Global EMC Inc. Labs

EMC & RF Test Report

As per

RSS 210 Issue 8:2010

&

FCC Part 15 Subpart C:2013

Unlicensed Intentional Radiators

on the

iVAC Pro Tool Plus

Yong Huang
Project Specialist
Global EMC Inc. Laval
2972 Joseph-A-Bombardier
Laval, QC, H7P 6E3 CANADA
Ph: (450) 687- 4976

Testing produced for

See Appendix A for full customer & EUT details.

REGISTRATION #6844B-1

REG#382292

Testing Laboratory Certificate #2555.01

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Report Scope

This report addresses the EMC verification testing and test results of the iVAC Pro Tool Plus, 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 15:2013

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

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

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

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

Summary

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

EUT FCC Certification #, FCC ID:	YCH-IVACTP
EUT Industry Canada Certification #, IC:	8940A-IVACTP
EUT Passed all tests performed.	Yes (see test results summary)
Tests conducted by	Yong Huang

Test Results Summary

Table 1 – Manual Operation

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) FCC 15.231(b) RSS-210 (Table 4)	Intentional / Spurious Radiated emissions	QuasiPeak Average	Pass
FCC 15.231(a) RSS-210 A1.1	Type of transmission	Not a continuous transmissions, voice, video or radio control of toys.	Pass See Justification
FCC 15.231 (a)(1) RSS-210 A1.1.1(a)	Manual transmission Release holdover	< 5 seconds	Pass See Justification
FCC 15.231 (a)(2) RSS-210 A1.1.1(b)	Automatic transmission Transmission time	< 5 seconds	N/A
FCC 15.231 (a)(3) RSS-210 A1.1.1(c)	Predetermined intervals Transmission	None	N/A
FCC 15.231 (a)(3) RSS-210 A1.1.1(c)	Predetermined intervals Transmission Security/Safety	< 2 seconds per hour	N/A
FCC 15.231 (c) RSS-210 A1.1.3	20 dB Bandwidth	< 0.25% of carrier	Pass
Overall Result			**PASS**

All tests were performed by Yong Huang.

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 is designed with an integral antenna or proprietary antenna connector which meets the requirements of FCC 15.203.

For the Restricted Bands of operation as specified in FCC 15.205, the EUT is designed to only operate at 434 MHz

For the scope of this test report, radiated testing of the EUT was pre-scanned in three orthogonal axis to maximize emissions. Maximum emissions were found in the vertical EUT polarization. This setup was used for all testing in this report.

For the power line conducted emissions requirements, the EUT is loaded with an electric fan. See *Test Setup Photographs* for picture.

The type of transmission is a data signal sent with a control signal, which complies with the requirements of 15.231(a) / 15.231(e).

The manual transmission is achieved by the user activating a tool powered through the module. A sensor on the module identifies the presence of current flow and transmits an activation signal to the receiver. The manual transmission release holdover time was verified to be for all practical circumstances, instantaneous. This is significantly less than the 5 second requirement.

The EUT transmits a pulse to a receiver unit each time it detects the presence of a current, and another when the current is removed. This transmission does not occur continuously, only enough to signal the receiver of the presence of a current. For the purpose of determining compliance with FCC 15.231(a)(1) or FCC 15.231(a)(2), this transmission is 15.90 milliseconds, and does not transmit for the entire duration of the sensed current. For the purpose of average duty cycle calculations, the maximum time to which this could repeat is over 100 milliseconds. The duty cycle average factor is calculated at 20 log 15.9/100 dB = -16 dB.

For 15.231(a)(3) compliance, this device does not transmit at pre-determined intervals. This device requires end-user activation of a connected tool to trigger the transmit function.

For 15.207 compliance, conducted emission was measured on both power supply lines of the device and the auxiliary tool.

Applicable Standards, Specifications and Methods

ANSI C63.4:2009	- Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
CFR 47 FCC 15	- Code of Federal Regulations – Radio Frequency Devices
CISPR 22:2008	- Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement
ICES-003:2012	- 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

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 - Released on May 06, 2014

Revision 2 - Revised on June 10, 2014. Modified as per ACB's require.

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

Calibrations and Accreditations

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

Testing Environmental Conditions and Dates

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

Date	Test	Init.	Temperature (ºC)	Humidity (%)	Pressure (kPa)
April 1 – 3, 2014	All	YH	20-25ºC	30-45%	100 -103kPa

Detailed Test Results Section

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.

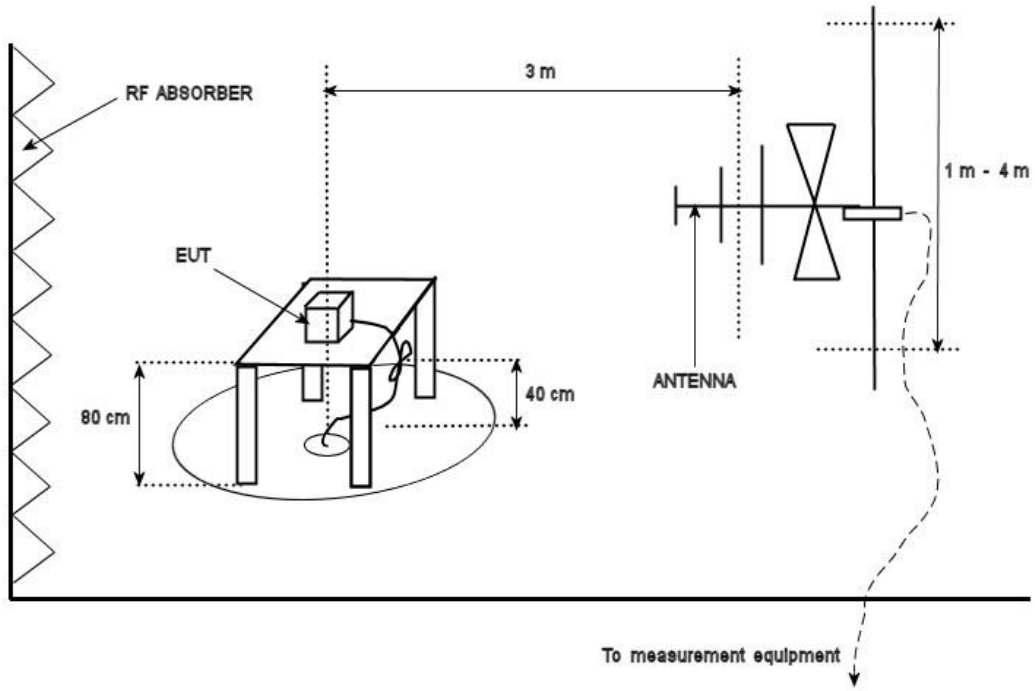
Limit(s) and Method

The method is as defined in ANSI C63.4
The limits are as defined in FCC Part 15, Section 15.209:

0.009 MHz – 0.490 MHz, 2400/F(kHz) uV/m at 300 m[4]
0.490 MHz – 1.705 MHz, 24000/F(kHz) uV/m at 30 m[4]
1.705 MHz – 30 MHz, 30 uV/m at 30 m[4]
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 (46.0 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
Above 1000 MHz, 5000 uV/m (74 dBuV/m[3]) 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
[3]Limit is with 1 MHz measurement bandwidth and using an Peak detector
[4]Limit is with using a Quasi-peak detector with a bandwidth as defined in CISPR 16-1-1

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.

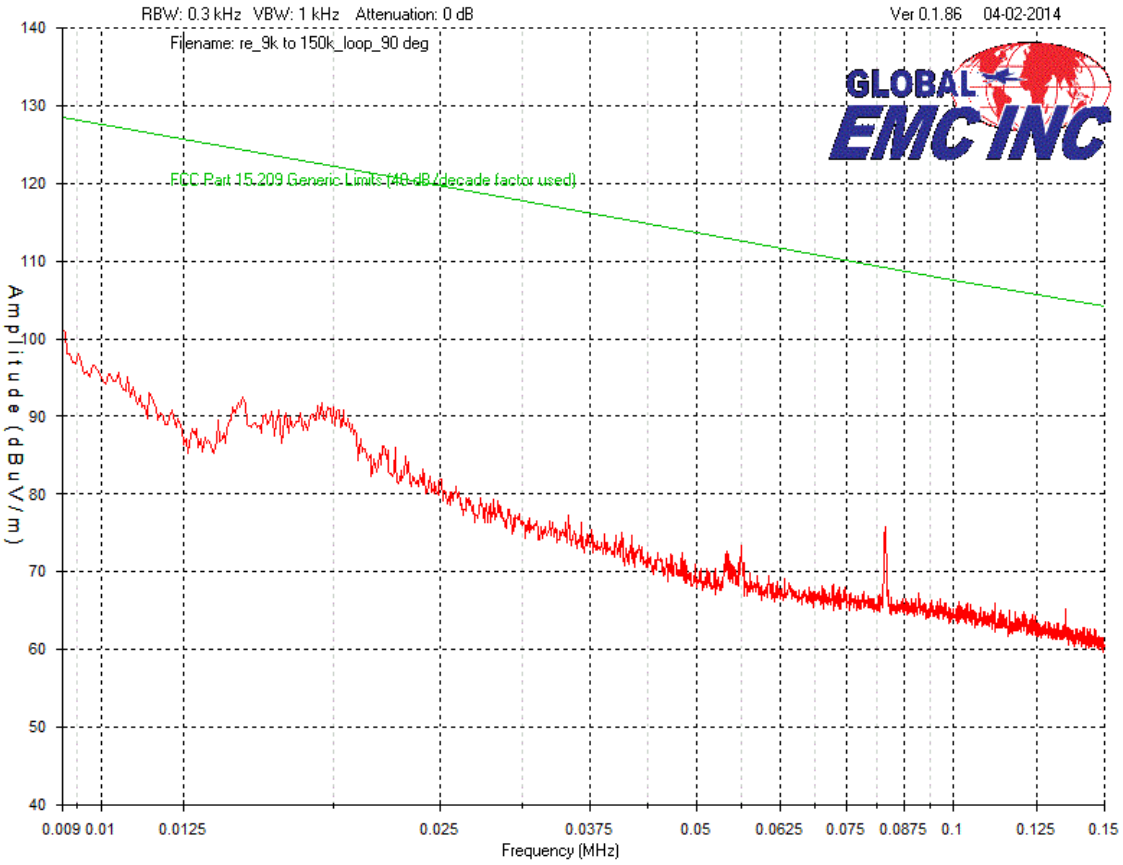
Preliminary Graphs

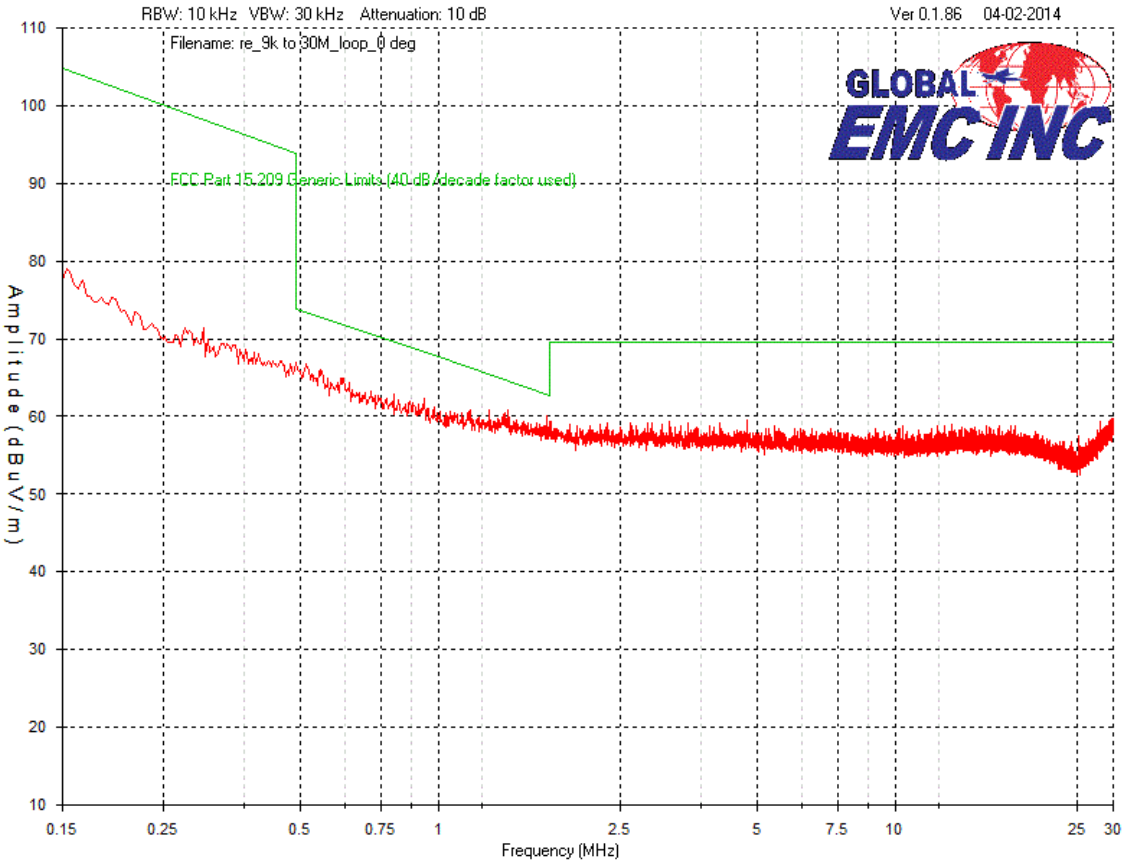
Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector, please refer to the final measurement table where applicable. The graph shown below is a maximized peak measurement graph, measured with a resolution bandwidth greater then the final 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 1 GHz.

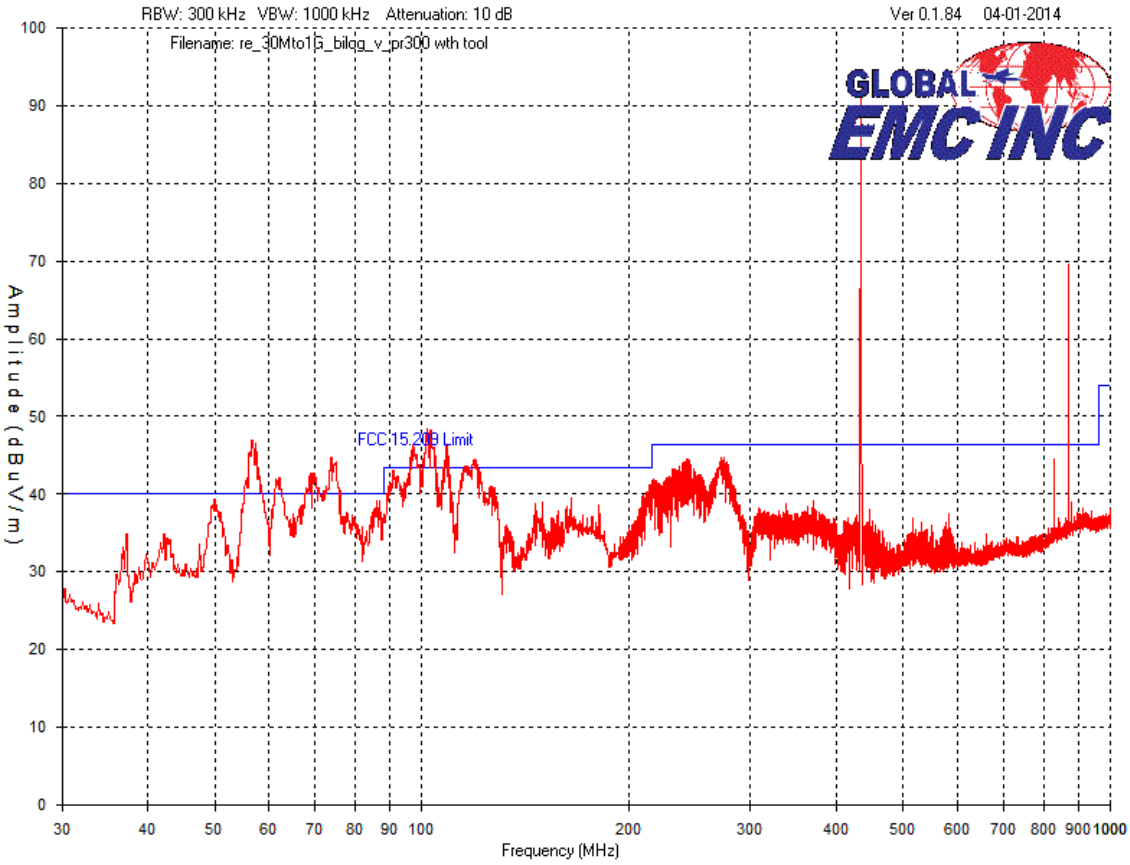
Devices scanned above 1GHz may be scanned at 1 meter test distance, and in accordance with FCC Part 15, Subpart A, Section 15.31, an extrapolation factor of 20 dB/decade was used. For example for 1 meter measurements, an extrapolation factor 9.5 dB from 20 Log (1m / 3m) is applied.

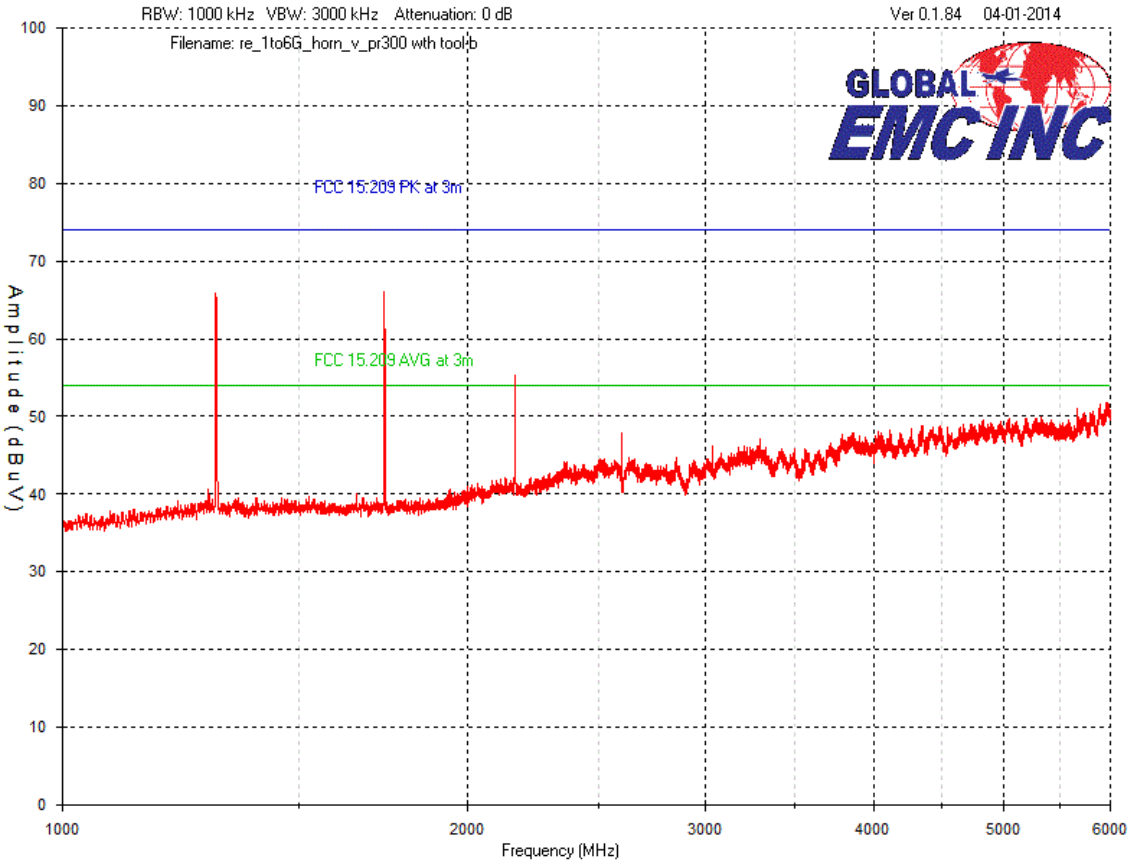
Loop @ 0 degree – Peak Emissions Graph



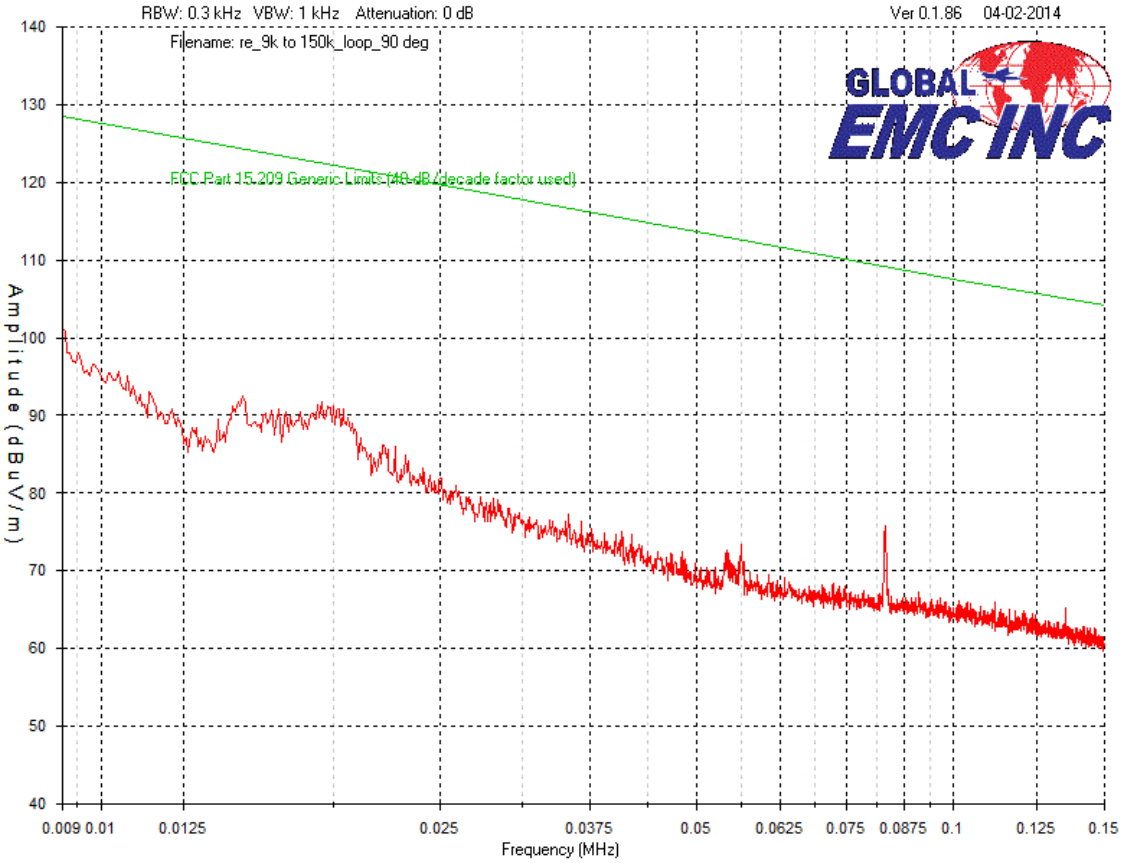


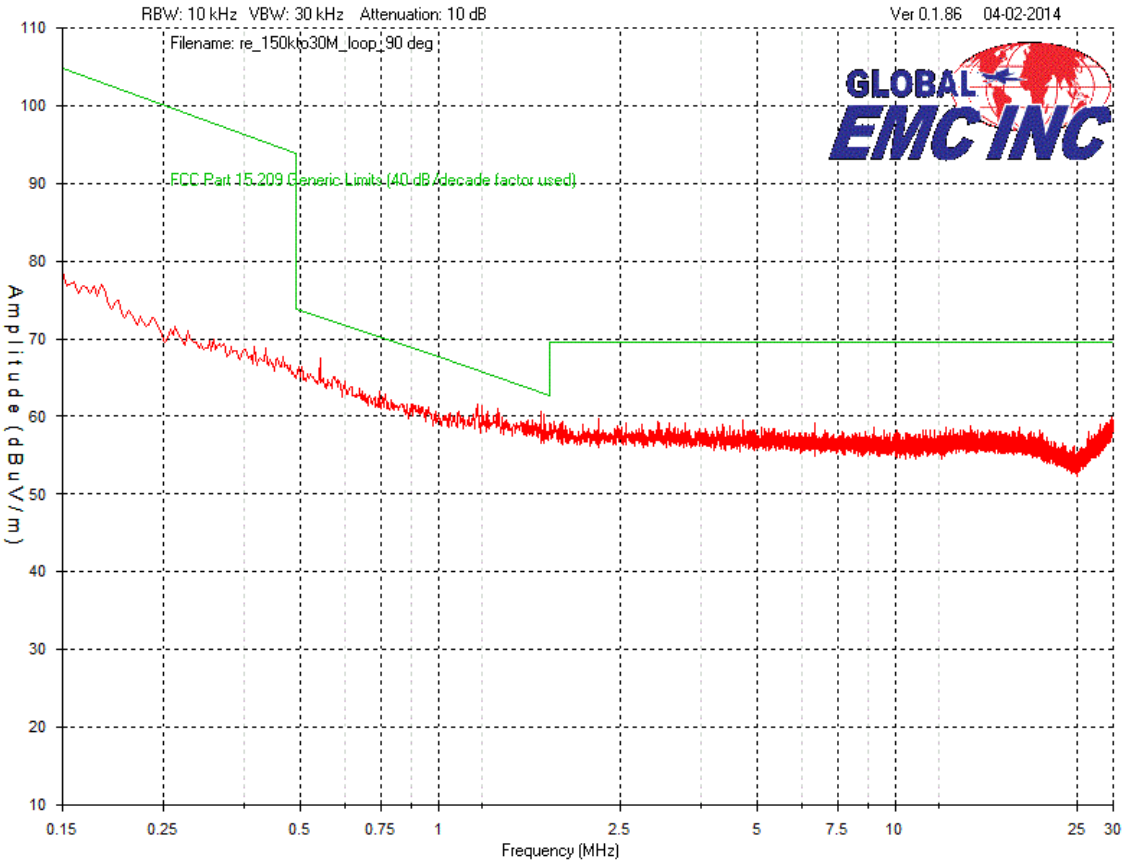
Vertical – Peak Emissions Graph



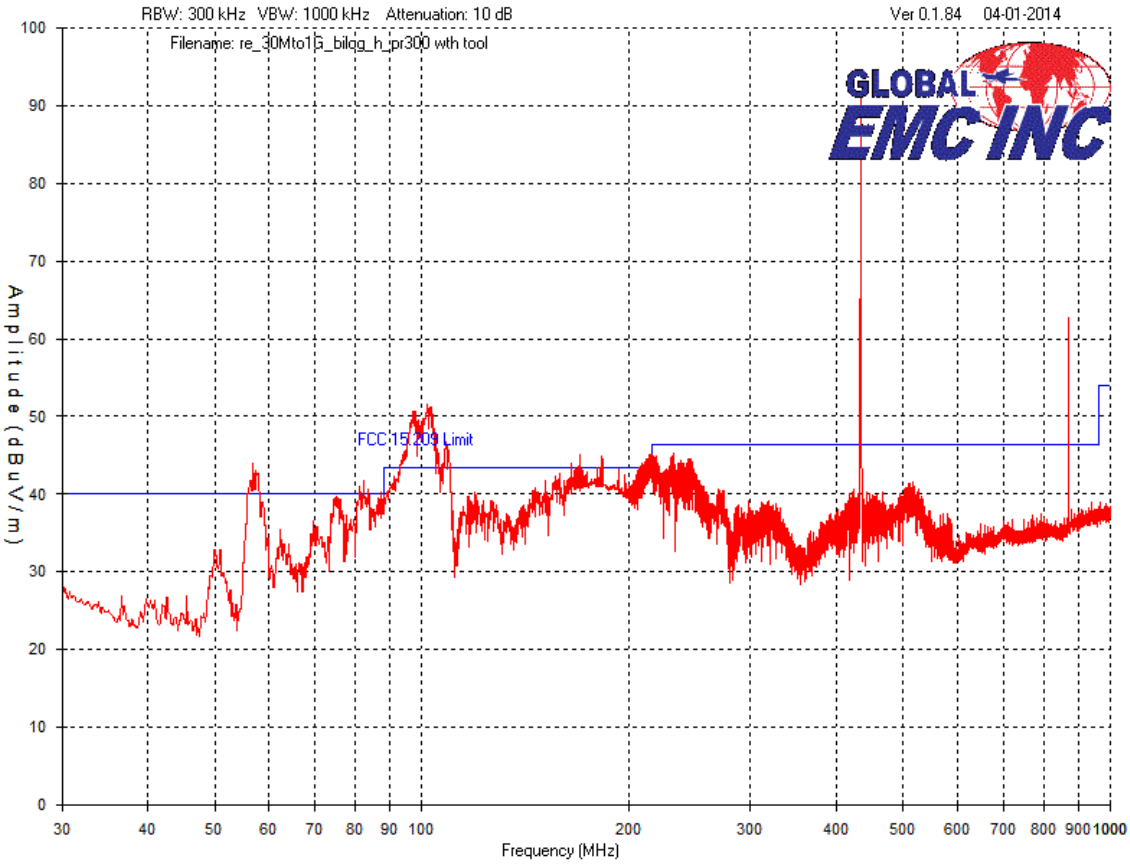


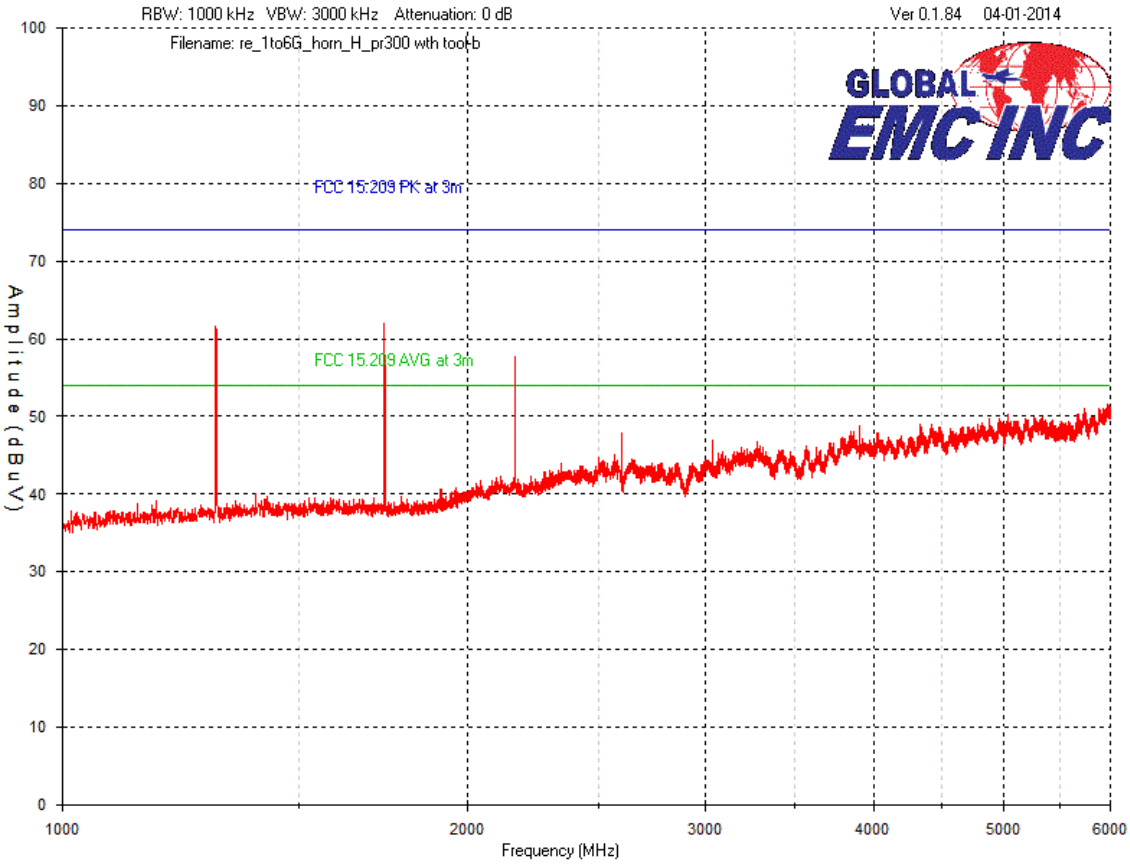
Loop @ 90 degree – Peak Emissions Graph





Horizontal – Peak Emissions Graph





Final Measurements

Emission Reading Table – Vertical

Frequency (MHz)	Det. mode	Raw (dBuV)	Ant. (dB/m)	Att. (dB)	Cab. (dB)	Amp (dB)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
56.675	Q.P	38.0	7.2	3	0.8	-28.5	20.5	40	19.5	Pass
101.877	Q.P	37.3	8	3	0.9	-28.5	20.7	43.5	22.8	Pass
73.941	Q.P	34.7	7.6	3	0.8	-28.5	17.6	40	22.4	Pass
97.027	Q.P	36.4	7.9	3	0.9	-28.5	19.7	43.5	23.8	Pass
108.667	Q.P	36.2	8.1	3	1	-28.5	19.8	43.5	23.7	Pass
62.107	Q.P	33.2	7.5	3	0.8	-28.5	16	40	24.0	Pass

Emission Reading Table – Horizontal

Frequency (MHz)	Det. mode	Raw (dBuV)	Ant. (dB/m)	Att. (dB)	Cab. (dB)	Amp (dB)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
101.877	Q.P	39.3	9	3	0.9	-28.5	23.7	43.5	19.8	Pass
56.772	Q.P	35.8	6.8	3	0.8	-28.5	17.9	40	22.1	Pass
108.279	Q.P	35.9	9.1	3	1	-28.5	20.5	43.5	23.0	Pass
82.283	Q.P	32.0	8	3	0.9	-28.5	15.4	40	24.6	Pass
214.203	Q.P	33.9	10.9	3	1.4	-28.6	20.6	43.5	22.9	Pass
169.874	Q.P	39.6	9.6	3	1.2	-28.5	24.9	43.5	18.6	Pass

Note:
All emissions meet the limits of spurious emissions in 15.231 (b). According to 15.231 (b)(3), it may meet whichever limit of 15.231 (b) or 15.209 permits a higher field strength, and so complies with the requirements of this standard.

The fundamental was measured to be 96.6 dBuV/m at 3 meters.

Above 1GHz, no emissions (other than harmonics of the fundamental) were detected above the limits.

See ‘Fundamental Emissions’ and ‘Spurious Emissions’ measurements for further detail.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	1/22/13	1/22/15	4169
Quasi Peak Adapter	85650A	HP	1/23/13	1/23/15	4170
Loop Antenna	EM 6879	Electro-Metrics	10-11-13	10-11-15	4040
BiLog Antenna	3142-C	ETS	4/25/13	4/25/15	4002
Attenuator 3 dB	FP-50-3	Trilithic	N/A	N/A	4028
9kHz-1GHz, 28dB preamp	LNA 6901	Teseq	8-6-13	8-6-15	4036
Horn Antenna	ATH1G18G	AR	4/3/13	4/3/15	4003
1GHz-26.5GHz preamp	HP 8449B	HP	4/25/13	4/25/15	4006
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	4026
RF Cable 1M	LMR-400-1M-50OHM-MN-MN	LexTec	N/A	N/A	4039
RF Cable 10m	LMR-400-10M-50OHM-MN-MN	LexTec	NCR	NCR	4025

This report module is based on GEMC template "FCC - 15.209 - Radiated Emissions_Rev5.doc"

20 dB Bandwidth of Periodically Operated Transmitters

Purpose

The purpose of this test is to ensure that the bandwidth occupied does not exceed a stated minimum. This helps ensure the utilization of the frequency allocation is sufficiently narrow, and not occupying excessive spectrum. This also helps prevent accidently interference of data by ensuring adequate data separation to distinguish the reception of the intended information by enabling the receiver to have a relatively narrow band response tuned to the transmitter's frequency.

Limits

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

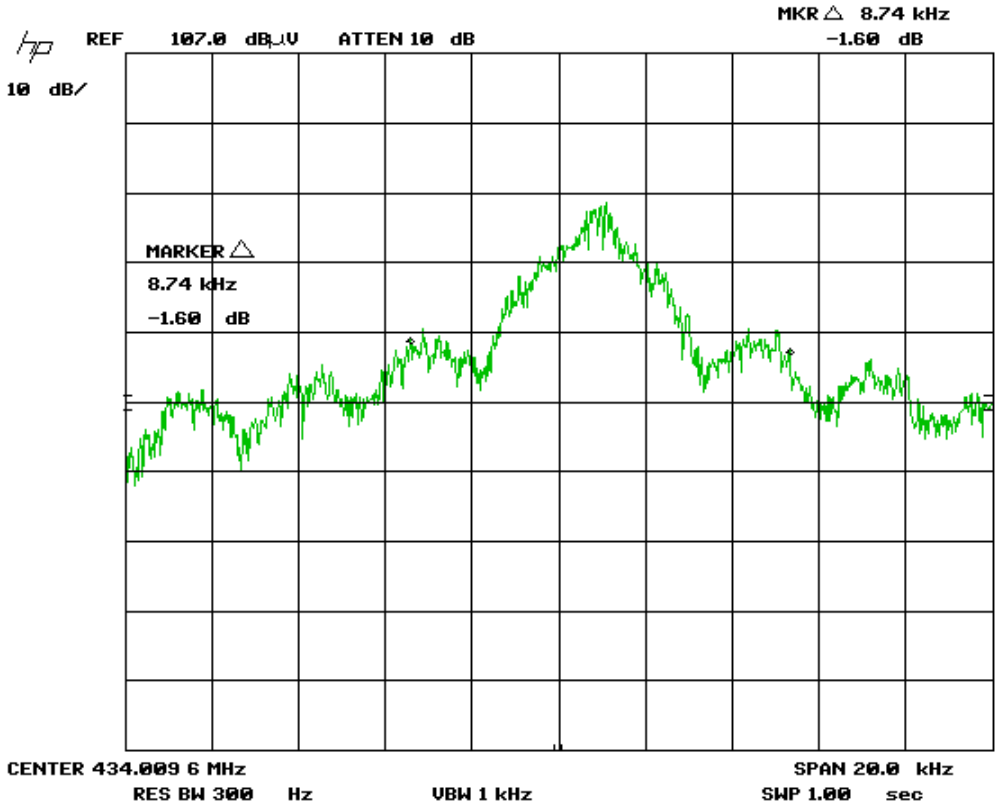
For periodic transmitters below 900 MHz, this should not exceed 0.25 % of the fundamental frequency. For periodic transmitters above 900 MHz, this should not exceed 0.5 % of the fundamental frequency. This should be measured with a RBW equal to approximately %1 of the 20 dB BW of the signal and a VBW > then the RBW.

Results

The EUT passed. The 20 dB BW measured was 8.7 kHz and the requirement was that this be less than 1.08 MHz.

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 approximately 1 % of the 20 dB BW during operation of the EUT. This measurement is a peak measurement. Max hold is performed for a duration of not less than 1 minute. Markers are set at 20 dB below peak.



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

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	1/22/13	1/22/15	4169
Quasi Peak Adapter	85650A	HP	1/23/13	1/23/15	4170
BiLog Antenna	3142-C	ETS	4/25/13	4/25/15	4002
Attenuator 3 dB	FP-50-3	Trilithic	N/A	N/A	4028
9kHz-1GHz, 28dB preamp	LNA 6901	Teseq	8-6-13	8-6-15	4036
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	4026
RF Cable 1M	LMR-400-1M-50OHM-MN-MN	LexTec	N/A	N/A	4039
RF Cable 10m	LMR-400-10M-50OHM-MN-MN	LexTec	NCR	NCR	4025

This report module is based on GEMC template "FCC - 15.231 - 20dB Bandwidth_Rev1.doc"

Radiated Emissions of Fundamental

Purpose

The purpose of this test is to ensure that the RF energy intentionally emitted from the EUT does not exceed the limit listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect other periodic operating devices, and licensed broadcasting devices, and so on, from unwanted interference.

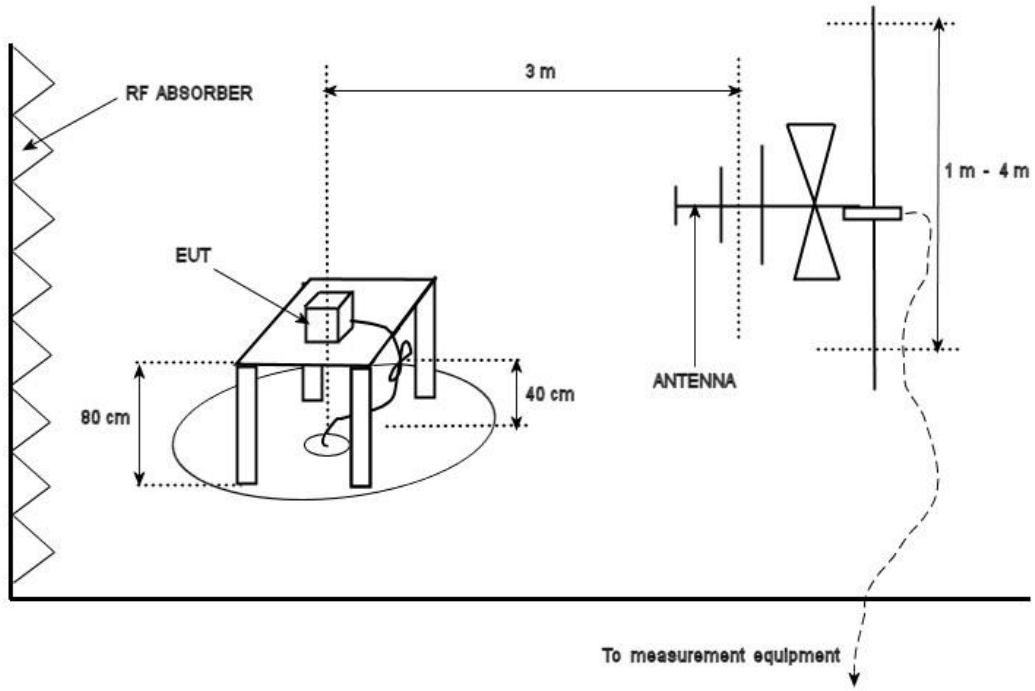
Limit(s) and Method

The method is as defined in ANSI C63.4:2003.
The limits are as defined in FCC Part 15, Section 15.231 (b), and is specific for the one frequency for the fundamental transmit frequency.

434 MHz – 80.8 dBuV/m[1].

[1]Based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector.

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.

Final Measurements

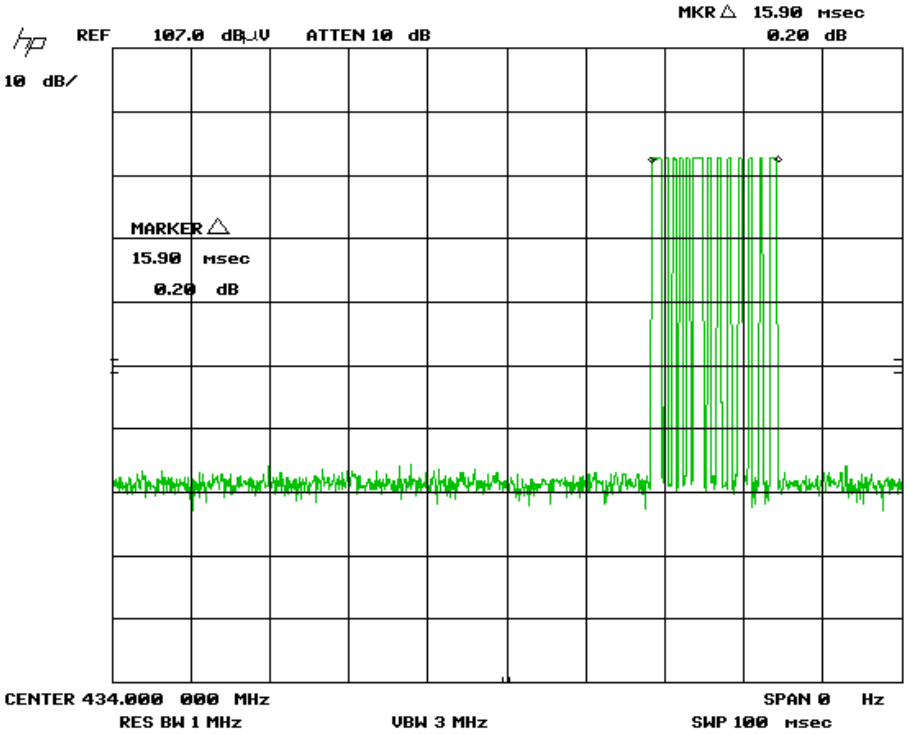
Test Freq. (MHz)	Detection mode	Antenna polarity (Horz/ Vert)	Raw signal dB(µV)	Antenna factor dB	Atten. dB	Cable loss dB	Pre-Amp Gain dB	Received signal dB(µV/m)	Emission limit dB(µV/m)	Margin dB(µV)	Result
434	Peak	Horz	101.1	17.1	3	1.9	-28.7	94.4	100.8	6.4	PASS
434	Avg	Horz	85.1	17.1	3	1.9	-28.7	78.4	80.8	2.4	PASS
434	Peak	Vert	103.9	16.5	3	1.9	-28.7	96.6	100.8	4.2	PASS
434	Avg	Vert	87.9	16.5	3	1.9	-28.7	80.6	80.8	0.2	PASS

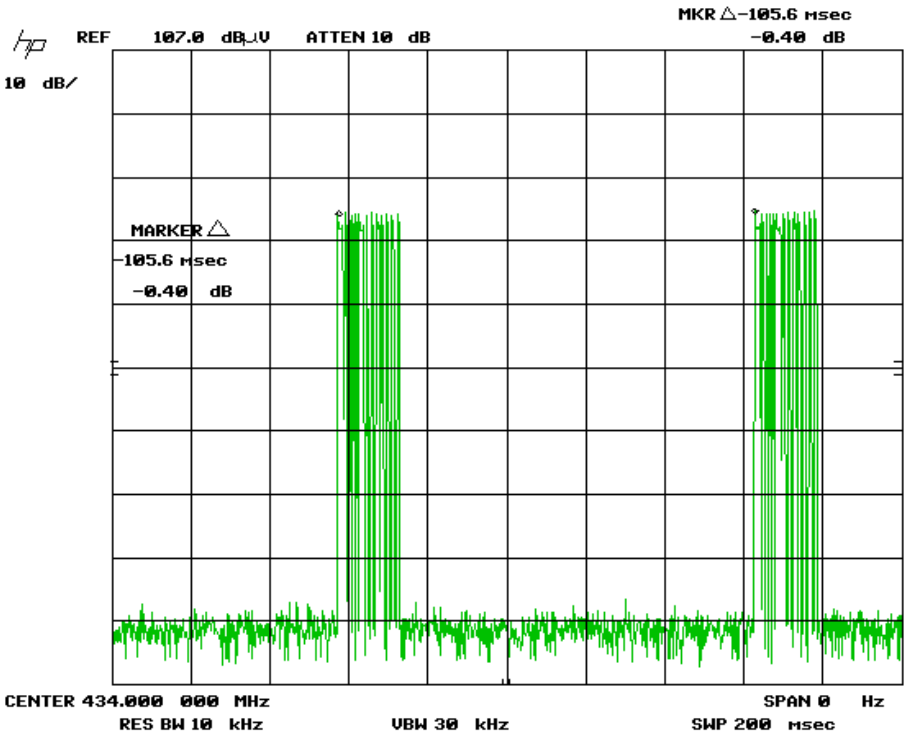
The device complies with the requirement. A worst case measurement of 96.6 dBuV/m at 3 meters was obtained at a center frequency of 434 MHz in the Vertical polarity.

The averaging factor was calculated from an ON time of 15.9ms per pulse using 20log(15.9ms/100ms) = -16.0dB. The Calculated Average is therefore 96.6-16.4=80.2dBuV/m. The limit is 80.8dBuV/m.

This is passing with 0.2 dB of margin to the requirement.

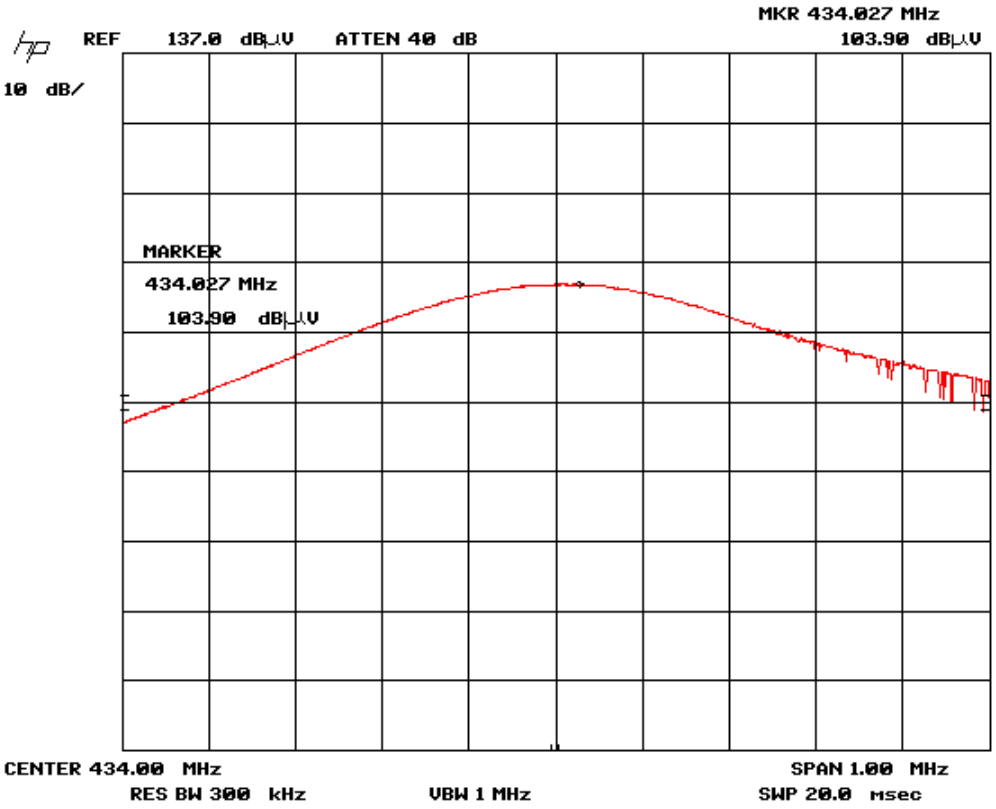
Screen capture of pulse width –
duty cycle





Maximum repeat time.

Screen capture of fundamental emission



Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	1/22/13	1/22/15	4169
Quasi Peak Adapter	85650A	HP	1/23/13	1/23/15	4170
BiLog Antenna	3142-C	ETS	4/25/13	4/25/15	4002
Attenuator 3 dB	FP-50-3	Trilithic	N/A	N/A	4028
9kHz-1GHz, 28dB preamp	LNA 6901	Teseq	8-6-13	8-6-15	4036
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	4026
RF Cable 1M	LMR-400-1M-50OHM-MN-MN	LexTec	N/A	N/A	4039
RF Cable 10m	LMR-400-10M-50OHM-MN-MN	LexTec	NCR	NCR	4025

This report module is based on GEMC template "FCC - 15.209 - Radiated Emissions_Rev5.doc"

Radiated Emissions of Spurious 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 15.231 (b), and 15.209 (a) in the frequency ranges specified in 15.205 (a), whichever limit permits the higher field strength. The tables below show the values of these limits.

FCC 15.231 (b) Emission Limits:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66–40.70	2,250	225
70–130	1,250	125
130–174	[1]1,250 to 3,750	[1]125 to 375
174–260	3,750	375
260–470	[1]3,750 to 12,500	[1]375 to 1,250
Above 470	12,500	1,250

[1]Linear interpolations.

(1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

FCC 15.205 (a) Restricted Frequency Bands:

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
[1]0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	([2])
13.36–13.41			

[1]Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.

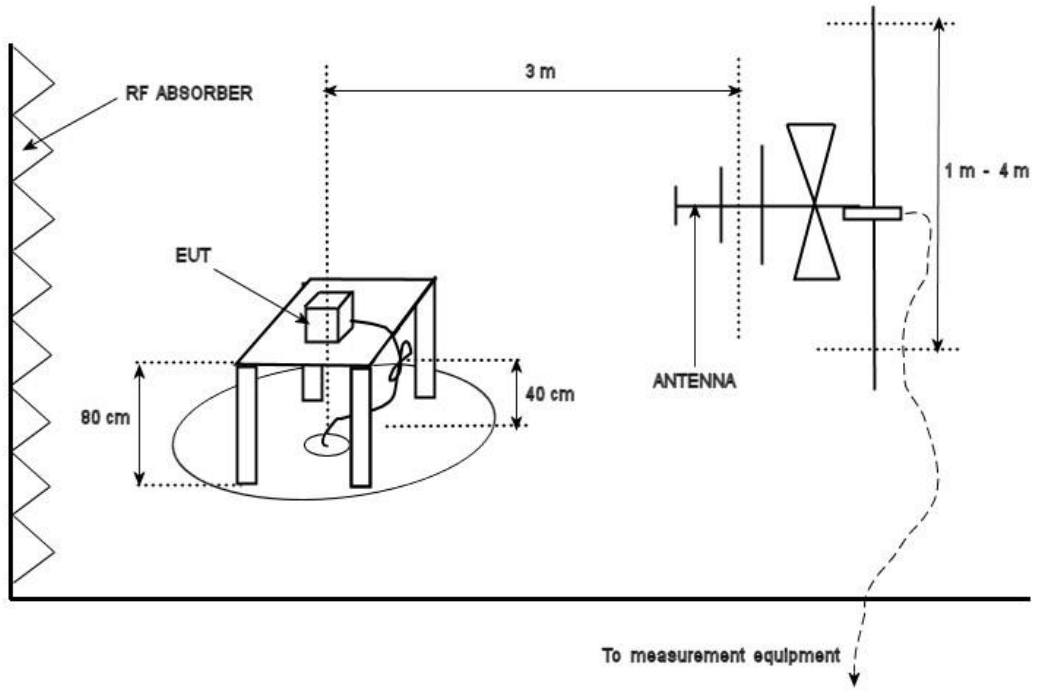
[2]Above 38.6

FCC 15.209 (a) Emission Limits

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	30	30
30–88	100**	3
88–216	150**	3
216–960	200**	3
Above 960	500	3

Note: A peak limit that is 20 dB higher than the limits specified above applies.

Typical Radiated Emissions Setup



Measurement Uncertainty

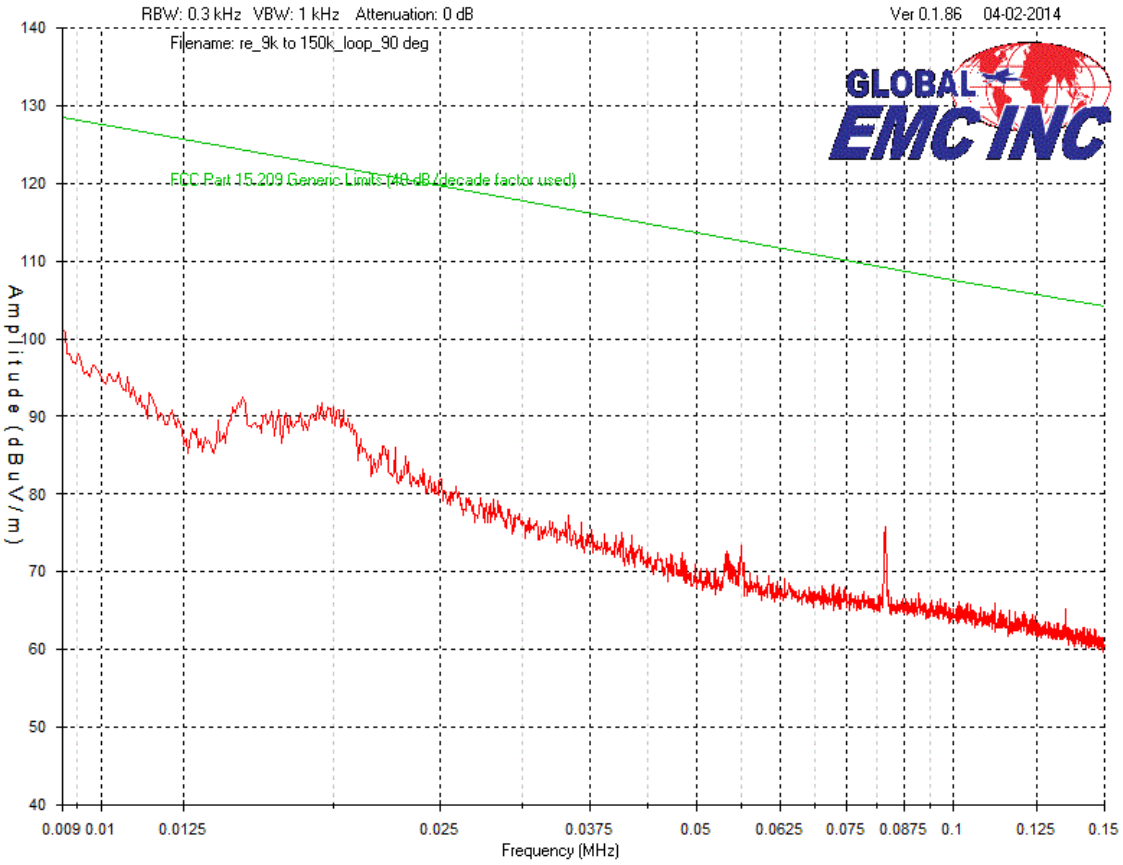
The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is +/-4.4 dB with a 'k=2' coverage factor and a 95% confidence level.

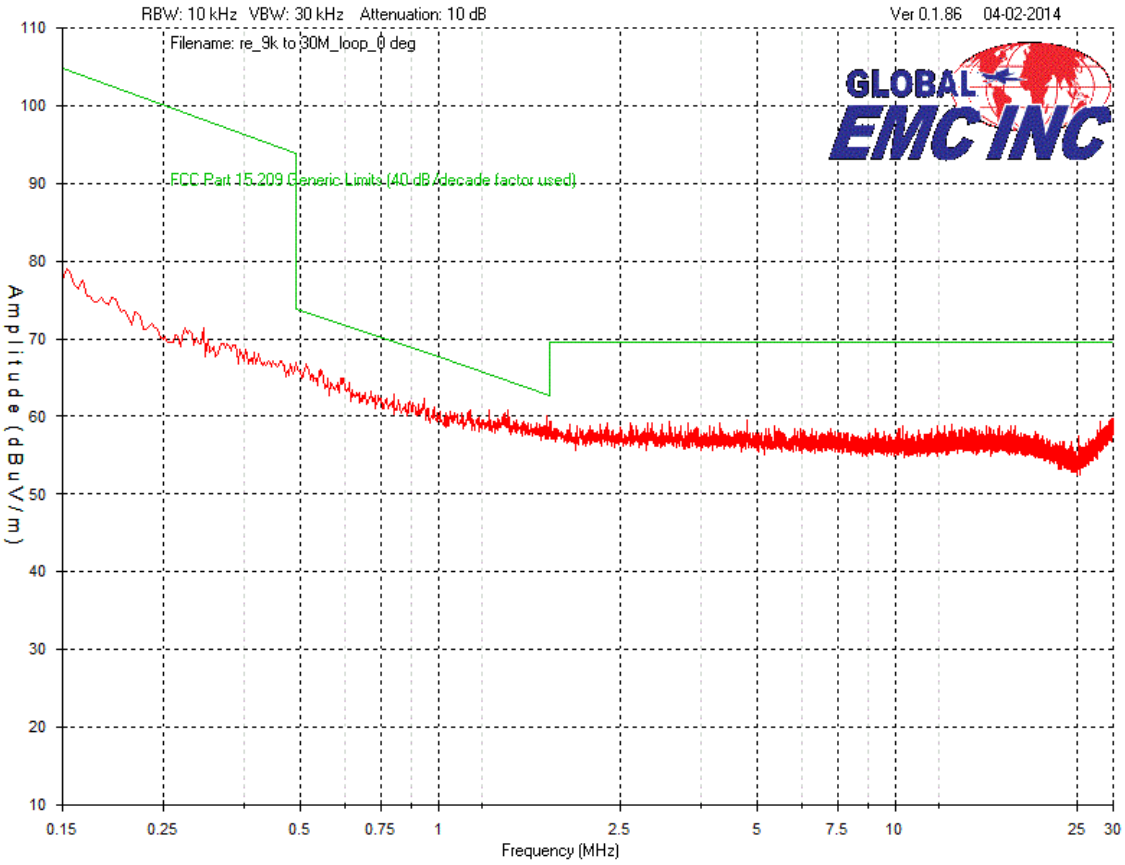
Preliminary Graphs

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.

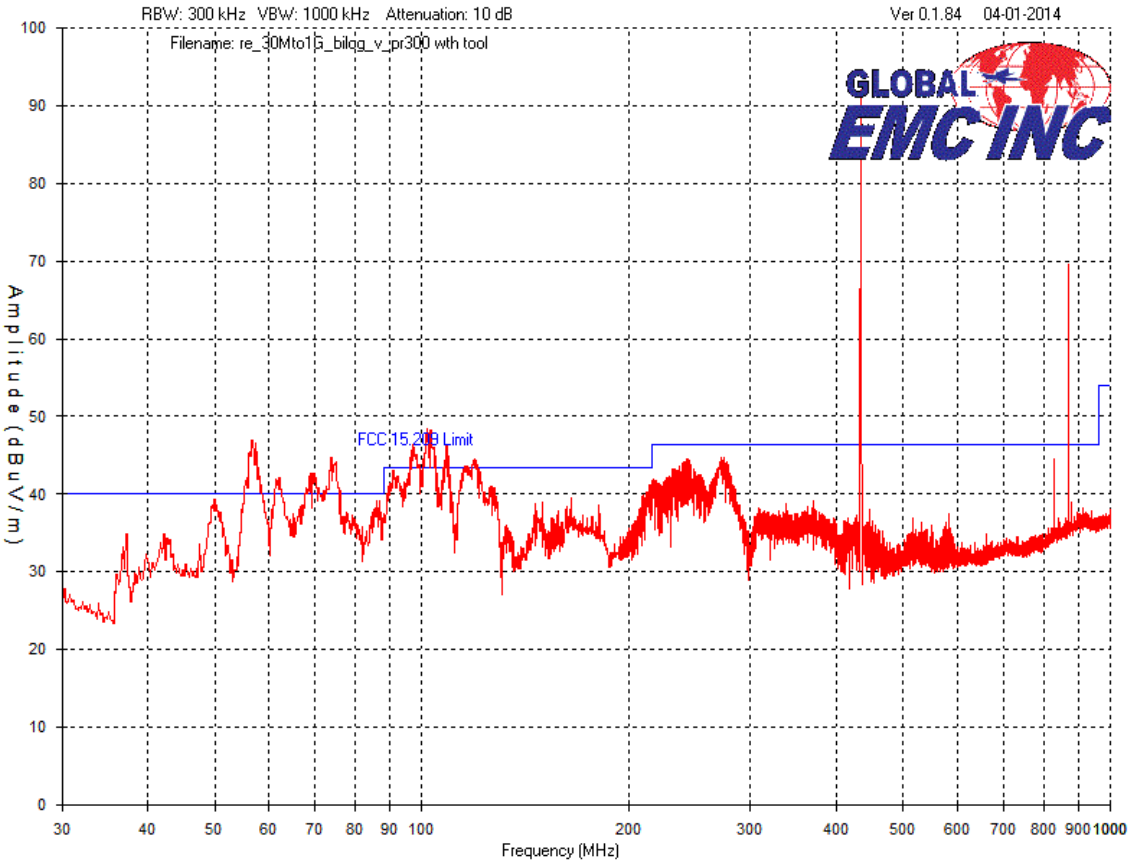
In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to a minimum of a 4.4 GHz.

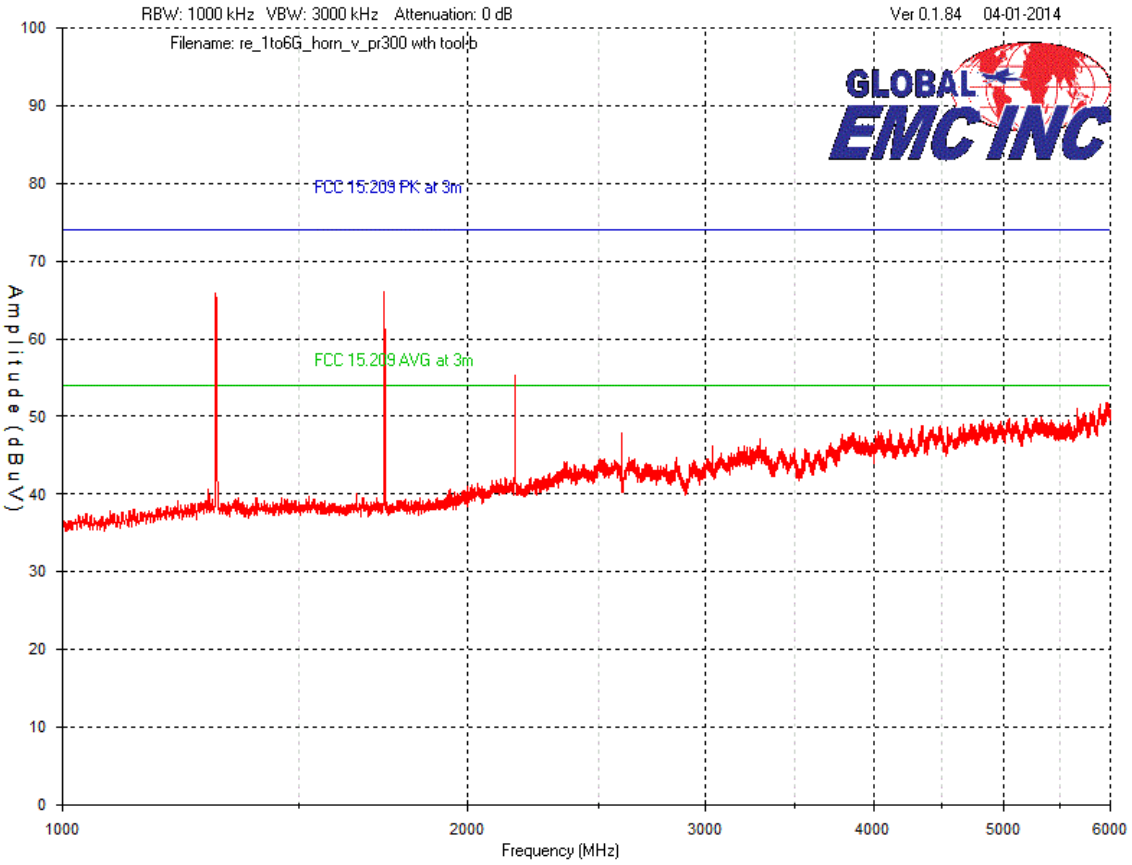
Loop @ 0 degree – Peak Emissions Graph



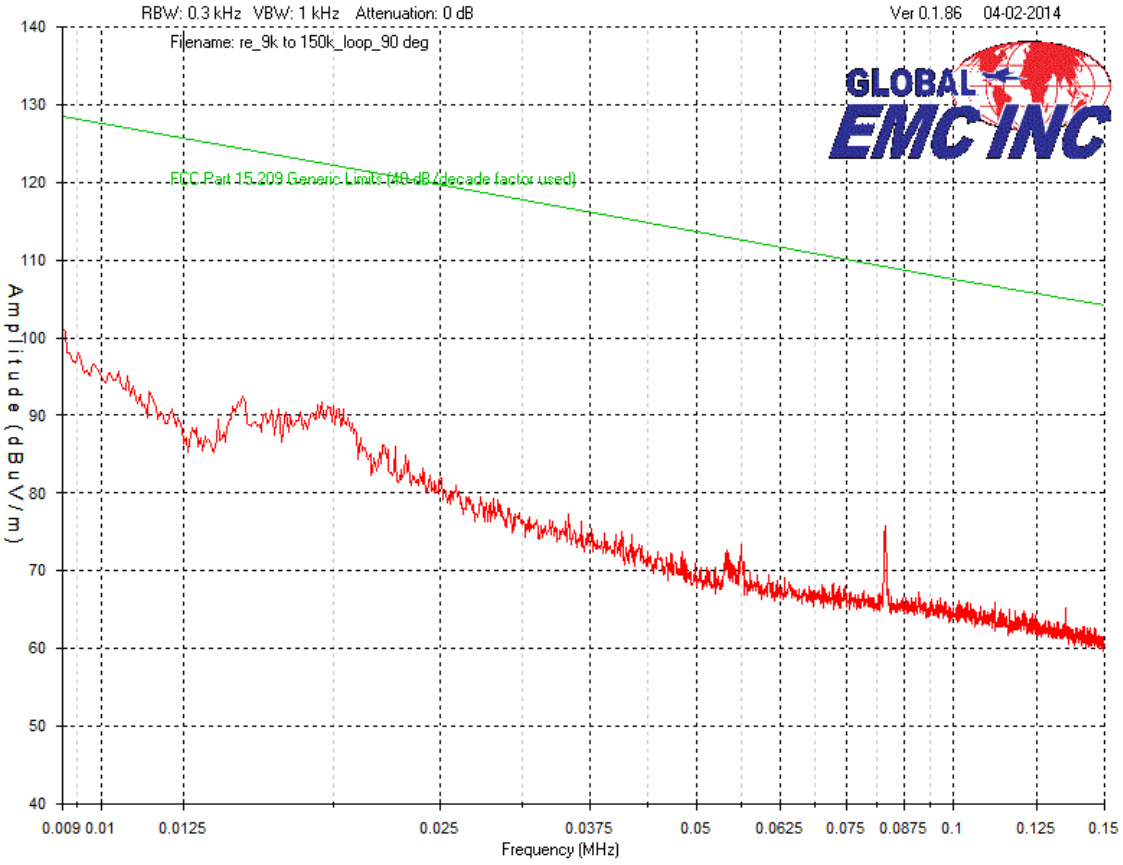


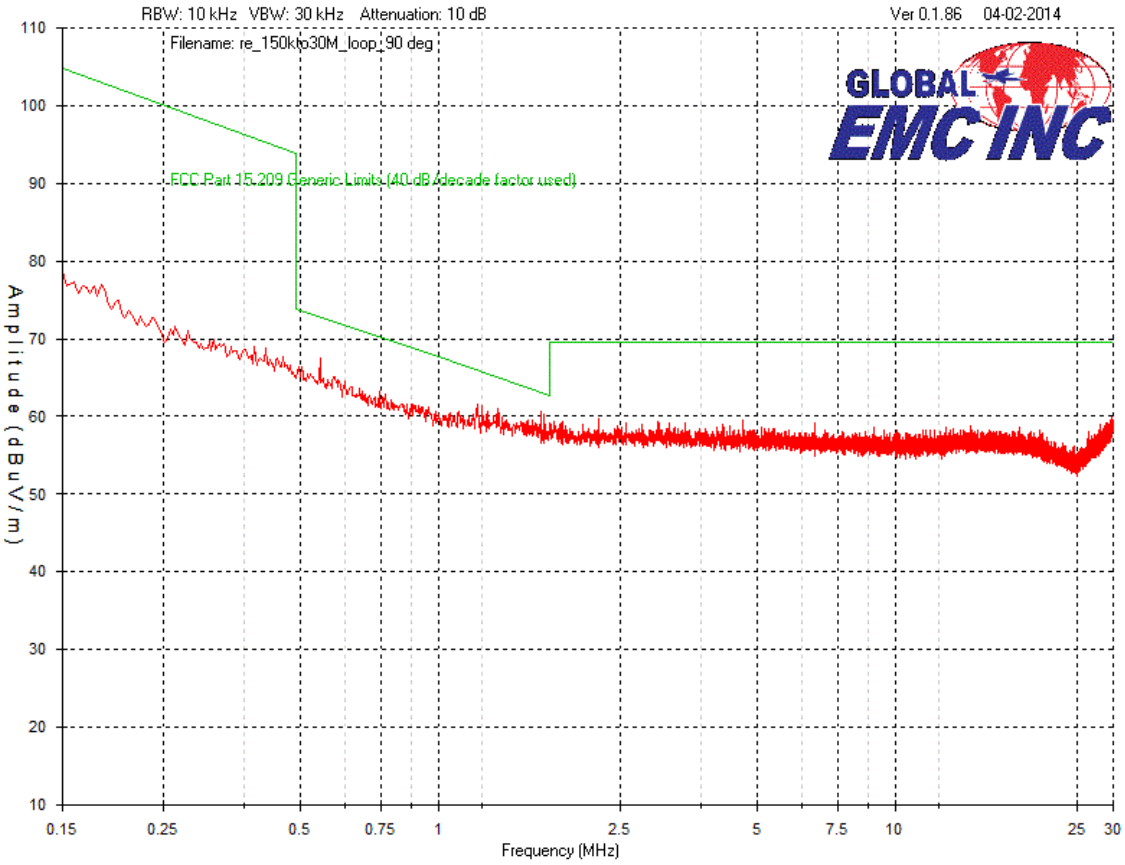
Vertical – Peak Emissions Graph



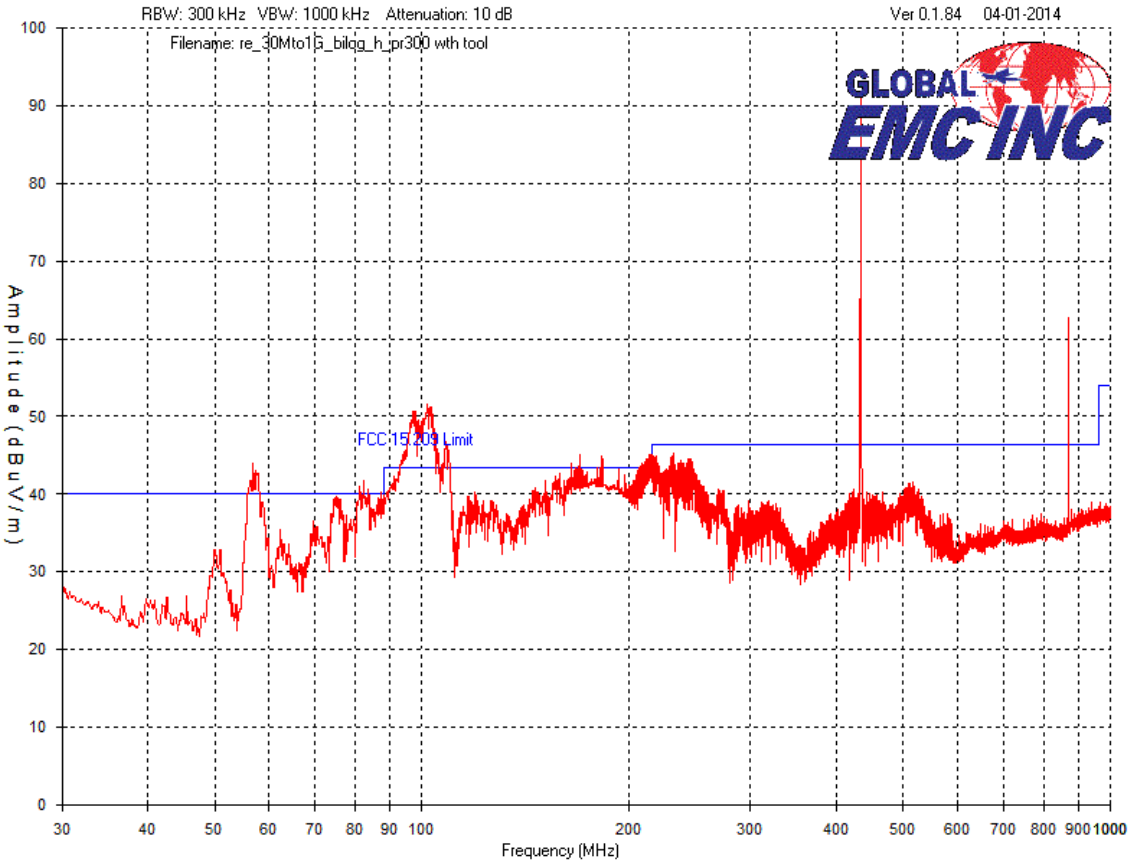


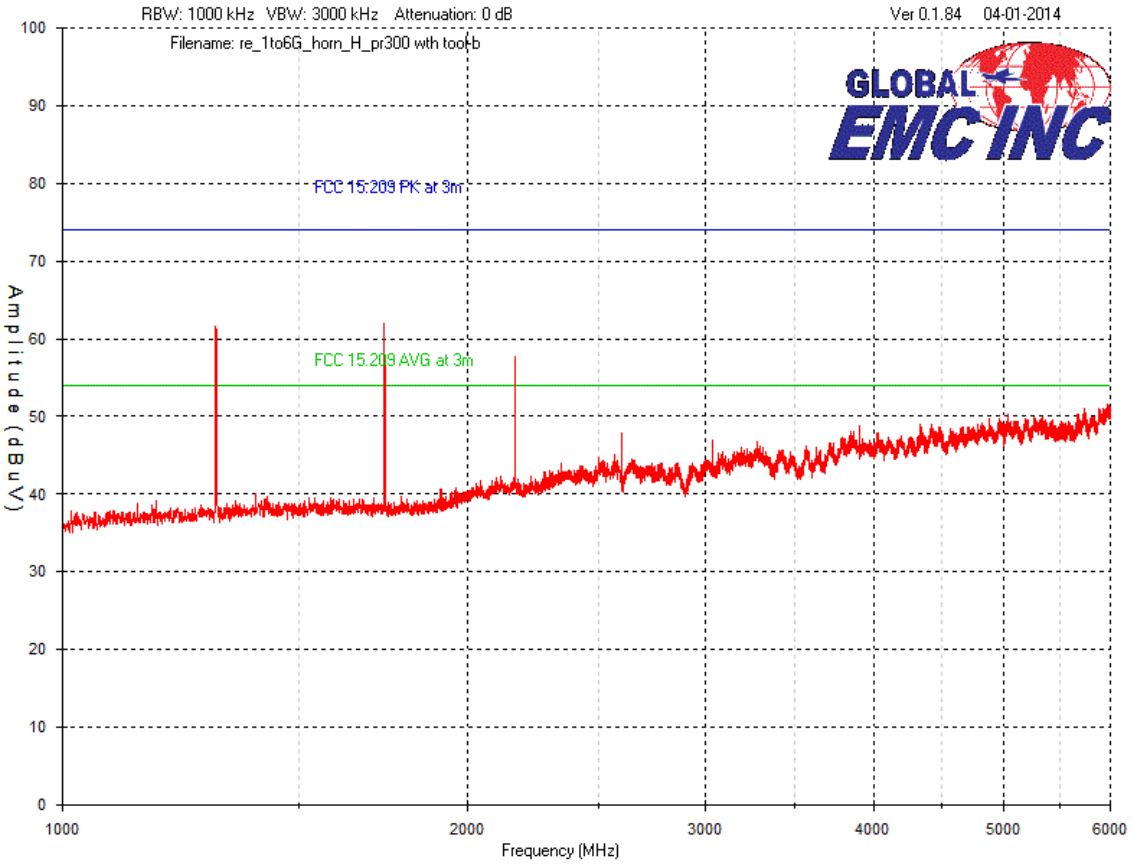
Loop @ 90 degree – Peak Emissions Graph





Horizontal – Peak Emissions Graph





Final Measurements

Test Frequency (MHz)	Detection mode	Antenna polarity (Horz/ Vert)	Raw signal dB(µV)	Antenna factor dB	Attenuator dB	Cable loss dB	Pre-Amp Gain dB	Received signal dB(µV/m)	Emission limit dB(µV/m)	Margin dB(µV)	Result
868	Peak	Horz	65.9	22.9	3	2.7	-28.5	66.0	80.8	14.8	PASS
868	Avg	Horz	49.9	22.9	3	2.7	-28.5	50.0	60.8	10.8	PASS
868	Peak	Vert	69.9	22.7	3	2.7	-28.5	69.8	80.8	11.0	PASS
868	Avg	Vert	53.9	22.7	3	2.7	-28.5	53.8	60.8	7.0	PASS
1302	Peak	Horz	67.9	25	0	3.4	-33.7	62.6	74	11.4	PASS
1302	Avg	Horz	51.9	25	0	3.4	-33.7	46.6	54	7.4	PASS
1302	Peak	Vert	72.2	25.6	0	3.4	-33.7	67.5	74	6.5	PASS
1302	Avg	Vert	56.2	25.6	0	3.4	-33.7	51.5	54	2.5	PASS
1736	Peak	Vert	72.0	24.9	0	3.9	-33.2	67.6	80.8	13.2	PASS
1736	Avg	Vert	56.0	24.9	0	3.9	-33.2	51.6	60.8	9.2	PASS
1736	Peak	Horz	66.5	24.8	0	3.9	-33.2	62.0	80.8	18.8	PASS
1736	Avg	Horz	50.5	24.8	0	3.9	-33.2	46.0	60.8	14.8	PASS
2170	Peak	Horz	59.1	27.2	0	4.6	-33.1	57.8	80.8	23.0	PASS
2170	Avg	Horz	43.1	27.2	0	4.6	-33.1	41.8	60.8	19.0	PASS
2170	Peak	Vert	57.0	27.1	0	4.6	-33.1	55.6	80.8	25.2	PASS
2170	Avg	Vert	41.0	27.1	0	4.6	-33.1	39.6	60.8	21.2	PASS

Note: Average measurements are shown by applying a duty cycle correction factor, as reported previously in this test report, to the peak data.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	1/22/13	1/22/15	4169
Quasi Peak Adapter	85650A	HP	1/23/13	1/23/15	4170
Loop Antenna	EM 6879	Electro-Metrics	10-11-13	10-11-15	4040
BiLog Antenna	3142-C	ETS	4/25/13	4/25/15	4002
Attenuator 3 dB	FP-50-3	Trilithic	N/A	N/A	4028
9kHz-1GHz, 28dB preamp	LNA 6901	Teseq	8-6-13	8-6-15	4036
Horn Antenna	ATH1G18G	AR	4/3/13	4/3/15	4003
1GHz-26.5GHz preamp	HP 8449B	HP	4/25/13	4/25/15	4006
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	4026
RF Cable 1M	LMR-400-1M-50OHM-MN-MN	LexTec	N/A	N/A	4039
RF Cable 10m	LMR-400-10M-50OHM-MN-MN	LexTec	NCR	NCR	4025

This report module is based on GEMC template "FCC - 15.209 - Radiated Emissions_Rev5.doc"

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

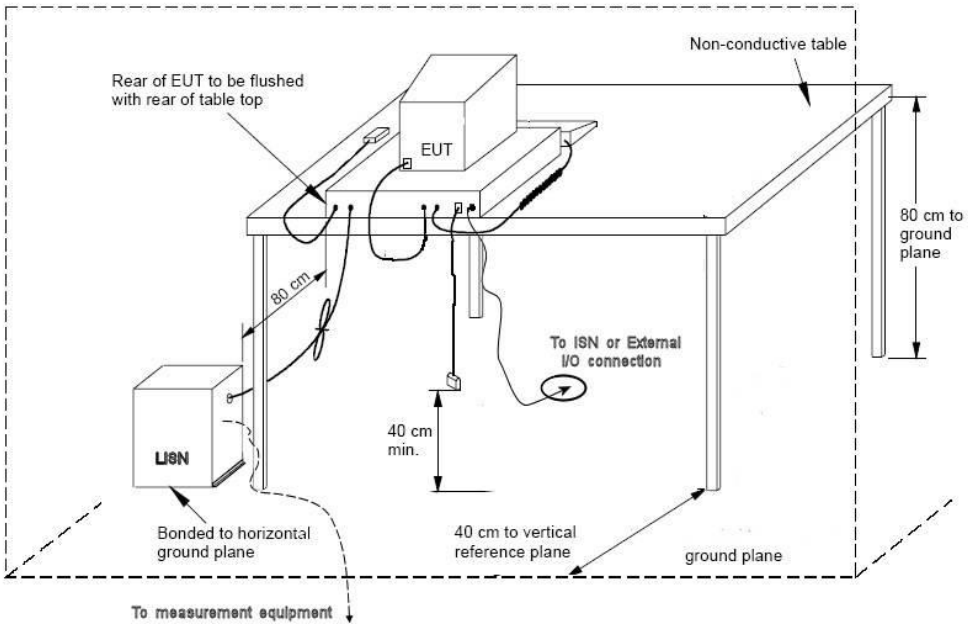
Average Limits		QuasiPeak Limits	
150 kHz – 500 kHz	56 to 46 dBuV	150 kHz – 500 kHz	66 to 56 dBuV
500 kHz – 5 MHz	46 dBuV	500 kHz – 5 MHz	56 dBuV
5 MHz – 30 MHz	50 dBuV	500 kHz – 30 MHz	60 dBuV

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

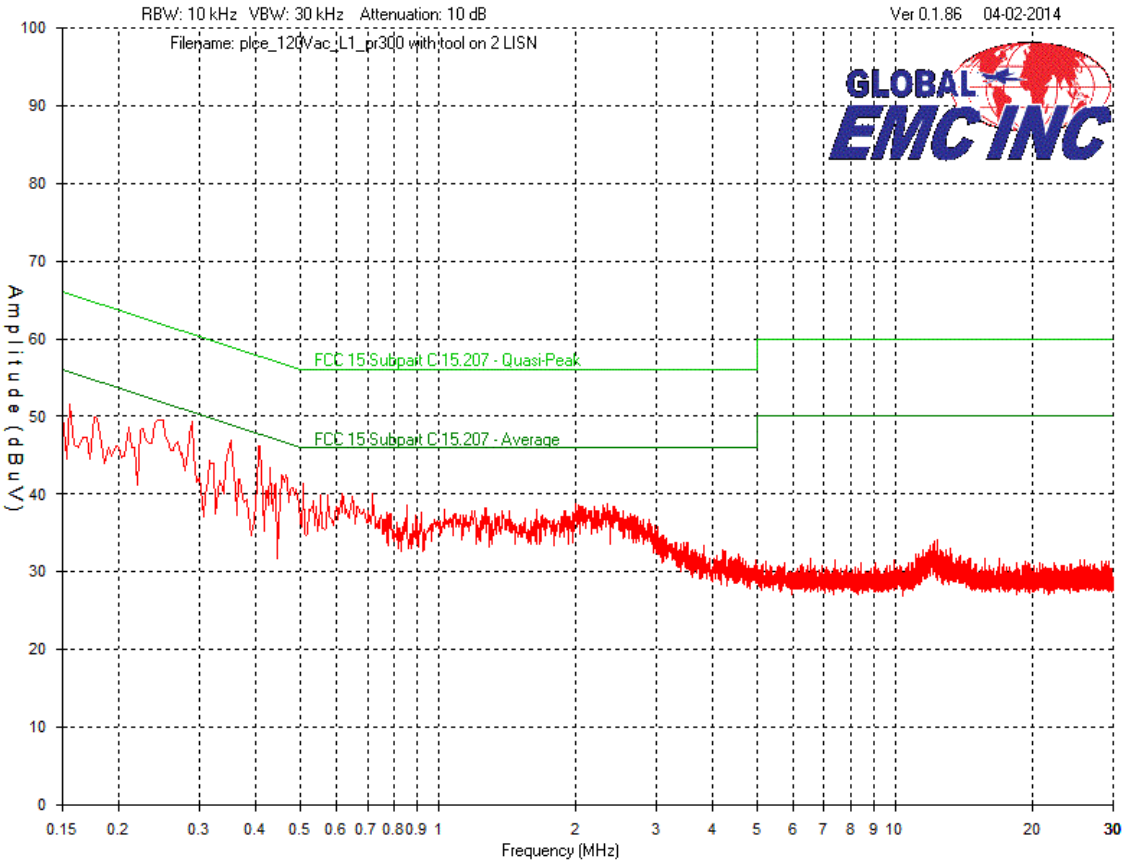
Measurement Uncertainty

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.

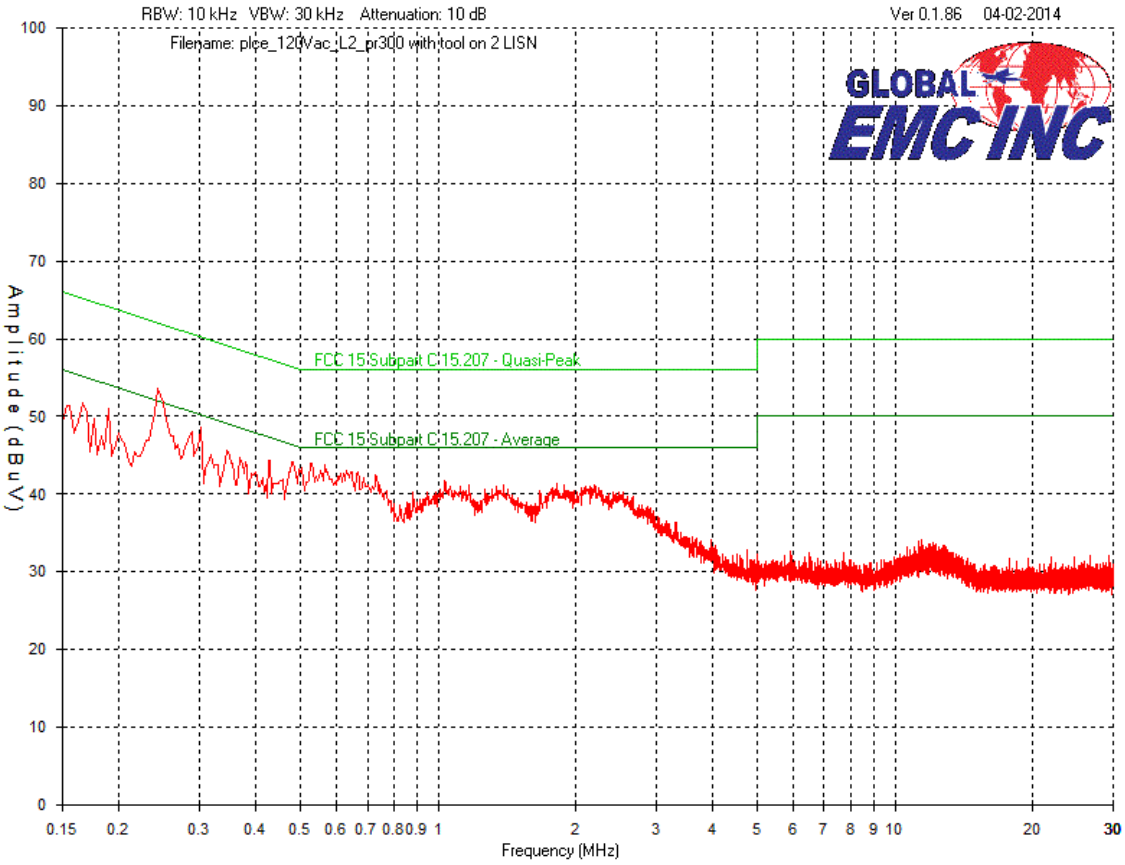
Preliminary Graphs

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.

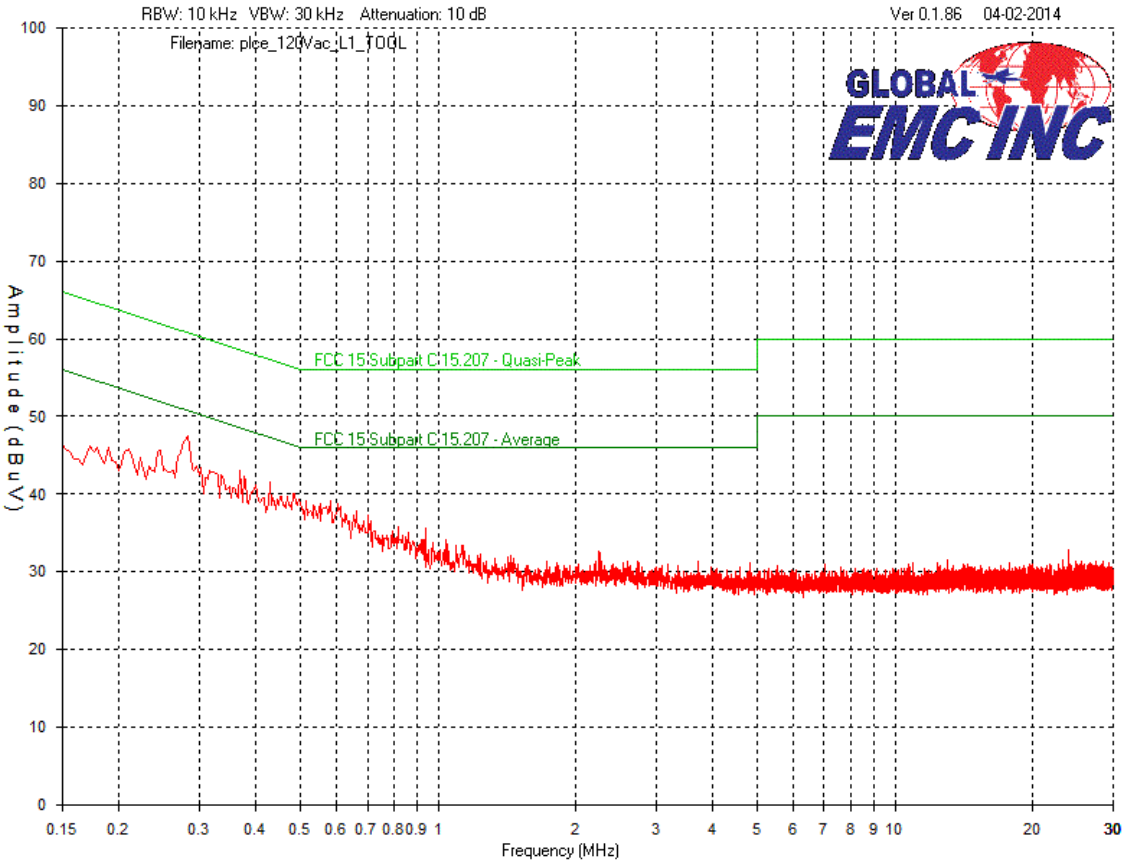
Phase (Black/Brown) - iVAC



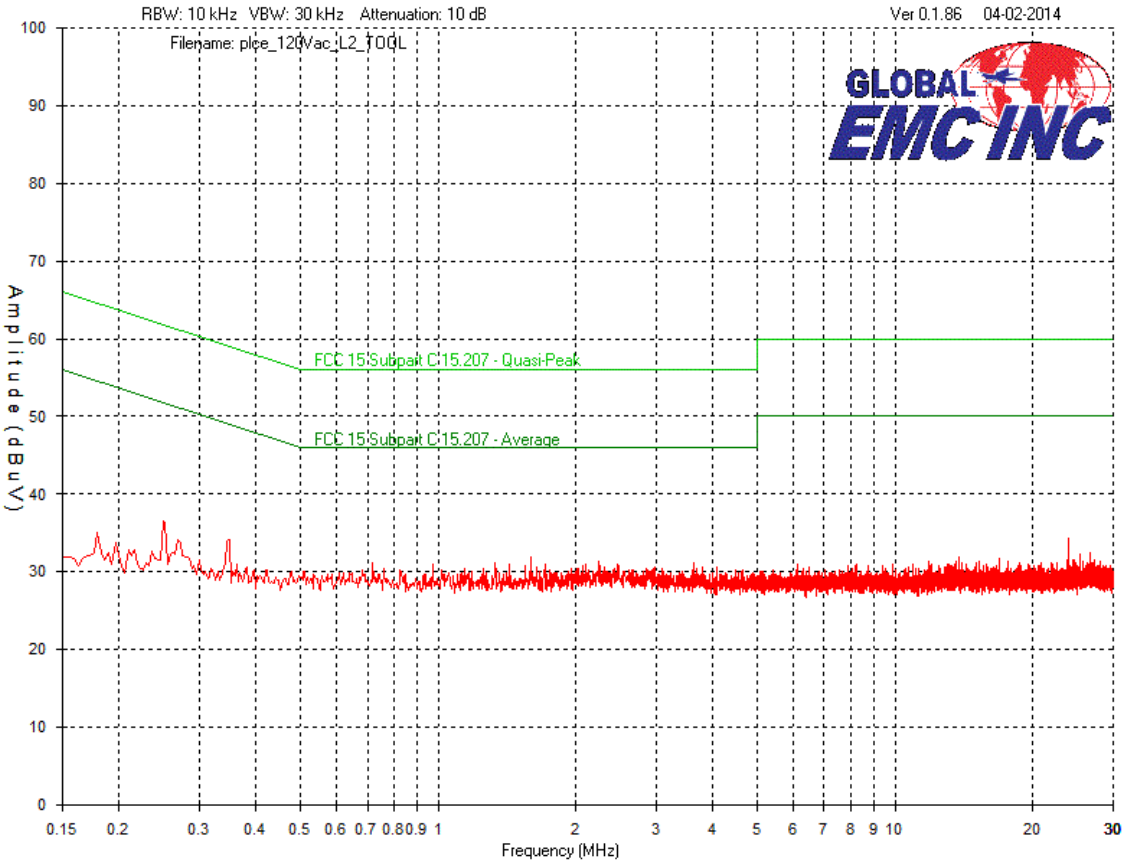
Neutral (White/Blue) - iVAC



Phase (Black/Brown) – Auxiliary Tool



Neutral (White/Blue) - Auxiliary Tool



Final Measurements

Peak Emissions vs. Average Limit Table - Line 1– 120Vac/60Hz

Test Frequency (MHz)	Det. mode	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	LISN factor (dB)	Emission Level (dBuV)	Emission limit (dBµV)	Margin (dB)	Result
0.2893	PEAK	38.7	10	0	0.6	49.3	50.5	1.2	PASS
0.4087	PEAK	36.0	10	0	0.2	46.2	47.7	1.5	PASS
0.3523	PEAK	36.5	10	0	0.3	46.8	48.9	2.1	PASS
0.2429	PEAK	38.8	10	0	0.8	49.6	52	2.4	PASS
0.4286	PEAK	33.2	10	0	0.2	43.4	47.3	3.9	PASS
0.4651	PEAK	32.3	10	0	0.2	42.5	46.6	4.1	PASS

Peak Emissions vs. Average Limit Table - Line 2 – 120Vac/60Hz

Test Frequency (MHz)	Det. mode	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	LISN factor (dB)	Emission Level (dBuV)	Emission limit (dBµV)	Margin (dB)	Result
0.2429	AVG	35.3	10	0	0.8	46.1	52	5.9	PASS
0.1999	AVG	31.8	10	0	1.1	42.9	54	11.1	PASS
0.2674	AVG	28.5	10	0	0.8	39.3	52	12.7	PASS
0.1898	PEAK	40.0	10	0	1.1	51.1	54	2.9	PASS
0.1666	PEAK	40.5	10	0	1.3	51.8	55.1	3.3	PASS
11.4134	PEAK	23.8	10	0.1	0.2	34.1	50	15.9	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#
HP Spectrum Analyzer	8566B	HP	2013-01-22	2015-01-22	4169
Spectrum Analyzer Display	8566B	HP	1-22-13	1-22-15	4168
Quasi Peak Adapter	85650A	HP	2013-01-23	2015-01-23	4170
LISN	FCC-LISN-50/250-16-2-01	FCC	2013-05-06	2015-05-06	4005
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	N/A	N/A	4025
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	N/A	N/A	4026
Attenuator 10 dB	FP-50-10	Trilithic	N/A	N/A	4027

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class A_Rev1"

Appendix A – EUT Summary

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

General EUT Description

Client Details	
Organization / Address	BCTINT Ltd. Unit 108 Iber Rd. Ottawa ON.K2S 1E9 Canada
Contact	Gary Lee
Phone	613 599 8988
Email	glee@bctint.com
Manufacturer Details (if not same as above)	
Organization / Address	Infotronics International. Lam Hing Street Hong Kong
Contact	Patrick Hui
Phone	852 27725232
Email	patrick@infotronic-int.com
EUT (Equipment Under Test) Details	
EUT Name (for report title)	iVAC Pro Tool Plus
EUT Model / SN (if known)	TPLUS
EUT revision	R6
EUT is powered using	The unit is powered by a 5Volt DC USB adaptor charger.
Input voltage range(s) (V)	5Volt DC +/- 5%
Frequency range(s) (Hz)	DC
Rated input current (A)	0.1Amps
Nominal power consumption (W)	0.5Watts
Number of power supplies in EUT	None
Transmits RF energy? (describe)	Rated output 0.001Watts
Frequency of all clocks present in EUT	4Mhz
I/O cable description Specify length and type	USB cable, 3M long. Power only

Available connectors on EUT	None
Peripherals required to exercise EUT Ex. Signal generator	AC powered device with a power cord and a current consumption of > 0.5Amps
Dimensions of product	L 95.25mm W 63.5mm H 44.5mm

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 information purposes only. Also refer to PDF files that are separate from this test report.

EUT's Photo

Radiated Emission Test Setup Photo #1:

Radiated Emission Test Setup Photo #2:

Radiated Emission Test Setup Photo #3:

Conducted Emission Test Setup Photo#1:

Conducted Emission Test Setup Photo#2: