Global EMC Inc. Labs

EMC & RF Test Report

As per

RSS 210 Issue 7:2007

&

FCC Part 15 Subpart C:2006

Unlicensed Intentional Radiators

On the

Radio Thermostat WiFi USNAP

RTMV-01

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Testing produced for

GOLDEN POWER MANUFACTURING LTD.

See Appendix A for full customer & EUT details.

Industry Canada

LAB REGISTRATION #6844A-1

FCC REGISTRATION #612361

ACCREDITED TESTING LABORATORY CERTIFICATE #2565.01

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Report Scope

This report addresses the EMC verification testing and test results of the Radio Thermostat WiFi USNAP RTMV-01 module, herein referred to as EUT (Equipment Under Test) performed at Global EMC Labs.

The EUT was tested for compliance against the following standards:

RSS 210 Issue 7:2007 / FCC Part 15 Subpart C 15:2006

Test procedures, results, justifications, and engineering considerations, if any, follow later in this report.

The results contained in this report relate only to the item(s) tested.

This report does not imply product endorsement by A2LA or any other accreditation agency, any government, or Global EMC Inc.

Opinions/interpretations expressed in this report, if any, are outside the scope of Global EMC Inc accreditation. Any opinions expressed do not necessarily reflect the opinions of Global EMC Inc, unless otherwise stated.

Summary

The results contained in this report relate only to the item(s) tested.

EUT FCC Certification #, FCC ID:	QO8-WIFI-M-0210
EUT Industry Canada Certification #, IC:	4714A-WIFIM0210
EUT Passed all tests performed.	Yes (see test results summary)
Tests conducted by	Ashwani Malhotra

Client	Golden Power Manufacturing Ltd.
Product	Radio Thermostat WiFi USNAP RTMV-01
Standard(s)	RSS 210 Issue 7:2007 / FCC Part 15 Subpart C 15:2006

Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique / PCB mounted	Pass See Justification
FCC 15.205 RSS 210 (Table 1)	Restricted Bands for intentional operation	QuasiPeak Average	Pass
FCC 15.207	Power line conducted emissions	QuasiPeak Average	Not applicable
FCC 15.209 RSS-210 (Table 2)	Spurious Radiated emissions	QuasiPeak Average	Pass
FCC 15.247(a)2 RSS-210 A8.2(a)	6 dB Bandwidth	> 500 kHz	Pass
FCC 15.247(b)2 RSS-210 A8.4(4)	Max output power	< 1 Watt	Pass
FCC 15.247(b)(4) RSS-210 A8.4(5)	Antenna Gain	< 6 dBi	Pass
FCC 15.247(d) RSS-210 A8.5	Antenna conducted spurious	< 20 dBc	Pass
FCC 15.247(e) RSS-210 A8.2(b)	Spectral Density	< 8 dBm (3 kHz BW)	Pass
FCC 15.247(i) IC Safety code 6	Maximum Permissible Exposure	> 20 cm separation.	Pass See justification and calculations
Overall Result			**PASS**

All tests were performed by Ashwani Malhotra

If the product as tested or otherwise complies with the specification, the EUT is deemed to comply with the requirement and is deemed a ‘PASS’ grade. If not ‘FAIL’ grade will be issued. Note that ‘PASS’ / ‘FAIL’ grade is independent of any measurement uncertainties. A ‘PASS’ / ‘FAIL’ grade within measurement uncertainty is marked with a ‘*’.

Justifications, Descriptions, or Deviations

The following justifications for tests not performed or deviations from the above listed specifications apply:

For the Antenna requirement specified in FCC 15.203 (RSS 210 section 5.5), the unit uses an antenna soldered to the PCB (Manufacturer – Airgain, Ultra 25 Antenna, Part #: M2430LTM, 2.8 dbi gain) with less than 6 dbi gain. Worst case emissions are shown in the report below.

The EUT can be operated in 802.11 b/g modes. Both modes were tested for the scope of this report.

For the Restricted Bands of operation, the EUT is designed to only operate between 2400 – 2475.0MHz for 802.11 b and 2400 – 2465 MHz for 802.11 g.

EUT powers from 3 Vdc and has no mains power supply. No AC line conducted emissions were performed on the unit.

For the scope of this testing the EUT was mounted horizontally and vertically to maximize emissions. Maximum emissions were found in the vertical EUT polarization. This setup was used for all testing in this report.

For maximum permissible exposure, this device operates at less than 1 Watt at 2400 – 2480.0 MHz and is designed to operate greater than 20 cm from personnel during normal operation. No testing is required, however worst case calculated exposure compliance follows later in this report.

The EUT is not a hybrid system and FCC 15.247 (f) does not apply to it. However the 15.247 (d) requirement of power density were met and are detailed later in this test report.

Applicable Standards, Specifications and Methods

ANSI C63.4:2003	- Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
CFR 47 FCC 15	- Code of Federal Regulations – Radio Frequency Devices
CISPR 22:1997	- Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement
ICES-003:2004	- Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
ISO 17025:2005	- General Requirements for the competence of testing and calibration laboratories
RSS 210:2007	- Issue 7: Spectrum Management and Telecommunications Policy. Radio Standards Specification Low Power Licence-Exempt Radiocommunication Devices

Sample calculation(s)

Margin = limit – (received signal + antenna factor + cable loss – pre-amp gain)
Margin = 50.5dBuV/m – (50dBuV + 10dB + 2.5dB – 20dB)
Margin = 8.5 dB

Document Revision Status

Revision 1 - October 8th, 2010 Initial report release
Revision 2 - October 14th, 2010, Updated the FCC ID and IC Codes. This report replaces the report issued on October 8th 2010, in its entirety.

Definitions and Acronyms

The following definitions and acronyms are applicable in this report.
See also ANSI C63.14.

AE – Auxiallary Equipment.

BW – Bandwidth. Unless otherwise stated, this is refers to the 6 dB bandwidth.

EMC – Electro-Magnetic Compatibility

EMI – Electro-Magnetic Immunity

EUT – Equipment Under Test

ITE – Information Technology Equipment with a primary function(s) of entry, storage, display, retrieval, transmission, processing, switching, or control, of data.

LISN – Line impedance stabilization network

NCR – No Calibration Required

RF – Radio Frequency

Testing Facility

Testing for EMC on the EUT was carried out at Global EMC labs in Toronto, Ontario, Canada. The testing lab consists of a 3m semi-anechoic chamber calibrated to be able to allow measurements on an EUT with a maximum width or length of up to 2m and height up to 3m. The chamber is equipped with a turn table that is capable of testing devices up to 3300lb in weight. This facility is capable of testing products that are rated for 120 Vac and 240Vac single phase, or 208 Vac 3 phase input. DC capability is also available. The chamber is equipped with an antenna mast that controls polarization and height from the control room adjoining the shielded chamber. Radiated emissions measurements are performed using a Bilog, and Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN.

Calibrations and Accreditations

The measurement site used is registered with Federal Communications Commission (FCC) and Industry Canada (IC). This site is calibrated for Normalized Site Attenuation (NSA) using test procedures outlined in ANSI C63.4 “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz”. The semi-anechoic chamber is lined with ferrite tiles and absorption cones to minimize any undesired reflections. All measuring equipment is calibrated on an annual or bi-annual basis as listed for each respective test.

Testing Environmental Conditions and Dates

Following were the environmental conditions in the facility during time of testing –

Date	Test	Init.	Temperature (ºC)	Humidity (%)	Pressure (kPa)
Jun 7-18, 2010	All	AM	23.8-24.5 ºC	40% - 44.9%	100.1 -101.47 kPa

Detailed Test Results Section

Spurious Radiated Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT does not exceed the limits listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect broadcast radio services such as television, FM radio, pagers, cellular telephones, emergency services, and so on, from unwanted interference.

Limit(s) and Method

The method is as defined in ANSI C63.4:2003.

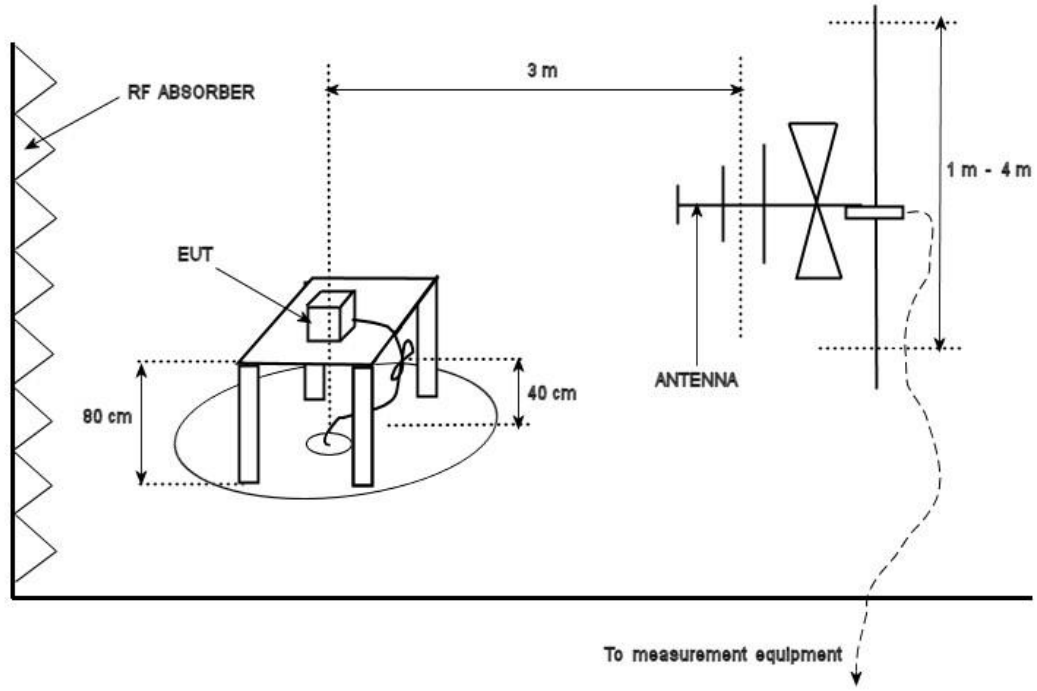
The limits, as defined in 15.247(d) for unintentional radiated emissions apply for those emissions that fall in the restricted bands, as defined in Section 15.205(a). These emissions must comply with the radiated emission limits specified in Section 15.209(a).

All unintentional emissions must also meet the 'Spurious Conducted Emissions' requirements of -20 dBc or greater. See also 'Spurious Conducted Emissions' for further details.

30 MHZ – 88 MHz, 100 uV/m (40.0 dBuV/m[1]) at 3 m
88 MHz – 216 MHz, 150 uV/m (43.5 dBuV/m[1]) at 3 m
216 MHz – 960 MHz, 200 uV/m (46.4 dBuV/m[1]) at 3 m
Above 960 MHz, 500 uV/m (54.0 dBuV/m[1]) at 3 m
Above 1000 MHz, 500 uV/m (54.0 dBuV/m[2]) at 3m

[1]Limit is with 120 kHz measurement bandwidth and a using a Quasi Peak detector.
[2]Limit is with 1 MHz measurement bandwidth and using an Average detector, scanned in accordance with 15.33 to above the 10th harmonic.

Typical Radiated Emissions Setup



Measurement Uncertainty

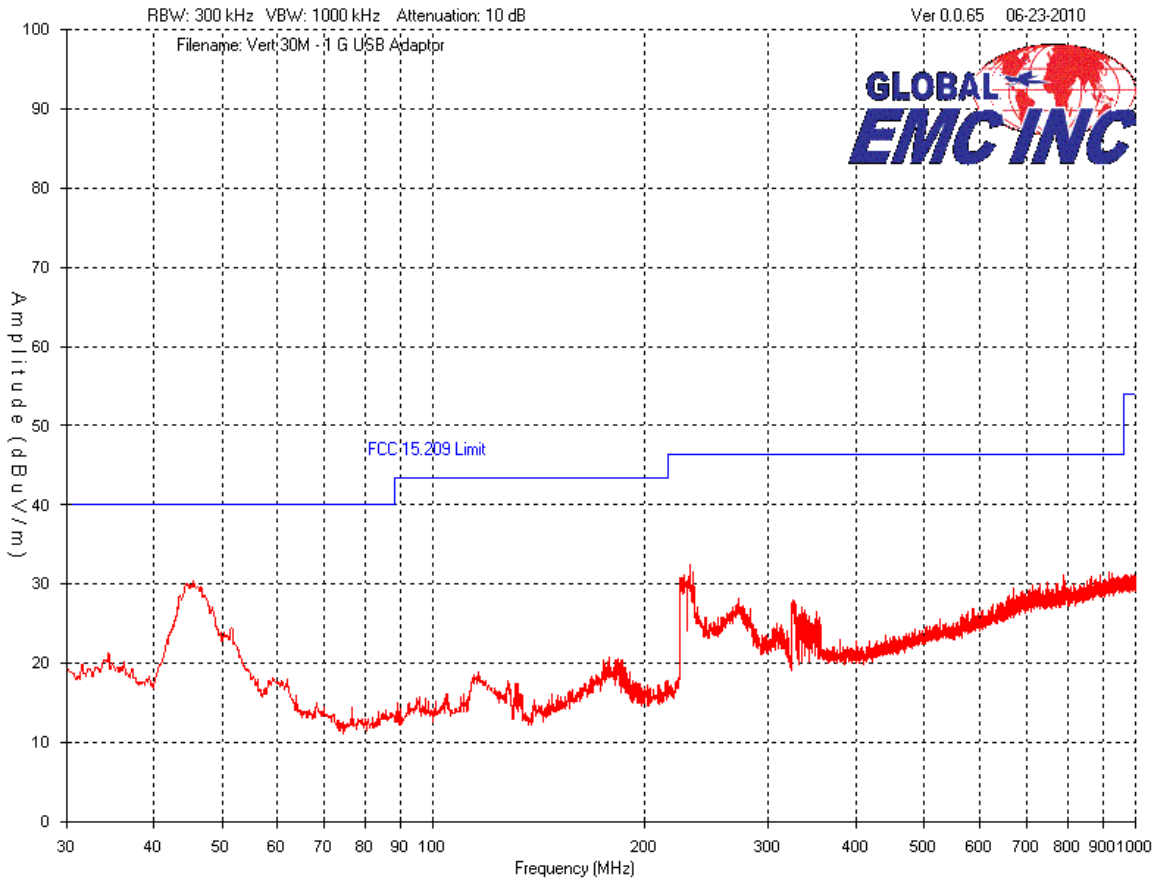
The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is +/-4.4 dB with a 'k=2' coverage factor and a %95 confidence level.

Preliminary Graphs

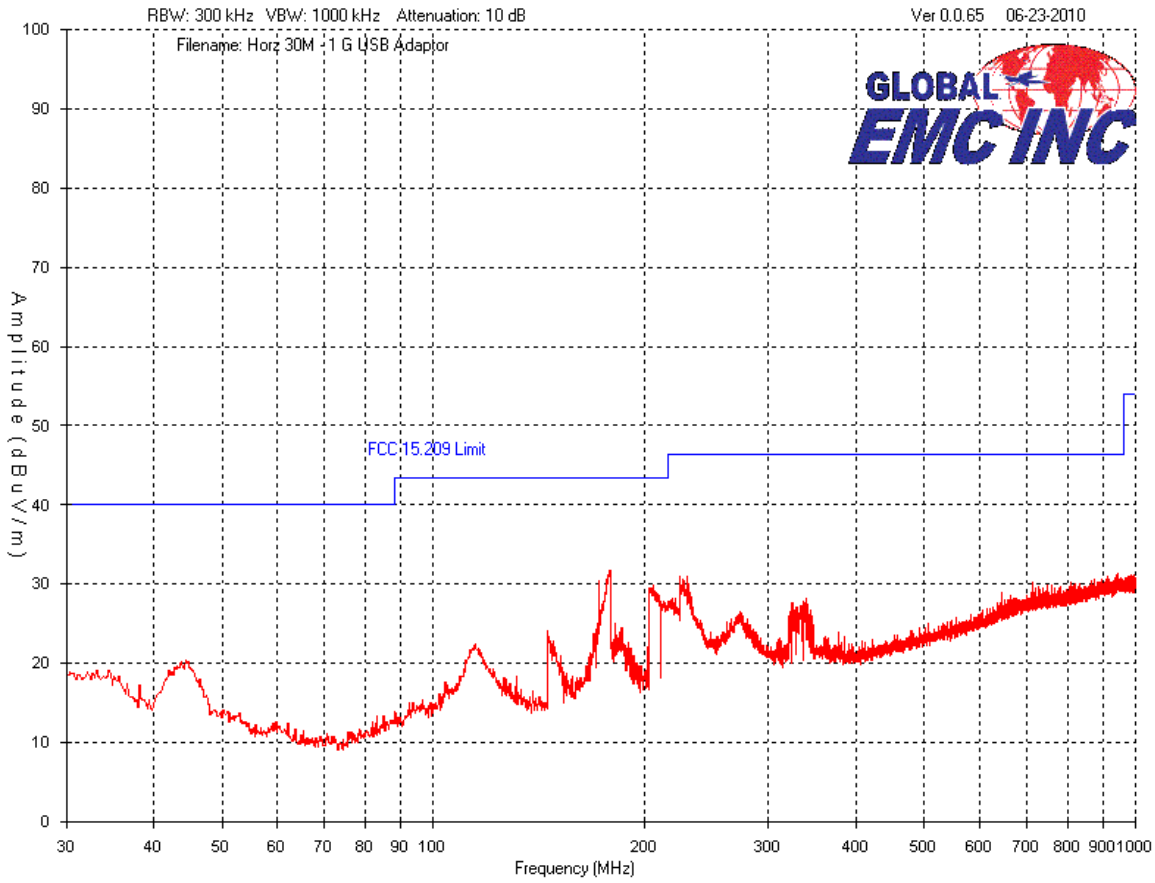
Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector, please refer to the final measurement table where applicable. The graph shown below is a maximized peak measurement graph, measured with a resolution bandwidth greater then the final required detector and over a full 0-360 rotation. This peaking process is done as a worst case measurement. This process enables the detection of frequencies of concern for final measurement, and provides considerable time savings.

In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to a minimum of a 25 GHz.

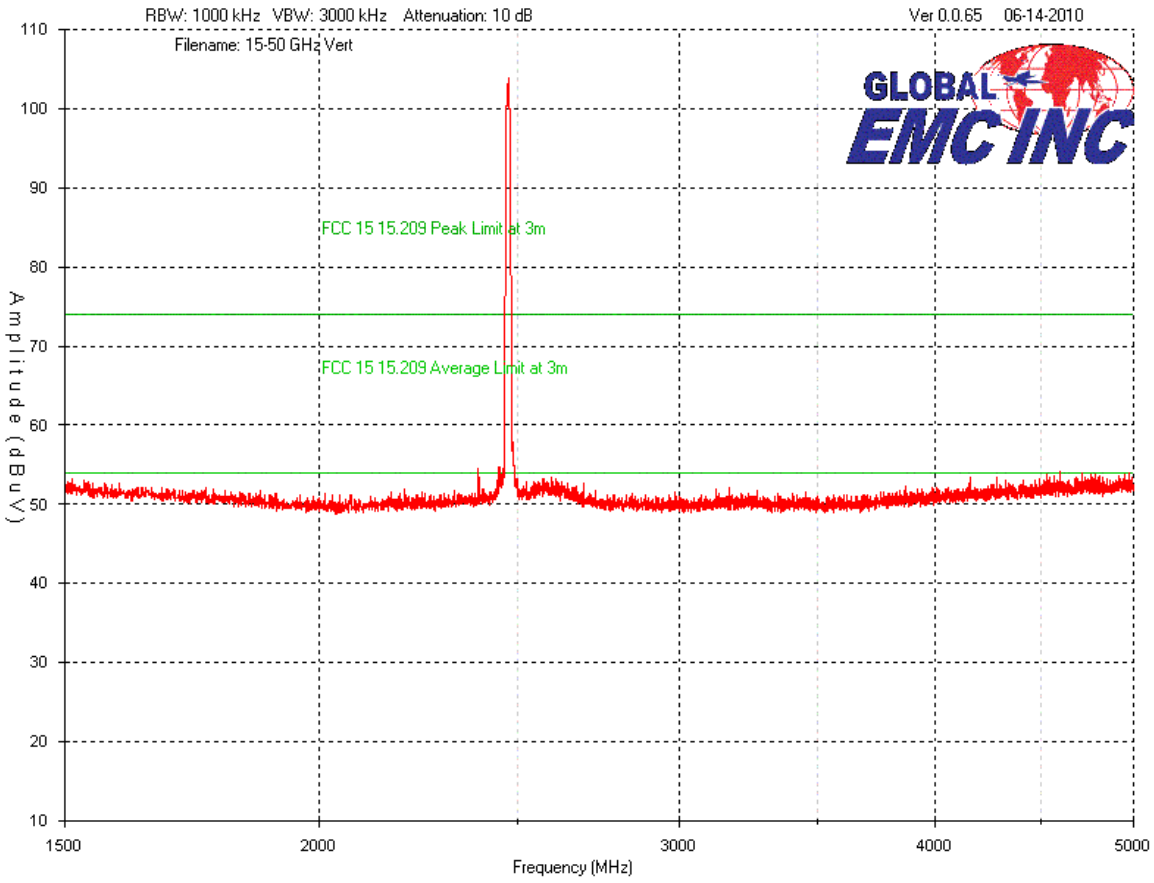
Hi Channel – 30MHz – 1 GHz (802.11 b)
Vertical – Peak Emissions Graph



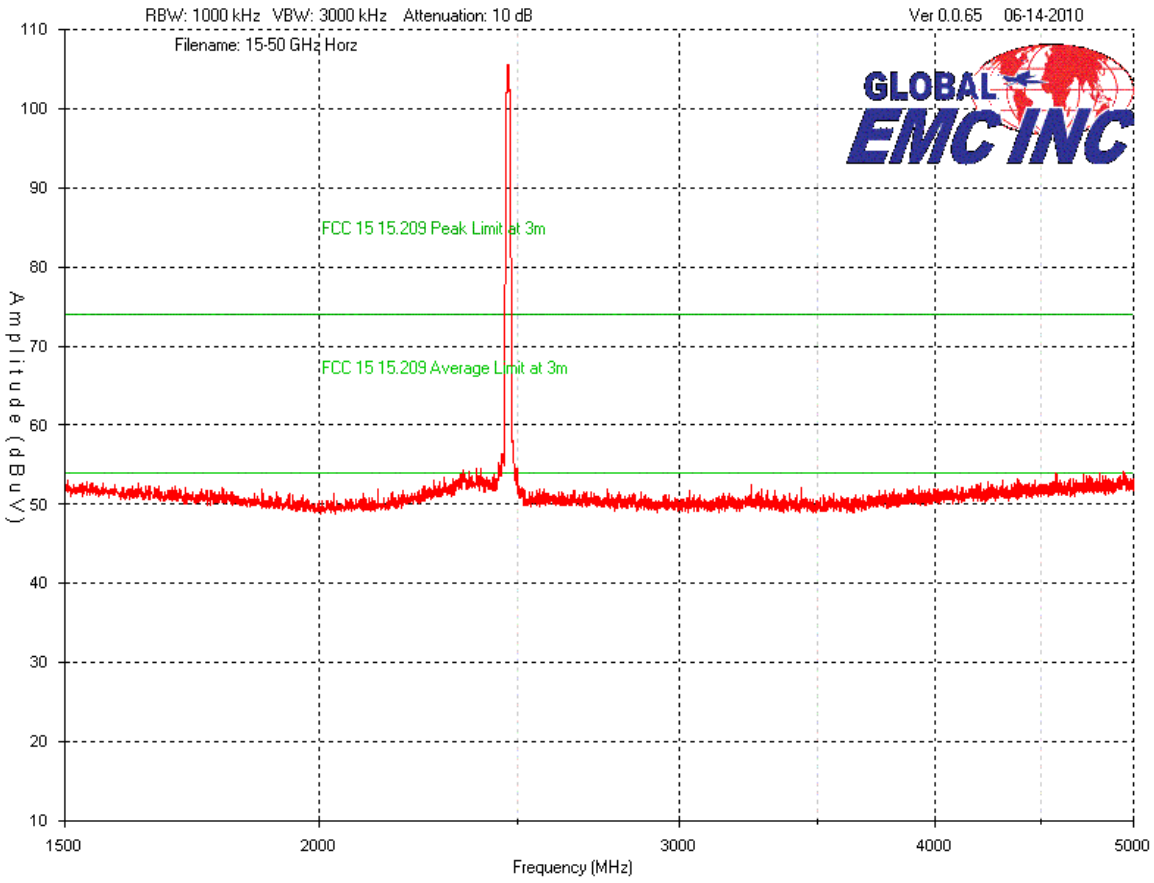
Hi Channel – 30MHz – 1 GHz (802.11 b)
Horizontal – Peak Emissions Graph



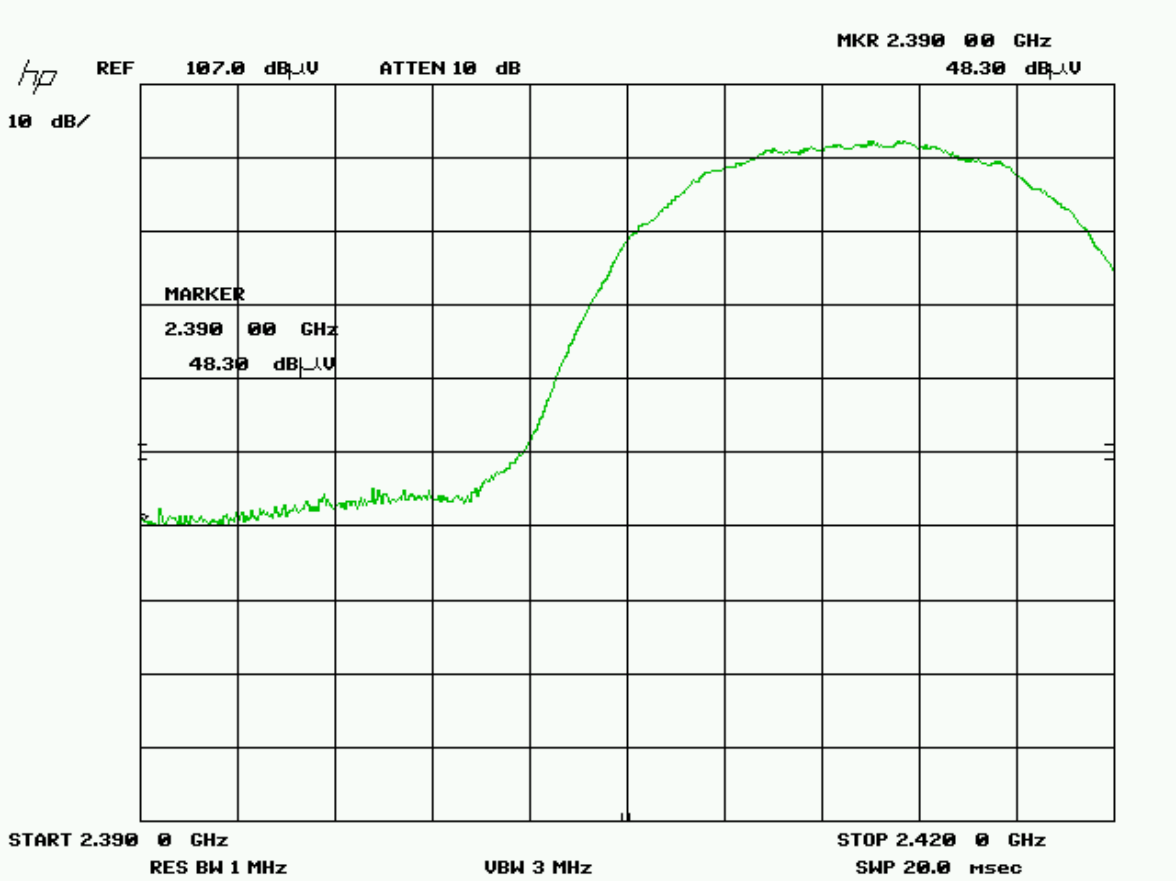
Hi Channel – 1-5.5 GHz (802.11 b)
Vertical – Peak Emissions Graph



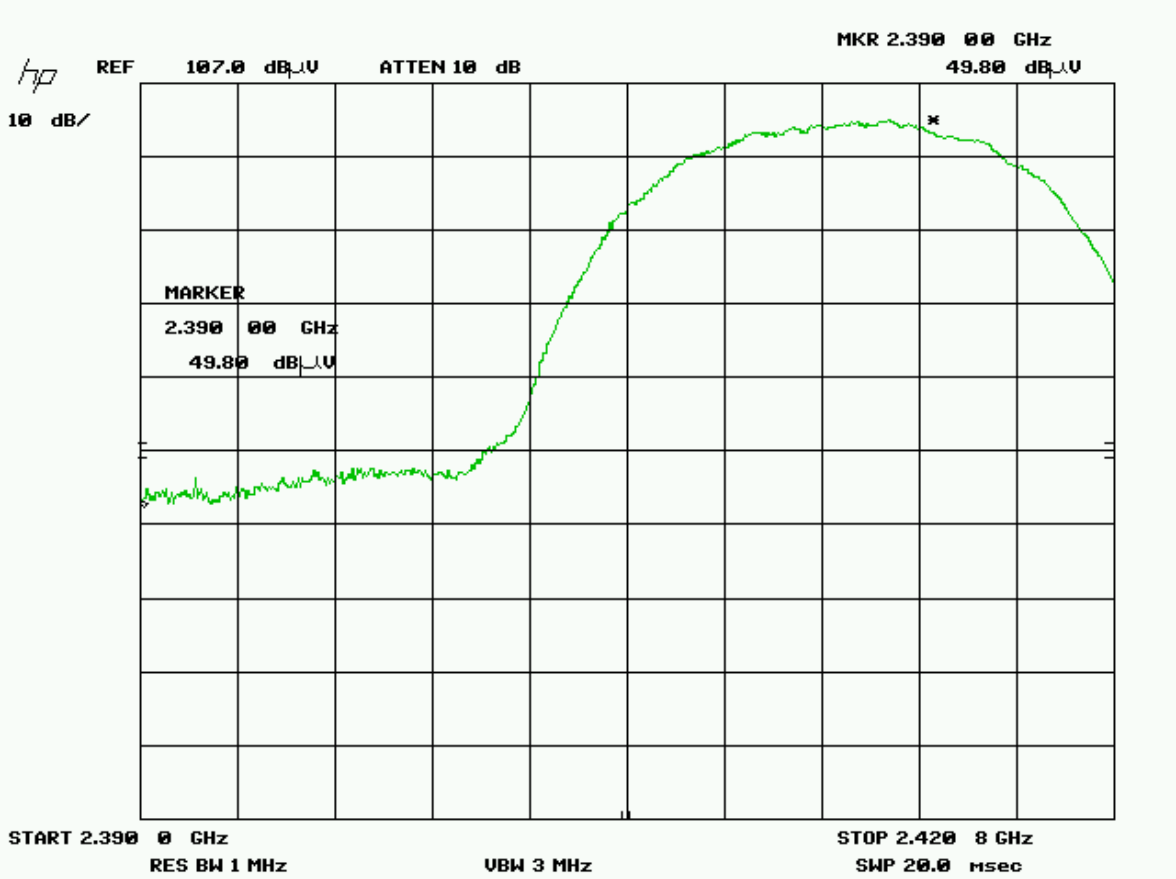
Hi Channel – 1-5.5 GHz (802.11 b)
Horizontal – Peak Emissions Graph



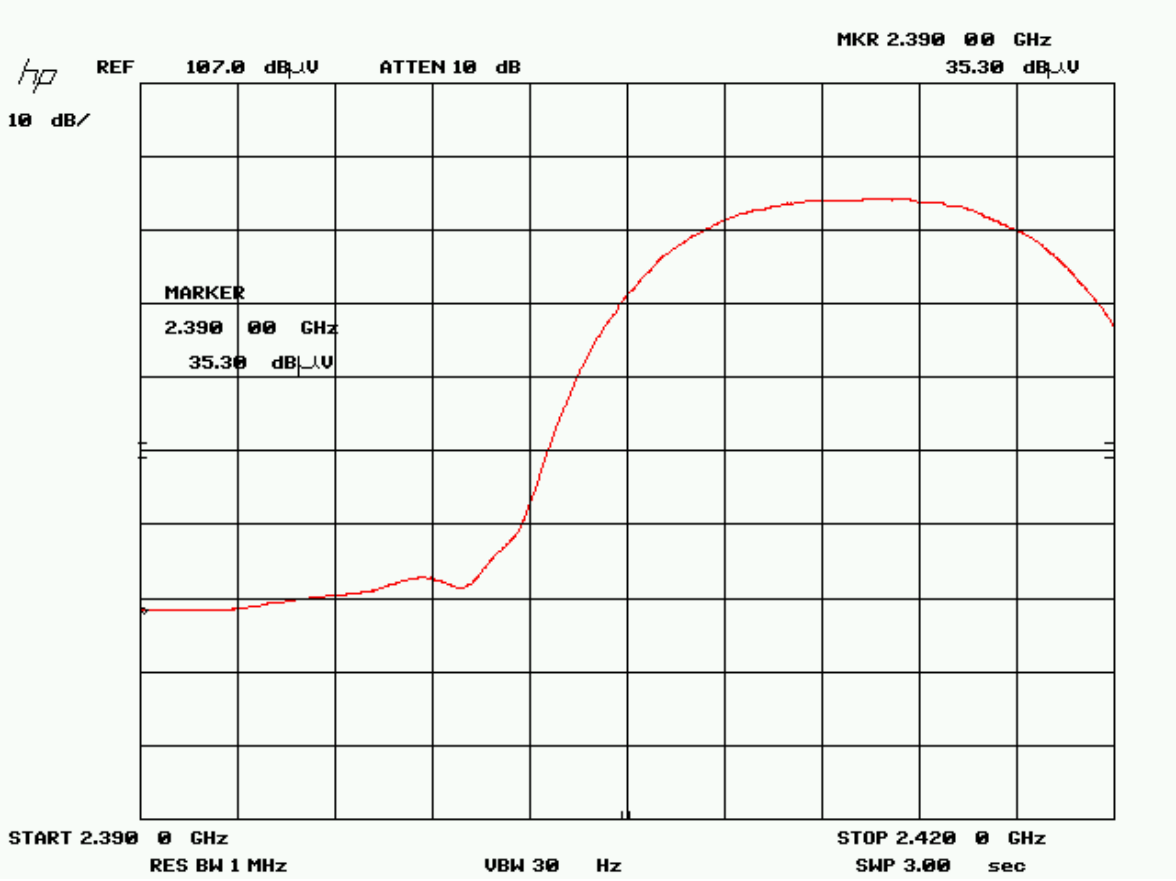
Band Edge – Low channel (802.11 b)
Vertical peak emissions



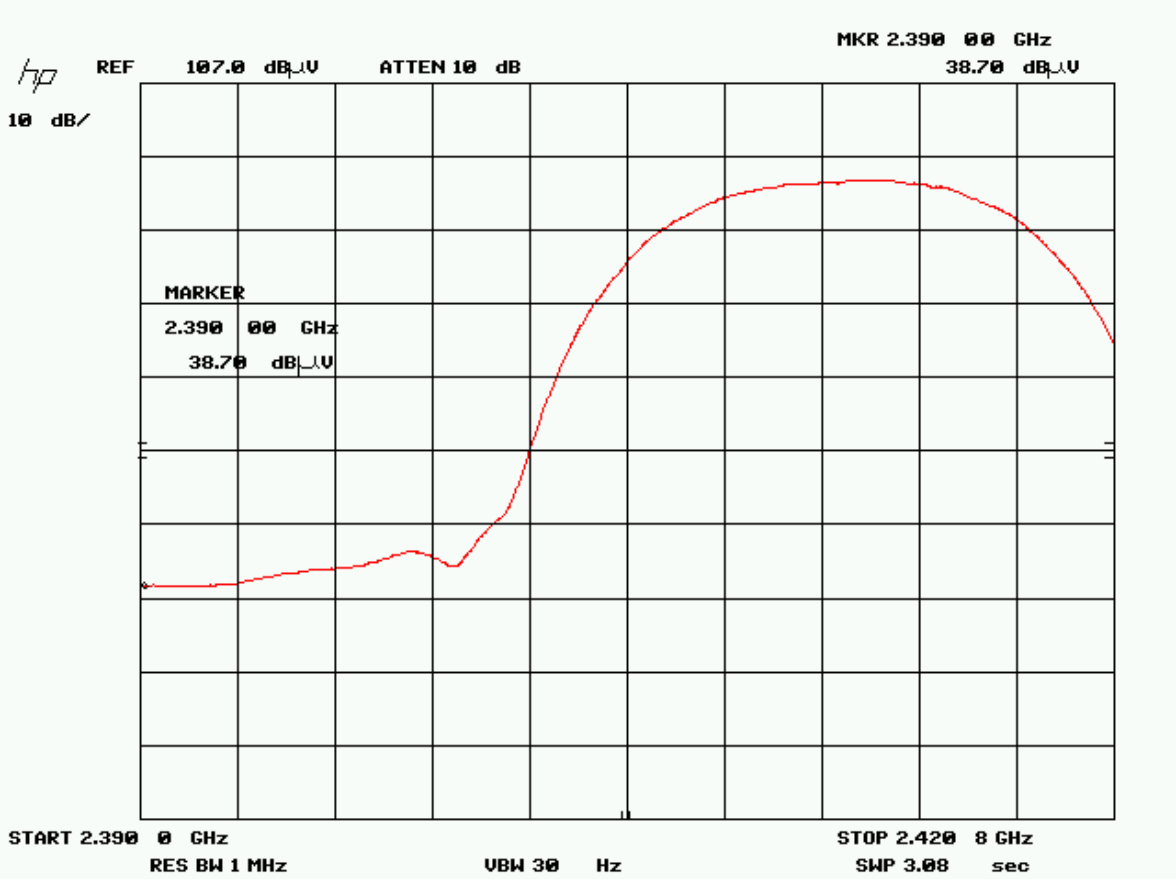
Band Edge – Low channel (802.11 b)
Horizontal peak emissions



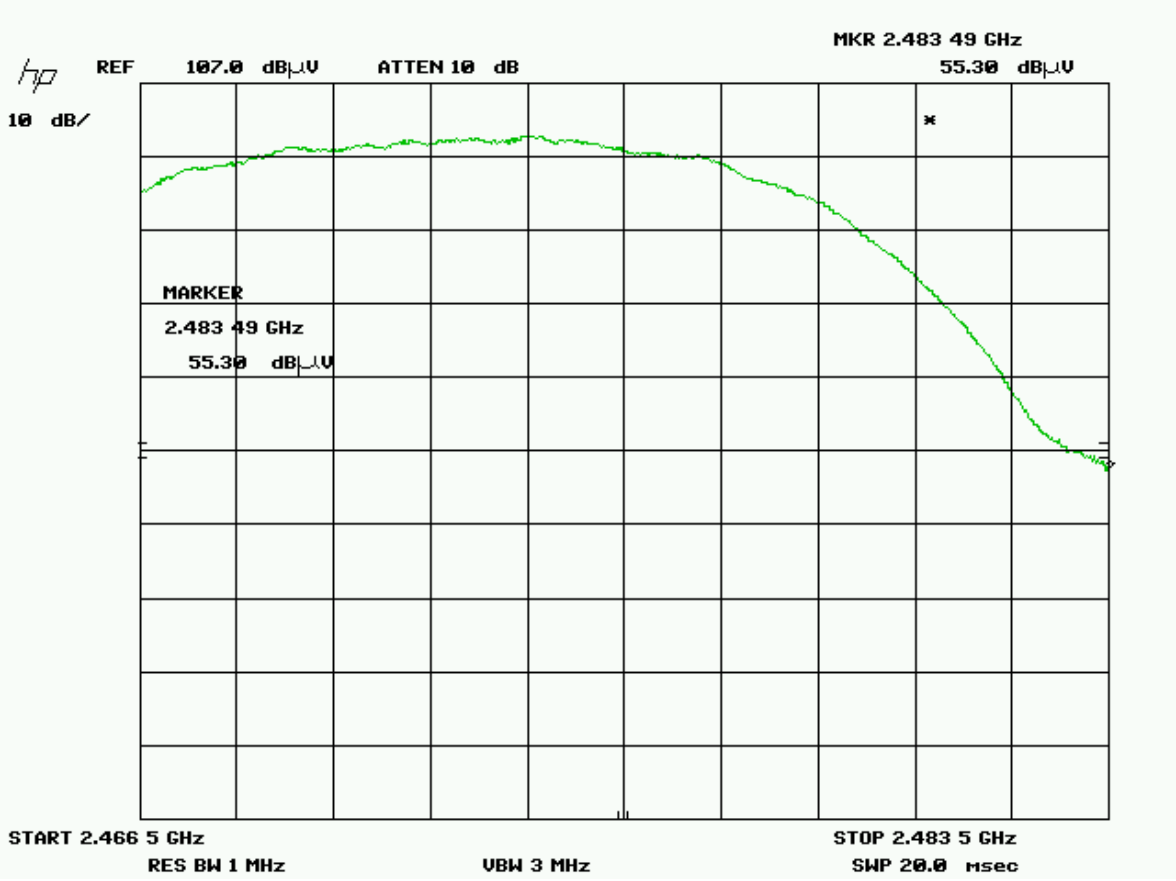
Band Edge – Low channel (802.11 b)
Vertical Average emissions



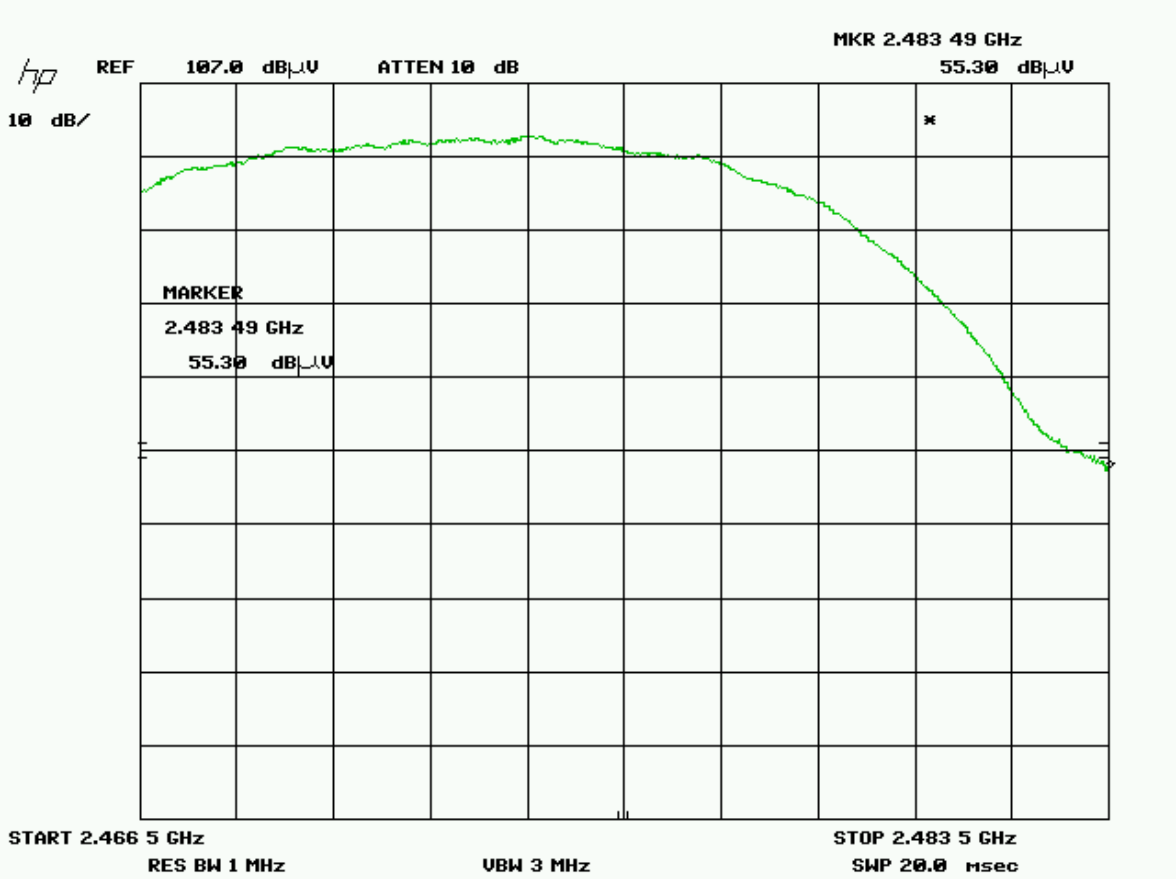
Band Edge – Low channel (802.11 b)
Horizontal Average emissions



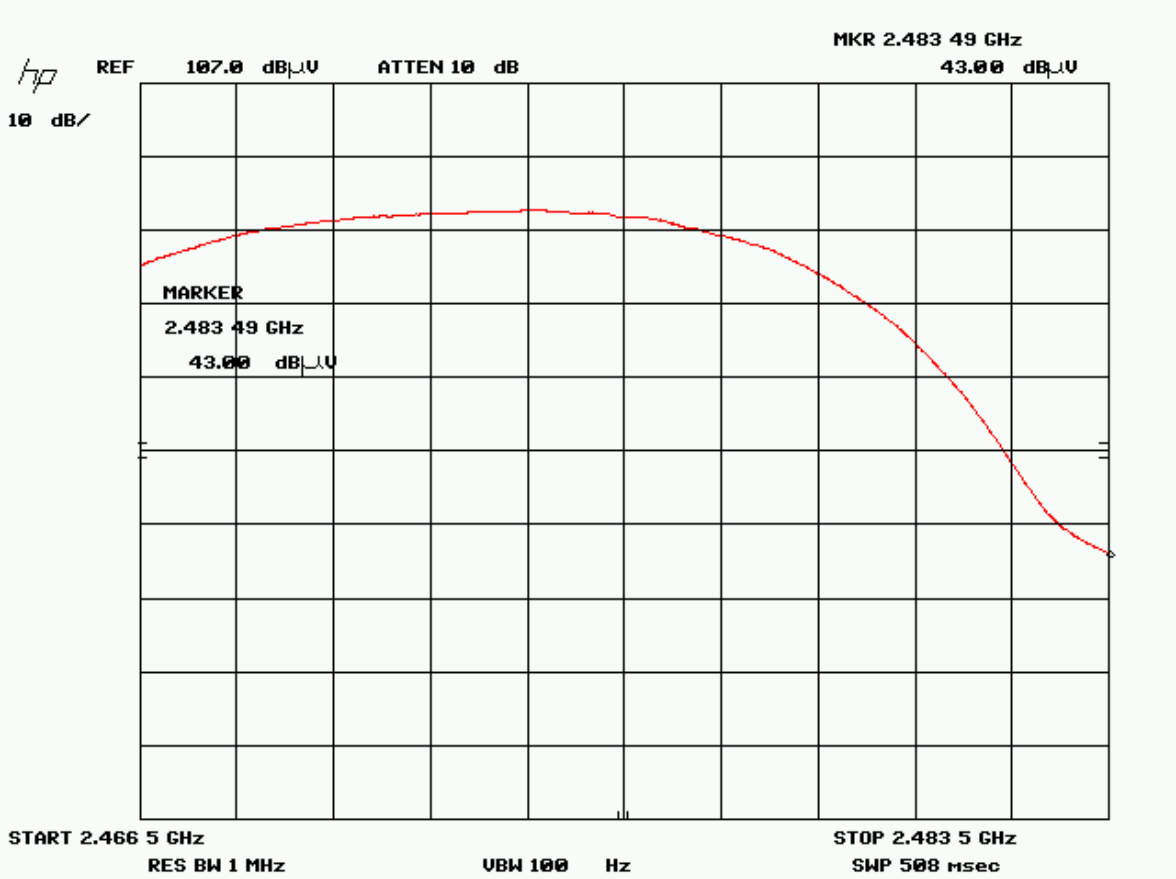
Band Edge – Hi channel (802.11 b)
Vertical peak emissions



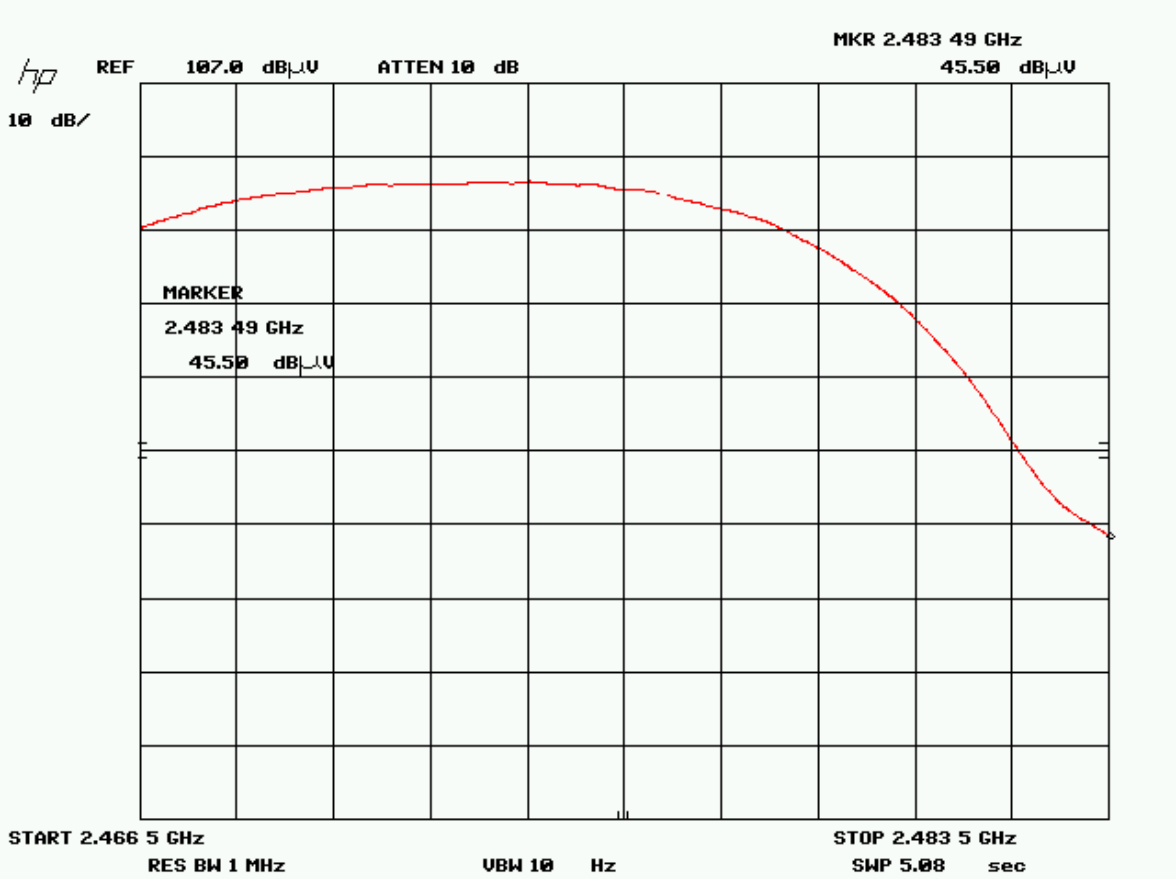
Band Edge – Hi channel (802.11 b)
Horizontal peak emissions



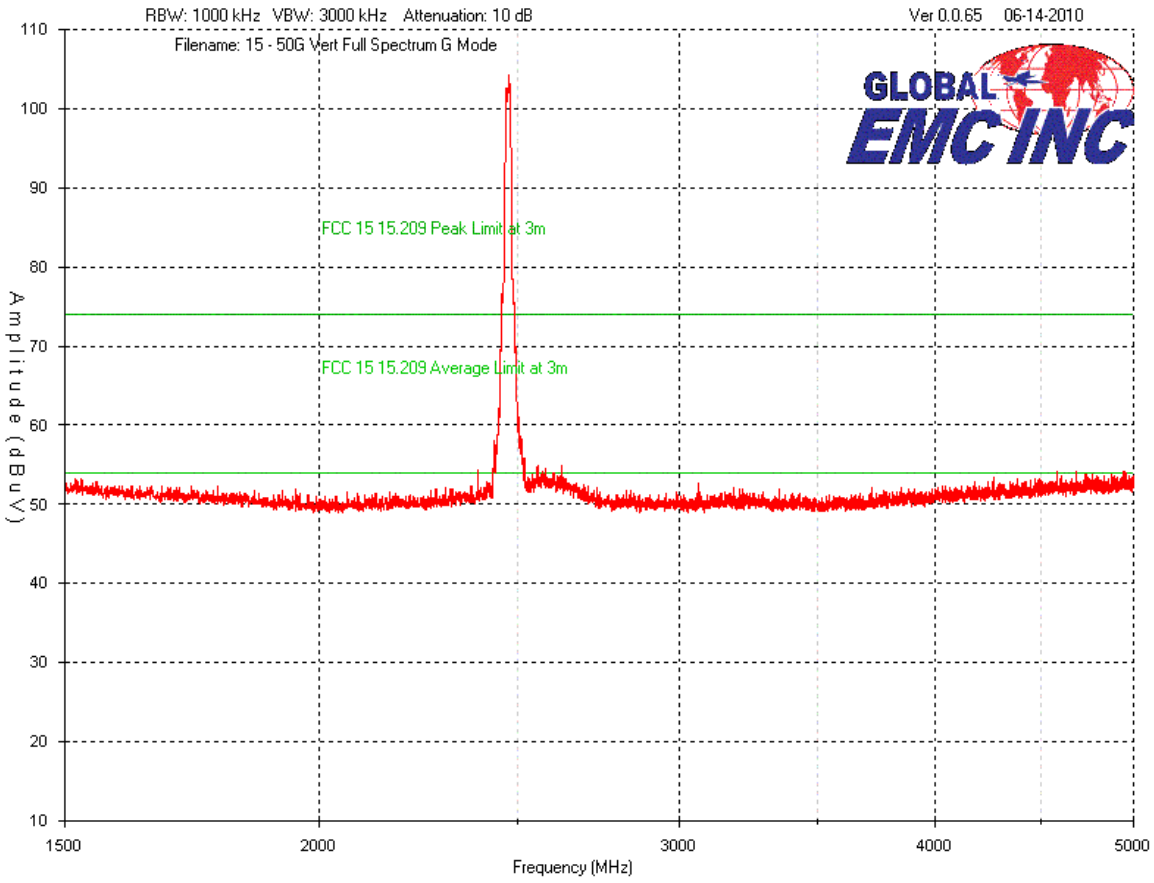
Band Edge – Hi channel (802.11 b)
Vertical Average emissions



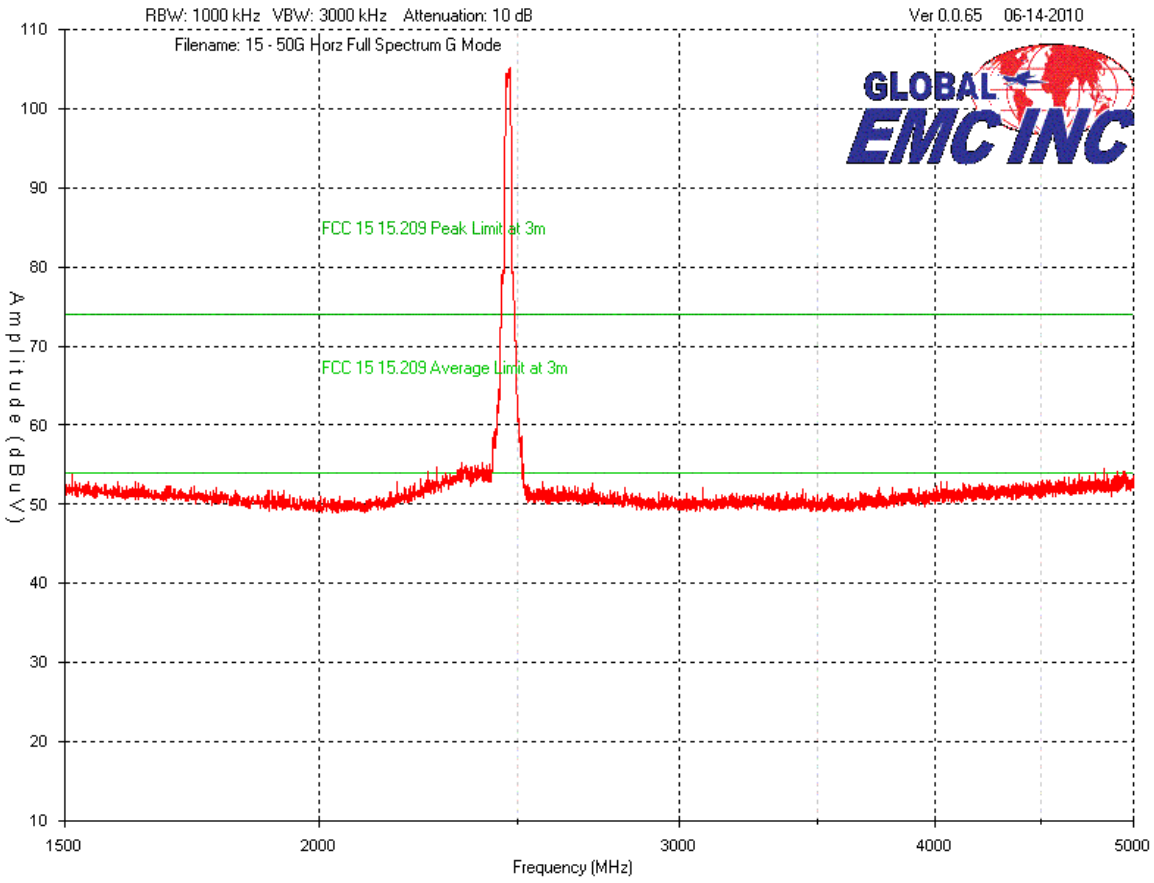
Band Edge – Hi channel (802.11 b)
Horizontal Average emissions



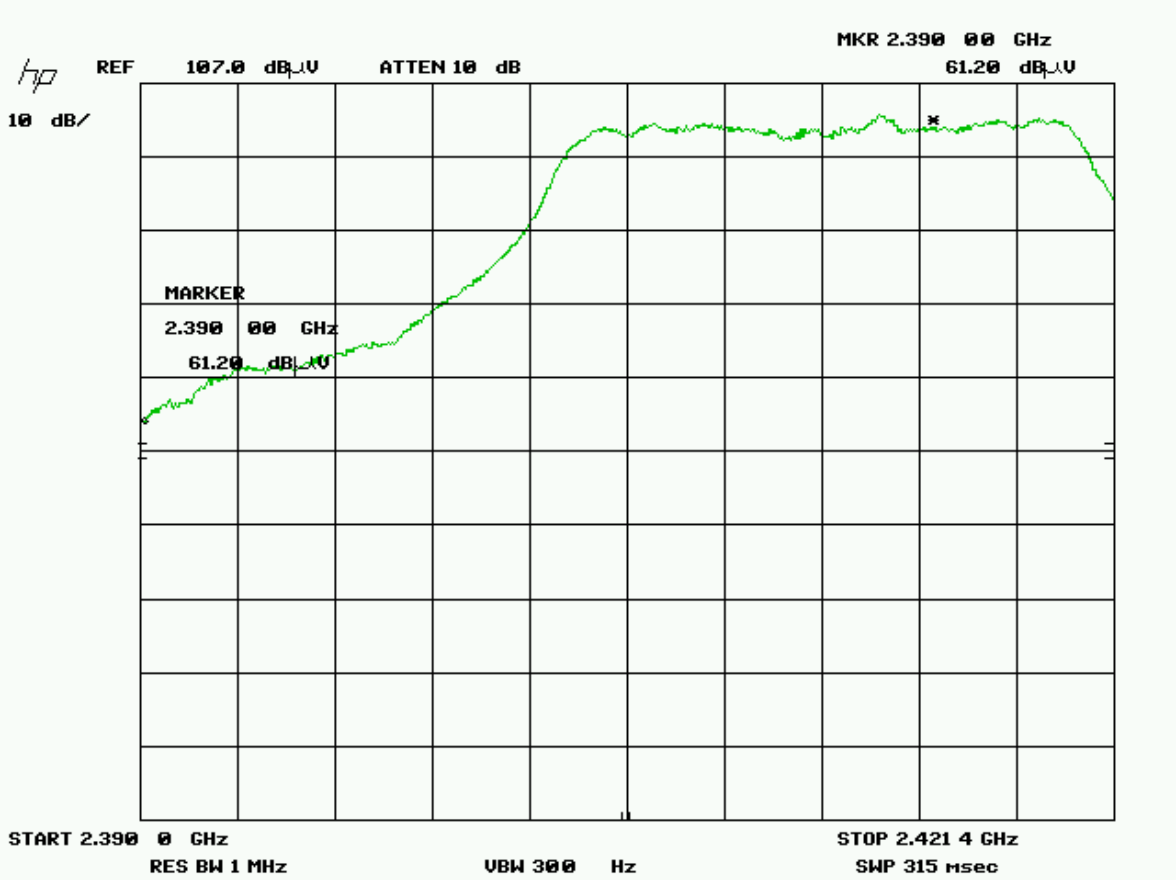
Hi Channel – 1-5.5 GHz (802.11 g)
Vertical – Peak Emissions Graph



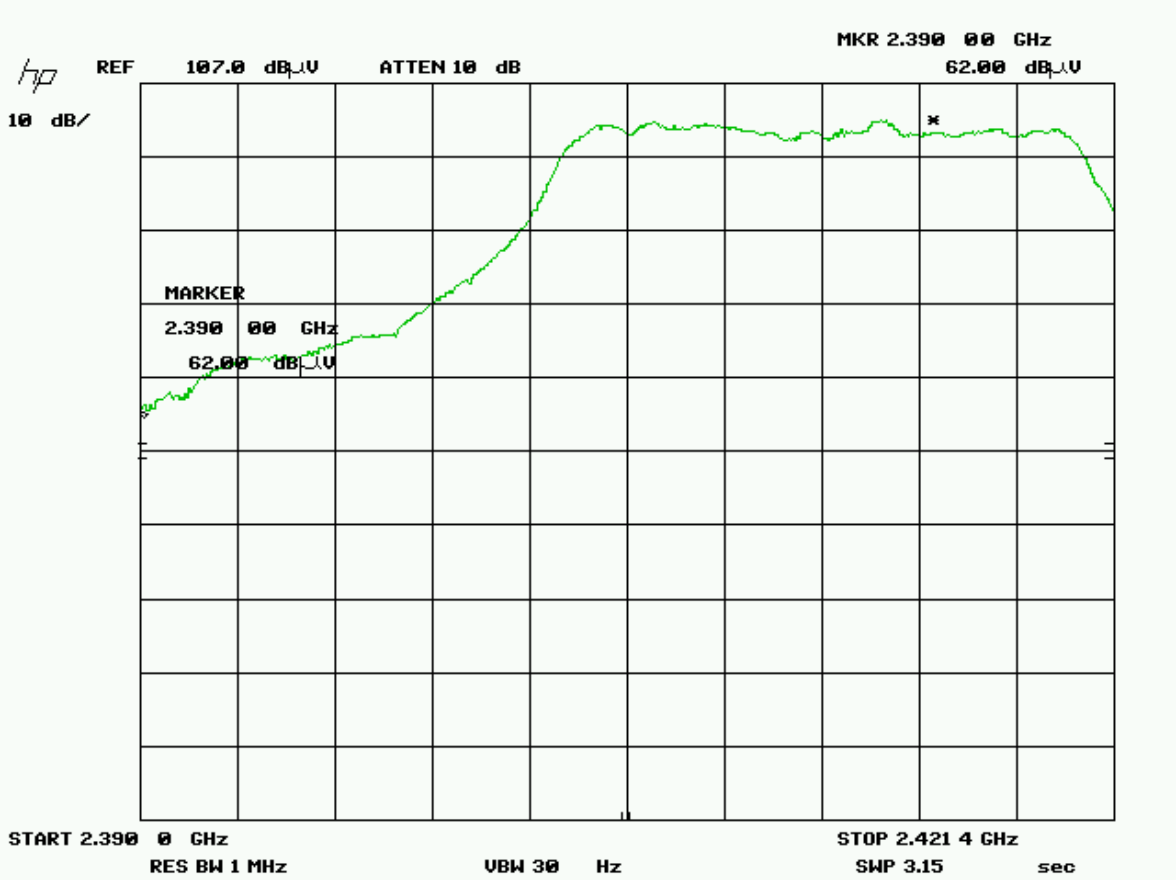
Hi Channel – 1-5.5 GHz (802.11 g)
Horizontal – Peak Emissions Graph



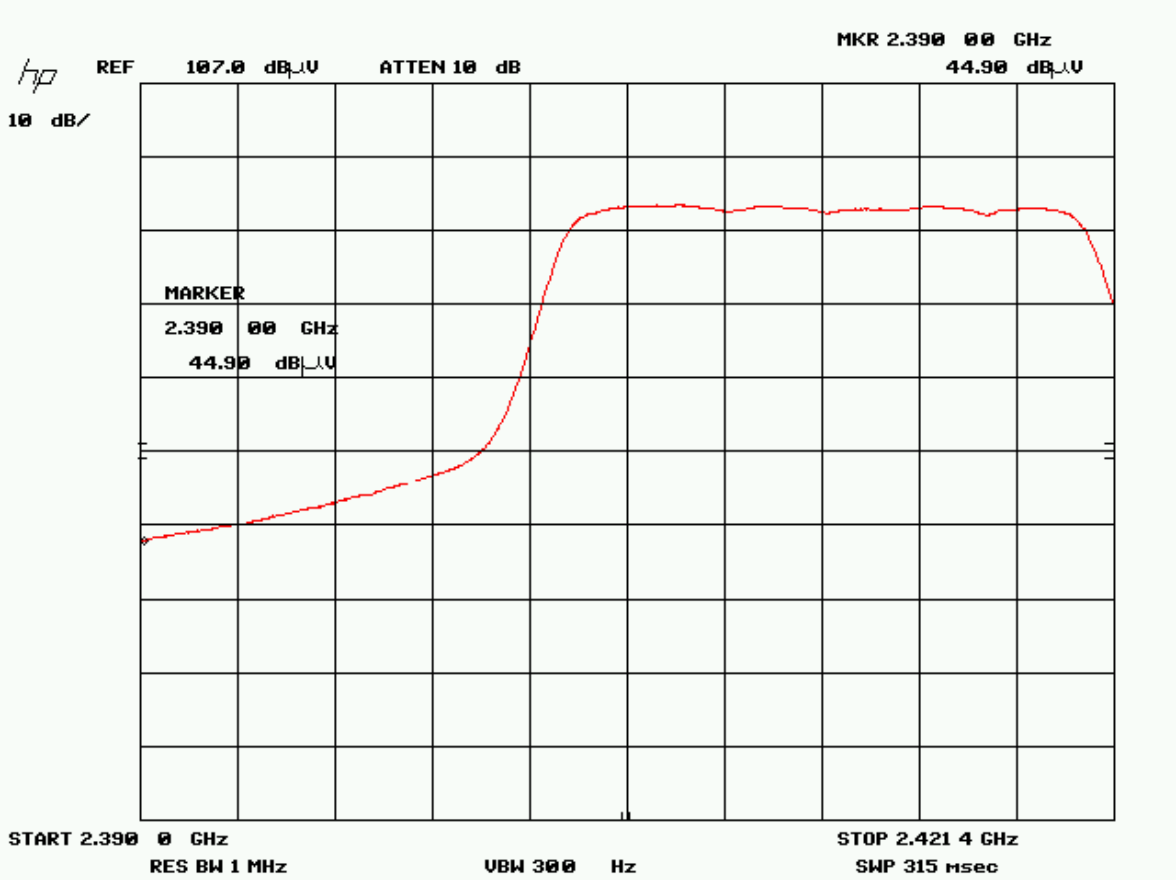
Band Edge – Low channel (802.11 g)
Vertical peak emissions



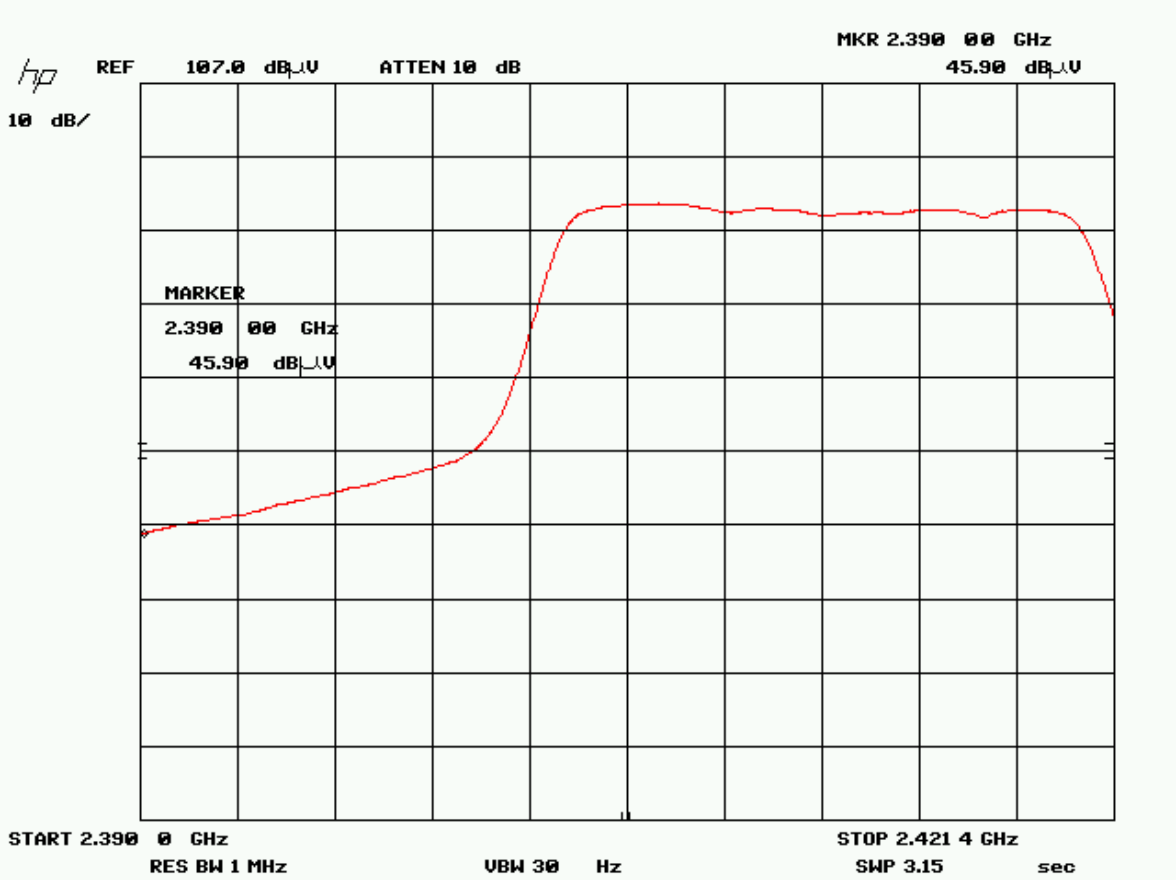
Band Edge – Low channel (802.11 g)
Horizontal peak emissions



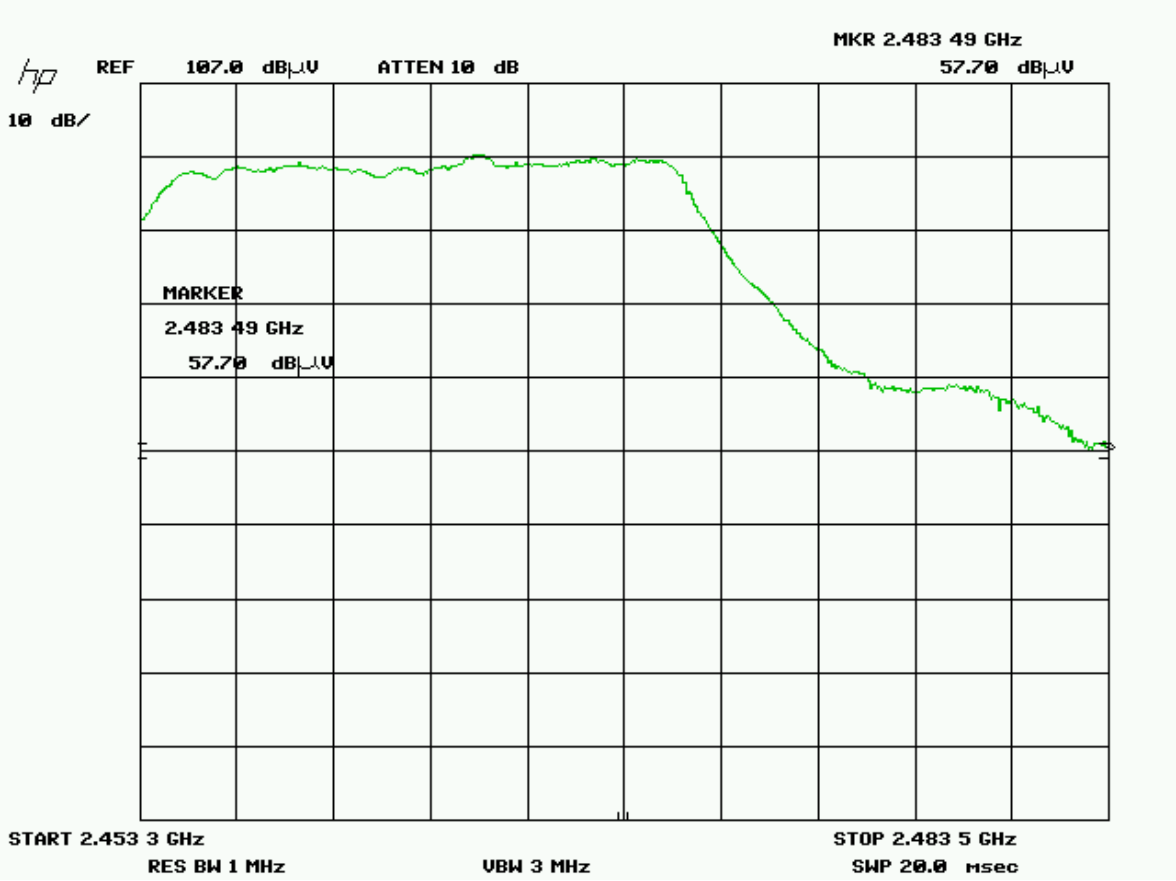
Band Edge – Low channel (802.11 g)
Vertical Average emissions



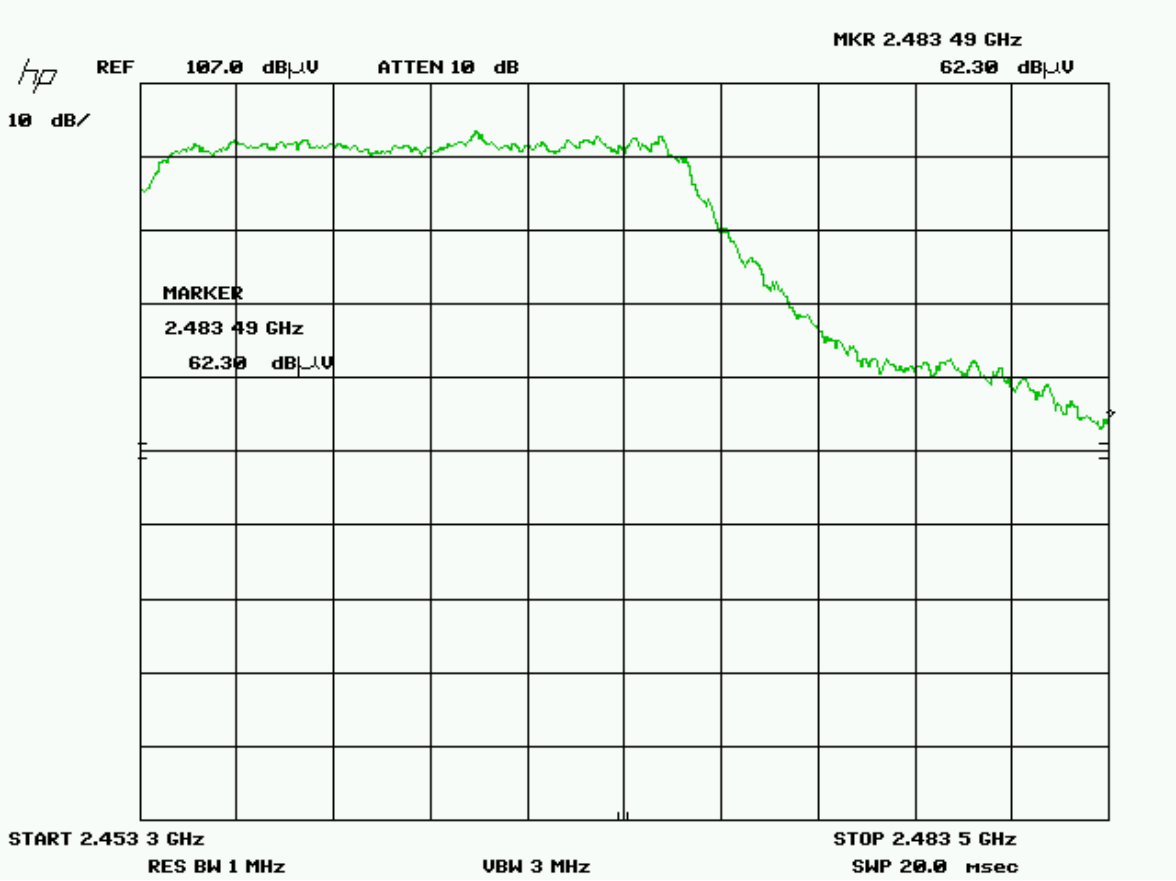
Band Edge – Low channel (802.11 g)
Horizontal Average emissions



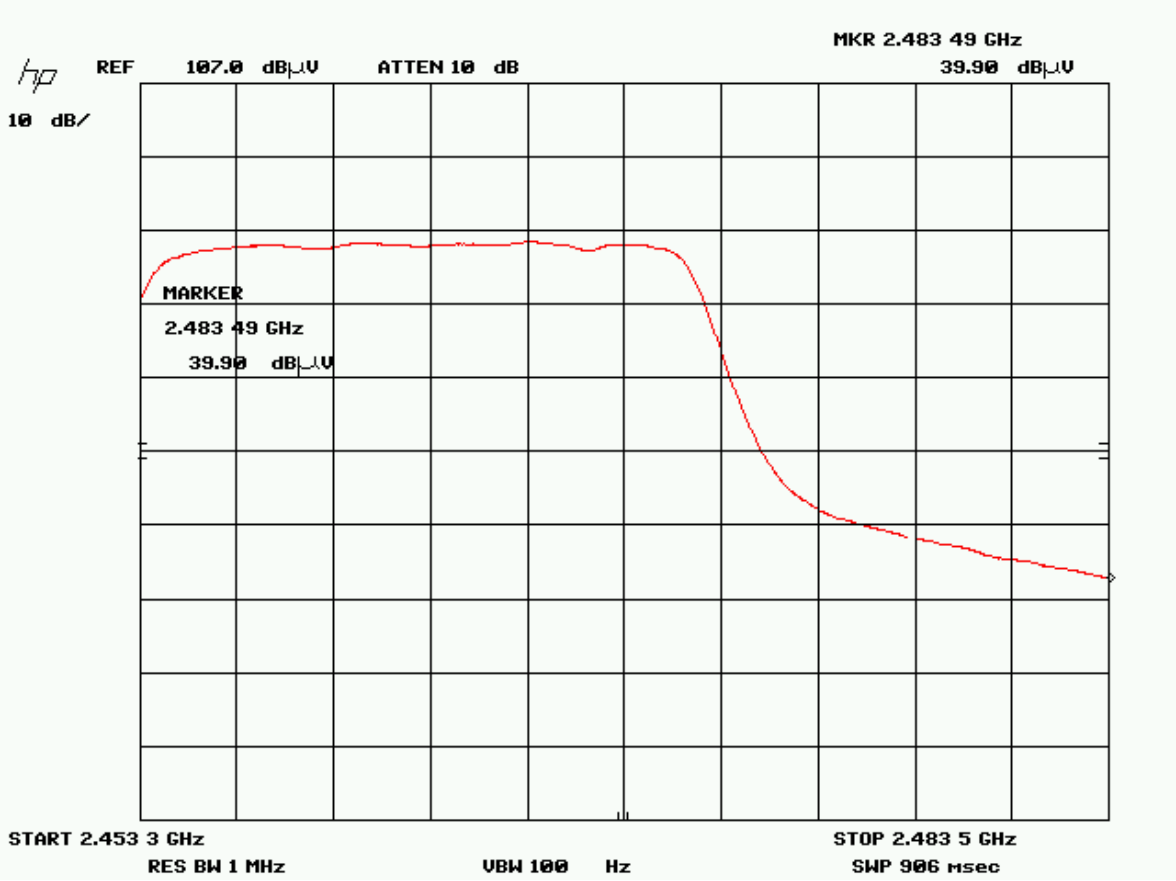
Band Edge – Hi channel (802.11 g)
Vertical peak emissions



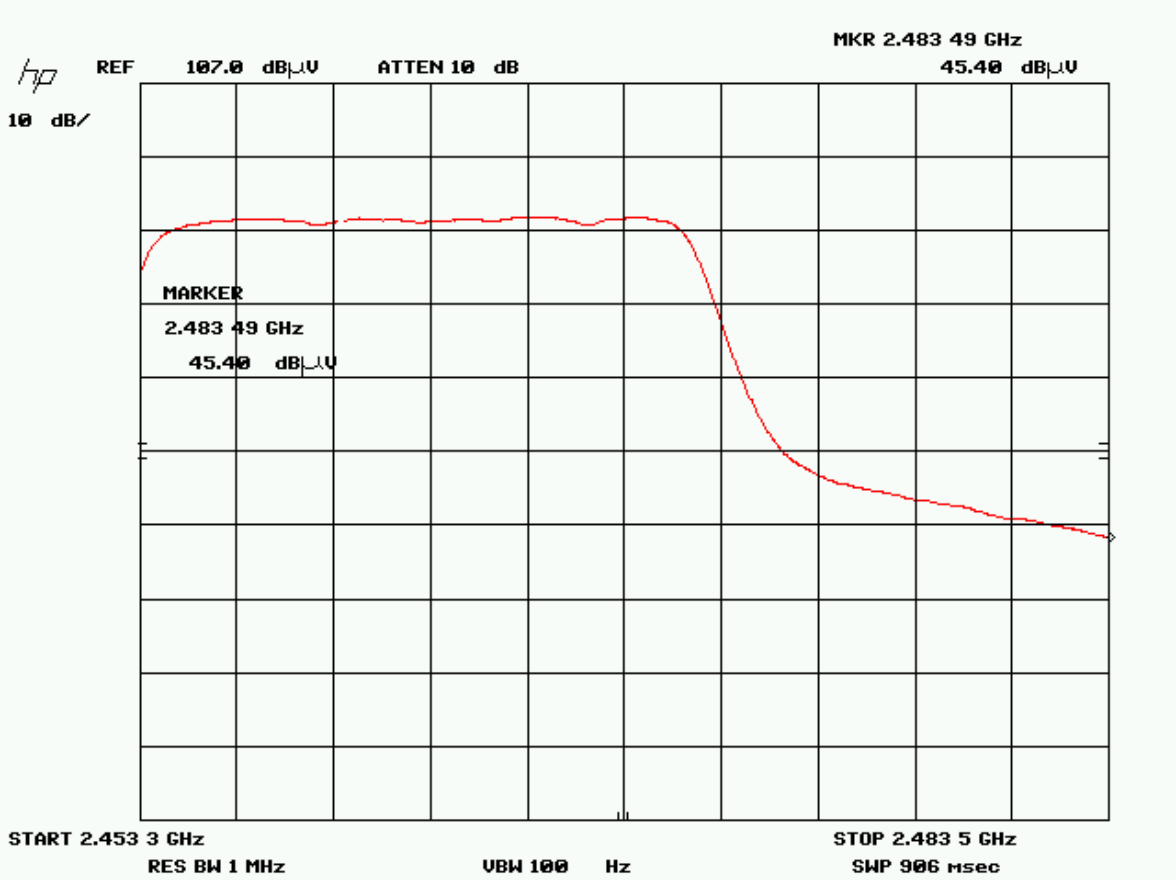
Band Edge – Hi channel (802.11 g)
Horizontal peak emissions



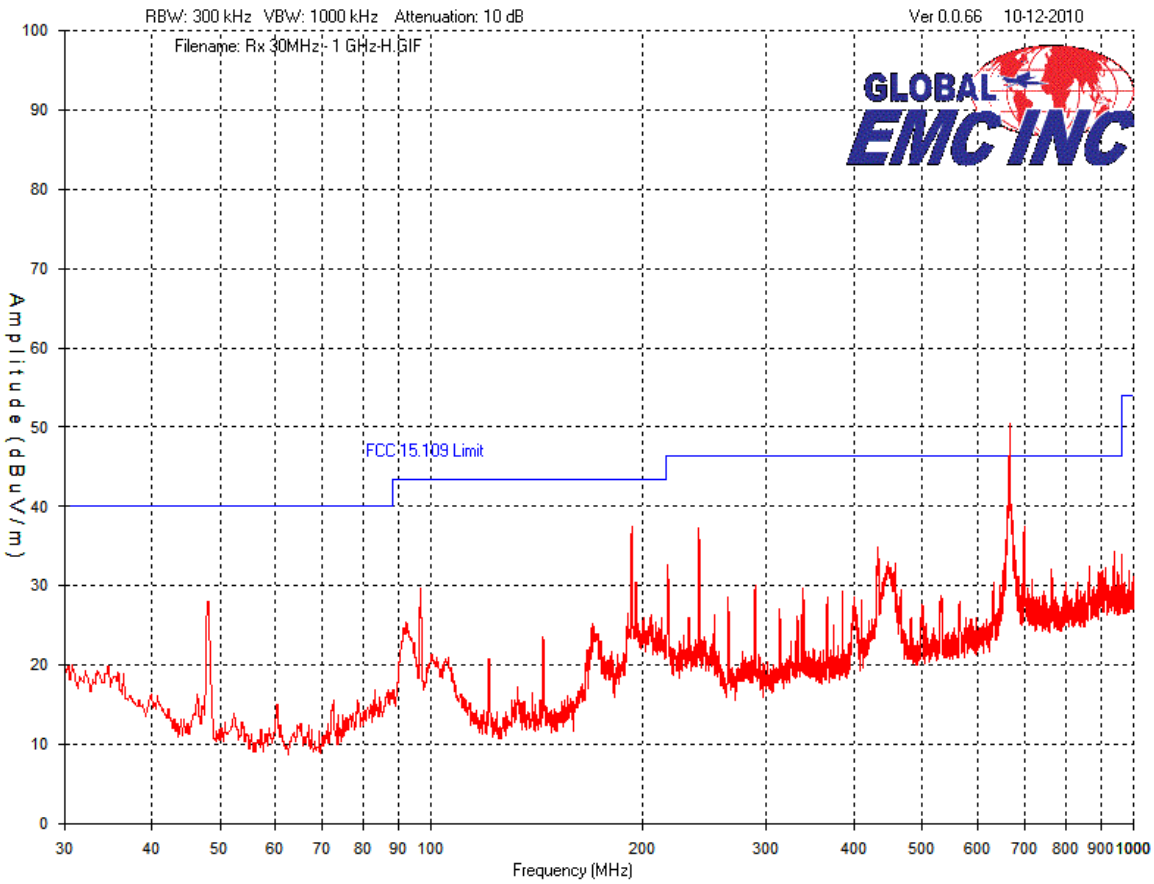
Band Edge – Hi channel (802.11 g)
Vertical Average emissions



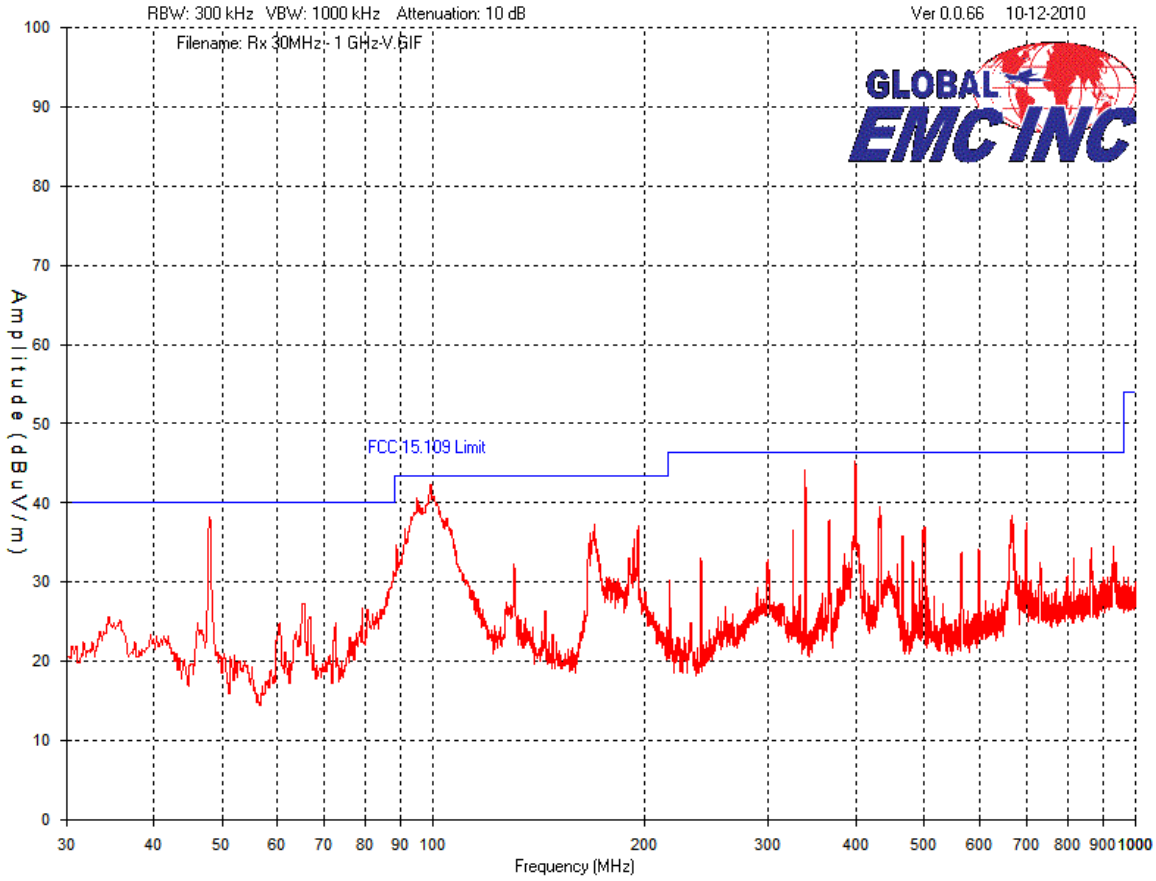
Band Edge – Hi channel (802.11 g)
Horizontal Average emissions



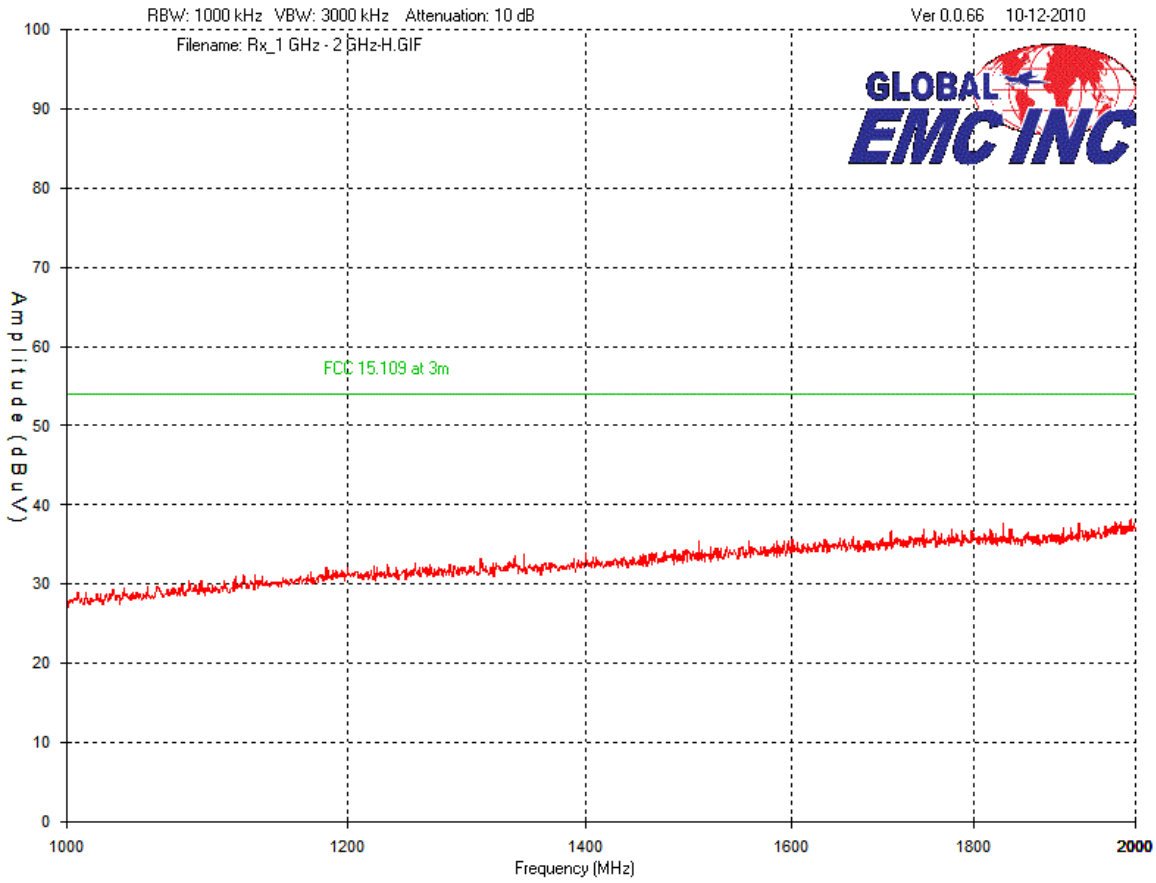
30 MHz – 1 GHz
Receiver Spurious Emissions – Horz



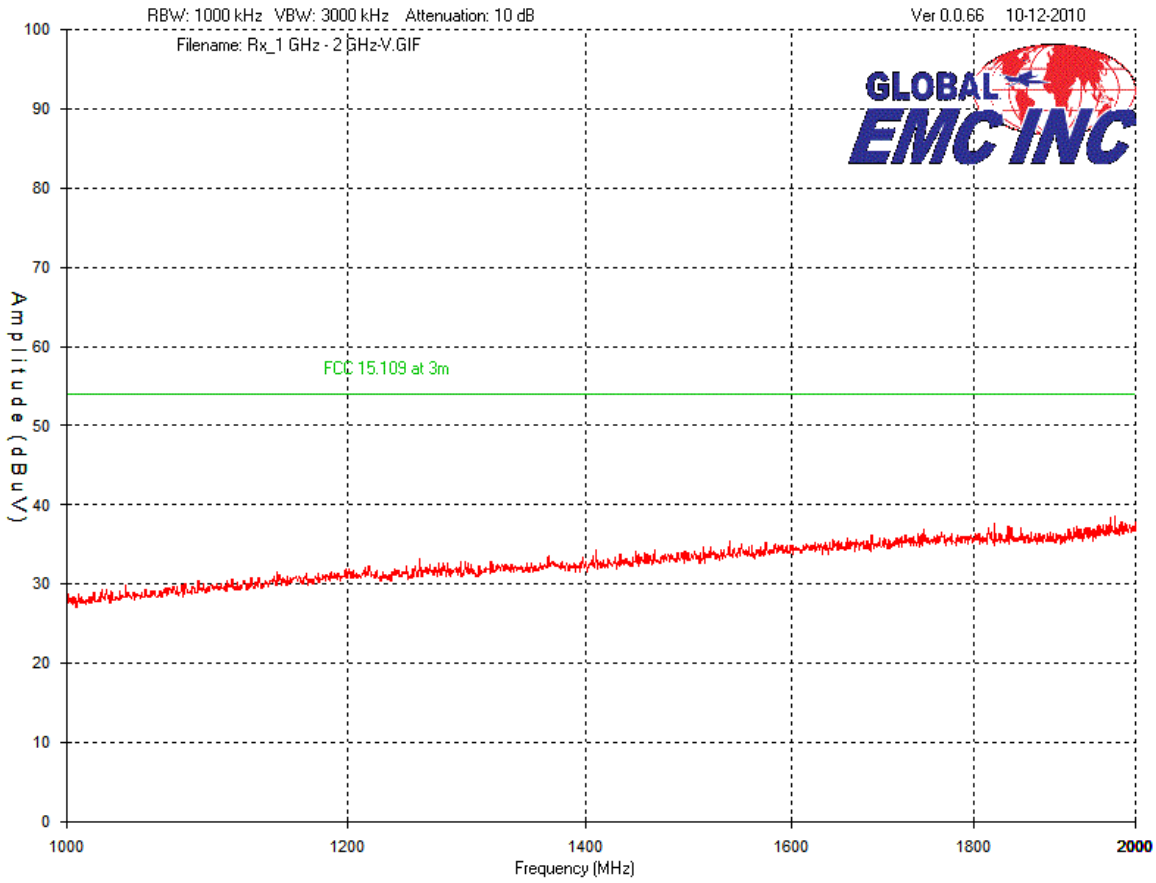
30 MHz – 1 GHz
Receiver Spurious Emissions – Vert



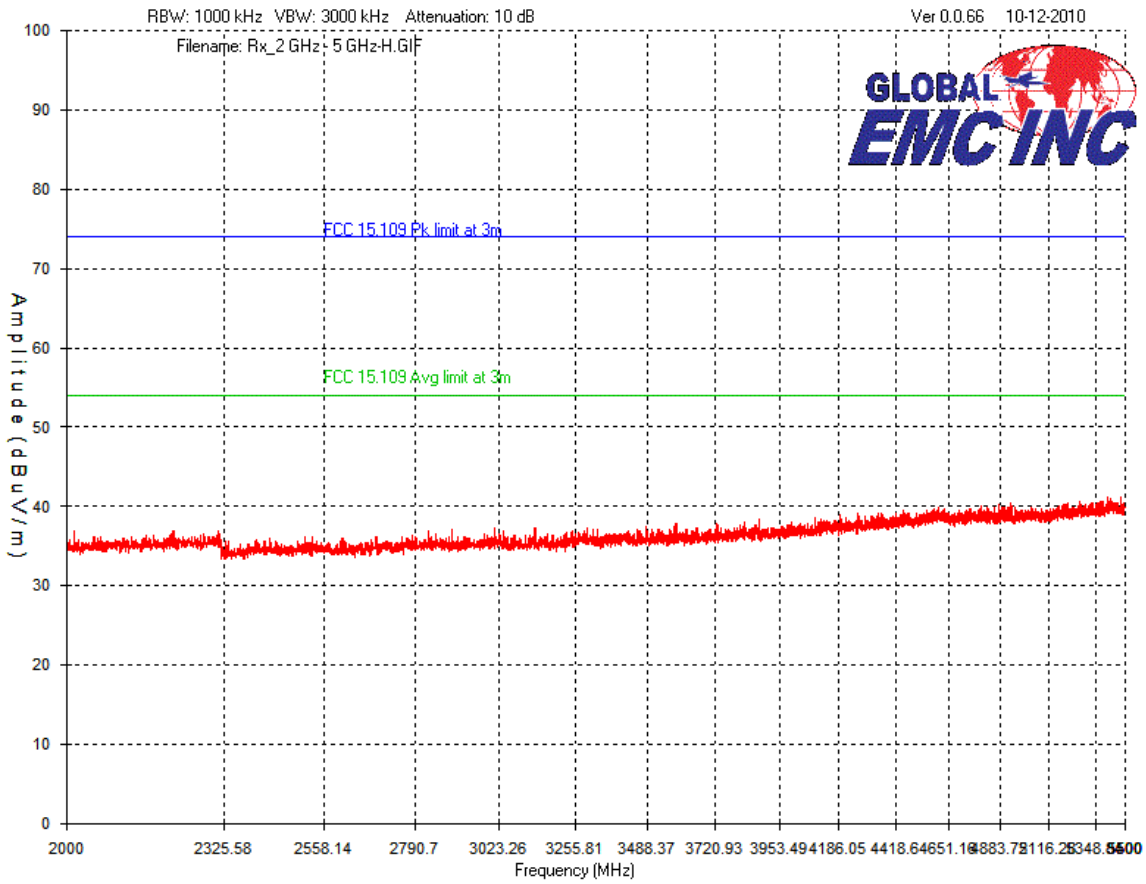
1 GHz – 2 GHz
Receiver Spurious Emissions – Horz



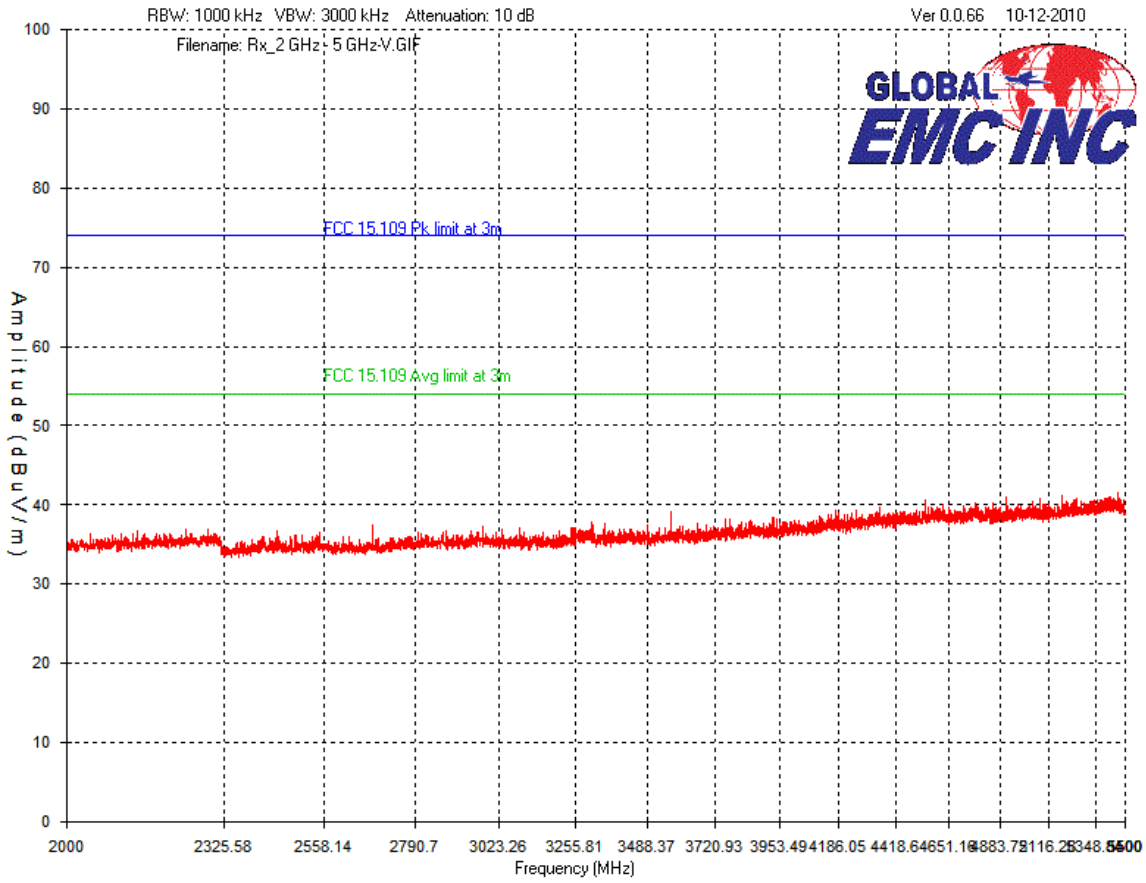
1 GHz – 2 GHz
Receiver Spurious Emissions – Vert



2 GHz – 5.5 GHz
Receiver Spurious Emissions – Horz



2 GHz – 5.5 GHz
Receiver Spurious Emissions – Vert



Final Measurements

Note:

1. In accordance with 15.247(d), only radiated emissions exceeding the 15.209 limit that occur within the bands listed in 15.205, need to be verified with a quasi-peak detector or an average detector.
2. Hi channel had the worst case emissions and results are documented below in the test report.
3. For 802.11 b mode, measured power was ~17.8 dbm.
    a. Low channel – Channel 1 – 2413 MHz
    b. Mid channel – Channel 7 – 2443 MHz
    c. Hi channel – Channel 13 – 2473 MHz

4. For 802.11 g mode, measured power was ~20 dbm for lo and mid channels. Hi channel power was reduced to ~18 dbm to comply with band edge requirements.
    a. Low channel – Channel 1 – 2413 MHz
    b. Mid channel – Channel 7 – 2443 MHz
    c. Hi channel – Channel 11 – 2463 MHz

The requirement of -20dBc is verified by the conducted method; please see 'Spurious Antenna Conducted Emissions' section of this report.

Some of the frequencies shown on the peak graph do not fall within a restricted band as listed in FCC 15.205 and does not need to be verified.

The following measurements were made at the harmonics shown in the above graphs.

See 'Spurious Antenna Conducted Emissions' measurements for -20 dBc requirements.

Client	Golden Power Manufacturing Ltd.
Product	Radio Thermostat WiFi USNAP RTMV-01
Standard(s)	RSS 210 Issue 7:2007 / FCC Part 15 Subpart C 15:2006

Radiated Emissions Measurements

Product category	Class A Group 1
Project Name / Number	RF Module

Test Frequency (MHz)	Detection mode (Q-Peak)	Antenna polarity (Horz/Vert)	Raw signal dB(µV)	Antenna factor dB	Cable loss dB + Preselecor	Attenuator dB	Pre-Amp Gain dB	Received signal dB(µV/m)	Emission limit dB(µV/m)	Margin dB(µV)	Result
Low Channel - TX antenna Vert 802.11b											
2413	Peak	Vert	99.1	31.5	1.0	10.0	36.0	105.6			PASS
2413	Avg	Vert	91.3	31.5	1.0	10.0	36.0	97.8			PASS
2413	Peak	Horz	102.6	31.5	1.0	10.0	36.0	109.1			PASS
2413	Avg	Horz	93.9	31.5	1.0	10.0	36.0	100.4			PASS
2390	Peak	Horz	49.8	31.5	1.0	10.0	36.0	56.3	74.0	17.7	PASS
2390	Avg	Horz	38.7	31.5	1.0	10.0	36.0	45.2	54.0	8.8	PASS
2390	Peak	Vert	48.3	31.5	1.0	10.0	36.0	54.8	74.0	19.2	PASS
2390	Avg	Vert	35.3	31.5	1.0	10.0	36.0	41.8	54.0	12.2	PASS
4826	Peak	Horz	46.8	32.4	1.5	10.0	36.0	54.7	74.0	19.3	PASS
4826	Avg	Horz	33.6	32.4	1.5	10.0	36.0	41.5	54.0	12.5	PASS

4826	Peak	Vert	44.1	32.4	1.5	10.0	36.0	52.0	74.0	22.0	PASS
4826	Avg	Vert	33.1	32.4	1.5	10.0	36.0	41.0	54.0	13.0	PASS
Mid Channel - TX antenna Vert 802.11b											
2443.5	Peak	Vert	101.4	31.5	1.0	10.0	36.0	107.9			PASS
2443.5	Avg	Vert	91.4	31.5	1.0	10.0	36.0	97.9			PASS
2443.5	Peak	Horz	101.5	31.5	1.0	10.0	36.0	108.0			PASS
2443.5	Avg	Horz	92.5	31.5	1.0	10.0	36.0	99.0			PASS
4887	Peak	Horz	45.5	32.4	1.5	10.0	36.0	53.4	74.0	20.6	PASS
4887	Avg	Horz	33.0	32.4	1.5	10.0	36.0	40.9	54.0	13.1	PASS
4887	Peak	Vert	44.6	32.4	1.5	10.0	36.0	52.5	74.0	21.5	PASS
4887	Avg	Vert	32.8	32.4	1.5	10.0	36.0	40.7	54.0	13.3	PASS
Hi Channel - TX antenna Vert 802.11b											
2473.5	Peak	Vert	99.9	31.5	1.0	10.0	36.0	106.4			PASS
2473.5	Avg	Vert	89.8	31.5	1.0	10.0	36.0	96.3			PASS
2473.5	Peak	Horz	102.7	31.5	1.0	10.0	36.0	109.2			PASS
2473.5	Avg	Horz	93.6	31.5	1.0	10.0	36.0	100.1			PASS
2483.5	Peak	Horz	58.4	31.5	1.0	10.0	36.0	64.9	74.0	9.1	PASS
2483.5	Avg	Horz	45.5	31.5	1.0	10.0	36.0	52.0	54.0	2.0	PASS
2483.5	Peak	Vert	55.3	31.5	1.0	10.0	36.0	61.8	74.0	12.2	PASS
2483.5	Avg	Vert	43.0	31.5	1.0	10.0	36.0	49.5	54.0	4.5	PASS
4944	Peak	Horz	47.4	32.4	1.5	10.0	36.0	55.3	74.0	18.7	PASS
4947	Avg	Horz	35.9	32.4	1.5	10.0	36.0	43.8	54.0	10.2	PASS

4947	Peak	Vert	44.2	32.4	1.5	10.0	36.0	52.1	74.0	21.9	PASS
4947	Avg	Vert	35.3	32.4	1.5	10.0	36.0	43.2	54.0	10.8	PASS
Low Channel - TX antenna Vert 802.11g											
2413	Peak	Vert	102.7	31.5	1.0	10.0	36.0	109.2			PASS
2413	Avg	Vert	90.5	31.5	1.0	10.0	36.0	97.0			PASS
2413	Peak	Horz	102.0	31.5	1.0	10.0	36.0	108.5			PASS
2413	Avg	Horz	90.6	31.5	1.0	10.0	36.0	97.1			PASS
2390	Peak	Horz	62.0	31.5	1.0	10.0	36.0	68.5	74.0	5.5	PASS
2390	Avg	Horz	45.9	31.5	1.0	10.0	36.0	52.4	54.0	1.6	PASS
2390	Peak	Vert	61.2	31.5	1.0	10.0	36.0	67.7	74.0	6.3	PASS
2390	Avg	Vert	44.8	31.5	1.0	10.0	36.0	51.3	54.0	2.7	PASS
4826	Peak	Horz	47.0	32.4	1.5	10.0	36.0	54.9	74.0	19.1	PASS
4826	Avg	Horz	31.2	32.4	1.5	10.0	36.0	39.1	54.0	14.9	PASS
4826	Peak	Vert	47.1	32.4	1.5	10.0	36.0	55.0	74.0	19.0	PASS
4826	Avg	Vert	33.3	32.4	1.5	10.0	36.0	41.2	54.0	12.8	PASS
Mid Channel - TX antenna Vert 802.11g											
2443.5	Peak	Vert	100.9	31.5	1.0	10.0	36.0	107.4			PASS
2443.5	Avg	Vert	89.1	31.5	1.0	10.0	36.0	95.6			PASS
2443.5	Peak	Horz	102.4	31.5	1.0	10.0	36.0	108.9			PASS
2443.5	Avg	Horz	89.6	31.5	1.0	10.0	36.0	96.1			PASS
4887	Peak	Horz	45.0	32.4	1.5	10.0	36.0	52.9	74.0	21.1	PASS
4887	Avg	Horz	31.7	32.4	1.5	10.0	36.0	39.6	54.0	14.4	PASS

4887	Peak	Vert	45.3	32.4	1.5	10.0	36.0	53.2	74.0	20.8	PASS
4887	Avg	Vert	31.7	32.4	1.5	10.0	36.0	39.6	54.0	14.4	PASS
Hi Channel - TX antenna Vert G Hi Channel = 11 Power 18 dbm 802.11g											
2463.7	Peak	Vert	97.4	31.5	1.0	10.0	36.0	103.9			PASS
2463.7	Avg	Vert	85.5	31.5	1.0	10.0	36.0	92.0			PASS
2463.7	Peak	Horz	100.8	31.5	1.0	10.0	36.0	107.3			PASS
2473.5	Avg	Horz	88.9	31.5	1.0	10.0	36.0	95.4			PASS
2483.5	Peak	Horz	62.3	31.5	1.0	10.0	36.0	68.8	74.0	5.2	PASS
2483.5	Avg	Horz	45.4	31.5	1.0	10.0	36.0	51.9	54.0	2.1	PASS
2483.5	Peak	Vert	57.7	31.5	1.0	10.0	36.0	64.2	74.0	9.8	PASS
2483.5	Avg	Vert	39.9	31.5	1.0	10.0	36.0	46.4	54.0	7.6	PASS
4927.4	Peak	Horz	44.1	32.4	1.5	10.0	36.0	52.0	74.0	22.0	PASS
4927.4	Avg	Horz	32.0	32.4	1.5	10.0	36.0	39.9	54.0	14.1	PASS
4927.4	Peak	Vert	45.1	32.4	1.5	10.0	36.0	53.0	74.0	21.0	PASS
4947	Avg	Vert	31.7	32.4	1.5	10.0	36.0	39.6	54.0	14.4	PASS
Receiver											
665	Peak	Horz	59.6	20.5	1	0	30.7	50.4	66.0	15.6	PASS
665	QP	Horz	51	20.5	1	0	30.7	41.8	46.0	4.2	PASS
192	Peak	Horz	58.4	10.3	0.5	0	31.8	37.4	63.5	26.1	PASS
192	QP	Horz	56.8	10.3	0.5	0	31.8	35.8	43.5	7.7	PASS
700	Peak	Horz	46	21.1	1	0	30.6	37.5	66.0	28.5	PASS
700	QP	Horz	44.2	10.3	0.5	0	31.8	23.2	46.0	22.8	PASS

398	Peak	Vert	60.4	15.4	0.6	0	31.3	45.1	66.0	20.9	PASS
398	QP	Vert	50.3	15.4	0.6	0	31.3	35	46.0	11.0	PASS
99	Peak	Vert	64.3	9.4	0.5	0	32	42.2	63.5	21.3	PASS
99	QP	Vert	61	9.4	0.5	0	32	38.9	43.5	4.6	PASS
48	Peak	Vert	61.1	8.7	0.4	0	32	38.2	60.0	21.8	PASS
48	QP	Vert	59.9	8.7	0.4	0	32	37	40.0	3.0	PASS

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
IFR Spectrum Analyzer	AN940	IFR	12/29/2009	12/29/2011	GEMC 6350
BiLog Antenna	3142-C	ETS	2009-02-12	2011-02-12	GEMC 8
Attenuator 3 dB	FP-50-3	Trilithic	NCR	NCR	GEMC 40
Chase Preamp 9kHz - 2 GHz	CPA9231A	Chase	8/25/2010	8/25/2012	GEMC 6403
Q-Par 1.5-18 GHz Horn	6878/24	Q-par	8/25/2010	8/25/2012	GEMC 65
1-26G pre-amp	HP 8449B	HP	8/25/2010	8/25/2012	GEMC 68
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29
RF Cable 0.5M	LMR-400-0.5M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 31

This report module is based on GEMC template "FCC - 15.209 - Radiated Emissions_Rev2.doc"

6dB Bandwidth of Digitally Modulated Systems

Purpose

The purpose of this test is to ensure that the bandwidth occupied exceeds a stated minimum. This helps ensure the utilization of the frequency allocation is sufficiently wide. This also helps prevent corruption of data by ensuring adequate data separation to distinguish the reception of the intended information.

Limits

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. This should be measured with a 100 kHz RBW and a 300 kHz VBW.

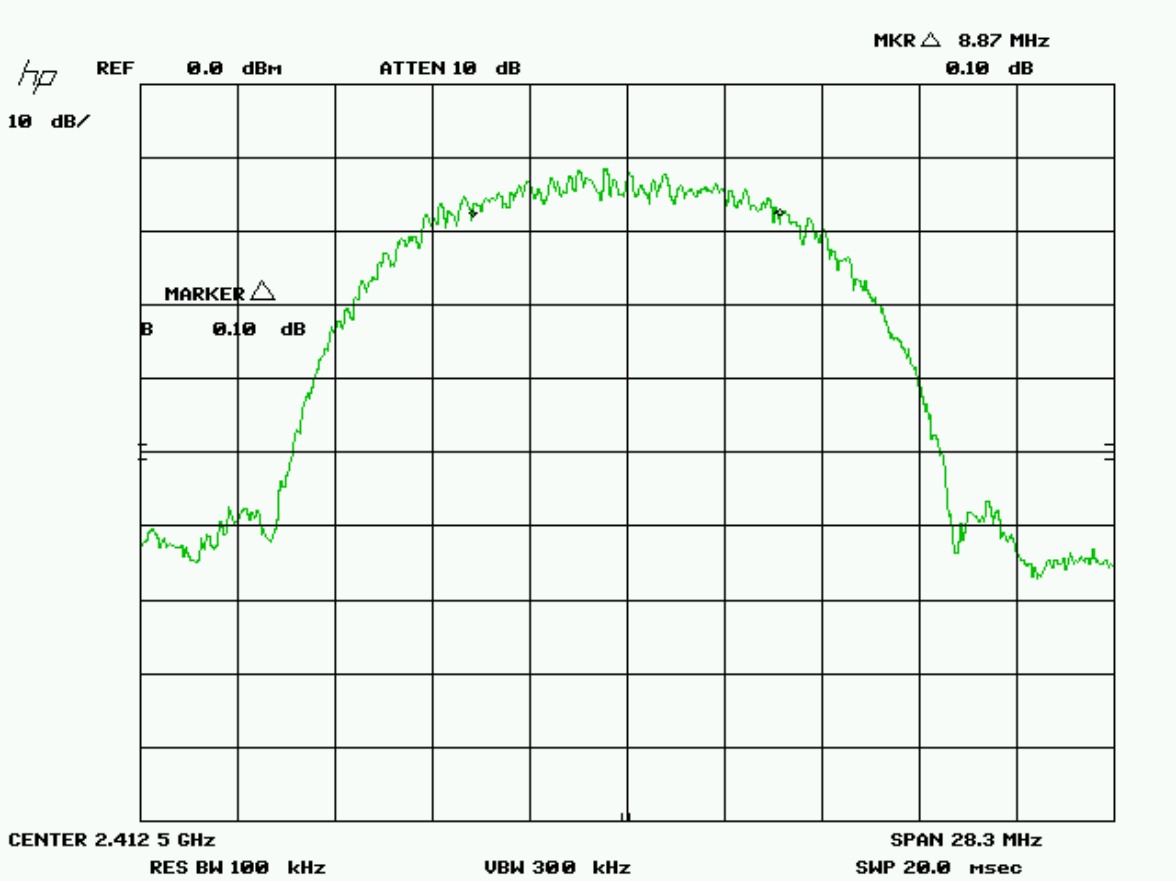
Results

The EUT passed. The 6 dB BW measured was
802.11 b – 8.87 MHz
802.11 g – 16.67 MHz

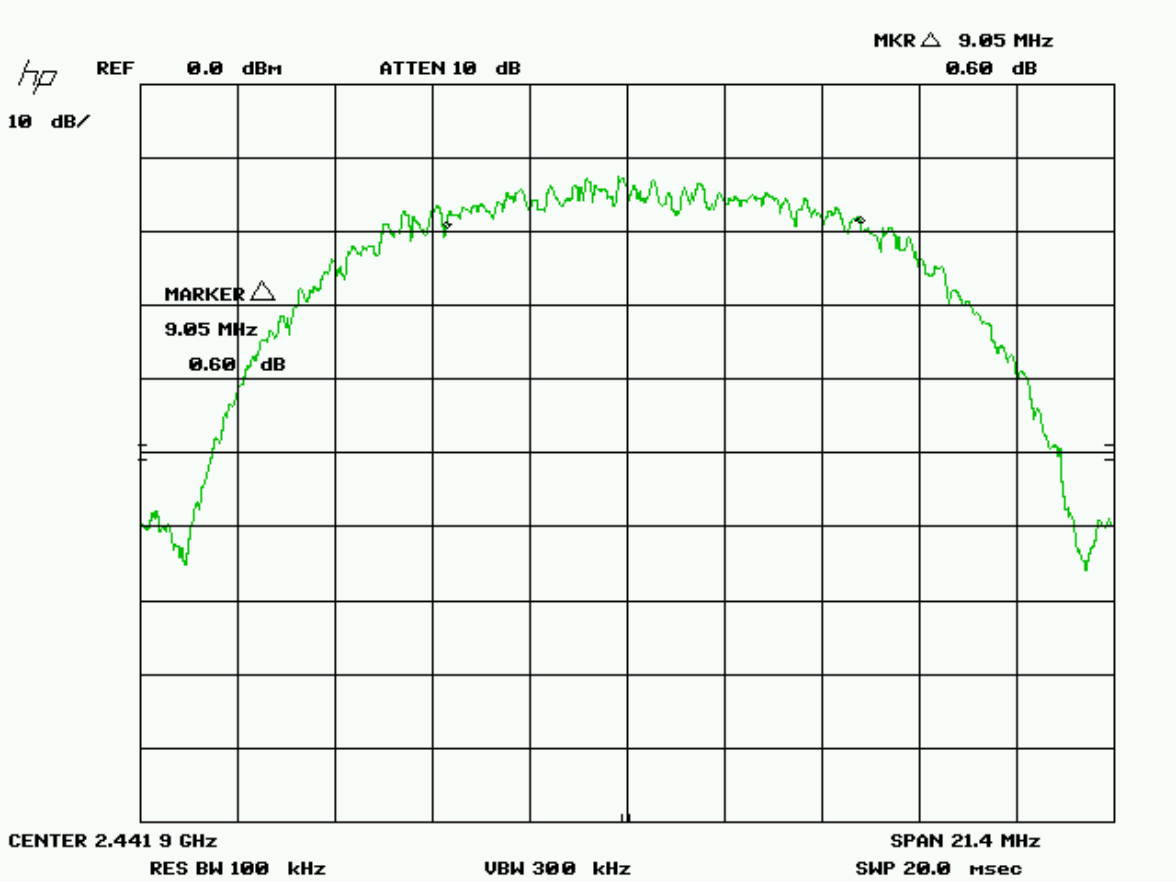
Graph(s)

The graphs shown below show the channel spacing during the operation of the device. This is measured by a max hold on the spectrum analyzer. This measurement is a peak measurement. Max hold is performed for a duration of not less then 1 minute.

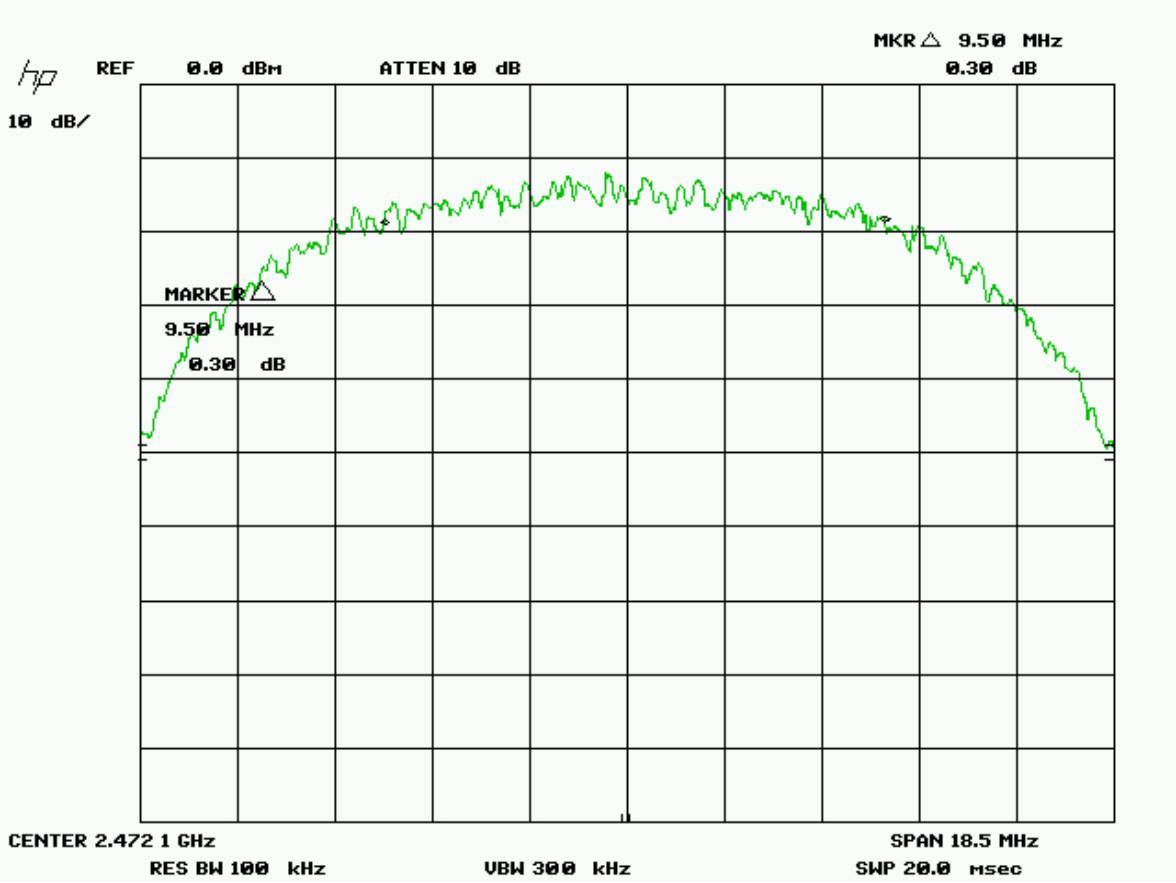
Low Channel – 802.11 b



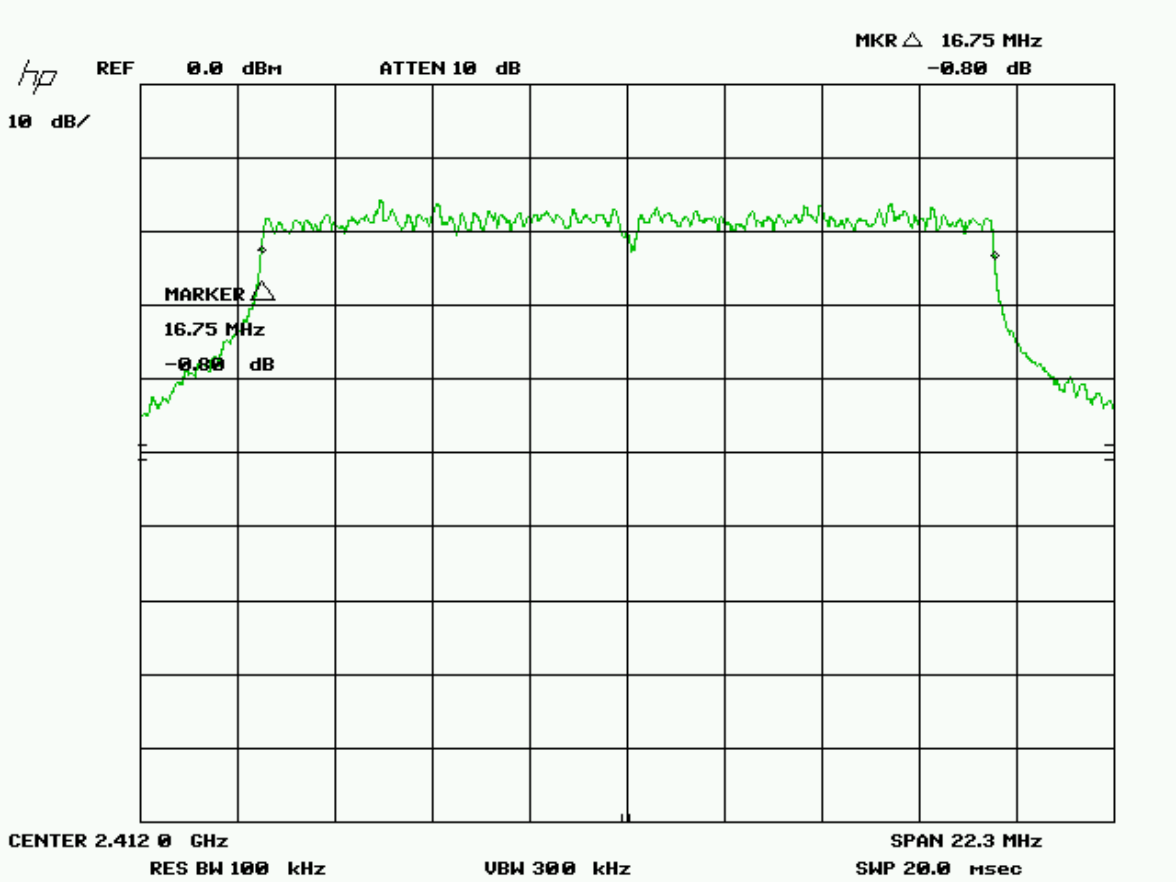
Medium Channel – 802.11 b



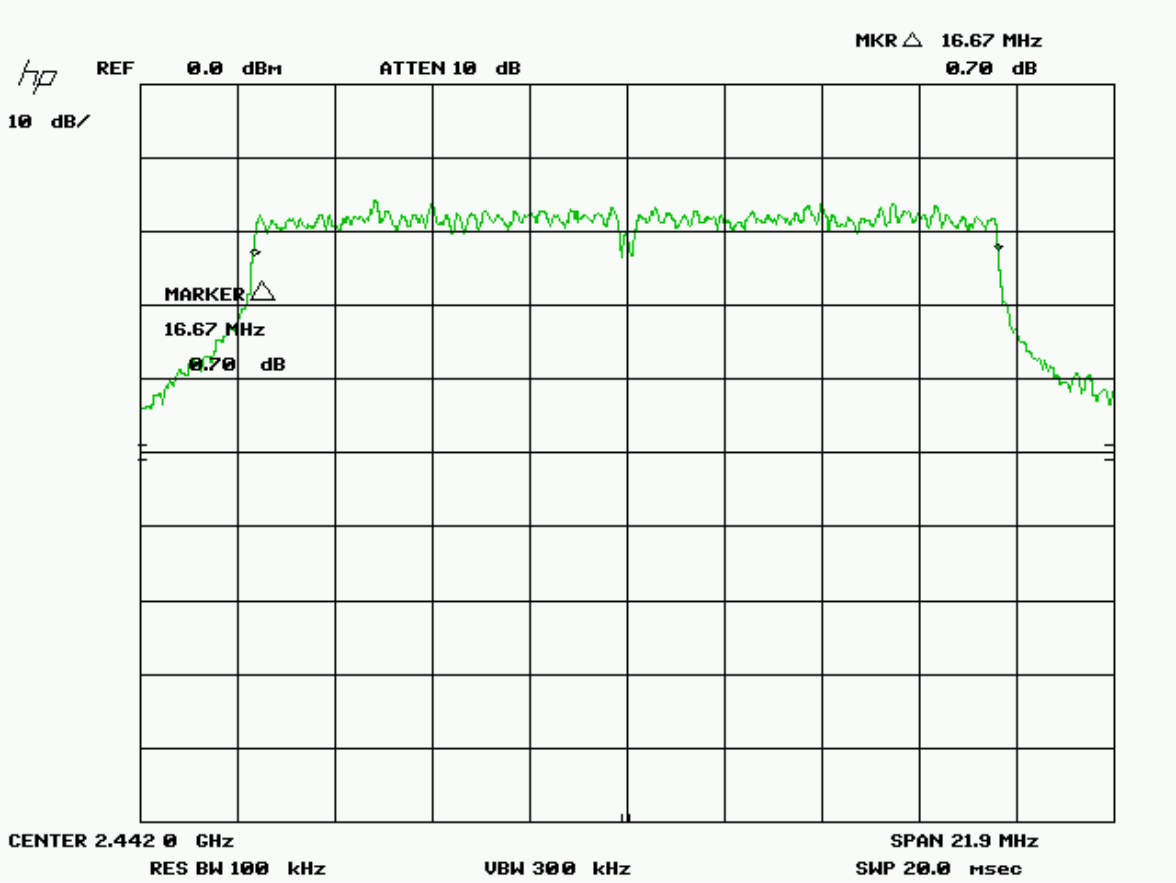
High Channel – 802.11 b



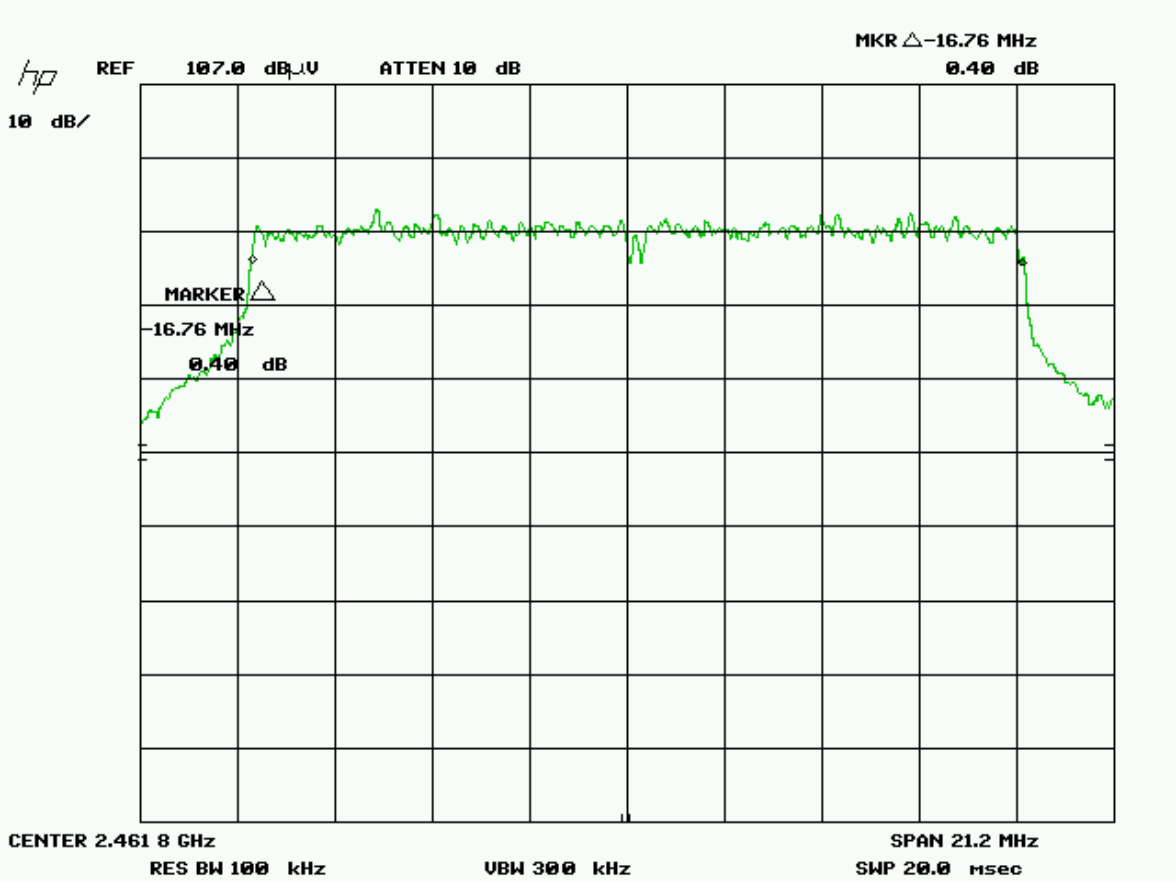
Low Channel – 802.11 g



Medium Channel – 802.11 g



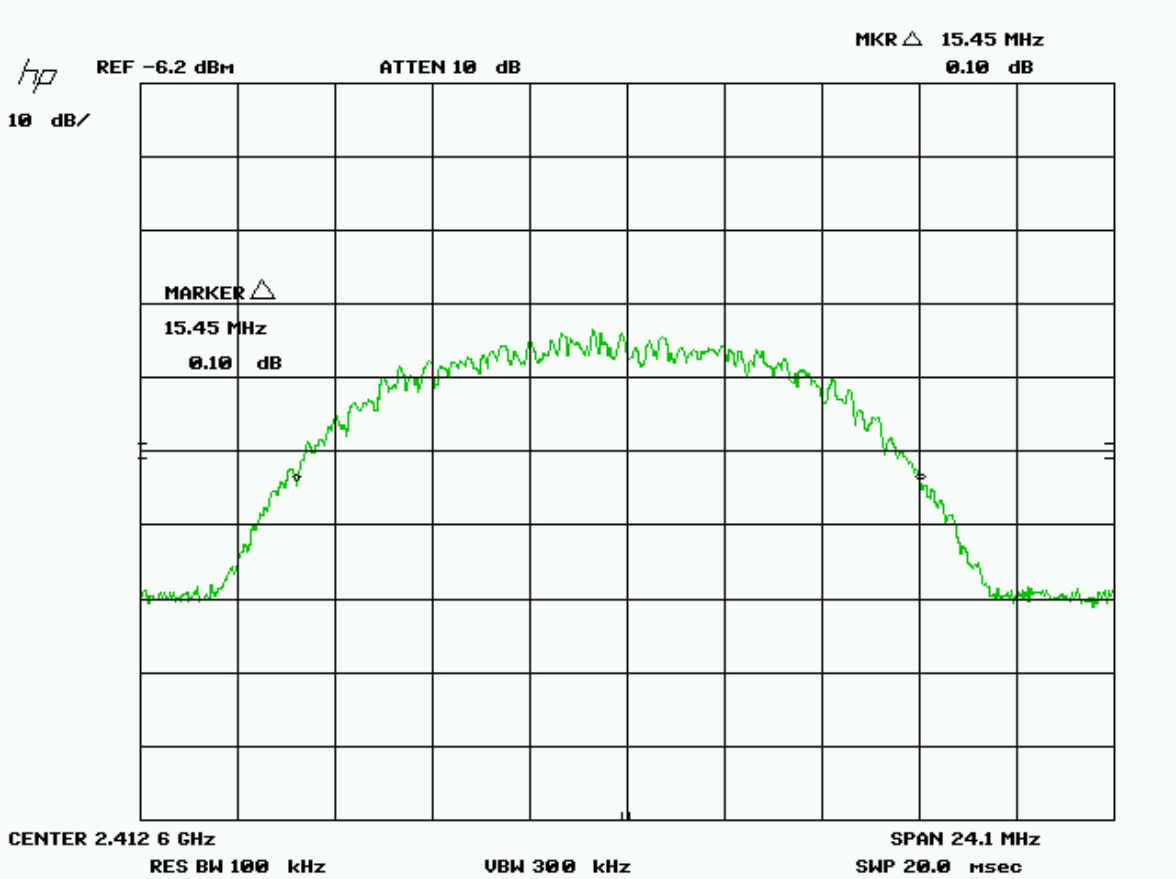
High Channel – 802.11 g



Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up.

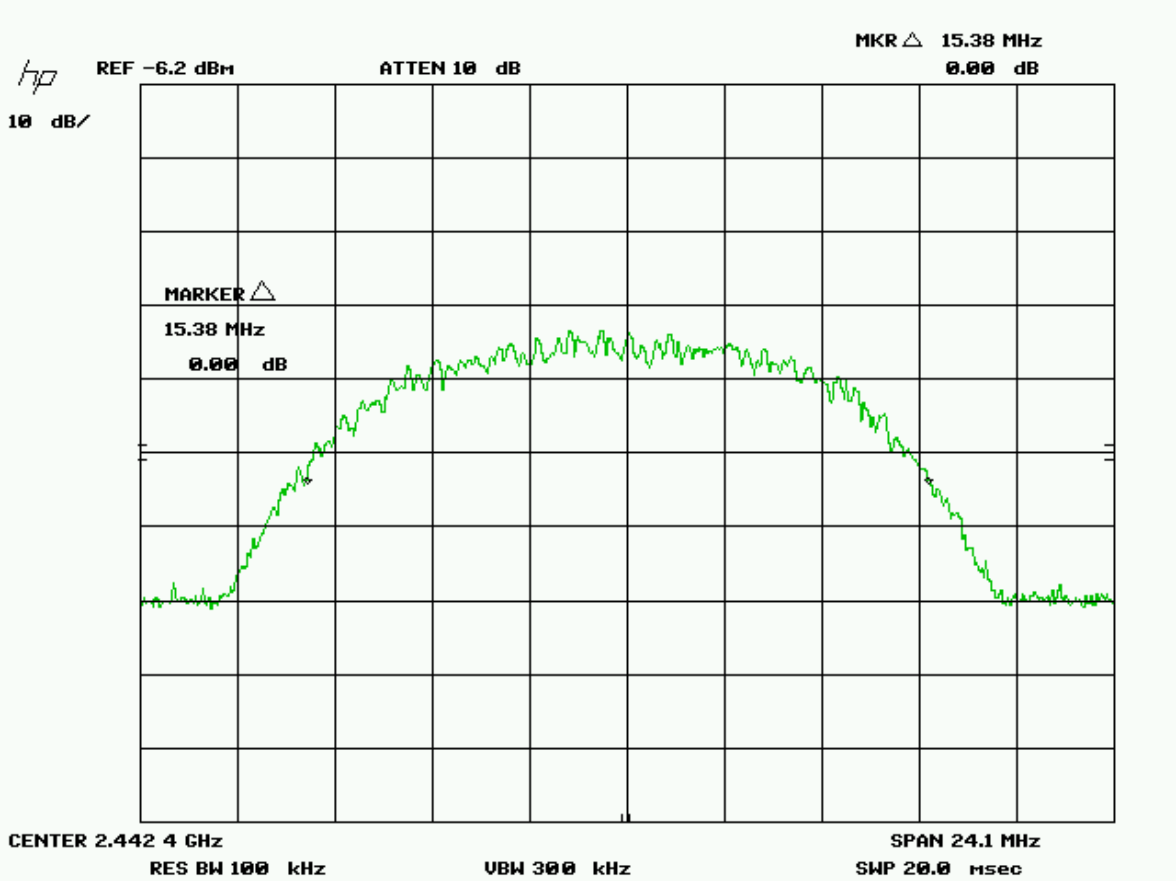
20 db Bandwidth 802.11 b

Lo



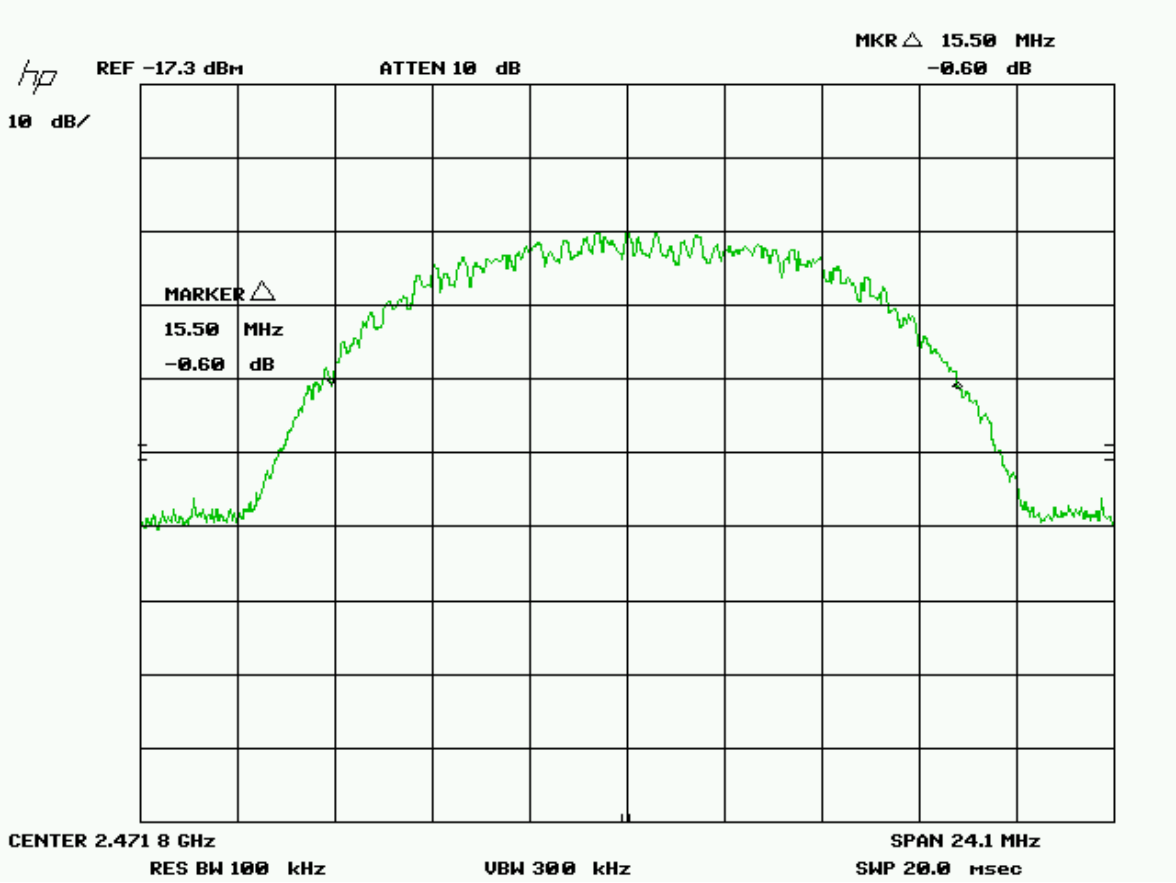
20 db Bandwidth 802.11 b

Mid



20 db Bandwidth 802.11 b

Hi

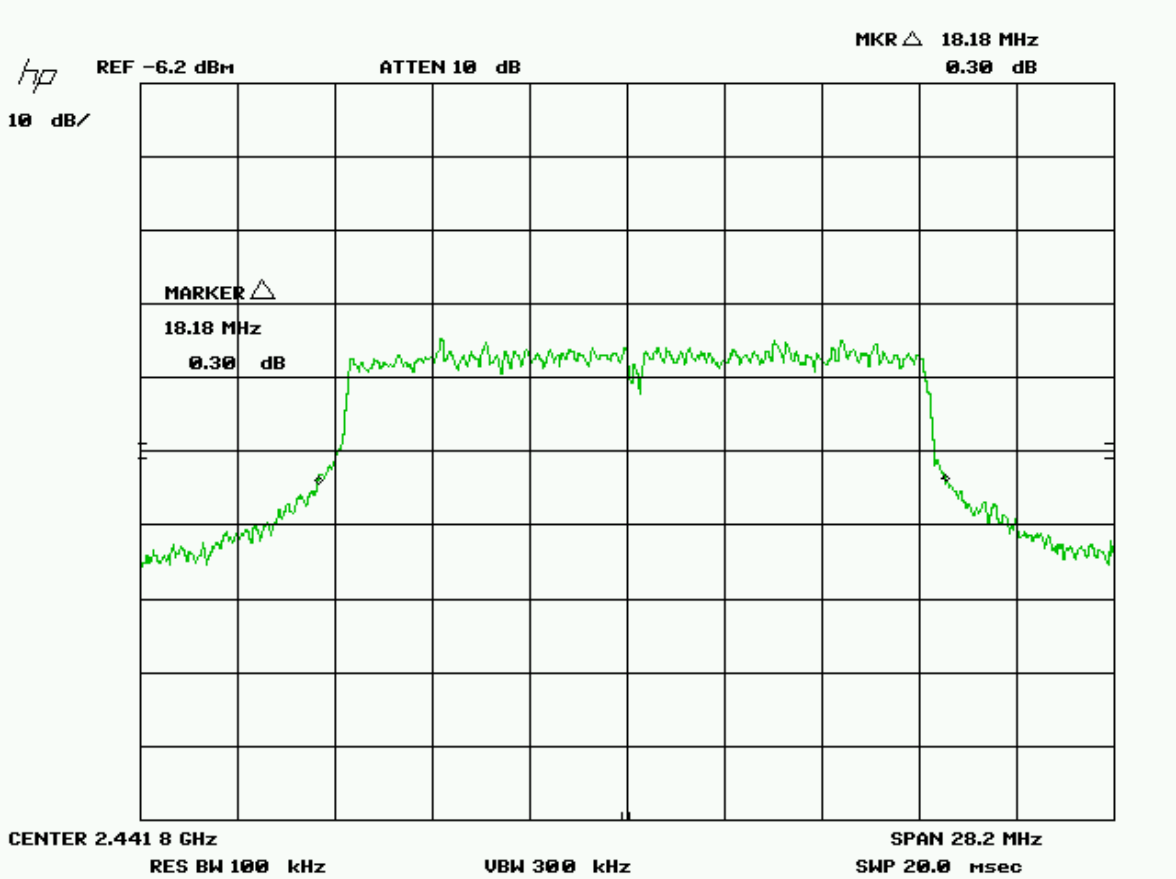


20 db Bandwidth 802.11 g

Lo

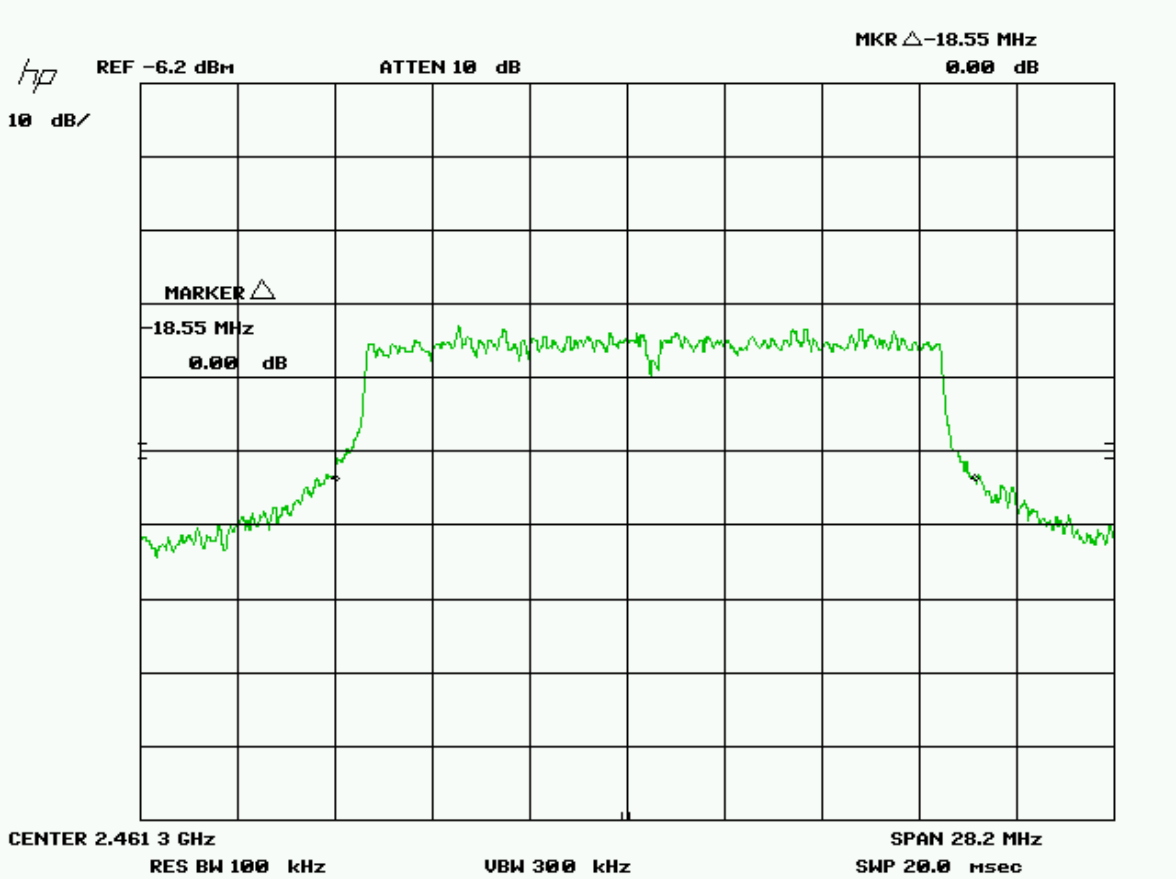
20 db Bandwidth 802.11 g

Mid



20 db Bandwidth 802.11 g

Hi



Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
IFR Spectrum Analyzer	AN940	IFR	12/29/2009	12/29/2011	GEMC 6350
Attenuator 10 dB	FP-50-10	Trilithic	NCR	NCR	GEMC 42
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29
Power Attenuator 20 dB	25-A-FFN-20	Bird / Hutton	NCR	NCR	GEMC 49

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Maximum Peak Envelope Conducted Power

Purpose

The purpose of this test is to ensure that the maximum power conducted to the radiating element does not exceed the limits specified. This ensures that if the end-user replaces the antenna, that the maximum power does not exceed an amount which may create an excessive power level.

Limits

The limits are defined in 15.247(b).
For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands, the peak limit is 1 watt.

Results

The EUT passed. The peak power measured was

1. 802.11 b –
    a. Lo → -2.18 + 20 = 17.82 dbm
    b. Mid → -2.75 + 20 = 17.25 dbm
    c. Hi → -2.15 + 20 = 17.85 dbm

2. 802.11 g
    a. Lo → -0.2 + 20 = 19.8 dbm
    b. Mid → +0.1 + 20 = 20.1 dbm
    c. Hi → -1.62 + 20 = 18.38 dbm

Table(s)

The tables shown below shows the peak power output of the device during the antenna conducted measurement during transmit operation of the EUT.

Tests were conducted using the power meter.

Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Power Meter	PM 2002	AR	Feb 11 2009	Feb 11 2011	GEMC 16
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29
Power Attenuator 20 dB	25-A-FFN-20	Bird / Hutton	NCR	NCR	GEMC 49

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Antenna Spurious Conducted Emissions (- 20 dbc Requirement)

Purpose

The purpose of this test is to ensure that the maximum power conducted to the radiating element at frequencies outside of the authorized spectrum does not exceed the limits specified. This ensures that the only the intended signal is delivered to the radiating element.

Limits

The limits are defined in 15.247(d). In any 100 kHz band, the peak spurious harmonics emissions must be at least 20 dB below the fundamental. Spurious Conducted emissions are to be evaluated up to the 10^{th} harmonic. This -20 dBc requirement also applies at the 'band edge' or 2.4 GHz and 2.4835 GHz.

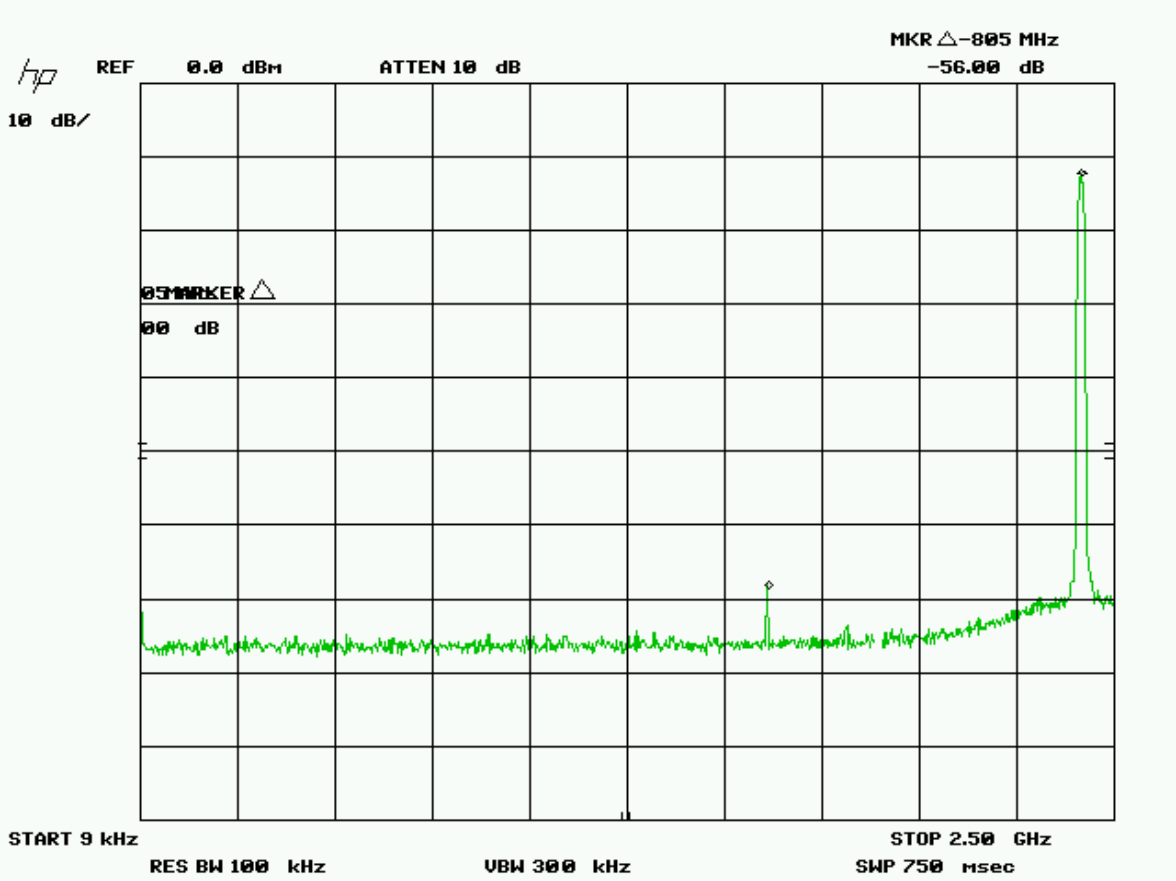
Results

The EUT passed the limits. Low, middle and high band was measured. The worst case for each mode is presented as a graph for the spectrum. The -20 dBc requirement is shown for the lower band edge at 2.4 GHz in the low band. The -20 dBc requirement is also shown for the higher band edge at 2.4835 GHz in the high band.

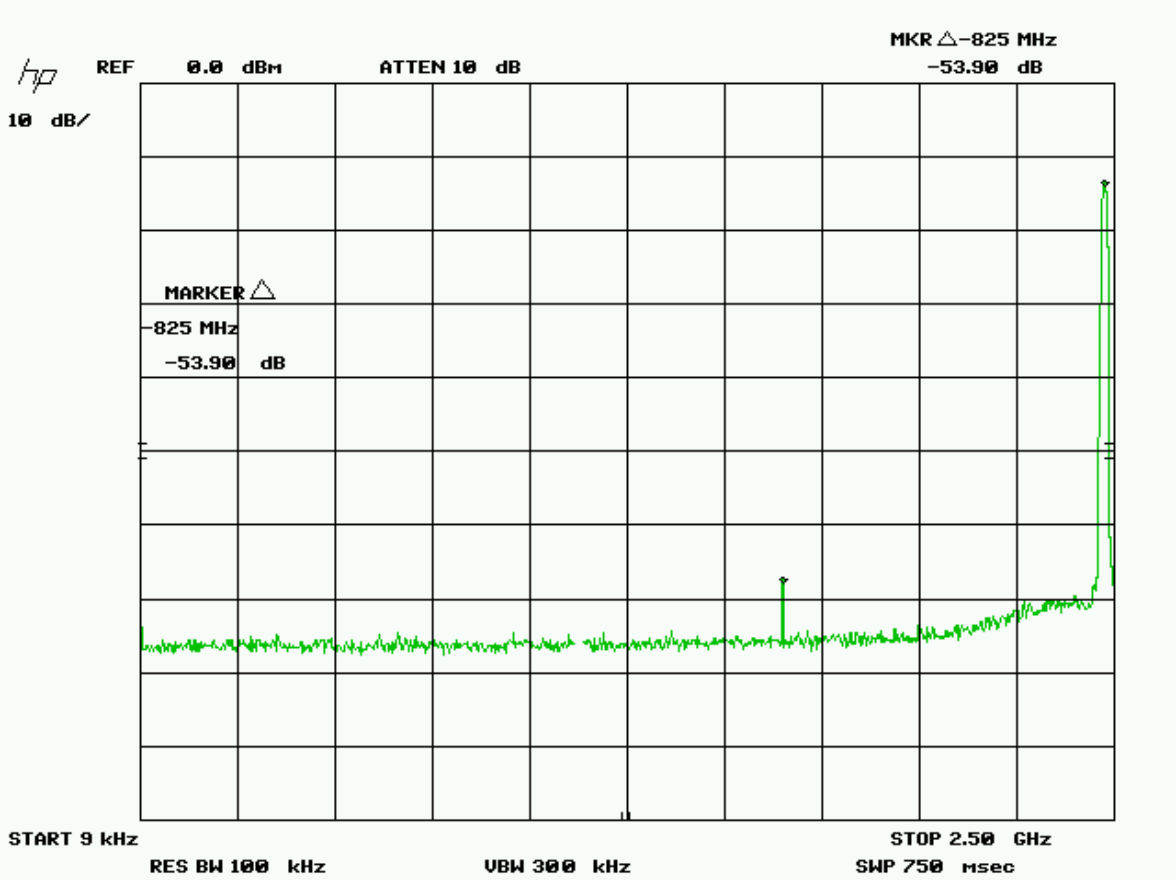
Graph(s)

The graphs shown below shows the peak power output of the device during the antenna conducted measurement during transmit operation of the EUT.

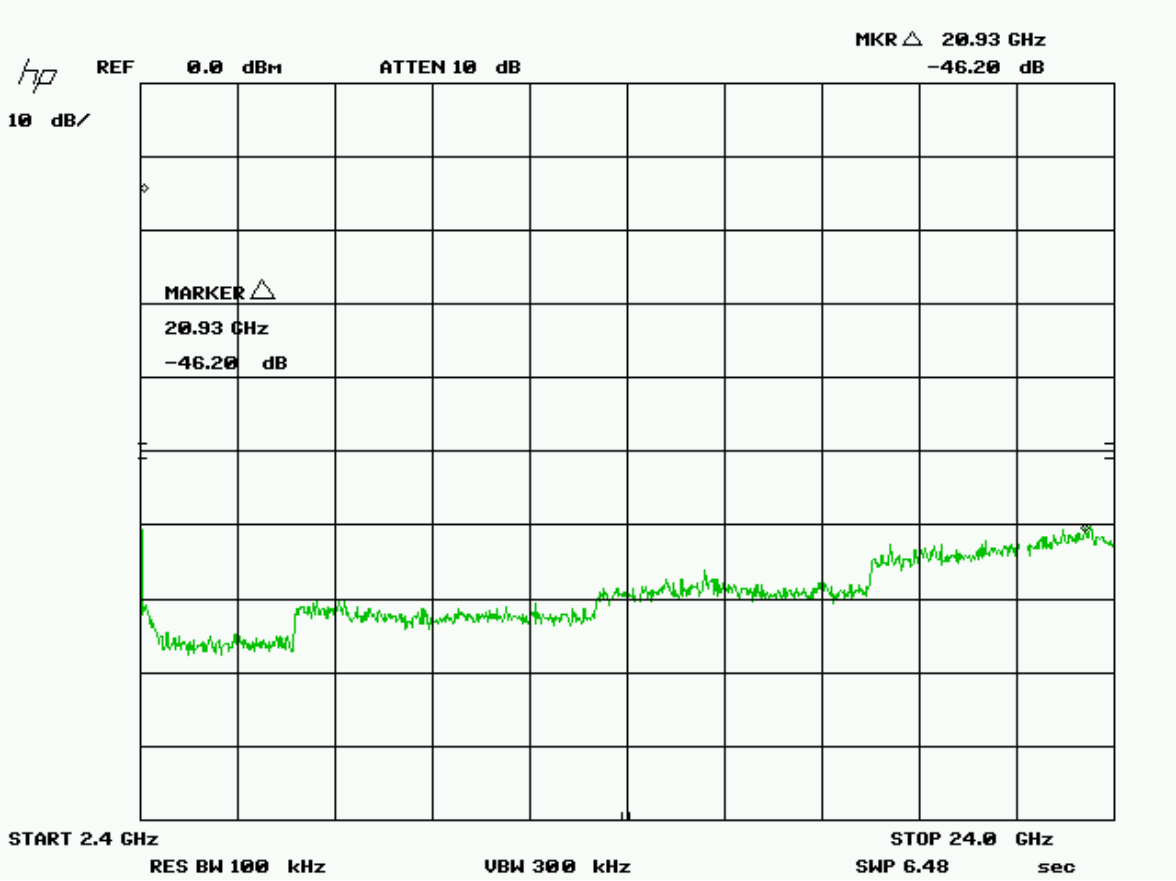
9 kHz – 2.5 GHz Lo
802.11 b



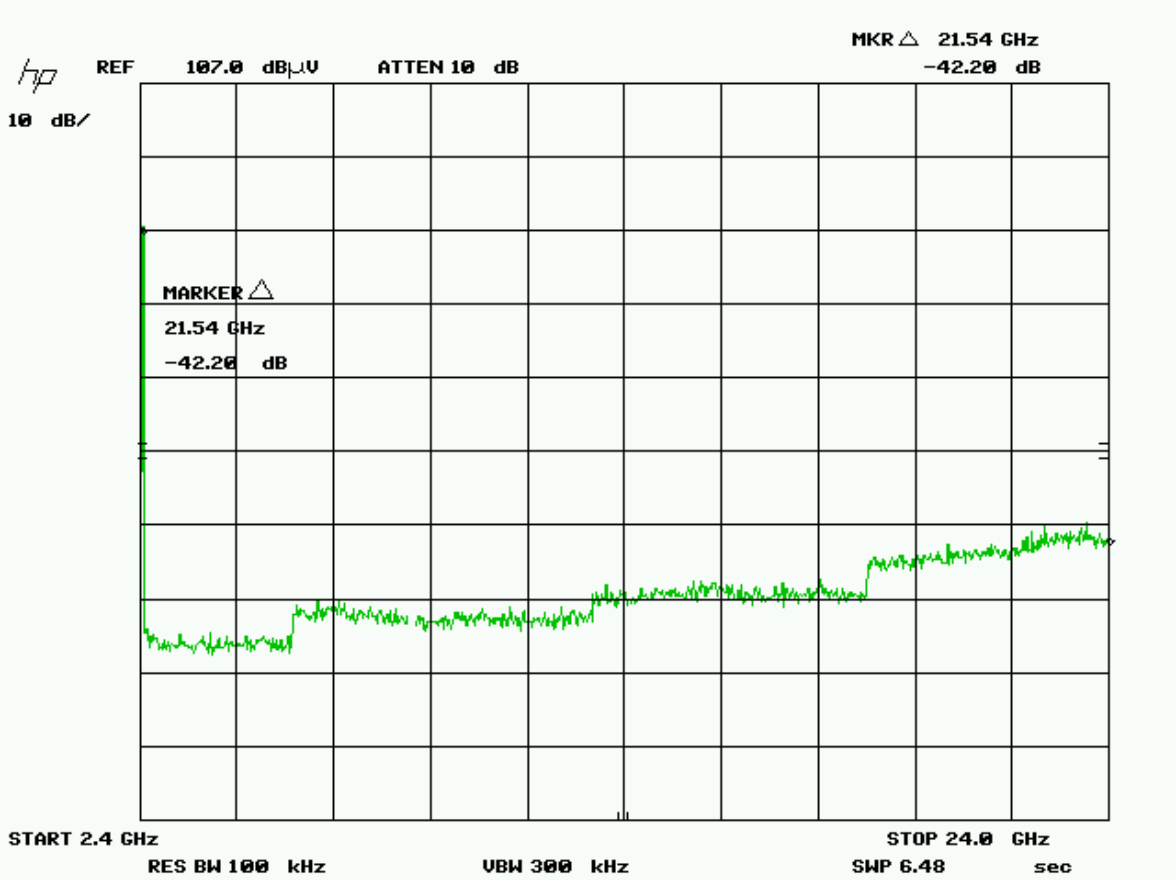
9 kHz – 2.5 GHz Hi
802.11 b



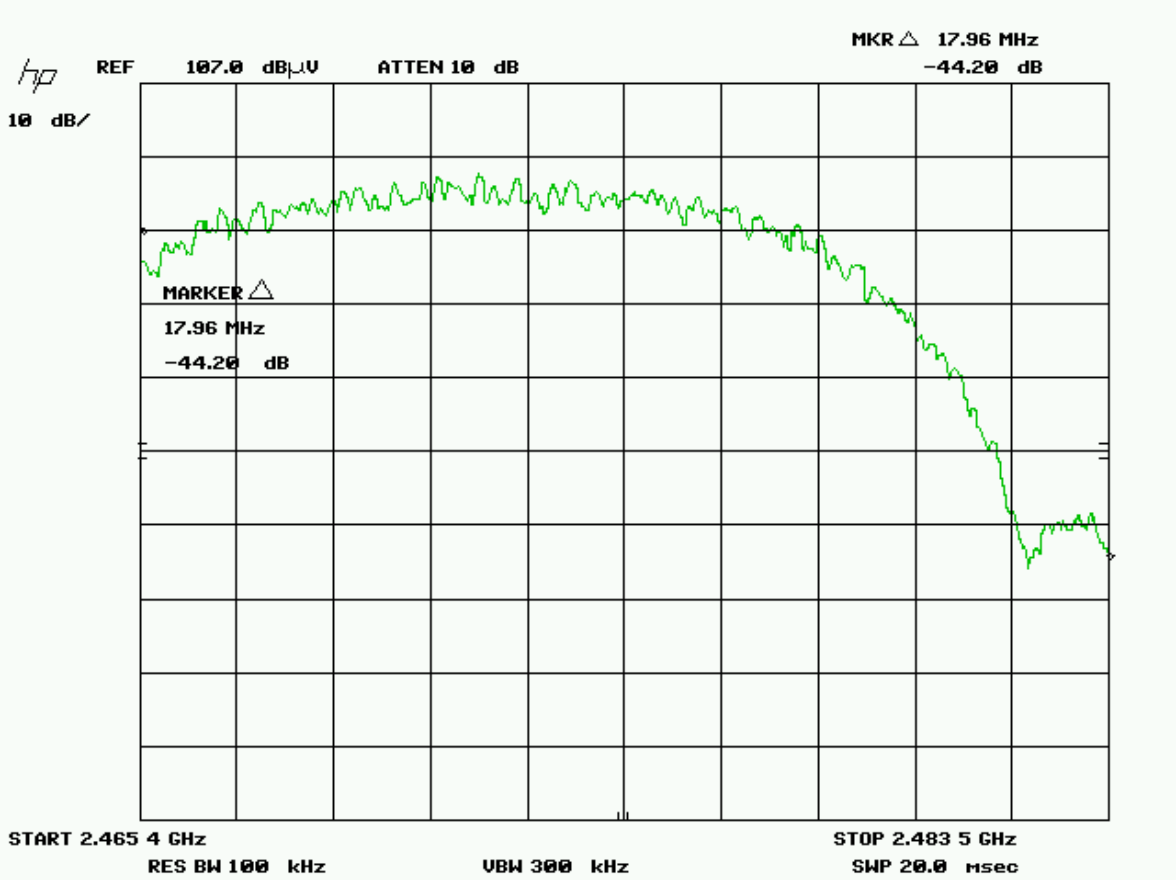
2 GHz – 22.5 GHz Lo
802.11 b



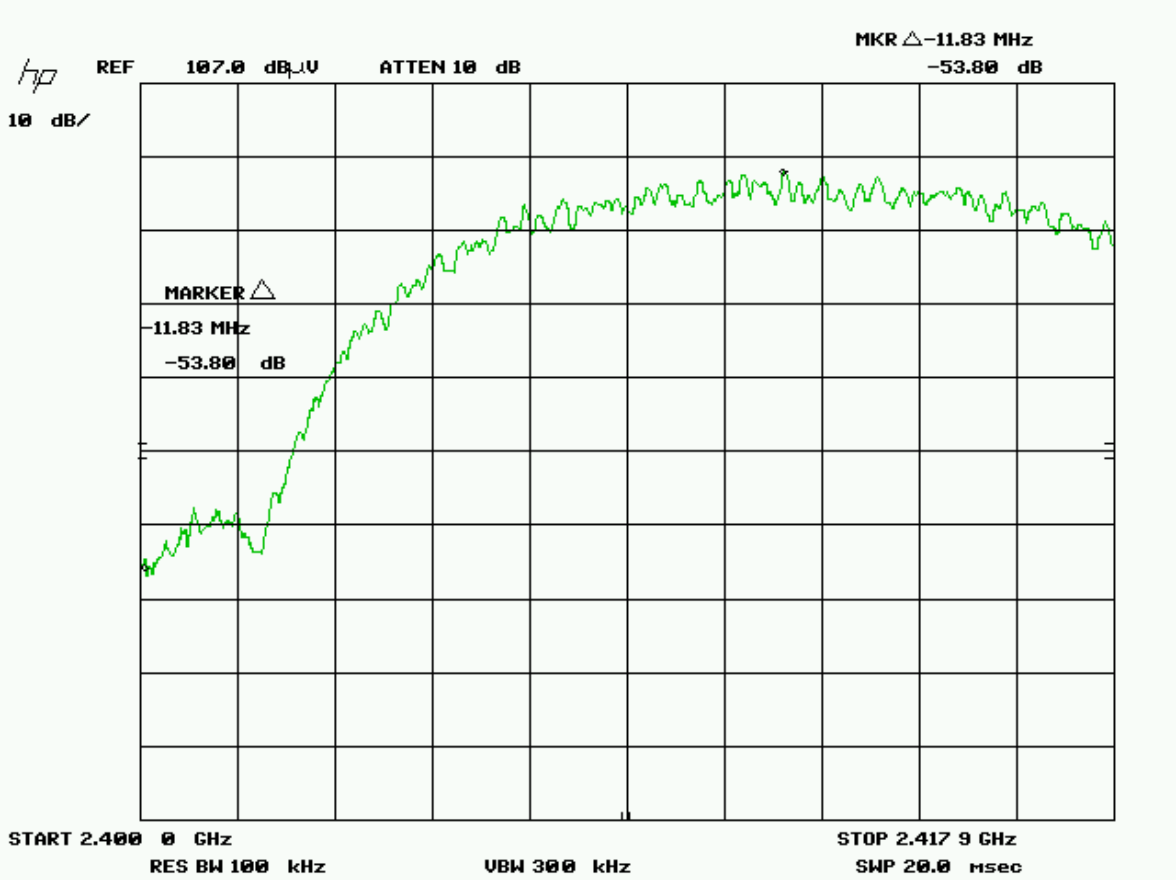
2 GHz – 22.5 GHz Hi
802.11 b



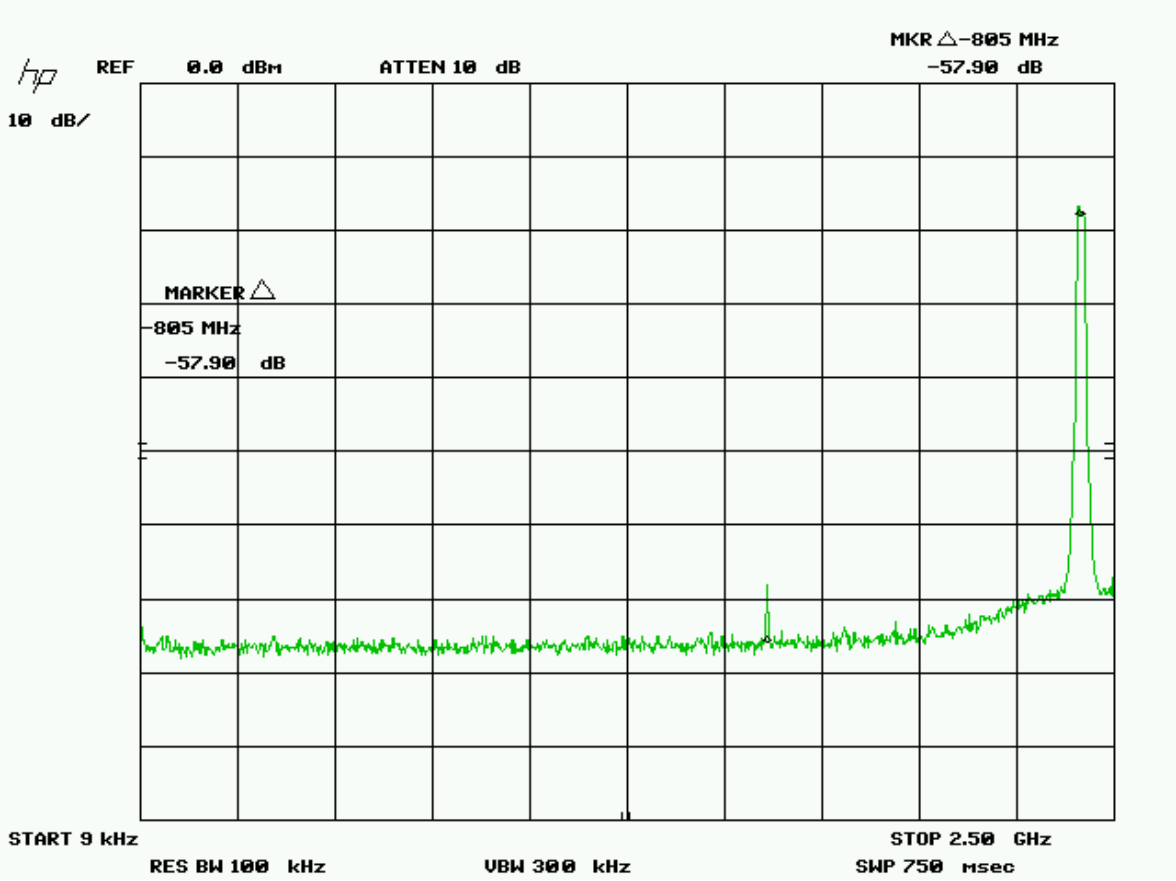
2483.5 MHz Band edge
802.11 b



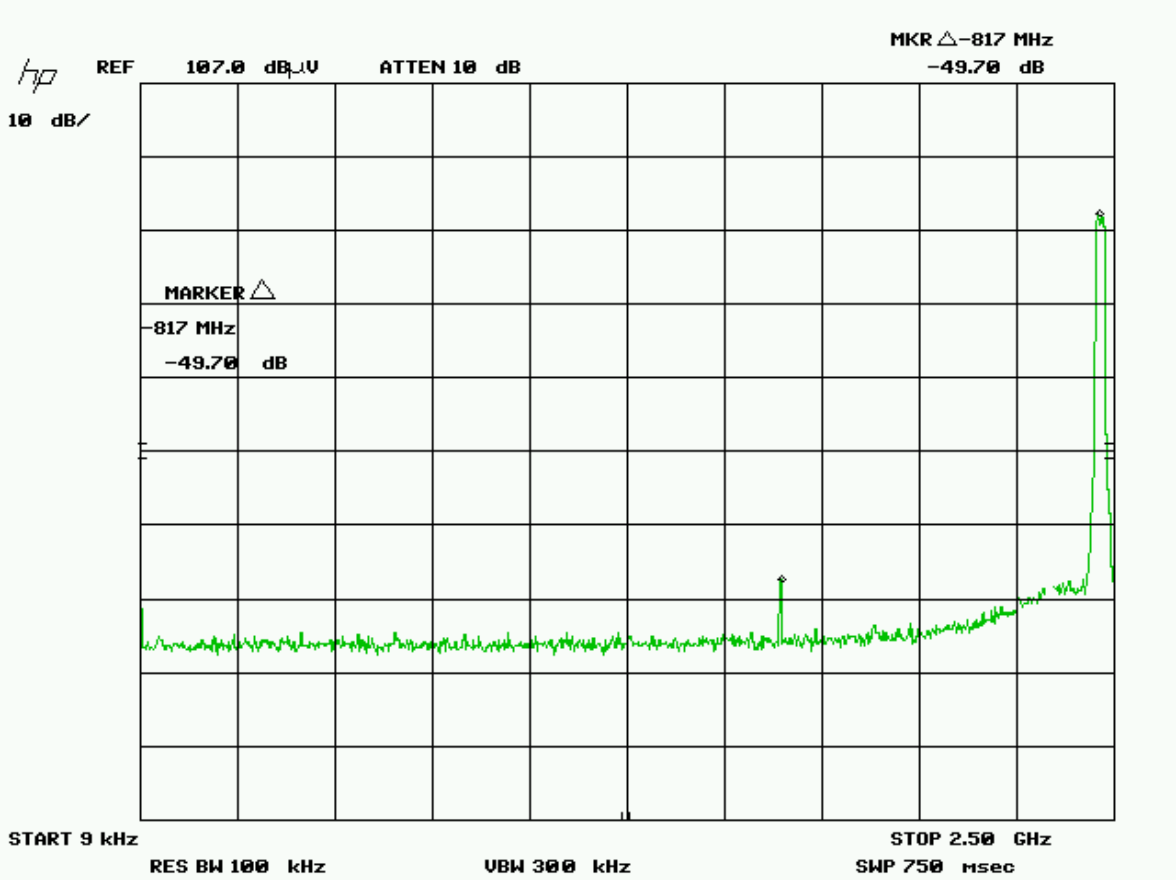
2390 MHz Band edge
802.11 b



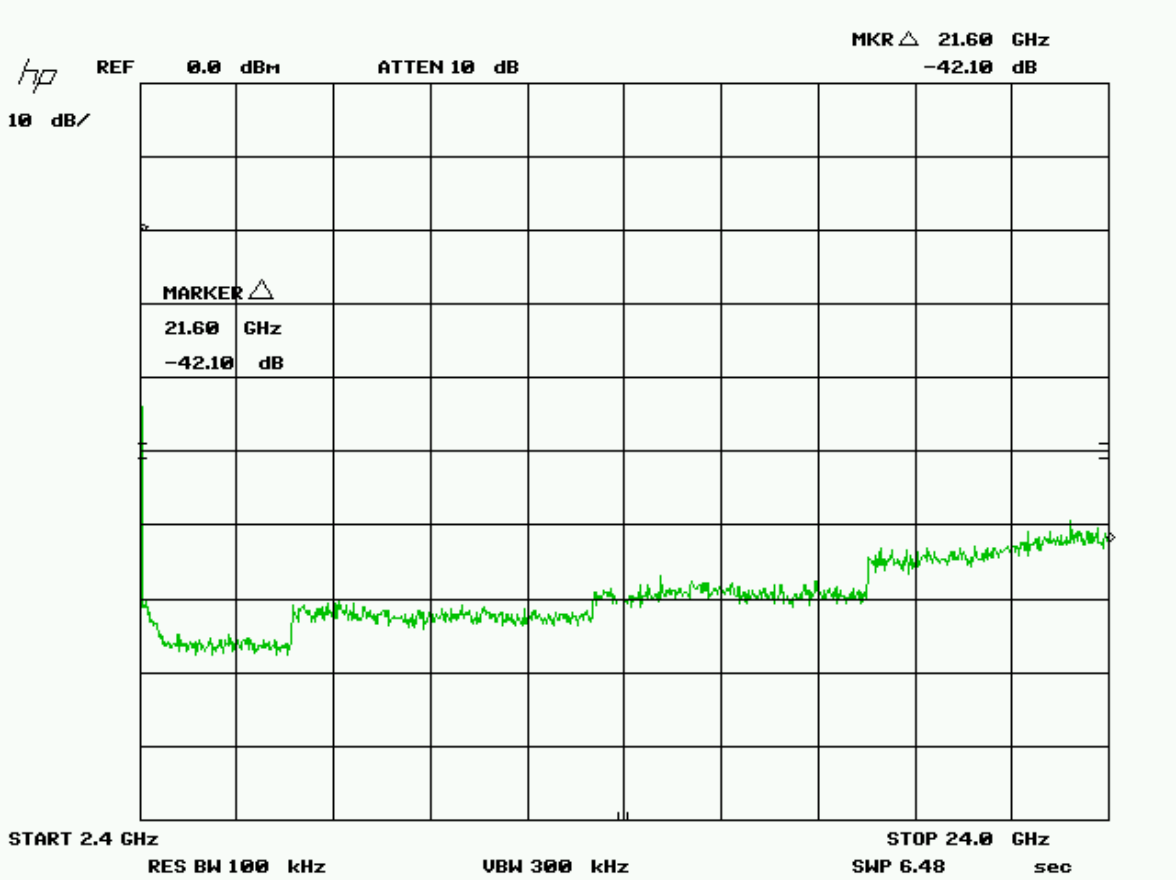
9 kHz – 2.5 GHz Lo
802.11 g



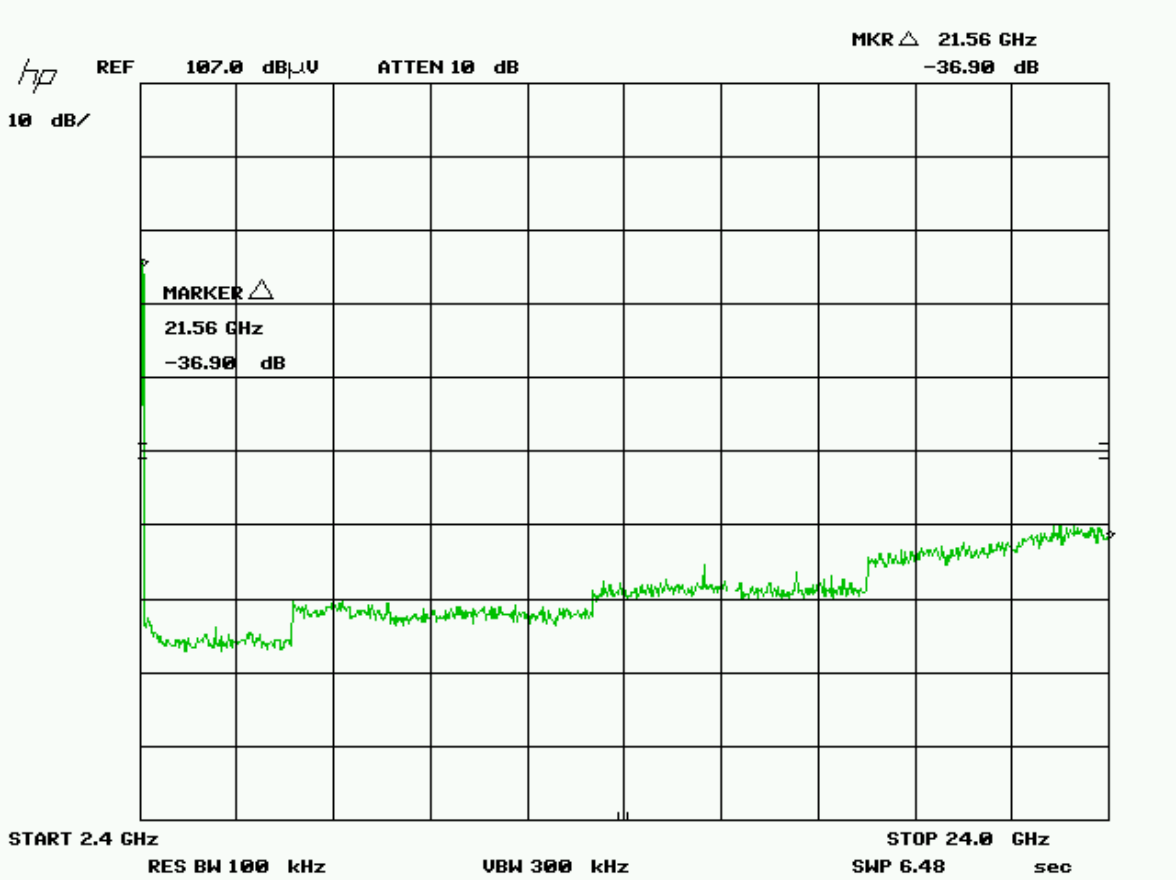
9 kHz – 2.5 GHz Hi
802.11 g



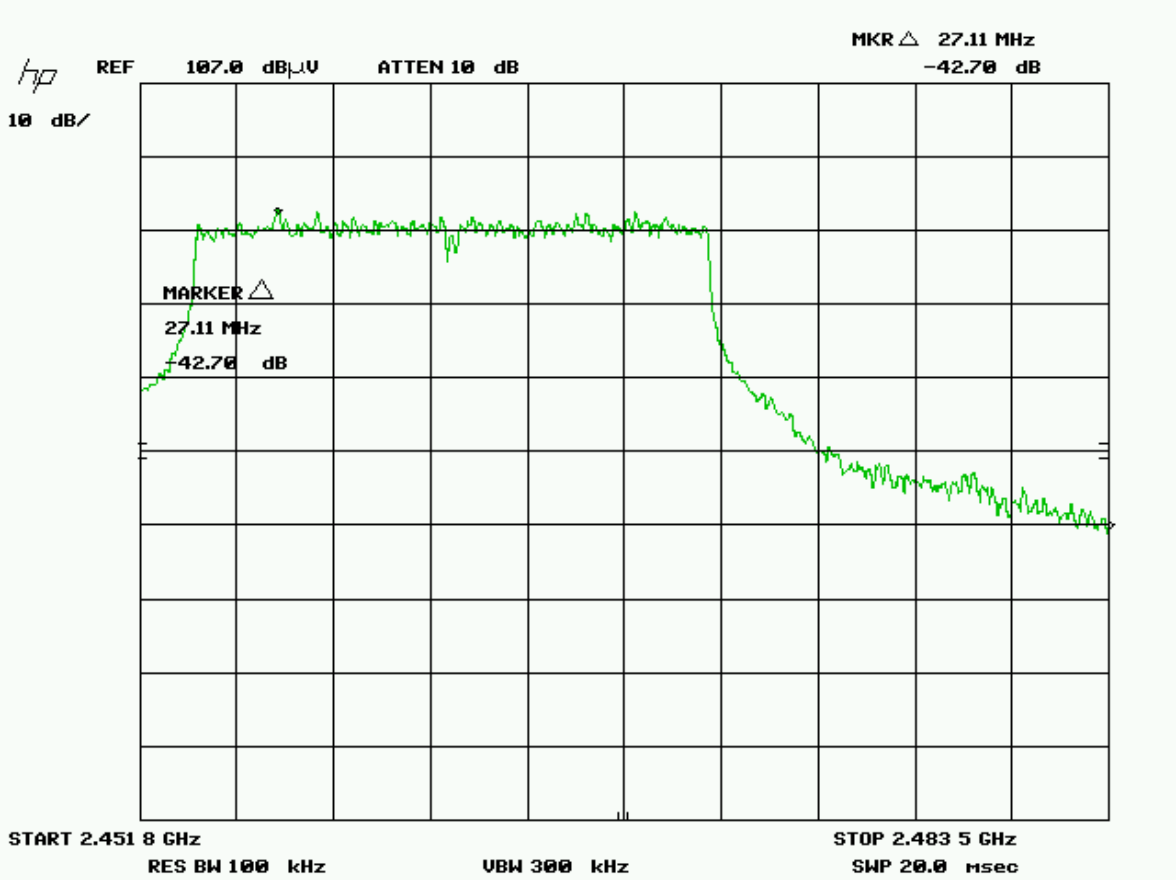
2 GHz – 22.5 GHz Lo
802.11 g



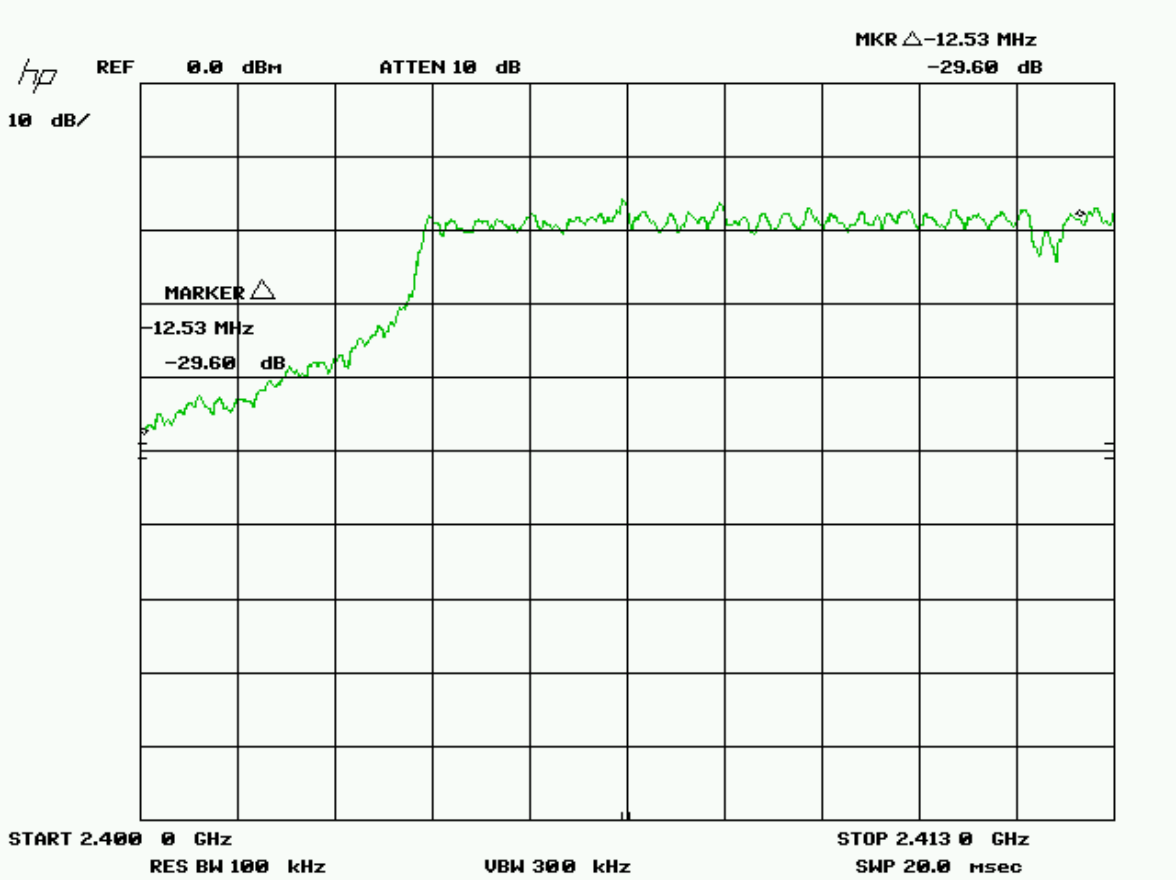
2 GHz – 22.5 GHz Hi
802.11 g



2483.5 MHz Band edge
802.11 g



2390 MHz Band edge
802.11 g



The plots show raw data and no correction factors are applied. They simply show a 20dbc differential between the peak and the band edge

Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Attenuator 1 dB	FP-50-1	Trilithic	NCR	NCR	GEMC 38
Attenuator 3 dB	FP-50-3	Trilithic	NCR	NCR	GEMC 40
Attenuator 6 dB	FP-50-6	Trilithic	NCR	NCR	GEMC 41
Attenuator 10 dB	FP-50-10	Trilithic	NCR	NCR	GEMC 42
Attenuator 20 dB	FP-50-20	Trilithic	NCR	NCR	GEMC 43
IFR Spectrum Analyzer	AN940	IFR	12/29/2009	12/29/2011	GEMC 6350
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29
Power Attenuator 20 dB	25-A-FFN-20	Bird / Hutton	NCR	NCR	GEMC 49

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Power Spectral Density

Purpose

The purpose of this test is to ensure that the maximum power spectral density to the radiating element does not exceed the limits specified. This ensures that the modulation is significantly wide enough, or low enough in power that it will allow for co-operation of other wireless devices operating within this frequency allocation.

Limits

The limits are defined in 15.247(e).

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.

Results

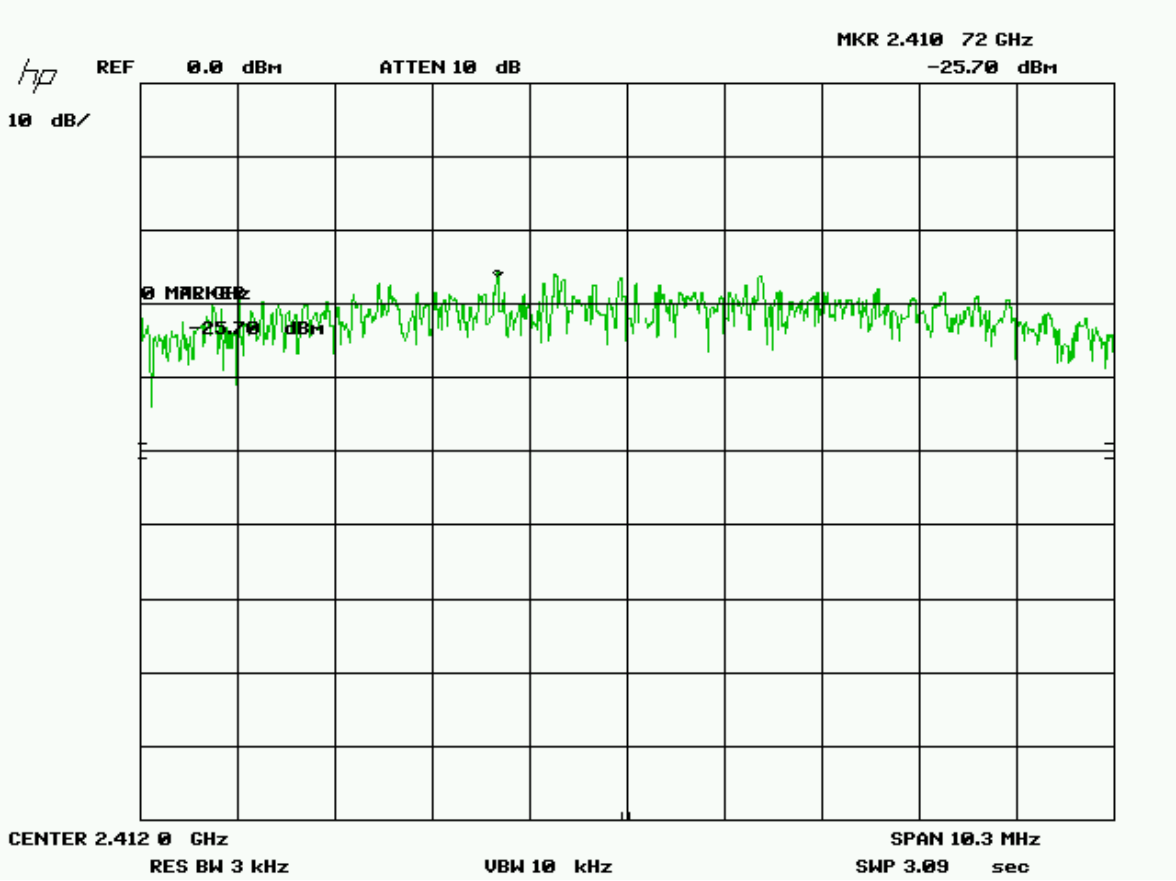
The EUT passed. Each mode was tested at low, medium, and high band. The worst case value is

1. 802.11 b
    a. Lo → -25.7 + 20 = -5.7 dbm
    b. Mid → -26.8 + 20 = -6.8 dbm
    c. Hi → -26.2 + 20 = -6.2 dbm
2. 802.11 g
    a. Lo → -25.1 + 20 = -5.1 dbm
    b. Mid → -25.6 + 20 = -5.6 dbm
    c. Hi → -24.6 + 20 = -4.6 dbm

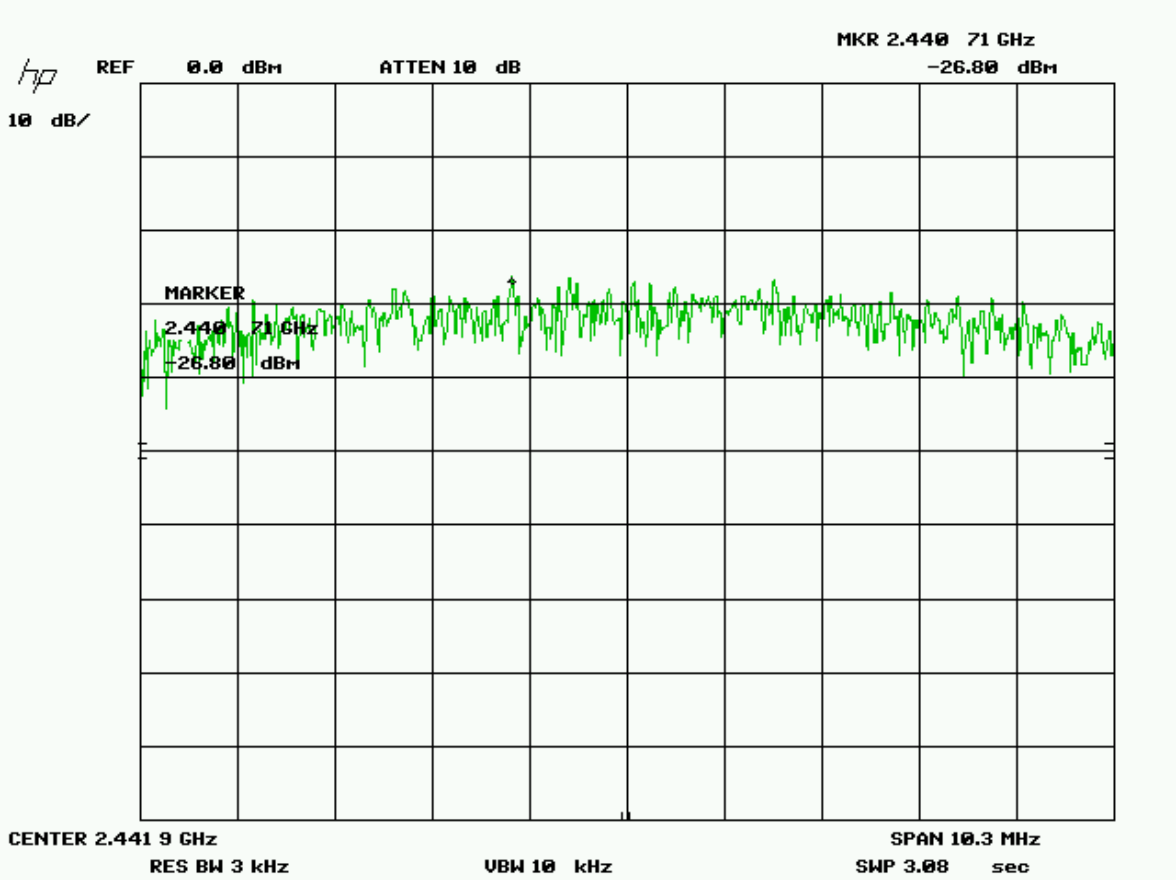
Graph(s)

The graphs shown below show the power spectral density of the device during the conducted measurement operation of the EUT. Low, middle, and high channel was investigated in each mode.

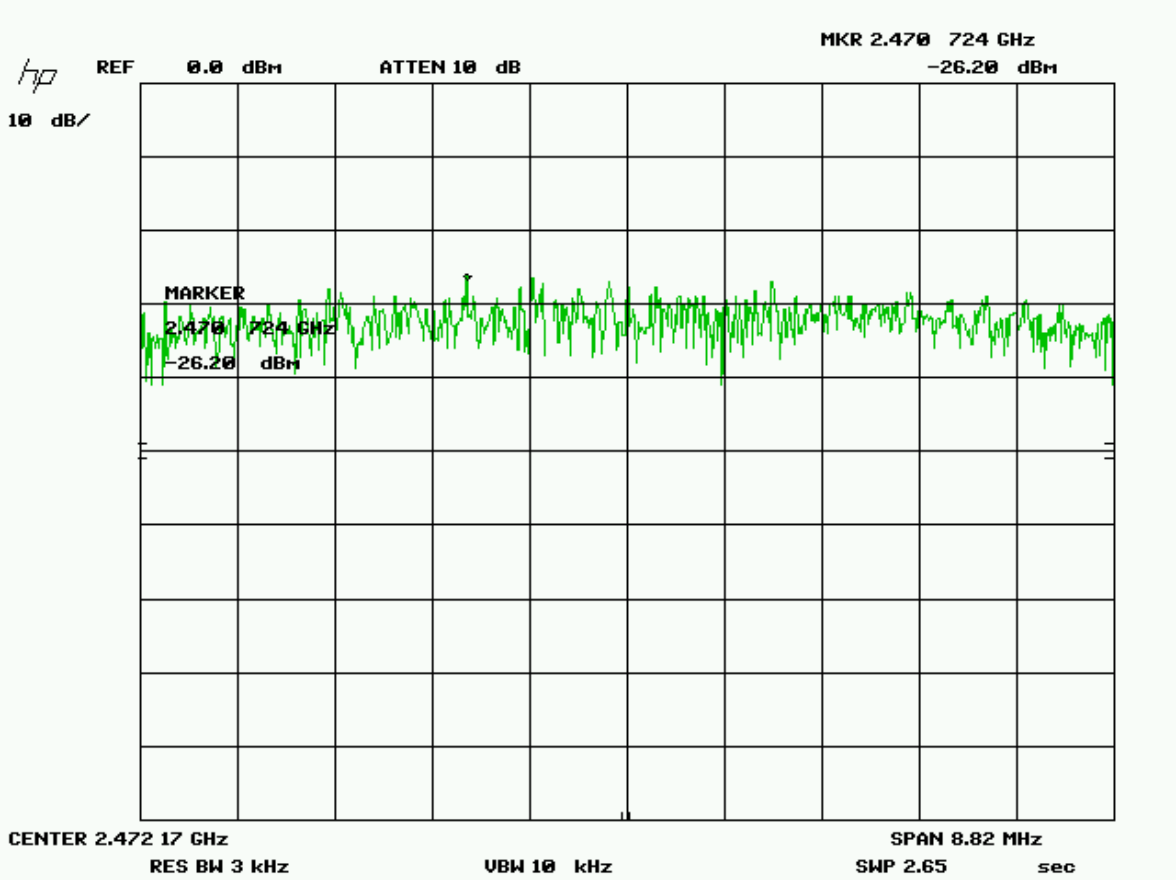
Low channel
802.11 b



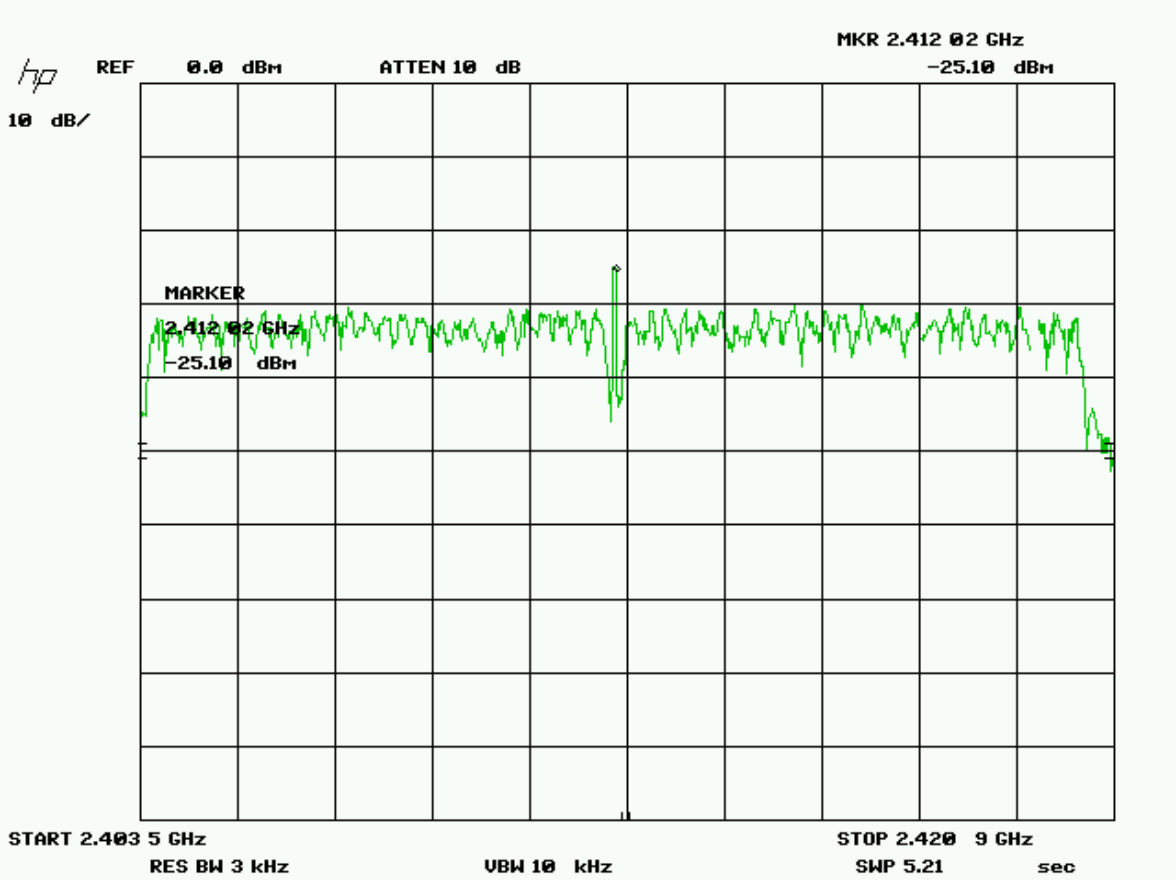
Med channel
802.11 b



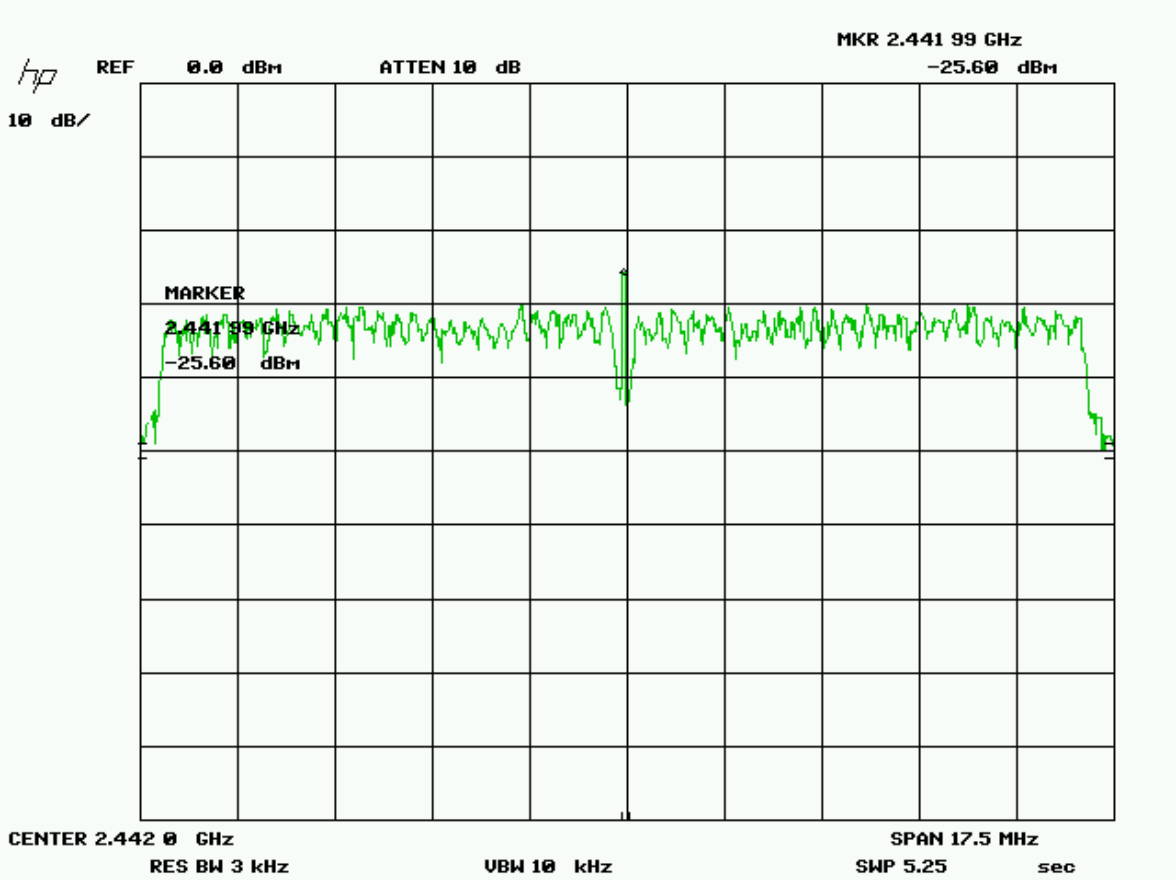
High channel
802.11 b



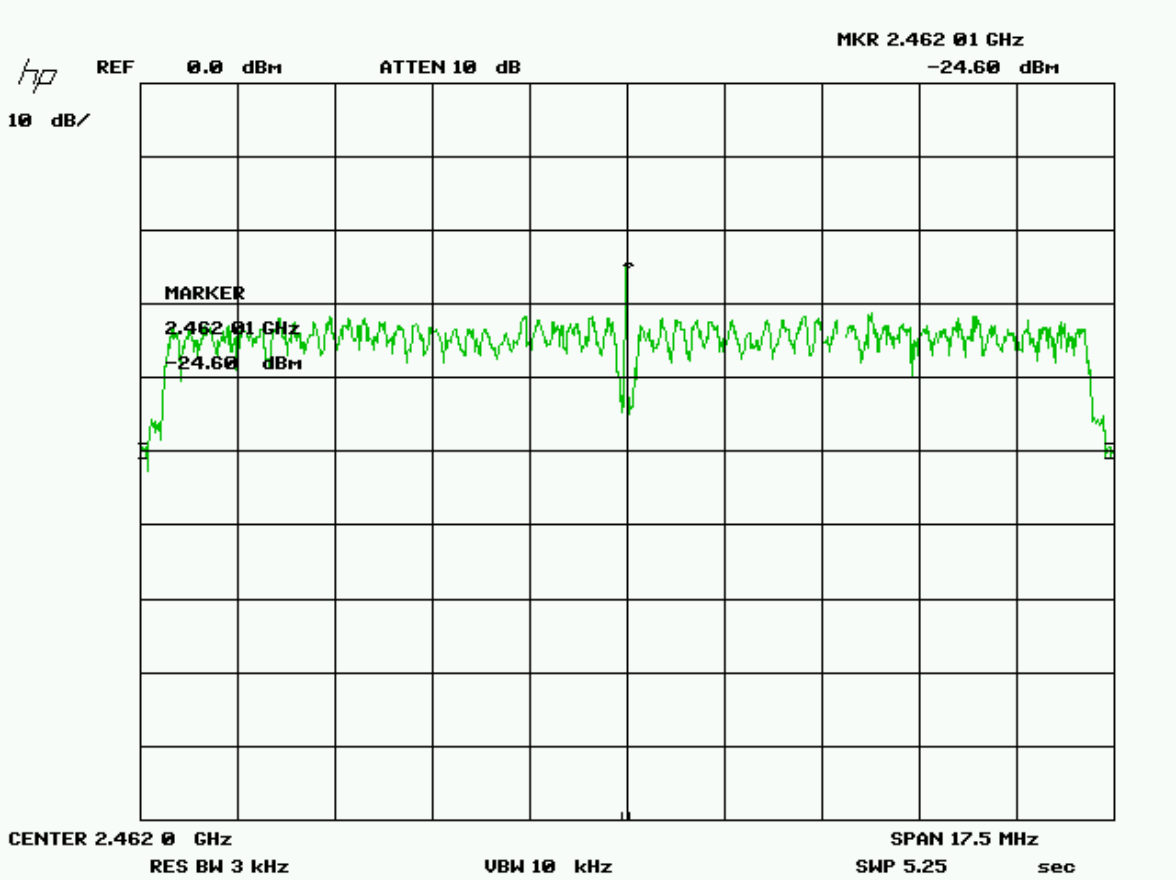
Low channel
802.11 g



Med channel
802.11 g



High channel
802.11 g



Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
IFR Spectrum Analyzer	AN940	IFR	12/29/2009	12/29/2011	GEMC 6350
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29
Power Attenuator 20 dB	25-A-FFN-20	Bird / Hutton	NCR	NCR	GEMC 49

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Maximum Permissible Exposure

Purpose

The purpose of this test is to ensure that the RF energy intentionally transmitted, in terms of power density emitted from the EUT at a stated operating distance does not exceed the limits listed below as defined in the applicable test standard, as calculated based upon readings obtained during testing. This helps protect human exposure to excessive RF fields.

Limit(s) and Method

The limits, as defined in FCC 15.247(i) and FCC 1.1310 Table 1 (B) limits for general public exposure was applied. The limit for the frequency range of 1.5 GHz to 100 GHz was applied. This is a limit of 1.0 mW/ cm^2. The distance used for calculations was 20cm, as this is the minimum distance an operator will be from the EUT during normal operation, as stated by the manufacturer.

Results

The EUT passed the requirements. The worst case calculated power density was 0.023 mW/cm^2 for 802.11 b and 0.039 mW/cm^2 for 802.11g, this is significantly under the 1.0 mW/cm^2 requirement.

Calculations

Method 1 (conducted power)

802.11 b

$P_d = (P_t * G) / (4 * pi * R^2)$
Where Pt = 17.85 dbm or 60.95mW as per Peak power conducted output
Where G = 2.8 dBi, or numerically 1.9
Where R = 20 cm

$P_d = (60.95 \times 1.9) / (4 \times pi \times 20cm^2)$
$P_d = 116.14$ mW / 5026 cm^2
$P_d = 0.023$ mW/cm^2

802.11 g

$P_d = (P_t * G) / (4 * pi * R^2)$
Where Pt = 20.1 dbm or 102.33 mW as per Peak power conducted output
Where G = 2.8 dBi, or numerically 1.9
Where R = 20 cm

$P_d = (102.39 \times 1.9) / (4 \times pi \times 20cm^2)$
$P_d = 194.98$ mW / 5026 cm^2
$P_d = 0.039$ mW/cm^2

Appendix A – EUT Summary

General EUT Description

Client	
Organization	Golden Power Manufacturing Ltd.
Contact	Wincan Chan
Address	1004 Kwan Chart Tower, 6 Tonnochoy road, Honk Kong.
EUT Details	
EUT Model number	RTMV-01
Equipment Category	Wireless module for energy management applications.
Basic EUT Functionality	RTMV-01 is a RF Device that is used for thermostat control. It operates on 802.11b and 802.11g Wifi protocols.
Input Voltage and Frequency	3 Vdc
Connectors available on EUT	None.
Peripherals Required for Test	None.
Release type	Final
Intentional Radiator Frequency	2400 – 2475 MHz for 802.11 b applications. 2400 – 2465.0 MHz for 802.11 g applications.

Note the EUT is considered to have been received the date of the commencement of the first test, unless otherwise stated. For a close-up picture of the EUT, see 'Appendix B – EUT & Test Setup Photographs'.

Appendix B – EUT and Test Setup Photographs

Figure 1 – EUT

Figure 2 – Radiated emission setup

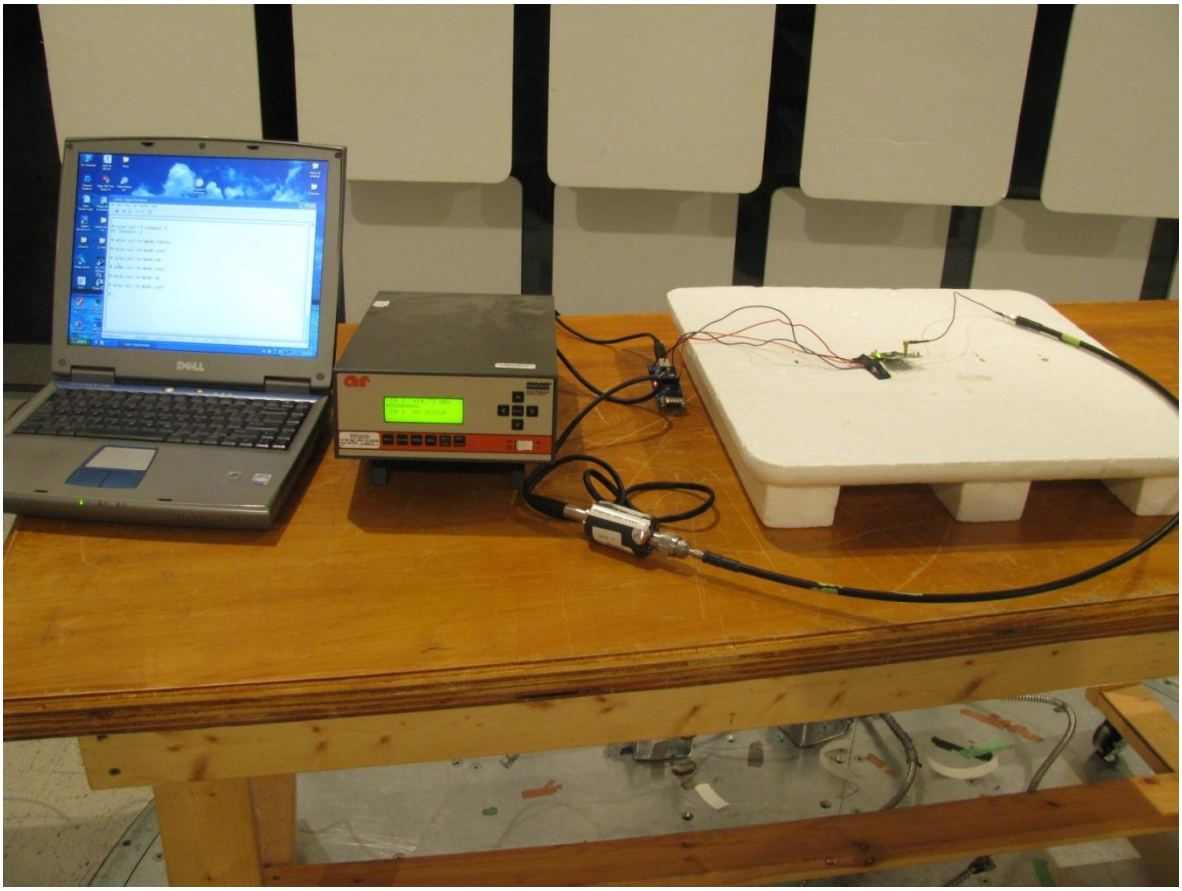


Figure 3 – Conducted power measurements

Note: These photos are for information purposes only. Also refer to PDF files that are separate from this test report.