



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

May 7, 2007

Motorola - Mesh Networks Product Group
1064 Greenwood Blvd. Suite 400
Lake Mary, FL 32746

Dear Thai Le,

Enclosed is the EMC test report for compliance testing of the Motorola - Mesh Networks Product Group, MOTOMESH Duo 4300-49 (4.9 GHz 802.11a), tested to the requirements of Title 47 of the Code of Federal Regulations (CFR), Part 90 for a Class A Digital Device.

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.

Samantha Sharbonda
Documentation Department

Reference: (\Motorola - Mesh Networks Product Group\EMC21852-FCC90)

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

Electromagnetic Compatibility Criteria Test Report

For the

**Motorola - Mesh Networks Product Group
MOTOMESH Duo 4300-49 (4.9 GHz 802.11a)**

Tested under

**The FCC Verification Rules
Contained in Title 47 of the CFR, Part 90, Subpart Y
for Private Land Mobile Radio Services**

MET Report: EMC21852-FCC90

May 7, 2007

**Prepared For:
Motorola - Mesh Networks Product Group
1064 Greenwood Blvd. Suite 400
Lake Mary, FL 32746**

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



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MET Report: EMC21852-FCC90

Dusmantha Tennakoon, Project Engineer
Electromagnetic Compatibility Lab

Samantha Sharbonda
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 90, Subpart Y of the FCC Rules under normal use and maintenance.

Dusmantha Tennakoon, Wireless Coordinator
Electromagnetic Compatibility Lab



Report Status Sheet

Revision	Report Date	Reason for Revision
Ø	May 7, 2007	Initial Issue.



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List of Terms and Abbreviations

AC	Alternating Current
ACF	Antenna Correction Factor
Cal	Calibration
d	Measurement Distance
dB	Decibels
dBμA	Decibels above one microamp
dBμV	Decibels above one microvolt
dBμA/m	Decibels above one microamp per meter
dBμV/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
f	Frequency
FCC	Federal Communications Commission
GRP	Ground Reference Plane
H	Magnetic Field
Hz	Hertz
kHz	kilohertz
kV	kilovolt
LISN	Line Impedance Stabilization Network
MHz	Megahertz
μ	microfarad
μs	microseconds
PRF	Pulse Repetition Frequency
RF	Radio Frequency
RMS	Root-Mean-Square
V/m	Volts per meter



I. Testing Summary



A Testing Summary

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 90, Subpart Y. All tests were conducted using measurement procedure ANSI TIA/EIA-603-A-2004.

Title 47 of the CFR, Part 90, Subpart Y, and FCC 04-265 Reference and Test Description	Conformance			Comments
	Yes	No	N/A	
	<i>Yes - Equipment complies with the Requirement</i> <i>No - Equipment does not comply with the Requirement</i> <i>N/A - Not applicable to the equipment under tests</i>			
2.1046; 90.1215(a) Peak Power Output	√			Compliant
2.1046; 90.1215(a) Peak Power Spectral Density	√			Compliant
2.1047(a) Modulation Characteristics			√	EUT is non-voice, data only.
2.1049; 90.210(M) Occupied Bandwidth (Emission Mask)	√			Compliant
2.1051; 90.210(M) Spurious Emissions at Antenna Terminals	√			Compliant
2.1053; 90.210(M) Radiated Spurious Emissions	√			Compliant
2.1055(a) (1); 90.213 Frequency Stability over Temperature Variations	√			Compliant
2.1055(d) (2) Frequency Stability over Voltage Variations	√			Compliant
15.107 AC Power Line Conducted Emissions for Unintentional Radiators	√			Compliant
15.109 Radiated Spurious Emissions for Unintentional Radiators	√			Compliant



II. Equipment Configuration



A Overview

MET Laboratories, Inc. was contracted by Motorola - Mesh Networks Product Group. to perform testing on the MOTOMESH Duo 4300-49 (4.9 GHz 802.11a) under Motorola - Mesh Networks Product Group purchase order number NP3196065.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Motorola - Mesh Networks Product Group., MOTOMESH Duo 4300-49 (4.9 GHz 802.11a).

An EMC evaluation to determine compliance of the TB 4.9 with the requirements of Part 90, Subpart Y, was conducted. (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 TB4.9. Motorola - Mesh Networks Product Group. should retain a copy of this document and it should be kept on file for at least five years after the manufacturing of the EUT has been **permanently** discontinued.

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

Model(s) Tested:	MOTOMESH Duo 4300-49 (4.9 GHz 802.11a)	
Model(s) Covered:	MOTOMESH Duo 4300-49 (4.9 GHz 802.11a)	
EUT Specifications:	Primary Power: Volts (V): 120 VAC Current (mA): 1A	
	FCC ID: QJE-MM-4300-49	
	Type of Modulations:	OFDM
	Emission Designators:	10 MHz OBW: 8M58W7D 20 MHz OBW: 16M53W7D
	Max Peak and Average Output Power:	10 MHz OBW: Peak 27.10dBm, Average 25.49 dBm 20 MHz OBW: Peak 27.37 dBm, Average 24.11 dBm
	Equipment Code:	DTS
	EUT Frequency Ranges:	10 MHz OBW: 4945.0 – 4985.0 MHz 20 MHz OBW: 4950.0 – 4980.0 MHz
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:	Dusmantha Tennakoon	
Date(s):	May 7, 2007	

* Note: The power levels for 10 MHz OBW channels can be set to a max of 27 dBm and for the 20 MHz OBW channels it can be set to a max of 29 dBm by the ART software and still meet the requirements of this rule part.

B Test Site

All testing was performed at MET Laboratories, Inc., 914 W. 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).

C Description of Test Sample

The MOTOMESH Duo 4300-49 (4.9 GHz 802.11a), Equipment Under Test (EUT), is a dual radio unit. The system operates at 2.4 GHz (ISM band 802.11 b/g) and at 4.9 GHz (802.11a) using an Atheros AP30 chipset.



Photograph 1. Motorola - Mesh Networks Product Group MOTOMESH Duo 4300-49 (4.9 GHz 802.11a)



D Equipment Configuration

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

Name / Description	Model Number
AP30 802.11a 4.9 GHz Radio module	MOTOMESH Duo 4300-49

Table 1. Equipment Configuration

E Support Equipment

Motorola - Mesh Networks Product Group supplied support equipment necessary for the operation and testing of the MOTOMESH Duo 4300-49. All support equipment supplied is listed in the following Support Equipment List.

Ref. ID	Name / Description	Manufacturer	Model Number	Serial Number
2	Laptop Computer	Toshiba	M10-S405	33083961P
3	Laptop's AC Adaptor	Toshiba	ADP-60FB	-

Table 2. 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.

F Ports and Cabling Information

Ref. ID	Port Name on EUT	Cable Description	Qty.	Length (m)	Shielded (Y/N)	Termination Point
1	ETH	8-pin / RJ45 ETH cat5 cable assembly	1	3	Y	ETH port of laptop
2	PWR	4-pin / pwr plug power cord cable assembly	1	2	N	Standard 110 VAC outlet
3	Antenna – AP30, 2.4 GHz	2.4 GHz 8 dBi Antenna	1	-	N/A	-
4	Antenna – AP30, 4.9 GHz	4.9 GHz 11 dBi Antenna	1	-	N/A	-

Table 3. Ports and Cabling Information

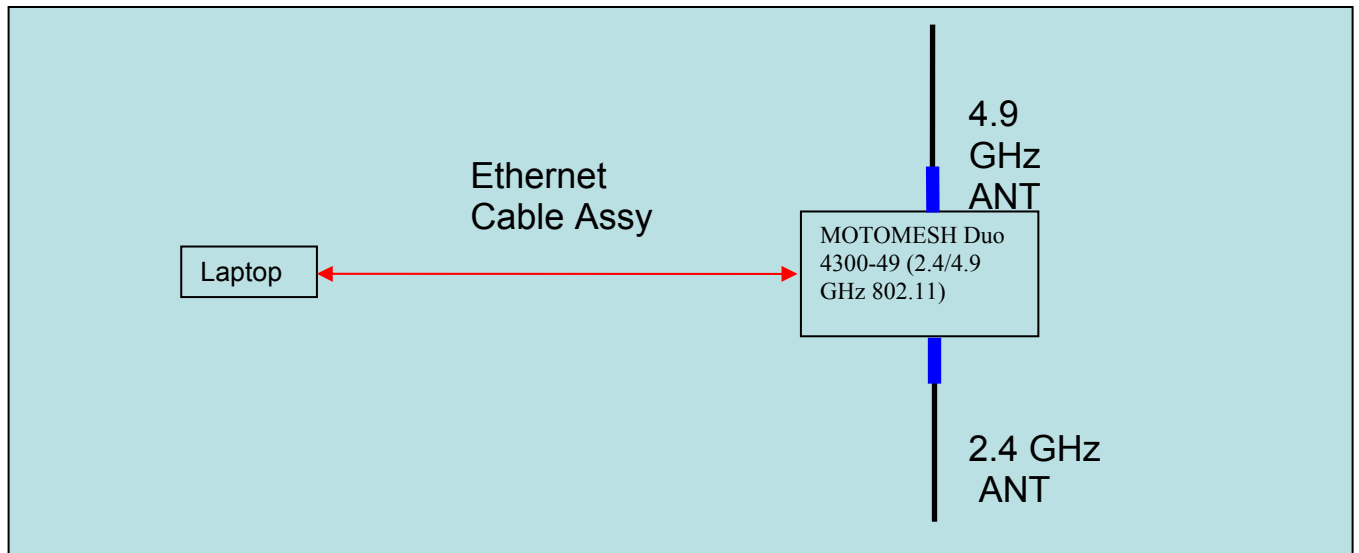


Figure 1. Block Diagram of Test Configuration



G Mode of Operation

AP30 – Mesh Atheros control through Atheros Radio Test (ART).

H Method of Monitoring EUT Operation

AP30 – Mesh Atheros control through Atheros Radio Test (ART).

I Modifications

a.) Modifications to EUT

No modifications were made to the EUT.

b.) Modifications to Test Standard

No modifications were made to the EUT.

J Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Motorola - Mesh Networks Product Group upon completion of testing.



III. Electromagnetic Compatibility Criteria for Unintentional Radiators



Electromagnetic Compatibility Criteria for Unintentional Radiators

§ 15.107 Conducted Emissions Limits

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

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

Frequency range (MHz)	15.107(b), Class A Limits (dBµV)		15.107(a), Class B Limits (dBµV)	
	Quasi-Peak	Average	Quasi-Peak	Average
0.15- 0.5	79	66	66 - 56	56 - 46
0.5 – 5.0	73	60	56	46
5.0 - 30	73	60	60	50

Note — The lower limit shall apply at the transition frequencies.

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

Test Procedures: The method of testing, test conditions, and test procedures of ANSI C63.4 were used. The EUT was powered through a 50Ω/50µH LISN. An EMI receiver, connected to the measurement port of the LISN, scanned the frequency range from 150 kHz to 30 MHz in order to find the peak conducted emissions. All peak emissions within 6 dB of the limit were remeasured using a quasi-peak and/or average detector as appropriate.

Test Results: The EUT was found compliant with the Class A requirement(s) of this section.

Test Engineer(s): Jeffrey Hazen

Test Date(s): 3/21/2007



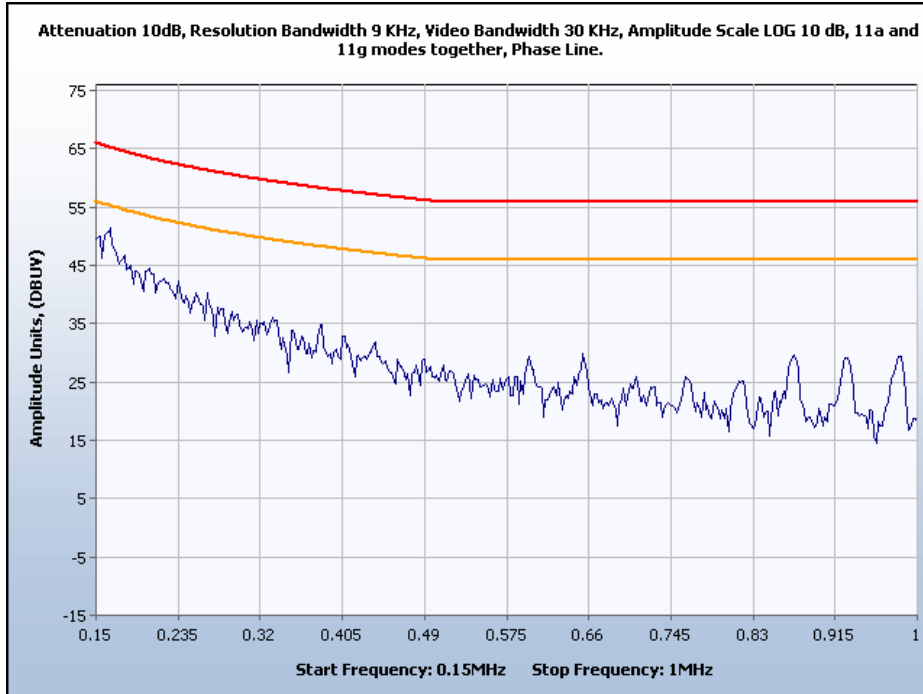
Conducted Emissions - Voltage, AC Power

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
0.1626	47.5	0.11	47.61	79	-17.83	39.9	0.11	40.01	66	-15.32
5.107	30.7	0.17	30.87	73	-29.3	26.6	0.17	26.77	60	-23.23
5.269	31.3	0.17	31.47	73	-28.7	25.1	0.17	25.27	60	-24.73
5.325	31.1	0.17	31.27	73	-28.9	26.7	0.17	26.87	60	-23.13
5.542	32.9	0.17	33.07	73	-27.1	26	0.17	26.17	60	-23.83
5.65	32.3	0.17	32.47	73	-27.7	27	0.17	27.17	60	-22.83

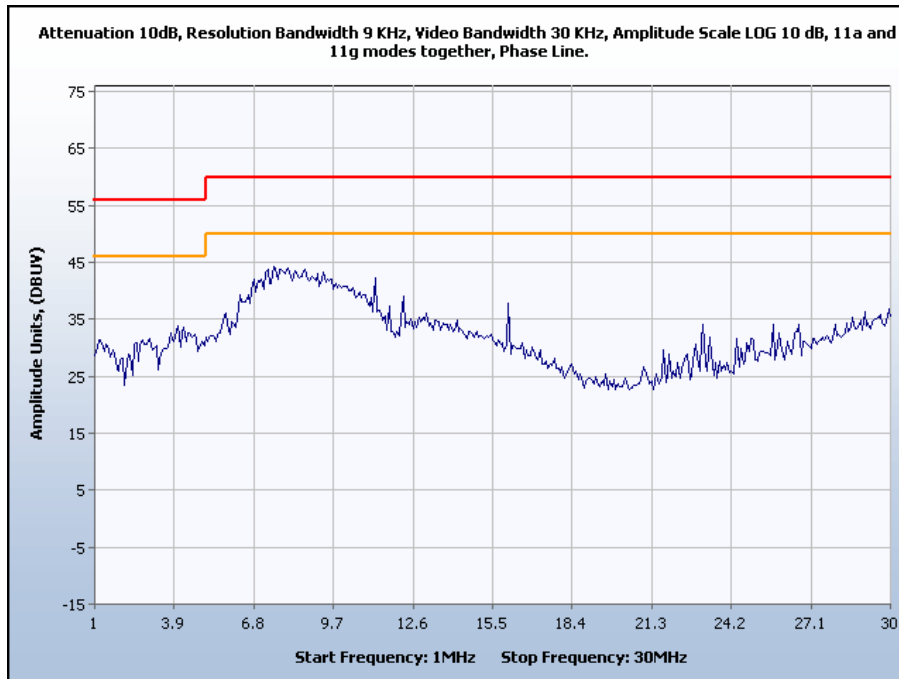
Table 5. Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz)



Conducted Emissions - Voltage, Worst Case Emissions, AC Power



Conducted Emission, Phase Line Plot, 0.15 MHz to 1 MHz



Conducted Emission, Phase Line Plots, 1 MHz to 30 MHz

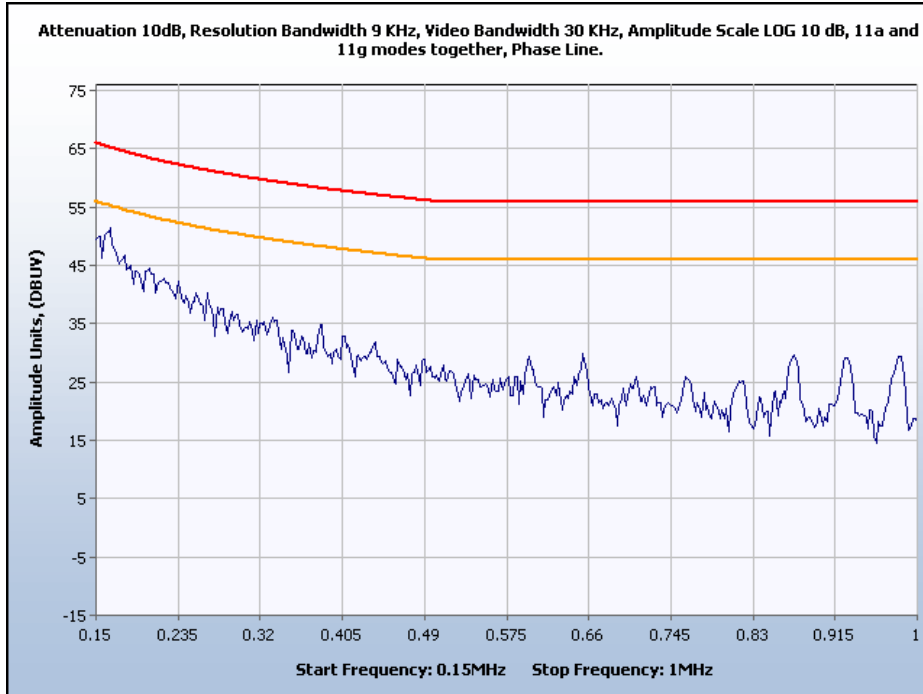


Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.152	39.9	0.09	39.99	73	-25.99	19.5	0.09	19.59	60	-36.30
0.162	48.2	0.11	48.31	73	-17.16	41	0.11	41.11	60	-14.25
4.4	32.4	0.17	32.57	73	-23.6	28.1	0.17	28.27	60	-17.73
4.41	32.4	0.17	32.57	73	-23.6	28.3	0.17	28.47	60	-17.53
5.322	32.2	0.17	32.37	73	-27.8	27	0.17	27.17	60	-22.83
5.427	32	0.17	32.17	73	-28	24.5	0.17	24.67	60	-25.33
8.923	35.9	0.27	36.17	79	-24.1	28.1	0.273	28.37	66	-21.63
11.119	38.3	0.33	38.63	79	-21.7	35.5	0.33	35.83	66	-14.17

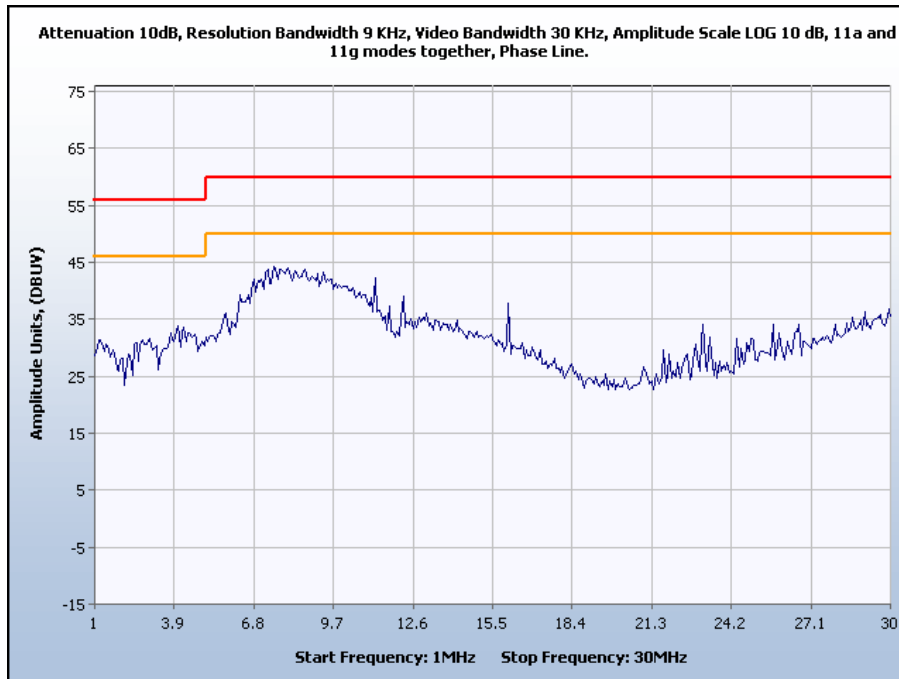
Table 6. Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz)



Conducted Emissions - Voltage, Worst Case Emissions, AC Power



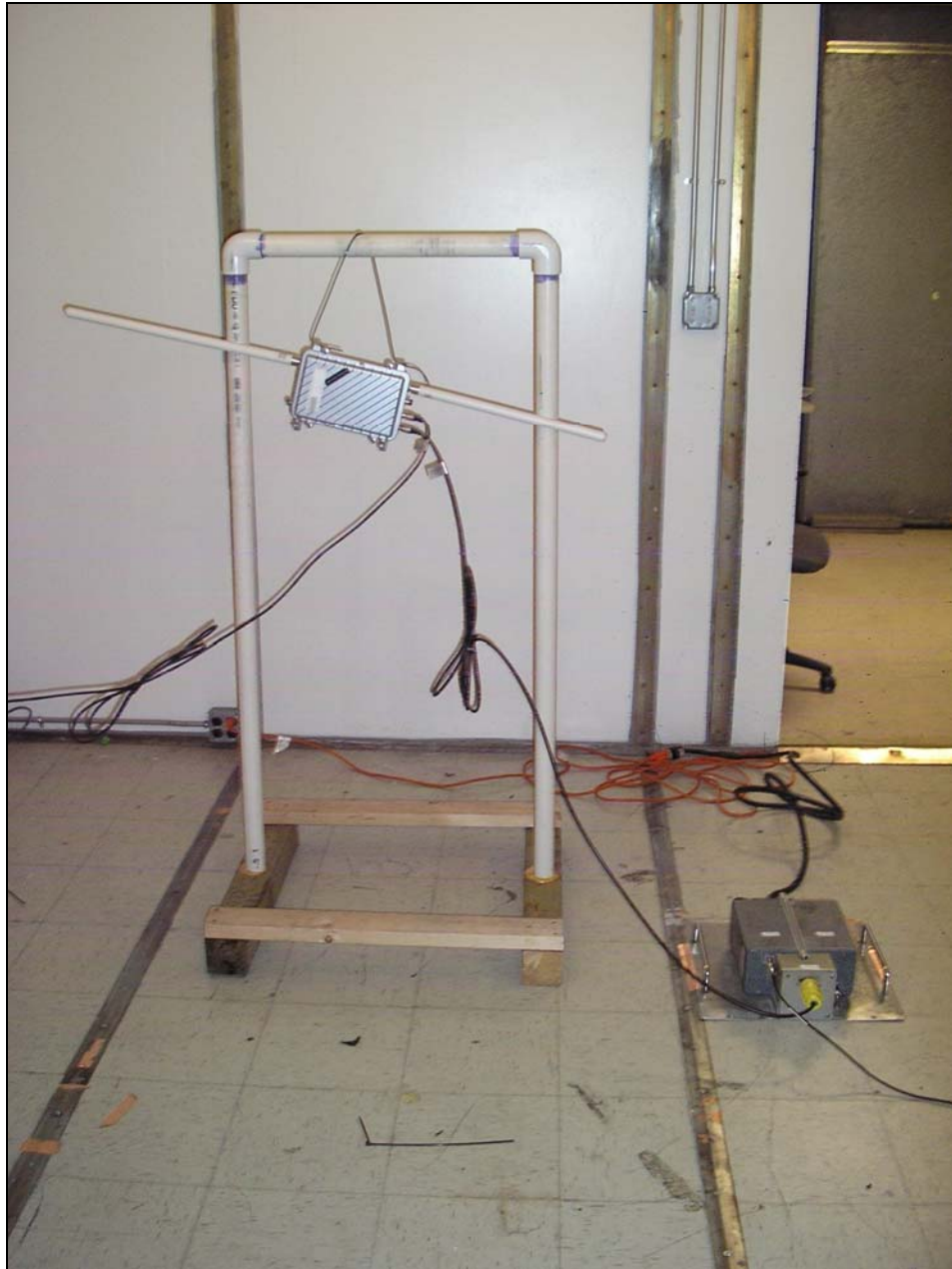
Conducted Emission, Neutral Line Plot, 0.15 MHz to 1 MHz



Conducted Emission, Neutral Line Plots, 1 MHz to 30 MHz



Conducted Emission Limits Test Setup



Photograph 2. Conducted Emissions Test Setup



Electromagnetic Compatibility Criteria for Unintentional Radiators

§ 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 7.

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 7.

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

Test Procedures: The EUT was placed inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.4 were used. An antenna was located 3 m from the EUT on an adjustable mast. 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 A requirement(s) of this section. Measured emissions below applicable limits.

Test Engineer(s): Len Knight

Test Date(s): 3/6/2007

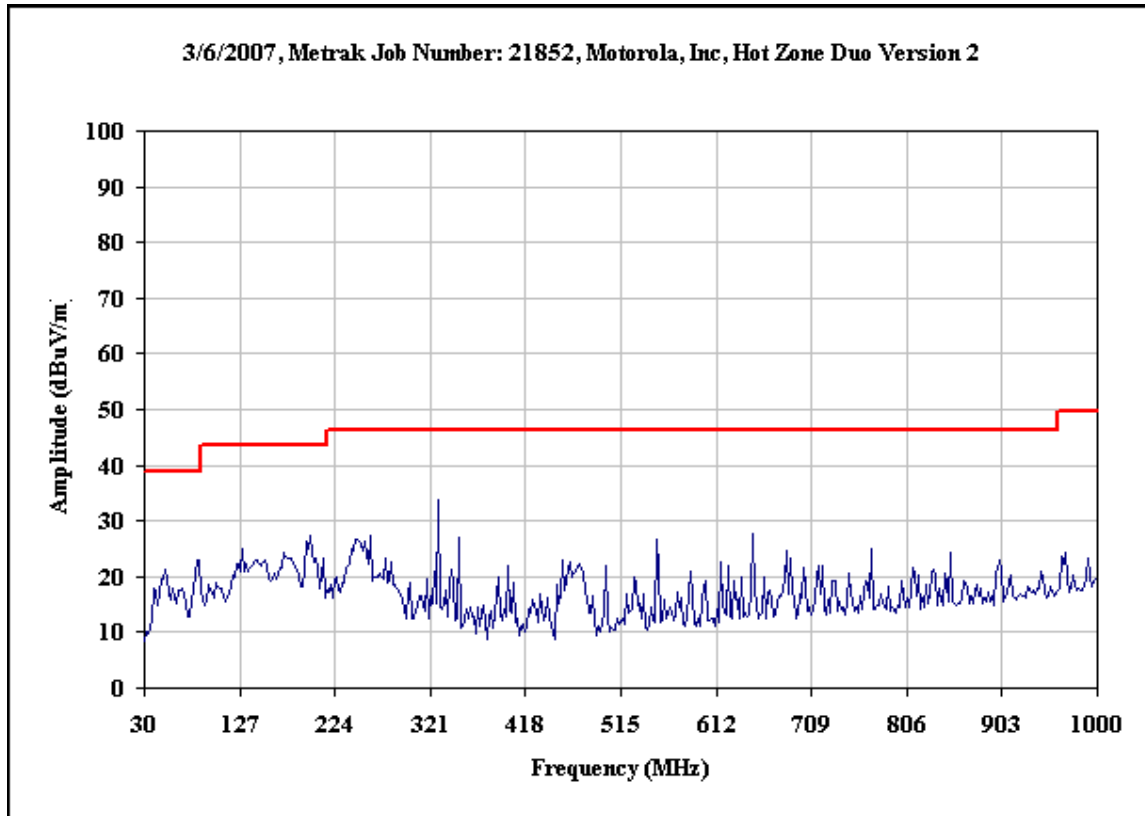


Radiated Emissions Limits Test Results, Class A

Frequency (MHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna HEIGHT (m)	Uncorrected EMI Meter Reading (dBuV)	Antenna Correction Factor (dB/m) (+)	Cable Loss (dB) (+)	Distance Correction Factor (dB) (-)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
38.988	140	H	2.18	6.09	8.42	0.54	10.46	4.58	39.00	-34.42
38.988	315	V	1.00	19.88	8.02	0.54	10.46	17.98	39.00	-21.02
50.401	186	H	3.76	11.48	9.55	0.62	10.46	11.19	39.00	-27.81
50.401	318	V	1.00	25.68	8.64	0.62	10.46	24.48	39.00	-14.52
85.361	178	H	2.56	26.37	6.72	0.75	10.46	23.38	39.00	-15.62
85.361	265	V	0.99	25.88	5.62	0.75	10.46	21.79	39.00	-17.21
122.761	166	H	1.41	25.91	7.26	0.88	10.46	23.59	43.50	-19.91
122.761	203	V	1.61	21.92	7.57	0.88	10.46	19.91	43.50	-23.59
156.513	162	H	1.69	13.41	8.06	0.90	10.46	11.91	43.50	-31.59
156.513	257	V	1.00	19.48	7.89	0.90	10.46	17.81	43.50	-25.69
257.715	196	H	1.20	13.97	12.85	1.38	10.46	17.74	46.40	-28.66
257.715	150	V	1.00	15.49	12.47	1.38	10.46	18.89	46.40	-27.51
329.996	62	H	1.00	24.15	13.80	1.57	10.46	29.06	46.40	-17.34
329.996	356	V	0.99	28.06	14.10	1.57	10.46	33.27	46.40	-13.13
349.992	221	H	1.69	18.31	14.70	1.61	10.46	24.16	46.40	-22.24
349.992	126	V	1.00	21.10	14.90	1.61	10.46	27.15	46.40	-19.25
400.007	172	H	1.41	15.73	15.60	1.70	10.46	22.57	46.40	-23.83
400.007	311	V	1.00	15.56	15.50	1.70	10.46	22.30	46.40	-24.10
769.984	165	H	1.00	13.22	21.30	2.65	10.46	26.71	46.40	-19.69
769.984	62	V	1.00	12.32	20.80	2.65	10.46	25.31	46.40	-21.09

Table 8. Radiated Emissions Limits Test Results

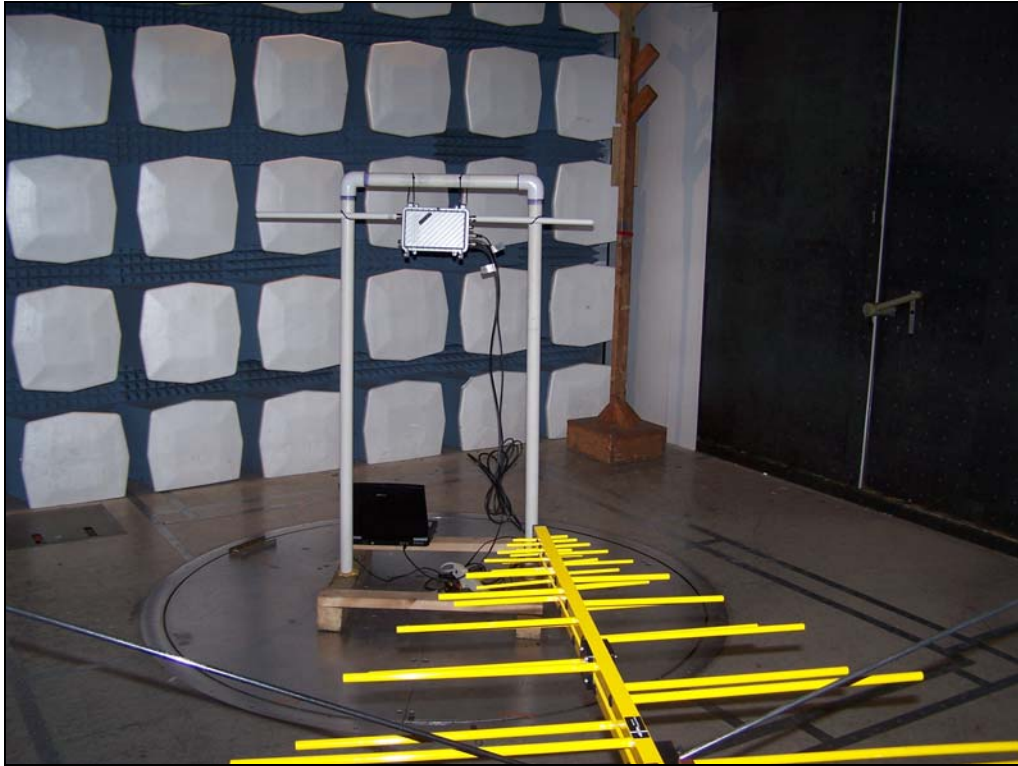
*Measurements were made at 3m but have been corrected for 10m.



Radiated Emission Limits, Test Results



Radiated Emission Limits Test Setup



Photograph 3. Radiated Emission Limits Test Setup



IV. Electromagnetic Compatibility Criteria for Intentional Radiators



Electromagnetic Compatibility RF Power Output Requirements

§2.1046 RF Power Output

Test Requirement(s): §2.1046 and §90.1215(a) with FCC 04-265

Test Procedures: As required by 47 CFR 2.1046, *RF power output measurements* were made at the RF output terminals using a Spectrum Analyzer.

A laptop was connected to EUT to control the RF power output and frequency channel. The EUT was connected to a Spectrum Analyzer to monitor the Peak and Average power. The EUT power was adjusted enough to produce maximum output power as to meet the requirements of this rule part. The output power was then recorded with peak and average reading.

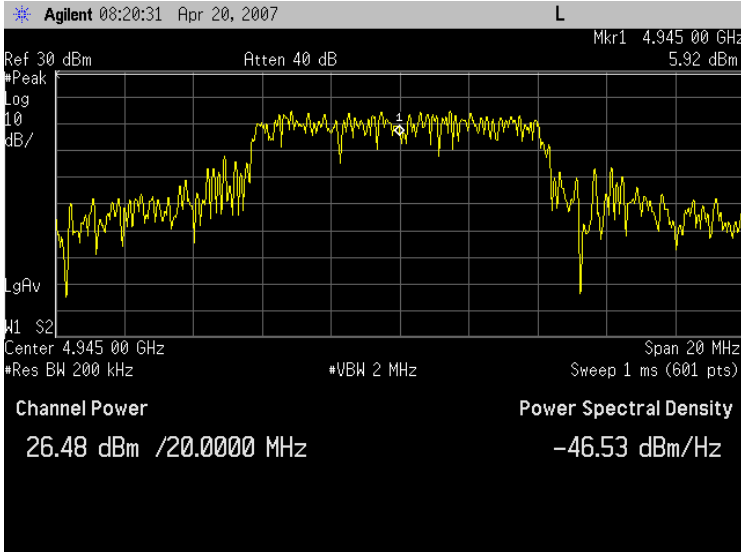
Test Results: Equipment complies with 47CFR 2.1046 and 90.1215(a) with FCC 04-265.

Cable losses have been accounted for in SA readings.

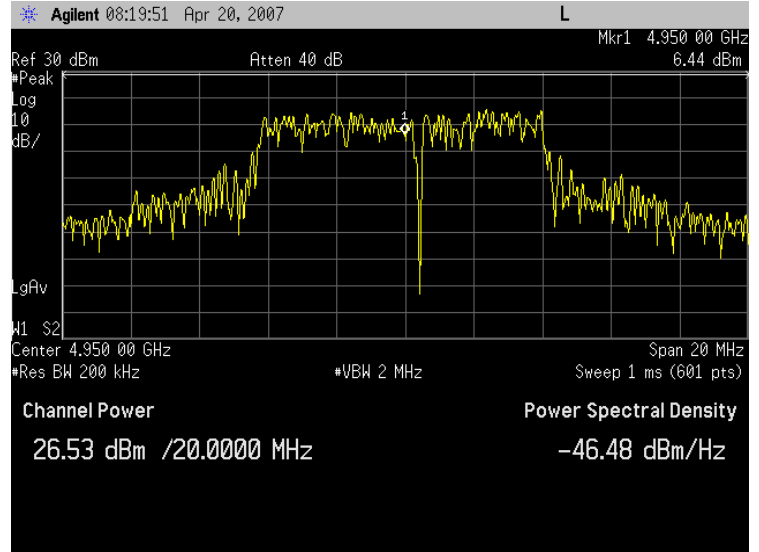
Channel Bandwidth (MHz)	Frequency (MHz)	Peak Power (dBm)	Average Power (dBm)
10	4945	26.48	24.13
	4950	26.53	24.25
	4955	26.71	24.36
	4960	27.1	24.35
	4965	26.01	23.77
	4970	26.96	24.74
	4975	26.75	25.49
	4980	26.07	25.16
20	4985	26.25	25.08
	4950	27.12	24.11
	4960	26.83	22.82
	4970	26.74	24.05
	4980	27.37	23.92

Test Engineer(s): Dusmantha Tennakoon

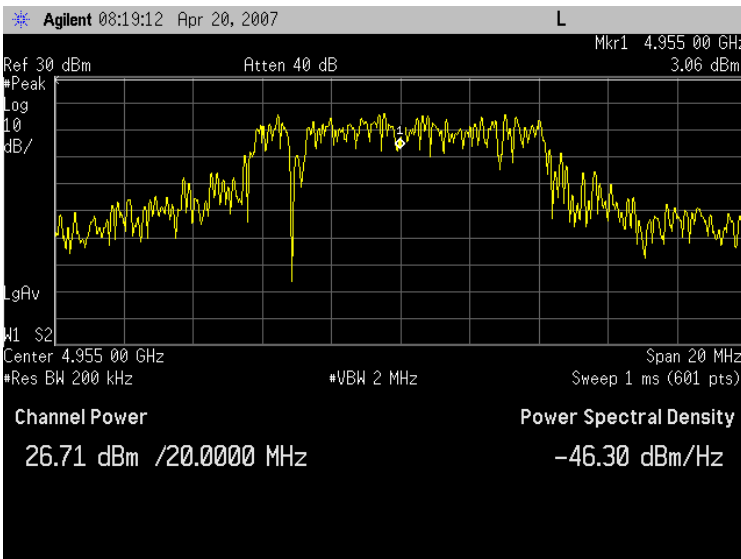
Test Date(s): 4/20/2007



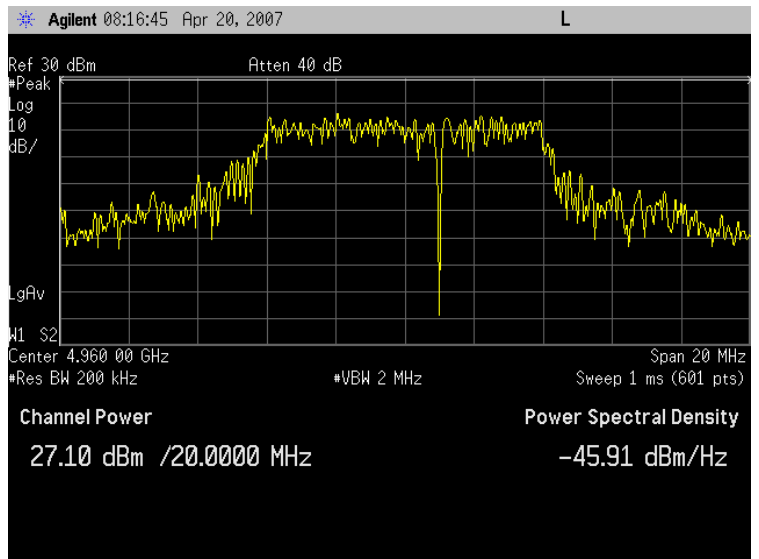
RF Power Output Test Results, 4945 MHz, 10 MHz OBW



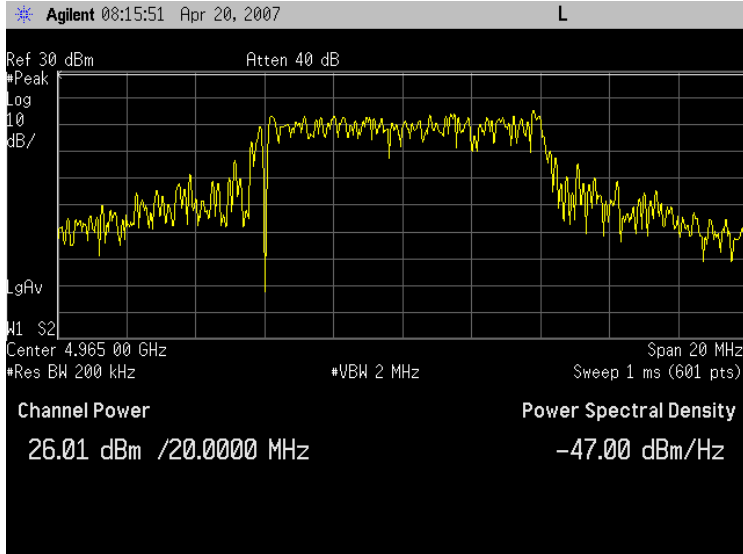
RF Power Output Test Results, 4950 MHz, 10 MHz OBW



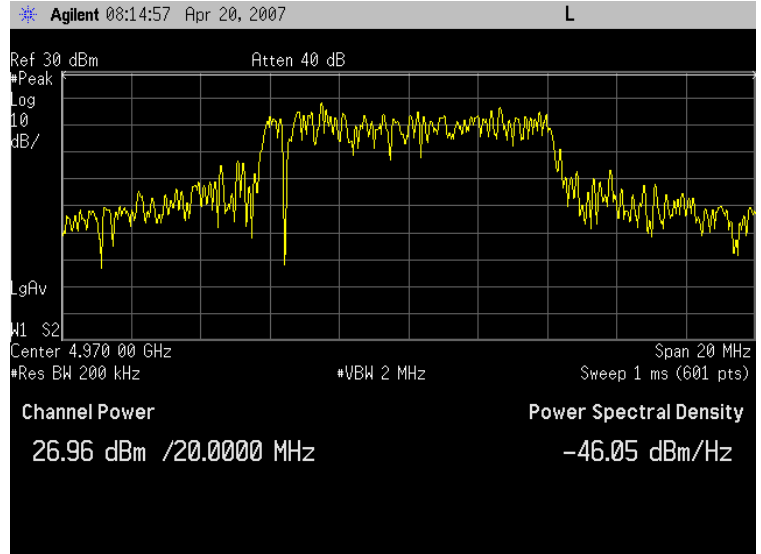
RF Power Output Test Results, 4955 MHz, 10 MHz OBW



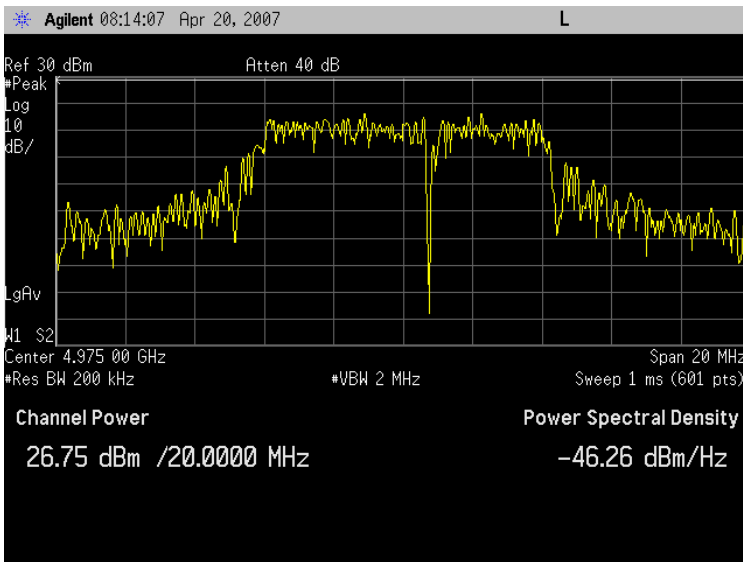
RF Power Output Test Results, 4960 MHz, 10 MHz OBW



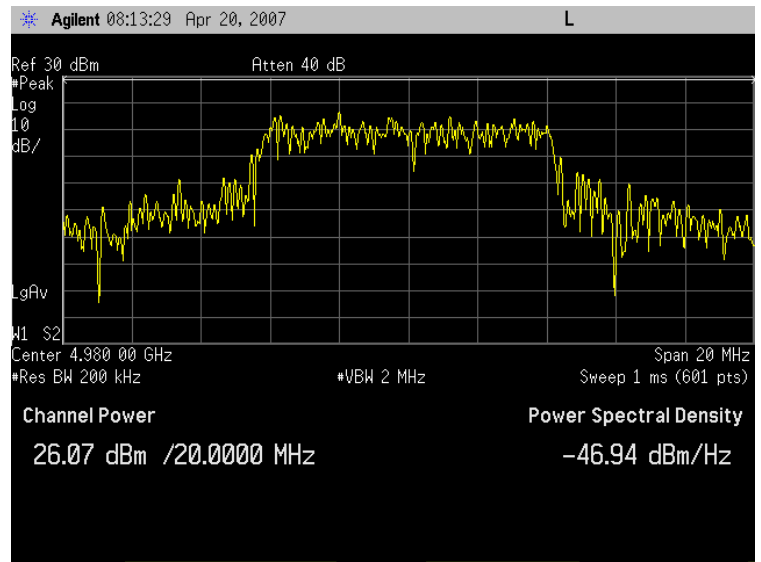
RF Power Output Test Results, 4965 MHz, 10 MHz OBW



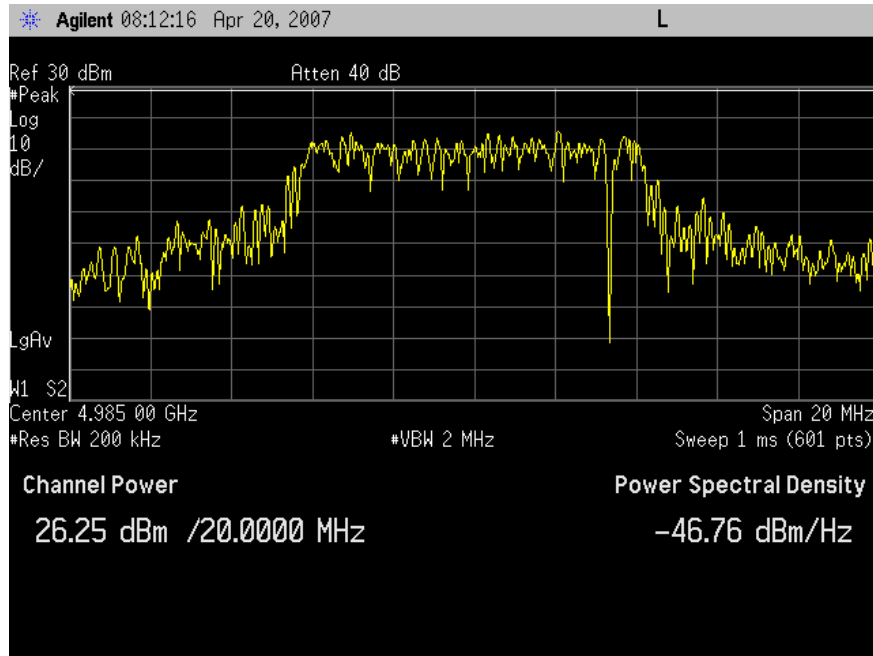
RF Power Output Test Results, 4970 MHz, 10 MHz OBW



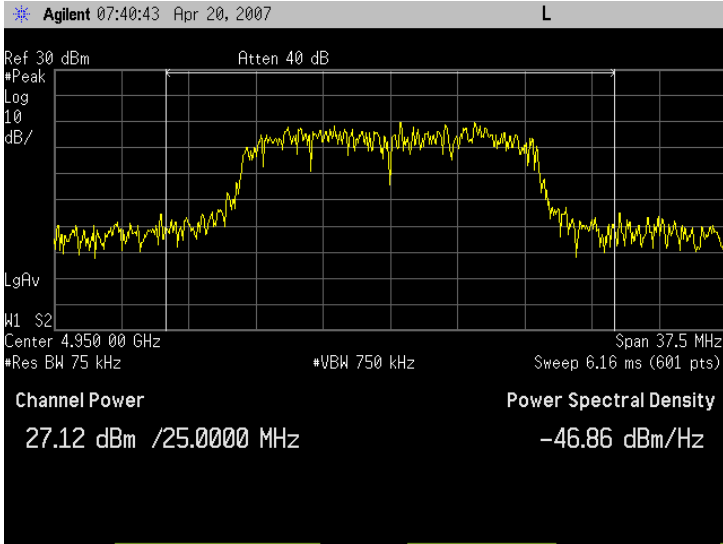
RF Power Output Test Results, 4975 MHz, 10 MHz OBW



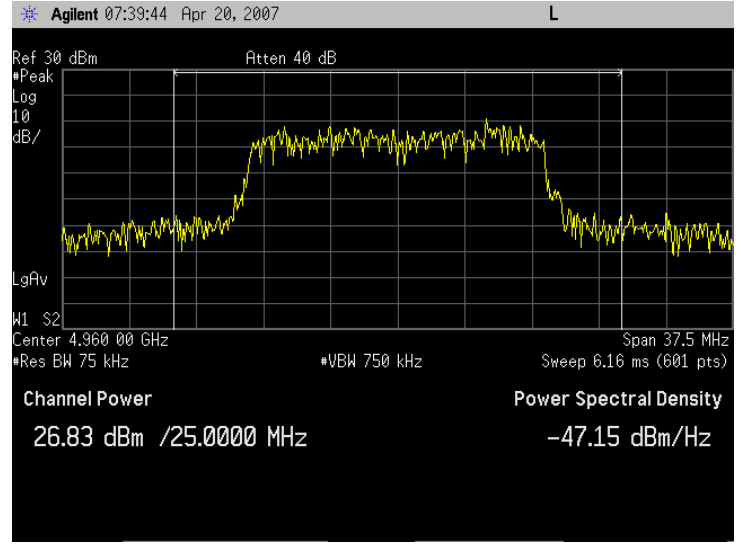
RF Power Output Test Results, 4980 MHz, 10 MHz OBW



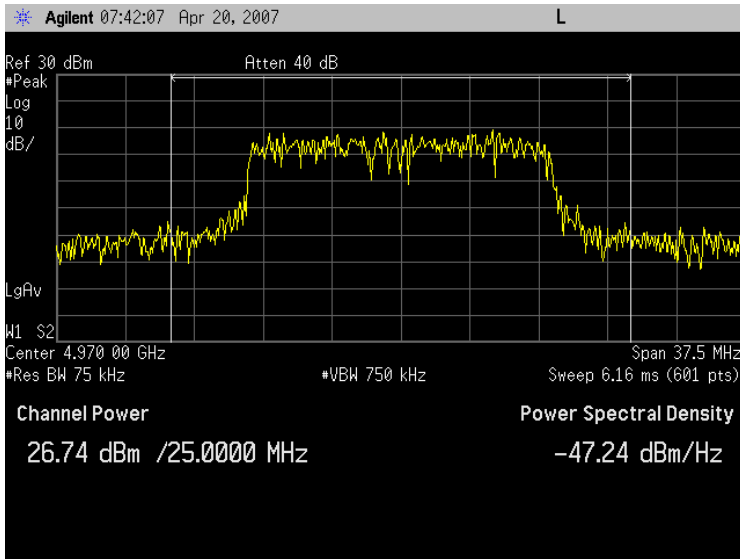
RF Power Output Test Results, 4985 MHz, 10 MHz OBW



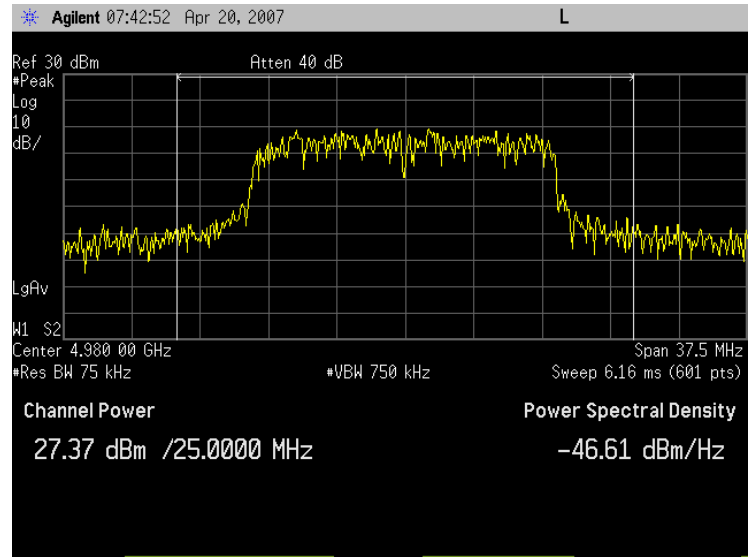
RF Power Output Test Results, 4950 MHz, 20 MHz OBW



RF Power Output Test Results, 4960 MHz, 20 MHz OBW



RF Power Output Test Results, 4970 MHz, 20 MHz OBW



RF Power Output Test Results, 4980 MHz, 20 MHz OBW



Electromagnetic Compatibility RF Power Output Requirements

§2.1046 Peak Power Spectral Density

Test Requirement(s): §90.1215(a) with FCC 04-265

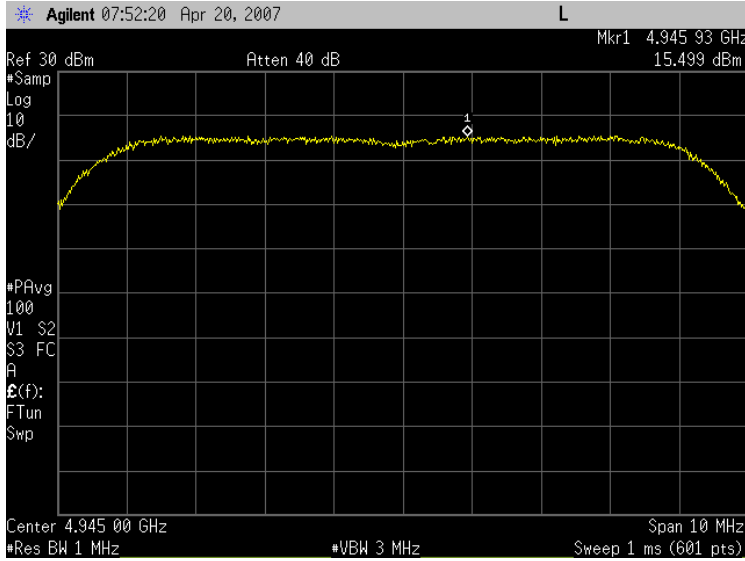
Test Procedures: As required by 47 CFR 2.1046, *RF power output measurements* were made at the RF output terminals using a Spectrum Analyzer.

A laptop was connected to EUT to control the RF power output and frequency channel. The EUT was connected to a Spectrum Analyzer in order to measure the power level. The Spectrum Analyzer was set to a RBW = 1 MHz, VBW = 3 MHz. The EUT power was adjusted at the maximum output power level. The max hold key from the Spectrum Analyzer was activated capturing the modulated envelope of the EUT. The Peak Power Spectral Density was then recorded.

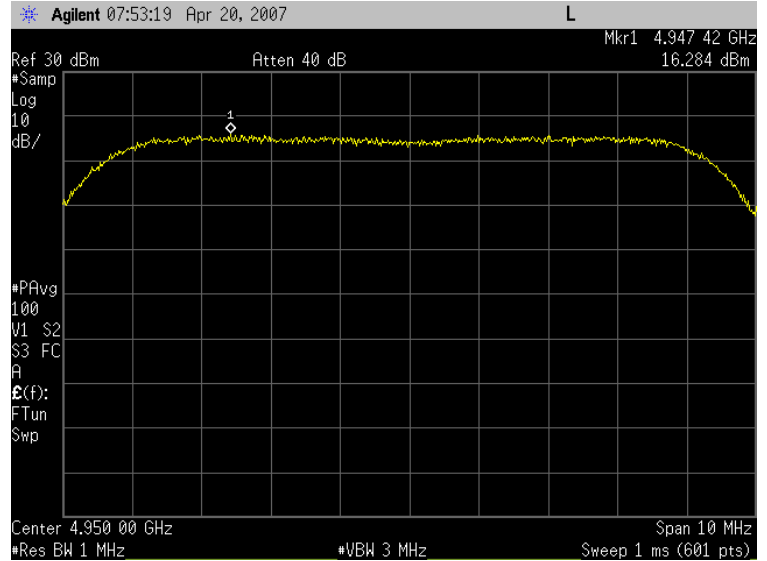
Test Results: Equipment complies with 47 CFR 2.1046 and 90.1215(a) with FCC 04-265 (High Power devices). The EUT does not exceed 21dBm/MHz peak power spectral density at the carrier frequency. All cable losses have been accounted for in the final SA readings.

Test Engineer(s): Dusmantha Tennakoon

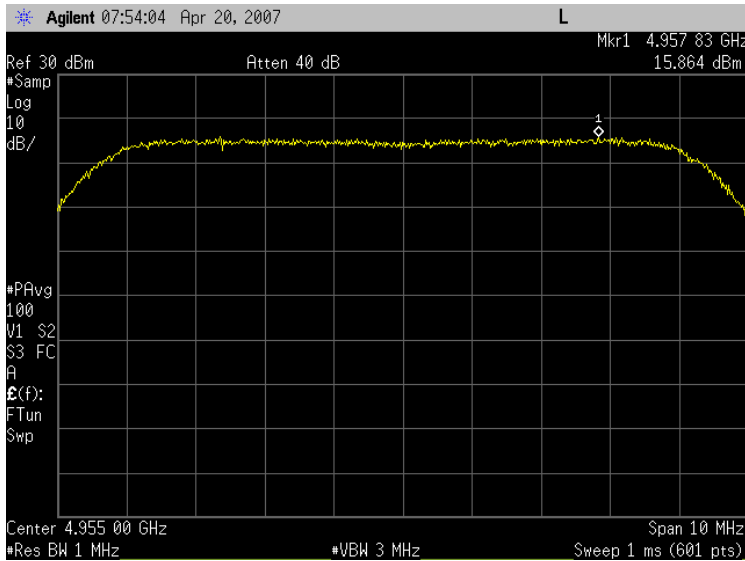
Test Date(s): 4/20/2007



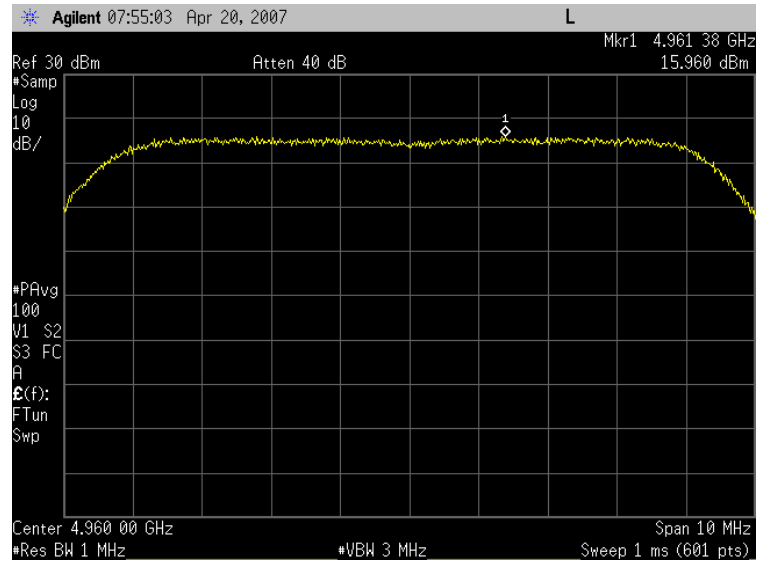
**Peak Power Spectral Density Test Results, 4945 MHz,
10 MHz OBW**



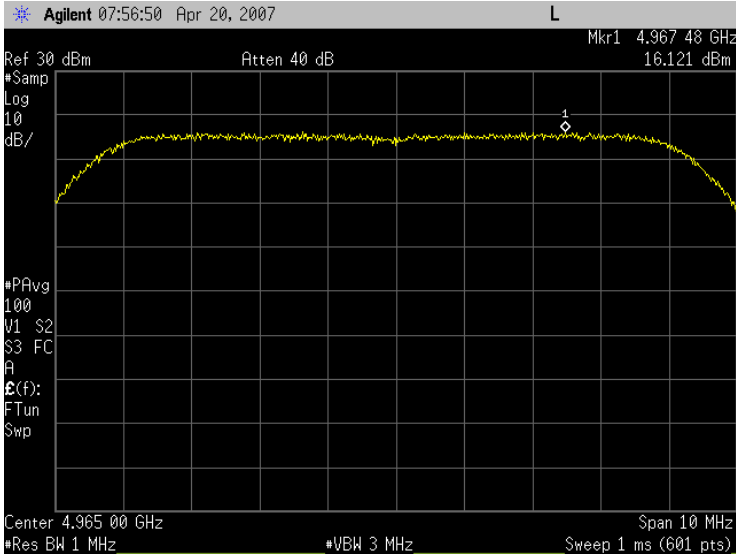
**Peak Power Spectral Density Test Results, 4950 MHz,
10 MHz OBW**



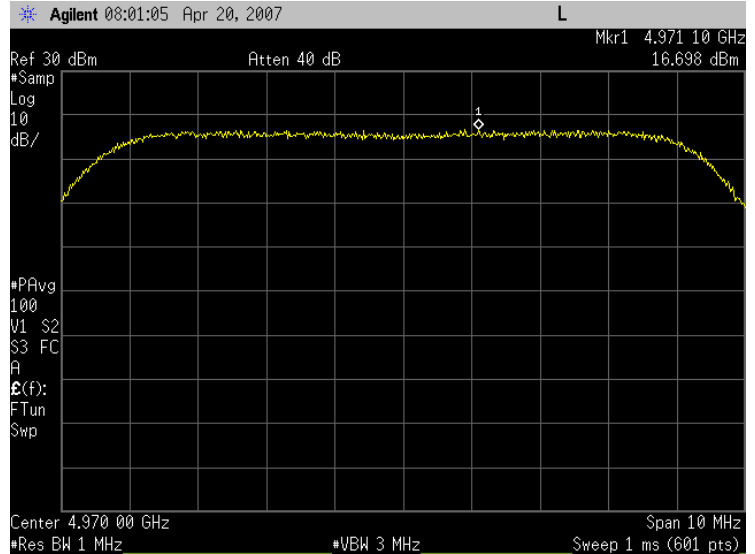
**Peak Power Spectral Density Test Results, 4955 MHz,
10 MHz OBW**



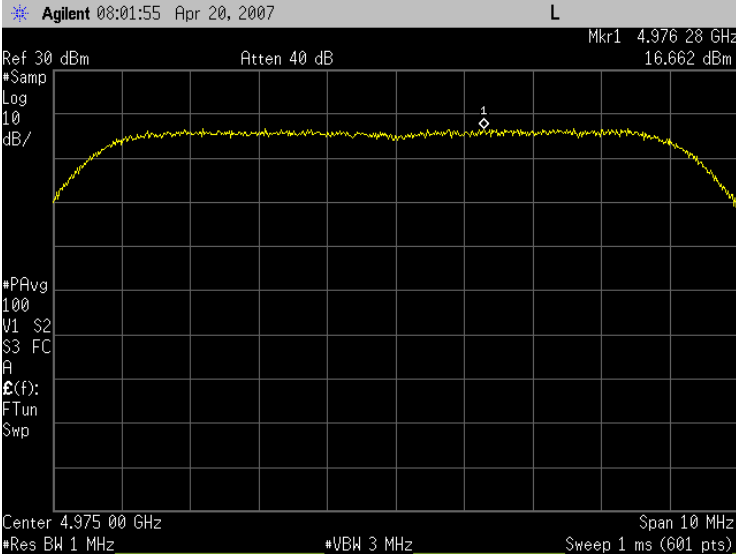
**Peak Power Spectral Density Test Results, 4960 MHz,
10 MHz OBW**



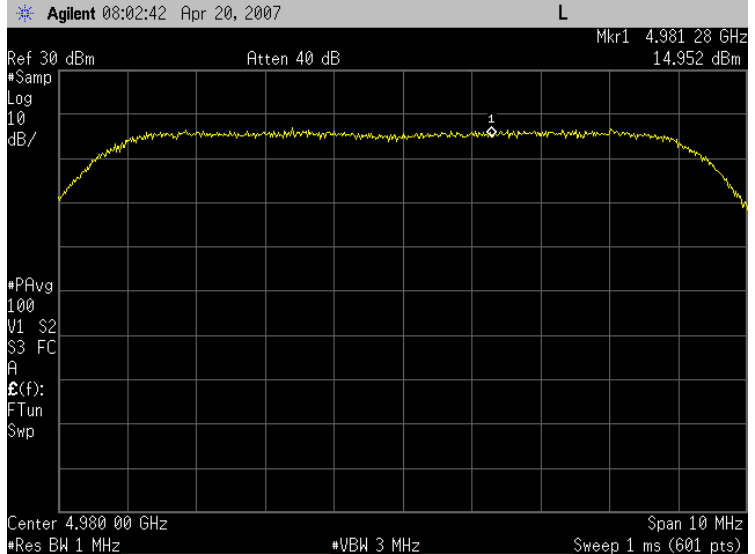
**Peak Power Spectral Density Test Results, 4965 MHz,
10 MHz OBW**



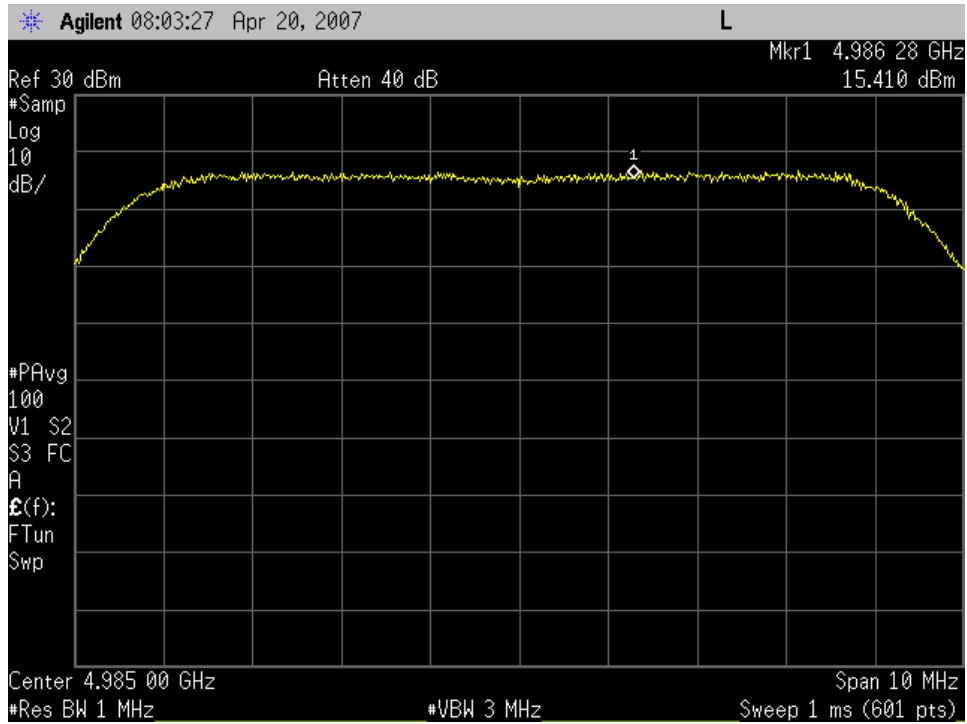
**Peak Power Spectral Density Test Results, 4970 MHz,
10 MHz OBW**



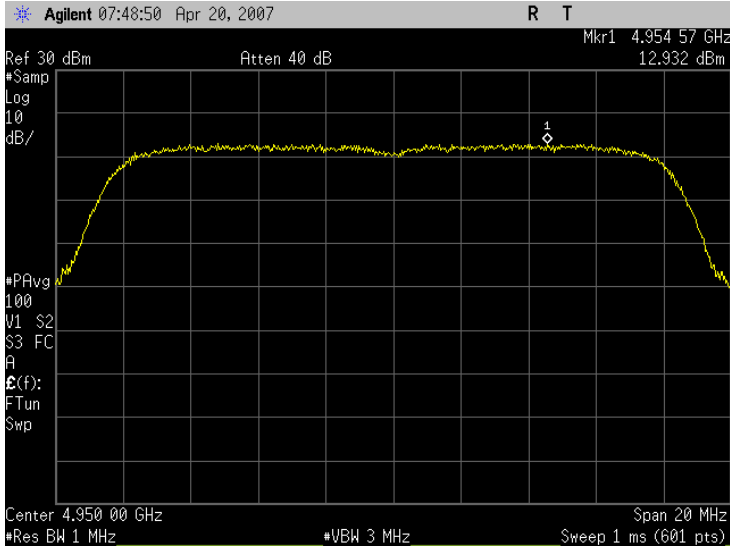
**Peak Power Spectral Density Test Results, 4975 MHz,
10 MHz OBW**



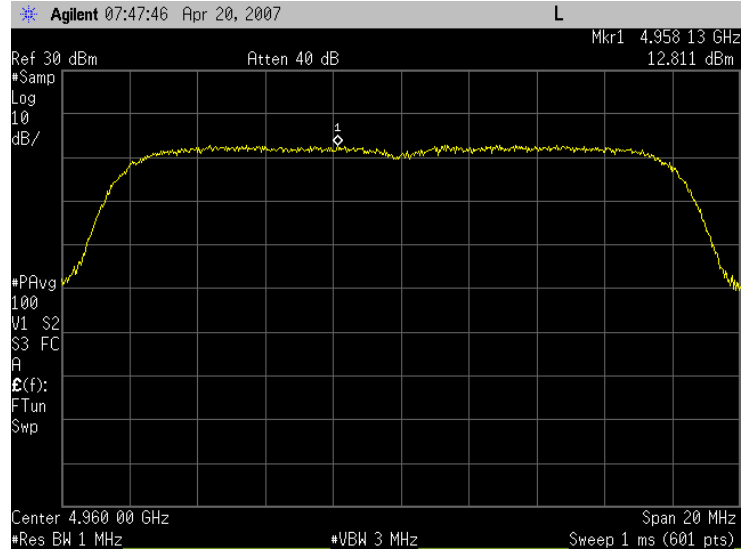
**Peak Power Spectral Density Test Results, 4980 MHz,
10 MHz OBW**



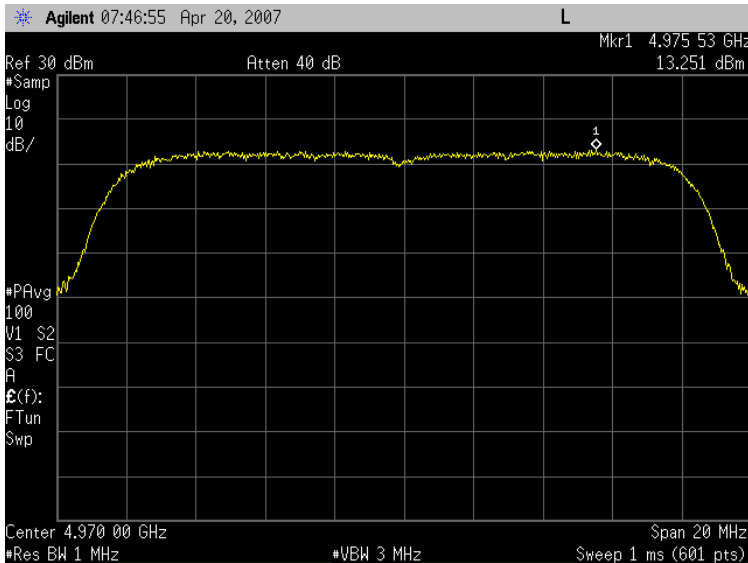
Peak Power Spectral Density Test Results, 4985 MHz, 10 MHz OBW



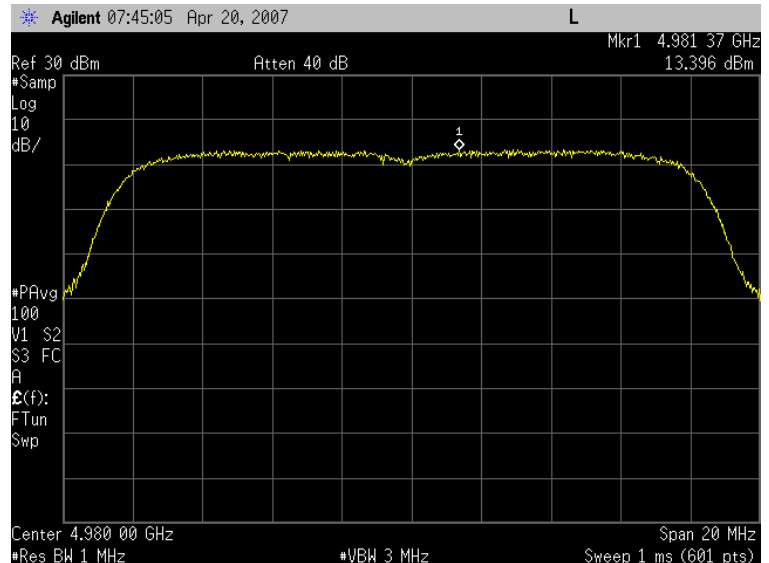
Peak Power Spectral Density Test Results, 4950 MHz,
20 MHz OBW



Peak Power Spectral Density Test Results, 4960 MHz,
20 MHz OBW



Peak Power Spectral Density Test Results, 4970 MHz,
20 MHz OBW



Peak Power Spectral Density Test Results, 4980 MHz,
20 MHz OBW



Electromagnetic Compatibility Occupied Bandwidth Requirements

§2.1049 Occupied Bandwidth (Emission Mask)

Test Requirement(s): §2.1049 and §90.210 (M) with FCC 04-265 (Emissions Mask M)

Test Procedures: As required by 47 CFR 2.1049, *occupied bandwidth measurements* were made at the RF output terminals using a Spectrum Analyzer.

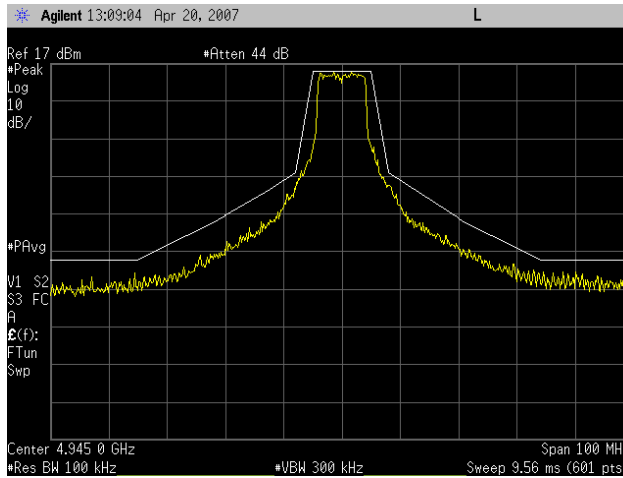
A laptop was connected to EUT to control the RF power output and frequency channel. The measured highest Average Power was set relative to zero dB reference. The RBW of the Spectrum Analyzer was set to at least 1% of the channel bandwidth. The EUT power was adjusted at the maximum output power level. Measurements were carried out at the low, mid and high channels of the TX band.

Test Results: Equipment complies with Section 2.1049 and 90.210(M) with FCC 04-265 (Emission Mask M). The EUT does not exceed the Emission Masks limit.

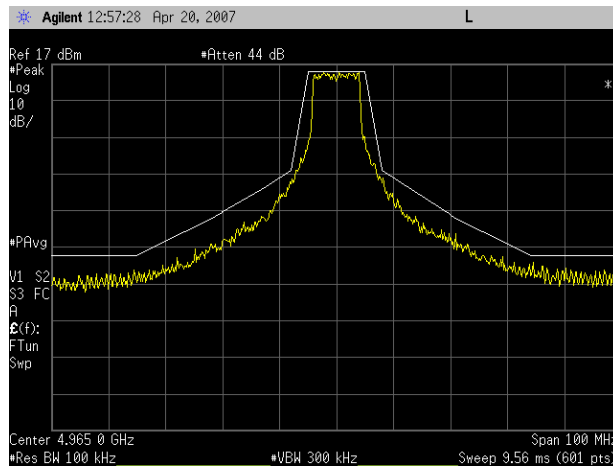
The following pages show measurements of Emission Mask plots and OBW plots.

Test Engineer(s): Dusmantha Tennakoon

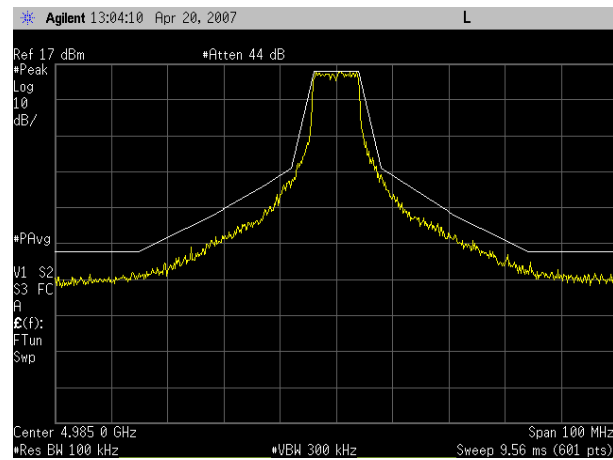
Test Date(s): 4/23/2007



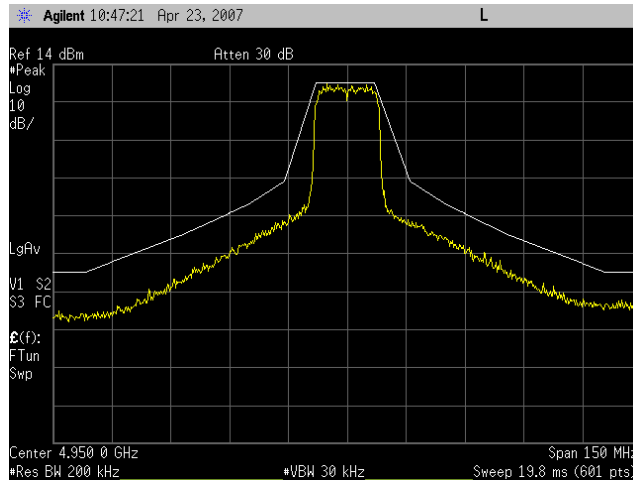
Peak Power Spectral Density Test Results, 4945 MHz, 10 MHz OBW



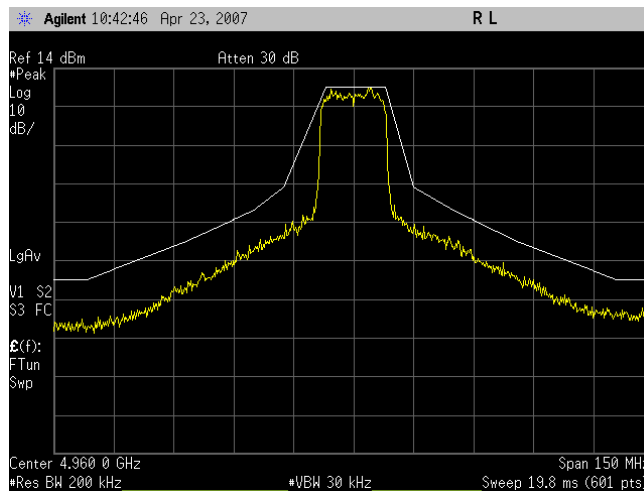
Peak Power Spectral Density Test Results, 4965 MHz, 10 MHz OBW



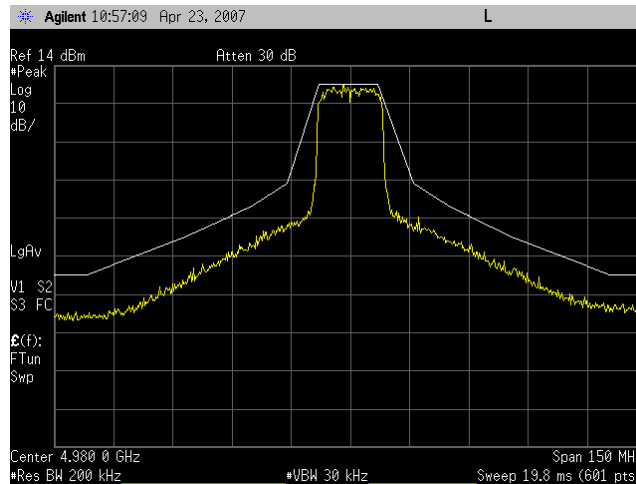
Peak Power Spectral Density Test Results, 4985 MHz, 10 MHz OBW



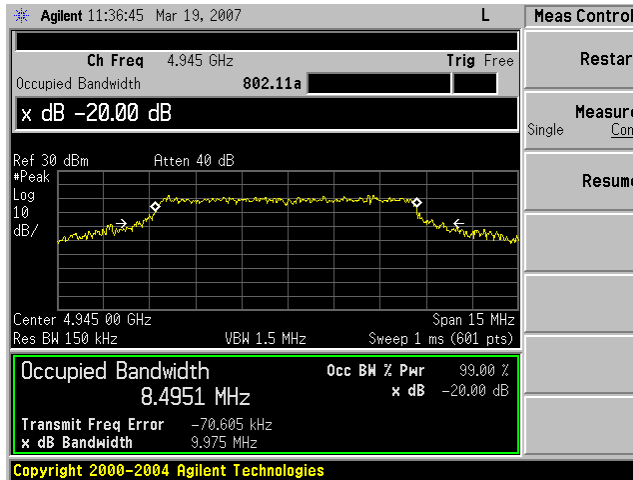
Peak Power Spectral Density Test Results, 4950 MHz, 20 MHz OBW



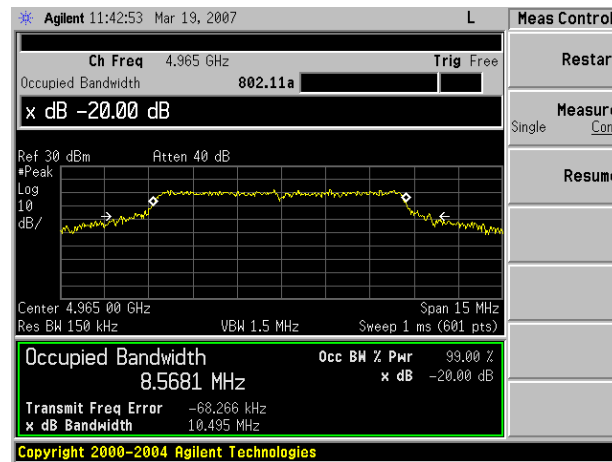
Peak Power Spectral Density Test Results, 4960 MHz, 20 MHz OBW



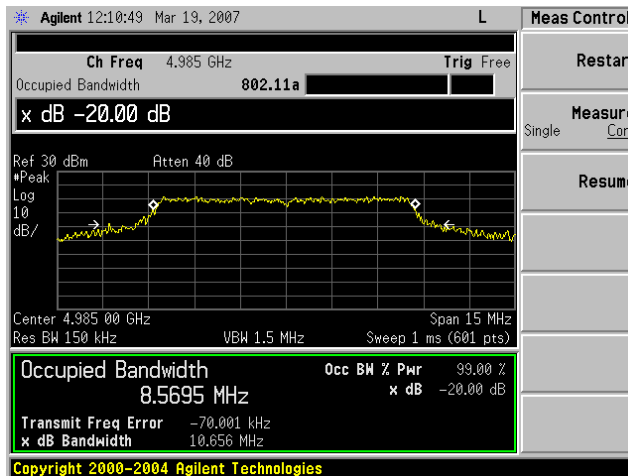
Peak Power Spectral Density Test Results, 4980 MHz, 20 MHz OBW



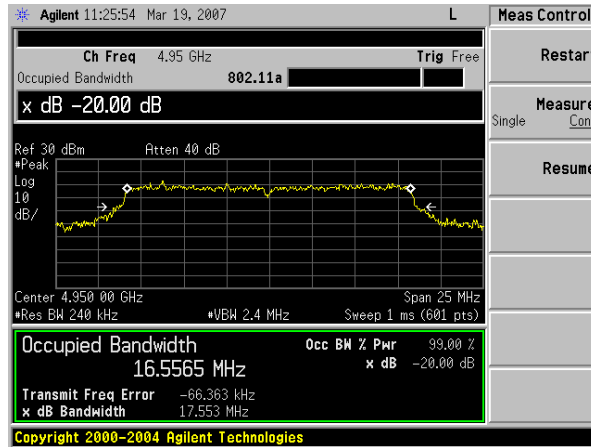
Emission Bandwidth Test Results, 4945 MHz, 10 MHz OBW



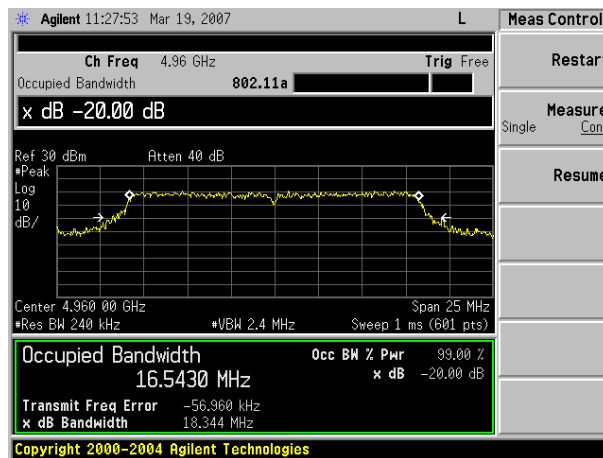
Emission Bandwidth Test Results, 4965 MHz, 10 MHz OBW



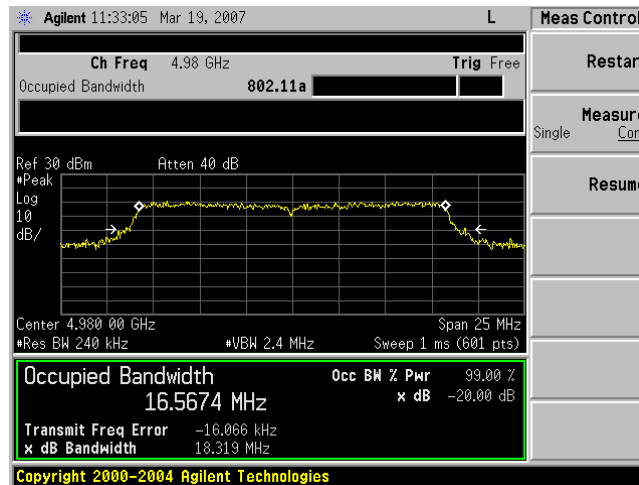
Emission Bandwidth Test Results, 4985 MHz, 10 MHz OBW



Emission Bandwidth Test Results, 4950 MHz, 20 MHz OBW



Emission Bandwidth Test Results, 4960 MHz, 20 MHz OBW



Emission Bandwidth Test Results, 4980 MHz, 20 MHz OBW



Electromagnetic Compatibility Spurious Emissions at Antenna Terminal Requirements

§2.1051 Spurious Emissions at Antenna Terminals

Test Requirement(s): §2.1051 and §90.210(M) with FCC 04-265

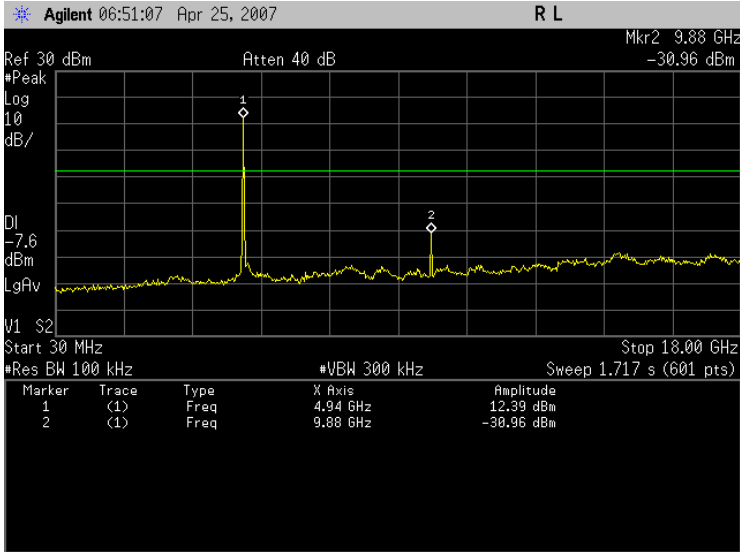
Test Procedures: As required by 47 CFR 2.1051, *spurious emissions at antenna terminal measurements* were made at the RF output terminals using a Spectrum Analyzer.

A laptop was connected to EUT to control the RF power output and frequency channel. The EUT was connected to a Spectrum Analyzer to monitor the output power level. The Spectrum Analyzer was set to sweep 30 MHz and up to 10th harmonic of the fundamental or 40GHz which ever is the lesser. Measurements were made at the low, mid and high channels.

Test Results: Equipment complies with Section 2.1051 and 90.210(M) with FCC 04-265.

Test Engineer(s): Dusmantha Tennakoon

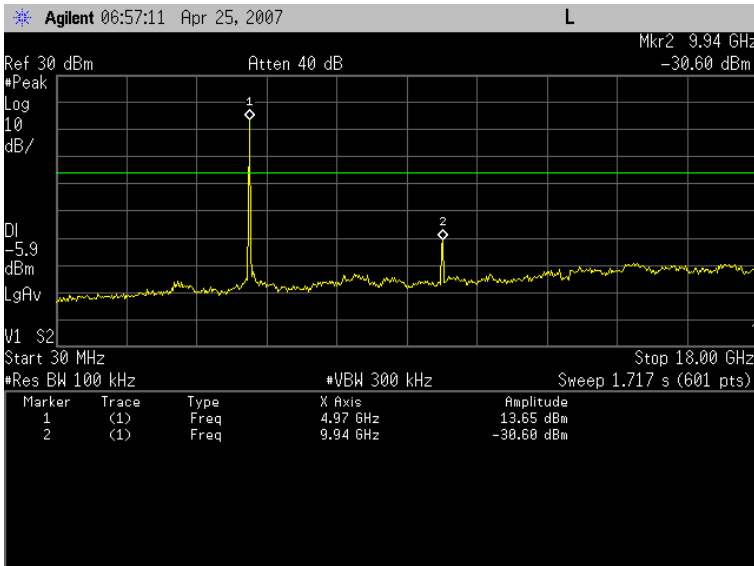
Test Date(s): 4/25/2007



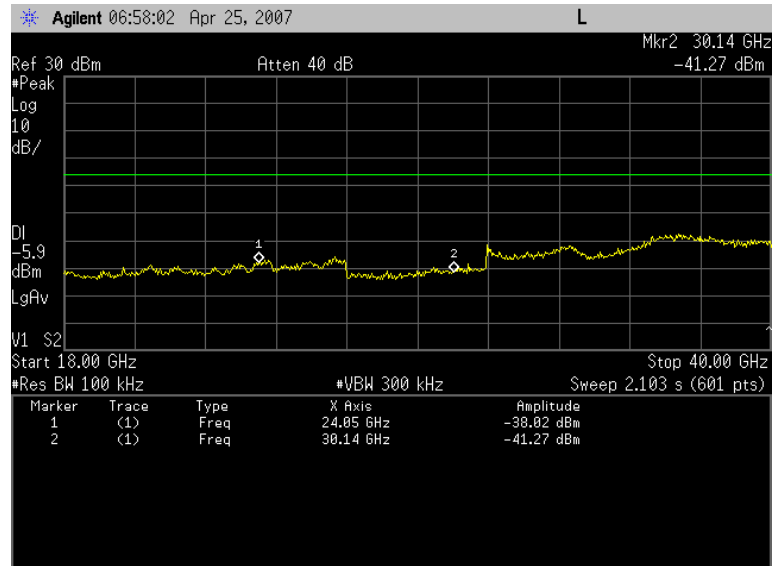
**Conducted Spurious Emissions Test Results,
 4945, 30 MHz to 18 GHz**



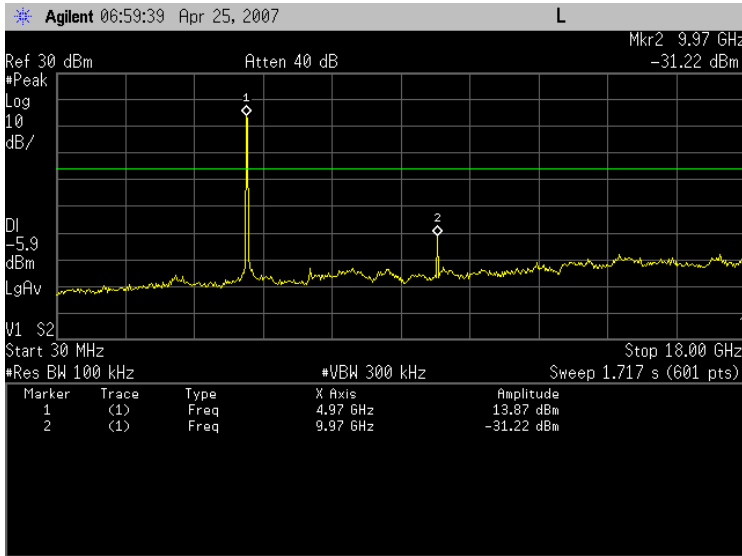
**Conducted Spurious Emissions Test Results,
 4945, 18 GHz to 40 GHz**



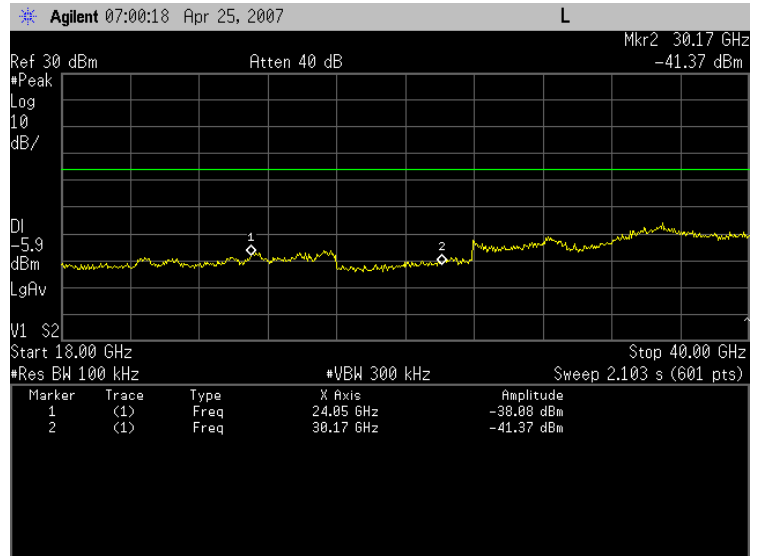
**Conducted Spurious Emissions Test Results,
 4965, 30 MHz to 18 GHz**



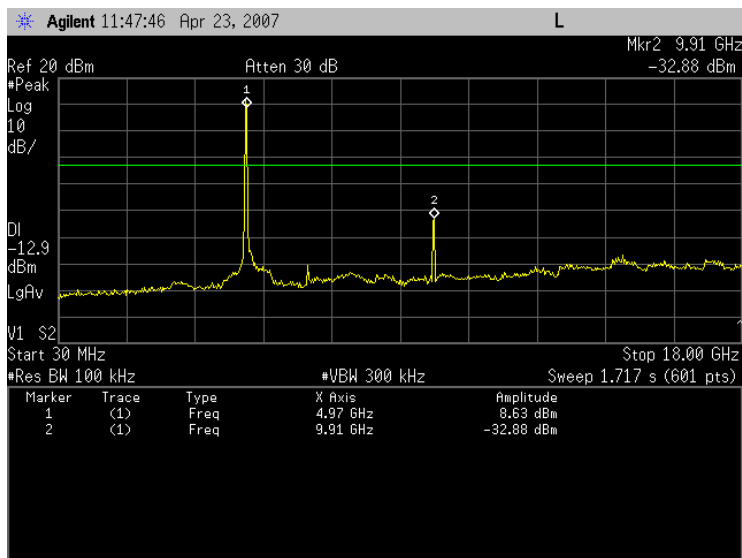
**Conducted Spurious Emissions Test Results,
 4965, 18 GHz to 40 GHz**



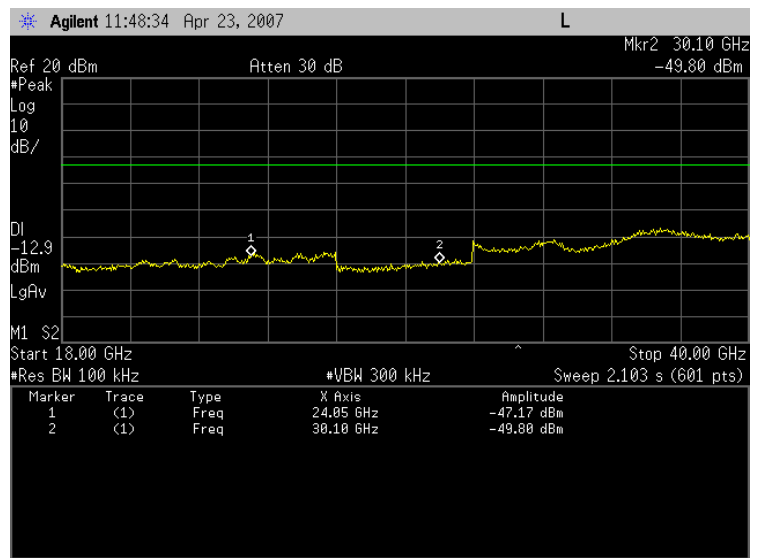
Conducted Spurious Emissions Test Results,
 4985, 30 MHz to 18 GHz



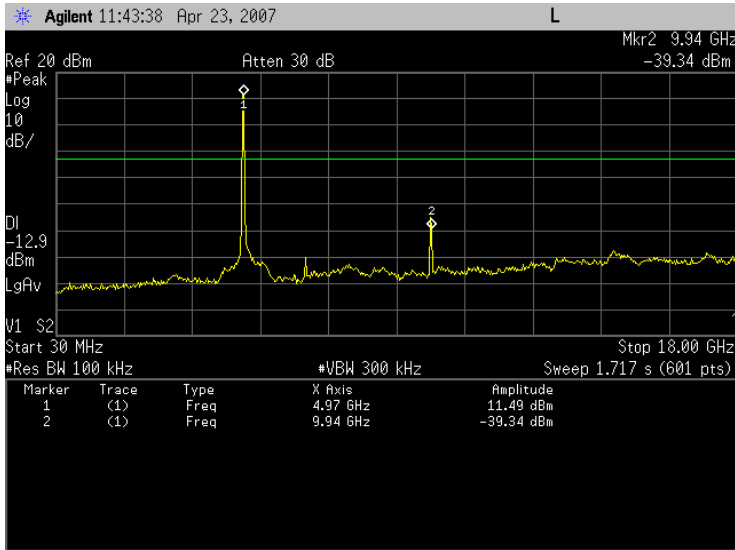
Conducted Spurious Emissions Test Results,
 4985, 18 GHz to 40 GHz



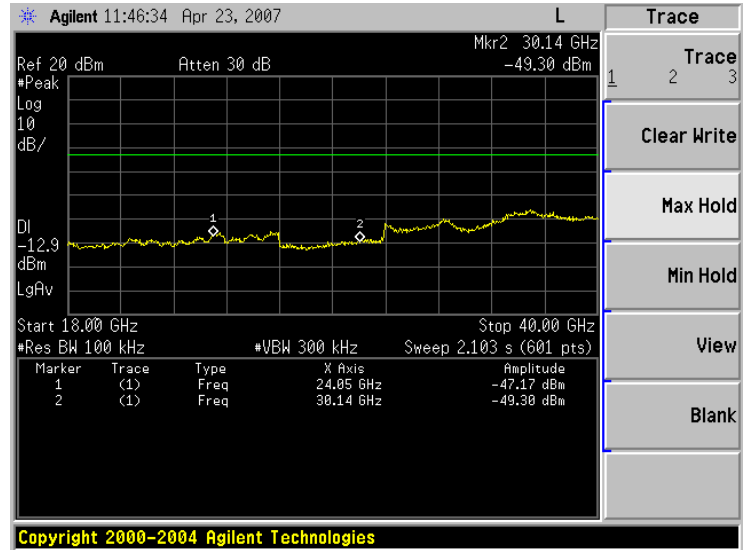
Conducted Spurious Emissions Test Results,
 4950, 30 MHz to 18 GHz



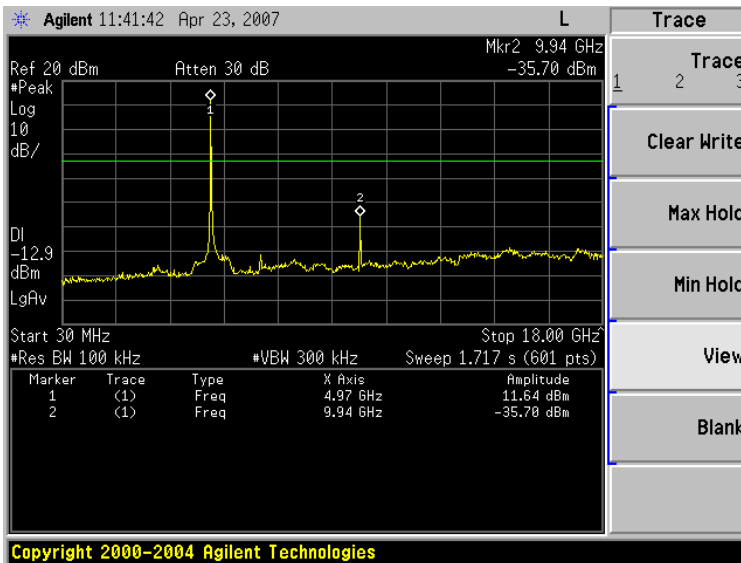
Conducted Spurious Emissions Test Results,
 4950, 18 GHz to 40 GHz



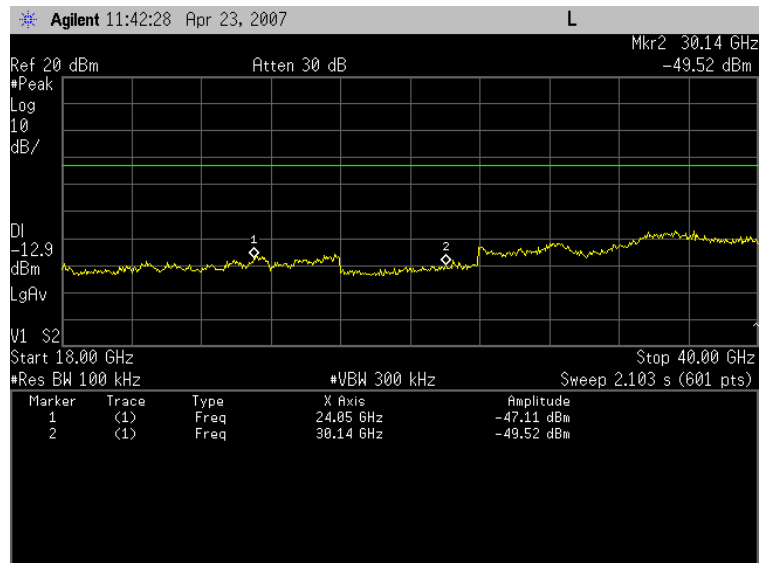
Conducted Spurious Emissions Test Results,
 4960, 30 MHz to 18 GHz



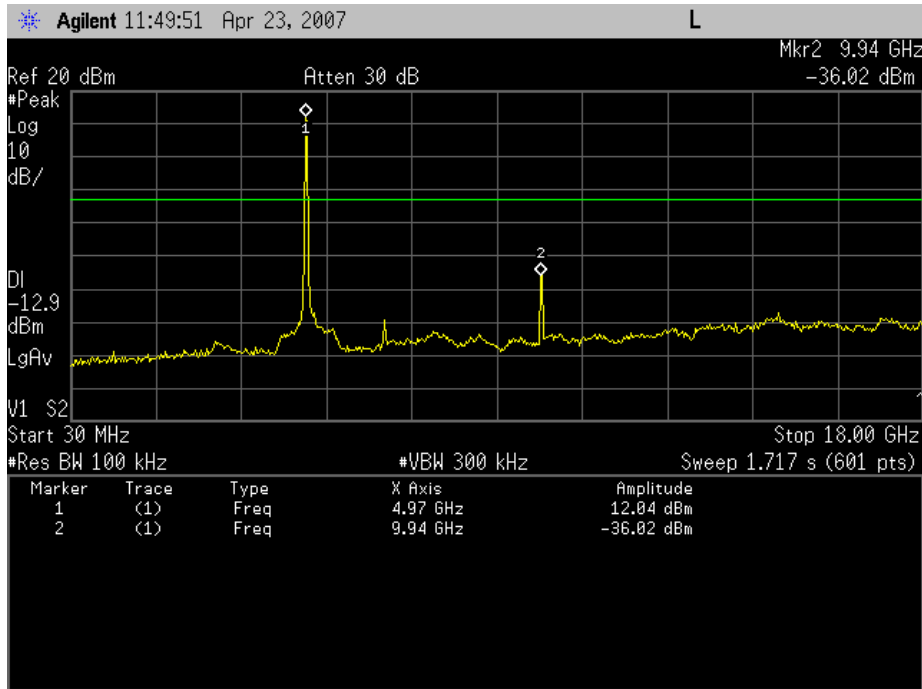
Conducted Spurious Emissions Test Results,
 4960, 18 GHz to 40 GHz



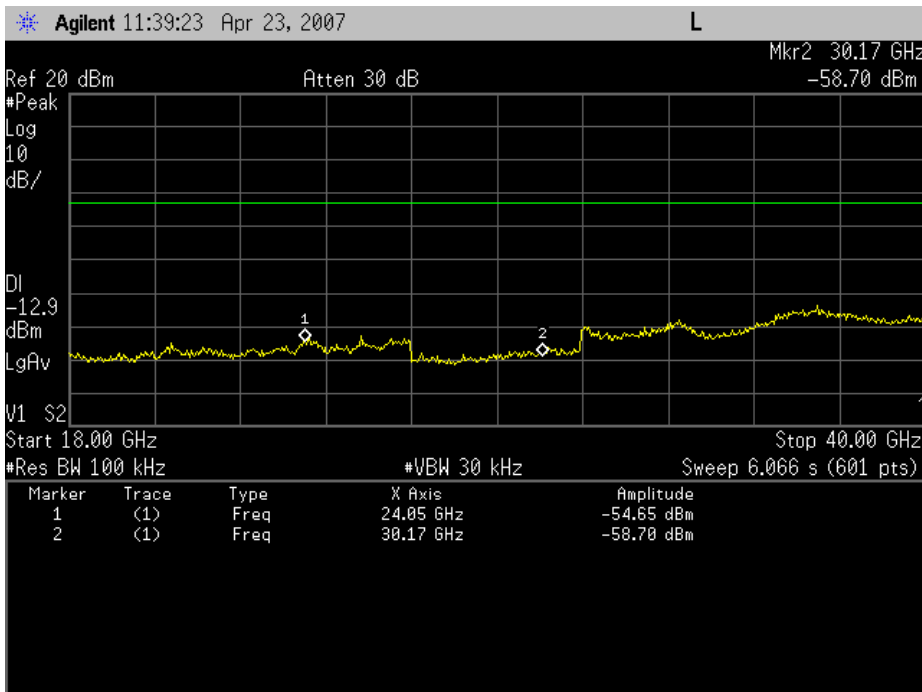
Conducted Spurious Emissions Test Results,
 4970, 30 MHz to 18 GHz



Conducted Spurious Emissions Test Results,
 4970, 18 GHz to 40 GHz



Conducted Spurious Emissions Test Results,
 4980, 30 MHz to 18 GHz



Conducted Spurious Emissions Test Results,
 4980, 18 GHz to 40 GHz



Electromagnetic Compatibility Radiated Emissions Requirements

§2.1053 Radiated Emissions (Substitution Method)

Test Requirement(s): §2.1053 and §90.210

Test Procedures: As required by 47 CFR 2.1053, *field strength of radiated spurious measurements* were made in accordance with the procedures of TIA/EIA-603-A-2001 "Land Mobile FM or PM Communications Equipment Measurement and Performance Standards".

Radiated emission measurements were performed inside a semi-anechoic chamber. The EUT was set at a distance of 3m from the receiving antenna. The EUT's RF ports were terminated to 50ohm load. The EUT was set to transmit at the low, mid and high channels of the transmitter frequency range at its maximum power level. The EUT was rotated about 360⁰ and the receiving antenna scanned from 1-4m in order to capture the maximum emission. A calibrated antenna source was positioned in place of the EUT and the previously recorded signal was duplicated. The maximum EIRP of the emission was calculated by adding the forward power to the calibrated source plus its appropriate gain value. These steps were carried out with the receiving antenna in both vertical and horizontal polarization. Harmonic emissions up to the 10th or 40GHz, which ever was the lesser, were investigated.

Test Results: Equipment complies with Section 2.1053 and 90.210.

Test Engineer(s): Dusmantha Tennakoon

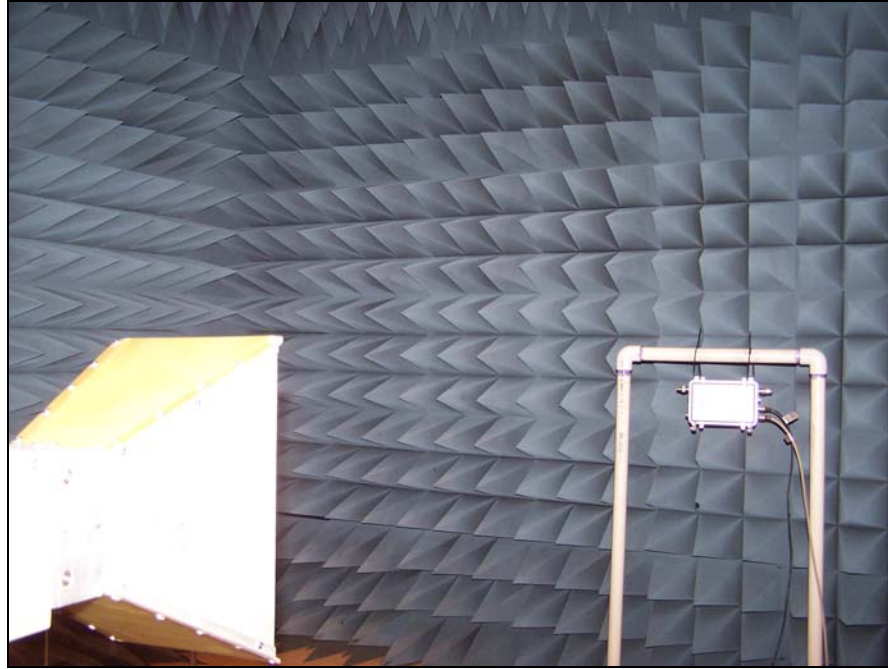
Test Date(s): 4/26/2007



Radiated Emissions (Substitution Method) Test Results

Channel Width (MHz)	Channel (MHz)	Frequency (MHz)	Polarity	SA Reading (dBm)	Substitution antenna power input (dBm)	Tx Antenna gain (dBi)	EIRP (dBm)	Limit (dBm)
10	4945	9890.50	H	-48.54	-55.2	11.30	-43.9	-21
		14834.50	H	-45.11	-53.2	13.00	-40.2	-21
	4965	9931.67	H	-52.45	-52.4	11.30	-41.1	-21
		14890.00	H	-44.84	-49.5	13.00	-36.5	-21
	4985	9972.00	H	-50.09	-55.4	11.30	-44.1	-21
		14948.25	H	-50.12	-55.2	13.00	-42.2	-21
20	4950	9903.00	H	-48.11	-54.7	11.30	-43.4	-21
		14853.50	H	-47.77	-53.6	13.00	-40.6	-21
	4960	9921.33	H	-47.96	-53.2	11.30	-41.9	-21
		14922.50	H	-48.96	-55.2	13.00	-42.2	-21
	4970	9937.33	H	-52.22	-57.8	11.30	-46.5	-21
		14903.83	H	47.94	-54.8	13.00	-41.8	-21
	4980	9957.83	H	-52.18	-57.5	11.30	-46.2	-21
		14947.67	H	-50.53	-55.4	13.00	-42.4	-21

Radiated Emissions Spurious Test Setup



Photograph 4. Radiated Emission Spurious Test Setup



Electromagnetic Compatibility Frequency Stability Requirements

§2.1055 Frequency Stability

Test Requirement(s): §2.1055 and §90.213

Test Procedures: The EUT was placed in the Environmental Chamber and support equipment was placed outside the chamber on a table. The EUT was set to transmit at a particular channel. A 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 -30 to 60^C.

Voltage supplied to EUT is 120 VAC reference temperature was done at 25^C. The voltage was varied by ± 15 % of nominal.

Test Results: Equipment complies with Section 2.1055 and 90.213.

Test Engineer(s): Len Knight

Test Date(s): 4/26/2007



Photograph 5. Frequency Stability Test Setup



Frequency Stability Test Results

Reference Freq.: 4.965 GHz

Temperature (Celsius)	Drift Freq (kHz)	Drift (ppm)
-30	-10 kHz	-0.01
-20	0 kHz	0
-10	30 kHz	0.03
0	10 kHz	0.01
10	30 kHz	0.03
20	30 kHz	0.03
25	Reference	
30	10 kHz	0.01
40	10 kHz	0.01
50	100 kHz	0.1
60	90 kHz	0.09

Table 9. Temperature Vs. Frequency Test Results

Reference: 120VAC at 25C, Frquency = 4.96496 GHz

Measured Voltage(dc) +/-15% of nominal	Measured Freq (MHz)	Drift (Hz)
102	-2.51	-2.51
138	-2.51	-2.51

Table 10. Frequency vs. Voltage Test Results



Electromagnetic Compatibility RF Exposure Requirements

§1.1307 RF Exposure Requirements

RF Exposure Requirements: §90.1217, §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 @ 4940-4990 MHz; highest conducted power = 27.37dBm (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm².**

EUT maximum antenna gain = 11dBi.

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

$$S = PG / 4\pi R^2$$

where, S = Power Density mW/m²
P = Power Input to antenna mili Watts
G = Numeric Antenna Gain
R = Distance to the center of radiation of the antenna
Antenna Numeric Gain = 10^{dBi/10}

Power at antenna port = 547 mW

Antenna Gain = 11 dBi

Numeric antenna gain = 10^{11/10} = 12.6

R=sqrt{(547*12.6)/(4*3.14)} = 23.4 cm

Therefore, EUT must have separation distance of at least 23.4cm from humans to meet the exposure requirements.



V. 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
1T4382	SHIELD ROOM 6	FIL-SHIELD	N/A	01/29/2007	01/29/2008
1T4156	SPECTRUM ANALYZER; EMC	HEWLETT PACKARD	8594EM	10/06/2006	10/06/2007
1T4577	THERMO/HYGROMETER	CONTROL COMPANY	S6-627-9	09/24/2006	09/24/2008
1T2947	LISN	SOLAR	8028-50-TS-24-BNC	10/26/2006	10/26/2007
1T2948	LISN	SOLAR	8028-50-TS-24-BNC	10/26/2006	10/26/2007
1T4565	LISN (24 AMP)	SOLAR ELECTRONICS	9252-50-R-24-BNC	09/01/2006	09/01/2007
1T4351	SPECTRUM ANALYZER	AGILENT	E7405A	SEE NOTE	
1T4548	AC POWER SOURCE	CALIFORNIA INSTRUMENTS	1251P	SEE NOTE	
1T4505	TEMPERATURE CHAMBER	TEST EQUITY	115	SEE NOTE	
1T4414	MICROWAVE PRE-AMPLIFIER	AH SYSTEMS	PAM-0118	SEE NOTE	
1T2511	ANTENNA; HORN	EMCO	3115	07/13/2006	07/13/2007
1T2665	ANTENNA; HORN	EMCO	3115	04/17/2007	04/17/2008
1T4351	SPECTRUM ANALYZER	AGILENT	E7405A	10/13/2006	10/13/2007
1T4514	SYNTH SWEEP GENERATOR	AGILENT	83752B/1E1	12/15/2006	12/15/2007
1T4480	MILITARY CHAMBER 20 X 20 X 12	ETS LINDGREN	SERIES 80	SEE NOTE	
US4207 0103	AGILENT PSA	AGILENT	E4448A	2/20/2007	2/20/2008

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



VI. Certification & User's Manual Information



Certification Label & 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 provision that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.



The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart Y — 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, whichever is applicable.

§ 2.902 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

B 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.

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 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.



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Electromagnetic Compatibility
End of Report
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