



Test Report

Prepared for: Command Electronics, LLC

Model: LevelMatePro

Description: Bluetooth enabled towed vehicle sensor

Serial Number: N/A

FCC ID: 2AHCZ-LEVELMATEPRO
IC: 21137-LEVLIMATEPRO

To

FCC Part 15.247 DTS

And

IC RSS-247

Date of Issue: February 24, 2016

On the behalf of the applicant:

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Attention of:

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Alex Macon
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	January 18, 2016	Alex Macon	Original Document
2.0	February 24, 2016	Alex Macon	Updated report with below a GHz data for 15.247 (d)



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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 C63.10-2009 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)
19.8 – 21.3	35.4 – 37.6	969.2 – 970.3

EUT Description

Model: LevelMatePro

Description: Bluetooth enabled towed vehicle sensor

Firmware: N/A

Software: N/A

Serial Number:

Additional Information:

The EUT is powered by a replaceable coin cell battery. The EUT incorporates a PCB antenna with a maximum gain of 3 dB

EUT Operation during Tests

The EUT was placed in a constant modulated transmit mode using manufacturer supplied test modes.

Accessories: None

Cables: None

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 Reports Summary

Specification	Test Name	Pass, Fail, N/A	Comments
15.247(b)	Peak Output Power	Pass	
15.247(b)	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	N/A	The EUT is a battery operated device and does not connect to the AC Mains.
RSS-Gen 6(b)	Receiver Spurious Emission Limits	Pass	



Peak Output Power

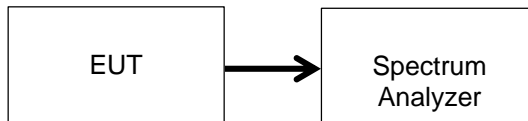
Engineer: Alex Macon

Test Date: 1/15/16

Test Procedure

The EUT was connected directly to a spectrum analyzer. The peak readings were taken and the result was then compared to the limit.

Test Setup



Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Value (dBm)	Specification Limit	Result
2402	-0.82	1 W (30 dBm)	Pass
2440	-1.19	1 W (30 dBm)	Pass
2480	-2.35	1 W (30 dBm)	Pass



Conducted Spurious Emission

Engineer: Alex Macon

Test Date: 1/15/16

Test Procedure

The EUT was connected to a spectrum analyzer to verify that the EUT met the requirements for spurious emissions. The frequency range from 30 MHz to the 10th harmonic of the fundamental transmitter was observed. Only detectable spurious emissions were recorded and plotted. The peak output power is added to the recorded measurement to provide the corrected spurious level dBc.

Only the worst case is recorded in the Conducted Spurious Emissions Summary Test Table.

Test Setup

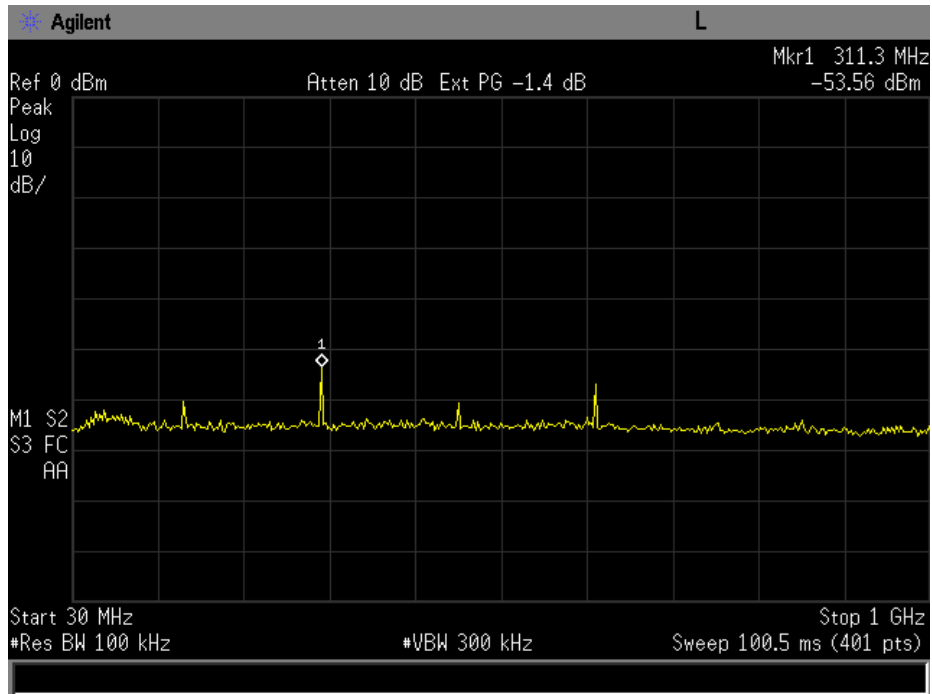


Conducted Spurious Emissions Summary Test Table

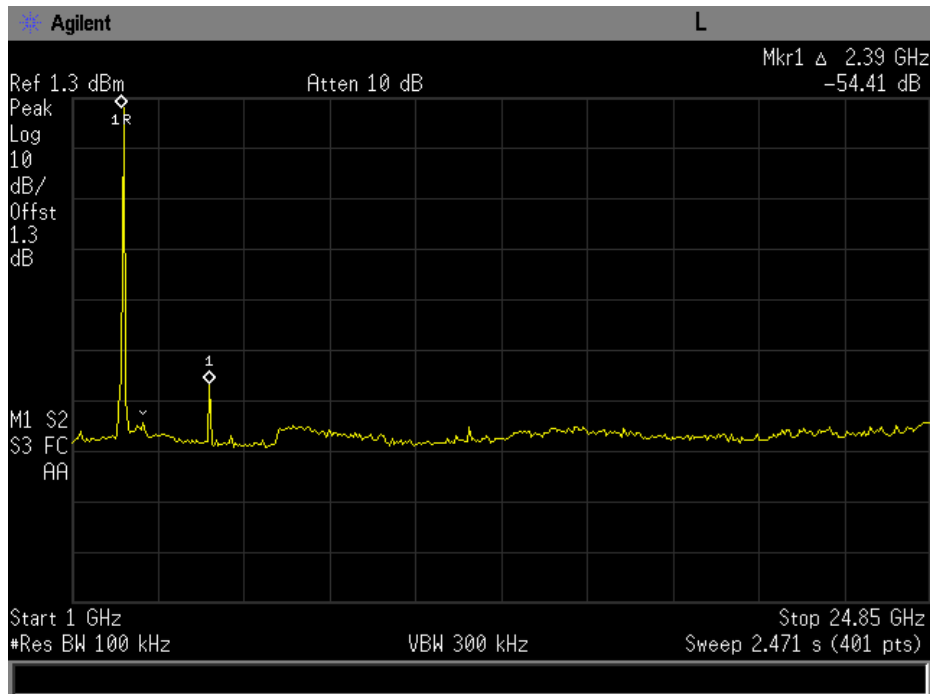
Tuned Frequency (MHz)	Emission Frequency (MHz)	Measured Value (dBc)	Specification Limit (dBc)	Result
2402	4804	-54.41	-20	Pass
2440	4880	-55.57	-20	Pass
2480	4960	-54.88	-20	Pass



Conducted Spurious Emissions Tuned Freq=2480 MHz

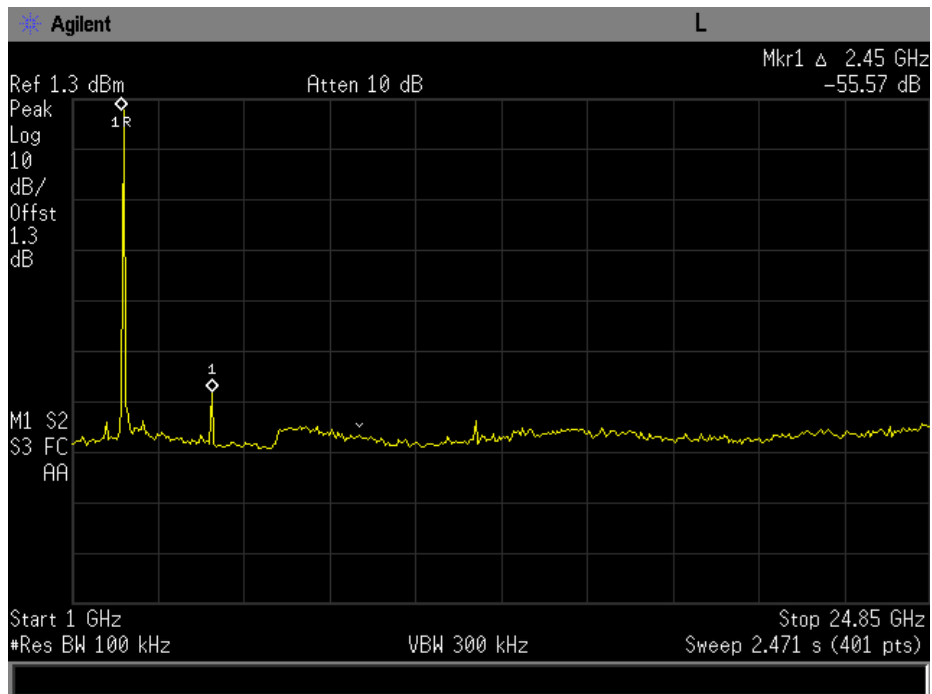


Conducted Spurious Emissions Tuned Freq=2402 MHz

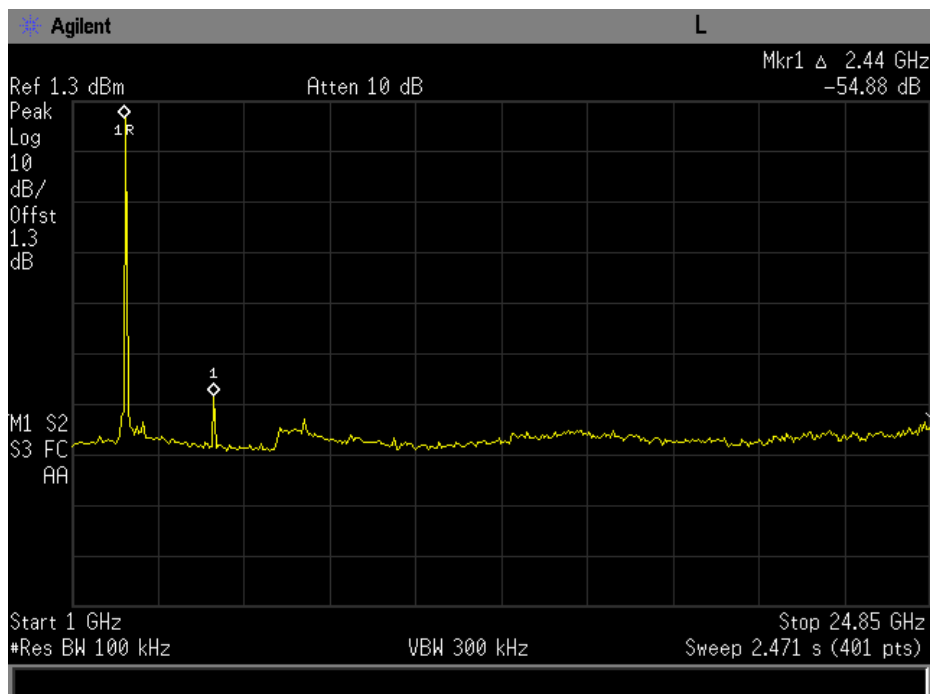




Conducted Spurious Emissions Tuned Freq=2440 MHz



Conducted Spurious Emissions Tuned Freq=2480 MHz





Radiated Spurious Emissions

Engineer: Alex Macon

Test Date: 1/18/16

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.

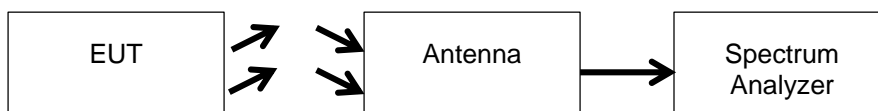
Correction factors were input into the spectrum analyzer before recording “Measured Level”.

RBW = 120 KHz

VBW = 300 KHz

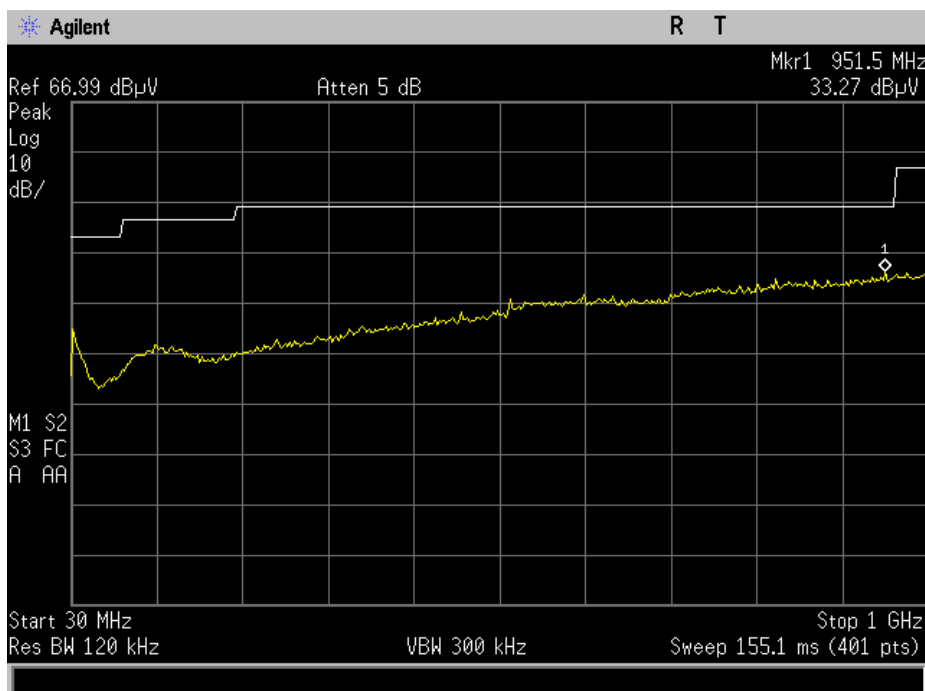
Detector – Quasi Peak

Test Setup



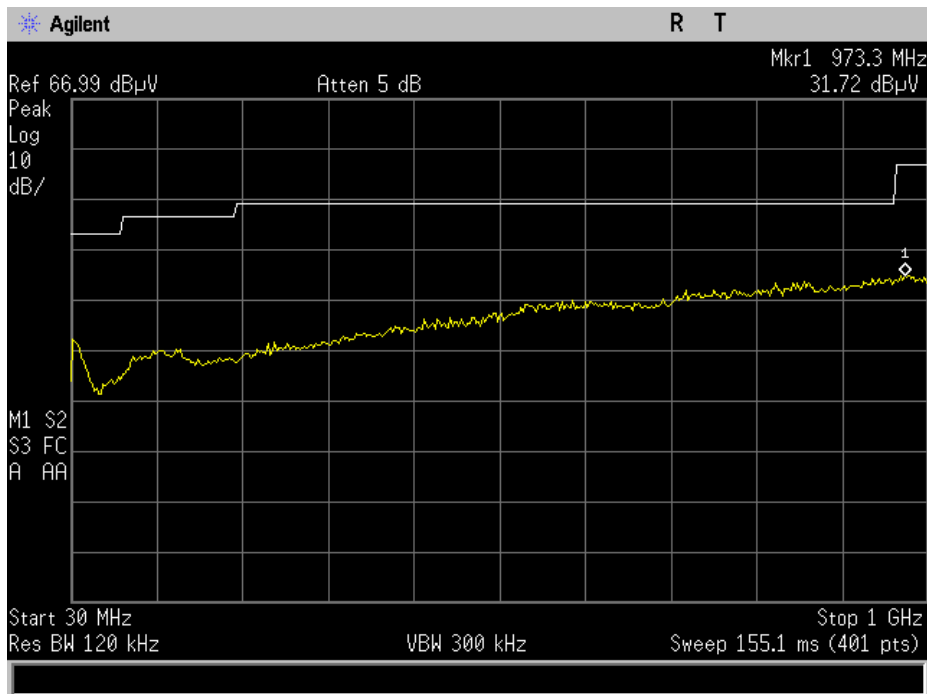
Radiated Spurious Emissions Test Data: 30 MHz – 1000 MHz Antenna=ANT-FP

2402 MHz
30 – 1000 MHz

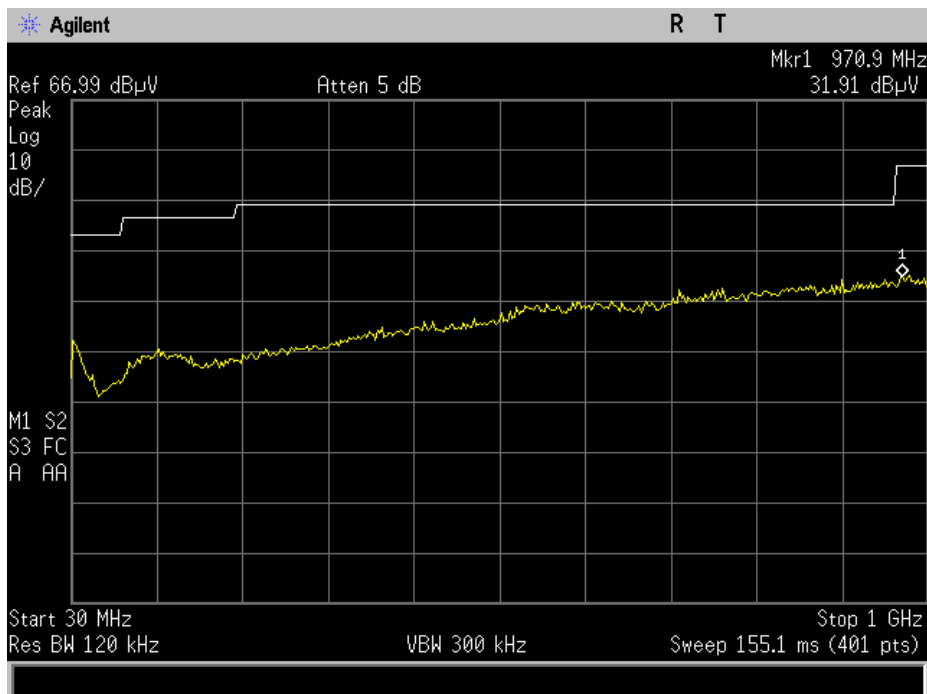




2440 MHz
30 – 1000 MHz



2480 MHz
30 – 1000 MHz





Test Procedure for Radiated Spurious Emissions above 1 GHz

The EUT was tested in a semi anechoic chamber set 1m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Spurious Emissions. The antenna, high pass 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 but only noise floor was seen after 15 GHz. All peak emissions are below the average limit.

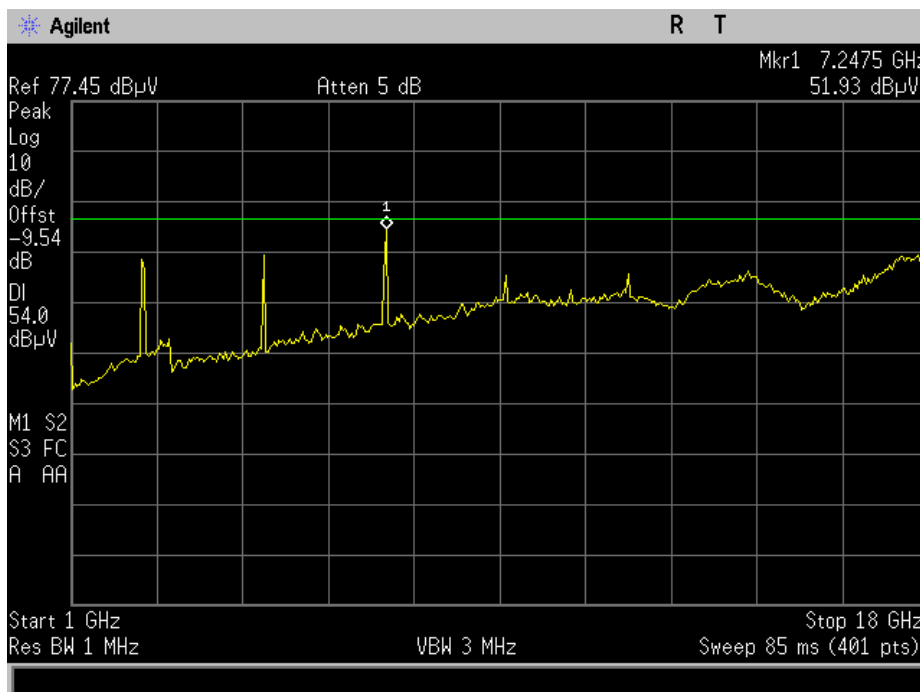
Test Setup



Detector Settings	RBW	VBW	Span
Peak	1 MHz	3 MHz	As Necessary
Average	1 MHz	3 MHz	As Necessary

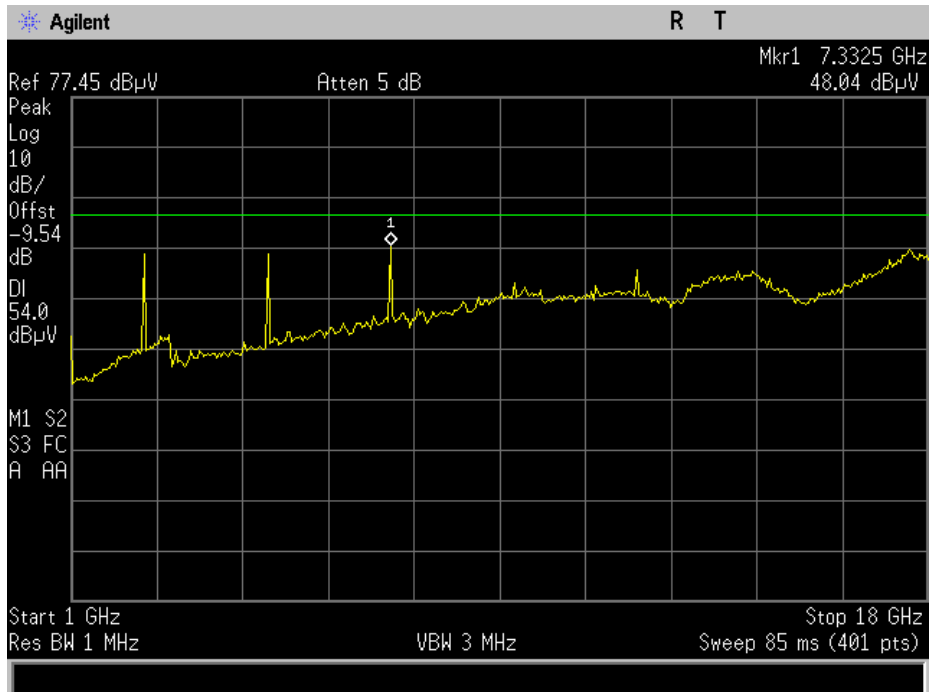
Radiated Spurious Emissions

Tuned Frequency = 2402 MHz

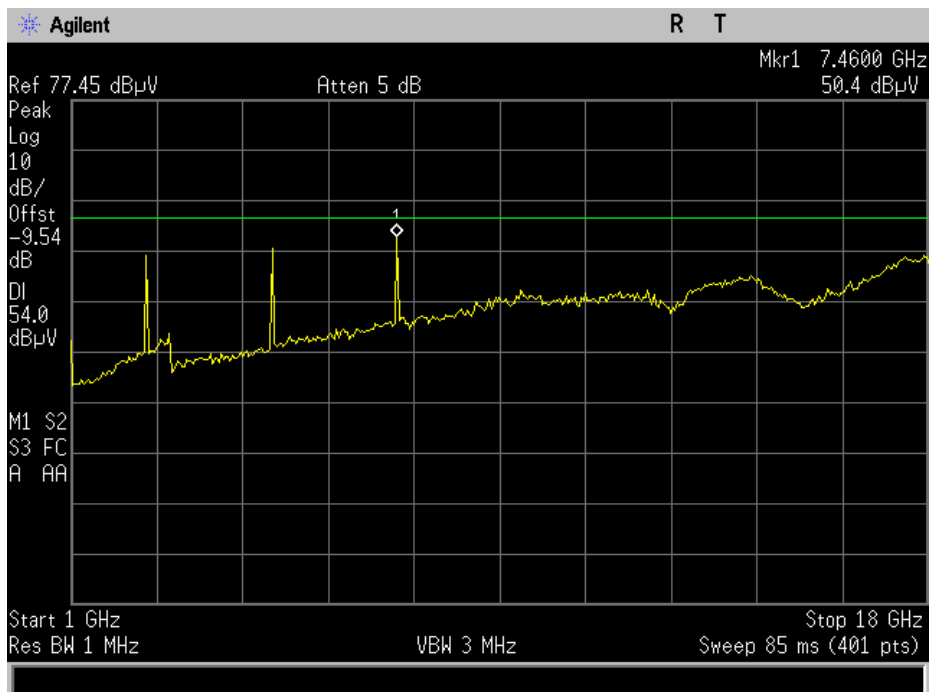




Tuned Frequency = 2440 MHz



Tuned Frequency = 2480 MHz





Emissions at Band Edges

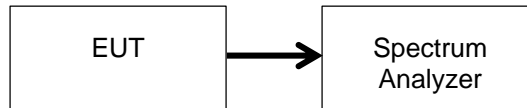
Engineer: Alex Macon

Test Date: 1/15/16

Test Procedure

The EUT was connected directly to a spectrum analyzer. 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.

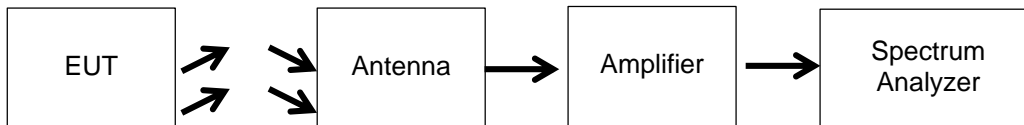
Band Edge Test Setup



Band Edge Emissions Summary

Tuned Frequency (MHz)	Emission Frequency (MHz)	Measured Value (dBc)	Detector	Limit (dBc)	Result
2402	2400	-48.46	Peak	-20	Pass
2480	2483.5	-55.63	Peak	-20	Pass

Restricted Band Test Setup



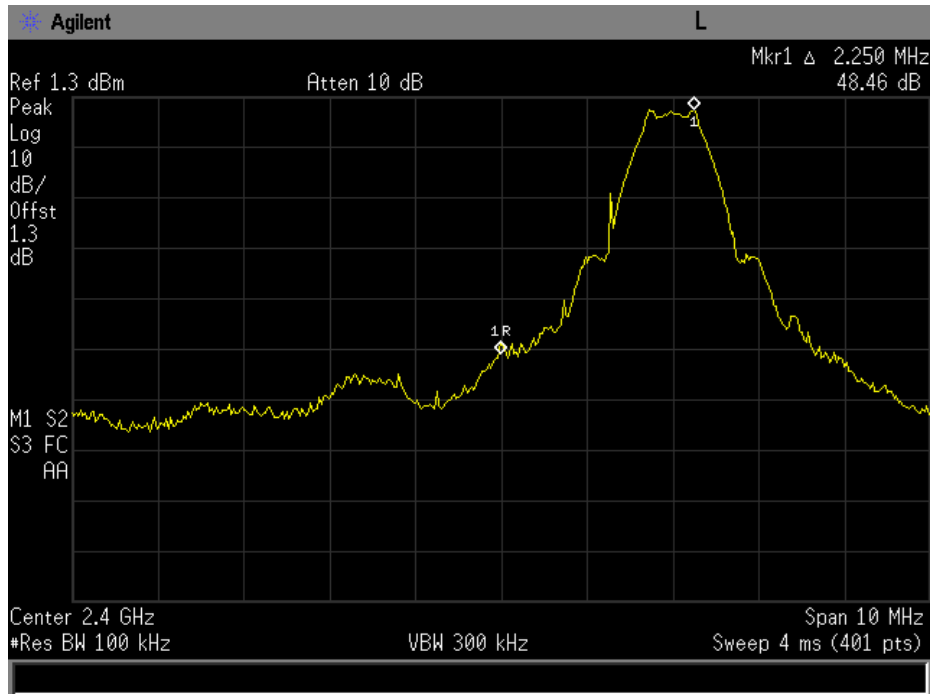
Restricted Band Emissions Summary

Restricted Band (MHz)	Tuned Frequency (MHz)	Emission Frequency (MHz)	Measured Value (dBuV/m)	Detector	Limit (dBuV/m)	Result
2300 – 2390	2402	2306	62.89	Peak	74	Pass
2300 – 2390	2402	2345.2	38.68	Average	54	Pass
2483.5 - 2500	2480	2483.5	*44.66	Peak	74	Pass

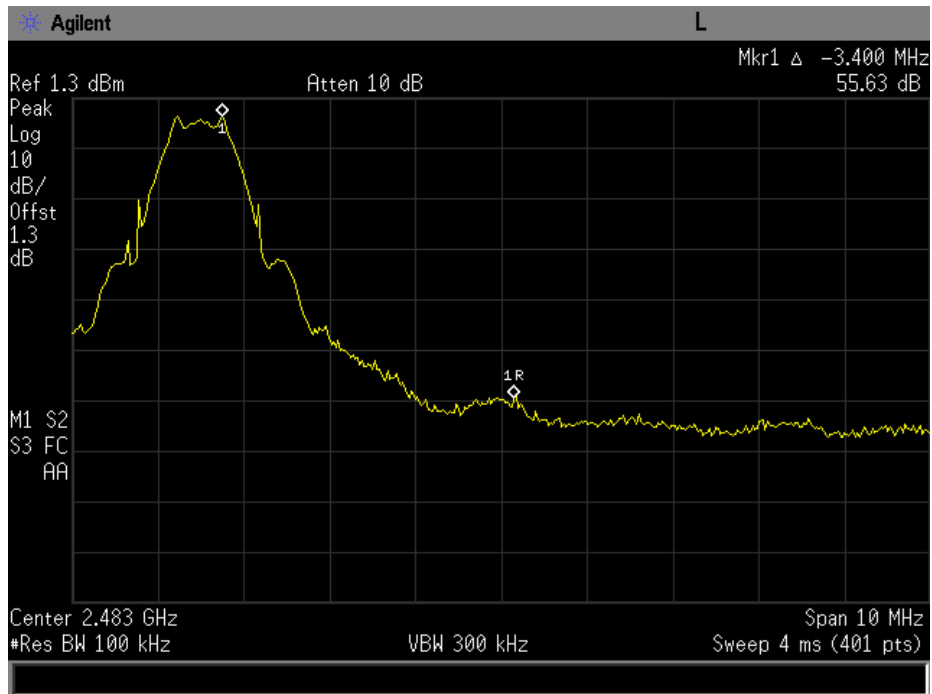
*peak amplitude is below the average limit of 54 dBuV.
Restricted band radiated measurements were taken at 3m.



Band Edge 2400 MHz
Tuned Freq = 2402 MHz

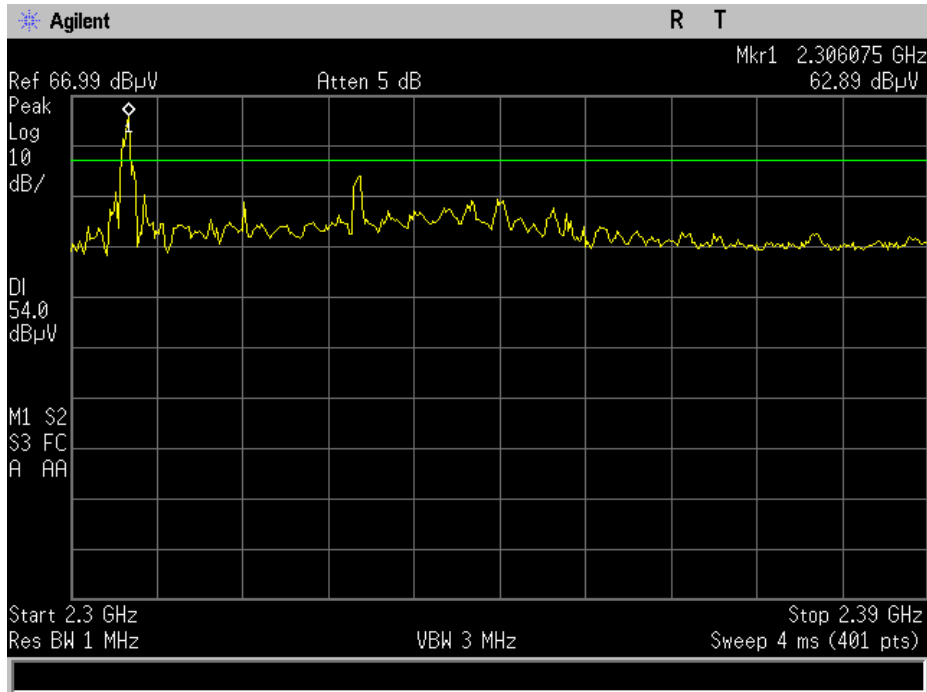


Band Edge 2483.5 MHz
Tuned Freq = 2480 MHz

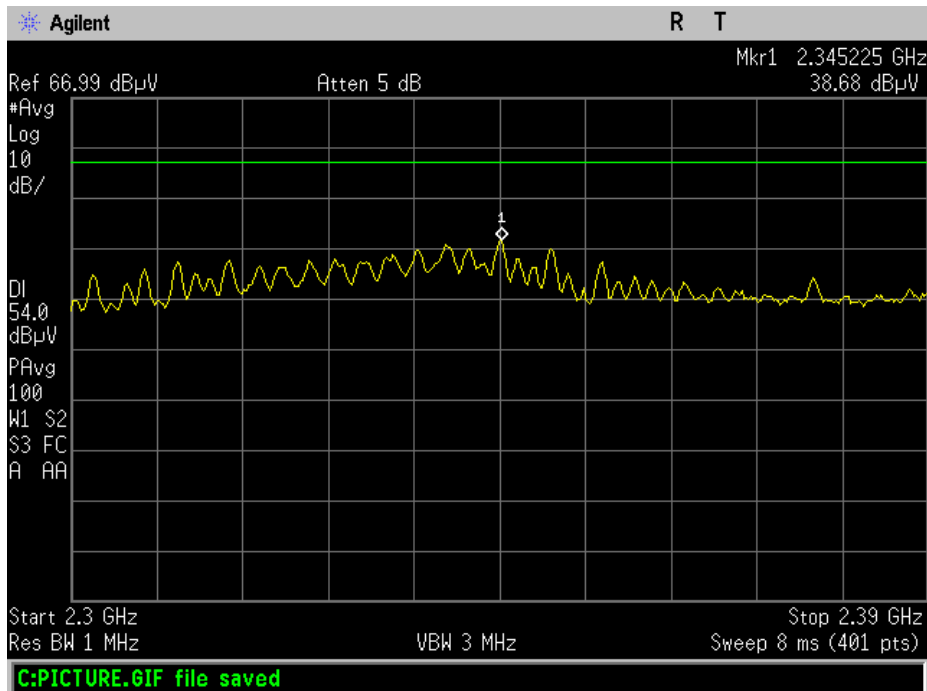




Restricted Band 2300 – 2390 MHz – Peak
Tuned Freq = 2402 MHz

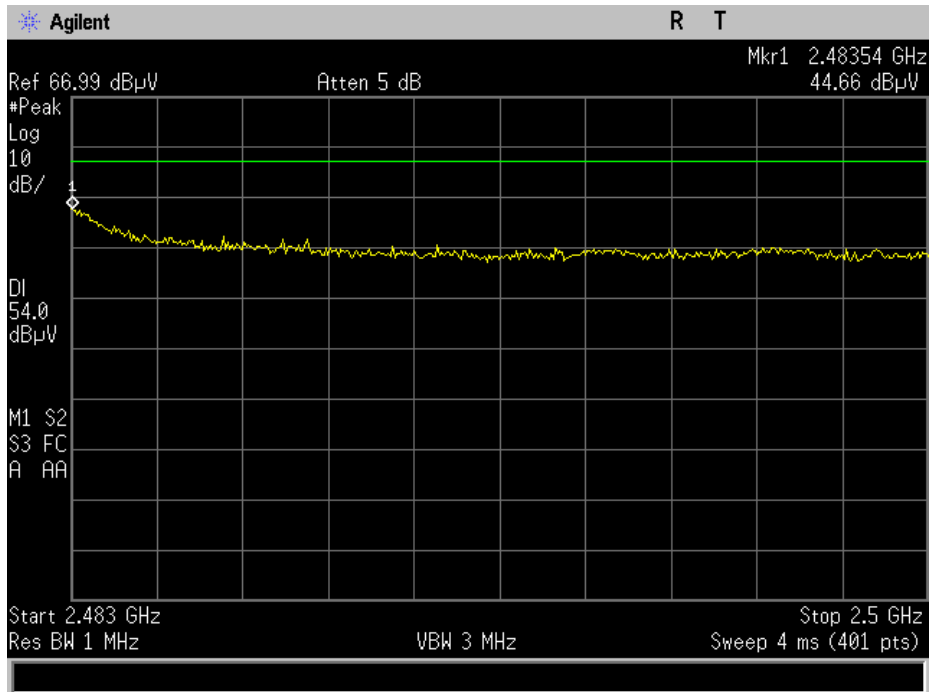


Restricted Band 2300 – 2390 MHz – Avg
Tuned Freq = 2402 MHz





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





Occupied Bandwidth

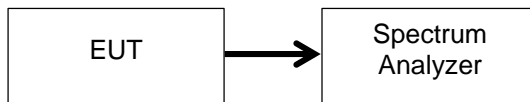
Engineer: Alex Macon

Test Date: 1/15/16

Test Procedure

The EUT was connected directly to a spectrum analyzer. The Span was set wide enough to capture the entire transmit spectrum and the resolution bandwidth was set to at least 1% of the span. The analyzer was set to max hold and when the entire spectrum was captured the 6dB and 99% bandwidths were measured to verify the bandwidth met the specification.

Test Setup



6 dB Occupied Bandwidth Summary

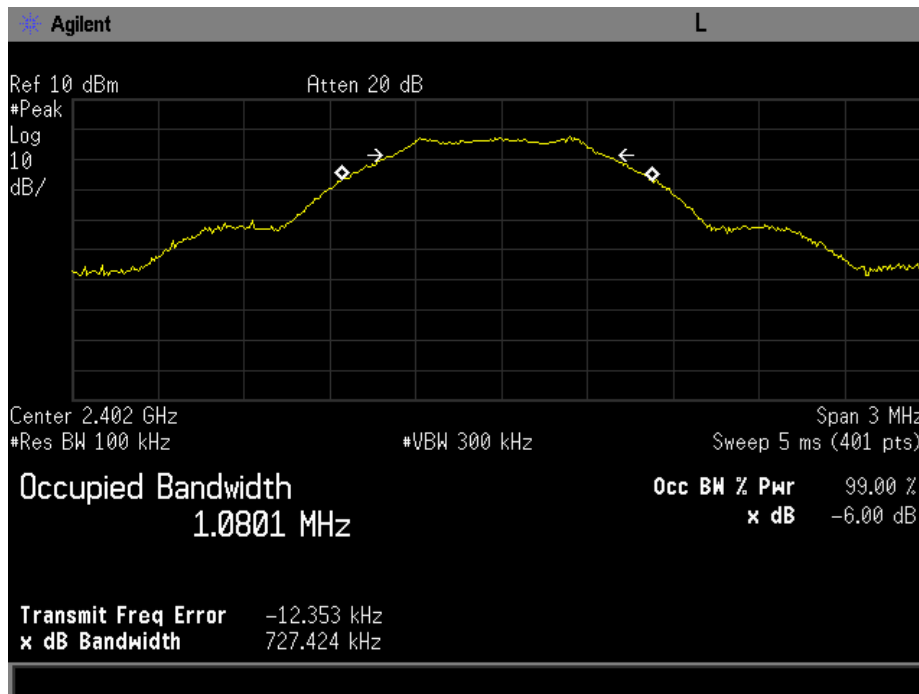
Frequency (MHz)	Measured Bandwidth (kHz)	Specification Limit (kHz)	Result
2402	727.42	≥ 500	Pass
2440	742.67	≥ 500	Pass
2480	757.65	≥ 500	Pass

99% Bandwidth Summary

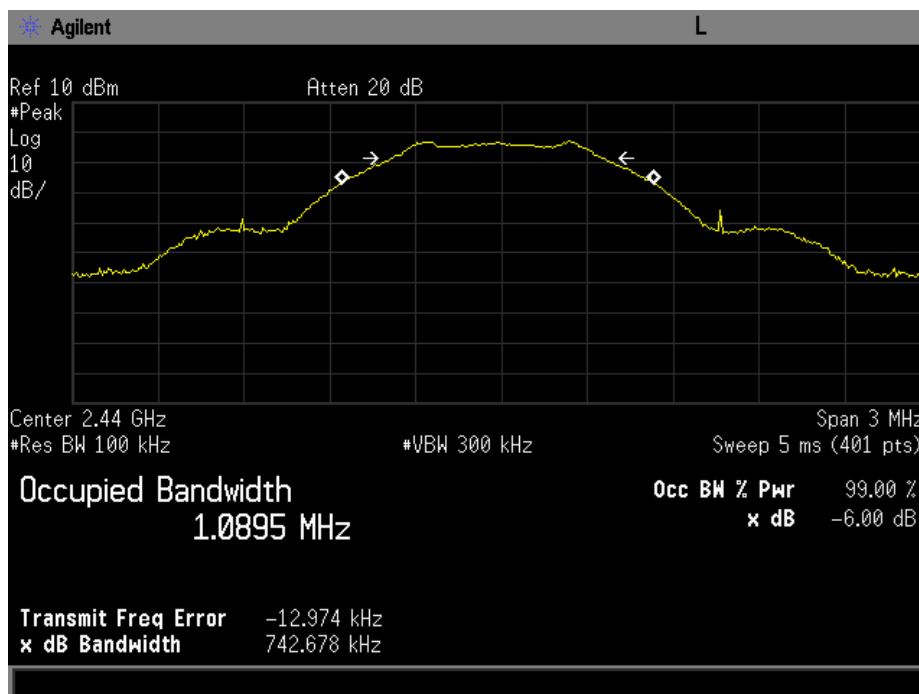
Frequency (MHz)	Measured Bandwidth (MHz)	Result
2402	1.080	Pass
2440	1.089	Pass
2480	1.092	Pass



Bandwidth 2402 MHz

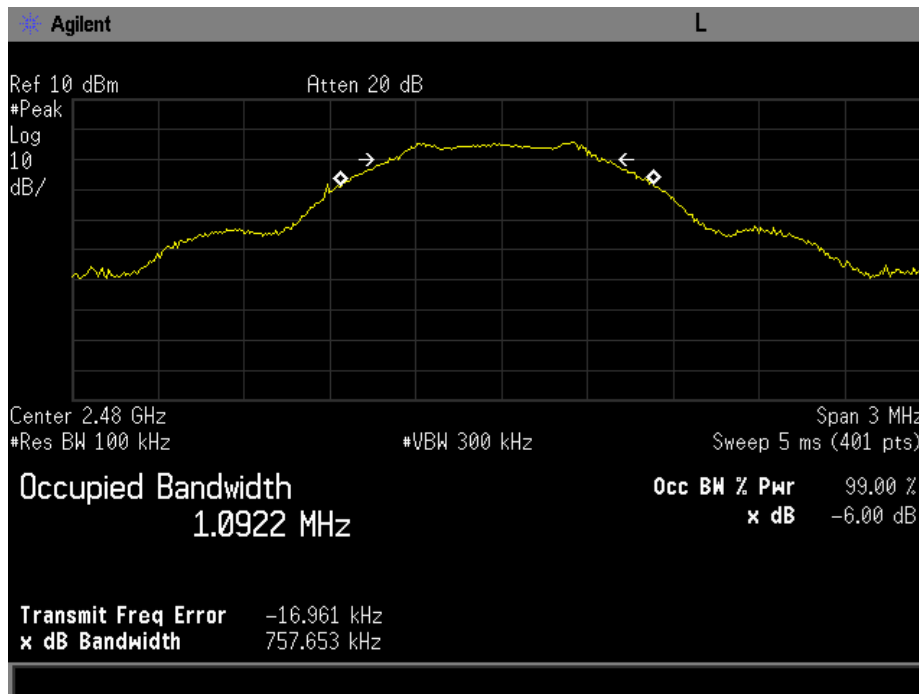


Bandwidth 2440 MHz





Bandwidth 2480 MHz





Transmitter Power Spectral Density (PSD)

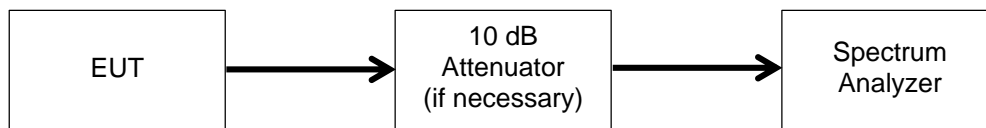
Engineer: Alex Macon

Test Date: 1/15/16

Test Procedure

The EUT was connected directly to a spectrum analyzer. The test was performed per section 6.11.2.3 of C63.10 - 2009 "Procedure for determining PSD for DTS devices".

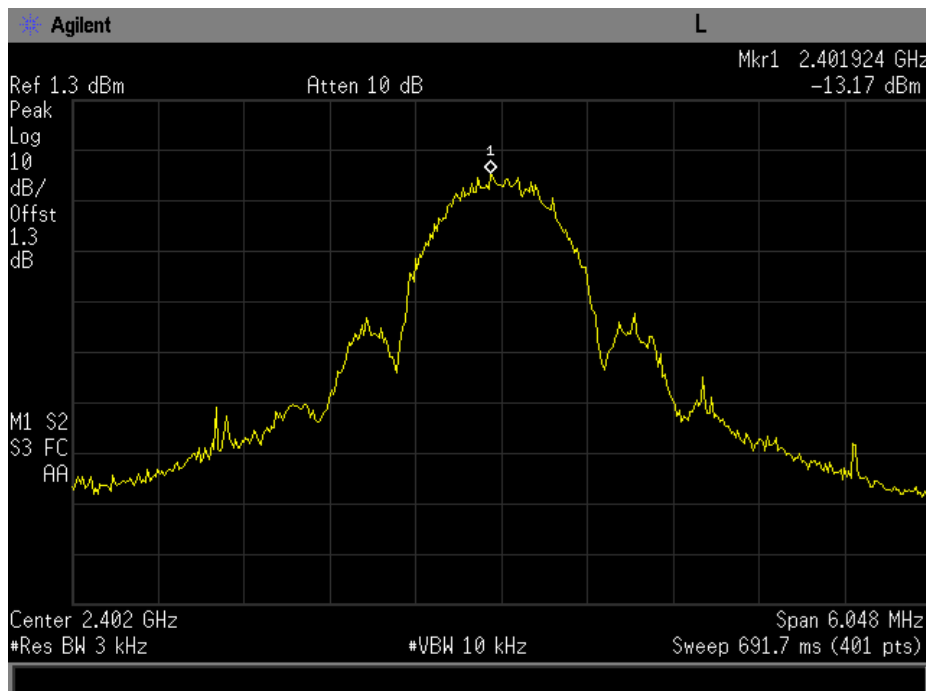
Test Setup



PSD Summary

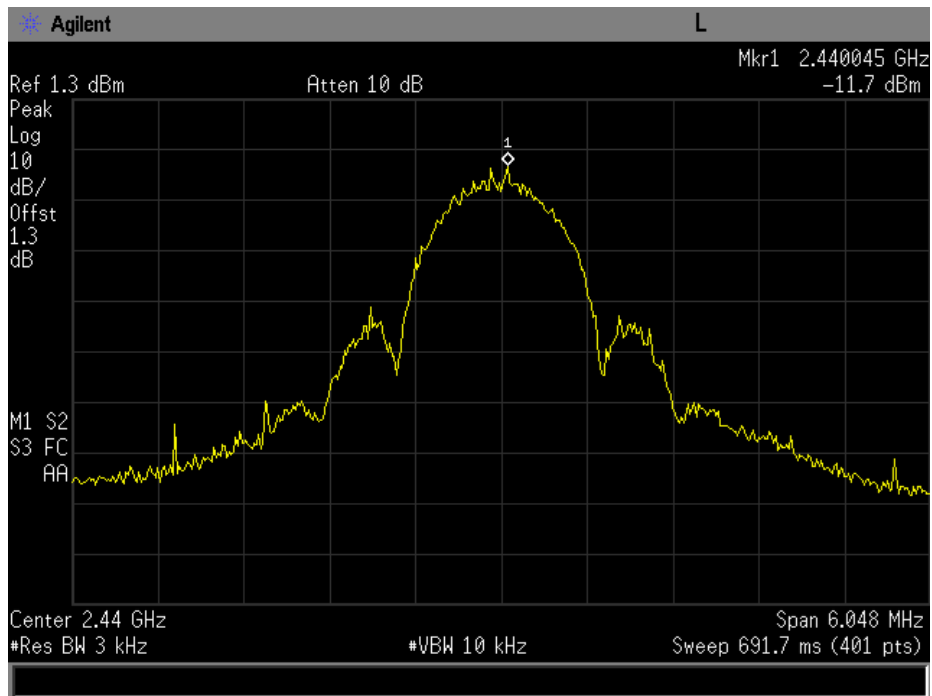
Frequency (MHz)	Measured Data (dBm)	Specification Limit (dBm)	Result
2402	-13.17	8	Pass
2440	-11.7	8	Pass
2480	-15.08	8	Pass

PSD 2402 MHz

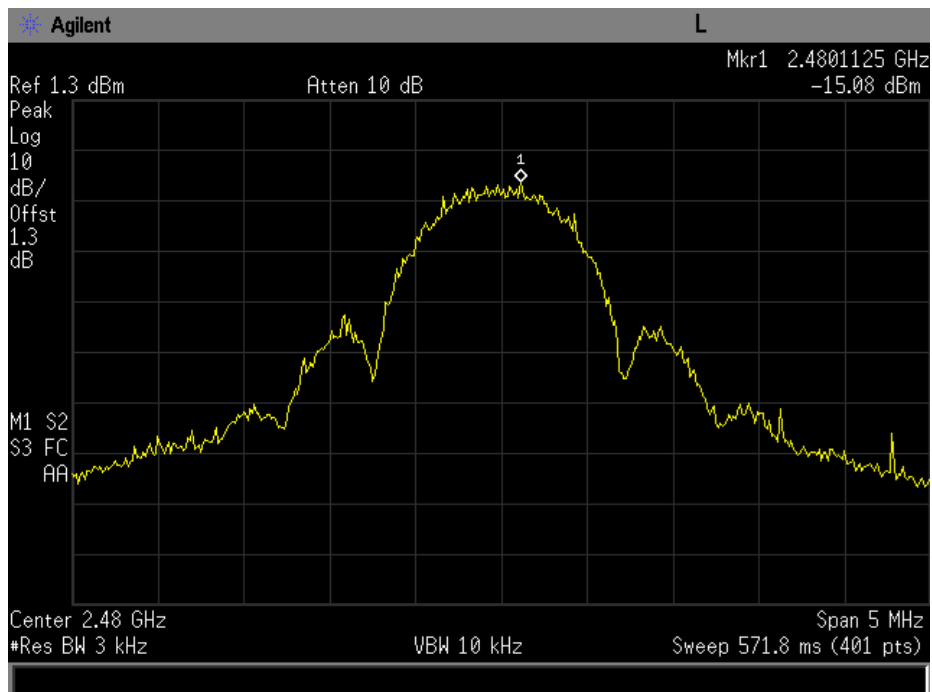




PSD 2440 MHz



PSD 2480 MHz





Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
High Pass Filter	Trilithic	4HX3400-3-XX	i00177	Verified on: 1/15/16	
Horn Antenna, Amplified	ARA	DRG-118/A	i00271	5/8/14	5/8/16
Horn Antenna, Amplified	ARA	MWH-1826/B	i00273	4/22/15	4/22/18
Humidity / Temp Meter	Newport	IBTHX-W-5	i00282	4/1/15	4/1/16
Voltmeter	Fluke	87III	i00319	2/20/15	2/20/16
Voltmeter	Fluke	75III	i00320	3/24/15	3/24/16
Spectrum Analyzer	Agilent	E4407B	i00331	9/18/15	9/18/16
Bi-Log Antenna	Schaffner	CBL 6111D	i00349	10/19/15	10/19/17
EMI Analyzer	Agilent	E7405A	i00379	2/5/15	2/5/16
3 Meter Semi-Anechoic Chamber	Panashield	3 Meter Semi-Anechoic Chamber	i00428	7/27/14	7/27/16

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