EMC TEST REPORT

Report Number: 102605175LAX-001
Project Number: G102605175

Report Issue Date: May 25, 2017

Model(s) Tested: FLF-ZWAVE5

Standards: **FCC CFR47 Part 15 Subpart C**
Intentional Radiator
§15.249, Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz, and 24.0-24.25 GHz

FCC CFR47 Part 15 Subpart B
Unintentional Radiator

Industry Canada RSS-210 Issue 9
License-exempt Radio Apparatus (All Frequency Bands): Category I Equipment
§A2.9, Bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz

Industry Canada ICES-003 Issue 6
Information Technology Equipment (ITE) - Limits and methods of measurement

Tested by:
Intertek
25791 Commercentre Drive
Lake Forest, CA 92630
USA

Client:
Ecolink
2055 Corte Del Nogal
Carlsbad, CA 92011
USA

Report prepared by

Amar Kacel
EMC Engineer

Report reviewed by

Krishna Vemuri
Engineering Team Lead

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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
6	Fundamental Field Strength (FCC §15.249(a), FCC §15.249(c); ISED RSS-210 Issue 9 §B.10a)	Compliant
7	Occupied Bandwidth (FCC §15.215; ISED RSS-Gen Issue 4 §6.6)	Compliant
8	Transmitter Radiated Emissions (FCC §15.249(a), FCC §15.249(c), FCC §15.249(d), FCC §15.209; FCC §15.205; ISED RSS-210 Issue 9 §B.10b, ISED RSS-Gen Issue 4 §8.9)	Compliant
9	Radiated Emissions (FCC §15.109; ISED ICES-003 Issue 6 §6.2)	Compliant
10	AC Mains Conducted Emissions (FCC §15.207; IC RSS-Gen Issue 4 §8.8) (FCC §15.107; IC ICES-003 Issue 5 §6.1)	N/A*

*: EUT is battery powered

3 Client Information

This EUT was tested at the request of:

Client: Ecolink
2055 Corte Del Nogal
Carlsbad, CA 92011
USA

Contact: Jay Stone
Telephone: (760) 431-8804
Fax: N/A
Email: jay@discoverecolink.com

4 Description of Equipment Under Test and Variant Models

Equipment Under Test			
Description	**Manufacturer**	**Model Number**	**Serial Number**
Flood/Freeze Sensor	Ecolink	FLF-ZWAVE5	908.42 MHz 916.00 MHz Production Firmware

Receive Date:	12/12/2016, 03/30/2017
Received Condition:	Good
Type:	Production

Description of Equipment Under Test

The equipment under test (EUT) is a flood/freeze sensor operating at 908.42 MHz and/or 916.00 MHz The EUT is battery powered and uses an integral antenna. This equipment is for indoor use only and it's wall mounted.

Equipment Under Test Power Configuration			
Rated Voltage	**Rated Current**	**Rated Frequency**	**Number of Phases**
3VDC	N/A	N/A	N/A

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	908.42 MHz, 9.6 kbps data rate, FSK Modulation
2	916.00 MHz, 100 kbps data rate, GFSK Modulation
3	Production Firmware

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	Modes 1 and 2 were programmed to transmit continuously during testing. Mode 3 was configured as normal operation.

Radio/Receiver Characteristics	
Frequency Band(s)	908.42 MHz, 916.00 MHz
Modulation Type(s)	FSK, GFSK
Test Channels	908.42 MHz, 916.00 MHz
Equipment Type	Standalone
Antenna Type and Gain	Integral

5 System Setup and Method

Cables					
ID	**Description**	**Length (m)**	**Shielding**	**Ferrites**	**Termination**
	None	N/A	N/A	N/A	N/A

Support Equipment			
Description	**Manufacturer**	**Model Number**	**Serial Number**
None	N/A	N/A	N/A

5.1 Method:

Configuration as required by ANSI C63.10-2013.

5.2 EUT Block Diagram:

6 Fundamental Field Strength

6.1 Performance Requirement(s)

The field strength of emissions, measured at 3 meters, from intentional radiators operated within the frequency band shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902-928 MHz	50	500

6.2 Method

Tests are performed in accordance with ANSI C63.10-2013.

The EUT was placed on a non-conducting table 80 cm (below 1 GHz) or 1.5 meters (above 1 GHz) above the ground plane (turntable). The antenna to EUT distance was 3 meters.

The transmitter configured to transmit continuously. The turntable containing the EUT was rotated through 360 degrees and the receive antenna height was varied from 1 to 4 meters to locate the worst-case emissions levels. Measurements were made with the antenna in both the horizontal and vertical polarizations. EUT was tested at three orthogonal planes. The worst-case data is recorded in this report.

TEST SITE:

The test is performed in the 3 meter semi-anechoic chamber located at 25791 Commercentre Drive, Lake Forest, California 92630 USA. This test facility meets the requirements of CISPR 16-1-4 and has been accredited by A2LA.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 3m	30-1000 MHz	4.2	6.3 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.

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 dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
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 dBμV 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 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

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

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

6.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
001140	EMI Test Receiver	Rohde & Schwarz	ESCI7	100825	02/22/2016	02/22/2017
001140	EMI Test Receiver	Rohde & Schwarz	ESCI7	100825	02/21/2017	02/21/2018
001147	Biconilog Antenna	TESEQ	CBL 6112D	32852	11/03/2016	11/03/2017
001576	Preamplifier 100kHz - 1 Ghz	Rhode & Schwarz	TS-PR1	102068	07/01/2016	07/01/2017
001517	RF Cable 30Mhz - 18Ghz	Rohde & Schwarz	TSPR-B7	101528	07/01/2016	07/01/2017
001518	RF Cable 30Mhz - 18Ghz	Rohde & Schwarz	TSPR-B7	101529	07/01/2016	07/01/2017
000637	EMC Emissions	Panashield	3m Chamber	250831-D-2	12/21/2015	12/21/2018
001001	Lab Monitor	Omega	iBTHX-W	0440775	04/22/2016	04/22/2017

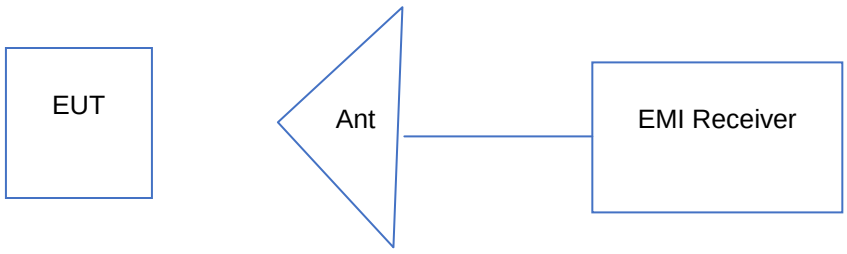
Software Utilized:

Name	Manufacturer	Version	Profile
Tile	Quantum Change	4.1	ESCI_RE_30MHz-1GHz_Bilog_1147_6dB
Tile	Quantum Change	3.4.K.29	ESCI_RE_1GHz-10GHz_Bilog_1093

6.4 Results:

The sample tested was found to comply.

6.5 Setup Diagram:



6.6 Plots/Data:

Field Strength at Fundamental, 908.42 MHz									
Antenna Polarization	Frequency (MHz)	EUT Orientation	Raw Data (dBuV/m)	Corrected Data	Limit (dBuV/m)	Margin (dB)	Turntable Degree	Antenna Height (cm)	Detector
V	908.42	XY	86.79	87.68	94.00	-6.31	75	120	QP

Field Strength at Fundamental, 916 MHz									
Antenna Polarization	Frequency (MHz)	EUT Orientation	Raw Data (dBuV/m)	Corrected Data	Limit (dBuV/m)	Margin (dB)	Turntable Degree	Antenna Height (cm)	Detector
V	916.00	XY	87.33	88.19	94.00	-5.81	245	107	QP

XY Orientation was determined to be the worst case after testing all three different orientations.

Deviations, Additions, or Exclusions: None

Test Personnel:	Amar Kacel	Test Date:	03/10/2017
Product Standard:	FCC 15.249, ISED RSS-210	Limit Applied:	FCC 15.249, ISED RSS-210
Input Voltage:	Battery		
Pretest Verification w/ Ambient Signals or BB Source:	Yes	Ambient Temperature:	23.7 ºC
		Relative Humidity:	38.8 %
		Atmospheric Pressure:	991.2 mbars

7 Occupied Bandwidth

7.1 Performance Requirement(s)

Intentional radiators must be designed to ensure that the 20 dB bandwidth of the emission is contained within the frequency band designated in the rule section under which the equipment is operated. (FCC §15.215(c))

The transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured. (IC RSS-Gen Issue 4 §6.6)

7.2 Method

Tests are performed in accordance with ANSI C63.10-2013.

TEST SITE:

The test is performed in the 3 meter semi-anechoic chamber located at 25791 Commercentre Drive, Lake Forest, California 92630 USA. This test facility meets the requirements of CISPR 16-1-4 and has been accredited by A2LA.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 3m	30-1000 MHz	4.2	6.3 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.

7.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
001140	EMI Test Receiver	Rohde & Schwarz	ESCI7	100825	02/22/2016	02/22/2017
001140	EMI Test Receiver	Rohde & Schwarz	ESCI7	100825	02/21/2017	02/21/2018
001147	Biconilog Antenna	TESEQ	CBL 6112D	32852	11/03/2016	11/03/2017
001576	Preamplifier 100kHz - 1 Ghz	Rhode & Schwarz	TS-PR1	102068	07/01/2016	07/01/2017
001517	RF Cable 30Mhz - 18Ghz	Rohde & Schwarz	TSPR-B7	101528	07/01/2016	07/01/2017
001518	RF Cable 30Mhz - 18Ghz	Rohde & Schwarz	TSPR-B7	101529	07/01/2016	07/01/2017
000637	EMC Emissions	Panashield	3m Chamber	250831-D-2	12/21/2015	12/21/2018
001001	Lab Monitor	Omega	iBTHX-W	0440775	04/22/2016	04/22/2017

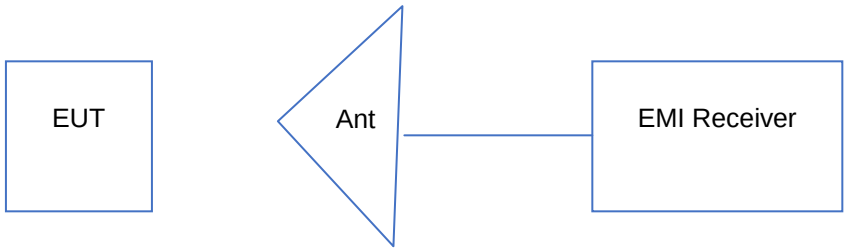
Software Utilized:

Name	Manufacturer	Version	Profile
N/A	N/A	N/A	N/A

7.4 Results:

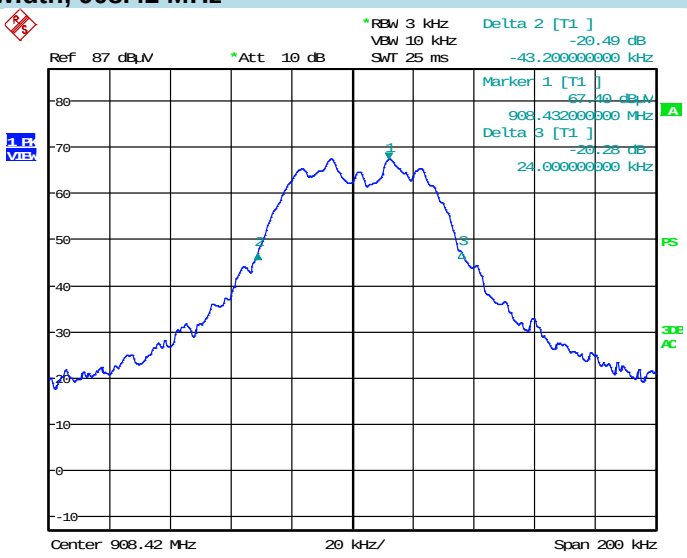
The sample tested was found to comply. The 20 dB and 99% bandwidth of the fundamental frequency remain inside the band of operation of 902-928 MHz.

7.5 Setup Diagram:



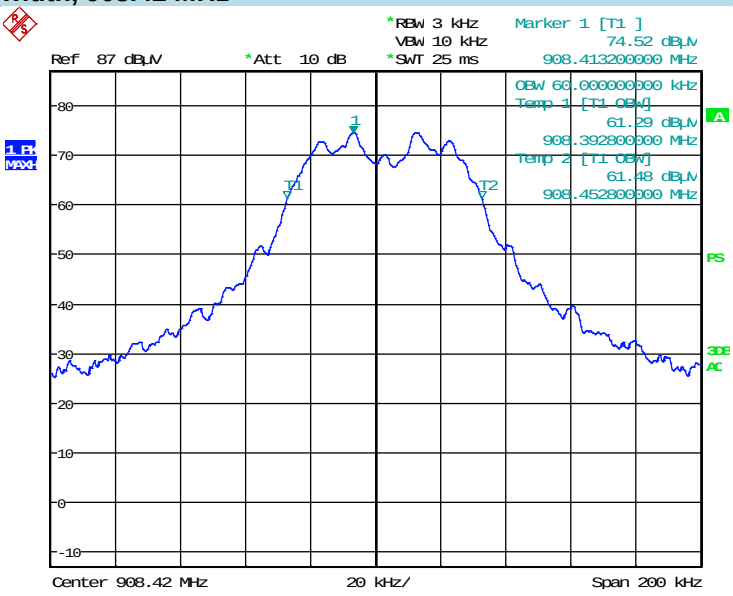
7.6 Plots/Data:

20 dB Bandwidth, 908.42 MHz



Date: 11.JAN.2017 20:47:29

99% Bandwidth, 908.42 MHz



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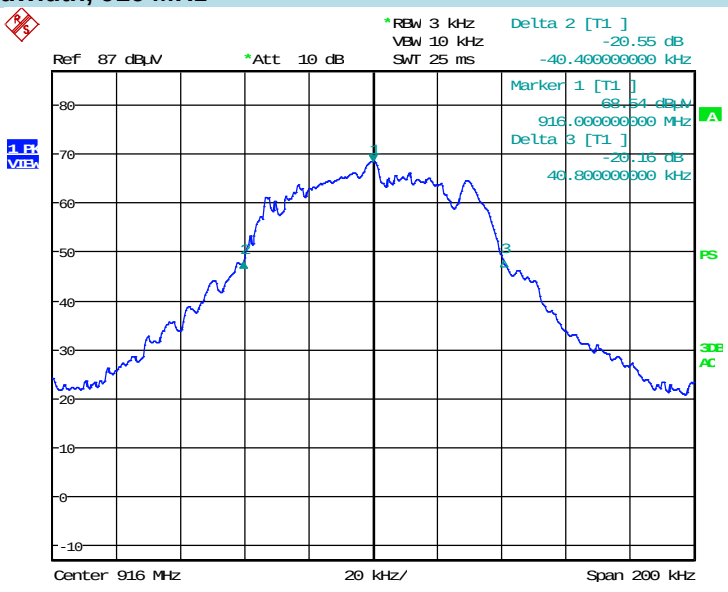
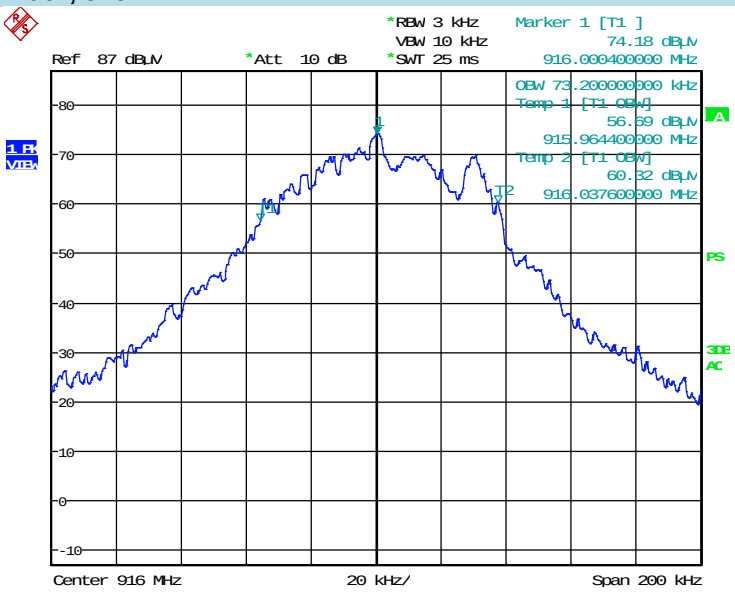
20 dB Bandwidth, 916 MHz



Date: 11.JAN.2017 20:43:13

99% Bandwidth, 916 MHz



Date: 11.JAN.2017 19:42:14

Test Personnel:	Amar Kacel	Test Date:	01/11/2017
Product Standard:	FCC 15.215, IC RSS-Gen	Limit Applied:	FCC 15.215, IC RSS-Gen
Input Voltage:	3 Vdc Battery		
Pretest Verification w/ Ambient Signals or BB Source:	Yes	Ambient Temperature:	19.4 ºC
		Relative Humidity:	49 %
		Atmospheric Pressure:	998.2 mbars

Deviations, Additions, or Exclusions: None

8 Transmitter Radiated Spurious Emissions

8.1 Performance Requirement(s)

The field strength of emissions from intentional radiators operated within the frequency band shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902-928 MHz	50	500

Field strength limits are specified at a distance of 3 meters. Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in FCC § 15.209 and IC RSS-Gen, whichever is the lesser attenuation. The peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

8.2 Method

Tests are performed in accordance with ANSI C63.10-2013.

The EUT was placed on a non-conducting table 80 cm (below 1 GHz) or 1.5 meters (above 1 GHz) above the ground plane (turntable). The antenna to EUT distance was 3 meters.

The spectrum from 30 MHz to the 10th harmonic was investigated with the transmitter configured to continuously transmit. The turntable containing the EUT was rotated through 360 degrees and the receive antenna height was varied from 1 to 4 meters to locate the worst-case emissions levels. Measurements were made with the antenna in both the horizontal and vertical polarizations. EUT was tested at three orthogonal planes. The worst-case data is recorded in this report.

TEST SITE:

The test is performed in the 3 meter semi-anechoic chamber located at 25791 Commercentre Drive, Lake Forest, California 92630 USA. This test facility meets the requirements of CISPR 16-1-4 and has been accredited by A2LA.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty(k=2)	Ucispr
Radiated Emissions, 3m	30-1000 MHz	4.2	6.3 dB
Radiated Emissions, 3m	1-10 GHz	4.4	5.2 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.

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 dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
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 dBμV 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 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

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

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

8.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
001140	EMI Test Receiver	Rohde & Schwarz	ESCI7	100825	02/22/2016	02/22/2017
001147	Biconilog Antenna	TESEQ	CBL 6112D	32852	11/03/2016	11/03/2017
001140	EMI Test Receiver	Rohde & Schwarz	ESCI7	100825	02/21/2017	02/21/2018
000690	Spectrum Analyzer, 9 KHz - 40 GHz	Rohde & Schwarz	FSP40	100027	01/11/2016	01/11/2017
000690	Spectrum Analyzer, 9 KHz - 40 GHz	Rohde & Schwarz	FSP40	100027	01/24/2017	01/24/2018
001576	Preamplifier 100kHz - 1 Ghz	Rhode & Schwarz	TS-PR1	102068	07/01/2016	07/01/2017
001517	RF Cable 30Mhz - 18Ghz	Rohde & Schwarz	TSPR-B7	101528	07/01/2016	07/01/2017
001518	RF Cable 30Mhz - 18Ghz	Rohde & Schwarz	TSPR-B7	101529	07/01/2016	07/01/2017
001093	Double Ridge Guide Horn Antenna	A.H. Systems Inc.	SAS-571	1513	02/12/2016	02/12/2017
000637	EMC Emissions	Panashield	3m Chamber	250831-D-2	12/21/2015	12/21/2018
001135	Amplifier	Miteq	AMF-6D-00501800-24-	1685147	04/15/2016	04/15/2017
000692	Double-Ridged Horn for frequency 1-18 GHz	ETS Lindgren	3115	00031626	07/08/2016	07/08/2017
001093	Double Ridge Guide Horn Antenna	A.H. Systems Inc.	SAS-571	1513	03/15/2017	03/15/2018
001001	Lab Monitor	Omega	iBTHX-W	0440775	04/22/2016	04/22/2017

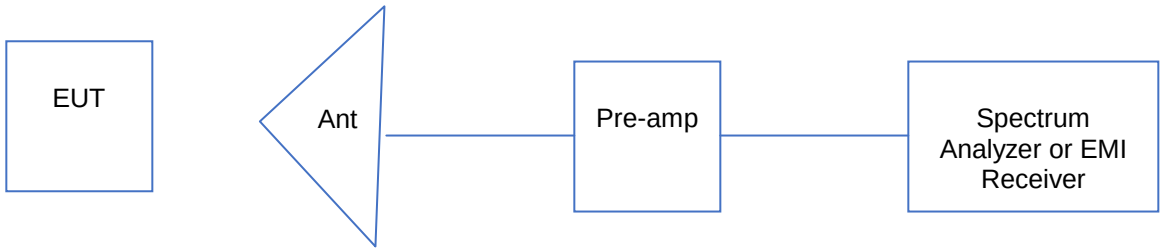
Software Utilized:

Name	Manufacturer	Version	Profile
Tile	Quantum Change	3.4.K.29	• ESCI_FCC_CISPR-RE-30MHz-1GHz_Bilog • FCC Part 15 FSP 1-10GHz

8.4 Results:

The sample tested was found to comply.

8.5 Setup Diagram:

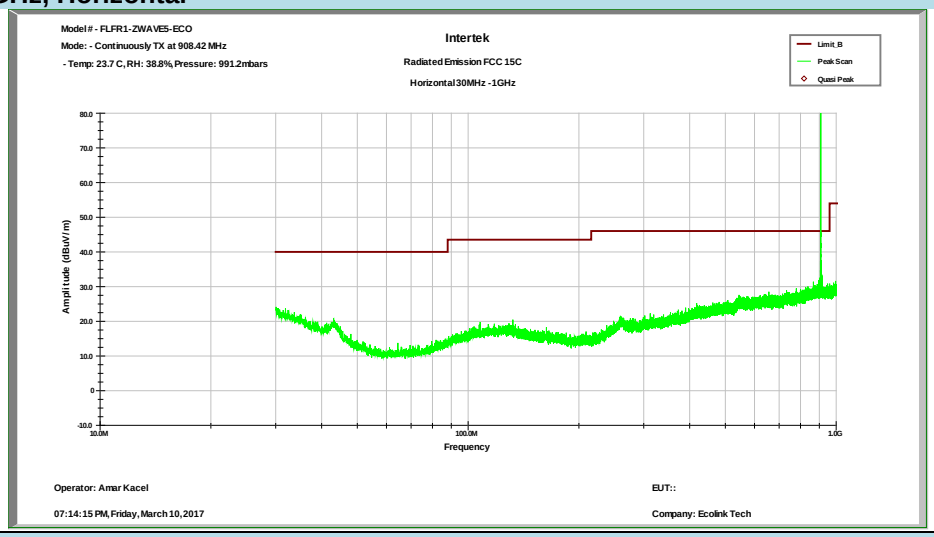


8.6 Plots/Data:

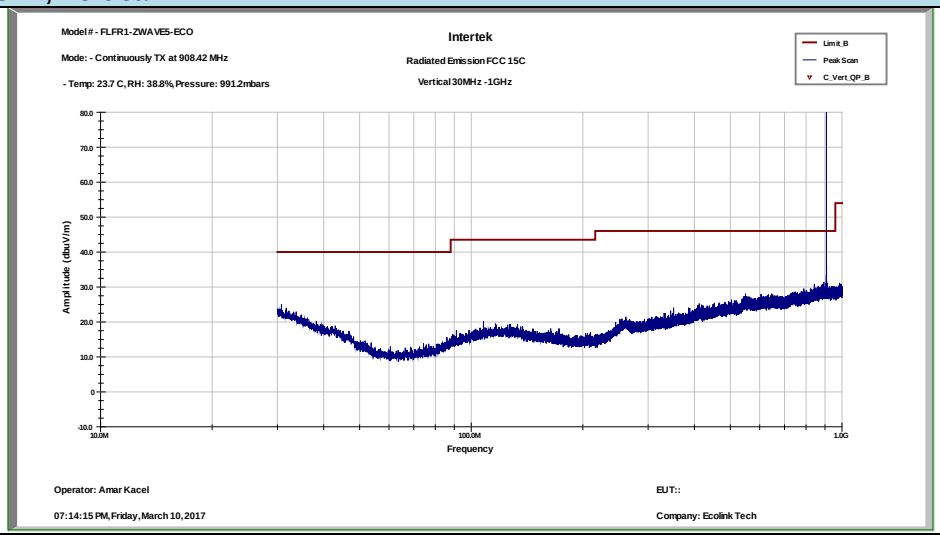
Test Personnel:	Amar Kacel	Test Date:	04/07/2017 – 05/23/207
Product Standard:	FCC 15.249, ISED RSS-210	Limit Applied:	FCC 15.249, FCC 15.209, IC RSS-210, IC RSS-Gen
Input Voltage:	3Vdc Battery	Ambient Temperature:	22.4 ºC / 24.4 ºC
Pretest Verification w/ Ambient Signals or BB Source:	Yes	Relative Humidity:	47.3 % / 51.2%
		Atmospheric Pressure:	993.1 mbars / 988.5 mbars

EUT Operating at 908.42 MHz

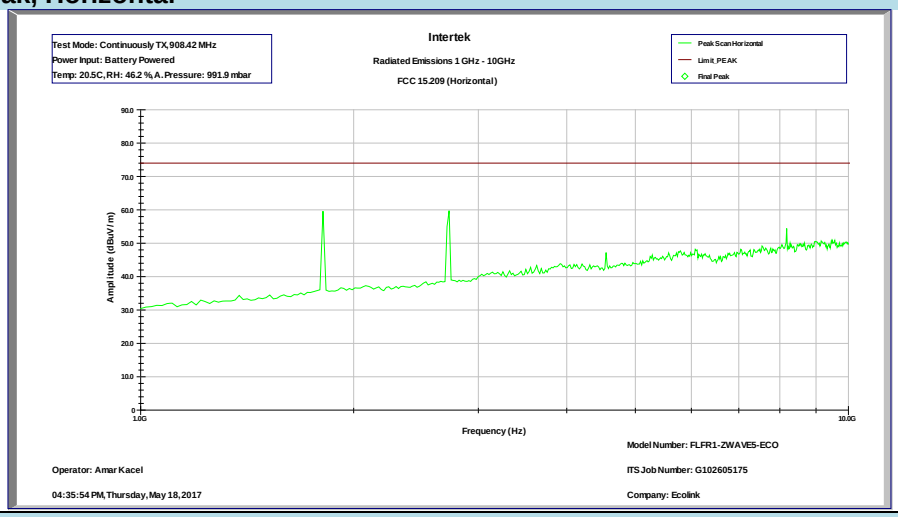
30 MHz – 1 GHz, Horizontal



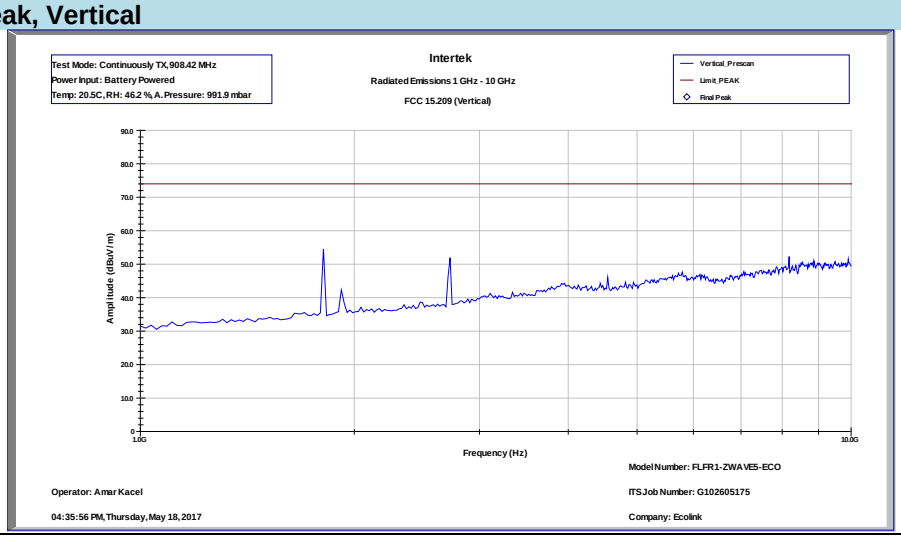
30 MHz – 1 GHz, Vertical



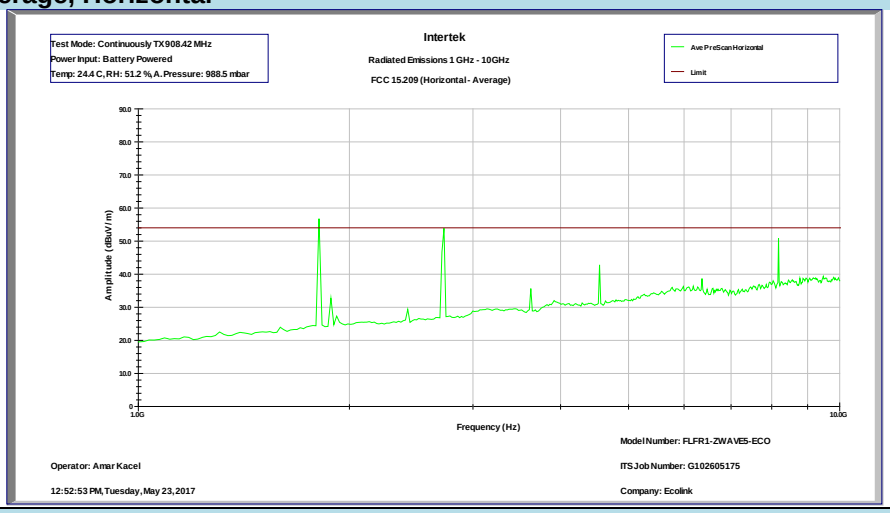
1 – 10GHz, Peak, Horizontal



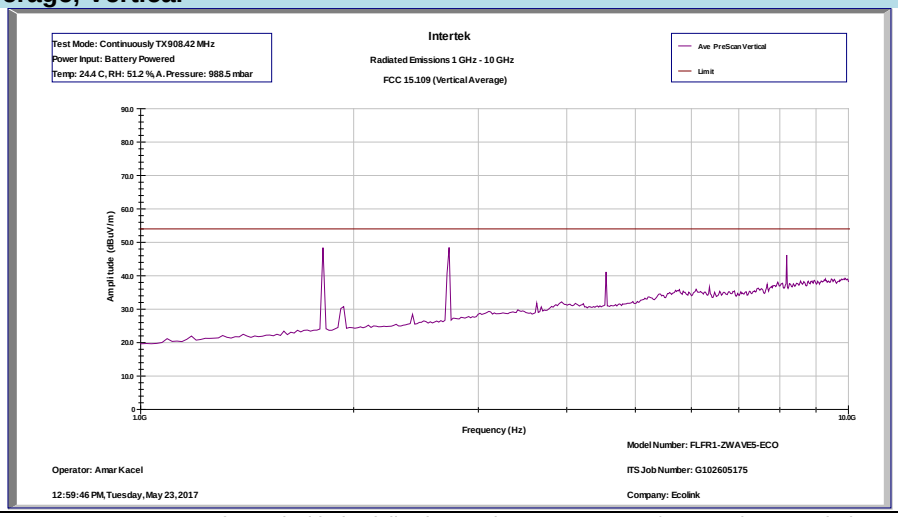
1 – 10GHz, Peak, Vertical



1 – 10GHz, Average, Horizontal



1 – 10GHz, Average, Vertical



Note: Preliminary average scans were performed with the following settings: RBW 1MHz/VBW 10kHz, Peak detector.

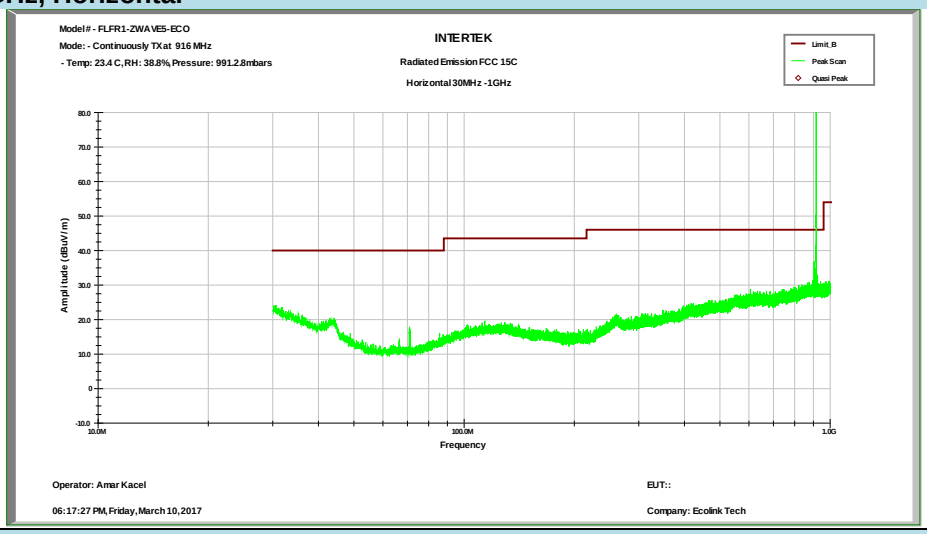
908.42 MHz									
Antenna Polarization	Frequency (MHz)	EUT Orientation	Measured Data (dBuV/m)	Corrected Data	Limit (dBuV/m)	Margin (dB)	Turntable Degree	Antenna Height (cm)	Detector
H	1816.80	XY	70.69	52.69	54	-01.31	278	165	AVE
H	2725.20	XY	63.11	52.11	54	-01.89	251	143	AVE
V	1816.82	XY	59.60	41.60	54	-12.40	124	229	AVE
V	2725.31	XY	50.70	39.70	54	-14.30	124	212	AVE

Note: Final average scans were performed using EMI receiver with the following settings: RBW 1MHz, Average detector.

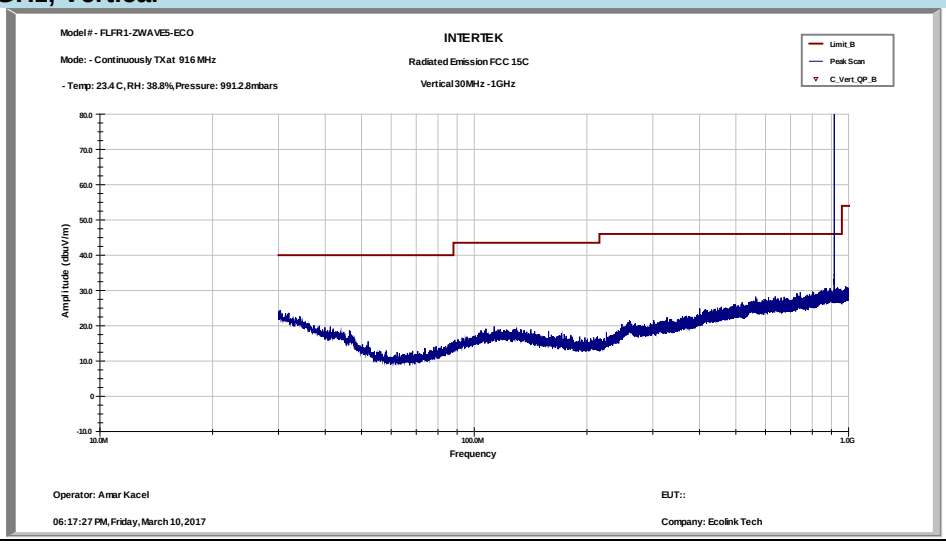
Deviations, Additions, or Exclusions: None

EUT Operating at 916 MHz

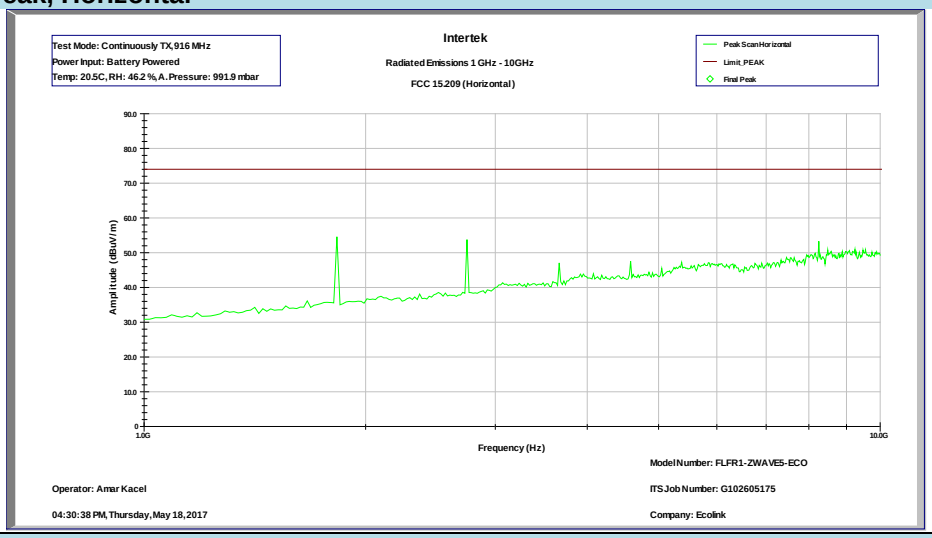
30 MHz – 1 GHz, Horizontal



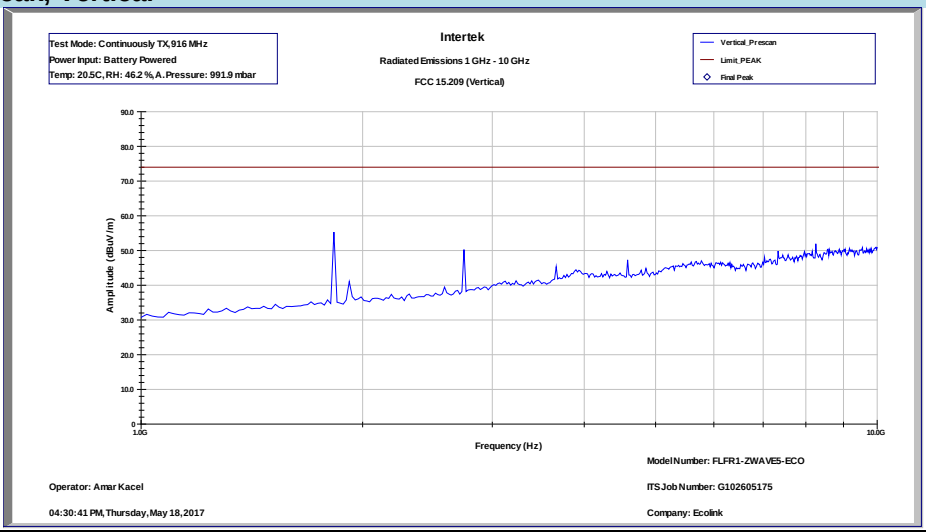
30 MHz – 1 GHz, Vertical



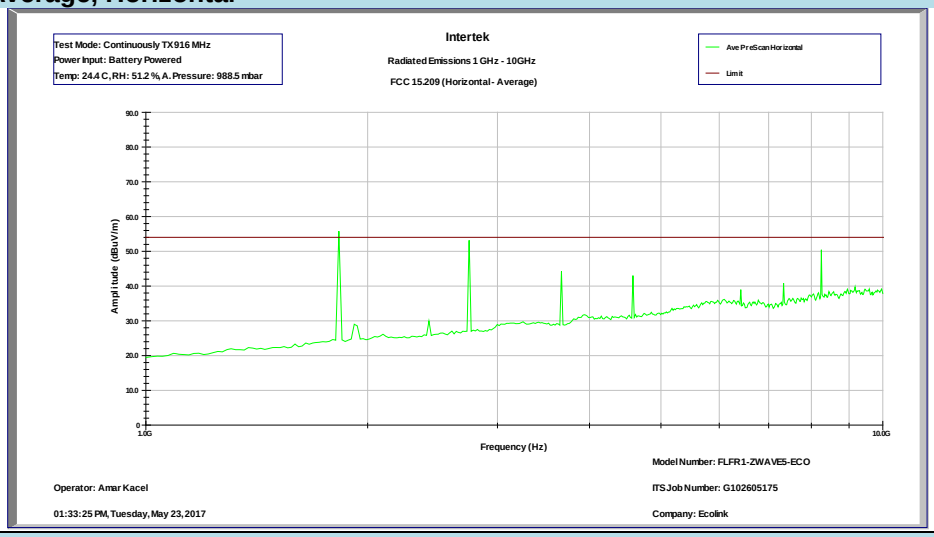
1 – 10GHz, Peak, Horizontal



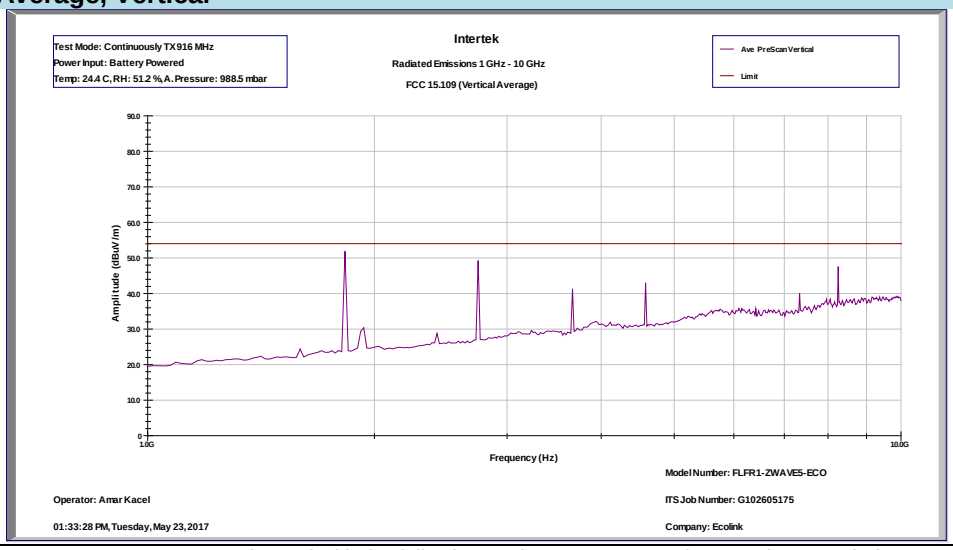
1 – 10GHz, Peak, Vertical



1 – 10GHz, Average, Horizontal



1 – 10GHz, Average, Vertical



Note: Preliminary average scans were performed with the following settings: RBW 1MHz/VBW 10kHz, Peak detector.

916 MHz									
Antenna Polarization	Frequency (MHz)	EUT Orientation	Raw Data (dBuV/m)	Corrected Data	Limit (dBuV/m)	Margin (dB)	Turntable Degree	Antenna Height (cm)	Detector
H	1832.00	XY	69.67	51.67	54	-02.33	265	151	AVE
H	2748.10	XY	60.80	49.80	54	-04.20	327	135	AVE
V	1832.00	XY	63.41	45.41	54	-08.59	134	150	AVE
V	2748.10	XY	58.69	47.69	54	-06.31	352	187	AVE

Note: Final average scans were performed using EMI receiver with the following settings: RBW 1MHz, Average detector.

Deviations, Additions, or Exclusions: None horizontal

9 Radiated Emissions

9.1 Performance Requirement(s)

Limits for Electromagnetic Radiated Emissions FCC Section 15.109(b), ICES-003*, RSS-Gen

Frequency (MHz)	Class A at 10m dB(uV/m)	Class B at 3m dB (uV/m)
33-88	39.0	40.0
88-216	43.5	43.5
216-960	46.4	46.0
Above 960	49.5	54.0

*According to FCC Part 15.109(g) an alternative to the radiated emission limits shown above, digital devices may be shown to comply with the limit of CISPR Pub.22

9.2 Method

Tests are performed in accordance with ANSI C63.4-2009.

The EUT was placed on a non-conducting table 80 cm above the ground plane (turntable). The antenna to EUT distance was 3 meters.

The spectrum from 30 MHz to the 5th harmonic was investigated with the EUT configured to normal operation. The turntable containing the EUT was rotated through 360 degrees and the receive antenna height was varied from 1 to 4 meters to locate the worst-case emissions levels. Measurements were made with the antenna in both the horizontal and vertical polarizations. EUT was tested at three orthogonal planes. The worst-case data is recorded in this report.

TEST SITE:

The test is performed in the 3 meter semi-anechoic chamber located at 25791 Commercentre Drive, Lake Forest, California 92630 USA. This test facility meets the requirements of CISPR 16-1-4 and has been accredited by A2LA.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 3m	30-1000 MHz	4.2	6.3 dB
Radiated Emissions, 3m	1-10 GHz	4.4	5.2 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.

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 dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
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 dBμV 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 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

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

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

9.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
001140	EMI Test Receiver	Rohde & Schwarz	ESCI7	100825	02/22/2016	02/22/2017
001147	Biconilog Antenna	TESEQ	CBL 6112D	32852	11/03/2016	11/03/2017
000690	Spectrum Analyzer, 9 KHz - 40 GHz	Rohde & Schwarz	FSP40	100027	01/11/2016	01/11/2017
001576	Preamplifier 100kHz - 1 Ghz	Rhode & Schwarz	TS-PR1	102068	07/01/2016	07/01/2017
001517	RF Cable 30Mhz - 18Ghz	Rohde & Schwarz	TSPR-B7	101528	07/01/2016	07/01/2017
001518	RF Cable 30Mhz - 18Ghz	Rohde & Schwarz	TSPR-B7	101529	07/01/2016	07/01/2017
001093	Double Ridge Guide Horn Antenna	A.H. Systems Inc.	SAS-571	1513	02/12/2016	02/12/2017
000692	Double-Ridged Horn for frequency 1-18 GHz	ETS Lindgren	3115	00031626	07/08/2016	07/08/2017
001093	Double Ridge Guide Horn Antenna	A.H. Systems Inc.	SAS-571	1513	03/15/2017	03/15/2018
000637	EMC Emissions	Panashield	3m Chamber	250831-D-2	12/21/2015	12/21/2018
001001	Lab Monitor	Omega	iBTHX-W	0440775	04/22/2016	04/22/2017

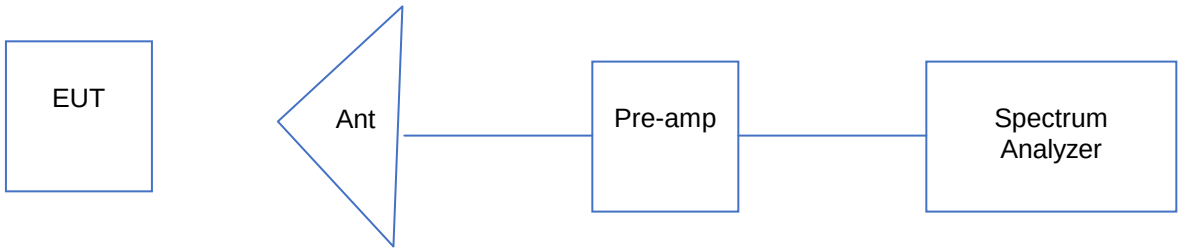
Software Utilized:

Name	Manufacturer	Version	Profile
Tile	Quantum Change	3.4.K.29	• ESCI_FCC_CISPR-RE-30MHz-1GHz_Bilog • FCC Part 15 FSP 1-10GHz

9.4 Results:

The sample tested was foundto Comply.

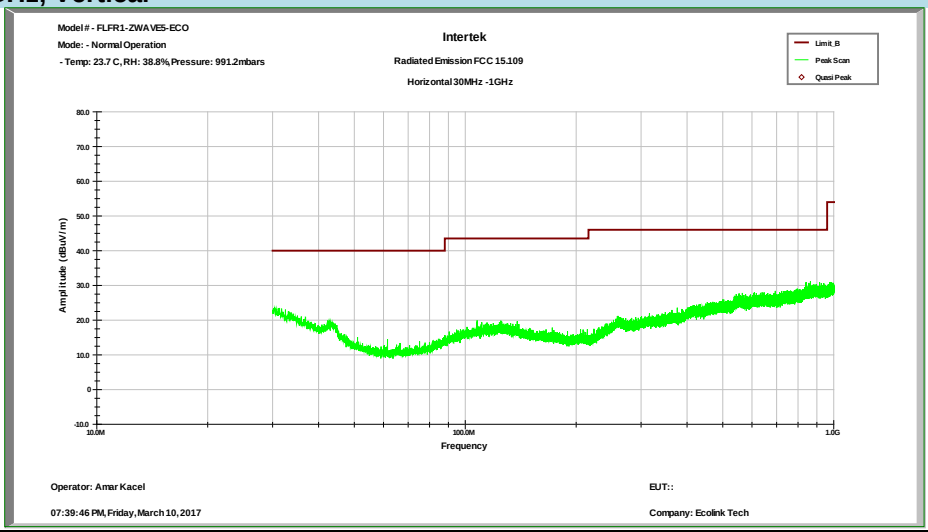
9.5 Setup Diagram:



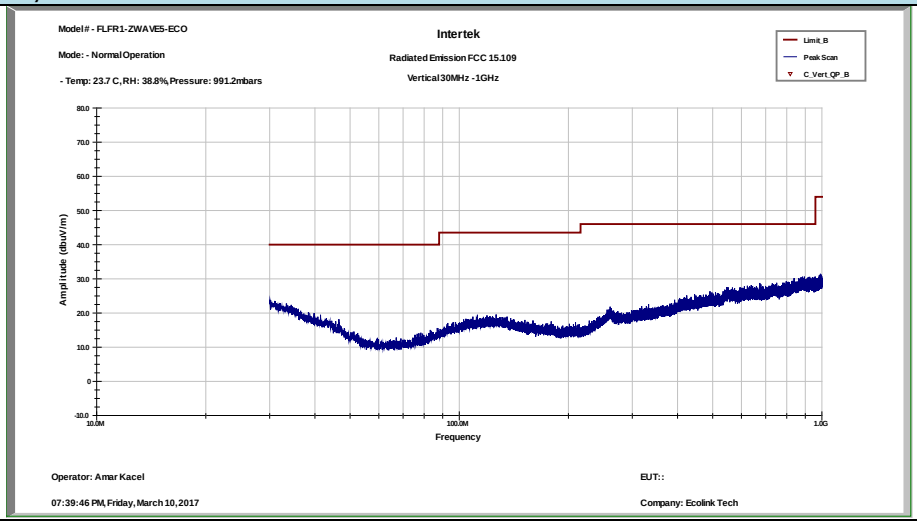
9.6 Plots/Data:

Test Personnel:	Amar Kacel	Test Date:	04/07/2017 – 05/23/2017
Product Standard:	FCC 15B, IC ICES-003	Limit Applied:	FCC 15.109, IC ICES-003
Input Voltage:	3 Vdc Battery		
Pretest Verification w/ Ambient Signals or BB Source:	Yes	Ambient Temperature:	22.4 ºC / 24.4 ºC
		Relative Humidity:	47.3 % / 51.2%
		Atmospheric Pressure:	993.1 mbars / 988.5 mbars

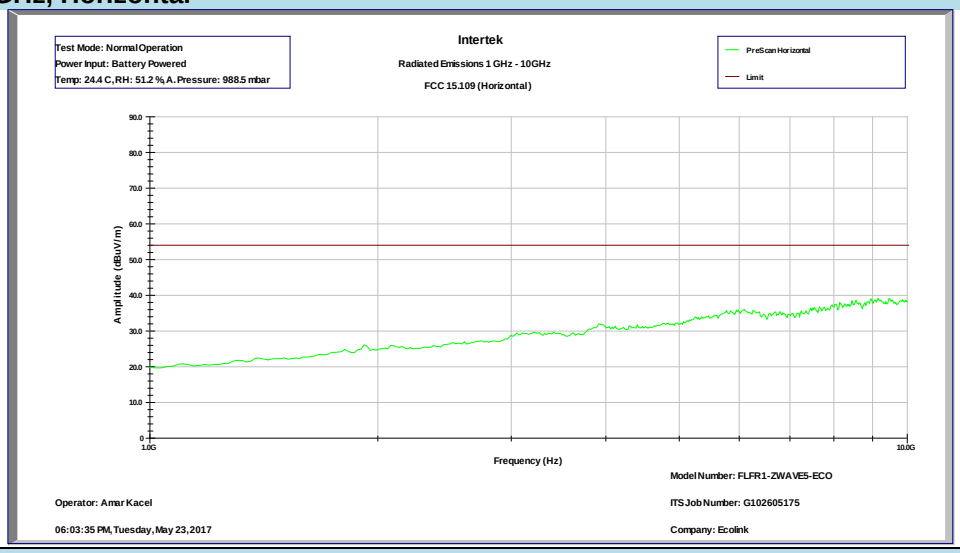
30 MHz – 1 GHz, Vertical



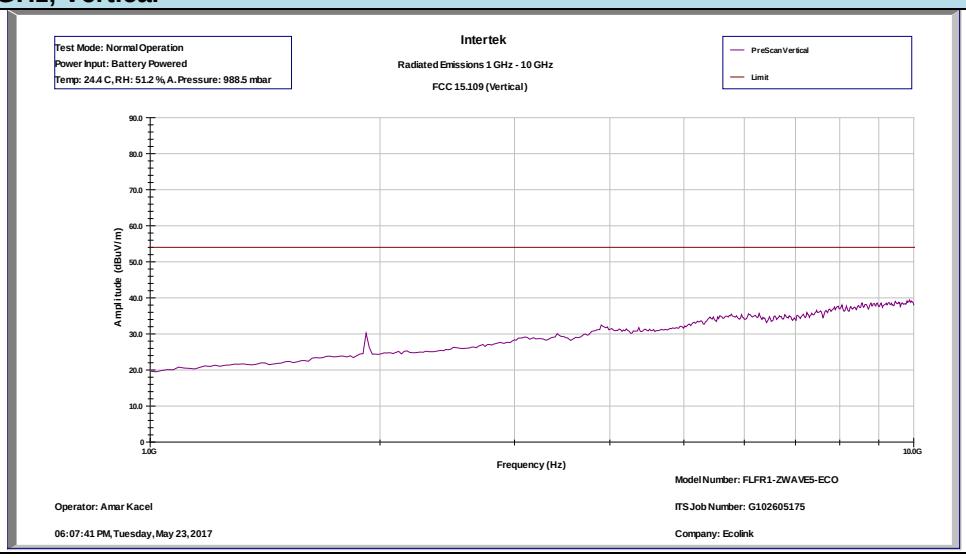
30 MHz – 1 GHz, Horizontal



1GHz – 10 GHz, Horizontal



1GHz – 10 GHz, Vertical



Deviations, Additions, or Exclusions: None

10 AC Mains Conducted Emissions

10.1 Method

Tests are performed in accordance with ANSI C63.4.

TEST SITE:

The test is performed in the 3 meter semi-anechoic chamber located at 25791 Commercentre Drive, Lake Forest, California 92630 USA. This test facility meets the requirements of CISPR 16-1-4 and has been accredited by A2LA.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
AC Line Conducted Emissions	150 kHz - 30 MHz	2.1 dB	3.4dB
Telco Port Emissions	150 kHz - 30 MHz	2.6 dB	5.0dB

As shown in the table above our conducted 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.

Sample Calculations

The following is how net line-conducted readings were determined:

NF = RF + LF + CF + AF
Where NF = Net Reading in dBμV
RF = Reading from receiver in dBμV
LF = LISN or ISN Correction Factor in dB
CF = Cable Correction Factor in dB
AF = Attenuator Loss Factor in dB

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 dBμV
$UF = 10^{(49.1\ dB\mu V / 20)}$ = 285.1 μV/m

10.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
N/A	N/A	N/A	N/A	N/A	N/A	N/A

Software Utilized:

Name	Manufacturer	Version	Profile
N/A	N/A	N/A	N/A

10.3 Results:

This test is not applicable as the EUT is battery powered.

11 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	05/25/2017	102605175LAX-001	AK	KV	Initial Release
1	06/19/2017	102605175LAX-001	AK	KV	Updated the report without setup photos