FCC Test Report

FOR

Manufacturer: 3M
Model Number: X1044V
FCC ID: DGF-TSSDX1044VXU
IC CERTIFICATION NUMBER: 458A-TSSDX1044VX

47 CFR Part 15.231
IC RSS-210 Issue 9

TEST REPORT #: EMC_3MMMM_003_13001_FCC15.231
DATE: 2014-05-02

ACCREDITED
TESTING LABORATORY
Certificate #2135.01

CTIA Authorized Test Lab
LAB CODE 20020328-00

FCC
A2LA Accredited

IC recognized #
3462B-1

***CETECOM* Inc.**
411 Dixon Landing Road ◆ Milpitas, CA 95035 ◆ U.S.A.
Phone: + 1 (408) 586 6200 ◆ Fax: + 1 (408) 586 6299 ◆ E-mail: info@cetecomusa.com ◆ http://www.cetecom.com
CETECOM Inc. is a Delaware Corporation with Corporation number: 2905571

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1 Assessment

The following device was tested against the applicable criteria specified in FCC rules Parts 15.231 of Title 47 of the Code of Federal Regulations and Industry Canada Standards RSS210 Issue 8. No deviations were ascertained during the course of the tests performed.

Company	Description	Model #
3M	Tracking Device	X1044V

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2014-05-02	Compliance	Franz Engert (Manager Compliance)	Digitally signed by Franz Engert DN: cn=Franz Engert, c=US, o=CETECOM, ou=Complience, email=franz.engert@cetecom.com Date: 2014.05.02 17:27:04 -07'00'

Responsible for the Report:

Date	Section	Name	Signature
2014-05-02	Compliance	Josie Sabado (EMC Lab Manager)	

The test results of this test report relate exclusively to the test item specified in Section3.
CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Address:	411 Dixon Landing Road Milpitas, CA 95035 U.S.A.
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
Test Lab Manager:	Josie Sabado
Responsible Project Leader:	Yadvinder Garcha

2.2 Identification of the Client

Applicant's Name:	3M Electronic Monitoring
Street Address:	3M Center, Building 235-03-A-09
City/Zip Code	St. Paul, MN 55144
Country	USA
Contact Person:	Chris Defant
Phone No.	(651) 733-2990
Fax:	
e-mail:	jcdefant@mmm.com

2.3 Identification of the Manufacturer

Manufacturer's Name:	3M Electronic Monitoring
Manufacturers Address:	2 Habarzel St.
City/Zip Code	Tel Aviv/61131
Country	Israel

3 Equipment under Test (EUT)

3.1 Specification of the Equipment under Test

Product Type:	Portable
Prototype/Production:	Pre-Production
RF Exposure Environment:	General / Uncontrolled
Dimensions:	67 x 112 x 21 mm
Exposure Conditions:	Held next to the ear Body worn
Marketing Name:	Smart XT
Model No:	X1044V
FCC ID:	DGF-TSSDX1044VXU
IC Certification Number:	458A-TSSDX1044VX
Antenna Type:	Internal
Operating Voltage Range:	Vmin: 3.5V/ Vnom: 3.6V/ Vmax: 4.2V
Operating Temperature Range:	Tmin: 0°C/Tnom: 24°C Tmax: 50°C
Supported Radios:	CDMA UHF GPS receiver at 1.575 MHz
Power Back-Off Modes:	None
Date of Testing:	November 15, 2013 – November 18, 2013, April 10, 2014 – April 11, 2014

3.2 Technical Specification of Supported Radios

Signal Type	Duty Cycle	Type(s) of Modulation	Band	Transmit Frequency Range (MHz)	Measured Maximum Conducted Output Power (dBm)
CDMA	100%	QPSK, HPSK	Band Class 0	824.7 – 848.31	23.12
			Band Class 1	1851.25 – 1908.75	23.05
UHF[2]	100%	FM	N/A	433	-29.3
GPS[1]	N/A	N/A	L1	N/A	N/A

NOTES:
1. Bands are supported by the EUT, but outside of the scope of this test report.
2. Output power is an ERP value.

3.3 Identification of the Equipment Under Test (EUT)

EUT #	Serial Number	HW Version	SW Version	Comment
1	35437702	5.0	V5.1.6.0	Radiated Unit
2	35437696	5.0	V5.1.6.0	Radiated Unit
3		5.0	V5.1.6.0	Conducted Unit

3.4 Identification of Accessory equipment

AE #	Type	Manufacturer	Serial No.	Cetecom ID
1	AC Adaptor	Samcon P/N 70067	N/A	N/A

4 Subject of Investigation

The objective of the measurements done by CETECOM Inc. was to measure the performance of the EUT as specified by requirements listed in FCC rules Part 15.231 of Title 47 of the Code of Federal Regulations and Industry Canada Standards RSS 210 Issue 8.

This test report is to support a request for new equipment authorization under the
FCC ID: DGF-TSSDX1044VXU
IC ID: 458A-TSSDX1044VX

All testing was performed on the product referred to in Section 3 as EUT.
This test report contains full radiated and conducted testing results as per

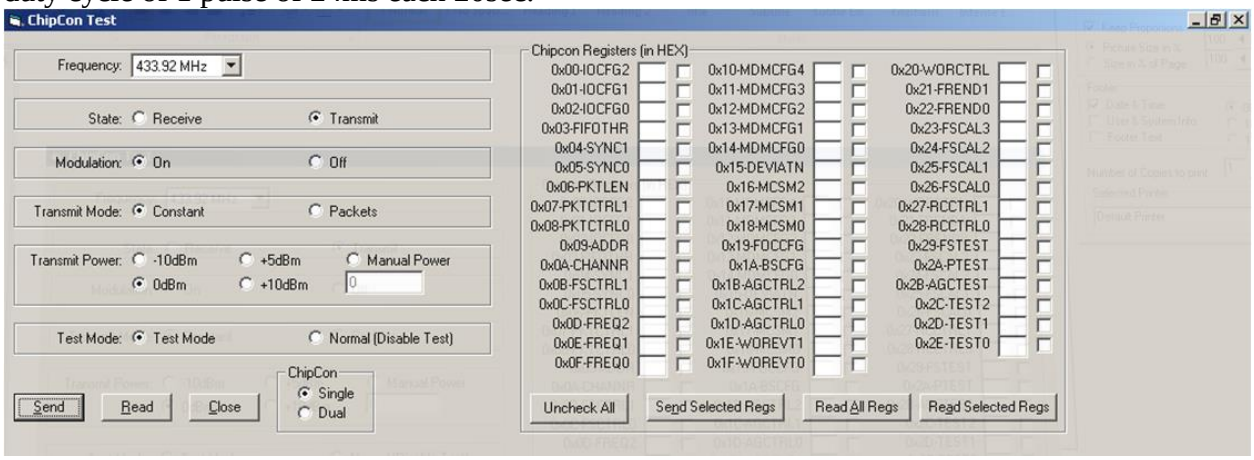
- 47 CFR Part 15: Title 47 of the Code of Federal Regulations: Chapter I-Federal Communications Commission subchapter A- General, Part 15- Radio Frequency Devices.
- RSS-210 Issue 8: Spectrum Management and Telecommunications-Radio Standards Specification. Low-power License-exempt radio communication devices (All frequency bands): Category 1 equipment.

5 Modes of operation:

Normal mode of operation is when EUT is connected to cargo and transmitting position via packet switched connection at interval of > 1min.

For feasibility of the measurement the fundamental and the emissions were measured with the transmitter permanently set to the -10**dBm power set point** that the product utilizes in the out of the box configuration. The ChipCon Test SW supplied by the manufacturer (screenshot below) was used to set the product to 433MHz transmission mode. According to the customer the power will be set to -10dBm on the market delivery SW version as this setting pass the fundamental field strength limits.
The spurious emissions have been measured with a +10dBm setting to establish a worst case scenario and be able to reuse the spurious measurements in case the customer is planning to change the power later on.

The duty cycle was measured with a tool provided by the manufacturer that sets the EUT to a worst case duty cycle of 1 pulse of 24ms each 20sec.



6 Testing Notes

Charger was changed to version listed above because initial charger was causing emission fails in 30MHz – 1GHz range. With current charger these emissions disappeared.

7 Summary of Measurement Results

Test Specification	Test Case	Temperature and Voltage Conditions	Pass	Fail	NA	NP	Result
§15.231 (e) RSS 210 A5 (b)	Transmitter Fundamental Field Strength	Nominal	■	☐	☐	☐	Complies
§15.231 (c)	Transmitter 20dB bandwidth	Nominal	■	☐	☐	☐	Complies
§15.231 (a) RSS 210 A5 (a)	Transmitter Duration	Nominal	■	☐	☐	☐	Complies
§15.35 (c) RSS 210 A5 (a)	Transmitter Duty Cycle	Nominal	■	☐	☐	☐	Complies
§15.231 (e) §15.209	Transmitter Radiated Emissions	Nominal	■	☐	☐	☐	Complies

Note: NA= Not Applicable; NP= Not Performed.

8 Measurements

8.1 Radiated Emissions Measurement Procedure

The radiated measurement is performed according to:
ANSI C63.4 (2009)
ANSI C63.10 (2009)

- The exploratory measurement is accomplished by running a matrix of 12 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to cover the 3 orthogonal axis of the EUT. A max peak detector is utilized during the exploratory measurement. The Test-SW creates an overall maximum trace for all 12 sweeps and saves the settings for each point of this trace. The maximum trace is part of the test report.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then put through the final measurement and again maximized in a 90deg range of the turntable, fine search in frequency domain and height scan between 1m and 4m.
- The above procedure is repeated for all possible ways of power supply to EUT and for all supported modulations.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 4 frequency ranges due to antenna bandwidth restrictions. A magnetic loop is used from 9kHz to 30MHz, a Biconlog antenna is used from 30MHz to 1GHz, two different horn antennas are used to cover frequencies up to 40GHz.

8.1.1 Sample Calculations

Measurements from the Spectrum Analyzer/ Receiver are used to calculate the Field Strength, taking into account the following parameters:

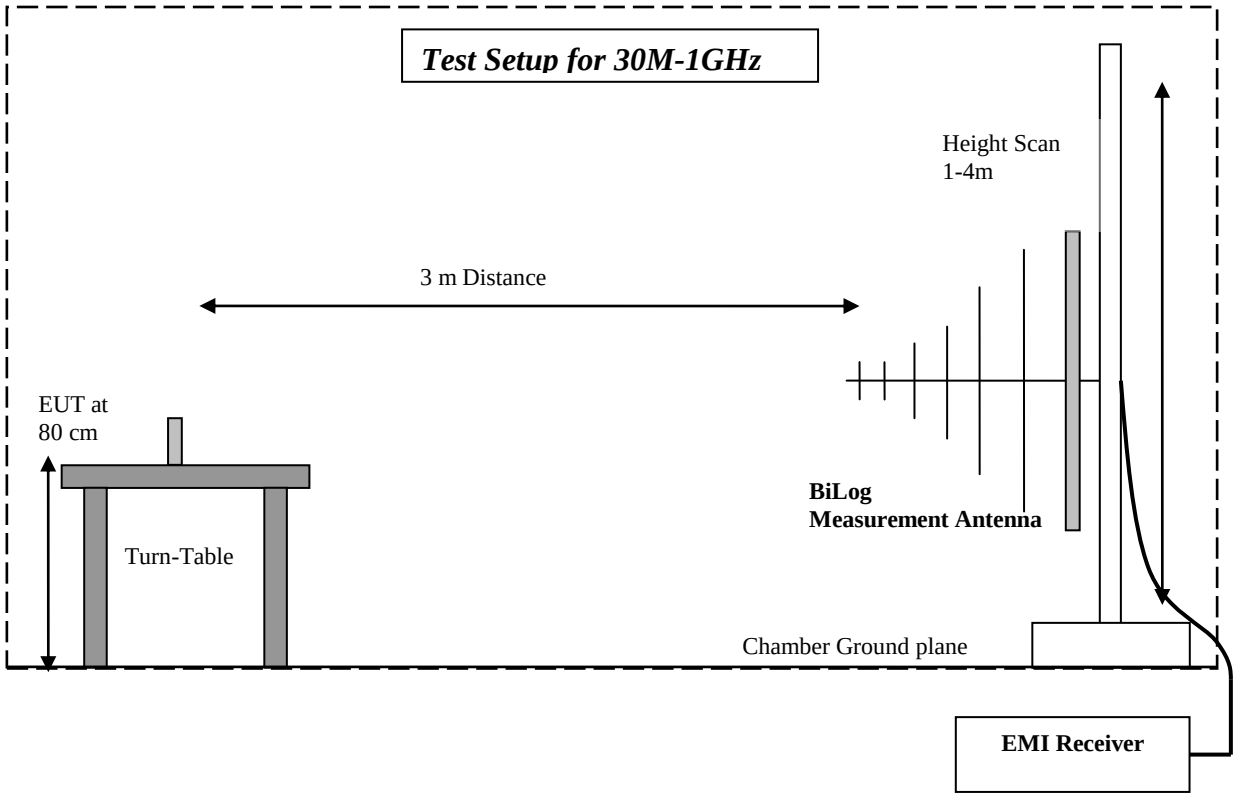
1. Measured reading in dBµV
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

FS (dBµV/m)= Measured Value on SA (dBµV)+ Cable Loss (dB)+ Antenna Factor (dB/m)
Eg:

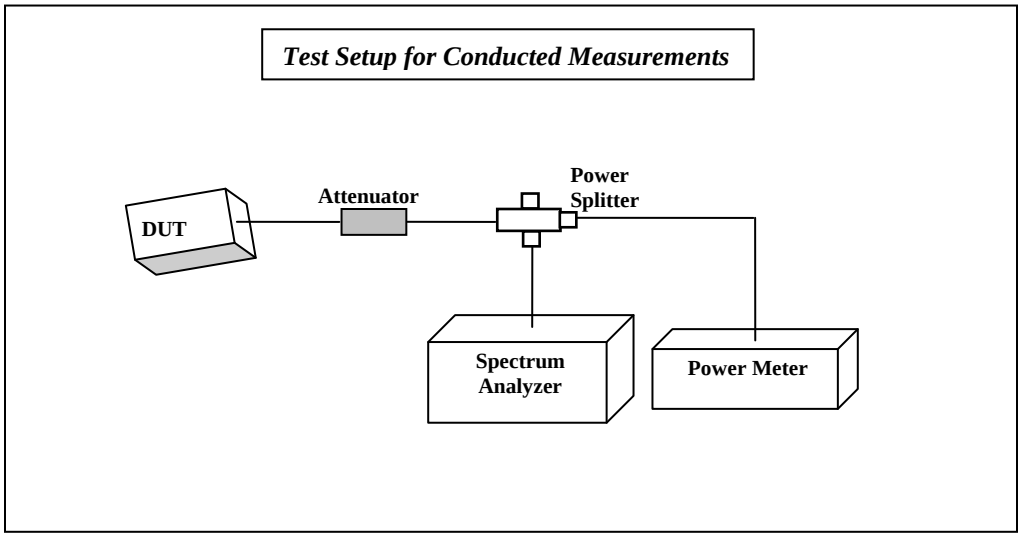
Frequency (MHz)	Measured SA (dBµV)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dBµV/m)
1000	80.5	3.5	14	98.0

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the above equation.

8.1.2 Radiated measurement setup



8.2 Conducted Measurement Procedure



1. Connect the equipment as shown in the above diagram.
2. The EUT is programmed using test utility provided by the manufacturer to set the required channel and operating mode.
3. Measurements are to be performed with the EUT set to the required transmit channel.

8.3 Measurement Uncertainty

	Uncertainty in dB radiated <30MHz	Uncertainty in in dB radiated 30MHz - 1GHz	Uncertainty in dB radiated > 1GHz	Uncertainty in dB Conducted measurement
standard deviation k=1	2.48	1.93	2.16	0.63
95% confidence interval in dB	4.86	3.79	4.23	1.24
95% confidence interval in dB in delta to Result	+-2.5 dB	+-2.0 dB	+- 2.3dB	+-0.7dB

8.4 Transmitter Fundamental Field Strength

8.4.1 Limits:

§15.231 (e)
Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided the intentional radiator complies with the provisions of paragraphs (b) through (d) of this section, except the field strength table in paragraph (b) of this section is replaced by the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emission (microvolts/meter)
40.66–40.70	1,000	100
70–130	500	50
130–174	500 to 1,500[1]	50 to 150[1]
174–260	1,500	150
260–470	1,500 to 5,000[1]	150 to 500[1]
Above 470	5,000	500

[1]Linear interpolations.
The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.
Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, 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. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.

For the EUT operating at 433.92 MHz, the fundamental field strength limit is calculated as follows:

Field Strength = (16.67 x F) – 2833.33 where F is the frequency in MHz
= 4400.1164 μV/m
= 72.88 dB μV/m

8.4.2 Test Conditions:

Tnom: 22°C; Vnom: 3V DC

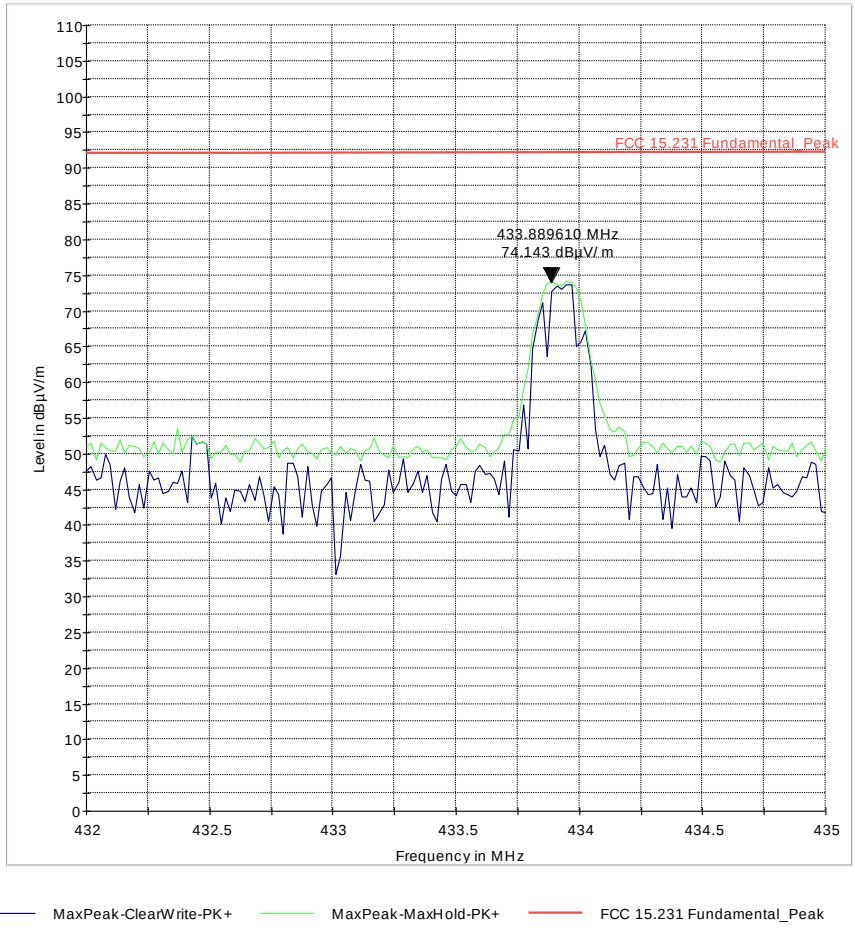
Spectrum Analyzer settings:

RBW=120 kHz; VBW=300 kHz; Detector: Average; Sweep Time: Auto; Span=3MHz
The result was maximized for all orientations of the EUT and H/V measurement antenna polarizations.

EUT settings:

Permanent transmission with duty cycle 100%
Set point for output power -10dBm

8.4.3 Test Data:



8.4.4 Measurement Result

Maximum power (dBµV/m at 3m)		Limit Average (dBµV/m)	Limit Peak (dBµV/m)	Verdict
Measured Peak value in dBuV/m	Calculated Average on worst case duty cycle in dBuV/m			
74.1	74.1 – 6.0 = 68.1	72.88	72.88 + 20 = 94.88	Pass

8.5 Transmitter 20dB Bandwidth

8.5.1 Limits:

§15.231 (c)
The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.
For 433.92 MHz transmitter, the 20 dB Bandwidth limit is 0.0025 x 433.92 MHz = **1084.8 kHz**.
Therefore, 20dB bandwidth should be <1084.8 kHz.

8.5.2 Test Conditions:

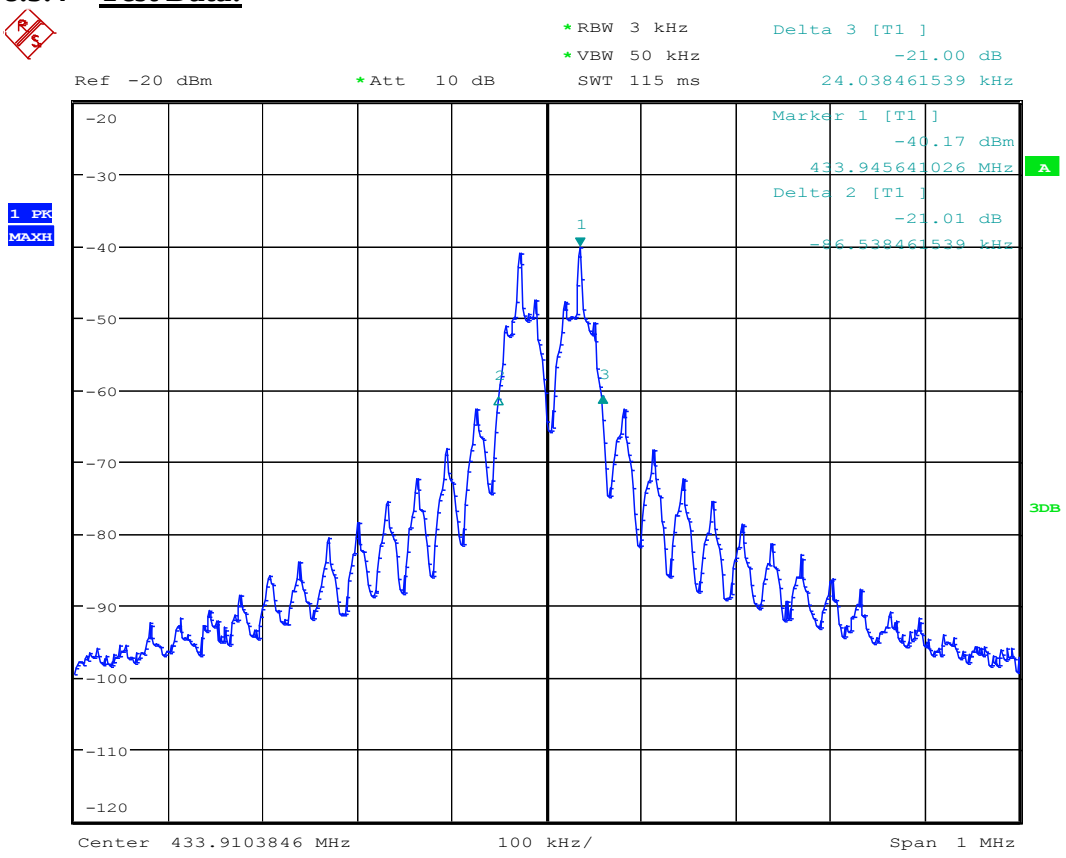
Tnom: 22°C; Vnom: 3V DC

Spectrum Analyzer settings:
RBW = 3kHz, VBW = 50 kHz, Detector: Peak- Max hold;
Sweep Time: 115ms
Span = 1 MHz

8.5.3 Measurement Result

Measured 20 dB bandwidth (kHz)	20 dB Bandwidth Limit(kHz)	Verdict
24.0 + 86.5=110.5	1084.8	**Pass**

8.5.4 Test Data:



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Date: 11.APR.2014 10:16:49

8.6 Transmitter Duty Cycle

8.6.1 Reference:
§15.35 (c)

8.6.2 Test Conditions:
Tnom: 22°C; Vnom: 3V DC

8.6.3 Spectrum Analyzer settings:
RBW=10MHz, VBW=10 MHz, Detector: Peak
Sweep Time: 21s/100ms
Span=Zero

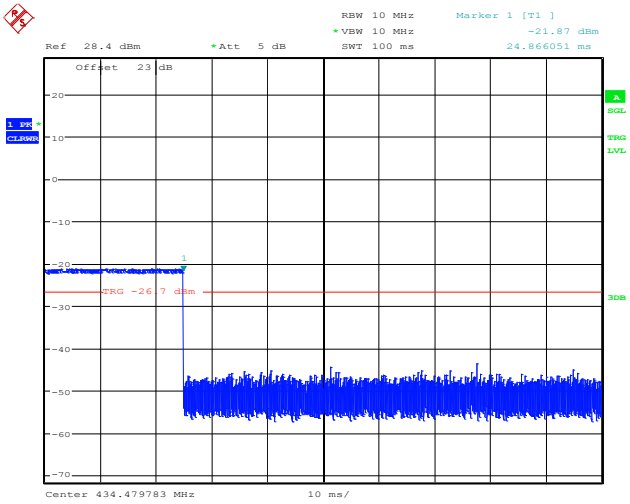
8.6.4 Measurement Result
Transmit on time = 24.9ms;
Period = 20s -> According to §15.35 (c) the maximum period for the correction is 100ms.
Duty Cycle = 24.9ms/100ms = 24.9 %

Correction factor [dB] = 20 Log (Duty Cycle) = 12.0dB

Note:
This correction formula is taken from C63.10 section 7.5 and 7.6. The standard explicitly describes that measured values in dBuV shall be corrected for duty cycle according to the above formula.

8.6.5 Test Data:

ON Time:



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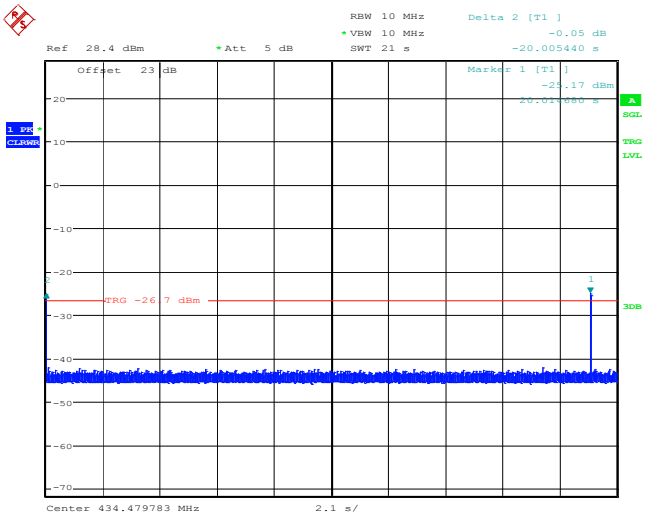
Date: 9.APR.2014 13:17:56

Period:



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Date: 9.APR.2014 13:20:09

8.7 Transmitter Spurious Emissions- Radiated

8.7.1 References:

FCC CFR 2.1053
FCC CFR 15.231 (e) and 15.209

8.7.2 Measurement requirements:

FCC 2.1053: Field strength of spurious radiation.
Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission.

8.7.3 Limits:

§15.231 (e)

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emission (microvolts/meter)
40.66–40.70	1,000	100
70–130	500	50
130–174	500 to 1,500[1]	50 to 150[1]
174–260	1,500	150
260–470	1,500 to 5,000[1]	150 to 500[1]
Above 470	5,000	500

8.7.4 Measurement Settings:

Peak detector used for the measurements- with RBW=120KHz for measurements below 1GHz and RBW= 1MHz for measurements above 1GHz.
Testing performed up to 10x Transmit frequency.

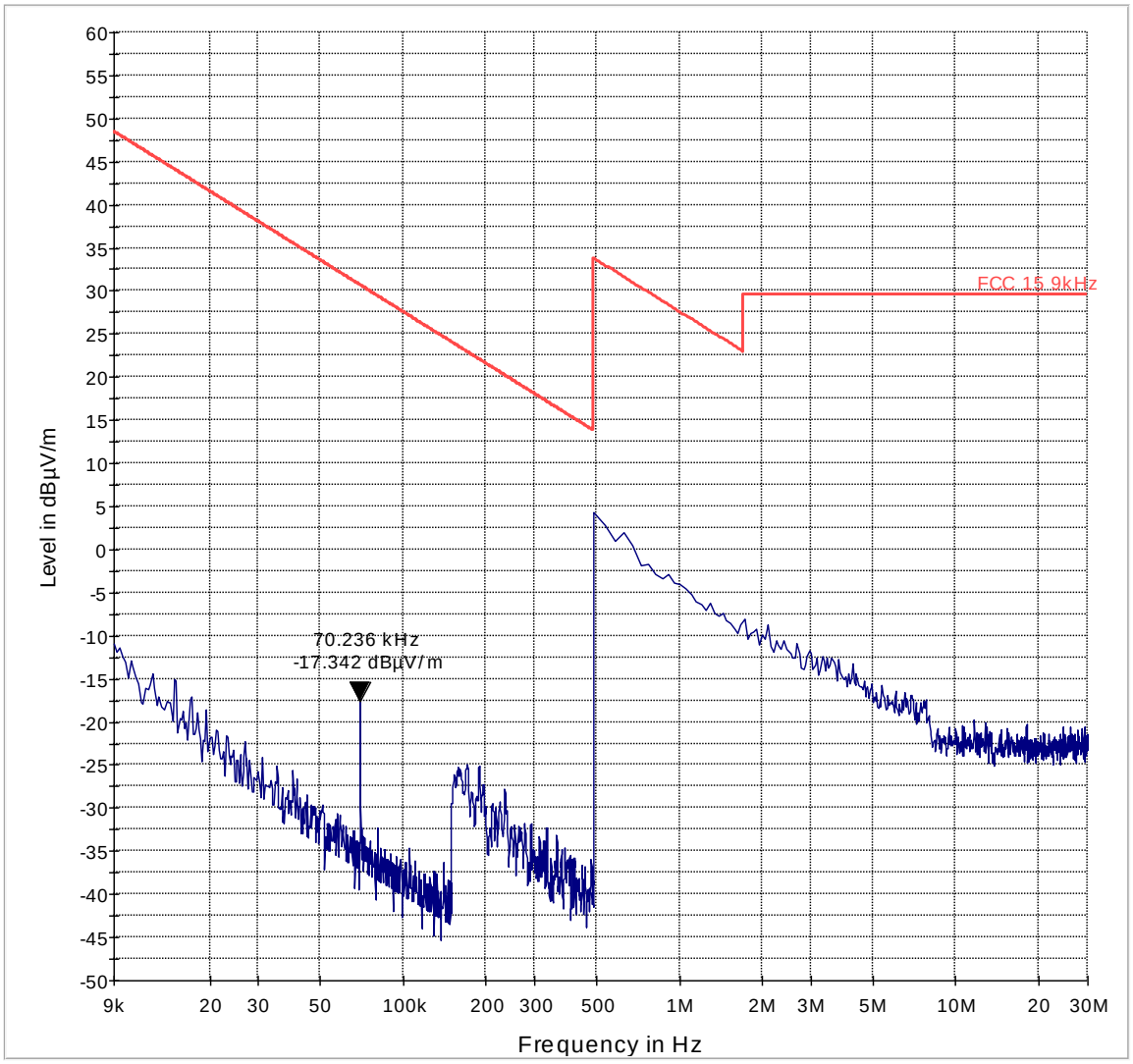
Measurement distance= 3m

8.7.5 Measurement Result

Pass.

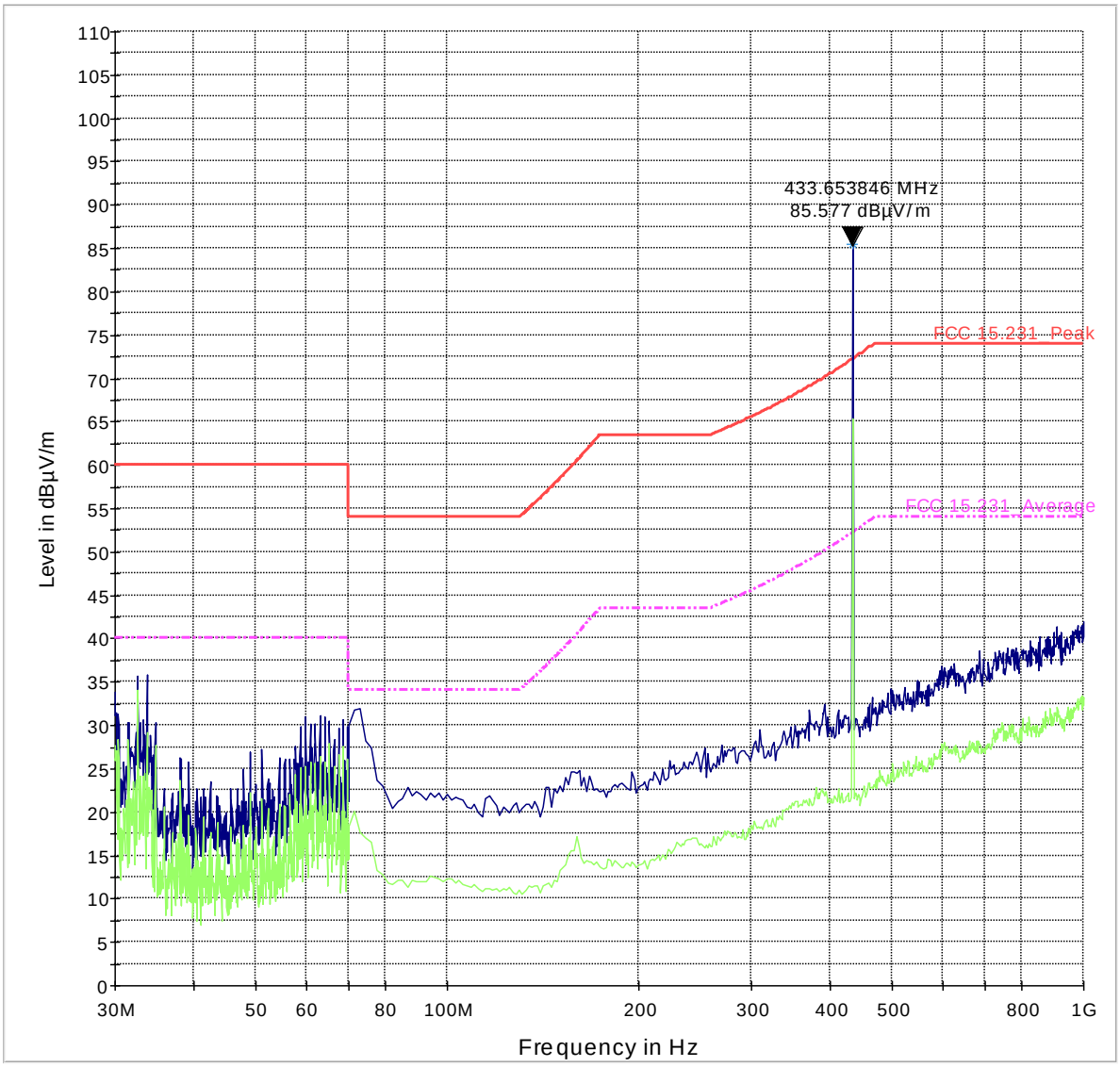
8.7.6 Test data/ plots:

Radiated spurious emissions: 9kHz- 30MHz

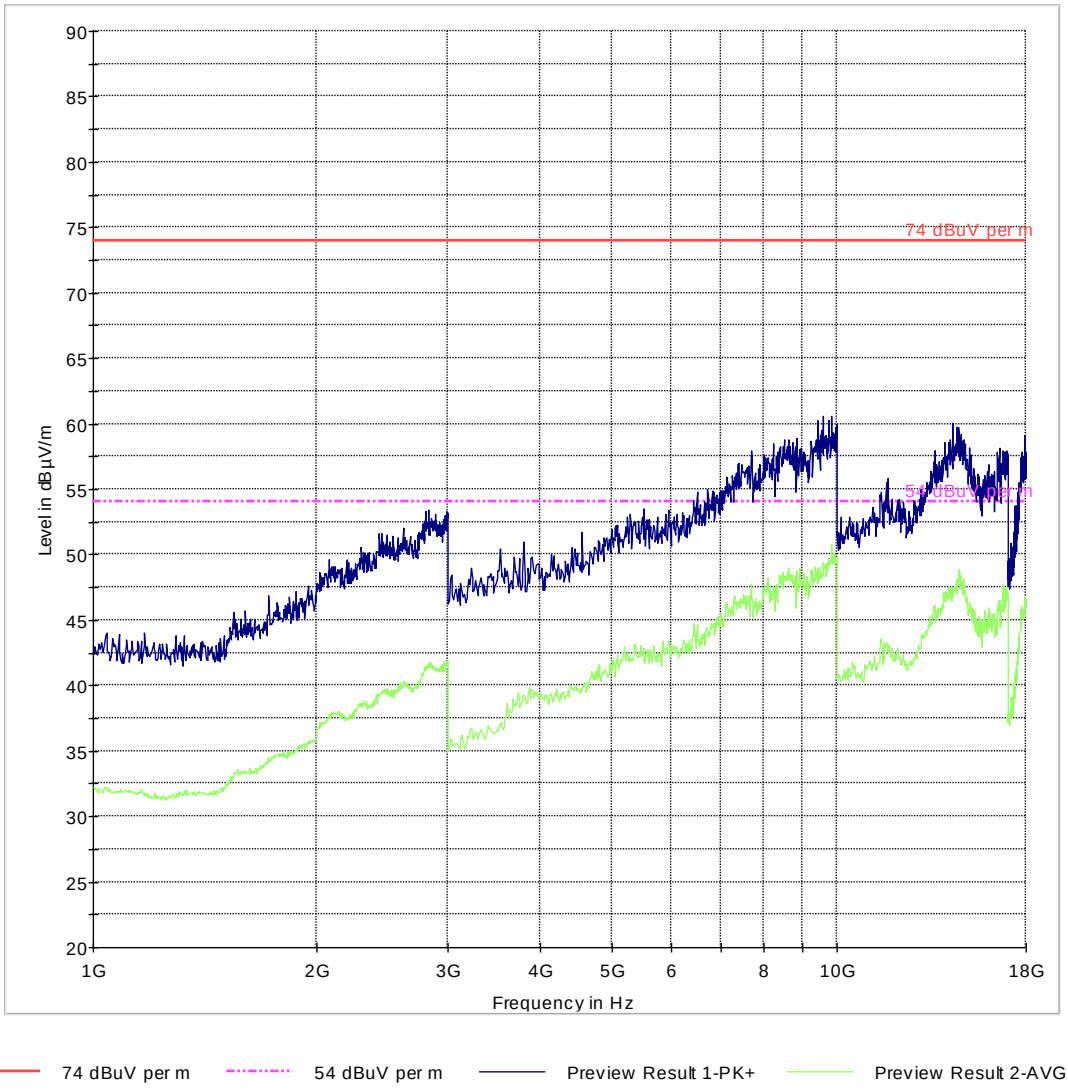


Radiated spurious emissions: 30M-1GHz

Measurement with both Peak and Average detector shown below.
Signal above the limit line is from the 433 MHz Transmitter.



Radiated spurious emissions: 1GHz-18GHz

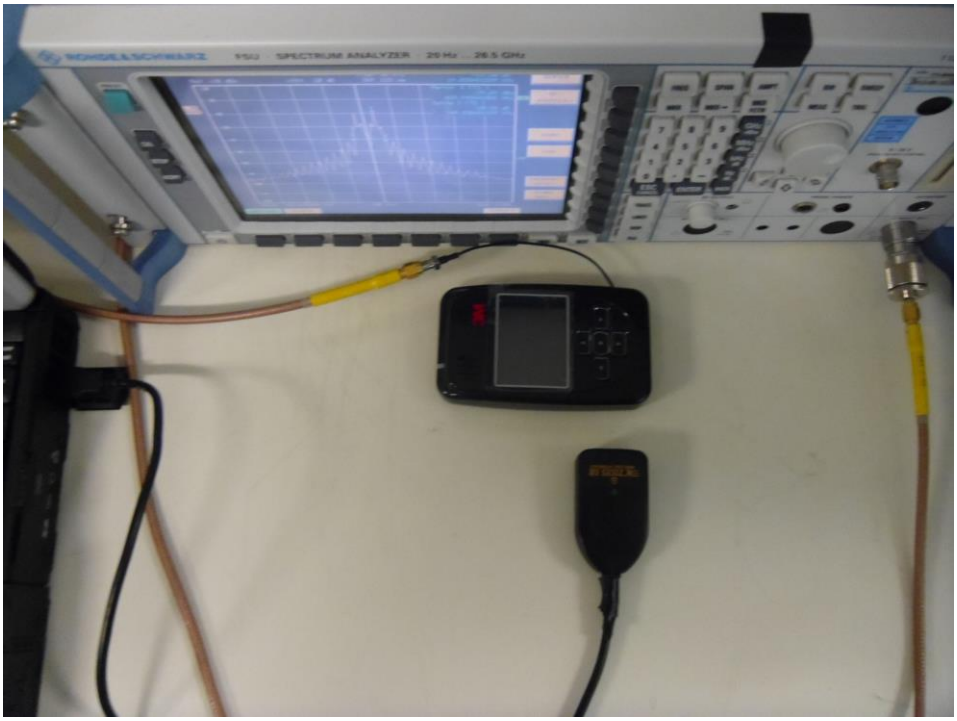


9 Test Equipment and Ancillaries used for tests

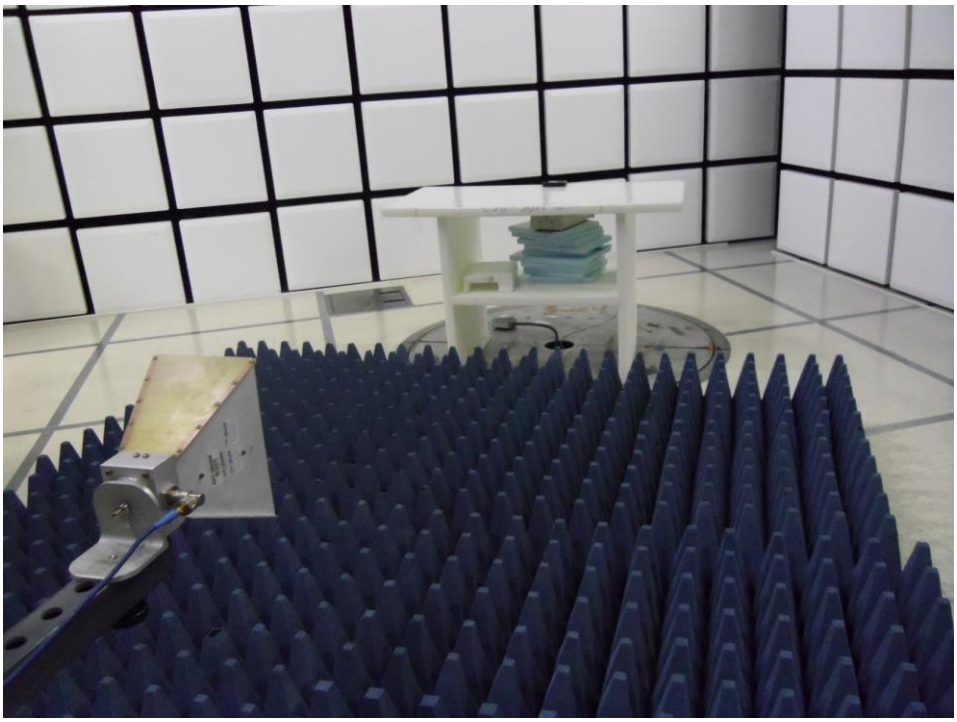
Item Name	Manufacturer	Equipment Type	Model	Serial #	Calibration Cycle	Last Calibration Date
Binconlog Antenna 3141	EMCO	Binconilog Antenna	3141	0005-1186	3 years	4/5/2012
Digital Radio Comm. Tester CMU 200# 4	R&S	Digital Radio Comm. Tester	CMU 200# 4	110229	2 Years	6/15/2013
Digital Radio Comm. Tester CMU 200 #1	R&S	Digital Radio Comm. Tester	CMU 200 #1	101821	2 Years	6/17/2013
Digital Radio Comm. Tester CMU 200 #2	R&S	Digital Radio Comm. Tester	CMU 200 #2	109879	2 Years	6/15/2013
Digital Radio Comm. Tester CMU 200 #3	R&S	Digital Radio Comm. Tester	CMU 200 #3	110759	2 Years	6/15/2013
ESU Receiver	R&S	EMI Receiver	ESU40	100251	2 Years	9/13/2013
Horn Antenna 3115	EMCO	Horn Antenna	3115	35114	3 years	3/6/2012
Horn Antenna 3116	EMCO	Horn Antenna	3116	70497	3 years	3/2/2012
LISN ESH3-Z5	R&S	LISN	ESH3-Z5	836679/003	2 Years	6/18/2013
LISN ESH3-Z6	R&S	LISN	ESH3-Z6	836154/011	2 Years	6/16/2013
LISN FCC-LISN-50-25-2-08	FCC	LISN	FCC-LISN-50-25-2-08	70497	2 Years	7/12/2012
Log Periodic Antenna 3149	ETS Lindgren	Log Periodic Antenna	3149	1186	3 years	8/23/2011
Loop Antenna 6512	ETS Lindgren	Loop Antenna	6512	49838	3 years	8/1/2011
Thermometer Humidity TM320	Dickson	Thermometer Humidity	TM320	5280063	1 Year	4/15/2013
Thermometer Humidity TM325	Dickson	Thermometer Humidity	TM325	5285354	2 Years	4/15/2013

10 Setup Pictures

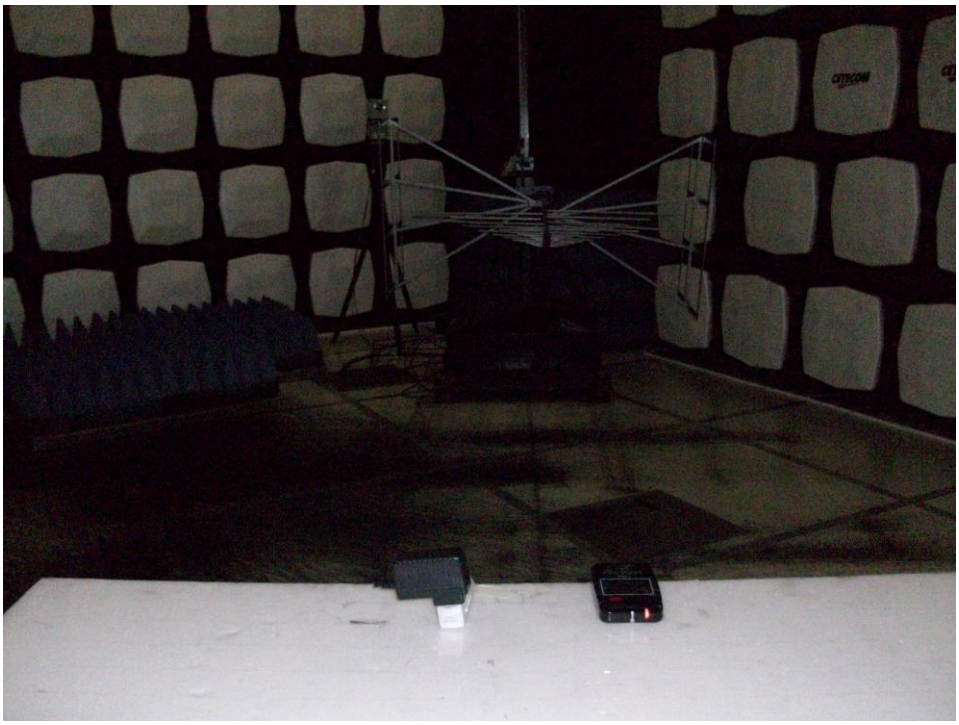
Conducted measurements:



Radiated >1GHz:



Radiated <1GHz



11 Revision History

Date	Report Name	Changes to report	Report prepared by
2014-05-02	EMC_3MMMM_003_13001_FCC15.231	Initial Version after adding IC Canada scope.	Franz Engert