



# **Dell<sup>®</sup> UNDP-1 Collocated MPE Calculations**

**J9CUNDP-1D**

**80-VK855-3 Rev. A**

**August 1, 2008**

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## Revision history

Revision	Date	Description
A	August 2008	Initial release

# 1 Introduction

This Maximum Permissible Exposure report demonstrates compliance with FCC CFR 47 §1.1310 and 2.1091 for collocated transmitters used in simultaneous conditions with the UNDP-1 WWAN mPCIe installed in a host platform categorized as “mobile”. The mobile classification applies when 20cm or more separation distance is maintained between the transmission antennas and the end-user.

The WWAN module is model UNDP-1 authorized with FCC ID J9CUNDP-1D.

## 1.1 Available Collocated WLAN Transmitters

Dell Inc. has provided the following list of WLAN FCC ID’s that may be installed in Dell® notebook computers listed in Table 1:

- E2KWM3945ABG
- E2K4965AGN
- E2K512ANHMW
- E2K533ANH
- PIWW360BT
- PPD-AR5BH92
- PPD-AR5BHB92
- QDS-BRCM1019
- QDS-BRCM1022
- QDS-BRCM1028
- QDS-BRCM1030
- QDS-BRCM1031
- QDS-BRCM1034
- QDS-BRCM1033
- QDS-BRCM1035

**Table 1 Dell Host Platforms**

Dell Model	Dell Model
Latitude D630 XFR	Precision M2400
Latitude D630	Precision M4400
Latitude 430	Precision M6400
Latitude 631	Studio 1435
Latitude 830	Studio 1536
Latitude ATG D630	Studio 1537
Latitude ATG E6400	Studio 1737
Latitude E4300	Studio XPS 1340
Latitude E5400	Studio XPS 1640
Latitude E6400	XPS M1330
Latitude E6500	XPS M1530

## 2 Transmitter Summary

Table 2 summarizes transmitter parameters associated with this permissive change application.

The WWAN modes of operation reflect the UNDP-1 parameters associated with this FCC ID J9CUND-1D.

The WLAN 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 1.1.

Integration of a WLAN module that exceeds the parameters requires a new FCC authorization or permissive change application. A worst case antenna gain of 3dBi has been assumed for all WLAN antennas as specified by Dell®.

**Table 2 WWAN and WLAN Declared Transmitter Parameters**

<b>FCC ID</b>	<b>Frequency (MHz)</b>	<b>Maximum Conducted Power (dBm)</b>	<b>Conducted Power (W)</b>	<b>Maximum Antenna Gain (dBi)</b>
J9CUNDP-1	824	32.98	1.986	4.00
J9CUNDP-1	824	24.91	0.310	4.00
J9CUNDP-1	824	24.42	0.277	4.00
J9CUNDP-1	1850	29.47	0.885	3.50
J9CUNDP-1	1850	24.61	0.289	3.50
J9CUNDP-1	1850	24.56	0.286	3.50
QDS-BRCM1033	2402 - 2490	6.33	0.004	3.00
QDS-BRCM1019	2412 - 2472	26.36	0.433	3.00
PPD-AR5BHB92	2412 - 2462	24.92	0.310	3.00
QDS-BRCM1019	5180 - 5330	29.58	0.907	3.00
PPD-AR5BHB92	5180 - 5240	16.82	0.048	3.00
PPD-AR5BHB92	5190 - 5230	16.89	0.049	3.00
PPD-AR5BHB92	5260 - 5330	23.68	0.233	3.00
PPD-AR5BHB92	5270 - 5310	23.43	0.220	3.00
E2K533ANH	5470 - 5745	16.53	0.045	3.00
PPD-AR5BH92	5500 - 5700	22.16	0.164	3.00
PPD-AR5BH92	5510 - 5670	23.58	0.228	3.00
E2K533ANH	5725 - 5850	26.44	0.441	3.00
PPD-AR5BH92	5745 - 5825	29.21	0.833	3.00
PPD-AR5BH92	5755 - 5795	29.94	0.985	3.00

### 3 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 3 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:

$$Pd = (Pout * G) / (4\pi R^2)$$

Where,

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

Pout = output power to antenna (mW)

G = gain of antenna in linear scale

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

## 4 MPE Calculations

### 4.1 Stand Alone Transmitter Calculations

The MPE calculations for standalone transmitters at a separation distance of 20 cm are shown in Table 4 per the transmit power and antenna gain values declared in Table 2.

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 with the grants listed in Section 1.1 *Available Collocated WLAN Transmitters*.

**Table 4 WWAN and WLAN Standalone MPE Calculations**

FCC ID	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> )
J9CUNDP-1	GPRS 2 UL	824	32.98	1.986	4.00	0.25	30.96	1.25	0.248	0.549
J9CUNDP-1	CDMA2000	824	24.91	0.310	4.00	1.00	28.91	0.78	0.155	0.549
J9CUNDP-1	UMTS	824	24.42	0.277	4.00	1.00	28.42	0.70	0.138	0.549
J9CUNDP-1	GPRS 2 UL	1850	29.47	0.885	3.50	0.25	26.95	0.50	0.099	1.000
J9CUNDP-1	CDMA2000	1850	24.61	0.289	3.50	1.00	28.11	0.65	0.129	1.000
J9CUNDP-1	UMTS	1850	24.56	0.286	3.50	1.00	28.06	0.64	0.127	1.000
QDS-BRCM1033	WLAN	2402 - 2490	6.33	0.004	3.00	1.00	9.33	0.01	0.002	1.000
QDS-BRCM1019	WLAN	2412 - 2472	26.36	0.433	3.00	1.00	29.36	0.86	0.172	1.000
PPD-AR5BHB92	WLAN	2422 - 2452	24.92	0.310	3.00	1.00	27.92	0.62	0.123	1.000
QDS-BRCM1019	WLAN	5180 - 5330	29.58	0.907	3.00	1.00	32.58	1.81	0.360	1.000
PPD-AR5BHB92	WLAN	5180 – 5240	16.82	0.048	3.00	1.00	19.82	0.10	0.019	1.000
PPD-AR5BHB92	WLAN	5190 - 5230	16.89	0.049	3.00	1.00	19.89	0.10	0.019	1.000
PPD-AR5BHB92	WLAN	5260 - 5330	23.68	0.233	3.00	1.00	26.68	0.47	0.093	1.000
PPD-AR5BHB92	WLAN	5270 - 5310	23.43	0.220	3.00	1.00	26.43	0.44	0.087	1.000
E2K533ANH	WLAN	5470 - 5745	16.53	0.045	3.00	1.00	19.53	0.09	0.018	1.000
PPD-AR5BH92	WLAN	5500 - 5700	22.16	0.164	3.00	1.00	25.16	0.33	0.065	1.000
PPD-AR5BH92	WLAN	5510 - 5670	23.58	0.228	3.00	1.00	26.58	0.45	0.090	1.000
E2K533ANH	WLAN	5725 - 5850	26.44	0.441	3.00	1.00	29.44	0.88	0.175	1.000
PPD-AR5BH92	WLAN	5745 - 5825	29.21	0.833	3.00	1.00	32.21	1.66	0.331	1.000
PPD-AR5BH92	WLAN	5755 - 5795	29.94	0.985	3.00	1.00	32.94	1.97	0.391	1.000

## 4.2 Collocated MPE Calculations

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

**Table 5 WWAN 850 MHz Collocation**

FCC ID	WLAN Band	(WLAN Pd) / (MPE Limit)	(WWAN 850 MHz) / MPE Limit)	(850 MHz WWAN fraction) + (WLAN fraction)	Limit	Pass/Fail
QDS-BRCM1033	2402 - 2490	0.0017	0.45	0.45	1	Pass
QDS-BRCM1019	2412 - 2472	0.1717	0.45	0.62	1	Pass
QDS-BRCM1019	2422 - 2452	0.1231	0.45	0.57	1	Pass
PPD-AR5BHB92	5180 - 5330	0.3601	0.45	0.81	1	Pass
PPD-AR5BHB92	5190 - 5230	0.0194	0.45	0.47	1	Pass
PPD-AR5BHB92	5260 - 5330	0.0925	0.45	0.54	1	Pass
PPD-AR5BHB92	5270 - 5310	0.0875	0.45	0.54	1	Pass
E2K533ANH	5470 - 5745	0.0179	0.45	0.47	1	Pass
PPD-AR5BHB92	5500 - 5700	0.0653	0.45	0.52	1	Pass
PPD-AR5BHB92	5510 - 5670	0.0904	0.45	0.54	1	Pass
E2K533ANH	5725 - 5850	0.1751	0.45	0.63	1	Pass
PPD-AR5BHB92	5745 - 5825	0.3307	0.45	0.78	1	Pass
PPD-AR5BHB92	5755 - 5795	0.3911	0.45	0.84	1	Pass
QDS-BRCM1033	2402 - 2490	0.0017	0.45	0.45	1	Pass

**Table 6 WWAN 1900 MHz Collocation Power Density**

FCC ID	WLAN Band	(WLAN Pd) / (MPE Limit)	(WWAN 1900 MHz) / MPE Limit)	(1900 MHz WWAN fraction) + (WLAN fraction)	Limit	Pass/Fail
QDS-BRCM1033	2402 - 2490	0.0017	0.13	0.13	1	Pass
QDS-BRCM1019	2412 - 2472	0.1717	0.13	0.13	1	Pass
QDS-BRCM1019	2422 - 2452	0.1231	0.13	0.30	1	Pass
PPD-AR5BHB92	5180 - 5330	0.3601	0.13	0.25	1	Pass
PPD-AR5BHB92	5190 - 5230	0.0194	0.13	0.49	1	Pass
PPD-AR5BHB92	5260 - 5330	0.0925	0.13	0.15	1	Pass
PPD-AR5BHB92	5270 - 5310	0.0875	0.13	0.22	1	Pass
E2K533ANH	5470 - 5745	0.0179	0.13	0.22	1	Pass
PPD-AR5BHB92	5500 - 5700	0.0653	0.13	0.15	1	Pass
PPD-AR5BHB92	5510 - 5670	0.0904	0.13	0.19	1	Pass
E2K533ANH	5725 - 5850	0.1751	0.13	0.22	1	Pass
PPD-AR5BHB92	5745 - 5825	0.3307	0.13	0.30	1	Pass
PPD-AR5BHB92	5755 - 5795	0.3911	0.13	0.46	1	Pass
QDS-BRCM1033	2402 - 2490	0.0017	0.13	0.13	1	Pass