ENGINEERING TEST REPORT

Buffalo Filter Limited Module RFID System
Model No.: BF0001

FCC ID: Y92-BF0001

Applicant:

Buffalo Filter
595 Commerce Drive
Buffalo, NY 14228
USA

In Accordance With

Federal Communications Commission (FCC)
Part 15, Subpart C
Unlicensed Low Power Transmitter Operating in the Band 13.110-14.010 MHz

UltraTech's File No.: BUF-005_F15C225

This Test report is Issued under the Authority of Tri M. Luu, B.A.Sc, Vice President of Engineering UltraTech Group of Labs Date: Mar. 27, 2011	
Report Prepared by: Dharmajit Solanki Issued Date: Mar. 27, 2011	Tested by: Hung Trinh, EMC/RFI Technician Test Dates: Mar. 23-25, 2011

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart C, Sec. 15.225 - Operation within the band 13.110 – 14.010 MHz.
Title:	Title 47, Code of Federal Regulations (CFR), Part 15, Subpart C
Purpose of Test:	To gain FCC Certification Authorization for Section 15.225 - Operation within the Band 13.110 - 14.010 MHz.
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
Environmental Classification:	Residential, commercial, industrial environment

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC 47 CFR 15	2010	Code of Federal Regulations – Telecommunication
ANSI C63.4	2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 KHz to 40 GHz
CISPR 22 EN 55022	2008-09, Edition 6.0 2006	Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement
CISPR 16-1-1 +A1 +A2	2006 2006 2007	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-1-2 +A1 +A2	2003 2004 2006	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-2: Conducted disturbances

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	Buffalo Filter
Address:	595 Commerce Drive Buffalo, NY 14228 USA
Contact Person:	Greg Pepe Phone #: 716-835-7000 x 219 Fax #: 716-225-4021 Email Address: greg.pepe@buffalofilter.com

MANUFACTURER	
Name:	Buffalo Filter
Address:	595 Commerce Drive Buffalo, NY 14228 USA
Contact Person:	Greg Pepe Phone #: 716-835-7000 x 219 Fax #: 716-225-4021 Email Address: greg.pepe@buffalofilter.com

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	Buffalo Filter
Product Name:	Buffalo Filter Limited Module RFID System
Model Name or Number:	BF0001
Serial Number:	Test sample
Type of Equipment:	Low Power Communication Device Transmitter
Input Power Supply Type:	120V 60Hz / 230V 50 Hz

2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Equipment Type:	Fixed based / mobile
Intended Operating Environment:	Commercial, Medical
Power Supply Requirement:	120V 60Hz / 230V 50 Hz
Field Strength:	68.3 dBμV/m at 10 m
Operating Frequency Range:	13.56 MHz
RF Output Impedance:	50 Ω
20 dB Bandwidth:	1.83 kHz
Modulation Type:	Manchester encoded, A = fc ± 423.75KHz, B= fc ± 484.29 KHz Low bit: Transition A to B High bit: Transition B to A
Oscillator Frequencies:	Manufacturer: Buffalo Filter Type: Loop Antenna Model: 901288 "RFID Antenna 49" Frequency Range: 13.56MHz
Antenna Connector Type:	2 pin header

2.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	COM	1	RJ-11	Non-shielded
2	COM	1	RJ-45	Non-shielded

2.5. ANCILLARY EQUIPMENT

The equipment under tests contains no ancillary devices

2.6. GENERAL TEST SETUP BLOCK DIAGRAM

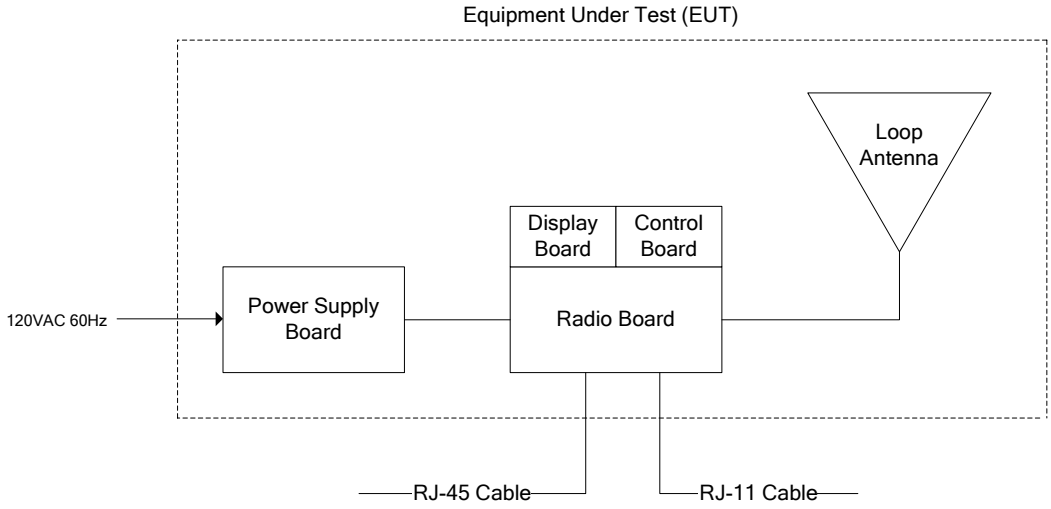


EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power input source:	120 V, 60 Hz

3.2. OPEPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	The EUT was configured for continuous transmission for the duration of testing.
Special Test Software:	N/A
Special Hardware Used:	N/A
Transmitter Test Antenna:	The EUT was tested with the antenna fitted in a manner typical of normal intended use as external antenna equipment.

Transmitter Test Signals:	
Frequency:	13.56 MHz
Transmitter Wanted Output Test Signals:	
▪ RF Power Output (measured maximum output power):	68.3 dBµV/m at 10 m
▪ Normal Test Modulation:	ASK
▪ Modulating signal source:	Internal

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).
- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 91038) and Industry Canada office (Industry Canada File No.: 2049A-3). Expiry Date: 2011-05-01.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Regulations	Test Requirements	Compliance (Yes/No)
15.203 & 15.204	The transmitter shall use a transmitting antenna that is an integral part of the device	Yes
15.215	20 dB & 99% Bandwidth	Yes
15.225(a) – (d), 15.209 & 15.109	Field Strength of Emissions Inside and Outside the Permitted Band 13.110 - 14.010 MHz & Unintentional radiator	Yes
15.225(e)	Frequency Stability	Yes
15.107 & 15.207	Class B - Power Line Conducted Emissions	Yes

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

The antenna cable was looped around a ferrite, Steward P/N #: 28A2029-0A2, for at least 2 turns.

EXHIBIT 5. TEST MEASUREMENT DATA

5.1. COMPLIANCE WITH FCC PART 15 – GENERAL TECHNICAL REQUIREMENTS

FCC Section	FCC Rules	
15.203	Described how the EUT complies with the requirement that either its antenna is permanently attached, or that it employs a unique antenna connector, for every antenna proposed for use with the EUT. The exception is in those cases where EUT must be professionally installed. In order to demonstrate that professional installation is required, the following 3 points must be addressed: • The application (or intended use) of the EUT • The installation requirements of the EUT • The method by which the EUT will be marketed	OEM installation only. The connector shall be within the enclosure of the Grantee final products.
15.204(c)	Provided the information for every antenna proposed for use with the EUT: (a) type (e.g. Yagi, patch, grid, dish, etc…), (b) manufacturer and model number (c) gain with reference to an isotropic radiator	Buffalo Filter custom loop antenna Model: 901288 “RFID Antenna 49” for OEM installation only.

5.2. OCCUPIED BANDWIDTH

5.2.1. Limits

The 20 dB bandwidth of the emission shall be contained within the band 13.110–14.010 MHz.

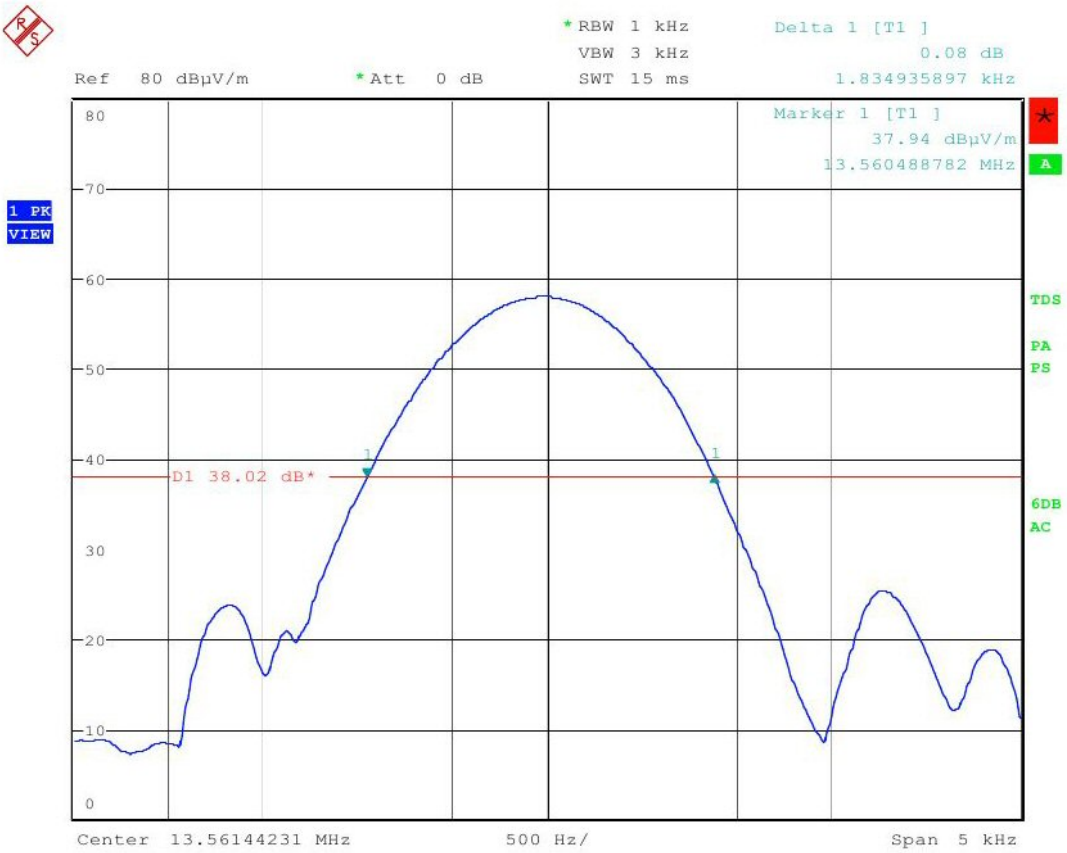
5.2.2. Method of Measurements

Refer to Ultratech Test Procedures, File # ULTR P001-2004 and ANSI C63.4 for measurement methods

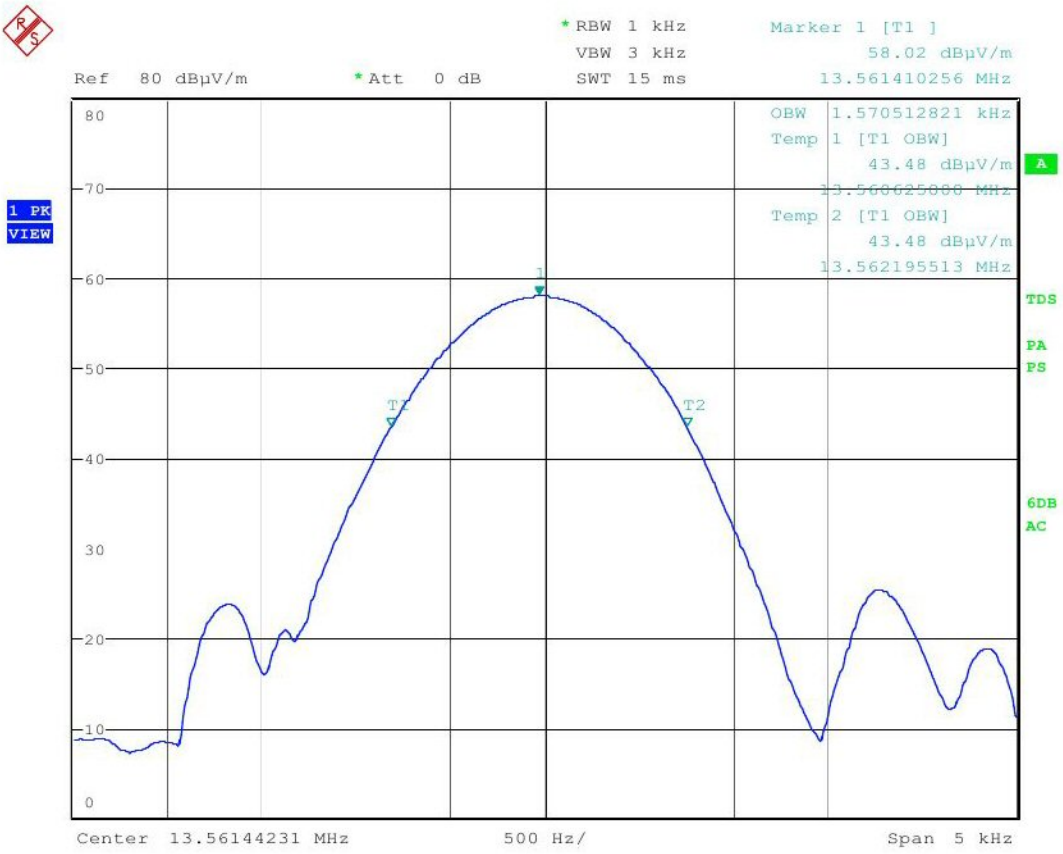
5.2.3. Test Data

Test Frequency (MHz)	Occupied Bandwidth (kHz)	
	20 dB BW	99 % BW
13.56	1.83	1.57

Plot #1: 20 dB Occupied Bandwidth - Test Frequency: 13.56 MHz



Plot #2: 99% Occupied Bandwidth - Test Frequency: 13.56 MHz



5.3. FIELD STRENGTH OF EMISSIONS INSIDE & OUTSIDE THE PERMITTED BAND 13.110-14.010 MHz [47 CFR 15.225 (a) to (d)] & 15.109, 15.209

5.3.1. Limits

(a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
(b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
(c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.
(d) The field strength of any emissions appearing outside of the 13.110 – 14.010 MHz band shall not exceed the general radiated emission limits in § 15.209.

47 CFR 15.209(a) – Radiated Emission Limts; general requirements

Frequency (MHz)	Field Strength Limits (microvolts/m)	Distance (Meters)
0.009 - 0.490	2,400 / F (KHz)	300
0.490 - 1.705	24,000 / F (KHz)	30
1.705 - 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

5.3.2. Method of Measurements

Refer to Ultratech Test Procedures, File # ULTR P001-2004 and ANSI C63.4 for measurement methods

Applies to harmonics/spurious that fall in the restricted bands listed in Section 15.205. the maximum permitted average field strength is listed in Section 15.209. A Pre-Amp and high-pass filter are used for this measurement.

- For measurements from 9 KHz to 150 KHz, set RBW = 200 Hz, VBW ≥ RBW, SWEEP=AUTO.
- For measurements from 150 KHz to 30 MHz, set RBW = 10 KHz, VBW ≥ RBW, SWEEP=AUTO.
- For measurements from 30 MHz to 1 GHz, set RBW = 100 KHz, VBW ≥ RBW, SWEEP=AUTO.
- For measurement above 1 GHz, set RBW = 1 MHz, VBW = 1 MHz, SWEEP=AUTO.

If the emission is pulsed, modified the unit for continuous operation, then use the settings above for measurements, then correct the reading by subtracting the peak-average correction factor derived from the appropriate duty cycle calculation. See Section 15.35(b) and (c).

5.3.3. Test Data

Remarks:

- For frequencies below 30 MHz, radiated spurious emissions measurements were performed at 10 m distance. The results at 10 meters can be extrapolated to 30 meters using a factor of 40 dB/decade.

5.3.3.1. Field Strength of Emissions Inside the Permitted Band

Frequency (MHz)	Measured Field Strength @ 10 m (dBµV/m)	Detector Used (Peak/QP)	Antenna Plane (H/V)	Field Strength Extrapolated Value @ 30m (dBµV/m)	§ 15.225 Field Strength Limits @ 30m	Margin (dB)
13.56	67.4	Peak	V	47.4	84.0	-36.6
13.56	68.3	Peak	H	48.3	84.0	-35.7

5.3.3.2. Field Strength of Emissions Outside the Permitted Band

FREQUENCY (MHz)	RF LEVEL @ 3m (dBµV/m)	DETECTOR USED (PEAK/QP)	ANTENNA PLANE (H/V)	LIMIT @ 3m (dBµV/m)	MARGIN (dB)	PASS/ FAIL
40.68	22.8	QP	V	40.0	-17.2	PASS
40.68	12.8	QP	H	40.0	-27.2	PASS
54.24	33.4	QP	V	40.0	-6.6	PASS
54.24	19.8	PEAK	H	40.0	-20.2	PASS
67.8	23.3	QP	V	40.0	-16.7	PASS
67.8	18.68	PEAK	H	40.0	-21.3	PASS
81.36	21.4	QP	V	40.0	-18.6	PASS
81.36	17.29	PEAK	H	40.0	-22.7	PASS
94.92	33.1	QP	V	43.5	-10.4	PASS
94.92	24.09	PEAK	H	43.5	-19.4	PASS
108.48	34.7	QP	V	43.5	-8.8	PASS
108.48	30.2	PEAK	H	43.5	-13.3	PASS
122.04	33.6	QP	V	43.5	-9.9	PASS
122.04	22.3	PEAK	H	43.5	-21.2	PASS
135.6	39.8	QP	V	43.5	-3.7	PASS
135.6	27.7	QP	H	43.5	-15.8	PASS
162.74	31.6	QP	V	43.5	-11.9	PASS
162.74	31.22	PEAK	H	43.5	-12.3	PASS
176.2	32.5	PEAK	V	43.5	-11.0	PASS
176.2	34.27	PEAK	H	43.5	-9.2	PASS

Continued ….

FREQUENCY (MHz)	RF LEVEL @ 3m (dBµV/m)	DETECTOR USED (PEAK/QP)	ANTENNA PLANE (H/V)	LIMIT @ 3m (dBµV/m)	MARGIN (dB)	PASS/ FAIL
189.90	34.32	PEAK	V	43.5	-9.2	PASS
189.90	32.56	PEAK	H	43.5	-10.9	PASS
203.36	31.27	PEAK	V	43.5	-12.2	PASS
203.36	33.58	PEAK	H	43.5	-9.9	PASS
217.06	30.36	PEAK	V	46.0	-15.6	PASS
217.06	30.09	PEAK	H	46.0	-15.9	PASS
230.52	27.96	PEAK	V	46.0	-18.0	PASS
230.52	32.44	PEAK	H	46.0	-13.6	PASS
244.23	32.11	PEAK	V	46.0	-13.9	PASS
244.23	40.69	PEAK	H	46.0	-5.3	PASS
257.69	33.47	PEAK	V	46.0	-12.5	PASS
257.69	35.47	PEAK	H	46.0	-10.5	PASS
271.39	31.61	PEAK	V	46.0	-14.4	PASS
271.39	33.44	PEAK	H	46.0	-12.6	PASS
298.55	31.26	PEAK	V	46.0	-14.7	PASS
298.55	34.34	PEAK	H	46.0	-11.7	PASS
325.32	30.65	PEAK	V	46.0	-15.4	PASS
325.32	30.98	PEAK	H	46.0	-15.0	PASS
447.75	32.37	PEAK	V	46.0	-13.6	PASS
447.75	36.78	PEAK	H	46.0	-9.2	PASS
475.00	34.33	PEAK	V	46.0	-11.7	PASS
475.00	32.71	PEAK	H	46.0	-13.3	PASS
488.46	33.93	PEAK	V	46.0	-12.1	PASS
488.46	32.91	PEAK	H	46.0	-13.1	PASS

- The spurious radiated emissions were scanned from 30 MHz – 6 GHz at 3 m distance
- All spurious emissions that are in excess of 20 dB below the specified limit shall be recorded.

5.4. FREQUENCY STABILITY [47 CFR 15.225(e)]

5.4.1. Limits

The frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

5.4.2. Method of Measurements

Refer to Ultratech Test Procedures, File # ULTR P001-2004.

5.4.3. Test Data

Remark: Test will be performed to equipment operating characteristics, with the operating temperature range of +10°C to +40°C.

Manufacturer's Specification:	+10**°C** to +40**°C**
Frequency Band:	13.56 MHz
Center Frequency:	13.56 MHz
Frequency Tolerance Limit:	± 0.01% (±1356 Hz)
Max. Frequency Tolerance Measured:	+80 Hz
Input Voltage Rating:	120 Vdc

Ambient Temperature (°C)	Frequency Drift (Hz)		
	Supply Voltage (Nominal) 120 Vac	Supply Voltage (85 % of Nominal) 102 Vac	Supply Voltage (115% of Nominal) 138 Vac
-20	N/A	N/A	N/A
-10	N/A	N/A	N/A
0	N/A	N/A	N/A
+10	+80	N/A	N/A
+20	0	-24	-12
+30	+80	N/A	N/A
+40	+80	N/A	N/A
+50	N/A	N/A	N/A

5.5. POWERLINE CONDUCTED EMISSIONS [47 CFR 15.107(a) & 15.207]

5.5.1. Limits

The equipment shall meet the limits of the following table:

Test Frequency Range (MHz)	Class B Limits (dBμV)		Measuring Bandwidth
	Quasi-Peak	Average	
0.15 to 0.5	66 to 56*	56 to 46*	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average
0.5 to 5	56	46	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average
5 to 30	60	50	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average

* Decreasing linearly with logarithm of frequency

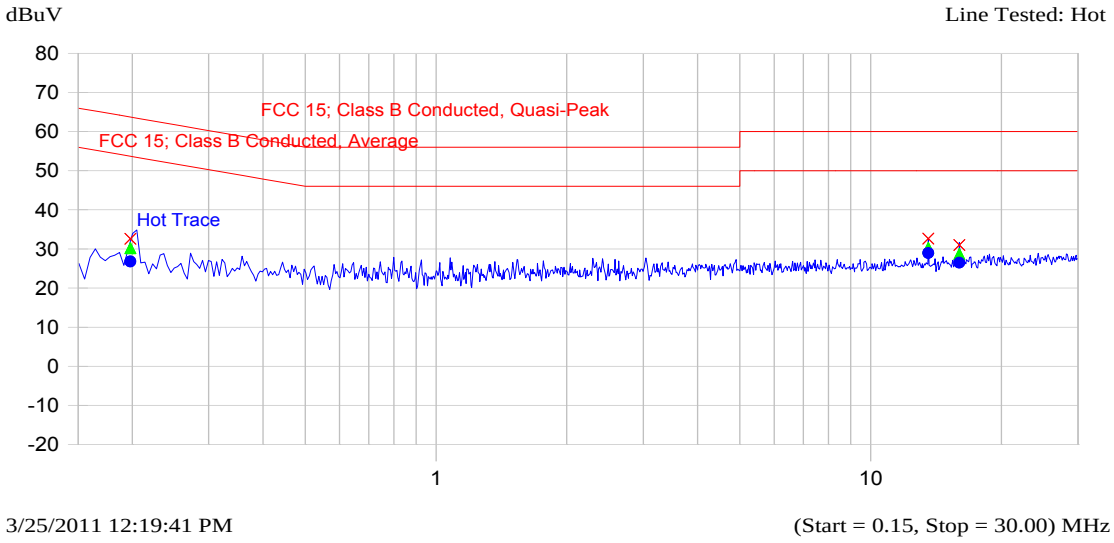
5.5.2. Method of Measurements

Refer to Ultratech Test Procedures, File # ULTR P001-2004 and ANSI C63.4 for measurement methods

5.5.3. Test Data

Plot # 3: Power Line Conducted Emission – Line tested: Hot

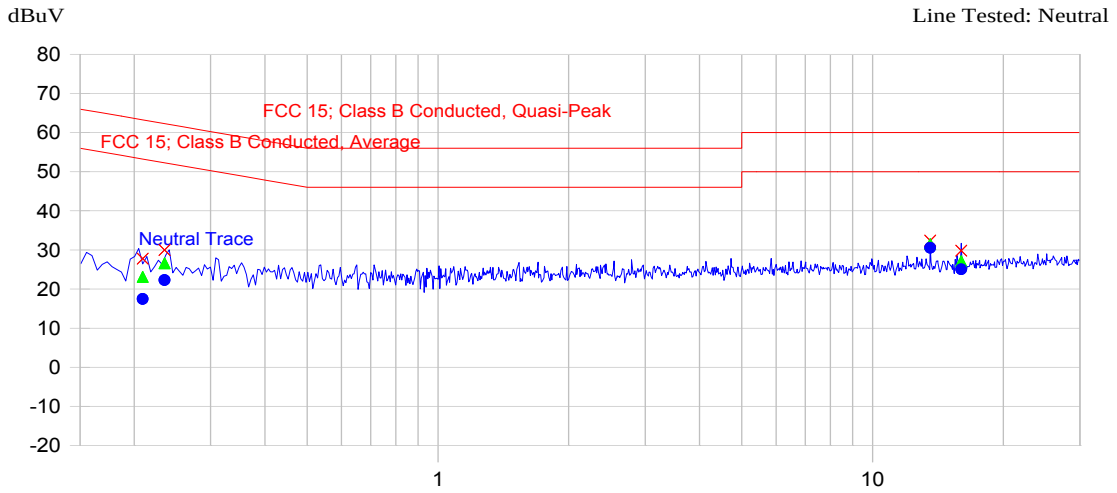
Description: Line Voltage 120 VAC
Setup Name: FCC 15 Class B
Customer Name: Buffalo Filter
Project Number: BUF-005Q
Operator Name: Hung
EUT Name: 13.56 MHz Modular
Date Created: 3/25/2011 12:13:07 PM
Date Modified: 3/25/2011 12:24:56 PM



Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.198	32.6	30.2	-34.4	26.8	-27.8	Hot Trace
13.562	32.6	30.2	-29.8	28.9	-21.1	Hot Trace
15.998	31.0	28.7	-31.3	26.5	-23.5	Hot Trace

Plot # 4: Power Line Conducted Emission – Line tested: Neutral

Description: Line Voltage 120 VAC
Setup Name: FCC 15 Class B
Customer Name: Buffalo Filter
Project Number: BUF-005Q
Operator Name: Hung
EUT Name: 13.56 MHz Modular
Date Created: 3/25/2011 12:13:07 PM
Date Modified: 3/25/2011 12:34:29 PM



Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.209	27.7	23.1	-41.2	17.4	-36.8	Neutral Trace
0.235	29.9	26.6	-37.0	22.3	-31.2	Neutral Trace
13.562	32.4	31.5	-28.5	30.5	-19.5	Neutral Trace
15.997	29.8	27.1	-32.9	25.1	-24.9	Neutral Trace

EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Operating Range	Calibration Due
EMI Receiver System	Agilent	E7401A	US40240432	9 KHz-1.5 GHz, 50 Ohms	10 Jan 2012
Transient Limiter	Pasternack	PE7010-20	--	DC – 2 GHz 20 dB attenuation	18 Jan 2012
L.I.S.N.	EMCO	3810/2	2209	9 kHz – 30 MHz 50 Ohms / 50 μH	25 Aug 2011
24'x16'x8' RF Shielded Chamber	RF Shielding	…	..	…	
Semi-Anechoic Chamber	TDK	FCC: 91038 IC: 2049A-3	--	--	01 May 2011
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20 Hz – 40 GHz	14 Aug 2011
Spectrum Analyzer	Rohde & Schwarz	ESU40	100037	20 Hz – 40 GHz	15 Mar 2012
RF Amplifier	Hewlett Packard	84498	3008A00769	1 – 26.5 GHz	17 Feb 2012
RF Amplifier	AH System	PAM-0118	225	20 MHz – 18 GHz	15 Mar 2012
Environmental Chamber	Envirotronics	SSH32C	11994847-S-11059	-60 to 177 degree C	06 Aug 2011
Loop Antenna	Emco	6502	2611	10 kHz – 30 MHz	08 Aug 2011
Horn Antenna	Emco	3155	5061	1 – 18 GHz	28 Nov 2011
Horn Antenna	Emco	3155	5955	1 – 18 GHz	09 Jan 2012
Biconi-Log Antenna	Emco	3142C	00026873	26 – 3000 MHz	18 Apr 2011
Dipole Antenna	Emco	3121C	434	26 – 1000 MHz	16 Aug 2011
Signal Generator	Hewlett Packard	83752B	3610A00457	0.01 – 20 GHz	19 Oct 2011
True RMS DMM	Greenlee Test Instruments	DM-820	004441758	50.00, 500.0mV; 5.000, 50.00, 500.0, 1000V	13 Sep 2011
Environmental Chamber	Envirotronics	SSH32C	11994847-S-11059	-60 to 177 degree C	06 Aug 2011
Multi-meter	Fluke	8842A	5436283	20mV, 200mV, 2V, 20V, 200V, 1000V	20 Aug 2011
Variable Voltage Transformer	Staco Energy Products	3PN501B	-	0 – 140Vac	Cal. on use
Variable Voltage Transformer	Powerstat The Superior Electric Co.	-	-	0 – 260Vac	Cal. on use

EXHIBIT 7. MEASUREMENT UNCERTAINTY

7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY (0.15-30 MHz)

	Line Conducted Emission Measurement Uncertainty (150 KHz – 30 MHz):	Measured	Limit
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)}$	**± 1.57**	**± 1.8**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 3.14**	**± 3.6**

7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

	Radiated Emission Measurement Uncertainty @ 3m, Horizontal (30-1000 MHz):	Measured	Limit
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)}$	**± 2.15**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.30**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3m, Vertical (30-1000 MHz):	Measured	Limit
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)}$	**± 2.39**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.78**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3 m, Horizontal & Vertical (1 – 18 GHz):	Measured	Limit
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)}$	**± 1.87**	Under consideration
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 3.75**	Under consideration