

t (886-2) 2299-3279

f (886-2) 2298-0488

[www.tw.sgs.com](http://www.tw.sgs.com)

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

BAND 2 / BW: 15M / 16QAM / RB: 1, 74

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	1857.5	18675	V	19.96	9.98	-4.48	25.45	33.01
			H	18.44	9.98	-4.48	23.93	33.01
	1880.0	18900	V	21.69	10.05	-4.52	<b>27.23</b>	33.01
			H	19.69	10.05	-4.52	25.22	33.01
	1902.5	19125	V	19.48	10.12	-4.55	25.05	33.01
			H	16.92	10.12	-4.55	22.49	33.01

**Power Density = EIRP\*Duty Cycle/(4πR<sup>2</sup>)**

Duty Cycle is 1 for LTE band operation and R is 20cm.

EIRP	<b>27.23</b>	(dBm)
EIRP	528.445	(mW)
Duty cycle:	<b>1</b>	(%)
Maximum Pav :	5.28445252	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	<b>1880</b>	(MHz)
MPE limit for uncontrolled exposure at prediction	1.0000	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm)	0.00105	(mW/cm <sup>2</sup> )

**Measurement Result**

The predicted power density level at 20 cm is 0.00105 mW/cm2.

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

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

**BAND 4 / 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 4	1715.0	20000	V	18.48	9.49	-4.31	23.66	30.00
			H	19.13	9.49	-4.31	24.31	30.00
	1732.0	20175	V	20.49	9.54	-4.31	<b>25.72</b>	30.00
			H	19.74	9.53	-4.31	24.96	30.00
	1750.0	20350	V	18.17	9.59	-4.32	23.44	30.00
			H	19.42	9.59	-4.32	24.69	30.00

**Power Density = EIRP\*Duty Cycle/(4πR<sup>2</sup>)**

**Duty Cycle is 1 for LTE band operation and R is 20cm.**

EIRP	<b>25.72</b>	(dBm)
EIRP	373.250	(mW)
Duty cycle:	<b>1</b>	(%)
Maximum Pav :	3.73250158	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	<b>1732.5</b>	(MHz)
MPE limit for uncontrolled exposure at prediction	1.0000	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm)	0.00074	(mW/cm <sup>2</sup> )

**Measurement Result**

The predicted power density level at 20 cm is 0.00074 mW/cm<sup>2</sup>.

This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 1732.5MHz.

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**Operation in LTE band 13 (777 to 787 MHz) \* Int. Antenna**
**BAND 13 / BW: 5M / 16QAM / RB: 1, 24**

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	779.5	23205	V	16.62	3.28	-2.91	16.98	34.77
			H	19.28	3.28	-2.91	19.65	34.77
	782.0	23230	V	17.34	3.28	-2.91	17.72	34.77
			H	20.75	3.29	-2.91	<b>21.13</b>	34.77
	784.5	23255	V	17.71	3.29	-2.91	18.10	34.77
			H	19.96	3.29	-2.91	20.35	34.77

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

Duty Cycle is 1 for LTE band operation and R is 20cm.

ERP	<b>21.13</b>	(dBm)
ERP	129.718	(mW)
Duty cycle:	<b>1</b>	(%)
Maximum Pav :	1.29717927	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	<b>782</b>	(MHz)
MPE limit for uncontrolled exposure at prediction	0.5213	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm)	0.00026	(mW/cm <sup>2</sup> )

**Measurement Result**

 The predicted power density level at 20 cm is 0.00026 mW/cm<sup>2</sup>.

 This is below the uncontrolled exposure limit of 0.5213 mW/cm<sup>2</sup> at 782MHz.

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台灣檢驗科技股份有限公司

t (886-2) 2299-3279

f (886-2) 2298-0488

www.tw.sgs.com

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

**BAND 2 / 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 2	1857.5	18675	V	19.10	9.96	-4.47	24.59	33.01
			H	19.75	9.96	-4.47	25.24	33.01
	1880.0	18900	V	20.00	10.04	-4.51	25.53	33.01
			H	21.48	10.04	-4.51	<b>27.01</b>	33.01
	1902.5	19125	V	17.80	10.12	-4.55	23.37	33.01
			H	18.53	10.12	-4.55	24.10	33.01

**Power Density = EIRP\*Duty Cycle/(4πR<sup>2</sup>)**

**Duty Cycle is 1 for LTE band operation and R is 20cm.**

EIRP	<b>27.01</b>	(dBm)
EIRP	502.343	(mW)
Duty cycle:	<b>1</b>	(%)
Maximum Pav :	5.0234259	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	<b>1880</b>	(MHz)
MPE limit for uncontrolled exposure at prediction	1.0000	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm)	0.00100	(mW/cm <sup>2</sup> )

**Measurement Result**

The predicted power density level at 20 cm is 0.001 mW/cm<sup>2</sup>.

This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 1880MHz.

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**Operation in LTE band 4 (1710 to 1755 MHz) \*Ext. Antenna**
**BAND 4 / BW: 15M / 16QAM / RB: 1, 99**

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	1715.0	20000	V	18.06	9.53	-4.31	23.28	30.00
			H	19.91	9.53	-4.31	25.13	30.00
	1732.0	20175	V	16.85	9.57	-4.31	22.11	30.00
			H	19.50	9.57	-4.31	24.76	30.00
	1750.0	20350	V	16.29	9.62	-4.33	21.57	30.00
			H	20.21	9.61	-4.33	<b>25.49</b>	30.00

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

Duty Cycle is 1 for LTE band operation and R is 20cm.

EIRP	25.49	(dBm)
EIRP	353.997	(mW)
Duty cycle:	1	(%)
Maximum Pav :	3.53997341	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	1745	(MHz)
MPE limit for uncontrolled exposure at prediction	1.0000	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm)	0.00070	(mW/cm <sup>2</sup> )

**Measurement Result**

 The predicted power density level at 20 cm is 0.0007 mW/cm<sup>2</sup>.

 This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 1745MHz.

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

**BAND 13 / BW: 10M / 16QAM / RB: 1, 49**

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	782.0	23230	V	19.30	3.29	-2.91	<b>19.68</b>	34.77
			H	18.35	3.29	-2.91	18.74	34.77

**Power Density = EIRP\*Duty Cycle/(4πR<sup>2</sup>)**

**Duty Cycle is 1 for LTE band operation and R is 20cm.**

ERP	<b>19.68</b>	(dBm)
ERP	92.897	(mW)
Duty cycle:	<b>1</b>	(%)
Maximum Pav :	0.92896639	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	<b>782</b>	(MHz)
MPE limit for uncontrolled exposure at prediction	0.5213	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm)	0.00018	(mW/cm <sup>2</sup> )

**Measurement Result**

The predicted power density level at 20 cm is 0.00018 mW/cm<sup>2</sup>.

This is below the uncontrolled exposure limit of 0.5213 mW/cm<sup>2</sup> at 782MHz.

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