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TEST REPORT

Report Number: **102570592LEX-002**
Project Number: **G102570592**

Report Issue Date: **6/10/2016**

Product Name: **Verifier Sentry**

Standards: **Title 47 CFR Part 15 Subpart C And RSS-210 Issue 8**

Radios Under Test: **NFC**

Tested by:
Intertek Testing Services NA, Inc.
731 Enterprise Drive
Lexington, KY 40510

Client:
Cross Match Technologies
3960 RCA Blvd Suite 6001
Palm Beach Gardens, FL 33410

Report prepared by

Carmen Davis, Project Engineer

Report reviewed by

Bryan Taylor, Team Lead-Engineering

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1 Introduction and Conclusion

The tests indicated in section 2 were performed on the product constructed as described in section 3. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test method, a list of the actual test equipment used, documentation photos, results and raw data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested complied with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested.

The INTERTEK-Lexington is located at 731 Enterprise Drive, Lexington Kentucky, 40510. The radiated emission test site is a 10-meter semi-anechoic chamber. The chamber meets the characteristics of CISPR 16-1 and ANSI C63.4. For measurements, a remotely controlled flush-mount metal-top turntable is used to rotate the EUT a full 360 degrees. A remote controlled non-conductive antenna mast is used to scan the antenna height from one to four meters. The test site is listed with the FCC under registration number 485103. The test site is listed with Industry Canada under site number IC 2042M-1.

2 Test Summary

Page	Test Name	FCC Reference	IC Reference	Result
6	20dB Bandwidth	§ 2.1049	RSS-GEN (4.6.1)	Pass
9	In-Band Radiated Spurious Emissions (Transmitter)	§ 15.225(a)(b)(c)	RSS-210 (A2.6)	Pass
11	Out of Band Radiated Spurious Emissions (Transmitter)	§ 15.225(d), § 15.209	RSS-210 (A2.6)	Pass
12	AC Powerline Conducted Emissions	§ 15.107, § 15.207	RSS-Gen (7.2.4)	Pass
15	Frequency Stability	§ 15.225(e)	RSS-210 (A2.6)	Pass
16	Antenna Requirement per FCC Part 15.203	§ 15.203	RSS-Gen (7.1.2)	Pass

3 Description of Equipment Under Test

Equipment Under Test	
Manufacturer	Cross Match Technologies
Serial Number	Sample 1
Receive Date	5/12/2016
Test Start Date	5/18/2015
Test End Date	5/27/2015
Device Received Condition	Good
Test Sample Type	Production
Frequency Band	13.56MHz
Mode(s) of Operation NFC	NFC Radio Transmitting
Transmission Control	Normal Operation
Antenna Type (15.203)	Internal
Power Supply	3.6V (Battery) with DC Charger Attached

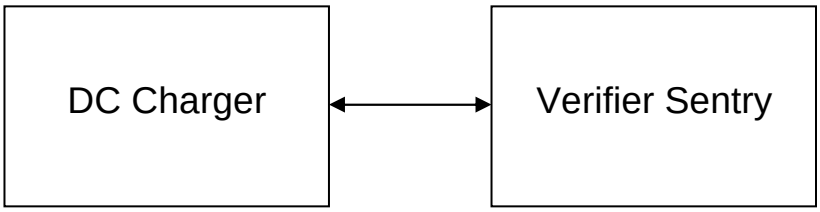
Description of Equipment Under Test
The Verifier Sentry handheld is designed to rapidly authenticate the identity of an individual using their secure credentials and biometrics.

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	NFC Radio enabled.
2	Receive / idle mode

3.1 System setup including cable interconnection details, support equipment and simplified block diagram

3.2 EUT Block Diagram:



3.3 Cables:

Cables					
Description	Length	Shielding	Ferrites	Connection	
				From	To
Power Cable	1m	No	No	DC Charger	Test Sample

4 20dB Bandwidth

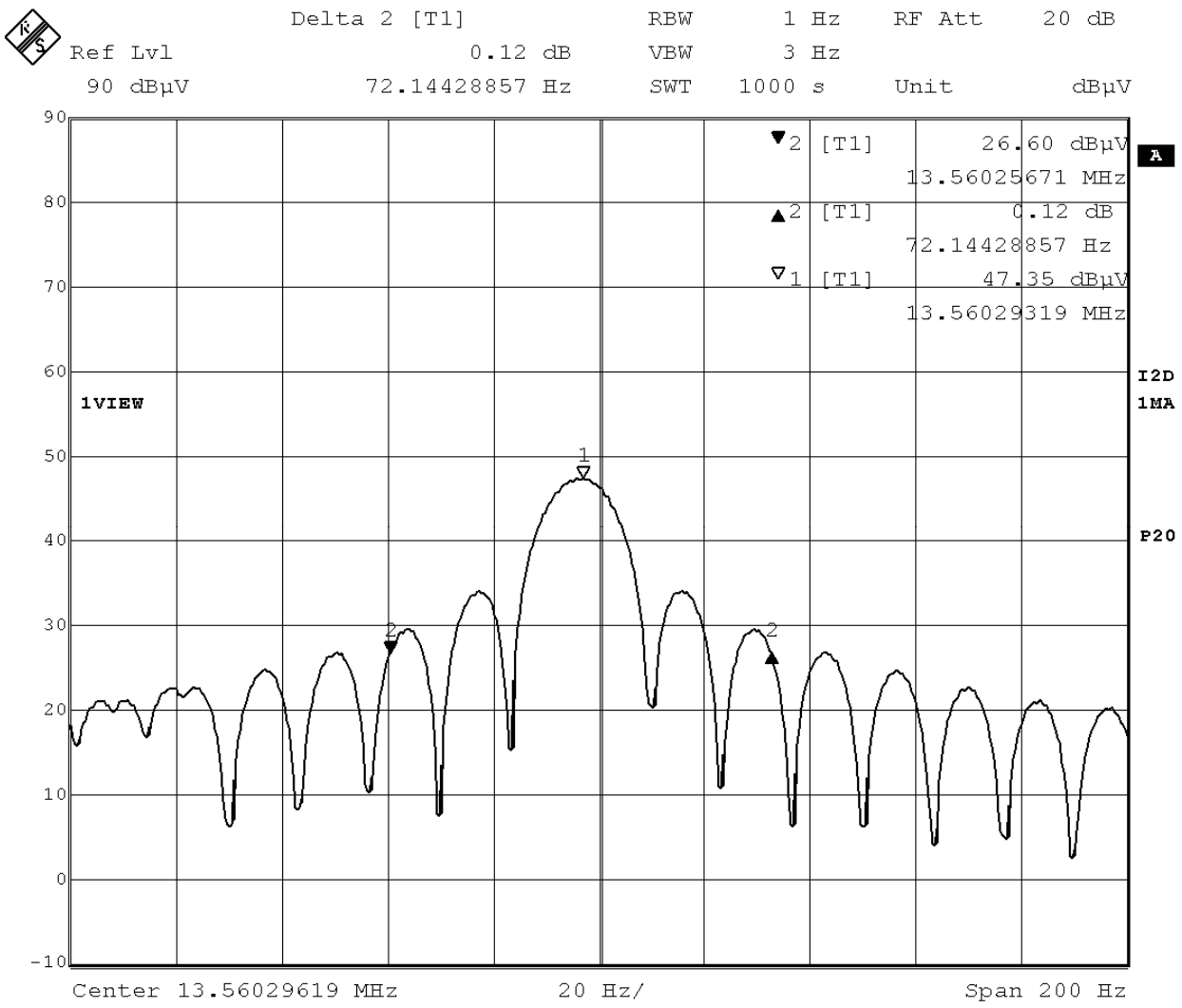
4.1 Test Limits
None

4.2 Test Procedure
The 20dB bandwidth was measured by a spectrum analyzer connected to a receive antenna placed near the test sample while it is transmitting. The “N dB Down” function of the analyzer was used to mark the bandwidth.

4.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	9/20/2015	9/20/2016
Active Loop Antenna	3416	ETS	6502	6/2/2015	6/2/2016

4.4 Results:
The 20dB bandwidth was measured to be 72.14 Hz as shown in the plot below.



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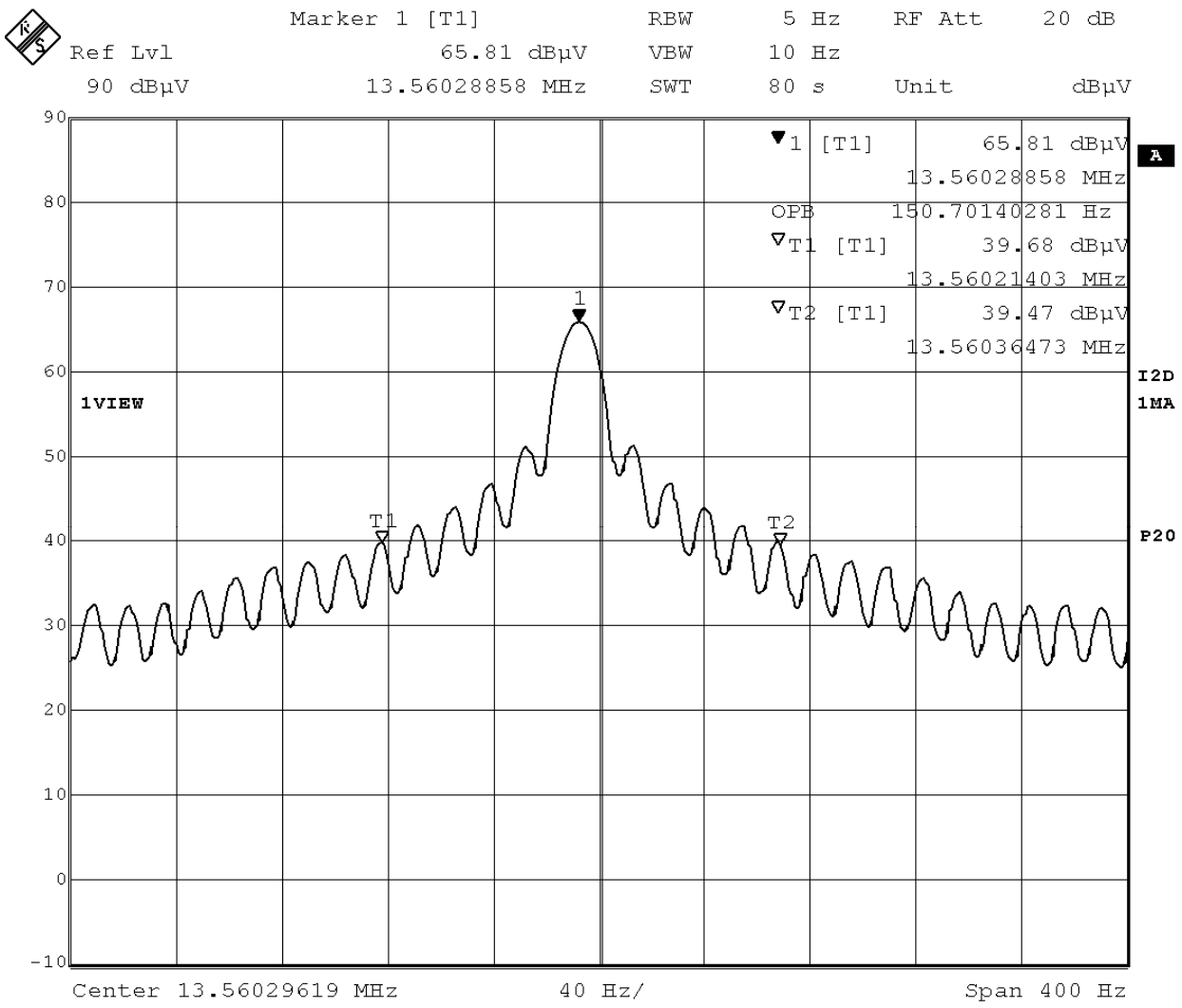
20dB bandwidth



99% power bandwidth

5 In-Band Radiated Spurious Emissions (Transmitter)

5.1 Test Limits

§ 15.225 Operation within the band 13.110-14.010 MHz.

(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.

5.2 Test Procedure

ANSI C63.10: 2014

5.3 Example of Field Strength Calculation Method:

The measured field strength was calculated by summing the readings taken from the spectrum analyzer with the appropriate correction factors associated with the antenna losses and cable losses. The calculation formula and sample calculations are listed below:

Formula:
FS = RA + AF + CF

FS = Field Strength in dBµV/m
RA = Receiver Amplitude in dBµV
AF = Antenna Factor in dB
CF = Cable Attenuation Factor in dB (Including preamplifier and filter attenuation)

Example Calculation:

RA = 19.48 dBµV
AF = 18.52 dB
CF = 0.78 dB

FS = 19.48 + 18.52 + 0.78 = 38.78 dBµV/m
Level in µV/m = Common Antilogarithm [(38.78 dBµV/m)/20] = 86.89 µV/m

5.4 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	1302.6005.40	Rohde & Schwarz	ESU40	9/19/2015	9/19/2016
Active Loop Antenna	3416	ETS	6502	6/2/2015	6/2/2016
System Controller	121701-1	Sunol Sciences	SC99V	Calibration Not Required	Calibration Not Required

5.5 Results:

The spurious emissions listed in the following tables are the worst case emissions. Emissions not reported were at or below the measurement noise floor.

Worst Case Spurious Emissions (NFC Radio Transmitting)

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Azimuth (deg)	Corr. (dB)	Comment
13.156134	-12.4	40.5	52.9	9kHz	0.0	-28.3	2:20:46 PM - 5/27/2016
13.316550	-8.43	40.5	48.93	9kHz	170.0	-28.3	2:27:12 PM - 5/27/2016
13.362760	-7.54	40.5	48.04	9kHz	169.0	-28.3	2:30:13 PM - 5/27/2016
13.429352	-13.41	50.4	63.81	9kHz	0.0	-28.3	2:23:42 PM - 5/27/2016
13.547126	-7.32	50.4	57.72	9kHz	0.0	-28.3	2:33:14 PM - 5/27/2016
13.560180	33.16	84.0	50.84	9kHz	90.0	-28.3	2:48:20 PM - 5/27/2016
13.577991	-17.21	50.4	67.61	9kHz	0.0	-28.3	2:36:41 PM - 5/27/2016
13.694262	-6.68	50.4	57.08	9kHz	171.0	-28.3	2:41:01 PM - 5/27/2016
13.741768	-10.48	40.5	50.98	9kHz	0.0	-28.3	2:46:28 PM - 5/27/2016

Notes:

(1) Peak detection was used.

(2) The test sample was evaluated in three orthogonal positions.

(3) All measurements were performed with a loop antenna positioned in three orthogonal axis with the level at the highest position being recorded.

(4) Measurements were performed at 3m distance and the level extrapolated to the specified measurement distance of 30m. An inverse linear distance extrapolation factor of 40dB/decade (from part 15.31(f)) was used to facilitate this. Extrapolation Factor = $20\log(30/3)^2$ = 40dB.

Manufacturer:	Crossmatch
Test Engineer:	Bryan Taylor
Date:	5/27/2016
Temp/Humidity/Pressure:	23.3C/47.4%/985.4mbar
Comment:	Transmitting an RFID Signal every second

6 Out of Band Radiated Spurious Emissions (Transmitter)

6.1 Test Limits

6.2 § 15.225 Operation within the band 13.110-14.010 MHz.

(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.

Part 15.209(a): Field General Strength Limits for Restricted Bands of Operation

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement 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

6.3 Test Procedure

ANSI C63.4: 2014

6.4 Example of Field Strength Calculation Method:

The measured field strength was calculated by summing the readings taken from the spectrum analyzer with the appropriate correction factors associated with the antenna losses and cable losses. The calculation formula and sample calculations are listed below:

Formula:
FS = RA + AF + CF

FS = Field Strength in dBµV/m
RA = Receiver Amplitude in dBµV
AF = Antenna Factor in dB
CF = Cable Attenuation Factor in dB (Including preamplifier and filter attenuation)

Example Calculation:

RA = 19.48 dBµV
AF = 18.52 dB
CF = 0.78 dB

FS = 19.48 + 18.52 + 0.78 = 38.78 dBµV/m
Level in µV/m = Common Antilogarithm [(38.78 dBµV/m)/20] = 86.89 µV/m

6.5 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	9/20/2015	9/20/2016
Preamplifier	SF456200904	Mini-Circuits	ZX60-3018G-S+	11/19/2015	11/19/2016
Bilog Antenna	145	AH Systems	SAS-521-4	3/4/2015	3/4/2017
Active Loop Antenna	3416	ETS	6502	6/2/2015	6/2/2016
System Controller	121701-1	Sunol Sciences	SC99V	Time of Use	Time of Use

6.6 Results:

All out of band emissions were below the general limits from Part 15.209. The sample was tested from 9kHz – 1GHz excluding the in band 13.110 – 14.010 MHz range. The spurious emissions listed in the following tables are the worst case emissions.

Worst Case Out of Band Spurious Emissions (NFC Radio Transmitting)

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.501000	30.67	40.00	9.33	120.000	358.9	V	153.0	23.7
40.620000	26.74	40.00	13.26	120.000	104.4	V	9.0	19.1
40.660000	25.86	40.00	14.14	120.000	401.5	V	200.0	19.0
40.742000	26.70	40.00	13.30	120.000	109.6	V	328.0	19.0
41.686000	25.51	40.00	14.49	120.000	320.8	V	-1.0	18.6
54.084000	24.79	40.00	15.21	120.000	117.4	V	192.0	14.9
54.180000	36.29	40.00	3.71	120.000	100.4	V	184.0	14.9
54.181000	37.11	40.00	2.89	120.000	107.6	V	181.0	14.9
62.493000	21.15	40.00	18.85	120.000	265.4	H	285.0	14.3
67.766000	22.94	40.00	17.06	120.000	107.0	V	126.0	14.2
67.820000	23.56	40.00	16.44	120.000	125.3	V	156.0	14.2
81.340000	24.45	40.00	15.55	120.000	118.3	V	208.0	15.6
81.400000	22.64	40.00	17.36	120.000	105.7	V	236.0	15.6
94.980000	23.33	43.52	20.19	120.000	123.7	V	285.0	16.7
108.420000	23.14	43.52	20.38	120.000	228.1	H	295.0	16.7
108.540000	23.06	43.52	20.46	120.000	105.1	V	248.0	16.7
122.020000	22.93	43.52	20.59	120.000	284.2	V	99.0	16.4
135.580000	23.02	43.52	20.50	120.000	330.7	V	156.0	16.5
149.180000	24.45	43.52	19.07	120.000	165.6	V	255.0	17.7

Notes:

(1) Quasi-Peak detection was used.

(2) All measurements below 30MHz were performed with a loop antenna positioned in three orthogonal axis with the level at the highest position being recorded.

(3) The test sample was evaluated in three orthogonal positions.

(4) All measurements above 30MHz were performed with a bilog antenna maximized from 1-4m in height and in vertical and horizontal polarities.

(5) Measurements were performed at 3m distance.

Manufacturer:	Crossmatch
Test Engineer:	Bryan Taylor
Date:	5/27/2016
Temp/Humidity/Pressure:	23.3C/47.4%/985.4mbar
Comment:	Transmitting an NFC Signal every second

7 AC Powerline Conducted Emissions

7.1 Test Limits

§ 15.107(e): Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

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

*Decreases with the logarithm of the frequency.

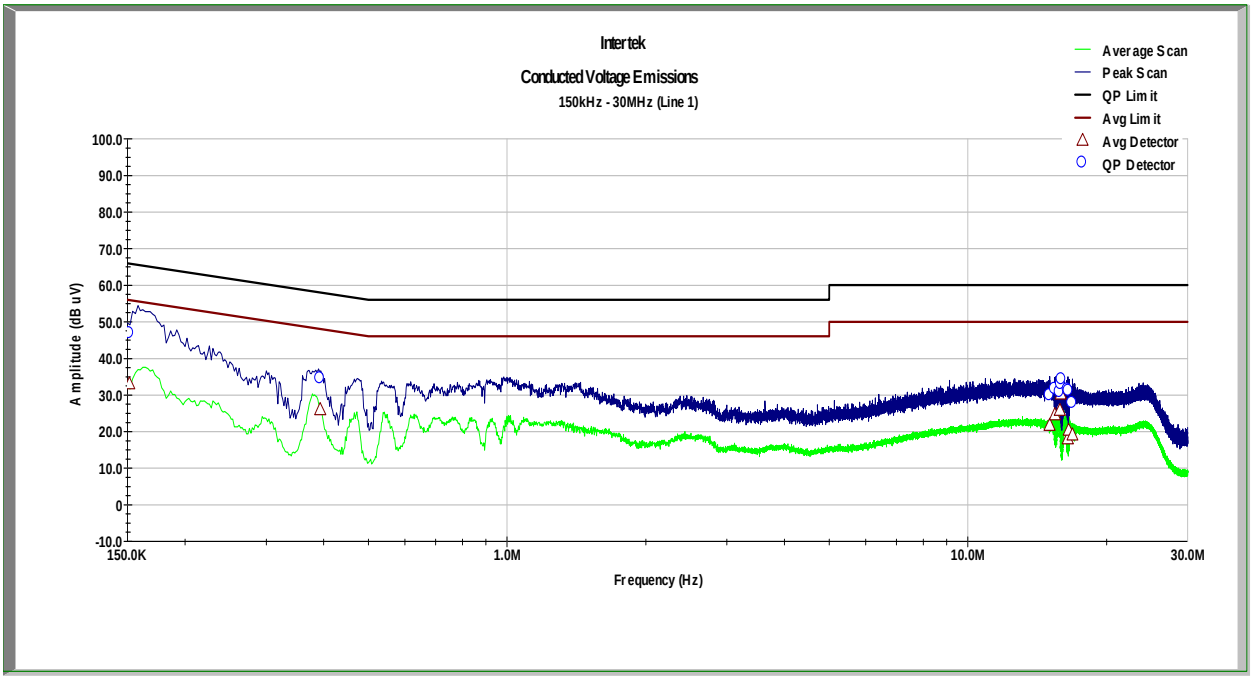
7.2 Test Procedure

ANSI C63.4: 2014

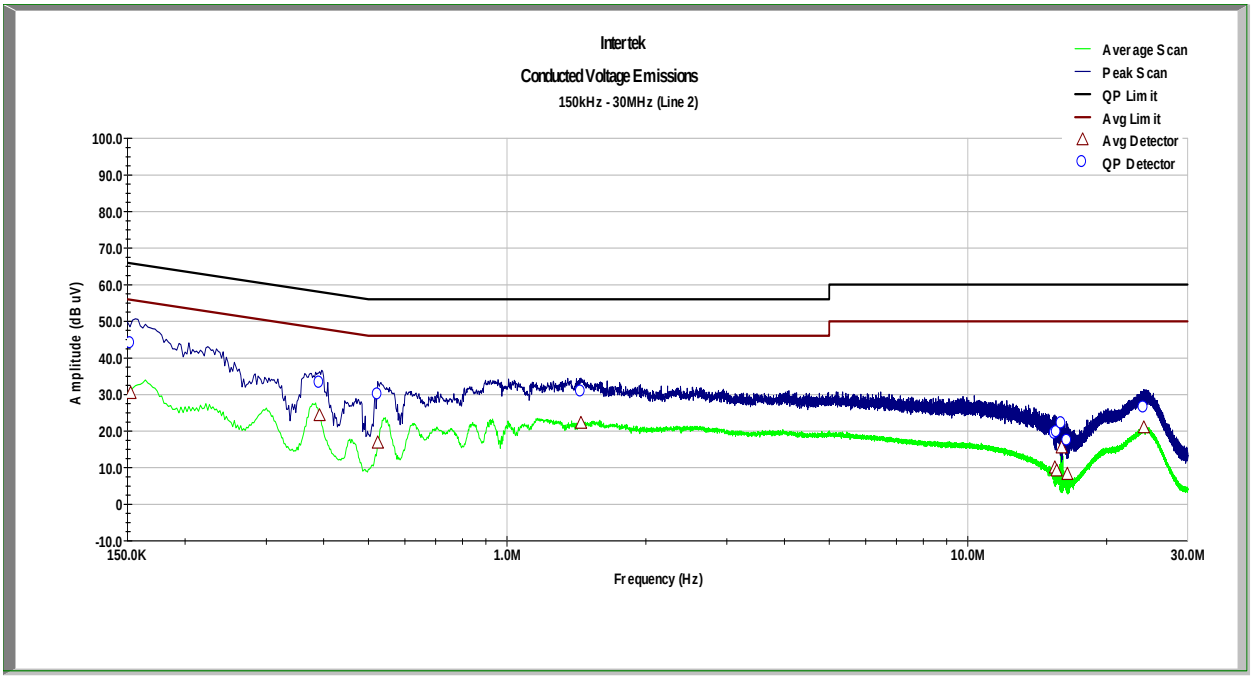
7.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	9/20/2015	9/20/2016
LISN	3333	Teseq	NNB52	5/21/2015	5/21/2016
Cable	Type N Cable “Cond 2”			11/19/2015	11/19/2016

7.4 Results:



Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
151.400 KHz	46.765	65.960	19.195	33.034	55.960	22.926
393.000 KHz	34.475	59.057	24.582	26.027	49.057	23.030
15.052 MHz	29.831	60.000	30.169	21.753	50.000	28.247
15.451 MHz	31.574	60.000	28.426	24.615	50.000	25.385
15.840 MHz	30.720	60.000	29.280	25.799	50.000	24.201
15.917 MHz	32.897	60.000	27.103	30.318	50.000	19.682
16.000 MHz	34.174	60.000	25.826	32.022	50.000	17.978
16.479 MHz	31.365	60.000	28.635	18.052	50.000	31.948
16.559 MHz	31.012	60.000	28.988	20.358	50.000	29.642
16.871 MHz	27.710	60.000	32.290	19.062	50.000	30.938



Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
152.300 KHz	43.887	65.934	22.048	30.333	55.934	25.601
391.700 KHz	33.050	59.094	26.044	24.194	49.094	24.900
524.000 KHz	29.907	56.000	26.093	16.732	46.000	29.268
1.446 MHz	30.641	56.000	25.359	22.150	46.000	23.850
15.444 MHz	19.188	60.000	40.812	9.893	50.000	40.107
15.589 MHz	19.572	60.000	40.428	9.099	50.000	40.901
15.983 MHz	21.944	60.000	38.056	15.430	50.000	34.570
16.441 MHz	17.271	60.000	42.729	8.149	50.000	41.851
24.097 MHz	26.337	60.000	33.663	20.889	50.000	29.111

8 Frequency Stability

8.1 Test Limits

8.2 § 15.225 Operation within the band 13.110-14.010 MHz.

(e) 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.

8.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3065	Rohde & Schwarz	FSP	9/18/2015	9/18/2016
Near Field Probe	2179	Com-Power	PS-400	Calibration Not Required	
Environmental Chamber	2164	Envirotronics	W-PH440-2-7.5	3/29/2016	3/29/2017

8.4 Results:

The data below shows that the test sample meets the frequency stability requirements from Part 15.225.

Frequency Stability Test Data

Operating Freqeuncy:		13,560,000	Hz		
Channel:		NFC			
Reference Voltage:		3.6	VAC		
Deviation Limit:		0.01	% =	135600	Hz
Notes:	Frequency Stability in Band 5				

Voltage (%)	Voltage (AC)	Temp (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)
100%	3.6	-30	13560537	537	0.0039602
100%	3.6	-20	13560524	524	0.0038643
100%	3.6	-10	13560462	462	0.0034071
100%	3.6	0	13560451	451	0.0033260
100%	3.6	10	13560448	448	0.0033038
100%	3.6	20	13560438	438	0.0032301
100%	3.6	30	13560427	427	0.0031490
100%	3.6	40	13560431	431	0.0031785
100%	3.6	50	13560442	442	0.0032596
100%	3.6	60	13560433	433	0.0031932
115%	4.1	20	13560437	437	0.0032227
85%	3.1	20	13560462	462	0.0034071

9 Antenna Requirement per FCC Part 15.203

9.1 Test Limits

§ 15.203: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

9.2 Results:

The sample tested met the antenna requirement. The device utilized an integral trace antenna.

10 Measurement Uncertainty

The measured value related to the corresponding limit will be used to decide whether the equipment meets the requirements.

The measurement uncertainty figures were calculated and correspond to a coverage factor of k = 2, providing a confidence level of respectively 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian).

Measurement uncertainty Table

Parameter	Uncertainty	Notes
Radiated emissions, 30 to 1000 MHz	±3.9dB	
Radiated emissions, 1 to 18 GHz	±4.2dB	
Radiated emissions, 18 to 40 GHz	±4.3dB	
Power Port Conducted emissions, 150kHz to 30 MHz	±2.8dB	

11 Revision History

Revision Level	Date	Report Number	Notes
0	6/10/2016	102570592LEX-002	Original Issue