Project 15398-15

Plum
Light Pad Dimmer
Bluetooth Low Energy Radio Section

Wireless Certification Report
(2 of 2)

Prepared for:

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By

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6 Aug 2015

Reviewed by

Larry Finn
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Written by

Eric Lifsey
EMC Engineer

Revision History

Revision Number	Description	Date
00	Draft for client and internal review.	24 Jul 2015
01	Revised.	31 Jul 2015
02	Revised to correct RSS-Gen references.	6 Aug 2015

Corrections:

Where witness Russ is shown the full name Russ Troxel applies.

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Compliance Certificate

Applicant	Device & Test Identification	
Plum (Rich Warwick) 9800 N. Lamar Blvd. Suite 310 Austin, TX 78701 Certificate Date: 6 Aug 2015	FCC ID: Industry Canada ID: Model(s): Laboratory Project ID:	2AFB9P1000 20409-P1000 Light Pad Dimmer Bluetooth Low Energy Radio Section 15398-15

The device named above was tested utilizing the following documents and found to be in compliance with the required criteria:

Requirement	Reference	Detail
FCC 47 CFR Part 15 C	15.247	Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
FCC 47 CFR Part 15 C	15.209	Radiated emission limits; general requirements.
FCC 47 CFR Part 15 C	15.107, 15.207	Conducted emission limits.
FCC 47 CFR Part 15 C	15.205	Restricted Bands of Operation
KDB 558074 D01	DR01	DTS Measurement Guidance v03r02
KDB 412172	D01	Guidelines for Determining the ERP and EIRP of an RF Transmitting System
OET Bulletin 65*	Edition 97-01, and Supplement C, Ed. 01-01	Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields
RSS-247	Issue 1	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen	Issue 4	General Requirements and Information for the Certification of Radio Apparatus
RSS-102	Issue 4	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

*MPE is reported separately from this document. **Corresponding RSS references are listed in the body of the report.

I, Eric Lifsey, for Professional Testing (EMI), Inc., being familiar with the above requirements and test procedures have reviewed the test setup, measured data, and this report. I believe them to be true and accurate.

Eric Lifsey
EMC Engineer

This report has been reviewed and accepted by the Applicant**.** The undersigned is responsible for ensuring that this device will continue to comply with the requirements listed above.

_____
Representative of Applicant

1.0 Introduction

1.1 Scope

This report describes the extent to which the equipment under test (EUT) conformed to the intentional radiator requirements of the United States and Canada.

Professional Testing (EMI), Inc., (PTI) follows the guidelines of National Institute of Standards and Technology (NIST) for all uncertainty calculations, estimates, and expressions thereof for electromagnetic compatibility testing.

1.2 EUT Description

Table 1.2.1: Equipment Under Test		
Manufacturer / Model	**Serial #**	**Description**
Plum / Light Pad Dimmer*	1600019	2400-2483.5 MHz FHSS transceiver; applies to Bluetooth Low Energy radio section.

Table 1.2.2: Support Equipment		
Manufacturer / Model	**Serial #**	**Description**
Plum	N/A	Incandescent lamp (200W) and cable assembly.

The EUT designed as a module for use in individual lighting assemblies to control lighting level.

The EUT measures approximately 10.5 cm x 5.4 cm x 3.8 cm. It is powered by a 3.3 VDC derived from 120 VAC 60 Hz mains.

1.3 EUT Operation

The EUT was exercised in a manner consistent with normal operations.

The Bluetooth Low Energy radio section is paired with a WiFi radio section. Each utilize the same antenna but with a common antenna-switch arrangement. Therefore, only one radio may transmit at a time.

The Bluetooth Low Energy radio is the sole means of initially configuring the WiFi section. Once configured, the Bluetooth Low Energy section currently remains unused until a change in configuration is required.

1.4 Modifications to Equipment

No modifications were made to the EUT during the performance of the test program.

1.5 Test Site

Measurements were made at the PTI semi-anechoic facility designated Site 45 (FCC 459644, IC 3036B-1) in Austin, Texas. The site is registered with the FCC under Section 2.948 and Industry Canada per RSS-GEN, and is subsequently confirmed by laboratory accreditation (NVLAP). The test site is located at 11400 Burnet Road, Austin, Texas 78758, while the main office is located at 1601 North A.W. Grimes Boulevard, Suite B, Round Rock, Texas, 78665.

1.6 Radiated Measurements

Radiated levels are determined as follows:

Raw Measured Level + Antenna Factor + Cable Losses – Amplifier Gain = Corrected Level

Conducted RF levels are determined as follows:

Raw Measured Level + Attenuator Factor + Cable Losses = Corrected Level

Conducted mains levels are determined as follows:

Raw Measured Level + LISN Factor + Cable/Filter/Limiter Losses = Corrected Level

Additionally, measurement distance extrapolation factors are applied and documented where used.

1.7 Applicable Documents and Clauses

Table 1.7.1: Applicable Documents

Document	Title
47 CFR	Part 15 – Radio Frequency Devices Subpart C -Intentional Radiators
RSS-247 Issue 1	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen Issue 4	General Requirements and Information for the Certification of Radio Apparatus
ANSI C63.4 2009	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipment

Table 1.7.2: Applicable Clauses

Parameter	FCC Part 15 Rule Paragraphs	IC RSS References
Transmitter Characteristics	15.247(a)(1)	RSS-247 5.1 (FHS) & 5.4, RSS-Gen
Hopping Characteristics	15.247(a)(1)	RSS-247 5.1 (FHS)
Bandwidth	15.247(a)(1), 2.1049, KDB 558074 D01	RSS-Gen 4.6
Spurious Emission	15.247, 15.209, 15.205	RSS-247 5.5, RSS-GEN 4.9, 4.10
Band Edge	15.247, 15.205	RSS-247 5.5, RSS-Gen 4.9
Antenna Requirement	15.203	RSS-Gen 8.3
Conducted Emissions, Mains	15.207	RSS-Gen 8.8

2.0 Fundamental Power

2.1 Test Procedure

Modulation is enabled and peak power is measured using conducted means. The output was coupled direct to a spectrum analyzer with no cable or attenuation to consider. The transmitter hopping sequence was disabled and was forced to operate on a single channel for the measurement.

2.2 Test Criteria

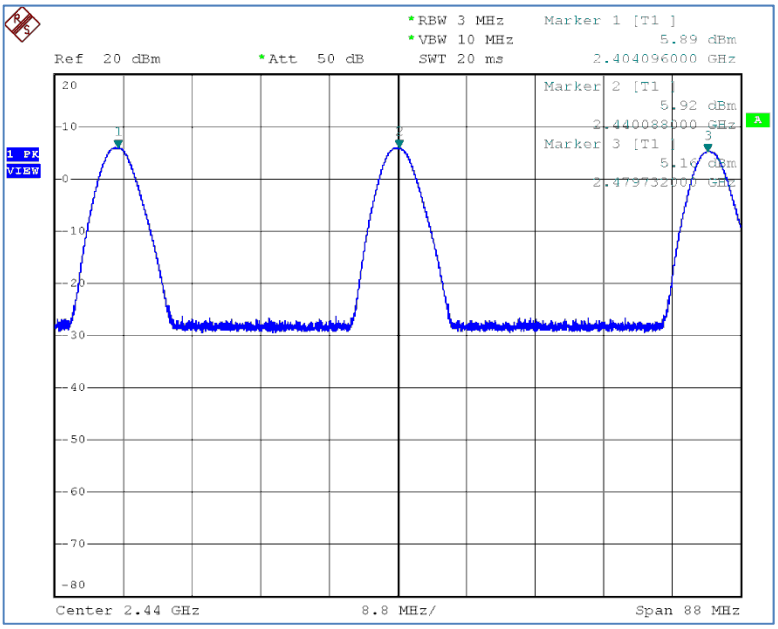
47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date
15.247(a)(3) // RSS-247 5.1	Fundamental Power, Hopping Radio Conducted Limits 1 Watt for ≥ 75 channels, 125 mW Otherwise	13 Jul 2015

2.3 Test Results

Table 2.3.1 Power, Peak, Conducted, Limit: 125 mW (21 dBm)		
Frequency MHz	**Measured Peak Power mW**	**Measured Peak Power dBm**
2404	3.88	5.89
2440	3.91	5.92
2480	3.28	5.16

Measured in 3 MHz RBW, 10 MHz VBW.

The EUT was found to be in compliance with the applicable criteria. Plotted measurement appears below.



Low, Middle, and High Channel Peak Power

3.0 Hopping Characteristics

3.1 Test Procedure

Modulation is enabled and the EUT is transmitting with hopping sequence enabled. The output is coupled to a spectrum analyzer with no cable or attenuation to consider. Spectrum and timing measurements are taken to evaluate the hopping characteristics and calculate the accumulated dwell time. Duty cycle is determined so averages can be calculated for spurious emissions.

3.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date
15.247(a)(3) // RSS-247 5.1	**Hopping Characteristics:** Number of Channels Channel Separation Channel Dwell Time Return to Channel Time Limit 400 ms Accumulated Dwell Time	17 Jul 2015

3.3 Test Results

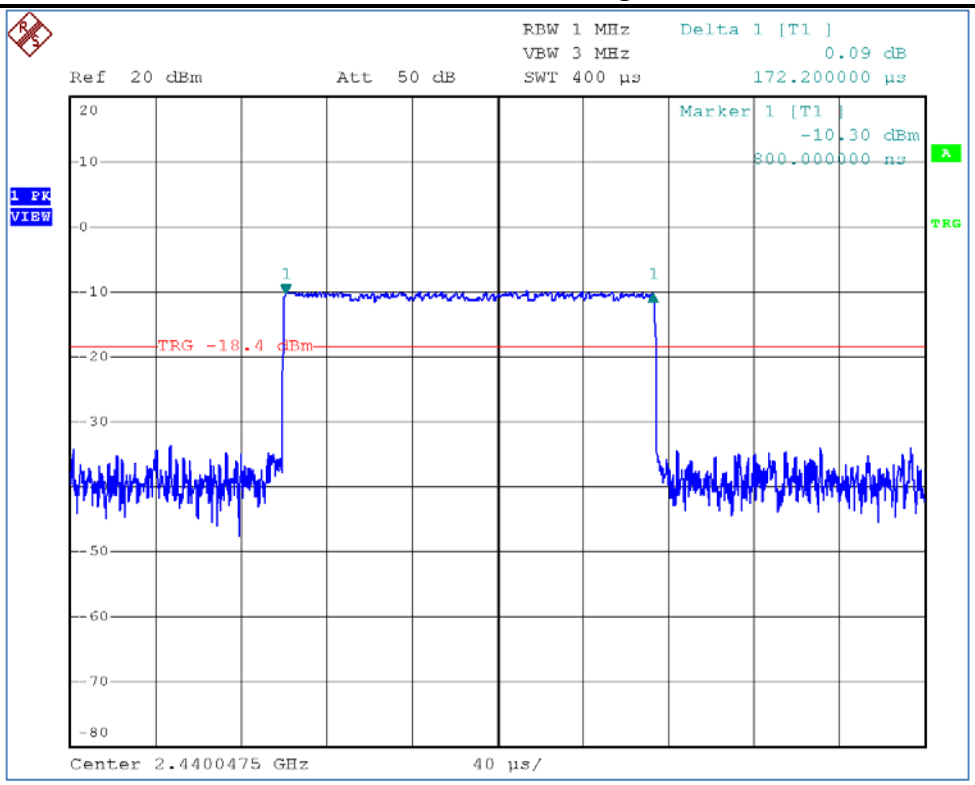
Hopping channel count was determined by max-holding and observing the spectrum analyzer display until it was evident that all channels are captured. The peaks of each channel are counted. Channel separation was determined by zooming in to view fewer channels and measure the frequency delta by markers of two adjacent channels; it is compared to the 20 dB bandwidth. The zero-span is then selected and one channel was captured with video trigger and max-hold to record the maximum channel dwell time. The time base is then slowed until two transmit events were captured and the return to channel time is measured. The final calculation of accumulated dwell time is based on a time assessment window or period of 400 ms.

The EUT satisfies the requirements. Tabular and plotted measurements appear below.

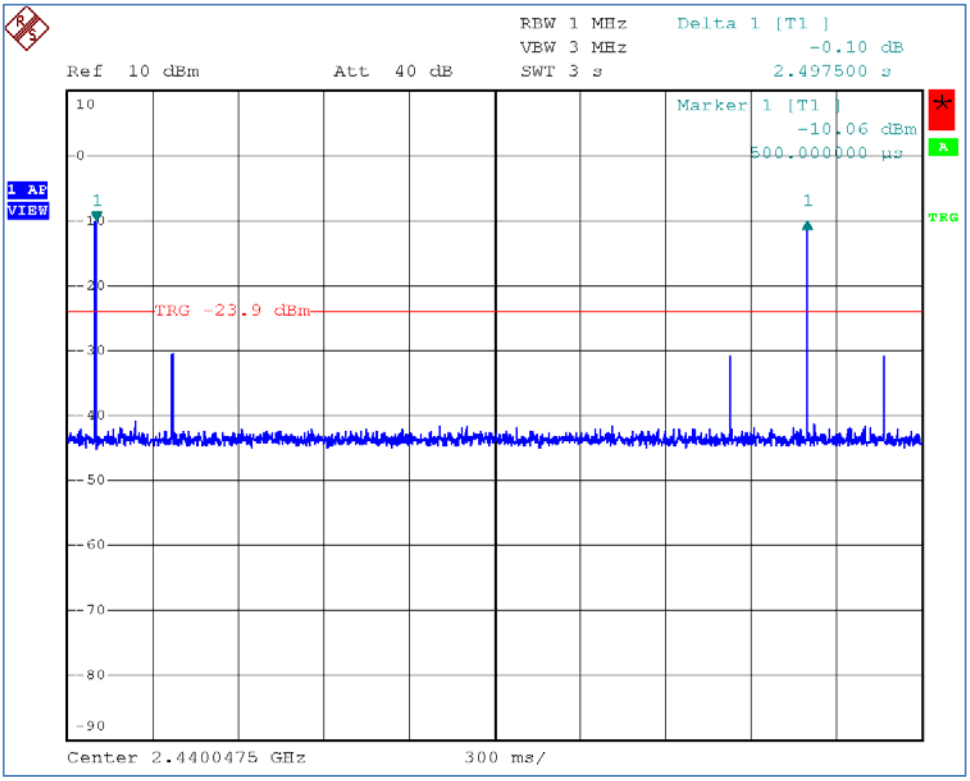
3.3.1 Hopping Characteristics Measured	
Number of Channels (Minimum 15 channels)	40
Channel Separation (Minimum the higher of 25 kHz or 2/3^{rds} of BW_{20dB})	2 MHz (BW_{20dB} = 1.188 MHz)
Channel Dwell Time	0.1722 ms
Return To Channel Time	2497.5 ms

3.3.2 Occupancy Calculations		
Parameter	**Calculation**	**Result**
Time to Assess Occupancy Time (Period)	400 ms * 40 channels	16 s
Number of Channel Events over Period	16 s / 2.4975 ms	6.406 events
Accumulated Dwell Time (limit 400 ms)	6.406 * 0.1722 ms	1.103 ms

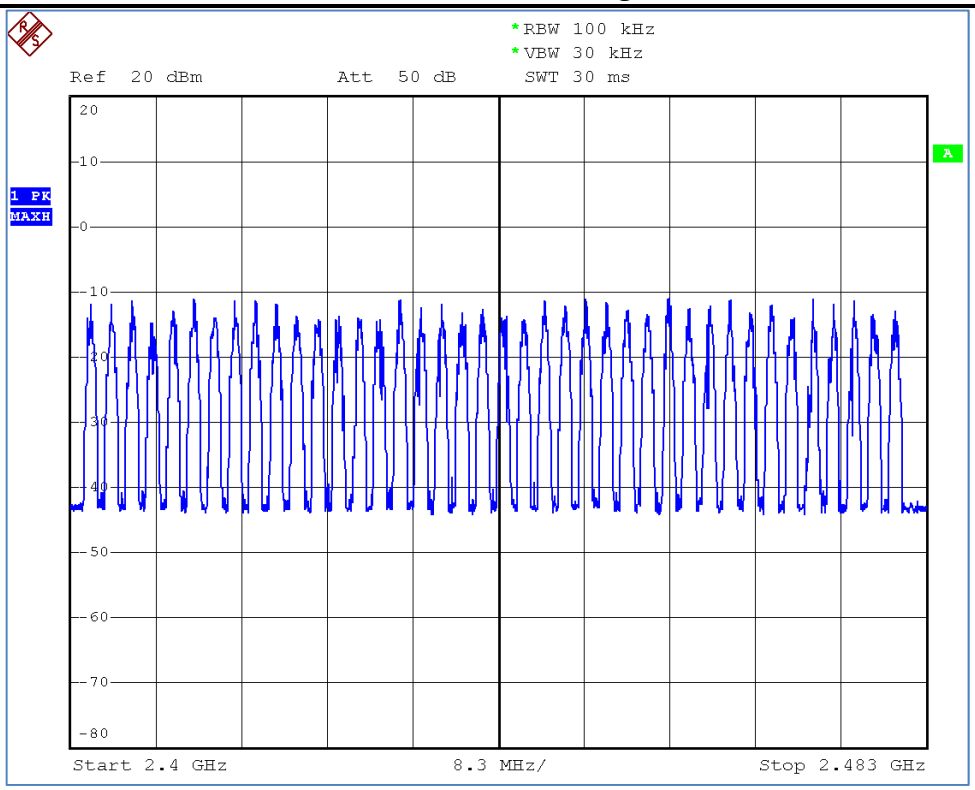
3.3.3 Duty Cycle Factor Calculation			
Time Inputs	**Calculation**	**Result**	**Allowed**
Channel Dwell, Return to Channel	20 Log_{10} (0.1722 ms / 2497.5 ms) =	-83 dB	-20 dB



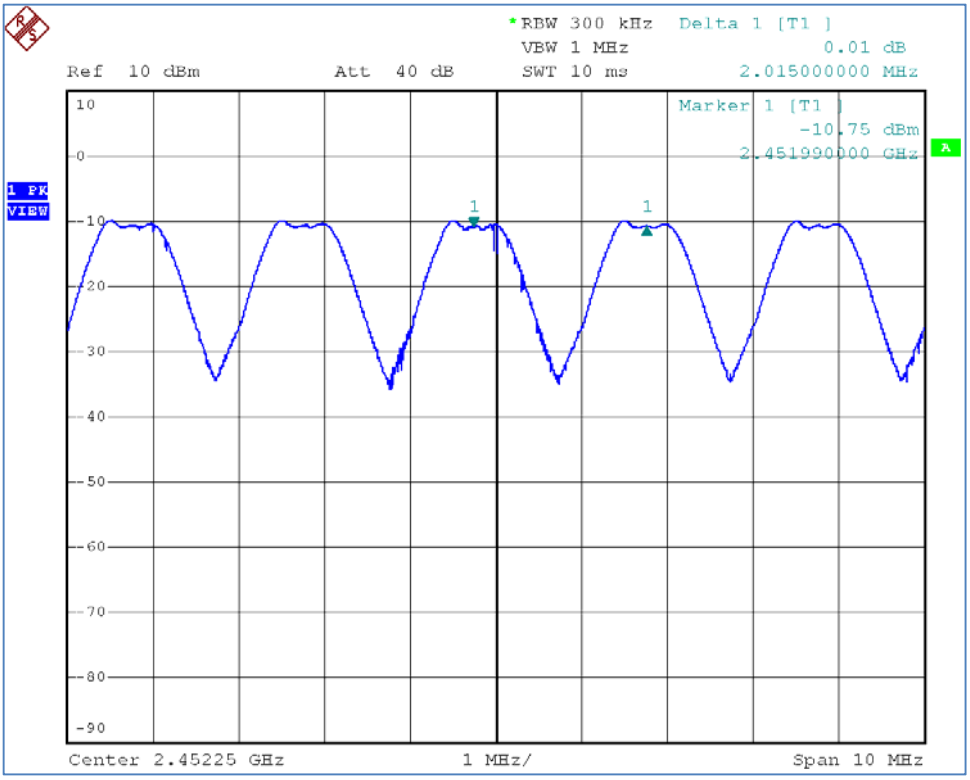
Channel Dwell Time



Return to Channel Time



Number of Channels



Channel Separation

4.0 Occupied Bandwidth

4.1 Test Procedure

Bandwidth is measured by conducted means. A recording of the results is included. For frequency hopping transmitters, the bandwidth is compared to the channel separation measurement in the previous section.

4.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
14.247(a)(2), 2.1049, KDB 558074 D01 // RSS-Gen 4.6	Bandwidth, 6 dB, 20 dB	10 Jul 2015

4.3 Test Results

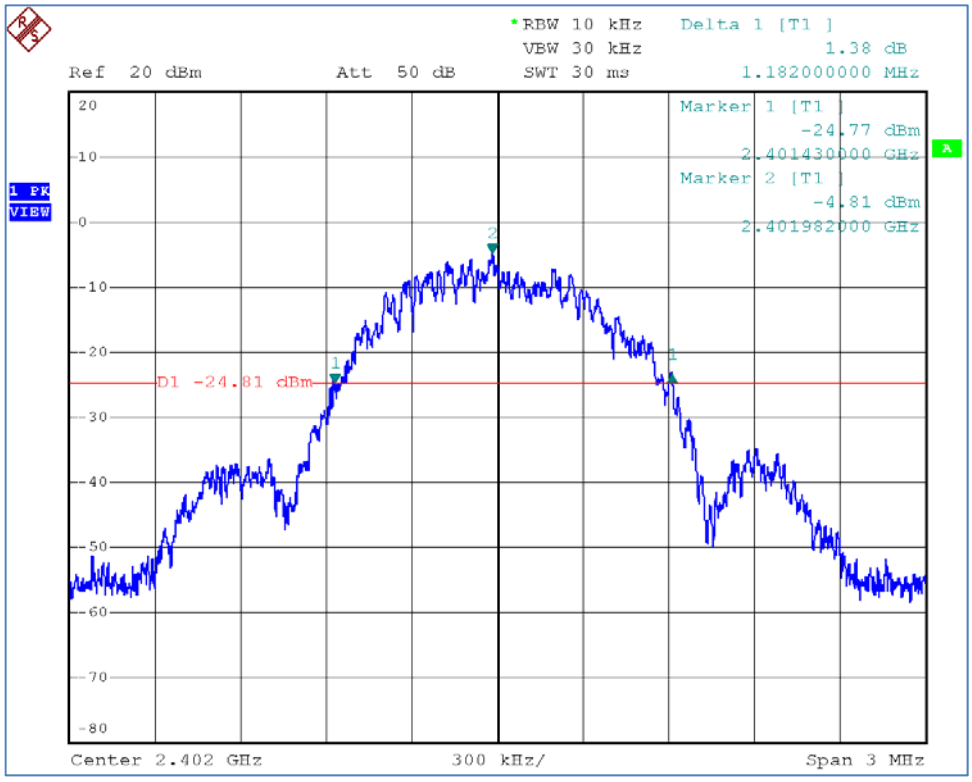
The bandwidth measurement is used to verify hopping characteristics and for general reporting for agency application.

The EUT was found to be in compliance with applicable requirements.

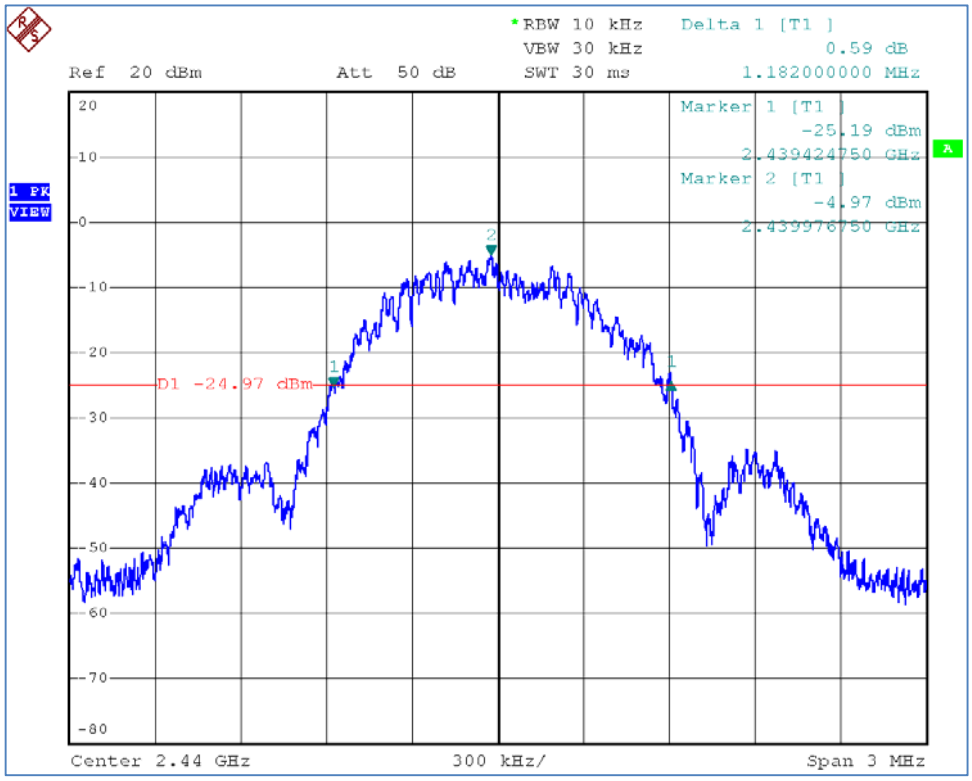
Table 5.3.1 Bandwidth 20 dB, Measure and Report			
Low Channel Measured BW (kHz)	Mid Channel Measured BW (kHz)	High Channel Measured BW (kHz)	**Reported Maximum BW (kHz)**
1182.0	1182.0	1188.0	**1188.0**

Plotted measurements appear on the following pages.

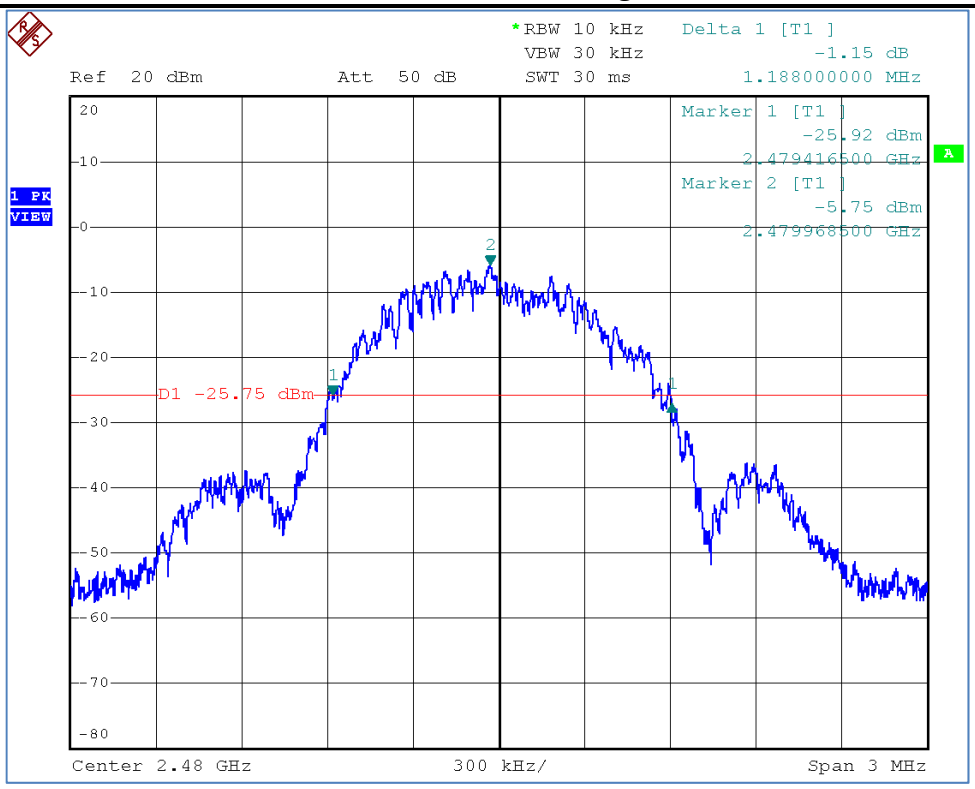
4.3.1 Bandwidth Plots, 20 dB



20 dB, Low Channel



20 dB, Middle Channel



20 dB, High Channel

5.0 Band Edge

5.1 Test Procedure

EUT is placed into normal transmit operation on the nearest band edge channel. The spectrum analyzer is centered on the band edge frequency with span sufficient to include the peak of the adjacent fundamental signal. Measurement includes at least two standard bandwidths from the respective band edge. If required, the band-edge marker-delta method of C63.4 is utilized.

5.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247, 15.205 // RSS-247 5.5, RSS-Gen 4.9	Unwanted Emissions Adjacent to Authorized Band, Radiated	14 Jul 2015

5.3 Test Results

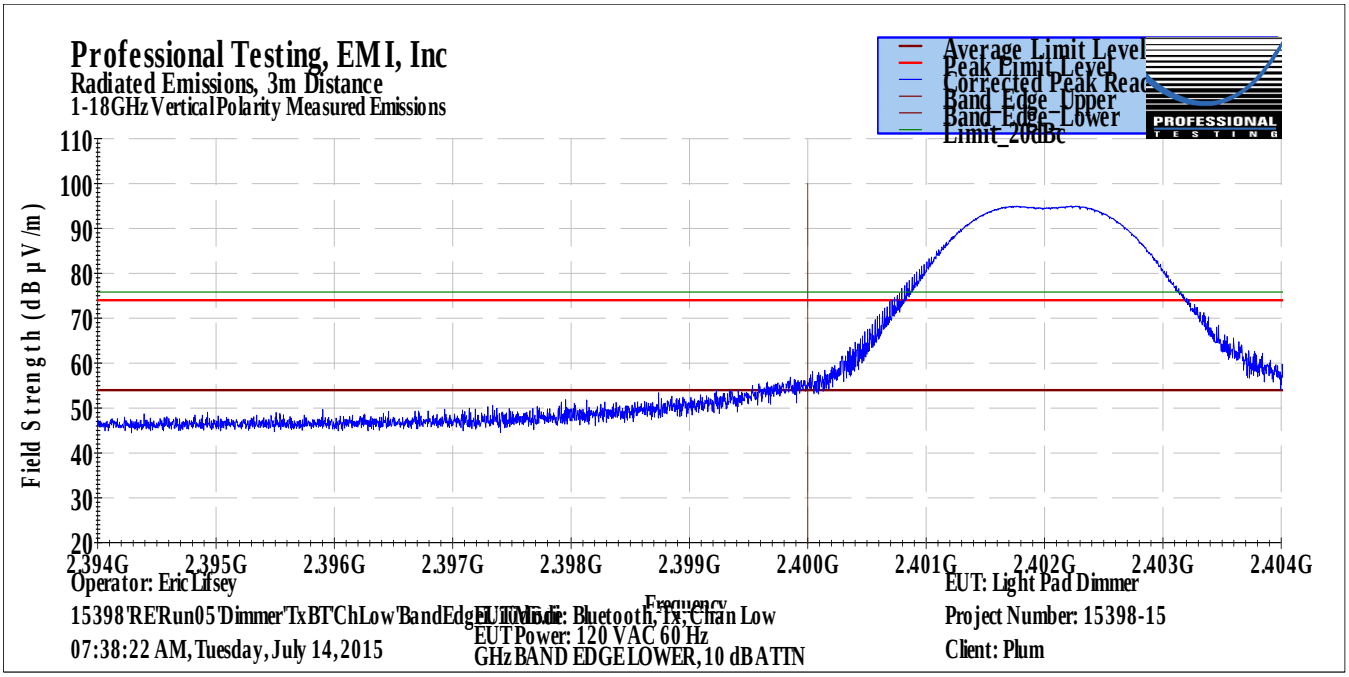
Measurements included more than 2 standard bandwidths (standard bandwidth 1 MHz) from the band edges to provide a clear view of the fundamental and the declining emission levels. Peak detection with max-hold was employed. Measurements were relative radiated at 1 meter with resulting deltas applied to the peak power measurements taken at 3 meters to determine corrected emission levels. Pre-amplification and post-antenna attenuation is employed for best dynamic range and avoid overload.

Above the operating band the general emission limits are applied using average limit 54 dBµV/m for 3 meters as that was the reference power measurement distance. Below the operating band the peak power -20 dBc level is referenced.

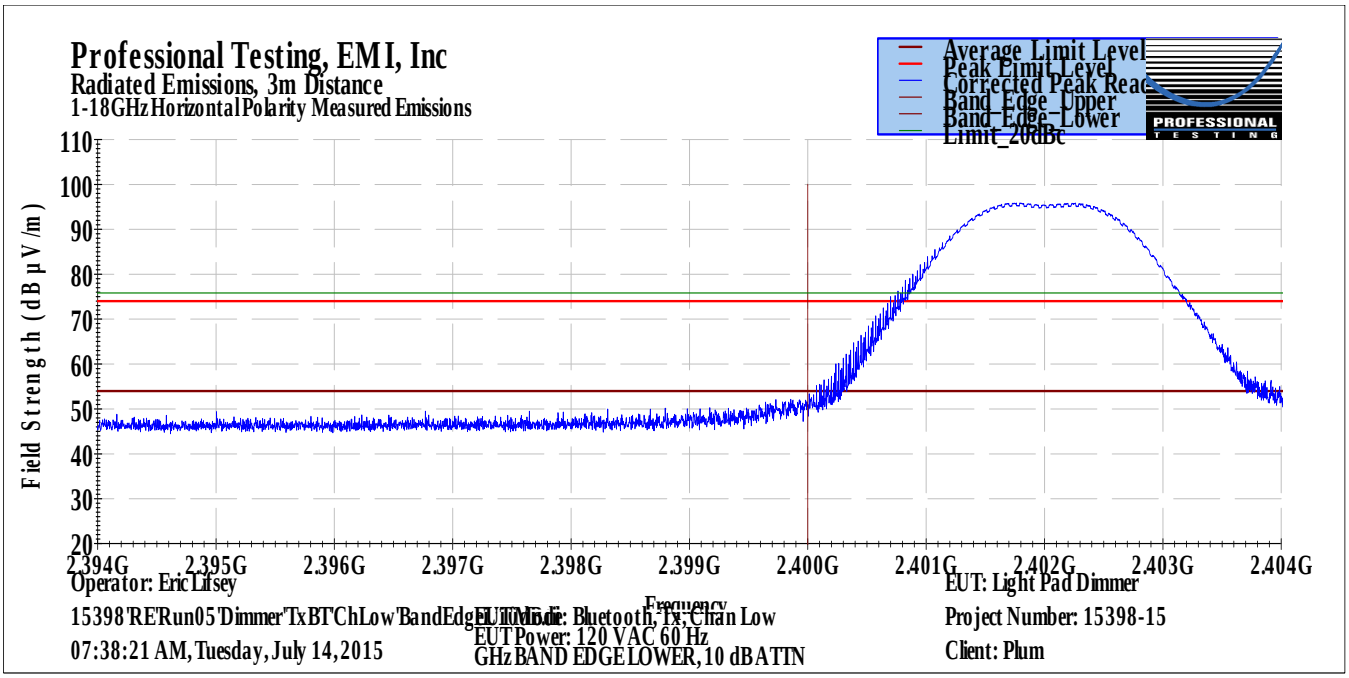
Peak detection of emissions at band lower edge were below the FCC 15.247 -20 dBc emission limits and decayed to below the general limits of 15.209 below ~1.3985 MHz. Peak detection of emissions at band upper edge were below the FCC 15.209 general emission limits. As calculated in Table 3.3.3, the averaging factor is -20 dB which can be applied implicitly to the peak measurements.

The EUT satisfied the criteria. Plotted results appears on the following pages.

5.3.1 Low Channel Band Edge

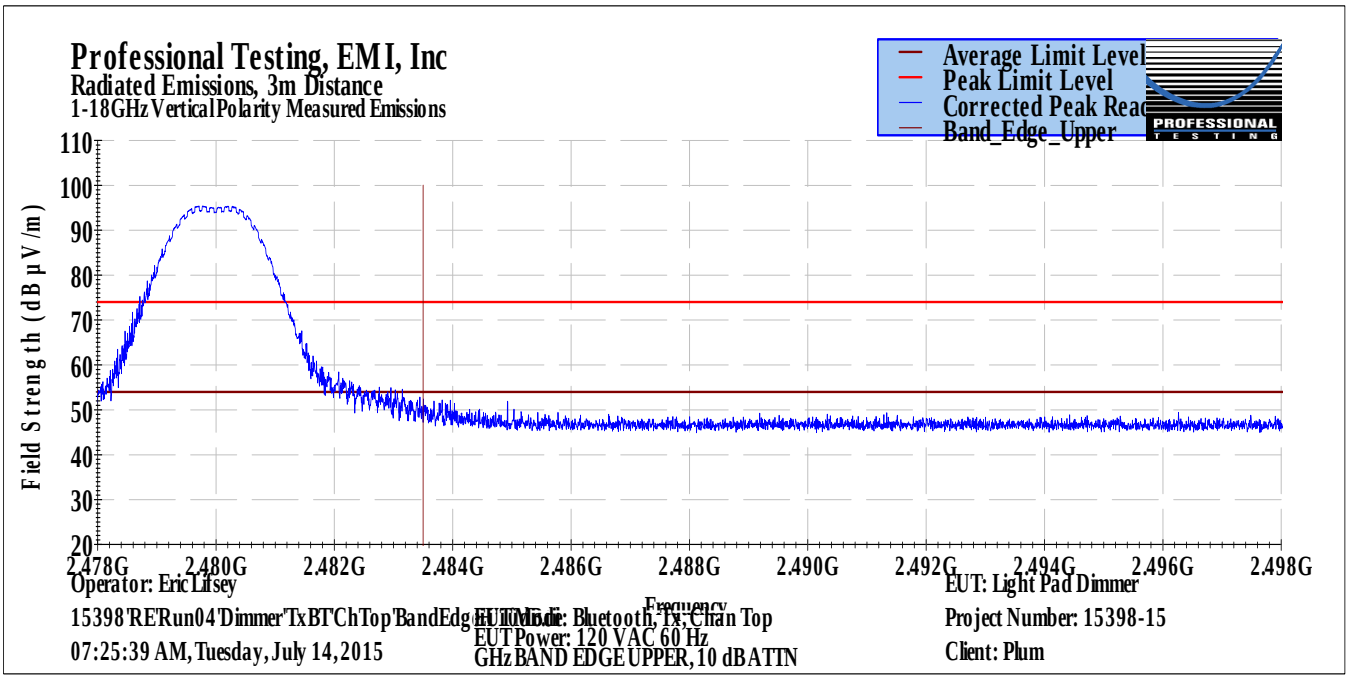


Vertical Polarity, Band Edge Emission, Satisfies -20 dBc Criteria (green line)
(Reference green line marking -20 dBc level. Decays below 15.209 average limit below ~2.3985 MHz.)

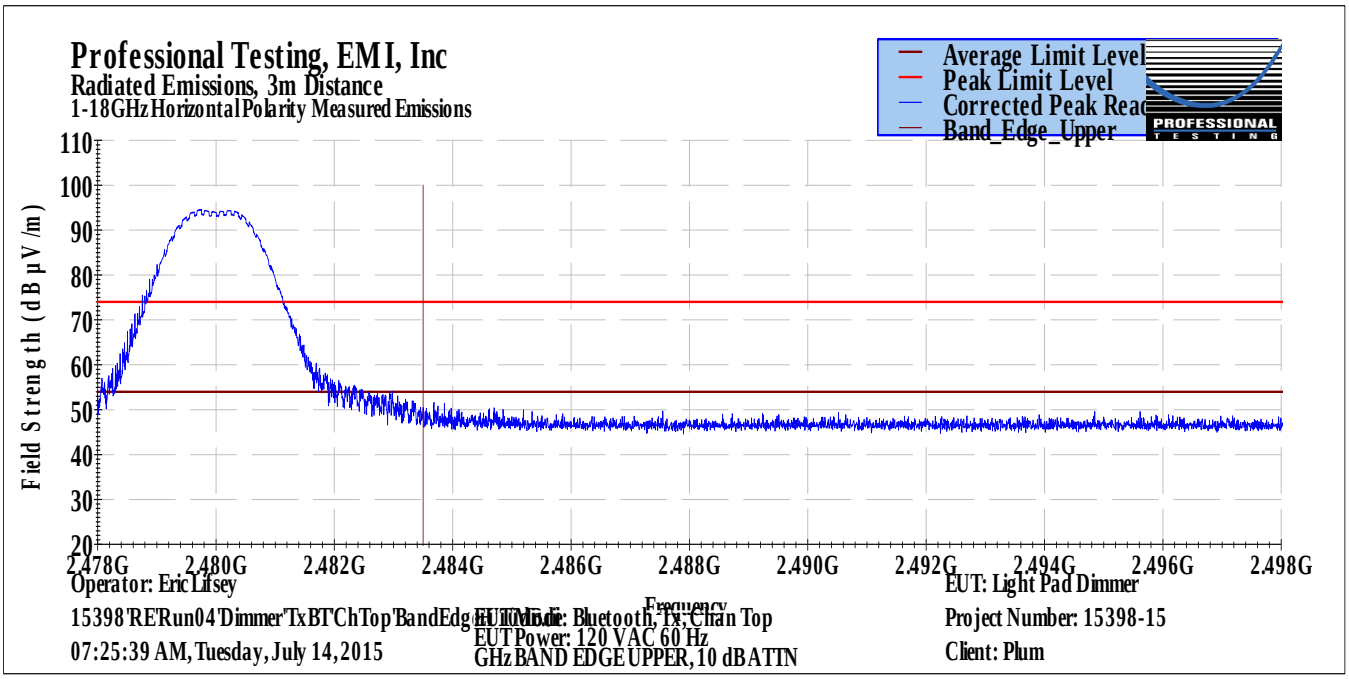


Band Edge Emission, Satisfies -20 dBc (green line) and 15.209 Criteria

5.3.2 Top Channel Band Edge



Vertical Polarity, Band Edge Emission, Satisfies -20dBc and 15.209 Criteria



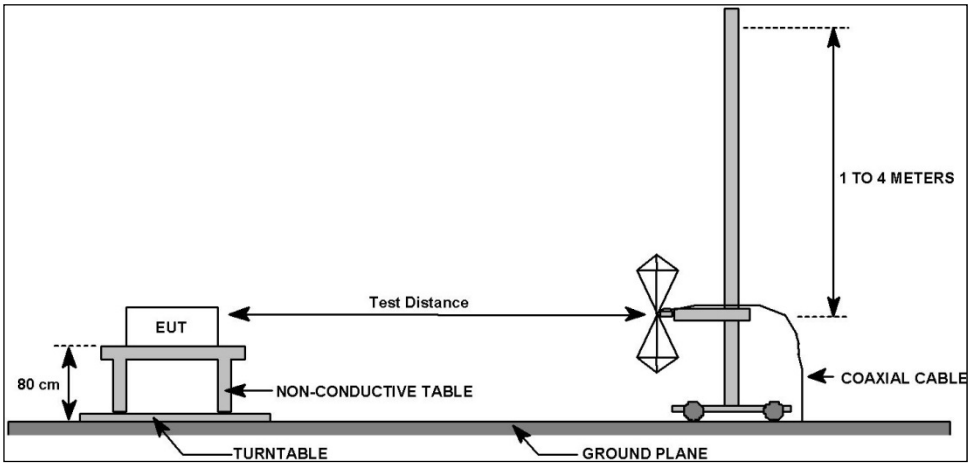
Horizontal Polarity, Band Edge Emission, Satisfies -20dBc and 15.209 Criteria

6.0 Radiated Spurious Emissions, Receive Mode

6.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The EUT was centered on a rotating turntable. Measurements below 1 GHz were taken at a test distance of 10 meters from the measurement antenna. Above 1 GHz the measurement distance was 3 meters.

Spurious emissions below 1 GHz were measured with quasi-peak detection with a resolution bandwidth of 120 kHz. Above 1 GHz peak measurements were taken and average measured where appropriate. A diagram showing the test setup appears below.



6.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247, 15.209 // RSS-247 5.5, RSS-Gen 4.9 & 4.10	Field Strength of Radiated Spurious/Harmonic Emissions Receive Mode	6 Jul 2015

6.3 Test Results

The EUT was tuned to the middle channel and placed in receive mode.

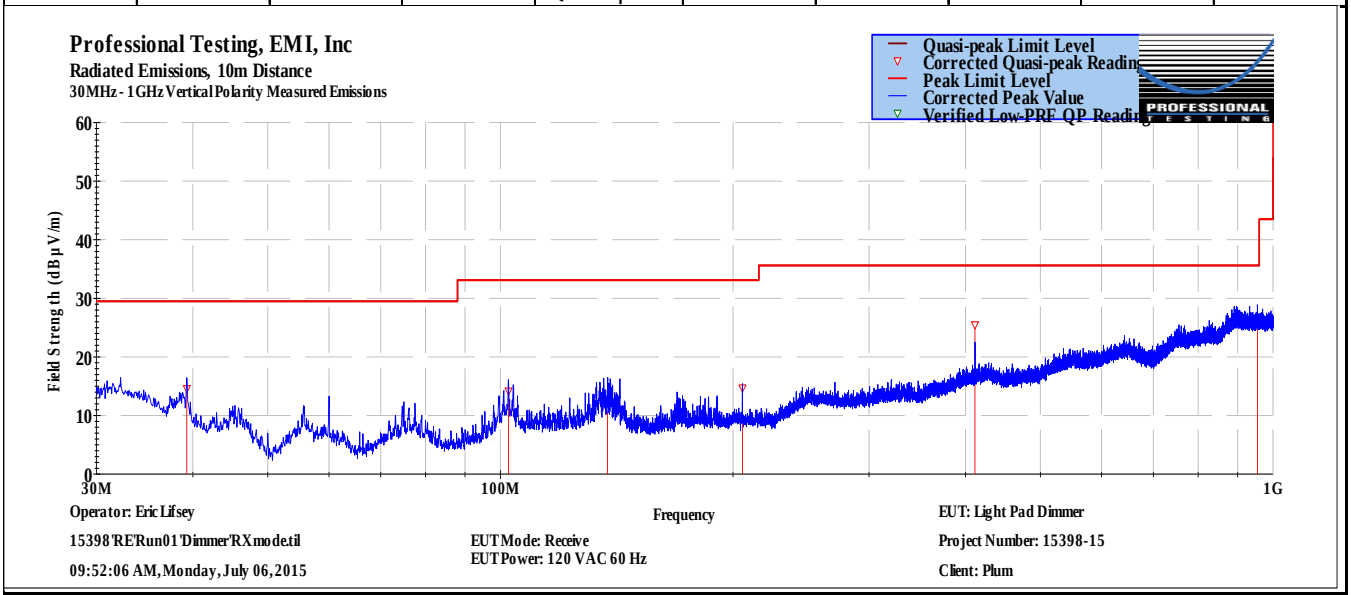
The EUT satisfied the criteria. Recorded data is presented below.

Table 6.3.1: Radiated Spurious Emissions, Receive Mode, Below 1 GHz, Vertical Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	7/6/2015	EUT Serial #:	1600019
Customer:	Plum	EUT Part #:	0
Project Number:	15398-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	Light Pad Dimmer	Witness' Name:	Russ

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	120 VAC	EUT Power Frequency:	60 Hz
Antenna Orientation:	Vertical	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Receive Mode	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
39.279	10	141	1.37	Quasi-peak	31.8	14.577	29.5	-14.9	Pass
102.461	10	320	1.4	Quasi-peak	30.6	14.19	33.1	-18.9	Pass
137.598	10	308	1.2	Quasi-peak	28.3	11.085	33.1	-22.0	Pass
205.727	10	42	1.25	Quasi-peak	29	14.71	33.1	-18.4	Pass
411.461	10	91	1.17	Quasi-peak	32	25.493	35.6	-10.1	Pass
954.825	10	340	3.08	Quasi-peak	21.1	26.325	35.6	-9.3	Pass



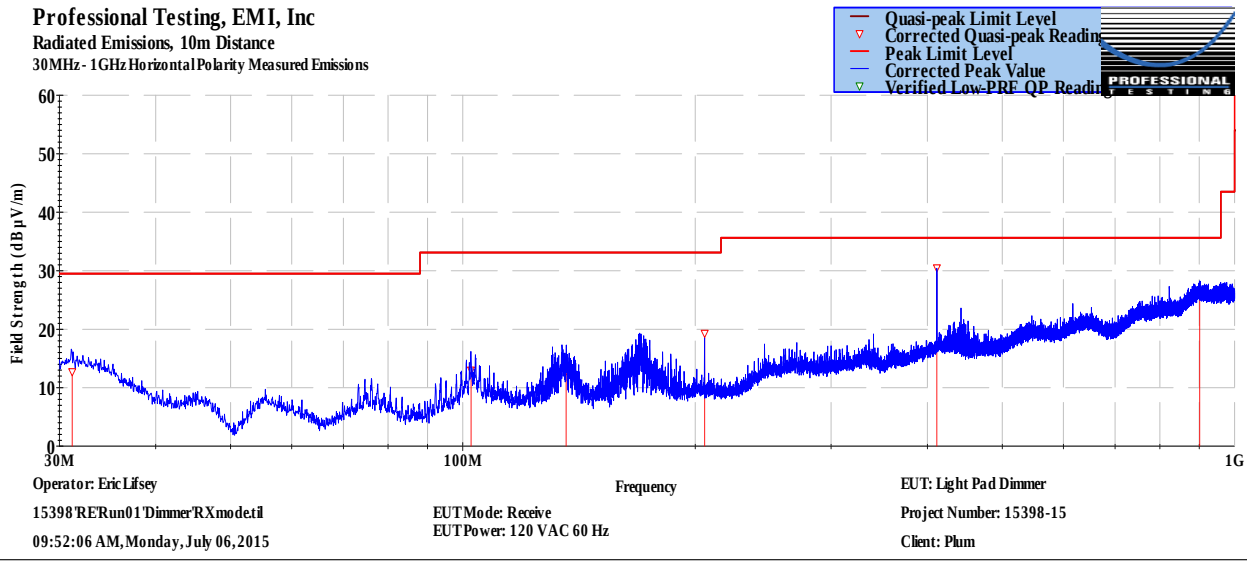
≤ 1GHz Vertical Antenna Polarity Measured Emissions

Table 6.3.2: Radiated Spurious Emissions, Receive Mode, Below 1 GHz, Horizontal Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	7/6/2015	**EUT Serial #:**	1600019
Customer:	Plum	**EUT Part #:**	0
Project Number:	15398-15	**Test Technician:**	Eric Lifsey
Purchase Order #:	NA	**Supervisor:**	Lisa Arndt
Equip. Under Test:	Light Pad Dimmer	**Witness' Name:**	Russ

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	120 VAC	**EUT Power Frequency:**	60 Hz
Antenna Orientation:	Horizontal	**Frequency Range:**	30MHz to 1GHz
EUT Mode of Operation:		Receive Mode	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
31.1808	10	291	1.38	Quasi-peak	24.2	12.73	29.5	-16.8	Pass
102.478	10	313	3.51	Quasi-peak	29.4	12.98	33.1	-20.1	Pass
136.095	10	255	3.97	Quasi-peak	30.2	12.896	33.1	-20.2	Pass
205.726	10	47	3.53	Quasi-peak	33.6	19.299	33.1	-13.8	Pass
411.447	10	237	1.42	Quasi-peak	37	30.483	35.6	-5.1	Pass
901.084	10	290	1.2	Quasi-peak	21.2	26.498	35.6	-9.1	Pass



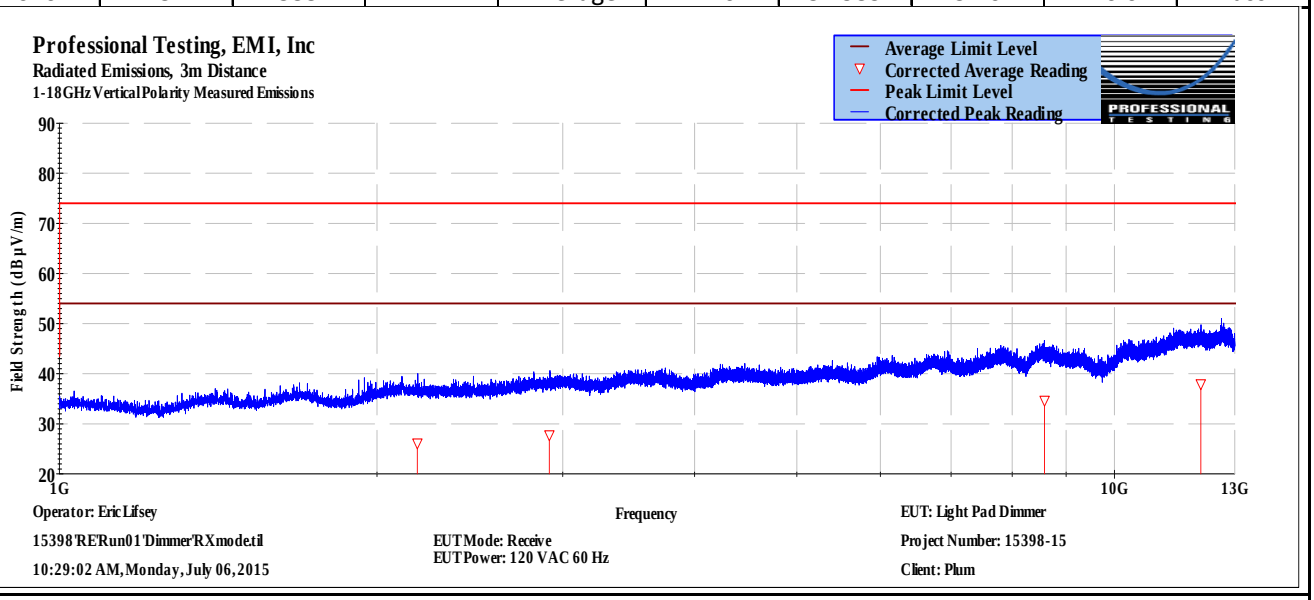
≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Table 6.3.3: Radiated Spurious Emissions, Receive Mode, Above 1 GHz, Vertical Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	7/6/2015	EUT Serial #:	1600019
Customer:	Plum	EUT Part #:	0
Project Number:	15398-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	Light Pad Dimmer	Witness' Name:	Russ

Radiated Emissions Test Results Data Sheet			Page: 1 of 1		
EUT Line Voltage:	120	VAC	EUT Power Frequency:	60	Hz
Antenna Orientation:	Vertical		Frequency Range:	Above 1GHz	
EUT Mode of Operation:			Receive Mode		

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
2184.42	3	176	1	Average	35.2	26.133	54.0	-27.8	Pass
2913.39	3	96	1	Average	34.7	27.759	54.0	-26.2	Pass
8586.06	3	219	1	Average	27.5	34.657	54.0	-19.3	Pass
12070.2	3	333	1	Average	27.6	37.939	54.0	-16.0	Pass



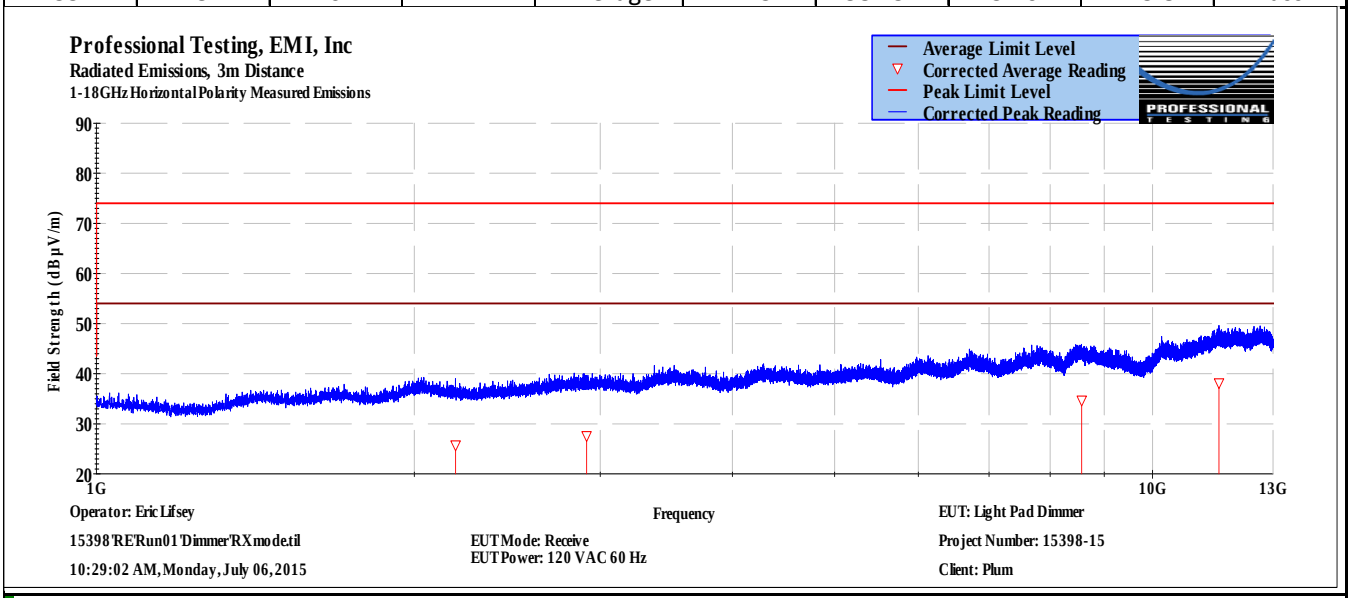
> 1GHz Vertical Antenna Polarity Measured Emissions

Table 6.3.4: Radiated Spurious Emissions, Receive Mode, Above 1 GHz, Vertical Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	7/6/2015	EUT Serial #:	1600019
Customer:	Plum	EUT Part #:	0
Project Number:	15398-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	Light Pad Dimmer	Witness' Name:	Russ

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	120 VAC	EUT Power Frequency:	60 Hz
Antenna Orientation:	Horizontal	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Receive Mode	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
2188.05	3	16	1	Average	34.8	25.738	54.0	-28.2	Pass
2911.38	3	351	1	Average	34.5	27.594	54.0	-26.4	Pass
8567.39	3	352	1	Average	27.5	34.672	54.0	-19.3	Pass
11557.4	3	262	1	Average	27.5	38.152	54.0	-15.8	Pass



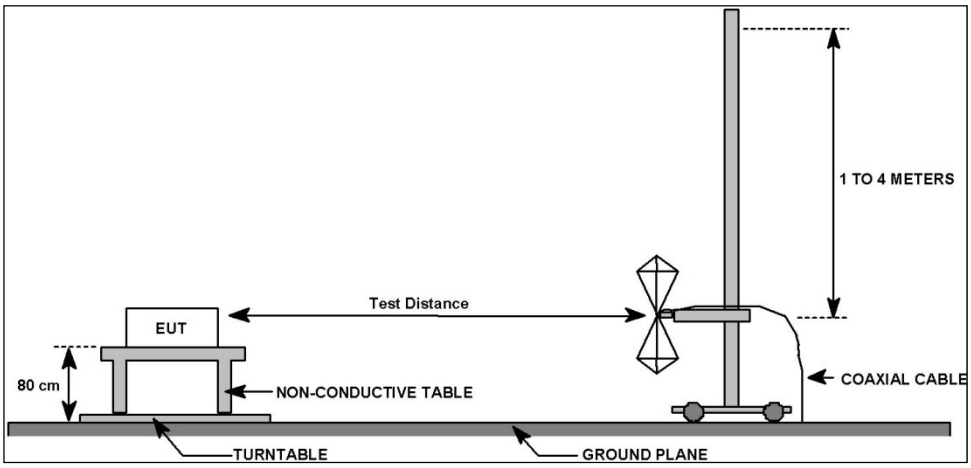
> 1GHz Horizontal Antenna Polarity Measured Emissions

7.0 Radiated Spurious Emissions, Transmit Mode

7.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The EUT was centered on a rotating turntable. Measurements below 1 GHz were taken at a test distance of 10 meters from the measurement antenna. Above 1 GHz the measurement distance was 3 meters.

Spurious emissions below 1 GHz were measured with quasi-peak detection with a resolution bandwidth of 120 kHz. Above 1 GHz peak measurements were taken and average measured where appropriate. A diagram showing the test setup appears below.



7.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247, 15.209 // RSS-247 5.5, RSS-Gen 4.9 & 4.10	Field Strength of Radiated Spurious/Harmonic Emissions Transmit Mode	13 Jul 2015

7.3 Test Results

Below 1 GHz measurements were taken for the middle channel. Above 1 GHz measurements were taken for the three standard channels of the band.

Modulation was disabled for this test and the transmitter was placed into continuous transmit mode.

All measurements used peak detection.

Measurements of dwell and return to channel time recorded in table 3.3.3 resulted in a duty cycle factor of -20 dB which can be applied to the peak measurements recorded for the harmonic signals recorded below. As such, all peaks had averages below the limit by the same amount the recorded peak signals were below the peak limit.

Table 7.3.1: TX Mode, Below 1 GHz, Vertical Polarity, Mid. Channel

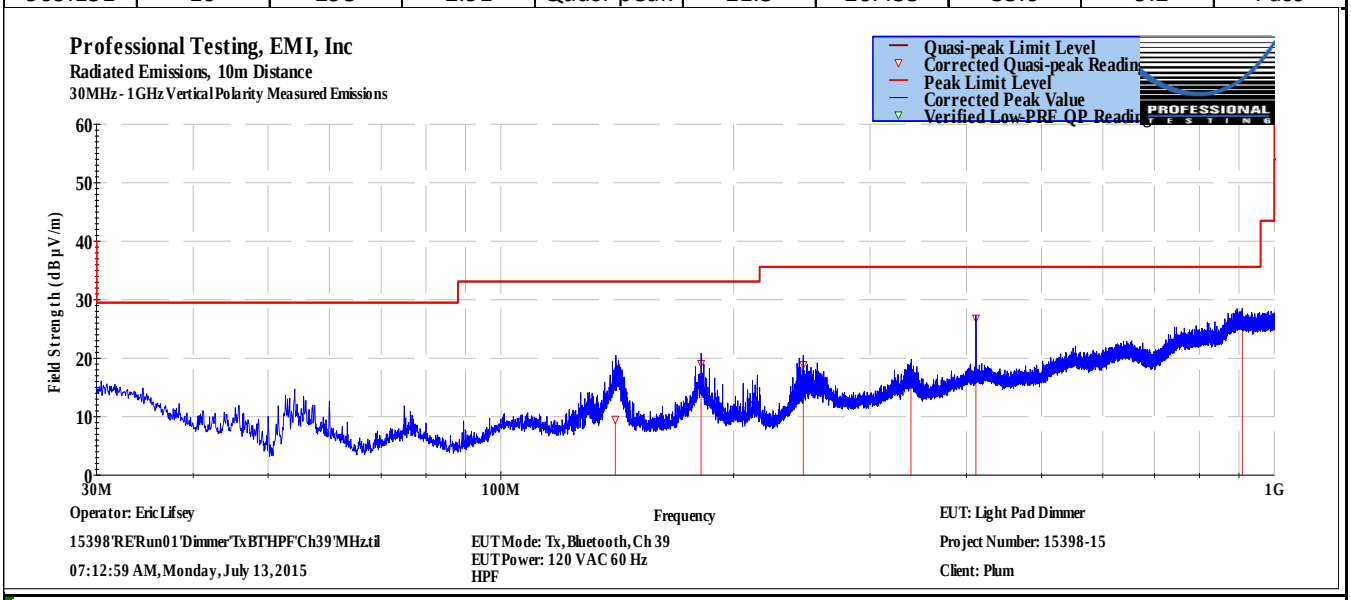
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	7/13/2015	**EUT Serial #:**	1600019
Customer:	Plum	**EUT Part #:**	0
Project Number:	15398-15	**Test Technician:**	Eric Lifsey
Purchase Order #:	NA	**Supervisor:**	Lisa Arndt
Equip. Under Test:	Light Pad Dimmer	**Witness' Name:**	Russ

Radiated Emissions Test Results Data Sheet — Page: 1 of 1

EUT Line Voltage:	120 VAC	**EUT Power Frequency:**	60 Hz
Antenna Orientation:	Vertical	**Frequency Range:**	30MHz to 1GHz
EUT Mode of Operation:		Transmit Mode, Bluetooth, Middle Chan	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
140.564	10	330	1.74	Quasi-peak	26.7	9.527	33.1	-23.6	Pass
181.518	10	197	2.35	Quasi-peak	34.1	19.092	33.1	-14.0	Pass
246.051	10	32	1.38	Quasi-peak	29.7	18.911	35.6	-16.7	Pass
339.024	10	36	1.3	Quasi-peak	25.2	15.572	35.6	-20.0	Pass
411.436	10	334	1.25	Quasi-peak	33.4	26.836	35.6	-8.8	Pass
909.151	10	298	2.91	Quasi-peak	21.3	26.435	35.6	-9.2	Pass



≤ 1GHz Vertical Antenna Polarity Measured Emissions

Table 7.3.2: TX Mode, Below 1 GHz, Horizontal Polarity, Mid. Channel

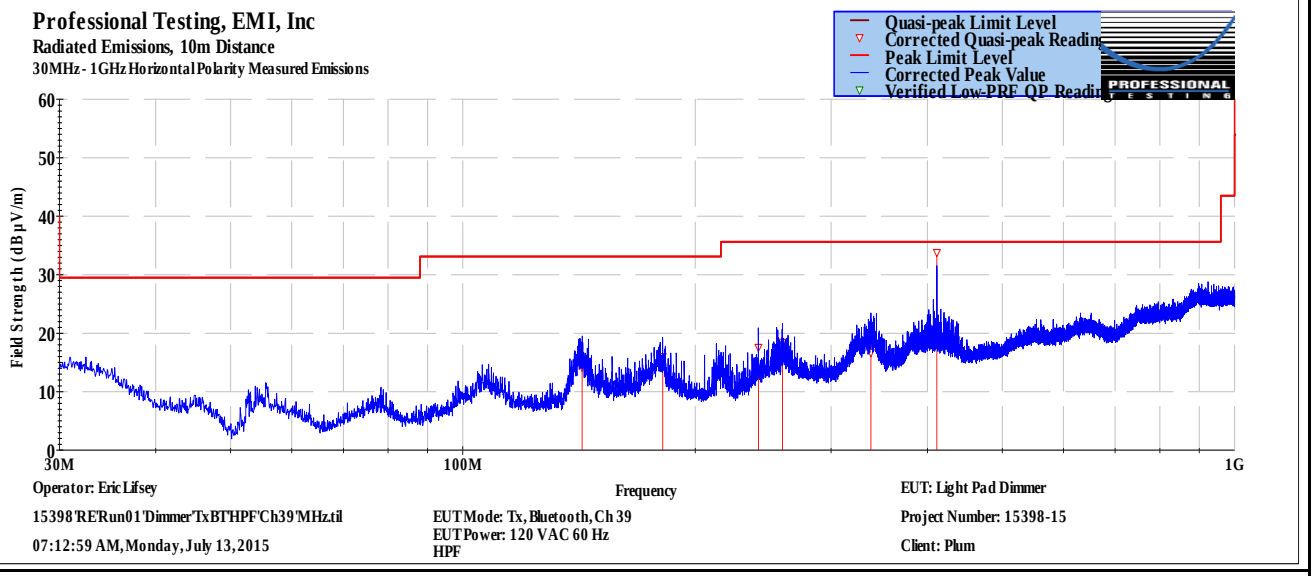
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	7/13/2015	**EUT Serial #:**	1600019
Customer:	Plum	**EUT Part #:**	0
Project Number:	15398-15	**Test Technician:**	Eric Lifsey
Purchase Order #:	NA	**Supervisor:**	Lisa Arndt
Equip. Under Test:	Light Pad Dimmer	**Witness' Name:**	Russ

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	120 VAC	**EUT Power Frequency:**	60 Hz
Antenna Orientation:	Horizontal	**Frequency Range:**	30MHz to 1GHz
EUT Mode of Operation:		Transmit Mode, Bluetooth, Middle Chan	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
142.729	10	54	2.38	Quasi-peak	31.2	14.162	33.1	-18.9	Pass
181.525	10	300	3.09	Quasi-peak	31	15.985	33.1	-17.1	Pass
241.562	10	256	3.42	Quasi-peak	29.1	17.576	35.6	-18.0	Pass
259.495	10	230	3.1	Quasi-peak	28.7	18.437	35.6	-17.2	Pass
337.803	10	54	2.15	Quasi-peak	26.3	16.681	35.6	-18.9	Pass
411.454	10	228	1.85	Quasi-peak	40.3	33.775	35.6	-1.8	Pass



≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Table 7.3.3: TX Mode, Above 1 GHz, Vertical Polarity, Low Channel

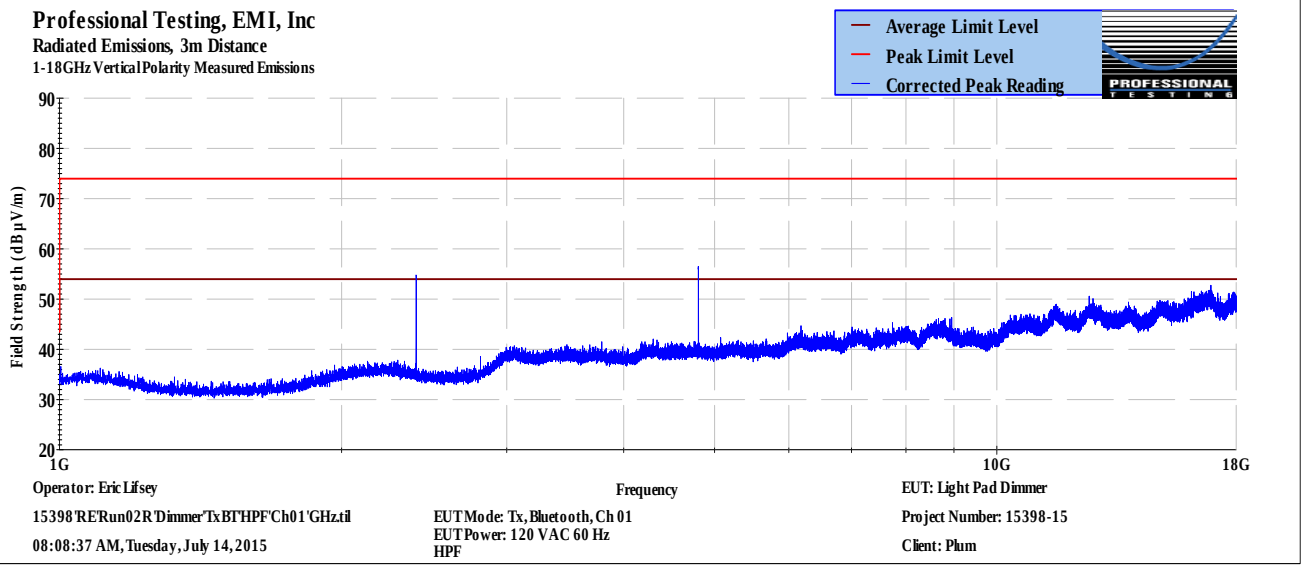
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	7/14/2015	**EUT Serial #:**	1600019
Customer:	Plum	**EUT Part #:**	0
Project Number:	15398-15	**Test Technician:**	Eric Lifsey
Purchase Order #:	NA	**Supervisor:**	Lisa Arndt
Equip. Under Test:	Light Pad Dimmer	**Witness' Name:**	Russ

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	120 VAC	**EUT Power Frequency:**	60 Hz
Antenna Orientation:	Vertical	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Transmit Mode, Bluetooth, Low Chan	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
4804.57	3	277	0	Peak	61.6	57.562	74.0	-16.4	Pass
16928	3	293	0	Peak	37.4	52.101	74.0	-21.9	Pass



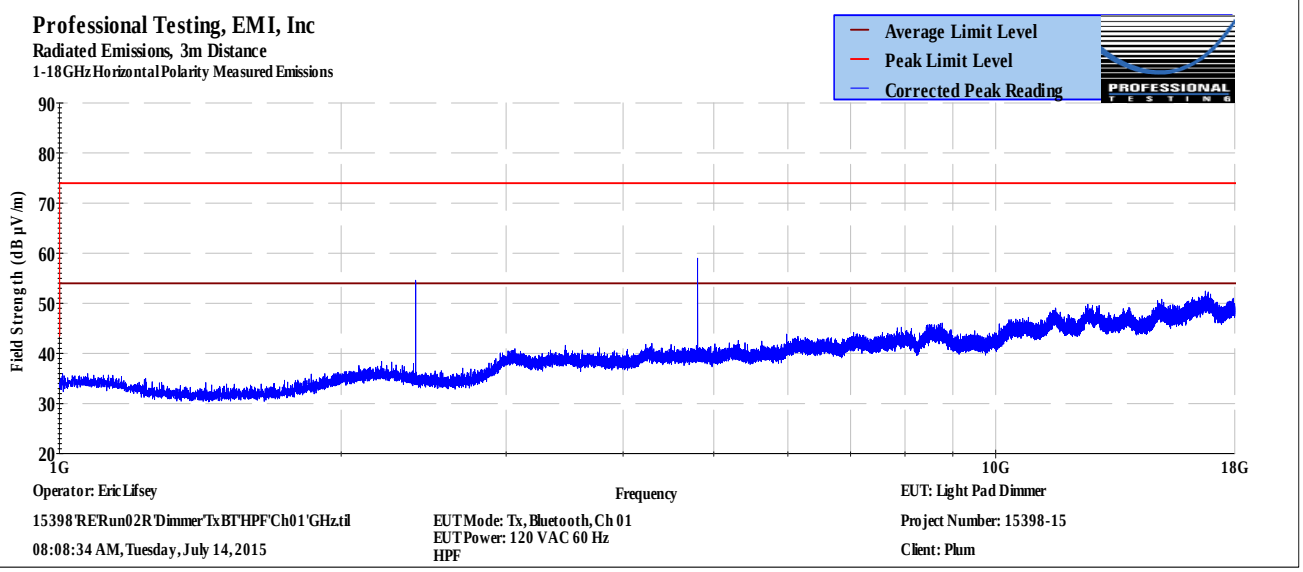
> 1GHz Vertical Antenna Polarity Measured Emissions

Table 7.3.4: TX Mode, Above 1 GHz, Horizontal Polarity, Low Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	7/14/2015	EUT Serial #:	1600019
Customer:	#VALUE!	EUT Part #:	0
Project Number:	15398-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	Light Pad Dimmer	Witness' Name:	Russ

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	120 VAC	EUT Power Frequency:	60 Hz
Antenna Orientation:	Horizontal	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Transmit Mode, Bluetooth, Low Chan	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
4803.53	3	192	0	Peak	61.6	57.577	74.0	-16.4	Pass
16743.7	3	293	0	Peak	37.4	52.167	74.0	-21.8	Pass



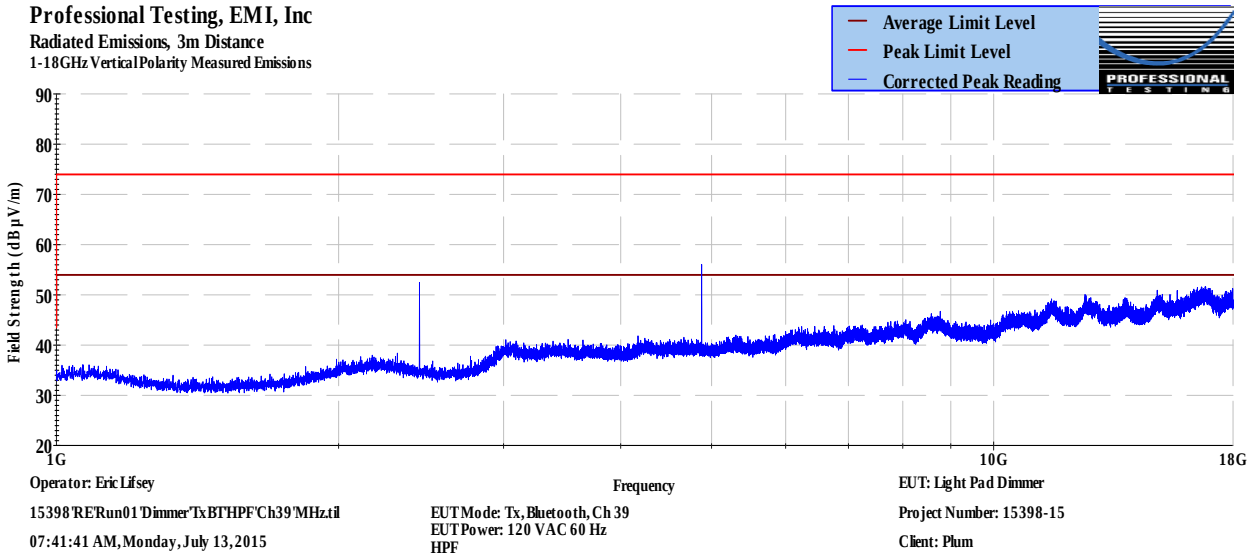
> 1GHz Horizontal Antenna Polarity Measured Emissions

Table 7.3.5: TX Mode, Above 1 GHz, Vertical Polarity, Middle Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	7/13/2015	EUT Serial #:	1600019
Customer:	Plum	EUT Part #:	0
Project Number:	15398-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	Light Pad Dimmer	Witness' Name:	Russ

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	120	VAC	EUT Power Frequency:	60	Hz	
Antenna Orientation:	Vertical		Frequency Range:	Above 1GHz		
EUT Mode of Operation:			Transmit Mode, Bluetooth, Middle Chan			

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
4880.28	3	220	1	Peak	57	53.235	74.0	-20.7	Pass



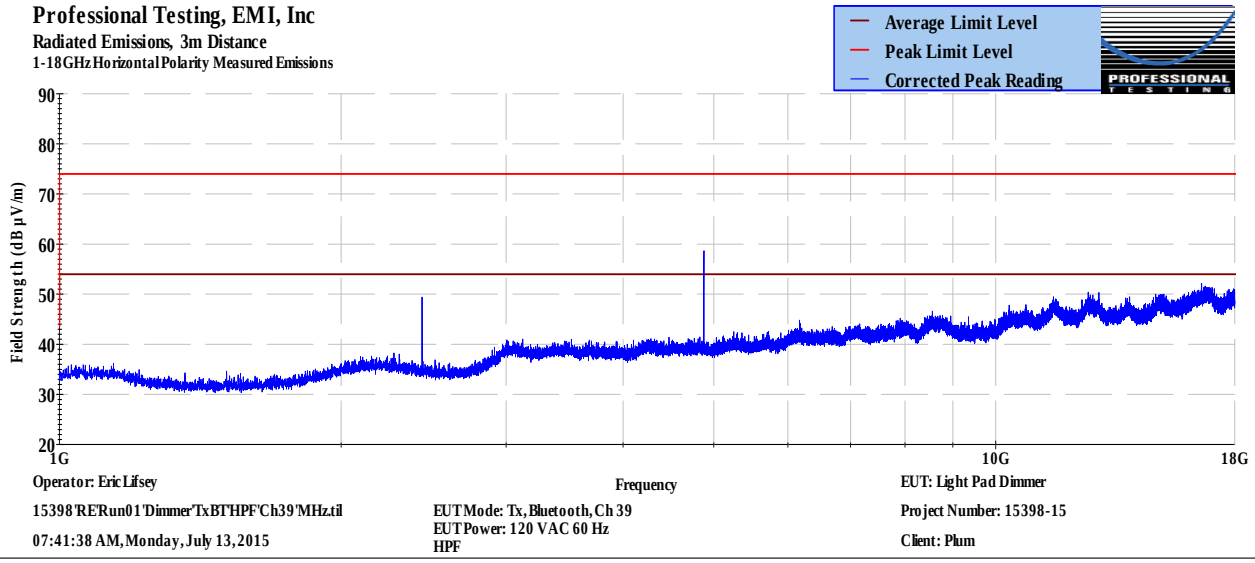
> 1GHz Vertical Antenna Polarity Measured Emissions

Table 7.3.6: TX Mode, Above 1 GHz, Horizontal Polarity, Middle Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	7/13/2015	EUT Serial #:	1600019
Customer:	Plum	EUT Part #:	0
Project Number:	15398-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	Light Pad Dimmer	Witness' Name:	Russ

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	120 VAC	EUT Power Frequency:	60 Hz			
Antenna Orientation:	Horizontal	Frequency Range:	Above 1GHz			
EUT Mode of Operation:		Transmit Mode, Bluetooth, Middle Chan				

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
4880.53	3	176	1	Peak	61.5	57.772	74.0	-16.2	Pass



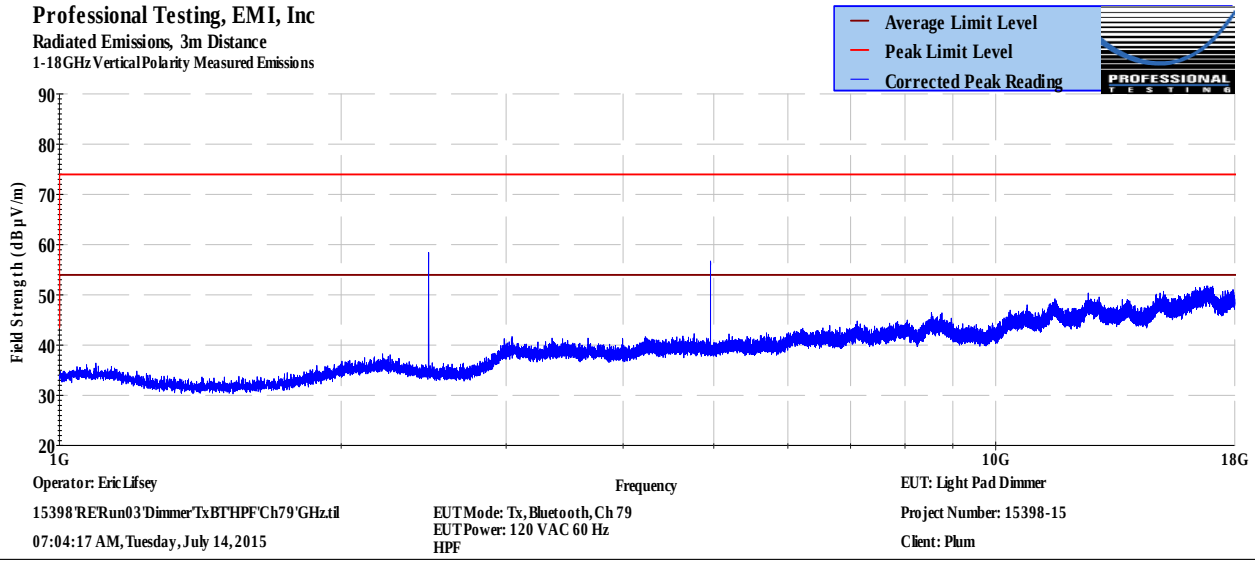
> 1GHz Horizontal Antenna Polarity Measured Emissions

Table 7.3.7: TX Mode, Above 1 GHz, Vertical Polarity, High Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	7/14/2015	EUT Serial #:	1600019
Customer:	Plum	EUT Part #:	0
Project Number:	15398-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	Light Pad Dimmer	Witness' Name:	Russ

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	120 VAC	EUT Power Frequency:	60 Hz			
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz			
EUT Mode of Operation:		Transmit Mode, Bluetooth, Top Chan				

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
4959.48	3	221	0	Peak	60.6	57.085	74.0	-16.9	Pass



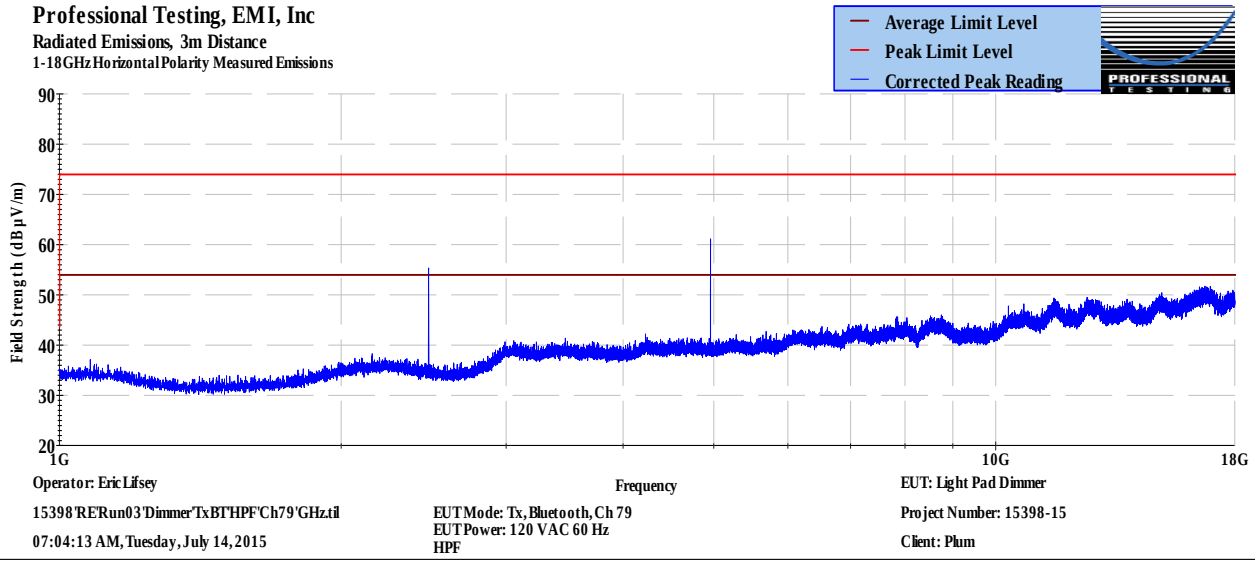
> 1GHz Vertical Antenna Polarity Measured Emissions

Table 7.3.8: TX Mode, Above 1 GHz, Horizontal Polarity, High Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	7/14/2015	EUT Serial #:	1600019
Customer:	Plum	EUT Part #:	0
Project Number:	15398-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	Light Pad Dimmer	Witness' Name:	Russ

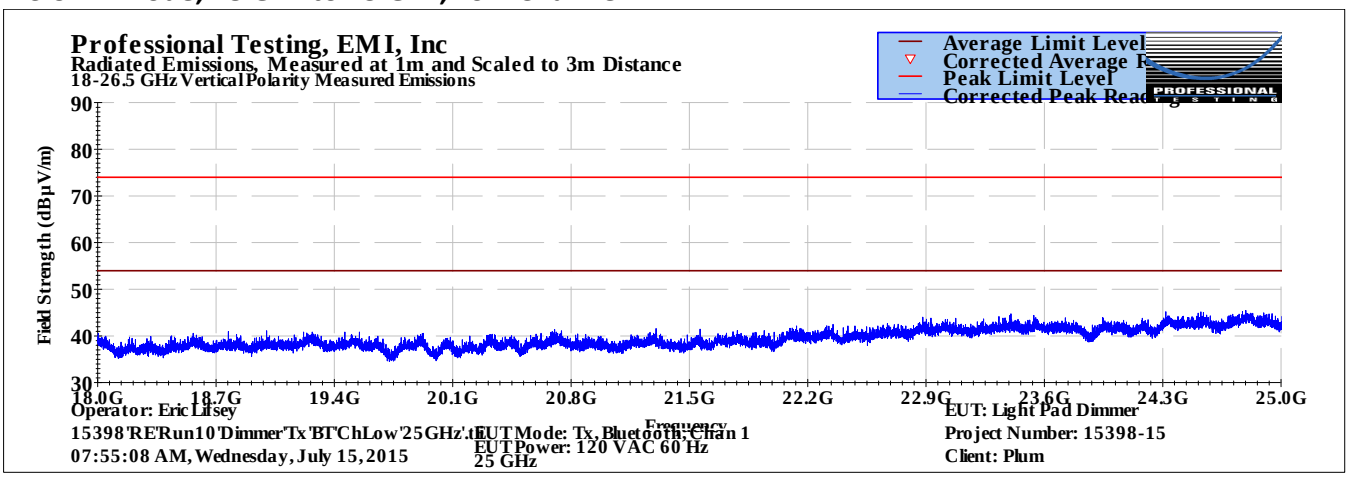
Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	120 VAC	EUT Power Frequency:	60 Hz
Antenna Orientation:	Horizontal	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Transmit Mode, Bluetooth, Top Chan	

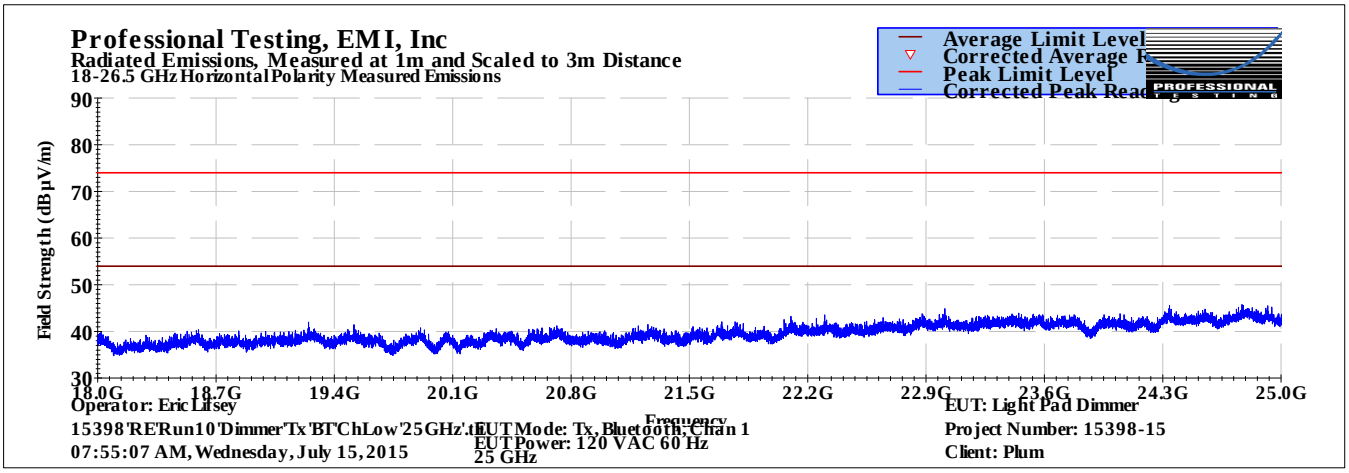
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
4960.49	3	179	0	Peak	63.6	60.086	74.0	-13.9	Pass



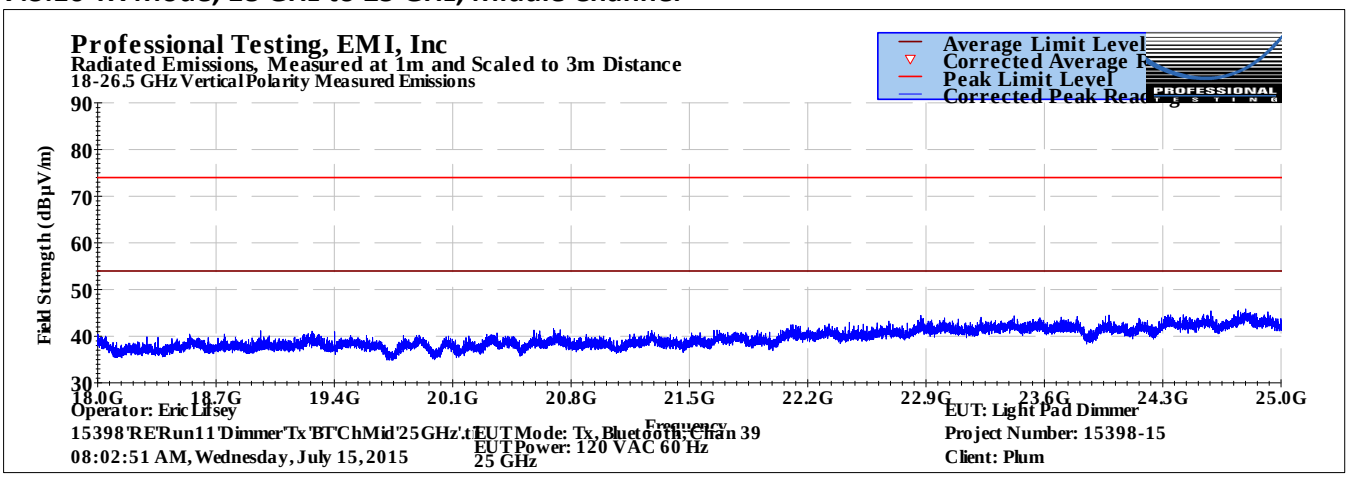
> 1GHz Horizontal Antenna Polarity Measured Emissions

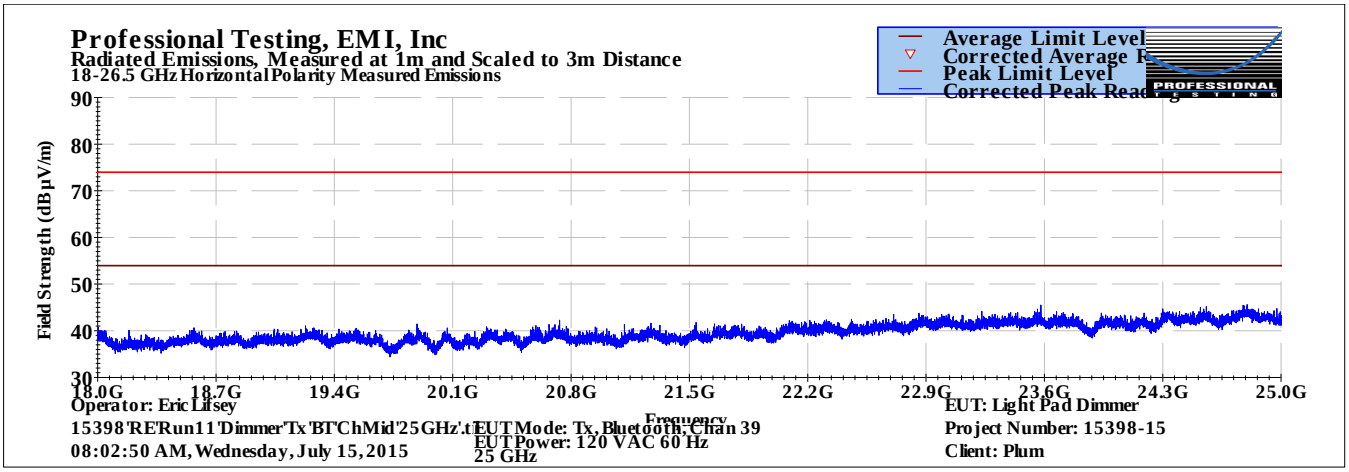
7.3.9 TX Mode, 18 GHz to 25 GHz, Low Channel



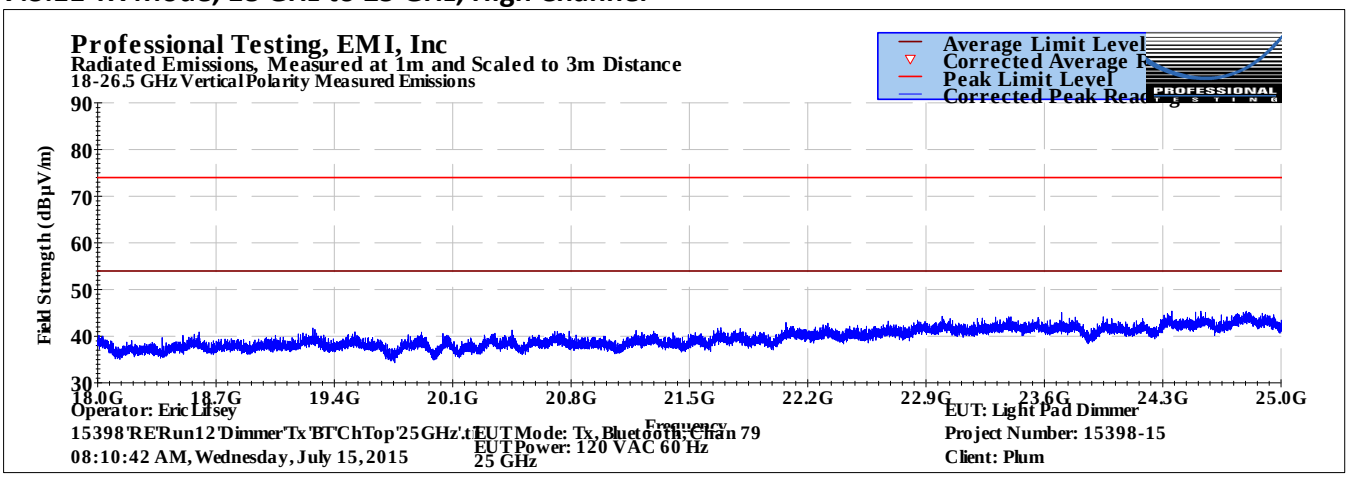


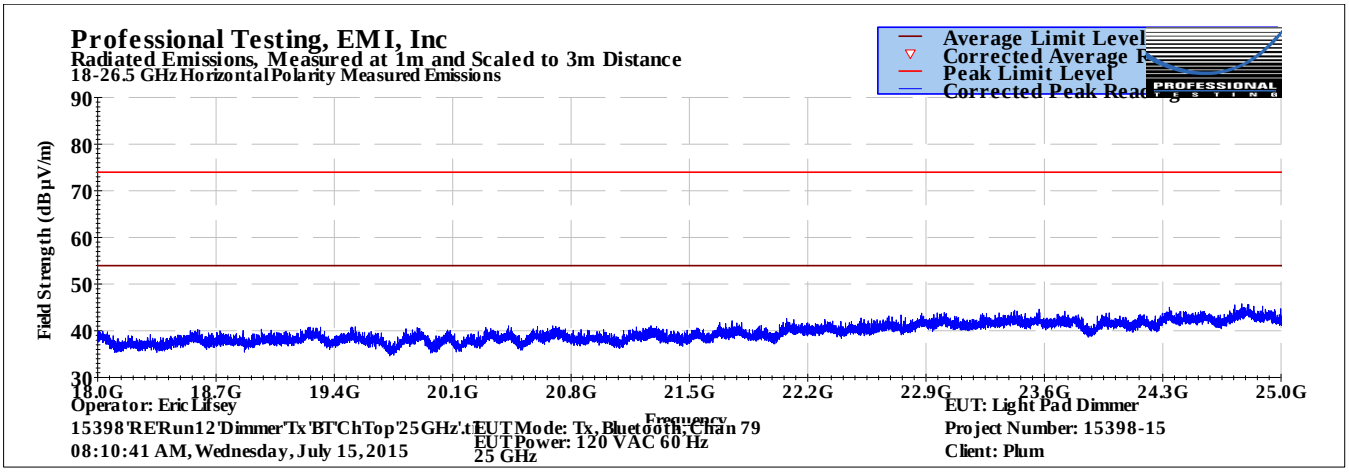
7.3.10 TX Mode, 18 GHz to 25 GHz, Middle Channel





7.3.11 TX Mode, 18 GHz to 25 GHz, High Channel





8.0 Antenna Construction Requirements

The design was investigated for meeting the antenna construction requirements of the applicable rules.

8.1 Procedure

A direct examination of the antenna construction is performed and compared to rule criteria that prevent wireless device antennas from being modified by end users in ways that would void their authorization to use the device.

8.2 Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.203 // RSS-Gen 8.3	Antenna Construction	24 Jul 2015

8.3 Results

Table 8.3.1 Antenna Construction Details	
Antenna Manufacturer and Model	**Specifications**
Manufacturer Plum Model: N/A	Printed circuit loaded monopole.

- Antenna is internal only.
- Antenna is etched into the circuit board.
- There is no external antenna connector.

The antenna design above satisfies the requirements of the rules.

9.0 Conducted Emissions, Mains

9.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the floor and 0.4 meters from the conductive reference plane (wall). The EUT is powered through a line impedance stabilization network (LISN) that provides a measurement tap and a termination approximating 50 Ohms in the measurement range of 150 kHz to 30 MHz. A spectrum analyzer is connected, in turn, to each mains line measurement tap and the measurement is taken.

9.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.107, 15.207 // RSS-Gen	Mains conducted emissions	10 Jul 2015

9.3 Test Results

The EUT satisfied the criteria.

Tabular and plotted measurements appear on the following pages.

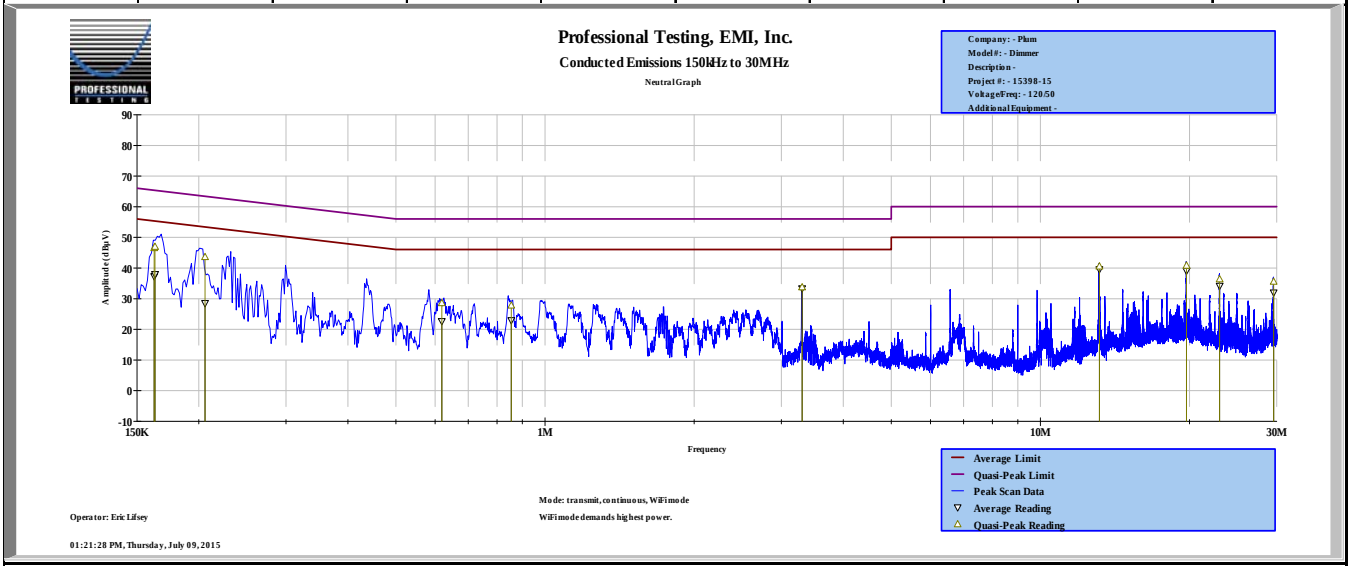
9.3.1 Mains, Neutral

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2009: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.107 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Conducted Emissions Limits		
Section:	15.107		
Test Date(s):	7/10/2015	**EUT Serial #:**	NA
Customer:	Plum	**EUT Part #:**	NA
Project Number:	15398-15	**Test Technician:**	Eric Lifsey
Purchase Order #:	NA	**Supervisor:**	Lisa Arndt
Equip. Under Test:	Light Pad Dimmer	**Witness' Name:**	Russ

Conducted Emissions Test Results Data Sheet - Neutral Lead **Page: 1 of 2**

EUT Line Voltage:	120	VAC	EUT Line Frequency:	60	Hz

Frequency Measured (MHz)	Peak Detector Reading (dBµV)	Quasi-peak Detector Reading (dBµV)	Quasi-peak Detector Limit (dBµV)	Quasi-peak Detector Margin (dB)	Quasi-peak Detector Test Results	Average Detector Reading (dBµV)	Average Detector Limit (dBµV)	Average Detector Margin (dB)	Average Detector Test Results
0.16251	52.2	46.5	65.3	-18.8	PASS	37.2	55.3	-18.1	PASS
0.16318	50.4	46.9	65.3	-18.4	PASS	37.9	55.3	-17.4	PASS
0.2059	47.9	43.6	63.4	-19.8	PASS	28.5	53.4	-24.9	PASS
0.6189	33.6	28.5	56	-27.5	PASS	22.6	46	-23.4	PASS
0.8548	30.6	27.8	56	-28.2	PASS	22.9	46	-23.1	PASS
3.3028	34.9	33.7	56	-22.3	PASS	33.3	46	-12.7	PASS
13.1558	42.2	40.5	60	-19.5	PASS	39.5	50	-10.5	PASS
19.7252	42.6	40.8	60	-19.2	PASS	39	50	-11	PASS
23.0087	38.2	36.4	60	-23.6	PASS	34.1	50	-15.9	PASS
29.58	37.8	35.6	60	-24.4	PASS	32	50	-18	PASS

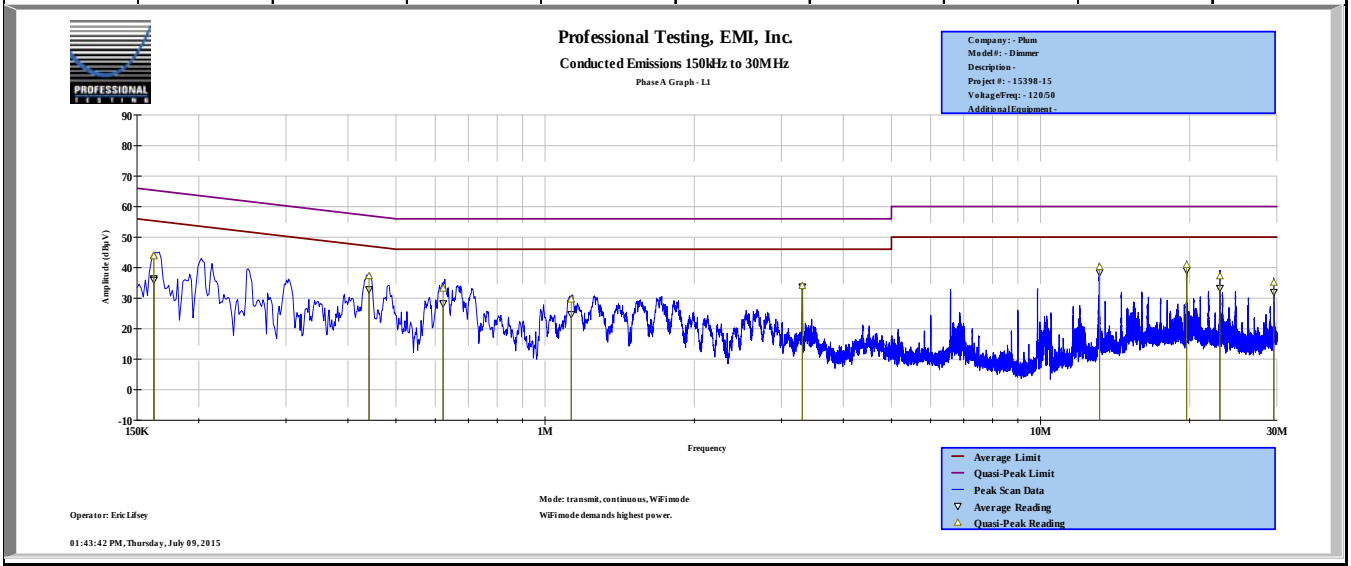


Measured Conducted Emissions - Neutral Lead

9.3.2 Mains, Phase

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2009: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.107 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Conducted Emissions Limits		
Section:	15.107		
Test Date(s):	7/10/2015	EUT Serial #:	NA
Customer:	Plum	EUT Part #:	NA
Project Number:	15398-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	Light Pad Dimmer	Witness' Name:	Russ

Conducted Emissions Test Results Data Sheet - Phase Lead (Line 1)								Page: 2 of 2	
EUT Line Voltage:			120	VAC	EUT Line Frequency:			60	Hz
Frequency Measured (MHz)	Peak Detector Reading (dBµV)	Quasi-peak Detector Reading (dBµV)	Quasi-peak Detector Limit (dBµV)	Quasi-peak Detector Margin (dB)	Quasi-peak Detector Test Results	Average Detector Reading (dBµV)	Average Detector Limit (dBµV)	Average Detector Margin (dB)	Average Detector Test Results
0.16223	47.2	44	65.3	-21.3	PASS	36.5	55.3	-18.9	PASS
0.16227	47	43.7	65.3	-21.6	PASS	36	55.3	-19.4	PASS
0.44102	39.8	37.2	57	-19.8	PASS	32.8	47	-14.2	PASS
0.6226	37	33.1	56	-22.9	PASS	28.3	46	-17.7	PASS
1.1288	32.9	29.6	56	-26.4	PASS	24.7	46	-21.3	PASS
3.3049	35.1	34.1	56	-21.9	PASS	33.8	46	-12.2	PASS
13.1626	41.7	40.2	60	-19.8	PASS	38.4	50	-11.6	PASS
19.7286	42.9	40.9	60	-19.1	PASS	39.2	50	-10.8	PASS
23.0196	39.4	37.2	60	-22.8	PASS	33.3	50	-16.7	PASS
29.5822	37.4	35.1	60	-24.9	PASS	32	50	-18	PASS



Measured Conducted Emissions - Phase Lead (Line 1)

10.0 Equipment

10.1 Spurious Radiated Emissions 30 MHz to 25 GHz

Professional Testing, EMI, Inc.			
Test Method:	**ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference,**		
In accordance with:	**FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits**		
Section:	**15.109**		
Test Date(s):	**7/6/2015, 7/10/2015**	**EUT Serial #:**	**1600019**
Customer:	**Plum**	**EUT Part #:**	**0**
Project Number:	**15398-15**	**Test Technician:**	**Eric Lifsey**
Purchase Order #:	**NA**	**Supervisor:**	**Lisa Arndt**
Equip. Under Test:	**Light Pad Dimmer**	**Witness' Name:**	**Russ**

Radiated Emissions Test Equipment List					
Tile! Software Version:		**4.2.A, May 23, 2010, 08:38:52 AM**			
Test Profile:		**Radiated Emissions_Profile Version October 12, 2011**			
Asset #	**Manufacturer**	**Model**	**Equipment Nomenclature**	**Serial Number**	**Calibration Due Date**
1509A	Braden	N/A	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	2/5/2016
1890	HP	8447F	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	2/6/2016
1937	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz	MY44303298	7/29/2015
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	1/26/2016
C027	N/A	RG214	Cable Coax, N-N, 25m	none	10/22/2015
1327	EMCO	1050	Controller, Antenna Mast	none	N/A
0942	EMCO	11968D	Turntable, 4ft.	9510-1835	N/A
1969	HP	11713A	Attenuator/Switch Driver	3748A04113	N/A
1509B	Braden	N/A	TDK 10M Chamber, VSWR > 1 GHz	DAC-012915-005	3/13/2016
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, .1-18GHz	0	12/29/2015
C030	N/A	0	Cable Coax, N-N, 30m	none	10/10/2015
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	110313	2/26/2016
2054	Mini-Circuits	VHF-3100+	Filter, High Pass	N/A	5/18/2016
1542	A.H. Systems	SAS-572	Antenna, Horn 18-26.5GHz, 20dB gain	225	N/A
1973	Agilent	83017A	Amplifier, Microwave 0.5-26.5 GHz	MY39500497	2/4/2016

10.2 Bandwidth, Fundamental Power, and Hopping/Timing Characteristics

Asset #	Manufacturer	Model #	Description	Calibration Due
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	29 Jan 2016

10.3 Mains Conducted Emissions

Professional Testing, EMI, Inc.			
Test Method:	**ANSI C63.4–2009: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (incorporated by reference, see §15.38).**		
In accordance with:	**FCC Part 15.107 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Conducted Emissions Limits**		
Section:	**15.107**		
Test Date(s):	**7/10/2015**	**EUT Serial #:**	**NA**
Customer:	**Plum**	**EUT Part #:**	**NA**
Project Number:	**15398-15**	**Test Technician:**	**Eric Lifsey**
Purchase Order #:	**NA**	**Supervisor:**	**Lisa Arndt**
Equip. Under Test:	**Light Pad Dimmer**	**Witness' Name:**	**Russ**

Conducted Emissions Test Equipment List	
Tile! Software Version:	**4.1.A.0, April 14, 2009, 11:01:00PM**
Test Profile:	**Profile#: CE_2014_R3.TIL, dated May 1, 2014**

Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1842	HP	8568B	Spectrum Analyzer	2732A03633	10/1/2015
2113	HP	85662A	Spec Anal Dsply for A/N 1842	2403A07470	N/A
0990	HP	85685A	RF Preselector	3010A01119	9/30/2016
1281	HP	85650A	Quasi Peak Adapter	2043A00063	N/A
1173	PTI	100k HPF	Filter, High Pass, 100kHz	none	1/15/2016
1087	PTI	PTI-ALF3	Attenuator Limiter Filter	none	4/28/2016
C107	Pomona	RG-223	Cable 9 ft BNC RG-223 (black)	none	8/11/2015
C108	HP	11170 C	Cable 5 ft BNC (Grey)	none	8/11/2015
C109	HP	none	Cable 19 inch BNC (grey)	none	8/11/2015
1185	EMCO	3825/2	LISN, 10kHz-100MHz	1235	11/11/2015

11.0 Measurement Bandwidths, Spurious Emissions

Radiated Emissions Spectrum Analyzer Bandwidth and Measurement Time - Peak Scan				
Frequency Band Start (MHz)	**Frequency Band Stop (MHz)**	**6 dB Bandwidth (kHz)**	**Number of Ranges Used**	**Measurement Time per Range**
0.009	0.15	0.3	2	Multiple Sweeps
0.15	30	9	6	Multiple Sweeps
30	1000	120	2	Multiple 800 mS Sweeps
1000	6000	1000	2	Multiple Sweeps
6000	18000	300	2	Multiple Sweeps

*Notes:
1. The settings above are specifically calculated for the E4440A series of spectrum analyzers, which have 8,000 data points per range.
2. The measurement receiver resolution bandwidth setting was 300 Hz for quasi-peak measurements from 9-150 kHz.
3. The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz.
4. The measurement receiver resolution bandwidth setting was 120 kHz for quasi-peak measurements from 30-1000 MHz.
5. The measurement receiver resolution bandwidth setting was 1 MHz for average measurements from 1-18 GHz.

Conducted Emissions Spectrum Analyzer Bandwidth and Measurement Time				
Frequency Band Start (MHz)	**Frequency Band Stop (MHz)**	**6 dB Bandwidth (kHz)**	**Number of Ranges Used**	**Measurement Time per Range**
0.01	0.15	0.3	7	Five 1 second sweeps
0.15	30	9	20	Five 1 second sweeps

*Notes:
1. The settings above are specifically calculated for the HP856X series of spectrum analyzers, which have 1,000 data points per range.
2. The measurement receiver resolution bandwidth setting was 300 Hz for quasi-peak measurements from 10-150 kHz.
3. The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz.

Appendix: Policy, Rationale, and Evaluation of EMC Measurement Uncertainty

All uncertainty calculations, estimates and expressions thereof shall be in accordance with NIST policy. Since PTI operates in accordance with NIST (NVLAP) Handbook 150-11: 2007, all instrumentation having an effect on the accuracy or validity of tests shall be periodically calibrated or verified traceable to national standards by a competent calibration laboratory. The certificates of calibration or verification on this instrumentation shall include estimates of uncertainty as required by NIST Handbook 150-11.

1. Rationale and Summary of Expanded Uncertainty.

Each piece of instrumentation at PTI that is used in making measurements for determining conformance to a standard (or limit), shall be assessed to evaluate its contribution to the overall uncertainty of the measurement in which it is used. The assessment of each item will be based on either a type A evaluation or a type B evaluation. Most of the evaluations will be type B, since they will be based on the manufacturer's statements or specifications of the calibration tolerances, or uncertainty will be stated along with a brief rationale for the type of evaluation and the resulting stated uncertainties.

The individual uncertainties included in the combined standard uncertainty for a specific test result will depend on the configuration in which the item of instrumentation is used. The combination will always be based on the law of propagation of uncertainty. Any systematic effects will be accommodated by including their uncertainties, in the calculation of the combined standard uncertainty; except that if the direction and amount of the systematic effect cannot be determined and separated from its uncertainty, the whole effect will be treated as uncertainty and combined along with the other elements of the test setup.

Type A evaluations of standard uncertainty will usually be based on calculating the standard deviation of the mean of a series of independent observations, but may be based on a least-squares curve fit or the analysis of variance for unusual situations. Type B evaluations of standard uncertainty will usually be based on manufacturer's specifications, data provided in calibration reports, and experience. The type of probability distribution used (normal, rectangular, a priori, or u-shaped) will be stated for each Type B evaluation.

In the evaluation of the uncertainty of each type of measurement, the uncertainty caused by the operator will be estimated. One notable operator contribution to measurement uncertainty is the manipulation of cables to maximize the measured values of radiated emissions. The operator contribution to measurement uncertainty is evaluated by having several operators independently repeat the same test. This results in a Type A evaluation of operator-contributed measurement uncertainty.

A summary of the expanded uncertainties of PTI measurements is shown as Table 1. These are the worst-case uncertainties considering all operative influence factors.

Table 1: Summary of Measurement Uncertainties for Site 45

Type of Measurement	Frequency Range	Meas. Dist.	Expanded Uncertainty U, dB (k=2)
Mains Conducted Emissions	150 kHz to 30 MHz	N/A	2.9
Telecom Conducted Emissions	150 kHz to 30 MHz	N/A	2.8
Radiated Emissions	30 to 1,000 MHz	10 m	4.8
	1 to 18 GHz	3 m	5.7

End of Report

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