Maximum Permissible Exposure (MPE) Evaluation Report

Report No. : **TS14030023-EME**
Model No. : **WMTB-177N**
Brand Name : lenovo ThinkPad
Issued Date : **Mar. 10, 2014**

Applicant: **Gemtek Technology Co., Ltd.**
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Test Method/ Standard: **FCC 1.1310**

Test By: **Intertek Testing Services Taiwan Ltd.**
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The test report was reviewed by: Rico Deng

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Title Senior Engineer

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Summary of Tests

MPE Evaluation meet FCC OET No. 65: 1997, IEEE C95.1-2005

Test	Reference	Results
MPE Evaluation	FCC Guidelines for Human Exposure IEEE C95.1	Complies

1. General information

1.1 Identification of the EUT

Product:	ThinkPad Enterprise Wireless Display Adapter
Model No.:	WMTB-177N
FCC ID.:	MXF-WMTB-177N
Frequency Range:	For 2.4 GHz 1. 2412 MHz ~ 2462 MHz for 802.11b, 802.11g, 802.11n HT20 2. 2422 MHz ~ 2452 MHz for 802.11n HT40 For 5 GHz 1. 5180 MHz ~ 5240 MHz for 802.11a, 802.11an HT20 2. 5190 MHz ~ 5230 MHz for 802.11an HT40 3. 5745 MHz ~ 5825 MHz for 802.11a, 802.11an HT20 4. 5755 MHz ~ 5795 MHz for 802.11an HT40
Channel Number:	For 2.4 GHz 1. 11 channels for 2412 MHz ~ 2462 MHz 2. 7 channels for 2422 MHz ~ 2452 MHz For 5 GHz 1. 4 channels for 5180 MHz ~ 5240 MHz for 802.11a, 802.11an HT20 2. 2 channels for 5190 MHz ~ 5230 MHz for 802.11an HT40 3. 4 channels for 5745 MHz ~ 5825 MHz for 802.11a, 802.11an HT20 4. 2 channels for 5755 MHz ~ 5795 MHz for 802.11an HT40
Access scheme:	DSSS, OFDM
Rated Power:	DC 5.2 V from adapter
Power Cord:	N/A
Sample Received:	Jul. 26, 2013
Sample condition:	Workable
Test Date(s):	Dec. 12, 2013
Note 1:	This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.
Note 2:	When determining the test conclusion, the Measurement Uncertainty of test has been considered.

1.2 Additional information about the EUT

The EUT is a ThinkPad Enterprise Wireless Display Adapter, and was defined as information technology equipment.

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

1.3 Antenna description

For 2.4 GHz
1. Antenna 0 (Chain 0)

The EUT uses a permanently connected antenna.

Antenna Gain	: 0.87 dBi max
Antenna Type	: PIFA antenna
Connector Type	: I-PEX

2. Antenna 1 (Chain 1)

The EUT uses a permanently connected antenna.

Antenna Gain	: 0.96 dBi max
Antenna Type	: PIFA antenna
Connector Type	: I-PEX

For 5 GHz
1. Antenna 0 (Chain 0)

The EUT uses a permanently connected antenna.

Antenna Gain	: 1.28 dBi max
Antenna Type	: PIFA antenna
Connector Type	: I-PEX

2. Antenna 1 (Chain 1)

The EUT uses a permanently connected antenna.

Antenna Gain	: 1.81 dBi max
Antenna Type	: PIFA antenna
Connector Type	: I-PEX

1.4 Peripherals equipment

Peripherals	Brand	Model No.	Serial No.	Data cable
Notebook PC	Toshiba	Protégé M800	N/A	USB Cable 1 meter
Notebook PC	DELL	TND-609	N/A	VGA Cable
Monitor	ViewSonic	VS11871-1E	QRE074990701	HDMI & VGA 1 meter
Headset	Phlips	N/A	N/A	3.5mm audio line

1.5 Adapter information

The EUT will be supplied with a power supply from below list:

No.	Brand	Model no.	Specification
Adapter	lenovo	PA-1100-17IL	I/P: 100-240V~, 0.3A, 50-60Hz O/P: 5.2V, 2.0A

2. Test specifications

2.1 Introduction

The EUT operates in the 2.4 GHz and 5GHz 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.

2.2 RF Exposure Limit

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).

SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and ≤ 50 mm

Approximate SAR Test Exclusion Power Thresholds at Selected Frequencies and Test Separation Distances are illustrated in the following Table.

MHz	5	10	15	20	25	mm
150	39	77	116	155	194	SAR Test Exclusion Threshold (mW)
300	27	55	82	110	137	
450	22	45	67	89	112	
835	16	33	49	66	82	
900	16	32	47	63	79	
1500	12	24	37	49	61	
1900	11	22	33	44	54	
2450	10	19	29	38	48	
3600	8	16	24	32	40	
5200	7	13	20	26	33	
5400	6	13	19	26	32	
5800	6	12	19	25	31	

MHz	30	35	40	45	50	mm
150	232	271	310	349	387	SAR Test Exclusion Threshold (mW)
300	164	192	219	246	274	
450	134	157	179	201	224	
835	98	115	131	148	164	
900	95	111	126	142	158	
1500	73	86	98	110	122	
1900	65	76	87	98	109	
2450	57	67	77	86	96	
3600	47	55	63	71	79	
5200	39	46	53	59	66	
5400	39	45	52	58	65	
5800	37	44	50	56	62	

Note: 10-g Extremity SAR Test Exclusion Power Thresholds are 2.5 times higher than the 1-g SAR Test Exclusion Thresholds indicated above. These thresholds do not apply, by extrapolation or other means, to occupational exposure limits.

SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and > 50 mm

Approximate SAR test exclusion power thresholds at selected frequencies and test separation distances are illustrated in the following table.

MHz	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	mm
100	474	481	487	494	501	507	514	521	527	534	541	547	554	561	567	
150	387	397	407	417	427	437	447	457	467	477	487	497	507	517	527	
300	274	294	314	334	354	374	394	414	434	454	474	494	514	534	554	
450	224	254	284	314	344	374	404	434	464	494	524	554	584	614	644	
835	164	220	275	331	387	442	498	554	609	665	721	776	832	888	943	
900	158	218	278	338	398	458	518	578	638	698	758	818	878	938	998	
1500	122	222	322	422	522	622	722	822	922	1022	1122	1222	1322	1422	1522	mW
1900	109	209	309	409	509	609	709	809	909	1009	1109	1209	1309	1409	1509	
2450	96	196	296	396	496	596	696	796	896	996	1096	1196	1296	1396	1496	
3600	79	179	279	379	479	579	679	779	879	979	1079	1179	1279	1379	1479	
5200	66	166	266	366	466	566	666	766	866	966	1066	1166	1266	1366	1466	
5400	65	165	265	365	465	565	665	765	865	965	1065	1165	1265	1365	1465	
5800	62	162	262	362	462	562	662	762	862	962	1062	1162	1262	1362	1462	

SAR Test Exclusion Thresholds for < 100 MHz and < 200 mm

Approximate SAR test exclusion power thresholds at selected frequencies and test separation distances are illustrated in the following table.

MHz	< 50	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	mm
100	237	474	481	487	494	501	507	514	521	527	534	541	547	554	561	567	
50	308	617	625	634	643	651	660	669	677	686	695	703	712	721	729	738	
10	474	948	961	975	988	1001	1015	1028	1041	1055	1068	1081	1095	1108	1121	1135	
1	711	1422	1442	1462	1482	1502	1522	1542	1562	1582	1602	1622	1642	1662	1682	1702	mW
0.1	948	1896	1923	1949	1976	2003	2029	2056	2083	2109	2136	2163	2189	2216	2243	2269	
0.05	1019	2039	2067	2096	2125	2153	2182	2211	2239	2268	2297	2325	2354	2383	2411	2440	
0.01	1185	2370	2403	2437	2470	2503	2537	2570	2603	2637	2670	2703	2737	2770	2803	2837	

2.3 RF Exposure calculations

From §FCC 1.1310 table 1, the maximum permissible RF exposure for an uncontrolled environment is 1 mW/(cm^2) (or 10 W/m^2)*

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

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

where, S = Power density (mW/cm^2)
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) = $(50 * 1)/4*\pi*20^2$ = 0.00995 (mW/cm^2) (or = 0.0995 W/m^2)

2.4 Operation mode

For 2.4 GHz
TX Mode: Based on “M Tool” to execute, and select different frequency and modulation.

With individual verifying, the maximum output power was found out 1 Mbps data rate for 802.11b mode, 6 Mbps data rate for 802.11g mode, 6.5 Mbps data rate for 802.11n HT 20 mode and 13.5 Mbps data rate for 802.11n HT 40 mode.

The final tests were executed under these conditions recorded in this report individually.

Please refer the details below:

802.11b ch6 chain0

Data rate (Mbps)	AV (dBm)
1	15.89
2	15.83
5.5	15.81
11	15.78

802.11g ch6 chain0

Data rate(Mbps)	AV (dBm)
6	14.70
9	14.69
12	14.58
18	14.55
24	14.53
36	14.51
48	14.50
54	14.44

802.11n HT20 ch6 chain1

Data rate(Mbps)	AV (dBm)
6.5	9.64
13	9.62
19.5	9.60
26	9.57
39	9.50
52	9.47
58.5	9.40
65	9.35

802.11n HT40 ch6 chain1

Data rate(Mbps)	AV (dBm)
13.5	9.66
27	9.58
40.5	9.56
27	9.53
81	9.51
108	9.50
121.5	9.49
135	9.45

For 5 GHz
TX Mode: Based on "M Tool" to execute, and select different frequency and modulation.

With individual verifying, the maximum output power was found at 6 Mbps data rate for 802.11a mode, 6.5 Mbps data rate for 802.11n HT 20 mode, and 13.5 Mbps data rate for 802.11n HT 40 mod. The final tests were executed under these conditions and recorded in this report individually.

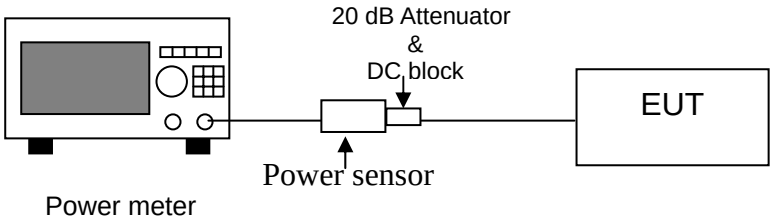
802.11a Ch40 chain0		802.11n HT20 Ch40 chain0		802.11n HT40 Ch38 chain0		802.11n HT20 Ch40 chain1+chain0	
Data rate (Mbps)	AV (dBm)	Data rate (Mbps)	AV (dBm)	Data rate (Mbps)	AV (dBm)	Data rate (Mbps)	AV (dBm)
6	12.36	6.5	9.79	13.5	9.60	6.5	12.15
9	12.32	13	9.75	27	9.58	13	12.12
12	12.30	19.5	9.73	40.5	9.54	19.5	12.10
18	12.27	26	9.72	27	9.51	26	12.06
24	12.24	39	9.69	81	9.48	39	12.03
36	12.21	52	9.67	108	9.45	52	12.00
48	12.19	58.5	9.64	121.5	9.42	58.5	11.97
54	12.16	65	9.62	135	9.39	65	11.94
802.11a Ch40 chain1		802.11n HT20 Ch40 chain1		802.11n HT40 Ch38 chain1		802.11n HT40 Ch38 chain1+chain0	
Data rate (Mbps)	AV (dBm)	Data rate (Mbps)	AV (dBm)	Data rate (Mbps)	AV (dBm)	Data rate (Mbps)	AV (dBm)
6	12.03	6.5	8.37	13.5	8.92	13.5	12.28
9	12.01	13	8.35	27	8.91	27	12.26
12	12.00	19.5	8.32	40.5	8.86	40.5	12.23
18	11.98	26	8.30	27	8.83	27	12.21
24	11.96	39	8.28	81	8.80	81	12.18
36	11.93	52	8.25	108	8.76	108	12.16
48	11.92	58.5	8.23	121.5	8.73	121.5	12.13
54	11.90	65	8.20	135	8.70	135	12.11

2.5 Test equipment

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
Power Meter	Anritsu	ML2495A	0844001	2013/10/10	2014/10/09
Power Senor	Anritsu	MA2411B	0738452	2013/10/10	2014/10/09

Note: The above equipments are within the valid calibration period.

2.6 Test Set-up



Remark: Cable loss is 2 dB.

3. Test results

Mode	Antenna Gain0 (numeric)	Output power to antenna 0 (mW)	Power density (mW/cm2)	Limit of power density (mW/cm2)	Distance (cm)
802.11b	1.22	39.54	0.010	1.0	20
802.11g	1.22	29.72	0.007	1.0	20

Mode	Antenna Gain0 (numeric)	Antenna Gain1 (numeric)	Output power to antenna 0 (mW)	Output power to antenna1 (mW)	Power density0 (mW/cm2)	Power density1 (mW/cm2)	Total of power density (mW/cm2)	Limit of power density (mW/cm2)	Dist. (cm)
802.11n (HT 20)	1.22	1.25	16.47	16.47	0.040	0.041	0.081	1.0	20
802.11n (HT 40)	1.22	1.25	17.03	17.03	0.041	0.042	0.084	1.0	20

Mode	Antenna Gain0 (numeric)	Output power to antenna 0 (mW)	Power density (mW/cm2)	Limit of power density (mW/cm2)	Distance (cm)
802.11a	1.52	17.70	0.005	1.0	20

Mode	Antenna Gain0 (numeric)	Antenna Gain1 (numeric)	Output power to antenna 0 (mW)	Output power to antenna1 (mW)	Power density0 (mW/cm2)	Power density1 (mW/cm2)	Total of power density (mW/cm2)	Limit of power density (mW/cm2)	Dist. (cm)
802.11an (HT 20)	1.34	1.52	15.08	15.08	0.004	0.005	0.009	1.0	20
802.11an (HT 40)	1.34	1.52	16.92	16.92	0.005	0.005	0.010	1.0	20

While installing and operating this transmitter, the radio frequency exposure limit of 1W/ (cm^2) 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.