Global EMC Inc. Labs

RF Test Report

As per

RSS 210 Issue 7:2007

&

FCC Part 15 Subpart C:2008

Unlicensed Intentional Radiators

on the

Viconics VWG-APP Wireless module

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Testing produced for

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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This report is based on GEMC Template "FCC 15 247 Rev2."

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Report Scope

This report addresses the EMC verification testing and test results of the Viconics Wireless Radio Module (VWG-APP), 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 15:2008

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.

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Client	Viconics
Product	VWG-APP
Standard(s)	RSS 210 Issue 7:2007 / FCC Part 15 Subpart C 15:2008

Summary

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

EUT FCC Certification #, FCC ID:	V95-VWG-APP
EUT Industry Canada Certification #, IC:	7591A-VWG-APP
EUT Passed all tests performed.	Yes (see test results summary)
Tests conducted by	Ashwani Malhotra

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Client	Viconics
Product	VWG-APP
Standard(s)	RSS 210 Issue 7:2007 / FCC Part 15 Subpart C 15:2008

Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique	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	Pass
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 See Justifications
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	Portable. 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 ‘*’.

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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 reverse polarity SMA connector on the VWG-APP.

For the Restricted Bands of operation, the EUT is designed to only operate between 2400 – 2483.5MHz

.

For the Antenna gain, the unit uses a 3 dbi antenna. There is a provision to use the antenna with an extension cable approximately 5.0 foot in length. The unit was tested for spurious emissions with this cable and no spurious emissions higher than the ones recorded below were recorded. The effective gain of the antenna (with cable loses) ends up being less than the setup without the cable.

The board was tested horizontally and vertically as it is a module. The worst case emissions were recorded with the unit in vertical orientation. All radiated test data in this report represents this orientation.

For maximum permissible exposure, this device operates at less than 1 Watt at 2400 – 2483.5 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.

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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

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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 – May 27, 2009 – Initial report release.

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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

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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.

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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)
May 3 – 8, 2009	All	AM	21-24ºC	35-46%	100.1 - 102.3kPa

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Detailed Test Results Section

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Power Line Conducted Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT's power line does not exceed the limits listed below as defined in the applicable test standard, as measured from a LISN. This helps protect lower frequency radio services such as AM radio, shortwave radio, amateur radio operators, maritime radio, CB radio, and so on, from unwanted interference.

Limits & Method

The limits are as defined in 47 CFR FCC Part 15 Section 15.207
Method is as defined in ANSI C64:2003

Average Limits		QuasiPeak Limits	
150 kHz – 500 kHz	56 to 46 dBuV	150 kHz – 500 kHz	66 to 56 dBuV
500 kHz – 5 MHz	46 dBuV	500 kHz – 5 MHz	56 dBuV
5 MHz – 30 MHz	50 dBuV	500 kHz – 30 MHz	60 dBuV

The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

Note: If the Peak or Quasi Peak detector measurements do not exceed the Average limits, then the EUT is deemed to have passed the requirements.

Both limits are applicable, and each is specified as being measured with a 9 kHz measurement bandwidth .

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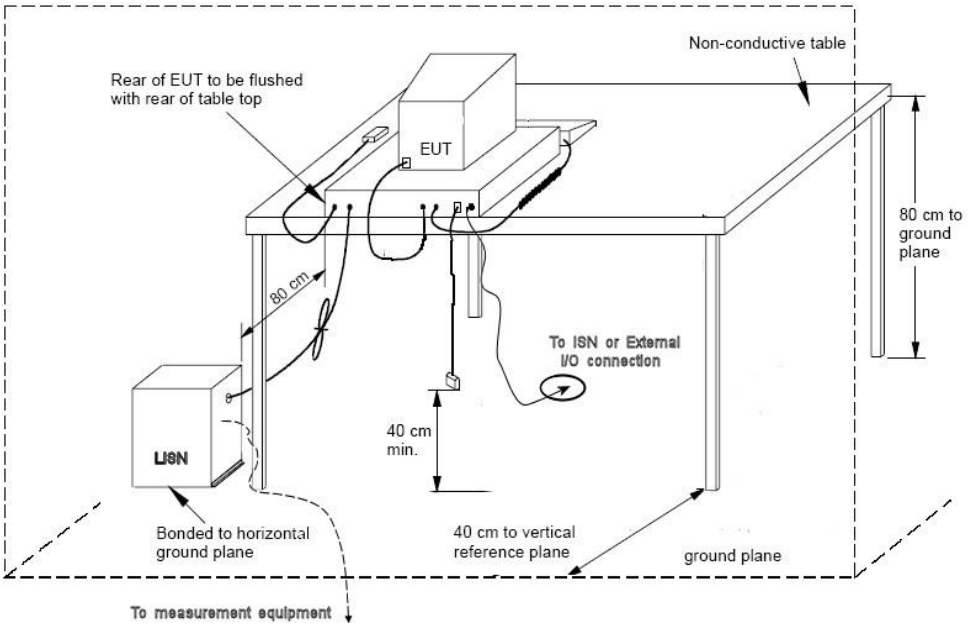
Typical Setup Diagram



Note: The vertical reference plane is optional as per ANSI C63.4 section 5.2.2

Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is +/-3.6 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 where applicable, please refer to the table. The graph shown below is a peak measurement graph, measured with a resolution bandwidth greater then or equal to the final required detector. This graphs are performed as a worst case measurement to enable the detection of frequencies of concern and for considerable time savings.

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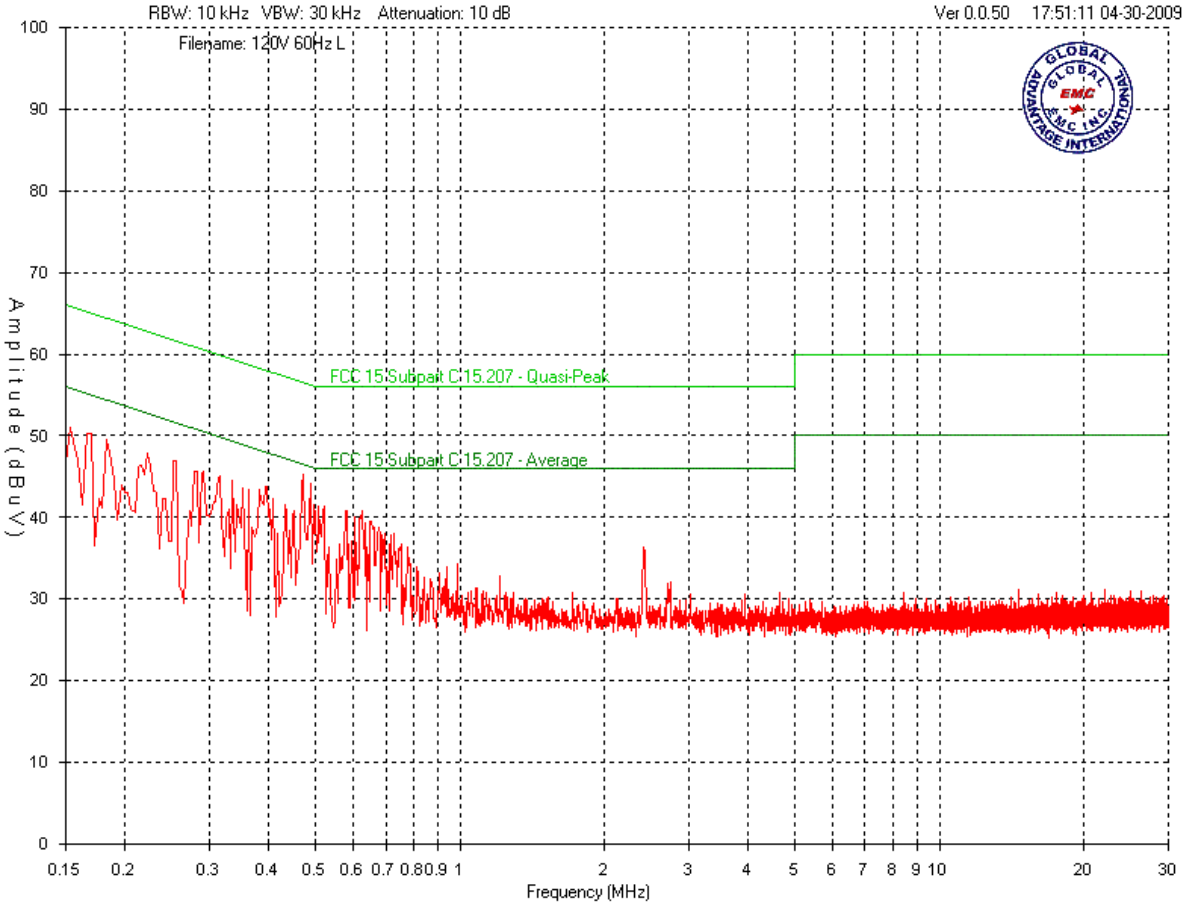
120V 60Hz Line



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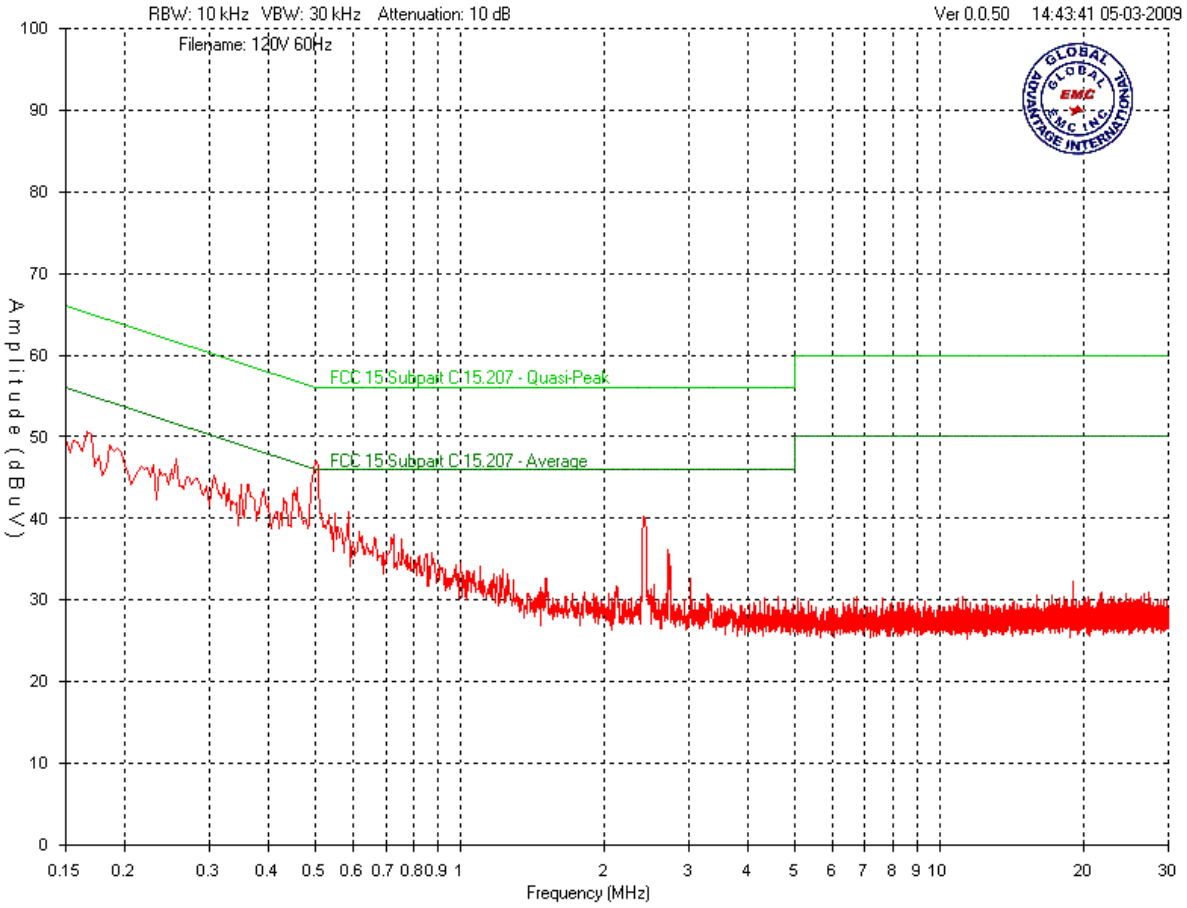
120V 60Hz Neutral



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Client	Viconics
Product	VWG-APP
Standard(s)	RSS 210 Issue 7:2007 / FCC Part 15 Subpart C 15:2008

Final Measurements

Average emissions results

Product category	Class B Avg								
Project	Viconics								
Test Frequency (MHz)	**Detection mode (Q-Peak / Avg)**	**Raw signal (dBuV)**	**Cable loss (dB)**	**Attenuator (dB)**	**LISN factor (dB)**	**Received signal (dBuV)**	**Emission limit (dBuV)**	**Margin (dBuV)**	**Result**
120V 60Hz L									
0.15	Avg	29	0.2	10	0.05	39.25	56	16.75	PASS
0.478	Avg	33	0.2	10	0.02	43.22	47	3.78	PASS
2.42	Avg	23.4	0.2	10	0.03	33.63	46	12.37	PASS
120V 60Hz N									
0.15	Avg	28.3	0.2	10	0.05	38.55	56	17.45	PASS
0.48	Avg	34	0.2	10	0.02	44.22	47	2.78	PASS
2.42	Avg	23.4	0.2	10	0.03	33.63	46	12.37	PASS

QP emissions results

Product category	Class B QP								
Project	Viconics								
Test Frequency (MHz)	**Detection mode (Q-Peak / Avg)**	**Raw signal (dBuV)**	**Cable loss (dB)**	**Attenuator (dB)**	**LISN factor (dB)**	**Received signal (dBuV)**	**Emission limit (dBuV)**	**Margin (dBuV)**	**Result**
120V 60Hz L									
0.15	QP	35	0.2	10	0.05	45.25	66	20.75	PASS
0.478	QP	34	0.2	10	0.02	44.22	57	12.78	PASS

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2.42	QP	24	0.2	10	0.03	34.23	56	21.77	PASS
120V 60Hz N									
0.15	QP	33	0.2	10	0.05	43.25	66	22.75	PASS
0.48	QP	38.2	0.2	10	0.02	48.42	57	8.58	PASS
2.42	QP	24.5	0.2	10	0.03	34.73	56	21.27	PASS

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

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	2008-02-28	2010-02-28	GEMC 6
Quasi Peak Adapter	85650A	HP	2008-02-28	2010-02-28	GEMC 7
LISN	FCC-LISN-50/250-16-2-01	FCC	2009-02-11	2011-02-11	GEMC 65
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
Attenuator 10 dB	FP-50-10	Trilithic	NCR	NCR	GEMC 42

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

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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 (25 GHz).

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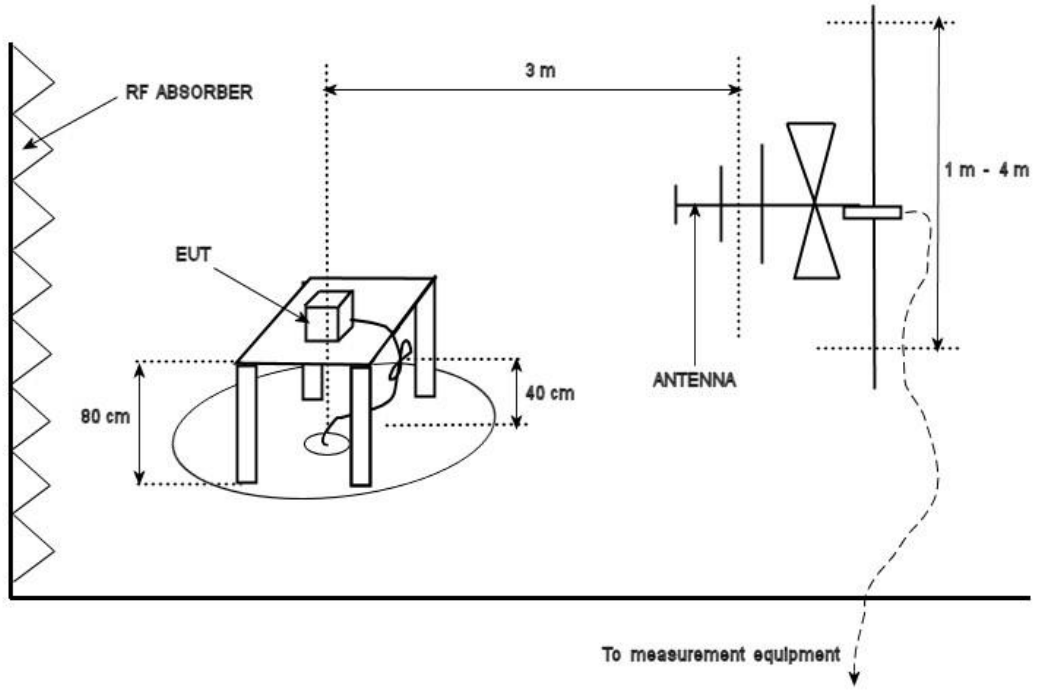
Typical Radiated Emissions Setup



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.

The graphs shown for the frequency ranges are representative of low, middle and high band emissions.

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

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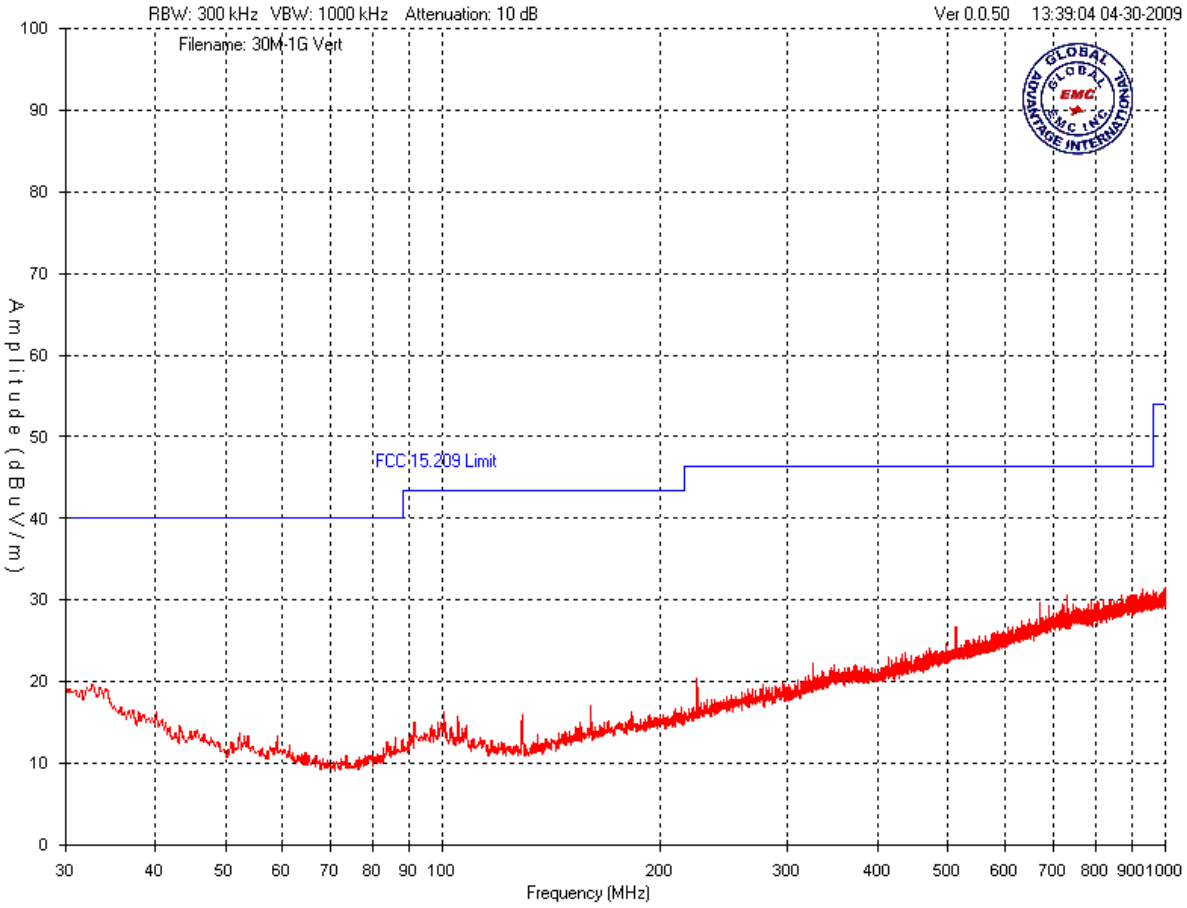
Mid Channel (worst case)
30MHz – 1 GHz Vertical peak emissions



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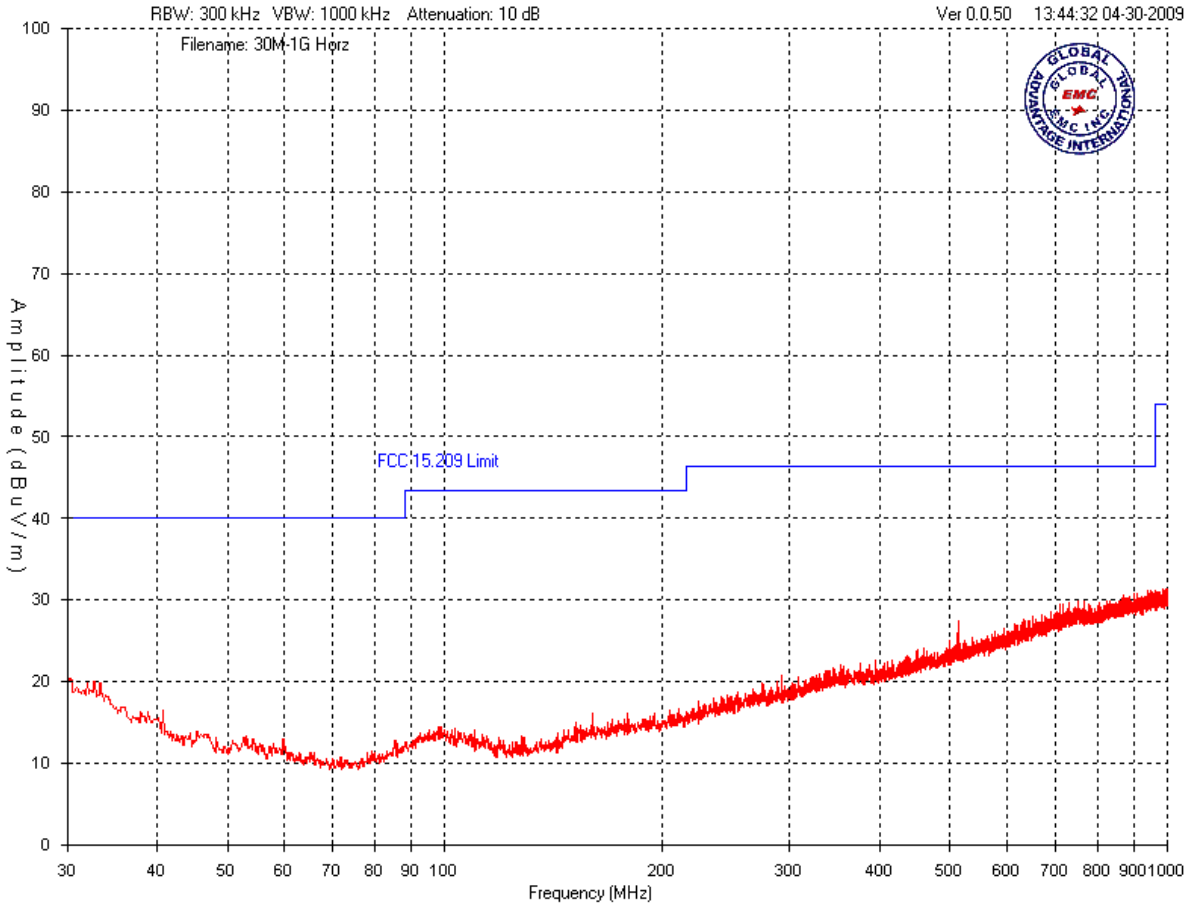
Mid Channel (worst case)
30MHz – 1 GHz Horizontal peak emissions



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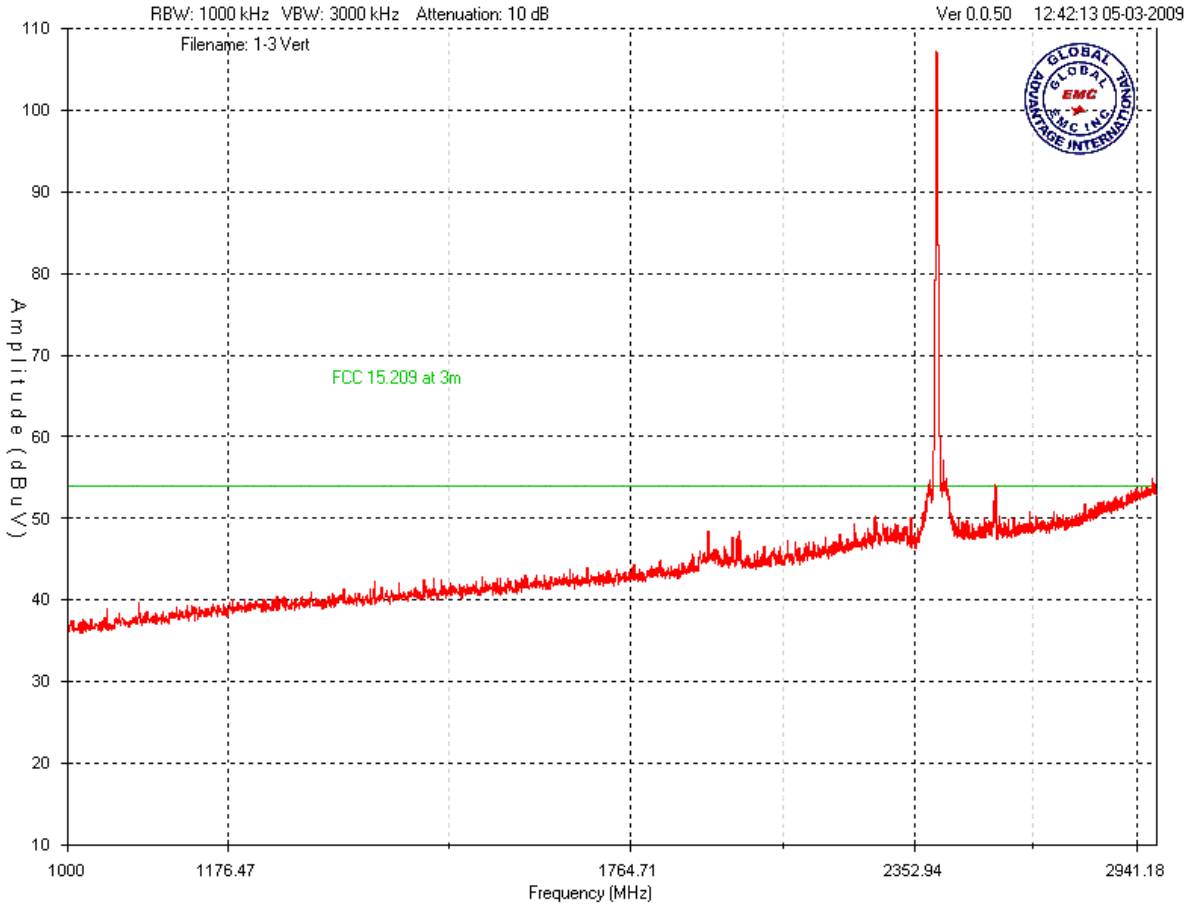
Mid Channel (worst case)
1 GHz – 3 GHz Vertical peak emissions



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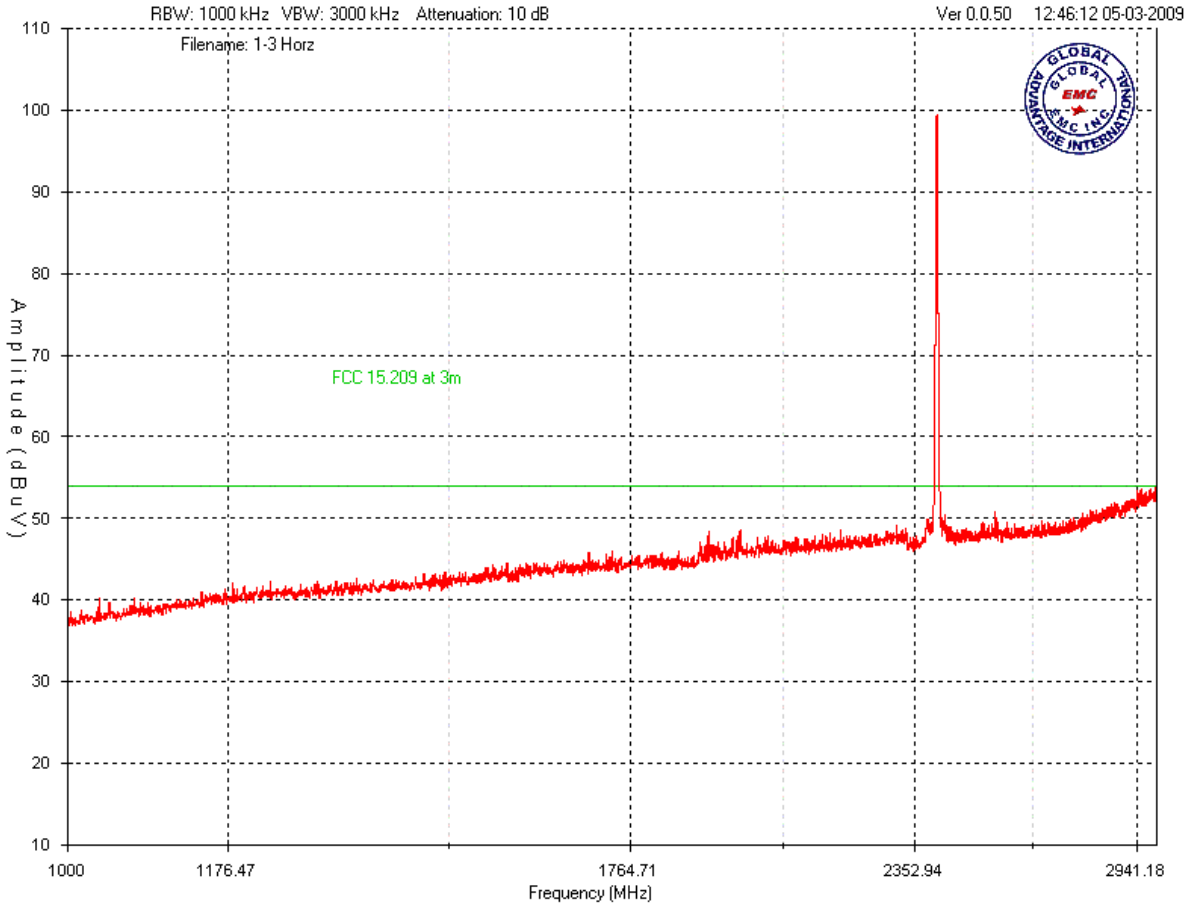
Mid Channel (worst case)
1 GHz – 3 GHz Horizontal peak emissions



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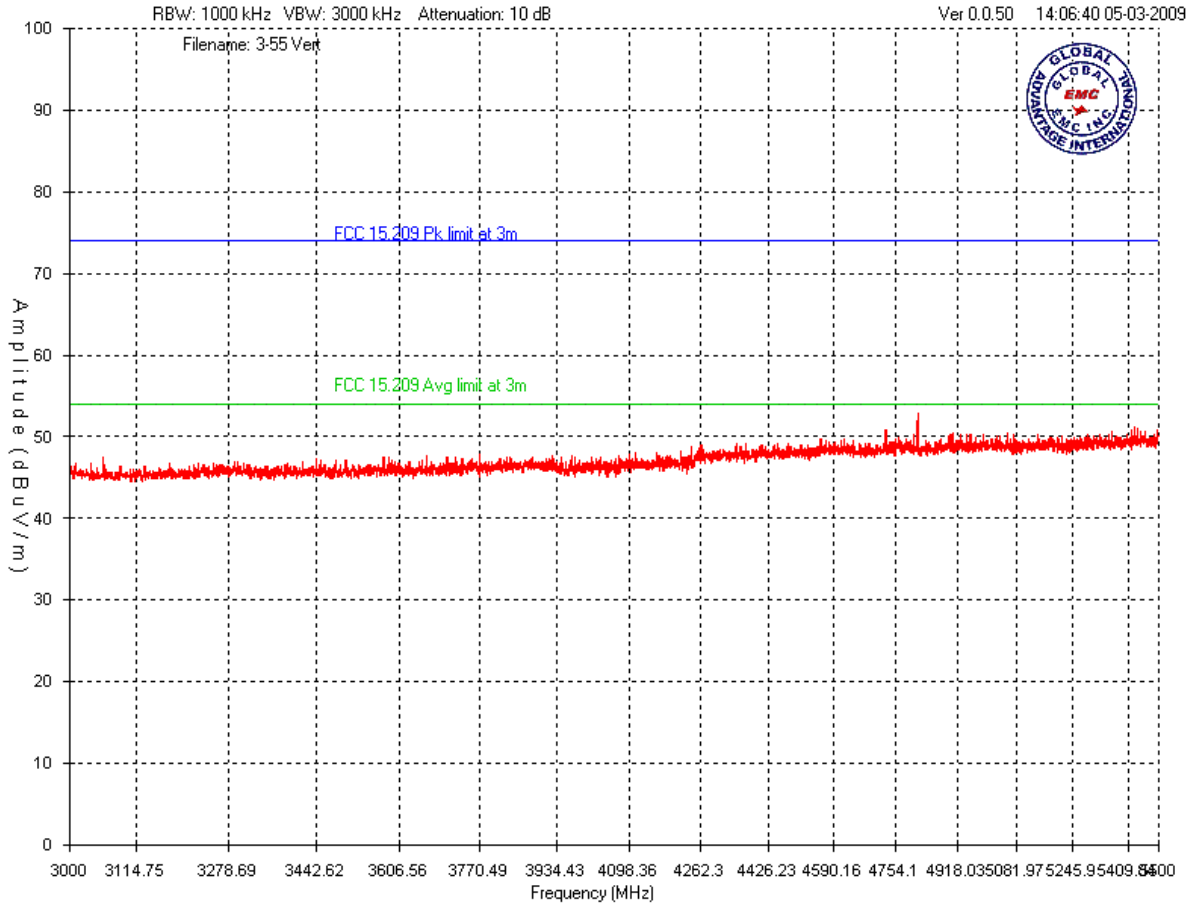
Mid Channel (worst case)
3 GHz – 5.5 GHz Vertical peak emissions



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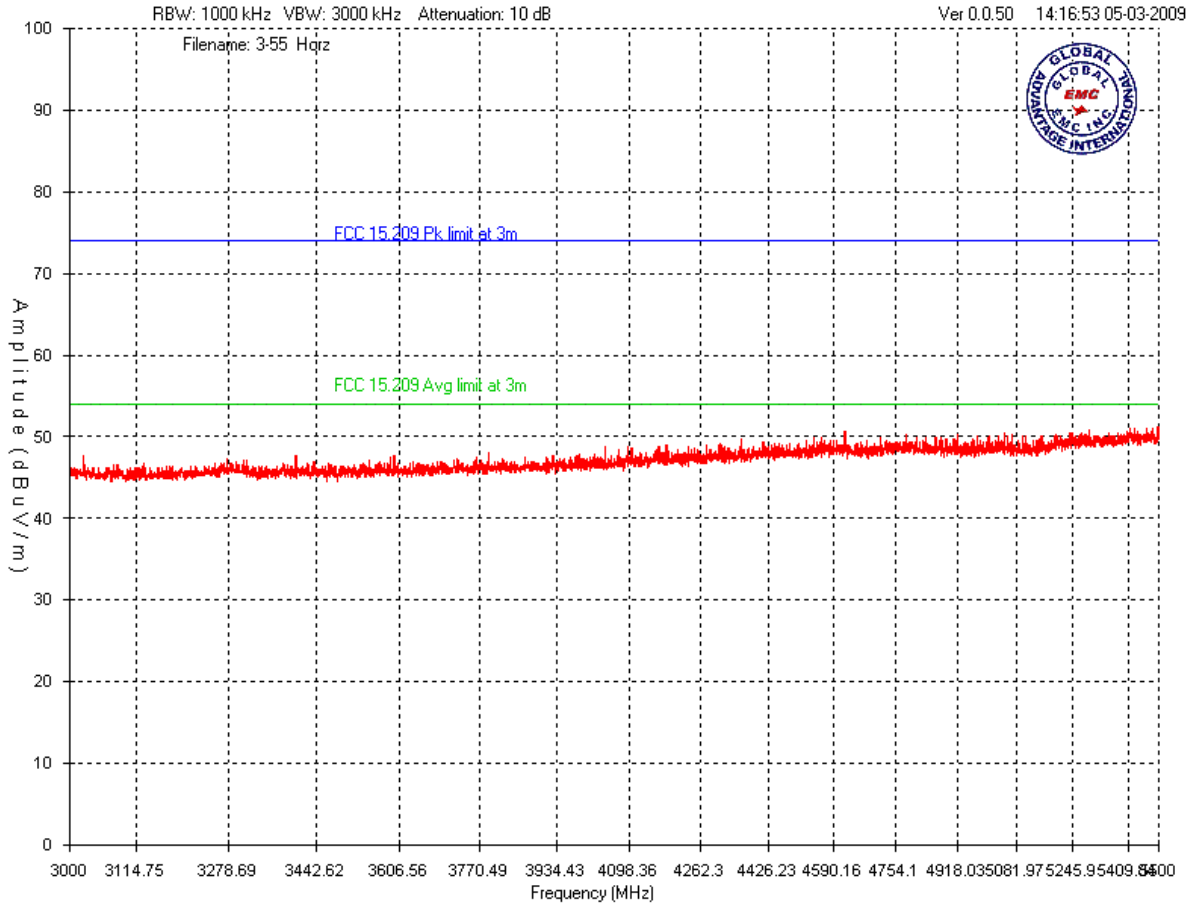
Mid Channel (worst case)
3 GHz – 5.5 GHz Horizontal peak emissions



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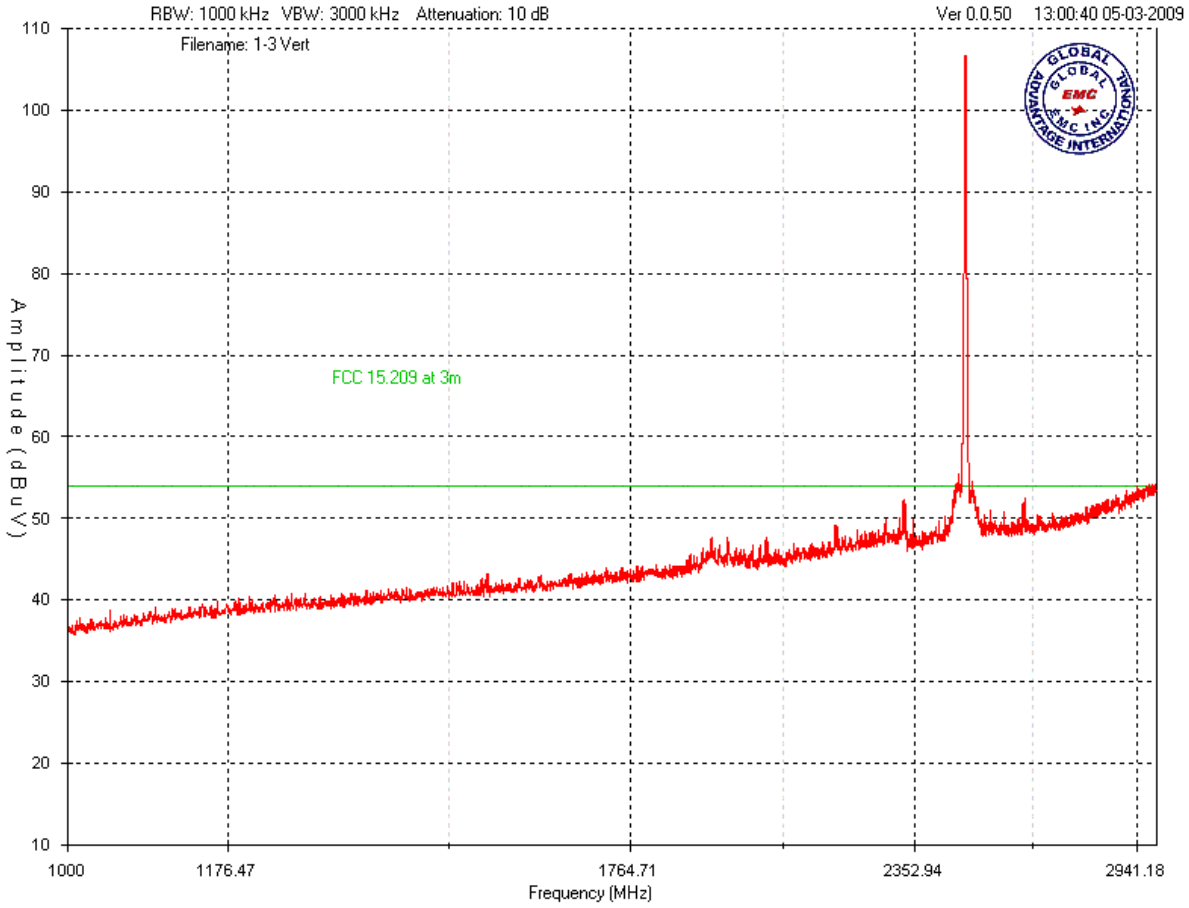
Hi Channel
1 GHz – 3 GHz Vertical peak emissions



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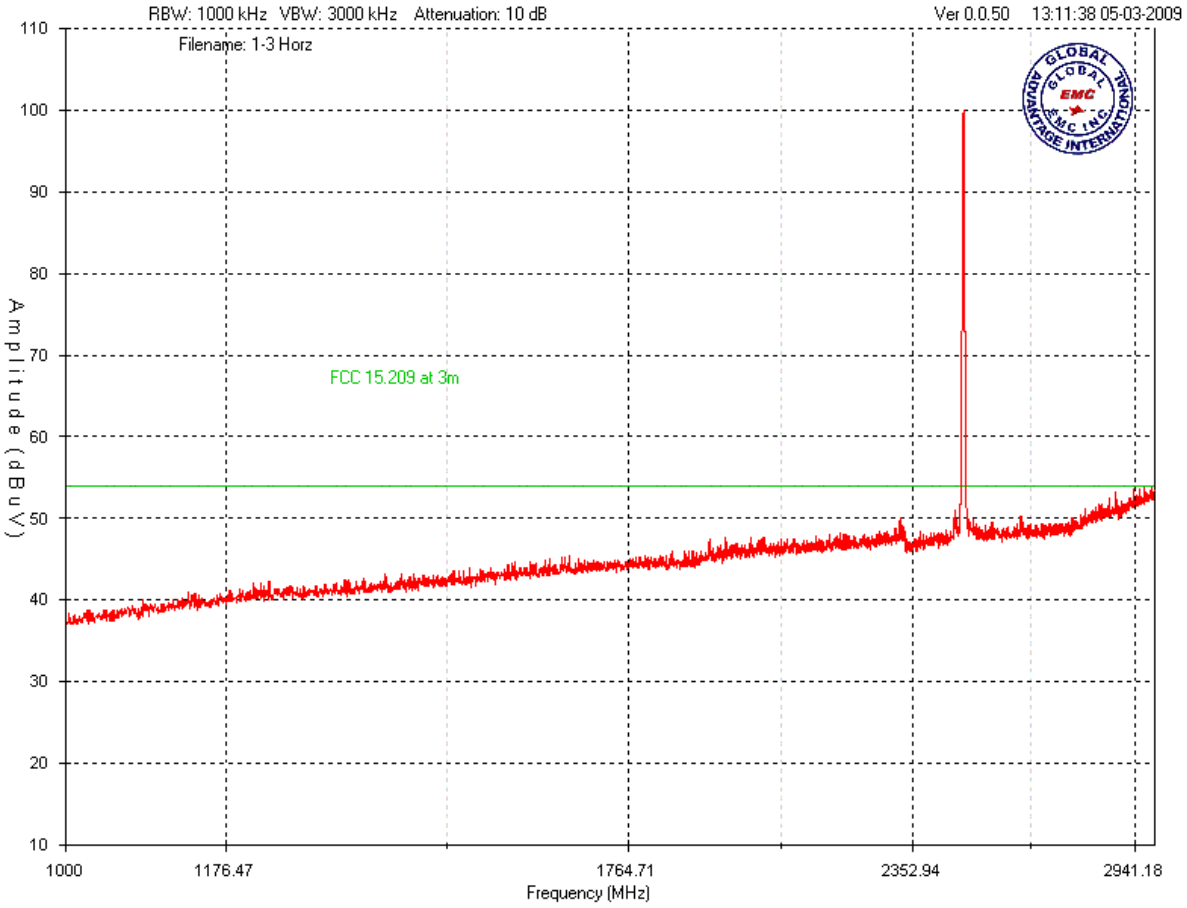
Hi Channel
1 GHz – 3 GHz Horizontal peak emissions



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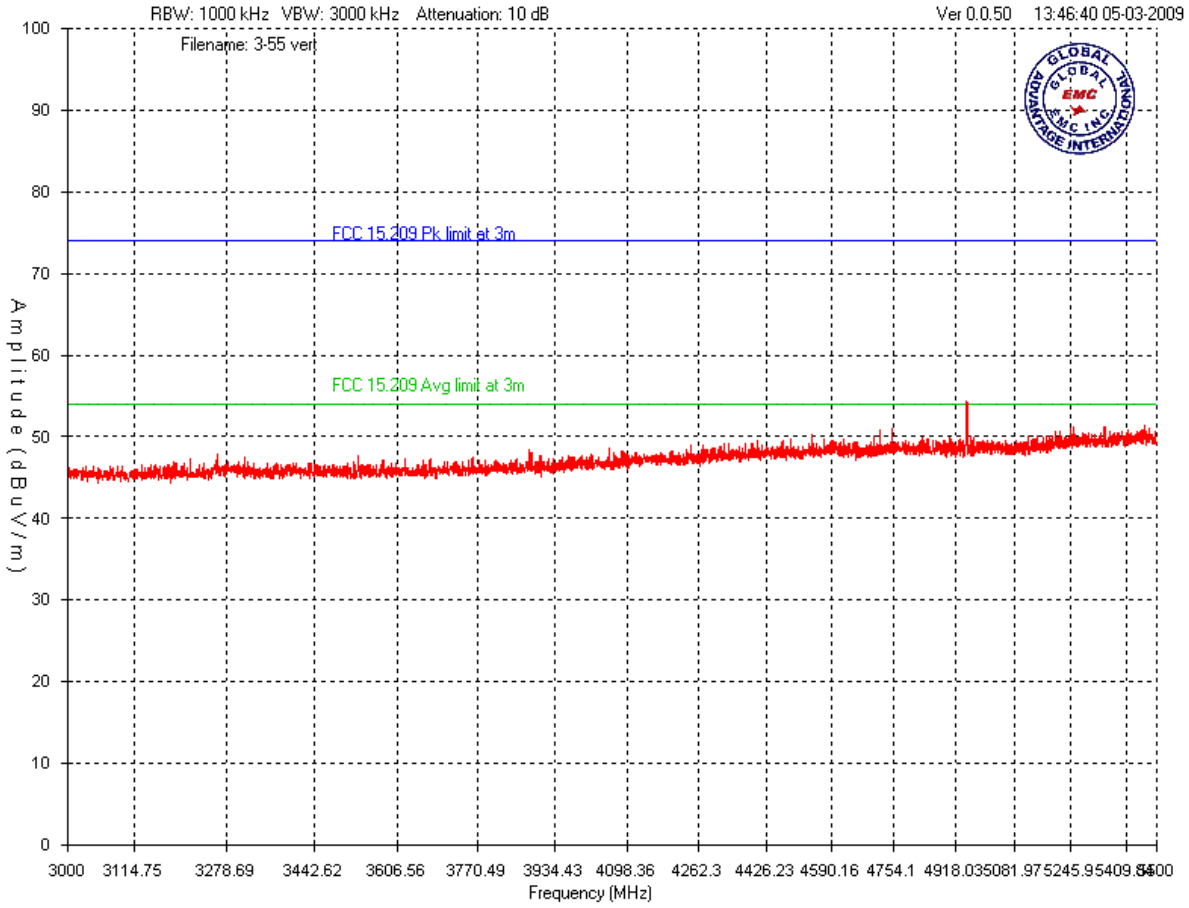
Hi Channel
3 GHz – 5.5 GHz Vertical peak emissions



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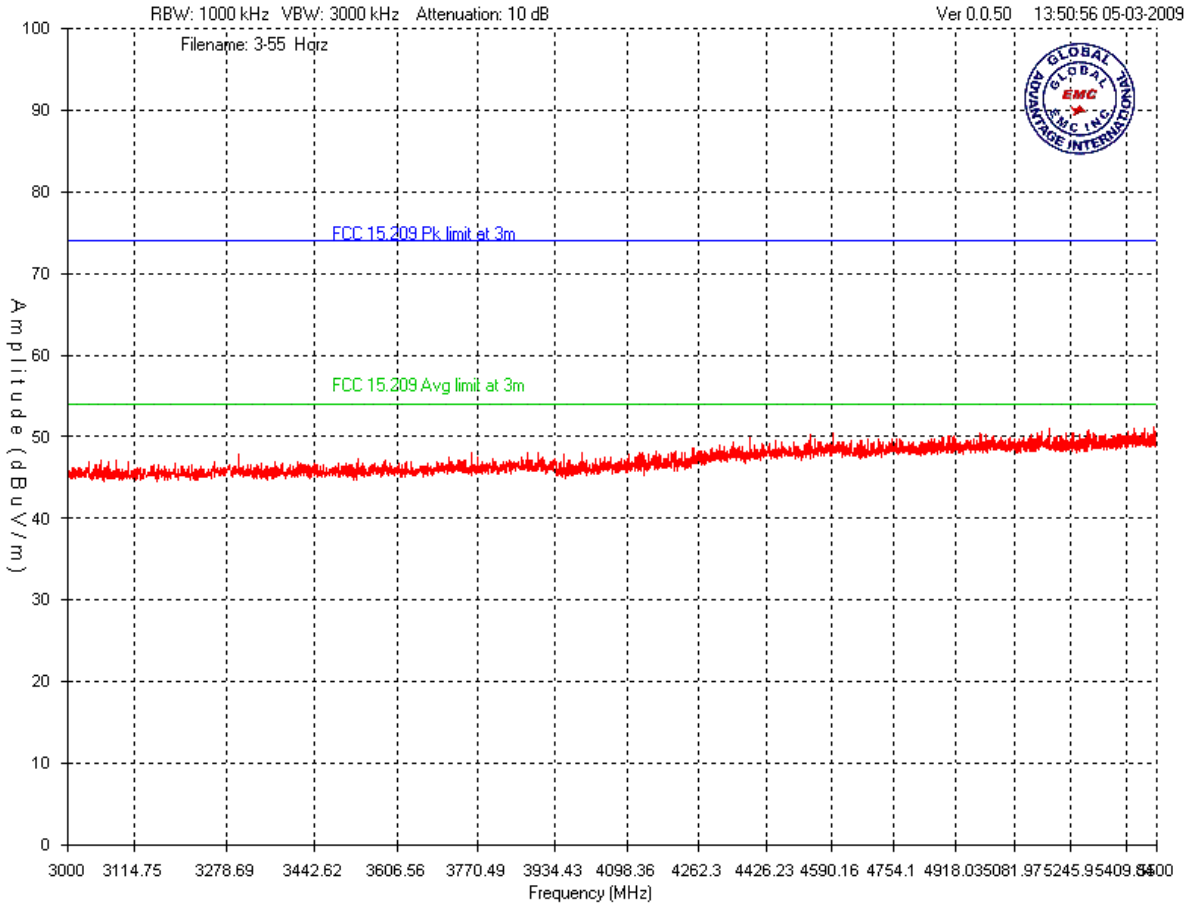
Hi Channel
3 GHz – 5.5 GHz Horizontal peak emissions



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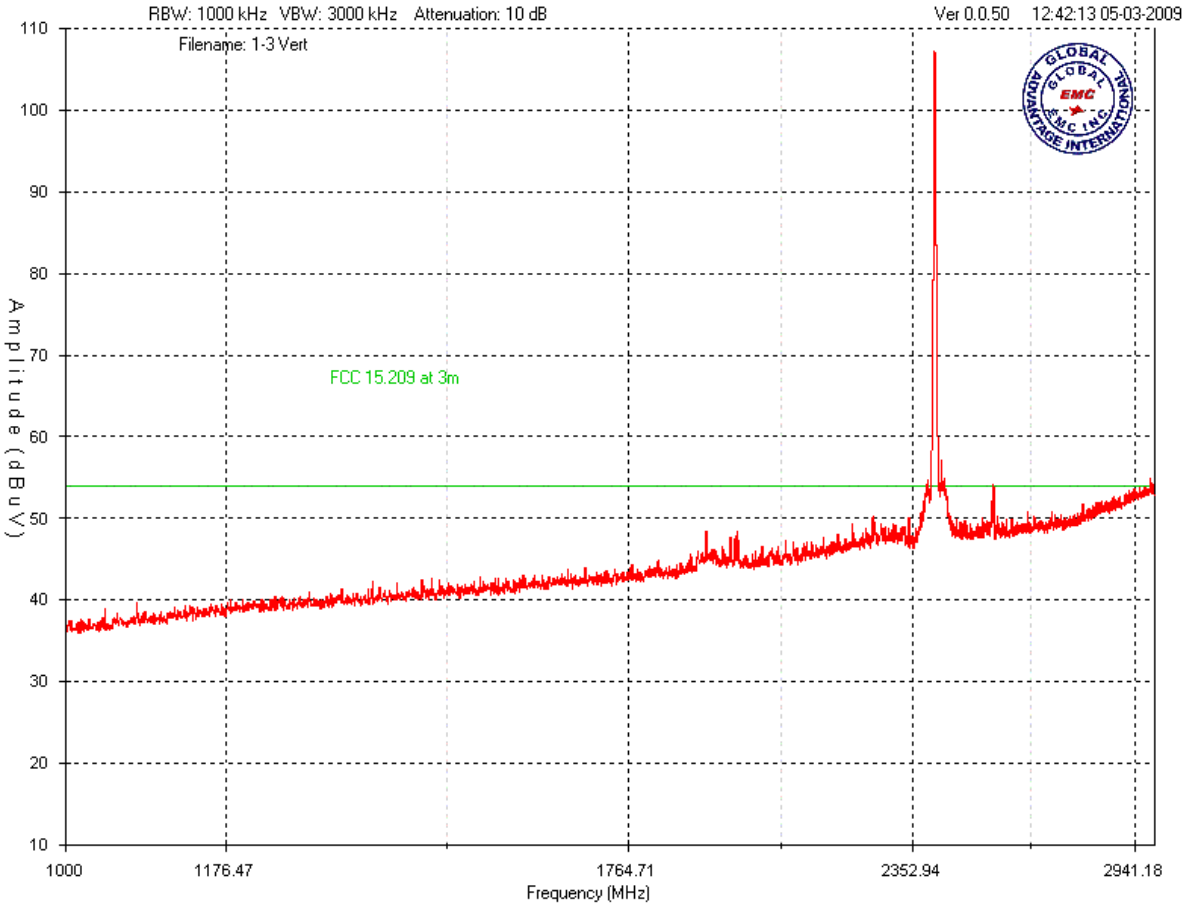
Lo Channel
1 GHz – 3 GHz Vertical peak emissions



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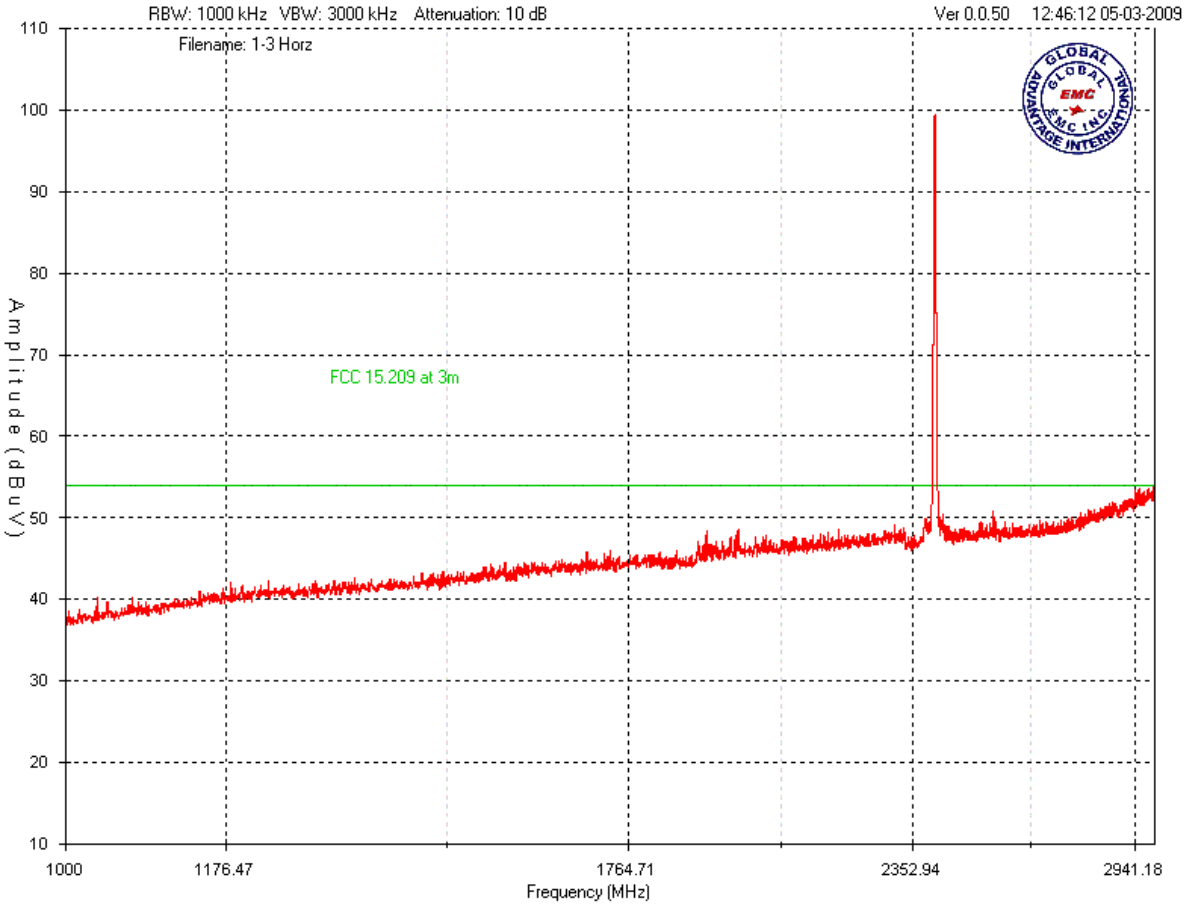
Lo Channel
1 GHz – 3 GHz Horizontal peak emissions



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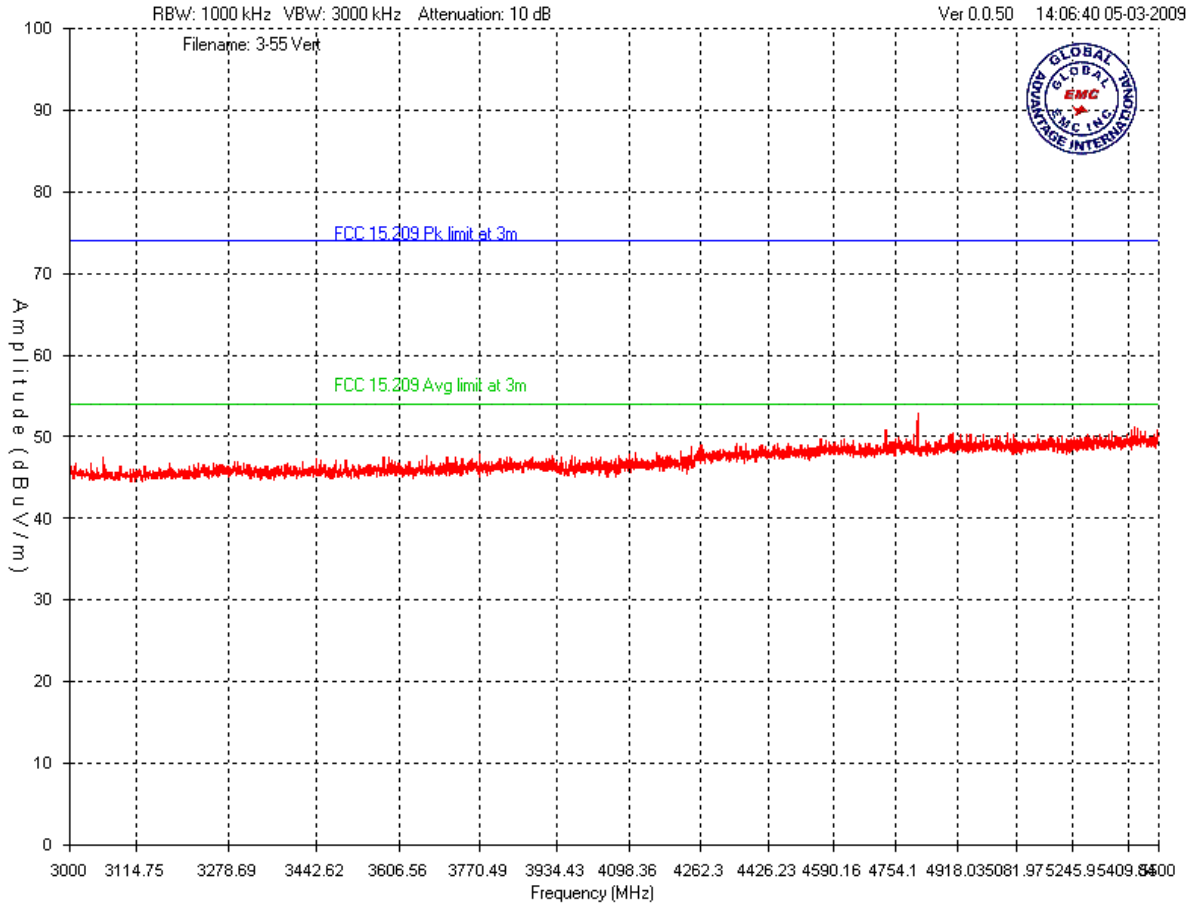
Lo Channel
3 GHz – 5.5 GHz Vertical peak emissions



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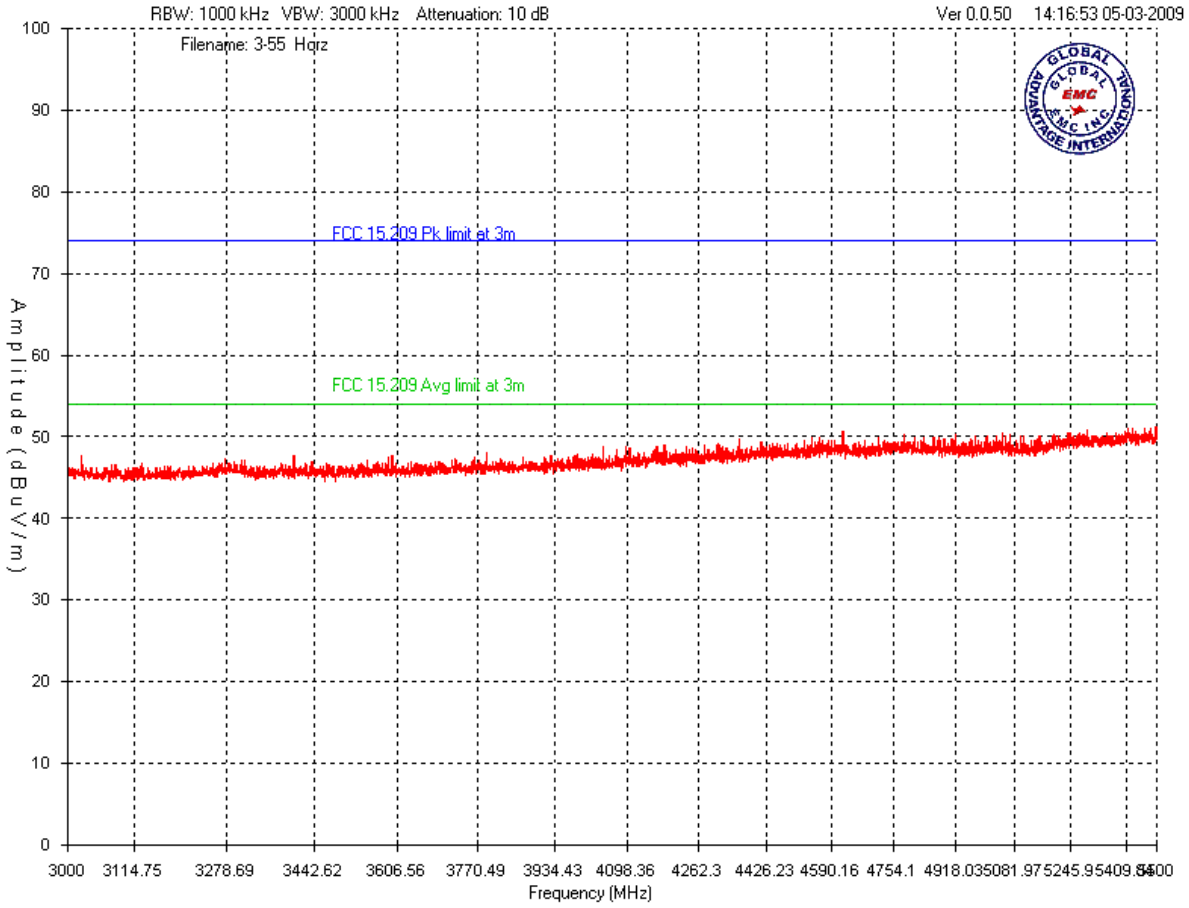
Lo Channel
3 GHz – 5.5 GHz Horizontal peak emissions



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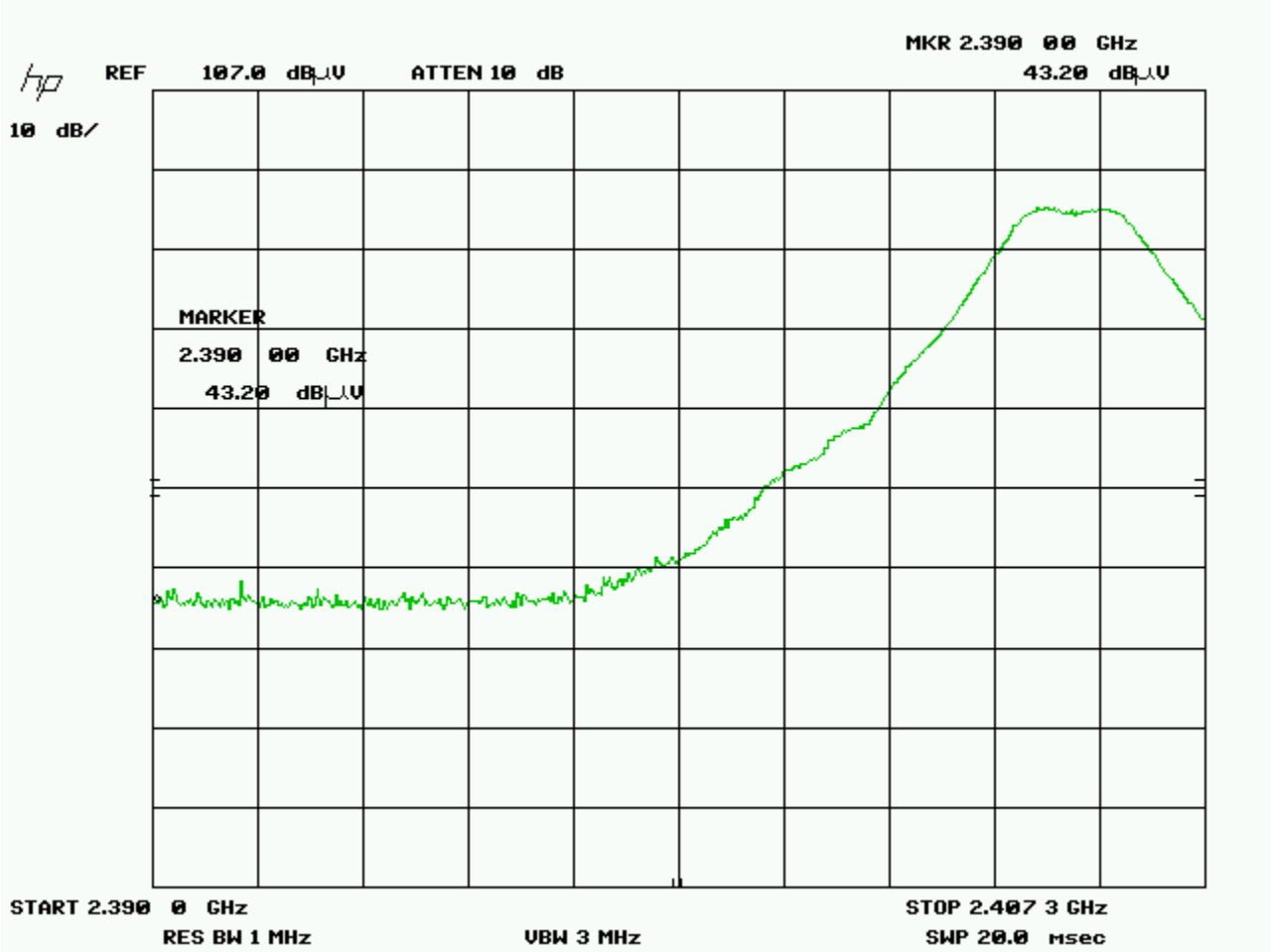
Band Edge Lo Channel
Horizontal Peak



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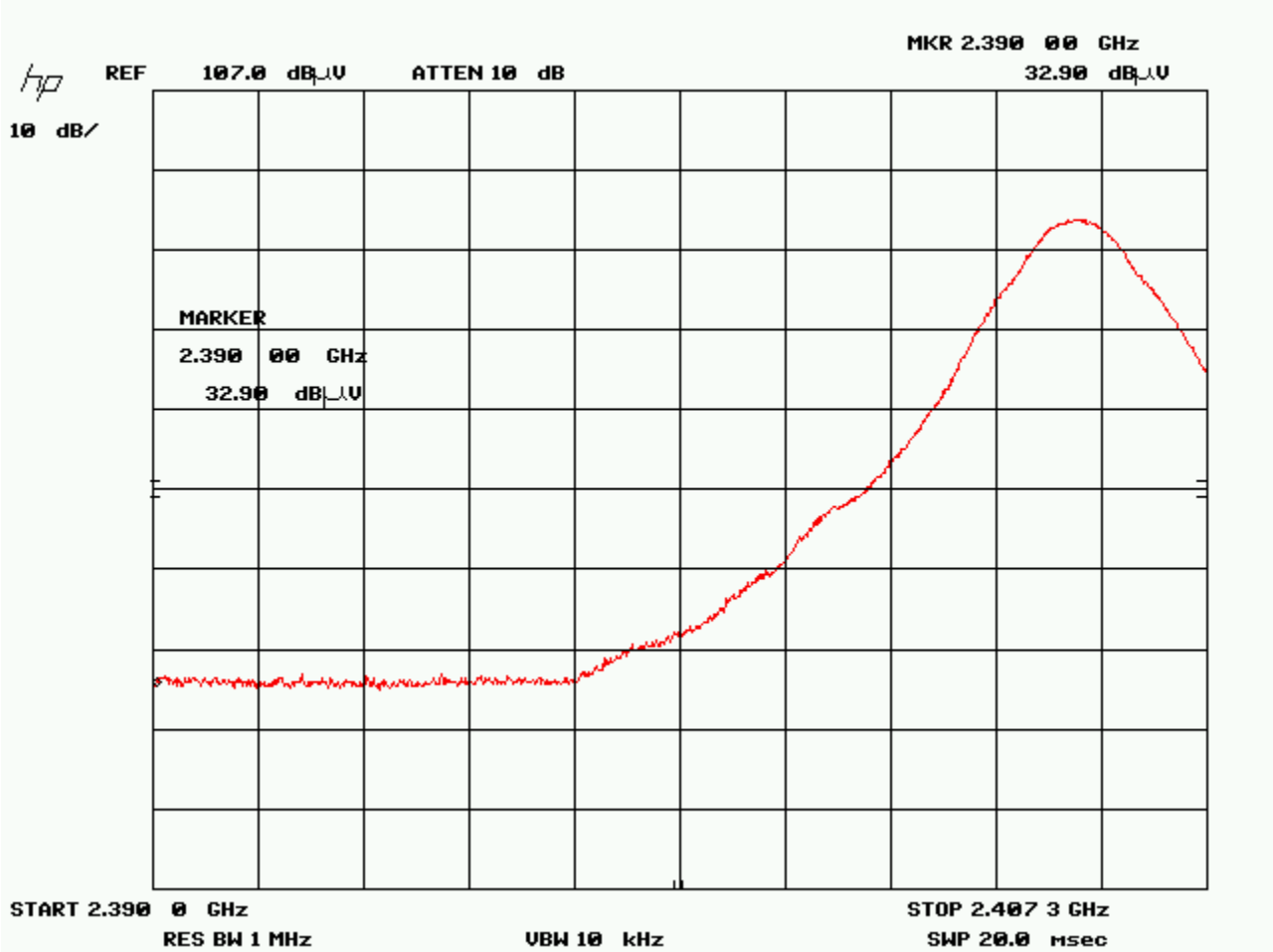
Band Edge Lo Channel
Horizontal Avg



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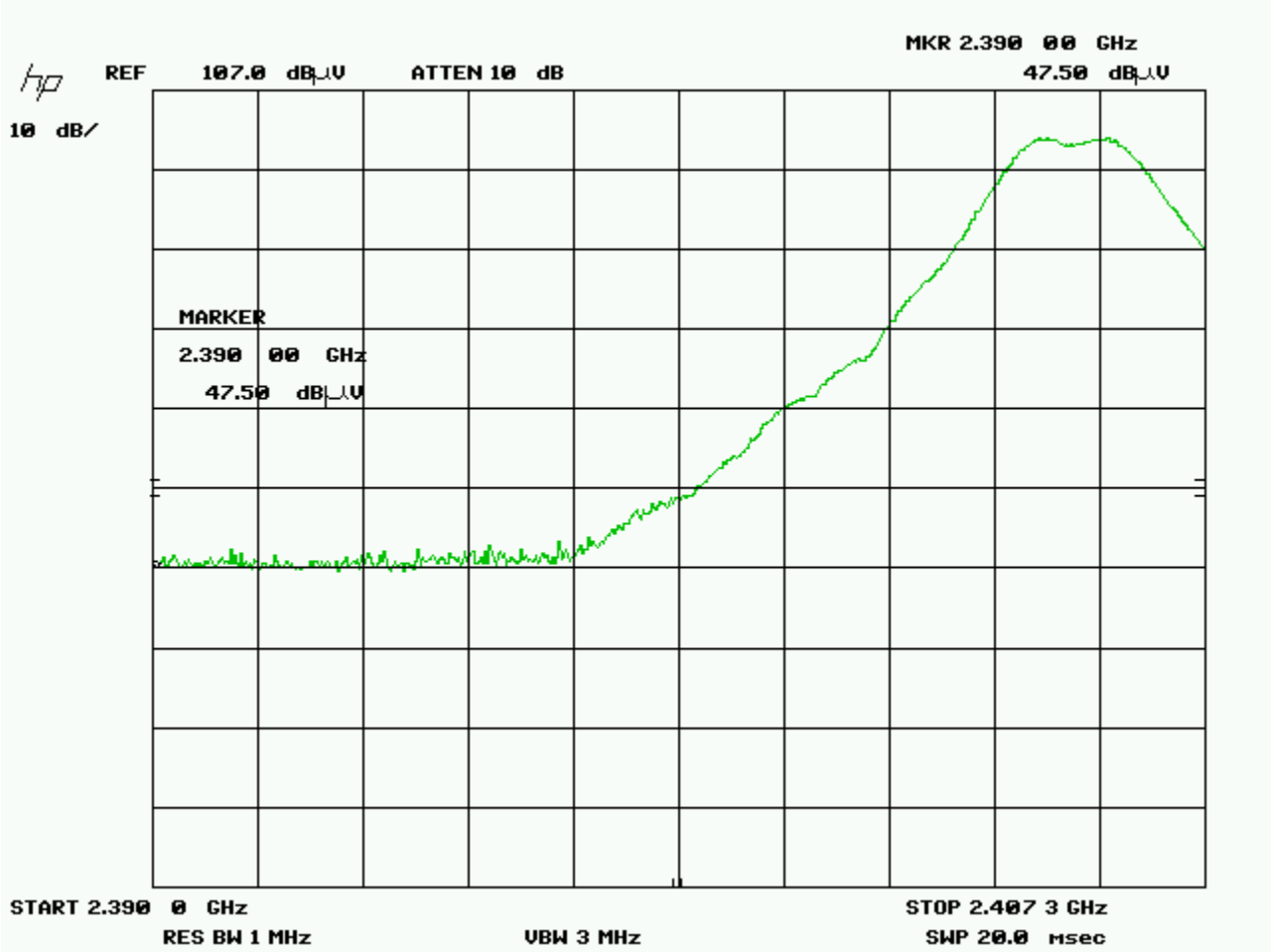
Band Edge Lo Channel
Vertical Peak



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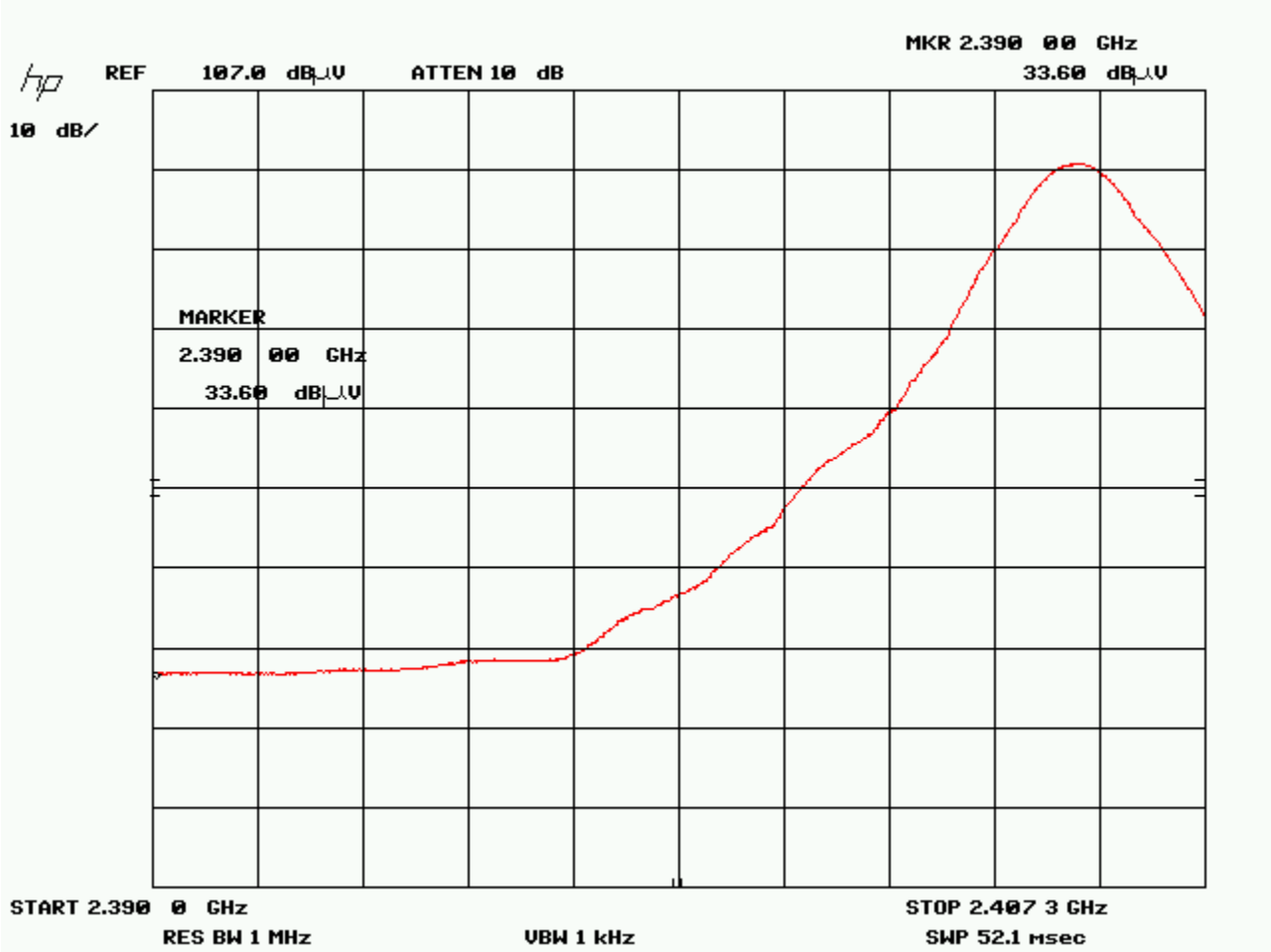
Band Edge Lo Channel
Vertical Avg



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Band Edge Hi Channel
Horizontal Peak

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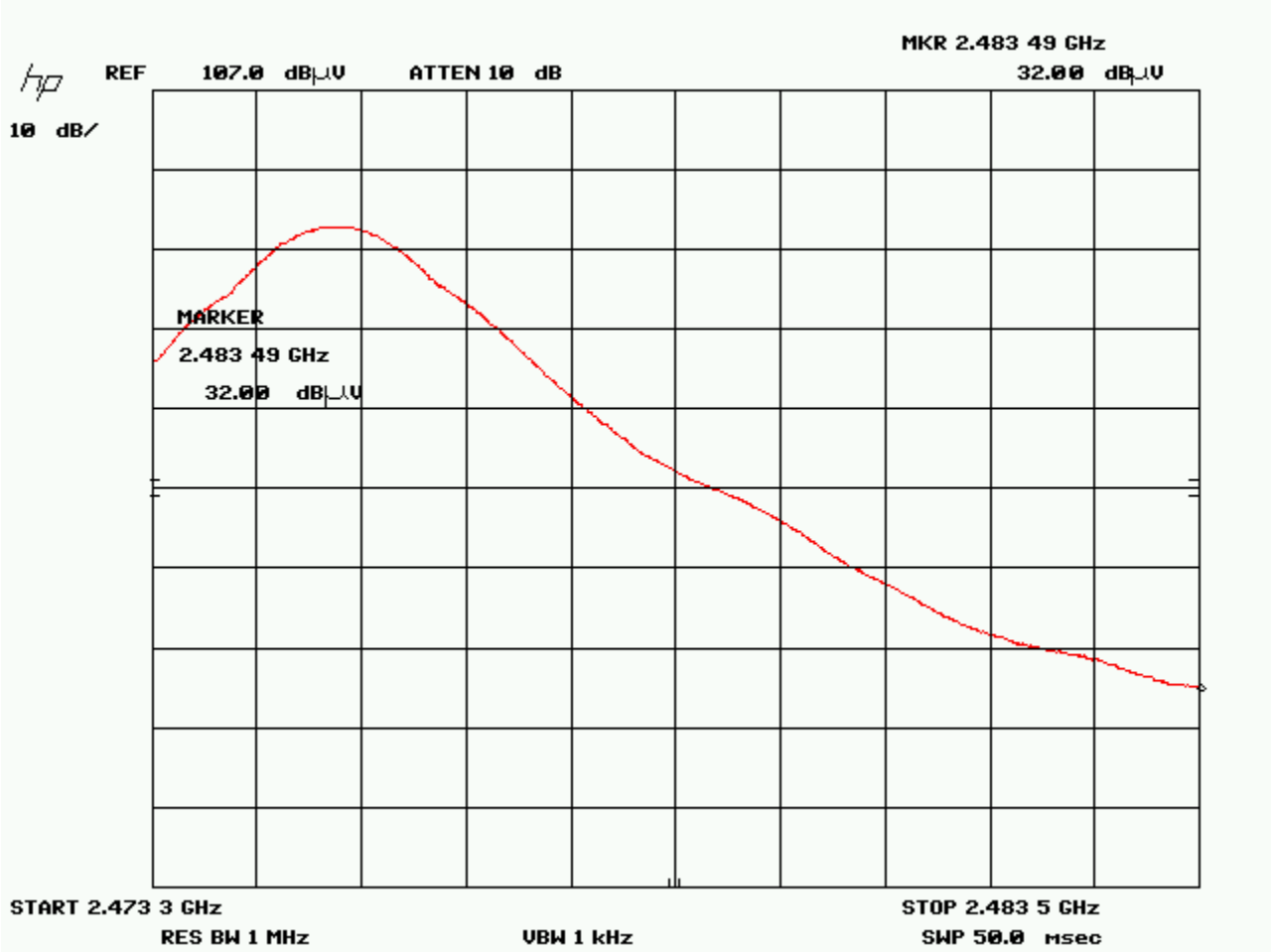
Band Edge Hi Channel
Horizontal Avg



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Band Edge Hi Channel
Vertical Peak

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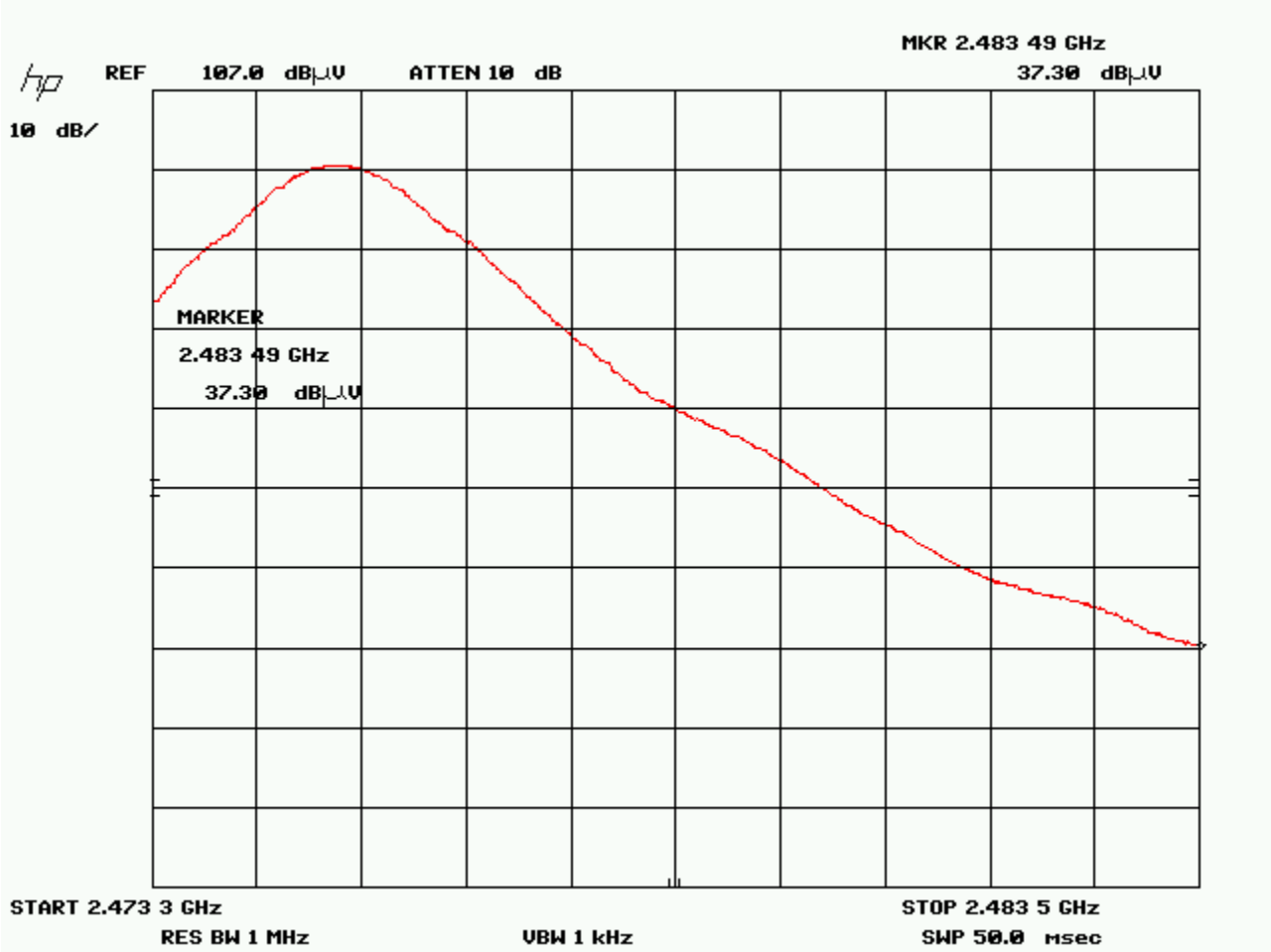
Band Edge Hi Channel
Vertical Avg



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Final Measurements

Note: 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.

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

The frequency shown on the peak graph between does not fall within a restricted band as listed in FCC 15.205 and does not need to be verified.

For information purposes, the fundamental was measured to be 108.2 dBuV/m at 3 meters, and none of the unintentional radiated emissions that fall outside of the restricted bands exceeded the -20dBc (or 88.2dBuV/m) requirement.

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

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

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Client	Viconics
Product	VWG-APP
Standard(s)	RSS 210 Issue 7:2007 / FCC Part 15 Subpart C 15:2008

Radiated Emissions Measurements

Product category	FCC 15.247 Spurious Radiated Emissions										
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**
Mid channel											
4860	Peak	Horz	42.0	33.0	1.1	10.0	35.7	50.4	74.0	23.6	PASS
4860	Avg	Horz	34.7	33.0	1.1	10.0	35.7	43.1	54.0	10.9	PASS
4858	Peak	Vert	48.3	33.0	1.1	10.0	35.7	56.7	74.0	17.3	PASS
4858	Avg	Vert	40.6	33.0	1.1	10.0	35.7	49.0	54.0	5.0	PASS
7290	Peak	Vert	45.2	36.0	1.6	10.0	35.8	57.0	74.0	17.0	PASS
7290	Avg	Vert	35.4	36.0	1.6	10.0	35.8	47.2	54.0	6.8	PASS
2430	Peak	Horz	92.4	31.6	1.0	10.0	36.0	99.0			PASS
2430	Avg	Horz	89.4	31.6	1.0	10.0	36.0	96.0			PASS
2430	Peak	Vert	101.7	31.5	1.0	10.0	36.0	108.2			PASS
2430	Avg	Vert	98.0	31.5	1.0	10.0	36.0	104.5			PASS

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2281	Peak	Horz	45.8	31.6	1.0	10.0	36.0	52.4	74.0	21.6	PASS
2281	Avg	Horz	34.0	31.6	1.0	10.0	36.0	40.6	54.0	13.4	PASS
2282	Peak	Vert	48.0	31.5	1.0	10.0	36.0	54.5	74.0	19.5	PASS
2282	Avg	Vert	43.0	31.5	1.0	10.0	36.0	49.5	54.0	4.5	PASS
Low channel											
2405	Peak	Horz	93.0	31.6	1.0	10.0	36.0	99.6			PASS
2405	Avg	Horz	91.0	31.6	1.0	10.0	36.0	97.6			PASS
2405	Peak	Vert	101.0	31.5	1.0	10.0	36.0	107.5			PASS
2404	Avg	Vert	97.8	31.5	1.0	10.0	36.0	104.3			PASS
2390	Peak	Horz	43.2	31.6	1.0	10.0	36.0	49.8	74.0	24.2	PASS
2390	Avg	Horz	32.9	31.6	1.0	10.0	36.0	39.5	54.0	14.5	PASS
2390	Peak	Vert	47.5	31.5	1.0	10.0	36.0	54.0	74.0	20.0	PASS
2390	Avg	Vert	33.6	31.5	1.0	10.0	36.0	40.1	54.0	13.9	PASS
4810	Peak	Horz	41.0	33.0	1.1	10.0	35.7	49.4	74.0	24.6	PASS
4810	Avg	Horz	29.6	33.0	1.1	10.0	35.7	38.0	54.0	16.0	PASS
4808	Peak	Vert	47.7	33.0	1.1	10.0	35.7	56.1	74.0	17.9	PASS
4808	Avg	Vert	38.4	33.0	1.1	10.0	35.7	46.8	54.0	7.2	PASS
7216	Peak	Vert	46.3	36.0	1.6	10.0	35.8	58.1	74.0	15.9	PASS
7216	Avg	Vert	36.3	36.0	1.6	10.0	35.8	48.1	54.0	5.9	PASS
2260	Peak	Vert	44.8	31.5	1.0	10.0	36.0	51.3	74.0	22.7	PASS
2260	Avg	Vert	37.4	31.5	1.0	10.0	36.0	43.9	54.0	10.1	PASS

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Client	Viconics
Product	VWG-APP
Standard(s)	RSS 210 Issue 7:2007 / FCC Part 15 Subpart C 15:2008

High channel											
2475	Peak	Horz	92.4	31.6	1.0	10.0	36.0	99.0			PASS
2475	Avg	Horz	90.2	31.6	1.0	10.0	36.0	96.8			PASS
2475	Peak	Vert	100.0	31.5	1.0	10.0	36.0	106.5			PASS
2475	Avg	Vert	96.0	31.5	1.0	10.0	36.0	102.5			PASS
2483.5	Peak	Horz	44.1	31.6	1.0	10.0	36.0	50.7	74.0	23.3	PASS
2483.5	Avg	Horz	32.0	31.6	1.0	10.0	36.0	38.6	54.0	15.4	PASS
2483.5	Peak	Vert	47.0	31.5	1.0	10.0	36.0	53.5	74.0	20.5	PASS
2483.5	Avg	Vert	37.3	31.5	1.0	10.0	36.0	43.8	54.0	10.2	PASS
4848	Peak	Vert	48.4	33.0	1.1	10.0	35.7	56.8	74.0	17.2	PASS
4948	Avg	Vert	39.1	33.0	1.1	10.0	35.7	47.5	54.0	6.5	PASS
7425	Peak	Vert	48.0	36.0	1.6	10.0	35.8	59.8	74.0	14.2	PASS
7425	Avg	Vert	39.3	36.0	1.6	10.0	35.8	51.1	54.0	2.9	PASS
2284	Peak	Vert	45.0	31.5	1.0	10.0	36.0	51.5	74.0	22.5	PASS
2282	Avg	Vert	35.5	31.5	1.0	10.0	36.0	42.0	54.0	12.0	PASS

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Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	2008-02-28	2010-02-28	6
Quasi Peak Adapter	85650A	HP	2008-02-28	2010-02-28	7
BiLog Antenna	3142-C	ETS	2009-02-12	2011-02-12	8
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	28
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	29
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	30
RF Cable 0.5M	LMR-400-0.5M-50OHM-MN-MN	LexTec	NCR	NCR	31
Attenuator 3 dB	FP-50-3	Trilithic	NCR	NCR	40
IFR Spectrum Analyzer	AN940	IFR	NCR	NCR	6350
A.H. Systems Horn Antenna 18 GHz - 26.5 GHz	SAS-572	AH	NCR	NCR	6371
Schaffner Preamp 9kHz - 2 GHz	CPA9231A	Schaffner	8/26/2008	8/26/2010	116
Q-Par 1.5-18 GHz Horn	6878/24	Q-par	8/25/2008	8/25/2010	6365
HP Preamp	HP-8449B	HP	8/25/2008	8/25/2010	6351

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

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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

The Limit is as specified in FCC Part 15 and RSS 210.

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 lowest 6 dB BW measured was 1.596 MHz.

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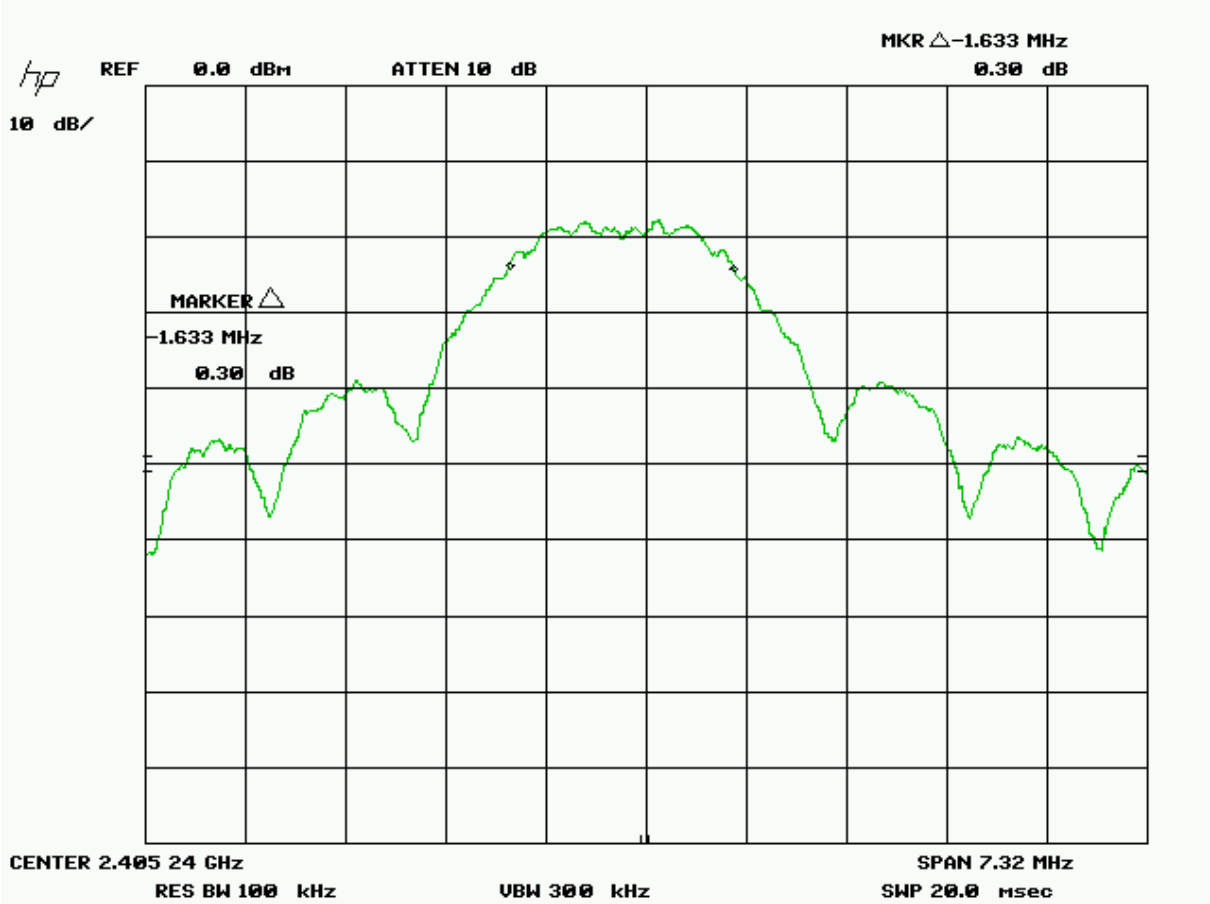
Graph(s)

The graph's shown below shows the channel spacing during the operation of the device. This is measured by a max hold on the spectrum analyzer and the highest resolution bandwidth that is sufficiently low to exhibit the 6 dB bandwidth of a channel during operation of the EUT. This measurement is a peak measurement. Max hold is performed for duration of not less than 1 minute.

Low Channel – 6 dB Bandwidth



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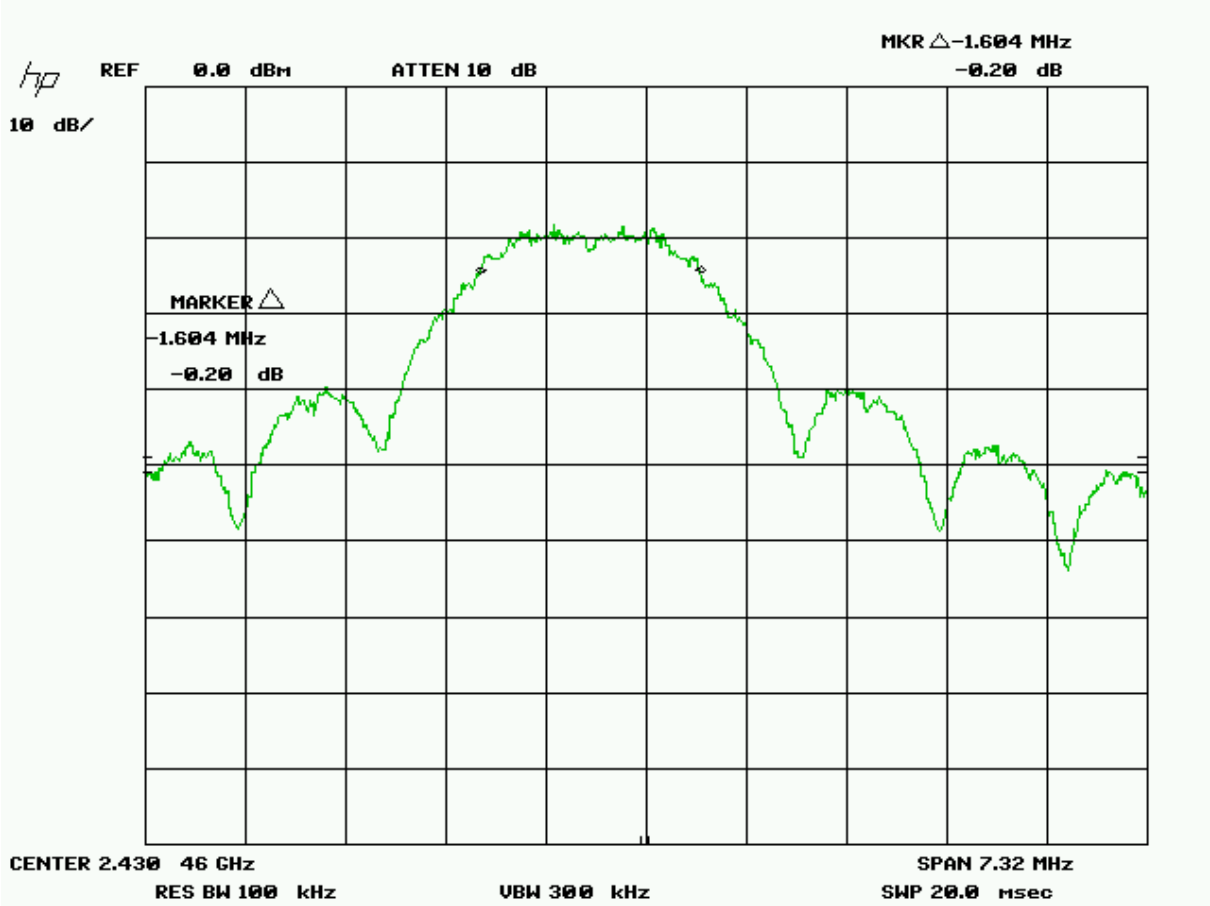
Mid Channel 6 dB Bandwidth



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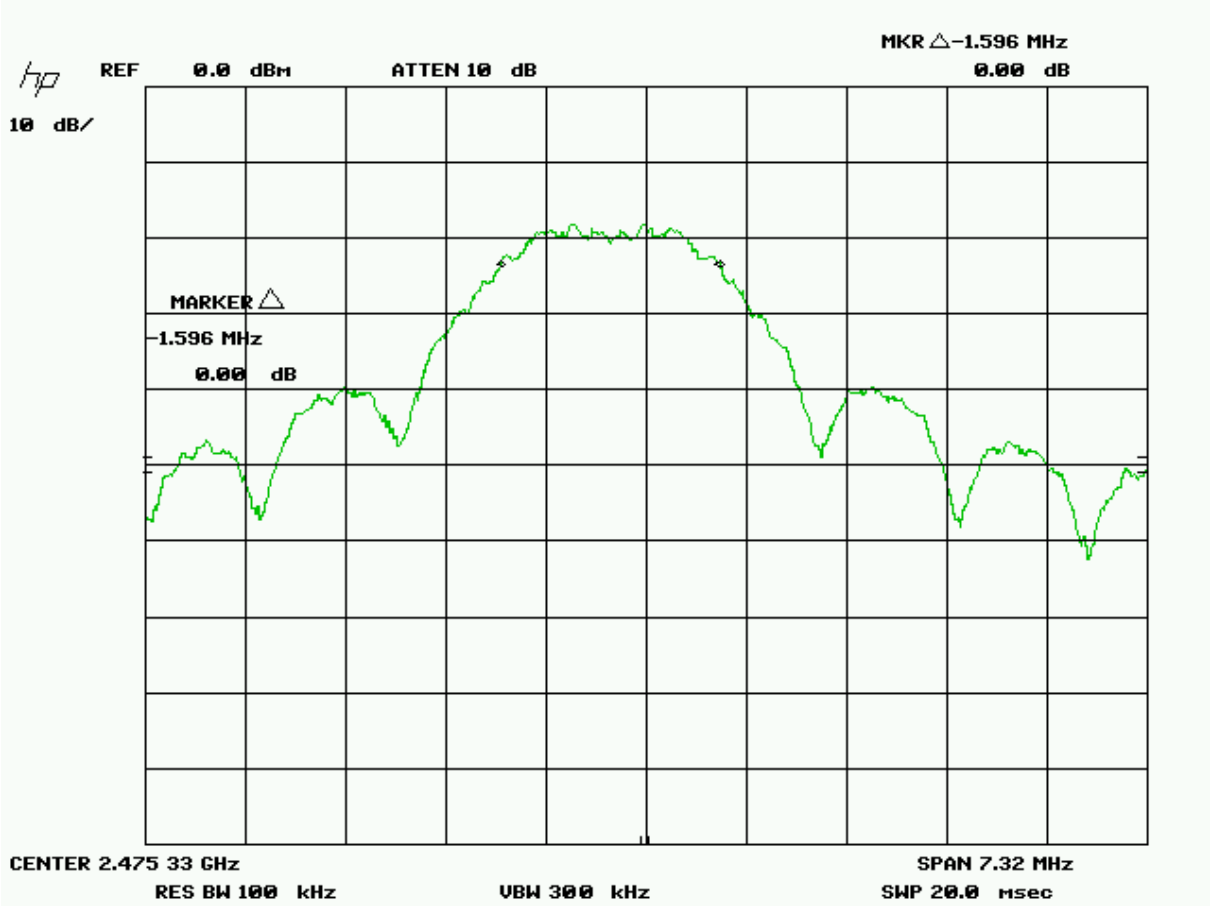
High Channel 6 dB Bandwidth



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

Test Equipment List

Equipment	Model #	Manufacturer	Cal date (yyyy-mm-dd)	Due Date (yyyy-mm-dd)	Equipment ID# (GEMC xxx)
Spectrum Analyzer	8566B	HP	2008-02-28	2010-02-28	6
RF Cable 0.5M	LMR-400-0.5M-50OHM-MN-MN	LexTec	NCR	NCR	31

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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 an excessive power level.

Limits

The limits are defined in FCC Part 15.247(b) and RSS 210.
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 11.3 dBm (13.49 mW).

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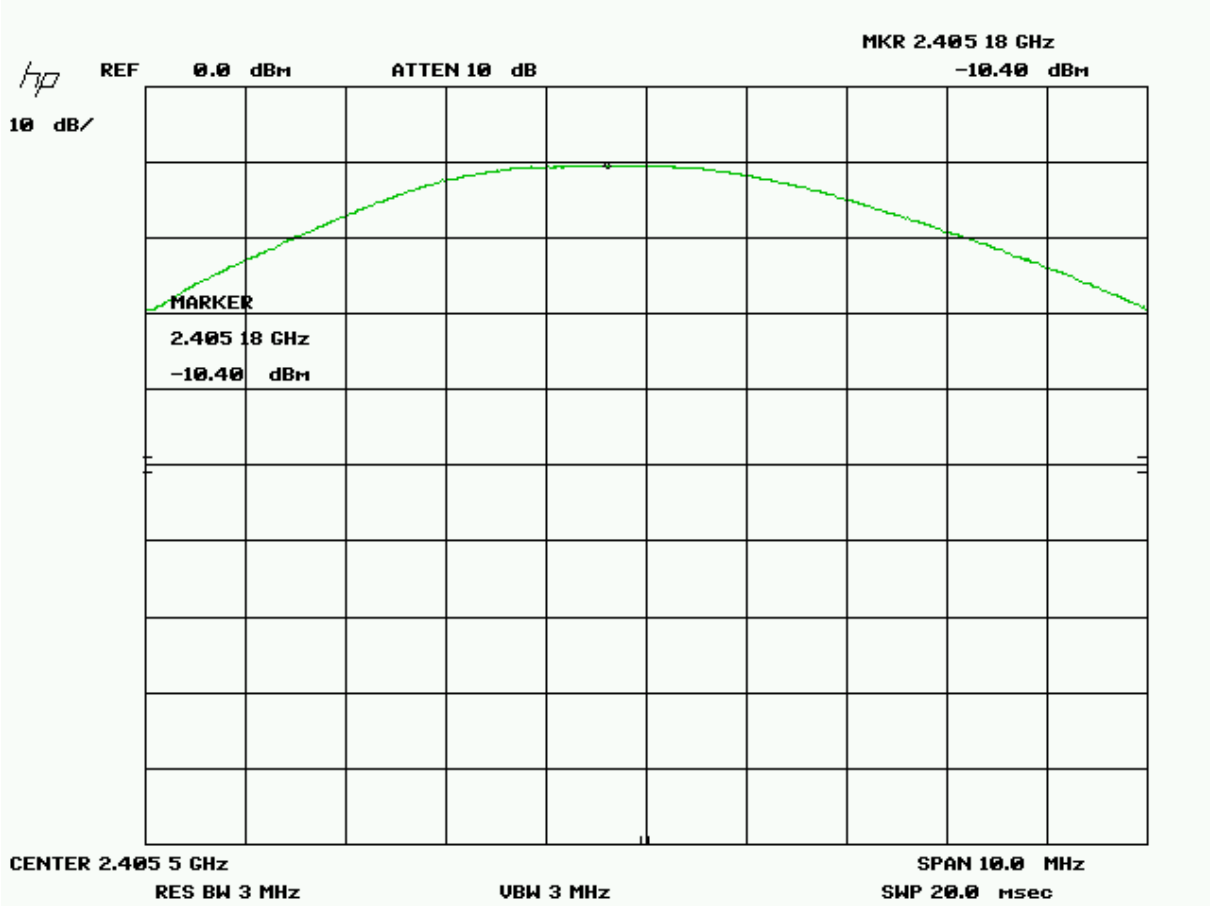
Plots

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

Lo Channel



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

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Test Results

Conducted Power	20 db Pad and cable losses	Output power (dBm)
-10.4	21.7	11.3
-10.6	21.7	11.1
-10.8	21.7	10.9

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	2008-02-28	2010-02-28	6
Power meter	PM 2002	AR	2008-07-17	2010-07-19	GEMC 16
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29

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Spurious Conducted Emissions

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. Low, middle and high band was measured. The worst case graphs for the spectrum are shown.

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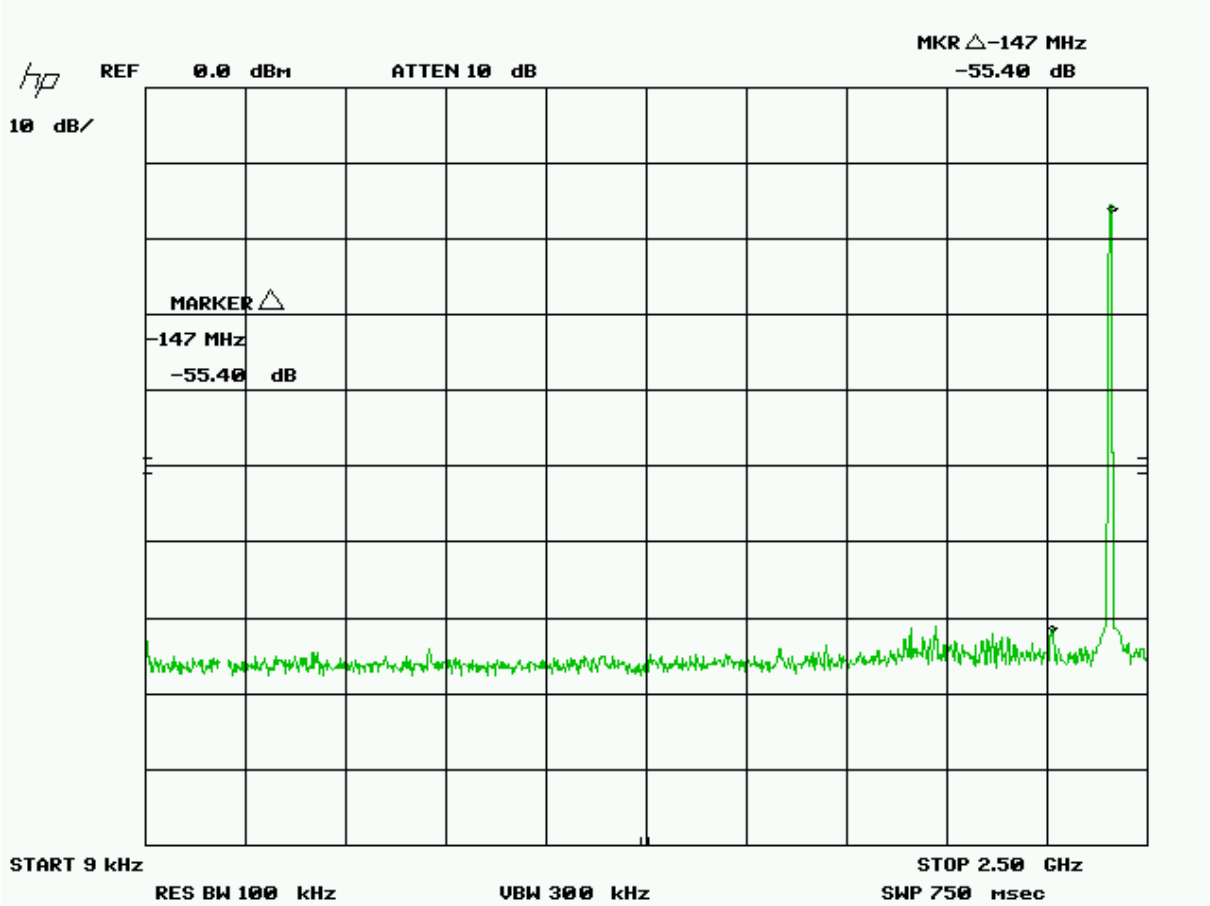
Graph(s)

The graphs shown below shows the peak power output of the device during the antenna conducted measurement during transmit operation of the EUT. Note there was 20 dB of external attenuation taken during this measurement.

9 kHz – 2.5 GHz Lo



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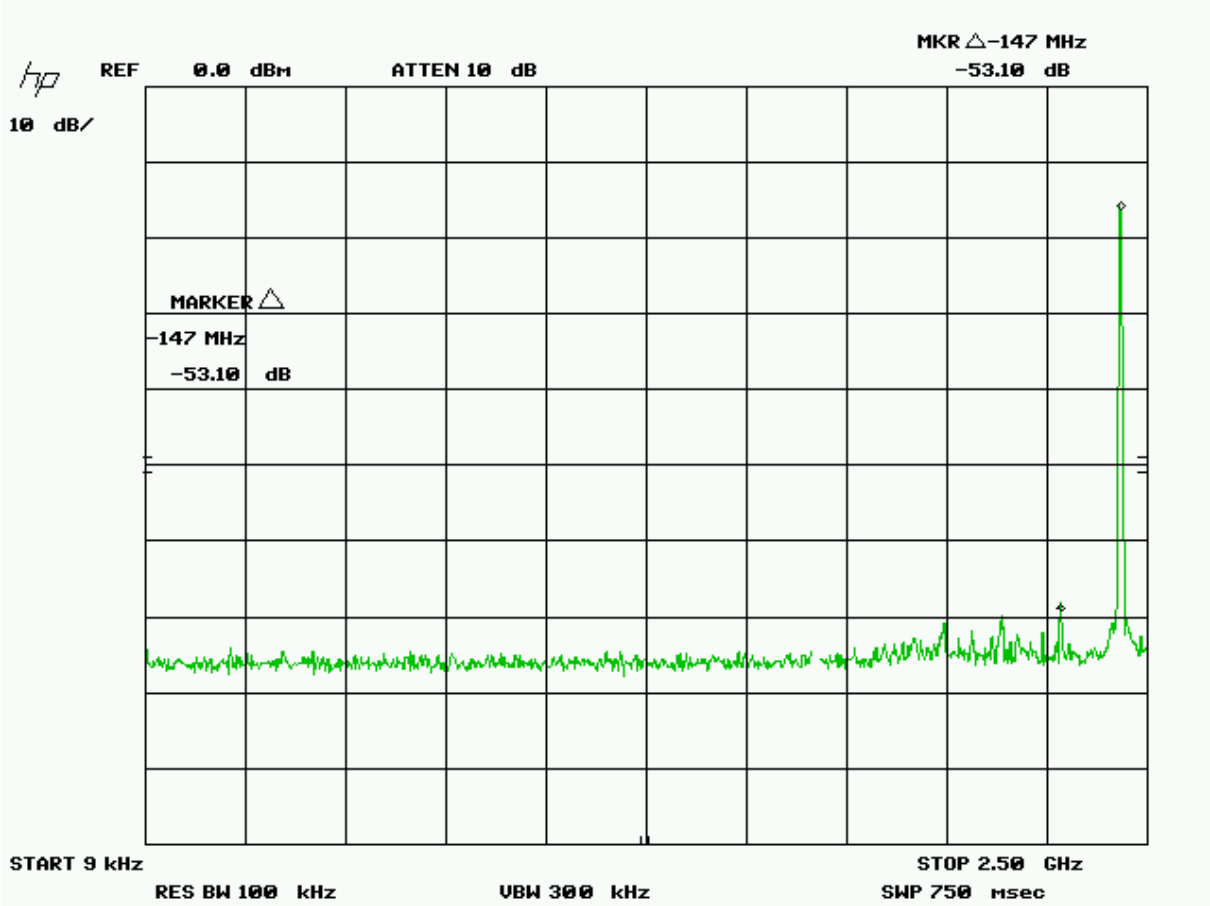
9 kHz – 2.5 GHz Med



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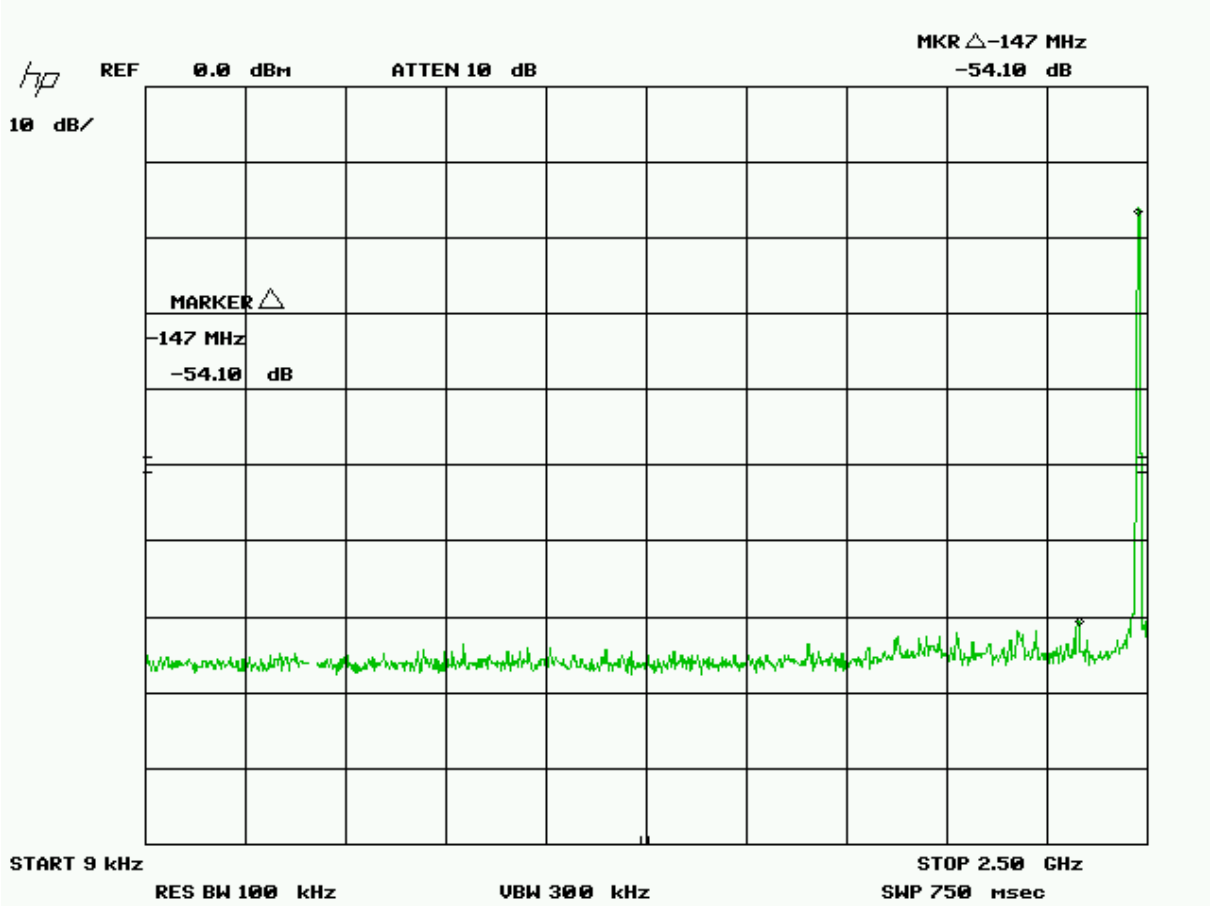
9 kHz – 2.5 GHz Hi



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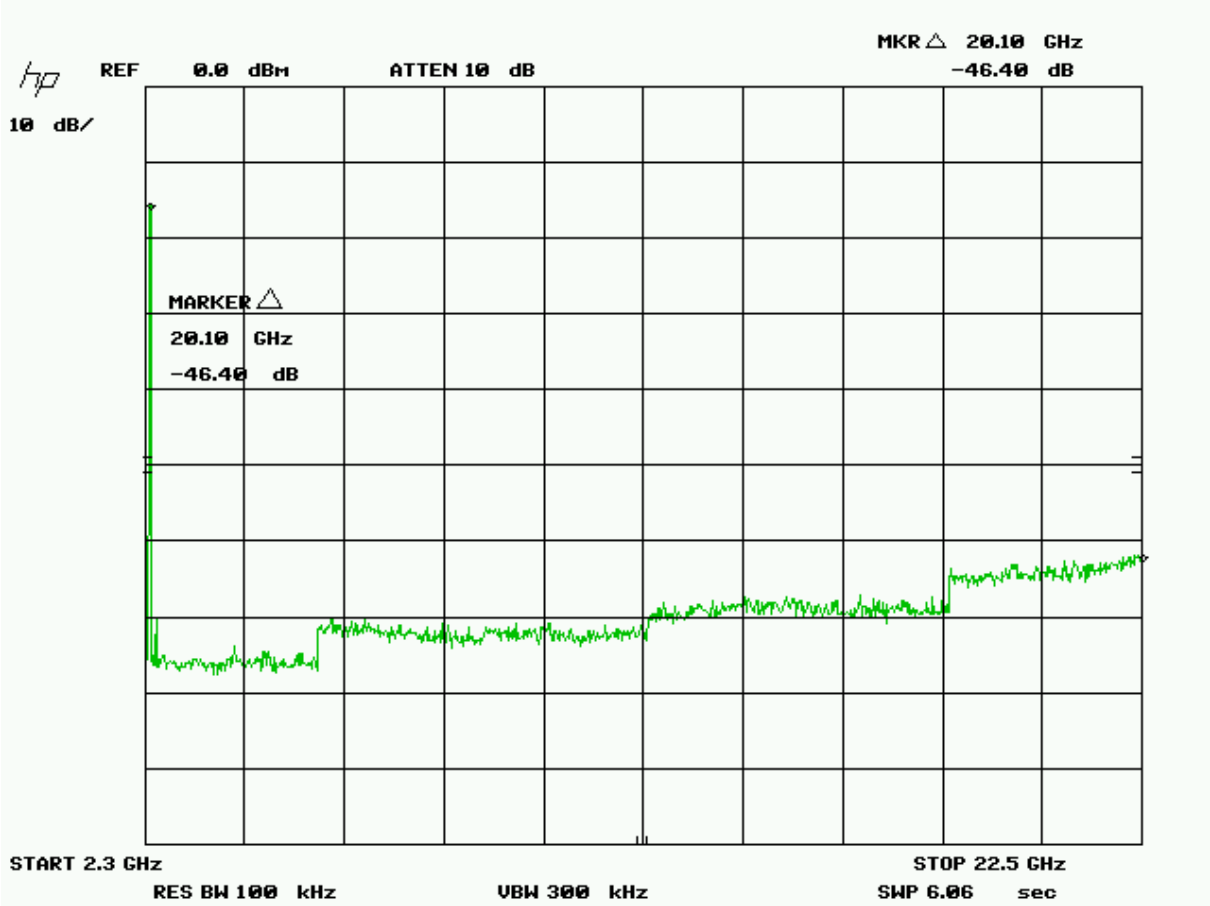
2 GHz – 22.5 GHz Lo



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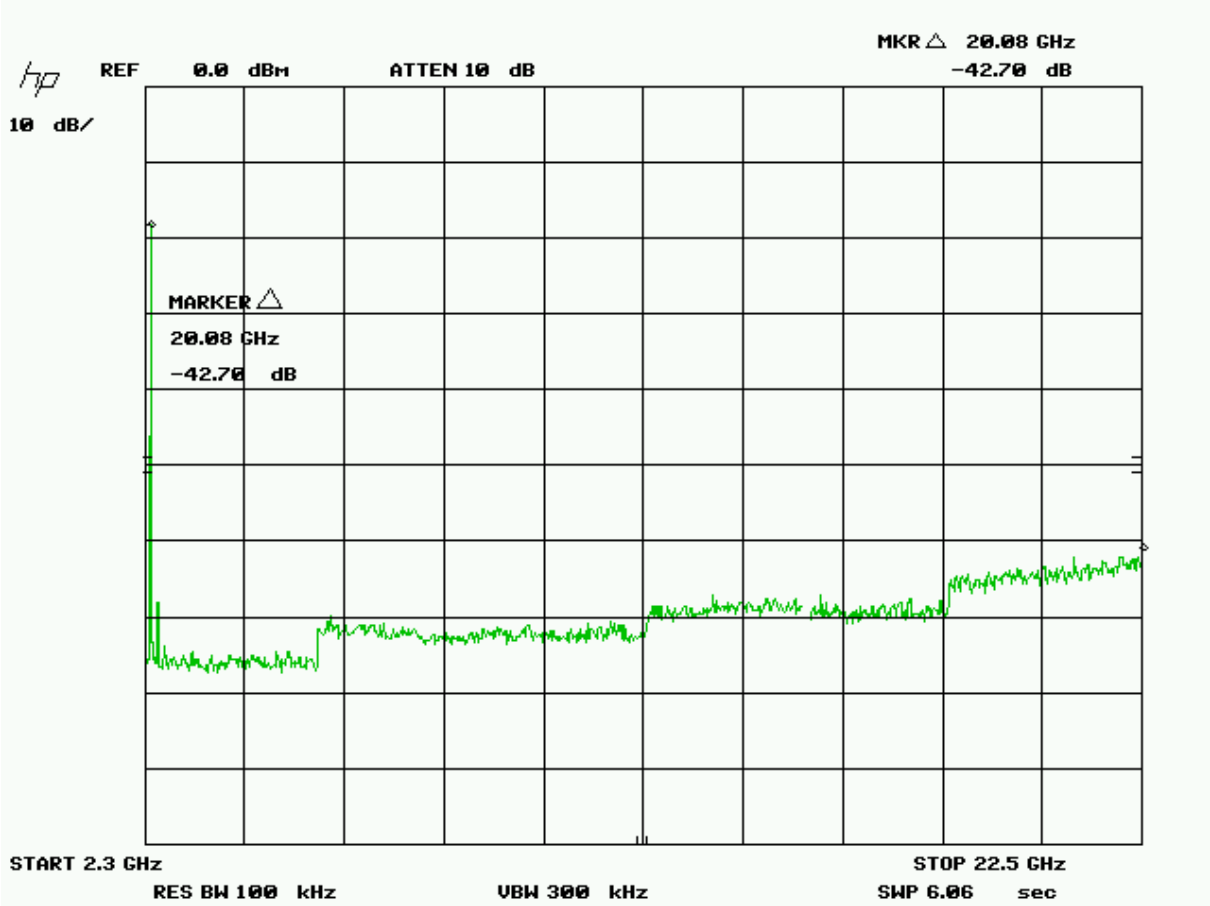
2 GHz – 22.5 GHz Med



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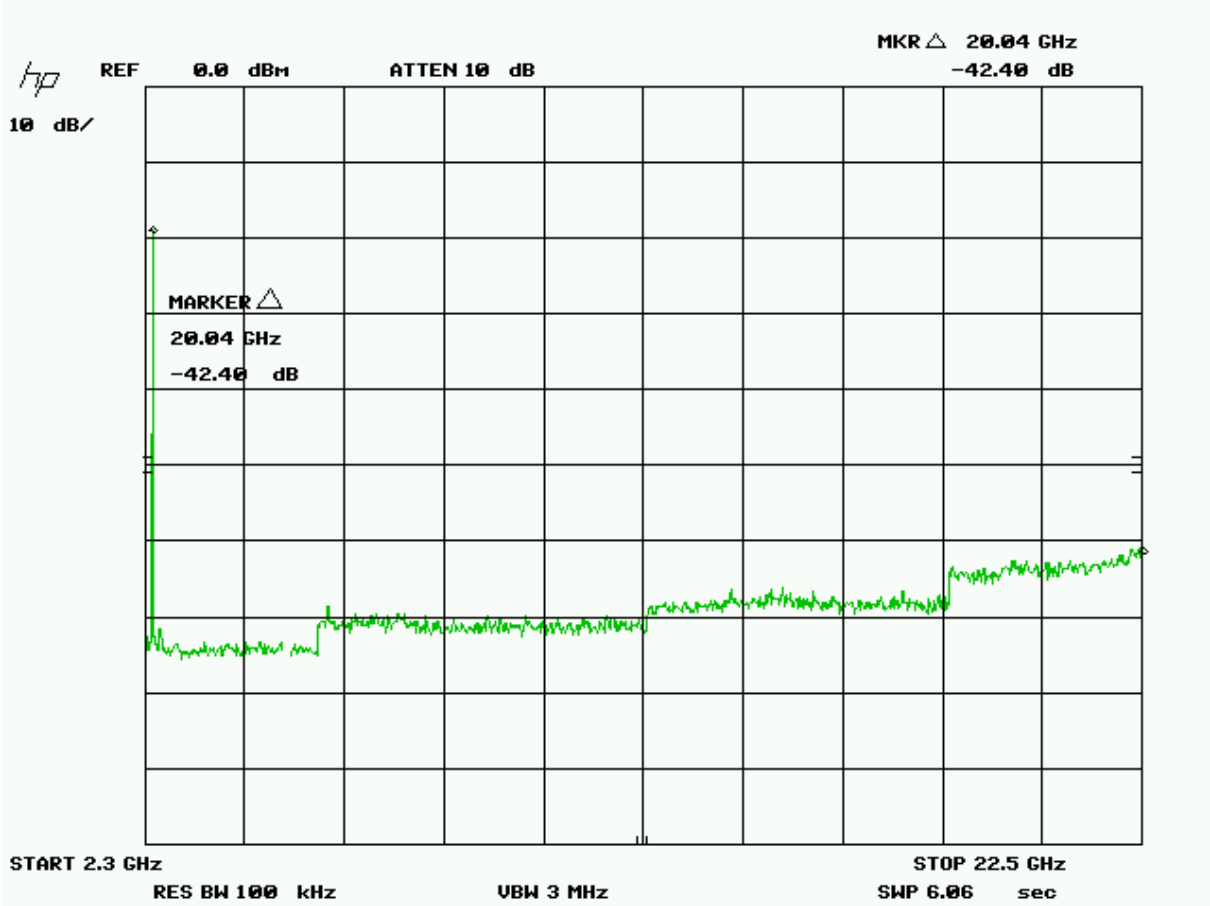
2 GHz – 22.5 GHz Hi



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2483.5 MHz Band edge
Vertical peak emissions

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2483.5 MHz Band edge
Horizontal peak emissions

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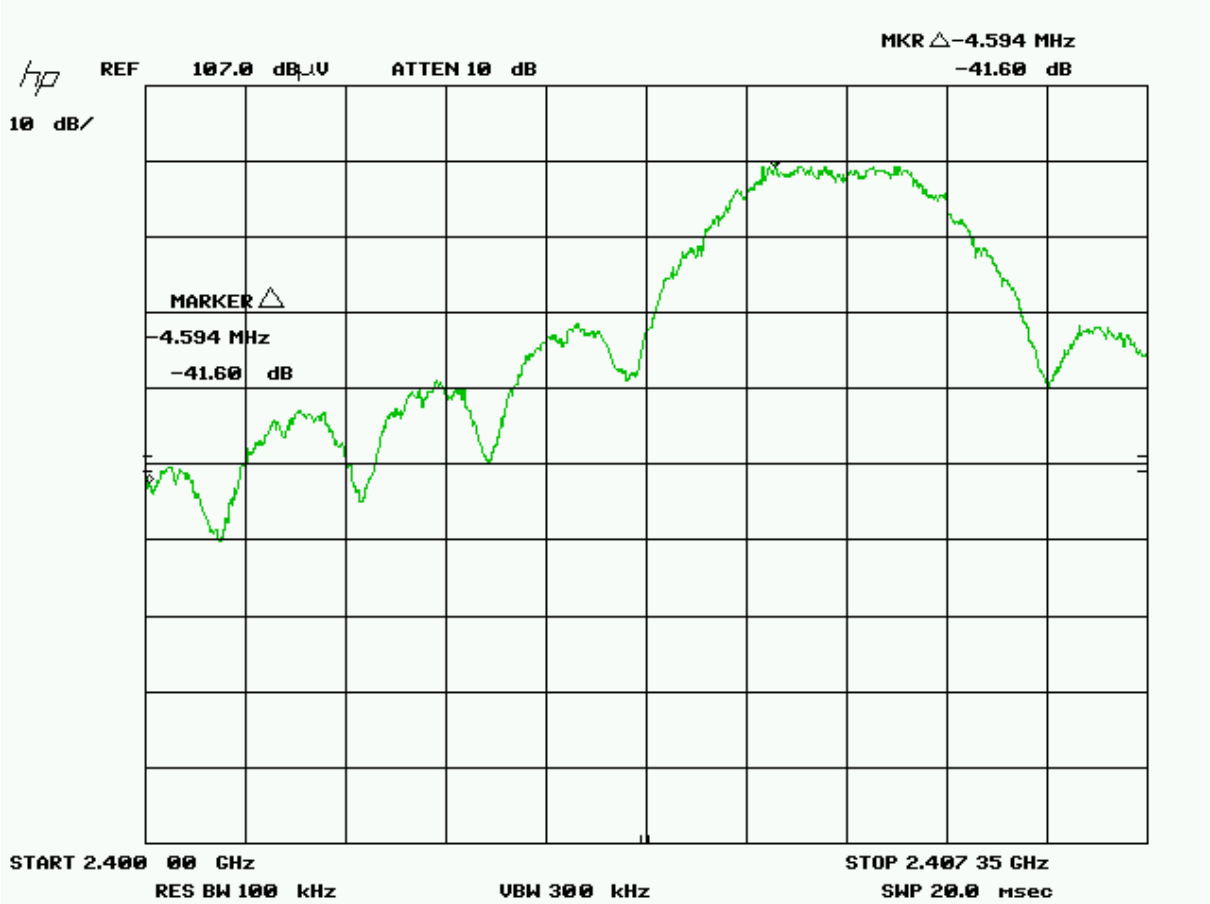
2390 MHz Band edge
Vertical peak emissions



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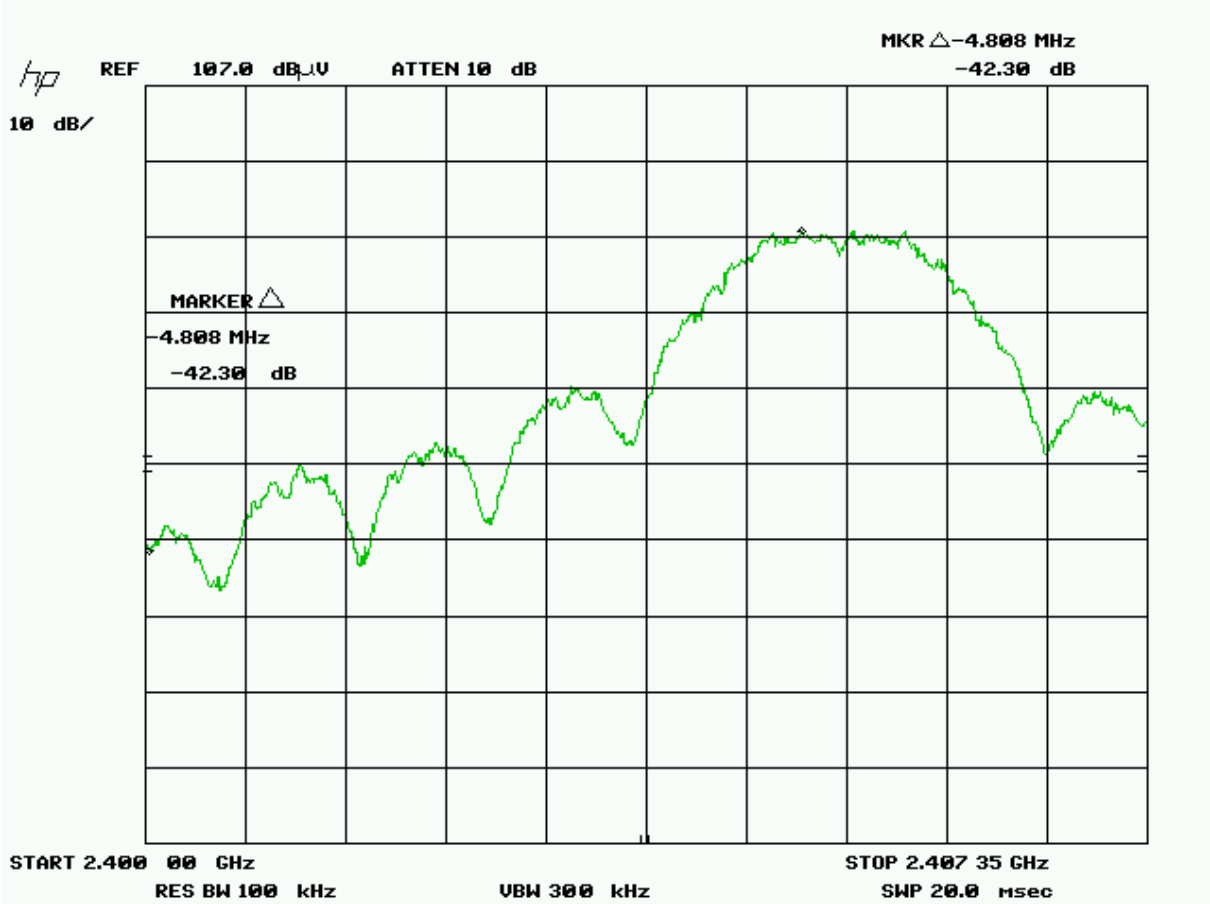
2390 MHz Band edge
Horizontal peak emissions



The frequency range of 22.5 – 25 GHz, the 10th harmonic and 9th harmonic where applicable, was additionally scanned using an alternate spectrum analyzer, in low, middle and high band for each mode. No emissions were detected at the 9th and 10th harmonic.

The band edge requirement was conducted using the radiated emission setup. The plots show raw data and no correction factors are applied. They simply show a 20dbc differential between the peak and the band edge. For actual values measured refer to spurious emissions section above in this report.

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

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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
Spectrum Analyzer	8566B	HP	2008-02-28	2010-02-28	GEMC 6
Quasi Peak Adapter	85650A	HP	2008-02-28	2010-02-28	GEMC 7
IFR Spectrum Analyzer	AN940	IFR	NCR	NCR	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"

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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 -24.9 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.

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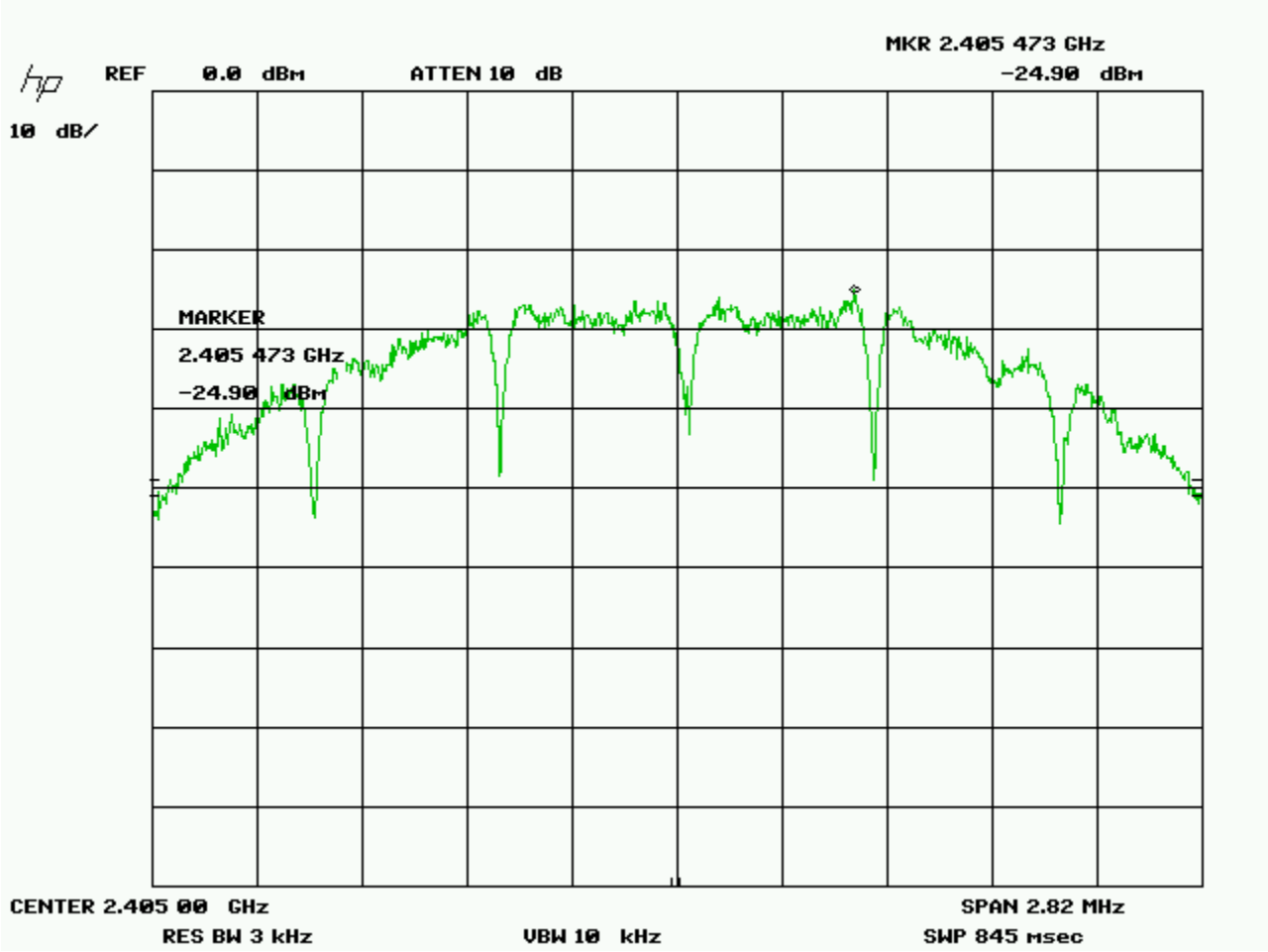
Low channel



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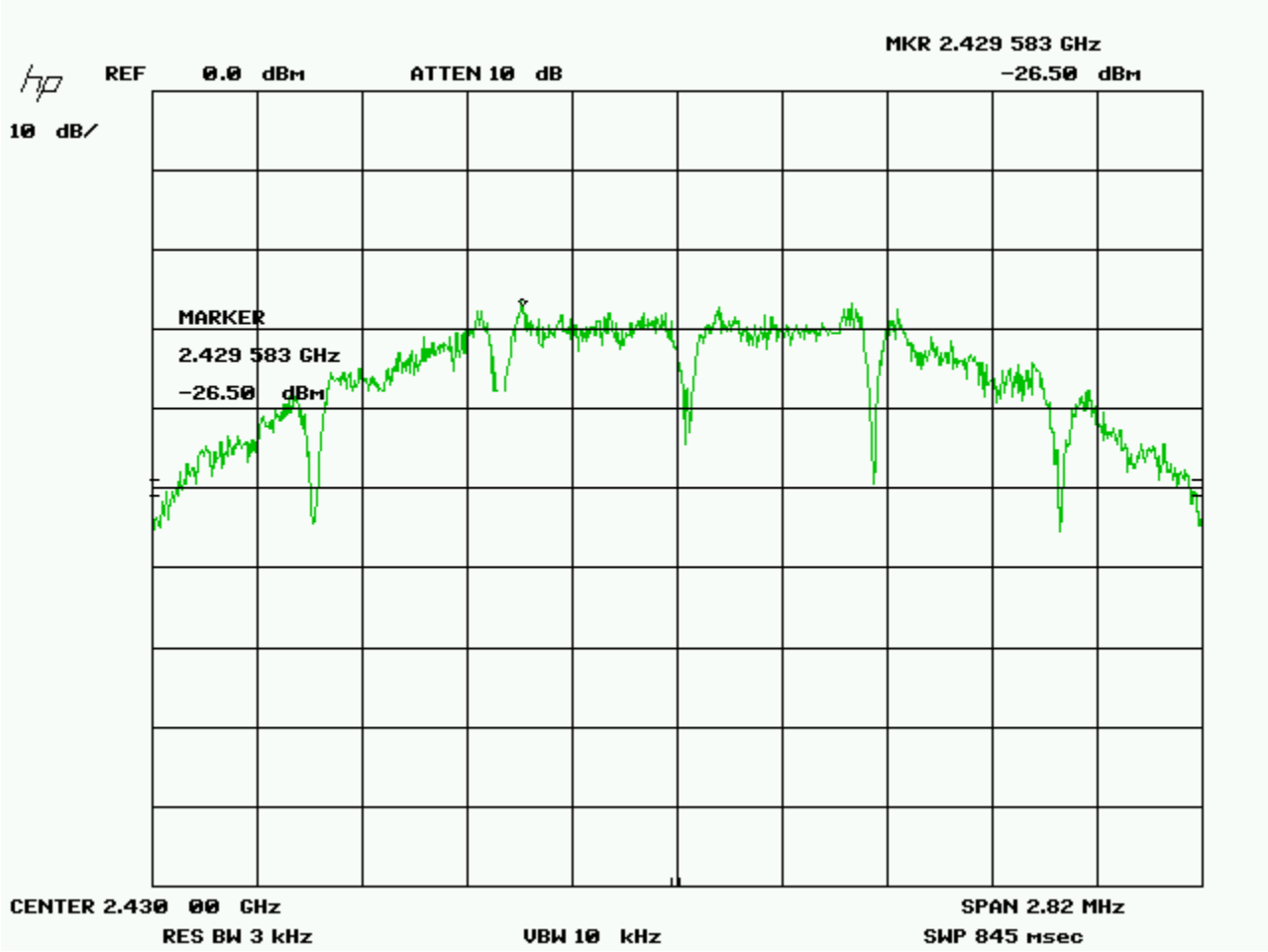
Mid channel



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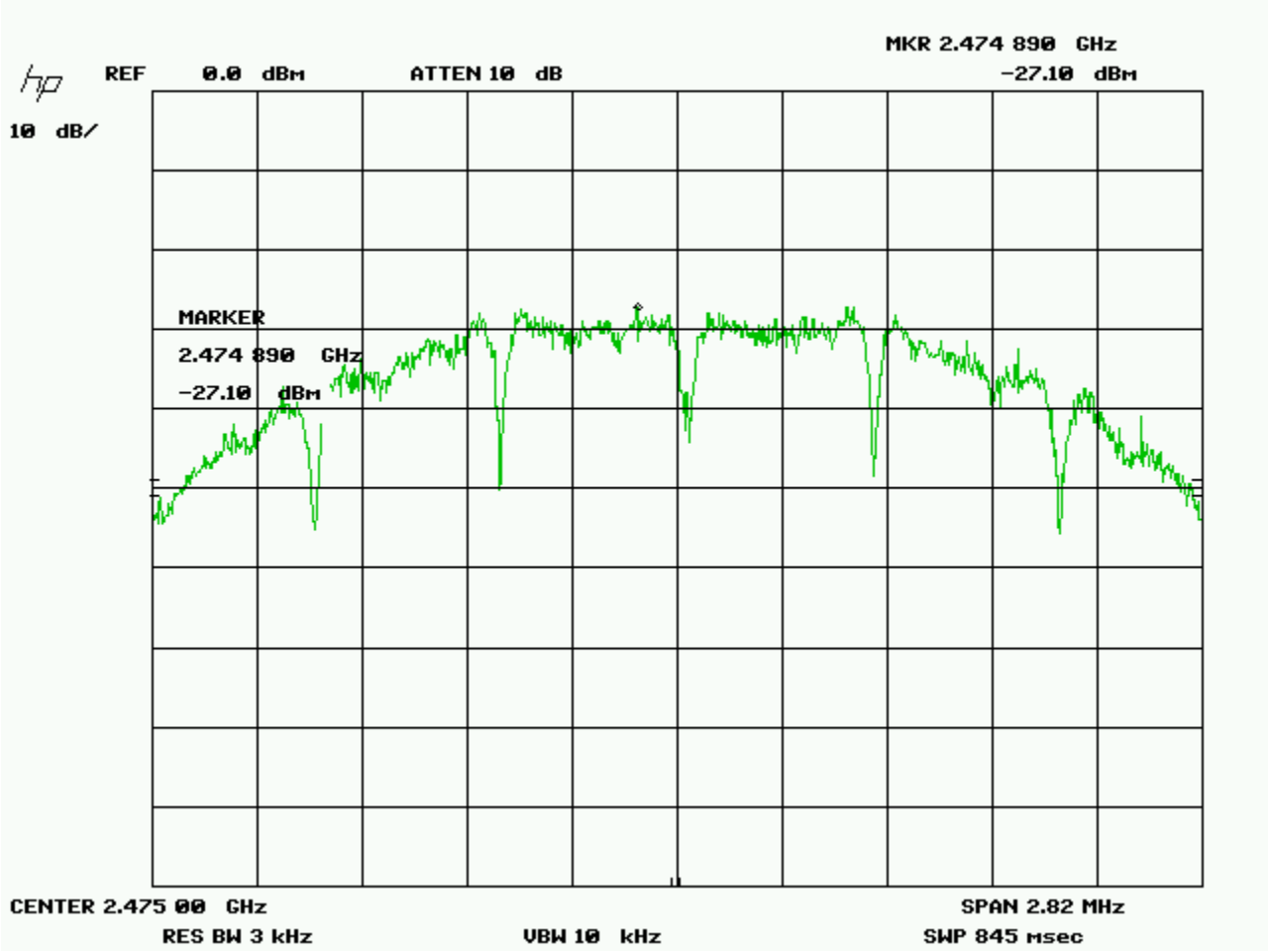
High channel



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 #
Spectrum Analyzer	8566B	HP	2008-02-28	2010-02-28	6
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29

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

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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 0.005355 mW/cm^2; this is significantly under the 1.0 mW/cm^2 requirement.

Calculations

Method 1 (conducted power)

$P_d = (P_t*G) / (4*pi*R^2)$
Where Pt = 11.3 or 13.5 mW as per Peak power conducted output
Where G = 3 dBi, or numerically 2
Where R = 20 cm

$P_d = (13.5\ mW * 2) / (4 * pi * 20cm^2)$
$P_d = 26.91\ mW / 5026\ cm^2$
$P_d = 0.005355\ mW/cm^2$

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Appendix A – EUT Summary

General EUT Description

Client	
Organization	Viconics
Contact	Paolo Primiani
Phone	1-800-563-5660
Email	paolo@viconics.com
EUT Details	
EUT Model number	VWG-APP
Equipment Category	Thermostat control equipment.
Basic EUT Functionality	Viconics Wireless Gateway (VWG-APP) and associated thermostats with wireless mesh network adapter, has been specifically designed to target the automation-less retrofit market equipped with stand-alone electromechanical or electronic controls. The Viconics wireless product line provides significant reduction in installed costs through the elimination of additional field communication wiring, allowing you to reuse the existing equipment-to-controller wiring infrastructure.
Input Voltage and Frequency	DC powered
Connectors available on EUT	None
Peripherals Required for Test	RS-232 connection to test board and laptop to control channel and output power.
Release type	Final
Intentional Radiator Frequency	2400 – 2483.5 MHz
I/O cable description	EUT has an antenna extender cable which is approximately 5 feet in length.

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Appendix B – EUT and Test Setup Photographs

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Figure 1 – EUT with extended cable antenna option

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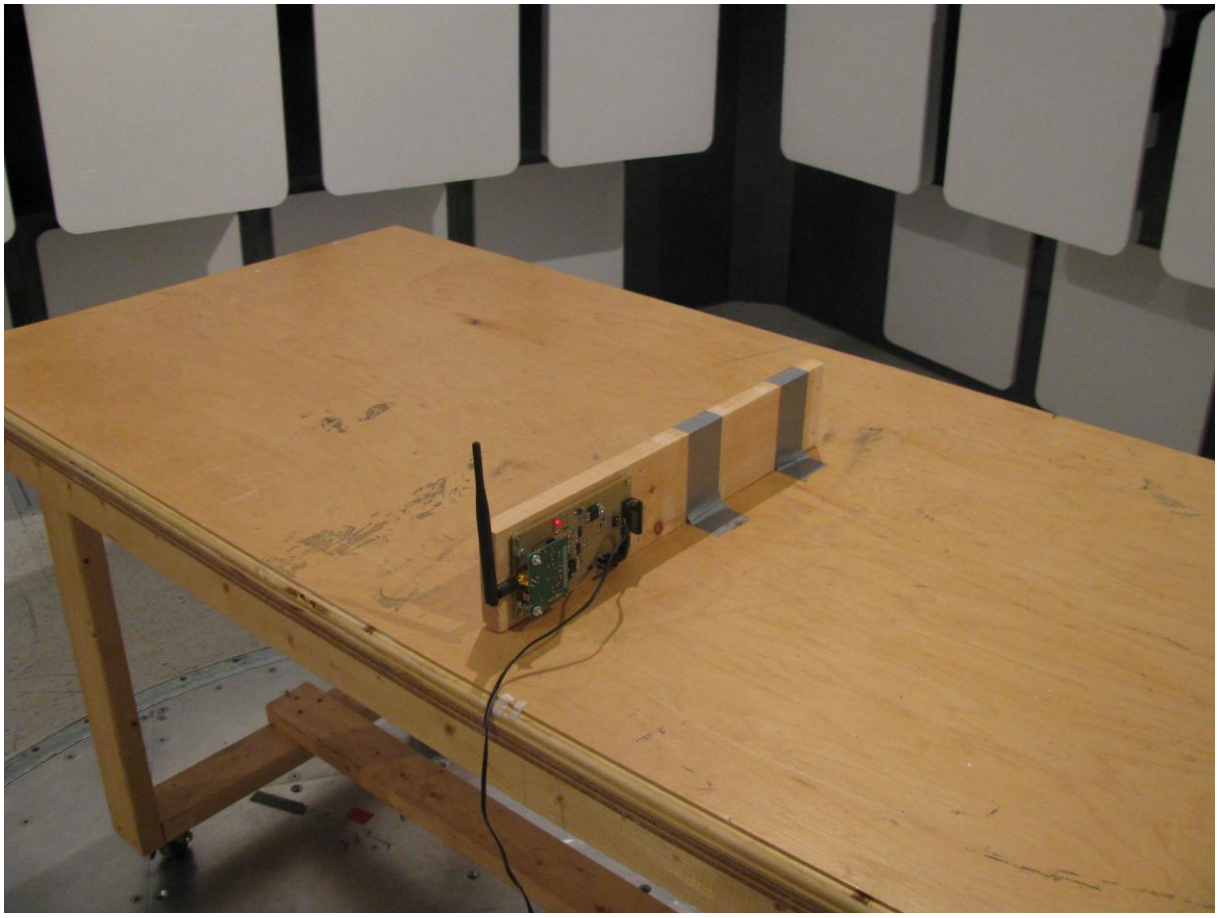

Figure 2 – Radiated emission setup

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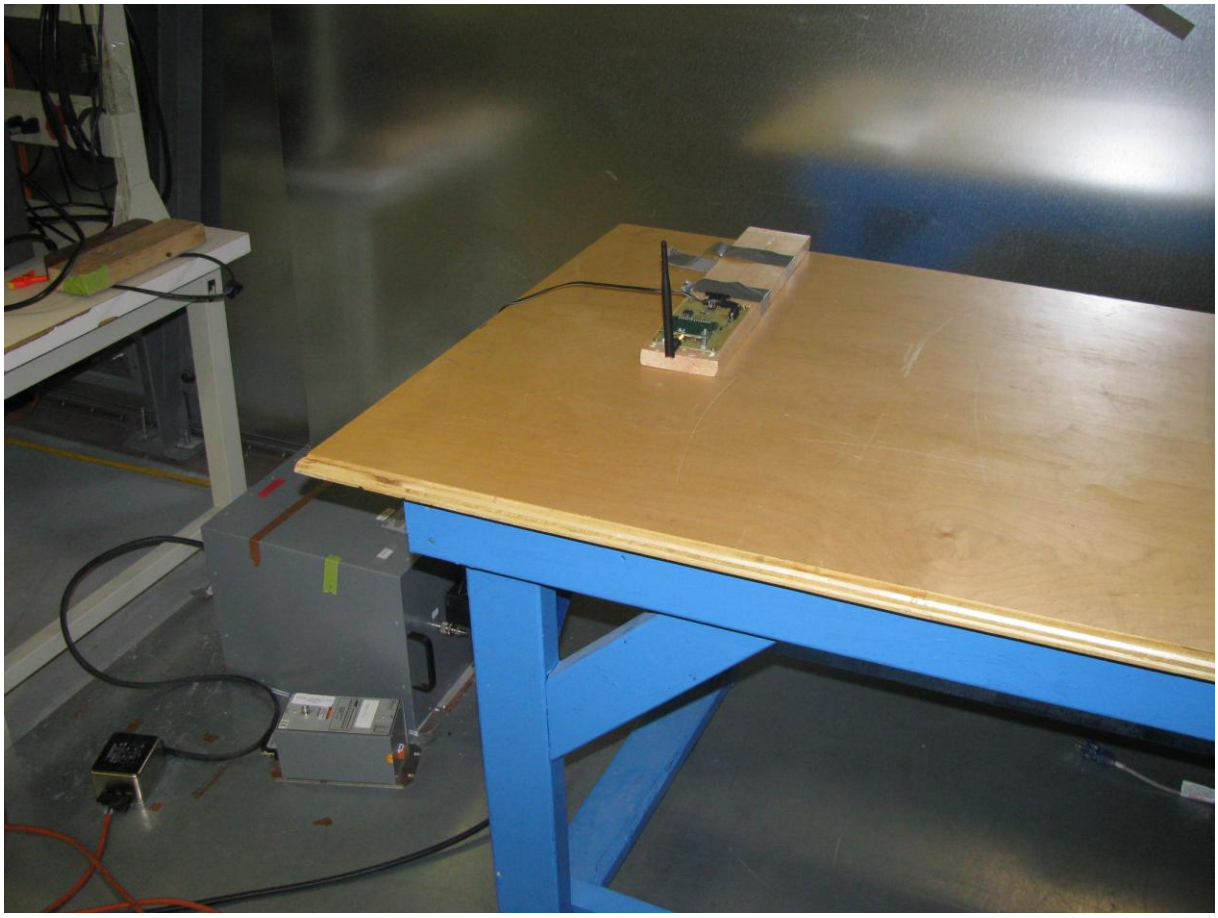

Figure 3 – Power line conducted emissions

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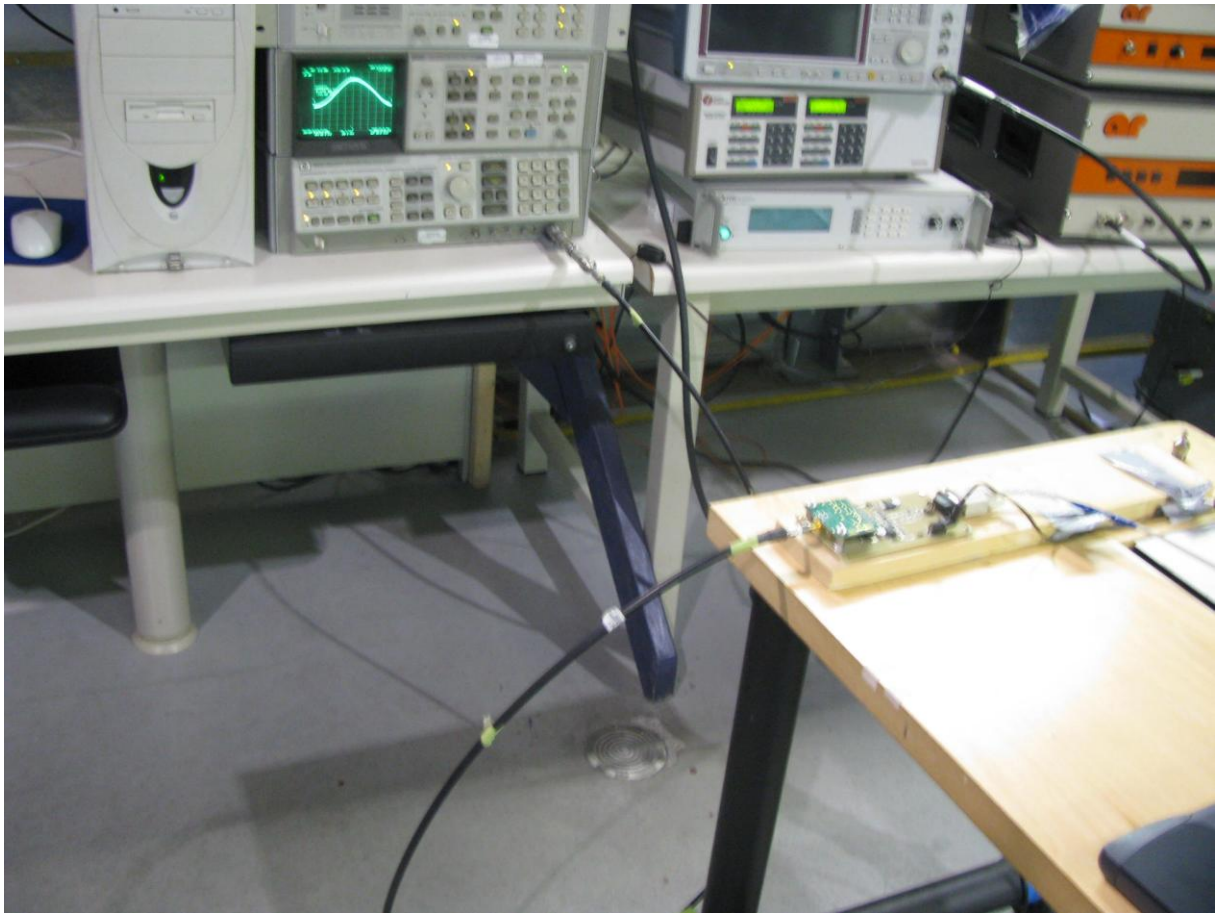

Figure 4 – Conducted power emissions

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

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