Compliance Testing, LLC
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http://www.ComplianceTesting.com
info@ComplianceTesting.com

Test Report

Prepared for: Garmin International, Inc.

Model: A03547

Description: Short Range Transceiver

Serial Numbers: 3970647127b and 3970647198b

FCC ID: IPH-03547

To

FCC Part 15.247 DTS

Date of Issue: July 23, 2018

On the behalf of the applicant:	**Garmin International, Inc.** **1200 E. 151st Street** **Olathe, KS 66062**
Attention of:	**William H. Pertner, Lead Compliance Engineer** **Ph: (913) 440-5471** **Email: bill.pertner@garmin.com**

Prepared By
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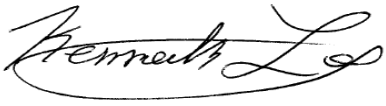
Project No: p1850022



Kenneth Lee
Project Test Engineer

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	May 23, 2018	Kenneth Lee	Original Document
2.0	July 20, 2018	Kenneth Lee	Updated Output Power Results to show the CW power of the radios

Table of Contents

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**

ACCREDITED
TESTING CERT
#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 (ºC)	**Humidity (%)**	**Pressure (mbar)**
17-28	24-36	942-989

EUT Description
Model: A03547
Description: Short Range Transceiver
Firmware: Main = v0.94, GPS = v2.10, Sensor Hub = v0.3
Software: Main = v0.94, GPS = v2.10, Sensor Hub = v0.3
Serial Numbers: 3970647127b and 3970647198b
Antenna Gain: 2.5 dBi
Additional Information: The EUT implements BLE and ANT. Because both ANT and BLE are from the same chipset, Radiated Spurious Emissions testing was done implementing a CW signal from the radio. Conducted Emissions testing was performed with the unit outputting BLE, ANT and again with a CW signal, the results were very similar and only the worst case is presented in this test report.

EUT Operation during Tests
The EUT was set to continuously transmit at the low, middle and high channel of operation at the maximum available output power.

Accessories:

Qty	Description	Manufacturer	Model	S/N
1	Switching Power Supply	GARMIN	PSAA10R-050	N/A

Cables: None

Modifications: None

15.203: Antenna Requirement:

X	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	Pass	
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	

References	Description
CFR47, Part 15, Subpart B	Unintentional Radiators
CFR47, Part 15, Subpart C	Intentional Radiators
ANSI C63.10-2013	American National standard for testing Unlicensed Wireless Devices
ANSI C63.4-2014	Method and Measurements of Radio-Noise Emissions from low-Voltage Electrical and Electronic Equipment in the range 9kHz to 40GHz.
ISO/IEC 17025:2005	General requirements for the Competence of Testing and Calibrations Laboratories
KDB 558074 D01 v04	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating under §15.247

Output Power
Engineer: Kenneth Lee
Test Date: 5/22/2018

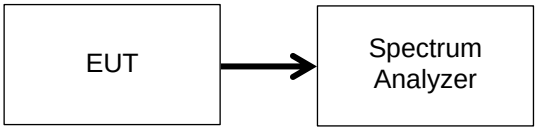
Test Procedure

The EUT was connected directly to a spectrum analyzer. The Spectrum Analyzer was set to the following:

RBW ≥ DTS Bandwidth
VBW ≥ 3 x RBW
Span ≥ 3 x RBW
Sweep time = auto couple
Detector = peak
Trace Mode = max hold

The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. The RF output power was measured using the spectrum analyzer's marker peak function. The EUT was tested outputting a CW signal, as the BLE and ANT radios use the same chipset.

Test Setup



Transmitter Output Power

CW Signal

Tuned Frequency (MHz)	Measured Value (dBm)	Specification Limit	Result
2402	3.789	1 W (30 dBm)	Pass
2457	3.716	1 W (30 dBm)	Pass
2480	3.757	1 W (30 dBm)	Pass

Radiated Spurious Emissions
Engineer: Kenneth Lee
Test Date: 5/24/2018

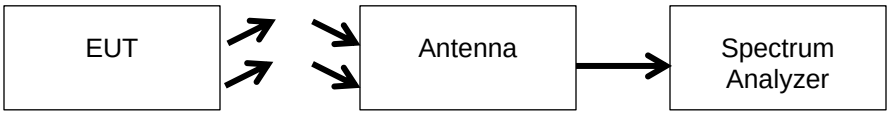
Test Procedure
Radiated Spurious Emissions: 30 – 1000 MHz

The EUT was setup in a semi-anechoic test chamber set 3m from the receiving antenna. The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. 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 – Quasi Peak

Test Setup

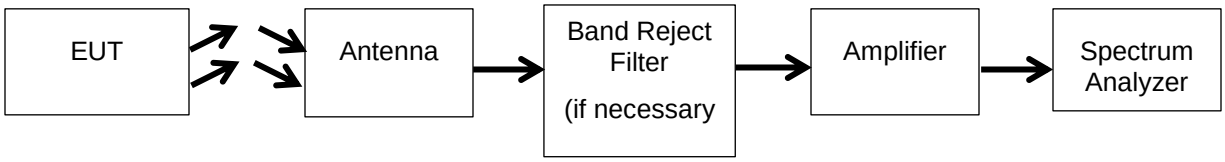


Test Procedure for
Radiated Spurious Emissions above 1 GHz

The EUT was setup in a semi-anechoic test chamber set 3m from the receiving antenna. The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. 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.

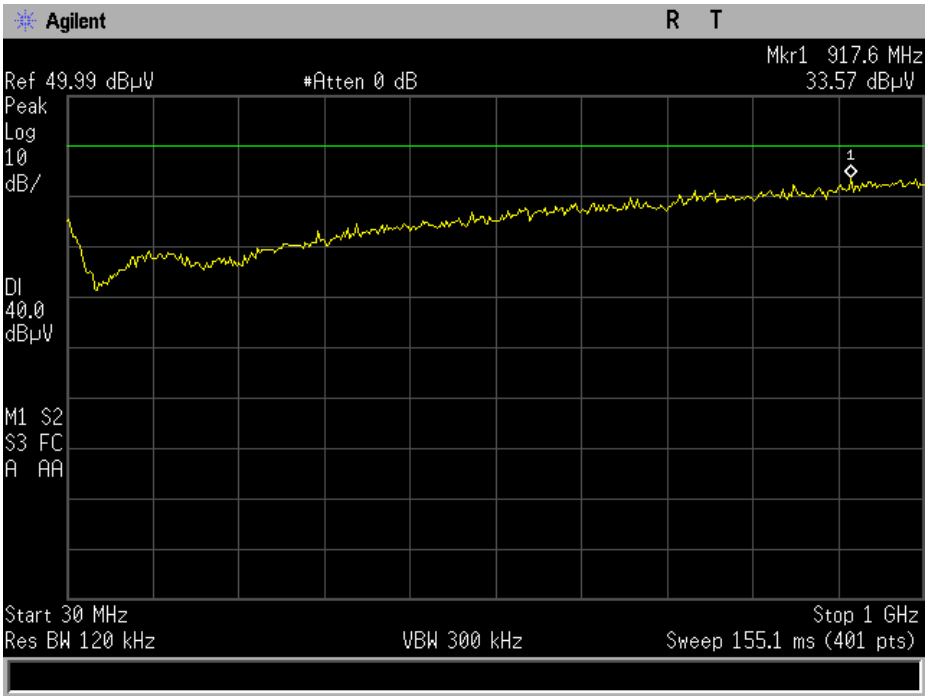
RBW = 1 MHz
VBW = 3 MHz
Detector – Peak

Test Setup

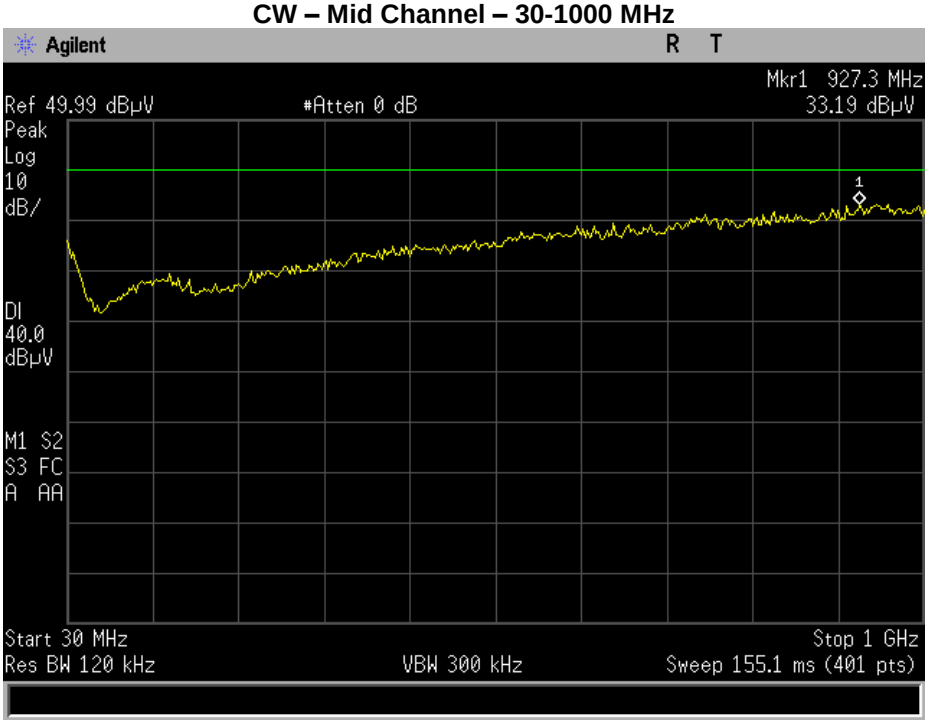


Radiated Spurious Emissions Plots

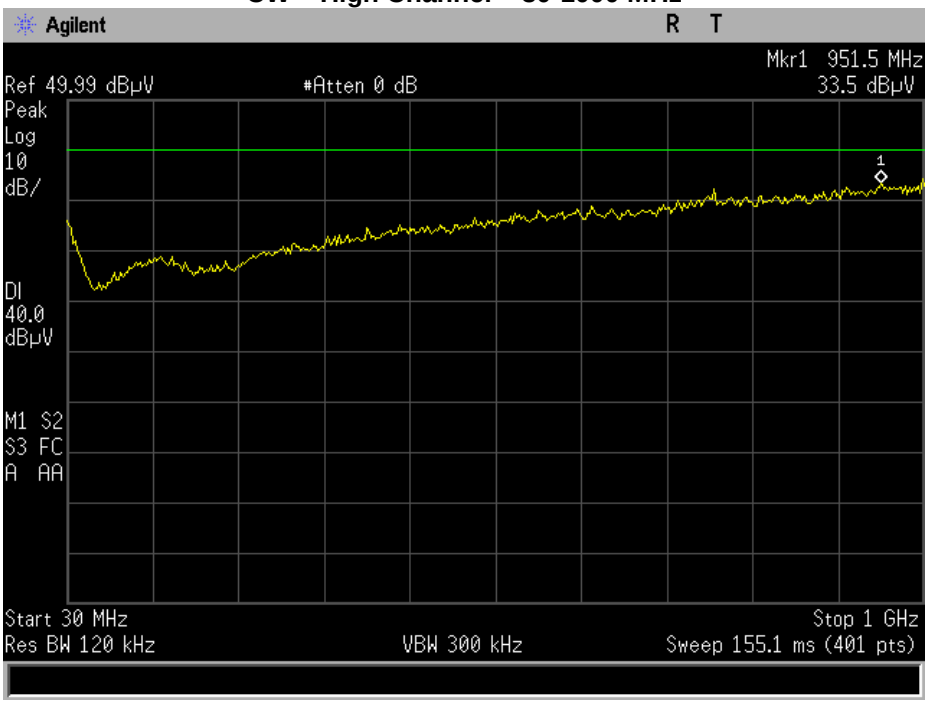
CW – Low Channel – 30-1000 MHz



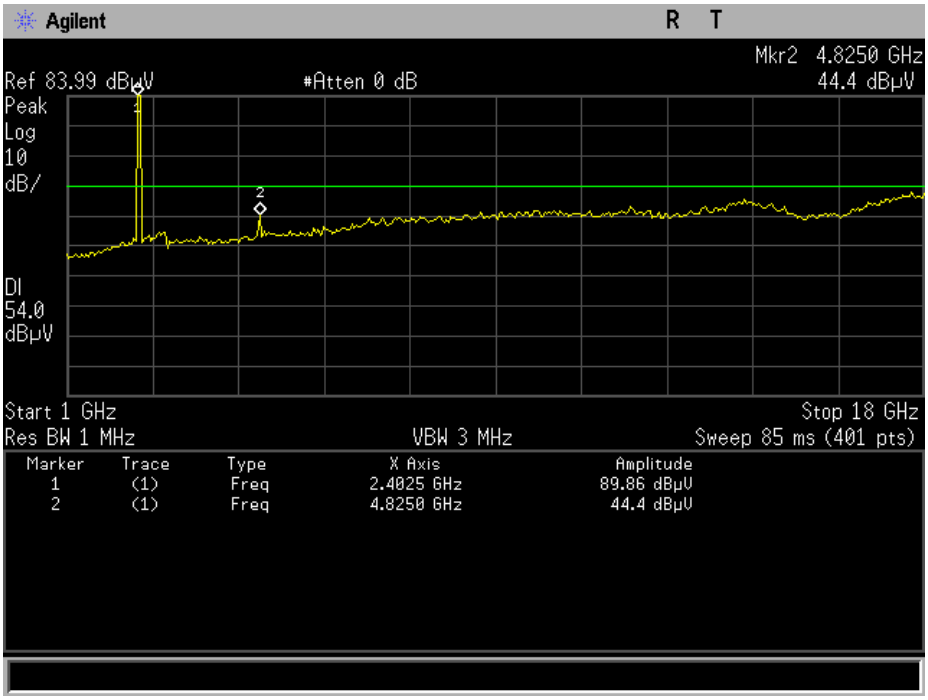
CW – Mid Channel – 30-1000 MHz



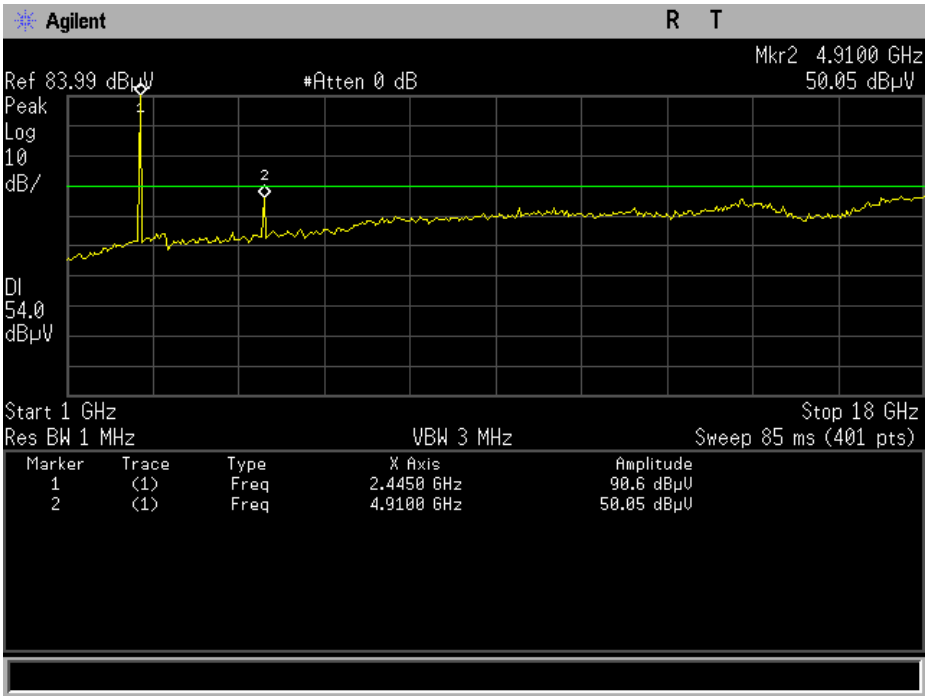
CW – High Channel – 30-1000 MHz



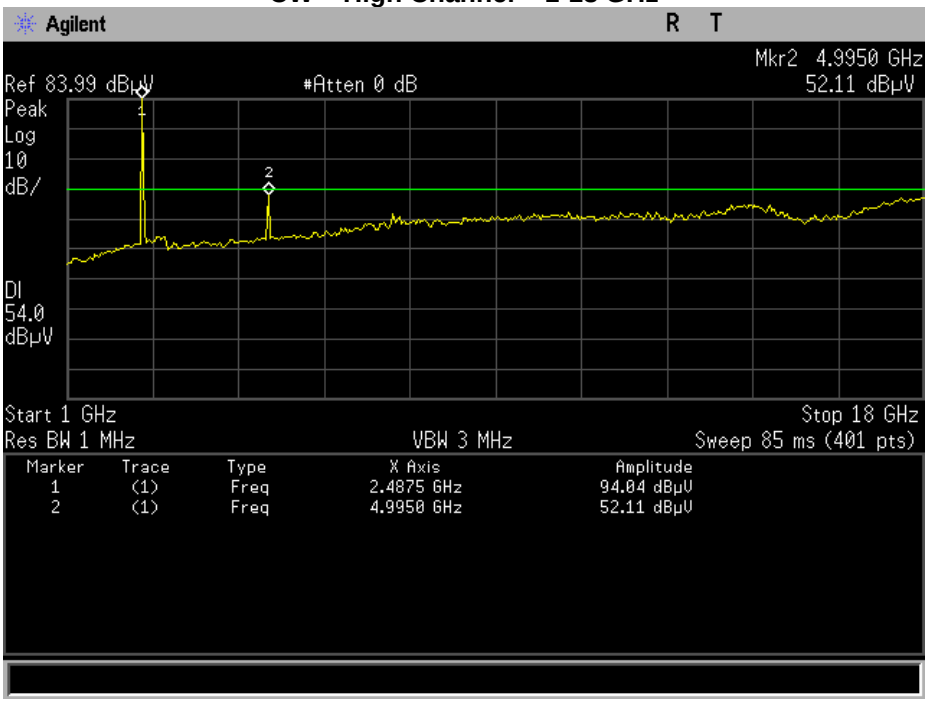
CW – Low Channel – 1-18 GHz



CW – Mid Channel – 1-18 GHz



CW – High Channel – 1-18 GHz



Testing was performed to the 10th harmonic of the EUT, only noise floor was discovered from 18-25 GHz.

Conducted Spurious Emissions
Engineer: Kenneth Lee
Test Date: 5/22/2018

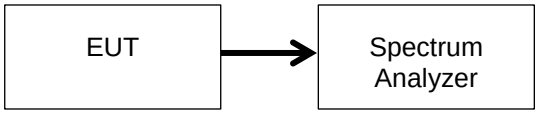
Test Procedure

The EUT was connected directly to a spectrum analyzer. The Spectrum Analyzer was set to the following:

RBW = 100 kHz
VBW ≥ 3 x RBW
Peak Detector
Trace mode = max hold
Sweep = auto couple
Frequency Range = 30MHz – 10th Harmonic of the fundamental

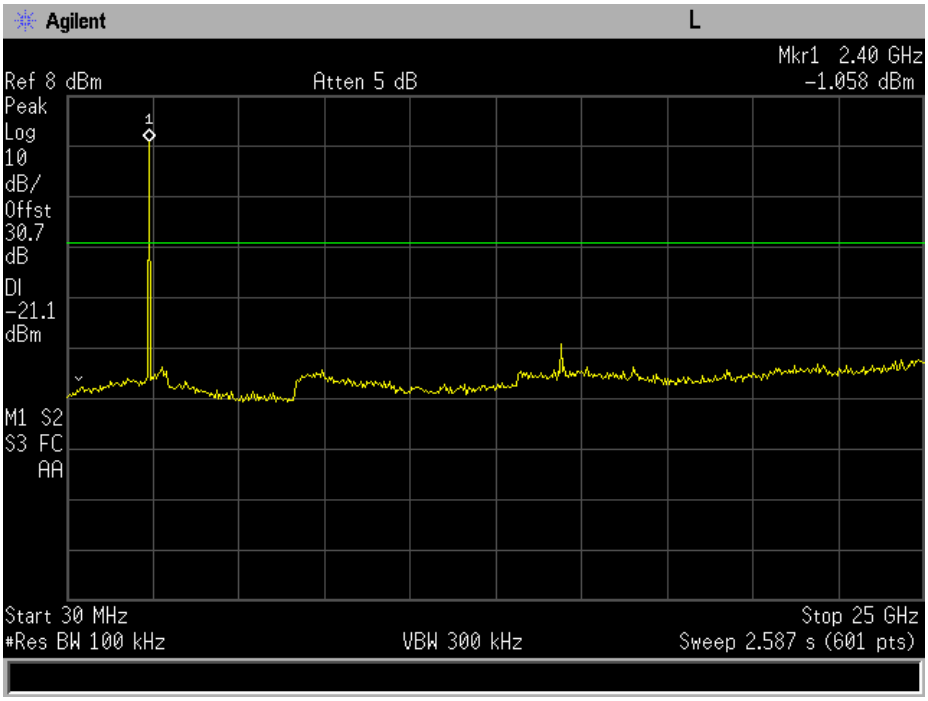
The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. The trace was allowed to stabilize. All emissions were investigated to insure they were attenuated from the peak fundamental by at least 20dB. If the average power levels were measured then the out-of-band emissions needed to be attenuated by 30dB. In addition emissions were investigated at the band edges to insure all out-of-band emissions were attenuated 20 or 30dB as necessary.

Test Setup

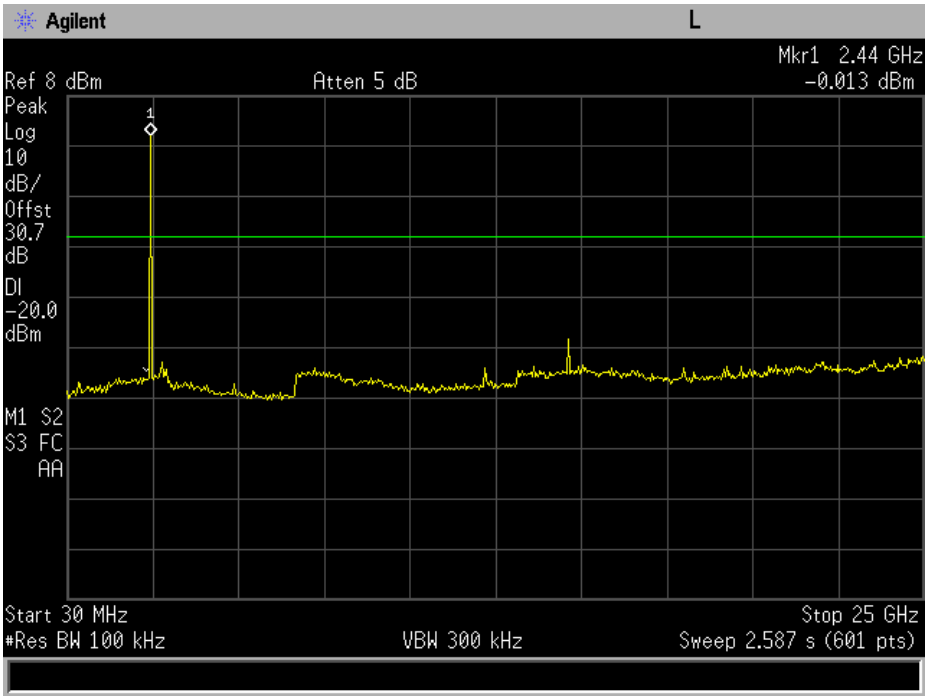


Conducted Spurious Emissions Plots

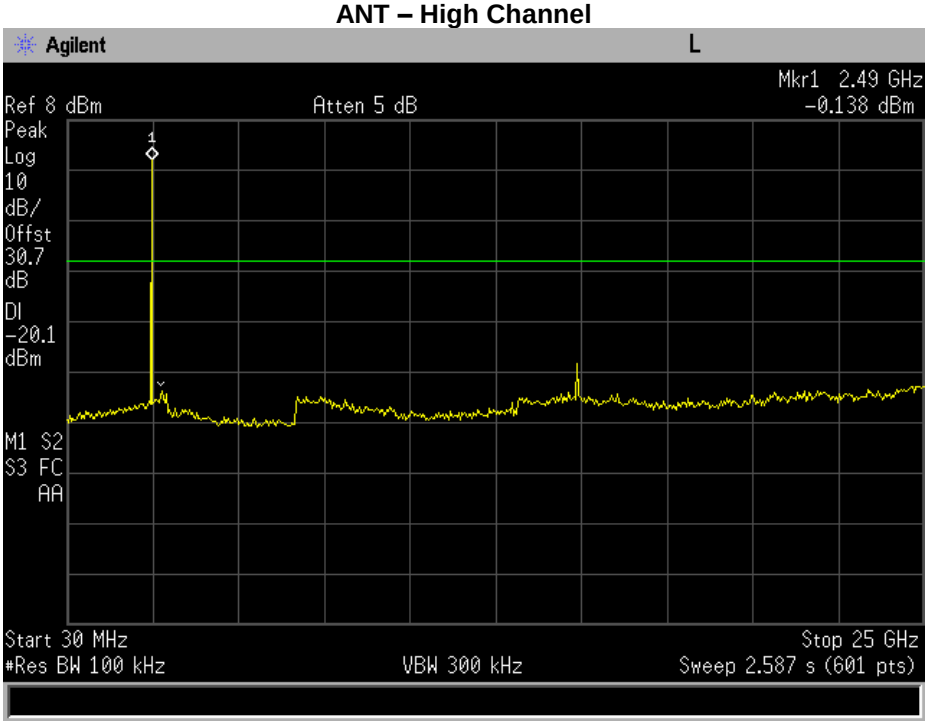
ANT – Low Channel



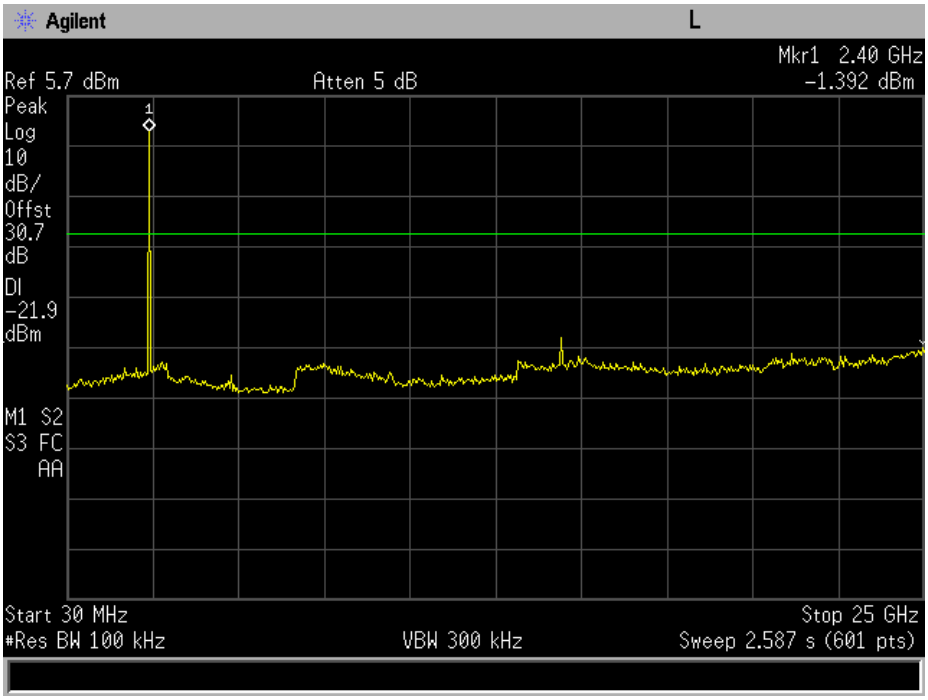
ANT – Middle Channel



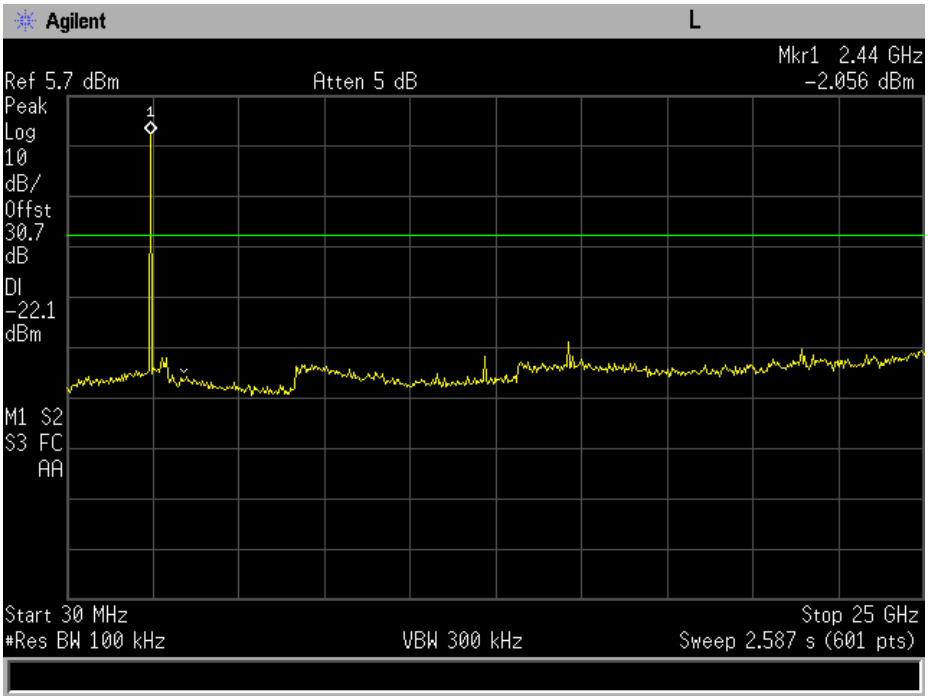
ANT – High Channel



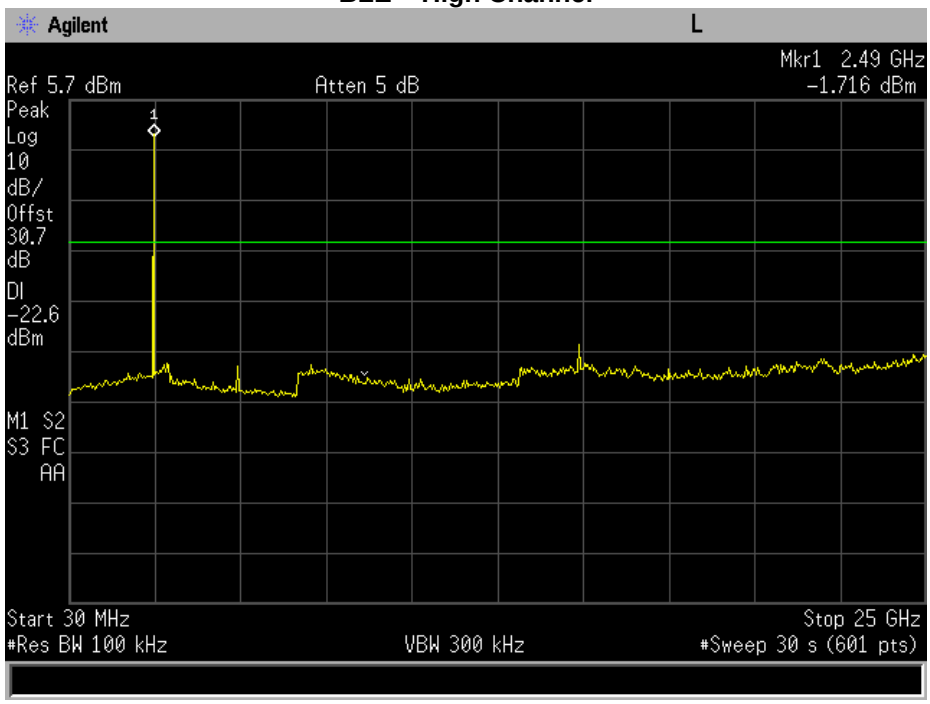
BLE – Low Channel



BLE – Middle Channel



BLE – High Channel



DTS Bandwidth
Engineer: Kenneth Lee
Test Date: 5/23/2018

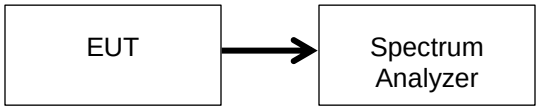
Test Procedure

The EUT was connected directly to a spectrum analyzer. The Spectrum Analyzer was set to the following:

RBW = 100 kHz
VBW ≥ 3 x RBW
Peak Detector
Trace mode = max hold
Sweep = auto couple
Span = 1.5 x EBW

The EUT was set to transmit at the lowest, middle and highest channels of the band at the maximum power levels. The maximum width of the emission that was determined by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that were attenuated by 6db and this value was used to determine the width of the carrier. Alternatively the spectrum analyzer's automatic bandwidth capability was used.

Test Setup



ANT – 6 dB Occupied Bandwidth Summary

Frequency (MHz)	Measured Bandwidth (kHz)	Specification Limit (kHz)	Result
2402	509.948	≥ 500	Pass
2440	501.313	≥ 500	Pass
2480	501.412	≥ 500	Pass

ANT – 99% Bandwidth Summary

Frequency (MHz)	Measured Bandwidth (MHz)	Result
2402	1.0276	Pass
2440	1.0289	Pass
2480	1.0265	Pass

BLE – 6 dB Occupied Bandwidth Summary

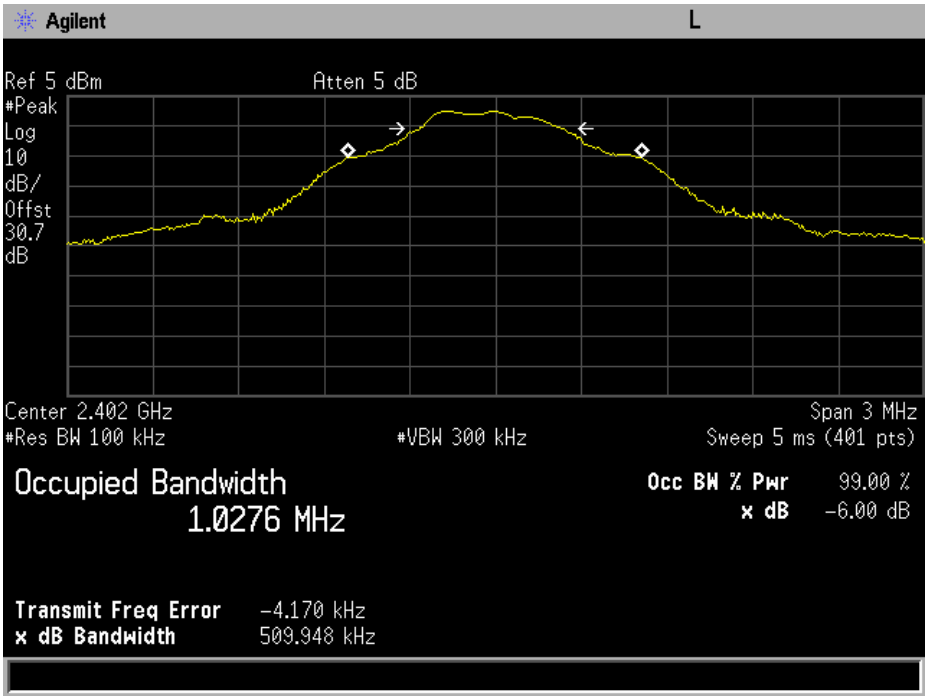
Frequency (MHz)	Measured Bandwidth (kHz)	Specification Limit (kHz)	Result
2402	735.664	≥ 500	Pass
2440	748.789	≥ 500	Pass
2480	749.609	≥ 500	Pass

BLE – 99% Bandwidth Summary

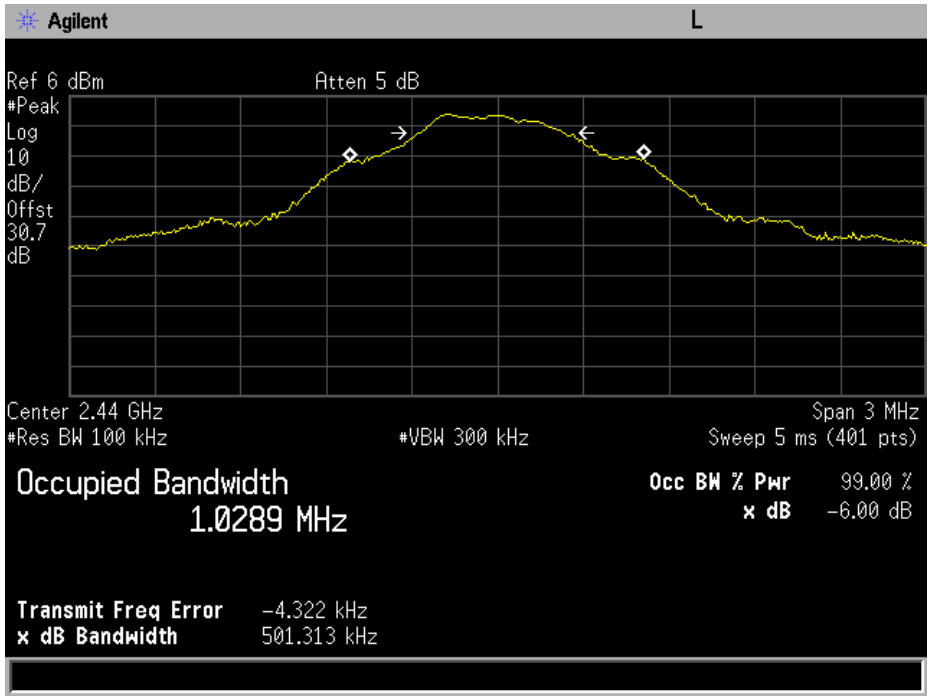
Frequency (MHz)	Measured Bandwidth (MHz)	Result
2402	1.0841	Pass
2440	1.0914	Pass
2480	1.0909	Pass

6 dB and 99% Bandwidth Plots

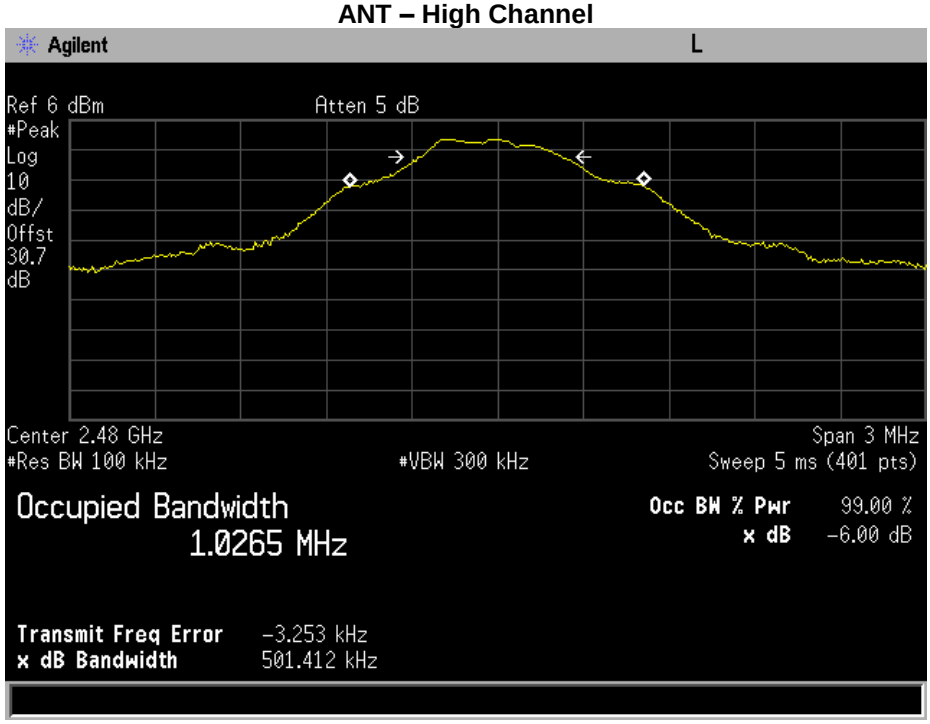
ANT – Low Channel



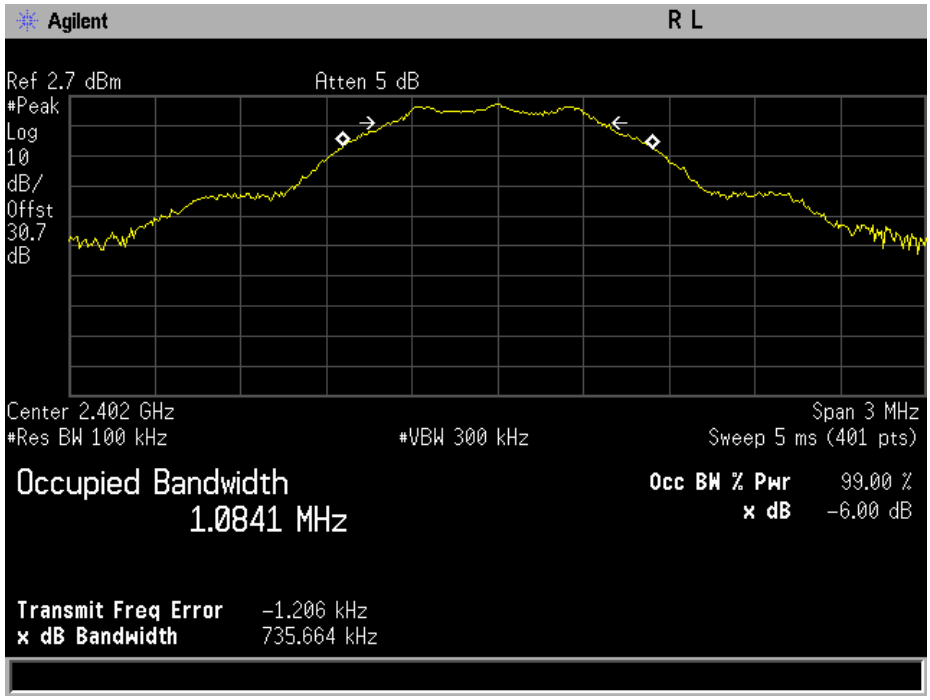
ANT – Mid Channel



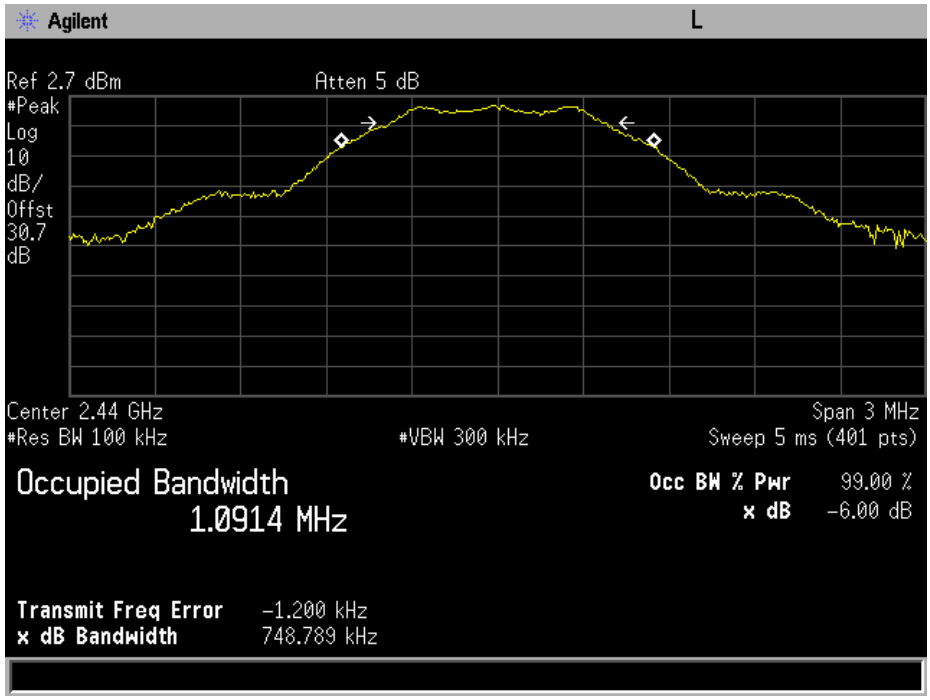
ANT – High Channel



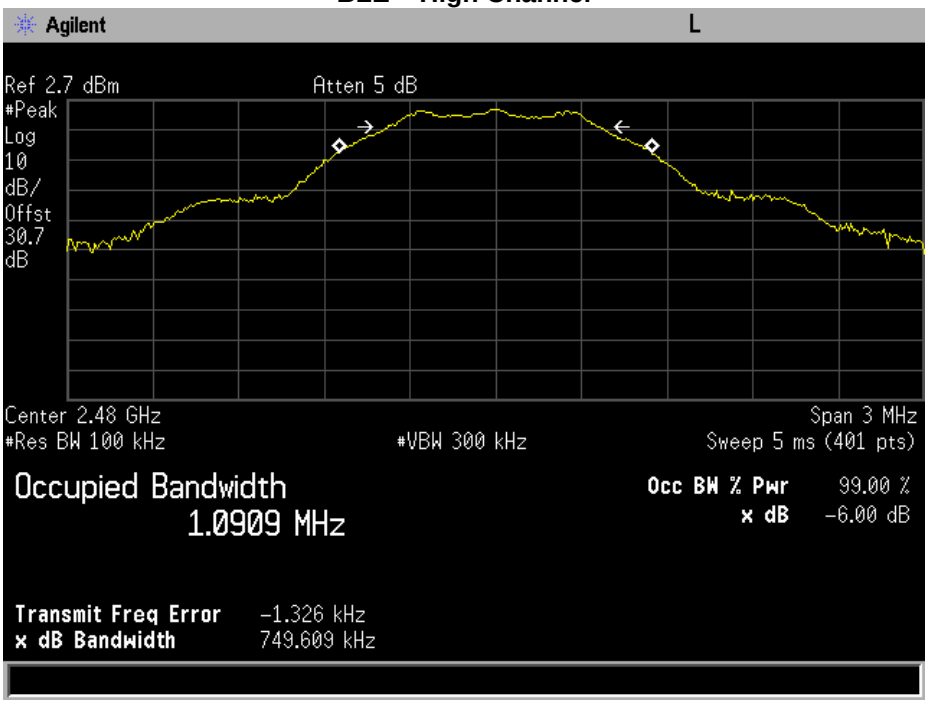
BLE – Low Channel



BLE – Mid Channel



BLE – High Channel



Transmitter Power Spectral Density (PSD)

Engineer: Kenneth Lee

Test Date: 5/23/2018

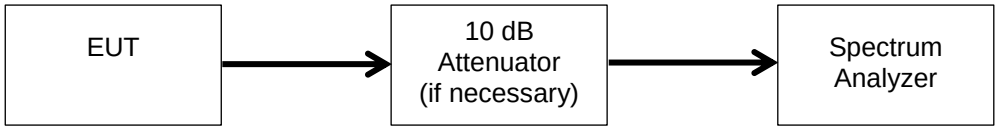
Test Procedure

The EUT was connected directly to a spectrum analyzer. The Spectrum Analyzer was set to the following:

DTS channel center frequency
Span 1.5 x DTS bandwidth
RBW =3 kHz ≤ RBW ≤ 100 kHz
VBW ≥ 3 x RBW
Peak Detector
Sweep time = auto couple
Trace mode = max hold

The EUT was set to transmit at the lowest, middle and highest channels of the band at the maximum power levels. Once the trace has stabilize the peak marker was used to determine the peak power spectral density.

Test Setup



ANT – PSD Summary

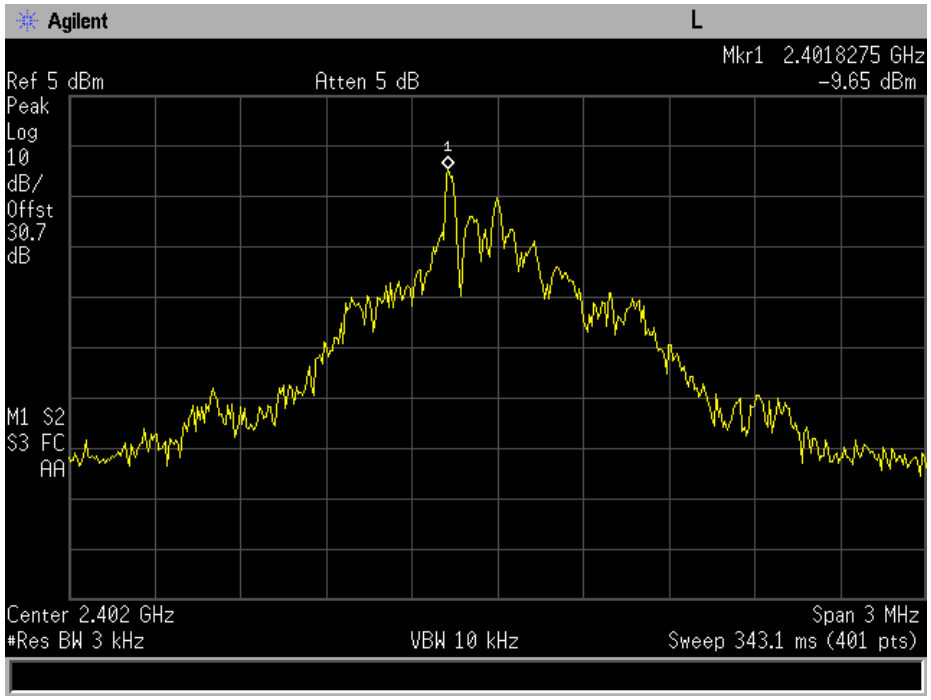
Frequency (MHz)	Measured Data (dBm)	Specification Limit (dBm)	Result
2402	-9.65	8	Pass
2440	-9.873	8	Pass
2480	-9.539	8	Pass

BLE – PSD Summary

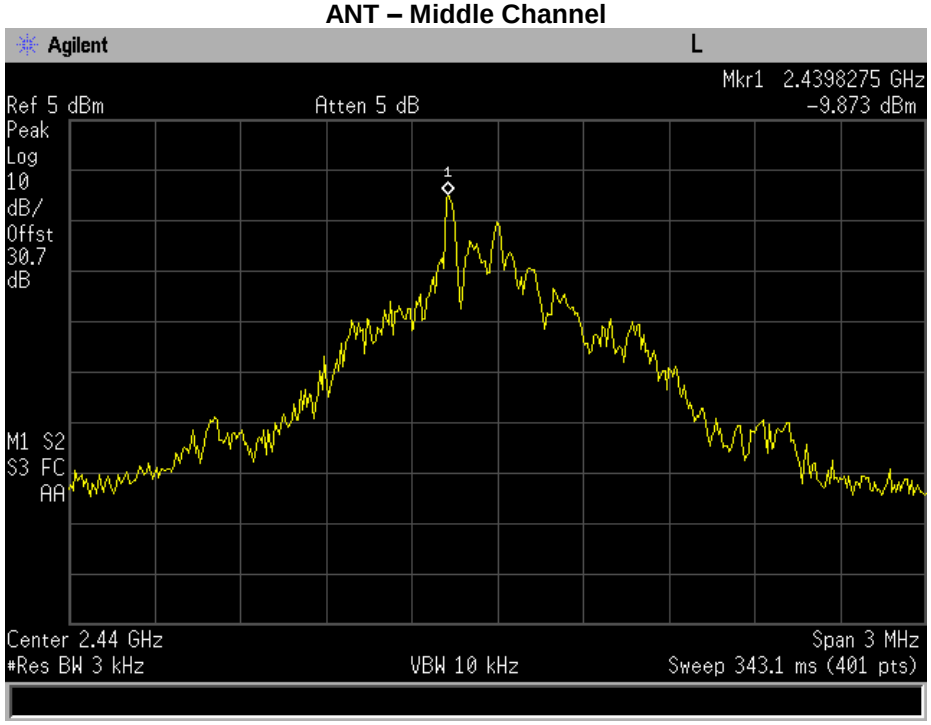
Frequency (MHz)	Measured Data (dBm)	Specification Limit (dBm)	Result
2402	-14.93	8	Pass
2440	-15.42	8	Pass
2480	-15.51	8	Pass

PSD Plots

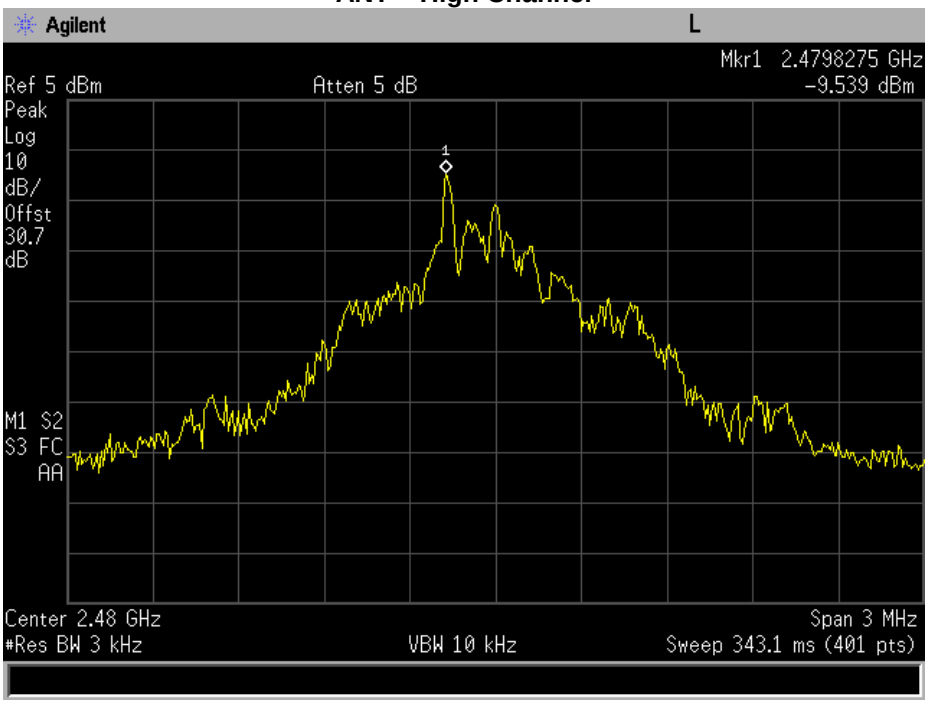
ANT – Low Channel



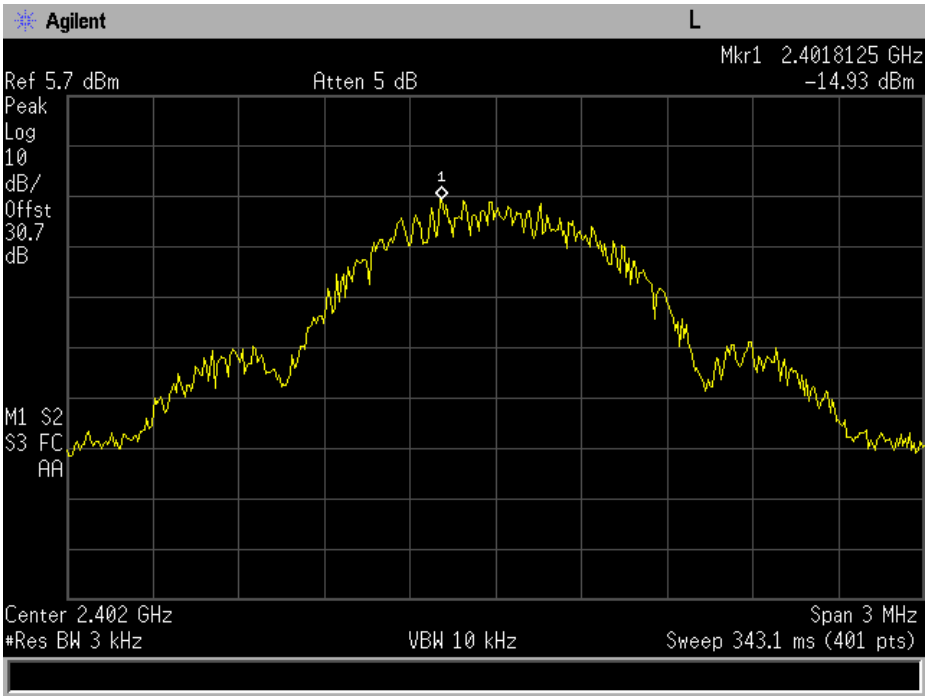
ANT – Middle Channel



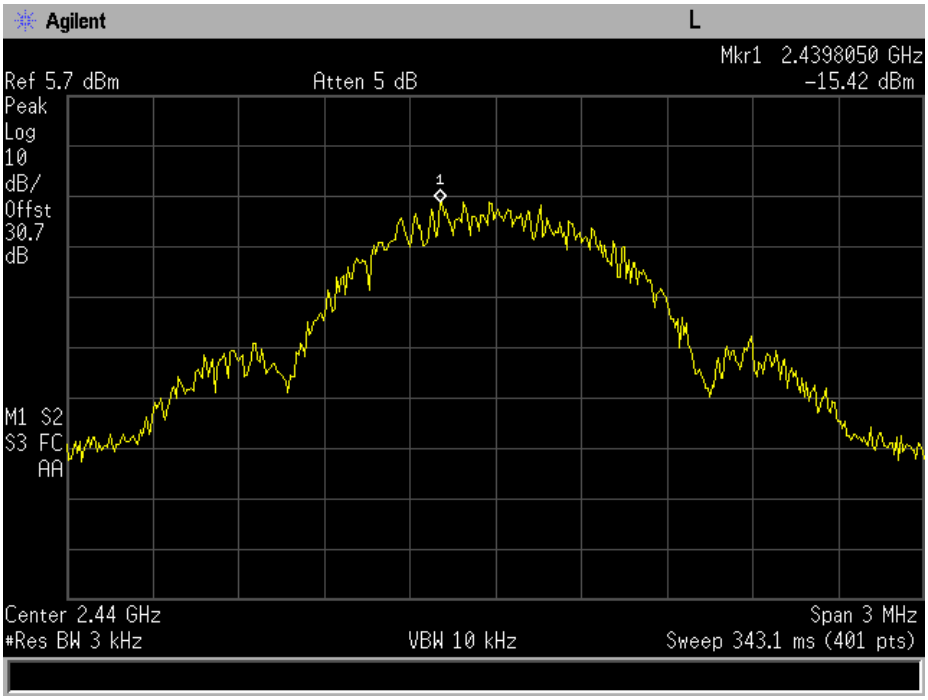
ANT – High Channel



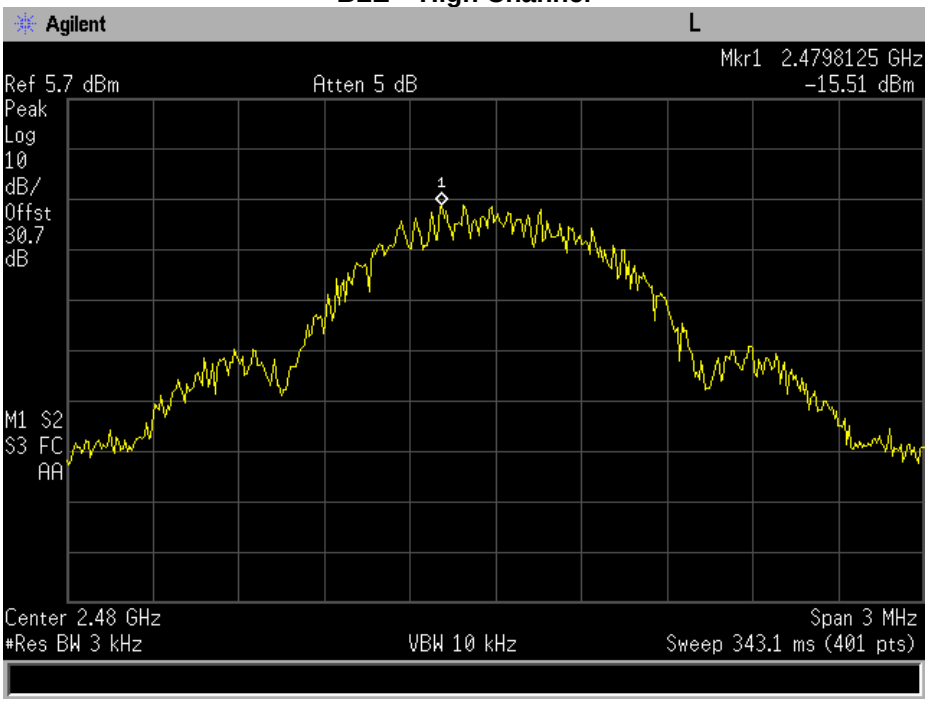
BLE – Low Channel



BLE – Middle Channel



BLE – High Channel



A/C Powerline Conducted Emission

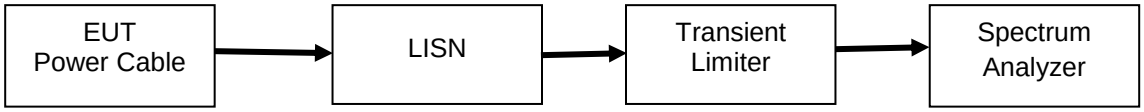
Engineer: Kenneth Lee

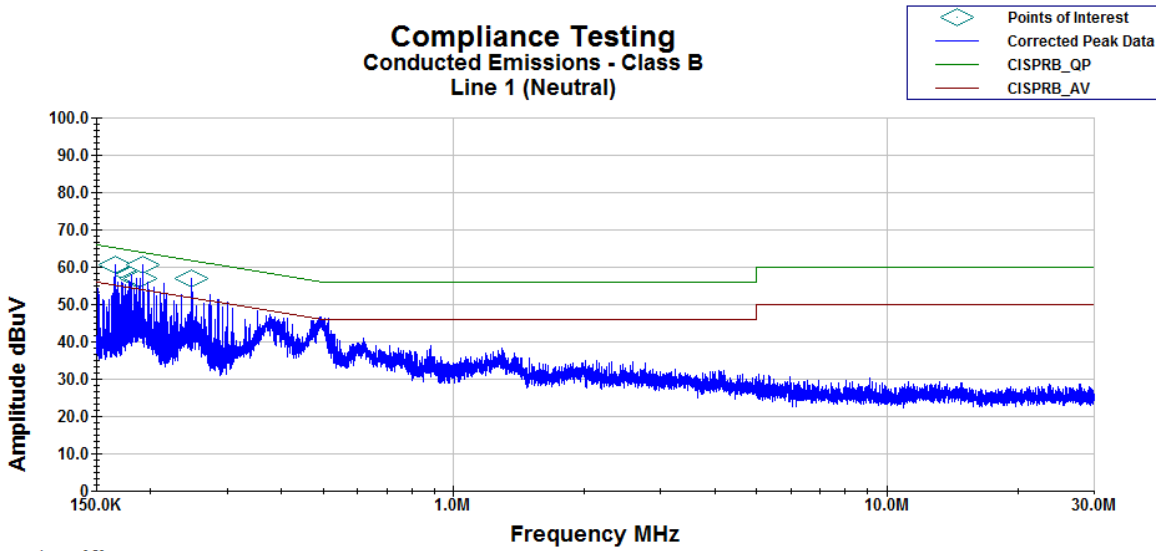
Test Date: 5/22/2018

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.

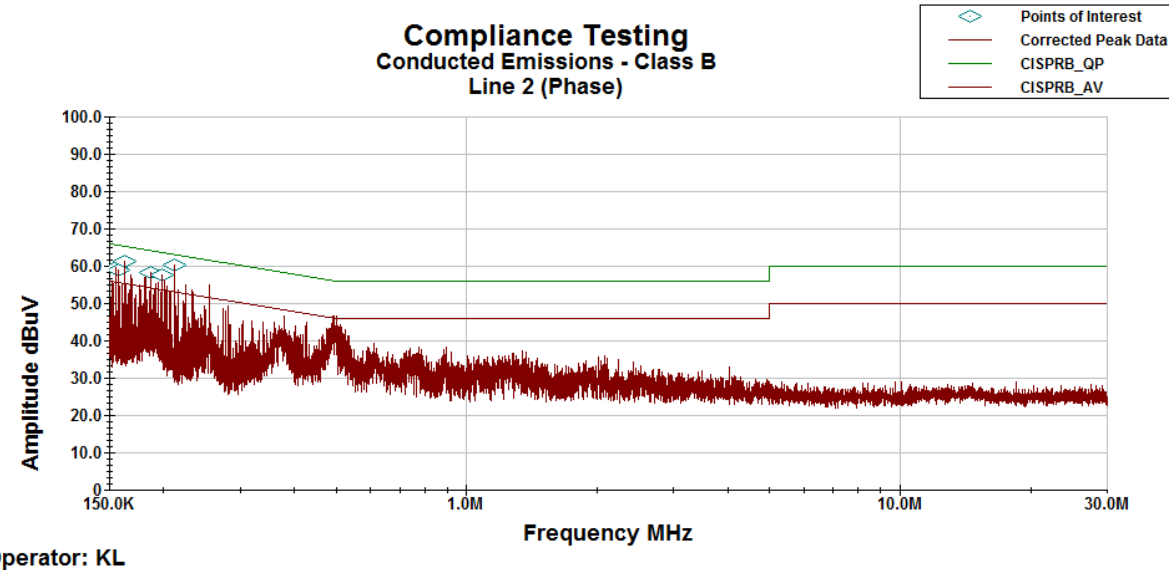
Test Setup





Operator: KL

Conducted Emissions - 209.til **Job #: p1850022**



Operator: KL

Conducted Emissions - 209.til **Job #: p1850022**

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)
162.29 KHz	15.92	0.2	0.02	10.177	26.317	55.649	-29.332
171.63 KHz	16.89	0.2	0.02	10.1	27.21	55.382	-28.172
176.04 KHz	20.69	0.2	0.02	10.1	31.013	55.256	-24.243
184.23 KHz	22.75	0.2	0.02	10.1	33.07	55.022	-21.952
195.39 KHz	21.31	0.2	0.02	10.1	31.627	54.703	-23.076
232.15 KHz	17.97	0.18	0.022	10.1	28.276	53.653	-25.377

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)
152.55 KHz	13.09	0.27	0.02	10.2	23.584	55.927	-32.343
158.7 KHz	14.07	0.21	0.02	10.2	24.5	55.751	-31.252
158.83 KHz	13.73	0.21	0.02	10.2	24.158	55.748	-31.589
189.05 KHz	17.53	0.2	0.02	10.1	27.847	54.884	-27.038
199.83 KHz	14.01	0.2	0.02	10.1	24.333	54.576	-30.243
214.08 KHz	10.34	0.19	0.021	10.1	20.657	54.169	-33.512

Line 1 Neutral QP Detector

Frequency	Measured Value (dBuV)	LISN Correction Factor (dB)	Cable Loss (dB)	Transient Limiter (dB)	Final Data (dBuV)	Limit (dBuV)	Avg Margin (dB)
162.29 KHz	32.27	0.2	0.02	10.177	42.667	65.649	-22.982
171.63 KHz	32.29	0.2	0.02	10.1	42.61	65.382	-22.772
176.04 KHz	33.74	0.2	0.02	10.1	44.06	65.256	-21.196
184.23 KHz	33.91	0.2	0.02	10.1	44.23	65.022	-20.792
195.39 KHz	32.03	0.2	0.02	10.1	42.35	64.703	-22.353
232.15 KHz	30.79	0.184	0.022	10.1	41.096	63.653	-22.557

Line 2 Phase QP Detector

Frequency	Measured Value (dBuV)	LISN Correction Factor (dB)	Cable Loss (dB)	Transient Limiter (dB)	Final Data (dBuV)	Limit (dBuV)	Avg Margin (dB)
152.55 KHz	34.94	0.27	0.02	10.2	45.434	65.927	-20.493
158.7 KHz	35.52	0.21	0.02	10.2	45.953	65.751	-19.798
158.83 KHz	34.24	0.21	0.02	10.2	44.672	65.748	-21.076
189.05 KHz	32.7	0.2	0.02	10.1	43.02	64.884	-21.864
199.83 KHz	31.14	0.2	0.02	10.1	41.46	64.576	-23.116
214.08 KHz	29.25	0.19	0.021	10.1	39.564	64.169	-24.605

Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
EMI Receiver	HP	8546A	i00033	3/26/18	3/26/19
Horn Antenna	EMCO	3115	i00103	2/3/17	2/3/19
Transient Limiter	Com-Power	LIT-153	i00123	Verified on: 5/22/18	
Bi-Log antenna	Chase	CBL6111C	i00267	3/8/18	3/8/20
Horn Antenna	ARA	DRG-118/A	i00271	6/16/16	6/16/18
Humidity / Temp Meter	Newport	IBTHX-W-5	i00282	6/9/17	6/9/18
Bi-Log Antenna	Schaffner	CBL 6111D	i00349	8/3/16	8/3/18
AC Power Source	Behlman	BL 6000	i00362	Verified on: 5/22/18	
EMI Analyzer	Agilent	E7405A	i00379	2/13/18	2/13/19
3 Meter Semi-Anechoic Chamber	Panashield	3 Meter Semi-Anechoic Chamber	i00428	8/15/16	8/15/19
LISN	COM-Power	LI-125A	i00447	9/11/17	9/11/19
LISN	COM-Power	LI-125A	i00449	9/11/17	9/11/19
Spectrum Analyzer	Agilent	E4407B	i00331	11/21/17	11/21/18
Preamplifier for 1-18GHz horn antenna	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