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Test Report

Company:	Greenfield Direct, LLC 14015 238th St. Greenwood, NE 68003
Contact:	Scott Miner
Product:	FloTrax
FCC ID: IC ID:	YBR-FT100 8924A-FT100
Test Report No:	R031510-01-02
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 FloTrax is designed to provide a user friendly way to control various settings within the system which can be operated from a location physical removed from the valves and the VIP. The FloTrax has a custom LCD screen and five momentary buttons which are used to provide the user interface to the system. The FloTrax also has an onboard piezo sounder to provide an audible alarm and also to provide audio feedback for keypad button presses. The FloTrax communicates with the VIP using an onboard TI CC1101 radio transceiver.

The FloTrax can be powered via battery or from an external 5 VDC 1A wall cube power supply. The power is switched between battery and the external supply using the FET battery switch. This enables the internal batteries in the FloTrax to be used as a backup of the external supply. 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

MODEL	FloTrax
POWER SUPPLY	2 AA Batteries/5VDC power supply
MODULATION TYPE	FSK
FREQUENCY RANGE	433.92MHz
NUMBER OF CHANNELS	1
MAXIMUM OUTPUT POWER	78.04dBµV/m at 3m (peak)
ANTENNA TYPE	Internal dipole
I/O PORTS	None
ASSOCIATED DEVICES	FloodBug, 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

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 also included a fourth mode of operation, in which it ran in its normal operating condition, waiting to receive data. It was not possible to complete testing while transmitting data because of the short duration of transmission for each data packet. Average measurements therefore required measurement of the continuous carrier with an averaging factor applied as seen in 2.6 below. Duty cycle information was provided by the manufacturer. The EUT is supplied with a 5VDC Tech Power Int. power supply, M/N TSA9-050120WU.

2.6 Duty Cycle Calculation

The FloTrax is designed to have a very low transmitter duty cycle. The only regular (sent every six hours) transmission the FloTrax makes is two short (85 millisecond) transmissions of the same packet to test system integrity. This packet contains the ID (serial number) of the FloTrax. The following is a screen shot which shows this transmission.

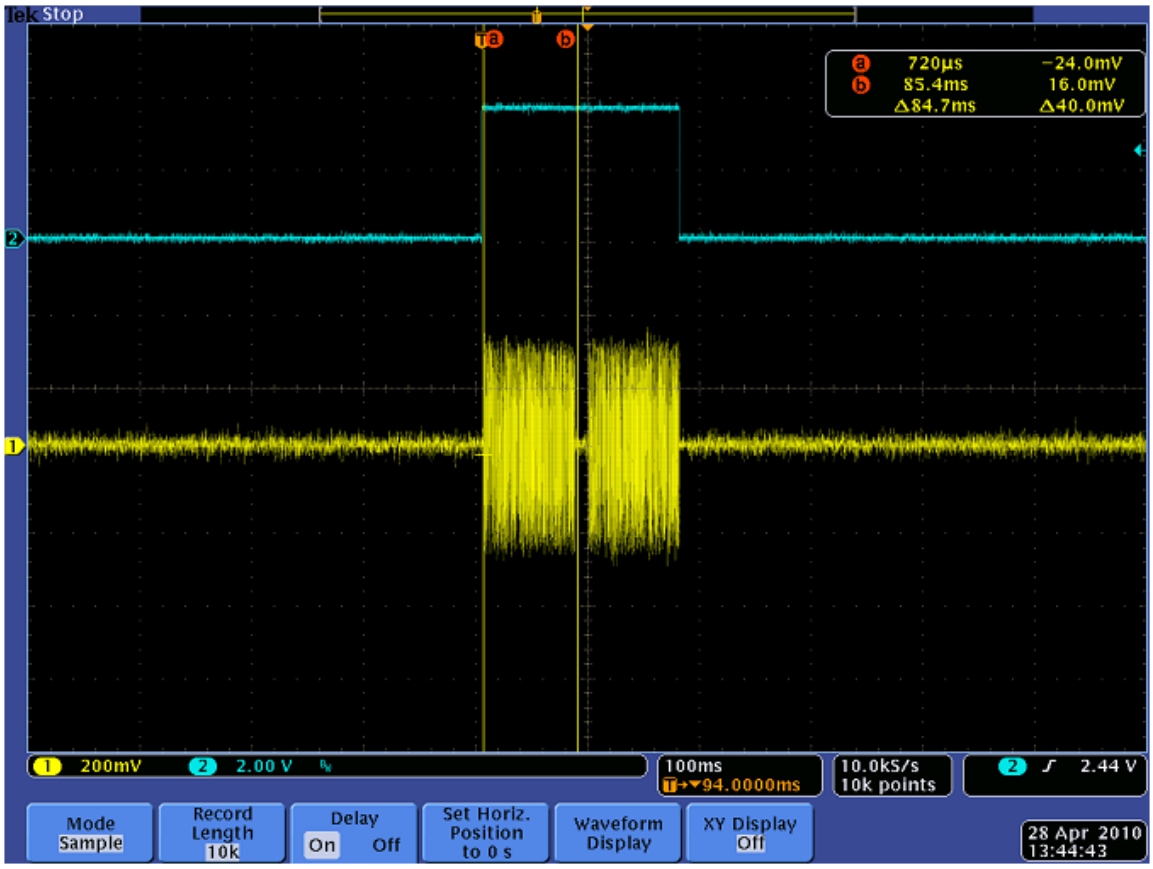


Figure 1 - RF Transmission Time

This transmission is acknowledged by the VIP assembly with a group of three identical short transmissions. The FloTrax also sends the VIP changes to setup information. These transmissions are initiated by to keypad input by the consumer. The only time a transmission of this type will occur is when the consumer has completed a change to a system setting which will be infrequent. The ID (serial number) of the FloTrax is sent with all transmissions and the length of each transmission is less than 100 milliseconds. Time between transmissions depends upon the consumer input but it would be impractical for these changes to occur more frequent than once every 10 seconds. There is no facility in the user interface that would allow the FloTrax to send a continuous transmission. An example of this is when the consumer initiates a water shutoff using the keypad input. The FloTrax will send two short bursts (less than 100 milliseconds each) which are encoded with the ID (serial number) and the command to close the valve. The following screen shot shows this type of transmission.

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.

4.3.3 Deviation from the test standard

No deviation

4.7.4 Test setup

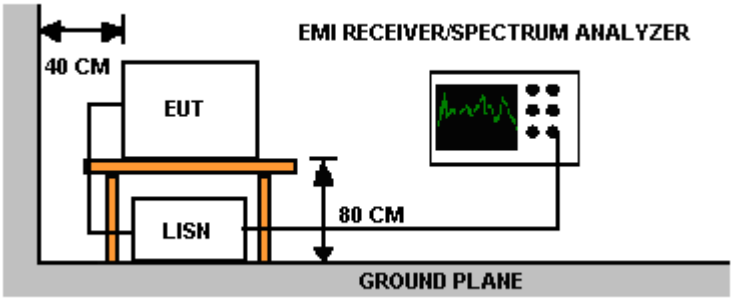


Figure 2 - Conducted Emissions Test Setup

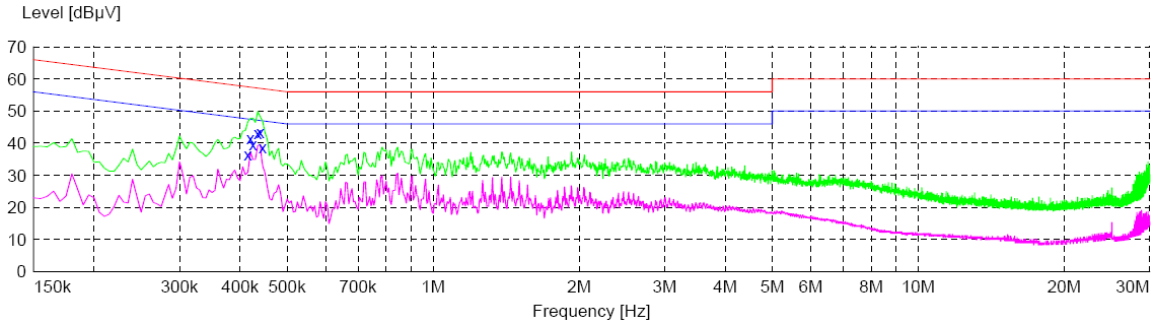
For actual test configuration, see photographs in Appendix A

4.3.5 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.

4.3.6 Test Results

EUT	FloTrax	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

Compared to Average Limit

Frequency	Level	Limit	Margin	Line	PE
MHz	dBµV/m	dBµV/m	dB		
0.42	36.50	47.55	11.05	N	FLO
0.42	41.70	47.45	5.75	N	FLO
0.43	39.60	47.35	7.75	N	GND
0.44	43.20	47.16	3.96	N	FLO
0.44	43.30	47.06	3.76	N	GND
0.45	38.60	46.97	8.37	N	FLO

4.3 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

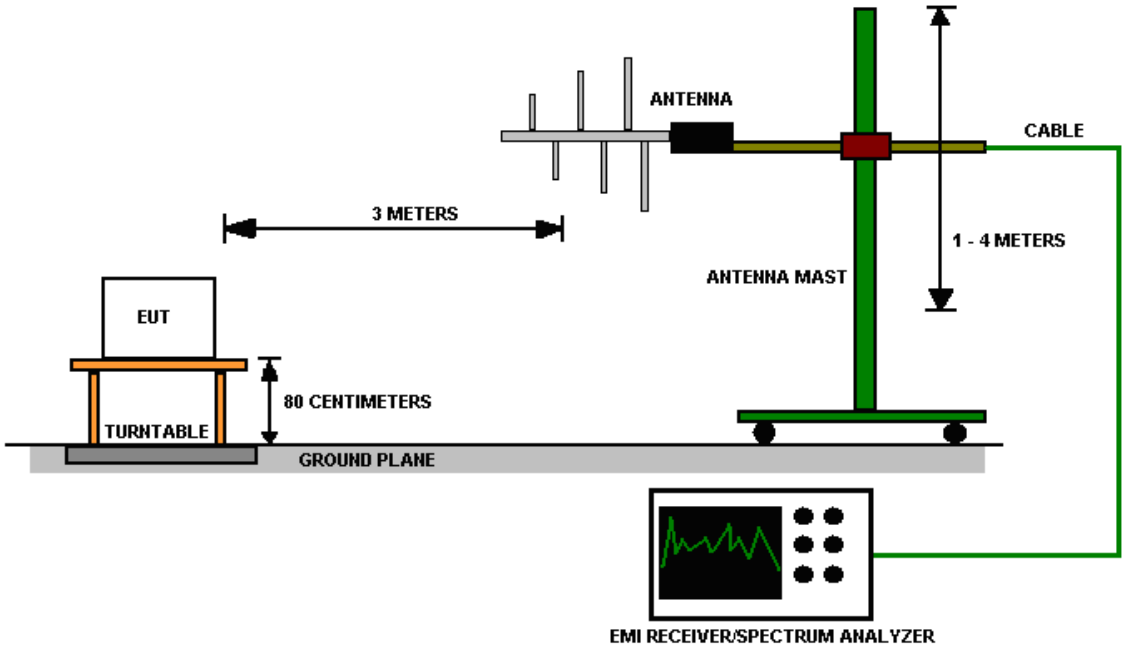


Figure 3 - Radiated Emissions Test Setup

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	FloTrax	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			
75.00	34.14	40.00	5.90	97	132	VERT
99.96	34.55	44.00	9.50	101	321	VERT
124.98	24.24	44.00	19.80	98	346	VERT
199.98	34.03	44.00	10.00	143	127	VERT
274.98	34.90	46.00	11.10	97	83	HORI
432.90	35.14	46.00	10.90	102	88	VERT
433.92	78.40*	80.84**	NA	107	63	VERT
867.84	35.87	46.00	10.10	99	107	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, Transmit Mode

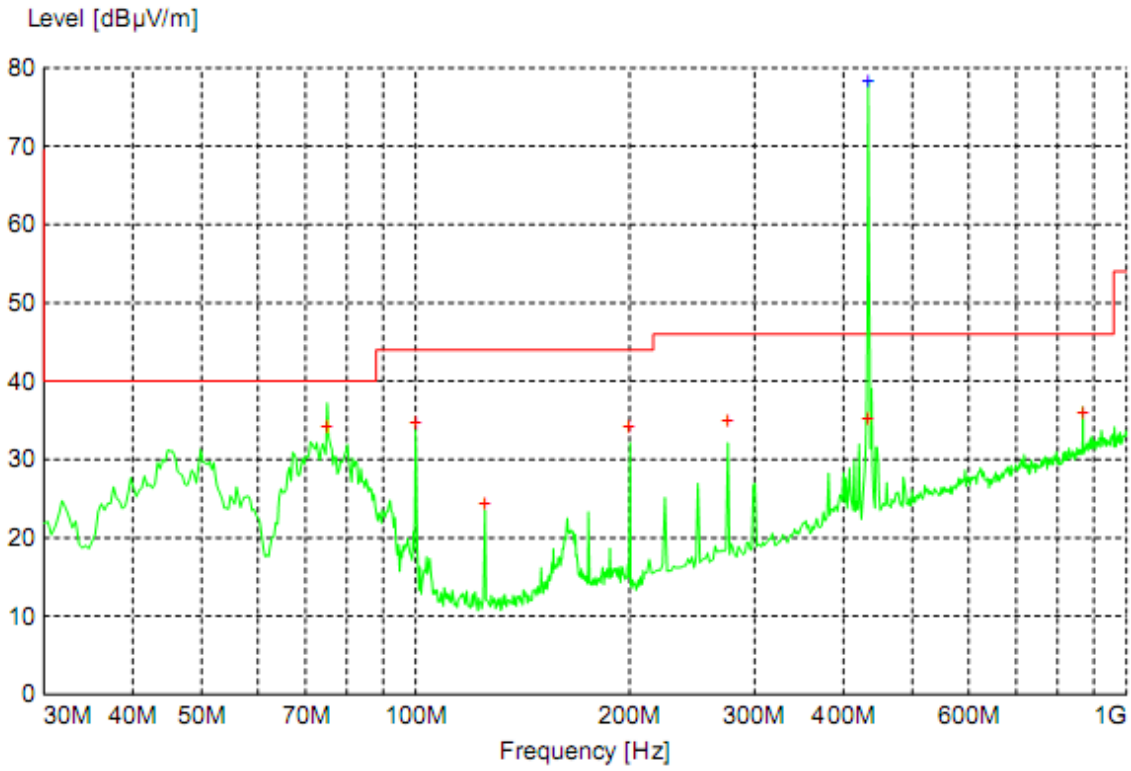


Table 3 - Radiated Emissions Quasi-peak Data, 30MHz - 1GHz, Receive Mode

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB			
42.54	20.14	40.00	19.90	394	209	VERT
45.12	20.07	40.00	19.90	395	151	VERT
85.08	24.85	40.00	15.10	110	45	VERT
100.02	40.32	44.00	3.70	100	316	VERT
124.98	25.92	44.00	18.10	106	312	VERT
175.02	28.26	44.00	15.70	201	268	VERT
199.98	39.36	44.00	4.60	143	219	VERT
225.00	38.44	46.00	7.60	143	161	VERT
250.02	29.98	46.00	16.00	103	209	VERT

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

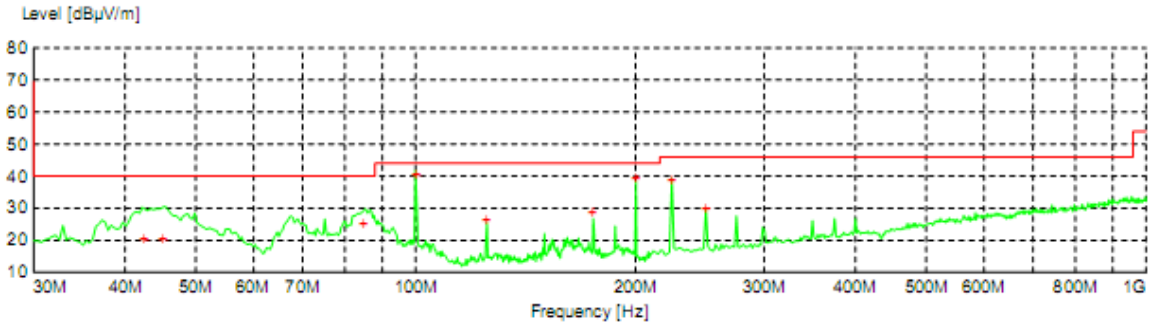


Table 4 - Radiated Emissions Peak Measurements, 1-5GHz, Receive Mode

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB			
2813.50	52.51	73.90	21.39	221	286	HORI
2908.50	52.78	73.90	21.12	335	360	HORI
2931.00	52.93	73.90	20.97	117	243	HORI
2971.50	53.44	73.90	20.46	148	223	VERT
2973.00	53.32	73.90	20.58	370	357	HORI
2980.50	53.08	73.90	20.82	399	253	HORI

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

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB			
2813.50	39.33	53.90	14.57	221	286	HORI
2908.50	39.69	53.90	14.21	335	360	HORI
2931.00	39.80	53.90	14.10	117	243	HORI
2971.50	39.83	53.90	14.07	148	223	VERT
2973.00	39.85	53.90	14.05	370	357	HORI
2980.50	39.75	53.90	14.15	399	253	HORI

Table 6 - Radiated Emissions Average Detector Measurements, 1-5GHz, Transmit Mode

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB			
1302.00	53.60	53.90	0.30	100	39	VERT
2169.50	53.28	60.80*	7.52	127	205	HORI
3037.50	58.39	60.80*	2.41	117	360	HORI
3471.50	58.72	60.80*	2.08	99	39	HORI
3905.50	51.37	53.90	2.53	106	53	HORI

Table 7 - Radiated Emissions Peak Measurements, 1-5GHz, Transmit Mode

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB			
1302.00	54.44	73.90	19.46	100	39	VERT
2169.50	57.26	73.90	16.64	127	205	HORI
3037.50	60.78	73.90	13.12	117	360	HORI
3471.50	60.78	73.90	13.12	99	39	HORI
3905.50	54.22	73.90	19.68	106	53	HORI

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

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

See section 4.2.4

4.3.5 EUT operating conditions

See section 2.5 for details.

4.7.6 Test results

EUT	FloTrax	DATE	21 April 2010
MODE	Cont. Transmit	INPUT POWER (SYSTEM)	3VDC (2 AA Batteries)
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Highest Out of Band Emissions

CHANNEL	Bandwidth (kHz)	Limit (Max, kHz)
1	334.37	1084.80

NOTE:
All values listed include all transducer and cable loss

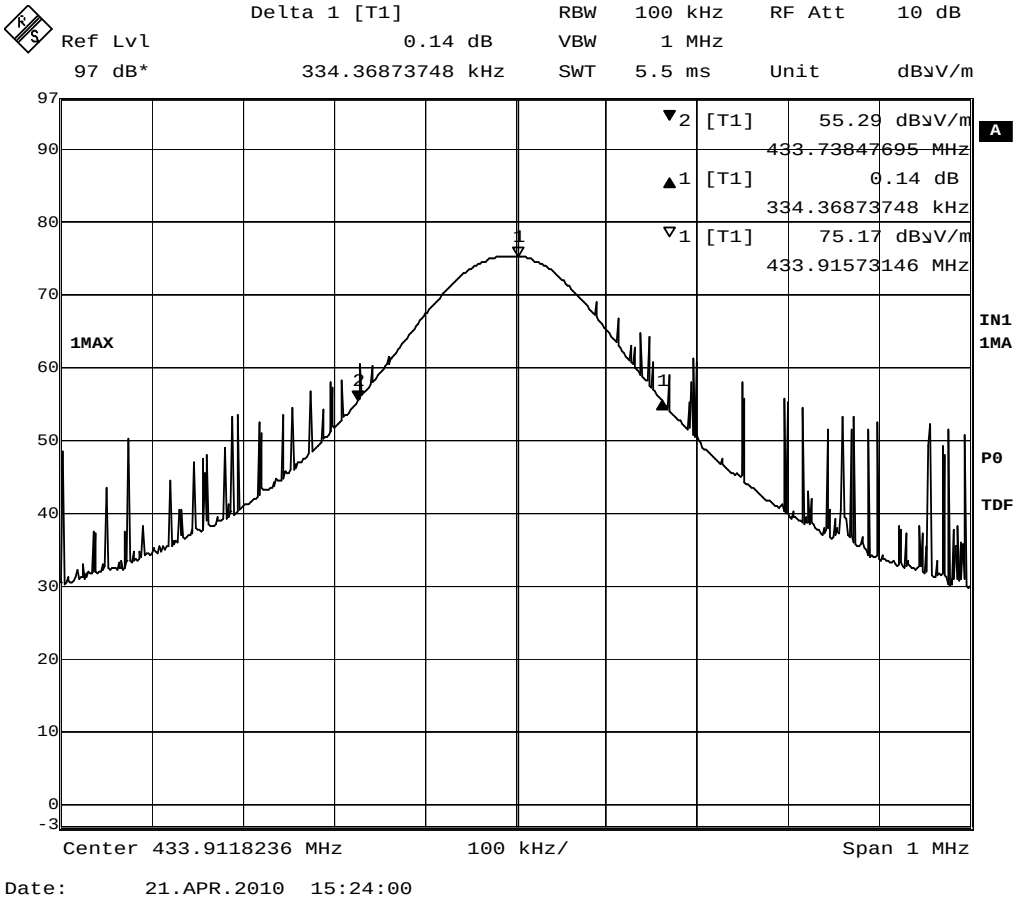


Figure 6 - Bandwidth Measurement

Appendix A: Test Photos

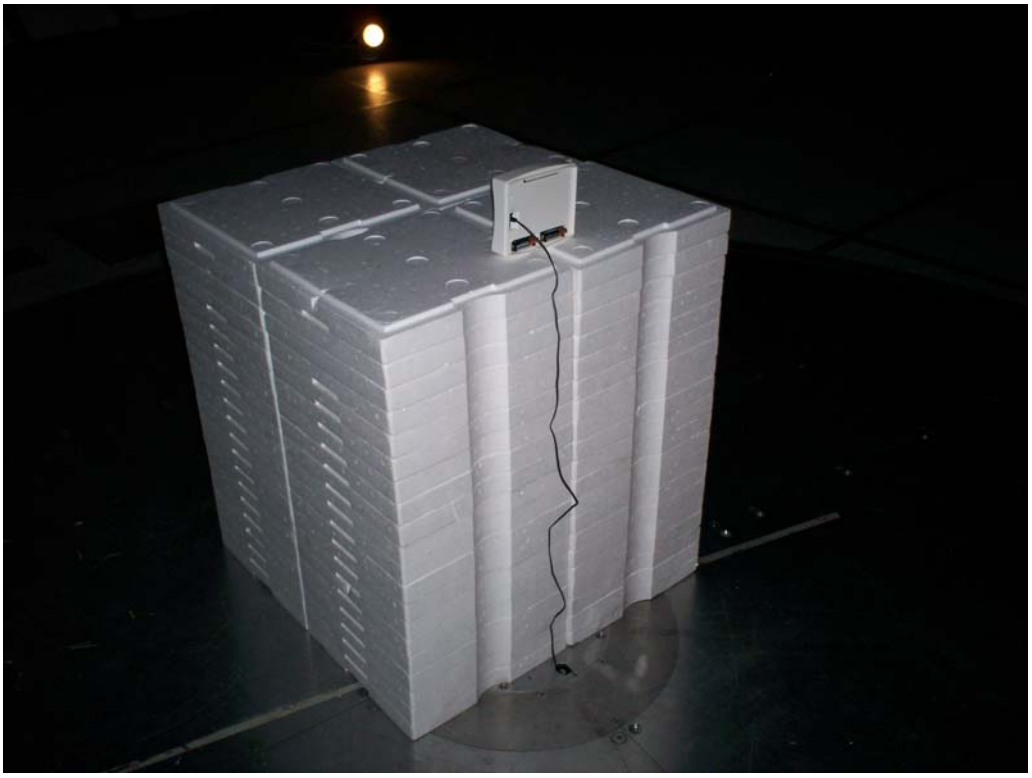


Figure 7 - Radiated Emissions Test Setup

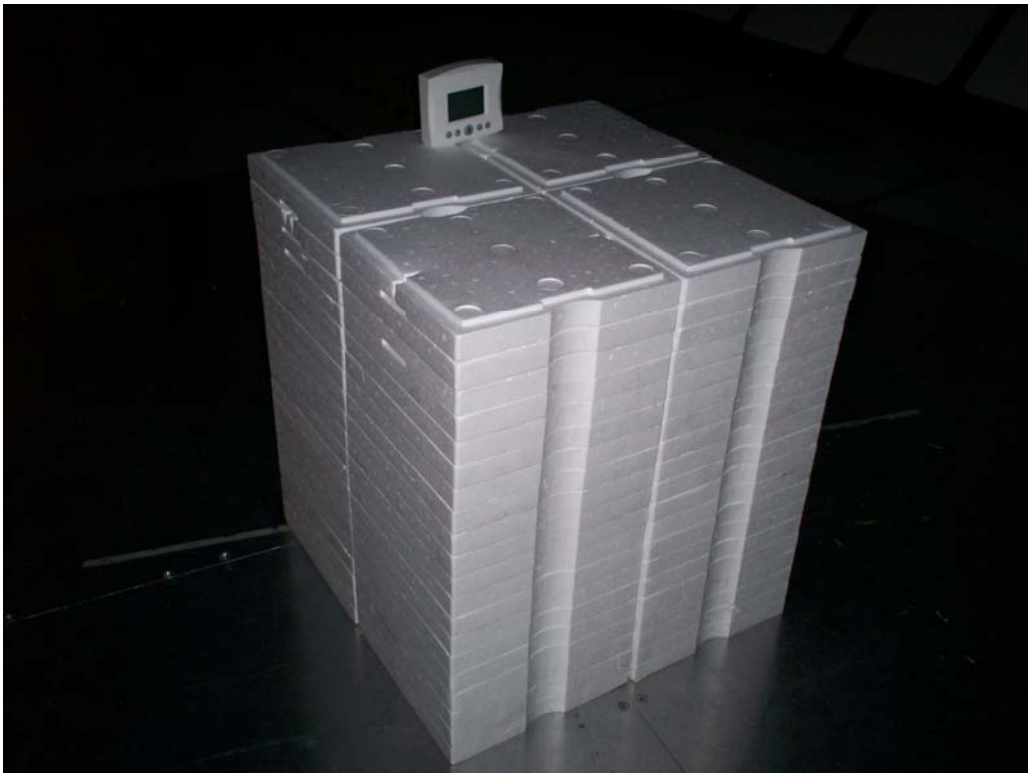


Figure 8 - Radiated Emissions Test Setup

Figure 9 - Conducted Emissions Test Setup

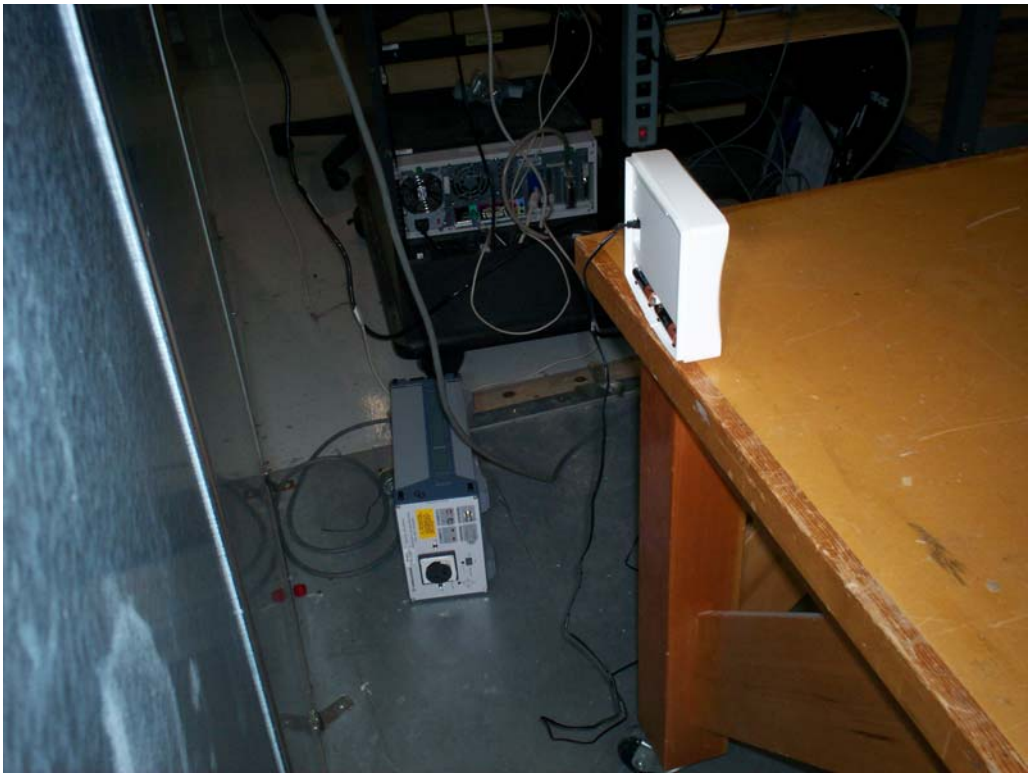


Figure 10 - Conducted Emissions Test Setup

Appendix B: Table of Figures

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