

Electromagnetic Compatibility

Test Report

FCC CFR47 Part 15 Subpart B, Subpart C 15.231, RSS Gen issue 4, ICES-003 Issue 5 & RSS 210 issue 8, Annex 1

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Testing laboratory: Quality Auditing Institute
Address: 3980 North Fraser Way, Burnaby, BC, V5J 5K5, Canada

Accreditations (ISO 17025):



Standard Council of Canada: Accredited Laboratory No. 743

International Accreditation Service Inc: Accredited Laboratory: No. TL-239

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Applicant's name: Smart Gadget Design
Address.....: 2060 Cortell Street, North Vancouver, BC, Canada V7P 2A5
Phone.....: (778) 388-7100

Test Standard.....: FCC CFR47 Part 15 Subpart B, Subpart C 15.231,
RSS Gen issue 4 & RSS-210 Issue 8 Annex 1

Test item description.....: 433 MHz Periodic Transmission Transmitter
Manufacturer.....: Smart Gadget Design
Model Number.....: ROSE1
FCC Registration (FRN).....: 0025133018
FCC ID: 2AGV7ROSE1
IC Certification No.: 20974-ROSE1

Revision History

Date	Report Number	Rev #	Details	Authors Initials
Dec-1-2015	E10740-1501	0.0	Draft Test Report	JQ
January 11, 2016	E10740-1501_SGD- ROSE1	1.0	Final Test Report	JQ
January 18, 2016	E10740-1501_SGD- ROSE1	2.0	Final Test Report	JQ
All previous versions of this Report have been superseded by the latest dated Revision as listed in the above table. Please dispose of all previous electronic and paper printed revisions accordingly.				

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EMC TEST SUMMARY

The following tests demonstrate the testimony to “FCC & IC” Mark Electromagnetic compatibility testing for “ROSE1” manufactured by Smart Gadget Design. The testing was performed pursuant to FCC CFR47 Part 15 Subpart B, Subpart C 15.231 15.212; RSS Gen issue 4, ICES-003 Issue 5 & RSS 210 issue 8, Annex 1

Test Item		Applicable Standard	Description	Performance Criteria
Part 1	Radiated Emissions	FCC CFR47 Part 15 Subpart B; RSS Gen issue 4, ICES-003 Issue 5	Measurements were performed in stand by mode(i.e. transmitter was not activated)	Complies
Part 2	Transmitter Radiated Emission	FCC CFR47 Part 15 Subpart C 15.231 15.212; RSS Gen issue 4 & RSS 210 issue 8, Annex 1	Field strength of fundamental and spurious emission are measured in the 30MHz-3.3Hz range	Complies
Part 3	Duty Cycle	FCC Part 15.35	Duty cycle correction	Complies
Part 4	20 dB Bandwidth	FCC CFR47 Part 15 Subpart C 15.231; RSS Gen issue 4 & RSS 210 issue 8, Annex 1	The bandwidth of the emission shall be no wider than 0.25% of the center frequency	Complies
Part 5	Transmitter Timing	FCC CFR47 Part 15 Subpart C 15.231; RSS Gen issue 4 & RSS 210 issue 8, Annex 1	A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.	Complies

Tests were conducted on a sample of the equipment as requested by Smart Gadget Design for the purpose of demonstrating compliance with FCC CFR47 Part 15 Subpart B, Subpart C 15.231; RSS Gen issue 4, ICES-003 Issue 5 & RSS 210 issue 8, Annex 1. Smart Gadget Design is responsible for the tested product configuration, continued product compliance with these standards listed, and for the appropriate auditing of subsequent products, as required. Please note that this list of tests may only comprise a partial list of the tests that are required before a FCC or IC label can be produced by the manufacturer.

This is to certify that the following report is true and correct to the best of our knowledge.



Written by Jack Qin
 RF/EMC Test Engineer/Technical Writer



Director of Business & Technical
 Development - EMC Division

PRODUCT DESCRIPTION

Equipment Under Test (EUT) DESCRIPTION:

FRN	0025133018
FCC ID	2AGV7ROSE1
IC Certification No.	20974-ROSE1
Model No.	ROSE1
Manufacturer	Smart Gadget Design
Transmitter Type	Short range device
Transmitter Frequency	433.9 MHz
Worst Transmit Power	79.63dB _μ V/m @ 3m distance at 433.9MHz
EUT Power	4.4Vdc,
Received Date	Nov-03-2015
Received By	Parm Singh
Sample Log	QAI Product Control Log (QM 1305 - Sample Inventory)

Antenna Information

Description	Copper Spring Antenna
Manufacturer	Nicerf (www.nicerf.com)
Part Number	SW433-TH10
Frequency Range	433 MHZ
Gain	2.15 db
Impedance	50 ohm
Max Power	10 W
Return Loss	<=1.8
Length	11.3 +/- 1mm
Width	5.5 +/- .1mm



ROSE1 (EUT)

FACILITIES AND ACCREDITATION

Main Laboratory Headquarters: Quality Auditing Institute
Headquarters Location/Address: 3980 North Fraser Way, Burnaby, BC, V5J 5K5, Canada
Associated Laboratory: Quality Auditing Institute
FCC Test Site Registration Number: (3 m /10 m Open Area Test Site [OATS]): 226383
FCC Designation Number: CA9543
Industry Canada Test Site Registration Number (OTAS) :9543C-1
Standard Council of Canada: ISO/IEC 17025:2005 Accredited Laboratory No. 743
International Accreditation Service Inc.: ISO/IEC 17025:2005 Accredited Laboratory: No. TL-239
US EMC Facility:
FCC Test Site Registration Number: 307482
FCC Designation Number: US1151
Industry Canada Test Site Registration Number (3m SAC): 11876A

ENVIRONMENTAL CONDITIONS:

INDOORS, Temperature: 22-28°C, R.H.: 39.7 - 54.4%

TESTING METHODOLOGY

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC CFR47, Part 15, Subpart C Section 15.231, 15.212, RSS Gen issue 4 & RSS 210 issue 8, Annex 1. Radiated tests were conducted in accordance with ANSI C63.4-2014 and ANSI C63.10:2013

EUT TESTING CONFIGURATION

EUT was powered up by 4.4Vdc and set up to transmit continuously in modulated modes of operation.

WORST TEST CASE

Worst-case orientation was determined by rotating the EUT on three axes, during the pre-compliance test and final radiated emissions tests were performed in that orientation. The worst case was determined when the EUT is sitting in vertical position and transmitting in channel 1 in vertical configuration.

GENERAL TEST PROCEDURES

Radiated Emissions

The EUT is placed on the turntable 0.8m above a ground plane 3m away from a receiving antenna. Height of receiving antenna varied from 1m to 4m, its polarity changes from vertical to horizontal. Turntable rotates 360 degrees. Motion of turntable and receiving antenna allows determining position of maximum emission level. Quasi-peak detector applies for measurements of emissions with frequency range of 30 to 1000MHz. and average/peak detector otherwise.

MEASUREMENT UNCERTAINTY

Radio Frequency	: $\pm 1,5 \times 10^{-5}$
Total RF power, conducted.....	: ± 1 dB
RF power density, conducted.....	: ± 2.75 dB
Spurious emissions, conducted.....	: ± 3 dB
All emissions, radiated.....	: ± 3.5 dB
Temperature.....	: $\pm 1^{\circ}\text{C}$
Humidity.....	: ± 5 %
DC and low frequency voltages.....	: ± 3 %

TEST EQUIPMENT LIST

Manufacturer	Model	Description	Serial No.	Last Cal	Cal Due Date
ETS Lindgren	2165	Turntable	00043677	N/A	N/A
ETS Lindgren	2125	Mast	00077487	N/A	N/A
Rohde & Schwarz	ESU40	EMI Receiver	100011	2014-11-20	2017-11-20
FCC	FCC-LISN-50-25-2	LISN (150kHz-30MHz)	9927	30-Nov-2012	30-Nov-2015
EMCO	6502	Loop Antenna 10kHz-30MHz	2178	8/21/2014	8/21/2017
Sunol Sciences	JB3	Biconilog Antenna 30MHz-3GHz (Prescan use only)	A120106	28-Oct-2013	28-Oct-2016
ETS Lindgren	3117	Horn Antenna 1GHz-18GHz	00075944	29-Aug-2013	29-Aug-2016
EMCO	3160-09	Horn Antenna 18GHz-26.54GHz	9701-1071	30-Aug-13	30-Aug-16
ETS Lindgren	S201	5 meter Semi-Anechoic Chamber	1030	N/A	N/A
A.H.Systems Inc	PAM-1840VH	Preamplifier	152	14-Jun-2013	14-Jun-2016
A.H.Systems Inc	SAC-40G-2.25	RF cable	396	Condition al use	
A.H.Systems Inc	SAC-40G-0.3	RF cable	395	Condition al use	
ETS Lindgren	7002-006	USB RF Power Sensor	14I00048SNO050	2014-11-20	2017-11-20

Measurement Software List

Manufacturer	Model	Version	Description
Rhode & Schwarz	EMC 32	6.20.0	Emissions Pre-scan Test Software

Part 1 - Radiated Emissions Testing (Unintentional Mode)

DATE: Nov-25-2015

TEST STANDARD: FCC CFR47 Part 15 Subpart B; RSS Gen issue 4, ICES-003 Issue 5

MINIMUM STANDARD: Except as provided elsewhere in FCC CFR47, Part 15, Subpart C & RSS 210 issue 8, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

Frequency (MHz)	Field Strength (dB μ V/m) at 3m
30 – 88	40
88 – 216	43.5
216 - 960	46
960 – above	54

Note: In the above emission table, the tighter limit applies at the band edges.

TEST SETUP: The EUT was placed on a turntable, which is 0.8 m above ground plane. Emissions in both horizontal and vertical polarizations were measured while rotating the EUT on a turntable and moving the receiving antenna from 1m to 4 m high to maximize the emissions signal strength. The equipment was set up in a 3-meter Semi Anechoic Chamber for preliminary measurements and finals were completed in 3m/10m Open Air Test Site at 3 meters.

MODIFICATIONS: No modification is required to comply for this test.

PERFORMANCE: Complies with standard.

MEASUREMENT DATA & PLOT:

Part 2 - Transmitter Radiated Emissions Testing

DATE: Nov 25, 2015

TEST STANDARD: FCC CFR47 Part 15 Subpart C 15.231 15.212; RSS Gen issue 4 & RSS 210 issue 8, Annex 1

MINIMUM STANDARD: The radiated emissions of fundamental and spurious frequency from the DUT shall meet the limits below:

Fundamental Frequency (MHz)	Field Strength of Fundamental (μ V/m)	Field Strength of Spurious Emission (μ V/m)
40.66 - 40.70	2250	225
70 - 130	1250	125
130 - 174	1250 - 3750**	125-375**
174 - 260	3750	375
260 - 470	3750 - 12500**	375-1250**
Above 470	12500	1250

Note: 1) In the above emission table, the tighter limit applies at the band edges.

2) ** Linear interpolations.

Except as otherwise described in the standards, only spurious emissions are permitted in any of the Frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
10.495-0.505	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

If there is field strength of spurious emissions appearing within these restricted bands, it shall not exceed the limits shown in the below table

Frequency (MHz)	Field Strength (dB μ V/m) at 3m
30 – 88	40
88 – 216	43.5
216 - 960	46
960 – above	54

Note: In the above emission table, the tighter limit applies at the band edges.

TEST SETUP:

The EUT was placed on a turntable, which is 0.8 m above ground plane. Emissions in both horizontal and vertical polarizations were measured while rotating the EUT on a turntable and moving the receiving antenna from 1m to 4 m high to maximize the emissions signal strength. The equipment was set up in a 3-meter Semi Anechoic Chamber for preliminary measurements and finals were completed in 3m/10m Open Air Test Site at 3 meters.

During pre-compliance test, Worst-case orientation was determined by rotating the EUT on three axes and final radiated emissions tests were performed in that orientation. Radiated emissions testing was performed separately when the EUT was set to transmit at 433.9MHz

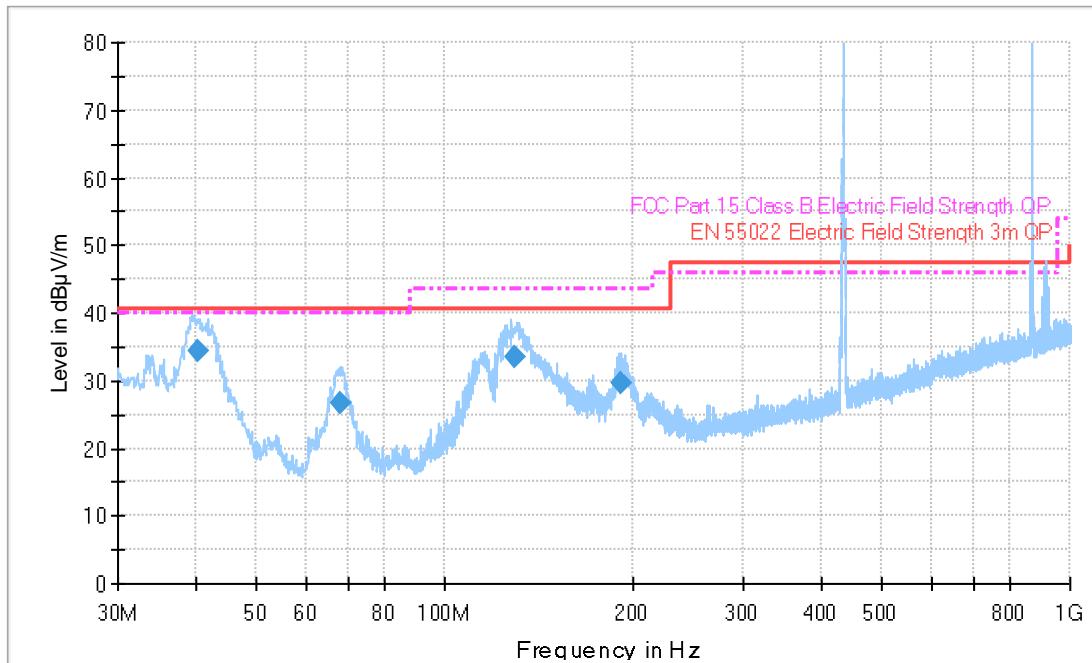
DEVICE DESCRIPTIONS: Refer to the Equipment Under Test Section.

MODIFICATIONS: No modification is required to comply for this test.

PERFORMANCE: Complies with standard.

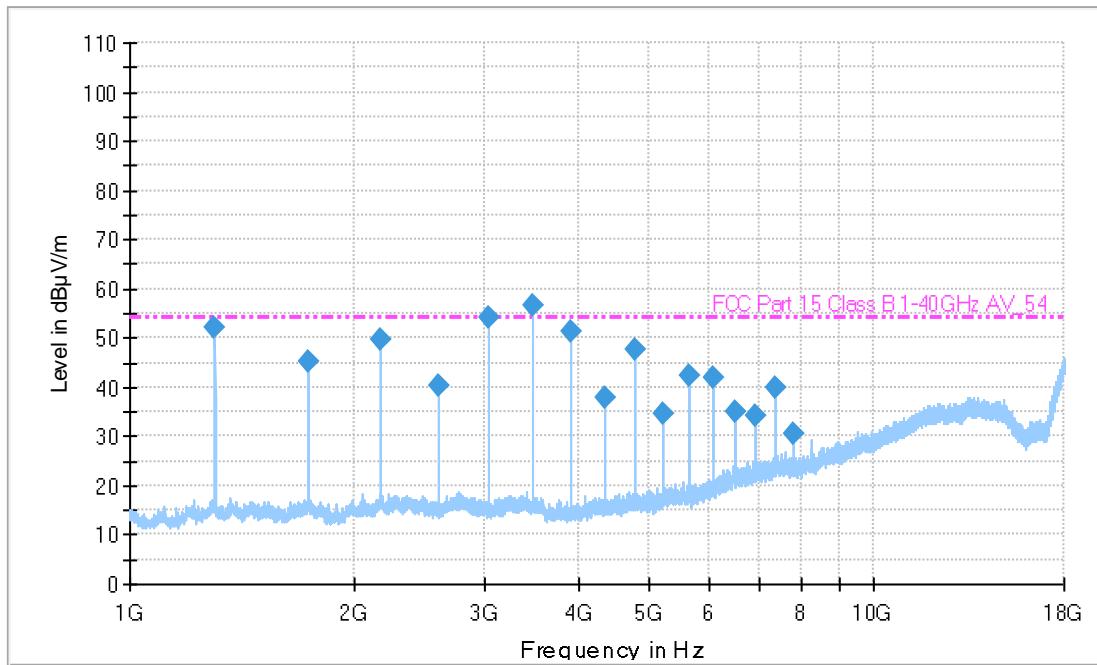
MEASUREMENT DATA:

TRANSMITTING AT 433.9MHz



Radiated Emissions 30MHz-1GHz at 3m - TX at 433.9MHz

Frequency (MHz)	QuasiPeak (dB μ V/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)
40.220720	34.4	1000.000	120.000	120.0	H	44.0	20.8	-6.1	40.5
67.960560	26.6	1000.000	120.000	131.0	V	6.0	14.4	-13.9	40.5
129.078800	33.4	1000.000	120.000	100.0	V	213.0	21.2	-7.1	40.5
191.270600	29.6	1000.000	120.000	150.0	H	87.0	19.2	-10.9	40.5



Radiated Emissions 1GHz-4.3GHz at 3m - TX at 433.9MHz

Radiated Emissions 30MHz-1GHz at 3m - TX at 433.9MHz

Freq.	Raw Peak	Ang	Height	Pol.	Ant factor	Cable Loss	Corrected Peak	Corr. Avg	AVG Limit	Peak Limit	AVG Margin	Peak Margin
MHz	dBuV	deg	cm	V/H	dB/m	dB	dBuV/m	dBuV/m	dBuV/m	dBuV/m	dB	dB
433.9	70.54	225	100	H	22.7	1.92	95.16	79.06	80.8	100.8	1.74	5.64
433.9	71.11	77	250	V	22.7	1.92	95.73	79.63	80.8	100.8	1.17	5.07
867.8	36.88	158	156	H	29	2.6	68.48	52.38	60.8	80.8	8.42	12.32
867.8	28.84	103	1151	V	29	2.6	60.44	44.34	60.8	80.8	16.46	20.36

Note: Average = Peak Value + 20 Log (Duty Cycle)

Duty cycle Correction factor of -16.10dB is calculated (see in Part -3 Duty Cycle)

Radiated Emissions 1GHz-3.3GHz at 3m - TX at 433.9MHz

Freq. MHz	Raw Peak dBuV	Ang deg	Height cm	Pol. V/H	Ant factor dB/m	Gain dB	Corrected Peak dBuV/m	Corr. Avg dBuV/m	AVG Limit dBuV/m	AVG Margin dB
1301.58	63.9	330	135	H	28.7	27.32	65.28	49.18	54	4.82
1301.58	66.12	62	120	V	28.7	27.32	67.5	51.4	54	2.6
1735.9	51.6	206	104	H	29.8	27.82	53.58	37.48	60.8	23.32
1735.9	58.15	220	113	V	29.8	27.82	60.13	44.03	60.8	16.77
2169.5	56.66	191	113	H	32	27.6	61.06	44.96	60.8	15.84
2169.5	59.9	141	114	V	32	27.6	64.3	48.2	60.8	12.6
2603.8	58.4	303	113	H	32.7	26.58	64.52	48.42	60.8	12.38
2603.8	58.96	228	114	V	32.7	26.58	65.08	48.98	60.8	11.82
3037.8	66	118	110	H	32.9	25.55	73.35	57.25	60.8	3.55
3037.8	65.8	110	100	V	32.9	25.55	73.15	57.05	60.8	3.75
3471.7	63.64	47	100	H	32.9	26.76	69.78	53.68	60.8	7.12
3471.7	69.75	27	100	V	32.9	26.76	75.89	59.79	60.8	1.01
3905.7	58.3	56	100	H	33.2	24.84	66.66	50.56	54	3.44
3905.7	60.6	353	100	V	33.2	24.84	68.96	52.86	54	1.14
4339	54.29	53	100	H	33.6	23.77	64.12	48.02	54	5.98
4339	52.24	360	108	V	33.6	23.77	62.07	45.97	54	8.03

Note: Average = Peak Value + 20 Log (Duty Cycle)

Duty cycle Correction factor of -16.10dB is calculated (see in Part -3 Duty Cycle)

Part 3 - Duty Cycle Correction Factor

DATE: Dec-1-2015

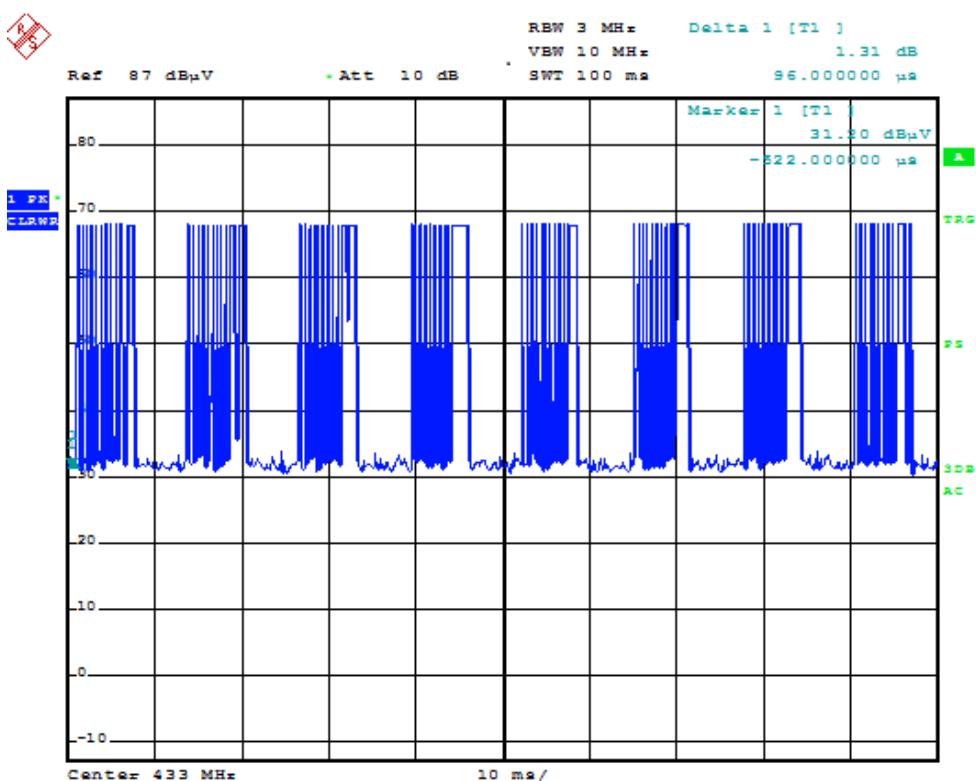
TEST STANDARD: FCC Part 15.35

MINIMUM STANDARD: (c) Unless otherwise specified, e.g., §§15.255(b), and 15.256(l)(5), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

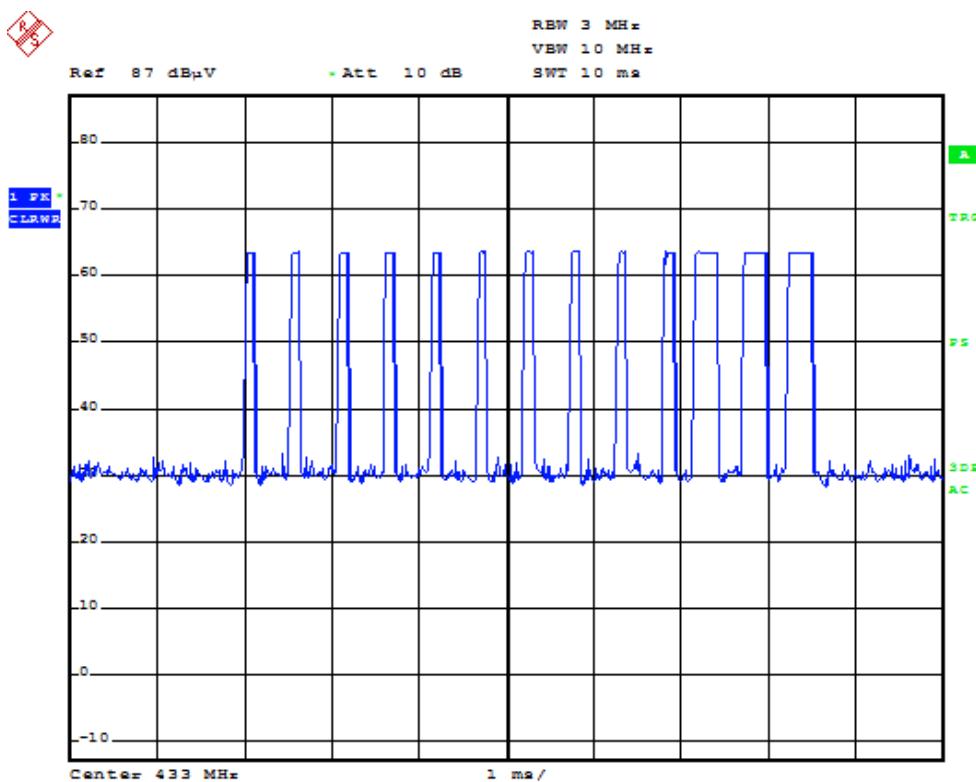
MEASUREMENT DATA:

DUTY CYCLE CORRECTION MEASUREMENT – 433.9MHz

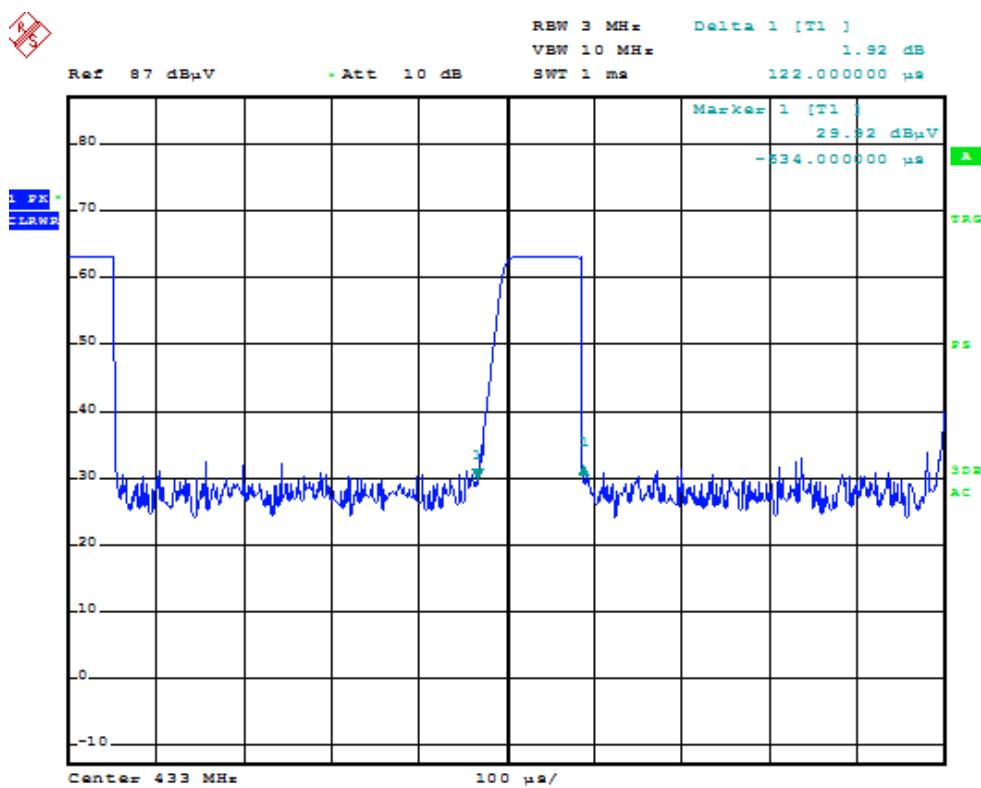
Data Transmissions		Number of Pulses
Transmission Burst Duration	8.0	
Long pulse Duration	0.268msec	3
Short pulse Duration	0.122msec	10
Total Transmissions Duration	$3(0.268)+10(0.268) = 1.96$ msec	
OnTime with in 100 msec	$8(1.96) = 15.68$ msec	
Dutycycle Correction factor	$20\log(15.68/100) = -16.10$ dB	



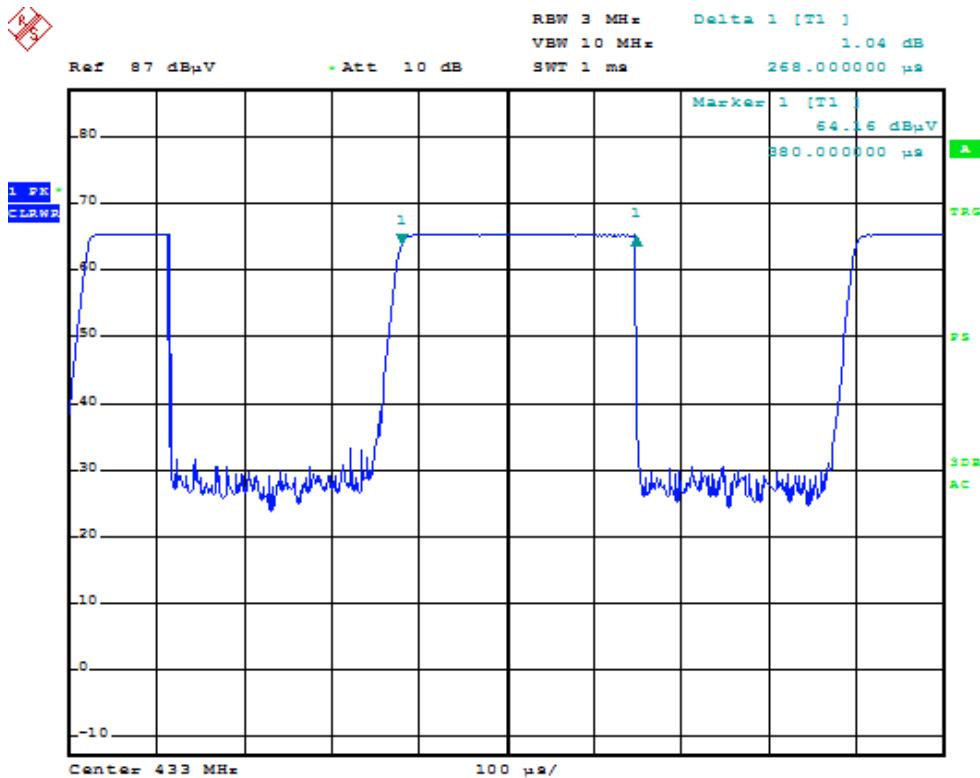
Number Transmissions Burst & Duration in 100ms



One Packet Duration



Short Pulse Duration



Long Pulse Duration

Part 4 - 20 dB Bandwidth

DATE: Dec 2, 2015

TEST STANDARD: FCC CFR47 Part 15 Subpart C 15.231; RSS Gen issue 4 & RSS 210 issue 8, Annex 1

MINIMUM STANDARD: 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.

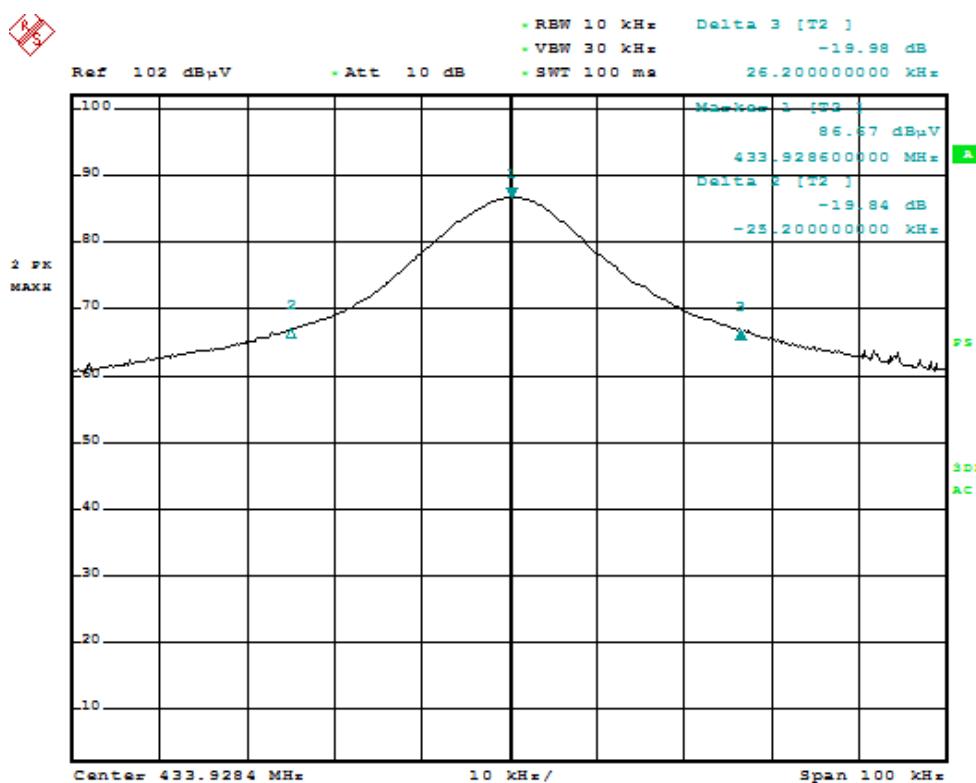
MODIFICATIONS: No modification is required to comply for this test.

PERFORMANCE: Complies with standard.

DATA & PLOT:

Frequency (MHz)	20dB Bandwidth (kHz)	Limit (kHz)
433.9	51.4	1084.8

$$= 26.2 \text{ kHz} + 25.2 \text{ kHz}$$



20dB Bandwidth – 433.9MHz

Part 5 - Deactivate Time after

DATE: Dec 08, 2015

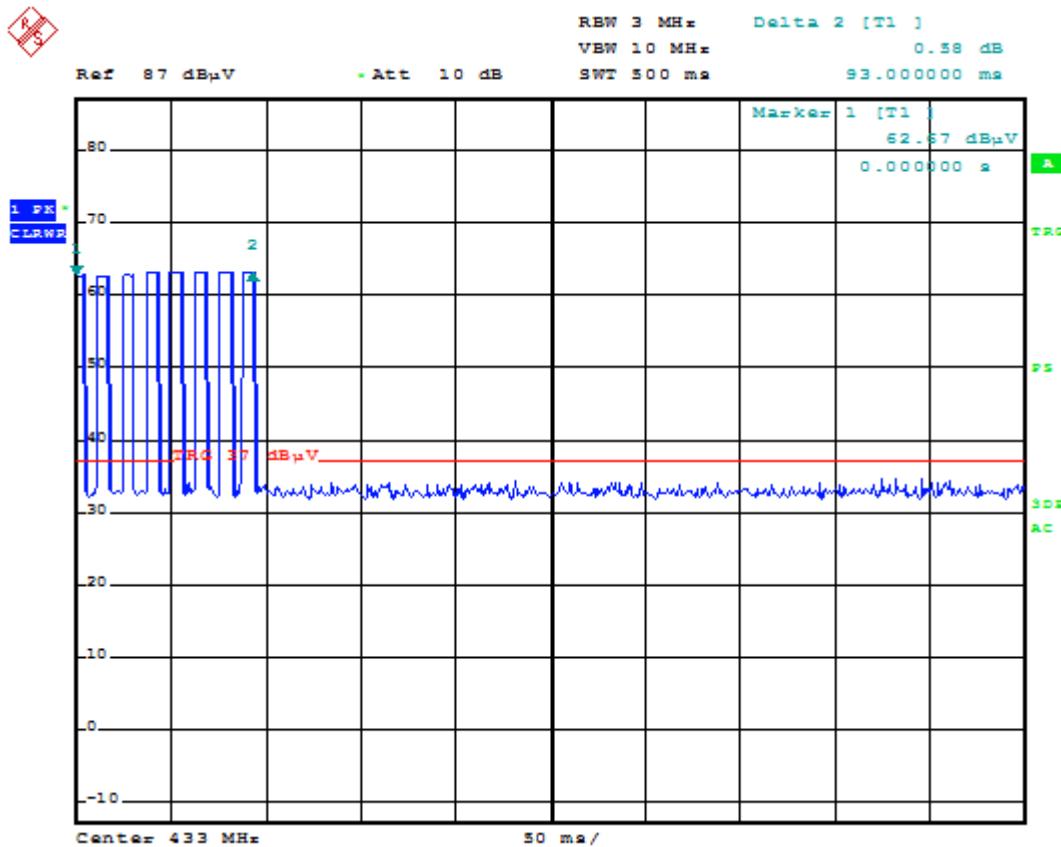
TEST STANDARD: FCC CFR47 Part 15 Subpart C 15.231; RSS Gen issue 4 & RSS 210 issue 8, Annex 1

MINIMUM STANDARD: (1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

MODIFICATIONS: No modification is required to comply for this test.

PERFORMANCE: Complies with standard. Transmission automatically deactivated within 5 seconds

DATA & PLOT:

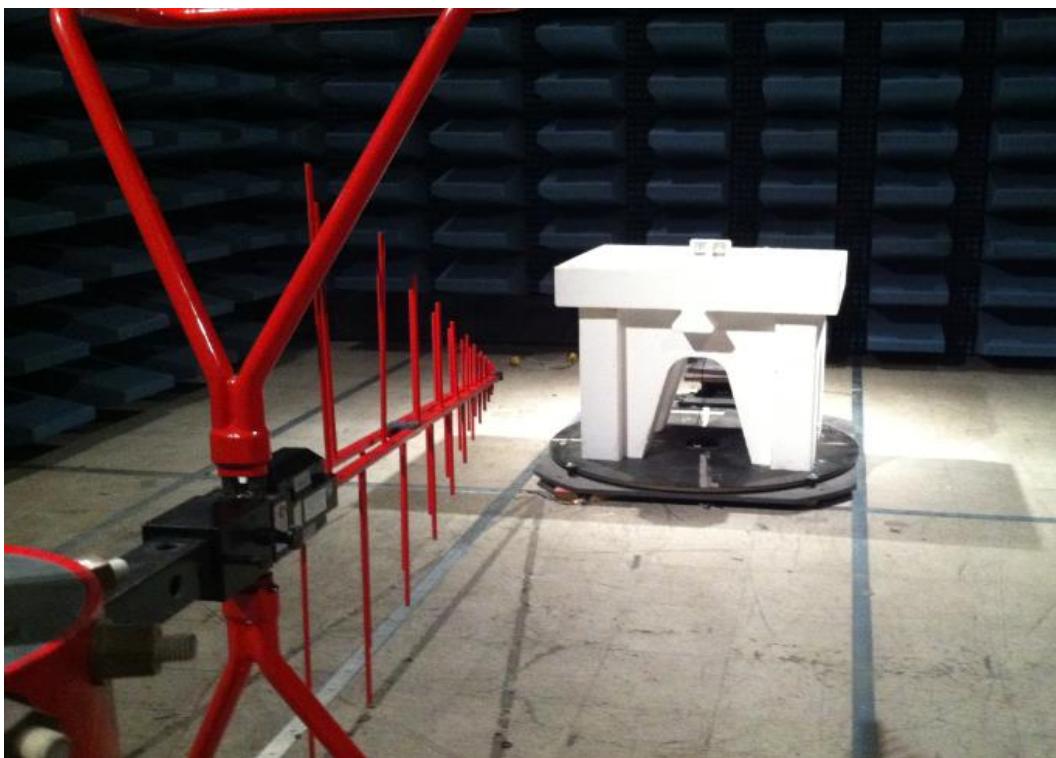


Timing Diagram for 433.9MHz

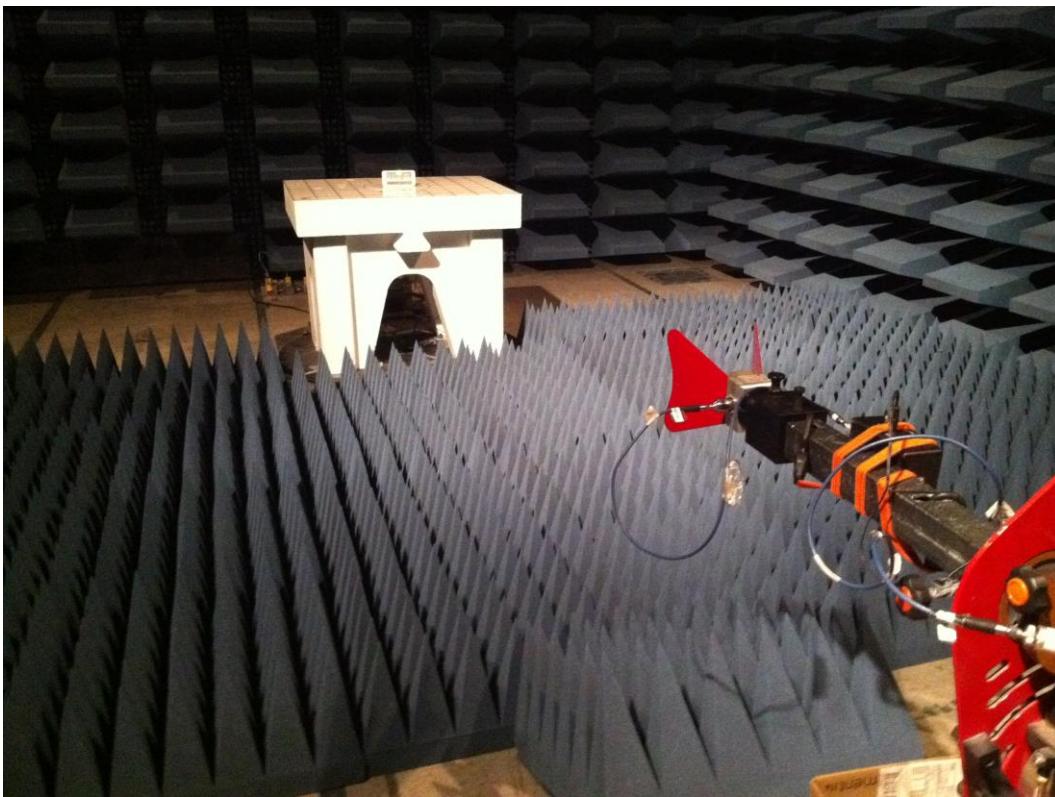
Appendix A: Test Setup Pictures



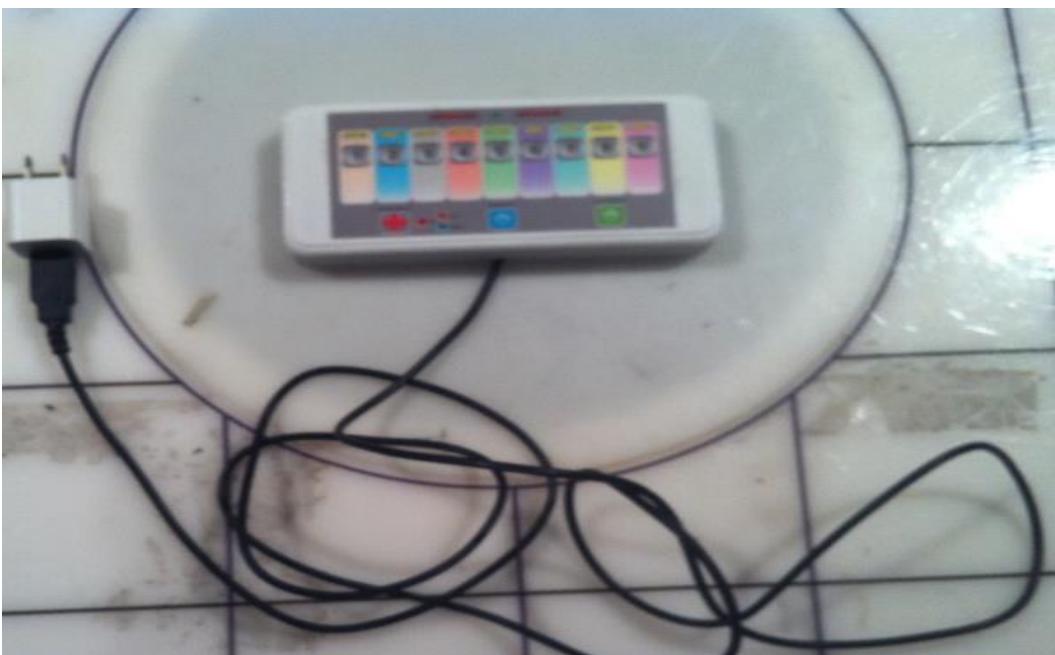
Conducted Emission Test Setup in Semi Anechoic Chamber – 150kHz – 30MHz



Radiated Emission test setup in Semi Anechoic Chamber – 30MHz - 1GHz



Radiated Emission test setup in Semi Anechoic Chamber – above 1GHz



Front side with of model Rose with AC to DC adapter



Back side with of model Rose with AC to DC adapter