



Test Report

Prepared for: **Centralite Systems**

Model: **3141-C**

Description: **Smart Dimmer Switch**

Serial Number: **N/A**

FCC ID: **T3L-SS040**
IC: **12192A-SS040**

To

FCC Part **15.247 DTS**

And

IC **RSS-247**

Date of Issue: **May 11, 2017**

On the behalf of the applicant:

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Attention of:

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Project No: **p1740001**

Alex Macon
Project Test Engineer

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Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	April 12, 2017	Alex Macon	Original Document
2.0	May 11, 2017	Alex Macon	Added details to PSD test procedure on page 20



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ILAC / A2LA

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The tests results contained within this test report all fall within our scope of accreditation, unless noted below.

Please refer to <http://www.compliancetesting.com/labscope.html> for current scope of accreditation.

Testing Certificate Number: **2152.01**



FCC Site Reg. #349717

IC Site Reg. #2044A-2

Non-accredited tests contained in this report:

N/A

The applicant has been cautioned as to the following

15.21 - Information to User

The user's manual or instruction manual for an intentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

15.27(a) - Special Accessories

Equipment marked to a consumer must be capable of complying with the necessary regulations in the configuration in which the equipment is marketed. Where special accessories, such as shielded cables and/or special connectors are required to enable an unintentional or intentional radiator to comply with the emission limits in this part, the equipment must be marketed with, i.e. shipped and sold with, those special accessories. However, in lieu of shipping or packaging the special accessories with the unintentional or intentional radiator, the responsible party may employ other methods of ensuring that the special accessories are provided to the consumer without an additional charge.

Information detailing any alternative method used to supply the special accessories for a grant of equipment authorization or retained in the verification records, as appropriate. The party responsible for the equipment, as detailed in § 2.909 of this chapter, shall ensure that these special accessories are provided with the equipment. The instruction manual for such devices shall include appropriate instructions on the first page of text concerned with the installation of the device that these special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.



Standard Test Conditions Engineering Practices

Except as noted herein, the following conditions and procedures were observed during the testing:

In accordance with ANSI C63.10-2013 and unless otherwise indicated in the specific measurement results, the ambient temperature of the actual EUT was maintained within the range of 10° to 40°C (50° to 104°F) unless the particular equipment requirements specified testing over a different temperature range. Also, unless otherwise indicated, the humidity levels were in the range of 10% to 90% relative humidity.

Measurement results, unless otherwise noted, are worst-case measurements.

Environmental Conditions		
Temperature (°C)	Humidity (%)	Pressure (mbar)
24.4	26.8	966.2

EUT Description

Model: 3141-C

Description: Smart Dimmer Switch

Firmware: N/A

Software: N/A

Serial Number: N/A

Additional Information:

The EUT is a wall mounted switched intended to control lighting in a residential environment. It incorporates a 2.4 GHz radio which spans from 2405MHz – 2480MHz with an emissions designator 2M52F7D

EUT Operation during Tests

The EUT was placed in a test mode using manufacturer provided software. The test modes enabled the device to transmit continuously with CW or modulated signals.



Accessories:

Qty	Description	Manufacturer	Model	S/N
1	Communication Unit	Silicon Labs	ISA3	N/A

Cables:

Qty	Description	Length (M)	Shielding Y/N	Shielded Hood Y/N	Ferrite Y/N
1	Ten Pin Cable	<3m	N	N	N

Modifications: None

15.203: Antenna Requirement:

- The antenna is permanently attached to the EUT
- The antenna uses a unique coupling
- The EUT must be professionally installed
- The antenna requirement does not apply



Test Results Summary

Specification	Test Name	Pass, Fail, N/A	Comments
15.247(b)	Peak Output Power	Pass	
15.247(d)	Conducted Spurious Emissions	N/A	The EUT incorporates an integral antenna
15.247(d), 15.209(a), 15.205	Radiated Spurious Emissions	Pass	
15.247(d), 15.209(a), 15.205	Emissions At Band Edges	Pass	
15.247(a)(2)	Occupied Bandwidth	Pass	
15.247(e)	Transmitter Power Spectral Density	Pass	
15.207	A/C Powerline Conducted Emissions	Pass	

Peak Output Power

Engineer: Alex Macon

Test Date: 4/12/17

Test Procedure

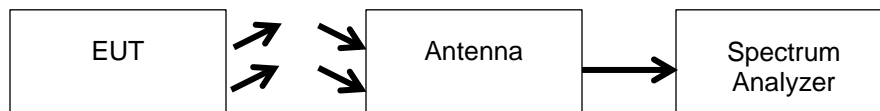
The EUT was tested in a semi-anechoic test chamber set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Peak Output Power. The EUT was tested by rotating it 360° with the antennas in both the vertical and horizontal orientation and was raised from 1 to 4 meters to ensure the TX signal levels were maximized.

The following equations were used to determine the EIRP from the field strength values.

$E[\text{dB}\mu\text{V}/\text{m}] = \text{EIRP}[\text{dBm}] - 20 \log(d[\text{meters}]) + 104.77$, where E = field strength and d = 3m

$E[\text{dB}\mu\text{V}/\text{m}] = \text{EIRP}[\text{dBm}] + 95.2$, for d = 3 meters.

Test Setup



Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Value (dBm)	Specification Limit	Result
2405	3.65	1 W (30 dBm)	Pass
2440	3.04	1 W (30 dBm)	Pass
2480	-19.30	1 W (30 dBm)	Pass



Radiated Spurious Emission 15.247(d)

Engineer: Alex Macon

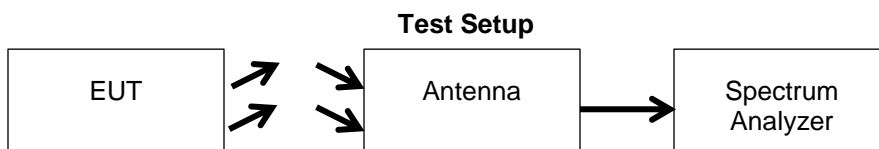
Test Date: 4/12/17

Test Procedure

The EUT was tested in a semi-anechoic test chamber set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Spurious. The EUT was tested by rotating it 360° with the antennas in both the vertical and horizontal orientation and was raised from 1 to 4 meters to ensure the TX signal levels were maximized.

All emissions from 30 MHz to 25 GHz were examined., Only the plots below measured emissions. Measured Level includes antenna and receiver cable correction factors. Correction factors were input into the spectrum analyzer before recording “Measured Level”.

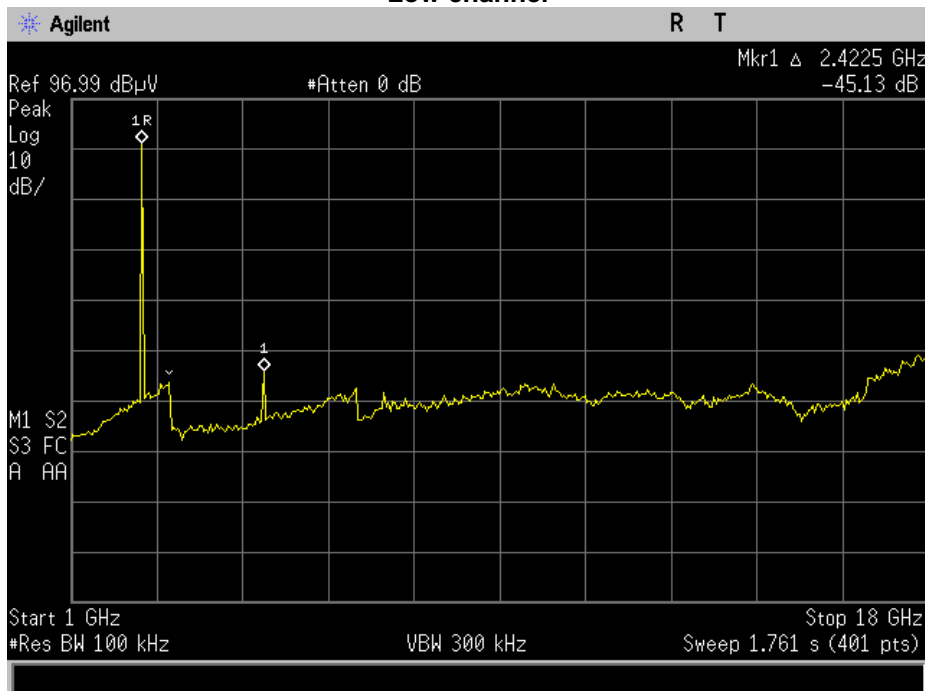
RBW = 100 KHz
VBW = 300 KHz
Detector –Peak



Conducted Spurious Emissions Summary Test Table

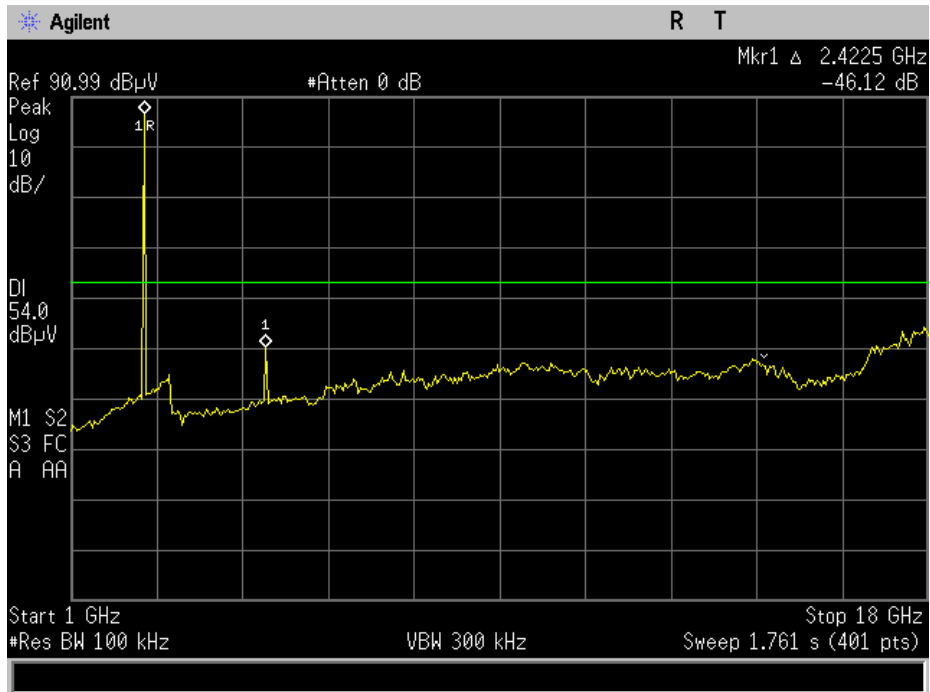
Tuned Frequency (MHz)	Emission Frequency (MHz)	Measurement (dBc)	Specification Limit (dBc)	Result
2405	4810	-45.13	-20	Pass
2440	4880	-46.12	-20	Pass
2480	14550	-26.38	-20	Pass

Low channel

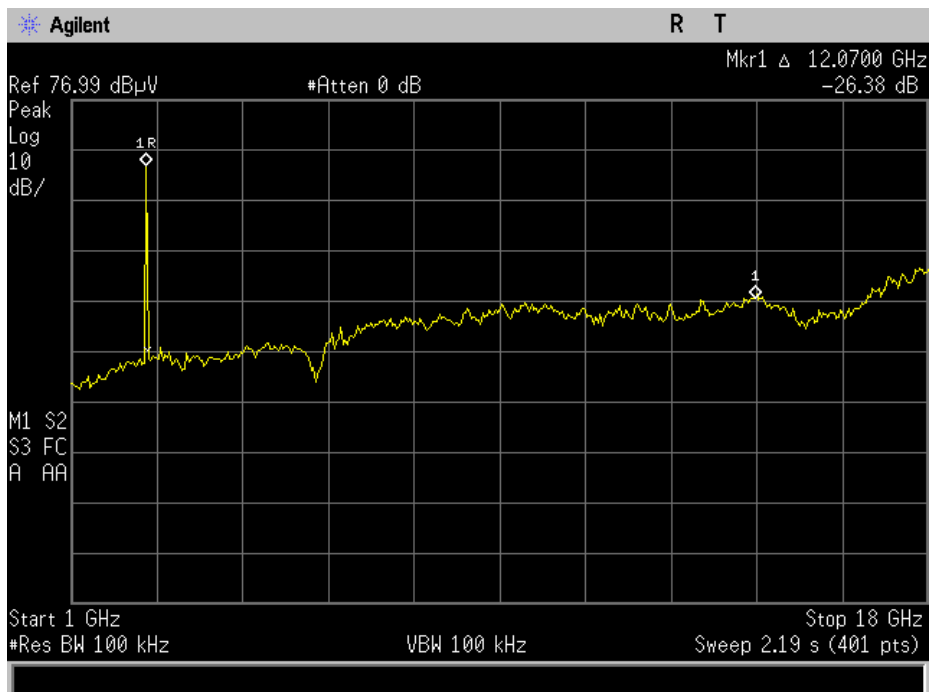




Mid Channel



High Channel





Radiated Spurious Emissions

Engineer: Alex Macon

Test Date: 4/12/17

Test Procedure Radiated Spurious Emissions: 30 – 1000 MHz

The EUT was tested in a semi-anechoic test chamber set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. The EUT was tested by rotating it 360° with the antennas in both the vertical and horizontal orientation and was raised from 1 to 4 meters to ensure the TX signal levels were maximized.

All emissions from 30 MHz to 1 GHz were examined.

Measured Level includes antenna and receiver cable correction factors.

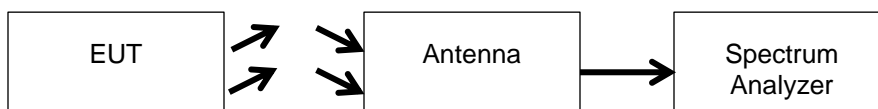
Correction factors were input into the spectrum analyzer before recording “Measured Level”.

RBW = 100 KHz

VBW = 300 KHz

Detector –Peak

Test Setup



See Annex A for test results

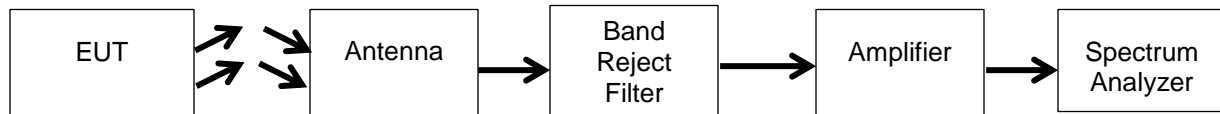


Test Procedure for Radiated Spurious Emissions above 1 GHz

The EUT was tested in a semi anechoic chamber set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Spurious Emissions. The antenna, band reject filter, amplifier and cable correction factors were input into the spectrum analyzer before recording the Measured Level to ensure accurate readings. The spectrum for each tuned frequency was examined to the 10th harmonic.

RBW = 1 MHz
VBW \geq 3 MHz
Detector – Peak

Test Setup



See Annex A for test results



Emissions at Band Edges

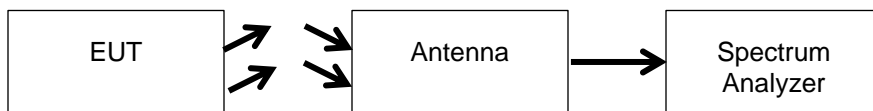
Engineer: Alex Macon

Test Date: 4/12/17

Test Procedure

The EUT was tested in a semi-anechoic chamber set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for band edge and restricted band for both peak and average measurements. The cable and antenna correction factors were input into the analyzer as a reference level offset to ensure accurate readings. For the restricted band the amplifier and band reject filter correction factors were also input to the spectrum analyzer.

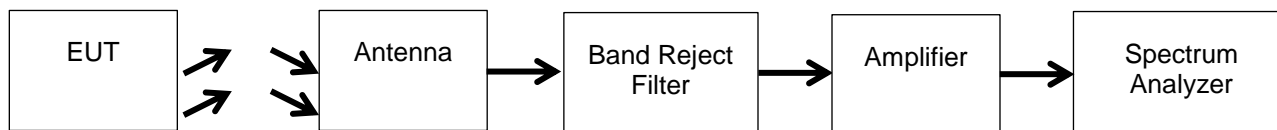
Band Edge Test Setup



Band Edge Emissions Summary

Tuned Frequency (MHz)	Emission Frequency (MHz)	Measured Value (dBc)	Detector	Limit (dBc)	Result
2405	2399.73	-42.52	Peak	-20 dBc	Pass
2480	2483.6	-31.25	Peak	-20dBc	Pass

Restricted Band Test Setup



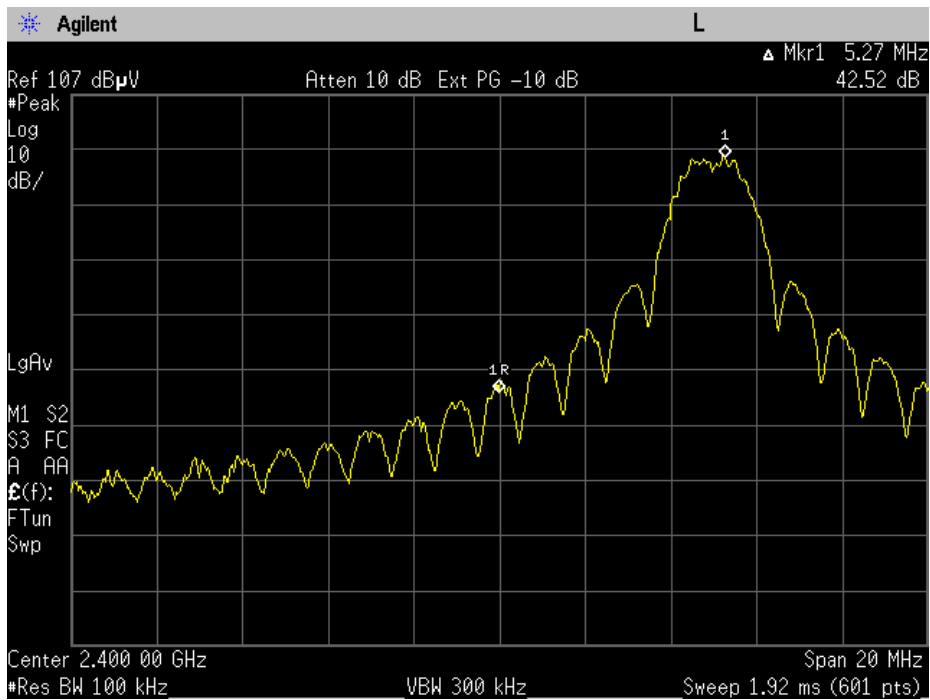
Restricted Band Emissions Summary

Restricted Band (MHz)	Tuned Frequency (MHz)	Emission Frequency (MHz)	Measured Value (dBuV/m)	Detector	Limit (dBuV/m)	Result
2300 – 2390	2405	2390	46.12	Peak	74	Pass
2300 – 2390	2405	2390	46.12	Peak	54	Pass
2483.5 - 2500	2480	2483.5	49.11	Peak	74	Pass
2483.5 - 2500	2480	2483.5	49.11	Peak	54	Pass

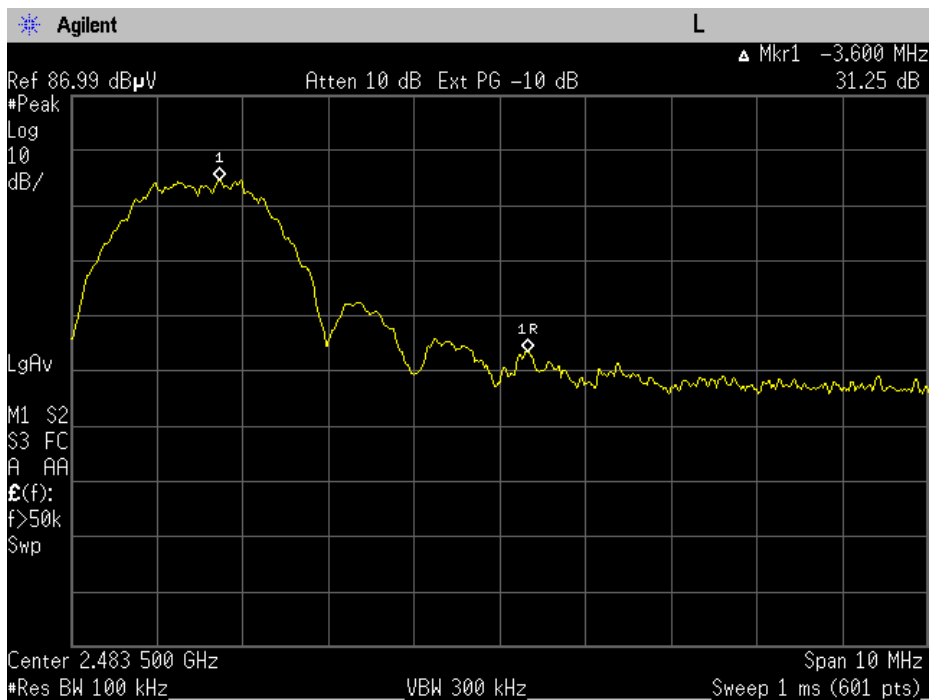
All peak emissions are below the Average limit of 54 dBuV



Band Edge 2400 MHz
Tuned Freq = 2405 MHz

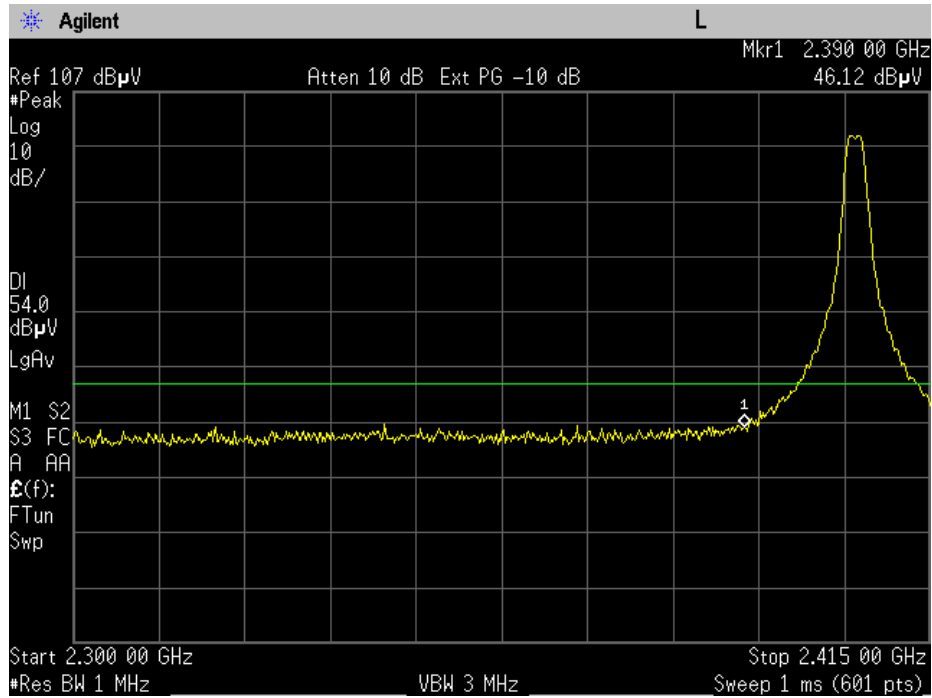


Band Edge 2483.5 MHz
Tuned Freq = 2480 MHz

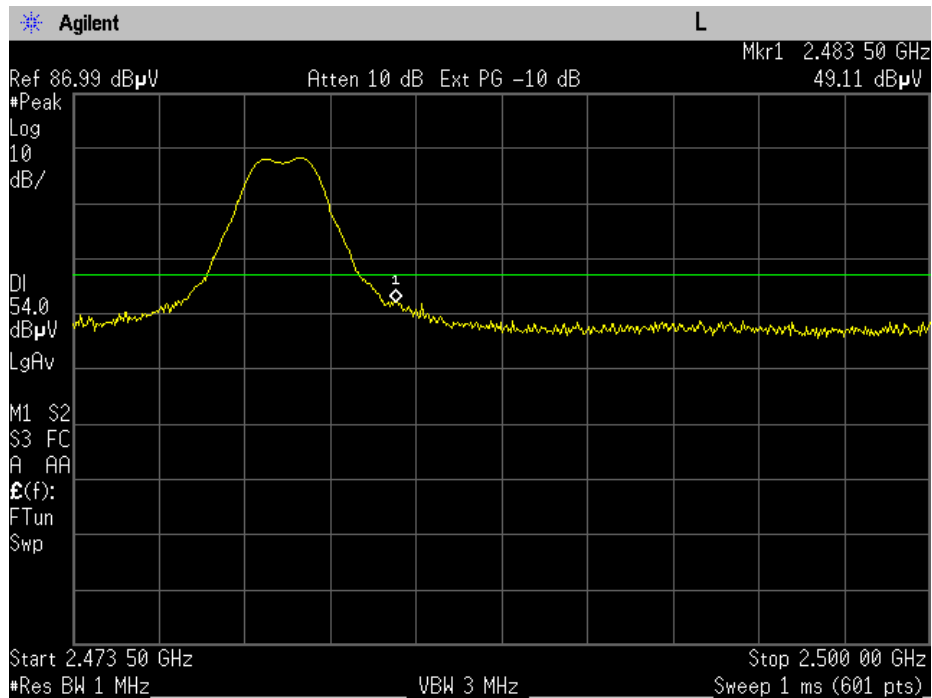




Restricted Band 2300 – 2390 MHz – Peak
Tuned Freq = 2405 MHz



Restricted Band 2483.5 – 2500 MHz – Peak
Tuned Freq = 2480 MHz





Occupied Bandwidth

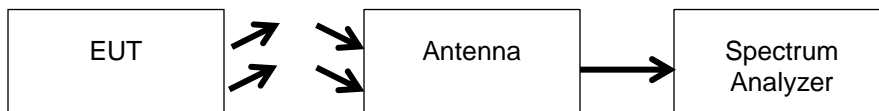
Engineer: Alex Macon

Test Date: 4/12/17

Test Procedure

The EUT was tested in a semi-anechoic chamber set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Occupied Bandwidth. The cable and antenna correction factors were input into the analyzer as a reference level offset to ensure accurate readings.

Test Setup



6 dB Occupied Bandwidth Summary

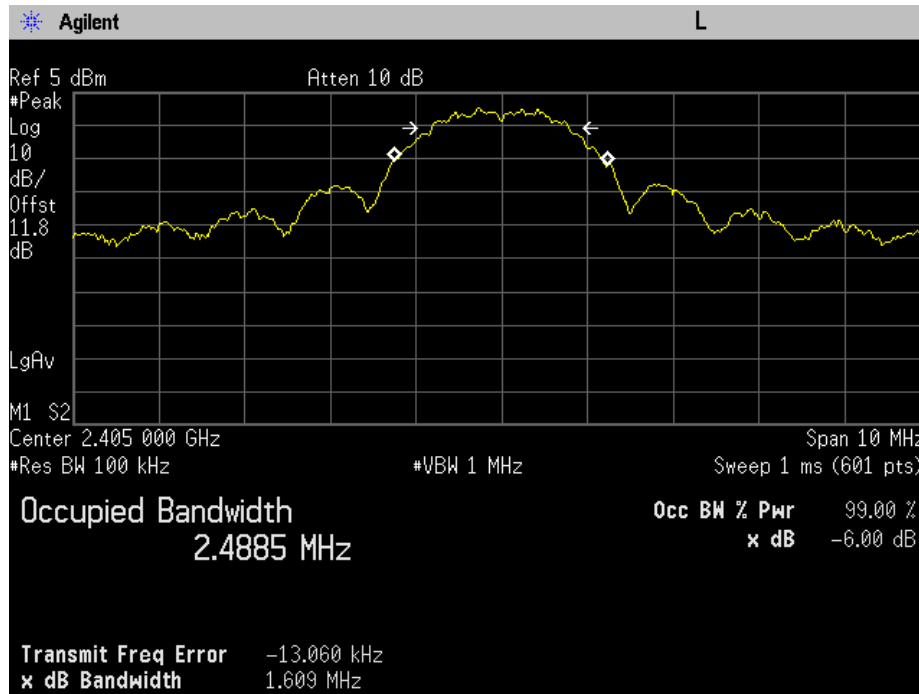
Frequency (MHz)	Measured Bandwidth (MHz)	Specification Limit (kHz)	Result
2405	1.609	≥ 500	Pass
2440	1.622	≥ 500	Pass
2480	1.633	≥ 500	Pass

99% Bandwidth Summary

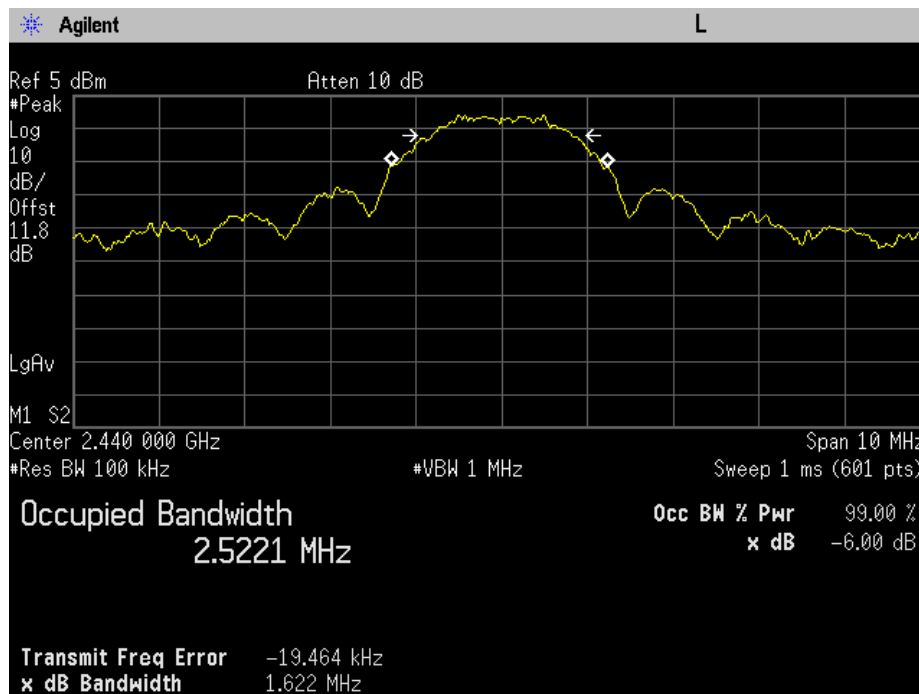
Frequency (MHz)	Measured Bandwidth (MHz)	Result
2405	2.4885	Pass
2440	2.5221	Pass
2480	2.5211	Pass



6dB Bandwidth 2405 MHz

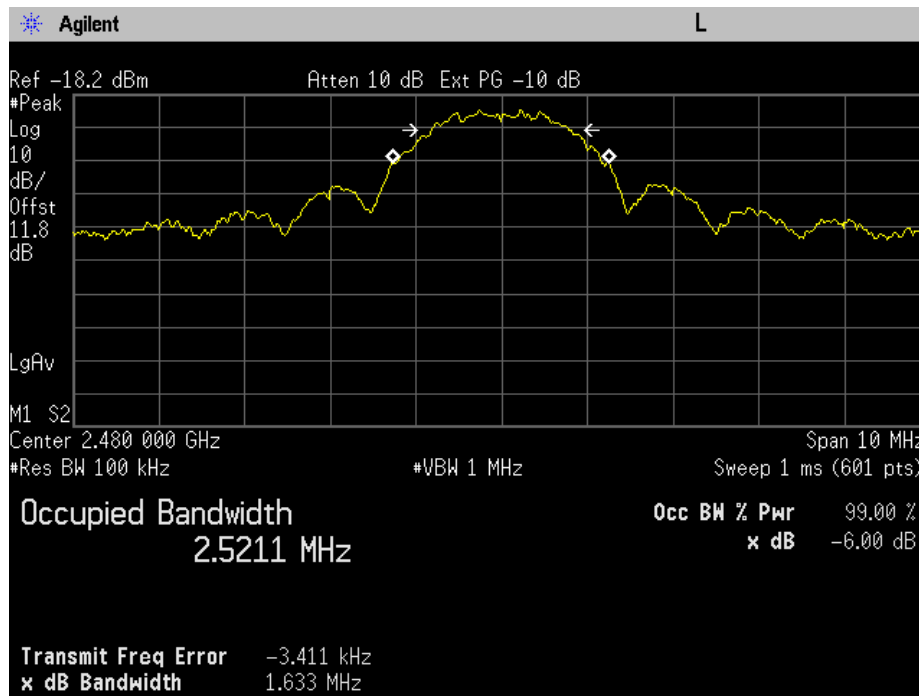


6dB Bandwidth 2440 MHz





6dB Bandwidth 2480 MHz





Transmitter Power Spectral Density (PSD)

Engineer: Alex Macon

Test Date:4/12/17

Test Procedure

The EUT was tested in a semi-anechoic test chamber set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Power Spectral Density. The EUT was tested by rotating it 360° with the antennas in both the vertical and horizontal orientation and was raised from 1 to 4 meters to ensure the TX signal levels were maximized. Method PKPSD Section 10.2 of KDB 558074 was followed to attain test results.

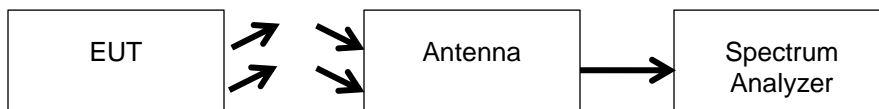
- b) Set the span to 1.5 x DTS bandwidth
- c) Set the RBW to: 3 kHz
- d) Set the VBW 9.1 kHz
- e)Detector = peak.
- f)Sweep time = auto couple.
- g)Trace mode = max hold.
- h)Allow trace to fully stabilize

The following equations were used to determine the EIRP from the field strength values.

$$E[\text{dB}\mu\text{V}/\text{m}] = \text{EIRP}[\text{dBm}] - 20 \log(d[\text{meters}]) + 104.77, \text{ where } E = \text{field strength and } d = 3\text{m}$$

$$E[\text{dB}\mu\text{V}/\text{m}] = \text{EIRP}[\text{dBm}] + 95.2, \text{ for } d = 3 \text{ meters.}$$

Test Setup



PSD Summary

Frequency (MHz)	Measured Data (dBm)	Specification Limit (dBm)	Result
2405	-12.31	8	Pass
2440	-13.74	8	Pass
2480	-37.54	8	Pass



A/C Powerline Conducted Emission

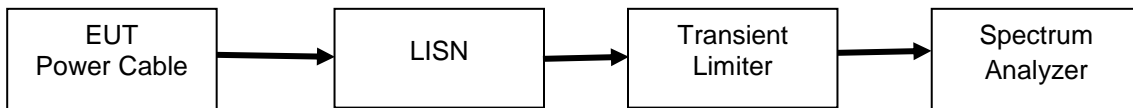
Engineer: Alex Macon

Test Date: 4/12/17

Test Procedure

The EUT power cable was connected to a LISN and the monitored output of the LISN was connected to a transient limiter, which then connected directly to a spectrum analyzer. The conducted emissions from 150 kHz to 30 MHz were measured and compared to the specification limits.

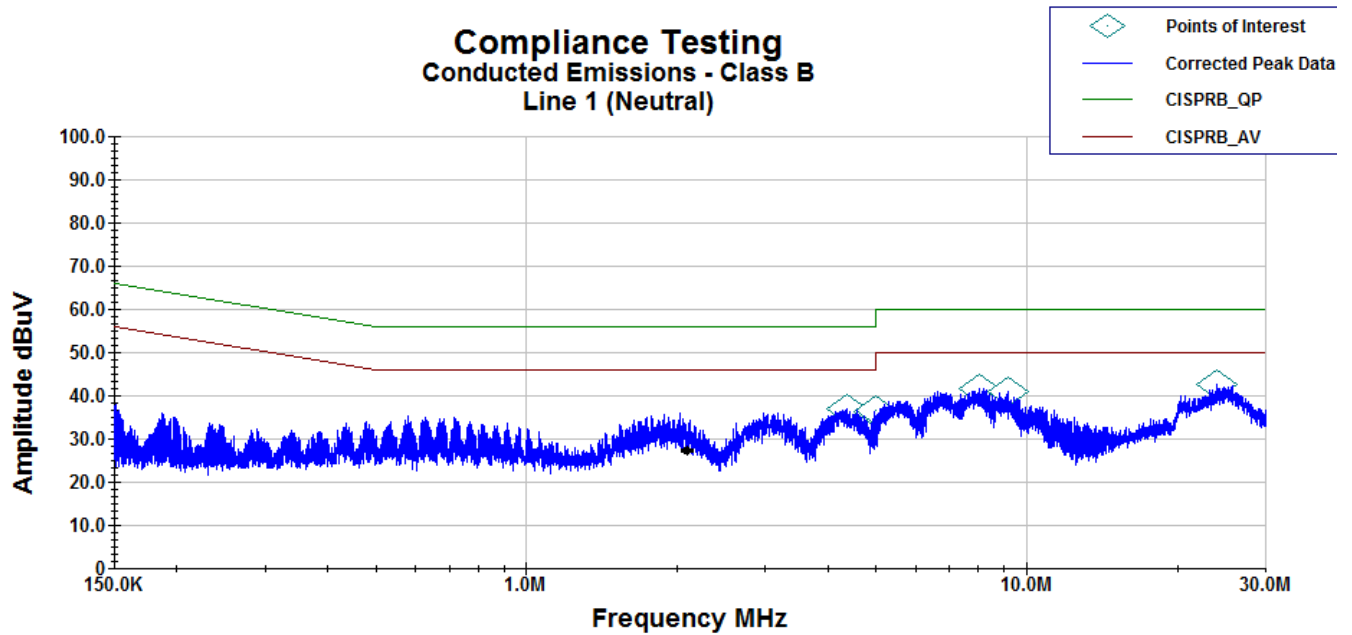
Test Setup





Conducted Emission Test Results

Line 1 Peak Plot

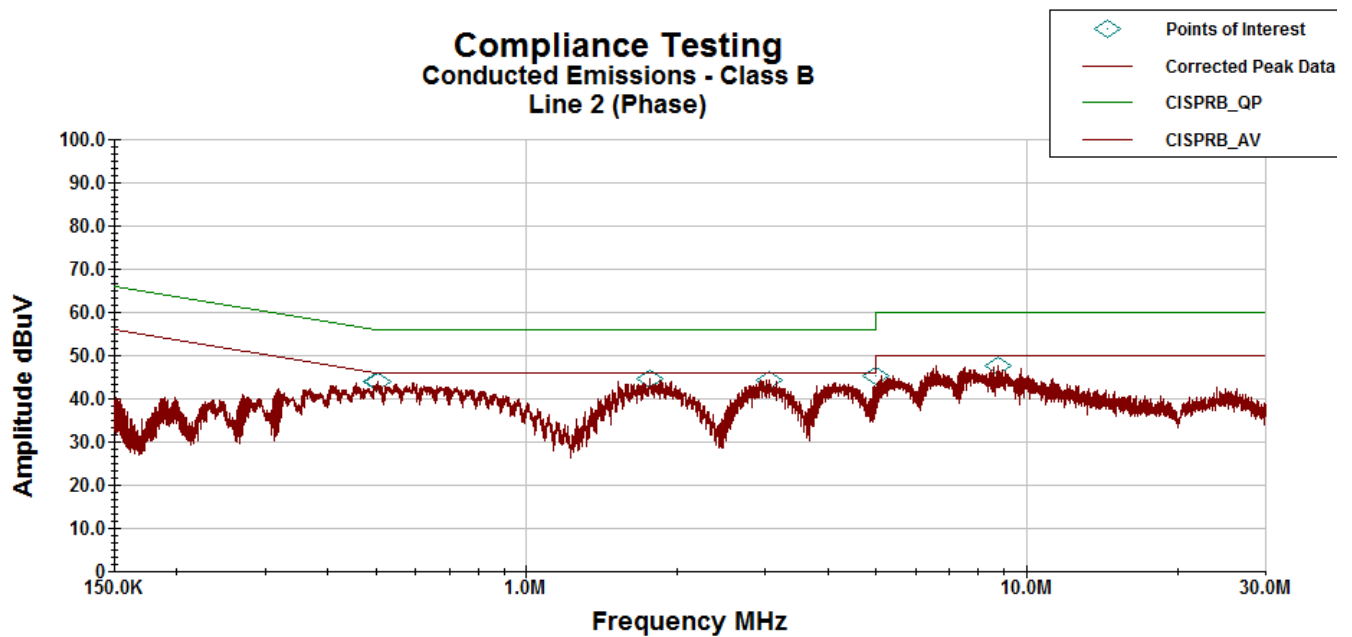


Operator: AM

EN55022 Class B_p1740001.til

Job #: p1740001

Line 2 Peak Plot



Operator: AM

EN55022 Class B_p1740001.til

Job #: p1740001

All peak emissions are below the quasi-peak and average limits



Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
EMI Receiver	HP	8546A	i00033	3/28/17	3/28/18
High Pass Filter	Trilithic	4HX3400-3-XX	i00177	Verified on: 4/12/17	
Horn Antenna	ARA	DRG-118/A	i00271	6/16/16	6/16/18
Horn Antenna, Amplified	ARA	MWH-1826/B	i00273	4/22/15	4/22/18
Humidity / Temp Meter	Newport	IBTHX-W-5	i00282	5/26/16	5/26/17
Voltmeter	Fluke	87III	i00319	4/11/16	4/11/19
Bi-Log Antenna	Schaffner	CBL 6111D	i00349	8/3/16	8/3/18
AC Power Source	Behlman	BL 6000	i00362	Verified on: 4/12/17	
EMI Analyzer	Agilent	E7405A	i00379	2/22/17	2/22/18
3 Meter Semi-Anechoic Chamber	Panashield	3 Meter Semi-Anechoic Chamber	i00428	8/15/16	8/15/19
PSA Spectrum Analyzer	Agilent	E4445A	i00471	8/30/16	8/30/17
Preamplifier	Miteq	AFS44 00101 400 23-10P-44	i00509	N/A	N/A

In addition to the above listed equipment standard RF connectors and cables were utilized in the testing of the described equipment. Prior to testing these components were tested to verify proper operation.

END OF TEST REPORT