



Compliance Testing, LLC

Previously Flom Test Lab

EMI, EMC, RF Testing Experts Since 1963

toll-free: (866) 311-3268

fax: (480) 926-3598

<http://www.ComplianceTesting.com>

info@ComplianceTesting.com

Test Report

Prepared for: Centralite Systems

Model: 3146

Description: Villa 3-Button In-Wall Relay

Serial Number: N/A

FCC ID: T3L-SS041

IC: 12192A-SS041

To

FCC Part 15.247 DTS

And

RSS-247

Date of Issue: July 3, 2017

On the behalf of the applicant:

Centralite Systems
1000 Cody Road South
Mobile, AL 36695

Attention of:

John Calagaz, CTO
Ph: (877)466-5483
Email: johncalagza@centralite.com

Prepared By
Compliance Testing, LLC
1724 S. Nevada Way
Mesa, AZ 85204
(480) 926-3100 phone / (480) 926-3598 fax
www.compliancetesting.com
Project No: p1740018

Poona Saber
Project Test Engineer

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All results contained herein relate only to the sample tested.



Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	May 3, 2017	Poona Saber	Original Document
2.0	June 30, 2017	Poona Saber	Page 14 modification, revised asset date on page 23



Table of Contents

<u>Description</u>	<u>Page</u>
Standard Test Conditions Engineering Practices.....	6
Average Output Power	9
Radiated Spurious Emission 15.247(d).....	10
Radiated Spurious Emissions	12
Emissions at Band Edges	14
Occupied Bandwidth.....	17
Transmitter Power Spectral Density (PSD)	20
Test Equipment Utilized	26

ILAC / A2LA

Compliance Testing, LLC, has been accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to the joint ISO-ILAC-IAF Communiqué dated January 2009).

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: 3146

Description: Villa 3-Button In-Wall Relay

Firmware: N/A

Software: N/A

Serial Number: N/A

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: N/A

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(b)	Conducted Spurious Emissions	N/A	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	
RSS-Gen §7	Receiver Spurious Emission Limits	Pass	



Average Output Power

Engineer: Poona Saber

Test Date: 4/27/16

Test Procedure

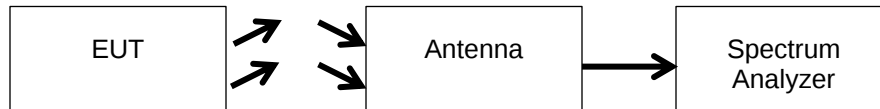
The EUT was tested in a semi-anechoic test chamber set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Peak Output Power. The EUT was tested by rotating it 360° with the antennas in both the vertical and horizontal orientation and was raised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

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

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

Test Setup



Transmitter Average Output Power

Tuned Frequency (MHz)	Measured Value (dBm)	Specification Limit	Result
2405	2.76	1 W (30 dBm)	Pass
2440	3.08	1 W (30 dBm)	Pass
2480	-19.76	1 W (30 dBm)	Pass



Radiated Spurious Emission 15.247(d)

Engineer: Poona Saber

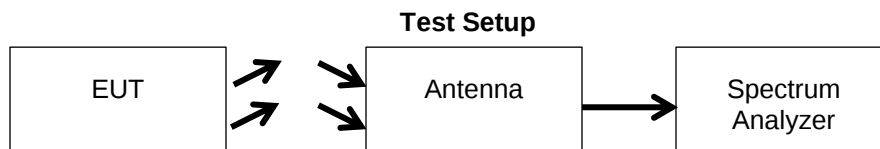
Test Date: 4/28/17

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.

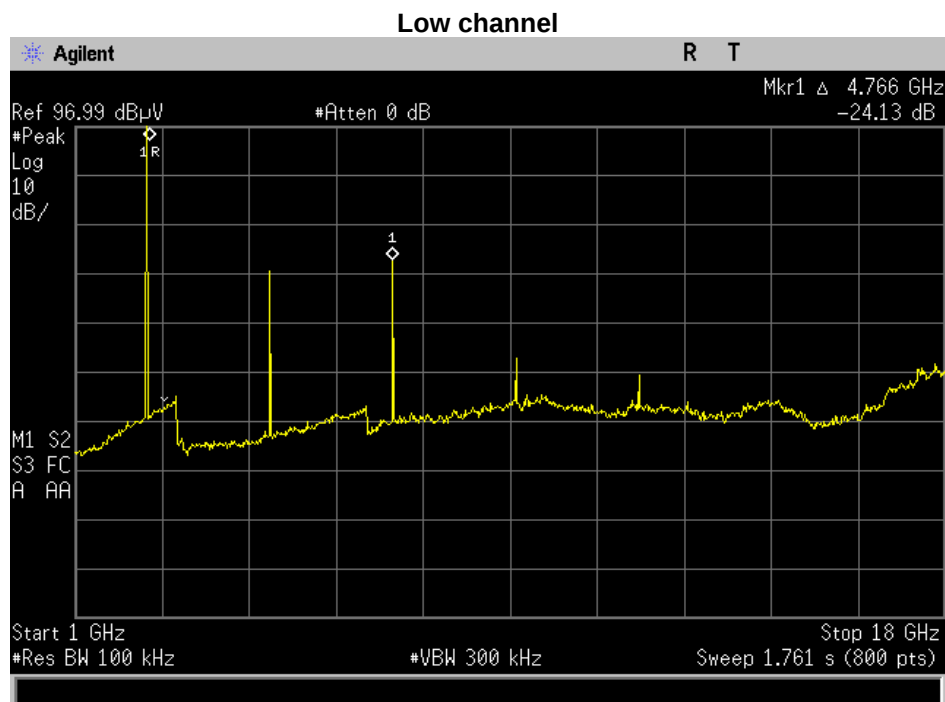
All emissions from 30 MHz to 25 GHz were examined; only the plots below measured emissions. Measured Level includes antenna and receiver cable correction factors. Correction factors were input into the spectrum analyzer before recording "Measured Level".

RBW = 100 KHz
VBW = 300 KHz
Detector –Peak



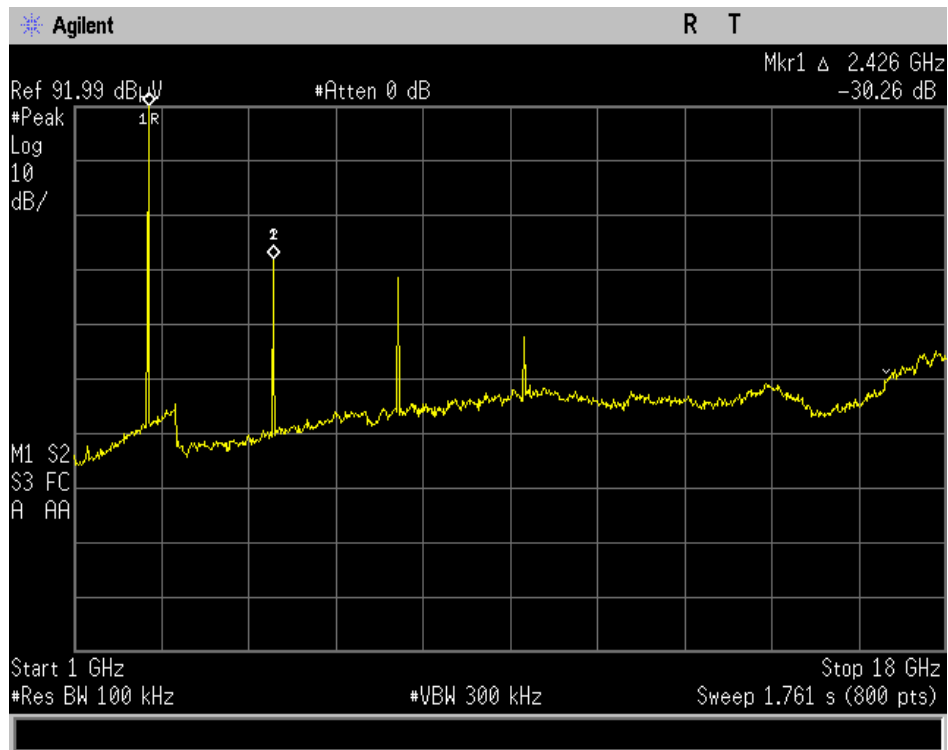
Conducted Spurious Emissions Summary Test Table

Tuned Frequency (MHz)	Emission Frequency (MHz)	Measurement (dBc)	Specification Limit (dBc)	Result
2405	4810	-24.13	-20	Pass
2440	4880	-30.26	-20	Pass
2480	14550	-22.28	-20	Pass

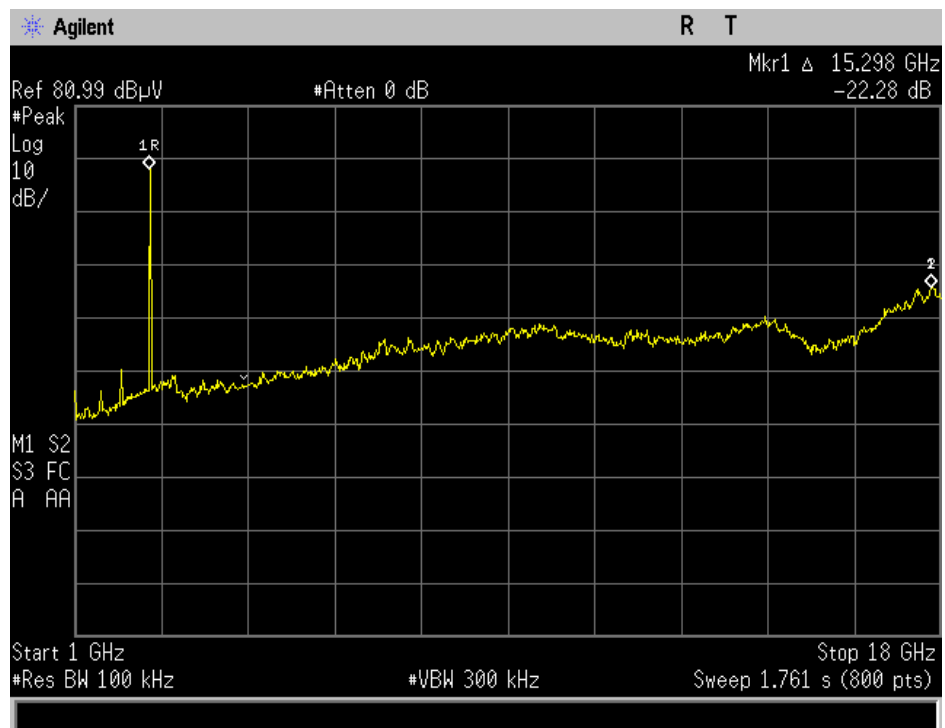




Mid Channel



High Channel





Radiated Spurious Emissions

Engineer: Poona Saber

Test Date: 4/28/17

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.

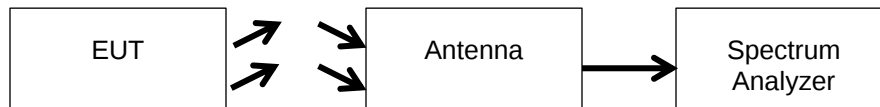
Correction factors were input into the spectrum analyzer before recording “Measured Level”.

RBW = 100 KHz

VBW = 300 KHz

Detector –Peak

Test Setup



See Annex A for test results

Note: For the emissions below 150 MHz further investigation was done. Device was put on standby mode to make sure the emission observed are not coming from the radio portion. Below are the testing results below 1GHz; shows compliance with the 15.209/109 limit.

Frequency	Measured Level	Limit	Margin	Antenna Height	Antenna Polarity	Turntable Position	Detector
MHz	dBuV	dBuV	dB	cm	H vor V	degrees	QP, Pk, Av
45.34	37.76	40	-2.24	100	H	51	QP
144.8	43.2	43.5	-0.3	100	H	100	QP
125.1	39.96	43.5	-3.54	100	H	207	QP
147.34	42.56	43.5	-0.94	100	H	95	QP
140.54	41.3	43.5	-2.2	100	H	78	QP
500.11	40.67	46	-5.33	100	V	254	QP

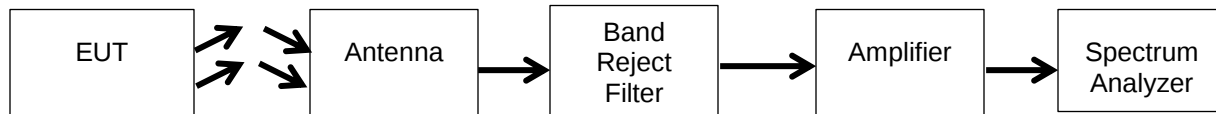


Test Procedure for Radiated Spurious Emissions above 1 GHz

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

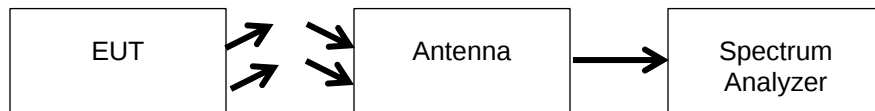
Engineer: Poona Saber

Test Date: 4/28/17

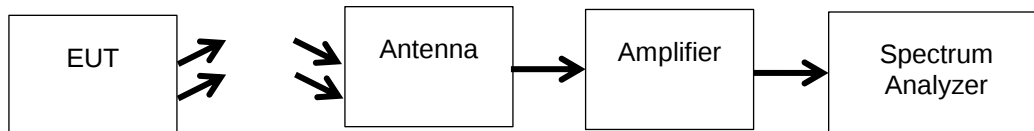
Test Procedure

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

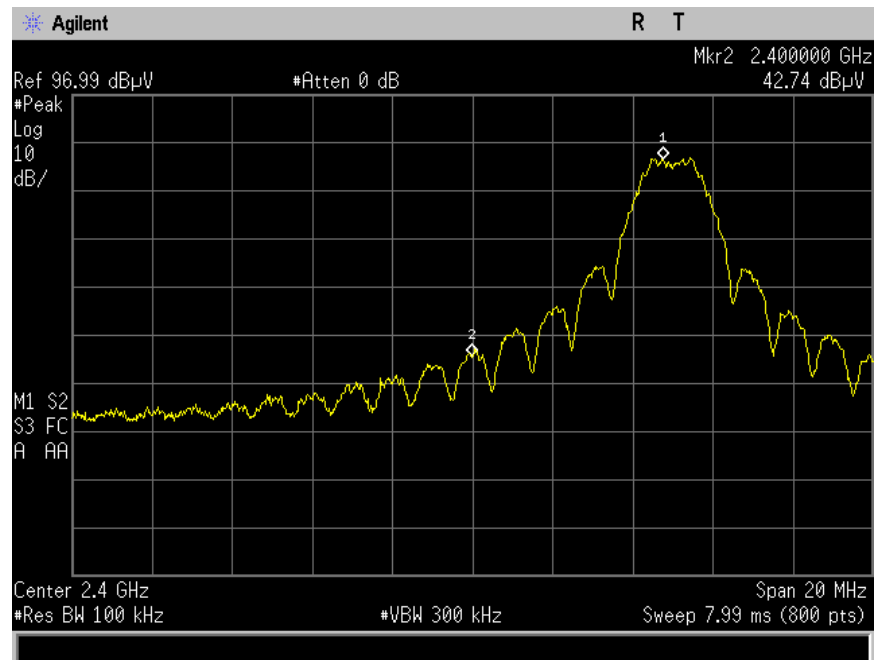


Restricted Band Test Setup

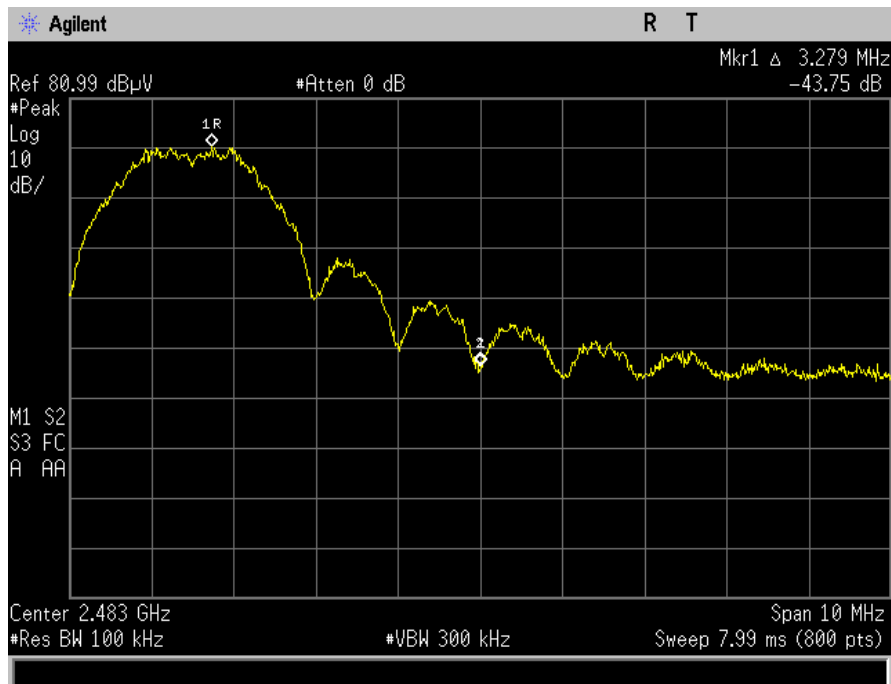




Band Edge 2400 MHz
Tuned Freq = 2405 MHz

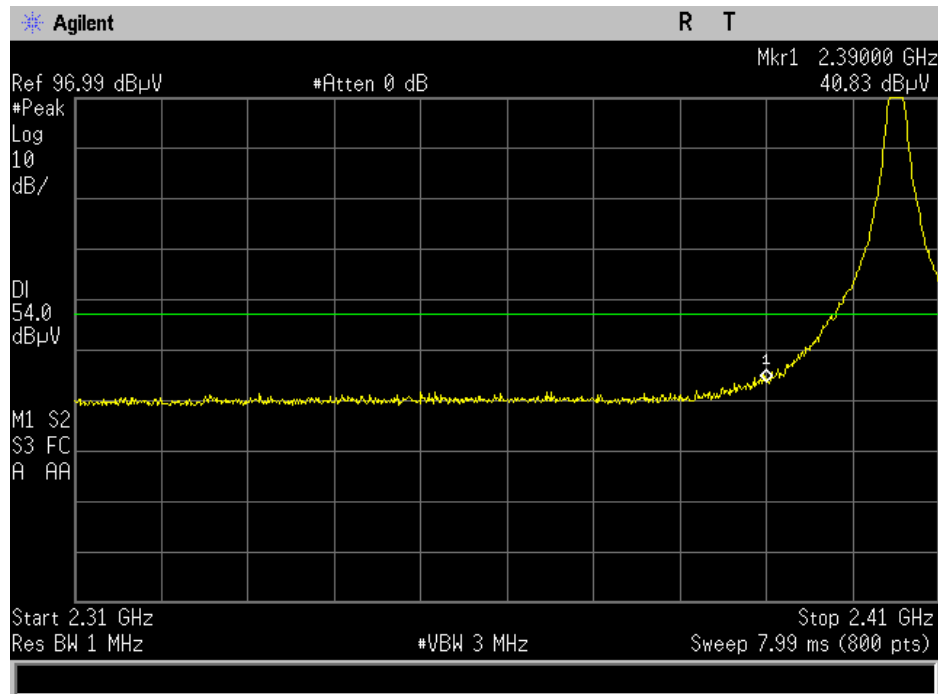


Band Edge 2483.5 MHz
Tuned Freq = 2480 MHz

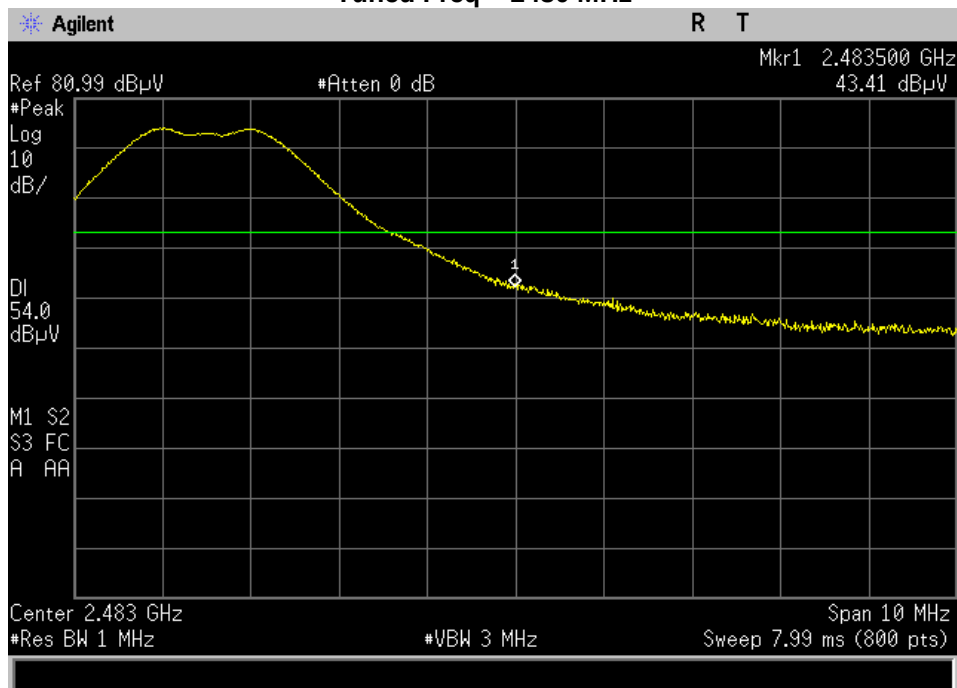




Restricted Band 2300 – 2390 MHz – Peak
Tuned Freq = 2405 MHz



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





Occupied Bandwidth

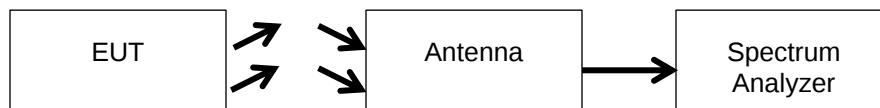
Engineer: Poona Saber

Test Date: 4/28/2017

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

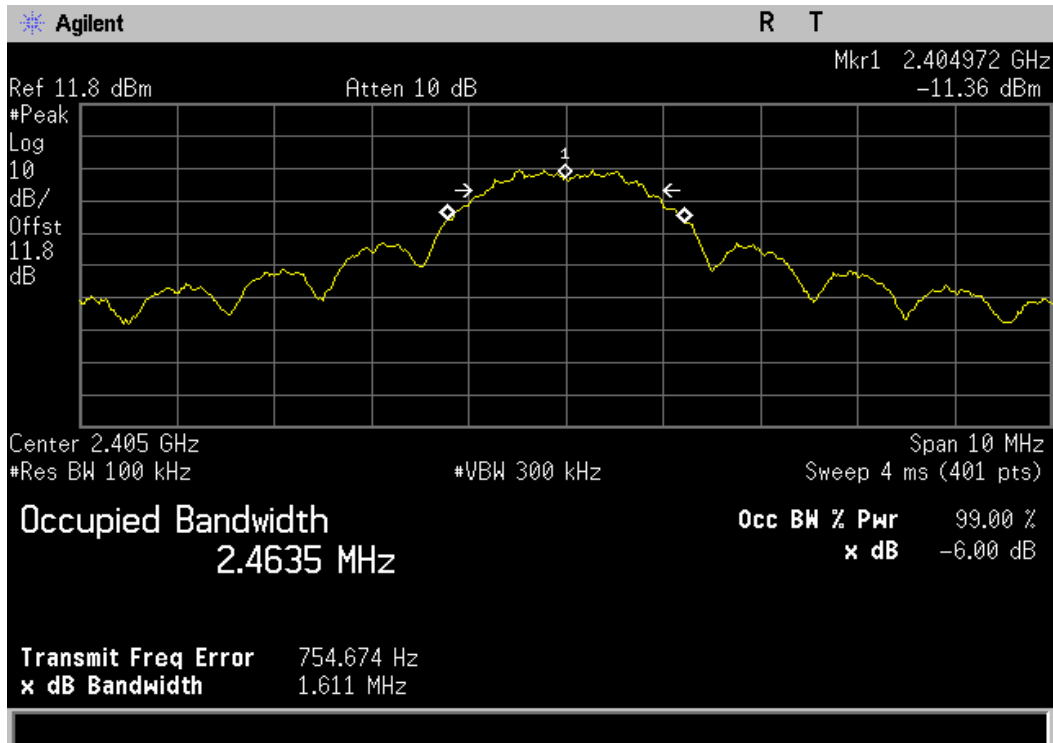
Frequency (MHz)	Measured Bandwidth (MHz)	Specification Limit (kHz)	Result
2405	1.61	≥ 500	Pass
2440	1.57	≥ 500	Pass
2480	1.60	≥ 500	Pass

99% Bandwidth Summary

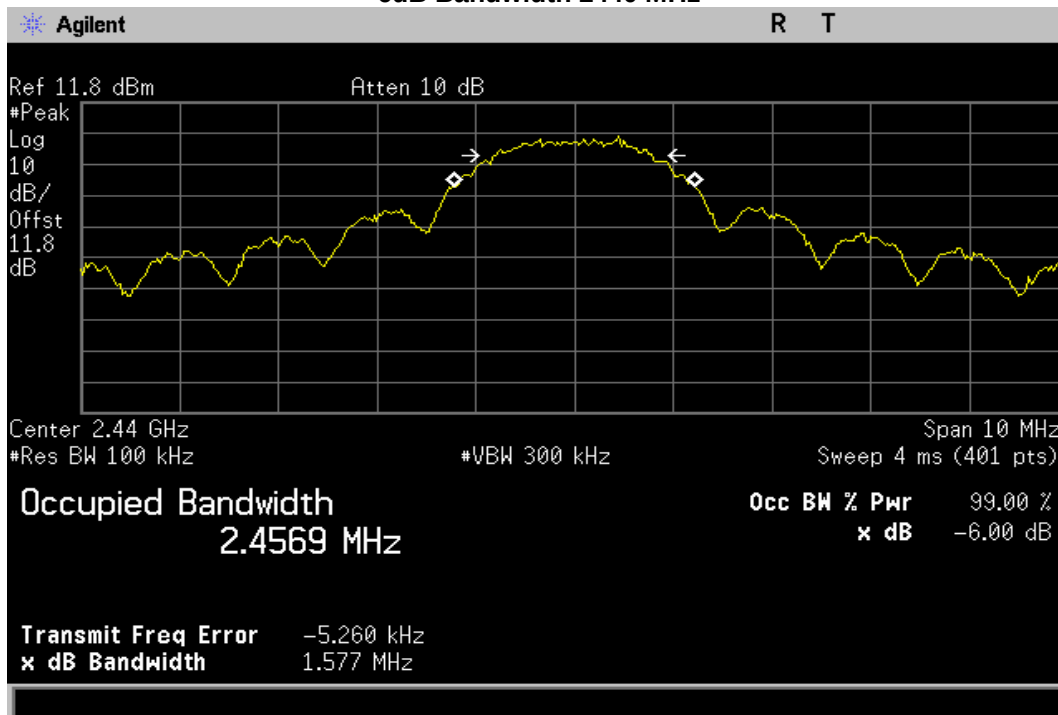
Frequency (MHz)	Measured Bandwidth (MHz)	Result
2405	2.46	Pass
2440	2.45	Pass
2480	2.57	Pass



6dB Bandwidth 2405 MHz

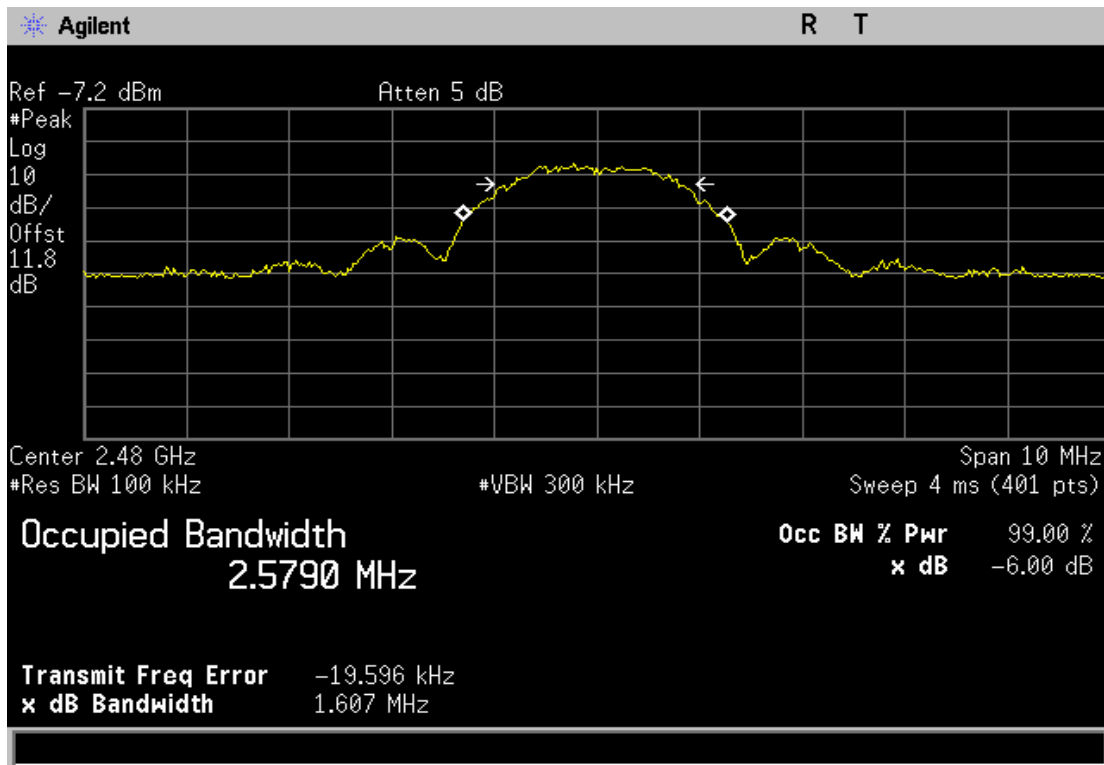


6dB Bandwidth 2440 MHz





6dB Bandwidth 2480 MHz





Transmitter Power Spectral Density (PSD)

Engineer: Poona Saber

Test Date: 4/28/17

Test Procedure

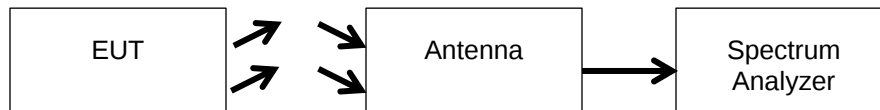
The EUT was tested in a semi-anechoic test chamber set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Power Spectral Density. The EUT was tested by rotating it 360° with the antennas in both the vertical and horizontal orientation and was raised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

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

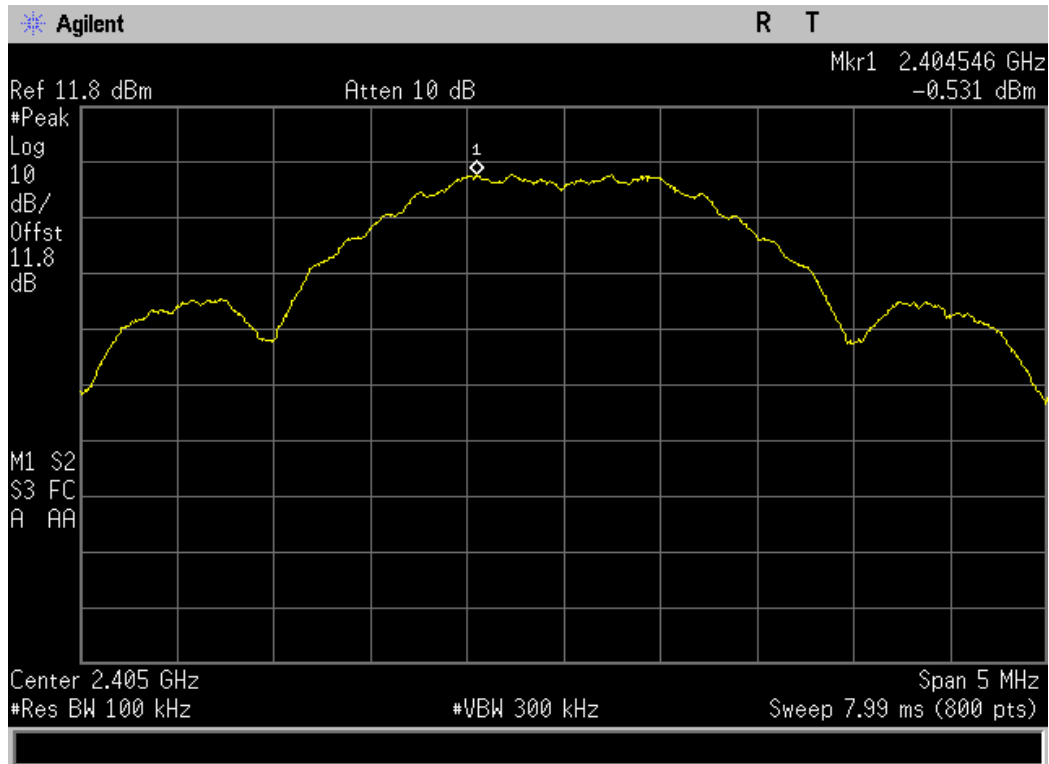


PSD Summary

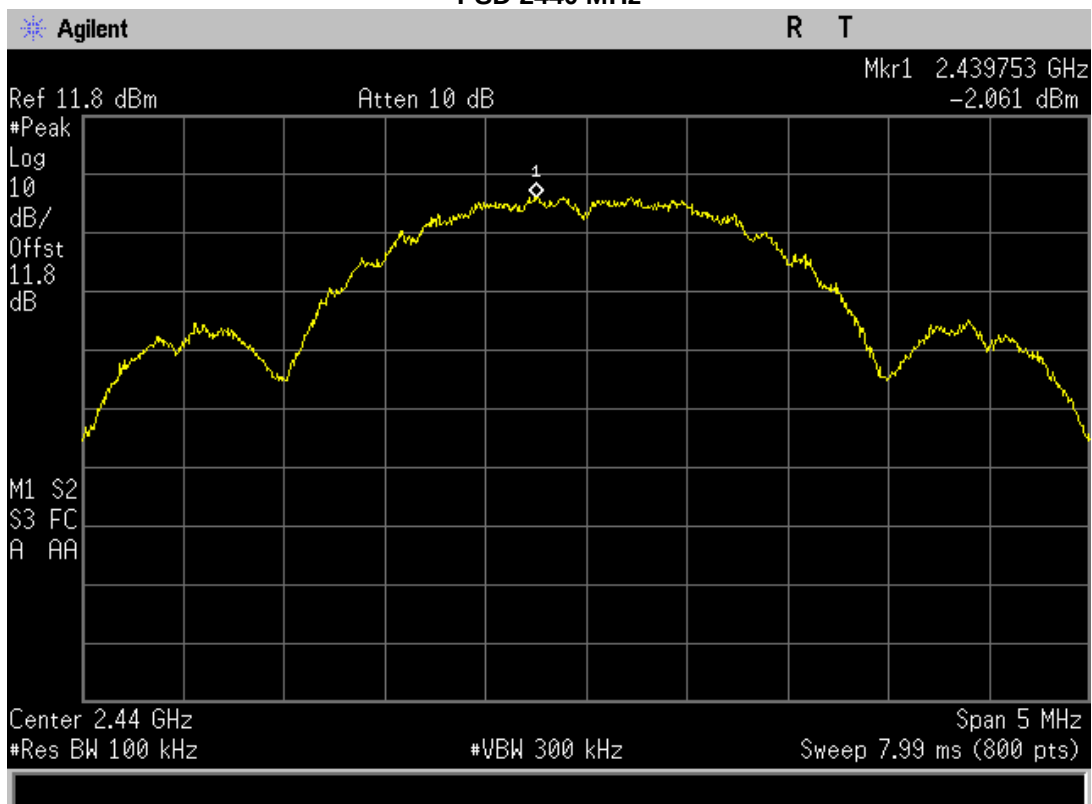
Frequency (MHz)	Measured Data (dBm)	Specification Limit (dBm)	Result
2405	-0.53	8	Pass
2440	-2.06	8	Pass
2480	-23.67	8	Pass

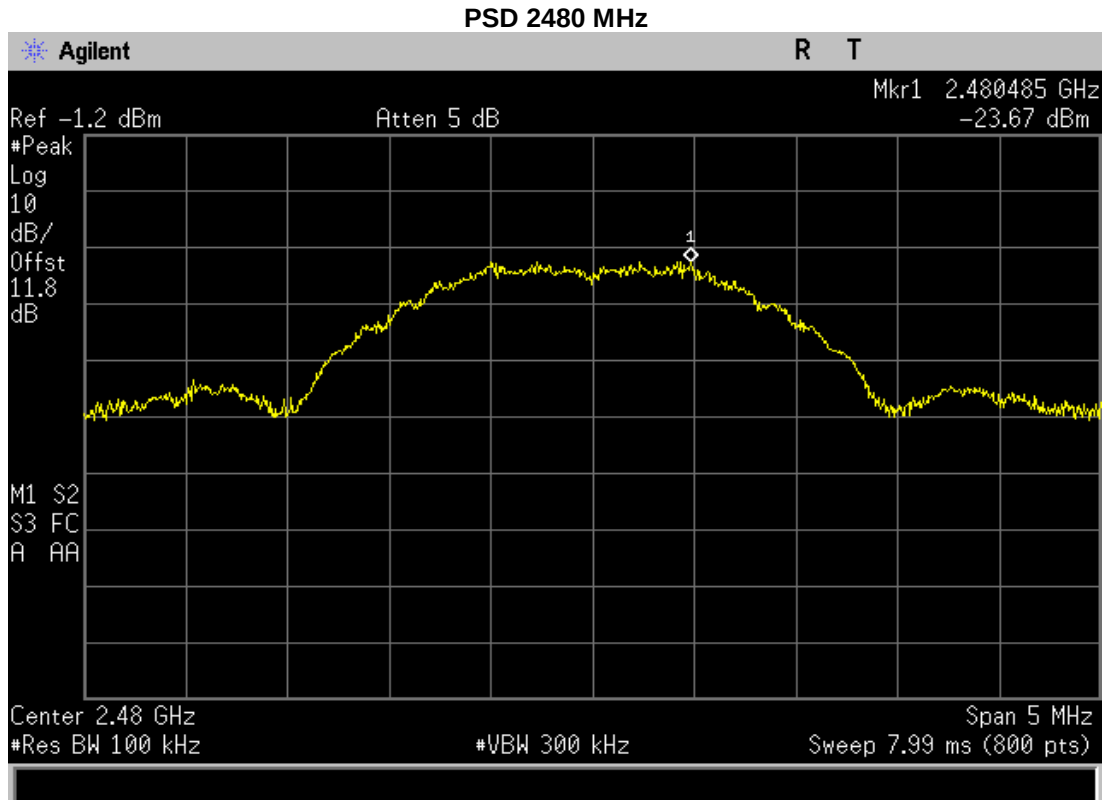


PSD 2405 MHz



PSD 2440 MHz







A/C Powerline Conducted Emission

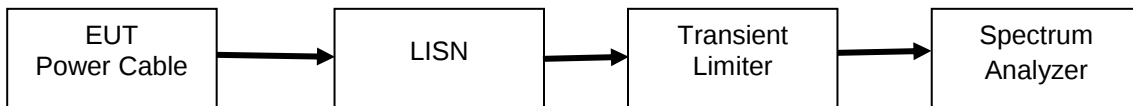
Engineer: Poona Saber

Test Date: 4/28/17

Test Procedure

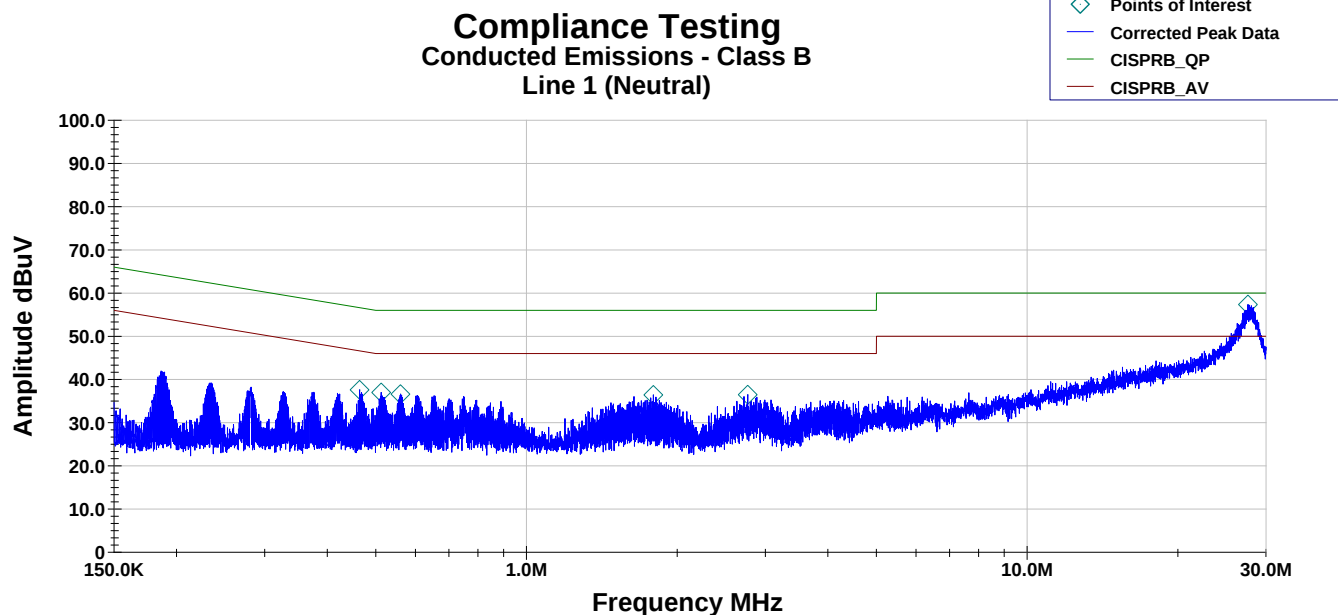
The EUT power cable was connected to a LISN and the monitored output of the LISN was connected to a transient limiter, which then connected directly to a spectrum analyzer. The conducted emissions from 150 kHz to 30 MHz were measured and compared to the specification limits.

Test Setup



Conducted Emission Test Results

Line 1 Peak Plot



Operator: PH

EN55022 Class B_85462 EMI Rec_V7_ACTIVE.til

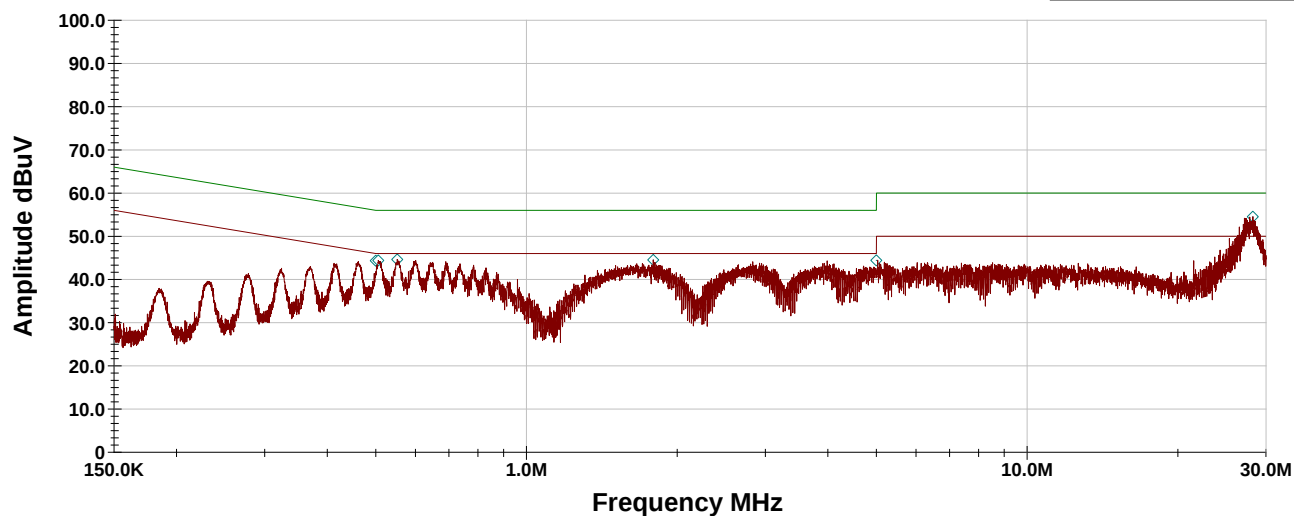
Job #:



Line 2 Peak Plot

Compliance Testing
Conducted Emissions - Class B
Line 2 (Phase)

- ◆ Points of Interest
- Corrected Peak Data
- CISPRB_QP
- CISPRB_AV



Operator: PH

EN55022 Class B_85462 EMI Rec_V7_ACTIVE.til

Job #:



Line 1 Neutral Avg Detector

Frequency	Measured Value (dBuV)	LISN Correction Factor (dB)	Cable Loss (dB)	Transient Limiter (dB)	Final Data (dBuV)	Limit (dBuV)	Avg Margin (dB)
466.83 KHz	9.08	0.1	0.03	10.1	19.307	46.948	-27.641
512.05 KHz	9.06	0.1	0.03	10.1	19.293	46	-26.707
560.29 KHz	8.15	0.1	0.03	10.1	18.377	46	-27.623
1.7959 MHz	7.61	0	0.06	10.1	17.77	46	-28.23
2.7656 MHz	11.51	0	0.07	10.1	21.683	46	-24.317
27.597 MHz	36.2	0.2	0.25	10.4	47.046	50	-2.954

Line 2 Phase Avg Detector

Frequency	Measured Value (dBuV)	LISN Correction Factor (dB)	Cable Loss (dB)	Transient Limiter (dB)	Final Data (dBuV)	Limit (dBuV)	Avg Margin (dB)
504.7 KHz	29.68	0.1	0.03	10.1	39.913	46	-6.087
506.86 KHz	30.34	0.1	0.03	10.1	40.567	46	-5.433
551.99 KHz	29.99	0.1	0.03	10.1	40.223	46	-5.777
1.7908 MHz	24.03	0	0.06	10.1	34.19	46	-11.81
4.9864 MHz	23.04	0	0.1	10.2	33.337	46	-12.663
28.233 MHz	33.38	0.2	0.252	10.4	44.235	50	-5.765

Line 1 Neutral QP Detector

Frequency	Measured Value (dBuV)	LISN Correction Factor (dB)	Cable Loss (dB)	Transient Limiter (dB)	Final Data (dBuV)	Limit (dBuV)	QP Margin (dB)
466.83 KHz	24.1	0.1	0.03	10.1	34.33	56.948	-22.618
512.05 KHz	23.91	0.1	0.03	10.1	34.14	56	-21.86
560.29 KHz	22.88	0.1	0.03	10.1	33.11	56	-22.89
1.7959 MHz	19.19	0	0.06	10.1	29.35	56	-26.65
2.7656 MHz	19.72	0	0.07	10.1	29.89	56	-26.11
27.597 MHz	42.11	0.2	0.25	10.4	52.96	60	-7.04

Line 2 Phase QP Detector

Frequency	Measured Value (dBuV)	LISN Correction Factor (dB)	Cable Loss (dB)	Transient Limiter (dB)	Final Data (dBuV)	Limit (dBuV)	QP Margin (dB)
504.7 KHz	32.38	0.1	0.03	10.1	42.61	56	-13.39
506.86 KHz	32.48	0.1	0.03	10.1	42.71	56	-13.29
551.99 KHz	32.51	0.1	0.03	10.1	42.74	56	-13.26
1.7908 MHz	29.65	0	0.06	10.1	39.81	56	-16.19
4.9864 MHz	29.31	0	0.1	10.2	39.61	56	-16.39
28.233 MHz	39.09	0.2	0.252	10.4	49.942	60	-10.058



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: 4/28/17	
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	6/9/2017	6/9/2018
Voltmeter	Fluke	87III	i00319	4/11/16	4/11/19
Bi-Log Antenna	Schaffner	CBL 6111D	i00349	8/3/16	8/3/18
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