

1. Maximum Permissible Exposure (MPE)

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 §2.1091 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

According to RSS 102 issue 5.

2.5.2 Exemption Limits for Routine Evaluation – RF Exposure Evaluation

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $22.48/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

Maximum Permissible Exposure (MPE) Evaluation

2.4GHz mode: BT

The worst case: refer to FCC test report for detail measurement date.

Power measurement:

Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)
Low	8.34	0.00682	1
Mid	8.57	0.00719	1
High	8.01	0.00632	1

Prediction of MPE limit at a given distance

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

$$S = \frac{P_G}{4 \pi R^2}$$

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

Maximum output power at antenna input terminal:	8.57	(dBm)
Maximum output power at antenna input terminal:	7.19448978	(mW)
Tune-Up power Tolerance:	1	dB
Duty cycle:	100	(%)
Maximum Pav :	9.057326009	(mW)
Antenna gain (typical):	2.44	(dBi)
Maximum antenna gain:	1.753880502	(numeric)
Prediction distance:	20	(cm)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm ²)
Power density at predication frequency at 20 (cm)	0.0031619	(mW/cm ²)

Measurement Result:

The predicted power density level at 20 cm is 0.0031619 mW/cm².. This is below the uncontrolled exposure limit of 1 mW/cm².

2.4GHz mode: BLE

The worst case: refer to FCC test report for detail measurement date.

Power measurement:

Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)
Low	5.52	0.00356	1
Mid	5.95	0.00394	1
High	5.31	0.00340	1

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

Maximum output power at antenna input terminal:	5.95	(dBm)
Maximum output power at antenna input terminal:	3.935500755	(mW)
Tune-Up power Tolerance:	1	dB
Duty cycle:	100	(%)
Maximum Pav :	4.954501908	(mW)
Antenna gain (typical):	2.44	(dBi)
Maximum antenna gain:	1.753880502	(numeric)
Prediction distance:	20	(cm)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm ²)
Power density at predication frequency at 20 (cm)	0.0017296	(mW/cm ²)

Measurement Result:

The predicted power density level at 20 cm is 0.0016825 mW/cm².. This is below the uncontrolled exposure limit of 1 mW/cm².

802.11n HT20

Cable loss = 0	Output Power		Limit (dBm)
CH	Detector		
	PK (dBm)	AV (dBm)	
Low	23.43	13.35	30.00
Mid	23.57	14.06	
High	23.46	13.39	

Prediction of MPE limit at a given distance

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

$$S = \frac{PG}{4\pi R^2}$$

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

Maximum output power at antenna input terminal:	23.57	(dBm)
Maximum output power at antenna input terminal:	227.5097431	(mW)
Tune-Up power Tolerance:	1	dB
Duty cycle:	100	(%)
Maximum Pav :	286.417797	(mW)
Antenna gain (typical):	2.44	(dBi)
Maximum antenna gain:	1.753880502	(numeric)
Prediction distance:	20	(cm)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm ²)
Power density at predication frequency at 20 (cm)	0.0999886	(mW/cm ²)

Measurement Result:

The predicted power density level at 20 cm is 0.0999886 mW/cm².. This is below the uncontrolled exposure limit of 1 mW/cm²..

5150MHz – 5350MHz Mode:

The worst case of Average power a mode: refer to FCC test report for detail measurement date.

Power measurement:

802.11a

Mode	Channel	power (dBm)	limit(dBm)	result
802.11a	5180	14.23	23.97	pass
	5260	14.07	23.97	pass
	5320	14.11	23.97	pass

Prediction of MPE limit at a given distance

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

$$S = \frac{P}{4\pi R^2}$$

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

Maximum output power at antenna input terminal:	14.23	(dBm)
Maximum output power at antenna input terminal:	26.48500139	(mW)
Tune-Up power Tolerance:	1	dB
Duty cycle:	100	(%)
Maximum Pav :	33.34264128	(mW)
Antenna gain (typical):	0.71	(dBi)
Maximum antenna gain:	1.177605974	(numeric)
Prediction distance:	20	(cm)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm ²)
Power density at predication frequency at 20 (cm)	0.0078154	(mW/cm ²)

Measurement Result

The predicted power density level at 20 cm is 0.0078154 mW/cm². This is below the uncontrolled exposure limit of 1 mW/cm².

5470MHz – 5725MHz Mode:

The worst case of Average power a mode: refer to FCC test report for detail measurement date.

Power measurement:

802.11n HT40

Mode	Channel	power (dBm)	limit(dBm)	result
802.11a	5510	14.01	23.97	pass
	5550	14.27	23.97	pass
	5670	14.19	23.97	pass

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

Maximum output power at antenna input terminal:	14.27	(dBm)
Maximum output power at antenna input terminal:	26.73006409	(mW)
Tune-Up power Tolerance:	1	dB
Duty cycle:	100	(%)
Maximum Pav :	33.65115694	(mW)
Antenna gain (typical):	0.71	(dBi)
Maximum antenna gain:	1.177605974	(numeric)
Prediction distance:	20	(cm)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm ²)
Power density at predication frequency at 20 (cm)	0.0078877	(mW/cm ²)

Measurement Result

The predicted power density level at 20 cm is 0.0078877mW/cm². This is below the uncontrolled exposure limit of 1 mW/cm².

5725MHz – 5850MHz Mode:

The worst case of Average power a mode: refer to FCC test report for detail measurement date.

Power measurement:

802.11n HT20

Mode	Channel	power (dBm)	limit(dBm)	result
802.11a	5745	14.02	30	pass
	5785	13.92	30	pass
	5825	14.25	30	pass

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

Maximum output power at antenna input terminal:	14.25	(dBm)
Maximum output power at antenna input terminal:	26.6072506	(mW)
Tune-Up power Tolerance:	1	dB
Duty cycle:	100	(%)
Maximum Pav :	33.49654392	(mW)
Antenna gain (typical):	0.71	(dBi)
Maximum antenna gain:	1.177605974	(numeric)
Prediction distance:	20	(cm)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm ²)
Power density at predication frequency at 20 (cm)	0.0078515	(mW/cm ²)

Measurement Result

The predicted power density level at 20 cm is 0.0078515mW/cm². This is below the uncontrolled exposure limit of 1 mW/cm².

IC EIRP/Conducted Power level: 2.4GHz, BT mode

IC EIRP level

Frequency:	2441	MHz
Maximum output power at antenna input terminal:	8.57	(dBm)
Tune-Up power Tolerance:	1	dB
Duty cycle:	100	(%)
Antenna gain (typical):	2.44	(dBi)
EIRP:	15.885	mW
EIRP:	0.01589	W
EIRP Limit	2.706	W

Measurement Result:

The EIRP level is 0.01589 W which less than RSS102 section 2.5.2 Exemption Limits above 300 MHz and below 6 GHz condition.

IC EIRP/Conducted Power level: 2.4GHz, BLE mode

IC EIRP level

Frequency:	2441	MHz
Maximum output power at antenna input terminal:	5.91	(dBm)
Tune-Up power Tolerance:	1	dB
Duty cycle:	100	(%)
Antenna gain (typical):	2.44	(dBi)
EIRP:	8.610	mW
EIRP:	0.00861	W
EIRP Limit	2.706	W

Measurement Result:

The EIRP level is 0.00861 W which less than RSS102 section 2.5.2 Exemption Limits above 300 MHz and below 6 GHz condition.

IC EIRP/Conducted Power level: 2.4GHz, 802.11 n_HT20 mode

	2400-2483.5 2437	MHz MHz
Tune-UP power at antenna input terminal:	23.57	(dBm)
Tune-Up power Tolerance:	1	dB
Duty cycle:	100	(%)
Antenna gain (typical):	2.44	(dBi)
Conducted Power:	286.418	mW
Conducted Power:	0.28642	W
EIRP:	502.343	mW
EIRP:	0.50234	W
EIRP Limit	2.703	W

Measurement Result:

The Conducted Power level is 0.28642 W which less than RSS102 section 2.5.2 Exemption Limits (2.703 W) above 300 MHz and below 6 GHz condition.

IC EIRP/Conducted Power level: 5150-5350MHz mode

	5150-5350 5180	MHz MHz
Tune-UP power at antenna input terminal:	14.23	(dBm)
Tune-Up power Tolerance:	1	dB
Duty cycle:	100	(%)
Antenna gain (typical):	0.71	(dBi)
Conducted Power:	33.343	mW
Conducted Power:	0.03334	W
EIRP:	39.264	mW
EIRP:	0.03926	W
EIRP Limit	4.525	W

Measurement Result:

The Conducted Power level is 0.03334 W which less than RSS247 section 2.5.2 Exemption Limits (4.525W) above 300 MHz and below 6 GHz condition.

IC EIRP/Conducted Power level: 5470-5725MHz, 802.11n_HT40 mode

	5470-5725 5550	MHz MHz
Tune-UP power at antenna input terminal:	14.27	(dBm)
Tune-Up power Tolerance:	1	dB
Duty cycle:	100	(%)
Antenna gain (typical):	0.71	(dBi)
Conducted Power:	33.651	mW
Conducted Power:	0.03365	W
EIRP:	39.628	mW
EIRP:	0.03963	W
EIRP Limit	4.744	W

Measurement Result:

The Conducted Power level is 0.03365W which less than RSS247 section 2.5.2 Exemption Limits (4.744W) above 300 MHz and below 6 GHz condition.

IC EIRP/Conducted Power level: 5725-5850MHz, 802.11 an mode

	5725-5850 5825	MHz MHz
Tune-UP power at antenna input terminal:	14.25	(dBm)
Tune-Up power Tolerance:	1	dB
Duty cycle:	100	(%)
Antenna gain (typical):	0.71	(dBi)
Conducted Power:	33.497	mW
Conducted Power:	0.03350	W
EIRP:	39.446	mW
EIRP:	0.03945	W
EIRP Limit	4.903	W

Measurement Result:

The Conducted Power level is 0.03350W which less than RSS247 section 2.5.2 Exemption Limits (4.903W) above 300 MHz and below 6 GHz condition.

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