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

January 23, 2008

BodyMedia, Inc
4 Smithfield Street, Ste 1100
Pittsburgh, PA 15222

Dear Scott Boehmke,

Enclosed is the EMC test report for compliance testing of the BodyMedia, Inc, BodyMedia® Armband Mini 2.4 as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-03 ed.), Part 15, Subpart C.

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 feel free to contact me.

Sincerely yours,
MET LABORATORIES, INC.

Jennifer Warnell
Documentation Department

Reference: (\BodyMedia, Inc\EMC23117-FCC247 Rev. 3)

DOC EMC702 9/13/2007

Electromagnetic Compatibility
Test Report

for the

BodyMedia, Inc
BodyMedia® Armband Mini 2.4

Verified under
the FCC Certification Rules
contained in
Title 47 of the CFR, Part 15.247, Subpart C
for Intentional Radiators

MET Report: EMC23117-FCC247 Rev. 3

January 23, 2008

Prepared For:

BodyMedia, Inc
4 Smithfield Street, Ste 1100
Pittsburgh, PA 15222

Prepared By:
MET Laboratories, Inc.
914 W. Patapsco Avenue
Baltimore, Maryland 21230

Electromagnetic Compatibility
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for Intentional Radiators

Jeffrey Hazen
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 15.247, of the FCC Rules under normal use and maintenance.

Shawn McMillen,
Wireless Coordinator, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	November 30, 2007	Initial Issue.
1	December 27, 2007	Corrected Occupied Bandwidth and Output Power plots.
2	January 2, 2008	Corrections per technical review request.
3	January 23, 2008	Added antenna information.

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List of Terms and Abbreviations

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

I. Executive Summary

1.1 Purpose of Test

An EMC evaluation was performed to determine compliance of the BodyMedia, Inc, BodyMedia® Armband Mini 2.4, with the requirements of Part 15, §15.247. 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 BodyMedia® Armband Mini 2.4. BodyMedia, Inc should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the BodyMedia® Armband Mini 2.4, has been **permanently** discontinued

1.2 Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.247, in accordance with BodyMedia, Inc, purchase order number 10031. All tests were conducted using measurement procedure ANSI C63.4-2003.

Reference	Description	Results
Title 47 of the CFR, Part 15, Subpart C, §15.207	AC Power Line Conducted Emissions	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.203/15.247(b)(c)	Antenna Requirement	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.205(d)	Band Edge Emissions	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.247(a)(2)	6dB Occupied Bandwidth	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.247(b)(3)	Maximum Peak Conducted Output Power	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.247(d)	Spurious Radiated Emissions	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.247(e)	Peak Power Spectral Density	Compliant

Table 1. Executive Summary of EMC Part 15.247 ComplianceTesting

II. Equipment Configuration

2.1 Overview

MET Laboratories, Inc. was contracted by BodyMedia, Inc to perform testing on the BodyMedia® Armband Mini 2.4, under BodyMedia, Inc's purchase order number 10031.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the BodyMedia, Inc, BodyMedia® Armband Mini 2.4.

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

Model(s) Tested:	BodyMedia® Armband Mini 2.4	
Model(s) Covered:	BodyMedia® Armband Mini 2.4	
EUT Specifications:	Primary Power: 3.7 – 4.2 V Battery, 25 mA (max)	
	FCC ID: PV8-MF	
	Type of Modulations:	MSK – identical to offset QPSK with half-sine shaping (data coding may differ)
	Equipment Code:	DXT
	Peak RF Conducted Output Power:	0.543 mW
	EUT TX Frequency Ranges:	2.406 – 2.481 GHz
Analysis:	The results obtained relate only to the item(s) tested.	
Evaluated by:	Jeffrey Hazen	
Date(s):	November 30, 2007	

2.2 References

CFR 47, Part 15, Subpart C	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

2.3 Test Site

All testing was performed at MET Laboratories, Inc., 914 West Patapsco Avenue, Baltimore, MD 21230. 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. In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories. In accordance with §2.948(d), MET Laboratories has been accredited by the National Voluntary Laboratory Accreditation Program (Lab Code: 100273-0).

2.4 Description of Test Sample

The BodyMedia® Armband Mini 2.4, Equipment Under Test (EUT), is physiological monitoring device that is worn on the upper arm over the tricep. It gathers data from multiple sensors, processes it with algorithms, and stores the results onboard for later retrieval. It is self powered with a lithium polymer battery. While worn on the body, data can be retrieved wirelessly via 2.4GHz ISM band communication. When removed from the body, a USB cable can be connected to the armband to enable battery charging and wired communication.

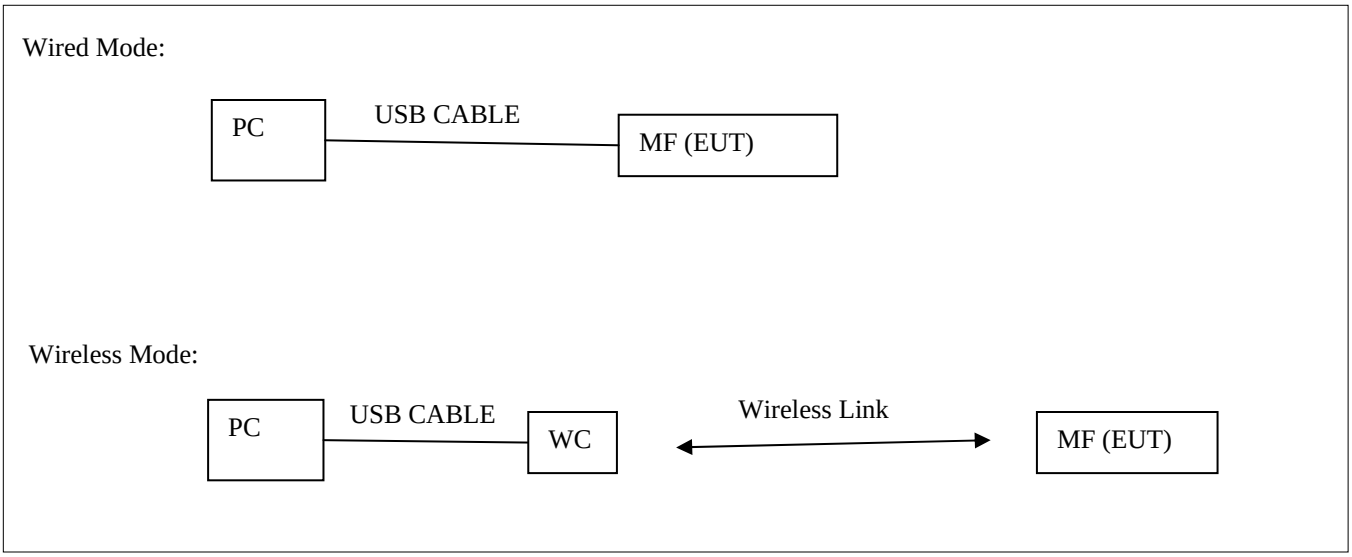


Figure 1. Block Diagram of Test Configuration (Radiated Emissions)

2.5 Equipment Configuration

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

Ref. ID	Name / Description	Model Number
MF	SENSEWEAR ARMBAND	MF

Table 2. Equipment Configuration

2.6 Support Equipment

BodyMedia, Inc supplied support equipment necessary for the operation and testing of the BodyMedia® Armband Mini 2.4. All support equipment supplied is listed in the following Support Equipment List.

Ref. ID	Name / Description	Manufacturer	Model Number	Serial Number
WC	BODYBUGG WIRELESS COMMUNICATOR V2	BODYMEDIA	908902PROD2	07154002, 07251721
PC	LAPTOP PC	SONY	VAIO	

Table 3. Support Equipment

2.7 Ports and Cabling Information

Ref. ID	Cable Description	Qty.	Length (m)	Shielded (Y/N)
USB CABLE	MINI-USB CABLE IS PLUGGED IN TO RECHARGE AND COMMUNICATE VIA USB. USB CABLE SHOULD NOT BE PLUGGED IN FOR WIRELESS OPERATION	1	2	Y

Table 4. Ports and Cabling Information

2.8 Mode of Operation

When awake, the system is constantly sensing and computing values, whether or not it is being worn on the body. To ensure the system is awake, press the button of the device.

2.9 Modifications

a) Modifications to EUT

No modifications were made to the EUT.

b) Modifications to Test Standard

No modifications were made to the test standard.

2.10 Disposition of EUT

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

III. Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

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

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

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

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

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

Results: The antenna is an integrated PCB Inverted-F type. Because it is an integrated antenna, it meets the requirements of this section. The EUT is therefore compliant with §15.203.

Test Engineer(s): Jeffrey Hazen

Test Date(s): 10/12/07

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.205 Band Edge Emissions

Test Requirement(s): **§ 15.205 (a):** Except as shown in paragraph (d) of **15.205 Restricted bands of operation**, only spurious emissions are permitted in any of the frequency bands specified in Table 5:

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Note
13.36–13.41.			
Note : Above 38.6			

Table 5. Restricted Bands of Operation from FCC Part 15, § 15.205

Test Procedure: The EUT was set up at maximum power. The first and the last channels were tested. It was verified that the channels tested were within the band 2400-2480 MHz and not infringing upon the restricted bands. The emissions were measured at 1 m from the EUT and corrected to 3 m distance using the correction factor of 20 log (1/3) = -9.54 dB.

Test Results: The EUT was compliant with the requirements of this section.

Test Engineer(s): Jeffrey Hazen

Test Date(s): 10/11/07

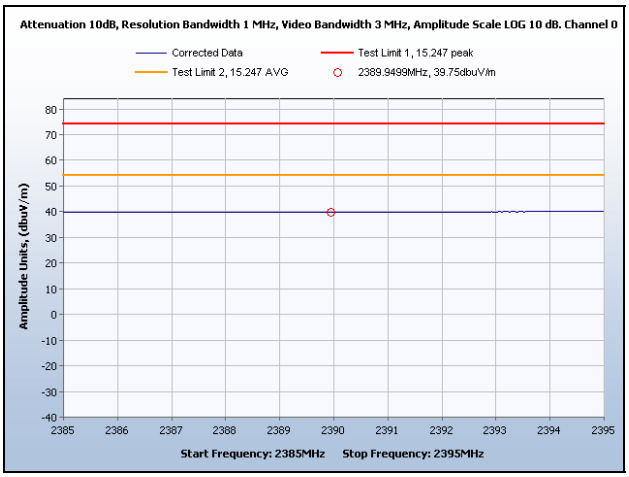
Band Edge Emissions – Test Results

Nearest Band Edge Frequency (GHz)	Actual Frequency Measured (GHz)	Channel of Operation	Corrected Measurement Average (dBuV/m)	Average Limit (dBuV/m)
2.39	2.3899	0	39.75	54
2.4835	2.4835	202	43.12	54

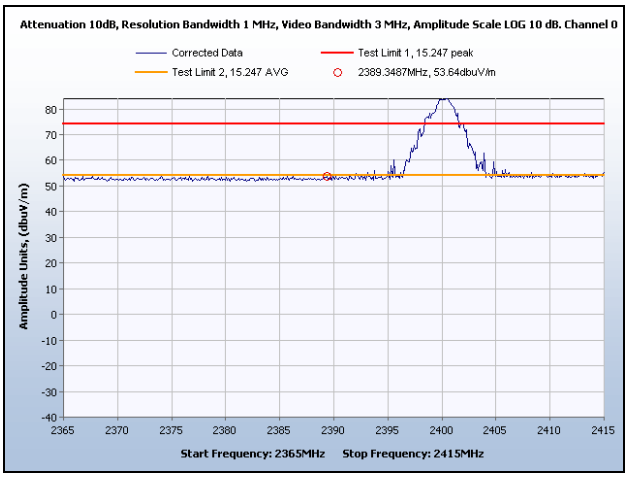
Table 6. Band Edge Average Emissions

Nearest Band Edge Frequency (GHz)	Actual Frequency Measured (GHz)	Channel of Operation	Corrected Measurement Average (dBuV/m)	Average Limit (dBuV/m)
2.39	2.389	0	53.64	74
2.4835	2.48355	202	66.17	74

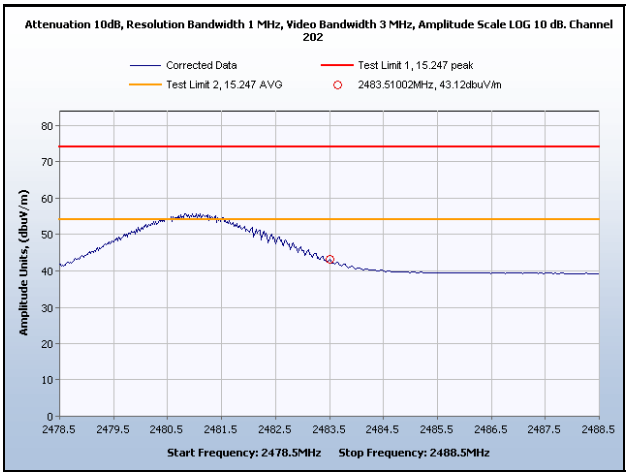
Table 7. Band Edge Peak Emissions



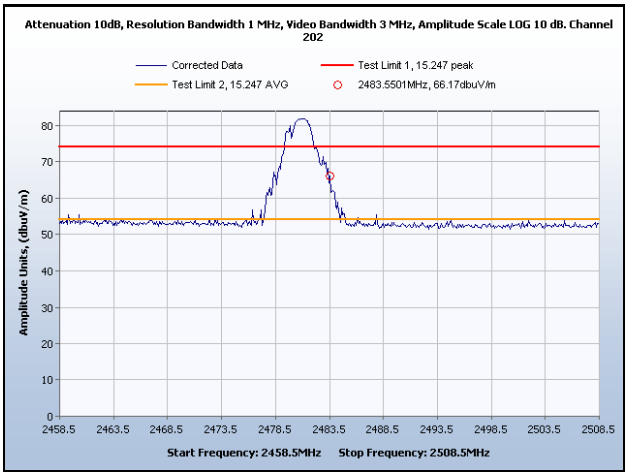
Band Edge Emissions, Channel 0, Average, LE



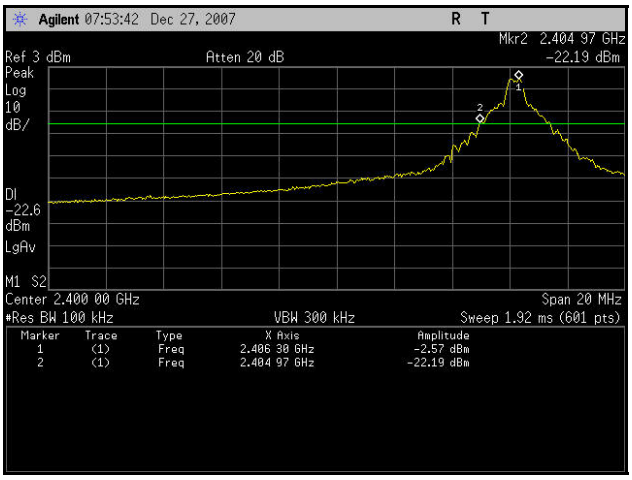
Band Edge Emissions, Channel 0, Peak, LE



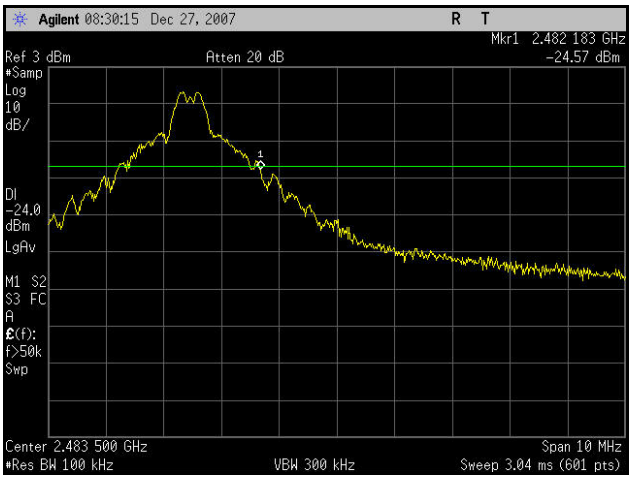
Band Edge Emissions, Channel 202, Average, HE



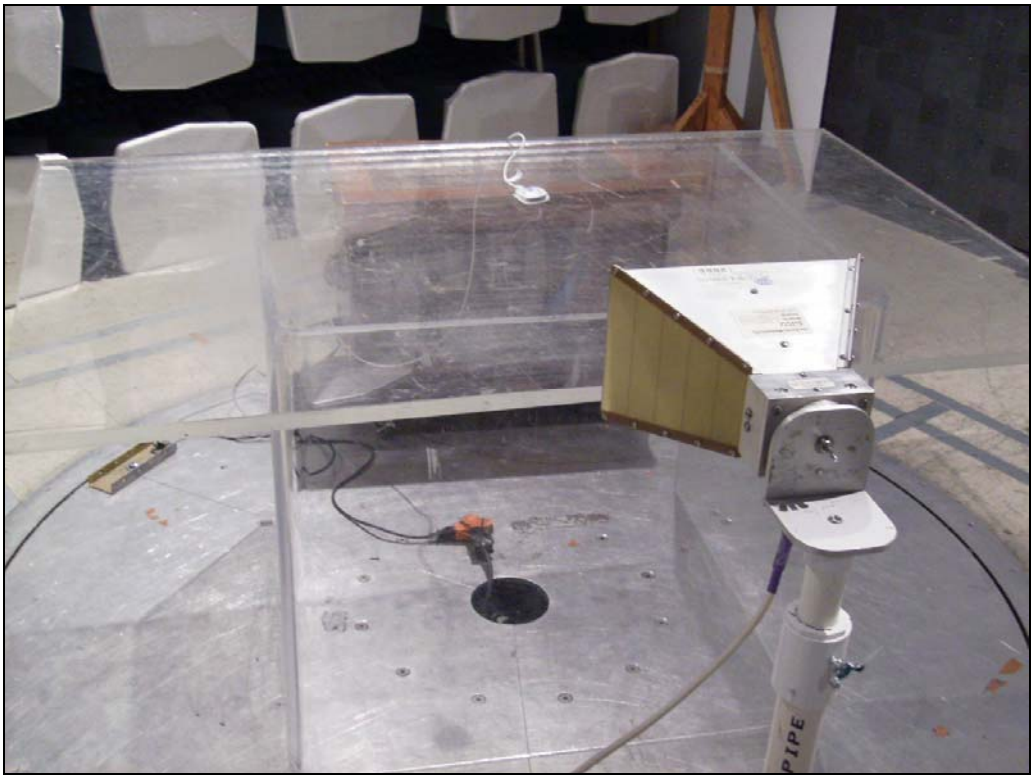
Band Edge Emissions, Channel 202, Peak, HE



Band Edge Conducted Emissions, Channel 15



Band Edge Conducted Emissions, Channel 202



Photograph 1. Band Edge Emissions, Test Setup

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 μH/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 (dBμV)	
	Quasi-Peak	Average
* 0.15- 0.45	66 - 56	56 - 46
0.45 - 0.5	56	46
0.5 - 30	60	50

Table 8. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Test Procedure: The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 μH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.4-1992 "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 μH LISN as the input transducer to an EMC/field intensity meter. The tests were conducted in a RF-shielded enclosure.

The EUT was operated in its normal mode of operation.

Test Results: The EUT was compliant with the Conducted Emission limits of **§15.207(a)** for Intentional Radiators. See following pages for detailed test results.

Test Engineer(s): Jeffrey Hazen

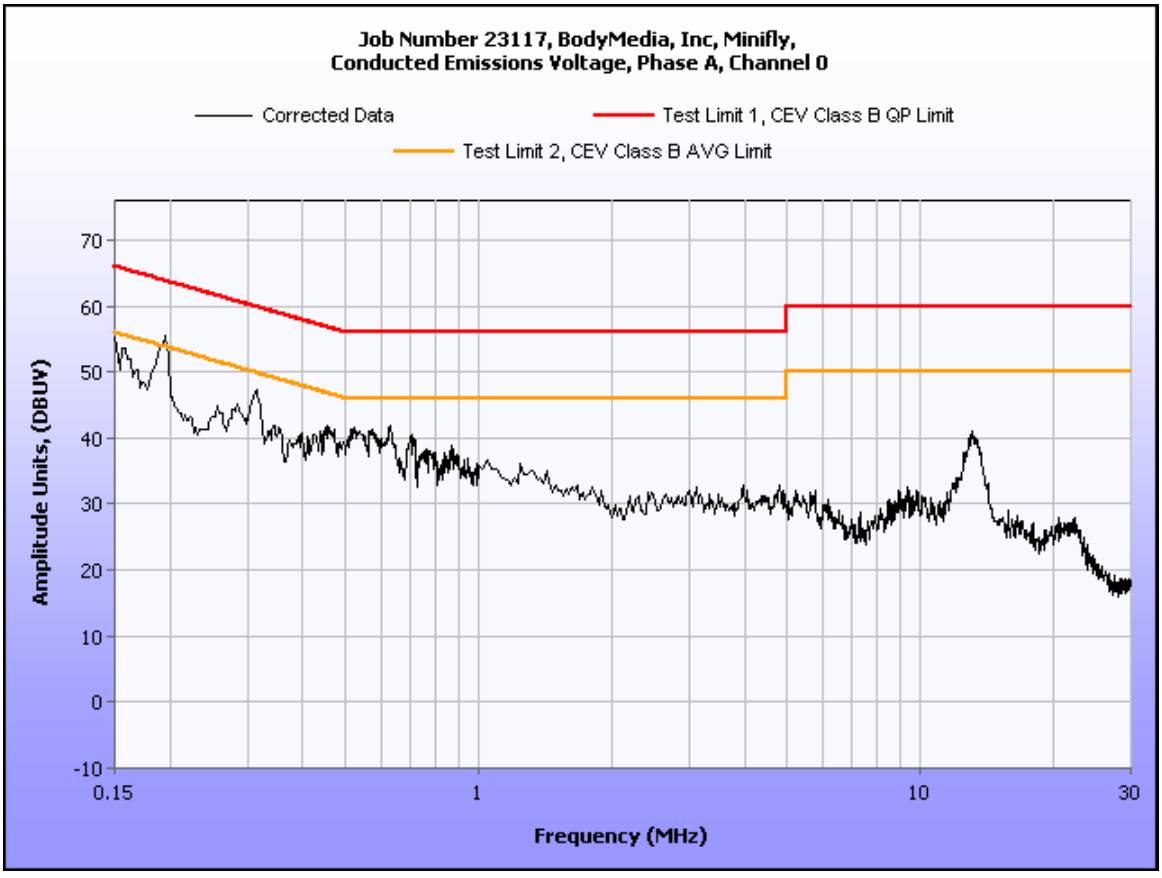
Test Date(s): 10/22/07

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207 Conducted Emissions Limits

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.318	45.9	0.17	46.07	59.76	-13.69	43.2	0.17	43.37	49.76	-6.39
0.204	43	0.0068	43.0068	63.45	-20.4432	32.4	0.0068	32.4068	53.45	-21.0432
0.634	39	0.17	39.17	56	-16.83	32.5	0.17	32.67	46	-13.33
0.71	36.9	0.17	37.07	56	-18.93	21.1	0.17	21.27	46	-24.73
0.518	35.7	0.17	35.87	56	-20.13	26.6	0.17	26.77	46	-19.23
0.714	36.6	0.17	36.77	56	-19.23	22.5	0.17	22.67	46	-23.33

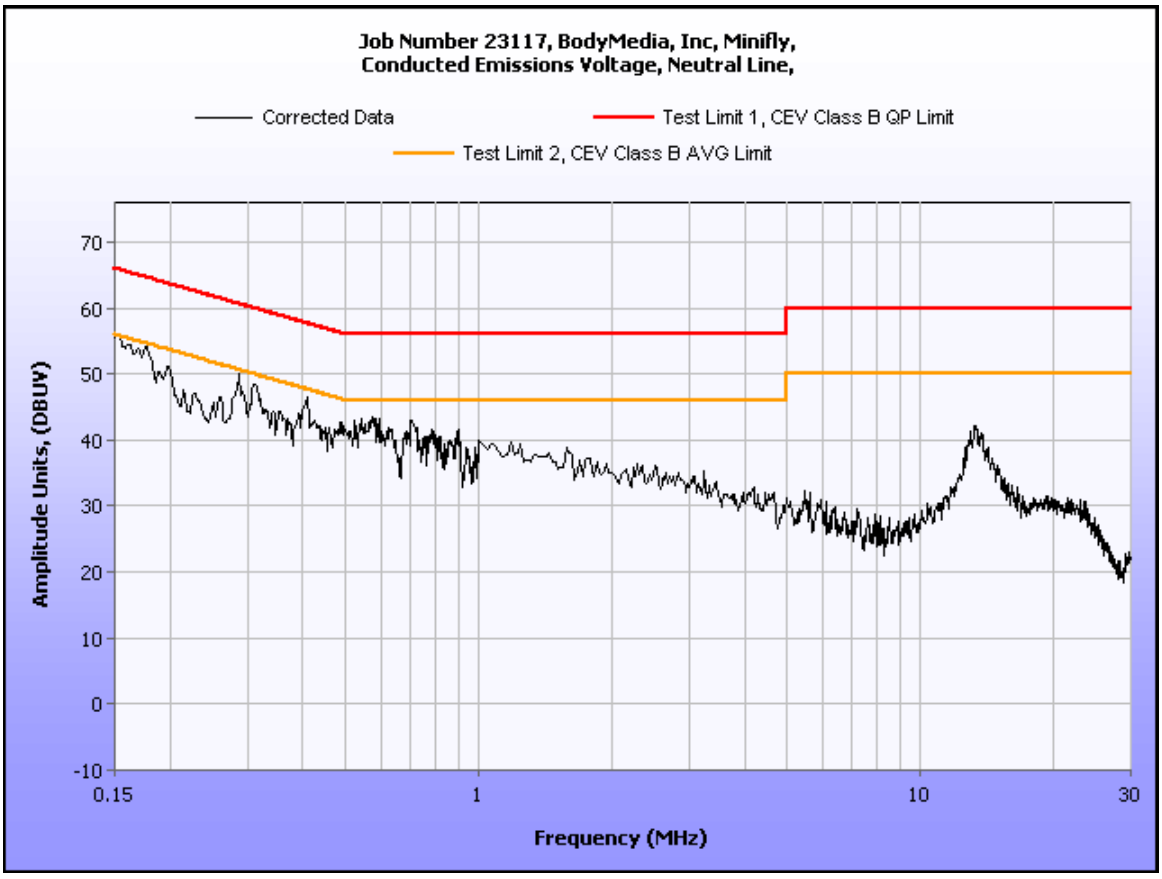
Table 9. Conducted Emissions - Voltage, Phase (120 VAC, 60 Hz), Channel 0



Plot 1. Conducted Emissions - Voltage, Phase Line Plot, Channel 0

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.17	51.8	0	51.8	64.96	-13.16	44.7	0	44.7	54.96	-10.26
0.318	47.4	0.17	47.57	59.76	-12.19	46.3	0.17	46.47	49.76	-3.29
0.259	43.9	0.1003	44.0003	61.46	-17.4597	40	0.1003	40.1003	51.46	-11.3597
0.201	43.5	0.0017	43.5017	63.57	-20.0683	38.5	0.0017	38.5017	53.57	-15.0683
0.636	40.8	0.17	40.97	56	-15.03	38.8	0.17	38.97	46	-7.03
0.691	39.9	0.17	40.07	56	-15.93	26.2	0.17	26.37	46	-19.63

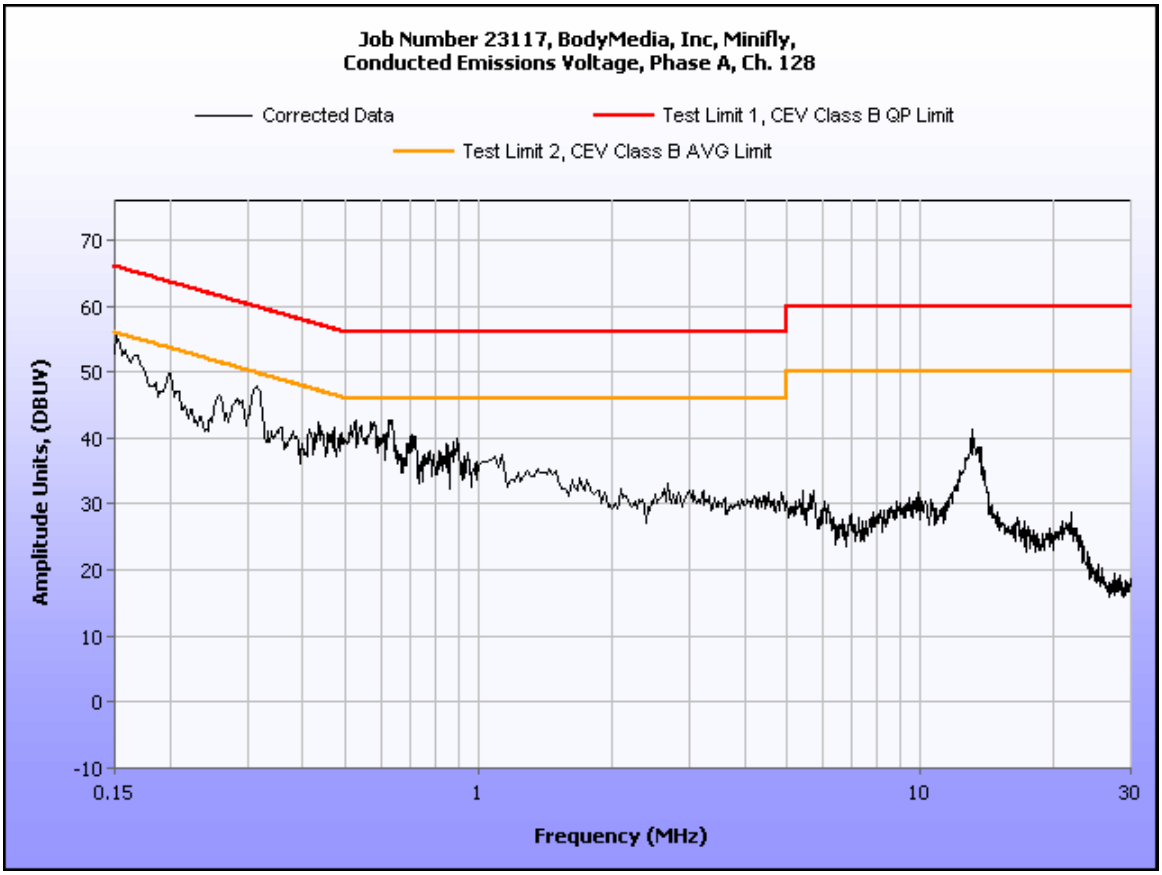
Table 10. Conducted Emissions - Voltage, Neutral (120 VAC, 60 Hz), Channel 0



Plot 2. Conducted Emissions - Voltage, Neutral Line Plot, Channel 0

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.317	47.1	0.17	47.27	59.79	-12.52	45	0.17	45.17	49.79	-4.62
0.202	46.6	0.0034	46.6034	63.53	-16.9266	34.7	0.0034	34.7034	53.53	-18.8266
0.288	43.8	0.1496	43.9496	60.58	-16.6304	39.5	0.1496	39.6496	50.58	-10.9304
0.261	43.3	0.1037	43.4037	61.4	-17.9963	39.9	0.1037	40.0037	51.4	-11.3963
0.234	41.1	0.0578	41.1578	62.31	-21.1522	35.8	0.0578	35.8578	52.31	-16.4522
0.635	40	0.17	40.17	56	-15.83	34.6	0.17	34.77	46	-11.23

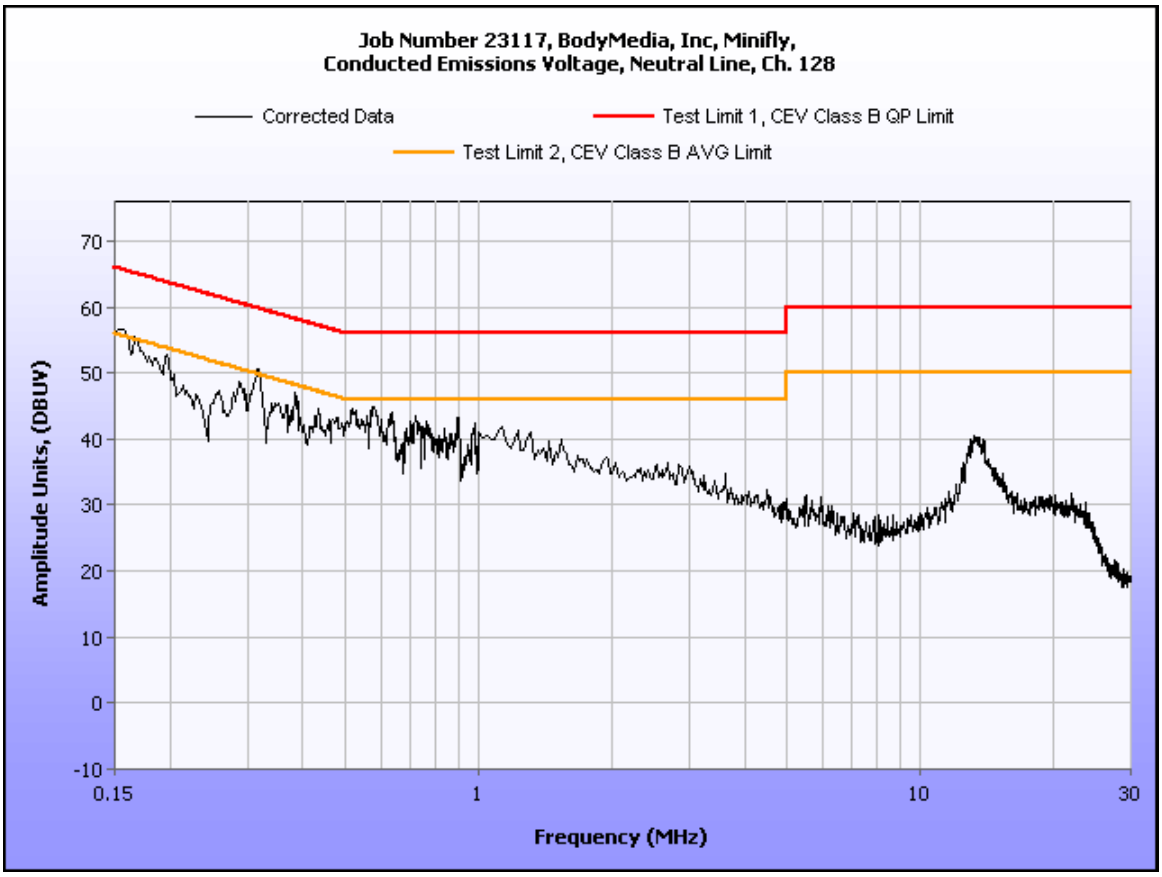
Table 11. Conducted Emissions - Voltage, Phase (120 VAC, 60 Hz), Channel 128



Plot 3. Conducted Emissions - Voltage, Phase Line Plot, Channel 128

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.319	48.2	0.17	48.37	59.73	-11.36	**47**	**0.17**	**47.17**	**49.73**	**-2.56**
0.292	45.7	0.1564	45.8564	60.47	-14.6136	40.8	0.1564	40.9564	50.47	-9.5136
0.258	44.1	0.0986	44.1986	61.5	-17.3014	40.2	0.0986	40.2986	51.5	-11.2014
0.579	42.4	0.17	42.57	56	-13.43	35.7	0.17	35.87	46	-10.13
0.432	42	0.17	42.17	57.21	-15.04	33.2	0.17	33.37	47.21	-13.84
0.633	41.4	0.17	41.57	56	-14.43	38.1	0.17	38.27	46	-7.73

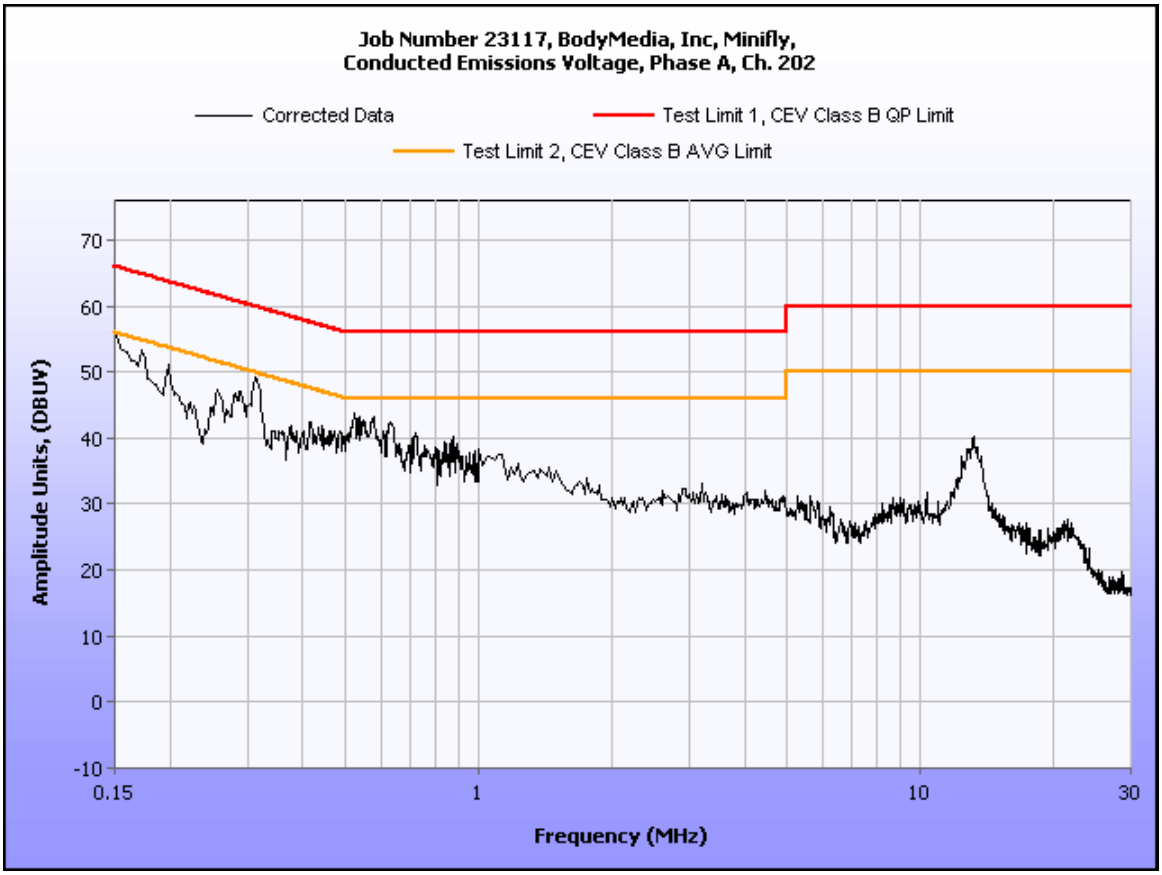
Table 12. Conducted Emissions - Voltage, Neutral (120 VAC, 60 Hz), Channel 128



Plot 4. Conducted Emissions - Voltage, Neutral Line Plot, Channel 128

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.317	47.6	0.17	47.77	59.79	-12.02	45.5	0.17	45.67	49.79	-4.12
0.291	42.9	0.1547	43.0547	60.5	-17.4453	37.2	0.1547	37.3547	50.5	-13.1453
0.258	42.8	0.0986	42.8986	61.5	-18.6014	39.1	0.0986	39.1986	51.5	-12.3014
0.522	38.3	0.17	38.47	56	-17.53	30.6	0.17	30.77	46	-15.23
0.634	39	0.17	39.17	56	-16.83	34.9	0.17	35.07	46	-10.93
0.176	47.8	0	47.8	64.67	-16.87	39.7	0	39.7	54.67	-14.97

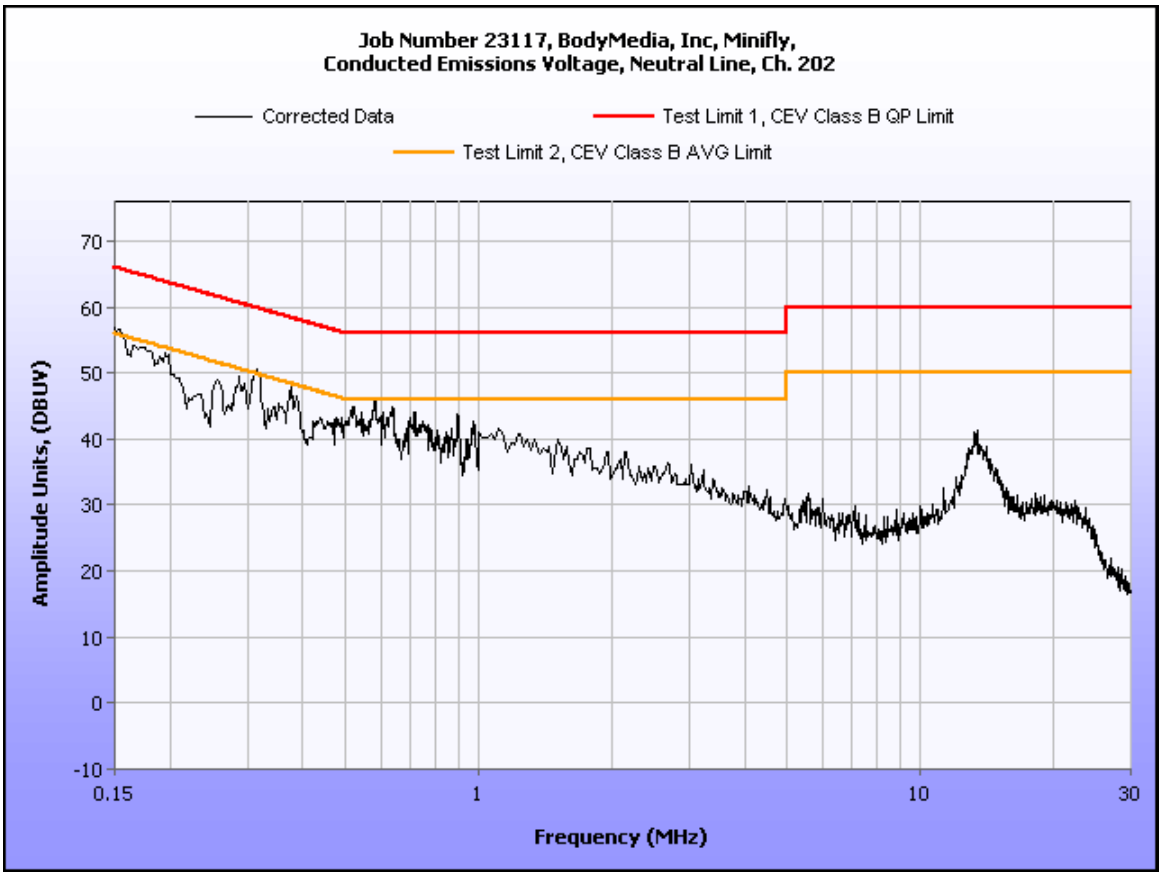
Table 13. Conducted Emissions - Voltage, Phase (120 VAC, 60 Hz), Channel 202



Plot 5. Conducted Emissions - Voltage, Phase Line Plot, Channel 202

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.321	47.1	0.17	47.27	59.68	-12.41	43.9	0.17	44.07	49.68	-5.61
0.262	45.5	0.1054	45.6054	61.37	-15.7646	41.6	0.1054	41.7054	51.37	-9.6646
0.386	42.8	0.17	42.97	58.15	-15.18	29.3	0.17	29.47	48.15	-18.68
0.353	42	0.17	42.17	58.89	-16.72	27.3	0.17	27.47	48.89	-21.42
0.431	41.3	0.17	41.47	57.23	-15.76	31.4	0.17	31.57	47.23	-15.66
0.374	41	0.17	41.17	58.41	-17.24	34.4	0.17	34.57	48.41	-13.84

Table 14. Conducted Emissions - Voltage, Neutral (120 VAC, 60 Hz), Channel 202



Plot 6. Conducted Emissions - Voltage, Neutral Line Plot, Channel 128

Electromagnetic Compatibility Criteria for Intentional Radiators

§15.109; § 15.209 Radiated Emissions – Unintentional Digital and Spurious

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 15.

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 15.

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

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

§ 15.205 (a): Except as shown in paragraph (d) of **15.205 Restricted bands of operation**, only spurious emissions are permitted in any of the frequency bands specified in Table 16:

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Note
13.36–13.41.			
Note: Above 38.6			

Table 16. Restricted Bands of Operation from FCC Part 15, § 15.205

§ 15.205 (b): (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

§ 15.35 (b): …When average radiated emission measurements are specified in this part, including emission measurements below 1000 MHz, there also is a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 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…

Frequency (MHz)	Field Strength (Microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F (kHz)	300
0.490 – 1.705	24000/F (kHz)	30
1.705 – 30.0	30	30
30 - 88	100 **	3
88 - 216	150 **	3
216 - 960	200 **	3
Above 960	500	3
** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.		

Table 17. Radiated Emissions Limits from § 15.209 (a)

Test Procedure:

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

The EUT was first setup in its normal mode of operation and placed on a 0.8 m high wooden table inside a semi-anechoic chamber. Measurements were performed with the EUT rotated 360° and varying the adjustable antenna mast with 1 m to 4 m height to determine the worst case orientation for maximum emissions. This showed the emissions most commonly associated with the unintentional digiral section.

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 10^{th} 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.

For radiated Spurious emissions, the EUT was scanned from 1 GHz to 14 GHz, excluding the band 2.3 GHz to 2.5 GHz, which was covered under Band Edge Emissions. In order to demonstrate compliance, measurements were taken in the form of peak plots shown with a peak and an average limit line. The plots were made at a 1m measurement distance and corrected for cable loss, distance correction, and antenna correction factors, by the capture software. At each channel of interest, the EUT was rotated about all three of its orthogonal axes.

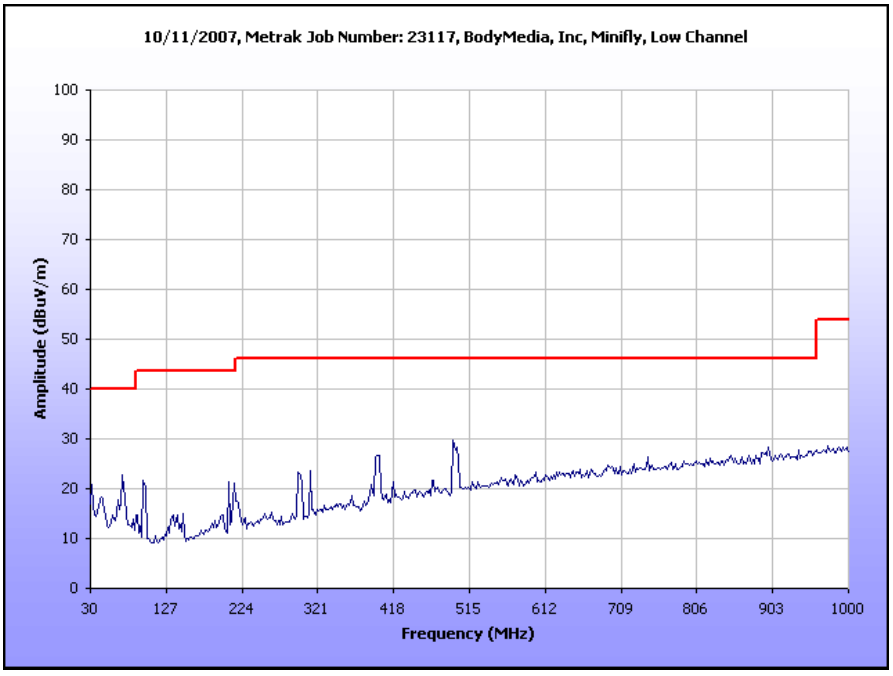
Peak measurements, which exceeded the average limit line were remeasured using video averaging and plotted against an average limit line. Tabular data shows measurements of interest. Channels 0, 7, 8, and 15 were tested.

Test Results: The EUT was compliant with the requirements of this section.
Test Engineer(s): Zijun Tong
Test Date(s): 10/11/07

Frequency (MHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna HEIGHT (m)	Uncorrected Amplitude (dBuV)	Antenna Correction Factor (dB/m) (+)	Cable Loss (dB) (+)	Distance Correction Factor (dB) (-)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
32.271	165	H	4.00	5.50	6.59	0.38	0.00	12.47	40.00	-27.53
32.271	133	V	1.00	12.96	5.19	0.38	0.00	18.53	40.00	-21.47
72.000	92	H	4.00	8.52	9.20	0.69	0.00	18.41	40.00	-21.59
72.000	360	V	1.00	12.90	8.24	0.69	0.00	21.83	40.00	-18.17
98.831	275	H	4.00	9.82	7.78	0.79	0.00	18.39	43.50	-25.11
98.831	197	V	1.00	13.92	7.21	0.79	0.00	21.92	43.50	-21.58
207.987	297	H	1.00	11.48	10.52	1.23	0.00	23.23	43.50	-20.27
207.987	0	V	1.71	9.30	10.30	1.23	0.00	20.83	43.50	-22.67
296.665	82	H	1.00	9.64	13.20	1.44	0.00	24.28	46.00	-21.72
296.665	232	V	1.72	6.51	12.60	1.44	0.00	20.55	46.00	-25.45
398.662	336	H	1.90	8.62	15.37	1.70	0.00	25.69	46.00	-20.31
398.662	205	V	2.88	5.72	15.35	1.70	0.00	22.77	46.00	-23.23
493.876	9	H	1.55	12.07	17.18	2.00	0.00	31.24	46.00	-14.76
493.876	283	V	1.98	9.87	17.20	2.00	0.00	29.07	46.00	-16.93

Table 18. Radiated Emissions, Channel 0

Note 1: The EUT was tested at 3 m. The data has been corrected for comparison with the 10 m limit using the formula: 20log (3 m/10 m) as expressed in the 'Distance Correction' column.

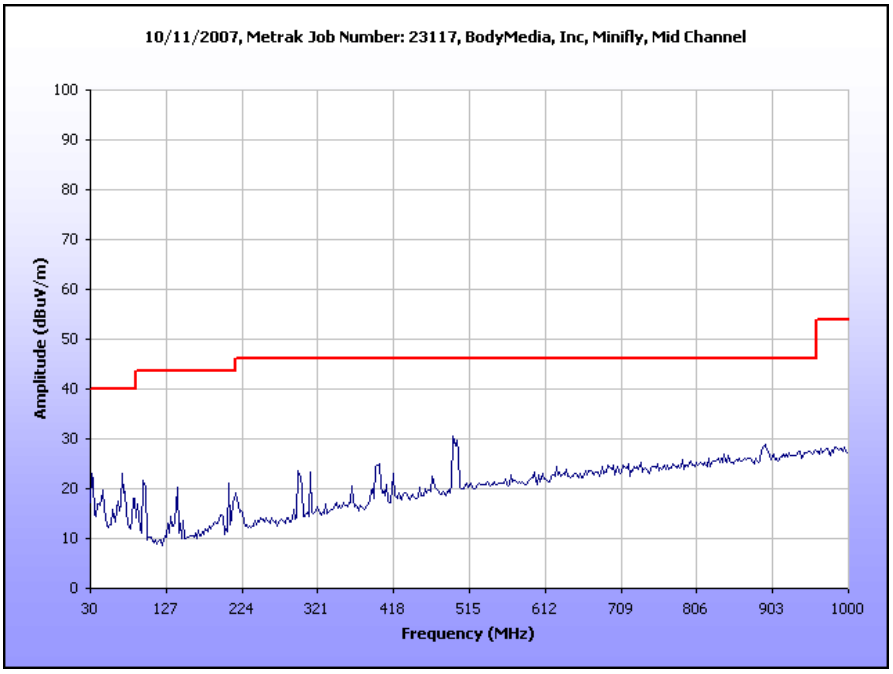


Plot 7. Radiated Emissions (30 MHz to 1 GHz), Pre-Scan, Channel 0

Frequency (MHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna HEIGHT (m)	Uncorrected Amplitude (dBuV)	Antenna Correction Factor (dB/m) (+)	Cable Loss (dB) (+)	Distance Correction Factor (dB) (-)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
72.009	90	H	4.00	8.62	9.20	0.69	0.00	18.50	40.00	-21.50
72.009	0	V	1.00	12.87	8.24	0.69	0.00	21.79	40.00	-18.21
98.826	112	H	2.12	11.12	7.78	0.79	0.00	19.69	43.50	-23.81
98.826	201	V	1.36	13.38	7.21	0.79	0.00	21.38	43.50	-22.12
207.992	298	H	1.00	11.24	10.52	1.23	0.00	22.99	43.50	-20.51
207.992	350	V	1.74	9.20	10.30	1.23	0.00	20.73	43.50	-22.77
296.678	81	H	1.00	9.78	13.20	1.44	0.00	24.42	46.00	-21.58
296.678	227	V	1.65	6.78	12.60	1.44	0.00	20.82	46.00	-25.18
399.035	345	H	1.00	7.48	15.38	1.70	0.00	24.56	46.00	-21.44
399.035	17	V	1.00	6.09	15.34	1.70	0.00	23.13	46.00	-22.87
493.839	0	H	1.54	12.53	17.18	2.00	0.00	31.70	46.00	-14.30
493.839	285	V	1.86	9.96	17.20	2.00	0.00	29.16	46.00	-16.84

Table 19. Radiated Emissions, Channel 128

Note 1: The EUT was tested at 3 m. The data has been corrected for comparison with the 10 m limit using the formula: 20log (3 m/10 m) as expressed in the 'Distance Correction' column.

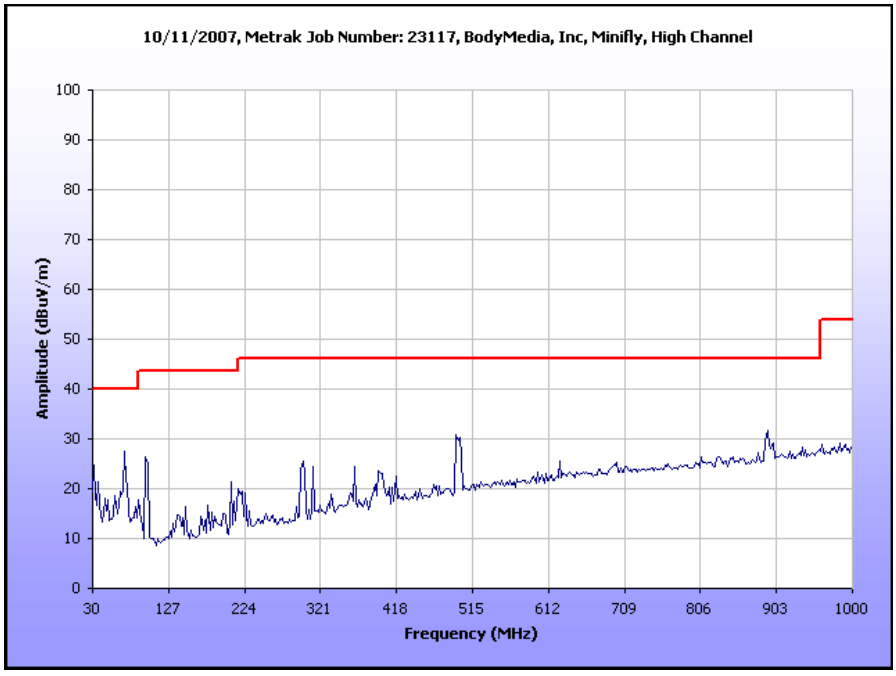


Plot 8. Radiated Emissions (30 MHz to 1 GHz), Pre-Scan, Channel 128

Frequency (MHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna HEIGHT (m)	Uncorrected Amplitude (dBuV)	Antenna Correction Factor (dB/m) (+)	Cable Loss (dB) (+)	Distance Correction Factor (dB) (-)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
72.033	75	H	4.00	9.15	9.19	0.69	0.00	19.03	40.00	-20.97
72.033	360	V	1.00	15.73	8.23	0.69	0.00	24.65	40.00	-15.35
95.067	0	H	1.00	6.78	7.70	0.78	0.00	15.26	43.50	-28.24
95.067	360	V	4.00	7.11	6.91	0.78	0.00	14.79	43.50	-28.71
98.822	282	H	4.00	10.32	7.78	0.79	0.00	18.89	43.50	-24.61
98.822	192	V	1.00	14.23	7.21	0.79	0.00	22.23	43.50	-21.27
207.995	85	H	1.00	10.67	10.52	1.23	0.00	22.42	43.50	-21.08
207.995	341	V	1.40	9.25	10.30	1.23	0.00	20.78	43.50	-22.72
299.169	311	H	1.00	8.78	13.20	1.45	0.00	23.43	46.00	-22.57
299.169	188	V	1.54	6.09	12.60	1.45	0.00	20.14	46.00	-25.86
493.968	353	H	1.51	12.25	17.18	2.00	0.00	31.43	46.00	-14.57
493.968	265	V	1.91	11.28	17.20	2.00	0.00	30.48	46.00	-15.52
889.100	238	H	2.63	6.23	22.20	2.86	0.00	31.29	46.00	-14.71
889.100	19	V	1.00	6.44	22.00	2.86	0.00	31.30	46.00	-14.70

Table 20. Radiated Emissions, Channel 202

Note 1: The EUT was tested at 3 m. The data has been corrected for comparison with the 10 m limit using the formula: 20log (3 m/10 m) as expressed in the 'Distance Correction' column.



Plot 9. Radiated Emissions (30 MHz to 1 GHz), Pre-Scan, Channel 128

Electromagnetic Compatibility Criteria for Intentional Radiators

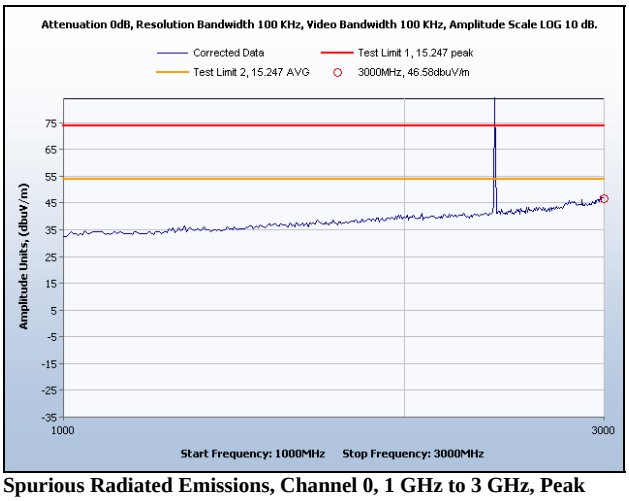
§ 15.209 Radiated Emissions – Spurious

Channel	Frequency (GHz)	Average Measurement (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)
0	7.83	<53.04	54	
128	9.965	<46.66	54	
202	7.76	<46.7	54	

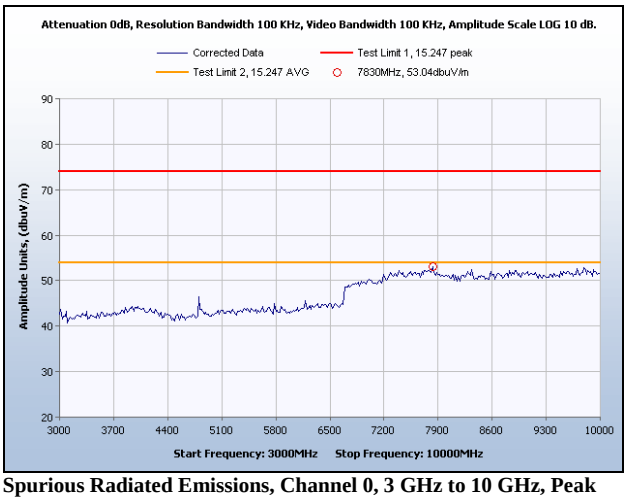
Table 21. Spurious Radiated Emissions, Average Test Results

Channel	Frequency (GHz)	Peak Measurement (dBuV/m)	Peak Limit (dBuV/m)	Margin (dB)
0	7.83	53.04	74	-20.96
128	9.965	46.66	74	-27.34
202	7.76	46.7	74	-27.30

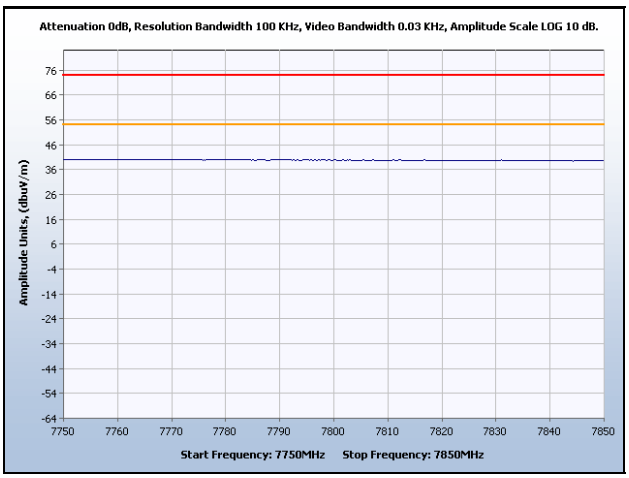
Table 22. Spurious Radiated Emissions, Peak Test Results



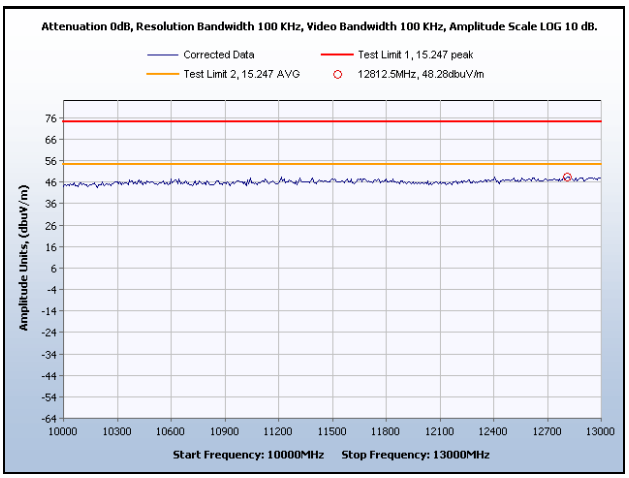
Spurious Radiated Emissions, Channel 0, 1 GHz to 3 GHz, Peak



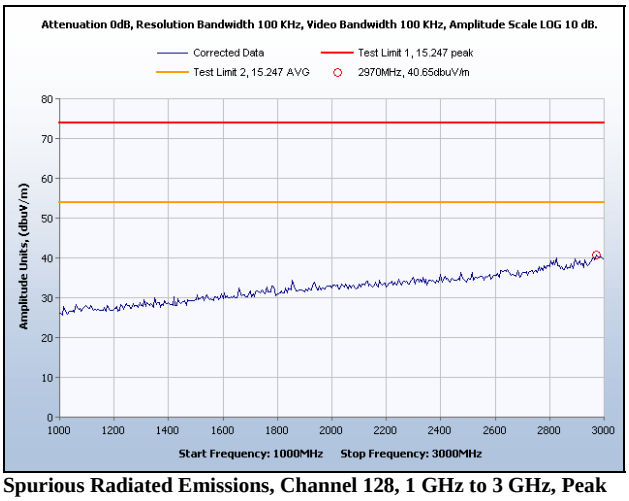
Spurious Radiated Emissions, Channel 0, 3 GHz to 10 GHz, Peak



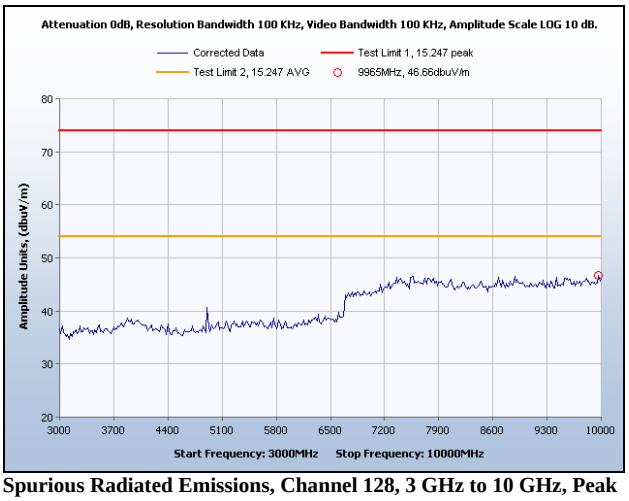
Spurious Radiated Emissions, Channel 0, 3 to 10 GHz, Average



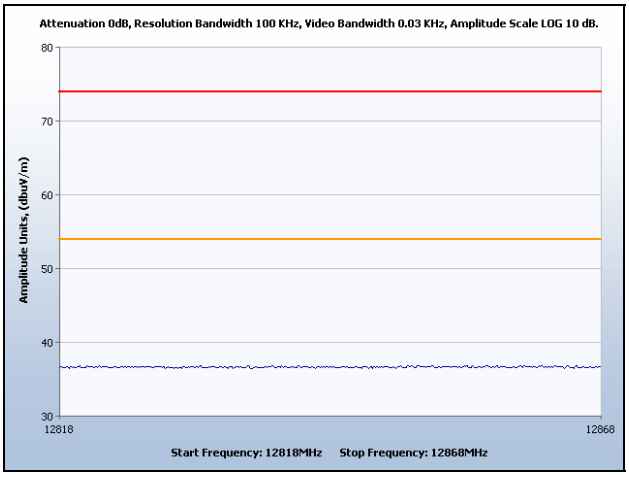
Spurious Radiated Emissions, Channel 0, 10 to 13 GHz, Peak



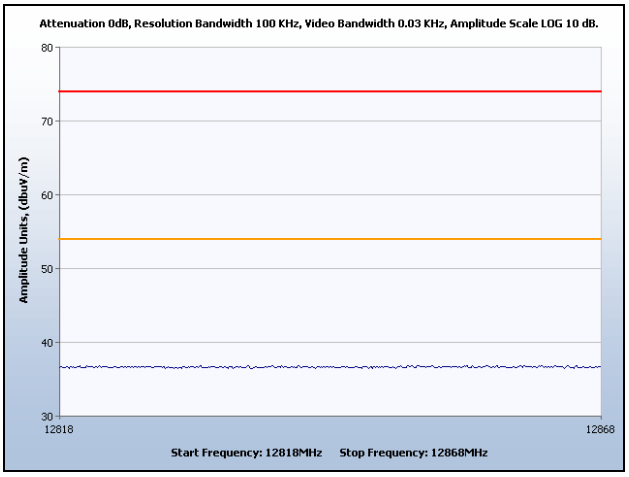
Spurious Radiated Emissions, Channel 128, 1 GHz to 3 GHz, Peak



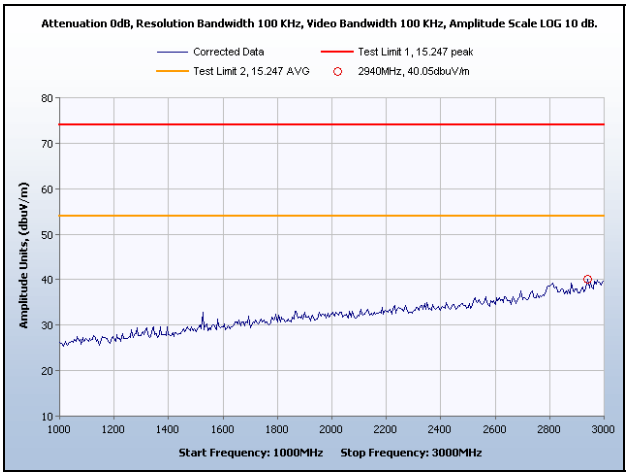
Spurious Radiated Emissions, Channel 128, 3 GHz to 10 GHz, Peak



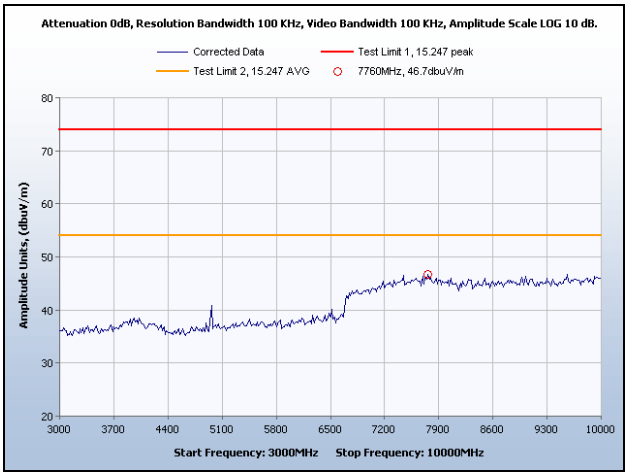
Spurious Radiated Emissions, Channel 128, 10 GHz to 13 GHz, Avg.



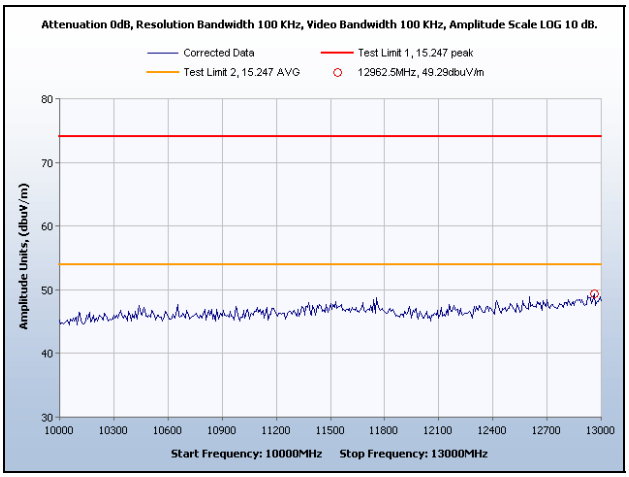
Spurious Radiated Emissions, Channel 128, 10 to 13 GHz, Avg.



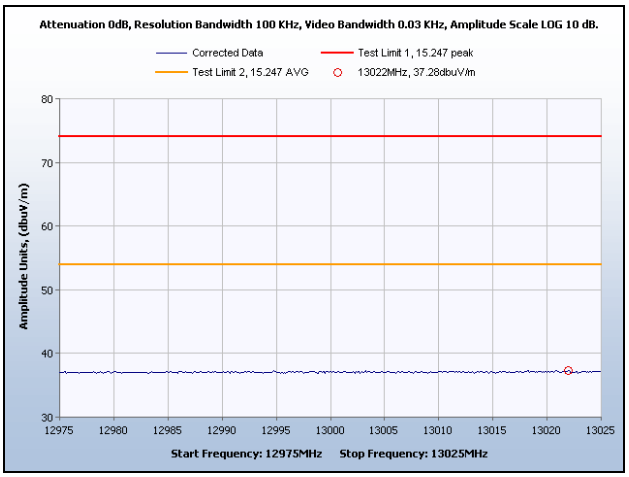
Spurious Radiated Emissions, Channel 202, 1 GHz to 3 GHz, Peak



Spurious Radiated Emissions, Channel 202, 3 GHz to 10 GHz, Peak



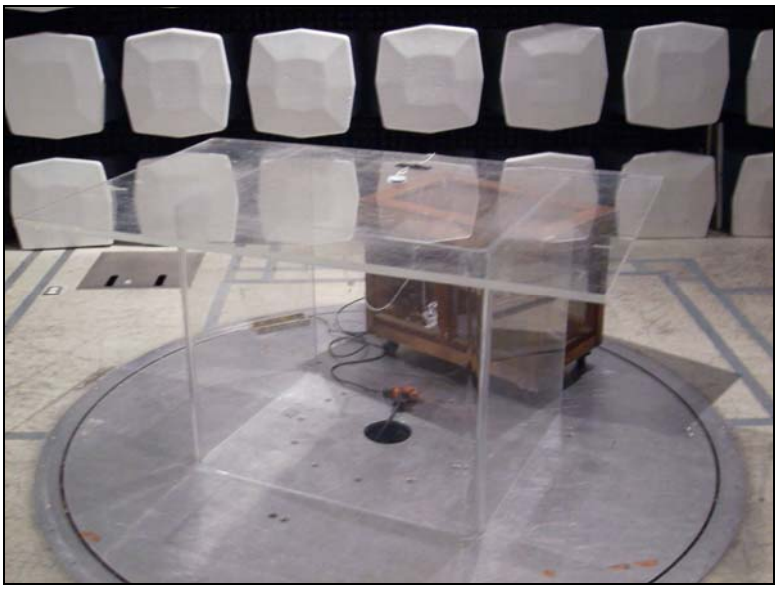
Spurious Radiated Emissions, Channel 202, 10 to 13 GHz, Peak



Spurious Radiated Emissions, Channel 202, 10 to 13 GHz, Avg.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.109; § 15.209 Radiated Emissions Limits



Photograph 2. Radiated Emission Test Setup (30 MHz to 1 GHz)

Photograph 3. Spurious Radiated Emissions, Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a) 6 dB a Bandwidth

Test Requirements: **§ 15.247(a):** Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:
§ 15.247(a)(2): For systems using digital modulation techniques, the EUT may operate in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

Test Procedure: A sample of the EUT filled with an SMA connector in place of the F antenna was used.

The transmitter was set to the channels 128 and 202 at the highest output power and connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW of 100 kHz, VBW > RBW. The 6 dB Bandwidth was measured and recorded.

Test Results: Equipment complies with § 15.247 (a). The 6 dB Bandwidth was determined from the plots on the following pages.

Test Engineer(s): Jeffrey Hazen

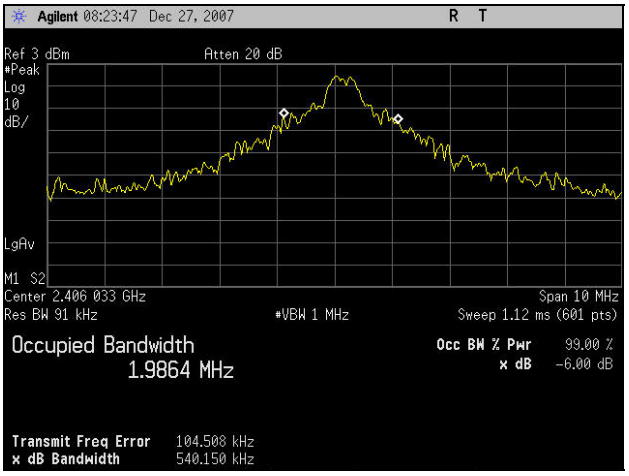
Test Date(s): 10/12/07

Electromagnetic Compatibility Criteria for Intentional Radiators

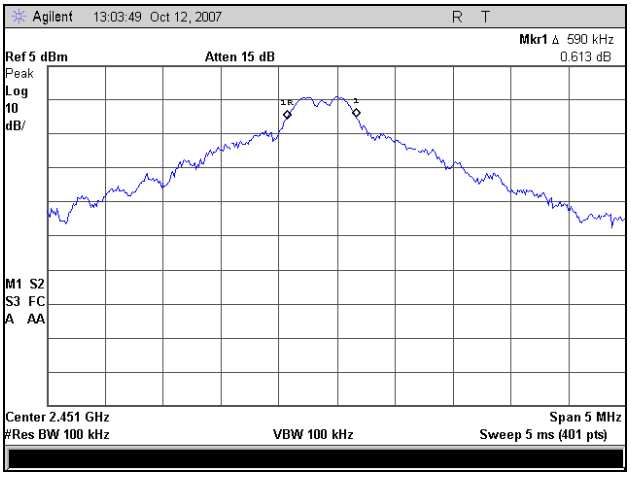
§ 15.247(a) 6 dB Bandwidth

Channel	Measured 6 dB Bandwidth	Test Limit (kHz)
15	540	>=500
128	590	>=500
202	535	>=500

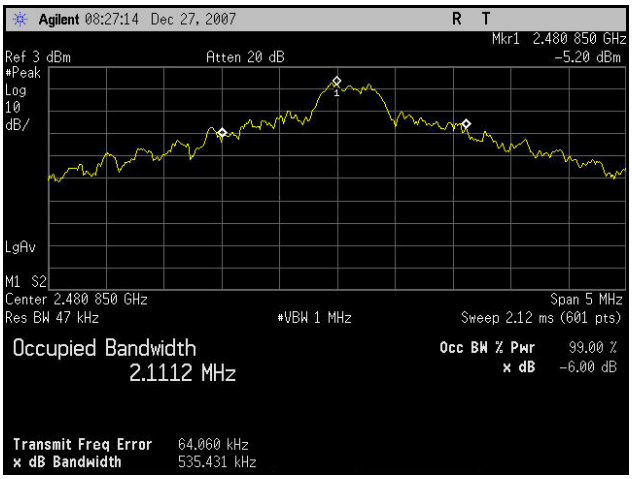
Table 23. 6 dB Bandwidth Test Results



6 dB Bandwidth, Channel 15



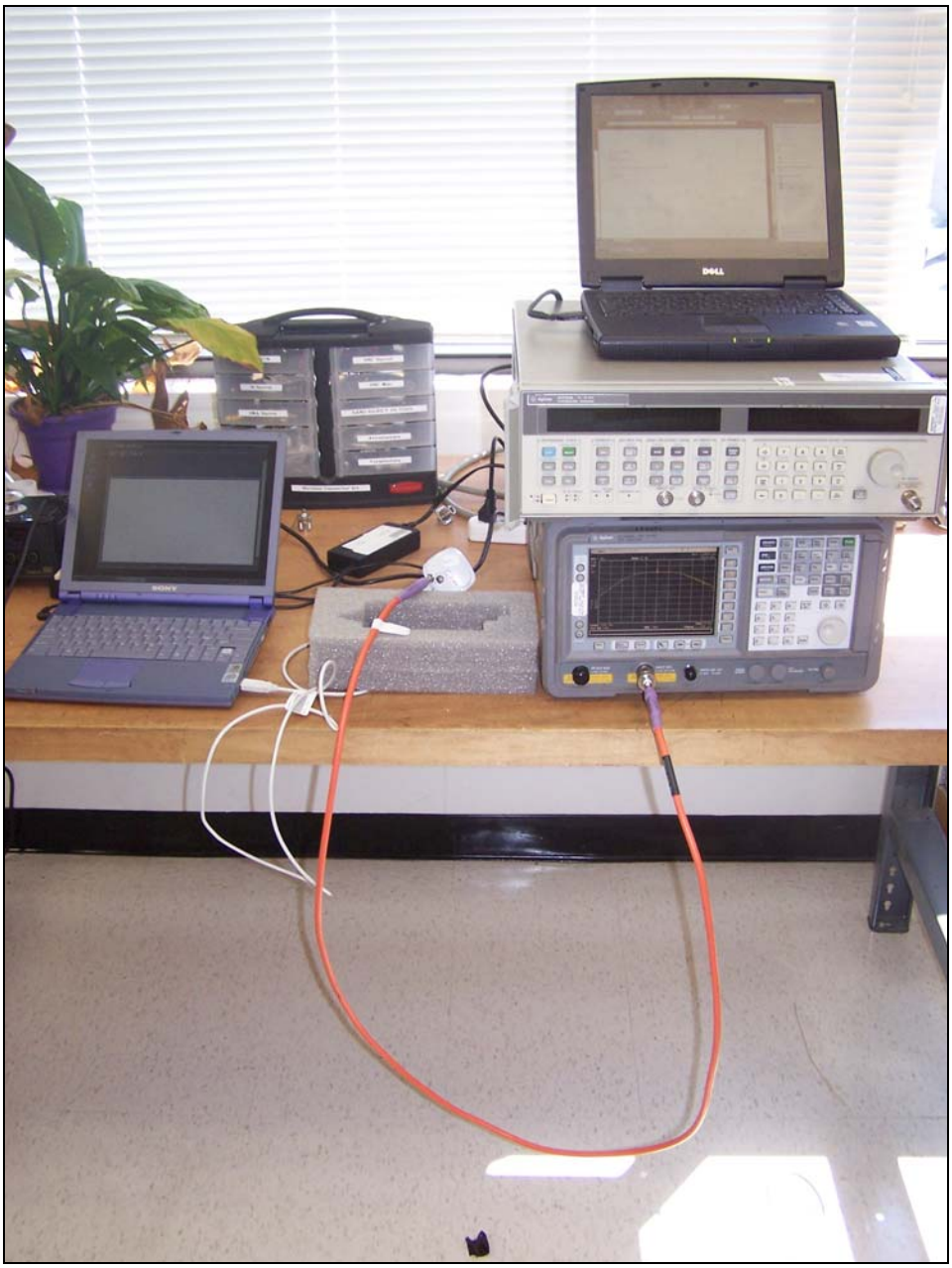
6 dB Bandwidth, Channel 128



6 dB Bandwidth, Channel 202

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a) 6 dB Bandwidth



Photograph 4. 6 dB Bandwidth Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output

Test Requirements: **§15.247(b):** The maximum peak output power of the intentional radiator shall not exceed the following:

Digital Transmission Systems (MHz)	Output Limit (Watts)
902-928	1.000
2400–2483.5	1.000
5725– 5850	1.000

Table 24. Output Power Requirements from §15.247

§15.247(c): if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in the Table 24, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 2400 – 2483.5 MHz band may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 5725 – 5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

Fixed, point-to-point operation excludes the use of point-to-multipoint systems, omni-directional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output

Test Procedure: A sample of the EUT fitted with an SMA connector, in place of the F antenna was used.

The transmitter was connected to a calibrated PSA Spectrum Analyzer. The EUT was measured at each channel.

Test Results: Equipment complies with the Peak Power Output limits of **§ 15.247(b)**.

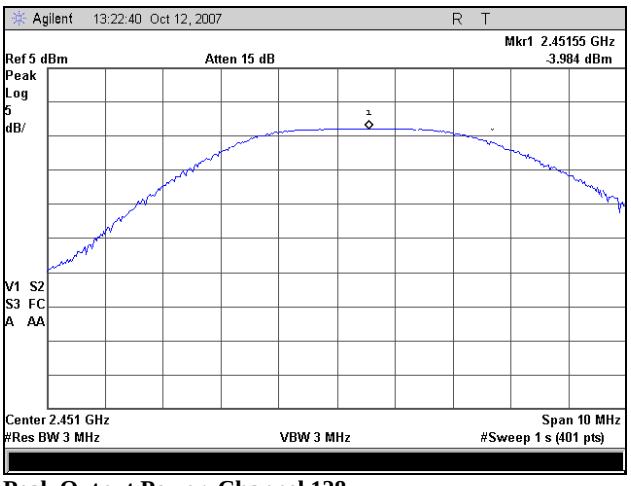
Channel #	Measured Output Power (dBm)
15	-2.65
128	-3.984
202	-3.67

Table 25. Peak Output Power

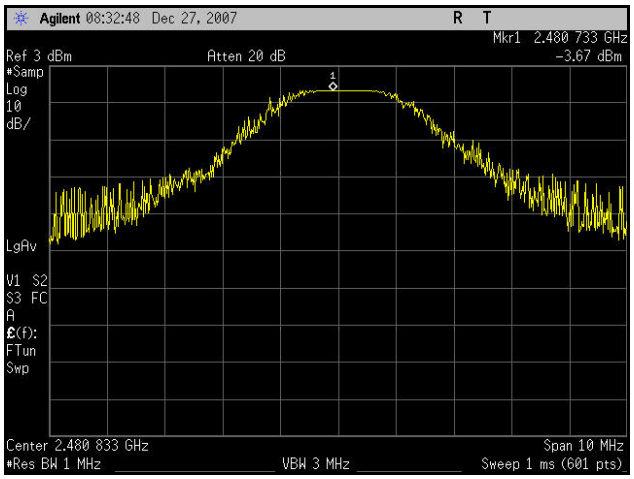
Test Engineer(s): Jeffrey Hazen

Test Date(s): 10/12/07

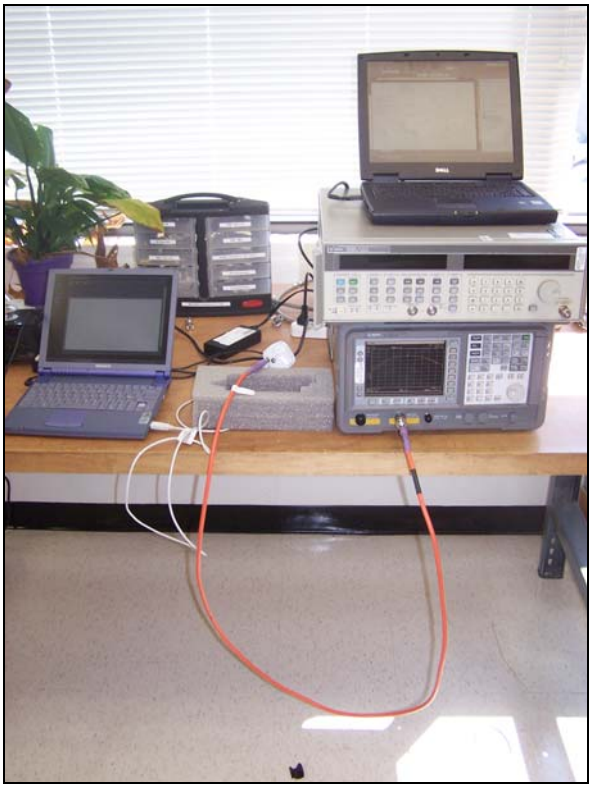
Peak Output Power, Channel 15



Peak Output Power, Channel 128



Peak Output Power, Channel 202



Photograph 5. Peak Power Output, Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Spurious Emissions – RF Conducted

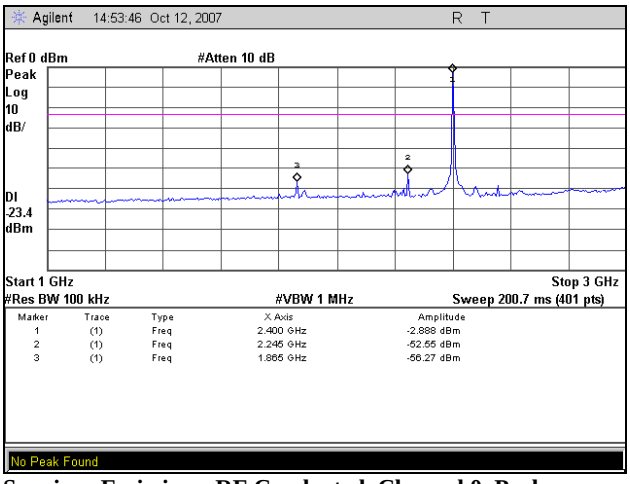
Test Requirements: **§15.247(d):** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a).

Test Procedure: The EUT was configured with the control software to transmit at maximum power. The transmit output was connected to the analyzer through an attenuator. RBW = 100 kHz, VBW ≥ RBW. Testing was performed for channels 0, 128, and 202.

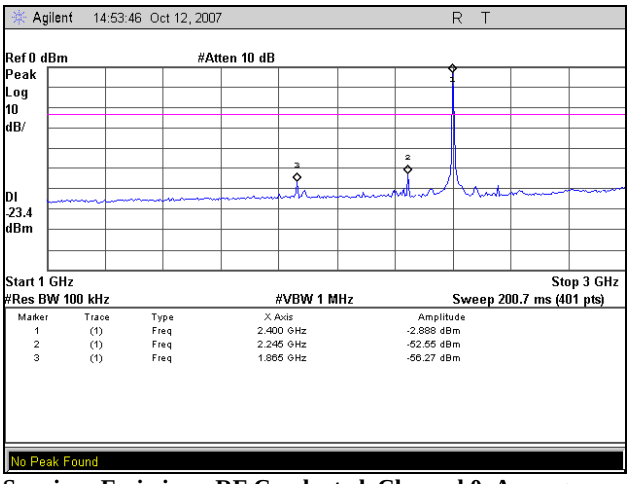
Test Results: The EUT was compliant with the requirements of this section.

Test Engineer(s): Jeffrey Hazen

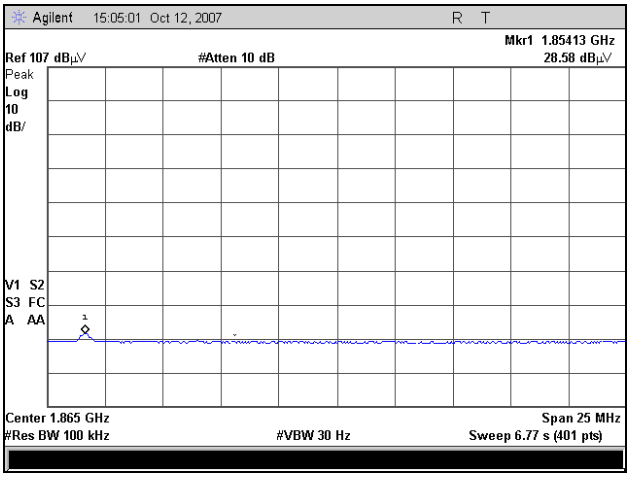
Test Date(s): 10/12/07



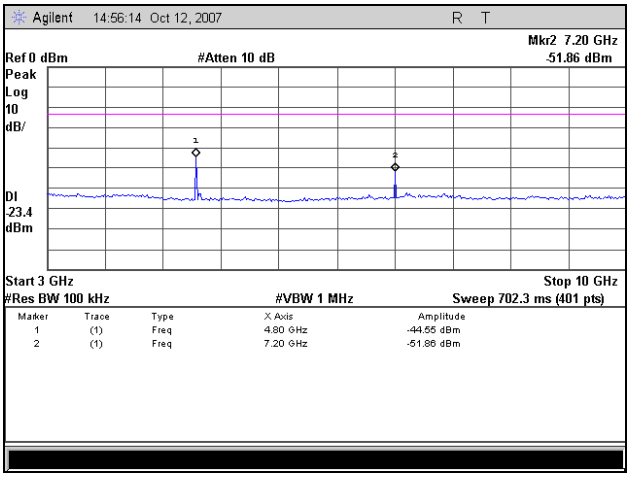
Spurious Emissions, RF Conducted, Channel 0, Peak



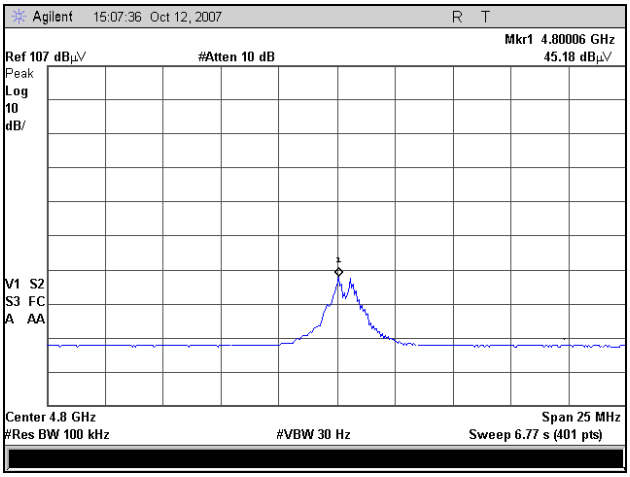
Spurious Emissions, RF Conducted, Channel 0, Average



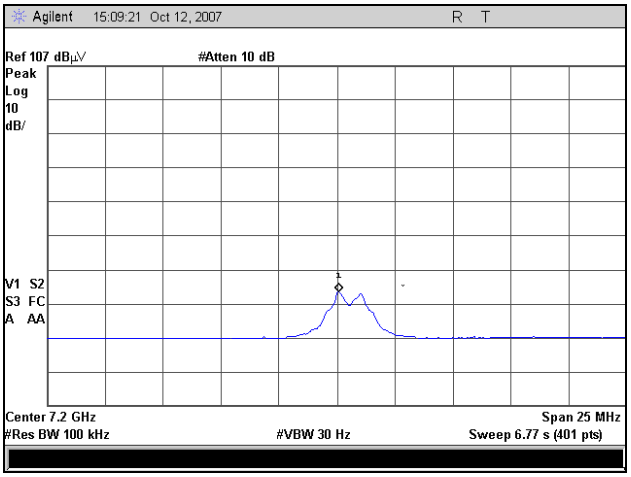
Spurious Emissions, RF Conducted, Channel 0, Average



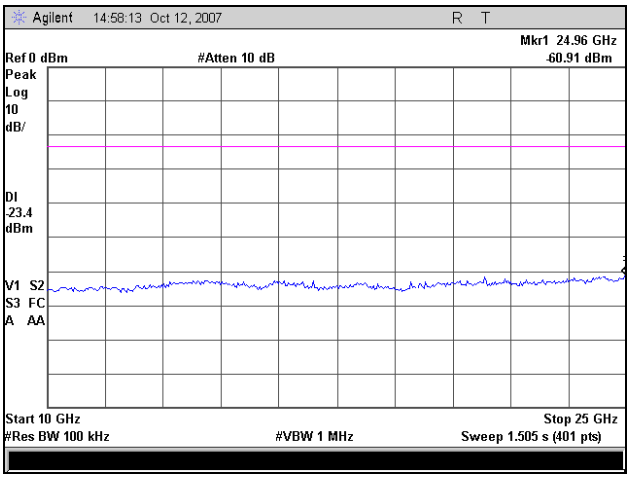
Spurious Emissions, RF Conducted, Channel 0, Peak, 3-10 GHz



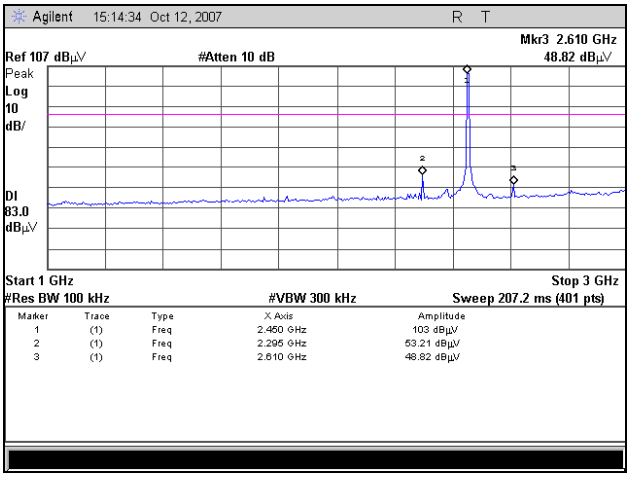
Spurious Emissions, RF Conducted, Channel 0, Average



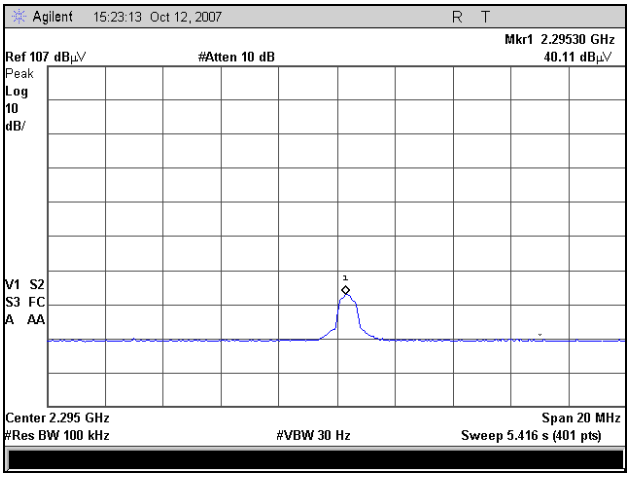
Spurious Emissions, RF Conducted, Channel 0, Average



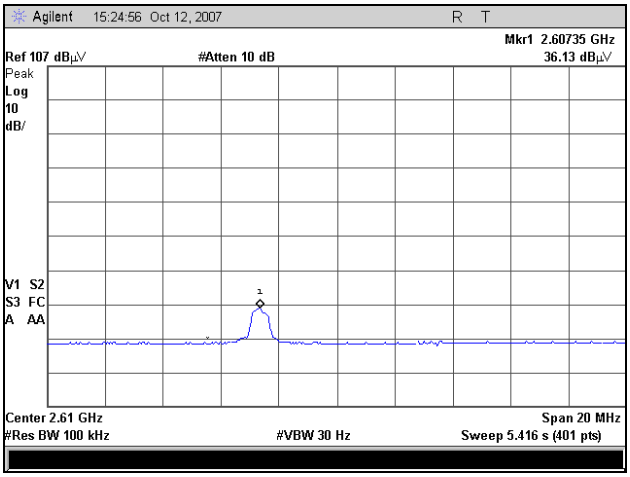
Spurious Emissions, RF Conducted, Channel 0, Peak, 10-25GHz



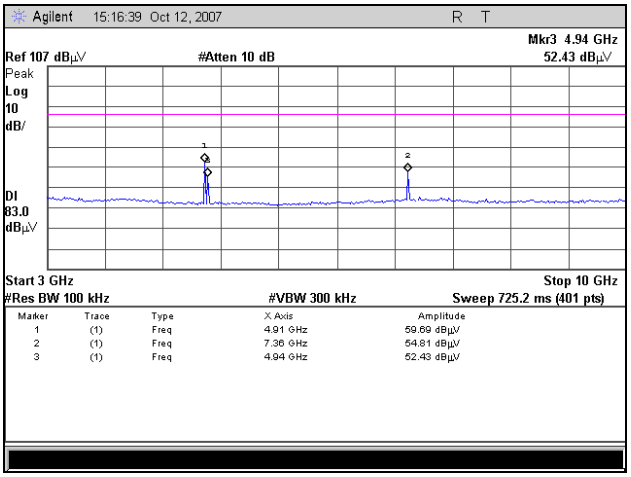
Spurious Emissions, RF Conducted, Channel 128, Peak



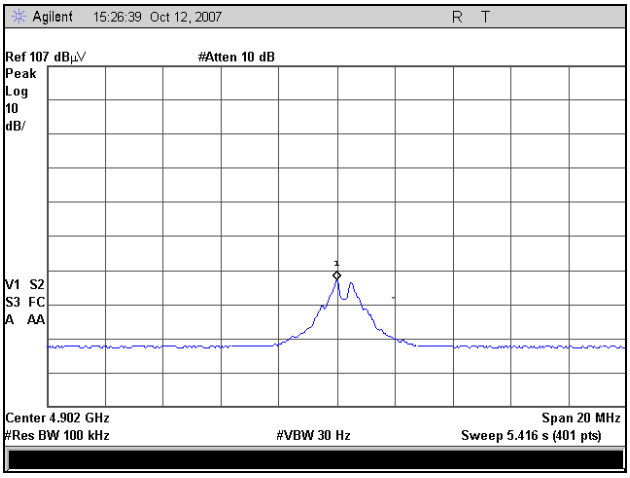
Spurious Emissions, RF Conducted, Channel 128, Peak



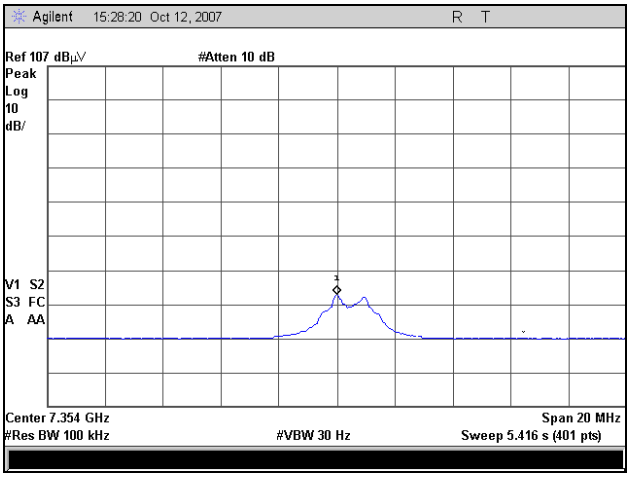
Spurious Emissions, RF Conducted, Channel 128, Peak



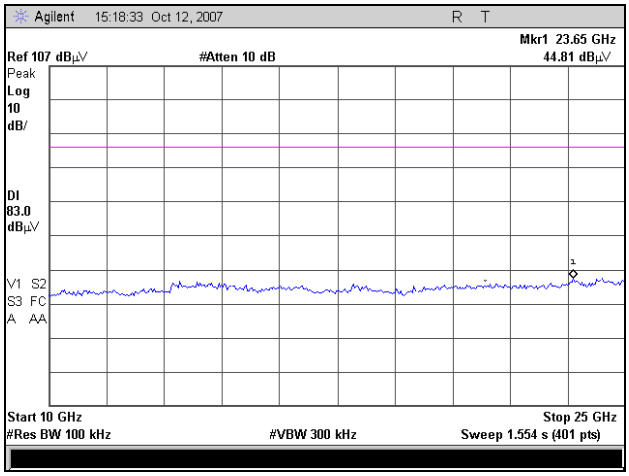
Spurious Emissions, RF Conducted, Channel 128, Peak, 3-10GHz



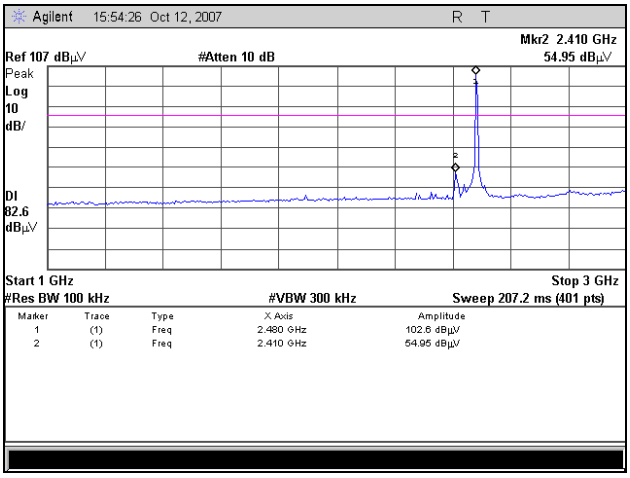
Spurious Emissions, RF Conducted, Channel 128, Avg., 3-10GHz



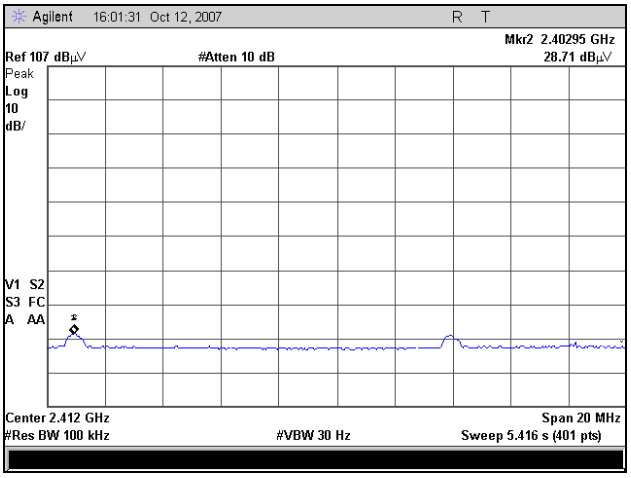
Spurious Emissions, RF Conducted, Channel 128, Avg., 3-10GHz



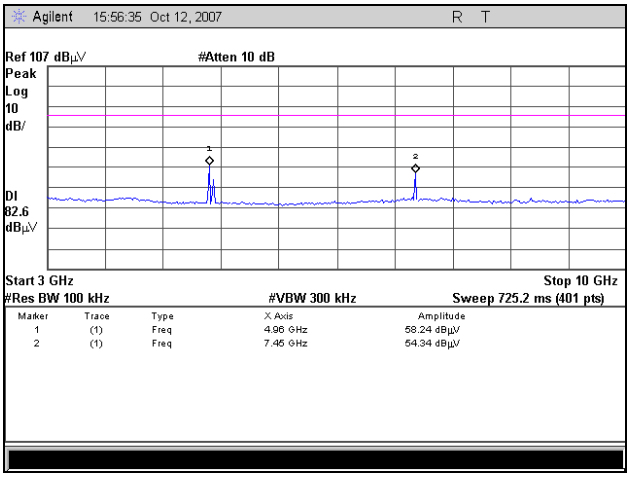
Spurious Emissions, RF Conducted, Channel 128, Peak, 10-25GHz



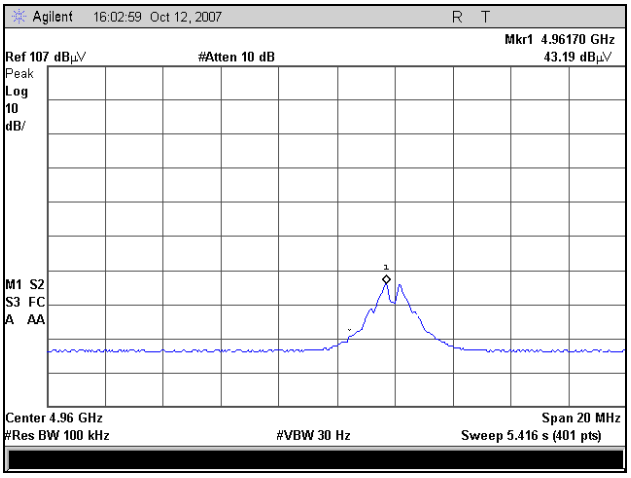
Spurious Emissions, RF Conducted, Channel 202, Peak, 1-3GHz



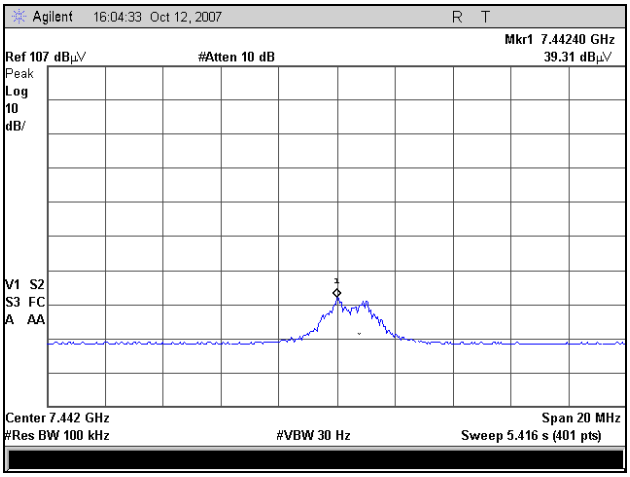
Spurious Emissions, RF Conducted, Channel 202, Avg., 1-3GHz



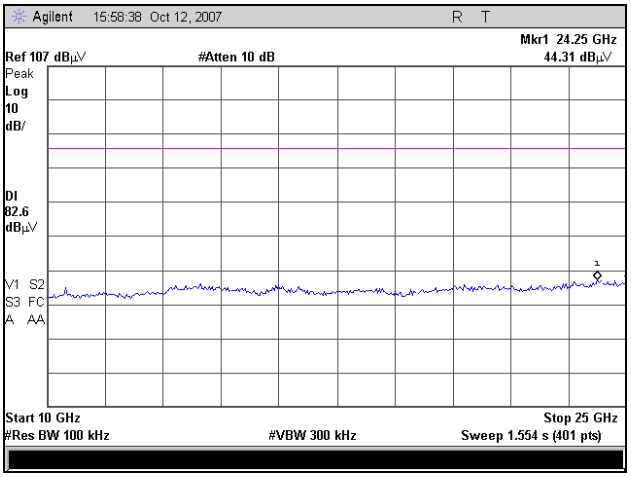
Spurious Emissions, RF Conducted, Channel 202, Peak, 3-10GHz



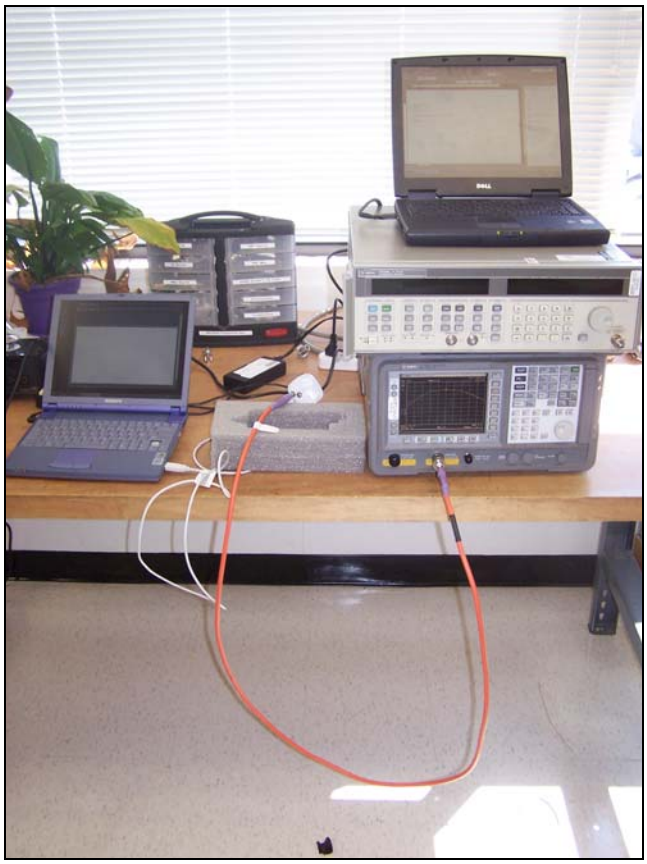
Spurious Emissions, RF Conducted, Channel 202, Avg., 3-10GHz



Spurious Emissions, RF Conducted, Channel 202, Avg., 3-10GHz



Spurious Emissions, RF Conducted, Channel 202, Peak, 10-25GHz



Photograph 6. Spurious Conducted Emissions, Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(e) Peak Power Spectral Density

Test Requirements: **§15.247(e):** For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

Test Procedure: The transmitter was connected directly to a Spectrum Analyzer. The power level was set to the maximum level.
RBW = 3 kHz, VBW>RBW
Sweep = Span/ 3 kHz

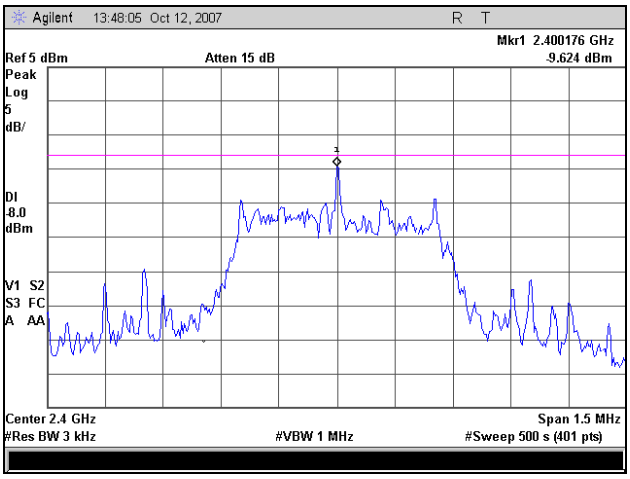
Test Results: Equipment complies with the peak power spectral density limits of **§ 15.247 (e)**. The peak power spectral density was determined from plots on the following page(s).

Test Engineer(s): Jeffrey Hazen

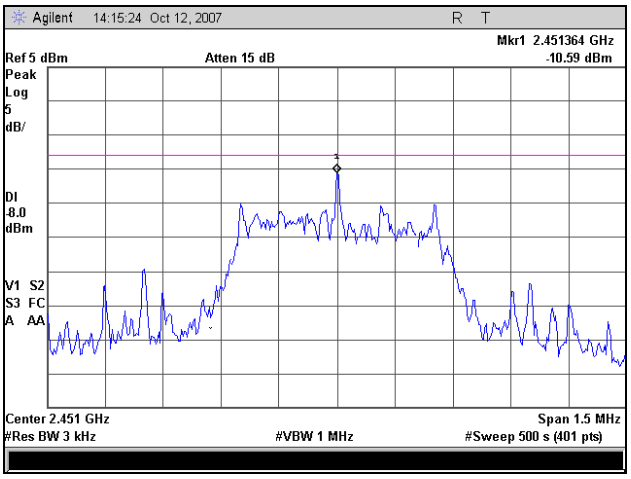
Test Date(s): 10/12/07

Channel	Measured PPSD (dBm)	Test Limit (dBm)
0	-9.624	8
128	-10.59	8
202	-11.4	8

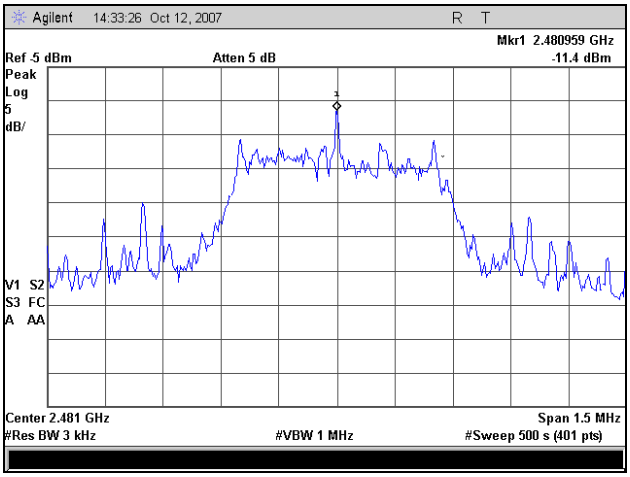
Table 26. Peak Power Spectral Density Test Results



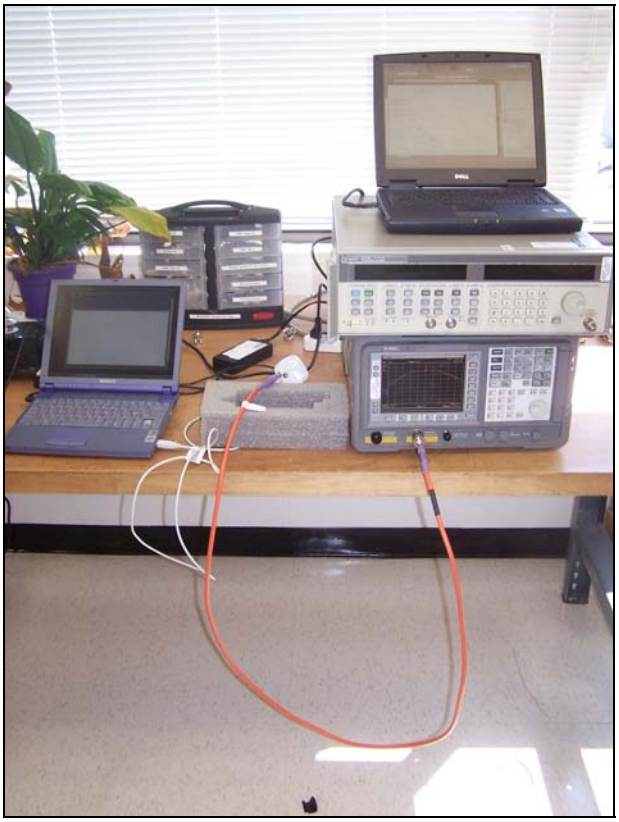
Peak Power Spectral Density, Channel 0



Peak Power Spectral Density, Channel 128



Peak Power Spectral Density, Channel 202



Photograph 7. Peak Power Spectral Density Test Setup

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.

Test Name: Conducted Emissions					Test Date: 10/22/07
MET Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1T4214	SHIELD ROOM #4	UNIVERSAL SHIELD INC	NONE	01/26/2007	01/26/2008
1T4302	EMI RECEIVER	HP	85462A	11/20/2006	11/20/2007
1T4565	LISN (24 AMP)	SOLAR ELECTRONICS	9252-50-R-24-BNC	09/10/2007	09/10/2008
1T4558	THERMOMETER/HYGROMETER	FISCHER SCIENTIFIC	S6-627-9	03/03/2006	03/03/2008
1T4502	COMB GENERATOR	COM-POWER	CGC-255	08/30/2007	08/30/2008
Test Name: Radiated Emissions					**Test Date: 10/11/07**
MET Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1T4554	THERMO-HYGROMETER	CONTROL COMPANY	56-627-9	04/11/2006	04/11/2008
1T4303	ANTENNA; BILOG	SCHAFNER - CHASE EMC	CBL6140A	06/29/2007	06/29/2008
1T4300	SEMI-ANECHOIC CHAMBER # 1	EMC TEST SYSTEMS	NONE	02/17/2006	01/17/2009
1T4400	FARADAY CAGE	MET LABORATORIES	N/A	SEE NOTE	
4561	TRANSIENT LIMITER	FISHER	N/A	SEE NOTE	
Test Name: 6 dB Bandwidth					**Test Date: 10/12/07**
MET Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1T4553	THERMO-HYGROMETER	CONTROL COMPANY	56-627-9	03/03/2006	03/03/2008
1T4351	SPECTRUM ANALYZER	AGILENT	E7405A	10/13/2006	10/13/2007
1T4514	SYNTH SWEEP GENERATOR	AGILENT	83752B/1E1	12/15/2006	12/15/2007
Test Name: Peak Power Output					**Test Date: 10/12/07**
MET Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1T4553	THERMO-HYGROMETER	CONTROL COMPANY	56-627-9	03/03/2006	03/03/2008
1T4351	SPECTRUM ANALYZER	AGILENT	E7405A	10/13/2006	10/13/2007
1T4514	SYNTH SWEEP GENERATOR	AGILENT	83752B/1E1	12/15/2006	12/15/2007
Test Name: Spurious Emissions					**Test Date: 10/21/07**
MET Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1T4300	SEMI-ANECHOIC CHAMBER # 1	EMC TEST SYSTEMS	NONE	02/17/2006	01/17/2009
1T2665	ANTENNA; HORN	EMCO	3115	04/17/2007	04/17/2008
1T4351	SPECTRUM ANALYZER	AGILENT	E7405A	10/13/2006	10/28/2007
1T4592	RF FILTER KIT	VARIOUS	N/A	SEE NOTE	
Test Name: Peak Power Spectral Density					**Test Date: 10/12/07**
MET Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1T4553	THERMO-HYGROMETER	CONTROL COMPANY	56-627-9	03/03/2006	03/03/2008
1T4351	SPECTRUM ANALYZER	AGILENT	E7405A	10/13/2006	10/13/2007
1T4514	SYNTH SWEEP GENERATOR	AGILENT	83752B/1E1	12/15/2006	12/15/2007

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

5.1 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

5.2 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 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.

VI. RF Exposure Letter

January 23, 2008

BodyMedia Minifly (Armband Mini 2.4) FCC ID: PV8-MF

In reference to TCB exclusions list on 17 July, 2002, portable transmitters with output power less than low threshold of 24.5mWatt. The distance between antenna and person's body within 2.5cm can be certified by FCC without SAR evaluation.

For SAR evaluation of the BodyMedia Armband Mini 2.4 FCC ID: PV8-MF, the maximum peak conducted output power was 0.543 mWatt.

Based on the above measurement it is concluded, that the BodyMedia Armband Mini 2.4 can be certified by FCC without SAR evaluation.

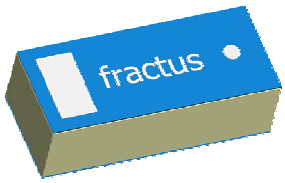
MET Laboratories

Appendix A – Antenna Information

Fractus Compact Reach Xtend™

Bluetooth®, 802.11b/g WLAN

Chip Antenna



Antenna Part Number:
FR05-S1-N-0-102

RoHS 2002/95/EC

TABLE OF CONTENTS

Fractus is an ISO 9001:2002 certified company
All our antennas are lead-free and RoHS compliant

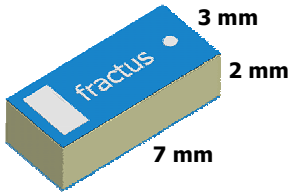
NOTES

The products described in this document are protected worldwide by at least one of the following Patents and Patent Applications owned by Fractus: WO0154225, WO0122528, PCT/EP01/10589, PCT/EP02/07837, US60/613394, US60/627653, and PCT/EP02/07836.

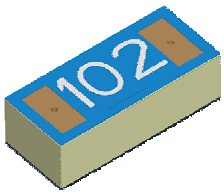
ANTENNA DESCRIPTION

Fractus® Compact Reach Xtend™ chip antenna is engineered specifically for Bluetooth®, WLAN 802.11 b/g and other wireless devices operating at the ISM 2.4 GHz band. Compact Reach Xtend combines small form factor size and high performance to improve the functionality of your wireless devices.

The Compact Reach Xtend is a low-cost antenna solution that combines small form factor and high performance with integration flexibility making it ideal for small consumer electronics devices such as wireless headsets and USB dongles.



Front



Back

APPLICATIONS

- Wireless Headsets
- WLAN 802.11 b/g USB-dongles
- Bluetooth USB and serial Dongles
- Compact Flash (CF) and Secure Digital (SD) cards
- Cellular handsets
- Digital Cameras

BENEFITS

- Low cost
- High efficiency
- Small form factor

QUICK REFERENCE GUIDE

Technical Features	
Frequency range	2400-2500 MHz
Radiation Efficiency	> 70%
Peak Gain	> 1 dBi
VSWR	< 2:1
Polarization	Linear
Weight	0.1 g
Temperature	-40 to + 85ºC
Impedance	50Ω
Dimensions	7x3x2 mm

Table 1 -*Technical Features*

Note : results measured in a reference evaluation board of 41x23 mm described in the following section.

Please contact your sales representative at Richardson Electronics if you require additional information on antenna integration or optimisation on your PCB.

RICHARDSON ELECTRONICS
Refer to page 12 of this User Manual for contact information of your local sales agent.

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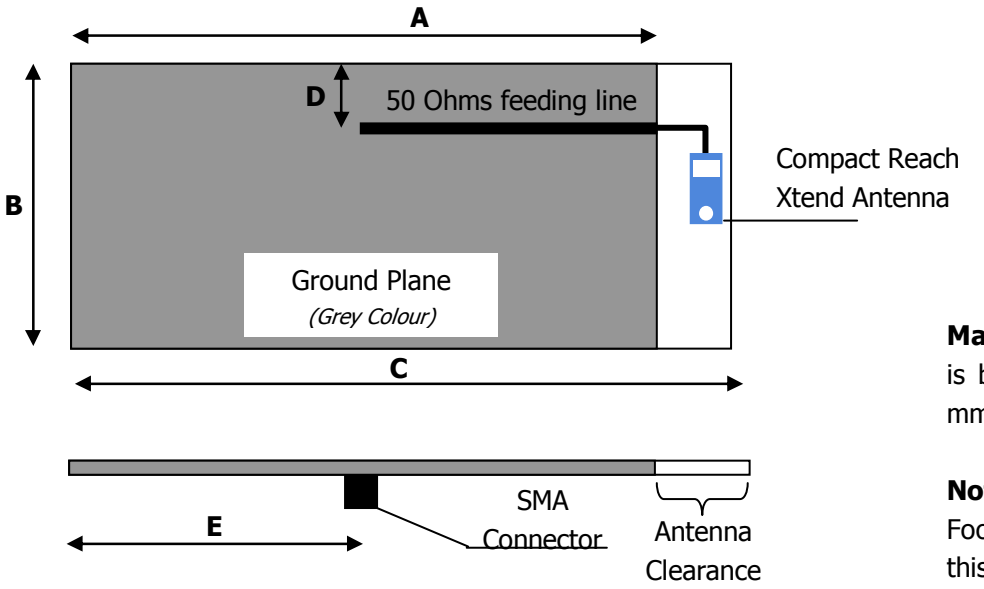
ELECTRICAL PERFORMANCE

FRACTUS EVALUATION BOARD

The Fractus configuration used in testing the Compact Reach Xtend chip antenna is displayed in Figure 1.



A	41.0 mm
B	23.0 mm
C	47.0 mm
D	7.0 mm
E	26.0 mm

Figure 1 – *Compact Reach Xtend Evaluation Board*

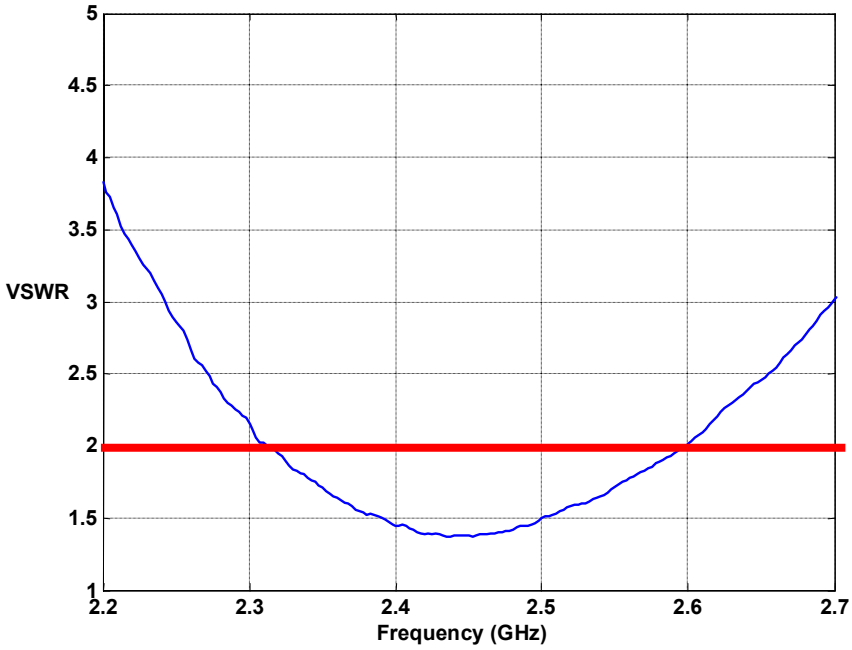
Material: the evaluation board is built on FR4 substrate of 1.0 mm of thickness.

Note: refer to the Antenna Footprint section on page 10 of this User Manual for additional information about the clearance area and antenna footprint.

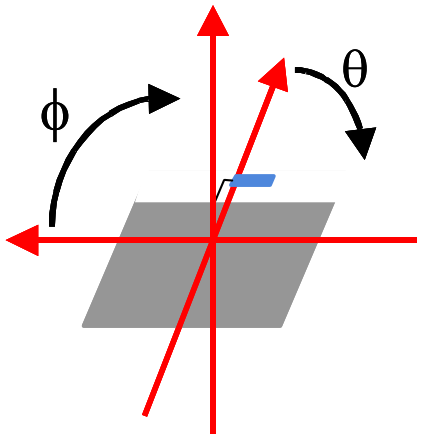
VSWR

VSWR (Voltage Standing Wave Ratio) versus Frequency (GHz)

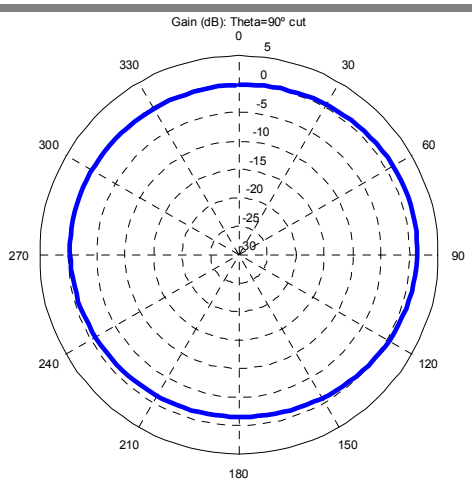
- <2:1 within the ISM-2.4 GHz band
  - 2.4-2.483 in US and Europe
  - 2.471-2.497 in Japan



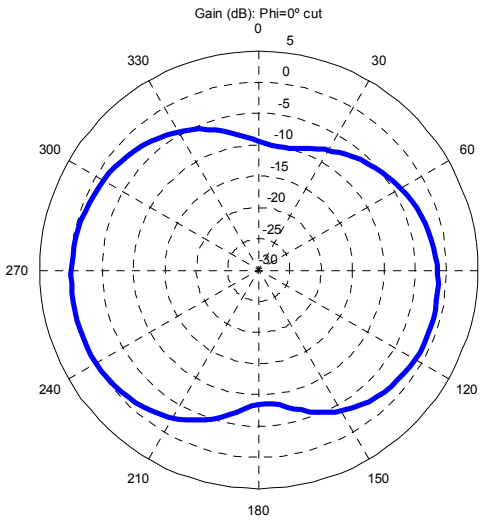
Radiation Pattern, Gain and Efficiency



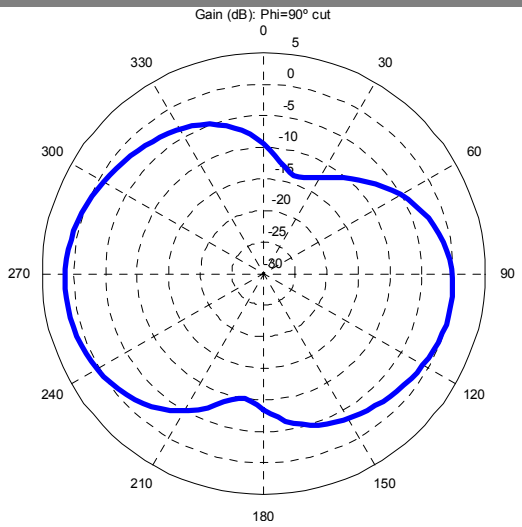
Orientation



Azimuth Cut



Elevation Cut ϕ = 0



Elevation Cut ϕ = 90

Gain	Peak Gain	1.5 dBi
	Average Gain	-2.3 dBi
Efficiency	Peak Efficiency	75 %
	Average Efficiency	70 %

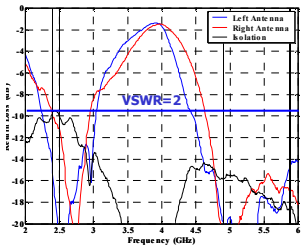
Table 2 – *Antenna Gain and Efficiency within the 2.4-2.5 GHz band*

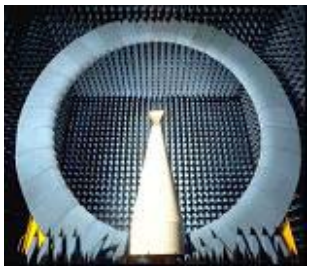
CAPABILITIES AND MEASUREMENT SYSTEMS

Fractus specialises in designing and manufacturing optimsed antennas for wireless applications and providing our clients with RF expertise. We offer turn-key antenna products and antenna integration support to minimise your time requirement and maximize your return on investment during your product development efforts. We also provide our clients with the opportunity to leverage our in-house testing and measurement facilities to obtain accurate results quickly and efficiently.

R&S VNA 20Khz-8GHz ZVCE

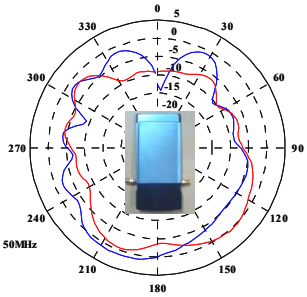
VSWR
&
S Parameters

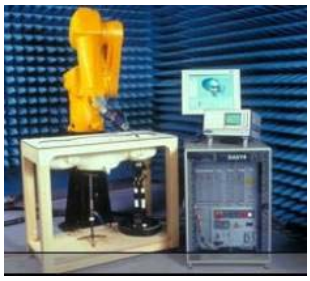




SATIMO's STARGATE 32

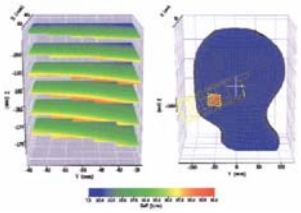
Radiation
Pattern
&
Efficiency

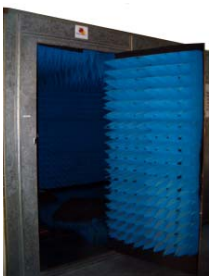




DASY-4 (SPEAG)

SAR Levels

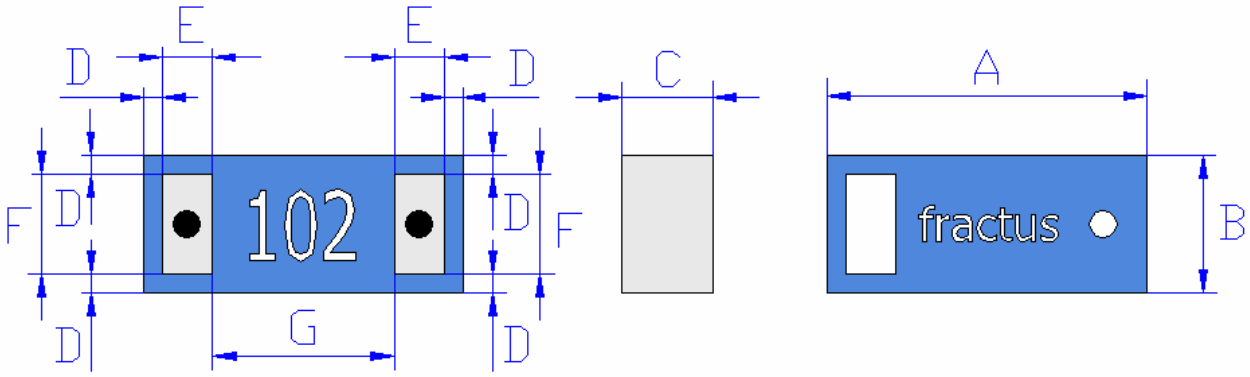




Anechoic and semi-anechoic chambers and full equipped in-house lab

MECHANICAL CHARACTERISTICS

DIMENSIONS, TOLERANCES & MATERIALS



Back side **Front side**

Figure 2 – *Antenna Dimensions and Tolerances*

A	7.00 ± 0.20	**E**	1.10 ± 0.10
B	3.00 ± 0.20	**F**	2.20 ± 0.10
C	2.00 ± 0.20	**G**	4.00 ± 0.20
D	0.40 ± 0.15		

All dimensions are in millimetres (mm)

The white rectangle located on the front side of the antenna provides you with a visual cue to mount the antenna. It is located physically above the feed point of the antenna and has been included to decrease possible manufacturing error.

Fractus Compact Reach Xtend chip antenna is compliant with the directive **2002/95/EC** on the restriction of the use of hazardous substances (**RoHS**). Should you require a green certificate (RoHS report), please contact your sales representative at Richardson Electronics. Refer to page 12 of this User Manual for contact information of your local sales agent.

ASSEMBLY PROCESS

Figure 3 shows the back and front view of the Compact Reach Xtend chip antenna, which indicates the location of the feeding point and the mounting pad:

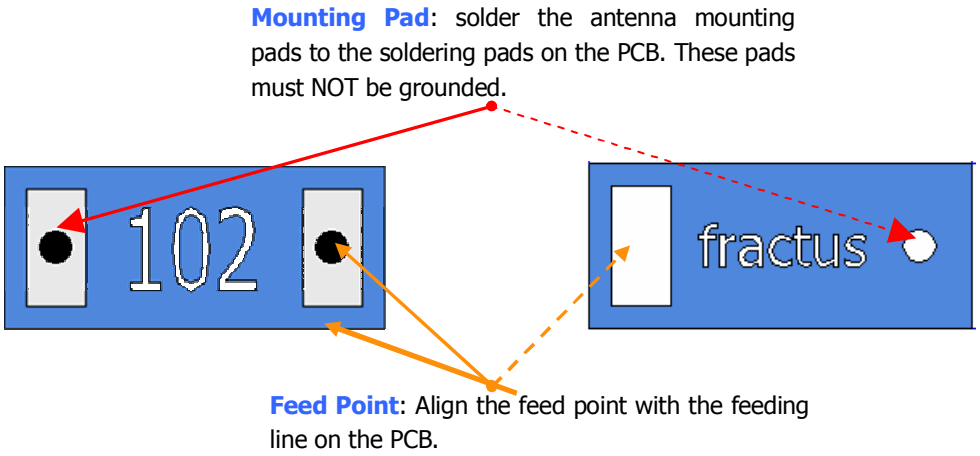


Figure 3 – *Views of the Compact Reach Xtend Chip Antenna.*

As a surface mount device (SMD), this antenna is compatible with industry standard soldering processes. The basic assembly procedure for this antenna is as follows:

1. Apply a solder paste on the pads of the PCB. Place the antenna on the board.
2. Perform a baking process according to the temperature profile detailed in table 3, in the following page.
3. After soldering the antenna to the circuit board, perform a cleaning process to remove any residual flux. Fractus recommends conducting a visual inspection after the cleaning process to verify that all reflux has been removed.

The drawing below shows the soldering details obtained after a correct assembly process:

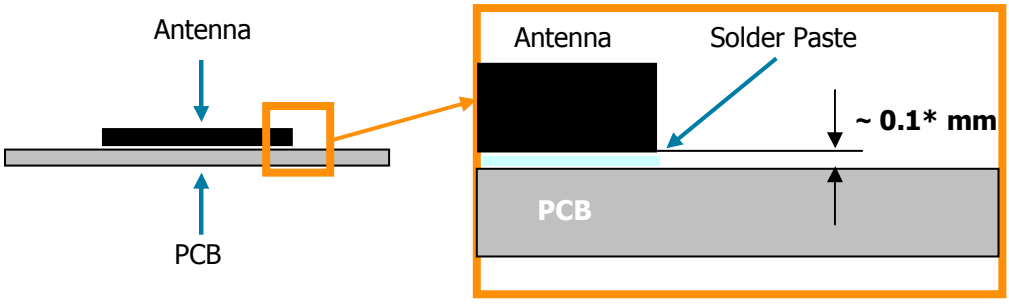


Figure 4 - *Soldering Details*

NOTE(*): Solder paste thickness after the assembly process will depend on the thickness of the soldering stencil mask. A stencil thickness equal or larger than **127 microns (5 mils)** is required.

Fractus Compact Reach Xtend chip antenna can be assembled following either Sn-Pb or Pb-free assembly processes. According to the Standards Normative **IPC/JEDEC J-STD-020C**, the temperature profile suggested in Pick and Place machines is as follows:

Phase	Profile features	Sn-Pb Assembly	Pb-Free Assembly (SnAgCu)
RAMP-UP	Avg. Ramp-up Rate (T_{smax} to Tp)	3 ºC / second (max.)	3 ºC / second (max.)
PREHEAT	- Temperature Min (T_{smin}) - Temperature Max (T_{smax}) - Time (t_{smin} to t_{smax})	100 ºC 150 ºC 60-120 seconds	150ºC 200ºC 60-180 seconds
REFLOW	- Temperature (T_L) - Total Time above T_L (t_L)	183 ºC 60-150 seconds	217 ºC 60-150 seconds
PEAK	- Temperature (T_p) - Time (tp)	235 ºC 10-30 seconds	260 ºC 20-40 second
RAMP-DOWN	Rate	6 ºC / second max.	6 ºC/second max.
Time from 25 ºC to Peak Temperature		6 minutes max.	8 minutes max.

Table 3 – *Recommended soldering temperatures*

Next graphic shows temperature profile (grey zone) for the antenna assembly process in a pick and place machine.

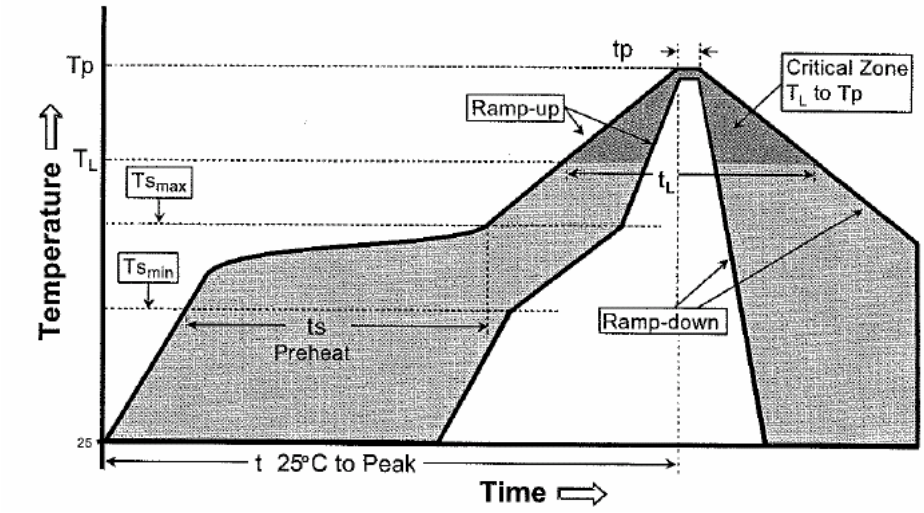
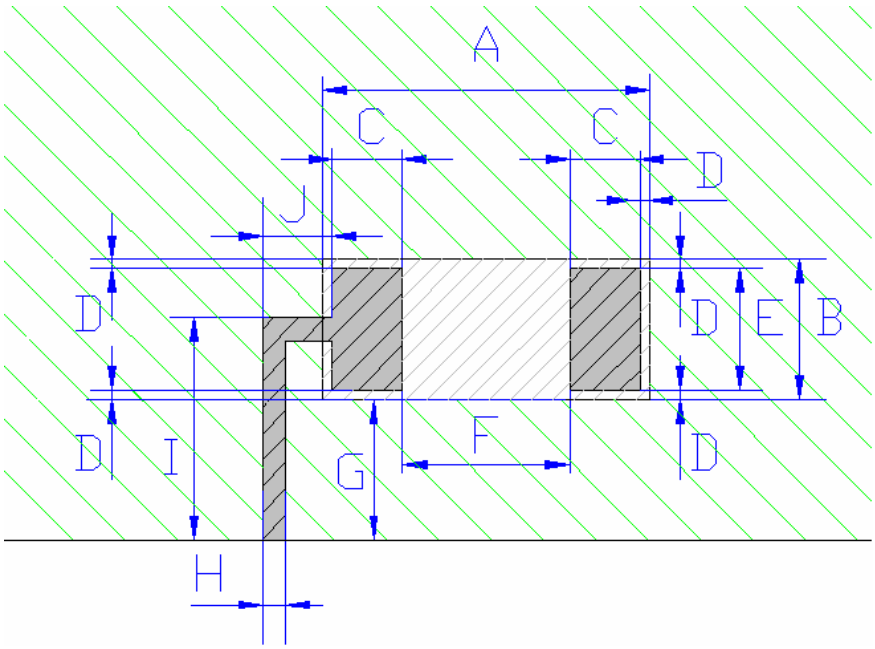


Figure 5 – *Temperature profile*

ANTENNA FOOTPRINT

This antenna footprint applies for the reference evaluation board described in page 4 of this User Manual. Feeding line dimensions over the clearance zone described in figure 6 applies for a 1 mm thickness FR4 PCB.



Letter	Meas.
A	7.00
B	3.00
C	1.50
D	0.20
E	2.60
F	3.60
G	3.00
H	0.50
I	4.75
J	1.50

All dimensions are in millimetres.

Zone occupied by the antenna

Soldering pads, feed point and feeding line

Clearance (PCB without ground-plane)

Figure 6 – *Antenna Footprint Details*

Other PCB form factors and configurations may require a different feeding configuration, feeding line dimensions and clearance areas. If you require support for the integration of the antenna in your industrial design, we would be pleased to assist you with this design process.

Please, contact your sales representative at Richardson Electronics to get additional information on recommended configurations for different devices:

RICHARDSON ELECTRONICS
Refer to page 12 of this User Manual for contact information of your local sales agent.

FRACTUS S.A.
wireless@fractus.com,
Tel: +34 935442690
Fax: +34 935442691

PACKAGING

The Compact Reach Xtend chip antenna is available in tape and reel packaging.

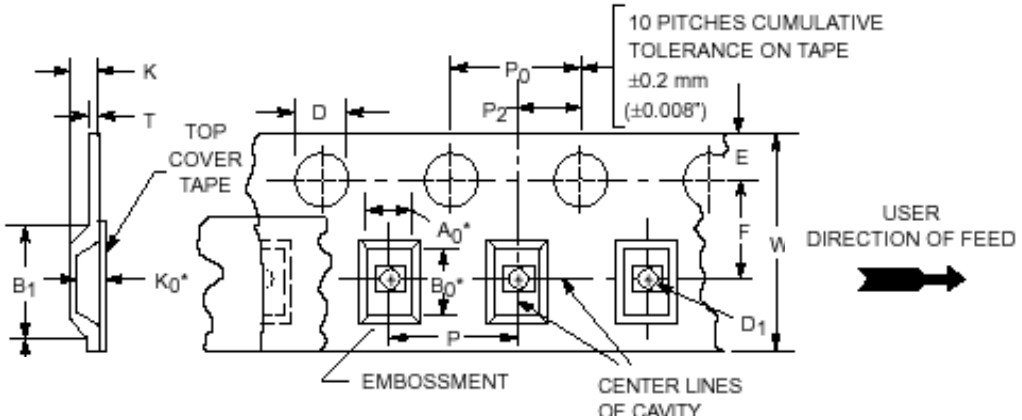
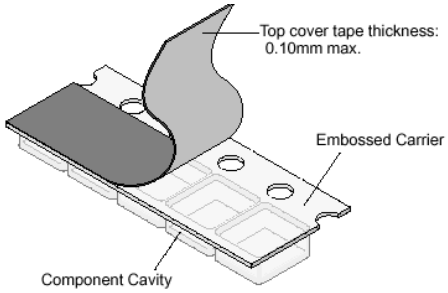
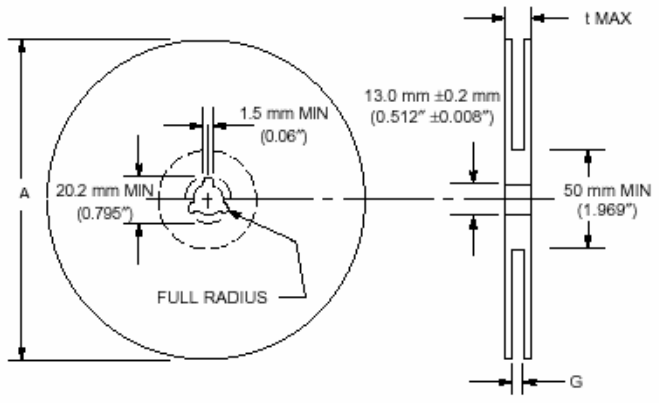


Figure 7 – *Tape Dimensions*

TAPE SIZE	12	Wmax	16.3
A0	3.5	E	1.7
B0	7.4	F	7.5
K0	2.3	K	2.4 max
B1	8.2 max	P	8.0
D	1.5	P0	4.0
D1	1.5 min	P2	2.0

All dimensions are in millimetres (mm).





A max	330
G	16.4
t max	22.4

All dimensions are in millimetres (mm)

Reel Capacity: 2500 antennas.

Figure 8 – *Reel Dimensions and Capacity*

HOW TO BUY FROM YOUR LOCAL DISTRIBUTOR

Please, contact your local Richardson Electronics' distributor to obtain pricing information and place an order.

Corporate Headquarters

Richardson Electronics
40W267 Keslinger Road
P.O. Box 393
LaFox, IL 60147-0393
Telephone: **(800) 737-6937**
(630) 208-3637
Fax: (630) 208-2550
Internet: rfwireless.rell.com
E-Mail: rwc@rell.com

North America

Eastern Sales Region Hdqtrs.
Ronkonkoma, NY
Telephone: **(800) 737-6937**
(631) 468-3900
Fax: (631) 468-3950

Central Sales Region Hdqtrs.
LaFox, IL
Telephone: **(800) 737-6937**
(630) 208-3637
Fax: (630) 208-2662

Western Sales Region Hdqtrs.
Woodland Hills, CA
Telephone: **(800) 737-6937**
(818) 594-5600
Fax: (818) 594-5650

Northwest Sales Region Hdqtrs.
San Jose, CA
Telephone: **(800) 737-6937**
(408) 428-3400
Fax: (408) 428-3450

Southeast Sales Region Hdqtrs.
Altamonte Springs, FL
Telephone: **(800) 737-6937**
(407) 339-6060
Fax: (407) 339-6650

U.S. Exporters
Brooklyn, NY
Telephone: **(800) 882-3397**
(718) 265-8200
Fax: (718) 265-8250

Canada
Brampton, Ontario
Telephone: **(800) 737-6937**
(905) 789-3000
Fax: (905) 789-3050

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Fax: (57-1) 636-1005

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Fax: (954) 735-3554

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Fax: +52 (5) 55 609-0006

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Hedenhusene
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Fax: (+45) 4655-5631

Finland
Oulunsalo
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Fax: +358-8-825-1110

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Telephone: +33 (1) 55.66.00.30
Fax: +33 (1) 55.66.00.31

Nozay
Telephone: +33 (1) 69.80.71.33
Fax: +33 (1) 69.80.76.28

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Fax: +49 (40) 555 88 444

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