TEST REPORT

Your Ref:

Date: 27 Nov 2003

Our Ref: 56S030780/02

DID: +65-6885 1448

Fax: +65-6777 6409

FORMAL REPORT ON TESTING IN ACCORDANCE WITH
FCC Parts 15B & C : 2003
OF A
WIRELESS BROADBAND ROUTER
[MODEL : APRT-2001g]
[FCC ID : PXP000002]

TEST FACILITY	Telecoms & EMC, Testing Group, PSB Corporation Pte Ltd 1 Science Park Drive, Singapore 118221
FCC REG. NO.	90937 (3m & 10m OATS) 99142 (10m Anechoic Chamber) 871638 (5m Anechoic Chamber)
IND. CANADA REG. NO.	IC 4257 (10m Anechoic Chamber)
PREPARED FOR	Mr Tan Moh Chuan RFNet Technologies Pte Ltd Unit 106, Innovation Centre, Block1 16 Nanyang Drive Singapore 637722 Republic of Singapore Tel : 65 6795 6919 Fax : 65 6795 9302
JOB NUMBER	56S030780
TEST PERIOD	15 Oct 2003 – 18 Nov 2003

PREPARED BY

Lim Cher Hwee
Engineer

APPROVED BY

Deng Junhong
Assistant Vice President

PSB TEST ®
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ACCREDITED LABORATORY
SAC-SINGLAS

LA-2001-0212-A
LA-2001-0213-F
LA-2001-0214-E
LA-2001-0215-B
LA-2001-0216-G
LA-2001-0217-G

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

TABLE OF CONTENTS

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

Test Results Summary

Test Standard	Description	Pass / Fail
FCC Part 15: 2003		
15.107, 15.207	Conducted Emissions	Pass
15.205	Radiated Emissions (Restricted Band Requirements)	Pass
15.109, 15.209	Radiated Emissions (Spurious Emissions)	Pass
15.247 (a)(2)	Spectrum Bandwidth (6dB Bandwidth Measurement)	Pass
15.247 (b)(3)	Maximum Peak Power	Pass
15.247 (c)	RF Conducted Spurious Emissions & Band Edge Compliance at the Transmitter Antenna Terminal	Pass
15.247 (d)	Peak Power Spectral Density	Pass
1.1310	Maximum Permissible Exposure	Pass

Notes

1. The channels as listed below, under the different configurations were tested:

Transmit Channel	Frequency (GHz)	Modulation
802.11b		
Channel 1	2.412	CCK (11Mbps)
Channel 7	2.442	CCK (11Mbps)
Channel 13	2.472	CCK (11Mbps)
802.11g		
Channel 1	2.412	OFDM (54Mbps)
Channel 7	2.442	OFDM (54Mbps)
Channel 11	2.462	OFDM (54Mbps)
802.11g (Turbo)		
Channel 6	2.437	OFDM (108Mbps)

2. All the measurements in section 15.247 were done based on conducted measurements.

3. The EUT is a Class B device when in non-transmitting state and meets the FCC Part15B Class B requirements.

Modifications

No modifications were done.

Description	:	The Equipment Under Test (EUT) is a **Wireless Broadband Router**, which has capability to operate both in 802.11b and 802.11g configurations.
Manufacturer	:	RFNet Technologies Pte Ltd
Model Number	:	APRT-2001g
FCC ID	:	PXP000002
Serial Number	:	Nil
Microprocessor	:	AR2312A (Atheros Communication, Inc.)
Operating / Transmitting Frequency	:	802.11b 2.412GHz to 2.472GHz with 13 channels. Starting at 2.412MHz with subsequent channel at 5MHz interval from the preceding channel. 802.11g 2.412GHz to 2.472GHz with 11 channels. Starting at 2.412MHz with subsequent channel at 5MHz interval from the preceding channel. 802.11g (Turbo) 2.437GHz (Channel 6).
Clock / Oscillator Frequency	:	40MHz
Modulation	:	802.11b CCK 802.11g OFDM 802.11g (Turbo) OFDM
Pulse Train Cycle	:	Continuos signal (in testing)
Port / Connectors	:	1 x DC port 1 x antenna port 1 x RJ45 port 4 x RJ11 ports
Rated Input Power	:	AC input: 120VAC 60Hz 150mA DC output: 9V 1000mA

Equipment Description (Including Brand Name)	**Model, Serial & FCC ID Number**	**Cable Description** (List Length, Type & Purpose)
Ranger Notebook PC	M/N : 892 S/N : Nil FCC ID : DoC	3.0m shielded RJ45 cable
Ranger AC/DC Power Adapter	M/N : F19603J S/N : Nil FCC ID : Nil	2.0m unshielded AC power cable 2.0m unshielded DC power cable with ferrite

EUT OPERATING CONDITIONS

The Wireless Broadband Router was powered from 110V, 60Hz mains supply.

Tests	Description Of Operation
1. Conducted Emissions 2. Radiated Emissions 3. Spectrum Bandwidth (6dB Bandwidth Measurement) 4. Maximum Peak Power 5. RF Conducted Spurious Emissions at the Transmitter Antenna Terminal 6. Band Edge Compliance at the Transmitter Antenna Terminal 7. Peak Power Spectral Density 8. Maximum Permissible Exposure	The EUT was exercised in test mode which enabled the EUT to be in continuous transmission with maximum power in following operating modes: 1. 802.11b - EUT in continuous transmission in Channel 1, Channel 7 and Channel 13 respectively with transmission rate of 11Mbps 2. 802.11g - EUT in continuous transmission in Channel 1, Channel 7 and Channel 11 respectively with transmission rate of 54Mbps 3. 802.11g (Turbo) - EUT in continuous transmission in Channel 6 with transmission rate of 108Mbps

FCC Part 15B (Class B) Conducted Emission Results

Frequency (MHz)	Q-P Value (dBμV)	Q-P Margin (dB)	AV Value (dBμV)	AV Margin (dB)	Operating Mode	Line
0.1980	49.6	-15.0	8.9	-45.7	Ch13 @ 802.11b 108Mbps	Live
0.3145	47.6	-13.7	8.3	-43.0	Ch13 @ 802.11b 108Mbps	Neutral
0.3195	47.5	-13.7	8.3	-42.9	Ch13 @ 802.11g 54Mbps	Neutral
0.3566	46.9	-13.2	8.4	-41.7	Ch6 @ 802.11g 108Mbps	Neutral
0.4239	44.6	-13.6	8.2	-40.0	Ch13 @ 802.11b 108Mbps	Neutral
0.4306	44.3	-13.7	8.0	-39.9	Ch13 @ 802.11g 54Mbps	Neutral

Tested by: AL

Notes

1. All possible modes of operation were investigated from 150kHz to 30MHz. Only the 6 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. 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 ±2.4dB.

Conducted Emission Setup (Front View)

Conducted Emission Setup (Rear View)

FCC Part 15C (15.209) Radiated Emission (Spurious Emissions) Results

Test Distance : 3m

Spurious Emissions ranging from 30MHz – 1GHz

Frequency (MHz)	Q-P Value (dBμV/m)	Q-P Margin (dB)	Channel	Azimuth (Degrees)	Height (cm)	Polarisation (H/V)
32.0108	30.8	-9.2	1 @ 802.11g 54Mbps	210	100	V
81.1768	26.1	-13.9	7 @ 802.11g 54Mbps	194	118	V
475.0311	35.6	-10.4	7 @ 802.11b 11Mbps	79	100	H
500.0331	34.7	-11.3	7 @ 802.11b 11Mbps	293	200	H
629.9758	38.1	-7.9	7 @ 802.11g 54Mbps	207	109	V
899.9790	38.0	-8.0	7 @ 802.11g 54Mbps	178	124	V

Spurious Emissions above 1GHz

Frequency (GHz)	Peak Value (dBμV/m)	Average Value (dBμV/m)	Average Margin (dB)	Channel	Azimuth (Degrees)	Height (cm)	Pol(H/V)
1.7371	39.2	28.1	-25.9	7 @ 802.11g 54Mbps	292	100	H
1.7648	38.1	28.0	-26.0	1 @ 802.11g 54Mbps	307	100	V
1.9023	36.2	28.7	-25.3	7 @ 802.11b 11Mbps	188	100	V
1.9500	37.6	29.1	-24.9	1 @ 802.11b 11Mbps	176	100	H
-	-	-	-		-	-	-
-	-	-	-		-	-	-

Tested by: WR

Notes

1. All possible modes of operation were investigated. Only the 6 worst case emissions measured, using the correct CISPR detectors, are reported. All other emissions were relatively insignificant.
2. The transmitting antenna was found to be in the worst case condition when it was orientated in a vertical position.
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 peak emissions above 1GHz show compliance to the requirement stated in Section 15.35 (b).
7. The upper frequency of radiated emission investigations were according to requirements stated in Section 15.33 (a) for intentional radiators & Section 15.33 (b) for unintentional radiators.
8. The channel in the table refers to the transmit channel of the EUT.
9. 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 ±4.3dB (for EUTs < 0.5m X 0.5m X 0.5m).

FCC Part 15C (15.205) Radiated Emissions (Restricted Band Requirements) Results

Test Distance : 3m

Spurious Emissions (Restricted Band) ranging from 30MHz – 1GHz

Frequency (MHz)	Q-P Value (dBμV/m)	Q-P Margin (dB)	Channel	Azimuth (Degrees)	Height (cm)	Polarisation (H/V)
269.9782	34.1	-11.9	6 @ 802.11g 108Mbps	274	101	V
400.0196	35.2	-10.8	1 @ 802.11g 54Mbps	33	100	H
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-

Spurious Emissions (Restricted Band) above 1GHz

Frequency (GHz)	Peak Value (dBμV/m)	Average Value (dBμV/m)	Average Margin (dB)	Channel	Azimuth (Degrees)	Height (cm)	Pol(H/V)
1.0799	42.8	34.1	-19.9	1 @ 802.11b 11Mbps	190	100	V
1.1713	38.5	23.8	-30.2	6 @ 802.11g 108Mbps	100	100	H
1.5001	37.3	27.2	-26.8	13 @ 802.11b 11Mbps	243	100	V
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

Tested by: WR

Notes

1. The Nil in the frequency column indicates no emissions were found in the band of interest and showed compliance to the limits as specified in section 15.209. The emissions were merely the noise floor.
2. The transmitting antenna was found to be in the worst case condition when it was orientated in a vertical position.
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. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:
   30MHz - 1GHz
   RBW: 120kHz VBW: 1MHz
   >1GHz
   RBW: 1MHz VBW: 1MHz
5. The peak emissions above 1GHz show compliance to the requirement stated in Section 15.35 (b).
6. 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 ±4.3dB (for EUTs < 0.5m X 0.5m X 0.5m).

Radiated Emissions Setup (Front View)

Radiated Emissions Setup (Rear View)

FCC Part 15C (15.247(a)(2)) Spectrum Bandwidth (6dB Bandwidth Measurement) Results

The EUT shows compliance to the requirements of this section, which states that for system using digital modulation techniques, the minimum 6dB bandwidth shall be at least 500kHz.

Operating Mode: 802.11b

Channel	Channel Frequency (GHz)	6dB Bandwidth (MHz)	Limit (Min. Bandwidth) (MHz)
1	2.412	13.17	0.5
7	2.442	12.67	0.5
13	2.472	13.25	0.5

Operating Mode: 802.11g

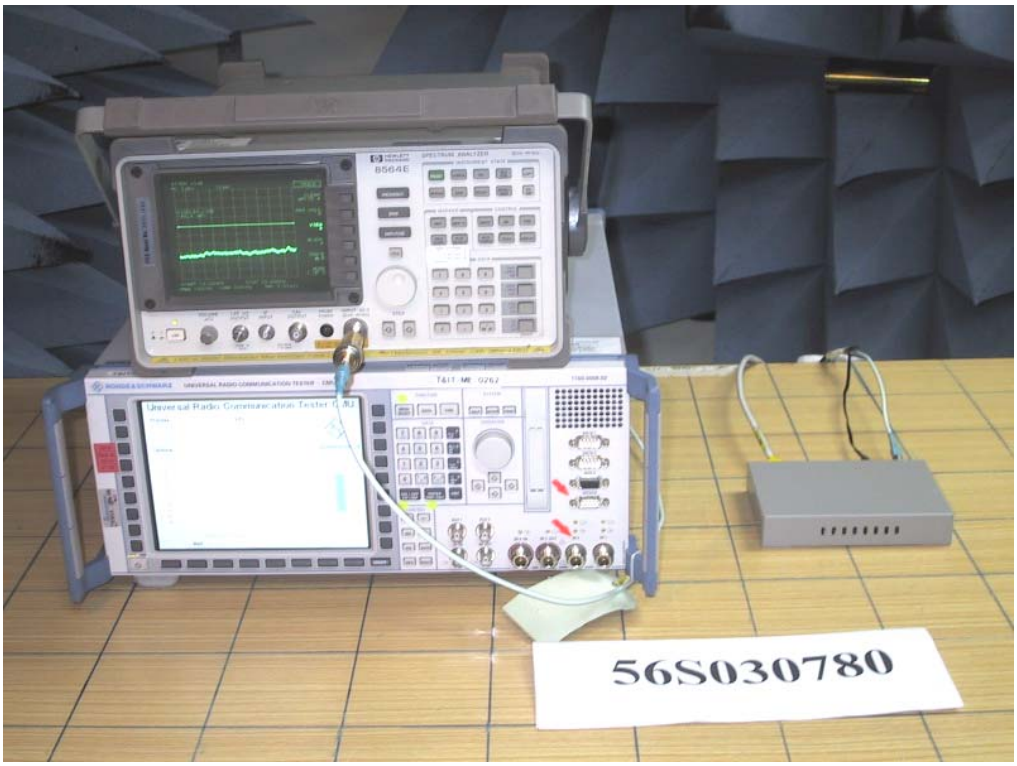
Channel	Channel Frequency (GHz)	6dB Bandwidth (MHz)	Limit (Min. Bandwidth) (MHz)
1	2.412	16.92	0.5
7	2.442	16.83	0.5
11	2.462	16.83	0.5

Operating Mode: 802.11g (Turbo)

Channel	Channel Frequency (GHz)	6dB Bandwidth (MHz)	Limit (Min. Bandwidth) (MHz)
6	2.437	33.80	0.5

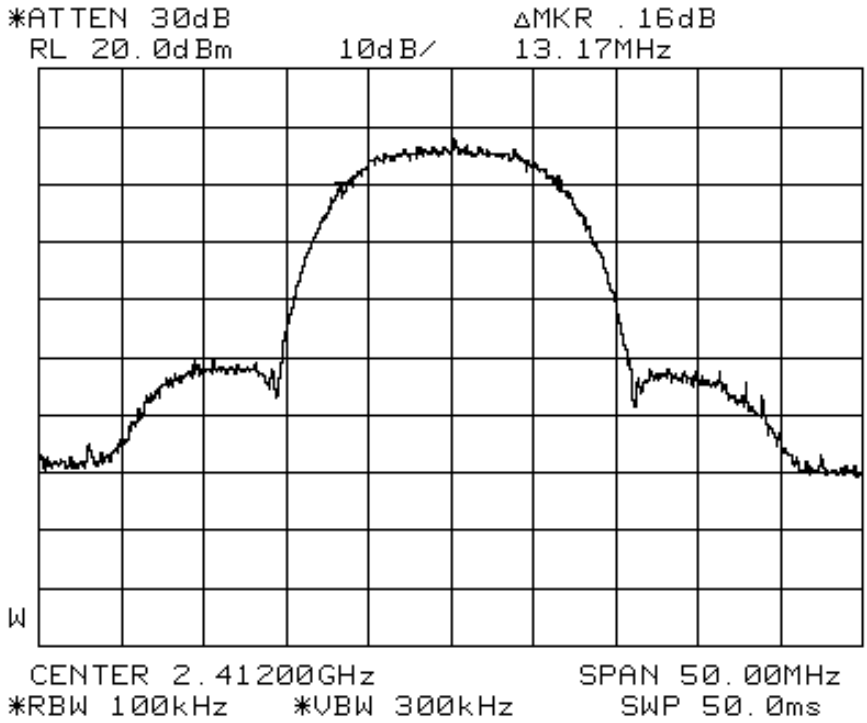
Please refer to the attached Plots 1 - 7 for details.

Tested by: LCH

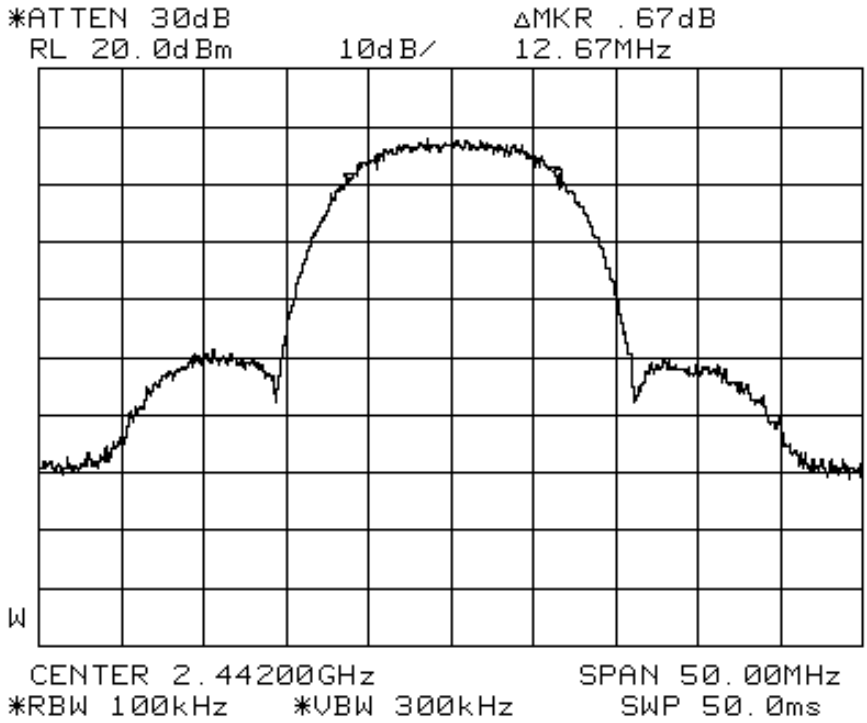


Spectrum Bandwidth Measurement Test Setup

SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) PLOTS

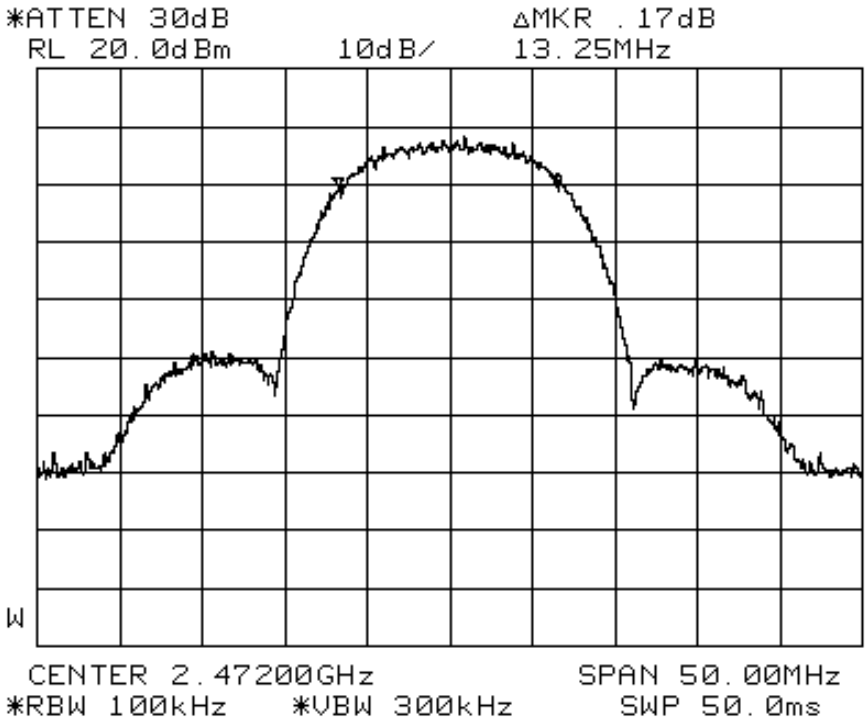


Plot 1 - Channel 1 @ 802.11b 11Mbps

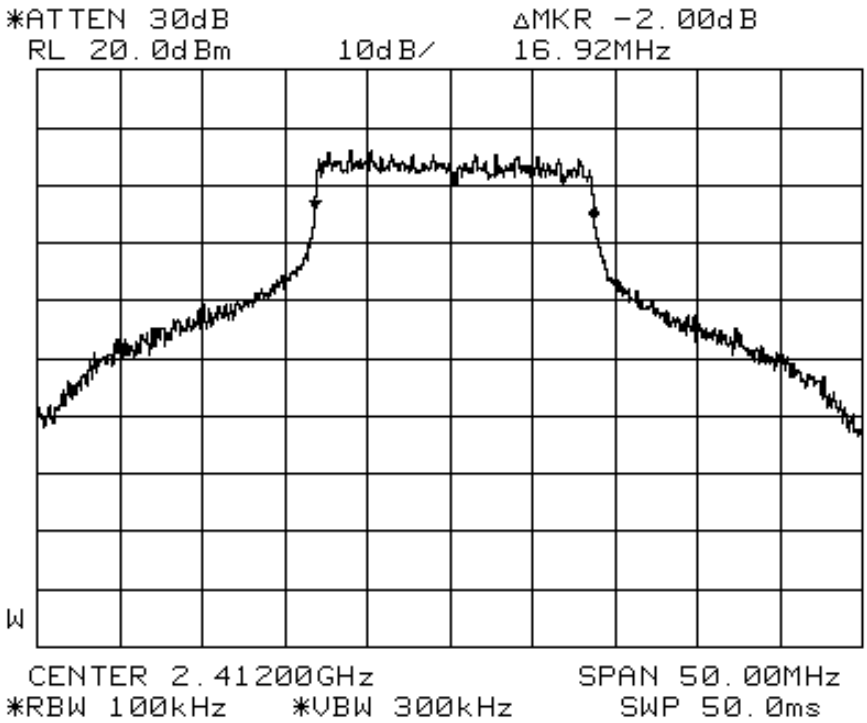


Plot 2 - Channel 7 @ 802.11b 11Mbps

SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) PLOTS

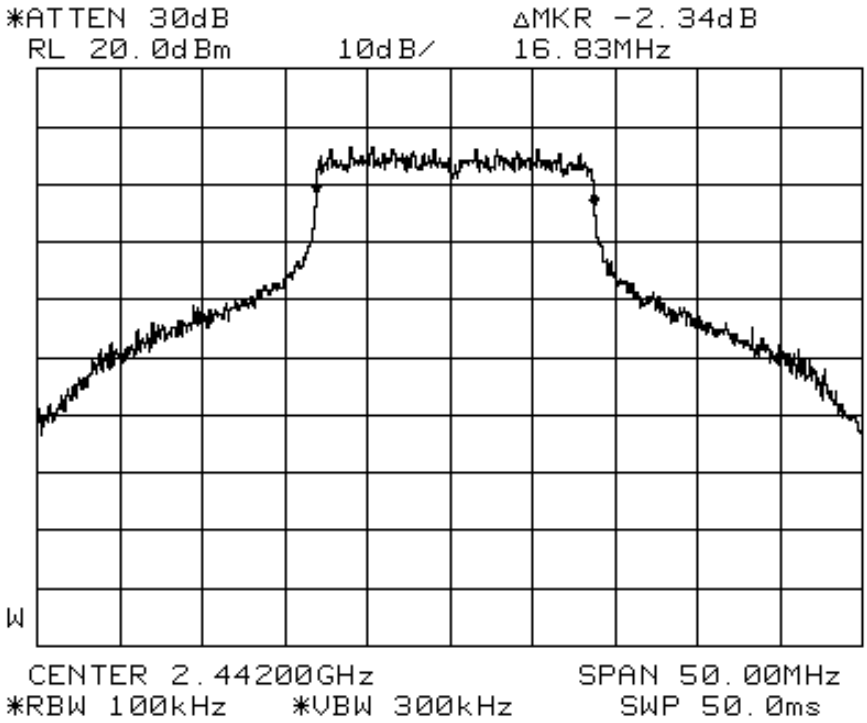


Plot 3 - Channel 13 @ 802.11b 11Mbps

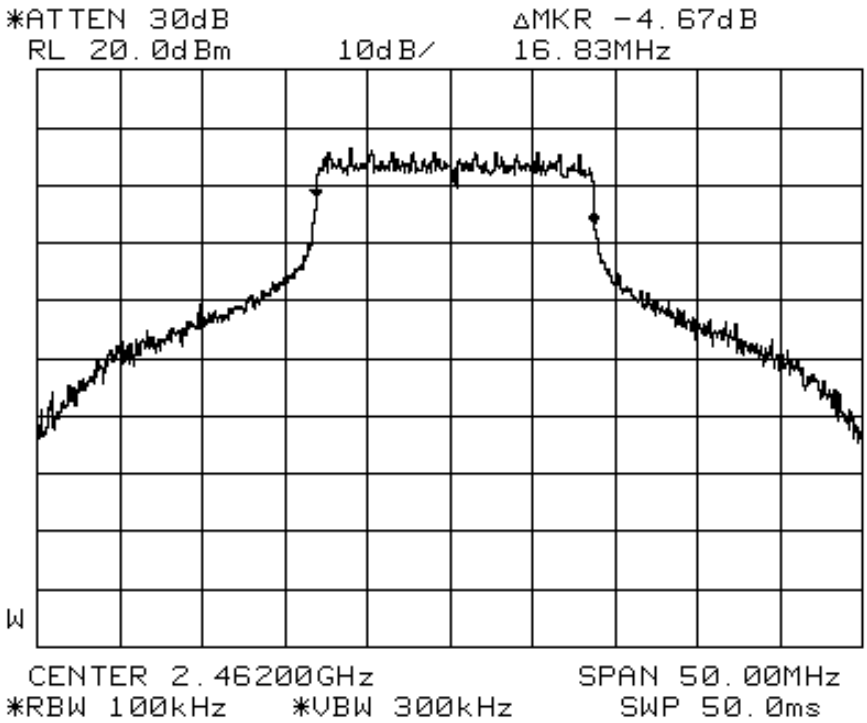


Plot 4 - Channel 1 @ 802.11g 54Mbps

SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) PLOTS

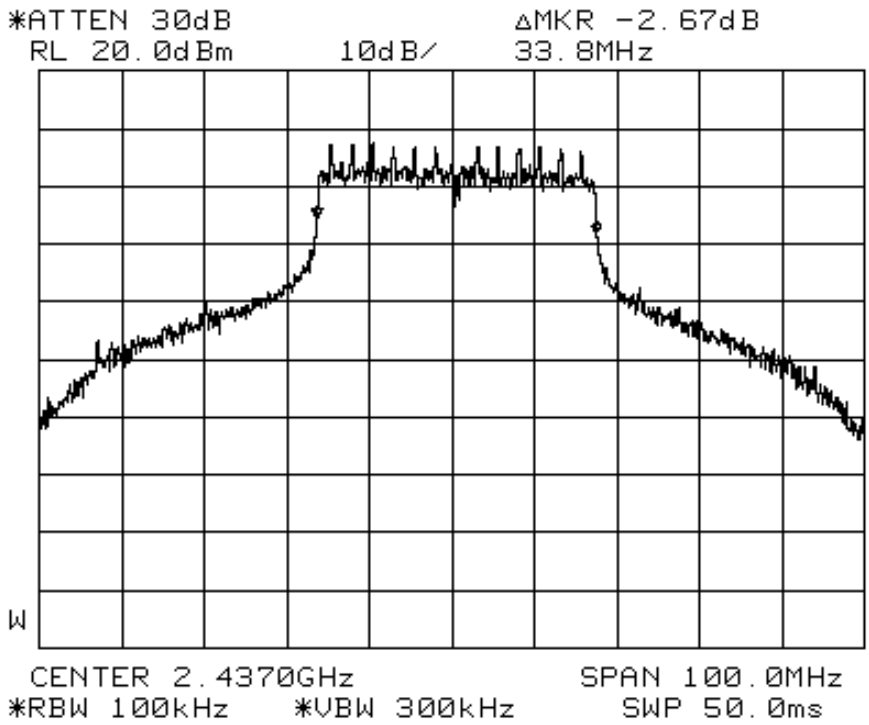


Plot 5 - Channel 7 @ 802.11g 54Mbps



Plot 6 - Channel 11 @ 802.11g 54Mbps

SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) PLOTS



Plot 7 - Channel 6 @ 802.11g 108Mbps (Turbo)

FCC Part 15C (15.247(b)(1)) Maximum Peak Power Results

The EUT shows compliance to the requirements of this section, which states the peak power of an intentional radiator (EUT) shall not exceed 30dBm (1 Watt).

Operating Mode: 802.11b

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)
1	2.412	0.062	1
7	2.442	0.065	1
13	2.472	0.072	1

Operating Mode: 802.11g

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)
1	2.412	0.053	1
7	2.442	0.068	1
11	2.462	0.069	1

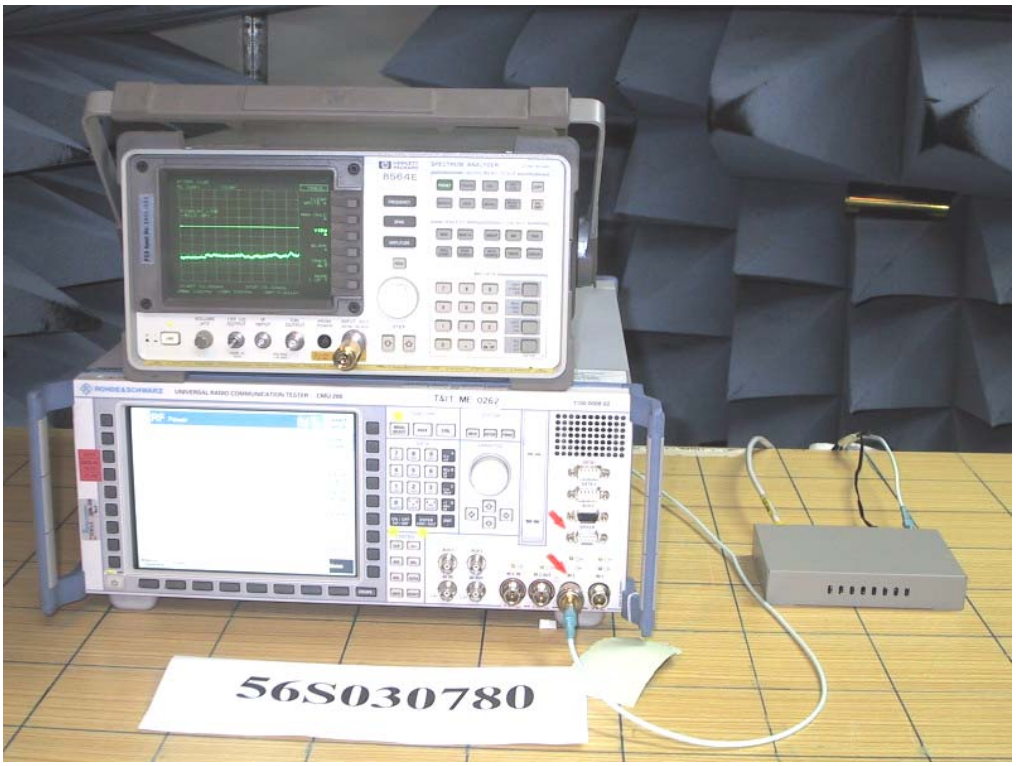
Operating Mode: 802.11g (Turbo)

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)
6	2.437	0.066	1

Tested by: LCH

Notes

1. Power analyser of Universal Radio Communication Tester was used for power measurement with peak detection as mode of measurement. The power analyser mode supports a wideband power measurement ranging from 100kHz to 2700MHz.



Maximum Peak Power Measurement Test Setup

FCC Part 15C (15.247(c)) RF Conducted Spurious Emissions & Band Edge Compliance at the Transmitter Antenna Results

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 RF power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of desired power.

The RF conducted spurious emissions were scanned from 10MHz to 25GHz for following channels. No significant signal was found and they were below the specified limit. Please refer to the attached Plots 8 - 21 for details.

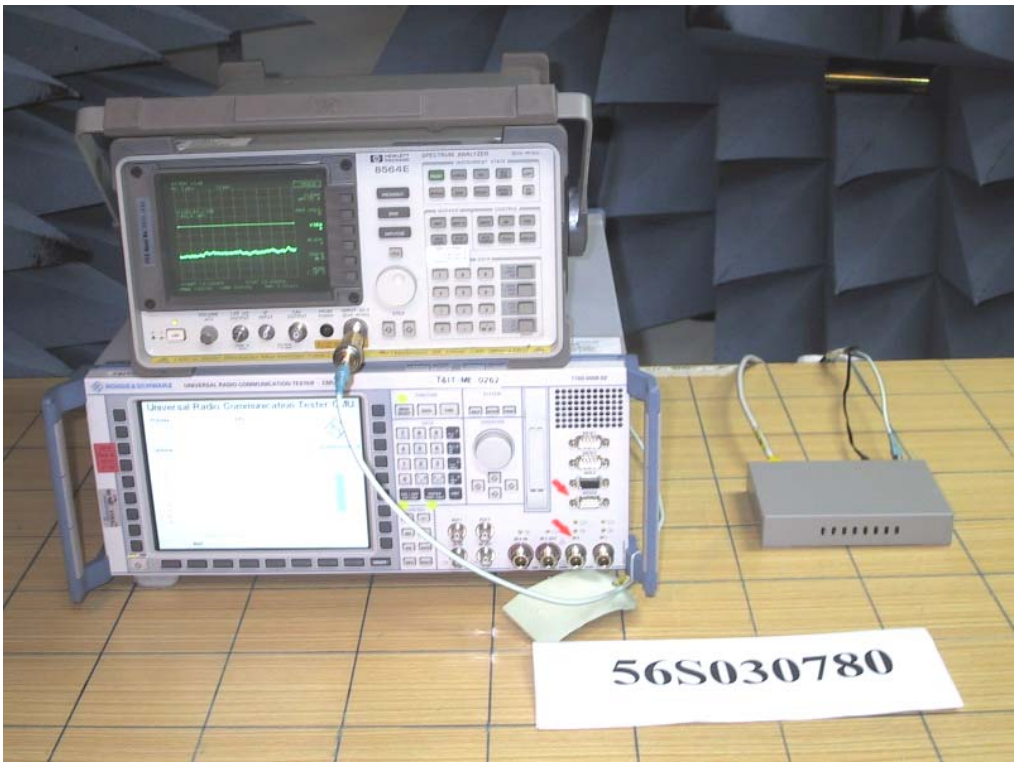
802.11b
Channels 1, 7 and 13

802.11g
Channels 1, 7 and 11

802.11g (Turbo)
Channel 6

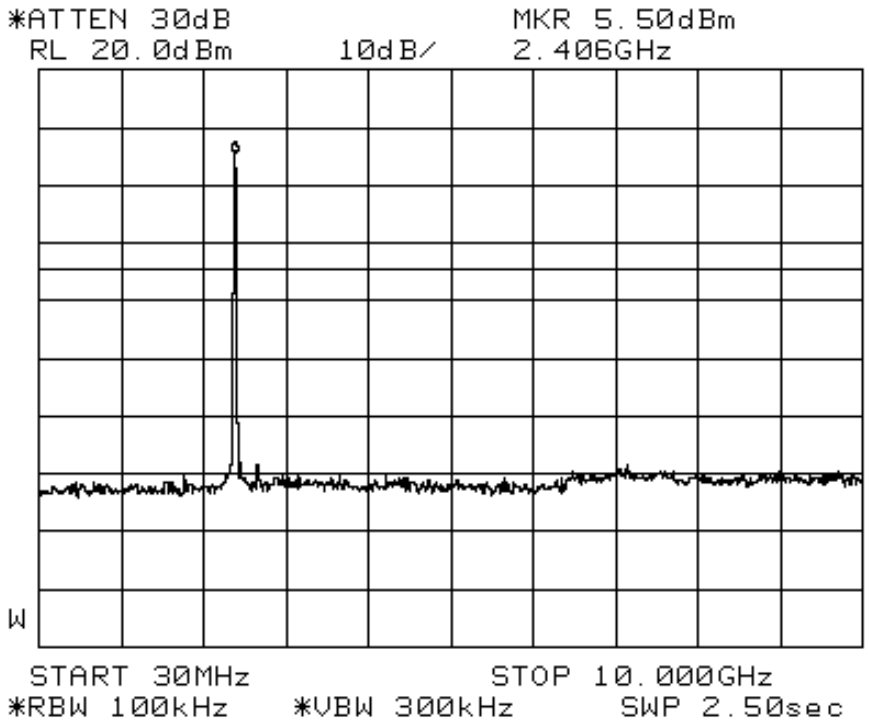
The conducted spurious at lower and upper band-edges (2.4000GHz and 2.4835GHz) were scanned. The spurious emissions at band-edges were found below the specified limit. Please refer to the attached Plots 22 - 25 for details.

Tested by: LCH

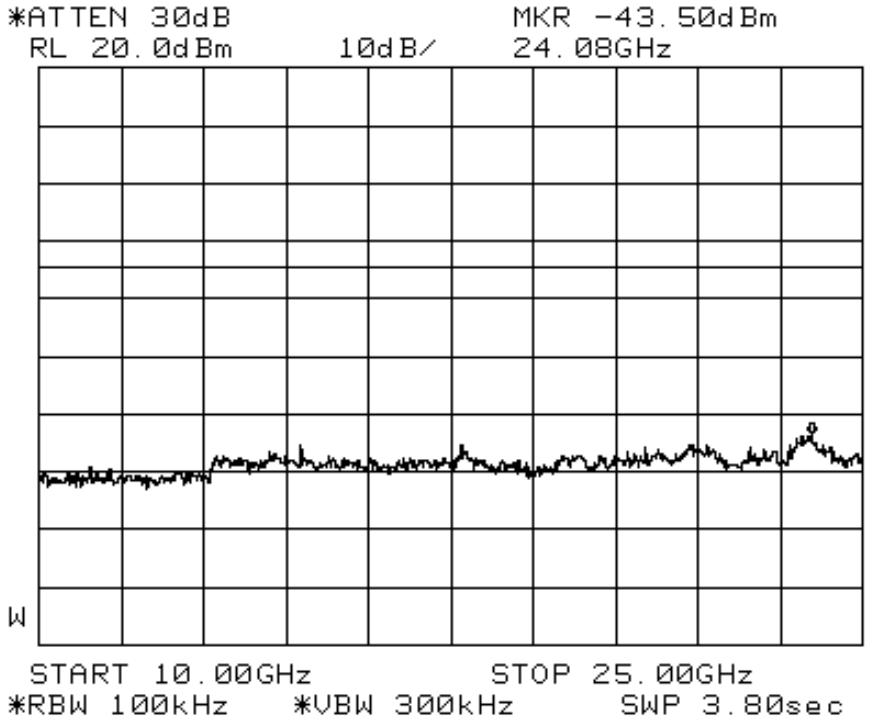


RF Conducted Spurious & Band Edge Measurement Test Setup

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

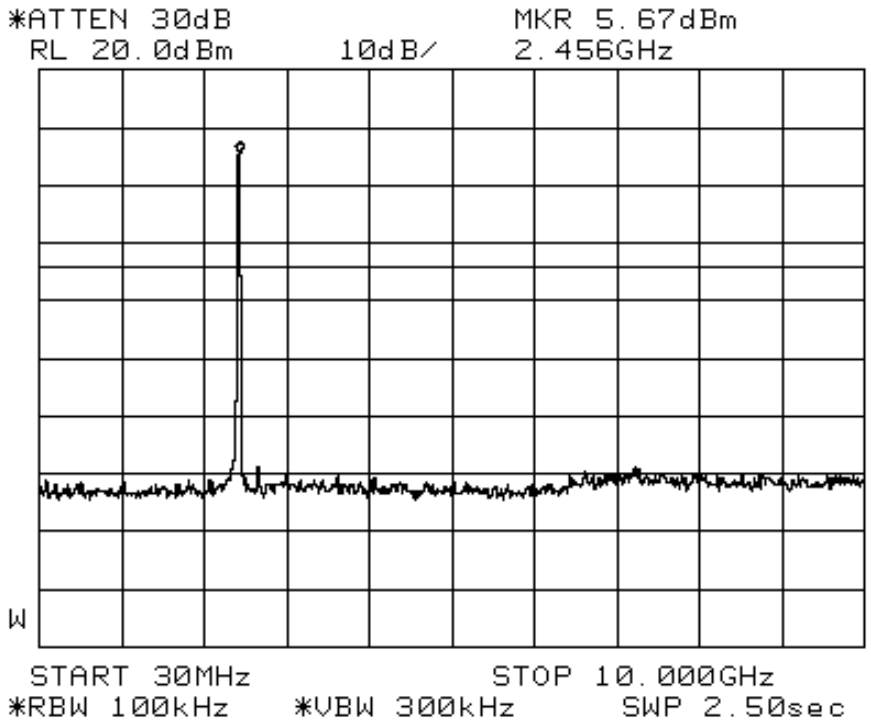


Plot 8 - Channel 1 @ 802.11b 11Mbps (30MHz-10GHz)

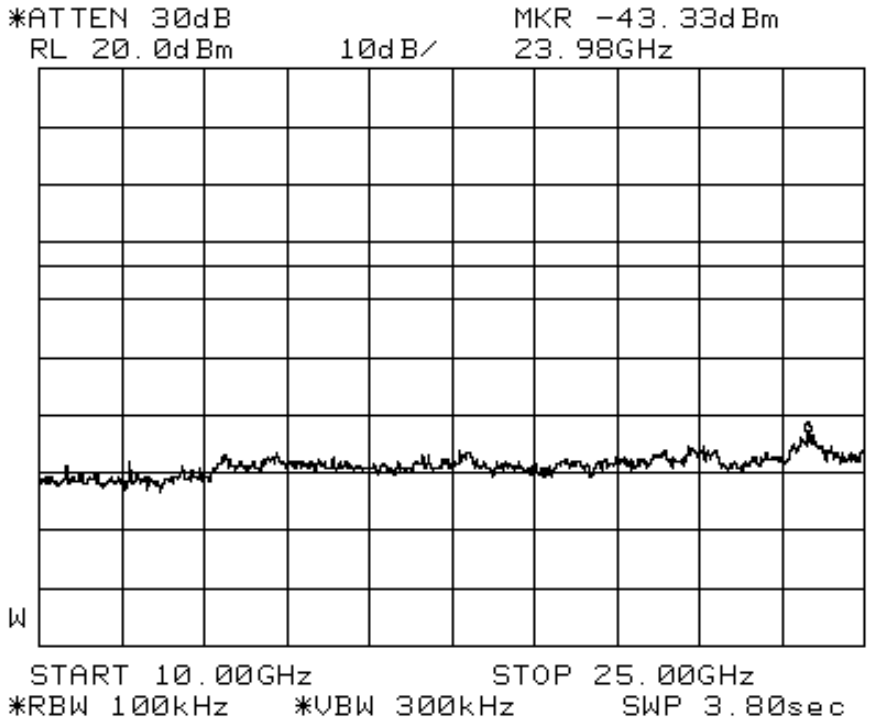


Plot 9 - Channel 1 @ 802.11b 11Mbps (10GHz-25GHz)

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

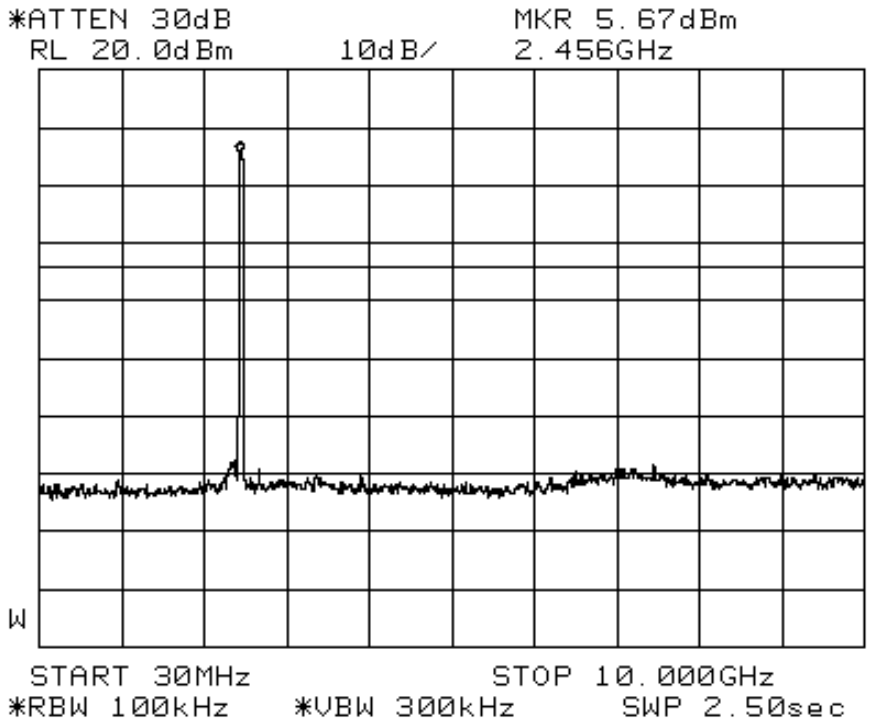


Plot 10 - Channel 7 @ 802.11b 11Mbps (30MHz-10GHz)

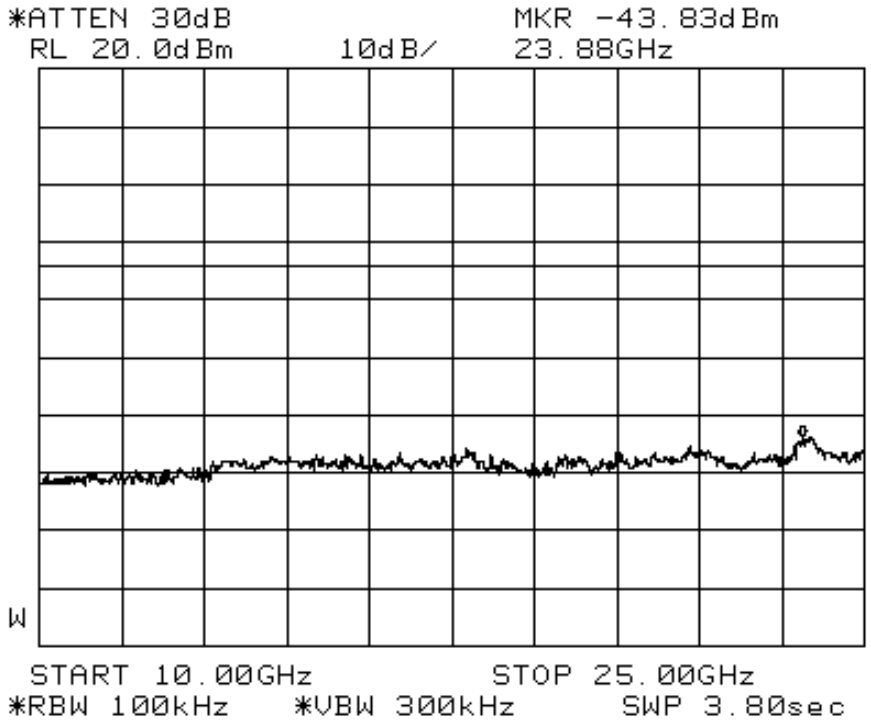


Plot 11 - Channel 7 @ 802.11b 11Mbps (10GHz-25GHz)

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

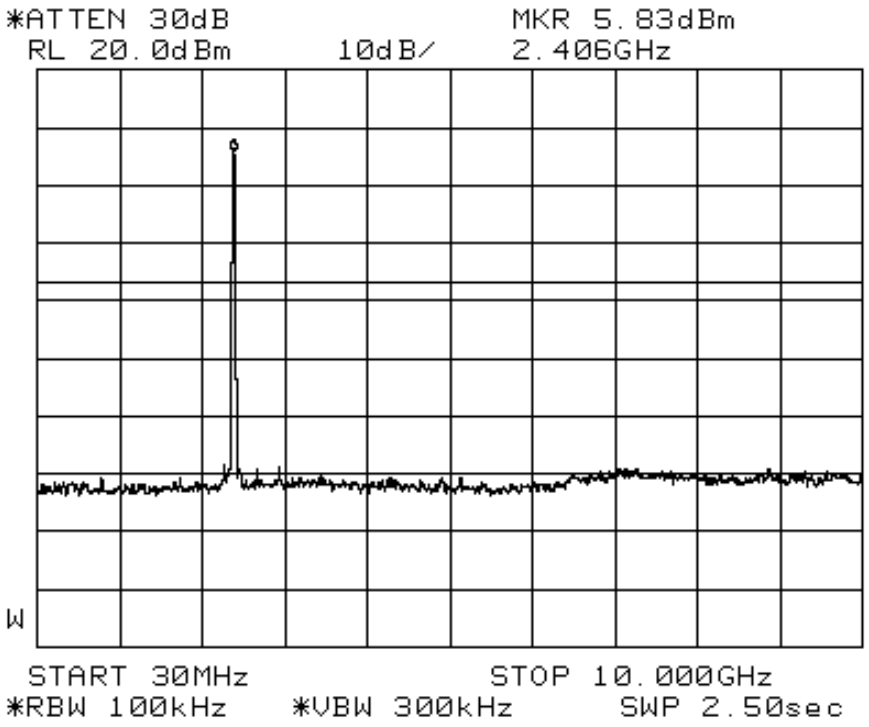


Plot 12 - Channel 13 @ 802.11b 11Mbps (30MHz-10GHz)

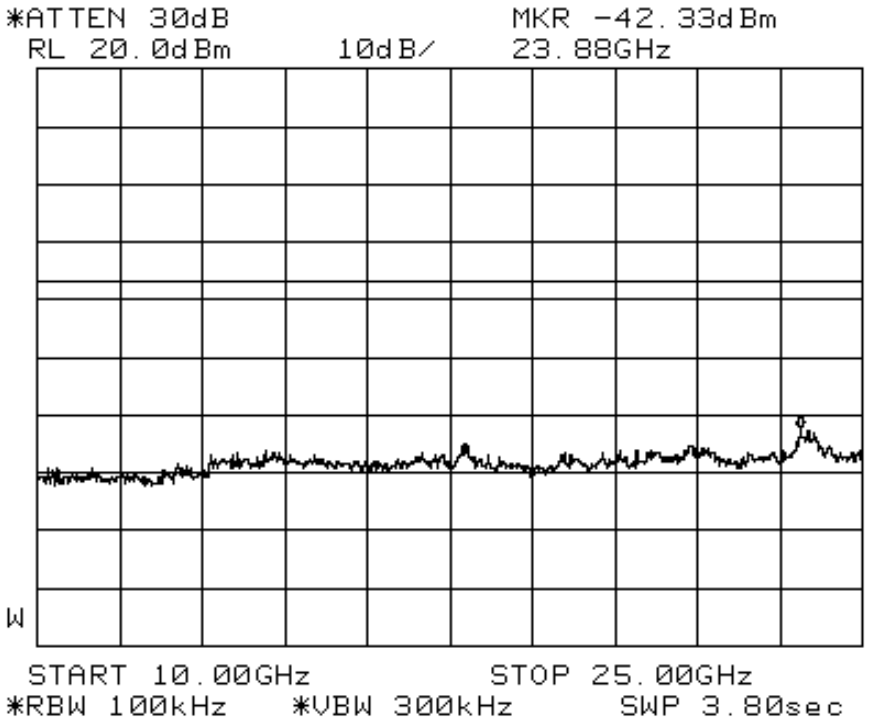


Plot 13 - Channel 13 @ 802.11b 11Mbps (10GHz-25GHz)

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

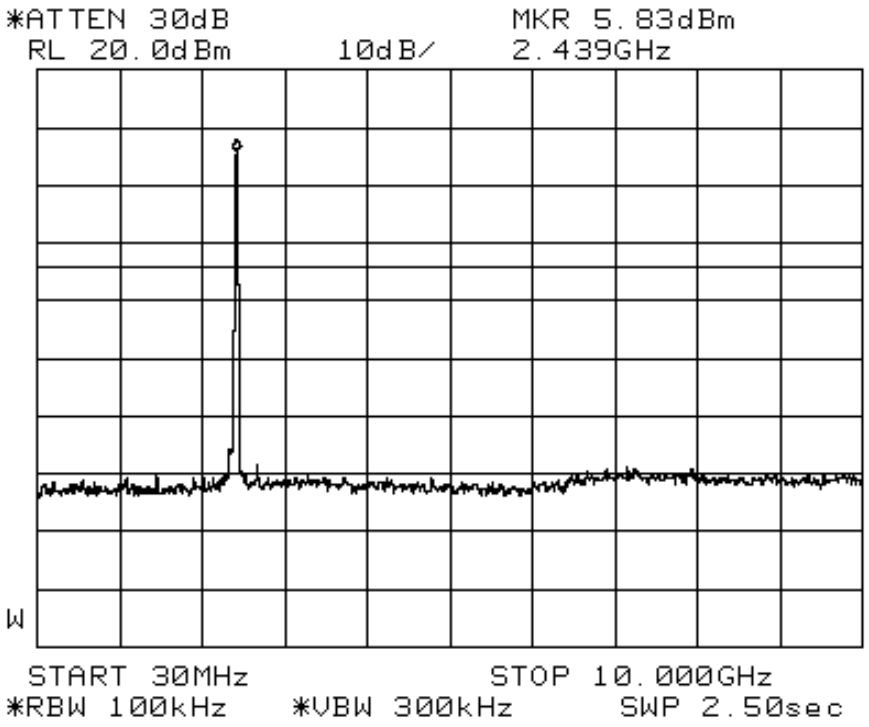


Plot 14 - Channel 1 @ 802.11g 54Mbps (30MHz-10GHz)

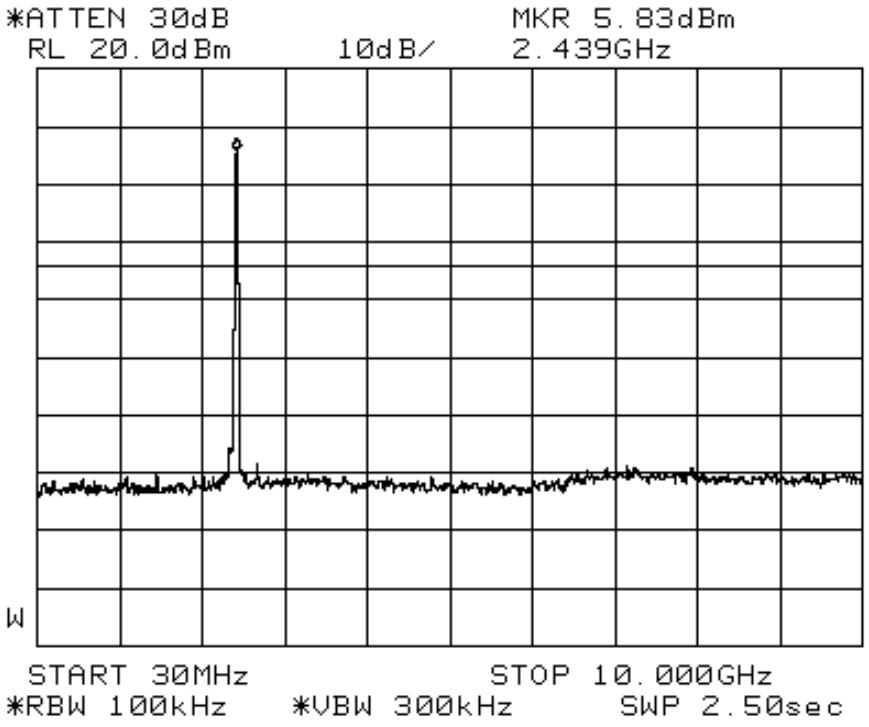


Plot 15 - Channel 1 @ 802.11g 54Mbps (10GHz-25GHz)

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

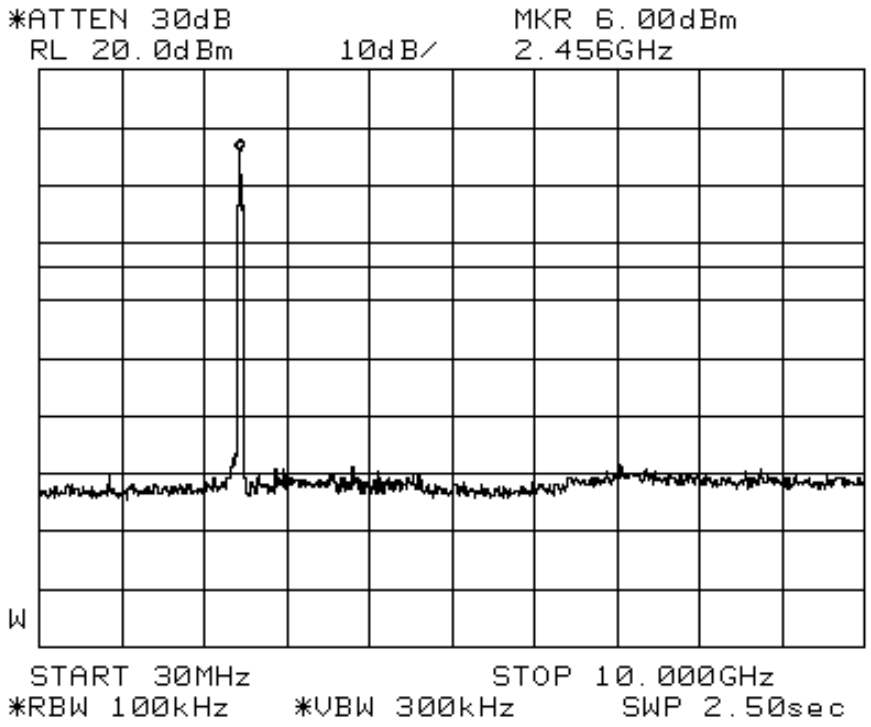


Plot 16 - Channel 7 @ 802.11g 54Mbps (30MHz-10GHz)

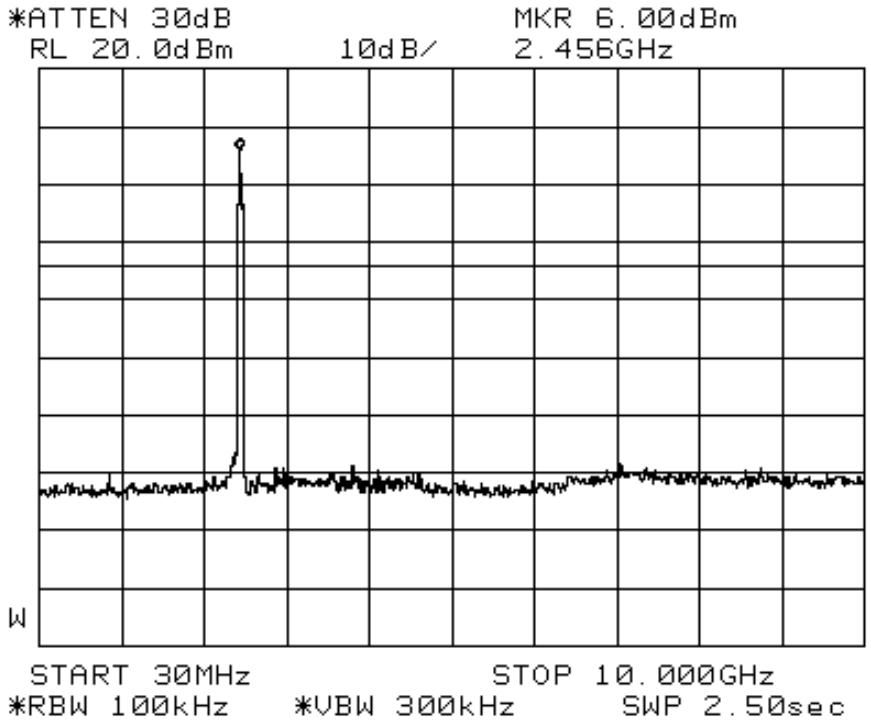


Plot 17 - Channel 7 @ 802.11g 54Mbps (10GHz-25GHz)

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

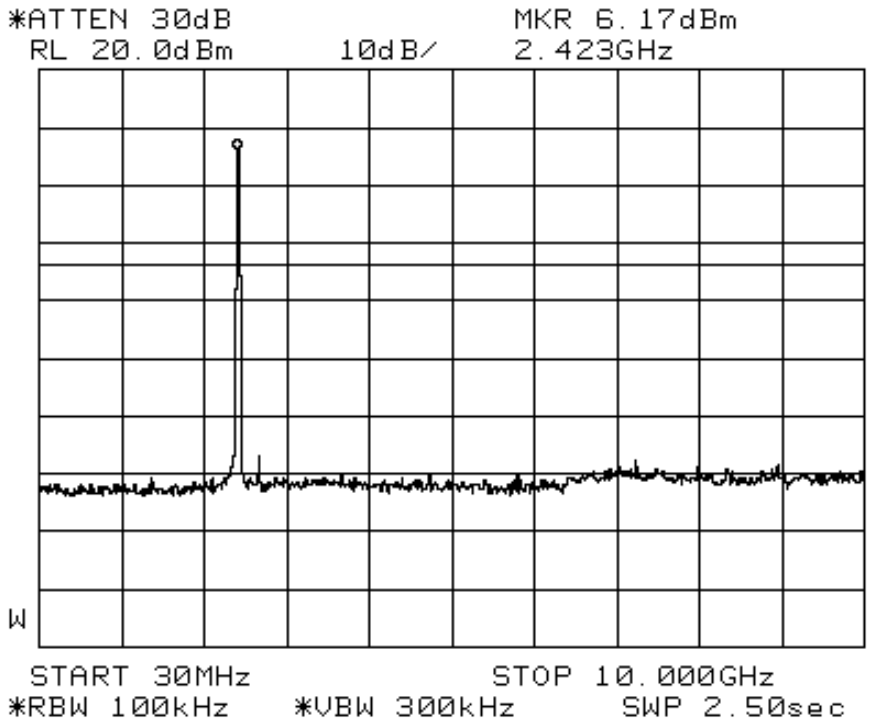


Plot 18 - Channel 11 @ 802.11g 54Mbps (30MHz-10GHz)

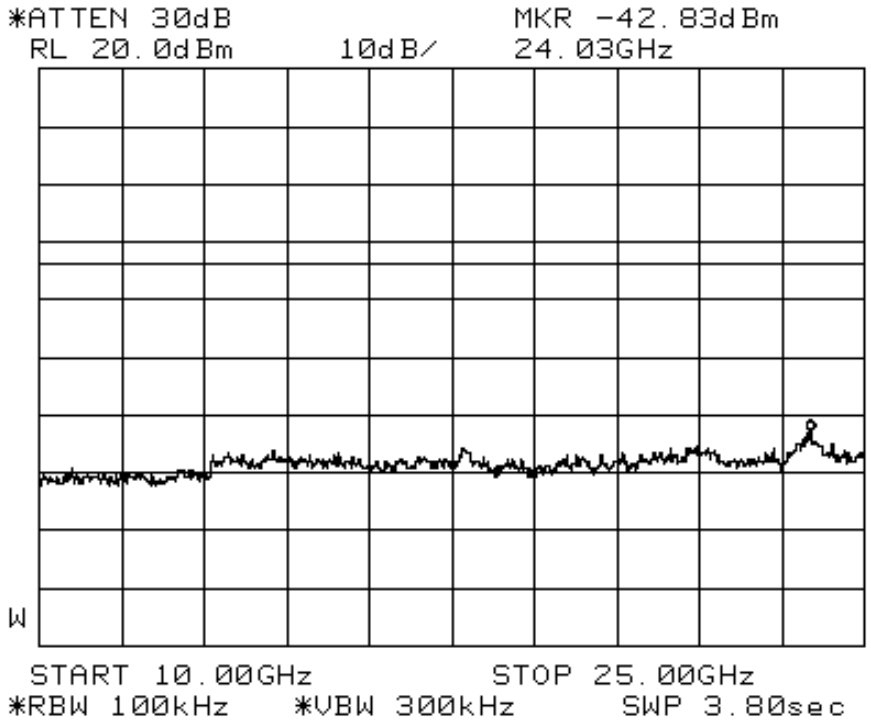


Plot 19 - Channel 11 @ 802.11g 54Mbps (10GHz-25GHz)

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

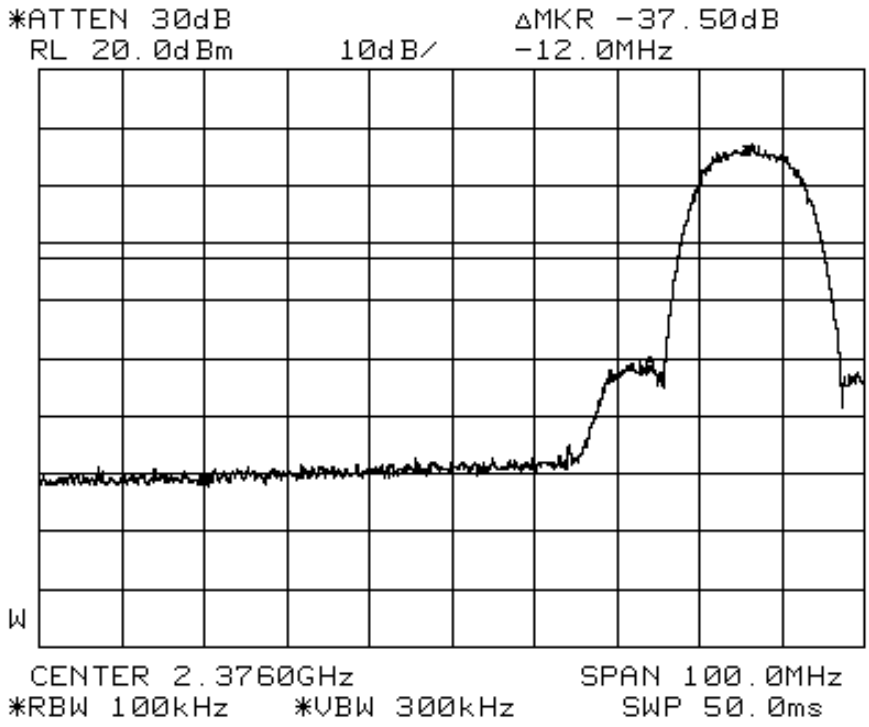


Plot 20 - Channel 6 @ 802.11g (Turbo) 108Mbps (30MHz-10GHz)

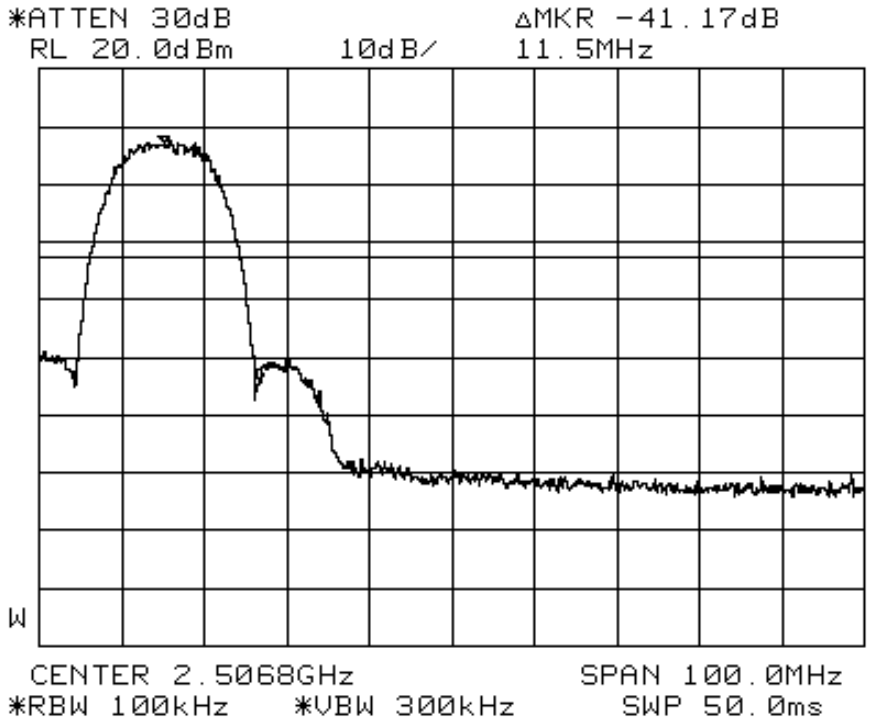


Plot 21 - Channel 6 @ 802.11g (Turbo) 108Mbps (10GHz-25GHz)

BAND EDGE COMPLIANCE PLOTS

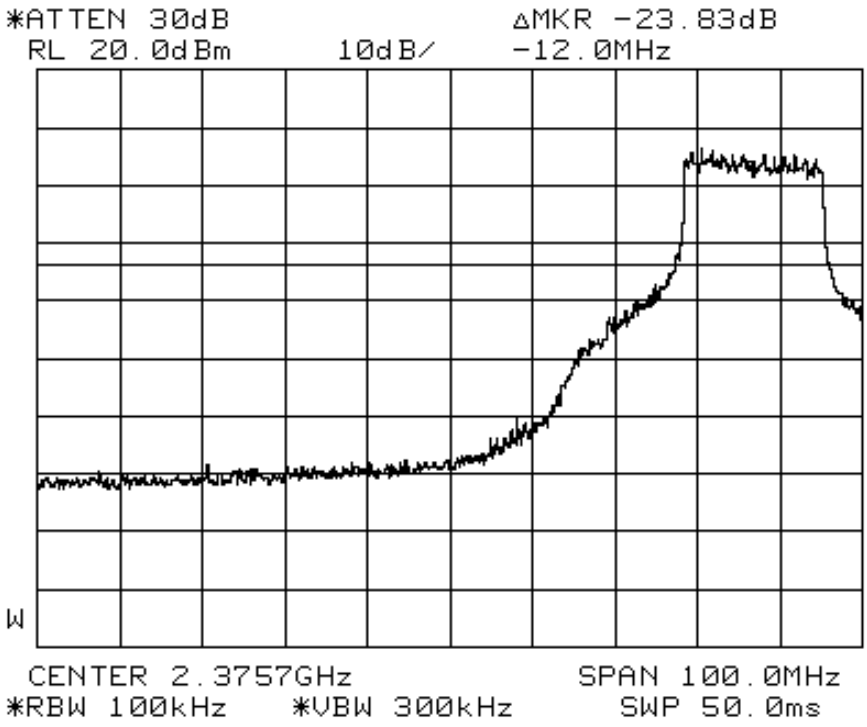


Plot 22 - Channel 1 @ 802.11b 11Mbps

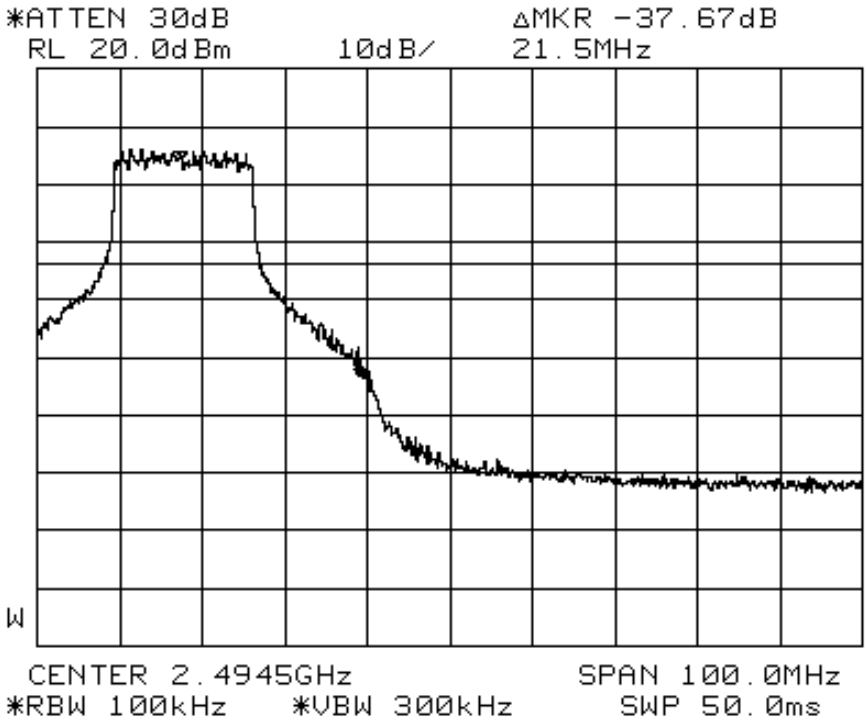


Plot 23 - Channel 13 @ 802.11b 11Mbps

BAND EDGE COMPLIANCE PLOTS



Plot 24 - Channel 1 @ 802.11g 54Mbps



Plot 25 - Channel 11 @ 802.11g 54Mbps

FCC Part 15C (15.247(d)) Peak Power Spectral Density Results

The EUT shows compliance to the requirements of this section, which states the peak power spectral density of an intentional radiator (EUT) to the antenna shall not be greater than 8dBm (6.3mW) in any 3kHz band during any time interval of continuous transmission.

Operating Mode: 802.11b

Channel	Channel Frequency (GHz)	Peak Power Spectral Density (mW)	Limit (mW)
1	2.412	0.63	6.3
7	2.442	0.66	6.3
13	2.472	0.27	6.3

Operating Mode: 802.11g

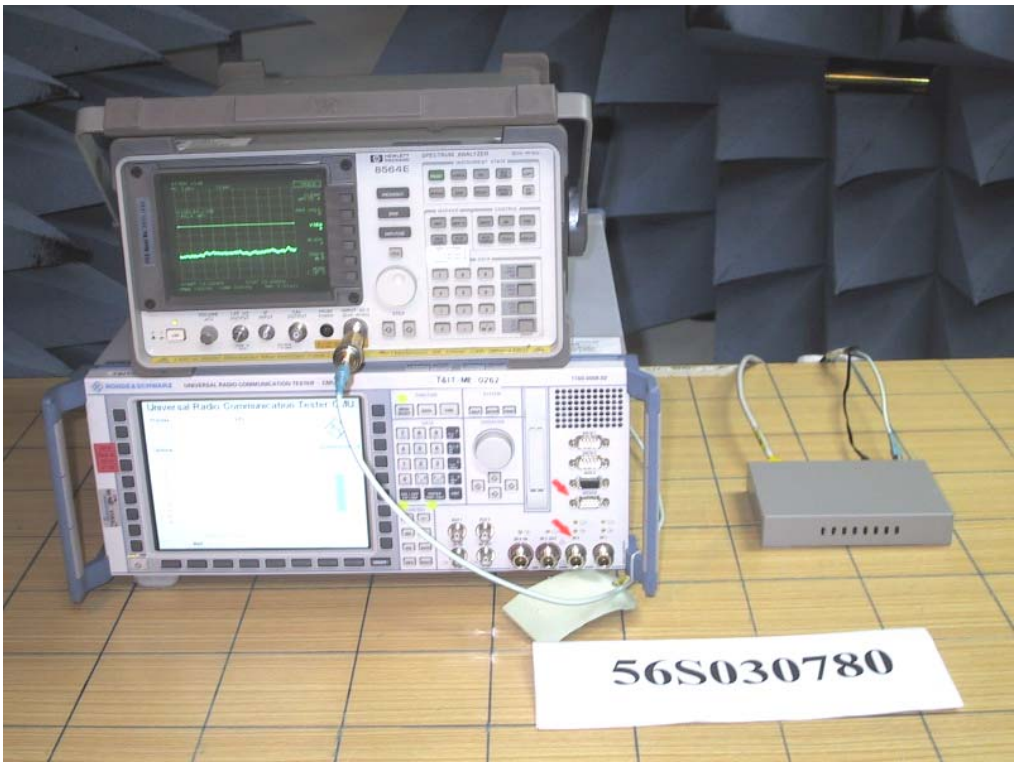
Channel	Channel Frequency (GHz)	Peak Power Spectral Density (mW)	Limit (mW)
1	2.412	0.16	6.3
7	2.442	0.20	6.3
13	2.472	0.76	6.3

Operating Mode: 802.11g (Turbo)

Channel	Channel Frequency (GHz)	Peak Power Spectral Density (mW)	Limit (mW)
13	2.437	0.10	6.3

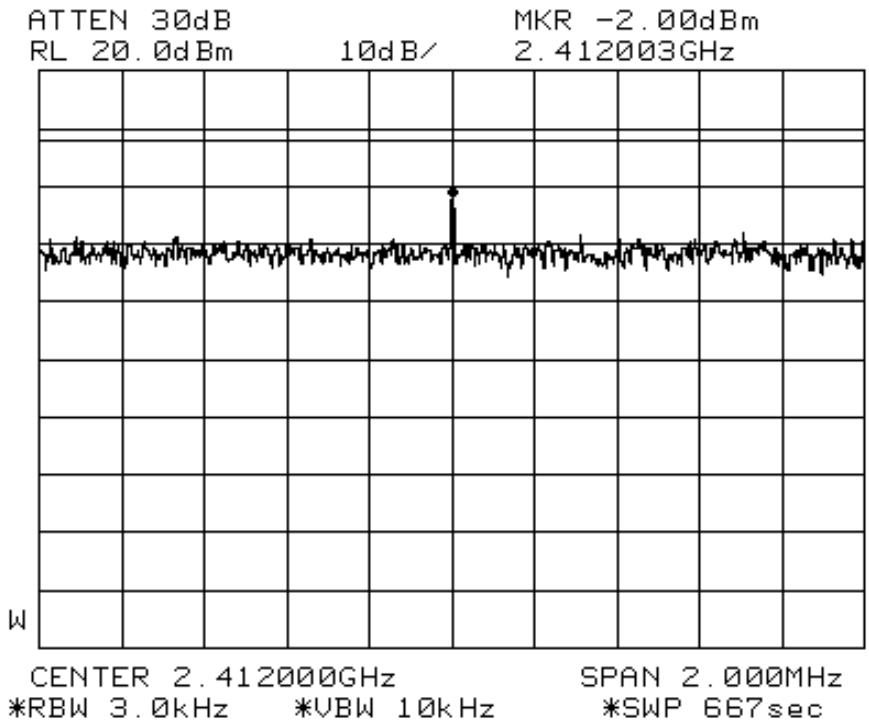
Please refer to the attached Plots 26 – 32 for details.

Tested by: LCH

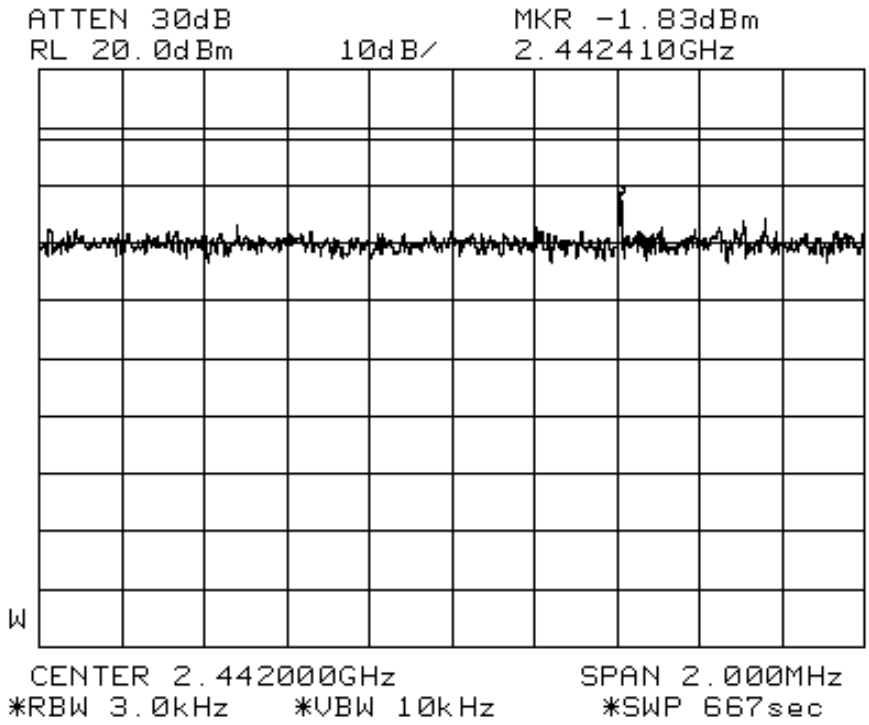


Peak Power Spectral Density Measurement Test Setup

PEAK POWER SPECTRAL DENSITY PLOTS

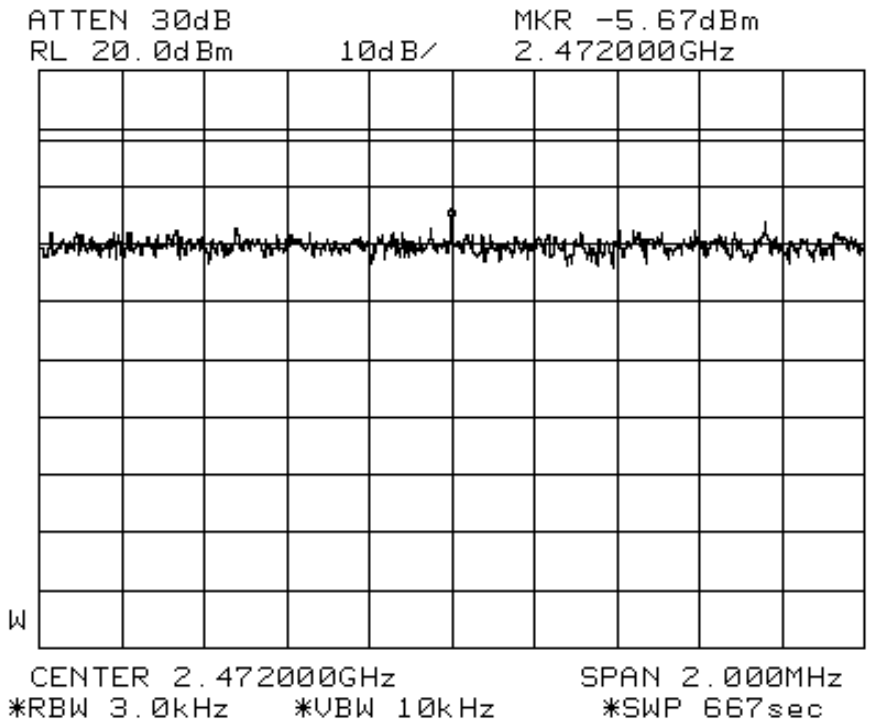


Plot 26 - Channel 1 @ 802.11b 11Mbps

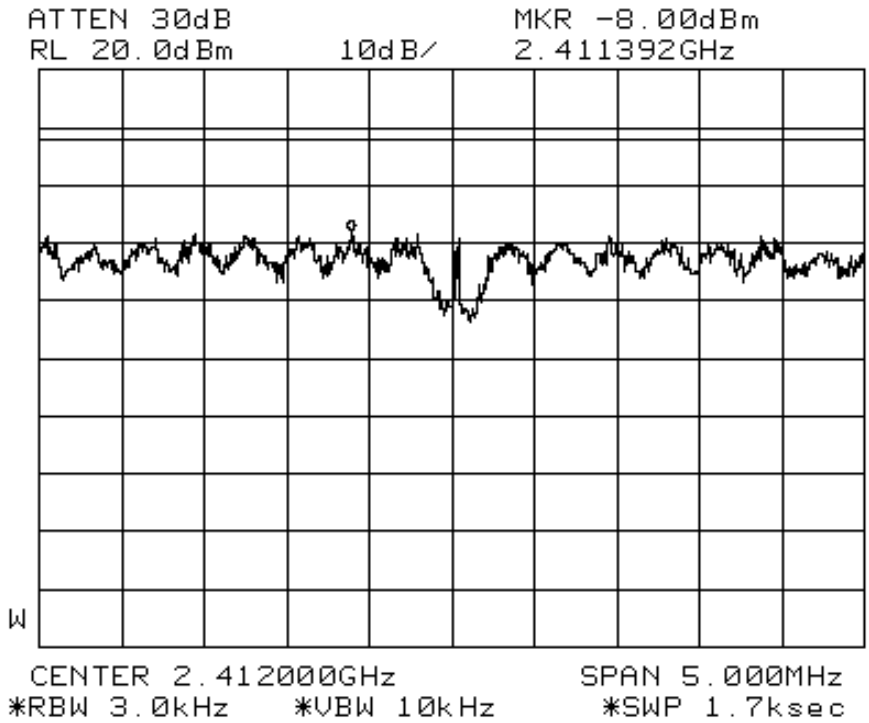


Plot 27 - Channel 7 @ 802.11b 11Mbps

PEAK POWER SPECTRAL DENSITY PLOTS

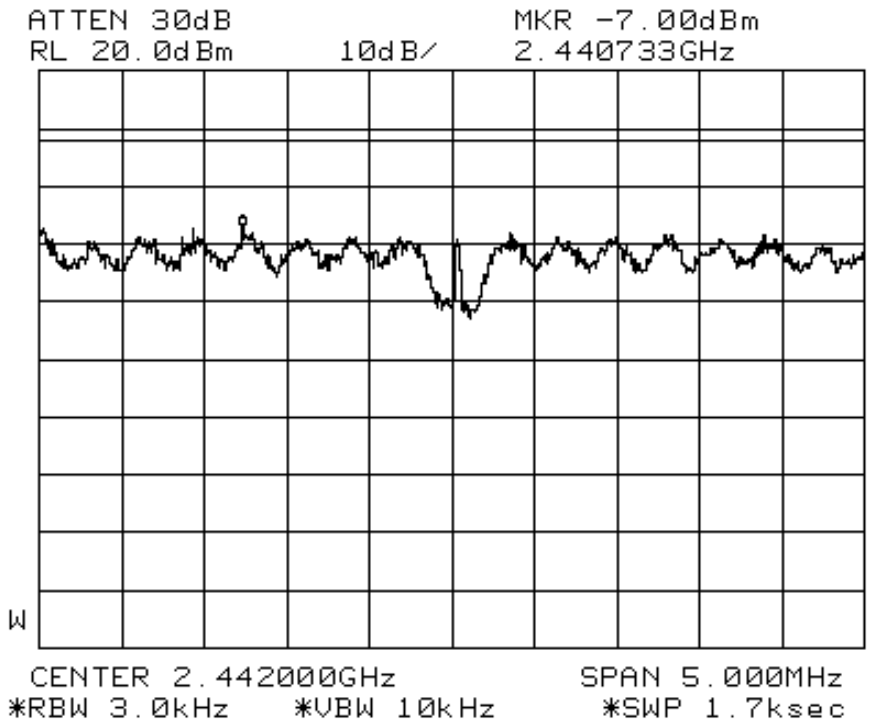


Plot 28 - Channel 13 @ 802.11b 11Mbps

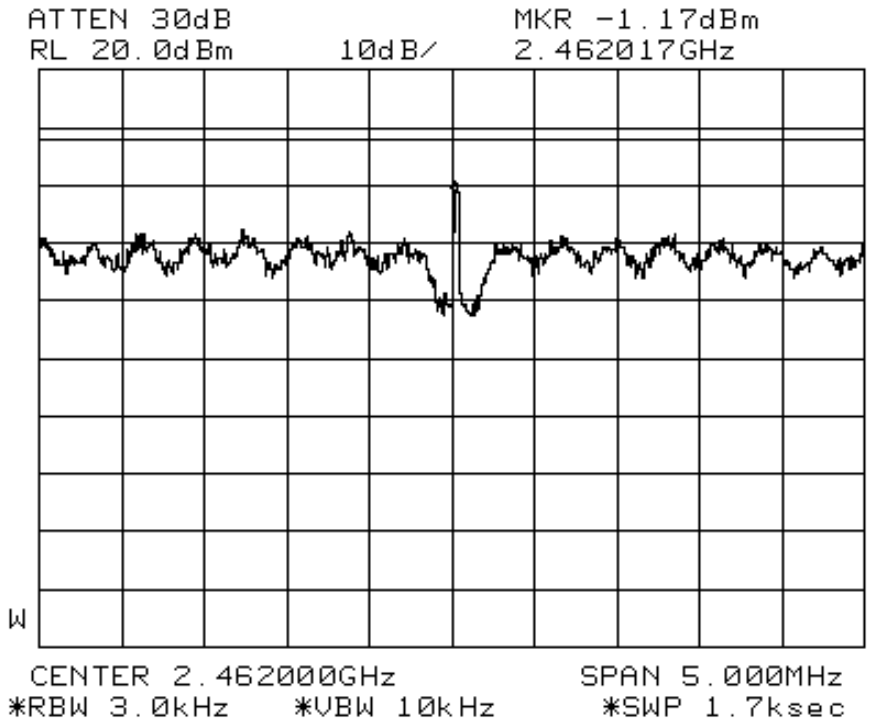


Plot 29 - Channel 1 @ 802.11g 54Mbps

PEAK POWER SPECTRAL DENSITY PLOTS

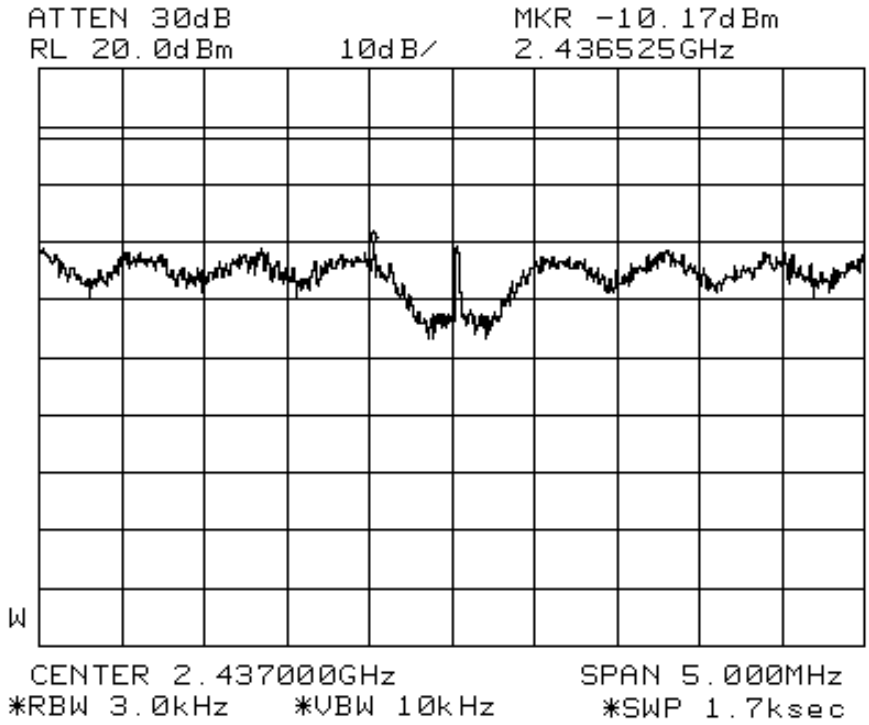


Plot 30 - Channel 7 @ 802.11g 54Mbps



Plot 31 - Channel 11 @ 802.11g 54Mbps

PEAK POWER SPECTRAL DENSITY PLOTS



Plot 32 - Channel 6 @ 802.11g (Turbo) 108Mbps

FCC Part 1.1310 Maximum Permissible Exposure (MPE) Results

Frequency (GHz)	Power Density Value (mW/cm^2)	Averaging Time (min)	Limit (mW/cm^2)	Margin (mW/cm^2)	Mode
2.472	0.042	30	1.0	-0.958	Ch13 @ 802.11b 11Mbps
2.462	0.663	30	1.0	-0.337	Ch11 @ 802.11g 54Mbps
2.437	0.025	30	1.0	-0.975	Ch6 @ 802.11g (Turbo) 108Mbps

Tested by: LCH

Notes

1. All possible modes of operation were investigated. Only the worst case, highest radiation levels were measured. Measurements were taken at the required averaging time. All other radiation levels 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. 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 0.1MHz – 3GHz is ±15% .

Maximum Permissible Exposure Measurement Test Setup

This Report is issued under the following conditions:

1. Results of the testing/calibration in the form of a report will be issued immediately after the service has been completed or terminated.

2. Unless otherwise requested, a report shall contain only technical results. Analysis and interpretation of the results and professional opinion and recommendations expressed thereupon, if required, shall be clearly indicated and additional fee paid for, by the Client.

3. This report applies to the sample of the specific product/equipment given at the time of its testing/calibration. The results are not used to indicate or imply that they are applicable to other similar items. In addition, such results must not be used to indicate or imply that PSB Corporation approves, recommends or endorses the manufacturer, supplier or user of such product/equipment, or that PSB Corporation in any way "guarantees" the later performance of the product/equipment.

4. The sample/s mentioned in this report is/are submitted/supplied/manufactured by the Client. PSB Corporation therefore assumes no responsibility for the accuracy of information on the brand name, model number, origin of manufacture, consignment or any information supplied.

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9. This report shall not be reproduced wholly or in parts and no reference shall be made by the Client to PSB Corporation or to the report or results furnished by PSB Corporation in any advertisements or sales promotion.

August 2003

ANNEX A

TEST INSTRUMENTATION & GENERAL PROCEDURES

TEST INSTRUMENTATION & GENERAL PROCEDURES ANNEX A

3m OATS Test Instrumentation (Conducted Emission)

Instrument	Model	S/No	Cal Due Date	
R&S Test Receiver (9kHz-30MHz)	ESH3	862301/005	25 Jul 2004	x
R&S Pulse Limiter	ESH3-Z2	357.8810.52	17 Apr 2004	x
EMCO LISN (for EUT) – LISN6	3825/2	9309-2127	2 Jun 2004	x
Solar Electronic Current Probe	6741-1	911317	11 Apr 2004	

10m Anechoic Chamber Test Instrumentation (Radiated Emissions)

Instrument	Model	S/No	Cal Due Date	
R&S Test Receiver (20Hz – 26.5GHz) – ESMI2	ESMI	829214/006 829550/001	25 Dec 2003	x
HP Preamplifier (for ESMI3, 0.01-3GHz) – PA6	87405A	3950M00353	29 Apr 2004	x
MITEQ Preamplifier (0.1-26.5GHz) – PA11	NSP2650-N	728231	16 Apr 2004	x
Schaffner Bilog Antenna – BL5	CBL6143	5041	21 May 2004	x
EMCO Horn Antenna – H14	3115	0003-6087	22 May 2004	x
Micro-tronics Band-Stop Filter	BRM50701	017	1 Apr 2004	x

Room 3 Test Instrumentation
(Spectrum Bandwidth (6dB Bandwidth Measurement), Maximum Peak Power, RF Conducted Spurious Emissions at the Transmitter Antenna Terminal, Band Edge Compliance at the Transmitter Antenna Terminal, Peak Power Spectral Density)

Instrument	Model	S/No	Cal Due Date	
HP Spectrum Analyzer	8564E	3846A01433	21 Nov 2003	x
R&S Universal Radio Communication Tester	CMU 200	837587/068	03 Apr 2004	x

Maximum Permissible Exposure

Instrument	Model	S/N	Cal Due Date	
PMM 8053 Portable Field Meter	8053	0220J10308	17 Apr 2004	x
PMM Electric and Magnetic Field Analyzer	EHP-50A	1311L10515	16 May 2004	x

TEST INSTRUMENTATION & GENERAL PROCEDURES ANNEX A

CONDUCTED EMISSIONS TEST DESCRIPTION

Test Set-up

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 50Ω/50μH 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.

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 limit = 250 μV = 47.96 dBμV

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

Q-P reading obtained directly from EMI Receiver = 40 dBμV
(Calibrated for system losses)

Therefore, Q-P margin = 40 - 47.96 = -7.96 i.e. **7.96 dB below limit**

TEST INSTRUMENTATION & GENERAL PROCEDURES ANNEX A

RADIATED EMISSIONS TEST DESCRIPTION (10m ANC)

Test Set-up

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.

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 frequencies.

3. The test was carried out at the selected frequency points obtained from the prescan. 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 25GHz, using the Bi-log antenna for frequencies from 30MHz up to 3GHz, and the Horn antenna above 3GHz.

Sample Calculation Example

At 300 MHz limit = 200 μV/m = 46 dBμV/m

Log-periodic antenna factor & cable loss at 300 MHz = 18.511 dB

Q-P reading obtained directly from EMI Receiver = 40 dBμV/m
(Calibrated level including antenna factors & cable losses)

Therefore, Q-P margin = 40 - 46 = -6 i.e. **6 dB below limit**

SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST DESCRIPTION

Test Set-up

1. The EUT and supporting equipment were set up in a shielded enclosure; 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 connected to a filtered mains.

3. The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.

4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 300kHz.

5. All other supporting equipment were powered separately from another filtered mains.

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 continuous transmitting at Channel 1 (2.412GHz) with CCK modulation (11Mbps), i.e. 802.11b operating condition.

2. The center frequency of the spectrum analyser was set to the transmitting frequency with the frequency span wide enough to capture the 6dB bandwidth of the transmitting frequency.

3. The spectrum analyser was set to max hold to capture the transmitting frequency. The signal capturing was continuous until no further changes were observed.

4. The peak of the transmitting frequency was detected with the marker peak function of the spectrum analyser. The frequencies below the 6dB peak frequency at lower (f_L) and upper (f_H) sides of the transmitting frequency were marked and measured by using the marker-delta function of the spectrum analyser.

5. The 6dB bandwidth of the transmitting frequency is the frequency difference between the marked lower and upper frequencies, $| f_H - f_L |$.

6. The steps 1 to 6 were repeated with the transmitting frequency was set to Channel 7 (2.442GHz) and Channel 13 (2.472GHz) respectively with modulation remains, i.e CCK modulation under 802.11b operating condition.

7. The measurement was repeated with EUT was configured to operate in continuous transmitting at Channel 1 (2.412GHz), Channel 7 (2.442GHz) and Channel 11 (2.462GHz) respectively with OFDM modulation (54Mbps), i.e. 802.11g operating condition.

8. The measurement was repeated with EUT was configured to operate in Turbo mode, i.e Channel 6 (2.437GHz) with ODFM modulation (108Mbps), 802.11g operating condition.

MAXIMUM PEAK POWER TEST DESCRIPTION

Test Set-up

1. The EUT and supporting equipment were set up in a shielded enclosure; 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 connected to a filtered mains.

3. The RF antenna connector was connected to the Universal Radio Communication Tester, which set into power analyser mode via a low-loss coaxial cable.

4. All other supporting equipment were powered separately from another filtered mains.

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 continuous transmitting at Channel 1 (2.412GHz) with CCK modulation (11Mbps), i.e. 802.11b operating condition.

2. The maximum peak power of the transmitting frequency was detected and recorded.

3. The steps 1 to 2 were repeated with the transmitting frequency was to Channel 7 (2.442GHz) and Channel 13 (2.472GHz) respectively with modulation remains, i.e CCK modulation under 802.11b operating condition.

4. The measurement was repeated with EUT was configured to operate in continuous transmitting at Channel 1 (2.412GHz), Channel 7 (2.442GHz) and Channel 11 (2.462GHz) respectively with OFDM modulation (54Mbps), i.e. 802.11g operating condition.

5. The measurement was repeated with EUT was configured to operate in Turbo mode, i.e Channel 6 (2.437GHz) with ODFM modulation (108Mbps), 802.11g operating condition.

RF CONDUCTED SPURIOUS EMISSIONS AT THE TRANSMITTER ANTENNA TERMINAL TEST DESCRIPTION

Test Set-up

1. The EUT and supporting equipment were set up in a shielded enclosure; 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 connected to a filtered mains.

3. The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.

4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 300kHz.

5. All other supporting equipment were powered separately from another filtered mains.

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 continuous transmitting at Channel 1 (2.412GHz) with CCK modulation (11Mbps), i.e. 802.11b operating condition.

2. The start and stop frequencies of the spectrum analyser were set to 30MHz and 10GHz.

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 frequency span was set from 10GHz to 25GHz.

5. The steps 1 to 4 were repeated with the transmitting frequency was to Channel 7 (2.442GHz) and Channel 13 (2.472GHz) respectively with modulation remains, i.e CCK modulation under 802.11b operating condition.

6. The measurement was repeated with EUT was configured to operate in continuous transmitting at Channel 1 (2.412GHz), Channel 7 (2.442GHz) and Channel 11 (2.462GHz) respectively with OFDM modulation (54Mbps), i.e. 802.11g operating condition.

7. The measurement was repeated with EUT was configured to operate in Turbo mode, i.e Channel 6 (2.437GHz) with ODFM modulation (108Mbps), 802.11g operating condition.

BAND EDGE COMPLIANCE AT THE TRANSMITTER ANTENNA TERMINAL TEST DESCRIPTION

Test Set-up

1. The EUT and supporting equipment were set up in a shielded enclosure; 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 connected to a filtered mains.

3. The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.

4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 300kHz.

5. All other supporting equipment were powered separately from another filtered mains.

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 continuous transmitting at Channel 1 (2.412GHz) with CCK modulation (11Mbps), i.e. 802.11b operating condition.

2. The frequency span of the spectrum analyser was set to wide enough to capture the lower band edge of the allowable transmission band (2.40GHz) 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. Set the EUT to continuous transmit at Channel 13 (2.472GHz) with the same modulation.

5. 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 allowable transmission band (2.4835GHz) and any spurious emissions at the band-edge.

6. The measurement was repeated with EUT was configured to operate in continuous transmitting at Channel 1 (2.412GHz) and Channel 11 (2.462GHz) respectively with OFDM modulation (54Mbps), i.e. 802.11g operating condition.

PEAK POWER SPECTRAL DENSITY TEST DESCRIPTION

Test Set-up

1. The EUT and supporting equipment were set up in a shielded enclosure; 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 connected to a filtered mains.

3. The RF antenna connector was connected to the spectrum via a low-loss coaxial cable.

4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 3kHz and 10kHz.

5. All other supporting equipment were powered separately from another filtered mains.

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 continuous transmitting at Channel 1 (2.412GHz) with CCK modulation (11Mbps), i.e. 802.11b operating condition.

2. The sweep time of the spectrum analyser was set to the value of the ratio of the frequency span divided by the RBW.

3. The peak power density of the transmitting frequency was detected and recorded.

4. The steps 1 to 3 were repeated with the transmitting frequency was set to Channel 7 (2.442GHz) and Channel 13 (2.472GHz) respectively with modulation remains, i.e CCK modulation under 802.11b operating condition.

5. The measurement was repeated with EUT was configured to operate in continuous transmitting at Channel 1 (2.412GHz), Channel 7 (2.442GHz) and Channel 11 (2.462GHz) respectively with OFDM modulation (54Mbps), i.e. 802.11g operating condition.

6. The measurement was repeated with EUT was configured to operate in Turbo mode, i.e Channel 6 (2.437GHz) with ODFM modulation (108Mbps), 802.11g operating condition.

MAXIMUM PERMISSIBLE EXPOSURE (MPE) TEST DESCRIPTION

EUT Characterisation

EUT characterisation, over the required frequency range as given in table 1 of FCC Part 1.1310 was carried out to determine the EUT mode of operation that produces the highest possible level of radio frequency radiation.

The EUT was placed in a anechoic chamber, at a height of about 1m on a table. Its radio frequency radiation profile was observed, using a field meter with the appropriate field proble antenna attached and 20cm away from the EUT. E-field (V/m) readings are recorded, since the field meter is most sensitive at this setting. Positions where maximum E-field readings are detected are noted for the final, actual measurement.

Test Set-up

1. The EUT and supporting equipment were set up on top of a non-metallic table.
2. The relevant field probe was positioned at least 20cm away from the EUT and supporting equipment boundary.

Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was carried out at the selected positions obtained from the EUT characterisation.
3. Power density measurement (mW/cm^2) was made using the field meter set to the required averaging time.
4. Steps 2 and 3 were repeated for the next position and its associate EUT operating mode, until all selected positions and modes were measured.

Sample Calculation Example

At 2400 MHz, limit = 1.0 mW/cm^2

Power density reading obtained directly from field meter = 0.3 mW/cm^2 averaged over the required 30 minutes.

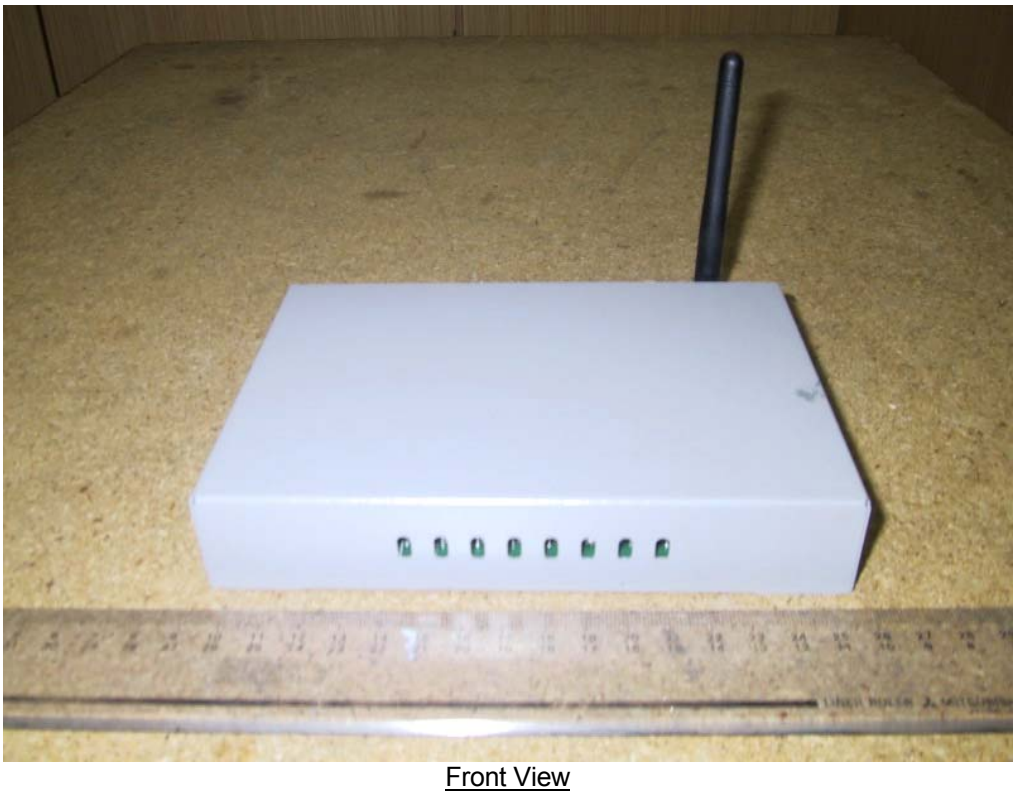
Therefore, margin = 0.3 – 1.0 = -0.7 mW/cm^2 i.e. **0.7 mW/cm^2 below limit**

ANNEX B

TEST PHOTOGRAPHS / DIAGRAMS

TEST PHOTOGRAPHS / DIAGRAMS ANNEX B

EUT PHOTOGRAPHS



Front View

Rear View

TEST PHOTOGRAPHS / DIAGRAMS ANNEX B

EUT PHOTOGRAPHS

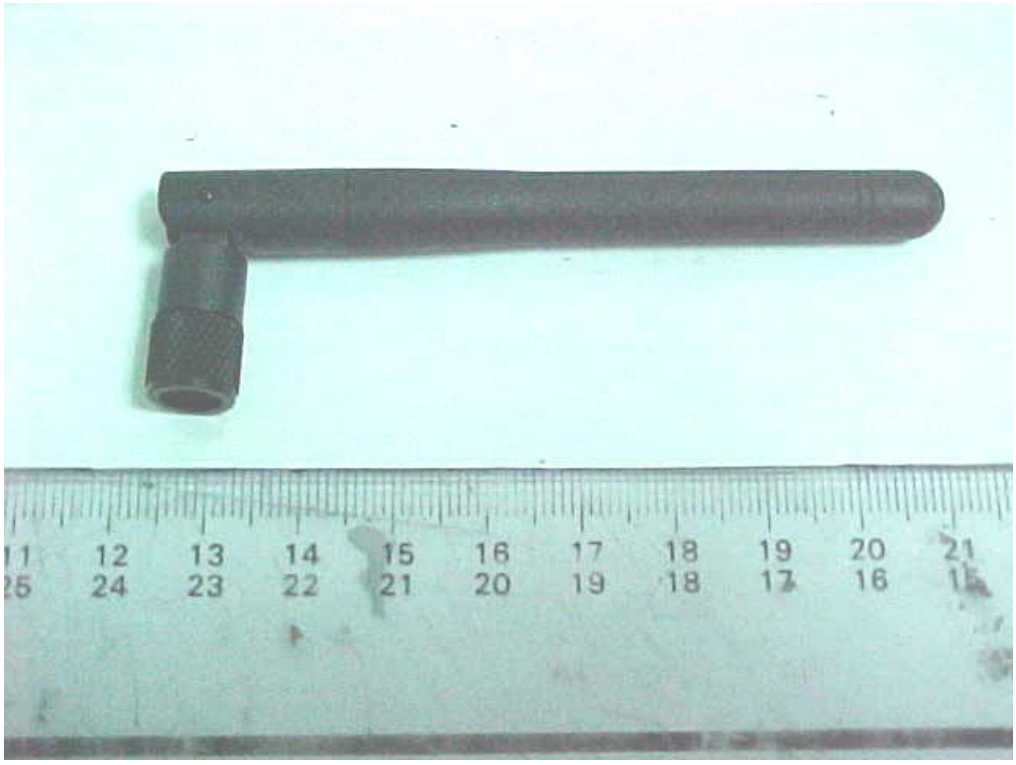
Left View

Right View

TEST PHOTOGRAPHS / DIAGRAMS ANNEX B

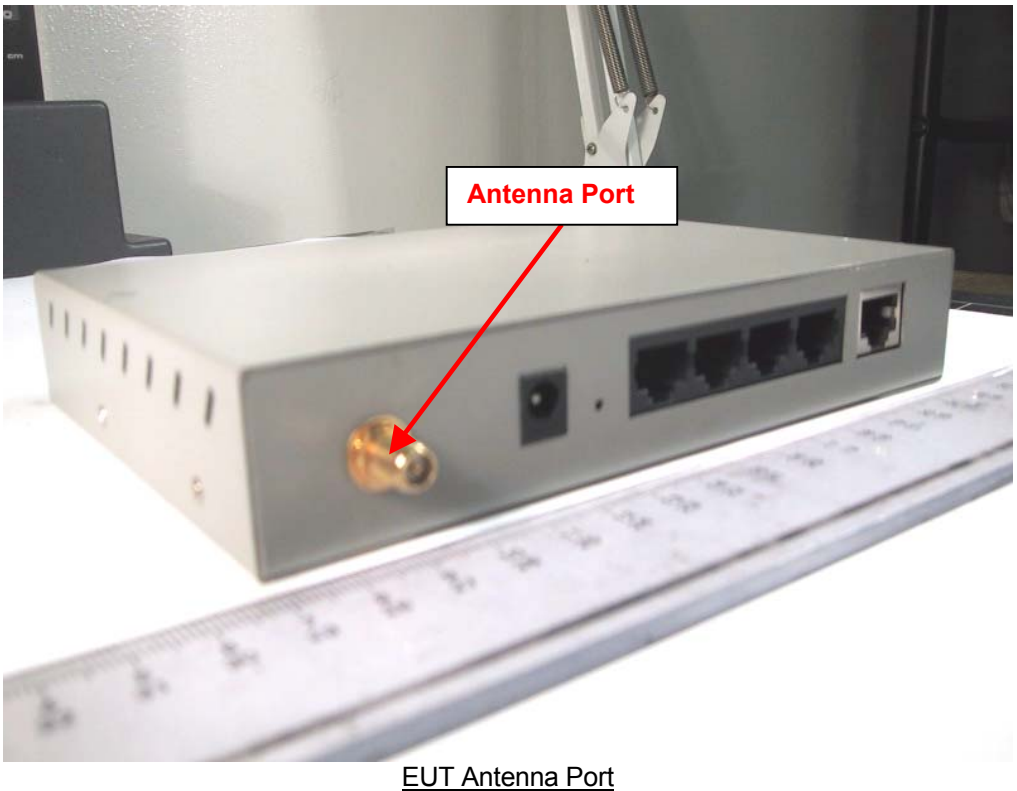
EUT PHOTOGRAPHS

Bottom View



EUT Antenna

EUT PHOTOGRAPHS



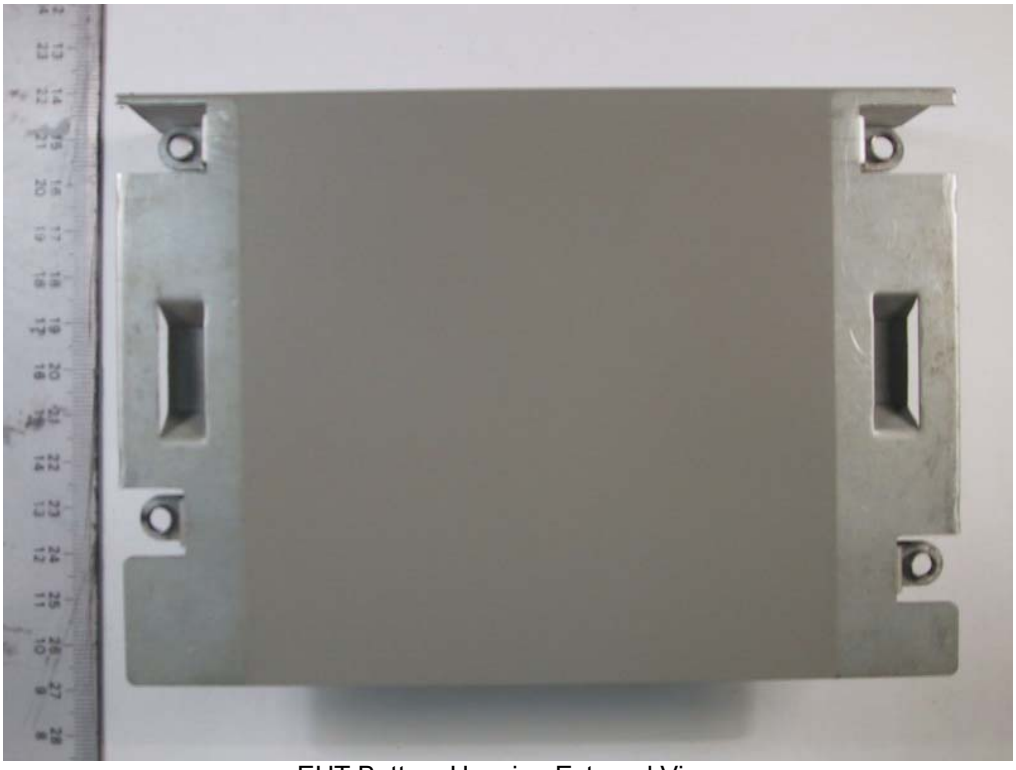
EUT Antenna Port

EUT Top Housing External View

TEST PHOTOGRAPHS / DIAGRAMS ANNEX B

EUT PHOTOGRAPHS

EUT Top Housing Internal View



EUT Bottom Housing External View

TEST PHOTOGRAPHS / DIAGRAMS ANNEX B

EUT PHOTOGRAPHS

EUT Bottom Housing Internal View

EUT Power Adapter Front View

TEST PHOTOGRAPHS / DIAGRAMS ANNEX B

EUT PHOTOGRAPHS

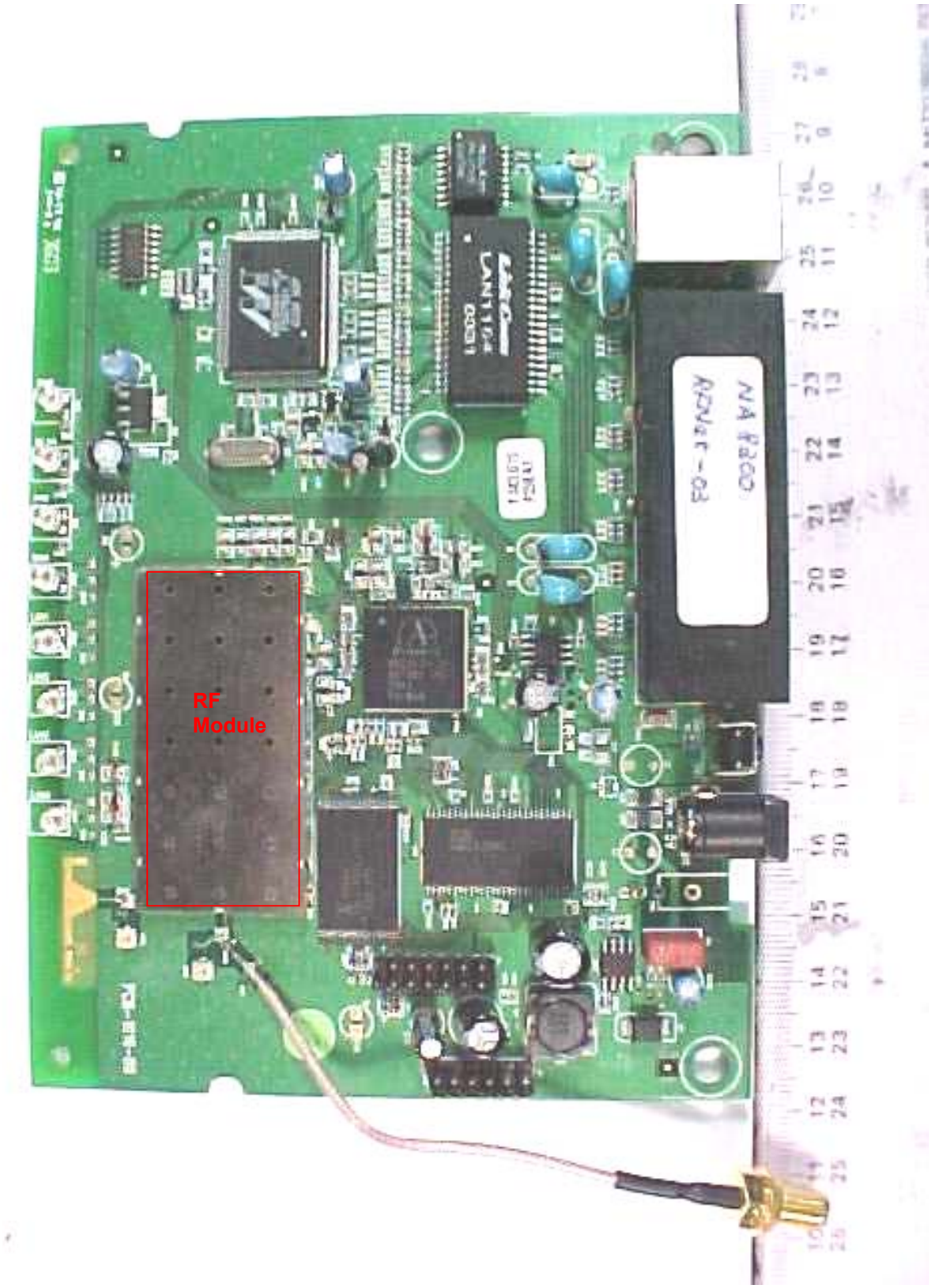
EUT Power Adapter Rear View

TEST PHOTOGRAPHS / DIAGRAMS ANNEX B

EUT PHOTOGRAPHS

EUT Internal View

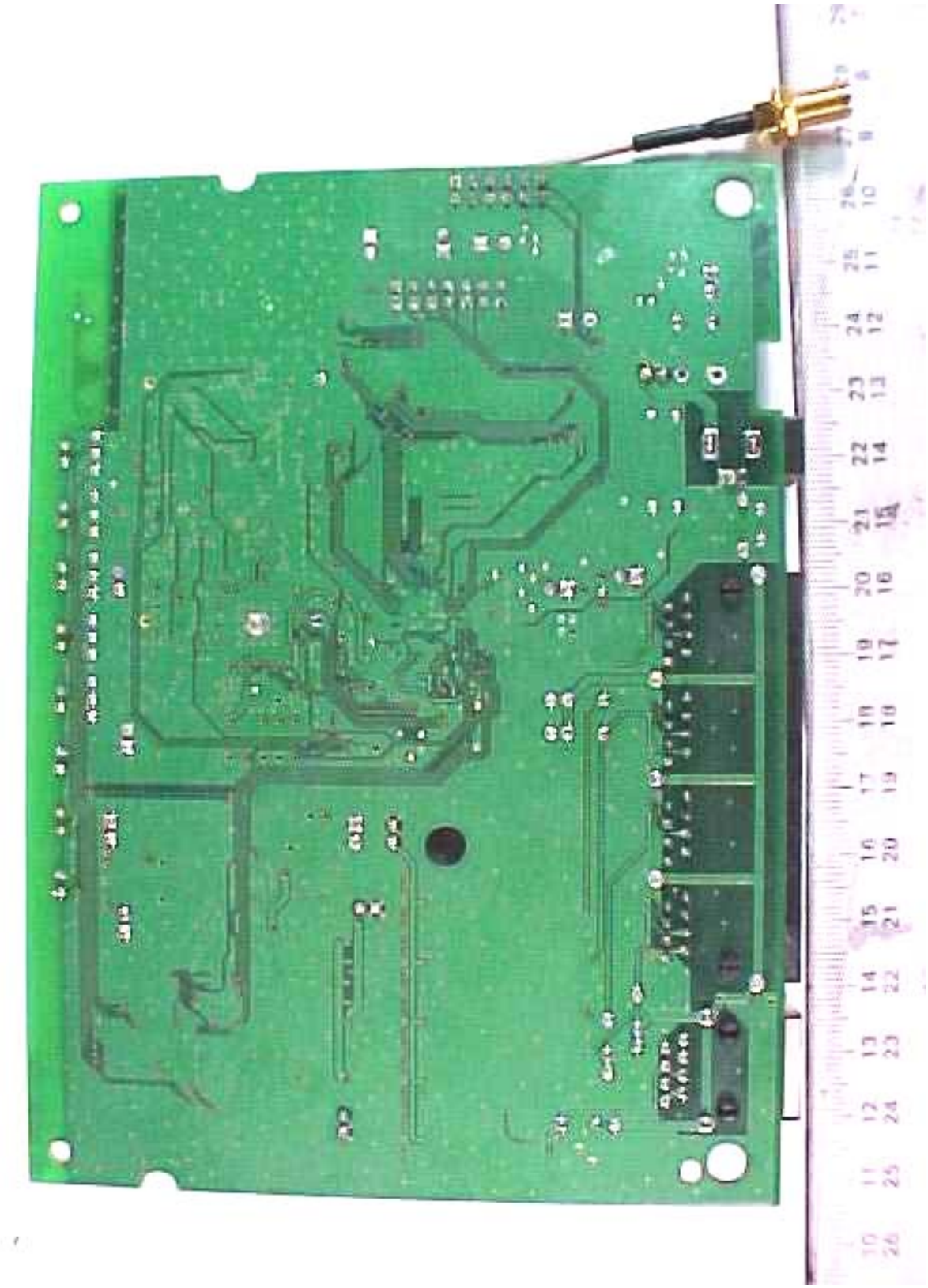
EUT PHOTOGRAPHS



EUT PCB Component Side

TEST PHOTOGRAPHS / DIAGRAMS ANNEX B

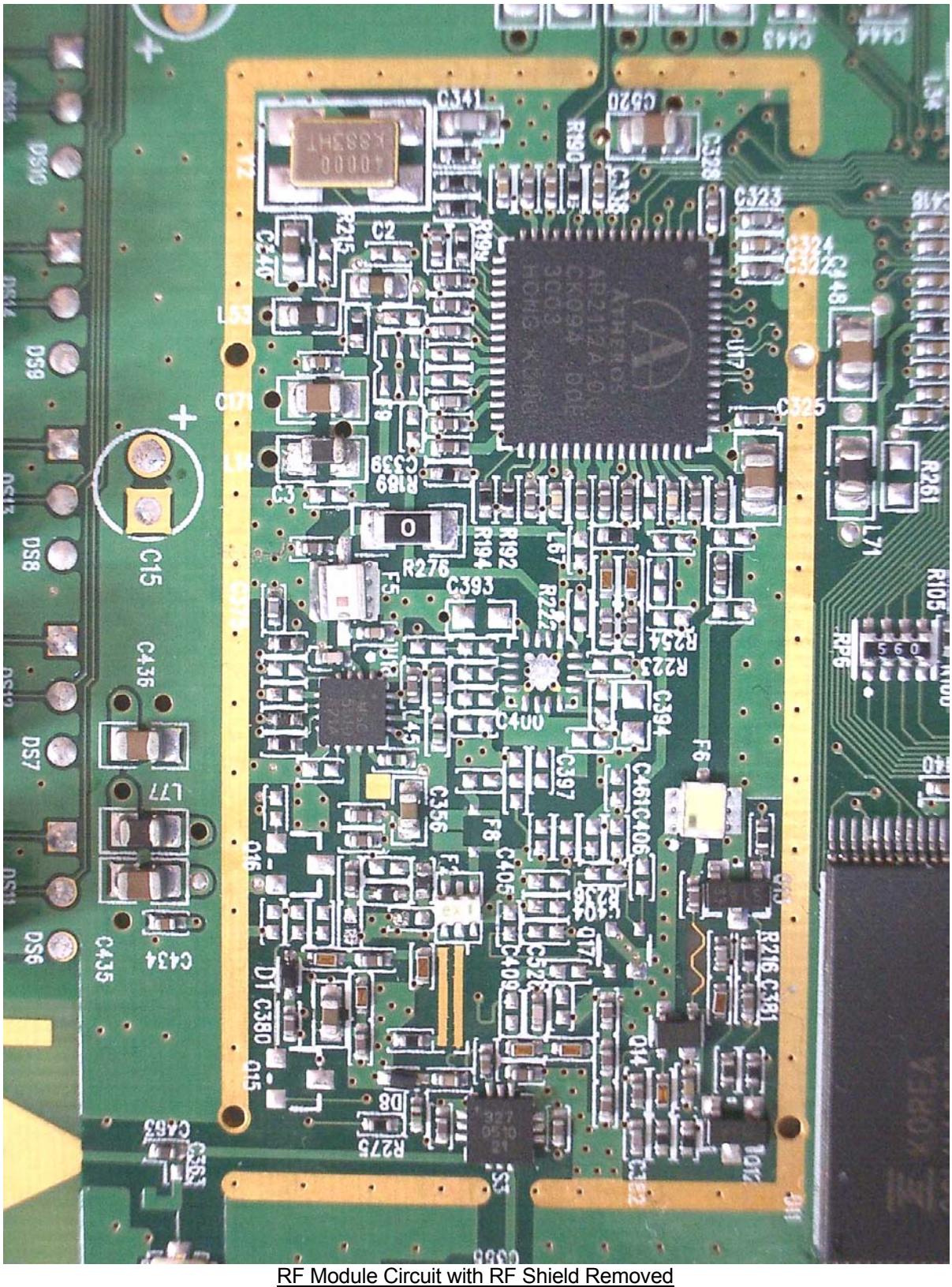
EUT PHOTOGRAPHS



EUT PCB Trace Side

TEST PHOTOGRAPHS / DIAGRAMS ANNEX B

EUT PHOTOGRAPHS



RF Module Circuit with RF Shield Removed

ANNEX C

USER MANUAL
TECHNICAL DESCRIPTION
BLOCK & CIRCUIT DIAGRAMS

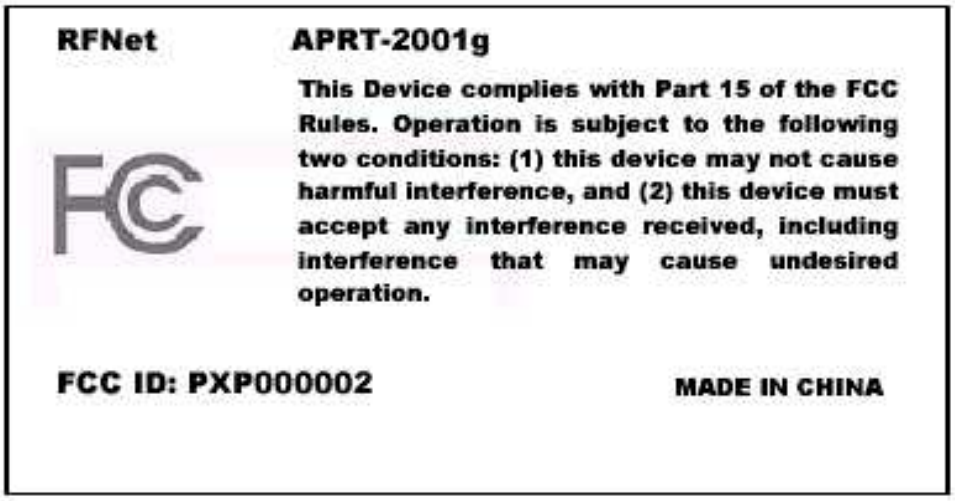
(Please refer to attached copy)

ANNEX D

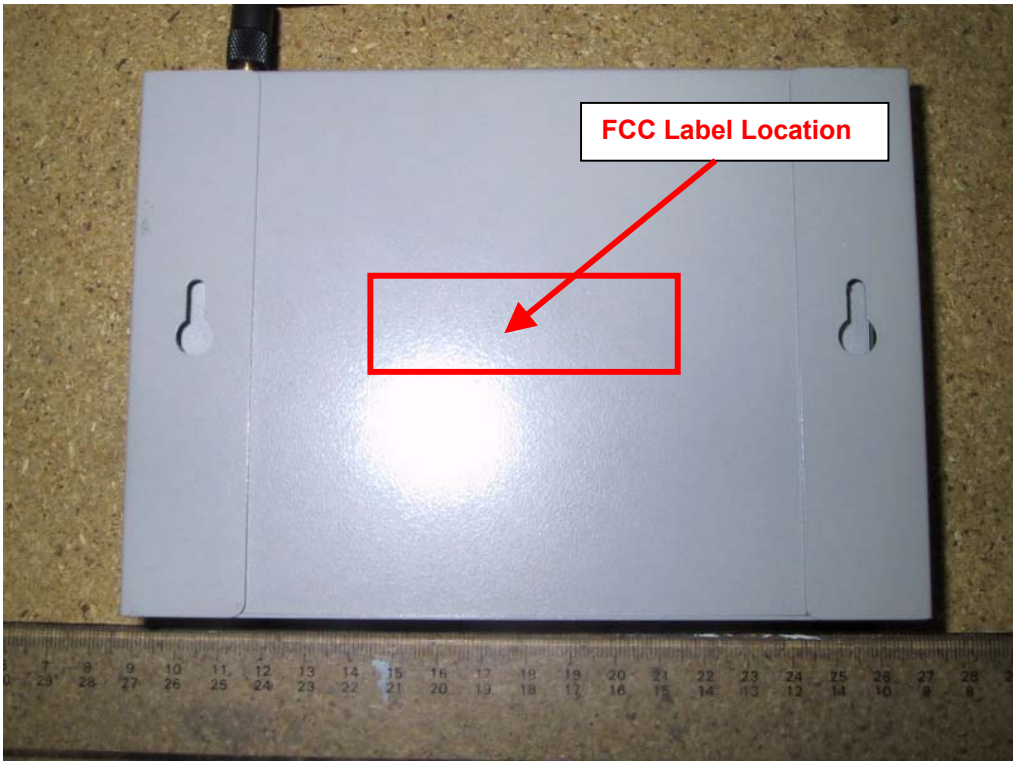
FCC LABEL & POSITION

Labelling requirements per Section 2.925 & 15.19

The label shown will be permanently affixed at a conspicuous location on the device and be readily visible to the user at the time of purchase.



Sample Label



Physical Location of FCC Label on EUT