Global EMC Inc. Labs

EMC & RF Test Report

As per

RSS 210 Issue 6:2005

&

FCC Part 15 Subpart C:2006

Unlicensed Intentional Radiators

On the

RadpidSE Zigbee Smart Energy Module
XFFZGB357PA10

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Testing produced for

See Appendix A for full customer & EUT details.

LAB REGISTRATION #6844A-1

FCC REGISTRATION #612361

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Report Scope

This report addresses the EMC verification testing and test results of the RadpidSE Zigbee Smart Energy, XFFZGB357PA10 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 6:2005 / 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.

Client	MMB Research	
Product	RapidSE Zigbee Smart Energy Module XFFZGB357PA10	
Standard(s)	RSS 210 Issue 6:2005 / FCC Part 15 Subpart C 15:2006	

Summary

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

EUT FCC Certification #, FCC ID:	XFFZGB357PA10
EUT Industry Canada Certification #, IC:	8365A- ZGB357PA10
EUT Passed all tests performed.	Yes (see test results summary)
Tests conducted by	Ashwani Malhotra

Client	MMB Research
Product	RapidSE Zigbee Smart Energy Module XFFZGB357PA10
Standard(s)	RSS 210 Issue 6:2005 / 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	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
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 a ceramic chip antenna (0.5 dbi gain - Johanson 2450AT43A100) or a External antenna (5.0 dbi gain - Belkin EDA-1713-2G4C1-A2) with less than 6 dbi gain for both. The antennas are mutually exclusive. Spurious emissions and band edges were measured for both of them. Worst case emissions are shown in the report below.

The EUT is duty cycled during the course of operation. As per the manufacturer of the chip, the maximum duty cycle the unit can operate on is 11%. All the measurements in the plots below show a correction factor using 11% duty cycle.

For the Restricted Bands of operation, the EUT is designed to only operate between 2400 – 2475.0MHz.

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 then 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 210:2005	- Issue 6: 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 - Sept 20th, 2010 Initial report release.

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)
Aug 1 - 10, 2010	All	AM	24.5-24.9ºC	33%-39%	101.2 -101.8 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.

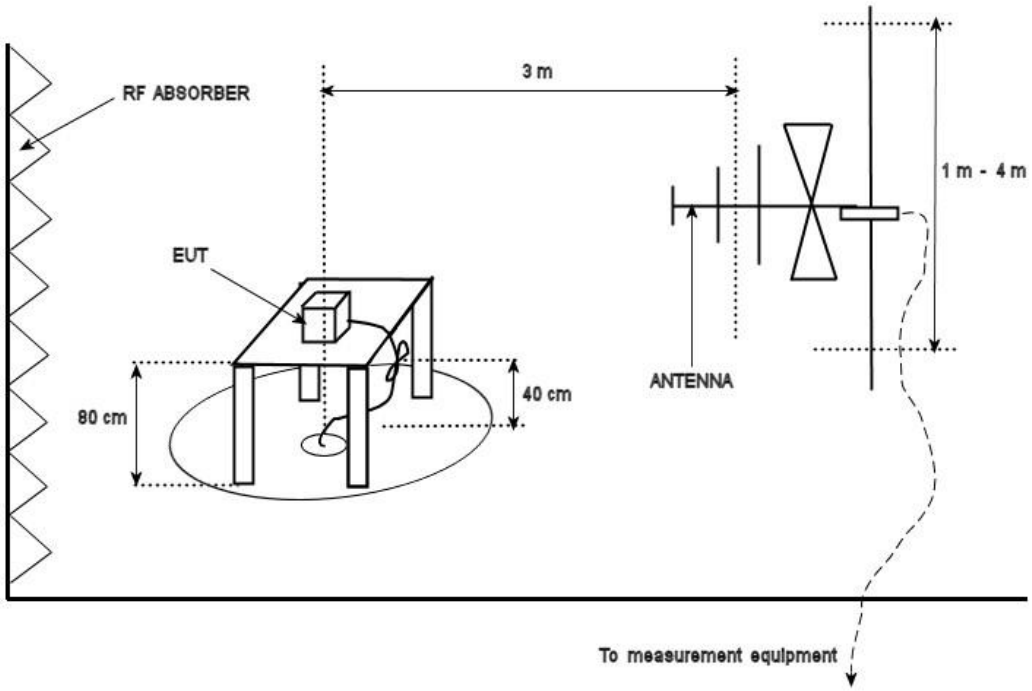
The limits, as defined in 15.247(d) for unintentional radiated emissions apply for those emissions that fall in the restricted bands, as defined in Section 15.205(a). These emissions must comply with the radiated emission limits specified in Section 15.209(a).

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

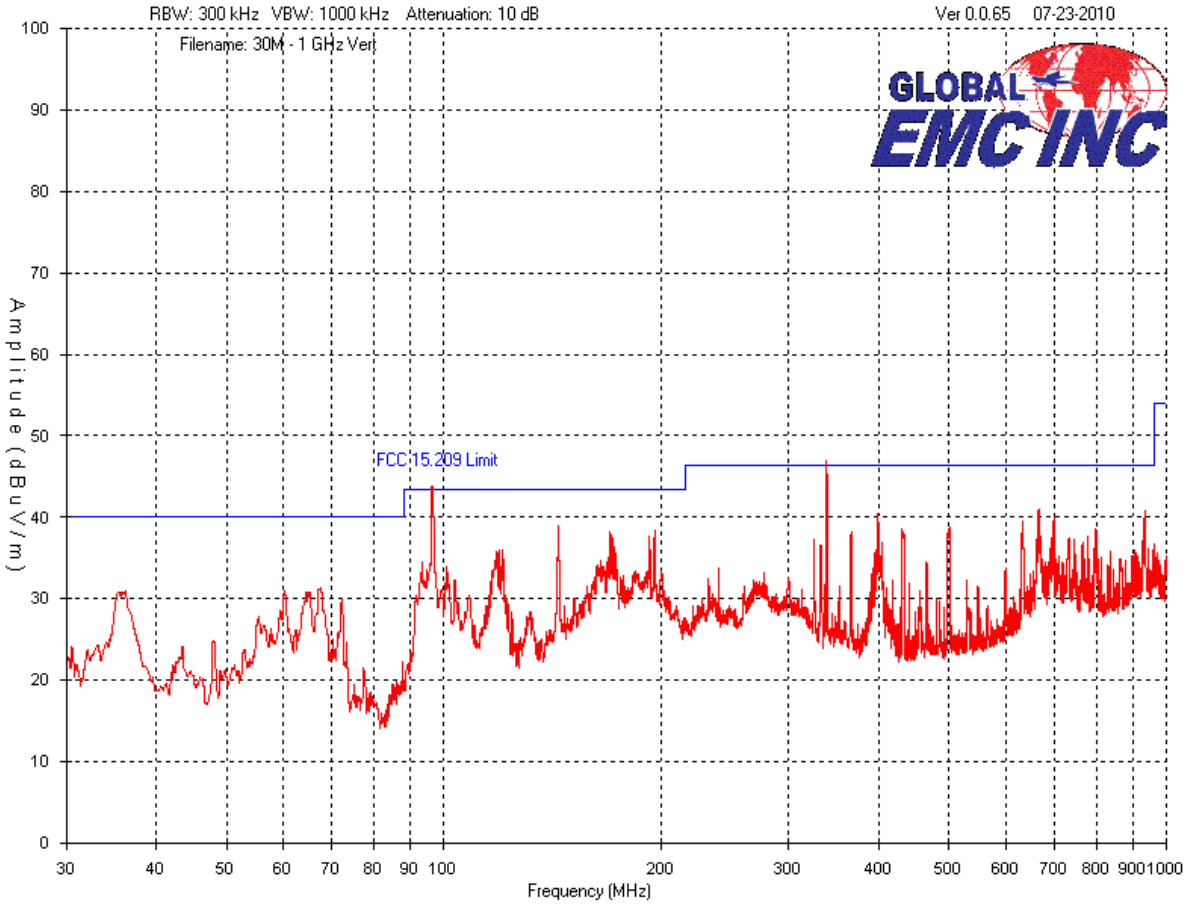
The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is +/-4.4 dB with a 'k=2' coverage factor and a %95 confidence level.

Preliminary Graphs

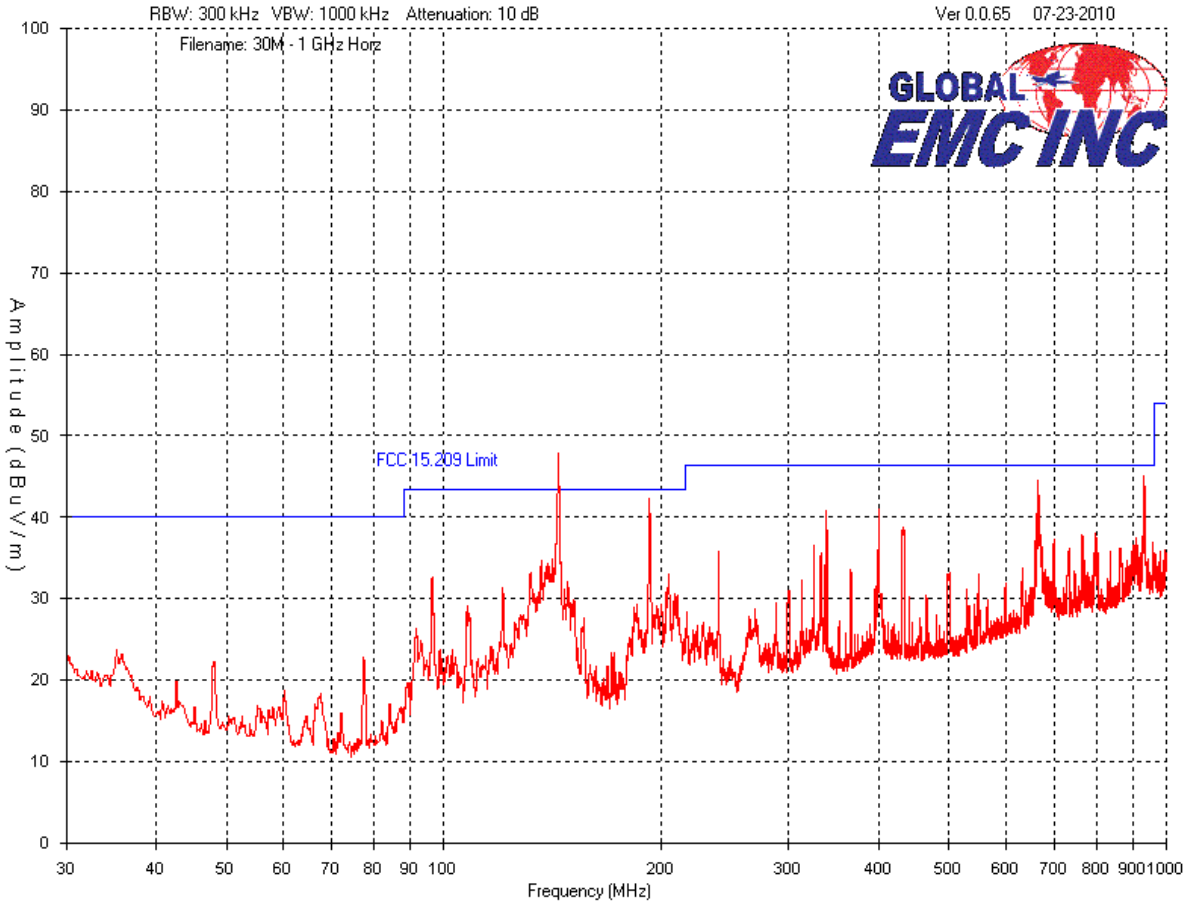
Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector, please refer to the final measurement table where applicable. The graph shown below is a maximized peak measurement graph, measured with a resolution bandwidth greater then the final 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.

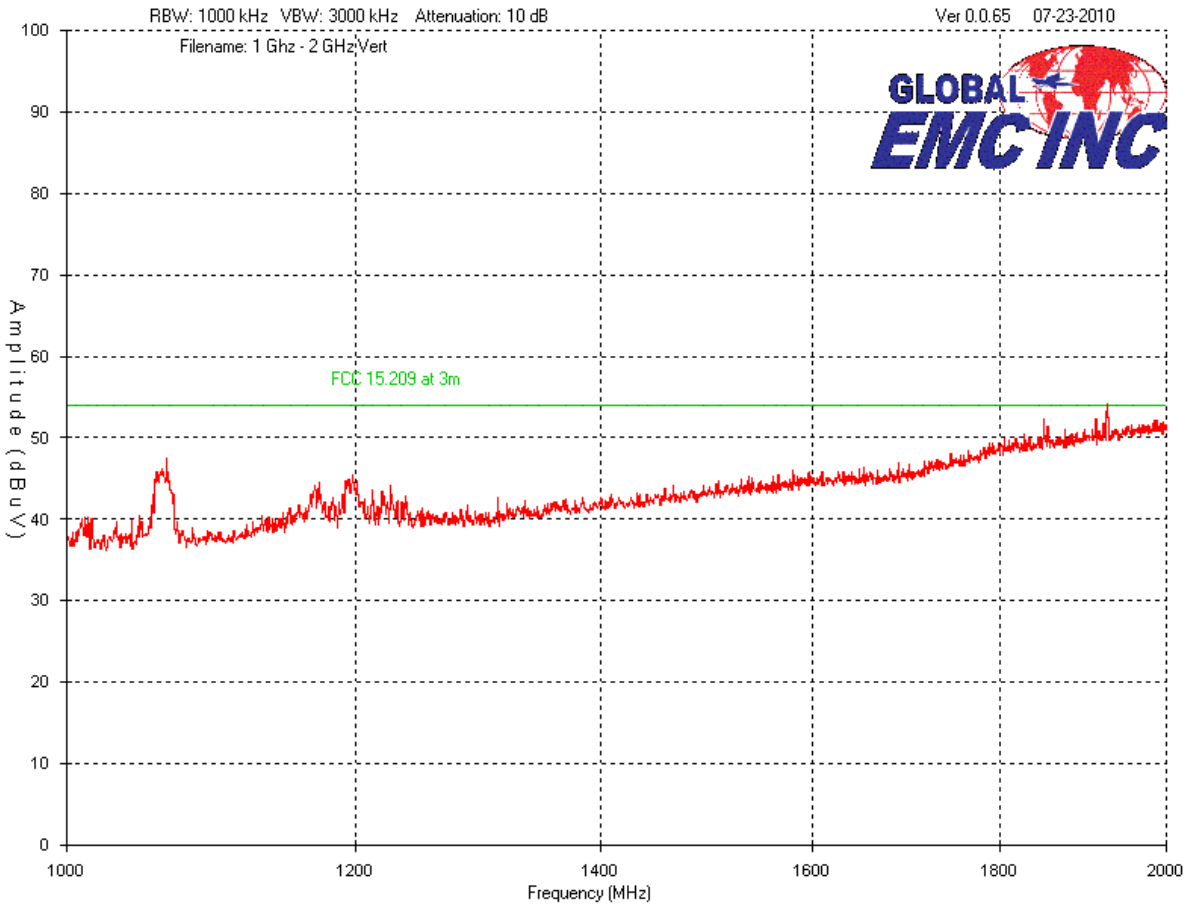
Hi Channel – 30MHz – 1 GHz
Vertical – Peak Emissions Graph



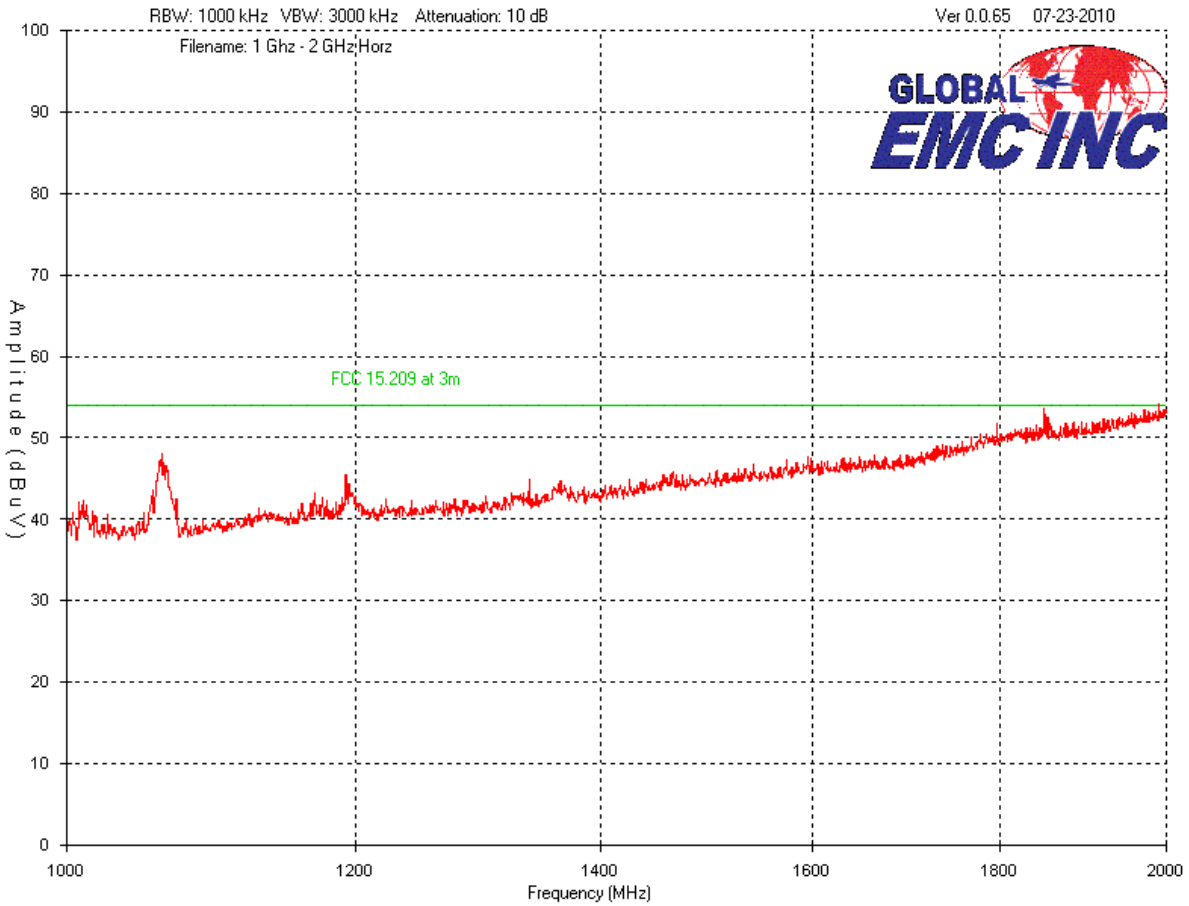
Hi Channel – 30MHz – 1 GHz
Horizontal – Peak Emissions Graph



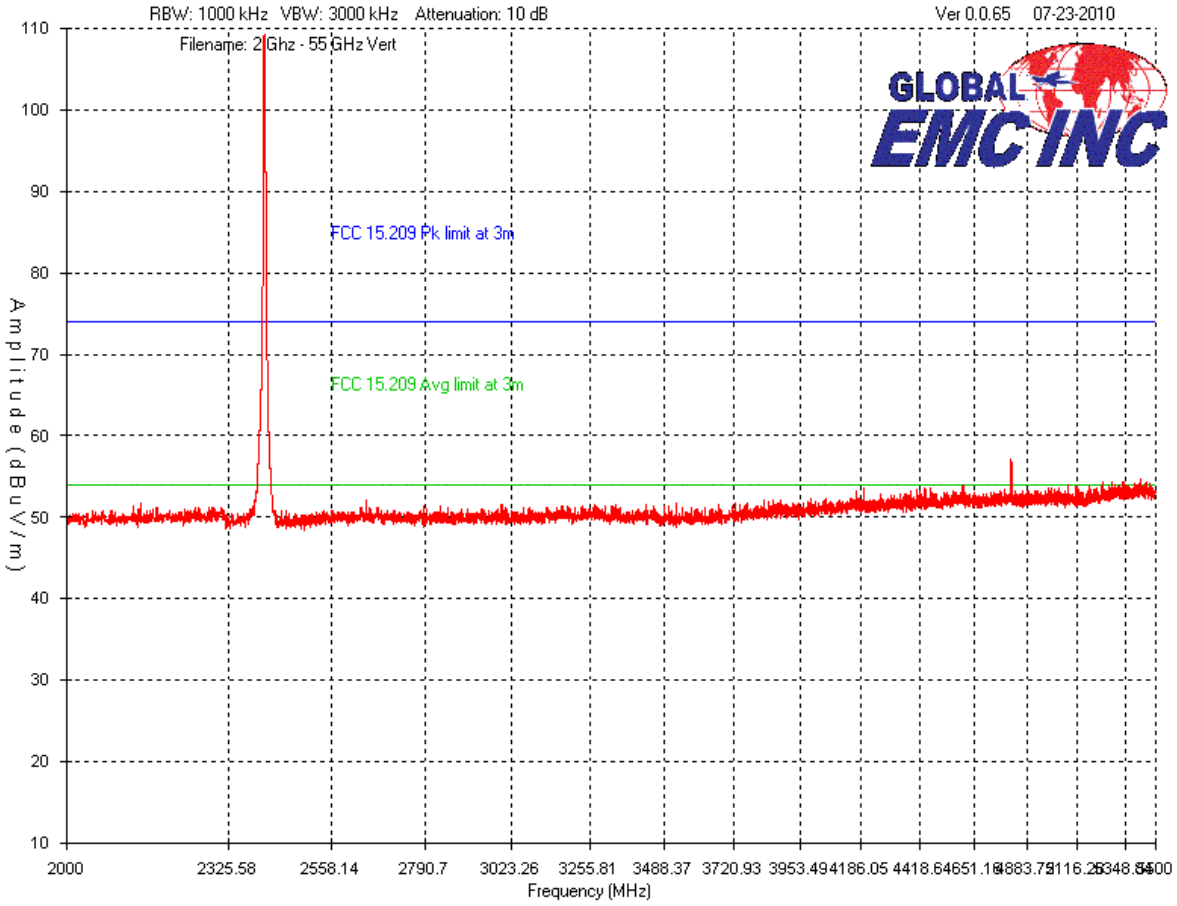
Hi Channel – 1 – 2GHz
Vertical – Peak Emissions Graph



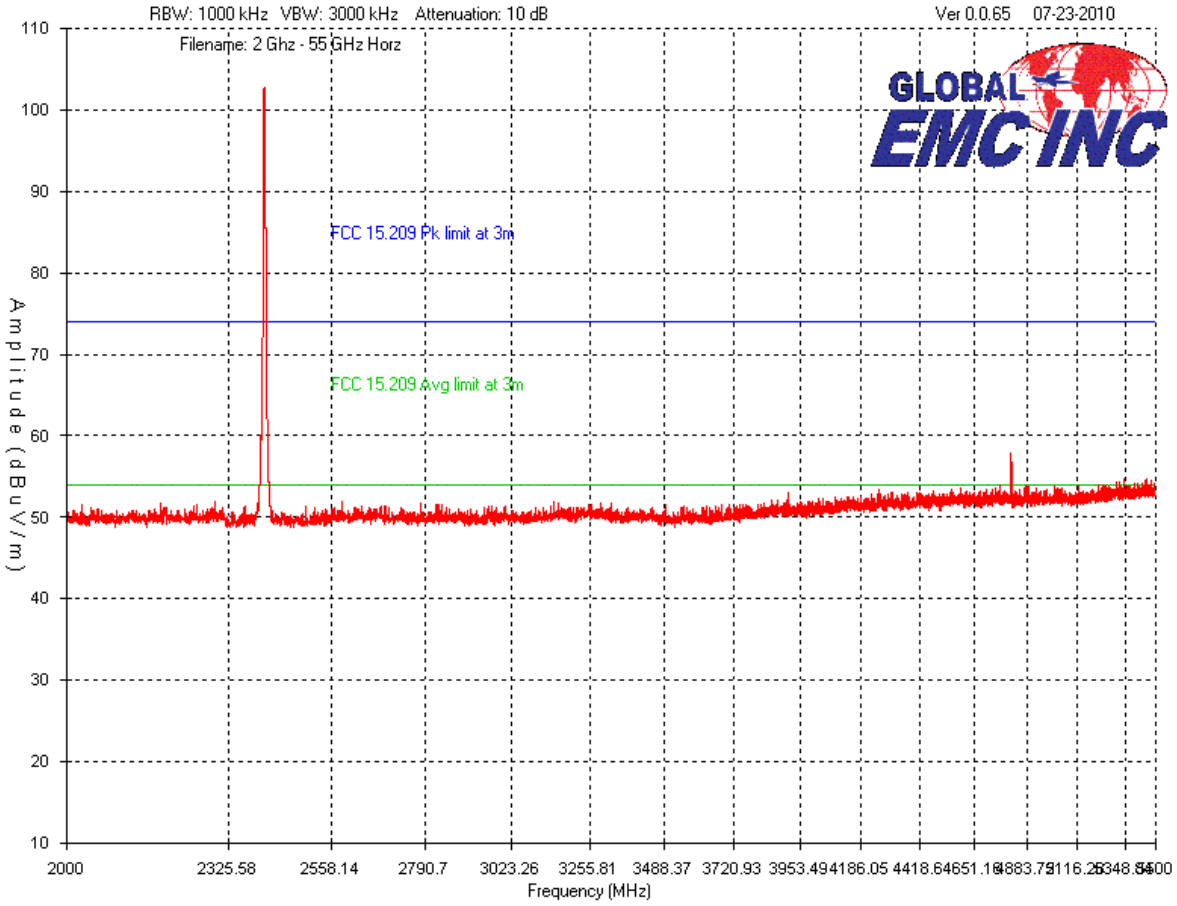
Hi Channel – 1 – 2GHz
Horizontal – Peak Emissions Graph



Hi Channel – 2-5.5 GHz
Vertical – Peak Emissions Graph



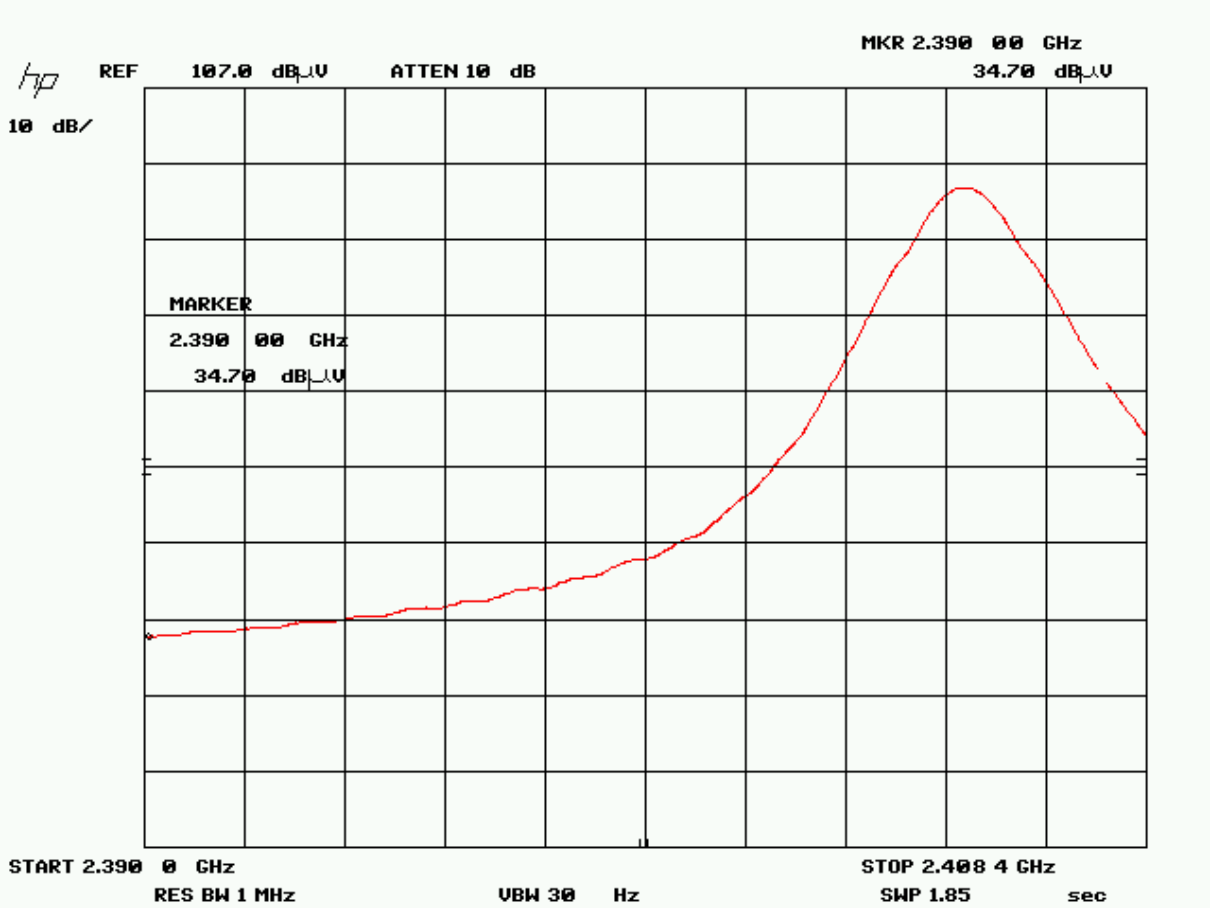
Hi Channel – 2-5.5 GHz
Horizontal – Peak Emissions Graph



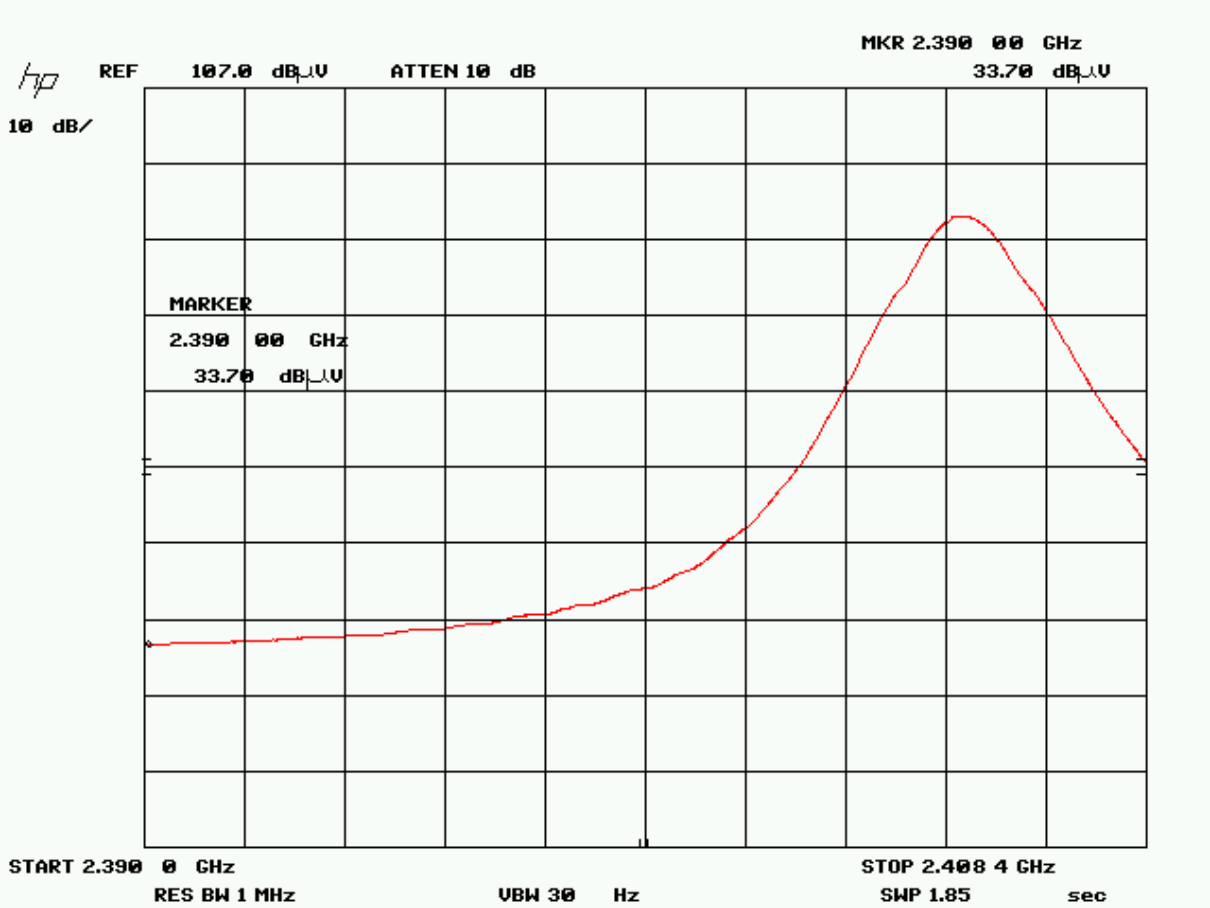
Band Edge – Low channel
Vertical peak emissions

Band Edge – Low channel
Horizontal peak emissions

Band Edge – Low channel
Vertical Average emissions



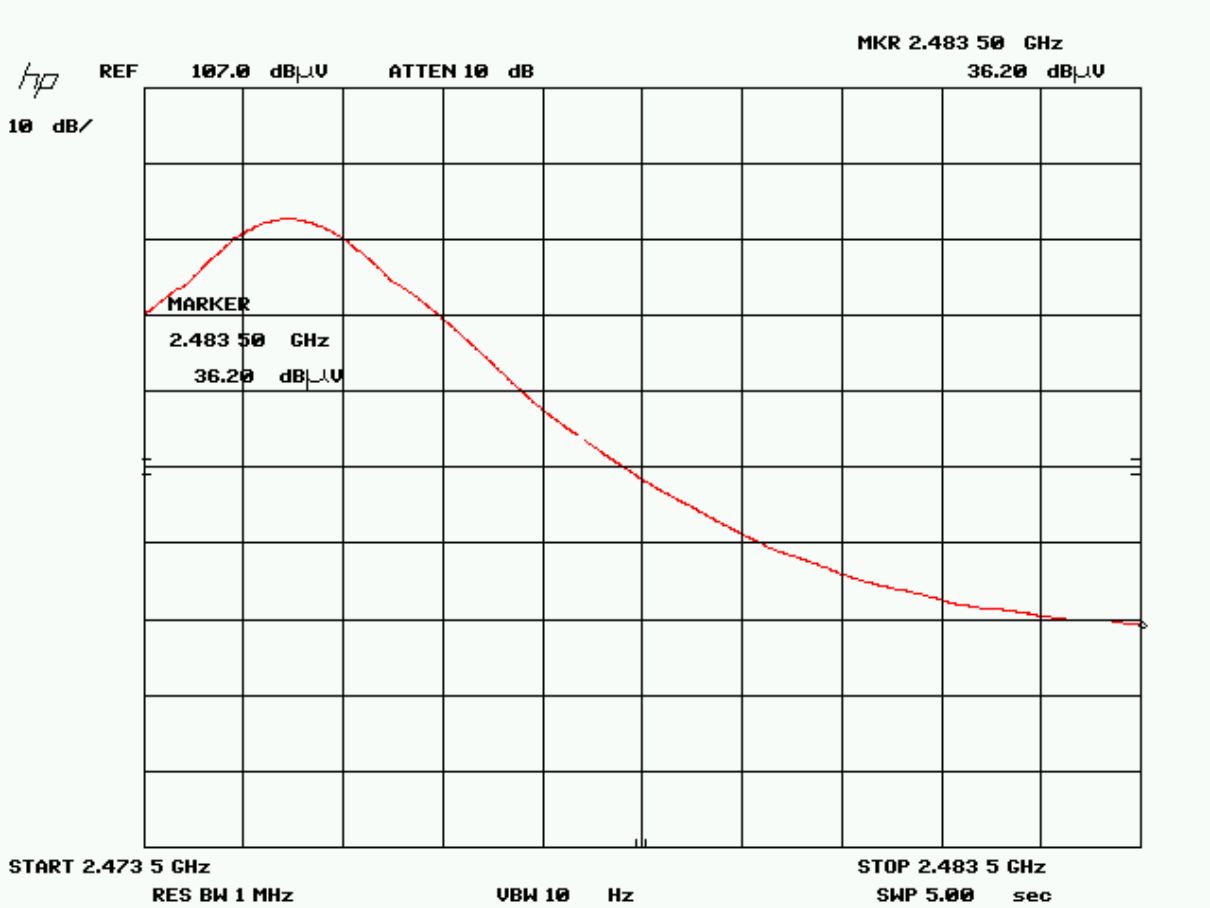
Band Edge – Low channel
Horizontal Average emissions



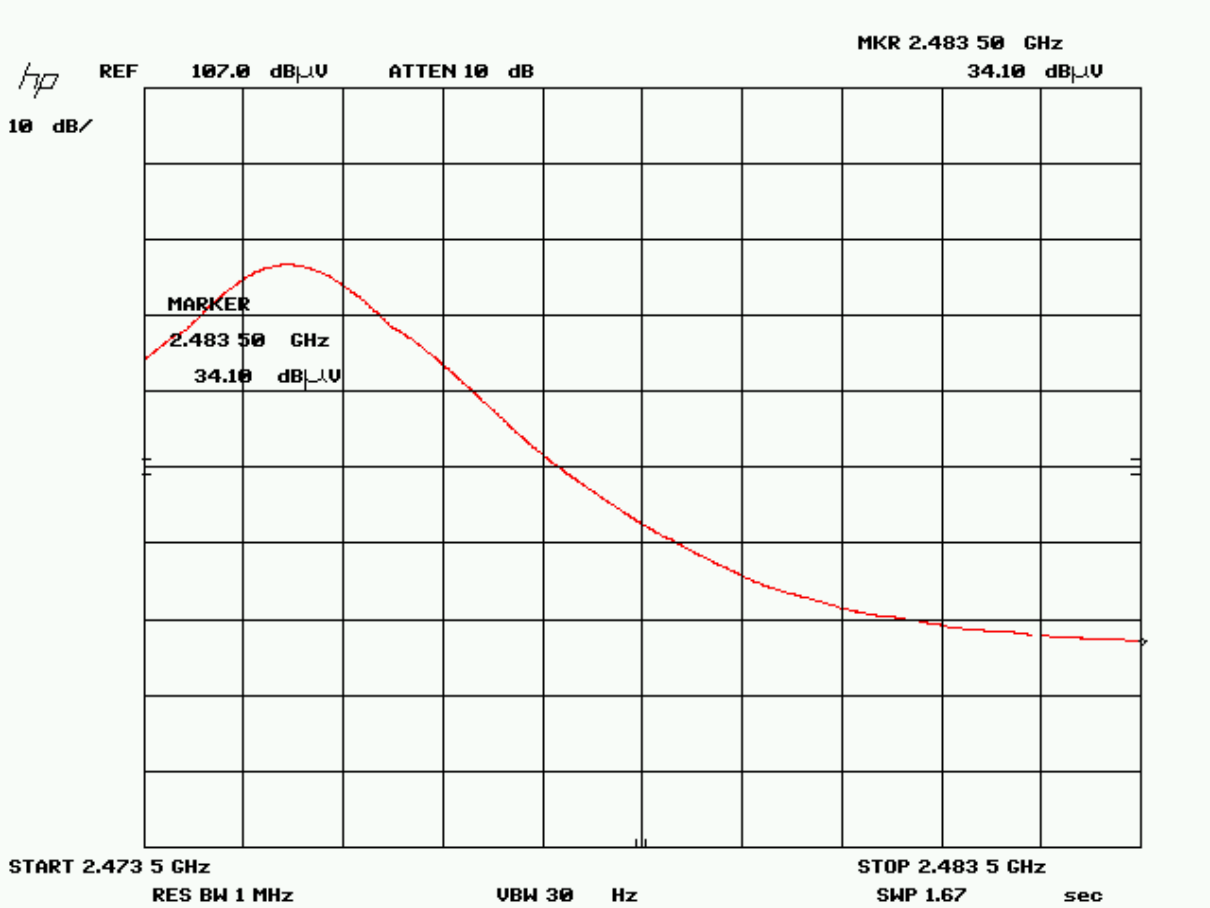
Band Edge – Hi channel
Vertical peak emissions

Band Edge – Hi channel
Horizontal peak emissions

Band Edge – Hi channel
Vertical Average emissions

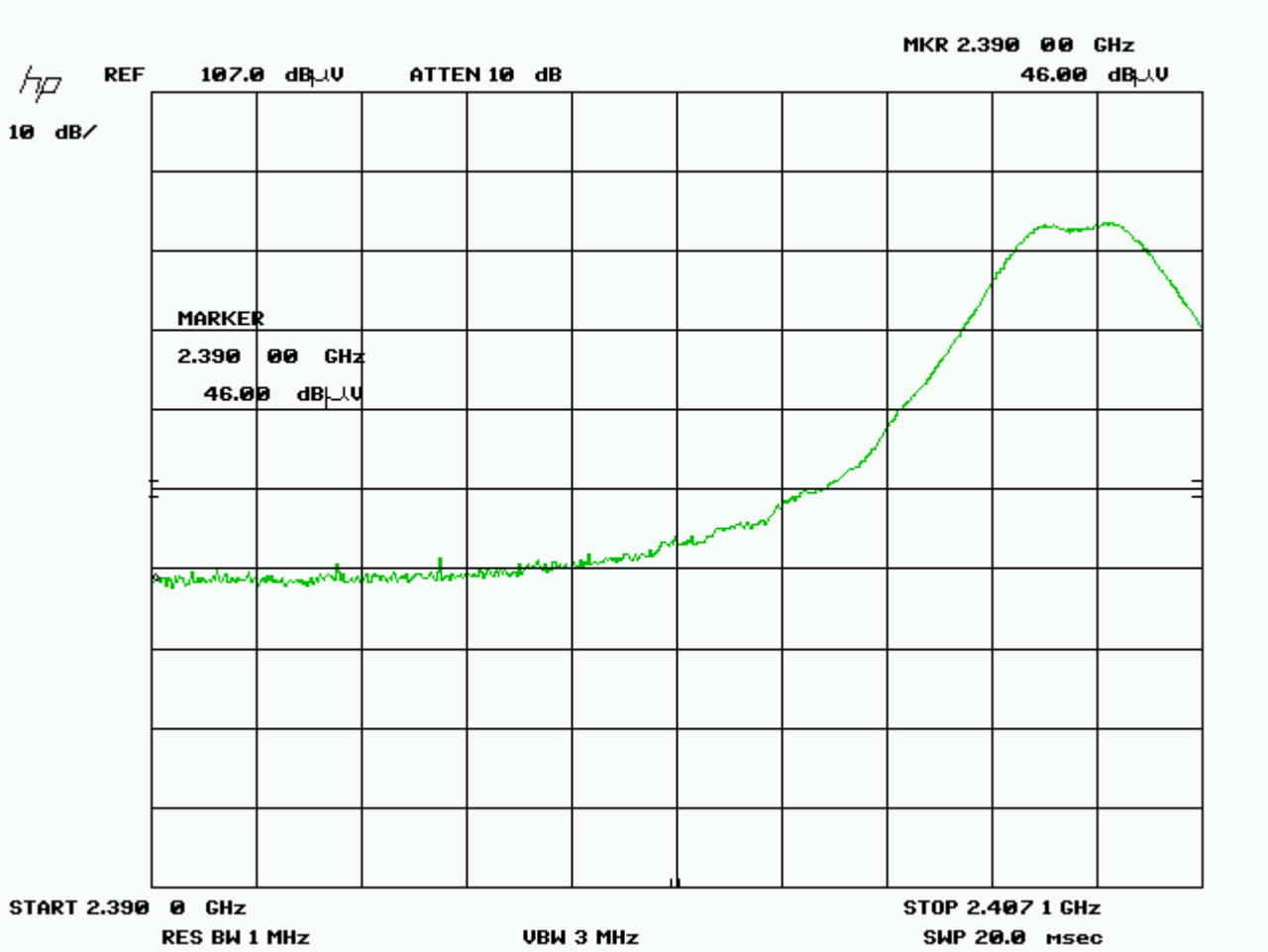


Band Edge – Hi channel
Horizontal Average emissions

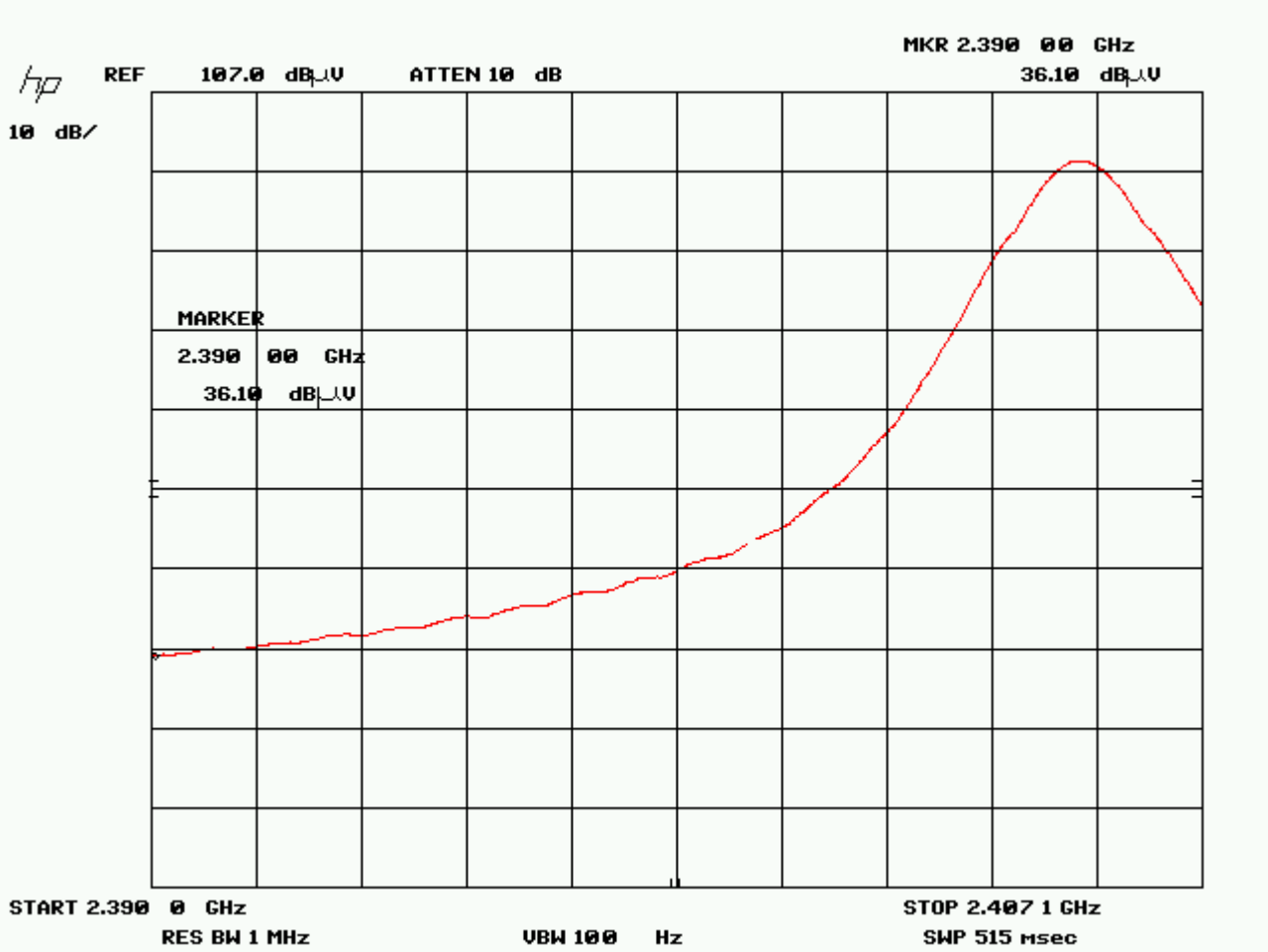


Band Edge – Low channel (External antenna)
Vertical peak emissions

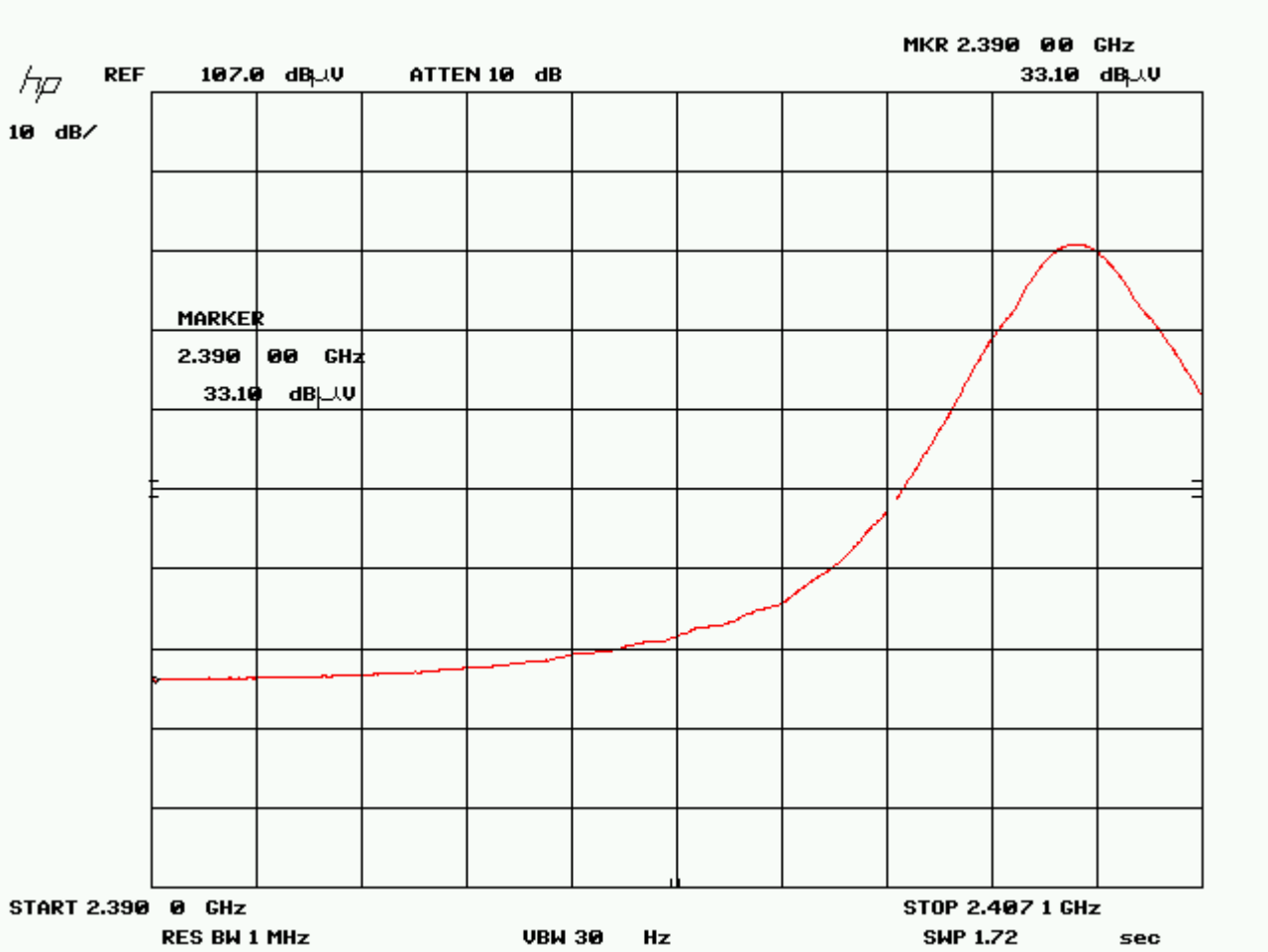
Band Edge – Low channel (External antenna)
Horizontal peak emissions



Band Edge – Low channel (External antenna)
Vertical Average emissions

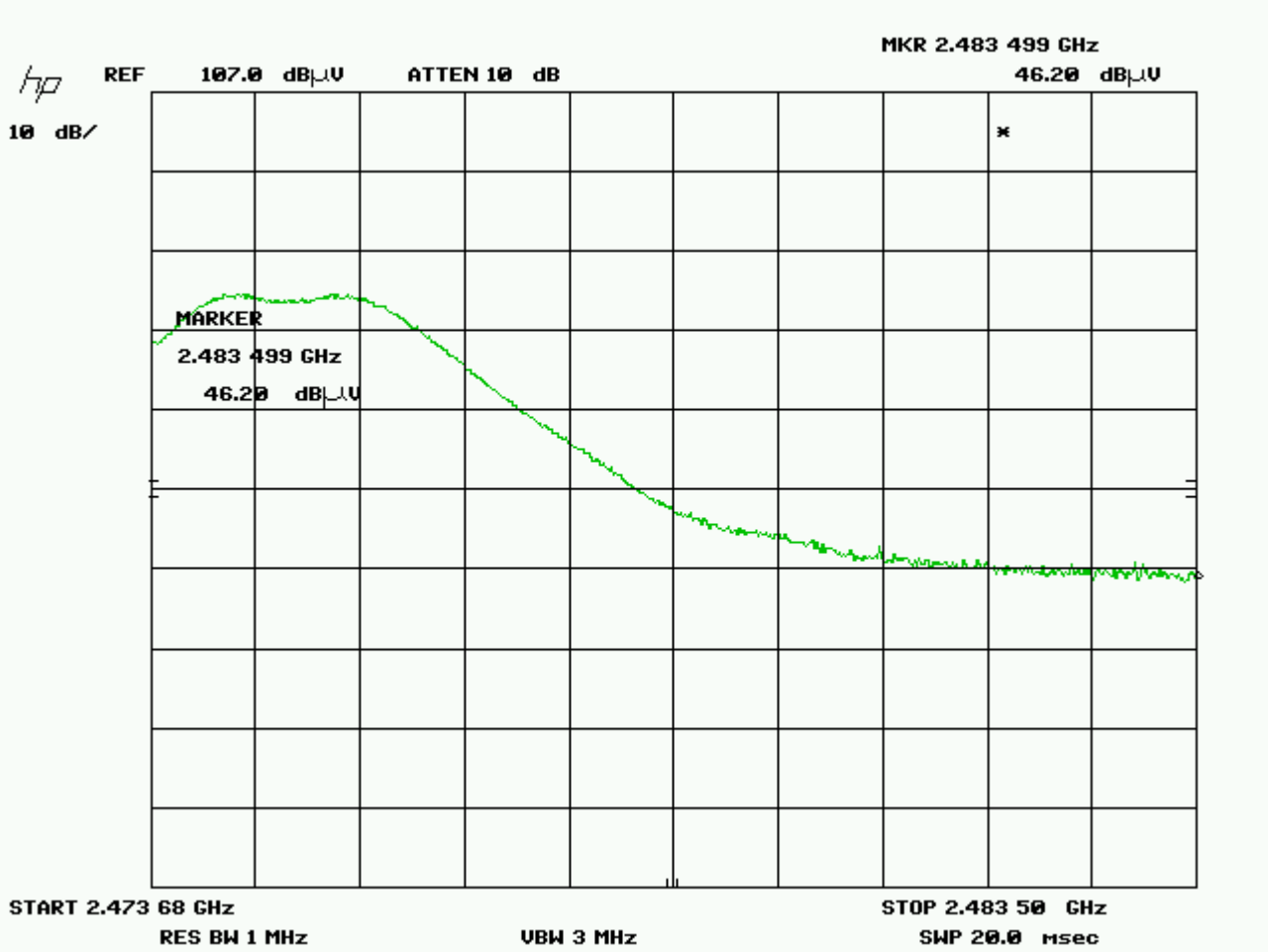


Band Edge – Low channel (External antenna)
Horizontal Average emissions

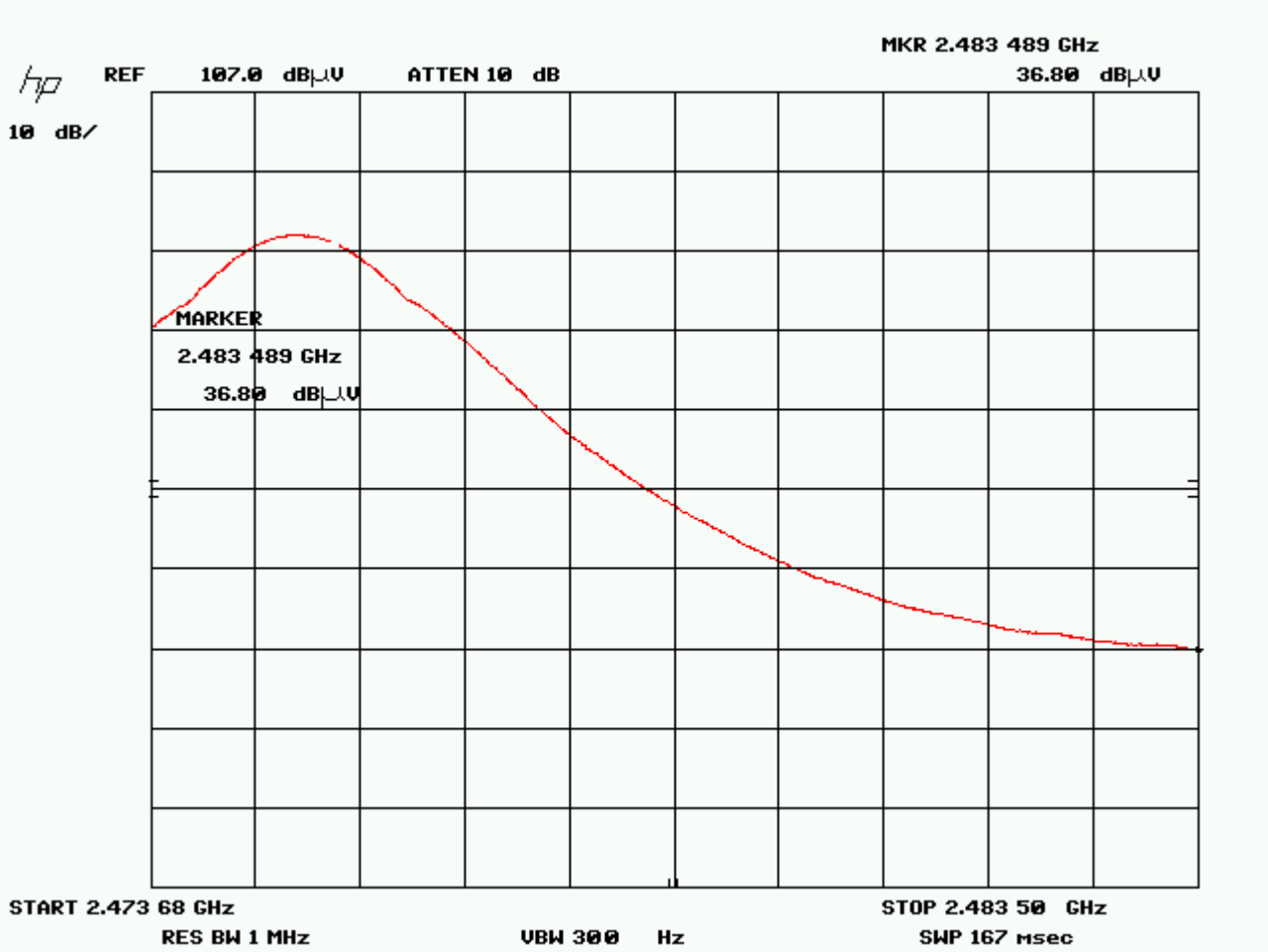


Band Edge – Hi channel (External antenna)
Vertical peak emissions

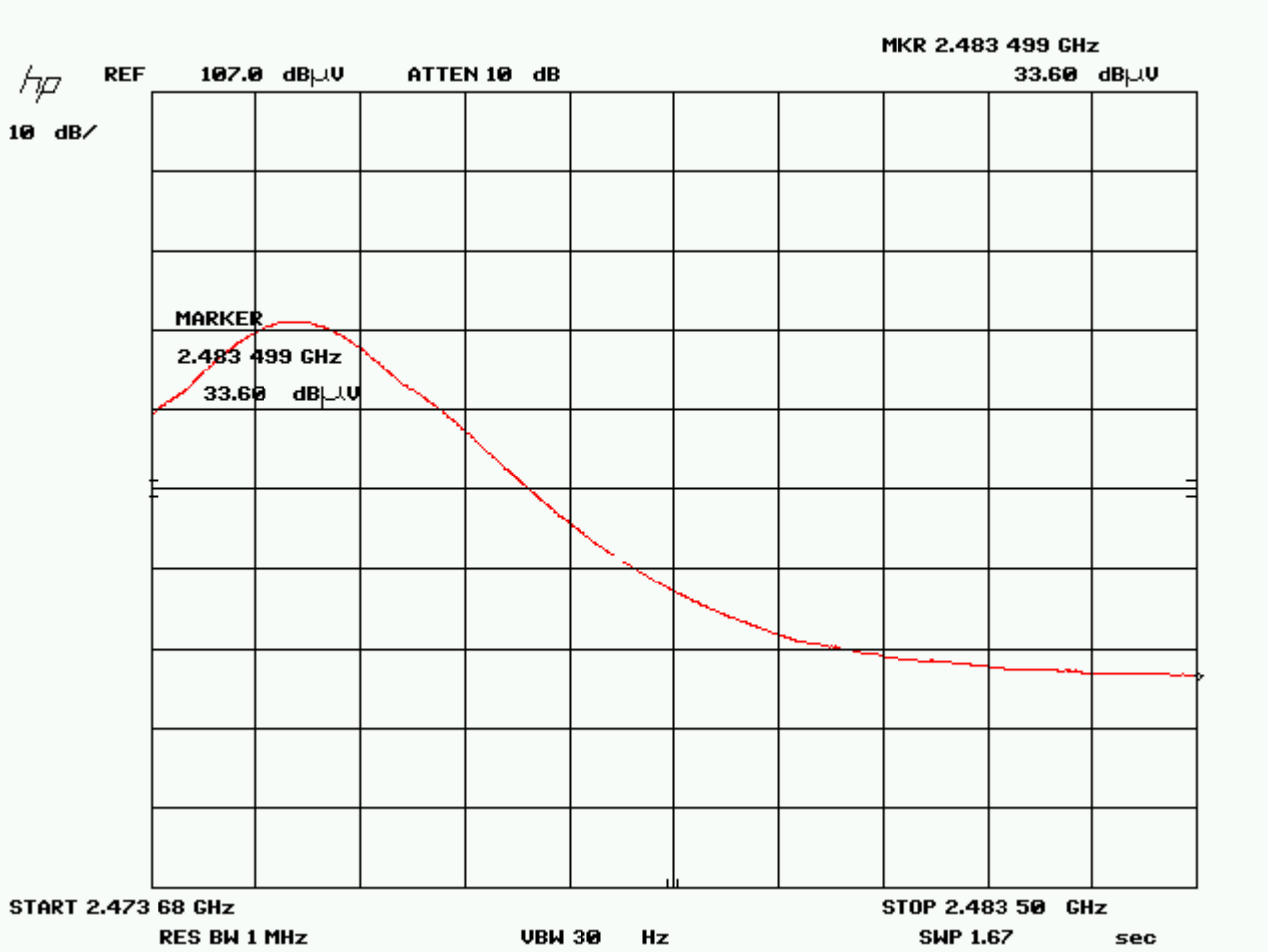
Band Edge – Hi channel (External antenna)
Horizontal peak emissions



Band Edge – Hi channel (External antenna)
Vertical Average emissions



Band Edge – Hi channel (External antenna)
Horizontal Average emissions



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. Equipment uses a duty cycle and this factor was used for AVG measurements above 1 GHz. The maximum duty cycle the unit can theoretically operate on is 11%. This correction factor was used for all the measurements.
   20 log (0.11) = -19.23 db.
4. The internal antenna has a gain of ~0.5 dbi. Maximum conducted power output was 19.8 dbm.
5. The external antenna has a gain of ~5 dbi and the maximum conducted power was limited to 16.9 dbm. For the Hi channel only the power was limited to 10.0 dbm to comply with band edge requirements.

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.

For information purposes, the fundamental was measured to be 113.8 dBuV/m at 3 meters and 117.1 dbuV/m at 3 meters for EXT antenna, and none of the unintentional radiated emissions that fall outside of the restricted bands exceeded the -20dBc requirement.

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

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

Client	MMB Research
Product	RapidSE Zigbee Smart Energy Module XFFZGB357PA10
Standard(s)	RSS 210 Issue 6:2005 / FCC Part 15 Subpart C 15:2006

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**
Low Channel - Mod ON setting 3 dbm											
2405	Peak	Vert	97.3	31.5	5.0	16.0	36.0	113.8			PASS
2405	Avg	Vert	96.3	31.5	5.0	16.0	36.0	112.8			PASS
2405	Peak	Horz	92.8	31.5	5.0	16.0	36.0	109.3			PASS
2405	Avg	Horz	90.0	31.5	5.0	16.0	36.0	106.5			PASS
2390	Peak	Horz	46.1	31.5	5.0	16.0	36.0	62.6	74.0	11.4	PASS
2390	Avg	Horz	26.9	31.5	5.0	16.0	36.0	43.4	54.0	10.6	PASS

2390	Peak	Vert	47.5	31.5	5.0	16.0	36.0	64.0	74.0	10.0	PASS
2390	Avg	Vert	28.3	31.5	5.0	16.0	36.0	44.8	54.0	9.2	PASS
4808	Peak	Horz	46.7	32.4	6.5	16.0	36.0	65.6	74.0	8.4	PASS
4810	Avg	Horz	27.5	32.4	6.5	16.0	36.0	46.4	54.0	7.6	PASS
4810	Peak	Vert	46.1	32.4	6.5	16.0	36.0	65.0	74.0	9.0	PASS
4810	Avg	Vert	26.9	32.4	6.5	16.0	36.0	45.8	54.0	8.2	PASS
7216	Peak	Horz	48.0	36.0	6.5	16.0	35.8	70.7	74.0	3.3	PASS
7216	Avg	Horz	28.8	36.0	6.5	16.0	35.8	51.5	54.0	2.5	PASS
7216	Peak	Vert	46.2	36.0	6.5	16.0	35.8	68.9	74.0	5.1	PASS
7216	Avg	Vert	27.0	36.0	6.5	16.0	35.8	49.7	54.0	4.3	PASS
Hi Channel (25) - Mod ON setting 3dbm											
2475	Peak	Vert	93.2	31.5	5.0	16.0	36.0	109.7			PASS
2475	Avg	Vert	89.6	31.5	5.0	16.0	36.0	106.1			PASS
2475	Peak	Horz	86.6	31.5	5.0	16.0	36.0	103.1			PASS
2475	Avg	Horz	83.7	31.5	5.0	16.0	36.0	100.2			PASS
2483.5	Peak	Horz	47.0	31.5	5.0	16.0	36.0	63.5	74.0	10.5	PASS
2483.5	Avg	Horz	27.8	31.5	5.0	16.0	36.0	44.3	54.0	9.7	PASS
2483.5	Peak	Vert	48.7	31.5	5.0	16.0	36.0	65.2	74.0	8.8	PASS
2483.5	Avg	Vert	29.5	31.5	5.0	16.0	36.0	46.0	54.0	8.0	PASS
4950	Peak	Horz	48.3	32.4	6.5	16.0	36.0	67.2	74.0	6.8	PASS
4950	Avg	Horz	29.1	32.4	6.5	16.0	36.0	48.0	54.0	6.0	PASS

4950	Peak	Vert	45.9	32.4	6.5	16.0	36.0	64.8	74.0	9.2	PASS
4950	Avg	Vert	26.7	32.4	6.5	16.0	36.0	45.6	54.0	8.4	PASS
7425	Peak	Horz	47.7	36.0	6.5	16.0	35.8	70.4	74.0	3.6	PASS
7425	Avg	Horz	28.5	36.0	6.5	16.0	35.8	51.2	54.0	2.8	PASS
7425	Peak	Vert	46.5	36.0	6.5	16.0	35.8	69.2	74.0	4.8	PASS
7425	Avg	Vert	27.3	36.0	6.5	16.0	35.8	50.0	54.0	4.0	PASS
Mid Channel (19) - Mod ON setting 3dbm											
2445	Peak	Vert	92.1	31.5	5.0	16.0	36.0	108.6			PASS
2445	Avg	Vert	89.2	31.5	5.0	16.0	36.0	105.7			PASS
2445	Peak	Horz	89.0	31.5	5.0	16.0	36.0	105.5			PASS
2445	Avg	Horz	85.0	31.5	5.0	16.0	36.0	101.5			PASS
4890	Peak	Horz	47.1	32.4	6.5	16.0	36.0	66.0	74.0	8.0	PASS
4890	Avg	Horz	27.9	32.4	6.5	16.0	36.0	46.8	54.0	7.2	PASS
4890	Peak	Vert	46.5	32.4	6.5	16.0	36.0	65.4	74.0	8.6	PASS
4890	Avg	Vert	27.3	32.4	6.5	16.0	36.0	46.2	54.0	7.8	PASS
7335	Peak	Horz	46.5	36.0	6.5	16.0	35.8	69.2	74.0	4.8	PASS
7335	Avg	Horz	27.3	36.0	6.5	16.0	35.8	50.0	54.0	4.0	PASS
7335	Peak	Vert	47.2	36.0	6.5	16.0	35.8	69.9	74.0	4.1	PASS
7335	Avg	Vert	28.0	36.0	6.5	16.0	35.8	50.7	54.0	3.3	PASS
Low Channel - Mod ON -2 dbm (EXT Antenna)											
2405	Peak	Vert	100.6	31.5	5.0	16.0	36.0	117.1			PASS

2405	Avg	Vert	98.5	31.5	5.0	16.0	36.0	115.0			PASS
2405	Peak	Horz	90.6	31.5	5.0	16.0	36.0	107.1			PASS
2405	Avg	Horz	87.8	31.5	5.0	16.0	36.0	104.3			PASS
2390	Peak	Horz	46.0	31.5	5.0	16.0	36.0	62.5	74.0	11.5	PASS
2390	Avg	Horz	26.8	31.5	5.0	16.0	36.0	43.3	54.0	10.7	PASS
2390	Peak	Vert	47.9	31.5	5.0	16.0	36.0	64.4	74.0	9.6	PASS
2390	Avg	Vert	28.7	31.5	5.0	16.0	36.0	45.2	54.0	8.8	PASS
4808	Peak	Horz	44.0	32.4	6.5	16.0	36.0	62.9	74.0	11.1	PASS
4810	Avg	Horz	24.8	32.4	6.5	16.0	36.0	43.7	54.0	10.3	PASS
4810	Peak	Vert	44.7	32.4	6.5	16.0	36.0	63.6	74.0	10.4	PASS
4810	Avg	Vert	25.5	32.4	6.5	16.0	36.0	44.4	54.0	9.6	PASS
Hi Channel (25) - Mod ON setting -7dbm (EXT Antenna)											
2475	Peak	Vert	94.1	31.5	5.0	16.0	36.0	110.6			PASS
2475	Avg	Vert	91.0	31.5	5.0	16.0	36.0	107.5			PASS
2475	Peak	Horz	81.5	31.5	5.0	16.0	36.0	98.0			PASS
2475	Avg	Horz	78.0	31.5	5.0	16.0	36.0	94.5			PASS
2483.5	Peak	Horz	46.2	31.5	5.0	16.0	36.0	62.7	74.0	11.3	PASS
2483.5	Avg	Horz	27.0	31.5	5.0	16.0	36.0	43.5	54.0	10.5	PASS
2483.5	Peak	Vert	50.7	31.5	5.0	16.0	36.0	67.2	74.0	6.8	PASS
2483.5	Avg	Vert	31.5	31.5	5.0	16.0	36.0	48.0	54.0	6.0	PASS
Mid Channel (19) - Mod ON setting -2dbm (EXT Antenna)											

2445	Peak	Vert	99.8	31.5	5.0	16.0	36.0	116.3			PASS
2445	Avg	Vert	97.0	31.5	5.0	16.0	36.0	113.5			PASS
2445	Peak	Horz	88.7	31.5	5.0	16.0	36.0	105.2			PASS
2445	Avg	Horz	86.4	31.5	5.0	16.0	36.0	102.9			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
Horn Antenna	6878/24	Q-Par	25/08/2008	25/08/2010	GEMC 6365
1-26G pre-amp	HP 8449B	HP	25/08/2008	25/08/2010	GEMC 6351
Schaffner Preamp 9kHz - 2 GHz	CPA9231A	Schaffner	8/26/2008	8/26/2010	GEMC 116
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.

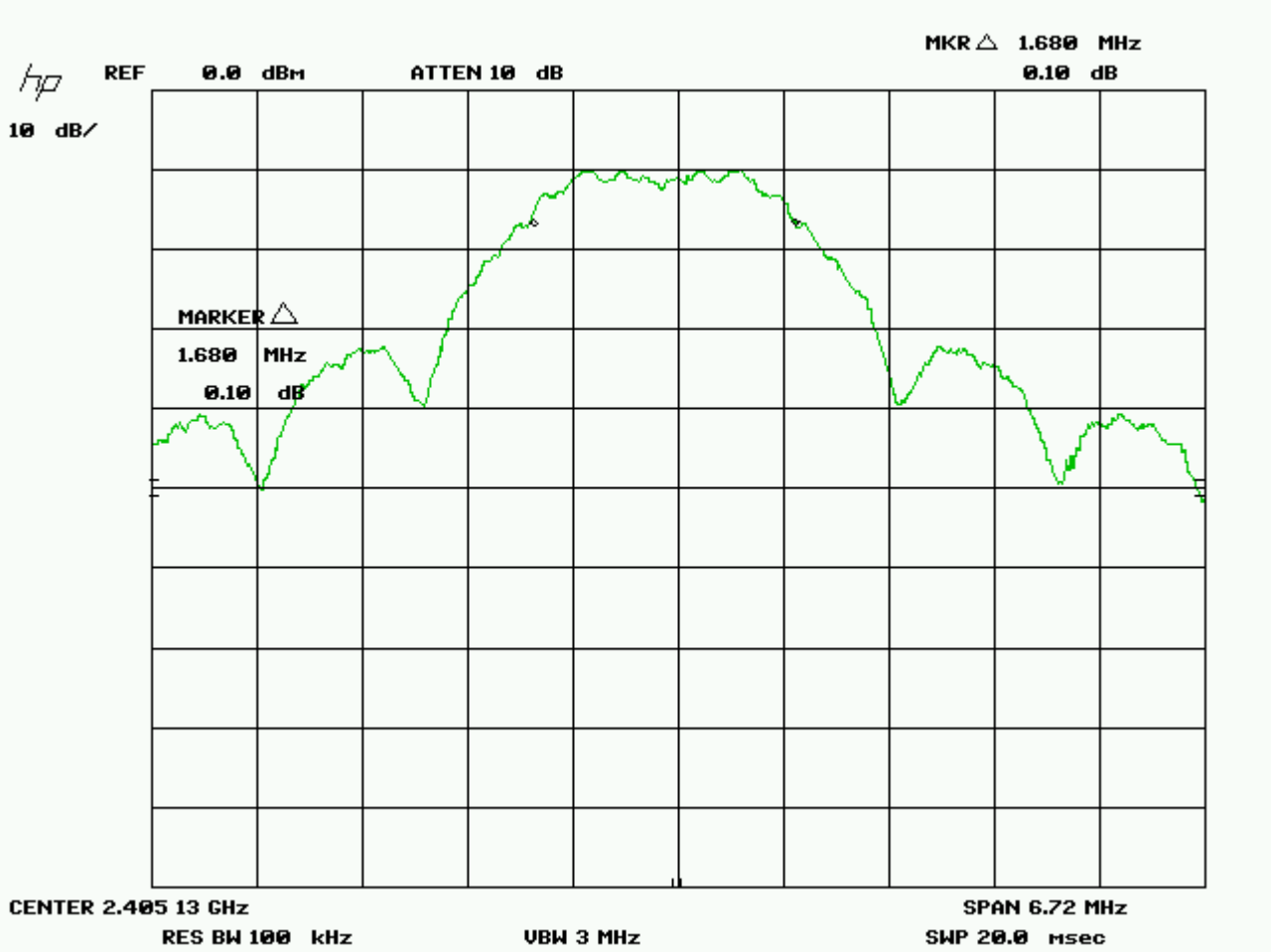
Results

The EUT passed. The 6 dB BW measured was 1.599 MHz.

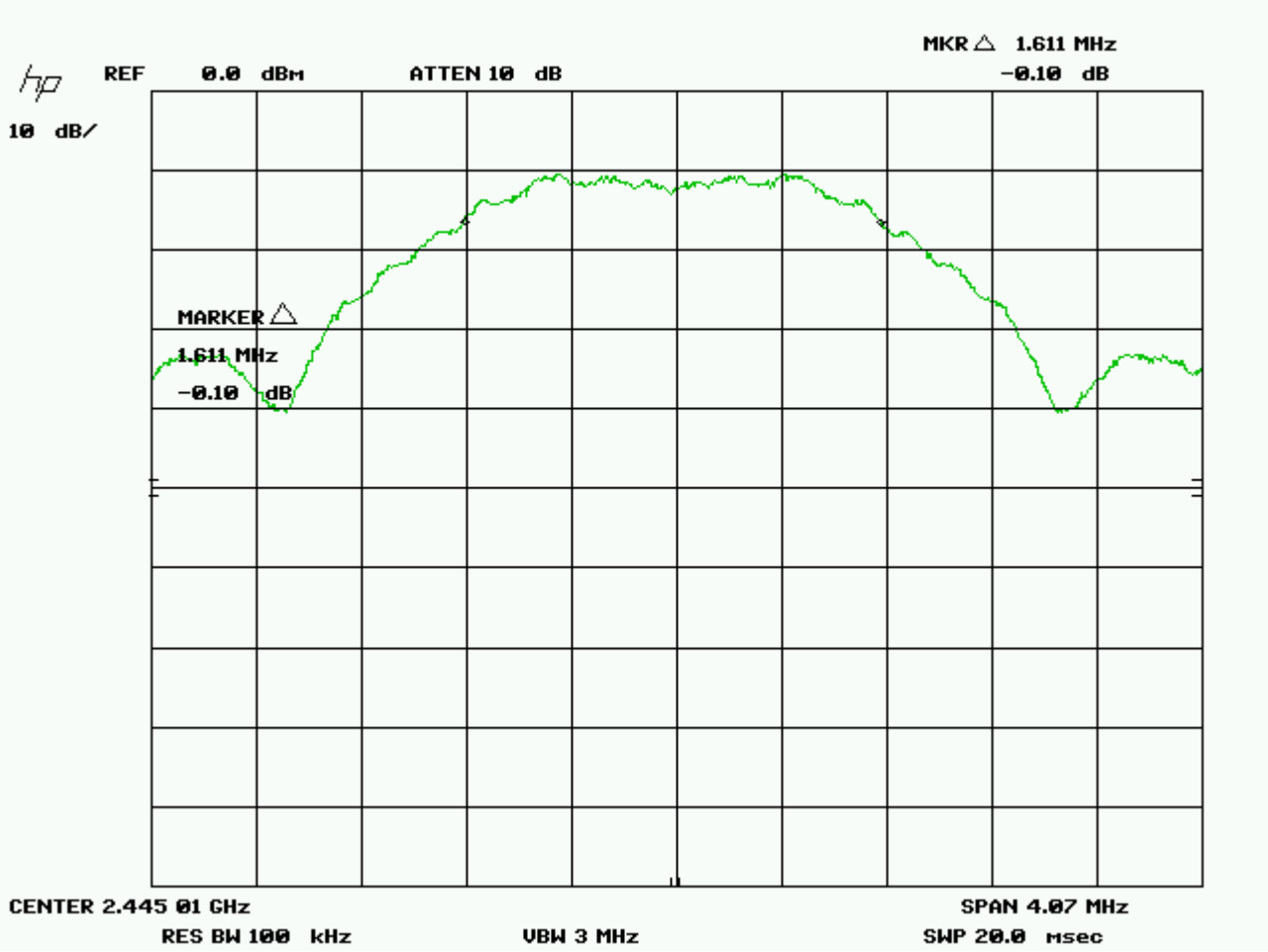
Graph(s)

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.

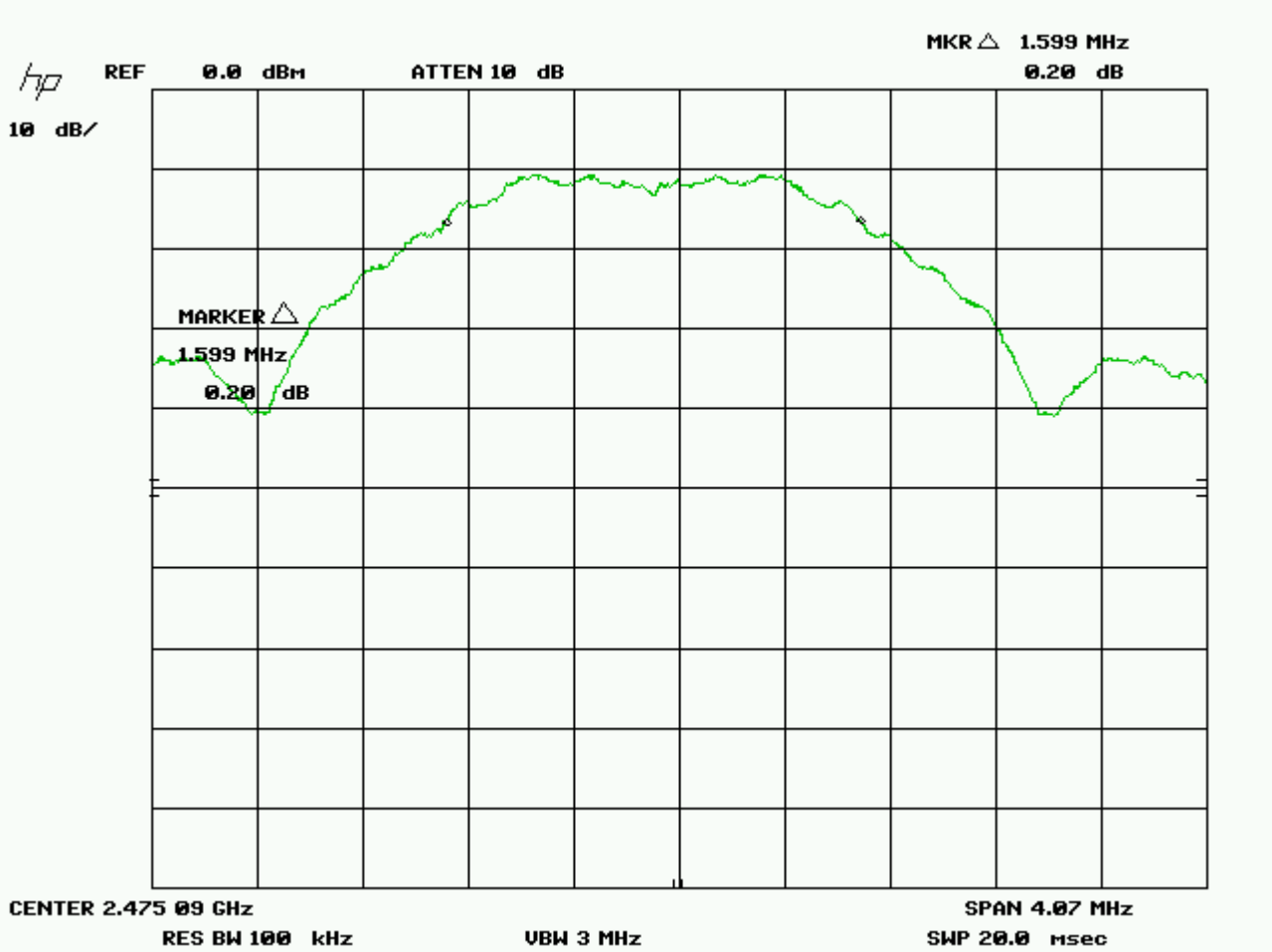
Low Channel



Medium Channel

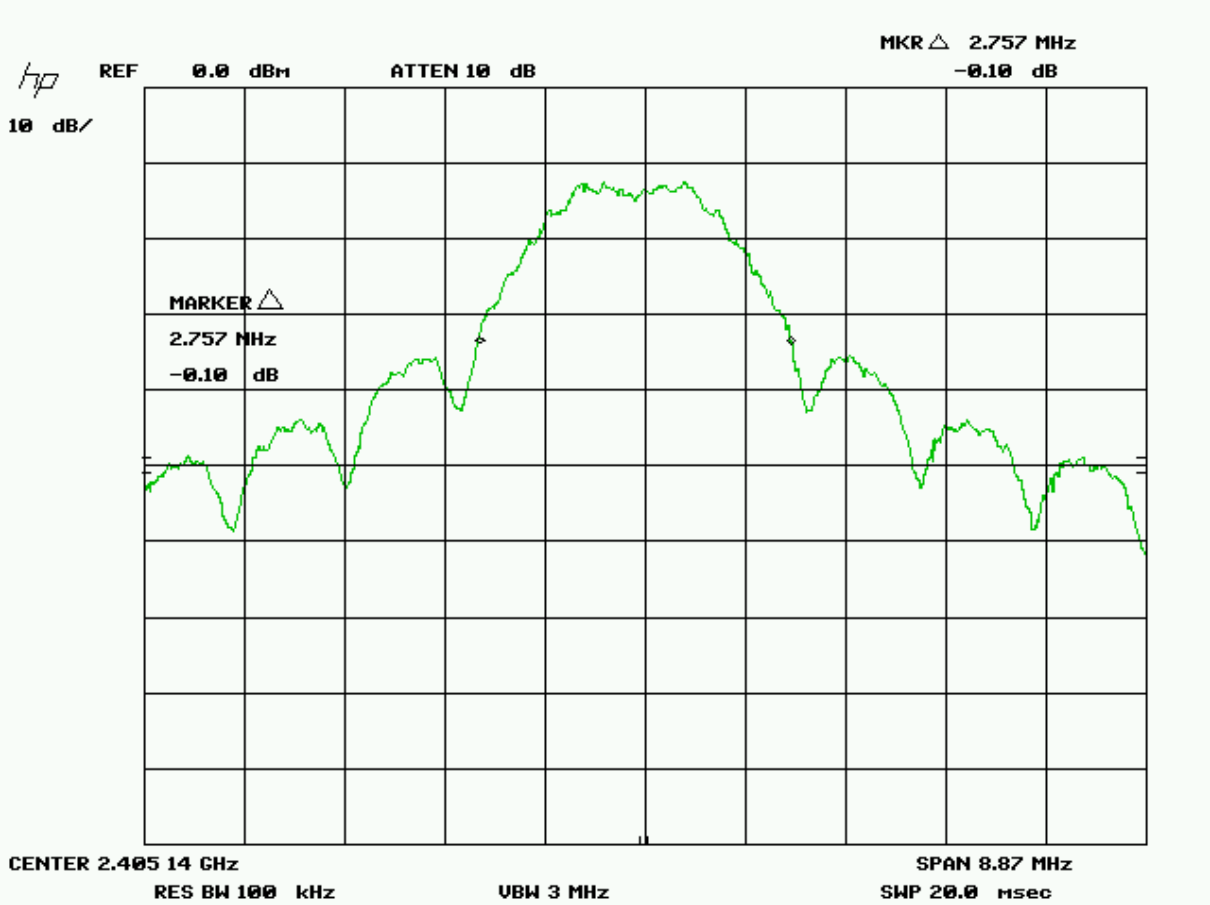


High Channel

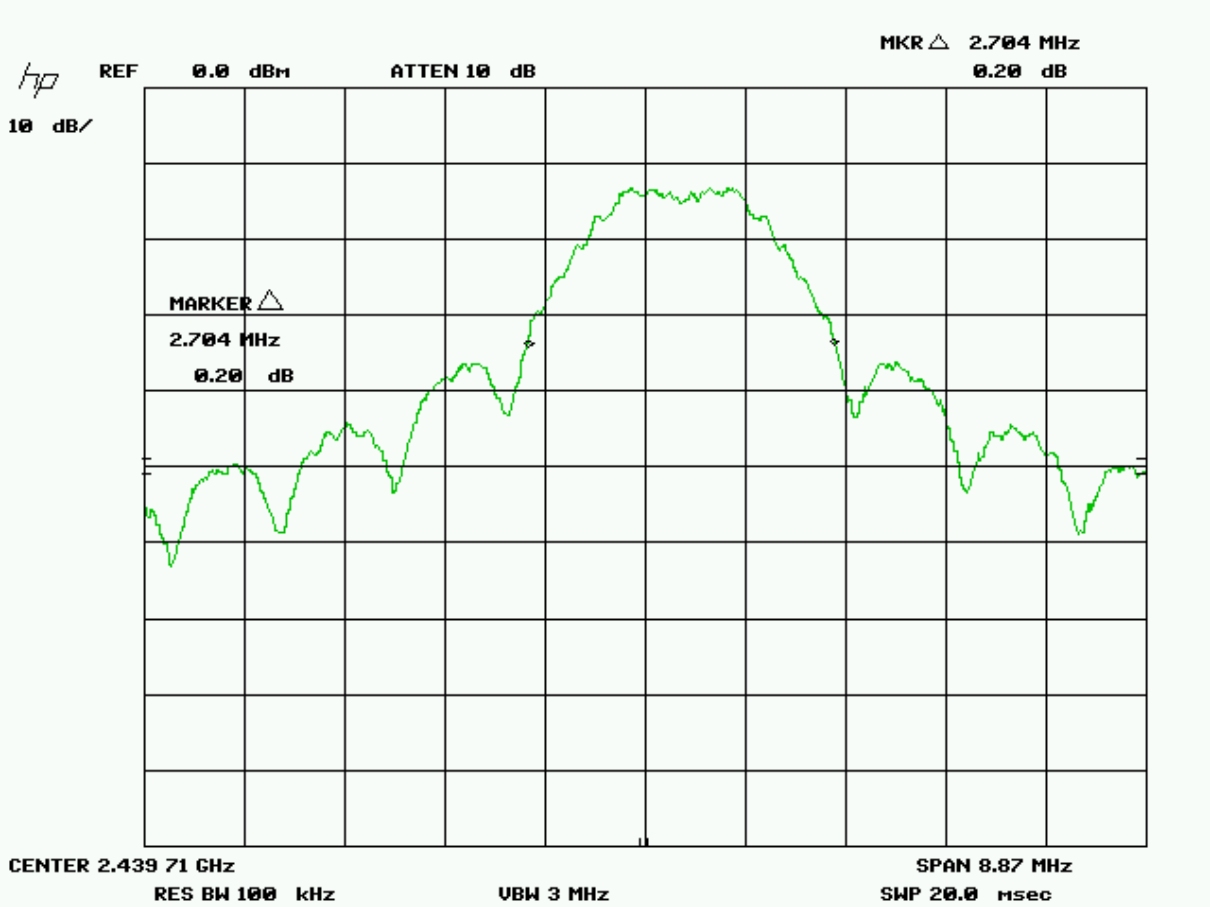


Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up.

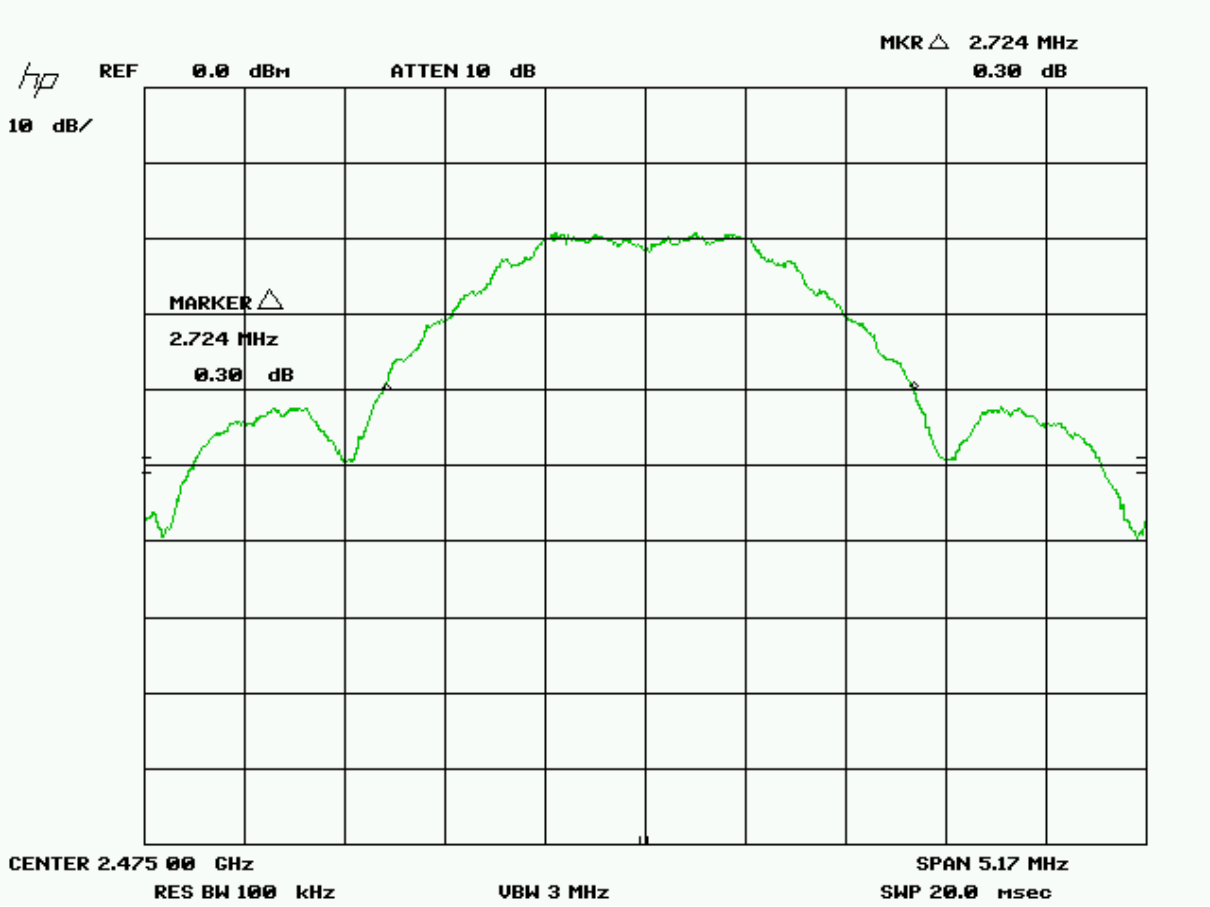
20 db Bandwidth for Low channel



20 db Bandwidth for Mid channel



20 db Bandwidth for Hi channel



Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
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 0.5M	LMR-400-0.5M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 31
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

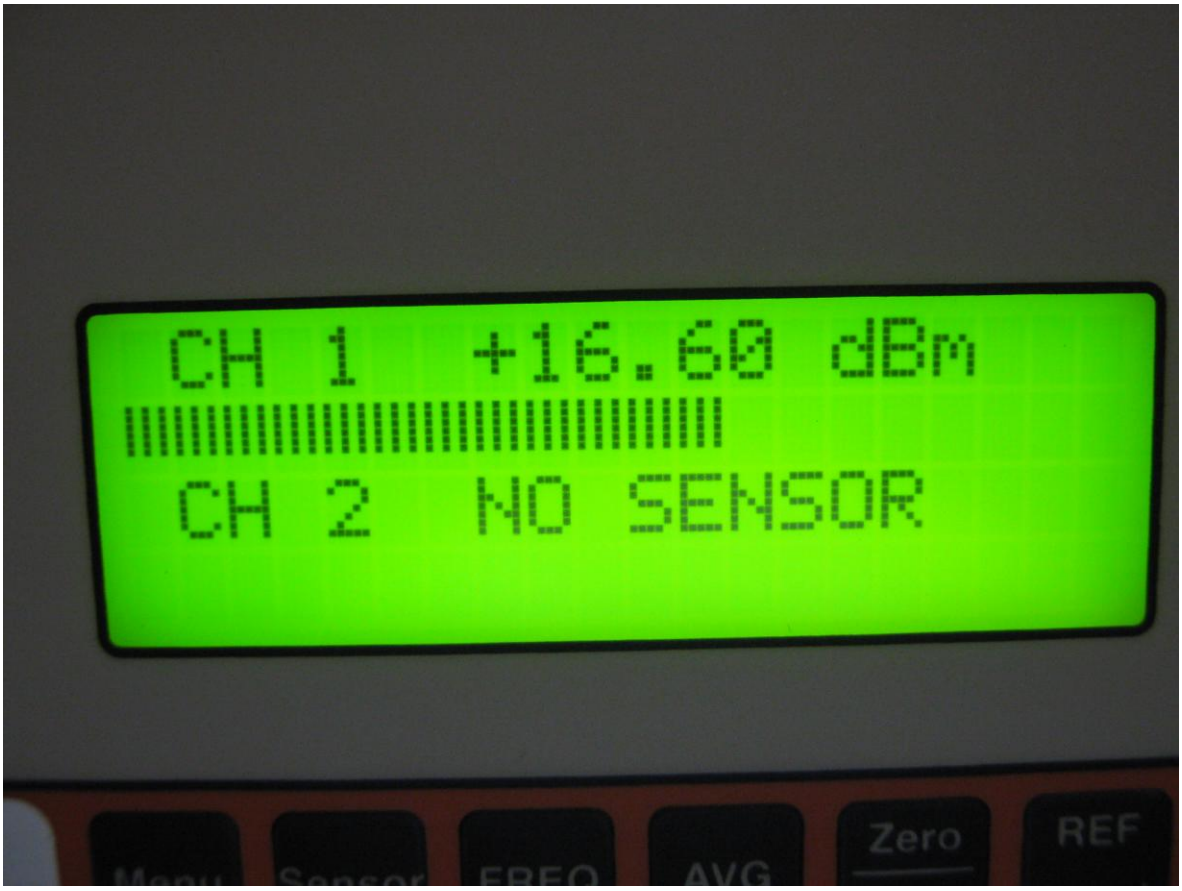
1. Internal antenna = 19.8 dbm (95.5 mW)
2. External antenna = 16.9 dbm (48.98 mW)
3. External antenna Hi Channel =10.0 dBm (10.0 mW).

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.

Lo, Mid and Hi Channels using 3 dbm setting in SW



Lo and Mid channel using -2 dbm setting in SW

Hi Channel Using External Antenna Setting of -7dbm in SW.

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 2010	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.

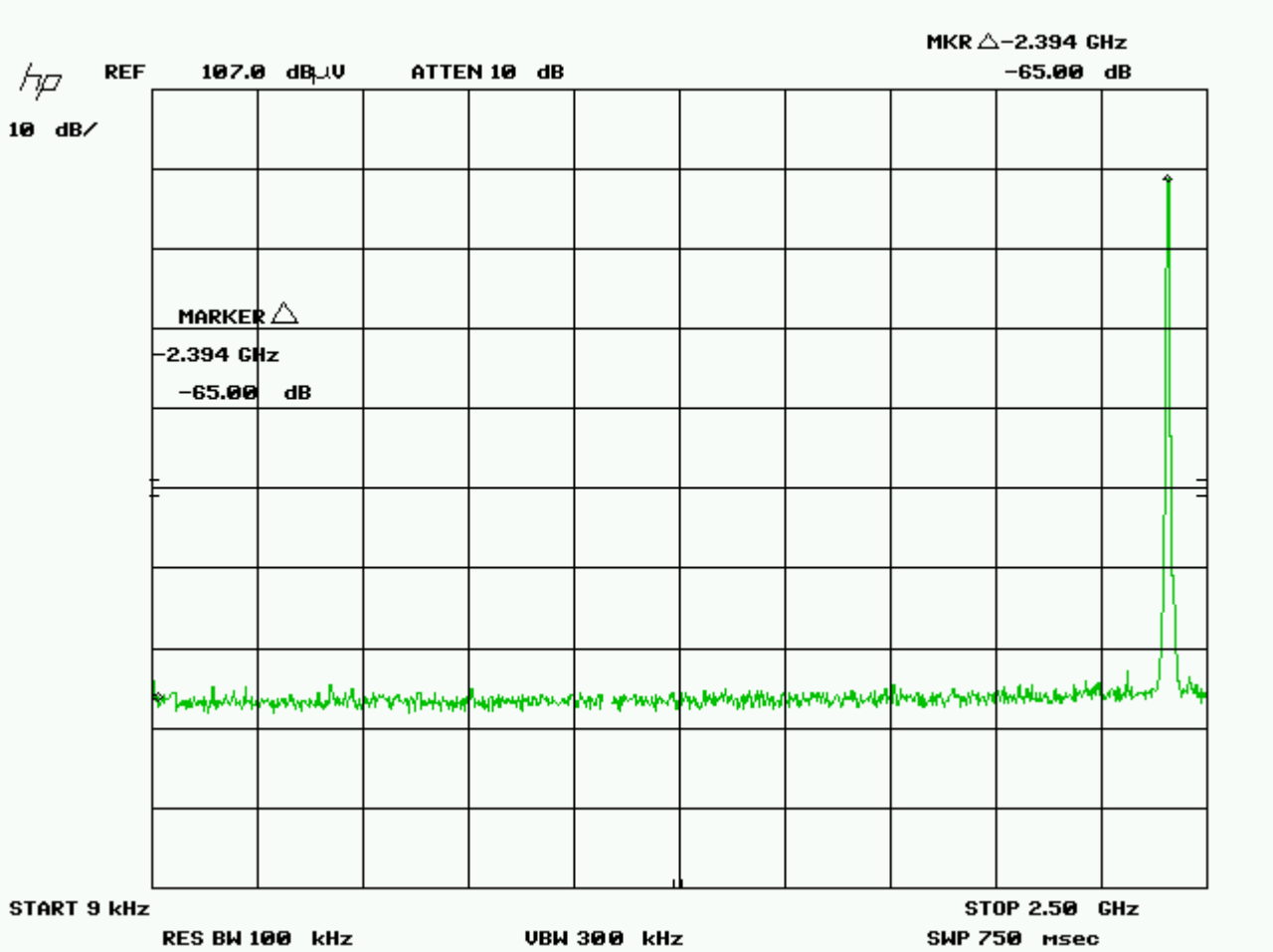
Results

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.

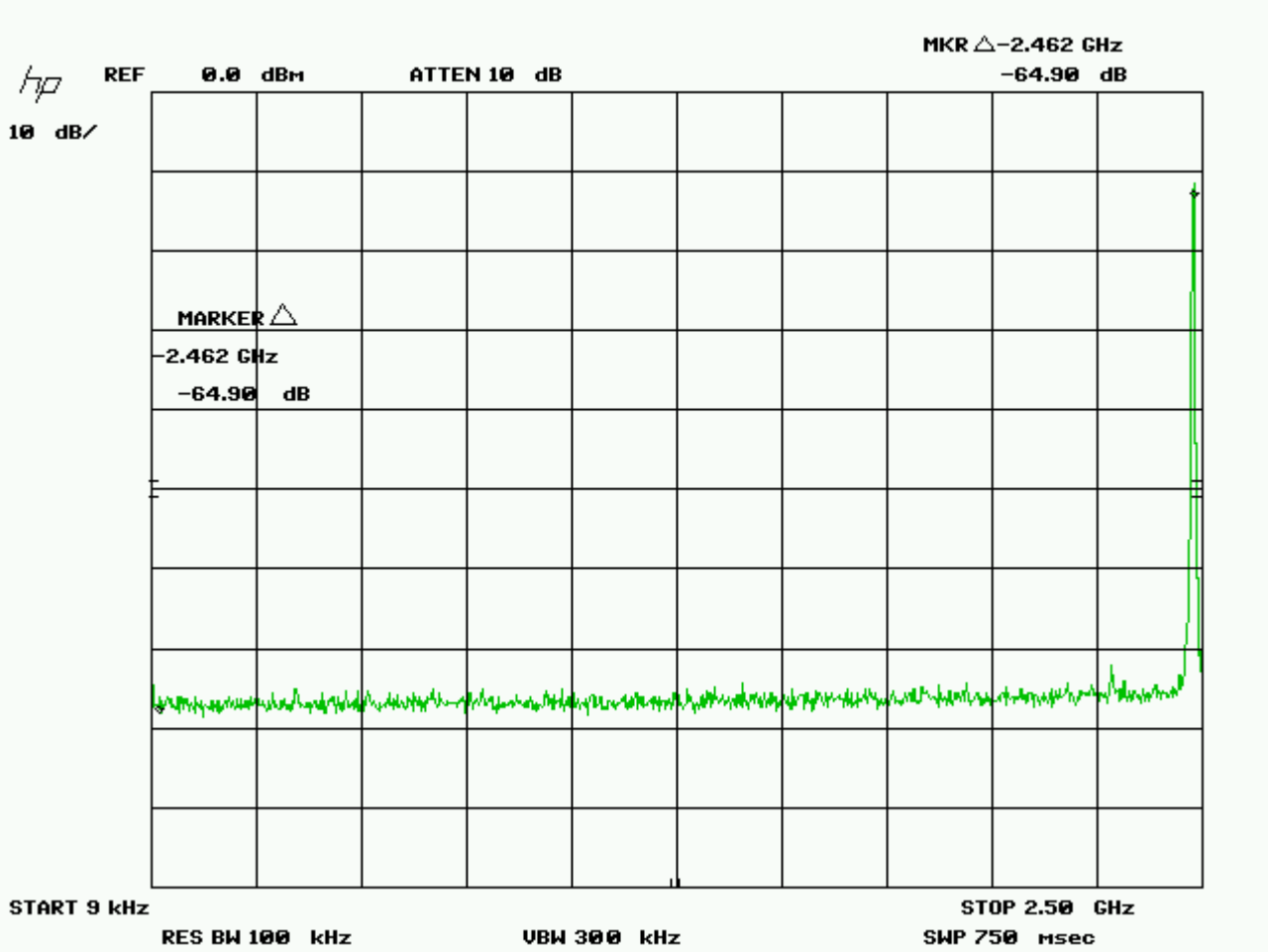
Graph(s)

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

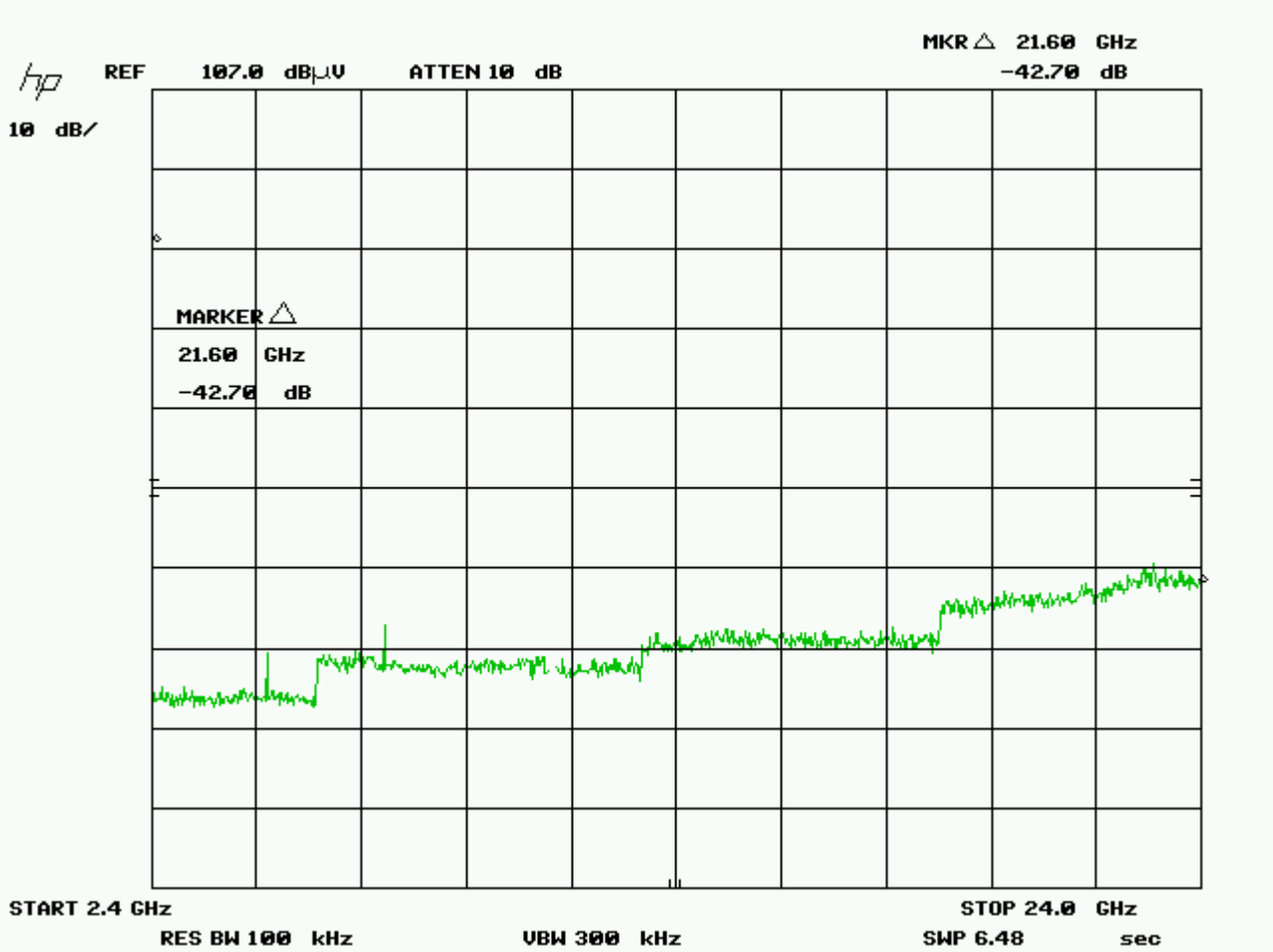
9 kHz – 2.5 GHz Lo



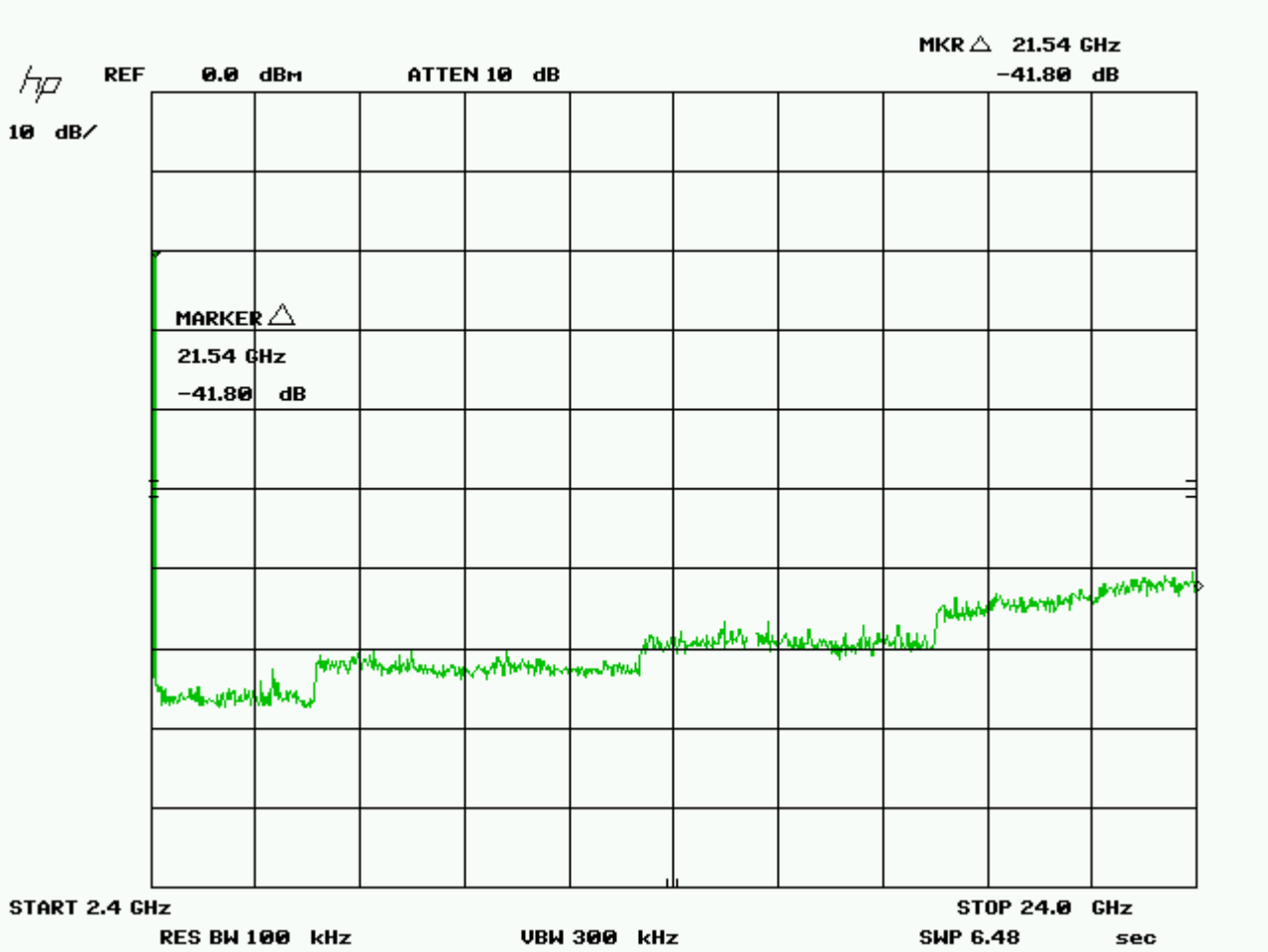
9 kHz – 2.5 GHz Hi



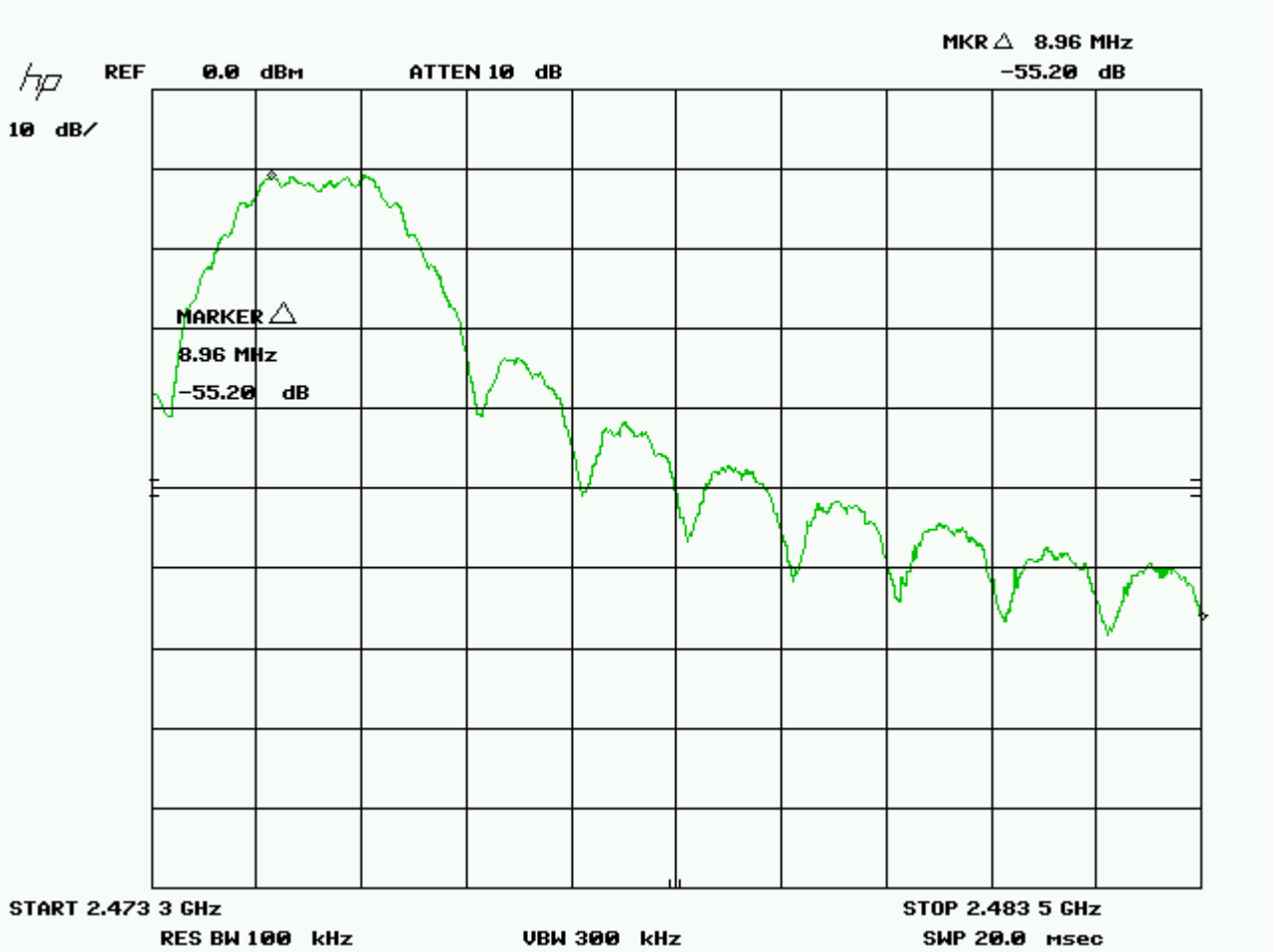
2 GHz – 22.5 GHz Lo



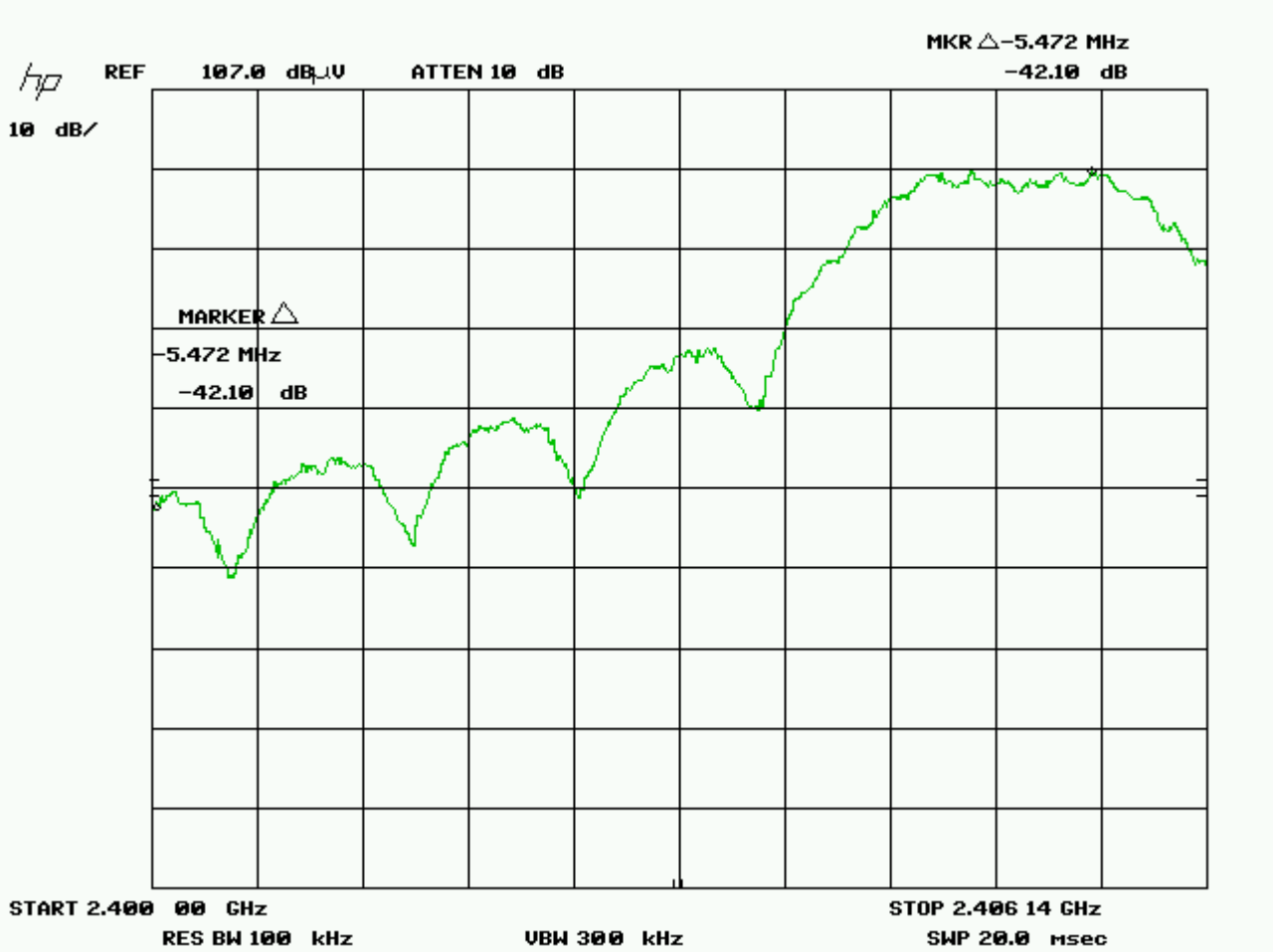
2 GHz – 22.5 GHz Hi



2483.5 MHz Band edge



2390 MHz Band edge



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 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
Spectrum Analyzer	AN940	IFR	Dec 29, 2009	Dec 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.

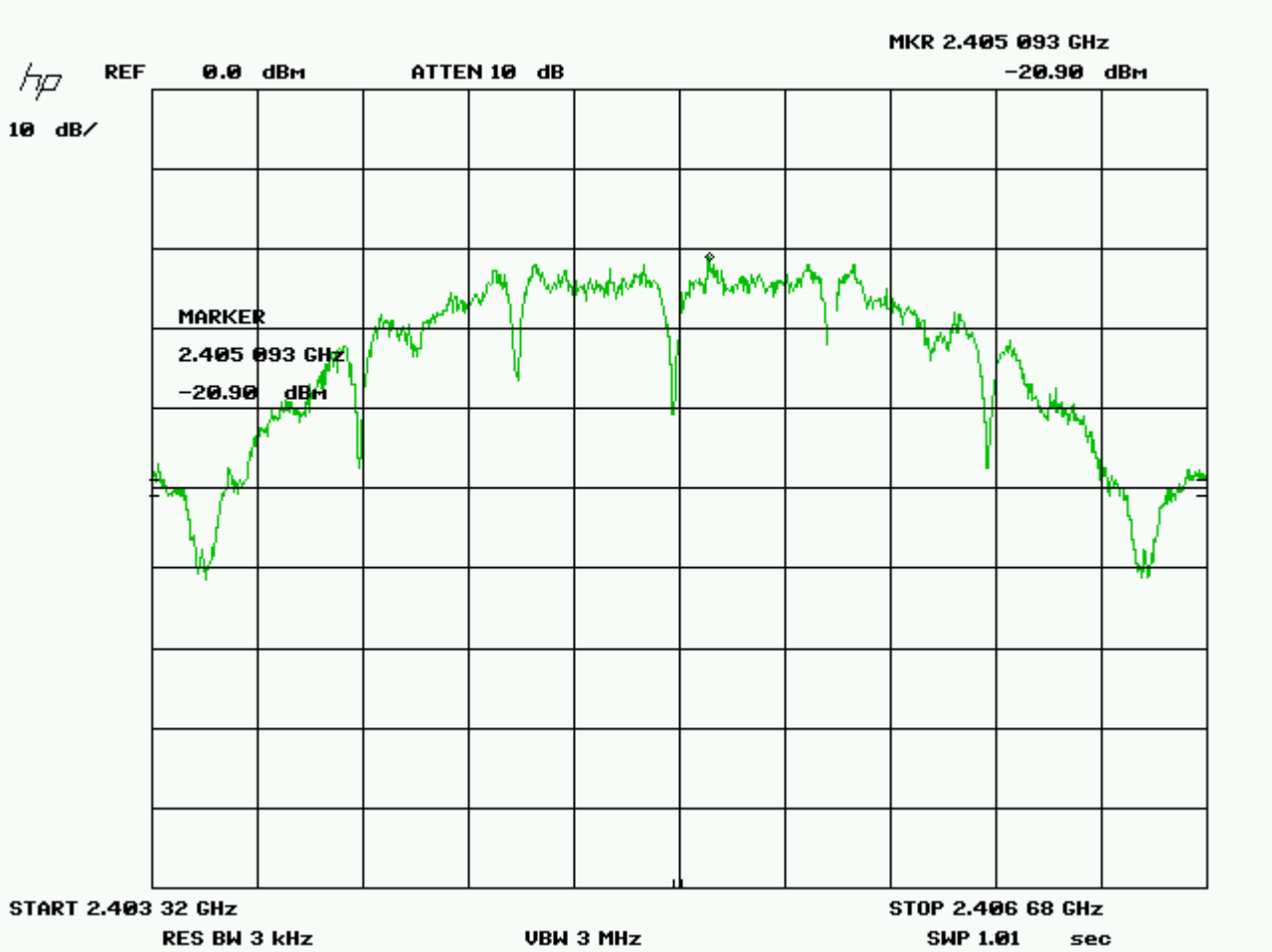
Results

The EUT passed. Each mode was tested at low, medium, and high band. The worst case value is 5.1 dbm {-20.9 + 26 db (attenuator) = 5.1 dbm}.

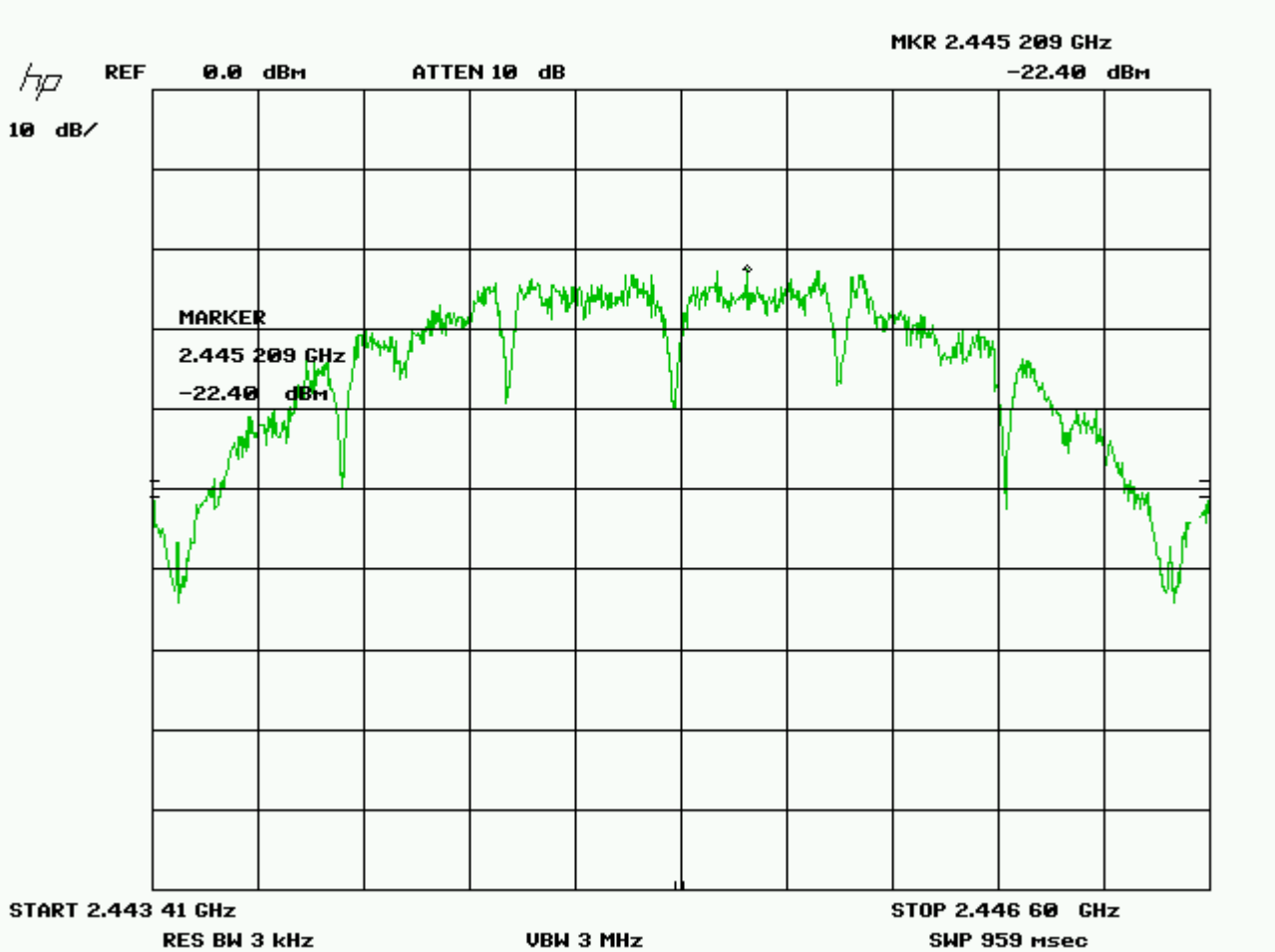
Graph(s)

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.

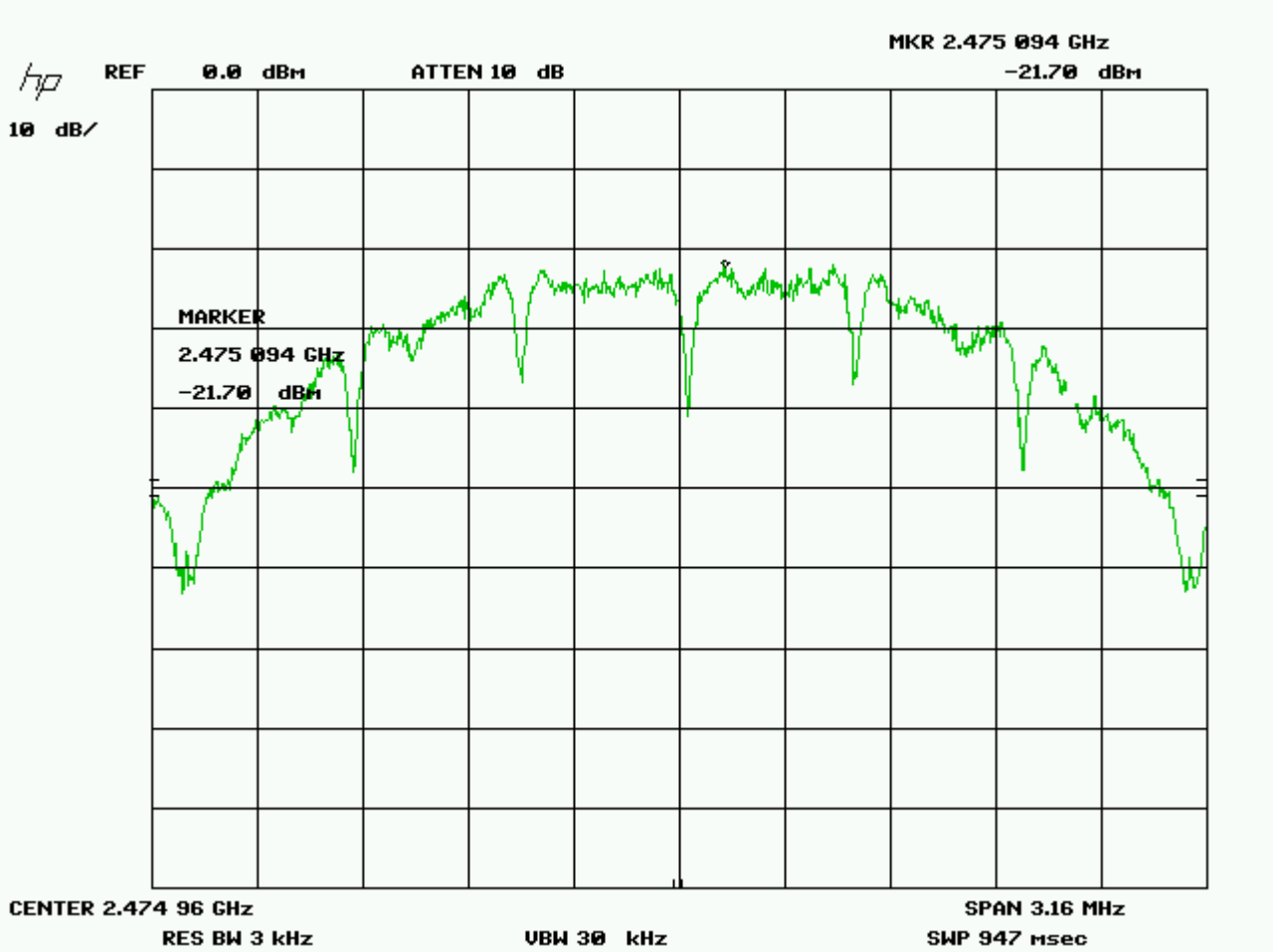
Low channel



Med channel



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	AN940	IFR	Dec 29, 2009	Dec 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 0.031 mW/cm^2, this is significantly under the 1.0 mW/cm^2 requirement.

Calculations

Method 1 (conducted power)
Internal Antenna

$P_d = (P_t * G) / (4 * pi * R^2)$
Where Pt = 19.8 dbm or 95.5mW as per Peak power conducted output
Where G = 0.5 dBi, or numerically 1.1
Where R = 20 cm

$P_d = (95.5 \times 1.1) / (4 \times pi \times 20cm^2)$
$P_d = 107.15 \text{ mW} / 5026 \text{ cm}^2$
$P_d = 0.021 \text{ mW/cm}^2$

External Antenna

$P_d = (P_t * G) / (4 * pi * R^2)$
Where Pt = 16.9 dbm or 48.97mW as per Peak power conducted output
Where G = 5.0 dBi, or numerically 3.16
Where R = 20 cm

$P_d = (48.97 \times 3.16) / (4 \times pi \times 20cm^2)$
$P_d = 154.88$ mW / 5026 cm^2
$P_d = 0.031$ mW/cm^2

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

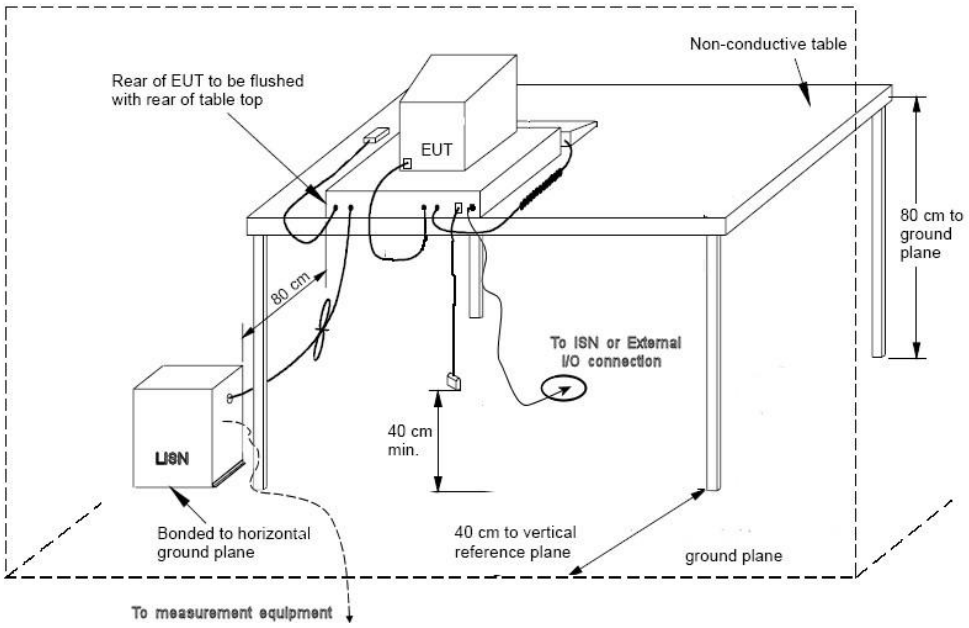
Average Limits		QuasiPeak Limits	
150 kHz – 500 kHz	56 to 46 dBuV	150 kHz – 500 kHz	66 to 56 dBuV
500 kHz – 5 MHz	46 dBuV	500 kHz – 5 MHz	56 dBuV
5 MHz – 30 MHz	50 dBuV	500 kHz – 30 MHz	60 dBuV

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.

Typical Setup Diagram



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

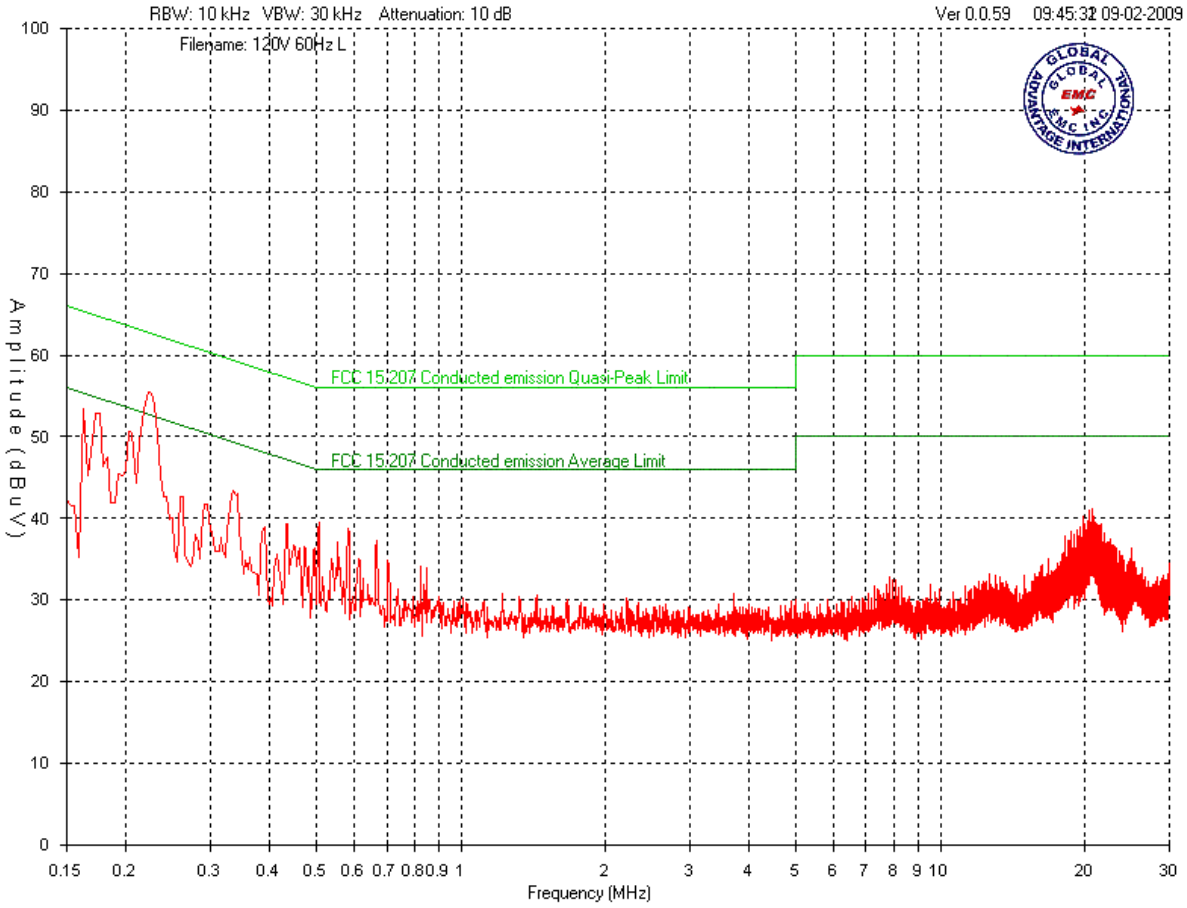
Measurement Uncertainty

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.

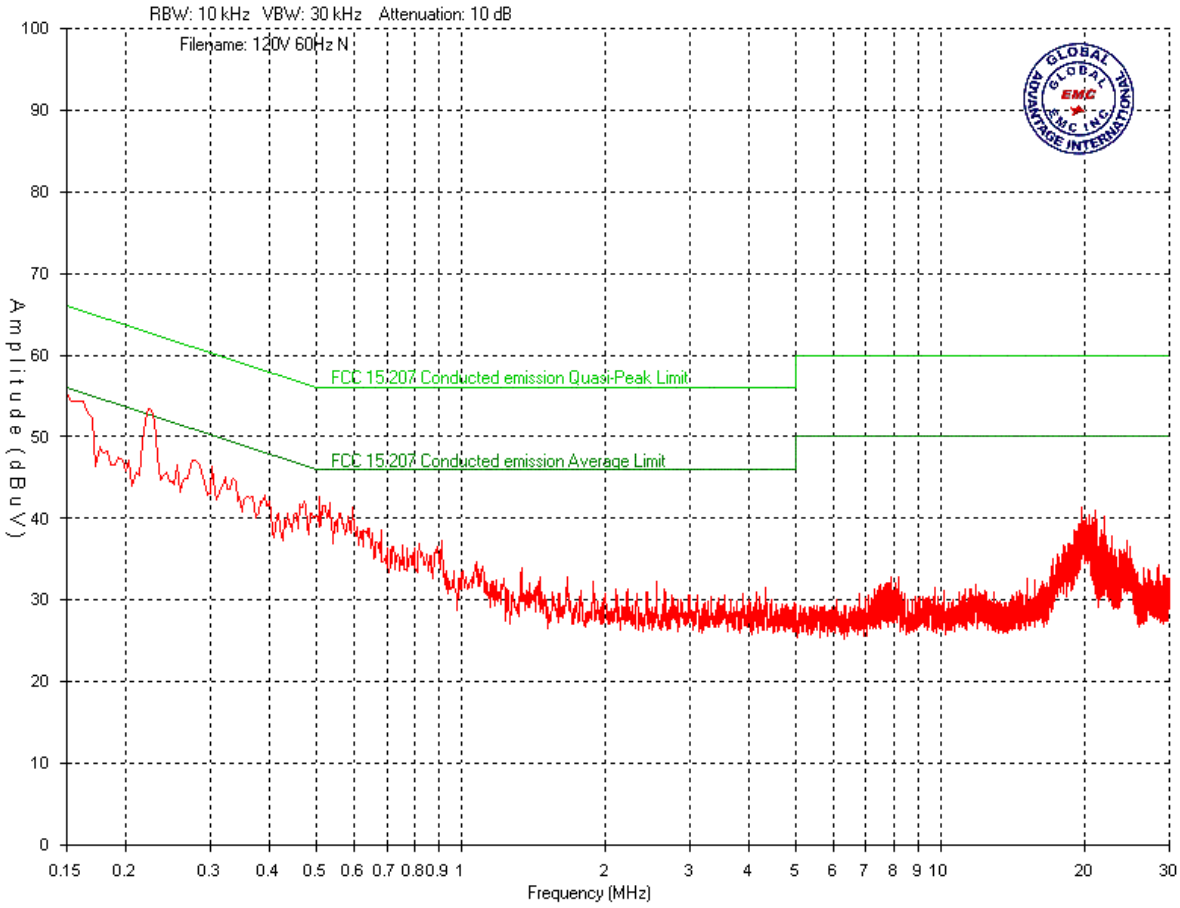
Preliminary Graphs

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. These graphs are performed as a worst case measurement to enable the detection of frequencies of concern and for considerable time savings.

120V Line
Peak emissions



120V Neutral
Peak emissions



Client	MMB Research
Product	RapidSE Zigbee Smart Energy Module XFFZGB357PA10
Standard(s)	RSS 210 Issue 6:2005 / FCC Part 15 Subpart C 15:2006

Final Measurements

Average Emissions Table

Product category	Class B Avg								
Project	Wireless module								
Phase									
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									
0.2	QP	40	0.2	10	0.03	50.23	55	4.77	PASS
0.15	QP	29	0.2	10	0.05	39.25	56	16.75	PASS
0.3	QP	31.2	0.2	10	0.03	41.43	52	10.57	PASS
120V 60Hz L									
0.2	QP	40.1	0.2	10	0.03	50.33	55	4.67	PASS
0.15	QP	34.2	0.2	10	0.05	44.45	56	11.55	PASS
0.35	QP	33	0.2	10	0.03	43.23	51	7.77	PASS

Note:

1. All readings were recorded using QP detector and compared against Average limits.
2. 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	AN940	IFR	12/29/2009	12/29/2011	GEMC 6350
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"

Appendix A – EUT Summary

General EUT Description

Client	
Organization	MMB Research Inc.
Contact	Mark Borins
Phone	416.636.3145
Email	mark.borins@mmbresearch.com
EUT Details	
EUT Model number	XFFZGB357PA10
Equipment Category	Wireless module for energy management applications.
Basic EUT Functionality	RapidSE™ is an embedded software package preloaded onto a ZigBee module. Integrated with your hardware, RapidSE acts as a gateway between your device and the local HAN. RapidSE maps ZigBee Smart Energy and Home Automation functions to a simple serial protocol, allowing you to issue and receive commands using your existing microcontroller.
Input Voltage and Frequency	5 Vdc
Connectors available on EUT	None.
Peripherals Required for Test	None.
Release type	Final
Intentional Radiator Frequency	2400 – 2475.0 MHz for Zigbee applications as described above.

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

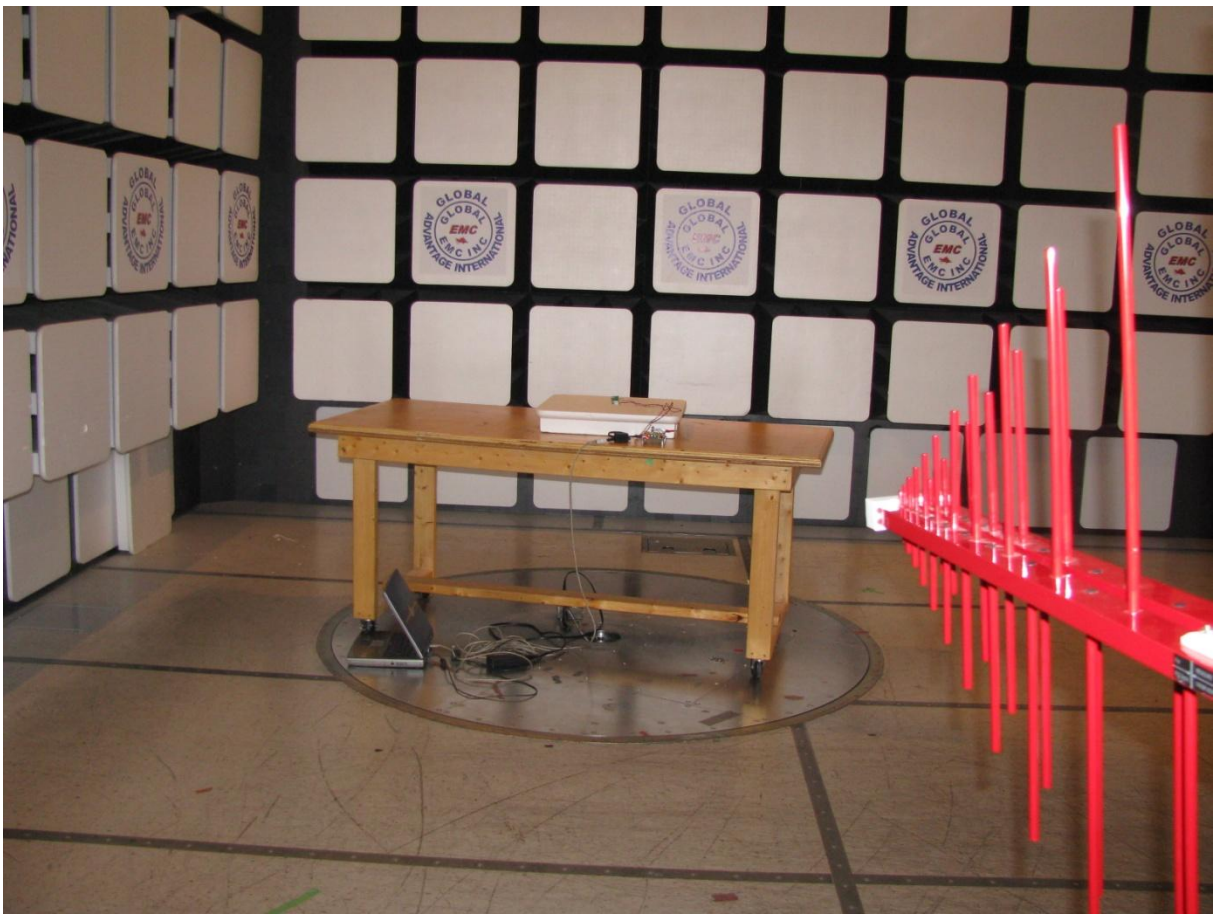


Figure 1 – EUT

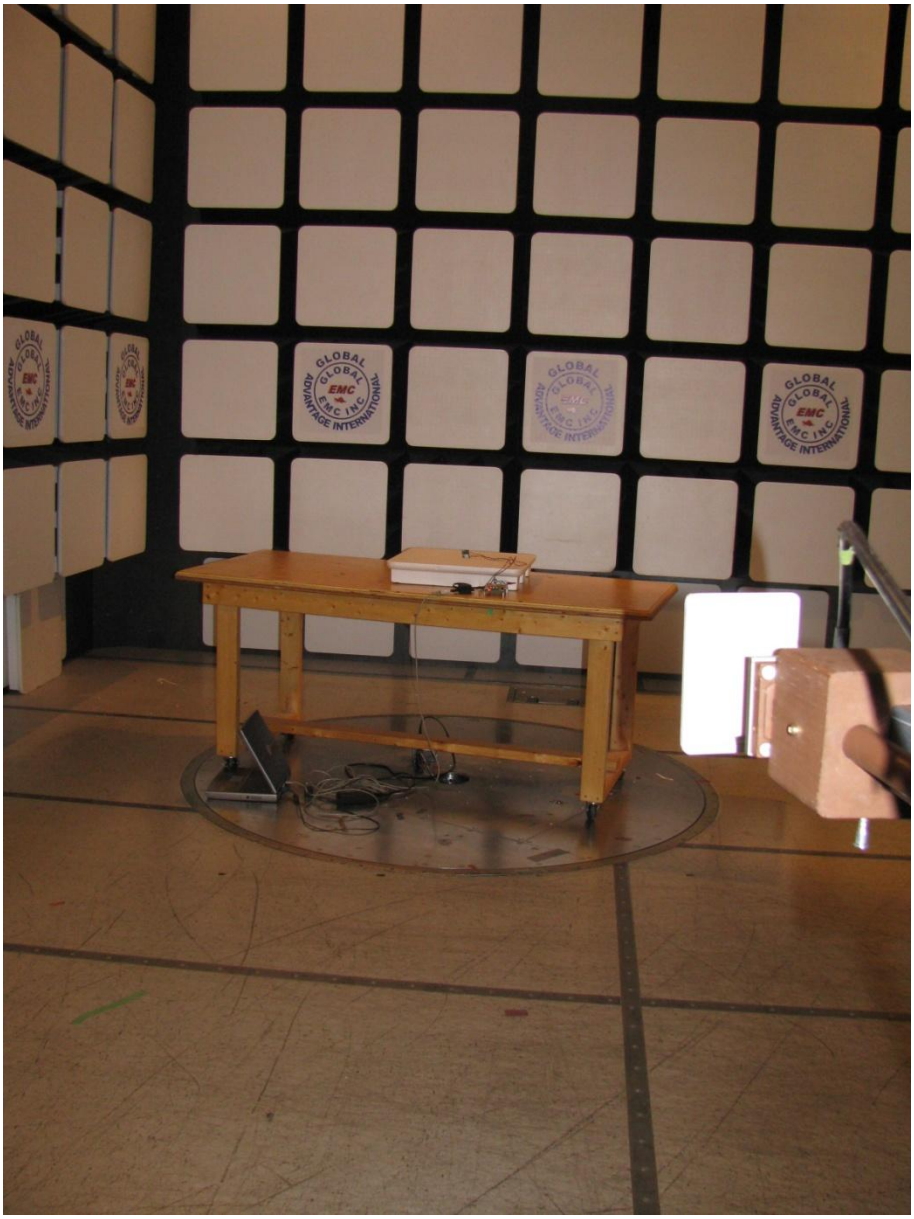


Figure 2 – Radiated emission setup

Figure 3 – Conducted power emissions

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