



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

914 WEST PATAPSCO AVENUE • BALTIMORE, MARYLAND 21230-3432 • PHONE (410) 354-3300 • FAX (410) 354-3313

33439 WESTERN AVENUE • UNION CITY, CALIFORNIA 94587 • PHONE (510) 489-6300 • FAX (510) 489-6372

3162 BELICK STREET • SANTA CLARA, CALIFORNIA 95054 • PHONE (408) 748-3585 • FAX (510) 489-6372

August 5, 2009

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., Telo as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Part 15, Subpart B for a Class B Digital Device and Subpart D 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.\EMCS81645-FCC15D)

Certificates and reports shall not be reproduced except in full, without the written permission of MET Laboratories, Inc.

Electromagnetic Compatibility Criteria Test Report

for the

**Ooma, Inc.
Model Telo**

Tested under

the FCC Rules contained in
Title 47 of the CFR, Part 15. Subpart B
for Unintentional Radiators
Title 47 of the CFR, Part 15. Subpart D
for Intentional Radiators

MET Report: EMCS81645-FCC15D

August 5, 2009

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 Test Report

for the

**Ooma, Inc.
Model Telo**

Tested Under

the FCC Certification Rules contained in
Title 47 of the CFR, Part 15. Subpart B
for Unintentional Radiators
Title 47 of the CFR, Part 15. Subpart D
for Intentional Radiators



Anderson Soungpanya, 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 under normal use and maintenance.



Shawn McMillen
Wireless Manager, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
Ø	August 5, 2009	Initial Issue.

Table of Contents

I.	Executive Summary	1
	A. Purpose of Test	2
	B. Executive Summary	2
II.	Equipment Configuration	3
	A. Overview.....	4
	B. References.....	5
	C. Test Site	5
	D. Description of Test Sample.....	5
	E. Equipment Configuration.....	8
	F. Support Equipment	8
	G. Ports and Cabling Information.....	9
	H. Mode of Operation.....	9
	I. Modifications	9
	a) Modifications to EUT.....	9
	b) Modifications to Test Standard.....	9
	J. Disposition of EUT	9
III.	Electromagnetic Compatibility Criteria for Unintentional Radiators	10
	§ 15.107(a) Conducted Emissions Limits.....	11
	§ 15.109(a) Radiated Emissions Limits.....	19
IV.	Electromagnetic Compatibility Criteria for Intentional Radiators.....	28
	§ 15.207(a) Conducted Emissions Limits.....	29
	§ 15.209(a) Radiated Emissions Limits.....	37
	§ 15.303(c) Emission Bandwidth	42
	§ 15.203 Antenna Requirement	45
	§ 15.319 Use of Digital Modulation	46
	§ 15.319(c) Peak Transmit Output	47
	§ 15.319(d) Power Spectral Density.....	50
	§ 15.319(e) Power Adjustment for Antenna Gain	52
	§ 15.319(f) Automatically Discontinue Transmission	53
	§ 15.323(d)(1) Spurious Emissions	55
	§ 15.323(c)(1) Monitoring Time	59
	§ 15.323(c)(2) Monitoring Threshold	60
	§ 15.323(c)(3) Maximum Transmit Time	61
	§ 15.323(c)(4) System Acknowledgment	62
	§ 15.323(c)(5) Least Interfered Channel	63
	§ 15.323(c)(5) Least Interfered Channel	64
	§ 15.323(c)(5) Power Measurement Resolution	65
	§ 15.323(c)(5) Segment Occupancy	66
	§ 15.323(c)(6) Random Waiting	67
	§ 15.323(c)(7) Monitoring Bandwidth	68
	§ 15.323(c)(7) Monitoring Reaction Time	69
	§ 15.323(c)(8) Monitoring Antenna	70
	§ 15.323(c)(9) Monitoring Threshold Relaxation	71
	§ 15.323(c)(10) Duplex System LBT	72
	§ 15.323(c)(11) Alternate Monitoring Channel	73
	§ 15.323(c)(12) Fair Access	74
	§ 15.323(e) Frame Period	75
	§ 15.323(f) Frequency Stability	76
V.	Test Equipment	78

VI. Certification & User's Manual Information.....	80
A. Certification Information	81
B. Label and User's Manual Information	85

List of Tables

Table 1. Executive Summary of EMC Part 15 Subpart D Compliance Testing.....	2
Table 2. Equipment Configuration.....	8
Table 3. Support Equipment.....	8
Table 4. Ports and Cabling Information	9
Table 5. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Section 15.107(a) (b).....	11
Table 6. Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz), Fairway - WRG10F-050A.....	12
Table 7. Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz), Fairway - WRG10F-050A	13
Table 8. Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz), Ooma - ITE HK-R110-A05.....	14
Table 9. Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz), Ooma - ITE HK-R110-A05	15
Table 10. Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz), Ooma - PSC11A-050.....	16
Table 11. Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz), Ooma - PSC11A-050.....	17
Table 12. Radiated Emissions Limits calculated from FCC Part 15, §15.109 (a) (b)	19
Table 13. Radiated Emissions Limits Test Results, Fairway-WRG10F-050A.....	20
Table 14. Radiated Emissions Limits Test Results, Ooma - ITE HK-R110-A05	22
Table 15. Radiated Emissions Limits Test Results, Ooma PSC11A-050.....	24
Table 16. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)	29
Table 17. Conducted Emissions, §15.207, Phase Line, Test Results, Fairway - WRG10F-050A	30
Table 18. Conducted Emissions, §15.207, Neutral Line, Test Results, Fairway - WRG10F-050A	31
Table 19. Conducted Emissions, §15.207, Phase Line, Test Results, Ooma - ITE HK-R110-A05	32
Table 20. Conducted Emissions, §15.207, Neutral Line, Test Results, Ooma - ITE HK-R110-A05	33
Table 21. Conducted Emissions, §15.207, Phase Line, Test Results, Ooma - PSC11A-050	34
Table 22. Conducted Emissions, §15.207, Neutral Line, Test Results, Ooma - PSC11A-050	35
Table 23. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)	37
Table 24. Radiated Harmonic Emissions, Test Results.....	38
Table 25. Occupied Bandwidth, Test Results.....	42
Table 26. Peak Transmit Power, Test Results	47
Table 27. Power Spectral Density, Test Results.....	50
Table 28. Automatic Discontinuance of Transmission, Test Results	53
Table 29. Least Interfered Channel, Test Results.....	63
Table 30. Frame Period, Test Results.....	75
Table 31. Frequency Stability, Test Results	77

List of Figures

Figure 1. Block Diagram of Test Configuration, FCC Part 15B	6
Figure 2. Block Diagram of Test Configuration, FCC Part 15D	7
Figure 3. Monitoring Bandwidth.....	68

List of Photographs

Photograph 1. Conducted Emissions, Test Setup	18
Photograph 2. Radiated Emission, Test Setup.....	26
Photograph 3. Radiated Emission, Test Setup, Back View.....	26
Photograph 4. Radiated Emission, Test Setup, Bilog.....	27
Photograph 5. Radiated Emission, Test Setup, Horn.....	27
Photograph 6. Conducted Emissions, §15.207, Test Setup	36
Photograph 7. Radiated Harmonic Emissions, Test Setup	41
Photograph 8. Radiated Harmonic Emissions, Horn	41

List of Terms and Abbreviations

AC	Alternating Current
ACF	Antenna Correction Factor
Cal	Calibration
<i>d</i>	Measurement Distance
dB	Decibels
dB_μA	Decibels above one microamp
dB_μV	Decibels above one microvolt
dB_μA/m	Decibels above one microamp per meter
dB_μV/m	Decibels above one microvolt per meter
DC	Direct Current μ
E	Electric Field
DSL	Digital Subscriber Line
ESD	Electrostatic Discharge
EUT	Equipment Under Test
<i>f</i>	Frequency
FCC	Federal Communications Commission
GRP	Ground Reference Plane
H	Magnetic Field
HCP	Horizontal Coupling Plane
Hz	Hertz
IEC	International Electrotechnical Commission
kHz	kilohertz
kPa	kilopascal
kV	kilovolt
LISN	Line Impedance Stabilization Network
MHz	Megahertz
μH	microhenry
μ	microfarad
μ s	microseconds
NEBS	Network Equipment-Building System
PRF	Pulse Repetition Frequency
RF	Radio Frequency
RMS	Root-Mean-Square
TWT	Traveling Wave Tube
V/m	Volts per meter
VCP	Vertical Coupling Plane

I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Ooma, Inc. Telo, 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 Telo. 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 Telo, 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 1694. All tests were conducted using measurement procedure ANSI C63.4-2003.

Requirement	FCC Part	Test Procedure (Section numbers refer to ANSI C63.17 unless otherwise noted)	Result
Emission Bandwidth	15.303(c) & 15.323 (a)	6.1.3	Compliant
Labeling Requirements	15.311 & 15.19(a)(3)		Compliant
Conducted Emissions	15.315 & 15.207	ANSI C63.4	Compliant
Antenna Requirements	15.317 & 15.203	Declaration	Compliant
Use digital modulation	15.319 (b)	6.1.4	Compliant
Peak transmit power	15.303(f) & 15.319 (c)	6.1.2	Compliant
Power spectral density	15.319 (d) & 15.107	6.1.5	Compliant
Power adjustment for antenna gain	15.319 (e)	4.3.1	Compliant
Automatically discontinue transmission	15.319 (f)		Compliant
Spurious emissions conducted	15.319 (g) & 15.209	6.1.6	Compliant
RF Exposure	15.319 (i) & 1.1307(b), 2.1091 and 2.1093	ANSI/IEEE C95.1	Compliant
Listen before talk	15.323 (c)	7	Compliant
Monitoring time	15.323 (c)(1)	7.3.4	Compliant
Monitoring threshold	15.323 (c)(2)	7.3	Compliant
Maximum transmit time	15.323 (c)(3)	8.2.2	Compliant
System acknowledgement	15.323 (c)(4)	8.1.1 & 8.1.2	Compliant
Least Interfered	15.323 (c)(5.1)	7.3.2 & 7.3.3	Compliant
Channel confirmation	15.323 (c)(5.2)	7.3.3 & 7.3.4	Compliant
Power measurement resolution	15.323 (c)(5.3)	7.3.3	Compliant
Segment occupancy	15.323 (c)(5.4)	Declaration	Compliant
Random waiting	15.323 (c)(6)	8.1.3	Compliant
Monitoring bandwidth	15.323 (c)(7.1)	7.4	Compliant
Monitoring reaction time	15.323 (c)(7.2))	7.5	Compliant
Monitoring antenna	15.323 (c)(8)	4	Compliant
Monitoring threshold relaxation	15.323 (c)(9)	4	Not Applicable
Duplex system LBT	15.323 (c)(10)	8.3	Compliant
Alternate monitoring interval	15.323 (c)(11)	8.4	Compliant
Fair access	15.323 (c)(12)	Declaration	Compliant
Frame period	15.323 (e)	6.2.2 & 6.2.3	Compliant
Frequency stability	15.323 (f)	6.2.1	Compliant
Radiated Out of Band Emissions	15.309 (b) & FCC Part 15 Subpart B, 15.109 and 15.209		Compliant

Table 1. Executive Summary of EMC Part 15 Subpart D Compliance Testing

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Ooma, Inc. to perform testing on the Telo, under Ooma, Inc.'s purchase order number 1694.

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., Telo.

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

Model(s) Tested:	Telo
Model(s) Covered:	Telo
EUT Specifications:	Primary Power: 120 VAC, 60 Hz
	FCC ID: XFT-TELO101
	Operating Mode: DECT Base Station
	Type of Modulations: GFSK
	Emission Designators: 1M66Q1E
	Equipment Code: PUB
	Peak RF Output Power:
	Low: 19.78 dB
	Mid: 19.74 dB
	High: 19.69 dB
	EUT Frequency Ranges: 1921.536-1928.448MHz
	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: 15-35° C
	Relative Humidity: 30-60%
	Barometric Pressure: 860-1060 mbar
Evaluated by:	Anderson Soungpanya
Report Date(s):	August 5, 2009

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
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
ANSI/NCSL Z540-1-1994	Calibration Laboratories and Measuring and Test Equipment - General Requirements
ANSI/ISO/IEC 17025:2000	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

The Ooma, Inc. Telo, is a VOIP router with DECT radio and PSTN interface.

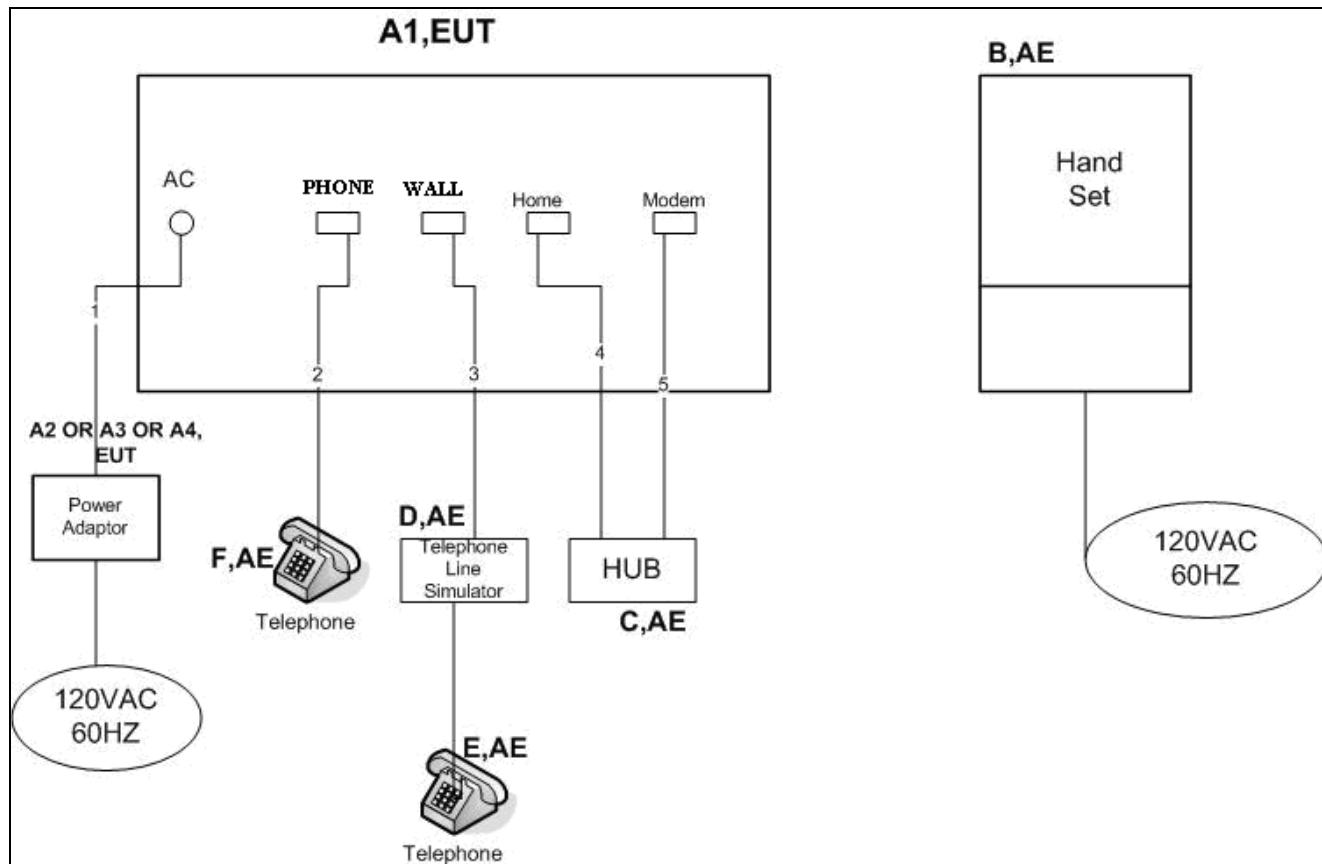


Figure 1. Block Diagram of Test Configuration, FCC Part 15B

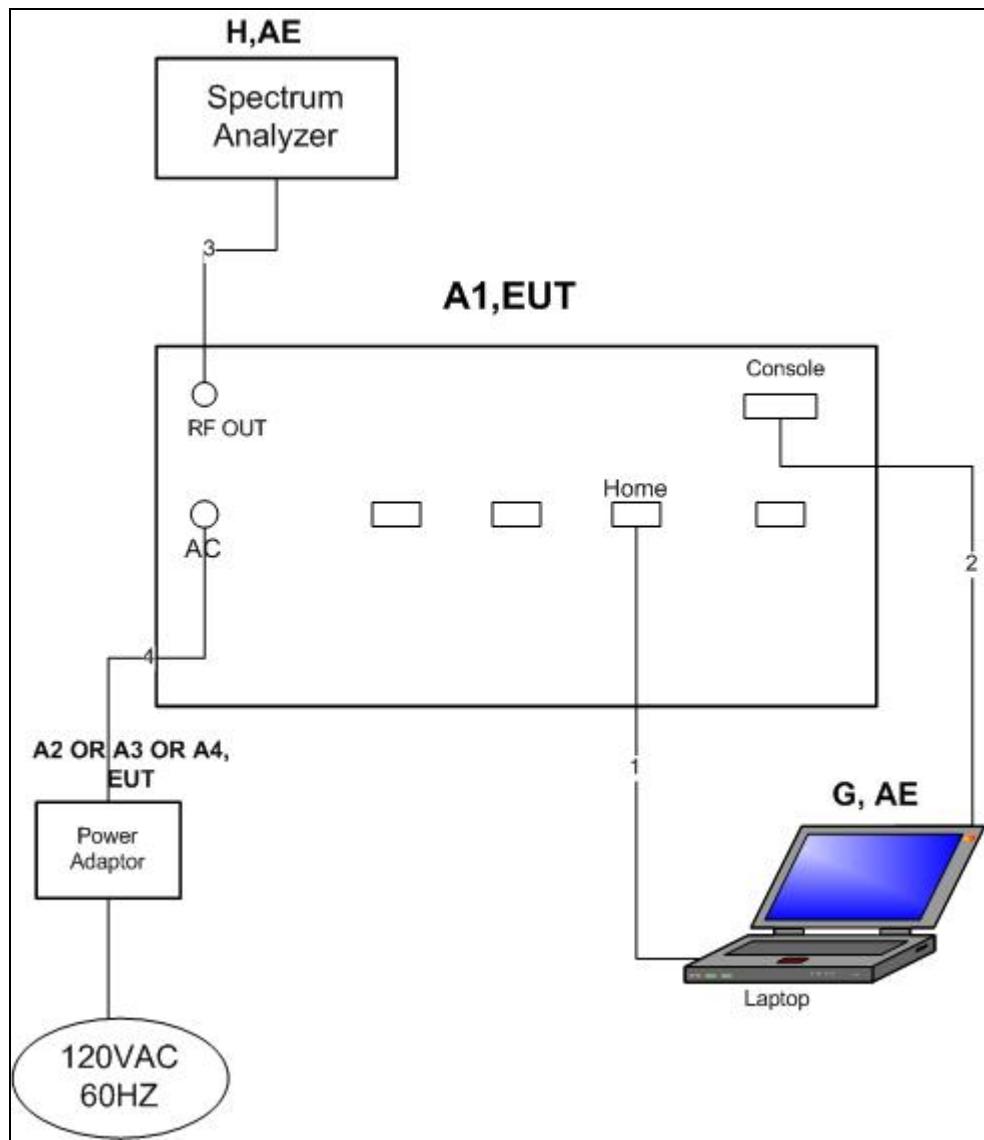


Figure 2. Block Diagram of Test Configuration, FCC Part 15D

E. Equipment Configuration

The EUT was set up as outlined in Figure 1 and Figure 2, 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
A1	TELO	OOMA TELO	NA	0018610200B0
A2	POWER ADAPTORS	OOMA/PHIHONG	160-0105-100/PSC12A-050	P73900965A1
A3	POWER ADAPTORS	FAIRWAY	WRG10F-050A	7516-21-J81645
A4	POWER ADAPTORS	I.T.E	HK-R110-A05	7516-5-J-81645

Table 2. Equipment Configuration

F. Support Equipment

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

Ref. ID	Name / Description	Manufacturer	Model Number	*Customer Supplied Calibration Data
B	DECT HANDSET	BAYCOM	7553-1-781645	NA
C	HUB	NETGEAR	DS104	NA
D	TELEPHONE LINE SIMULATOR	TELTON	TLS-5	NA
E	TELEPHONE	SAKAR	GXATE23DHT-2608	NA
F	TELEPHONE	AT&T	210	NA
G	LAPTOP	DELL	630M	NA
H	SPECTRUM ANALYZER	AGILENT	E4407/E4447	NA
I	CMD60 DECT	RHODE AND SCHWARZ	CMD60	NA

Table 3. Support Equipment

* The 'Customer Supplied Calibration Data' column will be marked as either not applicable, not available, or will contain the calibration date supplied by the customer.

G. Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty.	Length (m)	Shielded (Y/N)	Termination Box ID & Port Name
FCC Part 15B						
1	A1,AC	POWER CORD	1	1	N	A2 OR A3 OR A4 EUT
2	A1, PHONE	RJ11	1	0.2	N	F,AE
3	A1, WALL	RJ11	1	3	N	D,AE
4	A1,HOME	RJ45	1	3	N	C,AE
5	A1,MODEM	RJ45	1	3	N	C,AE
FCC Part 15D						
1	A1,HOME	RJ45	1	1	N	G, LAPTOP
2	A1, CONSOLE	SERIAL/USB CABLES	1	0.5	Y	G, LAPTOP
3	A1,RF OUT	COAXIAL CABLE	1	2	N	H, SPECTRUM ANALYZER
4	A1,AC	POWER CORD	1	1	N	A2 OR A3 OR A4 EUT

Table 4. Ports and Cabling Information

H. Mode of Operation

1. Continuous transmit mode on given frequency.
2. TBR6 test mode (DECT Spec).
3. Limit Frequency to 2 channels.

I. Modifications

a) Modifications to EUT

b) Modifications to Test 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 5. 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 5. 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 (dB μ V)		15.107(a), Class B Limits (dB μ V)	
	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 5. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Section 15.107(a) (b)

Test Procedures:

The EUT was placed on a 0.8m-high wooden table inside a semi-anechoic chamber. The method of testing, test conditions, and test procedures of ANSI C63.4 were used. The EUT was powered through a $50\Omega/50\mu$ H 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 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):

Anderson Soungpanya

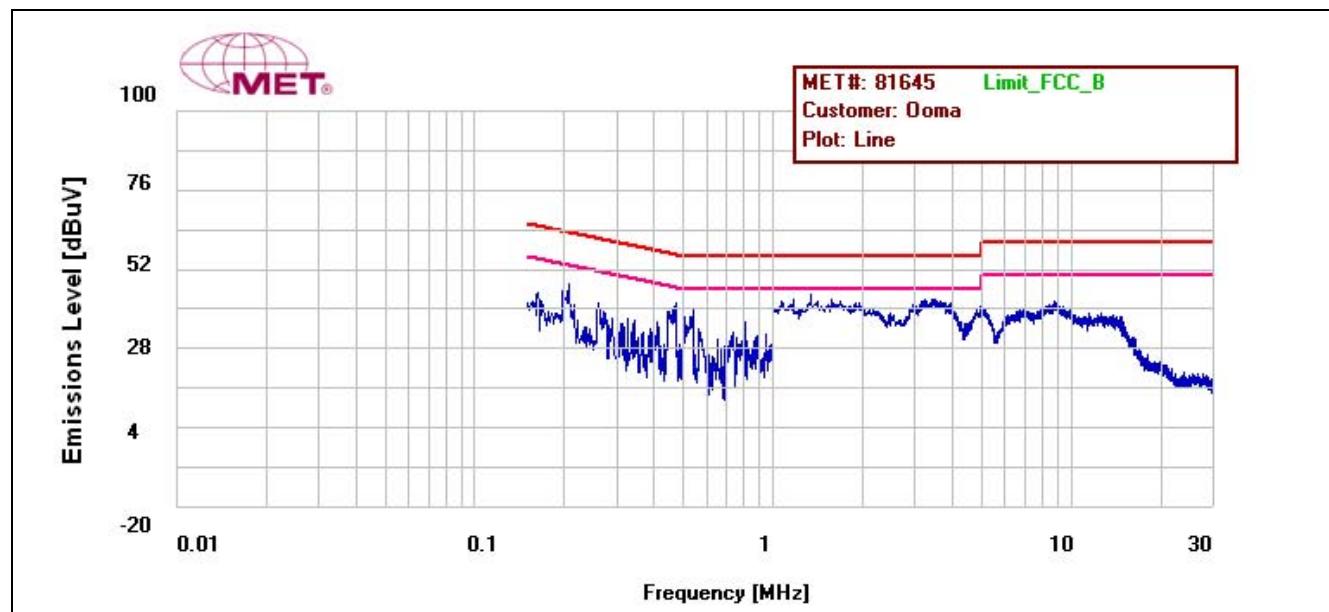
Test Date(s):

07/01/09

Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz)

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Line	1.70	37.01	56	-18.99	Pass	22.74	46	-23.26	Pass
Line	3.38	37.57	56	-18.43	Pass	25.12	46	-20.88	Pass
Line	.456	44.94	56.787	-11.847	Pass	33.36	46.787	-13.427	Pass

Table 6. Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz), Fairway - WRG10F-050A

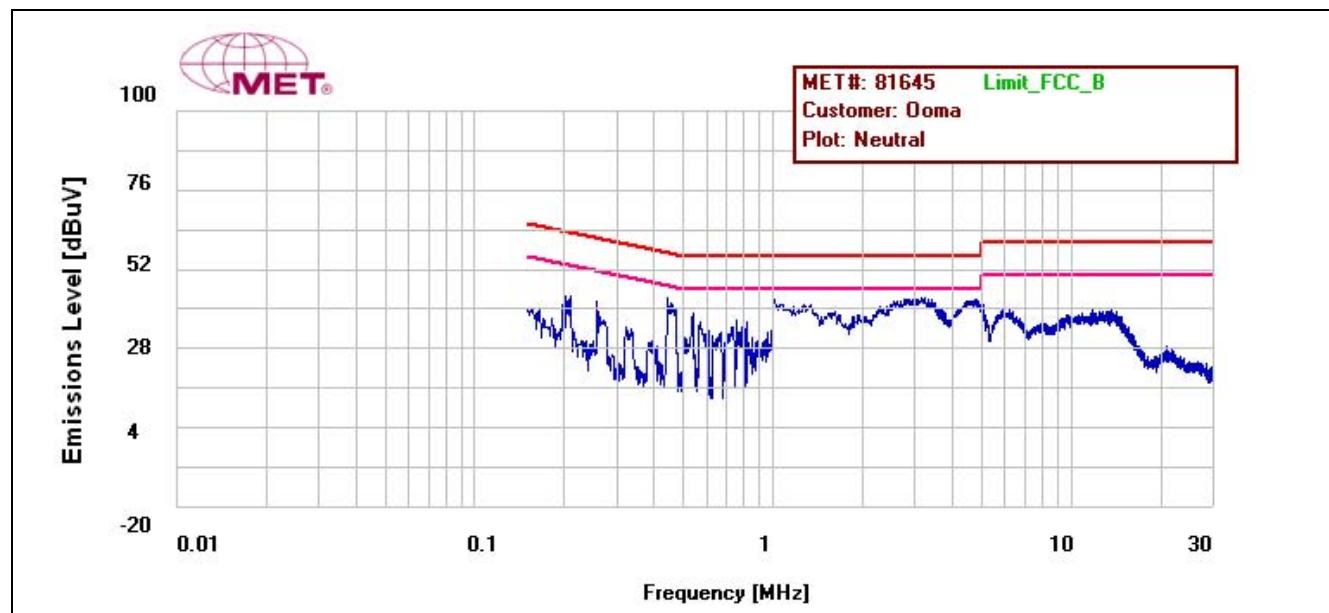


Plot 1. Conducted Emission, Phase Line Plot, Fairway - WRG10F-050A

Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz)

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Neutral	1.00	40.98	56	-15.02	Pass	25.06	46	-20.94	Pass
Neutral	.467	47.36	56.583	-9.223	Pass	31.14	46.583	-15.443	Pass
Neutral	2.95	40.04	56	-15.96	Pass	25.12	46	-20.88	Pass

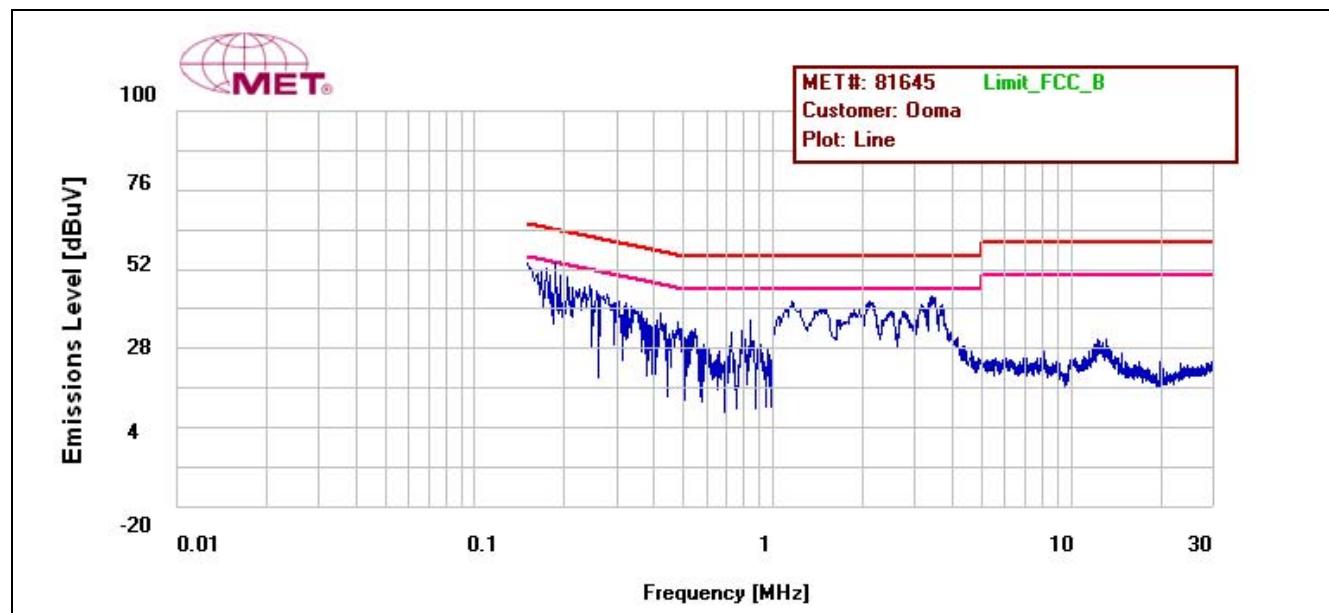
Table 7. Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz), Fairway - WRG10F-050A



Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz)

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Line	.178	59.28	64.582	-5.302	Pass	32.98	54.582	-21.602	Pass
Line	1.17	36.33	56	-19.67	Pass	28.59	46	-17.41	Pass
Line	3.26	32.31	56	-23.69	Pass	26.74	46	-19.26	Pass

Table 8. Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz), Ooma - ITE HK-R110-A05

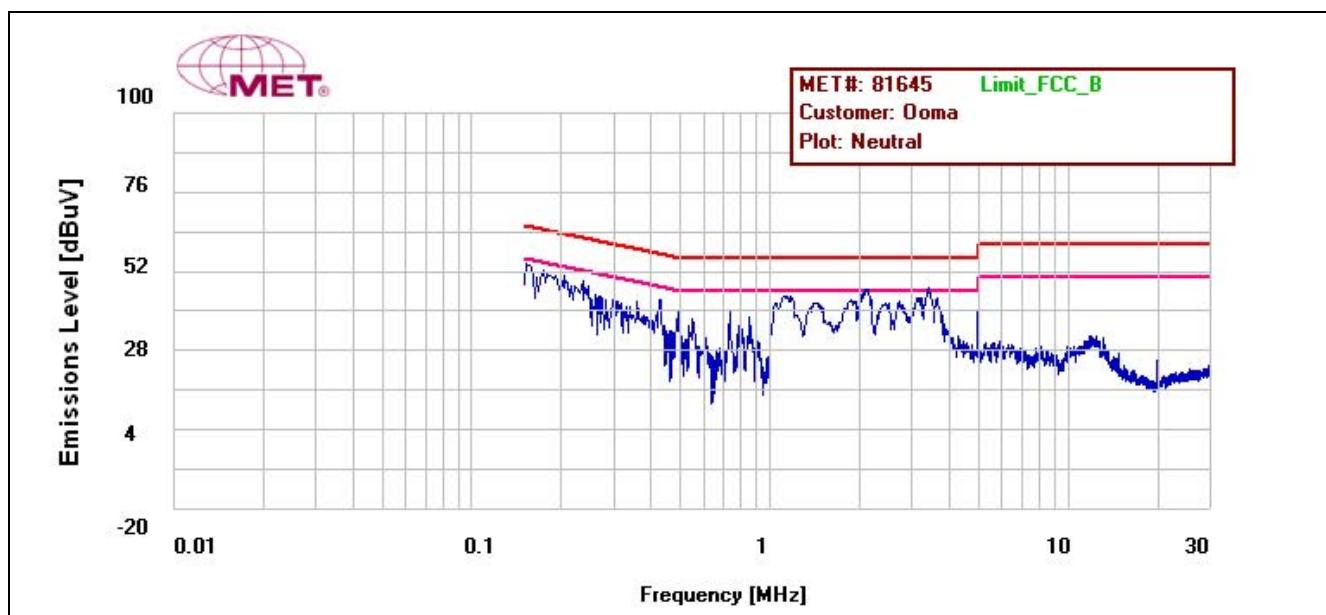


Plot 3. Conducted Emission, Phase Line Plot, Ooma - ITE HK-R110-A05

Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz)

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Neutral	2.07	43.93	56	-12.07	Pass	30.71	46	-15.29	Pass
Neutral	3.66	34.44	56	-21.56	Pass	23.15	46	-22.85	Pass
Neutral	4.42	30.31	56	-25.69	Pass	20.47	46	-25.53	Pass
Neutral	.159	60.57	65.517	-4.947	Pass	30.88	55.517	-24.637	Pass

Table 9. Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz), Ooma - ITE HK-R110-A05

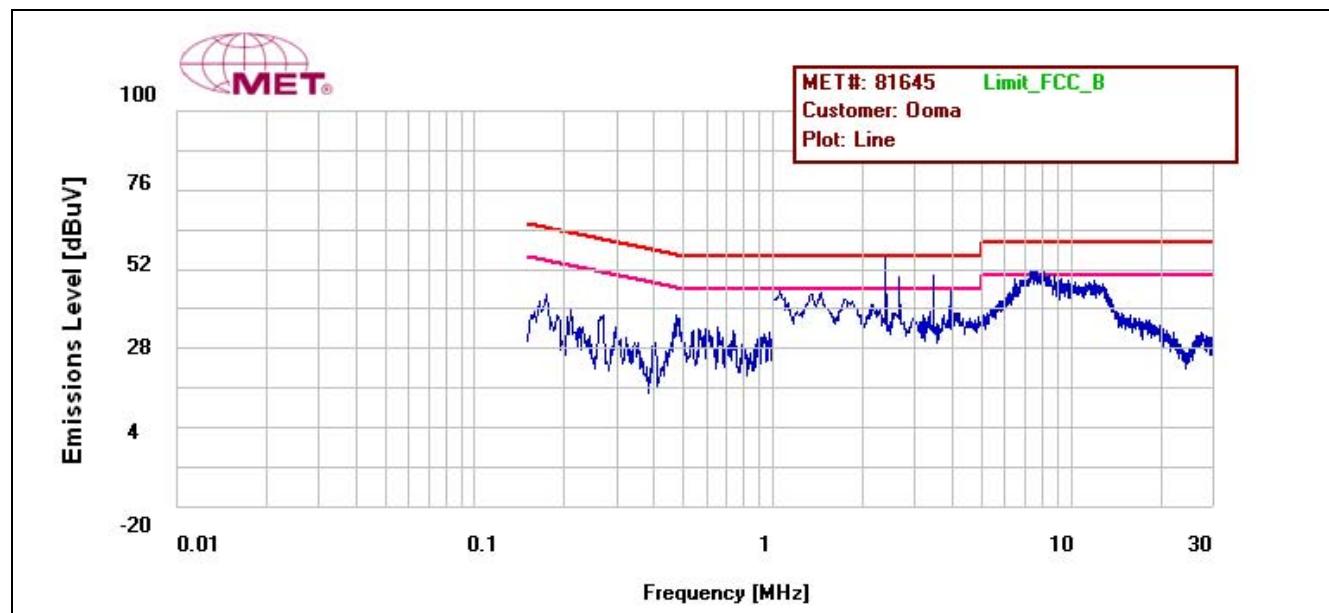


Plot 4. Conducted Emission, Neutral Line Plot, Ooma - ITE HK-R110-A05

Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz)

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Line	2.15	35.15	56	-20.85	Pass	24.14	46	-21.86	Pass
Line	3.93	40.98	56	-15.02	Pass	22.7	46	-23.3	Pass
Line	7.60	44.69	60	-15.31	Pass	34.72	50	-15.28	Pass

Table 10. Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz), Ooma - PSC11A-050

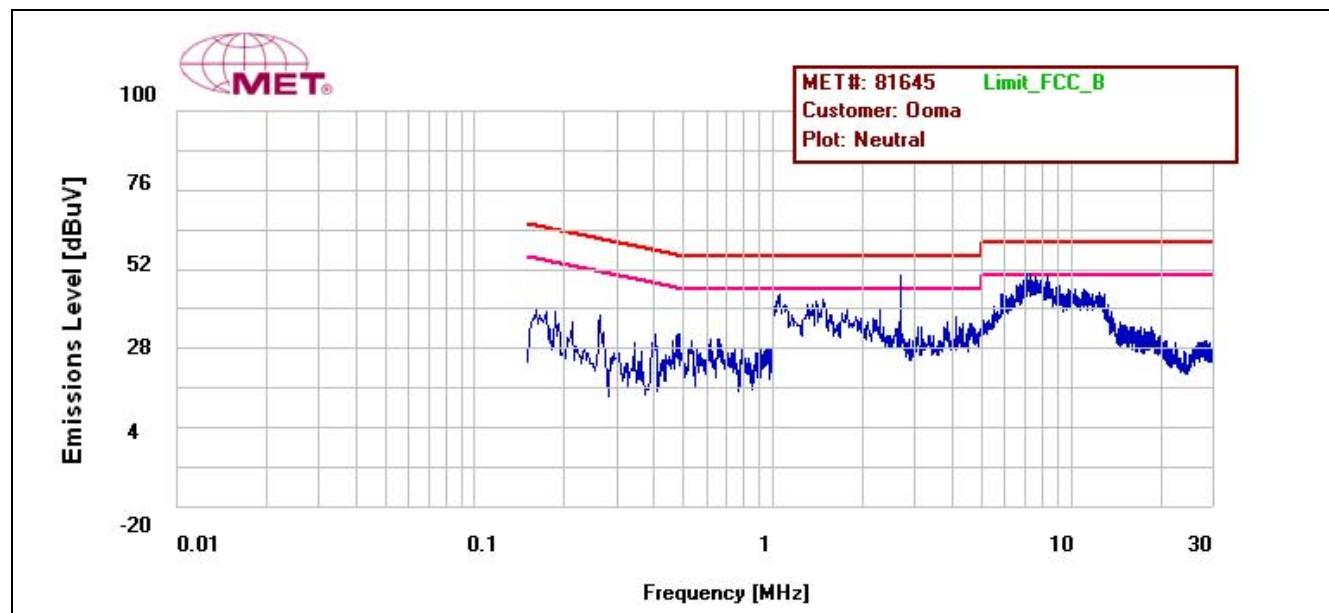


Plot 5. Conducted Emission, Phase Line Plot, Ooma - PSC11A-050

Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz)

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Neutral	1.04	37.22	56	-18.78	Pass	24.98	46	-21.02	Pass
Neutral	7.49	40.24	60	-19.76	Pass	31.05	50	-18.95	Pass
Neutral	8.30	38.62	60	-21.38	Pass	29.09	50	-20.91	Pass

Table 11. Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz), Ooma - PSC11A-050



Plot 6. Conducted Emission, Neutral Line Plot, Ooma - PSC11A-050

Conducted Emission Limits Test Setup



Photograph 1. Conducted Emissions, Test Setup

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 12.

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 12.

Frequency (MHz)	Field Strength (dB μ V/m)	
	§15.109 (b), Class A Limit (dB μ V) @ 10m	§15.109 (a), Class B Limit (dB μ V) @ 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 12. Radiated Emissions Limits calculated from FCC Part 15, §15.109 (a) (b)

Test Procedures:

The EUT was placed on a 0.8m-high wooden table inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.4 were used. An antenna was located 3m from the EUT. A pre-scan was first performed in order to find prominent radiated emissions. For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied between 1 m and 4 m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. Unless otherwise specified, measurements were made using a quasi-peak detector with a 120 kHz 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):

Anderson Soungpanya

Test Date(s):

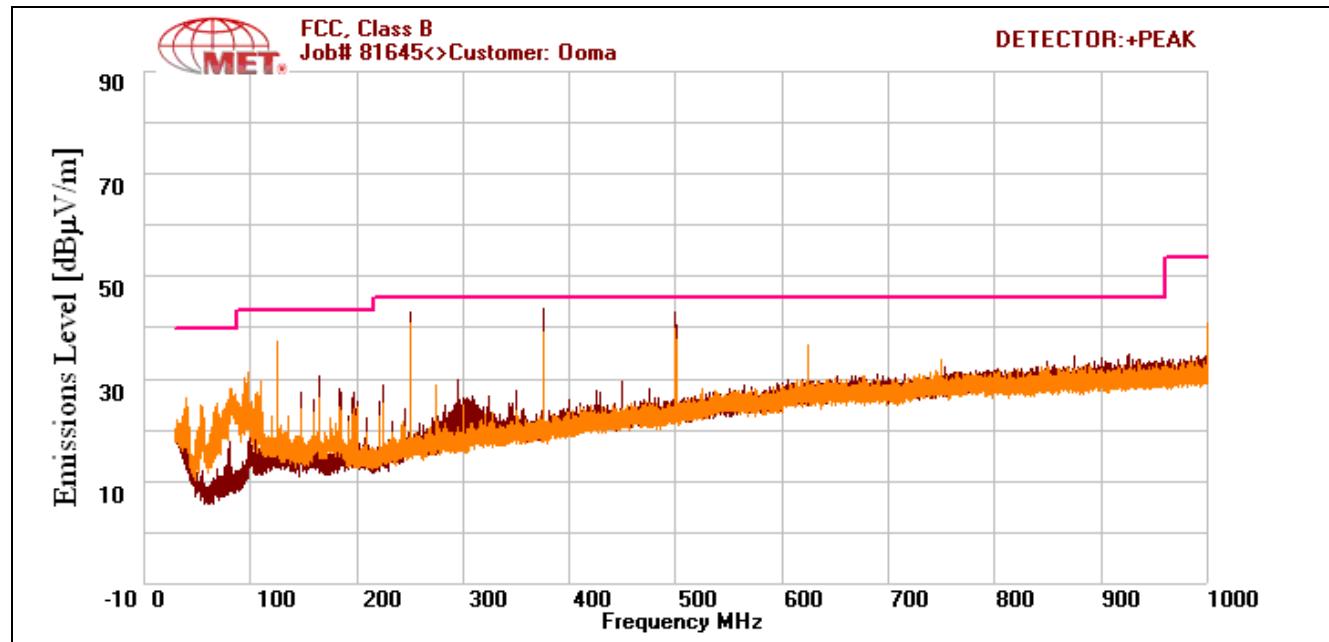
07/03/09

Radiated Emissions Limits Test Results, Class B

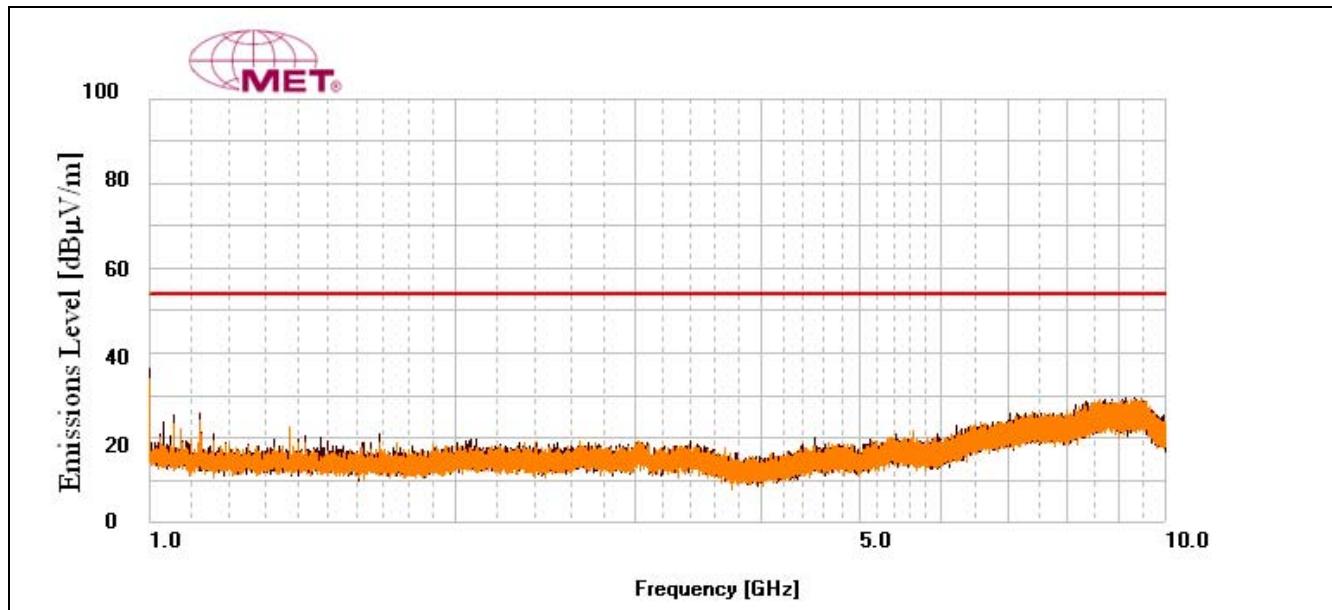
Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
*375	H	22.45	120	23.87	15.6	0	4.92	0	44.39	46	-1.61
*500	H	34	100	21.05	18	0	5.74	0	44.79	46	-1.21
125	V	10	100	22.35	13.3	0	2.775	0	38.425	43.5	-5.075
*250	V	35	100	27.79	12.7	0	3.99	0	44.48	46	-1.52
*250	H	76	162	28.04	12.9	0	3.99	0	44.93	46	-1.07
500	V	40	100	19.65	17.6	0	5.74	0	42.99	46	-3.01
375	V	20	100	18.35	15.6	0	4.92	0	38.87	46	-7.13
1000	H	200	100	70.12	-3.05	30	1.9	0	38.97	54	-15.03
1219	H	270	100	58.25	-2.524	30	2.207	0	27.933	54	-26.067

Table 13. Radiated Emissions Limits Test Results, Fairway-WRG10F-050A

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.



Plot 7. Radiated Emissions Pre-Scan, Fairway-WRG10F-050A, 30 MHz – 1 GHz



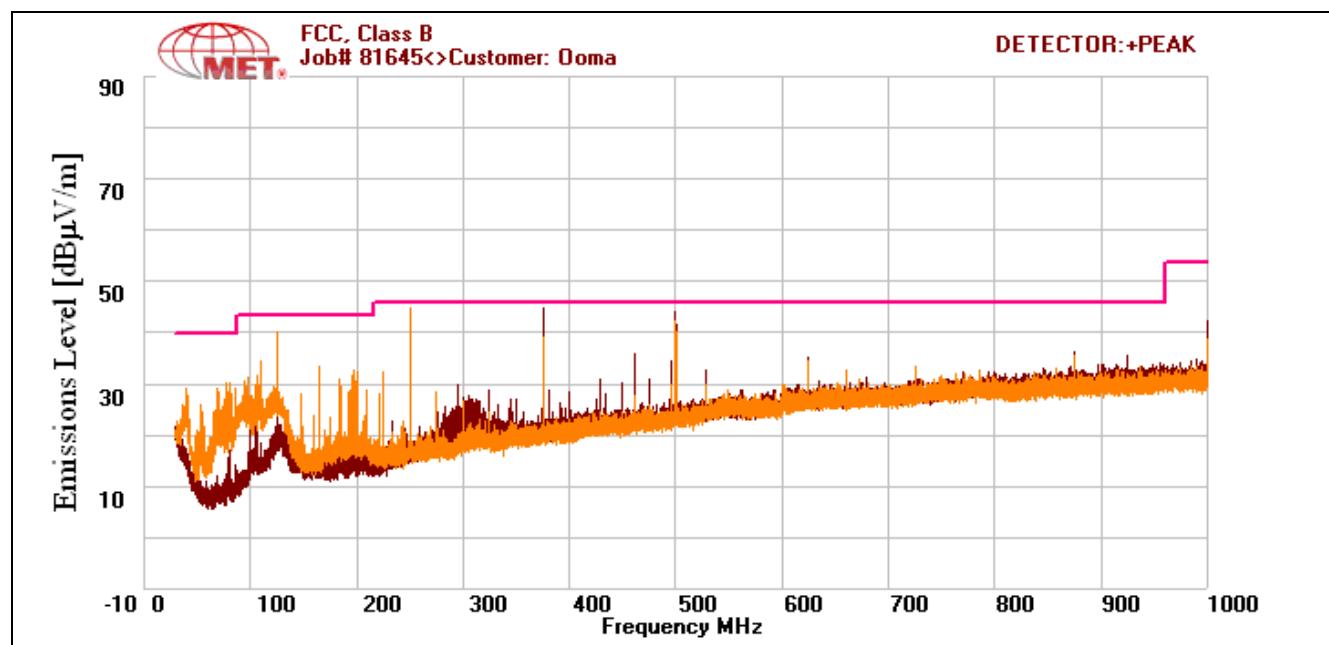
Plot 8. Radiated Emissions Pre-Scan, Fairway-WRG10F-050A, 1 GHz – 10 GHz

Radiated Emissions Limits Test Results, Class B

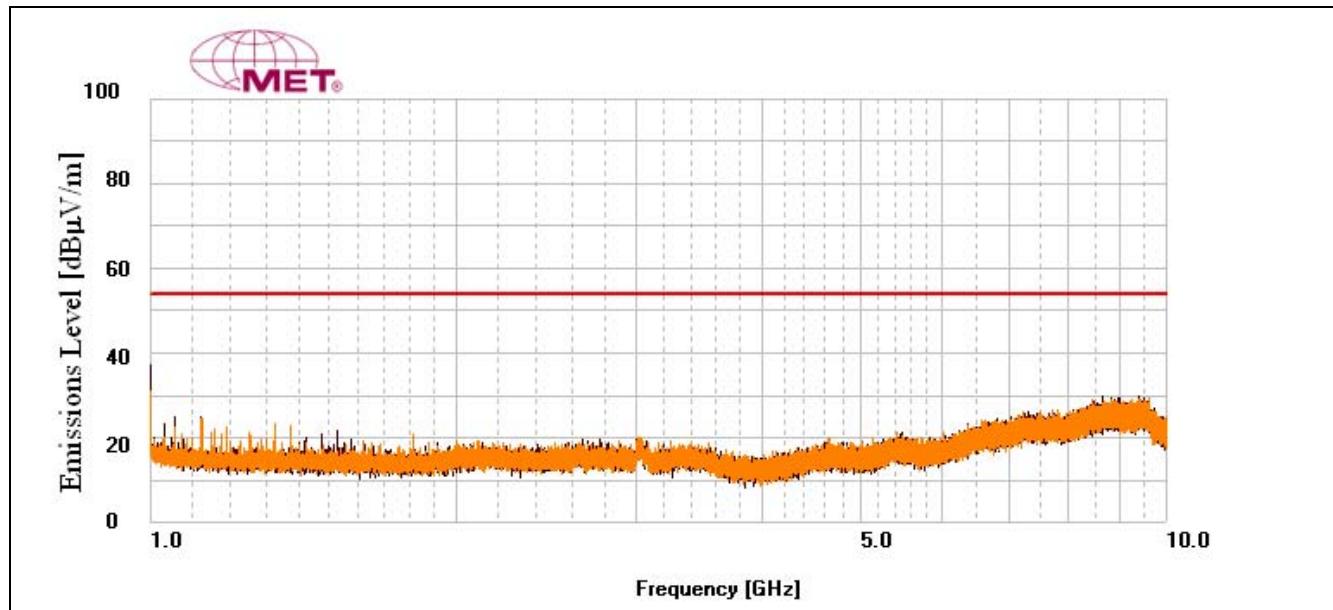
Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
*375	H	67	100	24.6	15.6	0	4.92	0	45.12	46	-0.88
*500	H	125	100	21.97	18	0	5.74	0	45.71	46	-0.29
*250	H	258	165	26.97	12.9	0	3.99	0	43.86	46	-2.14
*250	V	250	100	28.79	12.7	0	3.99	0	45.48	46	-0.52
*125	V	60	100	25.21	13.3	0	2.775	0	41.285	43.5	-2.215
500	V	153	100	18.97	17.6	0	5.74	0	42.31	46	-3.69
375	V	328	155	20.01	15.6	0	4.92	0	40.53	46	-5.47
1000	H	235	100	68.5	-3.05	30	1.9	0	37.35	54	-16.65
1125	H	205	140	53.65	-2.749	30	2.075	0	22.976	54	-31.024

Table 14. Radiated Emissions Limits Test Results, Ooma - ITE HK-R110-A05

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.



Plot 9. Radiated Emissions Pre-Scan, Ooma - ITE HK-R110-A05, 30 MHz – 1 GHz



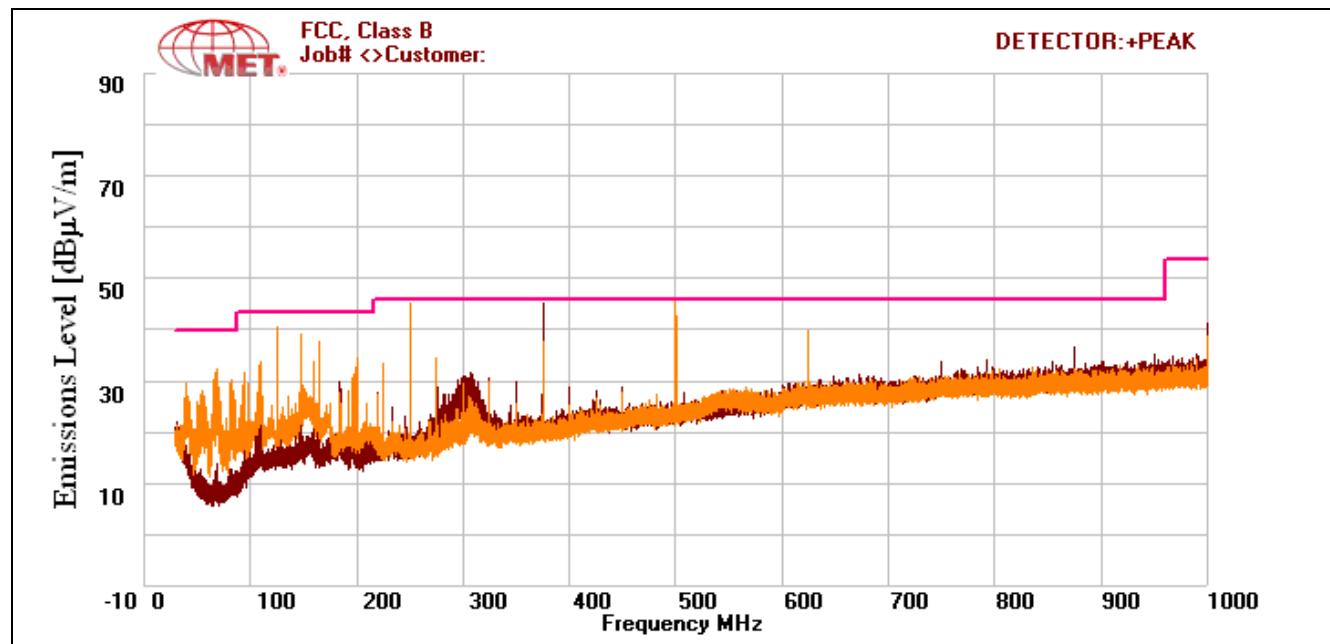
Plot 10. Radiated Emissions Pre-Scan, Ooma - ITE HK-R110-A05, 1 GHz – 10 GHz

Radiated Emissions Limits Test Results, Class B

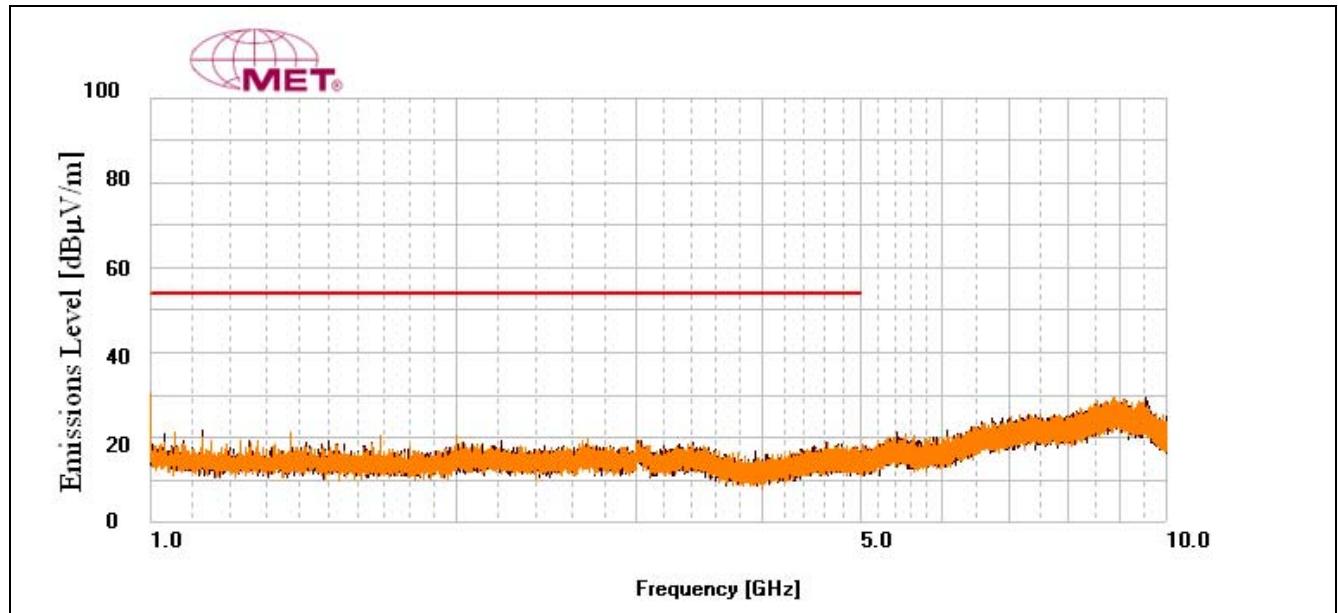
Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
*375	H	42	100	24.7	15.6	0	4.92	0	45.22	46	-0.78
*250	H	297	116	27.29	12.9	0	3.99	0	44.18	46	-1.82
*250	V	267	100	28.49	12.7	0	3.99	0	45.18	46	-0.82
*500	V	262	100	21.89	17.6	0	5.741	0	45.231	46	-0.769
125	V	68	100	24.38	13.3	0	2.775	0	40.455	43.5	-3.045
625	V	207	100	14.35	18.9	0	6.46	0	39.71	46	-6.29
1000	V	10	140	61.59	-3.05	30	1.9	0	30.44	54	-23.56
1000	H	182	167	62.45	-3.05	30	1.9	0	31.3	54	-22.7
*375	H	42	100	24.7	15.6	0	4.92	0	45.22	46	-0.78

Table 15. Radiated Emissions Limits Test Results, Ooma PSC11A-050

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.



Plot 11. Radiated Emissions Pre-Scan, Ooma PSC11A-050, 30 MHz – 1 GHz

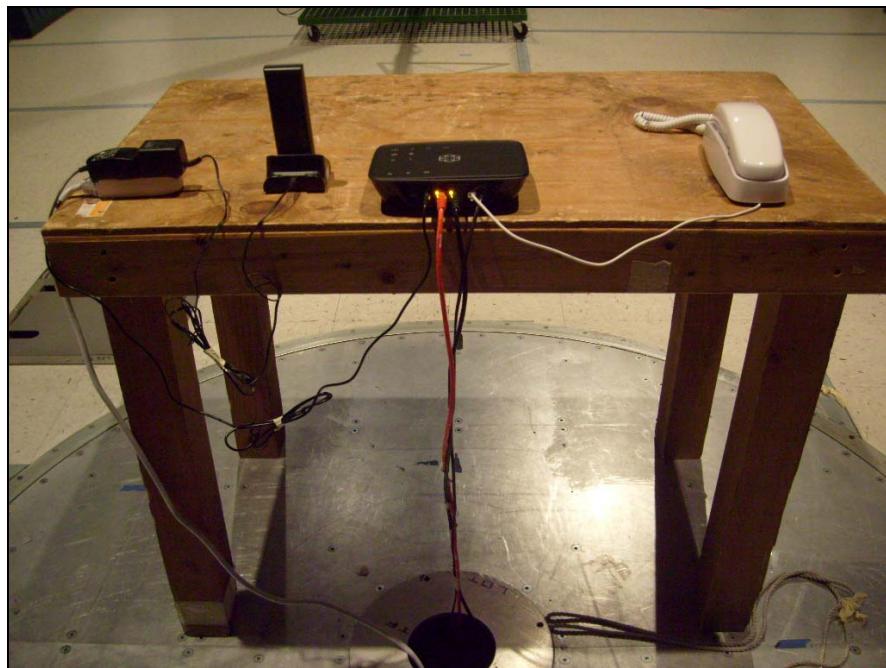


Plot 12. Radiated Emissions Pre-Scan, Ooma PSC11A-050, 1 GHz – 10 GHz

Radiated Emission Limits Test Setup



Photograph 2. Radiated Emission, Test Setup



Photograph 3. Radiated Emission, Test Setup, Back View



Photograph 4. Radiated Emission, Test Setup, Bilog



Photograph 5. Radiated Emission, Test Setup, Horn

IV. Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207

Conducted Emissions Limits

Test Requirement(s):

§ 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 μ H/50 Ω 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 (dB μ V)	
	Quasi-Peak	Average
* 0.15- 0.45	66 - 56	56 - 46
0.45 - 0.5	56	46
0.5 - 30	60	50

Table 16. 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 semi-anechoic chamber. 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 μ H 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 C63.4-1992 "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 μ H LISN as the input transducer to an EMC/field intensity meter. The tests were conducted in a RF-shielded enclosure.

Test Results:

The EUT is compliant with this requirement.

Test Engineer(s):

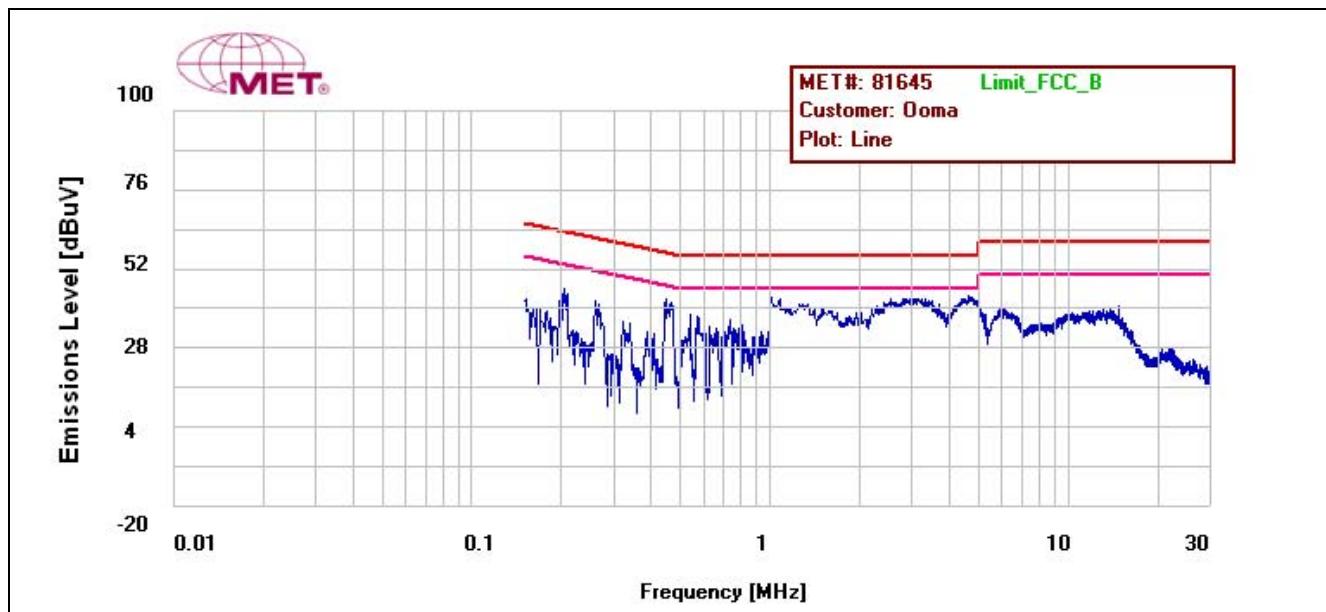
Anderson Soungpanya

Test Date(s):

07/01/09

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Line	.465	47.2	56.62	-9.42	Pass	33.53	46.62	-13.09	Pass
Line	1.00	41.01	56	-14.99	Pass	25.56	46	-20.44	Pass
Line	4.60	38.42	56	-17.58	Pass	26.5	46	-19.5	Pass

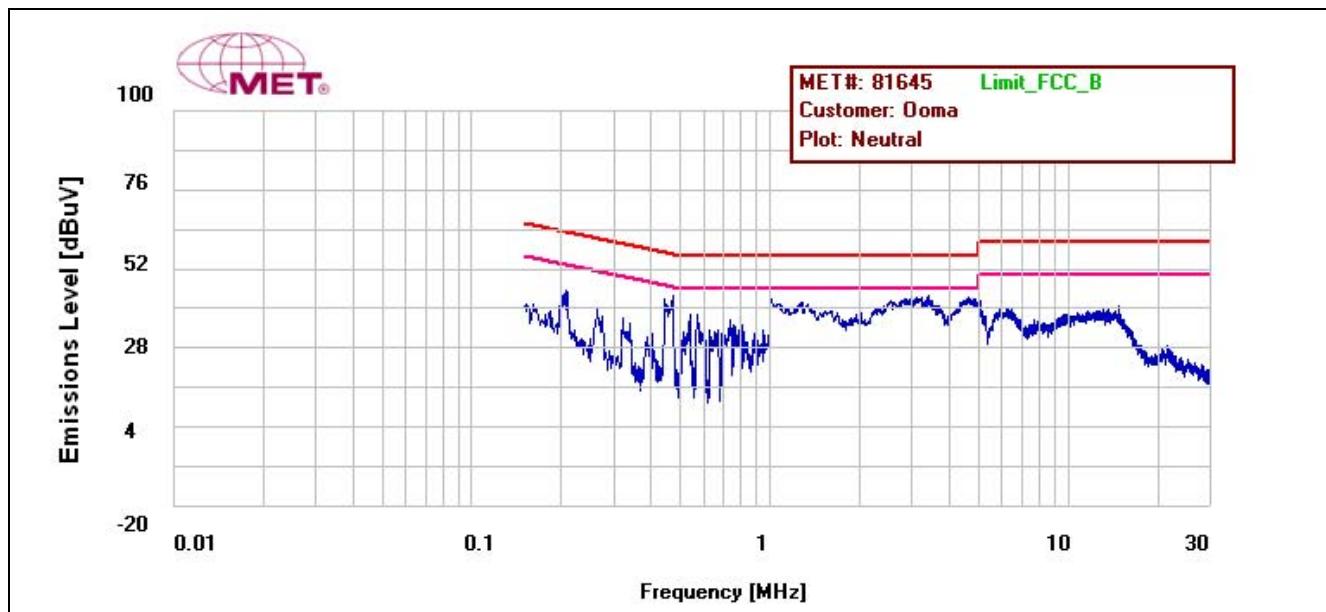
Table 17. Conducted Emissions, §15.207, Phase Line, Test Results, Fairway - WRG10F-050A



Plot 13. Conducted Emissions, §15.207, Phase Line, Fairway - WRG10F-050A

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Neutral	.465	47.22	56.62	-9.4	Pass	33.71	46.62	-12.91	Pass
Neutral	1.00	41.14	56	-14.86	Pass	25.85	46	-20.15	Pass
Neutral	2.89	40.21	56	-15.79	Pass	25.15	46	-20.85	Pass

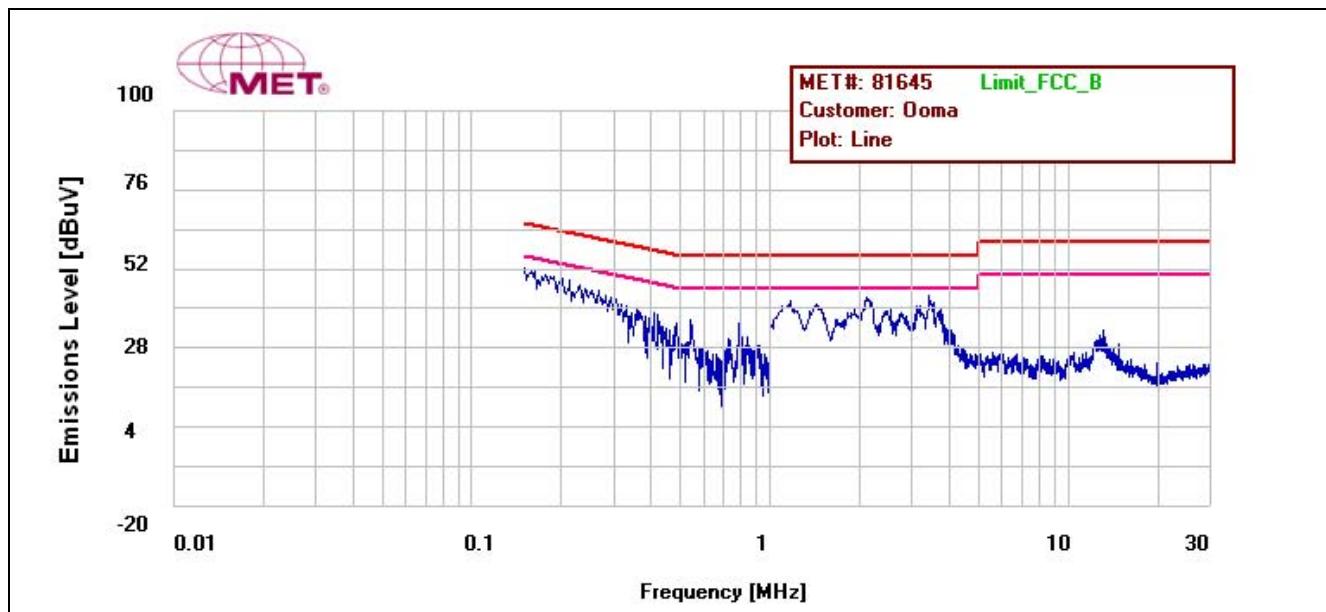
Table 18. Conducted Emissions, §15.207, Neutral Line, Test Results, Fairway - WRG10F-050A



Plot 14. Conducted Emissions, §15.207, Neutral Line, Fairway - WRG10F-050A

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Line	.210	39.09	63.213	-24.123	Pass	26.78	53.213	-26.433	Pass
Line	4.30	29.21	56	-26.79	Pass	21.84	46	-24.16	Pass
Line	.177	57.31	64.629	-7.319	Pass	34.93	54.629	-19.699	Pass

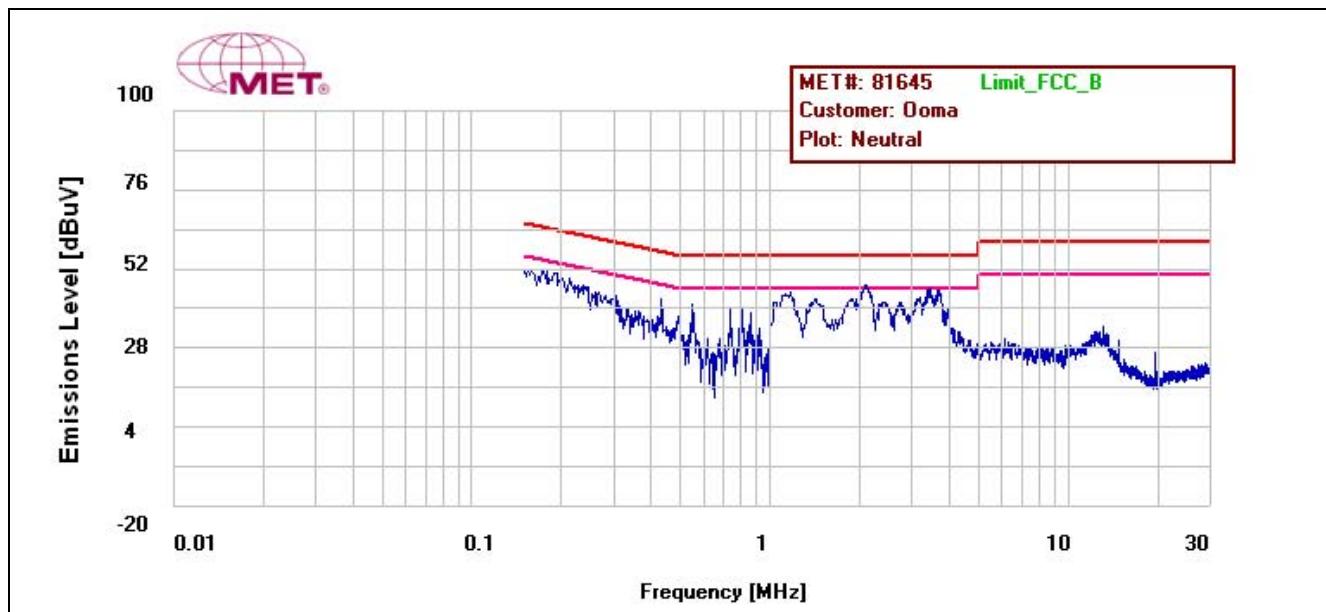
Table 19. Conducted Emissions, §15.207, Phase Line, Test Results, Ooma - ITE HK-R110-A05



Plot 15. Conducted Emissions, §15.207, Phase Line, Ooma - ITE HK-R110-A05

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Neutral	2.10	42.44	56	-13.56	Pass	30.03	46	-15.97	Pass
Neutral	4.28	30.98	56	-25.02	Pass	23.21	46	-22.79	Pass
Neutral	.178	59.92	64.582	-4.662	Pass	35.15	54.582	-19.432	Pass

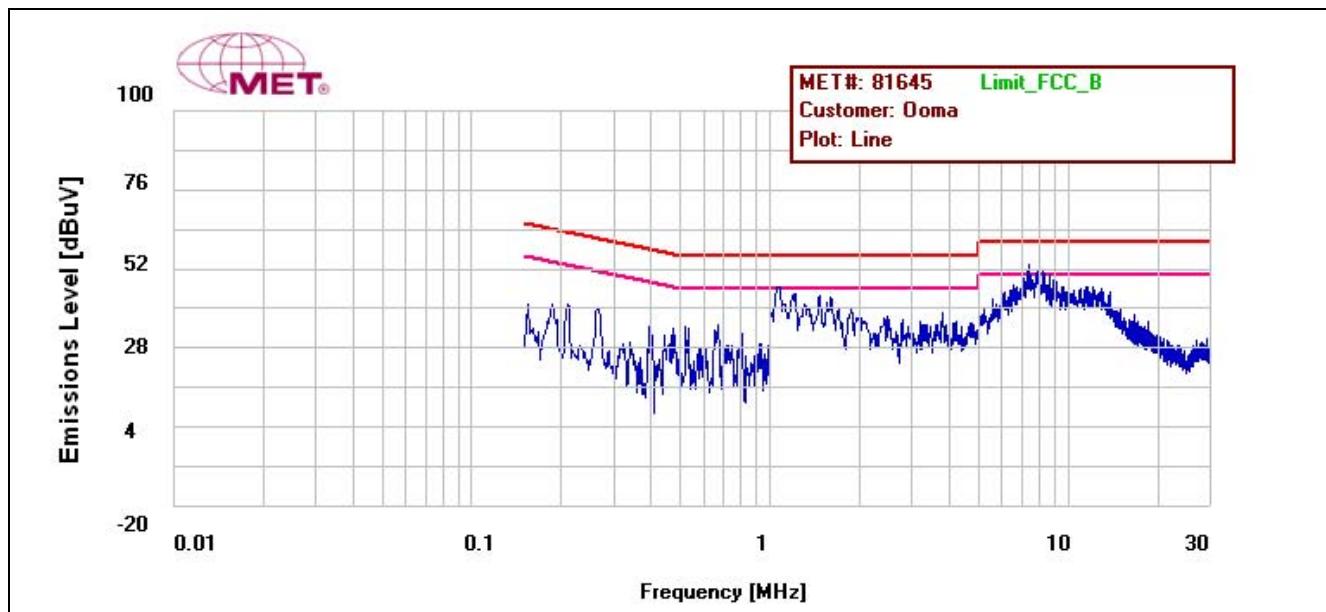
Table 20. Conducted Emissions, §15.207, Neutral Line, Test Results, Ooma - ITE HK-R110-A05



Plot 16. Conducted Emissions, §15.207, Neutral Line, Ooma - ITE HK-R110-A05

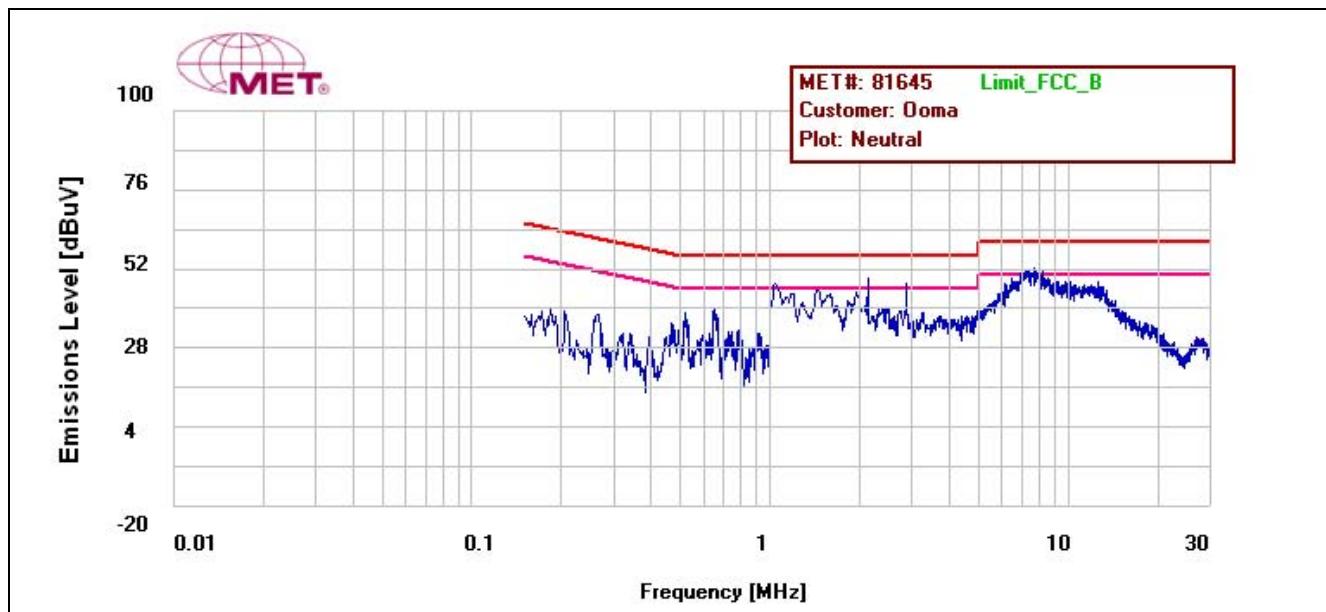
Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Line	7.59	40.93	60	-19.07	Pass	31.45	50	-18.55	Pass
Line	1.05	36.69	56	-19.31	Pass	23.9	46	-22.1	Pass
Line	10.75	36.17	60	-23.83	Pass	25.7	50	-24.3	Pass

Table 21. Conducted Emissions, §15.207, Phase Line, Test Results, Ooma - PSC11A-050



Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Neutral	7.14	44.65	60	-15.35	Pass	34.02	50	-15.98	Pass
Neutral	2.32	35.54	56	-20.46	Pass	24.28	46	-21.72	Pass
Neutral	1.56	30.4	56	-25.6	Pass	27.33	46	-18.67	Pass

Table 22. Conducted Emissions, §15.207, Neutral Line, Test Results, Ooma - PSC11A-050



Plot 18. Conducted Emissions, §15.207, Neutral Line, Ooma - PSC11A-050



Photograph 6. Conducted Emissions, §15.207, Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.309; § 15.209; § 15.109 Radiated Emissions Limits

Test Requirement(s): **§ 15.209 (a):** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 23.

Frequency (MHz)	§ 15.209(a), Radiated Emission Limits (dB μ V) @ 3m
30 - 88	40.00
88 - 216	43.50
216 - 960	46.00
Above 960	54.00

Table 23. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)

Test Procedure: The transmitter was set to the mid channel at the highest output power and placed on a 0.8 m high wooden table inside in a semi-anechoic chamber. Measurements were performed with the EUT rotated 360 degrees and varying the adjustable antenna mast with 1 m to 4 m height to determine worst case orientation for maximum emissions. Measurement were repeated the measurement at the low and highest channels.

For frequencies from 30 MHz to 1 GHz, measurements were made using a quasi-peak detector with a 120 kHz bandwidth.

For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per §15.33(a)(1) and §15.33(a)(4); i.e., the lowest RF signal generated or used in the device up to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

In accordance with §15.35(b) the limit on the radio frequency emissions as measured using instrumentation with a peak detector function shall be 20 dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules.

EUT Field Strength Final Amplitude = Raw Amplitude – Preamp gain + Antenna Factor + Cable Loss

Test Results: The EUT was compliant with this requirement.

Test Engineer(s): Anderson Sungpanya

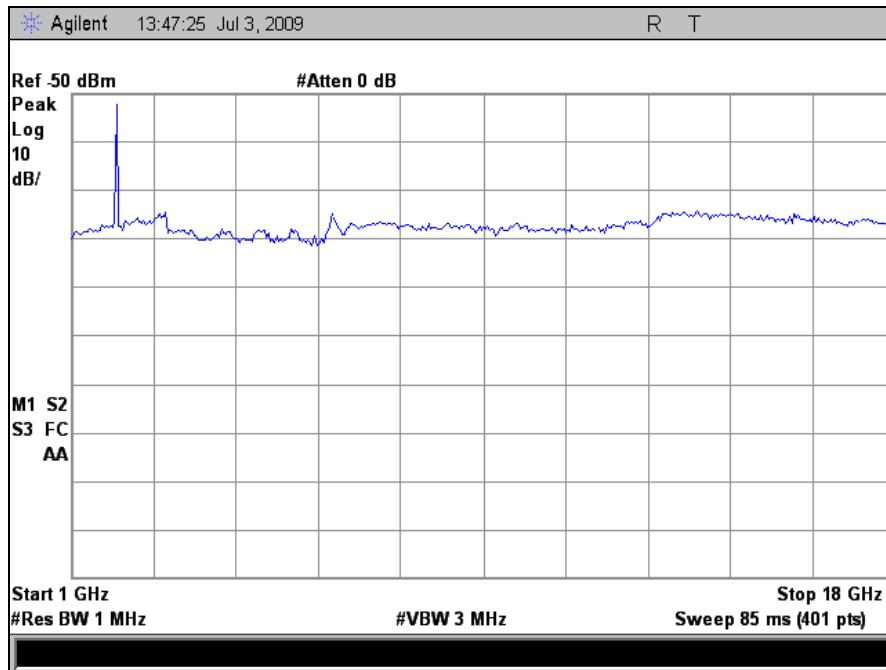
Test Date(s): 07/03/09

§ 15.209 Harmonic Emissions Requirements – Radiated

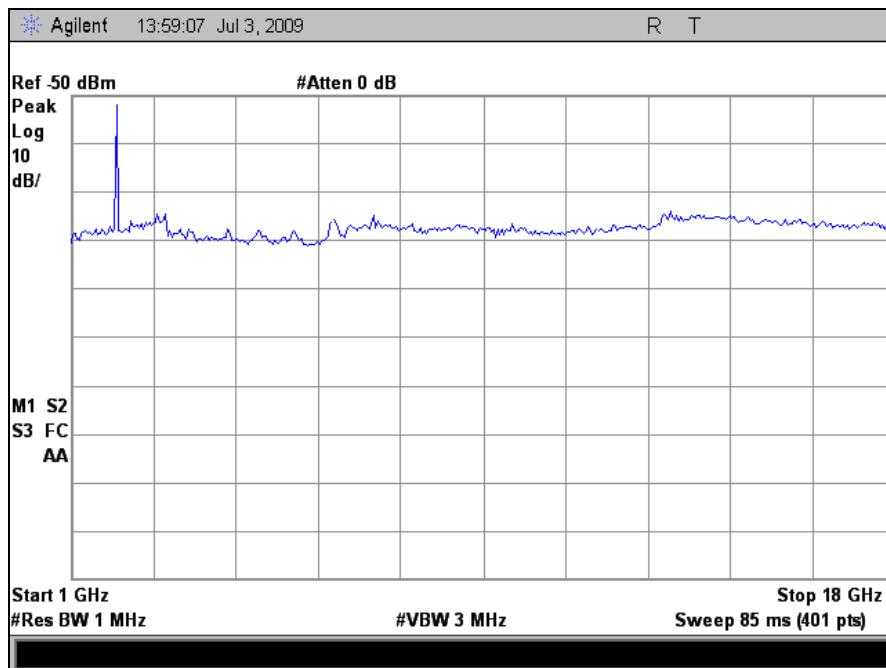
Low Channel – 1921.536 MHz									
Frequency (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 3 m (Peak) / (Avg.)	Preamp (dB)	Antenna Cor. Factor (dB)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Limit Detector Peak / Avg.	Limit @ 3m (dB μ V)	Margin (dB)
3.843072	H	43.67	34.71	31.97	5.66	46.58	Peak	74	-27.42
3.843072	H	29.75	34.71	31.97	5.66	32.66	Peak	54	-21.34
5.764608	H	44.31	34.59	34.27	9.07	53.06	Peak	74	-20.94
5.764608	H	29.83	34.59	34.27	9.07	38.58	Avg.	54	-15.42
7.686144	H	44.92	35.13	36.49	10.71	56.99	Peak	74	-17.01
7.686144	H	30.05	35.13	36.49	10.71	42.12	Avg.	54	-11.88
9.60768	H	44.32	35.59	37.90	10.77	57.40	Peak	74	-16.60
9.60768	H	29.79	35.59	37.90	10.77	42.87	Avg.	54	-11.13
Mid Channel – 1924.992 MHz									
Frequency (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 3 m (Peak) / (Avg.)	Preamp (dB)	Antenna Cor. Factor (dB)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Limit Detector Peak / Avg.	Limit @ 3m (dB μ V)	Margin (dB)
3.849984	H	45.21	34.71	31.98	5.70	48.18	Peak	74	-25.82
3.849984	H	30.21	34.71	31.98	5.70	33.18	Peak	74	-40.82
5.774976	H	44.83	34.59	34.26	9.08	53.59	Peak	74	-20.41
5.774976	H	29.04	34.59	34.26	9.08	37.80	Avg.	54	-16.20
7.699968	H	43.29	35.13	36.50	10.68	55.34	Peak	74	-18.66
7.699968	H	31.32	35.13	36.50	10.68	43.37	Avg.	54	-10.63
9.62496	H	45.92	35.59	37.92	10.78	59.04	Peak	74	-14.96
9.62496	H	30.27	35.59	37.92	10.78	43.39	Avg.	54	-10.61
High Channel – 1928.448 MHz									
Frequency (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 3 m (Peak) / (Avg.)	Preamp (dB)	Antenna Cor. Factor (dB)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Limit Detector Peak / Avg.	Limit @ 3m (dB μ V)	Margin (dB)
3.856896	H	46.33	34.72	32.00	5.73	49.35	Peak	74	-24.65
3.856896	H	31.05	34.72	32.00	5.73	34.07	Peak	74	-39.93
5.785344	H	45.35	34.60	34.26	9.10	54.11	Peak	74	-19.89
5.785344	H	30.98	34.60	34.26	9.10	39.74	Avg	54	-14.26
7.713792	H	46.49	35.13	36.51	10.66	58.52	Peak	74	-15.48
7.713792	H	31.33	35.13	36.51	10.66	43.36	Avg	54	-10.64
9.64224	H	45.09	35.58	37.94	10.79	58.25	Peak	74	-15.75
9.64224	H	29.42	35.58	37.94	10.79	42.58	Avg	54	-11.42

Table 24. Radiated Harmonic Emissions, Test Results

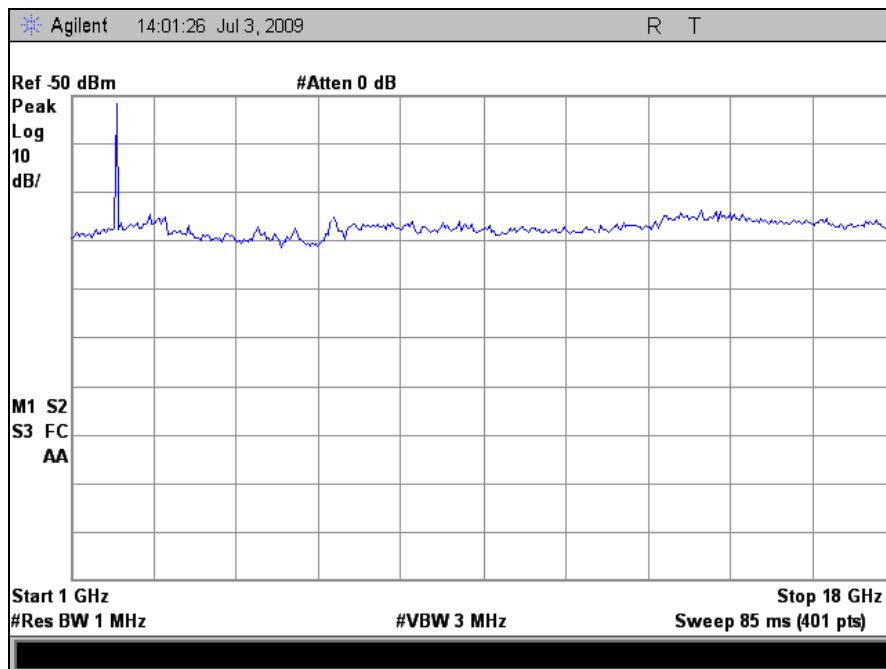
Note: All other emissions were measured at the noise floor of the spectrum analyzer.



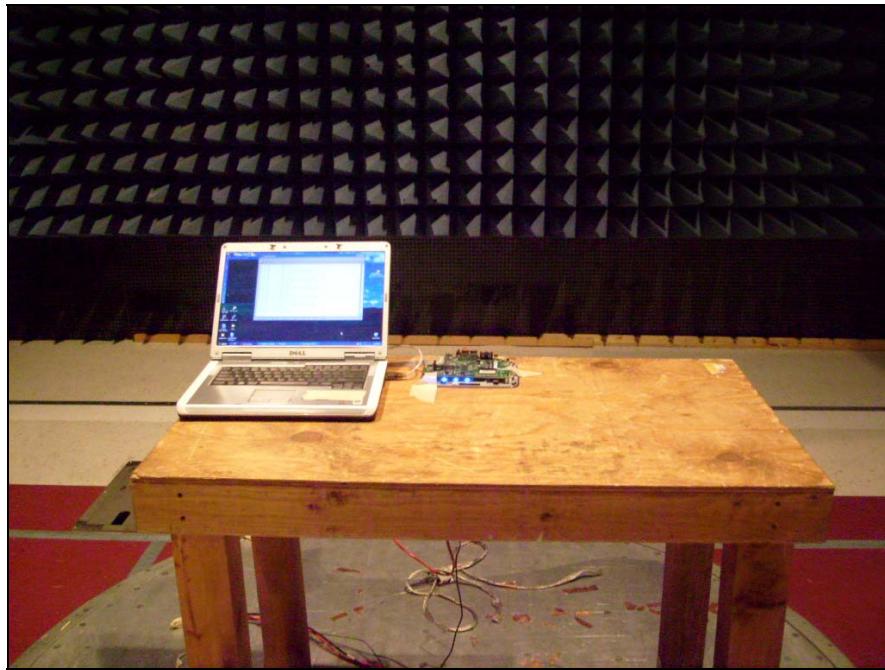
Plot 19. Radiated Harmonic Emissions, Low Channel



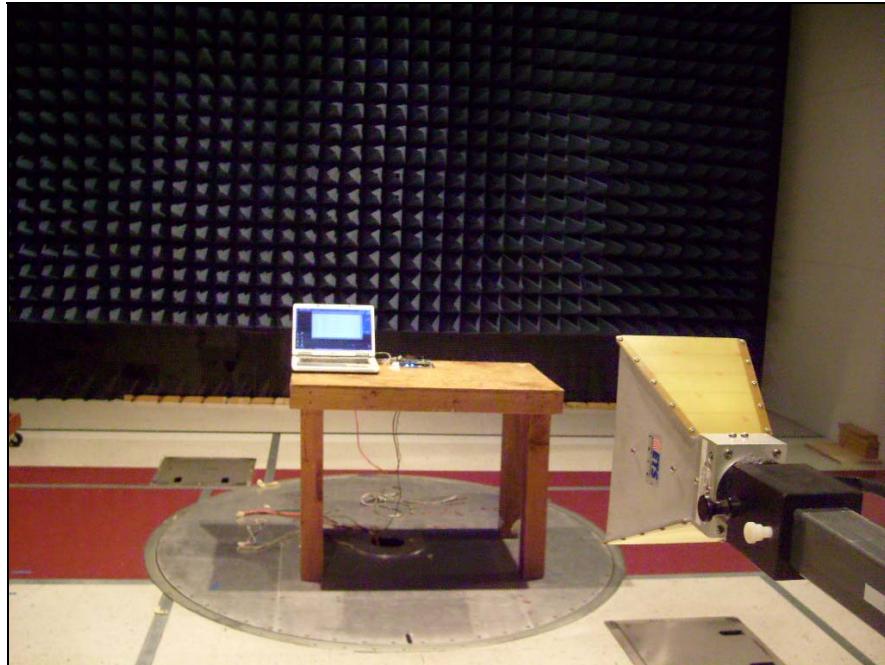
Plot 20. Radiated Harmonic Emissions, Mid Channel



Plot 21. Radiated Harmonic Emissions, High Channel



Photograph 7. Radiated Harmonic Emissions, Test Setup



Photograph 8. Radiated Harmonic Emissions, Horn

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.303 (c) Emission Bandwidth

Test Criteria: § 15.303(c): 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.

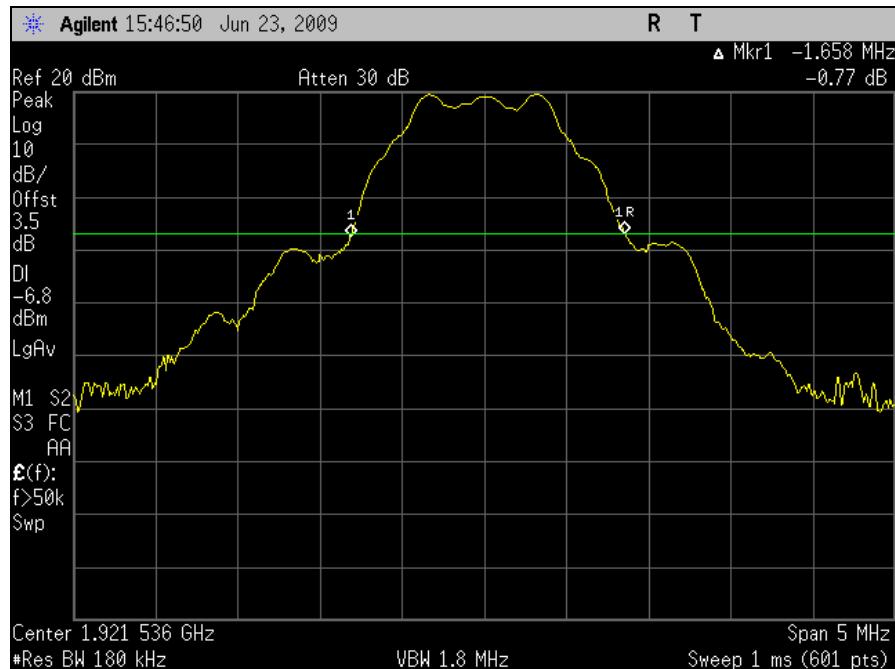
GFSK		
Carrier Channel	Frequency (MHz)	Measured 26 dB Bandwidth (MHz)
Low	1921.536	1.658
Mid	1924.992	1.650
High	1928.448	1.650

Table 25. Occupied Bandwidth, Test Results

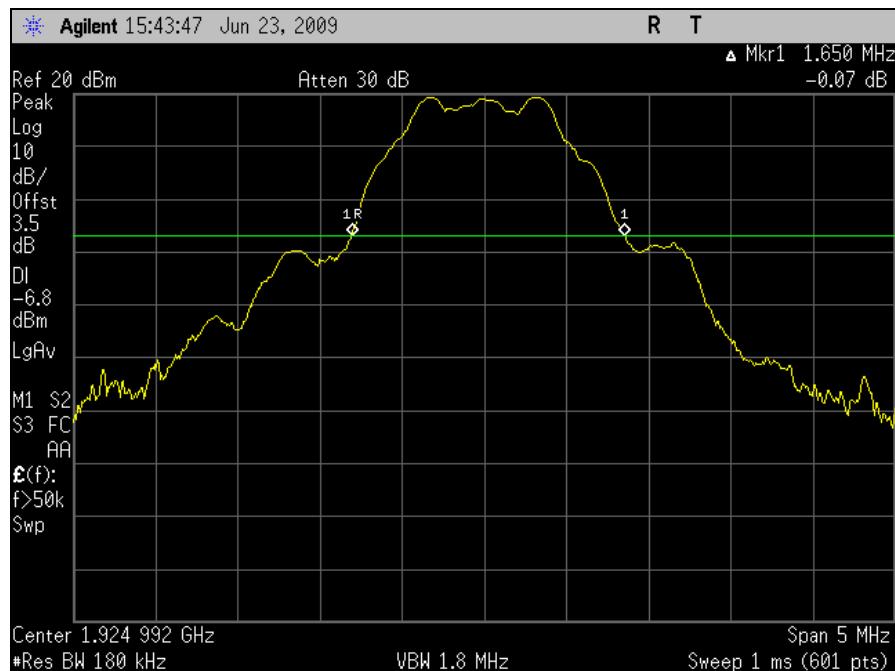
Test Engineer(s): Anderson Soungpanya

Test Date(s): 06/23/09

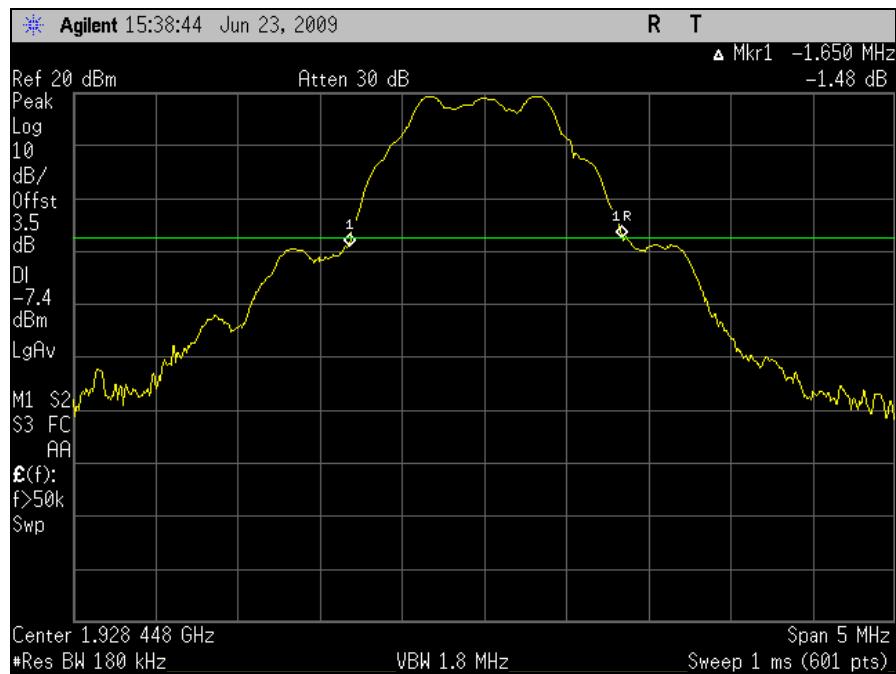
Electromagnetic Compatibility Criteria for Intentional Radiators



Plot 22. Occupied Bandwidth, Low Channel



Plot 23. Occupied Bandwidth, Mid Channel



Plot 24. Occupied Bandwidth, High Channel

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 meets the criteria of this rule by virtue of being permanently attached to the unit. The EUT is therefore compliant with §15.203.

Test Engineer(s): Anderson Soungpanya

Test Date(s): 06/26/09

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.319 Use of Digital Modulation

Test Criteria: § 15.319(b): All transmissions must use only digital modulation techniques. criteria:

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.

Test Engineer(s): Anderson Soungpanya

Test Date(s): 06/26/09

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).

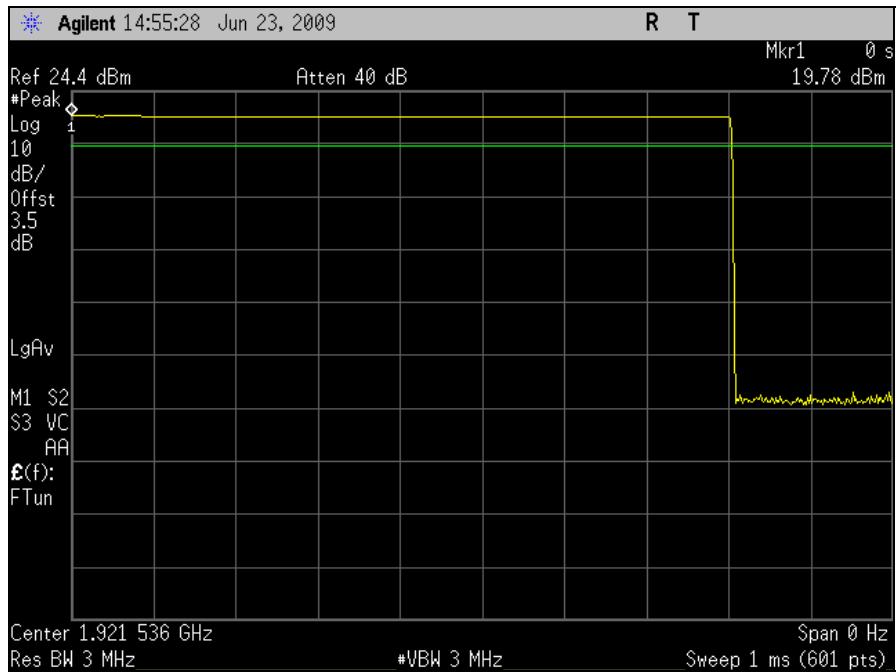
$$\begin{aligned}
 \text{Peak Transmit Power Limit} = & \quad 5\log B - 10 \text{dBm} \\
 & 5\log (1.658 \exp 6) - 10 \text{dBm} \\
 & 21.09 \text{dBm}
 \end{aligned}$$

RF Transmit Power		
Carrier Channel	Frequency (MHz)	Measured Peak Output Power dBm
Low	1921.536	19.78
Mid	1924.992	19.74
High	1928.448	19.69

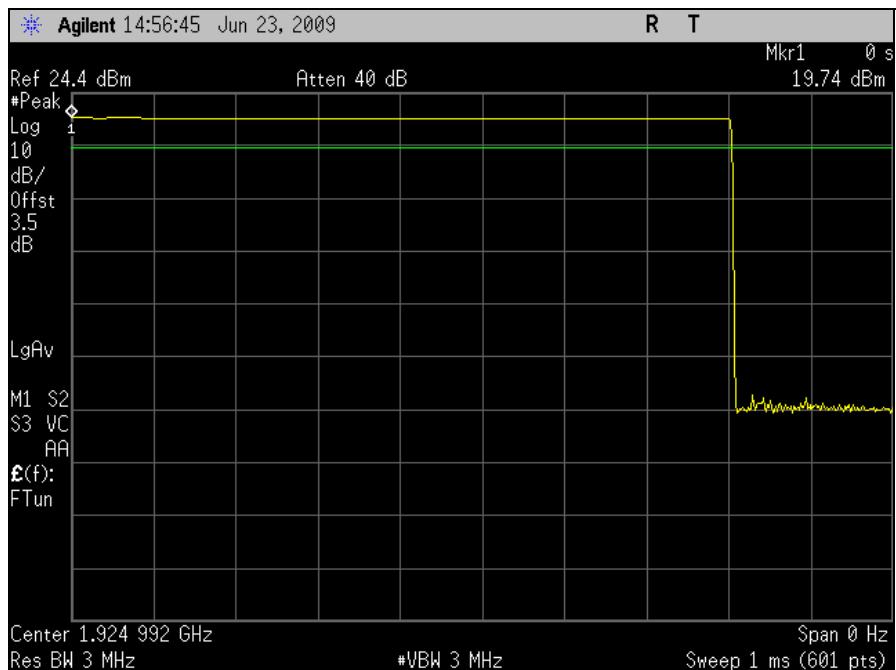
Table 26. Peak Transmit Power, Test Results

Test Engineer(s): Anderson Soungpanya

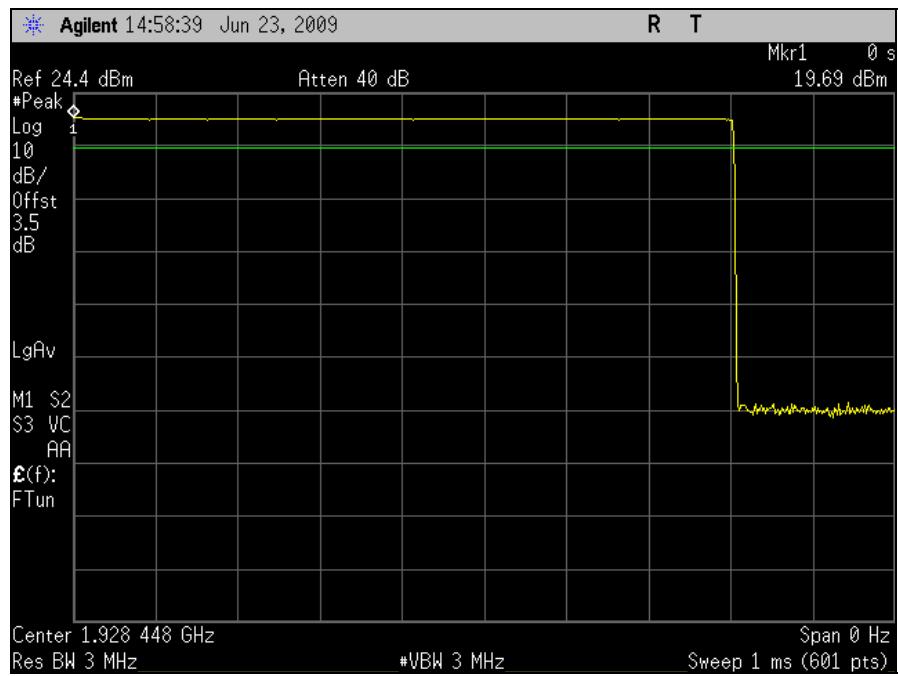
Test Date(s): 06/23/09



Plot 25. RF Output Power, Low Channel



Plot 26. RF Output Power, Mid Channel



Plot 27. 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.

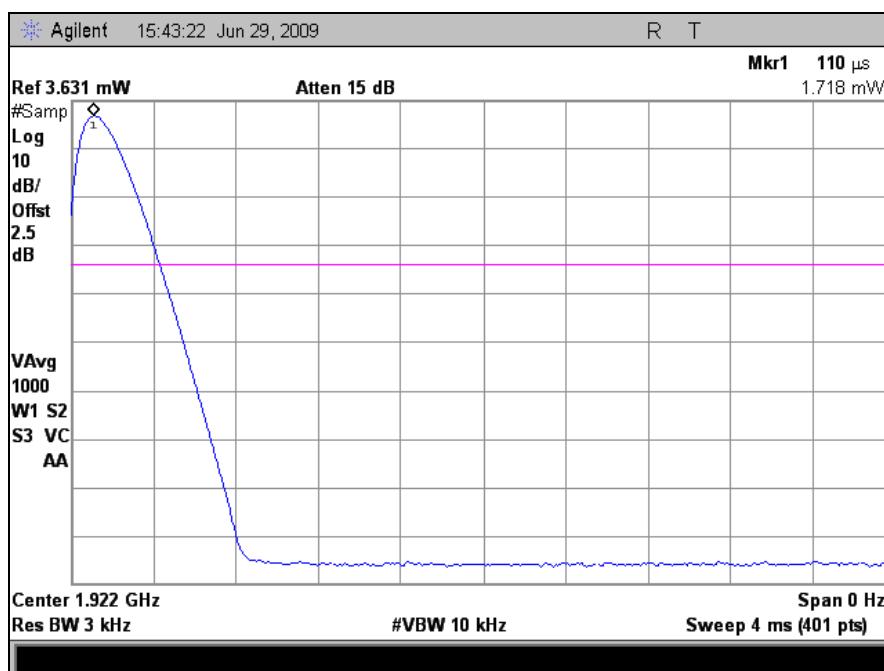
Test Results: Equipment complies with the Power Spectral Density limits of § 15.319(d).

Power Spectral Density		
Carrier Channel	Frequency (MHz)	Measured Peak Power Spectral Density (mW)
Low	1921.536	1.718
Mid	1924.992	1.683
High	1928.448	1.650

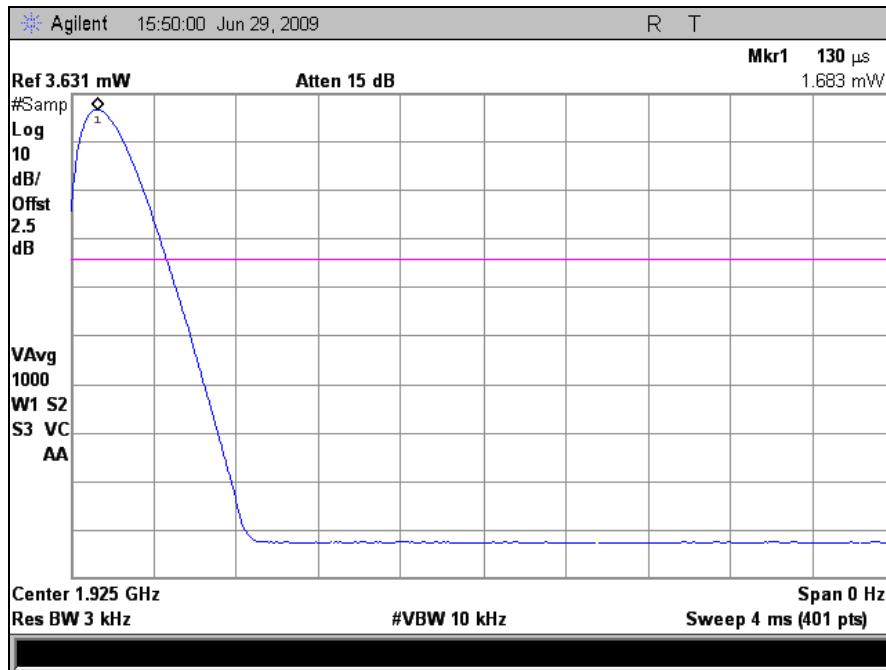
Table 27. Power Spectral Density, Test Results

Test Engineer(s): Anderson Soungpanya

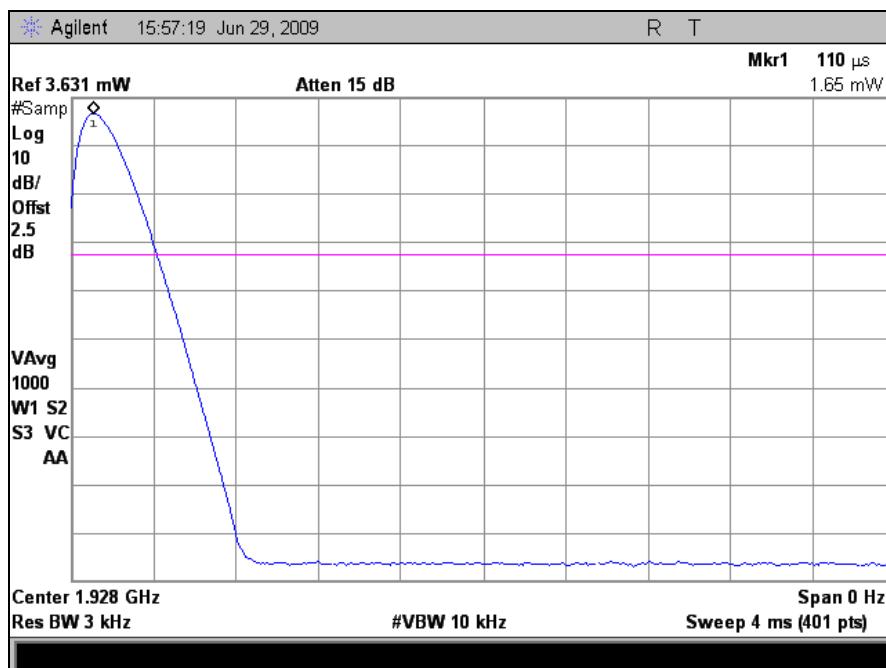
Test Date(s): 06/29/09



Plot 28. Peak Power Spectral Density, Low Channel



Plot 29. Peak Power Spectral Density, Mid Channel



Plot 30. 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 3.7 dBi Antenna. Max Output power allowed with this Gain is 20.39dBm. The Max Output power by the EUT is 19.78.

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

Test Engineer(s): Anderson Soungpanya

Test Date(s): 06/26/09

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 28. 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.

Test Engineer(s): Anderson Soungpanya

Test Date(s): 06/26/09

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.

MPE Limit Calculation: EUT's operating frequencies @ 1920-1930 MHz; highest conducted power = 19.78dBm (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm² or 10 W/m²**

EUT maximum antenna gain = 3.7 dBi.

Equation from page 18 of OET 65, Edition 97-01

$$S = PG / 4\pi R^2 \quad \text{or} \quad R = \sqrt{PG / 4\pi S}$$

where, S = Power Density (1 mW/cm²)
 P = Power Input to antenna (95.06mW)
 G = Antenna Gain (2.34 numeric)

$$R = (95.06 * 2.34 / 4 * 3.14 * 1.0)^{1/2} = (222.84 / 12.56)^{1/2} = 4.21\text{cm}$$

$$S = (95.06 * 2.34 / 4 * 3.14 * 20.0^2) = (222.84 / 5024) = 0.044 \text{ mW/cm}^2 \text{ @ 20cm separation}$$

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

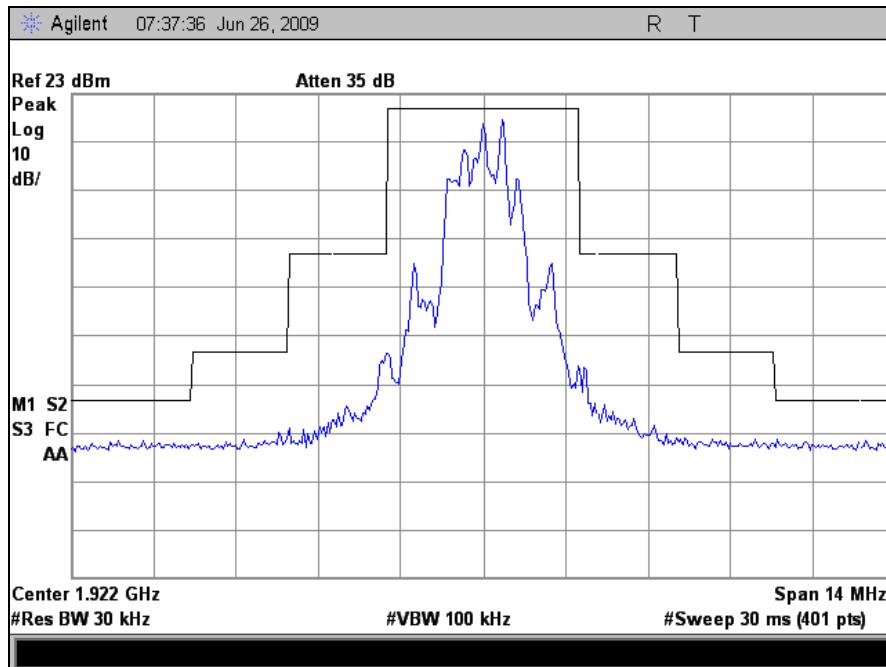
Emissions inside the band must comply with the following emission mask: In the bands between 1B and 2B measured from the center of the emission bandwidth, the total power emitted by the device shall be at least 30 dB below the transmit power permitted for that device; in the bands between 2B and 3B measured 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.

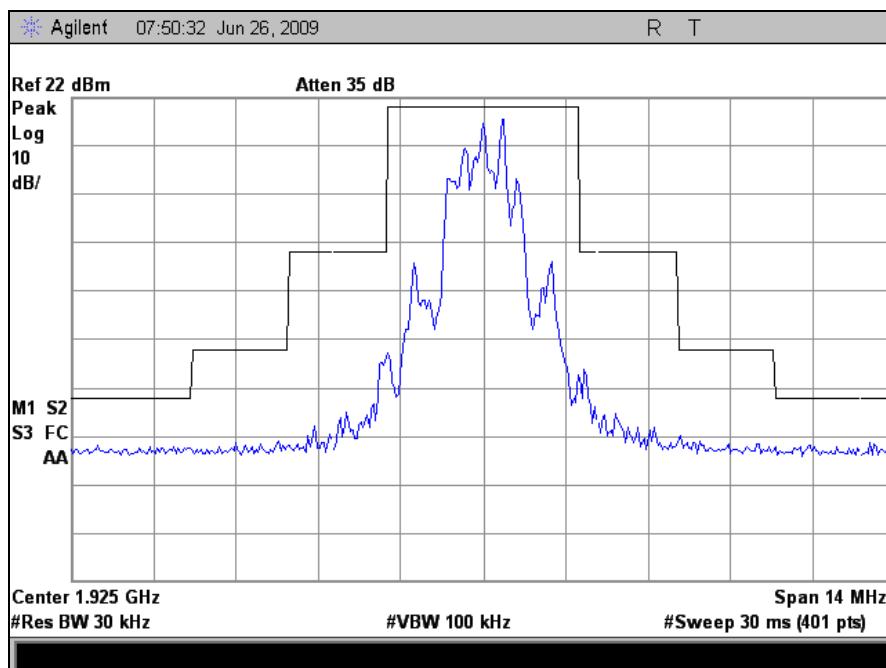
Test Results: Equipment complies with the Spurious Emission limits of § 15.323(d)(1).

Test Engineer(s): Anderson Soungpanya

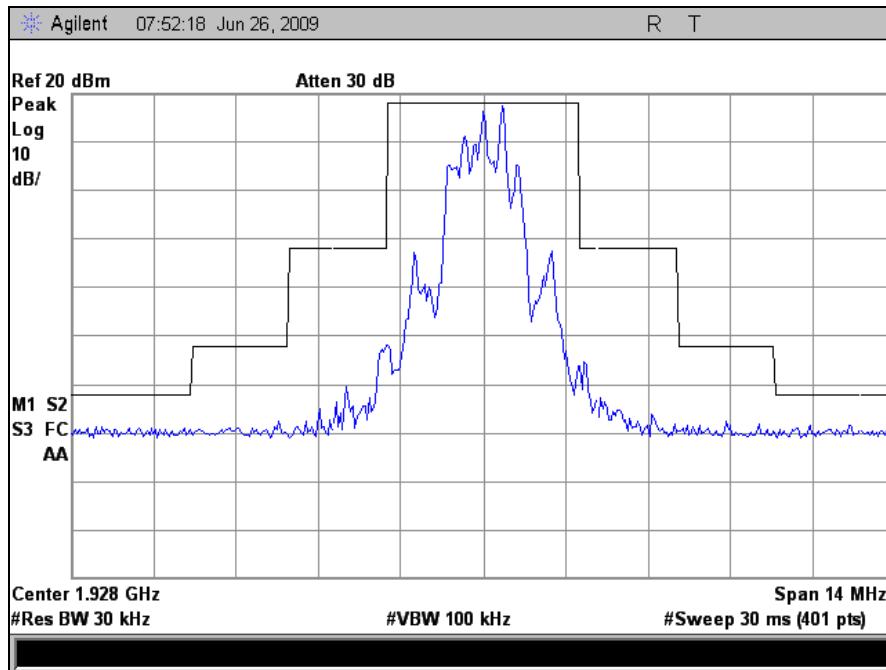
Test Date(s): 06/26/09 – 06/30/09



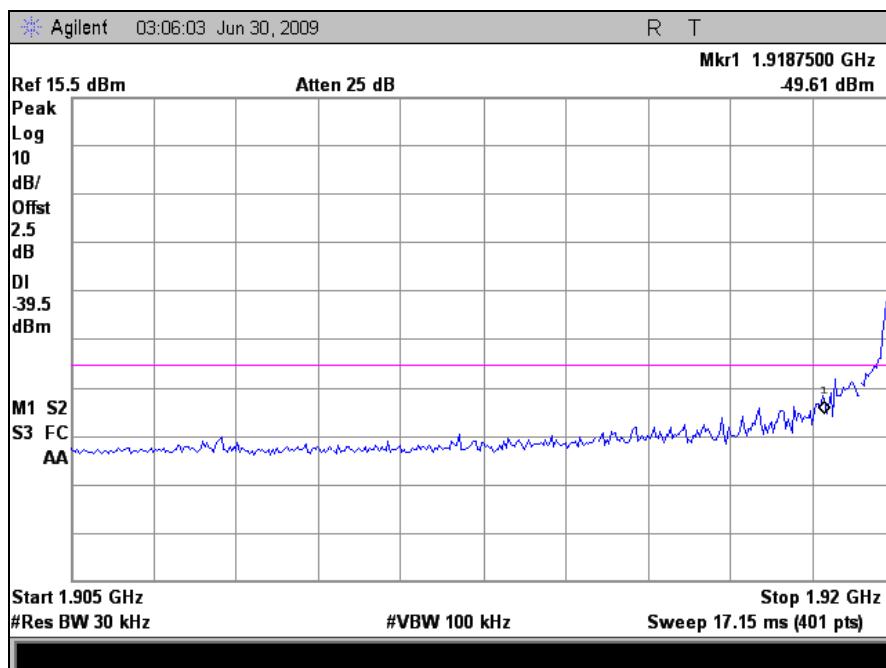
Plot 31. Conducted Spurious Emission, In-Band, Low Channel



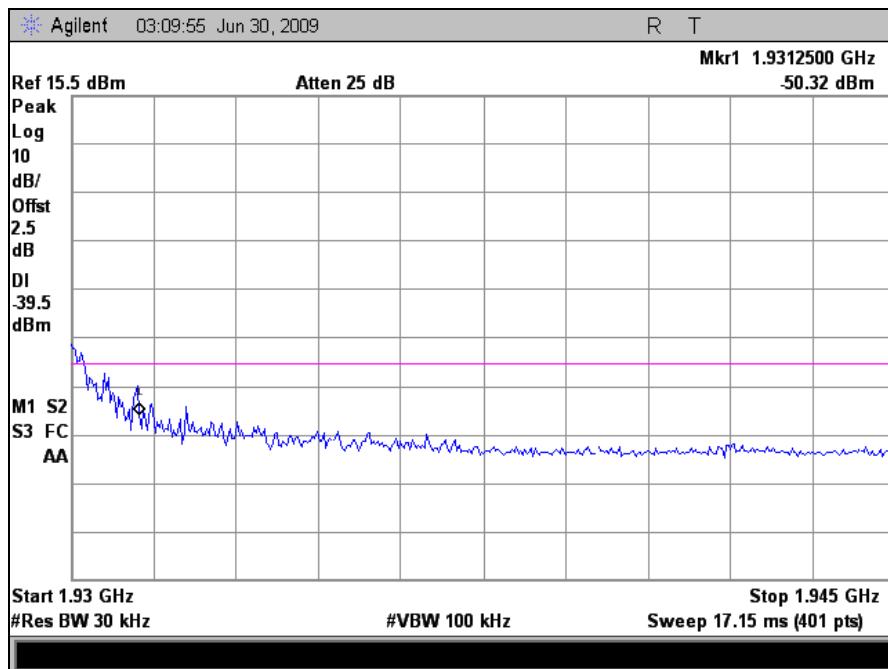
Plot 32. Conducted Spurious Emission, In-Band, Mid Channel



Plot 33. Conducted Spurious Emission, In-Band, High Channel



Plot 34. Conducted Spurious Emission, Out-of-Band, Low Channel



Plot 35. Conducted Spurious Emission, Out-of-Band, High Channel

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(c)(1) Monitoring 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 7.3.4, which provides the test methodology for this provision.

Attestation: This requirement is covered by results of Least Interfered Channel (LIC) test according to FCC 15.323(c)(5).

Test Engineer(s): Anderson Soungpanya

Test Date(s): 06/26/09

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(c)(2) 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.

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): Anderson Soungpanya

Test Date(s): 06/26/09

Upper Threshold

$$T_U < (15\log B - 184 + M_U - P_{EUT}) \text{ dBm}$$

$$B = 1.658 \text{ MHz}$$

$$M_U = 50 \text{ dB}$$

$$P_{EUT} = 19.78 \text{ dB}$$

$$T_U = -75.48 \text{ dBm}$$

Lower Threshold

$$T_L < (15\log B - 184 + M_L - P_{EUT}) \text{ dBm}$$

$$B = 1.658 \text{ MHz}$$

$$M_L = 30 \text{ dB}$$

$$P_{EUT} = 19.78 \text{ dB}$$

$$T_L = -95.48 \text{ dBm}$$

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(c)(3) Maximum Transmit Time

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:

The EUT was monitored for 8 hours and the call was terminated at approximately 7 hours and 55 minutes.

Test Engineer(s):

Anderson Soungpanya

Test Date(s):

06/26/09

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(c)(4) System Acknowledgement

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:

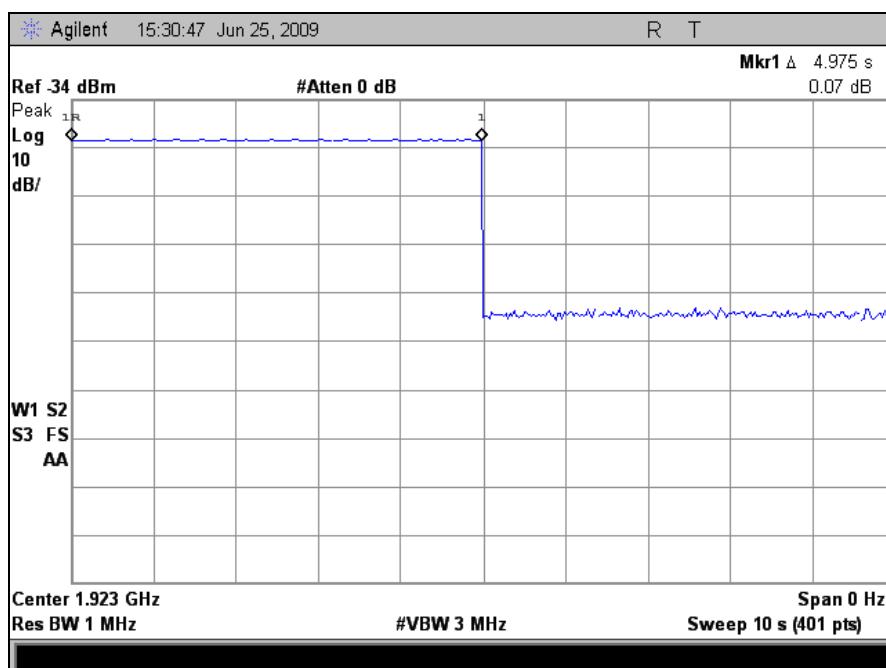
The EUT was compliant with this requirement.

Test Engineer(s):

Anderson Soungpanya

Test Date(s):

06/25/09



Plot 36. System Acknowledgment, 30 sec. Cease

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(c)(5) Least Interfered Channel

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.

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 $12 \times 5 = 60$ 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.

$$\begin{aligned} TU &< (-174 + 10\log B + MU + Pmax - PEUT) \text{ dBm} \\ B &= 1.9 \text{ MHz} \quad MU = 50 \text{ dB} \quad Pmax = PEUT \quad TU = -61.2 \text{ dBm} \end{aligned}$$

Test Results:

The EUT was compliant with this requirement.

Test Engineer(s):

Anderson Soungpanya

Test Date(s):

06/26/09

Control channels

1921.536 MHz
1924.992 MHz
1928.448 MHz

Clause 7.3.3(a)	EUT restricted to transmit on channels 23 and 27
Clause 7.3.3(b)	Apply interference on Ch 23 at -89 dBm Apply interference on Ch 17 at -82 dBm Setup link 5 times and verify transmission
Clause 7.3.3(c)	Apply interference on Ch 23 at -82 dBm Apply interference on Ch 27 at -89dBm Setup link 5 times and verify transmission
Clause 7.3.3(d)	Apply interference on Ch 23 at -88 dBm Apply interference on Ch 27 at -95 dBm Setup link 5 times and verify transmission
Clause 7.3.3(e)	Apply interference on Ch 23 at -95 dBm Apply interference on Ch 27 at -88 dBm Setup link 5 times and verify transmission

Clause 7.3.3(a)	The BS is restricted to CH1 or CH5.
Clause 7.3.3(b)	5 x CH1 transmission of control signals
Clause 7.3.3(c)	5 x CH1 transmission of control signals
Clause 7.3.3(d)	5 x CH1 transmission of control signals
Clause 7.3.3(e)	5 x CH1 transmission of control signals

Table 29. Least Interfered Channel, Test Results

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(c)(5) Channel Confirmation

Test Criteria:

§15.323 (c)(5) 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.

Test Procedure:

Testing to ANSI C63.17-2006 Clause 7.3.3 & 7.3.4, which provides the test methodology for this provision.

Test Results:

This test was performed in monitoring time and least interfered channel tests

Test Engineer(s):

Anderson Soungpanya

Test Date(s):

06/26/09

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(c)(5) Power Measurement Resolution

Test Criteria: §15.323 (c)(5) The power measurement resolution for this comparison must be accurate to within 6 dB..

Test Procedure: Testing to ANSI C63.17-2006 Clause 7.3.3, which provides the test methodology for this provision.

Test Results: The resolution accuracy was accurate to within 6 dB.

Test Engineer(s): Anderson Soungpanya

Test Date(s): 06/26/09

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(c)(5) Segment Occupancy

Test Criteria: **§15.323 (c)(5)** No device or group of cooperating devices located within 1 meter of each other shall occupy more than three 1.25 MHz channels during any frame period

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. During any frame period cooperating devices will not occupy more than one channel bandwidth. For further details see operational description or relevant portions of the DECT standards.

Test Engineer(s): Anderson Soungpanya

Test Date(s): 06/26/09

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): Anderson Soungpanya

Test Date(s): 06/26/09

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 $50 \times \text{SQRT}(1.25 / \text{emission bandwidth in MHz})$ microseconds for signals at the applicable threshold level but shall not be required to be less than 50 microseconds.

Test Procedure:

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

Test Results:

The EUT was compliant with this requirement.

Test Engineer(s):

Anderson Soungpanya

Test Date(s):

07/02/09

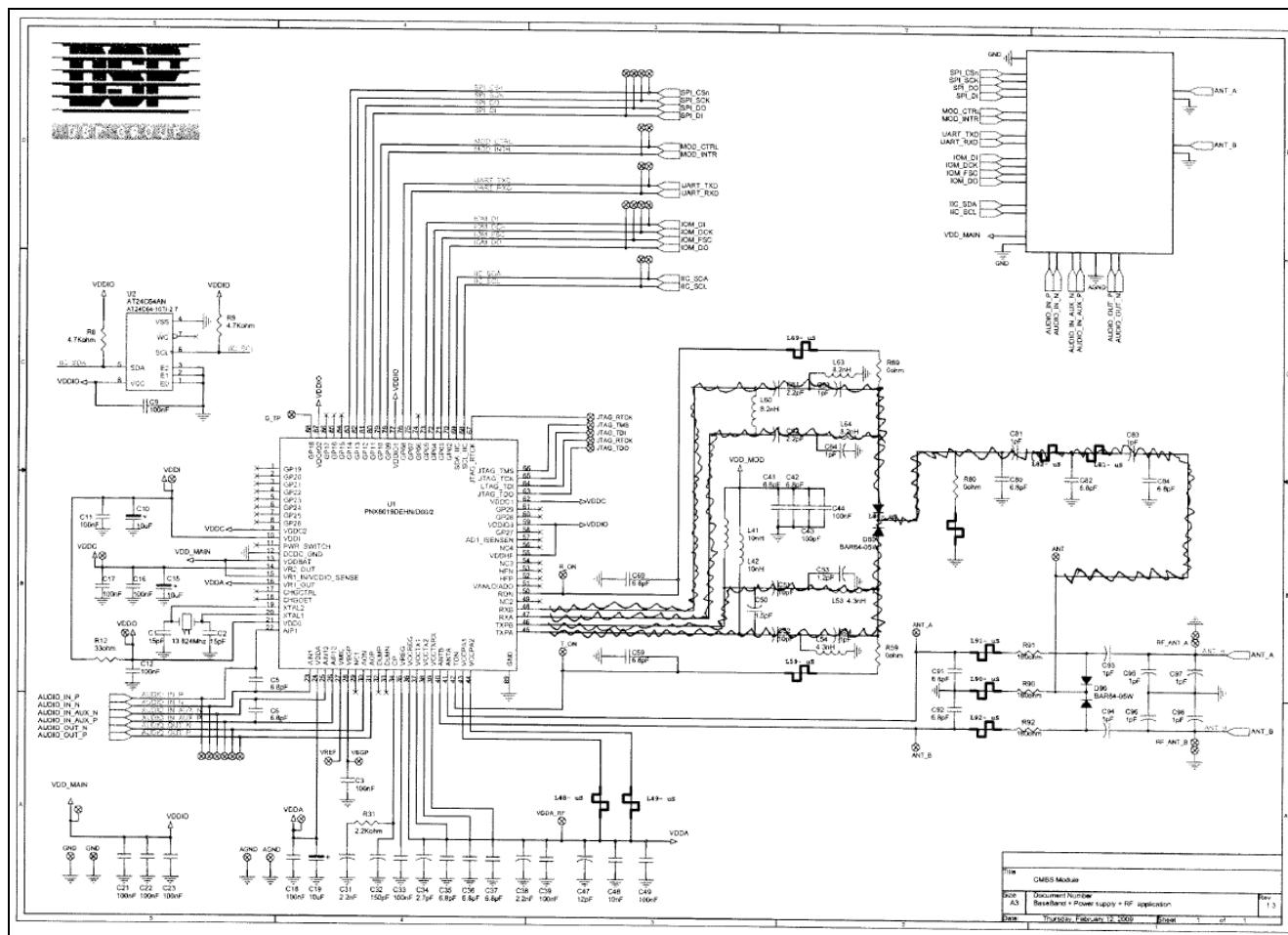


Figure 3. Monitoring Bandwidth

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(c)(7) Monitoring Reaction Time

Test Criteria: **§15.323 (c)(7)** If a signal is detected that is 6 dB or more above the applicable threshold level, the maximum reaction time shall be $35 \times \text{SQRT} (1.25/\text{emission bandwidth in MHz})$ microseconds but shall not be required to be less than 35 microseconds.

Test Procedure: Testing to ANSI C63.17-2006 Clause 7.5, which provides the test methodology for this provision..

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

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): Anderson Soungpanya

Test Date(s): 06/26/09

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(c)(9) Monitoring Threshold Relaxation

Test Criteria: **§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 4, which provides the test methodology for this provision

Test Results: The EUT was deemed not applicable with this requirement.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(c)(10) Duplex System LBT

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): Anderson Soungpanya

Test Date(s): 06/26/09

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.323(c)(11) Alternate Monitoring Channel

Test Criteria:

§15.323 (c)(11) 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 8.4, 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): Anderson Soungpanya

Test Date(s): 06/26/09

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): Anderson Soungpanya

Test Date(s): 06/26/09

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):

Anderson Soungpanya

Test Date(s):

06/26/09

Mean Frame Repetition (Hz)	Standard Deviation (Hz)	Frame Repetition Stability (ppm)	Result
199.99999641	0.000207227	3.11	Pass

Sample Calculation

$$\text{Frame Repetition Stability} = (3 \times \text{Standard Deviation}) / \text{Frame Rate} * 10^6$$

$$\text{Frame Rate} = 1 / 5\text{ms} = 200 \text{ Hz}$$

The following timing jitter was recorded

Mean Period (ms)	Standard Deviation (μsec)	Timing Jitter (μsec)	Results
5.0000001227	0.100	0.300	Pass

Table 30. Frame Period, Test Results

$$\text{Jitter } \mu\text{sec} = 3 * \text{Standard Deviation}$$

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 $\pm 10\text{ppm}$ over 1hour or the interval between channel access monitoring, which ever is shorter. The frequency stability shall be maintained over a temperature variation of -20° to $+50^{\circ}$ 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° 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 equipments 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 10° C increment until the unit is stabilized then recorded the reading in tabular format with the temperature range of -20° to $+50^{\circ}$ C.

Voltage supplied to EUT is 120 VAC reference temperature was done at 20° C. The voltage was varied by $\pm 15\%$ of nominal

Test Results: The EUT was compliant with this requirement.

Test Engineer(s): Anderson Soungpanya

Test Date(s): 06/26/09

Low Channel				
Reference @ 120VAC 20C	Voltage (AC)	Temperature (C)	Frequency (MHz)	PPM
	102	50	1921.537250	0.651
	120	50	1921.537250	0.651
	138	50	1921.539500	1.821
	102	20	1921.533500	1.301
	120	20	1921.536000	0.000
1921.536000	138	20	1921.533500	1.301
	102	-20	1921.533750	1.171
	120	-20	1921.534500	0.781
	138	-20	1921.535750	0.130
Mid Channel				
Reference @ 120VAC 20C	Voltage (AC)	Temperature (C)	Frequency (MHz)	PPM
	102	50	1924.994000	1.039
	120	50	1924.992250	0.130
	138	50	1924.993750	0.909
	102	20	1924.994250	1.169
	120	20	1924.994250	1.169
1924.992000	138	20	1924.991500	0.260
	102	-20	1924.987000	2.597
	120	-20	1924.987500	2.338
	138	-20	1924.988250	1.948
High Channel				
Reference @ 120VAC 20C	Voltage (AC)	Temperature (C)	Frequency (MHz)	PPM
	102	50	1928.452250	2.204
	120	50	1928.448750	0.389
	138	50	1928.449000	0.519
	102	20	1928.447500	0.259
	120	20	1928.447500	0.259
1928.448000	138	20	1928.447250	0.389
	102	-20	1928.446750	0.648
	120	-20	1928.444250	1.945
	138	-20	1928.445000	1.556

Table 31. 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 ANSI/NCSL Z540-1-1994 and ANSI/ISO/IEC 17025:2000.

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1S2457	HORN ANTENNA (1-18GHZ)	COM-POWER	AHA-118	4/17/2009	4/17/2010
1S2495	MULTI DEVICE CONTROLLER	ETS EMCO	2090	NO CALIBRATION REQUIRED	
1S2438	TRANSIENT LIMITER	AGILENT	11947A	SEE NOTE	
1S2508	AC LISN	SOLAR ELECTRONINCS	9252-50-R-24-BNC	6/5/2009	6/5/2010
1S2406	SPECTRUM ANALYZER	AGILENT	E4407	4/14/2009	4/14/2010
1S2198	HORN ANTENNA	EMCO	3115	9/10/2009	9/10/2010
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	
1S2121	PREAMP	HEWLETT PACKARD	8449B	10/26/2008	10/26/2009
1S2509	EMI TEST RECEIVER	RHODE & SCHWARZ	ESU40	4/27/2009	4/27/2010
1S2583	SPECTRUM ANALYZER	AGILENT	E4447A	1/12/2009	1/12/2010
1S2485	BILOG ANTENNA	TESEQ	CBL-6112D	1/26/2009	1/26/2010
1S2520	THERMO-HYGROMETER	FISHER SCIENTIFIC	11-661-7D	11/14/2007	11/13/2009
1S2482	5M CHAMBER	PANASHEILD	641431	11/18/2008	11/18/2009
1S2484	BILOG ANTENNA	TESEQ	CBL 6112D	1/21/2008	7/21/2009
N/A	HIGH PASS FILTER	MICRO-TRONICS	HPM13146	SEE NOTE	
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