Testing Tomorrow's Technology

Application for

US Code Title 47, Part 2, Subpart J, Section 2.947, Certification
Per
Part 15, Subpart C, for Intentional Radiators, Section 15.249, Intentional Radiator Operating within the Band 902 MHz to 928 MHz

And

US Code Title 47, Part 2, Subpart J, Section 2.902, Verification
Per
Part 15, Subpart B, for Unintentional Radiators, section 15.101, 15.107 and 15.109

For the

Model: Flex SI

Manufactured by

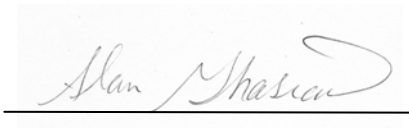
Numerex

UST Project: 11-0278
Test Date(s): December 19, 2011
Issue Date: January 10, 2012

3505 Francis Circle Alpharetta, GA 30004
PH: 770-740-0717 Fax: 770-740-1508
www.ustech-lab.com

I certify that I am authorized to sign for the test facility and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: 

Name: Alan Ghasiani

Title: Consulting Engineer - President

Date: January 10, 2012

NVLAP LAB CODE 200162-0

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MEASUREMENT/TECHNICAL REPORT

COMPANY NAME: Numerex

MODEL(S): Flex SI
FCC ID: TWV-FLEXSI
IC: 6322A-FLEXSI
DATE: January 10, 2012

This report concerns (check one): Original grant X
Class II change_____

Equipment type: **Intentional Radiator Operating within the bands 906 MHz**

Deferred grant requested per 47 CFR 0.457(d) (1) (ii)? yes_____ No X

If yes, defer until:_____
date

N.A. agrees to notify the Commission by N.A.
date
of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

US Tech
3505 Francis Circle
Alpharetta, GA 30004

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SUMMARY OF TEST REQUIREMENTS

FCC Requirement	Title	Disposition
15.205	Restricted Bands	Pass
15.207	Intentional Radiator Power Line Conducted Emissions	Pass
15.209	Intentional Radiator Radiated Emissions	Pass
15.249(a)	Fundamental Field Strength	Pass
15.107	Unintentional Radiator Power Line Conducted Emissions	Pass
15.109	Unintentional Radiator Radiated Emissions	Pass

N/A = Not applicable for this unit.

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1 General Information

1.1 Purpose of this Report

This report is prepared as a means of presenting test data to be used by a Telecom Certification Body in determination of whether this product is permitted for unlicensed dissemination to the general public according to the FCC Rules and Regulations for RF Devices Intentional Radiators.

1.2 Product Description

The Flex SI is an interface device that connects to a variety of monitoring sensors (tank level, door, etc) and wirelessly transmits the sensor readings and status on defined exception events to a host device.

1.3 Related Submittal(s)/Grant(s)

1.3.1 The EUT is subject to the following FCC authorizations:

a) Certification under section 15.249 as a transmitter
b) Verification under 15.101 as a digital device and receiver

1.3.2 Certification of the Transmitter

The EUT employs GFSK digital modulation, but is not being certified under CFR 15.247 because its minimum 6 dB bandwidth is less than 500 kHz and therefore does not meet the CFR 15.247 6 dB bandwidth requirement of 500 kHz or greater. It is instead being presented under the requirements of CFR 15.249. The EUT will operate at 906 MHz within the 900 MHz band.

1.3.3 Verification of the Digital apparatus

The Verification requirement shares many common report elements with the Certification report. Therefore, though this report is mostly intended to provide data for the Certification process, the Verification authorization report (part 15.107 and 109) for the Flex SI is included herewith.

2 Tests and Measurements

2.1 Configuration of Tested System

The sample was setup and tested per ANSI C63.4, *Methods of Measurement from Low-Voltage Electrical and Electronic Equipment in the Frequency Range of 9 kHz to 40 GHz (2003).* Conducted and radiated emissions data were taken with the EMC test receiver (or spectrum analyzer's) resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was off throughout the evaluation process. A Block diagram of the tested system is shown in Figure 1. A listing of the EUT and its test peripherals is found in Table 1 below. Test configuration photographs for spurious and fundamental emissions measurements are in the attached appendices.

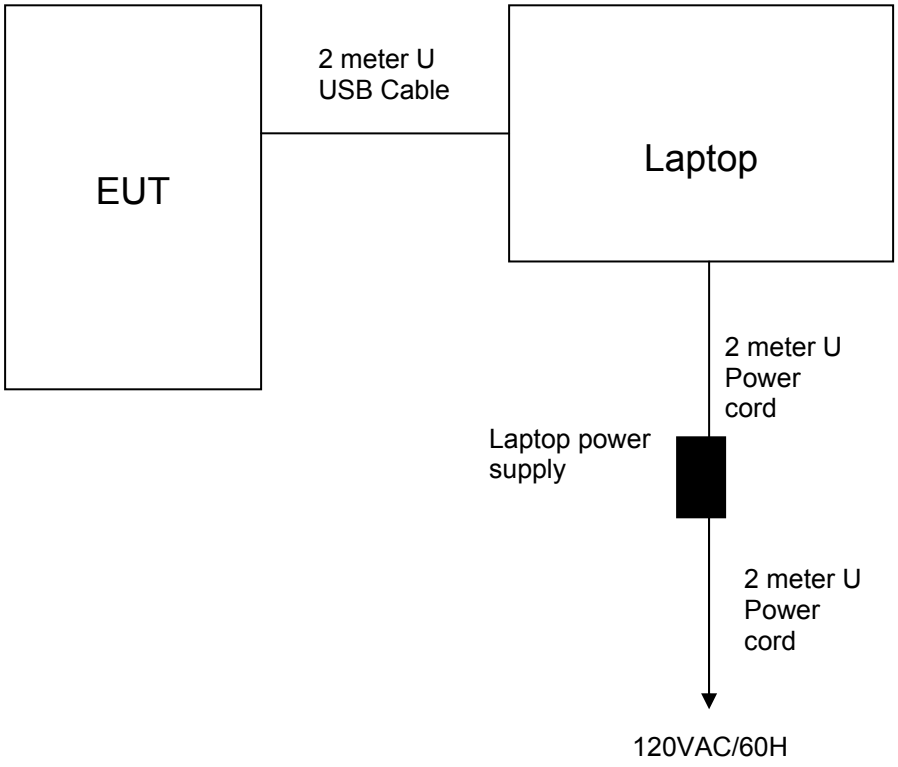


Figure 1. Test Configuration

Table 1. EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID:	CABLES P/D
EUT Numerex Corp.	Flex SI	None	TWV-FLEXSI	2 meter U USB cable
Laptop and laptop power supply IBM	T-48	--	--	2 meter U Power cord 2 meter U Power cord

2.2 EUT Characterization

The sample used for testing was received by US Tech on December 12, 2011 in good operating condition.

2.3 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA. This site has been fully described and registered with the FCC under designation number US5117. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 2982A-1.

2.4 Test Equipment

Table 2 describes test equipment used to evaluate this product.

Table 2. Test Instruments used for Evaluation.

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	DATE OF LAST CALIBRATION
SPECTRUM ANALYZER	8566B	HEWLETT-PACKARD	2410A00109	11/4/2011
SPECTRUM ANALYZER	8593E	HEWLETT-PACKARD	3205A00124	10/26/2011
RF PREAMP	8447D	HEWLETT-PACKARD	2944A07436	10/6/2011
LOOP ANTENNA	SAS-200/562	A. H. Systems	142	8/09/2011 2yrs
BICONICAL ANTENNA	3110B	EMCO	9306-1708	4/29/2011
LOG PERIODIC	3146	EMCO	9305-3600	11/22/2011 2yrs
LISN (x 2) 8028-50-TS24-BNC	8028	Solar Electronics	910495 & 910494	1/27/2011
HORN ANTENNA	3115	EMCO	9107-3723	8/10/2011 2 Year
PREAMP	8449B	HEWLETT-PACKARD	3008A00480	11/15/2011
CALCULATION PROGRAM	N/A	N/A	Ver. 6.0	N/A

Note: The calibration interval of the above test instruments is 12 months unless stated otherwise, and all calibrations are traceable to NIST/USA.

2.5 Modifications to EUT

No modifications were made by US Tech to bring the EUT into compliance with FCC Part 15, Subpart B, Class B Limits for the receiver and digital portion of the EUT or the Subpart C, Transmitter requirements.

2.6 Measurement Standards (CFR 15.31)

Intentional and unintentional radiators are to use the methods of ANSI C63.4 – 2003. Measurements were made on an Open Area Test Site (OATS) wherever possible. For battery powered equipment, new (or fully charged) batteries are used. Section 15.31(m) indicates that if the EUT System operates at 906 MHz ISM band, measurements must be made near the bottom of the band (around 902 MHz for example) and near the top of the band (908 MHz). However this EUT only operates at 906 MHz therefore only one channel, 906 MHz, was evaluated.

2.7 Frequency Range of Radiated Measurements (CFR 15.33)

The frequency range is detailed below for intentional and unintentional radiators.

2.7.1 Frequency Range for Intentional Radiators

The spectrum was investigated from the lowest RF signal generated without going below 9 kHz to the 10th harmonic of the highest fundamental transmitter frequency.

2.7.2 Frequency Range for Unintentional Radiators (CFR 15.33(b)(1))

The spectrum was investigated from the lowest RF signal generated without going below the lowest frequency for which an emissions limit is specified (30 MHz) to the 5th harmonic of the highest fundamental frequency of the digital device (5 GHz maximum).

2.7.3 Measurement Detector Function and Bandwidth (CFR 15.35)

On any frequency below 1000 MHz, the limits shown are based upon measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths. On frequencies above 1000 MHz, the radiation limits are based upon the use of measuring instrumentation employing an average detector function.

When average detector measurements are specified for use, including emission measurements below 1000 MHz, there is also a corresponding limit for Peak detector measurements having a limit of 20 dB above the corresponding average limit unless a different peak emission limit is specified. Measurements above 1000 MHz utilize a minimum resolution bandwidth of 1 MHz.

When radiated emissions limits are expressed in terms of the average value of the emission and pulsed operation is employed, the measurement field strength is determined by averaging over one complete pulse train (Duty Cycle) including blanking intervals for pulse trains up to 0.1 second in duration. The exact method of calculating the average field strength is included in paragraph 2.11 of this report. Refer to Figures 1 for duty cycle measurement data.

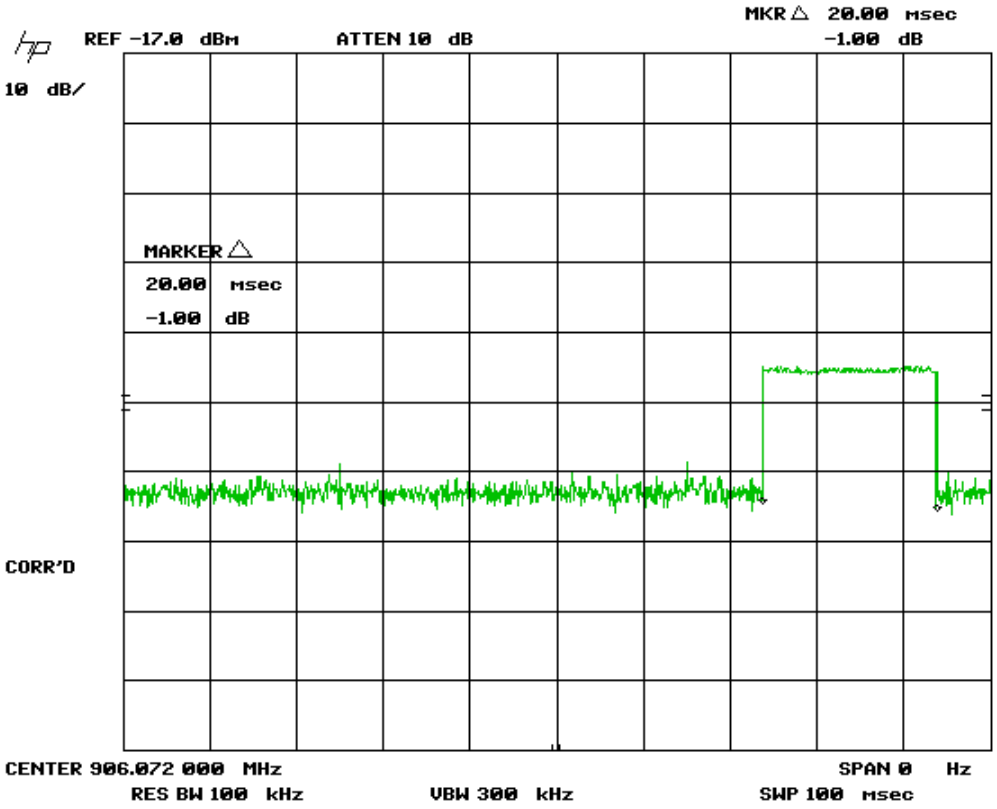


Figure 2. Transmitter Pulse Width

20 mS/100mS = 0.20 = 20 percent

DC = 20 Log(0.20) = -13.98

2.8 Antenna Requirement (CFR 15.203)

The intentional radiator is designed to assure that no antenna other than that furnished by the manufacturer is used with the device. The use of a permanently attached antenna is considered sufficient to comply with this requirement. Below is a table of the permanently attached antenna used with this system and its characteristics. If, in the future, additional antennas are contemplated for use, they must be formally evaluated and approved for suitability to these requirements.

Table 3. Flex SI Antennas

Manufacturer	Model Number	Antenna Type	Frequency Range	Peak Gain dBi	Impedance Ohms
Pulse Engineering	W3012	CHIP	902-928 MHz	2	50

2.9 Intentional Radiator, Power Line Conducted Emissions (CFR 15.207)

The EUT is connected to the power lines through the use of the USB cable to the Laptop computer or other PC. The user is able to interface with the EUT and is able to set the EUT into a transmit mode will connect to the PC or Laptop. This configuration is shown in Figure 1 above and is the configuration used for testing to CFR 15.207. The test data can be seen in Table 4 below.

The worst-case results for conducted emissions were determined to be produced when the EUT was operating under continuous transmission on the low channel.

Table 4. Intentional Conducted Emissions

CONDUCTED EMISSIONS 150 kHz to 30 MHz						
Tested By: S.S.	Specification Requirement: FCC Part 15.207 Class B		Project No.: 11-0278	Manufacturer: Numerex Corp. Model: Flex SI		
Frequency (MHz)	**Test Data (dBuV)**	**LISN+CL-PA (dB)**	**Corrected Results (dBuV)**	**Avg Limits (dBuV)**	**Margin (dB)**	**Detector**
120VAC, Phase						
0.1890	47.70	1.35	49.05	54.1	5.0	**QP**
0.6230	38.70	0.49	39.19	46.0	6.8	**QP**
2.4800	37.70	0.55	38.25	46.0	7.8	**PK**
9.8300	37.80	0.67	38.47	50.0	11.5	**PK**
21.0600	41.50	0.93	42.43	50.0	7.6	**PK**
20.0400	39.20	0.86	40.06	50.0	9.9	**PK**
120VAC, Neutral						
0.1520	45.80	1.70	47.50	55.9	8.4	**QP**
0.6355	40.30	0.48	40.78	46.0	5.2	**QP**
3.5720	31.90	0.51	32.41	46.0	13.6	**PK**
9.7400	36.90	0.67	37.57	50.0	12.4	**PK**
14.9400	39.50	0.77	40.27	50.0	9.7	**PK**
20.7000	36.10	0.86	36.96	50.0	13.0	**PK**
0.1520	45.80	1.70	47.50	55.9	8.4	**QP**

(*)= Quasi-Peak limit used
SAMPLE CALCULATIONS: At 0.189 MHz, = 47.70 + (1.35) = 49.05 dBuV

Test Date: January 5, 2012
Tested By
Signature: Sina Sobhaniyan Name: **Sina Sobhaniyan**

2.10 Intentional Radiator, Radiated Emissions (CFR 15.249 (a), (e))

The EUT frequency hopping was stopped and it was placed into a continuous transmit mode of operation. A preliminary scan was performed on the EUT to find signal frequencies that were caused by the transmitter part of the product and to obtain the worse case result the EUT tested in all X, Y and Z axis. Radiated measurements below 1 GHz were tested with a RBW = 120 kHz. Radiated measurements above 1 GHz were measured using a RBW =1 MHz VBW = 3 MHz. Test data is found in Tables 4 and 5.

2.11 Restricted Bands of Operation (CFR 15.205)

Only radiated harmonics and other spurious signals can be permitted to fall into the restricted bands of 15.205. All signals found in paragraph 2.7 above shall be examined for this requirement. Limits are based upon the limits of paragraph 15.209. Above 1 GHz, the limits are for Average value. See Tables 4 and 5 below for peak and Average measurements. According to CFR 15.35, the peak limits can exceed the average limits by 20 dB.

2.12 20 dB Bandwidth Measurement & Channel Spacing per CFR 15.249, 99% Occupied Bandwidth (IC RSS 210, A8.1)

2.12.1 20 dB Bandwidth Measurements

The EUT antenna port was connected to a spectrum analyzer having a 50 Ω input impedance. Measurements were performed similar to the method of FCC, KDB Publication No. DA 00-705 for a bandwidth of 20 dB. The RBW was set to approximately 1/100 of the manufacturers claimed RBW and with the VBW ≥ RBW. The results of this test are given in Table 13 and Figures 23 through 25.

The above method was not possible. The EUT does not have an antenna port; the test was preformed using the alternate radiated method per KDB publication No. DA 00-705.

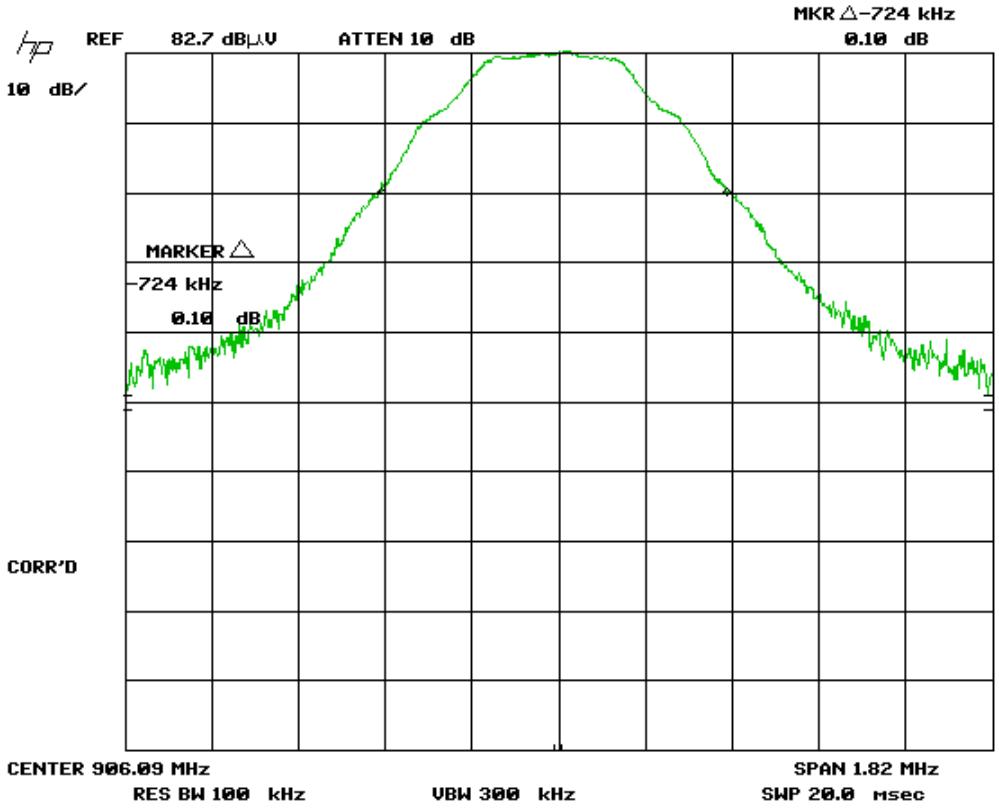


Figure 3. 20 dB -99% Bandwidth

Table 5. Peak Fundamental and Harmonics, (CFR15.249 (a))

Radiated Harmonic and Spurious Emissions, Tested from 30 MHz – 24 GHz							
Tested By: JCW	Test: FCC Part 15, Para 15.247(d)			Client: Numerex			
	Project: 11-0278			Model: Flex SI			
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Pass Margin (dB)**	**Detector PK / AVG**
906.1	73.5	31.95	102.96	114.0	3.0m./H	11.0	**PK**
1812	73.8	-6.45	67.35	74.0	3.0m./H	6.7	**PK**
2718.54	56.70	-2.24	54.46	94.3	3.0m./H	19.5	**PK**
3524.00	44.70	0.46	45.16	74.0	3.0m./H	28.8	**PK**

1. (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation of CFR 15.35.
2. ND = No other signals detected within 20 dB of specification limit.
SAMPLE CALCULATION:
3. Measurements taken at 1 meter distance were extrapolated to 3 meter using a factor of (-9.5 dB).
RESULTS: At 2718.54 MHz: = 56.7 dBuV+ -2.24 dB/m = 54.46 dBuV/m @ 3m
Margin = (74.0 – 54.46) = 19.5 dB

Test Date: December 19, 2011

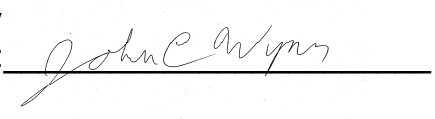
Tested By
Signature:  Name: John C. Wynn

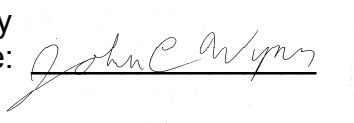
Table 6. Fundamental and Harmonics Avg. Limits, (CFR 15.35(b), 15.249(a))

Radiated Harmonic and Spurious Emissions, Tested from 30 MHz – 24 GHz							
Tested By: JCW	Test: FCC Part 15, Para 15.247(d)			Client: Numerex			
	Project: 11-0278			Model: Flex SI			
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Pass Margin (dB)**	**Detector PK / AVG**
906.1	72.50	15.29	87.79	94.0	1.0m./	6.2	**AVG**
1812.00	73.20	-20.35	52.85	54.0	1.0m./	1.15	**AVG**
2718.54	53.20	-16.14	37.06	54.0	1.0m./	16.9	**AVG**

1. (*) Falls within the restricted bands of CFR 15.205.
2. ND = No other emissions detected within 20 dB of the Part 15.209 limits for spurious emissions within Restricted Bands.
3. Test data values measured at 1 meter include a factor of -9.54 dB for distance extrapolation from a test distance of 1 meter to 3 meters.
4. Additional factors include a Duty Cycle, DC = -7.96 dB and filter factor of +1.0 dB.

SAMPLE CALCULATION:
RESULTS: At 1812.00 MHz: = (73.2) + (-20.35) = 52.85 dBuV/m @ 1m
Margin = (54.0 – 52.85) = 1.15 dB

Test Date: December 12, 2011

Tested By
Signature:  Name: John C. Wynn

2.13 Band Edge Measurements (CFR15.249(d))

The EUT has only one fundamental frequency. Therefore the Band Edge measurements were made at one frequency. A measurement was made of the fundamental and the emission was measured using a quasi peak setting. A Resolution Bandwidth of > 1% of the emission bandwidth was used. This procedure was repeated for the high side. The limits were derived in the following sections.

The fundamental frequency was measured and recorded using radiated emission techniques. The band edge was measured using conducted methods because ambient signals were also captured when recording the radiated band edge results on US Tech's OATS test site. The conducted plots were compared to the radiated peak and AVG fundamental measurements. Please see below.

2.13.1 High Band Edge

Above 906 MHz the limit per section 15.249(d) is 50 db below the fundamental or the value expressed by CFR 15.209 (46 dBuV/m) whichever is the lesser attenuation.

The channel fundamental recorded in Table 5 (radiated method) is 102.96 dBuV/m:
102.96 dBuV – 53dB = 49.95 dBuV/m
Passing Margin= (102.96-50) – 49.95= 3.01 dB

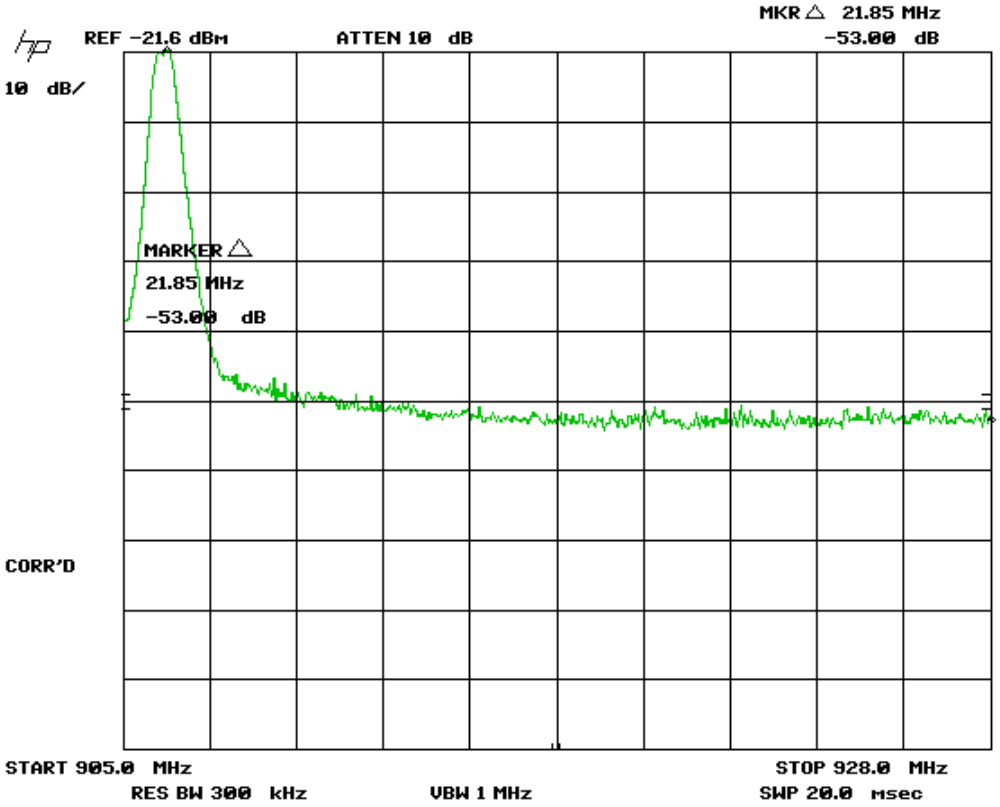


Figure 4. Band Edge Compliance – High Channel

2.13.2 Low Band Edge

The channel fundamental recorded in Table 5 (radiated method) is 102.96 dBuV/m
102.96 – 52.2 = 50.76 dB
Passing Margin= (102.96-50) – 50.76 = 2.2 dB

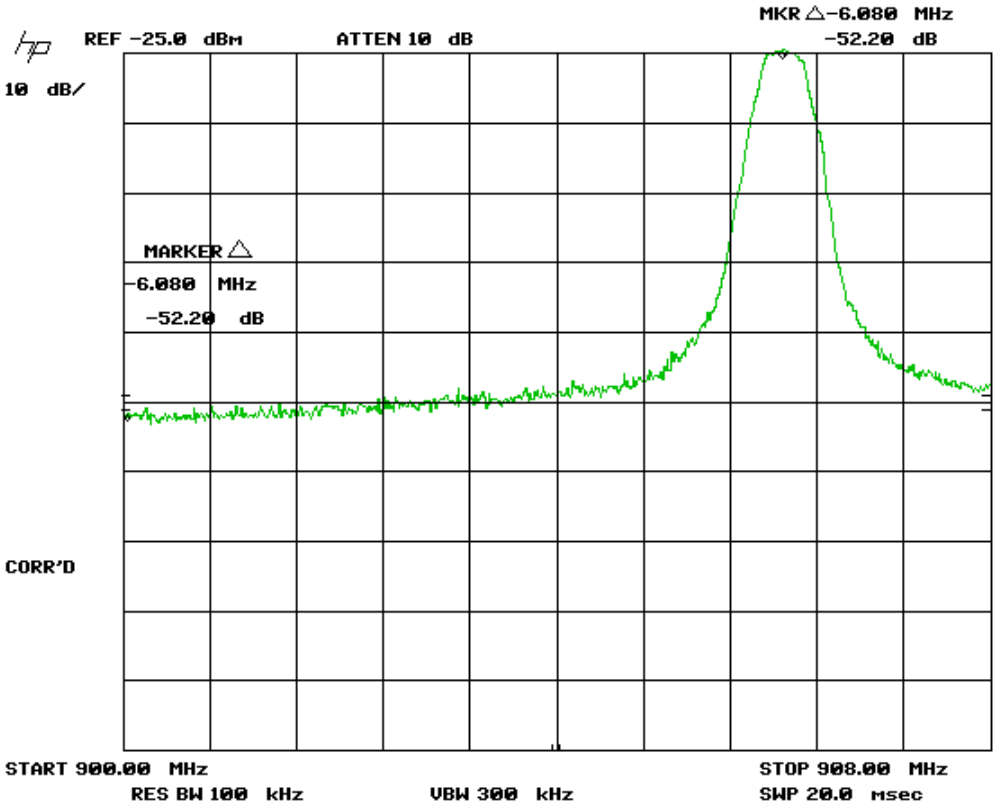


Figure 5. Band Edge Compliance – Low Channel

2.14 Unintentional Radiator, Power Conducted Emissions (CFR 15.107)

The unit was set up and measured for conducted power line emissions. The measurement setup and test procedures were in accordance with ANSI C63.4, paragraph 7. The EUT is connected to the power lines through the use of the USB cable to the Laptop computer or other PC. The user is able to interface with the EUT and is able to set the EUT into a transmit mode will connect to the PC or Laptop. This configuration is shown in Figure 1 above and is the configuration used for testing to CFR 15.207/CFR15.107 because this produced the worse case emissions.

Measurements were made over the 150 kHz to 30 MHz frequency range for the unit. The measurement receiver was connected to the RF (receiver) Port on the LISN and each power lead was individually measured. Test results are shown on Table 7 for the unit.

Table 7. Power line Conducted Emissions Data, Class B

CONDUCTED EMISSIONS 150 kHz to 30 MHz						
Tested By: S.S.	Specification Requirement: FCC Part 15.207 Class B		Project No.: 11-0278	Manufacturer: Numerex Corp. Model: Flex SI		
Frequency (MHz)	**Test Data (dBuV)**	**LISN+CL-PA (dB)**	**Corrected Results (dBuV)**	**Avg Limits (dBuV)**	**Margin (dB)**	**Detector**
120VAC, Phase						
0.1890	47.70	1.35	49.05	54.1	5.0	**QP**
0.6230	38.70	0.49	39.19	46.0	6.8	**QP**
2.4800	37.70	0.55	38.25	46.0	7.8	**PK**
9.8300	37.80	0.67	38.47	50.0	11.5	**PK**
21.0600	41.50	0.93	42.43	50.0	7.6	**PK**
20.0400	39.20	0.86	40.06	50.0	9.9	**PK**
120VAC, Neutral						
0.1520	45.80	1.70	47.50	55.9	8.4	**QP**
0.6355	40.30	0.48	40.78	46.0	5.2	**QP**
3.5720	31.90	0.51	32.41	46.0	13.6	**PK**
9.7400	36.90	0.67	37.57	50.0	12.4	**PK**
14.9400	39.50	0.77	40.27	50.0	9.7	**PK**
20.7000	36.10	0.86	36.96	50.0	13.0	**PK**
0.1520	45.80	1.70	47.50	55.9	8.4	**QP**

(*)= Quasi-Peak limit used
SAMPLE CALCULATIONS: At 0.189 MHz, = 47.75 + (1.35) = 49.05 dBuV

Test Date: January 5, 2012

Tested By
Signature: Sina Sobhaniyan Name: **Sina Sobhaniyan**

2.15 Unintentional Radiator, Radiated Emissions (CFR 15.109/15.209)

Radiated emissions within the band of 9 kHz to 30 MHz were investigated using a calibrated Loop Antenna and per the requirements of ANSI C63.4:2006.

Radiated emissions within the band 30 MHz to 12.5 GHz were measured with a spectrum analyzer via a pre-amplifier by connecting the spectrum analyzer to a receiving antenna spaced three (3) meters from the EUT. The spectrum analyzer was set for a 50 Ω input impedance with the VBW set to ≥ the RBW bandwidth. The antenna was raised and lowered over a span of 4 meters in order to maximize the signal coming from the EUT. Similarly, the turntable was rotated through 360 degrees in the same maximizing effort. Also the EUT was scanned for a maxima when placed in each of the three mutually exclusive orthogonal planes. The results of the measurements are given in Table 8.

Table 8. Unintentional Radiator, Peak Radiated Emissions (CFR 15.109)

Unintentional Radiator, Radiated Emissions							
Test By: JCW	Test: FCC Part 15.109, 15.209			Client: Numerex			
	Project: 11-0278 Class: B			Model: Flex SI			
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**DETECTOR PK / QP**
35.9930	44.90	-14.73	30.17	40.0	3m./Vert	9.8	**PK**
41.0000	50.50	-15.84	34.67	40.0	3m./Vert	5.3	**PK**
217.0100	45.20	-12.39	32.81	46.0	3m./Hor.	13.2	**PK**
386.0100	45.50	-7.95	37.56	46.0	3m./Hor.	8.4	**PK**
871.9650	35.80	1.51	37.31	46.0	3m./Hor.	8.7	**QP**
897.5000	24.90	1.90	26.80	46.0	3m./Hor.	19.2	**QP**
916.6490	38.10	1.59	39.69	46.0	3m./Hor.	6.3	**QP**
956.7800	36.30	2.83	39.13	46.0	3m./Hor.	6.9	**QP**
896.8680	38.60	-1.60	37.00	46.0	3m./Vert	9.0	**PK**
917.3500	37.10	-1.81	35.29	46.0	3m./Vert	10.7	**QP**

Note: All other emissions between 9 kHz to 12.5 GHz were 20 dB or greater below the limit. EUT was tested from 9 kHz to 12.5 GHz.

SAMPLE CALCULATION:
RESULTS at 467.9920 MHz, = 12.60 dBuV + (21.51) dB = 34.11 dBuV/m

Test date: January 4, 2012

Tested By
Signature: John C Wynn Name: John C. Wynn

2.16 Measurement Uncertainty

The measurement uncertainties given were calculated using the method detailed in CISPR 16-4. A coverage factor of k=2 was used to give a level of confidence of approximately 95%.

2.16.1 Conducted Emissions Measurement Uncertainty:

Measurement Uncertainty (within a 95% confidence level) for this test is ±2.8 dB.

The data listed in this test report has sufficient margin to negate the effects of uncertainty. This measurement unconditionally passes.

2.16.2 Radiated Emissions Measurement Uncertainty:

For a measurement distance of 3 m the measurement uncertainty (with a 95% confidence level) for this test using a Biconical Antenna (30 MHz to 200 MHz) is ±5.3 dB. This value includes all elements of measurement.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is ±5.1 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ±5.1 dB.

The data listed in this test report does not have sufficient margin to negate the effects of uncertainty, (more than the measurement uncertainty value at 627 MHz). Therefore, this test is conditionally acceptable.