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FCC PART 15.247

2.4 GHz DIGITAL SPREAD SPECTRUM

TEST REPORT

APPLICANT	SOUTHERN STATES LLC
ADDRESS	30 GEORGIA AVENUE HAMPTON, GA 30228 USA
FCC ID	2ADWTASD01
PRODUCT DESCRIPTION	WIRELESS HIGH VOLTAGE POWER LINE CURRENT SENSOR
DATE SAMPLE RECEIVED	5/1/2015
FINAL TEST DATE	6/12/2015
TESTED BY	Christian Pawlak
APPROVED BY	Sid Sanders

Report Number	Version Number	Description	Issue Date
802AUT15TestReport.pdf	Rev.1	Initial Issue	6/18/2015

THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL
WITHOUT THE WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.

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GENERAL REMARKS

The attached report shall not be reproduced except in full without the written permission of Timco Engineering Inc.

The test results relate only to the items tested.

Summary

The device under test does:

- ☒ Fulfill the general approval requirements as identified in this test report
☐ Not fulfill the general approval requirements as identified in this test report

Attestations

This equipment has been tested in accordance with the standards identified in this test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report.

All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025: 2005 requirements.

I attest that the necessary measurements were made, under my supervision, at:

Timco Engineering Inc.
849 NW State Road 45
Newberry, FL 32669

Authorized Signatory Name:



Christian Pawlak
Engineering Project Manager

Date: 06/17/2015

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GENERAL INFORMATION

EUT Specification

FCC Regulatory Standard	Title 47 CFR Part 15.247		
FCC ID	2ADWTASD01		
EUT Description	WIRELESS HIGH VOLTAGE POWER LINE CURRENT SENSOR		
Operating Frequency	TX: 2404 MHz – 2475 MHz		RX: N/A
EUT Power Source	☒ 110–120Vac/50– 60Hz		
	☐ DC Power		
	☐ Battery Operated Exclusively		
Test Item	☐ Prototype	☐ Pre-Production	☒ Production
Type of Equipment	☒ Fixed	☐ Mobile	☐ Portable
Antenna Connector	None		
Antenna	Integral Chip Antenna		
Test Facility	Timco Engineering Inc 849 NW State Road 45 Newberry, FL 32669 USA.		
Test Conditions	Temperature: 24-26°C Relative humidity: 50-65%		
Measurement Standard	KDB 558074 D01 DTS Meas Guidance v03r02, & ANSI C63.10-2009		
Test Exercise	Engineering Software was used to enable the modes of operation		
Notes	EUT is composed of two independent, cross polarized transmit chains that independently sample a sensor. For this reason, the EUT falls under guidance for completely uncorrelated transmitters as per KDB 662911.		

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RESULTS SUMMARY

Specification	FCC Rules Part	Result
Output Power	15.247(b)(3)	Pass
Power Spectral Density	15.247(e)	Pass
Occupied Bandwidth	15.247(a)(2)	Pass
Bandedge Emissions	15.247(d)	Pass
Radiated Spurious Emissions	15.247(d)	Pass
Restricted Band Emissions	15.205(a)(b)(c)	Pass
Antenna Requirement	15.203	Pass

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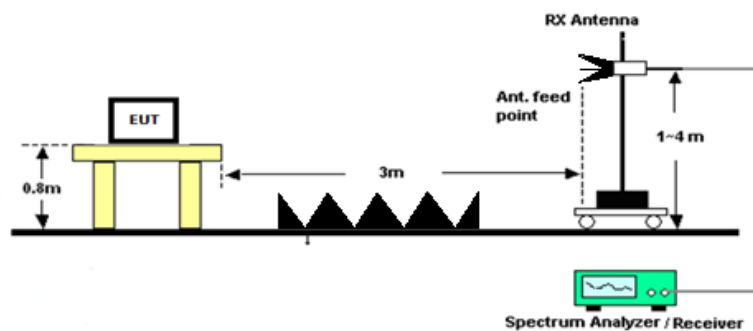
OUTPUT POWER

Rules Part No.: 15.247(b)(3)

Requirements: 1 watt conducted, 4 Watts EIRP. If the EUT uses an antenna with directional gain greater than 6 dBi the conducted power limit must be reduced as appropriate by the amount in dB that the directional gain antenna exceeds 6 dBi

Test Method: KDB 558074 D01 DTS Meas Guidance v03r03 § 9.1.1

Setup:



Test Data - Transmitter A: Output Power Measurement Table

Tuned Frequency (MHz)	FS @ 3M (dBuV / m)	EIRP (dBm)	Ant Gain (dBi)	ERP (dBm)	Limit (dBm)	Margin (dB)
2404	94.60	-0.60	6	-6.60	30	36.60
2444	97.10	1.90	6	-4.10	30	34.10
2475	101.75	6.55	6	0.55	30	29.45

Test Data - Transmitter B: Output Power Measurement Table

Tuned Frequency (MHz)	FS @ 3M (dBuV / m)	EIRP (dBm)	Ant Gain (dBi)	ERP (dBm)	Limit (dBm)	Margin (dB)
2404	89.82	-5.38	6	-11.38	30	41.38
2444	93.26	-1.94	6	-7.94	30	37.94
2475	96.66	1.46	6	-4.54	30	34.54

RESULTS: Meets Requirements

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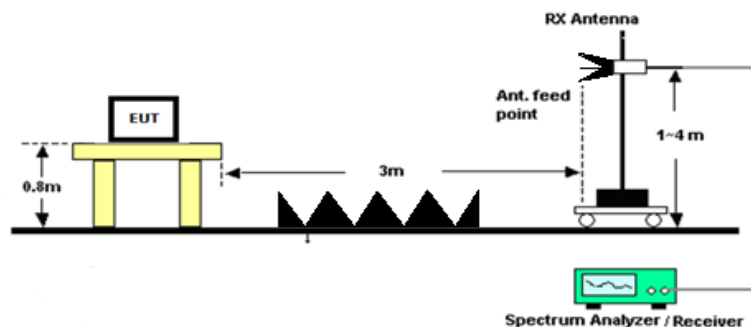
POWER SPECTRAL DENSITY

Rules Part No.: 15.247(e)

Requirements: The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Test Method: KDB 558074 D01 DTS Meas Guidance v03r03 § 10.2

Setup:



Test Data - Transmitter A: Measurement Table

Tuned Frequency (MHz)	FS @ 3M (dBuV / m)	EIRP (dBm)	Ant Gain (dBi)	ERP (dBm)	Limit (dBm)	Margin (dB)
2404	80.31	-14.89	6	-20.89	8	28.89
2444	82.58	-12.62	6	-18.62	8	26.62
2475	87.32	-7.88	6	-13.88	8	21.88

Test Data - Transmitter B: Measurement Table

Tuned Frequency (MHz)	FS @ 3M (dBuV / m)	EIRP (dBm)	Ant Gain (dBi)	ERP (dBm)	Limit (dBm)	Margin (dB)
2404	75.72	-19.48	6	-25.48	8	33.48
2444	78.67	-16.53	6	-22.53	8	30.53
2475	82.15	-13.05	6	-19.05	8	27.05

RESULTS: Meets Requirements

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POWER SPECTRAL DENSITY

Test Data: Transmitter A - Low End of Band

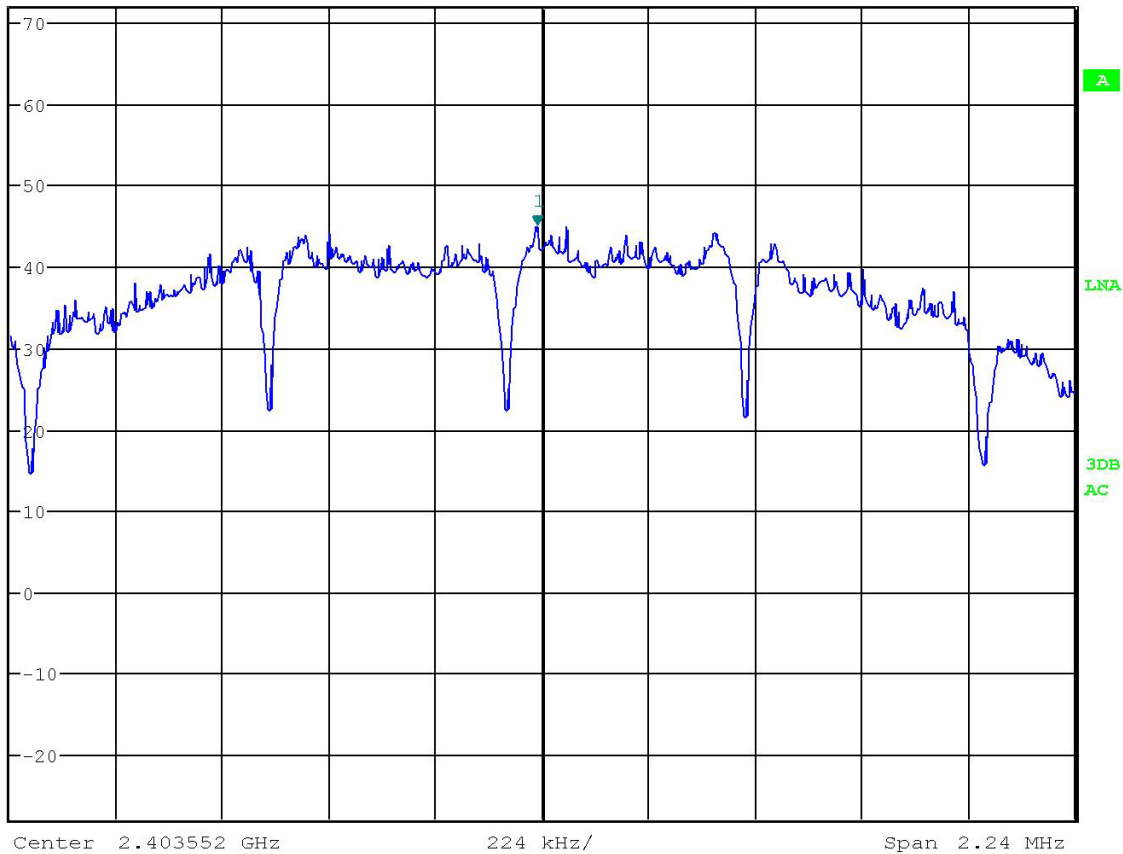


*RBW 3 kHz Marker 1 [T1]
 *VBW 10 kHz 44.98 dBμV
 SWT 250 ms 2.403541231 GHz

Ref 72 dBμV

*Att 0 dB

1 PK
VIEW



RESULTS: Meets Requirements

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POWER SPECTRAL DENSITY

Test Data: Transmitter A - Middle of Band

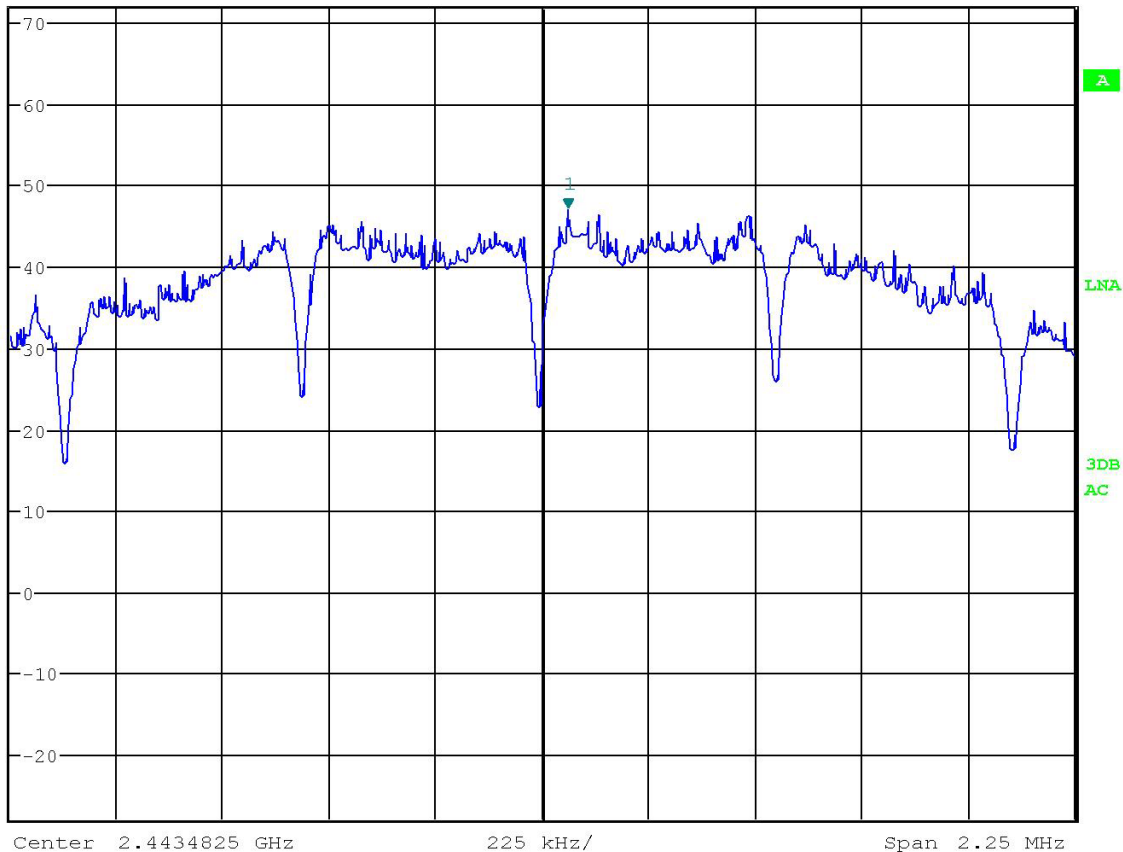


*RBW 3 kHz Marker 1 [T1]
 *VBW 10 kHz 47.14 dBμV
 SWT 250 ms 2.443536587 GHz

Ref 72 dBμV

*Att 0 dB

1 PK
VIEW

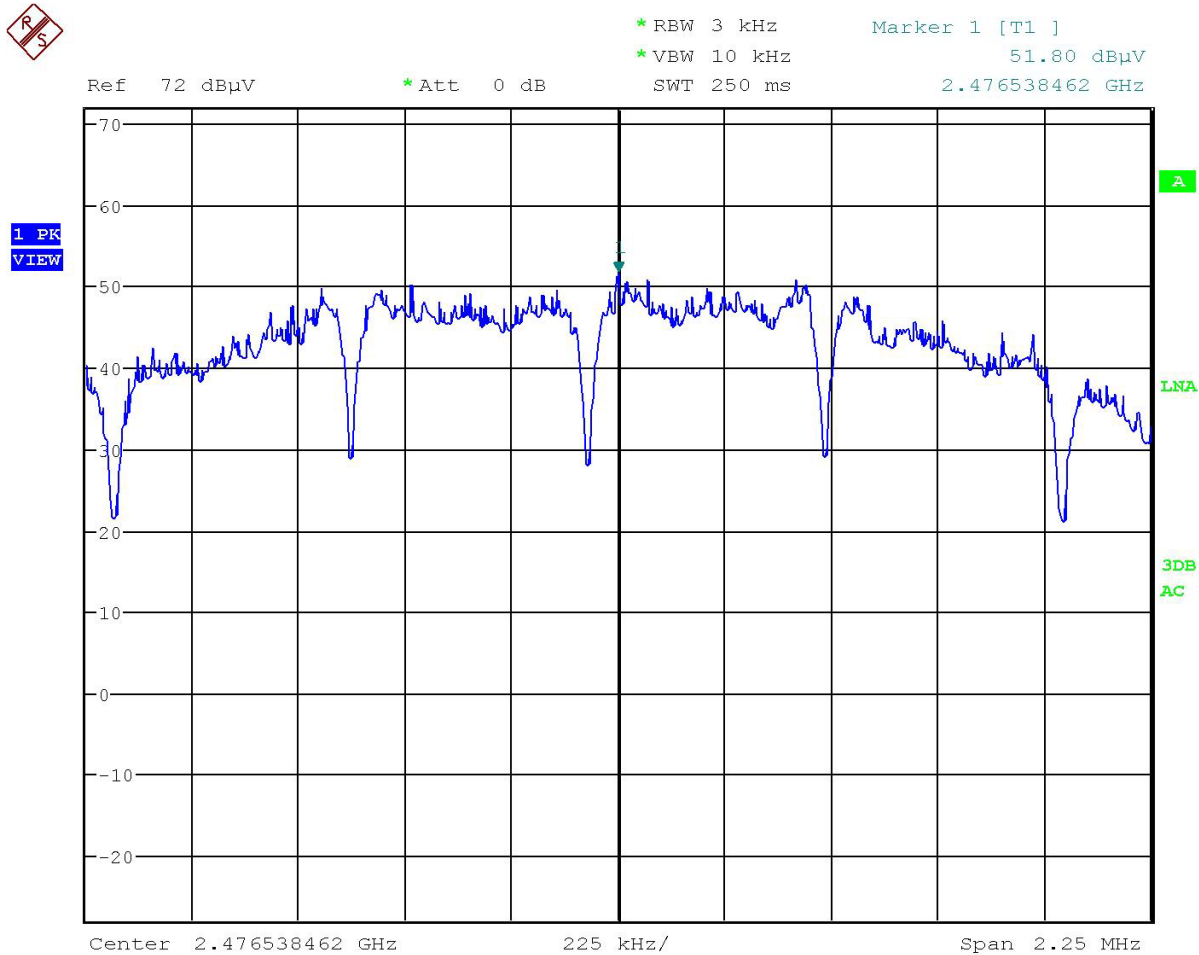


RESULTS: Meets Requirements

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POWER SPECTRAL DENSITY

Test Data: Transmitter A - High End of Band



RESULTS: Meets Requirements

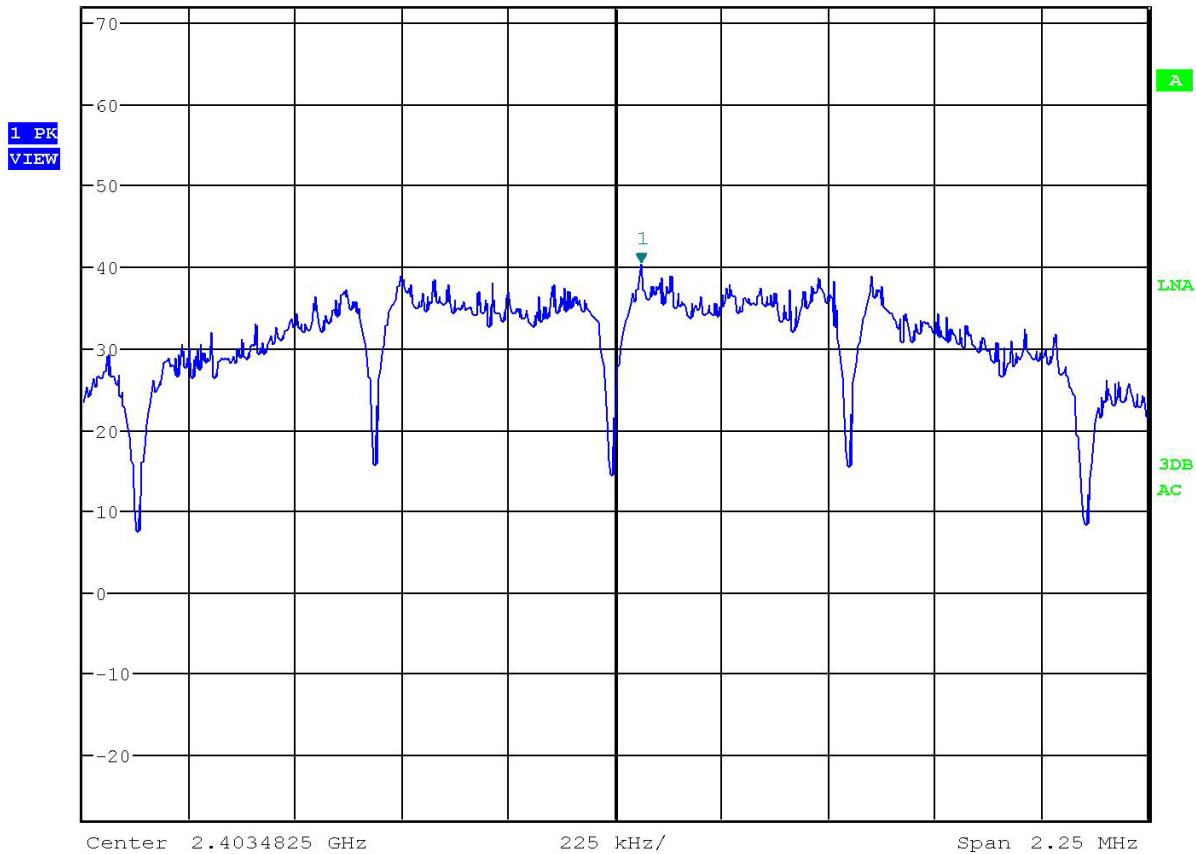
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POWER SPECTRAL DENSITY

Test Data: Transmitter B - Low End of Band



*RBW 3 kHz Marker 1 [T1] 40.39 dBμV
 *VBW 10 kHz
 Ref 72 dBμV *Att 0 dB SWT 250 ms 2.403536587 GHz



RESULTS: Meets Requirements

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POWER SPECTRAL DENSITY

Test Data: Transmitter B - Middle of Band

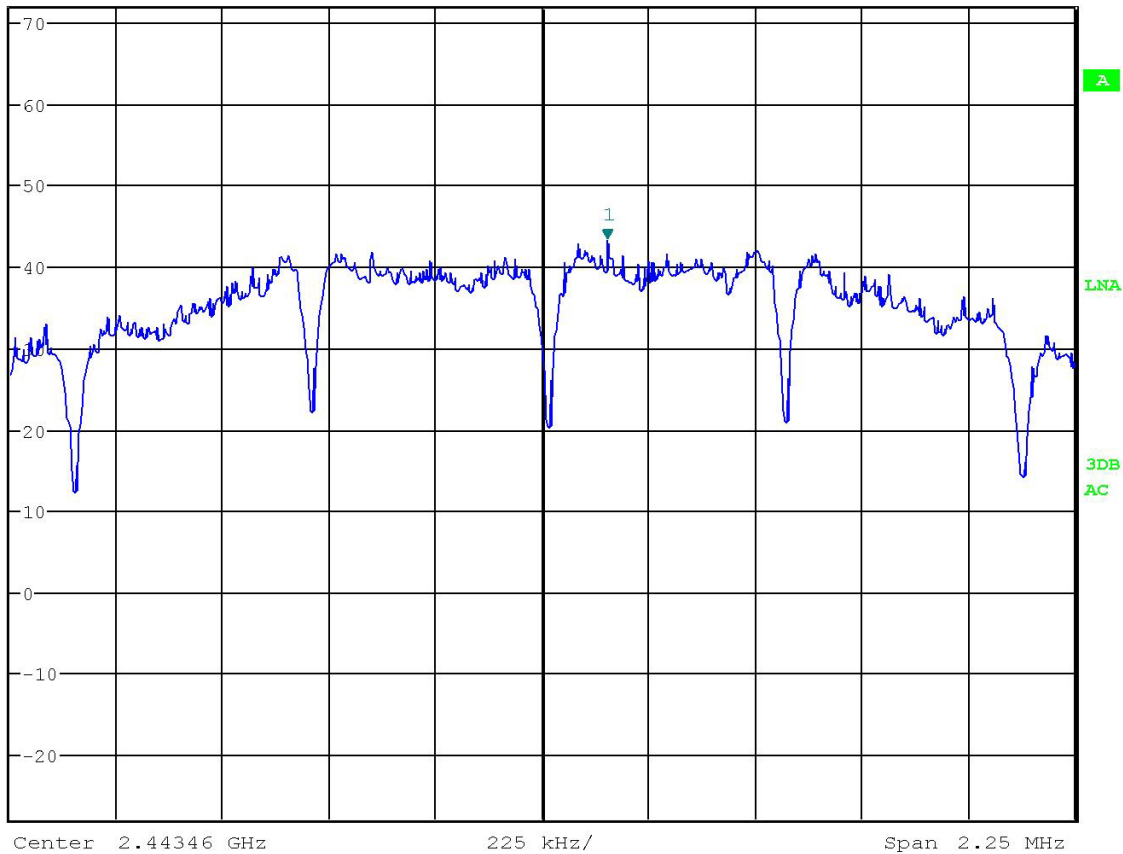


*RBW 3 kHz Marker 1 [T1]
 *VBW 10 kHz 43.23 dBμV
 SWT 250 ms 2.443597019 GHz

Ref 72 dBμV

*Att 0 dB

1 PK
VIEW



RESULTS: Meets Requirements

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POWER SPECTRAL DENSITY

Test Data: Transmitter B - High End of Band

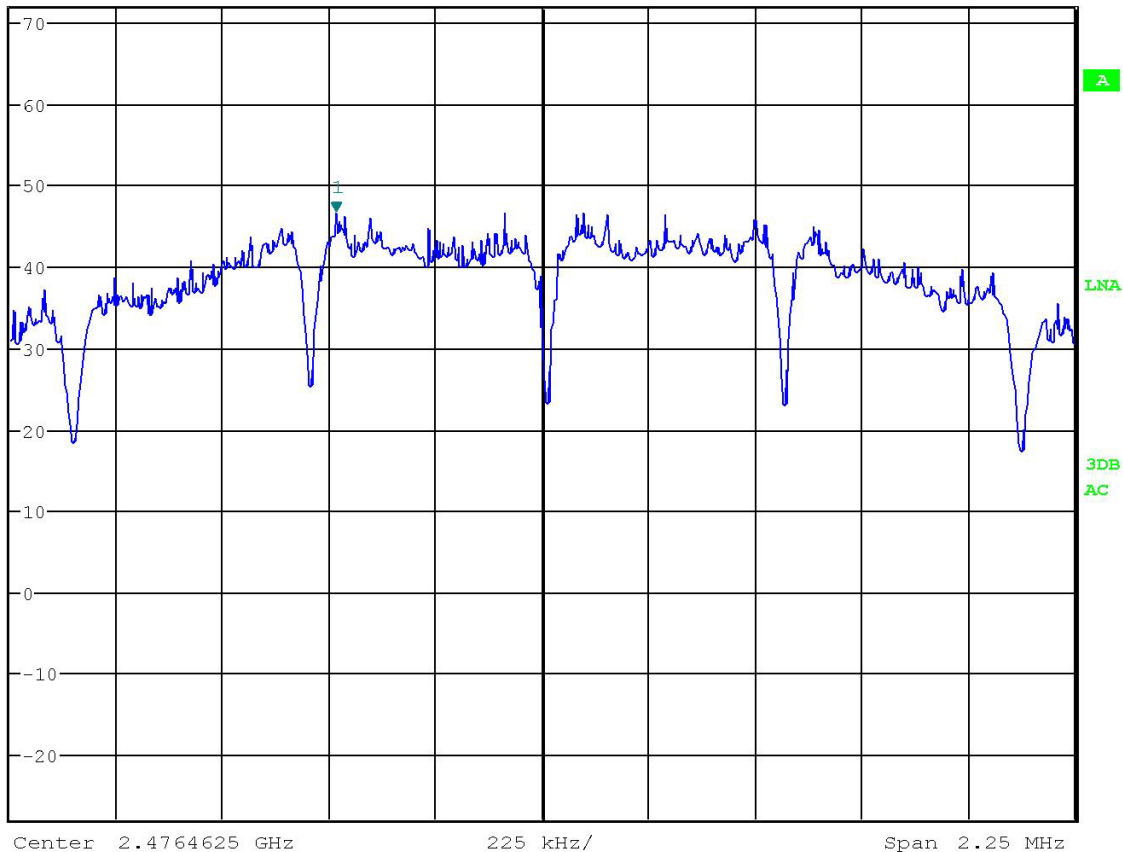


*RBW 3 kHz Marker 1 [T1]
 *VBW 10 kHz 46.63 dBμV
 SWT 250 ms 2.476026202 GHz

Ref 72 dBμV

*Att 0 dB

1 PK
 MAXH



RESULTS: Meets Requirements

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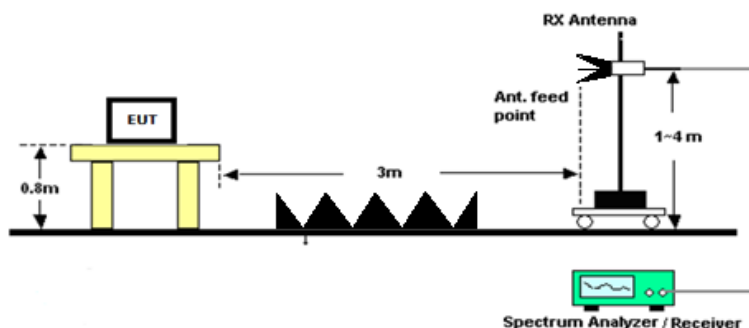
OCCUPIED BANDWIDTH

Rules Part No.: 15.247(a) (2)

Requirements: The minimum 6 dB bandwidth shall be at least 500 kHz.

Test Method: KDB 558074 D01 DTS Meas Guidance v03r03 § 8.2

Setup:



Test Data - Transmitter A: 6 dB Bandwidth Measurement Table

Tuned Frequency (MHz)	6 dB OBW (KHz)	Limit (KHz)	Margin (KHz)
2404	1587	500	1087
2444	1587	500	1087
2475	1587	500	1087

Test Data - Transmitter B: 6 dB Bandwidth Measurement Table

Tuned Frequency (MHz)	6 dB OBW (KHz)	Limit (KHz)	Margin (KHz)
2404	1554	500	1054
2444	1587	500	1087
2475	1587	500	1087

RESULTS: Meets Requirements

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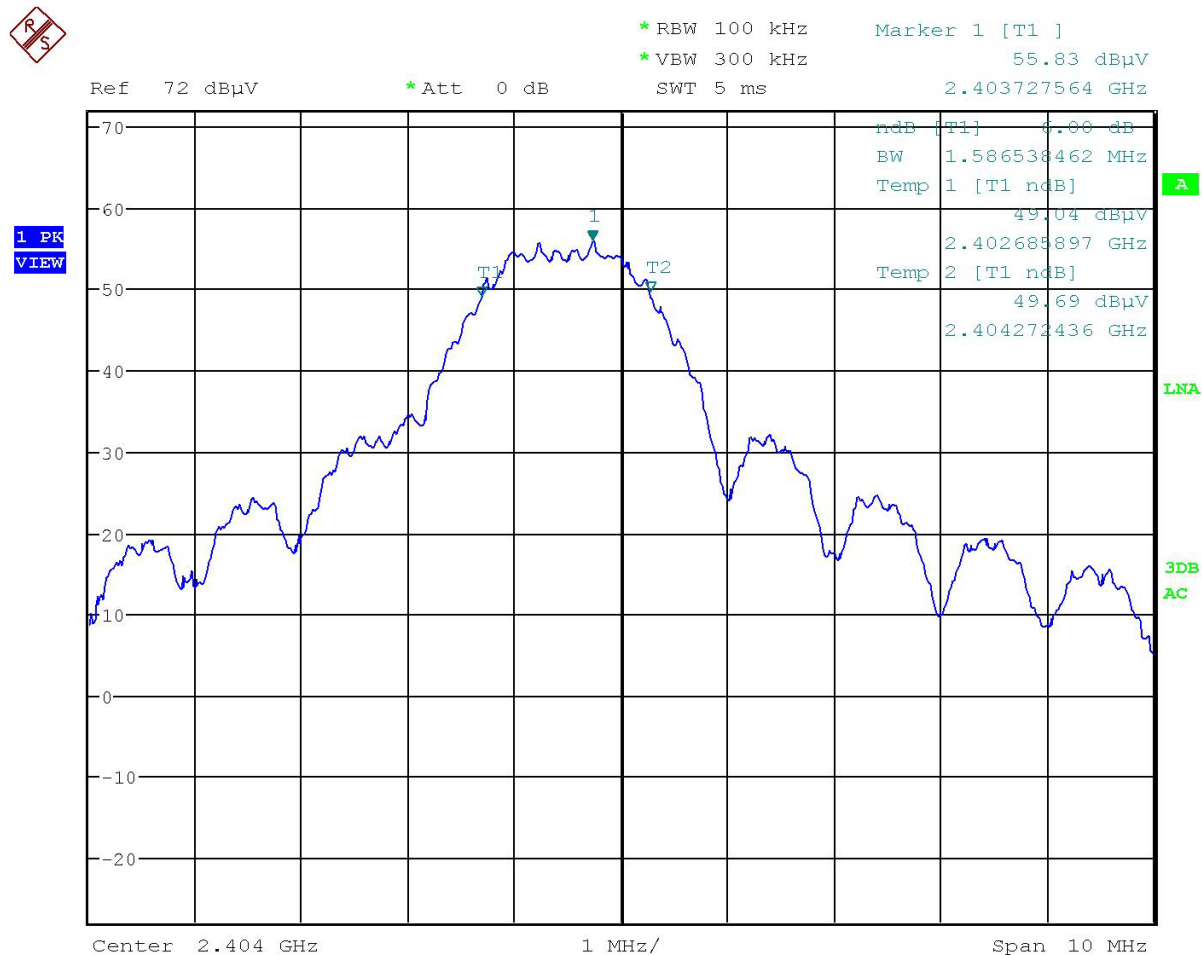
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OCCUPIED BANDWIDTH – TRANSMITTER A

Test Data: Transmitter A - Low End of Band

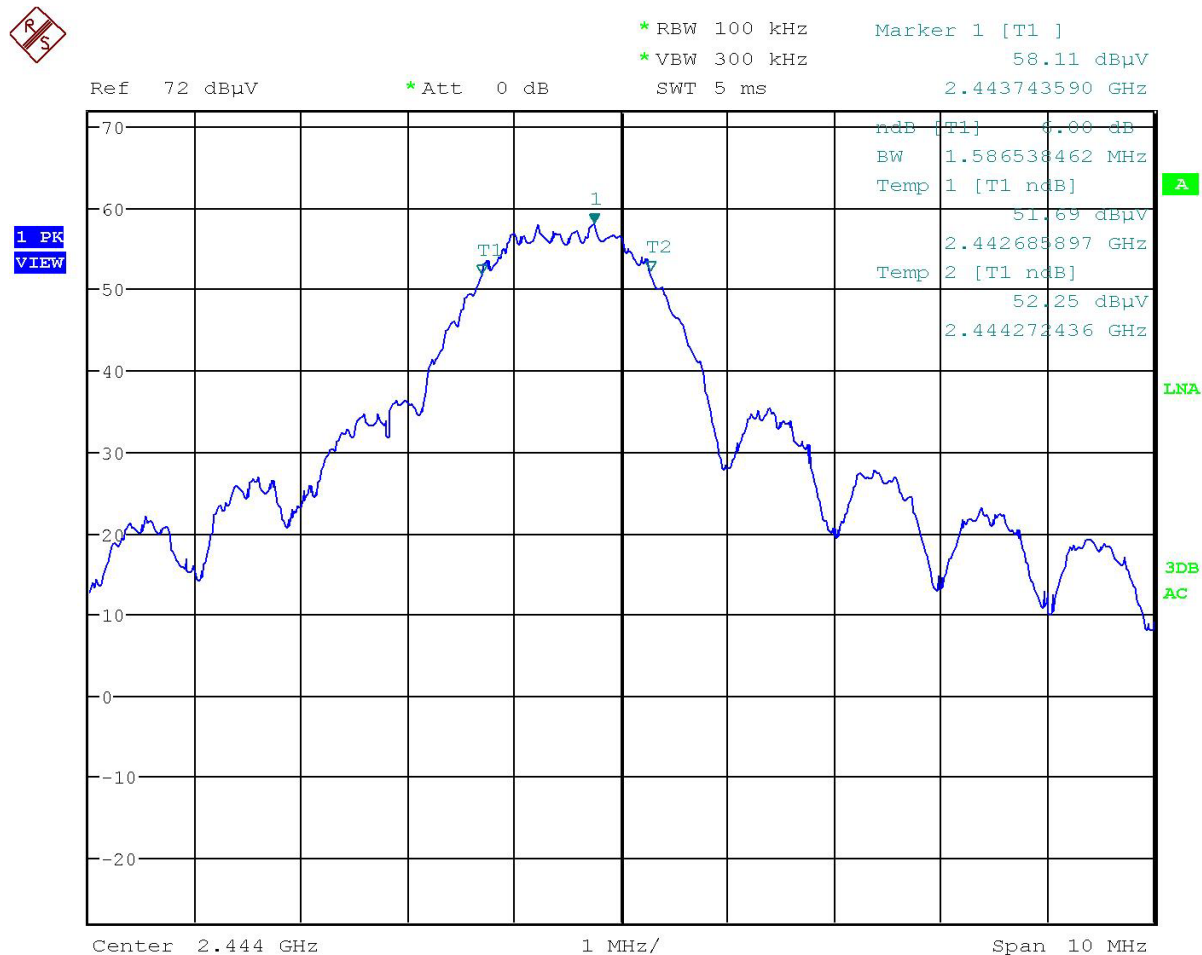


RESULTS: Meets Requirements

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OCCUPIED BANDWIDTH – TRANSMITTER A

Test Data: Transmitter A - Middle of Band



RESULTS: Meets Requirements

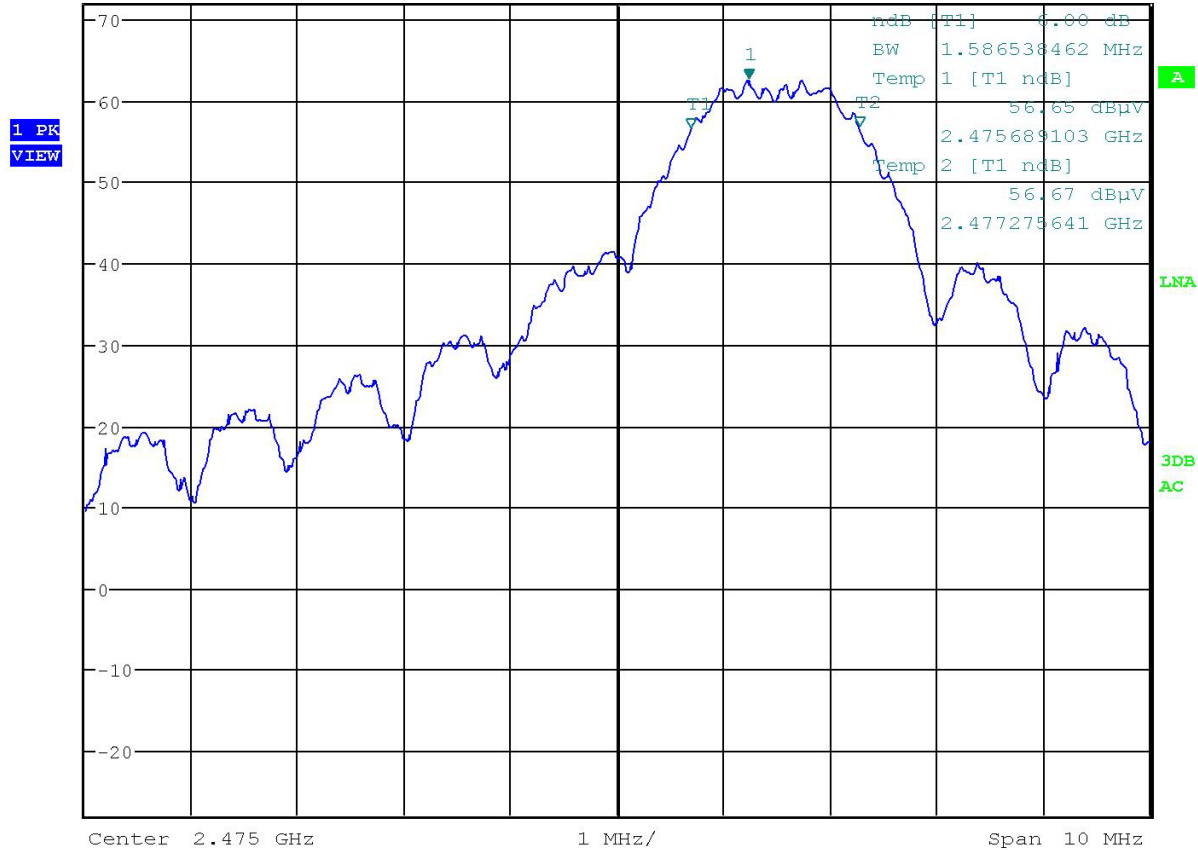
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OCCUPIED BANDWIDTH – TRANSMITTER A

Test Data: Transmitter A - High End of Band



*RBW 100 kHz Marker 1 [T1]
 *VBW 300 kHz 62.75 dBμV
 Ref 72 dBμV *Att 0 dB SWT 5 ms 2.476233974 GHz

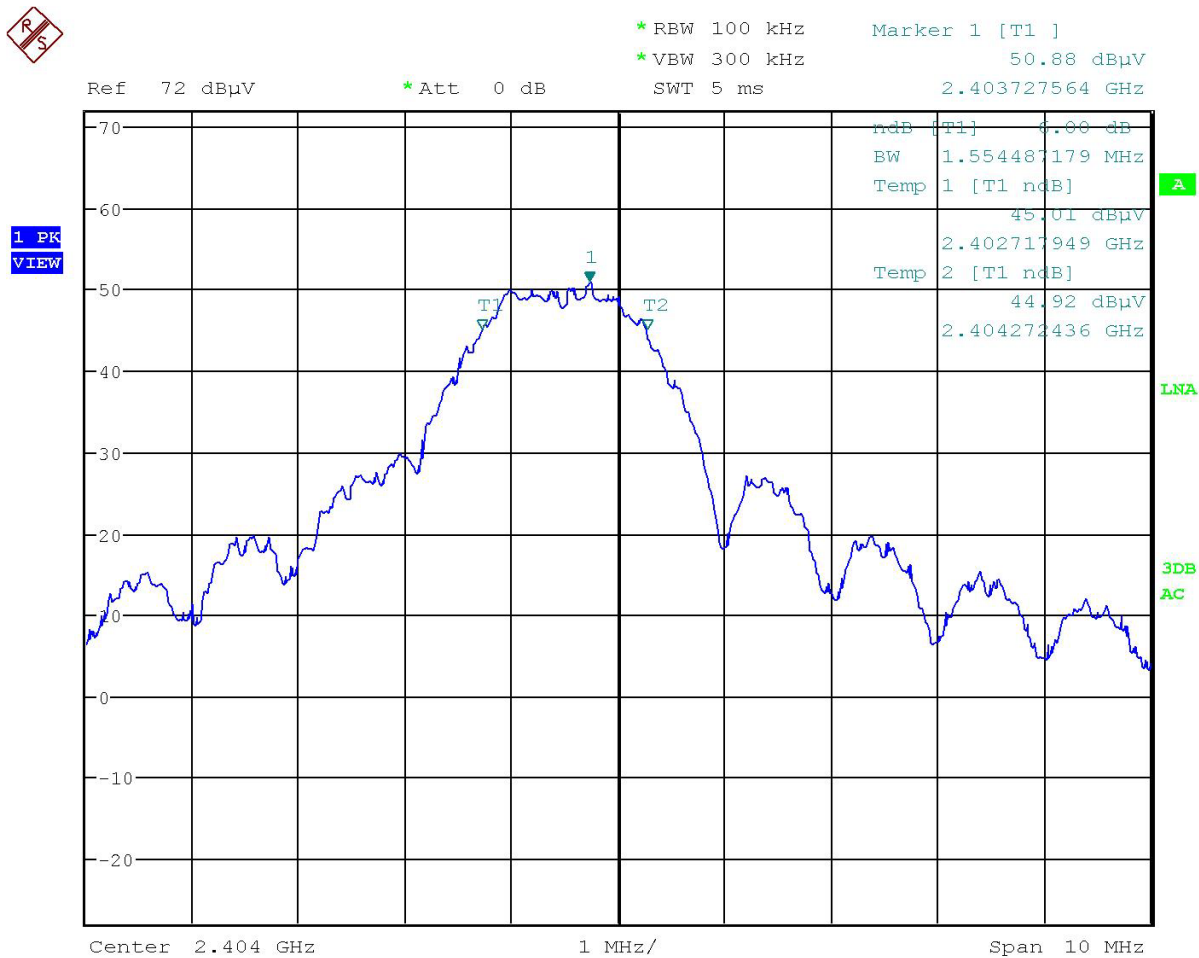


RESULTS: Meets Requirements

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OCCUPIED BANDWIDTH – TRANSMITTER B

Test Data: Transmitter B - Low End of Band

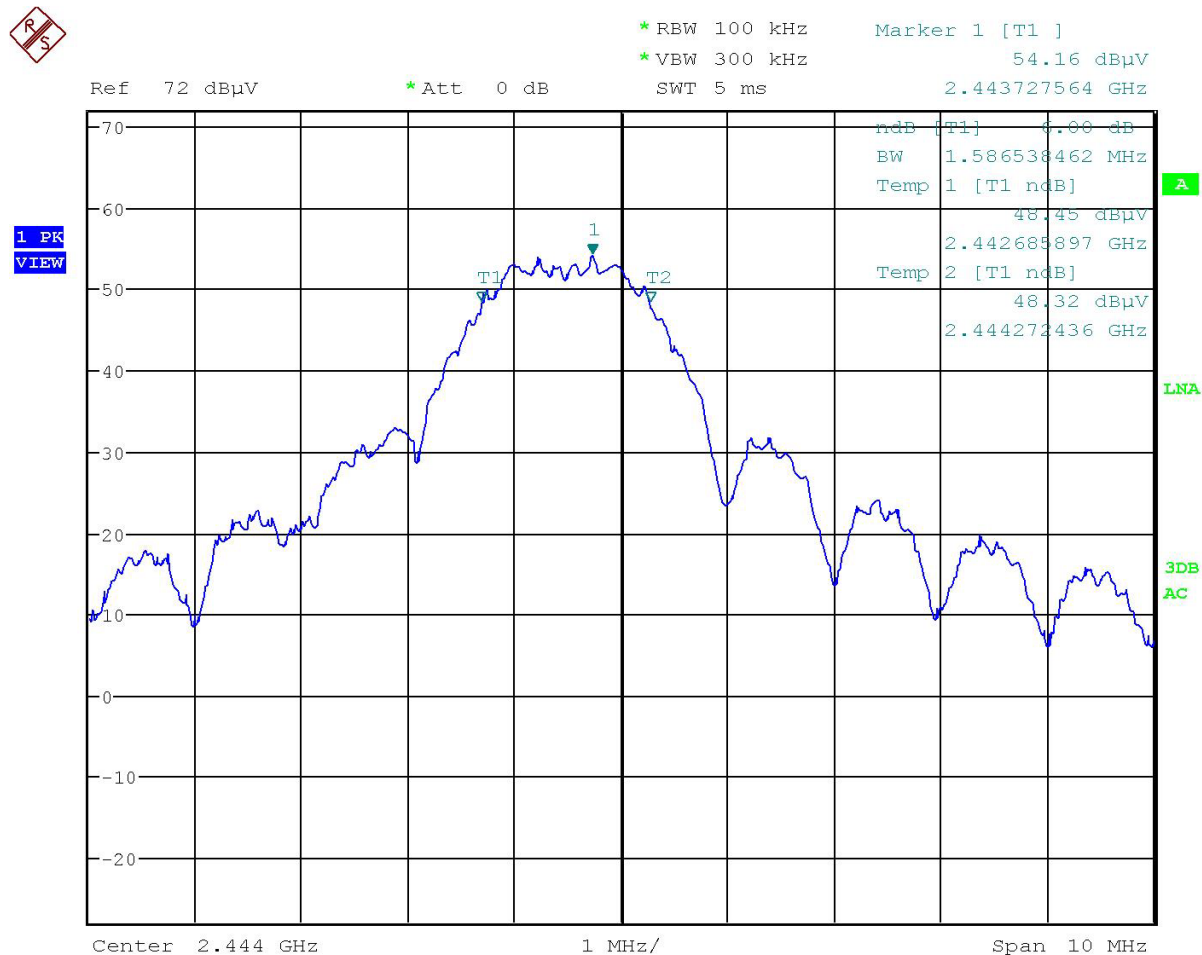


RESULTS: Meets Requirements

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OCCUPIED BANDWIDTH – TRANSMITTER B

Test Data: Transmitter B - Middle of Band



RESULTS: Meets Requirements

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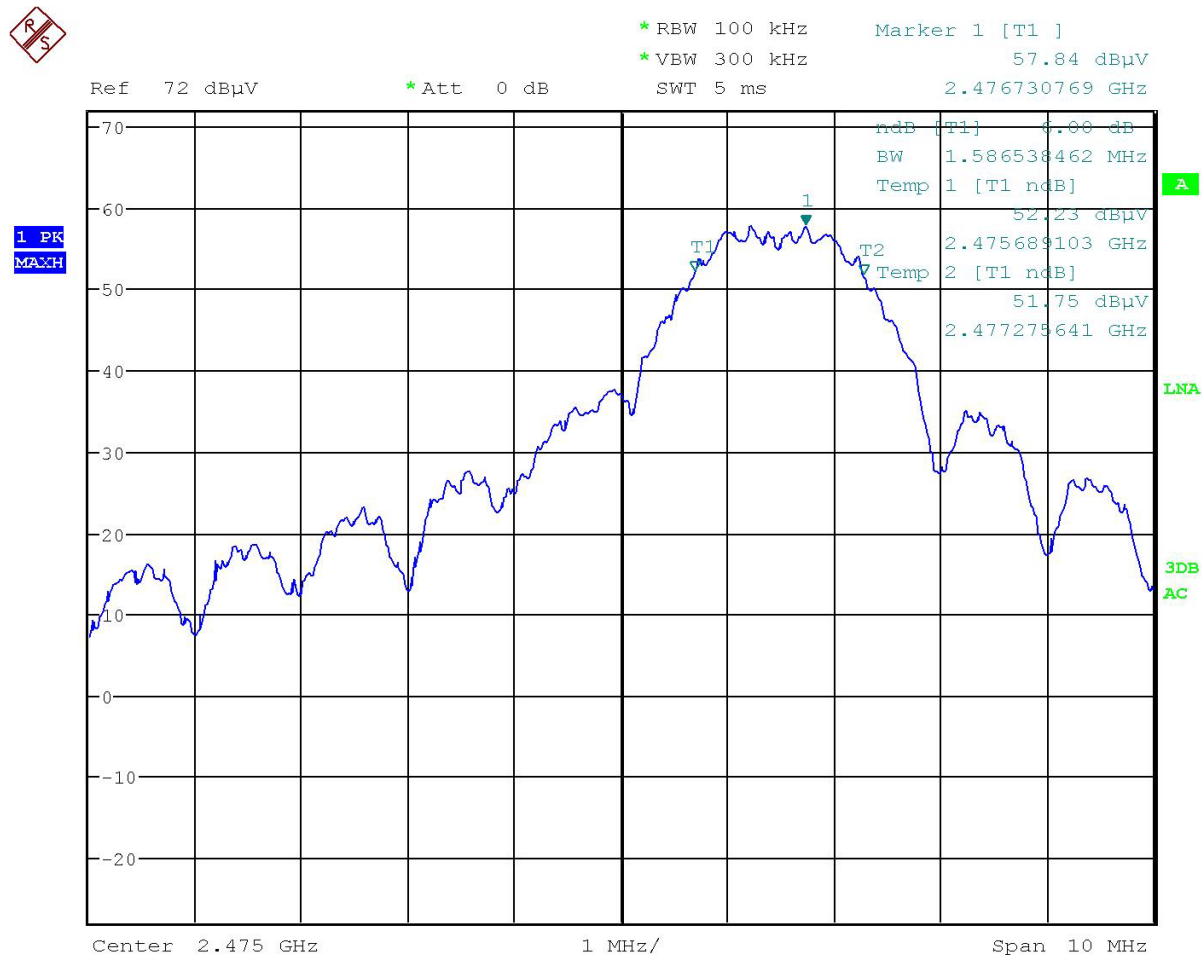
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OCCUPIED BANDWIDTH – TRANSMITTER B

Test Data: Transmitter B - High End of Band



RESULTS: Meets Requirements

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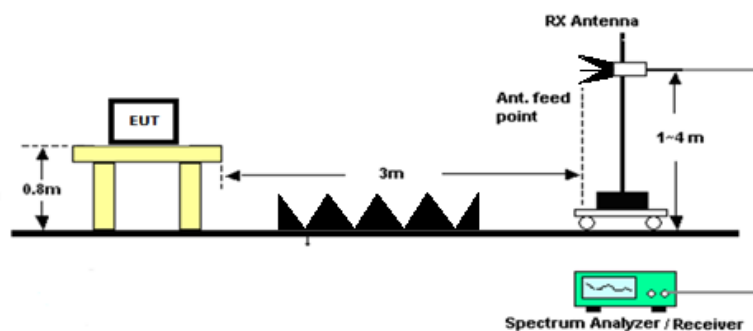
BANDEDGE EMISSIONS

Rule Part No.: 15.247(d), & 15.205(a) (b) (c)

Requirements: Emissions must be at least 20dB down from the highest emission level Within the authorized band as measured with a 100 kHz RBW, additionally adjacent restricted band edge emissions must comply with 15.209 limits.

Test Method: KDB 558074 D01 DTS Meas Guidance v03r02 § 10.2.5.2, for non-restricted bandedges & KDB 558074 D01 DTS Meas Guidance v03r02 § 10.2.5.2 for Restricted Bandedges for emissions within 2 MHz from Edge of Band.

Setup:

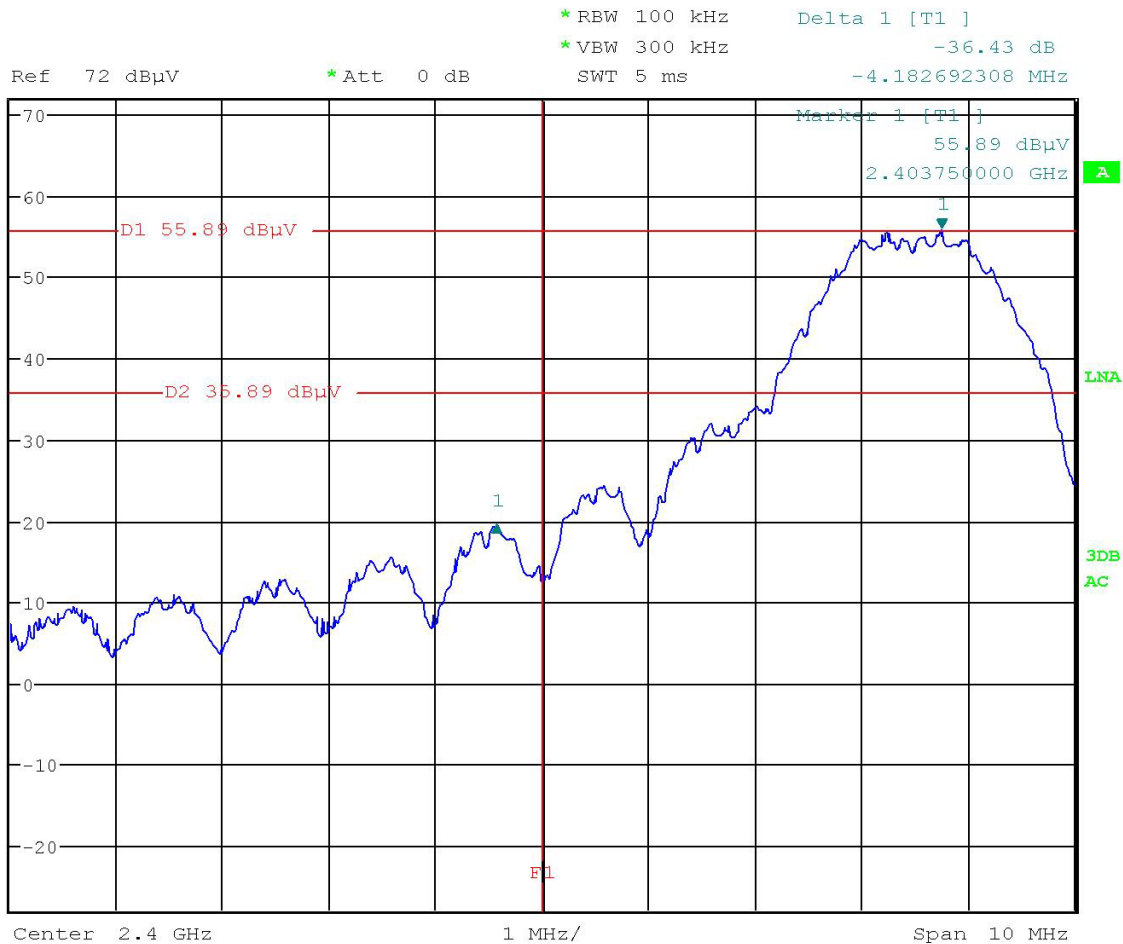


RESULTS: Meets Requirements

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BANDEDGE EMISSIONS

Data: Simultaneous Operation - Lower Band Edge



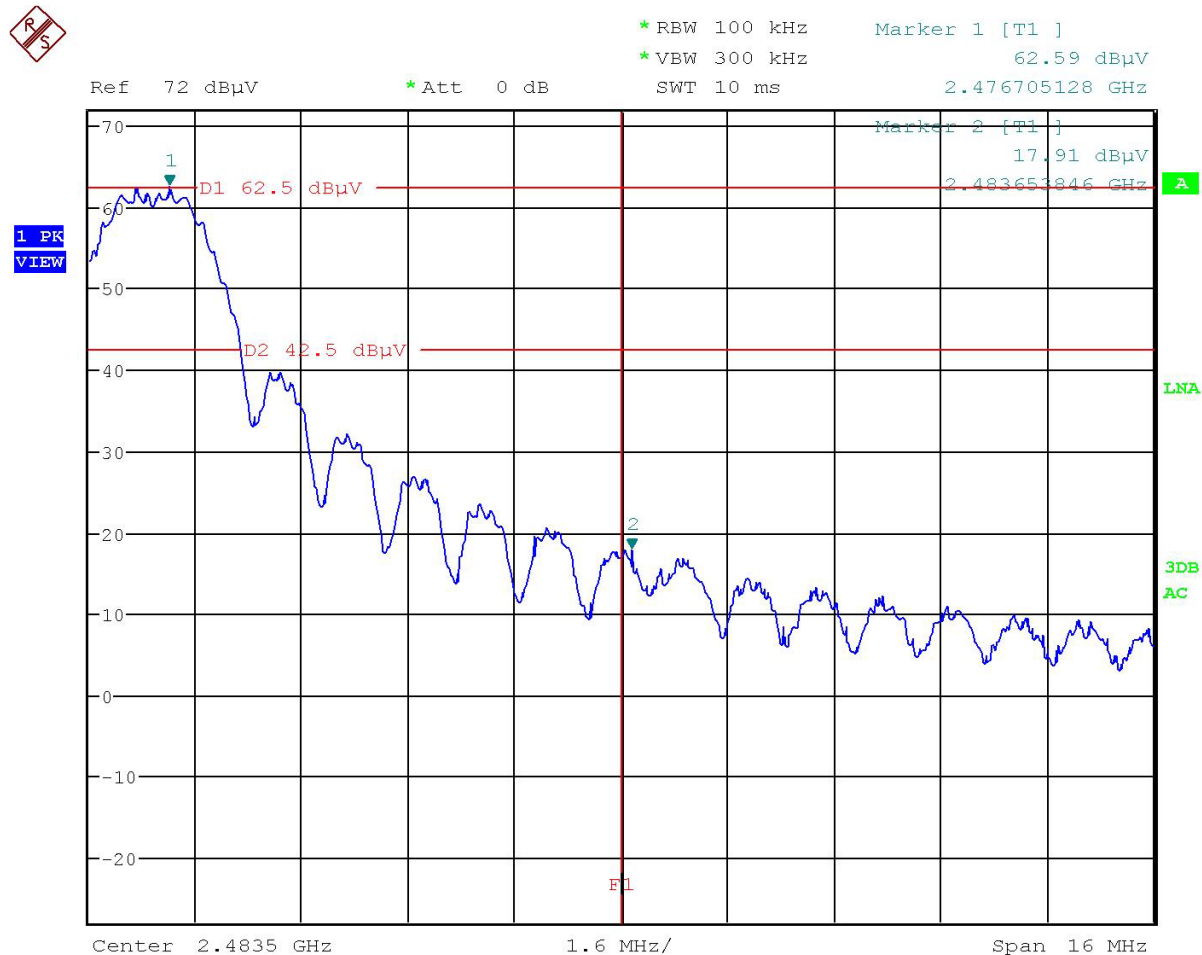
RESULTS: Meets Requirements

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BANDEDGE EMISSIONS

Data: Simultaneous Operation – Upper Restricted Band Edge

Field Strength of Carrier (dBuV/m)	Emission Level Below Carrier (dB)	Field Strength of Emission (dBuV/m)	Emission Limit (dBuV/m)	Margin (dB)
98.14	44.68	53.46	53.98	0.52



RESULTS: Meets Requirements

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RADIATED SPURIOUS EMISSIONS

Rules Part No.: 15.247(d), & 15.205(a) (b) (c)

Requirements: Emissions must be at least 20dB down from the highest emission level Within the authorized band as measured with a 100 kHz RBW. Emissions found in restricted bands of 15.205(a) must also meet the limits of 15.209

Frequency	Limits
FCC Part 15.209	
9 to 490 kHz	2400/F (kHz) μ V/m @ 300 meters
490 to 1705 kHz	24000/F (kHz) μ V/m @ 30 meters
1705 kHz to 30 MHz	29.54 dB μ V/m @ 30 meters
30 – 88	40.0 dB μ V/m @ 3 meters
80 – 216	43.5 dB μ V/m @ 3 meters
216 – 960	46.0 dB μ V/m @ 3 meters
Above 960	54.0 dB μ V/m @ 3 meters

Test Method: KDB 558074 D01 DTS Meas Guidance v03r02 § 10.2.1 & ANSI C63.10

Radiated Spurious Restricted Band Emissions:

ANSI C63.10-2009 using a spectrum analyzer, and an appropriate antenna. The analyzer was calibrated in dB above a microvolt at the output of the antenna. The resolution bandwidth was 100 kHz with an appropriate sweep speed and the video bandwidth was 300 kHz up to 1 GHz and 1 MHz with a video BW of 3 MHz above 1 GHz. When an emission was found, the table was rotated to produce the maximum signal strength. The antenna was placed in both the horizontal and vertical planes and the worst case emissions were reported. The spectrum was searched from the lowest radio frequency generated to at least the tenth (10) harmonic of the fundamental.

The EUT was placed on a table 80 cm high and with dimensions of 1m by 1.5m. The EUT was placed in the center of the table (1.5m side). The table used for radiated measurements is capable of continuous rotation.

When an emission was found, the table was rotated to produce the maximum signal strength. At this point, the antenna was raised and lowered from 1m to 4m. The antenna was placed in both the horizontal and vertical planes. Emissions attenuated more than 20 dB below the permissible value are not reported.

Formula of Conversion Factors: The field strength at 3m was established by adding the meter reading of the spectrum analyzer (which is set to read in units of dB μ V) to the antenna correction factor supplied by the antenna manufacturer plus the coax loss. The antenna correction factors are stated in terms of dB. The gain of the preselector was accounted for in the spectrum analyzer meter reading.

Example:

Freq (MHz)	Meter Reading	+ ACF	+ CL = FS
33	20 dB μ V	+ 10.36 dB	+ 0.5 = 30.86 dB μ V/m @ 3m

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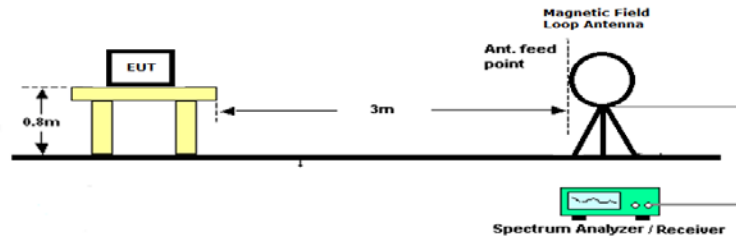
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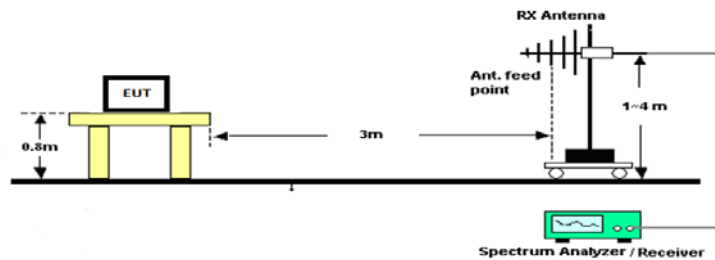
RADIATED SPURIOUS EMISSIONS

Setup:

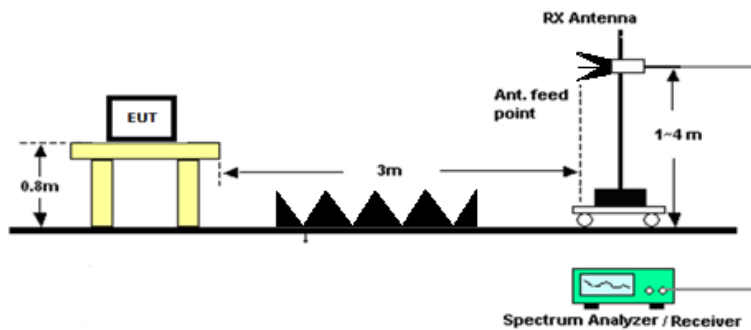
Emissions below 30 MHz



Emissions 30 – 1000 MHz



Emissions above 1 GHz



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RADIATED SPURIOUS EMISSIONS

Test Data:

No harmonics or spurious emissions present within 20dB of the limit in any operating mode.

EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Antenna: Biconnical Chamber	Eaton Chamber	94455-1	1057	06/14/13	12/14/15
Antenna: Log-Periodic Chamber	Eaton	96005	1243	05/31/13	11/30/15
Antenna: Passive Loop	EMC Test Systems	EMCO 6512	9706-1211	06/14/12	11/14/15
LISN	Electro-Metrics	ANS-25/2	2604	01/07/14	01/07/16
3-Meter Semi-Anechoic Chamber	Panashield	N/A	N/A	12/31/13	12/31/15
Ant: Double-Ridged Horn/ETS Horn 1 Ch	ETS-Lindgren Chamber	3117	00035923	06/13/14	06/13/16
EMI Test Receiver R & S ESIB 40 Screen Room	Rohde & Schwarz	ESIB 40	100274	08/12/14	08/12/16
EMI Test Receiver R & S ESU 40 Chamber	Rohde & Schwarz	ESU 40	100320	03/11/14	03/11/16

*EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

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