Global EMC Inc. Labs

EMC & RF Test Report

As per

RSS 210 Issue 8:2010

&

FCC Part 15 Subpart C:2010

Unlicensed Intentional Radiators

on the

mySpark Learn

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Testing produced for

mySpark TECHNOLOGIES

See Appendix A for full customer & EUT details.

Industry Canada

LAB REGISTRATION #6844A-2

FCC REGISTRATION #612361

ACCREDITED

Testing Laboratory Certificate #2555.01

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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 mySpark Learn, 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 8:2010 / 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.

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Client	**mySpark Technologies**
Product	Learn
Standard(s)	RSS 210 Issue 8:2010 / 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:	Z4J-2001101-001A
EUT Industry Canada Certification #, IC:	9939A-2001101001A
EUT Passed all tests performed.	Yes (see test results summary)
Tests conducted by	Scott Drysdale

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Client	**mySpark Technologies**
Product	Learn
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2010

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)(1) RSS 210 6.2.2(o)	Channel Separation	> 25 kHz (or 20 dB BW)	Pass
FCC 15.247(b)(1) RSS 210 6.2.2(o)	Number of channels	> 75	Pass
FCC 15.247(a)(1)(iii) RSS 210 6.2.2(o)	Time of occupancy	< 400 mSec in 31.6 sec period	Pass
FCC 15.247(b)(1) 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	Portable requirement	Pass See justification and calculations
Overall Result			**PASS**

All tests were performed by Scott Drysdale.

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.

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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), this device incorporates a PCB chip antenna, which is not end user replaceable.

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

For the Antenna gain, this device has less than 6 dBi gain.

This device does not incorporate intelligence to co-ordinate its frequency hopping to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

This device may use one of three separate power supplies. Each power supply was investigated at each mode of operation at each of low, medium, and high band of operation. Where applicable, the representative results of worst case power supply are presented in this test report.

For maximum permissible exposure, this device operates in frequency hopping mode at 2.4 mW at 2.4 GHz, in both portable and mobile conditions. This is below the 20 mW threshold, so it is exempt from SAR requirements.

Where low, middle, and high frequency are required, this was investigated with the frequency hopping off.

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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
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 210:2010	- Issue 8: 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 - November 16, 2011

Revision 2 - November 30, 2011
Accidental asterisk to graphs on page 67-69 replaced with new plots.
Asterisk was due to alternate trace (not shown) not having completed sweep.

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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)
Nov 1 – 14, 2011	RE	SD	20-25ºC	30-45%	100 -103kPa
Nov 1 – 14, 2011	PLCE	SD	20-25ºC	30-45%	100 -103kPa

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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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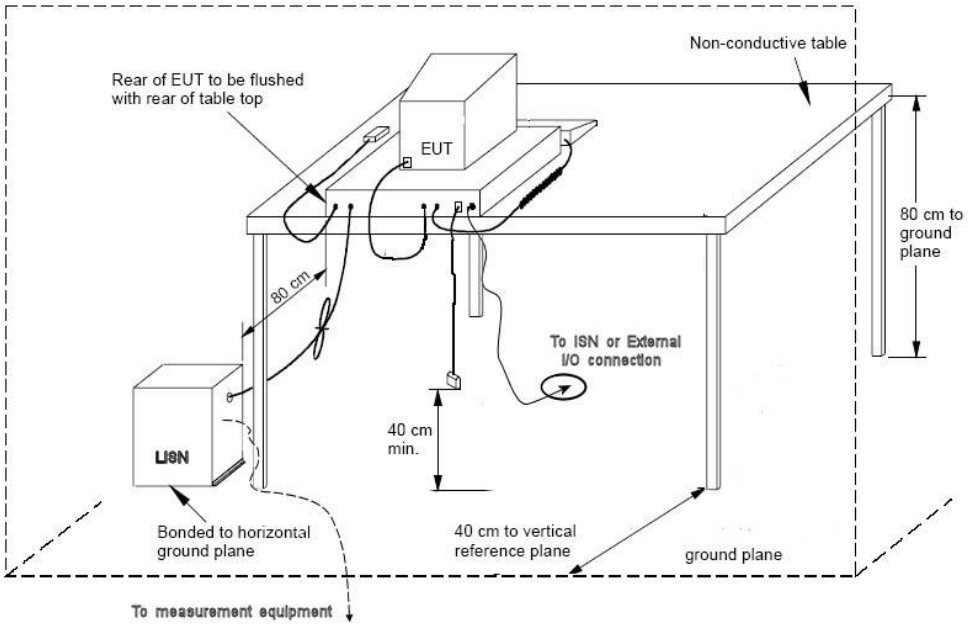
Typical Setup Diagram



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.

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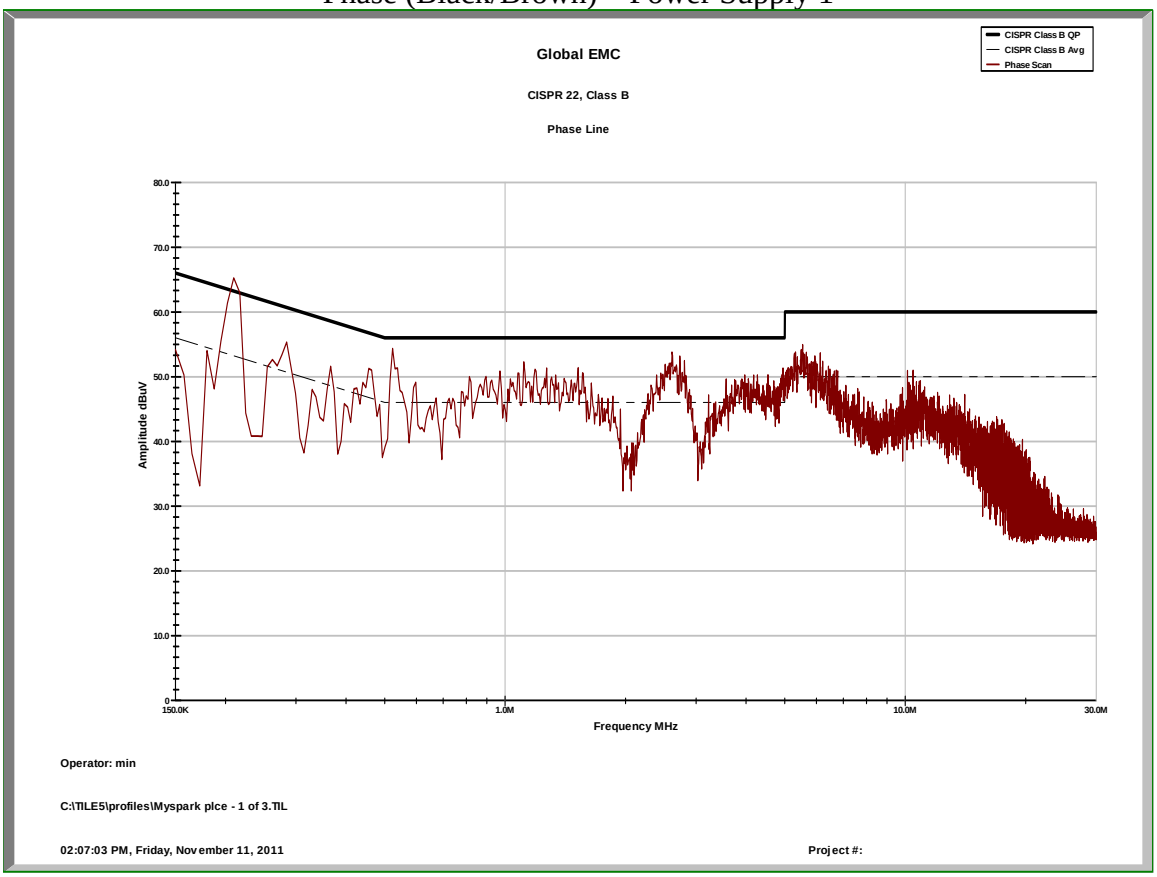
Phase (Black/Brown) – Power Supply 1



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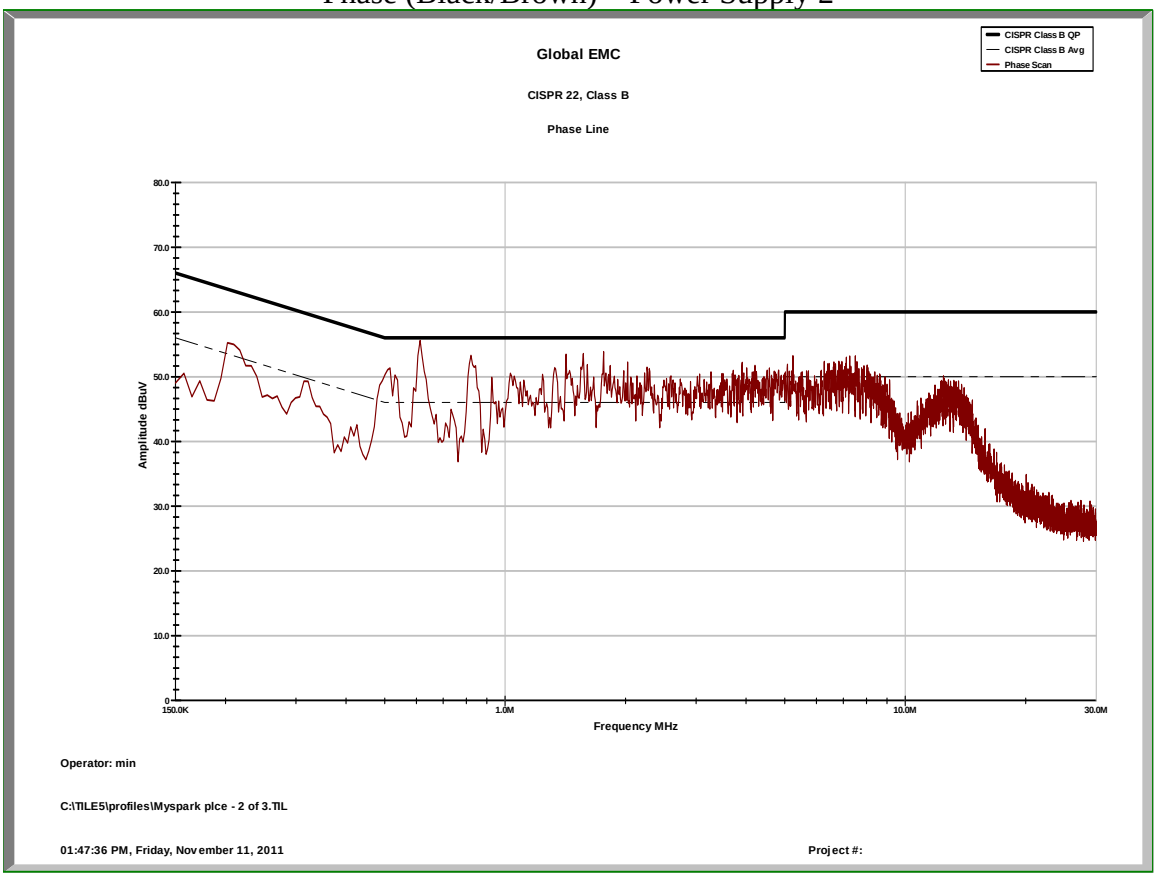
Phase (Black/Brown) – Power Supply 2



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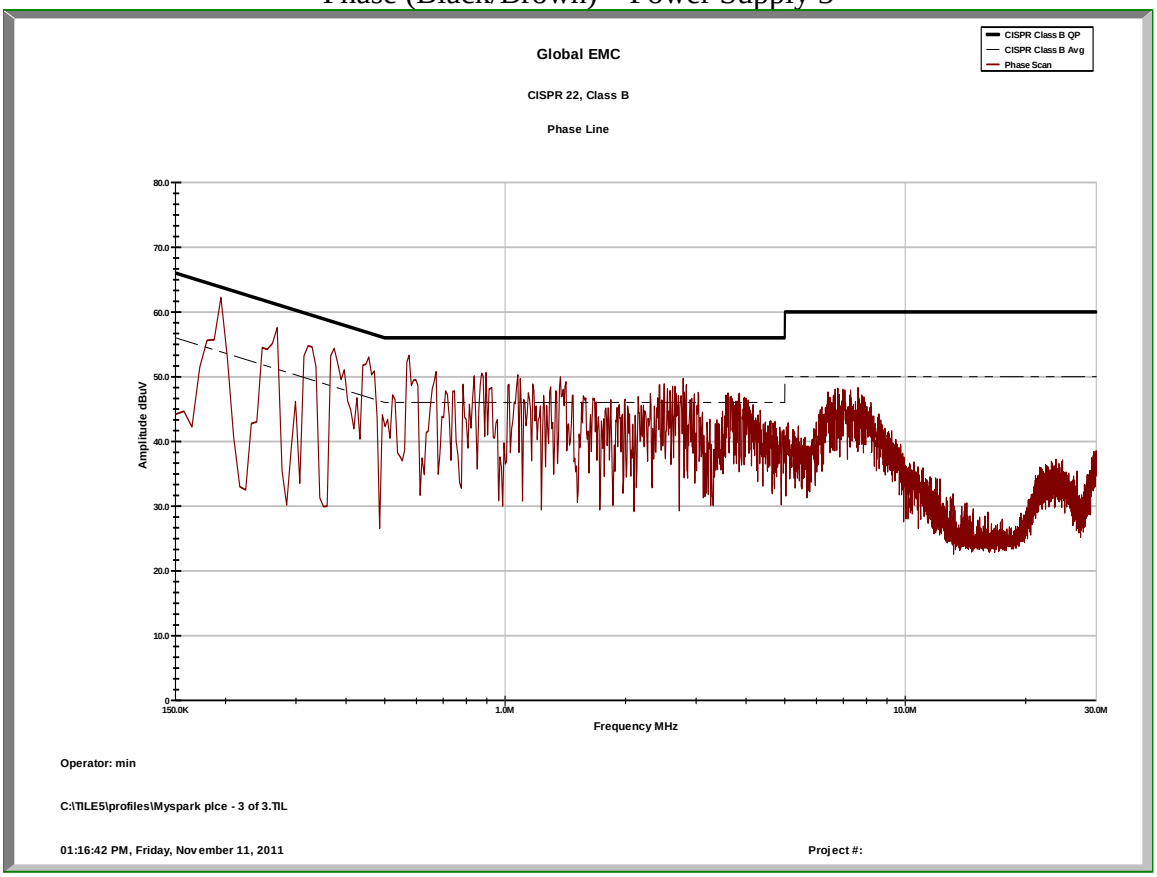
Phase (Black/Brown) – Power Supply 3



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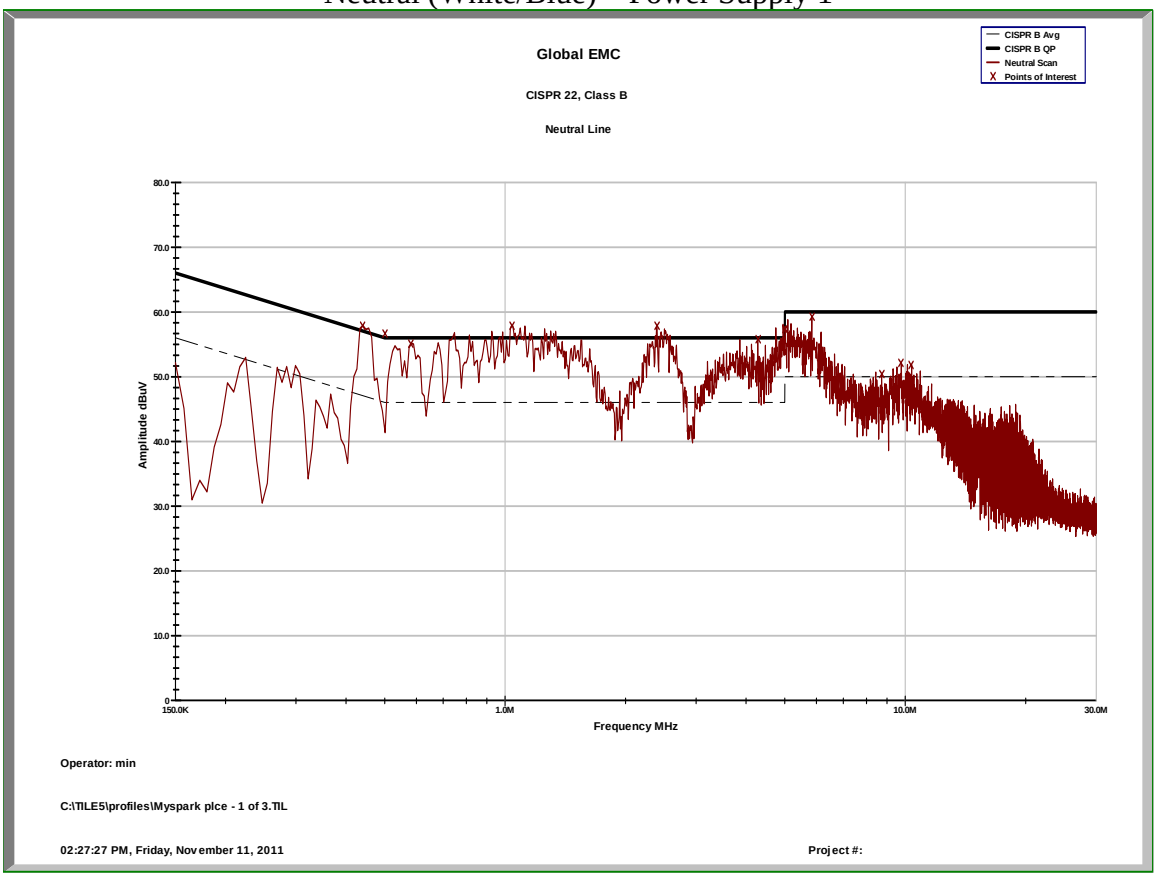
Neutral (White/Blue) – Power Supply 1



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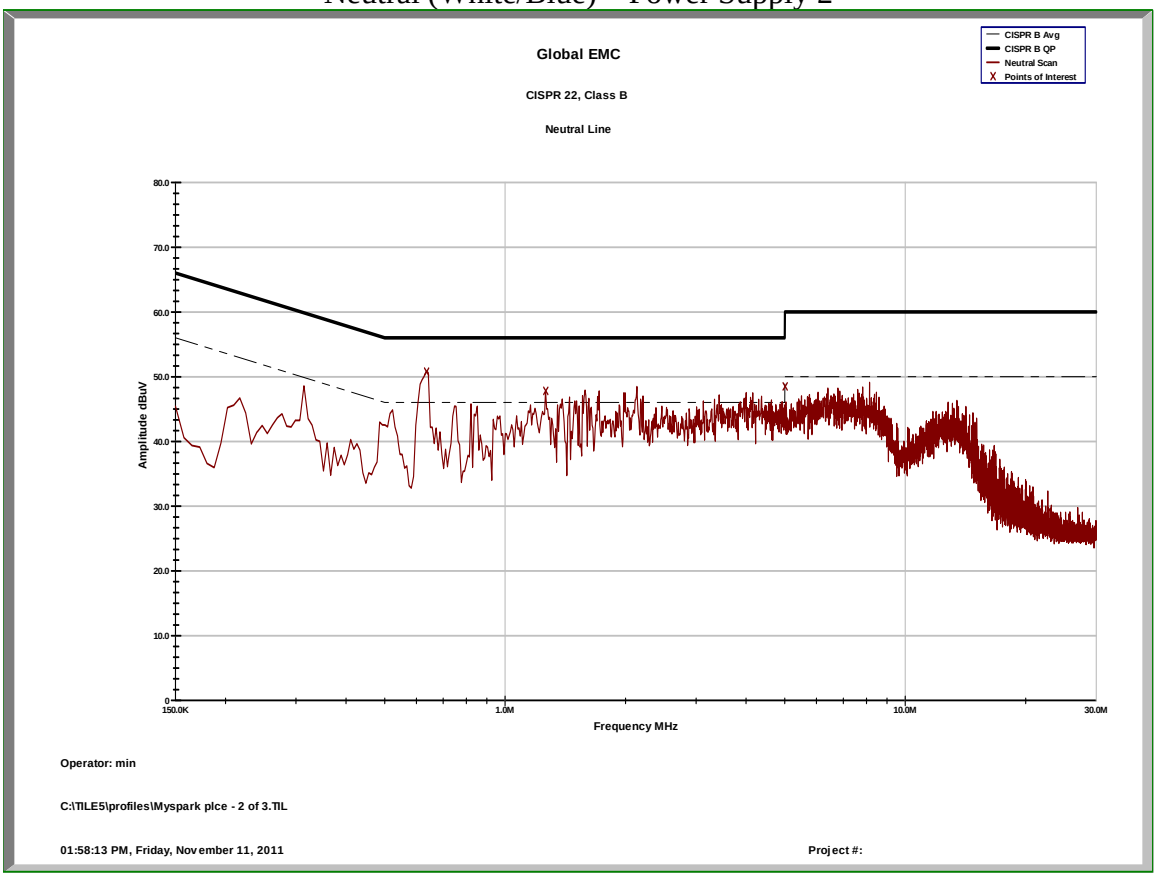
Neutral (White/Blue) – Power Supply 2



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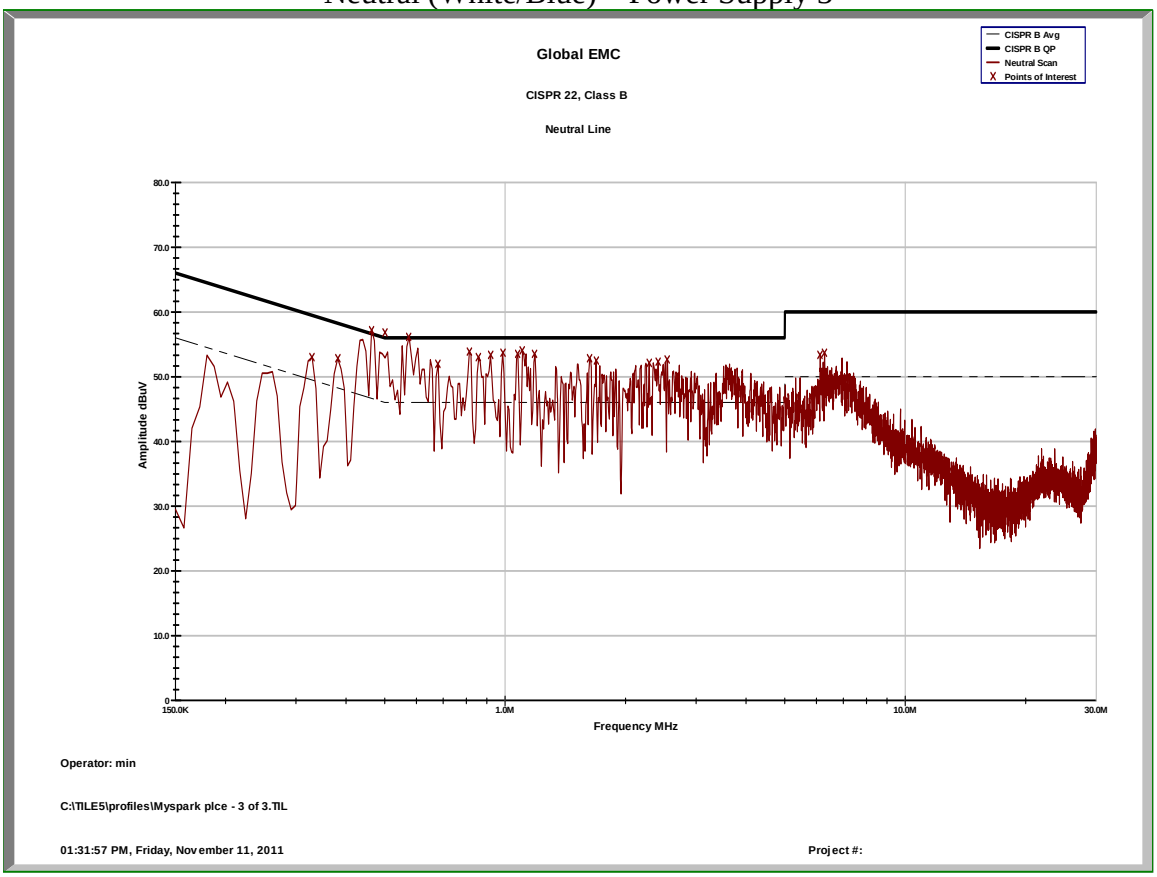
Neutral (White/Blue) – Power Supply 3



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Final Measurements

Top 6 - Quasi Peak – Power Supply 1 – Line 1

Frequency	Raw QP dBuV	LISN dB	Cable dB	Atten dB	QP dBuV	QP Limit dBuV	Margin dB
216.55 KHz	48.1	0.9	0.1	10	59.1	64.1	-5
4.9886 MHz	38	0.2	0.4	10	48.6	56	-7.4
2.6111 MHz	38	0.2	0.3	10	48.4	56	-7.6
538.23 KHz	37.1	0.2	0.1	10	47.4	56	-8.6
4.9863 MHz	35.8	0.2	0.4	10	46.4	56	-9.6
1.1171 MHz	35.8	0.2	0.2	10	46.2	56	-9.8

Top 6 – Average – Power Supply 1 – Line 1

Frequency	Raw AVG dBuV	LISN dBuV	Cable dB	Atten dB	AVG dBuV	Limit dBuV	Margin dB
2.6111 MHz	27.3	0.2	0.3	10	37.7	46	-8.3
4.9863 MHz	26	0.2	0.4	10	36.6	46	-9.4
1.1171 MHz	23.8	0.2	0.2	10	34.2	46	-11.8
452.56 KHz	24.2	0.2	0.1	10	34.5	47.4	-12.8
5.5559 MHz	26	0.2	0.5	10	36.7	50	-13.3
538.23 KHz	22.2	0.2	0.1	10	32.6	46	-13.4

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Top 6 - Quasi Peak – Power Supply 2 – Line 1

Frequency	Raw QP dBuV	LISN dB	Cable dB	Atten dB	QP dBuV	QP Limit dBuV	Margin dB
621.28 KHz	41.6	0.2	0.1	10	52	56	-4
833.63 KHz	40	0.2	0.1	10	50.3	56	-5.7
507.76 KHz	38.9	0.2	0.1	10	49.2	56	-6.8
507.3 KHz	38.8	0.2	0.1	10	49.2	56	-6.8
1.5602 MHz	38	0.2	0.2	10	48.4	56	-7.6
1.7794 MHz	35.5	0.2	0.2	10	45.9	56	-10.1

Top 6 – Average – Power Supply 2 – Line 1

Frequency	Raw AVG dBuV	LISN dBuV	Cable dB	Atten dB	AVG dBuV	Limit dBuV	Margin dB
621.28 KHz	29.5	0.2	0.1	10	39.8	46	-6.2
507.3 KHz	26.4	0.2	0.1	10	36.7	46	-9.3
833.63 KHz	26.3	0.2	0.1	10	36.7	46	-9.3
507.76 KHz	26.3	0.2	0.1	10	36.6	46	-9.4
1.5602 MHz	24.4	0.2	0.2	10	34.8	46	-11.2
1.7794 MHz	22.8	0.2	0.2	10	33.2	46	-12.8

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Top 6 - Quasi Peak – Power Supply 3 – Line 1

Frequency	Raw QP dBuV	LISN dB	Cable dB	Atten dB	QP dBuV	QP Limit dBuV	Margin dB
464.31 KHz	40.5	0.2	0.1	10	50.8	57	-6.2
589.36 KHz	38.5	0.2	0.1	10	48.8	56	-7.2
896.05 KHz	38.1	0.2	0.1	10	48.4	56	-7.6
670.83 KHz	37.7	0.2	0.1	10	48.1	56	-7.9
253.75 KHz	43.3	0.7	0.1	10	54.1	63	-8.9
1.0871 MHz	36.5	0.2	0.2	10	46.9	56	-9.1

Top 6 – Average – Power Supply 3 – Line 1

Frequency	Raw AVG dBuV	LISN dBuV	Cable dB	Atten dB	AVG dBuV	Limit dBuV	Margin dB
464.31 KHz	20.3	0.2	0.1	10	30.6	47	-16.4
464.31 KHz	20.3	0.2	0.1	10	30.6	47	-16.4
589.36 KHz	16.7	0.2	0.1	10	27	46	-19
589.36 KHz	16.7	0.2	0.1	10	27	46	-19
253.75 KHz	21.8	0.7	0.1	10	32.6	53	-20.4
253.75 KHz	21.8	0.7	0.1	10	32.6	53	-20.4

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Top 6 - Quasi Peak – Power Supply 1 – Line 2

Frequency	Raw QP dBuV	LISN dB	Cable dB	Atten dB	QP dBuV	QP Limit dBuV	Margin dB
446.19 KHz	45	0.2	0.1	10	55.3	57.5	-2.2
579.88 KHz	42.7	0.2	0.1	10	53.1	56	-2.9
1.0402 MHz	42.5	0.2	0.2	10	52.9	56	-3.1
4.996 MHz	41.6	0.2	0.4	10	52.2	56	-3.8
2.3771 MHz	40.9	0.2	0.2	10	51.3	56	-4.7
518.45 KHz	39.8	0.2	0.1	10	50.1	56	-5.9

Top 6 – Average – Power Supply 1 – Line 2

Frequency	Raw AVG dBuV	LISN dBuV	Cable dB	Atten dB	AVG dBuV	Limit dBuV	Margin dB
446.19 KHz	32.7	0.1	10	0.2	43	47.5	-4.5
4.996 MHz	30.8	0.4	10	0.2	41.4	46	-4.6
2.3771 MHz	30.3	0.2	10	0.2	40.8	46	-5.2
1.0402 MHz	27.9	0.2	10	0.2	38.3	46	-7.7
5.006 MHz	31	0.4	10	0.2	41.6	50	-8.4
518.45 KHz	25.6	0.1	10	0.2	35.9	46	-10.1

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Top 3 - Quasi Peak – Power Supply 2 – Line 1

Frequency	Raw QP dBuV	LISN dB	Cable dB	Atten dB	QP dBuV	QP Limit dBuV	Margin dB
646.46 KHz	32.6	0.2	0.1	10	43	56	-13
1.2628 MHz	31.8	0.2	0.2	10	42.2	56	-13.8
5.002 MHz	29.7	0.2	0.4	10	40.3	60	-19.7

Top 3 – Average – Power Supply 2 – Line 1

Frequency	Raw AVG dBuV	LISN dBuV	Cable dB	Atten dB	AVG dBuV	Limit dBuV	Margin dB
646.46 KHz	15.8	0.1	10	0.2	26.1	46	-19.9
1.2628 MHz	16.7	0.2	10	0.2	27.1	46	-18.9
5.002 MHz	15.6	0.4	10	0.2	26.2	50	-23.8

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Top 6 - Quasi Peak – Power Supply 3 – Line 2

Frequency	Raw QP dBuV	LISN dB	Cable dB	Atten dB	QP dBuV	QP Limit dBuV	Margin dB
563.66 KHz	42.3	0.2	0.1	10	52.6	56	-3.4
449.18 KHz	42.6	0.2	0.1	10	53	57.5	-4.5
490.55 KHz	40.4	0.2	0.1	10	50.7	56.3	-5.6
868.09 KHz	40.1	0.2	0.1	10	50.4	56	-5.6
923.69 KHz	40	0.2	0.2	10	50.4	56	-5.6
671.04 KHz	39.8	0.2	0.1	10	50.2	56	-5.8

Top 6 – Average – Power Supply 3 – Line 2

Frequency	Raw AVG dBuV	LISN dBuV	Cable dB	Atten dB	AVG dBuV	Limit dBuV	Margin dB
449.18 KHz	25.1	0.1	10	0.2	35.4	47.452	-12.1
563.66 KHz	23.6	0.1	10	0.2	33.9	46	-12.1
868.09 KHz	23.3	0.1	10	0.2	33.6	46	-12.4
1.114 MHz	21.1	0.2	10	0.2	31.5	46	-14.5
372.09 KHz	24.3	0.1	10	0.3	34.7	49.655	-14.9
671.04 KHz	20.7	0.1	10	0.2	31	46	-15

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

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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	Feb 03, 2011	Feb 03, 2013	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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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 are as defined in FCC Part 15, Section 15.209:
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 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

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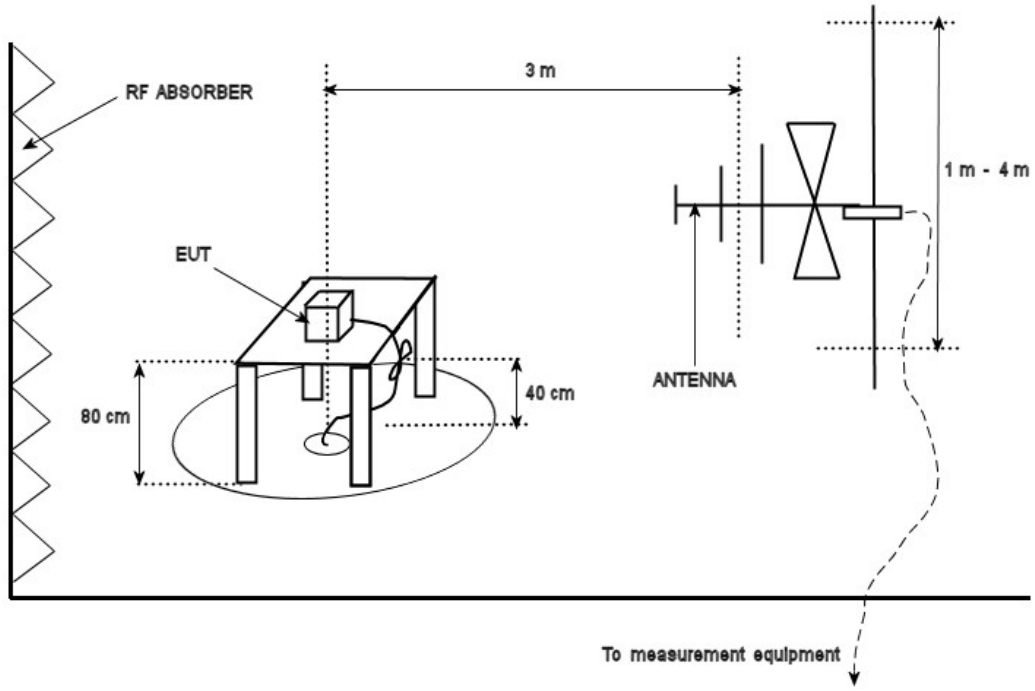
Typical Radiated Emissions Setup



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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 the 10^{th} harmonic (a minimum of a 25 GHz).

Devices scanned above 10 GHz were scanned at 1 meter test distance, and in accordance with FCC Part 15, Subpart A, Section 15.31, an extrapolation factor of 20 dB/decade was used.

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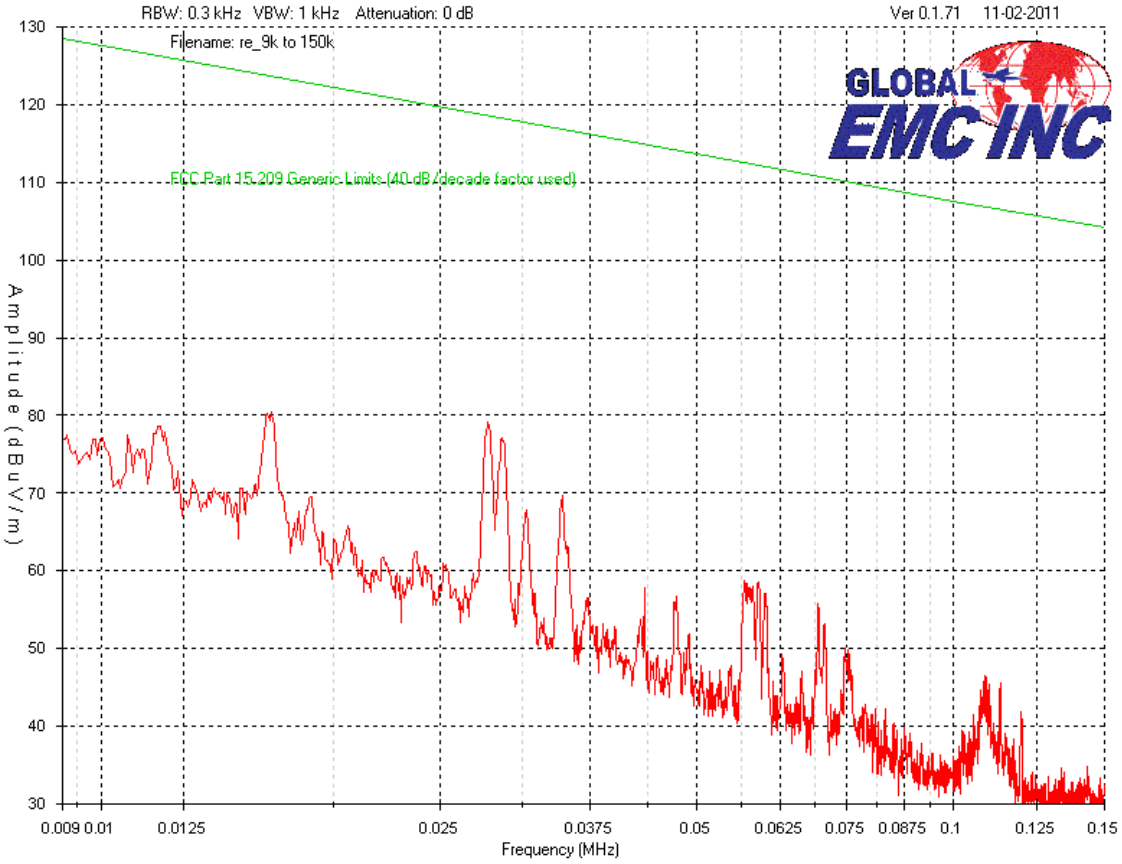
9 kHz to 150 kHz



Worst-case/representative power supply and band – Power supply 2

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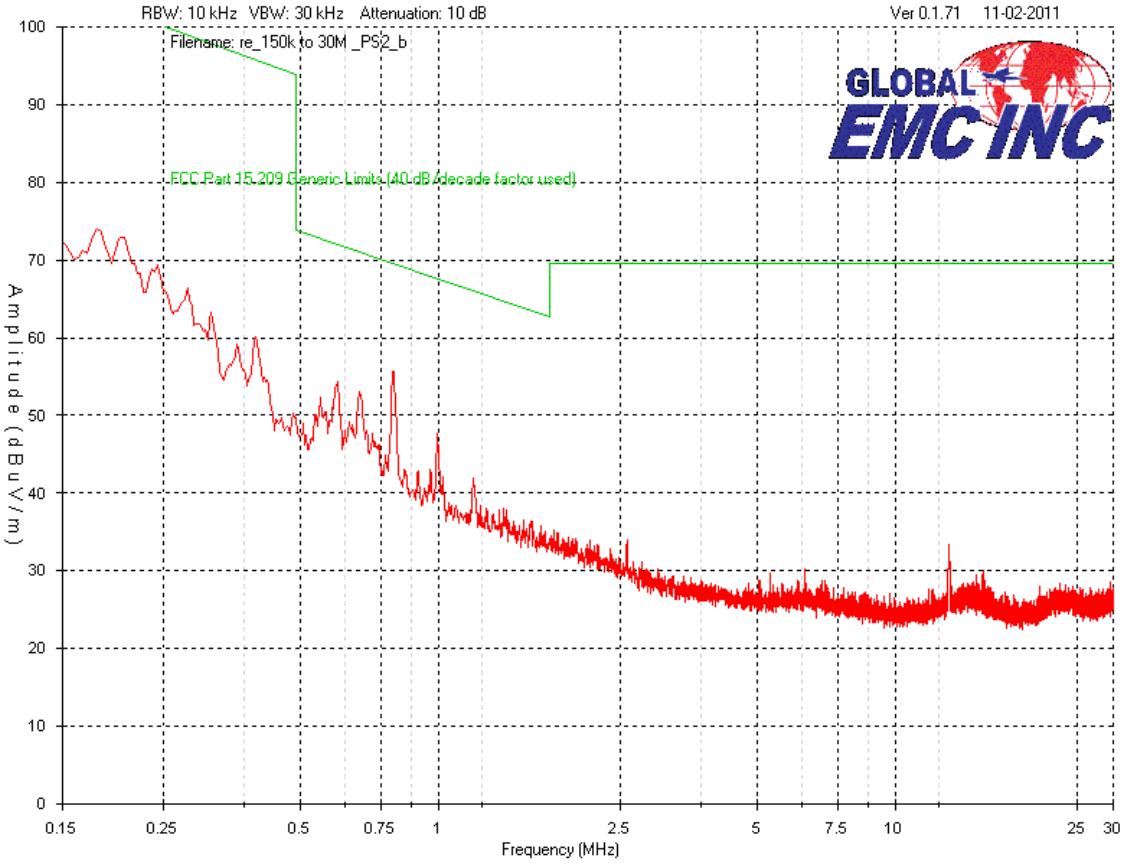
150 kHz to 30 MHz



Worst-case/representative power supply and band – Power supply 2

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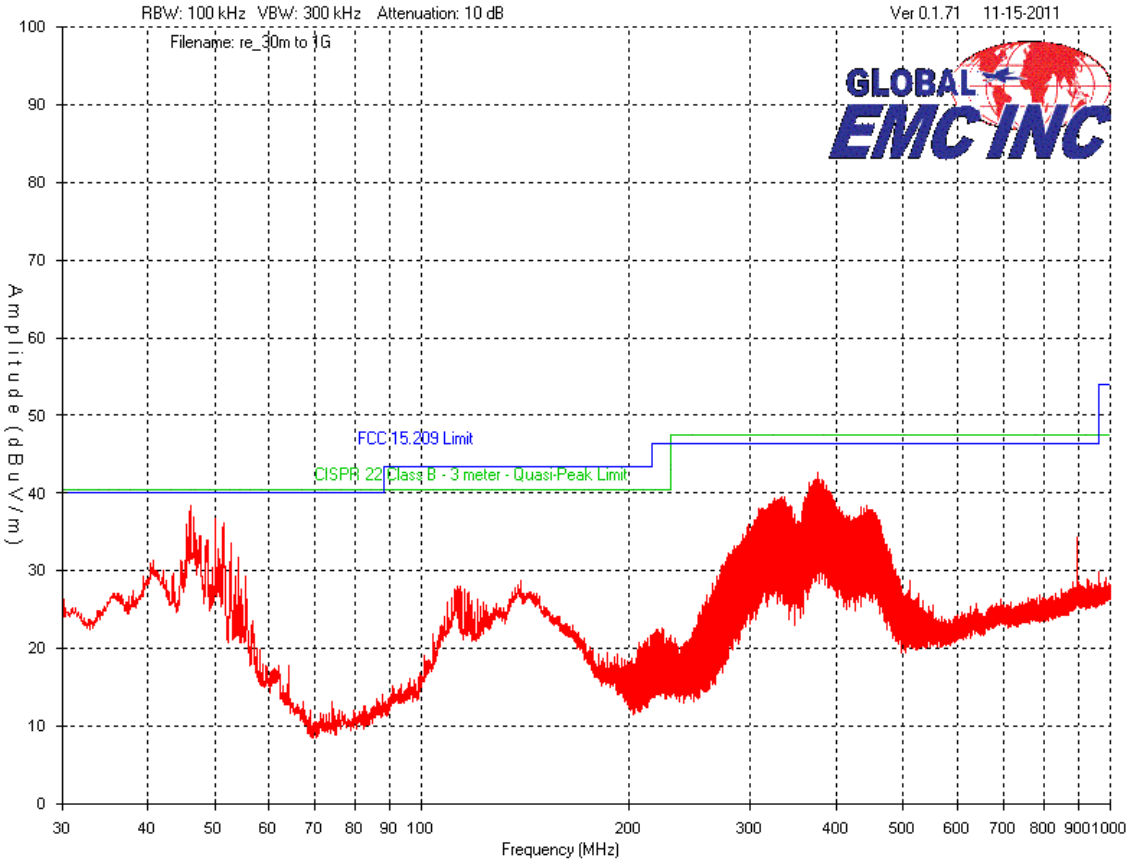
Vertical – Peak Emissions Graph 30 MHz – 1 GHz (Power Supply 1)



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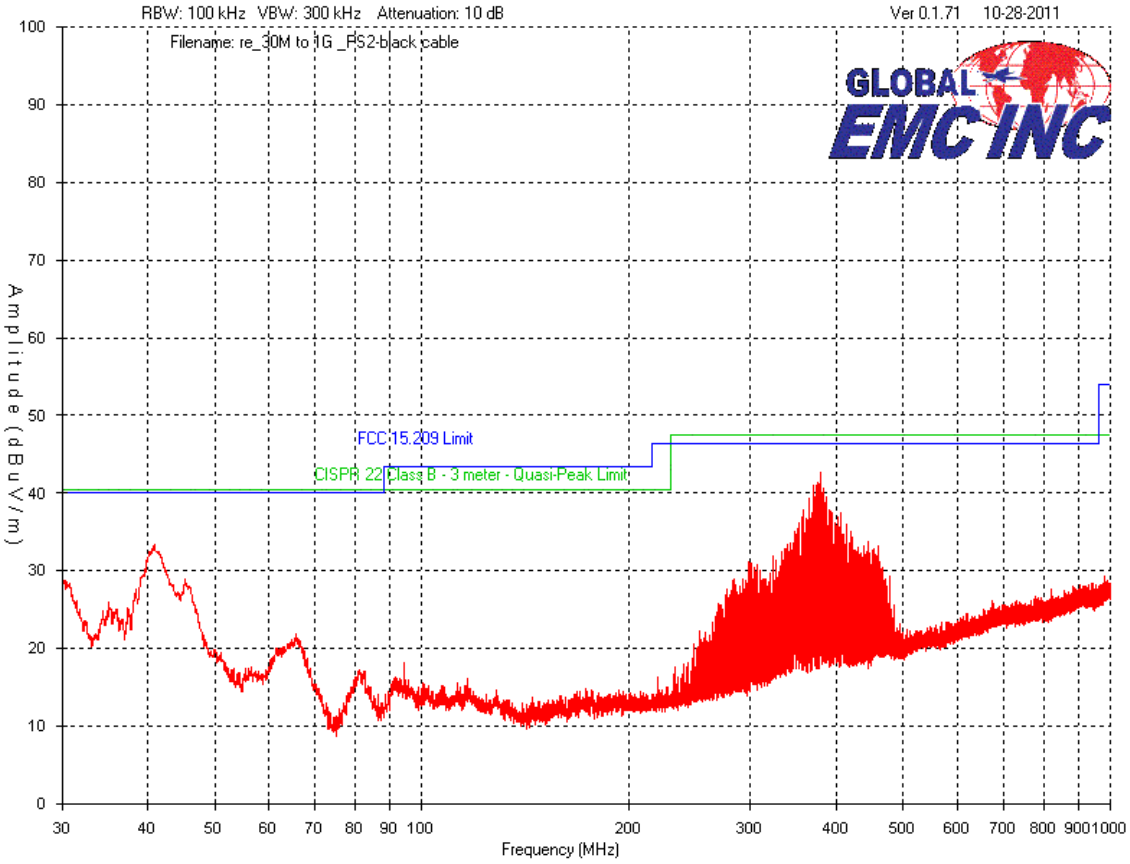
Vertical – Peak Emissions Graph 30 MHz – 1 GHz (Power Supply 2)



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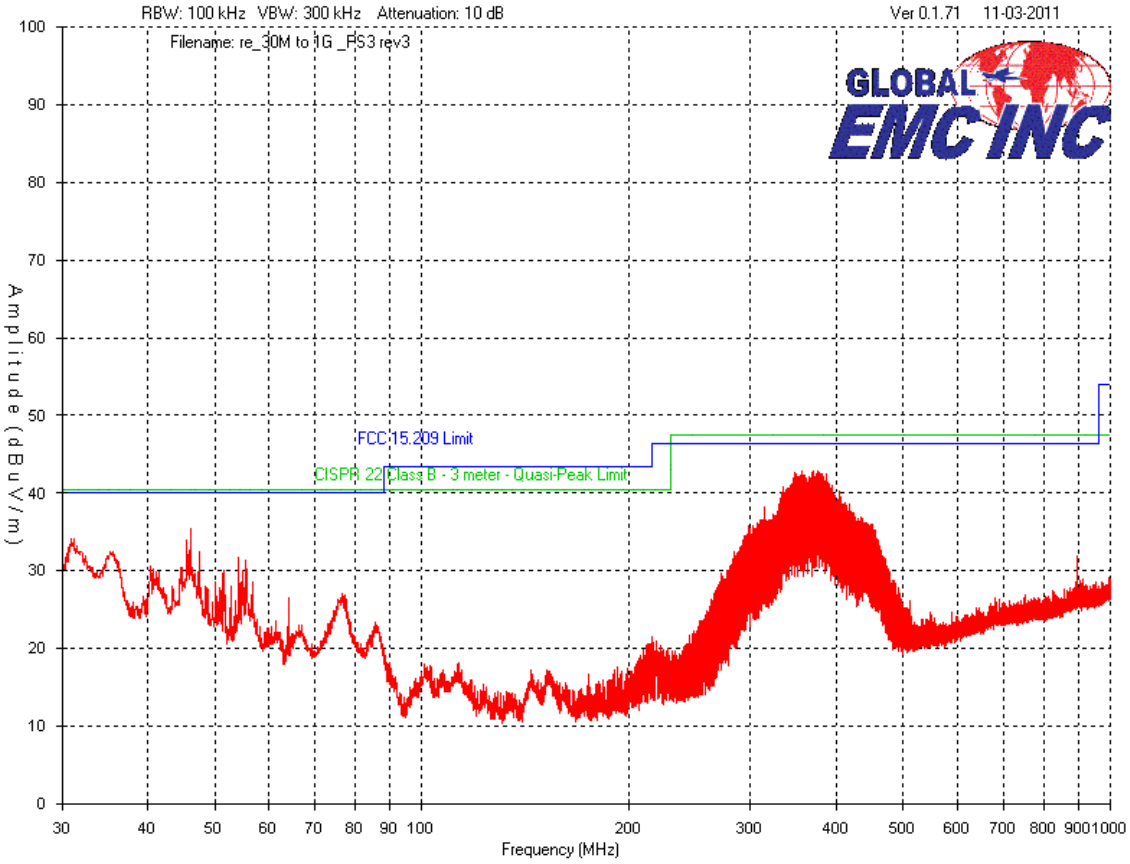
Vertical – Peak Emissions Graph 30 MHz – 1 GHz (Power Supply 3)



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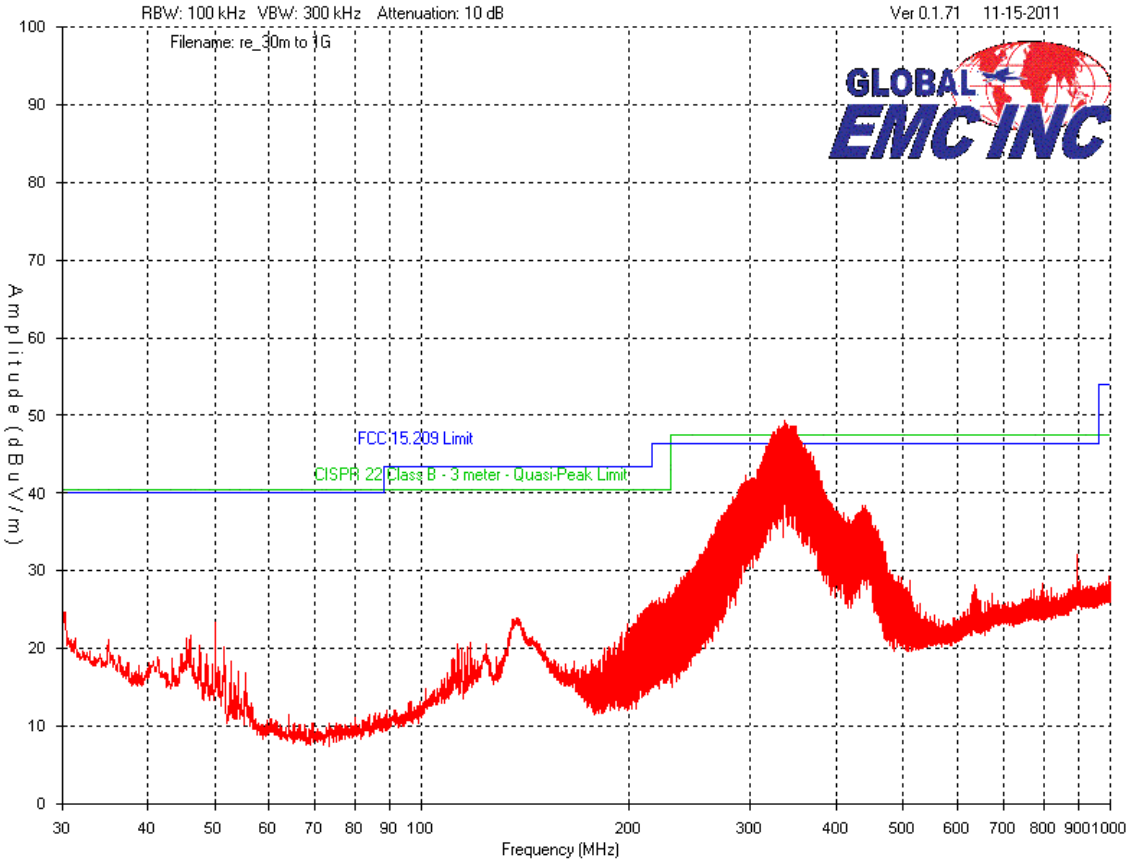
Horizontal – Peak Emissions Graph 30MHz to 1 GHz (Power Supply 1)



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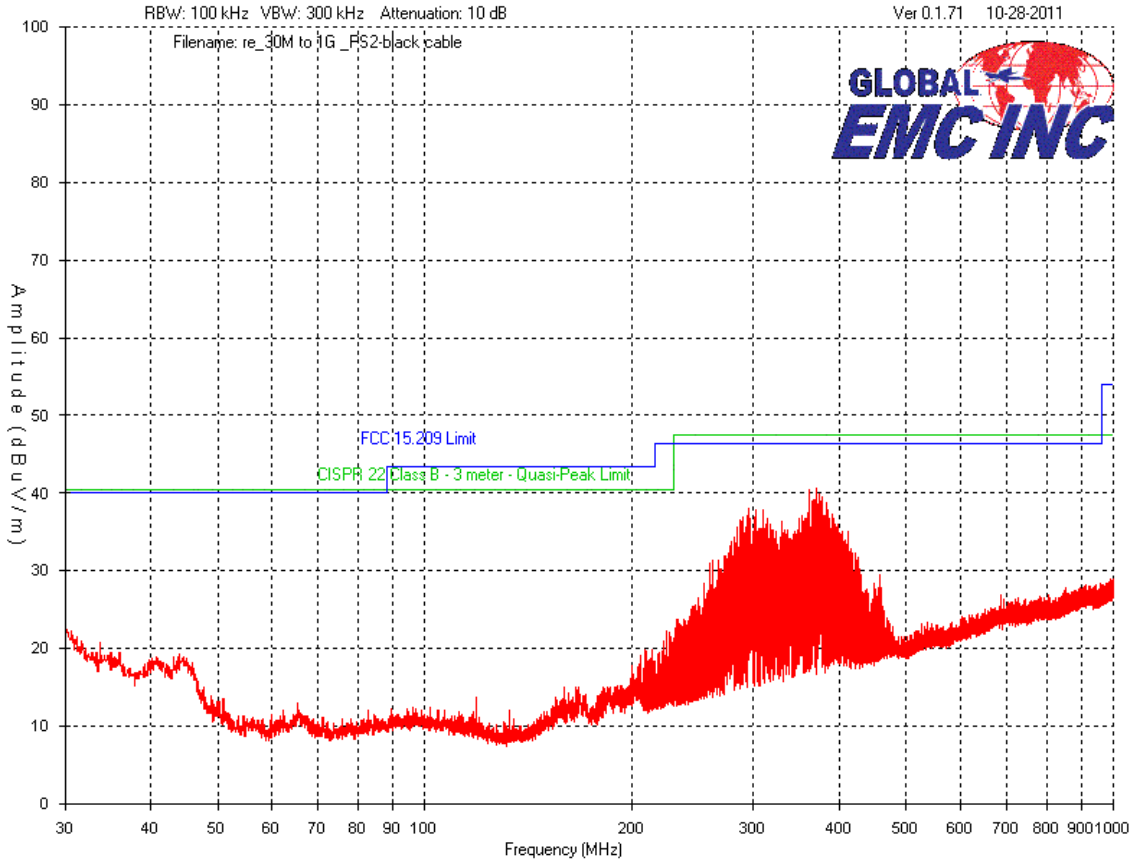
Horizontal – Peak Emissions Graph 30MHz to 1 GHz (Power Supply 2)



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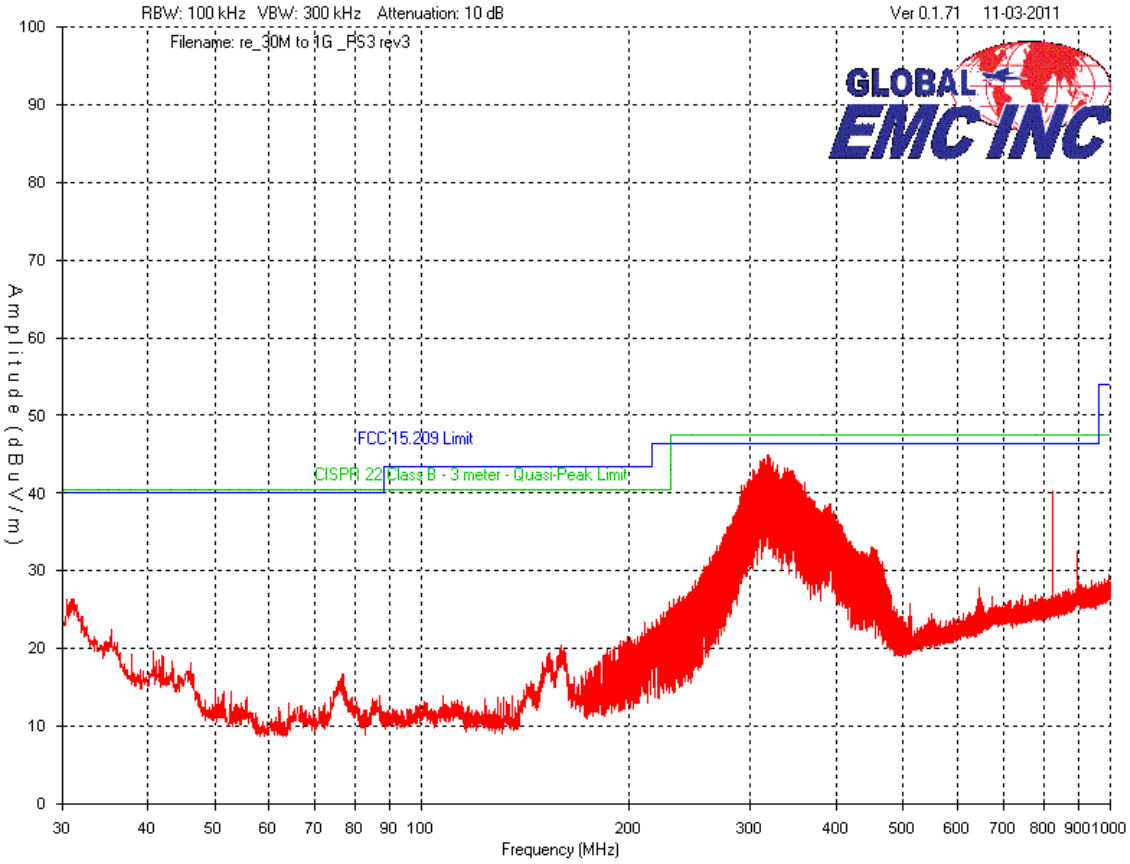
Horizontal – Peak Emissions Graph 30MHz to 1 GHz (Power Supply 3)



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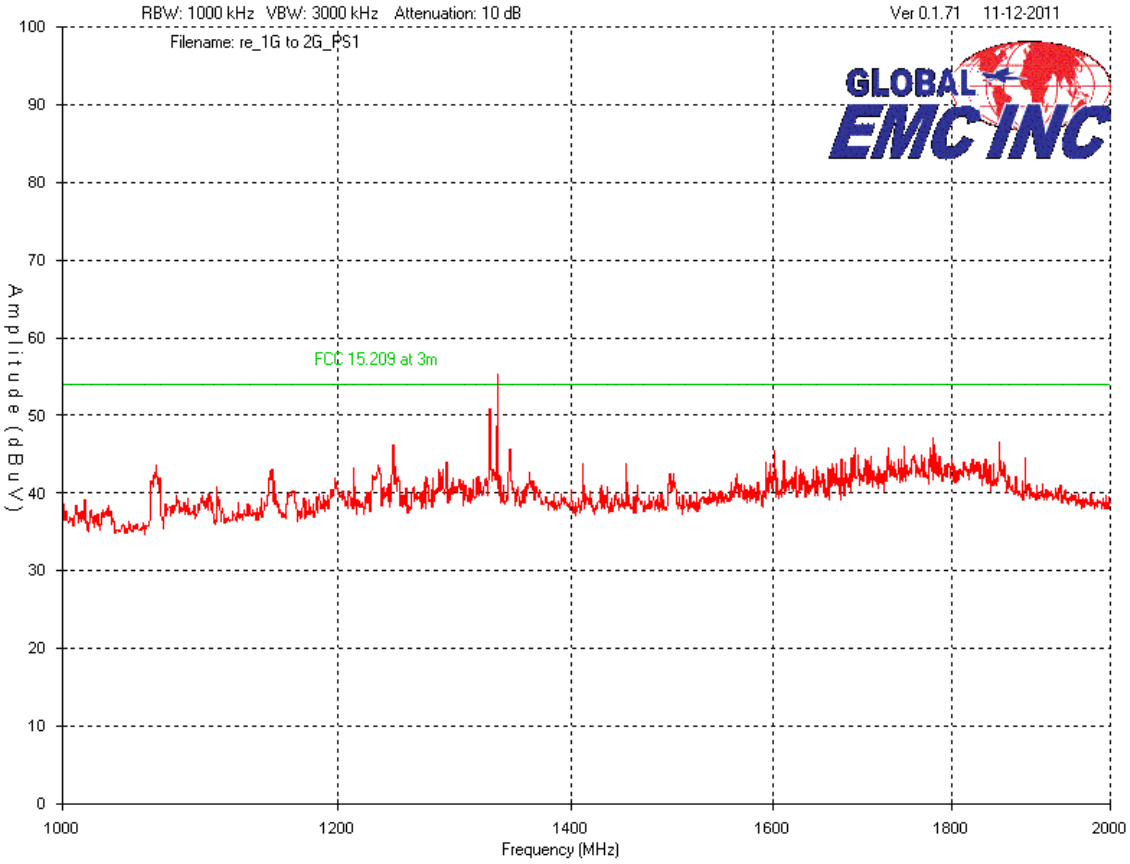
Vertical – 1GHz to 2 GHz



Worst-case/representative power supply and band – Power supply 1

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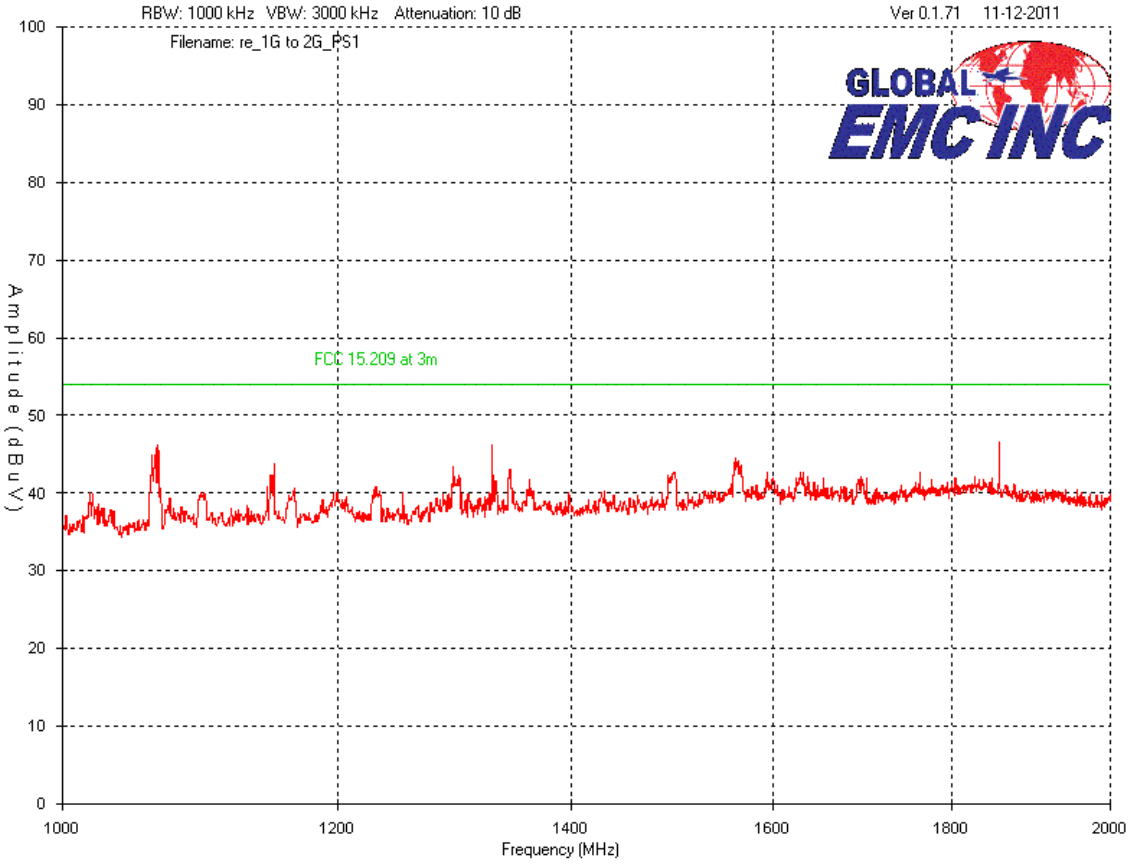
Horizontal – 1 GHz to 2 GHz



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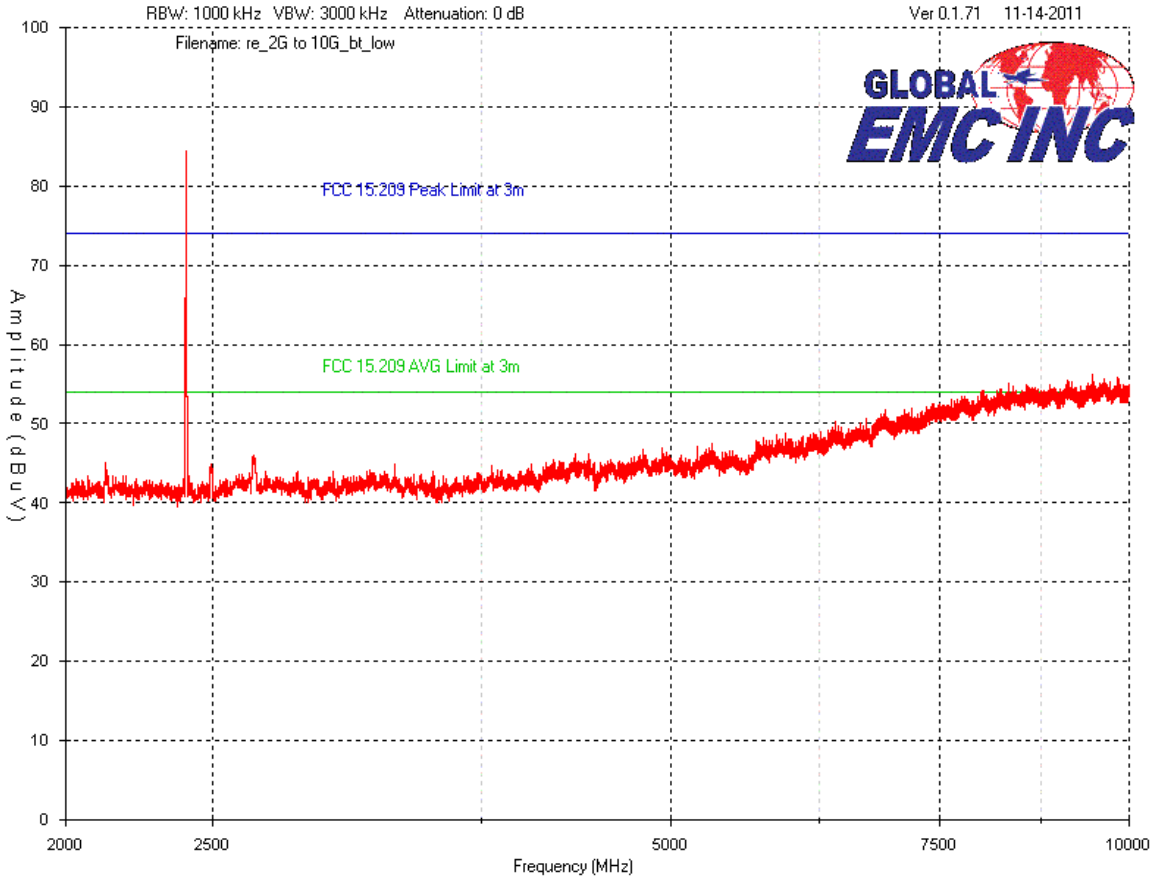
Vertical – 2 GHz to 10 GHz



The above graph represents low channel (channel 0) in Bluetooth mode as representative of peak frequency hopping emissions. See table for final maximized peak/average measurements.

Frequency range was scanned to 25 GHz, with no emissions detected above 10 GHz.

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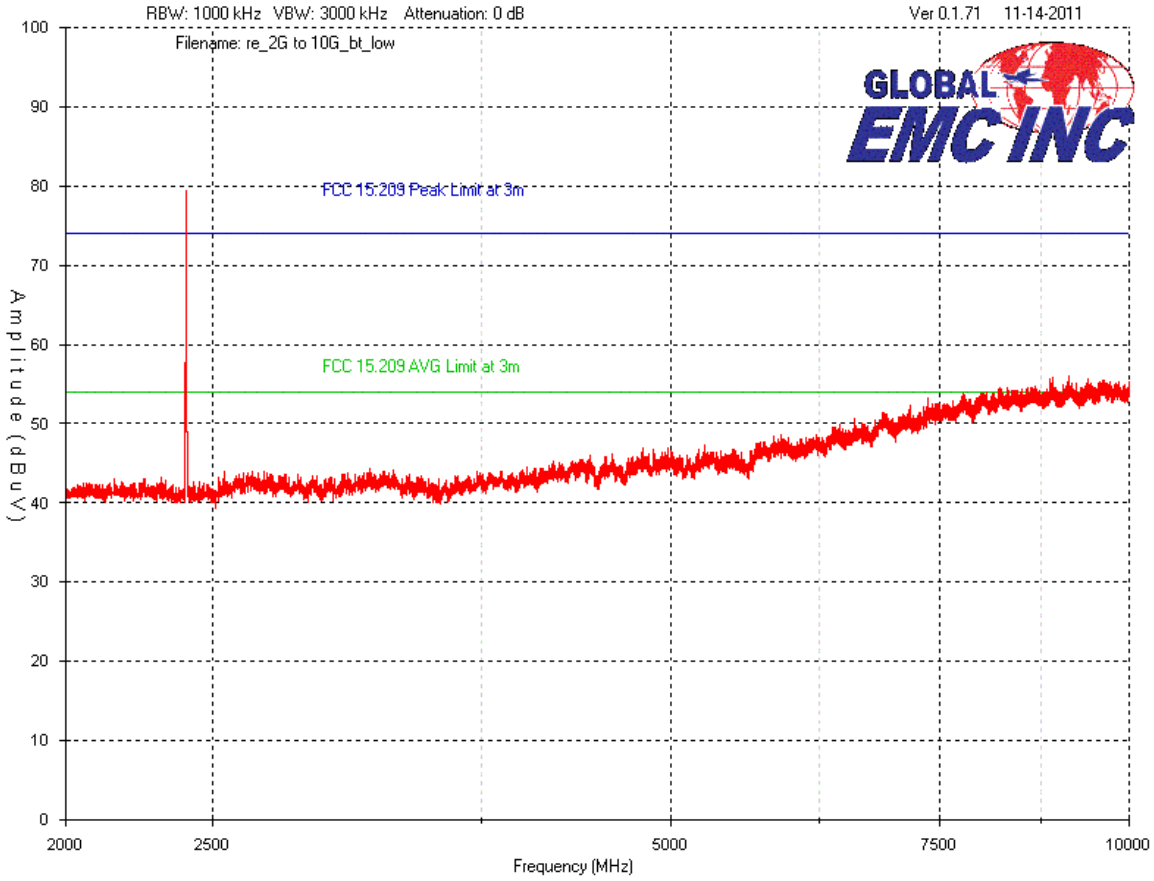
Horizontal – 2 GHz to 10 GHz



The above graph represents low channel (channel 0) in Bluetooth mode as representative of peak frequency hopping emissions. See table for final maximized peak/average measurements.

Frequency range was scanned to 25 GHz, with no emissions detected above 10 GHz.

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Final Measurements

Top Quasi-Peak Emissions 30MHz to 1 GHz - Table - Vertical

Frequency (MHz)	Power Supply	Raw (dBuV)	Ant. (dB/m)	Cable (dB)	Amp (dB)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/Fail
335.582	1	60.1	15	0.6	-30.4	45.3	46.4	1.1	Pass
338.169	1	59.7	15	0.6	-30.4	44.9	46.4	1.5	Pass
379.879	2	56.6	15.9	0.6	-30.4	42.7	46.4	3.7	Pass
40.864	2	50.4	12.8	0.3	-30.1	33.4	40	6.6	Pass
355.564	3	57.3	15.4	0.6	-30.4	42.9	46.4	3.5	Pass
369.403	3	56.9	15.7	0.6	-30.4	42.8	46.4	3.6	Pass

Low, medium and high channel were investigated, with no differences observed. Representative results presented above.

Top Quasi-Peak Emissions 30 MHz to 1 GHz Table - Horizontal

Frequency (MHz)	Power Supply	Raw (dBuV)	Ant. (dB/m)	Cable (dB)	Amp (dB)	Level (dBuV/m)	Limit (dBuv/m)	Margin (dB)	Pass/Fail
46.0697	1	57.8	10.5	0.3	-30.1	38.5	40	1.5	Pass
375.805	1	56.6	15.8	0.6	-30.4	42.6	46.4	3.8	Pass
370.858	2	54.7	15.7	0.6	-30.4	40.6	46.4	5.8	Pass
361.966	2	54.6	15.5	0.6	-30.4	40.3	46.4	6.1	Pass
316.894	3	60.5	14.3	0.6	-30.4	45	46.4	1.4	Pass
309.263	3	60.1	13.9	0.6	-30.4	44.2	46.4	2.2	Pass

Low, medium and high channel were investigated, with no differences observed. Representative results presented above.

Top Average emissions 1 GHz to 2 GHz – Vertical

Frequency (MHz)	Power Supply	Raw (dBuV)	Ant. (dB/m)	Cable (dB)	Amp (dB)	Level (dBuV/m)	Limit (dBuv/m)	Margin (dB)	Pass/Fail
1333.33	1, 2, and 3	58.7	26.9	1.7	-36.9	50.4	54	3.6	Pass

Low, medium and high channel were investigated, with no differences observed. Representative results presented above.

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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 0											
2402	Peak	Horz	89.5	30.6	2.2	0.0	36.2	86.1			PASS
2402	Avg	Horz	88.4	30.6	2.2	0.0	36.2	85.0			PASS
2402	Peak	Vert	83.6	30.6	2.2	0.0	36.2	80.2			PASS
2402	Avg	Vert	82.0	30.6	2.2	0.0	36.2	78.6			PASS
2400	Peak	Horz	56.5	30.6	2.2	0.0	36.2	53.1	74.0	20.9	PASS
2400	Avg	Horz	53.4	30.6	2.2	0.0	36.2	50.0	54.0	4.0	PASS
2400	Peak	Vert	50.7	30.6	2.2	0.0	36.2	47.3	74.0	26.7	PASS
2400	Avg	Vert	47.6	30.6	2.2	0.0	36.2	44.2	54.0	9.8	PASS
4804	Peak	Horz	45.0	33.7	2.9	0.0	35.7	45.9	74.0	28.1	PASS
4804	Avg	Horz	45.0	33.7	2.9	0.0	35.7	45.9	54.0	8.1	PASS
4804	Peak	Vert	45.0	33.7	2.9	0.0	35.7	45.9	74.0	28.1	PASS
4804	Avg	Vert	45.0	33.7	2.9	0.0	35.7	45.9	54.0	8.1	PASS
Mid channel											
2437	Peak	Horz	89.4	30.6	2.2	0.0	36.2	86.0			PASS
2437	Avg	Horz	88.4	30.6	2.2	0.0	36.2	85.0			PASS
2440	Peak	Vert	84.0	30.6	2.2	0.0	36.2	80.6			PASS
2440	Avg	Vert	82.1	30.6	2.2	0.0	36.2	78.7			PASS
4874	Peak	Horz	45.0	33.7	2.9	0.0	35.7	45.9	74.0	28.1	PASS
4874	Avg	Horz	45.0	33.7	2.9	0.0	35.7	45.9	54.0	8.1	PASS
4880	Peak	Vert	45.0	33.7	2.9	0.0	35.7	45.9	74.0	28.1	PASS
4880	Avg	Vert	45.0	33.7	2.9	0.0	35.7	45.9	54.0	8.1	PASS
High channel 79											
2480	Peak	Horz	89.3	30.6	2.2	0.0	36.2	85.9			PASS
2480	Avg	Horz	88.6	30.6	2.2	0.0	36.2	85.2			PASS
2480	Peak	Vert	83.9	30.6	2.2	0.0	36.2	80.5			PASS
2480	Avg	Vert	82.2	30.6	2.2	0.0	36.2	78.8			PASS
2483.5	Peak	Horz	53.3	30.6	2.2	0.0	36.2	49.9	74.0	24.1	PASS
2483.5	Avg	Horz	53.3	30.6	2.2	0.0	36.2	49.9	54.0	4.1	PASS
2483.5	Peak	Vert	48.3	30.6	2.2	0.0	36.2	44.9	74.0	29.1	PASS
2483.5	Avg	Vert	48.3	30.6	2.2	0.0	36.2	44.9	54.0	9.1	PASS
4960	Peak	Horz	45.0	33.7	2.9	0.0	35.7	45.9	74.0	28.1	PASS
4960	Avg	Horz	45.0	33.7	2.9	0.0	35.7	45.9	54.0	8.1	PASS
4960	Peak	Vert	45.0	33.7	2.9	0.0	35.7	45.9	74.0	28.1	PASS
4960	Avg	Vert	45.0	33.7	2.9	0.0	35.7	45.9	54.0	8.1	PASS

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Note 1: 2400 MHz was worst-case emission between 2300 MHz and 2400 MHz.

Note 2: Frequency was scanned to 25 GHz.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Loop Antenna	EM 6871	Electro-Metrics	2011-01-31	2013-01-31	70
Loop Antenna	EM 6872	Electro-Metrics	2011-01-31	2013-01-31	71
IFR Spectrum Analyzer	AN940	IFR	12/29/2009	12/29/2011	GEMC 6350
BiLog Antenna	3142-C	ETS	17-Jan-11	17-Jan-13	GEMC 137
Attenuator 3 dB	FP-50-3	Trilithic	NCR	NCR	GEMC 40
Chase Preamp 9kHz - 2 GHz	CPA9231A	Chase	8/25/2010	8/25/2012	GEMC 6403
Q-Par 1.5-18 GHz Horn	6878/24	Q-par	8/25/2010	8/25/2012	GEMC 65
1-26G pre-amp	HP 8449B	HP	8/25/2010	8/25/2012	GEMC 68
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29
RF Cable 0.5M	LMR-400-0.5M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 31

This report module is based on GEMC template "FCC - 15.209 - Radiated Emissions_Rev1.doc"

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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 666 kHz, so a limit of 666 kHz 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 666 kHz, and the device had a channel spacing of 995 kHz (+/- 30 kHz).

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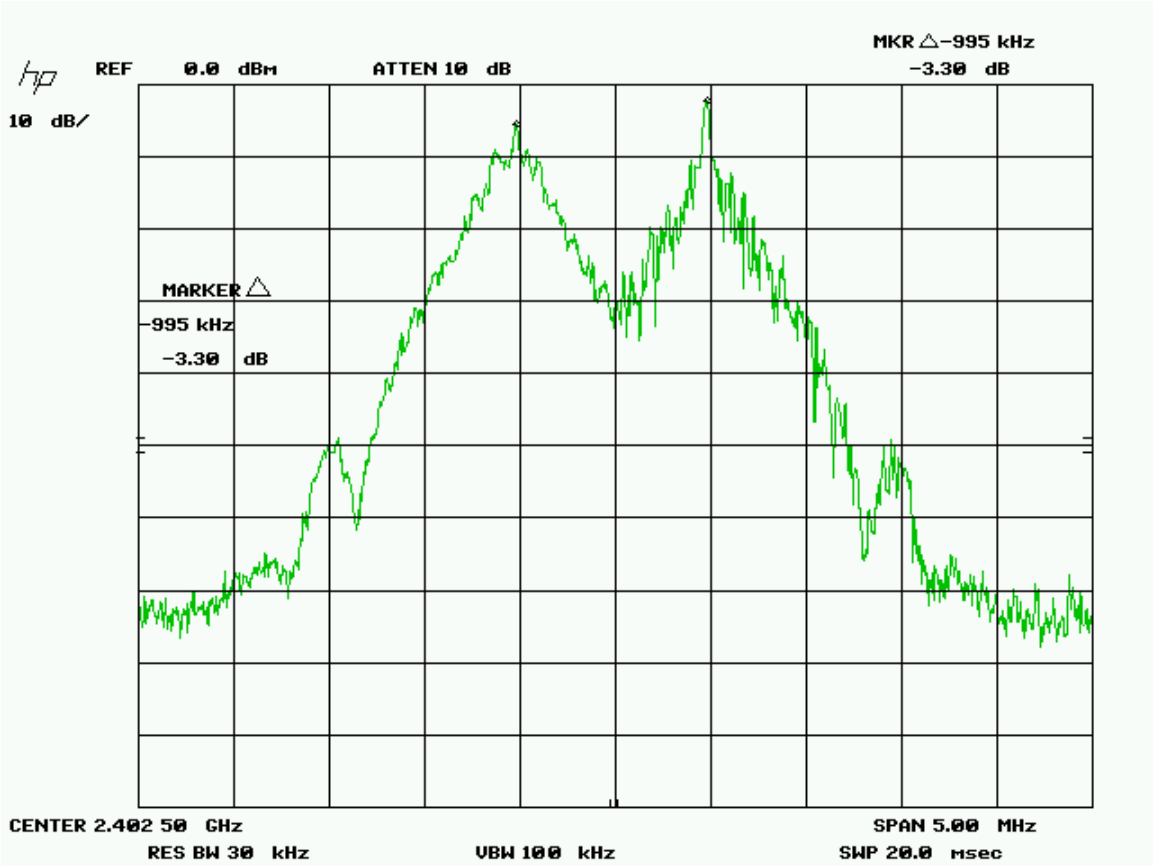
Graph(s)

The graphs 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, as the device is stepped through two adjacent channels.



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
IFR 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"

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Channel Carrier Bandwidth of Frequency Hopping Systems

Purpose

The purpose of this test is to allow for results that is 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 20 dB BW measured was 666 kHz.

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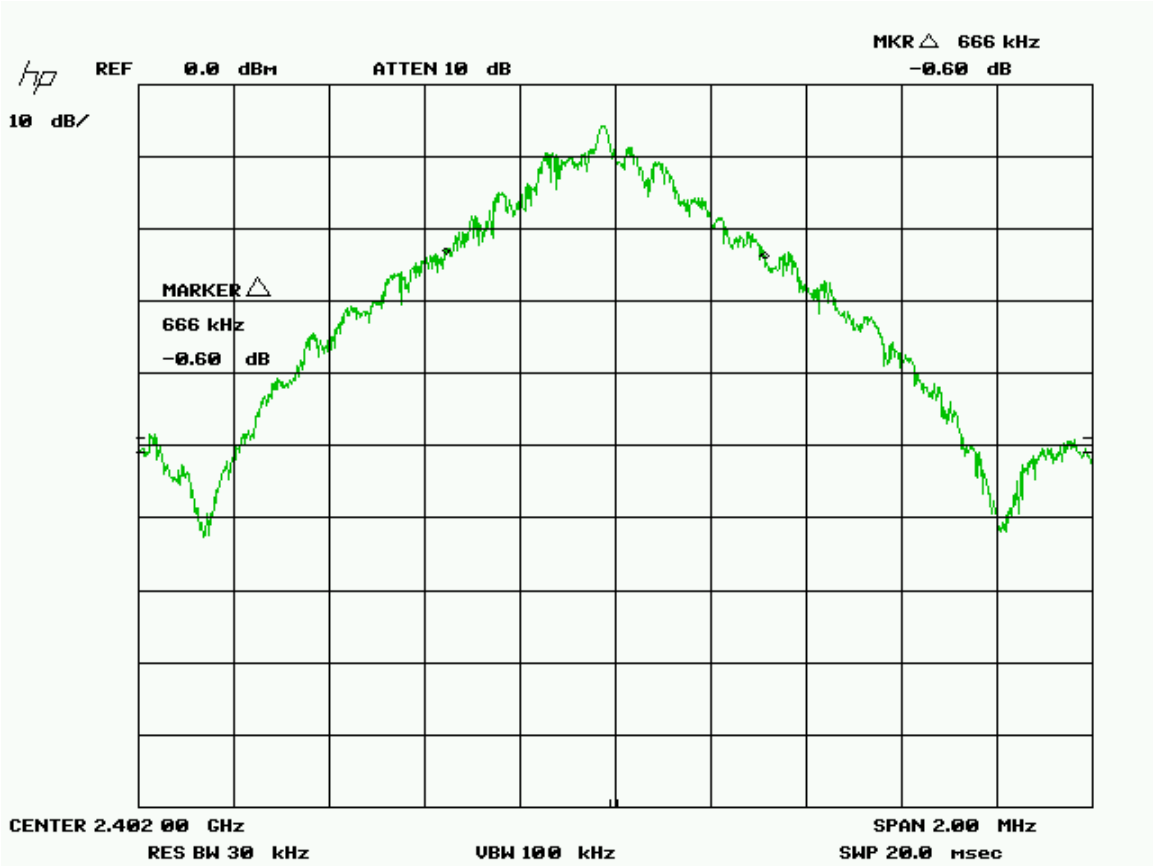
Graph(s)

The graphs 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.

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Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
IFR Spectrum Analyzer	AN940	IFR	Dec 29, 2009	Dec 29, 2011	GEMC 6350
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
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

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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 79, (19+20+20+20) channels in the allocation band of 2.4 to 2.4835 GHz.

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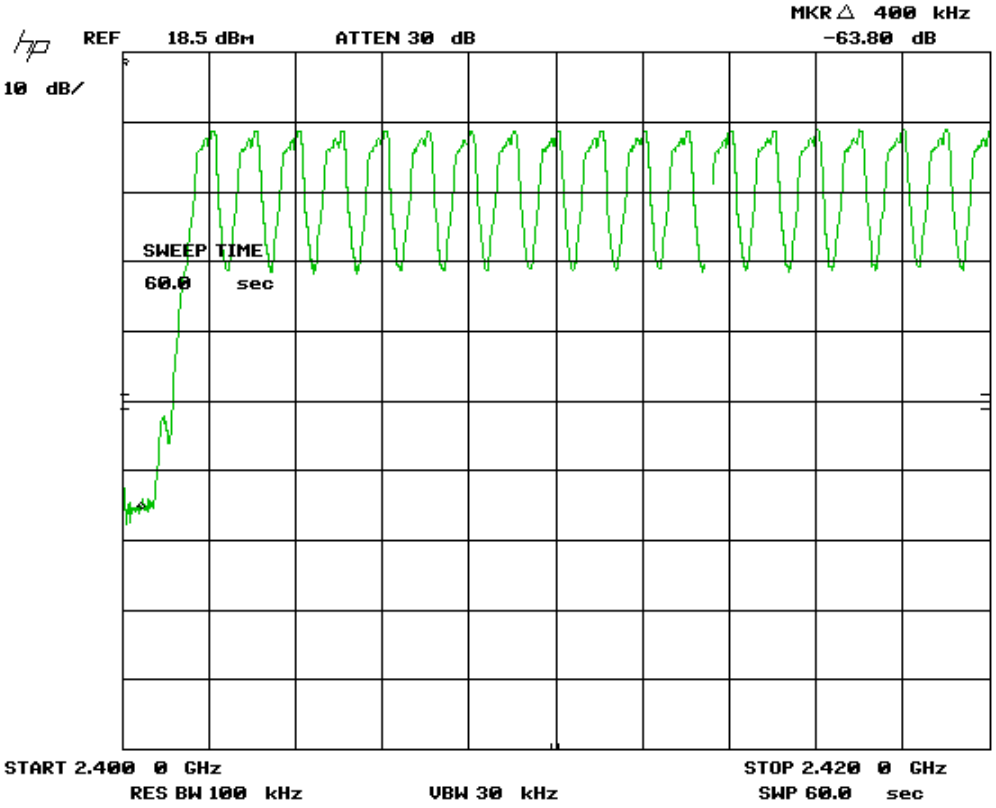
Graph(s)

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.

Graph 1 of 4 (19 channels)



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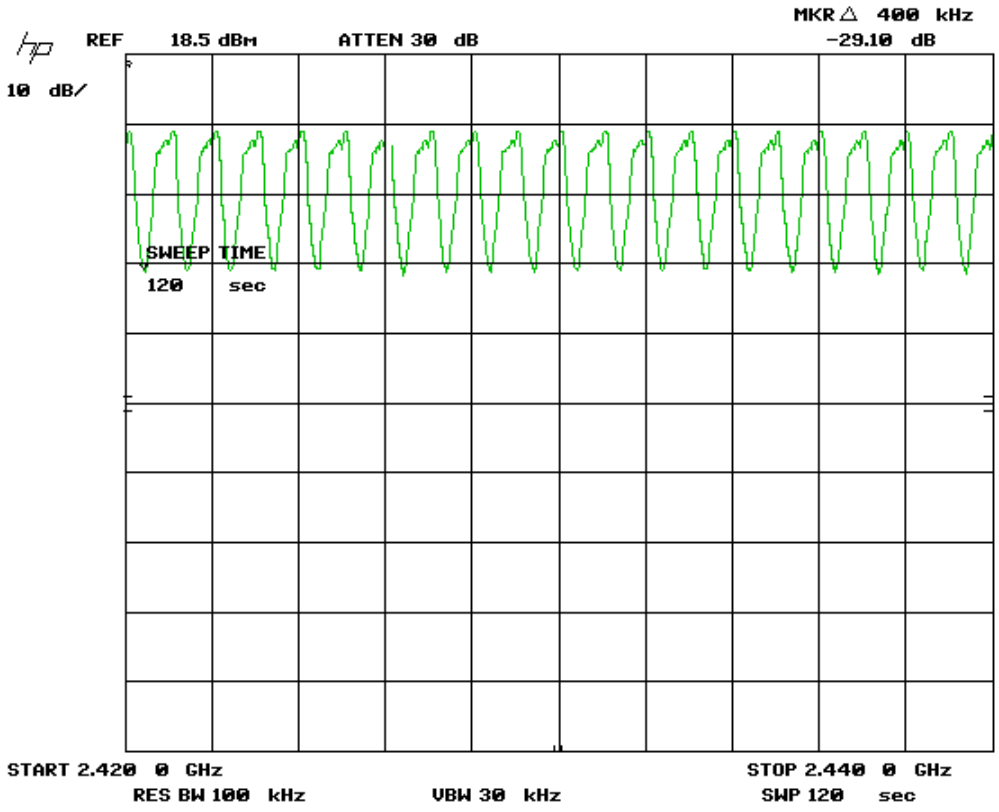
Graph 2 of 4 (20 channels)



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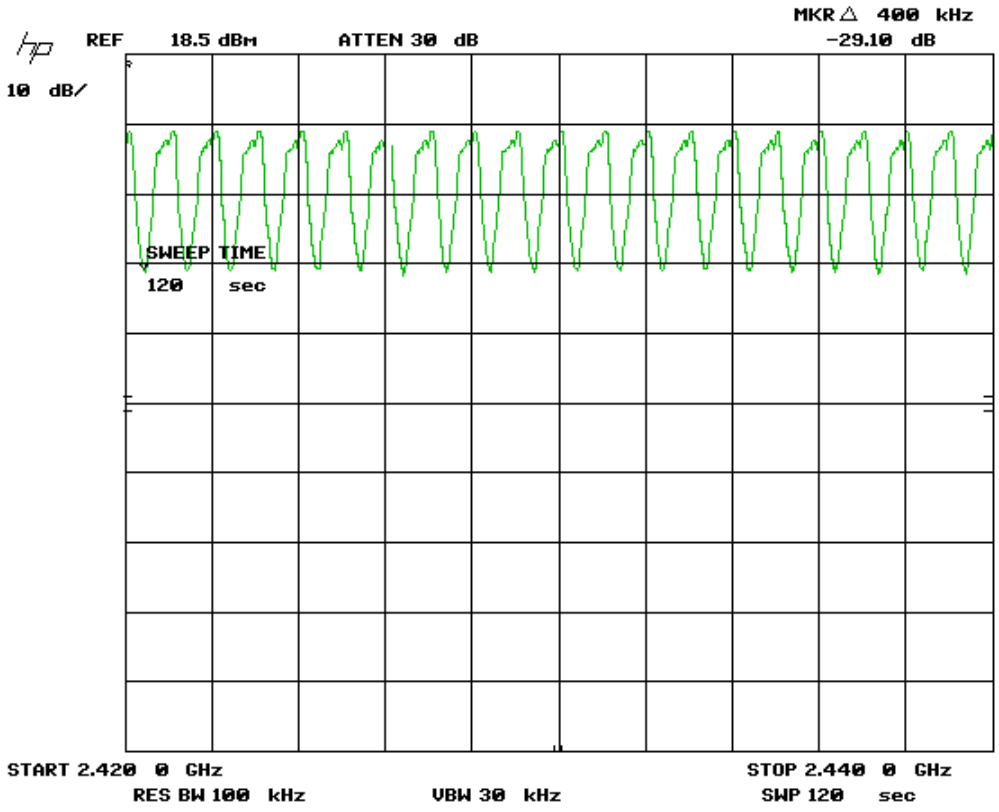
Graph 3 of 4 (20 more channels)



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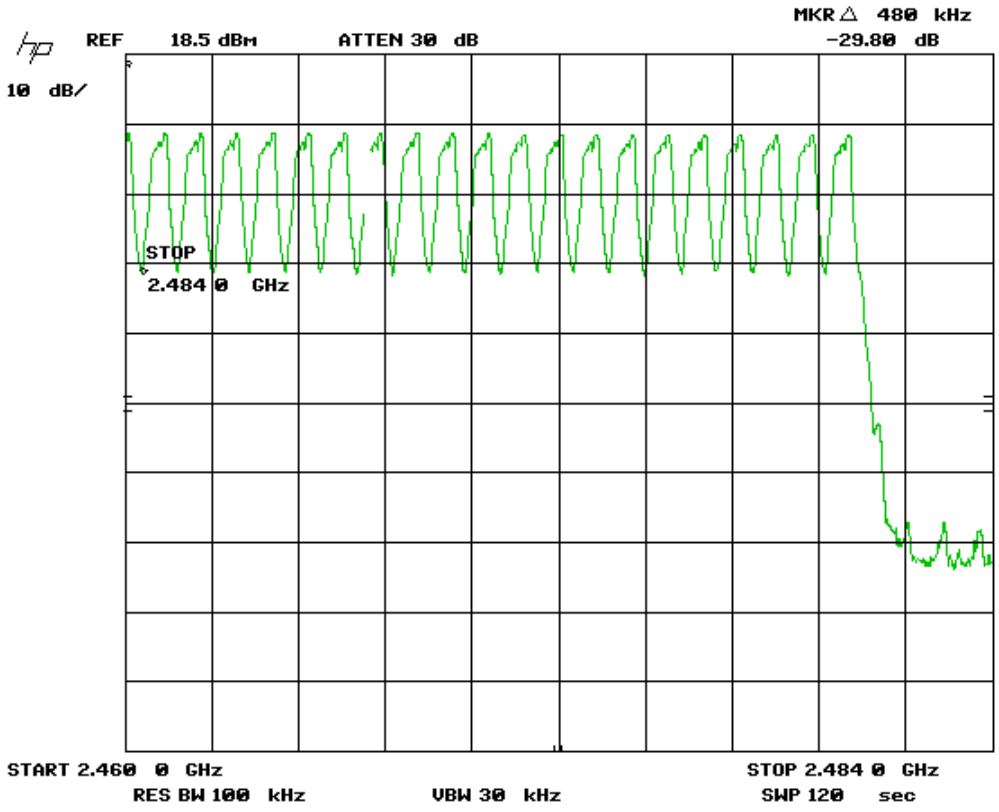
Graph 4 of 4 (20 more channels)



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Test Equipment List

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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	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

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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 passed the requirements. The EUT cycles through its pseudo-random generated list of hopping frequencies. There are 79 channels occupied in total. The average occupancy time is 0.38 ms per channel and each channel is repeated every 103 ms (3.2 seconds / 31 hops).

The complete observation time is
= # of channels x 400 ms
= 79 x 400 ms
= 31,600 ms
= 31.6 s

Number of time a channel is occupied in 31.6s = 31.6s / 103 ms
= 36100 ms / 103ms
= 306.8 times.

Total occupancy time in 31.6 s is
= 306.8 x 0.4ms
= 122.72 ms

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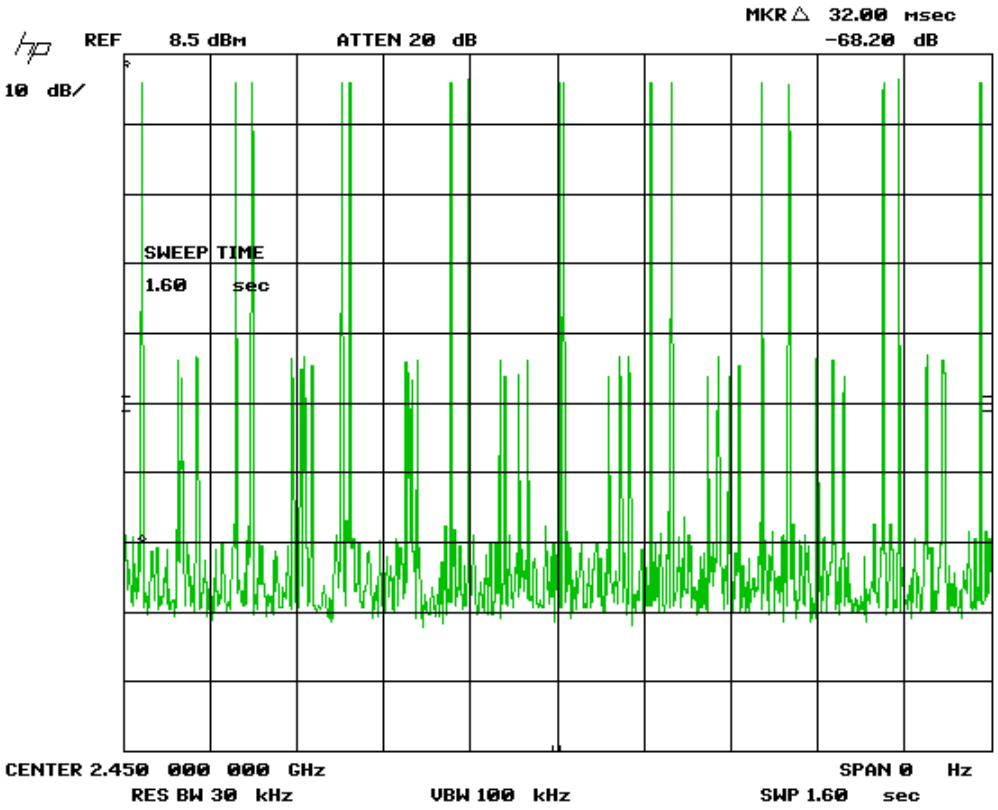
The EUT has an average occupancy of 122.72 msec within a 31.6 second period. This is under the 400 msec limit as per 15.247 (a) 1 (iii)

Graph(s)

Hopping List repeat rate (1 of 2)



16 occurrences in 1.6 seconds

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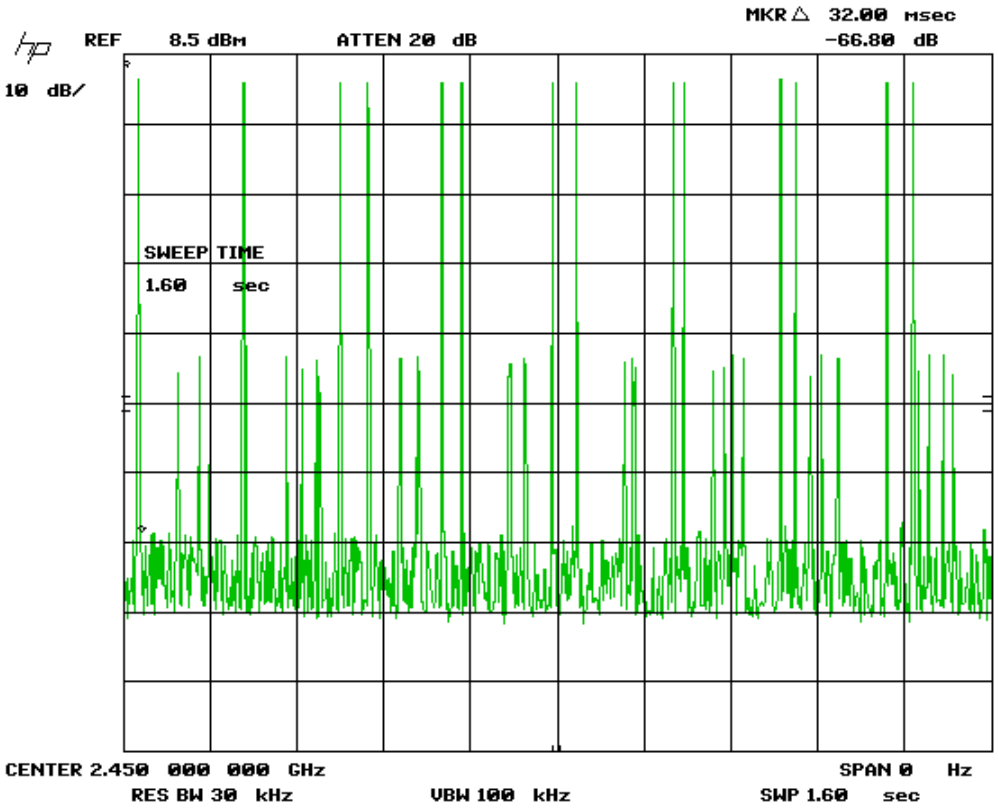
Hopping List repeat rate (2 of 2)



15 occurrences in 1.6 seconds

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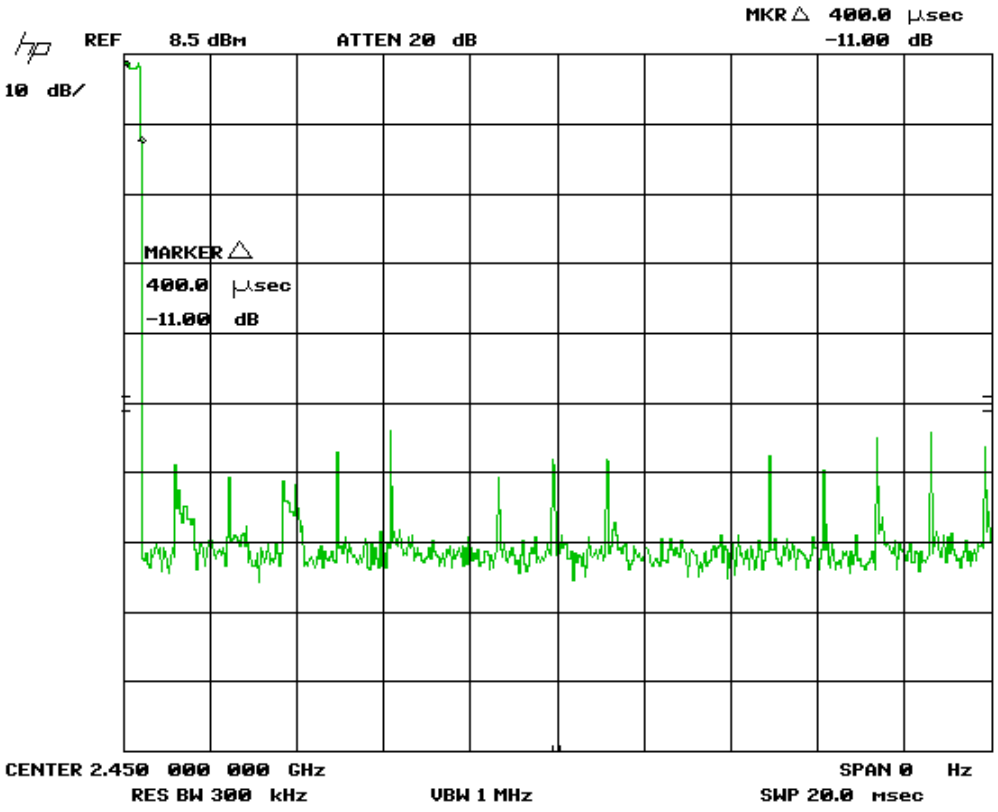
On time during each channel



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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	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

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Maximum Peak Envelope Conducted Power - FHSS

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 3.7 dBm (2.4 mW), in Bluetooth mode

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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.

Freq (MHz)	2402	2440	2480
Level (dBm)	3.7	3.4	3.1

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 #
Power Head	PH 2000	AR	2011-01-31	2013-01-31	GEMC 15
Power meter	PM 2002	AR	2011-01-31	2013-01-31	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

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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 pass. Low, middle and high band was measured for each 802.11b, 802.11g, 802.11n mode. 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 for all modes. The -20 dBc requirement is also shown for the higher band edge at 2.4835 GHz in the high band for all modes.

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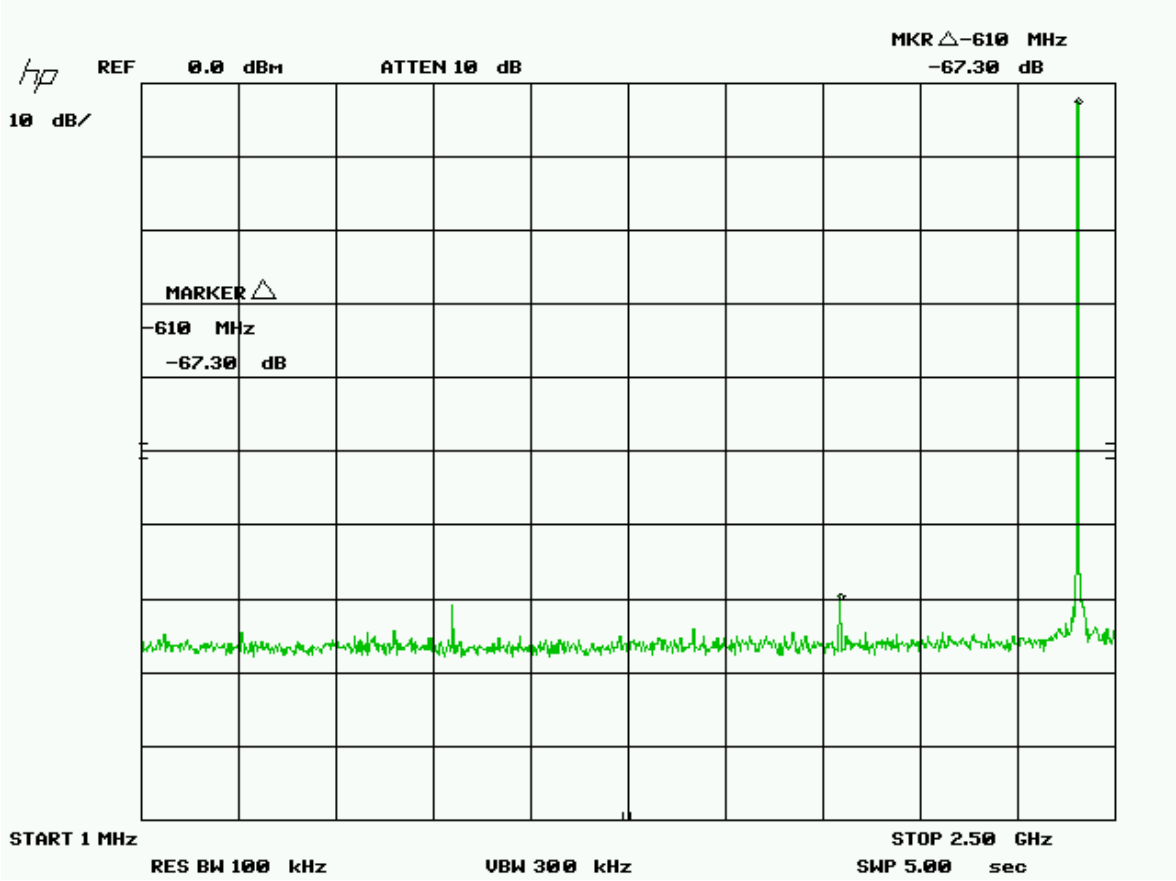
Graph(s)

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.

Frequencies below fundamental



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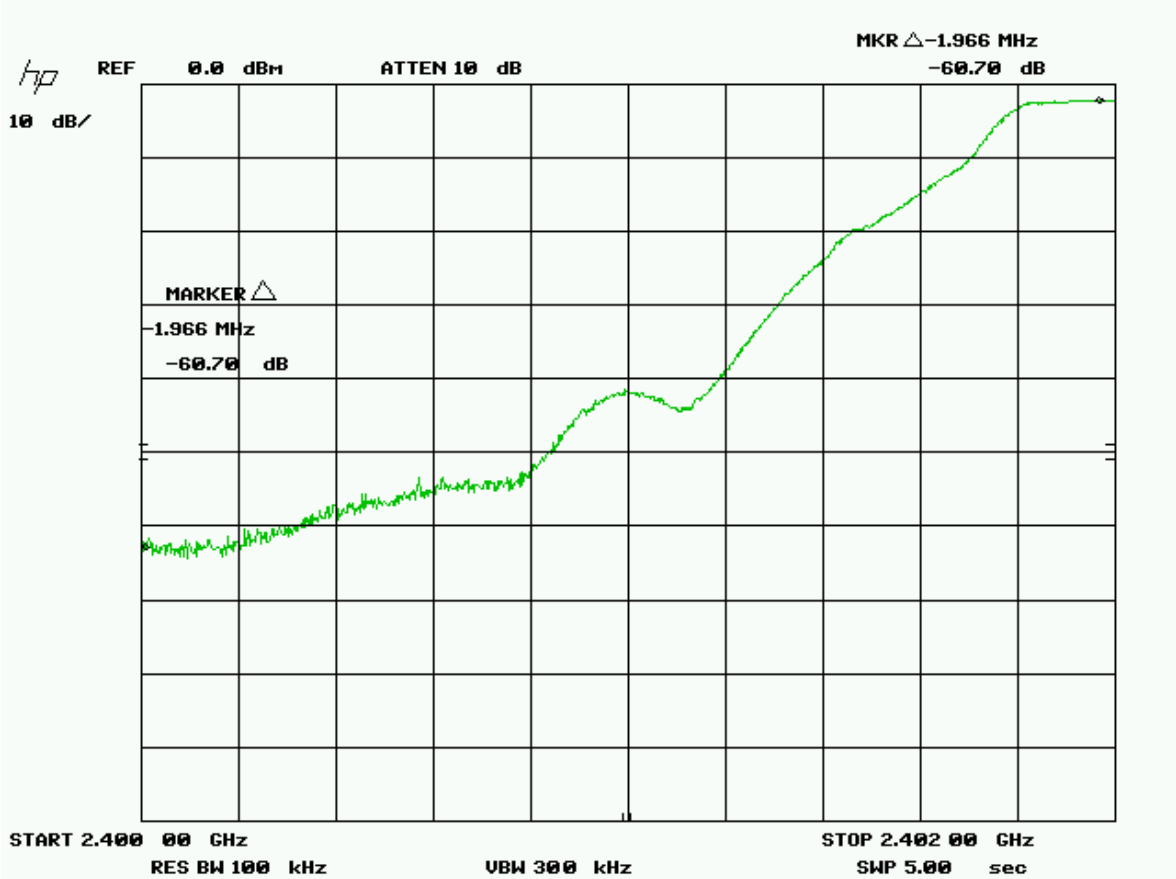
Frequencies below fundamental

Channel 0 - lower band edge



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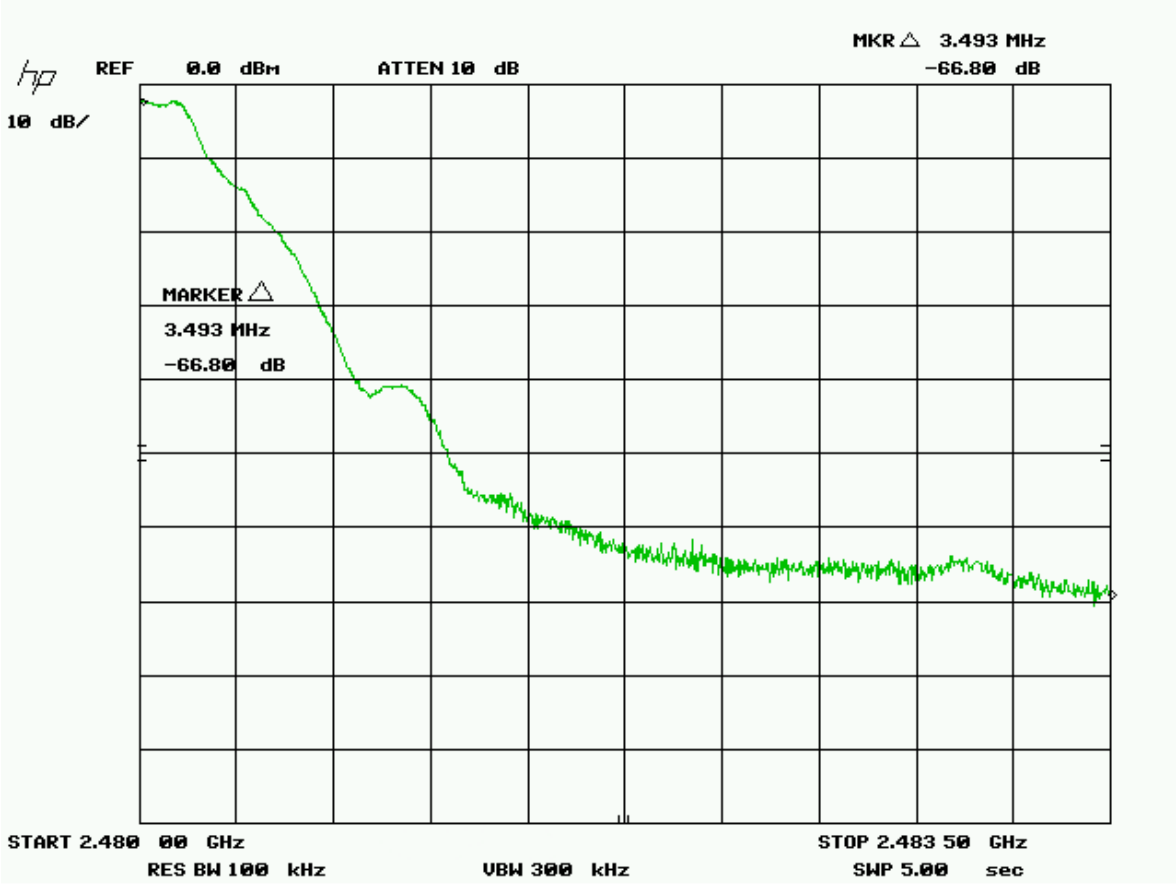
Channel 79 – upper band edge



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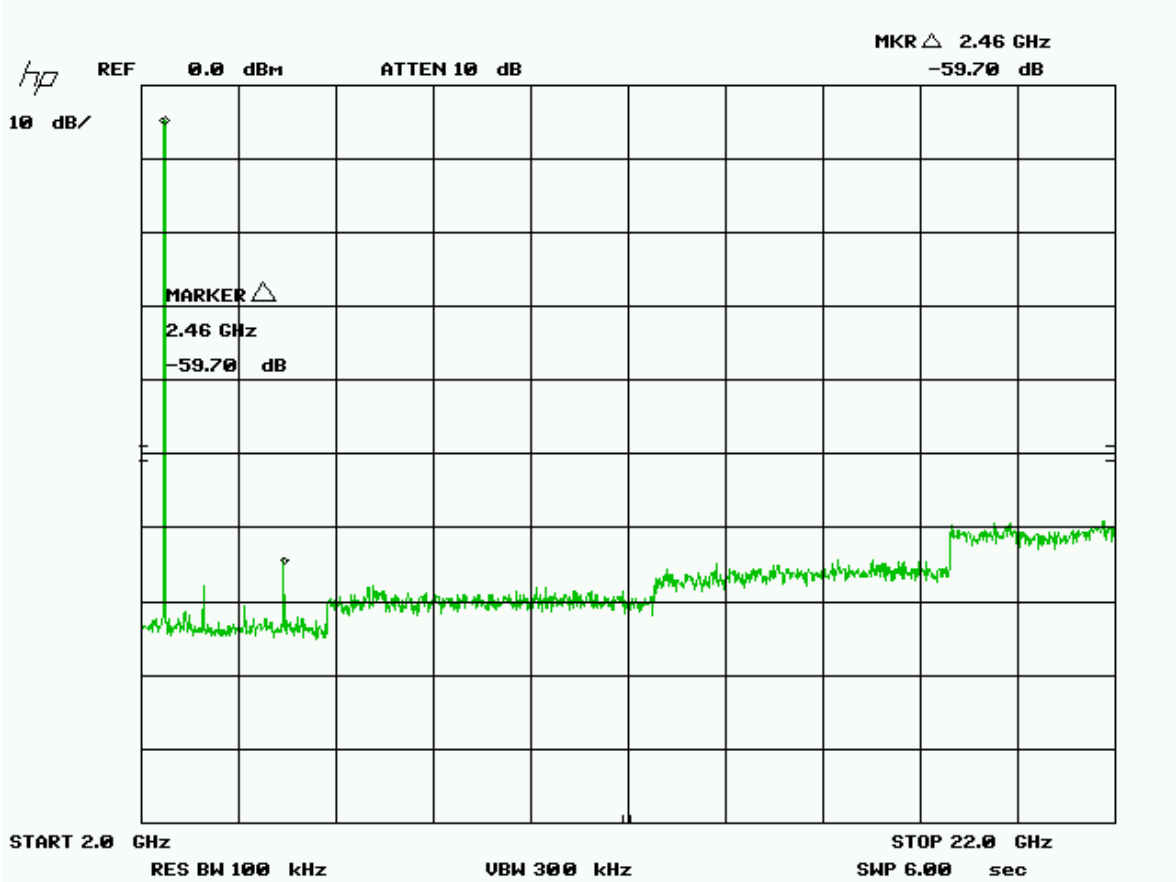
High Channel, Harmonics



The frequency range of 22 – 25 GHz, the 10th harmonic and 9th harmonic where applicable, was additionally scanned No emissions were detected at the 9th and 10th harmonic.

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

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Test Equipment List

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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

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Maximum Permissible Exposure - FHSS

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. In this mode, this device is less than 20 mW, and is therefore exempt.

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Appendix A – EUT Summary

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

General EUT Description

Manufacturer	mySpark Technologies
	Units 1 & 2, Building B 1550 16th Avenue Richmond Hill Ontario L4B 3K9 Canada
EUT Name	Learn
FCCID	Z4J-2001101-001A
IC #	9939A-2001101001A
Approximate Size (LxWxH)	27cm x 20cm x 2cm
Equipment Category (Commercial / Residential / Medical)	Residential
Input Voltage and Frequency	5Vdc, 1A
Intentional RF (If yes describe)	Yes – WiFi and BlueTooth
Table Top / Wall mount / Floor standing (choose table top if unsure)	Portable
I/O Connectors available on EUT	proprietary USB connector
Peripherals required for test	n/a
Minimum Separation distance from operator	n/a
Types and lengths of all I/O cables	1 meter proprietary cable.

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'.

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Appendix B – EUT and Test Setup Photographs

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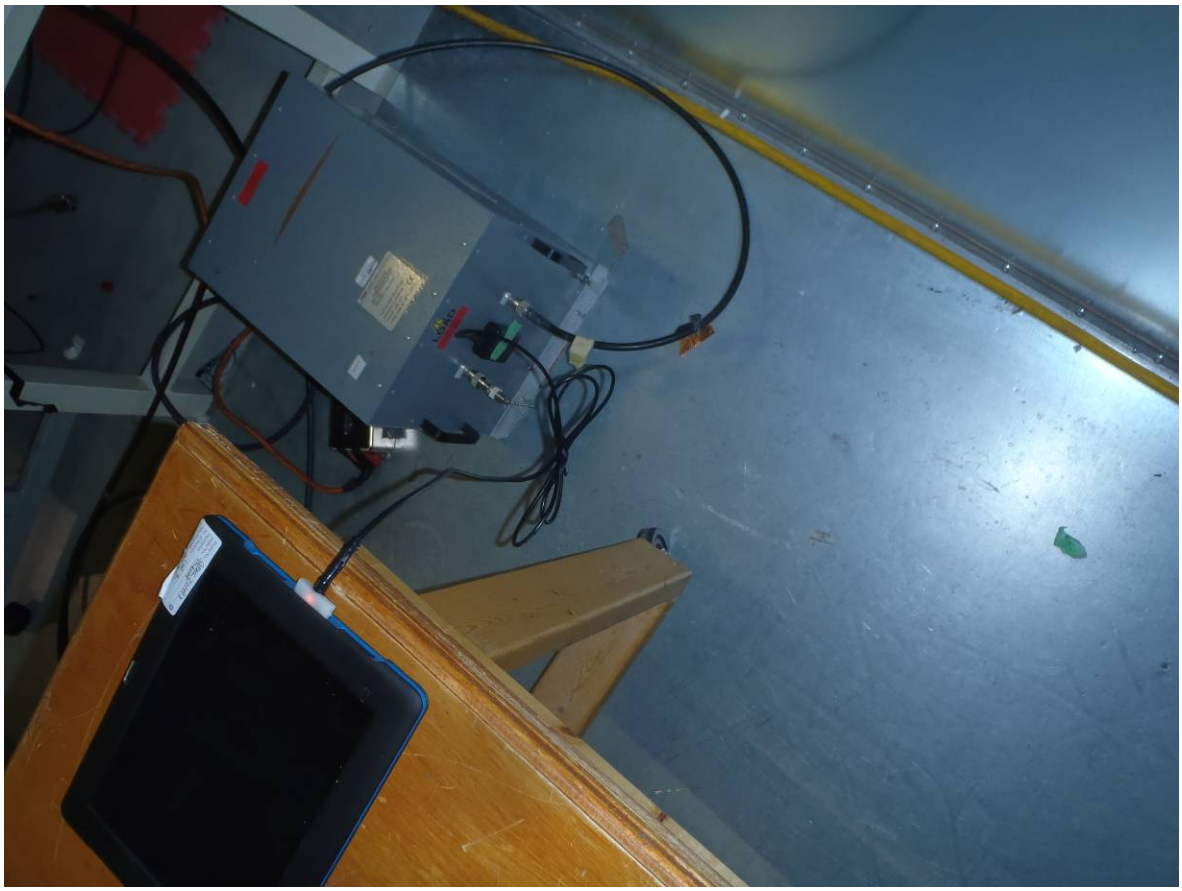
Note: These photos are for information purposes only. Also refer to PDF files that are separate from this test report.



Power Line Conducted Emissions - 1

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Power Line Conducted Emissions - 2

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Radiated Emissions - 9 kHz to 30 MHz

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Radiated Emissions – 30 MHz to 2 GHz

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Radiated Emissions – 2GHz to 26 GHz

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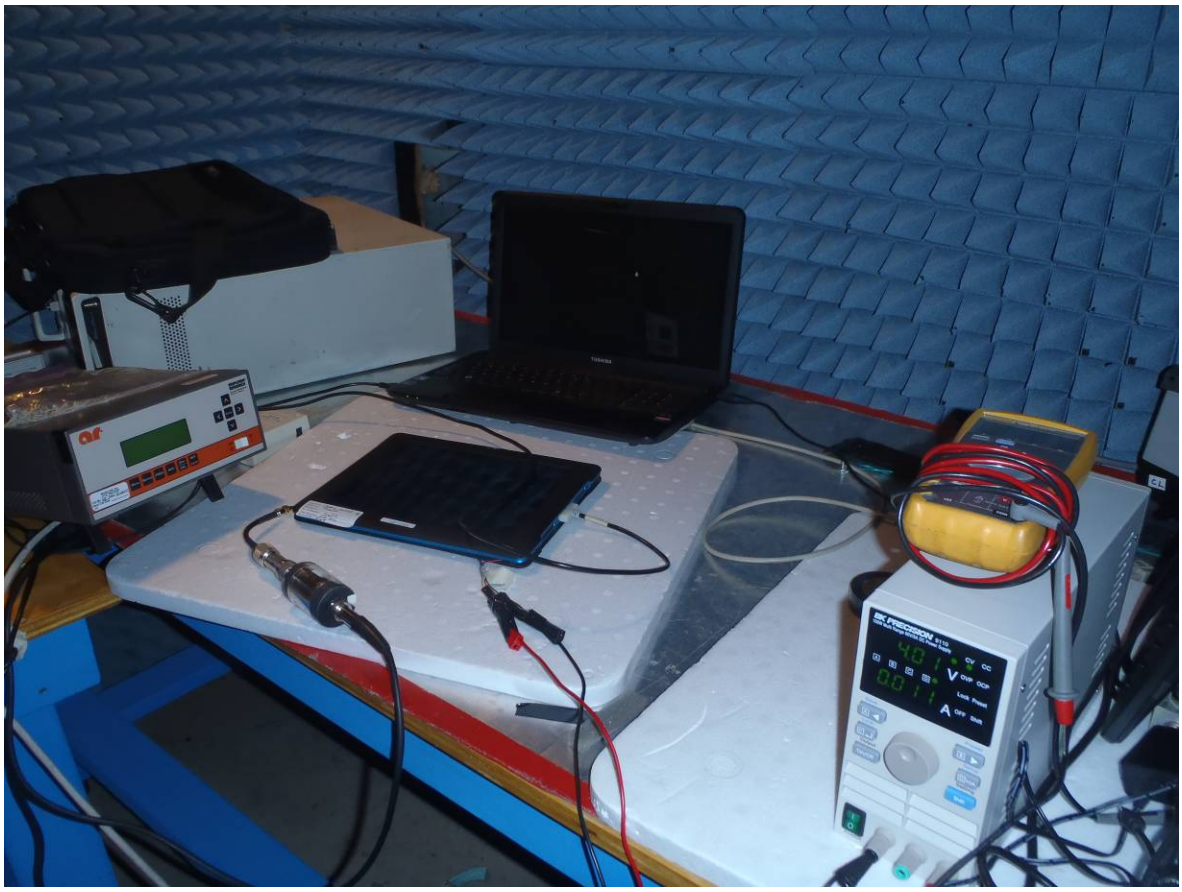

Antenna Conducted Measurements.

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