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

Nomadio digital telemetry
2400 Chestnut Street
Philadelphia, PA 19103

November 2, 2005

Dear Bhana Grover,

Enclosed is the EMC test report for compliance testing of the Nomadio digital telemetry, Modular Transceiver as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-03 ed.), Part 15 Subpart C, §15.247 for Intentional Radiators and FCC Declaration of Conformity under CFR, Part 15, Subpart B For a Class B Unintentional Radiator.

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.

Marie Ann Confroy
Documentation Department

Reference: (\Nomadio digital telemetry\ Modular Transceiver\ EMC17088B-FCC247)

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Electromagnetic Compatibility
Test Report

For the

Nomadio digital telemetry
Modular Transceiver

Tested in Accordance with
Title 47 of the CFR
FCC Part 15, Subpart B and Subpart C

MET Report: 17088B-FCC247

November 2, 2005

Prepared For:

Nomadio digital telemetry
2400 Chestnut Street
Philadelphia, PA 19103

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

Electromagnetic Compatibility
Test Report

For the

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Tested in Accordance with
Title 47 of the CFR
FCC Part 15, Subpart B and Subpart C

Kevin Mehaffey
Electromagnetic Compatibility Lab

Marie Ann Confroy
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, §15.247 of the FCC Rules under normal use and maintenance.

Christopher Eckert
Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
Ø	November 2, 2005	Initial Issue.

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
dBμV	**D**eci-**B**els above one **micro V**olt
dBμV/m	**D**eci-**B**els above one **micro V**olt **per m**eter
DC	**D**irect **C**urrent
DCF	**D**istance **C**orrection **F**actor
E	**E**lectric Field
EUT	**E**quipment **U**nder **T**est
f	**F**requency
FCC	**F**ederal **C**ommunications **C**ommission
H	Magnetic Field
GHz	**G**iga **H**ert**z**
Hz	**H**ert**z**
ICES	**I**nterference-**C**ausing **E**quipment **S**tandard
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
μ**H**	**micro H**enry
μ**F**	**micro F**arad
μ**s**	**micro s**econds
RF	**R**adio **F**requency
RMS	**R**oot-**M**ean-**S**quare

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1.0 Introduction

1.1 Overview

MET Laboratories, Inc. was contracted by Nomadio digital telemetry to perform testing on the Modular Transceiver, under Nomadio digital telemetry purchase order number 05-119.

This document describes the test setups, test methods, required test equipment, and the test limits used to perform compliance testing of the Modular Transceiver. All applicable tests were performed in accordance with Title 47 of the CFR, FCC Part 15, Subpart B and Subpart C.

Type of Submission/Rule:	Part 15.247 Original Filing	
Model(s) Tested:	Modular Transceiver	
Model(s) Covered:	Modular Transceiver	
EUT Specifications:	**Primary Power:**	4 AA batteries
	FCC ID:	NMD-AM02
	Equipment Code:	DSS
	RF Power Output:	0.00722 W
	Equipment Frequency Range:	2402 – 2479 MHzz
Analysis:	The results obtained relate only to the item(s) tested.	
Evaluated by:	Christopher Eckert and Dusmantha Tennakoon	
Date(s):	October 20, 2005	

1.2 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 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).

1.3 Testing Summary

Paragraph	Name of Test	Compliance
Part 15, Subpart C, §15.203	Antenna Requirement	Compliant
Part 15, Subpart C, §15.205	Restricted Bands of Operation	Compliant
Part 15, Subpart B, §15.109	Unintentional Radiators	Compliant
Part 15, Subpart C, §15.247(a)	Bandwidth Requirements	Compliant
Part 15, Subpart C, §15.247(i)	Output Power and RF Exposure	Compliant
Part 15, Subpart C, §15.247(c)	Spurious Conducted Emissions	Compliant
Part 15, Subpart C, §15.247(d)	Power Spectral Density	Compliant
Part 15, Subpart C, §15.247	Band Edge Measurement	Compliant

Table 1 Testing Summary

2.0 Equipment Configuration

2.1 Description of EUT

The Modular Transceiver, Equipment Under Test (EUT) is a transceiver that is meant to be put into remotely-controlled consumer scale-model vehicles.

2.2 Equipment Configuration

The EUT was set up as outlined in Figure 1. All equipment incorporated as part of the EUT is included in the following list.

Name / Description	Model Number
Modular Transceiver	AM02

Table 2. Equipment Configuration

2.3 Support Equipment

No support equipment was necessary for the normal operation and testing of the EUT.

2.4 Ports and Cabling Information

No external cabling was necessary for the normal operation and testing of the EUT. A USB interface was used to set the transmitter channel, power and data rate to the worst-case condition. All external cabling was removed prior to test.

2.5 Mode Of Operation

The EUT is transmitting continuously at max power and maximum data rate.

2.6 Modifications to EUT

The EUT chassis was painted with metalized paint in order to meet the requirements, for Radiated Emissions.

2.7 Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Nomadio digital telemetry upon completion of testing.

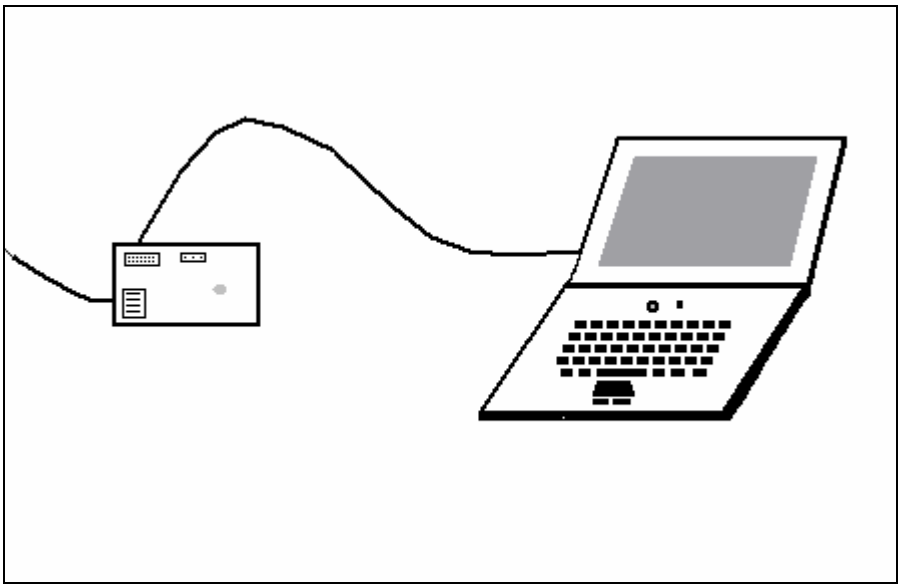


Figure 1. Block Diagram of Test Configuration

3.0 Electromagnetic Compatibility Test Data

3.1 Antenna Requirements

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 be permanently attached to the unit.

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

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

Results: The EUT complies with the requirements of this section. The EUT has a unique connector, reverse SMA, per the 15.203 requirements.

Type of Antenna: Homemade Whip Antenna

Gain of Antenna: 1.9 dBi

Test Engineer(s): Christopher Eckert

Test Date(s): 06/21/2005

Antenna Requirement Test Setup

Photograph 1. EUT with Antenna Connected

Antenna Requirement Test Setup

Photograph 2. EUT Antenna Port

3.2 Restricted Bands Of Operation

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 3:

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505 (Note 1)	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 2)
13.36–13.41.			
Note 1: Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz. Note 2: Above 38.6			

Table 3. 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 4. Radiated Emissions Limits from § 15.209 (a)

Test Procedure: The EUT was configured with the control software to transmit at maximum power. Measurements were made with a ridge guide horn antenna at a distance of 3 meters. Cable loss has been accounted for in the raw measurement. The frequency range of interest was that indicative to spurious emissions associated with the intentional radiator section of the EUT.

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

Test Engineer(s): Christopher Eckert

Test Date(s): 6/21/2005

Radiated Emissions Limits Test Results, 15.209 (a) - Average

Frequency (GHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna HEIGHT (m)	Uncorrected Amplitude (dBuv)	Antenna Correction Factor (dB) (+)	System Gain (dB) (-)	Distance Correction Factor (dB) (-)	Corrected Amplitude (dBuv)	Limit (dBuv)	Margin (dB)
2.484	210	H	1.00	27.78	28.77	-2.11	9.54	49.12	54.00	-4.88
2.484	330	V	1.00	25.38	28.67	-2.11	9.54	46.62	54.00	-7.38
4.882	210	H	1.00	16.22	33.79	-2.99	9.54	43.46	54.00	-10.54
4.882	0	V	1.00	15.20	33.69	-2.99	9.54	42.34	54.00	-11.66
7.325	0	H	1.00	19.10	37.08	-3.67	9.54	50.31	54.00	-3.69
7.325	0	V	1.00	19.14	36.98	-3.67	9.54	50.25	54.00	-3.75

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

Radiated Emissions Limits Test Results, 15.209 (a) - Peak

Frequency (GHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna HEIGHT (m)	Uncorrected Amplitude (dBuv)	Antenna Correction Factor (dB) (+)	System Gain (dB) (-)	Distance Correction Factor (dB) (-)	Corrected Amplitude (dBuv)	Limit (dBuv)	Margin (dB)
2.484	210	H	1.00	32.66	28.77	-2.11	9.54	54.00	74.00	-20.00
2.484	330	V	1.00	32.12	28.67	-2.11	9.54	53.36	74.00	-20.64
4.882	210	H	1.00	27.52	33.79	-2.99	9.54	54.76	74.00	-19.24
4.882	0	V	1.00	28.28	33.69	-2.99	9.54	55.42	74.00	-18.58
7.325	0	H	1.00	31.34	37.08	-3.67	9.54	62.55	74.00	-11.45
7.325	0	V	1.00	31.36	36.98	-3.67	9.54	62.47	74.00	-11.53

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

Photograph 3. Radiated Spurious Emission Test Setup

3.3 Unintentional Radiators

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 5.

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

Test Procedures: The EUT was configured to operate at maximum power. Though the purpose of this test is to measure the unintentional radiation from the digital portion, the transmitter was operated in case any digital circuitry lay idle while the transmitter is not operating.

For final radiated measurements, the EUT was placed on a 0.8 m high non-conductive table inside a semi-anechoic chamber, and located 3 m from an adjustable antenna mast. For pre-scanning, the spectrum analyzer scanned the frequency range from 30 MHz to 1 GHz to obtain an emission profile of the EUT.

For each point of measurement, the turntable was rotated, and the antenna height was varied between 1 m and 4 m, in order to find the maximum radiated emissions. Measurements above 30 MHz were taken using this technique with the antenna in two polarizations: horizontal and vertical.

Unless otherwise specified, measurements were made using a quasi-peak detector with a 120 kHz bandwidth for below 1 GHz.

Unintentional Radiators Test Results

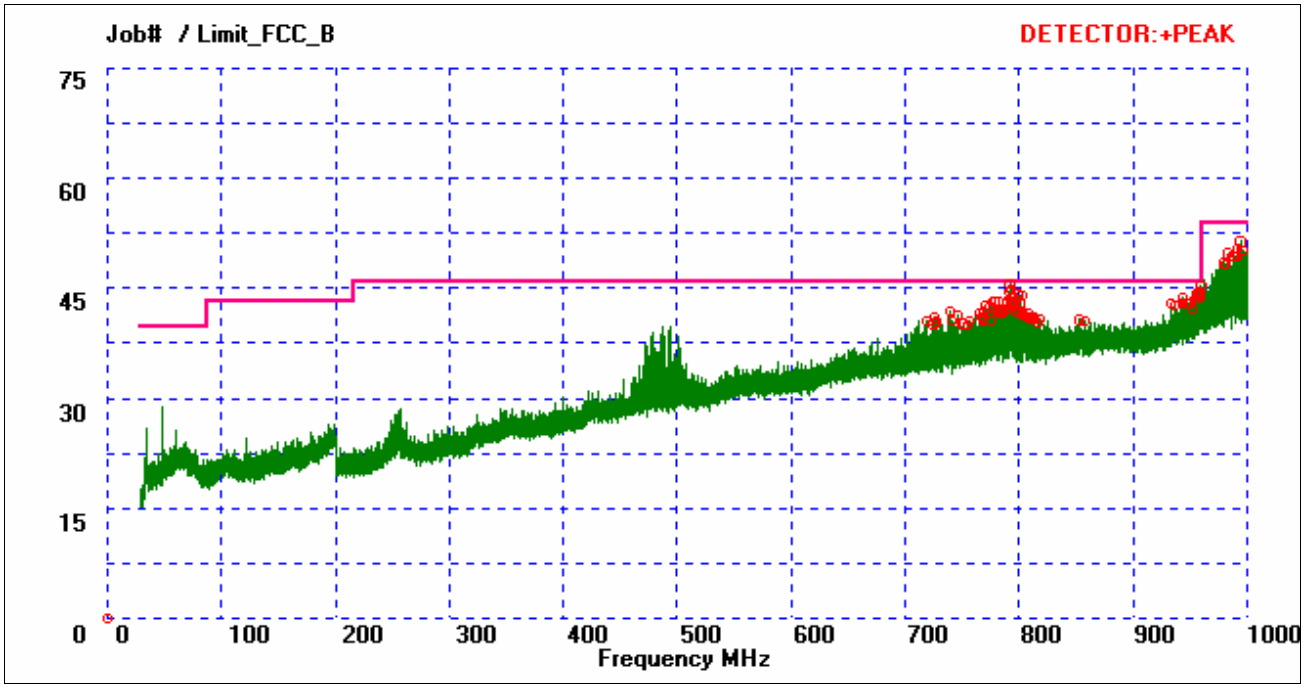
Test Results: The EUT was compliant with the requirements of this section.

Frequency (MHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna Height (m)	Amplitude (dBuv) @3 m	ACF (dB) (+)	Cable Loss (dB) (-)	DCF (dB) (-)	Corrected Amplitude (dBuv)	Class B Limit @ 3 m (dBuv)	Margin (dB)
791.1022	173	H	1	12.6	21.08	2.33	0	36.01	46	-9.99
791.1022	322	V	1.25	14.61	21.12	2.33	0	38.06	46	-7.94
952.56914	0	H	1.22	7.88	23.25	2.36	0	33.50	46	-12.50
952.56914	360	V	1	11.21	23.10	2.36	0	36.67	46	-9.33
481.44689	129	H	1.73	15.95	17.06	2.00	0	35.01	46	-10.99
481.44689	257	V	1.05	14.75	17.37	2.00	0	34.12	46	-11.88
992.82164	143	H	1	11.7	23.66	2.55	0	37.91	54	-16.09
992.82164	-1	V	1	15.1	23.60	2.55	0	41.25	54	-12.75
801.58317	360	H	1	15.32	21.06	2.33	0	38.71	46	-7.29
801.58317	-1	V	1.21	16.26	21.33	2.33	0	39.92	46	-6.08
766.32265	-1	H	1	15.32	20.80	2.33	0	38.45	46	-7.55
766.32265	360	V	1.24	15.8	20.77	2.33	0	38.90	46	-7.10
738.78758	360	H	1	14.8	20.72	2.33	0	37.85	46	-8.15
738.78758	0	V	1.28	15.06	20.92	2.33	0	38.31	46	-7.69
944.62725	361	H	1	16.03	22.99	2.33	0	41.35	46	-4.65
944.62725	360	V	1	16.26	22.99	2.33	0	41.58	46	-4.42

Test Engineer(s): Dusmantha Tennakoon

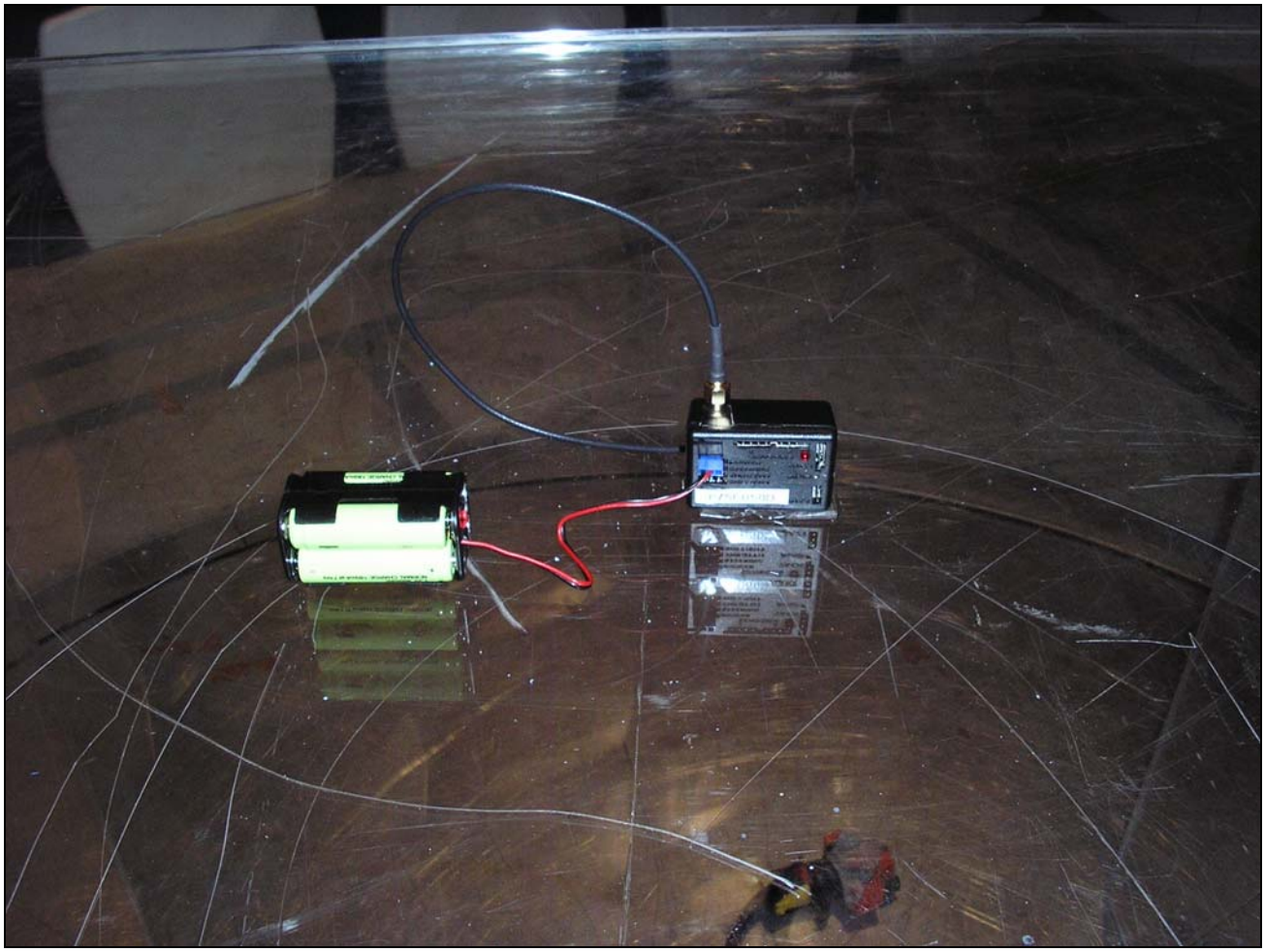
Test Date(s): 11/01/2005

Unintentional Radiators Test Results



Plot 1. Unintentional Radiators Test Results – Pre-scan

Unintentional Radiators Test Setup



Photograph 4. Unintentional Radiators Test Setup

3.4 Bandwidth Requirements

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): Systems using digital modulation techniques may operate in the 902 - -928 MHz, 2400 – 2483.5 MHz, and 5725 – 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Test Procedure: The EUT's transmitter output was connected directly to the spectrum analyzer. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW of 100 kHz and a , VBW> RBW. The 6 dB bandwidth was measured and recorded. See Photograph 5for a picture of the test setup

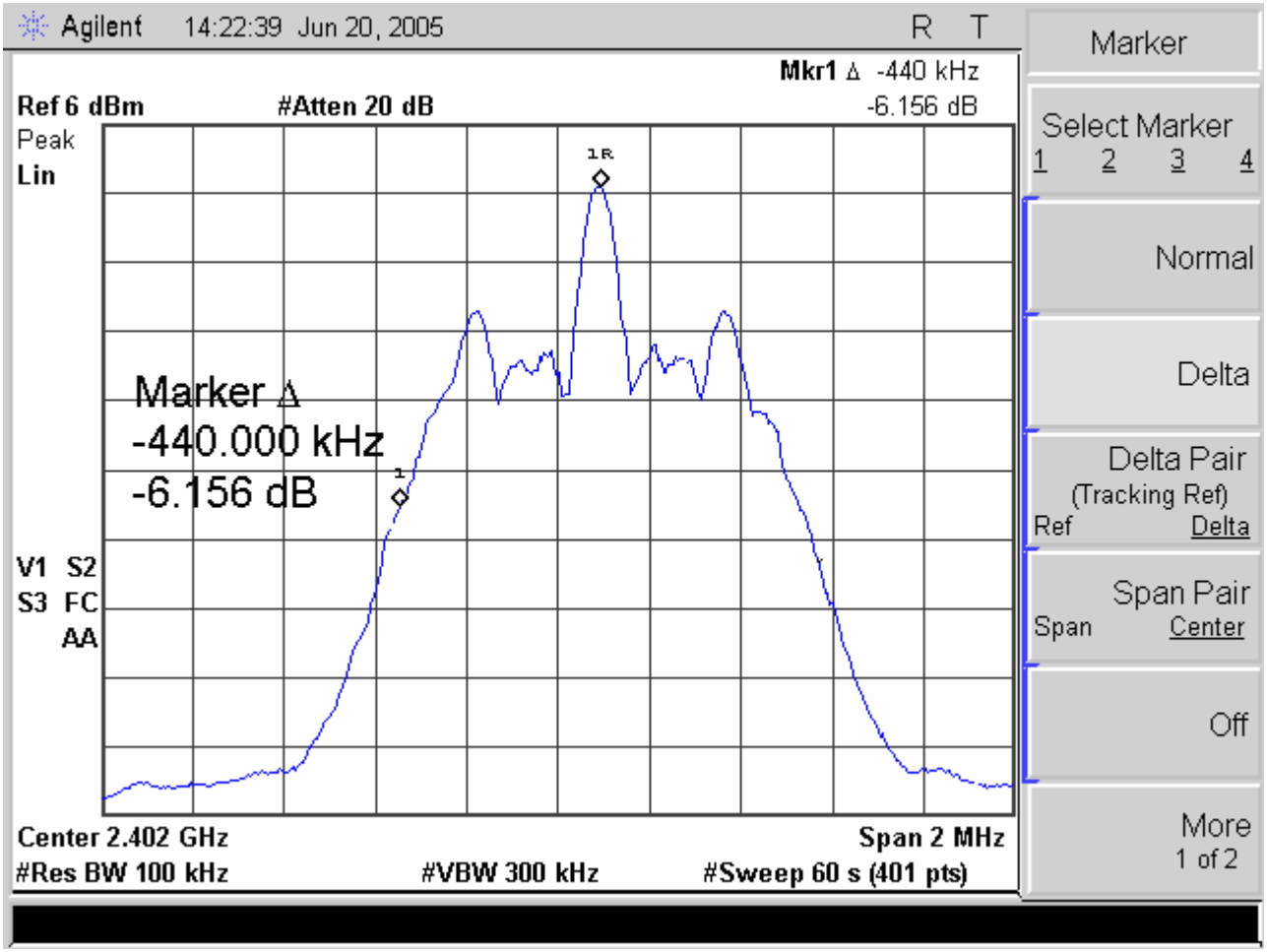
Test Results The EUT complies with the requirements of this section.

Test Engineer: Christopher Eckert, Dusmantha Tennakoon

Test Date: 06/20/2005, 10/24/2005

Occupied Bandwidth Test Data

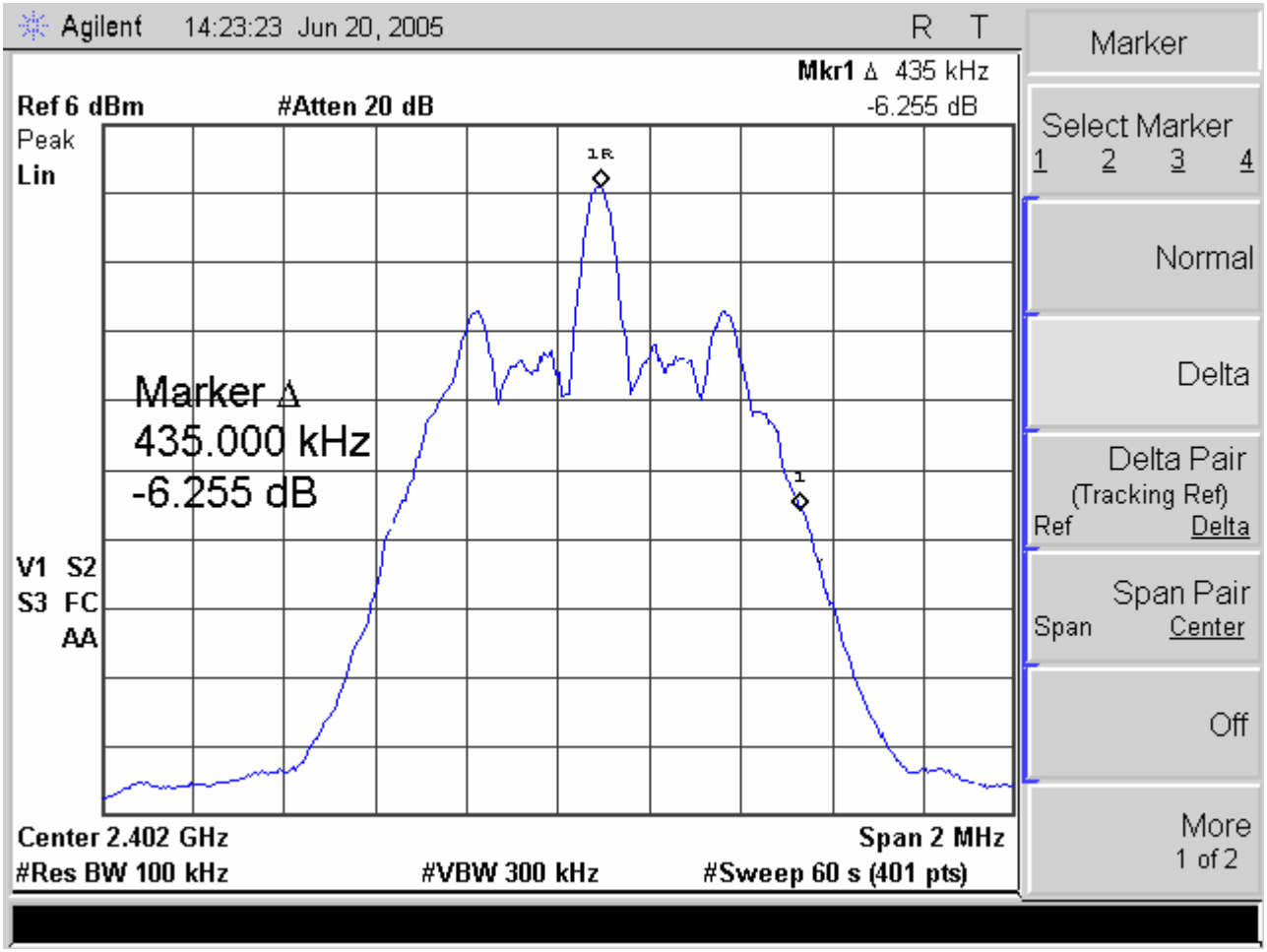
Occupied Bandwidth - Low Channel



Plot 2. Occupied Bandwidth; Test Results, Channel Ø

Occupied Bandwidth Test Data

Occupied Bandwidth - Low Channel

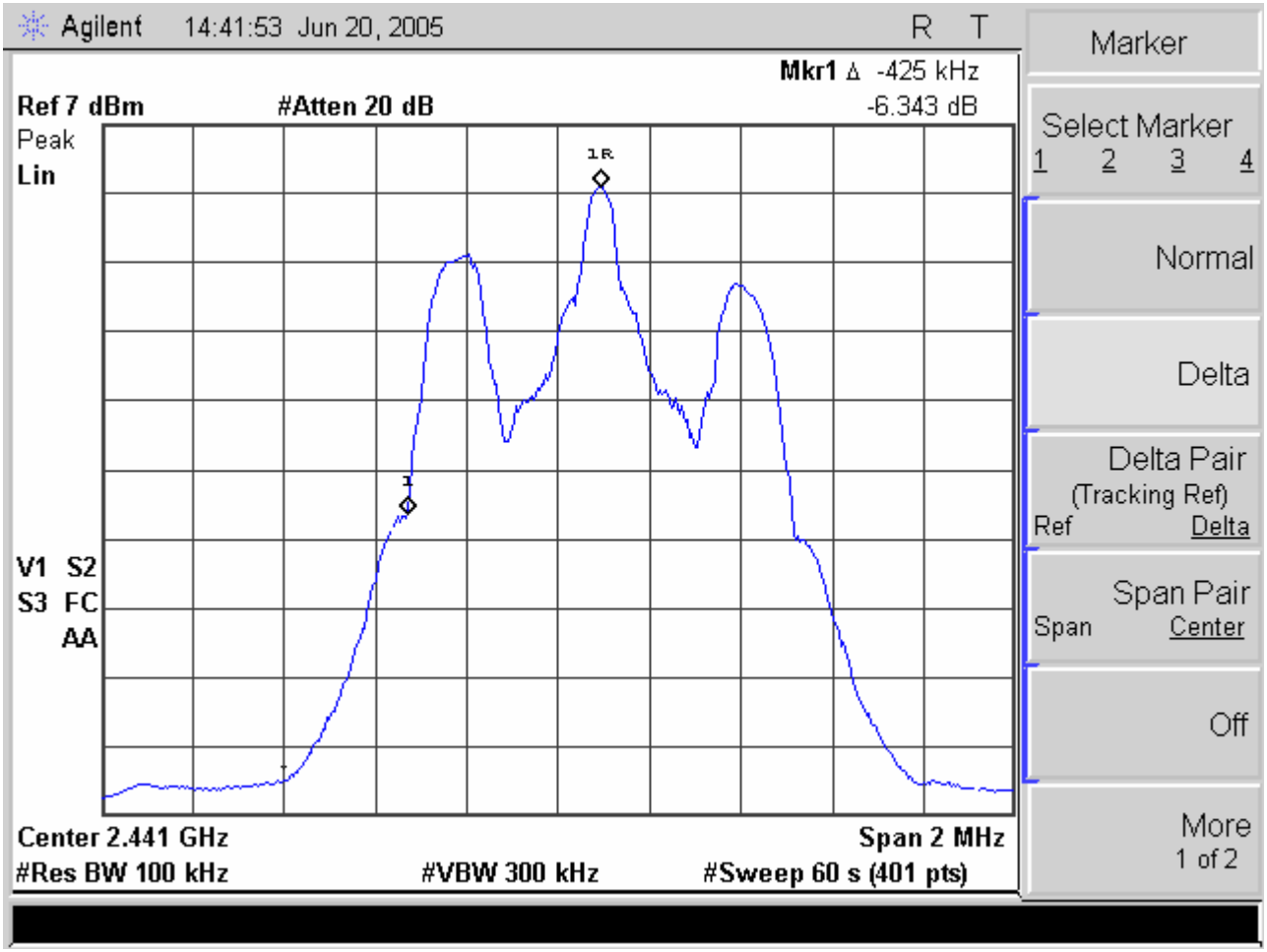


Plot 3. Occupied Bandwidth; Test Results, Channel Ø

BW = 875 kHz

Occupied Bandwidth Test Data

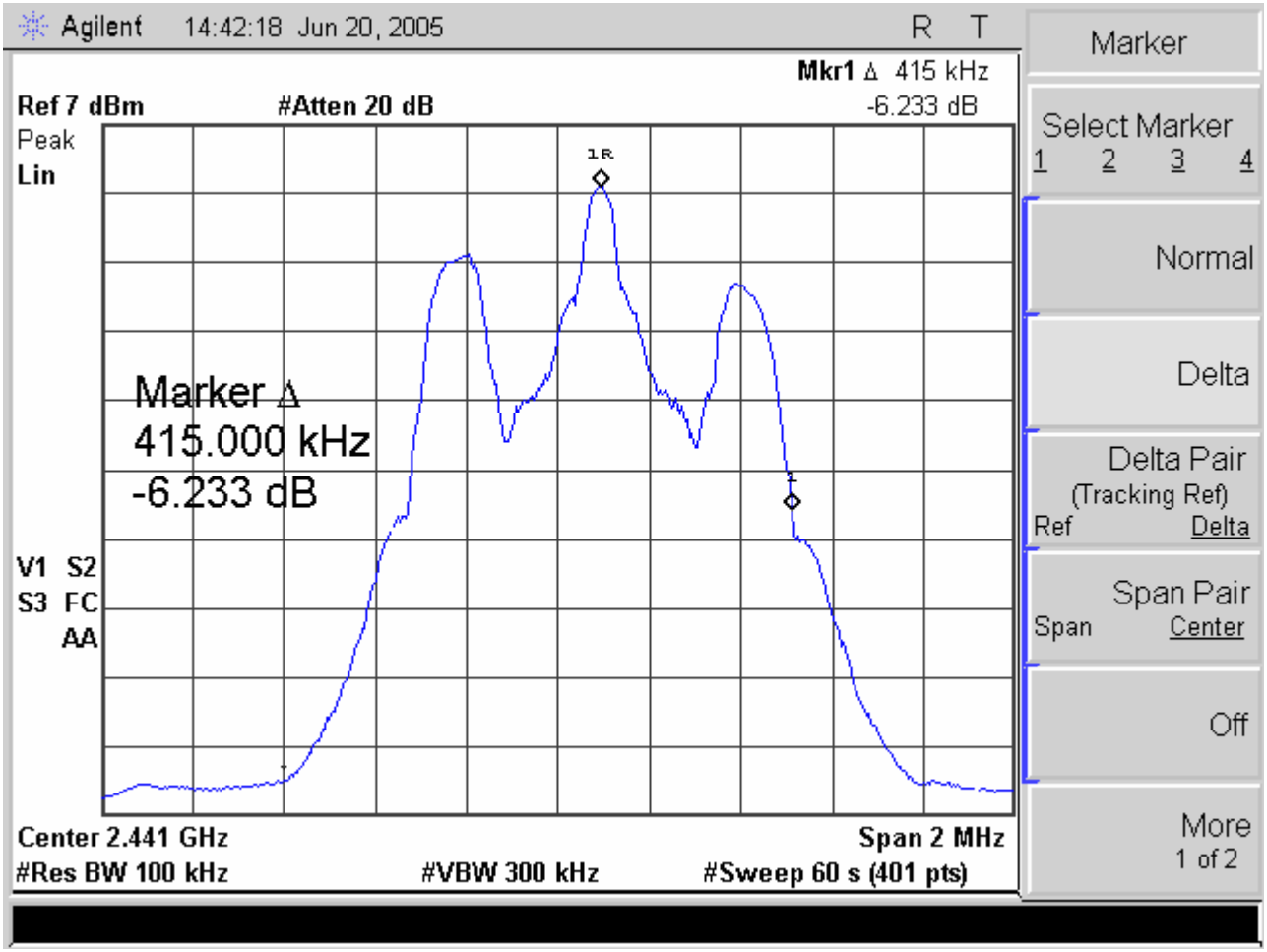
Occupied Bandwidth – Mid Channel



Plot 4. Occupied Bandwidth; Test Results, Channel 38

Occupied Bandwidth Test Data

Occupied Bandwidth – Mid Channel

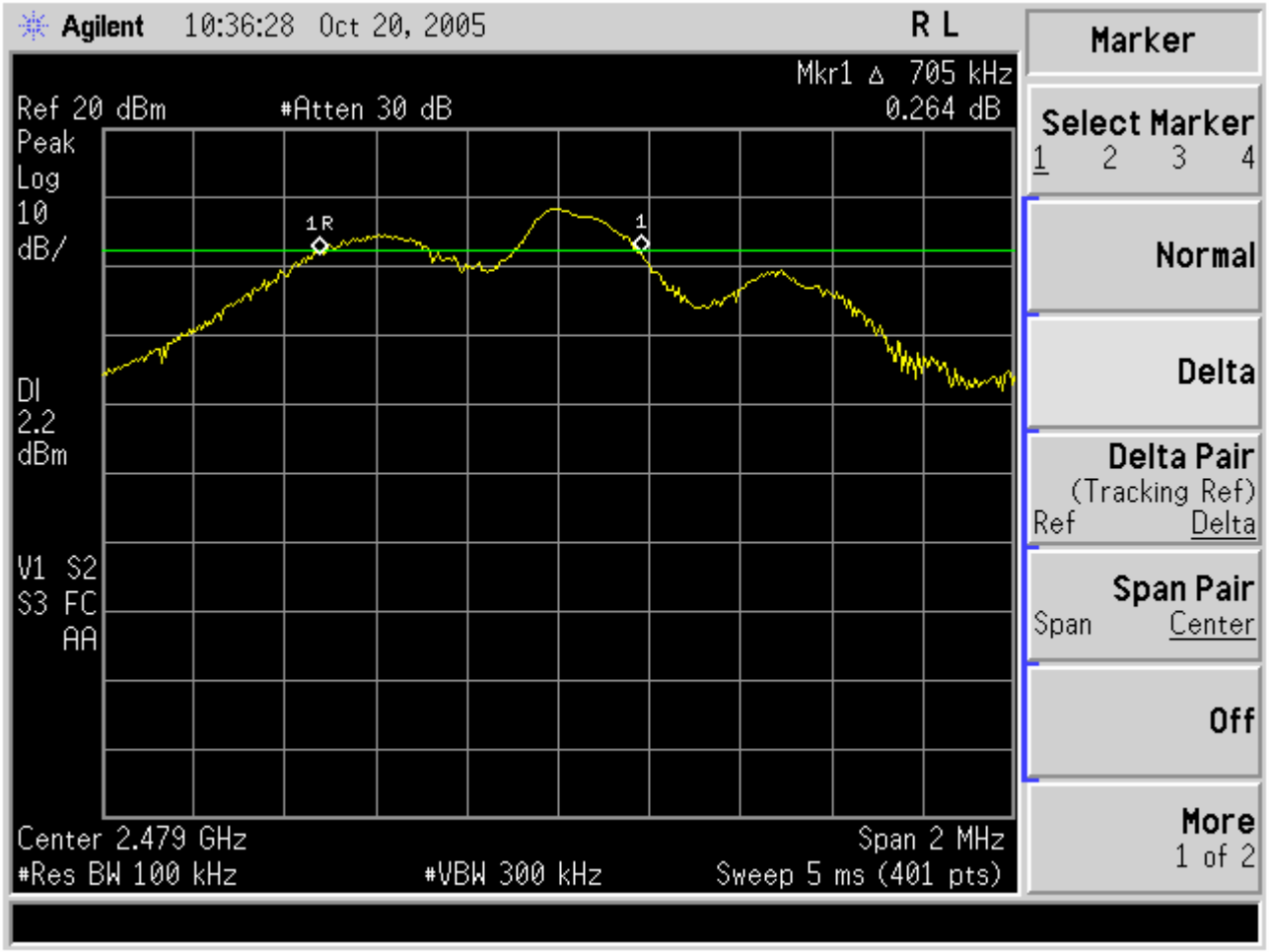


Plot 5. Occupied Bandwidth; Test Results, Channel

BW = 840 kHz

Occupied Bandwidth Test Data

Occupied Bandwidth – High Channel



Plot 6. Occupied Bandwidth; Test Results, Channel 77

BW = 705 kHz

Occupied Bandwidth Test Setup Photograph

Photograph 5. Occupied Bandwidth Test Setup

3.5 Peak Power Output

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

§15.247(b) (3): For systems using digital modulation in the 902 – 928 MHz, 2400 – 2483.5 MHz, and 5725 - -5850 MHz bands: 1 Watt.

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.

Test Procedure: The transmitter output of the EUT was connected to the spectrum analyzer through an attenuator. The power was set to the maximum output; low, imd, and high channels were measured.

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

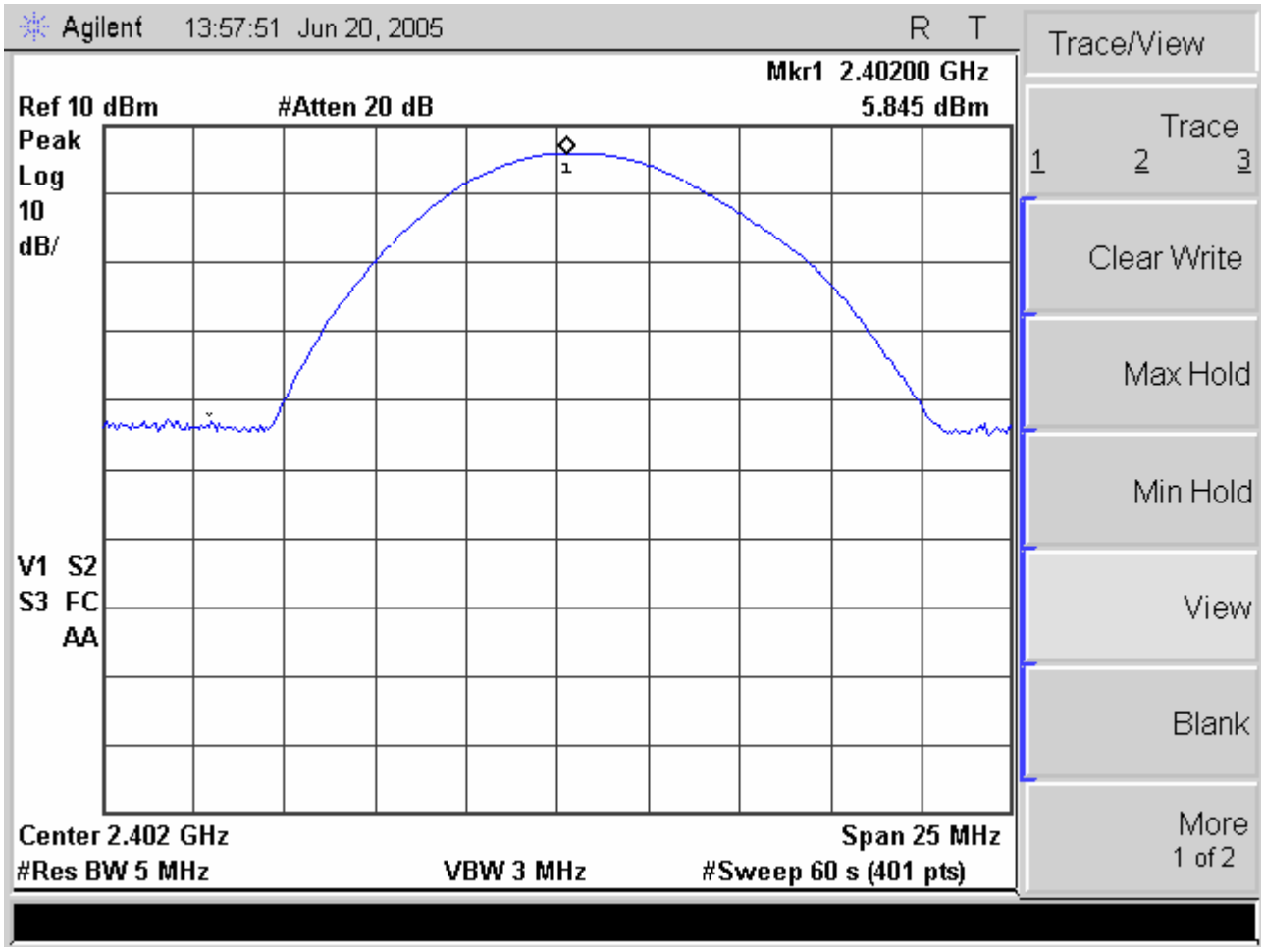
Peak Output Power = 0.00722 W.

The peak output power was determined from the plots on the following page(s).

Test Engineer: Christopher Eckert, Dusmmantha Tennakoon

Test Date: 5/19/2005, 10/24/2005

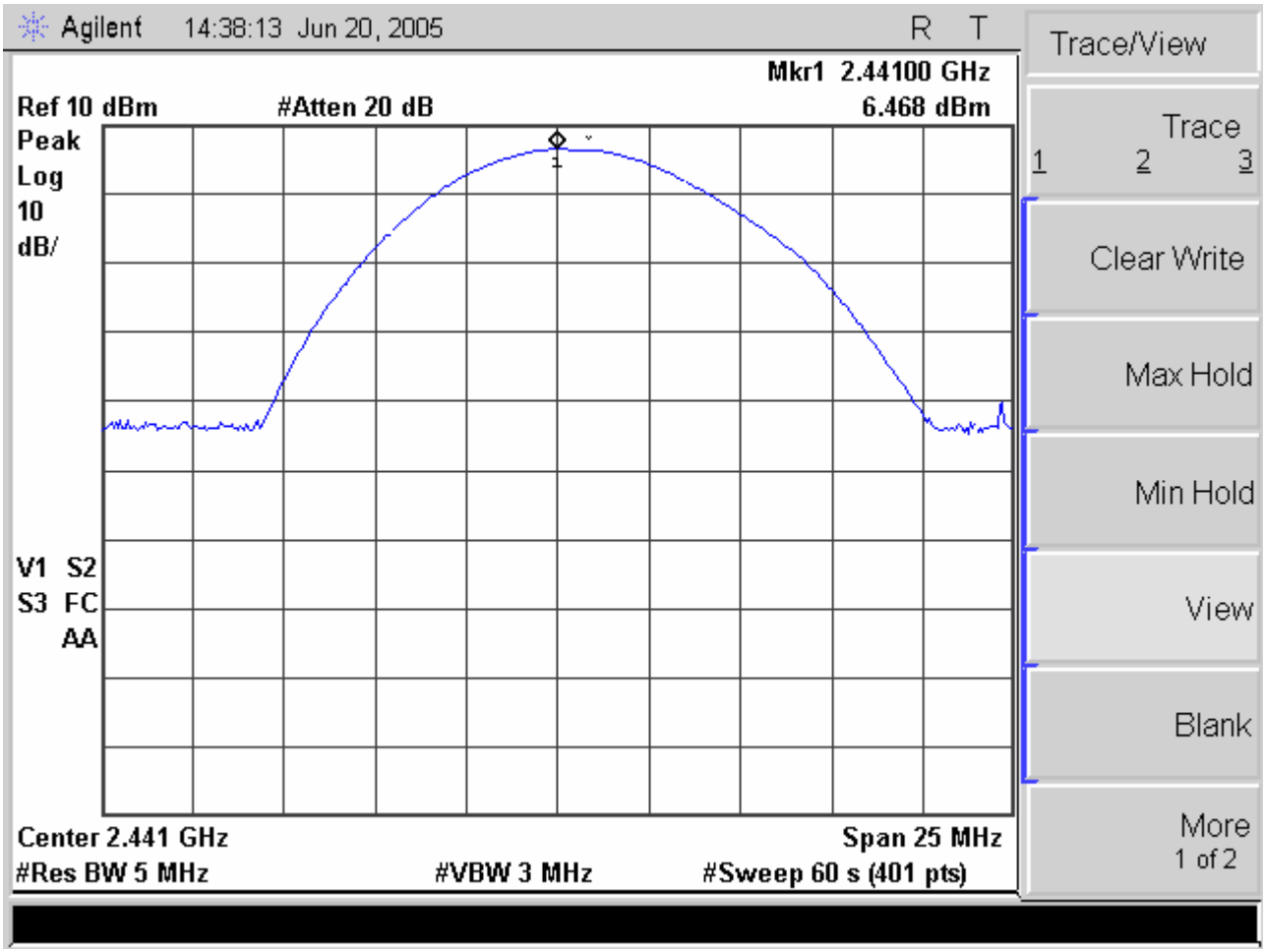
Peak Power Output Test Results



Plot 7. Peak Power Output Test Results – Channel Ø

Output Power = Measured + Cable Loss
= 5.845 + 2.11
= 7.955 dBm

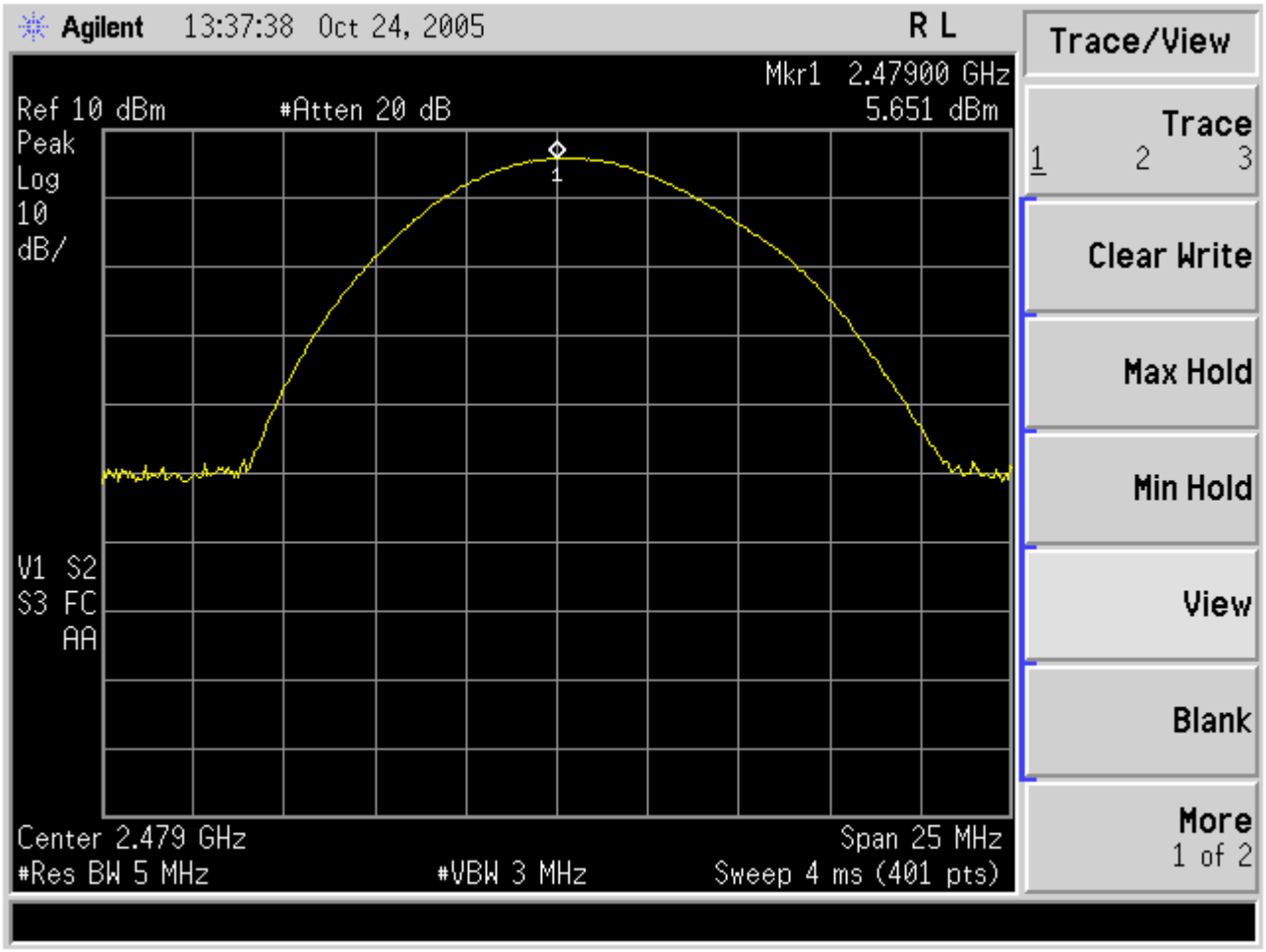
Peak Power Output



Plot 8. Peak Power Output Test Results – Channel 38

Output Power = Measured + Cable Loss
= 6.468 + 2.11
= 8.578 dBm

Peak Power Output



Plot 9. Peak Power Output Test Results – Channel 77

Output Power = Measured + Cable Loss
= 5.651 + 2.50
= 8.151 dBm

3.6 RF Exposure

RF Exposure Requirements - §15.247(b)(5): 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 Limits: §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. 2.1903 of this chapter.

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm²)	Average Time (minutes)
(A) Limits for Occupational / Control Exposures				
30 - 300	61.4	0.163	1.0	6
300 – 1500	--	--	F/300	6
1500 – 100,000	--	--	5	6
(B) Limits for General Population / Uncontrolled Exposure				
30 - 300	27.5	0.073	0.2	30
300 – 1500	--	--	F/1500	30
1500 – 100,000	--	--	1.0	30

Table 6. Limits for Maximum Permissible Exposure (MPE)

Note: F = Frequency in MHz

Test Results: MPE Limit Calculation: the EUT's operating frequencies @ 2402 – 2479 MHz; conducted power = 8.579 dBm (peak) with maximum antenna gain of 1.9 dBi. Therefore, Limit for Uncontrolled exposure: 1 mW/ cm ² or 10 W/m ²

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

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

Where, S = Power Density (10 W/m²)
P = Power Input to antenna (0.00722 Watts)
G = Antenna Gain (1.6 numeric)
R = distance to the center of radiation of antenna (in meter)

$$R = \sqrt{0.0103\ W} * \sqrt{1.6\ dB} / 4\pi\ (10\ W/m^2) = 0.0096\ m$$

The distance between the human and the RF antenna should not be less than 0.00096 m.

Test Engineer: Dusmantha Tennakoon, Len Knight

Test Date: 10/24/2005

3.7 Spurious Conducted Emissions

Test Requirements: **§15.247(c):** 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).

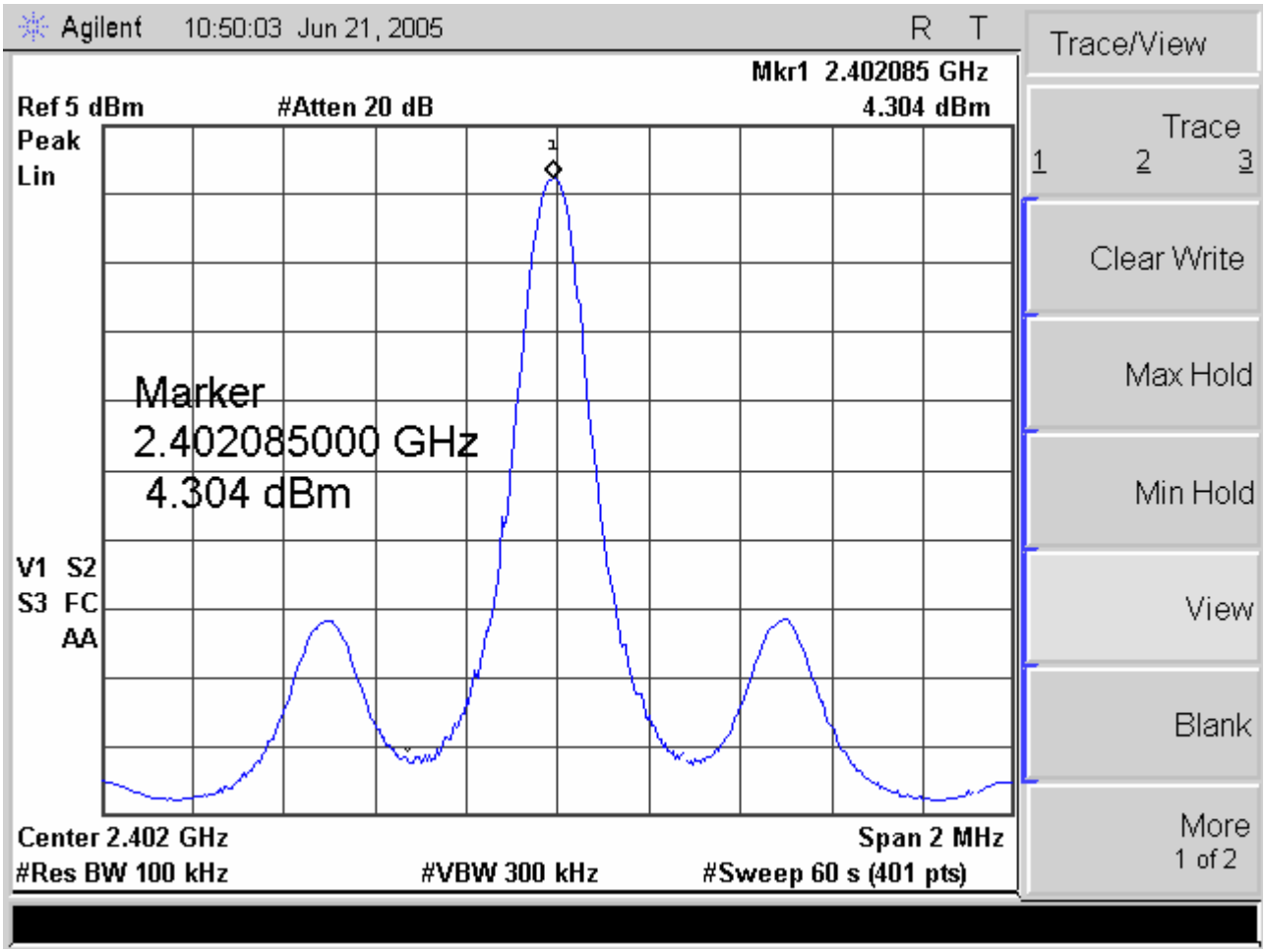
Test Procedure: The EUT was configured with the control software to transmit at maximum power. The transmit output was connected to the analyzer through an attenuator. RBW = 100 kHz, VBW $\geq$ RBW.

Test Results: The EUT complies with the requirements of this section. Plots were taken between 30 MHz and 25 GHz to ensure that no conducted Spurious Emission was greater than -20 dBc. See Photograph 6 for a picture of the test setup.

Test Engineer: Christopher Eckert, Dusmantha Tenakoon

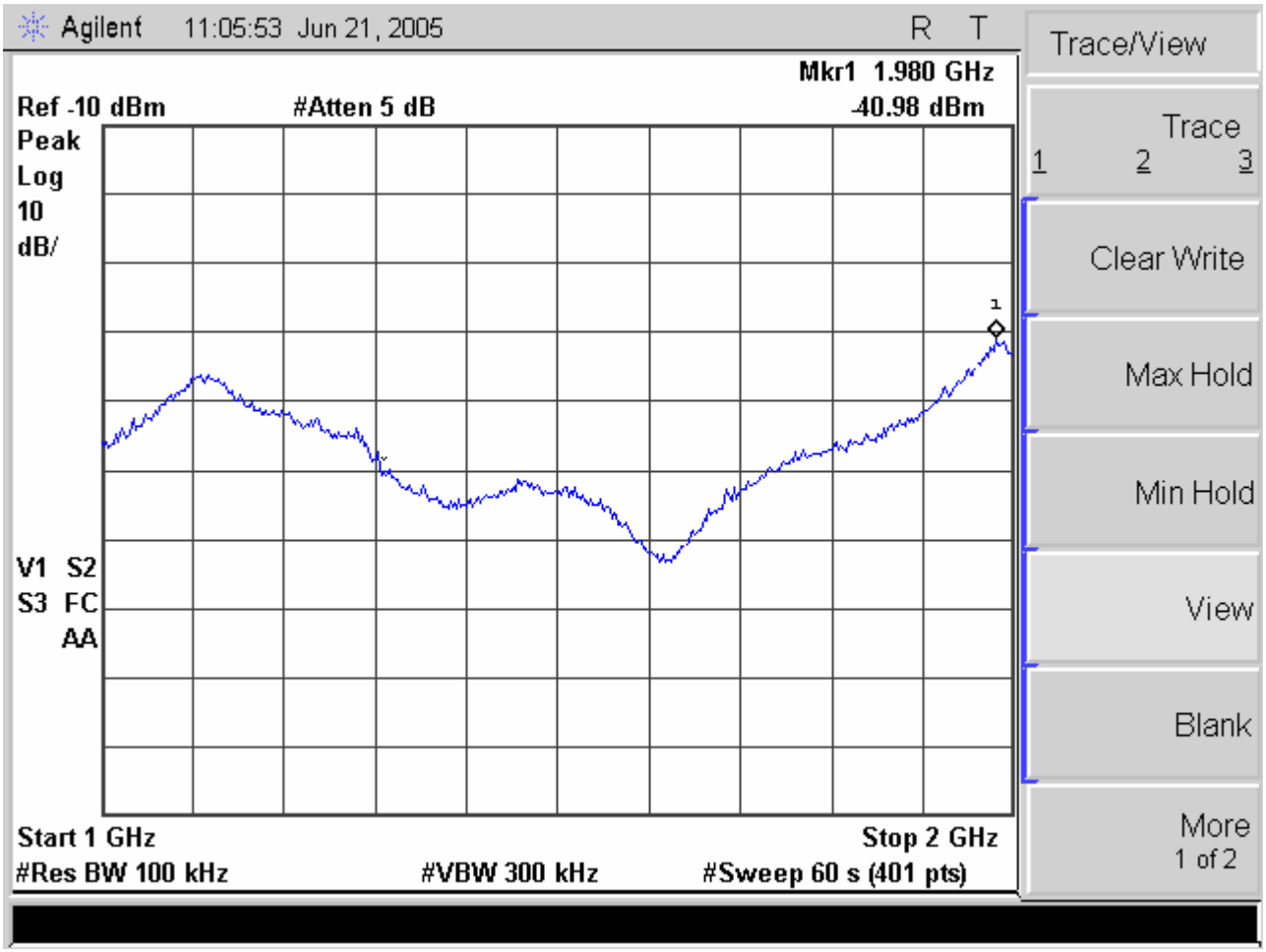
Test Date: 5/22/2005, 10/19/2005

Spurious Conducted Emissions



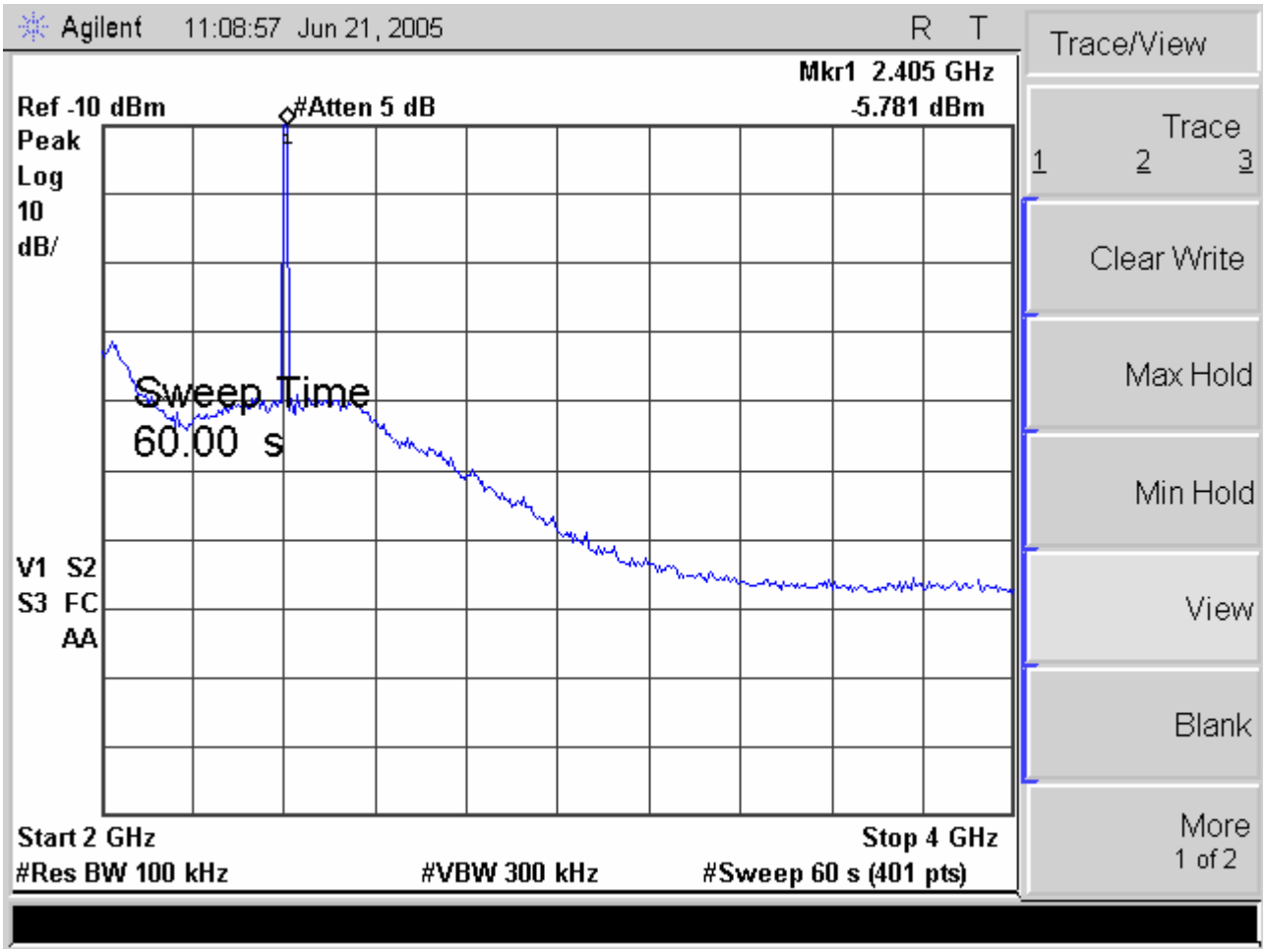
Plot 10. Spurious Conducted Emission Test Plot – Channel Ø

Spurious Conducted Emissions



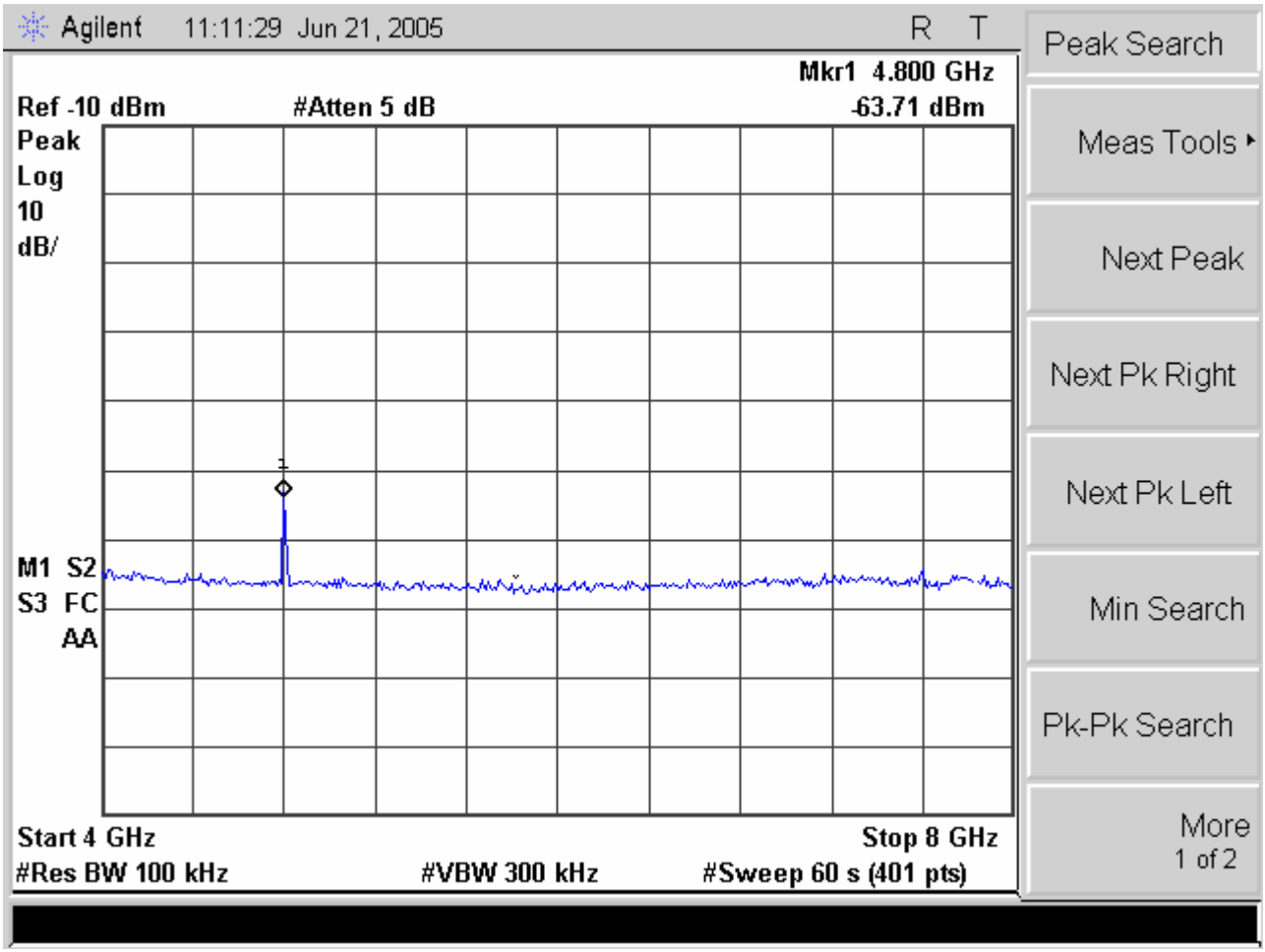
Plot 11. Spurious Conducted Emission Test Plot – Channel Ø

Spurious Conducted Emissions



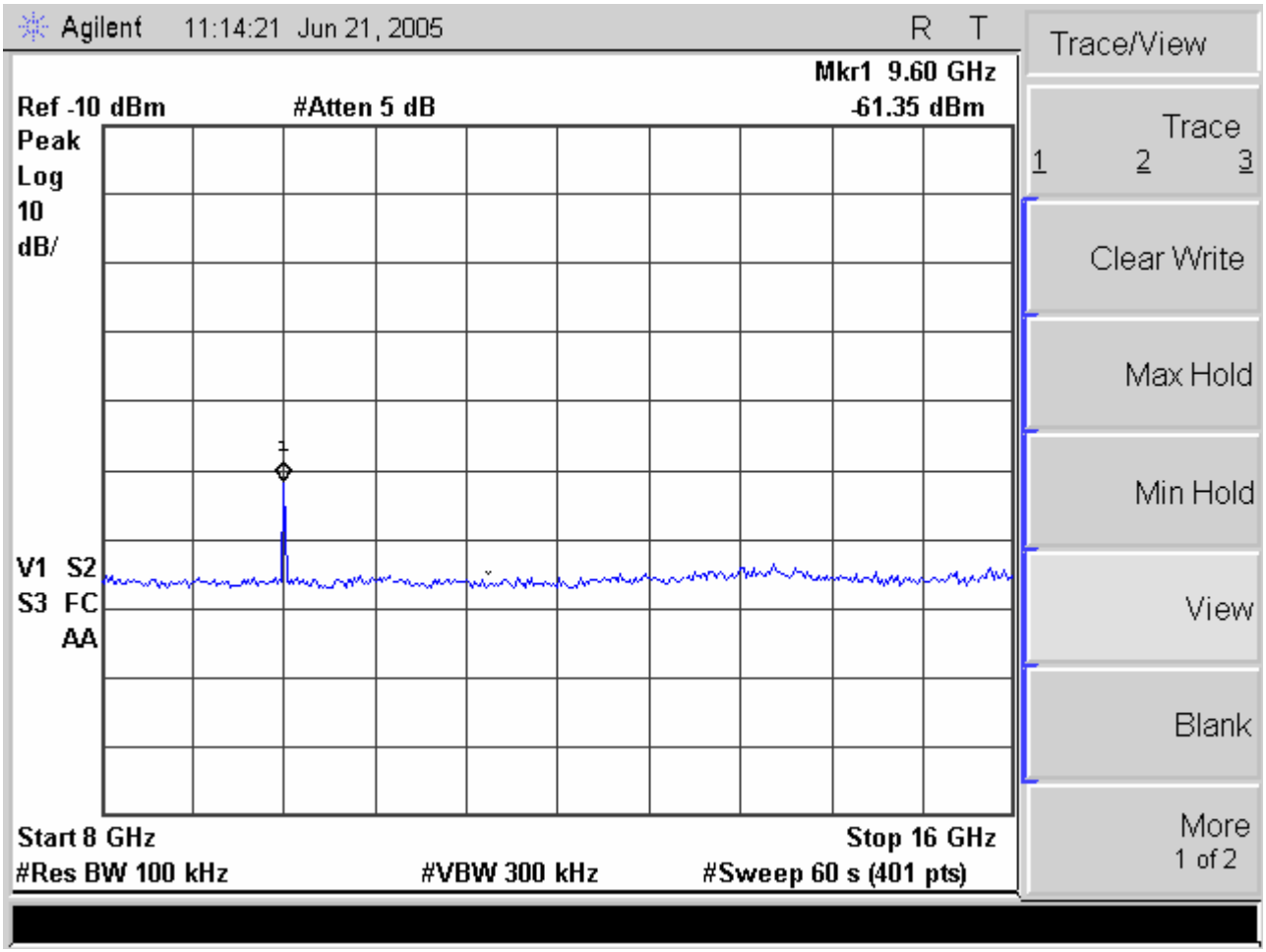
Plot 12. Spurious Conducted Emission Test Plot – Channel Ø

Spurious Conducted Emissions



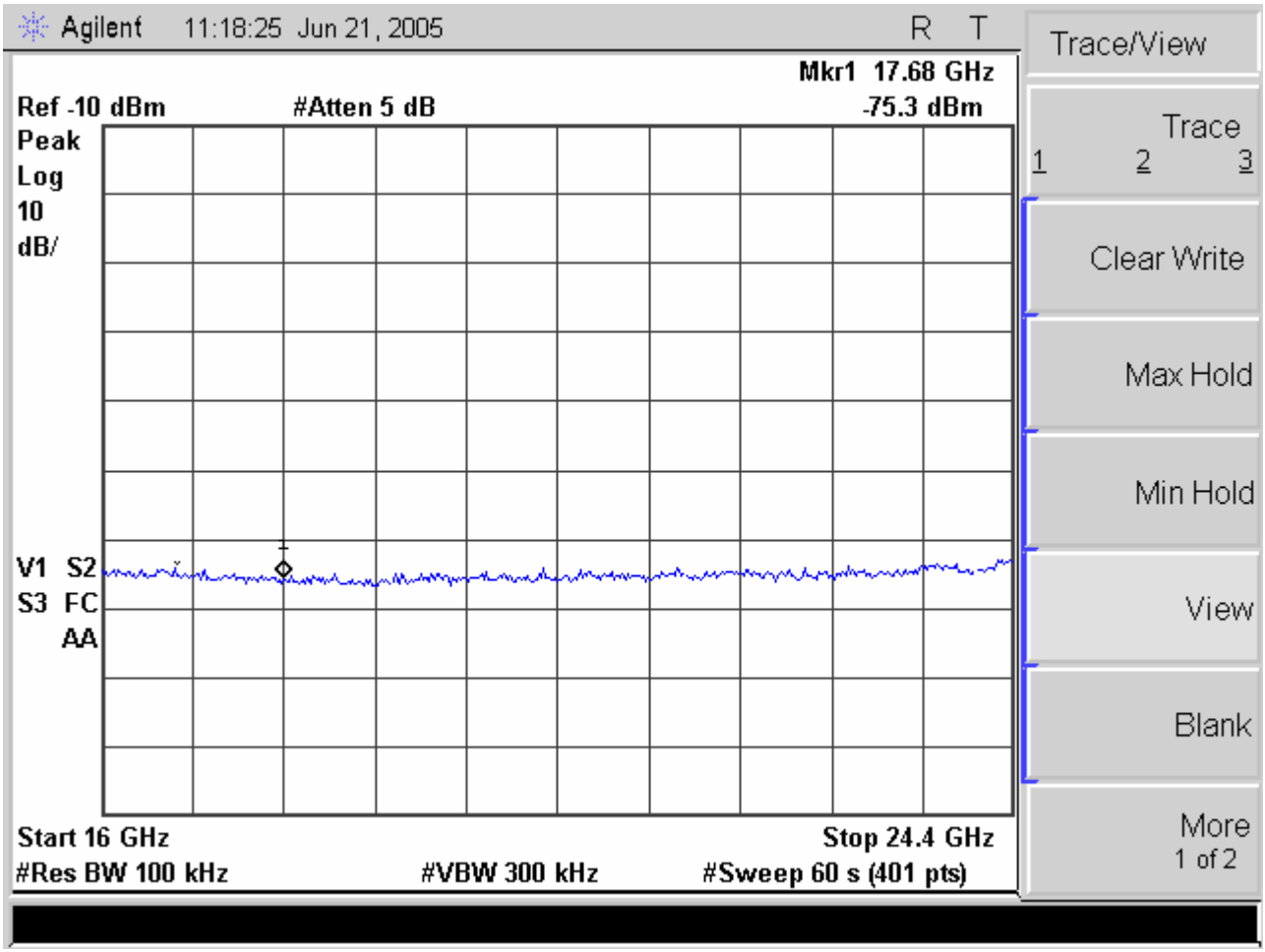
Plot 13. Spurious Conducted Emission Test Plot – Channel Ø

Spurious Conducted Emissions



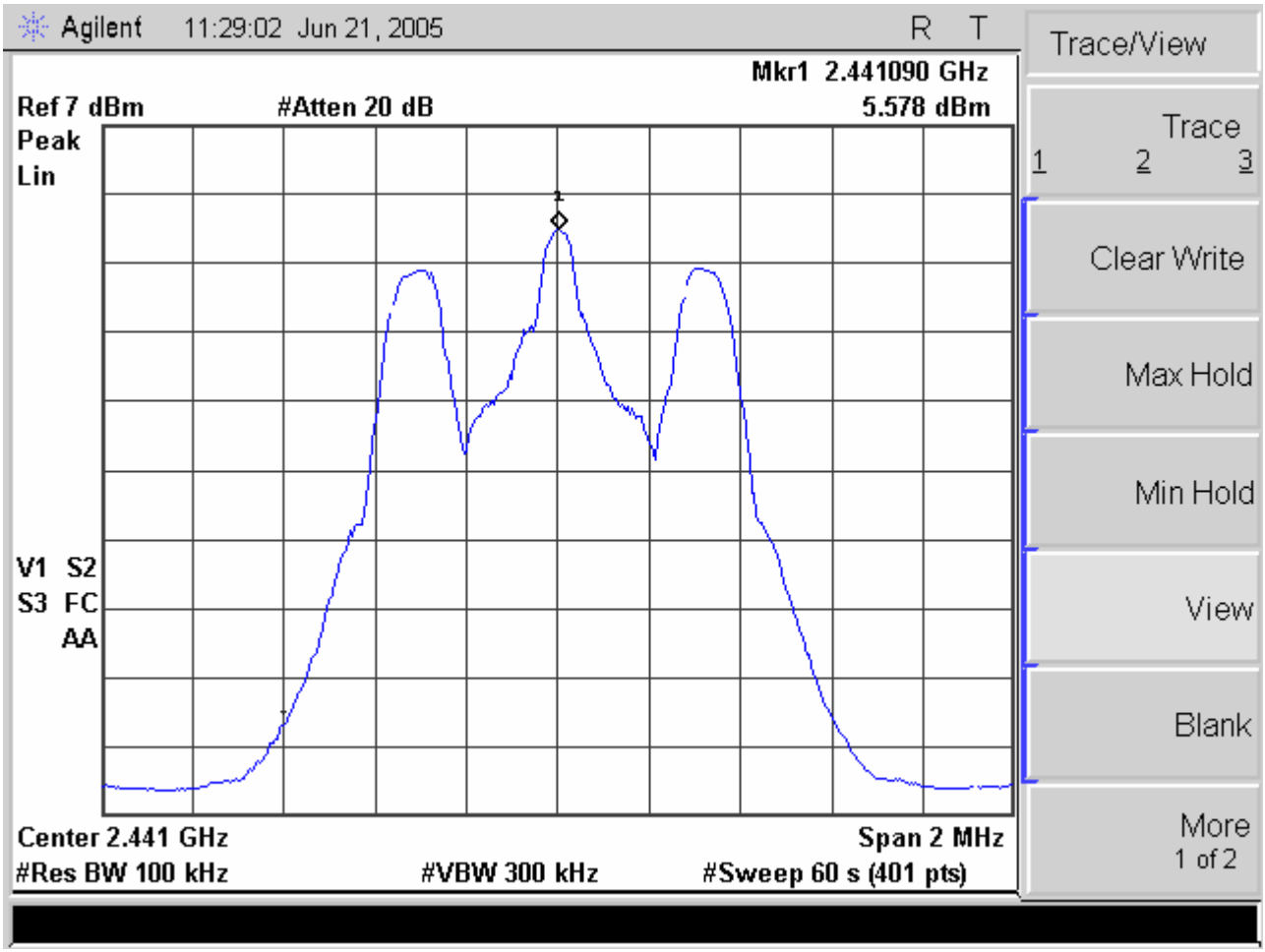
Plot 14. Spurious Conducted Emission Test Plot – Channel Ø

Spurious Conducted Emissions



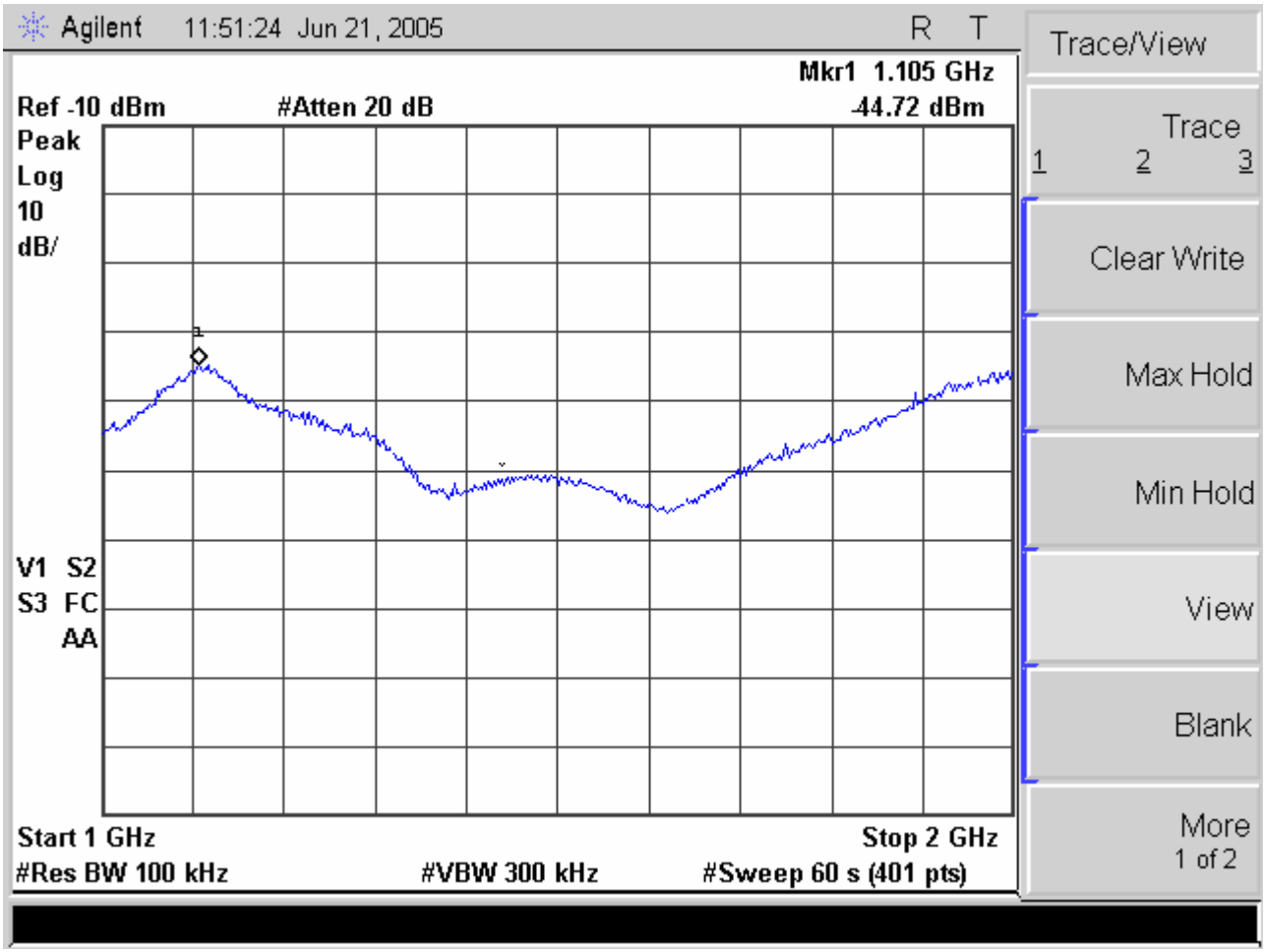
Plot 15. Spurious Conducted Emission Test Plot – Channel Ø

Spurious Conducted Emissions



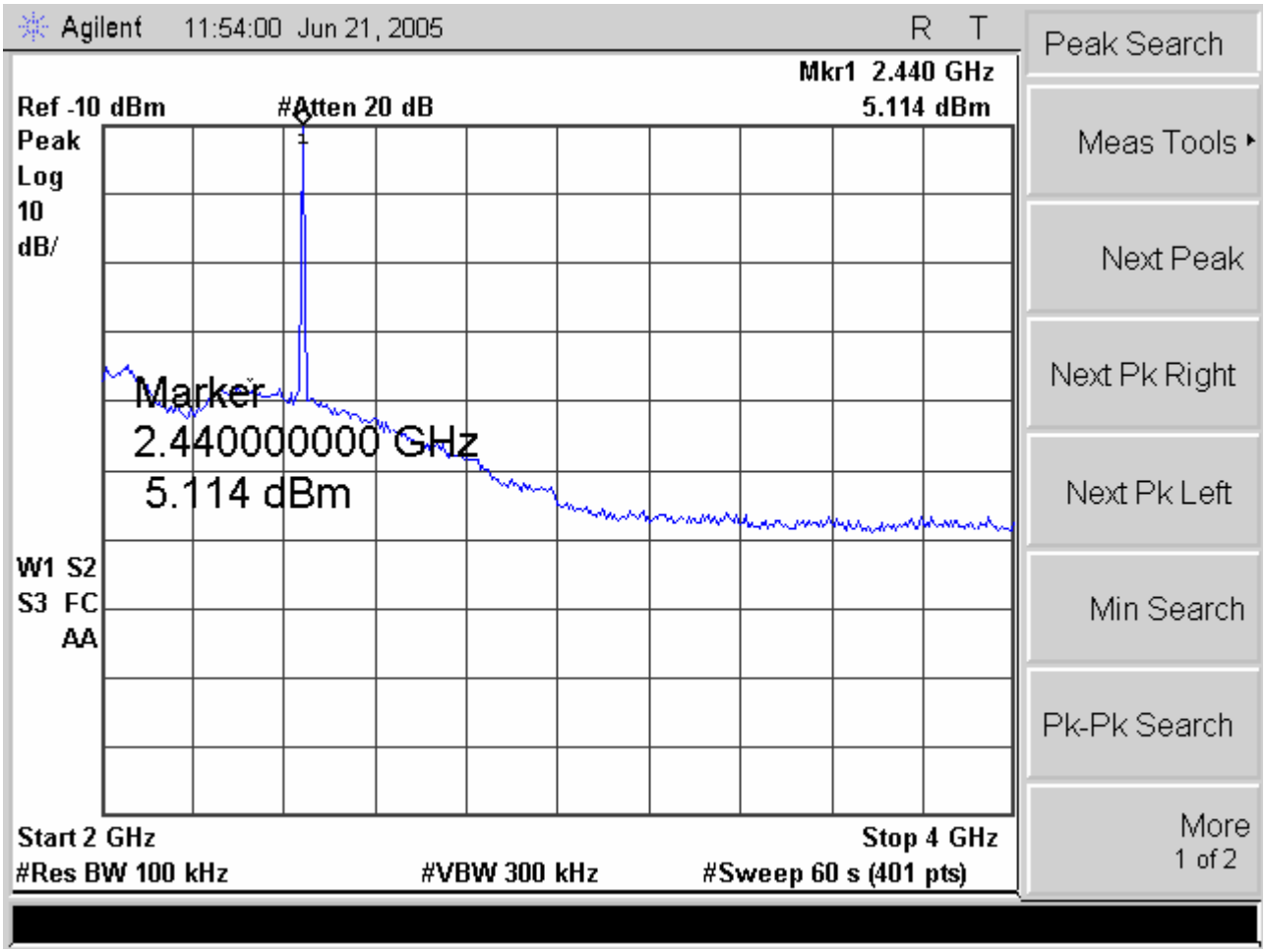
Plot 16. Spurious Conducted Emission Test Plot – Channel 38

Spurious Conducted Emissions



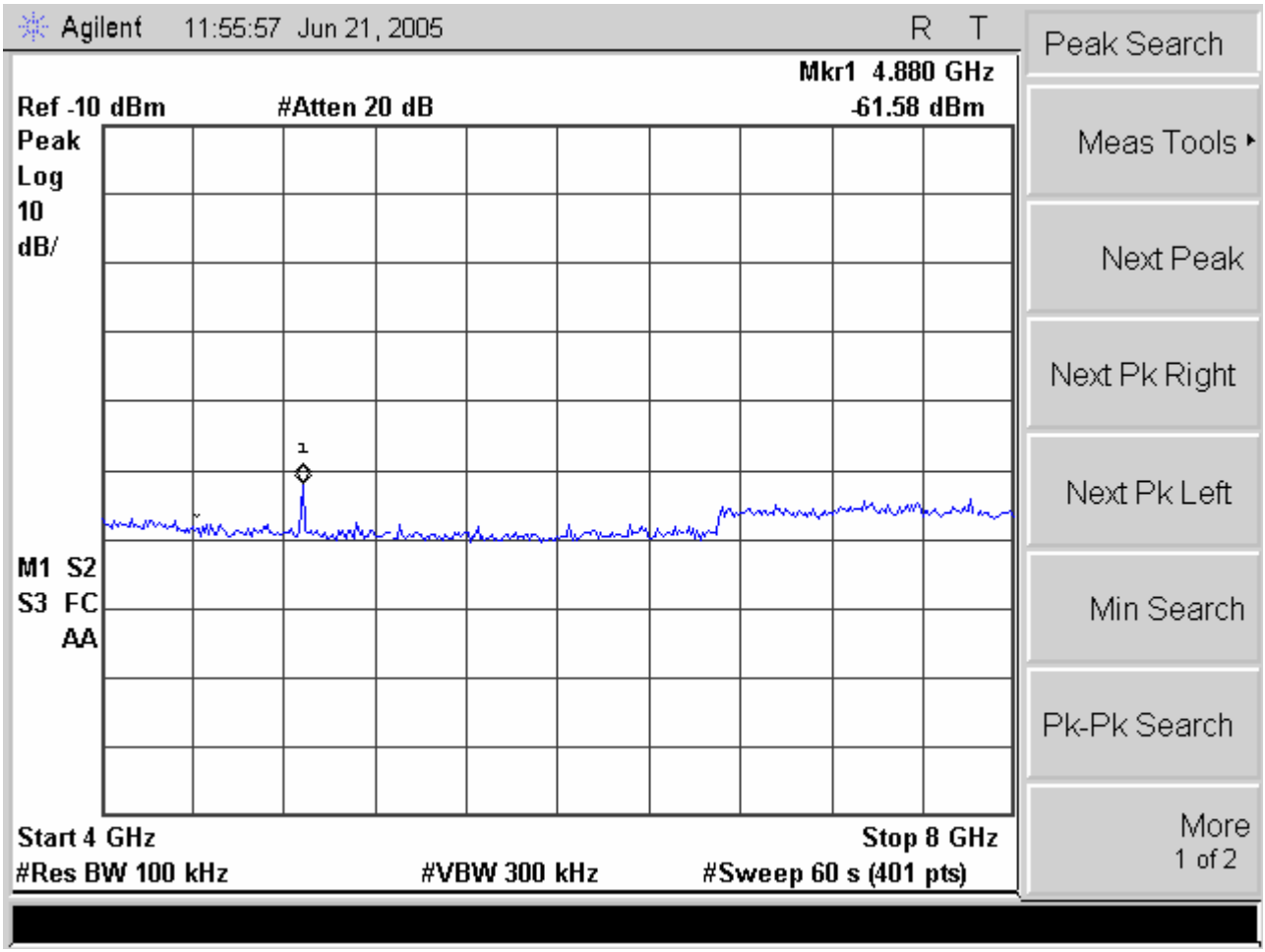
Plot 17. Spurious Conducted Emission Test Plot – Channel 38

Spurious Conducted Emissions



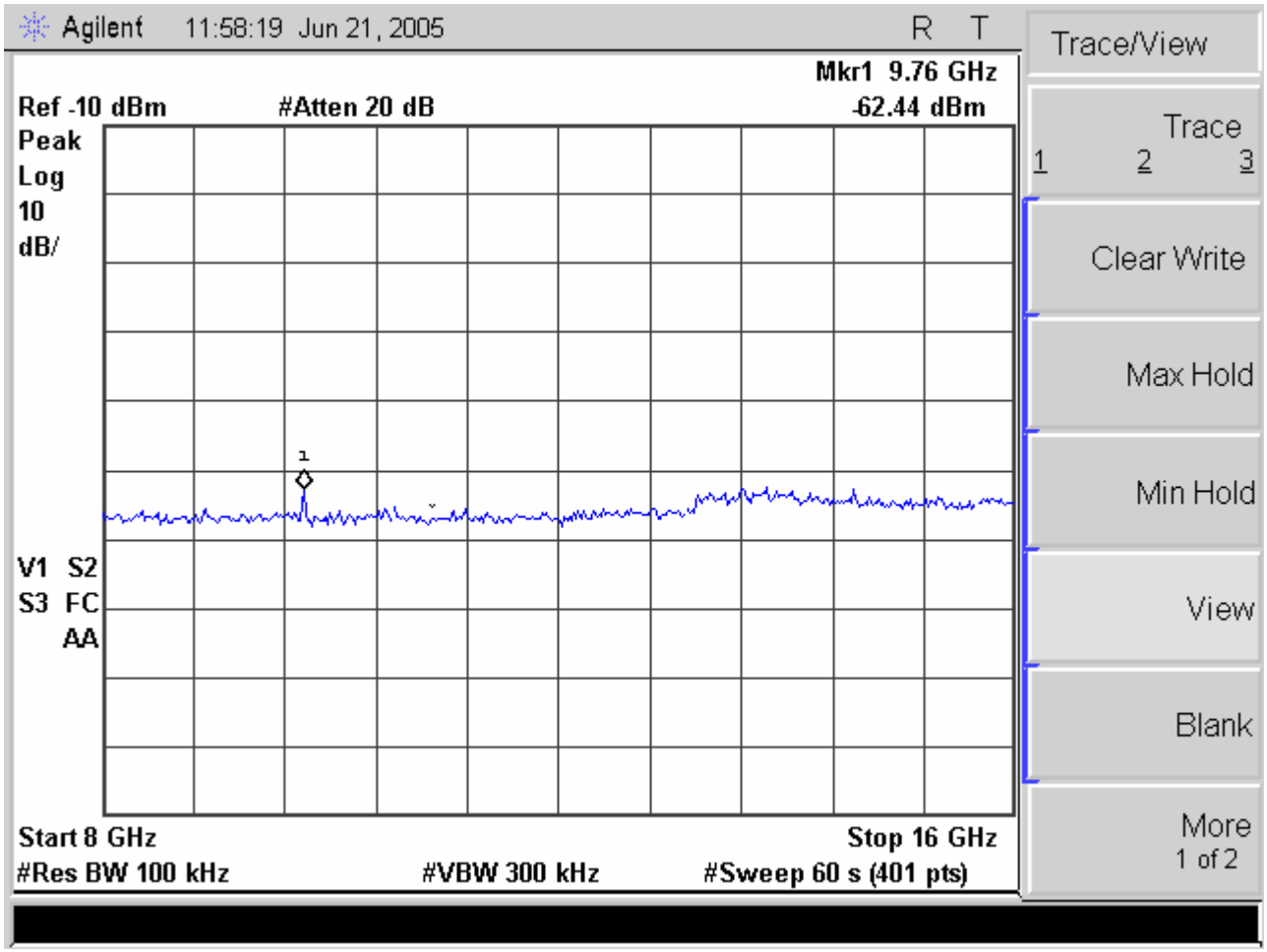
Plot 18. Spurious Conducted Emission Test Plot – Channel 38

Spurious Conducted Emissions



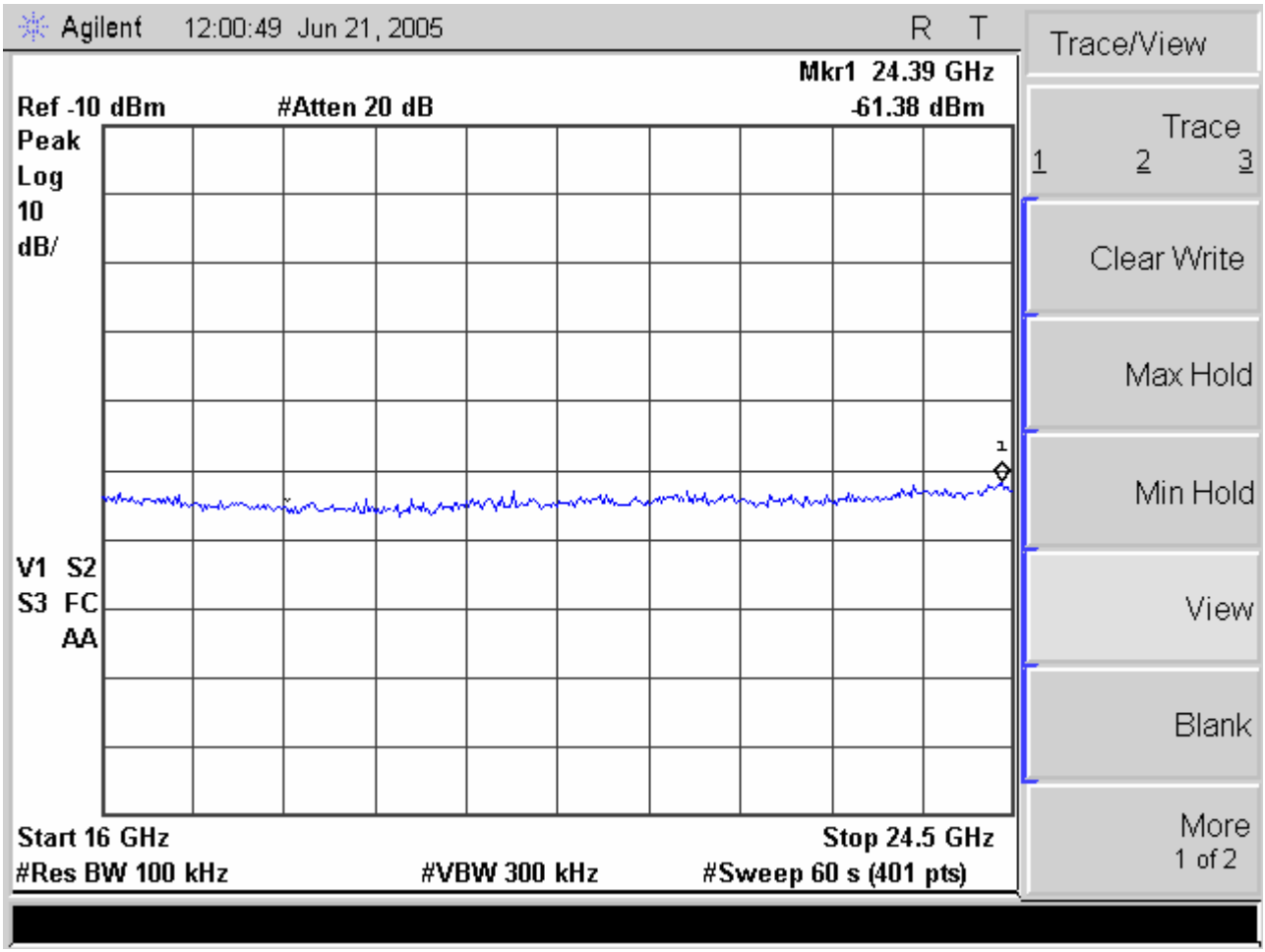
Plot 19. Spurious Conducted Emission Test Plot – Channel 38

Spurious Conducted Emissions



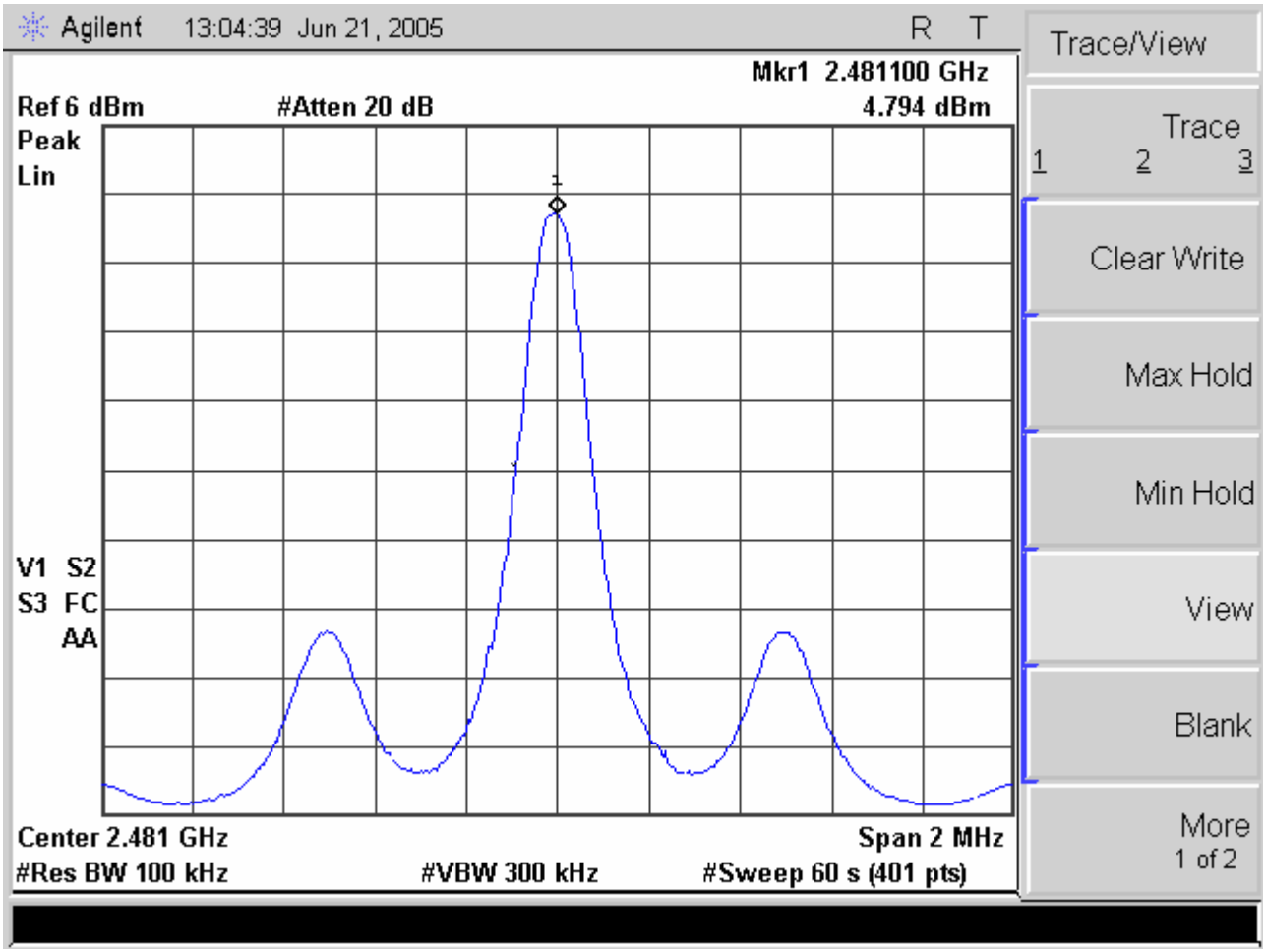
Plot 20. Spurious Conducted Emission Test Plot – Channel 38

Spurious Conducted Emissions



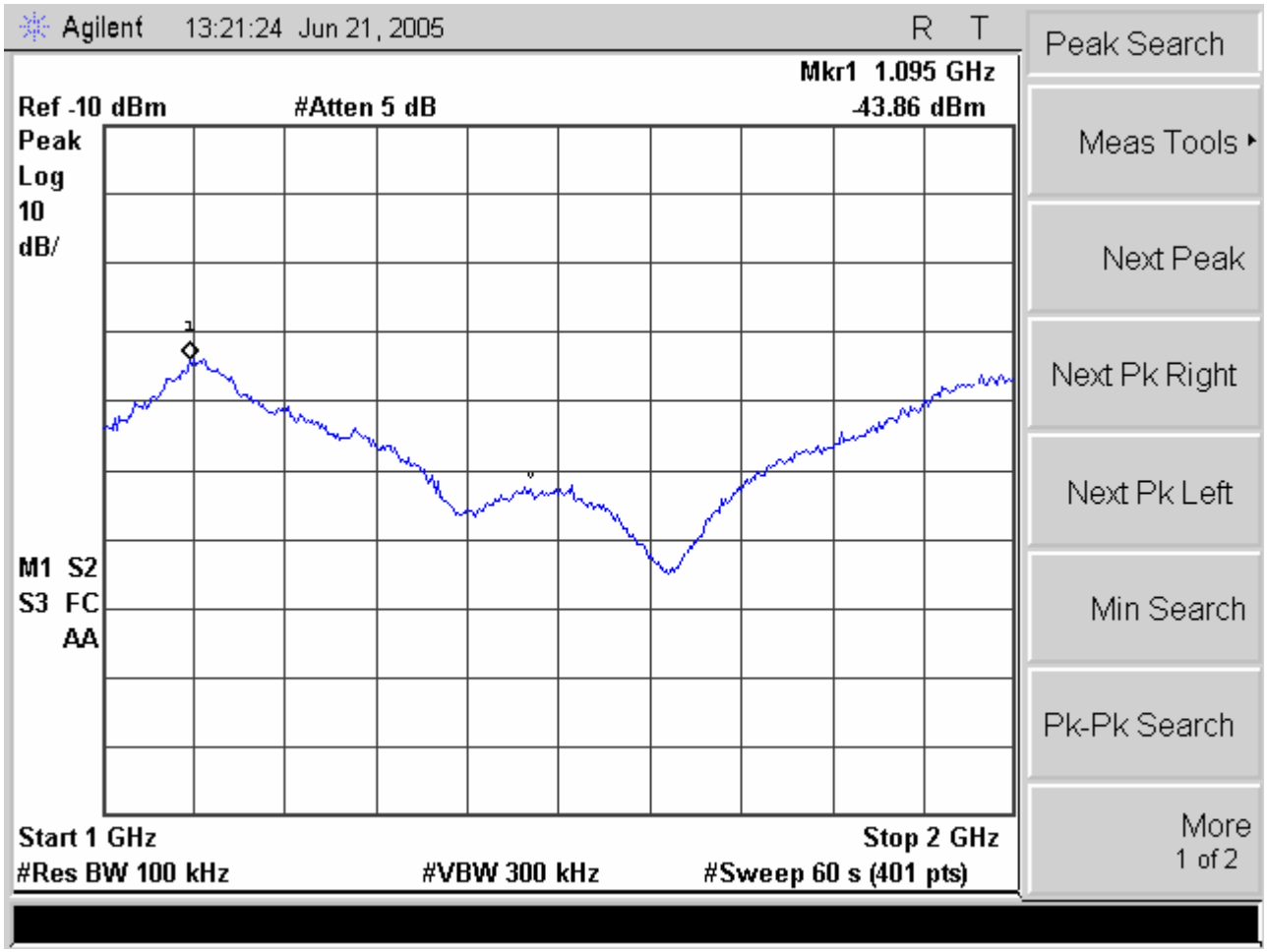
Plot 21. Spurious Conducted Emission Test Plot – Channel 38

Spurious Conducted Emissions



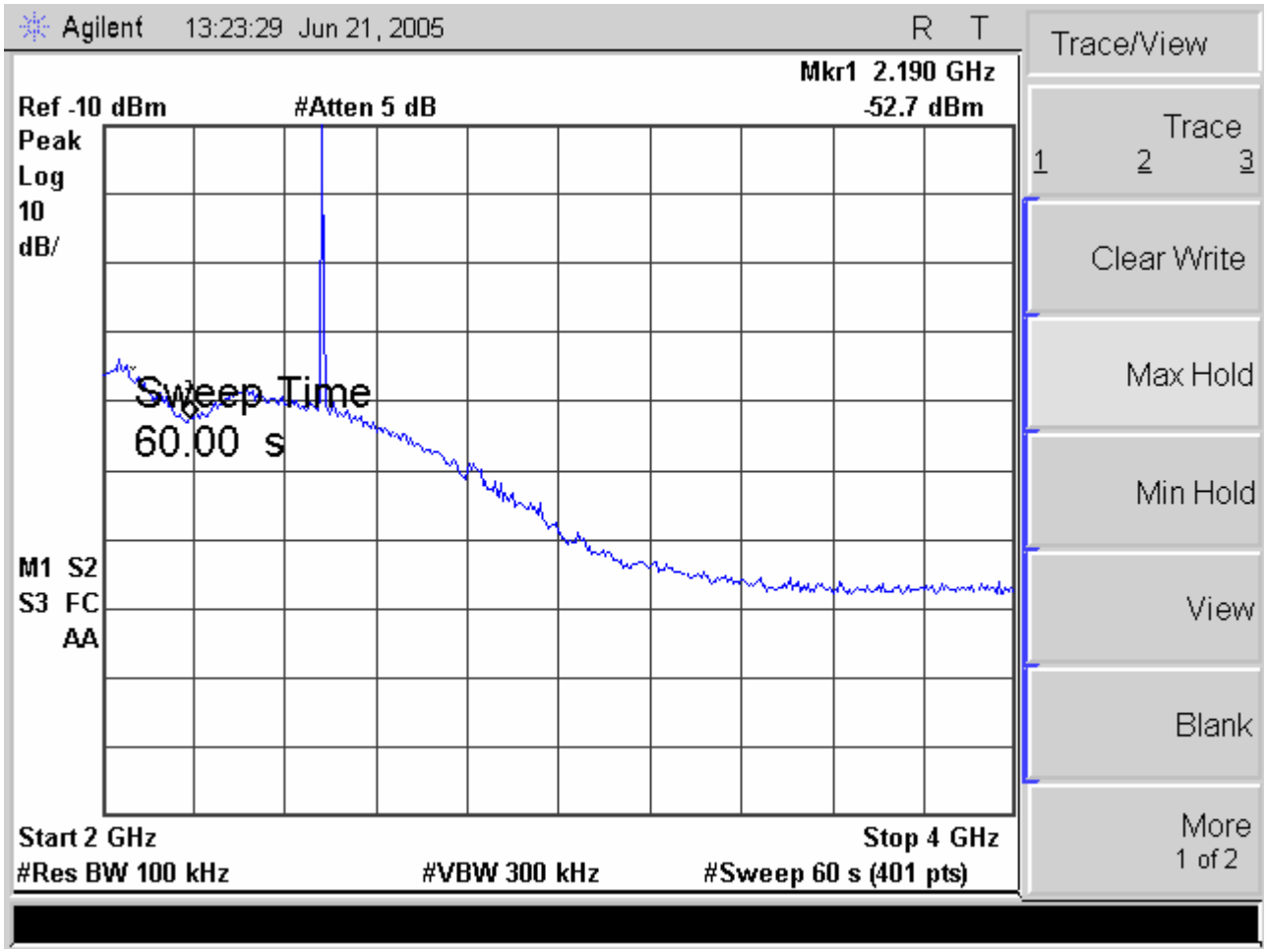
Plot 22. Spurious Conducted Emission Test Plot – Channel 77

Spurious Conducted Emissions



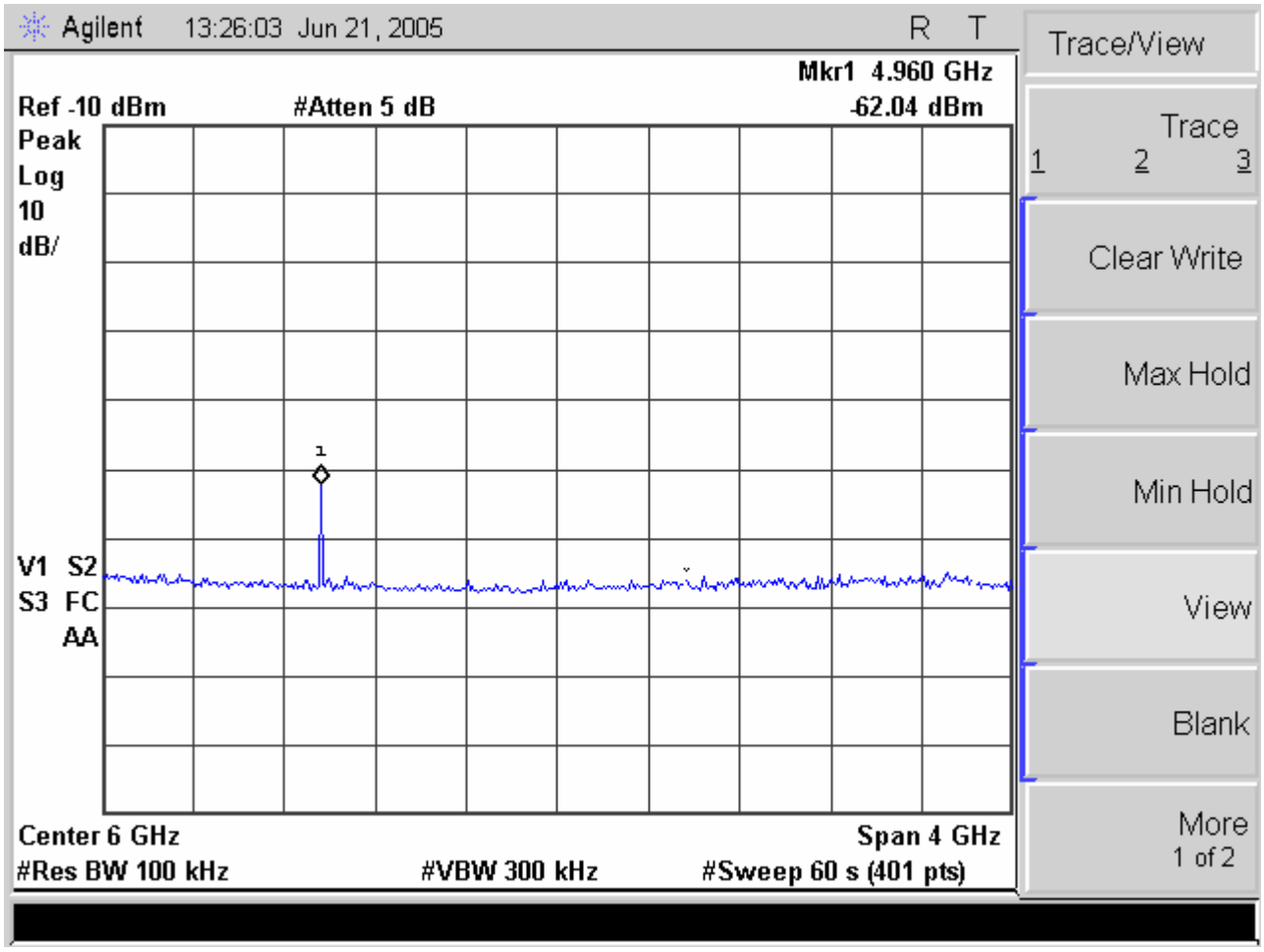
Plot 23. Spurious Conducted Emission Test Plot – Channel 77

Spurious Conducted Emissions



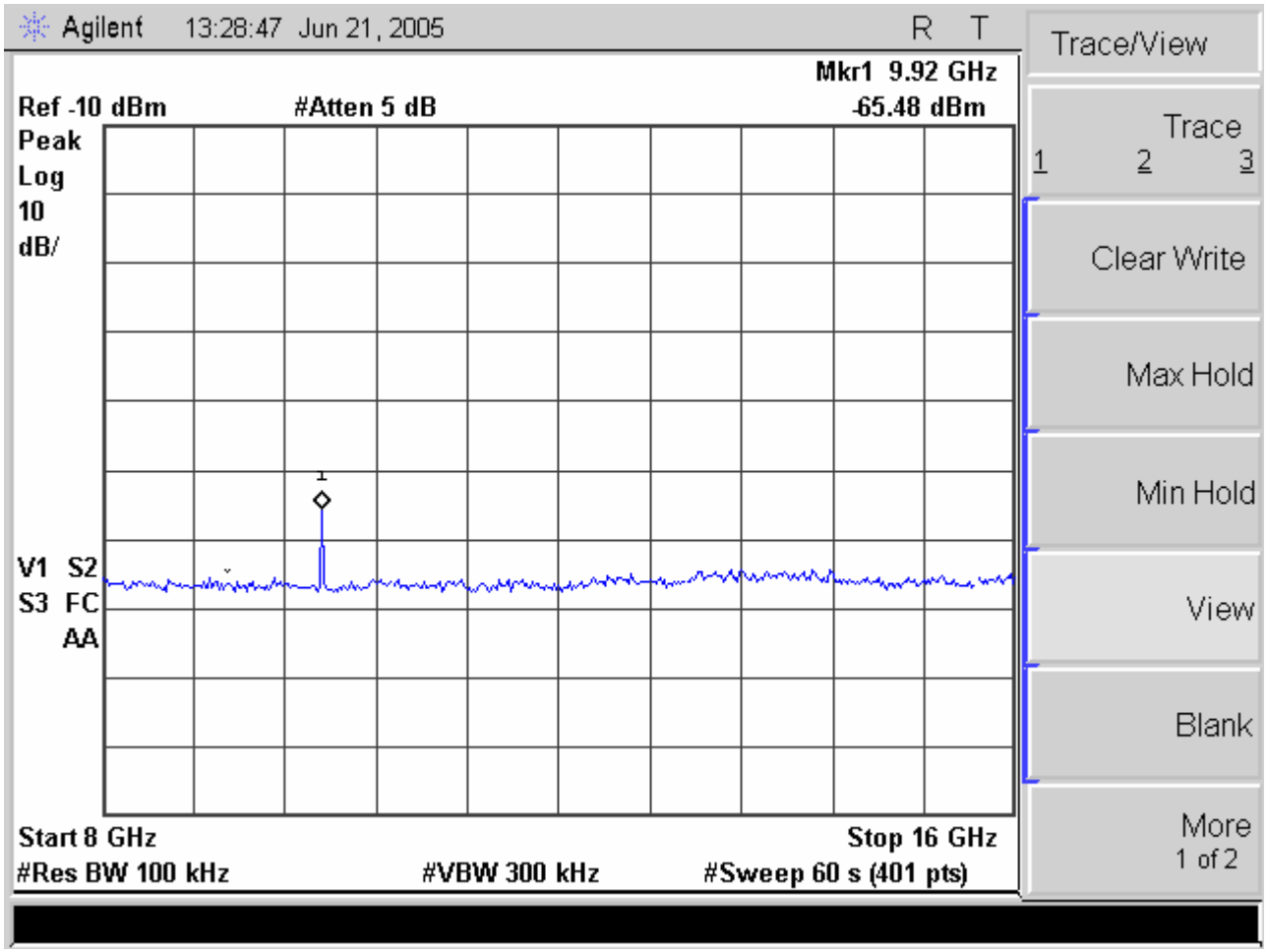
Plot 24. Spurious Conducted Emission Test Plot – Channel 77

Spurious Conducted Emissions



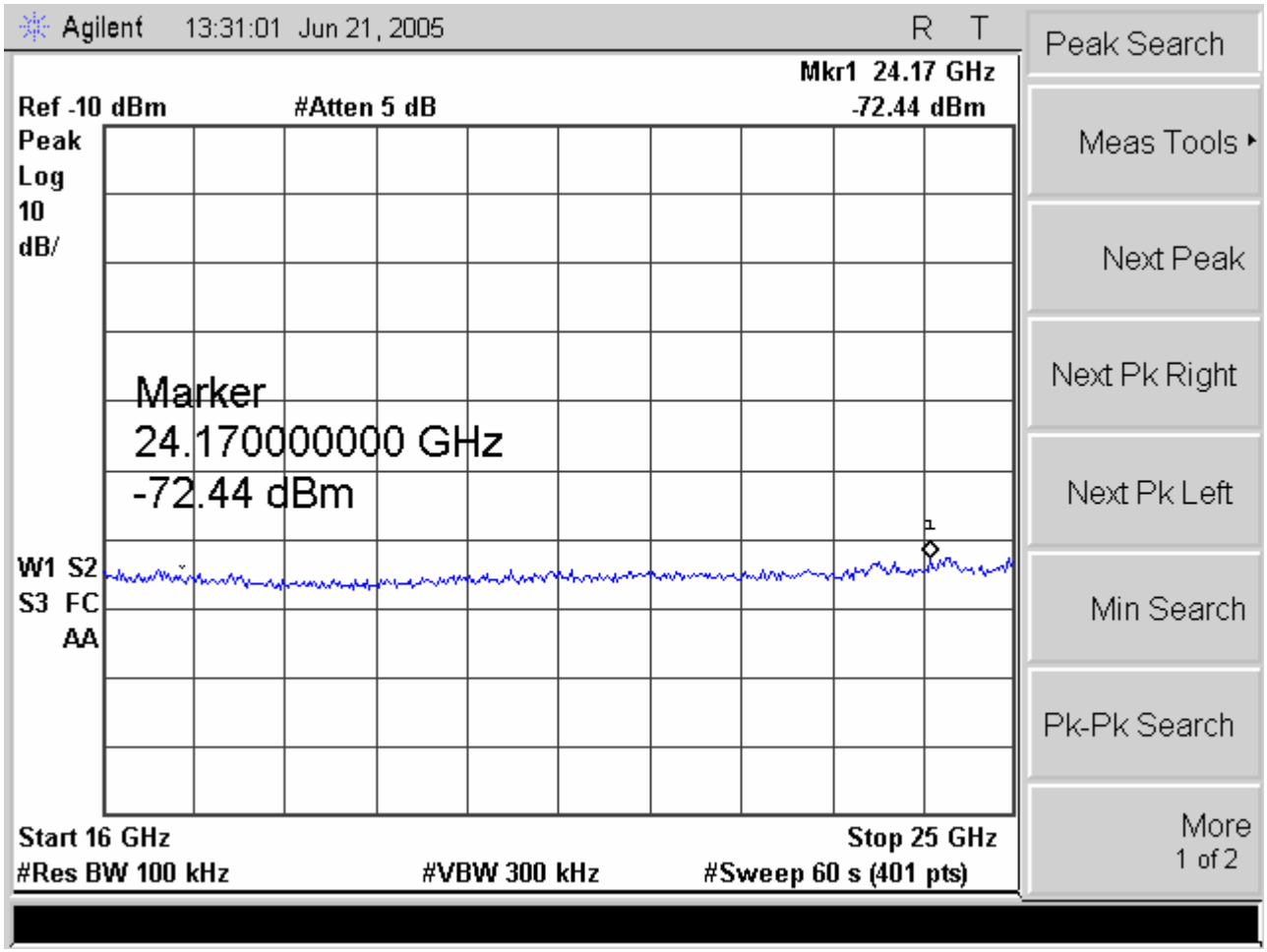
Plot 25. Spurious Conducted Emission Test Plot – Channel 77

Spurious Conducted Emissions



Plot 26. Spurious Conducted Emission Test Plot – Channel 77

Spurious Conducted Emissions



Plot 27. Spurious Conducted Emission Test Plot – Channel 77

Spurious Conducted Emissions

Photograph 6. Spurious Conducted Emissions Test setup

3.8 Power Spectral Density

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

Test Procedure: The transmitter output was connected to the spectrum analyzer through an attenuator.

RBW = 3kHz, VBW > RBW

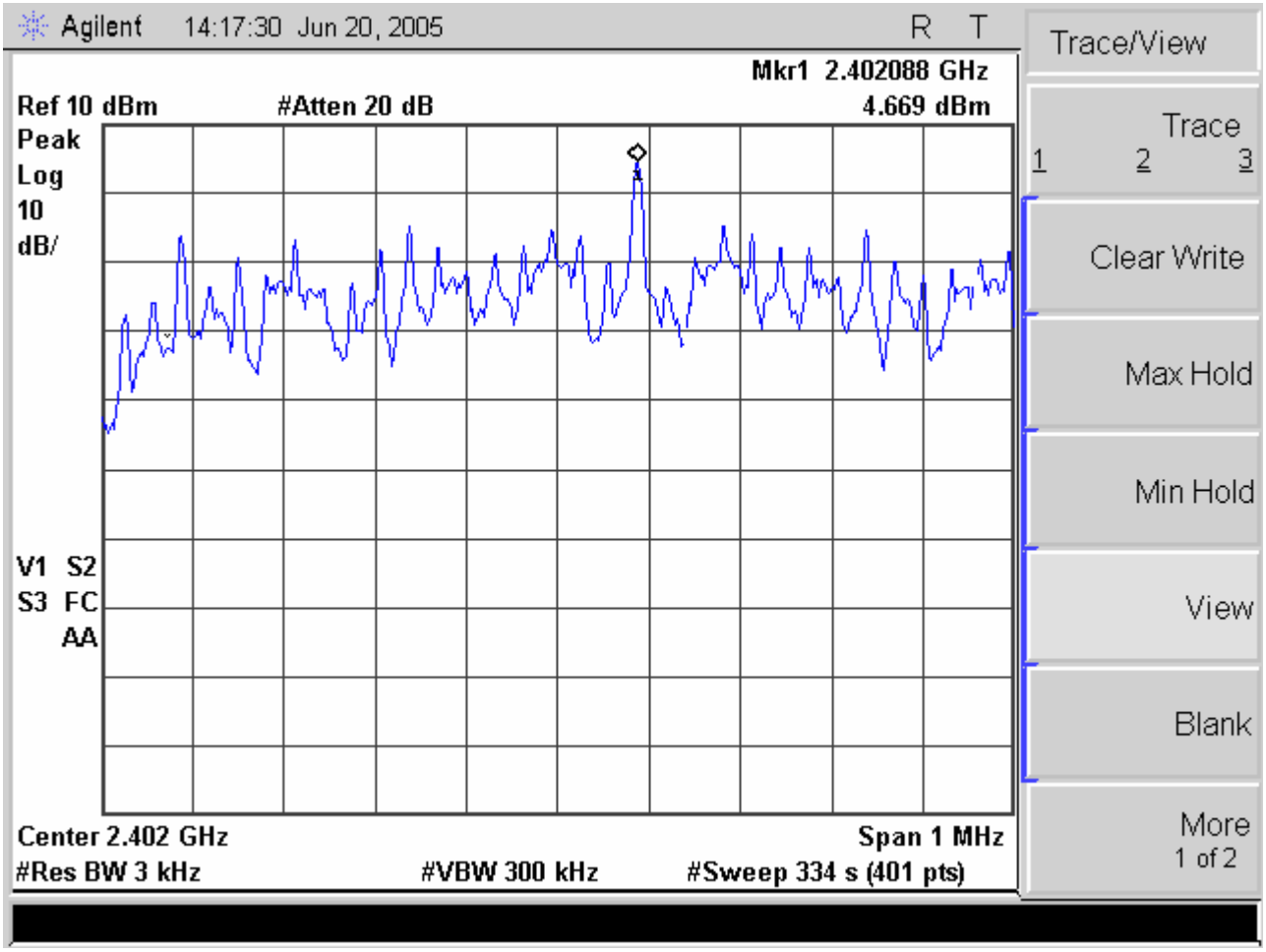
Sweep = Span/3kHz

Test Results: Equipment complies with the power spectral density limits of **§15.247 (d)**. The power spectral density was determined from plots on the following page(s). See Photograph 7 for a photograph of the test setup.

Test Engineer: Christopher Eckert, Dusmantha Tannakoon

Test Date: 06/20/2005, 10/24/2005

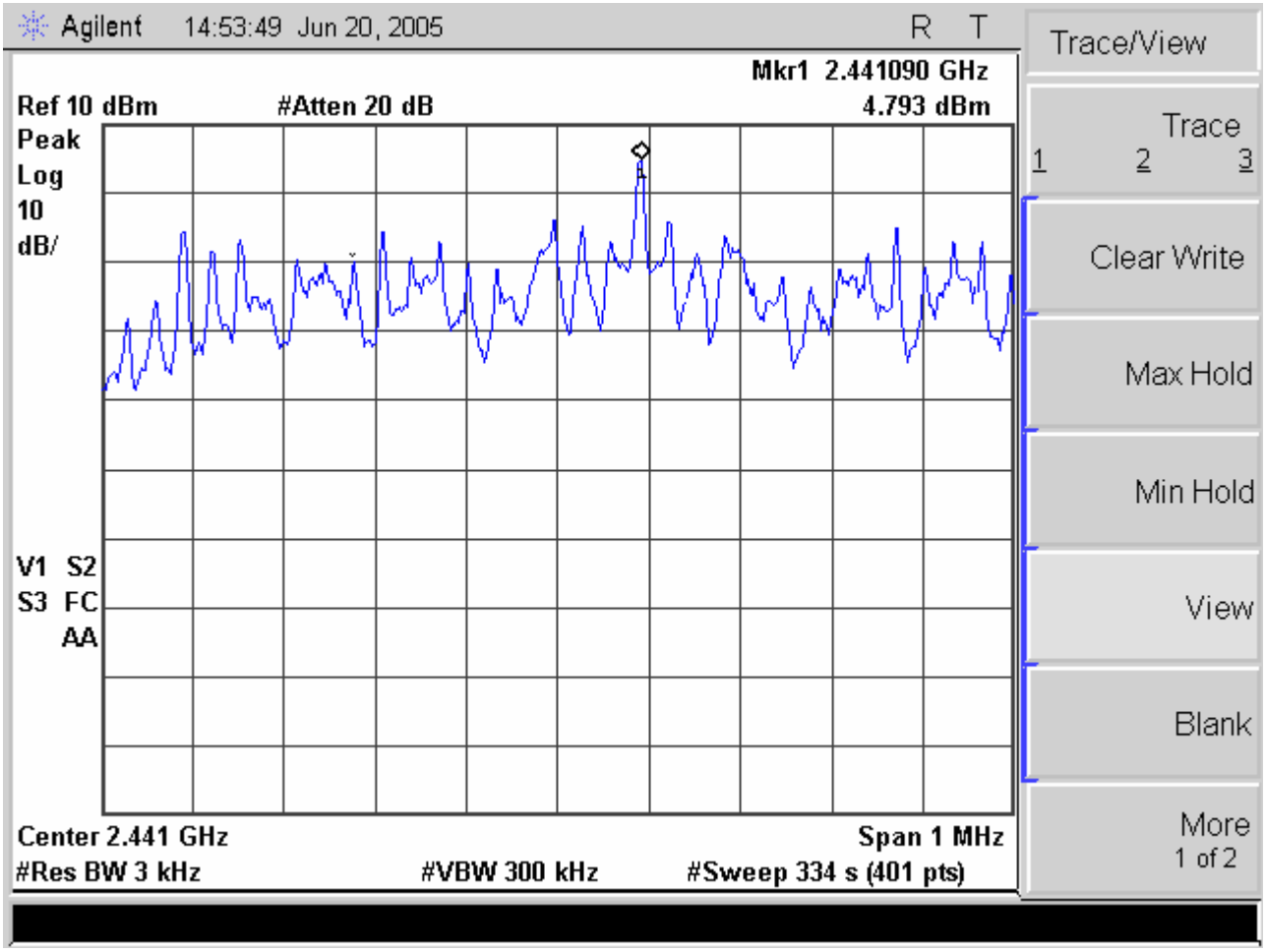
Power Spectral Density Test Results



Plot 28. Power Spectral Density Test Results (Channel 0)

PSD = Measured + Cable Loss
= 4.669 + 2.0
= 6.669 dBm

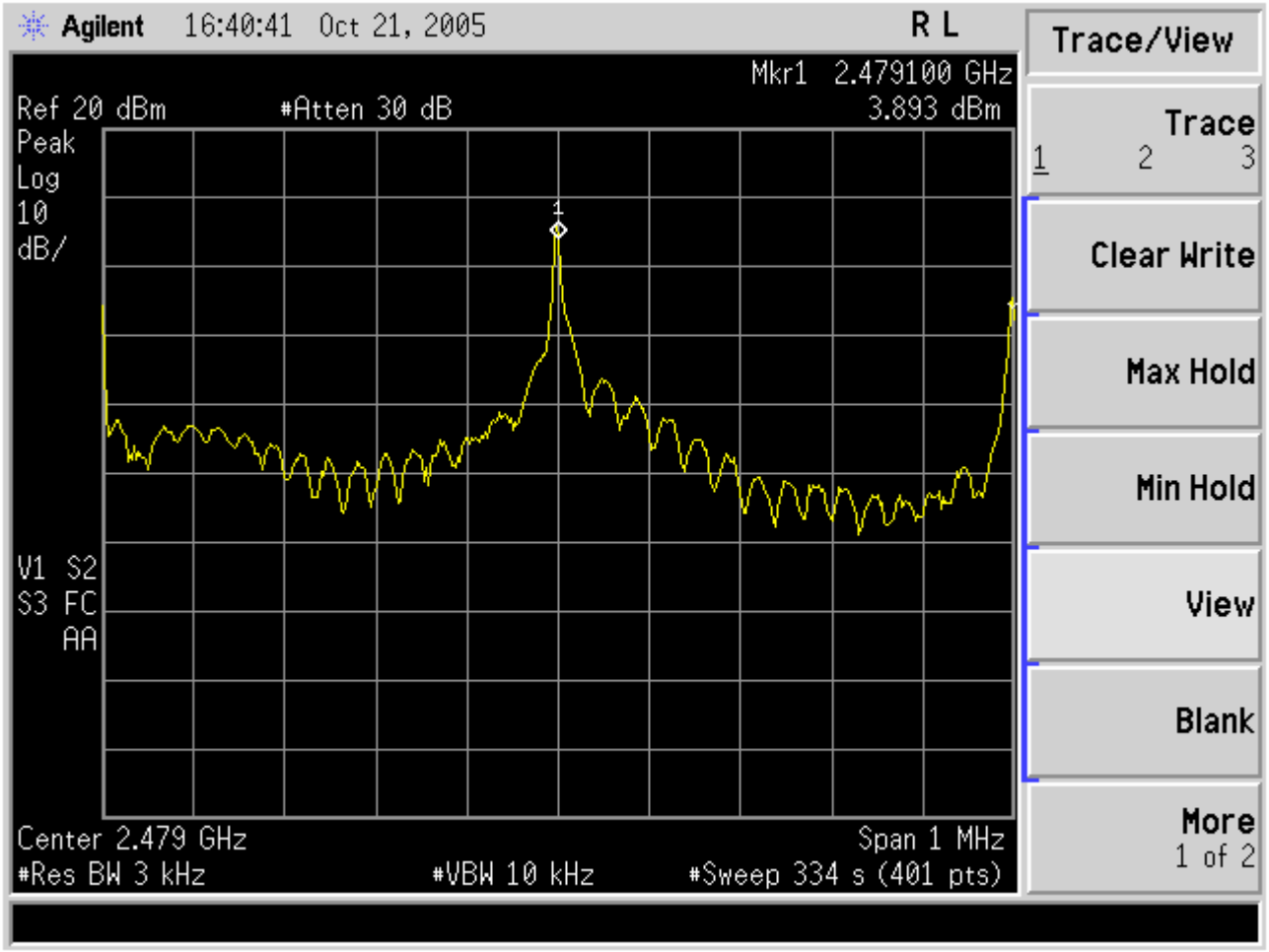
Power Spectral Density Test Results



Plot 29. Power Spectral Density Test Results (Channel 38)

PSD = Measured + Cable Loss
= 4.793 + 2.1
= 6.893 dBm

Power Spectral Density Test Results



Plot 30. Power Spectral Density Test Results (Channel 77)

PSD = Measured + Cable Loss
= 3.893 + 2.5
= 6.393 dBm

Power Spectral Density

Photograph 7. Power Spectral Density Test setup

3.9 Band Edge Measurements

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 3:

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505 (Note 1)	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 2)
13.36–13.41.			
Note 1: Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz. Note 2: Above 38.6			

Table 7. Restricted Bands of Operation from FCC Part 15, § 15.205

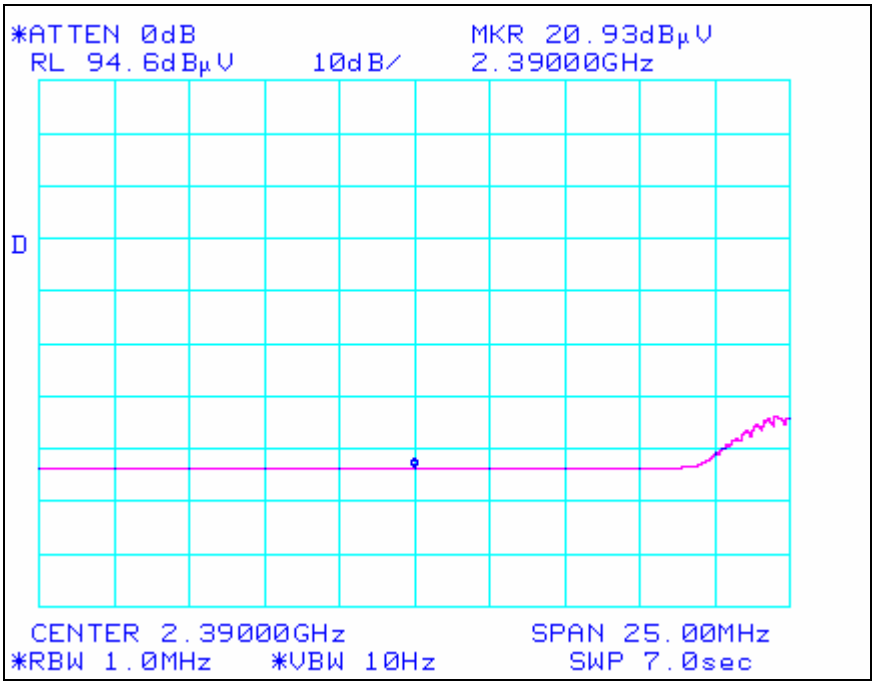
Test Procedure: The EUT was set up at maximum power, first on Channel Ø, then on Channel 77. A plot of each channel was taken with a marker showing the nearest bordering Restricted Band.

Test Results: The EUT complies with Band Edge Measurement requirements.

Test Engineer: Christopher Eckert, Dusmantha Tennakoon

Test Date: 06/20/2005, 10/24/2005

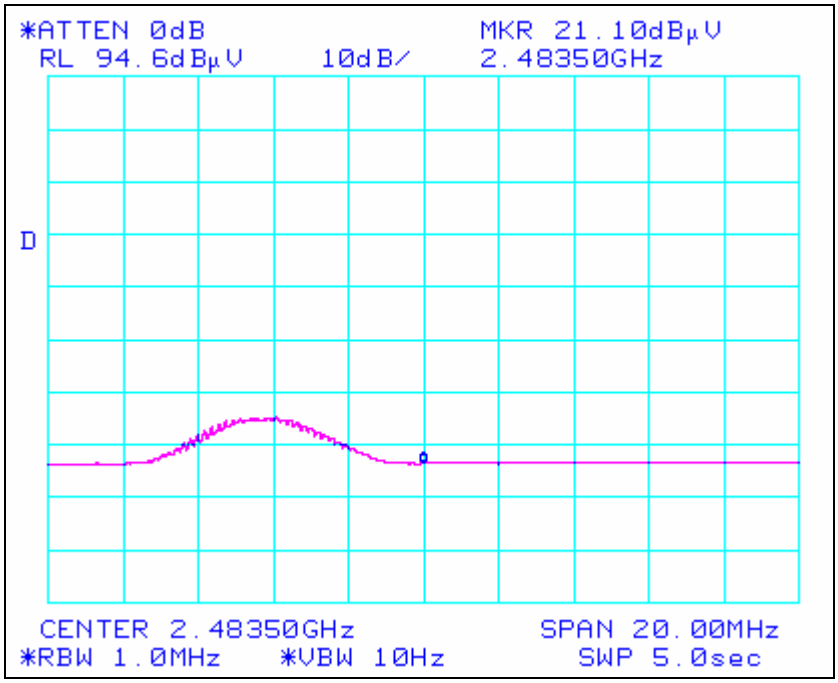
Band Edge Measurements Test Results



Plot 31. Band Edge Test Results, Channel Ø

Average Power Level @ 2.39 GHz = Measured + Antenna Correction Factor = Cable Loss
= 20.93 + 28 + 2.1
= 51.03 dBuv

Band Edge Measurements Test Results



Plot 32. Band Edge Test Results, Channel 77

Average Power Level @ 2.39 GHz = Measured + Antenna Correction Factor = Cable Loss
= 21.10 + 28 + 2.5
= 51.60 dBuV

Band Edge Measurements

Photograph 8. Band Edge Measurements Test setup

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 #	Nomenclature	Manufacturer	Model	Last Cal Date	Cal Due Date
1T4303	Antenna BILOG	Schafner-Chase EMC	CBL6140A	04/22/2004	05/22/2005
1T4300	Semi-anechoic Chamber # 1	EMC Test Systems	None Listed	05/03/2003	04/03/2006
1T4409	EMI Receiver	Rhode & Schwars	ESP17	04/14/2005	04/14/2006
1T4462	Thermo-Hygrometer	Fisher Scientific	11-661-7D	11/08/2004	11/08/2006
1T4459	Thermo-Hygrometer	Fisher Scientific	11-661-710	11/08/2004	11/08/2006
1T4351	Spectrum Analyzer	Agilent	F7405A	10/04/2005	10/04/2006
1T2511	Antenna; horn	EMCO	3115	6/28/2005	6/28/2006
1T2665	Antenna; horn	EMCO	3115	3/28/2005	3/28/2006
1T4288	Spectrum Antenna	HP	8563A	12/13/2004	12/13/2005
1T4351	Spectrum Antenna	Agilent	E7405A	10/4/2005	10/4/2006
1T503	Shielded Room	Universal Shielding	NA	4/30/2005	4/30/2006
1T4354	Signal Generator	HP	83752A	12/13/2004	12/13/2005

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

5.0 Compliance 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.

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.

§ 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.

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.

§ 15.27 Special Accessories.

(a) Equipment marketed to a consumer must be capable of complying with the necessary regulations in the configuration in which the cables and/or special connectors are required to enable an unintentional or intentional radiator to comply with the emission limits in this part, the equipment must be marketed with, i.e. shipped and sold with, those special accessories. However, in lieu of shipping or packaging the special accessories with the unintentional or intentional radiator, the responsible party may employ other methods of ensuring that the special accessories are provided to the consumer, without additional charge.

Information detailing any alternative method used to supply the special accessories for a grant of equipment authorization or retained in the verification records, as appropriate. The party responsible for the equipment, as detailed in §2.909 of this chapter, shall ensure that these special accessories are provided with the equipment. The instruction manual for such devices shall include appropriate instructions on the first page of text concerned with the installation of the device that these special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.

§ 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.