

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.

RSS 102 issue 5.

This is a Mobile device, the MPE is required.

FCC: According to §1.1310 and §2.1091 RF exposure is calculated.

Limits for Maximum Permissible 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

RSS 102 Issue 5 Mar. 2015

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 MHz⁶ 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.

Tune-Up Power and Tolerance:

	FCC	IC
RF power setting in TEST SoftWare	<p>2.4G :</p> <p>b mode : low(17) mid(17) high(16) g mode : low(13) mid(13) high(13) n20 mode : low(13) mid(13) high(12) n40 mode : low(13) mid(13) high(12)</p> <p>5G :</p> <p>B1 a mode : low(17) mid(17) high(17) n20 mode : low(13) mid(13) high(13) n40 mode : low(13) high(13) ac mode : CH 42 5210MHz(12)</p> <p>B4 a mode : low(17) mid(17) high(17) n20 mode : low(13) mid(13) high(13) n40 mode : low(13) high(13) ac mode : CH 155 5775MHz(12)</p>	<p>2.4G :</p> <p>b mode : low(17) mid(17) high(16) g mode : low(13) mid(13) high(13) n20 mode : low(13) mid(13) high(12) n40 mode : low(13) mid(13) high(12)</p> <p>5G :</p> <p>B1 a mode : low(14) mid(14) high(14) n20 mode : low(11) mid(11) high(11) n40 mode : low(11) high(11) ac mode : CH 42 5210MHz(11)</p> <p>B4 a mode : low(17) mid(17) high(17) n20 mode : low(13) mid(13) high(13) n40 mode : low(13) high(13) ac mode : CH 155 5775MHz(12)</p>

Power Tolerance: +/- 1 dB

Measured Power Level for FCC

Wi-Fi	Frequency Range (MHz)	Channels	Peak / Average Rated Power	Modulation Technology
802.11b	2412 – 2462(DTS)	11	19.74dBm (PK)	DSSS
802.11g	2412 – 2462(DTS)	11	22.26dBm (PK)	OFDM
802.11n (2.4G)	HT20 2412 – 2462(DTS)	11	22.17dBm (PK)	
	HT40 2422 – 2452(DTS)	7	22.17dBm (PK)	
802.11a	5180 – 5240(NII)	4	17.45dBm (AV)	
	5745 – 5825(NII)	5	13.51dBm (AV)	
802.11n(5G)	HT20, 5180 – 5240(NII)	4	16.79dBm (AV)	
	HT20, 5745 – 5825(NII)	5	12.38dBm (AV)	
	HT40, 5190 – 5230(NII)	2	15.33dBm (AV)	
	HT40, 5755 – 5815(NII)	2	13.85dBm (AV)	
802.11ac	HT80, 5210(NII)	1	20.14dBm (AV)	
	HT80, 5775(NII)	1	19.87dBm (AV)	
Modulation type		CCK, DQPSK, DBPSK for DSSS 256QAM.64QAM. 16QAM, QPSK, BPSK for OFDM		
Antenna Designation		Fixed Chip Antenna WiFi 2.4G Antenna : 2.1 dBi WiFi 5G Antenna : 2.4 dBi		

The EUT is compliance with IEEE 802.11 a/b/g/n/ac Standard.

Measured Power Level for IC

Wi-Fi	Frequency Range (MHz)	Channels	Peak / Average Rated Power	Modulation Technology
802.11b	2412 – 2462(DTS)	11	19.74dBm (PK)	DSSS
802.11g	2412 – 2462(DTS)	11	22.26dBm (PK)	OFDM
802.11n (2.4G)	HT20 2412 – 2462(DTS)	11	22.17dBm (PK)	
	HT40 2422 – 2452(DTS)	7	22.17dBm (PK)	
802.11a	5180 – 5240(NII)	4	16.95dBm EIRP (AV)	
	5745 – 5825(NII)	5	13.51dBm (AV)	
802.11n(5G)	HT20, 5180 – 5240(NII)	4	17.17dBm EIRP (AV)	
	HT20, 5745 – 5825(NII)	5	12.38dBm (AV)	
	HT40, 5190 – 5230(NII)	2	16.27dBm EIRP (AV)	
	HT40, 5755 – 5815(NII)	2	13.85dBm (AV)	
802.11ac	HT80, 5210(NII)	1	22.54dBm EIRP (AV)	
	HT80, 5775(NII)	1	19.87dBm (AV)	
Modulation type		CCK, DQPSK, DBPSK for DSSS 256QAM.64QAM. 16QAM, QPSK, BPSK for OFDM		
Antenna Designation		Fixed Chip Antenna WiFi 2.4G Antenna : 2.1 dBi WiFi 5G Antenna : 2.4 dBi		

The EUT is compliance with IEEE 802.11 a/b/g/n/ac Standard.

FCC: 2.4GHz mode: 802.11 b mode

Maximum Permissible Exposure (MPE) Evaluation: The worst case of Average power

Power measurement: refer to Part15.247 and RSS 247 report for details.

802.11b

Cable loss = 0	Output Power		Limit (dBm)
	Detector		
	PK (dBm)	AV (dBm)	
Low	19.74	13.51	30
Mid	19.42	13.36	
High	18.88	13.14	

Power Tolerance: +/- 1 dBm

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

	CH 1-11	
Tune-Up power at antenna input terminal:	13.51	(dBm)
Tune-Up power at antenna input terminal:	22.44	(mW)
Tune-Up power Tolerance:	1.00	dB
Duty cycle:	100.00	(%)
Maximum Pav :	28.25	(mW)
Antenna gain (typical):	2.10	(dBi)
Maximum antenna gain:	1.62	(numeric)
Prediction distance:	20.00	(cm)
MPE limit for uncontrolled exposure at prediction	1.00	(mW/cm ²)
Power density at predication frequency at 20 (cm) distance	0.0091	(mW/cm ²)

Measurement Result:

The worst power density is 0.0091 mW/cm² which is less than 1 mW/cm².

5150MHz – 5250MHz Mode:

Power measurement:

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

802.11AC HT80

Freq(MHz)	power (dBm)	limit(dBm)	result
5210	20.14	23.97	pass

Power Tolerance: +/- 1 dBm

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:	20.14	(dBm)
Maximum output power at antenna input terminal:	103.2761406	(mW)
Tune-Up power Tolerance:	1	dB
Duty cycle:	100	(%)
Maximum Pav :	130.0169578	(mW)
Antenna gain (typical):	2.4	(dBi)
Maximum antenna gain:	1.737800829	(numeric)
Prediction distance:	20	(cm)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm ²)
Power density at predication frequency at 20 (cm)	0.0449728	(mW/cm ²)

Result:

The predicted power density level at 20 cm is 0.04497 mW/cm². This is below the uncontrolled exposure limit of 1 mW/cm².

5725MHz – 5850MHz Mode:

Power measurement:

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

802.11AC HT80

Freq(MHz)	power (dBm)	limit(dBm)	result
5775	19.87	30	pass

Power Tolerance: +/- 1 dBm

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:	19.87	(dBm)
Maximum output power at antenna input terminal:	97.05099672	(mW)
Tune-Up power Tolerance:	1	dB
Duty cycle:	100	(%)
Maximum Pav :	122.179966	(mW)
Antenna gain (typical):	2.4	(dBi)
Maximum antenna gain:	1.737800829	(numeric)
Prediction distance:	20	(cm)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm ²)
Power density at predication frequency at 20 (cm)	0.0422620	(mW/cm ²)

Result:

The predicted power density level at 20 cm is 0.04226mW/cm². This is below the uncontrolled exposure limit of 1 mW/cm².

Simultaneous transmission mode

2.4GHz mode + (5150MHz – 5250MHz) Mode:

Prediction frequency:	2.4	(GHz)
Power density at predication frequency at 20 (cm)	0.0091	(mW/cm ²)

Prediction frequency:	5	(GHz)
Power density at predication frequency at 20 (cm)	0.04497	(mW/cm ²)
2.4GHz + 5GHz Power density at predication frequency at 20 (cm) distance	0.0540700	(mW/cm ²)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm ²)

The predicted power density level at 20 cm is 0.1049mW/cm². This is below the uncontrolled exposure limit of 1 mW/cm².

Simultaneous transmission mode

2.4GHz mode + (5725MHz – 5850MHz) Mode:

Prediction frequency:	2.4	(GHz)
Power density at predication frequency at 20 (cm)	0.0091	(mW/cm ²)

Prediction frequency:	5	(GHz)
Power density at predication frequency at 20 (cm)	0.04226	(mW/cm ²)
2.4GHz + 5GHz Power density at predication frequency at 20 (cm) distance	0.0513600	(mW/cm ²)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm ²)

Result:

The predicted power density level at 20 cm is 0.0619 mW/cm². This is below the uncontrolled exposure limit of 1 mW/cm².

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

	2400-2483.5	MHz
	2402	MHz
Tune-UP power at antenna input terminal:	13.51	(dBm)
Tune-Up power Tolerance:	1	dB
Duty cycle:	100	(%)
Antenna gain (typical):	2.1	(dBi)
Conducted Power:	28.249	mW
Conducted Power:	0.02825	W
EIRP:	45.814	mW
EIRP:	0.04581	W
EIRP Limit	2.676	W

IC EIRP/Conducted Power level: 5150-5250MHz mode, 802.11ac HT80 mode

	5150-5250	MHz
	5210	MHz
Tune-UP power at antenna input terminal:	22.54	(dBm)
Tune-Up power Tolerance:	1	dB
Duty cycle:	100	(%)
Antenna gain (typical):	2.4	(dBi)
Conducted Power:	225.944	mW
Conducted Power:	0.22594	W
EIRP:	392.645	mW
EIRP:	0.39264	W
EIRP Limit	4.543	W

IC EIRP/Conducted Power level: 5725-5850MHz, 802.11ac HT80 mode

	5725-5850 5775	MHz MHz
Tune-UP power at antenna input terminal:	22.27	(dBm)
Tune-Up power Tolerance:	1	dB
Duty cycle:	100	(%)
Antenna gain (typical):	2.4	(dBi)
Conducted Power:	212.324	mW
Conducted Power:	0.21232	W
EIRP:	368.978	mW
EIRP:	0.36898	W
EIRP Limit	4.874	W

Measurement Result:

The Conducted Power level is 0.36898W which less than RSS102 section 2.5.2 Exemption Limits (4.880W) above 300 MHz and below 6 GHz condition .

~~ End ~~