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FORMAL REPORT ON TESTING IN ACCORDANCE WITH  
FCC Parts 15B & C : 2007  
OF A  
**VERTICAL HAND HELD TERMINAL**  
[ Model : MX8 ]  
[ FCC ID : KDZLXE4830P ]

**TEST FACILITY**

TÜV SÜD PSB Pte Ltd,  
Electrical & Electronics Centre (EEC), Testing Services,  
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**FCC REG. NO.**

90937 (3m & 10m OATS)  
99142 (10m Anechoic Chamber)  
871638 (5m Anechoic Chamber)  
325572 (10m Anechoic Chamber)

**IND. CANADA REG. NO.**

IC 4257 (3m and 10m Anechoic Chambers)

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**QUOTATION NUMBER**

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LA-2007-0382-B  
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LA-2007-0385-E  
LA-2007-0386-C

The results reported herein have been performed in accordance with the laboratory's terms of accreditation under the Singapore Accreditation Council - Singapore Laboratory Accreditation Scheme. Tests/Calibrations marked "Not SAC-SINGLAS Accredited" in this Report are not included in the SAC-SINGLAS Accreditation Schedule for our laboratory.

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## TEST SUMMARY

The product was tested in accordance with the customer's specifications.

### Test Results Summary

Test Standard	Description	Pass / Fail
FCC Part 15: 2007 (Frequency Hopping Spread Spectrum Device – Bluetooth)		
15.107(a), 15.207	Conducted Emissions	Pass
15.109(a), 15.205, 15.209	Radiated Emissions (Spurious Emissions inclusive Restricted Bands Requirement)	Pass
15.247(a)(1)	Carrier Frequency Separation	Not Applicable *See Note 5
	Spectrum Bandwidth (20dB Bandwidth Measurement)	Not Applicable *See Note 5
15.247(a)(1)(iii)	Number of Hopping Frequencies	Not Applicable *See Note 5
	Average Frequency Dwell Time	Not Applicable *See Note 5
15.247(b)(1)	Maximum Peak Power	Pass
15.247(d)	RF Conducted Spurious Emissions	Not Applicable *See Note 5
15.247(d)	Band Edge Compliance (Conducted)	Not Applicable *See Note 5
15.247(d)	Band Edge Compliance (Radiated)	Pass
15.247(e)	Peak Power Spectral Density	Not Applicable *See Note 5

## TEST SUMMARY

The product was tested in accordance with the customer's specifications.

### Test Results Summary

Test Standard	Description	Pass / Fail
FCC Part 15: 2007 (Direct Sequence Spread Spectrum Device – WLAN 802.11b/g)		
15.107(a), 15.207	Conducted Emissions	Pass
15.109(a), 15.205, 15.209	Radiated Emissions (Spurious Emissions inclusive Restricted Bands Requirement)	Pass
15.247(a)(2)	Spectrum Bandwidth (6dB Bandwidth Measurement)	Not Applicable *See Note 5
15.247(b)(3)	Maximum Peak Power	Pass
15.247(d)	RF Conducted Spurious Emissions	Not Applicable *See Note 5
15.247(d)	Band Edge Compliance (Conducted)	Not Applicable *See Note 5
15.247(d)	Band Edge Compliance (Radiated)	Pass
15.247(e)	Peak Power Spectral Density	Not Applicable *See Note 5

## TEST SUMMARY

### Notes

1. The channels as listed below, which respectively represent the lower, middle and upper channels of the Equipment Under Test (EUT) when operating in Bluetooth, WLAN 802.11b and WLAN 802.11g modes. For each channel, the EUT was configured to operate in the test mode.

#### Bluetooth

<u>Transmit Channel</u>	<u>Frequency (GHz)</u>	<u>Modulation</u>	<u>Data Rate</u>
Channel 0	2.402	GFSK	--
Channel 39	2.441	GFSK	--
Channel 78	2.480	GFSK	--

#### WLAN 802.11b

<u>Transmit Channel</u>	<u>Frequency (GHz)</u>	<u>Modulation</u>	<u>Data Rate</u>
Channel 1	2.412	DBPSK	1Mbps
Channel 6	2.437	DBPSK	1Mbps
Channel 11	2.462	DBPSK	1Mbps
Channel 1	2.412	DQPSK	2Mbps
Channel 6	2.437	DQPSK	2Mbps
Channel 11	2.462	DQPSK	2Mbps
Channel 1	2.412	CCK	5.5Mbps
Channel 6	2.437	CCK	5.5Mbps
Channel 11	2.462	CCK	5.5Mbps
Channel 1	2.412	CCK	11Mbps
Channel 6	2.437	CCK	11Mbps
Channel 11	2.462	CCK	11Mbps

#### WLAN 802.11g

<u>Transmit Channel</u>	<u>Frequency (GHz)</u>	<u>Modulation</u>	<u>Data Rate</u>
Channel 1	2.412	BPSK	9Mbps
Channel 6	2.437	BPSK	9Mbps
Channel 11	2.462	BPSK	9Mbps
Channel 1	2.412	QPSK	18Mbps
Channel 6	2.437	QPSK	18Mbps
Channel 11	2.462	QPSK	18Mbps
Channel 1	2.412	16QAM	36Mbps
Channel 6	2.437	16QAM	36Mbps
Channel 11	2.462	16QAM	36Mbps
Channel 1	2.412	64QAM	54Mbps
Channel 6	2.437	64QAM	54Mbps
Channel 11	2.462	64QAM	54Mbps

2. The EUT is a Class A device when in non-transmitting state and meets the FCC Part15B Class A requirements.
3. All test measurement procedures are according to ANSI C63.4: 2003.

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## TEST SUMMARY

### Notes (Continued)

4. The Bluetooth module used in the Equipment Under Test (EUT) is a FCC limited modular approval which bears the FCC ID: KDZLXEBT001. Similarly for the WLAN 802.11b/g module used in the Equipment Under Test (EUT). It is FCC certified under the limited modular approval which bears the FCC ID: TWG-SDCCF10G.
5. The test is deemed to meet the FCC requirement of this clause without further testing as the module used is a FCC certified module. The integration of this module into the Equipment Under Test (EUT) does not change the RF performance of the module.
6. For WLAN 802.11b/g module, only the main RF port was exercised and evaluated as both the main and auxiliary RF ports are exhibiting the same RF performance.

### Modifications

No modifications were made.

## PRODUCT DESCRIPTION

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Description	: The Equipment Under Test (EUT) is a <b>VERTICAL HAND HELD TERMINAL.</b>
Applicant	: LXE Inc. 125 Technology Parkway Norcross, GA 30092 USA
Factor (ies)	: Celestica Philippine, Inc. Mactan Economic Zone 1 (MEZ 1) Lapu-lapu City, Cebu Philippine 6015
Manufacturer	: Olympus Technologies (S) Pte Ltd 41 Science Park Road, #04-17/18 The Gemini Singapore Science Park 2 Singapore 117610
Model Number	: MX8
FCC ID	: KDZLXE4830P
Serial Number	: Nil
Microprocessor	: Intel XScale PXA 270
Operating / Transmitting Frequency	: 2.402GHz – 2.480GHz (Bluetooth) 2.412GHz - 2.462GHz (WLAN 802.11b/g)
Clock / Oscillator Frequency	: 520MHz
Modulation	: <u>Bluetooth</u> Frequency Shift Keying (GFSK)
	<u>WLAN 802.11b</u> DBPSK @ 1Mbps DQPSK @ 2Mbps CCK @ 5.5Mbps CCK @ 11Mbps
	<u>WLAN 802.11g</u> BPSK @ 6Mbps BPSK @ 9Mbps QPSK @ 12Mbps QPSK @ 18Mbps 16QAM @ 24Mbps 16QAM @ 36Mbps 64QAM @ 48Mbps 64QAM @ 54Mbps

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**PRODUCT DESCRIPTION**

Antenna Gain	: 0dBi
Port / Connectors	: Refer to manufacturer's user manual / operating manual.
Rated Input Power	: Input 100V – 240V, 50/60Hz , 05A Output +5Vdc, 3A
Accessories	: ITE Power Adapter Model JPW118KA0500N02 Input 100V-240V, 60Hz/50Hz, 0.5A Output +5Vdc, 3A LPS Made in Korea
	USB Cable

**SUPPORTING EQUIPMENT DESCRIPTION**

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<b>Equipment Description (Including Brand Name)</b>	<b>Model, Serial &amp; FCC ID Number</b>	<b>Cable Description (List Length, Type &amp; Purpose)</b>
Dell Laptop (Emission and RF Test)	M/N: Latitude D400 S/N: Nil FCC ID: DoC	2.00m unshielded power cable 1.80m USB communication cable
Power Adapter (Laptop)	M/N: Nil S/N: Nil FCC ID: Nil	2.00m unshielded power cable

## **EUT OPERATING CONDITIONS**

### **FCC Part 15**

- 1. Conducted Emissions**
- 2. Radiated Emissions (Spurious Emissions inclusive Restricted Bands Requirement)**
- 3. Maximum Peak Power**
- 4. Band Edge Compliance (Radiated)**

### **RF**

#### **a. Bluetooth**

The EUT was exercised by operating in maximum continuous transmission with frequency hopping off, i.e transmitting at lower, middle and upper channels respectively at one time.

#### **b. WLAN 802.11b/g**

The EUT was exercised by operating in maximum continuous transmission in test mode, i.e transmitting at lower, middle and upper channels respectively at one time.

#### **c. Bluetooth & WLAN 802.11b/g**

The EUT was exercised by operating in conditions as mentioned in items a and b.

### **Digital Circuit (Non-RF)**

The EUT was exercised by continuously printing character 'H' to the LCD panel and exercising bar code scanner (continuously emitting infra-red (IR) signal from IR port).

**CONDUCTED EMISSION TEST**

**FCC Parts 15.107(a) and 15.207 Conducted Emission Limits**

Frequency Range (MHz)	Limit Values (dB $\mu$ V)	
	Quasi-peak (QP)	Average (AV)
0.15 - 0.5	66 – 56 *	56 – 46 *
0.5 - 5.0	56	46
5.0 - 30.0	60	50

\* Decreasing linearly with the logarithm of the frequency

**FCC Parts 15.107(a) and 15.207 Conducted Emission Test Instrumentation**

Instrument	Model	S/No	Cal Due Date
R&S Test Receiver (20Hz–26.5GHz) – ESMI2	ESMI	829214/006 829550/001	10 May 2008
Agilent EMC Analyzer-SA7	E7403A	US41160167	22 May 2008
EMCO LISN (for EUT) – LISN9	3825/2	9309-2128	13 Aug 2008
R&S Pulse Limiter – PL2	ESH3-Z2	100347	13 Apr 2008
EMCO LISN (for supporting) – LISN6	3825/2	9309-2127	03 Jul 2008

## CONDUCTED EMISSION TEST

### FCC Parts 15.107(a) and 15.207 Conducted Emission Test Setup

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.
2. The power supply for the EUT was fed through a  $50\Omega/50\mu\text{H}$  EUT LISN, connected to filtered mains.
3. The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable.
4. All other supporting equipment were powered separately from another LISN.

### FCC Parts 15.107(a) and 15.207 Conducted Emission Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. A scan was made on the NEUTRAL line over the required frequency range using an EMI test receiver.
3. High peaks, relative to the limit line, were then selected.
4. The EMI test receiver was then tuned to the selected frequencies and the necessary measurements made with a receiver bandwidth setting of 10kHz. Both Quasi-peak and Average measurements were made.
5. Steps 2 to 4 were then repeated for the LIVE line.

### Sample Calculation Example

At 20 MHz

Q-P limit (Class B) =  $1000 \mu\text{V} = 60.0 \text{ dB}\mu\text{V}$

Transducer factor of LISN, pulse limiter & cable loss at 20 MHz = 11.2 dB

Q-P reading obtained directly from EMI Receiver =  $40.0 \text{ dB}\mu\text{V}$   
(Calibrated for system losses)

Therefore, Q-P margin =  $40.0 - 60.0 = -20.0$

i.e. **20.0 dB below Q-P limit**

**CONDUCTED EMISSION TEST**



Conducted Emissions Test Setup - AC Mains (Front View)



Conducted Emissions Test Setup - AC Mains (Rear View)

**CONDUCTED EMISSION TEST**

**FCC Parts 15.107(a) and 15.207 Conducted Emission Results**

Test Input Power	110V 60Hz	Temperature	22°C
Line Under Test	AC Mains	Relative Humidity	58%
Operating Mode	Bluetooth	Atmospheric Pressure	1030mbar
			Tested By
			Kenneth Ler

Frequency (MHz)	Q-P Value (dB $\mu$ V)	Q-P Margin (dB)	AV Value (dB $\mu$ V)	AV Margin (dB)	Line	Channel
0.2002	53.5	-10.1	43.0	-10.6	Neutral	0
0.3990	41.7	-16.2	38.3	-9.6	Neutral	0
0.5318	41.0	-15.0	39.6	-6.4	Live	0
0.8646	37.4	-18.6	35.0	-11.0	Neutral	0
1.2627	33.5	-22.5	36.1	-9.9	Live	0
2.6607	37.0	-19.0	35.0	-11.0	Neutral	0

Test Input Power	110V 60Hz	Temperature	22°C
Line Under Test	AC Mains	Relative Humidity	58%
Operating Mode	WLAN 802.11b @ 1Mbps (Worst rate)	Atmospheric Pressure	1030mbar
			Tested By
			Kenneth Ler

Frequency (MHz)	Q-P Value (dB $\mu$ V)	Q-P Margin (dB)	AV Value (dB $\mu$ V)	AV Margin (dB)	Line	Channel
0.2010	53.1	-10.5	41.8	-11.8	Live	1
0.4660	41.2	-15.4	39.7	-6.9	Neutral	1
0.5328	40.9	-15.1	38.5	-7.5	Live	1
0.8654	37.1	-18.9	34.1	-11.9	Live	1
1.2649	38.0	-18.0	35.4	-10.6	Live	1
2.3969	36.0	-20.0	33.8	-12.2	Live	1

**CONDUCTED EMISSION TEST**

**FCC Parts 15.107(a) and 15.207 Conducted Emission Results**

Test Input Power	110V 60Hz	Temperature	22°C
Line Under Test	AC Mains	Relative Humidity	58%
Operating Mode	WLAN 802.11g @ 9Mbps (Worst rate)	Atmospheric Pressure	1030mbar
			Tested By
			Kenneth Ler

Frequency (MHz)	Q-P Value (dB $\mu$ V)	Q-P Margin (dB)	AV Value (dB $\mu$ V)	AV Margin (dB)	Line	Channel
0.1991	51.3	-12.3	39.8	-13.8	Live	1
0.2681	46.0	-15.2	38.5	-12.7	Live	1
0.4672	41.5	-15.1	40.3	-6.3	Neutral	1
0.7350	35.9	-20.1	32.2	-13.8	Live	1
1.2689	35.9	-20.1	32.2	-13.8	Live	1
1.6702	35.8	-20.2	32.8	-13.2	Live	1

Test Input Power	110V 60Hz	Temperature	22°C
Line Under Test	AC Mains	Relative Humidity	58%
Operating Mode	Bluetooth + WLAN 802.11b @ 1Mbps (Worst case)	Atmospheric Pressure	1030mbar
			Tested By
			Kenneth Ler

Frequency (MHz)	Q-P Value (dB $\mu$ V)	Q-P Margin (dB)	AV Value (dB $\mu$ V)	AV Margin (dB)	Line	Channel (BT / WLAN)
0.2009	53.1	-10.5	42.7	-10.9	Live	0 / 1
0.2672	46.9	-14.3	39.0	-12.2	Live	0 / 1
0.4667	41.5	-15.1	40.2	-6.4	Neutral	0 / 1
0.5336	39.1	-16.9	33.2	-12.8	Live	0 / 1
0.9994	35.4	-20.6	32.0	-14.0	Neutral	0 / 1
2.3974	35.8	-20.2	31.0	-15.0	Live	0 / 1

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**CONDUCTED EMISSION TEST**

**Notes**

1. All possible modes of operation were investigated from 150kHz to 30MHz. Only the worst case emissions measured, using the correct CISPR detectors, are reported. All other emissions were relatively insignificant.
2. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
3. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:  
9kHz - 30MHz  
RBW: 10kHz      VBW: 30kHz
4. Conducted Emissions Measurement Uncertainty  
All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 9kHz – 30MHz (Average & Quasi-peak) is  $\pm 3.0\text{dB}$ .

**RADIATED EMISSION TEST**

**FCC Part 15.205 Restricted Bands**

<b>MHz</b>	<b>MHz</b>	<b>MHz</b>	<b>GHz</b>
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	Above 38.6
13.36 - 13.41			

**FCC Parts 15.109(a) and 15.209 Radiated Emission Limits**

<b>Frequency Range (MHz)</b>	<b>Quasi-Peak Limit Values (dB<math>\mu</math>V/m) @ 3m</b>
30 - 88	40.0
88 - 216	43.5
216 - 960	46.0
Above 960	54.0*

\* Above 1GHz, average detector was used. A peak limit of 20dB above the average limit does apply.

**FCC Parts 15.109(a) and 15.209 Radiated Emission Test Instrumentation**

<b>Instrument</b>	<b>Model</b>	<b>S/No</b>	<b>Cal Due Date</b>
R&S Test Receiver (20Hz-26.5GHz) – ESMI3	ESMI	829214/005 829550/004	24 Nov 2007
Schaffner Preamplifier (9kHz-2GHz) – PA19	CPA9231A	18763	12 Jan 2008
MITEQ Preamplifier (0.1-26.5GHz) – PA10	NSP2650-N	728230	26 Jan 2008
Schaffner Bilog Antenna – BL	CBL6112D	22020	14 May 2008
EMCO Horn Antenna – H14	3115	0003-6087	18 May 2008
Mirco-Tronics 2.4GHz Bandstop Filter	BRM50701	042	13 Aug 2008

## RADIATED EMISSION TEST

### **FCC Parts 15.109(a) and 15.209 Radiated Emission Test Setup**

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m X 1.0m X 0.8m high, non-metallic table.
2. The filtered power supply for the EUT and supporting equipment were tapped from the appropriate power sockets located on the turntable.
3. The relevant broadband antenna was set at the required test distance away from the EUT and supporting equipment boundary.

### **FCC Parts 15.109(a) and 15.209 Radiated Emission Test Method**

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. A prescan was carried out to pick the worst emission frequencies from the EUT. For EUT which is a portable device, the prescan was carried out by rotating the EUT through three orthogonal axes to determine which altitude and equipment arrangement produces such emissions.
3. The test was carried out at the selected frequency points obtained from the prescan in step 2. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
  - a. Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
  - b. The EUT was then rotated to the direction that gave the maximum emission.
  - c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
4. A Quasi-peak measurement was made for that frequency point if it was less than or equal to 1GHz. For frequency point that above 1GHz, both Peak and Average measurements were carried out.
5. Steps 3 and 4 were repeated for the next frequency point, until all selected frequency points were measured.
6. The frequency range covered was from 30MHz to 10<sup>th</sup> harmonics of the EUT fundamental frequency, using the Bi-log antenna for frequencies from 30MHz up to 3GHz, and the Horn antenna above 3GHz.

### **Sample Calculation Example**

At 300 MHz

Q-P limit (Class B) = 200  $\mu$ V/m = 46.0 dB $\mu$ V/m

Log-periodic antenna factor & cable loss at 300 MHz = 18.5 dB

Q-P reading obtained directly from EMI Receiver = 40.0 dB $\mu$ V/m  
(Calibrated level including antenna factors & cable losses)

Therefore, Q-P margin = 40.0 - 46.0 = -6.0

i.e. **6 dB below Q-P limit**

**RADIATED EMISSION TEST**



Radiated Emissions Test Setup (Front View)



Radiated Emissions Test Setup (Rear View)

**RADIATED EMISSION TEST**

**FCC Parts 15.109(a), 15.205 and 15.209 Radiated Emission Results**

Test Input Power	110V 60Hz	Temperature	22°C
Test Distance	3m	Relative Humidity	58%
Operating Mode	Bluetooth	Atmospheric Pressure	1030mbar
		Tested By	Kenneth Ler

Spurious Emissions ranging from 30MHz – 1GHz

Frequency (MHz)	Q-P Value (dB $\mu$ V/m)	Q-P Margin (dB)	Azimuth (Degrees)	Height (cm)	Polarisation (H/V)	Channel
113.2900	39.6	-4.0	263	100	V	0
431.9500	42.5	-3.5	230	129	H	0
479.9559	43.2	-2.8	261	100	H	0
527.9600	39.8	-6.2	259	100	H	0
575.9543	42.0	-4.0	304	101	H	0
623.9500	44.8	-1.2	356	100	H	0

Spurious Emissions above 1GHz

Frequency (GHz)	Peak Value (dB $\mu$ V/m)	Average Value (dB $\mu$ V/m)	Average Margin (dB)	Azimuth (Degree)	Height (cm)	Pol (H/V)	Channel
4.9459	53.4	44.2	-9.8	235	100	H	78
11.9757	56.1	42.0	-12.0	28	100	V	0
12.3662	58.7	41.8	-12.2	351	100	H	78
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**RADIATED EMISSION TEST**

**FCC Parts 15.109(a), 15.205 and 15.209 Radiated Emission Results**

Test Input Power	110V 60Hz	Temperature	22°C
Test Distance	3m	Relative Humidity	58%
Test Mode	WLAN 802.11b @ 5.5Mbps (Worst mode of 802.11b/g)	Atmospheric Pressure	1030mbar
		Tested By	Kenneth Ler

Spurious Emissions ranging from 30MHz – 1GHz

Frequency (MHz)	Q-P Value (dB $\mu$ V/m)	Q-P Margin (dB)	Azimuth (Degrees)	Height (cm)	Polarisation (H/V)	Channel
35.9700	29.6	-10.4	94	100	H	1
365.5000	25.5	-20.5	71	100	H	1
381.2500	28.5	-17.5	220	397	V	1
438.7500	34.3	-11.7	294	101	V	1
807.9100	35.8	-10.2	75	100	H	1
842.6300	33.5	-12.5	212	100	H	1

Spurious Emissions above 1GHz

Frequency (GHz)	Peak Value (dB $\mu$ V/m)	Average Value (dB $\mu$ V/m)	Average Margin (dB)	Azimuth (Degree)	Height (cm)	Pol (H/V)	Channel
1.1440	41.2	27.9	-26.1	307	100	V	1
1.3519	42.4	23.7	-30.3	78	101	V	1
2.2093	46.1	35.0	-19.0	241	100	V	1
4.8241	54.0	37.5	-16.5	172	101	H	1
7.2405	53.1	37.4	-16.6	258	100	H	1
9.6485	53.5	39.3	-14.7	65	101	V	1

Spurious Emissions above 1GHz

Frequency (GHz)	Peak Value (dB $\mu$ V/m)	Average Value (dB $\mu$ V/m)	Average Margin (dB)	Azimuth (Degree)	Height (cm)	Pol (H/V)	Channel
1.0399	41.3	32.4	-21.6	67	100	H	6
1.1437	41.2	36.9	-17.1	335	101	V	6
1.7433	42.1	27.0	-27.0	51	100	V	6
4.8742	52.3	36.7	-17.3	179	101	H	6
7.3166	53.4	36.3	-17.7	194	100	V	6
9.6485	53.3	39.3	-14.7	65	101	V	6

**RADIATED EMISSION TEST**

**FCC Parts 15.109(a), 15.205 and 15.209 Radiated Emission Results**

Spurious Emissions above 1GHz

Frequency (GHz)	Peak Value (dB $\mu$ V/m)	Average Value (dB $\mu$ V/m)	Average Margin (dB)	Azimuth (Degree)	Height (cm)	Pol (H/V)	Channel
1.0399	41.2	31.6	-22.4	307	100	H	16
1.1440	41.3	36.0	-18.0	350	101	V	16
1.3323	41.5	24.4	-29.6	0	100	V	16
4.9266	52.2	37.6	-16.4	198	101	V	16
7.3965	53.1	36.2	-17.8	117	100	H	16
--	--	--	--	--	--	--	--

Test Input Power	110V 60Hz	Temperature	22°C
Test Distance	3m	Relative Humidity	58%
Test Mode	Bluetooth & WLAN 802.11b @ 5.5Mbps (Worst mode)	Atmospheric Pressure	1030mbar
		Tested By	Kenneth Ler

Spurious Emissions ranging from 30MHz – 1GHz

Frequency (MHz)	Q-P Value (dB $\mu$ V/m)	Q-P Margin (dB)	Azimuth (Degrees)	Height (cm)	Polarisation (H/V)	Channel (BT / WLAN)
126.6135	38.1	-5.4	10	100	V	0 / 1
321.7729	39.6	-6.4	100	104	V	0 / 1
400.4958	18.4	-27.6	83	100	H	0 / 1
420.4208	13.6	-32.5	359	100	H	0 / 1
599.9700	37.4	-8.6	196	101	H	0 / 1
841.5537	39.2	-6.8	22	100	H	0 / 1

Spurious Emissions above 1GHz

Frequency (GHz)	Peak Value (dB $\mu$ V/m)	Average Value (dB $\mu$ V/m)	Average Margin (dB)	Azimuth (Degree)	Height (cm)	Pol (H/V)	Channel (BT / WLAN)
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--

## RADIATED EMISSION TEST

### Notes

1. All possible modes of operation were investigated. Only the worst case emissions measured, using the correct CISPR detectors, are reported. All other emissions were relatively insignificant.
2. “-” indicates no emissions were found and shows compliance to the limits.
3. Quasi-peak measurement was used for frequency measurement up to 1GHz. Average and peak measurements were used for emissions above 1GHz. The average measurement was done by averaging over a complete cycle of the pulse train, including the blanking interval as the pulse train duration does not exceed 0.1 second.
4. A “-ve” margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
5. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:  
30MHz - 1GHz  
RBW: 120kHz      VBW: 1MHz  
>1GHz  
RBW: 1MHz      VBW: 1MHz
6. The upper frequency of radiated emission investigations was according to requirements stated in Section 15.33(a) for intentional radiators & Section 15.33(b) for unintentional radiators.
7. The channel in the table refers to the transmit channel of the EUT.
8. Radiated Emissions Measurement Uncertainty  
All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 30MHz – 25GHz (QP only @ 3m & 10m) is  $\pm 4.6\text{dB}$  (for EUTs  $< 0.5\text{m} \times 0.5\text{m} \times 0.5\text{m}$ ).

## **MAXIMUM PEAK POWER TEST**

### **FCC Part 15.247(b)(1) & (3) Maximum Peak Power Limits**

#### Bluetooth

The EUT shows compliance to the requirements of this section, which states the EUT employing at least 75 non-overlapping hopping channels shall not exceed 1W (30dBm). For the EUT employs other frequency hopping systems, the peak power shall not greater than 0.125W (21dBm).

#### WLAN 802.11g

The EUT shows compliance to the requirements of this section, which states the maximum peak power of the EUT employing digital modulation shall not exceed 1W (30dBm).

### **FCC Part 15.247(b)(1) & (3) Maximum Peak Power Test Instrumentation**

<b>Instrument</b>	<b>Model</b>	<b>S/No</b>	<b>Cal Due Date</b>
Anritsu Bluetooth Test Set	MT8850A	6K0000200	18 Jan 2008
Boonton RF Power Meter	4532	97701	28 Feb 2008
Boonton RF Power Sensor	51075	32002	28 Feb 2008

### **FCC Part 15.247(b)(1) & (3) Maximum Peak Power Test Setup**

1. The EUT and supporting equipment were set up as shown in the setup photo.
2. The power supply for the EUT was connected to a filtered mains.
3. The RF antenna connector was connected to the appropriate measuring device, which was set into power analyser mode via a low-loss coaxial cable.
4. All other supporting equipment were powered separately from another filtered mains.

### **FCC Part 15.247(b)(1) & (3) Maximum Peak Power Test Method**

#### Bluetooth

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode, non-hopping with transmitting frequency at Channel 0 (2.402GHz).
2. The maximum peak power of the transmitting frequency was detected and recorded.
3. The Equivalent Isotropic Radiated Power (EIRP) of the EUT was computed by adding its antenna gain to the measured maximum peak power.
4. The steps 2 to 3 were repeated with the transmitting frequency was set to Channel 39 (2.441GHz) and Channel 78 (2.480GHz) respectively.

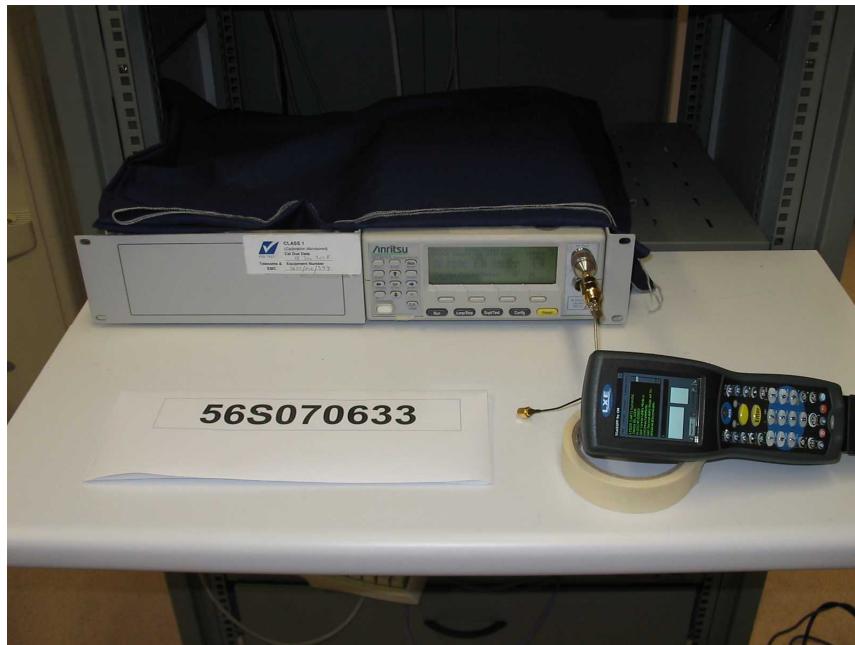
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**MAXIMUM PEAK POWER TEST**

**WLAN 802.11b/g**

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode at Channel 1 (2.412GHz) with specified modulation and data rate.
2. The maximum peak power of the transmitting frequency was detected and recorded.
3. Repeat steps 1 to 2 with all possible modulations and data rates.
4. The steps 2 to 3 were repeated with the transmitting frequency was set to Channel 6 (2.437GHz) and Channel 11 (2.462GHz) respectively.

**MAXIMUM PEAK POWER TEST**



**Maximum Peak Power Test Setup (Bluetooth)**



**Maximum Peak Power Test Setup (WLAN 802.11b/g)**

**MAXIMUM PEAK POWER TEST**

**FCC Part 15.247(b)(1) Maximum Peak Power Results**

Test Input Power	110V 60Hz	Temperature	22°C
Antenna Gain	0 dBi	Relative Humidity	58%
Operating Mode	Bluetooth	Atmospheric Pressure	1030mbar
Tested By			Kenneth Ler

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)
0	2.402	0.002	1.0
39	2.441	0.002	1.0
78	2.480	0.002	1.0

**Notes**

1. Nil

**MAXIMUM PEAK POWER TEST**

**FCC Part 15.247(b)(3) Maximum Peak Power Results**

Test Input Power	110V 60Hz	Temperature	22°C
Antenna Gain	0 dBi	Relative Humidity	58%
Operating Mode	WLAN 802.11b	Atmospheric Pressure	1030mbar
Tested By			Kenneth Ler

Channel	Channel Frequency (GHz)	Modulation	Data Rate	Maximum Peak Power (W)	Limit (W)
1	2.412	DBPSK	1Mbps	0.076	1.0
6	2.437	DBPSK	1Mbps	0.066	1.0
11	2.462	DBPSK	1Mbps	0.068	1.0
1	2.412	DQPSK	2Mbps	0.077	1.0
6	2.437	DQPSK	2Mbps	0.065	1.0
11	2.462	DQPSK	2Mbps	0.065	1.0
1	2.412	CCK	5.5Mbps	0.077	1.0
6	2.437	CCK	5.5Mbps	0.048	1.0
11	2.462	CCK	5.5Mbps	0.048	1.0
1	2.412	CCK	11Mbps	0.077	1.0
6	2.437	CCK	11Mbps	0.051	1.0
11	2.462	CCK	11Mbps	0.052	1.0

**Notes**

1. Nil

**MAXIMUM PEAK POWER TEST**

**FCC Part 15.247(b)(3) Maximum Peak Power Results**

Test Input Power	110V 60Hz	Temperature	22°C
Antenna Gain	0 dBi	Relative Humidity	58%
Operating Mode	WLAN 802.11g	Atmospheric Pressure	1030mbar
		Tested By	Kenneth Ler

Channel	Channel Frequency (GHz)	Modulation	Data Rate	Maximum Peak Power (W)	Limit (W)
1	2.412	BPSK	9Mbps	0.066	1.0
6	2.437	BPSK	9Mbps	0.052	1.0
11	2.462	BPSK	9Mbps	0.054	1.0
1	2.412	QPSK	18Mbps	0.063	1.0
6	2.437	QPSK	18Mbps	0.047	1.0
11	2.462	QPSK	18Mbps	0.052	1.0
1	2.412	16QAM	36Mbps	0.054	1.0
6	2.437	16QAM	36Mbps	0.036	1.0
11	2.462	16QAM	36Mbps	0.037	1.0
1	2.412	64QAM	54Mbps	0.055	1.0
6	2.437	64QAM	54Mbps	0.031	1.0
11	2.462	64QAM	54Mbps	0.033	1.0

**Notes**

1. Nil

## **BAND EDGE COMPLIANCE (RADIATED) TEST**

### **FCC Part 15.247(d) Band Edge Compliance (Radiated) Limits**

The EUT shows compliance to the requirements of this section, which states in any 100kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator (EUT) is operating, the radio frequency power that is produced by the EUT shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of desired power. In addition, radiated emissions which fall in the restricted bands shall comply to the radiated emission limits specified in 15.209.

### **FCC Part 15.247(d) Band Edge Compliance (Radiated) Test Instrumentation**

<b>Instrument</b>	<b>Model</b>	<b>S/No</b>	<b>Cal Due Date</b>
Rohde & Schwarz EMI Test Receiver	ESMI	829214-006 829550-001	24 Nov 2007
Schaffner Preamplifier (9kHz-2GHz) – PA19	CPA9231A	18763	12 Jan 2008
Schaffner Bilog Antenna – BL	CBL6112D	22020	14 May 2008
EMCO Horn Antenna – H14	3115	0003-6087	18 May 2008
MITEQ Preamplifier (0.1-26.5GHz) – PA10	NSP2650-N	728230	26 Jan 2008

### **FCC Part 15.247(d) Band Edge Compliance (Radiated) Test Setup**

1. The EUT and supporting equipment were set up as shown in the setup photo.
2. The power supply for the EUT was connected to a filtered mains.
3. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 300kHz to show compliance of spurious at band edges are at least 20dB below the carriers. For restricted band spurious at band edges, peak and average measurement plots were taken using the following setting:
  - a. Peak Plot:  
RBW = VBW = 1MHz
  - b. Average Plot  
RBW = 1MHz, VBW = 10Hz
4. All other supporting equipment were powered separately from another filtered mains.

### **FCC Part 15.247(d) Band Edge Compliance (Radiated) Test Method**

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode with frequency hopping sequence on.
2. The frequency span of the spectrum analyser was set to wide enough to capture the lower band edge of the transmission band, 2.400GHz and any spurious emissions at the band edge.
3. The spectrum analyser was set to max hold to capture any spurious emissions within the span. The signal capturing was continuous until no further spurious emissions were detected.
4. The steps 2 to 3 were repeated with the frequency span of the spectrum analyser was set to wide enough to capture the upper band edge frequency of the transmission band, 2.4835GHz and the any spurious emissions at the band-edge.

**BAND EDGE COMPLIANCE (RADIATED) TEST**



**Band Edge Compliance (Radiated) Test Setup**

**BAND EDGE COMPLIANCE (RADIATED) TEST**

**FCC Part 15.247(d) Band Edge Compliance (Radiated) Results**

Test Input Power	110V 60Hz	Temperature	22°C
Attached Plots	1 - 6	Relative Humidity	58%
Operating Mode	Bluetooth	Atmospheric Pressure	1030mbar
		Tested By	Kenneth Ler

No significant signal was found and they were below the specified limit.

Test Input Power	110V 60Hz	Temperature	22°C
Attached Plots	7 – 30	Relative Humidity	58%
Operating Mode	WLAN 802.11b	Atmospheric Pressure	1030mbar
		Tested By	Kenneth Ler

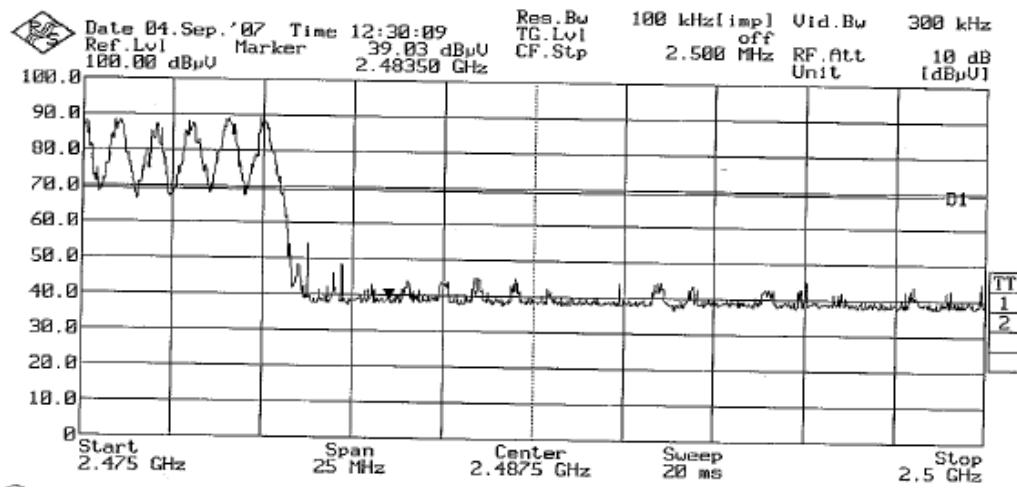
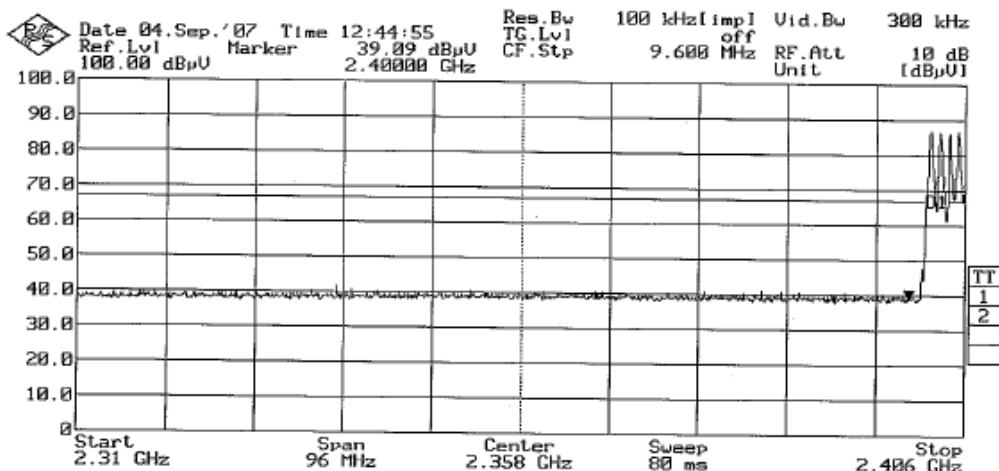
No significant signal was found and they were below the specified limit.

Test Input Power	110V 60Hz	Temperature	22°C
Attached Plots	31 – 54	Relative Humidity	58%
Operating Mode	WLAN 802.11g	Atmospheric Pressure	1030mbar
		Tested By	Kenneth Ler

No significant signal was found and they were below the specified limit.

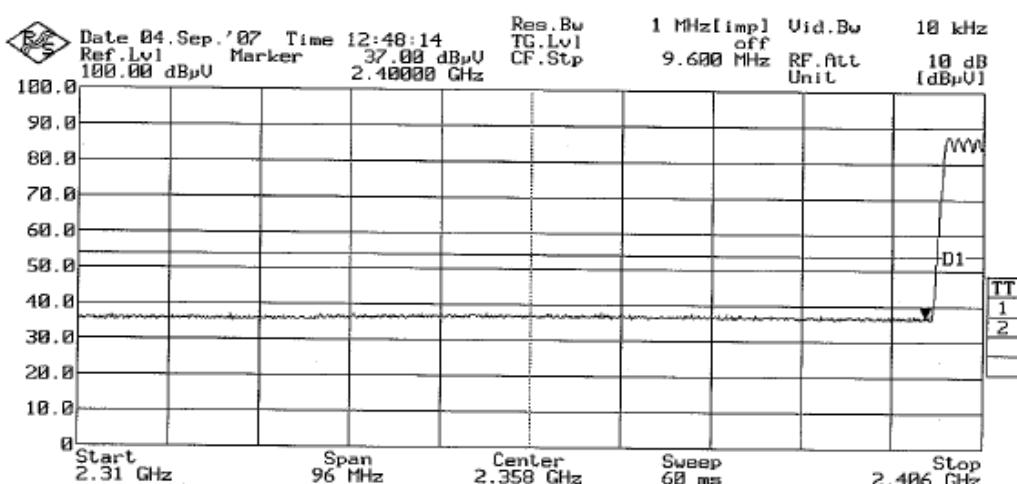
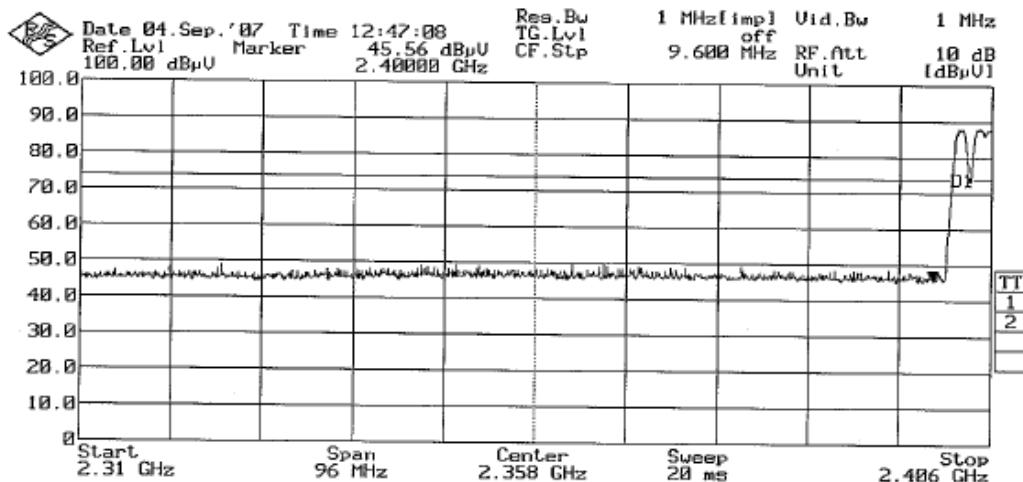
**BAND EDGE COMPLIANCE (RADIATED) TEST**

**Band Edge Compliance (Radiated) Plots (20dB Delta from Carrier at Band Edge) - Bluetooth**



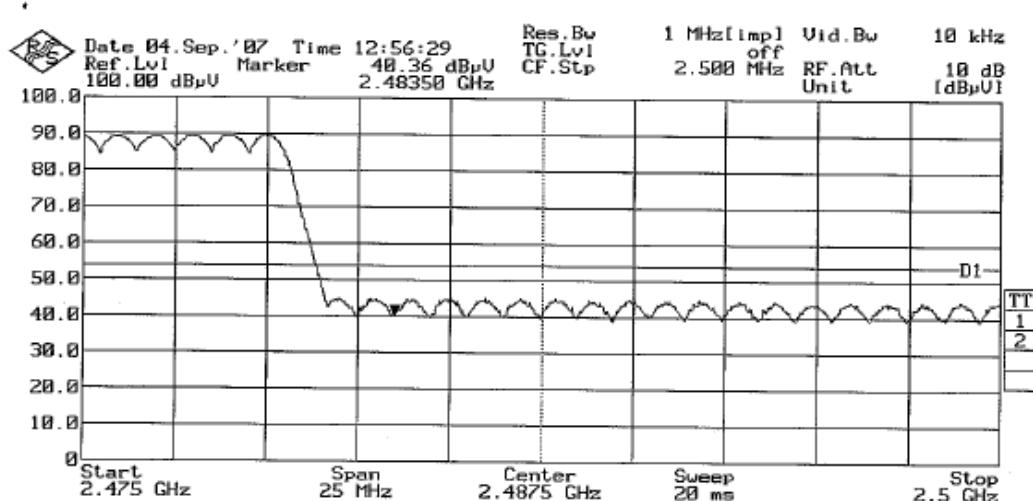
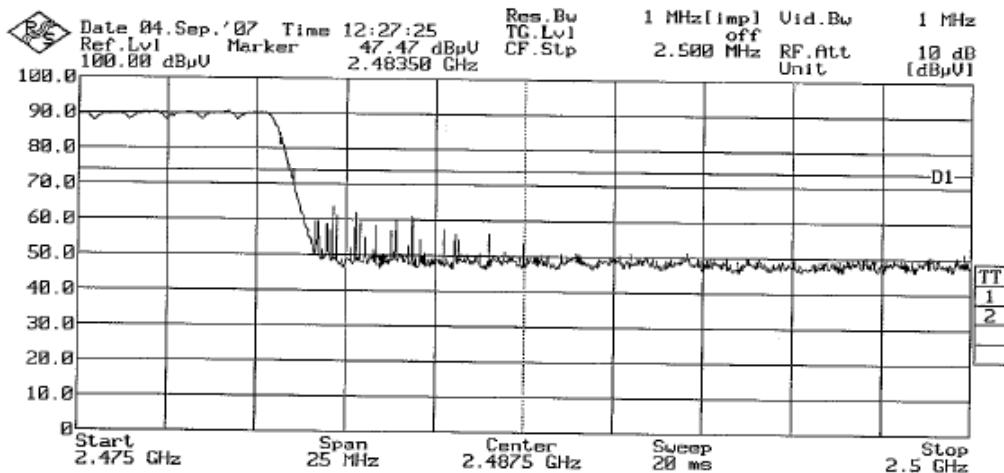
BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (Restricted Band) - Bluetooth



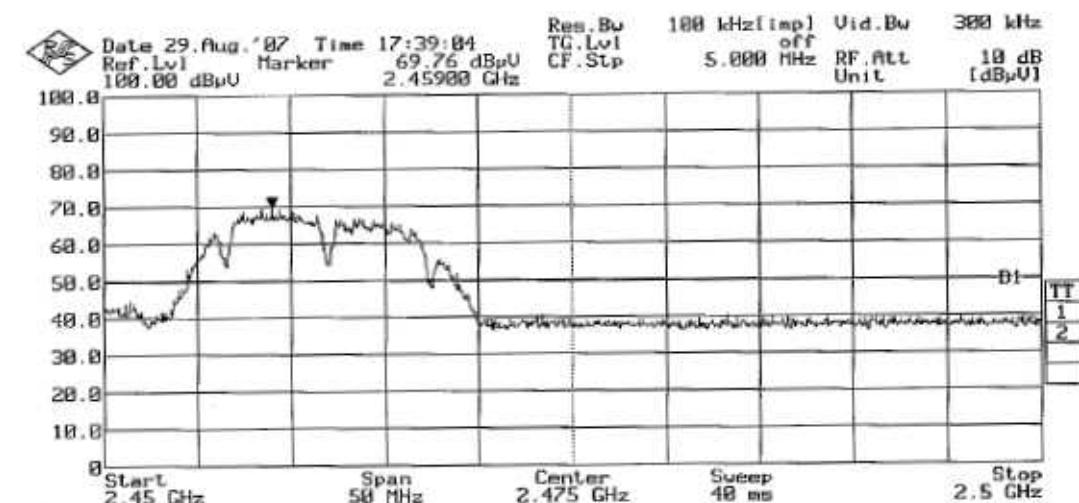
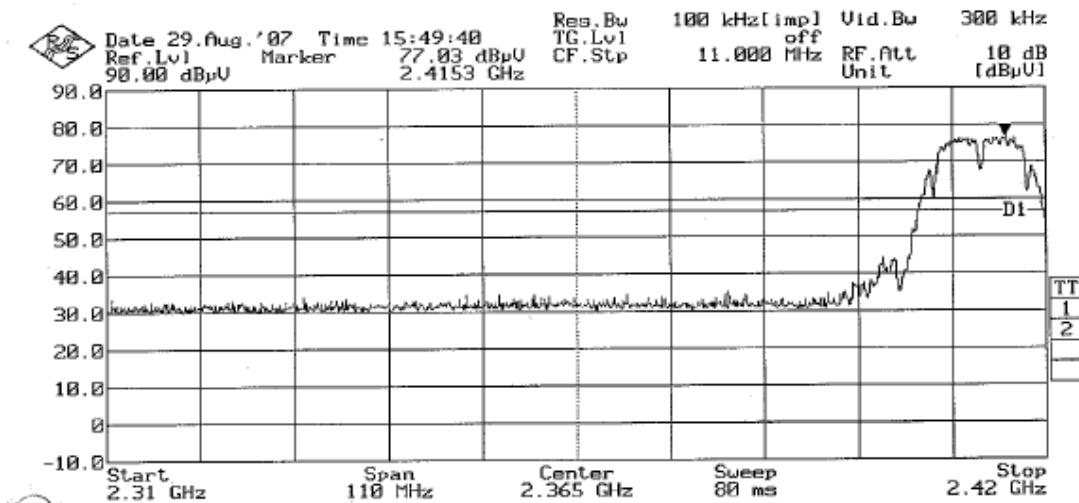
BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (Restricted Band) - Bluetooth



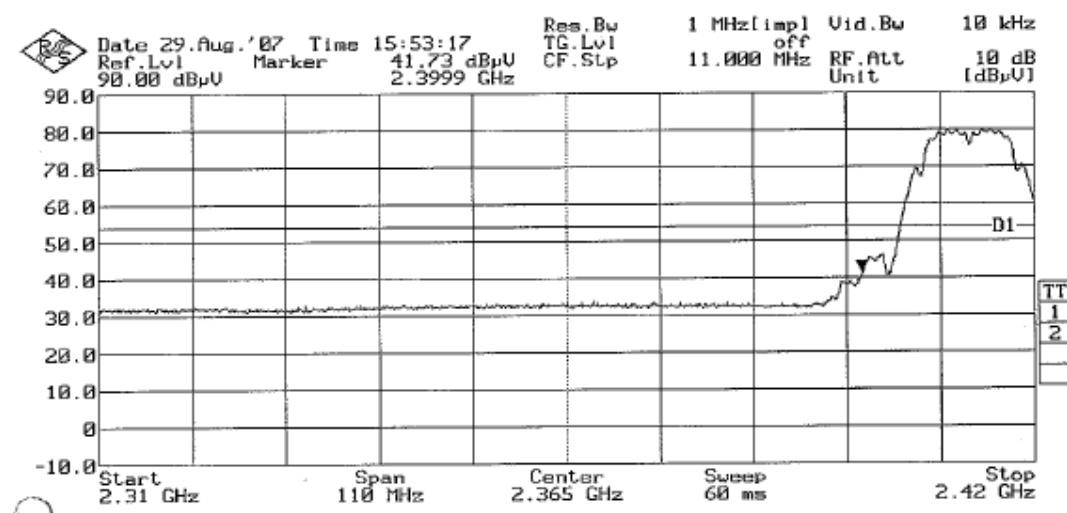
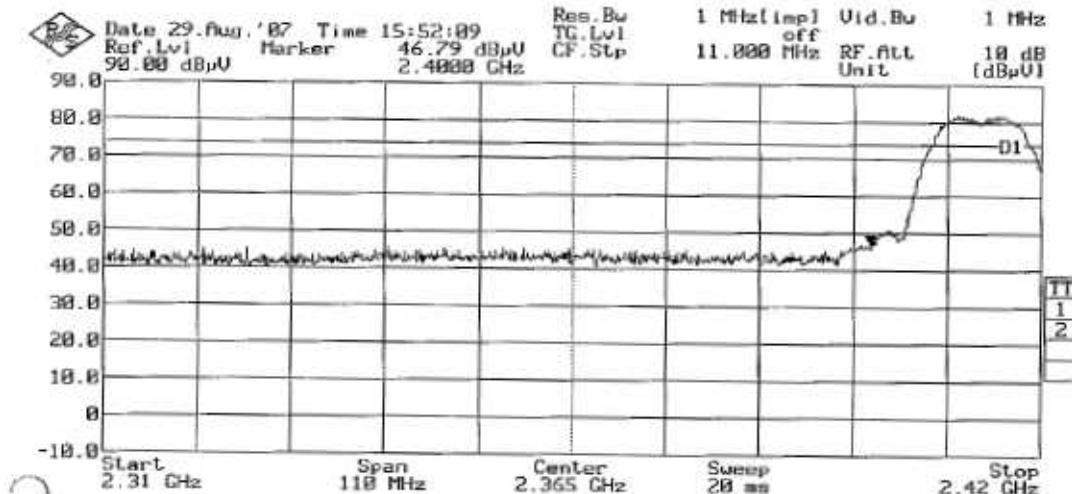
### BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (20dB Delta from Carrier at Band Edge) - WLAN 802.11b @ 1Mbps



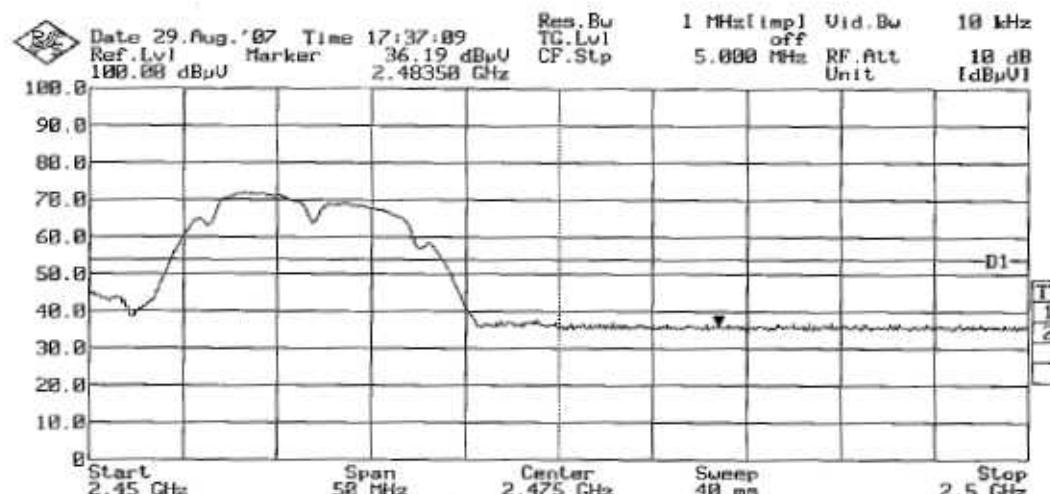
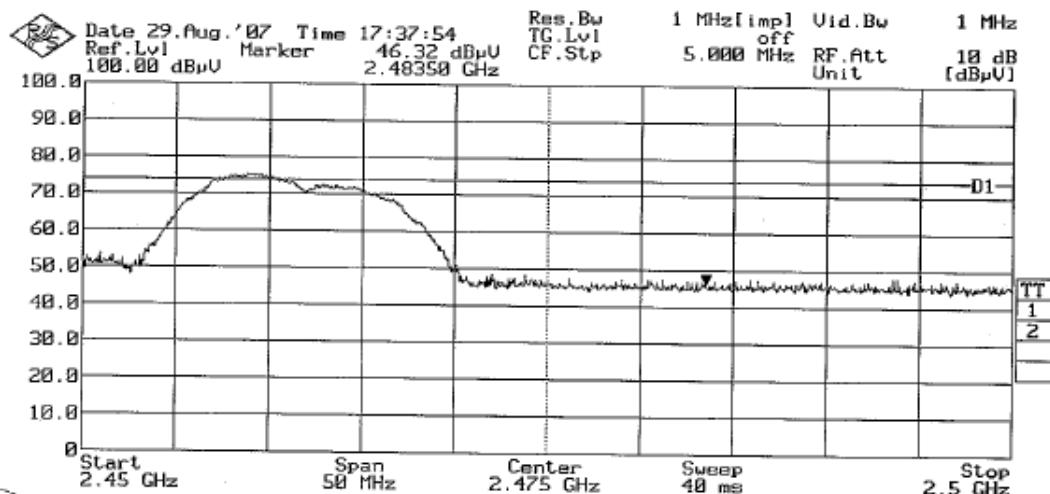
BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (Restricted Band) - WLAN 802.11b @ 1Mbps



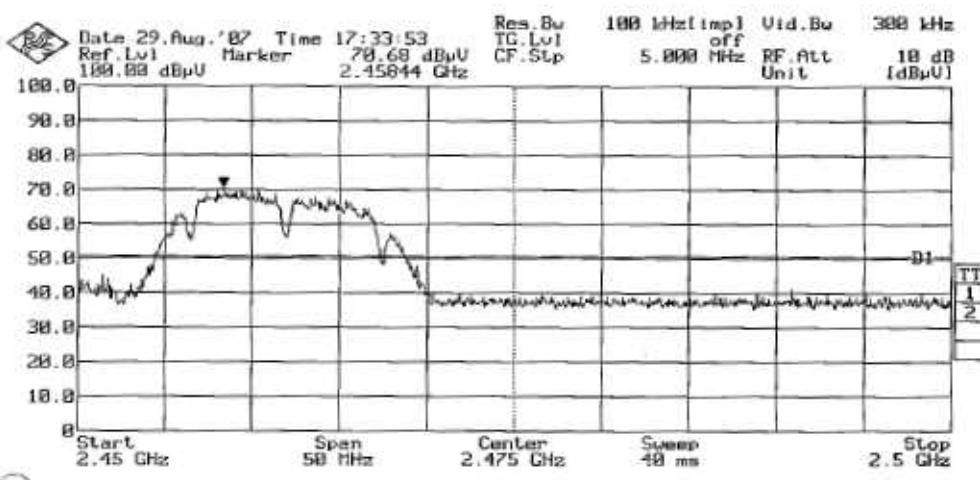
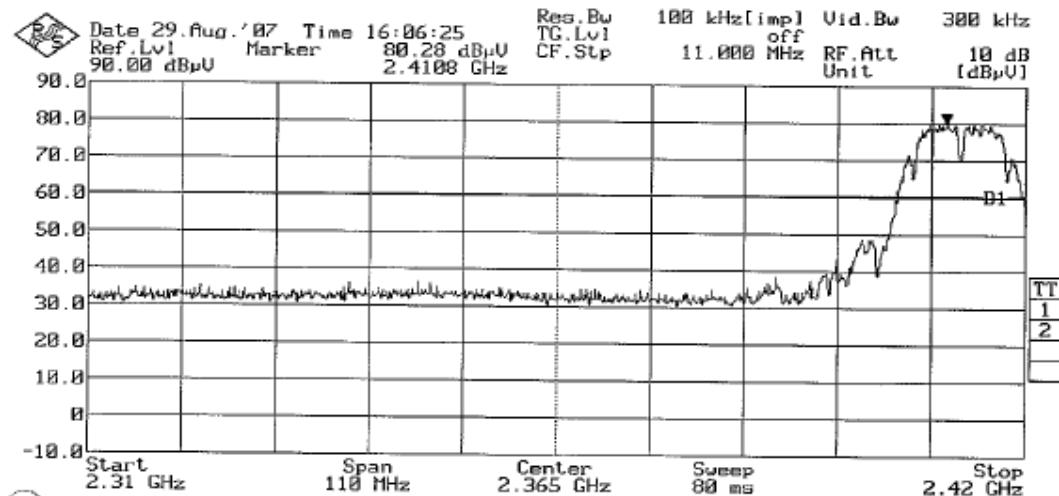
BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (Restricted Band) - WLAN 802.11b @ 1Mbps



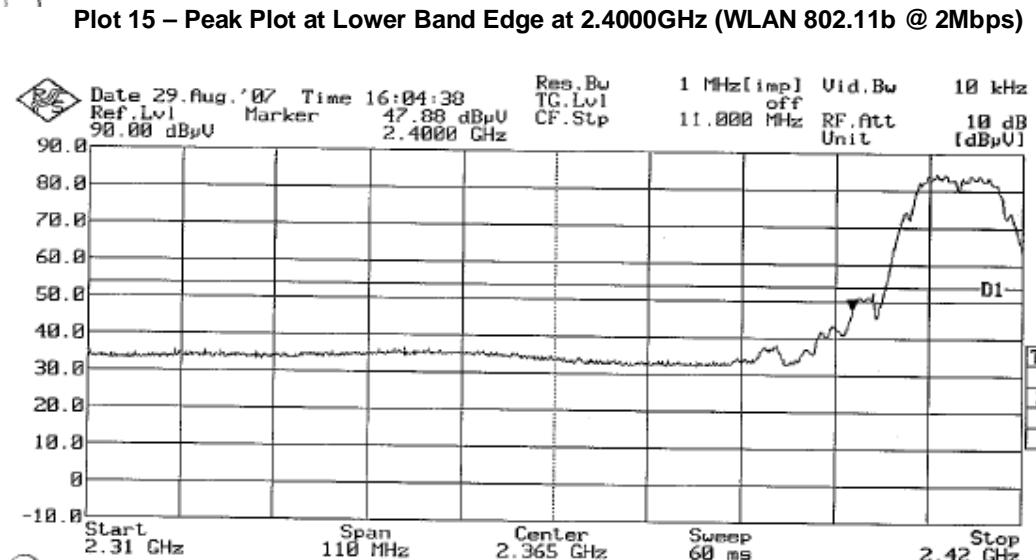
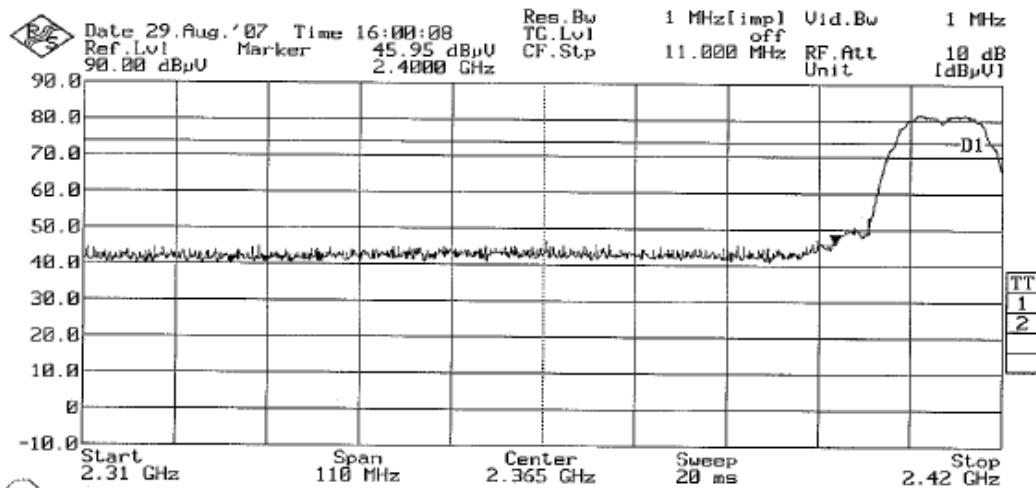
**BAND EDGE COMPLIANCE (RADIATED) TEST**

**Band Edge Compliance (Radiated) Plots (20dB Delta from Carrier at Band Edge) - WLAN 802.11b @ 2Mbps**



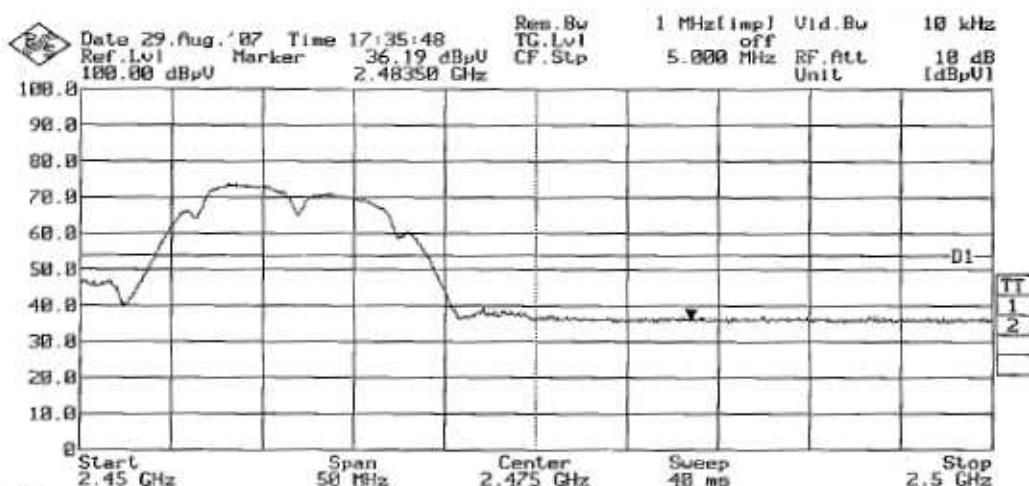
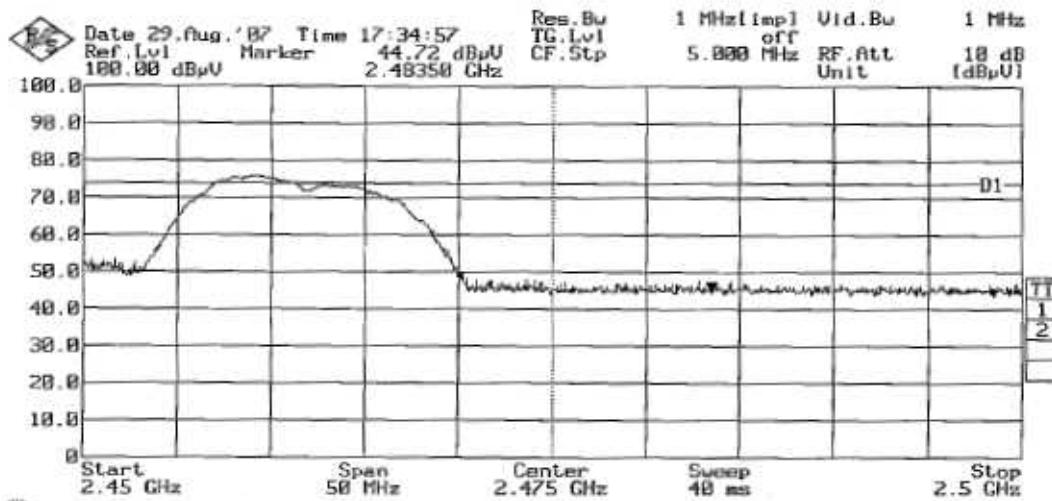
BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (Restricted Band) - WLAN 802.11b @ 2Mbps



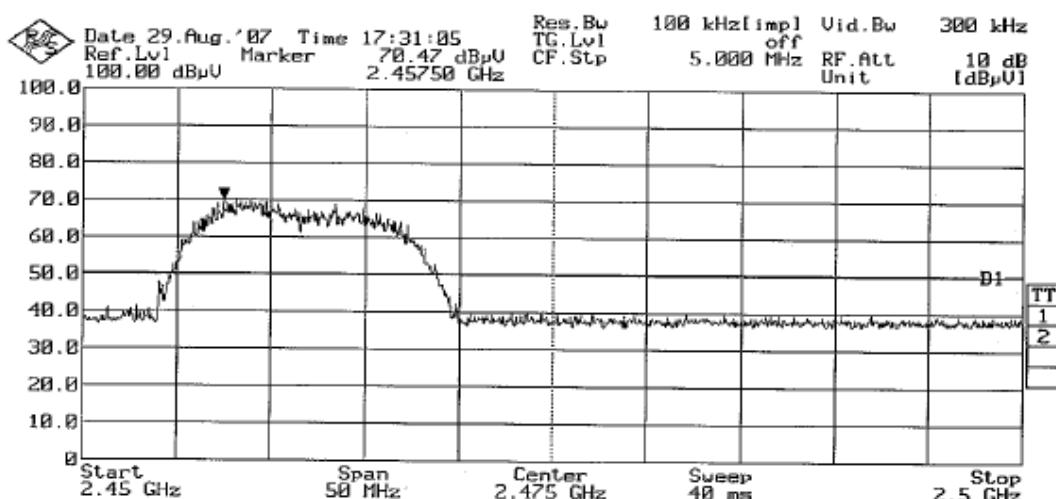
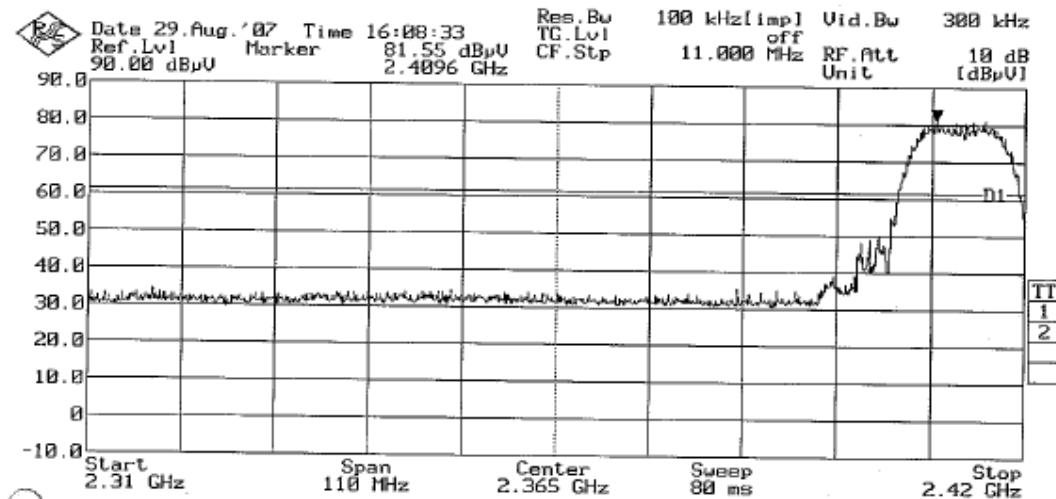
BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (Restricted Band) - WLAN 802.11b @ 2Mbps



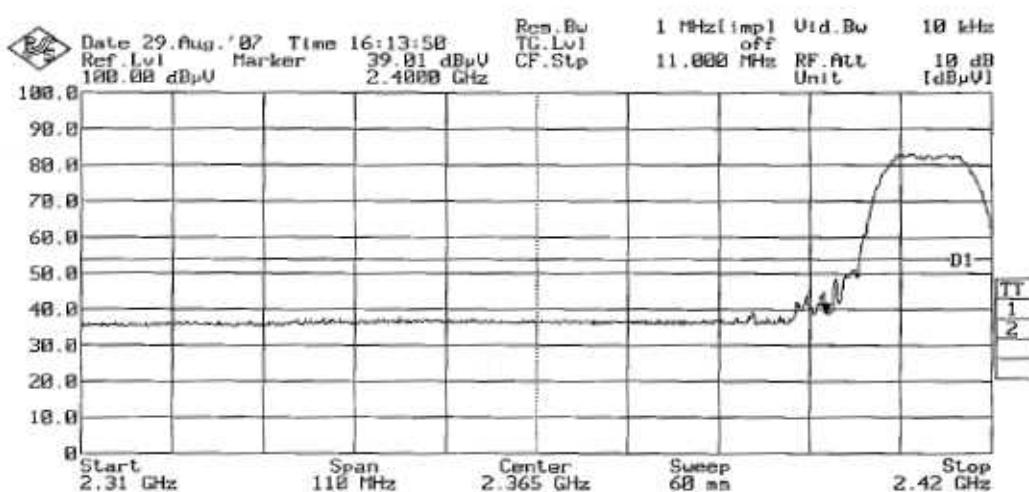
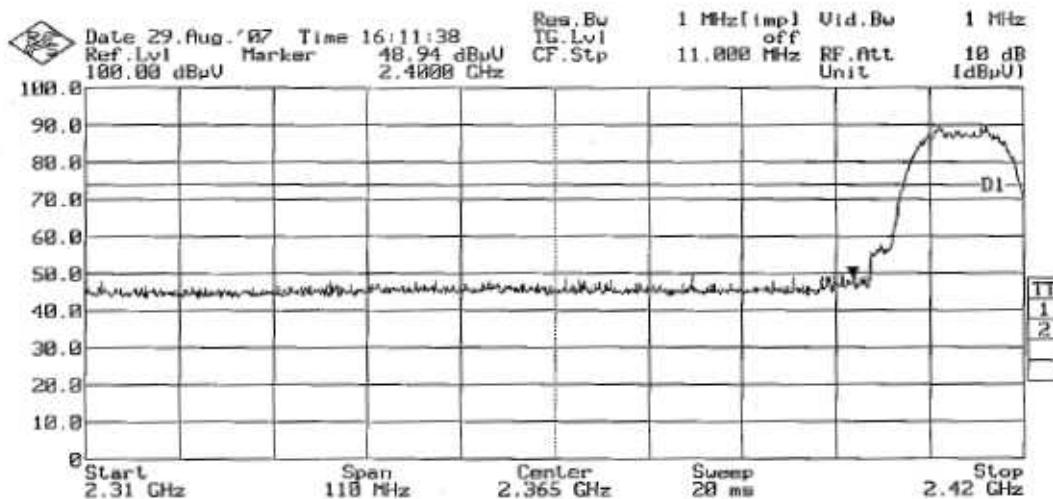
BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (20dB Delta from Carrier at Band Edge) - WLAN 802.11b @ 5.5Mbps



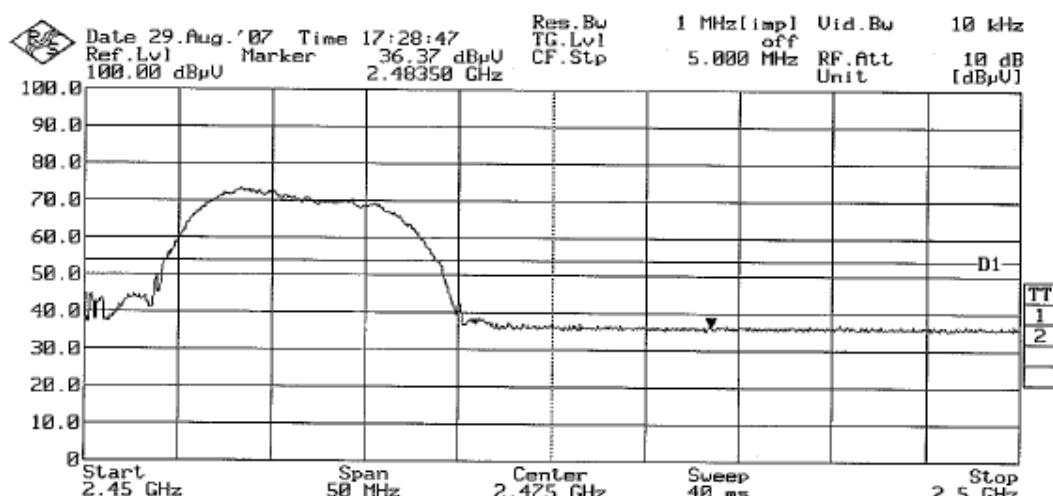
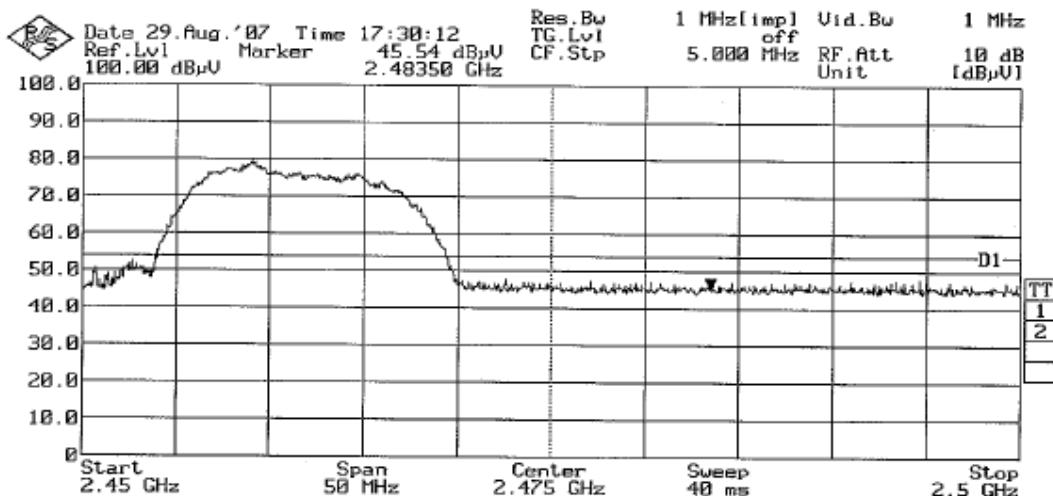
BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (Restricted Band) - WLAN 802.11b @ 5.5Mbps



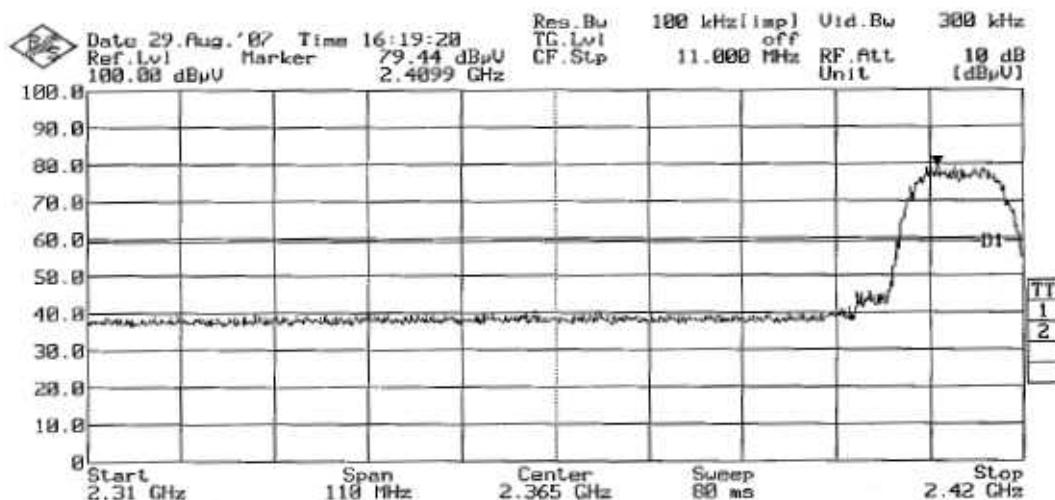
BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (Restricted Band) - WLAN 802.11b @ 5.5Mbps

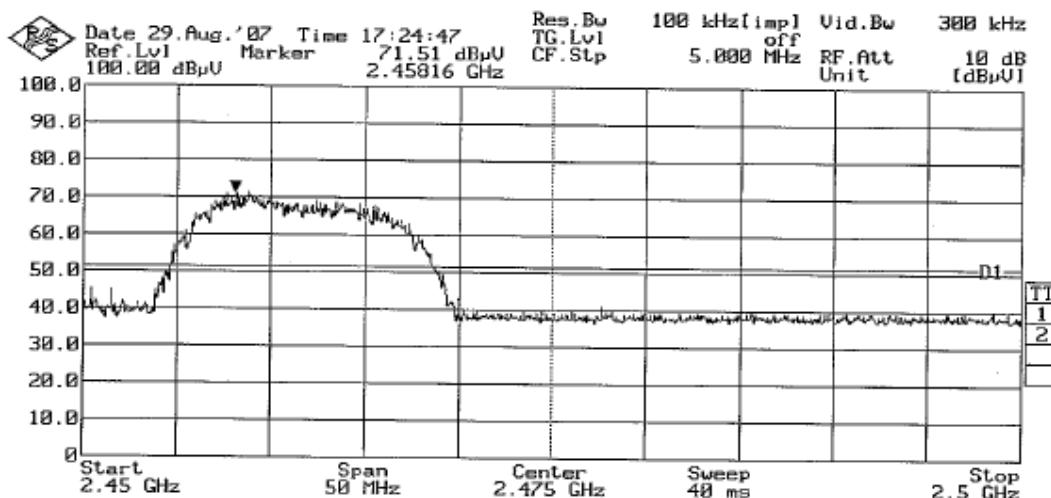


BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (20dB Delta from Carrier at Band Edge) - WLAN 802.11b @ 11Mbps

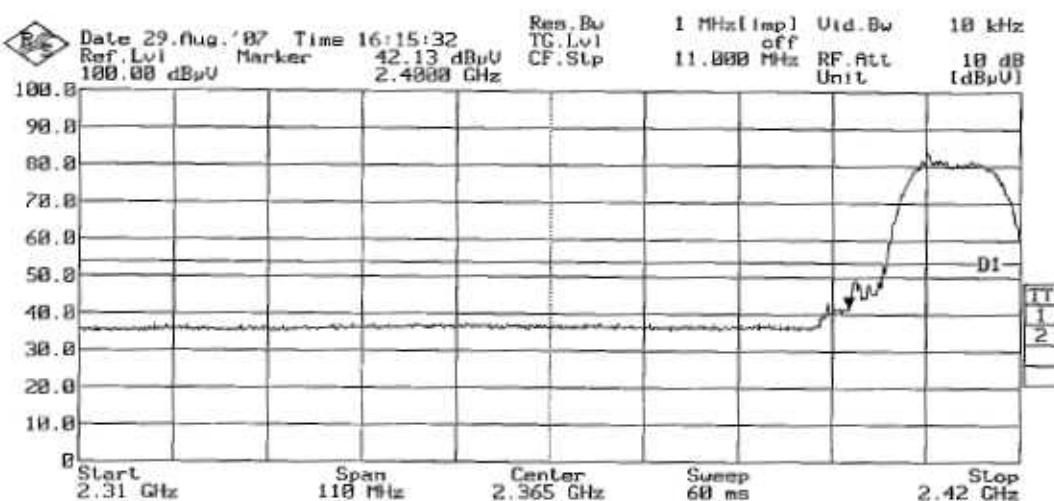
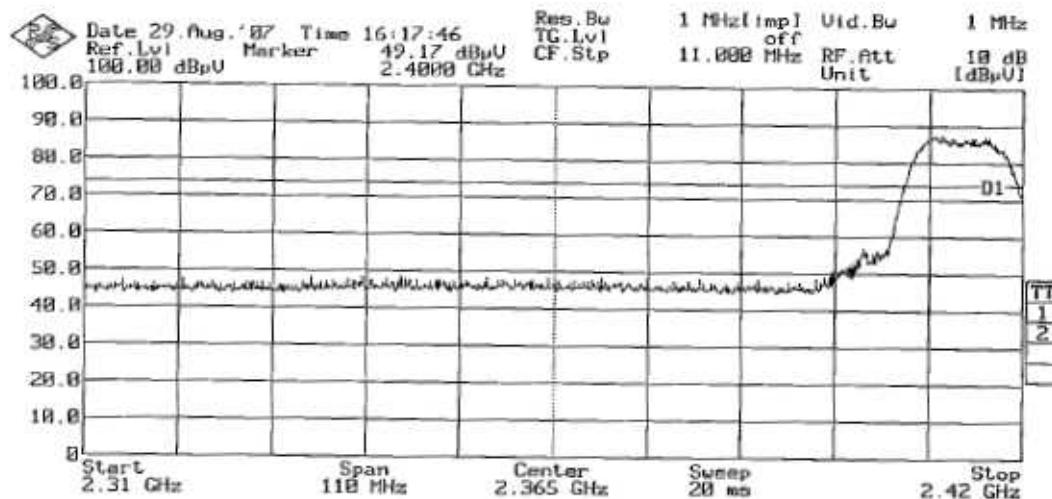


Plot 25 – Lower Band Edge at 2.4000GHz (WLAN 802.11b @ 11Mbps)



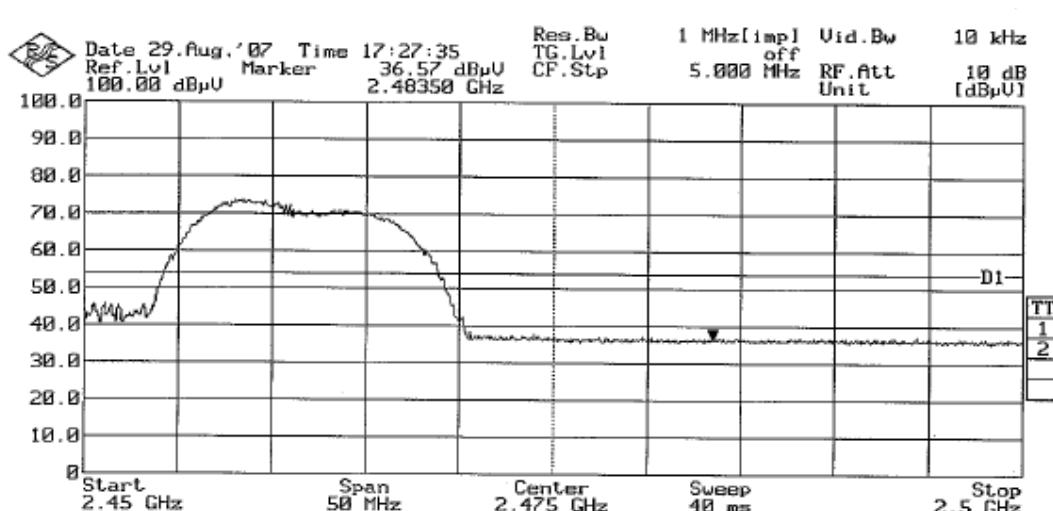
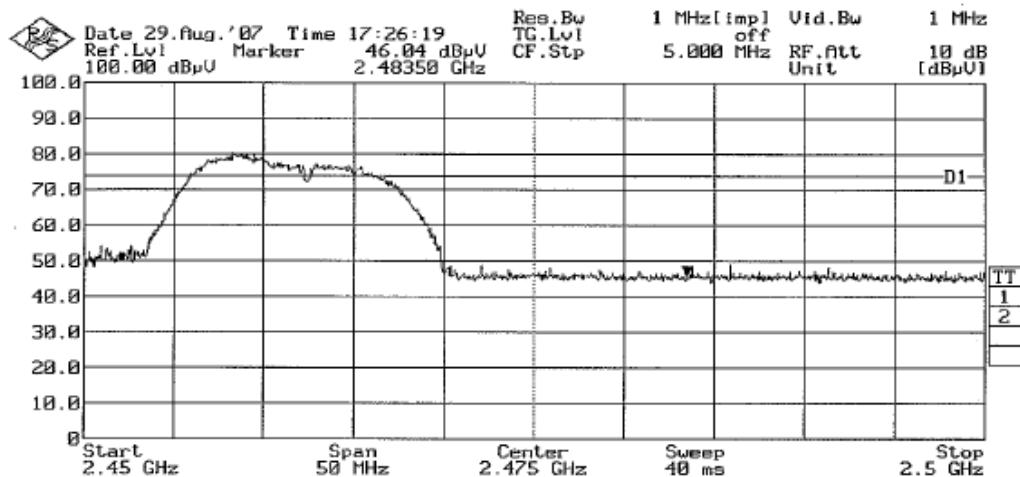
BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (Restricted Band) - WLAN 802.11b @ 11Mbps



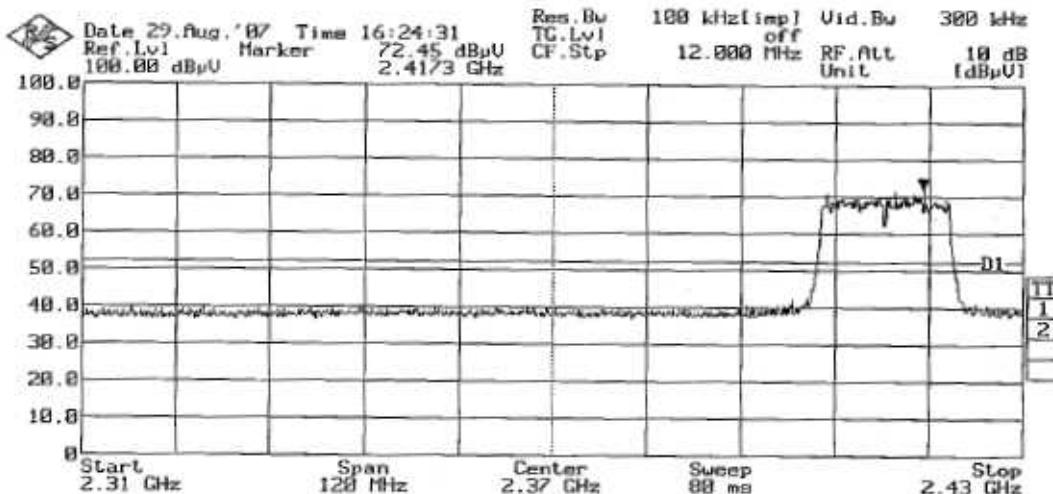
BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (Restricted Band) - WLAN 802.11b @ 11Mbps

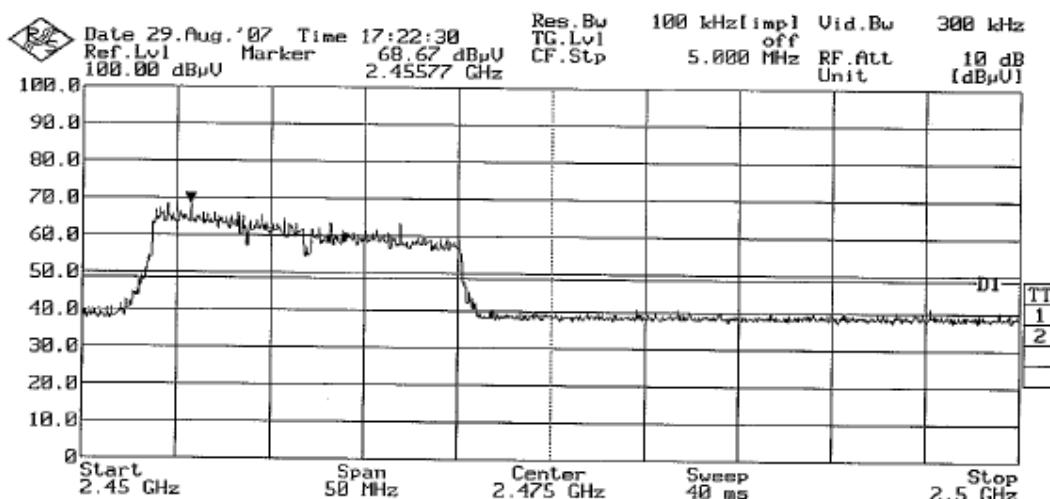


BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (20dB Delta from Carrier at Band Edge) - WLAN 802.11g @ 9Mbps

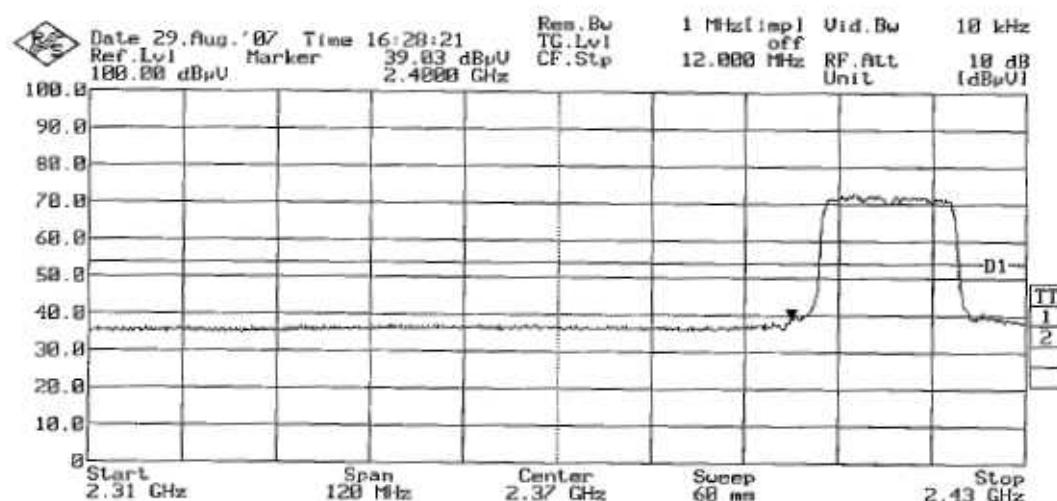
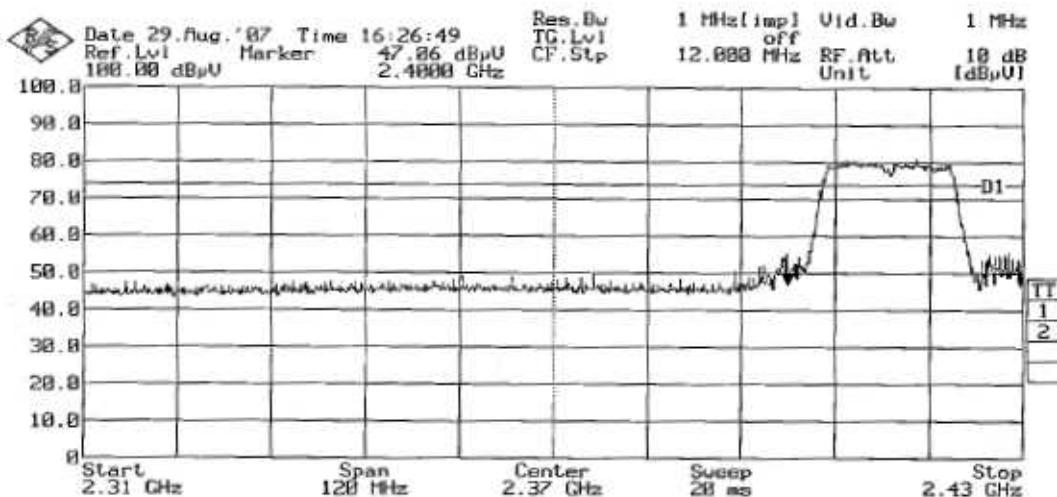


Plot 31 – Lower Band Edge at 2.4000GHz (WLAN 802.11g @ 9Mbps)



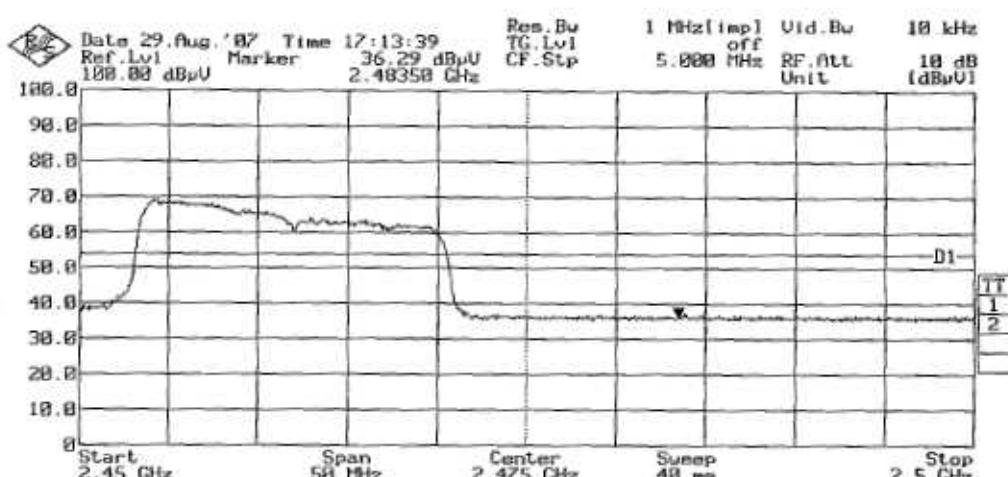
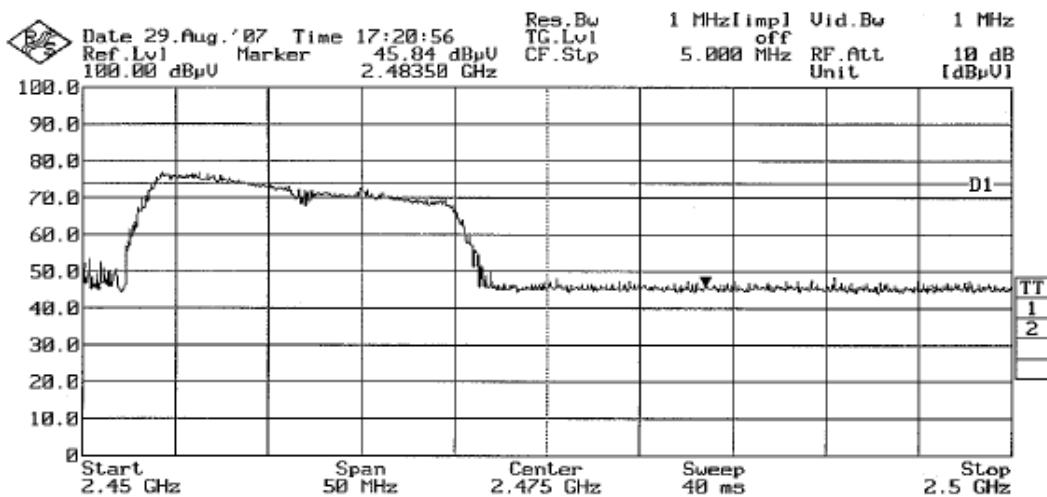
BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (Restricted Band) - WLAN 802.11g @ 9Mbps



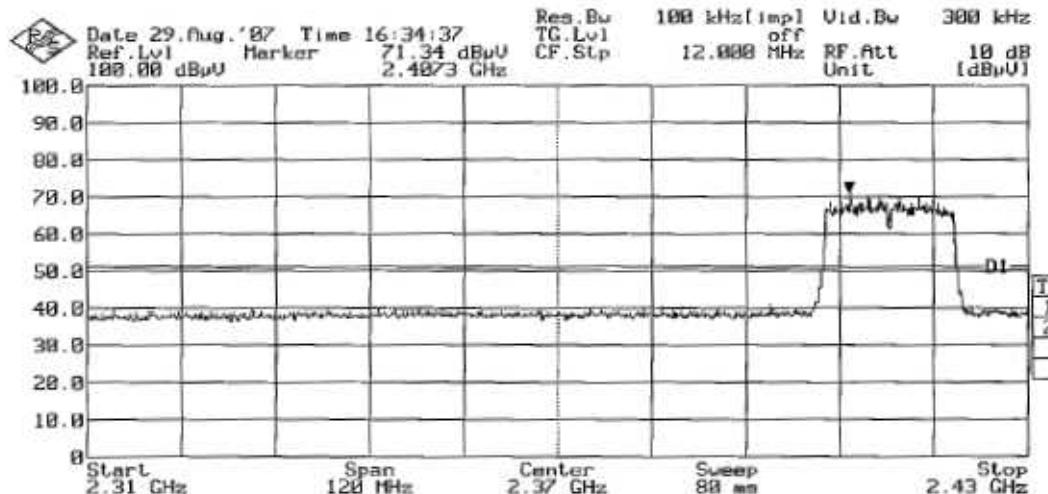
BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (Restricted Band) - WLAN 802.11g @ 9Mbps

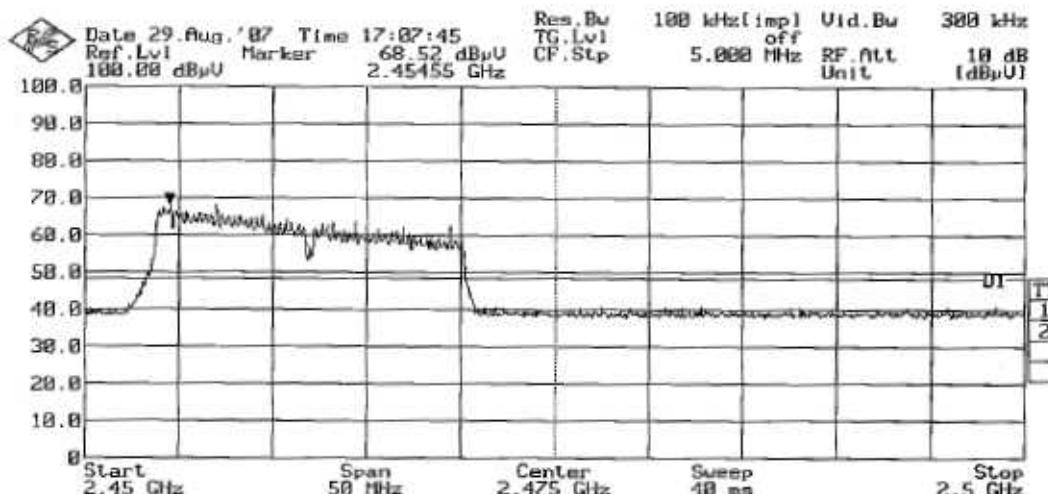


**BAND EDGE COMPLIANCE (RADIATED) TEST**

Band Edge Compliance (Radiated) Plots (20dB Delta from Carrier at Band Edge) - WLAN 802.11g @ 18Mbps



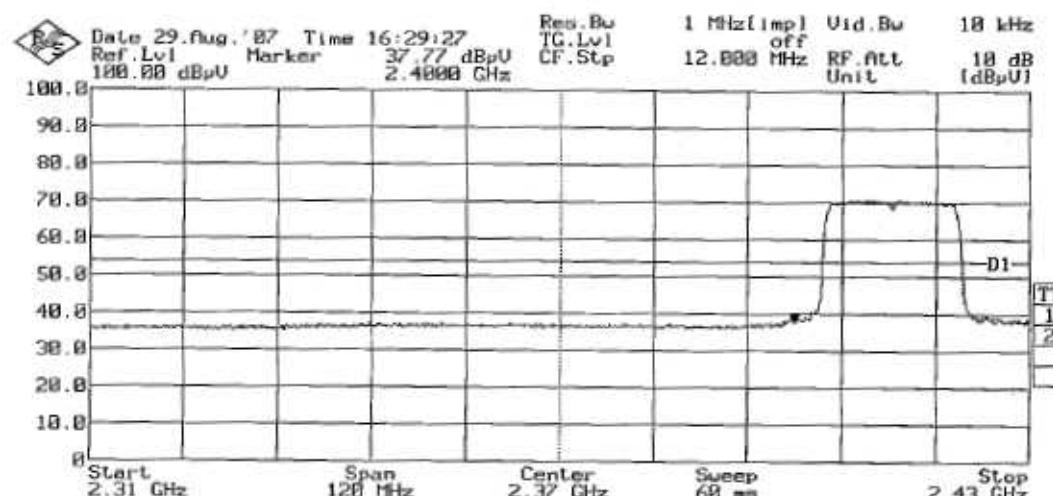
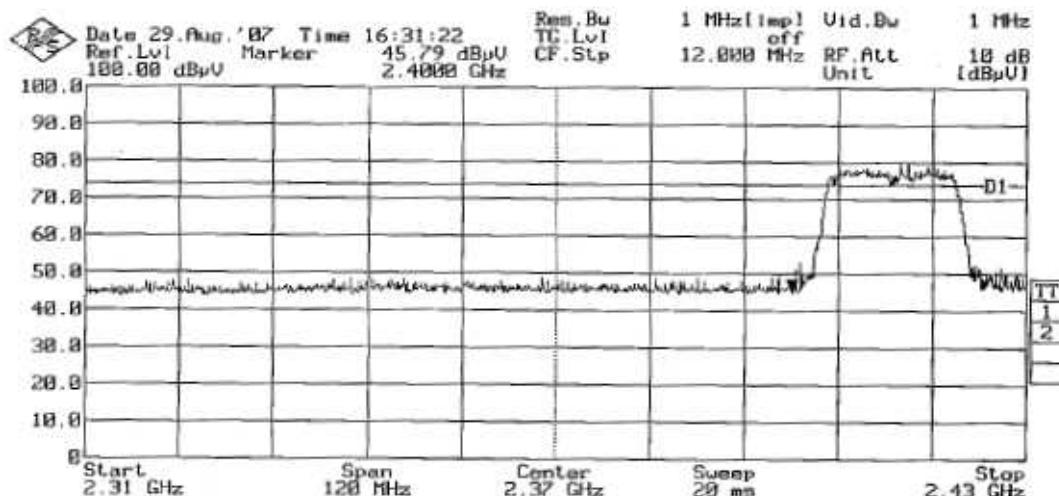
Plot 37 – Lower Band Edge at 2.4000GHz (WLAN 802.11g @ 18Mbps)



Plot 38 – Upper Band Edge at 2.4835GHz (WLAN 802.11g @ 18Mbps)

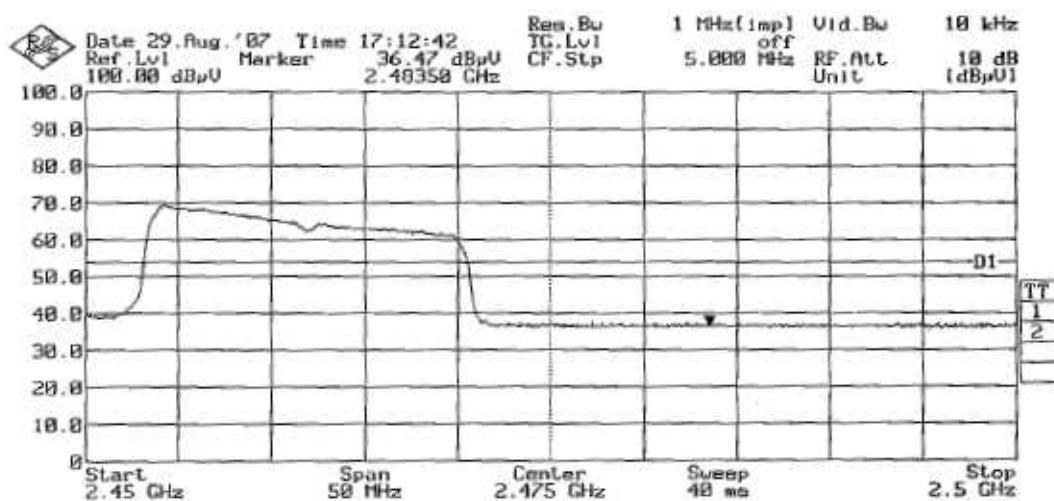
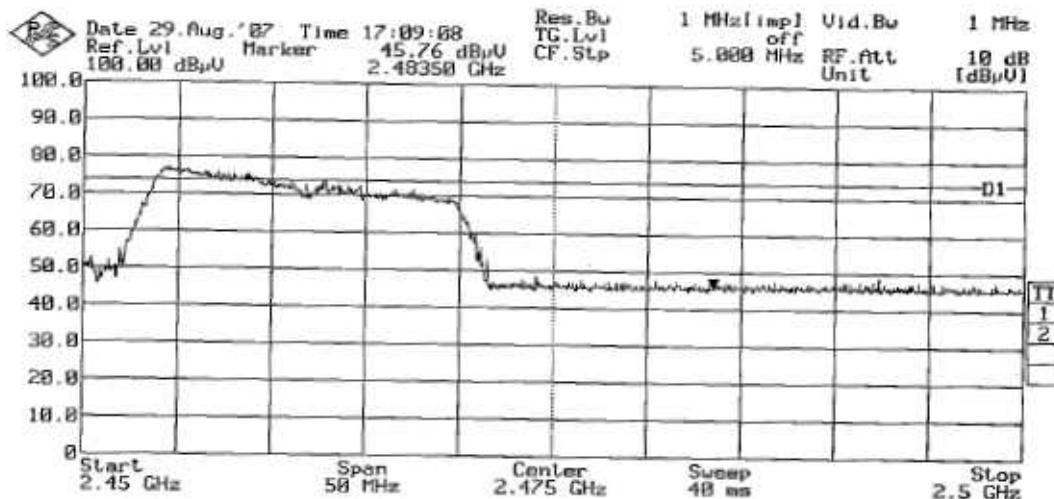
BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (Restricted Band) - WLAN 802.11g @ 18Mbps



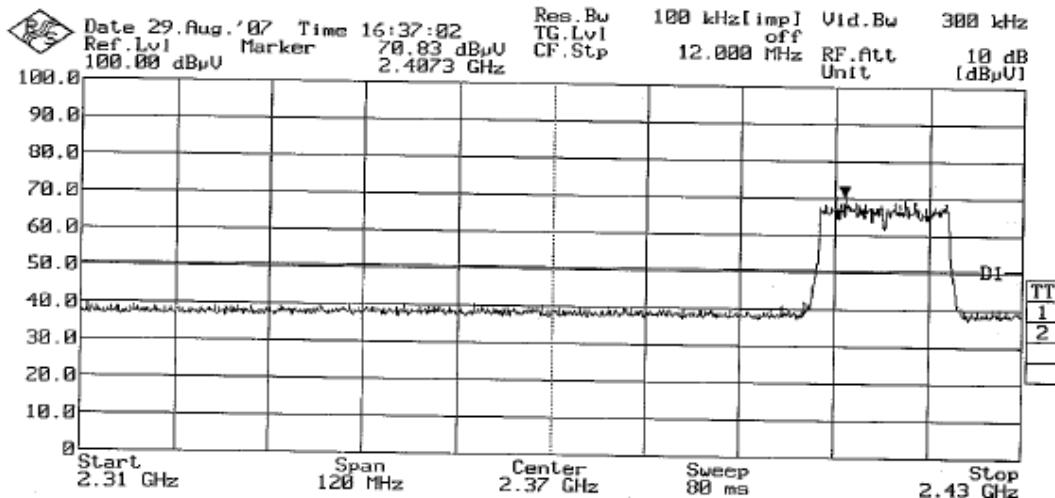
BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (Restricted Band) - WLAN 802.11g @ 18Mbps

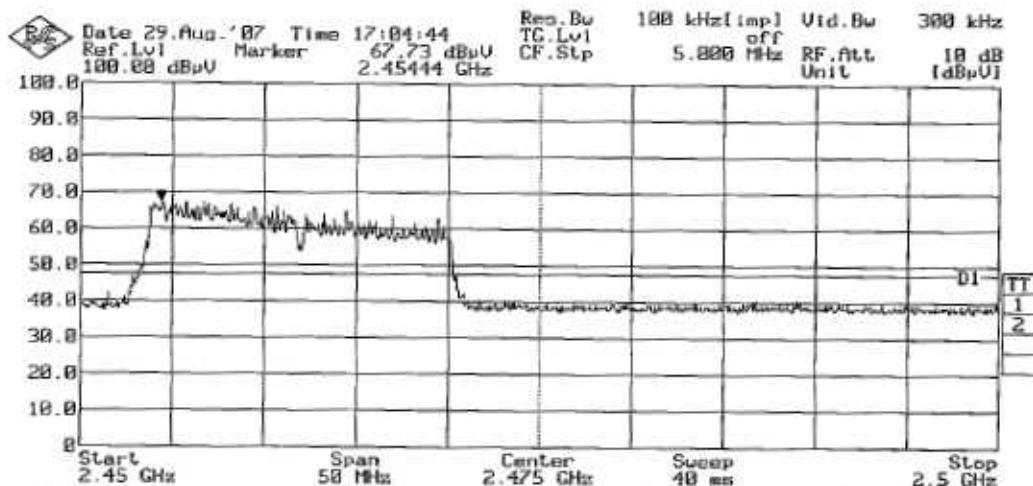


**BAND EDGE COMPLIANCE (RADIATED) TEST**

Band Edge Compliance (Radiated) Plots (20dB Delta from Carrier at Band Edge) - WLAN 802.11g @ 36Mbps

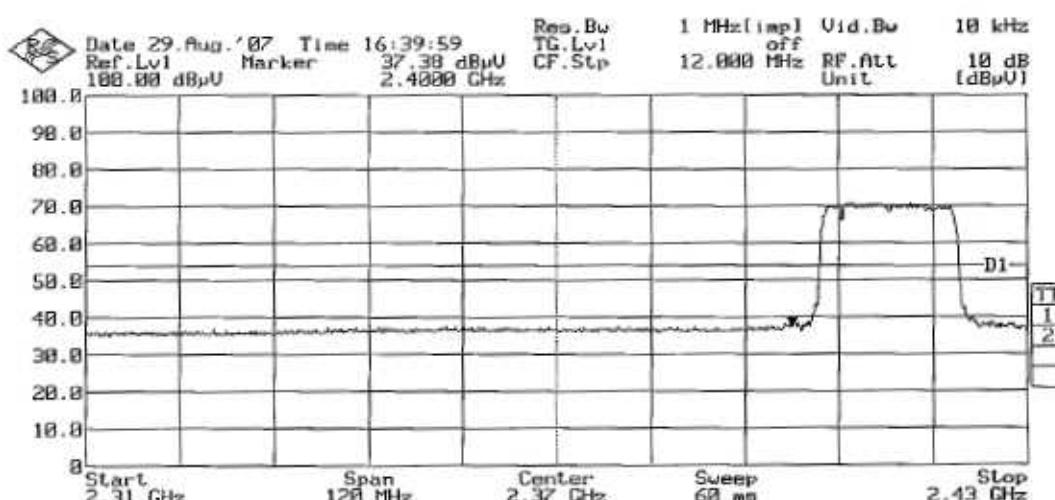
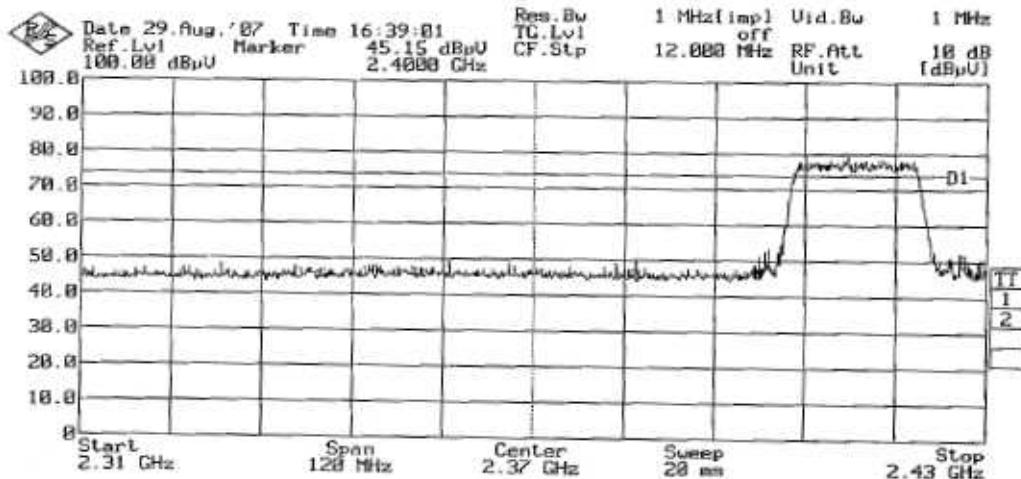


Plot 43 – Lower Band Edge at 2.4000GHz (WLAN 802.11g @ 36Mbps)



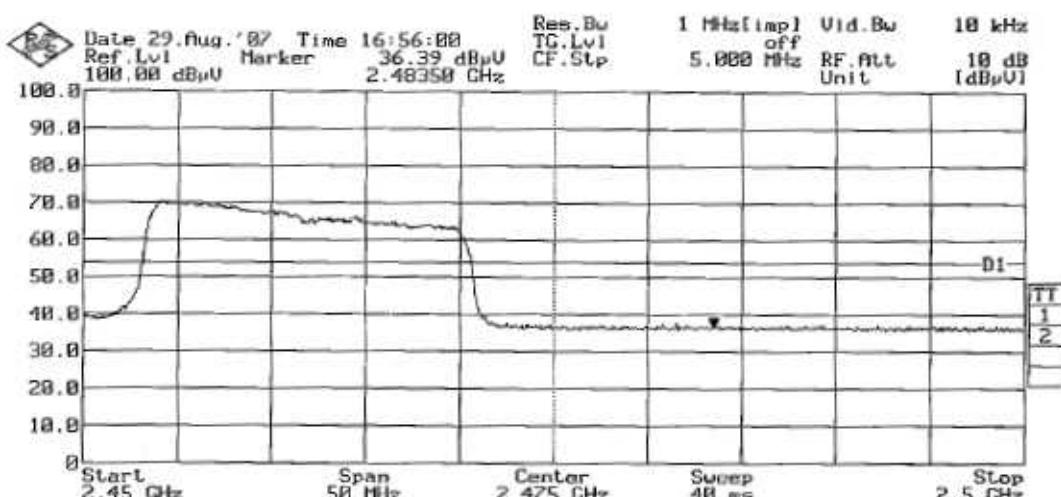
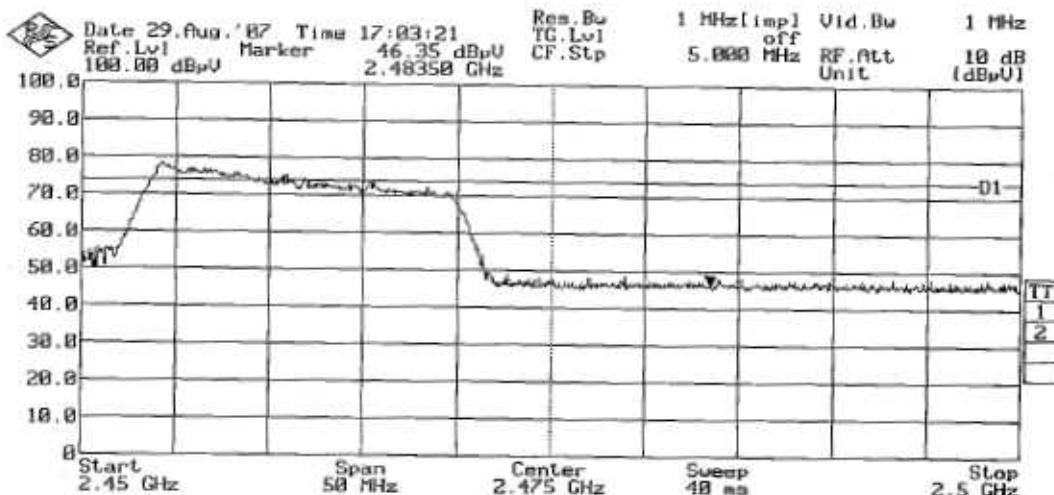
**BAND EDGE COMPLIANCE (RADIATED) TEST**

**Band Edge Compliance (Radiated) Plots (Restricted Band) - WLAN 802.11g @ 36Mbps**



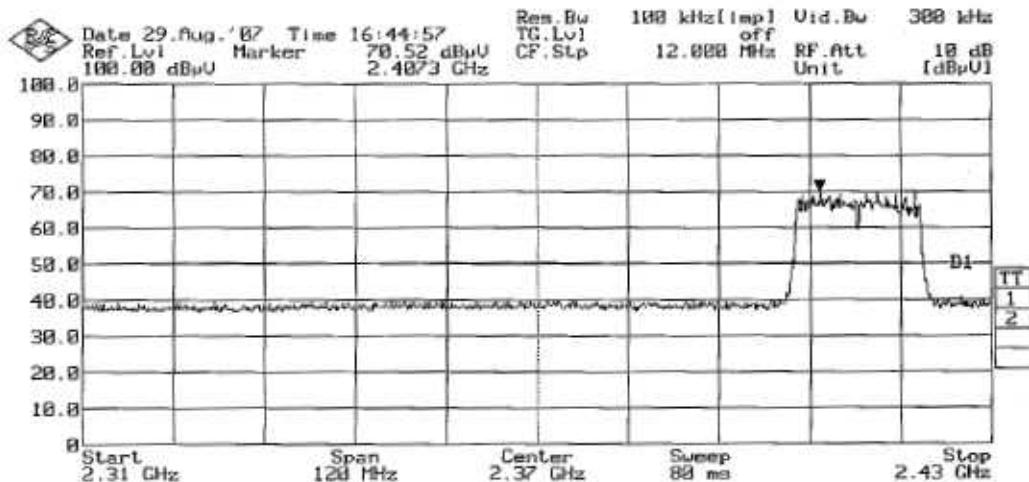
BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (Restricted Band) - WLAN 802.11g @ 36Mbps

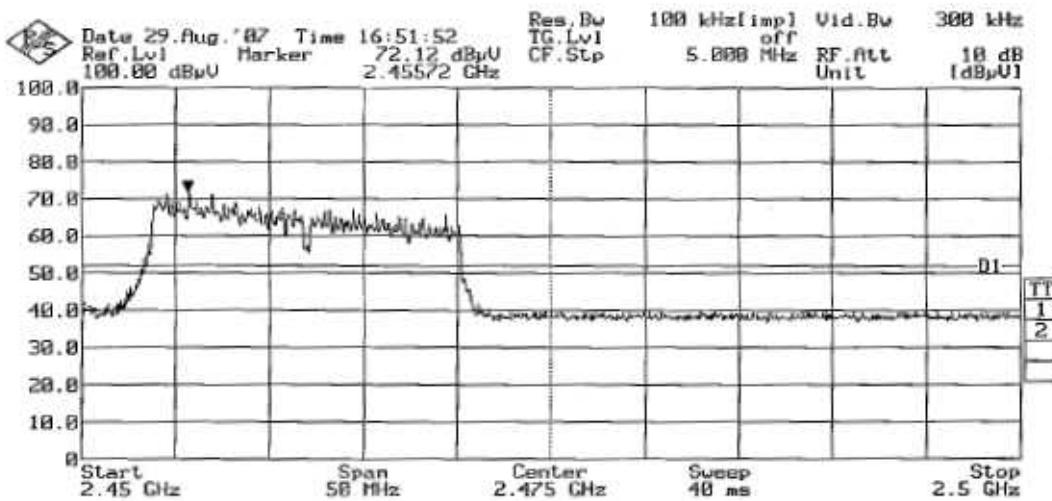


BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (20dB Delta from Carrier at Band Edge) - WLAN 802.11g @ 54Mbps



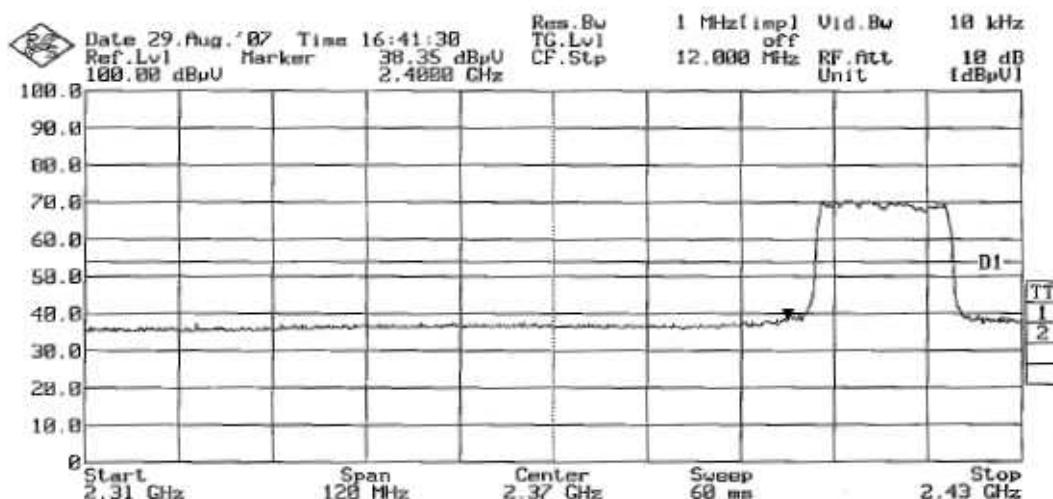
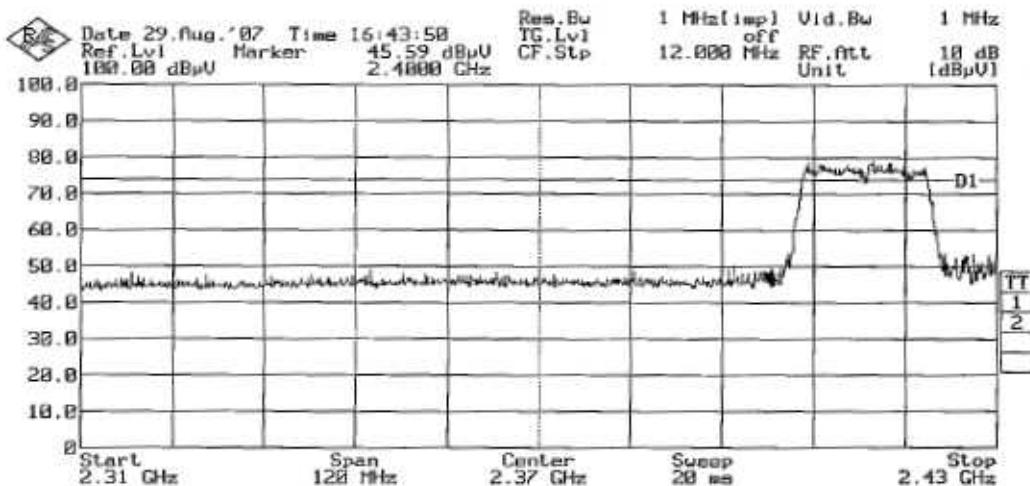
Plot 49 – Lower Band Edge at 2.4000GHz (WLAN 802.11g @ 54Mbps)



Plot 50 – Upper Band Edge at 2.4835GHz (WLAN 802.11g @ 54Mbps)

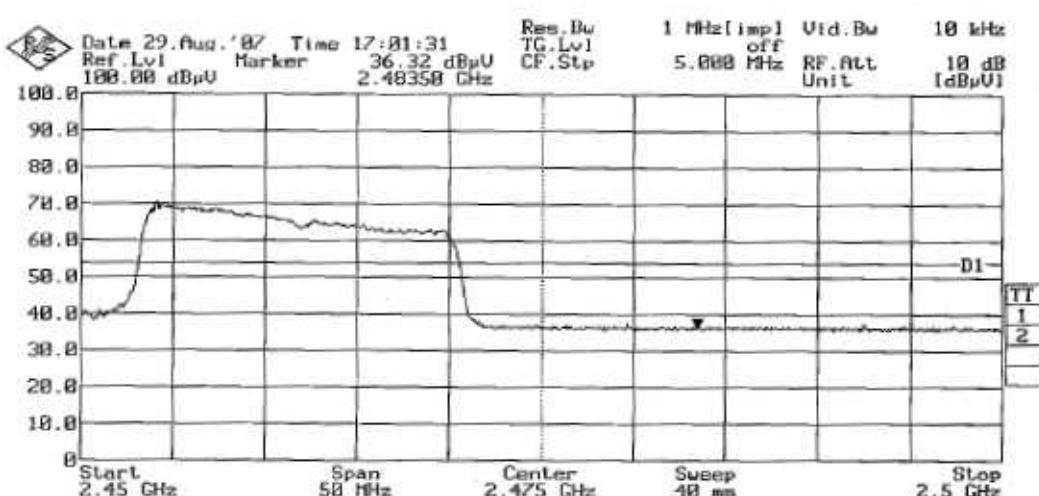
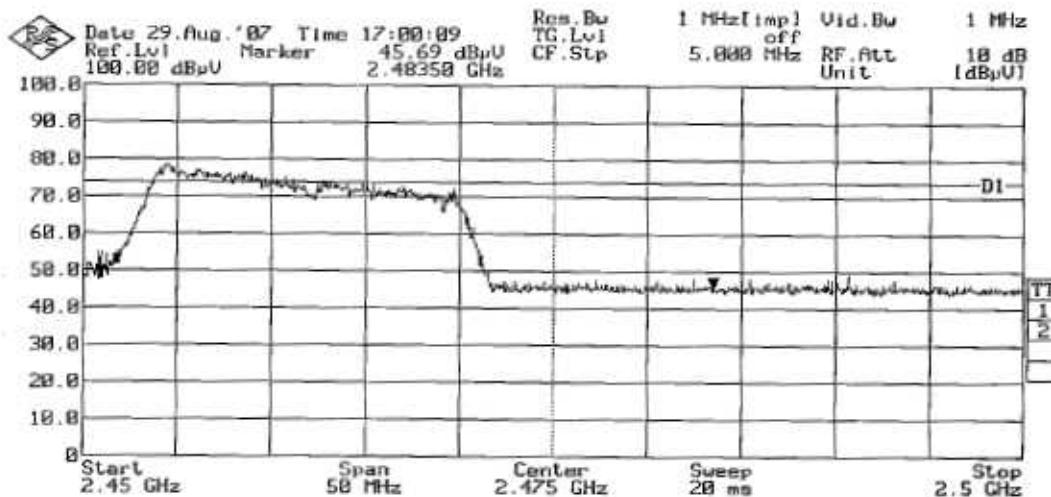
BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (Restricted Band) - WLAN 802.11g @ 54Mbps



BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (Restricted Band) - WLAN 802.11g @ 54Mbps



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May 2007