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

SXL1 Programmer Models:
159136RFINTXA1, 159136RFINTXB1, 159136RFINTXC1

Manufactured by

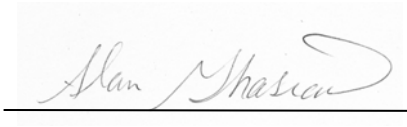
Numerex Corp.

UST Project: 10-0192
Test Date(s): August 28, 29,30, 2010 and October 5, 2010
Issue Date: January 5, 2011

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 5, 2011

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

MEASUREMENT/TECHNICAL REPORT

COMPANY NAME: Numerex Corp.

MODEL(S): 159136RFINTXA1, 159136RFINTXB1, 159136RFINTXC1
FCC ID: TWV-SXL1-P

DATE: January 5, 2011

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

Equipment type: **Intentional Radiator Operating within the bands 902-928 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

Phone Number: (770) 740-0717
Fax Number: (770) 740-1508

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.

Table of Contents

List of Tables

List of Figures

List of Appendices

Appendix	Title
A	Agency Agreement
B	Application Forms
C	Letter of Confidentiality
D	Equipment Label
E	Block Diagram(s)
F	Schematic(s)
G	Test Configuration Photographs
H	External Photographs
I	Internal Photographs
J	Theory of Operation
K	User's Manual

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 SXL1 Programmer is an ISM band transceiver operating at 906 MHz used to communicate with Numerex SXL1 devices. The SXL1 programmer can perform one of three functions. It can act as the interface between the SXL1 setup tool running on a PC and an SXL1, it can operate as an interface between a sensor and an SXL1, or it can allow an SXL1 sensor to communicate with the Numerex SX1 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 SXL1 Programmer 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.

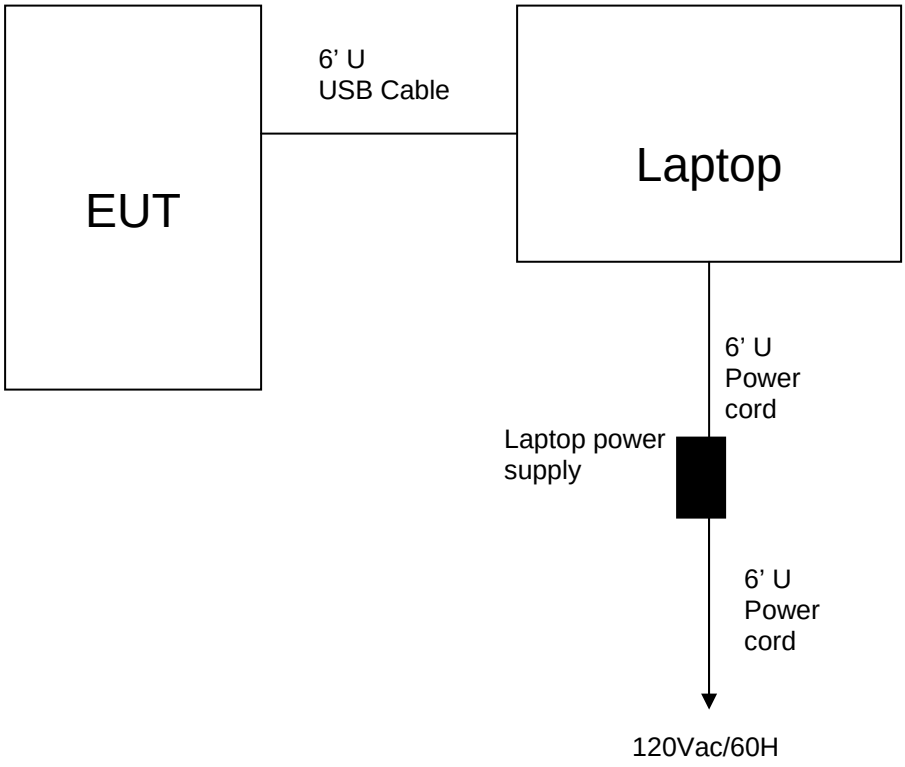


Figure 1 - Test Configuration

Table 1 - EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID:	CABLES P/D
EUT Numerex Corp.	159136RFINTXA1 159136RFINTXB1 159136RFINTXC1	None	TWV-SXL1-P	6' U USB cable
Laptop and laptop power supply IBM	T-48	--	--	6' U Power cord 6' U Power cord

2.2 EUT Characterization

The sample used for testing was received by US Tech on September 20, 2010 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	2332A10055	10/14/09
SPECTRUM ANALYZER	8593E	HEWLETT-PACKARD	3205A00124	10/07/09
RF PREAMP	8447D	HEWLETT-PACKARD	2944A06291	9/07/10
BICONICAL ANTENNA	3110B	EMCO	9307-1431	2/02/10
LOG PERIODIC	3146	EMCO	3110-3236	1/22/10 2yrs
LISN (x 2) 9247-50-TS-50-N	9247	Solar Electronics	955824 & 955826	1/25/10
HORN ANTENNA	3115	EMCO	9107-3723	11/4/08 2 Year
PREAMP	8449B	HEWLETT-PACKARD	3008A00480	9/11/09 Extended 60 days
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 over the 902 MHz to 928 MHz ISM band, measurements must be made near the bottom of the band (around 902 MHz for example) and in the middle of the band (915 MHz) as well as near the top of the band (928 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 10^{th} harmonic of the highest fundamental transmitter frequency.

2.7.2 Frequency Range for Unintentional Radiators

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 5^{th} 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 and 2 for duty cycle measurement data.

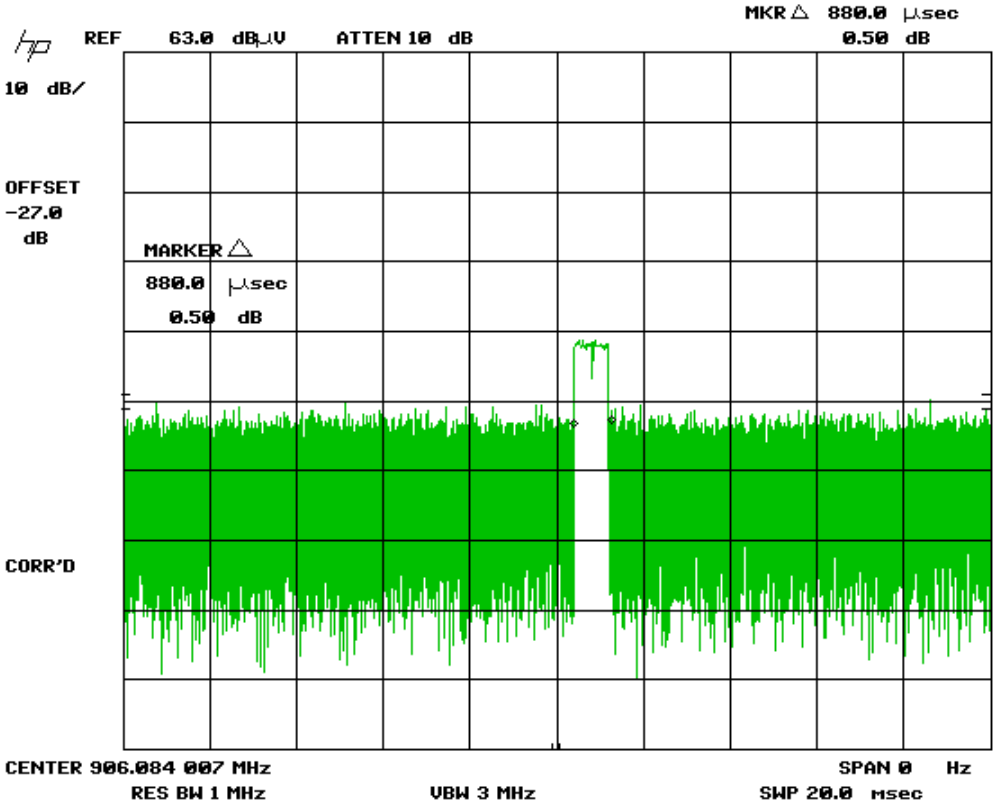
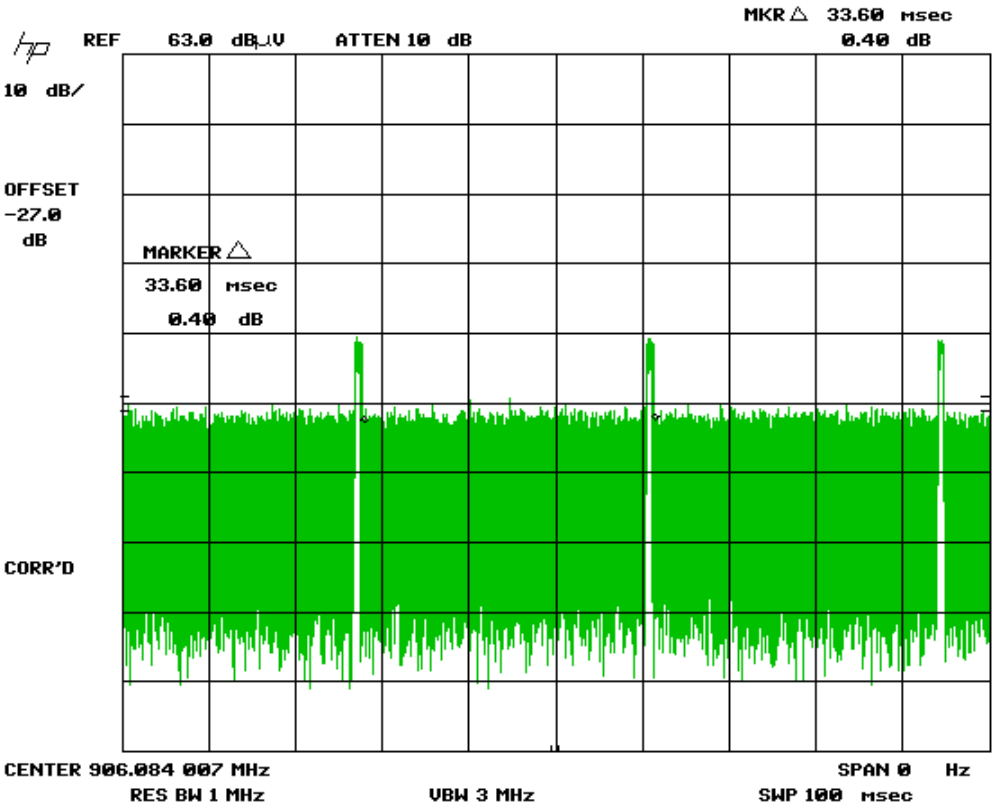


Figure 2 - Transmitter Pulse Width



0.880mS x 3 = 2.64mS/100mS=0.0264 = 2.64 percent

DC = 20 Log 0.0264 = -31.57dB

Figure 3– Pulses in a 100 mSec Period

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 – SXL1 Programmer 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 8 below.

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.

Table 4 - Peak Fundamental and Harmonics, (CFR15.249 (a))

Radiated Fundamental and Harmonics Emissions								
Test By: K.M&G.Y.	**Test:** Fundamental and Harmonics CFR 15.249 (a)				**Client:** Numerex Corp			
	Project: 10-0192		**Class: N/A**		**Model:** 159136RFINTXA1,159136RFINTXB1, 159136RFINTXC1			
Frequency (MHz)	**Test Data (dBuV)**	**DF+FL***	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Peak Limits (dBuV/m)**	**Distance / Polarity (Meters)**	**Margin (dB)**	**Det PK / QP**
906.2140	29.80		28.92	58.72		3m./		**PK**
1811.3000	52.10	1.00	-4.98	48.12	74.0	3m./	25.9	**PK**
2717.7500	50.34	1.00	-1.90	49.44	74.0	3m./	24.6	**PK**
3624.7500	45.10	1.00	1.85	47.95	74.0	3m./	26.1	**PK**
4530.0000	40.96	1.00	3.36	45.32	74.0	3m./	28.7	**PK**
5437.1800	39.47	-8.54	6.37	46.84	74.0	1m./	27.2	**PK**

All other emissions were at least 20 db below the limit.
*Correction factor for distance (DF) = -9.54 dB, and data corrected by 1.0 dB for loss of high pass filter (FL), except for fundamental

SAMPLE CALCULATION: at 906.214 MHz, = 29.80 dBuV+ 28.92 dB/m = 58.72 dBuV/m @ 3m

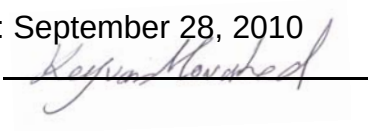
Tester
Test Date: September 28, 2010
Signature: Keyvan Muvahhid Name: Keyvan Muvahhid

Table 5 – Fund and Harmonics Average limits, (CFR 15.35(b), 15.249(a))

Radiated Fundamental and Harmonics Emissions								
Test By: K.M&G.Y.	**Test:** Fundamental and Harmonics CFR 15.249 (a)				**Client:** Numerex Corp			
	Project: 10-0192		**Class: N/A**		**Model:** 159136RFINTXA1,159136RFINTXB1, 159136RFINTXC1			
Frequency (MHz)	**Test Data (dBuV)**	**DF+FL**	**AF+CL-PA+DC (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarity (Meters)**	**Margin (dB)**	**Det PK / QP**
906.2140	29.80		28.92	58.72		3m./		**PK**
1811.3000	52.10	1.00	-4.98	48.12	54.0	3m./	5.9	**PK**
2717.7500	50.34	1.00	-1.90	49.44	54.0	3m./	4.6	**PK**
3624.7500	45.10	1.00	1.85	47.95	54.0	3m./	6.1	**PK**
4530.0000	40.96	1.00	3.36	45.32	54.0	3m./	8.7	**PK**
5437.1800	48.97	-8.50	6.37	46.84	54.0	1m./	7.2	**PK**

Correction factor for distance (DF) = -9.54 dB, and data corrected by 1.0 dB for loss of high pass filter (FL), except for fundamental

SAMPLE CALCULATION: at 906.214 MHz, = 29.80 dBuV+ 28.92 dB/m = 58.72 dBuV/m @ 3m

Tester
Test Date: September 28, 2010
Signature:  Name: Keyvan Muvahhid

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

Band Edge measurements were made at a Low Channel and High Channel peak at highest EUT related emission outside the upper and lower occupied bandwidth. 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 channel.
The limits were derived as follows:

2.12.1 High Band Edge

Above 928 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 High Channel fundamental recorded in Table 7 is 58.72 dBuV/m:
58.72 – 46.30 = 12.42
Passing Margin= 46 – 12.42= 33.58

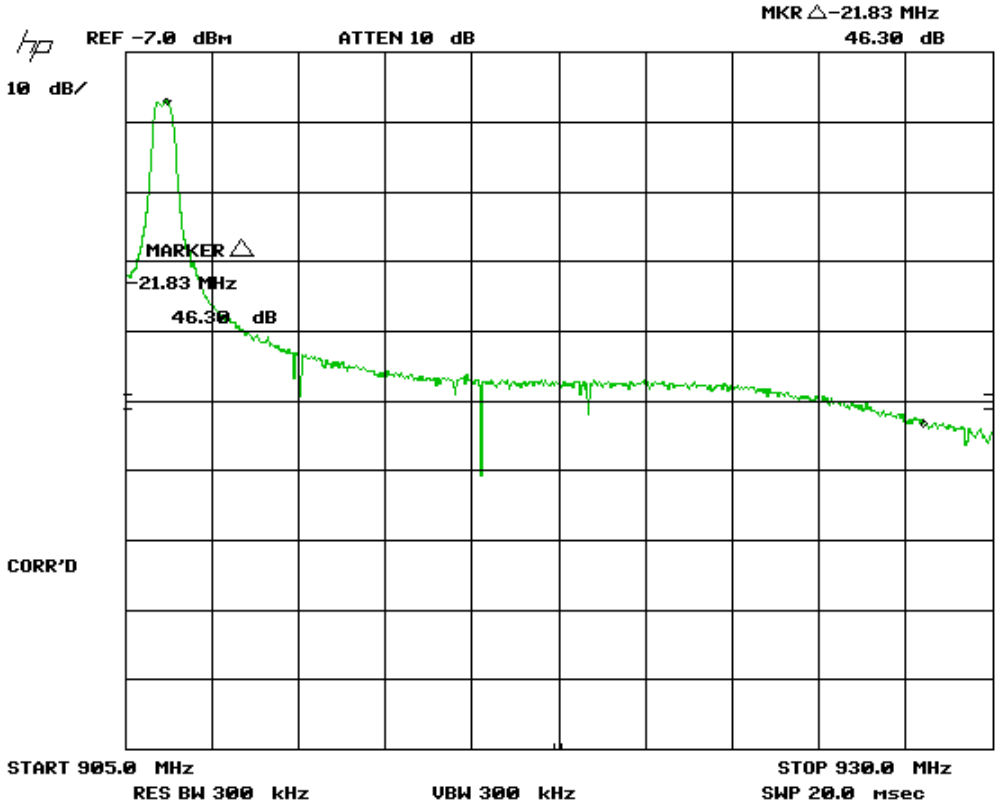


Figure 4 - Conducted Band Edge Compliance – High Channel Delta - QP

2.12.2 Low Band Edge

The low channel fundamental recorded in Table 5 is 85.22dBuV/m
58.72 – 45.50 = 13.22 dB.
Passing Margin= 46 – 13.22 = 32.78dB

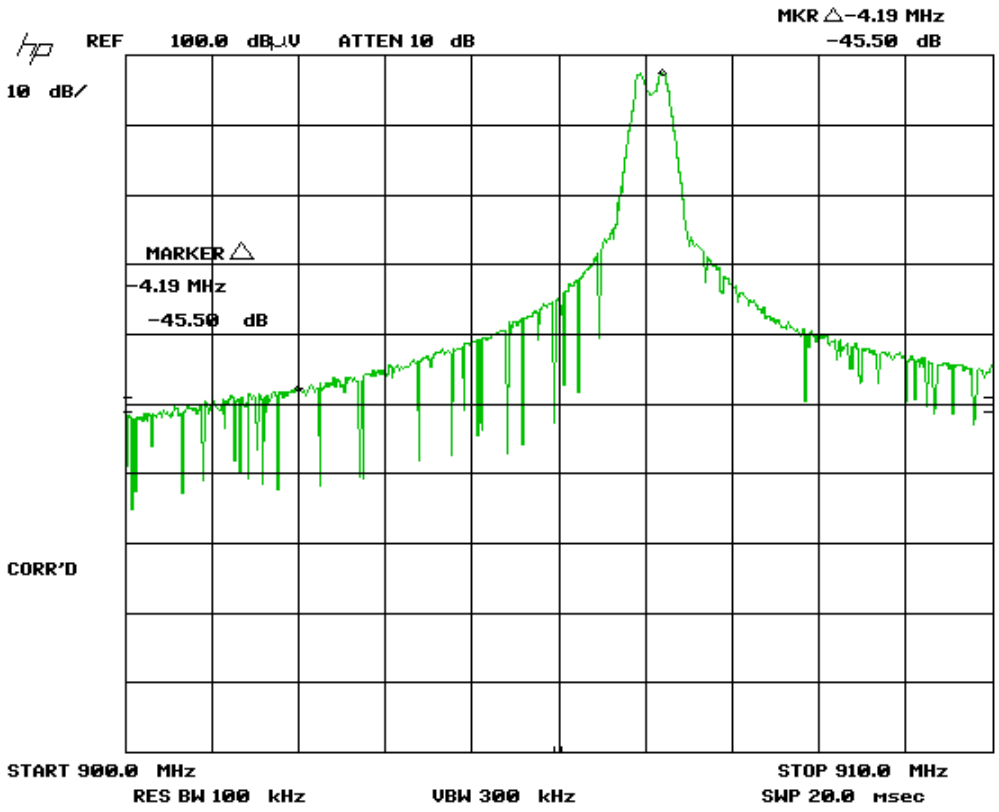


Figure 5 - Conducted Band Edge Compliance – Low Channel Delta – QP

2.13 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 8 for the unit.

Table 6 – Power line Conducted Emissions Data, Class B

Power Line Conducted Emissions							
Test By: G.Y.	**Test:** FCC Power Line Conducted Emissions 150 KHz – 30 MHz , Hot Phase			**Client:** Numerex Corp.			
	Project: 10-0192	Sect. 15.107/15.207 Class: B		**Model:** SXL1 Programmer			
Frequency (MHz)	**Test Data (dBuV)**	**IL+CL -PA (dB)**	**Results (dBuV)**	**AVG Limits (dBuV)**	**Phase /Neutral**	**Margin (dB)**	**PK / QP**
Hot Line							
0.1541	50.90	0.46	51.36	55.8	Phase	4.4	**PK**
0.5149	36.80	0.10	36.90	46.0	Phase	9.1	**PK**
1.3040	35.05	0.10	35.15	46.0	Phase	10.8	**PK**
6.7400	31.90	0.10	32.00	50.0	Phase	18.0	**PK**
10.1700	28.30	0.10	28.40	50.0	Phase	21.6	**PK**
28.8200	22.90	0.39	23.29	50.0	Phase	26.7	**PK**
Neutral Line							
0.1524	48.20	0.40	48.60	55.9	Neutral	7.3	**PK**
0.5134	37.50	0.20	37.70	46.0	Neutral	8.3	**PK**
2.0640	34.50	0.20	34.70	46.0	Neutral	11.3	**PK**
7.2200	35.20	0.10	35.30	50.0	Neutral	14.7	**PK**
10.3000	33.40	0.20	33.60	50.0	Neutral	16.4	**PK**
25.4500	26.60	0.50	27.10	50.0	Neutral	22.9	**PK**

Tested from 150 kHz to 30 MHz.
SAMPLE CALCULATIONS: at 0.1541 MHz, 50.90 dBuV + (0.46) = 51.36 dBuV

Tester
Test Date: October 5, 2010
Signature:_____ **Name: George Yang**

2.14 Unintentional Radiator, Radiated Emissions (CFR 15.109)

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 9.

Table 7 - Unintentional Radiator, Peak Radiated Emissions (CFR 15.109).

Peak Radiated Emissions, Digital Device and Receiver							
Test By: G.Y.	**Test:** Radiated Emissions- 30 MHz to 10 GHz			**Client:** Numerex Corp.			
	Project: 10-0192	**Requirement** 15.109/15.209, Class: B		**Model:** SXL1 Programmer			
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB)**	**Results (dBuV/m)**	**Peak Limits (dBuV/m)**	**Distance / Polarity (meters)**	**Margin (dB)**	**Detector PK / QP**
467.9920	12.60	21.51	34.11	46.0	3m./VERT	11.9	**PK**
60.0000	27.10	9.85	36.95	40.0	3m./VERT	3.1	**PK**
108.0200	24.00	12.79	36.79	43.5	3m./VERT	6.7	**PK**
70.8350	22.20	10.66	32.86	40.0	3m./HORZ	7.1	**PK**
167.9900	13.90	16.28	30.18	43.5	3m./VERT	13.3	**PK**
299.9950	8.10	19.22	27.32	46.0	3m./VERT	18.7	**PK**
294.0390	13.40	18.30	31.70	46.0	3m./HORZ	14.3	**PK**
1009.6300	58.18	-9.84	48.34	54.0	3m./VERT	5.7	**AVG**
1009.4300	53.44	-9.62	43.82	54.0	3m./HORZ	10.2	**PK**
1237.6800	54.89	-7.46	47.43	54.0	3m./HORZ	6.6	**PK**

Tested from 30 MHz to 10 GHz.

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

Tester
Test date: September 30, 2010
Signature:_____ Name: George Yang

2.15 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%.

2.15.1 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.

2.15.2 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.