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FCC CFR47 Part 15.247 DTS Test Report

Prepared for: Blackboard, Inc

Model: VR4101

Description: Vending Card Reader

to

Federal Communications Commission

Rule Part(s) 15.247

Date of Issue: June 23, 2011

On the behalf of the applicant:

**Blackboard, Inc.
22601 N 19th Ave
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Phoenix, AZ 85027**

Attention of:

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**Prepared by
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Project No: p1160003**

**John Erhard
Project Test Engineer**



Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	June 23, 2011	John Erhard	Original Document



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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 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 in the table below

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

Testing Certificate Number: **2152.01**



FCC OATS Reg, #933597

IC Reg. #2044A-1

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 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 specify 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	Humidity	Pressure
26.10	31.20	962.80

EUT Description

Vending machine card reader with integrated Wi-Fi and RFID

EUT Operation during Tests

The EUT utilized test software to run in continuous modulated and CW mode for testing purposes.

Accessories			
Qty	Type	Make, Model	S/N
None			

Cables					
Qty	Type	Length (m)	Shield	Shielded Hood	Ferrite
1	CAT-5	3	No	No	No



Test Results 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	Pass	
RSS GEN6(b)	Receiver Spurious Emissions	Pass	

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



Peak Output Power

Name of Test: Peak Output Power

Specification: 15.247(b)

Engineer: John Erhard

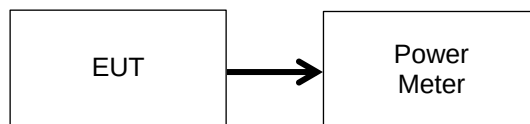
Test Equipment Utilized: i00331

Test Date: 6/22/2011

Test Procedure

The EUT was connected directly to a power meter input. The peak readings were taken and the result was then compared to the limit.

Test Setup



11 MB Transmitter Peak Output Power

Tuned Frequency MHz	Measured Data dBm	Specification Limit	Result
2412	4.78	1 W (30 dBm)	Pass
2437	4.92	1 W (30 dBm)	Pass
2462	4.96	1 W (30 dBm)	Pass

54 MB Transmitter Peak Output Power

Tuned Frequency MHz	Measured Data dBm	Specification Limit	Result
2412	-5.89	1 W (30 dBm)	Pass
2437	-4.95	1 W (30 dBm)	Pass
2462	-5.02	1 W (30 dBm)	Pass



Conducted Spurious Emission

Name of Test: Conducted Spurious Emissions

Specification: 15.247(d)

Engineer: John Erhard

Test Equipment Utilized: i00331

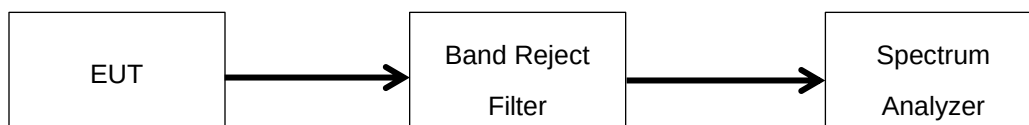
Test Date: 6/22/2011

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



11 MB Conducted Spurious Emissions Summary Test Table

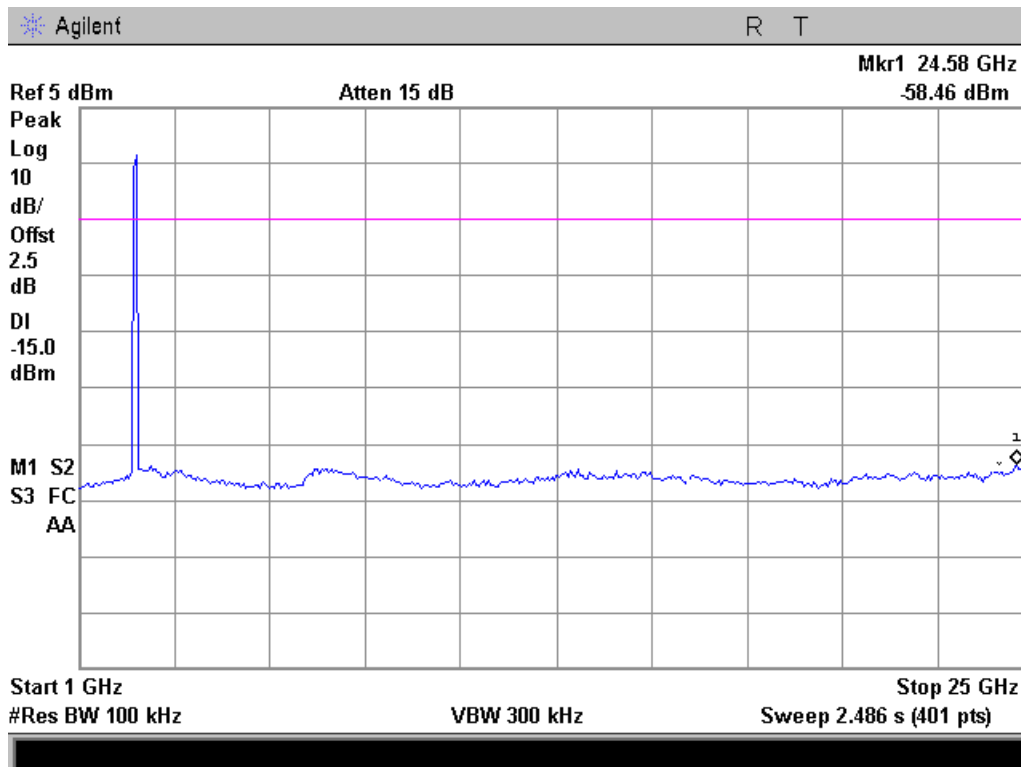
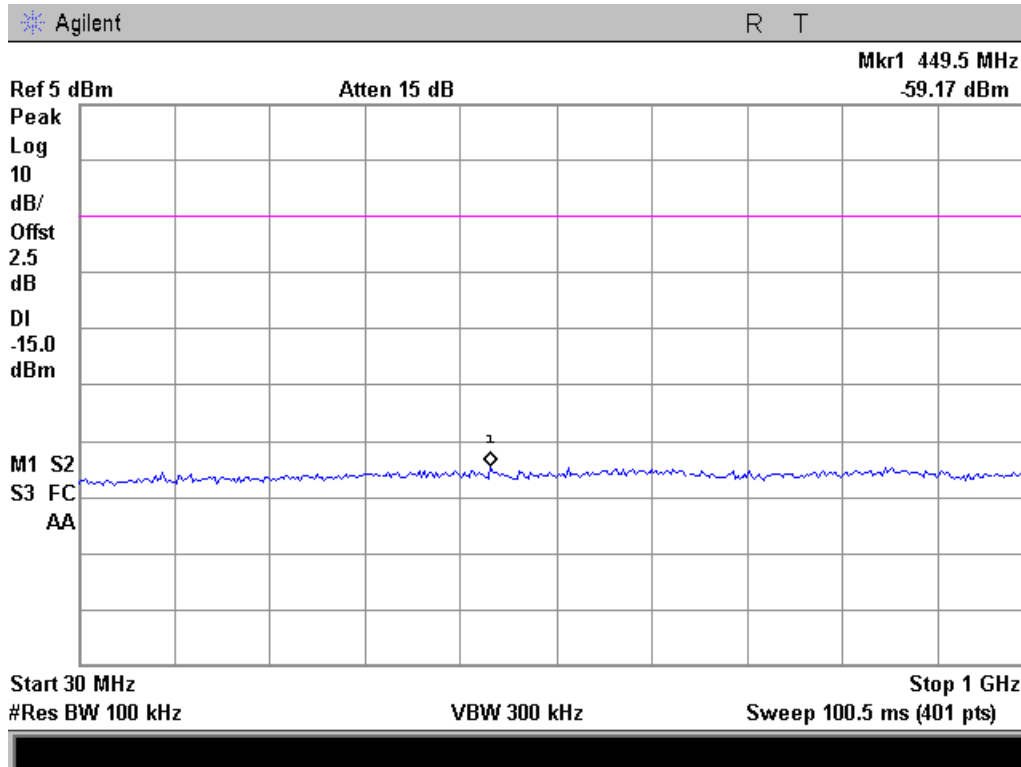
Tuned Frequency MHz	Emission Frequency MHz	Measured Data Value	Specification Limit dBc	Result
2412	24580	-59.17 dBm	-20	Pass
2437	24640	-58.46 dBm	-20	Pass
2462	24760	-59.08 dBm	-20	Pass

54 MB Conducted Spurious Emissions Summary Test Table

Tuned Frequency MHz	Emission Frequency MHz	Measured Data Value	Specification Limit dBc	Result
2412	24700	-68.05 dBm	-20	Pass
2437	24760	-68.71 dBm	-20	Pass
2462	24700	-68.90 dBm	-20	Pass

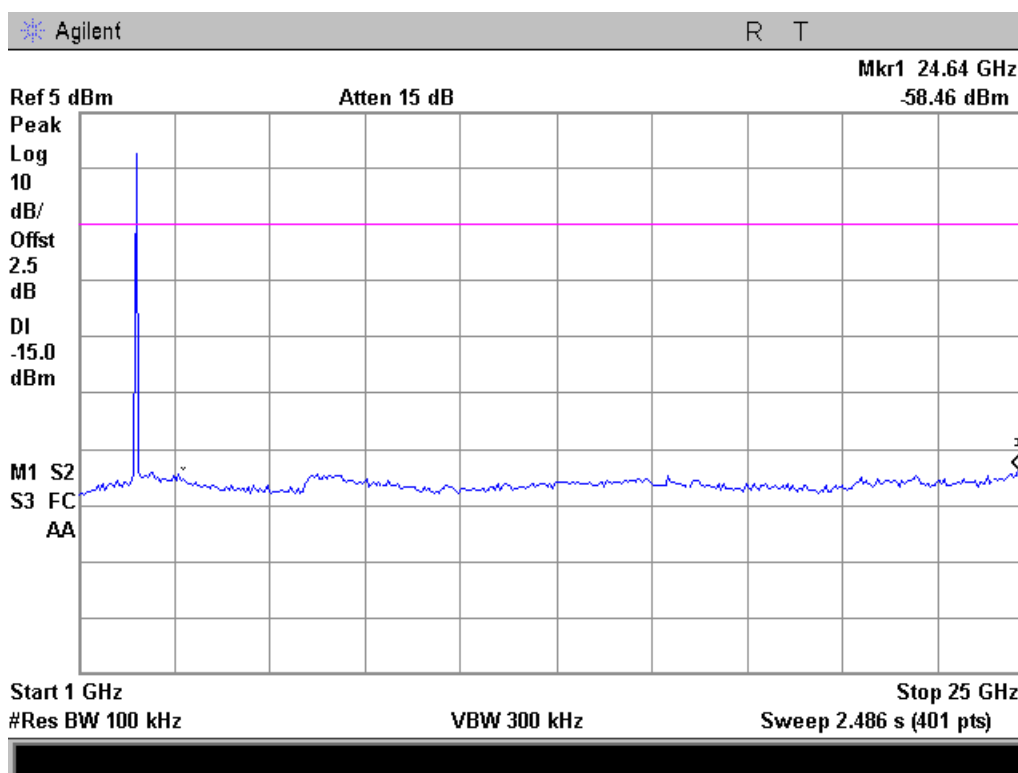
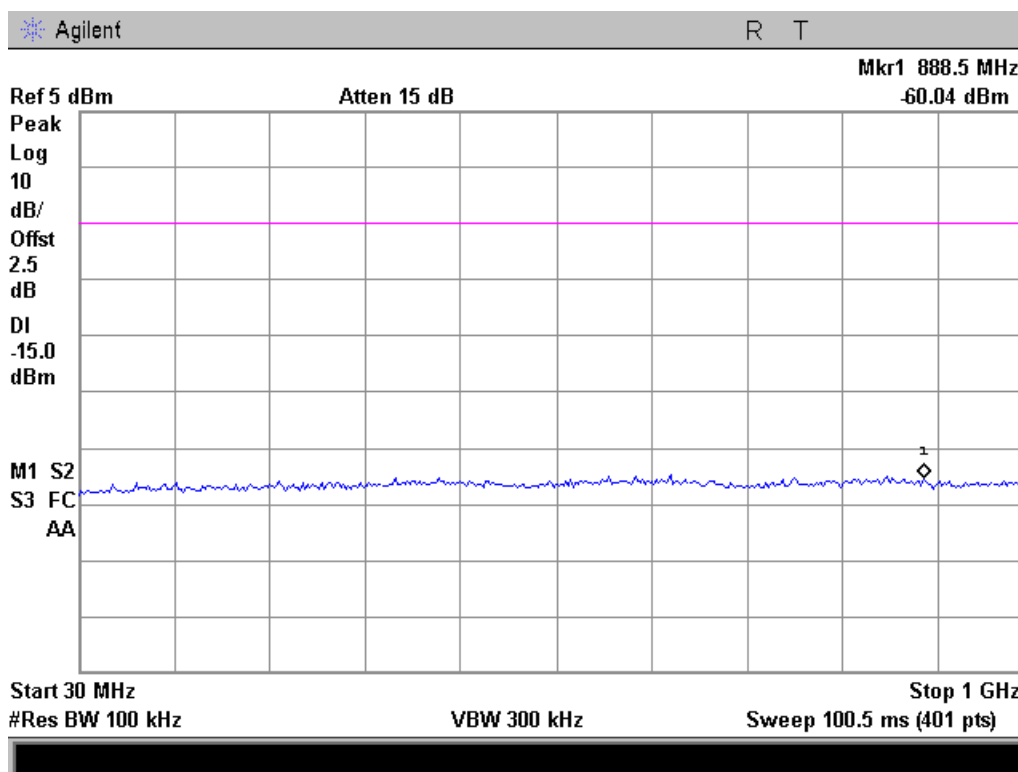


11 MB Conducted Spurious Emissions Tuned Freq=2412 MHz



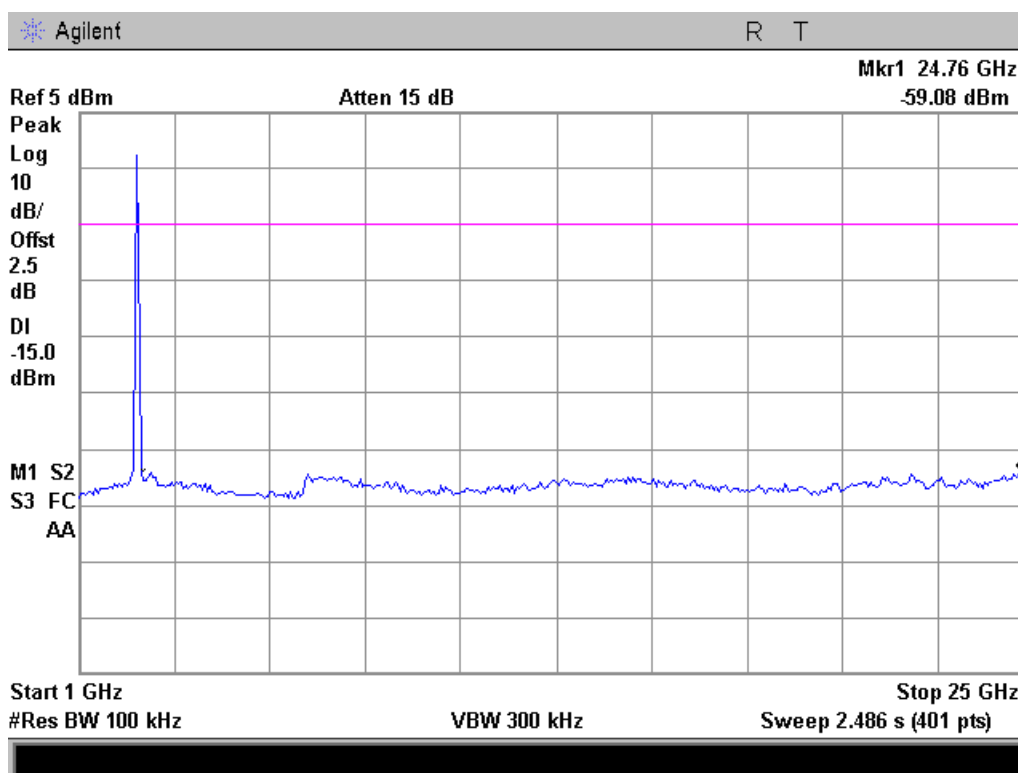
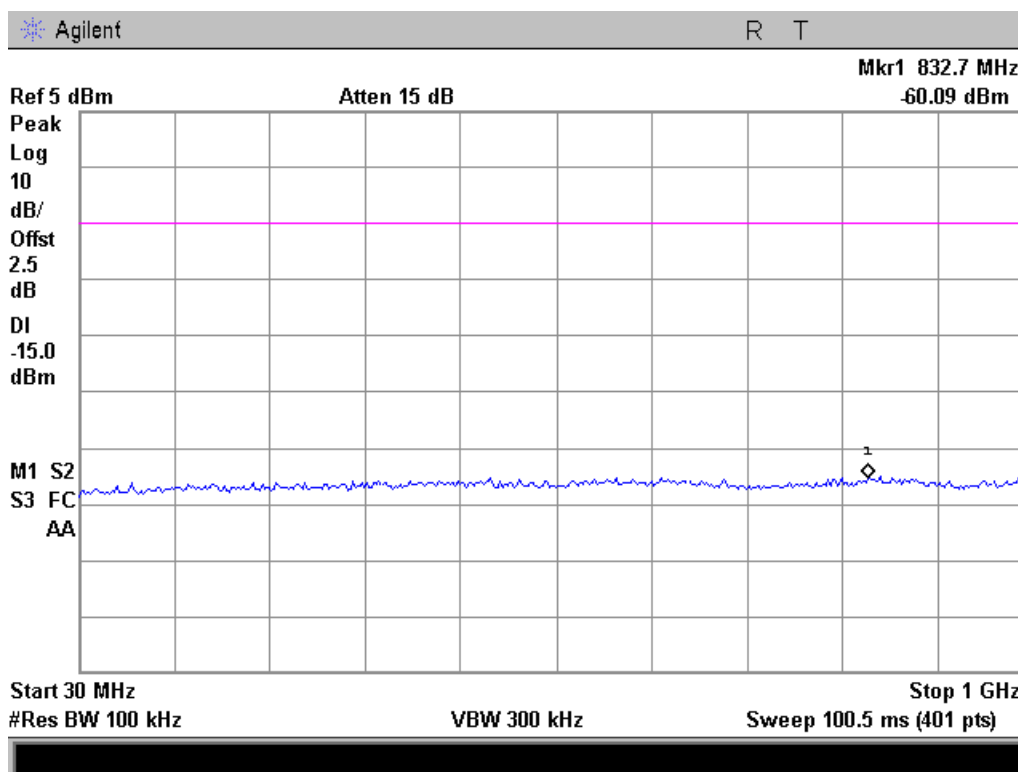


Tuned Freq=2437 MHz



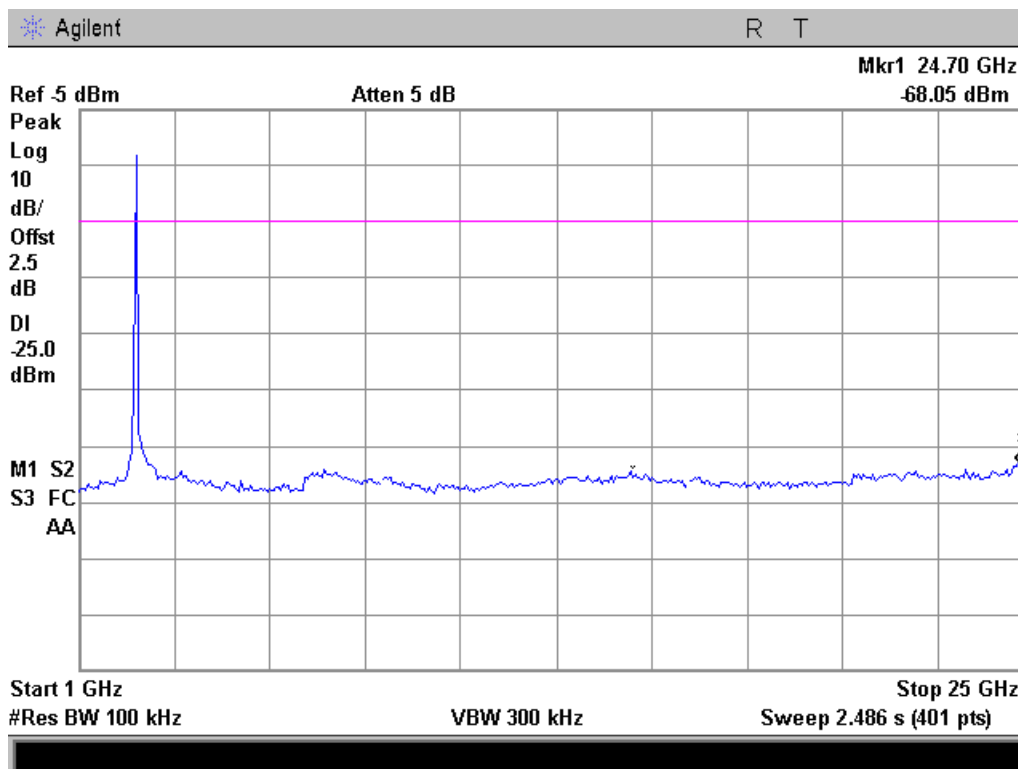
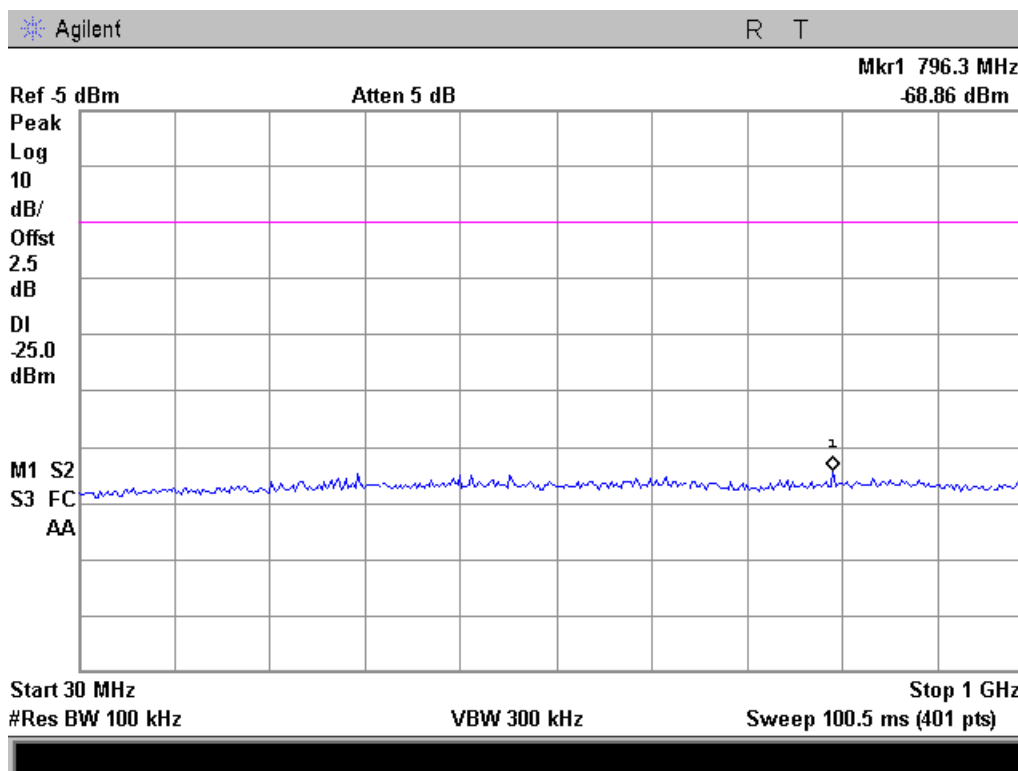


Tuned Freq=2462 MHz



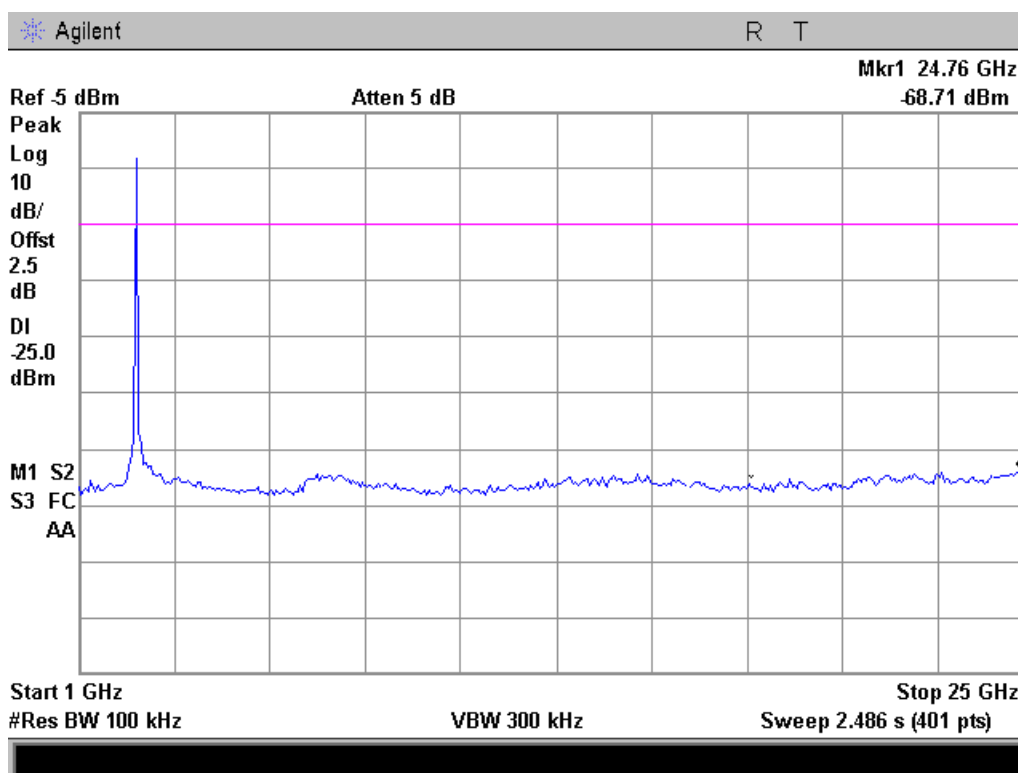
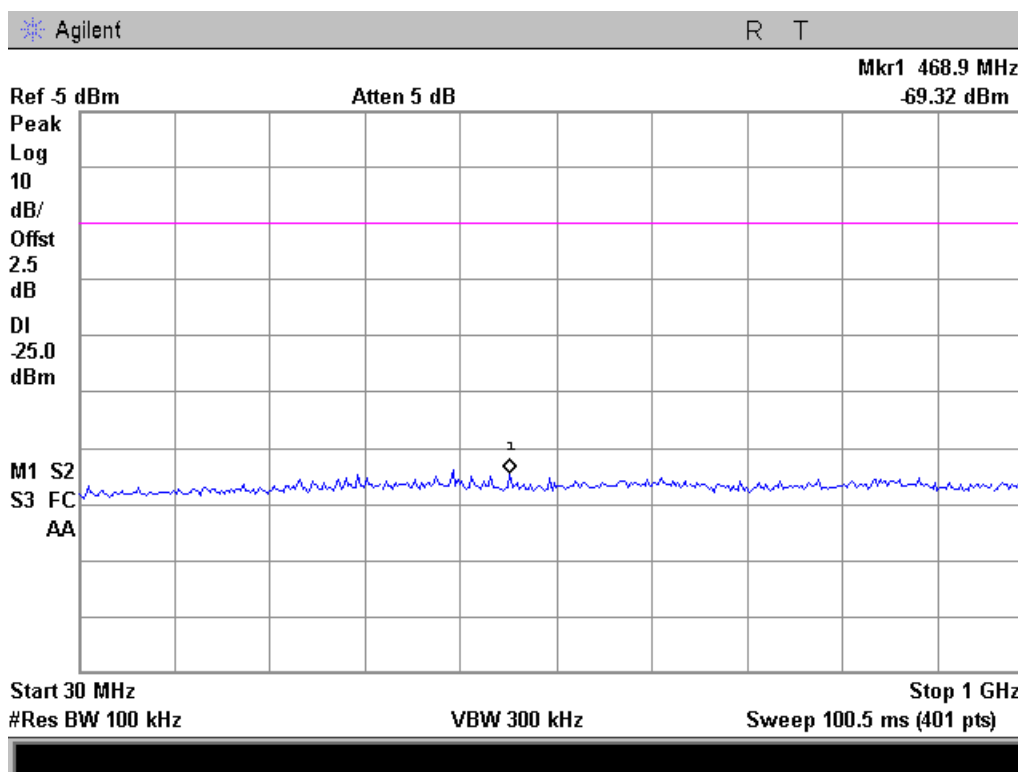


54 MB Conducted Spurious Emissions Tuned Freq=2412 MHz



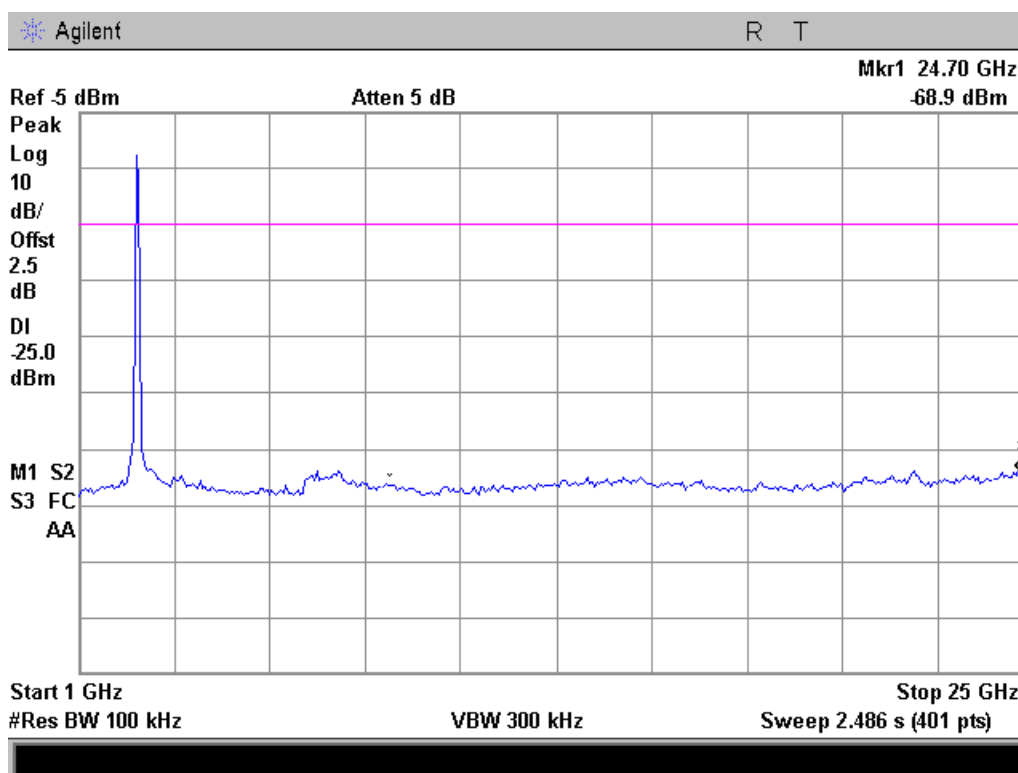
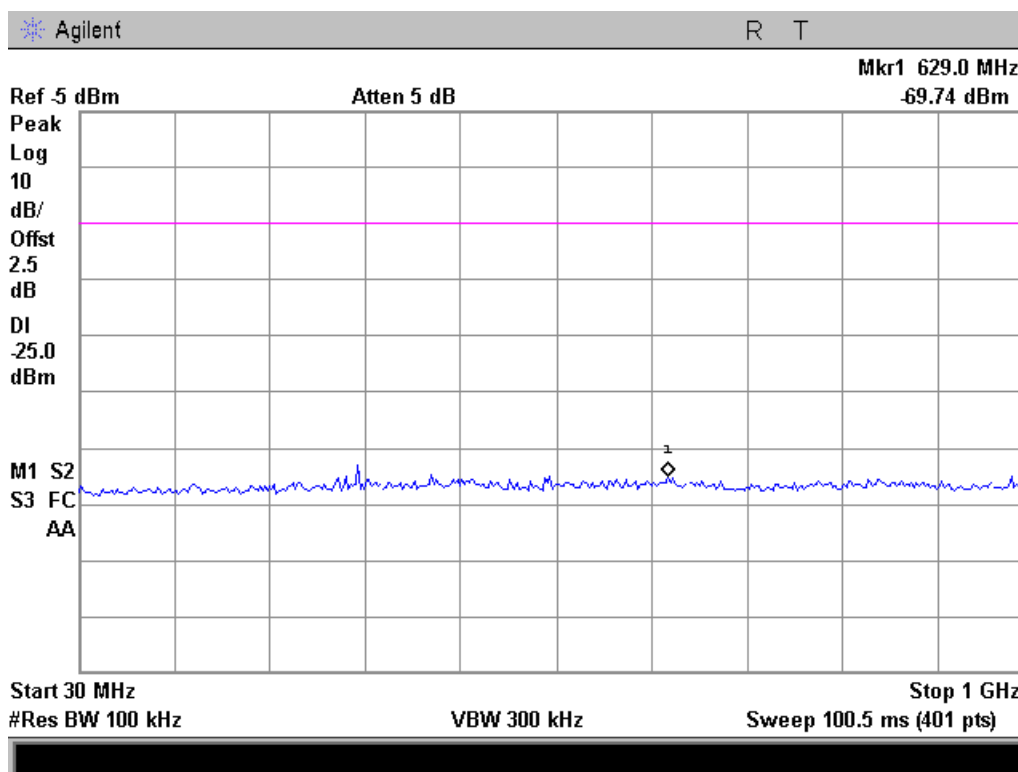


Tuned Freq=2437 MHz





Tuned Freq=2462 MHz





Radiated Spurious Emissions

Name of Test: Radiated Spurious Emissions

Specification: 15.247(d), 15.209(a), 15.205

Engineer: John Erhard

Test Equipment Utilized: i00028, i00103, i00331, i00033, i00267

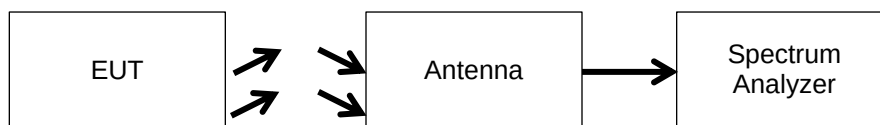
Test Date: 6/22/2011

Test Procedure Radiated Spurious Emissions: 30 – 1000 MHz

The EUT was tested in an Open Area Test Site (OATS) 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.

RBW = 120 KHz,
VBW = 300 KHz
Detector – Quasi Peak

Test Setup



Radiated Emissions

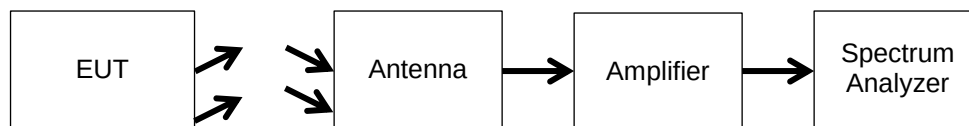
Emission Freq (MHz)	Measured Value (dBuV/m)	Correction Factor (dB)	Corrected Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
160.795	18.020	12.086	30.106	43.500	-13.394
158.725	25.530	12.277	37.807	43.500	-5.693
144.975	17.630	13.039	30.669	43.500	-12.831
37.300	1.830	16.313	18.143	40.000	-21.857
314.860	27.740	15.681	43.421	46.000	-2.579
645.000	5.060	22.437	27.497	46.000	-18.503



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.

Test Setup



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

11 MB Radiated Spurious Emissions

Tuned Freq (MHz)	Emission Freq (MHz)	Peak Measured Value (dBuV/m)	Peak Limit (dBuV/m)	Average Measured Value (dBuV/m)	Average Limit (dBuV/m)	Result
2412	4824	54.12	74.0	45.81	54.0	Pass
2412	7236	52.92	74.0	43.00	54.0	Pass
2412	9636	53.73	74.0	44.89	54.0	Pass
2437	4874	52.48	74.0	44.06	54.0	Pass
2437	7311	51.33	74.0	43.80	54.0	Pass
2437	9748	54.55	74.0	45.20	54.0	Pass
2462	4924	50.24	74.0	41.49	54.0	Pass
2462	7386	50.84	74.0	44.45	54.0	Pass
2462	9848	54.51	74.0	46.27	54.0	Pass

54 MB Radiated Spurious Emissions

Tuned Freq (MHz)	Emission Freq (MHz)	Peak Measured Value (dBuV/m)	Peak Limit (dBuV/m)	Average Measured Value (dBuV/m)	Average Limit (dBuV/m)	Result
2412	4824	37.80	74.0	31.82	54.0	Pass
2412	7236	41.15	74.0	35.37	54.0	Pass
2412	9636	42.43	74.0	36.77	54.0	Pass
2437	4874	38.26	74.0	31.62	54.0	Pass
2437	7311	40.20	74.0	36.48	54.0	Pass
2437	9748	42.97	74.0	37.10	54.0	Pass
2462	4924	37.00	74.0	32.91	54.0	Pass
2462	7386	42.28	74.0	35.91	54.0	Pass
2462	9848	41.74	74.0	36.58	54.0	Pass



Emissions at Band Edges

Name of Test: Emissions At Band Edges

Specification: 15.247(d), 15.209(a), 15.205

Engineer: John Erhard

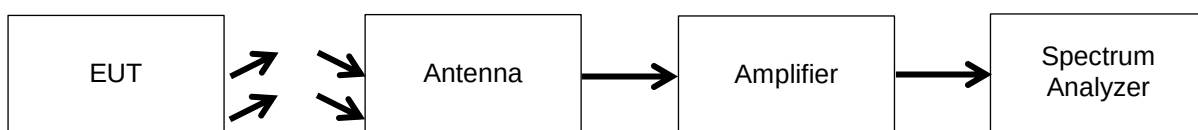
Test Equipment Utilized: i00028, i00103, i00331

Test Date: 6/22/2011

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 were obtained. For the restricted band the amplifier and band reject filter correction factors were also input to the spectrum analyzer.

Band Edge and Restricted Band Test Setup



11 MB Band Edge Emissions Summary

Tuned Freq (MHz)	Emission Freq (MHz)	Measured Data (dBc)	Detector	Limit (dBc)	Result
2412	2400	42.32	Peak	-20 dBc	Pass
2462	2483.5	44.09	Peak	-20dBc	Pass

11 MB Restricted Band Emissions Summary

Restricted Band (MHz)	Tuned Freq (MHz)	Emission Freq (MHz)	Measured Data (dBuV/m)	Detector	Limit (dBuV/m)	Result
2300 – 2390	2412	2328.25	43.87	Peak	74	Pass
2300 – 2390	2412	2312.10	36.50	Average	54	Pass
2483.5 - 2500	2462	2490.02	51.10	Peak	74	Pass
2483.5 - 2500	2462	2493.24	43.11	Average	54	Pass

54 MB Band Edge Emissions Summary

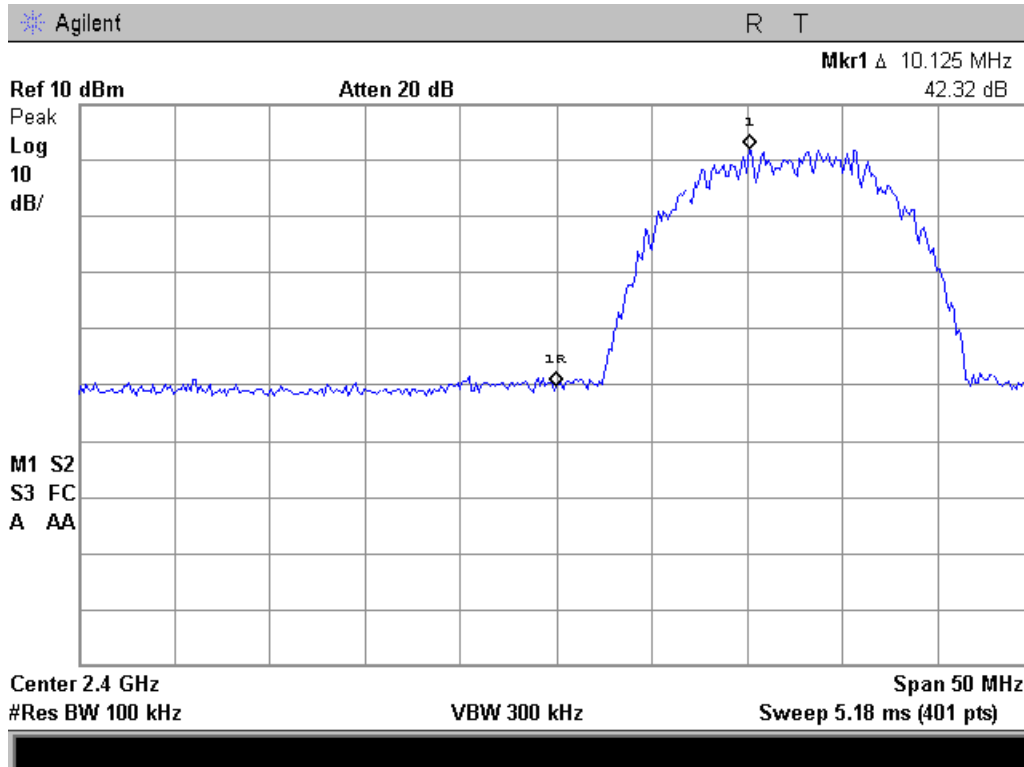
Tuned Freq (MHz)	Emission Freq (MHz)	Measured Data (dBc)	Detector	Limit (dBc)	Result
2412	2400	33.45	Peak	-20 dBc	Pass
2462	2483.5	43.58	Peak	-20dBc	Pass

54 MB Restricted Band Emissions Summary

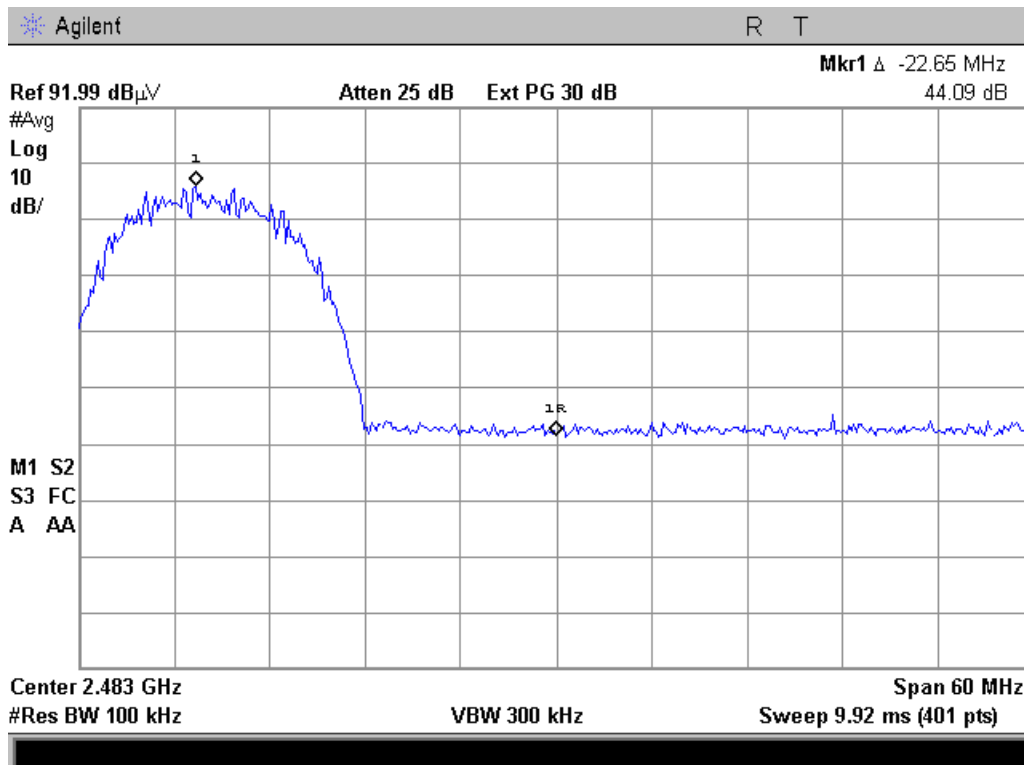
Restricted Band (MHz)	Tuned Freq (MHz)	Emission Freq (MHz)	Measured Data (dBuV/m)	Detector	Limit (dBuV/m)	Result
2300 – 2390	2412	2348.67	45.33	Peak	74	Pass
2300 – 2390	2412	2333.20	37.01	Average	54	Pass
2483.5 - 2500	2462	2488.20	45.71	Peak	74	Pass
2483.5 - 2500	2462	2493.03	36.58	Average	54	Pass



11 MB Band Edge 2400 MHz
Tuned Freq = 2412 MHz

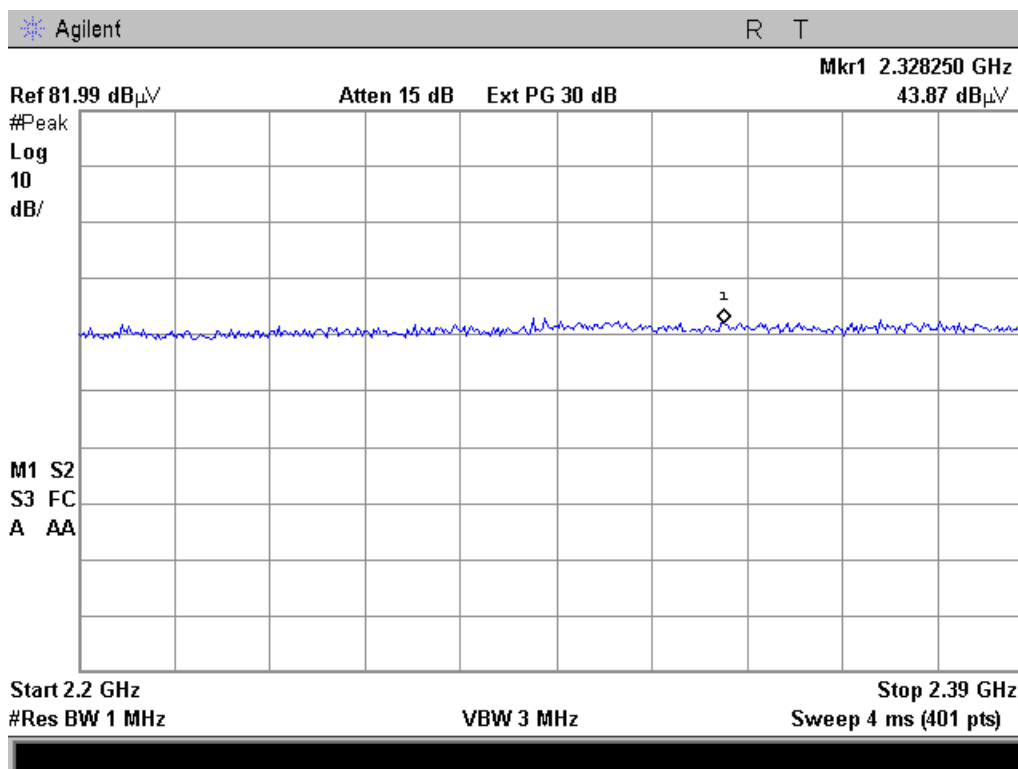


11 MB Band Edge 2483.5 MHz
Tuned Freq = 2462 MHz

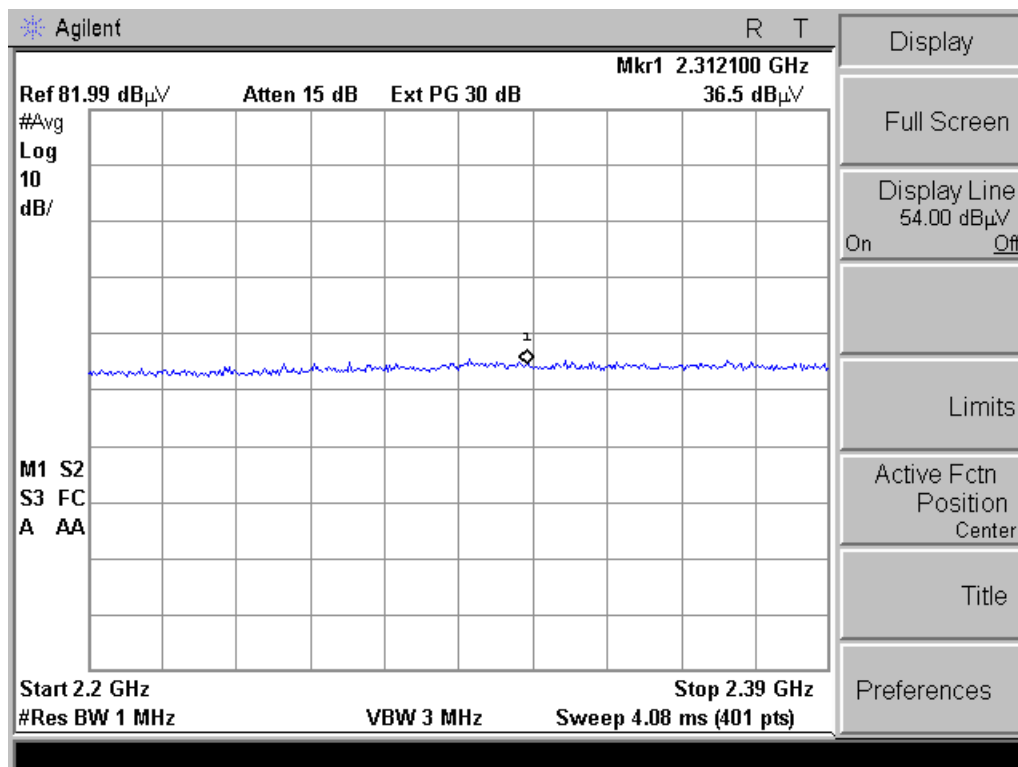




11 MB Restricted Band 2300 – 2390 MHz – Peak
Tuned Freq = 2412 MHz

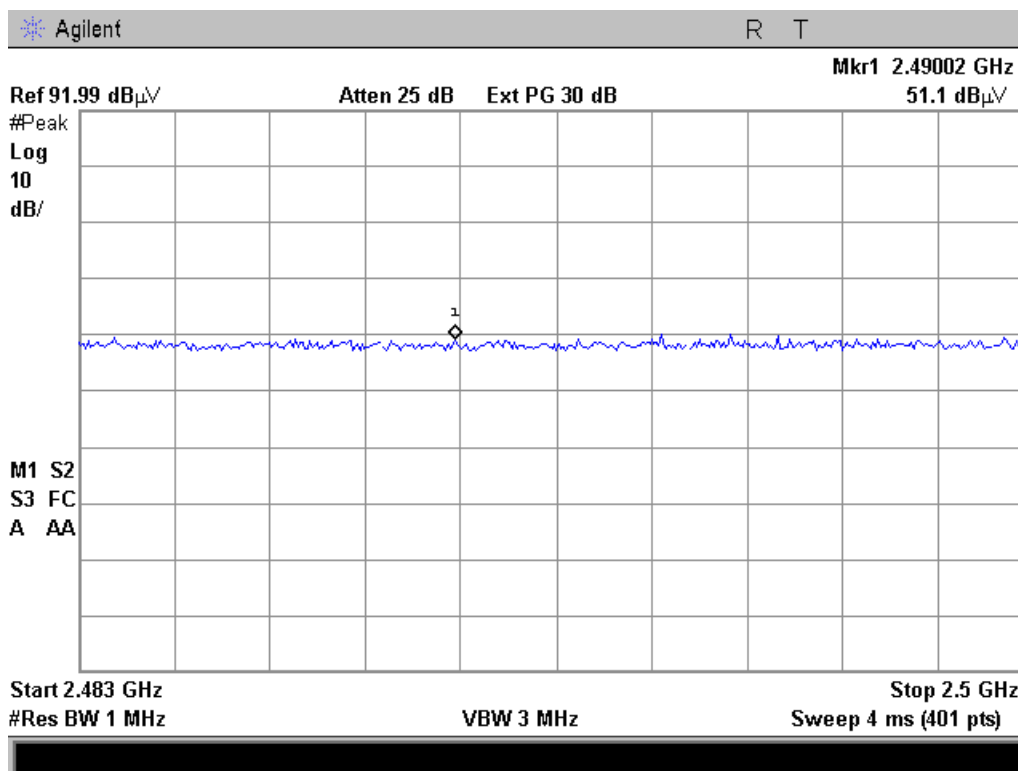


11 MB Restricted Band 2300 – 2390 MHz – Avg
Tuned Freq = 2412 MHz

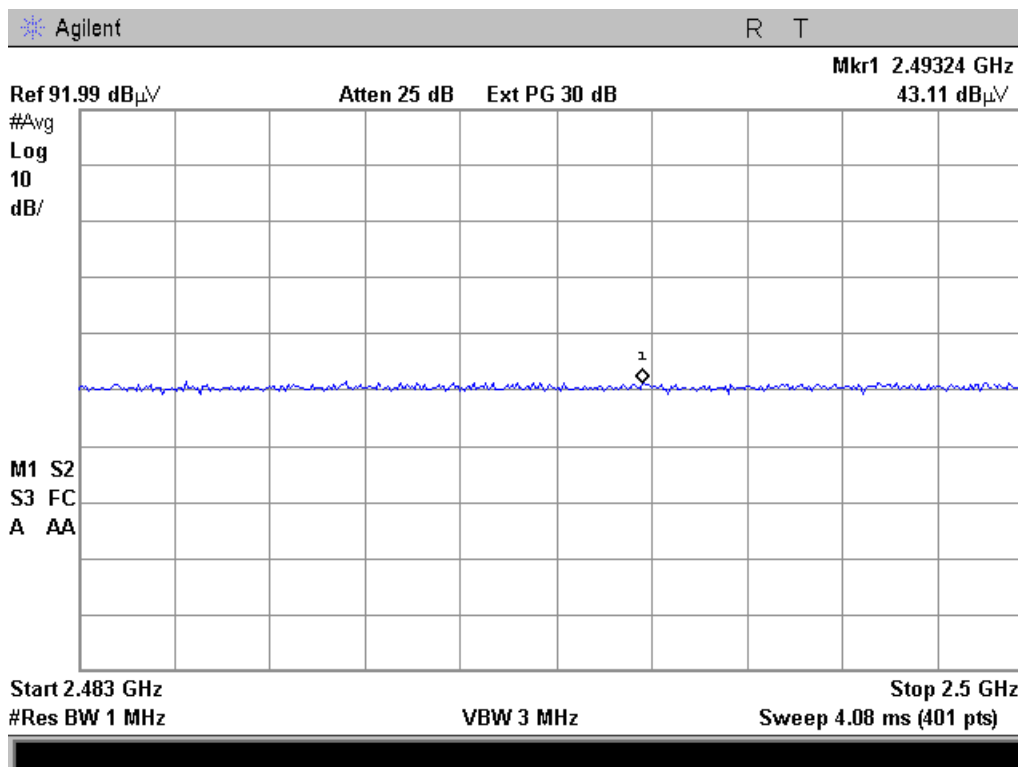




11 MB Restricted Band 2483.5 – 2500 MHz – Peak
Tuned Freq = 2462 MHz

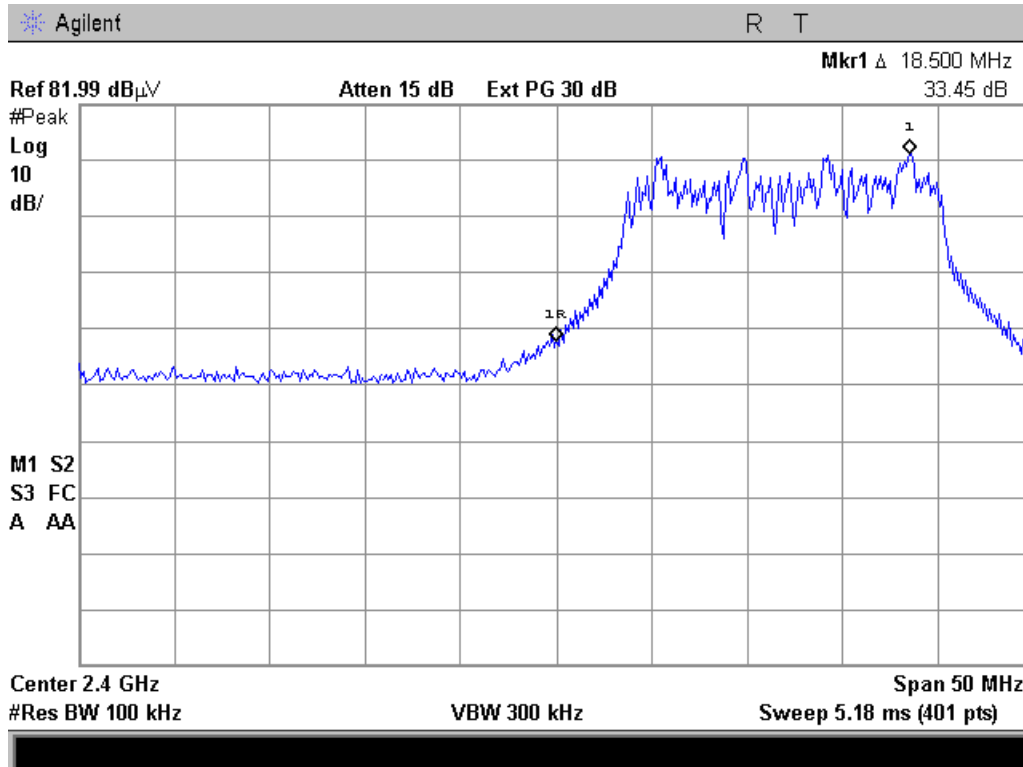


11 MB Restricted Band 2483.5 – 2500 MHz – Avg
Tuned Freq = 2462 MHz

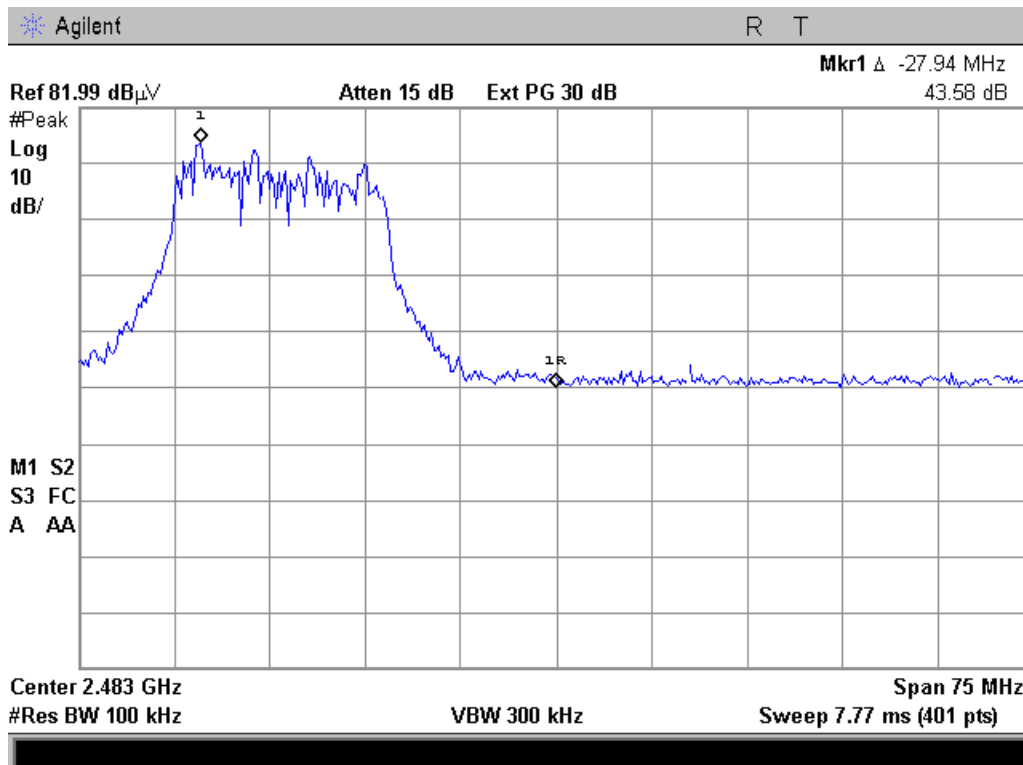




54 MB Band Edge 2400 MHz
Tuned Freq = 2412 MHz

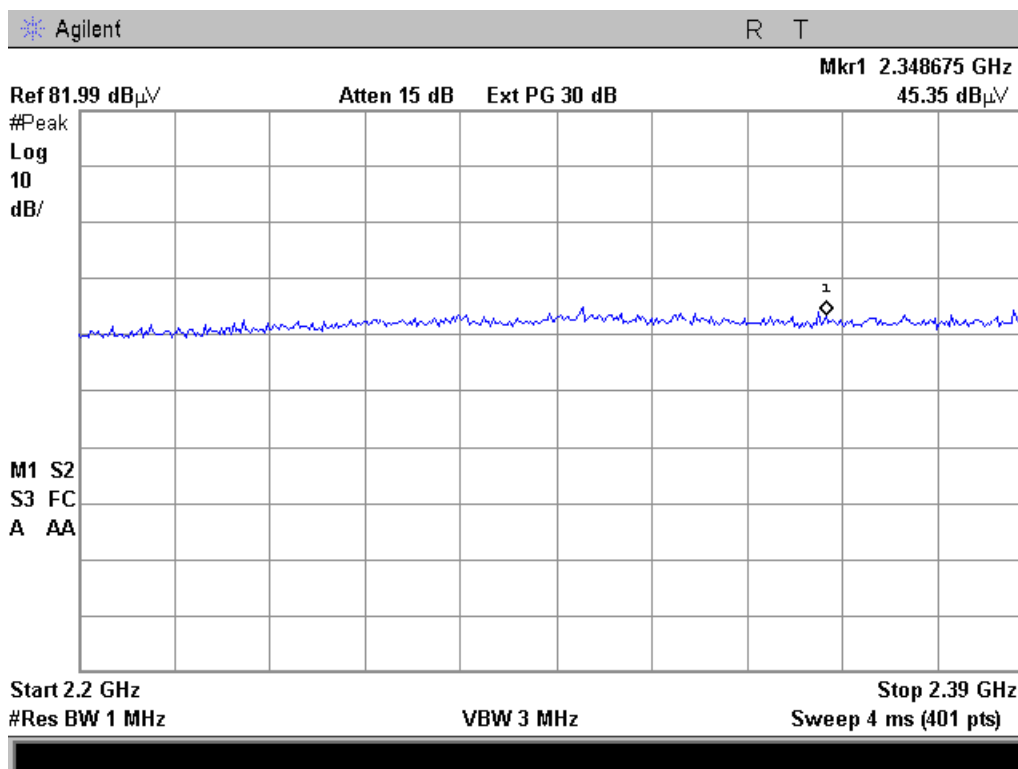


54 MB Band Edge 2483.5 MHz
Tuned Freq = 2462 MHz

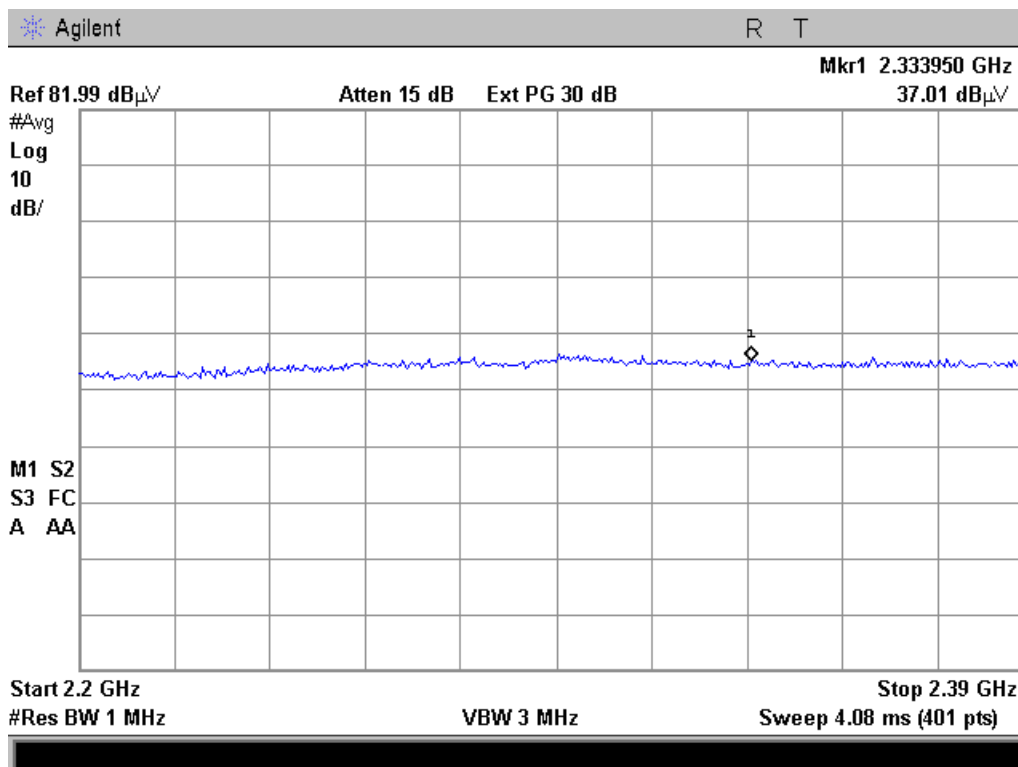




54 MB Restricted Band 2300 – 2390 MHz – Peak
Tuned Freq = 2412 MHz

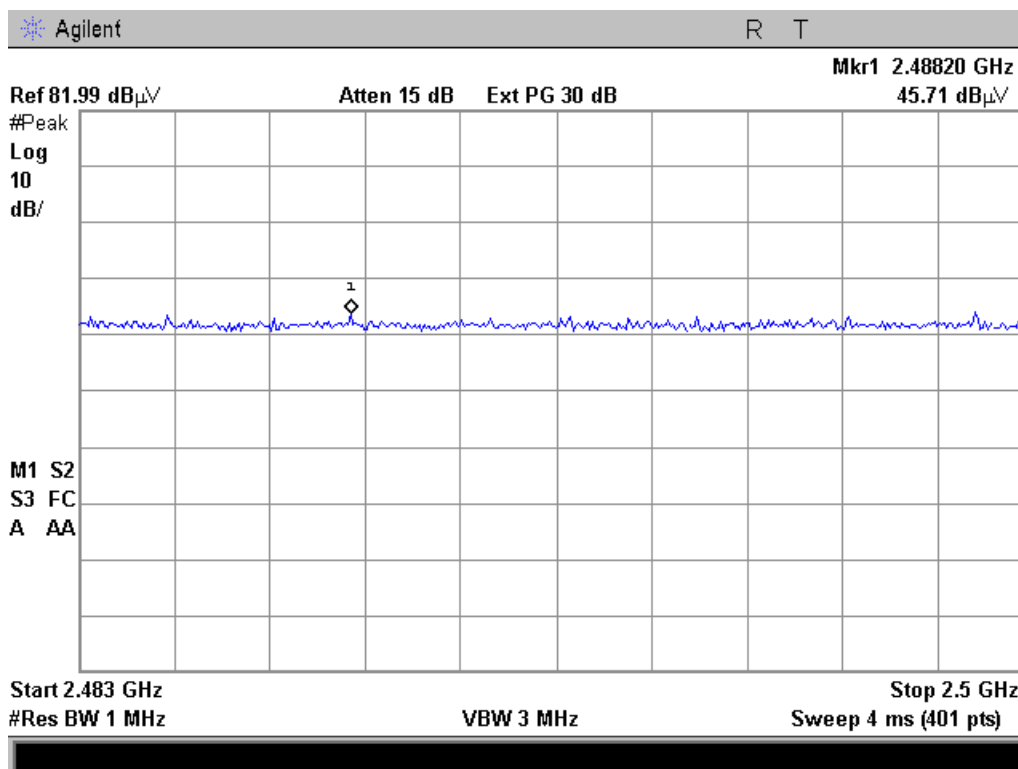


54 MB Restricted Band 2300 – 2390 MHz – Avg
Tuned Freq = 2412 MHz

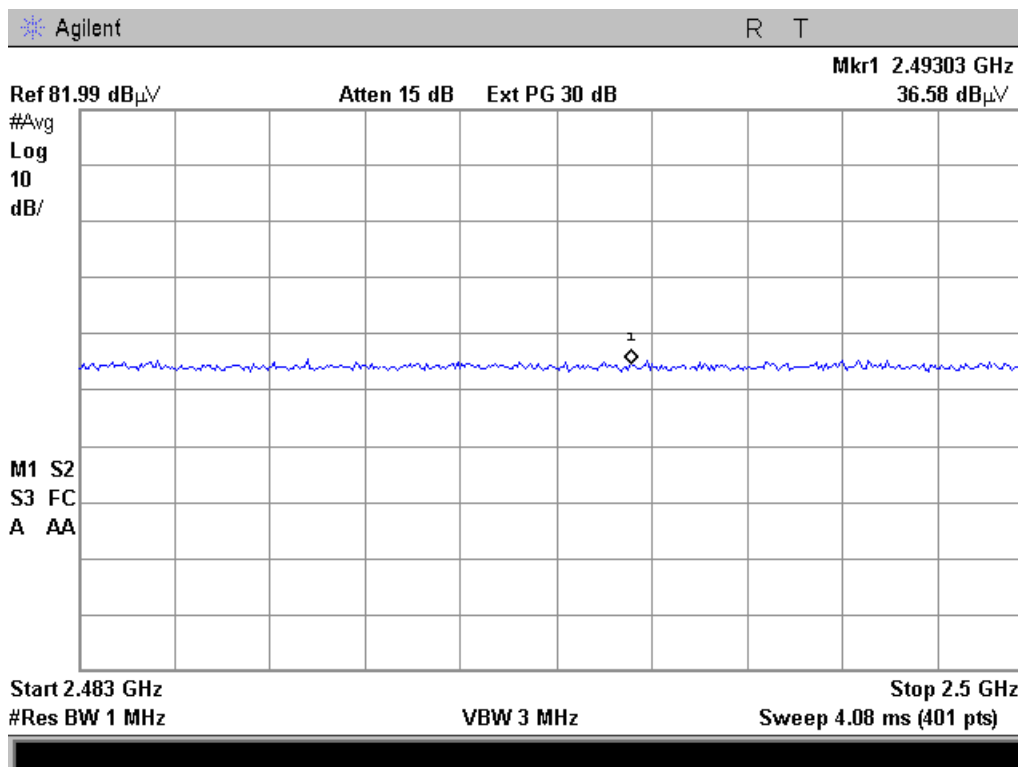




54 MB Restricted Band 2483.5 – 2500 MHz – Peak
Tuned Freq = 2462 MHz



54 MB Restricted Band 2483.5 – 2500 MHz – Avg
Tuned Freq = 2462 MHz





Occupied Bandwidth

Name of Test: Occupied Bandwidth

Specification: 15.247(a)(2)

Engineer: John Erhard

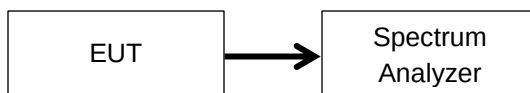
Test Equipment Utilized: i00331

Test Date: 6/22/2011

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



11 MB 6 dB Occupied Bandwidth Summary

Frequency MHz	Measured Bandwidth MHz	Specification Limit kHz	Result
2412	9.236	≥ 500	Pass
2437	9.222	≥ 500	Pass
2462	9.221	≥ 500	Pass

11 MB 99% Bandwidth Summary

Frequency MHz	Measured Bandwidth MHz	Result
2412	13.5451	Pass
2437	13.5927	Pass
2462	13.6552	Pass

54 MB 6 dB Occupied Bandwidth Summary

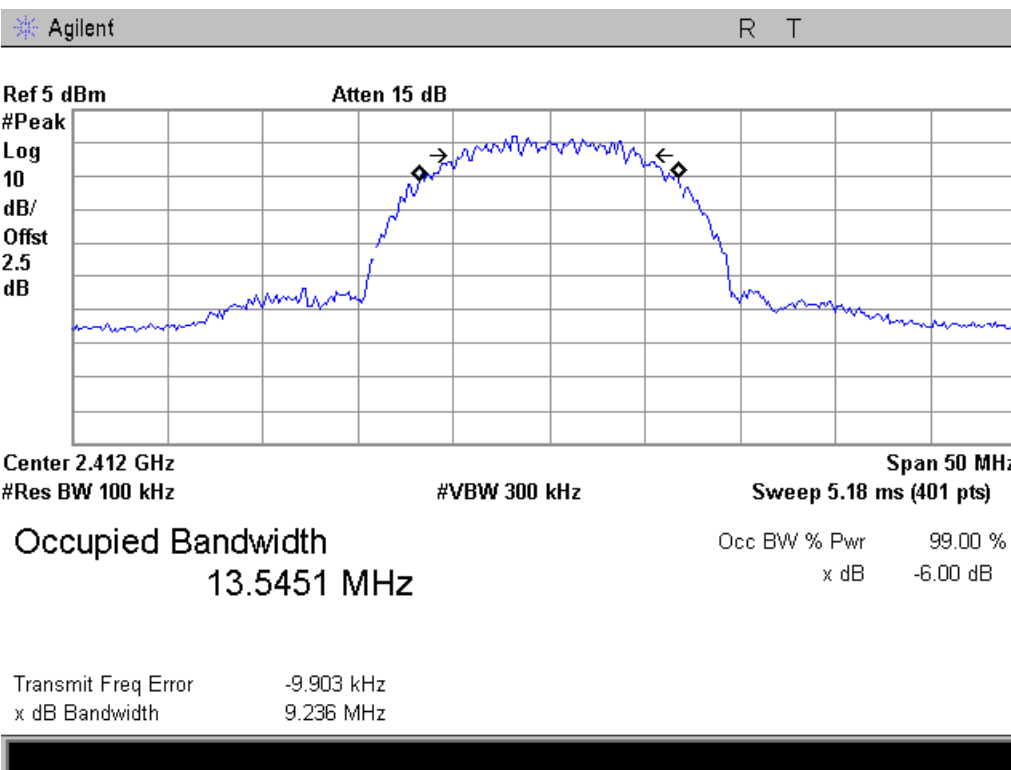
Frequency MHz	Measured Bandwidth MHz	Specification Limit kHz	Result
2412	15.867	≥ 500	Pass
2437	15.866	≥ 500	Pass
2462	15.350	≥ 500	Pass

54 MB 99% Bandwidth Summary

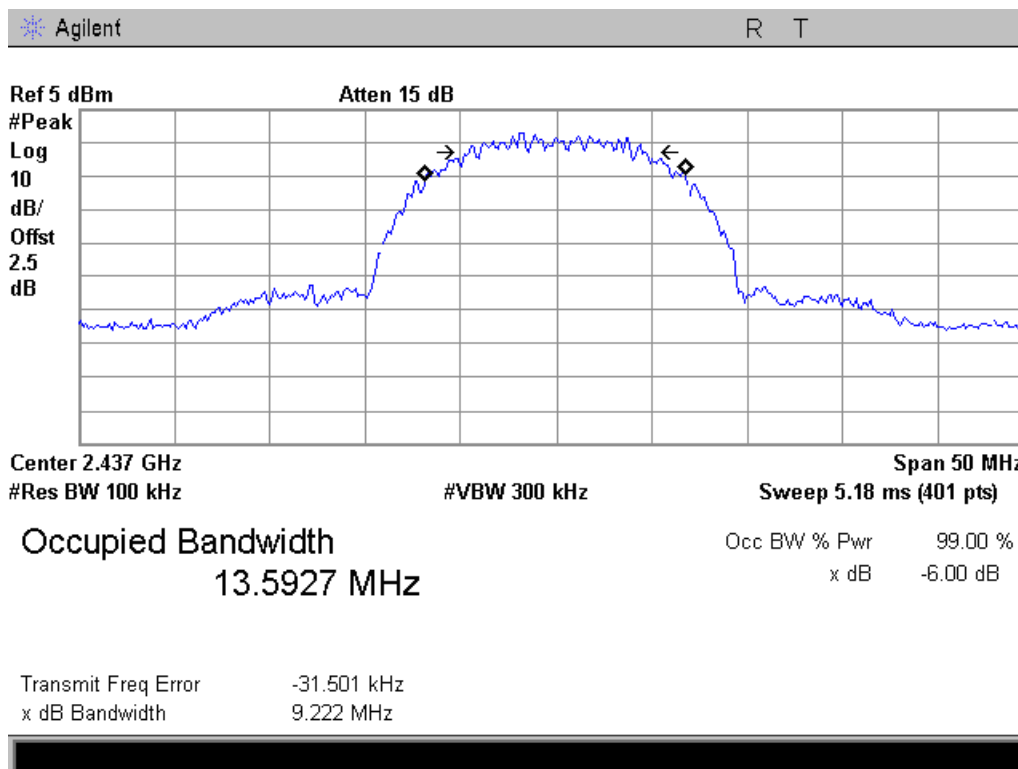
Frequency MHz	Measured Bandwidth MHz	Result
2412	16.613	Pass
2437	16.6278	Pass
2462	16.6329	Pass



11 MB Bandwidth 2412 MHz

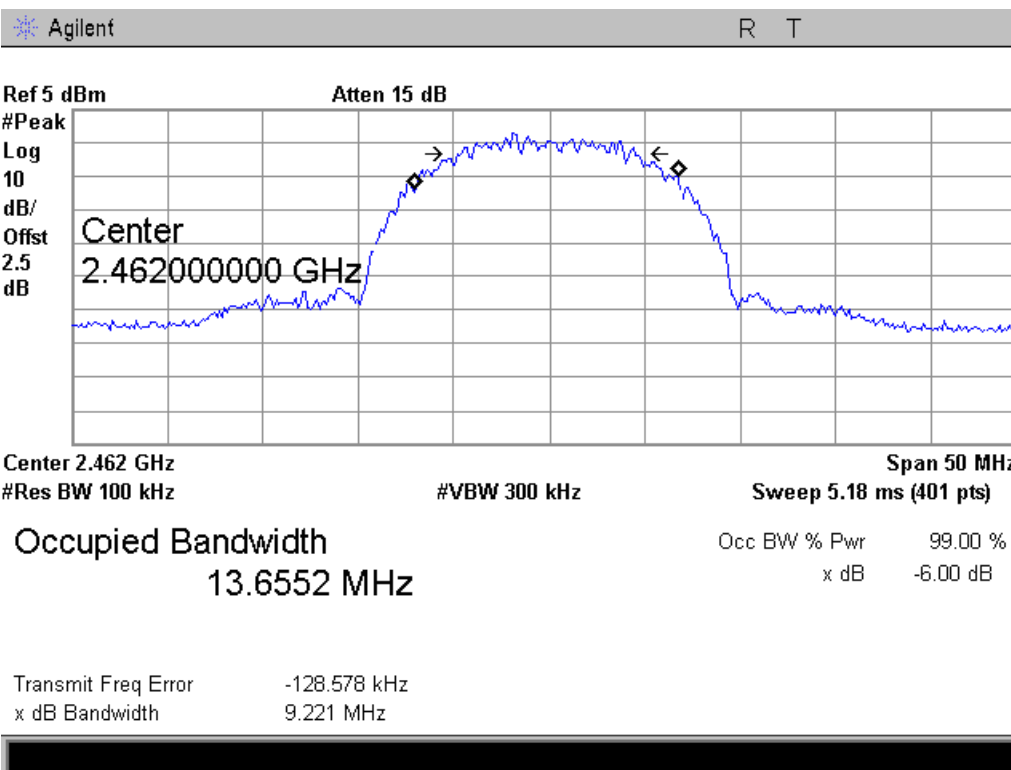


11 MB Bandwidth 2437 MHz

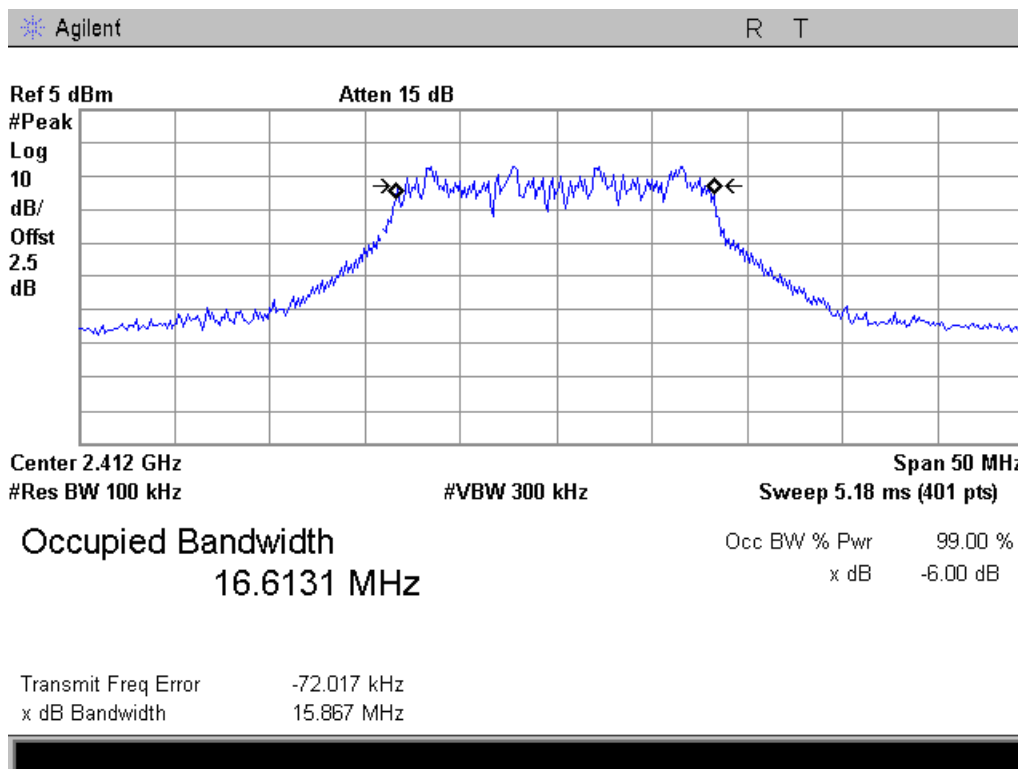




11 MB Bandwidth 2462 MHz

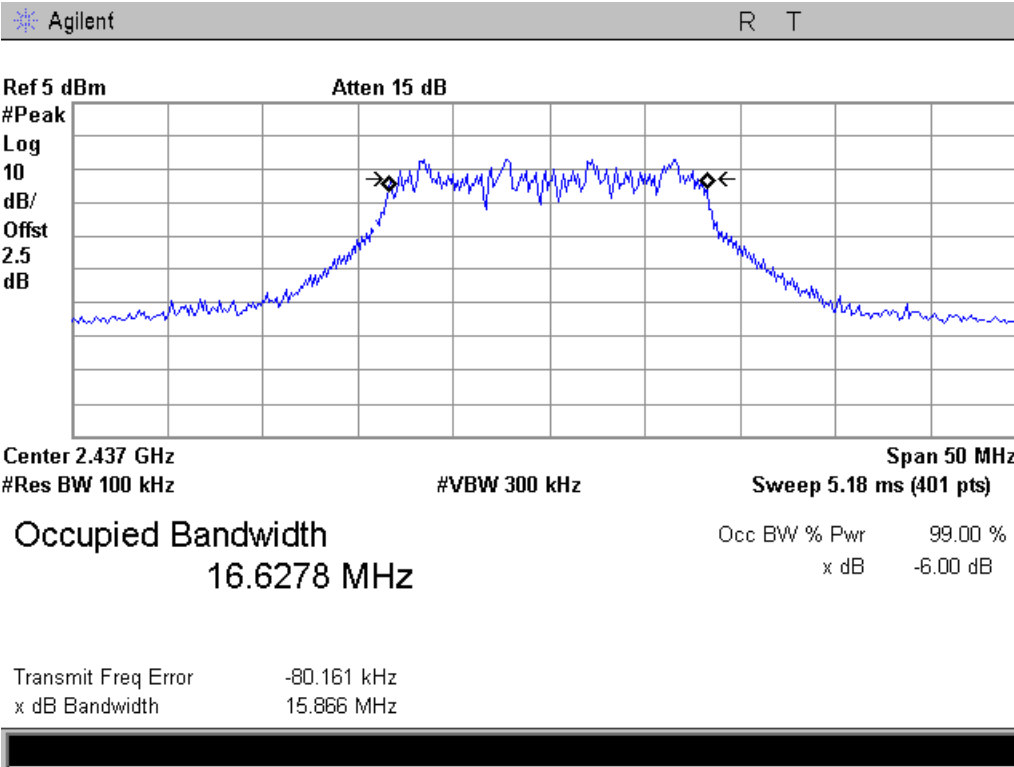


54 MB Bandwidth 2412 MHz

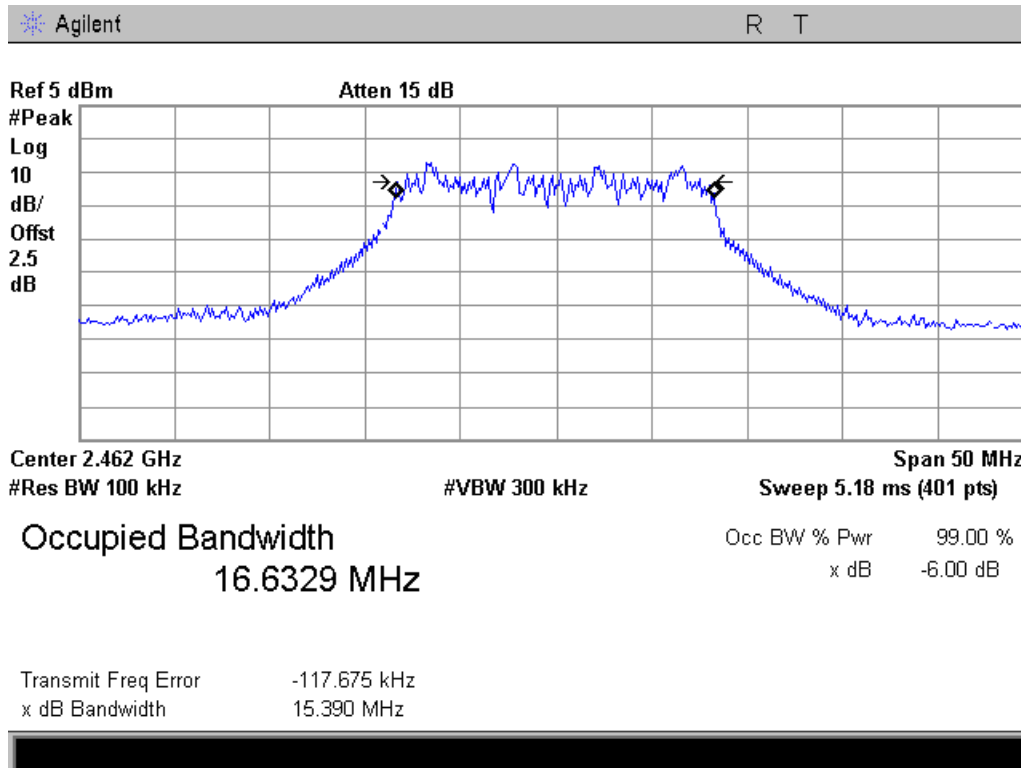




54 MB Bandwidth 2437 MHz



54 MB Bandwidth 2462 MHz





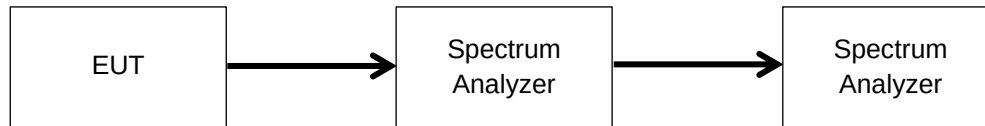
Transmitter Power Spectral Density (PSD)

Name of Test: Transmitter Power Spectral Density (PSD)
Specification: 15.247(e) **Engineer:** John Erhard
Test Equipment Utilized: i00331 **Test Date:** 6/22/2011

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



11 MB PSD Summary

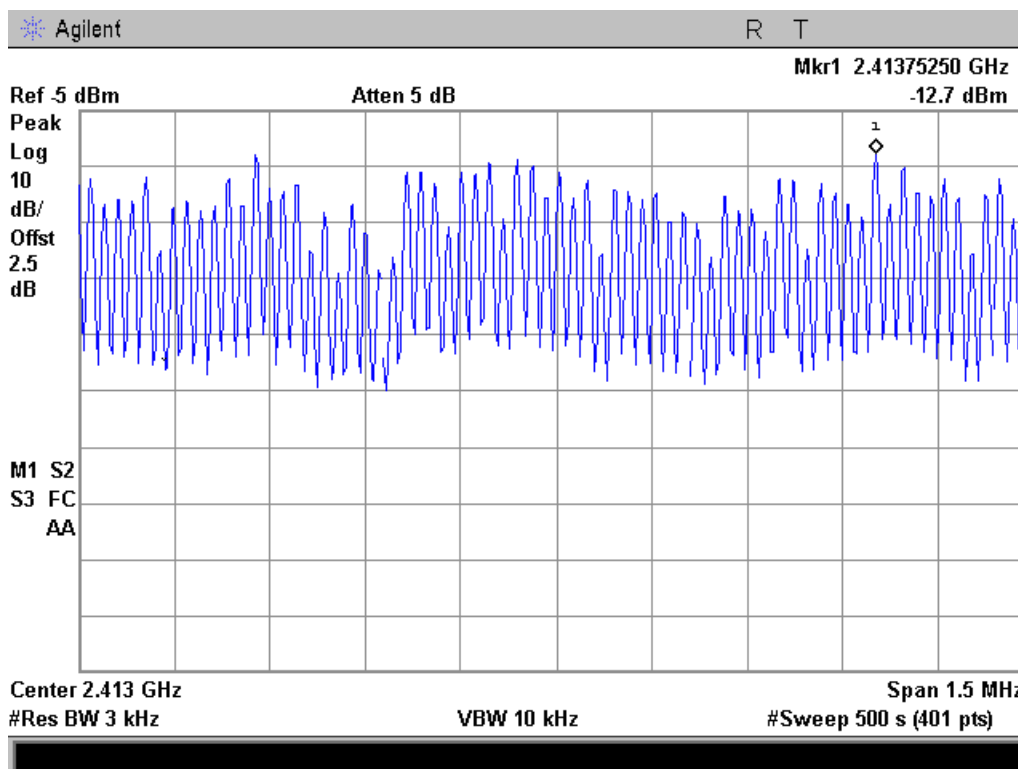
Frequency MHz	Measured Data dBm	Specification Limit dBm	Result
2412	-12.7	8	Pass
2437	-12.5	8	Pass
2462	-12.8	8	Pass

54 MB PSD Summary

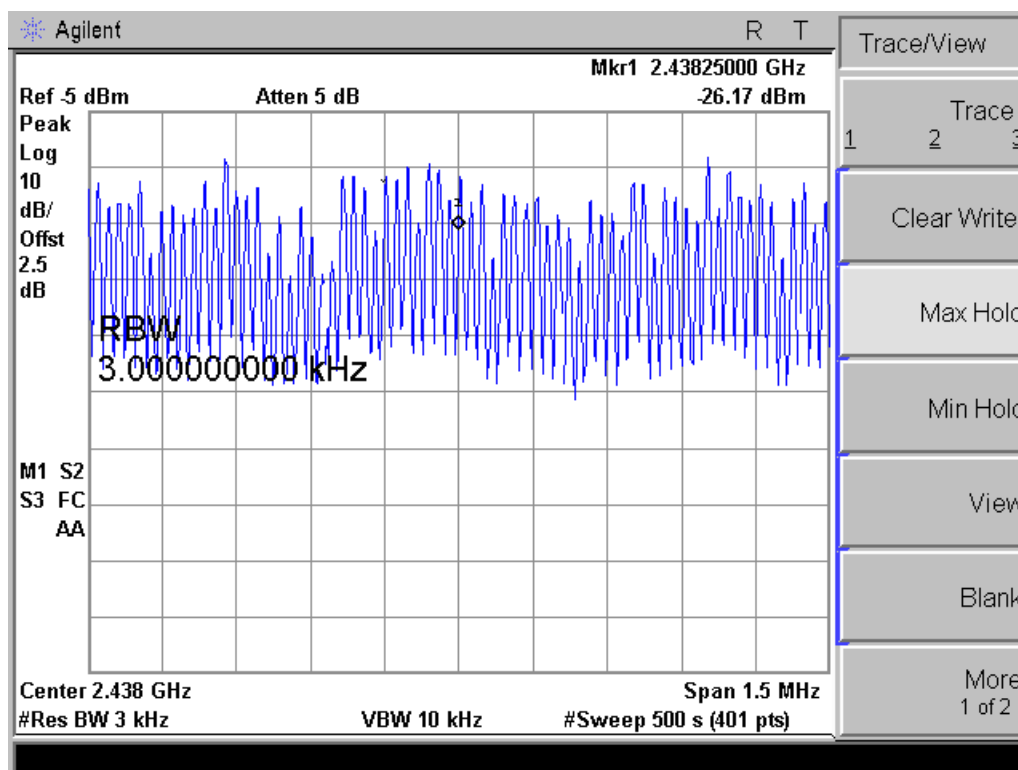
Frequency MHz	Measured Data dBm	Specification Limit dBm	Result
2412	-15.31	8	Pass
2437	-15.62	8	Pass
2462	-15.54	8	Pass



11 MB PSD 2412 MHz

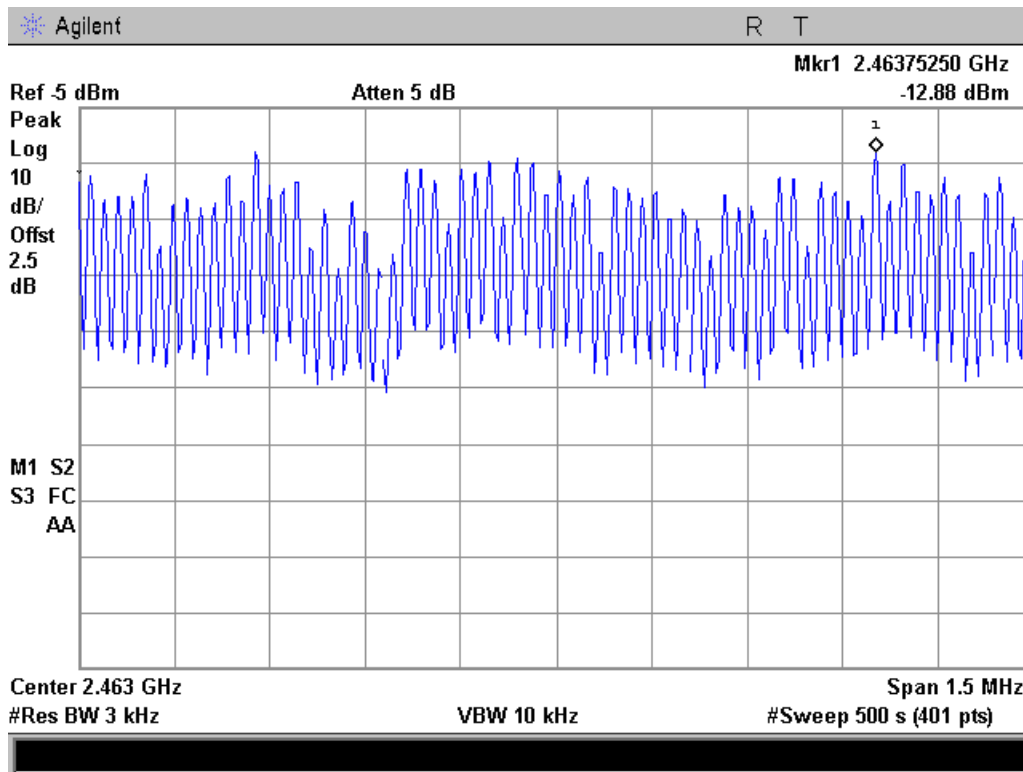


11 MB PSD 2437 MHz

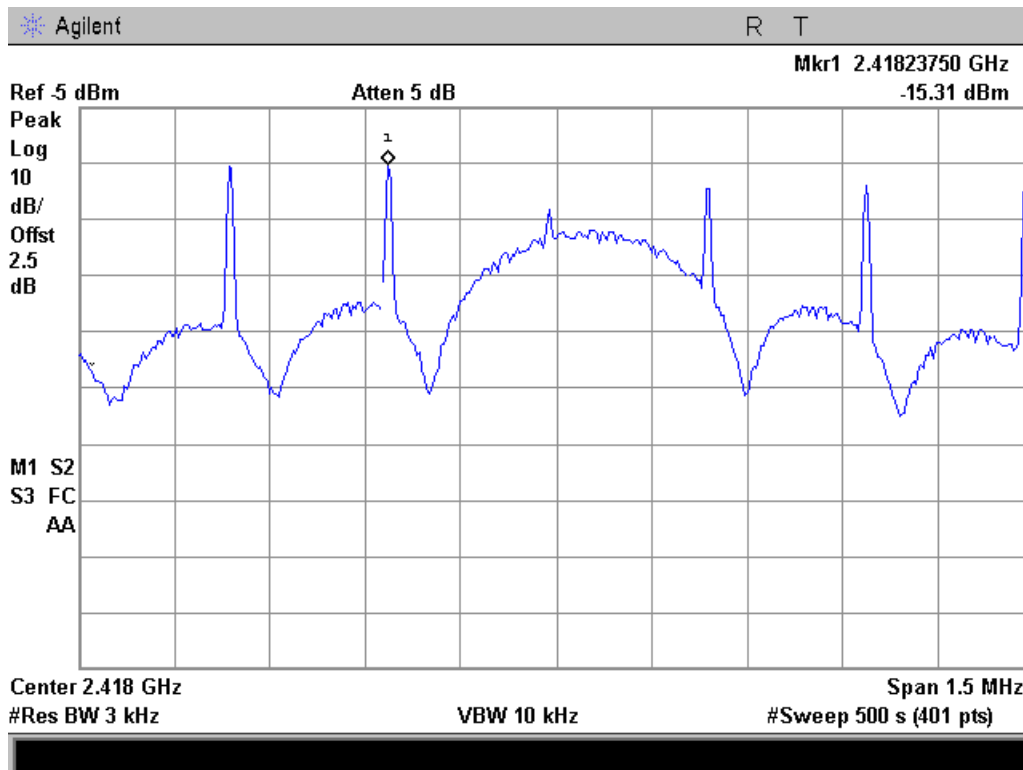




11 MB PSD 2462 MHz

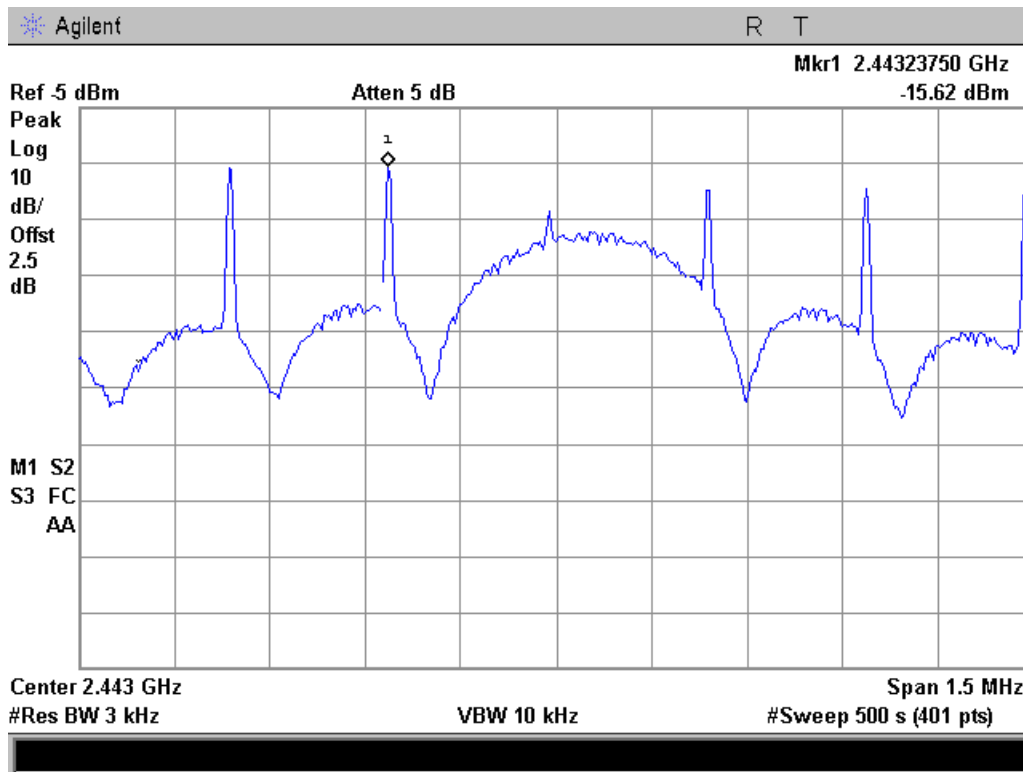


54 MB PSD 2412 MHz

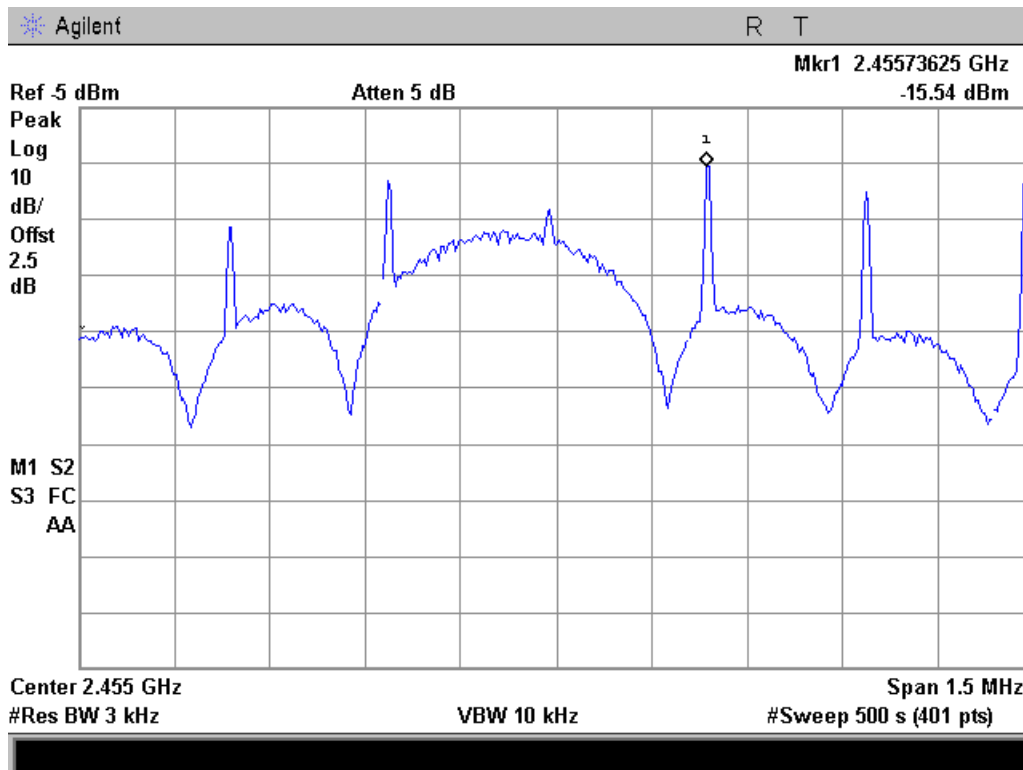




54 MB PSD 2437 MHz



54 MB PSD 2462 MHz





A/C Powerline Conducted Emission

Name of Test: A/C Powerline Conducted Emissions

Specification: 15.207

Engineer: John Erhard

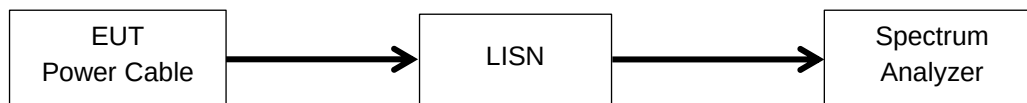
Test Equipment Utilized: i00270, i00379

Test Date: 6/22/2011

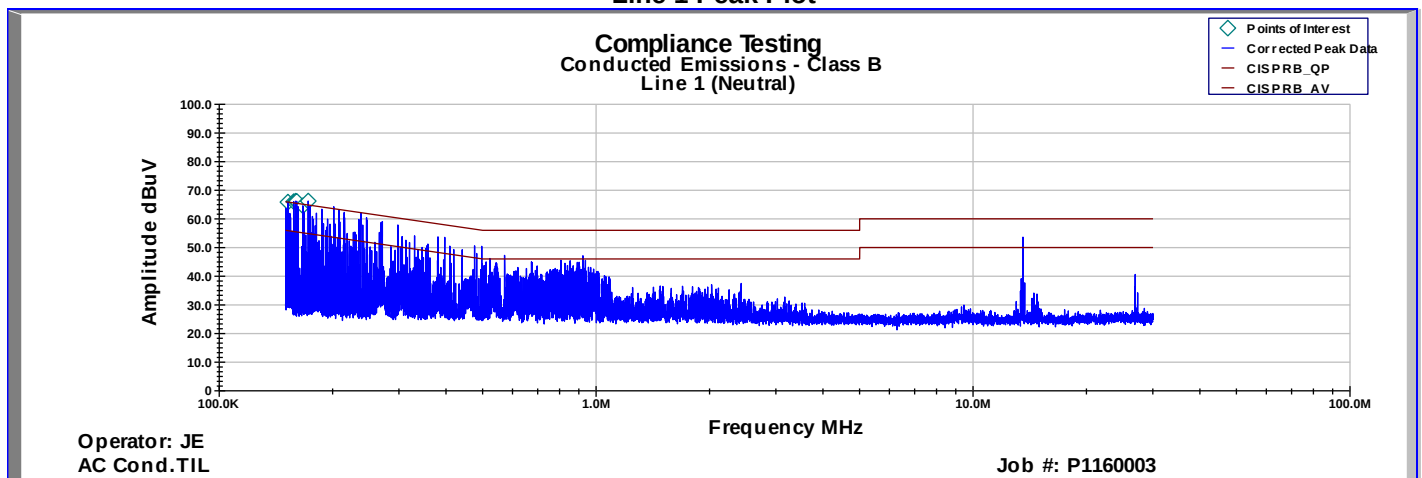
Test Procedure

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

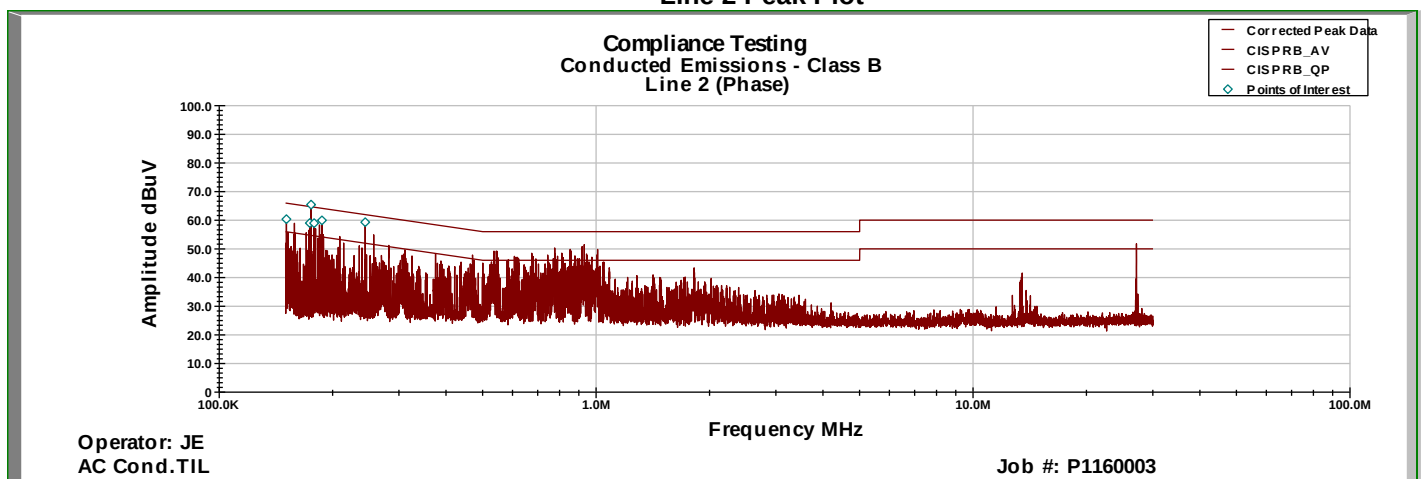
Test Setup



Line 1 Peak Plot



Line 2 Peak Plot





Line 1 Neutral AVG Detector

Frequency	Measured Value (dBuV)	LISN Corr Fact (dB)	Cable Loss (dB)	Attenuator (dB)	L1 Final Value (dBuV)	Limit (dBuV)	AVG Margin (dB)
164.19 KHz	24.38	0.20	0.031	10.000	34.612	55.595	-20.982
161.65 KHz	26.06	0.20	0.035	10.000	36.299	55.667	-19.368
156.76 KHz	28.02	0.23	0.041	10.000	38.298	55.807	-17.509
155.13 KHz	28.56	0.25	0.041	10.000	38.849	55.853	-17.005
152.26 KHz	29.14	0.28	0.039	10.000	39.457	55.936	-16.478
150.9 KHz	29.57	0.29	0.042	10.000	39.901	55.974	-16.073

Line 2 Phase AVG Detector

Frequency	Measured Value (dBuV)	LISN Corr Fact (dB)	Cable Loss (dB)	Attenuator (dB)	L1 Final Value (dBuV)	Limit (dBuV)	AVG Margin (dB)
248.99 KHz	21.30	0.18	0.085	10.000	31.565	53.172	-21.607
184.94 KHz	24.46	0.20	0.000	10.000	34.662	55.002	-20.339
182.14 KHz	22.70	0.20	0.005	10.000	32.902	55.082	-22.180
175.99 KHz	23.14	0.20	0.014	10.000	33.350	55.257	-21.907
161.91 KHz	24.75	0.20	0.035	10.000	34.982	55.660	-20.678
157.82 KHz	25.64	0.22	0.034	10.000	35.899	55.777	-19.878

Line 1 Neutral QP Detector

Frequency	Measured Value (dBuV)	LISN Corr Fact (dB)	Cable Loss (dB)	Attenuator (dB)	L1 Final Value (dBuV)	Limit (dBuV)	QP Margin (dB)
164.19 KHz	33.725	0.200	0.031	10.000	43.955	65.595	-21.639
161.65 KHz	36.817	0.200	0.035	10.000	47.051	65.667	-18.616
156.76 KHz	38.655	0.232	0.041	10.000	48.928	65.807	-16.879
155.13 KHz	40.242	0.249	0.041	10.000	50.532	65.853	-15.322
152.26 KHz	39.356	0.277	0.039	10.000	49.672	65.936	-16.263
150.9 KHz	40.084	0.291	0.042	10.000	50.417	65.974	-15.557

Line 2 Phase QP Detector

Frequency	Measured Value (dBuV)	LISN Corr Fact (dB)	Cable Loss (dB)	Attenuator (dB)	L1 Final Value (dBuV)	Limit (dBuV)	QP Margin (dB)
248.99 KHz	25.63	0.18	0.085	10.000	35.895	63.172	-27.277
184.94 KHz	28.99	0.20	0.000	10.000	39.188	65.002	-25.814
182.14 KHz	30.33	0.20	0.005	10.000	40.539	65.082	-24.543
175.99 KHz	31.03	0.20	0.014	10.000	41.244	65.257	-24.014
161.91 KHz	34.52	0.20	0.035	10.000	44.759	65.660	-20.901
157.82 KHz	34.87	0.22	0.034	10.000	45.124	65.777	-20.653



Receiver Spurious Emissions

Name of Test: Receiver Spurious Emissions

Specification: RSS-GEN-6(b)

Engineer: John Erhard

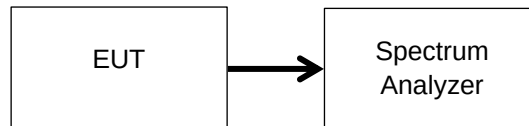
Test Equipment Utilized: i00331

Test Date: 6/22/2011

Test Procedure

The EUT was connected directly to a spectrum analyzer. The receiver spurious emissions were measured from 30 MHz to greater than 3 times the highest tunable frequency.

Test Setup

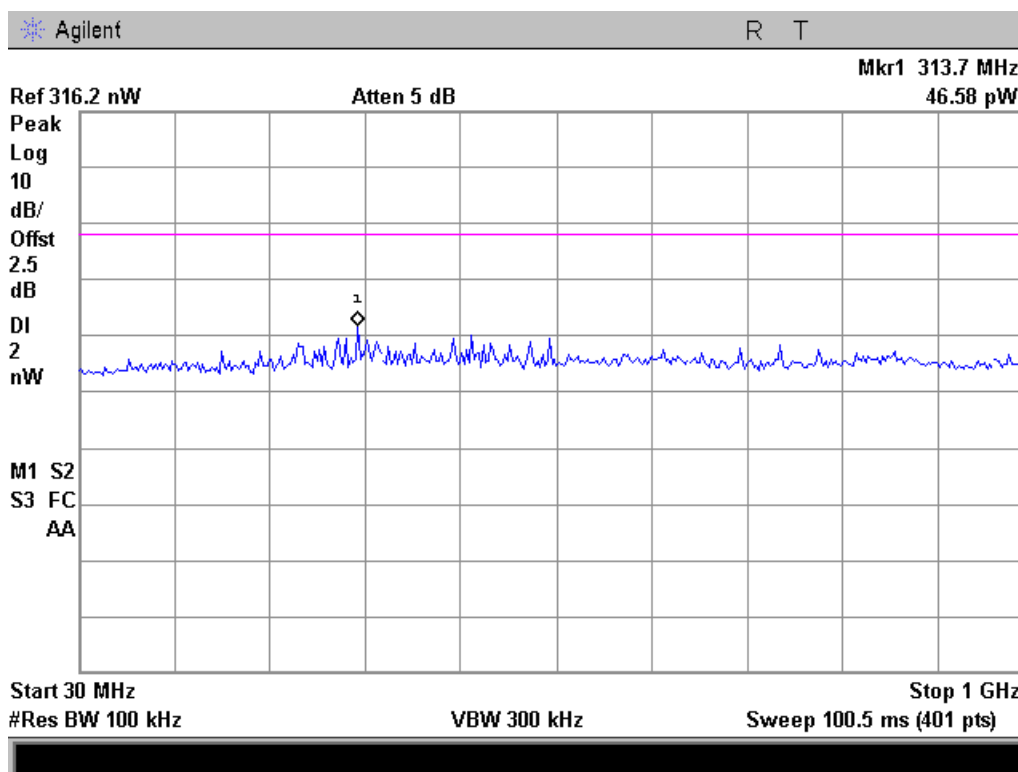


Receiver Spurious Emissions Summary

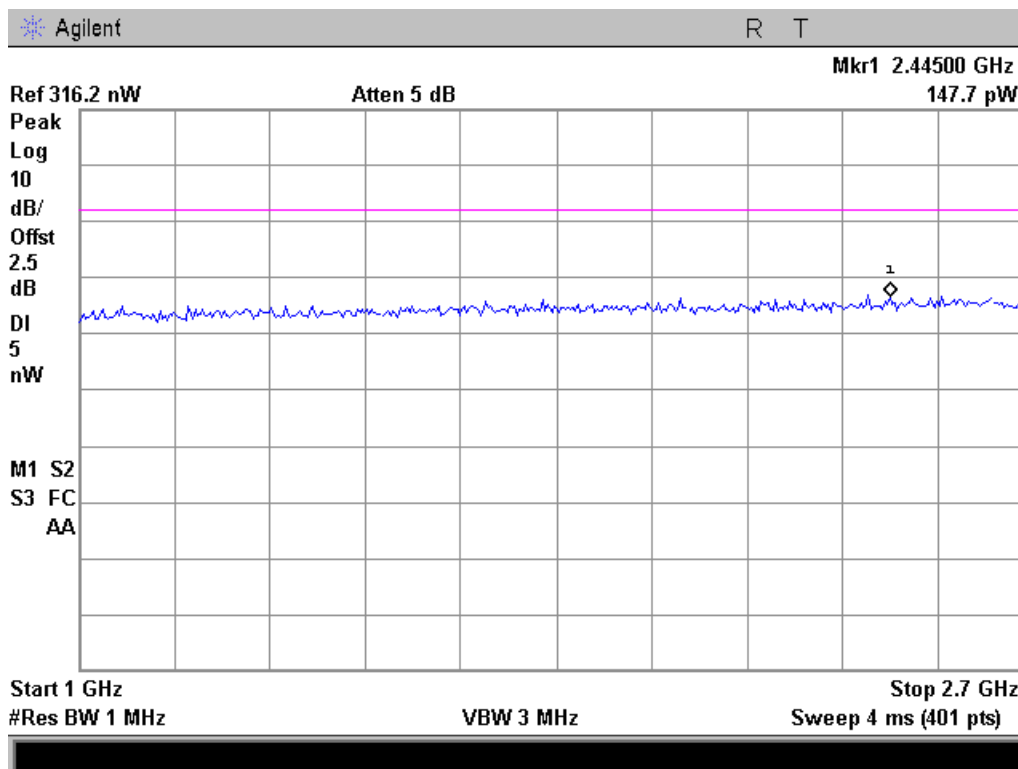
Frequency Range MHz	Recorded Measurement	Specification Limit	Result
30 – 1000	46.58 pW	2 nW (-57dBm)	Pass
1000 - 8000	147.7 pW	5 nW (-57dBm)	Pass



Receiver Spurious Emissions 30 MHz – 1 GHz



Receiver Spurious Emissions 1 GHz – 7.5 GHz





Test Equipment Utilized

Description	MFG	Model Number	CT Asset Number	Last Cal Date	Cal Due Dates
RF Pre-Amplifier	HP	8449	i00028	9/17/2010	9/17/2011
Spectrum Analyzer	HP	8546A	i00033	10/3/2010	10/3/2011
Horn Antenna	EMCO	3115	i00103	11/5/2010	11/5/2012
Bilog Antenna	Schaffner	CBL6111C	i00267	11/21/2009	11/21/2011
LISN	FCC	FCC-LISN-50-32-2-01	i00270	9/30/2010	9/30/2012
Spectrum Analyzer	Agilent	4407B	i00331	5/24/2011	5/24/2012
Spectrum Analyzer	Agilent	E7405A	i00379	11/22/2010	11/22/2011

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

End of Test Report