



MPE Evaluation for MC7750 Module

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1. Introduction

This Maximum Permissible Exposure (MPE) report demonstrates compliance for MC7750 module with FCC CFR 47 §2.1091 and IC RSS-102 for collocated simultaneous transmission in mobile exposure conditions. The MPE analysis is valid for transmitters operating within the parameters defined in Table 3 and limited for Canada / US bands only.

The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure.

A separation distance of 20cm or more shall be maintained between the end user and each WWAN, WiMAX, WLAN and Bluetooth transmitting antennas.

Portable user conditions or additional collocated modules not allowed based on this RF exposure analysis require a Class II permissive change and updated MPE or SAR report.

2. RF Exposure Limits and Equations

FCC RULES:

According to FCC OET Bulletin 65 Supplement C, 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) Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Time E ² , H ² or S (minutes)
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
1500-100,000	--	--	1.0	30

f = frequency in MHz *Plane-wave equivalent power density

Table 1 : Limits for Maximum Permissible Exposure (MPE)

IC RULES:

IC has adopted the RF field strength limits established in Health Canada’s RF exposure guideline. The limits are shown in Table 2 below per RSS-102.

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.

Table 2: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

EQUATIONS:

Power density is given by:

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

where

S = Power density (mW/cm²)

EIRP = Equivalent Isotropic Radiated Power (mW)

D = Separation distance (cm)

3. Product Declarations

Mode	Equipment Category	Max Transmitter Duty Cycle	Transmitter Range (MHz)	Maximum Conducted Power		Max Antenna Gain (dBi)
				(dBm)	(W)	
GPRS	Class 10	25%	824 - 849	33.0	2.00	5.0
			1850 - 1910	30.0	1.00	3.0
GPRS	Class 11	37.5%	824 - 849	31.2	1.32	5.0
			1850 - 1910	28.2	0.66	3.0
GPRS	Class 12	50.0%	824 - 849	30.0	1.00	5.0
			1850 - 1910	27.0	0.50	3.0
EDGE	Class 10	25%	824 - 849	28.0	0.63	5.0
			1850 - 1910	27.0	0.50	3.0
EDGE	Class 11	37.5%	824 - 849	26.2	0.42	5.0
			1850 - 1910	25.2	0.33	3.0
EDGE	Class 12	50.0%	824 - 849	25.0	0.32	5.0
			1850 - 1910	24.0	0.25	3.0
UMTS	HSDPA HSUPA	100%	824 - 849	24.0	0.25	5.0
			1850 - 1910	24.0	0.25	3.0
LTE	Band 13	100%	777 - 787	24.0	0.25	7.0
CDMA	EVDO rA	100%	824 - 849	25.0	0.32	5.0
			1850 - 1910	25.0	0.32	3.0

Table 3: WWAN Transmitter Declarations

This MPE analysis is applicable to any collocated transmitters with transmit power less than or equal to 29.0dBm for WLAN, less than or equal to 27.0dBm for WiMAX, and less than or equal to 15.0dBm for BT. Specific FCC IDs for those devices are not necessary or identified in this analysis providing they are classified as mobile transmitters. A 100% duty cycle is used for calculations to present a worse-case analysis.

4. MPE Calculations

The WiMAX, WLAN, and BT transmit power and antenna gain parameters represent a maximum transmit power for a given frequency band.

Integration of a WiMAX, WLAN, and BT module that exceeds the parameters requires a new FCC authorization or permissive change application. A maximum antenna gain of 4dBi for WLAN and 5 dBi for WiMAX/BT has been assumed for all collocated antennas.

Table 3 summarizes transmitter parameters associated with this analysis.

4.1. Individual Transmitter Calculations

The power density calculations for the individual transmitters per wireless technology at an exposure separation distance of 20cm are shown in Table 4.

For frequency dependent limit, the lowest transmitter frequency was used to represent the lowest MPE limit in this analysis (eg. 824MHz = 0.549mW/cm²)

The WiMAX, WLAN, and BT power levels listed represent the worse-case scenario for corresponding frequency ranges given.

Technology	Frequency (MHz)	Maximum Conducted Power (dBm)	Maximum Conducted Power (W)	Maximum Antenna Gain (dBi)	Duty Cycle	Average EIRP (dBm)	Average EIRP (mW)	Power Density @ 20cm (mW/cm ²)	FCC MPE Limit (mW/cm ²)
GPRS 2 UL	824 - 849	33	2.00	5	0.25	31.98	1577.393	0.314	0.549
GPRS 3 UL	824 - 849	31.2	1.32	5	0.375	31.94	1563.260	0.311	0.549
GPRS 4 UL	824 - 849	30	1.00	5	0.5	31.99	1581.139	0.315	0.549
UMTS	824 - 849	24	0.25	5	1	29.00	794.328	0.158	0.549
CDMA	824 - 849	25	0.32	5	1	30.00	1000.000	0.199	0.549
GPRS 2 UL	1850 - 1910	30	1.00	3	0.25	26.98	498.816	0.099	1.000
GPRS 3 UL	1850 - 1910	28.2	0.66	3	0.375	26.94	494.346	0.098	1.000
GPRS 4 UL	1850 - 1910	27	0.50	3	0.5	26.99	500.000	0.099	1.000
UMTS	1850 - 1910	24	0.25	3	1	27.00	501.187	0.100	1.000
CDMA	1850 - 1910	25	0.32	3	1	28.00	630.957	0.126	1.000
LTE	777 - 787	24	0.25	7	1	31.00	1258.925	0.250	0.469
WLAN	2400 - 2500	29	0.79	4	1	33.00	1995.262	0.397	1.000
WLAN	5150 - 5850	29	0.79	4	1	33.00	1995.262	0.397	1.000
WiMAX	2300 - 2400	27	0.50	5	1	32.00	1584.893	0.315	1.000
WiMAX	2500 - 2700	27	0.50	5	1	32.00	1584.893	0.315	1.000
WiMAX	3300 - 3800	27	0.50	5	1	32.00	1584.893	0.315	1.000
BT	2400 - 2500	15	0.032	5	1	20.00	100.000	0.020	1.000

Table 4: WWAN, WiMAX, WLAN, and BT Individual MPE Calculation

4.2. Collocated MPE Calculation

Per OET Bulletin 65, when RF sources have difference frequencies, the fraction of the FCC power density limit shall be determined and the sum of all fractional components shall be less than 1.

WLAN/WiMAX Band (GHz)	WLAN/WiMAX Pd (mW/cm ²)	BT Pd (mW/cm ²)	WLAN/WiMAX + BT Pd (mW/cm ²)	Limit
2.3 - 2.4	0.315	0.020	0.335	1.000
2.4 - 2.5	0.397		0.417	
2.5 - 2.7	0.315		0.335	
3.3 3.8	0.315		0.335	
5.15 - 5.85	0.397		0.417	

Table 5: WLAN/WiMAX + BT Collocated MPE Calculation

WLAN / WiMAX Band (GHz)	WLAN / WiMAX + BT Pd (mW/cm ²)	FCC MPE Limit (mW/cm ²)	(WLAN / WiMAX + BT Pd) / (MPE Limit)	850 MHz WWAN Pd (mW/cm ²)	FCC MPE Limit (mW/cm ²)	(WWAN 850 MHz) / MPE Limit	(850 MHz WWAN + WLAN / WiMAX + BT fraction)	Limit	Pass/Fail
2.3 - 2.4	0.335	1.000	0.335	0.315	0.549	0.573	0.908	1.000	Pass
2.4 - 2.5	0.417		0.417				0.989		Pass
2.5 - 2.7	0.335		0.335				0.908		Pass
3.3 - 3.8	0.335		0.335				0.908		Pass
5.15 - 5.85	0.417		0.417				0.989		Pass

Table 6: WWAN 850MHz + WLAN / WiMAX + BT Collocated MPE Calculation

WLAN / WiMAX Band (GHz)	WLAN / WiMAX + BT Pd (mW/cm ²)	FCC MPE Limit (mW/cm ²)	(WLAN / WiMAX + BT Pd) / (MPE Limit)	1900 MHz WWAN Pd (mW/cm ²)	FCC MPE Limit (mW/cm ²)	(WWAN 1900 MHz) / MPE Limit	(1900 MHz WWAN + WLAN / WiMAX + BT fraction)	Limit	Pass/Fail
2.3 - 2.4	0.335	1.000	0.335	0.126	1.000	0.126	0.461	1.000	Pass
2.4 - 2.5	0.417		0.417				0.542		Pass
2.5 - 2.7	0.335		0.335				0.461		Pass
3.3 - 3.8	0.335		0.335				0.461		Pass
5.15 - 5.85	0.417		0.417				0.542		Pass

Table 7: WWAN 1900MHz + WLAN / WiMAX + BT Collocated MPE Calculation

WLAN / WiMAX Band (GHz)	WLAN / WiMAX + BT Pd (mW/cm ²)	FCC MPE Limit (mW/cm ²)	(WLAN / WiMAX + BT Pd) / (MPE Limit)	700 MHz WWAN Pd (mW/cm ²)	FCC MPE Limit (mW/cm ²)	(WWAN 700 MHz) / MPE Limit	(700 MHz WWAN + WLAN / WiMAX + BT fraction)	Limit	Pass/Fail
2.3 - 2.4	0.335	1.000	0.335	0.250	0.469	0.534	0.869	1.000	Pass
2.4 - 2.5	0.417		0.417				0.950		Pass
2.5 - 2.7	0.335		0.335				0.869		Pass
3.3 - 3.8	0.335		0.335				0.869		Pass
5.15 - 5.85	0.417		0.417				0.950		Pass

Table 8: WWAN 700MHz + WLAN / WiMAX + BT Collocated MPE Calculation

5. Conclusion

The analysis concludes that the MC7750 module, when transmitting simultaneously with other co-located radio transmitters within a host device, is compliant with the FCC/IC RF exposure requirements in mobile-only exposure condition, provided the conducted power and antenna gain do not exceed the limits in Table 9 for each given frequency band per wireless technology.

	Technology	Frequency (MHz)	Maximum Conducted Power (dBm)	Maximum Antenna Gain (dBi)
MC7700 module	GPRS/EDGE	824 - 849	33	5
	UMTS	824 - 849	24	5
	CDMA	824 - 849	25	5
	GPRS/EDGE	1850 - 1910	30	3
	UMTS	1850 - 1910	24	3
	CDMA	1850 - 1910	25	3
	LTE	777 - 787	24	7
Collocated Transmitters	WLAN	2400 - 2500	29	4
	WLAN	5150 - 5850	29	4
	WiMAX	2300 - 2400	27	5
	WiMAX	2500 - 2700	27	5
	WiMAX	3300 - 3800	27	5
	BT	2400 - 2500	15	5

Table 9: Summary of Maximum Conducted Power and Antenna Gain