

EMISSIONS TEST REPORT

Report Number: 102085252BOX-001a

Project Number: G102085252

Report Issue Date: 06/05/2015

Product Designation: Modular Device (RF Card)

Standards: FCC 47CFR Part 15 Subpart C Section 15.231 (2015)
RSS-210 Issue 8 December 2010
RSS-Gen Issue 4 November 2014
ICES-003 Issue 5 August 2012

Tested by:
Intertek Testing Services NA, Inc.
70 Codman Hill Road
Boxborough, MA 01719
USA

Client:
IntelliSAW
100 Burtt Road
Andover, MA 01810
USA

Report prepared by



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Report reviewed by



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1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested Comply with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested.

2 Test Summary

Section	Test full name	Result
3	Client Information	--
4	Description of Equipment Under Test	--
5	System Setup and Method	--
6	Fundamental Field Strength and Conducted Output Power (CFR47 Part 15 Subpart C Section 15.231(e), RSS-210 Annex I)	Pass
7	Occupied Bandwidth (CFR47 Part 15 Subpart C Sections 15.215, 15.231(c), RSS-Gen Section 6.6)	Pass
8	Radiated Spurious Emissions (CFR47 Part 15 Subpart C Sections 15.205, 15.209, and 15.231(e), RSS-210 Annex I, RSS-Gen)	Pass
9	Duty Cycle (CFR47 Part 15 Section 15.35 and Subpart C Section 15.231(b)(2), RSS-Gen Section 6.10)	Pass
10	Automatically Limiting Operation (CFR47 Part 15 Subpart C Section 15.231(e), RSS-210 A1.1.5)	Pass
11	AC Line-Conducted Emissions (CFR47 FCC Part 15 Subpart C 15.207, ICES-003)	Pass
12	Receiver Radiated Spurious Emissions (CFR47 Part 15 Subpart B Sections 15.205, 5.209, ICES-003)	Pass
13	Revision History	--

3 Client Information

This EUT was tested at the request of:

Client: IntelliSAW
100 Burtt Road
Andover, MA 01810
USA

Contact: Jonathan P. Murray
Telephone: +1.978.409.1534 x204
Email: jmurray@intellisaw.com

4 Description of Equipment Under Test

Manufacturer: IntelliSAW
100 Burtt Road
Andover, MA 01810
USA

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Modular Device (RF Card)	IntelliSAW	400.00152.0001	08150695

Receive Date:	04/09/2015 & 05/01/2015
Received Condition:	Good
Type:	Production

Description of Equipment Under Test (provided by client)	
The IntelliSAW RF card is a circuit board assembly integral to multiple current and future products. It is not sold to third parties and is therefore eligible for certain exceptions as a Limited Modular Approval. The module was tested with a PIFA patch antenna and a 17 cm monopole antenna.	
400.00152.0001 (ASSEMBLY, INTERROGATOR RF BOARD, PARTIAL DISCHARGE, SMA)	

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
IntelliSAW RF Module			
4.3 to 5.5 Vdc	500 mA	N/A	N/A
IS485 host equipment			
24 Vdc	125 mA	N/A	N/A

Notes: All tests except CEMI – Cotek 80 ~ 265 Vac/dc class II power supply (meets class A CEMI)
CEMI test of module: Agilent E3620 120Vac variable DC supply. Module-only, 5 Vdc; IS485 host unit 24 Vdc.

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	The EUT was programmed to transmit between 425-445 MHz with a 100% duty cycle. Lab tests – TX power at operating limits of the hardware for all spurious emissions Site field test – +9.15 dBm conducted power limited by setting PA = 7 and PPS = 11
2	Device was in Rx/idle mode

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	None

5 System Setup and Method

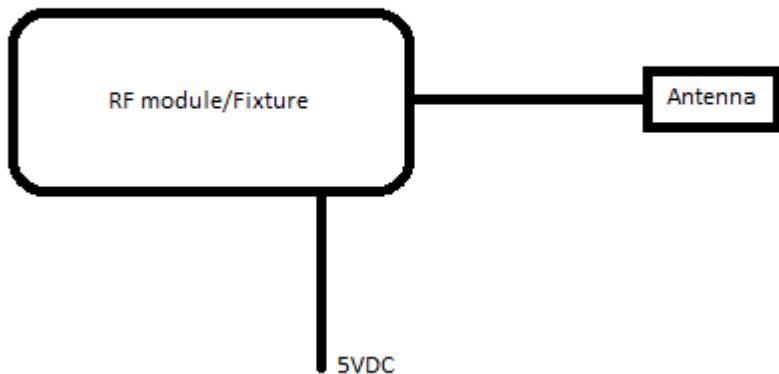
Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	Two DC wires	10m	N/A	N/A	24VDC supply

Note that cable had 4-wire plus ground, DC power and 9600 baud RS485 with a common on ground.

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
24 VDC Class II power supply	PHOENIX CONTAC	UNO-PS/1AC/24DC/100W	3039923677
RS-45 converter	SerialGear	USBG-COMi-SI-M	239694
Host device	IntelleSaw	IS485-24-TPH	46140572
Variable power supply	Agilent	E3620A	MY40005590

5.1 Method:

Configuration as required by FCC 47 CFR PT 15.231(e), ANSI C63.10:2009, ICES-003, RSS-Gen, RSS-210.

5.2 EUT Block Diagram (Intertek Lab)

5.3 EUT Block Diagram (National Grid)

The Washington Substation in Lincoln, RI comprises two ANSI/IEEE C37.20 outdoor switchgear, each representing a typical installation under FCC Part 15.15.201(c) and 15.31(d). The site has safety constraints due to overhead high voltage equipment. These concerns prevent measurements along four radials, as outlined below.

Fifteen safe measurement locations were chosen that allow measurement of twelve of the 16 standard radials. This report details measurements of the northernmost switchgear, a 1978 Gould ITT switchgear with ITT breakers.



Figure 1 shows the measurement locations and safety concerns of the site.

Position photos – note that positions 11 – 14 “see” the EUT through two other structures and the EUT is not visible line of sight.

Test method: Per the KDB, two antennas were time division multiplexed with 100ms on time and about 100ms to switch between antennas. The following results show the stronger of the two emissions over the sampling time.

The selected antenna positions are optimal for measuring the passive sensors located as indicated by the red squares. The primary radiation sources outside the switchgear will be the door seal and the louvered ventilation slots. The ventilation slots are covered with a metal mesh filter, as seen below. In most cases this filter is present, as it was in this switchgear. Note that the metal screens loosely contact painted metal and that the doors "seal" painted metal to painted metal with various locking mechanisms. As such, the equipment represents a worst case condition compared to modern, arc-resistant enclosures.

For this test site (southeast switchgear #261; capacitor bank feeder 2643) radials at NNE (22.5^0) and ENE (67.5^0) through ESE (112.5^0) cannot be measured within an acceptable radial distance because of serious safety concerns. These are shown as heavy red bars from the nearest point on the switchgear. The presence of overhead 115kV lines prevent the use of a 4.5 meter tall mast structure due to risk of electrocution.

Measurements at SE (135^0) are possible at 10 meters or more. Measurement at N (0^0) and NNW (-22.5^0) are possible at extended distances of about 22m, while NW (-45^0) can be measured at 15m. For safety, the origin of the radial to N was offset slightly. NE (45^0) was measured at a slightly longer radial. The remaining seven radials will be made between 3 and 10 meters, as needed to avoid obstacles.

Locations were chosen to satisfy the needs of both this installation and the second installation (located in switchgear 262 to the northwest) while minimizing the movement of equipment.

The 17cm monopole with nominal gain of 3.2 dBi is mounted on the left wall of a cable compartment (left photo) and the PIFA antenna with a nominal gain of 3.5 dBi is located on the door of the switchgear, facing inwards.

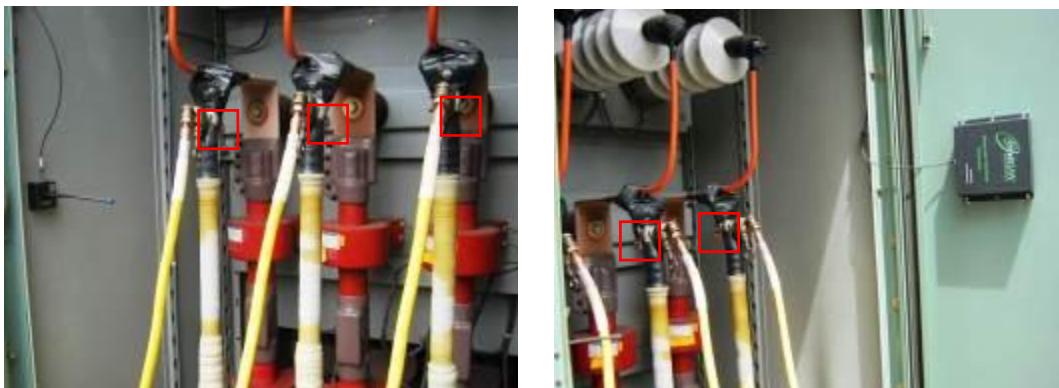


Figure 2 shows the two antennas, mounted to optimally read the passive sensors.

The selected antenna positions are optimal for measuring the passive sensors located as indicated by the red squares. The primary radiation sources outside the switchgear will be the door seal and the louvered ventilation slots. The ventilation slots are covered with a metal mesh filter, as seen below. In most cases this filter is present, as it was in this switchgear.



Figure 3 shows the exterior of the switchgear with the door open(left) showing the mesh filter (red outline). Yellow grounding cables are removed to secure and energize the system. Also shown is an internal view of the digital device hosting the transmitter (right). The digital device (red outline) is located in a secured building, inside a secured enclosure integral to the switchgear.

6 Fundamental Field Strength and Output power

6.1 Method

Tests are performed in accordance with FCC 47 CFR PT 15.231(e), RSS-210 and ANSI C63.10:2009. Test points were selected for testing as shown in the block diagram. The receiving antenna polarity varied between vertical and horizontal. The emissions were maximized by raising receiving antenna up and down from 1 meter to 4 meters.

TEST SITE: National Grid Substation

All testing took place at Washington National Grid Substation in Lincoln, RI.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A wooden table 80 cm high is used for table-top equipment.

Measurement Uncertainty

For radiated emissions, U_{lab} (3.5 dB at 3m and 3.5 dB at 10m below 1 GHz, and 4.2 dB at 3m above 1 GHz) $< U_{CISPR}$ (5.2 dB), which is the reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where

FS = Field Strength in $\text{dB}\mu\text{V}/\text{m}$

RA = Receiver Amplitude (including preamplifier) in $\text{dB}\mu\text{V}$

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB

AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 $\text{dB}\mu\text{V}$ is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 $\text{dB}\mu\text{V}/\text{m}$. This value in $\text{dB}\mu\text{V}/\text{m}$ was converted to its corresponding level in $\mu\text{V}/\text{m}$.

$$RA = 52.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB}/\text{m}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$FS = 32 \text{ dB}\mu\text{V}/\text{m}$$

To convert from $\text{dB}\mu\text{V}$ to μV or mV the following was used:

$$UF = 10^{(NF/20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

$$NF = \text{Net Reading in } \text{dB}\mu\text{V}$$

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V}/\text{m}$$

6.2 Test Equipment Used

Test equipment used on 06/01/2015

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
MAN1'	Digital 4 Line Barometer	Mannix	0ABA116	MAN1	08/29/2014	08/29/2016
ANT1C'	BROADBAND ANTENNA	Compliance Design	B300	00668	11/04/2014	11/04/2015
147149'	Spectrum Analyzer	Hewlett Packard	8591E	3346A02258	07/05/2014	07/05/2015
CBLEMC3'	2' BNC Cable	Hewlett Packard	10503A	3	04/02/2015	04/02/2016

Test equipment used on 4/09/2015

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/17/2014	03/17/2015
145-410'	Cables 145-400 145-403 145-405 145-406 145-407	Huber + Suhner	10m Track A Cables	multiple	10/04/2014	10/04/2015
145106'	Bilog Antenna (30MHz - 5GHz)	Sunol Sciences	JB5	A111003	10/24/2014	10/24/2015
Dav004'	Weather Station	Davis Instruments	7400	PE80529A61A	10/06/2014	10/06/2015

Software Utilized:

Name	Manufacturer	Version
EMI Boxborough.xls	Intertek	08/27/2010

6.3 Results:

The sample tested was found to Comply

(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

¹Linear interpolations.

6.4 Setup Photographs:

Position 1



Position 2



Position 3





Position 5



Position 6



Position 7



Position 8



Position 9



Position 10





Position 12



Position 13



Position 14



Position 15



6.5 Test Data:

Site 1 - Position 1 Radiated Emissions at 12 meters

Test Site: National Grid Substation in Washington National Grid, Lincoln RI

Company: Intellisaw Antenna & Cables: N Bands: N, LF, HF, SHF

Model #: Switchgears (425 to 442 MHz) Antenna: ANT1-10mV 11-04-2015.txt ANT1-10mH 11-04-2015.txt

Serial #: 8150695 Cable(s): CBLEMC3 04-02-16.txt NONE.

Engineers: Kouma Sinn Location: National Grid Barometer: MAN1 Filter: NONE

Project #: G102085252 Date(s): 06/01/15

Standard: FCC Part 15 Subpart C Section 15.231e Temp/Humidity/Pressure: 11C 91% 1013mbar

Receiver: 147-149 Limit Distance (m): 3

PreAmp: None Test Distance (m): 12

PreAmp Used? (Y or N): N Voltage/Frequency: Powered from substation Frequency Range: 425 MHz, 434MHz & 445 MHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Site 1 , Position 1 at 12 meters. Output Power Setting: 9.15 dBm, AVG = Peak Readings - Average Factor of 20 dB from 10% duty cycle											
A distance factor of 12.04 dB was added to the readings (shown as negative) to compensate for testing at 12 instead of 3 meters											
Notes: Output power setting was set to 9.15 dBm in order to bring the emission into compliant.											
Max PK	V	434.000	58.11	21.58	0.72	0.00	-12.04	92.45	92.87	-0.42	120/300 kHz
AVG	V	434.000	38.11	21.58	0.72	0.00	-12.04	72.45	72.87	-0.41	120/300 kHz
Max PK	H	434.000	52.96	22.34	0.72	0.00	-12.04	88.06	92.87	-4.81	120/300 kHz
AVG	H	434.000	32.96	22.34	0.72	0.00	-12.04	68.06	72.87	-4.80	120/300 kHz
Max PK	V	445.000	51.70	23.00	0.74	0.00	-12.04	87.48	93.22	-5.74	120/300 kHz
AVG	V	445.000	31.70	23.00	0.74	0.00	-12.04	67.48	73.22	-5.75	120/300 kHz
Max PK	H	445.000	55.37	22.20	0.74	0.00	-12.04	90.35	93.22	-2.87	120/300 kHz
AVG	H	445.000	35.37	22.20	0.74	0.00	-12.04	70.35	73.22	-2.88	120/300 kHz
Max PK	H	425.000	56.82	22.00	0.71	0.00	-12.04	91.57	92.57	-1.00	120/300 kHz
AVG	H	425.000	36.82	22.00	0.71	0.00	-12.04	71.57	72.57	-1.00	120/300 kHz
Max PK	V	425.000	50.94	21.60	0.71	0.00	-12.04	85.29	92.57	-7.28	120/300 kHz
AVG	V	425.000	30.94	21.60	0.71	0.00	-12.04	65.29	72.57	-7.28	120/300 kHz

Site 1 - Position 2 Radiated Emissions at 10 meters

Test Site: National Grid Substation in Washington National Grid, Lincoln RI

Company: Intellisaw

Model #: Switchgears (425 to 442 MHz)

Serial #: 8150695

Engineers: Kouma Sinn

Project #: G102085252

Date(s): 06/01/15

Standard: FCC Part 15 Subpart C Section 15.231e

Receiver: 147-149

Limit Distance (m): 3

PreAmp: None

Test Distance (m): 10

PreAmp Used? (Y or N): N Voltage/Frequency: Powered from substation Frequency Range: 425 MHz, 434MHz & 445 MHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Site 1 , Position 2 at 10 meters. Output Power Setting: 10 dBm, AVG = Peak Readings - Average Factor of 20 dB from 10% duty cycle											
A distance factor of 10.46 dB was added to the readings (shown as negative) to compensate for testing at 10 meters instead of 3 meters											
Max PK	H	434.000	58.39	22.34	0.72	0.00	-10.46	91.91	92.87	-0.96	120/300 kHz
AVG	H	434.000	38.39	22.34	0.72	0.00	-10.46	71.91	72.87	-0.96	120/300 kHz
Max PK	V	434.000	51.68	21.58	0.72	0.00	-10.46	84.44	92.87	-8.43	120/300 kHz
AVG	V	434.000	31.68	21.58	0.72	0.00	-10.46	64.44	72.87	-8.43	120/300 kHz
Max PK	V	445.000	48.69	23.00	0.74	0.00	-10.46	82.89	93.22	-10.33	120/300 kHz
AVG	V	445.000	28.69	23.00	0.74	0.00	-10.46	62.89	73.22	-10.34	120/300 kHz
Max PK	H	445.000	56.98	22.20	0.74	0.00	-10.46	90.38	93.22	-2.84	120/300 kHz
AVG	H	445.000	36.98	22.20	0.74	0.00	-10.46	70.38	73.22	-2.85	120/300 kHz
Max PK	H	425.000	58.38	22.00	0.71	0.00	-10.46	91.55	92.57	-1.02	120/300 kHz
AVG	H	425.000	38.38	22.00	0.71	0.00	-10.46	71.55	72.57	-1.02	120/300 kHz
Max PK	V	425.000	54.53	21.60	0.71	0.00	-10.46	87.30	92.57	-5.27	120/300 kHz
AVG	V	425.000	34.53	21.60	0.71	0.00	-10.46	67.30	72.57	-5.27	120/300 kHz

Site 1 - Position 3 Radiated Emissions at 10 meters

Test Site: National Grid Substation in Washington National Grid, Lincoln RI

Company: Intellisaw

Model #: Switchgears (425 to 442 MHz)

Serial #: 8150695

Engineers: Kouma Sinn

Project #: G102085252

Date(s): 06/01/15

Standard: FCC Part 15 Subpart C Section 15.231e

Receiver: 147-149

Limit Distance (m): 3

PreAmp: None

Test Distance (m): 10

PreAmp Used? (Y or N): N Voltage/Frequency: Powered from substation Frequency Range: 425 MHz, 434MHz & 445 MHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Site 1 , Position 3 at 10 meters. Output Power Setting: 9.15 dBm, AVG = Peak Readings - Average Factor of 20 dB from 10% duty cycle											
A distance factor of 10.46 dB was added to the readings (shown as negative) to compensate for testing at 10 meters instead of 3 meters											
Max PK	V	434.000	56.26	21.58	0.72	0.00	-10.46	89.02	92.87	-3.85	120/300 kHz
AVG	V	434.000	36.26	21.58	0.72	0.00	-10.46	69.02	72.87	-3.84	120/300 kHz
Max PK	H	434.000	54.05	22.34	0.72	0.00	-10.46	87.57	92.87	-5.30	120/300 kHz
AVG	H	434.000	34.05	22.34	0.72	0.00	-10.46	67.57	72.87	-5.29	120/300 kHz
Max PK	H	445.000	56.38	22.20	0.74	0.00	-10.46	89.78	93.22	-3.44	120/300 kHz
AVG	H	445.000	36.38	22.20	0.74	0.00	-10.46	69.78	73.22	-3.45	120/300 kHz
Max PK	V	445.000	51.73	23.00	0.74	0.00	-10.46	85.93	93.22	-7.29	120/300 kHz
AVG	V	445.000	31.73	23.00	0.74	0.00	-10.46	65.93	73.22	-7.30	120/300 kHz
Max PK	H	425.000	55.26	22.00	0.71	0.00	-10.46	88.43	92.57	-4.14	120/300 kHz
AVG	H	425.000	35.26	22.00	0.71	0.00	-10.46	68.43	72.57	-4.14	120/300 kHz
Max PK	V	425.000	53.26	21.60	0.71	0.00	-10.46	86.03	92.57	-6.54	120/300 kHz
AVG	V	425.000	33.26	21.60	0.71	0.00	-10.46	66.03	72.57	-6.54	120/300 kHz

Site 1 - Position 4 Radiated Emissions at 7 meters

Test Site: National Grid Substation in Washington National Grid, Lincoln RI

Company: Intellisaw

Model #: Switchgears (425 to 442 MHz)

Serial #: 8150695

Engineers: Kouma Sinn

Project #: G102085252

Date(s): 06/01/15

Standard: FCC Part 15 Subpart C Section 15.231e

Receiver: 147-149

Limit Distance (m): 3

PreAmp: None

Test Distance (m): 7

PreAmp Used? (Y or N): N Voltage/Frequency: Powered from substation Frequency Range: 425 MHz, 434MHz & 445 MHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Site 1 , Position 4 at 7 meters. Output Power Setting: 9.15 dBm, AVG = Peak Readings - Average Factor of 20 dB from 10% duty cycle											
A distance factor of 7.40 dB was added to the readings (shown as negative) to compensate for testing at 7 meters instead of 3 meters											
Max PK	V	434.000	53.10	21.58	0.72	0.00	-7.40	82.80	92.87	-10.07	120/300 kHz
AVG	V	434.000	33.10	21.58	0.72	0.00	-7.40	62.80	72.87	-10.06	120/300 kHz
Max PK	H	434.000	56.80	22.34	0.72	0.00	-7.40	87.26	92.87	-5.61	120/300 kHz
AVG	H	434.000	36.80	22.34	0.72	0.00	-7.40	67.26	72.87	-5.60	120/300 kHz
Max PK	V	445.000	51.99	23.00	0.74	0.00	-7.40	83.13	93.22	-10.09	120/300 kHz
AVG	V	445.000	31.99	23.00	0.74	0.00	-7.40	63.13	73.22	-10.10	120/300 kHz
Max PK	H	445.000	58.42	22.20	0.74	0.00	-7.40	88.76	93.22	-4.46	120/300 kHz
AVG	H	445.000	38.42	22.20	0.74	0.00	-7.40	68.76	73.22	-4.47	120/300 kHz
Max PK	H	425.000	57.78	22.00	0.71	0.00	-7.40	87.89	92.57	-4.68	120/300 kHz
AVG	H	425.000	37.78	22.00	0.71	0.00	-7.40	67.89	72.57	-4.68	120/300 kHz
Max PK	V	425.000	51.96	21.60	0.71	0.00	-7.40	81.67	92.57	-10.90	120/300 kHz
AVG	V	425.000	31.96	21.60	0.71	0.00	-7.40	61.67	72.57	-10.90	120/300 kHz

Site 1 - Position 5 Radiated Emissions at 8.4 meters

Test Site: National Grid Substation in Washington National Grid, Lincoln RI

Company: Intellisaw

Model #: Switchgears (425 to 442 MHz)

Serial #: 8150695

Engineers: Kouma Sinn

Project #: G102085252

Date(s): 06/01/15

Standard: FCC Part 15 Subpart C Section 15.231e

Receiver: 147-149

Limit Distance (m): 3

PreAmp: None

Test Distance (m): 8.4

PreAmp Used? (Y or N): N Voltage/Frequency: Powered from substation Frequency Range: 425 MHz, 434MHz & 445 MHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Site 1 , Position 5 at 8.4 meters. Output Power Setting: 9.15 dBm, AVG = Peak Readings - Average Factor of 20 dB from 10% duty cycle											
A distance factor of 8.94 dB was added to the readings (shown as negative) to compensate for testing at 8.4 meters instead of 3 meters											
Max PK	V	434.000	51.38	21.58	0.72	0.00	-8.94	82.62	92.87	-10.25	120/300 kHz
AVG	V	434.000	31.38	21.58	0.72	0.00	-8.94	62.62	72.87	-10.24	120/300 kHz
Max PK	H	434.000	55.31	22.34	0.72	0.00	-8.94	87.31	92.87	-5.56	120/300 kHz
AVG	H	434.000	35.31	22.34	0.72	0.00	-8.94	67.31	72.87	-5.55	120/300 kHz
Max PK	V	445.000	43.44	23.00	0.74	0.00	-8.94	76.12	93.22	-17.10	120/300 kHz
AVG	V	445.000	23.44	23.00	0.74	0.00	-8.94	56.12	73.22	-17.11	120/300 kHz
Max PK	H	445.000	58.88	22.20	0.74	0.00	-8.94	90.76	93.22	-2.46	120/300 kHz
AVG	H	445.000	38.88	22.20	0.74	0.00	-8.94	70.76	73.22	-2.47	120/300 kHz
Max PK	H	425.000	58.67	22.00	0.71	0.00	-8.94	90.32	92.57	-2.25	120/300 kHz
AVG	H	425.000	38.67	22.00	0.71	0.00	-8.94	70.32	72.57	-2.25	120/300 kHz
Max PK	V	425.000	52.30	21.60	0.71	0.00	-8.94	83.55	92.57	-9.02	120/300 kHz
AVG	V	425.000	32.30	21.60	0.71	0.00	-8.94	63.55	72.57	-9.02	120/300 kHz

Site 1 - Position 6 Radiated Emissions at 7.32 meters

Test Site: National Grid Substation in Washington National Grid, Lincoln RI

Company: Intellisaw

Model #: Switchgears (425 to 442 MHz)

Antenna & Cables: N Bands: N, LF, HF, SHF

Serial #: 8150695

Antenna: ANT1-10mV 11-04-2015.txt ANT1-10mH 11-04-2015.txt

Cable(s): CBLEMC3 04-02-16.txt NONE.

Engineers: Kouma Sinn

Location: National Grid Barometer: MAN1

Filter: NONE

Project #: G102085252

Date(s): 06/01/15

Standard: FCC Part 15 Subpart C Section 15.231e

Temp/Humidity/Pressure: 11C 91% 1013mbar

Receiver: 147-149

Limit Distance (m): 3

PreAmp: None

Test Distance (m): 7.32

PreAmp Used? (Y or N): N Voltage/Frequency: Powered from substation Frequency Range: 425 MHz, 434MHz & 445 MHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Site 1 , Position 6 at 7.32 meters. Output Power Setting: 9.15 dBm, AVG = Peak Readings - Average Factor of 20 dB from 10% duty cycle											
A distance factor of 7.75 dB was added to the readings (shown as negative) to compensate for testing at 7.32 meters instead of 3 meters											
Max PK	V	434.000	45.89	21.58	0.72	0.00	7.75	60.44	92.87	-32.43	120/300 kHz
AVG	V	434.000	25.89	21.58	0.72	0.00	7.75	40.44	72.87	-32.42	120/300 kHz
Max PK	H	434.000	47.51	22.34	0.72	0.00	7.75	62.82	92.87	-30.05	120/300 kHz
AVG	H	434.000	27.51	22.34	0.72	0.00	7.75	42.82	72.87	-30.04	120/300 kHz
Max PK	V	445.000	43.77	23.00	0.74	0.00	7.75	59.76	93.22	-33.46	120/300 kHz
AVG	V	445.000	23.77	23.00	0.74	0.00	7.75	39.76	73.22	-33.47	120/300 kHz
Max PK	H	445.000	42.50	22.20	0.74	0.00	7.75	57.69	93.22	-35.53	120/300 kHz
AVG	H	445.000	22.50	22.20	0.74	0.00	7.75	37.69	73.22	-35.54	120/300 kHz
Max PK	H	425.000	47.80	22.00	0.71	0.00	7.75	62.76	92.57	-29.81	120/300 kHz
AVG	H	425.000	27.80	22.00	0.71	0.00	7.75	42.76	72.57	-29.81	120/300 kHz
Max PK	V	425.000	46.59	21.60	0.71	0.00	7.75	61.15	92.57	-31.42	120/300 kHz
AVG	V	425.000	26.59	21.60	0.71	0.00	7.75	41.15	72.57	-31.42	120/300 kHz

Site 1 - Position 7 Radiated Emissions at 6 meters

Test Site: National Grid Substation in Washington National Grid, Lincoln RI

Company: Intellisaw

Model #: Switchgears (425 to 442 MHz)

Serial #: 8150695

Engineers: Kouma Sinn

Project #: G102085252

Date(s): 06/01/15

Standard: FCC Part 15 Subpart C Section 15.231e

Receiver: 147-149

Limit Distance (m): 3

PreAmp: None

Test Distance (m): 6

PreAmp Used? (Y or N): N Voltage/Frequency: Powered from substation Frequency Range: 425 MHz, 434MHz & 445 MHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Site 1 , Position 7 at 6 meters. Output Power Setting: 9.15 dBm, AVG = Peak Readings - Average Factor of 20 dB from 10% duty cycle											
A distance factor of 6.02 dB was added to the readings (shown as negative) to compensate for testing at 6 meters instead of 3 meters											
Max PK	V	434.000	42.81	21.58	0.72	0.00	-6.02	71.13	92.87	-21.74	120/300 kHz
AVG	V	434.000	22.81	21.58	0.72	0.00	-6.02	51.13	72.87	-21.73	120/300 kHz
Max PK	H	434.000	43.31	22.34	0.72	0.00	-6.02	72.39	92.87	-20.48	120/300 kHz
AVG	H	434.000	23.31	22.34	0.72	0.00	-6.02	52.39	72.87	-20.47	120/300 kHz
Max PK	V	445.000	42.96	23.00	0.74	0.00	-6.02	72.72	93.22	-20.50	120/300 kHz
AVG	V	445.000	22.96	23.00	0.74	0.00	-6.02	52.72	73.22	-20.51	120/300 kHz
Max PK	H	445.000	41.87	22.20	0.74	0.00	-6.02	70.83	93.22	-22.39	120/300 kHz
AVG	H	445.000	21.87	22.20	0.74	0.00	-6.02	50.83	73.22	-22.40	120/300 kHz
Max PK	H	425.000	42.92	22.00	0.71	0.00	-6.02	71.65	92.57	-20.92	120/300 kHz
AVG	H	425.000	22.92	22.00	0.71	0.00	-6.02	51.65	72.57	-20.92	120/300 kHz
Max PK	V	425.000	40.88	21.60	0.71	0.00	-6.02	69.21	92.57	-23.36	120/300 kHz
AVG	V	425.000	20.88	21.60	0.71	0.00	-6.02	49.21	72.57	-23.36	120/300 kHz

Site 1 - Position 8 Radiated Emissions at 11.6 meters

Test Site: National Grid Substation in Washington National Grid, Lincoln RI

Company: Intellisaw

Model #: Switchgears (425 to 442 MHz)

Antenna & Cables: N Bands: N, LF, HF, SHF

Serial #: 8150695

Antenna: ANT1-10mV 11-04-2015.txt ANT1-10mH 11-04-2015.txt

Cable(s): CBLEMC3 04-02-16.txt NONE.

Engineers: Kouma Sinn

Location: National Grid Barometer: MAN1

Filter: NONE

Project #: G102085252

Date(s): 06/01/15

Standard: FCC Part 15 Subpart C Section 15.231e

Temp/Humidity/Pressure: 11C 91% 1013mbar

Receiver: 147-149

Limit Distance (m): 3

PreAmp: None

Test Distance (m): 11.6

PreAmp Used? (Y or N): N Voltage/Frequency: Powered from substation Frequency Range: 425 MHz, 434MHz & 445 MHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Site 1 , Position 8 at 11.6 meters. Output Power Setting: 9.15 dBm, AVG = Peak Readings - Average Factor of 20 dB from 10% duty cycle											
A distance factor of 11.75 dB was added to the readings (shown as negative) to compensate for testing at 11.6 meters instead of 3 meters											
Max PK	V	434.000	41.21	21.58	0.72	0.00	-11.75	75.26	92.87	-17.61	120/300 kHz
AVG	V	434.000	21.21	21.58	0.72	0.00	-11.75	55.26	72.87	-17.60	120/300 kHz
Max PK	H	434.000	37.81	22.34	0.72	0.00	-11.75	72.62	92.87	-20.25	120/300 kHz
AVG	H	434.000	17.81	22.34	0.72	0.00	-11.75	52.62	72.87	-20.24	120/300 kHz
Max PK	V	445.000	41.98	23.00	0.74	0.00	-11.75	77.47	93.22	-15.75	120/300 kHz
AVG	V	445.000	21.98	23.00	0.74	0.00	-11.75	57.47	73.22	-15.76	120/300 kHz
Max PK	H	445.000	39.88	22.20	0.74	0.00	-11.75	74.57	93.22	-18.65	120/300 kHz
AVG	H	445.000	19.88	22.20	0.74	0.00	-11.75	54.57	73.22	-18.66	120/300 kHz
Max PK	H	425.000	41.99	22.00	0.71	0.00	-11.75	76.45	92.57	-16.12	120/300 kHz
AVG	H	425.000	21.99	22.00	0.71	0.00	-11.75	56.45	72.57	-16.12	120/300 kHz
Max PK	V	425.000	42.28	21.60	0.71	0.00	-11.75	76.34	92.57	-16.23	120/300 kHz
AVG	V	425.000	22.28	21.60	0.71	0.00	-11.75	56.34	72.57	-16.23	120/300 kHz

Site 1 - Position 9 Radiated Emissions at 14.6 meters

Test Site: National Grid Substation in Washington National Grid, Lincoln RI

Company: Intellisaw

Model #: Switchgears (425 to 442 MHz)

Serial #: 8150695

Engineers: Kouma Sinn

Project #: G102085252

Date(s): 06/01/15

Standard: FCC Part 15 Subpart C Section 15.231e

Receiver: 147-149

Limit Distance (m): 3

PreAmp: None

Test Distance (m): 14.6

PreAmp Used? (Y or N): N Voltage/Frequency: Powered from substation Frequency Range: 425 MHz, 434MHz & 445 MHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Site 1 , Position 9 at 14.6 meters. Output Power Setting: 9.15 dBm, AVG = Peak Readings - Average Factor of 20 dB from 10% duty cycle											
A distance factor of 11.75 dB was added to the readings (shown as negative) to compensate for testing at 14.6 meters instead of 3 meters											
Max PK	V	434.000	42.90	21.58	0.72	0.00	-13.74	78.94	92.87	-13.93	120/300 kHz
AVG	V	434.000	22.90	21.58	0.72	0.00	-13.74	58.94	72.87	-13.92	120/300 kHz
Max PK	H	434.000	38.78	22.34	0.72	0.00	-13.74	75.58	92.87	-17.29	120/300 kHz
AVG	H	434.000	18.78	22.34	0.72	0.00	-13.74	55.58	72.87	-17.28	120/300 kHz
Max PK	V	445.000	36.76	23.00	0.74	0.00	-13.74	74.24	93.22	-18.98	120/300 kHz
AVG	V	445.000	16.76	23.00	0.74	0.00	-13.74	54.24	73.22	-18.99	120/300 kHz
Max PK	H	445.000	39.72	22.20	0.74	0.00	-13.74	76.40	93.22	-16.82	120/300 kHz
AVG	H	445.000	19.72	22.20	0.74	0.00	-13.74	56.40	73.22	-16.83	120/300 kHz
Max PK	H	425.000	38.59	22.00	0.71	0.00	-13.74	75.04	92.57	-17.53	120/300 kHz
AVG	H	425.000	18.59	22.00	0.71	0.00	-13.74	55.04	72.57	-17.53	120/300 kHz
Max PK	V	425.000	40.64	21.60	0.71	0.00	-13.74	76.69	92.57	-15.88	120/300 kHz
AVG	V	425.000	20.64	21.60	0.71	0.00	-13.74	56.69	72.57	-15.88	120/300 kHz

Site 1 - Position 10 Radiated Emissions at 16.8 meters

Test Site: National Grid Substation in Washington National Grid, Lincoln RI

Company: Intellisaw

Model #: Switchgears (425 to 442 MHz)

Serial #: 8150695

Engineers: Kouma Sinn

Project #: G102085252

Date(s): 06/01/15

Standard: FCC Part 15 Subpart C Section 15.231e

Receiver: 147-149

Limit Distance (m): 3

PreAmp: None

Test Distance (m): 16.8

PreAmp Used? (Y or N): N Voltage/Frequency: Powered from substation Frequency Range: 425 MHz, 434MHz & 445 MHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Site 1 , Position 10 at 16.8 meters. Output Power Setting: 9.15 dBm, AVG = Peak Readings - Average Factor of 20 dB from 10% duty cycle											
A distance factor of 14.96 dB was added to the readings (shown as negative) to compensate for testing at 16.8 meters instead of 3 meters											
Max PK	V	434.000	41.12	21.58	0.72	0.00	-14.96	78.38	92.87	-14.49	120/300 kHz
AVG	V	434.000	21.12	21.58	0.72	0.00	-14.96	58.38	72.87	-14.48	120/300 kHz
Max PK	H	434.000	36.92	22.34	0.72	0.00	-14.96	74.94	92.87	-17.93	120/300 kHz
AVG	H	434.000	16.92	22.34	0.72	0.00	-14.96	54.94	72.87	-17.92	120/300 kHz
Max PK	V	445.000	35.10	23.00	0.74	0.00	-14.96	73.80	93.22	-19.42	120/300 kHz
AVG	V	445.000	15.10	23.00	0.74	0.00	-14.96	53.80	73.22	-19.43	120/300 kHz
Max PK	H	445.000	37.53	22.20	0.74	0.00	-14.96	75.43	93.22	-17.79	120/300 kHz
AVG	H	445.000	17.53	22.20	0.74	0.00	-14.96	55.43	73.22	-17.80	120/300 kHz
Max PK	H	425.000	38.31	22.00	0.71	0.00	-14.96	75.98	92.57	-16.59	120/300 kHz
AVG	H	425.000	18.31	22.00	0.71	0.00	-14.96	55.98	72.57	-16.59	120/300 kHz
Max PK	V	425.000	39.72	21.60	0.71	0.00	-14.96	76.99	92.57	-15.58	120/300 kHz
AVG	V	425.000	19.72	21.60	0.71	0.00	-14.96	56.99	72.57	-15.58	120/300 kHz

Site 1 - Position 11 Radiated Emissions at 17.7 meters

Test Site: National Grid Substation in Washington National Grid, Lincoln RI

Company: Intellisaw

Model #: Switchgears (425 to 442 MHz)

Serial #: 8150695

Engineers: Kouma Sinn

Project #: G102085252

Date(s): 06/01/15

Standard: FCC Part 15 Subpart C Section 15.231e

Receiver: 147-149

Limit Distance (m): 3

PreAmp: None

Test Distance (m): 17.7

PreAmp Used? (Y or N): N Voltage/Frequency: Powered from substation Frequency Range: 425 MHz, 434MHz & 445 MHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Site 1 , Position 11 at 17.7 meters. Output Power Setting: 9.15 dBm, AVG = Peak Readings - Average Factor of 20 dB from 10% duty cycle											
A distance factor of 15.42 dB was added to the readings (shown as negative) to compensate for testing at 17.7 meters instead of 3 meters											
Max PK	V	434.000	32.41	21.58	0.72	0.00	-15.42	70.13	92.87	-22.74	120/300 kHz
AVG	V	434.000	12.41	21.58	0.72	0.00	-15.42	50.13	72.87	-22.73	120/300 kHz
Max PK	H	434.000	33.10	22.34	0.72	0.00	-15.42	71.58	92.87	-21.29	120/300 kHz
AVG	H	434.000	13.10	22.34	0.72	0.00	-15.42	51.58	72.87	-21.28	120/300 kHz
Max PK	V	445.000	35.96	23.00	0.74	0.00	-15.42	75.12	93.22	-18.10	120/300 kHz
AVG	V	445.000	15.96	23.00	0.74	0.00	-15.42	55.12	73.22	-18.11	120/300 kHz
Max PK	H	445.000	34.23	22.20	0.74	0.00	-15.42	72.59	93.22	-20.63	120/300 kHz
AVG	H	445.000	14.23	22.20	0.74	0.00	-15.42	52.59	73.22	-20.64	120/300 kHz
Max PK	H	425.000	36.10	22.00	0.71	0.00	-15.42	74.23	92.57	-18.34	120/300 kHz
AVG	H	425.000	16.10	22.00	0.71	0.00	-15.42	54.23	72.57	-18.34	120/300 kHz
Max PK	V	425.000	35.38	21.60	0.71	0.00	-15.42	73.11	92.57	-19.46	120/300 kHz
AVG	V	425.000	15.38	21.60	0.71	0.00	-15.42	53.11	72.57	-19.46	120/300 kHz

Site 1 - Position 12 Radiated Emissions at 21 meters

Test Site: National Grid Substation in Washington National Grid, Lincoln RI

Company: Intellisaw

Model #: Switchgears (425 to 442 MHz)

Serial #: 8150695

Engineers: Kouma Sinn

Project #: G102085252

Date(s): 06/01/15

Standard: FCC Part 15 Subpart C Section 15.231e

Receiver: 147-149

Limit Distance (m): 3

PreAmp: None

Test Distance (m): 21

PreAmp Used? (Y or N): N

Voltage/Frequency: Powered from substation

Frequency Range: 425 MHz, 434MHz & 445 MHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Site 1 , Position 12 at 21 meters. Output Power Setting: 9.15 dBm, AVG = Peak Readings - Average Factor of 20 dB from 10% duty cycle											
A distance factor of 16.90 dB was added to the readings (shown as negative) to compensate for testing at 21 meters instead of 3 meters											
Max PK	V	434.000	36.44	21.58	0.72	0.00	-16.90	75.64	92.87	-17.23	120/300 kHz
AVG	V	434.000	16.44	21.58	0.72	0.00	-16.90	55.64	72.87	-17.22	120/300 kHz
Max PK	H	434.000	36.74	22.34	0.72	0.00	-16.90	76.70	92.87	-16.17	120/300 kHz
AVG	H	434.000	16.74	22.34	0.72	0.00	-16.90	56.70	72.87	-16.16	120/300 kHz
Max PK	V	445.000	34.60	23.00	0.74	0.00	-16.90	75.24	93.22	-17.98	120/300 kHz
AVG	V	445.000	14.60	23.00	0.74	0.00	-16.90	55.24	73.22	-17.99	120/300 kHz
Max PK	H	445.000	31.32	22.20	0.74	0.00	-16.90	71.16	93.22	-22.06	120/300 kHz
AVG	H	445.000	11.32	22.20	0.74	0.00	-16.90	51.16	73.22	-22.07	120/300 kHz
Max PK	H	425.000	35.61	22.00	0.71	0.00	-16.90	75.22	92.57	-17.35	120/300 kHz
AVG	H	425.000	15.61	22.00	0.71	0.00	-16.90	55.22	72.57	-17.35	120/300 kHz
Max PK	V	425.000	33.49	21.60	0.71	0.00	-16.90	72.70	92.57	-19.87	120/300 kHz
AVG	V	425.000	13.49	21.60	0.71	0.00	-16.90	52.70	72.57	-19.87	120/300 kHz

Site 1 - Position 13 Radiated Emissions at 11.89 meters

Test Site: National Grid Substation in Washington National Grid, Lincoln RI

Company: Intellisaw

Model #: Switchgears (425 to 442 MHz)

Serial #: 8150695

Engineers: Kouma Sinn

Project #: G102085252

Date(s): 06/02/15

Standard: FCC Part 15 Subpart C Section 15.231e

Receiver: 147-149

Limit Distance (m): 3

PreAmp: None

Test Distance (m): 11.89

PreAmp Used? (Y or N): N

Voltage/Frequency: Powered from substation

Frequency Range: 425 MHz, 434MHz & 445 MHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Site 1 , Position 13 at 11.89 meters. Output Power Setting: 9.15 dBm, AVG = Peak Readings - Average Factor of 20 dB from 10% duty cycle											
A distance factor of 11.96 dB was added to the readings (shown as negative) to compensate for testing at 11.89 meters instead of 3 meters											
Max PK	V	434.000	39.96	21.58	0.72	0.00	-11.96	74.22	92.87	-18.65	120/300 kHz
AVG	V	434.000	19.96	21.58	0.72	0.00	-11.96	54.22	72.87	-18.64	120/300 kHz
Max PK	H	434.000	33.62	22.34	0.72	0.00	-11.96	68.64	92.87	-24.23	120/300 kHz
AVG	H	434.000	13.62	22.34	0.72	0.00	-11.96	48.64	72.87	-24.22	120/300 kHz
Max PK	V	445.000	31.00	23.00	0.74	0.00	-11.96	66.70	93.22	-26.52	120/300 kHz
AVG	V	445.000	11.00	23.00	0.74	0.00	-11.96	46.70	73.22	-26.53	120/300 kHz
Max PK	H	445.000	31.00	22.20	0.74	0.00	-11.96	65.90	93.22	-27.32	120/300 kHz
AVG	H	445.000	11.00	22.20	0.74	0.00	-11.96	45.90	73.22	-27.33	120/300 kHz
Max PK	H	425.000	30.31	22.00	0.71	0.00	-11.96	64.98	92.57	-27.59	120/300 kHz
AVG	H	425.000	10.31	22.00	0.71	0.00	-11.96	44.98	72.57	-27.59	120/300 kHz
Max PK	V	425.000	31.73	21.60	0.71	0.00	-11.96	66.00	92.57	-26.57	120/300 kHz
AVG	V	425.000	11.73	21.60	0.71	0.00	-11.96	46.00	72.57	-26.57	120/300 kHz

Site 1 - Position 14 Radiated Emissions at 19.5 meters

Test Site: National Grid Substation in Washington National Grid, Lincoln RI

Company: Intellisaw

Model #: Switchgears (425 to 442 MHz)

Serial #: 8150695

Engineers: Kouma Sinn

Project #: G102085252

Date(s): 06/02/15

Standard: FCC Part 15 Subpart C Section 15.231e

Receiver: 147-149

Limit Distance (m): 3

PreAmp: None

Test Distance (m): 19.5

PreAmp Used? (Y or N): N

Voltage/Frequency: Powered from substation

Antenna & Cables: N Bands: N, LF, HF, SHF

Antenna: ANT1-10mV 11-04-2015.txt ANT1-10mH 11-04-2015.txt

Cable(s): CBLEMC3 04-02-16.txt NONE.

Location: National Grid Barometer: MAN1

Filter: NONE

Temp/Humidity/Pressure: 11C 84% 1010mbar

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Site 1 , Position 14 at 19.5 meters. Output Power Setting: 9.15 dBm, AVG = Peak Readings - Average Factor of 20 dB from 10% duty cycle											
A distance factor of 16.26 dB was added to the readings (shown as negative) to compensate for testing at 19.5 meters instead of 3 meters											
Max PK	V	434.000	31.00	21.58	0.72	0.00	-16.26	69.56	92.87	-23.31	120/300 kHz
AVG	V	434.000	11.00	21.58	0.72	0.00	-16.26	49.56	72.87	-23.30	120/300 kHz
Max PK	H	434.000	32.90	22.34	0.72	0.00	-16.26	72.22	92.87	-20.65	120/300 kHz
AVG	H	434.000	12.90	22.34	0.72	0.00	-16.26	52.22	72.87	-20.64	120/300 kHz
Max PK	V	445.000	31.00	23.00	0.74	0.00	-16.26	71.00	93.22	-22.22	120/300 kHz
AVG	V	445.000	11.00	23.00	0.74	0.00	-16.26	51.00	73.22	-22.23	120/300 kHz
Max PK	H	445.000	31.00	22.20	0.74	0.00	-16.26	70.20	93.22	-23.02	120/300 kHz
AVG	H	445.000	11.00	22.20	0.74	0.00	-16.26	50.20	73.22	-23.03	120/300 kHz
Max PK	H	425.000	30.50	22.00	0.71	0.00	-16.26	69.47	92.57	-23.10	120/300 kHz
AVG	H	425.000	10.50	22.00	0.71	0.00	-16.26	49.47	72.57	-23.10	120/300 kHz
Max PK	V	425.000	37.54	21.60	0.71	0.00	-16.26	76.11	92.57	-16.46	120/300 kHz
AVG	V	425.000	17.54	21.60	0.71	0.00	-16.26	56.11	72.57	-16.46	120/300 kHz

Site 1 - Position 15 Radiated Emissions at 14.17 meters

Test Site: National Grid Substation in Washington National Grid, Lincoln RI

Company: Intellisaw

Model #: Switchgears (425 to 442 MHz)

Serial #: 8150695

Engineers: Kouma Sinn

Project #: G102085252

Date(s): 06/02/15

Standard: FCC Part 15 Subpart C Section 15.231e

Receiver: 147-149

Limit Distance (m): 3

PreAmp: None

Test Distance (m): 14.17

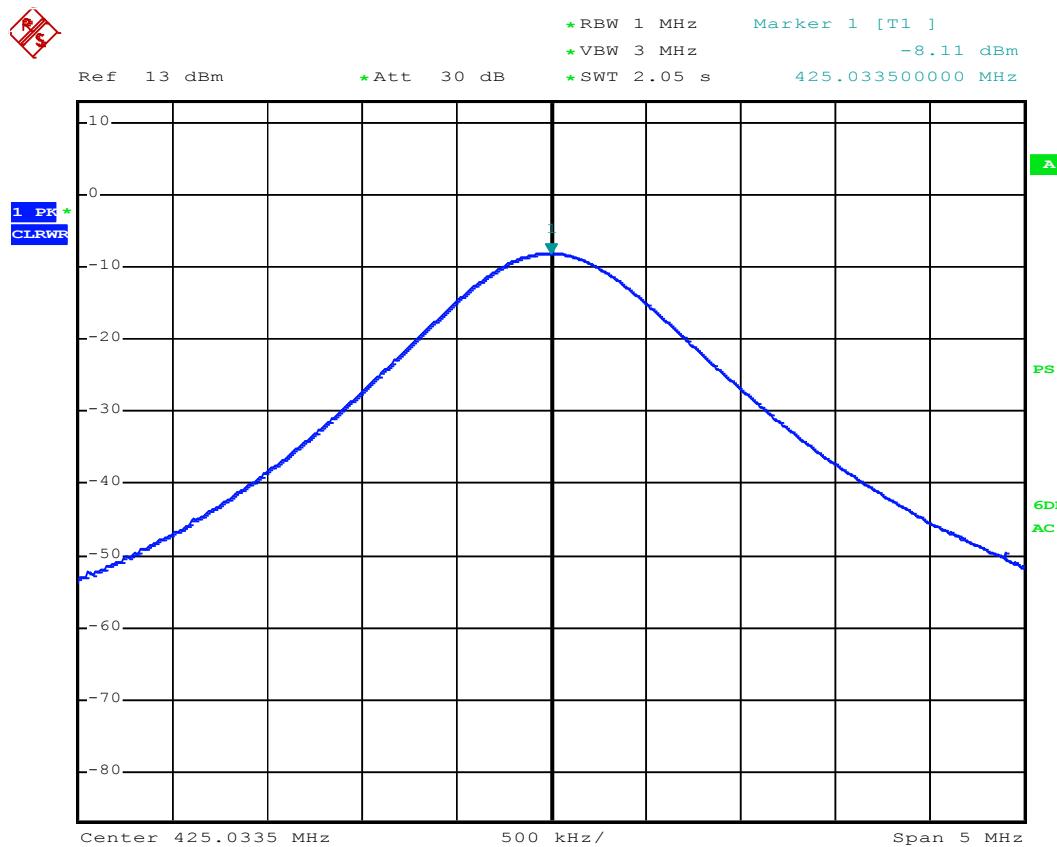
PreAmp Used? (Y or N): N Voltage/Frequency: Powered from substation Frequency Range: 425 MHz, 434MHz & 445 MHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Site 1 , Position 15 at 14.17 meters. Output Power Setting: 9.15 dBm, AVG = Peak Readings - Average Factor of 20 dB from 10% duty cycle											
A distance factor of 13.48 dB was added to the readings (shown as negative) to compensate for testing at 14.17 meters instead of 3 meters											
Max PK	V	434.000	41.44	21.58	0.72	0.00	-13.48	77.22	92.87	-15.65	120/300 kHz
AVG	V	434.000	21.44	21.58	0.72	0.00	-13.48	57.22	72.87	-15.64	120/300 kHz
Max PK	H	434.000	39.17	22.34	0.72	0.00	-13.48	75.71	92.87	-17.16	120/300 kHz
AVG	H	434.000	19.17	22.34	0.72	0.00	-13.48	55.71	72.87	-17.15	120/300 kHz
Max PK	V	445.000	42.03	23.00	0.74	0.00	-13.48	79.25	93.22	-13.97	120/300 kHz
AVG	V	445.000	22.03	23.00	0.74	0.00	-13.48	59.25	73.22	-13.98	120/300 kHz
Max PK	H	445.000	42.27	22.20	0.74	0.00	-13.48	78.69	93.22	-14.53	120/300 kHz
AVG	H	445.000	22.27	22.20	0.74	0.00	-13.48	58.69	73.22	-14.54	120/300 kHz
Max PK	H	425.000	42.45	22.00	0.71	0.00	-13.48	78.64	92.57	-13.93	120/300 kHz
AVG	H	425.000	22.45	22.00	0.71	0.00	-13.48	58.64	72.57	-13.93	120/300 kHz
Max PK	V	425.000	45.90	21.60	0.71	0.00	-13.48	81.69	92.57	-10.88	120/300 kHz
AVG	V	425.000	25.90	21.60	0.71	0.00	-13.48	61.69	72.57	-10.88	120/300 kHz

Antenna Port Conducted Power at 425 MHz

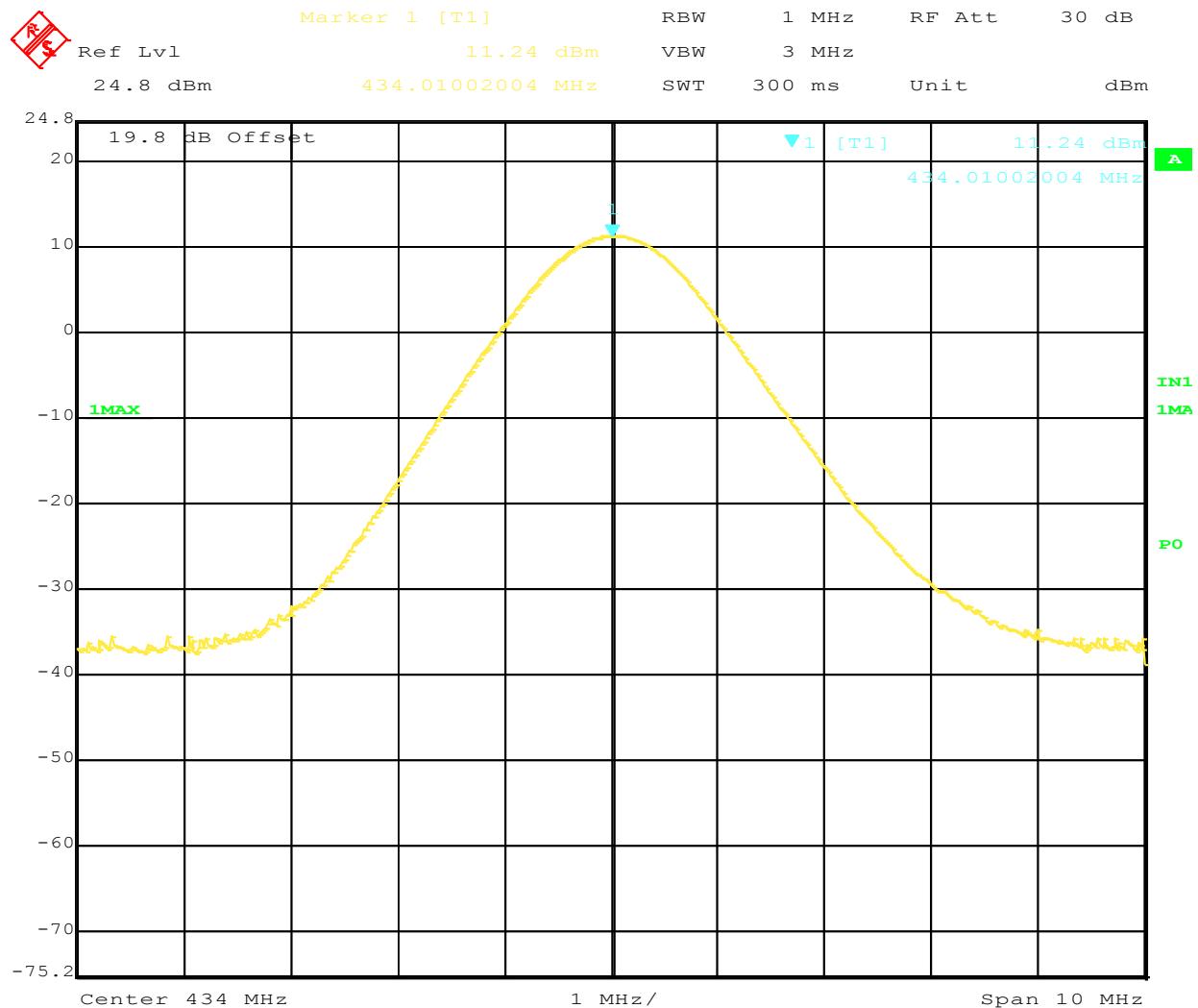


Date: 10.APR.2015 17:29:57

Output power for frequency 425 MHz is 11.69 dB(m)

Output power = -8.11+19.8 (cable loss + attenuator factor)

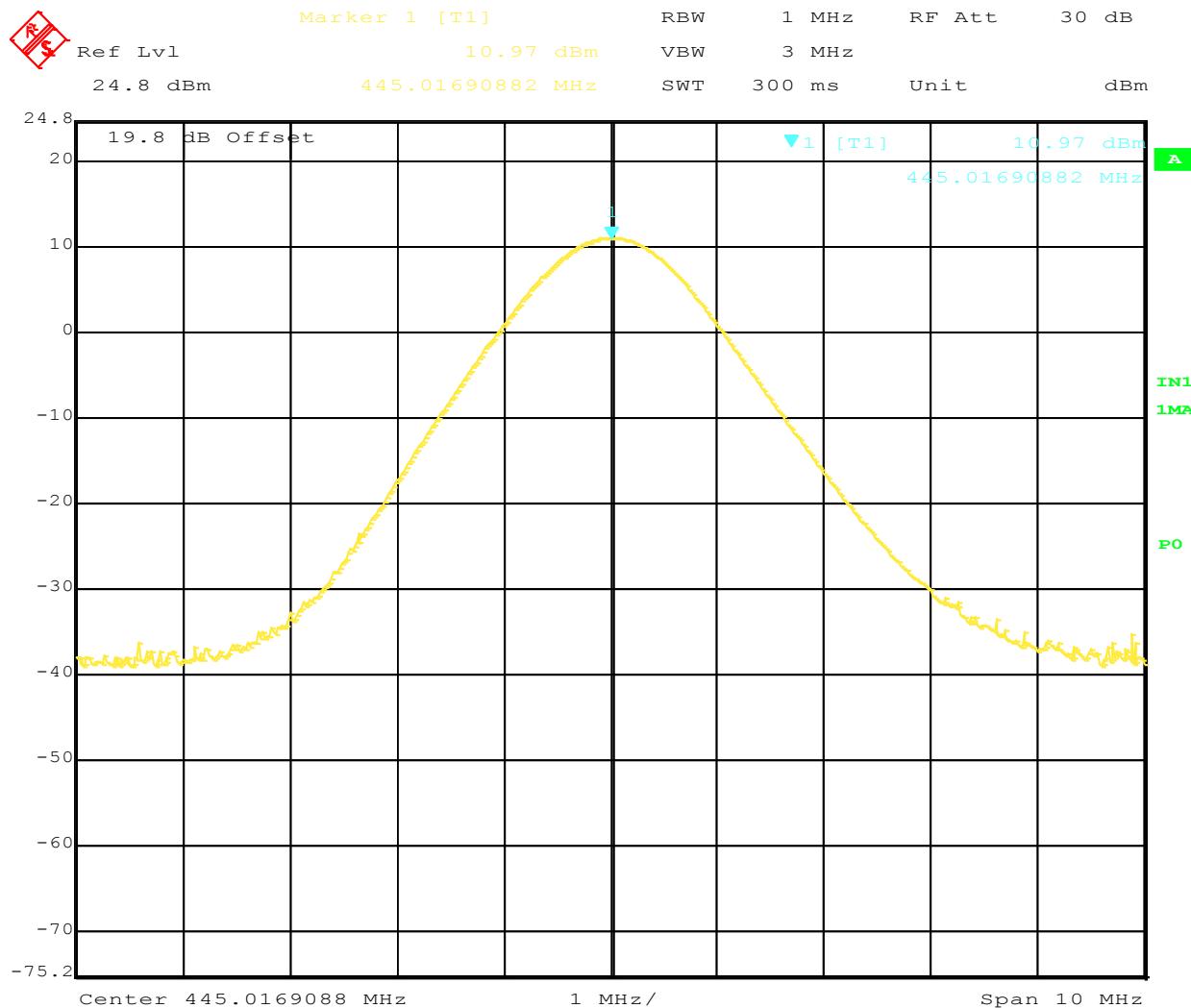
Antenna Port Conducted Power at 434 MHz



Date: 9.APR.2015 19:11:55

Output power for frequency 434 MHz is 11.24 dB(m)

Antenna Port Conducted Power at 445 MHz



Date: 9.APR.2015 19:16:48

Output power for frequency 445 MHz is 10.97 d(Bm)

Test Personnel: Vathana VenTest Date: 04/09/2015Kouma Sinn06/01/2015

Supervising/Reviewing

Engineer:

(Where Applicable)

N/AProduct Standard: FCC Part 15 Subpart C, RSS-Limit Applied: Section 15.231(e)210Input Voltage: Powered from 24VDC HostAmbient Temperature: See data tables

Pretest Verification w/

Ambient Signals or

BB Source: Ambient SignalsRelative Humidity: See data tablesAtmospheric Pressure: See data tables

Deviations, Additions, or Exclusions: None

7 Occupied Bandwidth

7.1 Method

Tests are performed in accordance with FCC 47CFR Part 15 Subpart C Section 15.231(c), ANSI C63.10:2009, RSS-Gen.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A wooden table 80 cm high is used for table-top equipment.

7.2 Test Equipment Used:

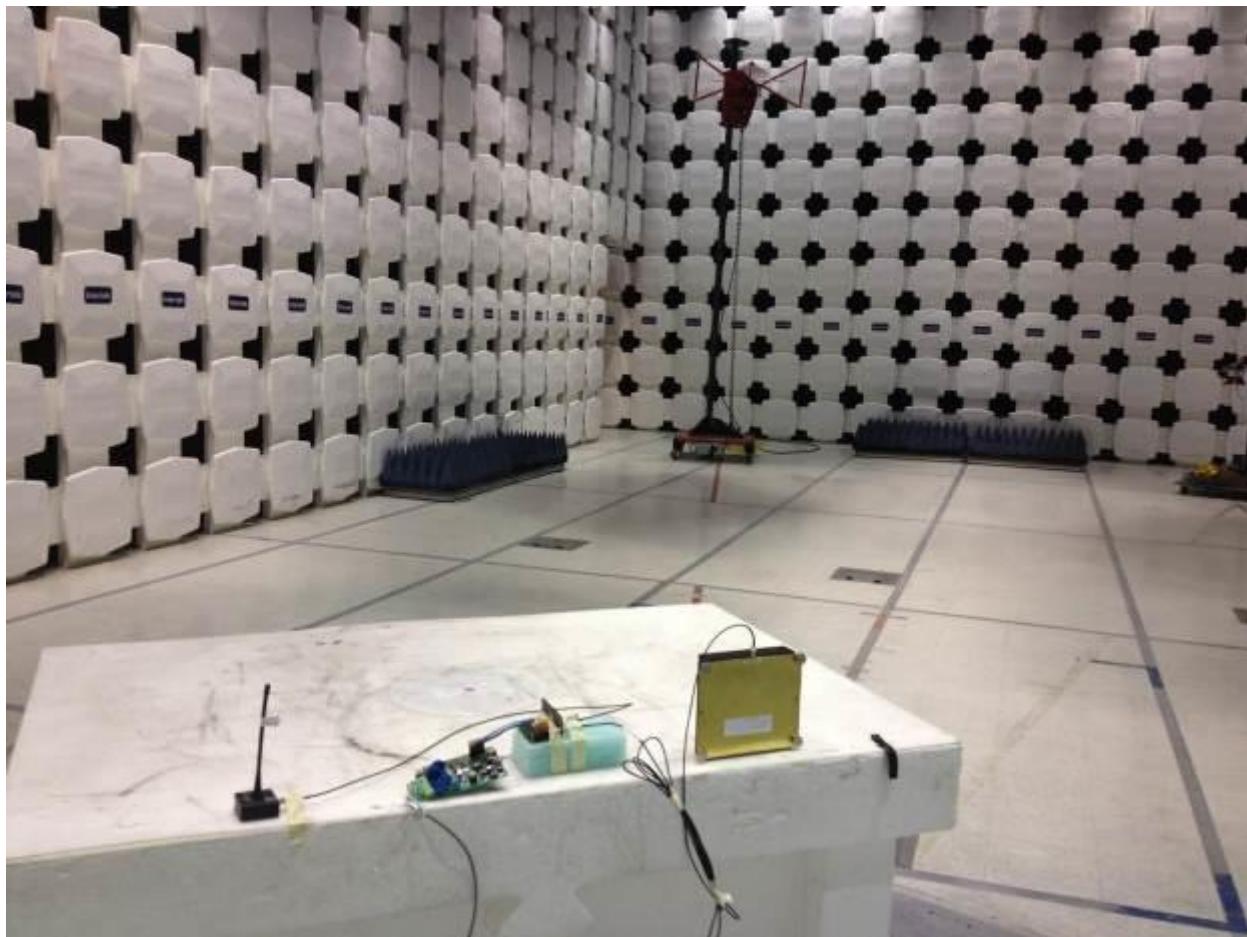
Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
145128'	EMI Receiver (20 Hz - 40 GHz)	Rohde & Schwarz	ESIB 40	839283/001	03/14/2015	03/14/2016
145-410'	Cables 145-400 145-403 145-405 145-406 145-407	Huber + Suhner	10m Track A Cables	multiple	10/04/2014	10/04/2015
145106'	Bilog Antenna (30MHz - 5GHz)	Sunol Sciences	JB5	A111003	10/24/2014	10/24/2015
Dav004'	Weather Station	Davis Instruments	7400	PE80529A61A	10/06/2014	10/06/2015

Software Utilized:

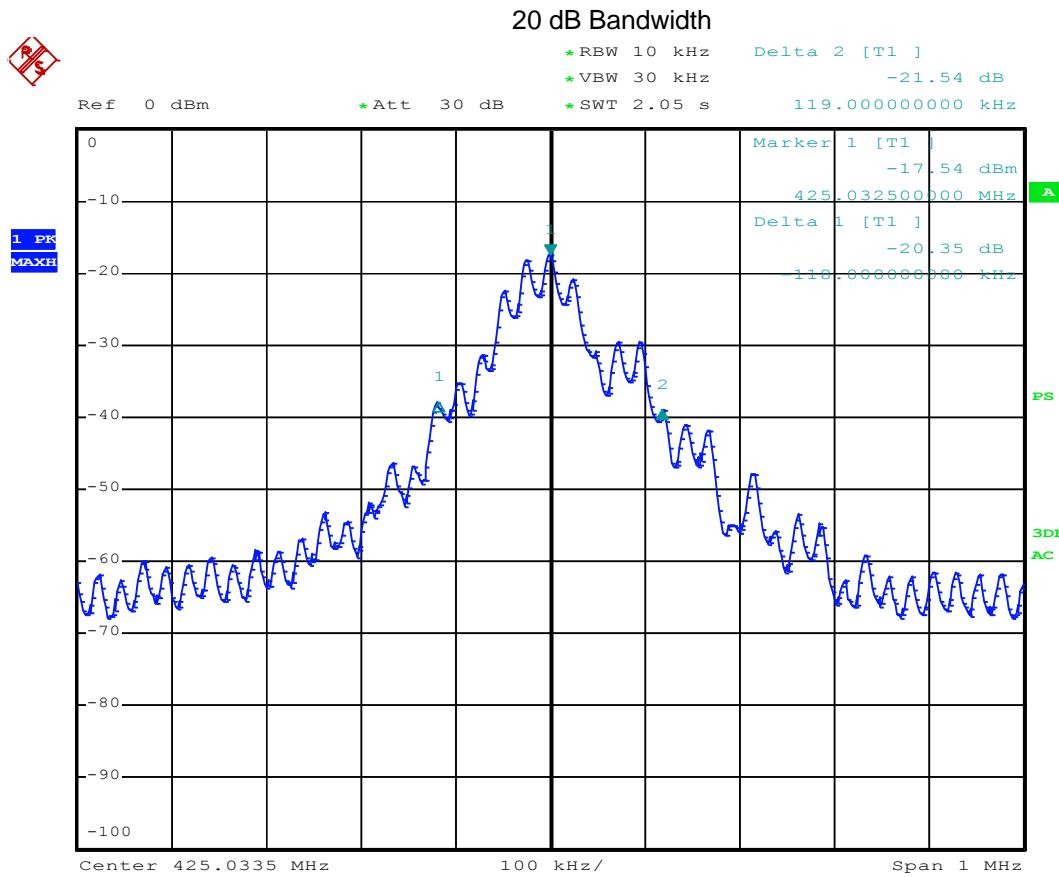
Name	Manufacturer	Version
None		

7.3 Results:

The sample tested was found to Comply. 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. Therefore the bandwidth must not exceed 1.06 MHz for 425 MHz, 1.09 MHz for 434 MHz, and 1.11 MHz for 445 MHz.

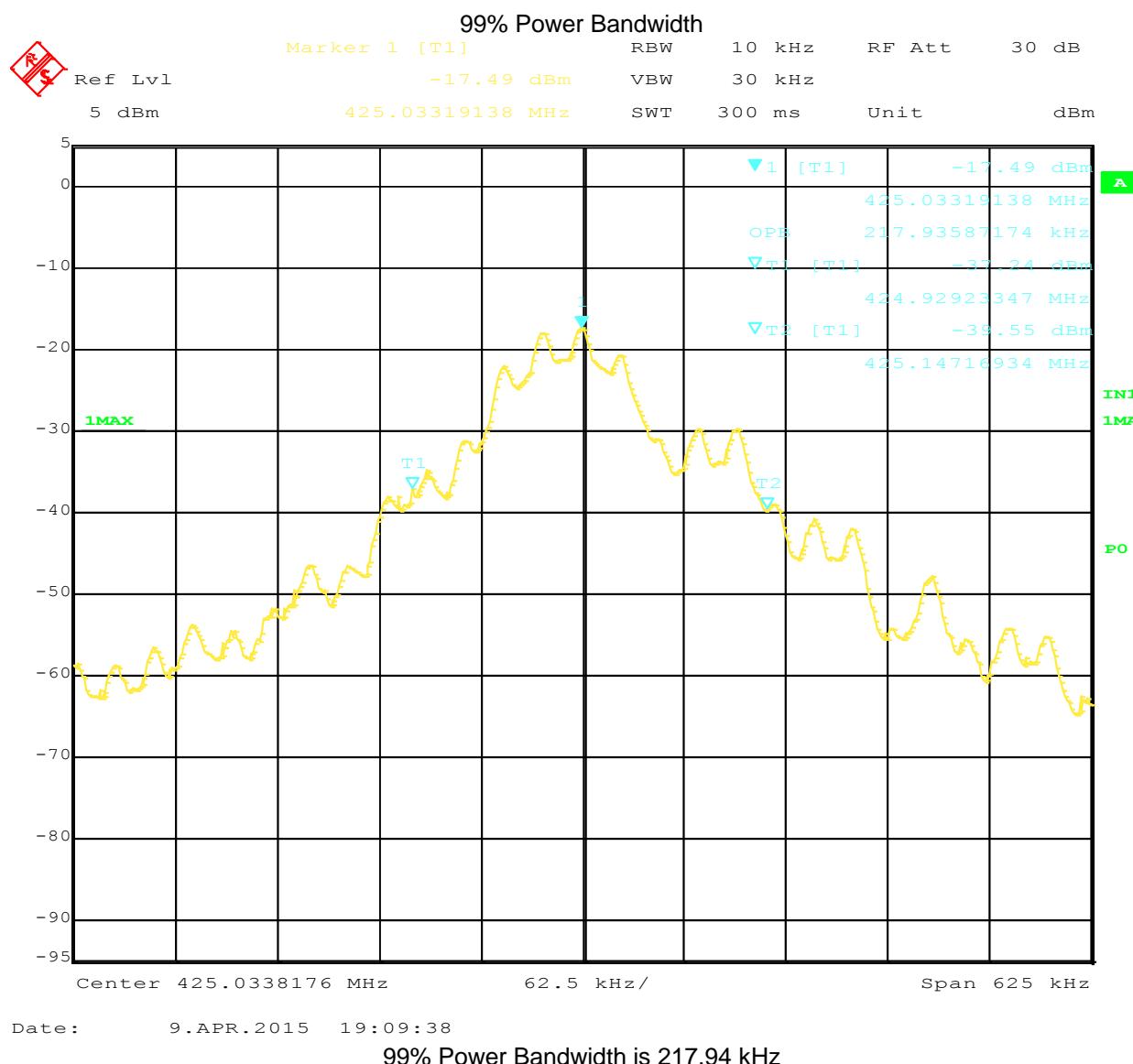
7.4 Setup Photograph:

7.5 Plots/Data:

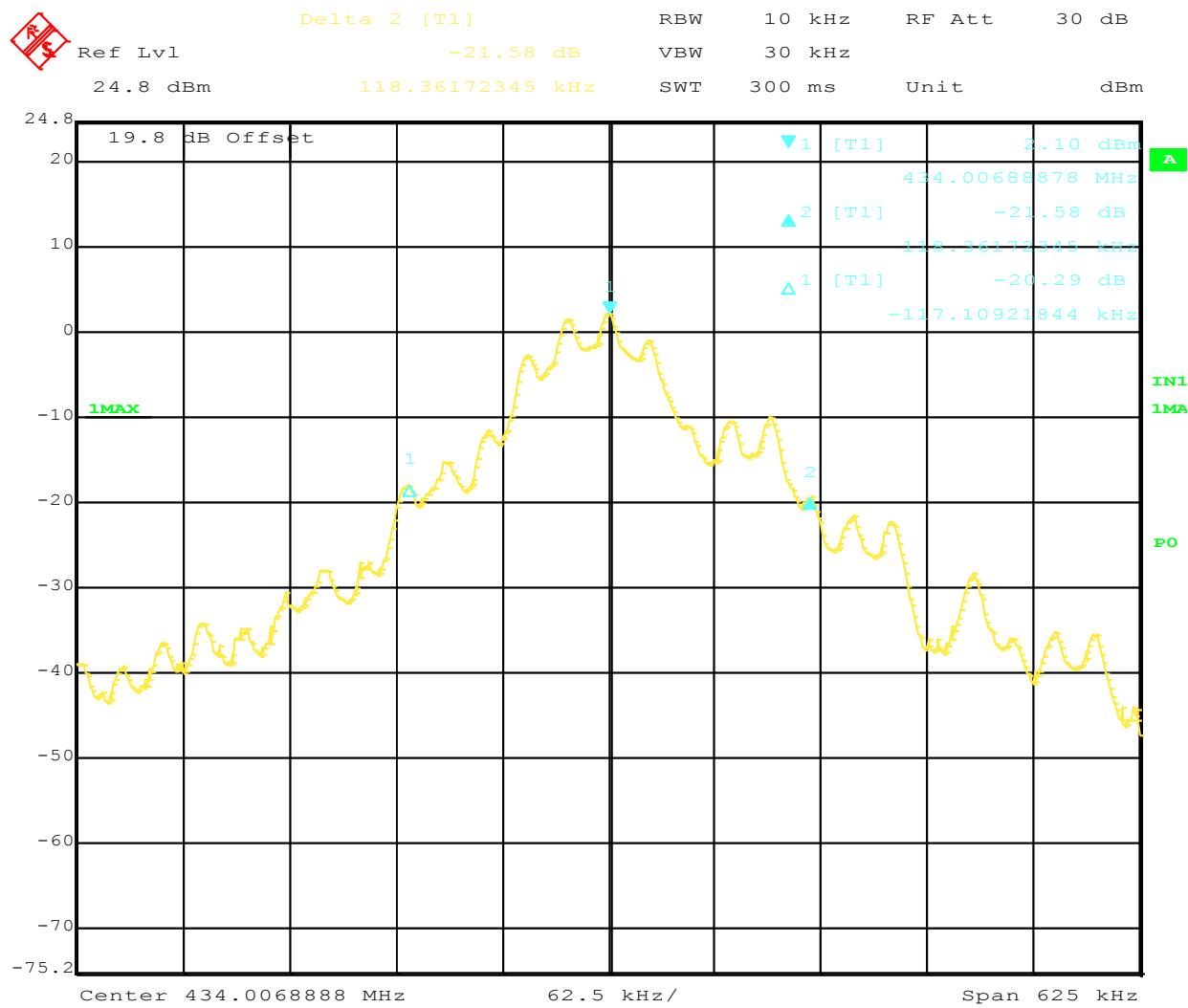


Date: 10.APR.2015 17:34:01

20 dB Bandwidth is 237 kHz



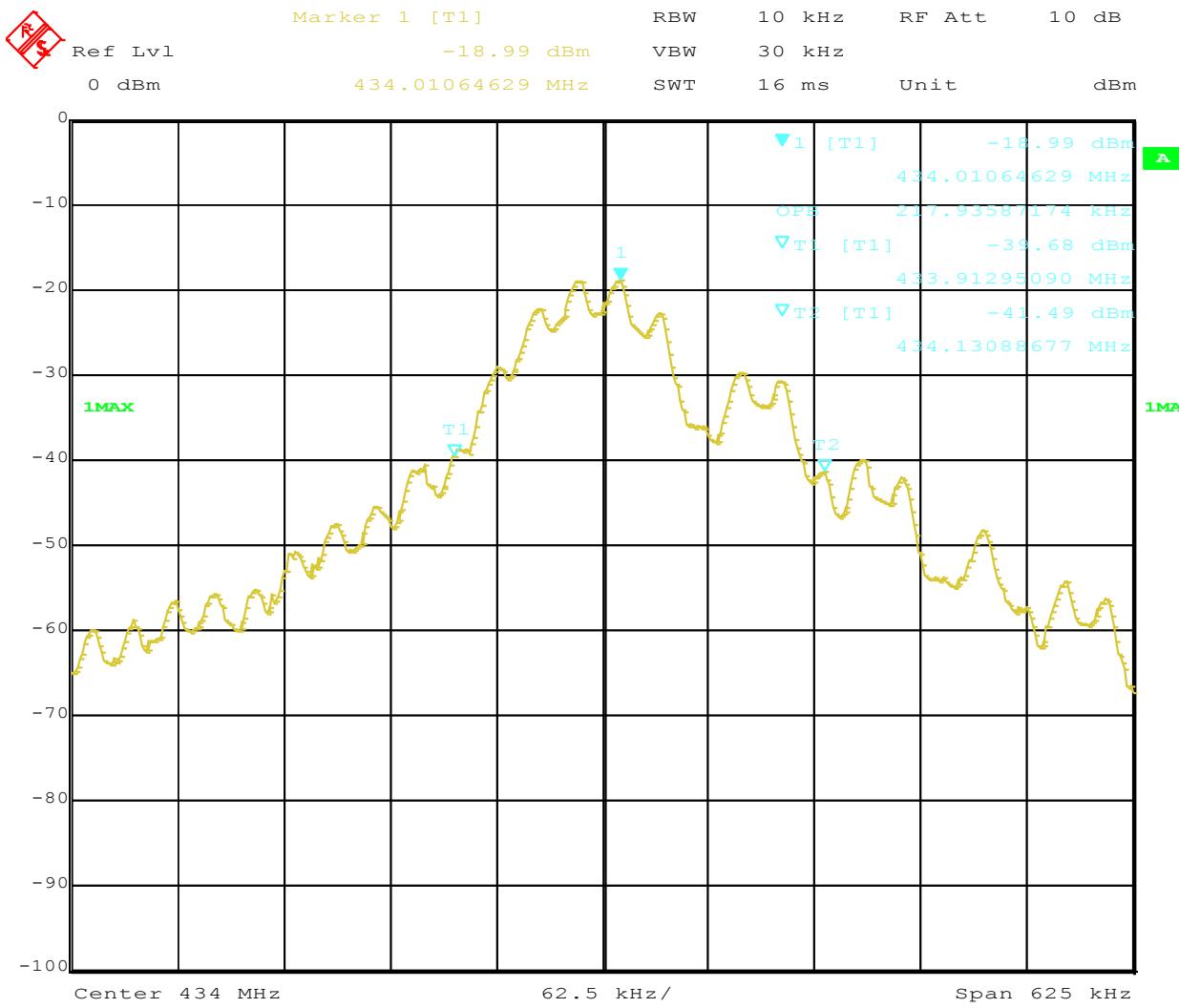
20 dB Bandwidth



Date: 9.APR.2015 19:13:22

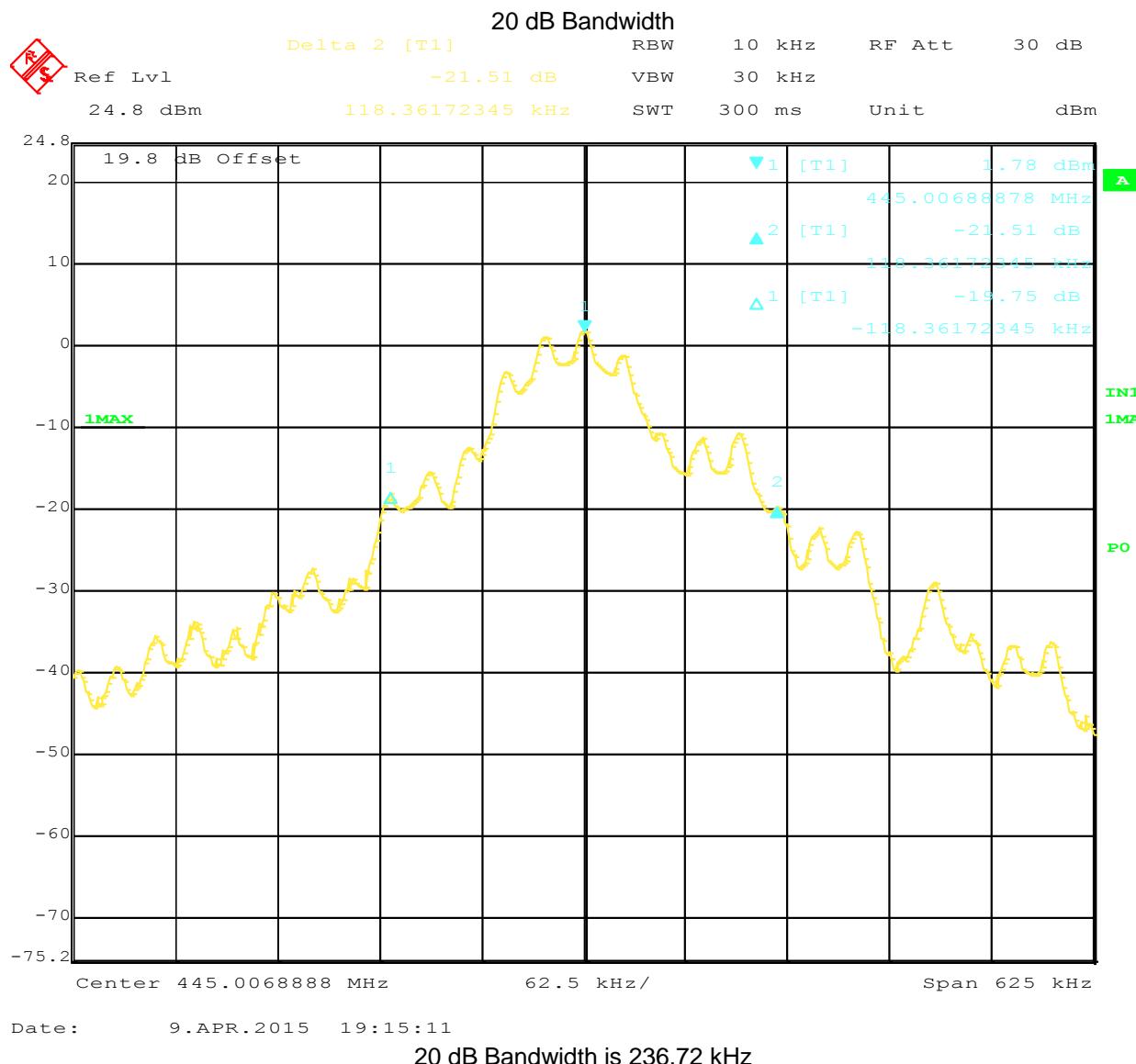
20 dB Bandwidth is 235.46 kHz

99% Power Bandwidth

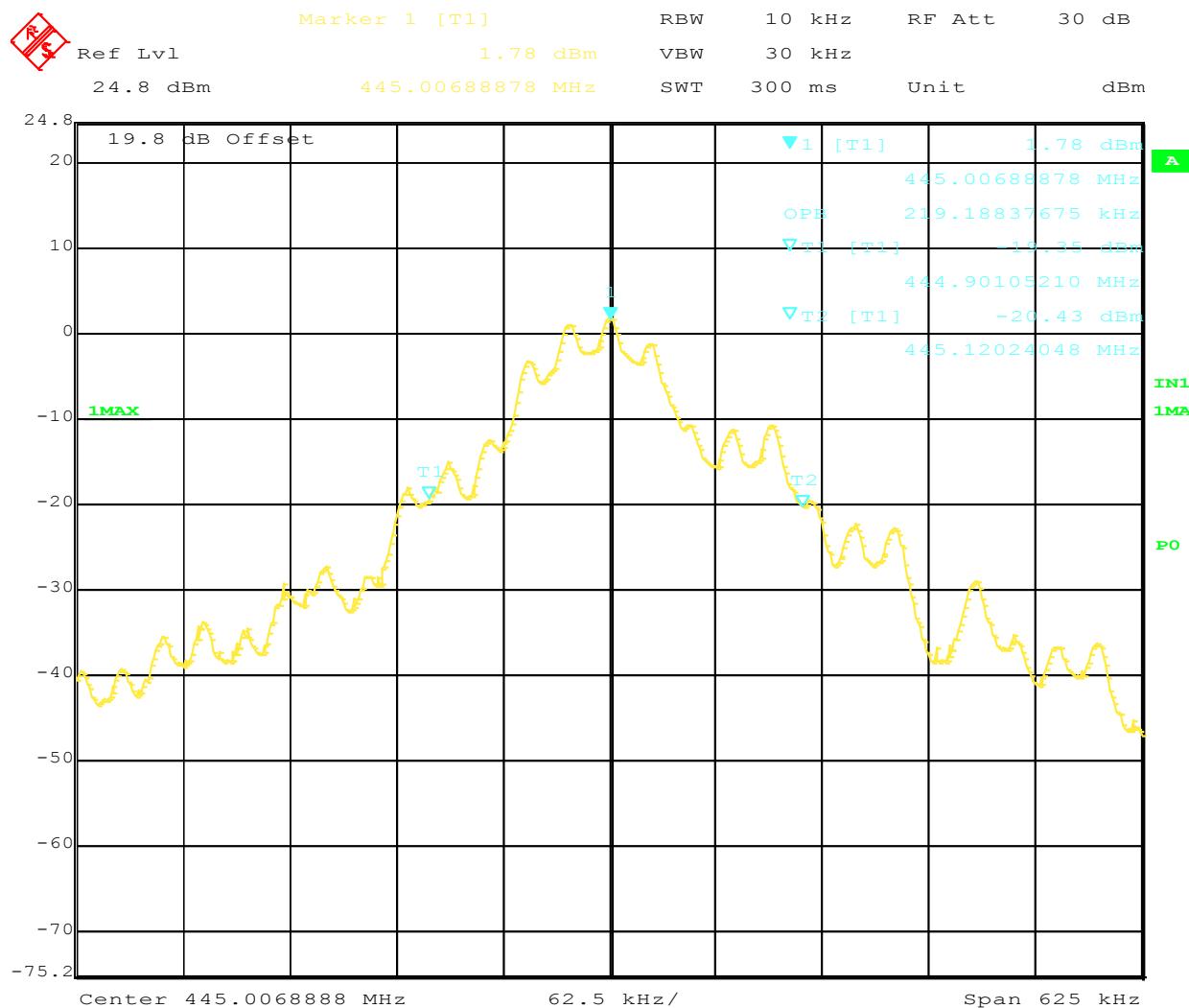


Date: 1.JAN.1997 00:35:40

99% Power Bandwidth is 217.94 kHz



99% Power Bandwidth



Date: 9.APR.2015 19:15:41

99% Power Bandwidth is 219.19 kHz

Test Personnel: Vathana Ven
 Supervising/Reviewing
 Engineer:
 (Where Applicable) N/A
 Product Standard: FCC Part 15 Subpart C, RSS Gen
 Input Voltage: Powered from 24VDC Host
 Pretest Verification w/
 Ambient Signals or
 BB Source: Ambient Signals

Test Date: 04/28/2015
 Limit Applied: Section 15.231(c)
 Ambient Temperature: 22 °C
 Relative Humidity: 10 %
 Atmospheric Pressure: 1007 mbars

8 Radiated and Spurious Emissions

8.1 Method

Tests are performed in accordance with FCC 47CFR Part 15 Subpart C Section 15.231(e), ANSI C63.10:2009, RSS-210

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A wooden table 80 cm high is used for table-top equipment.

Measurement Uncertainty

For radiated emissions, U_{lab} (3.5 dB at 3m and 3.5 dB at 10m below 1 GHz, and 4.2 dB at 3m above 1 GHz) $< U_{CISPR}$ (5.2 dB), which is the reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where

FS = Field Strength in $\text{dB}\mu\text{V}/\text{m}$

RA = Receiver Amplitude (including preamplifier) in $\text{dB}\mu\text{V}$

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB

AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 $\text{dB}\mu\text{V}$ is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 $\text{dB}\mu\text{V}/\text{m}$. This value in $\text{dB}\mu\text{V}/\text{m}$ was converted to its corresponding level in $\mu\text{V}/\text{m}$.

$$RA = 52.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB}/\text{m}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$FS = 32 \text{ dB}\mu\text{V}/\text{m}$$

To convert from $\text{dB}\mu\text{V}$ to μV or mV the following was used:

$$UF = 10^{(NF/20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

$$NF = \text{Net Reading in } \text{dB}\mu\text{V}$$

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V}/\text{m}$$

8.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/14/2015	03/14/2016
145-410'	Cables 145-400 145-403 145-405 145-406 145-407	Huber + Suhner	10m Track A Cables	multiple	10/04/2014	10/04/2015
145106'	Bilog Antenna (30MHz - 5GHz)	Sunol Sciences	JB5	A111003	10/24/2014	10/24/2015
Dav004'	Weather Station	Davis Instruments	7400	PE80529A61A	10/06/2014	10/06/2015
REA003'	1GHz High Pass Filter	Reactel, Inc	7HS-1G/10G-S11	06-1	12/30/2013	12/30/2015
145-416'	Cables 145-400 145-402 145-404 145-408	Huber + Suhner	3m Track B cables	multiple	10/04/2014	10/04/2015
145014'	Preamplifier (1 GHz to 26.5 GHz)	Hewlett Packard	8449B	3008A00232	05/05/2014	05/05/2015
ETS002'	1-18GHz DRG Horn Antenna	ETS Lindgren	3117	00143260	04/10/2015	04/10/2016

Software Utilized:

Name	Manufacturer	Version
EMI Boxborough	Intertek	8/27/2010
C5	TESEQ	Build 5.26.46.46

8.3 Results:

The sample tested was found to Comply.

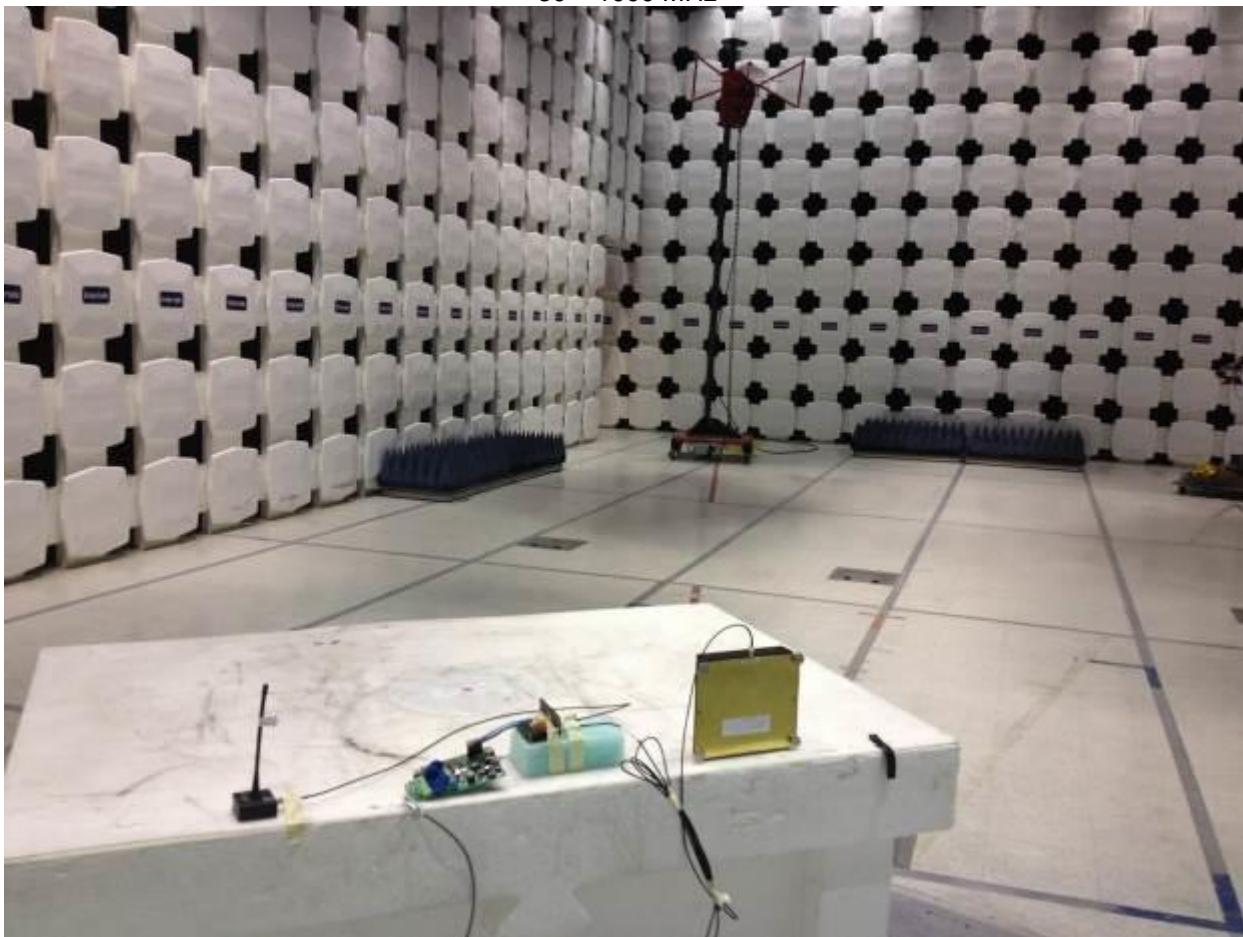
(e) Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided the intentional radiator complies with the provisions of paragraphs (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

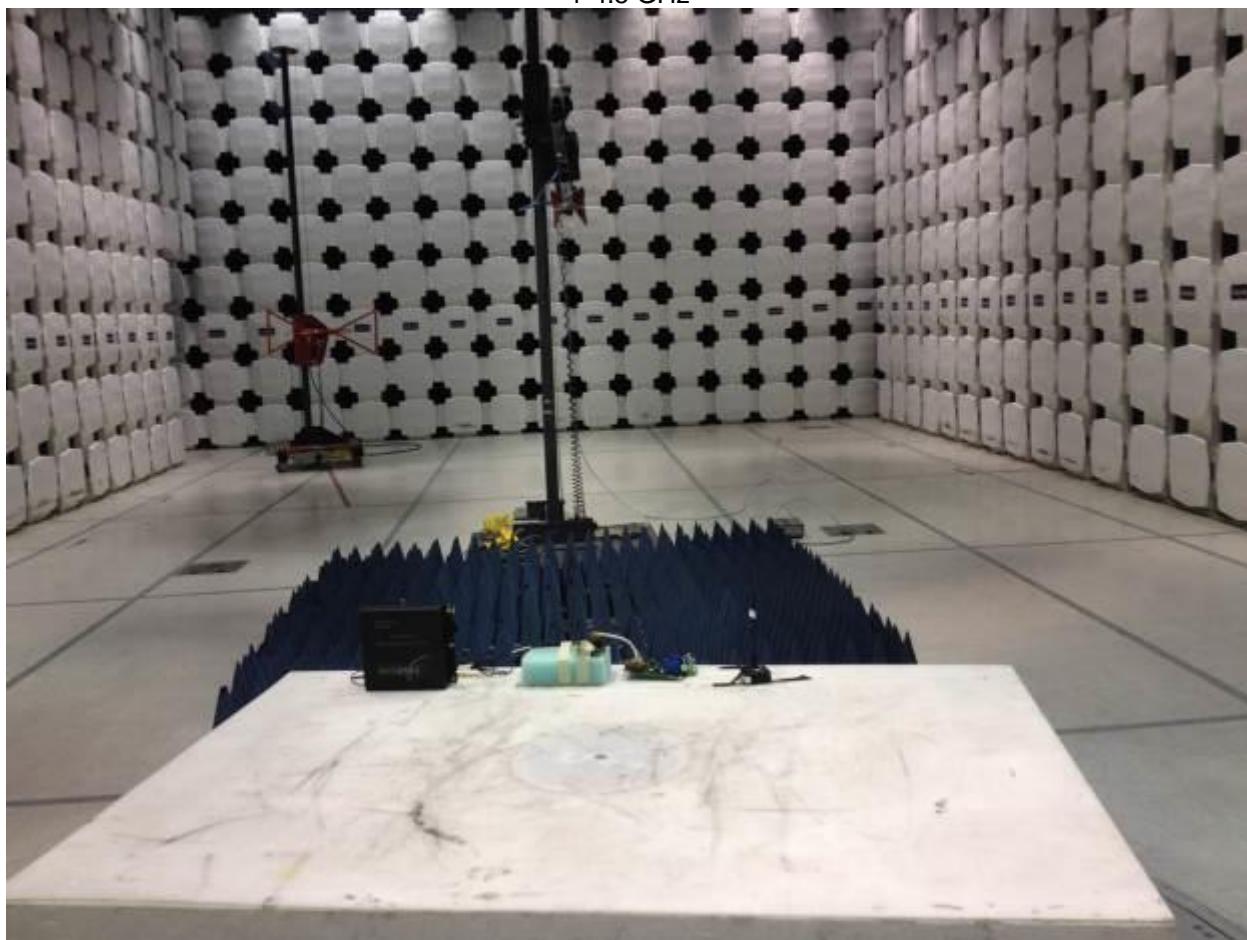
¹Linear interpolations.

8.4 Setup Photographs:

30 – 1000 MHz



1-4.5 GHz



8.5 Plots/Data:**Radiated Emissions**

Company: Intellisaw
 Model #: 400.00152.0001
 Serial #: 08150695
 Engineers: Vathana Ven
 Project #: 500592446 Date(s): 04/09/15
 Standard: FCC Part 15 Subpart C, 15.231e, RSS-210
 Receiver: R&S ESI (145-128) 03-14-2016 Limit Distance (m): 3
 PreAmp: NONE. Test Distance (m): 10
 PreAmp Used? (Y or N): N Voltage/Frequency: 5VDC Frequency Range: 30-1000 MHz
 Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)
 Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth	FCC	IC
F = 425 MHz, X-Axis, PPS = 15 and PA = 7, Antenna (IA-MM-17, 17cm monopole antenna, +3.2 dBi)													
PK	V	45.000	34.16	10.60	1.07	0.00	-10.46	56.28	72.57	-16.29	120/300 kHz		
AVG	V	45.000	14.16	10.60	1.07	0.00	-10.46	36.28	52.57	-16.29	120/300 kHz		
PK	V	55.000	32.87	7.00	1.18	0.00	-10.46	51.51	72.57	-21.06	120/300 kHz		
AVG	V	55.000	12.87	7.00	1.18	0.00	-10.46	31.51	52.57	-21.06	120/300 kHz		
PK	V	850.000	25.75	21.90	4.76	0.00	-10.46	62.87	72.57	-9.70	120/300 kHz		
AVG	V	850.000	5.75	21.90	4.76	0.00	-10.46	42.87	52.57	-9.70	120/300 kHz		Noise Floor

Radiated Emissions

Company: Intellisaw
 Model #: 400.00152.0001
 Serial #: 08150695

Engineers: Vathana Ven
 Project #: 500592446 Date(s): 04/09/15
 Standard: FCC Part 15 Subpart C, 15.231e, RSS-210
 Receiver: R&S ESI (145-128) 03-14-2016 Limit Distance (m): 3
 PreAmp: NONE. Test Distance (m): 10
 PreAmp Used? (Y or N): N Voltage/Frequency: 5VDC Frequency Range: 30-1000 MHz
 Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth	FCC	IC
F = 425 MHz, X-Axis, PPS = 15 and PA = 7, Antenna (IA-MM-TPD, PIFA Patched Inverted F antenna)													
PK	V	45.000	33.50	10.60	1.07	0.00	-10.46	55.62	72.57	-16.95	120/300 kHz		
AVG	V	45.000	13.50	10.60	1.07	0.00	-10.46	35.62	52.57	-16.95	120/300 kHz		
PK	V	55.000	32.87	7.00	1.18	0.00	-10.46	51.51	72.57	-21.06	120/300 kHz		
AVG	V	55.000	12.87	7.00	1.18	0.00	-10.46	31.51	52.57	-21.06	120/300 kHz		
PK	V	850.000	25.75	21.90	4.76	0.00	-10.46	62.87	72.57	-9.70	120/300 kHz	Noise Floor	
AVG	V	850.000	5.75	21.90	4.76	0.00	-10.46	42.87	52.57	-9.70	120/300 kHz	Noise Floor	

Radiated Emissions

Company: Intellisaw
 Model #: 400.00152.0001
 Serial #: 08150695

Engineers: Vathana Ven
 Project #: 500592446 Date(s): 04/09/15
 Standard: FCC Part 15 Subpart C, 15.231e, RSS-210

Receiver: R&S ESI (145-128) 03-14-2016 Limit Distance (m): 3
 PreAmp: NONE. Test Distance (m): 10
 PreAmp Used? (Y or N): N Voltage/Frequency: 5VDC Frequency Range: 30-1000 MHz
 Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
$F = 434 \text{ MHz, X-Axis, PPS = 15 and PA = 7, Antenna (IA-MM-17, 17cm monopole antenna, +3.2 dBi)}$											
PK	V	45.000	31.69	10.60	1.07	0.00	-10.46	53.81	72.87	-19.06	120/300 kHz
AVG	V	45.000	11.69	10.60	1.07	0.00	-10.46	33.81	52.87	-19.06	120/300 kHz
PK	V	55.000	32.23	7.00	1.18	0.00	-10.46	50.87	72.87	-22.00	120/300 kHz
AVG	V	55.000	12.23	7.00	1.18	0.00	-10.46	30.87	52.87	-22.00	120/300 kHz
PK	V	868.000	25.99	21.80	4.79	0.00	-10.46	63.03	72.87	-9.84	120/300 kHz
AVG	V	868.000	5.99	21.80	4.79	0.00	-10.46	43.03	52.87	-9.84	120/300 kHz

FCC IC
 Noise Floor Noise Floor

Radiated Emissions

Company: Intellisaw
 Model #: 400.00152.0001
 Serial #: 08150695

Engineers: Vathana Ven
 Project #: 500592446 Date(s): 04/09/15
 Standard: FCC Part 15 Subpart C, 15.231e, RSS-210
 Receiver: R&S ESI (145-128) 03-14-2016 Limit Distance (m): 3
 PreAmp: NONE. Test Distance (m): 10
 PreAmp Used? (Y or N): N Voltage/Frequency: 5VDC Frequency Range: 30-1000 MHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth	FCC	IC
F = 434 MHz, X-Axis, PPS = 15 and PA = 7, Antenna (IA-MM-TPD, PIFA Patched Inverted F antenna)													
PK	V	45.000	31.81	10.60	1.07	0.00	-10.46	53.93	72.87	-18.94	120/300 kHz		
AVG	V	45.000	12.00	10.60	1.07	0.00	-10.46	34.12	52.87	-18.75	120/300 kHz		
PK	V	55.000	32.23	7.00	1.18	0.00	-10.46	50.87	72.87	-22.00	120/300 kHz		
AVG	V	55.000	12.23	7.00	1.18	0.00	-10.46	30.87	52.87	-22.00	120/300 kHz		
PK	V	868.000	25.99	21.80	4.79	0.00	-10.46	63.03	72.87	-9.84	120/300 kHz	Noise Floor	
AVG	V	868.000	5.99	21.80	4.79	0.00	-10.46	43.03	52.87	-9.84	120/300 kHz	Noise Floor	

Radiated Emissions

Company: Intellisaw
 Model #: 400.00152.0001
 Serial #: 08150695

Engineers: Vathana Ven
 Project #: 500592446 Date(s): 04/09/15
 Standard: FCC Part 15 Subpart C, 15.231e, RSS-210
 Receiver: R&S ESI (145-128) 03-14-2016 Limit Distance (m): 3
 PreAmp: NONE. Test Distance (m): 10
 PreAmp Used? (Y or N): N Voltage/Frequency: 5VDC Frequency Range: 30-1000 MHz
 Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth	FCC	IC
F = 445 MHz, X-Axis, PPS = 15 and PA = 7, Antenna (IA-MM-17, 17cm monopole antenna, +3.2 dBi)											
PK	V	45.000	33.20	10.60	1.07	0.00	-10.46	55.32	73.22	-17.90	120/300 kHz
AVG	V	45.000	13.20	10.60	1.07	0.00	-10.46	35.32	53.22	-17.90	120/300 kHz
PK	V	55.000	31.92	7.00	1.18	0.00	-10.46	50.56	73.22	-22.66	120/300 kHz
AVG	V	55.000	11.92	7.00	1.18	0.00	-10.46	30.56	53.22	-22.66	120/300 kHz
PK	V	890.000	25.59	21.90	4.82	0.00	-10.46	62.76	73.22	-10.46	120/300 kHz
AVG	V	890.000	5.59	21.90	4.82	0.00	-10.46	42.76	53.22	-10.46	120/300 kHz
											Noise Floor
											Noise Floor

Radiated Emissions

Company: Intellisaw

Model #: 400.00152.0001

Serial #: 08150695

Engineers: Vathana Ven

Location: 10M

Antenna & Cables: N Bands: N, LF, HF, SHF

Antenna: 145106 10mh 10-21-15.txt 145106 10mh 10-21-15.txt

Cable(s): 145106 10M Track A Cables SHF to 2 GHz REDUCED POINTS 10-04-15.m

NONE.

Project #: 500592446

Date(s): 04/09/15

Barometer: DAV004

Filter: NONE

Standard: FCC Part 15 Subpart C, 15.231e, RSS-210

Temp/Humidity/Pressure: 21 deg C 29% 1017 mB

Receiver: R&S ESI (145-128) 03-14-2016

Limit Distance (m): 3

PreAmp: NONE.

Test Distance (m): 10

PreAmp Used? (Y or N): N Voltage/Frequency: 5VDC Frequency Range: 30-1000 MHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth	FCC	IC
F = 445 MHz, X-Axis, PPS = 15 and PA = 7, Antenna (IA-MM-TPD, PIFA Patched Inverted F antenna)													
PK	V	45.000	33.20	10.60	1.07	0.00	-10.46	55.32	73.22	-17.90	120/300 kHz		
AVG	V	45.000	13.20	10.60	1.07	0.00	-10.46	35.32	53.22	-17.90	120/300 kHz		
PK	V	55.000	31.92	7.00	1.18	0.00	-10.46	50.56	73.22	-22.66	120/300 kHz		
AVG	V	55.000	11.92	7.00	1.18	0.00	-10.46	30.56	53.22	-22.66	120/300 kHz		
PK	V	890.000	25.59	21.90	4.82	0.00	-10.46	62.76	73.22	-10.46	120/300 kHz	Noise Floor	
AVG	V	890.000	5.59	21.90	4.82	0.00	-10.46	42.76	53.22	-10.46	120/300 kHz	Noise Floor	

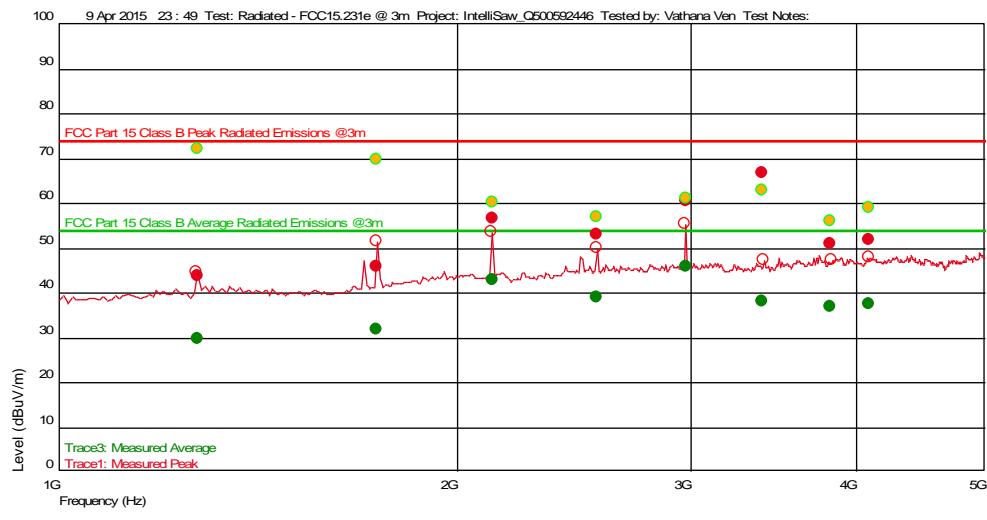
1-4.5 GHz

Test Information

Test Details User Entry
 Test: Radiated - FCC15.231(e) @ 3m
 Project: IntelliSaw_Q500592446
 Test Notes: 120VAC/60Hz, 425 MHz both antennas, X-Axis, worst-case
 Temperature: 21 deg C
 Humidity: 29%, 1017 mb
 Tested by: Vathana Ven
 Test Started: 9 Apr 2015 23 : 49

Additional Information

Prescan Emission Graph



- Measured Peak Value
- Measured Quasi Peak Value
- Measured Average Value
- Maximum Value of Mast and Turntable
- Swept Peak Data
- Swept Quasi Peak Data
- Swept Average Data

Emissions Test Data

Trace1: Measured Peak

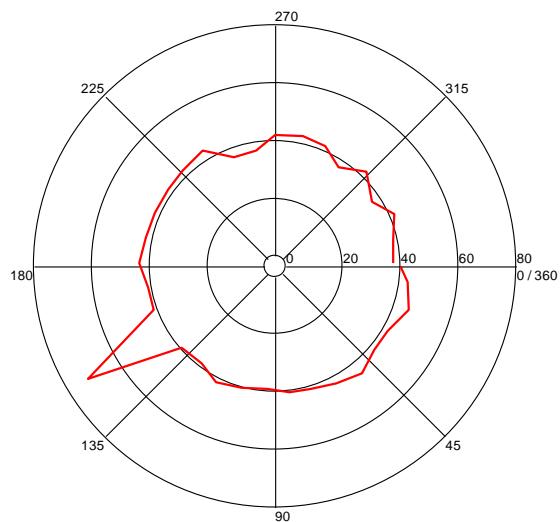
Frequency (Hz)	Level (dBuV/m)	AF	PA+CL	Limit (dBuV/m)	Margin (dBuV/m)	Hor (--), Ver ()	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
1.27499666 G	43.65	28.685	-27.800	72.570	-28.92	--	160	1.53	1 M	
1.738383434 G	45.68	29.339	-26.815	72.570	-26.89		109	2.40	1 M	
3.829144957 G	50.83	33.594	-23.933	72.570	-21.74		333	1.20	1 M	
4.093934536 G	51.82	33.463	-23.194	72.570	-20.75	--	164	2.51	1 M	
2.55011356 G	52.92	32.515	-25.850	72.570	-19.65	--	28	2.88	1 M	
2.12510354 G	56.66	31.269	-26.015	72.570	-15.91	--	266	2.05	1 M	
2.975317301 G	60.52	32.905	-25.127	72.570	-12.05	--	51	2.30	1 M	
3.40008016 G	66.86	32.966	-24.908	72.570	-5.71	--	105	2.17	1 M	

Trace3: Measured Average

Frequency (Hz)	Level (dBuV/m)	AF	PA+CL	Limit (dBuV/m)	Margin(dBuV/m)	Hor (--), Ver ()	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
1.27499666 G	23.65	28.685	-27.800	52.570	-28.92	--	160	1.53	1 M	
1.738383434 G	25.68	29.339	-26.815	52.570	-26.89		109	2.40	1 M	
3.829144957 G	30.83	33.594	-23.933	52.570	-21.74		333	1.20	1 M	
4.093934536 G	31.82	33.463	-23.194	52.570	-20.75	--	164	2.51	1 M	
2.55011356 G	32.92	32.515	-25.850	52.570	-19.65	--	28	2.88	1 M	
2.12510354 G	36.66	31.269	-26.015	52.570	-15.91	--	266	2.05	1 M	
2.975317301 G	40.52	32.905	-25.127	52.570	-12.05	--	51	2.30	1 M	
3.40008016 G	46.86	32.966	-24.908	52.570	-5.71	--	105	2.17	1 M	

Azimuth Plots

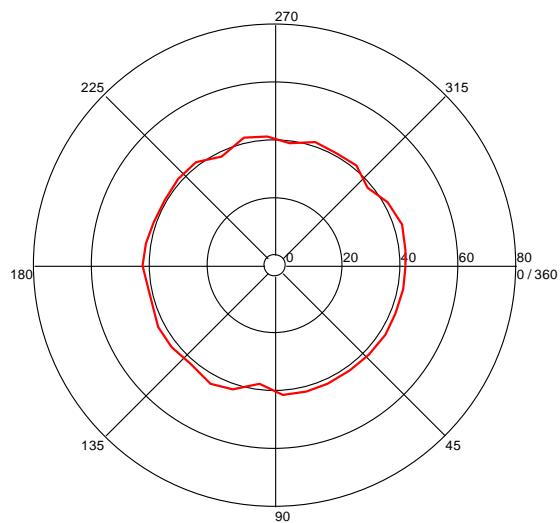
Turntable Plot (1.27499666 GHz)



All Polarities

Azimuth (Degrees)

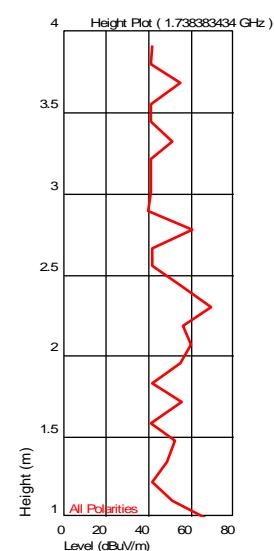
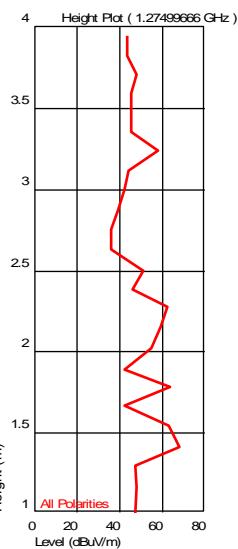
Turntable Plot (1.738383434 GHz)



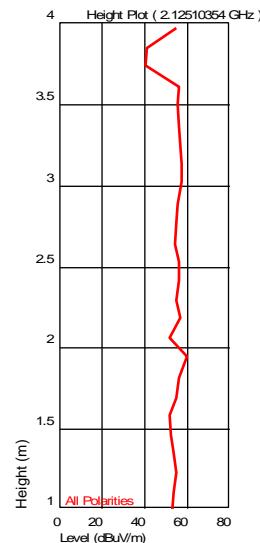
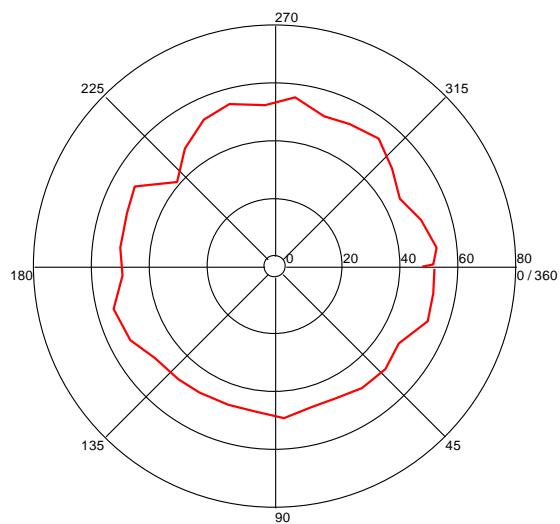
All Polarities

Azimuth (Degrees)

Turntable Plots

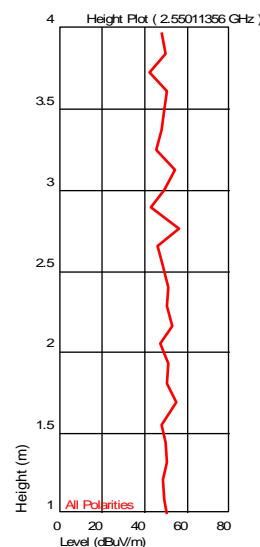
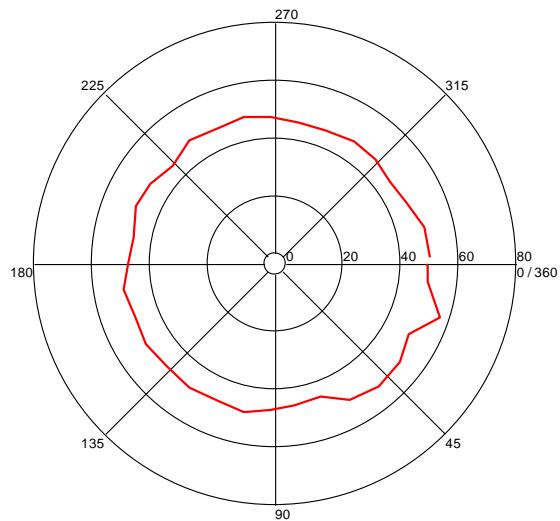


Turntable Plot (2.12510354 GHz)



All Polarities

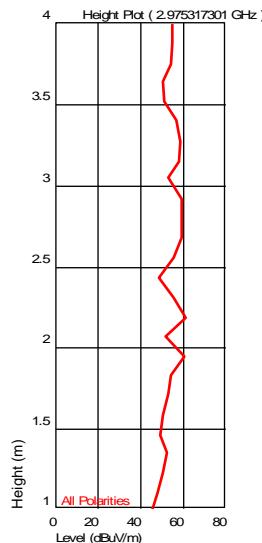
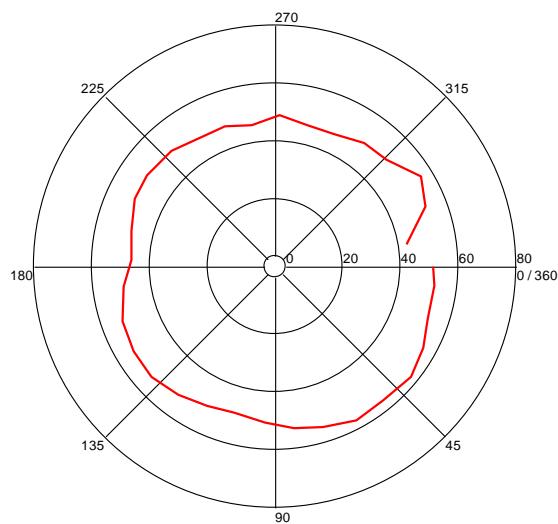
Turntable Plot (2.55011356 GHz)



All Polarities

Azimuth (Degrees)

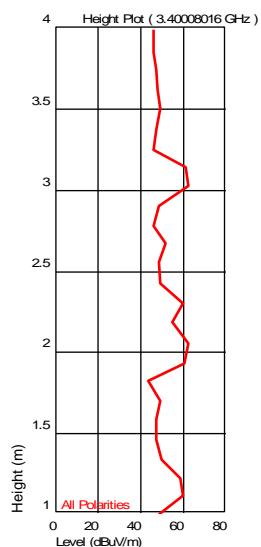
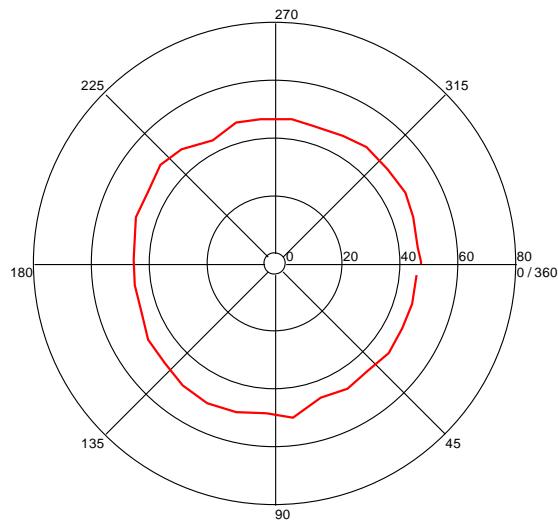
Turntable Plot (2.975317301 GHz)



All Polarities

Azimuth (Degrees)

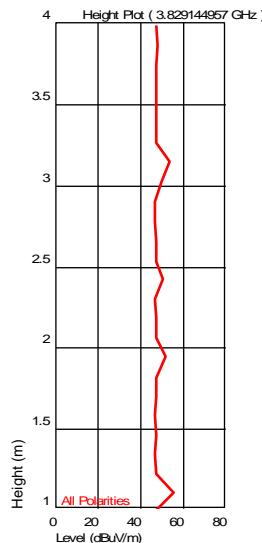
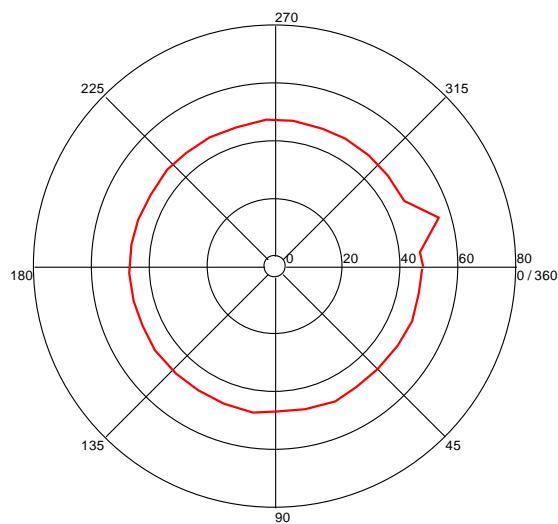
Turntable Plot (3.40008016 GHz)



All Polarities

Azimuth (Degrees)

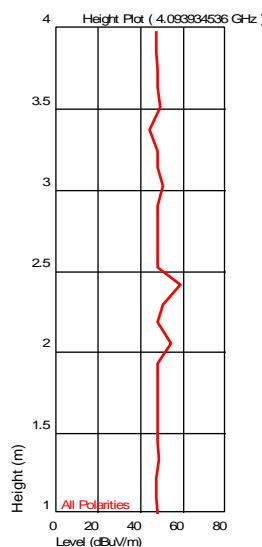
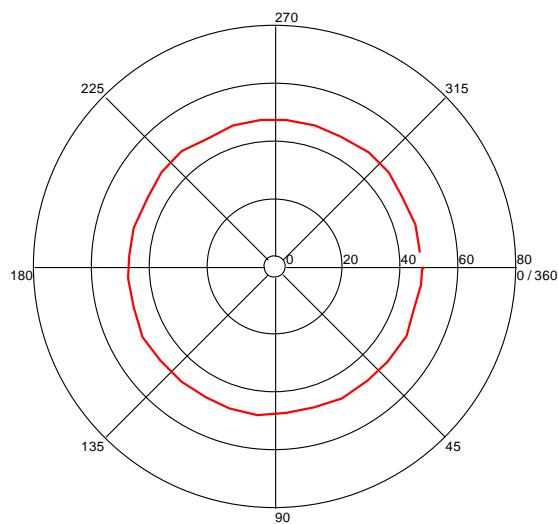
Turntable Plot (3.829144957 GHz)



All Polarities

Azimuth (Degrees)

Turntable Plot (4.093934536 GHz)



All Polarities

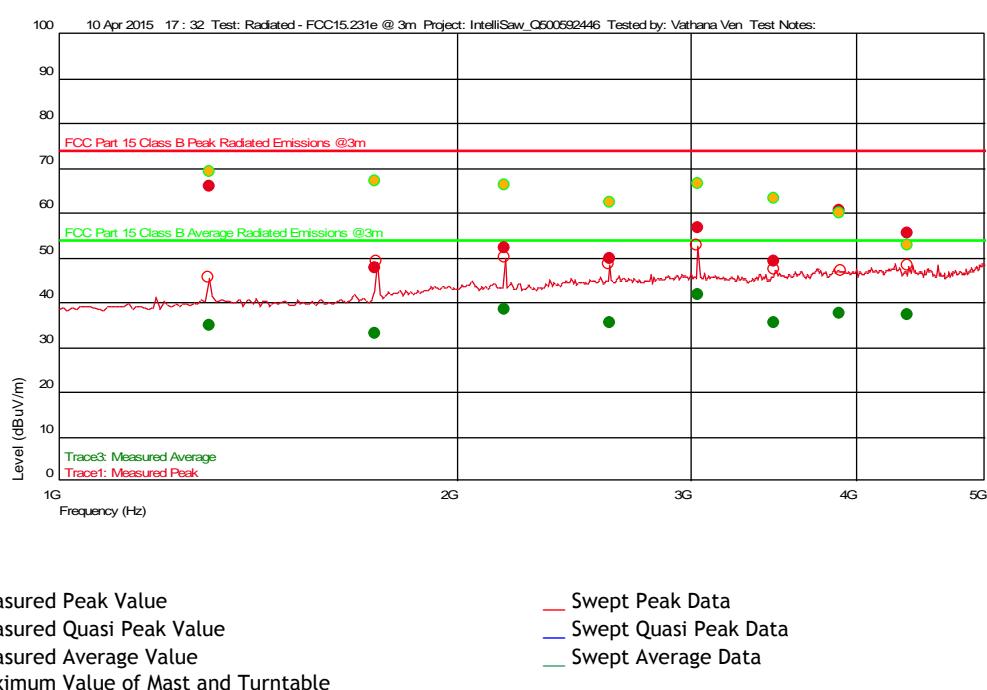
Azimuth (Degrees)

Test Information

Test Details User Entry
 Test: Radiated - FCC15.231e @ 3m
 Project: IntelliSaw_Q500592446
 Test Notes: 120VAC/60Hz, Both antennas, 434 MHz, X-Axis, worst-case
 Temperature: 21 deg C
 Humidity: 38%, 994 mB
 Tested by: Vathana Ven
 Test Started: 10 Apr 2015 17 : 32

Additional Information

Prescan Emission Graph



Emissions Test Data

Trace1: Measured Peak

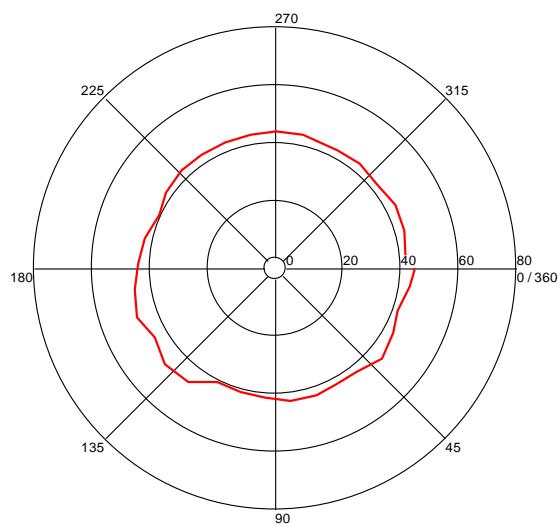
Frequency (Hz)	Level (dBuV/m)	AF	PA+CL	Limit (dBuV/m)	Margin (dBuV/m)	Hor (--), Ver ()	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
1.736212425 G	47.53	29.318	-26.823	72.870	-25.34		30	2.76	1 M	
3.473132933 G	49.00	32.984	-24.905	72.870	-23.87		0	1.09	1 M	
2.606800267 G	49.81	32.588	-25.681	72.870	-23.06		8	1.80	1 M	
2.169899799 G	52.13	31.286	-25.971	72.870	-20.74	--	292	1.32	1 M	
4.377682031 G	55.31	33.626	-23.629	72.870	-17.56	--	21	2.53	1 M	
3.037822311 G	56.68	32.966	-25.105	72.870	-16.19		287	2.04	1 M	
3.890567802 G	60.50	33.670	-23.781	72.870	-12.37	--	360	1.09	1 M	
1.301863727 G	65.69	28.874	-27.576	72.870	-7.18		150	1.09	1 M	

Trace3: Measured Average

Frequency (Hz)	Level (dBuV/m)	AF	PA+CL	Limit (dBuV/m)	Margin (dBuV/m)	Hor (--), Ver ()	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
1.736212425 G	27.53	29.318	-26.823	52.870	-25.34		30	2.76	1 M	
3.473132933 G	29.00	32.984	-24.905	52.870	-23.87		0	1.09	1 M	
2.606800267 G	29.81	32.588	-25.681	52.870	-23.06		8	1.80	1 M	
2.169899799 G	32.13	31.286	-25.971	52.870	-20.74	--	292	1.32	1 M	
4.377682031 G	35.31	33.626	-23.629	52.870	-17.56	--	21	2.53	1 M	
3.037822311 G	36.68	32.966	-25.105	52.870	-16.19		287	2.04	1 M	
3.890567802 G	40.50	33.670	-23.781	52.870	-12.37	--	360	1.09	1 M	
1.301863727 G	45.69	28.874	-27.576	52.870	-7.18		150	1.09	1 M	

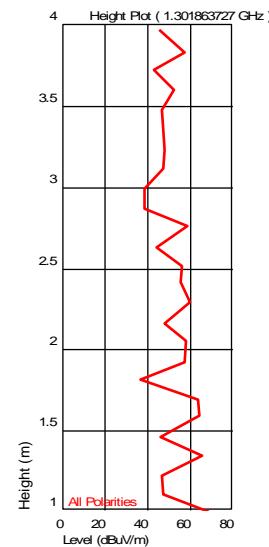
Azimuth Plots

Turntable Plot (1.301863727 GHz)

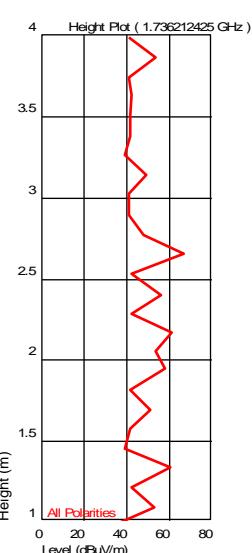
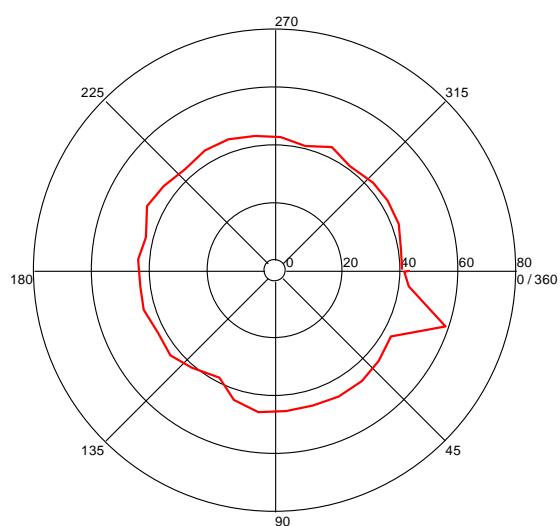


Turntable Plots

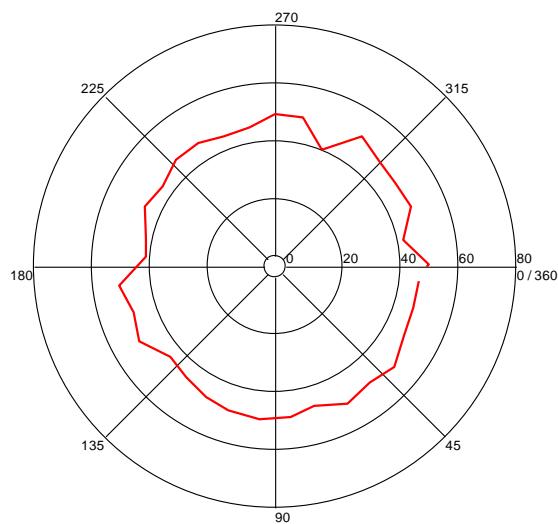
Height Plot (1.301863727 GHz)



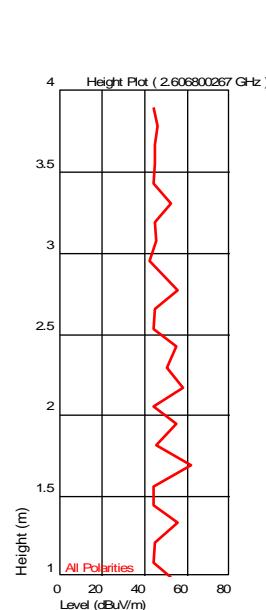
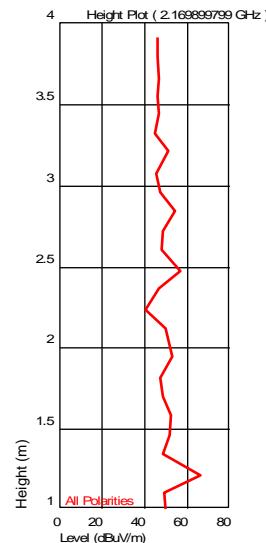
Turntable Plot (1.736212425 GHz)



Turntable Plot (2.169899799 GHz)



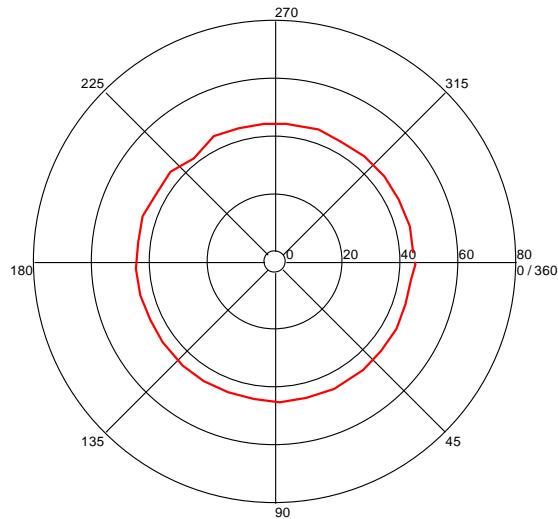
Level (dBuV/m)



All Polarities

Azimuth (Degrees)

Turntable Plot (2.606800267 GHz)

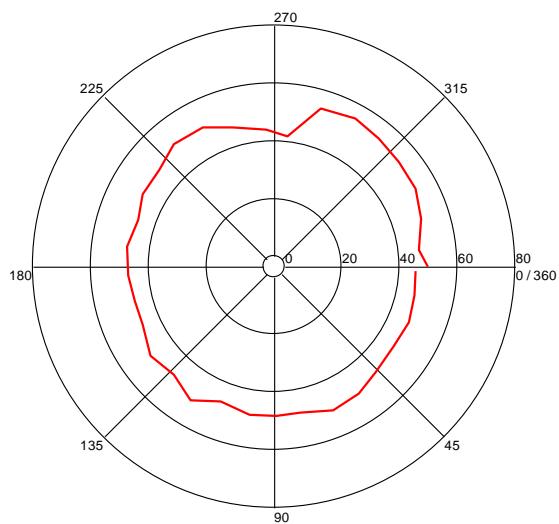


Level (dBuV/m)

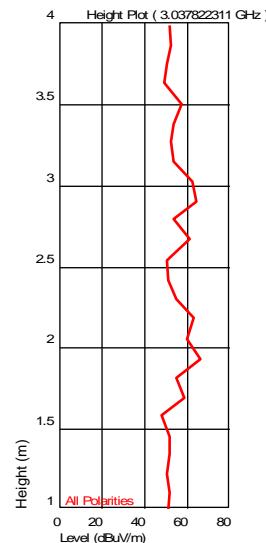
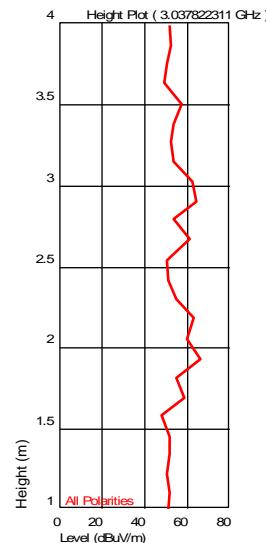
All Polarities

Azimuth (Degrees)

Turntable Plot (3.037822311 GHz)



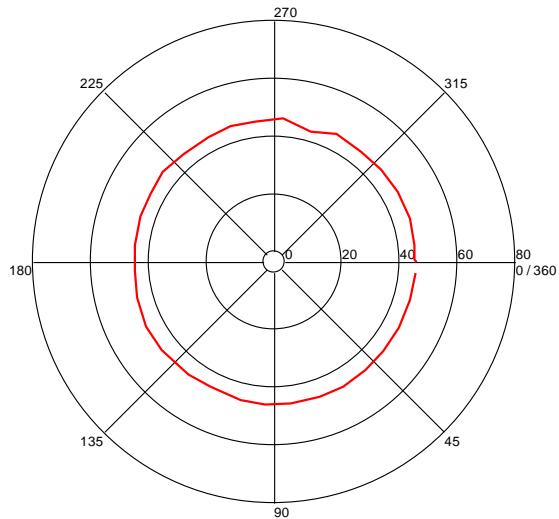
Level (dBuV/m)



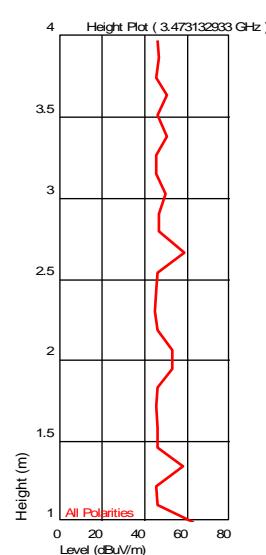
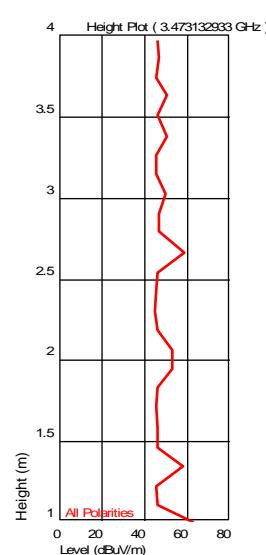
All Polarities

Azimuth (Degrees)

Turntable Plot (3.473132933 GHz)



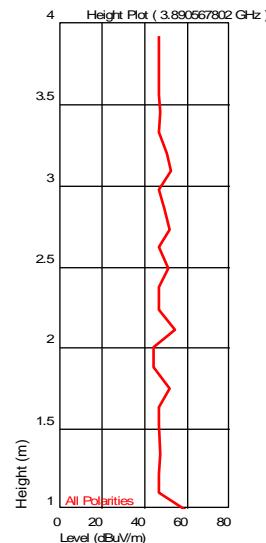
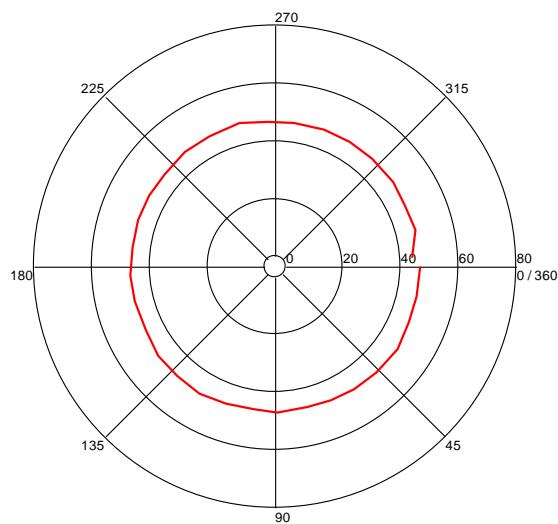
Level (dBuV/m)



All Polarities

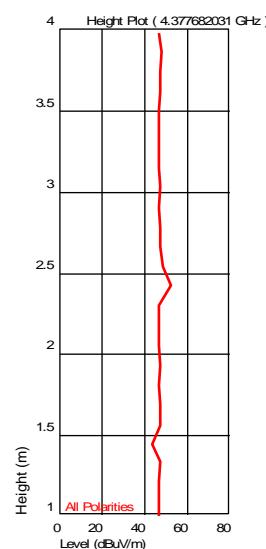
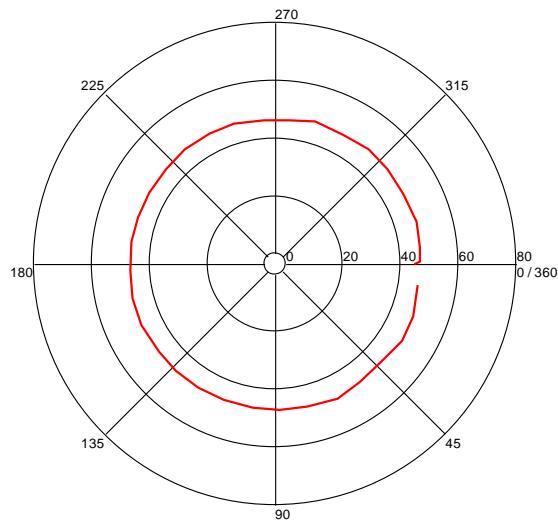
Azimuth (Degrees)

Turntable Plot (3.890567802 GHz)



All Polarities

Turntable Plot (4.377682031 GHz)



All Polarities

Test Information

Test Details
 Test: User Entry
 Project: Radiated - FCC15.231e @ 3m
 IntelliSaw_Q500592446
 Test Notes: 120VAC/60Hz, Both antennas, 445 MHz, X-Axis, worst-case
 Temperature: 21 deg C
 Humidity: 38%, 994 mB
 Tested by: Vathana Ven
 Test Started: 10 Apr 2015 18 : 29

Additional Information

Prescan Emission Graph



Emissions Test Data

Trace1: Measured Peak

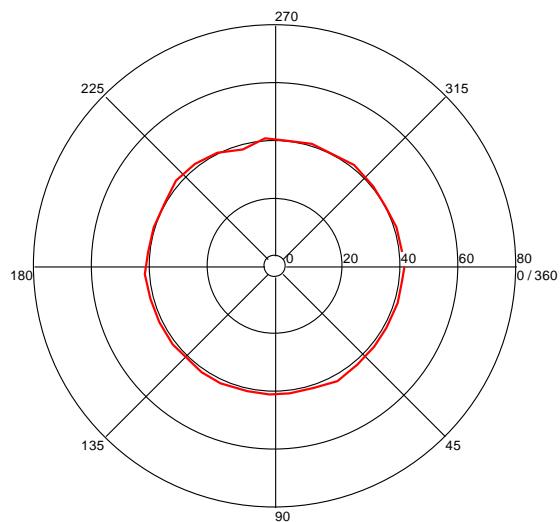
Frequency (Hz)	Level (dBuV/m)	AF	PA+CL	Limit (dBuV/m)	Margin (dBuV/m)	Hor (--), Ver ()	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
1.332732131 G	43.97	28.823	-27.486	73.220	-29.25	--	187	1.19	1 M	
3.550627922 G	49.67	33.042	-24.420	73.220	-23.55		50	1.80	1 M	
2.669812959 G	51.88	32.519	-25.522	73.220	-21.34		317	2.29	1 M	
2.22490982 G	53.82	31.306	-26.041	73.220	-19.40		192	2.52	1 M	
3.114856379 G	56.86	32.979	-25.220	73.220	-16.36		249	3.12	1 M	
1.77993988 G	59.56	29.739	-26.674	73.220	-13.66	--	195	1.09	1 M	

Trace3: Measured Average

Frequency (Hz)	Level (dBuV/m)	AF	PA+CL	Limit (dBuV/m)	Margin (dBuV/m)	Hor (--), Ver ()	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
1.332732131 G	23.97	28.823	-27.486	53.220	-29.25	--	187	1.19	1 M	
3.550627922 G	29.67	33.042	-24.420	53.220	-23.55		50	1.80	1 M	
2.669812959 G	31.88	32.519	-25.522	53.220	-21.34		317	2.29	1 M	
2.22490982 G	33.82	31.306	-26.041	53.220	-19.40		192	2.52	1 M	
3.114856379 G	36.86	32.979	-25.220	53.220	-16.36		249	3.12	1 M	
1.77993988 G	39.56	29.739	-26.674	53.220	-13.66	--	195	1.09	1 M	

Azimuth Plots

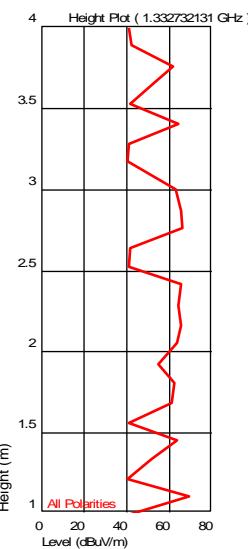
Turntable Plot (1.332732131 GHz)



All Polarities

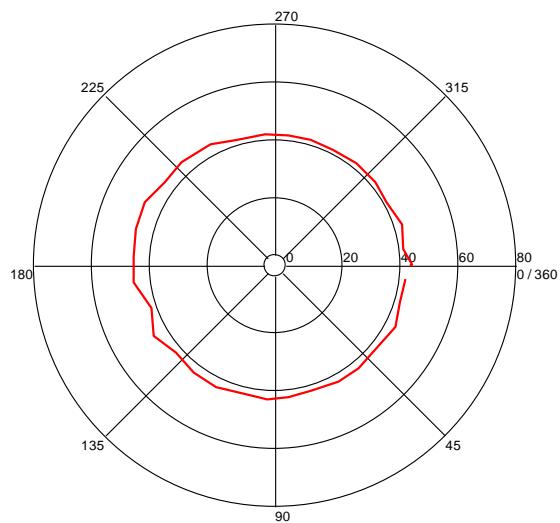
Level (dBuV/m)

Turntable Plots



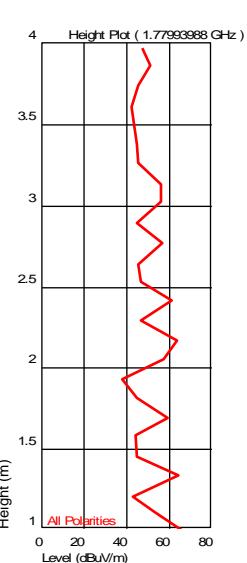
Height Plot (1.332732131 GHz)
 Height (m)
 1 1.5 2 2.5 3 3.5 4
 0 20 40 60 80
 All Polarities

Turntable Plot (1.77993988 GHz)



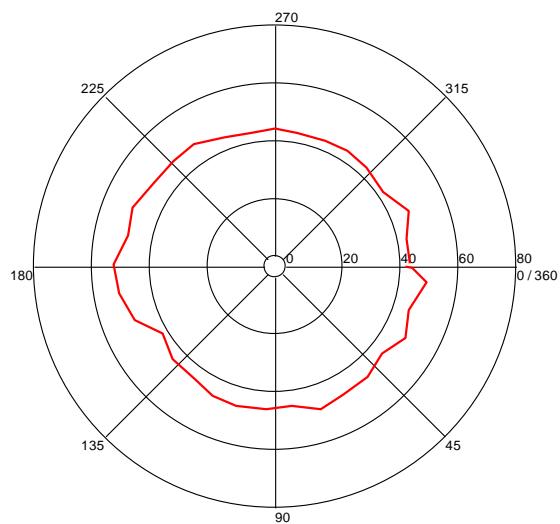
All Polarities

Level (dBuV/m)

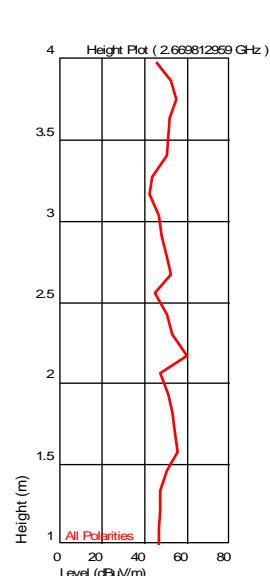
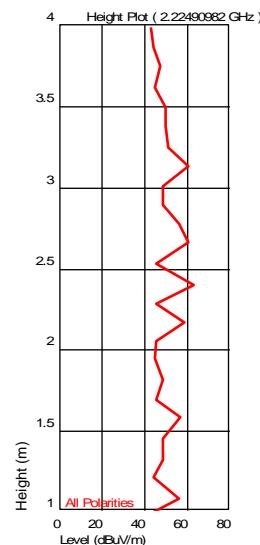


Height Plot (1.77993988 GHz)
 Height (m)
 1 1.5 2 2.5 3 3.5 4
 0 20 40 60 80
 All Polarities

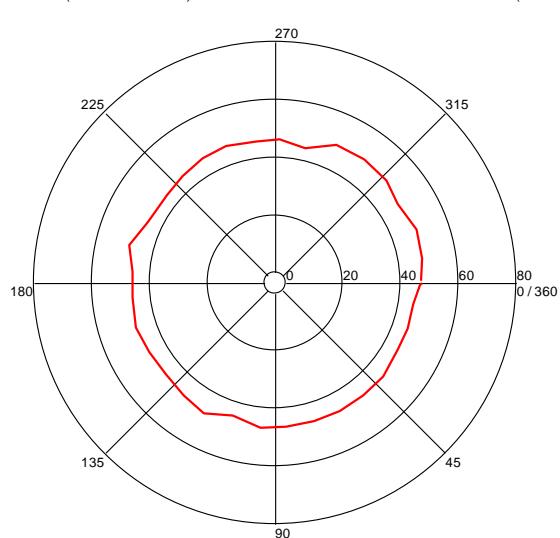
Turntable Plot (2.22490982 GHz)



Level (dBuV/m)



Turntable Plot (2.669812959 GHz)

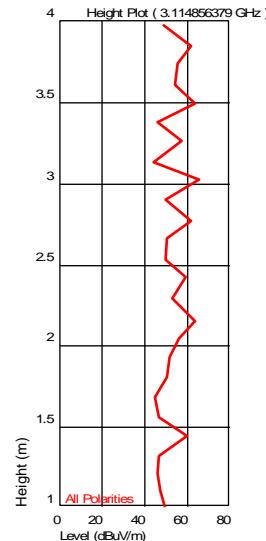
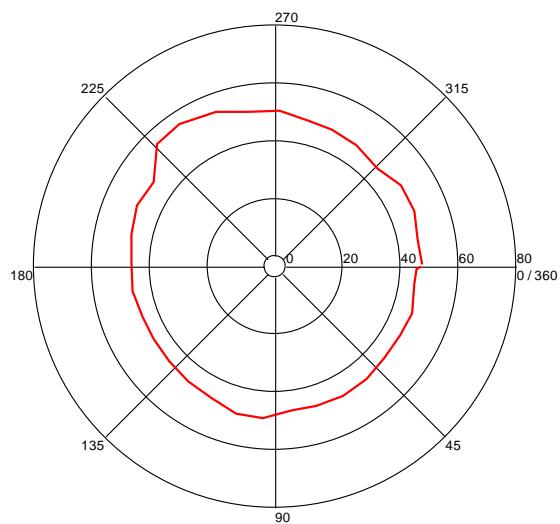


Level (dBuV/m)

All Polarities

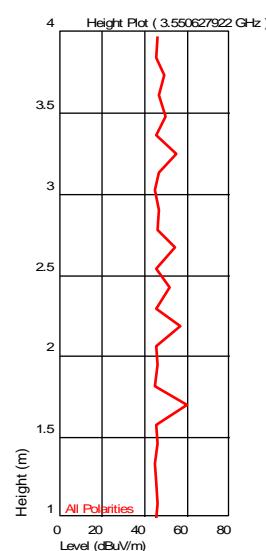
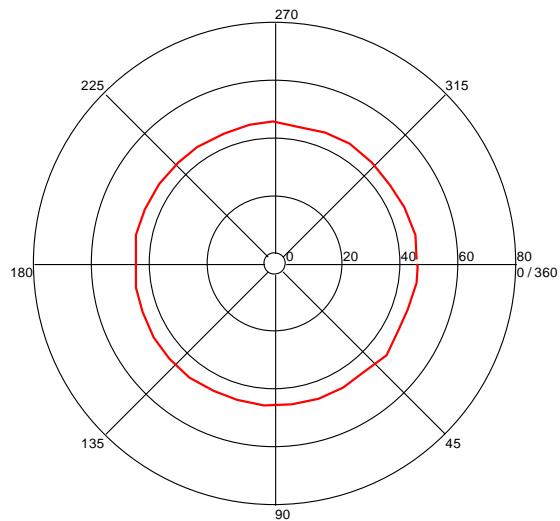
Azimuth (Degrees)

Turntable Plot (3.114856379 GHz)



All Polarities

Turntable Plot (3.550627922 GHz)



All Polarities

Test Personnel: Vathana Ven

Supervising/Reviewing Engineer: _____

(Where Applicable) _____

Product Standard: FCC Part 15 Subpart C, RSS-210

Input Voltage: Powered from 24VDC Host

Pretest Verification w/
Ambient Signals or
BB Source: Ambient Signals

Test Date: 04/09/2015

Limit Applied: Section 15.231(e), RSS-210

Ambient Temperature: See data tables

Relative Humidity: See data tables

Atmospheric Pressure: See data tables

9 Duty Cycle

9.1 Method

Tests are performed in accordance with FCC 47CFR Part 15 Subpart C Section 15.231(c), ANSI C63.10:2009, RSS-Gen Section 6.10.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A wooden table 80 cm high is used for table-top equipment.

9.2 Test Equipment Used:

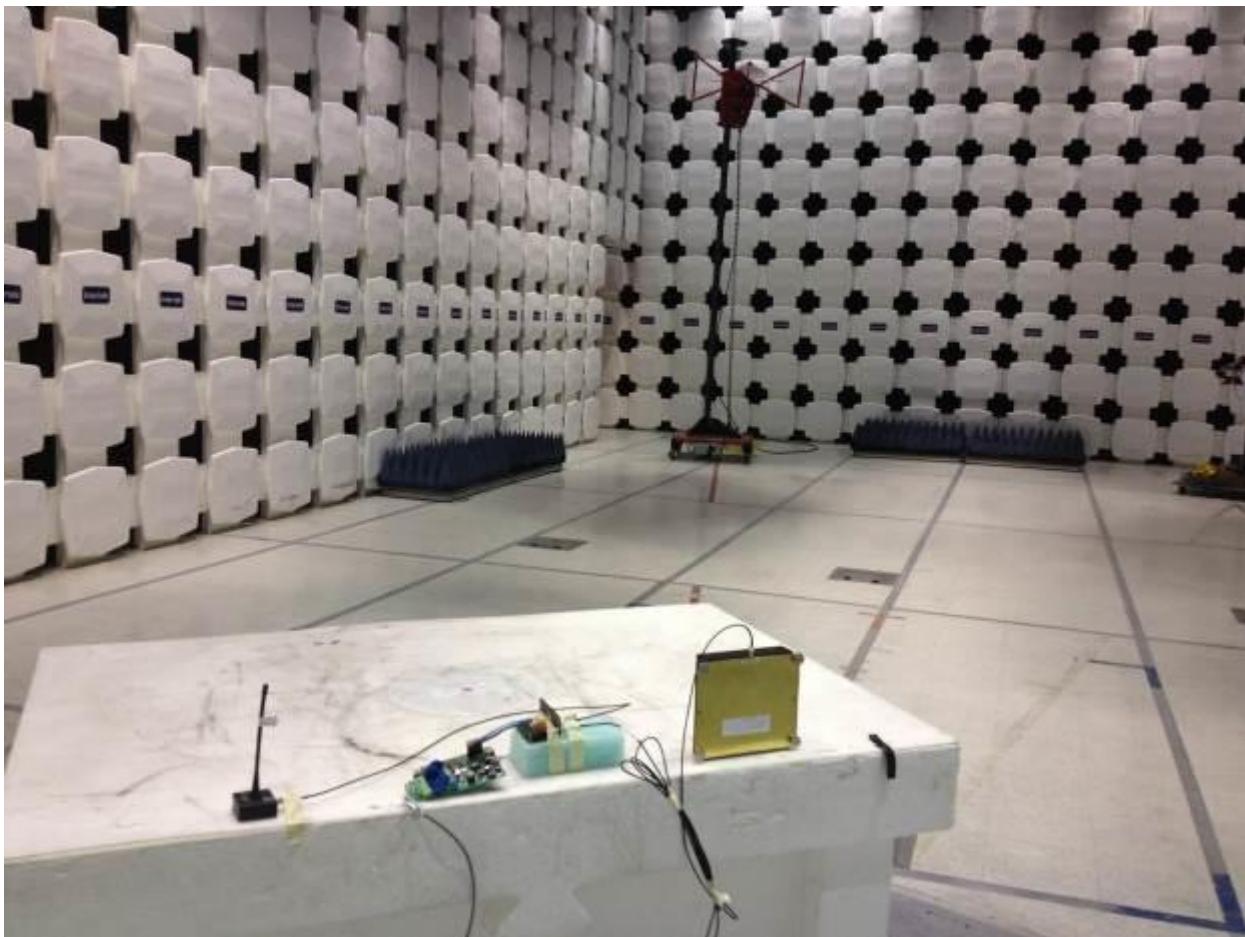
Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
145128'	EMI Receiver (20 Hz - 40 GHz)	Rohde & Schwarz	ESIB 40	839283/001	03/14/2015	03/14/2016
145-410'	Cables 145-400 145-403 145-405 145-406 145-407	Huber + Suhner	10m Track A Cables	multiple	10/04/2014	10/04/2015
145106'	Bilog Antenna (30MHz - 5GHz)	Sunol Sciences	JB5	A111003	10/24/2014	10/24/2015
Dav004'	Weather Station	Davis Instruments	7400	PE80529A61A	10/06/2014	10/06/2015

Software Utilized:

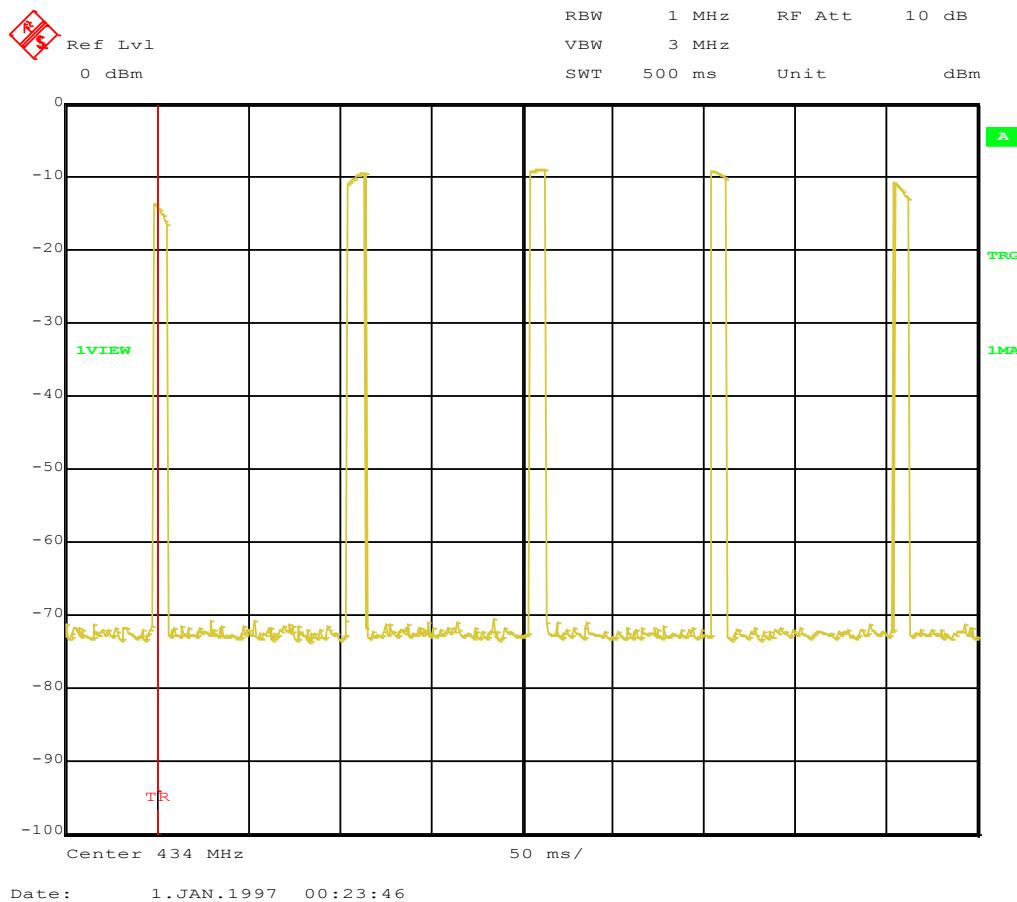
Name	Manufacturer	Version
None		

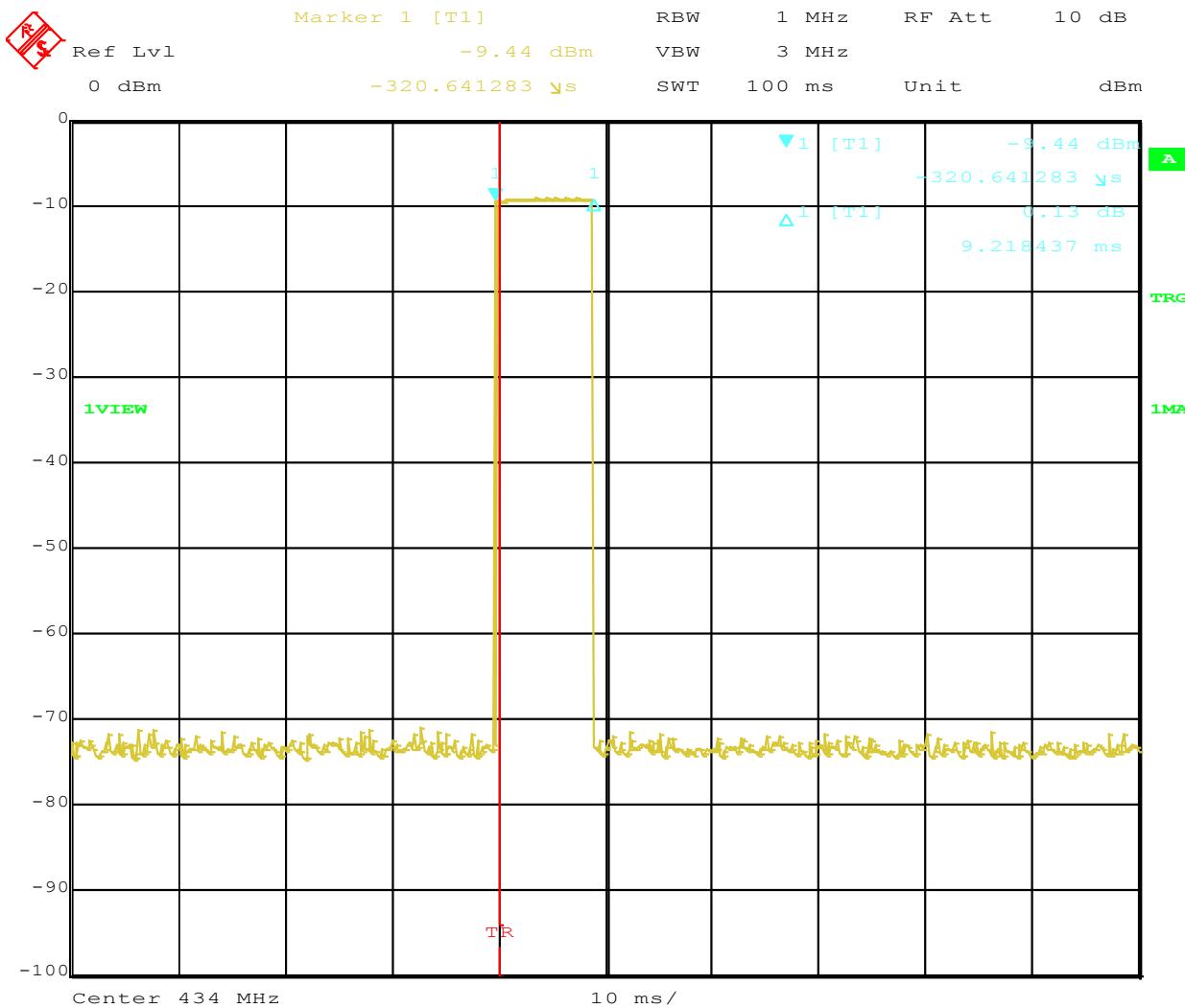
9.3 Results:

There is no limit on duty cycle, it is used to obtain the average value of emissions. The duty cycle average factor was determined to be 20 dB.

9.4 Setup Photograph:

9.5 Plots/Data:





Date: 1.JAN.1997 00:25:51

Test Personnel: Vathana Ven
 Supervising/Reviewing
 Engineer:
 (Where Applicable) N/A
 Product Standard: FCC Part 15 Subpart C, RSS-Gen
 Input Voltage: Powered from 24VDC Host
 Pretest Verification w/
 Ambient Signals or
 BB Source: Ambient Signals

Test Date: 04/09/2015
 Limit Applied: N/A
 Ambient Temperature: 21 °C
 Relative Humidity: 38 %
 Atmospheric Pressure: 994 mbars

10 Automatically Limiting Operation

10.1 Method

Tests are performed in accordance with FCC 47CFR Part 15 Subpart C Section 15.231(e), ANSI C63.10:2009, RSS-210.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A wooden table 80 cm high is used for table-top equipment.

10.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
ROS001'	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	05/19/2014	05/19/2015
CBLSHF203'	Cable, SMA - SMA, < 18GHz	Sucoflex (Huber Suhner)	104PE	CBLSHF203	06/03/2004	06/03/2015
WEI8'	Attenuator	Weinschel Corp	47-10-34	BD8309	04/02/2015	04/02/2016
Dav004'	Weather Station	Davis Instruments	7400	PE80529A61A	10/06/2014	10/06/2015

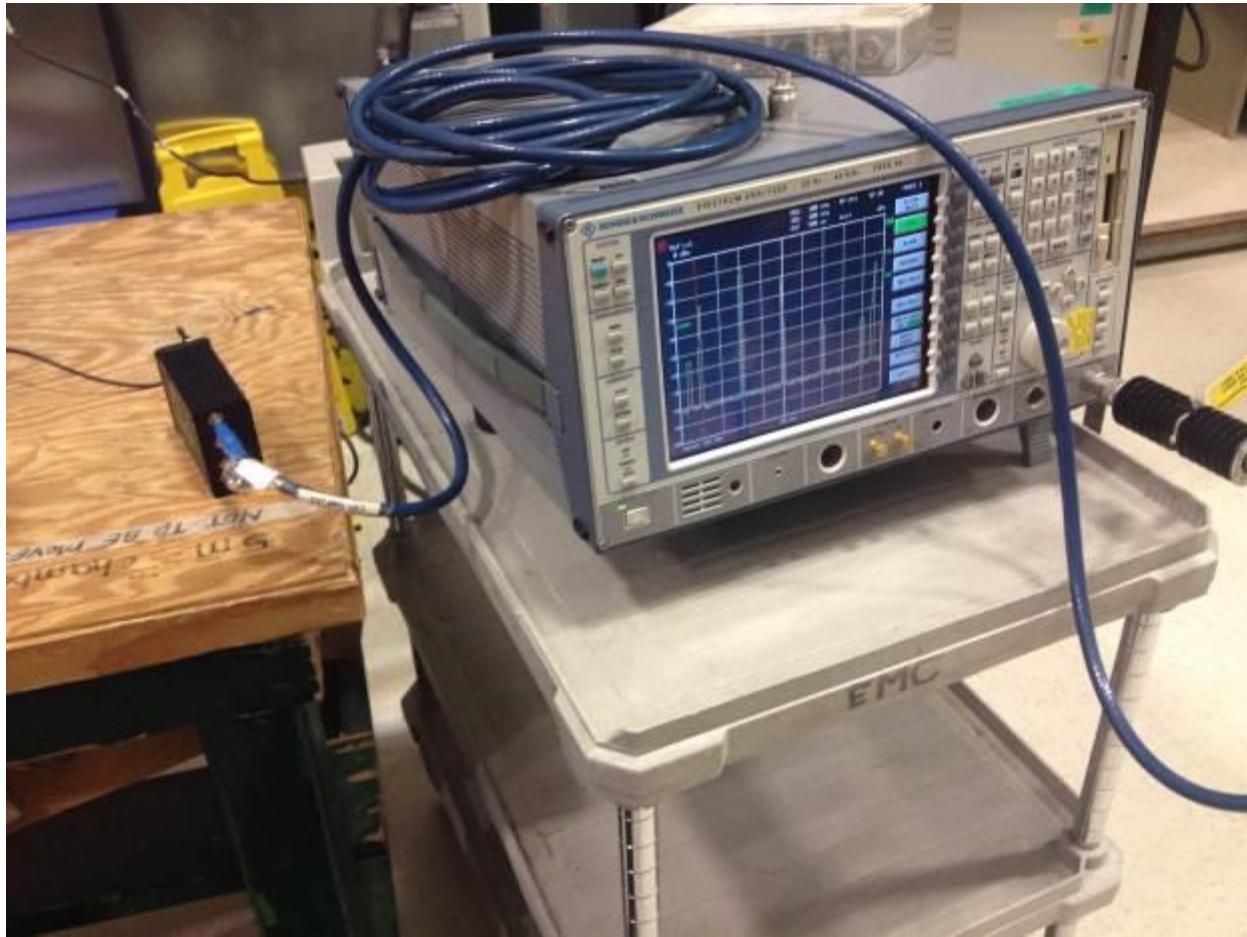
Software Utilized:

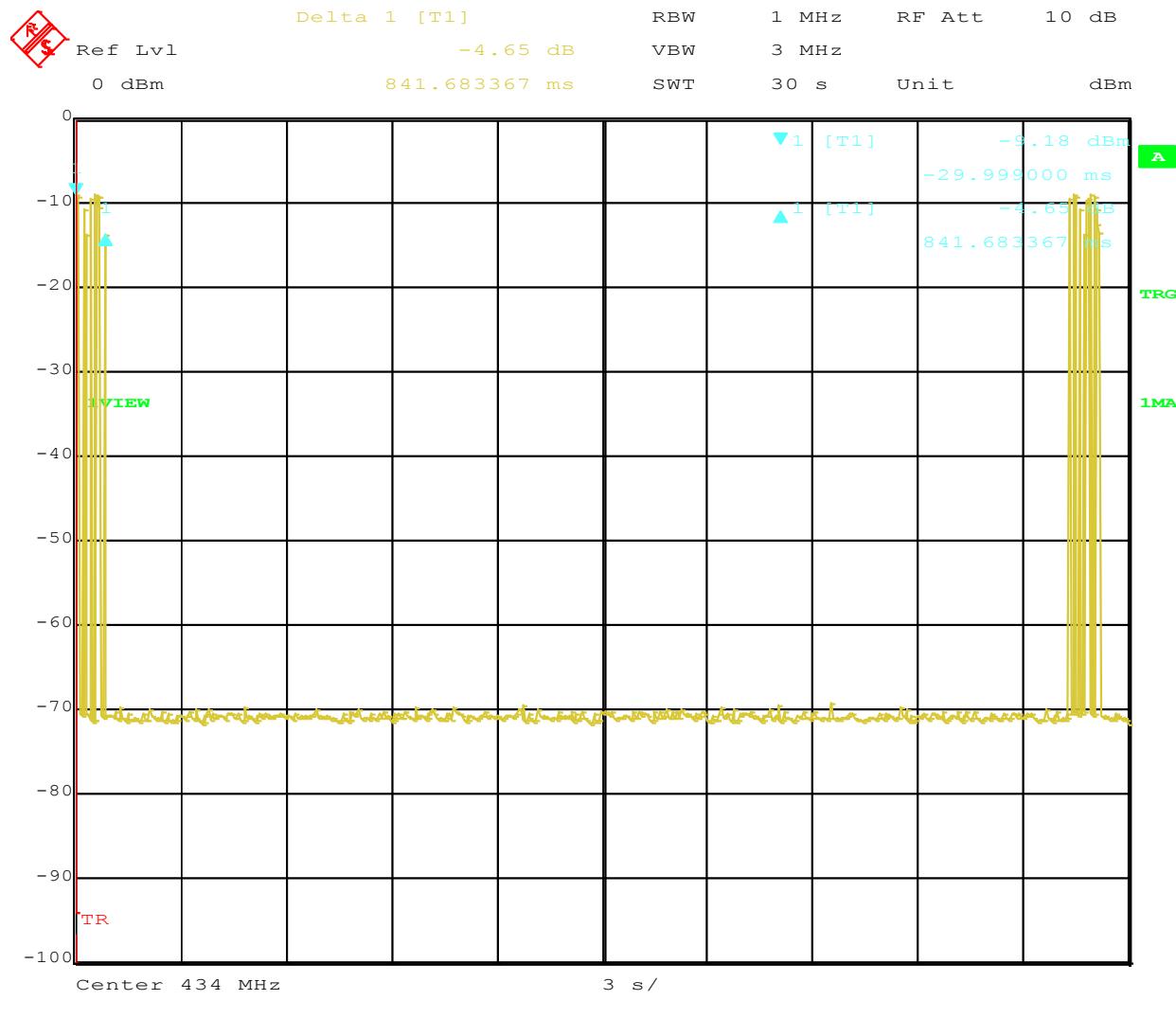
Name	Manufacturer	Version
None		

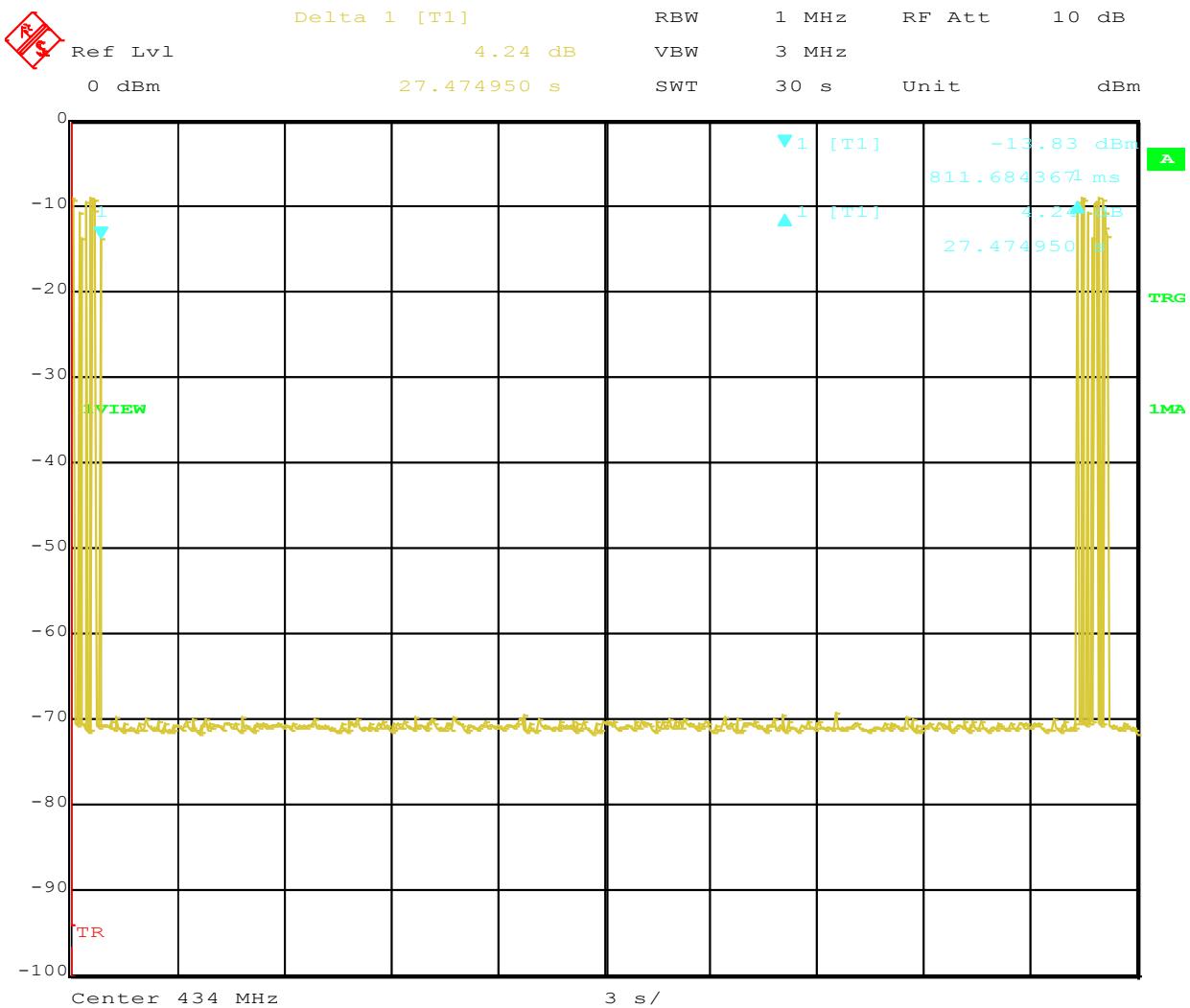
10.3 Results:

The sample tested was found to Comply.

In addition, devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

10.4 Setup Photograph:

10.5 Plots/Data:



Test Personnel: Vathana Ven
Supervising/Reviewing
Engineer:
(Where Applicable) N/A
Product Standard: FCC Part 15 Subpart C, RSS-210
Input Voltage: Powered from 24VDC Host

Pretest Verification w/
Ambient Signals or
BB Source: Ambient Signals

Test Date: 04/09/2015
Limit Applied: Section 15.231(e), RSS-210
Ambient Temperature: 21 °C
Relative Humidity: 38 %
Atmospheric Pressure: 994 mbars

11 AC Mains Conducted Emissions

11.1 Method

Tests are performed in accordance with FCC 47CFR Part 15 Subpart B, ANSI C63.10:2009, ICES-003.

TEST SITE: 10m ALSE

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
AC Line Conducted Emissions	150 kHz - 30 MHz	2.8	3.4
Telco Port Emissions	150 kHz - 30 MHz	3.2	5

Sample Calculations

The following is how net line-conducted readings were determined:

$$NF = RF + LF + CF + AF$$

Where NF = Net Reading in $dB\mu V$

RF = Reading from receiver in $dB\mu V$

LF = LISN or ISN Correction Factor in dB

CF = Cable Correction Factor in dB

AF = Attenuator Loss Factor in dB

To convert from $dB\mu V$ to μV or mV the following was used:

$$UF = 10^{(NF/20)} \text{ where } UF = \text{Net Reading in } \mu V$$

NF = Net Reading in $dB\mu V$

Example:

$$NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 \text{ } dB\mu V$$

$$UF = 10^{(49.1 \text{ } dB\mu V / 20)} = 285.1 \text{ } \mu V/m$$

Alternately, when C5 Software is used, the "Level" includes all losses and gains and is compared directly in the "Margin" column to the "Limit". "TF" is the Transducer Factor; in this case LISN or ISN loss.

11.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV004	Weather Station	Davis Instruments	7400	PE80529A61 A	10/06/2014	10/06/2015
145128	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/14/2015	03/14/2016
LISN32	LISN - CISPR16 Compliant 9kHz-30MHz	Com-Power	LI-215A	191955	03/18/2015	03/18/2016
DS27	Attenuator, 20dB	Mini Circuits	20dB, 50 ohm	DS27	10/01/2014	10/01/2015
CBLBNC1 0	25 ft, 50 Ohm BNC Cable	Pomona	RG 58 C/U	CBLBNC10	10/04/2014	10/04/2015

Software Utilized:

Name	Manufacturer	Version
C5	TESEQ	Build 5.26.46.46

11.3 Results:

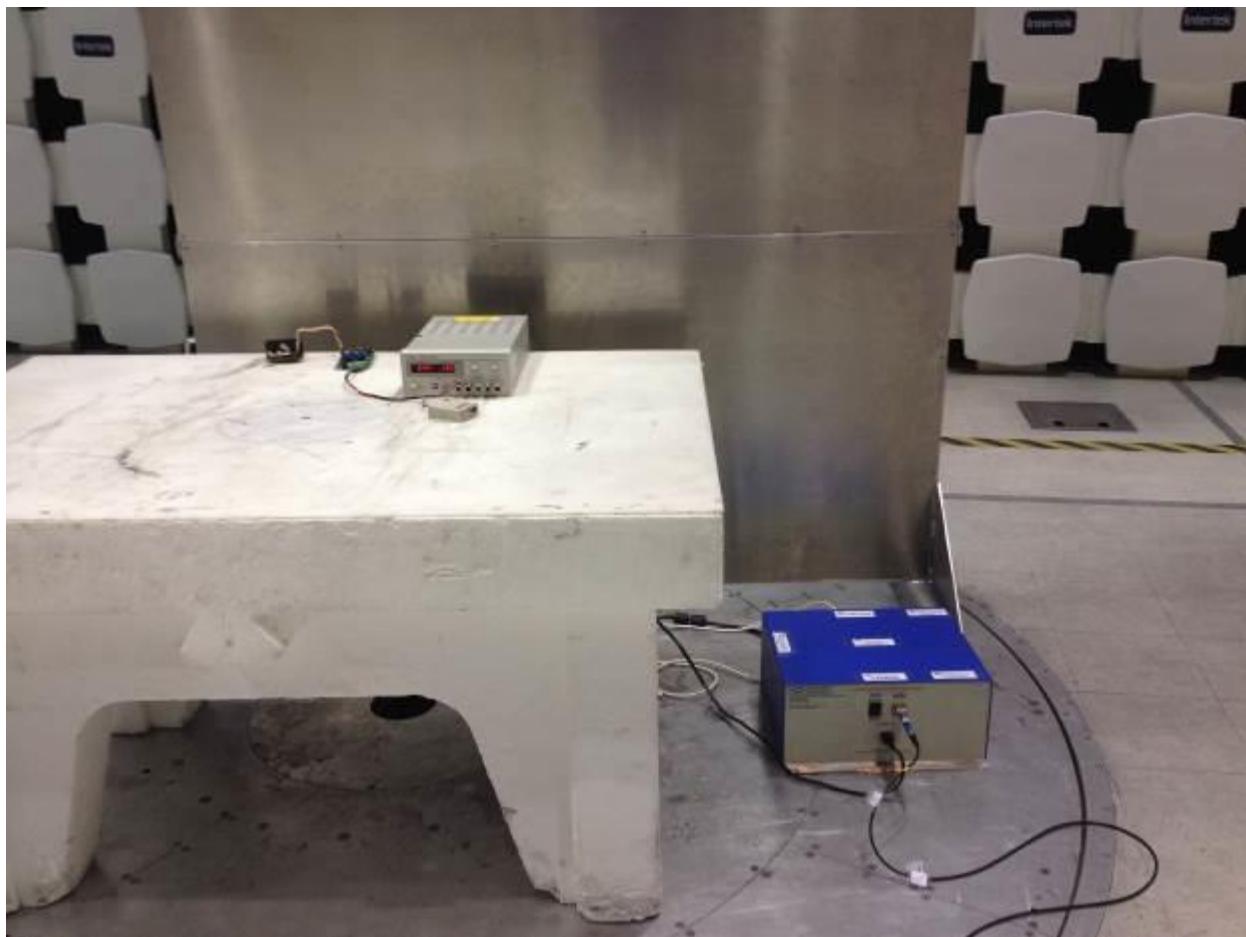
The sample tested was found to Comply.

11.4 Setup Photographs:

With Phoenix Contact power supply



With Agilent variable power supply



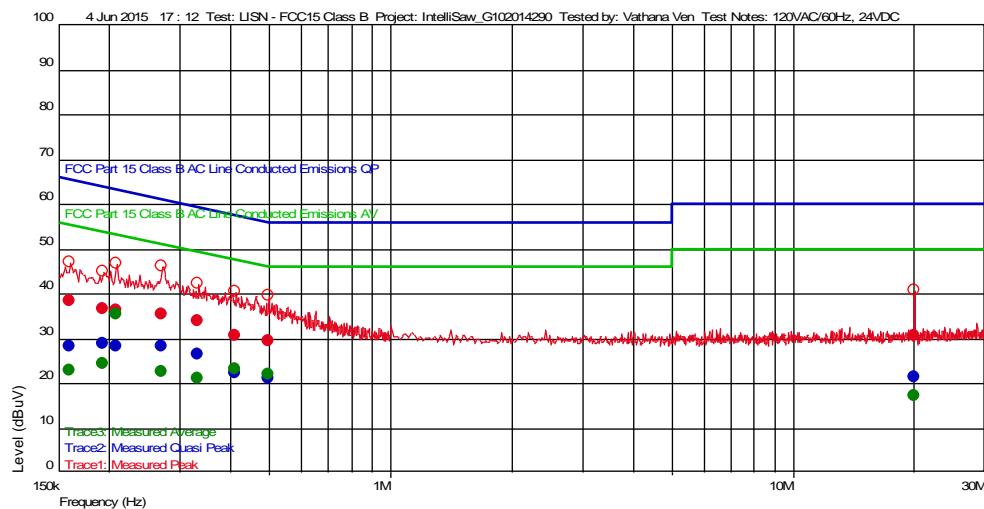
11.5 Plots/Data:

Test Information

Test Details
 Test: LISN - FCC15 Class B
 Project: IntelliSaw_G102014290
 Test Notes: 120VAC/60Hz, 24VDC
 Temperature: 22 deg C
 Humidity: 37%, 1013 mB
 Tested by: Vathana Ven
 Test Started: 4 Jun 2015 17:12

Additional Information

Prescan Emission Graph



Emissions Test Data

Trace2: Measured Quasi Peak

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
20.02004008 M	21.29	0.110	21.174	60.000	-38.71	9 k		L1
160.220440882 k	28.22	0.070	20.460	65.453	-37.23	9 k		L1
414.028056112 k	22.29	0.030	20.589	57.567	-35.28	9 k		L1
194.288577154 k	28.80	0.056	20.508	63.851	-35.05	9 k		L1
497.49498998 k	21.07	0.030	20.589	56.042	-34.97	9 k		L1
209.619238477 k	28.26	0.048	20.521	63.220	-34.96	9 k		L1
270.941883768 k	28.11	0.040	20.570	61.089	-32.98	9 k		L1
333.967935872 k	26.40	0.033	20.570	59.352	-32.95	9 k		L1

Trace2: Measured Quasi Peak

Trace2: Measured Quasi Peak

Trace2: Measured Quasi Peak

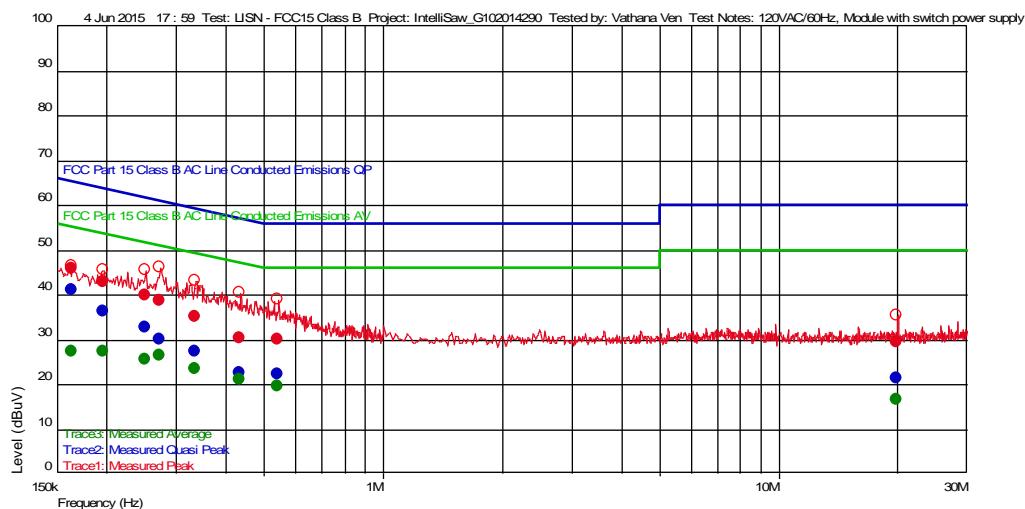
Trace3: Measured Average

Test Information

Test Details User Entry
 Test: LISN - FCC15 Class B
 Project: IntelliSaw_G102014290
 Test Notes: 120VAC/60Hz, Module with switch power supply
 Temperature: 22 deg C
 Humidity: 37%, 1013 mB
 Tested by: Vathana Ven
 Test Started: 4 Jun 2015 17 : 59

Additional Information

Prescan Emission Graph



- Measured Peak Value
- Measured Quasi Peak Value
- Measured Average Value
- Maximum Value of Mast and Turntable
- Swept Peak Data
- Swept Quasi Peak Data
- Swept Average Data

Emissions Test Data

Trace2: Measured Quasi Peak

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
19.9799592 M	21.28	0.110	21.156	60.000	-38.72	9 k		L1
436.172344689 k	22.65	0.030	20.579	57.134	-34.49	9 k		N
543.486973948 k	22.30	0.030	20.598	56.000	-33.70	9 k		N
335.671342685 k	27.30	0.033	20.573	59.310	-32.01	9 k		N
272.645290581 k	29.85	0.040	20.570	61.037	-31.19	9 k		N
250.501002004 k	32.76	0.040	20.557	61.741	-28.98	9 k		N
195.991983968 k	36.20	0.054	20.498	63.779	-27.58	9 k		N
163.627254509 k	41.11	0.066	20.460	65.278	-24.17	9 k		N

Trace3: Measured Average

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
19.9799592 M	16.53	0.110	21.156	50.000	-33.47	9 k		L1
163.627254509 k	27.22	0.066	20.460	55.278	-28.06	9 k		N
195.991983968 k	27.24	0.054	20.498	53.779	-26.54	9 k		N
250.501002004 k	25.40	0.040	20.557	51.741	-26.34	9 k		N
543.486973948 k	19.67	0.030	20.598	46.000	-26.33	9 k		N
436.172344689 k	21.06	0.030	20.579	47.134	-26.07	9 k		N
335.671342685 k	23.34	0.033	20.573	49.310	-25.97	9 k		N
272.645290581 k	26.41	0.040	20.570	51.037	-24.63	9 k		N

Test Personnel: Vathana Ven
Supervising/Reviewing
Engineer:
(Where Applicable)
Product Standard: FCC Part 15, ICES003
Input Voltage: 120VAC/60Hz
Pretest Verification w/
Ambient Signals or
BB Source: Yes

Test Date: 06/04/2015
Limit Applied: Class B
Ambient Temperature: 22 °C
Relative Humidity: 37 %
Atmospheric Pressure: 1013 mbars

Deviations, Additions, or Exclusions: None

12 Receiver Radiated Spurious Emissions

12.1 Method

Tests are performed in accordance with FCC 47CFR Part 15 Subpart B, ANSI C63.10:2009, ICES-003

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A wooden table 80 cm high is used for table-top equipment.

Measurement Uncertainty

For radiated emissions, U_{lab} (3.5 dB at 3m and 3.5 dB at 10m below 1 GHz, and 4.2 dB at 3m above 1 GHz) $< U_{CISPR}$ (5.2 dB), which is the reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where

FS = Field Strength in $\text{dB}\mu\text{V}/\text{m}$

RA = Receiver Amplitude (including preamplifier) in $\text{dB}\mu\text{V}$

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB

AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 $\text{dB}\mu\text{V}$ is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 $\text{dB}\mu\text{V}/\text{m}$. This value in $\text{dB}\mu\text{V}/\text{m}$ was converted to its corresponding level in $\mu\text{V}/\text{m}$.

$$RA = 52.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB}/\text{m}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$FS = 32 \text{ dB}\mu\text{V}/\text{m}$$

To convert from $\text{dB}\mu\text{V}$ to μV or mV the following was used:

$$UF = 10^{(NF/20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

$$NF = \text{Net Reading in } \text{dB}\mu\text{V}$$

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V}/\text{m}$$

12.2 Test Equipment Used:

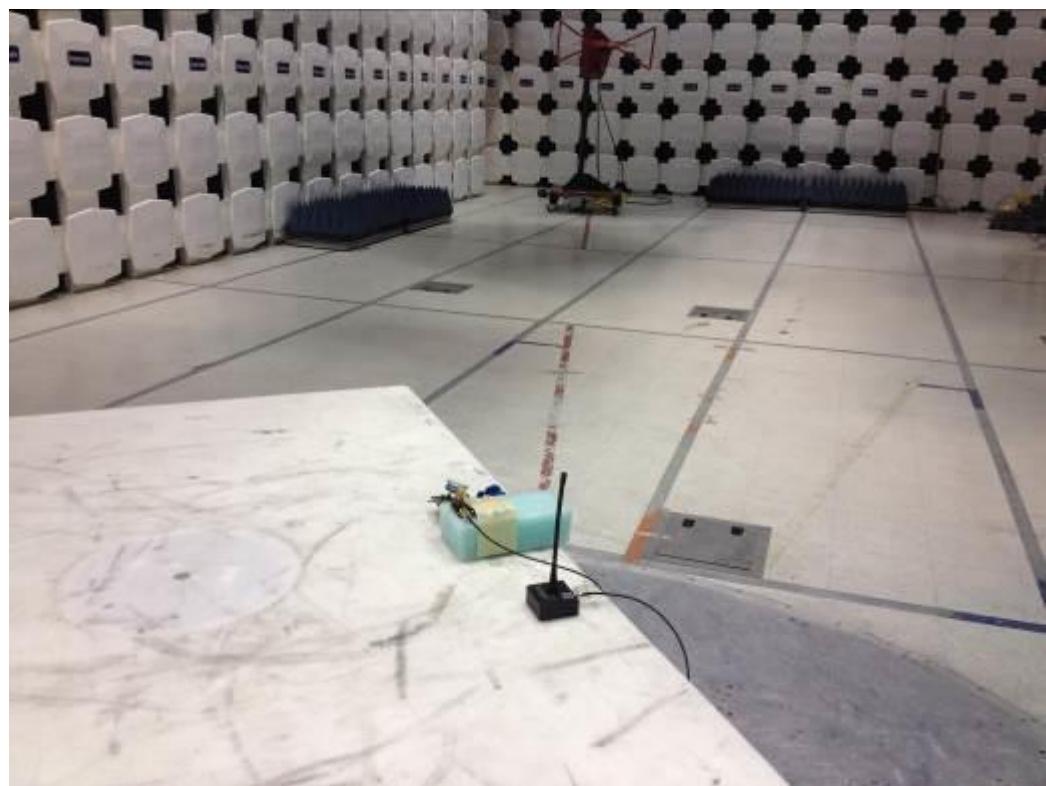
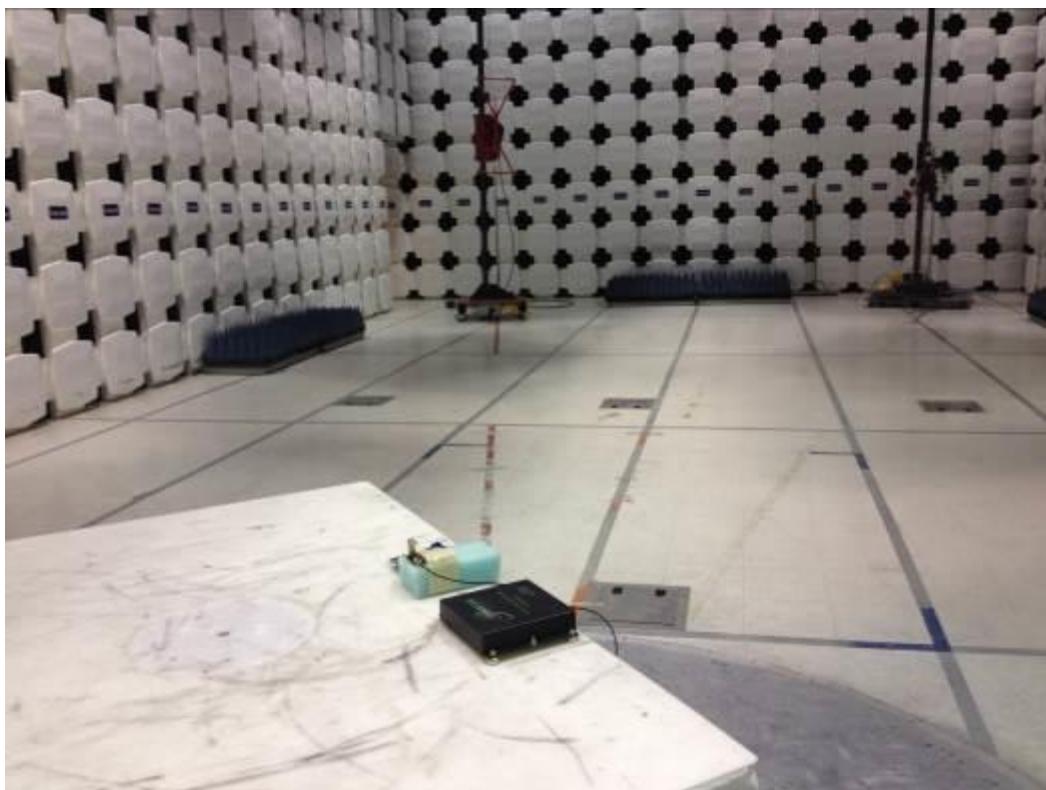
Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/14/2015	03/14/2016
145-410'	Cables 145-400 145-403 145-405 145-406 145-407	Huber + Suhner	10m Track A Cables	multiple	10/04/2014	10/04/2015
145106'	Bilog Antenna (30MHz - 5GHz)	Sunol Sciences	JB5	A111003	10/24/2014	10/24/2015
Dav004'	Weather Station	Davis Instruments	7400	PE80529A61A	10/06/2014	10/06/2015
REA003'	1GHz High Pass Filter	Reactel, Inc	7HS-1G/10G-S11	06-1	12/30/2013	12/30/2015
145-416'	Cables 145-400 145-402 145-404 145-408	Huber + Suhner	3m Track B cables	multiple	10/04/2014	10/04/2015
145014'	Preamplifier (1 GHz to 26.5 GHz)	Hewlett Packard	8449B	3008A00232	05/05/2014	05/05/2015
ETS002'	1-18GHz DRG Horn Antenna	ETS Lindgren	3117	00143260	04/10/2015	04/10/2016

Software Utilized:

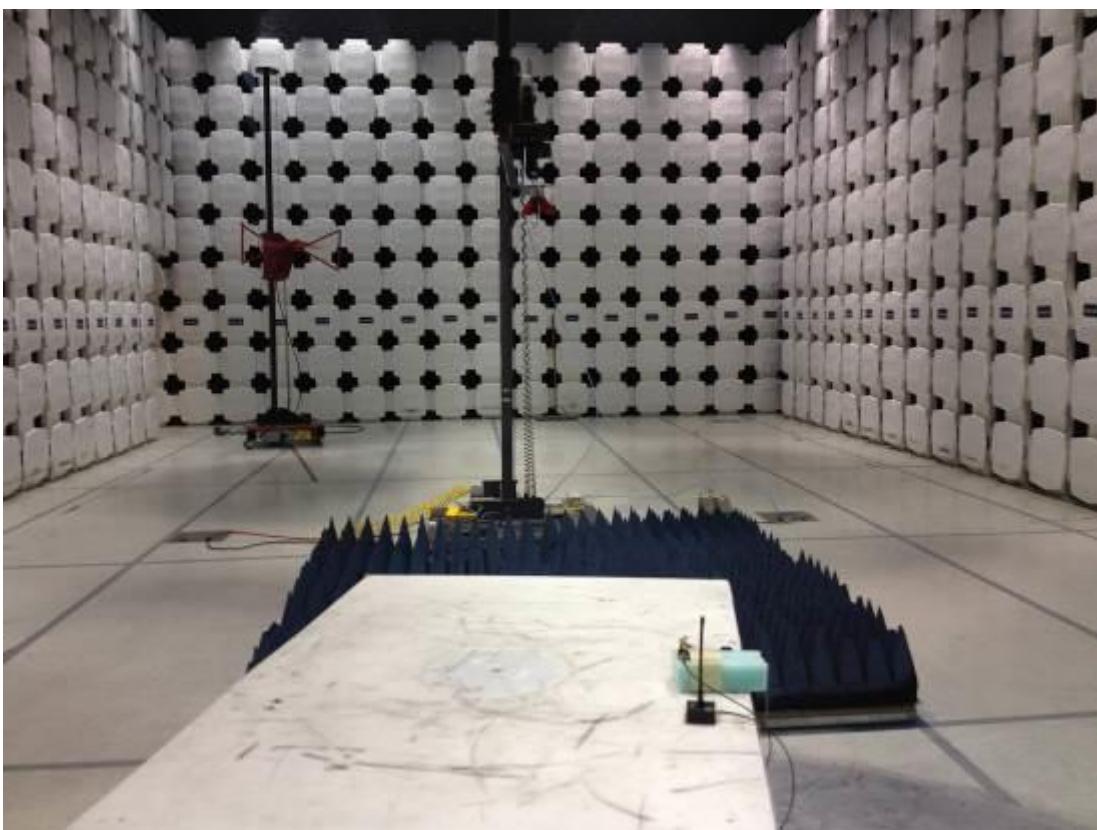
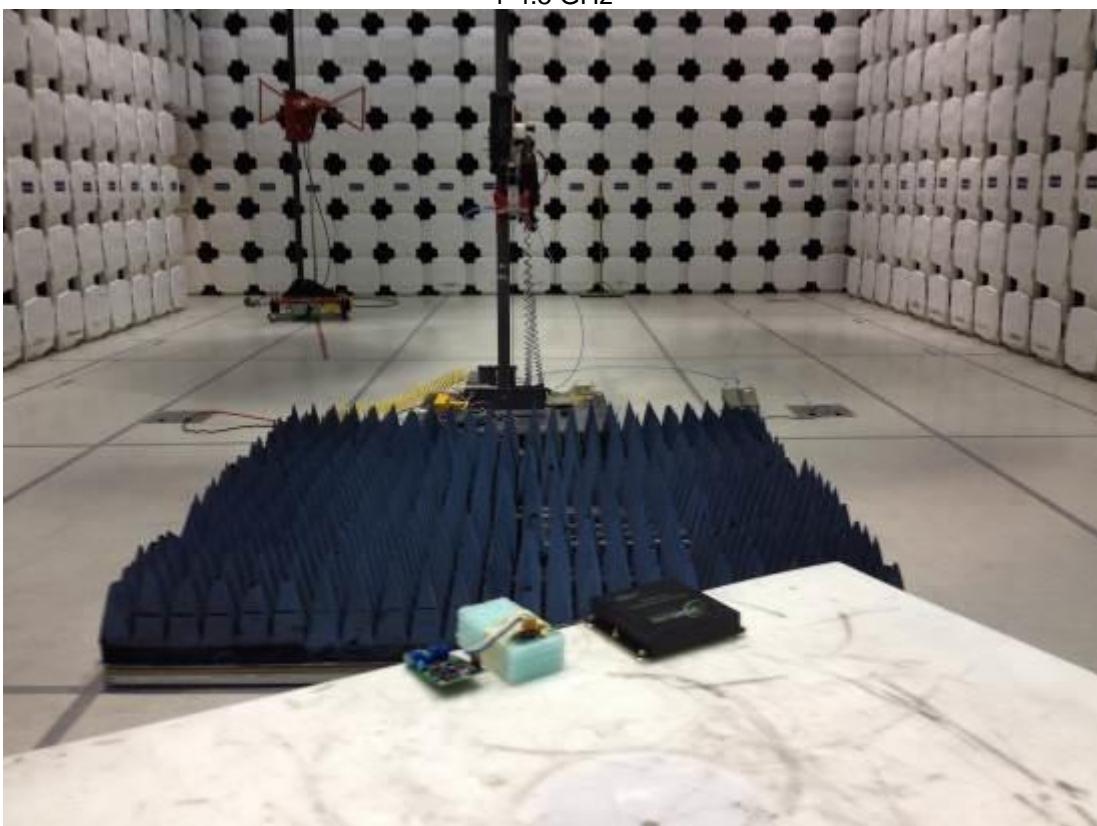
Name	Manufacturer	Version
EMI Boxborough	Intertek	8/27/2010
C5	TESEQ	Build 5.26.46.46

12.3 Results:

The sample tested was found to Comply.

12.4 Setup Photographs:

1-4.5 GHz



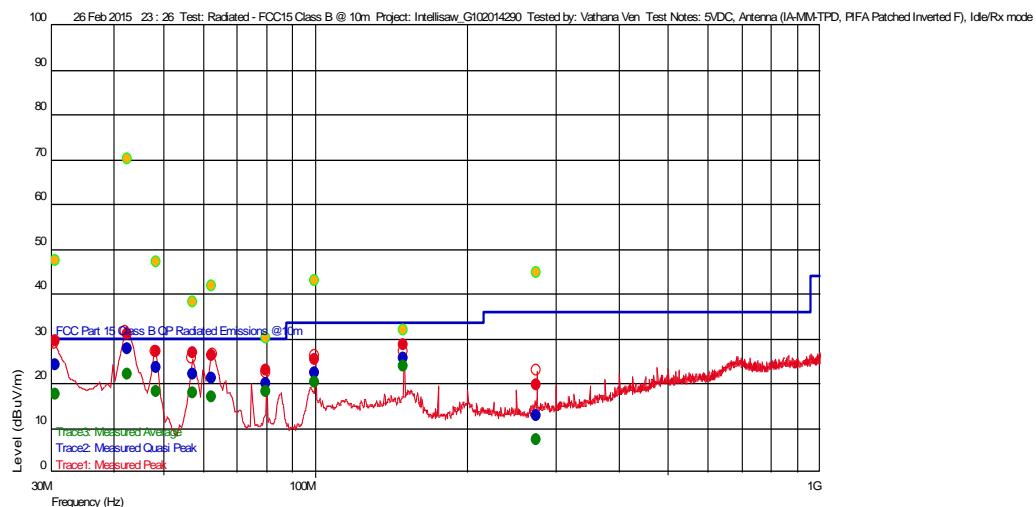
12.5 Plots/Data:

Test Information

Test Details User Entry
 Test: Radiated - FCC15 Class B @ 10m
 Project: Intellisaw_G102014290
 Test Notes: 5VDC, Antenna (IA-MM-TPD, PIFA Patched Inverted F), Idle/Rx mod
 Temperature: 22 deg C
 Humidity: 10%, 1007 mB
 Tested by: Vathana Ven
 Test Started: 26 Feb 2015 23 : 26

Additional Information

Prescan Emission Graph



- Measured Peak Value
- Measured Quasi Peak Value
- Measured Average Value
- Maximum Value of Mast and Turntable
- Swept Peak Data
- Swept Quasi Peak Data
- Swept Average Data

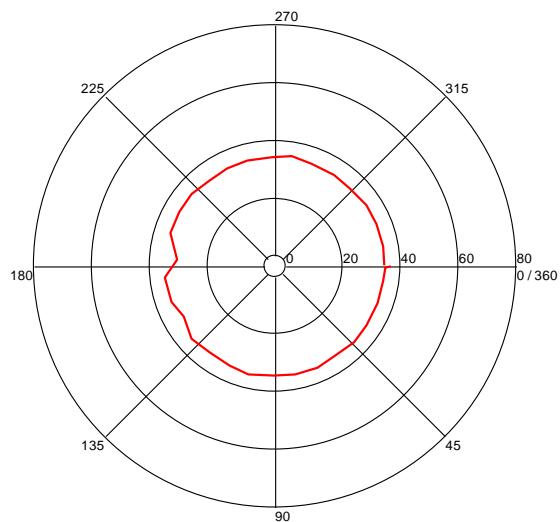
Emissions Test Data

Trace2: Measured Quasi Peak

Frequency (Hz)	Level (dBuV/m)	AF	PA+CL	Limit (dBuV/m)	Margin (dBuV/m)	Hor (--), Ver ()	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
275.129459198 M	12.54	13.403	-23.356	36.020	-23.48		360	1.06	120 k	
100.051302685 M	22.33	10.310	-24.729	33.520	-11.19		275	4.00	120 k	
80.030260301 M	19.85	7.497	-24.948	30.000	-10.15		31	3.21	120 k	
62.621242301 M	21.01	7.700	-25.056	30.000	-8.99		281	4.00	120 k	
57.327455052 M	21.86	7.200	-25.062	30.000	-8.14		328	2.83	120 k	
150.006212285 M	25.55	12.700	-24.130	33.520	-7.97		328	1.16	120 k	
48.485370874 M	23.33	8.606	-25.230	30.000	-6.67		259	4.00	120 k	
30.684769595 M	23.95	20.789	-25.461	30.000	-6.05		1	2.72	120 k	
42.723246896 M	27.50	12.194	-25.324	30.000	-2.50		230	3.73	120 k	

Azimuth Plots

Turntable Plot (30.684769595 MHz)



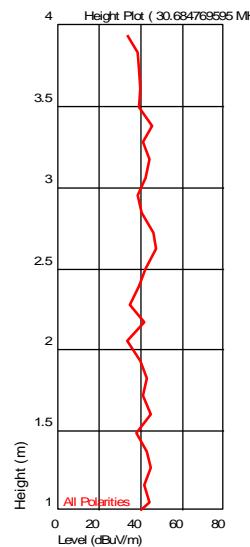
All Polarities

Azimuth (Degrees)

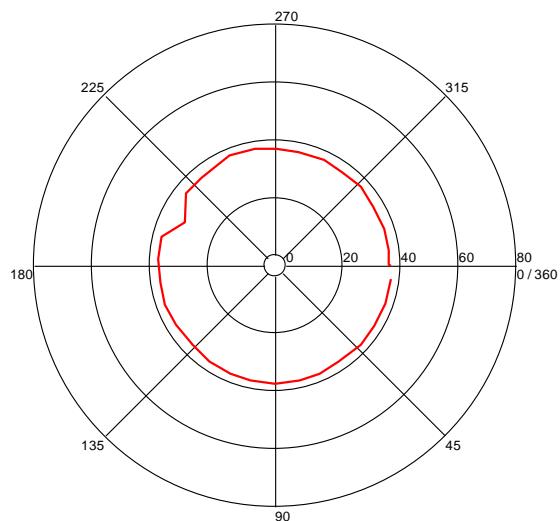
Level (dBuV/m)

Turntable Plots

Height Plot (30.684769595 MHz)

Height (m)
0 20 40 60 80
Level (dBuV/m)

Turntable Plot (42.723246896 MHz)

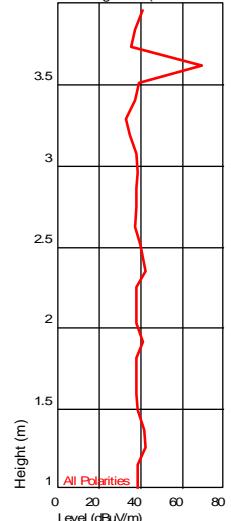


All Polarities

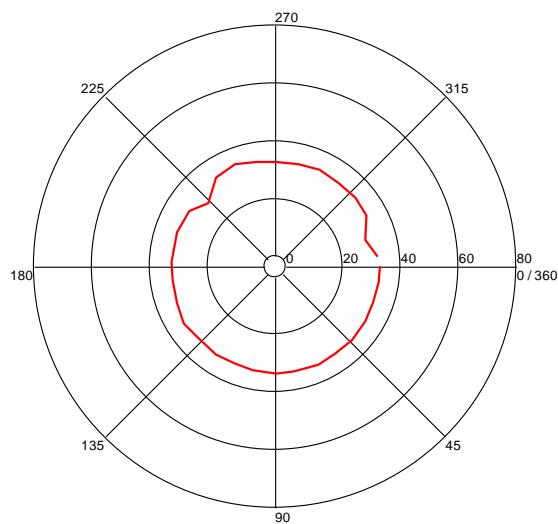
Azimuth (Degrees)

Level (dBuV/m)

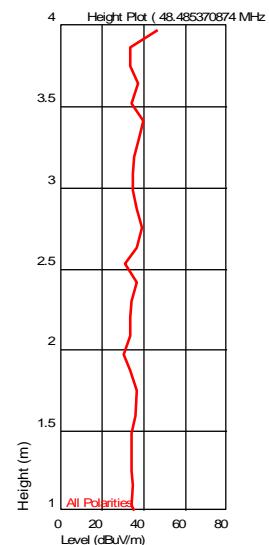
Height Plot (42.723246896 MHz)

Height (m)
0 20 40 60 80
Level (dBuV/m)

Turntable Plot (48.485370874 MHz)



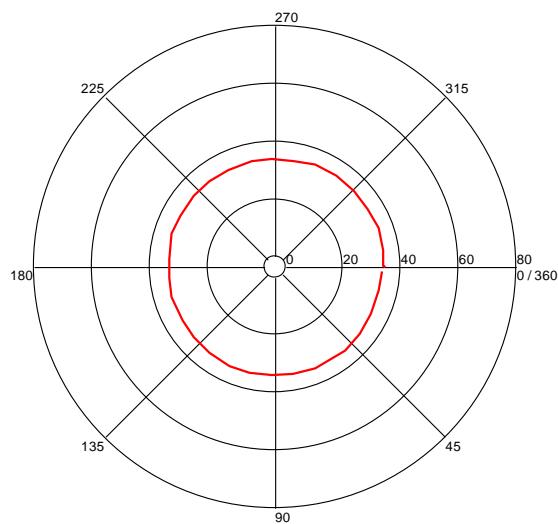
Level (dBuV/m)



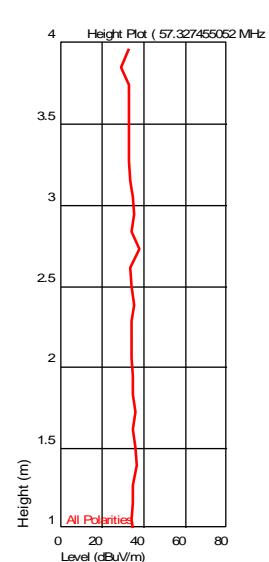
All Polarities

Azimuth (Degrees)

Turntable Plot (57.327455052 MHz)



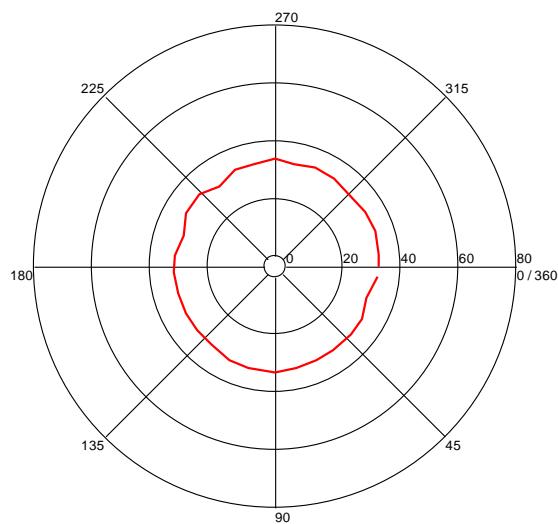
Level (dBuV/m)



All Polarities

Azimuth (Degrees)

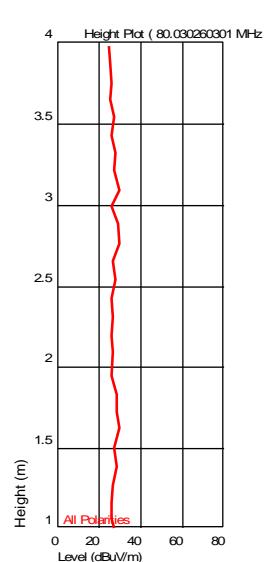
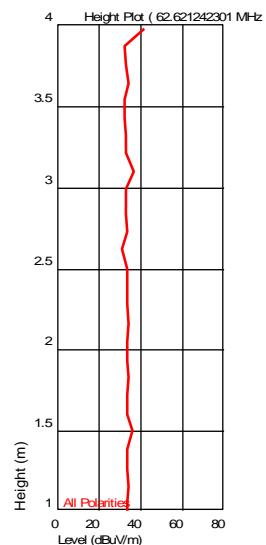
Turntable Plot (62.621242301 MHz)



Level (dBuV/m)

Azimuth (Degrees)

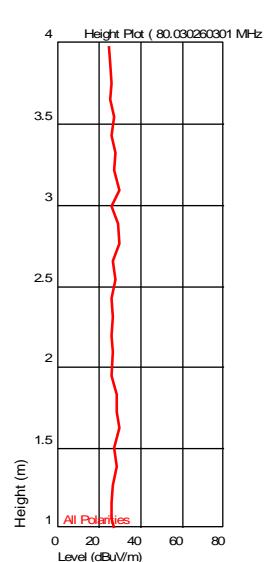
All Polarities



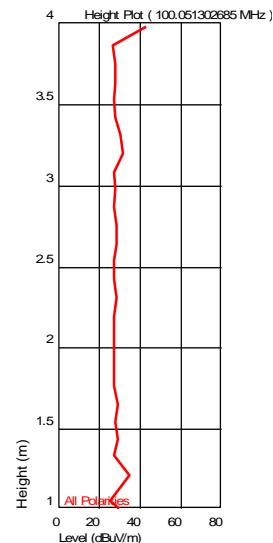
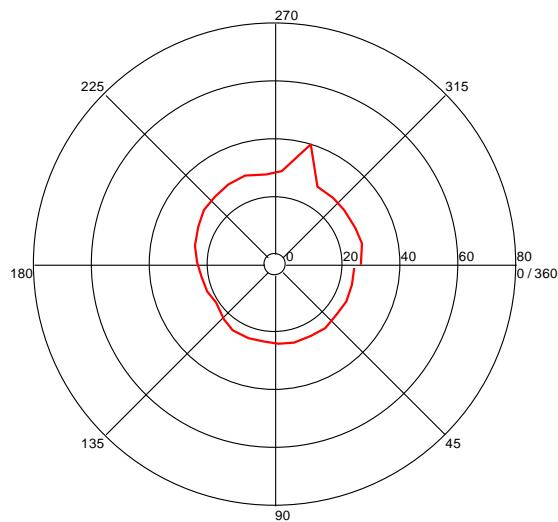
Level (dBuV/m)

Azimuth (Degrees)

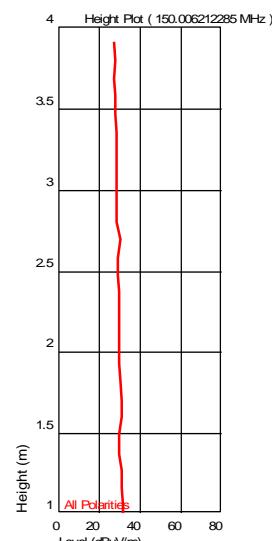
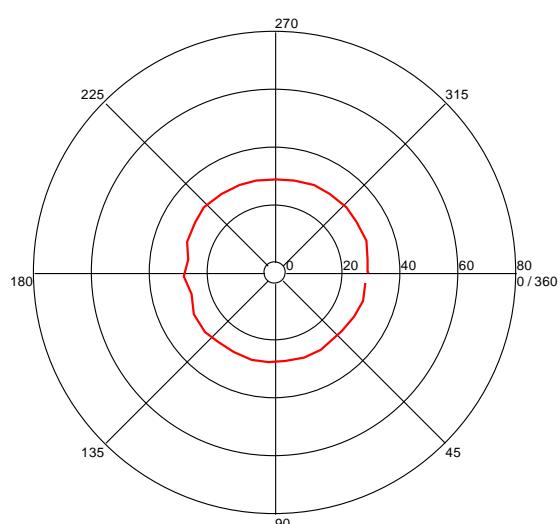
All Polarities



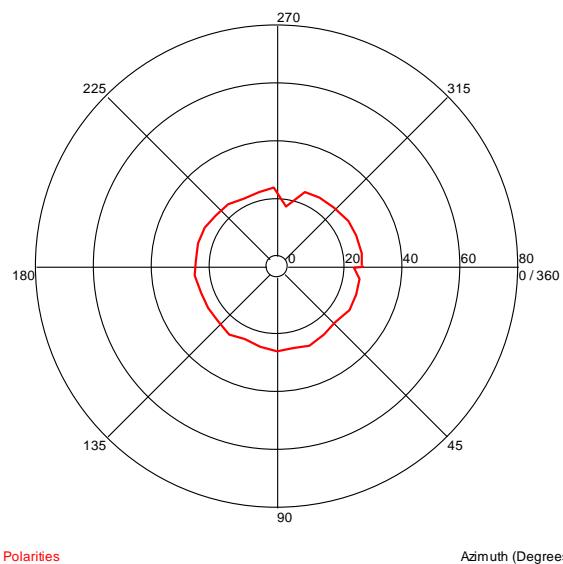
Turntable Plot (100.051302685 MHz)



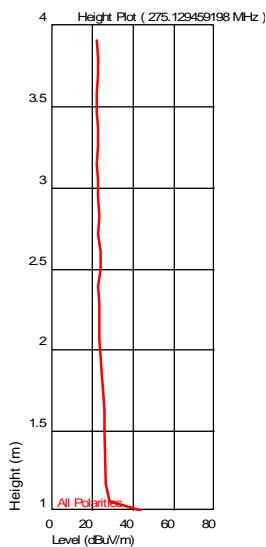
Turntable Plot (150.006212285 MHz)



Turntable Plot (275.129459198 MHz)



All Polarities

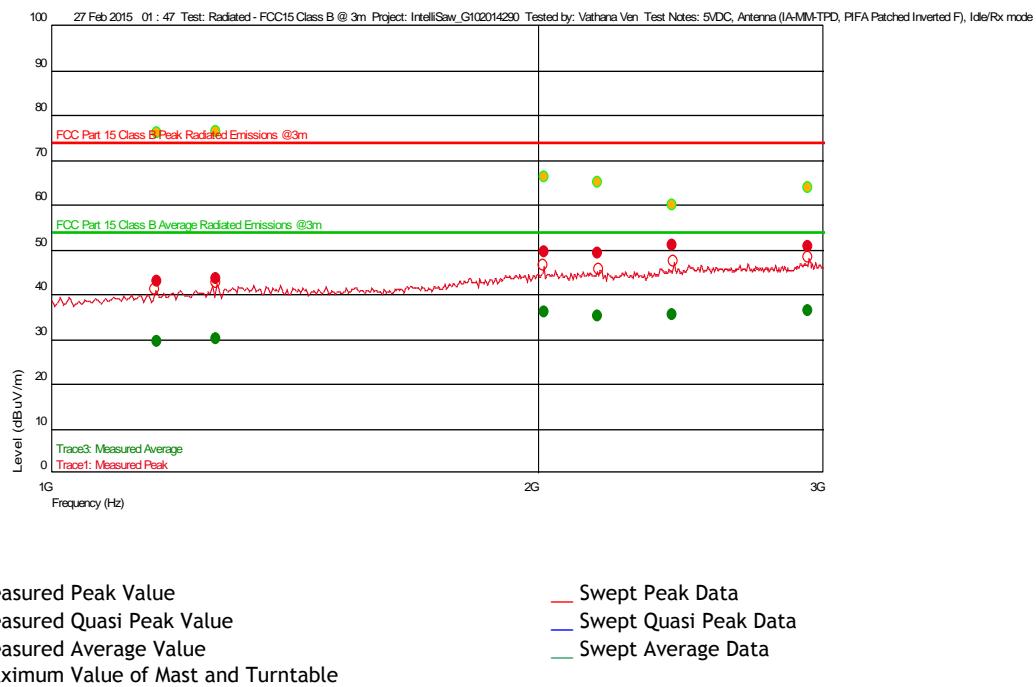


Test Information

Test Details User Entry
 Test: Radiated - FCC15 Class B @ 3m
 Project: IntelliSaw_G102014290
 Test Notes: 5VDC, Antenna (IA-MM-TPD, PIFA Patched Inverted F), Idle/Rx mod
 Temperature: 22 deg C
 Humidity: 10%, 1007 mB
 Tested by: Vathana Ven
 Test Started: 27 Feb 2015 01 : 47

Additional Information

Prescan Emission Graph



Emissions Test Data

Trace1: Measured Peak

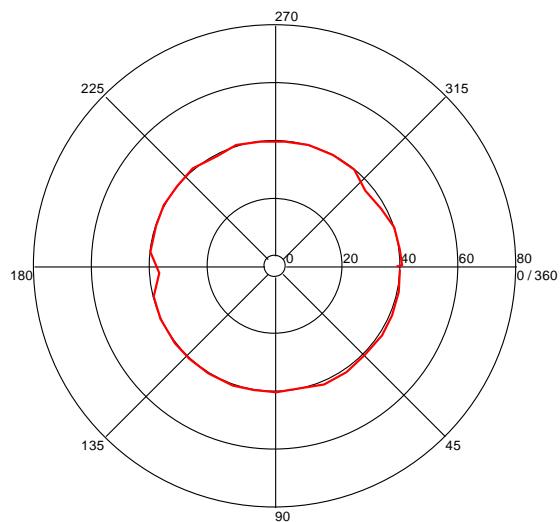
Frequency (Hz)	Level (dBuV/m)	AF	PA+CL	Limit (dBuV/m)	Margin (dBuV/m)	Hor (--), Ver ()	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
1.16251169 G	42.94	27.812	-28.184	74.000	-31.06	--	0	1.08	1 M	
1.265190381 G	43.44	28.610	-27.839	74.000	-30.56	--	15	1.32	1 M	
2.178804275 G	48.98	31.290	-25.987	74.000	-25.02	--	320	1.06	1 M	
2.019124916 G	49.52	31.224	-25.906	74.000	-24.48		360	1.78	1 M	
2.937254509 G	50.45	32.853	-25.170	74.000	-23.55	--	172	1.91	1 M	
2.419826319 G	50.84	32.094	-25.873	74.000	-23.16		193	1.07	1 M	

Trace3: Measured Average

Frequency (Hz)	Level (dBuV/m)	AF	PA+CL	Limit (dBuV/m)	Margin (dBuV/m)	Hor (--), Ver ()	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
1.16251169 G	29.33	27.812	-28.184	54.000	-24.67	--	0	1.08	1 M	
1.265190381 G	30.01	28.610	-27.839	54.000	-23.99	--	15	1.32	1 M	
2.178804275 G	35.15	31.290	-25.987	54.000	-18.85	--	320	1.06	1 M	
2.419826319 G	35.30	32.094	-25.873	54.000	-18.70		193	1.07	1 M	
2.019124916 G	36.01	31.224	-25.906	54.000	-17.99		360	1.78	1 M	
2.937254509 G	36.27	32.853	-25.170	54.000	-17.73	--	172	1.91	1 M	

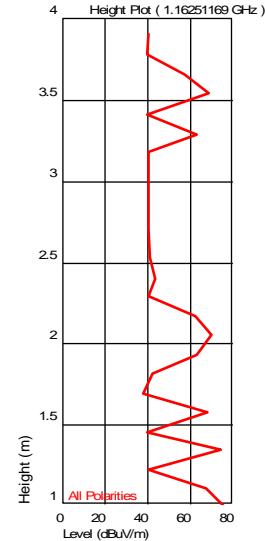
Azimuth Plots

Turntable Plot (1.16251169 GHz)

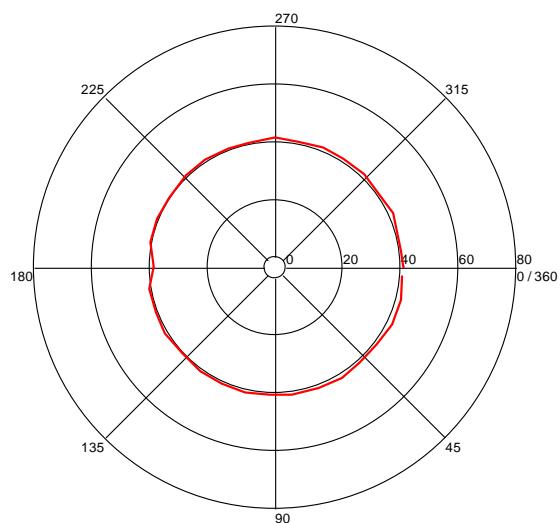


Turntable Plots

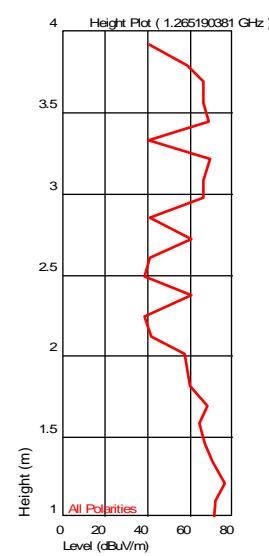
Height Plot (1.16251169 GHz)



Turntable Plot (1.265190381 GHz)



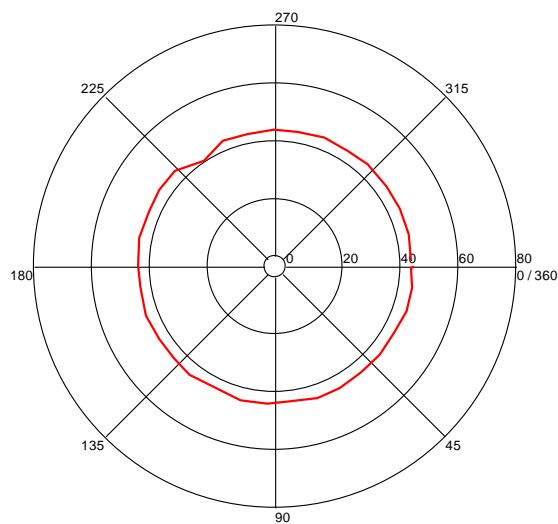
Azimuth (Degrees)



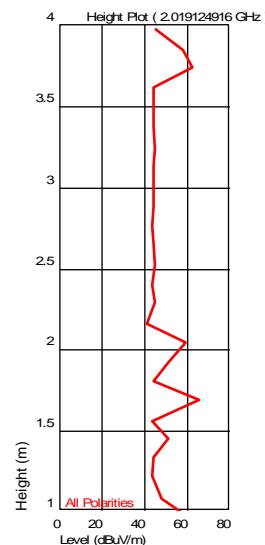
All Polarities

Azimuth (Degrees)

Turntable Plot (2.019124916 GHz)



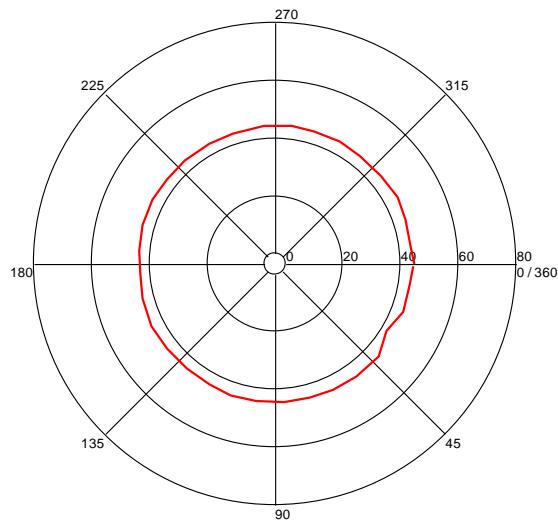
Level (dBuV/m)



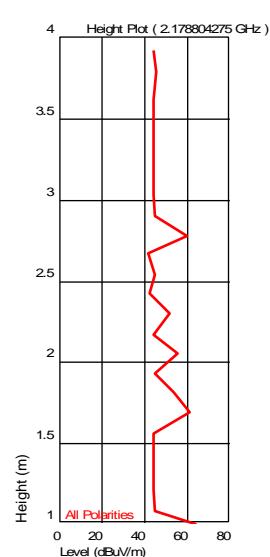
All Polarities

Azimuth (Degrees)

Turntable Plot (2.178804275 GHz)



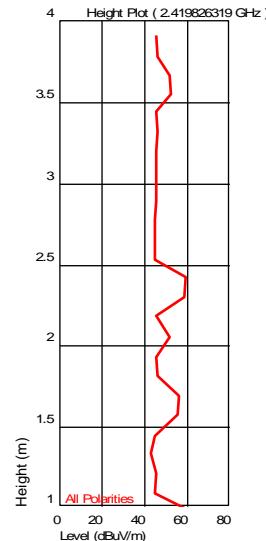
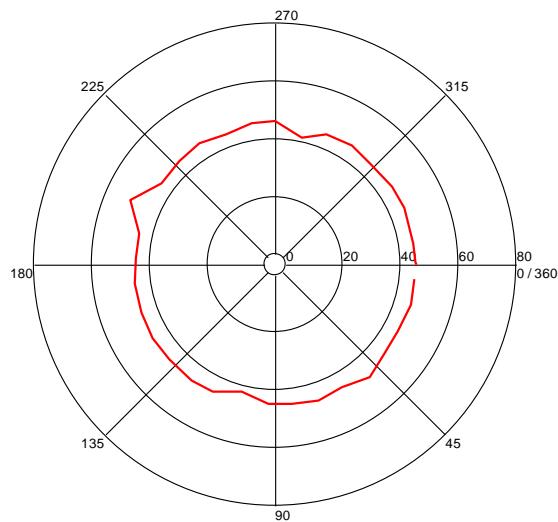
Level (dBuV/m)



All Polarities

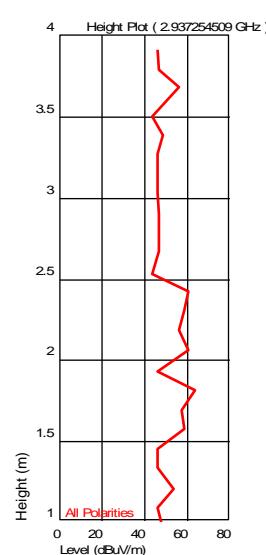
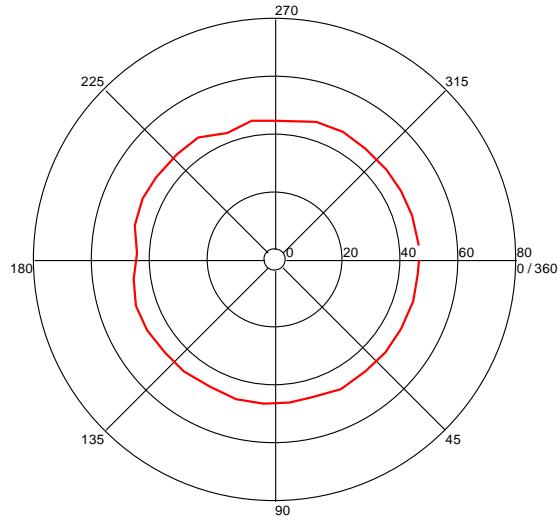
Azimuth (Degrees)

Turntable Plot (2.419826319 GHz)



All Polarities

Turntable Plot (2.937254509 GHz)



All Polarities

Test Personnel: Vathana Ven
 Supervising/Reviewing
 Engineer:
 (Where Applicable) N/A
 Product Standard: FCC Part 15 Subpart C, RSS-210
 Input Voltage: Powered from 24VDC Host
 Pretest Verification w/
 Ambient Signals or
 BB Source: Ambient Signals

Test Date: 02/27/2015
 Limit Applied: Section 15.231(e), RSS-210
 Ambient Temperature: See data tables
 Relative Humidity: See data tables
 Atmospheric Pressure: See data tables

13 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	06/05/2015	102085252BOX-001a	VFV <i>VJV</i>	MFM <i>MJF</i>	Original Issue