Project 15398-15

Plum Light Pad Dimmer Bluetooth Low Energy Radio Section

Wireless Certification Report (2 of 2)

Prepared for:

Rich Warwick Plum 9800 N. Lamar Blvd. Suite 310 Austin, TX 78753

By

Professional Testing (EMI), Inc. 1601 North A.W. Grimes Blvd., Suite B Round Rock, Texas 78665

6 Aug 2015

Reviewed by

Written by

Larry Finn Chief Technical Officer

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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Plum – Light Pad Dimmer – Bluetooth BLE Section

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Compliance Certificate

Applicant	Device & Test Identification	
Plum (Rich Warwick)	FCC ID:	2AFB9P1000
9800 N. Lamar Blvd.	Industry Canada ID:	20409-P1000
Suite 310	Model(s):	Light Pad Dimmer
Austin, TX 78701		Bluetooth Low Energy Radio Section
Certificate Date: 6 Aug 2015	Laboratory Project ID:	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, <u>2400-2483.5 MHz</u> , 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.



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 /	1600019	2400-2483.5 MHz FHSS transceiver; applies to Bluetooth Low	
Light Pad Dimmer*	1600019	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:

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	
47 CFK	Subpart C -Intentional Radiators	
RSS-247 Issue 1	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-	
K33-247 ISSUE 1	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	
ANSI C05.4 2009	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

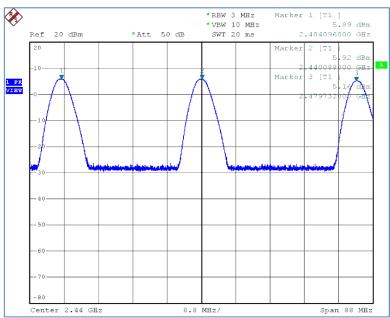
47 CFR (USA) // IC (Canada)			
Section Reference	Parameter	Date	
15.247(a)(3) // RSS-247 5.1	Fundamental Power, Hopping Radio Conducted Limits 1 Watt for ≥ 75 channels, 125 mW Otherwise	13 Jul 2015	

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

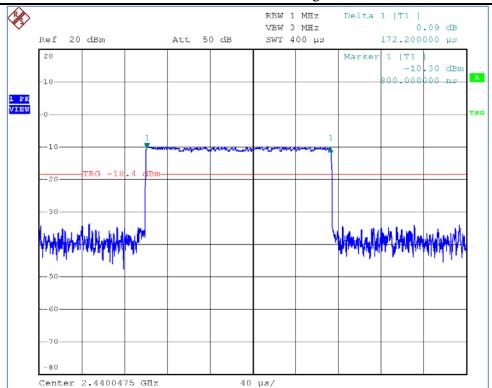
Hopping channel count was determined by max-holding and observing the spectrum analyzer display until it was evident that all channels are captured. The peaks of each channel are counted. Channel separation was determined by zooming in to view fewer channels and measure the frequency delta by markers 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.

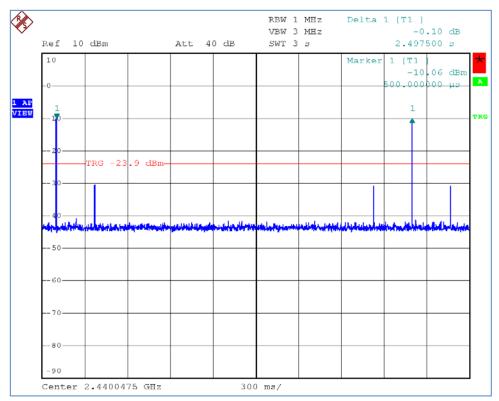
3.3.1 Hopping Characteristics Measured								
Number of Channels (Minimum 15 channels)	40							
Channel Separation (Minimum the higher of 25 kHz or 2/3 ^{rds} of BW _{20dB})	2 MHz (BW _{20dB} = 1.188 MHz)							
Channel Dwell Time	0.1722 ms							
Return To Channel Time	2497.5 ms							

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								

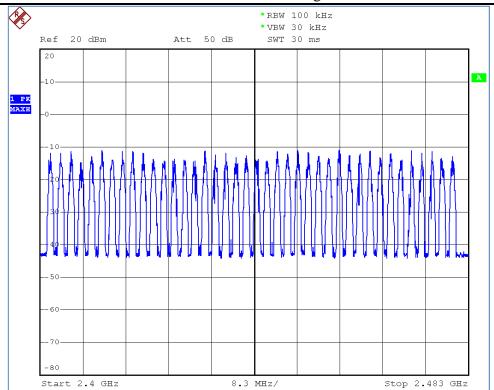
3.3.3 Duty Cycle Factor Calculation			
Time Inputs	Calculation	Result	Allowed
Channel Dwell, Return to Channel	20 Log ₁₀ (0.1722 ms / 2497.5 ms) =	-83 dB	-20 dB



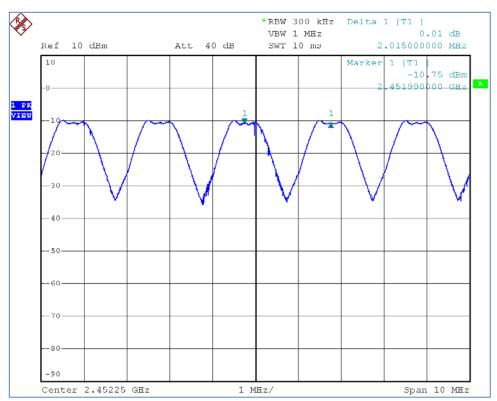
Channel Dwell Time



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

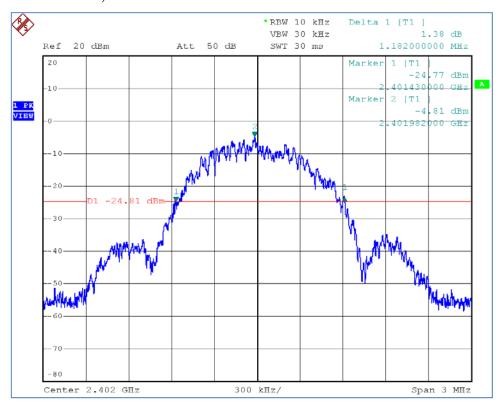
The bandwidth measurement is used to verify hopping characteristics and for general reporting for agency application.

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

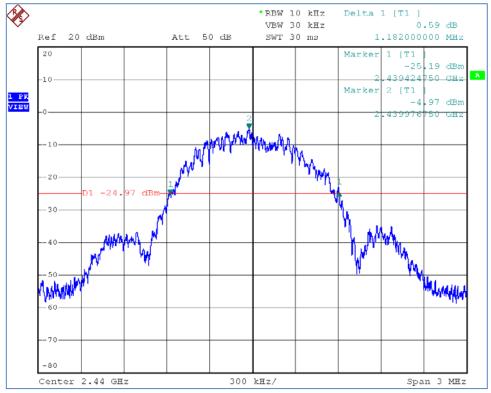
Table 5.3.1 Bandwidth 20 dB, Measure and Report										
Low Channel	Low Channel Mid Channel High Channel									
Measured BW	Measured BW	Measured BW	Maximum BW							
(kHz)	(kHz)	(kHz)	(kHz)							
1182.0	1182.0	1188.0	1188.0							

Plotted measurements appear on the following pages.

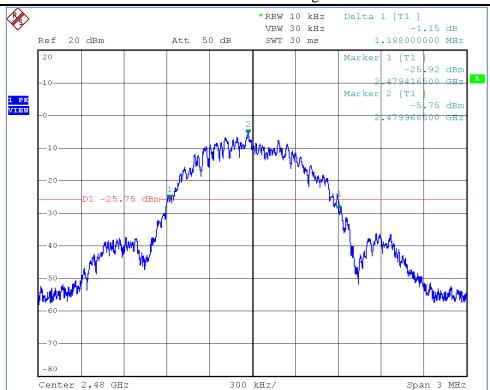
4.3.1 Bandwidth Plots, 20 dB



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 //	Unwanted Emissions Adjacent to Authorized	14 Jul 2015							
RSS-247 5.5, RSS-Gen 4.9	Band, Radiated	14 Jul 2015							

5.3 Test Results

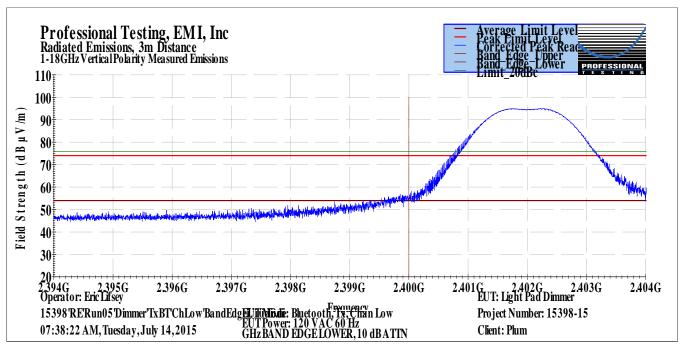
Measurements included more than 2 standard bandwidths (standard bandwidth 1 MHz) from the band edges to provide a clear view of the fundamental and the declining emission levels. Peak detection with max-hold was employed. Measurements were relative radiated at 1 meter with resulting deltas applied to 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 $54 \ dB\mu V/m$ for 3 meters as that was the reference power measurement distance. Below the operating band the peak power -20 dBc level is referenced.

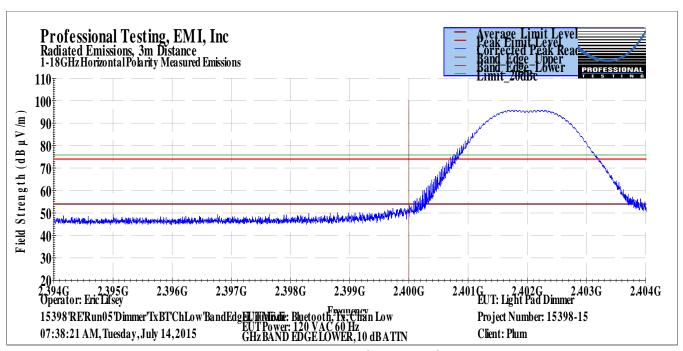
Peak detection of emissions at band lower edge were below the FCC 15.247 -20 dBc emission limits and decayed to below the general limits of 15.209 below ~1.3985 MHz. Peak detection of emissions at band upper edge were below the FCC 15.209 general emission limits. As calculated in Table 3.3.3, the averaging 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

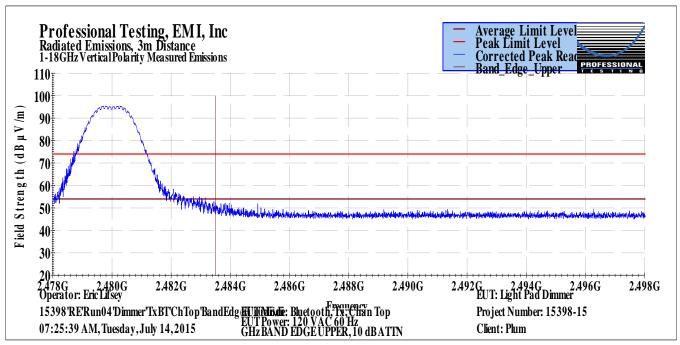


Vertical Polarity, Band Edge Emission, Satisfies -20 dBc Criteria (green line)
(Reference green line marking -20 dBc level. Decays below 15.209 average limit below ~2.3985 MHz.)

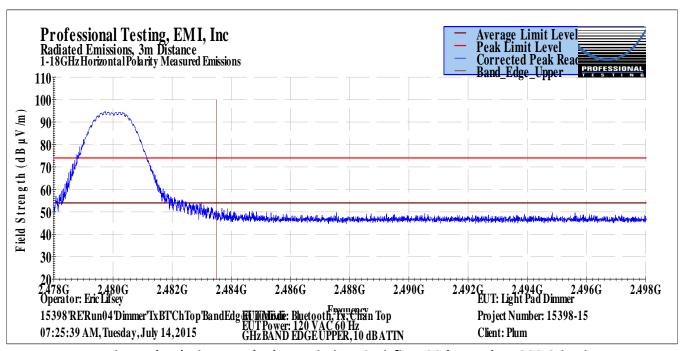


Band Edge Emission, Satisfies -20 dBc (green line) and 15.209 Criteria

5.3.2 Top Channel Band Edge



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



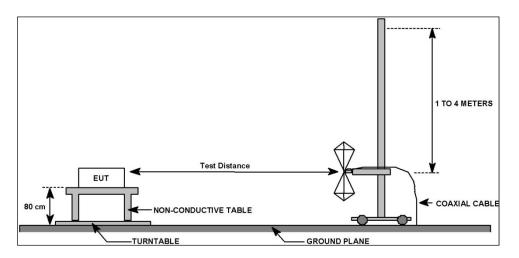
Horizontal Polarity, Band Edge Emission, Satisfies -20dBc and 15.209 Criteria

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												
	15		EUT Serial	#:		•						
			EUT Part #:									
	.5		Test Techn	ician:	7	•						
			•			dt						
Light Pa	id Dimmer		Witness' N	ame:	Russ							
Radiated	Emissions Test	t Results Data	a Sheet			Page:	1	of	1			
ge:	120 VAC		EUT Pow	ver Frequen	cy:	60	Hz					
ion:	Vertic	al	Frequ	ency Range:		301	/lHz to	1GHz				
Mode of 0	Operation:			R	eceive N	1ode						
	0	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)			•	Test Res	ults			
141	1.37	Quasi-peak	31.8	14.577	29.5	-:	14.9	Pass				
320	1.4		30.6	14.19	33.1	-:	18.9					
308	1.2	Quasi-peak	28.3	11.085	33.1	-:	22.0	Pass				
42	1.25	Quasi-peak	29	14.71	33.1	+						
91	1.17	Quasi-peak	32	25.493	35.6	-:	10.1	Pass				
340	3.08	Quasi-peak	21.1	26.325	35.6	-	-9.3	Pass				
Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz-1GHz Vertical Polarity Measured Emissions Oussi-peak Limit Level Corrected Quasi-peak Readin Peak Limit Level Corrected Peak Value Verified Low-PRF QP Readin Oussi-peak Limit Level Peak Limit Level Corrected Peak Value Verified Low-PRF QP Readin Oussi-peak Limit Level Peak Limit Level Corrected Peak Value Verified Low-PRF QP Readin Oussi-peak Limit Level Peak Limit Level Corrected Peak Value Verified Low-PRF QP Readin Oussi-peak Limit Level Peak Limit Level Corrected Peak Value Verified Low-PRF QP Readin Oussi-peak Limit Level Peak Limit Level Corrected Peak Value Verified Low-PRF QP Readin Oussi-peak Limit Level Peak Limit Level Corrected Peak Value Verified Low-PRF QP Readin Oussi-peak Limit Level Peak Limit Level Corrected Peak Value Verified Low-PRF QP Readin Outsi-peak Limit Level Peak Limit Level Corrected Peak Value Verified Low-PRF QP Readin Outsi-peak Limit Level Peak Limit Level Corrected Peak Value Verified Low-PRF QP Readin Outsi-peak Limit Level Peak Limit Level Corrected Peak Value Verified Low-PRF QP Readin Outsi-peak Limit Level Peak Limit Level Corrected Peak Value Verified Low-PRF QP Readin Outsi-peak Limit Level Peak Limit Level Corrected Peak Value Verified Low-PRF QP Readin Outsi-peak Limit Level Peak Limit Level Corrected Peak Value Verified Low-PRF QP Readin Outsi-peak Limit Level Peak Limit Level Corrected Peak Value Verified Low-PRF QP Readin Outsi-peak Limit Level Peak Limit Level Corrected Peak Value Verified Low-PRF QP Readin Outsi-peak Limit Level Peak Limit Level												
9 t	ANSI C63 Electroni FCC Part Emission 15.109 7/6/200 Plum 15398-1 NA Light Pa Radiated ge: tion: Mode of (Degree 141 320 308 42 91 340 ng, EMI, Inc	ANSI C63.4–2003: "Methor Electronic Equipment in the FCC Part 15.109 - Code of Emissions Limits 15.109 7/6/2015 Plum 15398-15 NA Light Pad Dimmer Radiated Emissions Test ge: 120 VAC tion: Vertice Mode of Operation: EUT Antenna Height (Meters) 141 1.37 1320 1.4 1308 1.2 142 1.25 11.17 1340 3.08 Ing, EMI, Inc	Professional Te ANSI C63.4–2003: "Methods of Measurer Electronic Equipment in the Range of 9 kH FCC Part 15.109 - Code of Federal Regulat Emissions Limits 15.109 7/6/2015 Plum 15398-15 NA Light Pad Dimmer Radiated Emissions Test Results Data Ge: 120 VAC tion: Vertical Mode of Operation: EUT Antenna Height (Meters) 141 1.37 Quasi-peak 1320 1.4 Quasi-peak 1308 1.2 Quasi-peak 1308 1.2 Quasi-peak 1308 1.2 Quasi-peak 1308 1.2 Quasi-peak 1308 1.17 Quasi-peak 1309 3.08 Quasi-peak 1309 3.08 Quasi-peak 1309 3.08 Quasi-peak 1309 3.08 Quasi-peak	Professional Testing, EN ANSI C63.4–2003: "Methods of Measurement of Radio-Electronic Equipment in the Range of 9 kHz to 40 GHz" FCC Part 15.109 - Code of Federal Regulations Part 47, 9 Emissions Limits 15.109 7/6/2015 Plum EUT Part #: 15398-15 Test Techn NA Supervisor: Light Pad Dimmer Witness' N Radiated Emissions Test Results Data Sheet ge: 120 VAC EUT Pow tion: Vertical Frequi Mode of Operation: EUT Direction (Degrees) (Meters) Antenna Direction (Degrees) (Meters) Antenna Direction (Degrees) (Meters) Antenna Direction (Degrees) (Meters) Antenna Detector Function (Amplitude (BµV) 141 1.37 Quasi-peak 30.6 308 1.2 Quasi-peak 28.3 42 1.25 Quasi-peak 29 91 1.17 Quasi-peak 32 340 3.08 Quasi-peak 32 340 3.08 Quasi-peak 32 340 3.08 Quasi-peak 32 340 3.08 Quasi-peak 31.8	Professional Testing, EMI, Inc. ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissic Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Ur Emissions Limits 15.109 7/6/2015 EUT Serial #: 15398-15 Test Technician: NA Supervisor: Light Pad Dimmer Witness' Name: Radiated Emissions Test Results Data Sheet ge: 120 VAC EUT Power Frequent Frequency Range: Mode of Operation: R Wheters Mode of Operation: Function (Degrees) Meters Antenna Height (Meters) Detector Function (Degrees) Meters Antenna Hoight (Meters) Antenna Hoight (Meters) Detector Function (Degrees) Antenna Hoight (Meters) Antenna Hoight (Meters) Detector Function (ABµV) Al.41 Al.577 320 1.4 Quasi-peak 30.6 14.19 308 1.2 Quasi-peak 28.3 11.085 42 1.25 Quasi-peak 29 14.71 91 1.17 Quasi-peak 32 25.493 340 3.08 Quasi-peak 21.1 Distance Introduction Introduction I	Professional Testing, EMI, Inc. ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from L Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference of the Picture of Picture) and the Picture of Picture o	Professional Testing, EMI, Inc. ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Volta Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see Electronic Emissions Limits 15.109 7/6/2015 EUT Serial #: 1600019 Plum EUT Part #: 0 15398-15 Test Technician: Eric Lifsey NA Supervisor: Lisa Arndt Light Pad Dimmer Witness' Name: Russ Radiated Emissions Test Results Data Sheet Page: 120 VAC EUT Power Frequency: 60 tion: Vertical Frequency Range: 30N Mode of Operation: Receive Mode Function (BaµV) (dBµV/m) (dBµV/m	Professional Testing, EMI, Inc. ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Elect Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38). FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radi Emissions Limits 15.109 7/6/2015	Professional Testing, EMI, Inc. 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). FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits 15.109 7/6/2015			

Operator: Eric Lifsey

15398 RERun01 Dimmer RX mode.til

09:52:06 AM, Monday, July 06, 2015

Frequency

≤ 1GHz Vertical Antenna Polarity Measured Emissions

EUT Mode: Receive EUT Power: 120 VAC 60 Hz

EUT: Light Pad Dimmer

Client: Plum

Project Number: 15398-15

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

			Profes	sional Te	sting, El	VII, Inc.						
Test Metho	d:			ds of Measurer e Range of 9 kH				•				
In accordance with: FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits												
Section:												
Test Date(s):	7/6/2015			EUT Serial		1600019					
Customer:		Plum			EUT Part #:		0					
Project Nur		15398-15			Test Techn		Eric Lifsey					
Purchase O		NA			Supervisor:		Lisa Arndt					
Equip. Und	er Test:	Light Pad	Dimmer		Witness' N	ame:	Russ					
	R	Radiated Er	nissions Test	t Results Data	Sheet		Pa	ge: 1	of 1			
EUT Li	ne Voltage:	: 1	.20 VAC		EUT Pow	ver Frequen	icy: 6	0 Hz				
Antenna	Orientatio	n:	Horizor	ntal	Frequ	ency Range	•	30MHz to	1GHz			
	EUT N	lode of Op	eration:			R	Receive Mod	le				
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			
Radiated 30MHz-10	ional Testing, Emissions, 10m Di GHzHorizontal Polari	stance	ns .			— Coi	asi-peak Limit Lev rrected Quasi-peak ak Limit Level rrected Peak Valu rified Low-PRF QI	e	SIONAL			
	eric Lifsey Run01 'Dimmer'R Xmo	odetil	100M EUT Mod EUT Powe	•	uency	P	TUT: Light Pad Dimme roject Number: 15398		1G			

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

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

Table 6.5.	o. Nauiate	u spu			s, Receive N sional Te			vertical P	Olarity			
Test Metho	d:		63.4–200	3: "Metho	ds of Measurer	nent of Radio-	-Noise Emissic		_			
Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38). In accordance with: Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38). FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits												
Section:	ection: 15.109											
Test Date(s):	7/6/2	015			EUT Serial	#:	1600019				
Customer:		Plum				EUT Part #:		0				
Project Nur	nber:	15398	-15			Test Techni	ician:	Eric Lifsey				
Purchase O	rder #:	NA				Supervisor:		Lisa Arndt				
Equip. Und	er Test:	Light I	Pad Dim	nmer		Witness' Na	ame:	Russ				
	F	Radiate	d Emiss	sions Test	Results Data	Sheet		Pa	ige: 1	of 1		
EUT Li	ne Voltage:	:	120	VAC		EUT Pow	ver Frequen	cy:	60 Hz			
Antenna	Orientatio	n:		Vertic	al	Frequ	ency Range:		Above 1	GHz		
	EUT N	lode o	f Opera	tion:			R	eceive Mod	de			
Frequency Measured (MHz)	Test Distance (Meters)	EU Direct (Degr	tion	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results		
2184.42	3	17	6	1	Average	35.2	26.133	54.0	-27.8	Pass		
2913.39	3	96	6	1	Average	34.7	27.759	54.0	-26.2	Pass		
8586.06	3	21	9	1	Average	27.5	34.657	54.0	-19.3	Pass		
12070.2	3	33	3	1	Average	27.6	37.939	54.0	-16.0	Pass		
Professional Testing, EMI, Inc Radiated Emissions, 3m Distance 1-18GHz Vertical Polarity Measured Emissions 90 80								SIONAL				
Field Strength (dB µV/m) 900 900 900 900 900 900 900 900 900 90	tales and the state of the stat	n Aud Marie			Y	or the same that the same			7	i de la		
20 G 10G 1: Operator: EricLifsey Frequency EUT: Light Pad Dimmer 15398 RERun01 Dimmer'RXmodetil EUTMode: Receive Project Number: 15398-15 10:29:02 AM, Monday, July 06, 2015 EUTPower: 120 VAC 60 Hz Client: Plum								13G				

> 1GHz Vertical Antenna Polarity Measured Emissions

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

				Pro	ofess	sional Te	sting, El	VII, Inc.																																
Test Metho	d:					ds of Measurer Range of 9 kH					_			1																										
In accordan	ce with:		rt 15.10 ons Limi		ode of F	ederal Regulat	ions Part 47, S	Subpart B - Un	intenti	onal Ra	diator	s, Radi	ated																											
Section:		15.109																																						
Test Date(s):	7/6/2	015				EUT Serial	#:	16000)19																														
Customer:		Plum					EUT Part #:		0																															
Project Nur		15398	3-15				Test Techn	ician:	Eric Li																															
Purchase O		NA					Supervisor		Lisa A	rndt																														
Equip. Und	er Test:	Light I	Pad Di	mme	er		Witness' N	ame:	Russ																															
	F	Radiate	ed Emi	ssion	s Test	Results Data	a Sheet			Pag	e:	1	of	1																										
EUT Li	ne Voltage:		120	0	VAC		EUT Pow	ver Frequen	су:	60)	Hz																												
Antenna	Orientatio	n:		Н	orizon	tal	Frequ	ency Range:	:		Ab	ove 1	GHz																											
	EUT N	/lode o	f Ope	ratio	n:			R	eceive	Mode	9																													
Frequency Measured (MHz)	Test Distance (Meters)	EU Direc (Degr	tion	Hei	enna ght ters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit (dBµ\				Margin (dB)																											
2188.05	3	16	6	1	1	Average	34.8	25.738	54	.0	-2	8.2	Pa	SS																										
2911.38	3	351		1		1		1		1		1		1		1		1		1		1		1		1		1		1		Average	34.5	27.594	54	.0	-2	6.4	Pa	SS
8567.39	3	35	2	1	L	Average	27.5	34.672	54	.0	-19.3		Pass																											
11557.4	3	26	2	1	1	Average	27.5	38.152	54	.0	-1	5.8	Pa	SS																										
Radiated	ional Testing, Emissions, 3m Dis orizontal Polarity Me	tance						∇ CorPea	ak Limit I	verage Re	Ŭ	PROFES	SIONAL																											
30	Tradesta programme and the state of the stat					 				-			·																											
20 IG	drio Lifeov			+				10	TIT: 1 :- k4 P	od Dimme-	1	0G	130	;																										
Operator: Eric Lifsey Frequency EUT: Light Pad Dimmer 15398 RETRun 01 Dimmer RX modetil EUT Mode: Receive Project Number: 15398-15 10:29:02 AM, Monday, July 06, 2015 Client: Plum																																								

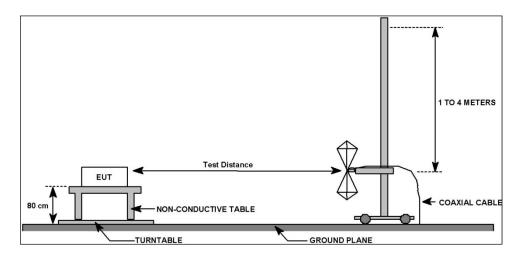
> 1GHz Horizontal Antenna Polarity Measured Emissions

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.

EUT: Light Pad Dimmer

Client: Plum

Project Number: 15398-15

Table 7.3.1: TX Mo	de, Below	1 GHz, Ver		y, Mid. Ch				
		Profes	sional Te	sting, El	VII, Inc.			
Test Method:		–2003: "Metho Equipment in th					_	
In accordance with:	FCC Part 15 Emissions I	5.109 - Code of Limits	Federal Regulat	tions Part 47,	Subpart B - Un	intentional F	Radiators, R	adiated
Section:	15.109							
Test Date(s):	7/13/201	5		EUT Serial		1600019		
Customer:	Plum			EUT Part #:		0		
Project Number:	15398-15			Test Techn		Eric Lifsey		
Purchase Order #:	NA			Supervisor		Lisa Arndt		
Equip. Under Test:	Light Pad	Dimmer		Witness' N	ame:	Russ		
	Radiated E	missions Tes	t Results Data	a Sheet		Pa	age:	1 of 1
EUT Line Volta	ge:	120 VAC		EUT Pov	ver Frequen	cy:	60 Hz	!
Antenna Orienta	ion:	Vertic	cal	Frequ	ency Range:		30MHz	to 1GHz
EU1	Mode of O	peration:		Tra	nsmit Mode	e, Bluetoot	h, Middle	Chan
Frequency Test Measured Distance (MHz) (Meters			Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margir (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
Professional Testin Radiated Emissions, 10m 30MHz-1GHz Vertical Pola 60 50 (Ell / Add 30 30 30 20 20 20 20 20 20 20 20 20 20 20 20 20	Distance	S IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII			— Qu Cor Per Cor Ver	asi-peak Limit L rrected Quasi-per ak Limit Level rrected Peak Val rified Low-PRF (evel ak Readin ue QP Readin	FESSIONAL 3 Y 1 N 6

Frequency

100M

EUT Mode: Tx, Bluetooth, Ch 39 EUT Power: 120 VAC 60 Hz HPF

Operator: Eric Lifsey

15398'RE'Run01'Dimmer'TxBT'HPF'Ch39'MHztil

07:12:59 AM, Monday, July 13, 2015

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

Гable 7.3.2			· · · · · · · · · · · · · · · · · · ·	sional Te					
Test Metho	d:			ds of Measurer e Range of 9 kH				•	
In accordan	ce with:	FCC Part 15. Emissions Li		Federal Regulat	ions Part 47, S	Subpart B - Un	intentional R	adiators, Rad	iated
Section:		15.109							
Test Date(s):	7/13/2015			EUT Serial		1600019		
Customer:		Plum			EUT Part #:		0		
Project Nun		15398-15			Test Techni		Eric Lifsey		
Purchase O		NA			Supervisor:		Lisa Arndt		
Equip. Und	er Test:	Light Pad I	Dimmer		Witness' N	ame:	Russ		
Radiated Emissions Test Results Data S							Pa	ge: 1	of 1
EUT Li	ne Voltage:	1	20 VAC		EUT Pow	er Frequen	су: 6	0 Hz	
Antenna	Orientatio	n:	Horizor	ntal	Frequ	ency Range:	:	30MHz to	1GHz
	EUT N	lode of Op	eration:		Tra	nsmit Mod	e, Bluetoot	h, Middle C	han
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
Radiated 1 30MHz - 10 60	ional Testing, Emissions, 10m Di GHz Horizontal Polari	stance	ns			— Cor	asi-peak Limit Lev rrected Quasi-peal ak Limit Level rrected Peak Valu ified Low-PRF Q	e	SIONAL
50 (m) A 40 (m) A 10	and the state of t	Market	100M	Westernal to the state of the s			V		IG

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

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

				Profess	sional Te	sting, EN	VII, Inc.				
Γest	Metho	d:			ds of Measurer e Range of 9 kH					_	
In ac	cordan	ice with:	FCC Part 15. Emissions Li		ederal Regulat	ions Part 47, S	Subpart B - Un	intentio	nal Ra	diators, Rad	iated
Secti	on:		15.109								
Test	Date(s):	7/14/2015			EUT Serial		16000	19		
	omer:		Plum			EUT Part #:		0			
	ct Nur		15398-15			Test Techni		Eric Lif			
		rder #:	NA			Supervisor:		Lisa Ar	ndt		
-qui	o. Und	er Test:	Light Pad [Jimmer		Witness' Na	ame:	Russ			
		F	Radiated En	nissions Test	Results Data	a Sheet			Pag	e: 1	of 1
	EUT Li	ne Voltage:	1	20 VAC		EUT Pow	er Frequen	су:	60) Hz	
A	ntenna	Orientatio	n:	Vertic	al	Freque	ency Range:			Above 1	GHz
		EUT N	lode of Op	eration:		Tı	ransmit Mo	de, Blu	etoot	h, Low Ch	an
Mea	uency sured IHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit L (dBµV		Margin (dB)	Test Resul
480	4.57	3	277	0	Peak	61.6	57.562	74.	0	-16.4	Pass
16	928	3	293	0	Peak	37.4	52.101	74.	0	-21.9	Pass
	Radiated	sional Testing, Emissions, 3m Dis erticalPolarity Measu	tance				— Pea	erage Limi ak Limit Le rrected Pea	evel	PROFES	SIONAL
dΒμV/m)	70										
Field Strength (dBµV/m)	70 60	Eric Lifsey Run02R Dimmer Tx B	PUDECHALICH. 4		Freq: Tx. Bluetooth. Ch 01	uency		1 UT: Light Pa			18G

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

			Profess	ional Te	sting, El	VII, Inc.			
Test Metho	od:		2003: "Methoo Juipment in the					•	
In accorda	nce with:	FCC Part 15. Emissions Li	109 - Code of F mits	ederal Regula	tions Part 47, S	Subpart B - Uni	intentional Ra	adiators, Rad	liated
Section:		15.109							
Test Date(s):	7/14/2015			EUT Serial		1600019		
Customer:		#VALUE!			EUT Part #:		0		
Project Nu		15398-15			Test Techn		Eric Lifsey		
Purchase C		NA			Supervisor:		Lisa Arndt		
Equip. Und	ler Test:	Light Pad I	Dimmer		Witness' N	ame:	Russ		
	R	adiated En	nissions Test	Results Dat	a Sheet		Pa	ge: 1	of 1
EUT L	ine Voltage:	1	20 VAC		EUT Pow	ver Frequenc	cy: 6	0 Hz	
Antenn	a Orientatio	n:	Horizon	tal	Frequ	ency Range:		Above 1	.GHz
	EUT N	lode of Op	eration:		Ti	ransmit Mod	le, Bluetoo	th, Low Ch	an
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
Radiated	sional Testing, Emissions, 3m Diss Horizontal Polarity Me	ance				— Peal	rage Limit Level k Limit Level rected Peak Readi	ng PROFES	SSIONAL
30 — — 30 — —	and the same of the same of the same	treated and the state of the st			And the state of t				

> 1GHz Horizontal Antenna Polarity Measured Emissions

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

			,	ical Polarit	y, iviladic	Cilainici						
			Profess	ional Te	sting, El	VII, Inc.						
Test Metho	od:			ds of Measurer Range of 9 kH					_			
In accorda	nce with:	FCC Part 15.2 Emissions Lir		ederal Regulat	tions Part 47, S	Subpart B - U	nintenti	ional Ra	diator	s, Rad	iated	
Section:		15.109										
Test Date(s	s):	7/13/2015			EUT Serial	#:	16000	019				
Customer:		Plum			EUT Part #:		0					
Project Nu		15398-15			Test Techn	ician:	Eric L					
Purchase C		NA			Supervisor:		Lisa A	Arndt				
quip. Und	er Test:	Light Pad D	immer		Witness' N	ame:	Russ					
	F	Radiated Em	issions Test	Results Data	a Sheet			Pag	ge:	1	of	1
EUT L	ine Voltage:	1	20 VAC		EUT Pow	ver Freque	ncy:	60)	Hz		
Antenn	a Orientatio	n:	Vertica	al	Frequ	ency Range	e:		Ab	ove 1	GHz	
	EUT N	lode of Op	eration:		Tra	ansmit Mod	le, Blu	etooth	, Mid	dle C	han	
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit (dBµ	Level V/m)		rgin B)	Test Re	sult
4880.28	3	220	1	Peak	57	53.235	74	1.0	-2	0.7	Pas	s
Radiated	sional Testing, Emissions, 3m Dis Vertical Polarity Measu	tance				— P	verage Lin eak Limit l	Level	ng	PROFES T E S	SSIONAL T N 6	
80												
€ 70 –												
од Вр Од Вр												
reng th (dB µV								_	er, a des	and the same of th		
ed Strength (dB µV		+			In the second se	and the state of t						
Field Strength (Making and the state of the sta	A Company of the Comp		Allek a sara and has keep keep as yan iya	the control of the co	and the state of t			****			
30	de designation and a second second second				A through the same of the same				******			
30 20 C				Milet Access to beta key ben at a point of a				10G	****		18G	
30 20 G Operator:		HDE/Ch202014-42	DUTM-2-	Freq Tx, Bluetooth, Ch 39	uency		EUT: Light I	Pad Dimmer	15		18G	

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

			Profess	sional Te	sting, El	MI, Inc.				
Test Metho	od:		-2003: "Methoo quipment in the						•	
In accordai	nce with:	FCC Part 15. Emissions Li	109 - Code of F mits	ederal Regula	tions Part 47,	Subpart B - Ur	intenti	ional Ra	diators, Rad	liated
Section:		15.109								
Test Date(s	s):	7/13/2015			EUT Serial		16000	019		
Customer:		Plum			EUT Part #		0			
Project Nu		15398-15			Test Techn		Eric L			
Purchase C		NA	Dimmon.		Supervisor		Lisa A	irnat		
Equip. Und	ier rest:	Light Pad	Jimmer		Witness' N	ame:	Russ			
	F	Radiated Er	nissions Test	Results Dat	a Sheet			Pag	e: 1	of 1
EUT L	ine Voltage	: 1	20 VAC		EUT Pov	ver Frequen	су:	60) Hz	
Antenn	a Orientatio	n:	Horizon	tal	Frequ	ency Range			Above 1	.GHz
	EUT N	/lode of Op	eration:		Tra	ansmit Mod	e, Blue	etooth	, Middle C	Chan
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit (dBµ\		Margin (dB)	Test Resu
4880.53	3	176	1	Peak	61.5	57.772	74	1.0	-16.2	Pass
Radiated	sional Testing, Emissions, 3m Dis Horizontal Polarity M	tance				— Pea	erage Lim ak Limit I rected Po		PROFE	SSIONAL
30 20 1G Operator:	Eric Lifsey 'Run01' Dimmer TxBT	честь зо мни на		Free	luency		UT: Light F	10G Pad Dimmer	15	18G

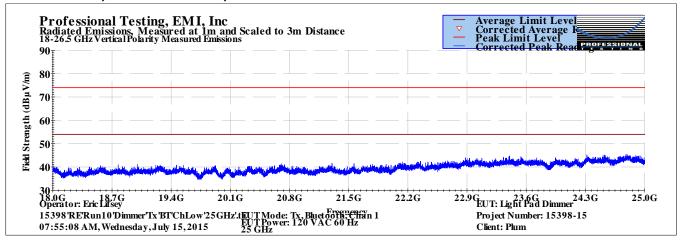
Table 7.3.7: TX Mode, Above 1 GHz, Vertical Polarity, High Channel

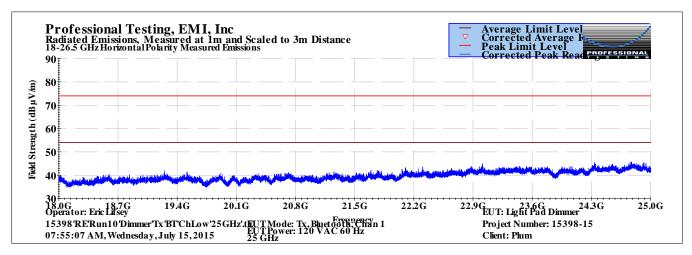
			Profess	sional Te	sting, El	MI, Inc.				
Test Metho	od:		2003: "Metho Juipment in the					_		
In accorda	nce with:	FCC Part 15. Emissions Li	109 - Code of F mits	ederal Regula	tions Part 47, S	Subpart B - Ur	intentiona	al Radiato	rs, Rad	liated
Section:		15.109								
Test Date(s):	7/14/2015			EUT Serial		1600019)		
Customer:		Plum			EUT Part #:		0			
Project Nu		15398-15			Test Techn		Eric Lifse	•		
Purchase C		NA Vista Basta			Supervisor		Lisa Arn	at		
Equip. Und	ler Test:	Light Pad I	Jimmer		Witness' N	ame:	Russ			
	F	Radiated En	nissions Test	Results Dat	a Sheet			Page:	1	of :
EUT L	ine Voltage:	. 1	20 VAC		EUT Pow	ver Frequen	су:	60	Hz	
Antenn	a Orientatio	n:	Vertic	al	Frequ	ency Range:		Ab	ove 1	.GHz
	EUT N	lode of Op	eration:		Т	ransmit Mo	de, Bluet	ooth, To	op Ch	an
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Lev (dBµV/n	-	nrgin dB)	Test Resu
4959.48	3	221	0	Peak	60.6	57.085	74.0	-1	6.9	Pass
Radiated 1-18GHz	sional Testing, Emissions, 3m Dis Vertical Polarity Measu	tance				— Pea	erage Limit Lovel ak Limit Level erected Peak I	l	PROFES T E S	SSIONAL T N 6
80‡ – (w/ \ni g						+ + +				
ਜ਼ ਉ 60 –					A COLLAR TO THE	and the state of t				
Field Strength (dB µV/m) 40 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	linte, p	Manager Land	Match Delivery to the street of the street o	district the district section by						

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

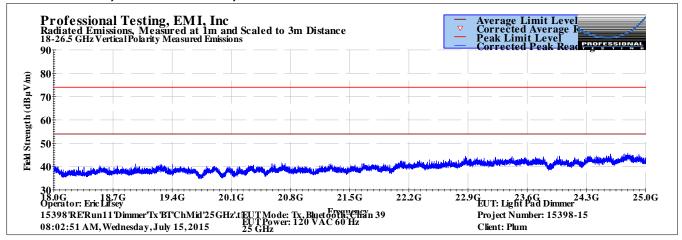
			Profess	ional Te	sting, EN	VII, Inc.			
Test Metho	od:				ment of Radio- Hz to 40 GHz"			•	
In accorda	nce with:	FCC Part 15.1 Emissions Lin		ederal Regula	tions Part 47, S	Subpart B - Un	intentional	Radiators, Rac	diated
Section:		15.109			_				
Test Date(s		7/14/2015			EUT Serial		1600019		
Customer:		Plum			EUT Part #:		0		
Project Nu		15398-15			Test Techni		Eric Lifsey		
Purchase C		NA			Supervisor:		Lisa Arndt	:	
Equip. Und	er Test:	Light Pad D	immer		Witness' N	ame:	Russ		
	R	adiated Em	nissions Test	Results Dat	a Sheet		P	age: 1	of 1
EUT L	ine Voltage:	1.	20 VAC		EUT Pow	er Frequen	cy:	60 Hz	
Antenn	a Orientatio	n:	Horizon	tal	Frequ	ency Range:		Above 1	lGHz
	EUT N	lode of Ope	eration:		T	ransmit Mo	de, Blueto	oth, Top Ch	an
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Leve (dBµV/m)		Test Resul
4960.49	3	179	0	Peak	63.6	60.086	74.0	-13.9	Pass
Radiated	sional Testing, Emissions, 3m Dist Horizontal Polarity Me	tance				— Pea	erage Limit Leve ak Limit Level rected Peak Rea		SSIONAL 7 I N 6
Field Strength (dB µV/m) 90 90 90 90 90 90 90 90 90 9								and the second second second	

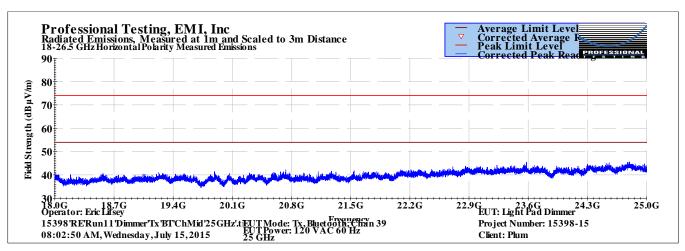
7.3.9 TX Mode, 18 GHz to 25 GHz, Low Channel



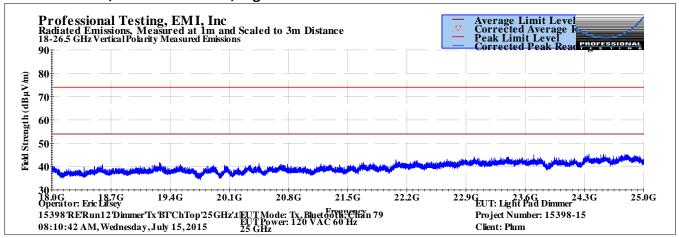


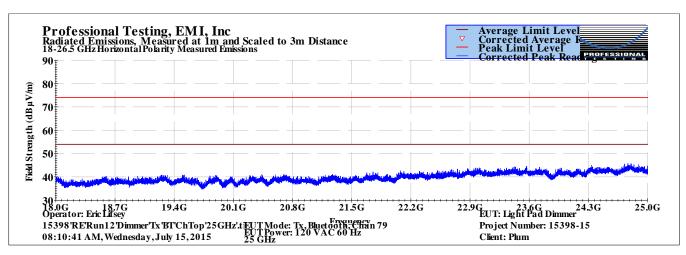
7.3.10 TX Mode, 18 GHz to 25 GHz, Middle Channel





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

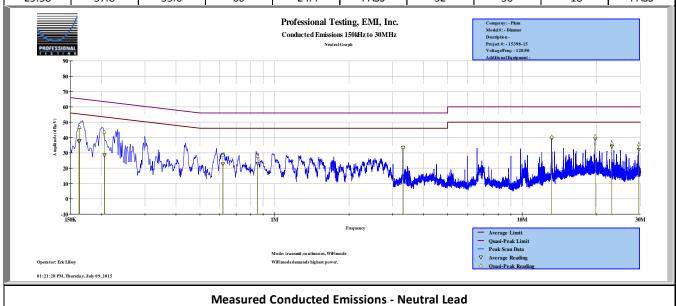
The EUT satisfied the criteria.

Tabular and plotted measurements appear on the following pages.

9.3.1 Mains, Neutral

	Professional Testing, EMI, Inc.							
Test Method:		Measurement of Radio-Noise Emissi z to 40 GHz (incorporated by refere	ions from Low-Voltage Electrical and Electronic ence, see §15.38).					
In accordance with:	FCC Part 15.107 - Code of Feder Limits	ral Regulations Part 47, Subpart B - I	Unintentional Radiators, Conducted Emissions					
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					

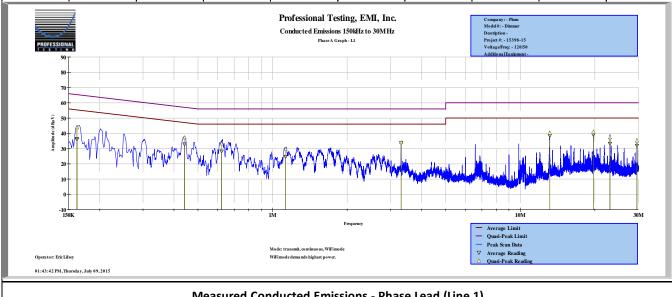
	Conducted Emissions Test Results Data Sheet - Neutral Lead						Pa	ge: 1	of 2
EU	T Line Volta	ge:	120	VAC	EUT	Line Freque	ncy:	60	Hz
Frequency Measured (MHz)	Peak Detector Reading (dBµV)	Quasi-peak Detector Reading (dBµV)	Quasi-peak Detector Limit (dBµV)	Quasi-peak Detector Margin (dB)	Quasi-peak Detector 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



Mains, Phase 9.3.2

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)							ge: 2	of 2
EU	EUT Line Voltage:		120	VAC	EUT Line Frequency:		ncy:	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



10.0 Equipment

10.1 Spurious Radiated Emissions 30 MHz to 25 GHz

		Profes	sional Testing, EMI, Inc.		
Гest Metho	a: Electi	C63.4–2003: "Metl	nods of Measurement of Radio-Noise Equipment in the Range of 9 kHz to	40 GHz" (incorpora	ated by referen
n accordan		art 15.109 - Code of ted Emissions Limited	of Federal Regulations Part 47, Subpa	art B - Unintention	al Radiators,
ection:	15.10				
est Date(s		1600019			
Customer: Project Nun	Plum nber: 15398		EUT Part #: Test Technician:	0 Eric Lifsey	
Purchase O		5-15	Supervisor:	Lisa Arndt	
quip. Und	er Test: Light	Pad Dimmer	Witness' Name:	Russ	
		Radiate	d Emissions Test Equipment List		
Til	le! Software Version		May 23, 2010, 08:38:52 AM		
	Test Profile:	Radia	ted Emissions_Profile Version Octob	er 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

		Profes	sional Testing, EMI, Inc.		
Test Metho	d: Electr		ods of Measurement of Radio-Noise Equipment in the Range of 9 kHz t		J
In accordan	ice with:	art 15.107 - Code o ucted Emissions Li	of Federal Regulations Part 47, Subprits	oart B - Unintention	al Radiators,
Section:	15.10	7			
Test Date(s): 7/10/	2015	EUT Serial #:	NA	
Customer:	Plum		EUT Part #:	NA	
Project Nur	nber: 15398	3-15	Test Technician:	Eric Lifsey	
Purchase O	rder #: NA		Supervisor:	Lisa Arndt	
Equip. Und	er Test: Light	Pad Dimmer	Witness' Name:	Russ	
		Conduct	ed Emissions Test Equipment List		
Ti	le! Software Version	on: 4.1.A.	0, April 14, 2009, 11:01:00PM		
	Test Profile:	Profil	e#: CE_2014_R3.TIL, dated May 1, 2	014	
Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1842	НР	8568B	Spectrum Analyzer	2732A03633	10/1/2015
2113	НР	85662A	Spec Anal Dsply for A/N 1842	2403A07470	N/A
0990	НР	85685A	RF Preselector	3010A01119	9/30/2016
1281	НР	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 Cab		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	НР	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
Radiated Ellissions	1 to 18 GHz	3 m	5.7

End of Report

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