MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*

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February 5, 2014

Ooma, Inc.
1840 Embarcadero Rd.
Palo Alto, CA 94303

Dear Michal Smulski,

Enclosed is the EMC Wireless test report for compliance testing of the Ooma, Inc., Ooma Telo, Ooma Office, and Ooma Telo 2 as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Part 15, Subpart B and ICES-003, Issue 5, August 2012 for a Class B Digital Device and Subpart D and RSS-213, Issue 2, December 2005 for Intentional Radiators.

Thank you for using the services of MET Laboratories, Inc. If you have any questions regarding these results or if MET can be of further service to you, please contact me.

Sincerely yours,
MET LABORATORIES, INC.

Jennifer Warnell
Documentation Department

Reference: (\Ooma, Inc.\EMCS39244-FCC15D Rev. 3)

Electromagnetic Compatibility Criteria Test Report

for the

Ooma, Inc.
Model Ooma Telo, Ooma Office, Ooma Telo 2

Tested under
the FCC Rules contained in
Title 47 of the CFR, Part 15. Subpart B and ICES-003
for Unintentional Radiators
Title 47 of the CFR, Part 15. Subpart D and RSS-213
for Intentional Radiators

MET Report: EMCS39244-FCC15D Rev. 3

February 5, 2014

Prepared For:

Ooma, Inc.
1840 Embarcadero Rd.
Palo Alto, CA 94303

Prepared By:
MET Laboratories, Inc.
914 W. Patapsco Ave.
Baltimore, MD 21230

Electromagnetic Compatibility Criteria
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Title 47 of the CFR, Part 15. Subpart B and ICES-003
for Unintentional Radiators
Title 47 of the CFR, Part 15. Subpart D and RSS-213
for Intentional Radiators

Poona Saber, Project Engineer
Electromagnetic Compatibility Lab

Jennifer Warnell
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Part 15 Subparts B & D, of the FCC Rules and Industry Canada standards ICES-003, Issue 5, August 2012 and RSS-213, Issue 2, December 2005 under normal use and maintenance.

Asad Bajwa
Director, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	January 8, 2014	Initial Issue.
1	January 16, 2014	Editorial correction.
2	January 20, 2014	Revised to reflect engineer corrections.
3	February 5, 2014	Revised to reflect retesting of Part 15B for the Telo 2.

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List of Terms and Abbreviations

AC	**A**lternating **C**urrent
ACF	**A**ntenna **C**orrection **F**actor
Cal	**Cal**ibration
d	**M**easurement **D**istance
dB	**D**eci**b**els
dBµA	**D**eci**b**els above one **micro**amp
dBµV	**D**eci**b**els above one **micro**volt
dBµA/m	**D**eci**b**els above one **micro**amp **per m**eter
dBµV/m	**D**eci**b**els above one **micro**volt **per m**eter
DC	**D**irect **C**urrent
E	**E**lectric Field
DSL	**D**igital **S**ubscriber **L**ine
ESD	**E**lectro**s**tatic **D**ischarge
EUT	**E**quipment **U**nder **T**est
f	**F**requency
FCC	**F**ederal **C**ommunications **C**ommission
GRP	**G**round **R**eference **P**lane
H	Magnetic Field
HCP	**H**orizontal **C**oupling **P**lane
Hz	**H**ert**z**
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**k**ilo**h**ert**z**
kPa	**k**ilo**pa**scal
kV	**k**ilo**v**olt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**h**ertz
µH	**microh**enry
µ	**microf**arad
µs	**micros**econds
NEBS	**N**etwork **E**quipment-**B**uilding **S**ystem
PRF	**P**ulse **R**epetition **F**requency
RF	**R**adio **F**requency
RMS	**R**oot-**M**ean-**S**quare
TWT	**T**raveling **W**ave **T**ube
V/m	**V**olts **per m**eter
VCP	**V**ertical **C**oupling **P**lane

I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Ooma, Inc. Ooma Telo, Ooma Office, Ooma Telo 2, with the requirements of Part 15 Subpart B and Subpart D. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the Ooma Telo, Ooma Office, Ooma Telo 2. Ooma, Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Ooma Telo, Ooma Office, Ooma Telo 2, has been **permanently** discontinued.

B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15 Subpart B and Subpart D, in accordance with Ooma, Inc., purchase order number 4056.

Requirement	FCC Part	Canada RSS-213	Test Procedure (Section numbers refer to ANSI C63.17 unless otherwise noted)	Result
Emission Bandwidth	15.303(c) & 15.323 (a)	6.4	6.1.3	Compliant
Labeling Requirements	15.311 & 15.19(a)(3)	RSS-Gen	--	Compliant
Conducted Emissions	15.315 & 15.207	6.3	ANSI C63.4	Compliant
Antenna Requirements	15.317 & 15.203	N/A	Declaration	Compliant
Use digital modulation	15.319 (b)	6.1	6.1.4	Compliant
Peak transmit power	15.303(f) & 15.319 (c)	6.5	6.1.2	Compliant
Power spectral density	15.319 (d) & 15.107	6.6	6.1.5	Compliant
Power adjustment for antenna gain	15.319 (e)	4.3.4(b)	4.3.1	Compliant
Automatically discontinue transmission	15.319 (f)	4.3.4(a)	--	Compliant
Spurious emissions conducted	15.319 (g) & 15.209	6.7	6.1.6	Compliant
RF Exposure	15.319 (i) & 1.1307(b), 2.1091 and 2.1093	RSS-102	ANSI/IEEE C95.1	Compliant
Listen before talk	15.323 (c)		7	Compliant
Monitoring time	15.323 (c)(1)	4.3.4(b)	7.3.4	Compliant
Monitoring threshold	15.323 (c)(2)	4.3.4(b)	7.3	Compliant
Maximum transmit time	15.323 (c)(3)	4.3.4(b)	8.2.2	Compliant
System acknowledgement	15.323 (c)(4)	4.3.4(b)	8.1.1 & 8.1.2	Compliant
Least Interfered	15.323 (c)(5.1)	4.3.4(b)	7.3.2 & 7.3.3	Compliant
Channel confirmation	15.323 (c)(5.2)	4.3.4(b)	7.3.3 & 7.3.4	Compliant
Power measurement resolution	15.323 (c)(5.3)	4.3.4(b)	7.3.3	Compliant
Segment occupancy	15.323 (c)(5.4)	4.3.4(b)	Declaration	Compliant

Requirement	FCC Part	Canada RSS-213	Test Procedure (Section numbers refer to ANSI C63.17 unless otherwise noted)	Result
Random waiting	15.323 (c)(6)	4.3.4(b)	8.1.3	Compliant
Monitoring bandwidth	15.323 (c)(7.1)	4.3.4(b)	7.4	Compliant
Monitoring reaction time	15.323 (c)(7.2))	4.3.4(b)	7.5	Compliant
Monitoring antenna	15.323 (c)(8)	4.3.4(b)	4	Compliant
Monitoring threshold relaxation	15.323 (c)(9)	4.3.4(b)	4	Not Applicable
Duplex system LBT	15.323 (c)(10)	4.3.49(b)	8.3	Compliant
Alternate monitoring interval	15.323 (c)(11)	4.3.4(b)	8.4	Compliant
Fair access	15.323 (c)(12)	4.3.4(b)	Declaration	Compliant
Frame period	15.323 (e)	4.3.4(b)	6.2.2 & 6.2.3	Compliant
Frequency stability	15.323 (f)	6.2	6.2.1	Compliant
Radiated Out of Band Emissions	15.309 (b) & FCC Part 15 Subpart B, 15.109 and 15.209	4.3.4(b)	--	Compliant

Table 1. Executive Summary of EMC Part 15 Subpart D ComplianceTesting

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Ooma, Inc. to perform testing on the Ooma Telo, Ooma Office, Ooma Telo 2, under Ooma, Inc.'s purchase order number 4056.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Ooma, Inc., Ooma Telo, Ooma Office, Ooma Telo 2.

The results obtained relate only to the item(s) tested.

Model(s) Tested:	Ooma Telo, Ooma Office, Ooma Telo 2	
Model(s) Covered:	Ooma Telo, Ooma Office, Ooma Telo 2	
EUT Specifications:	Primary Power: 120 VAC, 60 Hz	
	FCC ID: XFT-TELO103 IC: 9769A-OOMATELO103	
	Operating Mode:	DECT Base Station
	Type of Modulations:	GFSK
	Emission Designators:	1M66Q1E
	Equipment Code:	PUB
	Peak RF Output Power:	Low: 20.14 dB
		Mid: 20.16 dB
		High: 20.3
	EUT Frequency Ranges:	1921.536-1928.448 MHz
	Time Slot Length	24/10 [ms] (1 frame=10ms, 24 slots per frame)
	Slots per Frame	24
	Number of Channels	5
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35º C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Evaluated by:	Poona Saber	
Report Date(s):	February 5, 2014	

B. References

CFR 47, Part 15, Subpart D	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies
CFR 47, Part 15, Subpart B	Electromagnetic Compatibility: Criteria for Radio Frequency Devices
ICES-003, Issue 5, August 2012	Information Technology Equipment (ITE) - Limits and methods of measurement
RSS-213, Issue 2, December 2005	2 GHz Licence-exempt Personal Communications Service Devices (LE-PCS)
ANSI C63.4:2003	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
ISO/IEC 17025:2005	General Requirements for the Competence of Testing and Calibration Laboratories

C. Test Site

All testing was performed at MET Laboratories, Inc., 3162 Belick St., Santa Clara, CA 95054. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed in a semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

D. Description of Test Sample

Ooma Telo, Telo 2, and Office are different configurations of the same design . It is a VOIP phone system using DECT wireless technology with integrated FXS telephone port and two 10/100 Mbps Ethernet ports. It is designed to be a DECT phone base-station as well as a VOIP router allowing access to Ooma telephony services.

Ooma Telo is intended to be used in a household environment to replace traditional telephone service.

Ooma Telo 2 is the cost-reduction version of the Telo.

Ooma Office is intended to be used in a small business environment.

Photograph 1. Ooma Telo, Back View

Photograph 2. Ooma Telo, Top View

Photograph 3. Ooma Telo, Bottom View

Photograph 4. CYA0015BUH01 Power Adapter

Photograph 5. F12W-050200SPAU Power Adapter

Photograph 6. ADS012PM-W 050200 Power Adapter

Photograph 7. Version 5 Boyle Power Supply

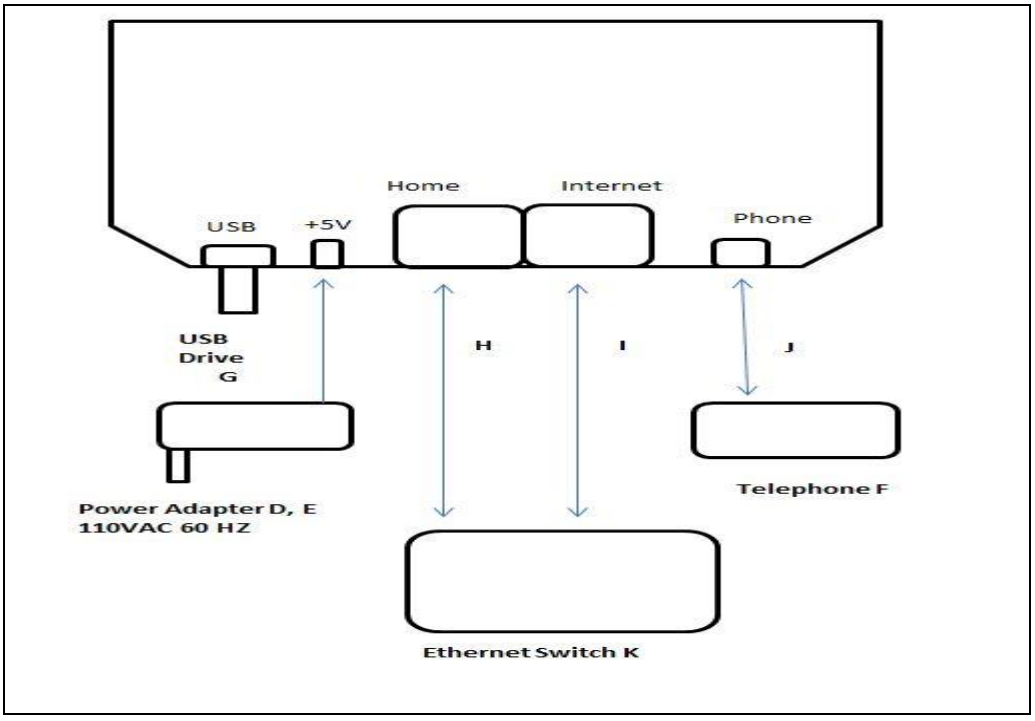


Figure 1. Block Diagram of Test Configuration

E. Equipment Configuration

The EUT was set up as outlined in Figure 1, Block Diagram of Test Setup. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

Ref. ID	Name / Description	Model Number	Part Number	Serial Number
A	Ooma Telo	--	110-0102-103	US0938SQ0CF4
B	Ooma Telo 2	--	--	--
C	Ooma Office	--	--	--
D	Ooma Power Adapter	CYA0015BUH01	-	-
D	Ooma Power Adapter	F12W-050200SPAU	-	-
D	Ooma Power Adapter	ADS012PM-W 050200	-	-

Table 2. Equipment Configuration

F. Support Equipment

Ooma, Inc. supplied support equipment necessary for the operation and testing of the Ooma Telo, Ooma Office, Ooma Telo 2. All support equipment supplied is listed in the following Support Equipment List.

Ref. ID	Name / Description	Manufacturer	Model Number
F	ATT telephone	ATT	TR1909
G	USB Flash Drive	Patriot	PSF16GLSABUSB
H	Home RJ45 Ethernet Cable	--	--
I	INTERNET RJ45 Ethernet Cable	--	--
J	Phone RJ11 Cable	--	--
K	Ethernet Switch	TP-LINK	TL-SG105

Table 3. Support Equipment

G. Mode of Operation

The device must be powered via a supplied power adapter, connected to the internet via the WAN port connector. After booting (about 2 minutes), the system will go into service.

H. Method of Monitoring

Telo – all LEDs on the front panel should be on.

Telo 2 – the Ooma logo on top of the device should be blue.

Office – the LED on the side should be blue.

I. Modifications

a) Modifications to EUT

No modifications were made to the EUT.

b) Modifications to Test Standard

No modifications were made to the standard.

J. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Ooma, Inc. upon completion of testing.

III. Electromagnetic Compatibility Criteria for Unintentional Radiators

Electromagnetic Compatibility Criteria for Unintentional Radiators

§ 15.107 Conducted Emissions Limits

Test Requirement(s): **15.107 (a)** "Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in Table 4. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals."

15.107 (b) "For a Class A digital device that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in Table 4. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals. The lower limit applies at the band edges."

Frequency range (MHz)	15.107(b), Class A Limits (dBμV)		15.107(a), Class B Limits (dBμV)	
	Quasi-Peak	Average	Quasi-Peak	Average
0.15- 0.5	79	66	66 - 56	56 - 46
0.5 – 5.0	73	60	56	46
5.0 - 30	73	60	60	50
Note 1 — The lower limit shall apply at the transition frequencies.				

Table 4. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Section 15.107(a) (b)

Test Procedures: The EUT was placed on an acrylic table located in a semi-anechoic chamber. The method of testing, test conditions, and test procedures of CISPR 22 were used. The EUT was powered through a 50Ω/50μH LISN. An EMI receiver, connected to the measurement port of the LISN, scanned the frequency range from 150 kHz to 30 MHz in order to find the peak conducted emissions. All peak emissions within 6 dB of the limit were re-measured using a quasi-peak and/or average detector as appropriate.

Test Results: The EUT was found compliant with the Class B requirement(s) of this section. Measured emissions were below applicable limits.

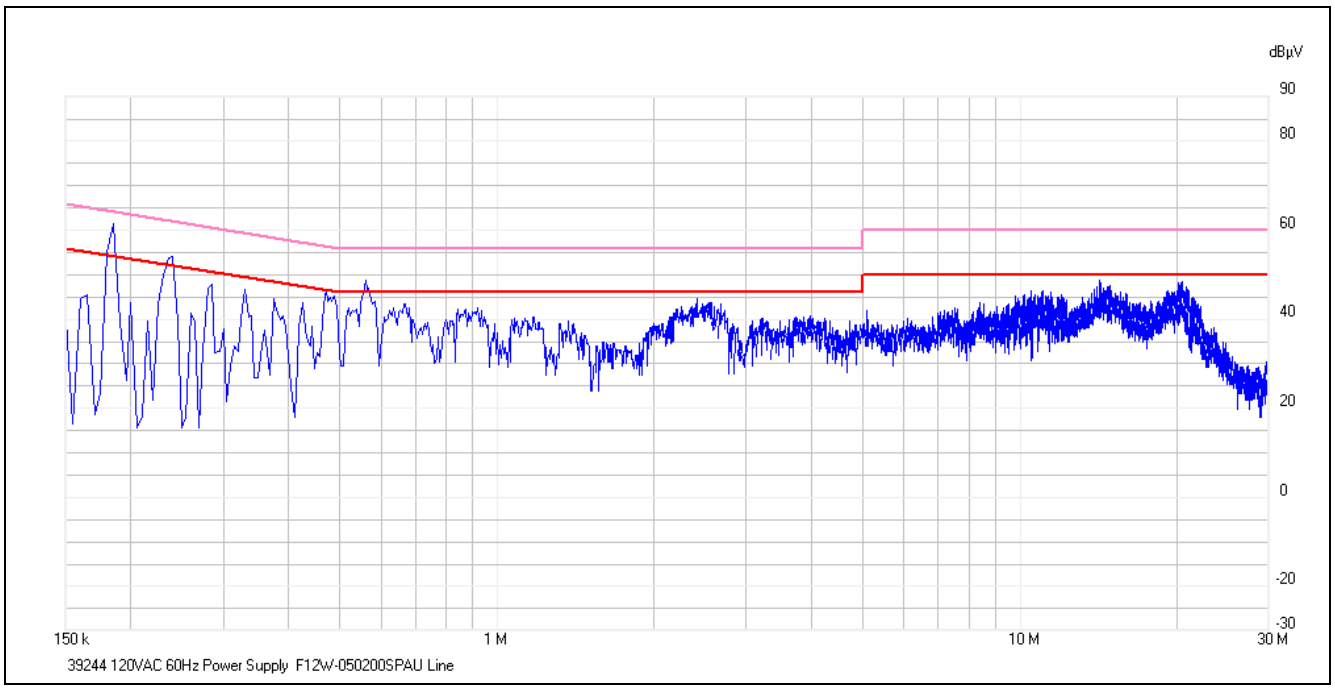
Test Engineer(s): Mario Garcia; Cliff DePuy; Sandeep Brar; Danny Alvendia

Test Date(s): 11/04/13; 07/15/13; 09/18/13; 01/17/14

Conducted Emissions, Phase Line, Ooma Office (120 VAC, 60 Hz)

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Results	Average Amplitude	Average Limit	Delta	Results
Line 1	0.185	58.7	64.263	-5.563	Pass	37.18	54.263	-17.083	Pass
Line 1	0.24	46.12	62.107	-15.987	Pass	24.36	52.107	-27.747	Pass
Line 1	0.285	40.32	60.683	-20.363	Pass	20.52	50.683	-30.163	Pass
Line 1	0.56	43.55	56	-12.45	Pass	31.68	46	-14.32	Pass
Line 1	14.125	42.06	60	-17.94	Pass	35.33	50	-14.67	Pass
Line 1	20.43	41.01	60	-18.99	Pass	32.12	50	-17.88	Pass

Table 5. Conducted Emissions, Phase Line, Ooma Office, F12W-050200SPAU Power Supply

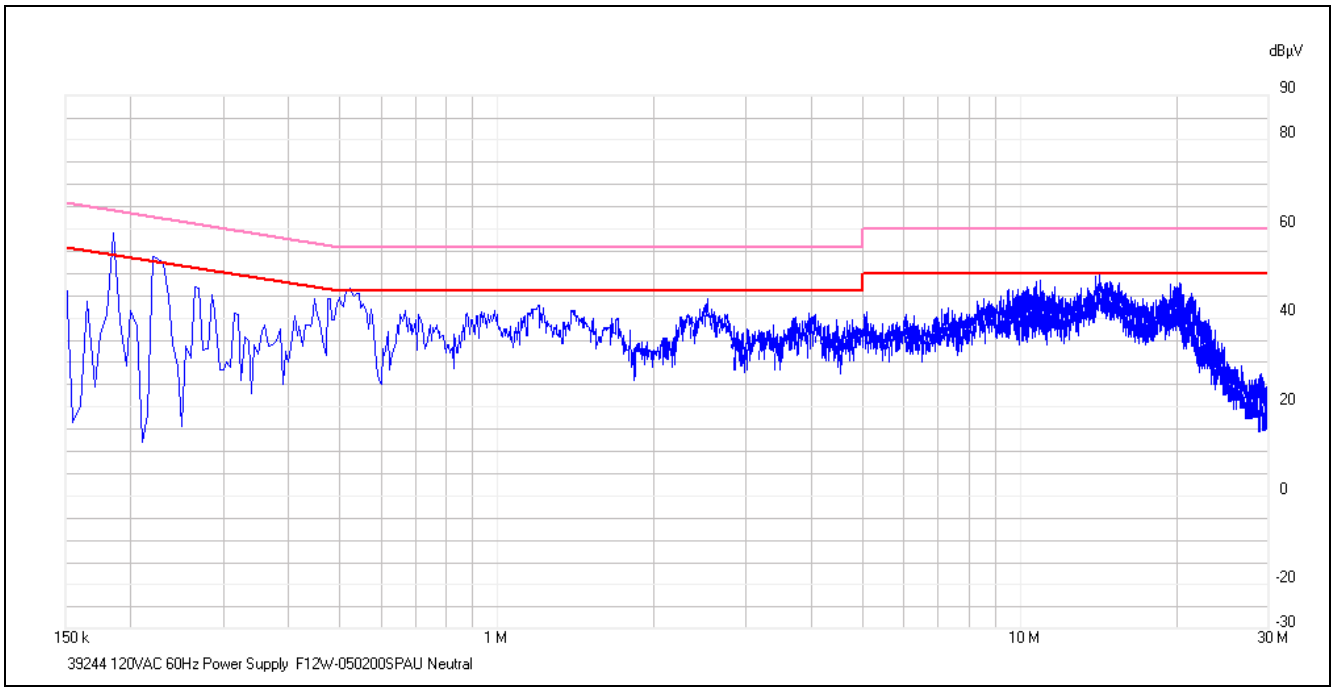


Plot 1. Conducted Emission, Phase Line, Ooma Office, F12W-050200SPAU Power Supply

Conducted Emissions, Neutral Line, Ooma Office (120 VAC, 60 Hz)

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Results	Average Amplitude	Average Limit	Delta	Results
Neutral	0.15	58.08	66	-7.92	Pass	30.77	56	-25.23	Pass
Neutral	0.185	56.38	64.263	-7.883	Pass	37.36	54.263	-16.903	Pass
Neutral	0.22	50.51	62.828	-12.318	Pass	29.65	52.828	-23.178	Pass
Neutral	10.89	40.8	60	-19.2	Pass	30.13	50	-19.87	Pass
Neutral	14.12	42.17	60	-17.83	Pass	35.55	50	-14.45	Pass
Neutral	20.05	42.02	60	-17.98	Pass	33.88	50	-16.12	Pass

Table 6. Conducted Emissions, Neutral Line, Ooma Office, F12W-050200SPAU Power Supply

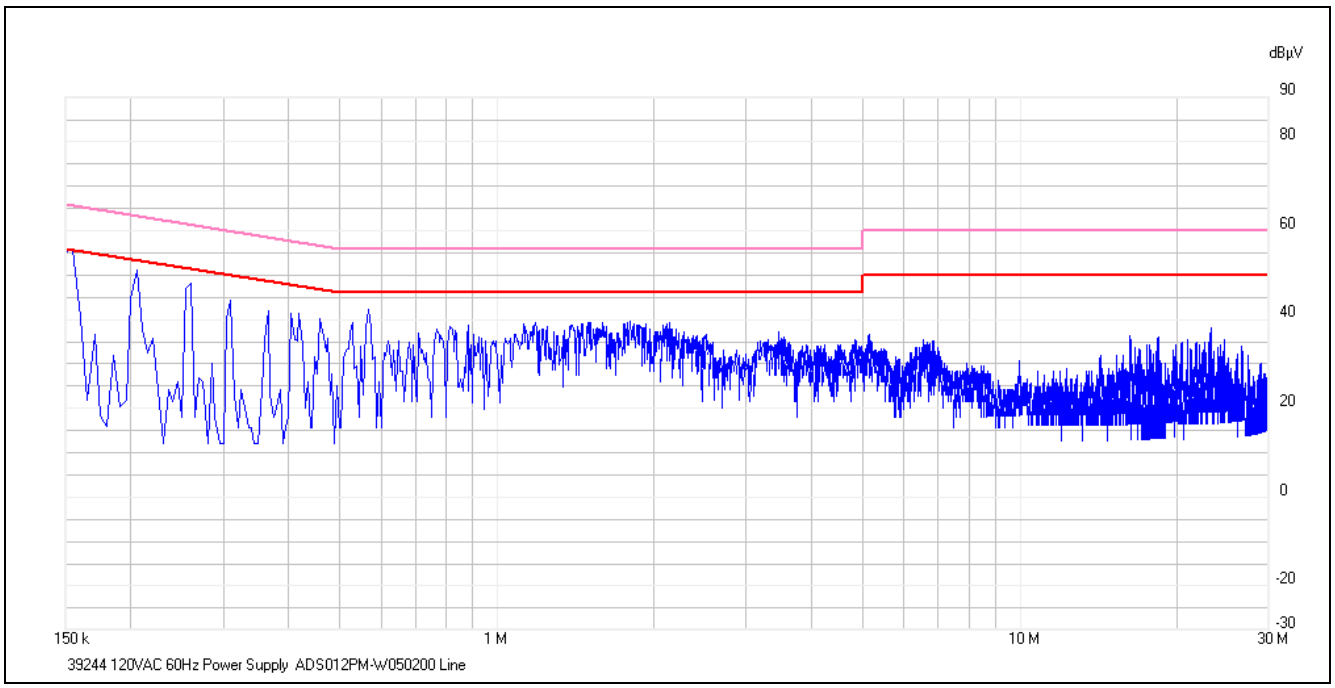


Plot 2. Conducted Emission, Neutral Line, Ooma Office, F12W-050200SPAU Power Supply

Conducted Emissions, Phase Line, Ooma Office (120 VAC, 60 Hz)

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Results	Average Amplitude	Average Limit	Delta	Results
Line 1	0.155	53.13	65.728	-12.598	Pass	37.87	55.728	-17.858	Pass
Line 1	0.205	48.29	63.413	-15.123	Pass	35.39	53.413	-18.023	Pass
Line 1	0.26	43.9	61.444	-17.544	Pass	27.87	51.444	-23.574	Pass
Line 1	0.31	39.96	59.987	-20.027	Pass	22.4	49.987	-27.587	Pass
Line 1	0.365	33.99	58.634	-24.644	Pass	14.18	48.634	-34.454	Pass
Line 1	0.57	38.31	56	-17.69	Pass	29.19	46	-16.81	Pass

Table 7. Conducted Emissions, Phase Line, Ooma Office, ADS012PM-W050200 Power Supply

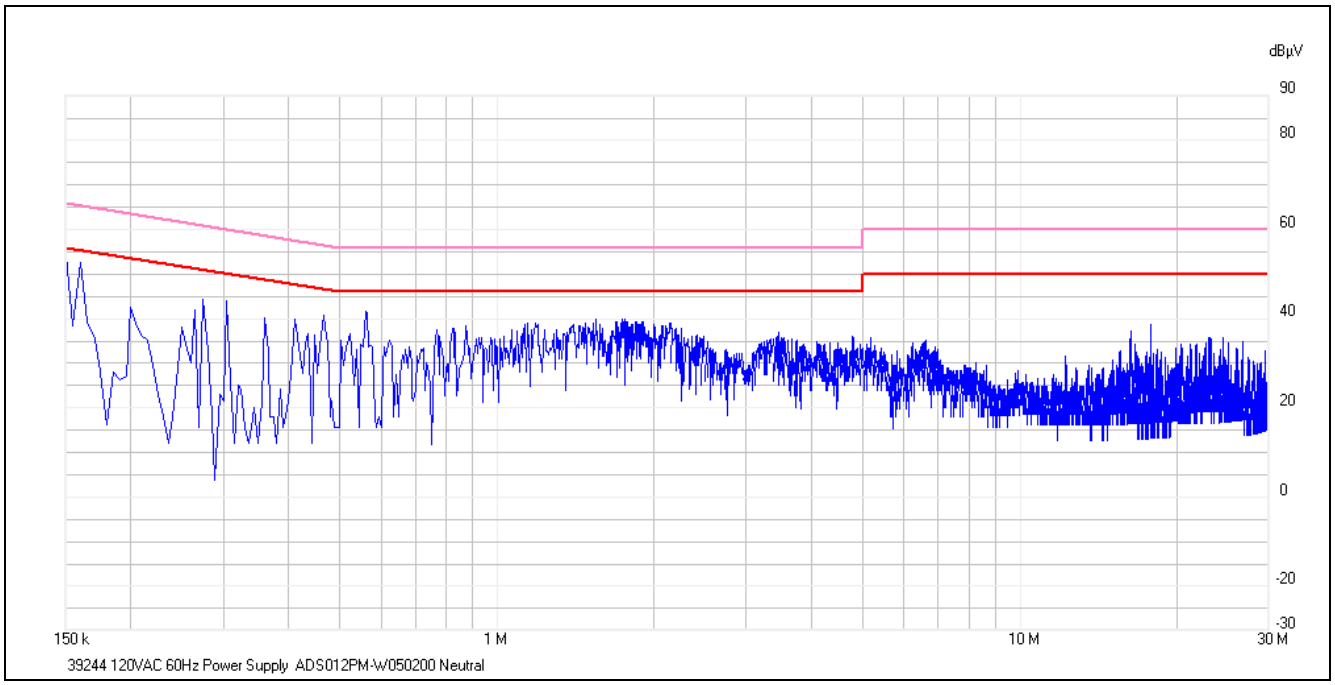


Plot 3. Conducted Emission, Phase Line, Ooma Office, ADS012PM-W050200 Power Supply

Conducted Emissions, Neutral Line, Ooma Office (120 VAC, 60 Hz)

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Results	Average Amplitude	Average Limit	Delta	Results
Neutral	0.15	51.47	66	-14.53	Pass	34.59	56	-21.41	Pass
Neutral	0.16	47.8	65.465	-17.665	Pass	27.96	55.465	-27.505	Pass
Neutral	0.2	46.56	63.617	-17.057	Pass	29.26	53.617	-24.357	Pass
Neutral	0.265	37.56	61.286	-23.726	Pass	15.92	51.286	-35.366	Pass
Neutral	0.275	36.66	60.979	-24.319	Pass	7.47	50.979	-43.509	Pass
Neutral	0.305	39.68	60.122	-20.442	Pass	20.19	50.122	-29.932	Pass

Table 8. Conducted Emissions, Neutral Line, Ooma Office, ADS012PM-W050200 Power Supply

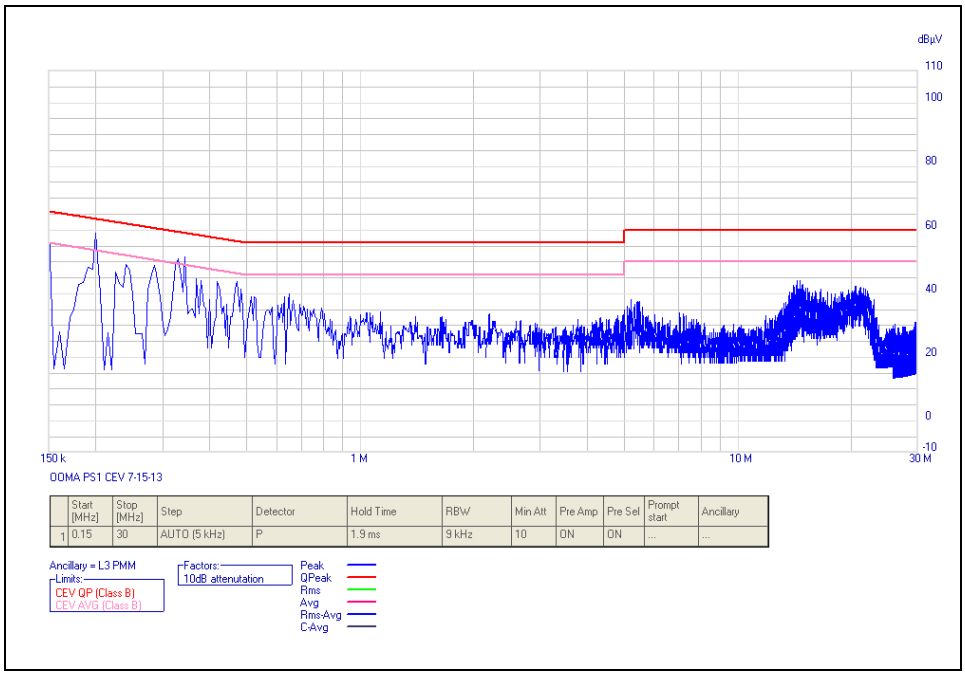


Plot 4. Conducted Emission, Neutral Line, Ooma Office, ADS012PM-W050200 Power Supply

Conducted Emissions, Phase Line, Ooma Telo (120 VAC, 60 Hz)

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Results	Average Amplitude	Average Limit	Delta	Results
Ooma PS1 Line1 7-15-13	0.2	39.93	63.617	-23.687	Pass	17.4	53.617	-36.217	Pass
Ooma PS1 Line1 7-15-13	0.345	52.24	59.101	-6.861	Pass	34.57	49.101	-14.531	Pass
Ooma PS1 Line1 7-15-13	14.54	55.07	60	-4.93	Pass	40.51	50	-9.49	Pass

Table 9. Conducted Emissions, Phase Line, Ooma Telo, CYA0015BUH01 Power Supply

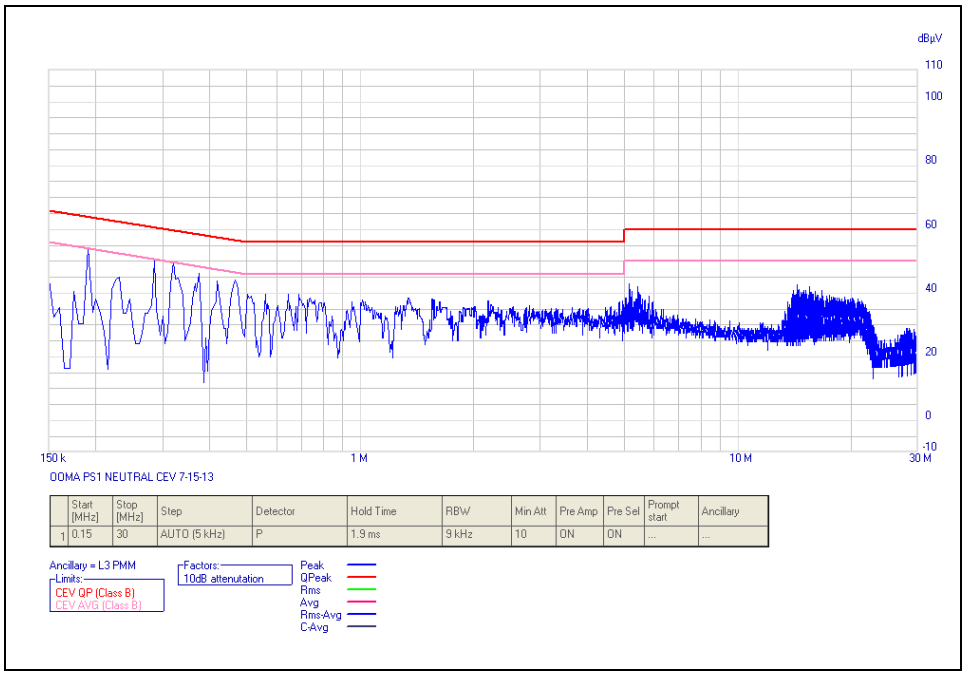


Plot 5. Conducted Emission, Phase Line, Ooma Telo, CYA0015BUH01 Power Supply

Conducted Emissions, Neutral Line, Ooma Telo (120 VAC, 60 Hz)

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Results	Average Amplitude	Average Limit	Delta	Results
Ooma PS1 Neutral 7-15-13	0.19	56.97	64.042	-7.072	Pass	33.78	54.042	-20.262	Pass
Ooma PS1 Neutral 7-15-13	0.32	55.17	59.724	-4.554	Pass	33.49	49.724	-16.234	Pass
Ooma PS1 Neutral 7-15-13	5.145	53.35	60	-6.65	Pass	37.62	50	-12.38	Pass

Table 10. Conducted Emissions, Neutral Line, Ooma Telo, CYA0015BUH01 Power Supply

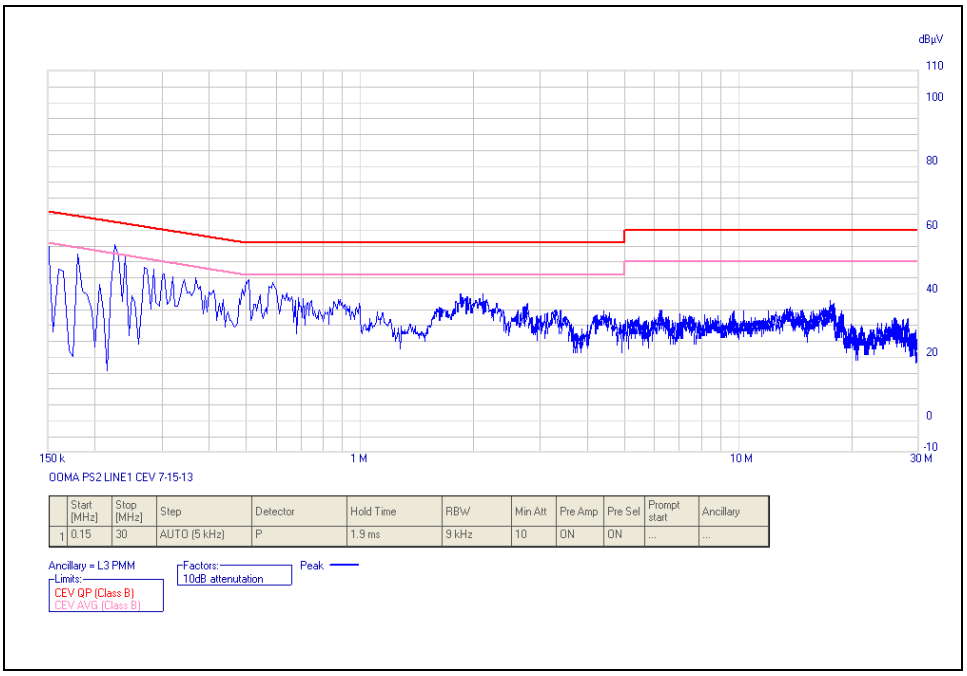


Plot 6. Conducted Emission, Neutral Line, Ooma Telo, CYA0015BUH01 Power Supply

Conducted Emissions, Phase Line, Ooma Telo (120 VAC, 60 Hz)

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Results	Average Amplitude	Average Limit	Delta	Results
Ooma PS2 Line1 7-15-13	0.18	58.44	64.49	-6.05	Pass	36.12	54.49	-18.37	Pass
Ooma PS2 Line1 7-15-13	0.225	56.51	62.641	-6.131	Pass	27.07	52.641	-25.571	Pass
Ooma PS2 Line1 7-15-13	0.24	54.21	62.107	-7.897	Pass	31.32	52.107	-20.787	Pass

Table 11. Conducted Emissions, Phase Line, Ooma Telo, F12W-050200SPAU Power Supply

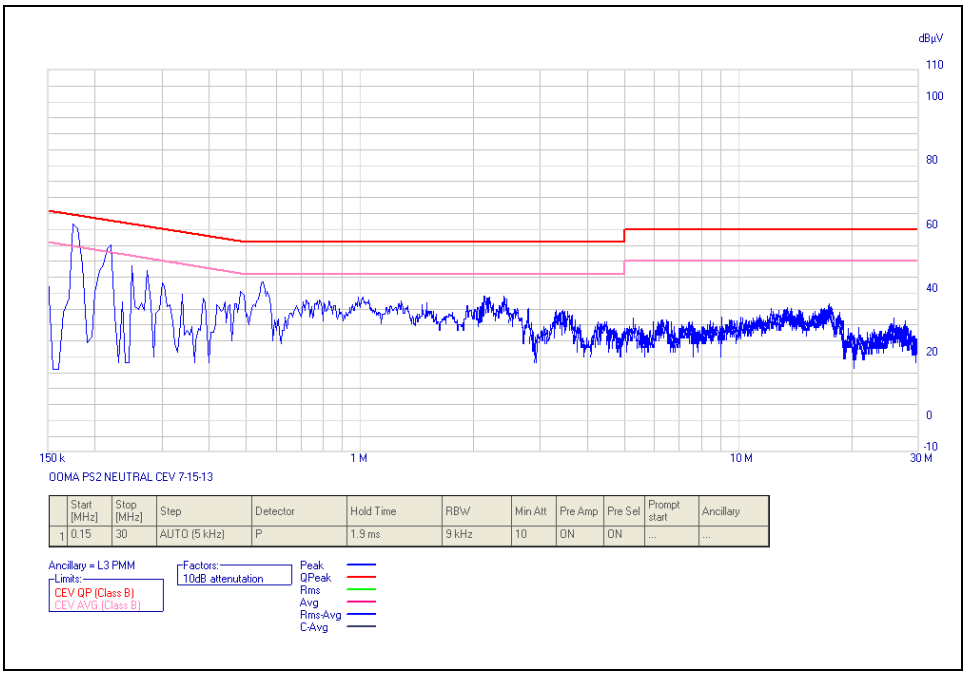


Plot 7. Conducted Emission, Phase Line, Ooma Telo, F12W-050200SPAU Power Supply

Conducted Emissions, Neutral Line, Ooma Telo (120 VAC, 60 Hz)

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Results	Average Amplitude	Average Limit	Delta	Results
Ooma PS2 Neutral 7-15-13	0.175	61.51	64.723	-3.213	Pass	39.03	54.723	-15.693	Pass
Ooma PS2 Neutral 7-15-13	0.22	55.43	62.828	-7.398	Pass	30.04	52.828	-22.788	Pass
Ooma PS2 Neutral 7-15-13	0.555	44.43	56	-11.57	Pass	34.68	46	-11.32	Pass

Table 12. Conducted Emissions, Neutral Line, Ooma Telo, F12W-050200SPAU Power Supply

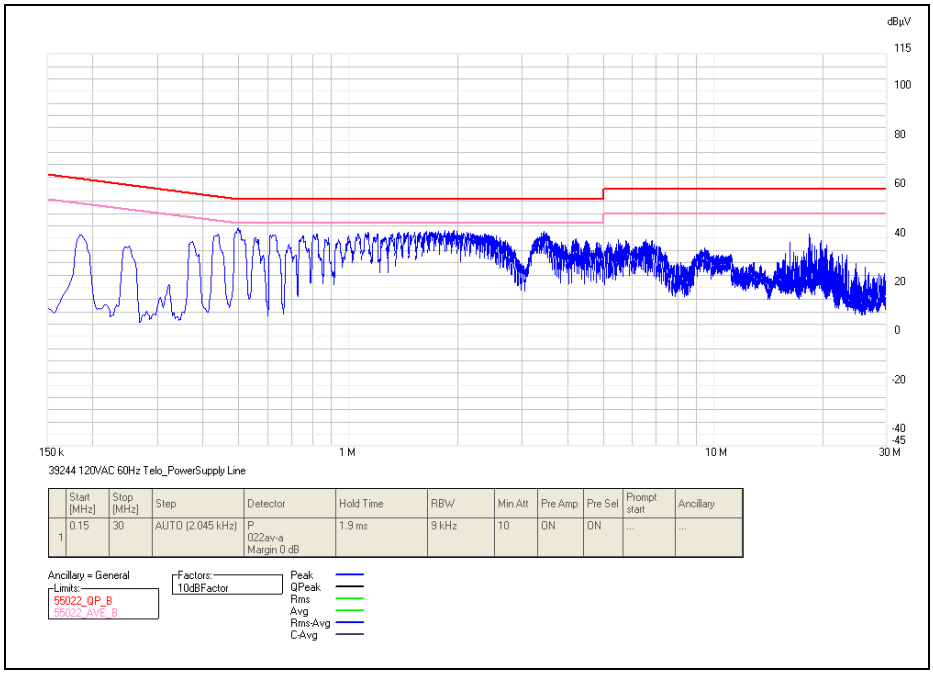


Plot 8. Conducted Emission, Neutral Line, Ooma Telo, F12W-050200SPAU Power Supply

Conducted Emissions, Phase Line, Ooma Telo (120 VAC, 60 Hz)

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Results	Average Amplitude	Average Limit	Delta	Results
120VAC 60Hz Power Supply Line	0.499695	41.31	56.005	-14.695	Pass	25.19	46.005	-20.815	Pass
120VAC 60Hz Power Supply Line	1.45062	38.78	56	-17.22	Pass	24.95	46	-21.05	Pass
120VAC 60Hz Power Supply Line	1.63058	38.24	56	-17.76	Pass	25.26	46	-20.74	Pass
120VAC 60Hz Power Supply Line	1.828945	39.01	56	-16.99	Pass	25.78	46	-20.22	Pass
120VAC 60Hz Power Supply Line	1.943465	38.95	56	-17.05	Pass	25.54	46	-20.46	Pass
120VAC 60Hz Power Supply Line	3.424045	37.35	56	-18.65	Pass	24.31	46	-21.69	Pass

Table 13. Conducted Emissions, Phase Line, Ooma Telo, ADS012PM-W050200 Power Supply

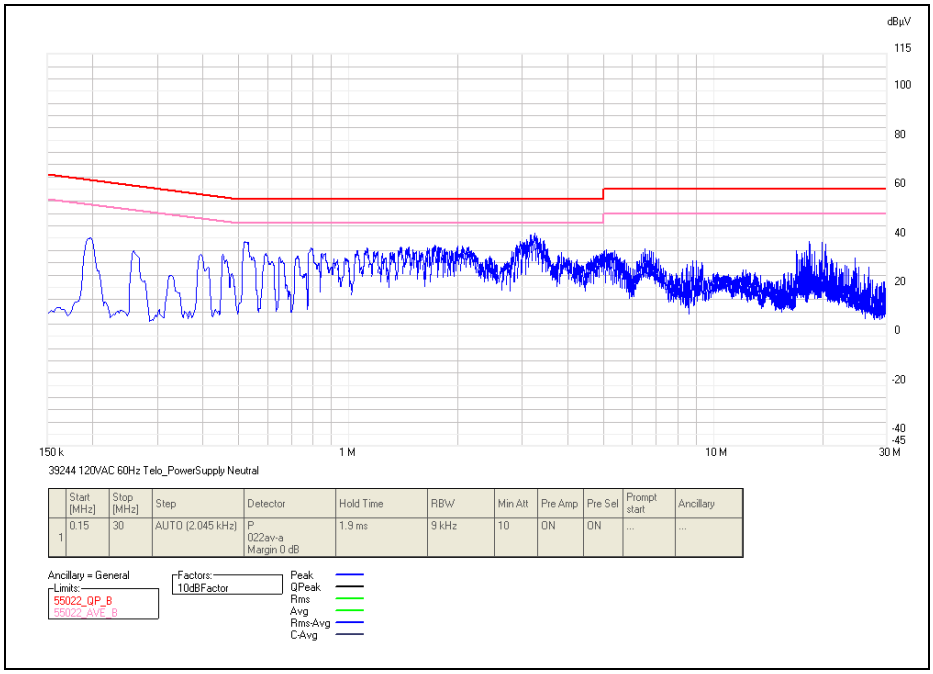


Plot 9. Conducted Emission, Phase Line, Ooma Telo, ADS012PM-W050200 Power Supply

Conducted Emissions, Neutral Line, Ooma Telo (120 VAC, 60 Hz)

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Results	Average Amplitude	Average Limit	Delta	Results
120VAC 60Hz Power Supply Neutral	0.197035	48.56	63.741	-15.181	Pass	33.66	53.741	-20.081	Pass
120VAC 60Hz Power Supply Neutral	0.520145	36.94	56	-19.06	Pass	22.65	46	-23.35	Pass
120VAC 60Hz Power Supply Neutral	3.07026	34.19	56	-21.81	Pass	21.41	46	-24.59	Pass
120VAC 60Hz Power Supply Neutral	3.227725	35.62	56	-20.38	Pass	23.36	46	-22.64	Pass
120VAC 60Hz Power Supply Neutral	18.2462	41.1	60	-18.9	Pass	36.15	50	-13.85	Pass
120VAC 60Hz Power Supply Neutral	19.71042	38.27	60	-21.73	Pass	34.38	50	-15.62	Pass

Table 14. Conducted Emissions, Neutral Line, Ooma Telo, ADS012PM-W050200 Power Supply

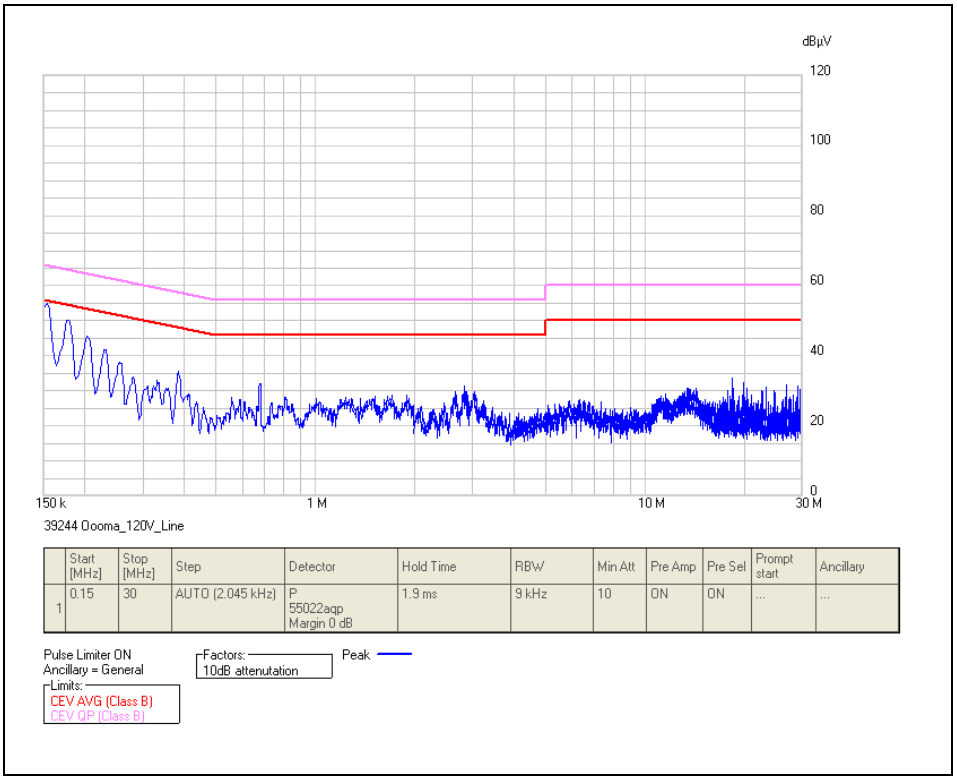


Plot 10. Conducted Emission, Neutral Line, Ooma Telo, ADS012PM-W050200 Power Supply

Conducted Emissions, Phase Line, Ooma Telo 2 (120 VAC, 60 Hz)

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Results	Average Amplitude	Average Limit	Delta	Results
39244_120V_L	0.154	51.91	65.782	-13.872	Pass	31.59	55.782	-24.192	Pass
39244_120V_L	0.177	48.24	64.629	-16.389	Pass	29.45	54.629	-25.179	Pass
39244_120V_L	0.203	43.48	63.494	-20.014	Pass	23.96	53.494	-29.534	Pass
39244_120V_L	0.23	38.85	62.459	-23.609	Pass	19.43	52.459	-33.029	Pass
39244_120V_L	0.25	35.96	61.769	-25.809	Pass	17.58	51.769	-34.189	Pass
39244_120V_L	0.28	33.49	60.83	-27.34	Pass	17.57	50.83	-33.26	Pass

Table 15. Conducted Emissions, Phase Line, Ooma Telo 2, Version 5 Boyle Power Supply

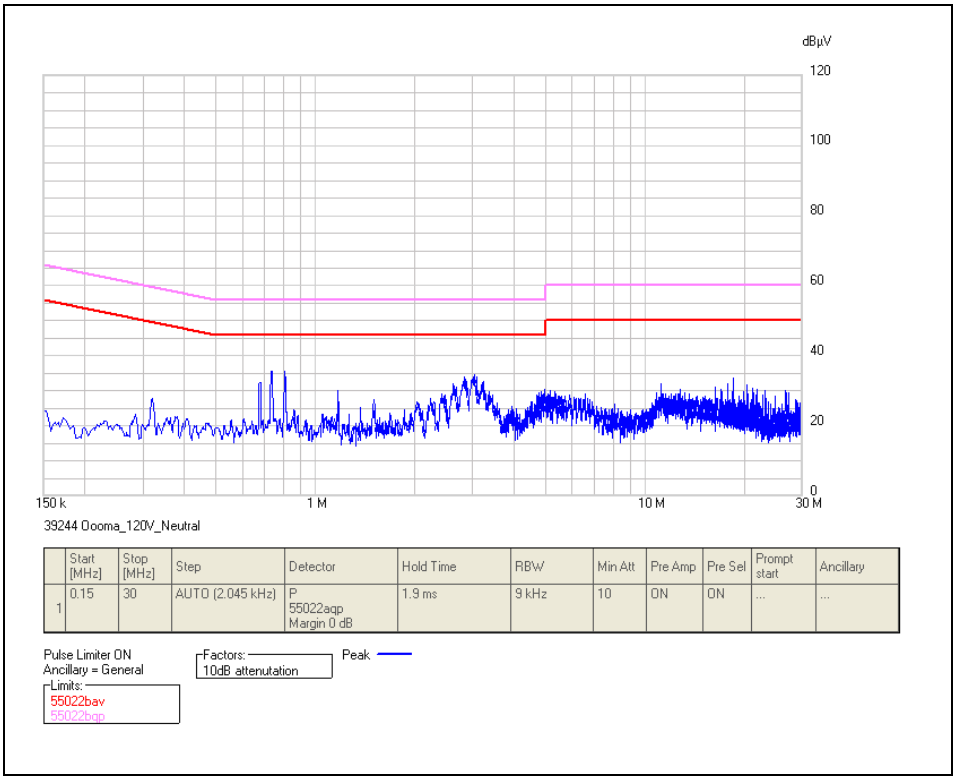


Plot 11. Conducted Emission, Phase Line, Ooma Telo 2, Version 5 Boyle Power Supply

Conducted Emissions, Neutral Line, Ooma Telo 2 (120 VAC, 60 Hz)

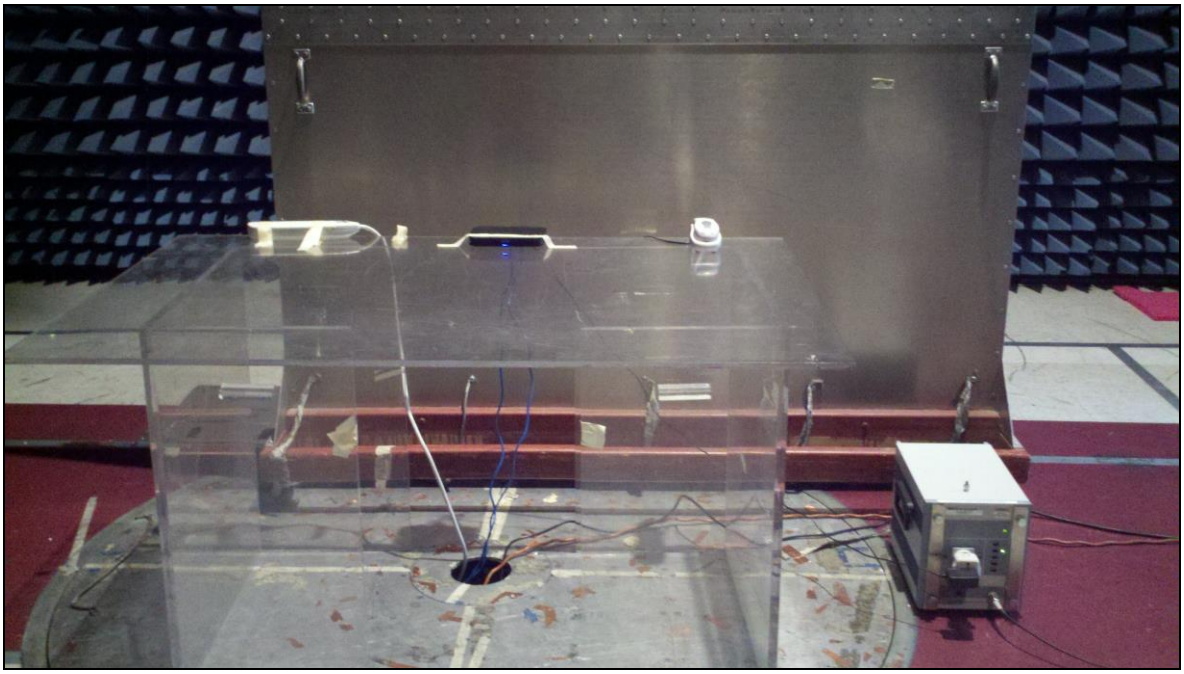
Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Results	Average Amplitude	Average Limit	Delta	Results
39244_120V_N	0.68	33.34	56	-22.66	Pass	27.7	46	-18.3	Pass
39244_120V_N	0.737	32.53	56	-23.47	Pass	25.13	46	-20.87	Pass
39244_120V_N	0.806	32.94	56	-23.06	Pass	25.04	46	-20.96	Pass
39244_120V_N	2.616	26.5	56	-29.5	Pass	17.67	46	-28.33	Pass
39244_120V_N	2.81	29.15	56	-26.85	Pass	19.99	46	-26.01	Pass
39244_120V_N	3	29.79	56	-26.21	Pass	20.48	46	-25.52	Pass

Table 16. Conducted Emissions, Neutral Line, Ooma Telo 2, Version 5 Boyle Power Supply

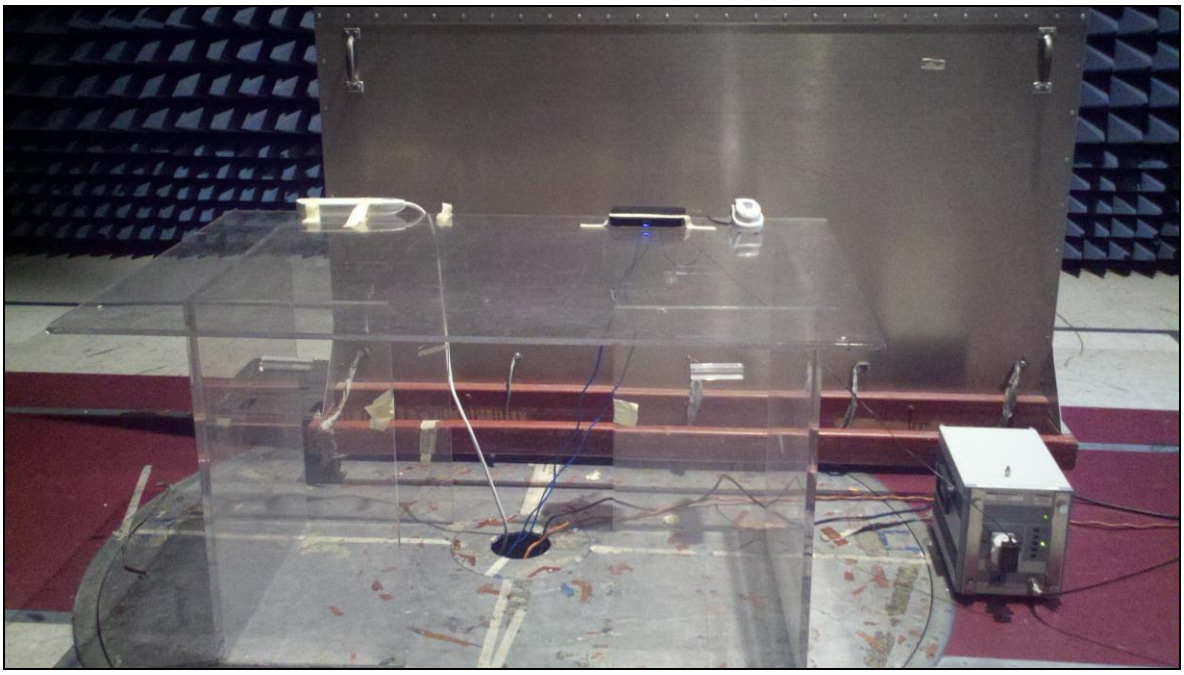


Plot 12. Conducted Emission, Neutral Line, Ooma Telo 2, Version 5 Boyle Power Supply

Conducted Emission Limits Test Setup

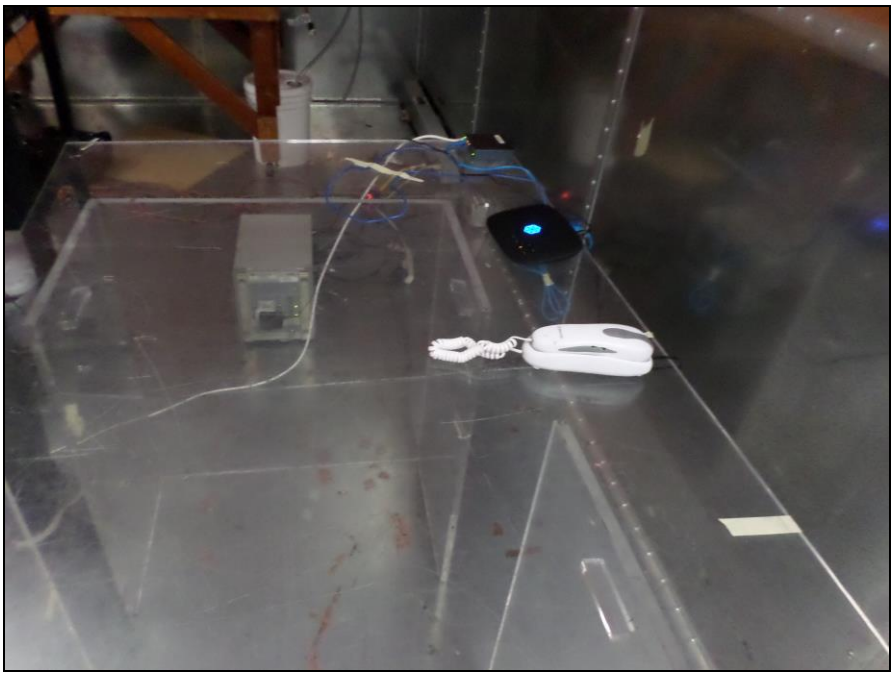


Photograph 8. Conducted Emissions, Test Setup, Ooma Office, F12W-050200SPAU Power Supply



Photograph 9. Conducted Emissions, Test Setup, Ooma Office, ADS012PM-W050200 Power Supply

Photograph 10. Conducted Emissions, Test Setup, Telo



Photograph 11. Conducted Emissions, Test Setup, Telo 2

Radiated Emission Limits

§ 15.109 Radiated Emissions Limits

Test Requirement(s): **15.109 (a)** Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the Class B limits expressed in Table 17.

15.109 (b) The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the Class A limits expressed in Table 17.

Frequency (MHz)	Field Strength (dBµV/m)	
	§15.109 (b), Class A Limit (dBµV) @ 10m	§15.109 (a),Class B Limit (dBµV) @ 3m
30 - 88	39.00	40.00
88 - 216	43.50	43.50
216 - 960	46.40	46.00
Above 960	49.50	54.00

Table 17. Radiated Emissions Limits calculated from FCC Part 15, §15.109 (a) (b)

Test Procedures: The EUT was placed on a non-metallic table located inside a semi-anechoic chamber. Various antennas were placed near the EUT and measurements were taken of the field strengths and frequencies. For final radiated measurements, the EUT was placed in a semi-anechoic chamber, and located 3 m and 10 m from an adjustable antenna mast.

For pre-scanning, the spectrum analyzer scanned the frequency range from 30 MHz to 40 GHz to obtain an emission profile of the EUT. For each point of measurement, the turntable was rotated, and the antenna height was varied between 1 m and 4 m, in order to find the maximum radiated emissions. Measurements above 30 MHz were taken using this technique with the antenna in two polarizations: horizontal and vertical. Unless otherwise specified, measurements were made using a quasi-peak detector with a 120 kHz bandwidth (30 MHz – 1 GHz) and 1 MHz bandwidth (1-6 GHz).

For emission between 1 GHz and 18 GHz, a double ridged guide horn was located 3 m from the EUT on an adjustable mast. A pre-scan was performed and used to find prominent radiated emissions. The pre-scan method includes investigation of the cone(s) of radiation output from the EUT using a boresighting antenna or with manual investigation by hand. For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied depending on the geometry of the EUT and previously investigated cone(s) of radiation. In order to ensure maximized emissions, the horn antenna was positioned both vertically and laterally. Measurements in both horizontal and vertical polarities were made and the data was recorded. Unless otherwise specified, measurements were made using an average detector with a 1 MHz resolution bandwidth.

For emission between 18 GHz and 40 GHz, a horn antenna was located 3 m from the EUT on an adjustable mast for class A device and 1m distance for class B device. A pre-scan was performed and used to find prominent radiated emissions. The pre-scan method includes investigation of the cone(s) of radiation output from the EUT using a bore sighting antenna or with manual investigation by hand. For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied depending on the geometry of the EUT and previously investigated cone(s) of radiation. In order to ensure maximized emissions, the horn antenna was positioned both vertically and laterally. Measurements in both horizontal and vertical polarities were made and the data was recorded. Unless otherwise specified, measurements were made using an average detector with a 1 MHz resolution bandwidth.

Test Results: The EUT was found compliant with the Class B requirement(s) of this section. Measured emissions were below applicable limits

Test Engineer(s): Cliff DePuy; Sandeep Brar; Mario Garcia; Danny Alvendia

Test Date(s): 08/09/13; 09/18/13; 11/04/13; 01/17/14

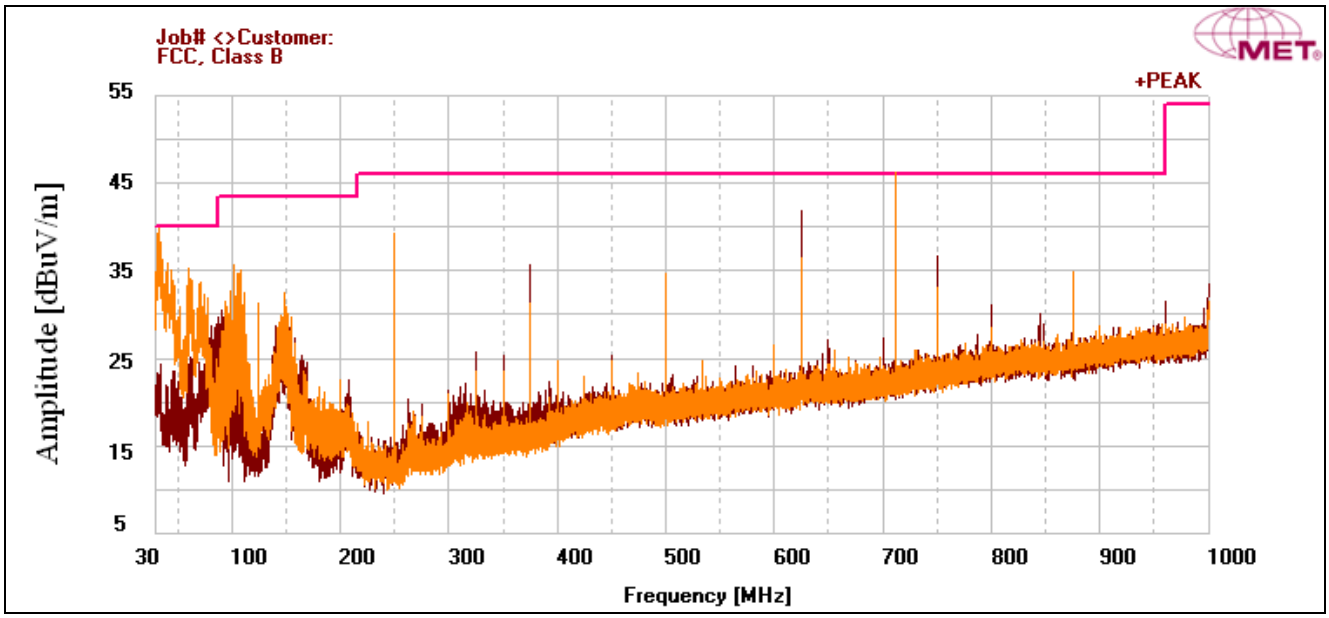
Radiated Emissions Limits Test Results, Ooma Office, F12W-050200SPAU Power Supply

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBµV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
749.992	H	183	175.47	20.32	21.2	0	4.21	0	45.73	46	-0.270
43.826	V	261	100	26.74	11.804	0	0.918	0	39.462	40	-0.538
249.977	V	50	100	26.19	12.1	0	2.39	0	40.68	46	-5.32
374.982	V	221	101.58	26.19	15.7	0	2.892	0	44.782	46	-1.218
500.023	V	188	100	14.61	18.1	0	3.42	0	36.13	46	-9.87
875.037	V	152	100	8.06	22.5	0	4.668	0	35.228	46	-10.772

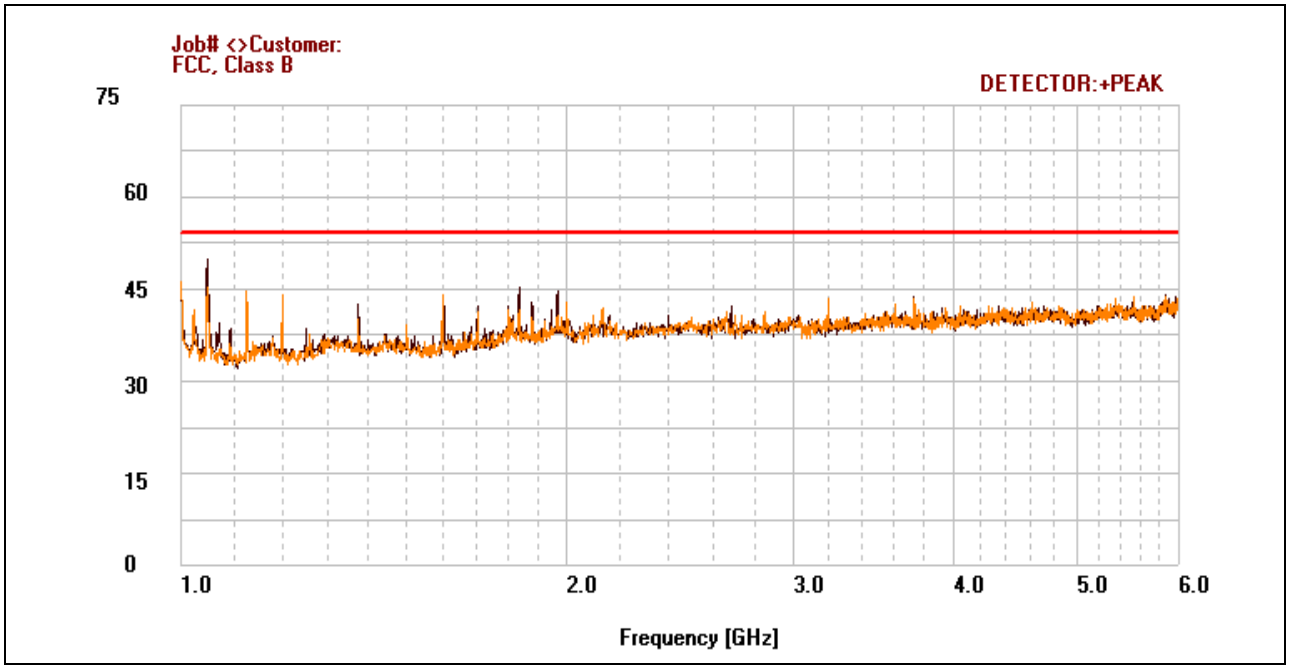
Table 18. Radiated Emissions, Ooma Office, F12W-050200SPAU Power Supply, 30 MHz – 1 GHz

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBµV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1049	H	44	100	44.9	27.614	30.992	0	0	41.522	54	-12.478
1049	V	315	100	46.02	27.832	31.03	0	0	42.822	54	-11.178
1837	H	188	100	48.88	27.832	31.03	0	0	45.682	54	-8.318
1600	V	14	100	42.6	28.727	30.557	0	0	40.77	54	-13.23
1974	H	0	100	33.09	32.903	30.953	0	0	35.04	54	-18.96
1123	V	0	100	27.78	33.042	31.031	0	0	29.791	54	-24.209

Table 19. Radiated Emissions, Ooma Office, F12W-050200SPAU Power Supply, 1 GHz – 6 GHz



Plot 13. Radiated Emissions, Ooma Office, F12W-050200SPAU Power Supply, 30 MHz – 1 GHz



Plot 14. Radiated Emissions, Ooma Office, F12W-050200SPAU Power Supply, 1 GHz – 6 GHz

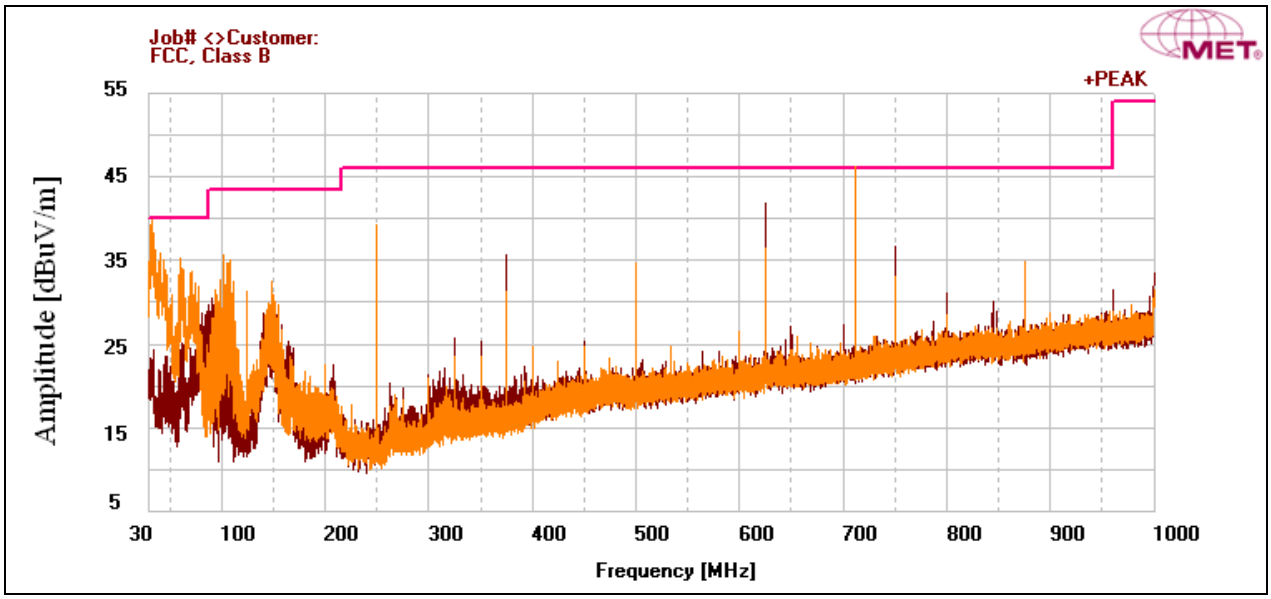
Radiated Emissions Limits Test Results, Ooma Office, ADS012PM-W050200 Power Supply

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBµV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
625.028	H	200	115.76	18.94	19.802	0	3.833	0	42.575	46	-3.425
750.032	H	189	175.05	13.35	21.201	0	4.21	0	38.761	46	-7.239
34.64	V	127	100	18.92	18.524	0	0.846	0	38.29	40	-1.71
249.973	V	44	100	25.4	12.101	0	2.39	0	39.891	46	-6.109
249.973	H	47	184	22.92	12.101	0	2.39	0	37.411	46	-8.589
374.978	H	129	100	16.47	15.7	0	2.892	0	35.062	46	-10.938

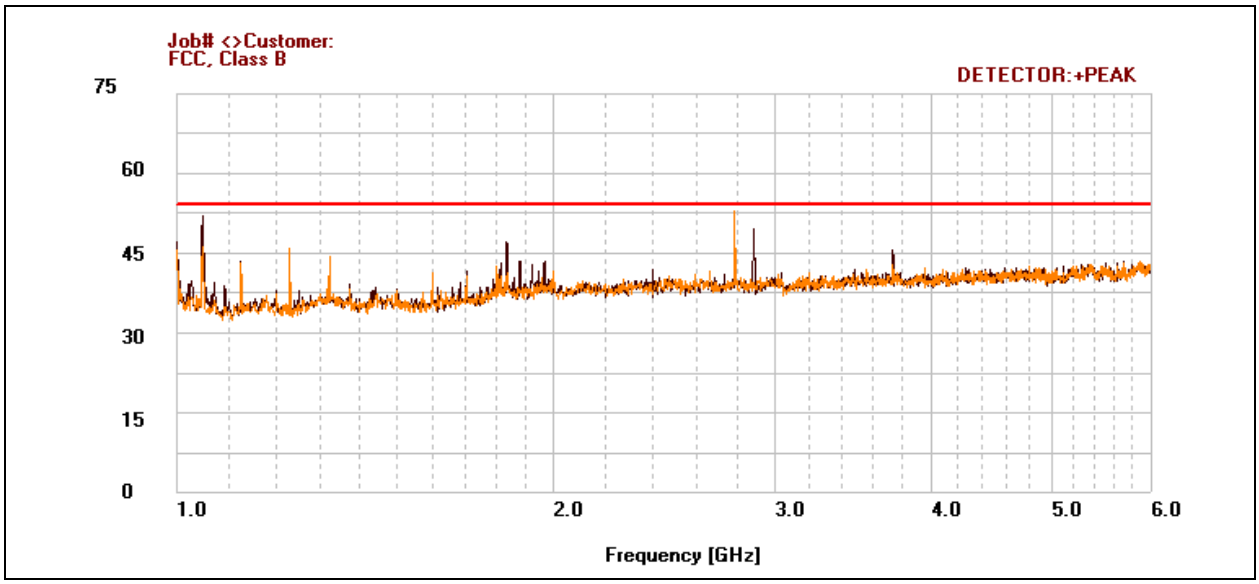
Table 20. Radiated Emissions, Ooma Office, ADS012PM-W050200 Power Supply, 30 MHz – 1 GHz

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBµV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1048	H	83	100	52.67	27.614	30.992	0	0	49.292	54	-4.708
1000	H	0	100	49.43	27.832	31.03	0	0	46.232	54	-7.768
1000	V	173	100	49.56	27.832	31.03	0	0	46.362	54	-7.638
1599	V	0	111.47	42.6	28.727	30.557	0	0	40.77	54	-13.23
2801	V	0	100	27.29	32.903	30.953	0	0	29.24	54	-24.76
2889	V	0	100	27.05	33.042	31.031	0	0	29.061	54	-24.939

Table 21. Radiated Emissions, Ooma Office, ADS012PM-W050200 Power Supply, 1 GHz – 6 GHz



Plot 15. Radiated Emissions, Ooma Office, ADS012PM-W050200 Power Supply, 30 MHz – 1 GHz



Plot 16. Radiated Emissions, Ooma Office, ADS012PM-W050200 Power Supply, 1 GHz – 6 GHz

Radiated Emissions Limits Test Results, Ooma Telo, F12W-050200SPAU Power Supply

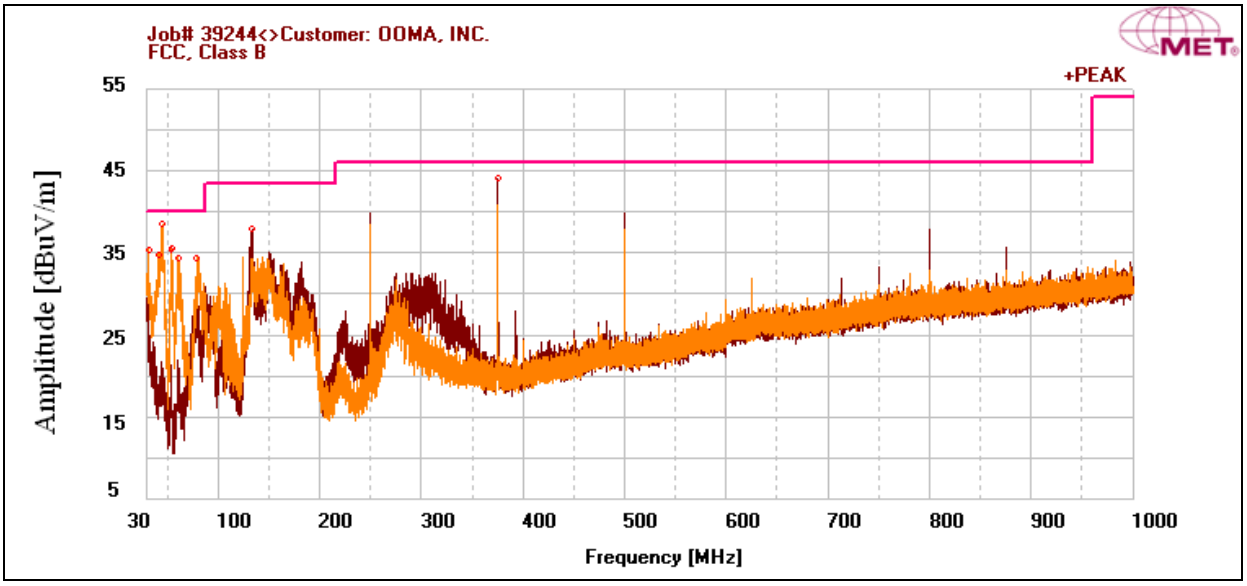
Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBµV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
*375.02	H	215	100	26.4	15.7	0	2.893	0	44.993	46	-1.007
500.02	H	329	100	12.3	18.1	0	3.42	0	33.82	46	-12.18

Table 22. Radiated Emissions, Ooma Telo, F12W-050200SPAU Power Supply, 30 MHz – 1 GHz

Note: * - At this frequency, the measured electric-field strength exhibits a margin of compliance that is less than 3 dB below the specification limit. We recommend that every emission measured, have at least a 3 dB margin to allow for deviations in the emission characteristics that may occur during the production process.

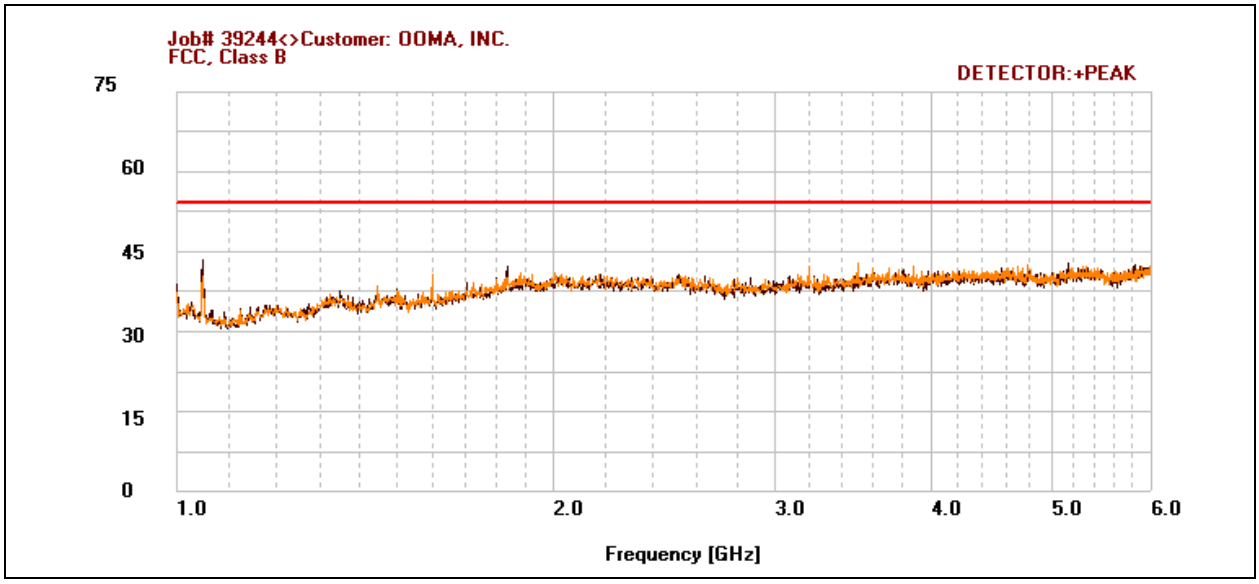
Frequency (MHz)	Antenna Polarity	Corrected PEAK Amplitude (dBµV)	QP Limit (dBµV)	Margin (dB)
45.786	V	38.47	40	-1.53
32.75	V	35.38	40	-4.62
250.01	H	39.86	46	-6.14
133.87	H	37.8	43.5	-5.70

Table 23. Radiated Emissions, Ooma Telo, F12W-050200SPAU Power Supply, 30 MHz – 1 GHz, Peak



Plot 17. Radiated Emissions, Pre-Scan, Ooma Telo, F12W-050200SPAU Power Supply, 30 MHz – 1 GHz

= Vertical Polarization
= Horizontal Polarization



Plot 18. Radiated Emissions, Pre-Scan, Ooma Telo, F12W-050200SPAU Power Supply, 1 GHz – 6 GHz

= Vertical Polarization
= Horizontal Polarization

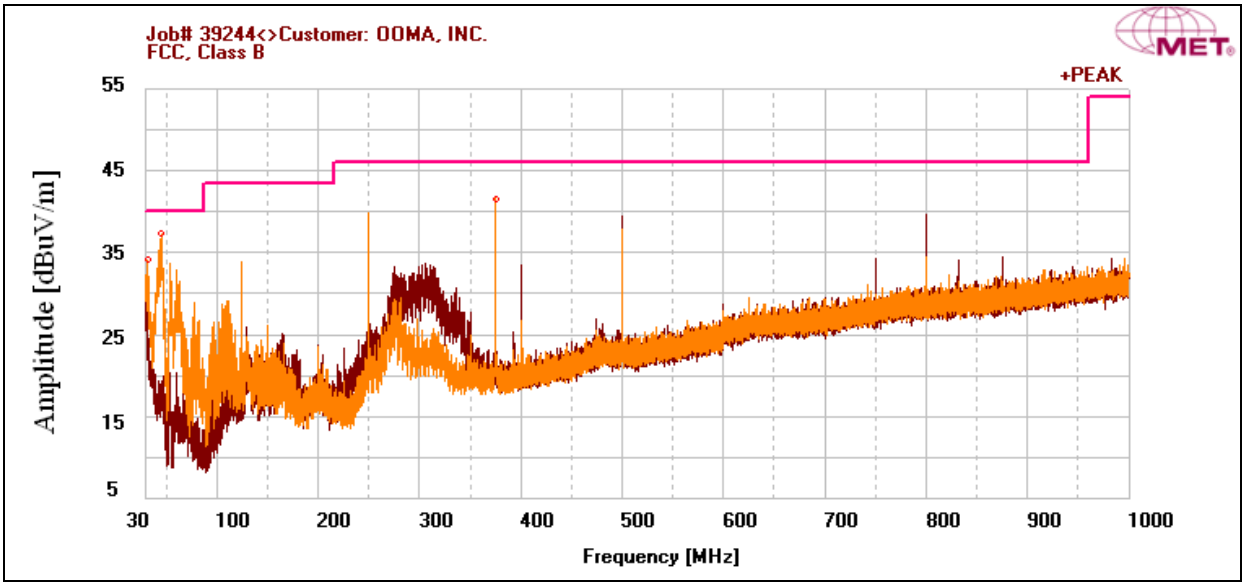
Radiated Emissions Limits Test Results, Ooma Telo, CYA0015BUH01 Power Supply

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBµV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV.m)	Margin (dB)
45.786	V	40	100	23.3	10.607	0	0.947	0	34.854	40	-5.146
250.01	V	9	100	25.1	12.1	0	2.39	0	39.59	46	-6.41
375.02	V	172	117.05	24.3	15.7	0	2.893	0	42.893	46	-3.107

Table 24. Radiated Emissions, Ooma Telo, CYA0015BUH01 Power Supply, 30 MHz – 1 GHz

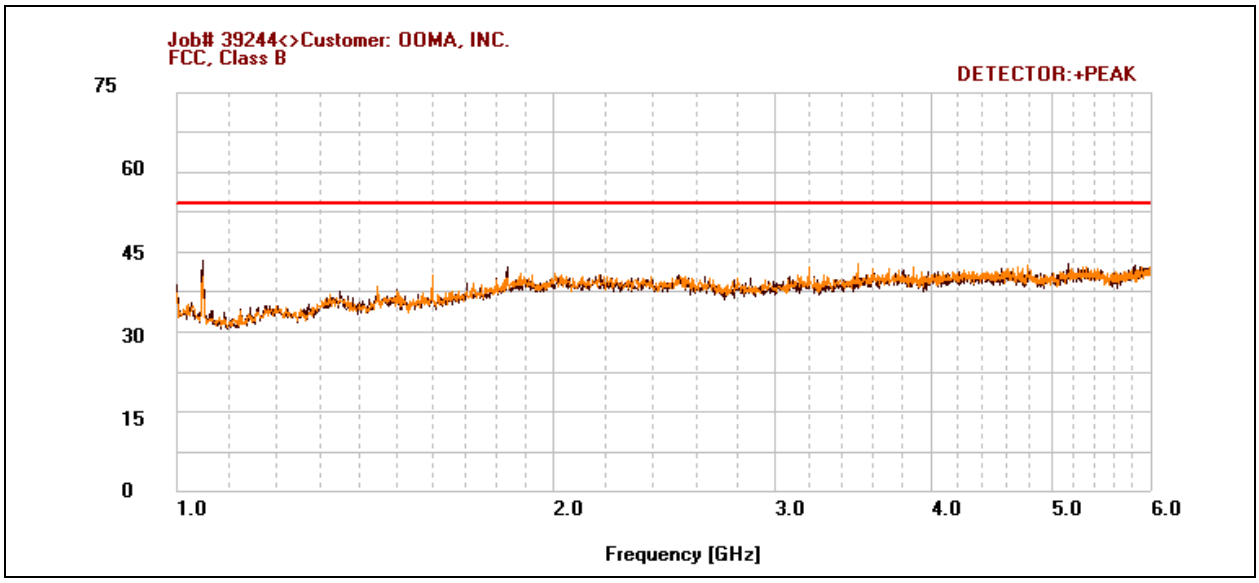
Frequency (MHz)	Antenna Polarity	Corrected PEAK Amplitude (dBuV)	QP Limit (dBuV)	Margin (dB)
500.00	H	39.34	46	-6.56
800.00	H	39.65	46	-6.35
32.75	V	33.6	40	-6.4

Table 25. Radiated Emissions, Ooma Telo, CYA0015BUH01 Power Supply, 30 MHz – 1 GHz, Peak



Plot 19. Radiated Emissions, Pre-Scan, Ooma Telo, CYA0015BUH01 Power Supply, 30 MHz – 1 GHz

= Vertical Polarization
= Horizontal Polarization



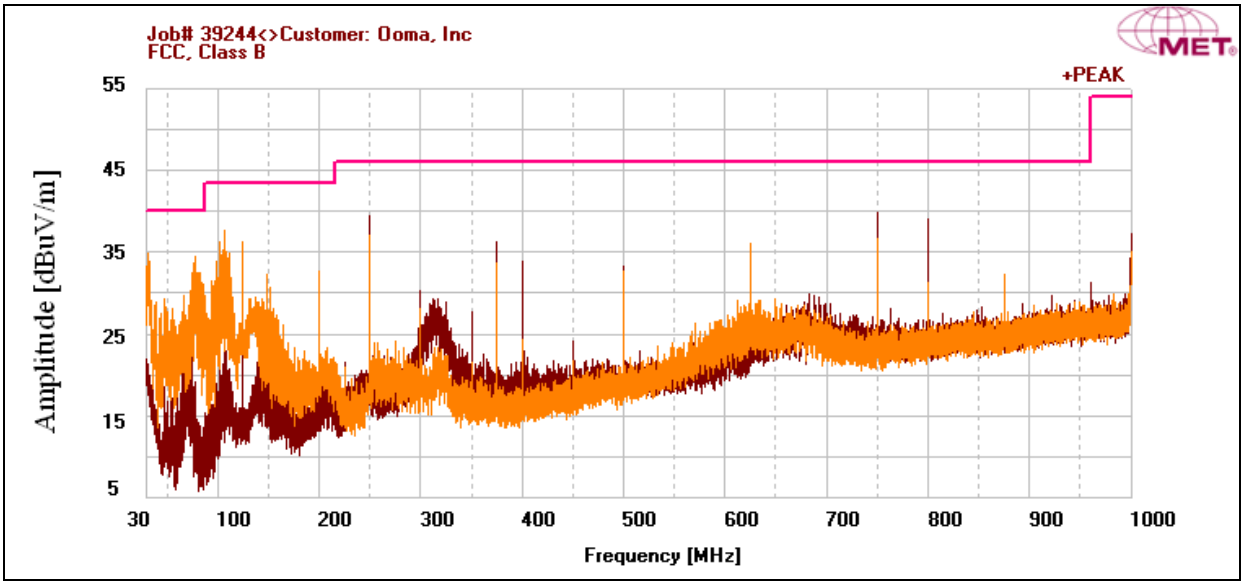
Plot 20. Radiated Emissions, Pre-Scan, Ooma Telo, CYA0015BUH01 Power Supply, 1 GHz – 6 GHz

= Vertical Polarization
= Horizontal Polarization

Radiated Emissions Limits Test Results, Ooma Telo, ADS012PM-W 050200 Power Supply

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBµV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
106.72	V	176	100	24.51	11.844	0	1.474	0	37.828	43.5	-5.672
250	H	96	120.29	24.11	12.1	0	2.39	0	38.6	46	-7.4
375	H	69	100	18.29	15.7	0	2.893	0	36.883	46	-9.117
625	V	280	100	12.59	19.8	0	3.832	0	36.222	46	-9.778
750	H	224	113.82	16.12	21.2	0	4.21	0	41.53	46	-4.47
800	H	54	100	12.85	21.8	0	4.4	0	39.05	46	-6.95

Table 26. Radiated Emissions, Ooma Telo, ADS012PM-W 050200 Power Supply, 30 MHz – 1 GHz



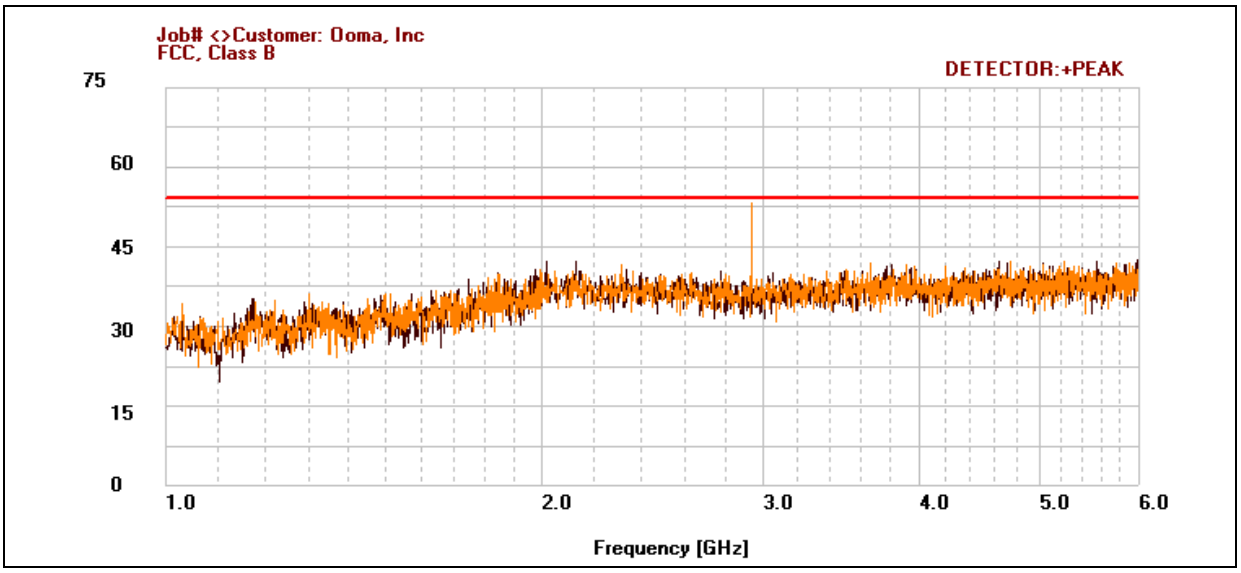
Plot 21. Radiated Emissions, Pre-Scan, Ooma Telo, ADS012PM-W 050200 Power Supply, 30 MHz – 1 GHz

= Vertical Polarization
= Horizontal Polarization

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBµV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1048.616	H	284	100	51.89	27.611	35.544	0	0	43.957	54	-10.043

Table 27. Radiated Emissions, Ooma Telo, ADS012PM-W 050200 Power Supply, 1 GHz – 6 GHz

Note: Spike @ ~2.9GHz was from measurement receiver.



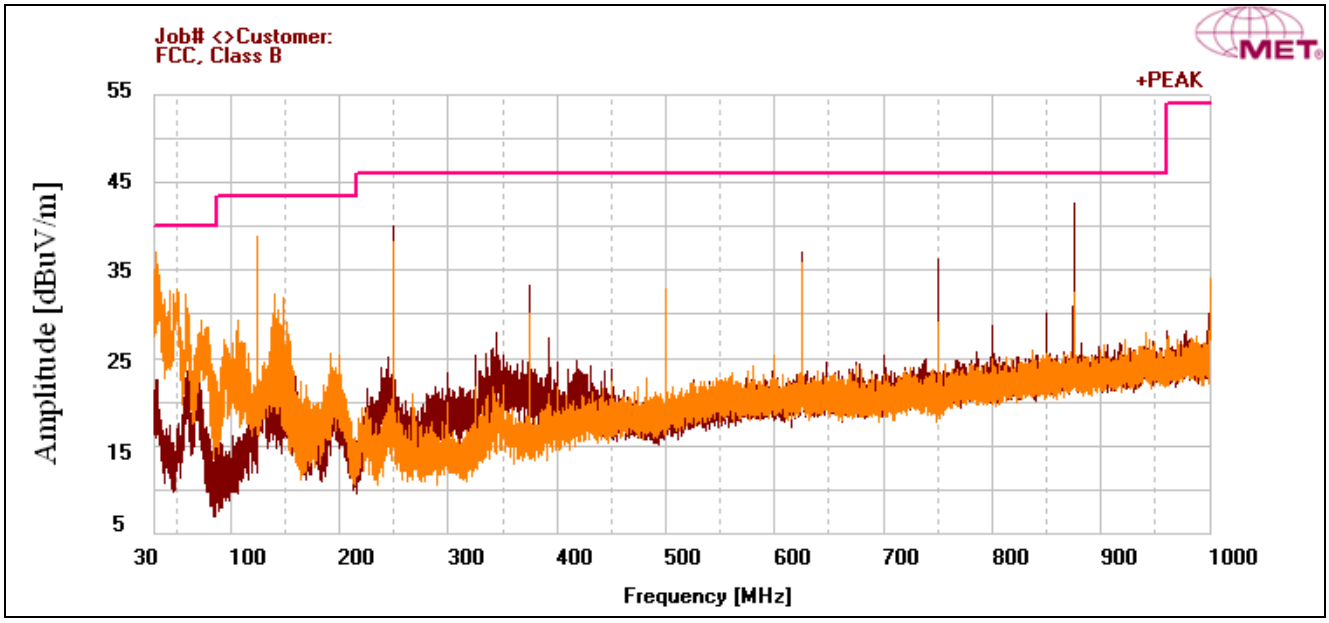
Plot 22. Radiated Emissions, Pre-Scan, Ooma Telo, ADS012PM-W 050200 Power Supply, 1 GHz – 6 GHz

= Vertical Polarization
= Horizontal Polarization

Radiated Emissions Limits Test Results, Ooma Telo 2, Version 5 Boyle Power Supply

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBµV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
875	H	219	100.	19.34	20.7	0	4.668	0	44.708	46	-1.292
124	V	126	100.	23.46	12.708	0	1.604	0	37.772	43.5	-5.728
250	V	167	100.	23.48	12.08	0	2.39	0	37.95	46	-8.05
250	H	169	100.	25.68	12.08	0	2.39	0	40.15	46	-5.85
625	H	264	100.	13.12	18.91	0	3.832	0	35.862	46	-10.138
750	H	155	100.	12.83	18.81	0	4.21	0	35.85	46	-10.15

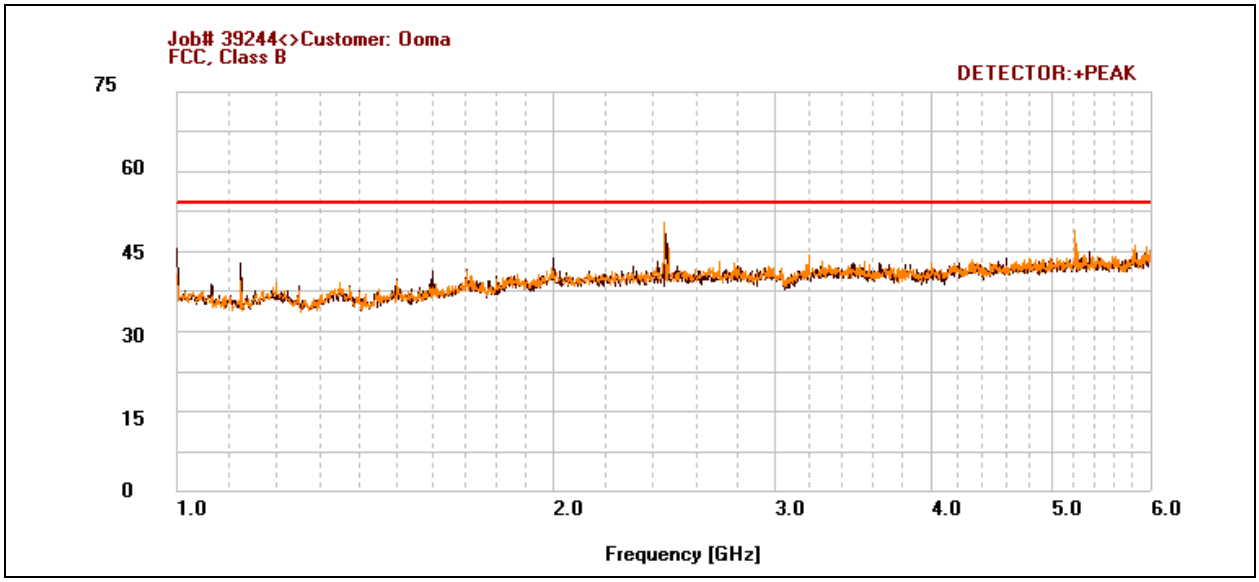
Table 28. Radiated Emissions, Ooma Telo 2, Version 5 Boyle Power Supply, 30 MHz – 1 GHz



Plot 23. Radiated Emissions, Pre-Scan, Ooma Telo 2, Version 5 Boyle Power Supply, 30 MHz – 1 GHz

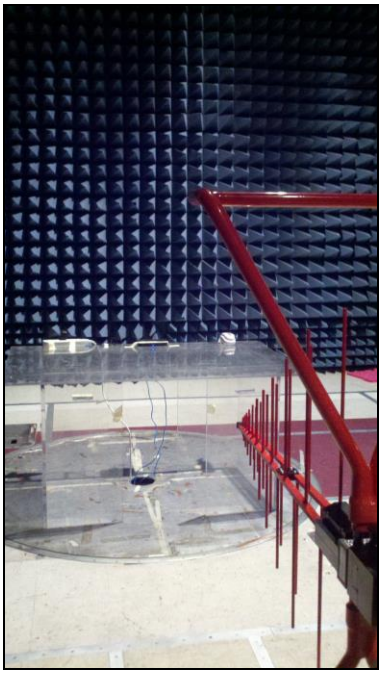
Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBµV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1125.167	V	29	200	42.63	28.201	33.497	0	0	37.334	54	-16.666
5330	V	0	100	31.87	34.832	33.014	0	0	33.688	54	-20.312
1000	V	359	100	42.48	27.6	33.55	0	0	36.53	54	-17.47
5200	H	0	100	31.03	34.72	33.048	0	0	32.702	54	-21.298
1125	H	188	100	45.23	28.2	33.497	0	0	39.933	54	-14.067
2000	H	75	100	41.26	31.6	33.13	0	0	39.73	54	-14.27

Table 29. Radiated Emissions, Ooma Telo 2, Version 5 Boyle Power Supply, 1 GHz – 6 GHz

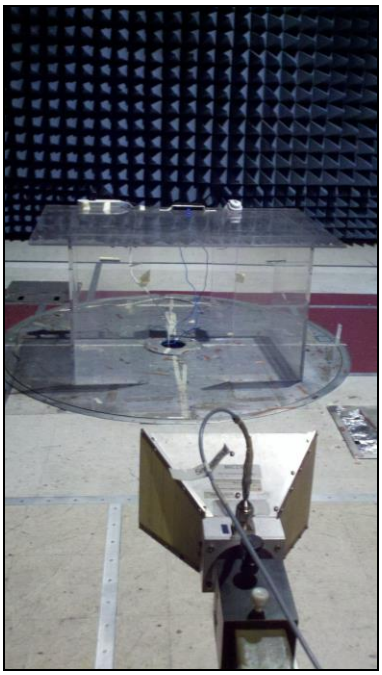


Plot 24. Radiated Emissions, Pre-Scan, Ooma Telo 2, Version 5 Boyle Power Supply, 1 GHz – 6 GHz

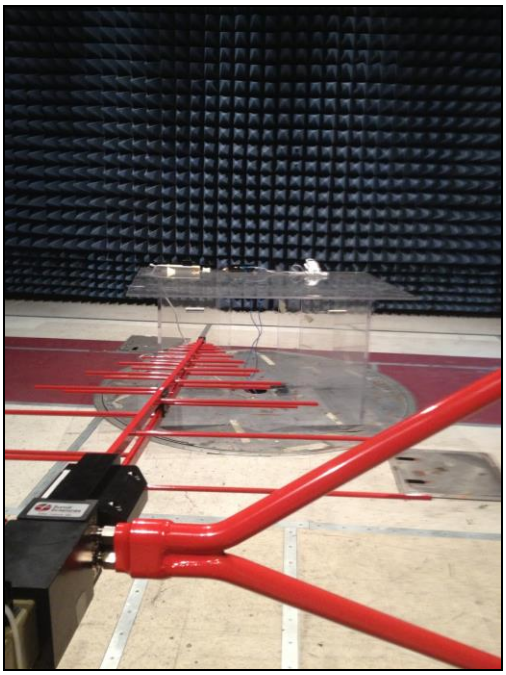
Radiated Emission Limits Test Setup



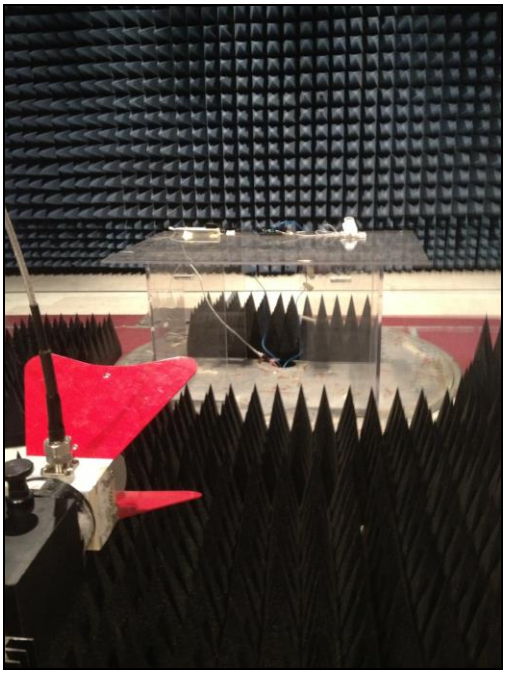
Photograph 12. Radiated Emission, Test Setup, Ooma Office, 30 MHz – 1 GHz



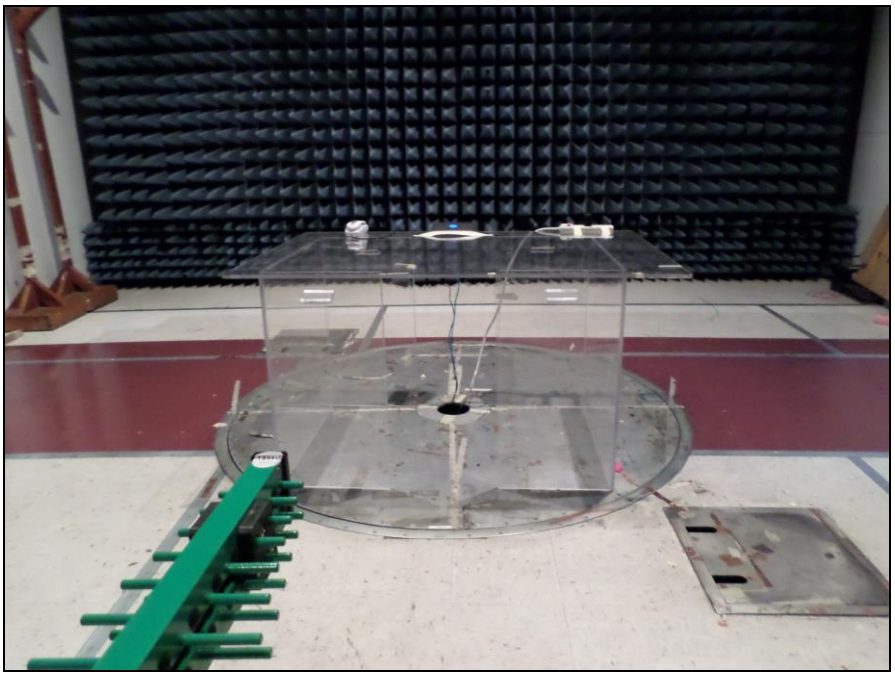
Photograph 13. Radiated Emission, Test Setup, Ooma Office, 1 GHz – 6 GHz



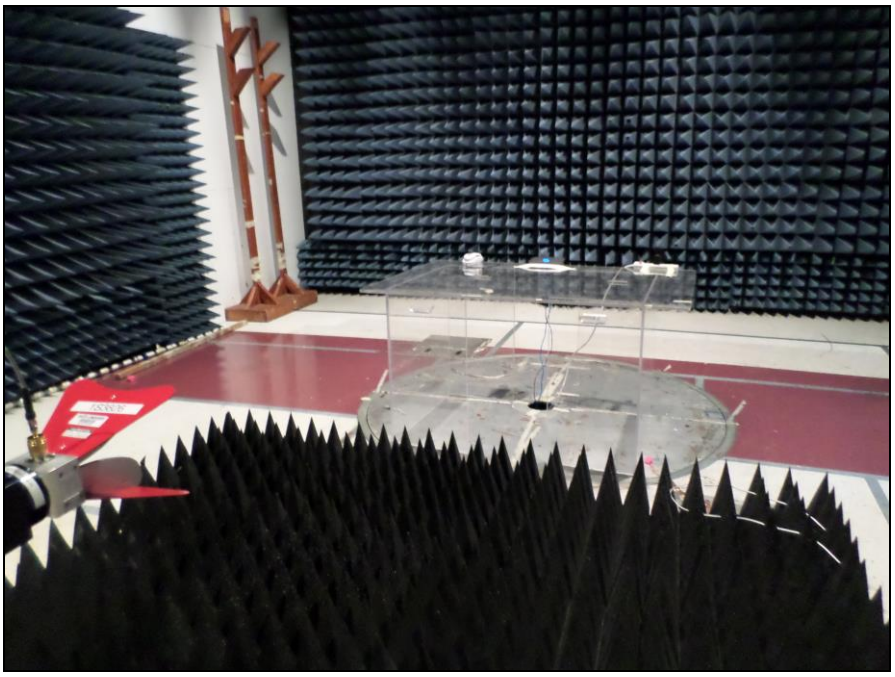
Photograph 14. Radiated Emission, Test Setup, Ooma Telo, 30 MHz – 1 GHz



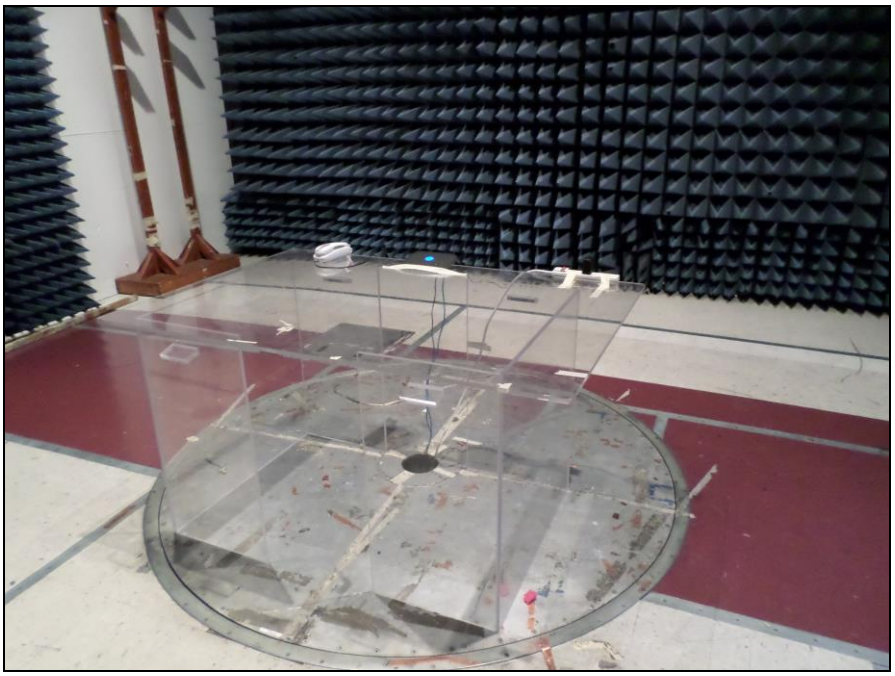
Photograph 15. Radiated Emission, Test Setup, Ooma Telo, 1 GHz – 6 GHz



Photograph 16. Radiated Emission, Test Setup, Ooma Telo 2, 30 MHz – 1 GHz



Photograph 17. Radiated Emission, Test Setup, Ooma Telo 2, 1 GHz – 6 GHz



Photograph 18. Radiated Emission, Test Setup, Ooma Telo 2, Version 5 Boyle

IV. Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

Test Requirement: **§ 15.203:** An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

The structure and application of the EUT were analyzed to determine compliance with Section 15.203 of the Rules. Section 15.203 states that the subject device must meet at least one of the following criteria:

a.) Antenna must be permanently attached to the unit.

b.) Antenna must use a unique type of connector to attach to the EUT.

c.) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

Results: The EUT as tested is compliant the criteria of §15.203. The antenna is permanently attached to the unit.

Test Engineer(s): Tony Permsombut

Test Date(s): 08/17/13

Electromagnetic Compatibility Criteria for Intentional Radiators

§15.315 Conducted Emissions Voltage

Test Requirement(s): **§15.315 Conducted limits** - An unlicensed PCS device that is designed to be connected to the public utility (AC) power line must meet the limits specified in §15.207.

§15.207 (a): For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 Σ line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency range (MHz)	§ 15.207(a), Conducted Limit (dBμV)	
	Quasi-Peak	Average
* 0.15- 0.45	66 - 56	56 - 46
0.45 - 0.5	56	46
0.5 - 30	60	50

Table 30. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Test Procedure: The EUT was placed on a 0.8 m-high wooden table inside a screen room. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 μH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.4-2003 "Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz"*. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω/50 μH LISN as the input transducer to an EMC/field intensity meter. For the purpose of this testing, the transmitter was turned on. Scans were performed with the transmitter on.

Test Results: The EUT was compliant with this requirement. Measured emissions were below applicable limits.

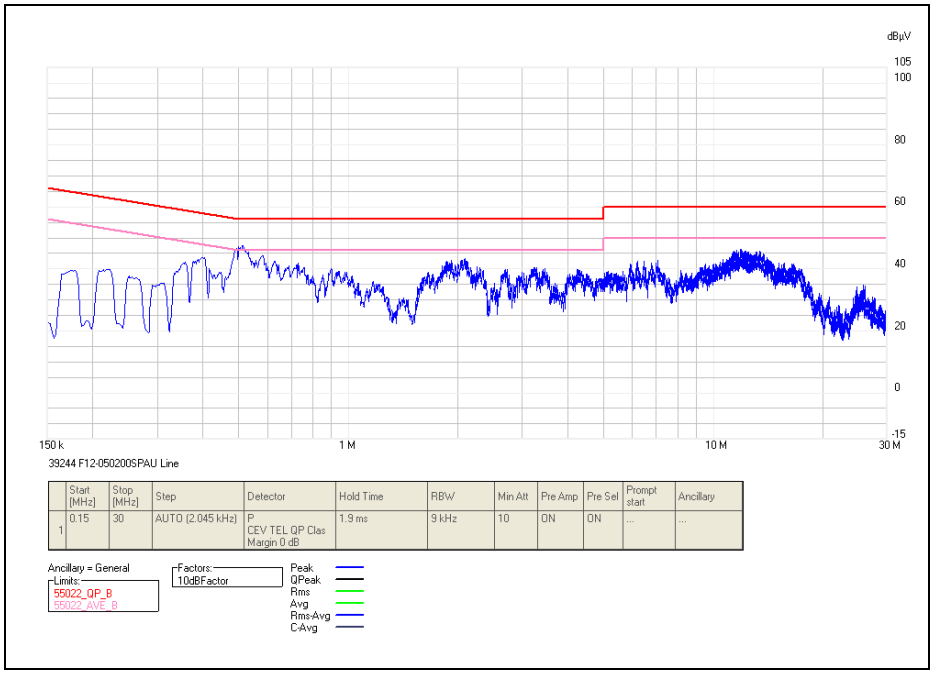
Test Engineer(s): Dan Phan

Test Date(s): 10/02/13

§15.315 – Conducted Emissions Test Results

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
39244 F12-050200SPAU Line	0.397445	40.64	57.929	-17.289	Pass	30.59	47.929	-17.339	Pass
39244 F12-050200SPAU Line	0.51401	45.17	56	-10.83	Pass	36.21	46	-9.79	Pass
39244 F12-050200SPAU Line	2.074345	40.48	56	-15.52	Pass	34.37	46	-11.63	Pass
39244 F12-050200SPAU Line	7.02529	38.57	60	-21.43	Pass	32.31	50	-17.69	Pass
39244 F12-050200SPAU Line	10.5795	40.84	60	-19.16	Pass	34.17	50	-15.83	Pass
39244 F12-050200SPAU Line	11.85558	40.68	60	-19.32	Pass	34.59	50	-15.41	Pass

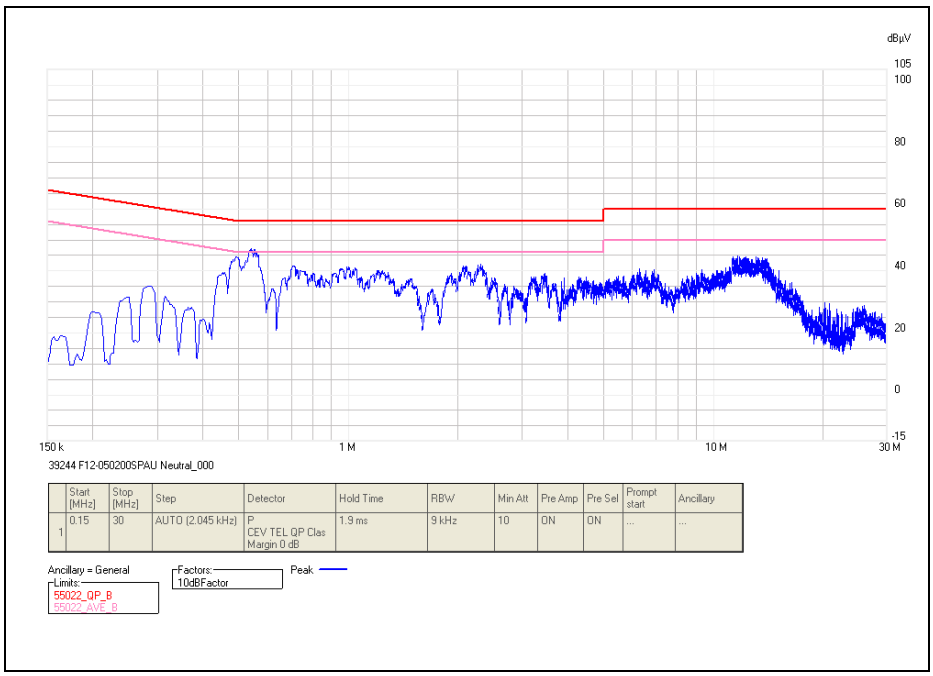
Table 31. Conducted Emissions, §15.315, Phase Line, F12W-050200SPAU Power Supply



Plot 25. Conducted Emissions, §15.315, Phase Line, F12W-050200SPAU Power Supply

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
39244 F12-050200SPAU Neutral	0.491515	42.63	56.146	-13.516	Pass	35.31	46.146	-10.836	Pass
39244 F12-050200SPAU Neutral	0.54264	44.57	56	-11.43	Pass	37.68	46	-8.32	Pass
39244 F12-050200SPAU Neutral	0.70624	39.26	56	-16.74	Pass	32.43	46	-13.57	Pass
39244 F12-050200SPAU Neutral	2.094795	38.8	56	-17.2	Pass	32.94	46	-13.06	Pass
39244 F12-050200SPAU Neutral	2.30134	38.85	56	-17.15	Pass	32.3	46	-13.7	Pass
39244 F12-050200SPAU Neutral	11.59587	39.08	60	-20.92	Pass	32.95	50	-17.05	Pass

Table 32. Conducted Emissions, §15.315, Neutral Line, F12W-050200SPAU Power Supply

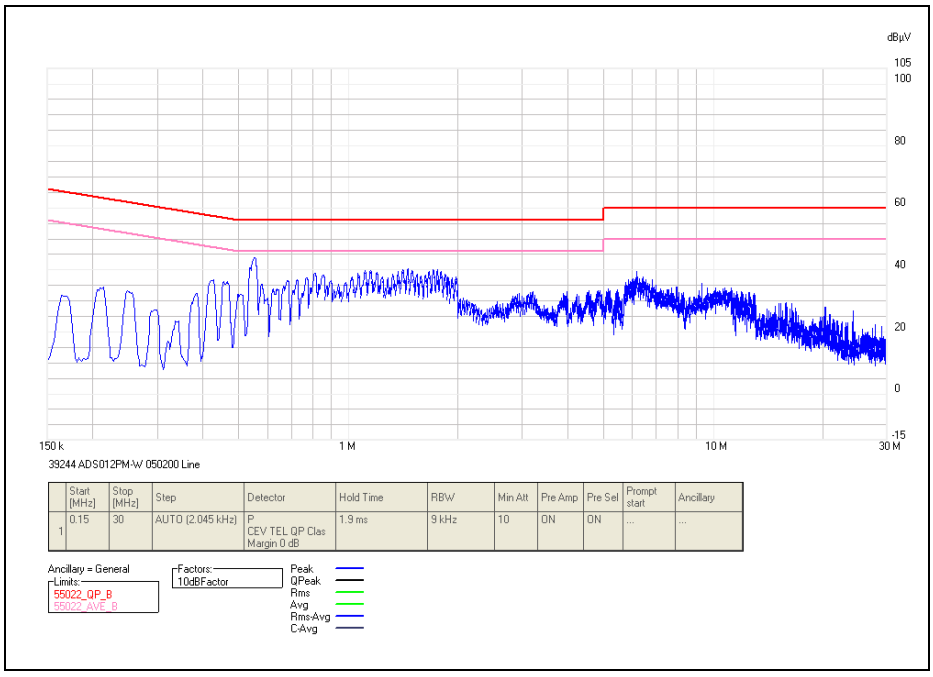


Plot 26. Conducted Emissions, §15.315, Neutral Line, F12W-050200SPAU Power Supply

§15.315 – Conducted Emissions Test Results

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
39244 ADS012PM-W 050200 Line	0.55491	51.52	56	-4.48	Pass	42.08	46	-3.92	Pass
39244 ADS012PM-W 050200 Line	1.10706	46.62	56	-9.38	Pass	37.65	46	-8.35	Pass
39244 ADS012PM-W 050200 Line	1.150005	46.22	56	-9.78	Pass	36.7	46	-9.3	Pass
39244 ADS012PM-W 050200 Line	1.40563	46.48	56	-9.52	Pass	36.39	46	-9.61	Pass
39244 ADS012PM-W 050200 Line	1.448575	46.24	56	-9.76	Pass	36.31	46	-9.69	Pass
39244 ADS012PM-W 050200 Line	1.7042	46.13	56	-9.87	Pass	36.13	46	-9.87	Pass

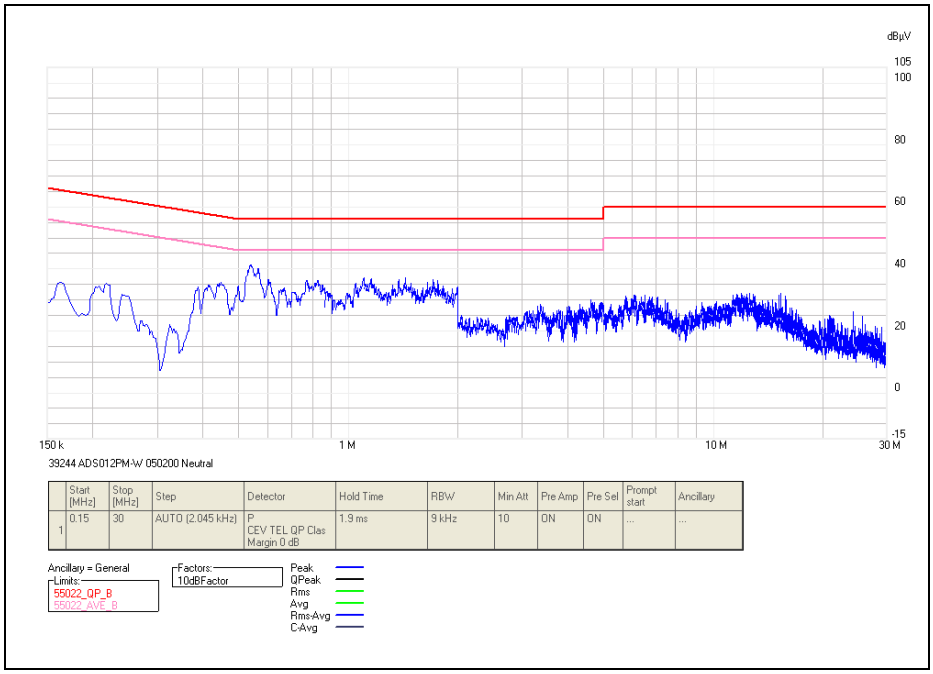
Table 33. Conducted Emissions, §15.315, Phase Line, ADS012PM-W 050200 Power Supply



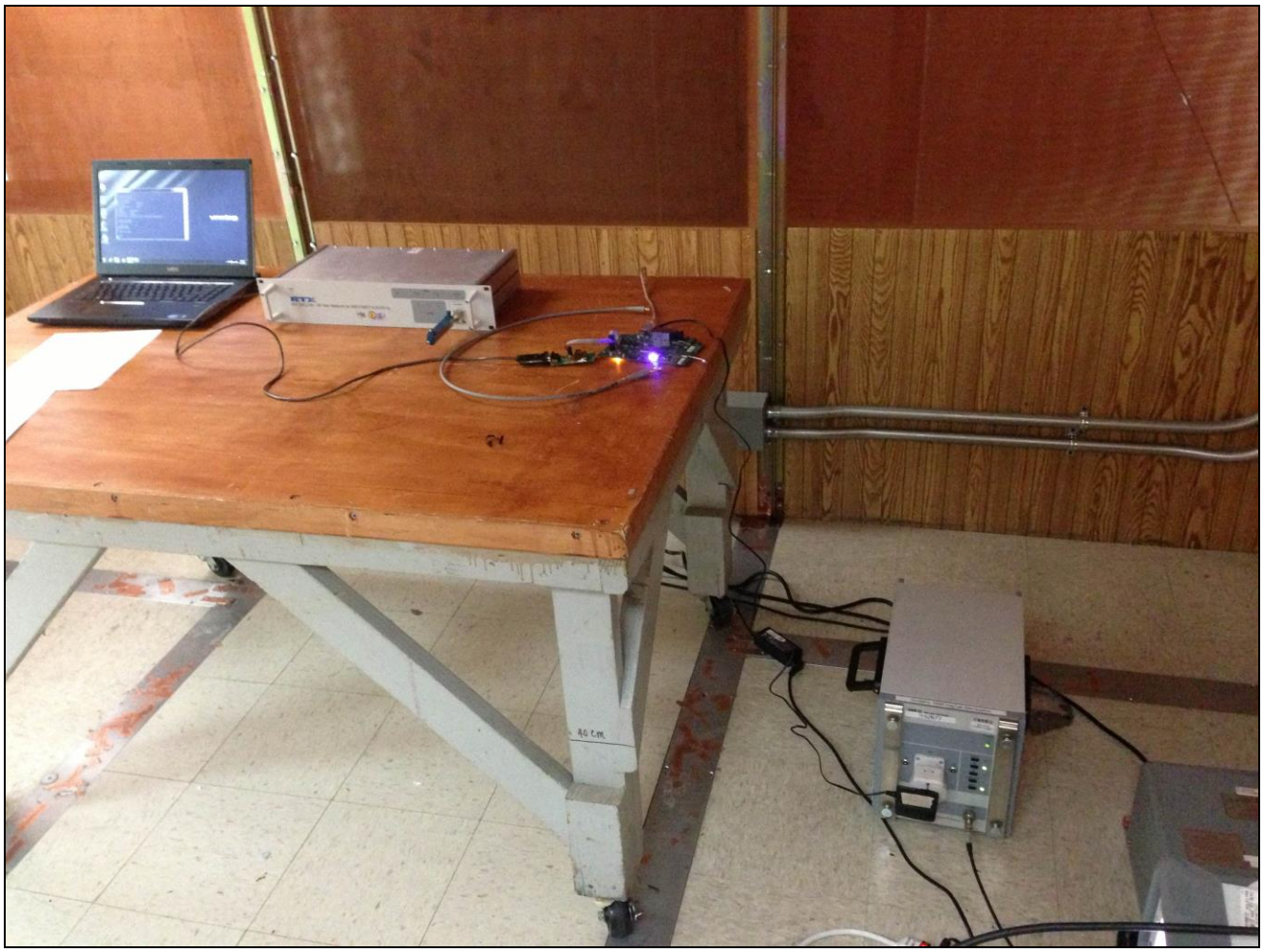
Plot 27. Conducted Emissions, §15.315, Phase Line, ADS012PM-W 050200 Power Supply

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
39244 ADS012PM-W 050200 Neutral	0.54264	48.46	56	-7.54	Pass	39.8	46	-6.2	Pass
39244 ADS012PM-W 050200 Neutral	0.601945	42.79	56	-13.21	Pass	29.39	46	-16.61	Pass
39244 ADS012PM-W 050200 Neutral	0.76759	40.34	56	-15.66	Pass	30.14	46	-15.86	Pass
39244 ADS012PM-W 050200 Neutral	1.09888	41.71	56	-14.29	Pass	32.6	46	-13.4	Pass
39244 ADS012PM-W 050200 Neutral	1.43017	42	56	-14	Pass	32.7	46	-13.3	Pass
39244 ADS012PM-W 050200 Neutral	1.7042	41.48	56	-14.52	Pass	32.22	46	-13.78	Pass

Table 34. Conducted Emissions, §15.315, Neutral Line, ADS012PM-W 050200 Power Supply



Plot 28. Conducted Emissions, §15.315, Neutral Line, ADS012PM-W 050200 Power Supply



Photograph 19. Conducted Emissions, §15.315, Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.319(b) Modulation Techniques

Test Requirement: **§ 15.319:** All transmissions must use only digital modulation techniques.

Test Procedure: Attestation of manufacturer supported by reference to relevant DECT specifications.

Attestation: This device is compliant with the DECT standards described in European Standards EN 300 175-2 and EN 300 175-3. DECT transmissions are MC/TDMA/TDD (Multi carrier / Time Division Multiple Access / Time Division Duplex) using Digital GFSK modulation. For further details see operational description or relevant portions of the DECT standards.

Results: The EUT as tested is compliant the criteria of §15.319(b).

Test Engineer(s): Tony Permsombut

Test Date(s): 08/17/13

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(a) Emission Bandwidth

Test Criteria: **§ 15.323(a):** For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. Compliance with the emissions limits is based on the use of measurement instrumentation employing a peak detector function with an instrument resolutions bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.

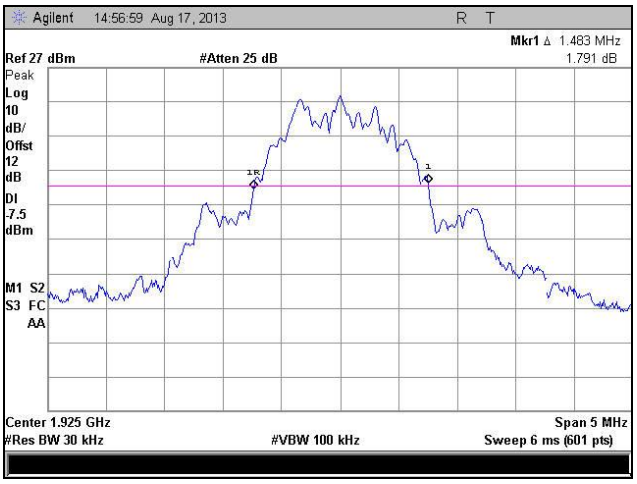
Test Procedure: Operation shall be contained within the 1920-1930 MHz band. The emission bandwidth shall be less than 2.5 MHz. The power level shall be as specified in §15.319(c), but in no event shall the emission bandwidth be less than 50 kHz.

Test Results The EUT was compliant with this requirement.

Test Engineer(s): Tony Permsombut

Test Date(s): 08/17/13

Plot 29. Occupied Bandwidth, Low Channel



Plot 30. Occupied Bandwidth, Mid Channel

Plot 31. Occupied Bandwidth, High Channel

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.319(c) Peak Transmit Power

Test Criteria: **§15.319(c):** The peak transmit power shall not exceed 100 microwatts multiplied by the square root of the emission bandwidth in hertz. Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

Test Procedure: Testing to ANSI C63.17 draft ballot 3.0 Clause 6.1.2, which provides the test methodology for this provision. The EUT is controlled from a personal computer and set into continuous transmission mode.

Test Results: Equipment complies with the Peak Transmit Output limits of **§ 15.319(c)**.

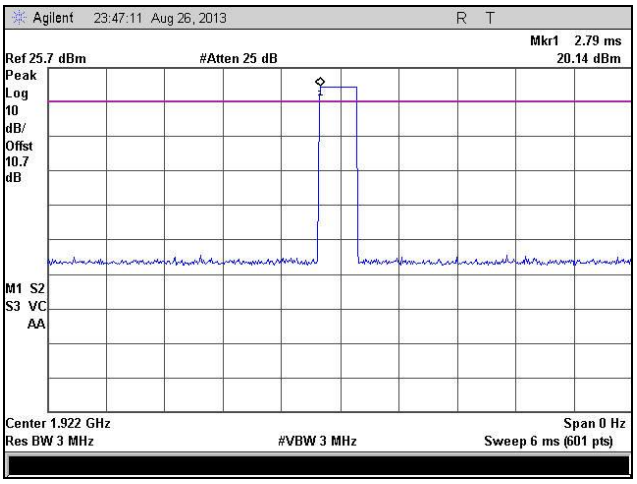
Peak Transmit Power Limit= 5logB-10dBm
5Log (1.483 exp6) – 10dBm
20.8dBm

Test Engineer(s): Tony Permsombut; Arden Huang

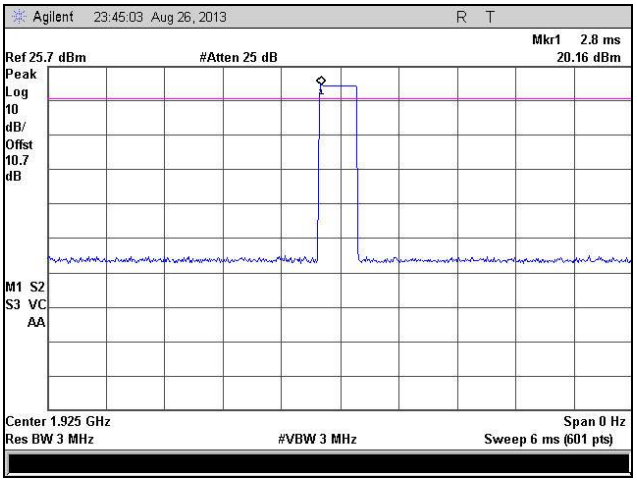
Test Date(s): 08/17/13; 09/06/13

RF Transmit Power		
Carrier Channel	**Frequency (MHz)**	**Measured Peak Output Power dBm**
Low	1922.1	20.14
Mid	1925.1	20.16
High	1928.0	20.30

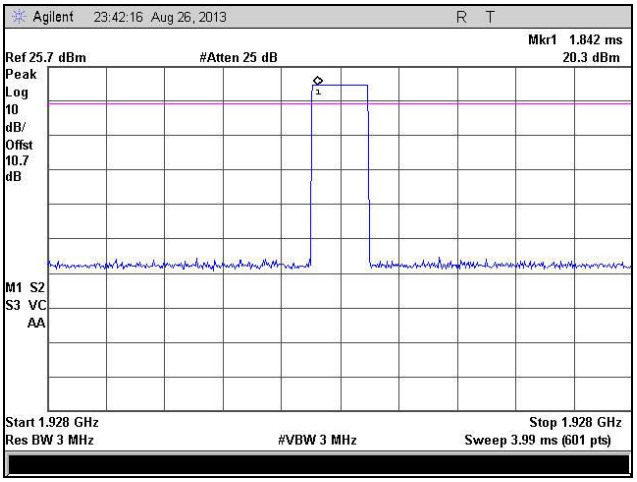
Table 35. Peak Transmit Power, Test Results



Plot 32. RF Output Power, Low Channel



Plot 33. RF Output Power, Mid Channel



Plot 34. RF Output Power, High Channel

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.319(d) Power Spectral Density

Test Criteria: **§15.319(d):** Power spectral density shall not exceed 3 milliwatts in any 3 kHz bandwidth as measured with a spectrum analyzer having a resolution bandwidth of 3 kHz.

Test Procedure: Testing to ANSI C63.17:2006 Clause 6.1.5, which provides the test methodology for this provision.

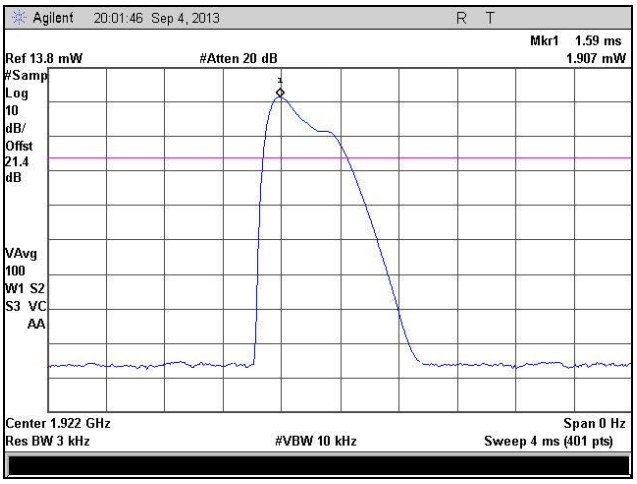
Test Results: Equipment complies with the Power Spectral Density limits of **§ 15.319(d)**.

Test Engineer(s): Arden Huang

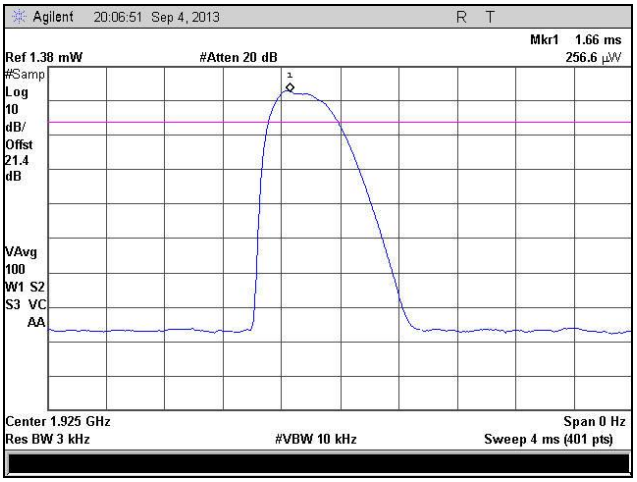
Test Date(s): 09/06/13

Power Spectral Density		
Carrier Channel	**Frequency (MHz)**	**Measured Peak Power Spectral Density (mW)**
Low	1922.1	1.90
Mid	1925.1	0.2566
High	1928.0	2.067

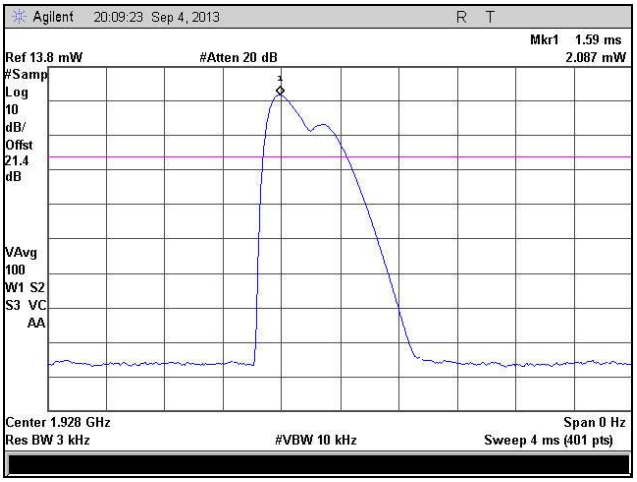
Table 36. Power Spectral Density, Test Results



Plot 35. Peak Power Spectral Density, Low Channel



Plot 36. Peak Power Spectral Density, Mid Channel



Plot 37. Peak Power Spectral Density, High Channel

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.319(e) Power Adjustment for Antenna Gain

Test Criteria: **§15.319(e):** The peak transmit power shall be reduced by the amount in decibels that the maximum directional gain of the antenna exceeds 3 dBi.

Test Procedure: Testing to ANSI C63.17-2006 Clause 4.3.1, which provides the test methodology for this provision.

Test Results: Equipment Employs a 3.5 dBi Antenna. Max output power allowed with this gain is 20.3dBm. The Max output power by the EUT is 20.3.

The Output Power complies with the Power Adjustment for Antenna Gain requirements of **§15.319(e)**.

Test Engineer(s): Poona Saber

Test Date(s): 09/24/13

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.319(f) Automatically Discontinue Transmission

Test Criteria: **§15.319(f):** The device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. These provisions are not intended to preclude transmission of control and signaling information or use of repetitive codes used by certain digital technologies to complete frame or burst intervals.

Test Procedure: Attestation of manufacturer supported by test results. The statement shall include a description of how the EUT operates when there is no data to transmit. This may be met by reference to relevant portions of the DECT standards.

Test Results: Equipment complies with the Automatic Discontinuance of transmission in accordance with **§15.319(f)**.

	Test	Reaction of EUT	Result
1	Remove Power from Companion Device	A	Pass
2	Switch off the companion device	A	Pass
3	Terminate call at the companion device	A	Pass
4	Switch off the EUT	A	Pass
5	Terminate call at the EUT	A	Pass

Table 37. Automatic Discontinuance of Transmission, Test Results

A - Connection was terminated and transmission ceased.
B - Connection was terminated but the EUT transmits control or signaling information.
C - Connection was terminated but the companion device transmits control or signaling information.

NA 1 - Companion Device does not have an on/off switch
NA 2 - Companion Device does not have a switch to terminate call

Test Engineer(s): Poona Saber

Test Date(s): 10/08/13

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.319(i) RF Exposure

RF Exposure Requirements: **§1.1307(b)(1) and §1.1307(b)(2):** Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

RF Radiation Exposure Limit: **§1.1310:** As specified in this section, the Maximum Permissible Exposure (MPE) Limit shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Sec. 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Sec. 2.1093 of this chapter.

EUT maximum antenna gain = 3.5 dBi
S= Power Density (1 mW/cm2)
P= Power input to antenna (107.15mW)
G= Antenna Gain (2.24 numeric)

R= (107.15*2.24/4*3.14*1)^1/2 = (240.016/12.56)^1/2 =4.37cm
S=(107.15*2.24/4*3.14*20^2) = (240.026/5024) = 0.044 mW/cm^2 @ 20cm separation

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(c)(1) Monitoring of Intended Transmit Window and Maximum Reaction Time

Test Criteria: **§15.323 (c)(1)** Immediately prior to initiating transmission, devices must monitor the combined time and spectrum windows in which they intend to transmit for a period of at least 10 milliseconds for systems designed to use a 10 milliseconds or shorter frame period or at least 20 milliseconds for systems designed to use a 20 milliseconds frame period.

Test Procedure: Testing to ANSI C63.17-2006 Clause 7.3, which provides the test methodology for this provision. The Clause states that the lower threshold is for devices that do not use the LIC procedure. The equation for the lower monitoring threshold is given in ANSI C63.17 Clause 4.3.4.

Test Results: The EUT is compliant with this requirement.

Test Engineer(s): Poona Saber

Test Date(s): 10/08/13

	Test Description	EUT Transmission	Results
1	Applied interference on f1 and no interference on f2	F2	Pass
2	Applied interference on f2 and removed interference on f1	F1	Pass

Table 38. Monitoring of Intended Transmit Window and Maximum Reaction Time, Test Results

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(c)(2); (c)(9) Monitoring Threshold

Test Criteria: **§15.323 (c)(2).** The monitoring threshold must not be more than 30 dB above the thermal noise power for a bandwidth equivalent to the emission bandwidth used by the device.

§15.323 (c)(9). Devices that have a power output lower than the maximum permitted under this subpart may increase their monitoring detection threshold by one decibel for each one decibel that the transmitter power is below the maximum permitted.

Test Procedure: Testing to ANSI C63.17-2006 Clause 7.3, which provides the test methodology for this provision. The Clause states that the lower threshold is for devices that do not use the LIC procedure. The equation for the lower monitoring threshold is given in ANSI C63.17 Clause 4.3.4.

Test Results: The EUT is compliant with this requirement.

Test Engineer(s): Dan Phan

Test Date(s): 10/03/13

Upper Threshold		
B	1483000	Hz
Mu	50	dB
Peut	20.3	dBm
Tu =	-61.73	dBm
Lower Threshold		
B	1483000	Hz
Ml	30	dB
Peut	20.3	dBm
Tl =	-81.73	dBm

Table 39. Monitoring Threshold, Test Results

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(c)(3) Duration of Transmission

Test Criteria: **§15.323 (c)(3)** If no signal above the threshold level is detected, transmission may commence and continue with the same emission bandwidth in the monitored time and spectrum windows without further monitoring. However, occupation of the same combined time and spectrum windows by a device or group of cooperating devices continuously over a period of time longer than 8 hours is not permitted without repeating the access criteria.

Test Procedure: Testing to ANSI C63.17-2006 Clause 4, which provides the test methodology for this provision. A communication link is established between BS and MS in a conducted mode and in a room without other US DECT devices to prevent influence from other transmissions. According to FCC Part 15.323(c)(3), the access criteria have to be verified at least every 8 hours. The following test is performed:

Attestation: Max Transmission time was 4H, 15 min., therefore, EUT meets the requirement.

Test Engineer(s): Dan Phan; Poona Saber

Test Date(s): 10/03/13 – 10/04/13

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(c)(4) Connection Acknowledgment

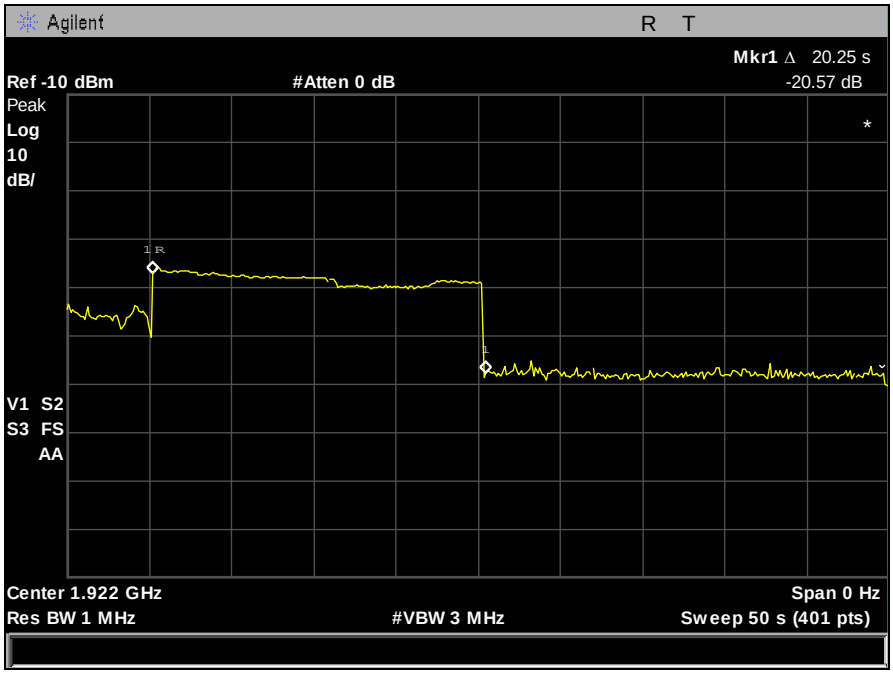
Test Criteria: **§15.323 (c)(4)** Once access to specific combined time and spectrum windows is obtained an acknowledgment from a system participant must be received by the initiating transmitter within one second or transmission must cease. Periodic acknowledgments must be received at least every 30 seconds or transmission must cease. Channels used exclusively for control and signaling information may transmit continuously for 30 seconds without receiving an acknowledgment, at which time the access criteria must be repeated.

Test Procedure: Testing to ANSI C63.17-2006 Clause 8.2.1, which provides the test methodology for this provision.

Test Results: The EUT was compliant with this requirement.

Test Engineer(s): Poona Saber

Test Date(s): 10/07/13 – 10/08/13



Plot 38. Connection Acknowledgment, Less than 30 Minutes

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(c)(5) Selected Channel Confirmation, Power Accuracy, Segment Occupancy

Test Criteria: **§15.323 (c)(5)** If access to spectrum is not available as determined by the above, and a minimum of 40 duplex system access channels are defined for the system, the time and spectrum windows with the lowest power level below a monitoring threshold of 50 dB above the thermal noise power determined for the emission bandwidth may be accessed. A device utilizing the provisions of this paragraph must have monitored all access channels defined for its system within the last 10 seconds and must verify, within the 20 milliseconds (40 milliseconds for devices designed to use a 20 milliseconds frame period) immediately preceding actual channel access that the detected power of the selected time and spectrum windows is no higher than the previously detected value. The power measurement resolution for this comparison must be accurate to within 6 dB. No device or group of co-operating devices located within 1 meter of each other shall during any frame period occupy more than 6 MHz of aggregate bandwidth, or alternatively, more than one third of the time and spectrum windows defined by the system.

Test Procedure: Testing to ANSI C63.17-2006 Clause 7.3.2. & 7.3.3, which provides the test methodology for this provision. The current product offers 12 duplex channels per frequency channel and therefore 12x5=60 duplex channels in total. Hence Part §15.323(c)(5) applies. The equation for the upper monitoring threshold is given in ANSI C63.17 Clause 4.3.3.

Max measured interference level (dBm) = -88 dBm

Test Results: The EUT was compliant with this requirement.

Test Engineer(s): Poona Saber

Test Date(s): 10/07/13 – 10/08/13

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(c)(6) Random Waiting

Test Criteria: **§15.323 (c)(6)**) If the selected combined time and spectrum windows are unavailable, the device may either monitor and select different windows or seek to use the same windows after waiting an amount of time, randomly chosen from a uniform random distribution between 10 and 150 milliseconds, commencing when the channel becomes available.

Test Procedure: Testing to ANSI C63.17-2006 Clause 8.1.3, which provides the test methodology for this provision.

Attestation: The Manufacturer declared that this provision is not utilized by the EUT.

Test Engineer(s): Poona Saber

Test Date(s): 10/04/13

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(c)(7) Monitoring Bandwidth

Test Criteria: **§15.323 (c)(7)** The monitoring system bandwidth must be equal to or greater than the emission bandwidth of the intended transmission and have a maximum reaction time less than 50xSQRT (1.25/ emission bandwidth in MHz) microseconds for signals at the applicable threshold level but shall not be required to be less than 50 microseconds. If a signal is detected that is 6 dB or more above the applicable threshold level, the maximum reaction time shall be 35xSQRT (1.25/emission bandwidth in MHz) microseconds but shall not be required to be less than 35 microseconds.

Test Procedure: Testing to ANSI C63.17-2006 Clause 7.4, which provides the test methodology for this provision.

Test Results: Per Manufacturer the monitoring is made through the radio receiver used by the EUT for communication, the intended bandwidth requirement on the monitoring system is meet. Based on manufacturer's declaration this requirement is considered to be meet.

Test Engineer(s): Poona Saber

Test Date(s): 10/04/13

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(c)(8) Monitoring Antenna

Test Criteria: **§15.323 (c)(8)**) Transmission is intended to occupy. The following criteria must be met: (8) The monitoring system shall use the same antenna used for transmission, or an antenna that yields equivalent reception at that location.

Test Procedure: Testing to ANSI C63.17-2006 Clause 4, which provides the test methodology for this provision.

Attestation: The EUT uses the same antennas for transmission and reception as for monitoring.

Test Engineer(s): Poona Saber

Test Date(s): 10/04/13

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(c)(10) Duplex Connections

Test Criteria: **§15.323 (c)(10)** An initiating device may attempt to establish a duplex connection by monitoring both its intended transmit and receive time and spectrum windows. If both the intended transmit and receive time and spectrum windows meet the access criteria, then the initiating device can initiate a transmission in the intended transmit time and spectrum window. If the power detected by the responding device can be decoded as a duplex connection signal from the initiating device, then the responding device may immediately begin transmitting on the receive time and spectrum window monitored by the initiating device

Test Procedure: Testing to ANSI C63.17-2006 Clause 8.3, which provides the test methodology for this provision. The MS is the initiating device and the BS is the companion device

Test Results: The Manufacturer declares that this provision is not utilized by the EUT.

Test Engineer(s): Poona Saber

Test Date(s): 10/04/13

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(c)(11) Alternative Monitoring Interval For Co-Located Devices

Test Criteria: **§15.323 (c)(11)** An initiating device that is prevented from monitoring during its intended transmit window due to monitoring system blocking from the transmissions of a co-located (within one meter) transmitter of the same system, may monitor the portions of the time and spectrum windows in which they intend to receive over a period of at least 10 milliseconds. The monitored time and spectrum window must total at least 50 percent of the 10 millisecond frame interval and the monitored spectrum must be within the 1.25 MHz frequency channel(s) already occupied by that device or co-located co-operating devices. If the access criteria is met for the intended receive time and spectrum window under the above conditions, then transmission in the intended transmit window by the initiating device may commence.

Test Procedure: Testing to ANSI C63.17-2006 Clause 8.4, which provides the test methodology for this provision. The MS is initiating device and the BS is the companion device

Test Results: The Manufacturer declares that this provision is not utilized by the EUT.

Test Engineer(s): Poona Saber

Test Date(s): 10/04/13

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(c)(12) Fair Access

Test Criteria: **§15.323 (c)(12)** The provisions of (c)(10) or (c)(11) of this section shall not be used to extend the range of spectrum occupied over space or time for the purpose of denying fair access to spectrum to other devices

Test Procedure: The manufacturer supplies an attestation.

Attestation: The manufacturer declares that the EUT does not work in a mode which denies fair access to spectrum for other devices.

Test Engineer(s): Poona Saber

Test Date(s): 10/04/13

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(d)(1) Spurious Emissions

Test Criteria:

§15.323(d)(1): Out of Band Emissions

Emissions shall be attenuated below a reference power of 112 milliwatts as follows: 30 dB between the band edge and 1.25 MHz above or below the band; 50 dB between 1.25 and 2.5 MHz above or below the band; and 60 dB at 2.5 MHz or greater above or below the band.

§15.323(d)(2): In-Band Emissions

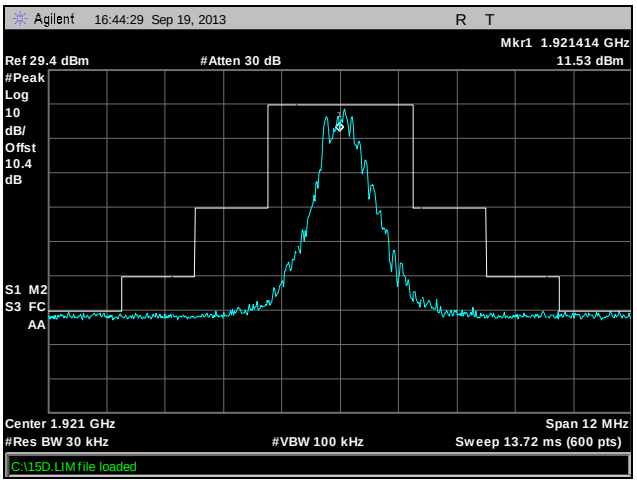
Emissions inside the band must comply with the following emission mask: In the bands between 1B and 2B measured from the center of the emission bandwidth, the total power emitted by the device shall be at least 30 dB below the transmit power permitted for that device; in the bands between 2B and 3B measured from the center of the emission bandwidth, the total power emitted by an intentional radiator shall be at least 50 dB below the transmit power permitted for that radiator; in the bands between 3B and the band edge, the total power emitted by an intentional radiator in the measurement bandwidth shall be at least 60 dB below the transmit power permitted for that radiator. "B" is defined as the emission bandwidth of the device in hertz. Compliance with the emission limits is based on the use of measurement instrumentation employing peak detector function with an instrument resolution bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.

Test Procedure: For both in and out of band emissions the EUT was connected directly to a spectrum analyzer. The RBW of the spectrum analyzer was set to a minimum 1% of the emission band width.

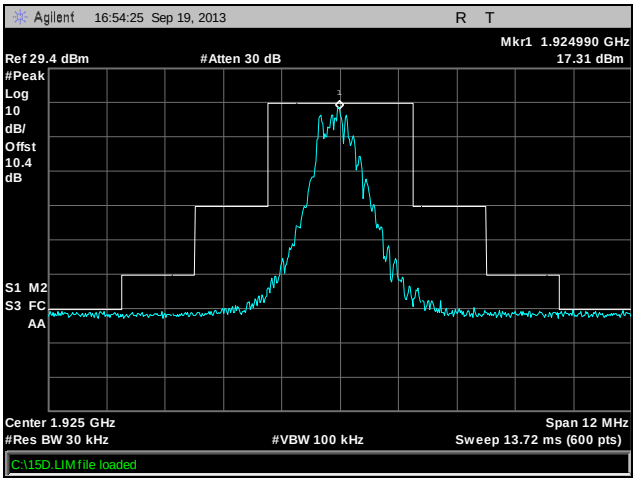
Test Results: Equipment complies with the Spurious Emission limits of **§ 15.323(d)(1)**.

Test Engineer(s): Poona Saber

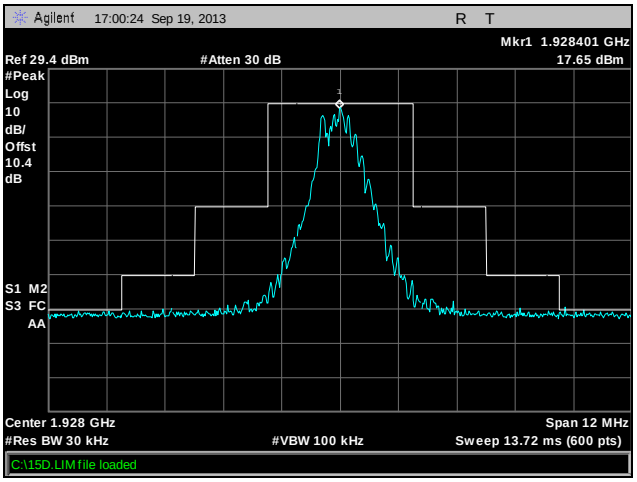
Test Date(s): 09/20/13



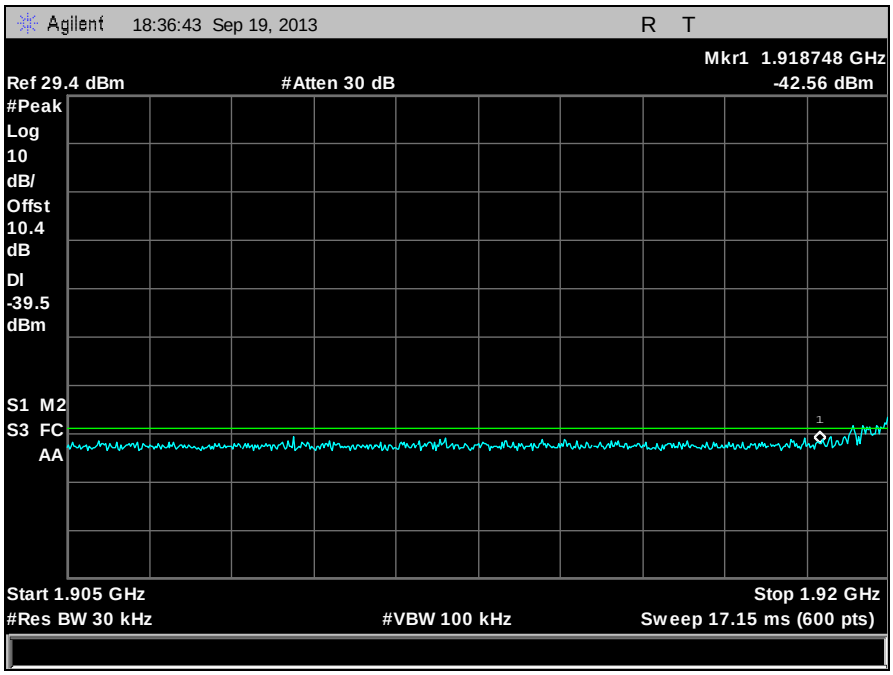
Plot 39. Conducted Spurious Emission, In-Band, Low Channel



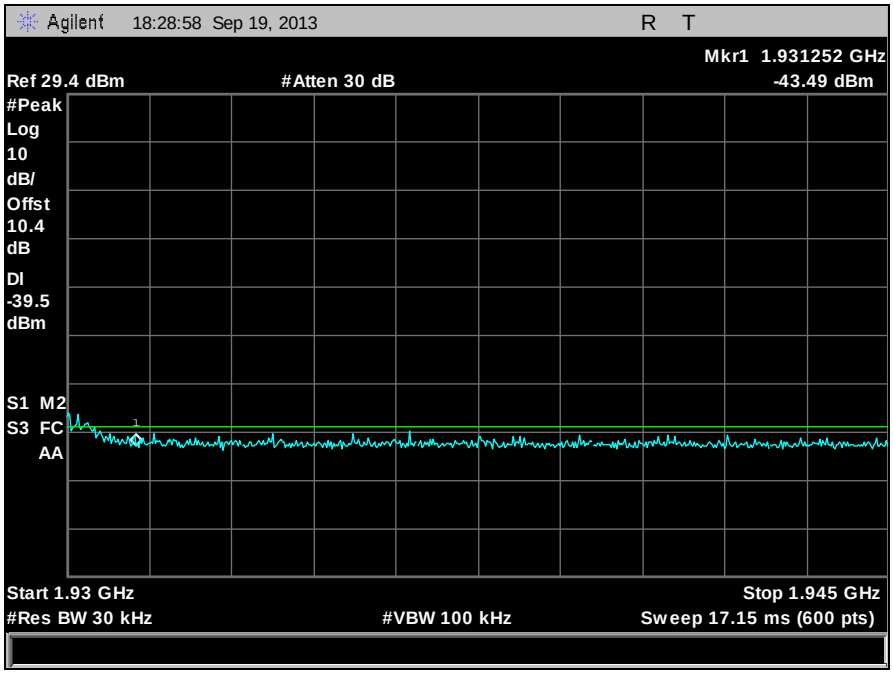
Plot 40. Conducted Spurious Emission, In-Band, Mid Channel



Plot 41. Conducted Spurious Emission, In-Band, High Channel



Plot 42. Conducted Spurious Emission, Out-of-Band, Low Channel



Plot 43. Conducted Spurious Emission, Out-of-Band, High Channel

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(e) Frame Period

Test Criteria:

§15.323 (e) The frame period (a set of consecutive time slots in which the position of each time slot can be identified by reference to a synchronizing source) of an intentional radiator operating in these sub-bands shall be 20 milliseconds or 10 milliseconds/X where X is a positive whole number. Each device that implements time division for the purposes of maintaining a duplex connection on a given frequency carrier shall maintain a frame repetition rate with a frequency stability of at least 50 parts per million (ppm). Each device which further divides access in time in order to support multiple communication links on a given frequency carrier shall maintain a frame repetition rate with a frequency stability of at least 10 ppm.

Timing Jitter

§ 15.323 (e) Specific requirements for isochronous devices operating in the 1920–1930 MHz sub-band. The jitter (time-related, abrupt, spurious variations in the duration of the frame interval) introduced at the two ends of such a communication link shall not exceed 25 microseconds for any two consecutive transmissions. Transmissions shall be continuous in every time and spectrum window during the frame period defined for the device.

Test Procedure: The manufacturer supplies an attestation.

Test Engineer(s): Poona Saber

Test Date(s): 10/07/13 – 10/08/13

Mean Frame Repetition (Hz)	Standard Deviation (Hz)	Frame Repetition Stability (ppm)	Limit (PPM)	Result
199.6007984	0.0001027	1.543581	10	Pass

Table 40. Frame Period, Test Results

Sample Calculation

Frame Repetition Stability = (3 x Standard Deviation) / Frame Rate) * 10^6

Frame Rate = 1 / 5ms = 200 Hz

The following timing jitter was recorded:

Measured Max Jitter (µsec)	Limit (µsec)	Results
0.232	25	Pass

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(f) Frequency Stability

Test Criteria: **§15.323 (f)** The frequency stability of the carrier frequency of the intentional radiator shall be maintained within ±10ppm over 1hour or the interval between channel access monitoring, whichever is shorter. The frequency stability shall be maintained over a temperature variation of -20º to +50º C at normal supply voltage and over a variation in the primary supply voltage of 85% to 115% of the rated supply voltage at a temperature of 20^0 C. For equipment that is capable only of operating from a battery, the frequency stability tests shall be performed using a new battery without any further requirement to vary supply voltage.

Test Procedure: The EUT was placed in the Environmental Chamber and support equipment are outside the chamber on a table. A CW signal was injected into the EUT at the appropriate RF level. The frequency counter option on the Spectrum Analyzer was used to measure frequency deviations. The frequency drift was investigated for every 10º C increment until the unit is stabilized then recorded the reading in tabular format with the temperature range of -20º to +50º C.

Voltage supplied to EUT is 120 VAC reference temperature was done at 20º C. The voltage was varied by ± 15 % of nominal

Test Results: The EUT was compliant with this requirement.

Test Engineer(s): Poona Saber

Test Date(s): 09/19/13

Low Channel (1922)				
Reference @ 120VAC 20C	Voltage (AC)	Temperature (°C)	Frequency (MHz)	PPM
	50	1921.170250	5.075	50
	40	1921.170110	5.148	40
	30	1921.170000	5.205	30
	20	1921.180000	0.000	20
	10	1921.170150	5.127	10
1921.180000	0	1921.179140	0.448	0
	-10	1921.177040	1.541	-10
	-20	1921.170530	4.929	-20
Mid Channel (1925)				
Reference @ 120VAC 20C	Voltage (AC)	Temperature (°C)	Frequency (MHz)	PPM
	50	1924.626370	3.029	50
	40	1924.626900	2.754	40
	30	1924.629400	1.455	30
	20	1924.632200	0.000	20
	10	1924.634510	1.200	10
1924.632200	0	1924.635200	1.559	0
	-10	1924.632900	0.364	-10
	-20	1924.626580	2.920	-20
High Channel (1928)				
Reference @ 120VAC 20C	Voltage (AC)	Temperature (°C)	Frequency (MHz)	PPM
	50	1928.082120	2.972	50
	40	1928.082530	2.759	40
	30	1928.085180	1.385	30
	20	1928.087850	0.000	20
	10	1928.090250	1.245	10
1928.087850	0	1928.090960	1.613	0
	-10	1928.088610	0.394	-10
	-20	1928.082140	2.961	-20

Table 41. Frequency Stability, Test Results

IV. Test Equipment

Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2005.

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1S2617	HORN ANTENNA (1-18GHZ)	COM-POWER	AHA-118	12/05/2012	06/05/2014
1S2641	LISN	SOLAR ELECTRONICS	8610-50-TS-100-N	02/11/2013	08/11/2014
1S2460	1-26GHZ SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4407B	07/27/2012	01/27/2014
1S2198	HORN ANTENNA	EMCO	3115	10/18/2012	04/18/2014
N/A	2-WAY POWER SPLITTER	MINI-CIRCUITS	ZB3PD-2400W-S	SEE NOTE	
N/A	3-WAY POWER SPLITTER	MINI-CIRCUITS	ZN2PD2-50-S+	SEE NOTE	
1S2229	TEMPERATURE CHAMBER	TENNY	T6	09/18/2013	03/18/2015
1S2399	TURNTABLE CONTROLLER	SUNOL SCIENCE	SC99V	SEE NOTE	
1S2498	VARIABLE POWER SUPPLY	ISE., INC	5021CT-DVAM	SEE NOTE	
1S2482	5 METER CHAMBER (NSA)	PANASHIELD	5 METER SEMI-ANECHOIC CHAMBER	08/12/2013	02/12/2015
1S2198	HORN ANTENNA	EMCO	3115	10/18/2012	04/18/2014
1S2121	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	SEE NOTE	
1S2501	EMI TEST RECEIVER 20HZ-40GHZ	ROHDE & SCHWARZ	ESU40	09/19/2013	09/19/2014
1S2583	SPECTRUM ANALYZER	AGILENT/HP	E4447A	11/01/2013	05/01/2015
N/A	HIGH PASS FILTER	MICRO-TRONICS	HPM13146	SEE NOTE	
1S2603	DOUBLE RIDGED WAVEGUIDE HORN	ETS-LINDGREN	3117	04/24/2013	04/24/2015
1S2034	COUPLER, DIRECTIONAL 1-20 GHZ	KRYTAR	101020020	SEE NOTE	

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing

V. Certification & User's Manual Information

Certification & User's Manual Information

A. Certification Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart I — Marketing of Radio frequency devices:

§ 2.801 Radio-frequency device defined.

As used in this part, a radio-frequency device is any device which in its operation is capable of Emitting radio-frequency energy by radiation, conduction, or other means. Radio- frequency devices include, but are not limited to:

(a) The various types of radio communication transmitting devices described throughout this chapter.

(b) The incidental, unintentional and intentional radiators defined in Part 15 of this chapter.

(c) The industrial, scientific, and medical equipment described in Part 18 of this chapter.

(d) Any part or component thereof which in use emits radio-frequency energy by radiation, conduction, or other means.

§ 2.803 Marketing of radio frequency devices prior to equipment authorization.

(a) Except as provided elsewhere in this chapter, no person shall sell or lease, or offer for sale or lease (including advertising for sale or lease), or import, ship or distribute for the purpose of selling or leasing or offering for sale or lease, any radio frequency device unless:

(1) In the case of a device subject to certification, such device has been authorized by the Commission in accordance with the rules in this chapter and is properly identified and labeled as required by §2.925 and other relevant sections in this chapter; or

(2) In the case of a device that is not required to have a grant of equipment authorization issued by the Commission, but which must comply with the specified technical standards prior to use, such device also complies with all applicable administrative (including verification of the equipment or authorization under a Declaration of Conformity, where required), technical, labeling and identification requirements specified in this chapter.

(d) Notwithstanding the provisions of paragraph (a) of this section, the offer for sale solely to business, commercial, industrial, scientific or medical users (but not an offer for sale to other parties or to end users located in a residential environment) of a radio frequency device that is in the conceptual, developmental, design or pre-production stage is permitted prior to equipment authorization or, for devices not subject to the equipment authorization requirements, prior to a determination of compliance with the applicable technical requirements *provided* that the prospective buyer is advised in writing at the time of the offer for sale that the equipment is subject to the FCC rules and that the equipment will comply with the appropriate rules before delivery to the buyer or to centers of distribution.

(e)(1) Notwithstanding the provisions of paragraph (a) of this section, prior to equipment authorization or determination of compliance with the applicable technical requirements any radio frequency device may be operated, but not marketed, for the following purposes and under the following conditions:

(i) Compliance testing;

(ii) Demonstrations at a trade show provided the notice contained in paragraph (c) of this section is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iii) Demonstrations at an exhibition conducted at a business, commercial, industrial, scientific or medical location, but excluding locations in a residential environment, provided the notice contained in paragraphs (c) or (d) of this section, as appropriate, is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iv) Evaluation of product performance and determination of customer acceptability, provided such operation takes place at the manufacturer's facilities during developmental, design or pre-production states; or

(v) Evaluation of product performance and determination of customer acceptability where customer acceptability of a radio frequency device cannot be determined at the manufacturer's facilities because of size or unique capability of the device, provided the device is operated at a business, commercial, industrial, scientific or medical user's site, but not at a residential site, during the development, design or pre-production stages.

(e)(2) For the purpose of paragraphs (e)(1)(iv) and (e)(1)(v) of this section, the term *manufacturer's facilities* includes the facilities of the party responsible for compliance with the regulations and the manufacturer's premises, as well as the facilities of other entities working under the authorization of the responsible party in connection with the development and manufacture, but not the marketing, of the equipment.

(f) For radio frequency devices subject to verification and sold solely to business, commercial, industrial, scientific and medical users (excluding products sold to other parties or for operation in a residential environment), parties responsible for verification of the devices shall have the option of ensuring compliance with the applicable technical specifications of this chapter at each end user's location after installation, provided that the purchase or lease agreement includes a proviso that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.

Certification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart J — Equipment Authorization Procedures:

§ 2.901 Basis and Purpose

(a) In order to carry out its responsibilities under the Communications Act and the various treaties and international regulations, and in order to promote efficient use of the radio spectrum, the Commission has developed technical standards for radio frequency equipment and parts or components thereof. The technical standards applicable to individual types of equipment are found in that part of the rules governing the service wherein the equipment is to be operated.[1] *In addition to the technical standards provided, the rules governing the service may require that such equipment be verified by the manufacturer or importer*, be authorized under a Declaration of Conformity, or receive an equipment authorization from the Commission by one of the following procedures: certification or registration.

(b) The following sections describe the verification procedure, the procedure for a Declaration of Conformity, and the procedures to be followed in obtaining certification from the Commission and the conditions attendant to such a grant.

§ 2.907 Certification.

(a) Certification is an equipment authorization issued by the Commission, based on representation and test data submitted by the applicant.

(b) Certification attaches to all units subsequently marketed by the grantee which are identical (see Section 2.908) to the sample tested except for permissive changes or other variations authorized by the Commission pursuant to Section 2.1043.

[1] In this case, the equipment is subject to the rules of Part 15. More specifically, the equipment falls under Subpart B (of Part 15), which deals with unintentional radiators.

Certification & User's Manual Information

§ 2.948 Description of measurement facilities.

(a) Each party making measurements of equipment that is subject to an equipment authorization under Part 15 or Part 18 of this chapter, regardless of whether the measurements are filed with the Commission or kept on file by the party responsible for compliance of equipment marketed within the U.S. or its possessions, shall compile a description of the measurement facilities employed.

(1) If the measured equipment is subject to the verification procedure, the description of the measurement facilities shall be retained by the party responsible for verification of the equipment.

(i) If the equipment is verified through measurements performed by an independent laboratory, it is acceptable for the party responsible for verification of the equipment to rely upon the description of the measurement facilities retained by or placed on file with the Commission by that laboratory. In this situation, the party responsible for the verification of the equipment is not required to retain a duplicate copy of the description of the measurement facilities.

(ii) If the equipment is verified based on measurements performed at the installation site of the equipment, no specific site calibration data is required. It is acceptable to retain the description of the measurement facilities at the site at which the measurements were performed.

(2) If the equipment is to be authorized by the Commission under the certification procedure, the description of the measurement facilities shall be filed with the Commission's Laboratory in Columbia, Maryland. The data describing the measurement facilities need only be filed once but must be updated as changes are made to the measurement facilities or as otherwise described in this section. At least every three years, the organization responsible for filing the data with the Commission shall certify that the data on file is current.

Certification & User's Manual Information

Label and User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart A — General:

§ 15.19 Labeling requirements.

(a) In addition to the requirements in Part 2 of this chapter, a device subject to certification or verification shall be labeled as follows:

(1) Receivers associated with the operation of a licensed radio service, e.g., FM broadcast under Part 73 of this chapter, land mobile operation under Part 90, etc., shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

(2) A stand-alone cable input selector switch, shall bear the following statement in a conspicuous location on the device:

This device is verified to comply with Part 15 of the FCC Rules for use with cable television service.

(3) All other devices shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

(4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified under paragraph (a) of this section is required to be affixed only to the main control unit.

(5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

§ 15.21 Information to user.

The users manual or instruction manual for an intentional or unintentional 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.

Verification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart B — Unintentional Radiators:

§ 15.105 Information to the user.

(a) For a Class A digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at own expense.

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

– Reorient or relocate the receiving antenna.

– Increase the separation between the equipment and receiver.

– Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

– Consult the dealer or an experienced radio/TV technician for help.

End of Report

