

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. And Part 90 subpart S For 47 CFR 1.1310 Radio frequency 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

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t (886-2) 2299-3279

f (886-2) 2298-0488

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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/ <i>f</i>	2.19/ <i>f</i>	-	6
10-30	28	2.19/ <i>f</i>	-	6
30-300	28	0.073	2*	6
300-1500	1.585 <i>f</i> ^{0.5}	0.0042 <i>f</i> ^{0.5}	<i>f</i> /150	6
1500-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ <i>f</i> ^{1.2}
150000-300000	0.158 <i>f</i> ^{0.5}	4.21 x 10 ⁻⁴ <i>f</i> ^{0.5}	6.67 x 10 ⁻⁵ <i>f</i>	616000/ <i>f</i> ^{1.2}

Note: *f* is frequency in MHz.

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

Note:

Pre-scanned was done on antenna: GSA.8841.A.105111, and antenna: TG.30.8111 Apex, and antenna GSA.8841.A.105111 results higher emission. Therefore, the completed set of measurement was done on antenna: GSA.8841.A.105111 to presented on this MPE evaluation.

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Maximum Permissible Exposure (MPE) Evaluation (Antenna Part No.: GSA.8841.A.10511)

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

Operation in cellular band (824 – 849 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
GPRS 850	824.2	128	V	25.25	3.45	-2.94	25.77	38.45
			H	17.07	3.45	-2.94	17.58	38.45
	836.6	190	V	25.46	3.46	-2.97	25.95	38.45
			H	16.88	3.46	-2.97	17.36	38.45
	848.8	251	V	25.20	3.47	-3.01	25.66	38.45
			H	18.13	3.47	-3.01	18.59	38.45

$$\text{ERP} = 25.95 \text{ dBm} = 393.55 \text{ mW}$$

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

$$= 393.55 \times 0.25 / (4 \times \pi \times 20^2) = 0.0196 \text{ mW/cm}^2$$

where Duty Cycle is 0.25 for GPRS operation (class 10) and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and can be calculated as follows:

$$\text{MPE limit} = 836.6 / 1500 = 0.56 \text{ mW/cm}^2$$

As we can see the resulted power density is below the MPE limit, this is compliant with the FCC rules on RF exposure.

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Operation in PCS band (1850 – 1910 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
GPRS 1900	1850.2	512	V	26.92	4.84	-4.49	27.28	33.01
			H	17.93	4.84	-4.49	18.29	33.01
	1880.0	661	V	26.35	4.79	-4.53	26.62	33.01
			H	23.46	4.79	-4.53	23.73	33.01
	1909.8	810	V	26.36	4.74	-4.57	26.54	33.01
			H	20.89	4.74	-4.57	21.07	33.01

$$\text{EIRP} = 27.28 \text{ dBm} = 534.56 \text{ mW}$$

$$\begin{aligned} \text{Power Density} &= \text{EIRP} \times \text{Duty Cycle} / (4 \pi R^2) \\ &= 534.56 \times 0.25 / (4 \times \pi \times 20^2) = 0.0266 \text{ mW/cm}^2 \end{aligned}$$

where Duty Cycle is 0.25 for GPRS operation (class 10) and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and 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, this is compliant with the FCC rules on RF exposure.

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Operation in HSDPA band II (1850 – 1910 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
HSDPA B2	1852.4	9262	V	26.86	4.84	-4.49	27.22	33.01
			H	15.33	4.84	-4.49	15.68	33.01
	1880.0	9400	V	26.86	4.79	-4.53	27.13	33.01
			H	20.93	4.79	-4.53	21.20	33.01
	1907.6	9538	V	27.13	4.75	-4.56	27.32	33.01
			H	18.13	4.75	-4.56	18.31	33.01

$$\text{EIRP} = 27.32 \text{ dBm} = 539.51 \text{ mW}$$

$$\begin{aligned} \text{Power Density} &= \text{EIRP} \times \text{Duty Cycle} / (4 \pi R^2) \\ &= 539.51 \times 1 / (4 \times \pi \times 20^2) = 0.1073 \text{ mW/cm}^2 \end{aligned}$$

where Duty Cycle is 1 for HSUPA band II mode and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and 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, this is compliant with the FCC rules on RF exposure.

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Operation in HSDPA band IV (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
HSDPA B4	1712.4	1312	V	27.75	5.09	-4.29	28.55	30.00
			H	16.47	5.09	-4.29	17.26	30.00
	1732.6	1413	V	27.34	5.05	-4.31	28.08	30.00
			H	18.05	5.05	-4.31	18.79	30.00
	1752.6	1513	V	28.35	5.01	-4.37	28.99	30.00
			H	20.50	5.01	-4.37	21.14	30.00

$$\text{EIRP} = 28.99 \text{ dBm} = 792.50 \text{ mW}$$

$$\begin{aligned} \text{Power Density} &= \text{EIRP} \times \text{Duty Cycle} / (4 \pi R^2) \\ &= 792.50 \times 1 / (4 \times \pi \times 20^2) = 0.1577 \text{ mW/cm}^2 \end{aligned}$$

where Duty Cycle is 1 for HSUPA band IV mode and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and 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, this is compliant with the FCC rules on RF exposure.

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Operation in HSDPA band V (826 – 849 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
HSDPA B5	826.4	4132	V	21.11	3.46	-2.95	21.62	38.45
			H	11.55	3.46	-2.94	12.06	38.45
	836.6	4183	V	21.38	3.46	-2.97	21.87	38.45
			H	12.42	3.46	-2.97	12.90	38.45
	846.6	4233	V	21.36	3.47	-3.00	21.82	38.45
			H	13.70	3.47	-3.00	14.17	38.45

$$\text{ERP} = 21.87 \text{ dBm} = 153.82 \text{ mW}$$

$$\begin{aligned} \text{Power Density} &= \text{ERP} \cdot \text{Duty Cycle} / (4 \pi R^2) \\ &= 153.82 \cdot 1 / (4 \cdot \pi \cdot 20^2) = 0.0196 \text{ mW/cm}^2 \end{aligned}$$

where Duty Cycle is 1 for HSDPA band V mode and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and can be calculated as follows:

$$\text{MPE limit} = 836.6 / 1500 = 0.56 \text{ mW/cm}^2$$

As we can see the resulted power density is below the MPE limit, this is compliant with the FCC rules on RF exposure.

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Operation in cellular band (824 – 849 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
CDMA BC0	824.7	1013	V	20.49	3.45	-2.94	21.00	38.45
			H	9.98	3.45	-2.94	10.50	38.45
	836.52	384	V	21.05	3.46	-2.97	21.54	38.45
			H	10.21	3.46	-2.97	10.70	38.45
	848.31	777	V	19.87	3.47	-3.00	20.33	38.45
			H	9.01	3.47	-3.00	9.47	38.45

$$\text{ERP} = 21.54\text{dBm} = 142.56 \text{ mW}$$

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

$$= 142.56 \cdot 1 / (4 \cdot \pi \cdot 20^2) = 0.0283 \text{ mW/cm}^2$$

where Duty Cycle is 1 for CDMA BC0 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 can be calculated as follows:

$$\text{MPE limit} = 836.52 / 1500 = 0.56 \text{ mW/cm}^2$$

As we can see the resulted power density is below the MPE limit, this is compliant with the FCC rules on RF exposure.

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Operation in PCS band (1850 – 1910 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
CDMA BC1	1851.25	25	V	20.92	4.84	-4.49	21.27	33.00
			H	9.55	4.84	-4.49	9.91	33.00
	1880.0	600	V	20.06	4.79	-4.53	20.33	33.00
			H	10.99	4.79	-4.53	11.26	33.00
	1908.75	1175	V	16.74	4.75	-4.56	16.92	33.00
			H	6.89	4.75	-4.56	7.07	33.00

$$\text{EIRP} = 21.27 \text{ dBm} = 133.97 \text{ mW}$$

$$\begin{aligned} \text{Power Density} &= \text{EIRP} \times \text{Duty Cycle} / (4 \pi R^2) \\ &= 133.97 \times 1 / (4 \times \pi \times 20^2) = 0.0267 \text{ mW/cm}^2 \end{aligned}$$

where Duty Cycle is 1 for CDMA2000 BC1operation and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and 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, this is compliant with the FCC rules on RF exposure.

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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

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Operation in cellular band (817.9 – 823.1 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
CDMA BC10	817.9	476	V	20.60	3.45	-2.92	21.14	50.00
			H	12.12	3.45	-2.92	12.66	50.00
	820.5	580	V	20.84	3.45	-2.93	21.37	50.00
			H	9.30	3.45	-2.92	9.83	50.00
	823.1	684	V	20.66	3.45	-2.93	21.18	50.00
			H	4.03	3.45	-2.93	4.55	50.00

$$\text{ERP} = 21.37 \text{ dBm} = 137.09 \text{ mW}$$

$$\begin{aligned} \text{Power Density} &= \text{ERP} \times \text{Duty Cycle} / (4 \pi R^2) \\ &= 137.09 \times 1 / (4 \times \pi \times 20^2) = 0.0273 \text{ mW/cm}^2 \end{aligned}$$

where Duty Cycle is 1 for CDMA2000 BC10 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 can be calculated as follows:

$$\text{MPE limit} = 820.5/1500 = 0.54 \text{ mW/cm}^2$$

As we can see the resulted power density is below the MPE limit, this is compliant with the FCC rules on RF exposure.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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Operation in LTE band (1850.7 – 1909.3 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
BAND 2 BW: 1.4M 16QAM RB: 1,0	1850.7	18607	V	29.03	4.84	-4.49	29.38	33.01
			H	17.21	4.84	-4.49	17.57	33.01
	1880.0	18900	V	28.79	4.80	-4.52	29.06	33.01
			H	16.88	4.79	-4.53	17.14	33.01
	1909.3	19193	V	26.82	4.75	-4.56	27.00	33.01
			H	11.59	4.75	-4.56	11.78	33.01

$$\text{EIRP} = 29.38 \text{ dBm} = 866.96 \text{ mW}$$

$$\begin{aligned} \text{Power Density} &= \text{EIRP} \times \text{Duty Cycle} / (4 \pi R^2) \\ &= 866.96 \times 1 / (4 \times \pi \times 20^2) = 0.1725 \text{ mW/cm}^2 \end{aligned}$$

where Duty Cycle is 1 for LTE band 2 1.4MHz /16QAM/RB 1 0 offset 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 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, this is compliant with the FCC rules on RF exposure.

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Operation in LTE band (1715.5 – 1747.5 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
BAND 4 BW: 15M 16QAM RB: 1,74	1717.5	20025	V	26.55	5.06	-4.30	27.30	30.00
			H	13.27	5.06	-4.30	14.03	30.00
	1732.5	20175	V	28.37	5.03	-4.34	29.06	30.00
			H	17.91	5.03	-4.34	18.61	30.00
	1747.5	20325	V	28.84	5.01	-4.37	29.49	30.00
			H	15.86	5.01	-4.37	16.50	30.00

$$\text{EIRP} = 29.49 \text{ dBm} = 889.20 \text{ mW}$$

$$\begin{aligned} \text{Power Density} &= \text{EIRP} \times \text{Duty Cycle} / (4 \pi R^2) \\ &= 889.20 \times 1 / (4 \times \pi \times 20^2) = 0.1769 \text{ mW/cm}^2 \end{aligned}$$

where Duty Cycle is 1 for LTE band 4 15MHz /16QAM/RB 1 74 offset 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 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, this is compliant with the FCC rules on RF exposure.

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t (886-2) 2299-3279

f (886-2) 2298-0488

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Operation in LTE band (824.7 – 848.3 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
BAND 5 BW: 1.4M 16QAM RB: 1,0	824.7	20407	V	21.59	3.46	-2.94	22.10	38.45
			H	17.56	3.46	-2.94	18.08	38.45
	836.5	20525	V	21.88	3.46	-2.97	22.37	38.45
			H	15.88	3.46	-2.97	16.37	38.45
	848.3	20643	V	18.36	3.47	-3.01	18.82	38.45
			H	16.48	3.47	-3.00	16.95	38.45

$$\text{ERP} = 22.37 \text{ dBm} = 172.58 \text{ mW}$$

$$\begin{aligned} \text{Power Density} &= \text{ERP} \cdot \text{Duty Cycle} / (4 \pi R^2) \\ &= 172.58 \cdot 1 / (4 \cdot \pi \cdot 20^2) = 0.0343 \text{ mW/cm}^2 \end{aligned}$$

where Duty Cycle is 1 for LTE band 5 1.4MHz /16QAM/RB 1 0 offset 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 can be calculated as follows:

$$\text{MPE limit} = 836.5/1500 = 0.56 \text{ mW/cm}^2$$

As we can see the resulted power density is below the MPE limit, this is compliant with the FCC rules on RF exposure.

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t (886-2) 2299-3279

f (886-2) 2298-0488

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Operation in LTE band (782 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
BAND 13 BW: 5M 16QAM RB: 1,24	779.5	23205	V	22.13	3.38	-2.78	22.73	34.77
			H	15.08	3.38	-2.78	15.68	34.77
	782.0	23230	V	22.19	3.39	-2.79	22.78	34.77
			H	13.90	3.37	-2.77	14.50	34.77
	784.5	23255	V	23.04	3.40	-2.80	23.64	34.77
			H	13.18	3.39	-2.80	13.77	34.77

$$\text{ERP} = 23.64 \text{ dBm} = 231.21 \text{ mW}$$

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

$$= 231.21 \times 1 / (4 \times \pi \times 20^2) = 0.04600 \text{ mW/cm}^2$$

where Duty Cycle is 1 for LTE band 13 10MHz /16QAM/RB 1 49 offset 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 can be calculated as follows:

$$\text{MPE limit} = 784.5/1500 = 0.52 \text{ mW/cm}^2$$

As we can see the resulted power density is below the MPE limit, this is compliant with the FCC rules on RF exposure.

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Operation in LTE band (706.5 – 713.5 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
BAND 17 BW: 5M 16QAM RB: 1,0	706.5	23755	V	20.48	3.37	-2.60	21.25	34.77
			H	16.58	3.37	-2.60	17.35	34.77
	710.0	23790	V	20.60	3.37	-2.60	21.37	34.77
			H	14.39	3.37	-2.60	15.16	34.77
	713.5	23825	V	21.54	3.35	-2.61	22.29	34.77
			H	13.93	3.35	-2.61	14.68	34.77

$$\text{ERP} = 22.29 \text{ dBm} = 169.43 \text{ mW}$$

$$\begin{aligned} \text{Power Density} &= \text{ERP} \cdot \text{Duty Cycle} / (4 \pi R^2) \\ &= 169.43 \cdot 1 / (4 \cdot \pi \cdot 20^2) = 0.0337 \text{ mW/cm}^2 \end{aligned}$$

where Duty Cycle is 1 for LTE band 17 5MHz /16QAM/RB 1 0 offset 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 can be calculated as follows:

$$\text{MPE limit} = 713.5/1500 = 0.48 \text{ mW/cm}^2$$

As we can see the resulted power density is below the MPE limit, this is compliant with the FCC rules on RF exposure.

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Operation in LTE 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
BAND 25 BW: 1.4M 16QAM RB: 1,5	1850.7	26047	V	29.12	4.84	-4.49	29.47	33.00
			H	21.33	4.84	-4.49	21.68	33.00
	1882.5	26365	V	29.91	4.79	-4.53	30.18	33.00
			H	19.00	4.79	-4.53	19.26	33.00
	1914.3	26683	V	30.07	4.74	-4.57	30.24	33.00
			H	18.15	4.74	-4.57	18.32	33.00

$$\text{EIRP} = 30.24 \text{ dBm} = 1056.82 \text{ mW}$$

$$\begin{aligned} \text{Power Density} &= \text{EIRP} \times \text{Duty Cycle} / (4 \pi R^2) \\ &= 1056.82 \times 1 / (4 \times \pi \times 20^2) = 0.2102 \text{ mW/cm}^2 \end{aligned}$$

where Duty Cycle is 1 for LTE band 25 1.4MHz /16QAM/RB 1 5 offset 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 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, this is compliant with the FCC rules on RF exposure.

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Collocated MPE analysis:

The modem may transmit simultaneously with other collocated radio transmitters within a host device, provided the following conditions are met:

- Each collocated radio transmitter has been certified by FCC/IC for mobile application (that will be met since SQNS module will have its own FCC ID and host device will have its own FCC ID)
- At least 20 cm separation distance between the antennas of the collocated transmitters and the user's body must be maintained at all times (host installation should taking care of that)

The output power and antenna gain in a collocated configuration must not exceed the limits and configurations stipulated in the following table 1. The power density calculations for the individual transmitters per wireless technology at an exposure minimum separation distance of 20cm.

Exclusion of test condition:

Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on calculated or measured field strengths or power density, is ≤ 1.0 .

$$\sum MPE\ ratio1 + MPE\ ratio2 + MPE\ ratio3 \leq 1.0$$

The spreadsheet as FCC deduces, and releases is employed to conduct the measurement:

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Table 1 : Collocated MPE Calculation (Worse-case table)

Technology	Frequency (MHz)	Max Conducted Power (dBm)	Max Gain (dBi)	Duty Cycle	FCC Power Density @20cm (mW/cm ²)	FCC MPE Limit (mW/cm ²)
LTE B13	782.0	23.76	1.65	1.00	0.069	0.521
WCDMA B5	826.4	23.53	1.65	1.00	0.065	0.549
WCDMA B4	1712.4	23.86	4.76	1.00	0.145	1.000
LTE B2	1909.3	23.79	4.76	1.00	0.143	1.000
WLAN (2.4GHz)	2462	19.92	4.25	0.99	0.510	1.000
WLAN (2.4GHz MIMO)	2462	16.42	7.26	0.97	0.045	1.000
WLAN (5GHz)	5500	15.32	5.5	0.97	0.023	1.000
WLAN (5GHz MIMO)	5500	18.64	8.51	0.97	0.100	1.000
BT LE	2402	-1.30	0.5	0.60	0.0001	1.000

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t (886-2) 2299-3279

f (886-2) 2298-0488

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Scenario 1:

External Antenna:

Wifi b or g + Bluetooth LE + 2/3/4G (frequency band 700)

WLAN (mW/cm ²)	WLAN / MPE limit	(WLAN) / MPE limit	BLE (mW/cm ²)	BLE / MPE limit	(BLE) / MPE limit	WWAN 700 MHz (mW/cm ²)	FCC MPE limit (mW/cm ²)	(WWAN 700MHz) / MPE limit	(WWAN 700MHz +WLAN+ BLE)	FCC Limit (mW/cm ²)
0.510	1.00	0.510	0.0001	1.00	0.0001	0.069	0.521	0.132	0.6421	1.000

Scenario 2:

External Antenna:

Wifi n_MIMO 2.4G + Bluetooth LE+ 2/3/4G (frequency band 700)

WLAN (mW/cm ²)	WLAN MIMO / MPE limit	(WLAN) MIMO / MPE limit	BLE (mW/cm ²)	BLE / MPE limit	(BLE) / MPE limit	WWAN 700 MHz (mW/cm ²)	FCC MPE limit (mW/cm ²)	(WWAN 700MHz) / MPE limit	(WWAN 700MHz +WLAN MIMO + BLE)	FCC Limit (mW/cm ²)
0.045	1.00	0.045	0.0001	1.00	0.0001	0.069	0.521	0.132	0.1771	1.000

Scenario 3:

External Antenna:

Wifi a + Bluetooth LE + 2/3/4G (frequency band 700)

WLAN (mW/cm ²)	WLAN / MPE limit	(WLAN) / MPE limit	BLE (mW/cm ²)	BLE / MPE limit	(BLE) / MPE limit	WWAN 700 MHz (mW/cm ²)	FCC MPE limit (mW/cm ²)	(WWAN 700MHz) / MPE limit	(WWAN 700MHz +WLAN MIMO + BLE)	FCC Limit (mW/cm ²)
0.023	1.00	0.023	0.0001	1.00	0.0001	0.069	0.521	0.132	0.1551	1.000

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t (886-2) 2299-3279

f (886-2) 2298-0488

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Scenario 4:

External Antenna:

Wifi n_MIMO 5G + Bluetooth LE + 2/3/4G (frequency band 700)

WLAN MIMO (mW/cm ²)	WLAN MIMO / MPE limit	(WLAN) MIMO / MPE limit	BLE (mW/cm ²)	BLE / MPE limit	(BLE) / MPE limit	WWAN 700 MHz (mW/cm ²)	FCC MPE limit (mW/cm ²)	(WWAN 700MHz) / MPE limit	(WWAN 700MHz +WLAN MIMO + BLE)	FCC Limit (mW/cm ²)
0.100	1.00	0.100	0.0001	1.00	0.0001	0.069	0.521	0.132	0.2321	1.000

Scenario 5:

External Antenna:

Wifi b or g + Bluetooth LE + 2/3/4G (frequency band 850)

WLAN (mW/cm ²)	WLAN / MPE limit	(WLAN) / MPE limit	BLE (mW/cm ²)	BLE / MPE limit	(BLE) / MPE limit	WWAN 850 MHz (mW/cm ²)	FCC MPE limit (mW/cm ²)	(WWAN 850MHz) / MPE limit	(WWAN 850MHz +WLAN+ BLE)	FCC Limit (mW/cm ²)
0.510	1.00	0.510	0.0001	1.00	0.0001	0.065	0.549	0.118	0.6281	1.000

Scenario 6:

External Antenna:

Wifi n_MIMO 2.4G + Bluetooth LE+ 2/3/4G (frequency band 850)

WLAN MIMO (mW/cm ²)	WLAN MIMO / MPE limit	(WLAN) MIMO / MPE limit	BLE (mW/cm ²)	BLE / MPE limit	(BLE) / MPE limit	WWAN 850 MHz (mW/cm ²)	FCC MPE limit (mW/cm ²)	(WWAN 850MHz) / MPE limit	(WWAN 850MHz +WLAN MIMO + BLE)	FCC Limit (mW/cm ²)
0.045	1.00	0.045	0.0001	1.00	0.0001	0.065	0.549	0.118	0.1631	1.000

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f (886-2) 2298-0488

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Scenario 7:

External Antenna:

Wifi a + Bluetooth LE+ 2/3/4G (frequency band 850)

WLAN (mW/cm ²)	WLAN / MPE limit	(WLAN) / MPE limit	BLE (mW/cm ²)	BLE / MPE limit	(BLE) / MPE limit	WWAN 850 MHz (mW/cm ²)	FCC MPE limit (mW/cm ²)	(WWAN 850MHz) / MPE limit	(WWAN 850MHz +WLAN+ BLE)	FCC Limit (mW/cm ²)
0.023	1.00	0.023	0.0001	1.00	0.0001	0.065	0.549	0.118	0.1411	1.000

Scenario 8:

External Antenna:

Wifi n_MIMO 5G + Bluetooth LE+ 2/3/4G (frequency band 850)

WLAN MIMO (mW/cm ²)	WLAN MIMO / MPE limit	(WLAN) MIMO / MPE limit	BLE (mW/cm ²)	BLE / MPE limit	(BLE) / MPE limit	WWAN 850 MHz (mW/cm ²)	FCC MPE limit (mW/cm ²)	(WWAN 850MHz) / MPE limit	(WWAN 850MHz +WLAN MIMO + BLE)	FCC Limit (mW/cm ²)
0.100	1.00	0.100	0.0001	1.00	0.0001	0.065	0.549	0.118	0.2181	1.000

Scenario 9:

External Antenna:

Wifi b or g + Bluetooth LE + 2/3/4G (frequency band 1700)

WLAN (mW/cm ²)	WLAN / MPE limit	(WLAN) / MPE limit	BLE (mW/cm ²)	BLE / MPE limit	(BLE) / MPE limit	WWAN 1700 MHz (mW/cm ²)	FCC MPE limit (mW/cm ²)	(WWAN 1700MH z) / MPE limit	(WWAN 1700MHz +WLAN+ BLE)	FCC Limit (mW/cm ²)
0.510	1.00	0.510	0.0001	1.00	0.0001	0.145	1.00	0.145	0.6551	1.000

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Scenario 10:

External Antenna:

Wifi n_MIMO 2.4G + Bluetooth LE + 2/3/4G (frequency band 1700)

WLAN MIMO (mW/cm ²)	WLAN MIMO / MPE limit	(WLAN) MIMO / MPE limit	BLE (mW/cm ²)	BLE / MPE limit	(BLE) / MPE limit	WWAN 1700 MHz (mW/cm ²)	FCC MPE limit (mW/cm ²)	(WWAN 1700MHz) / MPE limit	(WWAN 1700MHz +WLAN MIMO + BLE)	FCC Limit (mW/cm ²)
0.045	1.00	0.045	0.0001	1.00	0.0001	0.145	1.00	0.145	0.1901	1.000

Scenario 11:

External Antenna:

Wifi a + Bluetooth LE + 2/3/4G (frequency band 1700)

WLAN (mW/cm ²)	WLAN / MPE limit	(WLAN) / MPE limit	BLE (mW/cm ²)	BLE / MPE limit	(BLE) / MPE limit	WWAN 1700 MHz (mW/cm ²)	FCC MPE limit (mW/cm ²)	(WWAN 1700MHz z) / MPE limit	(WWAN 1700MHz +WLAN+ BLE)	FCC Limit (mW/cm ²)
0.023	1.00	0.023	0.0001	1.00	0.0001	0.145	1.00	0.145	0.1681	1.000

Scenario 12:

External Antenna:

Wifi n_MIMO 5G + Bluetooth LE + 2/3/4G (frequency band 1700)

WLAN MIMO (mW/cm ²)	WLAN MIMO / MPE limit	(WLAN) MIMO / MPE limit	BLE (mW/cm ²)	BLE / MPE limit	(BLE) / MPE limit	WWAN 1700 MHz (mW/cm ²)	FCC MPE limit (mW/cm ²)	(WWAN 1700MHz) / MPE limit	(WWAN 1700MHz +WLAN MIMO + BLE)	FCC Limit (mW/cm ²)
0.100	1.00	0.100	0.0001	1.00	0.0001	0.145	1.00	0.145	0.2451	1.000

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Scenario 13:

External Antenna:

Wifi b or g + Bluetooth LE + 2/3/4G (frequency band 1900)

WLAN (mW/cm ²)	WLAN / MPE limit	(WLAN) / MPE limit	BLE (mW/cm ²)	BLE / MPE limit	(BLE) / MPE limit	WWAN 1900 MHz (mW/cm ²)	FCC MPE limit (mW/cm ²)	(WWAN 1900MHz z) / MPE limit	(WWAN 1900MHz +WLAN+ BLE)	FCC Limit (mW/cm ²)
0.510	1.00	0.510	0.0001	1.00	0.0001	0.143	1.00	0.143	0.6531	1.000

Scenario 14:

External Antenna:

Wifi n_MIMO 2.4G + Bluetooth LE+ 2/3/4G (frequency band 1900)

WLAN MIMO (mW/cm ²)	WLAN MIMO / MPE limit	(WLAN) MIMO / MPE limit	BLE (mW/cm ²)	BLE / MPE limit	(BLE) / MPE limit	WWAN 1900 MHz (mW/cm ²)	FCC MPE limit (mW/cm ²)	(WWAN 1900MHz) / MPE limit	(WWAN 1900MHz +WLAN MIMO + BLE)	FCC Limit (mW/cm ²)
0.510	1.00	0.510	0.0001	1.00	0.0001	0.143	1.00	0.143	0.6531	1.000

Scenario 15:

External Antenna:

Wifi a + Bluetooth LE + 2/3/4G (frequency band 1900)

WLAN (mW/cm ²)	WLAN / MPE limit	(WLAN) / MPE limit	BLE (mW/cm ²)	BLE / MPE limit	(BLE) / MPE limit	WWAN 1900 MHz (mW/cm ²)	FCC MPE limit (mW/cm ²)	(WWAN 1900MHz z) / MPE limit	(WWAN 1900MHz +WLAN+ BLE)	FCC Limit (mW/cm ²)
0.023	1.00	0.023	0.0001	1.00	0.0001	0.143	1.00	0.143	0.1661	1.000

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f (886-2) 2298-0488

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Scenario 16:

External Antenna:

Wifi n_MIMO 5G + Bluetooth LE + 2/3/4G (frequency band 1900)

WLAN MIMO (mW/cm ²)	WLAN MIMO / MPE limit	(WLAN) MIMO / MPE limit	BLE (mW/cm ²)	BLE / MPE limit	(BLE) / MPE limit	WWAN 1900 MHz (mW/cm ²)	FCC MPE limit (mW/cm ²)	(WWAN 1900MHz) / MPE limit	(WWAN 1900MHz +WLAN MIMO + BLE)	FCC Limit (mW/cm ²)
0.100	1.00	0.100	0.0001	1.00	0.0001	0.143	1.00	0.143	0.2431	1.000

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