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Test Report

Company:	Greenfield Direct, LLC 14015 238th St. Greenwood, NE 68003
Contact:	Scott Miner
Product:	FloodBug
FCC ID: IC ID:	YBR-FB100 8924A-FB100
Test Report No:	R031510-01-01
APPROVED BY:	Nic Johnson Test Engineer
DATE:	14 June 2010
Total Pages:	27

1.0 Summary of test results

1.1 Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARDS: 47 CFR Part 15 & RSS-210			
Standard Section	**Test Type and Limit**	**Result**	**Remark**
15.207 RSS-Gen	Conducted AC Mains Emissions	Pass	Meets the requirement of the limit.
15.209, 15.231 RSS-Gen	Radiated Emissions Peak Output Field Strength Limit: 80.83dBµV/m	Pass	Meets the requirement of the limit.
15.231 RSS-210 Issue 7	Bandwidth	Pass	Meets the requirement of the limit.

2.0 Description

2.1 Equipment under test

The FloodBug is a moisture detector which wirelessly transmits an alarm to a central valve controller (the VIP or Valve Interface Panel) to shut off water in a home or business. The FloodBug can operate either using battery or an external DC power supply. It can use a built-in water sensor or a remote water sensor, connected by a cable.

The FloodBug is anticipated to be more often than not powered by two AA non-rechargeable alkaline cell batteries. The ground line on the battery will be disconnected, however, when a 5VDC power supply is plugged into the 2.1 MM power jack. The EUT is supplied with a 5VDC Tech Power Int. power supply, M/N TSA9-050120WU.

EUT Received Date: 4/21/2010
EUT Tested Date: 4/21/2010

PRODUCT	FloodBug
MODEL	GF1001
POWER SUPPLY	2 AA Batteries/5VDC power supply
MODULATION TYPE	FSK
FREQUENCY RANGE	433.92MHz
NUMBER OF CHANNELS	1
MAXIMUM OUTPUT POWER	79.79dBµV/m at 3m (peak)
ANTENNA TYPE	Internal dipole
I/O PORTS	1 – External water sensor (FloTrol)
ASSOCIATED DEVICES	FloTrax, V.I.P. Digital

NOTE:
1. For more detailed features description, please refer to the manufacturer's specifications or User's Manual.

2.2 Laboratory description

All testing was performed at the NCEE Lincoln facility, which is a FCC and IC registered lab. This site has been fully described in previously submitted reports. Laboratory environmental conditions varied slightly throughout the tests:

Relative humidity of 45 ± 4%
Temperature of 20 ± 3° Celsius

2.3 Description of test modes

The EUT was modified by the manufacturer to transmit continuously for testing purposes. It was set to transmit one packet after another with 20ms in between transmissions

2.4 Applied standards

The EUT is a low-power transmitter device operating on one frequency at 433.92MHz. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15.207, 15.209 and 15.231 using ANSI/IEEE C63.4: 2003
Industry Canada, RSS 210, Issue 7, Category I Equipment

All test items have been performed and recorded as per the above standards.

2.5 Configuration of system under test

The EUT was set to transmit a continuous carrier signal at the lowest possible frequency, highest possible frequency, and on in the middle of the operating range. The EUT was also tested in a mode of operation in which it ran in its normal operating condition, waiting to receive data.

The EUT was tested with the 5VDC supply and remote water sensor (See Appendix A for photos).

2.6 Duty Cycle Calculation

The FloodBug (Part No. GF1001 Rev-1) is designed to have a very low duty cycle. During normal operation the FloodBug transmits only once every 22 hours and this is a short transmission (measured to be 85 milliseconds) which includes the ID (serial number) of the FloodBug and is used to test system integrity. This message is repeated two more times, separated by an inter-message gap designed to reduce the chance of collisions. This inter-message gap is 125 milliseconds times a random number between 0 and 7 plus the time overhead in communicating with the radio chip. The overall timing of the regular heartbeat (system integrity test message) is controlled by the microcontroller which turns the TI CC1101 radio chip off and then puts itself into a low power state that allows interrupts to be generated by the water detection circuitry or by an on-board tilt switch.

On water detect or tilt detect (alarms sent by the FloodBug) a message is sent which is 85 milliseconds in length. This message is repeated two more times, separated by an inter-message gap designed to reduce the chance of collisions.

This inter-message gap is 125 milliseconds times a random number between 0 and 7. After sending the three packets the FloodBug waits 30 seconds before retransmitting the alarm messages. There is no acknowledgement in the system for these messages.

Pressing the test/sync button on the FloodBug also causes the bug to send three packets using the same collision avoidance scheme described above. If the button is held down the FloodBug does not continue to send packets.

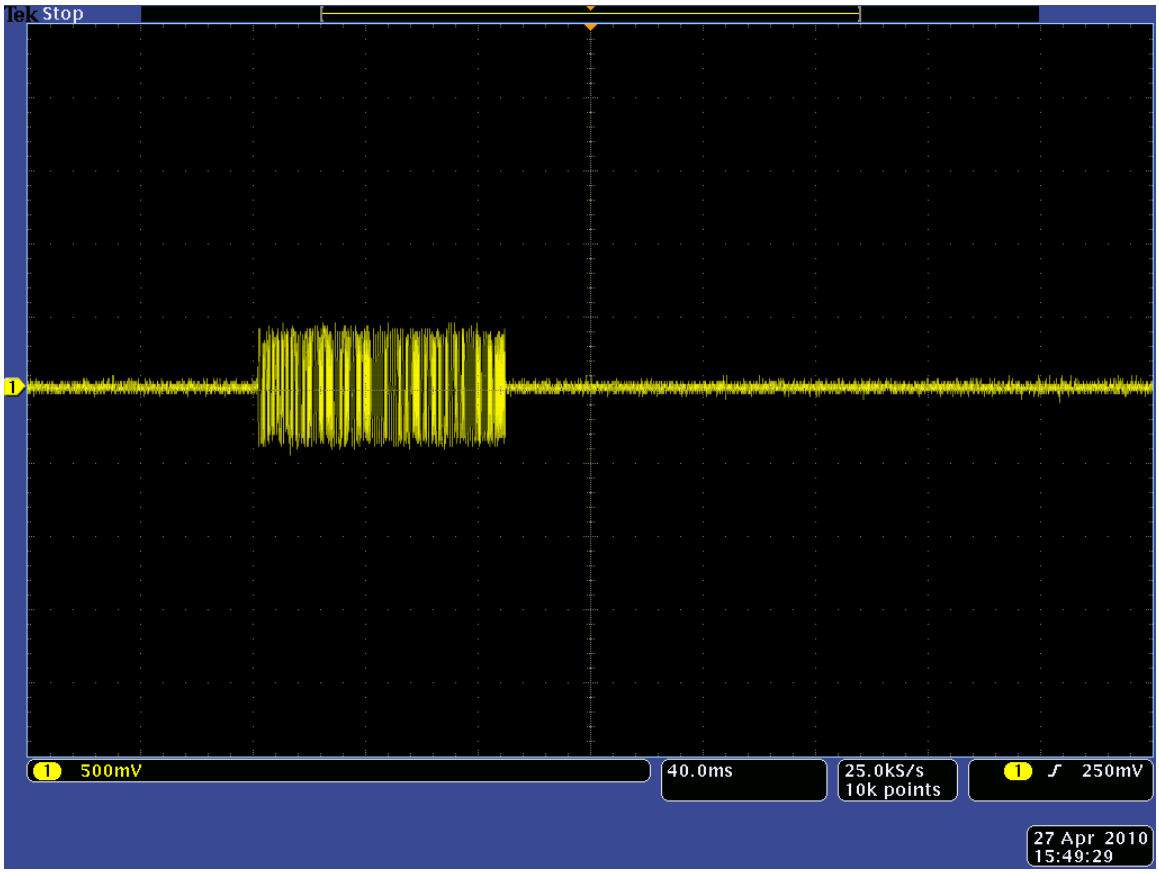


Figure 1 - Transmission Length Plot, 85ms

3.0 Test equipment used

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE
*Rohde & Schwarz Test Receiver	ESIB26	100037	06/09/2009
Rohde & Schwarz Test Receiver	ESI7	100007	06/09/2009
EMCO Biconilog Antenna	3142B	1647	02/10/2010
EMCO Horn Antenna	3115	6416	02/06/2009
Rohde & Schwarz Preamplifier	TS-PR18	082001/003	12/15/2009*
Rohde & Schwarz LISN	ESH3-Z5	836679/010	2/10/2010

*Internal characterization

4.0 Detailed results

4.1 15.207 Conducted AC emissions

4.1.1 Limits for conducted emissions measurements

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56	56 to 46
0.5-5	56	46
5-30	60	50

NOTE: 1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz.
3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

4.1.2 Test Procedures

a. The EUT was placed 0.8m above a ground reference plane and 0.4 meters from the conducting wall of a shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). The LISN provides 50 ohm/ 50uH of coupling impedance for the measuring instrument.

b. Both lines of the power mains connected to the EUT were checked form maximum conducted interference as well as the ground. The EUT was powered by a 5VDC power supply.

c. The frequency range from 150 kHz to 30 MHz was searched.

4.1.3 Deviation from the test standard

No deviation

4.1.4 Test setup

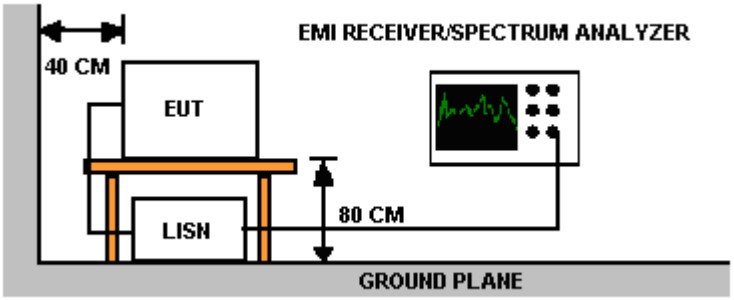


Figure 2 - Conducted Emissions Test Setup

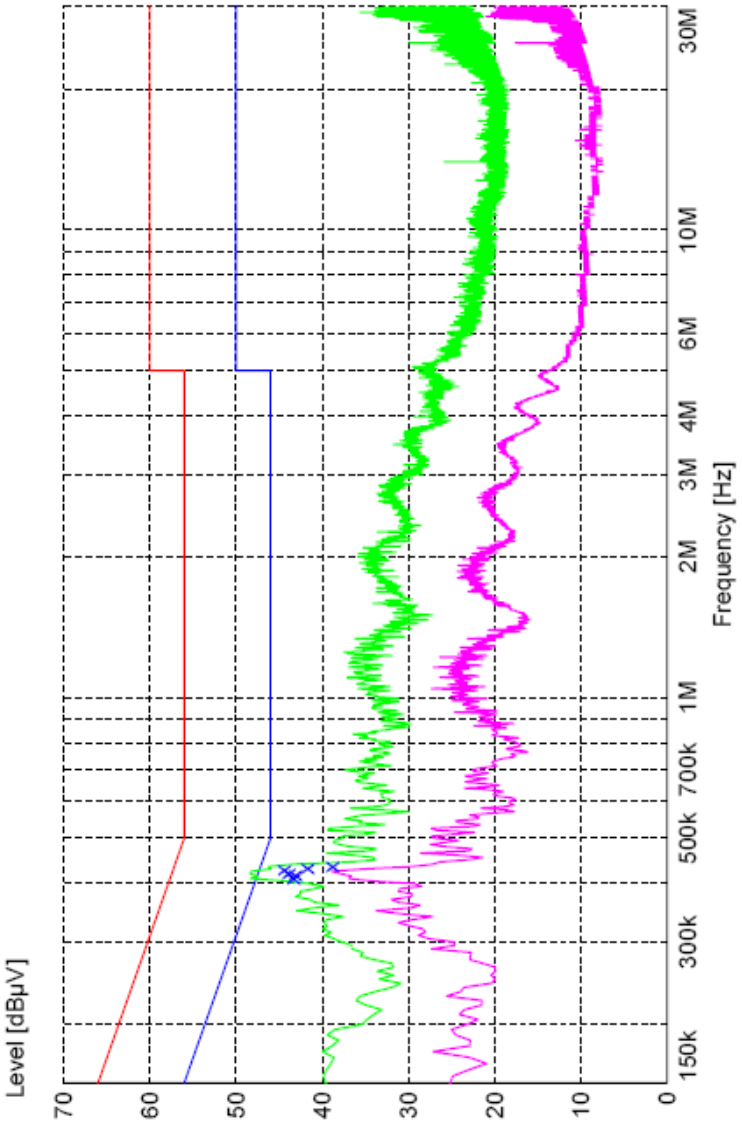
For actual test configuration, see photographs in Appendix A

4.1.5 EUT operating conditions

The conducted emissions were tested from a 5VDC power supply from Tech-power International, M/N TSA9-050120WU while providing power to the EUT. The EUT was set to transmit continuously.

4.1.6 Test Results

EUT	FloodBug	MODE	Cont. Transmit
INPUT POWER	5VDC	FREQUENCY RANGE	150kHz – 30MHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson



REMARKS:
1. Q.P. and AV. are abbreviations for quasi-peak and average respectively.
2. The red line indicates the quasi-peak/peak limits, and the green line the peak measurements.
3. The blue line indicates the average limits, and the violet the peak measurements.

Table 1 - Conducted Emissions Quasi-peak Measurements

Shown compared to average limits.

Frequency	Level	Limit	Margin	Line	PE
MHz	dBµV/m	dBµV/m	dB		
0.41	43.50	47.65	4.15	L1	FLO
0.42	43.30	47.55	4.25	L1	GND
0.42	44.10	47.45	3.35	L1	GND
0.43	44.60	47.35	2.75	L1	GND
0.43	41.90	47.25	5.35	L1	GND
0.44	39.00	47.16	8.16	L1	GND

4.2 15.209, 15.231 Radiated emissions

4.2.1 Limits for radiated emissions measurements

Emissions radiated outside of the specified bands shall be applied to the limits in 15.209 as followed:

FREQUENCIES (MHz)	FIELD STRENGTH (μV/m)	MEASUREMENT DISTANCE (m)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	3
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

NOTE:
1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 * log * Emission level (uV/m).
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits by more than 20dB under any condition of modulation.
4. The radiated emissions limit according to FCC Part 15.231(b) for a transmitter operating at 433.02MHz is 80.84dBμV/m at a 3m test distance.

4.2.2 Test procedures

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground plane in a 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The receive antenna was a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are used to make the measurement.

d. For each suspected emission, the EUT was arranged to maximize its emissions and then the antenna height was varied from 1 meter to 4 meters and the rotating table was turned from 0 degrees to 360 degrees to find the maximum emission reading.

e. The test-receiver system was set to use a peak detector with a specified resolution bandwidth. For spectrum analyzer measurements, the composite maximum of several analyzer sweeps was used for final measurements.

NOTE:
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequencies below 1GHz.

2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz for peak and average detectors at frequencies above 1GHz.

4.2.3 Deviations from test standard

No deviation.

4.2.4 Test setup

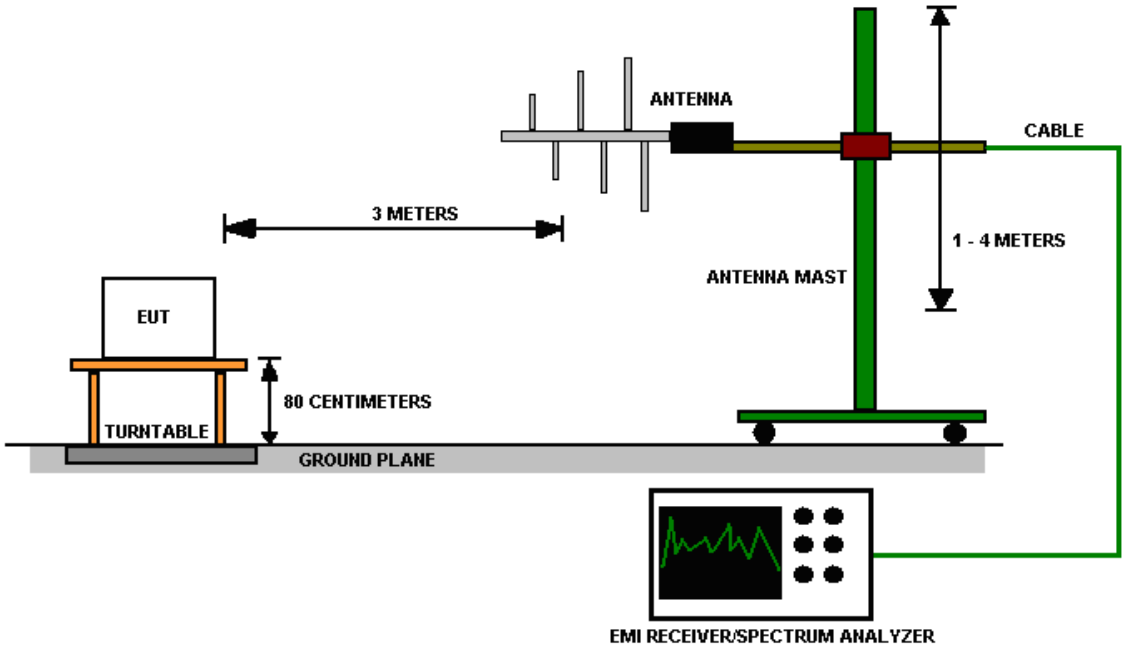


Figure 3 - Radiated Emissions Test Setup

For the actual test configuration, please refer to Appendix A for photographs of the test configuration.

4.2.5 EUT operating conditions

See section 2.5 for details.

4.2.6 Test results

EUT	FloodBug	DATE	21 April 2010
MODE	Transmit Continuously Receive/Standby	FREQUENCY RANGE	30MHz – 5GHz
INPUT POWER (SYSTEM)	5VDC	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

REMARKS:
1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.
5. The radiated emissions limit according to FCC Part 15.231(a) is 80.83dBµV/m for 433.92MHz at a 3m test distance. This applies to an average measurement. See calculations after the chart.

Table 2 - Radiated Emissions Quasi-peak Measurements, 30MHz – 1GHz, Transmit Mode

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
39.84	31.60	40.00	8.40	97	33	VERT
40.02	31.57	40.00	8.40	101	0	VERT
100.02	40.78	44.00	3.20	100	316	VERT
124.98	33.37	44.00	10.60	98	357	VERT
174.96	29.62	44.00	14.40	99	44	VERT
199.98	33.29	44.00	10.70	101	83	VERT
225.00	38.86	46.00	7.10	160	67	VERT
379.74	22.20	46.00	23.80	135	292	VERT
433.92	79.79*	80.84**	1.05	99	306	VERT
867.84	35.39	46.00	10.60	113	77	VERT

*Peak measurement; if peak measurements are compliant with average limit, average measurements are not required.
**Average limit.

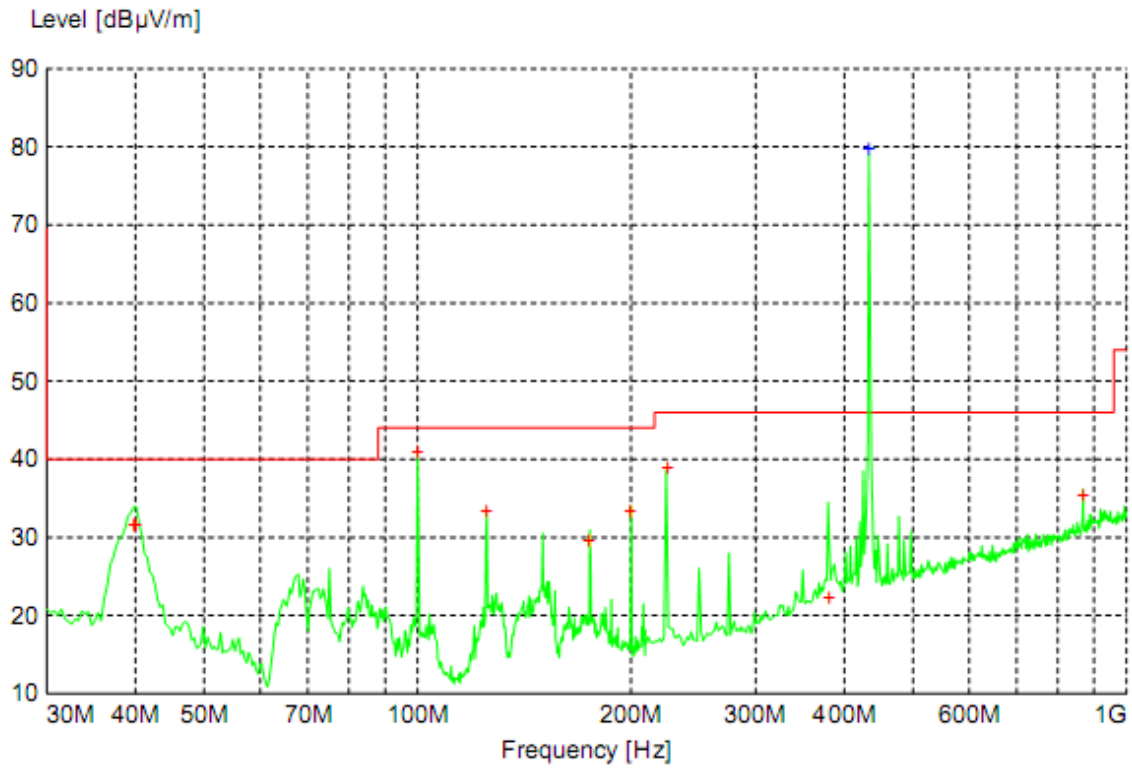


Figure 4- Radiated Emissions Plot, 30MHz - 1GHz, Transit Mode

Table 3 - Radiated Emissions Quasi-peak Data, 30MHz - 1GHz, Receive Mode

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
38.28	20.82	40.00	19.20	98	146	VERT
38.64	20.35	40.00	19.70	111	6	VERT
49.50	23.20	40.00	16.80	100	39	VERT
49.98	26.26	40.00	13.70	100	262	VERT
50.22	21.87	40.00	18.10	100	83	VERT
75.00	26.74	40.00	13.30	127	102	VERT
100.02	38.15	44.00	5.80	101	311	VERT
174.96	31.43	44.00	12.60	99	262	VERT
199.98	41.01	44.00	3.00	100	83	VERT
225.00	34.33	46.00	11.70	206	9	VERT

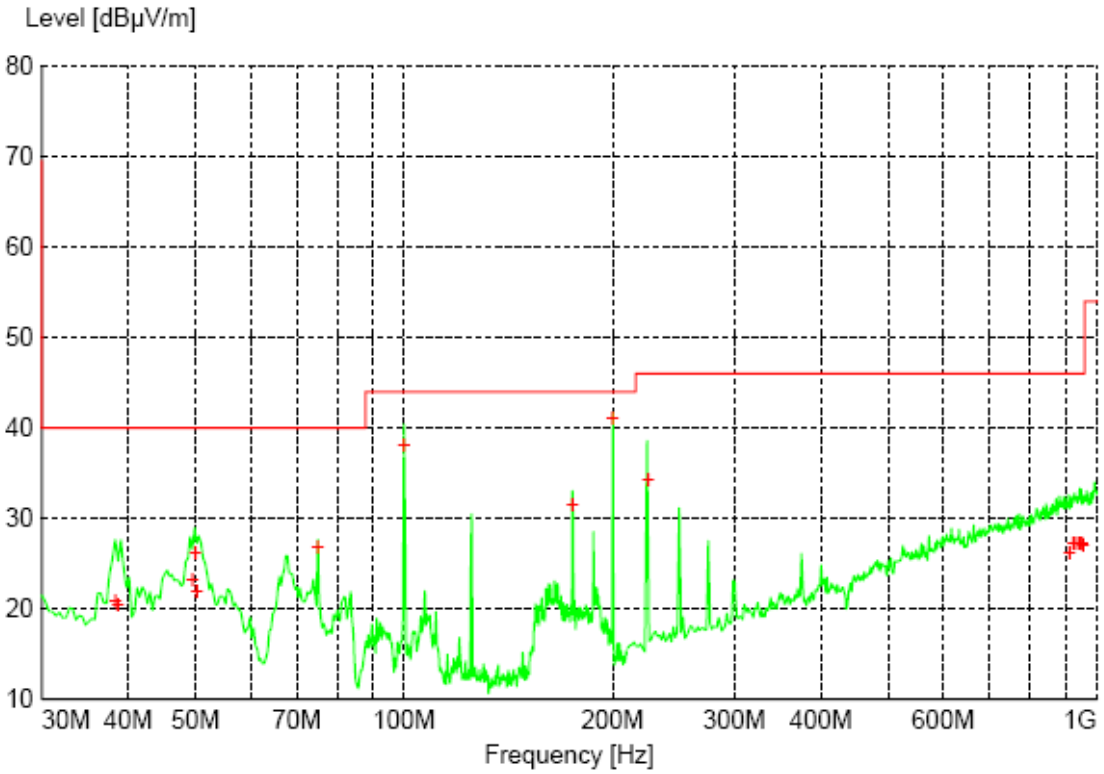


Figure 5 - Radiated Emissions Plot, 30MHz - 1GHz, Receive Mode

Table 4 - Radiated Emissions Peak Detector Measurements, 1-5GHz, Transmit Mode

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
1302.00	51.03	73.90	22.87	163.00	253	VERT
2169.50	53.22	73.90	20.68	130.00	277	VERT
2603.52	51.15	73.90	22.75	382.00	184	VERT
3037.50	54.97	73.90	18.93	99.00	321	HORI
3905.50	53.68	73.90	20.22	139.00	286	HORI

Table 5 - Radiated Emissions Average Detector Measurements, 1-5GHz, Transmit Mode

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
1302.00	50.83	53.90	3.07	163.00	253	VERT
2169.50	51.38	53.90	2.52	130.00	277	VERT
2603.52	47.64	53.90	6.26	382.00	184	VERT
3037.50	53.39	60.80*	7.41	99.00	321	HORI
3905.50	49.69	53.90	3.21	139.00	286	HORI

*Limit from FCC Part 15.231(a) for spurious emissions. All other limits are general limits from FCC Part 15.209

Table 6 - Radiated Emissions Peak Detector Measurements, 1-5GHz, Receive Mode

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2910.50	53.18	73.90	20.72	149	136	VERT
2945.00	53.03	73.90	20.87	349	140	VERT
2958.50	53.50	73.90	20.40	115	360	VERT
2982.50	53.23	73.90	20.67	288	137	VERT
2989.00	53.65	73.90	20.25	322	306	HORI

Table 7 - Radiated Emissions Average Detector Measurements, 1-5GHz, Receive Mode

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2910.50	39.73	53.90	14.17	149	136	VERT
2945.00	39.82	53.90	14.08	349	140	VERT
2958.50	39.75	53.90	14.15	115	360	VERT
2982.50	39.29	53.90	14.61	288	137	VERT
2989.00	39.84	53.90	14.06	322	306	HORI

Limits are from FCC Part 15.209. All emissions above 1GHz are compliant with these general limits.

4.3 15.231, Bandwidth

4.3.1 Limits of bandwidth measurements

FCC Part 15.231 (c):
The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

4.3.2 Test procedures

The EUT was tested in the same method as described in section *4.2 - Radiated emissions*. The EUT was oriented as to produce the maximum emission levels. The resolution bandwidth was set to 100kHz.

4.3.3 Deviations from test standard

No deviation.

4.3.4 Test setup

Bandwidth was made as a radiated measurement as specified in Section 4.3.4. Screen capture was taken at angle/pol/height of maximum emission.

4.3.5 EUT operating conditions

The EUT was operating off of the 5VDC power supply.

4.4.6 Test results

EUT	FloodBug	DATE	21 April 2010
MODE	Cont. Transmit	INPUT POWER (SYSTEM)	5VDC
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Bandwidth

CHANNEL	Bandwidth (kHz)	Limit (Max, kHz)
1	334.67	1084.80

NOTE:
The plot does not include transducer factor from receiving antenna or cables. Measurement is relative, so they are not necessary.

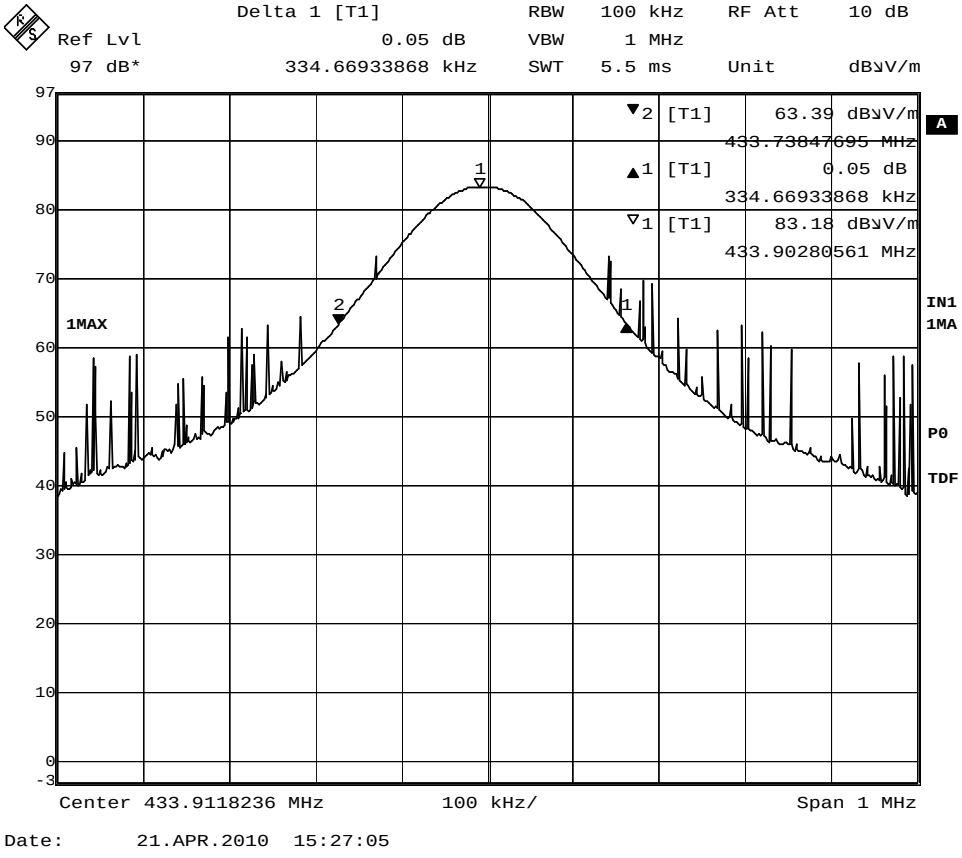


Figure 6 - Bandwidth Measurement

Appendix A: Test Photos

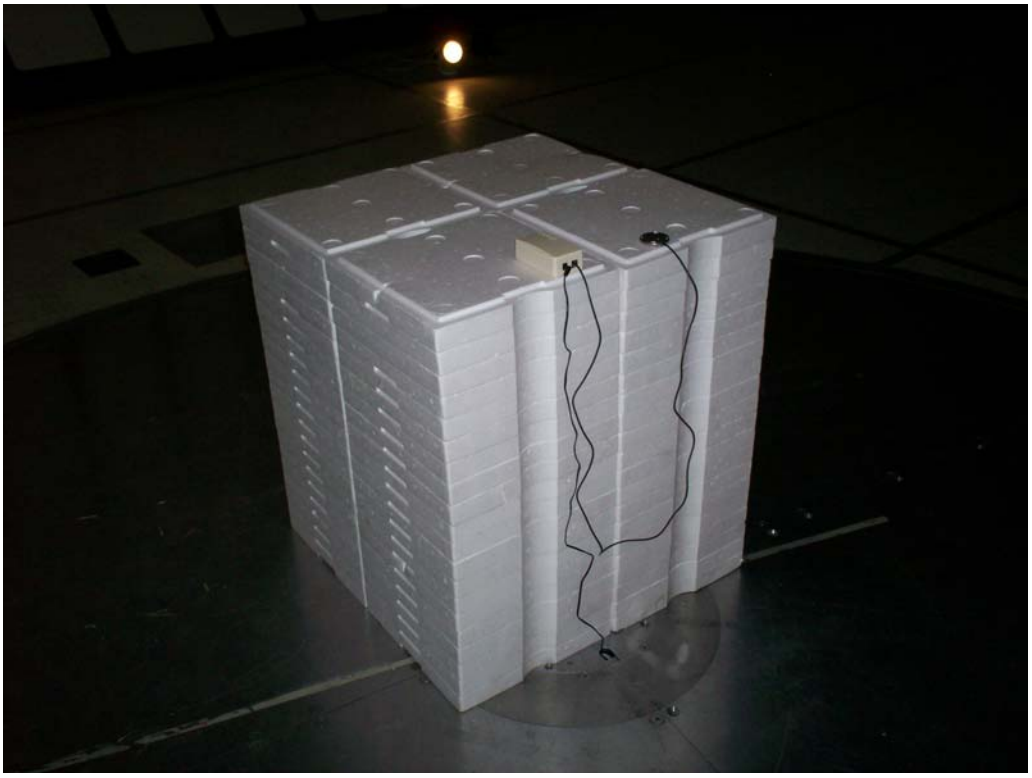


Figure 7 - Radiated Emissions Test Setup

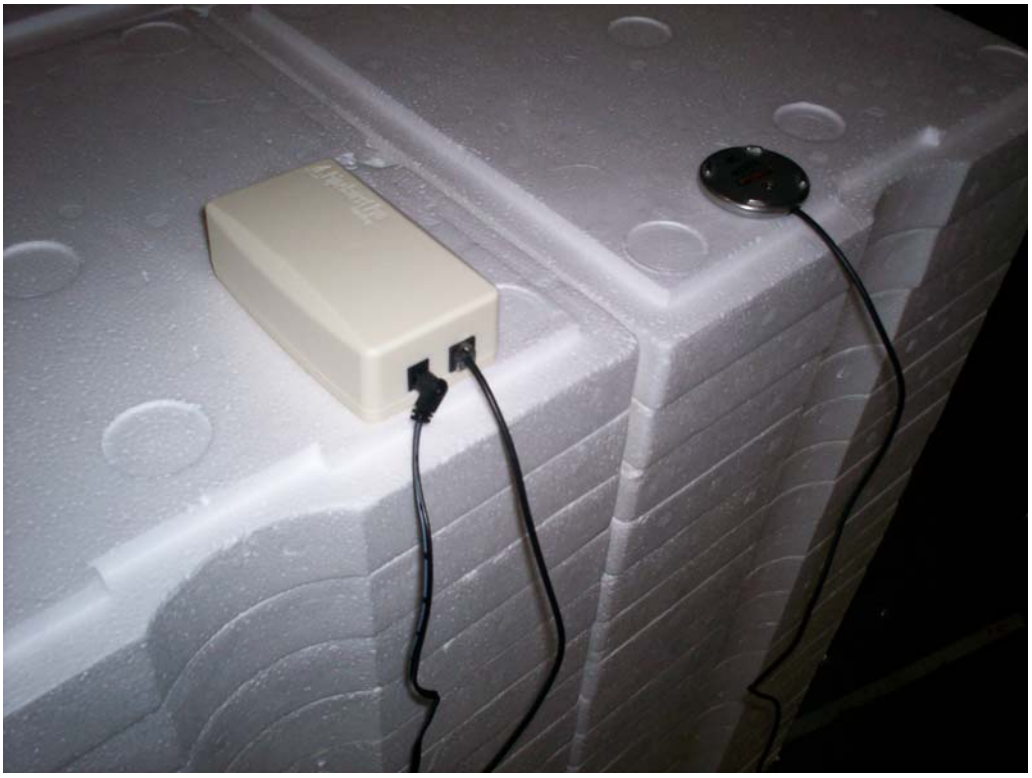


Figure 8 - Radiated Emissions Test Setup

Figure 9 - Conducted Emissions Test Setup

Figure 10 - Conducted Emissions Test Setup

Appendix B: Table of Figures

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