

MAXIMUM PERMISSIBLE EXPOSURE

The WL11A module is used with an antenna whose gain at 5GHz bands is higher than one filed in the original submission. Far-field antenna gain generally does not apply to SAR. On the other hand, the Maximum Permissible Exposure (MPE) must be evaluated with the maximum antenna gain allowed for each frequency band. Therefore, with new antenna gain at 5GHz, the MPE is evaluated and SAR evaluation isn't performed.

This MPE report demonstrates compliance for WL11A Module with FCC CFR 47 §1.1310 and 2.1091 and IC Safety Code 6, Section 2.2.1 (a) for standalone and collocated simultaneous transmission in mobile exposure conditions. The MPE analysis is valid for transmitters operating within the parameters defined in Table A2 and A3 used for analysis.

Any collocated transmitter must have a valid FCC ID documenting equivalent or degraded RF Output Power with the collocated parameters calculated in this MPE analysis.

The mobile classification applies when 20 cm or more separation distance is maintained between the end user and WWAN, WLAN and Bluetooth transmission antennas.

FCC RULES

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—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 (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	€
3.0–30	1842/f	4.89/f	*(900/f ²)	€
30–300	61.4	0.163	1.0	€
300–1500			f/300	€
1500–100,000			5	€
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	3C
1.34–30	824/f	2.19/f	*(180/f ²)	3C

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

IC RULES

IC Safety Code 6, Section 2.2.1 (a) A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column 1 of Table 5, if the field strength exceeds the value given in Column 2 or 3 of Table 5, when averaged spatially and over time, or if the power density exceeds the value given in Column 4 of Table 5, when averaged spatially and over time.

Table 5
Exposure Limits for Persons Not Classed As RF and Microwave Exposed Workers (Including the General Public)

1 Frequency (MHz)	2 Electric Field Strength; rms (V/m)	3 Magnetic Field Strength; rms (A/m)	4 Power Density (W/m ²)	5 Averaging Time (min)
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
300–1 500	1.585 <i>f</i> ^{0.5}	0.0042 <i>f</i> ^{0.5}	<i>f</i> /150	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	616 000 / <i>f</i> ^{1.2}
150 000–300 000	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>	616 000 / <i>f</i> ^{1.2}

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

- Notes:**
1. Frequency, *f*, is in MHz.
 2. A power density of 10 W/m² is equivalent to 1 mW/cm².
 3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

EQUATIONS

Power density is given by:

$$S = \text{EIRP} / (4 * \text{Pi} * D^2)$$

where

S = Power density in W/m²

EIRP = Equivalent Isotropic Radiated Power in W

D = Separation distance in m

Power density in units of W/m² is converted to units of mWc/m² by dividing by 10.

In the table(s) below, Power and Gain are entered in units of dBm and dBi respectively and conversions to linear forms are used for the calculations.

LIMITS

From FCC §1.1310 Table 1 (B),

the maximum value of

S = 0.469 mW/cm² @ 704MHz

S = 0.521 mW/cm² @ 779.5MHz

S = 0.549 mW/cm² @ 824.2MHz

S = 1.0 mW/cm² @ 1710MHz, 1900MHz, 2.4GHz, 5GHz

From IC Safety Code 6, Section 2.2 Table 5 Column 4,

S = 4.69 W/m² @ 704MHz

S = 5.21 W/m² @ 779.5MHz

S = 5.49 W/m² @ 824.2MHz

S = 10 W/m² @ 1710MHz, 1900MHz, 2.4GHz, 5GHz

1. Stand Alone Transmitter Calculation

RESULTS

When the Module WL11A is installed into Panasonic Laptop PC (Representative Model: CF-53mk2), the antenna gains at 5GHz bands are changed from ones of the original filing to the followings:

<u>Bands</u>	<u>Originally Listed Gain</u>	<u>Main Antenna Gain</u>	<u>Sub Antenna Gain</u>
2400-2500MHz	3.2dBi	0.9dBi	3.06dBi
5150-5350MHz	3.7dBi	0.9dBi	<u>6.74dBi</u>
5470-5725MHz	4.8dBi	1.35dBi	<u>5.94dBi</u>
5725-5850MHz	5.0dBi	1.35dBi	<u>6.22dBi</u>

Table A1: WL11A

Technology	Separation Distance (m)	Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	IC Power Density (W/m²)	FCC Power Density (mW/cm²)
2412 - 2462	0.20	16.70	3.20	19.90	0.19	0.019
5150 - 5250	0.20	16.30	6.74	23.04	0.40	0.040
5250 - 5350	0.20	16.20	6.74	22.94	0.39	0.039
5470 - 5725	0.20	16.70	5.94	22.64	0.37	0.037
5725 - 5850	0.20	16.70	6.22	22.92	0.39	0.039

Note 1: The output power is from the original filing (FCC ID: PD962205ANH, IC: 1000M-62205ANH). The value is average power.

Table A2: Bluetooth

Technology	Separation Distance (m)	Output Power (dBm)	Antenna Gain (dBi)	IC Power Density (W/m²)	FCC Power Density (mW/cm²)
2402 - 2480	0.20	13.85	5.0	0.15	0.015

Table A3: WWAN

Technology	Frequency (MHz)	Separation Distance (m)	Output Power (dBm)	Antenna Gain (dBi)	ERP (W) *3	Duty Cycle (%)	Average EIRP (dBm)	Average EIRP (W)	FCC Power Density (mW/cm ²)	FCC MPE Limit (mW/cm ²)
GPRS/EDGE 850 (2 UL Slots)	824 - 849	0.20	32.50	1.32	1.47	25	27.82	0.61	0.120	0.549
GPRS/EDGE 1900 (2 UL Slots)	1850 - 1910	0.20	29.70	3.0	1.14	25	26.70	0.47	0.093	1.000
LTE Band 4	1710 - 1755	0.20	24.50	5.5	0.61	100	30.00	1.00	0.199	1.000
LTE Band 17	704 - 716	0.20	24.20	3.0	0.32	100	27.20	0.52	0.104	0.469
LTE Band 13	779.5 - 784.5	0.20	23.60	9.0	1.11	100	32.60	1.82	0.362	0.521
WCDMA/HSPA 850MHz *1	824-849	0.20	25.00	7.0	0.97	100	32.00	1.58	0.315	0.549
CDMA 850MHz *2	824-849	0.20	25.00	7.0	0.97	100	32.00	1.58	0.315	0.549
WCDMA/HSPA 1900MHz *1	1850 - 1910	0.20	25.00	3.5	0.43	100	28.50	0.71	0.141	1.000
CDMA 1900MHz *2	1850 - 1910	0.20	25.00	3.5	0.43	100	28.50	0.71	0.141	1.000

Remarks:

*1: This mode includes REL99, Rel5 HSDPA and Rel6 HSUPA.

*2: This mode includes 1xEVDO Release 0 and 1xEVDO Revision A.

*3: The FCC OET Bulletin 65 Supplement C states that mobile devices identified in 47 CFR §2.1091 they operate at frequencies below 1.5 GHz with an ERP of 1.5 watts or more, or if they operate at frequencies above 1.5 GHz and their ERP is 3 watts or more are required to perform routine environmental evaluation for RF exposure prior to equipment authorization or use; otherwise, they are categorically excluded.

2. Collocated MPE Calculations

From FCC KDB 447498 Section 8, transmitters and modules for use in mobile exposure conditions that allow simultaneous transmission should address the following conditions;

- a) Transmitters and modules certified for mobile or portable exposure conditions and categorically excluded by § 2.1091(c) can be incorporated in mobile host devices without further testing or certification when:
- i) The closest separation among all simultaneous transmitting antennas is ≥ 20 cm; or
 - ii) The antenna separation distance and MPE compliance boundary requirements that enable all simultaneous transmitting antennas incorporated within the host to comply with MPE limits are specified in the application filing of at least one of the certified transmitters incorporated in the host device. In addition, when transmitters certified for portable use are incorporated in a mobile host device the antenna(s) must be ≥ 5 cm from all other simultaneous transmitting antennas.
- b) All antennas in the final product must be at least 20 cm from users and nearby persons.

OET Bulletin 65 "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields"

Σ [(the highest MPE for each mobile transmitter/antenna included in the simultaneous transmission configuration) / (the corresponding MPE limit)] < 1

Note: This formula is quoted from "KDB616217 D03 Section-Simultaneous Transmission Considerations 4)b)ii)".

RESULTS

Table B1: WL11A + Bluetooth

Technology	WLAN only FCC Power Density (mW/cm ²)	WLAN + BT FCC Power Density (mW/cm ²)	WLAN + BT/ MPE Limit
2412 - 2462	0.019	0.034	0.034
5150 - 5250	0.040	0.055	0.055
5250 - 5350	0.039	0.054	0.054
5470 - 5725	0.037	0.052	0.052
5725 - 5850	0.039	0.054	0.054

Table B2: WWAN

Technology	Frequency (MHz)	FCC Power Density (mW/cm ²)	FCC MPE Limit (mW/cm ²)	WWAN/MPE Limit
GPRS 850 (2 UL Slots)	824 - 849	0.120	0.549	0.219
GPRS 1900 (2 UL Slots)	1850 - 1910	0.093	1.000	0.093
LTE Band 4	1710 - 1755	0.199	1.000	0.199
LTE Band 17	704 - 716	0.104	0.469	0.222
LTE Band 13	779.5 - 784.5	0.362	0.521	0.695
WCDMA 850MHz	824 - 849	0.315	0.549	0.574
CDMA 850MHz	824 - 849	0.315	0.549	0.574
WCDMA 1900MHz	1850 - 1910	0.141	1.000	0.141
CDMA 1900MHz	1850 - 1910	0.141	1.000	0.141

Table C: WL11A + Bluetooth + WWAN

Technology	WWAN/MPE Limit	WLAN(2.4G Hz) + BT/MPE Limit	WLAN(5.2G Hz) + BT/MPE Limit	WLAN(5.3G Hz) + BT/MPE Limit	WLAN(5.5G Hz) + BT/MPE Limit	WLAN(5.8G Hz) + BT/MPE Limit	Sum	Limit
GPRS 850 (2 UL Slots)	0.219	0.034					0.253	1
	0.219		0.055				0.274	1
	0.219			0.054			0.273	1
	0.219				0.052		0.271	1
	0.219					0.054	0.273	1
GPRS 1900 (2 UL Slots)	0.093	0.034					0.127	1
	0.093		0.055				0.148	1
	0.093			0.054			0.147	1
	0.093				0.052		0.145	1
	0.093					0.054	0.147	1
LTE Band 4	0.199	0.034					0.233	1
	0.199		0.055				0.254	1
	0.199			0.054			0.253	1
	0.199				0.052		0.251	1
	0.199					0.054	0.253	1
LTE Band 17	0.222	0.034					0.256	1
	0.222		0.055				0.277	1
	0.222			0.054			0.276	1
	0.222				0.052		0.274	1
	0.222					0.054	0.276	1
LTE Band 13	0.695	0.034					0.729	1
	0.695		0.055				0.750	1
	0.695			0.054			0.749	1
	0.695				0.052		0.747	1
	0.695					0.054	0.749	1
WCDMA 850MHz	0.574	0.034					0.608	1
	0.574		0.055				0.629	1
	0.574			0.054			0.628	1
	0.574				0.052		0.626	1
	0.574					0.054	0.628	1
CDMA 850MHz	0.574	0.034					0.608	1
	0.574		0.055				0.629	1
	0.574			0.054			0.628	1
	0.574				0.052		0.626	1
	0.574					0.054	0.628	1
WCDMA 1900MHz	0.141	0.034					0.175	1
	0.141		0.055				0.196	1
	0.141			0.054			0.195	1
	0.141				0.052		0.193	1
	0.141					0.054	0.195	1
CDMA 1900MHz	0.141	0.034					0.175	1
	0.141		0.055				0.196	1
	0.141			0.054			0.195	1
	0.141				0.052		0.193	1
	0.141					0.054	0.195	1

As shown in the calculations above, when all devices are operational, the worst case combination is within the limit at a distance of 20cm from the device.