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FCC PART 15.247 & RSS-210 DIGITAL SPREAD SPECTRUM COMBINED TEST REPORT

Applicant	BUILDING 36 TECHNOLOGIES, LLC
Address	35 HIGHLAND CIRCLE SUITE 300 NEEDHAM MA 02494 USA
FCC ID	2AC3T-H200BRA
IC Cert #	12323A-H200BRA
Model Number	B36-H200-B
Product Description	GATEWAY
Date Sample Received	2/27/2015
Date Tested	4/15/2015
Tested By	Cory Leverett
Approved By	Sid Sanders

Report Number	Version Number	Description	Issue Date
411AUT15TestReport	Rev.1	Initial Issue	4/17/2015

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

APPLICANT: BUILDING 36 TECHNOLOGIES, LLC
FCC ID: 2AC3T-H200BRA
IC Cert#: 12323A-H200BRA
REPORT: B\BUILDING 36\411AUT15\411AUT15TestReport.docx

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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:



Cory Leverett
Engineering Project Manager

Date: 4/17/2015

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GENERAL INFORMATION

EUT Specification

FCC Regulatory Standard	Title 47 CFR Part 15.247		
IC Regulatory Standard	RSS-210 (i8)		
FCC ID	2AC3T-H200BRA		
IC Cert	12323A-H200BRA		
EUT Description	GATEWAY		
Operating Frequency	TX: 912 – 924 MHz	RX: 912 – 924 MHz	
Number of channels	7		
EUT Power Source	<input checked="" type="checkbox"/> 110–120Vac/50– 60Hz		
	<input type="checkbox"/> DC Power		
	<input type="checkbox"/> Battery Operated Exclusively		
Test Item	<input type="checkbox"/> Prototype	<input checked="" type="checkbox"/> Pre-Production	<input type="checkbox"/> Production
Type of Equipment	<input checked="" type="checkbox"/> Fixed	<input type="checkbox"/> Mobile	<input type="checkbox"/> Portable
Antenna Connector	None		
Antenna	Fixed 2.81 dBi gain PCB Trace Antenna		
Test Facility	Timco Engineering Inc. located at 849 NW State Road 45 Newberry, FL 32669 USA.		
Test Conditions	Temperature: 24-26°C Relative humidity: 50-65%		
Measurement Standard	KDB 558074 D01 v03r02 (DTS Meas Guidance) ANSI C63.10-2009		
Test Exercise	Multiple samples were used		

Test Supporting Equipment

Supporting Device	Manufacturer	Model / FCC ID	S/N	Supplied By
100-240 VAC Power Supply	JFEC	JF006WR-0900066UH	4000161	Applicant

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SUMMARY

Specification	FCC Rules Part	IC RSS	Result
Power Line Conducted Emissions	15.207(a)	210 2.1	Pass
Occupied Bandwidth	15.247(a)(2)	210 A8.2(a)	Pass
Bandedge	15.205(a)(b)	210 2.2	N/A(1)
Output Power	15.247(b)(3-4)	210 A8.4(4)	Pass
Power Spectral Density	15.247(e)	210 A8.2(b)	Pass
Antenna Conducted Emissions	15.247(d)	210 A8.5	Pass
Radiated Emissions	15.205(a)(b)	210 2.2	Pass
Antenna Requirements	15.203	NA	Pass

Notes:

1. The EUT's band of operation does not have an adjacent restricted band as found in part 15.205 and RSS-Gen 8.10; no testing is required for Adjacent Restricted Bandedge compliance, only radiated emissions falling in restricted bands are required and are reported with the radiated emissions.

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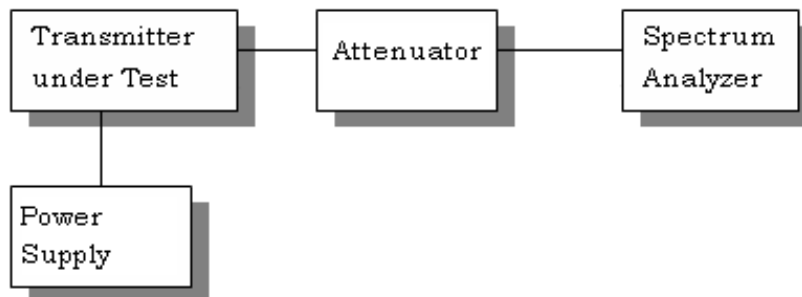
POWER OUTPUT

Rules Part No.: FCC 15.247(b)(3-4), RSS-210 A8.4(4)

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: Measurements were made conducted following KDB 558074 § 9.1.1

Setup:



Test Data: Output Power Measurement Table

Conducted Power Output Measurements

Tuned Frequency MHz	dBm	mW
912	5.74	3.7
918	5.86	3.8
924	5.93	3.9

Calculated EIRP Measurements

Tuned Frequency MHz	Conducted Power dBm	Ant Gain dBi	EIRP dBm	EIRP mW
912	5.74	2.81	8.55	7.1
918	5.86	2.81	8.67	7.3
924	5.93	2.81	8.74	7.4

RESULTS: Meets Requirements

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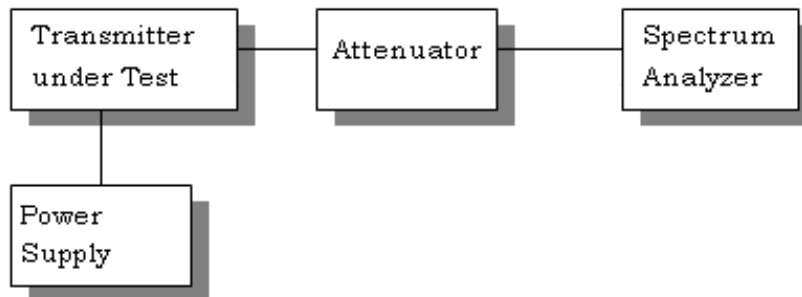
POWER SPECTRAL DENSITY

Rules Part No.: FCC 15.247(e), RSS-210 A8.2(a)

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

Test Method: Measurements were made conducted following KDB 558074 § 10.2

Setup:



Test Data: Table of Measured Power Spectral Density

Conducted Power Spectral Density Measurements

Tuned Frequency MHz	dBm	Limit dBm	Margin dB
912	5.66	8	2.34
918	5.71	8	2.29
924	5.70	8	2.30

RESULTS: Meets all Requirements

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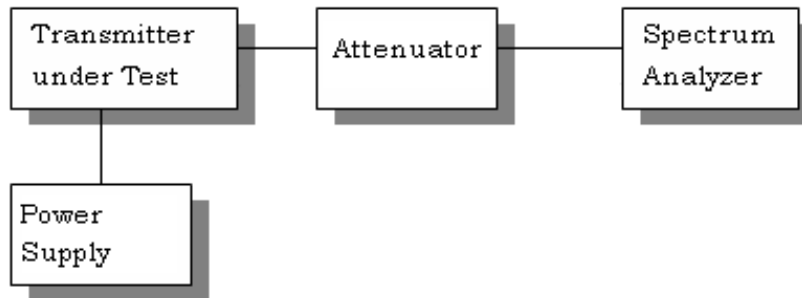
OCCUPIED BANDWIDTH

Rules Part No.: FCC 15.247(a)(2), RSS-210 A8.2(a)

Requirements: The 6 dB DTS bandwidth must be greater than 500 kHz.

Test Method: Measurements were made conducted following KDB 558074 § 8.1

Setup:



Test Data: Occupied Bandwidth Measurement Table

Tuned Frequency MHz	99% OBW KHz	20 dB OBW KHz	6 dB DTS BW KHz
912	816.98	928.13	661.36
918	816.98	928.13	655.80
924	811.52	928.13	655.80

RESULTS: Meets Requirements

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OCCUPIED BANDWIDTH

Test Data: 6dB DTS Bandwidth Low end of Band = 661.36 KHz



13.Apr 15 19:25

Ref -20.4 dBm

*Att 10 dB

*RBW 100 kHz

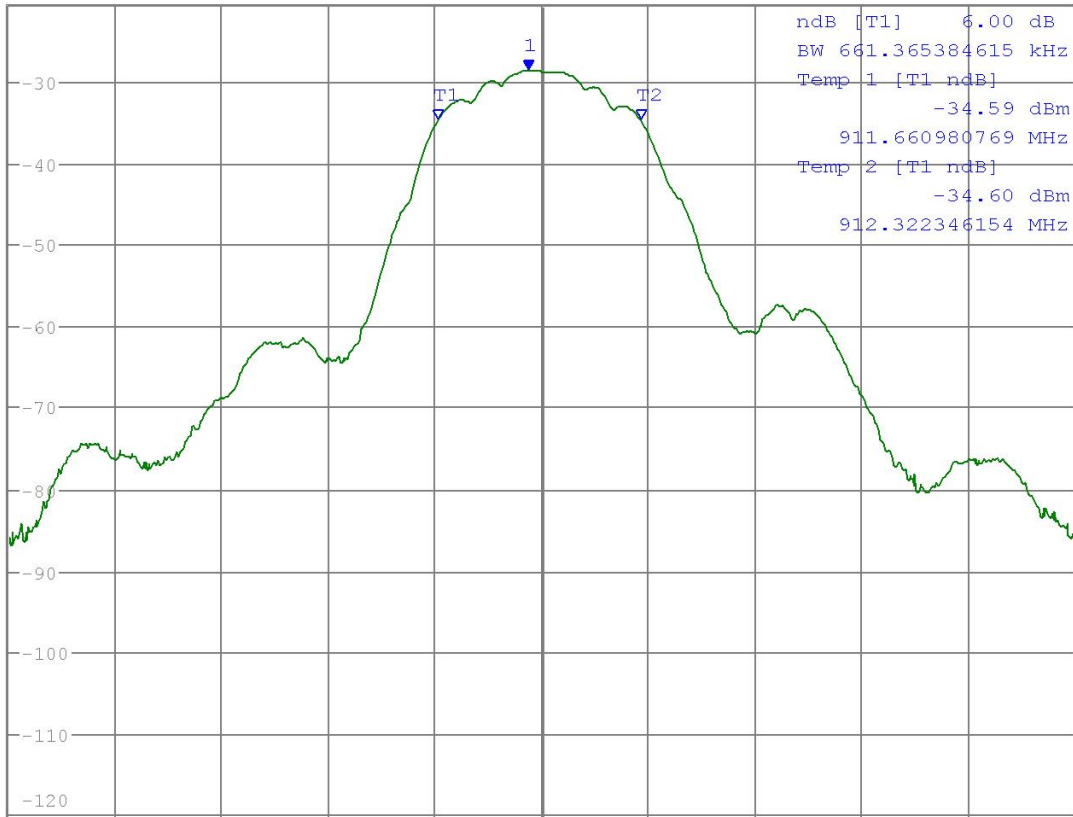
*VBW 300 kHz

SWT 2.5 ms

Marker 1 [T1]

-28.46 dBm

911.955538462 MHz



Center 912 MHz

346.8 kHz/

Span 3.468 MHz

Date: 13.APR.2015 19:25:23

RESULTS: Meets Requirements

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OCCUPIED BANDWIDTH

Test Data: 6dB DTS Bandwidth Middle of Band = 655.80 KHz



13.Apr 15 19:28

Ref -20.4 dBm

*Att 10 dB

*RBW 100 kHz

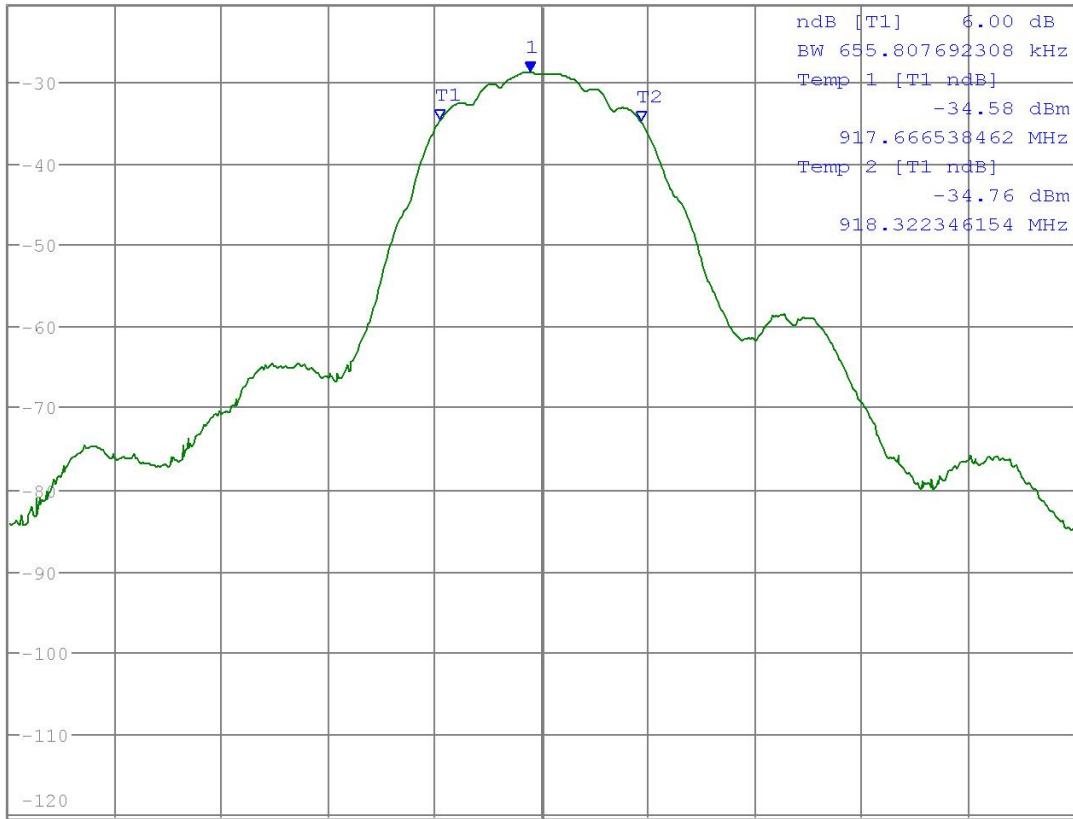
*VBW 300 kHz

SWT 2.5 ms

Marker 1 [T1]

-28.76 dBm

917.961096154 MHz



Center 918 MHz

346.8 kHz/

Span 3.468 MHz

Date: 13.APR.2015 19:28:33

RESULTS: Meets Requirements

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OCCUPIED BANDWIDTH

Test Data: 6dB DTS Bandwidth High end of Band = 655.80 KHz



13.Apr 15 19:34

Ref -20.4 dBm

*Att 10 dB

*RBW 100 kHz

*VBW 300 kHz

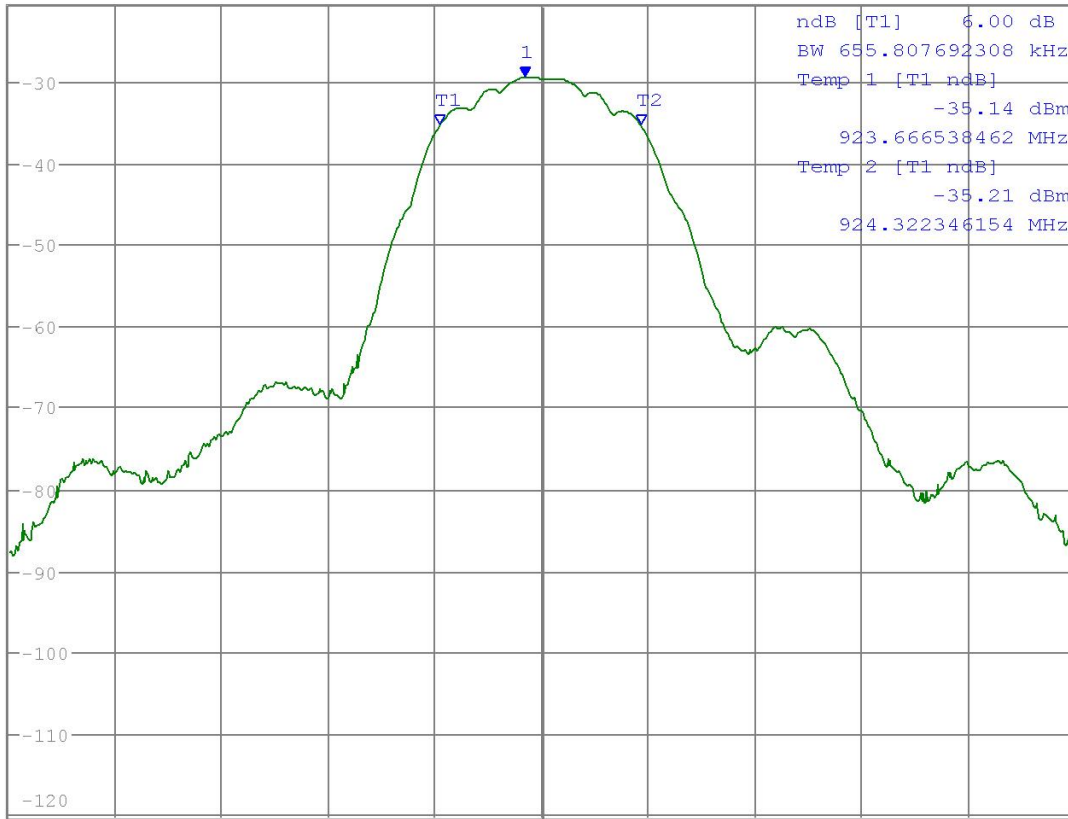
SWT 2.5 ms

Marker 1 [T1]

-29.29 dBm

923.944423077 MHz

1 PK
VIEW



PA
PS

3DB
AC

Date: 13.APR.2015 19:34:29

RESULTS: Meets Requirements

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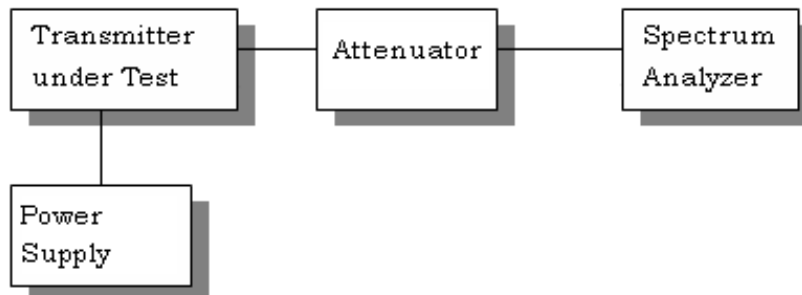
BANDEDGE

Rule Part No.: FCC 15.205(a)(b), RSS-210 2.2

Requirements: For any bands an EUT operates in which have adjacent restricted bands, a Bandedge measurement of emissions within 2 MHz of the authorized bandedge must be made. These emissions must comply with the general field strength limits of FCC 15.09 & RSS-GEN 8.9.

Test Method: Measurements were made conducted following KDB 558074 § 13.0

Setup:



Data: NO Bandedge test required for this EUT, the EUT uses a band without an adjacent restricted band.

RESULTS: Meets Requirements

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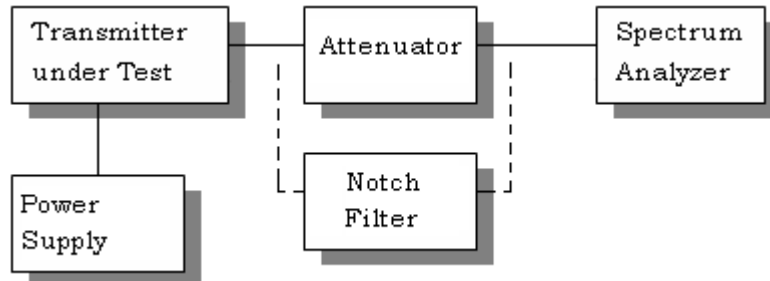
SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Rules Part No.: FCC 15.247(d), RSS-210 A8.5

Requirements: Emissions must be at least 20dB down from the highest emission level Within the authorized band as measured with a 100 kHz RBW.

Test Method: Measurements were made conducted following KDB 558074 § 11.0 – 11.3

Setup:



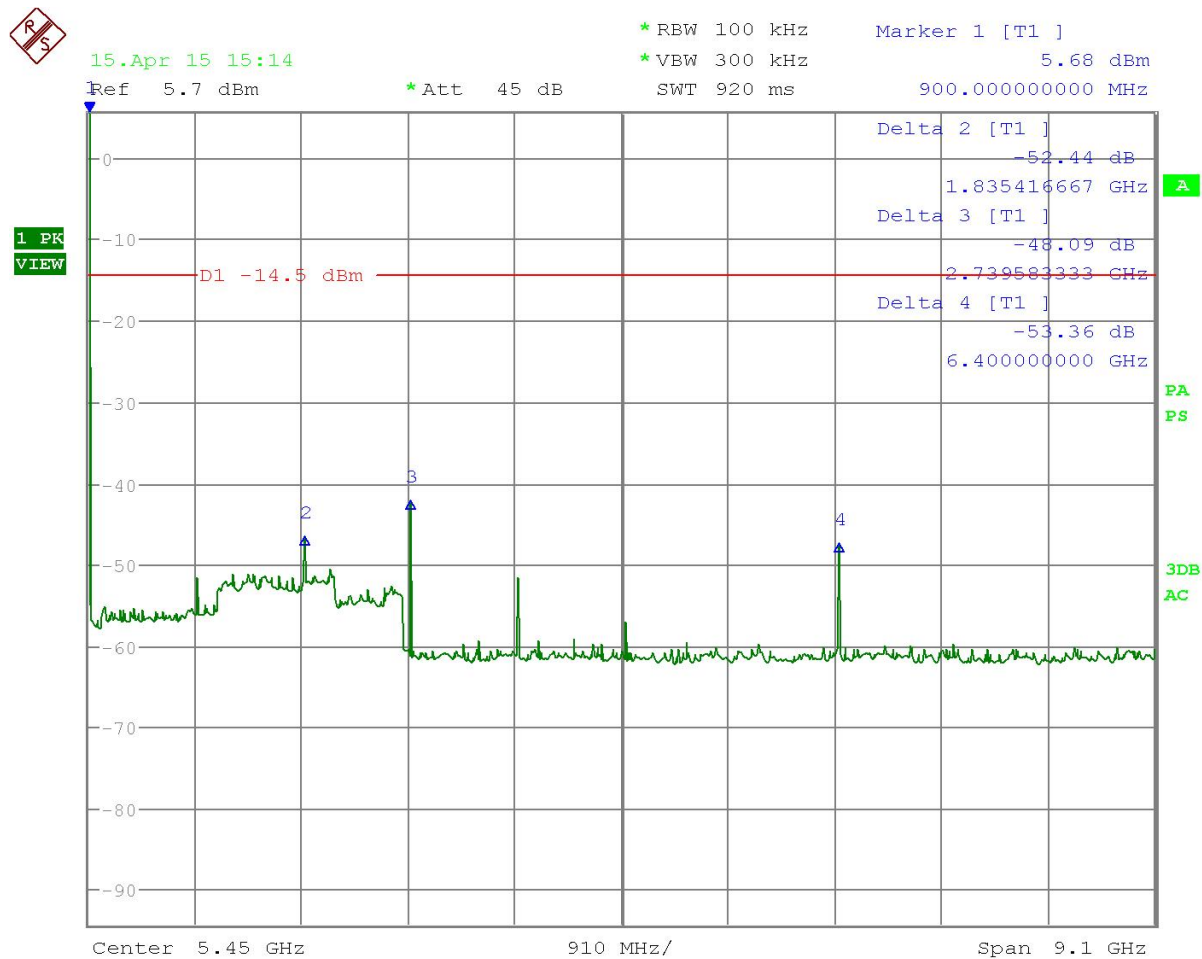
Test Data: Emissions were measured from the lowest radio frequency generated to the tenth harmonic of the highest tuned fundamental frequency. The plots on the following pages represent the three highest emissions found for each place in the band.

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SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Test Data:

Low end of band plot



Date: 15.APR.2015 15:14:16

Results - Meets Requirements

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SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Test Data:

Middle of band plot



Date: 15.APR.2015 15:51:17

Results - Meets Requirements

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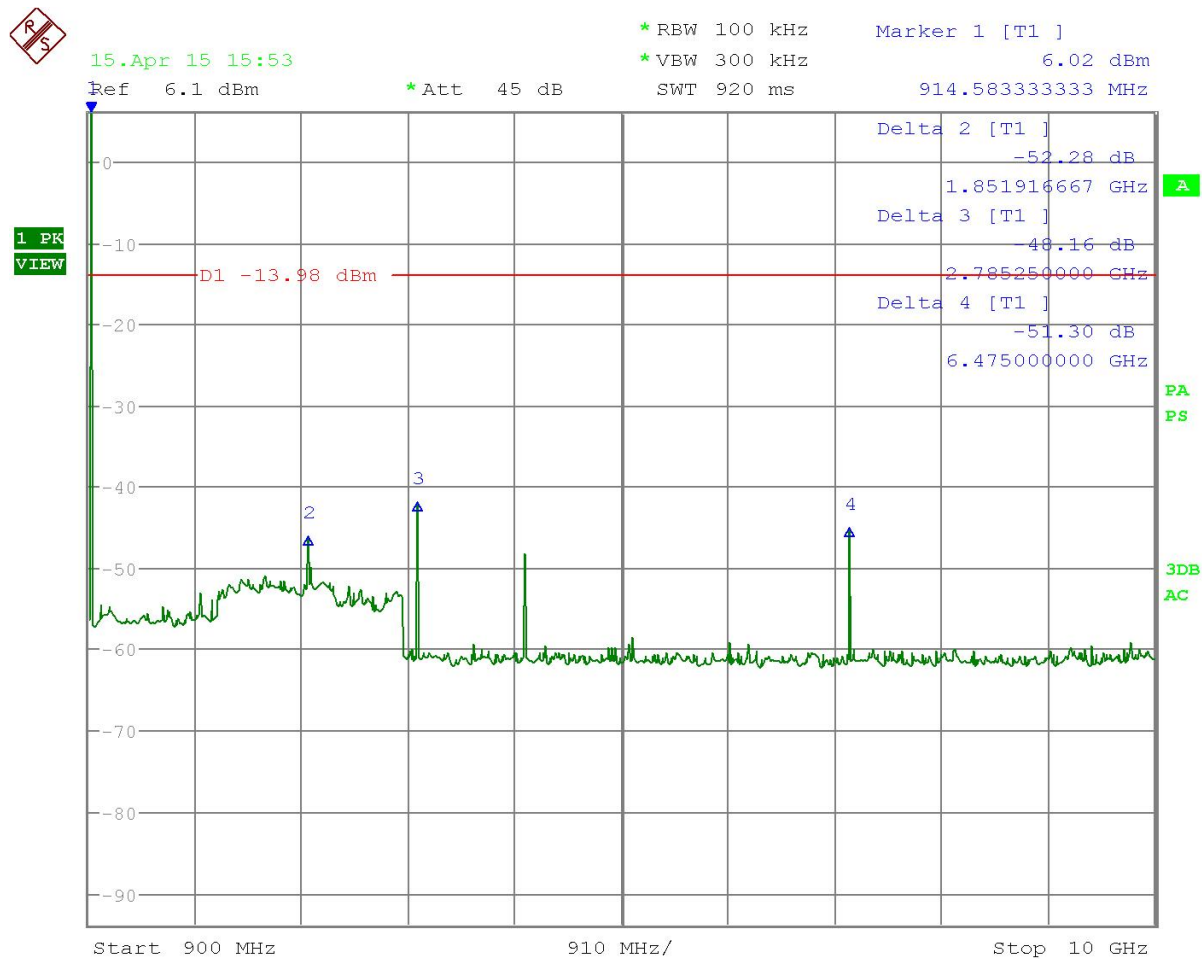
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SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Test Data:

High end of band plot



Date: 15.APR.2015 15:53:28

Results - Meets Requirements

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RADIATION INTERFERENCE

Rules Part No.: FCC part 15.205(a)(b), RSS-210 2.2

Requirements: For all emissions found in restricted bands the levels must comply with the general limits found in FCC part 15.209 & RSS-GEN 8.9

Frequency	Limits
FCC Part 15.209 & RSS-GEN 8.9	
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: Measurements were made radiated in a 3 meter RF shielded anechoic chamber, following KDB 558074 § 12.2.7 & ANSI C63.10 § 6.3 – 6.6

Method of Measuring Radiated Spurious Emissions: Radiation Interference: 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 worse case emissions were reported. The spectrum was searched to at least the tenth (10) harmonic of the fundamental.

ANSI C63.4-2003 10.1 Measurement Procedures: 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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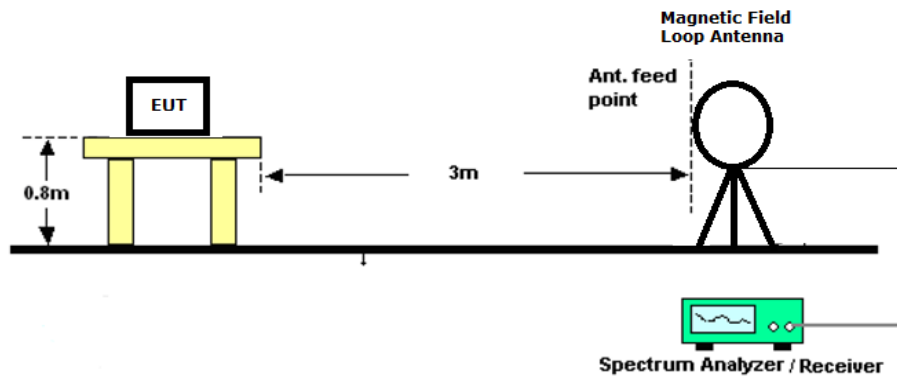
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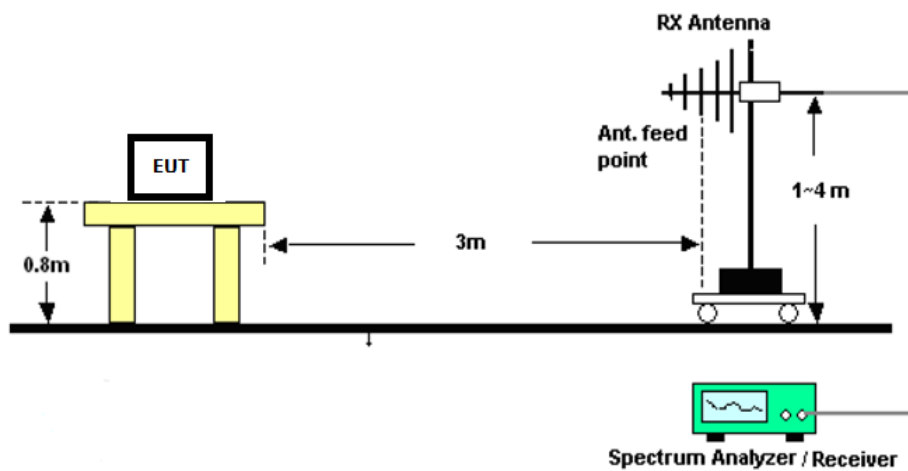
RADIATION INTERFERENCE

Setup:

Emissions below 30 MHz



Emissions Above 30 MHz

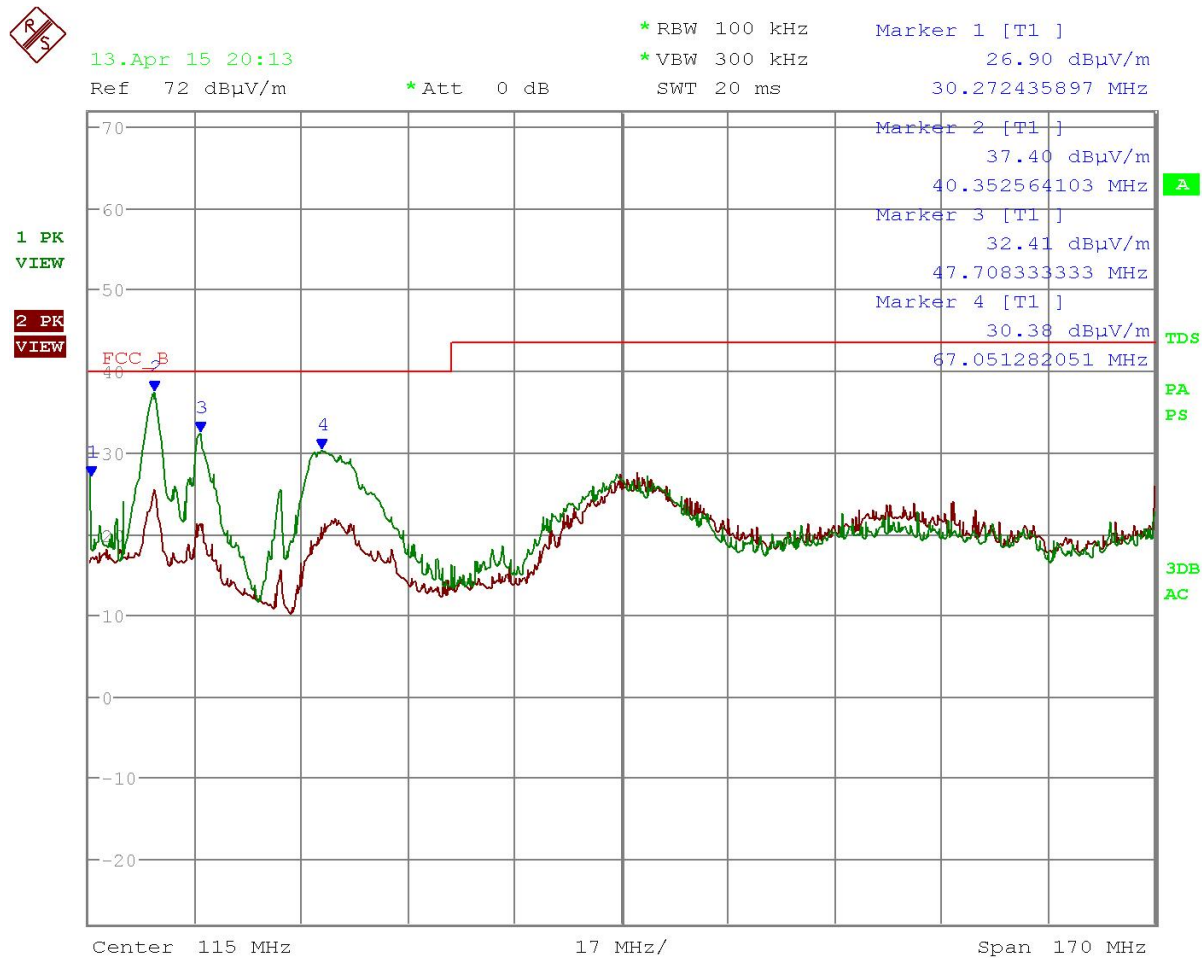


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RADIATION INTERFERENCE

Test Data: The plots on the following pages represent the worst case emissions found for this EUT. Three places in the band were checked. All emissions were maximized in respect to the procedures described in ANSI C63.4 for maximizing emission.

30-200 MHZ PLOT



Date: 13.APR.2015 20:13:50

Ant Polarity: T1 (Green)=Vertical, T2 (Red)=Horizontal

Results - Meets Requirements

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RADIATION INTERFERENCE

Test Data:

200 - 902 MHz PLOT High end of band



Date: 13.APR.2015 20:04:50

Ant Polarity: T1 (Green)=Vertical, T2 (Red)=Horizontal

Results - Meets Requirements

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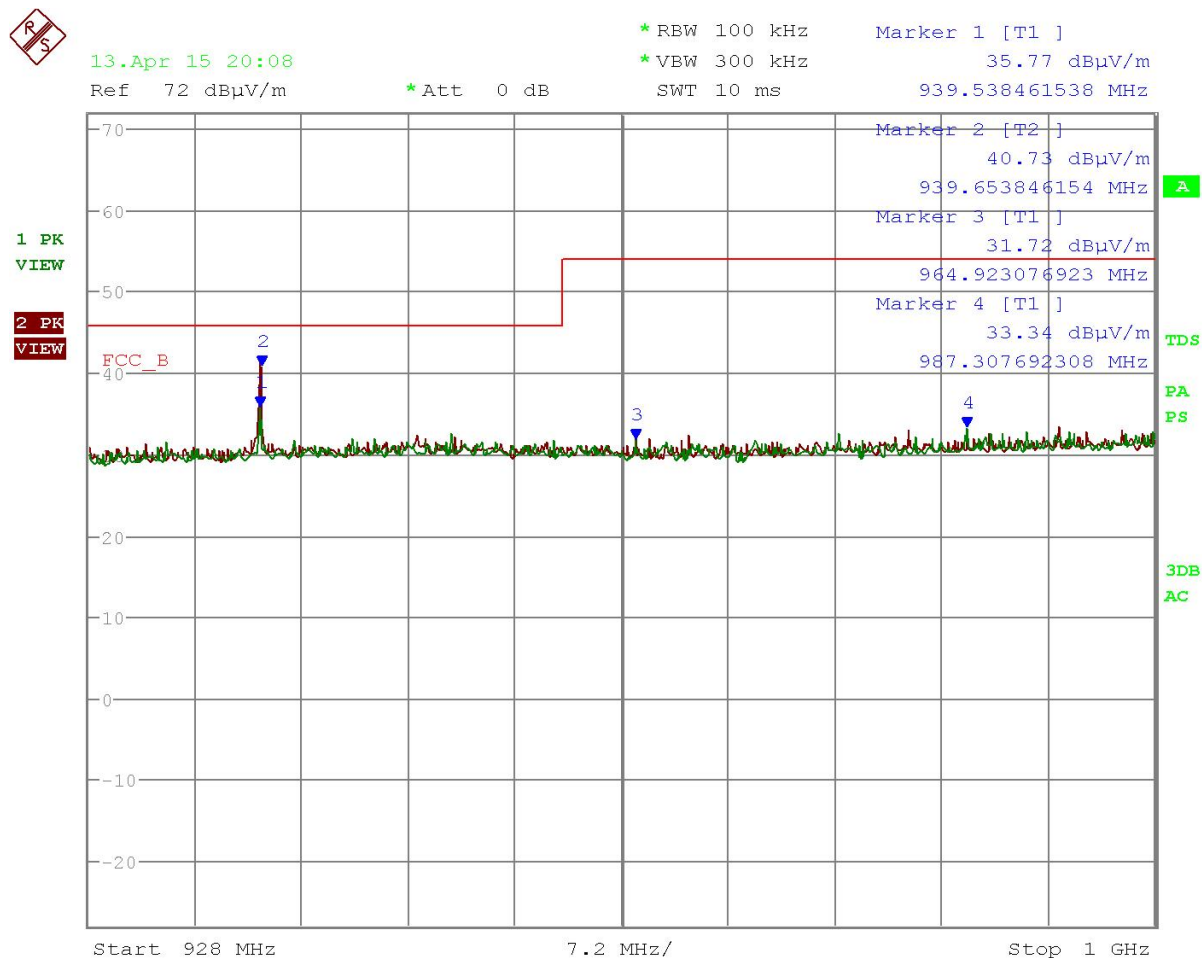
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RADIATION INTERFERENCE

Test Data:

928 - 1000 MHZ PLOT High end of band



Date: 13.APR.2015 20:08:23

Ant Polarity: T1 (Green)=Vertical, T2 (Red)=Horizontal

Results - Meets Requirements

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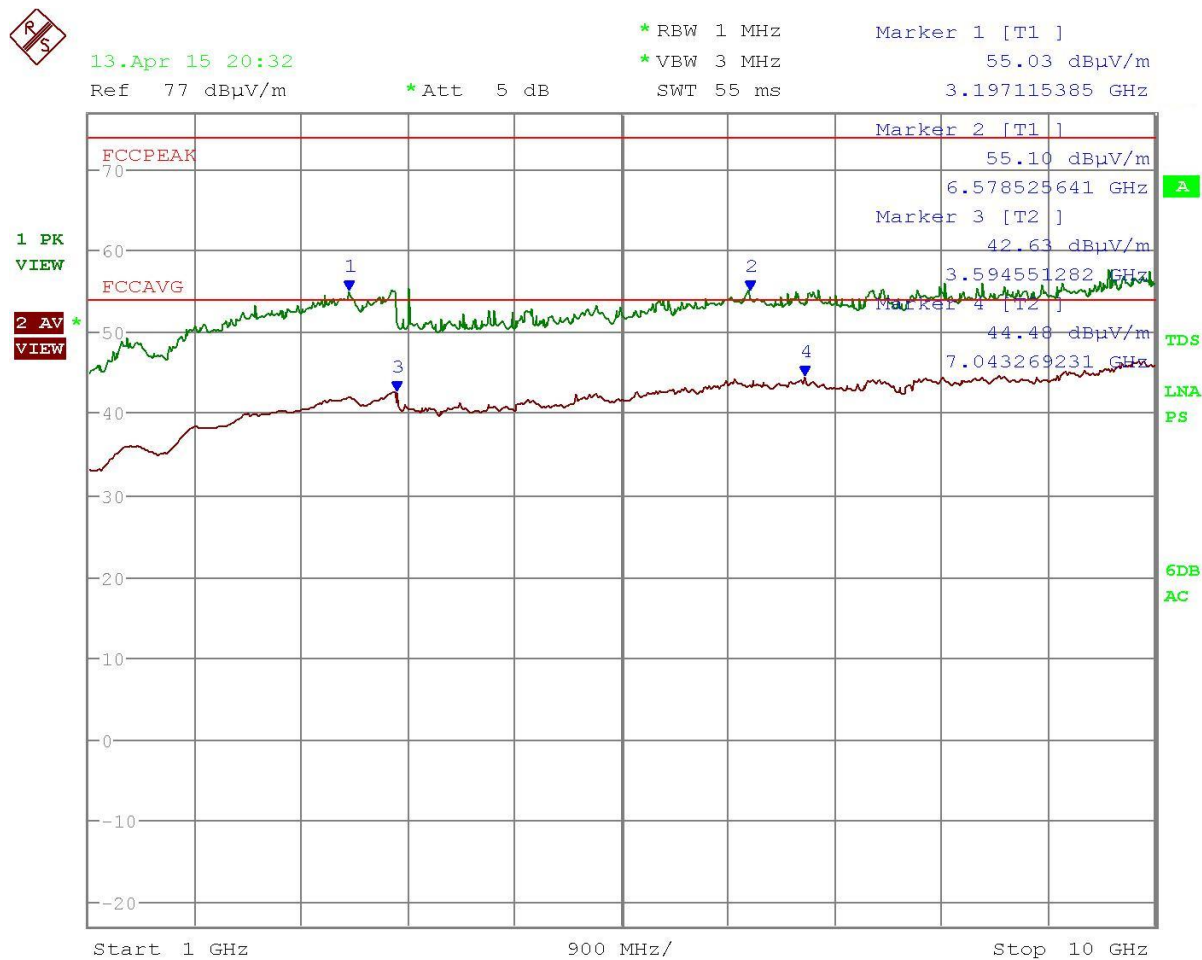
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RADIATION INTERFERENCE

Test Data:

1-10 GHz PLOT High end of band



Date: 13.APR.2015 20:32:20

Ant Polarity: T1 (Green)=Vertical, T2 (Red)=Horizontal

Results - Meets Requirements

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POWER LINE CONDUCTED INTERFERENCE

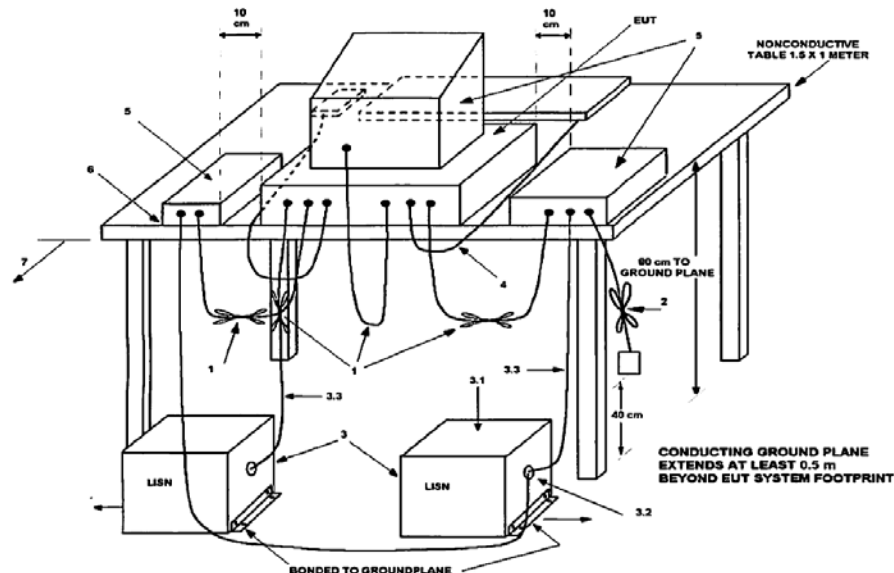
Rules Part No.: FCC 15.207(a), RSS-210 (2.1)

Requirements:

Frequency (MHz)	Quasi Peak Limits (dB μ V)	Average Limits (dB μ V)
0.15 – 0.5	66 – 56 *	56 – 46 *
0.5 – 5.0	56	46
5.0 – 30	60	50
* Decrease with logarithm of frequency		

Test Method: The procedure used was ANSI C63.10 using a 50uH LISN. Both lines were observed. The bandwidth of the spectrum analyzer was 10 kHz with an appropriate sweep speed. The spectrum was scanned from 0.15 to 30 MHz.

Setup:

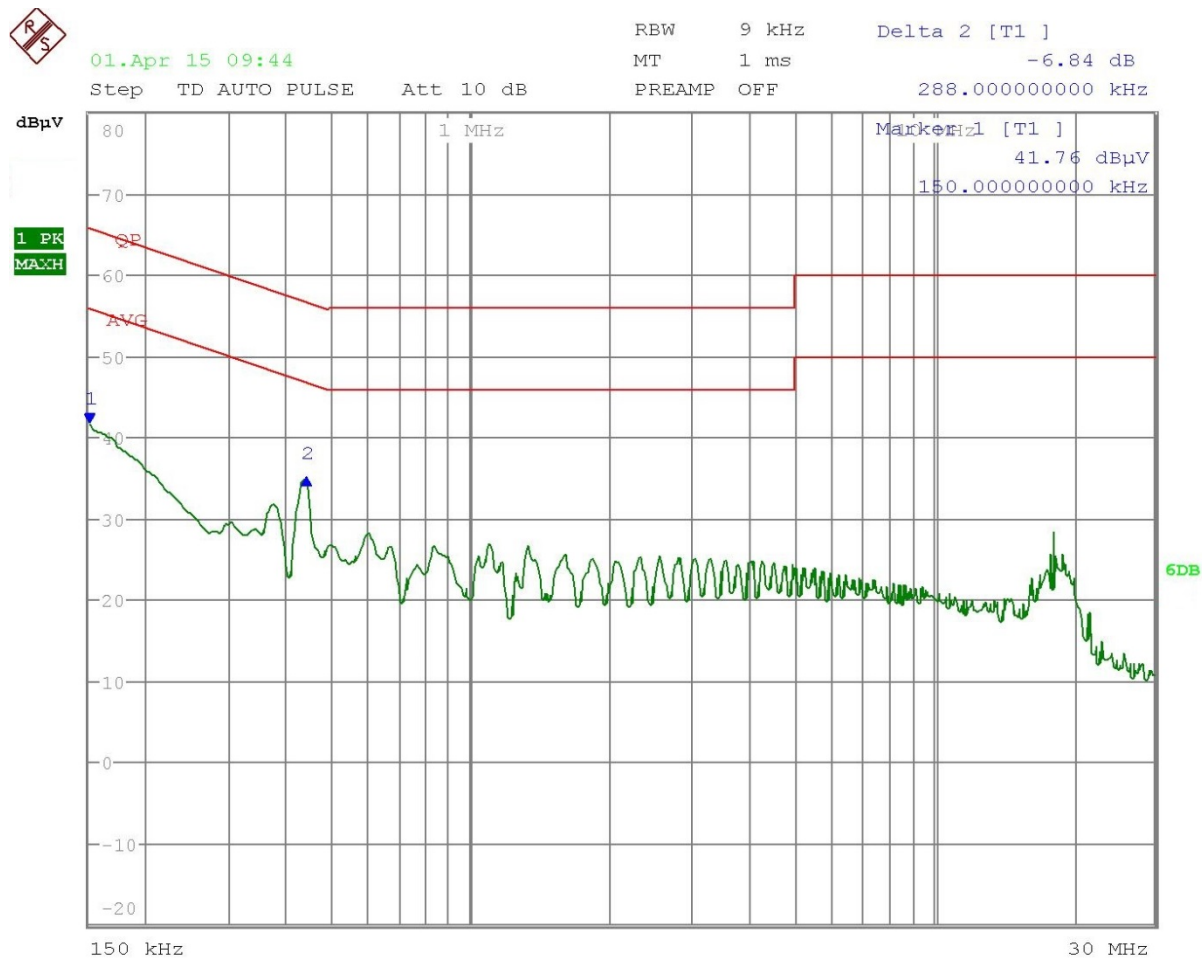


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POWER LINE CONDUCTED INTERFERENCE

Test Data: The following plots represent the emissions read for power line Conducted. Both lines were observed.

LINE 1



Date: 1.APR.2015 09:44:31

RESULTS: Meets Requirements

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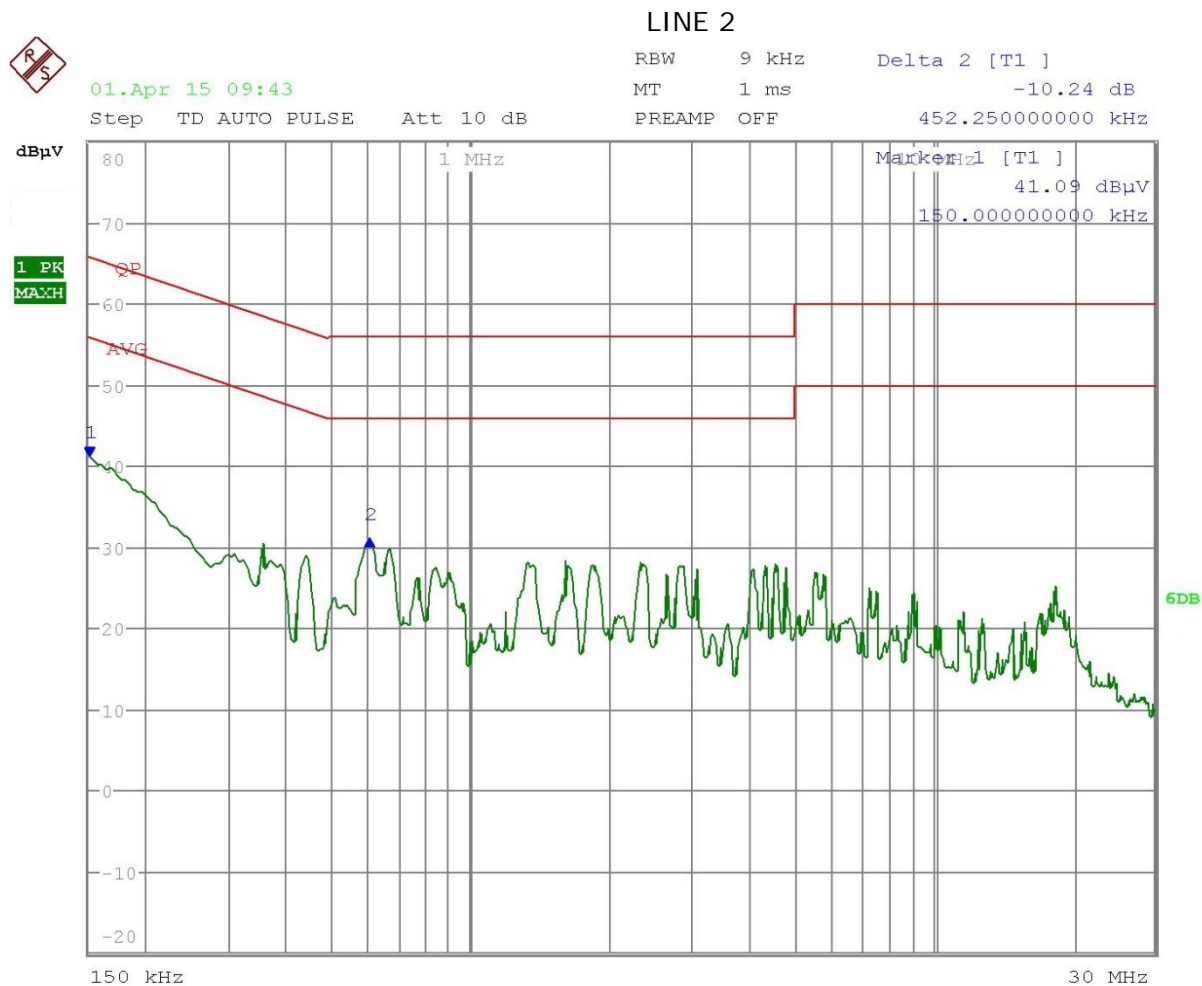
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POWER LINE CONDUCTED INTERFERENCE

Test Data:



Date: 1.APR.2015 09:43:08

RESULTS: Meets Requirements

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EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Antenna: Biconnical Chamber	Eaton Chamber	94455-1	1057	06/14/13	06/14/15
Antenna: Log-Periodic Chamber	Eaton	96005	1243	05/31/13	05/31/15
Antenna: Passive Loop	EMC Test Systems	EMCO 6512	9706-1211	06/14/12	06/14/15
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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