Nemko Test Report:	121967-1TRFWL
Applicant:	CalAmp Corporation 200-5500 avenue Royalmount Mont-Royal, QC Canada H4P 1H7
Apparatus:	Vanguard 3G Model: 140-71
FCC ID:	EOT14071R2
In Accordance With:	FCC Part 15 Subpart C, 15.247 FHSS System and Digitally Modulated Radiators 902-928 MHz, 2400 - 2483.5 MHz, 5725-5850 MHz
Authorized By:	 Jason Nixon, Wireless/Telecom Specialist
Date:	May 5, 2009, 2009
Total Number of Pages:	27

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Section 1 : Report Summary

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, Subpart C. Radiated tests were conducted in accordance with ANSI C63.4-2003.

The assessment summary is as follows:

Apparatus Assessed:	Vanguard 3G Model: 140-71
Specification:	FCC Part 15 Subpart C, 15.247
Compliance Status:	Complies
Exclusions:	None
Non-compliances:	None
Report Release History:	Original Release
Test Location:	Nemko Canada Inc. 303 River Road Ottawa, Ontario K1V 1H2
Registration Number:	176392 (3 m Semi-Anechoic Chamber)
Tests Performed By:	Andrey Adelberg, EMC/Wireless Specialist
Test Dates:	February 18, 2009 to March 6, 2009

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Section 2 : Equipment Under Test

2.1 Identification of Equipment Under Test (EUT)

The following information identifies the EUT under test:

Type of Equipment:	Mobile Data Modem
Brand Name:	Dataradio
Model Number:	140-71
Part Numbers:	(GSM) 140-7106-110 (CDMA) 140-7105-110
Serial Number:	(GSM): 031 (CDMA): 100086
Nemko Sample Number:	(GSM): 5 (CDMA): 6
FCC ID:	EOT14071R2
Date of Receipt:	February 13, 2009

2.2 Accessories

No additional accessories were used to exercise the EUT during testing.

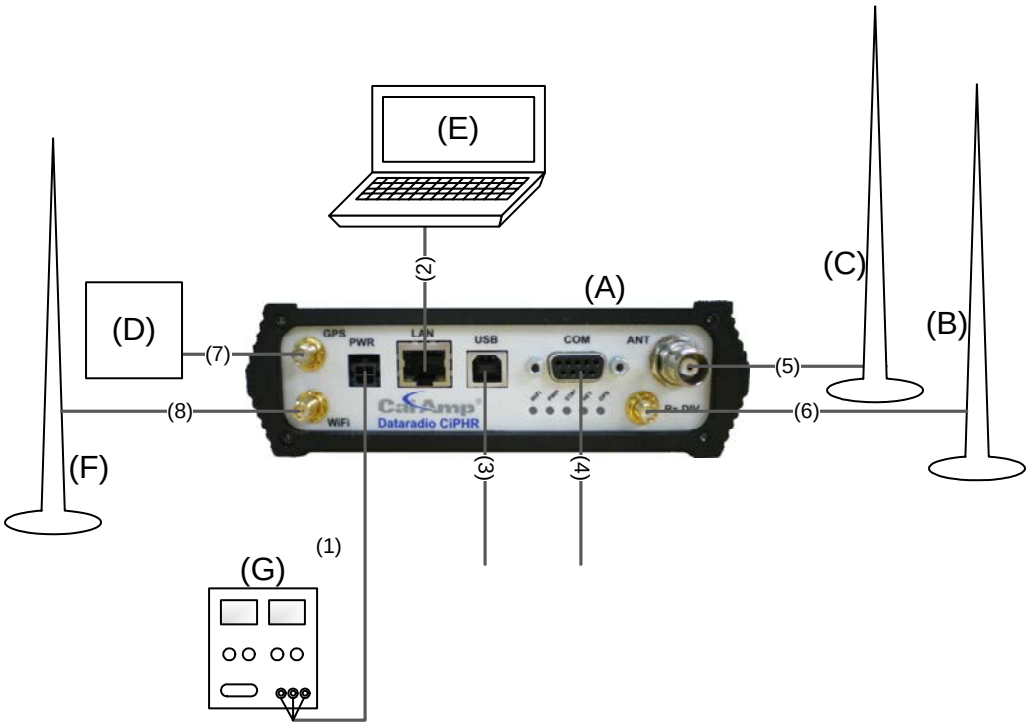
2.3 EUT Description

The CalAmp Cellular Industrial Packet Handler Radio (Vanguard 3G) is a flexible modular data modem designed specifically for Machine-to-Machine (M2M) communication links of fixed and mobile equipment. It can provide Cellular and WiFi communication links simultaneously.

2.4 Technical Specifications of the EUT

Operating Band:	2400 – 2483.5 MHz
Operating Frequency:	2412 – 2462 MHz
Modulation:	DSSS, CCK, OFDM
Occupied Bandwidth:	12.2 MHz (CCK), 16.5 MHz (OFDM)
Emission Designator:	12M2G1D (CCK), 16M5W7D (OFDM)
Antenna Data:	5.5 dBi Radiolabs WiFi antenna MN# 2.4Mobile-3 with reversed SMA connector.
Power Supply Requirements:	12 VDC

2.5 EUT Setup diagram



Item	Description
(A)	(EUT) Modem
(B)	Maxrad GSM 16 dBi antenna
(C)	PCTEL TNC Cellular 3 dBi antenna
(D)	PCTEL SMA Rx Diversity 3 dBi antenna
(E)	IBM Laptop
(F)	Radiolabs WiFi antenna 5.5 dBi
(G)	Topward Power supply

EUT Ports
Description (connector type)
ANT (TNC)
Rx DIV (SMA)
WiFi (reversed SMA)
PWR (4 pins DC input)
USB (Type B)
COM (D-type-9)
LAN (8P8C)
GPS (SMA)

Inter-Connection Cables	
Item	**Description**
(1)	DC Power cable, 3 wire with fuse on positive wire
(2)	Ethernet cable
(3)	USB cable
(4)	Serial cable (RS-232)
(5)	RF cable to Cellular antenna
(6)	RF cable to Rx Diversity antenna
(7)	RF cable to GPS antenna
(8)	RF cable to WiFi antenna

2.6 Operation of the EUT during testing

Customer supplied instructions to make EUT transmit modulated signal constantly with maximum power at the desired channel.

2.7 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

Section 3 : Test Conditions

3.1 Specifications

The apparatus was assessed against the following specifications:

FCC Part 15 Subpart C, 15.247
FHSS System and Digitally Modulated Radiators
902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz

3.2 Deviations From Laboratory Test Procedures

No deviations were made from laboratory test procedures.

3.3 Test Environment

All tests were performed under the following environmental conditions:

Temperature range	:	15–30 °C
Humidity range	:	20–75 %
Pressure range	:	86–106 kPa
Power supply range	:	±5 % of rated voltages

3.4 Measurement Uncertainty

Nemko Canada measurement uncertainty has been calculated using guidance of UKAS LAB 34:2003 and TIA-603-B Nov 7, 2002. All calculations have been performed to provide a confidence level of 95 % and can be found in Nemko Canada document MU-003.

3.5 Test Equipment

Equipment	Manufacturer	Model No.	Asset/Serial No.	Cal. Date	Next Cal.
3 m EMI Test Chamber	TDK	SAC-3	FA002047	May 06/08	May 06/09
Bilog	Sunol	JB3	FA002108	Jan. 27/09	Jan. 27/10
Flush Mount Turntable	Sunol	FM2022	FA002082	NCR	NCR
Controller	Sunol	SC104V	FA002060	NCR	NCR
Mast	Sunol	TLT2	FA002061	NCR	NCR
International Power Supply	California Inst.	3001i	FA001021	Jan. 13/09	Jan. 13/10
Horn Antenna #2	EMCO	3115	FA000825	Jan. 21/09	Jan. 21/10
1 – 18 GHz Amplifier	JCA	JCA118-503	FA002091	Oct 2/08	Oct 2/09
50 Coax cable	HUBER + SUHNER	None	FA002015	Aug. 05/08	Aug. 05/09
50 Coax cable	HUBER + SUHNER	None	FA002022	July 07/08	July 07/09
50 Coax cable	HUBER + SUHNER	None	FA002074	July 07/08	July 07/09
LISN	Rohde & Schwarz	ENV216	FA002023	Sept. 02/08	Sept. 02/09
Receiver/Spectrum Analyzer	Rohde & Schwarz	ESU 26	FA002043	Dec. 16/08	Dec. 16/09
Spectrum Analyzer	Rohde & Schwarz	FSU	FA001877	Sept. 03/08	Sept. 03/09

COU – Calibrate on Use
NCR – No Calibration Required

Section 4 : Results Summary

This section contains the following:

FCC Part 15 Subpart C : Test Results

The column headed 'Required' indicates whether the associated clauses were invoked for the apparatus under test. The following abbreviations are used:

N No : not applicable / not relevant.

Y Yes : Mandatory i.e. the apparatus shall conform to these tests.

N/T Not Tested, mandatory but not assessed. (See Report Summary)

4.1 FCC Part 15 Subpart C : Test Results

Part 15	Test Description	Required	Result
15.31(e)	Variation of power supply	Y	PASS
15.207(a)	Powerline Conducted Emissions	Y	PASS
15.209(a)	Radiated Emissions within Restricted Bands	Y	PASS
15.247(a)(1)	Frequency hopping systems	N	
15.247(a)(1)(i)	Frequency hopping systems operating in the 902-928 MHz band	N	
15.247(a)(1)(ii)	Frequency hopping systems operating in the 5725-5850 MHz band	N	
15.247(a)(1)(iii)	Frequency hopping systems operating in the 2400-2483.5 MHz band	N	
15.247(a)(2)	6 dB bandwidth	Y	PASS
15.247(b)(1)	Maximum peak output power of Frequency hopping systems operating in the 2400-2483.5 MHz band and 5725-5850 MHz band	N	
15.247(b)(2)	Maximum peak output power of Frequency hopping systems operating in the 902-928 MHz band	N	
15.247(b)(3)	Maximum peak output power of systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands	N	
15.247(b)(4)	Maximum peak output power	Y	PASS
15.247(c)(1)	Fixed point-to-point Operation with directional antenna gains greater than 6 dBi	N	
15.247(c)(2)	Transmitters operating in the 2400-2483.5 MHz band that emit multiple directional beams	N	
15.247(d)	Conducted Spurious Emissions	Y	PASS
15.247(e)	Power Spectral Density for Digitally Modulated Devices	Y	PASS
15.247(f)	Time of Occupancy for Hybrid Systems	N	

Appendix A : Test Results

Clause 15.207(a) Powerline Conducted Emissions

Frequency of Conducted limit (dBµV)

Emission (MHz)	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

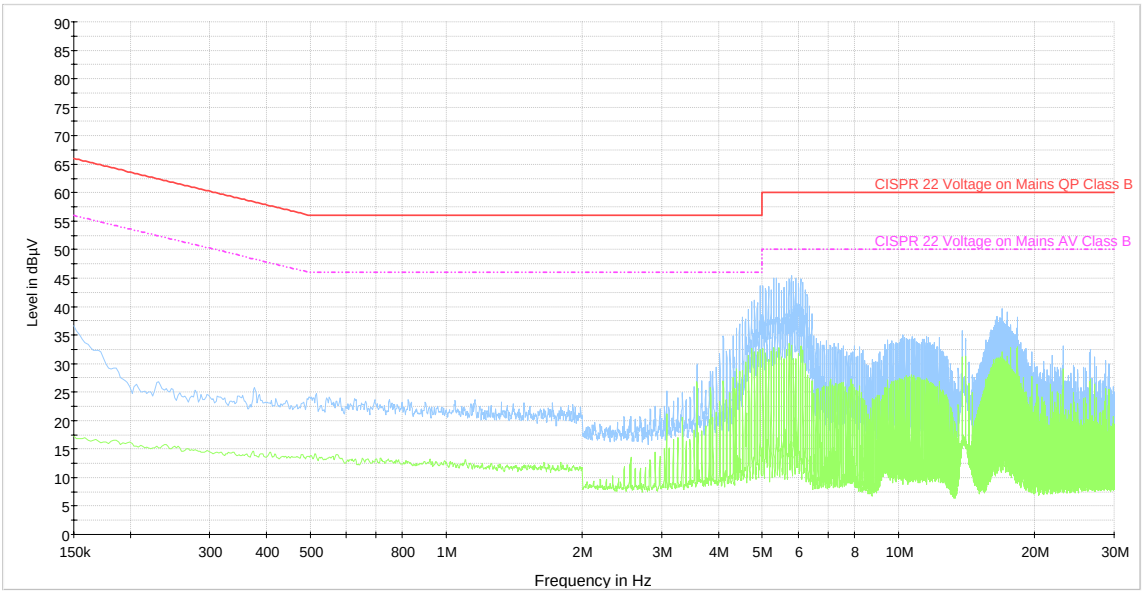
Test Results: Pass

Additional Observations:

All plots were obtained using a sweeping receiver with an IF of 9 kHz using a Peak and Average detector. The plots have been corrected with the cable loss and LISN loss to show compliance.

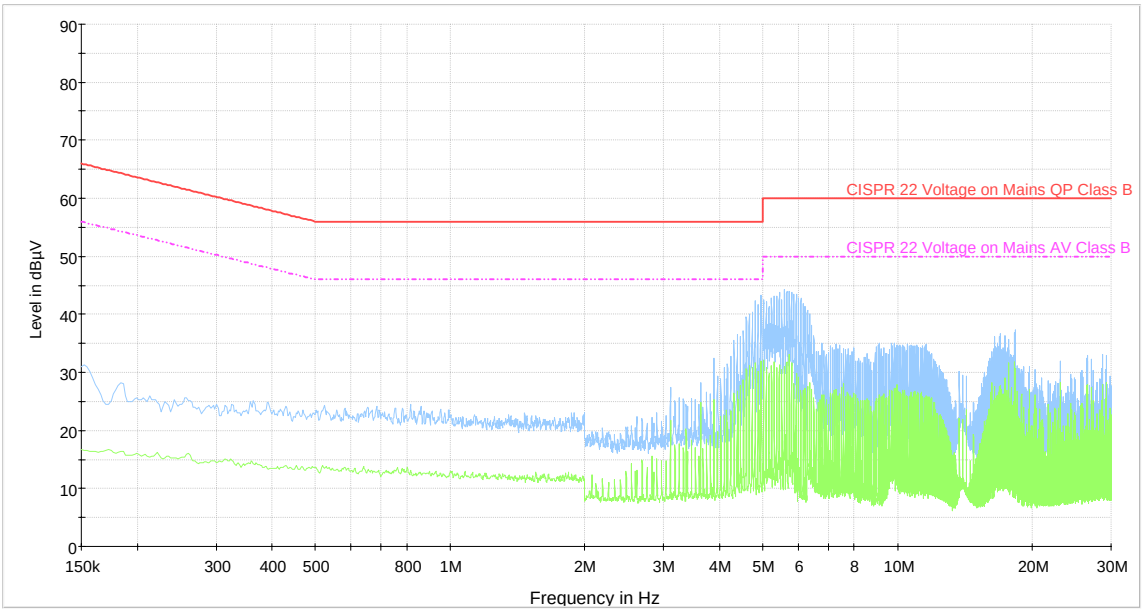
No emissions were detected within 6 dB of limit.

Phase:



Conducted Emissions on Phase Line
CISPR 22 Voltage on Mains QP Class B.LimitLine
CISPR 22 Voltage on Mains AV Class B.LimitLine
Preview Result 1
Preview Result 2

Neutral:



Conducted Emissions on Neutral Line
CISPR 22 Voltage on Mains QP Class B.LimitLine
CISPR 22 Voltage on Mains AV Class B.LimitLine
Preview Result 1
Preview Result 2

Clause 15.209(a) Radiated Emissions within Restricted Bands

Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvoltsmeter)	Measurement Distance (meters)
0.009-0.490	2400/F (kHz)	300
0.490-1.705	24000/F (kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Results: Pass

Additional Observations:

The Spectrum was searched from 30 MHz to the 10th Harmonic.

These results apply to emissions found in the Restricted bands defined in FCC Part 15 Subpart C, 15.205.

All measurements were performed at 3 m distance.

For the testing purposes EUT was transmitting with 100 % duty cycle.

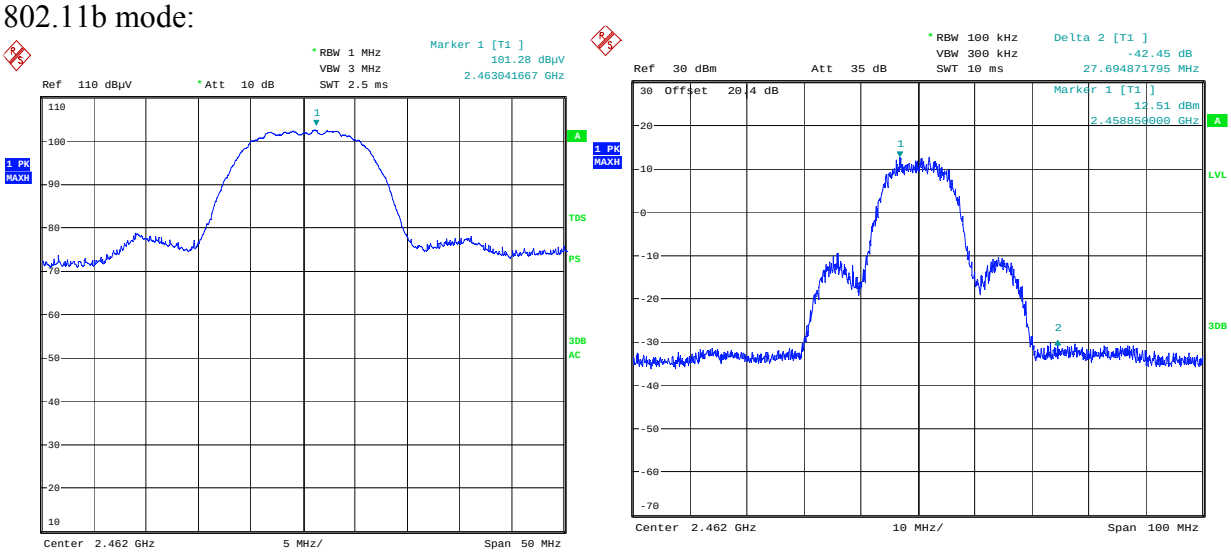
Measurements below 1 GHz were tested with 100 kHz RBW/VBW. For emissions above 1 GHz Peak measurements were tested with 1 MHz RBW/3 MHz VBW and Average measurements with 1 MHz RBW/10 Hz VBW.

Channel	Freq, MHz	Pol	Peak Field Strength, dBµV/m	Average Field Strength, dBµV/m	Peak Limit, dBµV/m	Peak margin, dB	Average Limit, dBµV/m	Average margin, dB
Low	4824.000	H	56.78	48.44	74.00	17.22	54.00	5.56
Low	4824.000	V	57.13	48.79	74.00	16.87	54.00	5.21
Mid	4874.000	V	58.59	50.25	74.00	15.41	54.00	3.75
Mid	4874.000	H	57.71	49.37	74.00	16.29	54.00	4.63
High	4923.840	V	54.46	46.12	74.00	19.54	54.00	7.88
High	4923.840	H	54.11	45.77	74.00	19.89	54.00	8.23
High	7394.654	V	60.18	51.84	74.00	13.82	54.00	2.16
High	7394.654	H	59.30	50.96	74.00	14.70	54.00	3.04

Note: Antenna factor, cable loss and amplifier gain are included in Field Strength result.

Delta Marker Measurement for 2.4835 GHz Band Edge

802.11b mode:



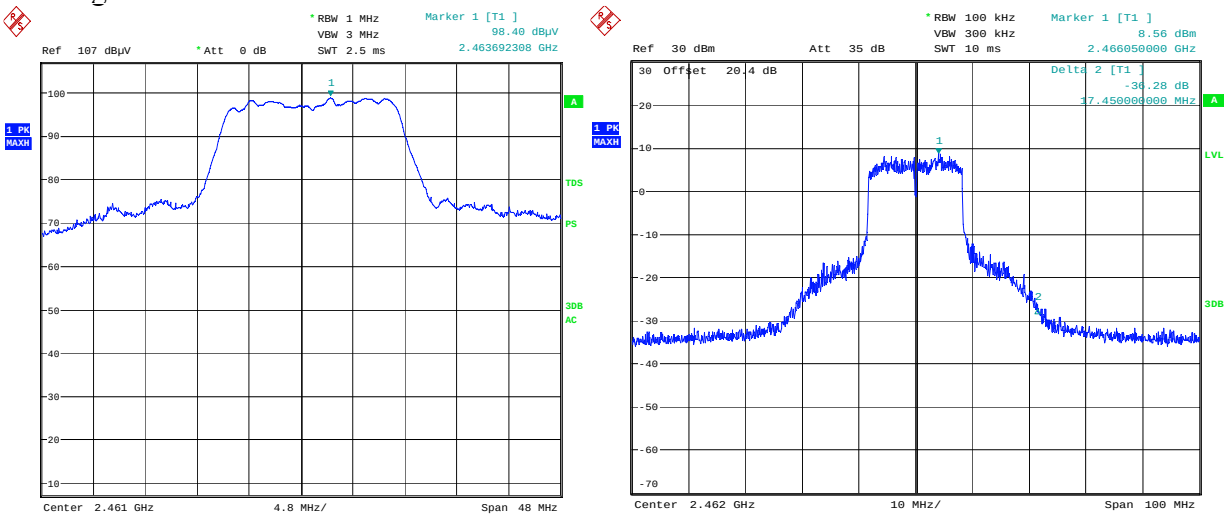
Measured Field Strength for High Channel in 1 MHz RBW/3 MHz VBW = 101.28 dBµV/m
Measured Field Strength for High Channel in 1 MHz RBW/10 Hz VBW = 92.94 dBµV/m

Delta Marker = 42.45 dB

Therefore, Peak Field Strength = 101.28 dBµV/m – 42.45 dB = 58.83 dBµV/m
Limit = 74 dBµV/m
Average Field Strength = 92.94 dBµV/m – 42.45 dB = 50.49 dBµV/m
Limit = 54 dBµV/m

Delta Marker Measurement for 2.4835 GHz Band Edge

802.11g mode:



Measured Field Strength for High Channel in 1 MHz RBW/3 MHz VBW = 98.40 dBµV/m
Measured Field Strength for High Channel in 1 MHz RBW/10 Hz VBW = 86.94 dBµV/m

Delta Marker = 36.28 dB

Therefore, Peak Field Strength = 98.40 dBµV/m – 36.28 dB = 62.12 dBµV/m
Limit = 74 dBµV/m
Average Field Strength = 86.94 dBµV/m – 36.28 dB = 50.66 dBµV/m
Limit = 54 dBµV/m

Clause 15.247(a)(2) 6 dB bandwidth

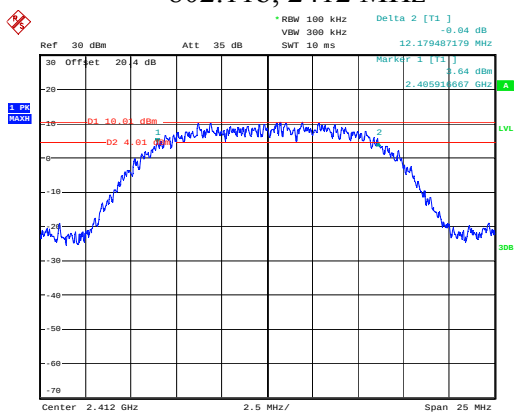
Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Test Results: Pass

6 dB Bandwidth:

Mode	Frequency, MHz	6 dB bandwidth, MHz	Limit, kHz	Margin, MHz
802.11b	2412	12.179	500	11.679
	2437	12.201	500	11.701
	2462	11.912	500	11.412
802.11g	2412	16.504	500	16.004
	2437	16.466	500	15.966
	2462	16.466	500	15.966

802.11b, 2412 MHz



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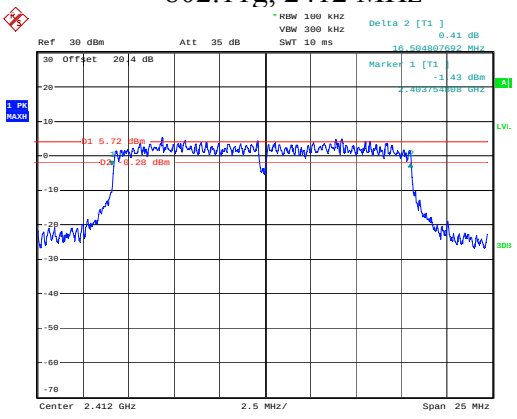
802.11g, 2412 MHz



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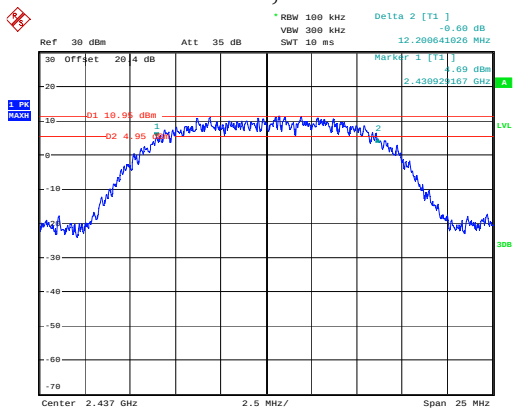
802.11b, 2437 MHz



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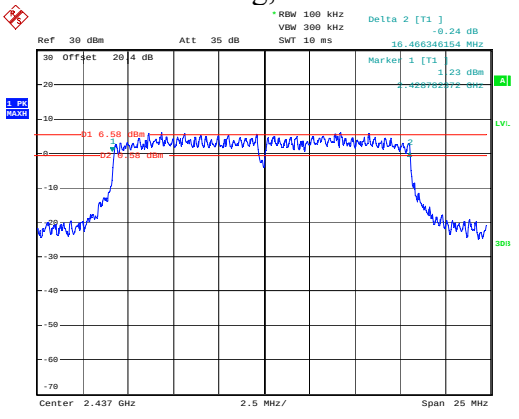
802.11g, 2437 MHz



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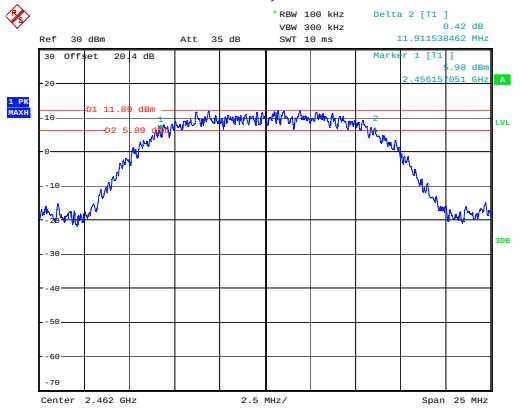
802.11b, 2462 MHz



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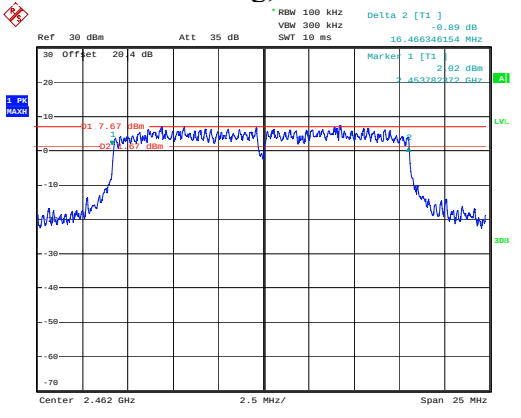
802.11g, 2462 MHz



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Clause 15.247(b)(3) Maximum peak output power of systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 W. As an alternative to a peak power measurement, compliance with the 1 W limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signalling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmitting power occurring in any mode.

Clause 15.247(b)(4) Maximum peak output power

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Test Results: Pass

Conducted Output Power:

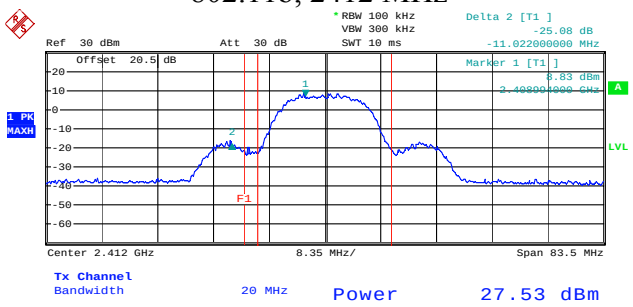
The output power was measured at ±15 % of the supply voltage and found that there was no significant change.

The power was calculated over 26 dB EBW

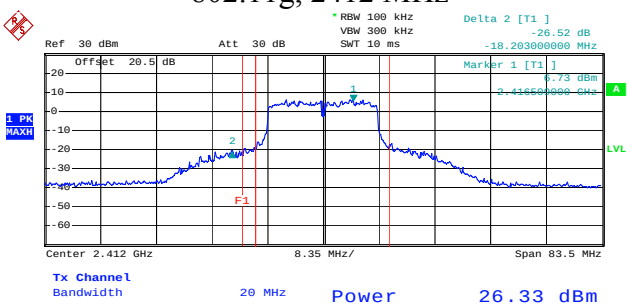
Mode	Frequency, MHz	Peak Output Power, dBm	Peak Output Power, W	POP Limit, dBm	Margin, dB
802.11b	2412	27.53	0.566	30.00	2.47
	2437	28.04	0.637	30.00	1.96
	2462	28.73	0.746	30.00	1.27
802.11g	2412	26.33	0.430	30.00	3.67
	2437	26.86	0.485	30.00	3.14
	2462	27.80	0.603	30.00	2.20

Mode	Frequency, MHz	Peak Output Power, dBm	Antenna gain, dBi	EIRP, dBm	EIRP Limit, dBm	Margin, dB
802.11b	2412	27.53	5.5	33.03	36.00	2.97
	2437	28.04	5.5	33.54	36.00	2.46
	2462	28.73	5.5	34.23	36.00	1.77
802.11g	2412	26.33	5.5	31.83	36.00	4.17
	2437	26.86	5.5	32.36	36.00	3.64
	2462	27.80	5.5	33.30	36.00	2.70

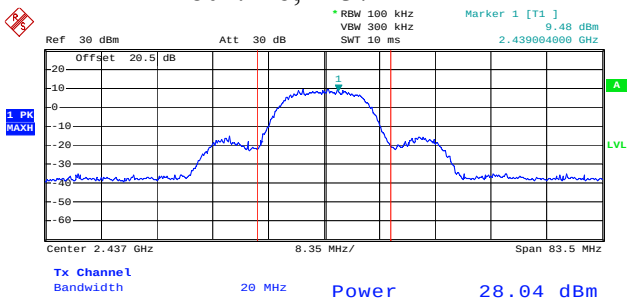
802.11b, 2412 MHz



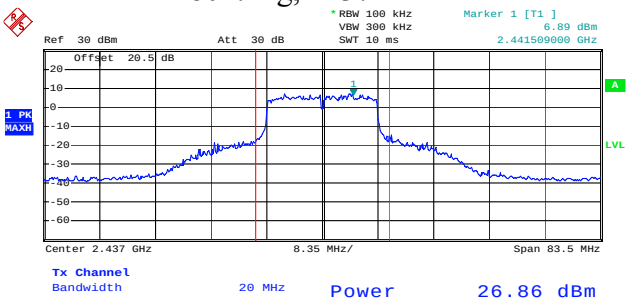
802.11g, 2412 MHz



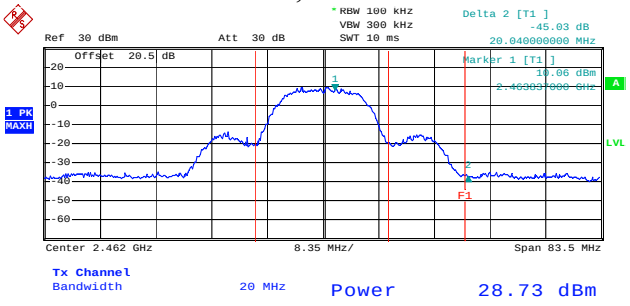
802.11b, 2437 MHz



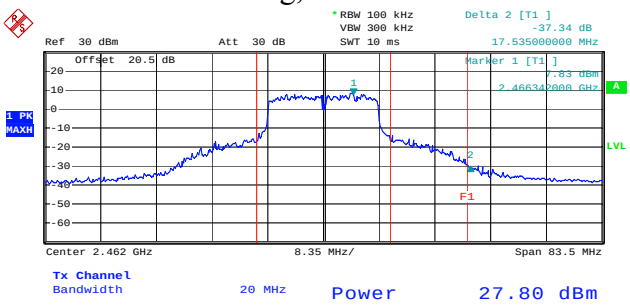
802.11g, 2437 MHz



802.11b, 2462 MHz



802.11g, 2462 MHz



Supply voltage: 12 VDC (Nominal): Output power was 28.73 dBm.
Supply voltage: 10.2 VDC (Nominal – 15 %): Output power was 28.65 dBm.
Supply voltage: 13.8 VDC (Nominal + 15 %): Output power was 28.70 dBm.

Clause 15.247(d) Conducted Spurious Emissions

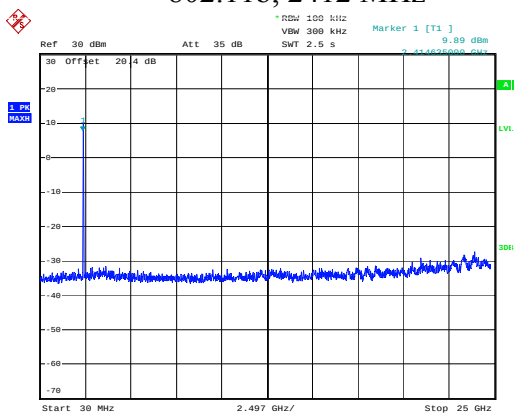
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions, which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Test Results: Pass

Additional Observations:

No spurious emissions were detected in 30 dB below in-band emission measured with 100 kHz.

802.11b, 2412 MHz



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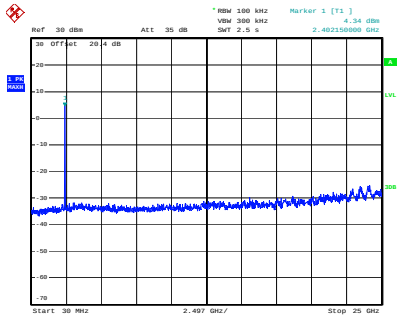
802.11g, 2412 MHz



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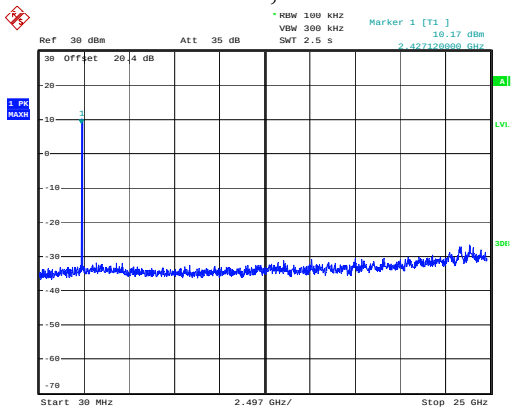
802.11b, 2437 MHz



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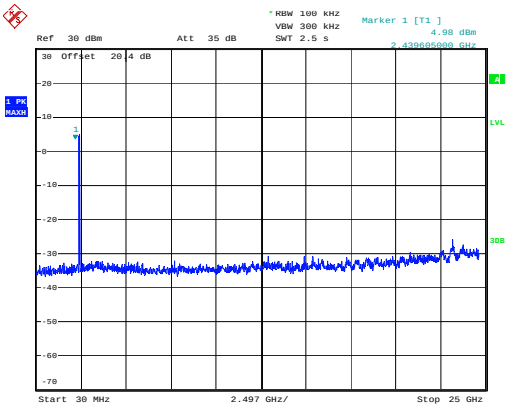

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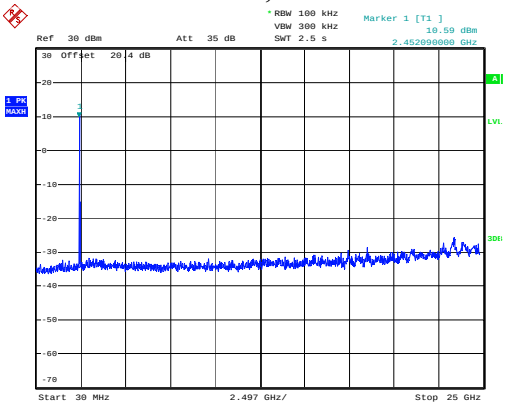
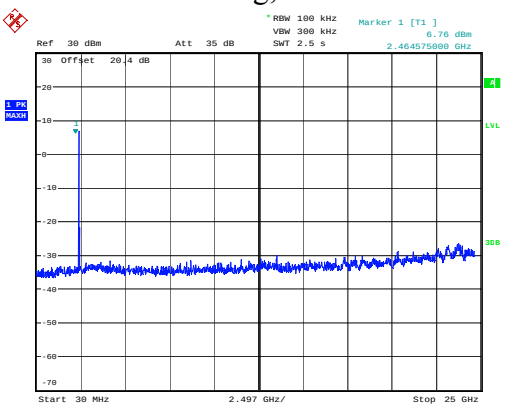
802.11b, 2462 MHz



Date: 4.MAR.2009 13:40:38

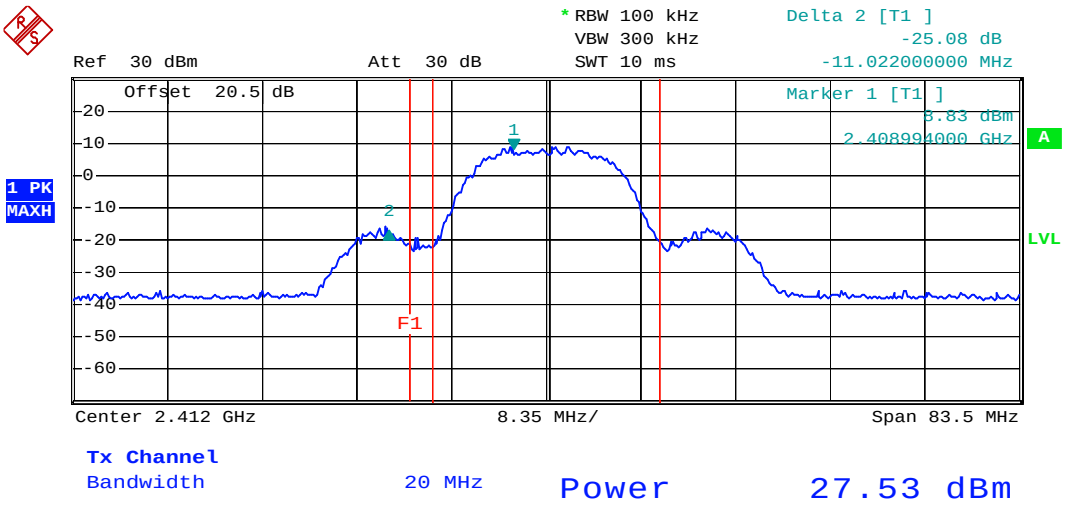
802.11g, 2462 MHz



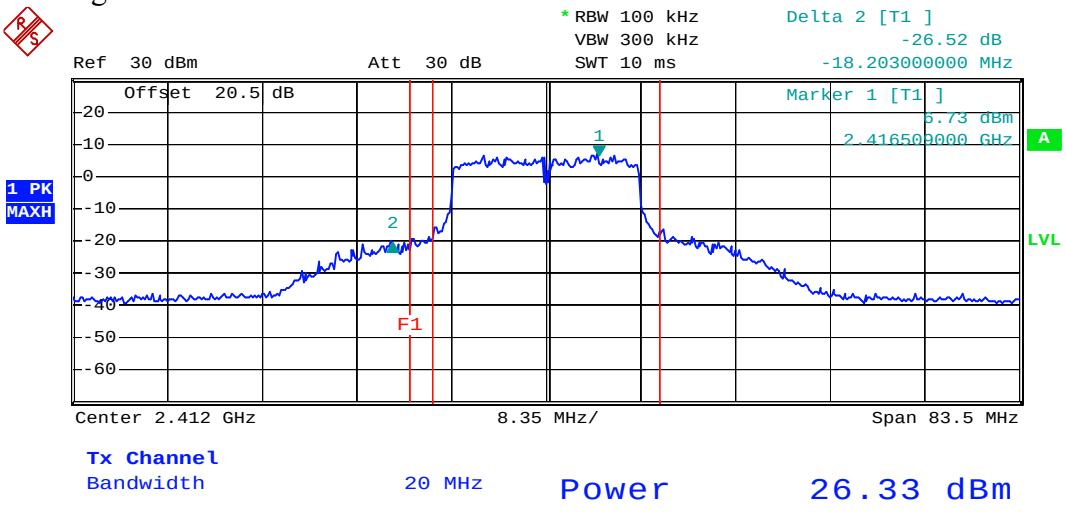
Date: 4.MAR.2009 13:43:38

Band Edge Measurement for 2.4 GHz Band Edge

802.11b mode:



802.11g mode:



Clause 15.247(e) Power Spectral Density for Digitally Modulated Devices

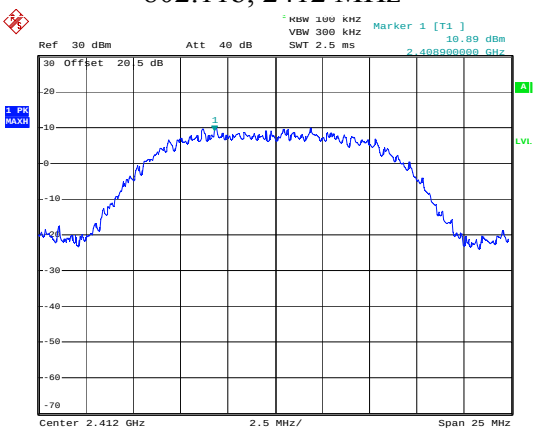
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Test Results: Pass

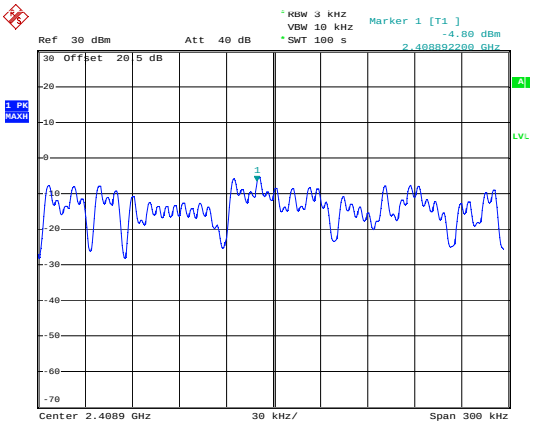
Power Spectral Density

Mode	Frequency, MHz	PSD, dBm/3 kHz	Limit, dBm/3 kHz	Margin, dB
802.11b	2412	−4.80	8.00	12.80
	2437	−4.23	8.00	12.23
	2462	−3.04	8.00	11.04
802.11g	2412	−8.77	8.00	16.77
	2437	−7.97	8.00	15.97
	2462	−7.29	8.00	15.29

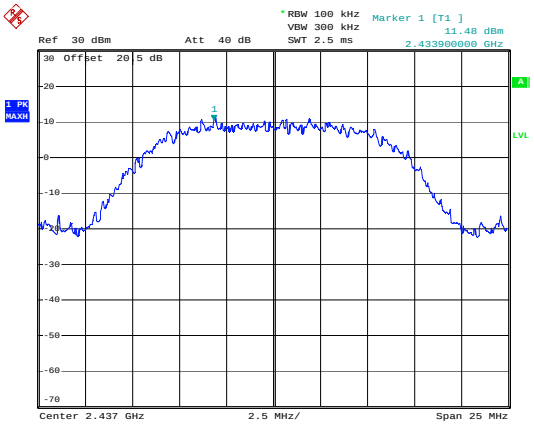
802.11b, 2412 MHz



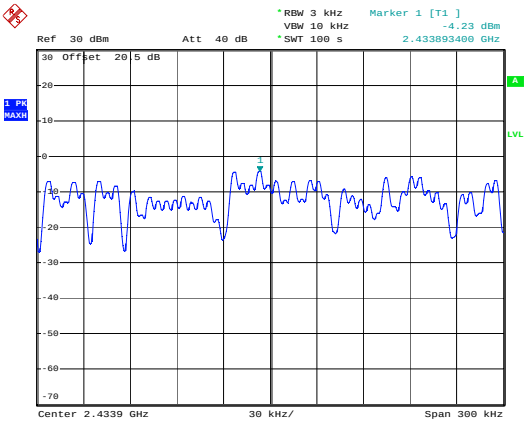
802.11b, 2412 MHz



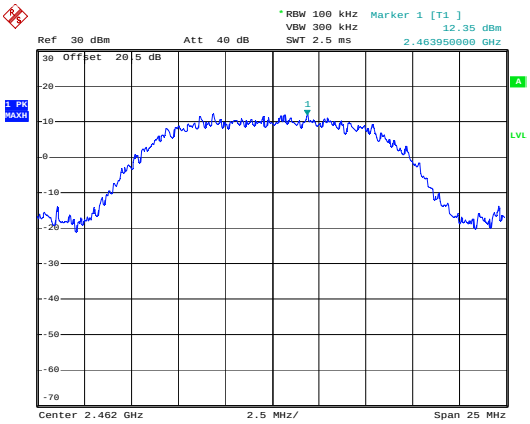
802.11b, 2437 MHz



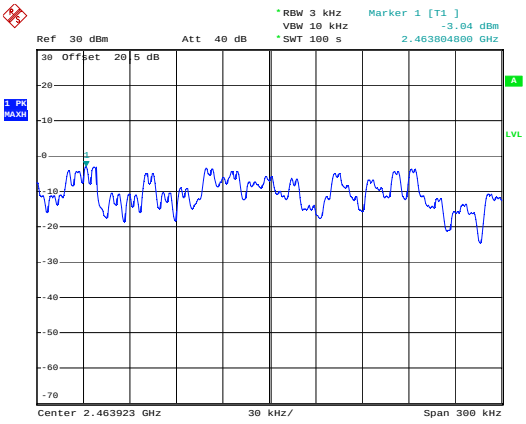
802.11b, 2437 MHz



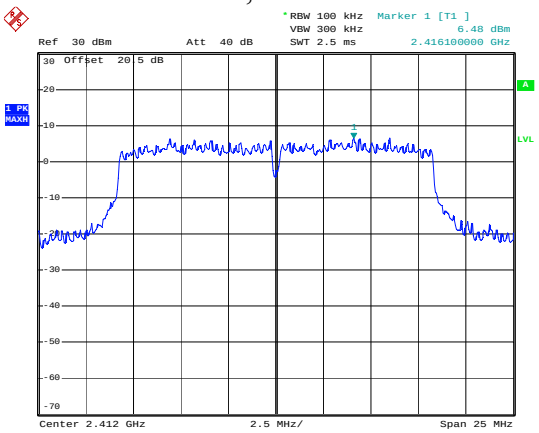
802.11b, 2462 MHz



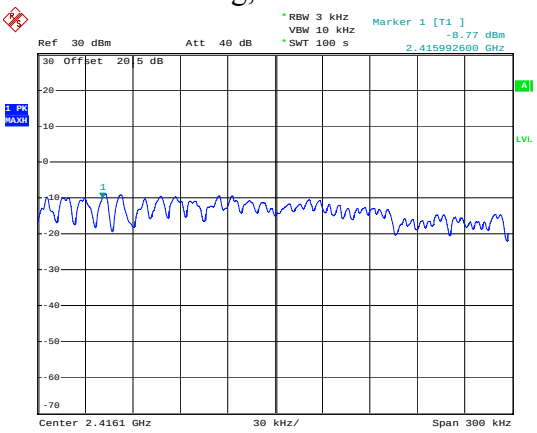
802.11b, 2462 MHz



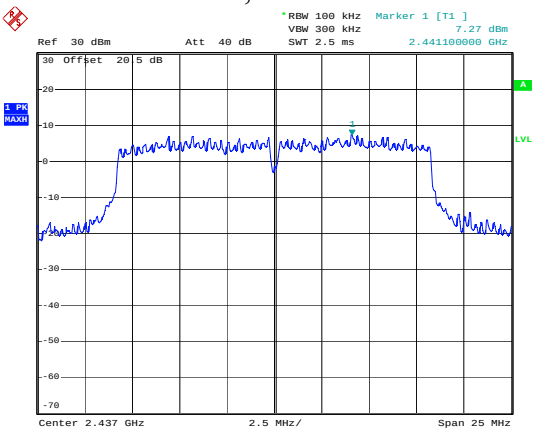
802.11a, 2412 MHz



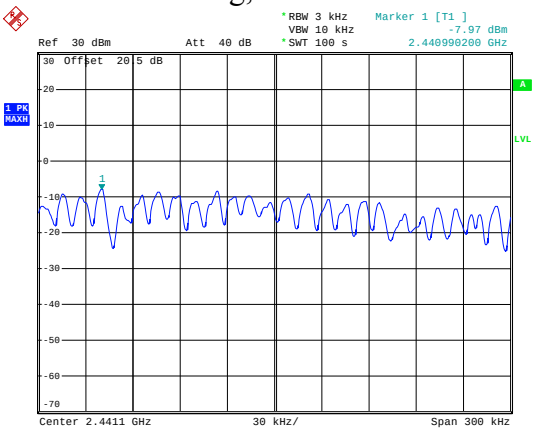
802.11g, 2412 MHz



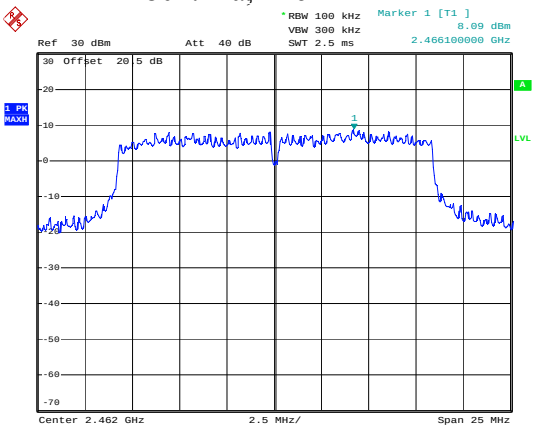
802.11a, 2437 MHz



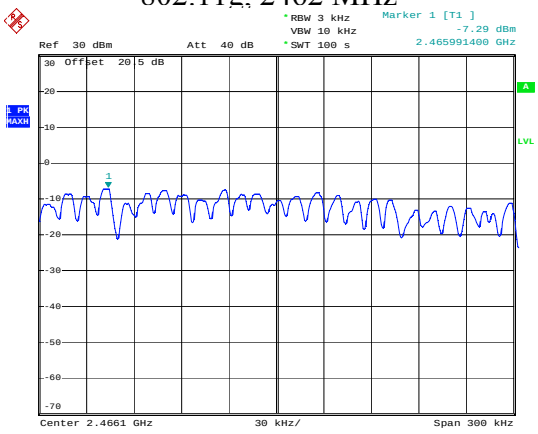
802.11g, 2437 MHz



802.11a, 2462 MHz



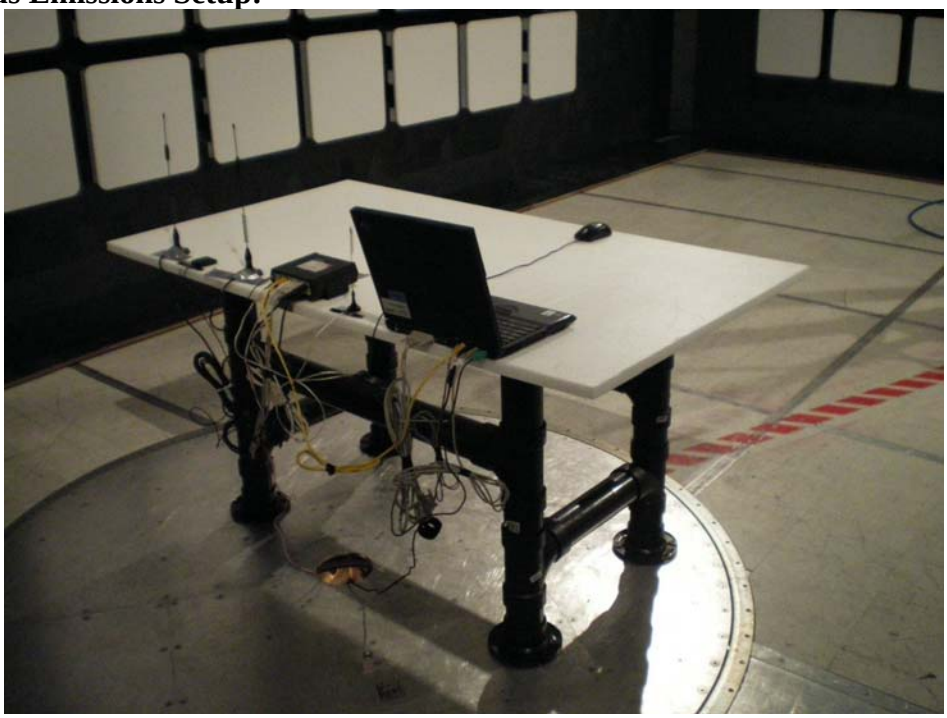
802.11g, 2462 MHz



Appendix B : Setup Photographs

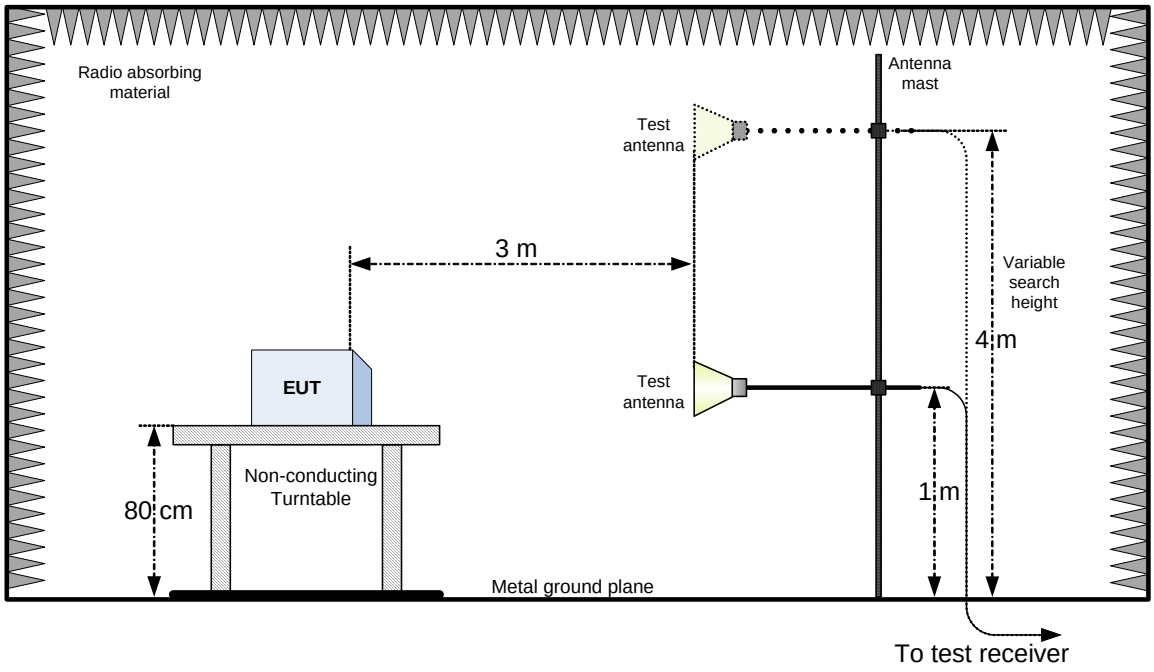
Conducted Emissions Setup:

Spurious Emissions Setup:



Appendix C : Block Diagram of Test Setups

Radiated Emissions above 30 MHz Test Site



Conducted Emissions Test Site