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## EMC TEST REPORT

Report No.	: EME-060590/01
Model No.	: WN6501CEP
<b>Issued Date</b>	: Jun. 17, 2006

- Applicant : SEIKO EPSON CORPORATION 4897 Shimauchi, Matsumoto-shi, Nagano-ken 390-8640 JAPAN
- Test By : Intertek Testing Services Taiwan Ltd. No. 11, Lane 275, Ko-Nan 1 Street, Chia-Tung Li, Shiang-Shan District, Hsinchu City, Taiwan

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Project Engineer

Kevin Chen

Reviewed By

Jerry Liu



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FCC ID. : BKMWN6501C

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#### **Summary of Tests**

### Wireless LAN 802.11a/b/g USB adapter -Model: WN6501CEP FCC ID: BKMWN6501C

#### 1. 802.11b+g

Test	Reference	Results
Maximum Output Power test	15.247(b)	Pass
Radiated Spurious Emission test	15.205, 15.209	Pass
Emission on the Band Edge test	15.247(d)	Pass

#### 2. 802.11a

Test	Reference	Results
Peak output power test	15.407 (a)(1)/(2)/(3)	Pass
Radiated spurious emission test	15.407(b)(1)/(2)/(3), 15.209	Pass



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#### 1. General information

#### 1.1 Identification of the EUT

Applicant	: SEIKO EPSON CORPORATION
Product	: Wireless LAN 802.11a/b/g USB adapter
Model No.	: WN6501CEP
FCC ID.	: BKMWN6501C
Frequency Range	: 1. 2412 MHz ~ 2462 MHz 2. 5180 MHz ~ 5320 MHz
Channel Number (802.11 a+b+g)	: 1. 11Channels for 2412 MHz ~ 2462 MHz 2. 8Channels for 5180 MHz ~ 5320 MHz
Frequency of Each Channel (802.11 a+b+g)	: 1. 2412 MHz + 5k MHz, k=0~10 2. 5180 MHz + 20k MHz, k=0~7
1 1	
(802.11 a+b+g)	2. 5180 MHz + 20k MHz, k=0~7
(802.11 a+b+g) Type of Modulation	2. 5180 MHz + 20k MHz, k=0~7 : DSSS, OFDM
(802.11 a+b+g) Type of Modulation Rated Power	<ul> <li>2. 5180 MHz + 20k MHz, k=0~7</li> <li>: DSSS, OFDM</li> <li>: DC 5V from Notebook PC</li> </ul>
(802.11 a+b+g) Type of Modulation Rated Power Power Cord	<ul> <li>2. 5180 MHz + 20k MHz, k=0~7</li> <li>: DSSS, OFDM</li> <li>: DC 5V from Notebook PC</li> <li>: N/A</li> </ul>

FCC Part 15 B report has been issued for this EUT.

#### 1.2 Additional information about the EUT

The EUT is a Wireless LAN 802.11a/b/g USB adapter, and was defined as information technology equipment. It has TPC function.

The EUT meets special requirements for LMA modular approval on FCC Public Notice DA 00-1407 and the device is only for OEM integrator, please refer the test result in this report.

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



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#### 1.3 Antenna description

The EUT uses a permanently connected antenna.

Antenna Type : PCB printed antenna Connector Type : N/A

USB ante	USB antenna		G_avg	VSWR
2.4GHz	XY plane HP	2.92	-3.00	1.15
2.5GHz	XY plane HP	1.57	-3.48	2.35
4.9GHz	XY plane HP	3.68	-2.08	1.45
5.35GHz	XY plane HP	2.71	-2.20	
5.85GHz	XY plane HP	1.20	-3.58	2.94

#### **1.4 Peripherals equipment**

Peripherals	Manufacturer	Product No. Serial No.		FCC ID
Notebook PC	DELL	PP02X	8Y210A04	FCC DoC Approved
Printer	HP	C2642A TH86K1N2ZB		ARSCM560S
Modem	Dynalink	V1456VQE	00V230A00051494	FCC DoC Approved



#### 2. Test specifications

#### 2.1 Test standard

The EUT was performed according to the procedures in FCC Part 15 Subpart C Section § 15.205、 §15.207、 §15.209、 §15.247 and ANSI C63.4/2003.

The test of radiated measurements according to FCC Part15 Section 15.33(a) had been conducted and the field strength of this frequency band were all meet limit requirement, thus we evaluate the EUT pass the specified test.

The EUT was performed according to the procedures in FCC Part 15 Subpart E Section § 15.207、§15.209 、§15.407 and ANSI C63.4/2001.

The AC power conducted emissions was invested over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9kHz. (15.207 paragraph)

Radiated emissions were invested cover the frequency range from 30MHz to 1000MHz using a receiver RBW of 120kHz record QP reading, and the frequency over 1GHz using a spectrum analyzer RBW of 1MHz and 10Hz VBW record Average reading. (15.209 paragraph), the Peak reading recorded also on the report.

The test of radiated measurements according to FCC Part15 Section 15.33(a) had been conducted and the field strength of this frequency band were all meet limit requirement, thus we evaluate the EUT pass the specified test.

The EUT setup configurations please refer to the photo of test configuration in item.

#### **2.2 Operation mode**

The EUT was supplied with 5Vdc from Notebook PC and it was running in operating mode.

Plug the EUT into Notebook PC via USB interface, then turn on the Notebook PC power and run the test program "QA" under windows OS, which provide by manufacturer.

The EUT was transmitted continuously during the test.

With individual verifying, the maximum output power was found at 1Mbps data rate for 802.11b mode, 6Mbps data rate for 802.11g mode and 6Mbps data rate for 802.11a mode. The final tests were executed under these conditions and recorded in this report individually.



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#### 2.3 Test equipment

Equipment	Brand	Frequency range	Model No.	Intertek ID No.	Next Cal. Date
EMI Test Receiver	Rohde & Schwarz	9kHz~2.75GHz	ESCS 30	EC303	04/17/2007
EMI Test Receiver	Rohde & Schwarz	20Hz~26.5GHz	ESMI	EC317	08/07/2006
Spectrum Analyzer	Rohde & Schwarz	9kHz~30GHz	FSP 30	EC353	07/24/2006
Spectrum Analyzer	Rohde & Schwarz	20Hz~40GHz	FSEK 30	EC365	11/01/2006
Horn Antenna	SCHWARZBECK	1GHz~18GHz	BBHA 9120 D	EC371	12/22/2007
Horn Antenna	SCHWARZBECK	14GHz~40GHz	BBHA 9170	EC351	07/08/2007
Bilog Antenna	SCHWARZBECK	25MHz~2GHz	VULB 9168	EC347	12/23/2007
Pre-Amplifier	MITEQ	100MHz~26.5GHz	919981	EC373	02/11/2007
Wideband Peak Power Meter/ Sensor	Anritsu	100MHz~18GHz	ML2497A/ MA2491A	EC396	11/10/2006
Controller	HDGmbH	N/A	CM 100	EP346	N/A
Antenna Tower	HDGmbH	N/A	MA 240	EP347	N/A
LISN	Rohde & Schwarz	9KHz~30MHz	ESH3-Z5	EC344	01/13/2007

Note: 1. The above equipments are within the valid calibration period.

2. The test antennas (receiving antenna) are calibration per 3 years.



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#### **3. Maximum Output Power test (FCC 15.247)**

#### **3.1 Operating environment**

Temperature:	25	
Relative Humidity:	60	%
Atmospheric Pressure:	1023	hPa

#### **3.2 Test setup & procedure**

The power output per FCC §15.247(b) was measured on the EUT using a 50 ohm SMA cable connected to peak power meter via power sensor. Power was read directly and cable loss correction (2.5 dB) was added to the reading to obtain power at the EUT antenna terminals. The test was performed at 3 channels (lowest, middle and highest channel).

#### 3.3 Measured data of Maximum Output Power test results

Channel	Freq.	C.L.	Reading		Peak Output wer	Limit
	(MHz)	(dB)	(dBm)	(dBm)	(mW)	(W)
1 (lowest)	2412	2.5	16.75	19.25	84.14	1
6 (middle)	2437	2.5	15.95	18.45	69.98	1
11 (highest)	2462	2.5	16.37	18.87	77.09	1

#### Test Mode: 802.11b(DSSS Modulation) operating mode

Remark:

Conducted Peak Output Power = Reading + C.L.

#### Test Mode: 802.11g(OFDM Modulation) operating mode

Channel	Freq.	C.L.	Reading Conducted Peak Output Power		U	Limit
	(MHz)	(dB)	(dBm)	(dBm)	(mW)	(W)
1 (lowest)	2412	2.5	18.87	21.37	137.09	1
6 (middle)	2437	2.5	17.96	20.46	111.17	1
11 (highest)	2462	2.5	18.35	20.85	121.62	1

Remark:

Conducted Peak Output Power = Reading + C.L.



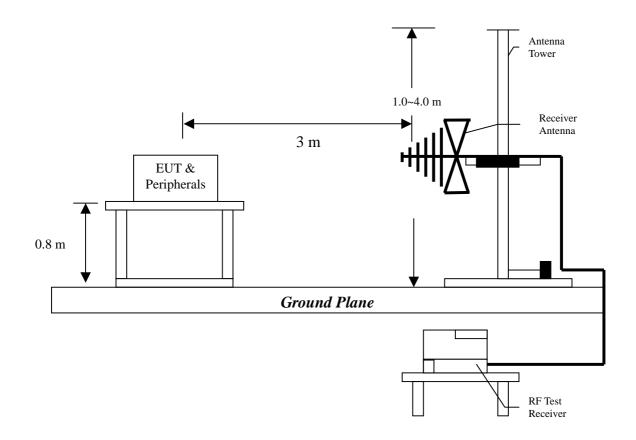
#### 4. Radiated Emission test (FCC 15.247)

#### 4.1 Operating environment

Temperature:	23	
Relative Humidity:	58	%
Atmospheric Pressure:	1023	hPa

#### 4.2 Test setup & procedure

The Diagram below shows the test setup, which is utilized to make these measurements.



Radiated emissions were invested cover the frequency range from 30MHz to 1000MHz using a receiver RBW of 120kHz record QP reading, and the frequency over 1GHz using a spectrum analyzer RBW of 1MHz and 10Hz VBW record Average reading. (15.209 paragraph), the Peak reading (1MHz RBW/VBW) recorded also on the report.

The EUT for testing is arranged on a wooden turntable. If some peripherals apply to the EUT, the peripherals will be connected to EUT and the whole system. During the test, all cables were arranged to produce worst-case emissions. The signal is maximized through rotation. The height of antenna and polarization is changing constantly for exploring for maximum signal level. The height of antenna can be up to 4 meters and down to 1 meter.

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The measurement for radiated emission will be done at the distance of three meters unless the signal level is too low to measure at that distance. In the case of the reading under noise floor, a pre-amplifier is used and/or the test is conducted at a closer distance. And then all readings are extrapolated back to the equivalent 3 meter reading using inverse scaling with distance.

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The EUT test configuration, please refer to the "Spurious set-up photo.pdf".

#### **4.3 Emission limits**

The spurious Emission shall test through the 10th harmonic. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

Frequency (MHz)	Limits (dB µ V/m@3m)
30-88	40
88-216	43.5
216-960	46
Above 960	54

Remark:

- 1. In the above table, the tighter limit applies at the band edges.
- 2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

Uncertainty was calculated in accordance with NAMAS NIS 81. Expanded uncertainty (k=2) of radiated emission measurement is 4.98 dB.



#### 4.4 Radiated spurious emission test data

The maximum radiated spurious emissions is at

Frequency(MHz)	Margin
526.640	-4.49

That is less than uncertainty. This is within the stated measurement uncertainty, this may affect compliance determined in other test arrangements.

#### 4.4.1 Measurement results: frequencies equal to or less than 1 GHz

The test was performed on EUT under 802.11a, 802.11b and 802.11g continuously transmitting mode. Channel 1, 6, 11 were verified. The worst case occurred at 802.11g Tx channel 6.

EUT	: WN6501CEP
Worst Case	: 802.11g Tx at channel 6

Antenna	Freq.	Receiver	Corr.	Reading	Corrected	Limit	Margin
Polariz.			Factor		Level	@ 3 m	
(V/H)	(MHz)	Detector	(dB/m)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)
V	84.320	QP	8.50	25.26	33.76	40.00	-6.25
V	237.580	QP	12.18	22.31	34.49	46.00	-11.51
V	518.880	QP	18.56	20.54	39.10	46.00	-6.91
V	526.640	QP	19.46	19.66	39.12	46.00	-6.88
V	575.140	QP	20.71	15.35	36.06	46.00	-9.94
V	666.320	QP	21.50	17.66	39.16	46.00	-6.84
Н	235.640	QP	11.74	27.45	39.19	46.00	-6.81
Н	332.640	QP	14.40	15.34	29.74	46.00	-16.27
Н	526.640	QP	19.65	13.65	33.30	46.00	-12.70
Н	575.140	QP	20.84	19.02	39.86	46.00	-6.15
Н	798.240	QP	23.52	12.45	35.97	46.00	-10.03
Н	959.260	QP	25.54	13.55	39.09	46.00	-6.91

Remark:

1. Corr. Factor = Antenna Factor + Cable Loss

2. Corrected Level = Reading + Corr. Factor



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#### 4.4.2 Measurement results: frequency above 1GHz

EUT: WN6501CEPTest Condition: 802.11b and 802.11g Tx at channel 1, 6, 11

Test Result: No spurious emission was found above the spectrum analyzer's noise floor.

The noise floor are listed as below:

For PK: 1GHz to 3 GHz: 20dBuV 3GHz to14 GHz: 27dBuV 14GHz to 26.5 GHz: 39dBuV

For AV: 1 GHz to3GHz: 10dBuV 3 GHz to GHz: 16dBuV 14 GHz to 26.5GHz: 28dBuV



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#### 5. Emission on the band edge (FCC 15.247)

In any 100kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 KHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

#### **5.1 Operating environment**

Temperature:	25	
Relative Humidity:	50	%
Atmospheric Pressure	1023	hPa

#### 5.2 Test setup & procedure

The output of EUT was connected to spectrum analyzer via a 50ohm cable.

The setting of spectrum analyzer is:

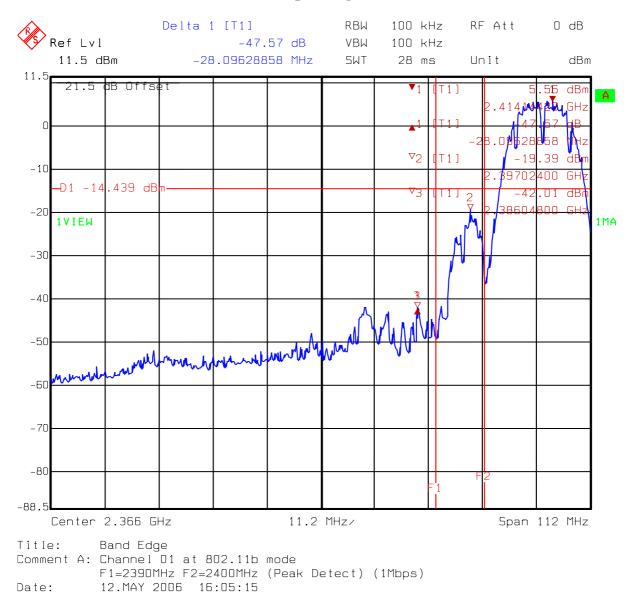
Peak:	RBW =	100kHz;	VBW	=	100kHz
Average:	RBW =	1MHz;	VBW	=	10Hz



#### 5.3 Test Result

#### **5.3.1 Conducted Method**

#### Test Mode: 802.11b(DSSS Modulation) operating mode



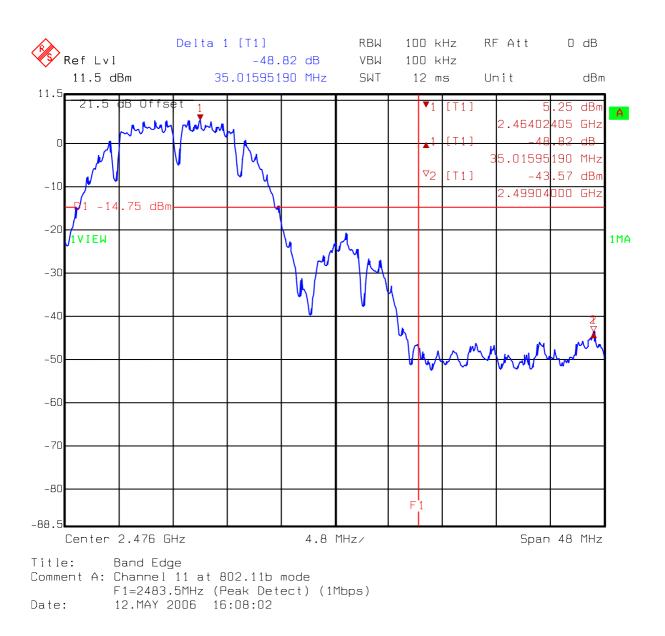


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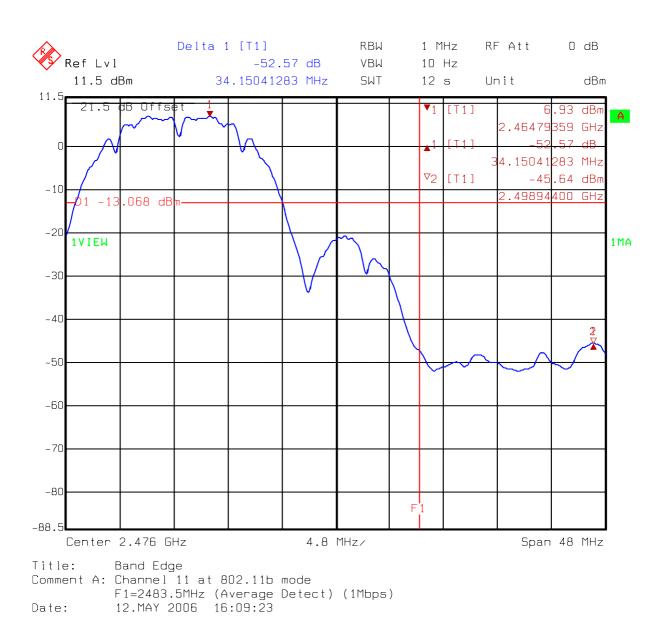


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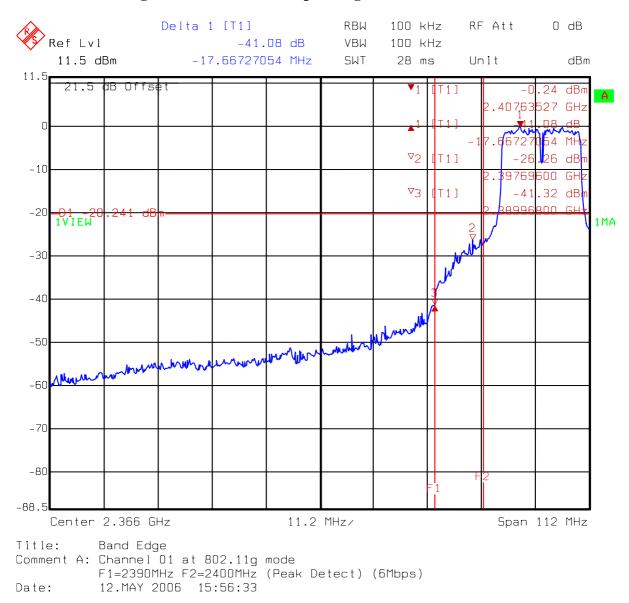




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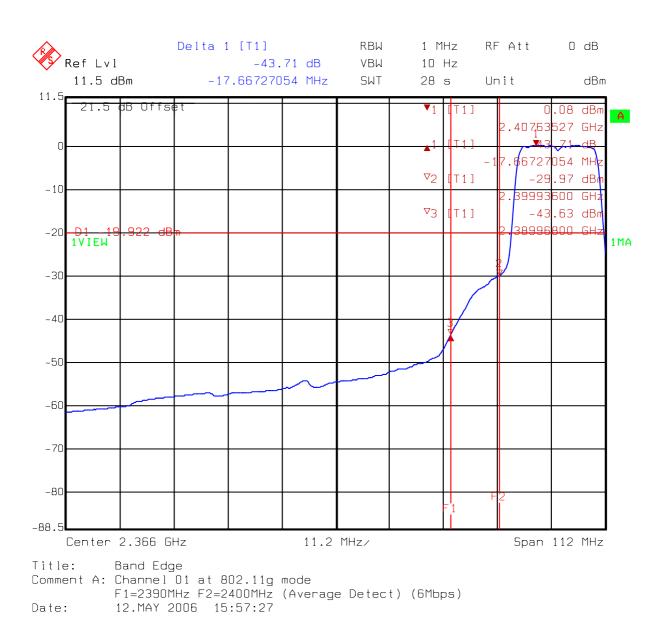




#### Test Mode: 802.11g(OFDM Modulation) operating mode

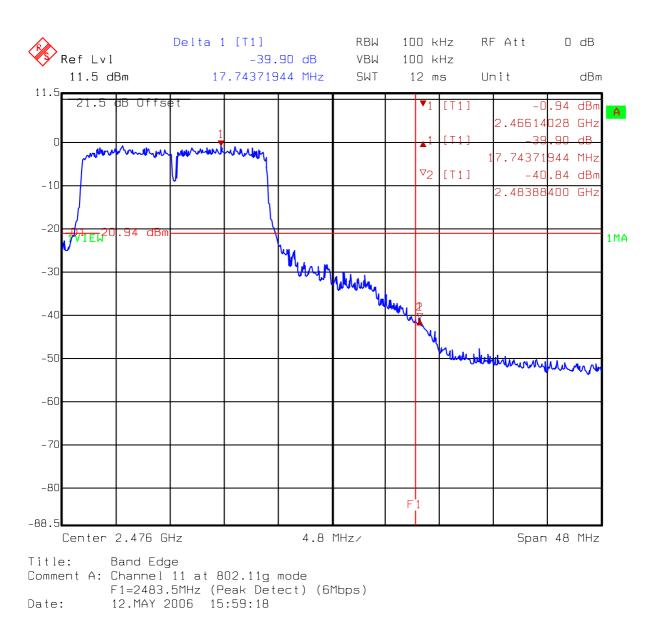


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Delta 1 [T1] RBW 1 MHz RFAtt OdB Ref Lvl -43.87 dB VBW 10 Hz 11.5 dBm 18.46583567 MHz SWT 12 s dBm Unit 11.5 21.5 dB Offset **v**<sub>1</sub> [T1] .13 dBr A 2.46508<mark>216 GH</mark>z 87 гт dB 1 0 ۵ 18.46583567 MHz ▽2 [T1] -43.99 dBm -10 2.48354<mark>800 GHz</mark> -20 1VIEW 1MA -30 -40 -50 -60 -70 -80 F1 -88.5 Center 2.476 GHz 4.8 MHz/ Span 48 MHz Title: Band Edge Comment A: Channel 11 at 802.11g mode F1=2483.5MHz (Average Detect) (6Mbps) Date: 12.MAY 2006 16:00:06



#### 5.3.2 Radiated Method

#### Test Mode: 802.11b(DSSS Modulation) operating mode

		Radiated Method	Conducted Method	The Max.		
Channel	Detector	Max. Field Strength of Fundamental @3m (dBuV/m)	Between Carrier Max. Power and Local Max. Emission in Restrict Band (dBc)	Field Strength in Restrict Band (dBuV/m)	Limit @ 3 m (dBuV/m)	Margin (dB)
		А	В	С	D	Е
1 (lowest)	РК	107.29	47.57	59.72	74	-14.28
I (IOwest)	AV	102.26	49.32	52.94	54	-1.06
11 (highest)	РК	107.73	48.82	58.91	74	-15.09
11 (ingliest)	AV	103.73	52.57	51.16	54	-2.84

Remark: 1. C = A - B2. E = C - D



#### Test Mode: 802.11g(OFDM Modulation) operating mode

		Radiated Method	Conducted Method	The Max.		
Channel	Detector	Max. Field Strength of Fundamental @3m (dBuV/m)	Between Carrier Max. Power and Local Max. Emission in Restrict Band (dBc)	Field Strength in Restrict Band (dBuV/m)	Limit @ 3 m (dBuV/m)	Margin (dB)
		А	В	С	D	Е
1 (lowest)	РК	106.18	41.08	65.1	74	-8.9
I (IOwest)	AV	96.52	43.71	52.81	54	-1.19
11 (highast)	РК	106.41	39.9	66.51	74	-7.49
11 (highest)	AV	96.74	43.87	52.87	54	-1.13

Remark: 1. C = A - B2. E = C - D



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#### 6. Peak Output Power test (FCC 15.407)

#### **6.1 Operating environment**

Temperature:	25	
Relative Humidity:	50	%
Atmospheric Pressure:	1023	hPa

#### 6.2 Test setup & procedure

The power output per FCC §15.407(a) was measured on the EUT using a 50 ohm SMA cable connected to power meter via power sensor. Power was read directly and cable loss correction (7.0dB) was added to the reading to obtain power at the EUT antenna terminals.

#### 6.3 Limit

Operating Frequency (MHz)	Output power limit
5150~5250	< 50mW (17dBm) or 4dBm+10 log B
5250~5350, 5470~5725	< 250mW (24dBm) or 11dBm+10 log B
5725~5825	< 1W (30dBm) or 17dBm+10 log B

Remark: where B is the -26 dB emission bandwidth in MHz.

#### 6.4 Measured data of Maximum Output Power test results

#### For Frequency band (5180MHz ~ 5240MHz)

Channel	Frequency (MHz)	Max. Output power (dBm)	Limit (dBm)
36	5180	16.26	17
40	5200	15.66	17
48	5240	15.31	17



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#### For Frequency band (5260MHz ~ 5320MHz)

Channel	nel Frequency (Max. Output power (dBm)		Limit (dBm)	
52	5260	15.31	24	
60	5300	14.80	24	
64	5320	14.66	24	

Please see the plot below.



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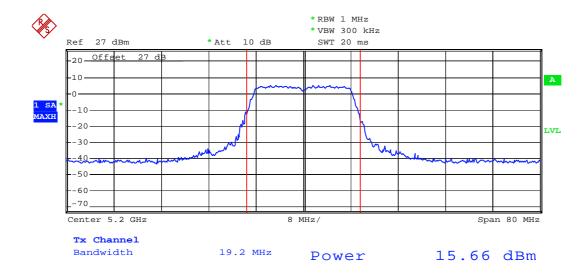
#### Ŵ \*RBW 1 MHz \* VBW 300 kHz Ref 27 dBm \* Att 10 dB SWT 20 ms 20 Offset 27 dB -10-Α -0-1 SA MAXH -10 -20 LVL --30m 40 -50 -60--70 Center 5.18 GHz 8 MHz/ Span 80 MHz Tx Channel 19.4 MHz Bandwidth 16.26 dBm Power

#### For Frequency band (5150MHz ~ 5250MHz)

CPO 5180 Date: 6.JUL.2006 18:55:42



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CPO 5180 Date: 6.JUL.2006 18:57:00



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CPO

Date: 6.JUL.2006 18:58:27



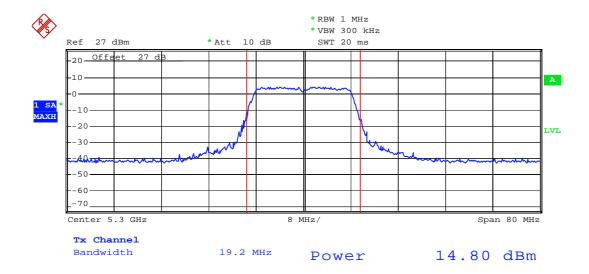
#### For Frequency band (5250MHz ~ 5350MHz)



CPO Date: 6.JUL.2006 18:59:12



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CPO

Date: 6.JUL.2006 19:01:02



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CPO

Date: 6.JUL.2006 19:02:21



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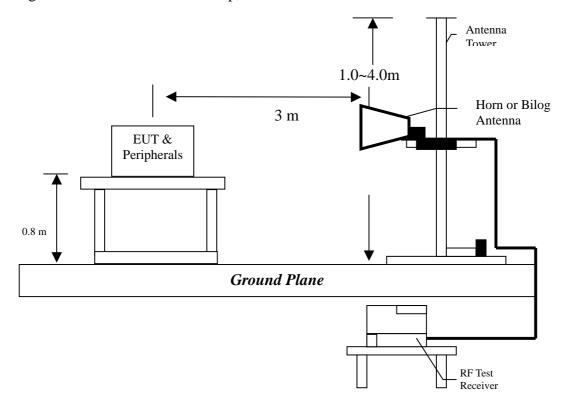
#### 7. Radiated Emission test (FCC 15.205 & 15.209)

#### 7.1 Operating environment

Temperature:	23	
Relative Humidity:	58	%
Atmospheric Pressure	1023	hPa

#### 7.2 Test setup & procedure

The Diagram below shows the test setup, which is utilized to make these measurements.



Radiated emission measurements were performed from 30MHz to tenth harmonic or 40GHz. The EUT for testing is arranged on a wooden turntable. If some peripherals apply to the EUT, the peripherals will be connected to EUT and the whole system. During the test, all cables were arranged to produce worst-case emissions. The signal is maximized through rotation. The height of antenna and polarization is changing constantly for exploring for maximum signal level. The height of antenna can be up to 4 meters and down to 1 meter.

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The measurement for radiated emission will be done at the distance of three meters unless the signal level is too low to measure at that distance. In the case of the reading under noise floor, a pre-amplifier is used and/or the test is conducted at a closer distance. And then all readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance.

#### 7.3 Emission limits

The spurious Emission shall test through the 10th harmonic. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

Frequency (MHz)	Limits (dB µ V/m@3m)		
30-88	40		
88-216	43.5		
216-960	46		
Above 960	54		

Remark:

- 1. In the above table, the tighter limit applies at the band edges.
- 2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

Uncertainty was calculated in accordance with NAMAS NIS 81.

Expanded uncertainty (k=2) of radiated emission measurement is  $\pm 3.078$  dB. Expanded uncertainty (k=2) of conducted emission measurement is  $\pm 2.02$  dB.



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#### 7.4 Radiated spurious emission test data

#### 7.4.1 Measurement results: frequencies equal to or less than 1 GHz

The test was performed on EUT under 802.11a, 802.11b and 802.11g continuously transmitting mode. Channel 1, 6, 11 were verified. The worst case occurred at 802.11g Tx channel 6. Detail data please see the page 21.



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#### 7.4.2 Measurement results: frequency above 1GHz

EUT: WN6501CEPTest Condition: 802.11a

Test Result: No spurious emission was found above the spectrum analyzer's noise floor.

The noise floor are listed as below :

For PK: 1GHz-3GHz: 20dBuV 3GHz-14GHz: 27dBuV 14GHz-26.5GHz: 39dBuV 26.5GHz-40GHz: 42dBuV

For AV: 1GHz-3GHz: 10dBuV 3GHz-14GHz: 16dBuV 14GHz-26.5GHz: 28dBuV 26.5GHz-40GHz: 29dBuV



#### 8. Emission on the band edge §FCC 15.205

The measurement was made to the average and peak field strength of the fundamental frequency. And the spurious emission in the restrict band must also comply with the FCC subpart C 15.209.

#### **8.1 Operating environment**

Temperature:	22	
Relative Humidity:	56	%
Atmospheric Pressure	1023	hPa

#### 8.2 Test setup & procedure

The output of EUT was connected to spectrum analyzer via a 50ohm cable.

The setting of spectrum analyzer is:

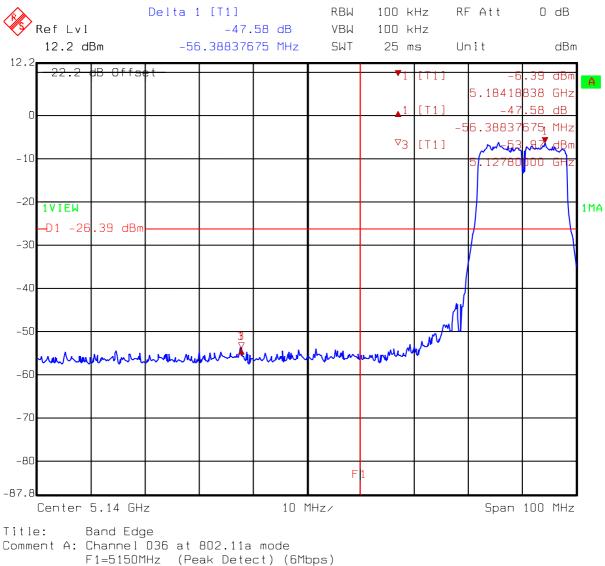
Peak:	RBW =	1MHz;	VBW	=	1MHz
Average:	RBW =	1MHz;	VBW	=	10Hz



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#### 8.3 Test Result

#### 8.3.1 Conducted Method



Date: 12.MAY 2006 16:12:34

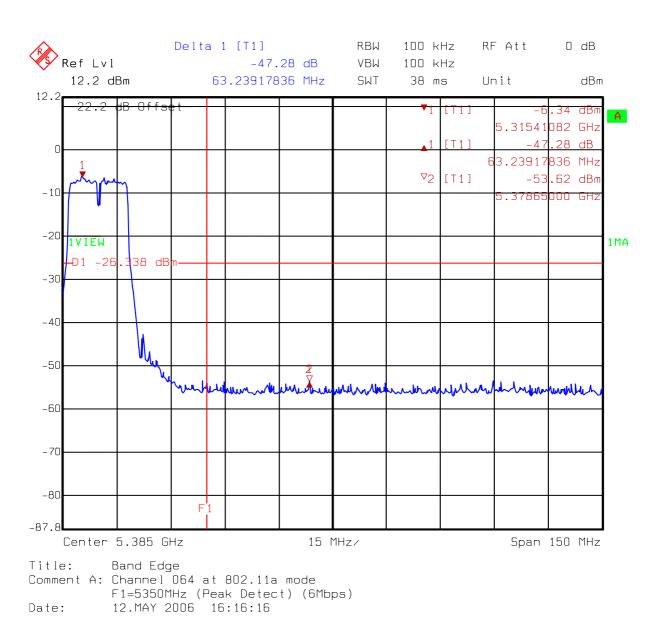


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Delta 1 [T1] RBW 1 MHz RFAtt OdB Ref Lvl -51.56 dB VBW 10 Hz 12.2 dBm -49.17354709 MHz SWT 25 s dBm Unit 12.2 22.2 dB Off: •1 dBr .22 A 5.17677<mark>355</mark> GHz [T1] .56 dB 51 1 0 49.17354709 MHz ∇3 [T1] -5 dBr 77 -10 000 12760 GF -20 **1VIEW** 1MA -D1 -26.216 dB -30 -40 -50 3 X -60 -70 -80 F1 -87.8 Center 5.14 GHz 10 MHz/ Span 100 MHz Title: Band Edge Comment A: Channel 036 at 802.11a mode F1=5150MHz (Average Detect) (6Mbps) 12.MAY 2006 16:13:47 Date:

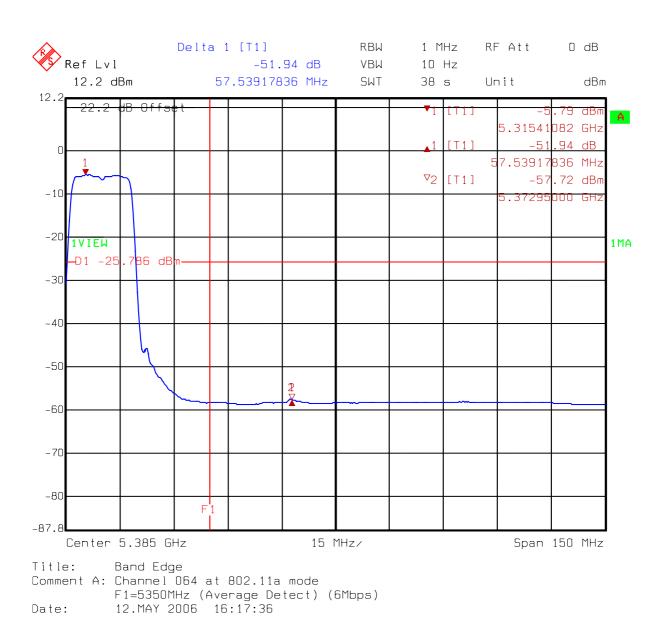


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#### 8.3.2 Radiated Method

#### Test Mode: 802.11a (OFDM Modulation) operating mode

Channel	Channel Detector	Radiated Method Max. Field Strength of Fundamental @3m (dBuV/m)	Conducted Method Between Carrier Max. Power and Local Max. Emission in Restrict Band (dBc)	The Max. Field Strength in Restrict Band (dBuV/m)	Limit @ 3 m (dBuV/m)	Margin (dB)
		А	В	С	D	Е
36	РК	102	47.58	54.42	74	-19.58
(5180MHz)	AV	91.8	51.56	40.24	54	-13.76
64 (5320MHz)	РК	93.69	47.28	46.41	74	-27.59
	AV	83.37	51.94	31.43	54	-22.57

Remark: 1. C = A - B2. E = C - D