

Maximum Permissible Exposure (MPE) Evaluation Report

Report No. : TS09120112-EME

Model No. : HL-11N

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**Test Method/ FCC 1.1310 and Safety Code 6
Standard:**

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Summary of Tests

MPE Evaluation meet FCC OET No. 65: 1997, IEEE C95.1-2005 and IC Safety Code 6

**802.11n WLAN Mini-PCI Module - Model: HL-11N
FCC ID: TWS-HL-11N**

Test	Reference	Results
MPE Evaluation	FCC Guidelines for Human Exposure IEEE C95.1 and IC Safety Code 6	Complies

1. Introduction

The EUT operates in the 2.4 GHz ISM band. Due to the EUT (include antenna) at its normal operation distance is at least 20 cm from the human body, the EUT was defined as a Mobile Device.

The reason to do the MPE Evaluation is to avoid the RF hazard to human body. The maximum output power and gain of the antenna were used to calculate the limited Power density (S) at 20 cm distance away from the product. The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 and Safety Code 6 are followed.

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.

2. RF Exposure Limit

For FCC:

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

Limits for Maximum Permissible Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time (minutes)
(A) Limits for Occupational / Control Exposures				
30-300	61.4	0.163	1.0	6
300-1500	-	-	F/300	6
1500-100,000	-	-	5	6
(B) Limits for General Population / Uncontrolled Exposure				
30-300	27.5	0.073	0.2	30
300-1500	-	-	F/1500	30
1500-100,000	-	-	1.0	30

F= Frequency in MHz

For IC:
 Exposure Limits for Persons Not Classed As RF and Microwave Exposed Workers
 (Including the General Public)

Frequency Range (MHz)	Electric Field Strength; rms (V/m)	Magnetic Field Strength; rms (A/m)	Power Density (W/m ²)	Average Time (minutes)
0.003-1	280	2.19	-	6
1-10	280/f	2.19/f	-	6
10-30	28	2.19/f	-	6
30-300	28	0.073	2*	30
300-1500	1.585 f ^{0.5}	0.0042 f ^{0.5}	F/150	30
1500-15000	61.4	0.163	10	30
15000-150000	61.4	0.163	10	616000/f ^{1.2}
150000-300000	0.158 f ^{0.5}	4.21 × 10 ⁻⁴ f ^{0.5}	6.67 × 10 ⁻⁵ f	616000/f ^{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).

3. RF Exposure calculations

From §FCC 1.1310 table 1 and §Safety Code 6 table 5, the maximum permissible RF exposure for an uncontrolled environment is 1 mW/(cm²) (or 10 W/m²)*

* 10 W/m² = 1 mW/ (cm²)

Power density (S) is calculated by the following formula:

$$S = (P * G)/4\pi R^2$$

where, S = Power density (mW/cm²)

P = Output power to antenna (mW)

R = Distance between radiating structure and observation point (cm)

G = Gain of antenna in numeric

π = 3.1416

Example:

Assume a mobile device operates at 2412MHz and its maximum output power is 50mW, and the maximum gain of antenna is 1 (numeric) /0dBi.

then the power density (S) = (50 * 1)/4*π*20² = 0.00995 (mW/cm²) (or = 0.0995 W/m²)

4. Description of EUT

The EUT is a 802.11n WLAN Mini-PCI Module. It supports two transmitted and three received MIMO functions. It can transmit solely at 802.11b/g mode and transmit independently and simultaneously at 802.11n mode.

For more detail features, please refer to User's manual as file name “Installation guide.pdf”

4.1 Antenna description

The antenna is affixed to the EUT using a unique connector, which allows for replacement of a broken antenna, but DOES NOT use a standard antenna jack or electrical connector.

Ant.	Model number	Antenna Type	Connector Type	Gain (dBi)
1	IWX-144RSXXX-257	Dipole Antenna	SMA Reverse	2
2	IWX-1511RSXX-999	Dipole Antenna	SMA Reverse	5
3	IWF-144XIPAX-257	Dipole Antenna attached with antenna cable	IPEX	2
4	C612-510008-A	Dipole Antenna	SMA Reverse	2

Antenna Cable description

Ant. Cable	Product Name	Connector Type	Cable Length (mm)
1	Cable Assy MI-113 L=160MM SMA For I-PEX	SMA Reverse to IPEX	160mm
2	Cable Assy MI-113 L=215MM SMA For I-PEX	SMA Reverse to IPEX	215mm



Operation mode

The EUT was supplied with DC 3.3V from Notebook PC (test voltage: 120 Vac, 60 Hz) and it was running in operating mode controlled by “QAtest” program.

The EUT was transmitted continuously during the test.

The following test mode(s) were pre-tested:

Test Mode		
Mode	Antenna	Antenna cable
1	IWX-144RSXXX-257	1
2	IWX-1511RSXX-999	1
3	IWF-144XIPAX-257	-
4	C612-510008-A	1
5	IWX-144RSXXX-257	2
6	IWX-1511RSXX-999	2
7	C612-510008-A	2

After pretest, the final tests were executed under test modes with highest emission and recorded in this report individually.

The following test modes were final test modes:

Final Test Mode	
Maximum Output Power	Mode 1, Mode 2

5. Test results

Test Mode: Mode 1

Mode	Channel Frequency (MHz)	Maximum antenna gain (numeric)	Output power to antenna (mW)	Power density (mW/cm ²)	Limit of power density (mW/cm ²)
802.11b	2412	1.58	92.68	0.029223360	1.0
	2437	1.58	113.50	0.035787400	1.0
	2462	1.58	71.12	0.022424881	1.0
802.11g	2412	1.58	199.07	0.062766823	1.0
	2437	1.58	237.14	0.074770476	1.0
	2462	1.58	197.24	0.062191373	1.0
802.11n HT20	2412	1.58	327.21	0.103169399	1.0
	2437	1.58	452.93	0.142810879	1.0
	2462	1.58	254.02	0.080093799	1.0
802.11n HT40	2422	1.58	147.11	0.046384074	1.0
	2437	1.58	339.52	0.107053012	1.0
	2452	1.58	244.65	0.077140678	1.0

Test Mode: Mode 2

Mode	Channel Frequency (MHz)	Maximum antenna gain (numeric)	Output power to antenna (mW)	Power density (mW/cm ²)	Limit of power density (mW/cm ²)
802.11b	2412	3.16	63.83	0.040154123	1.0
	2437	3.16	82.04	0.051609559	1.0
	2462	3.16	49.20	0.030954953	1.0
802.11g	2412	3.16	187.07	0.117687448	1.0
	2437	3.16	237.14	0.149186713	1.0
	2462	3.16	184.93	0.116340291	1.0
802.11n HT20	2412	3.16	260.13	0.163653400	1.0
	2437	3.16	452.93	0.284945165	1.0
	2462	3.16	254.02	0.159808138	1.0
802.11n HT40	2422	3.16	107.50	0.067629013	1.0
	2437	3.16	347.57	0.218660583	1.0
	2452	3.16	215.80	0.135765343	1.0

The Notice in Installation Manual has been stated as below:

While installing and operating this transmitter, the radio frequency exposure limit of 1 mW/ (cm²) may be exceeded at distances close to the transmitter. therefore, the user must maintain a minimum distance of 20 cm from the device at all time.