

EchoStar Technologies L.L.C. **TEST REPORT**

SCOPE OF WORK

EMC TESTING – CLIENT STB WITH RF4CE, MODEL: E97

REPORT NUMBER

103235083LAX-001

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EMC TEST REPORT
(FULL COMPLIANCE)

Report Number: 103235083LAX-001

Project Number: G103235083

Report Issue Date: January 9, 2018

Model(s) Tested: E97

Standards: **FCC CFR47 Part 15 Subpart C, January 2018**

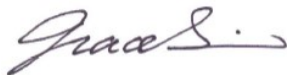
Intentional Radiator

§15.247, Operation within the bands 902-928 MHz, 2400-2483.5 MHz,
and 5725-5850 MHz

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

Client:
EchoStar Technologies L.L.C.
9601 Meridian Blvd
Englewood, CO 80112
USA

Report prepared 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	-
6	6 dB Bandwidth (FCC §15.247(a)(2))	Compliant
7	Maximum Peak Conducted Output Power at Antenna Terminals (FCC §15.247(b)(3))	Compliant
8	Maximum Power Spectral Density (FCC §15.247(e))	Compliant
9	Conducted Spurious Emissions (FCC §15.247(d))	Compliant
10	Radiated Spurious Emissions ((FCC §15.247(d), §15.209, §15.205)	Compliant
11	AC Mains Conducted Emissions (FCC §15.207)	Compliant
12	Revision History	-

3 Client Information

This EUT was tested at the request of:

Client: EchoStar Technologies L.L.C.
9601 Meridian Blvd
Englewood, CO 80112
USA

Contact: Ian Schroeder
Telephone: 303-706-4410
Fax: -
Email: ian.schroeder@dish.com

4 Description of Equipment Under Test and Variant Models

Manufacturer: EchoStar Technologies L.L.C.
9601 Meridian Blvd
Englewood, CO 80112
USA

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Client STB with RF4CE	EchoStar Technologies L.L.C.	E97	LPP323 (Conducted)
Client STB with RF4CE	EchoStar Technologies L.L.C.	E97	LPP301, LPP351 (Radiated)
AC Adapter	LITE ON	PB-1180-6ES1	ETC1620121353

Receive Date:	12/29/2017	Test Started	01/03/2018
Received Condition:	Good	Test Ended	01/04/2018
Type:	Production		

Description of Equipment Under Test (provided by client)

The equipment under test is a set-top box that is intended to be connected to any secondary television in a consumer's home. It uses IEEE 802.15.4 protocols.

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
100-120 Vac (O/P: 12Vdc)	0.5 A (O/P: 1.46A)	60 Hz	1

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Test Mode – Continuously Transmitting

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	Under test mode, the EUT was programmed to transmit continuously during testing. Software: SWID1022, Revision: 01.

Radio/Receiver Characteristics	
Frequency Band(s)	2425 MHz, 2450 MHz, 2475 MHz
Modulation Type(s)	O-QPSK
Maximum Output Power	3.66 dBm (2.32 mW)
Test Channels	15 (2425 MHz), 20 (2450 MHz), 25 (2475) MHz
Occupied Bandwidth (6 dB)	1,602 kHz
Frequency Hopper: Number of Hopping Channels	Not Applicable
Frequency Hopper: Channel Dwell Time	Not Applicable
Frequency Hopper: Max interval between two instances of use of the same channel	Not Applicable
MIMO Information (# of Transmit and Receive antenna ports)	Not Applicable
Equipment Type	Standalone
Antenna Type and Gain	Inverted F, 4.1 dBi

Variant Models:

The following variant models were not tested as part of this evaluation, but have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

None.

5 System Setup and Method

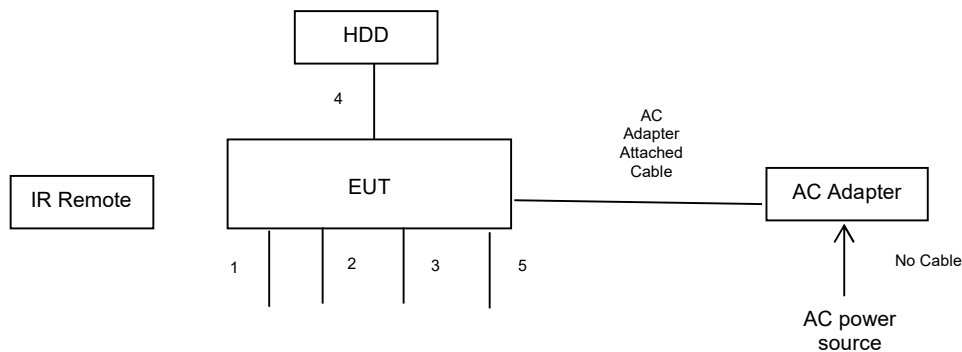
Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	MoCA, Coaxial (RG6 connector)	1.0	Yes	No	Yes
2	HDMI	1.8	Yes	No	No
3	RCA	1.8	Yes	No	No
4	USB	0.5	Yes	No	Yes
5	Ethernet	2.0	No	No	No

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
IR Remote (for setup only)	EchoStar Technologies LLC	21.0	175895
HDD	WD	4611B	WX81A31A3906

5.1 Method:

Configuration as required by ANSI C63.10-2013 and FCC Publication 558074 D01 DTS Meas Guidance v04, April 5, 2017.

5.2 EUT Setup Block Diagram:



6 6 dB Bandwidth

6.1 Requirement(s)

The minimum 6 dB bandwidth shall be at least 500 kHz.

6.2 Method

The procedure described in the FCC Publication *558074 D01 DTS Meas Guidance v04*, April 5, 2017 was used to determine the 6 dB bandwidth. Section *8.1 Option 1* was used.

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

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. IC test site registration number is 2042T.

6.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
1140	EMI Test Receiver	R&S	ESCI7	100825	02/21/2017	02/21/2018
1002	Barometer Temp/Humidity	Omega	IBTHX-W	0440776	01/22/2017	01/22/2018

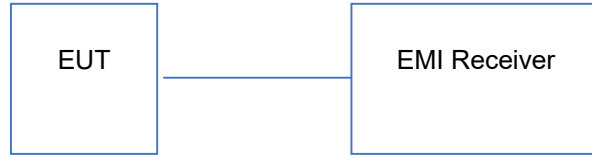
Software Utilized:

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

6.4 Results:

The sample tested was found to Comply.

6.5 Setup Diagram:

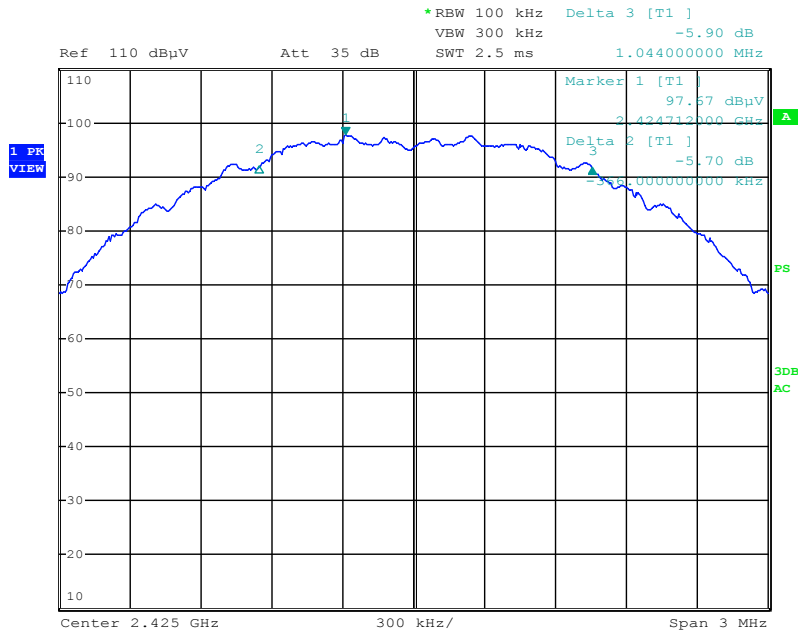


6.6 Plots/Data:

Frequency (MHz)	Channel	6 dB Bandwidth (kHz)
2425	15	1,410
2450	20	1,602
2475	25	1,560

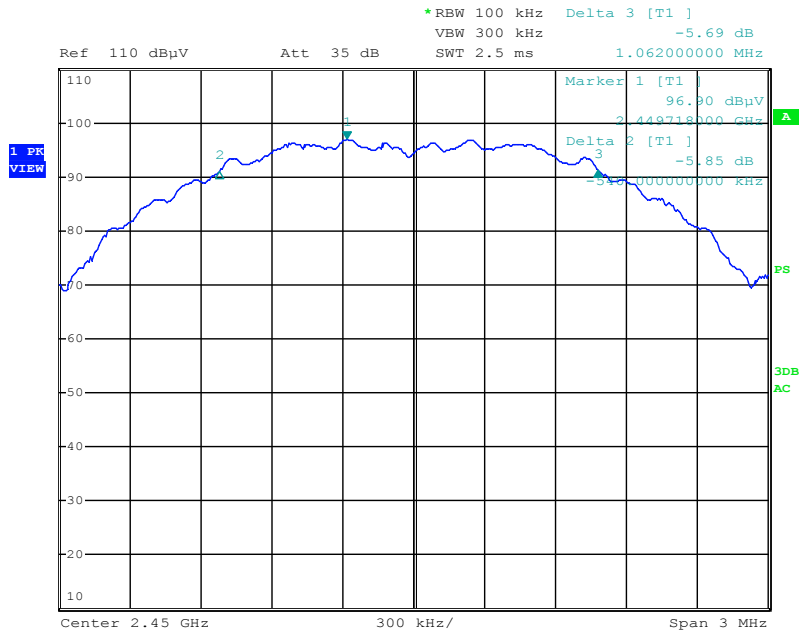
Note: The RF level in the plots is relative and is not the indication of RF output power.

Channel 15:



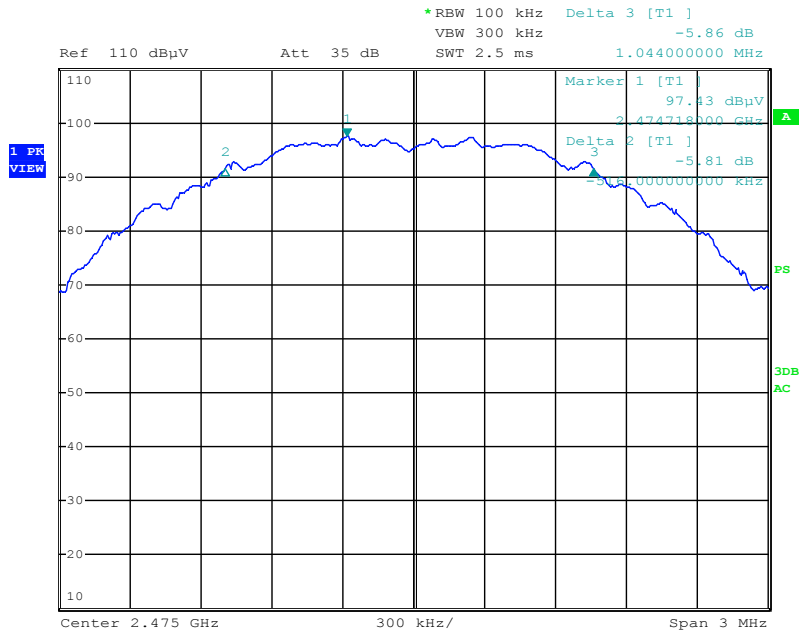
Date: 3.JAN.2018 12:03:31

Channel 20:



Date: 3.JAN.2018 12:08:11

Channel 25:



Date: 3.JAN.2018 12:06:34

Test Personnel: Grace Lin
 Product Standard: FCC 15.247
 Input Voltage: 120 Vac, 60 Hz
 Pretest Verification w/
 BB Source: N/A

Test Date: 01/03/2018
 Limit Applied: FCC 15.247
 Ambient Temperature: 20.7 °C
 Relative Humidity: 38.5 %
 Atmospheric Pressure: 993.9 mbars

Deviations, Additions, or Exclusions: None

7 Maximum Peak Conducted Output Power at Antenna Terminals

7.1 Requirement(s)

For antennas with gains of 6 dBi or less, maximum allowed transmitter output is 1 watt or 30 dBm. For antennas with gains greater than 6 dBi, transmitter output level must be decreased appropriately, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

7.2 Method

The procedure described in FCC Publication *558074 D01 DTS Meas Guidance v04*, April 5, 2017 was used. Specifically, Section 9.1.1 *RBW ≥ DTS bandwidth* was utilized as the spectrum analyzer's resolution bandwidth was greater than the DTS bandwidth.

1. Set the RBW ≥ DTS Bandwidth
2. Set the VBW ≥ 3 x RBW
3. Set the span ≥ 3 x RBW
4. Sweep time = Auto couple
5. Detector = Peak
6. Trace mode = Max Hold
7. Allow trace to fully stabilize
8. Use peak marker function to determine the peak amplitude level.

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. IC test site registration number is 2042T.

7.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
1140	EMI Test Receiver	R&S	ESCI7	100825	02/21/2017	02/21/2018
1002	Barometer Temp/Humidity	Omega	IBTHX-W	0440776	01/22/2017	01/22/2018

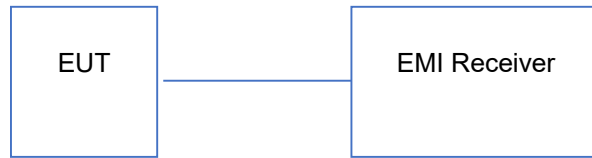
Software Utilized:

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

7.4 Results:

The sample tested was found to Comply.

7.5 Setup Diagram:

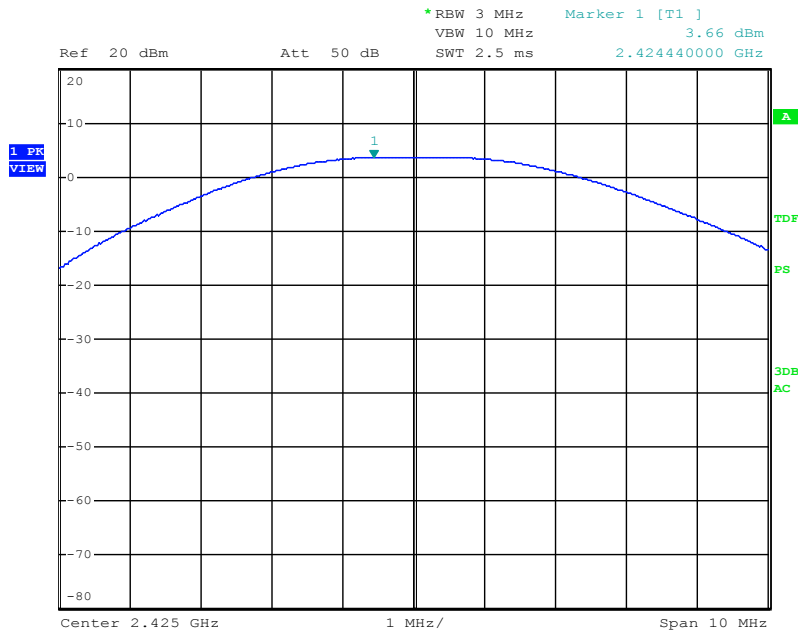


7.6 Plots/Data:

Frequency (MHz)	Channel	Peak Conducted Output Power	
		dBm	mW
2425	15	3.66	2.32
2450	20	3.57	2.28
2475	25	3.66	2.32

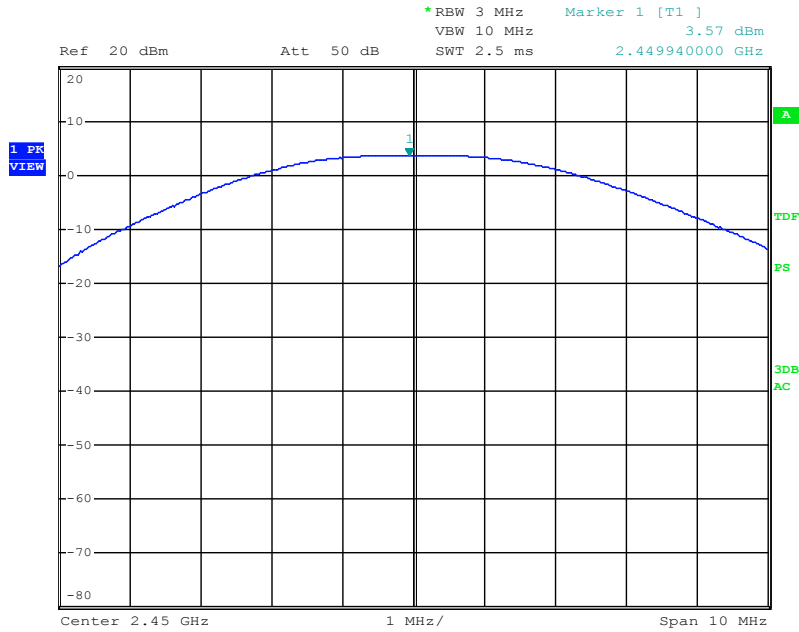
Note: The insertion loss was compensated for in the receiver

Channel 15:



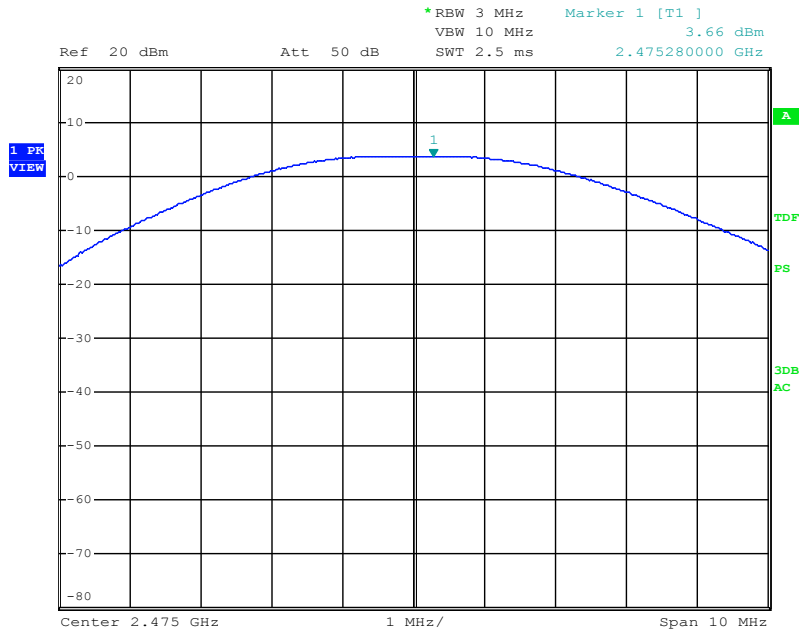
Date: 3.JAN.2018 12:58:24

Channel 20:



Date: 3.JAN.2018 12:49:47

Channel 25:



Date: 3.JAN.2018 12:48:39

Test Personnel:	Grace Lin	Test Date:	01/03/2018
Product Standard:	FCC 15.247	Limit Applied:	FCC 15.247
Input Voltage:	120 Vac, 60 Hz	Ambient Temperature:	20.7 °C
Pretest Verification w/ BB Source:	N/A	Relative Humidity:	38.5 %
		Atmospheric Pressure:	993.9 mbars

Deviations, Additions, or Exclusions: None

8 Maximum Power Spectral Density

8.1 Requirement(s)

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna should not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

8.2 Method

The procedure described in FCC Publication *558074 D01 DTS Meas Guidance v04*, April 5, 2017, specifically Section *10.2 Method PKPSD (peak PSD)* was utilized.

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the *DTS bandwidth*.
3. Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
4. Set the VBW $\geq 3 \times \text{RBW}$.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

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. IC test site registration number is 2042T.

8.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
1140	EMI Test Receiver	R&S	ESCI7	100825	02/21/2017	02/21/2018
1002	Barometer Temp/Humidity	Omega	IBTHX-W	0440776	01/22/2017	01/22/2018

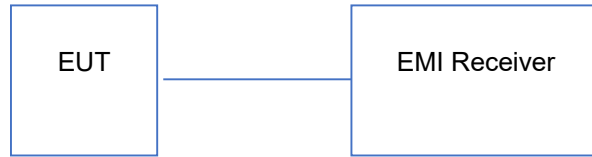
Software Utilized:

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

8.4 Results:

The sample tested was found to Comply.

8.5 Setup Diagram:

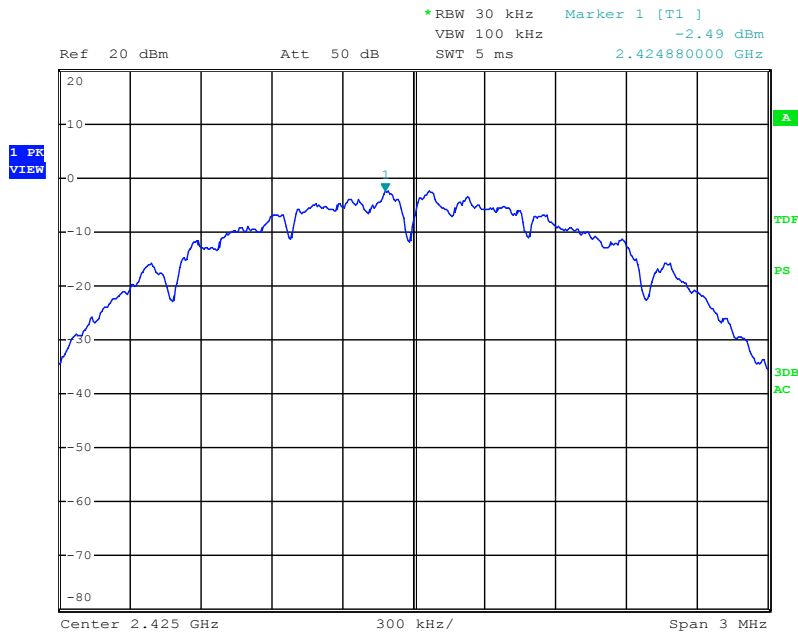


8.6 Plots/Data:

Frequency (MHz)	Channel	Maximum Power Spectral Density (dBm)
2425	15	-2.49
2450	20	-2.94
2475	25	-2.56

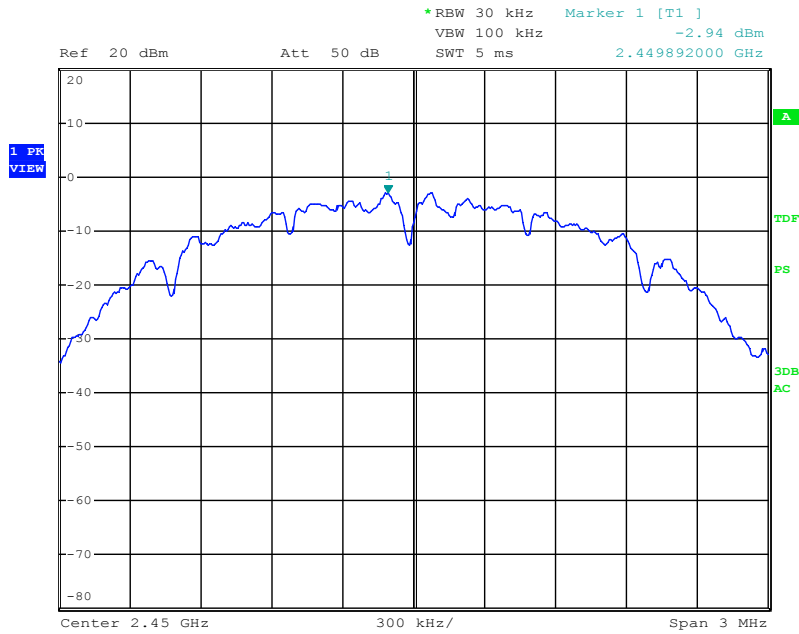
Note: The insertion loss was compensated for in the receiver

Channel 15:



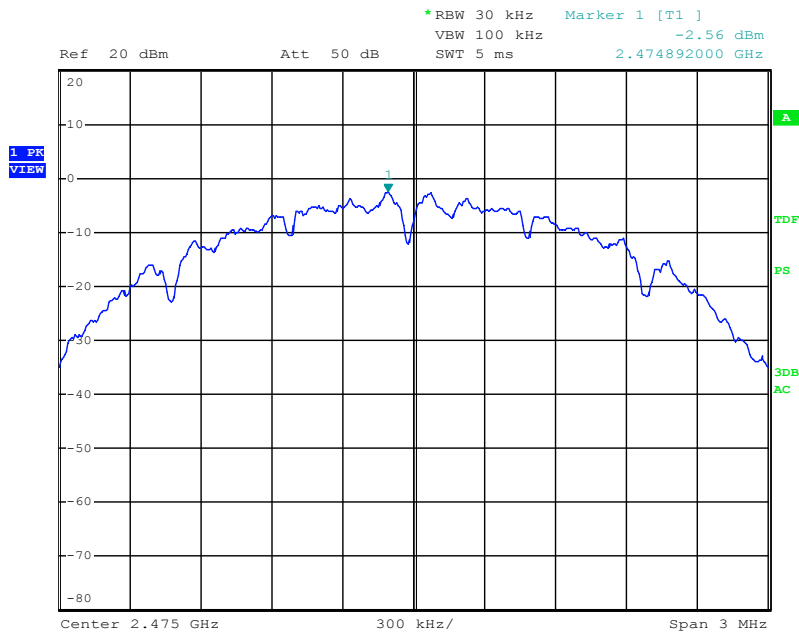
Date: 3.JAN.2018 13:03:45

Channel 20:



Date: 3.JAN.2018 13:16:44

Channel 25:



Date: 3.JAN.2018 13:07:13

Test Personnel:	Grace Lin	Test Date:	01/03/2018
Product Standard:	FCC 15.247	Limit Applied:	FCC 15.247
Input Voltage:	120 Vac, 60 Hz	Ambient Temperature:	20.7 °C
Pretest Verification w/ BB Source:	N/A	Relative Humidity:	38.5 %
		Atmospheric Pressure:	993.9 mbars

Deviations, Additions, or Exclusions: None

9 Conducted Spurious Emissions

9.1 Requirement(s)

In any 100 kHz bandwidth outside the frequency band, the radio frequency power shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of the RMS averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB.

In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), shall comply with the radiated emission limits specified in § 15.209(a)

9.2 Method

The procedure described in FCC Publication *558074 D01 DTS Meas Guidance v04*, April 5, 2017, specifically Section *11.0 Emissions in non-restricted frequency bands* was utilized.

A spectrum analyzer was connected to the antenna port of the transmitter.

1. Set the RBW = 100 kHz.
2. Set the VBW $\geq 3 \times$ RBW.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

The unwanted emissions were measured from 30 MHz to 25 GHz. Plots below are corrected for cable loss and then compared to the limits. The RF level in the plots is relative and is not the indication of RF output power.

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. IC test site registration number is 2042T.

9.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
690	Spectrum Analyzer, 9 KHz - 40 GHz	R&S	FSP40	100027	01/24/2017	01/24/2018
1140	EMI Test Receiver	R&S	ESCI7	100825	02/21/2017	02/21/2018
1002	Barometer Temp/Humidity	Omega	IBTHX-W	0440776	01/22/2017	01/22/2018

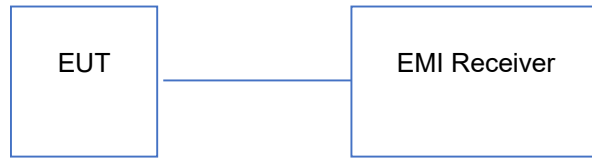
Software Utilized:

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

9.4 Results:

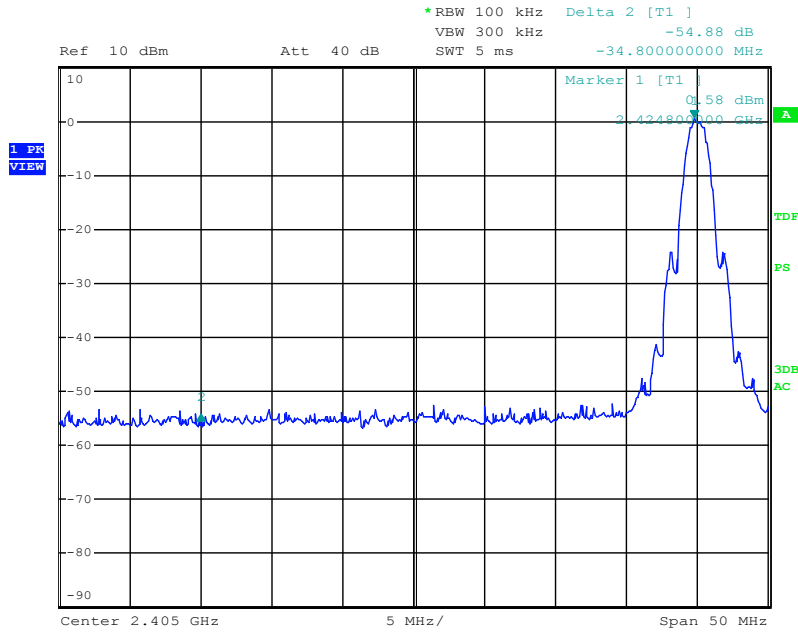
The sample tested was found to Comply.

9.5 Setup Diagram:

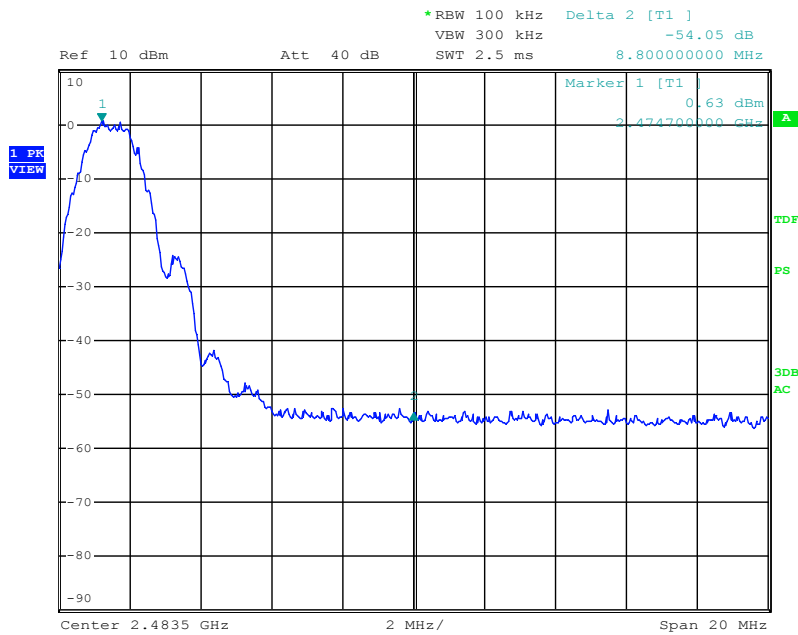


9.6 Plots/Data:

Band Edge:

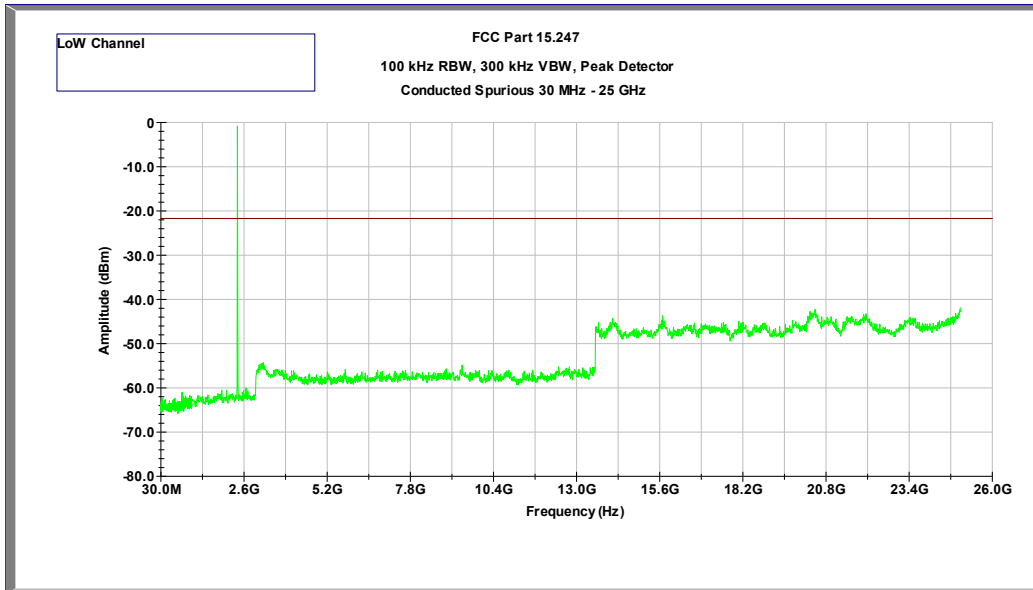


Date: 3.JAN.2018 13:39:56

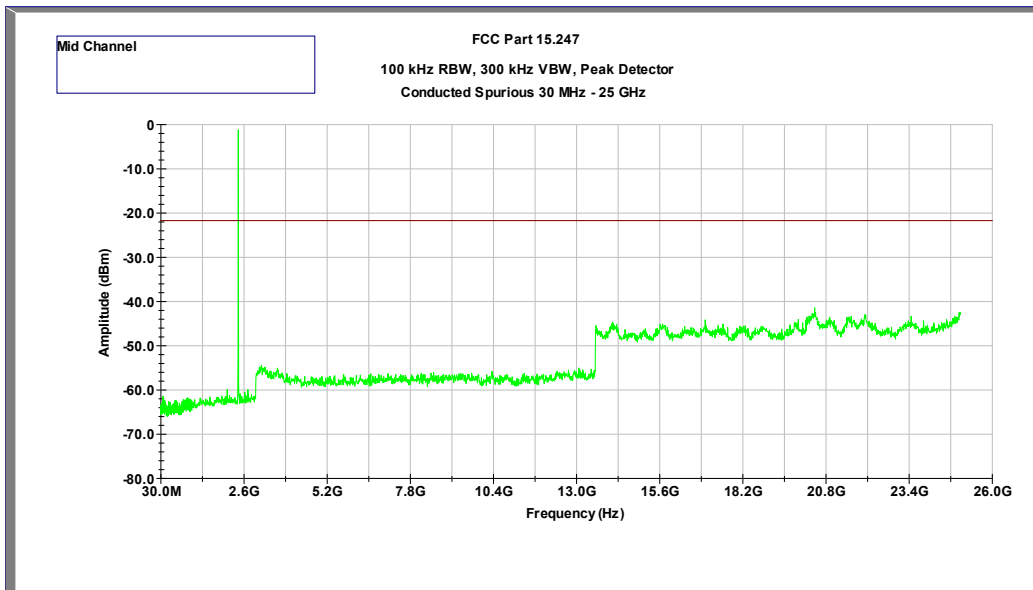


Date: 3.JAN.2018 13:24:11

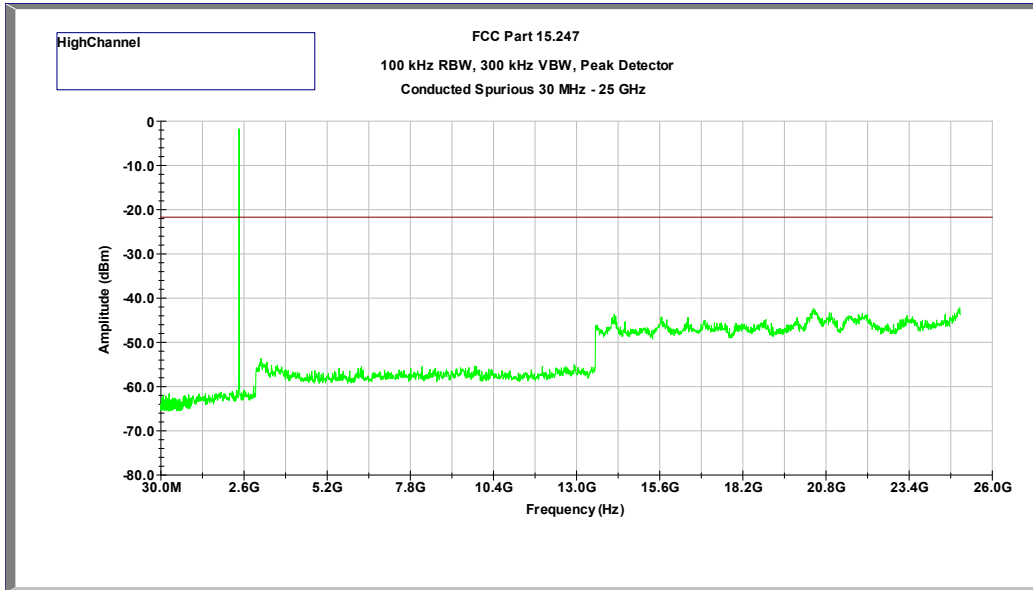
Channel 15:



Channel 20:



Channel 25:



Test Personnel: Grace Lin
Product Standard: FCC 15.247
Input Voltage: 120 Vac, 60 Hz
Pretest Verification w/
BB Source: N/A

Test Date: 01/03/2018
Limit Applied: FCC 15.247
Ambient Temperature: 20.7 °C
Relative Humidity: 38.5 %
Atmospheric Pressure: 993.9 mbars

Deviations, Additions, or Exclusions: None

10 Radiated Spurious Emissions

10.1 Requirement(s)

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

In any 100 kHz bandwidth outside the frequency band, the radio frequency power shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of the RMS averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB.

10.2 Method

EUT was configured to transmit continuously. Radiated emission measurements were performed from 30 MHz to 25 GHz according to the procedure described in ANSI C64.10. Spectrum analyzer resolution bandwidth is 120 kHz for frequencies 30 MHz to 1000 MHz. Above 1 GHz, both Peak and Average measurements were performed. The peak level of radiated emissions was measured with a resolution bandwidth (RBW) of 1 MHz and a video bandwidth (VBW) of 3 MHz, and a peak detector. The average level of radiated emissions was measured with a resolution bandwidth (RBW) of 1 MHz, a video bandwidth (VBW) of 3 MHz, and a RMS detector with trace averaging.

The EUT is placed on a plastic turntable that is 80 cm in height for frequencies 30 MHz to 1000 MHz, 1.5 meters for frequency above 1000 MHz. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). During testing, all cables were manipulated to produce worst-case emissions. The signal is maximized through rotation. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters.

Radiated emissions are taken at 3 meters for frequencies below 18 and 1 meter for frequencies above 18 GHz.

Data included is representative of the worst-case configuration (the configuration which resulted in the highest emission levels). Plots below are corrected for distance, cables, preamp, filters and antenna factors then compared to the limits.

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. IC test site registration number is 2042T.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	U _{CISPR}
Radiated Emissions, 3m	30-1000 MHz	4.3	6.3 dB
Radiated Emissions, 3m	1-18 GHz	5.5	5.2 dB
Radiated Emissions, 1m	18-26.5 GHz	4.5	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:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μ V
NF = Net Reading in dB μ V

Example:

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

10.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
637	3m Semi-anechoic Chamber	Panashield	3 meter	25 331-D-Z	December 2015	December 2018
1669	EMI Test Receiver	R&S	ESW44	101636	07/14/2017	07/14/2018
1140	EMI Test Receiver	R&S	ESCI7	100825	02/21/2017	02/21/2018
690	Spectrum Analyzer, 9 KHz - 40 GHz	R&S	FSP40	100027	01/24/2017	01/24/2018
1147	Bilog Antenna	TESEQ Gmbh	CBL 6112D	32852	11/16/2017	11/16/2018
1515	Horn Antenna	ETS-Lindgren	3115	00161631	03/15/2017	03/15/2018
880	Horn Antenna	ETS-Lindgren	3116C	00153521	03/14/2017	03/14/2018
1576	Pre-amp	R&S	TS-PR1	102068	06/20/2017	06/20/2018
1556	Pre-amp	R&S	TS-PR18	102144	07/29/2017	07/29/2018
1517	Cable	R&S	TSPR-B7	101528	07/13/2017	07/13/2018
1518	Cable	R&S	TSPR-B7	101529	07/13/2017	07/13/2018
1002	Barometer Temp/Humidity	Omega	IBTHX-W	0440776	01/22/2017	01/22/2018

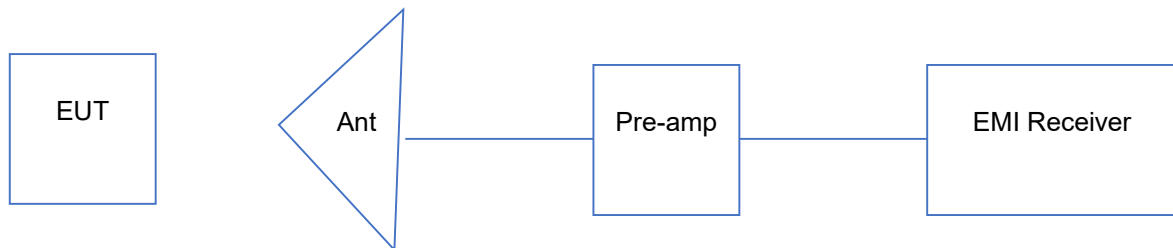
Software Utilized:

Name	Manufacturer	Version	Profile
Tile	Quantum Change	4.1	FCC 30 to 1000 FSP FCC Part 15-209 1-18GHz

10.4 Results:

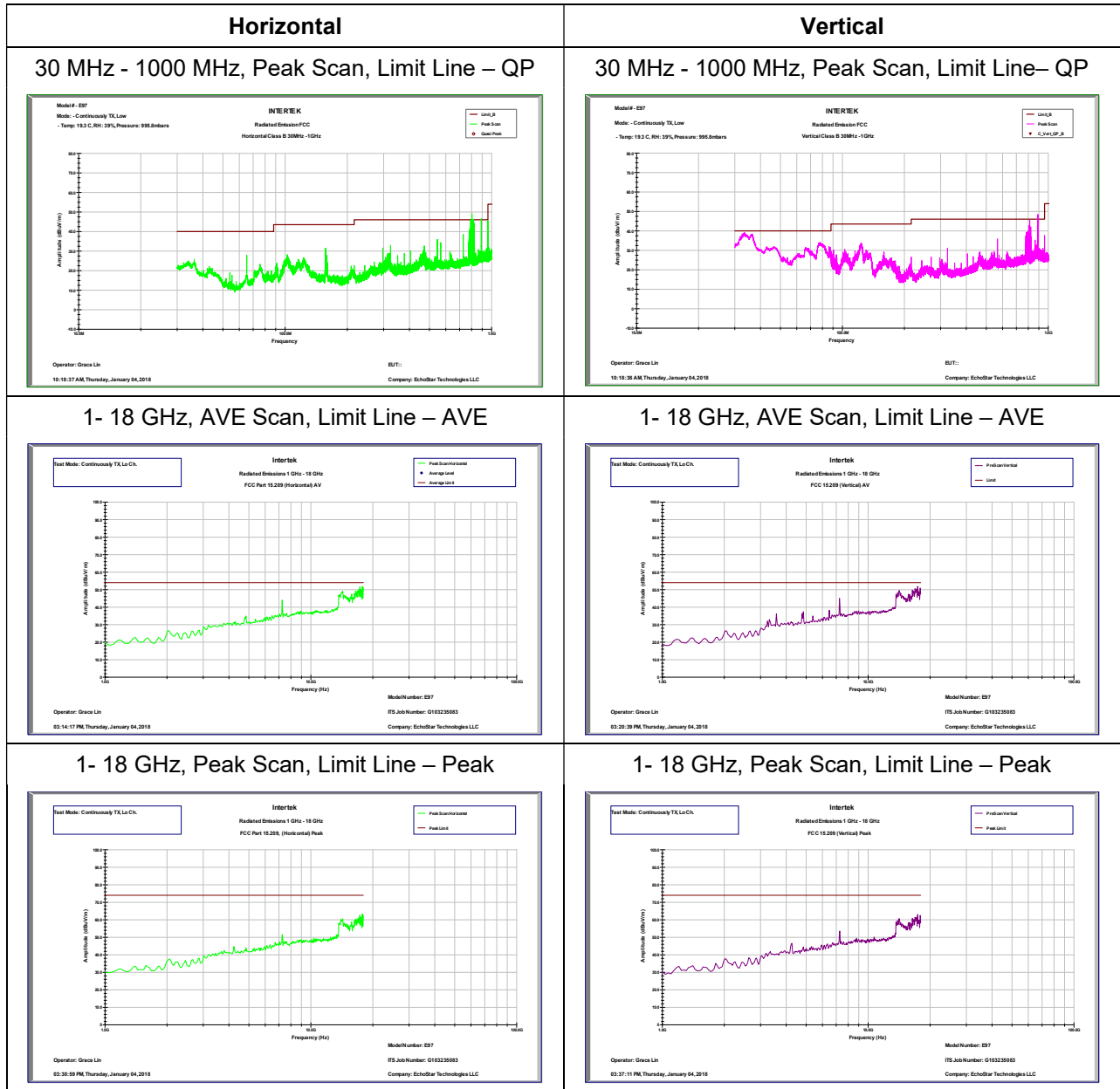
The sample tested was found to Comply.

10.5 Setup Diagram:



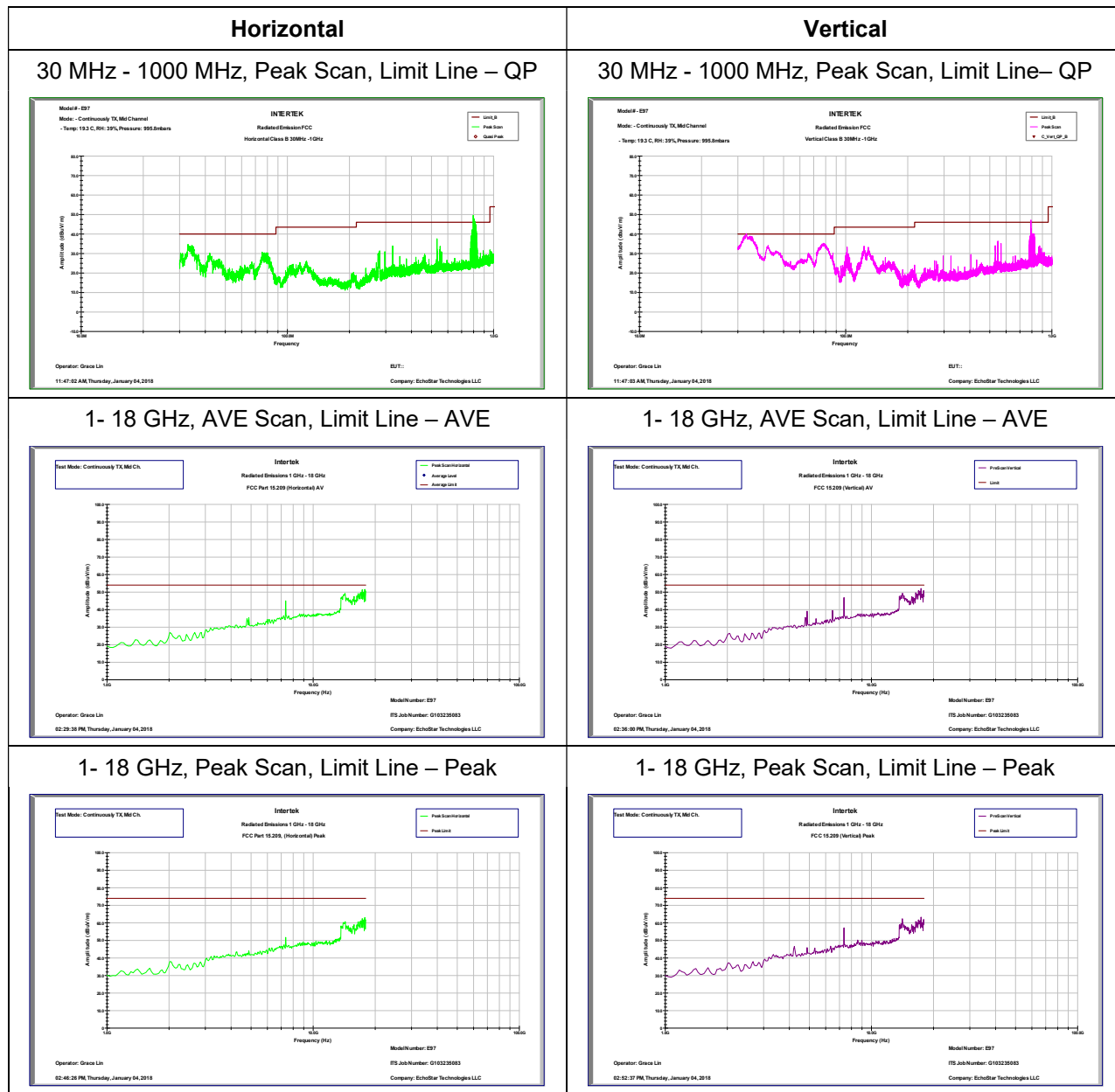
10.6 Plots/Data:

Radiated Spurious Emissions 2425 MHz



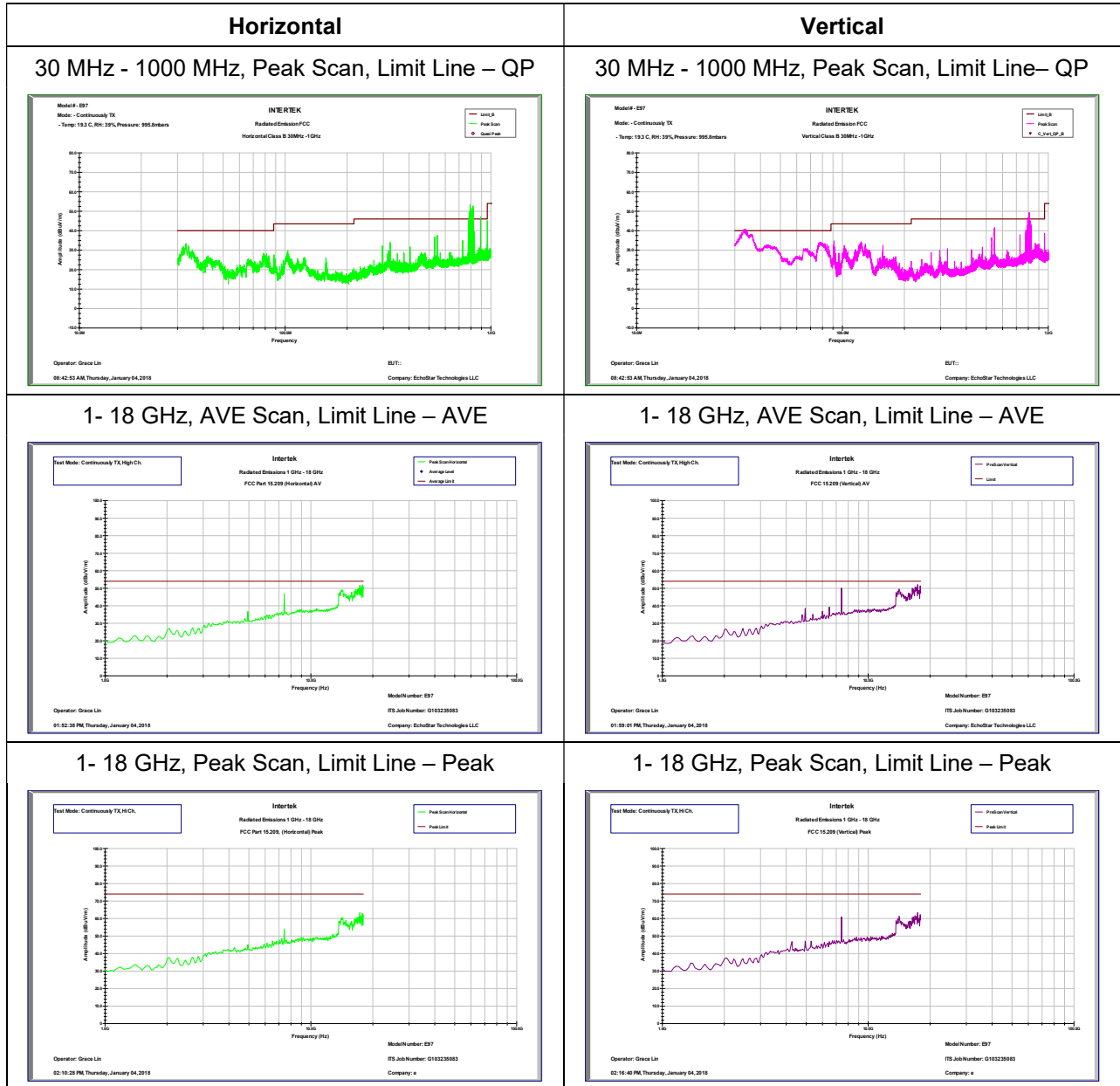
Note: Radiated emission measurements were performed up to 25 GHz. No emissions were identified when scanned from 18-25 GHz.

Radiated Spurious Emissions 2450 MHz



Note: Radiated emission measurements were performed up to 25 GHz. No emissions were identified when scanned from 18-25 GHz.

Radiated Spurious Emissions 2475 MHz



Note: Radiated emission measurements were performed up to 25 GHz. No emissions were identified when scanned from 18-25 GHz.

Antenna Polarization	Frequency (MHz)	Channel No.	Measured Data (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Turntable Degree	Antenna Height (cm)	Detector
H	960.0	15	43.2	46	-2.8	156	231	QP
V	36.4	20	35.4	40	-4.6	105	239	QP
V	891.0	20	32.0	46	-14.0	237	121	QP
H	816.5	25	41.4	46	-4.6	360	128	QP
V	33.4	25	36.4	40	-3.6	100	100	QP
V	2390.0	15	23.3	54	-30.8	127	267	AVE
V	2390.0	15	34.3	74	-39.8	127	267	PK
V	7275.0	15	50.2	54	-3.8	244	269	AVE
V	7275.0	15	56.9	74	-17.1	244	269	PK
V	7350.0	20	49.7	54	-4.3	241	250	AVE
V	7350.0	20	56.0	74	-18.0	241	250	PK
V	2483.5	25	24.9	54	-29.1	229	242	AVE
V	2483.5	25	42.5	74	-31.5	229	242	PK
V	7425.0	25	52.2	54	-1.8	246	256	AVE
V	7425.0	25	58.7	74	-15.3	246	256	PK

Note: Radiated emission measurements were performed up to 25 GHz. No emissions were identified when scanned from 18-25 GHz.

Test Personnel:	Grace Lin	Test Date:	01/04/2018
Product Standard:	FCC 15.247	Limit Applied:	FCC 15.247
Input Voltage:	120 Vac, 60 Hz	Ambient Temperature:	19.3 °C
Pretest Verification w/ BB Source:	N/A	Relative Humidity:	39 %
		Atmospheric Pressure:	995.8 mbars

Deviations, Additions, or Exclusions: None

11 AC Mains Conducted Emissions

11.1 Performance Criterion

Frequency Band MHz	Class B Limit dB(μ V)		Class A Limit dB(μ V)	
	Quasi-Peak	Average	Quasi-Peak	Average
0.15-0.50	66 to 56 *	56 to 46 *	79	66
0.50-5.00	56	46	73	60
5.00-30.00	60	50	73	60

*Note: *Decreases linearly with the logarithm of the frequency
At the transition frequency the lower limit applies.*

11.2 Method

Measurements are carried out using quasi-peak and average detector receivers in accordance with CISPR 16. An AMN is required to provide a defined impedance at high frequencies across the power feed at the point of measurement of terminal voltage and also to provide isolation of the circuit under test from the ambient noise on the power lines. An AMN as defined in CISPR 16 shall be used.

The EUT is located so that the distance between the boundary of the EUT and the closest surface of the AMN is 0.8m.

Where a flexible mains cord is provided by the manufacturer, this shall be 1m long or if in excess of 1m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4m in length.

The EUT is arranged and connected with cables terminated in accordance with the product specification.

Conducted disturbance is measured between the phase lead and the reference ground, and between the neutral lead and the reference ground. Both measured values are reported.

The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. A vertical, metal reference plane is placed 0.4m from the EUT. The vertical metal reference-plane is at least 2m by 2m. The EUT shall be kept at least 0.8m from any other metal surface or other ground plane not being part of the EUT. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.

Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

Equipment setup for conducted disturbance tests followed the guidelines of 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. IC test site registration number is 2042T.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucisp
AC Line Conducted Emissions	150 kHz - 30 MHz	2.1 dB	3.4dB

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, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculations

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

$$NF = RF + LF + CF + AF$$

Where NF = Net Reading in dB μ V

RF = Reading from receiver in dB μ V

LF = LISN or ISN Correction Factor in dB

CF = Cable Correction Factor in dB

AF = Attenuator Loss Factor in dB

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

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

$$NF = \text{Net Reading in dB}\mu\text{V}$$

Example:

$$NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 \text{ dB}\mu\text{V}$$

$$UF = 10^{(49.1 \text{ dB}\mu\text{V} / 20)} = 285.1 \mu\text{V/m}$$

11.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
637	3m Semi-anechoic Chamber	Panashield	3 meter	25 331-D-Z	December 2015	December 2018
1140	EMI Test Receiver	R&S	ESCI7	100825	02/21/2017	02/21/2018
546	LISN	EMCO	3816/2	9605-1039	03/13/2017	03/13/2018
1470	Cable	MegaPhase	TM18-N1N1	-	06/16/2017	06/16/2018
1002	Barometer Temp/Humidity	Omega	IBTHX-W	0440776	01/22/2017	01/22/2018

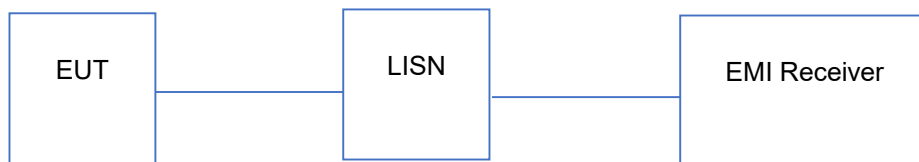
Software Utilized:

Name	Manufacturer	Version	Profile
Tile	Quantum Change	4.1	Master CE FCC

11.4 Results:

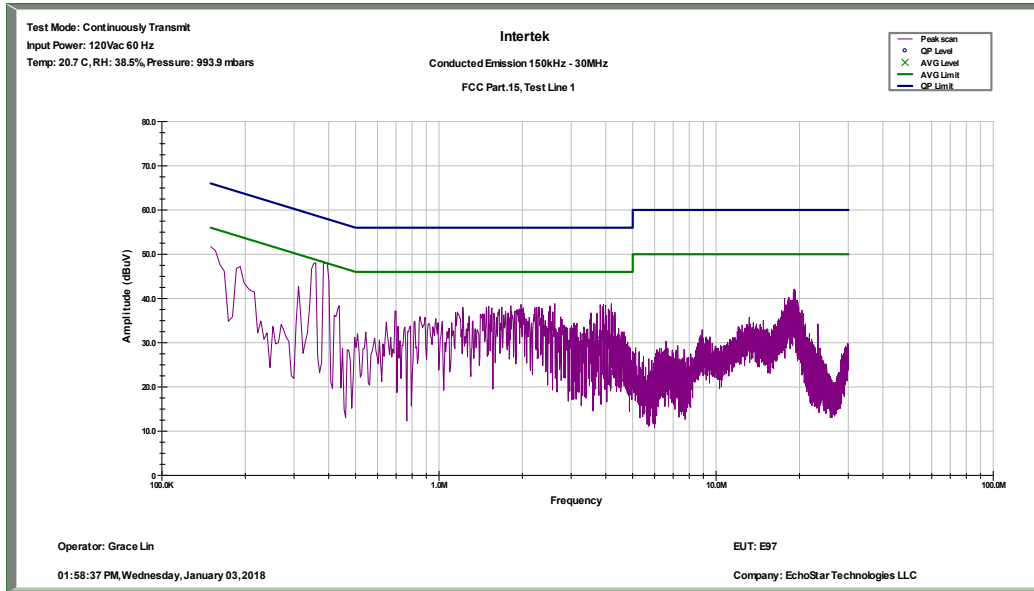
The sample tested was found to Comply.

11.5 Test Setup Diagram:



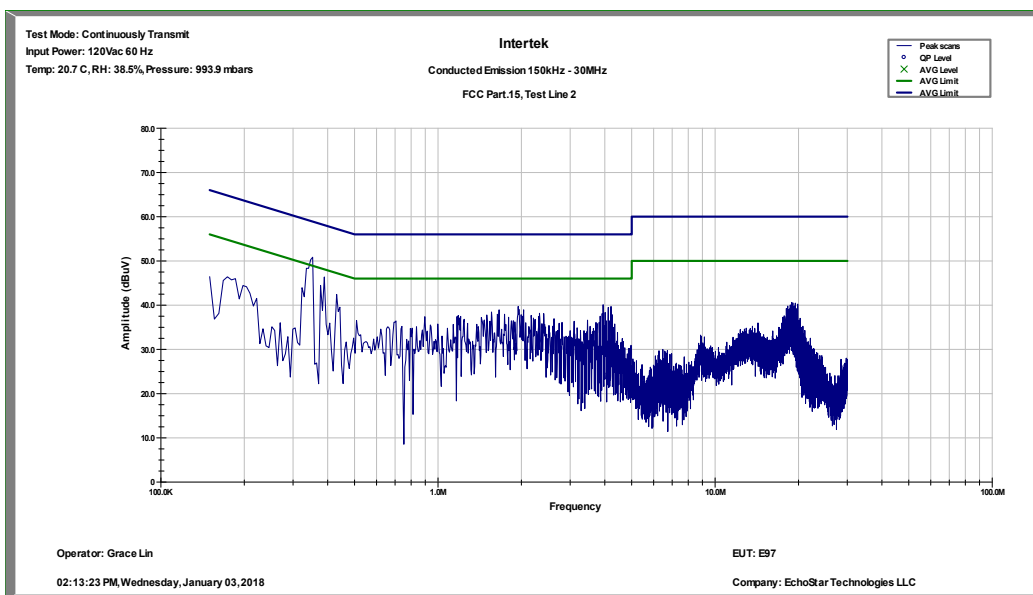
11.6 Plots/Data:

Line 1:



Frequency	AVG Level	QP Level	AVG Limit	QP Limit	AVG Margin	QP Margin
MHz	dBuV	dBuV	dBuV	dBuV	dB	dB
0.152	38.4	47.1	56.0	66.0	-17.6	-18.9
0.194	38.5	45.6	54.8	64.8	-16.3	-19.1
0.312	30.8	39.5	51.4	61.4	-20.6	-21.9
0.349	44.9	49.3	50.3	60.3	-5.4	-11.0
0.383	38.3	48.4	49.4	59.4	-11.1	-11.0
4.110	22.4	34.1	46.0	56.0	-23.6	-21.9
19.111	28.2	35.4	50.0	60.0	-21.8	-24.6

Line 2:



Frequency	AVG Level	QP Level	AVG Limit	QP Limit	AVG Margin	QP Margin
MHz	dBuV	dBuV	dBuV	dBuV	dB	dB
0.152	38.8	47.9	56.0	66.0	-17.1	-18.1
0.173	38.6	48.3	55.3	65.3	-16.7	-17.1
0.356	43.1	50.1	50.1	60.1	-7.0	-10.0
0.385	40.5	48.0	49.3	59.3	-8.8	-11.3
0.428	33.6	41.7	48.1	58.1	-14.5	-16.3
3.952	22.9	34.9	46.0	56.0	-23.1	-21.1
4.202	21.9	34.5	46.0	56.0	-24.1	-21.5
18.777	27.3	34.7	50.0	60.0	-22.7	-25.3

Test Personnel: Grace Lin
 Product Standard: FCC 15.247
 Input Voltage: 120 Vac, 60 Hz
 Pretest Verification w/
 BB Source: N/A

Test Date: 01/03/2018
 Limit Applied: FCC 15.207
 Ambient Temperature: 20.7 °C
 Relative Humidity: 38.5 %
 Atmospheric Pressure: 993.9 mbars

Deviations, Additions, or Exclusions: None

12 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	01/08/2018	103235083LAX-001	GL	KV	Original Issue