

### 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:

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**Operation in WCDMA II band (1852.4 – 1907.6 MHz)**

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
WCDMA Band II	1852.4	9262	V	19.94	9.58	-6.86	<b>22.66</b>	33.01
			H	9.42	9.58	-6.86	12.14	33.01
	1880.0	9400	V	19.42	9.69	-6.91	22.2	33.01
			H	5.36	9.69	-6.91	8.14	33.01
	1907.6	9538	V	19.33	9.81	-6.96	22.18	33.01
			H	3.54	9.81	-6.96	6.39	33.01

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

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

EIRP	<b>22.66</b>	(dBm)
EIRP	184.502	(mW)
Duty cycle:	<b>100</b>	(%)
Maximum Pav :	184.501542	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	<b>1852.4</b>	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1.0000	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm) distance	0.03672	(mW/cm <sup>2</sup> )

**Measurement Result**

The predicted power density level at 20 cm is 0.03672 mW/cm<sup>2</sup>.

This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 1852.4MHz.

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**Operation in WCDMA IV band (1712.4 – 1752.6 MHz)**

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
WCDMA Band IV	1712.4	1312	V	22.26	8.99	-6.58	<b>24.67</b>	30.00
			H	13.66	8.99	-6.59	16.06	30.00
	1732.6	1413	V	20.73	9.07	-6.62	23.18	30.00
			H	12.29	9.07	-6.62	14.74	30.00
	1752.6	1513	V	20.75	9.16	-6.67	23.24	30.00
			H	10.49	9.16	-6.67	12.98	30.00

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

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

EIRP	<b>24.67</b>	(dBm)
EIRP	293.089	(mW)
Duty cycle:	<b>100</b>	(%)
Maximum Pav :	293.089325	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	<b>1712.4</b>	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1.0000	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm) distance	0.05834	(mW/cm <sup>2</sup> )

**Measurement Result**

The predicted power density level at 20 cm is 0.05834 mW/cm<sup>2</sup>.

This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 1712.4MHz.

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**Operation in WCDMA V band (826.4 – 846.6 MHz)**

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
WCDMA Band V	826.4	4132	V	20.26	5.13	-4.19	<b>21.20</b>	38.45
			H	18.63	5.13	-4.19	19.57	38.45
	836.6	4183	V	19.35	5.1	-4.22	20.23	38.45
			H	17.76	5.1	-4.23	18.63	38.45
	846.6	4233	V	19.14	5.06	-4.26	19.94	38.45
			H	18.48	5.06	-4.26	19.28	38.45

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

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

ERP	<b>21.20</b>	(dBm)
ERP	131.826	(mW)
Duty cycle:	<b>100</b>	(%)
Maximum Pav :	131.825674	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	<b>826.4</b>	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	0.5509	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm) distance	0.02624	(mW/cm <sup>2</sup> )

**Measurement Result**

The predicted power density level at 20 cm is 0.02624 mW/cm<sup>2</sup>.

This is below the uncontrolled exposure limit of 0.5509 mW/cm<sup>2</sup> at 826.4MHz.

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**Operation in LTE 2 band (1855.0 – 1905.0 MHz)**

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: 1.4M QPSK RB: 1,0	1850.7	18607	V	17.78	9.57	-6.86	20.49	33.01
			H	9.96	9.57	-6.86	12.67	33.01
	1880.0	18900	V	20.01	9.69	-6.91	<b>22.79</b>	33.01
			H	11.02	9.69	-6.91	13.80	33.01
	1909.3	19193	V	17.13	9.82	-6.97	19.98	33.01
			H	9.08	9.82	-6.97	11.93	33.01

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

**Duty Cycle is 1 for LTE 2 band operation and R is 20cm.**

EIRP	<b>22.79</b>	(dBm)
EIRP	190.108	(mW)
Duty cycle:	<b>100</b>	(%)
Maximum Pav :	190.107828	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	<b>1880</b>	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1.0000	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm) distance	0.03784	(mW/cm <sup>2</sup> )

**Measurement Result**

The predicted power density level at 20 cm is 0.03784 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 4 band (1711.5 – 1753.5 MHz)**

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: 5M 16QAM RB: 1,0	1712.5	19975	V	17.36	8.98	-6.58	19.76	30.00
			H	11.43	8.98	-6.58	13.83	30.00
	1732.5	20175	V	16.39	9.07	-6.62	18.84	30.00
			H	12.87	9.07	-6.62	15.32	30.00
	1752.5	20375	V	19.18	9.15	-6.66	<b>21.67</b>	30.00
			H	10.34	9.15	-6.66	12.83	30.00

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

EIRP	<b>21.67</b>	(dBm)
EIRP	146.893	(mW)
Duty cycle:	<b>100</b>	(%)
Maximum Pav :	146.892628	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	<b>1752.5</b>	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1.0000	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm) distance	0.02924	(mW/cm <sup>2</sup> )

**Measurement Result**

The predicted power density level at 20 cm is 0.02924 mW/cm<sup>2</sup>.  
 This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 1752.5MHz.

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**Operation in LTE 5 band (825.5 – 847.5 MHz)**

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 5 BW: 3M 16QAM RB: 1,0	825.5	20415	V	23.61	5.13	-4.19	24.55	38.45
			H	18.92	5.14	-4.18	19.88	38.45
	836.5	20525	V	21.83	5.10	-4.22	22.71	38.45
			H	18.14	5.10	-4.22	19.02	38.45
	847.5	20635	V	21.63	5.07	-4.26	22.44	38.45
			H	16.89	5.07	-4.26	17.70	38.45

**Power Density = ERP\*Duty Cycle/(4πR<sup>2</sup>)**  
**Duty Cycle is 1 for LTE 5 band operation and R is 20cm.**

ERP	24.55	(dBm)
ERP	285.102	(mW)
Duty cycle:	100	(%)
Maximum Pav :	285.101827	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	825.5	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	0.5503	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm) distance	0.05675	(mW/cm <sup>2</sup> )

**Measurement Result**

The predicted power density level at 20 cm is 0.05675 mW/cm<sup>2</sup>.

This is below the uncontrolled exposure limit of 0.5503 mW/cm<sup>2</sup> at 825.5MHz.

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**Operation in LTE 7 band (2507.5 – 2562.5 MHz)**

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 7 BW: 5M 16QAM RB: 1,24	2502.5	20775	V	20.58	10.71	-7.83	23.46	33.01
			H	11.35	10.71	-7.84	14.22	33.01
	2535.0	21100	V	20.76	10.74	-7.87	23.63	33.01
			H	12.39	10.75	-7.87	15.27	33.01
	2567.5	21425	V	21.24	10.78	-7.91	<b>24.11</b>	33.01
			H	12.15	10.78	-7.91	15.02	33.01

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

**Duty Cycle is 1 for LTE 7 band operation and R is 20cm.**

EIRP	24.11	(dBm)
EIRP	257.632	(mW)
Duty cycle:	100	(%)
Maximum Pav :	257.632116	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	2567.5	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1.0000	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm) distance	0.05128	(mW/cm <sup>2</sup> )

**Measurement Result**

The predicted power density level at 20 cm is 0.05128 mW/cm<sup>2</sup>.

This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 2567.5MHz.

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**Operation in LTE 12 band (700.5 – 714.5 MHz)**

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 12 BW: 1.4M QPSK RB: 1,5	699.7	23017	V	24.25	5.06	-3.82	<b>25.49</b>	24.77
			H	17.27	5.06	-3.82	18.51	24.77
	707.5	23095	V	22.66	5.08	-3.84	23.90	24.77
			H	16.20	5.08	-3.84	17.44	24.77
	715.3	23173	V	21.76	5.09	-3.87	22.98	24.77
			H	14.34	5.09	-3.87	15.56	24.77

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

**Duty Cycle is 1 for LTE 12 band operation and R is 20cm.**

ERP	<b>25.49</b>	(dBm)
ERP	353.997	(mW)
Duty cycle:	<b>100</b>	(%)
Maximum Pav :	353.997341	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	<b>699.7</b>	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	0.4665	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm) distance	0.07046	(mW/cm <sup>2</sup> )

**Measurement Result**

The predicted power density level at 20 cm is 0.07046 mW/cm<sup>2</sup>.

This is below the uncontrolled exposure limit of 0.4665 mW/cm<sup>2</sup> at 699.7MHz.

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**Operation in LTE 13 band (779.5 – 784.5 MHz)**

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 16QAM RB: 1,0	779.5	23205	V	23.95	5.19	-4.04	25.10	34.77
			H	21.17	5.19	-4.04	22.32	34.77
	782.0	23230	V	24.58	5.20	-4.05	<b>25.73</b>	34.77
			H	22.02	5.20	-4.05	23.17	34.77
	784.5	23255	V	24.10	5.20	-4.06	25.24	34.77
			H	21.59	5.20	-4.06	22.73	34.77

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

Duty Cycle is 1 for LTE 13 band operation and R is 20cm.

ERP	<b>25.73</b>	(dBm)
ERP	374.111	(mW)
Duty cycle:	<b>100</b>	(%)
Maximum Pav :	374.110588	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	<b>782</b>	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	0.5213	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm) distance	0.07446	(mW/cm <sup>2</sup> )

**Measurement Result**

The predicted power density level at 20 cm is 0.07446 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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**Operation in LTE 25 band (1850.7 – 1914.3 MHz)**

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 25 BW: 1.4M QPSK RB: 1,5	1850.7	26047	V	21.78	9.58	-6.86	24.50	33.01
			H	13.50	9.57	-6.86	16.21	33.01
	1882.5	26365	V	21.28	9.71	-6.92	24.07	33.01
			H	9.18	9.71	-6.92	11.97	33.01
	1914.3	26683	V	19.71	9.84	-6.98	22.57	33.01
			H	9.13	9.84	-6.98	11.99	33.01

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

**Duty Cycle is 1 for LTE 25 band operation and R is 20cm.**

EIRP	24.50	(dBm)
EIRP	281.838	(mW)
Duty cycle:	100	(%)
Maximum Pav :	281.838293	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	1850.7	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1.0000	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm) distance	0.05610	(mW/cm <sup>2</sup> )

**Measurement Result**

The predicted power density level at 20 cm is 0.0561 mW/cm<sup>2</sup>.

This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 1850.7MHz.

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**Operation in LTE 26 band (825.5 – 847.5 MHz)**

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 26 BW: 3M 16QAM RB: 1,14	825.5	26805	V	24.39	5.13	-4.19	25.33	38.45
			H	22.92	5.13	-4.19	23.86	38.45
	836.5	26915	V	22.50	5.09	-4.23	23.36	38.45
			H	20.84	5.09	-4.23	21.70	38.45
	847.5	27025	V	21.18	5.06	-4.26	21.98	38.45
			H	19.40	5.06	-4.26	20.20	38.45

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

**Duty Cycle is 1 for LTE 26 band operation and R is 20cm.**

ERP	25.33	(dBm)
ERP	341.193	(mW)
Duty cycle:	100	(%)
Maximum Pav :	341.192912	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	825.5	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	0.5503	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm) distance	0.06791	(mW/cm <sup>2</sup> )

**Measurement Result**

The predicted power density level at 20 cm is 0.06791 mW/cm<sup>2</sup>.

This is below the uncontrolled exposure limit of 0.5503 mW/cm<sup>2</sup> at 825.5MHz.

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**Operation in LTE 26 band (815.5 – 822.5 MHz) for Part 90S**

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 26 BW: 1.4M QPSK RB: 1,5	814.7	26697	V	25.02	5.17	-4.15	<b>26.04</b>	50.00
			H	24.17	5.17	-4.14	25.20	50.00
	819.0	26740	V	23.72	5.15	-4.16	24.71	50.00
			H	22.81	5.16	-4.16	23.81	50.00
	823.3	26783	V	23.28	5.14	-4.17	24.25	50.00
			H	22.24	5.14	-4.18	23.20	50.00

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

Duty Cycle is 1 for LTE 26 band operation and R is 20cm.

ERP	<b>26.04</b>	(dBm)
ERP	401.791	(mW)
Duty cycle:	<b>100</b>	(%)
Maximum Pav :	401.790811	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	<b>814.7</b>	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	0.5431	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm) distance	0.07997	(mW/cm <sup>2</sup> )

**Measurement Result**

The predicted power density level at 20 cm is 0.07997 mW/cm<sup>2</sup>.

This is below the uncontrolled exposure limit of 0.5431 mW/cm<sup>2</sup> at 814.7MHz.

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**Operation in LTE 30 band (2307.5 – 2312.5 MHz)**

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 30 BW: 5M 16QAM RB: 1,0	2307.5	27685	V	23.69	10.51	-7.59	26.61	34.77
			H	13.00	10.51	-7.59	15.92	34.77
	2310.0	27710	V	24.42	10.51	-7.59	<b>27.34</b>	34.77
			H	13.62	10.51	-7.59	16.54	34.77
	2312.5	27735	V	23.20	10.51	-7.59	26.12	34.77
			H	13.19	10.51	-7.59	16.11	34.77

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

Duty Cycle is 1 for LTE 30 band operation and R is 20cm.

EIRP	<b>27.34</b>	(dBm)
EIRP	542.001	(mW)
Duty cycle:	<b>100</b>	(%)
Maximum Pav :	542.00089	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	<b>2310</b>	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1.0000	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm) distance	0.10788	(mW/cm <sup>2</sup> )

**Measurement Result**

The predicted power density level at 20 cm is 0.10788 mW/cm<sup>2</sup>.

This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 2310MHz.

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**Operation in LTE 41 band (2506.0 – 2680.0 MHz)**

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 41 BW: 5M QPSK RB: 1,24	2498.5	39675	V	24.47	10.70	-7.83	27.34	33.00
			H	15.34	10.70	-7.83	18.21	33.00
	2593.0	40620	V	24.89	10.81	-7.93	<b>27.77</b>	33.00
			H	12.21	10.82	-7.94	15.09	33.00
	2687.5	41565	V	22.95	10.93	-8.03	25.85	33.00
			H	12.23	10.93	-8.03	15.13	33.00

**Power Density = EIRP\*Duty Cycle/(4πR<sup>2</sup>)**  
**Duty Cycle is 1 for LTE 41 band operation and R is 20cm.**

EIRP	<b>27.77</b>	(dBm)
EIRP	598.412	(mW)
Duty cycle:	<b>100</b>	(%)
Maximum Pav :	598.411595	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	<b>2593</b>	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1.0000	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm) distance	0.11911	(mW/cm <sup>2</sup> )

**Measurement Result**

The predicted power density level at 20 cm is 0.11911 mW/cm<sup>2</sup>.  
 This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 2593MHz.

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