



EMC TEST REPORT

FULL COMPLIANCE

Report Number: 100315802ATL-001B

Project Number: G100315802

Report Issue Date: March 1, 2016

Model(s) Tested: RFT-1

Standards: CFR47 FCC Part 15 Subpart C:2015 Section 15.35, 15.205, 15.209, 15.215, 15.247
CFR47 FCC Part 15 Subpart B:2015 Section 15.109
Industry Canada RSS-247 Issue 1 May 2015, Section 5
Industry Canada RSS-GEN Issue 4 November 2014

Tested by:
Intertek Testing Services NA, Inc.
1950 Evergreen Blvd, Suite 100
Duluth, GA 30096 USA

Client:
TPI Corporation - REDD-i Division
PO Box 4973
114 Roscoe Fitz
Johnson City, TN 37602-4973 USA

Report prepared by

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Report reviewed by

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1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. 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 **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Test Summary

Section	Test full name	Result
3	Client Information	--
4	Description of Equipment Under Test and Variant Models	--
5	System Setup and Method	--
-	AC Mains Conducted Emissions (CFR47 FCC Part 15 Subpart C:2015 Section 15.205, 15.209, 15.215, 15.247(d); Industry Canada RSS-247 Issue 1 May 2015, Section 5; Industry Canada RSS-GEN Issue 4 December 2014, Section 6.13) Battery operated device	N/A
6	Transmitter Antenna Port Conducted Spurious Emissions (CFR47 FCC Part 15 Subpart C:2015 Section 15.205, 15.209, 15.215, 15.247(d); Industry Canada RSS-247 Issue 1 May 2015, Section 5; Industry Canada RSS-GEN Issue 4 December 2014, Section 6.13)	Compliant
7	Transmitter Spurious Radiated Emissions (CFR47 FCC Part 15 Subpart C:2015 Section 15.205, 15.209, 15.215, 15.247(d); Industry Canada RSS-247 Issue 1 May 2015, Section 5; Industry Canada RSS-GEN Issue 3 December 2014, Section 6.13)	Compliant
8	Receiver Spurious Radiated Emissions (CFR47 FCC Part 15 Subpart B:2015 Section 15.109; Industry Canada RSS-GEN Issue 4 December 2014, Section 7.1)	Compliant
9	Carrier Frequency Separation (CFR47 FCC Part 15 Subpart C:2015 Section 15.247(a)(1); Industry Canada RSS-247 Issue 1 May 2015, Section 5)	Compliant
10	Number of Hopping Frequencies (CFR47 FCC Part 15 Subpart C:2015 Section 15.247(a)(1)(i); Industry Canada RSS-247 Issue 1 May 2015, Section 5)	Compliant
11	Time of Occupancy (Dwell Time) (CFR47 FCC Part 15 Subpart C:2015 Section 15.247(a)(1)(i); Industry Canada RSS-247 Issue 1 May 2015, Section 5)	Compliant

Section	Test full name	Result
12	Peak Output Power (CFR47 FCC Part 15 Subpart C:2015 Section 15.247(b)(2); Industry Canada RSS-247 Issue 1 May 2015, Section 5; Industry Canada RSS-GEN Issue 4 December 2014, Section 6.12)	Compliant
13	Bandedge (CFR47 FCC Part 15 Subpart C:2015 Section 15.205, 15.215, 15.247(d); Industry Canada RSS-247 Issue 1 May 2015, Section 5)	Compliant
14	20dB and Occupied Bandwidth (CFR47 FCC Part 15 Subpart C:2015 Section 15.215; 15.247(a)(1)(i); Industry Canada RSS-247 Issue 1 May 2015, Section 5; Industry Canada RSS-GEN Issue 4 December 2014, Section 6.6)	Compliant
15	RF Exposure Compliance (CFR47 FCC Part 15 Subpart C:2014 Section 15.215; 15.247(i); Industry Canada RSS-GEN Issue 4 December 2014, Section 3.2)	Compliant
16	Duty Cycle	Compliant
17	Revision History	--

3 Client Information

This EUT was tested at the request of:

Client: TPI Corporation - REDD-i Division
PO Box 4973
114 Roscoe Fitz
Johnson City, TN 37602-4973
USA

Contact: Tim Maden
Telephone: 423-477-4131
Fax: 423-477-8201
Email: Tmaden@tpicorp.com

4 Description of Equipment Under Test and Variant Models

Manufacturer: TPI Corporation - REDD-i Division
PO Box 4973
114 Roscoe Fitz
Johnson City, TN 37602-4973
USA

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Relay Package	TPI Corporation	RFT-1	Intertek Assigned: ATL1507281024-002 – Radiated Sample
Relay Package	TPI Corporation	RFT-1	Intertek Assigned: ATL1509041002-001 – Conducted Sample

Receive Date:	07/28/2015 and 09/04/2015
Received Condition:	Good
Type:	Production

Description of Equipment Under Test (provided by client)

The product is a wireless interface between a thermostat and a remotely located HVAC relay electronics using short-range radios operating in the 915MHz ISM band. The system is a point-to-point configuration with both ends located indoors. The thermostat end of the system is battery powered. The relay end of the communication link is typically located within 100 feet of the thermostat unit and is powered from wall current.

Equipment Under Test Power Configuration

Rated Voltage	Rated Current	Rated Frequency	Number of Phases
3 Vdc	28 mA	N/A	N/A

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Continuous Transmission with hopping function enabled
2	Continuous Transmission with hopping function disabled
3	Continuous Receiving

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	SD (Setback On-Demand) Thermostat software

Radio/Receiver Characteristics	
Frequency Band(s)	914.0 to 926.6 MHz
Modulation Type(s)	F1D
Maximum Output Power	10 dBm
Test Channels	Low, Mid and High
Occupied Bandwidth	Low channel = 380 kHz; Mid channel and High channels = 375 kHz
Frequency Hopper: Number of Hopping Channels	64
Frequency Hopper: Channel Dwell Time	395 ms
Frequency Hopper: Max interval between two instances of use of the same channel	25.6 seconds
MIMO Information (# of Transmit and Receive antenna ports)	N/A
Equipment Type	Standalone
ETSI LBT/Adaptivity	N/A
ETSI Adaptivity Type	N/A
ETSI Temperature Category (I, II, III)	N/A
ETSI Receiver Category (1, 2, 3)	N/A
Antenna Type and Gain	50 Ohm inverted F type, 0.0 dBi

5 System Setup and Method

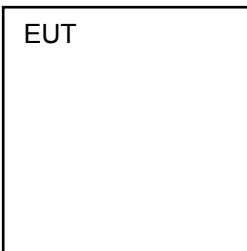
Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
None					

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
None			

5.1 Method:

Configuration as required by Configuration as required by ANSI C63.10: 2013 and FCC Public Notice DA 00-705 Released March 30, 2000: Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

5.2 EUT Block Diagram:



6 Transmitter Antenna Port Conducted Spurious Emissions

6.1 Method

Tests are performed in accordance with CFR47 FCC Part 15 Subpart C: 2015 Section 15.205, 15.247(d); Industry Canada RSS-247 Issue 1 May 2015, Section 5; Industry Canada RSS-GEN Issue 4 December 2014 Section 8.8

TEST SITE: Shielded Room

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

6.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
211872;	Barometer, Temperature, and Humidity sensor - Network based. Also marked as iServer MicroServer.	Omega	iBTHX-W	0240116	11/07/2014	11/07/2015
Borrowed;	EMC Analyzer	Agilent	E7405A	US3915014	08/03/2015	08/03/2016
None;	5 dB Attenuator	Mini-Circuits	VAT -5+	15542	VBV	Verified
None;	5 dB Attenuator	Mini-Circuits	VAT -5+	15542	VBV	Verified
E208;	RF Coax Cable	Megaphase	TM18-N1N1-120	14065201-002	05/07/2015	05/07/2016

Software Utilized:

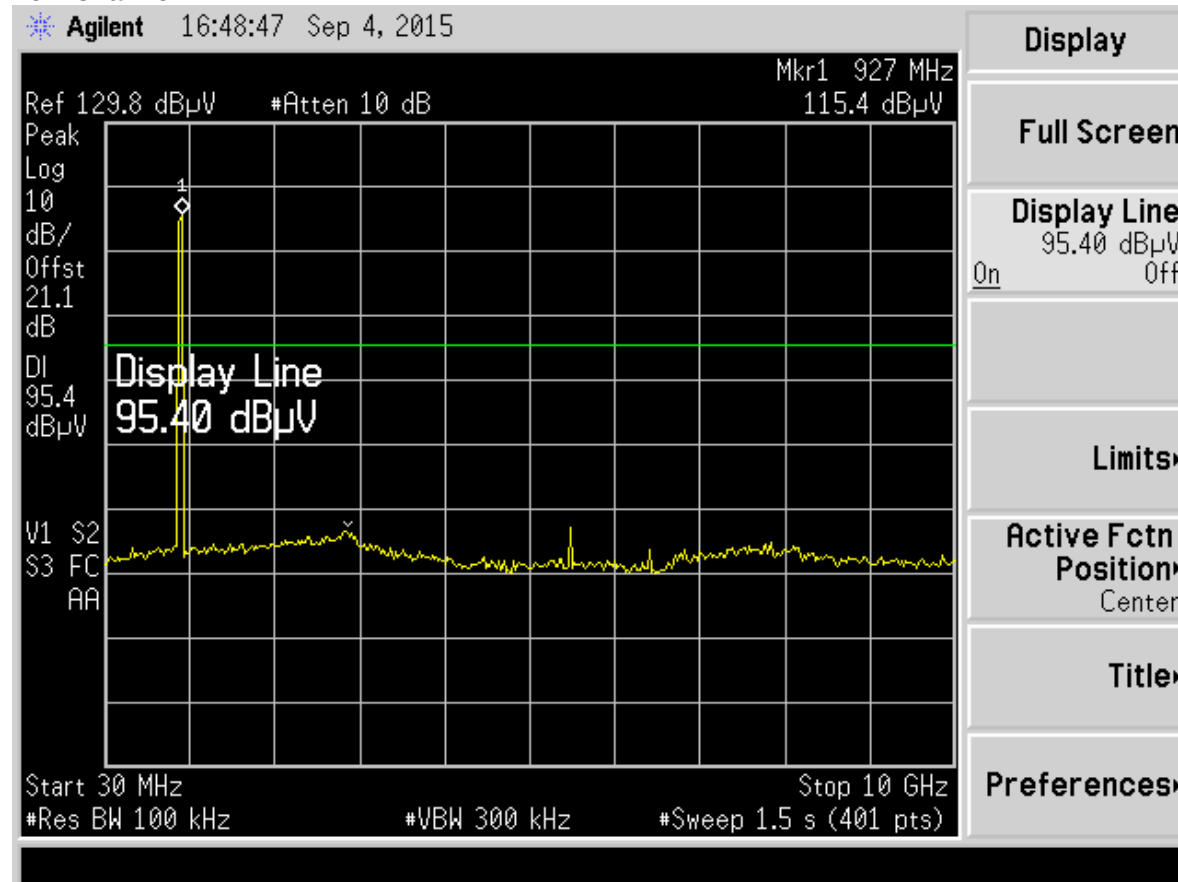
Name	Manufacturer	Version
None (Spectrum Analyzer Firmware)		

6.3 Results:

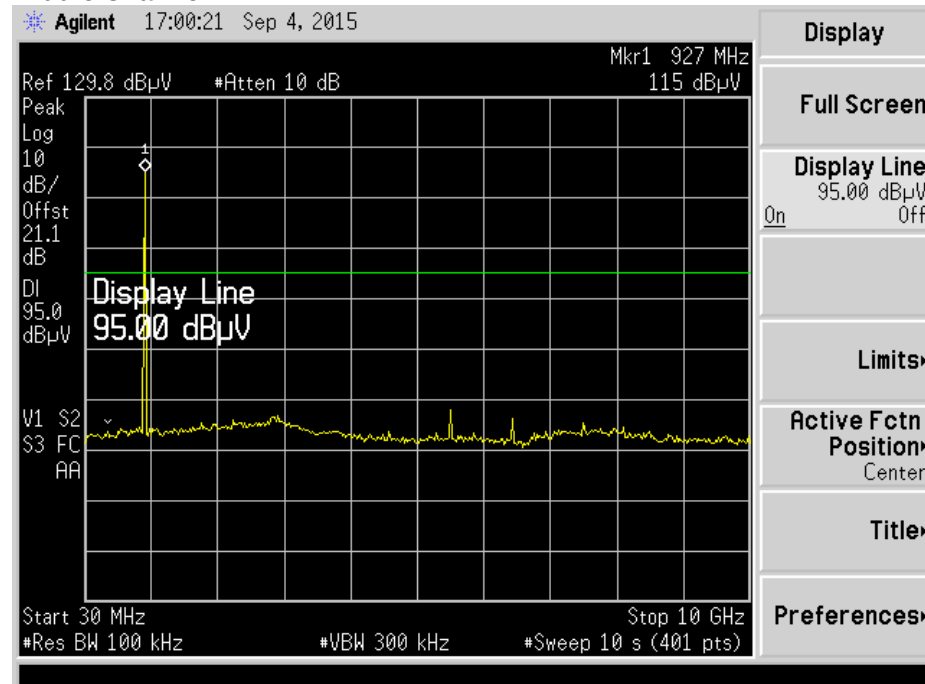
The sample tested was found to Comply. Testing was performed with hopping disabled and EUT transmitting on low, mid and high channels.

6.4 Plots/Data:

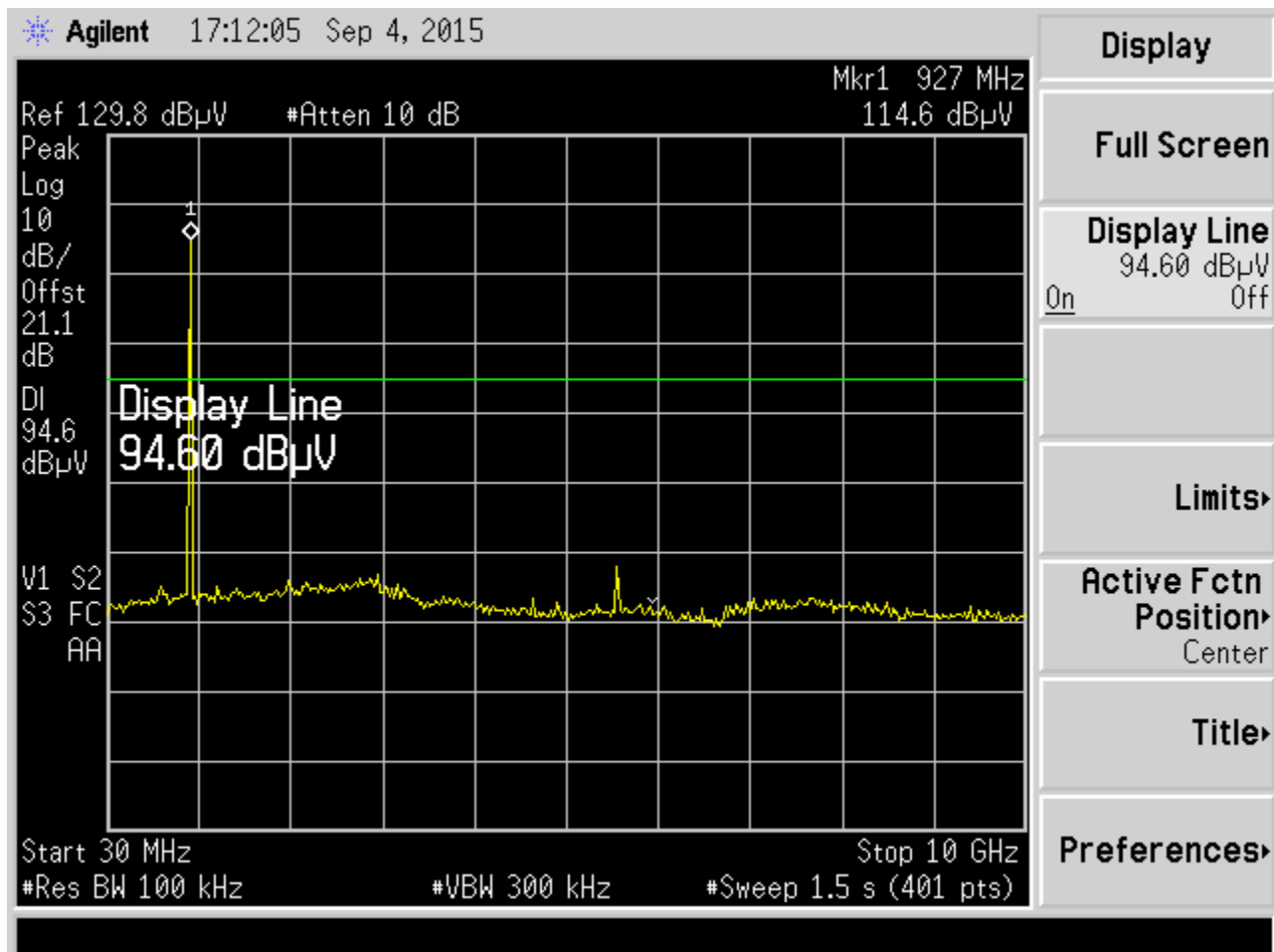
Low Channel



Middle Channel



High Channel



Test Personnel: Mary Sampson *MTS*
Supervising/Reviewing Engineer:
(Where Applicable) N/A
Product Standard: FCC 15.205, 15.209, 15.215,
15.247, IC RSS-247, IC RSS-GEN
Input Voltage: 24Vac

Test Date: 09/04/2015

Limit Applied: 15..209, 15.215, 15.247,
IC RSS-247

Ambient Temperature: 23.8 °C
Relative Humidity: 48.5 %
Atmospheric Pressure: 982.1 mbars

Deviations, Additions, or Exclusions: None

7 Transmitter Spurious Radiated Emissions

7.1 Method

Tests are performed in accordance with CFR47 FCC Part 15 Subpart C: 2015 Section 15.205, 15.209, 15.247(d); Industry Canada RSS-247 Issue 1 May 2015, Section 5; Industry Canada RSS-GEN Issue 4 December 2014.

TEST SITE: 10m Semi-Anechoic Chamber

10 Meter Semi-Anechoic Chamber The test site for radiated emissions is located at 1950 Evergreen Blvd, Suite 100, Duluth, Georgia 30096. It is a 10 meter semi-anechoic chamber manufactured by Panashield. Embedded in the floor is a 3 meter diameter turntable.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucisp
Radiated Emissions, 10m	30-1000 MHz	3.6 dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	3.9 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.2 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	4.2 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	4.2 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.2 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where

- FS = Field Strength in dB μ V/m
- RA = Receiver Amplitude (including preamplifier) in dB μ V
- CF = Cable Attenuation Factor in dB
- AF = Antenna Factor in dB
- AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

$$RA = 52.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB/m}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$FS = 32 \text{ dB}\mu\text{V/m}$$

To convert from dB μ V to μ V or mV the following was used:

$$UF = 10^{(NF / 20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

NF = Net Reading in dB μ V

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V/m}$$

7.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
211872;	Barometer, Temperature, and Humidity sensor - Network based. Also marked as iServer MicroServer.	Omega	iBTHX-W	0240116	11/07/2014	11/07/2015
TT7;	RF Coax Cable	Andrews	FSJ2-50	A001827924	06/10/2015	06/10/2016
MP3;	Cable MP3, 18 GHz, N, 10m	Megaphase	G919-NKNK-394	MP3	05/07/2015	05/07/2016
E207;	RF Coax Cable	Megaphase	TM18-N1N1-120	14065201-001	05/07/2015	05/07/2016
E209;	RF Coax Cable	Megaphase	TM18-N1N1-120	14065201-003	05/07/2015	05/07/2016
200162;	EMI Receiver (20Hz-40GHz)	Rohde & Schwarz	ESU 40	100314	03/02/2015	03/02/2016
211386;	Antenna, BiLog, 20-2000MHz	Chase	CBL6112B	2622	12/18/2014	12/18/2015
200082;	Preamplifier, 20MHz to 2GHz, 40 dB	A.H. Systems	PAM-0202	203	03/13/2015	03/13/2016
213061;	Antenna, Horn, <18 GHz	EMCO	3115	9208-3919	07/27/2015	07/27/2016
200108;	Preamplifier, 20 MHz to 18 GHz, 40 dB	A.H. Systems	PAM-0118	199	12/03/2014	12/03/2015
211873;	Barometer, Temperature, and Humidity sensor - Network based. Also marked as iServer MicroServer.	Omega	iBTHX-W	0240115	12/09/2014	12/09/2015
211897;	Digital Pocket Thermometer and Hydrometer	Mannix	SAM700BAR	none	01/07/2015	01/07/2016

Software Utilized:

Name	Manufacturer	Version
Tile	Quantum Change	3.4.K.22

7.3 Results:

The sample tested was found to Comply. Testing was performed with EUT in X, Y, Z axis and transmitting on low, middle and high channels. Worst case data presented in section 8.5.

7.4 Setup Photographs:

Below 1 GHz



Above 1 GHz



7.5 Test Data:

Client: TPI Corporation Model Number: RFT-1 Project Number: G100315802 Tested By: MTS Date: 10/16/2015 Frequency Range (MHz): 30 to 1000 Input power: 3 Vdc, 2 x AAA batteries	Receiver: R&S ESU40 Antenna: Chase 2622 Cables: TT-7+TW2+E-207+E-209 Preamplifier: PAM-0202 Test Distance (m): 10 Limit: FCC15 Class B-10m
---	---

NOTE: TX High ch, Z-Axis **Modifications for compliance (y/n):** n

A	B	C	D	E	F	G	H	I	J
Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Net dB(uV/m)	10m Limit dB(uV/m)	Margin dB	Detectors / Bandwidths Det/RBW
H	926.600	88.3	21.2	5.9	41.2	74.3	114.0	-39.7	PK/120kHz
H	926.600	88.2	21.2	5.9	41.2	74.2	114.0	-39.8	QP/120kHz
H	30.970	38.0	17.9	1.1	40.8	16.2	29.5	-13.3	PK/120kHz
H	30.970	32.2	17.9	1.1	40.8	10.4	29.5	-19.1	QP/120kHz
H	643.137	37.6	18.9	4.9	40.7	20.7	35.5	-14.8	PK/120kHz
H	643.137	31.3	18.9	4.9	40.7	14.4	35.5	-21.1	QP/120kHz
H	972.549	37.9	21.6	6.1	41.2	24.3	43.5	-19.2	PK/120kHz
H	972.549	31.6	21.6	6.1	41.2	18.0	43.5	-25.5	QP/120kHz
V	826.079	37.6	20.1	5.5	41.0	22.1	35.5	-13.4	PK/120kHz
V	826.079	31.4	20.1	5.5	41.0	15.9	35.5	-19.6	QP/120kHz
V	996.023	38.1	21.4	6.2	41.3	24.5	43.5	-19.0	PK/120kHz
V	996.023	31.6	21.4	6.2	41.3	18.0	43.5	-25.5	QP/120kHz
Calculations		G=C+D+E-F		I=G-H					

Client: TPI Corporation
Model Number: RFT-1
Project Number: G100315802
Tested By: MTS
Date: 6/3/15

Receiver: R&S ESU40
Antenna: EMCO 3115
Cables: MP8+MP3+E-207+E-209
Preamp: HP8449B-213191
Limit: FCC15 Class B-3m

Frequency Range (MHz): 1000-10000

Test Distance (m): 3

Input power: Battery

Modifications for compliance (y/n): n

Notes: TX mode @1.5m table height, Z-Axis

A	B	C	D	E	F	G	H	I	J	K
Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Duty Cycle Factor dB	Net dB(uV/m)	3m Limit dB(uV/m)	Margin dB	Det/RBW
Low Channel										
V	1827.806	44.1	26.7	4.3	41.0	0.0	34.1	105.5	-71.4	PK/1MHz
V	1827.806	44.1	26.7	4.3	41.0	40.0	-5.9	85.5	-91.4	AVG/1MHz
V	2741.000	35.4	28.9	5.4	41.2	0.0	28.5	74.0	-45.5	PK/1MHz
V	2741.000	35.4	28.9	5.4	41.2	40.0	-11.5	54.0	-65.5	AVG/1MHz
V	3654.000	34.4	31.8	6.3	41.4	0.0	31.1	74.0	-42.9	PK/1MHz
V	3654.000	34.4	31.8	6.3	41.4	40.0	-8.9	54.0	-62.9	AVG/1MHz
V	9579.700	34.5	31.8	6.3	41.4	0.0	31.2	74.0	-42.8	PK/1MHz
V	9579.700	34.5	31.8	6.3	41.4	40.0	-8.8	54.0	-62.8	AVG/1MHz
Mid Channel										
H	1840.600	44.5	28.9	4.3	41.0	0.0	36.7	74.0	-37.3	PK/1MHz
H	1840.600	44.5	28.9	4.3	41.0	40.0	-3.3	54.0	-57.3	AVG/1MHz
H	3681.181	36.7	27.0	4.3	41.0	0.0	27.0	74.0	-47.0	PK/1MHz
H	3681.181	36.7	27.0	4.3	41.0	40.0	-13.0	54.0	-67.0	AVG/1MHz
High Channel										
H	1853.200	46.7	27.0	4.3	41.0	0.0	37.0	74.0	-37.0	PK/1MHz
H	1853.200	46.7	27.0	4.3	41.0	40.0	-3.0	54.0	-57.0	AVG/1MHz
H	1852.978	47.0	27.0	4.3	41.0	0.0	37.3	74.0	-36.7	PK/1MHz
H	1852.978	47.0	27.0	4.3	41.0	40.0	-2.7	54.0	-56.7	AVG/1MHz
Calculations		H=C+D+E+F-G			J=I-H					

Test Personnel: Mary Sampson *MTS*
Supervising/Reviewing Engineer:
 (Where Applicable) N/A
Product Standard: FCC 15.205, 15.209, 15.215, 15.247, IC RSS-247
Input Voltage: 3 Vdc
Pretest Verification w/ Ambient Signals or BB Source: BB Source

Test Date: 06/03 and 10/16/2015
Limit Applied: FCC 15.205, 15.209, 15.215, 15.247, IC RSS-247
Ambient Temperature: 23.8 and 21.8 °C
Relative Humidity: 46.8 and 45.8 %
Atmospheric Pressure: 981.2 and 986.6 mbars

Deviations, Additions, or Exclusions: None

8 Receiver Spurious Radiated Emissions

8.1 Method

Tests are performed in accordance with in accordance with CFR 47 FCC Part 15 Subpart B: 2015 Section 15.109; Industry Canada RSS-GEN Issue 4 December 2014.

TEST SITE: TEST SITE: 10m Semi-Anechoic Chamber

10 Meter Semi-Anechoic Chamber The test site for radiated emissions is located at 1950 Evergreen Blvd, Suite 100, Duluth, Georgia 30096. It is a 10 meter semi-anechoic chamber manufactured by Panashield. Embedded in the floor is a 3 meter diameter turntable.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucisp
Radiated Emissions, 10m	30-1000 MHz	3.6 dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	3.9 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.2 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	4.2 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	4.2 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.2 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where FS = Field Strength in dB μ V/m
 RA = Receiver Amplitude (including preamplifier) in dB μ V
 CF = Cable Attenuation Factor in dB
 AF = Antenna Factor in dB
 AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

RA = 52.0 dB μ V
 AF = 7.4 dB/m
 CF = 1.6 dB
 AG = 29.0 dB
 FS = 32 dB μ V/m

To convert from dB μ V to μ V or mV the following was used:

$$UF = 10^{(NF / 20)} \text{ where UF = Net Reading in } \mu\text{V}$$

NF = Net Reading in dB μ V

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V/m}$$

8.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
211872;	Barometer, Temperature, and Humidity sensor - Network based. Also marked as iServer MicroServer.	Omega	iBTHX-W	0240116	11/07/2014	11/07/2015
TT7;	RF Coax Cable	Andrews	FSJ2-50	A001827924	06/10/2015	06/10/2016
MP3;	Cable MP3, 18 GHz, N, 10m	Megaphase	G919-NKNK-394	MP3	05/07/2015	05/07/2016
E207;	RF Coax Cable	Megaphase	TM18-N1N1-120	14065201-001	05/07/2015	05/07/2016
E209;	RF Coax Cable	Megaphase	TM18-N1N1-120	14065201-003	05/07/2015	05/07/2016
200162;	EMI Receiver (20Hz-40GHz)	Rohde & Schwarz	ESU 40	100314	03/02/2015	03/02/2016
211386;	Antenna, BiLog, 20-2000MHz	Chase	CBL6112B	2622	12/18/2014	12/18/2015
200082;	Preamplifier, 20MHz to 2GHz, 40 dB	A.H. Systems	PAM-0202	203	03/13/2015	03/13/2016
213061;	Antenna, Horn, <18 GHz	EMCO	3115	9208-3919	07/27/2015	07/27/2016
200108;	Preamplifier, 20 MHz to 18 GHz, 40 dB	A.H. Systems	PAM-0118	199	12/03/2014	12/03/2015

Software Utilized:

Name	Manufacturer	Version
Tile	Quantum Change	3.4.K.22

8.3 Results:

The sample tested was found to Comply. Testing was performed with EUT in X,Y,Z axis in receive mode from 30 to 5000 MHz. Worst data presented in section 9.5.

8.4 Setup Photographs:

Below 1 GHz



Above 1 GHz

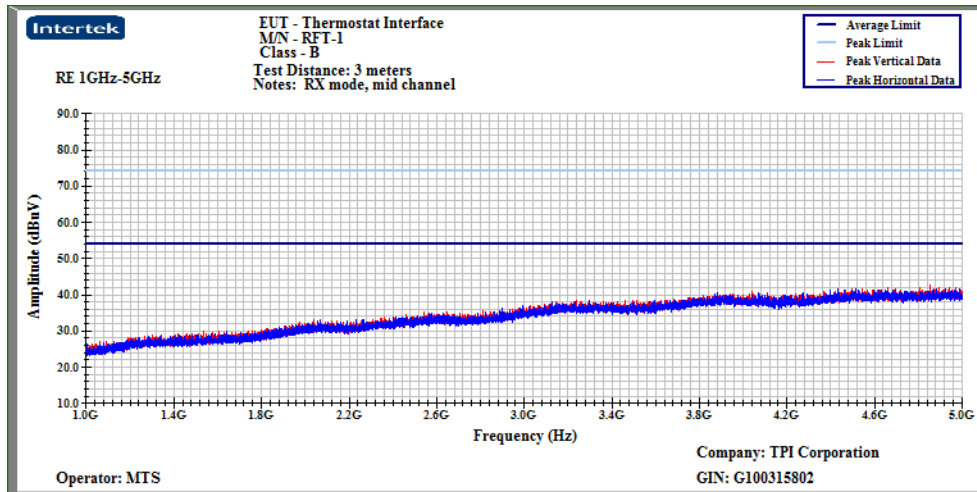


8.5 Plots/Data:

Client: TPI Corporation Model Number: RFT-1 Project Number: G100315802 Tested By: MTS Date: 10/16/2015 Frequency Range (MHz): 30 to 1000 Input power: 3 Vdc, 2 x AAA batteries	Receiver: R&S ESU40 Antenna: Chase 2622 Cables: TT-7+TW2+E-207+E-209 Preamp: PAM-0202 Test Distance (m): 10 Limit: FCC15 Class B-10m
---	---

NOTE: RX, MID ch, Z-Axis **Modifications for compliance (y/n):** n

A	B	C	D	E	F	G	H	I	J
Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Net dB(uV/m)	10m Limit dB(uV/m)	Margin dB	Detectors / Bandwidths Det/RBW
Noise floor readings									
V	30.097	31.9	19.0	1.1	40.9	11.2	29.5	-18.3	QP/120kHz
V	32.328	32.0	17.8	1.1	40.8	10.1	29.5	-19.4	QP/120kHz
V	113.323	31.5	12.1	2.1	40.7	5.0	33.0	-28.0	QP/120kHz
V	264.837	31.3	13.9	3.1	40.5	7.7	35.5	-27.8	QP/120kHz
V	890.875	31.3	20.2	5.7	41.1	16.2	35.5	-19.3	QP/120kHz
V	1000.000	31.4	21.5	6.2	41.3	17.9	43.5	-25.6	QP/120kHz
Calculations		G=C+D+E-F		I=G-H					



Test Personnel: Mary Sampson MTS
 Supervising/Reviewing Engineer: N/A
 (Where Applicable)
 Product Standard: FCC 15.109, IC RSS-GEN
 Input Voltage: 3 Vdc
 Pretest Verification w/ Ambient Signals or BB Source: BB Source

Test Date: 10/16/2015
 Limit Applied: FCC 15.109(a), IC RSS-GEN Section 6.1
 Ambient Temperature: 21.8 °C
 Relative Humidity: 45.8 %
 Atmospheric Pressure: 986.6 mbars

Deviations, Additions, or Exclusions: None

9 Carrier Frequency Separation

9.1 Method

Tests are performed in accordance with CFR47 FCC Part 15 Subpart C: 2015 Section 15.247(a)(1); Industry Canada RSS-247 Issue 1 May 2015, Section 5; Industry Canada RSS-GEN Issue 4 December 2014.

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

9.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
211873;	Barometer, Temperature, and Humidity sensor - Network based. Also marked as iServer MicroServer.	Omega	iBTHX-W	0240115	12/09/2014	12/09/2015
Borrowed;	EMC Analyzer	Agilent	E7405A	US3915014	08/03/2015	08/03/2016
200008;	Attenuator, 20 dB, <18GHz	Weinschel Corp	2	BK2323	01/07/2015	01/07/2016
E208;	RF Coax Cable	Megaphase	TM18-N1N1-120	14065201-002	05/07/2015	05/07/2016

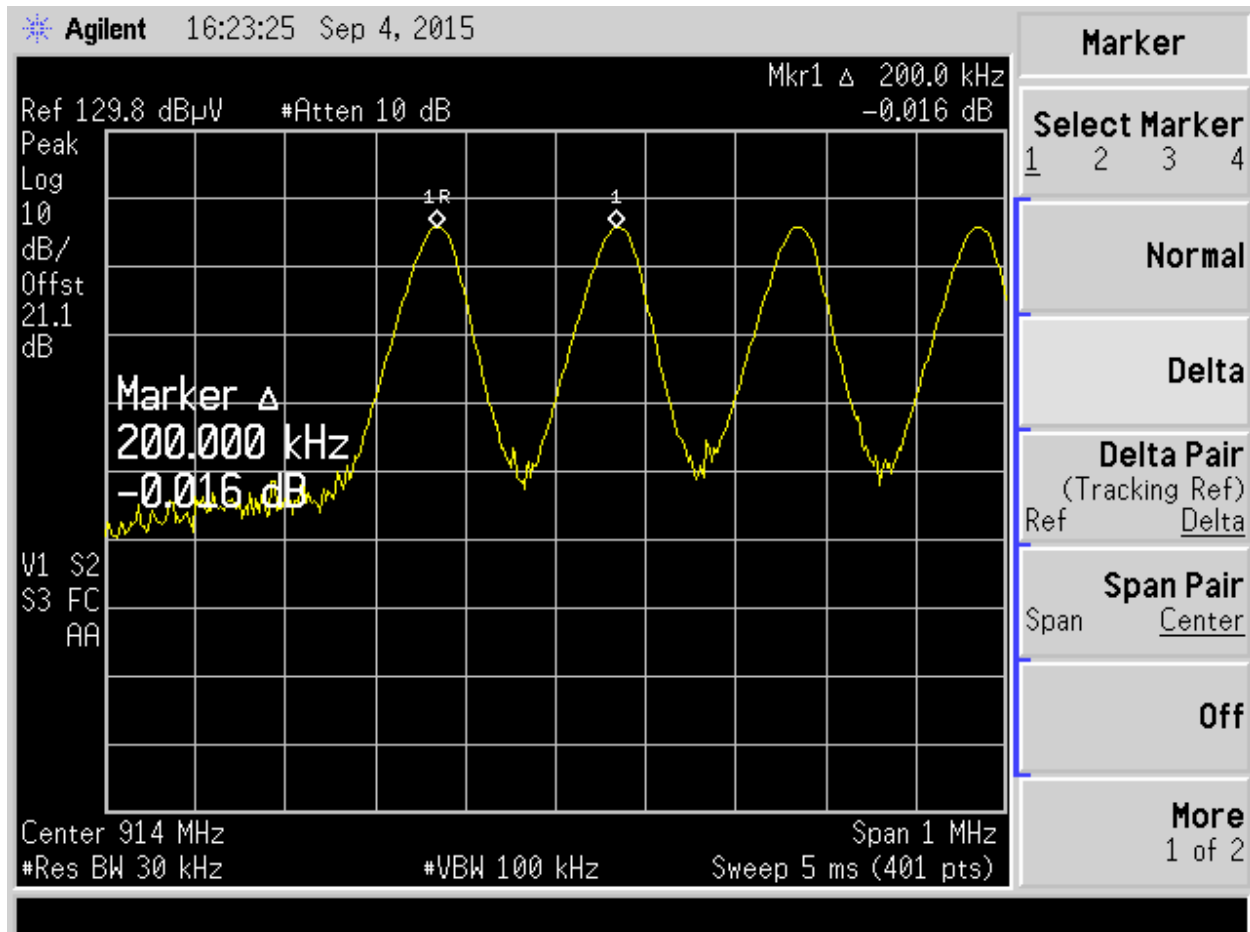
Software Utilized:

Name	Manufacturer	Version
None (Spectrum Analyzer Firmware)		

9.3 Results:

The sample tested was found to Comply. Carrier frequency separation is 200 kHz.

9.4 Plots/Data:



Test Personnel: Mary Sampson MTS

Supervising/Reviewing Engineer: N/A

(Where Applicable)

Product Standard: FCC 15.247, IC RSS-247

Input Voltage: 3 Vdc

Test Date: 9/4/2015

Limit Applied: FCC 15.247(a)(1), RSS-247 Section 5.1(2)

Ambient Temperature: 23.8 °C

Relative Humidity: 48.5 %

Atmospheric Pressure: 982.1 mbars

Deviations, Additions, or Exclusions: None

10 Number of Hopping Frequencies

10.1 Method

Tests are performed in accordance with CFR47 FCC Part 15 Subpart C: 2015 Section 15.247(a)(1)(i); Industry Canada RSS-247 Issue 1 May 2015, Section 5.

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

10.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
211873;	Barometer, Temperature, and Humidity sensor - Network based. Also marked as iServer MicroServer.	Omega	iBTHX-W	0240115	12/09/2014	12/09/2015
200008;	Attenuator, 20 dB, <18GHz	Weinschel Corp	2	BK2323	01/07/2015	01/07/2016
Borrowed;	EMC Analyzer	Agilent	E7405A	US3915014	08/03/2015	08/03/2016
E208;	RF Coax Cable	Megaphase	TM18-N1N1-120	14065201-002	05/07/2015	05/07/2016

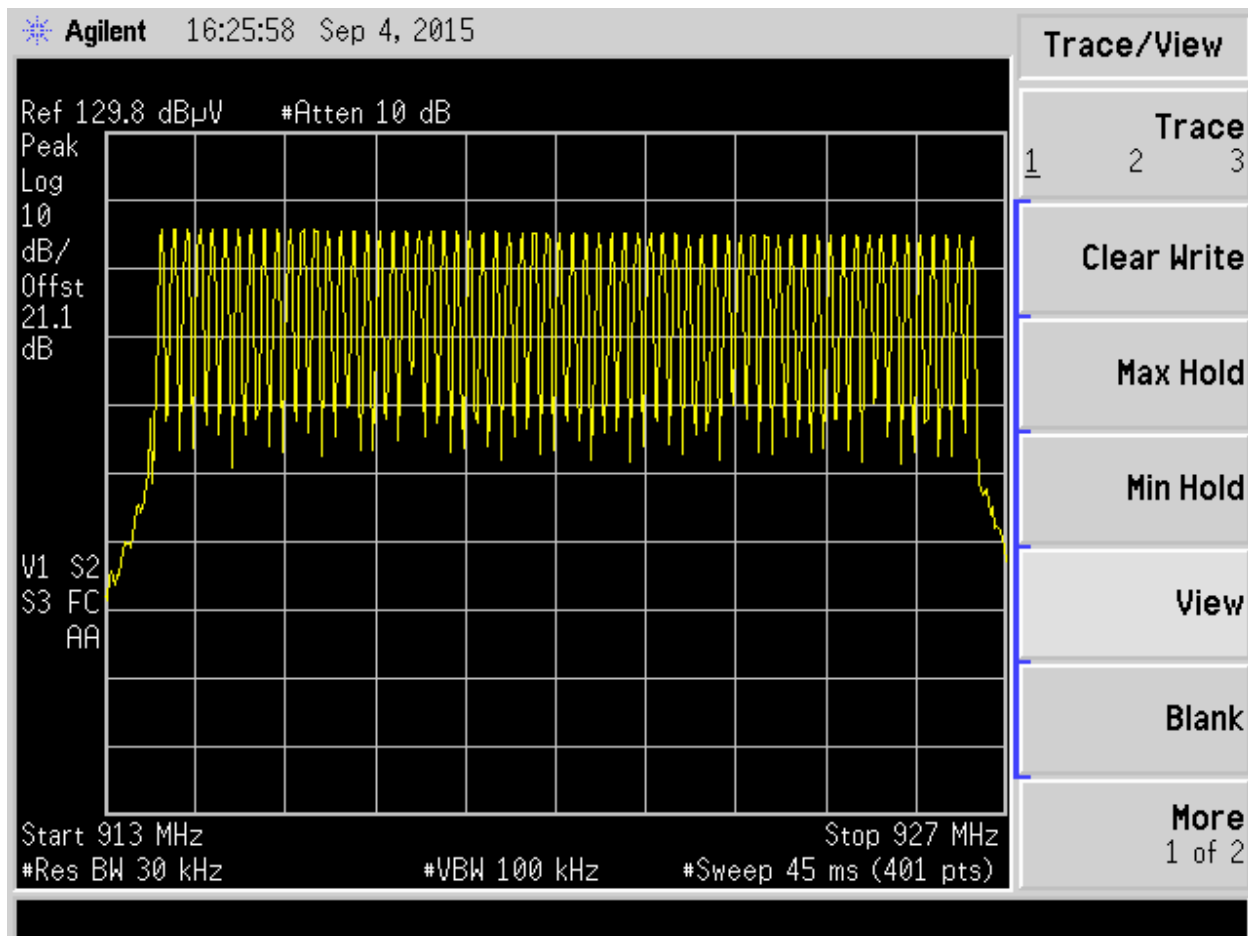
Software Utilized:

Name	Manufacturer	Version
None (Spectrum Analyzer Firmware)		

10.3 Results:

The sample tested was found to Comply. Number of hopping channels is 64.

10.4 Plots/Data:



Number of Hopping Channels Measured = 64 channels

Test Personnel: Mary Sampson MTS
Supervising/Reviewing Engineer:
(Where Applicable) N/A
Product Standard: FCC 15.247, IC RSS-247
Input Voltage: 3 Vdc

Test Date: 09/04/2015Limit Applied: FCC 15.247(a)(1)(i), RSS-247
Section 5.1(3)Ambient Temperature: 23.8 °CRelative Humidity: 48.5 %Atmospheric Pressure: 982.1 mbars

Deviations, Additions, or Exclusions: None

11 Time of Occupancy (Dwell Time)

11.1 Method

Tests are performed in accordance with CFR47 FCC Part 15 Subpart C: 2015 Section 15.247(a)(1)(i); Industry Canada RSS-247 Issue 1 May 2015, Section 5.1(3).

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

11.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
211873;	Barometer, Temperature, and Humidity sensor - Network based. Also marked as iServer MicroServer.	Omega	iBTHX-W	0240115	12/09/2014	12/09/2015
200008;	Attenuator, 20 dB, <18GHz	Weinschel Corp	2	BK2323	01/07/2015	01/07/2016
Borrowed;	EMC Analyzer	Agilent	E7405A	US3915014	08/03/2015	08/03/2016
E208;	RF Coax Cable	Megaphase	TM18-N1N1-120	14065201-002	05/07/2015	05/07/2016

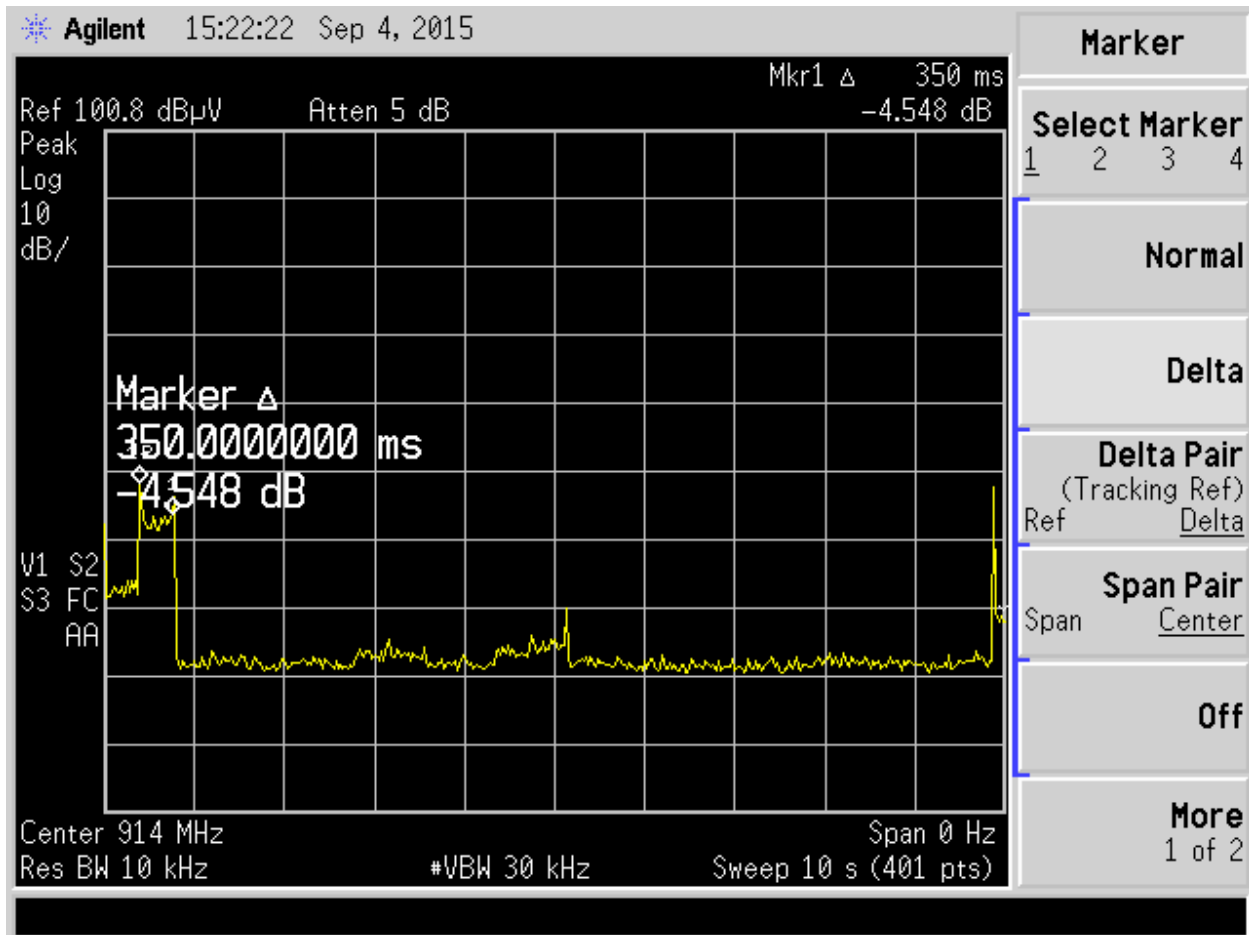
Software Utilized:

Name	Manufacturer	Version
None (Spectrum Analyzer Firmware)		

11.3 Results:

The sample tested was found to Comply. Time of occupancy is 350 ms out of 10 second period. Hopping was enabled.

11.4 Plots/Data:



Test Personnel: Mary Sampson MTS
 Supervising/Reviewing Engineer:
 (Where Applicable) N/A
 Product Standard: FCC 15.247, IC RSS-247
 Input Voltage: 24 Vac

Test Date: 09/4/2015

Limit Applied: FCC 15.247(a)(1), RSS-247
Section 5.1(3)

Ambient Temperature: 23.8 °C
 Relative Humidity: 48.5 %
 Atmospheric Pressure: 982.1 mbars

Deviations, Additions, or Exclusions: None

12 Conducted Peak Output Power

12.1 Method

Tests are performed in accordance with CFR47 FCC Part 15 Subpart C: 2015 Section 15.247(b)(2); Industry Canada RSS-247 Issue 1 May 2015, Section 5; Industry Canada RSS-GEN Issue 4 December 2014, Section 6.12.

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

12.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
211873;	Barometer, Temperature, and Humidity sensor - Network based. Also marked as iServer MicroServer.	Omega	iBTHX-W	0240115	12/09/2014	12/09/2015
200008;	Attenuator, 20 dB, <18GHz	Weinschel Corp	2	BK2323	01/07/2015	01/07/2016
Borrowed;	EMC Analyzer	Agilent	E7405A	US3915014	08/03/2015	08/03/2016
E208;	RF Coax Cable	Megaphase	TM18-N1N1-120	14065201-002	05/07/2015	05/07/2016

Software Utilized:

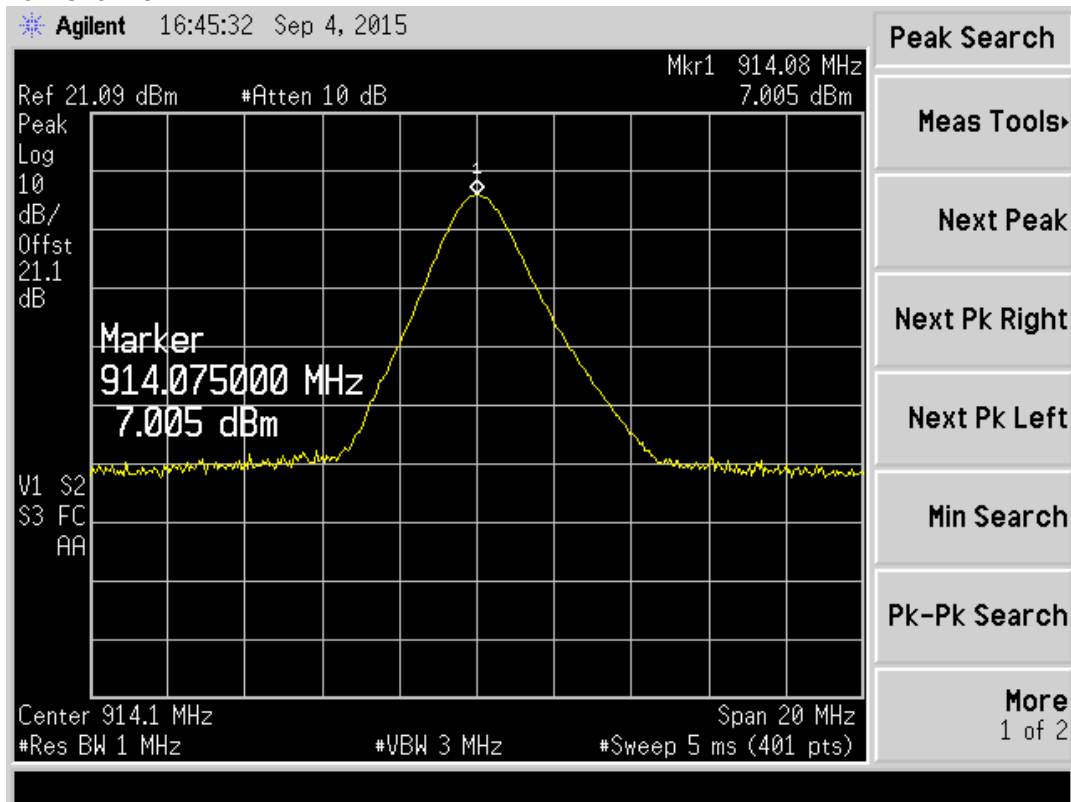
Name	Manufacturer	Version
None (Spectrum Analyzer Firmware)		

12.3 Results:

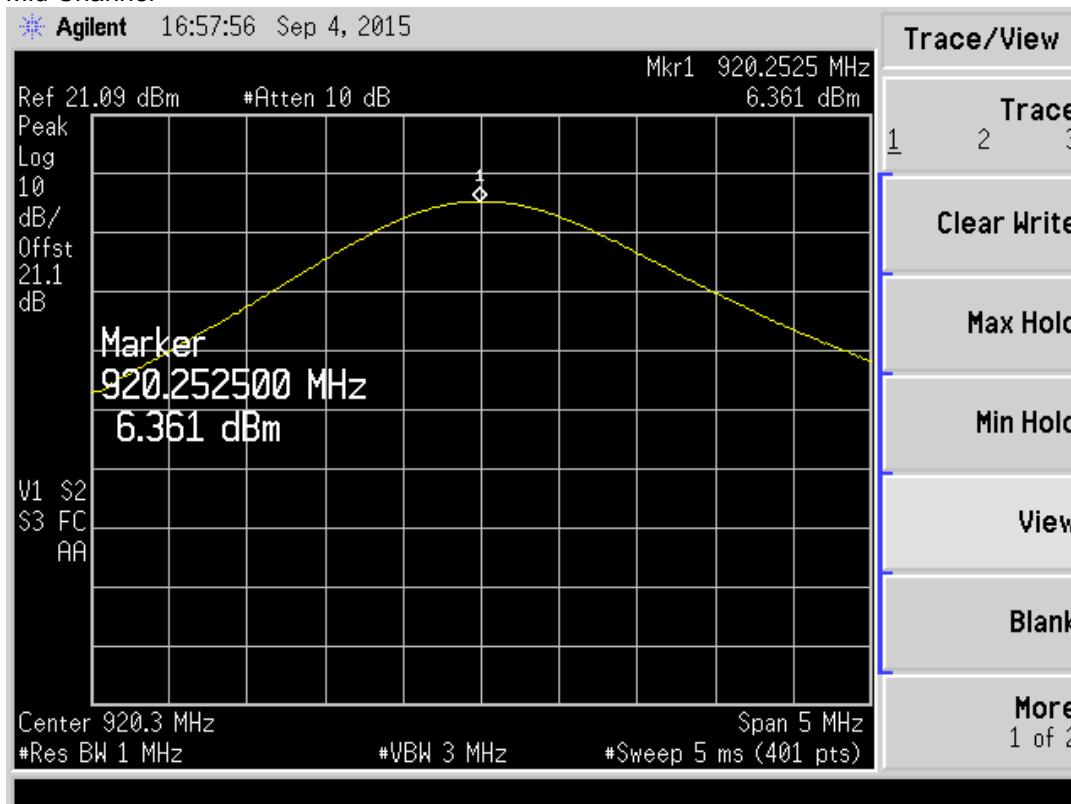
The sample tested was found to Comply. The highest conducted power measured was 7.005 dBm with device operating on low channel. Hopping was disabled.

12.4 Plots/Data:

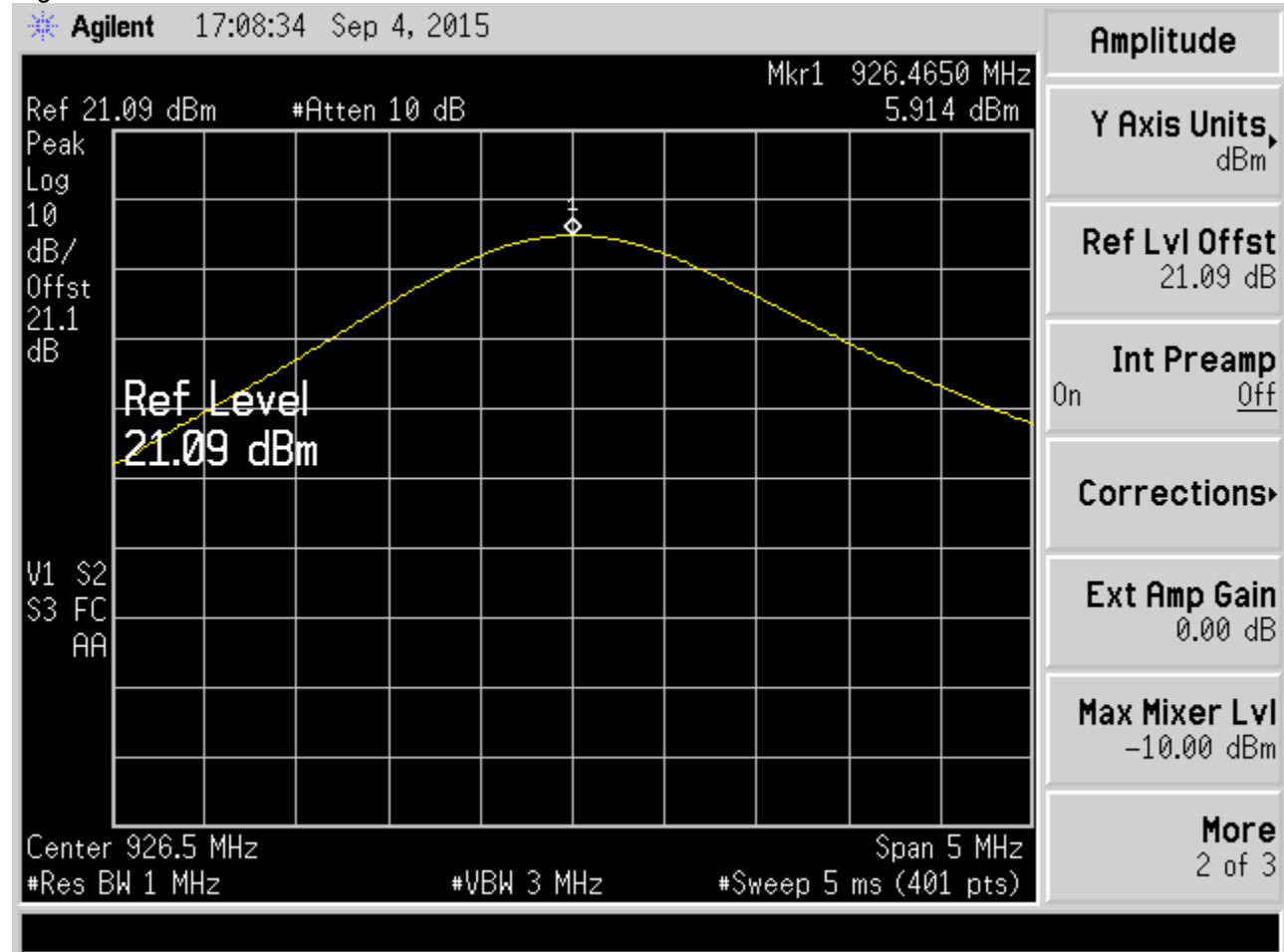
Low Channel



Mid Channel



High Channel



Test Personnel: Mary Sampson MTS

Supervising/Reviewing Engineer: N/A

(Where Applicable)

Product Standard: FCC 15.247, IC RSS-247

Input Voltage: 3 Vdc

Test Date: 09/04/2015

Limit Applied: FCC 15.247(a)(1), RSS-247 Section 5

Ambient Temperature: 23.8 °C

Relative Humidity: 48.5 %

Atmospheric Pressure: 982.1 mbars

Deviations, Additions, or Exclusions: None

13 Bandedge

13.1 Method

Tests are performed in accordance with Tests are performed in accordance with CFR47 FCC Part 15 Subpart C: 2015 Section 15.247(a)(1); Industry Canada RSS-247 Issue 1 May 2015.

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

13.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
211873;	Barometer, Temperature, and Humidity sensor - Network based. Also marked as iServer MicroServer.	Omega	iBTHX-W	0240115	12/09/2014	12/09/2015
E208;	RF Coax Cable	Megaphase	TM18-N1N1-120	14065201-002	05/07/2015	05/07/2016
Borrowed;	EMC Analyzer	Agilent	E7405A	US3915014	08/03/2015	08/03/2016
200008;	Attenuator, 20 dB, <18GHz	Weinschel Corp	2	BK2323	01/07/2015	01/07/2016
213309;	RF Coax Cable - 10MHz to 18GHz, 1 ft.	Hasco, Inc.	HULL320-S1-S1-12	14045577	09/17/2015	09/17/2016
213310;	RF Coax Cable - 10MHz to 18GHz, 1.5 ft.	Hasco, Inc.	HULL320-S1-S1-18	13105554	09/17/2015	09/17/2016

Software Utilized:

Name	Manufacturer	Version
None (Spectrum Analyzer Firmware)		

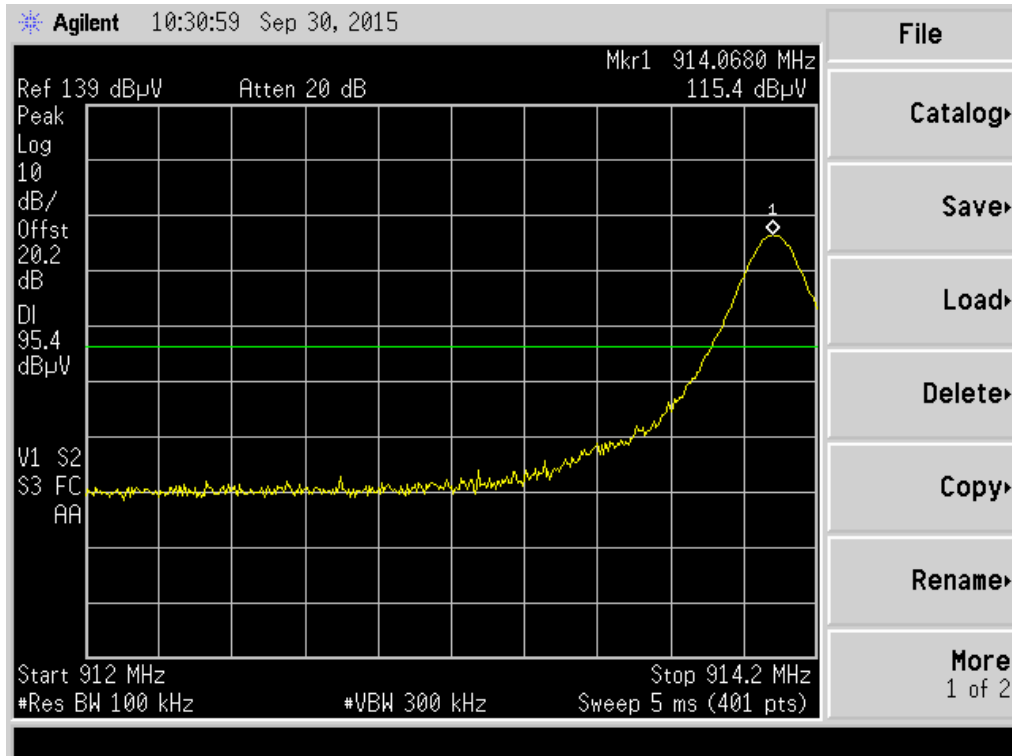
13.3 Results:

The sample tested was found to Comply.

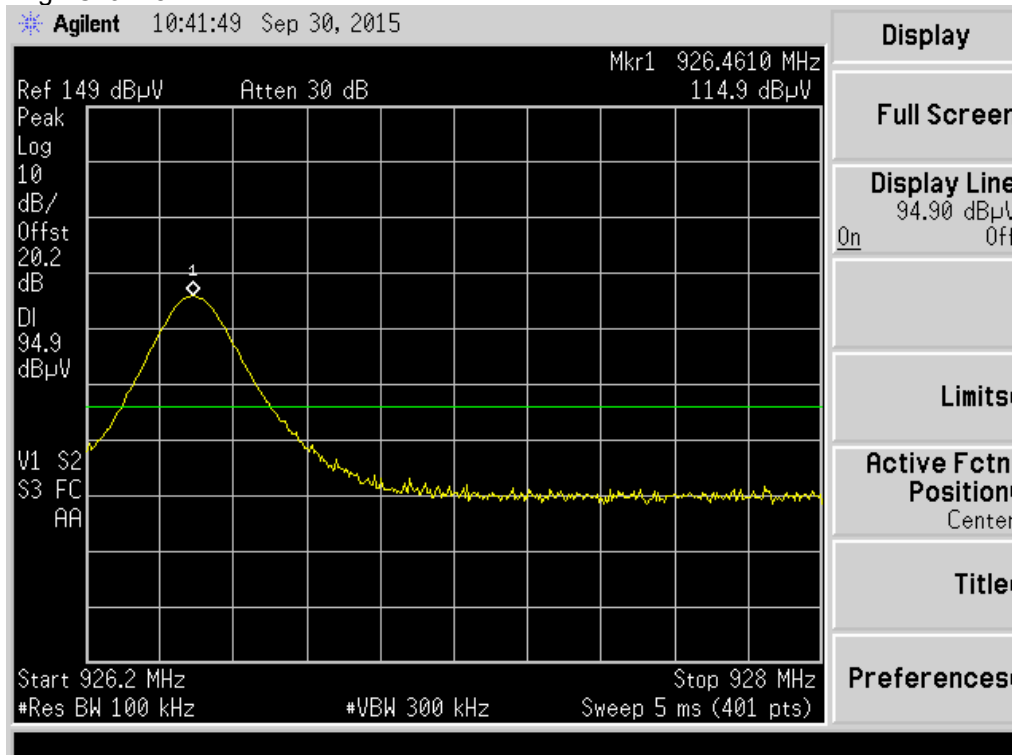
13.4 Plots/Data:

Hopping Disabled

Low Channel

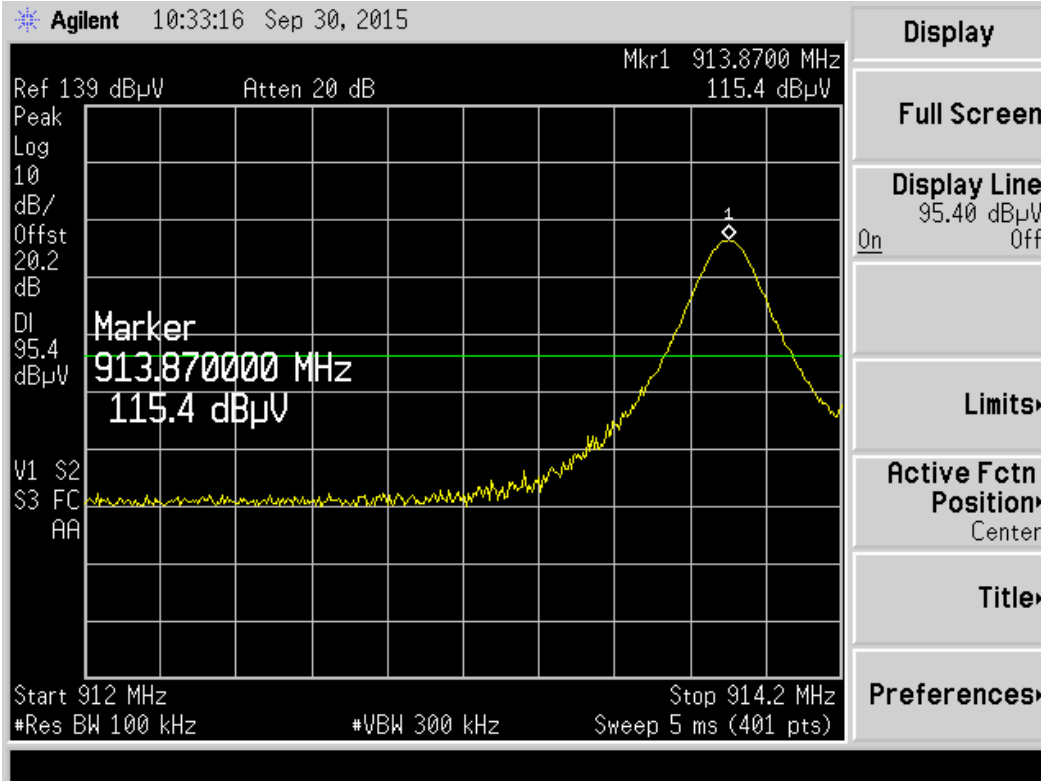


High Channel

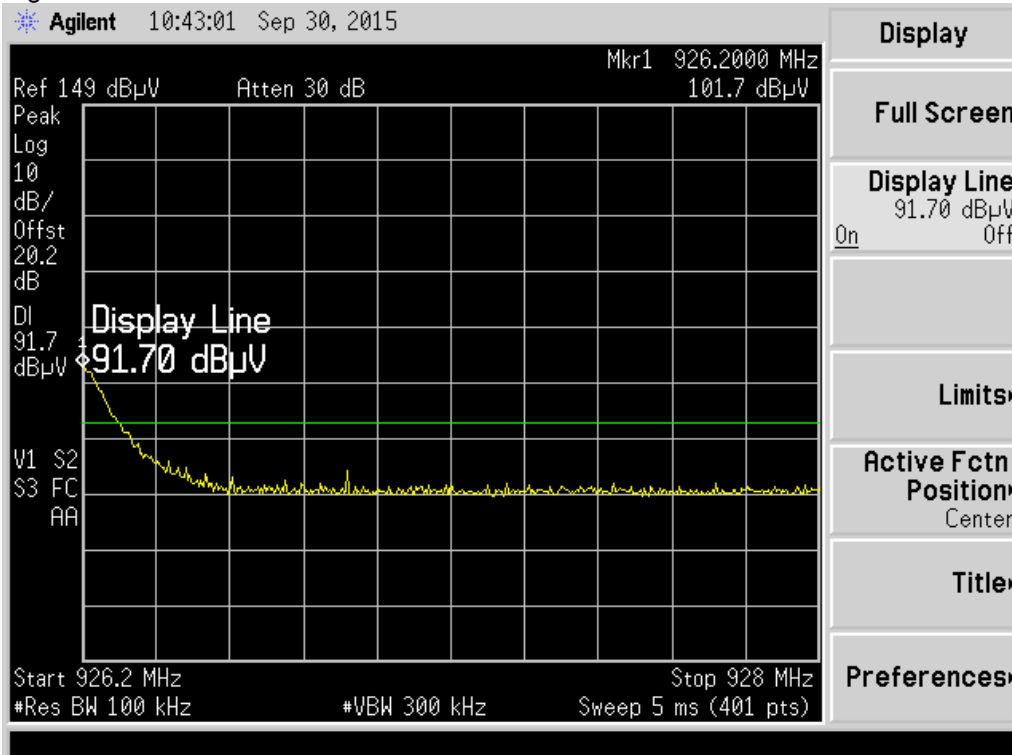


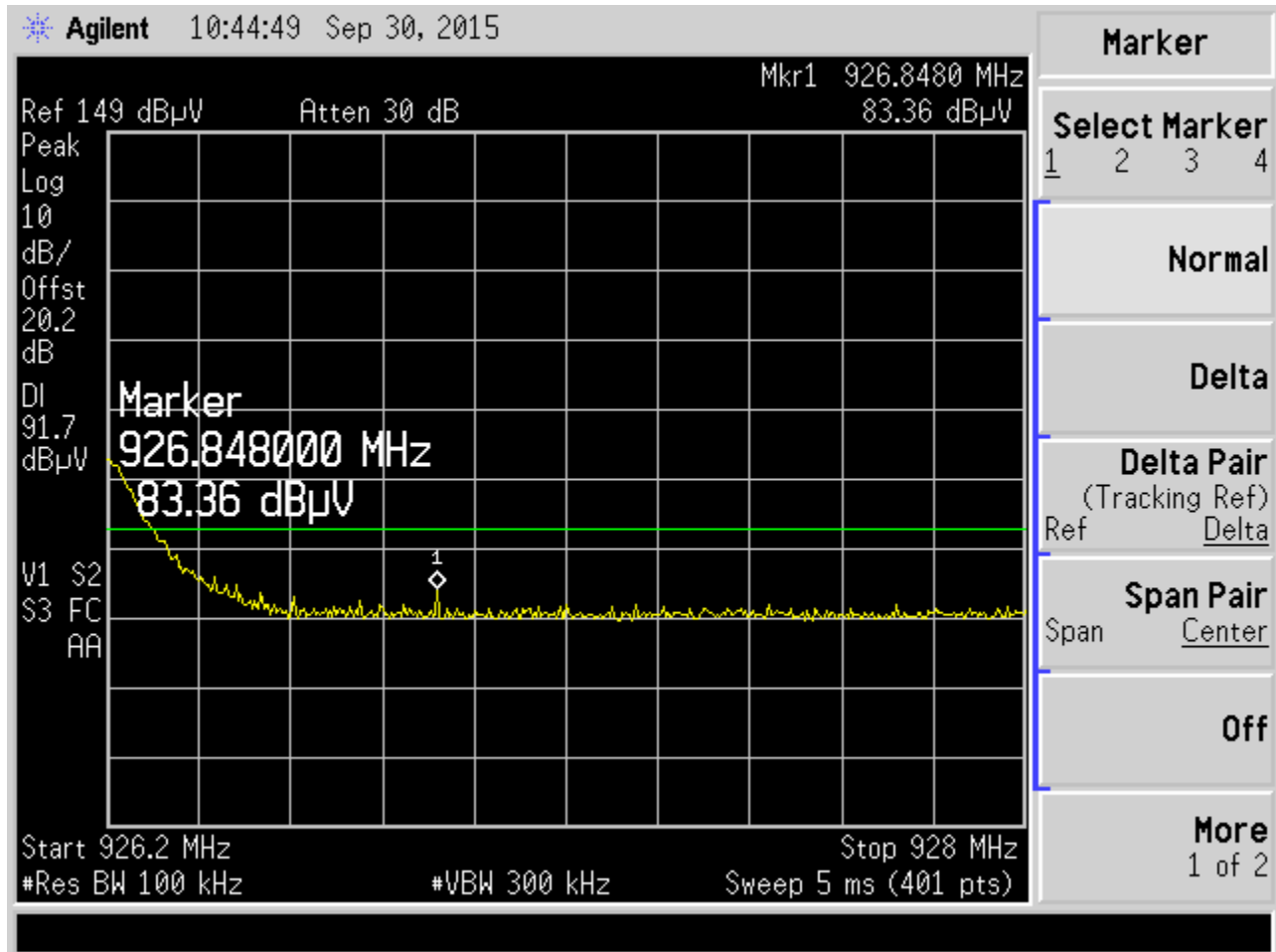
Hopping Enabled

Low Channel



High Channel





Test Personnel: Mary Sampson *MTS*
Supervising/Reviewing Engineer:
(Where Applicable) N/A
Product Standard: FCC 15.215, 15.247; RSS-247
Input Voltage: 3 Vdc

Test Date: 09/30/2015

Limit Applied: FCC 15.247(d); RSS-247, Section 5

Ambient Temperature: 24.2 °C
Relative Humidity: 49.6 %
Atmospheric Pressure: 976.0 mbars

14 20dB and Occupied Bandwidth

14.1 Method

Tests are performed in accordance with CFR47 FCC Part 15 Subpart C: 2015 Section 15.215; 15.247(a)(1)(i); Industry Canada RSS-247 Issue 1 May 2015, Section 5; Industry Canada RSS-GEN Issue 3 December 2014, Section 6.6.

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

14.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
211873;	Barometer, Temperature, and Humidity sensor - Network based. Also marked as iServer MicroServer.	Omega	iBTHX-W	0240115	12/09/2014	12/09/2015
E208;	RF Coax Cable	Megaphase	TM18-N1N1-120	14065201-002	05/07/2015	05/07/2016
Borrowed;	EMC Analyzer	Agilent	E7405A	US3915014	08/03/2015	08/03/2016
200008;	Attenuator, 20 dB, <18GHz	Weinschel Corp	2	BK2323	01/07/2015	01/07/2016
213309;	RF Coax Cable - 10MHz to 18GHz, 1 ft.	Hasco, Inc.	HULL320-S1-S1-12	14045577	09/17/2015	09/17/2016
213310;	RF Coax Cable - 10MHz to 18GHz, 1.5 ft.	Hasco, Inc.	HULL320-S1-S1-18	13105554	09/17/2015	09/17/2016

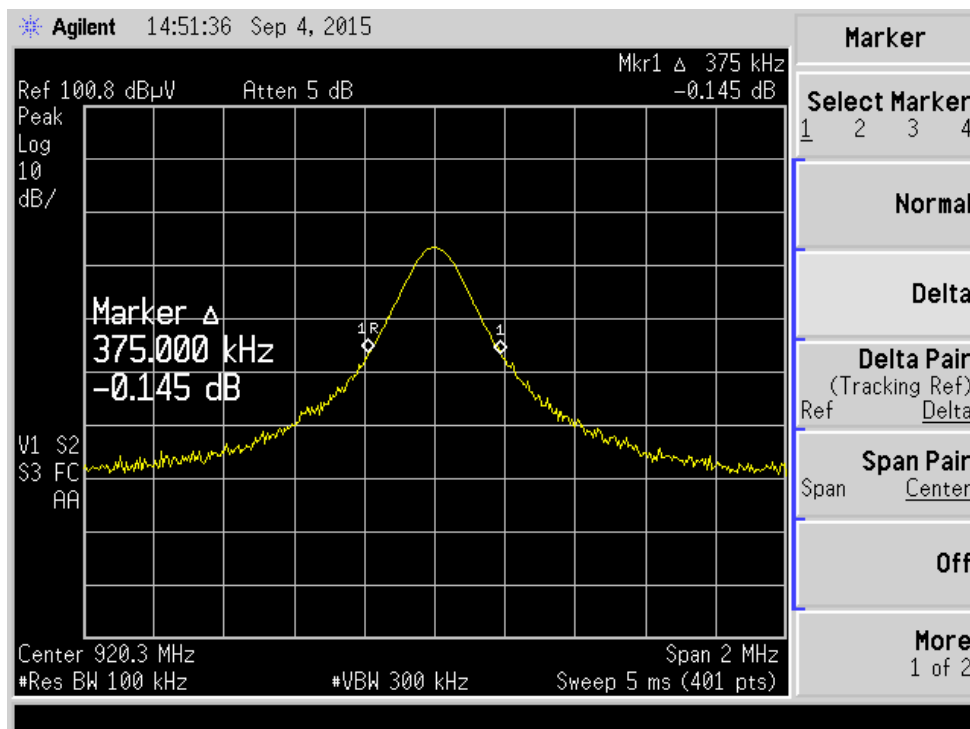
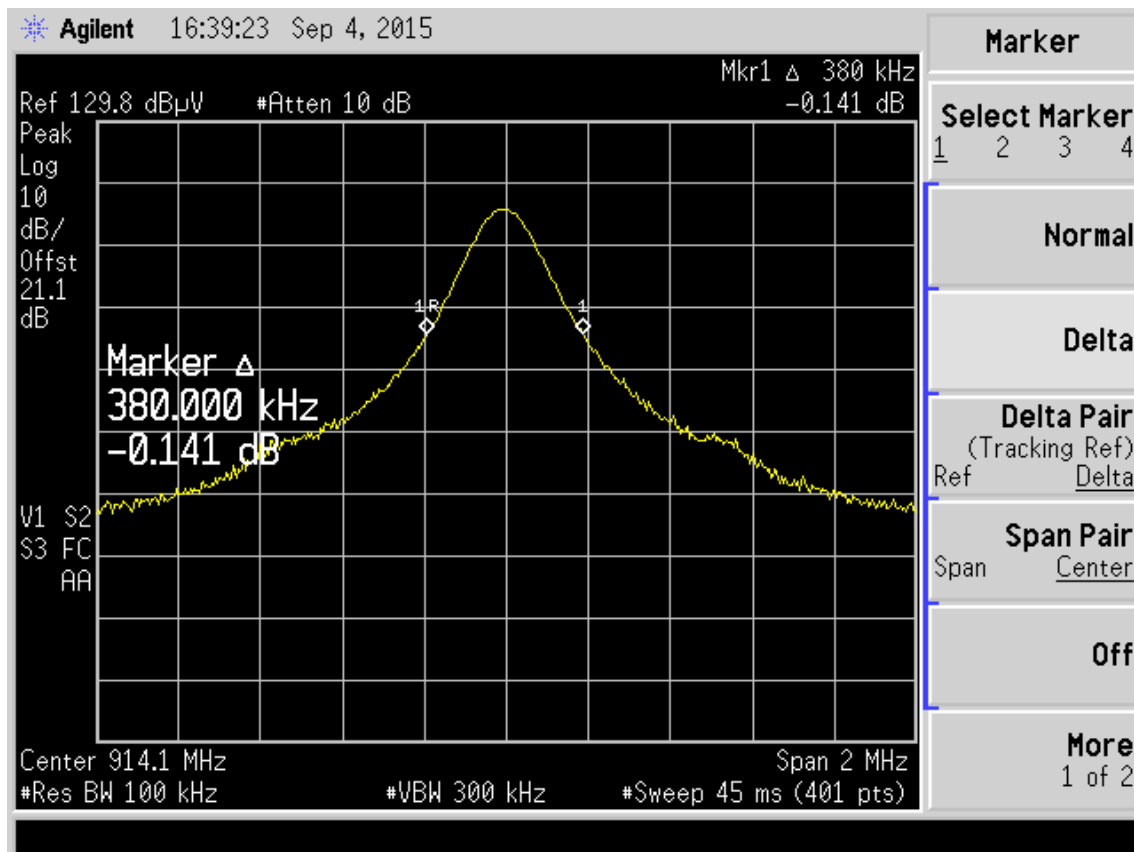
Software Utilized:

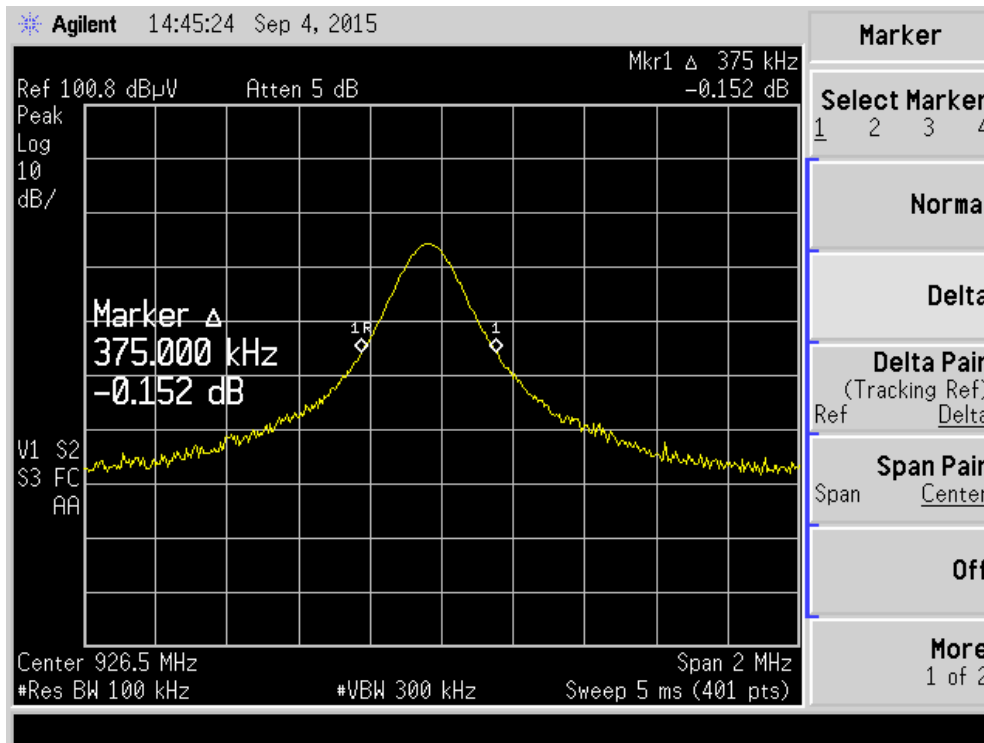
Name	Manufacturer	Version
None (Spectrum Analyzer Firmware)		

14.3 Results:

The sample tested was found to Comply.

14.4 Plots/Data:





Test Personnel: Mary Sampson *MTS*
Supervising/Reviewing
Engineer:
(Where Applicable) N/A
Product Standard: FCC 15.247, RSS-
247, Section 5, RSS-GEN
Input Voltage: Annex 6.6
3 Vdc

Test Date: 09/04/2015

Limit Applied: FCC 15.247(a)(1), RSS-247
Section 5.1(1)

Ambient Temperature: 24.2 °C

Relative Humidity: 49.6 %

Atmospheric Pressure: 976.0 mbars

Deviations, Additions, or Exclusions: None

15 RF Exposure Compliance

The maximum measured conducted power, P is 7.005 dBm.

The antenna gain, G is 0.0 dBi.

The maximum EIRP power = P+G

EIRP = 7.005 + 0.0 = 7.005 dBm or 0.0050176457904 W

The limits for Maximum Permissible Exposure (MPE) for transmitter operating at 902-928 MHz, MPE is $928/1500 = 0.619 \text{mW/cm}^2$ or 6.2W/m^2 .

The Power Density, S is related to EIRP with the equation:

$S = \text{EIRP} / 4\pi D^2$, where D is the safe separation distance and = 0.2m, or 20cm

$S = 0.0050176457904 / 4\pi 0.2^2$,

$S = 0.0099 \text{ W/m}^2$

which is below the Maximum Permissible Exposure (MPE) of 6.2W/m^2

16 Duty Cycle

16.1 Method

Tests are performed in accordance with CFR47 FCC Part 15 Subpart C: 2015 Section 15.247(a)(1); Industry Canada RSS-247 Issue 1 May 2015.

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

16.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
211872;	Barometer, Temperature, and Humidity sensor - Network based. Also marked as iServer MicroServer.	Omega	iBTHX-W	0240116	11/07/2014	11/07/2015
Borrowed;	EMC Analyzer	Agilent	E7405A	US3915014	08/03/2015	08/03/2016
200008;	Attenuator, 20 dB, <18GHz	Weinschel Corp	2	BK2323	01/07/2015	01/07/2016
213310;;	RF Coax Cable - 10MHz to 18GHz, 1.5 ft.	Hasco, Inc.	HULL320-S1-S1-18	13105554	09/17/2015	09/17/2016
213309;	RF Coax Cable - 10MHz to 18GHz, 1 ft.	Hasco, Inc.	HULL320-S1-S1-12	14045577	09/17/2015	09/17/2016

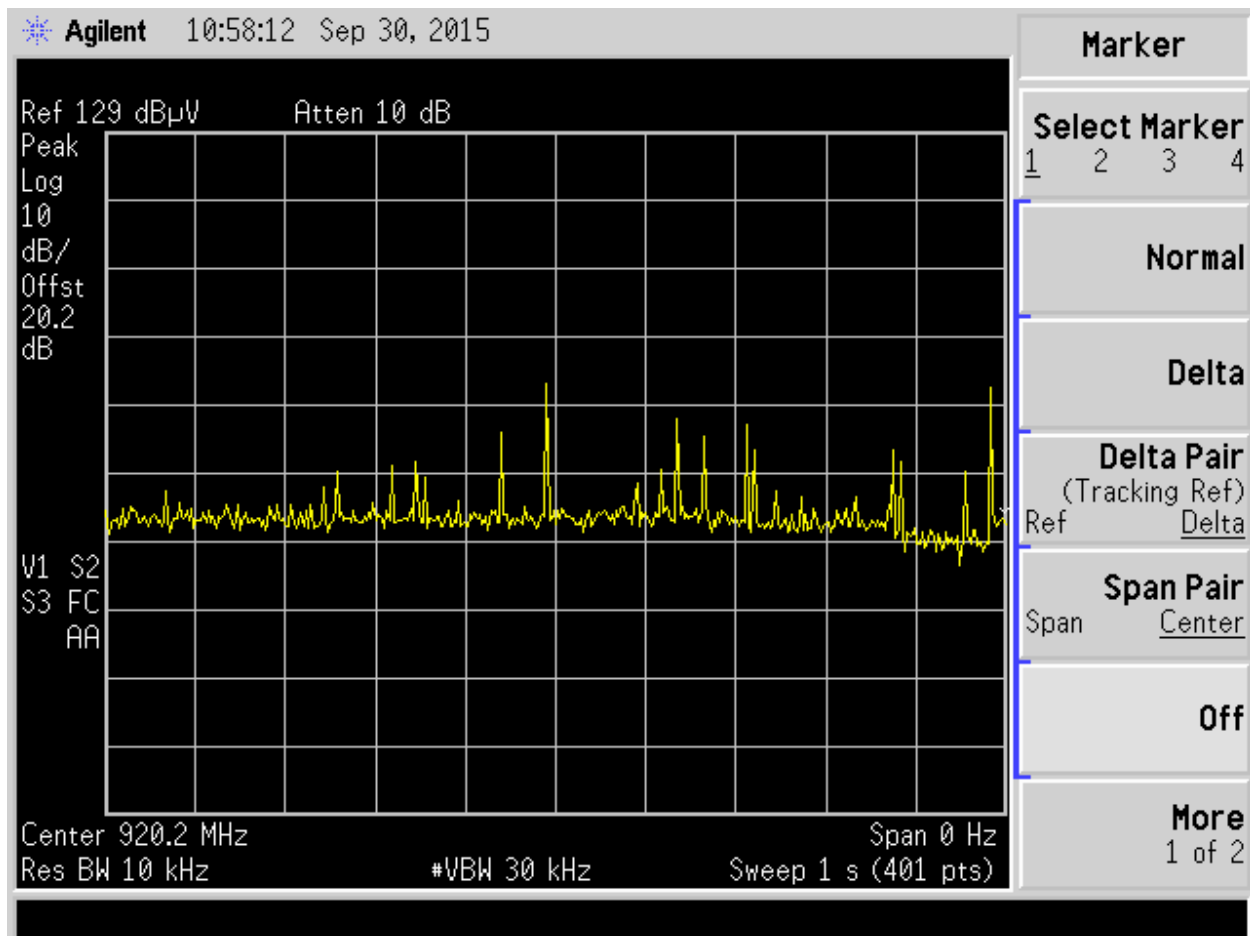
Software Utilized:

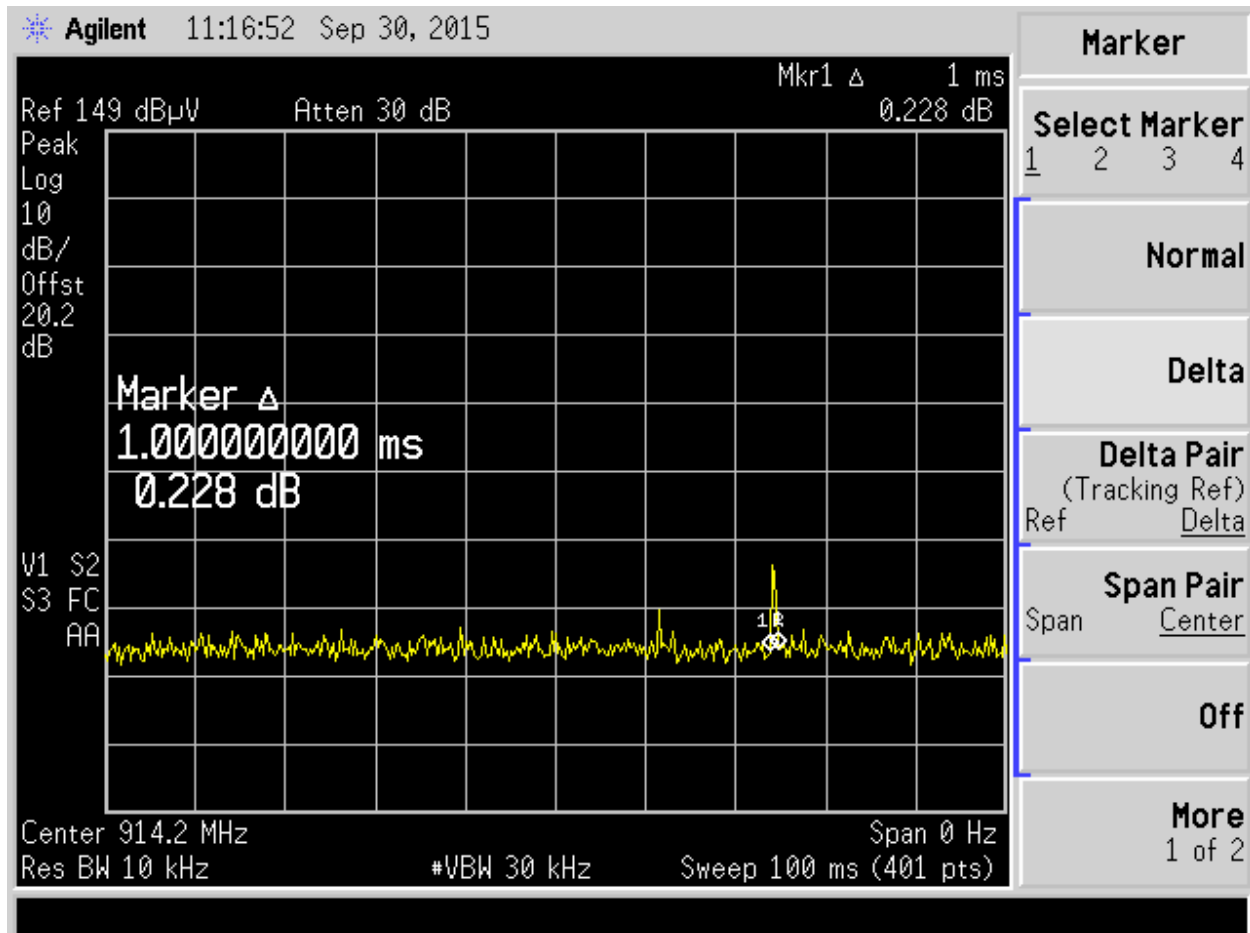
Name	Manufacturer	Version
None (Spectrum Analyzer Firmware)		

16.3 Results:

The sample tested was found to Comply.

16.4 Plots/Data:





The duty cycle = $1.0\text{ms}/100\text{ ms} = 0.1$
Average factor = $20 \cdot \text{LOG}(0.1) = -40\text{ dB}$

Test Personnel: Mary Sampson MTS
Supervising/Reviewing Engineer:
(Where Applicable) N/A
Product Standard: FCC 15.247, IC RSS-247
Input Voltage: 3 Vdc

Test Date: 09/30/2015

Limit Applied: FCC 15.247(a)(1), RSS-247 Section 5

Ambient Temperature: 24.2 °C
Relative Humidity: 49.6 %
Atmospheric Pressure: 976 mbars

Deviations, Additions, or Exclusions: None

17 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	11/04/2015	100315802ATL-001A	MTS <i>MTS</i>	KPS <i>KPS</i>	Original Issue