1. MAXIMUM PERMISSIBLE EXPOSURE (MPE)

1.1. Standard Applicable

According to §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

This is a Mobile device, the MPE is required.

According to §1.1310 and §2.1093 RF exposure is calculated.

Limits for Maximum Permissive Exposure (MPE)

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

1.2. Maximum Permissible Exposure (MPE) Evaluation (Worst Case)

1M BR mode (Average):

CH	Freq. (MHz)	Avg. Output Power (dBm)	Output Power (mW)	Limit (mW)
0	2402	5.95	3.936	125
39	2441	6.28	4.246	125
78	2480	4.84	3.048	125

MPE Prediction (BT-BR)

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S=PG/4\pi R^2$

Where: S = Power density

P = Power input to antenna

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna

Max. output power including tune-up tolerancel:	6.28	(dBm)
Max. output power including tune-up tolerancel:	4.2461956	(mW)
Duty cycle:	77	(%)
Maximum Pav :	3.2695706	(mW)
Peak Antenna gain (Maximum):	0.8	(dBi)
Peak Antenna gain (linear):	1.2022644	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2441	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.001	(mW/cm2)

Measurement Result

The predicted power density level at 20 cm is 0.001 mW/cm2.

This is below the uncontrolled exposure limit of 1 mW/cm2 at 2441MHz.

BLE mode:

CH	Frequency (MHz)	Peak Power Output (dBm)	Required Limit
0	2402	3.91	1 Watt = 30 dBm
19	2440	**4.82**	1 Watt = 30 dBm
39	2480	3.38	1 Watt = 30 dBm

BLE mode:

CH	Frequency (MHz)	Avg. Output Power (dBm)	Required Limit
0	2402	3.00	1 Watt = 30 dBm
19	2440	3.96	1 Watt = 30 dBm
39	2480	2.38	1 Watt = 30 dBm

**Note: Measured by power meter, cable loss as 10.7 dB that offsets on the power meter*

Note: Measured by power meter,* ***as Duty cycle factor that offsets on the power meter in Peak.*

MPE Prediction (BLE)

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S=PG/4\pi R^2$

Where: S = Power density

P = Power input to antenna

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna

Max. output power including tune-up tolerancel:	3.96	(dBm)
Max. output power including tune-up tolerancel:	2.4888573	(mW)
Duty cycle:	85.46	(%)
Maximum Pav :	2.1269775	(mW)
Peak Antenna gain (Maximum):	0.8	(dBi)
Peak Antenna gain (linear):	1.2022644	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2440	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.001	(mW/cm2)

Measurement Result

The predicted power density level at 20 cm is 0.001 mW/cm2.

This is below the uncontrolled exposure limit of 1 mW/cm2 at 2440MHz.

802.11b Main								
CH	Frequency (MHz)	Data Rate	Peak Output Power (dBm)	Peak Output Power (mW)	Limit			RESULT
1	2412	1	19.00	79.43	1 Watt =	30.00	dBm	PASS
6	2437	1	19.61	91.41	1 Watt =	30.00	dBm	PASS
11	2462	1	**19.80**	**95.50**	1 Watt =	30.00	dBm	PASS
802.11b Main								
CH	Frequency (MHz)	Data Rate	Avg. Output Power (dBm)	Avg. Output Power (mW)	Limit			RESULT
1	2412	1	16.11	40.83	1 Watt =	30.00	dBm	PASS
6	2437	1	16.72	46.99	1 Watt =	30.00	dBm	PASS
11	2462	1	**16.87**	**48.64**	1 Watt =	30.00	dBm	PASS

MPE Prediction (WLAN-802.11 b)

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S=PG/4\pi R^2$

Where: S = Power density

P = Power input to antenna

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna

Max. output power including tune-up tolerancel:	16.87	(dBm)
Max. output power including tune-up tolerancel:	48.640721	(mW)
Duty cycle:	99.54	(%)
Maximum Pav :	48.416973	(mW)
Peak Antenna gain (Maximum):	0.8	(dBi)
Peak Antenna gain (linear):	1.2022644	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2462	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.012	(mW/cm2)

Measurement Result

The predicted power density level at 20 cm is 0.012 mW/cm2.

This is below the uncontrolled exposure limit of 1 mW/cm2 at 2462MHz.

802.11a_Main

CH	Frequency (MHz)	Data Rate	TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
36	5180	MCS0	13.64	23.121	23.98	PASS
44	5220	MCS0	15.30	33.884	23.98	PASS
48	5240	MCS0	**15.33**	**34.119**	23.98	PASS
52	5260	MCS0	15.05	31.989	23.98 or 11+10log(B) = 23.24	PASS
60	5300	MCS0	**15.12**	**32.509**	23.98 or 11+10log(B) = 23.22	PASS
64	5320	MCS0	15.06	32.063	23.98 or 11+10log(B) = 23.23	PASS
100	5500	MCS0	14.84	30.479	23.98 or 11+10log(B) = 23.22	PASS
116	5580	MCS0	**16.04**	**40.179**	23.98 or 11+10log(B) = 23.23	PASS
140	5700	MCS0	15.21	33.189	23.98 or 11+10log(B) = 23.23	PASS
149	5745	MCS0	**13.23**	**21.038**	30	PASS
157	5785	MCS0	12.97	19.815	30	PASS
165	5825	MCS0	12.99	19.907	30	PASS

MPE Prediction (WLAN-802.11 a)

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S=PG/4\pi R^2$

Where: S = Power density

P = Power input to antenna

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna

5150~5250MHz

Max. output power including tune-up tolerancel:	15.33	(dBm)
Max. output power including tune-up tolerancel:	34.119291	(mW)
Duty cycle:	99.36	(%)
Maximum Pav :	33.900928	(mW)
Peak Antenna gain (Maximum):	-0.2	(dBi)
Peak Antenna gain (linear):	0.9549926	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5240	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.006	(mW/cm2)

Measurement Result
The predicted power density level at 20 cm is 0.006 mW/cm2.
This is below the uncontrolled exposure limit of 1 mW/cm2 at 5240MHz.

5250~5350MHz

Max. output power including tune-up tolerancel:	15.12	(dBm)
Max. output power including tune-up tolerancel:	32.50873	(mW)
Duty cycle:	99.36	(%)
Maximum Pav :	32.300674	(mW)
Peak Antenna gain (Maximum):	2	(dBi)
Peak Antenna gain (linear):	1.5848932	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5300	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.010	(mW/cm2)

Measurement Result
The predicted power density level at 20 cm is 0.01 mW/cm2.
This is below the uncontrolled exposure limit of 1 mW/cm2 at 5300MHz.

5470~5725MHz

Max. output power including tune-up tolerancel:	16.04	(dBm)
Max. output power including tune-up tolerancel:	40.179081	(mW)
Duty cycle:	99.36	(%)
Maximum Pav :	39.921935	(mW)
Peak Antenna gain (Maximum):	-0.6	(dBi)
Peak Antenna gain (linear):	0.8709636	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5580	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.007	(mW/cm2)

Measurement Result
The predicted power density level at 20 cm is 0.007 mW/cm2.
This is below the uncontrolled exposure limit of 1 mW/cm2 at 5580MHz.

5725~5850MHz

Max. output power including tune-up tolerancel:	13.23	(dBm)
Max. output power including tune-up tolerancel:	21.037784	(mW)
Duty cycle:	99.36	(%)
Maximum Pav :	20.903143	(mW)
Peak Antenna gain (Maximum):	0.3	(dBi)
Peak Antenna gain (linear):	1.0715193	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5745	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.004	(mW/cm2)

Measurement Result
The predicted power density level at 20 cm is 0.004 mW/cm2.
This is below the uncontrolled exposure limit of 1 mW/cm2 at 5745MHz.

1.3. 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.

1.4. Special Accessories

Not available for this EUT intended for grant

1.5. Equipment Modifications

Not available for this EUT intended for grant.

1.6. 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

1.7. 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:

GPRS 850 / GSM 1900, HSDPA II / HSDPA IV / WCDMA V

LTE 2 (BW: 10M / QPSK / RB: 1,0), LTE 4 (BW: 3M / QPSK / RB: 1,14)

LTE 5 (BW: 3M / QPSK / RB: 1,14), LTE 7 (BW: 15M / QPSK / RB: 1,74)

LTE 12 (BW: 3M / QPSK / RB: 1,14), LTE 17 (BW: 10M / QPSK / RB: 1,49)

LTE 26 (BW: 3M / QPSK / RB: 1,0), LTE 41 (BW: 20M / QPSK / RB: 1,0)

LTE 26 for Part 90S (BW: 3M / QPSK / RB: 1,14)

Operation in GPRS850 band (824.2 – 848.8 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	20.98	3.31	-2.92	21.36	38.45
			H	24.43	3.31	-2.92	24.81	38.45
	836.6	190	V	21.18	3.29	-2.96	21.5	38.45
			H	24.32	3.29	-2.96	24.65	38.45
	848.8	251	V	21.72	3.27	-3	21.99	38.45
			H	24.59	3.27	-3	**24.86**	38.45

Power Density = ERP*Duty Cycle/(4πR^2)
Duty Cycle is 0.5 for GPRS 850 band operation and R is 20cm.

ERP	24.86	(dBm)
ERP	306.196	(mW)
Duty cycle:	50	(%)
Maximum Pav :	153.098172	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	848.8	(MHz)
MPE limit for uncontrolled exposure at prediction	0.5659	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.03047	(mW/cm2)

Measurement Result
The predicted power density level at 20 cm is 0.03047 mW/cm2.
This is below the uncontrolled exposure limit of 0.5659 mW/cm2 at 848.8MHz.

Operation in GSM1900 band (1850.2 – 1909.8 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
GSM 1900	1850.2	512	V	11.06	9.94	-4.46	16.54	33.01
			H	18.74	9.94	-4.46	24.22	33.01
	1880.0	661	V	13.51	10.03	-4.51	19.03	33.01
			H	18.66	10.03	-4.51	24.19	33.01
	1909.8	810	V	14.13	10.13	-4.55	19.71	33.01
			H	21.64	10.13	-4.55	**27.22**	33.01

Power Density = EIRP*Duty Cycle/(4πR^2)
Duty Cycle is 0.125 for GSM 1900 band operation and R is 20cm.

EIRP	27.22	(dBm)
EIRP	527.230	(mW)
Duty cycle:	12.5	(%)
Maximum Pav :	65.9037327	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	1909.8	(MHz)
MPE limit for uncontrolled exposure at prediction	1.0000	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.01312	(mW/cm2)

Measurement Result
The predicted power density level at 20 cm is 0.01312 mW/cm2.
This is below the uncontrolled exposure limit of 1 mW/cm2 at 1909.8MHz.

Operation in HSDPA 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
HSDPA Band II	1852.4	9262	V	10.4	9.95	-4.46	15.88	33.00
			H	16.41	9.95	-4.46	21.9	33.00
	1880.0	9400	V	11.02	10.03	-4.51	16.55	33.00
			H	19.42	10.03	-4.51	24.95	33.00
	1907.6	9538	V	12.51	10.12	-4.55	18.08	33.00
			H	21.94	10.12	-4.55	**27.51**	33.00

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

EIRP	27.51	(dBm)
EIRP	563.638	(mW)
Duty cycle:	100	(%)
Maximum Pav :	563.637656	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	1907.6	(MHz)
MPE limit for uncontrolled exposure at prediction	1.0000	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.11219	(mW/cm2)

Measurement Result
The predicted power density level at 20 cm is 0.11219 mW/cm2.
This is below the uncontrolled exposure limit of 1 mW/cm2 at 1907.6MHz.

Operation in HSDPA 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
HSDPA Band IV	1712.4	1312	V	11.49	9.48	-4.31	16.66	30.00
			H	15.29	9.48	-4.31	20.46	30.00
	1732.6	1413	V	12.1	9.55	-4.31	17.34	30.00
			H	14.36	9.55	-4.31	19.6	30.00
	1752.6	1513	V	10.97	9.62	-4.33	16.25	30.00
			H	16.76	9.62	-4.34	**22.04**	30.00

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

EIRP	22.04	(dBm)
EIRP	159.956	(mW)
Duty cycle:	100	(%)
Maximum Pav :	159.955803	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	1752.6	(MHz)
MPE limit for uncontrolled exposure at prediction	1.0000	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.03184	(mW/cm2)

Measurement Result
The predicted power density level at 20 cm is 0.03184 mW/cm2.
This is below the uncontrolled exposure limit of 1 mW/cm2 at 1752.6MHz.

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	17.29	3.3	-2.93	17.66	38.45
			H	20.18	3.3	-2.93	20.55	38.45
	836.6	4183	V	16.42	3.29	-2.96	16.75	38.45
			H	19.96	3.29	-2.96	20.28	38.45
	846.6	4233	V	16.35	3.27	-2.99	16.63	38.45
			H	21.27	3.27	-3	**21.55**	38.45

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

ERP	21.55	(dBm)
ERP	142.889	(mW)
Duty cycle:	1	(%)
Maximum Pav :	1.42889396	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	846.6	(MHz)
MPE limit for uncontrolled exposure at prediction	0.5644	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.00028	(mW/cm2)

Measurement Result
The predicted power density level at 20 cm is 0.00028 mW/cm2.
This is below the uncontrolled exposure limit of 0.5644 mW/cm2 at 846.6MHz.

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
BAND 2 BW: 10M QPSK RB: 1,0	1855.0	18650	V	10.05	9.95	-4.46	15.54	33.01
			H	17.56	9.95	-4.46	23.04	33.01
	1880.0	18900	V	11	10.02	-4.5	16.52	33.01
			H	19.3	10.02	-4.5	24.82	33.01
	1905.0	19150	V	11.07	10.09	-4.54	16.63	33.01
			H	20.01	10.09	-4.54	**25.57**	33.01

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

EIRP	25.57	(dBm)
EIRP	360.579	(mW)
Duty cycle:	100	(%)
Maximum Pav :	360.578643	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	1905	(MHz)
MPE limit for uncontrolled exposure at prediction	1.0000	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.07177	(mW/cm2)

Measurement Result
The predicted power density level at 20 cm is 0.07177 mW/cm2.
This is below the uncontrolled exposure limit of 1 mW/cm2 at 1905MHz.

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
BAND 4 BW: 3M QPSK RB: 1,14	1711.5	19965	V	9.42	9.48	-4.31	14.59	30.00
			H	13.94	9.48	-4.31	**19.11**	30.00
	1732.5	20175	V	8.47	9.55	-4.31	13.71	30.00
			H	12.45	9.55	-4.31	17.69	30.00
	1753.5	20385	V	7.48	9.62	-4.34	12.76	30.00
			H	12.74	9.62	-4.34	18.02	30.00

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

EIRP	19.11	(dBm)
EIRP	81.470	(mW)
Duty cycle:	100	(%)
Maximum Pav :	81.4704284	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	1711.5	(MHz)
MPE limit for uncontrolled exposure at prediction	1.0000	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.01622	(mW/cm2)

Measurement Result
The predicted power density level at 20 cm is 0.01622 mW/cm2.
This is below the uncontrolled exposure limit of 1 mW/cm2 at 1711.5MHz.

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	dBi	dB	dBm	dBm
BAND 5 BW: 3M QPSK RB: 1,14	825.5	20415	V	23.82	3.3	-2.93	24.19	38.45
			H	25.79	3.3	-2.93	**26.17**	38.45
	836.5	20525	V	21.91	3.29	-2.96	22.23	38.45
			H	24.18	3.29	-2.96	24.51	38.45
	847.5	20635	V	20.37	3.27	-3	20.64	38.45
			H	23.77	3.27	-3	24.04	38.45

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

ERP	26.17	(dBm)
ERP	414.000	(mW)
Duty cycle:	100	(%)
Maximum Pav :	413.999675	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	825.5	(MHz)
MPE limit for uncontrolled exposure at prediction	0.5503	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.08240	(mW/cm2)

Measurement Result
The predicted power density level at 20 cm is 0.0824 mW/cm2.
This is below the uncontrolled exposure limit of 0.5503 mW/cm2 at 825.5MHz.

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
BAND 7 BW: 15M QPSK RB: 1,74	2507.5	20825	V	14	10.92	-5.27	19.65	33.01
			H	10.62	10.92	-5.27	16.27	33.01
	2535.0	21100	V	16.02	10.95	-5.32	**21.66**	33.01
			H	11.15	10.95	-5.32	16.78	33.01
	2562.5	21375	V	13.89	10.99	-5.34	19.54	33.01
			H	7.64	10.99	-5.34	13.29	33.01

Power Density = EIRP*Duty Cycle/(4πR^2)
Duty Cycle is 1 for LTE 7 band operation and R is 20cm.

EIRP	21.66	(dBm)
EIRP	146.555	(mW)
Duty cycle:	100	(%)
Maximum Pav :	146.554784	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	2535	(MHz)
MPE limit for uncontrolled exposure at prediction	1.0000	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.02917	(mW/cm2)

Measurement Result
The predicted power density level at 20 cm is 0.02917 mW/cm2.
This is below the uncontrolled exposure limit of 1 mW/cm2 at 2535MHz.

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	dBi	dB	dBm	dBm
BAND 12 BW: 3M QPSK RB: 1,14	700.5	23025	V	20.6	3.08	-2.98	20.71	34.77
			H	25.07	3.08	-2.99	**25.17**	34.77
	707.5	23095	V	17.86	3.1	-3.04	17.92	34.77
			H	23.14	3.1	-3.04	23.19	34.77
	714.5	23165	V	17.91	3.11	-3.06	17.96	34.77
			H	23.96	3.11	-3.06	24.01	34.77

Power Density = ERP*Duty Cycle/(4πR^2)
Duty Cycle is 1 for LTE 12 band operation and R is 20cm.

ERP	25.17	(dBm)
ERP	328.852	(mW)
Duty cycle:	100	(%)
Maximum Pav :	328.851631	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	700.5	(MHz)
MPE limit for uncontrolled exposure at prediction	0.4670	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.06546	(mW/cm2)

Measurement Result
The predicted power density level at 20 cm is 0.06546 mW/cm2.
This is below the uncontrolled exposure limit of 0.467 mW/cm2 at 700.5MHz.

Operation in LTE 17 band (709.0 – 711.0 MHz)

EUT			Measurement					
Operation Band	Fundamental Frequency	CH	Antenna Pol.	S.G. Output	Antenna Gain	Cable Loss	ERP	Limit
	MHz		V/H	dBm	dBi	dB	dBm	dBm
BAND 17 BW: 10M QPSK RB: 1,49	709.0	23780	V	19.1	3.11	-3.06	19.14	34.77
			H	23.75	3.11	-3.06	23.8	34.77
	710.0	23790	V	18.99	3.11	-3.06	19.03	34.77
			H	23.97	3.11	-3.07	24.01	34.77
	711.0	23800	V	19.11	3.11	-3.06	19.16	34.77
			H	24.35	3.11	-3.06	**24.4**	34.77

Power Density = ERP*Duty Cycle/(4πR^2)
Duty Cycle is 1 for LTE 17 band operation and R is 20cm.

ERP	24.40	(dBm)
ERP	275.423	(mW)
Duty cycle:	100	(%)
Maximum Pav :	275.42287	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	711	(MHz)
MPE limit for uncontrolled exposure at prediction	0.4740	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.05482	(mW/cm2)

Measurement Result
The predicted power density level at 20 cm is 0.05482 mW/cm2.
This is below the uncontrolled exposure limit of 0.474 mW/cm2 at 711MHz.

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	dBi	dB	dBm	dBm
BAND 26 BW: 3M QPSK RB: 1,0	825.5	26805	V	15.07	3.31	-2.92	15.45	38.50
			H	17.22	3.31	-2.92	**17.61**	38.50
	836.5	26915	V	12.46	3.29	-2.95	12.79	38.50
			H	15.87	3.29	-2.96	16.21	38.50
	847.5	27025	V	9.69	3.27	-3	9.96	38.50
			H	14.23	3.28	-2.99	14.52	38.50

Power Density = ERP*Duty Cycle/(4πR^2)
Duty Cycle is 1 for LTE 26 band operation and R is 20cm.

ERP	17.61	(dBm)
ERP	57.677	(mW)
Duty cycle:	100	(%)
Maximum Pav :	57.6766463	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	825.5	(MHz)
MPE limit for uncontrolled exposure at prediction	0.5503	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.01148	(mW/cm2)

Measurement Result
The predicted power density level at 20 cm is 0.01148 mW/cm2.
This is below the uncontrolled exposure limit of 0.5503 mW/cm2 at 825.5MHz.

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
BAND 41 BW: 20M QPSK RB: 1,0	2506.0	39750	V	16.68	10.9	-5.25	22.33	33.01
			H	10.81	10.9	-5.25	16.46	33.01
	2593.0	40620	V	17.04	11.01	-5.34	**22.71**	33.01
			H	11.83	11.01	-5.34	17.5	33.01
	2680.0	41490	V	15.9	11.13	-5.48	21.55	33.01
			H	10.64	11.13	-5.48	16.29	33.01

Power Density = EIRP*Duty Cycle/($4\pi R^2$)
Duty Cycle is 1 for LTE 41 band operation and R is 20cm.

EIRP	22.71	(dBm)
EIRP	186.638	(mW)
Duty cycle:	100	(%)
Maximum Pav :	186.637969	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	2593	(MHz)
MPE limit for uncontrolled exposure at prediction	1.0000	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.03715	(mW/cm2)

Measurement Result
The predicted power density level at 20 cm is 0.03715 mW/cm2.
This is below the uncontrolled exposure limit of 1 mW/cm2 at 2593MHz.

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	dBi	dB	dBm	dBm
BAND 26 BW: 3M QPSK RB: 1,14	815.5	26705	V	14.05	3.32	-2.89	14.47	50.00
			H	18.5	3.32	-2.9	**18.92**	50.00
	819.0	26740	V	13.71	3.31	-2.91	14.12	50.00
			H	17.66	3.31	-2.91	18.06	50.00
	822.5	26775	V	13.53	3.31	-2.92	13.92	50.00
			H	17.14	3.31	-2.92	17.54	50.00

Power Density = ERP*Duty Cycle/(4πR^2)
Duty Cycle is 1 for LTE 26 band operation and R is 20cm.

ERP	18.92	(dBm)
ERP	77.983	(mW)
Duty cycle:	100	(%)
Maximum Pav :	77.9830111	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	815.5	(MHz)
MPE limit for uncontrolled exposure at prediction	0.5437	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.01552	(mW/cm2)

Measurement Result
The predicted power density level at 20 cm is 0.01552 mW/cm2.
This is below the uncontrolled exposure limit of 0.5437 mW/cm2 at 815.5MHz.

2. 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 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.

∑MPE ratio1 + MPE ratio2+MPE ration <=1.0

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

Table 1: Collocated MPE Calculation (Worst 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)
BT-BR	2441	6.28	0.80	77	0.00078	1.000
WLAN 2.4G	2462	16.87	0.80	99.54	0.01159	1.000
WLAN 5G	5580	16.04	-0.60	99.36	0.00692	1.000
GPRS 850	824.2	32.58	0.70	50	0.21180	0.549
WCDMA Band V	826.4	24.46	0.70	100	0.06531	0.551
LTE Band 26	841.5	23.97	0	100	0.04965	0.561

Scenario 1:

BT-BR+GPRS 850

BT-BR (mW/cm^2)	FCC MPE (mW/cm^2)	BT-BR / MPE limit	GPRS 850 (mW/cm^2)	FCC MPE (mW/cm^2)	GPRS 850 / MPE limit	BT-BR+GPRS 850	FCC Limit (mW/cm^2)
0.00078	1	0.00078	0.21180	0.549466667	0.38546	0.38624	1

Scenario 2:

WLAN 2.4G+GPRS 850

WLAN 2.4G (mW/cm^2)	FCC MPE (mW/cm^2)	WLAN / MPE limit	GPRS 850 (mW/cm^2)	FCC MPE (mW/cm^2)	GPRS 850 / MPE limit	WLAN 2.4G+GPRS 850	FCC Limit (mW/cm^2)
0.01159	1	0.01159	0.21180	0.549466667	0.38546	0.39705	1

Scenario 3:

WLAN 5G+GPRS 850

WLAN 5G (mW/cm^2)	FCC MPE (mW/cm^2)	WLAN 5G / MPE limit	GPRS 850 (mW/cm^2)	FCC MPE (mW/cm^2)	GPRS 850 / MPE limit	WLAN 5G+GPRS 850	FCC Limit (mW/cm^2)
0.00692	1	0.00692	0.21180	0.549466667	0.38546	0.39238	1

Scenario 4:

BT-BR+WCDMA Band V

BT-BR (mW/cm^2)	FCC MPE (mW/cm^2)	BT-BR / MPE limit	WCDMA (mW/cm^2)	FCC MPE (mW/cm^2)	WCDMA / MPE limit	BT-BR+WCDMA Band V	FCC Limit (mW/cm^2)
0.00078	1	0.00078	0.06531	0.550933333	0.11854	0.11932	1

Scenario 5:

WLAN 2.4G+WCDMA Band V

WLAN 2.4G (mW/cm^2)	FCC MPE (mW/cm^2)	WLAN / MPE limit	WCDMA (mW/cm^2)	FCC MPE (mW/cm^2)	WCDMA / MPE limit	WLAN 2.4G+WCDMA Band V	FCC Limit (mW/cm^2)
0.01159	1	0.01159	0.06531	0.550933333	0.11854	0.13012	1

Scenario 6:

WLAN 5G+WCDMA Band V

WLAN 5G (mW/cm^2)	FCC MPE (mW/cm^2)	WLAN 5G / MPE limit	WCDMA (mW/cm^2)	FCC MPE (mW/cm^2)	WCDMA / MPE limit	WLAN 5G+WCDMA Band V	FCC Limit (mW/cm^2)
0.00692	1	0.00692	0.06531	0.550933333	0.11854	0.12546	1

Scenario 7:

BT-BR+LTE Band 26

BT-BR (mW/cm^2)	FCC MPE (mW/cm^2)	BT-BR / MPE limit	LTE Band 26 (mW/cm^2)	FCC MPE (mW/cm^2)	LTE Band / MPE limit	BT-BR+LTE Band 26	FCC Limit (mW/cm^2)
0.00078	1	0.00078	0.04965	0.561	0.08851	0.08929	1

Scenario 8:

WLAN 2.4G+LTE Band 26

WLAN 2.4G (mW/cm^2)	FCC MPE (mW/cm^2)	WLAN / MPE limit	LTE Band 26 (mW/cm^2)	FCC MPE (mW/cm^2)	LTE Band / MPE limit	WLAN 2.4G+LTE Band 26	FCC Limit (mW/cm^2)
0.01159	1	0.01159	0.04965	0.561	0.08851	0.10010	1

Scenario 9:

WLAN 5G+LTE Band 26

WLAN 5G (mW/cm^2)	FCC MPE (mW/cm^2)	WLAN 5G / MPE limit	LTE Band 26 (mW/cm^2)	FCC MPE (mW/cm^2)	LTE Band / MPE limit	WLAN 5G+LTE Band 26	FCC Limit (mW/cm^2)
0.00692	1	0.00692	0.04965	0.561	0.08851	0.09543	1

Scenario 10:

BT-BR+WLAN 5G

BT-BR (mW/cm^2)	FCC MPE (mW/cm^2)	BT-BR / MPE limit	WLAN 5G (mW/cm^2)	FCC MPE (mW/cm^2)	WLAN 5G / MPE limit	BT-BR+ WLAN 5G	FCC Limit (mW/cm^2)
0.00078	1	0.00078	0.00692	1	0.00692	0.00770	1

Scenario 11:

BT-BR+WLAN 5G+GPRS 850

BT-BR (mW/cm^2)	FCC MPE (mW/cm^2)	BT-BR / MPE limit	WLAN 5G (mW/cm^2)	FCC MPE (mW/cm^2)	WLAN 5G / MPE limit	GPRS 850 (mW/cm^2)	FCC MPE (mW/cm^2)	GPRS 850 / MPE limit	BT-BR+ WLAN 5G+ GPRS 850	FCC Limit (mW/cm^2)
0.00078	1	0.00078	0.00692	1	0.00692	0.21180	0.549	0.38546	0.39316	1

Scenario 12:

BT-BR+WLAN 5G+WCDMA Band V

BT-BR (mW/cm^2)	FCC MPE (mW/cm^2)	BT-BR / MPE limit	WLAN 5G (mW/cm^2)	FCC MPE (mW/cm^2)	WLAN 5G / MPE limit	WCDMA Band V (mW/cm^2)	FCC MPE (mW/cm^2)	WCDMA / MPE limit	BT-BR+ WLAN 5G+ WCDMA Band V	FCC Limit (mW/cm^2)
0.00078	1	0.00078	0.00692	1	0.00692	0.06531	0.551	0.11854	0.12624	1

Scenario 13:

BT-BR+WLAN 5G+LTE Band 26

BT-BR (mW/cm^2)	FCC MPE (mW/cm^2)	BT-BR / MPE limit	WLAN 5G (mW/cm^2)	FCC MPE (mW/cm^2)	WLAN 5G / MPE limit	LTE Band 26 (mW/cm^2)	FCC MPE (mW/cm^2)	LTE Band / MPE limit	BT-BR+ WLAN 5G+ LTE Band 26	FCC Limit (mW/cm^2)
0.00078	1	0.00078	0.00692	1	0.00692	0.04965	0.561	0.08851	0.09621	1