Global EMC Inc. Labs

EMC & RF Test Report

As per

RSS 210 Issue 7:2007

&

FCC Part 15 Subpart C:2010

Unlicensed Intentional Radiators

on the

HT205 Wireless Module

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Testing produced for

Paradigm

See Appendix A for full customer & EUT details.

Industry Canada

LAB REGISTRATION #6844A-1

FCC REGISTRATION #612361

ACCREDITED

Testing Laboratory Certificate #2555.01

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Report Scope

This report addresses the EMC verification testing and test results of the HT205 transceiver module for use in the Paradigm Millenia Sub wireless subwoofer, 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 15:2010

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	**Paradigm**
Product	HT205
Standard(s)	RSS 210 Issue 7:2007 / FCC Part 15 Subpart C 15:2010

Summary

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

EUT FCC Certification #, FCC ID:	YZY-HT205
EUT Industry Canada Certification #, IC:	9261A-HT205
EUT Passed all tests performed.	Yes (see test results summary)
Tests conducted by	Raymond Lee Au

Client	**Paradigm**
Product	HT205
Standard(s)	RSS 210 Issue 7:2007 / FCC Part 15 Subpart C 15:2010

Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203 RSS 210 Section 5.5	Antenna Requirement	Unique	Pass See Justification
FCC 15.205 RSS 210 Section 6.3 (Table 2)	Restricted Bands for intentional operation	None within chart	Pass See Justification
FCC 15.207 RSS 210 Section 6.6	Power line conducted emissions	QuasiPeak Average	Pass
FCC 15.209 RSS 210 Section 6.2.1 (Tables 3 & 7)	Radiated emissions	QuasiPeak Average	Pass
FCC 15.247(a)(1) RSS 210 6.2.2(o)	Channel Separation	> 25 kHz	Pass
FCC 15.247(a)(1)(i) RSS 210 6.2.2(o)	Number of channels	> 15	Pass
FCC 15.247(a)(1)(i) RSS 210 6.2.2(o)	Time of occupancy	< 400 mSec in 8 sec period	Pass
FCC 15.247(b) RSS 210 6.2.2(o)	Max output power	< 1 Watt	Pass
FCC 15.247(b)(4) RSS 210 6.2.2(o)	Antenna Gain	< 6 dBi	Pass See Justification
FCC 15.247(d) RSS 210 6.2.2(d)	Antenna conducted spurious †	> 20 dBc	Pass
FCC 15.247(h)	FHSS Intelligence	No coordination	Pass See Justification
FCC 15.247(i) IC Safety code 6	Maximum Permissible Exposure	> 20 cm separation.	Pass See justification
Overall Result			**PASS**

† Test performed radiated method. See *Justifications, Descriptions, or Deviations* section for more details.

All tests were performed by Raymond Lee Au.

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), this device uses a PCB trace antenna, and has no provisions for end-user replacement.

For the Restricted Bands of operation, the EUT is designed to only operate between 2.4 to 2.4835 GHz band.

For the Antenna gain, the stated gain according to the antenna manufacturer is less than 6 dBi. The EUT was flipped vertically and horizontally in order to obtain the maximum emissions.

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

Due to the permanent connection of a chip antenna, it was deemed technically not feasible to remove the antenna and perform antenna conducted measurements. Antenna conducted measurements are extrapolated from radiated measurements.

The EUT is not a hybrid system and FCC 15.247 (f) does not apply to it. However the requirement of power density were met and are detailed 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
ANSI C63.10:2009	- American national standard for testing unlicensed wireless devices
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 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 - November 29, 2010

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. Global EMC is accredited by A2LA for testing as listed on the A2LA website.

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)
Oct. 6 - 20, 2010	All	RA	20-25ºC	30-45%	100 -103kPa

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.

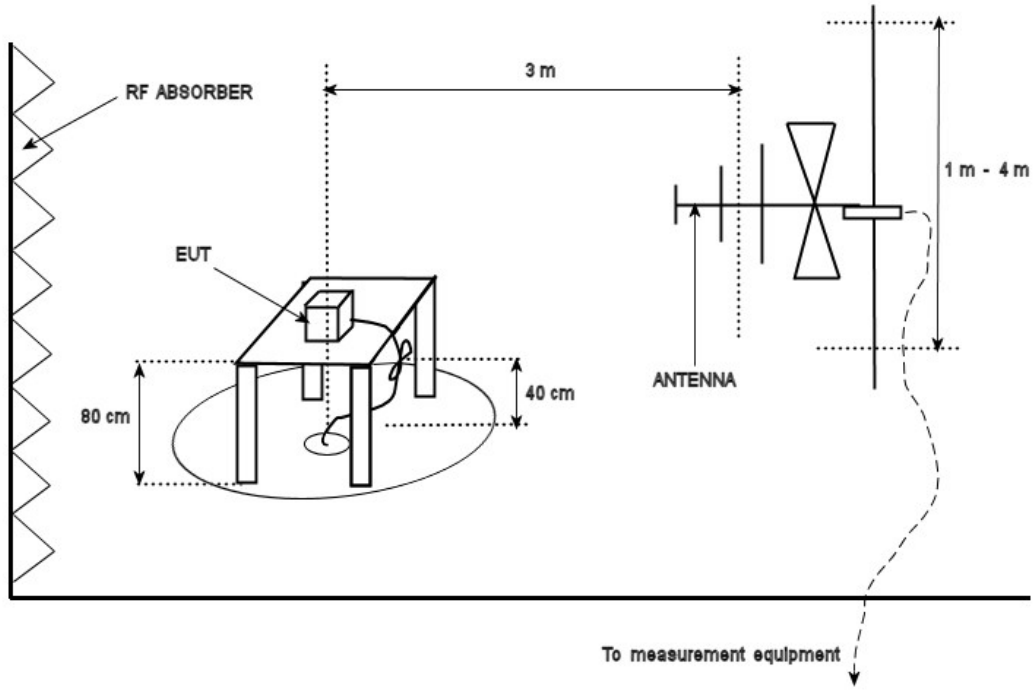
The limits, as defined in 15.247(d) for unintentional radiated emissions apply for those emissions that fall in the restricted bands, as defined in Section 15.205(a). These emissions must comply with the radiated emission limits specified in Section 15.209(a).

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 (26 GHz).

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.

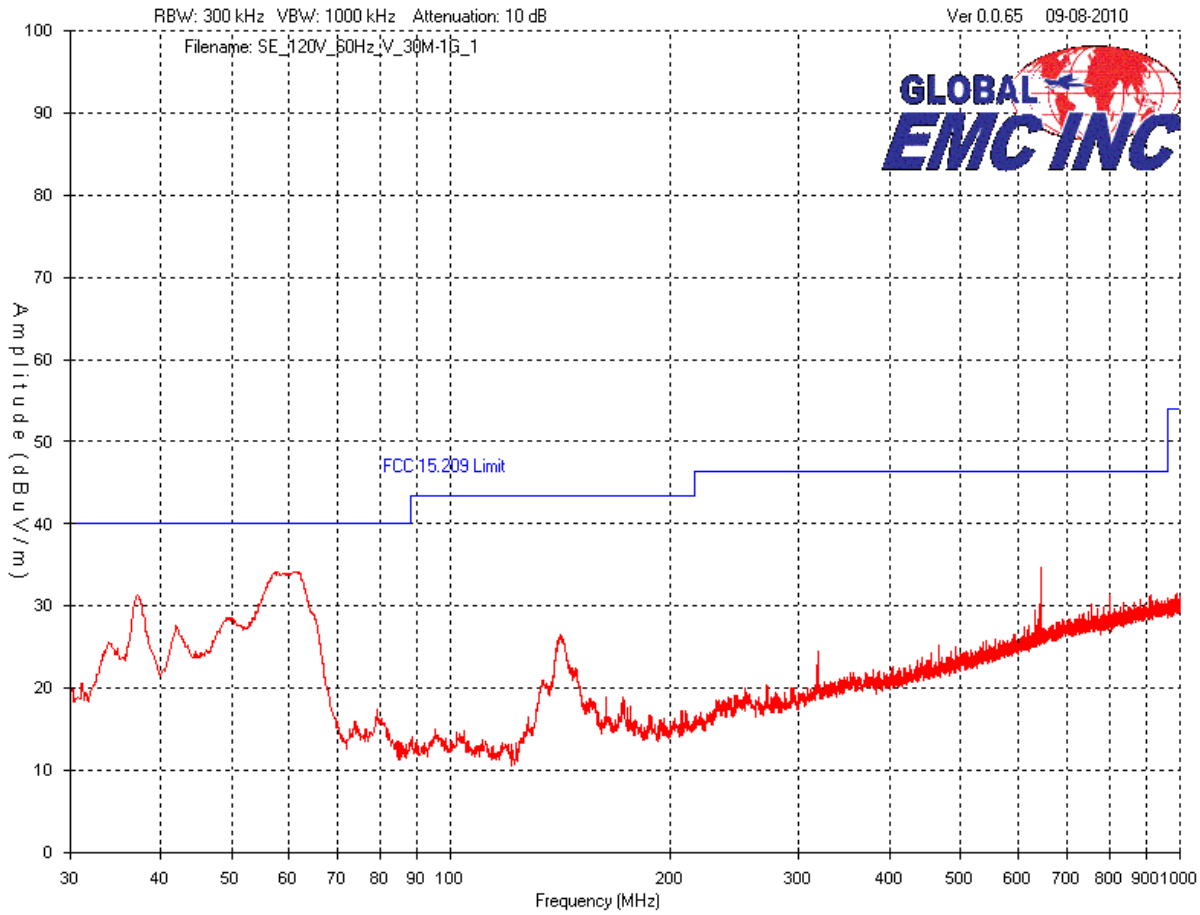
Preliminary Graphs

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 26 GHz.

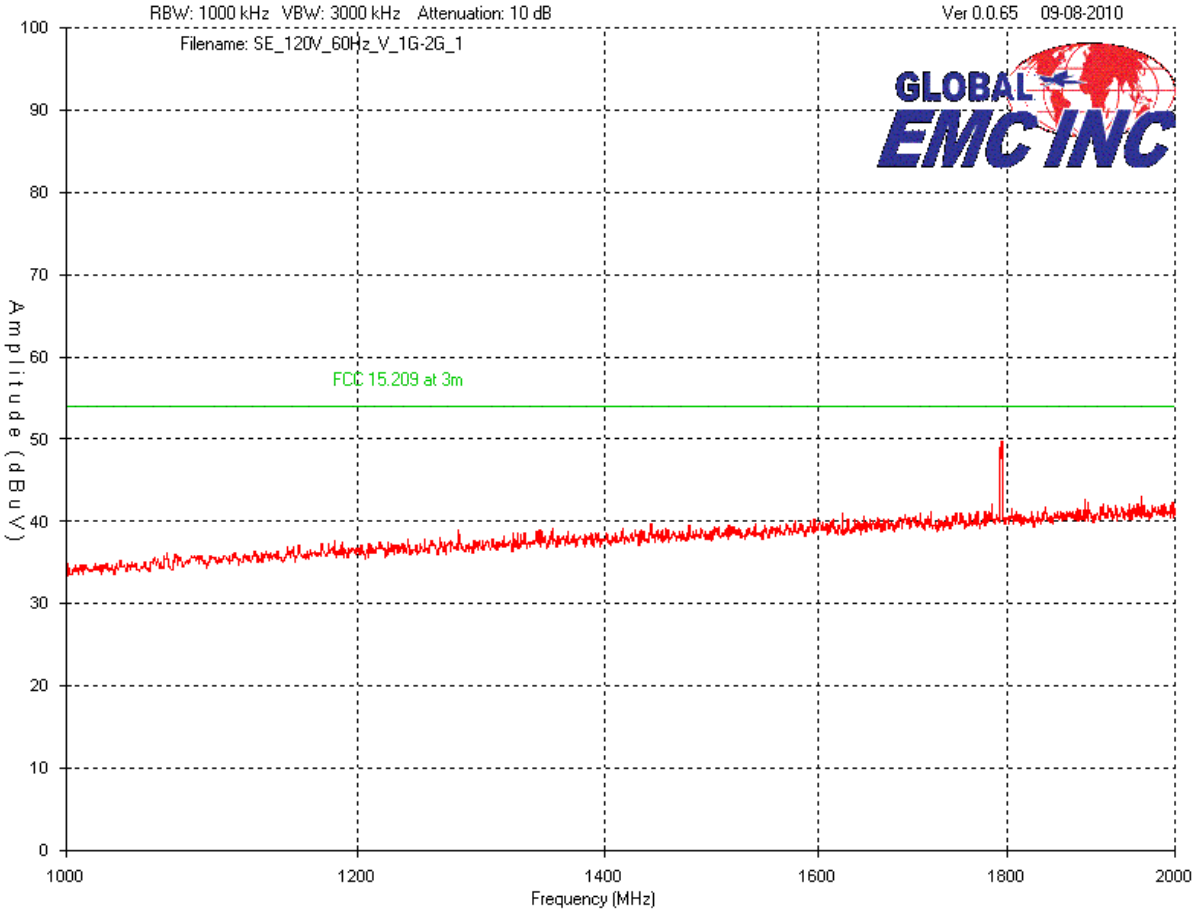
Low, middle, and high modes as well as frequency hopping was investigated, however the worst case graphs are presented.

Vertical – Peak Emissions Graph – Low Band (hopping stopped) 30MHz – 1 GHz



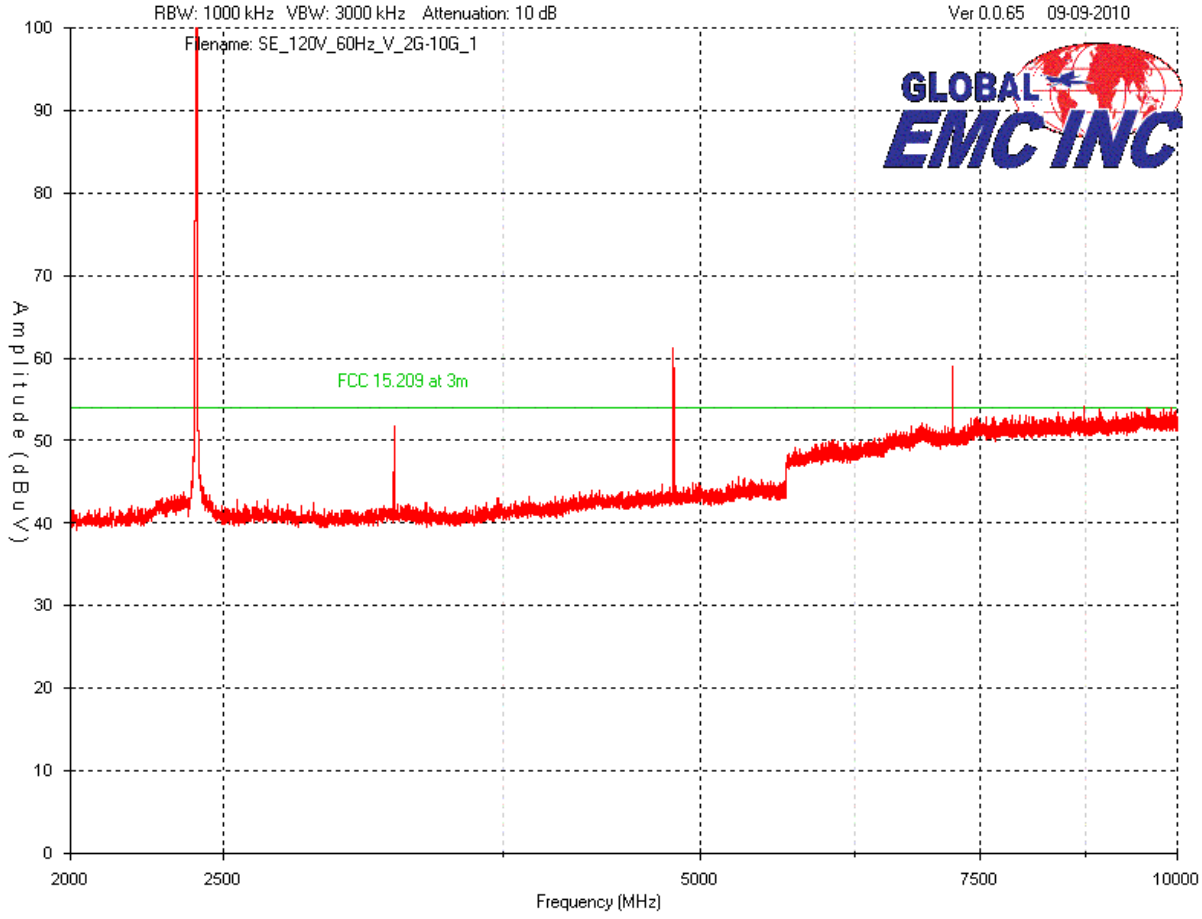
Note: Receive mode was identical

Vertical – Peak Emissions Graph – Low Band (hopping stopped) 1 GHz – 2 GHz



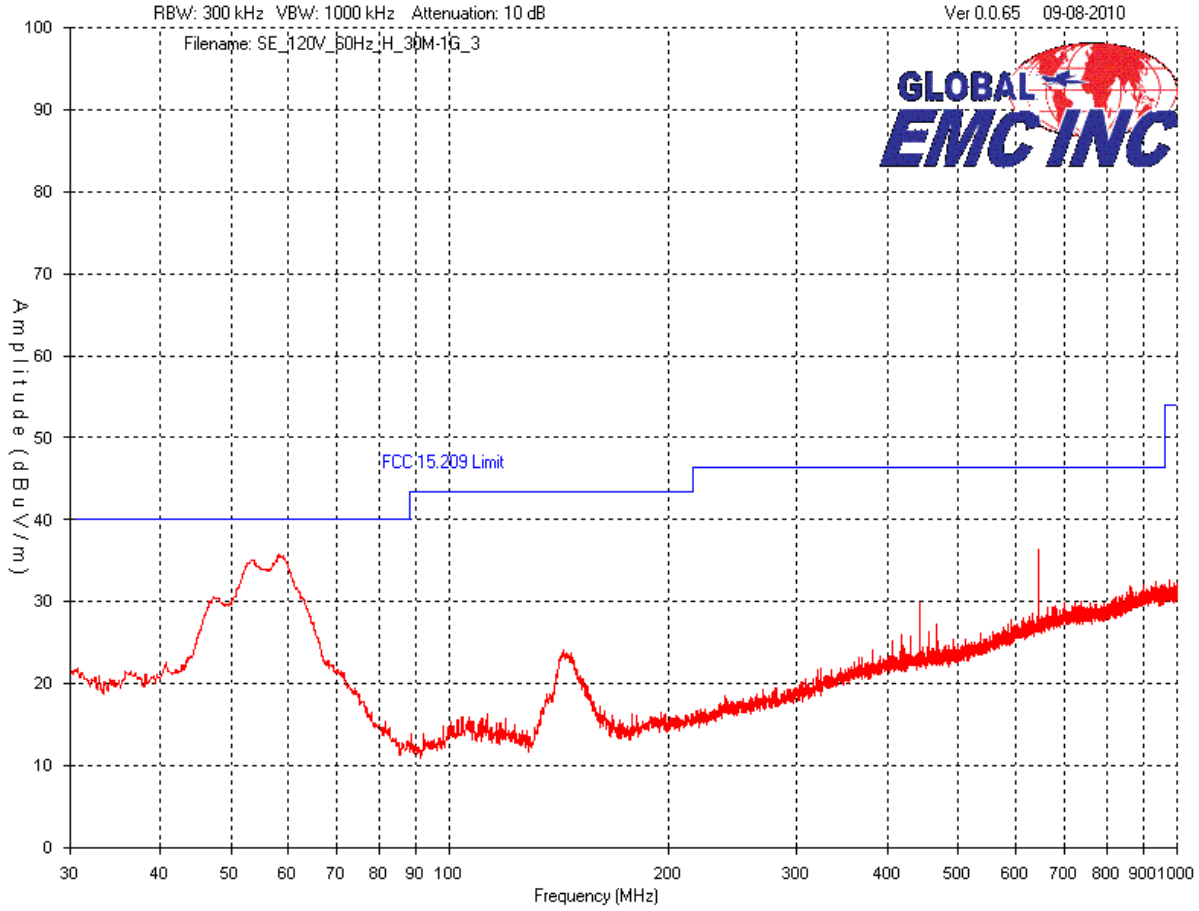
Note: Receive mode was identical

Vertical – Peak Emissions Graph – Low Band (hopping stopped) 2 GHz – 10 GHz



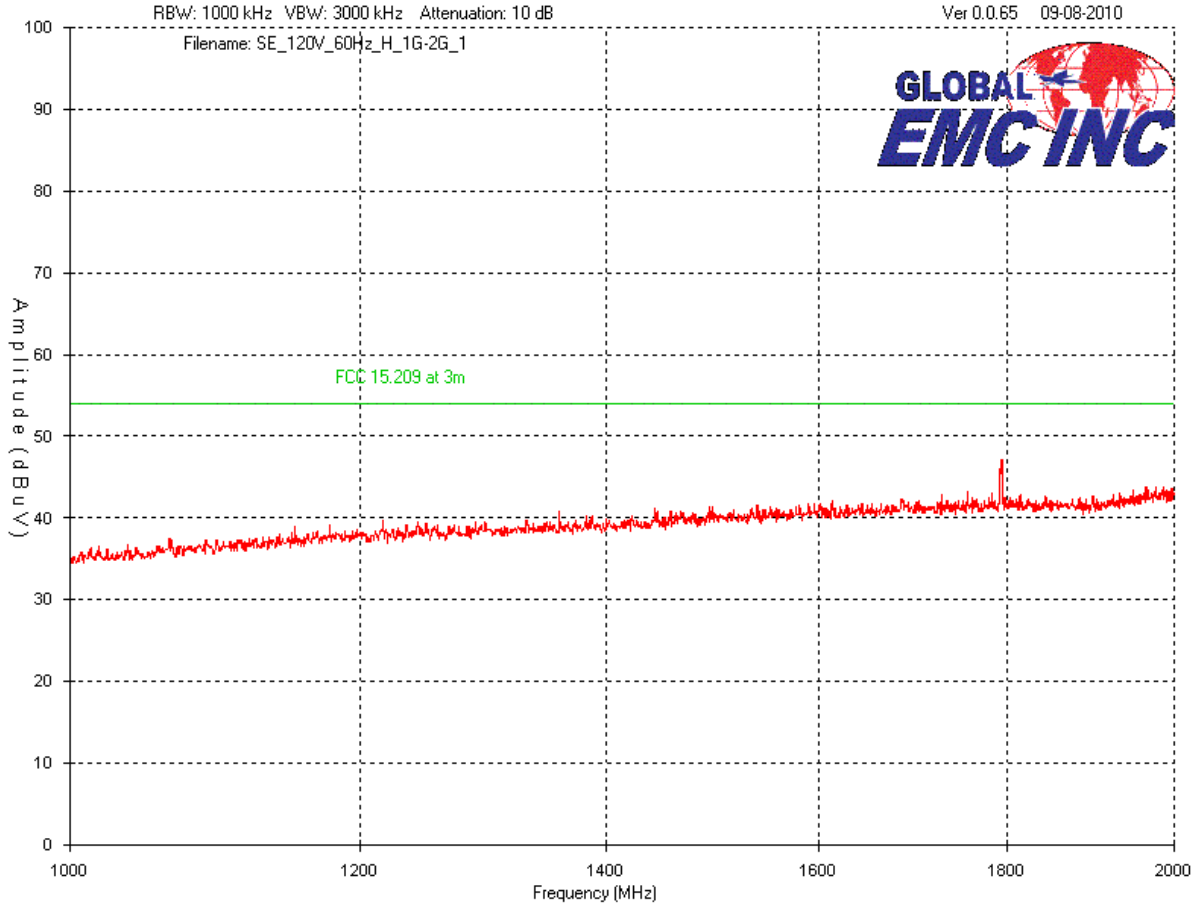
Note: Receive mode was identical, with the exception of the first, third, and fourth (L-R) frequency spikes shown above not being present.

Horizontal – Peak Emissions Graph – Low Band (hopping stopped) 30MHz – 1 GHz



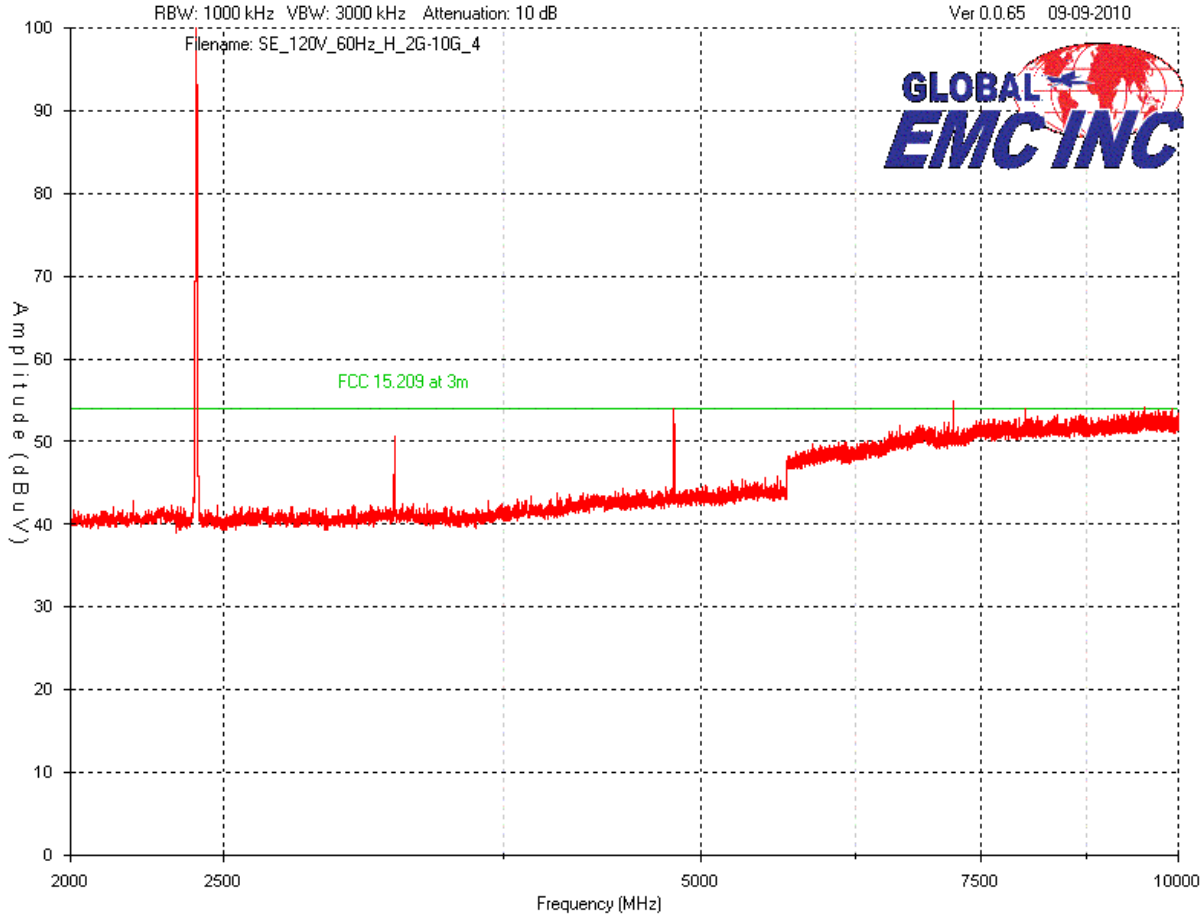
Note: Receive mode was identical

Horizontal – Peak Emissions Graph – Low Band (hopping stopped) 1 – 2 GHz



Note: Receive mode was identical

Horizontal – Peak Emissions Graph – Low Band (hopping stopped) 2 – 10 GHz



Note: Receive mode was identical, with the exception of the first, third, and fourth (L-R) frequency spikes shown above not being present.

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.

For the requirement of -20dBc, please see *20 dBc Requirement* section of this report.

The frequency shown on the peak graphs between 2000 – 2500 MHz, which are above the 15.209 limits, falls at 2400 MHz, which is not within the restricted bands as listed in FCC 15.205 and does not need to be verified.

For information purposes, the fundamental was measured to be 107.7 dBuV/m at 3 meters, and none of the unintentional radiated emissions that fall outside of the restricted bands exceeded the -20dBc (or 56.9dBuV/m) requirement.

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

Client	**Paradigm**
Product	HT205
Standard(s)	RSS 210 Issue 7:2007 / FCC Part 15 Subpart C 15:2010

Radiated Emissions Measurements

Project Name / Number	Transceiver Module/19699										
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											
2403	Peak	Horz	105.3	30.6	2.2	0.0	36.2	101.9	--	--	PASS
2403	Avg	Horz	103.1	30.6	2.2	0.0	36.2	99.7	--	--	PASS
2403	Peak	Vert	111.1	30.6	2.2	0.0	36.2	107.7	--	--	PASS
2403	Avg	Vert	108.6	30.6	2.2	0.0	36.2	105.2	--	--	PASS
2390	Peak	Horz	46.0	30.6	2.2	0.0	36.2	42.6	74.0	31.4	PASS
2390	Avg	Horz	34.0	30.6	2.2	0.0	36.2	30.6	54.0	23.4	PASS
2390	Peak	Vert	46.3	30.6	2.2	0.0	36.2	42.9	74.0	31.1	PASS
2390	Avg	Vert	34.9	30.6	2.2	0.0	36.2	31.5	54.0	22.5	PASS
2400	Peak	Horz	72.9	30.6	2.2	0.0	36.2	69.5	74.0	4.5	PASS
2400	Avg	Horz	44.7	30.6	2.2	0.0	36.2	41.3	54.0	12.7	PASS
2400	Peak	Vert	59.3	30.6	2.2	0.0	36.2	55.9	74.0	18.1	PASS
2400	Avg	Vert	56.8	30.6	2.2	0.0	36.2	53.4	54.0	0.6	PASS
2398	Peak	Horz	53.5	30.6	2.2	0.0	36.2	50.1	74.0	23.9	PASS
2398	Avg	Horz	41.7	30.6	2.2	0.0	36.2	38.3	54.0	15.7	PASS
2398	Peak	Vert	63.5	30.6	2.2	0.0	36.2	60.1	74.0	13.9	PASS
2398	Avg	Vert	50.7	30.6	2.2	0.0	36.2	47.3	54.0	6.7	PASS
4806	Peak	Horz	52.0	33.7	2.9	0.0	35.7	52.9	74.0	21.1	PASS
4806	Avg	Horz	42.8	33.7	2.9	0.0	35.7	43.7	54.0	10.3	PASS
4806	Peak	Vert	63.4	33.7	2.9	0.0	35.7	64.3	74.0	9.7	PASS
4806	Avg	Vert	51.7	33.7	2.9	0.0	35.7	52.6	54.0	1.4	PASS
7209	Peak	Vert	54.2	37.9	4.3	0.0	35.9	60.5	74.0	13.5	PASS
7209	Avg	Vert	43.6	37.9	4.3	0.0	35.9	49.9	54.0	4.1	PASS
7209	Peak	Horz	48.0	37.9	4.3	0.0	35.9	54.3	74.0	19.7	PASS
7209	Avg	Horz	36.1	37.9	4.3	0.0	35.9	42.4	54.0	11.6	PASS
Mid channel											
2442	Peak	Horz	105.0	30.6	2.2	0.0	36.2	101.6	--	--	PASS
2442	Avg	Horz	103.1	30.6	2.2	0.0	36.2	99.7	--	--	PASS
2442	Peak	Vert	108.6	30.6	2.2	0.0	36.2	105.2	--	--	PASS
2442	Avg	Vert	106.6	30.6	2.2	0.0	36.2	103.2	--	--	PASS
4884	Peak	Horz	52.8	33.7	2.9	0.0	35.7	53.7	74.0	20.3	PASS
4884	Avg	Horz	43.7	33.7	2.9	0.0	35.7	44.6	54.0	9.4	PASS
4884	Peak	Vert	55.4	33.7	2.9	0.0	35.7	56.3	74.0	17.7	PASS
4884	Avg	Vert	46.3	33.7	2.9	0.0	35.7	47.2	54.0	6.8	PASS

7326	Peak	Vert	48.8	37.9	4.3	0.0	35.9	55.1	74.0	18.9	PASS
7326	Avg	Vert	35.8	37.9	4.3	0.0	35.9	42.1	54.0	11.9	PASS
7326	Peak	Horz	49.7	37.9	4.3	0.0	35.9	56.0	74.0	18.0	PASS
7326	Avg	Horz	38.0	37.9	4.3	0.0	35.9	44.3	54.0	9.7	PASS
High channel											
2480	Peak	Horz	106.1	30.6	2.2	0.0	36.2	102.7	--	--	PASS
2480	Avg	Horz	103.9	30.6	2.2	0.0	36.2	100.5	--	--	PASS
2480	Peak	Vert	107.7	30.6	2.2	0.0	36.2	104.3	--	--	PASS
2480	Avg	Vert	105.6	30.6	2.2	0.0	36.2	102.2	--	--	PASS
2483.5	Peak	Horz	67.2	30.6	2.2	0.0	36.2	63.8	74.0	10.2	PASS
2483.5	Avg	Horz	41.5	30.6	2.2	0.0	36.2	38.1	54.0	15.9	PASS
2483.5	Peak	Vert	68.7	30.6	2.2	0.0	36.2	65.3	74.0	8.7	PASS
2483.5	Avg	Vert	45.6	30.6	2.2	0.0	36.2	42.2	54.0	11.8	PASS
4960	Peak	Horz	52.4	33.7	2.9	0.0	35.7	53.3	74.0	20.7	PASS
4960	Avg	Horz	43.3	33.7	2.9	0.0	35.7	44.2	54.0	9.8	PASS
4960	Peak	Vert	53.1	33.7	2.9	0.0	35.7	54.0	74.0	20.0	PASS
4960	Avg	Vert	44.5	33.7	2.9	0.0	35.7	45.4	54.0	8.6	PASS
7440	Peak	Vert	50.6	37.9	4.3	0.0	35.9	56.9	74.0	17.1	PASS
7440	Avg	Vert	39.4	37.9	4.3	0.0	35.9	45.7	54.0	8.3	PASS
7440	Peak	Horz	50.2	37.9	4.3	0.0	35.9	56.5	74.0	17.5	PASS
7440	Avg	Horz	38.3	37.9	4.3	0.0	35.9	44.6	54.0	9.4	PASS
2485.5	Peak	Horz	52.0	37.9	4.3	0.0	35.9	58.3	74.0	15.7	PASS
2485.5	Avg	Horz	42.5	37.9	4.3	0.0	35.9	48.8	54.0	5.2	PASS
2485.5	Peak	Vert	55.0	37.9	4.3	0.0	35.9	61.3	74.0	12.7	PASS
2485.5	Avg	Vert	46.1	37.9	4.3	0.0	35.9	52.4	54.0	1.6	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	02/12/2009	02/12/2011	GEMC 8
Horn Antenna	6878/24	Q-Par	8/25/2010	8/25/2012	GEMC 6365
1-26G pre-amp	HP 8449B	HP	8/25/2010	8/25/2012	GEMC 6351
Chase Preamp 9kHz - 2 GHz	CPA9231A	Chase	8/25/2010	8/25/2012	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"

Channel Carrier Separation for Frequency Hopping Systems

Purpose

The purpose of this test is to ensure that the RF energy of frequency hopping systems is sufficiently spread over a spectrum and that the radio energy is not overly dense. This limit helps allow for other spread spectrum devices to co-exist in the same frequency spectrum. This also helps prevent corruption of data by ensuring adequate channel separation to distinguish the reception of the intended information.

Limits

The limits are as defined in 47 CFR FCC Part 15 Section 15.247(a)(1)

	902 to 928 MHz	2.4 to 2.4835 GHz	5.275 to 5.85 GHz
No conditions	25 kHz or 20 dB BW[1]	25 kHz or 20 dB BW[1]	25 kHz or 20 dB BW[1]
< 125 mW	25 kHz or 20 dB BW[1]	25 kHz or 2/3 of 20 dB BW[1]	25 kHz or 20 dB BW[1]

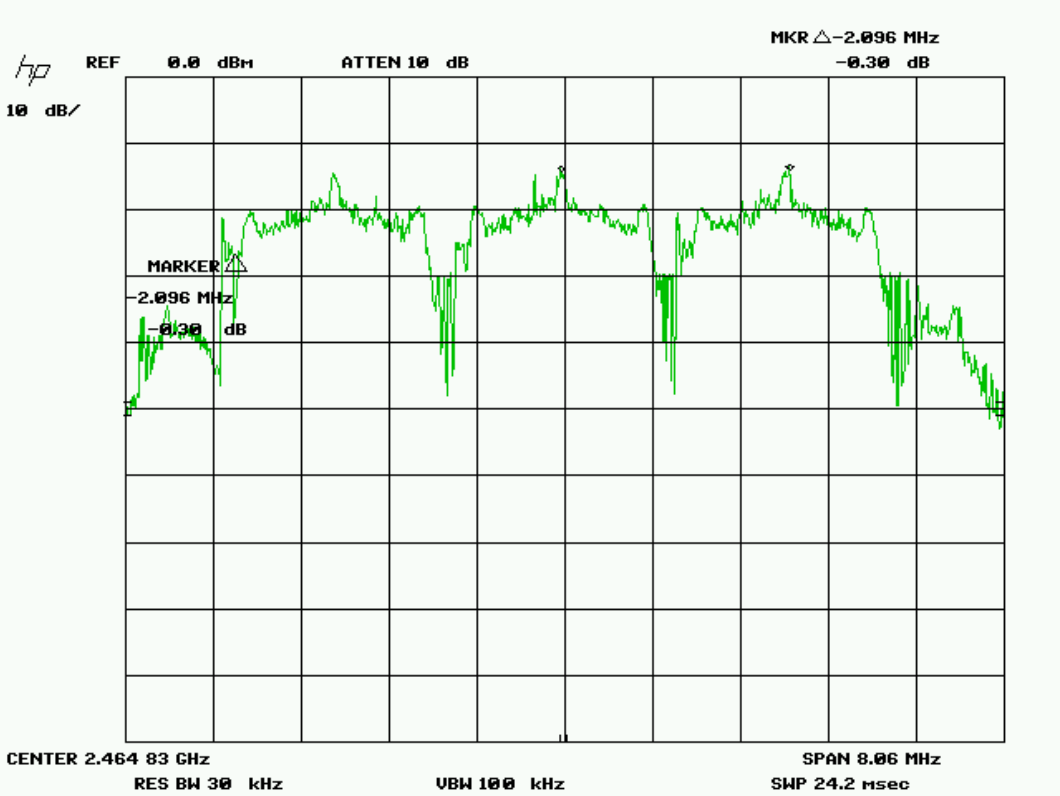
Note 1: Whichever is greater. The 20 dB BW of the system was measured to be 1.74 MHz, so a limit of 1.74 MHz applies.

Results

The EUT passed the requirements of channel carrier spacing exceeding the measured 20 dB BW of the EUT. The 20 dB BW previously measured was 1.74 MHz, and the device had a channel spacing of 2.1 MHz.

Graph(s)

The graph 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 channel spacing of the signal being measured. This measurement is a peak measurement. Max hold is performed for a duration of not less then 1 minute.



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"

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.

Limits

The limits are defined in 15.247(b).
For frequency hopping systems operating in the 902-928 MHz band employing more then 50 hopping channels, the peak limit is 1 watt.

Results

The EUT passed. The peak power measured was 12.5 dBm (17.8 mW).

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.

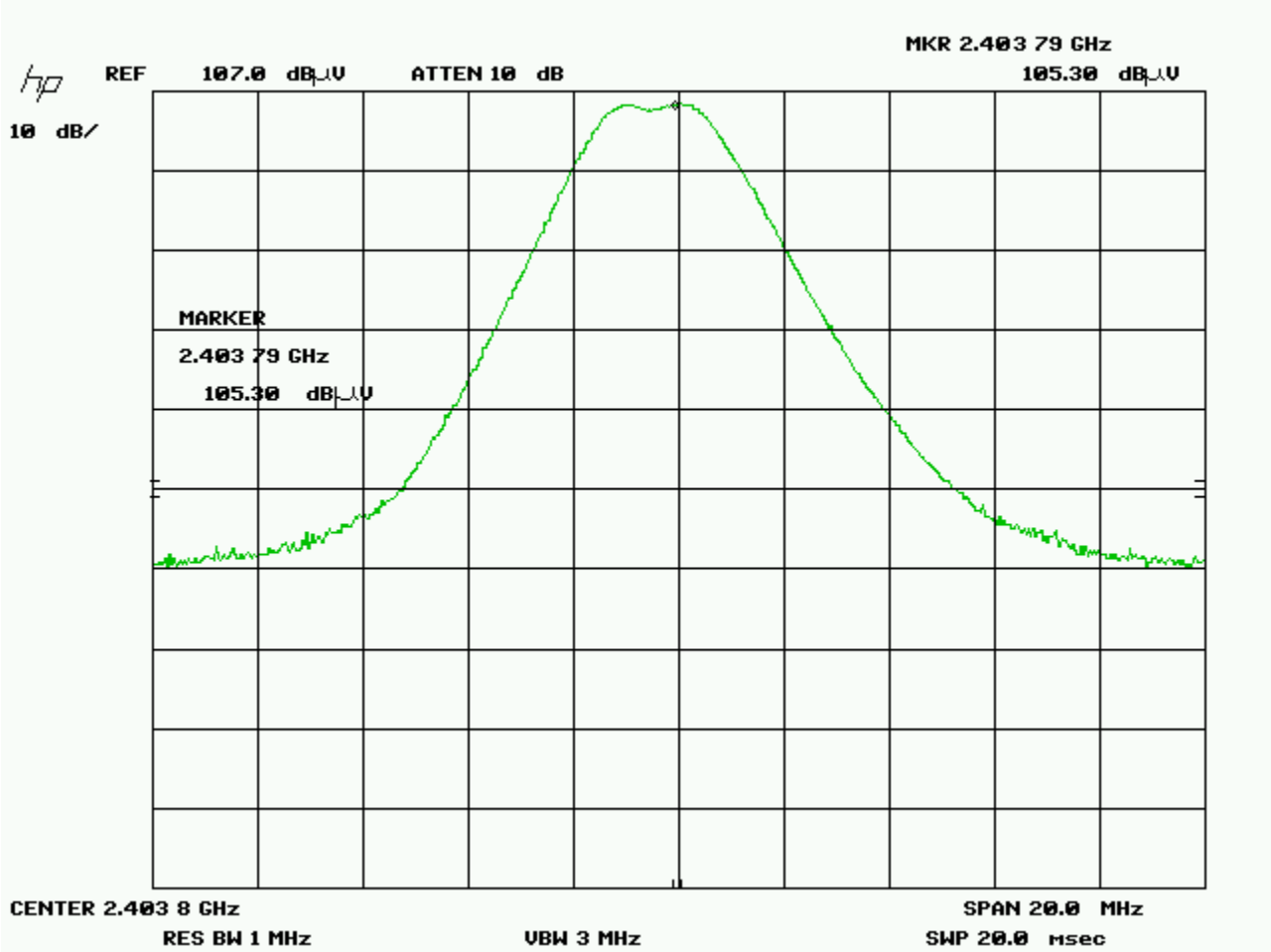
See *Radiated Emissions Measurements* chart in *Spurious Radiated Emissions* section for peak received power.

The calculated value is:

[Peak Received Power] = [Peak received signal adjusted for pre-amps, losses, etc.] – 95.2
12.5dBm = 107.7dBµV - 95.2

[Received Power] – [Antenna Gain] = [Peak Power Output]
Antenna Gain = 0dB

Peak Power Output = 12.5dBm



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"

20 dBc Requirement

Purpose

The purpose of this test is to ensure that the maximum power conducted to the radiating element does not exceed the limits specified.

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.

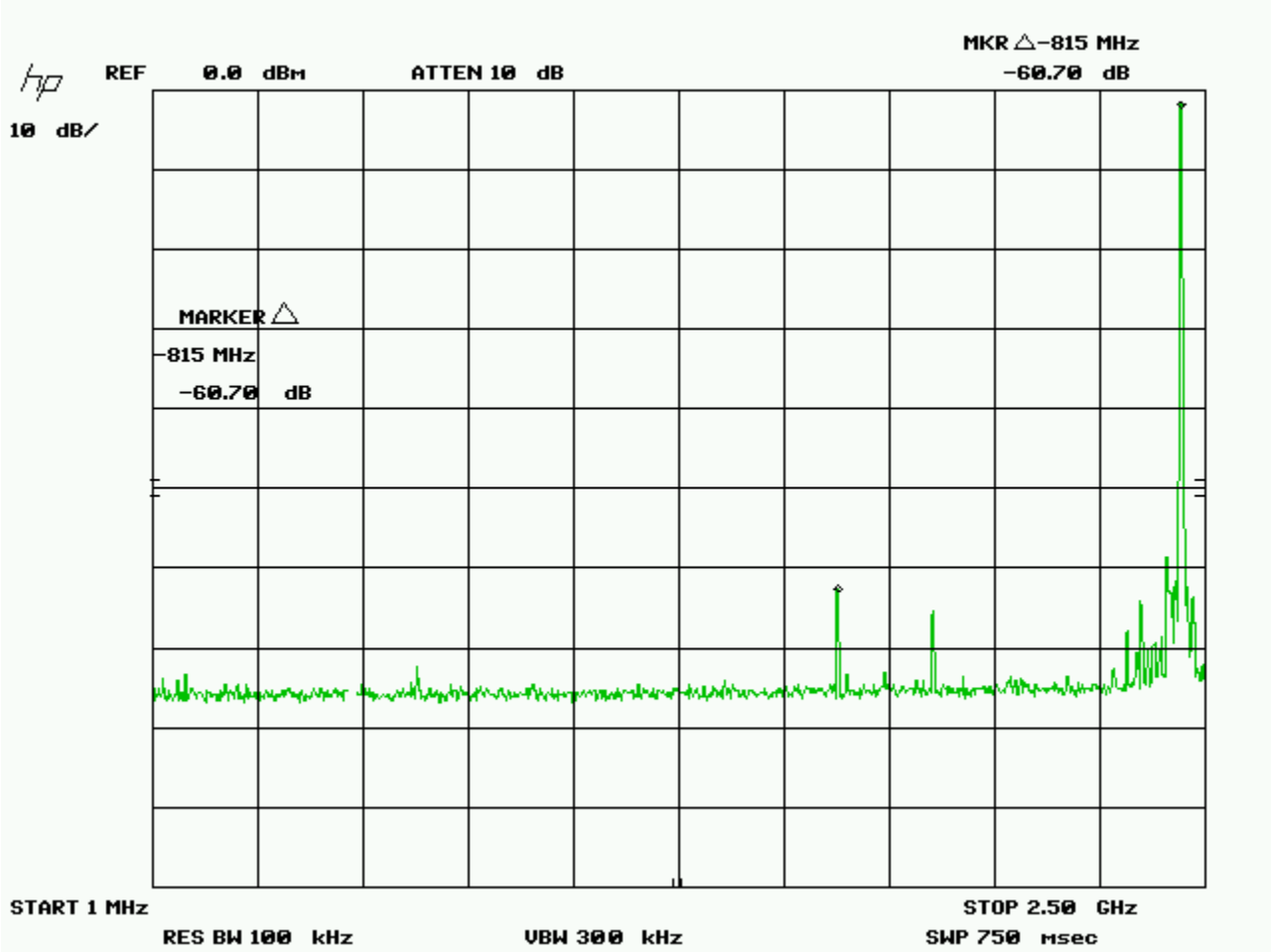
Results

The EUT passed the requirements. Low, middle, high bands, and hopping were measured. The worst case is presented as a graph for the spectrum.
The -20 dBc requirement is shown for the lower band edge at 2.401 GHz in the low band and at 2.480 GHz in the high band.

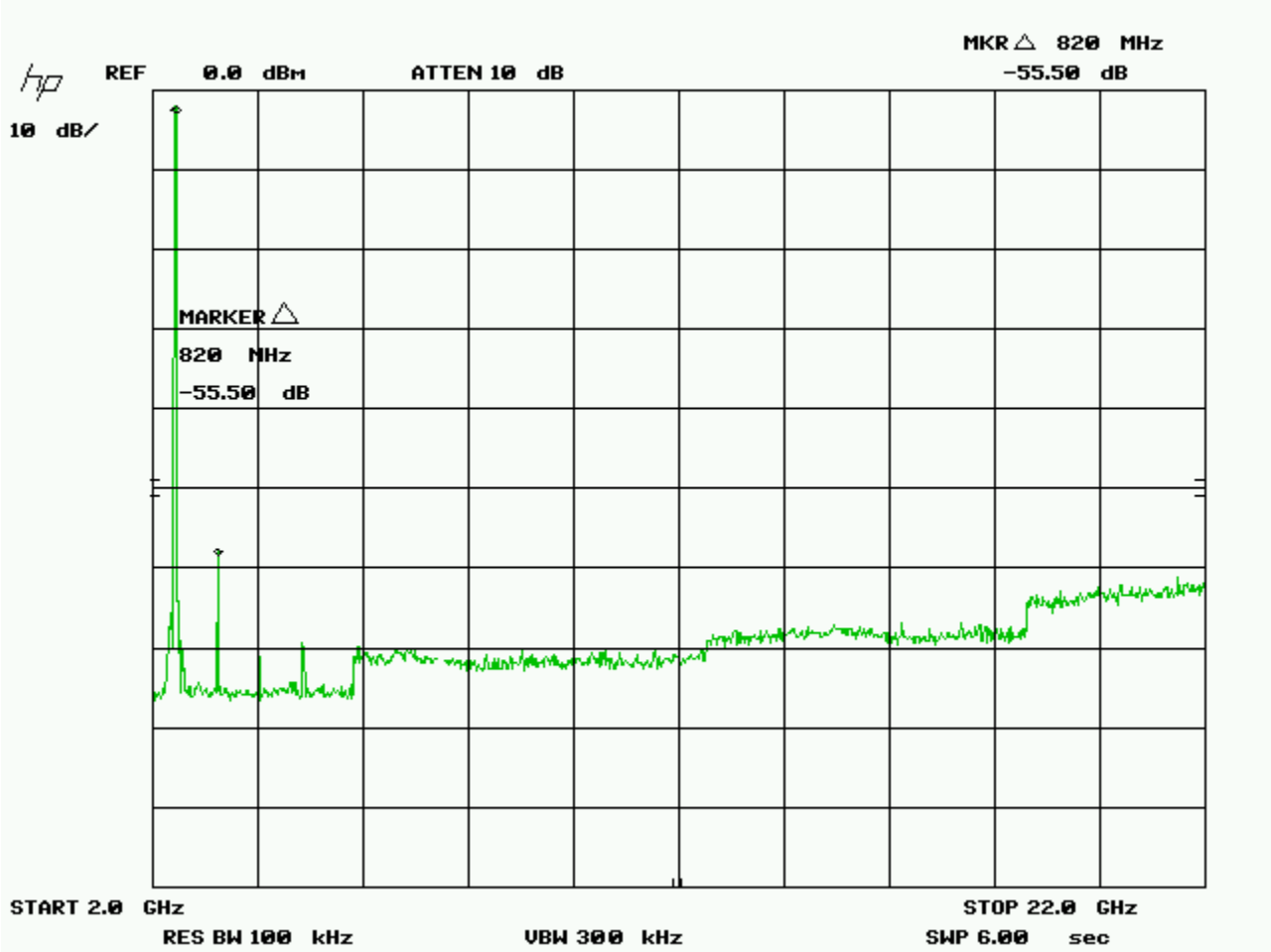
Graph(s)

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

1 MHz – 2.5 GHz Low



2.5 GHz – 22.0 GHz Low



2.40 GHz Band Edge Low

2483.5 MHz Band Edge Hi

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"

Frequency Occupancy for Frequency Hopping Systems

Purpose

The purpose of this test is to ensure that the RF energy of frequency hopping systems is hopping at a minimum defined rate. This helps ensure sufficient time off to enable other frequency hopping devices to co-operate within this allocated band.

Limits

For 2400 – 2483.5 MHz systems, the limits are as defined in 47 CFR FCC Part 15 Section 15.247(a)(1)(iii).

For frequency hopping systems in 2400 – 2483.5 MHz, the unit shall use at least 15 channels. The average time of occupancy shall not be greater than 0.4s in a period of 0.4s X # of channels occupied.

Results

The EUT passed the requirements. The EUT cycles through its pseudo-random generated list of hopping frequencies. There are 20 channels occupied in total. The average occupancy time is 4.6 ms per channel and each channel is repeated every 107.0 ms.
The complete observation time is
= # of channels x 400 ms
= 20 x 400 ms
= 8000 ms
= 8 s

Number of time a channel is occupied in 8s = 8s / 107ms
= 8000 ms / 107ms
= 74.8 times.

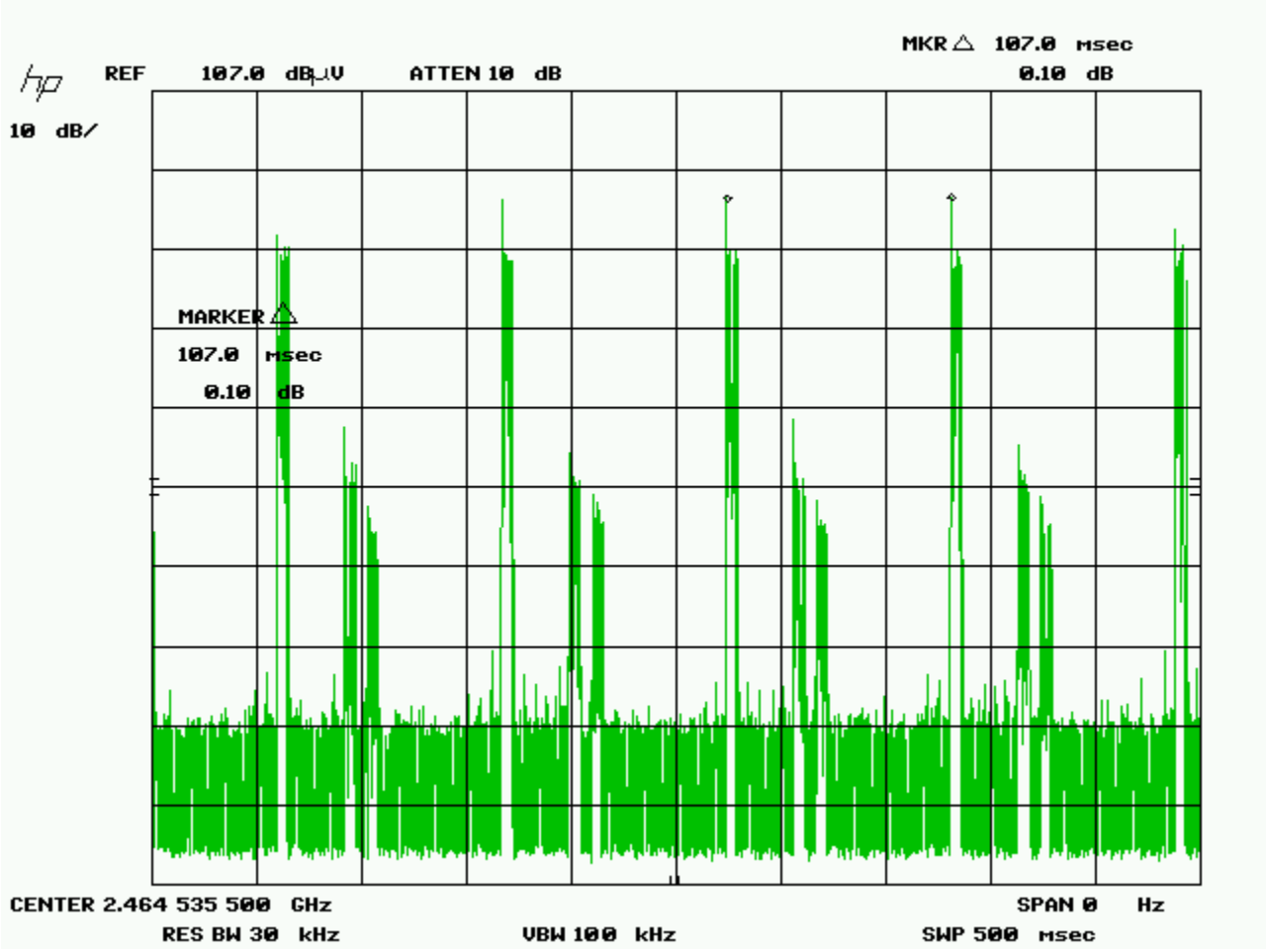
Total occupancy time in 8 s is
= 74.8 x 4.6 ms
= 344.1 ms

The EUT has an average occupancy of 344.1 msec within an 8 second period. This is under the 400 msec limit as per 15.247 (a) 1 (iii)

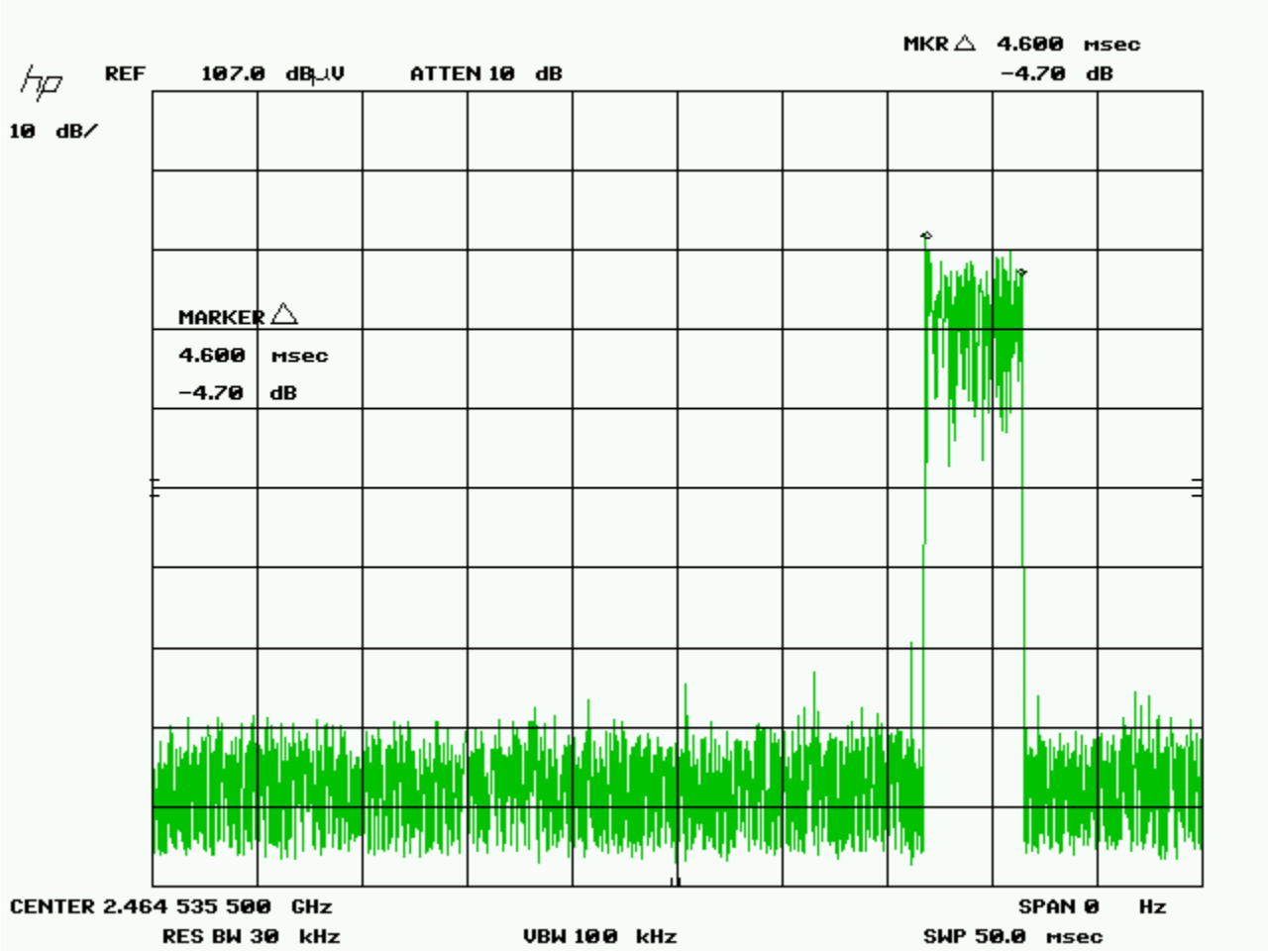
Graph(s)

The first graph shown below shows the repeat time of the pseudorandom generated hopping list. The second graph shows the on time. Note that in the first graph, the peak represents the 'on' of the frequency being measured. The lower signals are artifacts of nearby channels due to the wide resolution BW used.

Hopping List repeat rate



On time during each 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 #
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"

Number of Channels for Frequency Hopping Systems

Purpose

The purpose of this test is to ensure that the RF energy of frequency hopping systems is sufficiently spread over a spectrum and that the radio energy is not overly dense. This limit helps allow for other spread spectrum devices to co-exist in the same frequency spectrum. This also helps prevent corruption of data by ensuring adequate channel separation to distinguish the reception of the intended information.

Limits

The limits are as defined in 47 CFR FCC Part 15 Section 15.247(a)(1)

	902 to 928 MHz	2.4 to 2.4835 GHz	5.275 to 5.85 GHz
No conditions	>= 50 channels	>= 15 channels	>= 75 channels
20 dB BW exceeds 250 kHz	>= 25 channels	>= 15 channels	>= 75 channels

Results

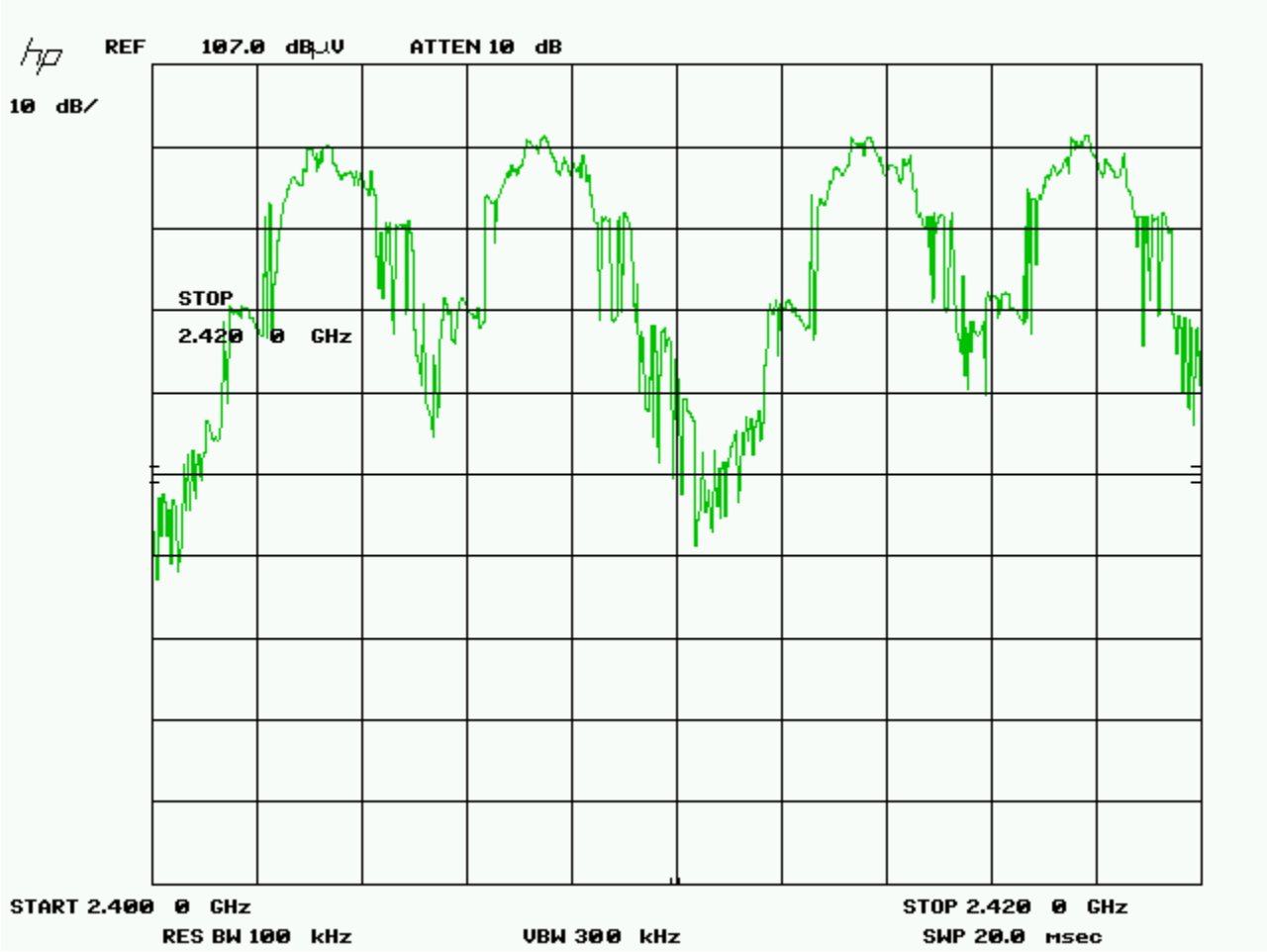
The EUT passed the requirements of the number of channels. The number of channels the device occupies is 20 channels in the allocation band of 2400 MHz – 2483.5 MHz.

Graph(s)

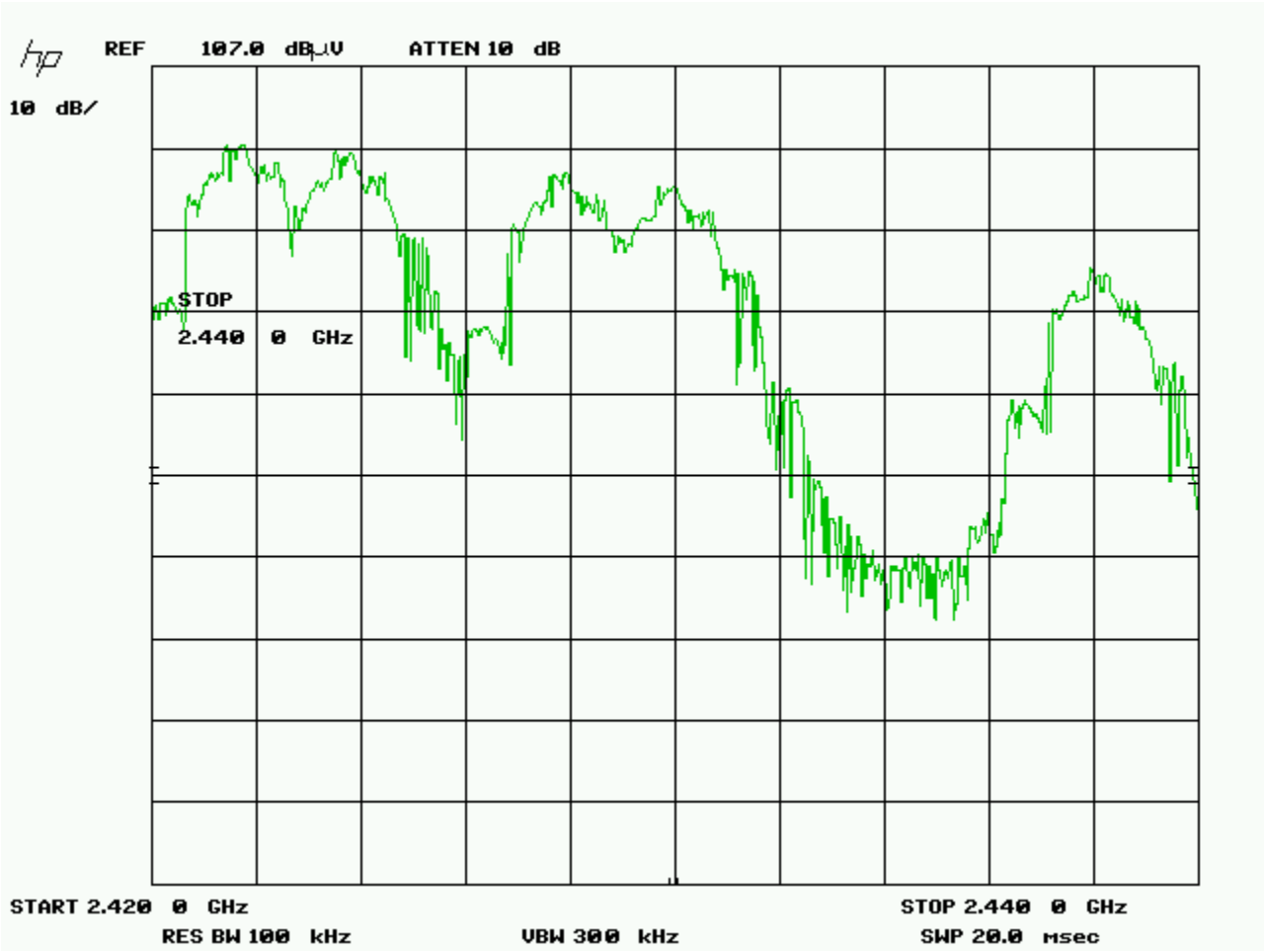
The graphs shown below shows the number of occupied channels during the operation of the device. This is measured by a max hold on the spectrum analyzer and the highest resolution bandwidth that is sufficiently low to exhibit the channel spacing of the signal being measured. This measurement is a peak measurement. Max hold is performed for a duration of not less then 10 minutes, or as sufficient to capture the channels occupied.

The number of Channels is 20

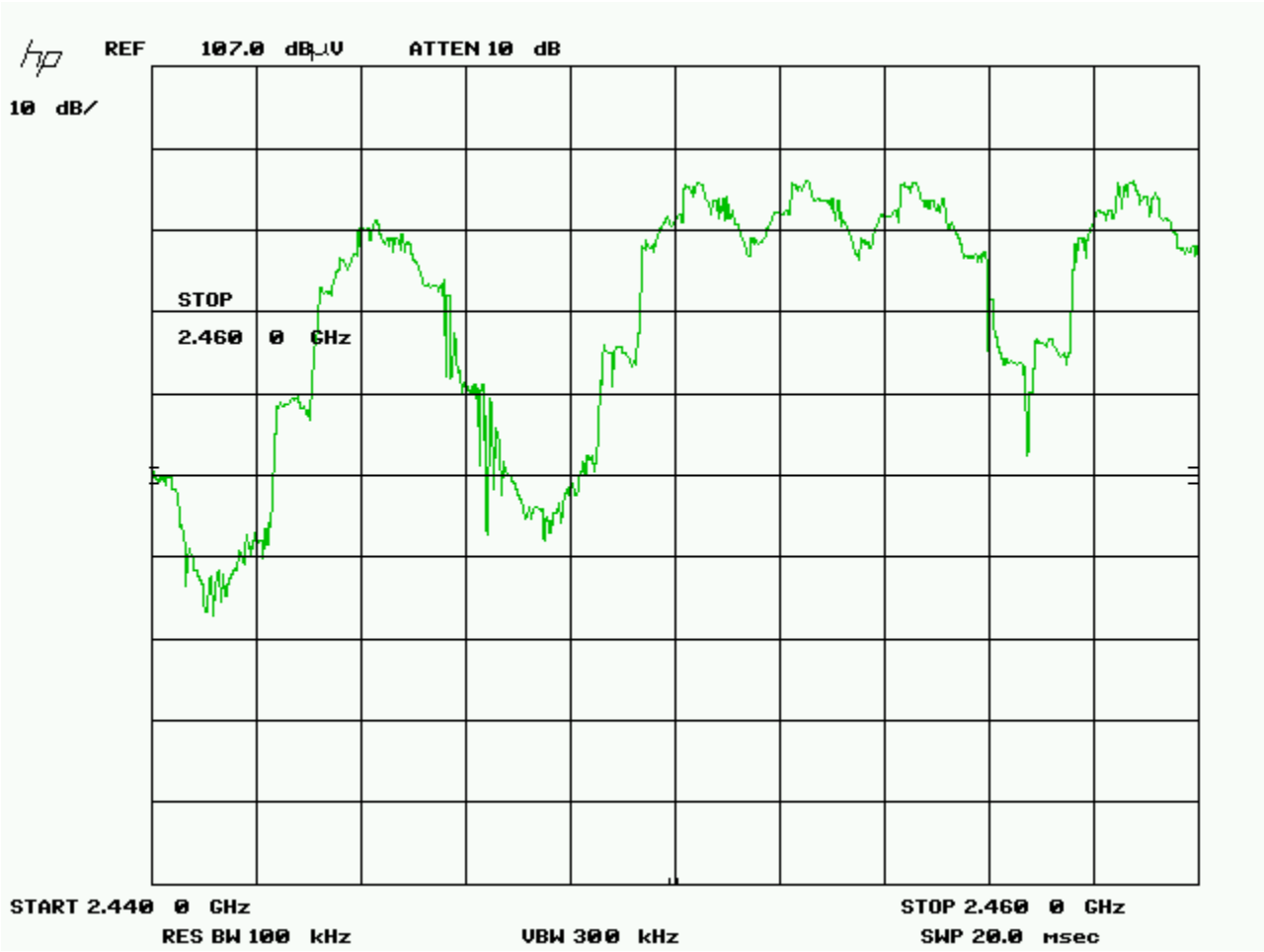
Channel 1 – 4



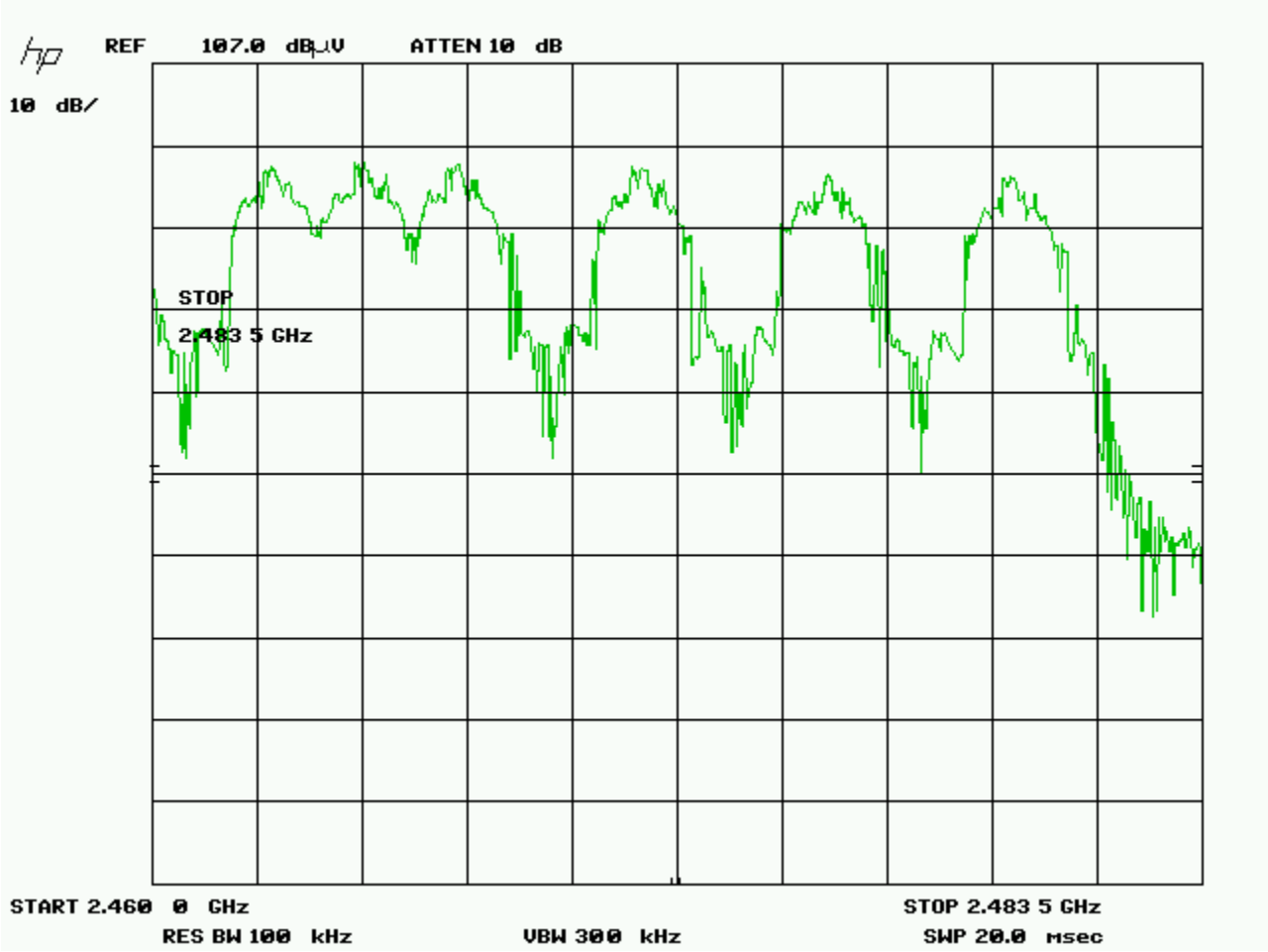
Channel 5 – 9



Channel 10 – 14



Channel 15 – 20



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"

Channel Carrier Bandwidth of Frequency Hopping Systems

Purpose

The purpose of this test is to allow for results that are used to help establish other limits. Although there is not specific limit for this requirement, the derived limits dependant on this information helps allow for other spread spectrum devices to co-exist in the same frequency spectrum. This also helps prevent corruption of data by ensuring adequate channel separation to distinguish the reception of the intended information.

Limits

There is no specified limit. However, an approximate calculated maximum limit can be obtained by dividing the maximum bandwidth of the frequency allocation by the minimum number of channels. Note that this is a maximum bandwidth, and the measurement is used to calculate other limits.

902 to 928 MHz[1]	902 to 928 MHz[2]	2.4 to 2.4835 GHz	5.725 GHz to 5.85 GHz
26 MHz / 50	26 MHz / 25	83.5 MHz / 15	125 MHz / 75
520 kHz	1.04 MHz	5.57 MHz	1.67 MHz

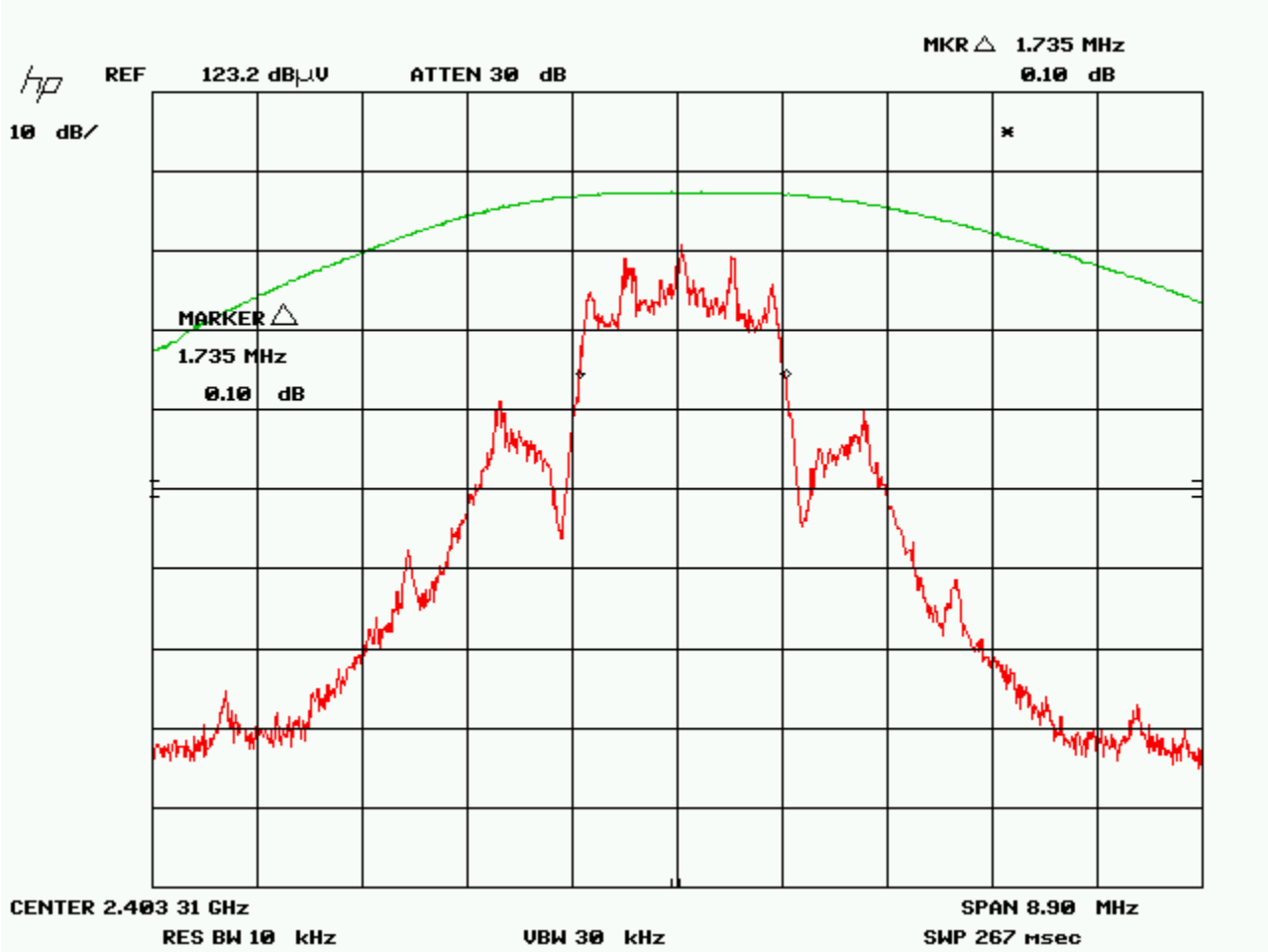
Note 1: When the 20 dB BW is less then 250 kHz
Note 2: When the 20 dB BW is greater then 250 kHz

Results

The EUT passed. The 20 dB BW measured was 1.74 MHz.

Graph(s)

The graph 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 20 dB bandwidth of a channel during operation of the EUT. This measurement is a peak measurement. Max hold is performed for a duration of not less then 1 minute.



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"

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 0.0076 mW/cm^2, this is significantly under the 1.0 mW/cm^2 requirement.

Calculations

$P_d = (P_t * G) / (4\pi R^2)$
Where Pt = 12.5 dBm or 17.78 mW as per peak power output
Where G = 3.3 dBi, or numerically 2.14
Where R = 20 cm

$P_d = (17.78\ mW * 2.14) / (4\pi(20cm)^2)$
$P_d = 38.05\ mW / 5026\ cm^2$
$P_d = 0.00756\ mW/cm^2$

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

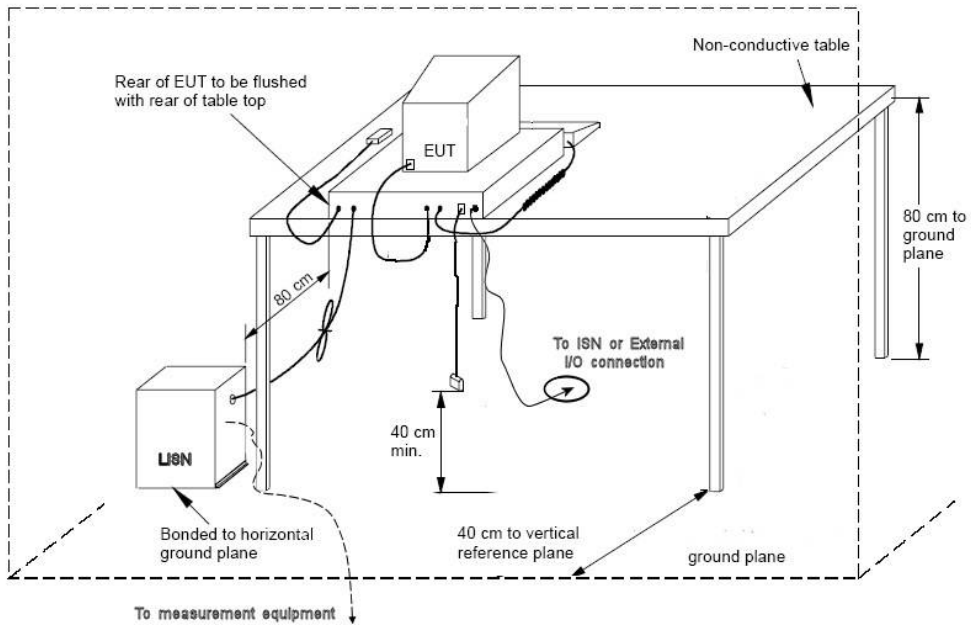
Average Limits		QuasiPeak Limits	
150 kHz – 500 kHz	56 to 46 dBuV	150 kHz – 500 kHz	66 to 56 dBuV
500 kHz – 5 MHz	46 dBuV	500 kHz – 5 MHz	56 dBuV
5 MHz – 30 MHz	50 dBuV	500 kHz – 30 MHz	60 dBuV

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

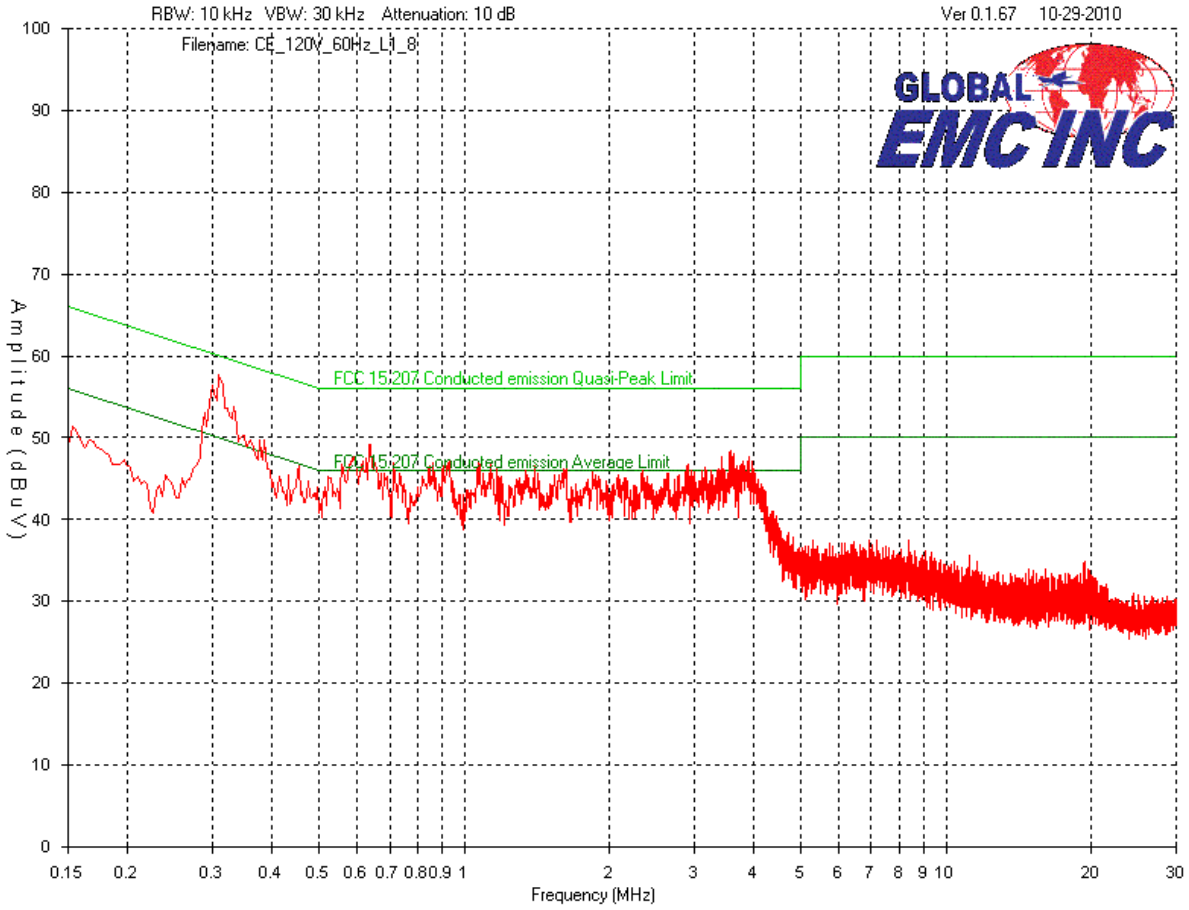
Measurement Uncertainty

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.

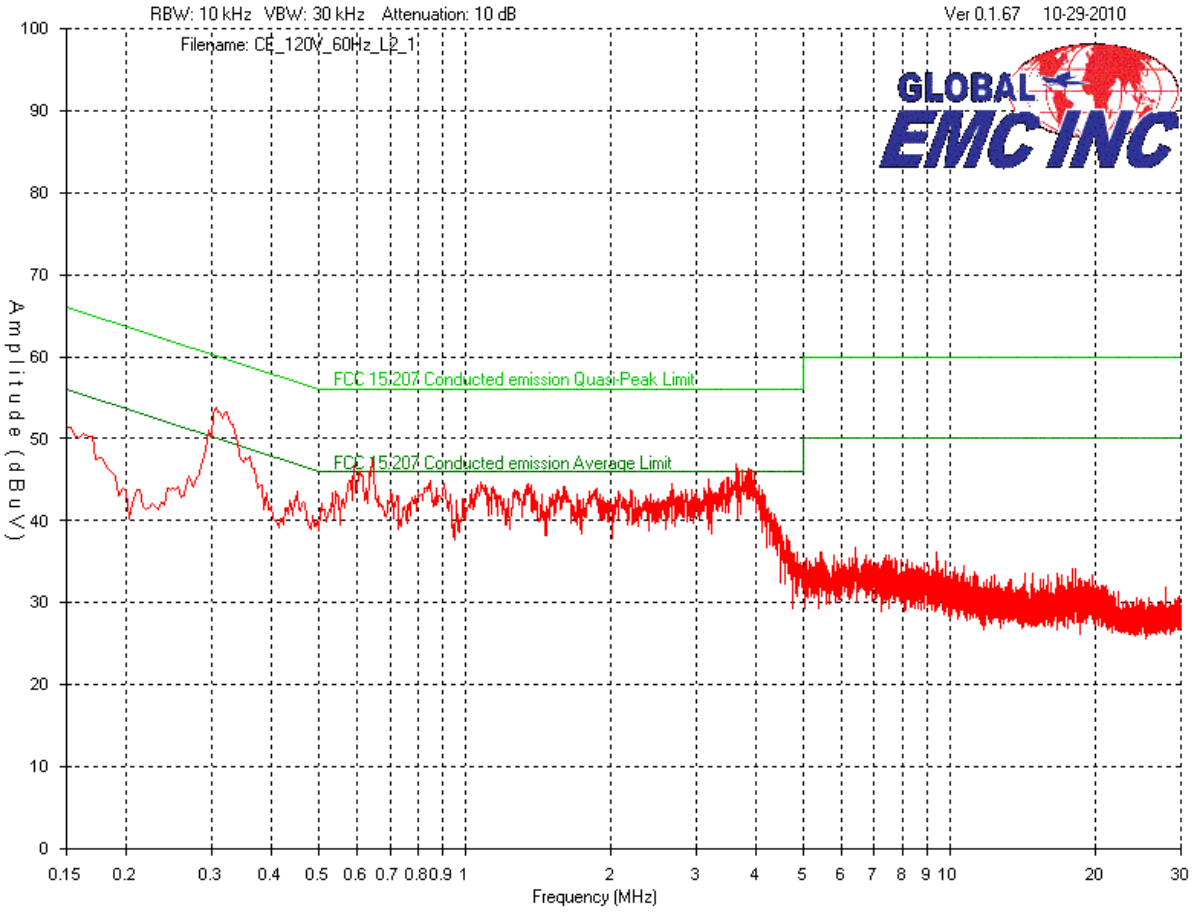
Preliminary Graphs

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, 60Hz Phase Line
Peak Emissions



120V, 60Hz Neutral Line
Peak Emissions



Final Measurements

Emissions Table
Average Emissions

Test Frequency (MHz)	Line Phase/ Neutral	Detector	Received signal (dBµV	Attenuator (dB)	Cable loss (dB)	LISN factor (dB)	Emission Level (dBuV)	Average Emission limit (dBµV)	Average Margin (dB)	Result
0.319	Phase	Average	37.9	10	0.1	0.4	48.4	49.7	1.3	Pass
0.624	Phase	Average	28.6	10	0.1	0.2	38.9	46	7.1	Pass
3.67	Phase	Average	24.7	10	0.1	0.2	35	46	11	Pass
1.34	Phase	Average	26	10	0.1	0.2	36.3	46	9.7	Pass
1.11	Phase	Average	26.7	10	0.1	0.2	37	46	9	Pass
0.873	Phase	Average	27.7	10	0.1	0.2	38	46	8	Pass
2.89	Phase	Average	23.6	10	0.1	0.2	33.9	46	12.1	Pass
1.59	Phase	Average	25.6	10	0.1	0.2	35.9	46	10.1	Pass
0.306	Neutral	Average	33.8	10	0.1	0.5	44.4	50.1	5.7	Pass
0.644	Neutral	Average	25	10	0.1	0.2	35.3	46	10.7	Pass
3.629	Neutral	Average	22.5	10	0.1	0.2	32.8	46	13.2	Pass
3.84	Neutral	Average	24	10	0.2	0.2	34.4	46	11.6	Pass
1.08	Neutral	Average	24	10	0.1	0.2	34.3	46	11.7	Pass
0.581	Neutral	Average	25.3	10	0.1	0.2	35.6	46	10.4	Pass

Emissions Table
Quasi-Peak (QP) Emissions

Test Frequency (MHz)	Line Phase/ Neutral	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	LISN factor (dB)	Emission Level (dBuV)	Quasi-Peak Emission limit (dBµV)	Quasi-Peak Margin (dB)	Result
0.319	Phase	QP	47.2	10	0.1	0.5	57.8	60	2.2	Pass
0.624	Phase	QP	38.9	10	0.1	0.2	49.2	56	6.8	Pass
3.67	Phase	QP	38	10	0.1	0.2	48.3	56	7.7	Pass
1.34	Phase	QP	37.4	10	0.1	0.2	47.7	56	8.3	Pass
1.11	Phase	QP	37.3	10	0.2	0.2	47.7	56	8.3	Pass
0.873	Phase	QP	36.8	10	0.1	0.2	47.1	56	8.9	Pass
0.306	Neutral	QP	43.2	10	0.1	0.5	53.8	60.1	6.3	Pass
0.644	Neutral	QP	37.1	10	0.1	0.2	47.4	56	8.6	Pass
3.629	Neutral	QP	36.6	10	0.1	0.2	46.9	56	9.1	Pass
3.84	Neutral	QP	36.1	10	0.2	0.2	46.5	56	9.5	Pass
3.19	Neutral	QP	34.7	10	0.1	0.2	45	56	11	Pass
1.08	Neutral	QP	34.4	10	0.1	0.2	44.7	56	11.3	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 #
IFR 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

For further details for filing purposes, refer to filing package.

General EUT Description

Client Details	
Organization / Address	Paradigm Electronics 205 Annagem Blvd. Mississauga, Ontario L5T2V1
Contact	Greg Salt
Phone	905-564-1994
Email	gsalt@paradigm.com
EUT (Equipment Under Test) Details	
EUT Name/Model	HT205
FCC ID	YZY-HT205
IC #	9261A-HT205
EUT revision	New product
Equipment category	Residential
EUT is powered using	AC
Input voltage range(s) (V)	120v
Frequency range(s) (Hz)	50/60hz
Rated input current (A)	0.1A
Number of power supplies in EUT	1
Transmits RF energy? (describe)	2.4 GHz, 0.08W
Basic EUT functionality description	This module is a part of wireless subwoofer system. The audio signal source is connected to the transmitter unit containing this module, which wirelessly transmits to a subwoofer unit with a receiver in a remote location so a physical connection between the subwoofer and audio signal source is not required.
Modes of operation	1

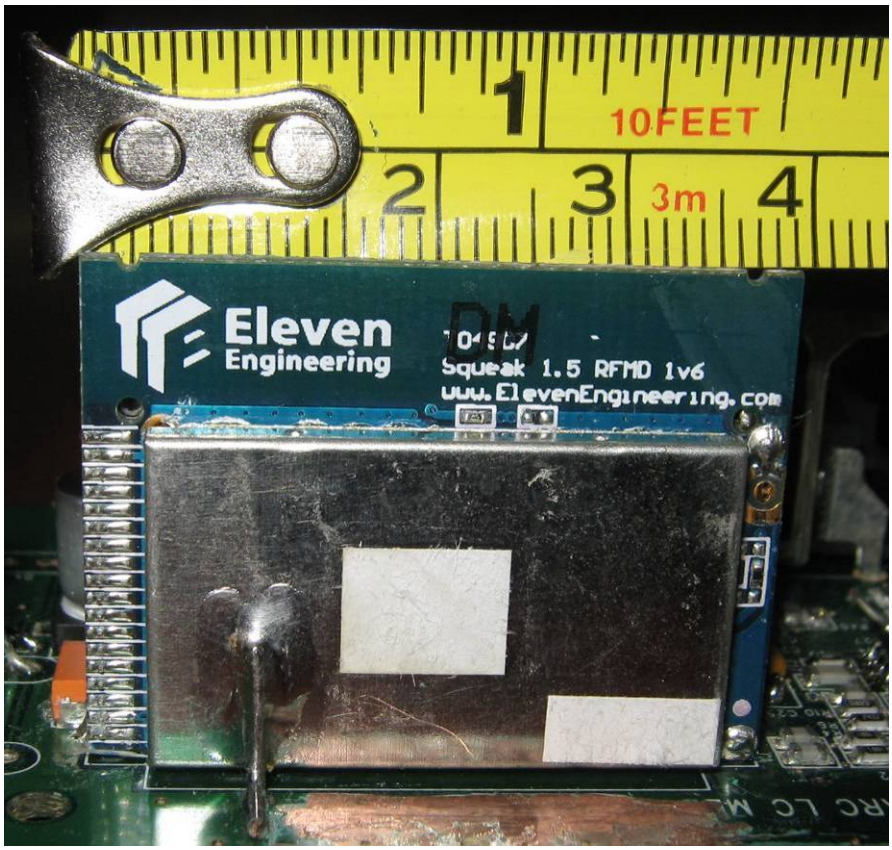
Step by step instructions for setup and operation	Plug power into wall. Adjust volume on subwoofer to center postion. Connect signal source, to RCA input connector of RF transmitter(PT-2). Signal transmitted through RCA cable, will play on the subwoofer.
I/O cable description Specify length and type	6' RCA-RCA cable to connect signal source to PT-2 transmitter.
Available connectors on EUT	RCA connectors, USB is for system setup.
Peripherals required to exercise EUT	Signal Generator
Dimensions of product (approx.)	L 38mm W 28mm H 6mm

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'.

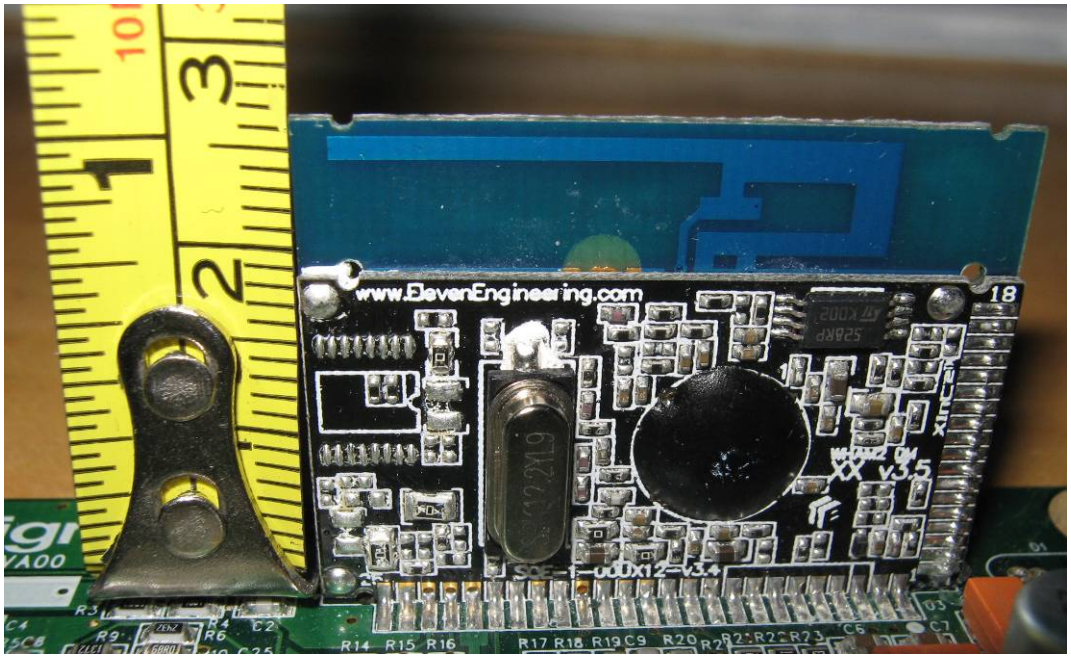
Appendix B – EUT and Test Setup Photographs

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

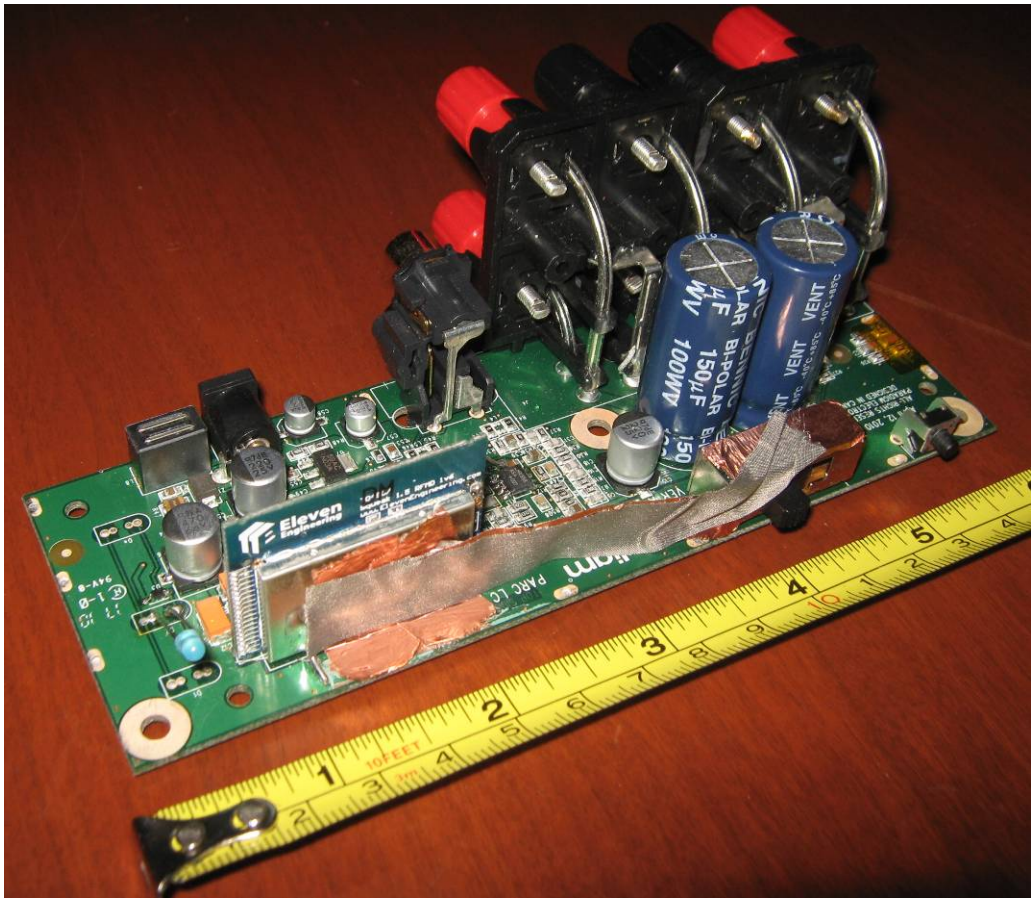
EUT – Transceiver module (side 1)



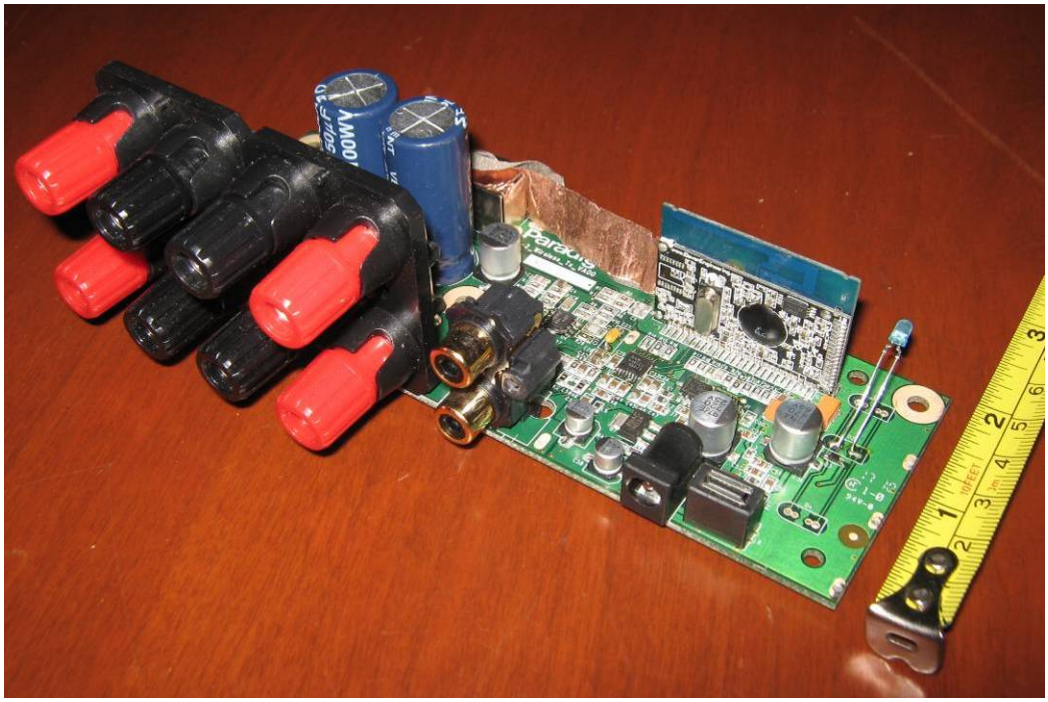
EUT – Transceiver module (side 2)



Transceiver module mounted on transmitter board (PT-2_Wireless_Tx_VA00) – View 1



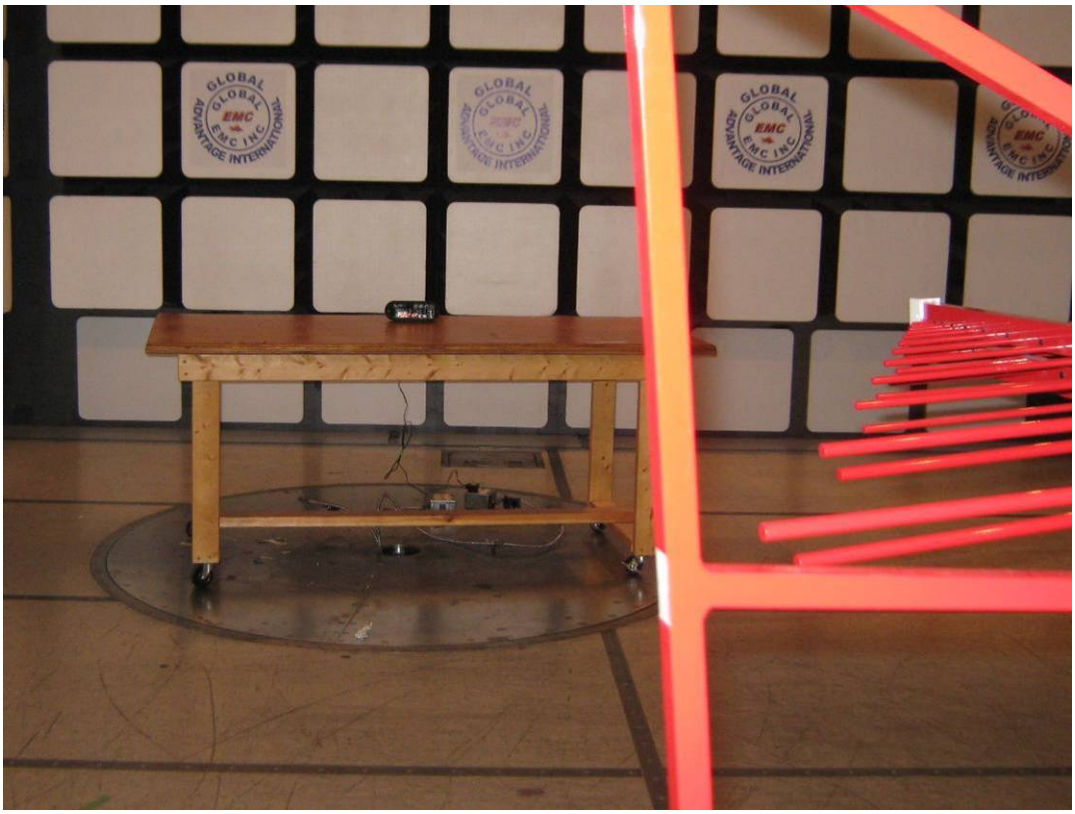
Transceiver module mounted on transmitter board (PT-2_Wireless_Tx_VA00) – View 2



Transmitter unit within enclosure

Radiated Emissions Photo 1

Radiated Emissions Photo 2



Power Line Conducted Emissions