



# ***UNDP-1 Lenovo Collocated Mobile Generic MPE Report***

**80-VK276-11 Rev. A**

**July 29, 2009**

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**QUALCOMM Incorporated  
5775 Morehouse Drive  
San Diego, CA 92121-1714  
U.S.A.**

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## Revision history

Revision	Date	Description
A	July 2009	Initial release

# 1 Introduction

This Maximum Permissible Exposure report demonstrates compliance with FCC CFR 47 §1.1310 and 2.1091 for any collocated transmitters used in simultaneous conditions with the UNDP-1 WWAN mPCIe installed into any Lenovo® host platform categorized as “mobile” where the collocated transmitter has a valid FCC ID documenting equivalent or degraded RF characteristics with the collocated parameters defined in this MPE report.

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

The WWAN module is model UNDP-1 authorized under FCC ID J9CUNDP-1L.

The WWAN MPE calculations in the filing are based on the conducted transmit power levels listed in FCC ID J9CUNDP-1L filings and the maximum allowable antenna gains per relevant grant notes.

The Collocated MPE calculations are based on worst case conducted transmit powers and antenna gain parameters. The WLAN FCC IDs referenced in section 1.1 have equal or lower conducted power and antenna gain than that used in the calculations of this report.

Additional future collocated modules to be added to the host notebooks subsequent to this filing may be excluded from further submission, subject to the conditions of KDB 447498, section 7.

## 1.1 Available Collocated Transmitters

Table 1 lists available WLAN FCC IDs that may be installed in Lenovo notebook computers listed in Table 2. This MPE report is also applicable to future modules with equal or less transmit power than that defined in this MPE report even though the FCC IDs are not identified in this report.

**Table 1 Lenovo Collocated FC ID**

Available Collocated FCC IDs	
PD9512ANXMU	PD9533ANXMU
PD9512ANXHU	PD9112BNHU
PD9512ANHU	PD9533ANMU
PD9533ANHU	PD9LEN512ANMU
TX2-RTL8191SE-L	PPD-AR5BHB63-L

Bluetooth modular transmitter can also be installed in the subject host laptop PCs. The transmission power is 4.1 mW or less and the separation distance between the WWAN and Bluetooth antennas is 20 cm or longer. Therefore the Bluetooth is not considered a collocated transmitter and any collocation evaluation is not required pursuant to the FCC KDB 616217.

A UWB antenna is built into the T400s. The UWB transmitter is not mentioned in FCC CFR 47 Section 2.1091 and 2.1093, so it is not subject to RF exposure requirement. Therefore, no additional SAR testing or RF Exposure evaluation is required for any combination with UWB transmitter.

## 2 Host Products

Table 2 lists known mobile host devices at the time of the Class II permissive change submission. Additional host notebooks may be added in the future without permissive change filings per the rules defined in Section 7 of KDB447498.

**Table 2 Lenovo Mobile Platforms**

<b>Available Host Models</b>	
ThinkPad L410/SL410	ThinkPadSL400
ThinkPad L510/SL510	ThinkPad SL500
ThinkPad T400s	X301
ThinkPad SL300	X200/X200s

### 3 Transmitter Summary

Table 3 summarizes transmitter parameters associated with this permissive change application.

The WWAN modes of operation reflect the UNDP-1 parameters associated with this FCC ID J9CUNDP-1L.

The WLAN and WIMAX transmit power and antenna gain parameters represent the highest transmit power for a given frequency band from all of the WLAN/WPAN FCC IDs identified in Section 0.

Integration of a WLAN module that exceeds the parameters requires a new FCC authorization or permissive change application. A worst-case antenna gain of 5 dBi has been assumed for all WLAN/WIMAX antennas.

**Table 3 WWAN and WLAN Declared Transmitter Parameters**

<b>Technology</b>	<b>Frequency (MHz)</b>	<b>Maximum Conducted Power (dBm)</b>	<b>Conducted Power (W)</b>	<b>Maximum Antenna Gain (dBi)</b>	<b>Duty Cycle</b>
GPRS 2 UL	824	32.98	1.986	4.00	0.25
CDMA2000	824	24.91	0.310	4.00	1.00
UMTS	824	24.42	0.277	4.00	1.00
GPRS 2 UL	1850	29.47	0.885	3.50	0.25
CDMA2000	1850	24.61	0.289	3.50	1.00
UMTS	1850	24.56	0.286	3.50	1.00
WLAN	2400	29.00	0.794	5.00	1.00
WIMAX	2600	29.00	0.794	5.00	1.00
WLAN	5150	29.00	0.794	5.00	1.00
WLAN	5250	29.00	0.794	5.00	1.00
WLAN	5500	29.00	0.794	5.00	1.00
WLAN	5725	29.00	0.794	5.00	1.00

## 4 RF Exposure Limits and Equations

According to FCC CFR 47 §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).

**Table 4 Limits for Maximum Permissible Exposure (MPE)**

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Average Time (Minutes)
(A) Limits For Occupational / Control Exposures (f = frequency)				
30-300	61.4	0.163	1.0	6
300-1500	...	...	f/300	6
1500-100,000	...	...	5.0	6
(B) Limits For General Population / Uncontrolled Exposure (f = frequency)				
30-300	27.5	0.073	0.2	30
300-1500	...	...	f/1500	30
1500-100,000	...	...	1.0	30

Friis transmission formula:

$$P_d = \frac{P_{out} \times G}{4\pi R^2}$$

Where,

$P_d$  = power density (mW/cm<sup>2</sup>)

$P_{out}$  = output power to antenna (mW)

G = gain of antenna in linear scale

R = distance between observation point and center of the radiator (cm)

## 5 MPE Calculations

### 5.1 Stand Alone Transmitter Calculations

The power density calculations for standalone transmitters at an exposure separation distance of 20 cm are shown in Table 5 per the transmit power and antenna gain values declared in Table 3.

For frequency dependent limits, the lowest transmitter frequency was used to represent the lowest MPE limit (e.g. 824MHz = 0.549 mW/cm<sup>2</sup>).

The WLAN power levels listed represent the worst-case values for the corresponding frequency ranges associated.

**Table 5 WWAN and WLAN Standalone MPE Calculations**

Technology	Frequency (MHz)	Maximum Conducted Power (dBm)	Conducted Power (W)	Maximum Antenna Gain (dBi)	Duty Cycle	Average EIRP (dBm)	Average EIRP (W)	Power Density @ 20cm (mW/cm <sup>2</sup> )	FCC MPE Limit (mW/cm <sup>2</sup> )
GPRS 2 UL	824	32.98	1.986	4.00	0.25	30.96	1.25	<b>0.248</b>	0.549
CDMA2000	824	24.91	0.310	4.00	1.00	28.91	0.78	0.155	0.549
UMTS	824	24.42	0.277	4.00	1.00	28.42	0.70	0.138	0.549
GPRS 2 UL	1850	29.47	0.885	3.50	0.25	26.95	0.50	0.099	1.000
CDMA2000	1850	24.61	0.289	3.50	1.00	28.11	0.65	<b>0.129</b>	1.000
UMTS	1850	24.56	0.286	3.50	1.00	28.06	0.64	0.127	1.000
WLAN	2400	29.00	0.794	5.00	1.00	34.00	2.51	0.500	1.000
WLAN	5150	29.00	0.794	5.00	1.00	34.00	2.51	0.500	1.000
WLAN	5250	29.00	0.794	5.00	1.00	34.00	2.51	0.500	1.000
WLAN	5500	29.00	0.794	5.00	1.00	34.00	2.51	0.500	1.000
WLAN	5800	29.00	0.794	5.00	1.00	34.00	2.51	0.500	1.000
WIMAX	2600	29.00	0.794	5.00	1.00	34.00	2.51	0.500	1.000



## 5.2 Collocated MPE Calculations

Per OET 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.

**Table 6 WWAN 850 MHz Collocation Power Density**

WLAN Band	WLAN Pd (mW/cm <sup>2</sup> )	FCC MPE Limit (mW/cm <sup>2</sup> )	(WLAN Pd) / (MPE Limit)	850 MHz WWAN Pd (mW/cm <sup>2</sup> )	FCC MPE Limit (mW/cm <sup>2</sup> )	(WWAN 850 MHz) / MPE Limit	(850 MHz WWAN fraction) + (WLAN fraction)	Limit	Pass/Fail
2.4 GHz	0.500	1.000	0.500	0.248	0.549	0.452	0.951	1	Pass
5.1 GHz	0.500	1.000	0.500	0.248	0.549	0.452	0.951	1	Pass
5.2 GHz	0.500	1.000	0.500	0.248	0.549	0.452	0.951	1	Pass
5.5 GHz	0.500	1.000	0.500	0.248	0.549	0.452	0.951	1	Pass
5.8 GHz	0.500	1.000	0.500	0.248	0.549	0.452	0.951	1	Pass
2.6 GHz	0.500	1.000	0.500	0.248	0.549	0.452	0.951	1	Pass

**Table 7 WWAN 1900 MHz Collocation Power Density**

Band	WLAN Pd (mW/cm <sup>2</sup> )	FCC MPE Limit (mW/cm <sup>2</sup> )	(WLAN Pd) / (MPE Limit)	1900 MHz Pd (mW/cm <sup>2</sup> )	FCC MPE Limit (mW/cm <sup>2</sup> )	(WWAN 1900 MHz) / MPE Limit	(1900 MHz WWAN fraction) + (WLAN fraction)	Limit	Pass/Fail
2.4 GHz	0.500	1.000	0.500	0.129	1.000	0.129	0.628	1	Pass
5.1 GHz	0.500	1.000	0.500	0.129	1.000	0.129	0.628	1	Pass
5.2 GHz	0.500	1.000	0.500	0.129	1.000	0.129	0.628	1	Pass
5.5 GHz	0.500	1.000	0.500	0.129	1.000	0.129	0.628	1	Pass
5.8 GHz	0.500	1.000	0.500	0.129	1.000	0.129	0.628	1	Pass
2.6 GHz	0.500	1.000	0.500	0.129	1.000	0.129	0.628	1	Pass