MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
914 WEST PATAPSCO AVENUE ! BALTIMORE, MARYLAND 21230-3432 ! PHONE (410) 354-3300 ! FAX (410) 354-3313
33439 WESTERN AVENUE ● UNION CITY, CALIFORNIA 94587 ● PHONE (510) 489-6300 ● FAX (510) 489-6372
3162 BELICK STREET ● SANTA CLARA, CALIFORNIA 95054 ● PHONE (408 748-3585 ● FAX (510) 489-6372

July 16, 2009

Ubiquiti Networks
495-499 Montague Expressway
Milpitas, CA 95035

Dear Robert Pera,

Enclosed is the EMC Wireless test report for compliance testing of the Ubiquiti Networks, M5 as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Part 15, Subpart B, ICES-003, Issue 4 February 2004 for a Class A Digital Device and FCC Part 15 Subpart C, RSS-210, Issue 7, June 2007 for Intentional Radiators

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

Sincerely yours,
MET LABORATORIES, INC.

Jennifer Warnell
Documentation Department

Reference: (\Ubiquiti Networks\EMCS81509B-FCC247_Rev3)

Electromagnetic Compatibility Criteria
Test Report

for the

Ubiquiti Networks
Model M5

Tested under
the FCC Certification Rules
contained in
Title 47 of the CFR, Parts 15 Subpart B & ICES-003
for Class A Digital Devices
&
15.247 Subpart C & RSS-210, Issue 7, June 2007
for Intentional Radiators

MET Report: EMCS81509B-FCC247_Rev3

July 16, 2009

Prepared For:

Ubiquiti Networks
495-499 Montague Expressway
Milpitas, CA 95035

Prepared By:
MET Laboratories, Inc.
3162 Belick St.
Santa Clara, CA 95054

Electromagnetic Compatibility Criteria
Test Report

for the

Ubiquiti Networks
Model M5

Tested Under

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

Anderson Soungpanya, Project Engineer
Electromagnetic Compatibility Lab

Jennifer Warnell
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of FCC Rules Parts 15B, 15.247 and Industry Canada standards ICES-003, Issue 4 February 2004, RSS-210, Issue 7, June 2007 under normal use and maintenance.

Shawn McMillen,
Wireless Manager, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	June 26, 2009	Initial Issue.
1	June 30, 2009	Rev 1 (revise typo in table 1) Update MIMO RF output power results
2	July 14, 2009	Update Radiated Harmonics Section
3	July 16, 2009	Update configuration

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List of Terms and Abbreviations

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

I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Ubiquiti Networks M5, with the requirements of Part 15, §15.247. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the M5. Ubiquiti Networks should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the M5, has been **permanently** discontinued.

B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.247, in accordance with Ubiquiti Networks, purchase order number 904016. All tests were conducted using measurement procedure ANSI C63.4-2003.

FCC Reference	IC Reference	Description	Compliance
47 CFR Part 15.247:2005	RSS-210 Issue 6: 2005	Applicable Standard	Compliant
Title 47 of the CFR, Part 15 §15.203	N/A	Antenna Requirement	Compliant
Title 47 of the CFR, Part 15 §15.205	RSS-210(A8.5)	Emissions at Restricted Band	Compliant
Title 47 of the CFR, Part 15 §15.207(a)	RSS-210(7.2.2)	Conducted Emission Voltage	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(1)	RSS-210(A8.1)	Occupied Bandwidth	Compliant
Title 47 of the CFR, Part 15 §15.247(b)	RSS-210(A8.4)	RF Output Power	Compliant
Title 47 of the CFR, Part 15 §15.247(c)	RSS-210(A8.4)	Antenna Gain >6dBi	Compliant
Title 47 of the CFR, Part 15 §15.209, §15.247(d)	RSS-210(A8.5)	Radiated and Conducted Spurious Emissions	Compliant
Title 47 of the CFR, Part 15; §15.247(e)	RSS-210(A8.3)	Power Spectral Density	Compliant
Title 47 of the CFR, Part 15 §15.247(f)	RSS-210(A8.3)	Hybrid System Requirements	N/A
Title 47 of the CFR, Part15 15.247(g)	RSS-210(A8.1)	Hopping Capability	N/A
Title 47 of the CFR, Part 15 §15.247(h)	RSS-210(A8.1)	Hopping Coordination Requirement	N/A
Title 47 of the CFR, Part 15 §15.247(i)	RSS-Gen(5.5)	Maximum Permissible Exposure	Compliant
N/A	RSS-Gen(4.8)	Receiver Spurious Emissions	Compliant

Table 1. Executive Summary of EMC Part 15.247 ComplianceTesting

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Ubiquiti Networks to perform testing on the M5, under Ubiquiti Networks's purchase order number 904016.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Ubiquiti Networks, M5.

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

Model(s) Tested:	M5			
Model(s) Covered:	M5			
EUT Specifications:	Primary Power: 15 VDC			
	FCC ID: SWX-M5 IC: 6545A-M5			
	Type of Modulations:	DSSS (Direct Sequence Spread Spectrum) OFDM (Orthogonal Frequency Division multiplexing)		
	Emission Designators:		**6dB**	**99%**
		HT20:	17M6D7D	17M8D7D
		HT40:	36M2D7D	36M4D7D
		A Mode:	17M6D7D	17M8D7D
	Equipment Code:	DTS		
	Peak RF Output Power:	**HT20:**	26.12dBm (0.409W)	
		HT40:	25.88dBm (0.387W)	
		A Mode:	26.54dBm (0.450W)	
		MIMO	28.99dBm (0.792W)	
	EUT Frequency Ranges:	5.745 - 5.825 GHz		
Analysis:	The results obtained relate only to the item(s) tested.			
Environmental Test Conditions:	Temperature: 15-35º C			
	Relative Humidity: 30-60%			
	Barometric Pressure: 860-1060 mbar			
Evaluated by:	Anderson Soungpanya			
Report Date(s):	July 16, 2009			

Table 2. EUT Summary Table

B. References

CFR 47, Part 15, Subpart C	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies
RSS-210, Issue 7, June 2007	Low-power Licence-exempt Radiocommunications Devices (All Frequency Bands): Category I Equipment
CFR 47, Part 15, Subpart B	Electromagnetic Compatibility: Criteria for Radio Frequency Devices
ICES-003, Issue 4 February 2004	Electromagnetic Compatibility: Criteria for Radio Frequency Devices
ANSI C63.4:2003	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI/NCSL Z540-1-1994	Calibration Laboratories and Measuring and Test Equipment - General Requirements
ANSI/ISO/IEC 17025:2000	General Requirements for the Competence of Testing and Calibration Laboratories

Table 3. References

C. Test Site

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

Radiated Emissions measurements were performed in a 10 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

D. Description of Test Sample

The Ubiquiti Networks, Inc. M5, Equipment Under Test (EUT), is a an outdoor radio 802.11a/n.

Photograph 1. Ubiquiti Networks M5

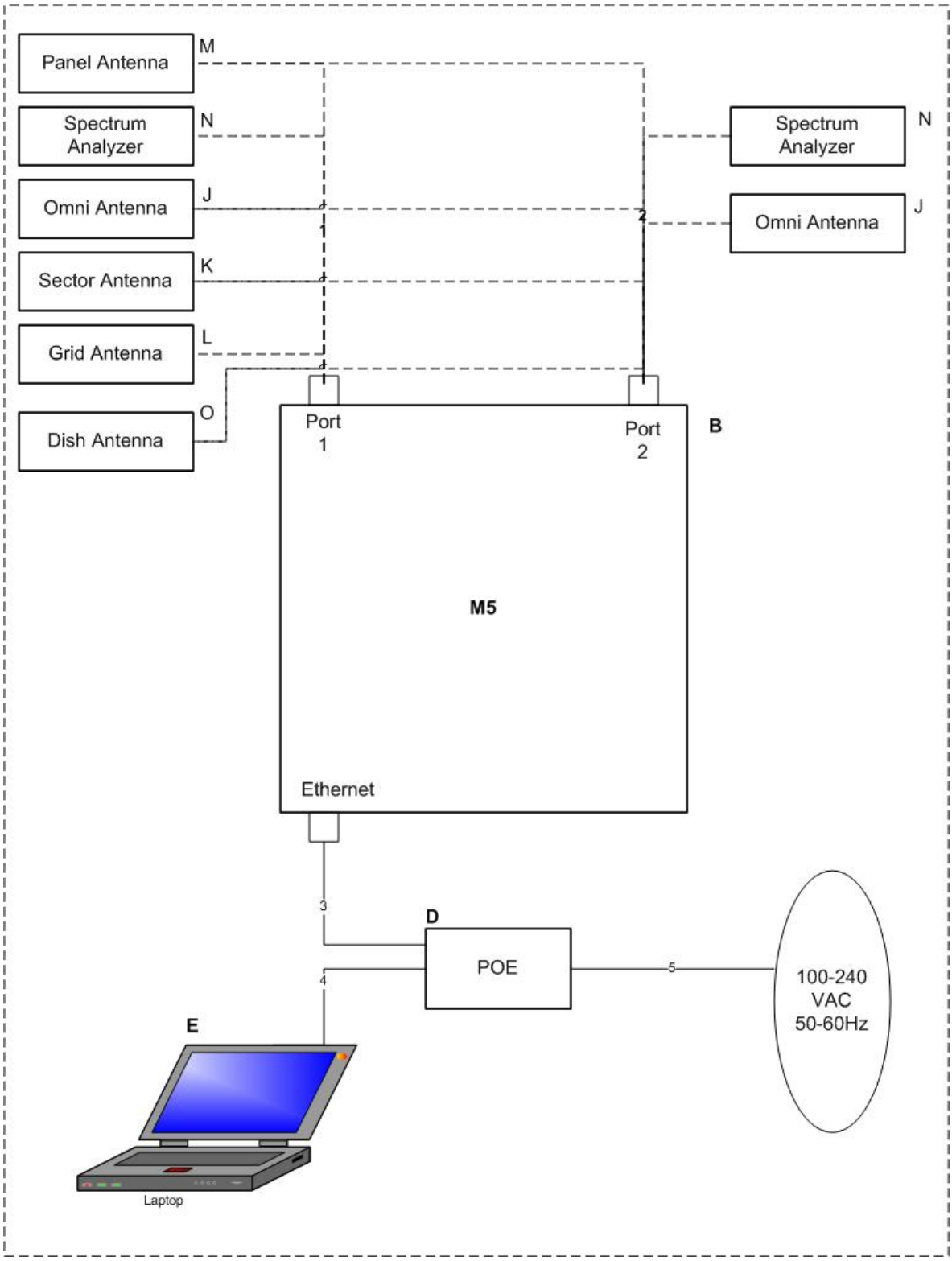


Figure 1. Block Diagram of Test Configuration

E. Equipment Configuration

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

Ref. ID	Name / Description	Model Number	Part Number	Serial Number
B	M5	M5	M5	4-16-09
C	POWER OVER ETHERNET (UBIQUITI NETWORKS)	UB1-POE-15-8	NA	0901-0004848

Table 4. Equipment Configuration

F. Support Equipment

Ubiquiti Networks supplied support equipment necessary for the operation and testing of the M5. All support equipment supplied is listed in the following Support Equipment List.

Ref. ID	Name / Description	Manufacturer	Model Number	*Customer Supplied Calibration Data
M5				
N	SPECTRUM ANALYZER	AGILENT	E4447A	N/A
E	LAPTOP	DELL	VOSTRO 1000	N/A
J	7 DBI OMNI ANTENNAS	UBIQUITI	O-5G-7	N/A
K	20 DBI SECTOR ANTENNA	UBIQUITI	AMS-5G-20	N/A
L	30 DBI GRID ANTENNA	UBIQUITI	AG-5G-30	N/A
M	24 DBI PANEL ANTENNA	UBIQUITI	RP-5G-24	N/A
O	30DBI DISH ANTENNA	UBIQUITI	RD-5G-30	N/A

Table 5. Support Equipment

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

G. Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty.	Length (m)	Shielded (Y/N)	Termination Box ID & Port Name
M5						
1	B, ANTENNA PORT1	COAXIAL CABLE	1	3	Y	J OR K OR L OR M
2	B, ANTENNA PORT2	COAXIAL CABLE	1	3	Y	J OR K OR L OR M
3	B, ETHERNET	CAT 5	1	3	N	D
4	D, DATA	CAT 5	1	3	N	E, LAPTOP
5	D, POE	POWER CORD	1	.5	N	100-240V AC POWER

Table 6. Ports and Cabling Information

H. Mode of Operation

Using Atheros Radio Test Software.

I. Method of Monitoring EUT Operation

Ping Times out and doesn't return. Unit locks up requires power down is a fail.

J. Modifications

a) Modifications to EUT

No modifications were made to the EUT.

b) Modifications to Test Standard

No modifications were made to the test standard.

K. Disposition of EUT

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

III. Electromagnetic Compatibility Criteria for Unintentional Radiators

Electromagnetic Compatibility Criteria

§ 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 7. 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 7. 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.

15.207(a), Except as shown in paragraphs (b) and (c) of this section*, charging, AC adapters or battery eliminators 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 the Table 7, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency range (MHz)	Class A Conducted Limits (dBµV)		*Class B Conducted Limits (dBµV)	
	Quasi-Peak	Average	Quasi-Peak	Average
* 0.15- 0.45	79	66	66 - 56	56 - 46
0.45 - 0.5	79	66	56	46
0.5 - 30	73	60	60	50
Note 1 — The lower limit shall apply at the transition frequencies. Note 2 — The limit decreases linearly with the logarithm if the frequency in the range 0.15 MHz to 0.5 MHz. * -- Limits per Subsection 15.207(a).				

Table 7. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Subsections 15.107(a) (b) and 15.207(a)

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

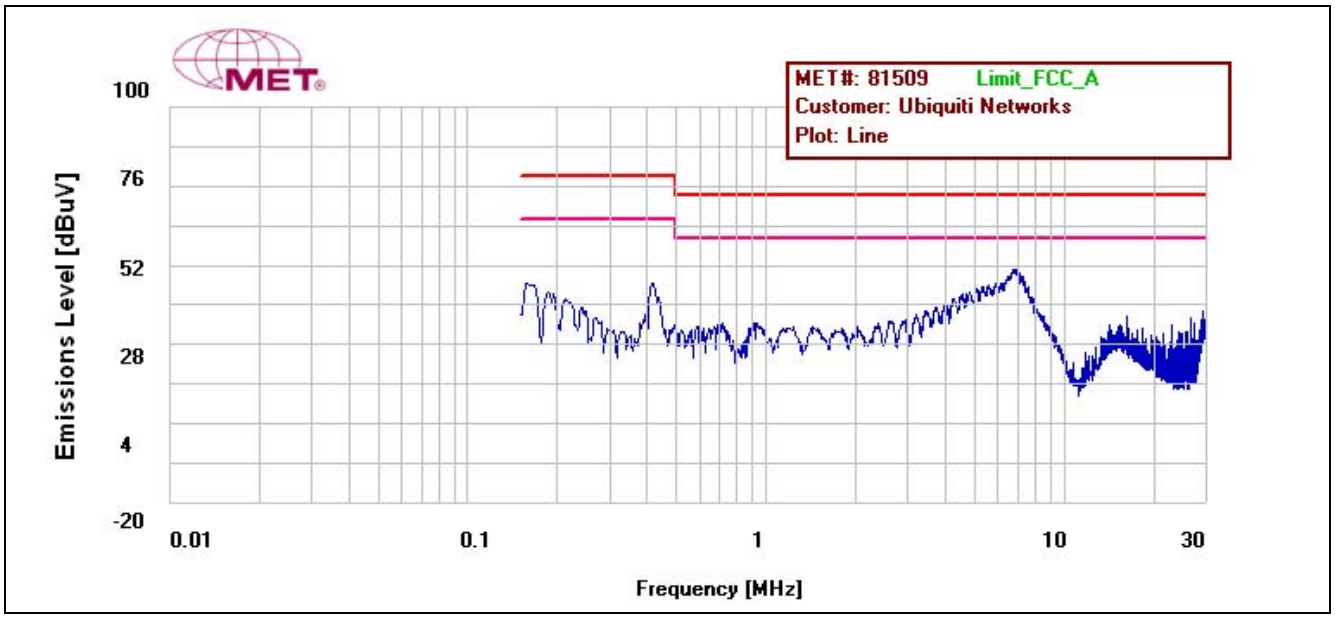
Test Engineer(s): Anderson Soungpanya

Test Date(s): 05/04/09

Conducted Emissions - Voltage, AC Power, Phase Line

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Line	6.70	48.71	73	-24.29	Pass	42.15	60	-17.85	Pass
Line	.417	46.77	79	-32.23	Pass	37.54	66	-28.46	Pass
Line	.159	42.02	79	-36.98	Pass	25.2	66	-40.8	Pass

Table 8. Conducted Emissions - Voltage, AC Power, Phase Line

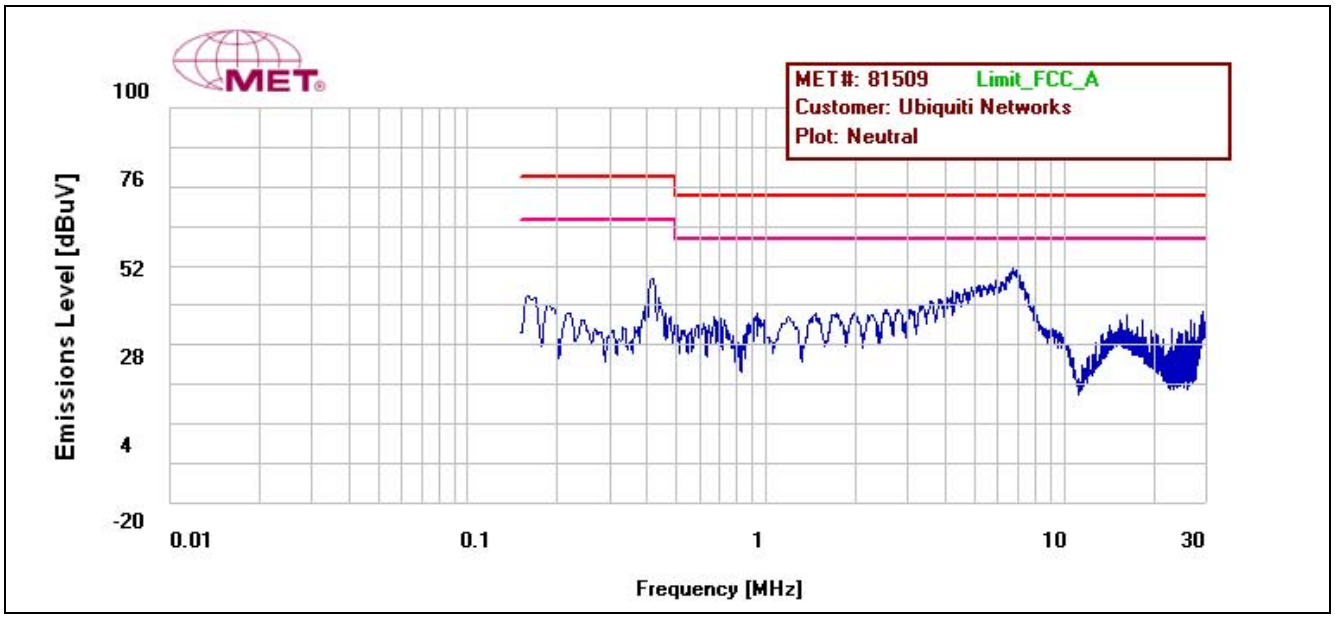


Plot 1. Conducted Emission, Phase Line Plot

Conducted Emissions - Voltage, AC Power, Neutral Line

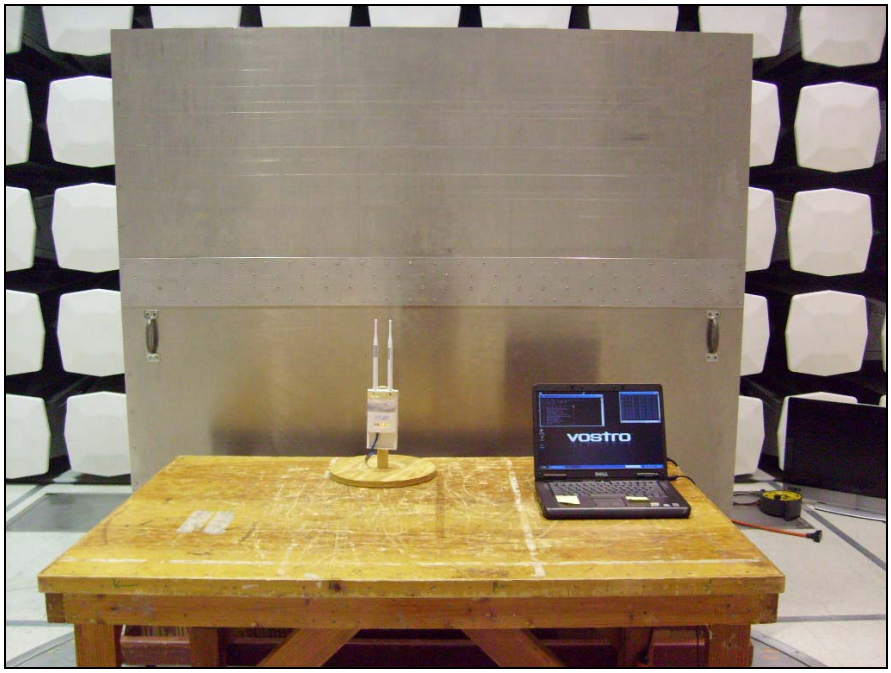
Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Neutral	6.75	48.14	73	-24.86	Pass	41.37	60	-18.63	Pass
Neutral	.414	47.94	79	-31.06	Pass	37.27	66	-28.73	Pass
Neutral	.160	41.53	79	-37.47	Pass	25.35	66	-40.65	Pass

Table 9. Conducted Emissions - Voltage, AC Power, Neutral Line



Plot 2. Conducted Emission, Neutral Line Plot

Conducted Emission Limits Test Setup



Photograph 2. Conducted Emissions, Test Setup

Radiated Emission Limits

§ 15.109 Radiated Emissions Limits

Test Requirement(s): **15.109 (a)** Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the Class B limits expressed in Table 10.

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 10.

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

Frequency Band (MHz)	Class A Quasi-Peak limits 10 m measurement distance (dBµV/m)	Class B Quasi-Peak limits 10 m measurement distance (dBµV/m)
30 to 230	40	30
230 to 1000	47	37

Table 11. Radiated Emissions Limits calculated from ICES-003 Issue 4 February 2004

Test Procedures: The EUT was placed on a 0.8m-high wooden table inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.4 were used. An antenna was located 10 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 to comply with the Class A requirement(s) of this section. Measured emissions were below applicable limits

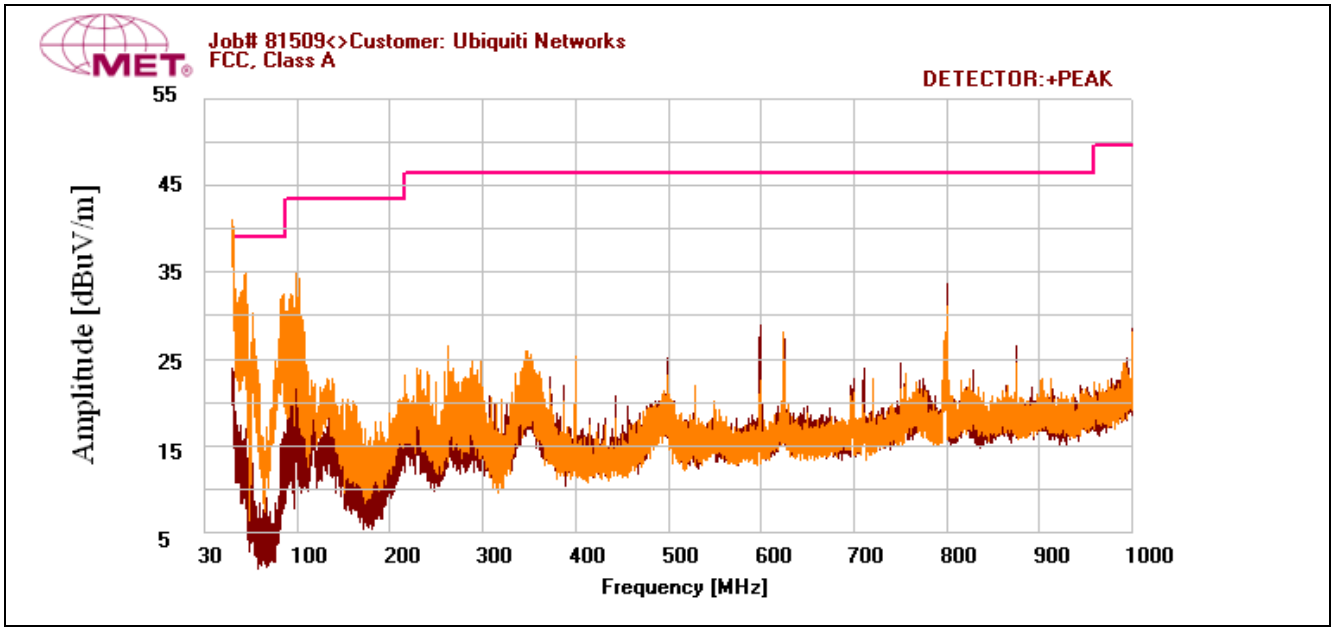
Test Engineer(s): Anderson Soungpanya

Test Date(s): 05/04/09

FCC 15B Radiated Emissions Limits Test Results, Class A

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ref.
30.52	V	258	100	57.42	17.336	40	0.898	0	35.654	39	-3.346	1
43.79	V	146	277	63.92	9.505	40	1.027	0	34.452	39	-4.548	2
98.44	V	254	100	62.05	10.626	40	1.542	0	34.218	43.5	-9.282	3
84.62	V	97	125	62.59	8.894	40	1.471	0	32.955	39	-6.045	4
799.98	V	264	245	46.53	19.699	40	4.755	0	30.984	46.4	-15.416	5
800	H	128	109	50.39	19.5	40	4.755	0	34.645	46.4	-11.755	6

Table 12. Radiated Emissions, Test Results, FCC Limits

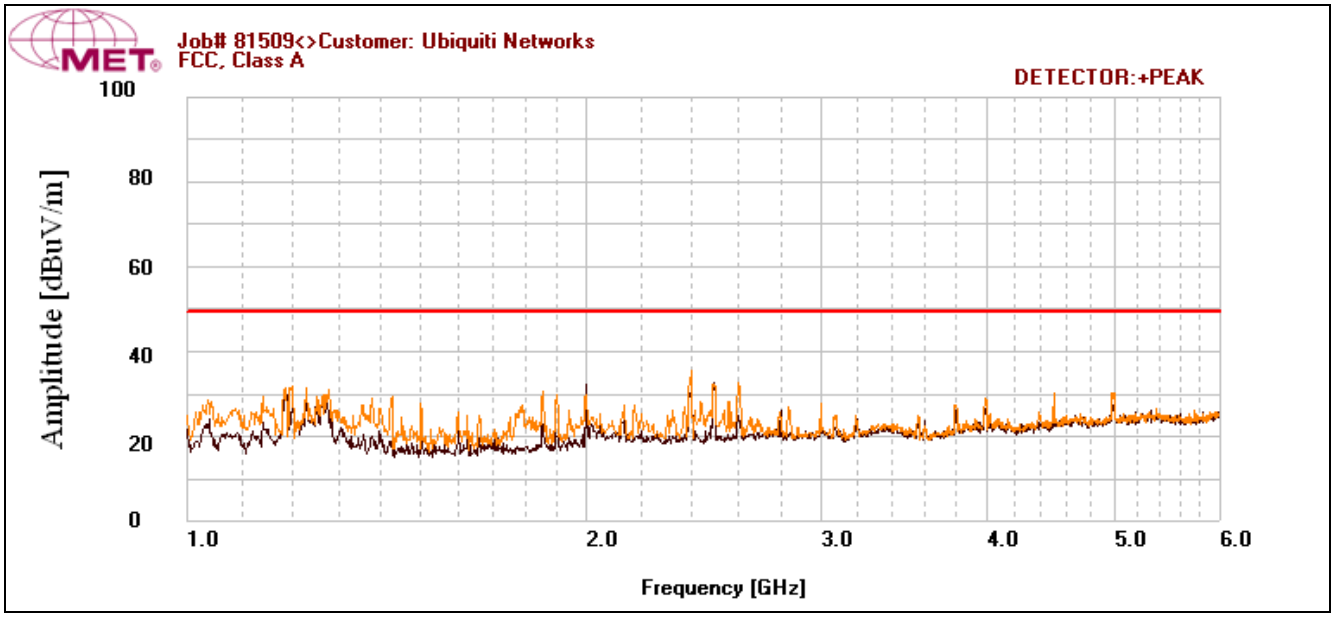


Plot 3. Radiated Emissions, Pre-Scan, FCC Limits

FCC 15B Radiated Emissions Limits Test Results, Class A

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2392	V	349	100	37.84	1.731	20	2.858	-10.46	11.969	49.5	-37.531
2488	V	0	100	37.01	1.897	20	2.926	-10.46	11.373	49.5	-38.127
2000	H	99	100	57.37	1.052	20	2.58	-10.46	30.542	49.5	-18.958

Table 13. Radiated Emissions, Test Results, FCC Limits, Above 1 GHz

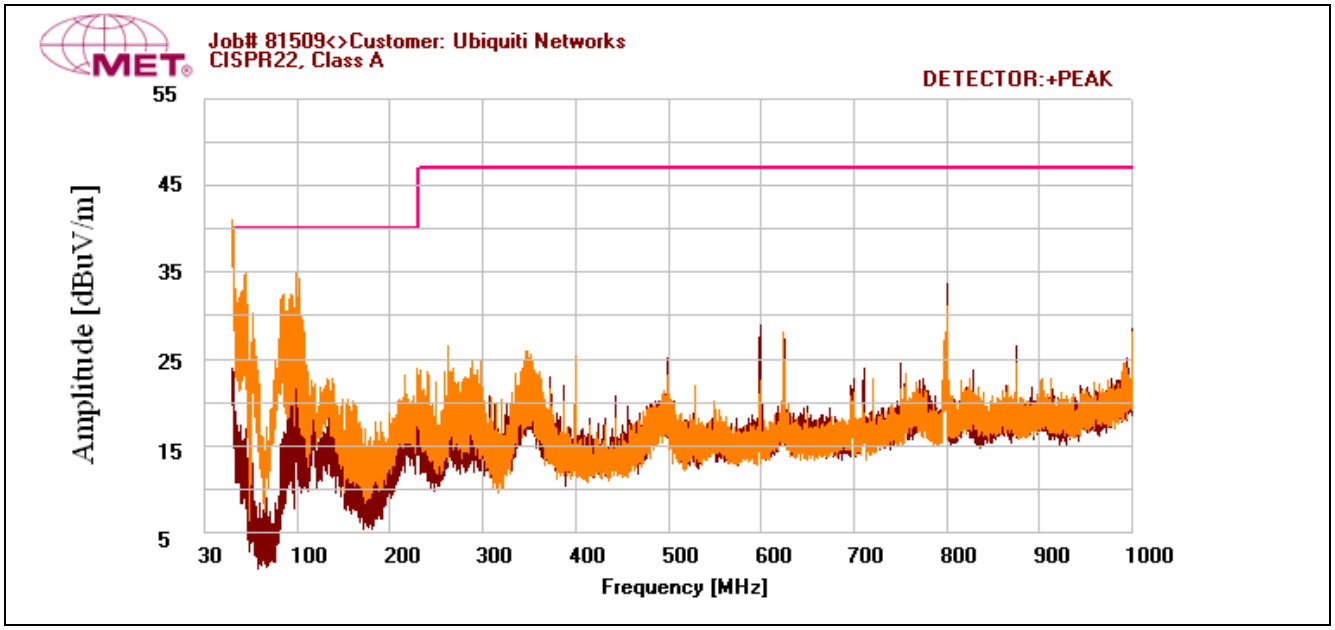


Plot 4. Radiated Emissions, Pre-Scan, FCC Limits, Above 1 GHz

Industry Canada ICES-003 Radiated Emissions Limits Test Results, Class A

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.52	V	258	100	57.42	17.336	40	0.898	0	35.654	40	-4.346
43.79	V	146	277	63.92	9.505	40	1.027	0	34.452	40	-5.548
98.44	V	254	100	62.05	10.626	40	1.542	0	34.218	40	-5.782
84.62	V	97	125	62.59	8.894	40	1.471	0	32.955	40	-7.045
799.98	V	264	245	46.53	19.699	40	4.755	0	30.984	47	-16.016
800	H	128	109	50.39	19.5	40	4.755	0	34.645	47	-12.355

Table 14. Radiated Emissions, Test Results, ICES-003 Limits



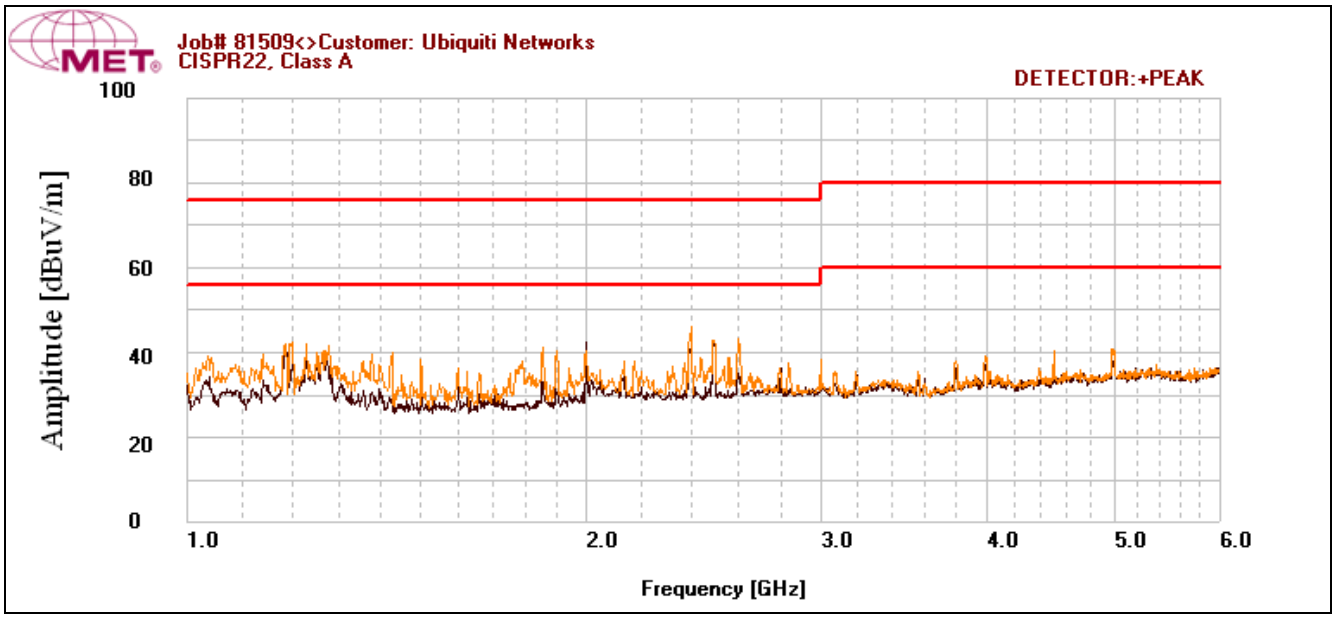
Plot 5. Radiated Emissions, Pre-Scan, ICES-003 Limits

Industry Canada ICES-003 Radiated Emissions Limits Test Results, Class A

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2392	V	349	100	37.84	1.731	20	2.858	0	22.429	56	-33.571
2488	V	0	100	37.01	1.897	20	2.926	0	21.833	56	-34.167
2000	H	99	100	57.37	1.052	20	2.58	0	41.002	56	-14.998

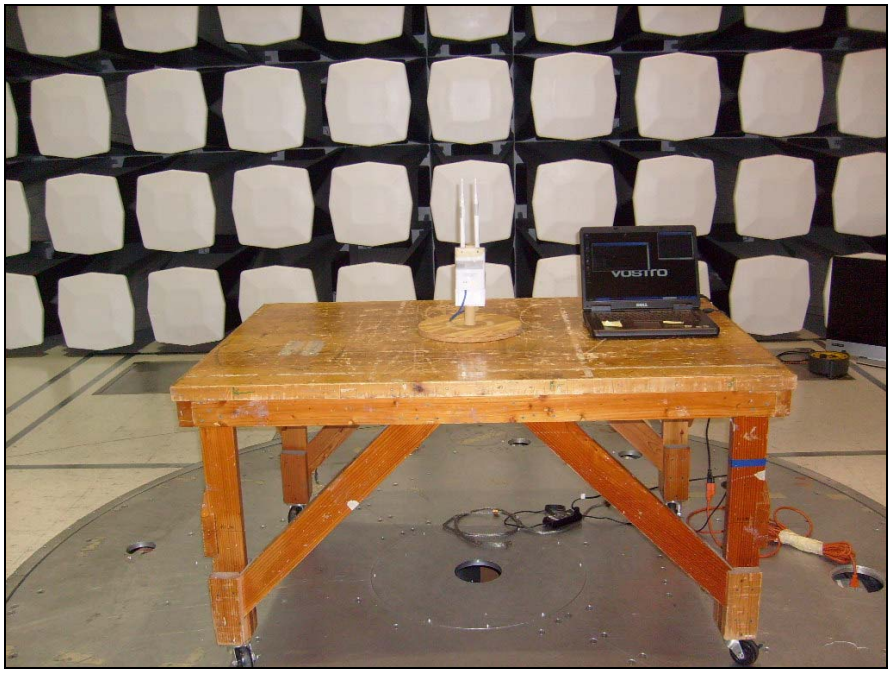
Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2392	V	349	100	64.77	1.731	20	2.858	0	49.359	76	-26.641
2488	V	0	100	64.21	1.897	20	2.926	0	49.033	76	-26.967
2000	H	99	100	67.34	1.052	20	2.58	0	50.972	76	-25.028

Table 15. Radiated Emissions, Test Results, ICES-003 Limits, Above 1 GHz

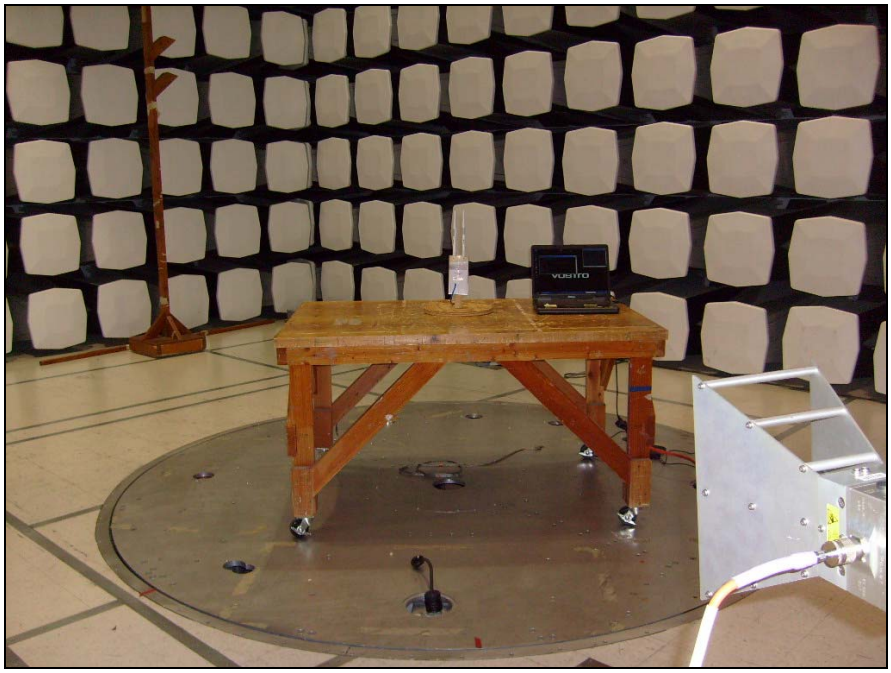


Plot 6. Radiated Emissions, Test Results, ICES-003 Limits, Above 1 GHz

Radiated Emission Limits Test Setup



Photograph 3. Radiated Emission, Test Setup



Photograph 4. Radiated Emission, Test Setup, Above 1 GHz

IV. Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

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

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

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

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

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

Results: The EUT as tested meets the criteria of this rule by virtue of having professionally installed. The EUT is therefore compliant with §15.203.

Gain/Type	Model	Manufacturer
7dBi Omni	O-5G-7	Ubiquiti Networks
20dBi Sector	AMS-5G-20	Ubiquiti Networks
30dBi Grid	AG-5G-30	Ubiquiti Networks
24dBi Dual-Polarity Panel	RP-5G-24	Ubiquiti Networks
30dBi Dual-Polarity Dish	RD-5G-30	Ubiquiti Networks

Test Engineer(s): Anderson Soungpanya

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207 Conducted Emissions Limits

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

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

Table 16. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Test Procedure: The EUT was placed on a 0.8 m-high wooden table inside a semi-anechoic chamber. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 μH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.4-1992 "Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz"*. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω/50 μH LISN as the input transducer to an EMC/field intensity meter. The tests were conducted in a RF-shielded enclosure.

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

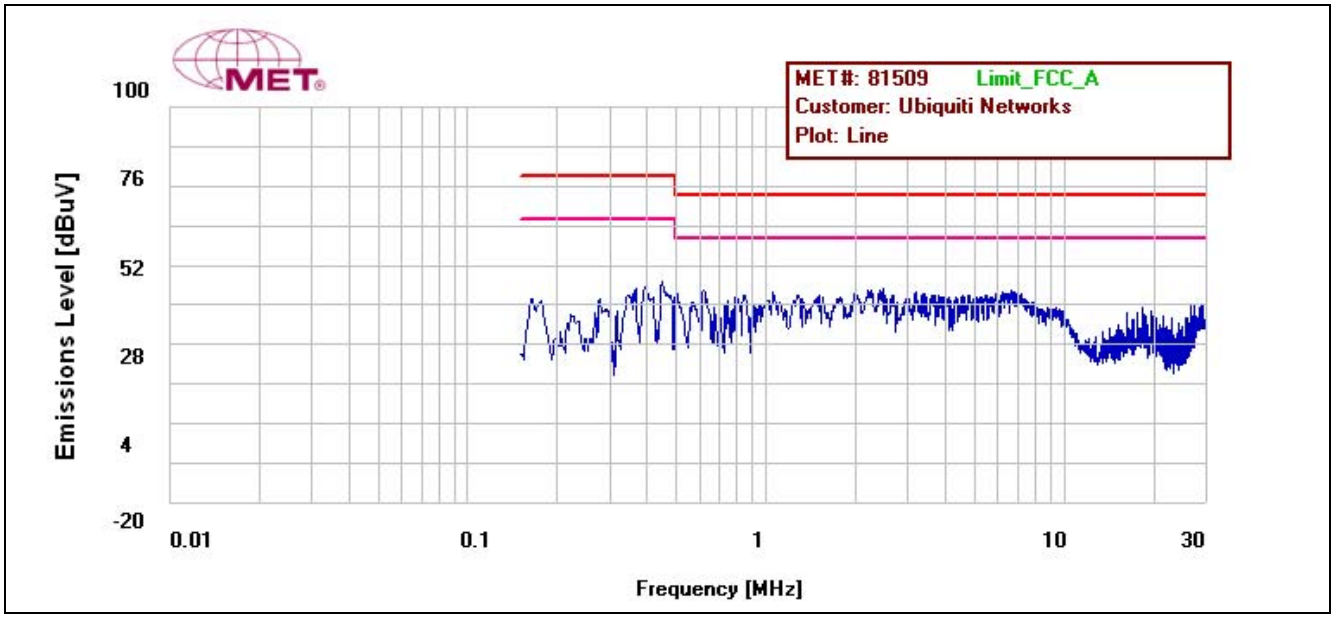
Test Engineer(s): Anderson Soungpanya

Test Date(s): 05/04/09

Conducted Emissions - Voltage, AC Power, Phase Line

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Line	.444	45.14	79	-33.86	Pass	31.44	66	-34.56	Pass
Line	.392	45.49	79	-33.51	Pass	34.63	66	-31.37	Pass
Line	2.42	42.54	73	-30.46	Pass	25.67	60	-34.33	Pass

Table 17. Conducted Emissions - Voltage, AC Power, Phase Line

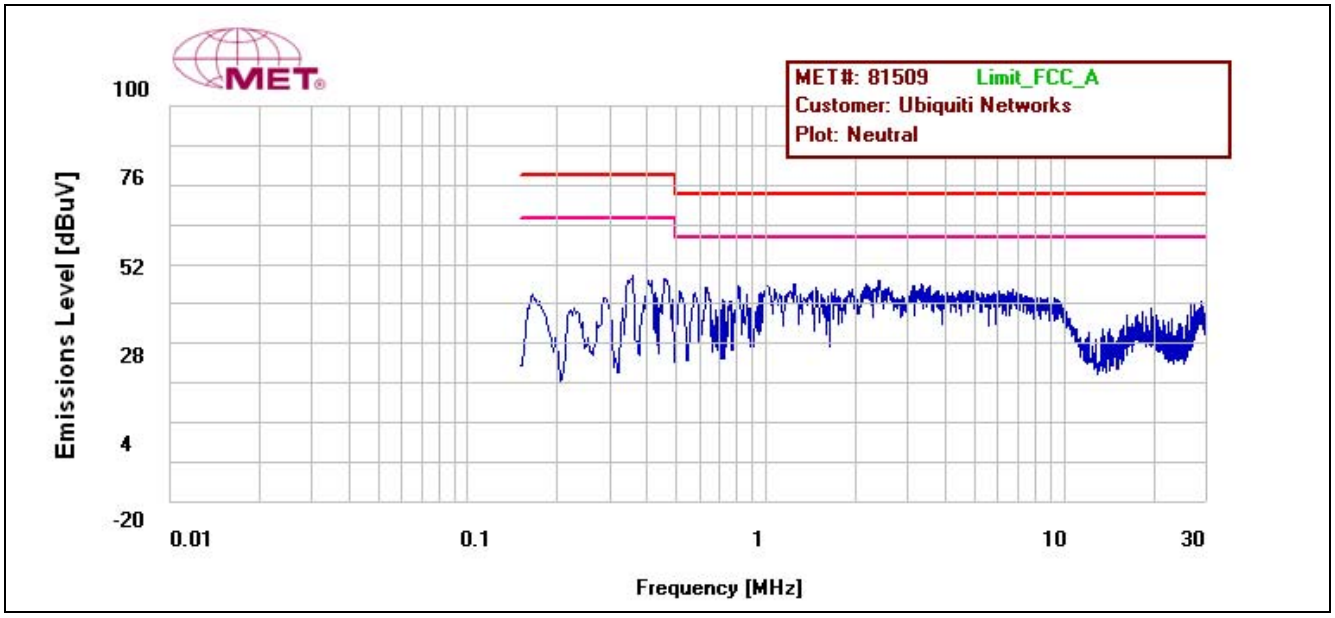


Plot 7. Conducted Emissions, 15.207, Phase Line Plot

Conducted Emissions - Voltage, AC Power, Neutral Line

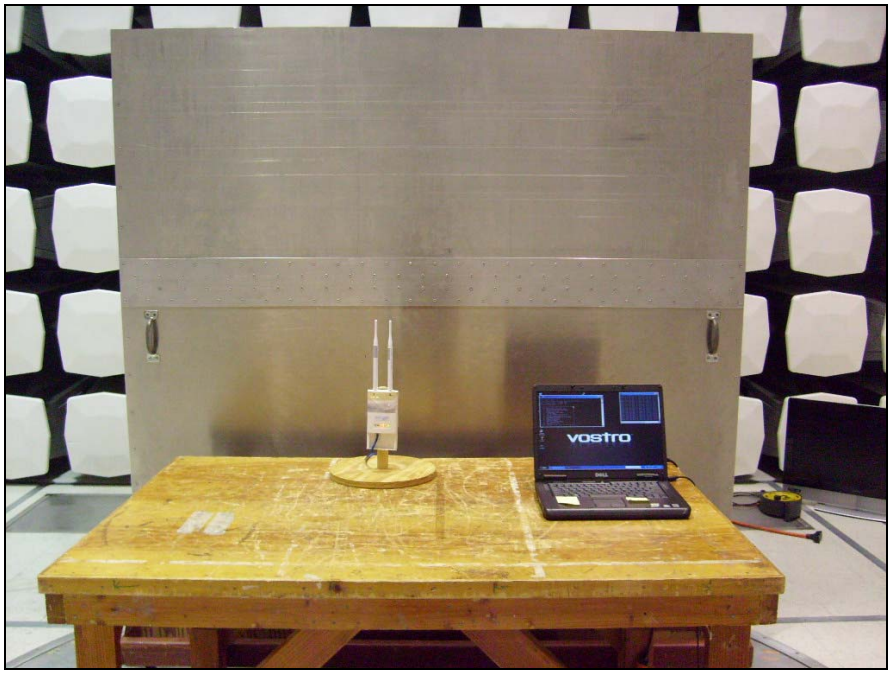
Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Neutral	.292	41.1	79	-37.9	Pass	27.82	66	-38.18	Pass
Neutral	.357	46.95	79	-32.05	Pass	27.76	66	-38.24	Pass
Neutral	1.25	45.3	73	-27.7	Pass	26.13	60	-33.87	Pass

Table 18. Conducted Emissions - Voltage, AC Power, Neutral Line



Plot 8. Conducted Emissions, 15.207, Neutral Line Plot

Conducted Emission Limits Test Setup



Photograph 5. Conducted Emissions, Test Setup, 15.207

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a) 6 dB and 99% Bandwidth

Test Requirements: **§ 15.247(a):** Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

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

Test Procedure: The transmitter was set to the mid channel at the highest output power and connected to the spectrum analyzer through an attenuator and a directional coupler. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately 1% of the total emission bandwidth, VBW > RBW. The 6 dB Bandwidth was measured and recorded. The measurements were repeated at the low and high channels.

Test Results Equipment complies with § 15.247 (a). The 6 dB and 99% Bandwidth was determined from the plots on the following pages.

Test Engineer(s): Anderson Soungpanya

Test Date(s): 04/27/09

Electromagnetic Compatibility Criteria for Intentional Radiators

HT20 mode – Port 1			
Carrier Channel	**Frequency (MHz)**	**Measured 6 dB Bandwidth (MHz)**	**Measured 99% Bandwidth (MHz)**
Low	5745	17.667	17.8020
Mid	5785	17.657	17.6896
High	5825	17.619	17.7061

Table 19. Occupied Bandwidth Summary Results for HT20 (Port 1)

HT40 mode – Port 1			
Carrier Channel	**Frequency (MHz)**	**Measured 6 dB Bandwidth (MHz)**	**Measured 99% Bandwidth (MHz)**
Low	5745	35.850	36.2790
Mid	5785	35.975	36.4244
High	5825	36.115	36.4236

Table 20. Occupied Bandwidth Summary Results for HT40 (Port 1)

802.11a Mode – Port 1			
Carrier Channel	**Frequency (MHz)**	**Measured 6 dB Bandwidth (MHz)**	**Measured 99% Bandwidth (MHz)**
Low	5745	17.667	17.8020
Mid	5785	17.657	17.6896
High	5825	17.619	17.7061

Table 21. Occupied Bandwidth Summary Results for 802.11a Mode (Port 1)

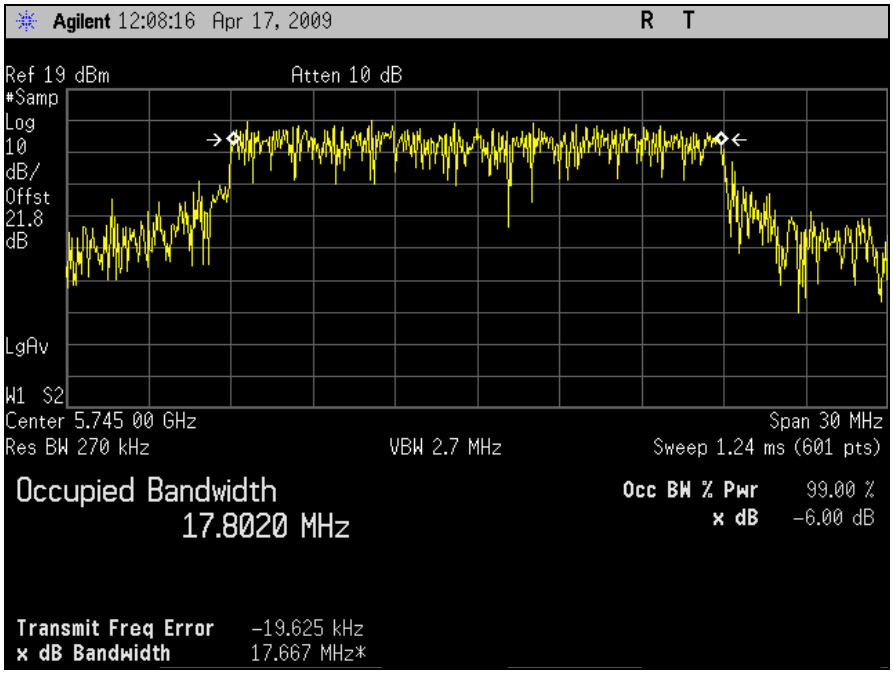
HT20 mode – Port 2			
Carrier Channel	**Frequency (MHz)**	**Measured 6 dB Bandwidth (MHz)**	**Measured 99% Bandwidth (MHz)**
Low	5745	17.679	17.7392
Mid	5785	17.519	17.7339
High	5825	17.003	17.7307

Table 22. Occupied Bandwidth Summary Results for HT20 (Port 2)

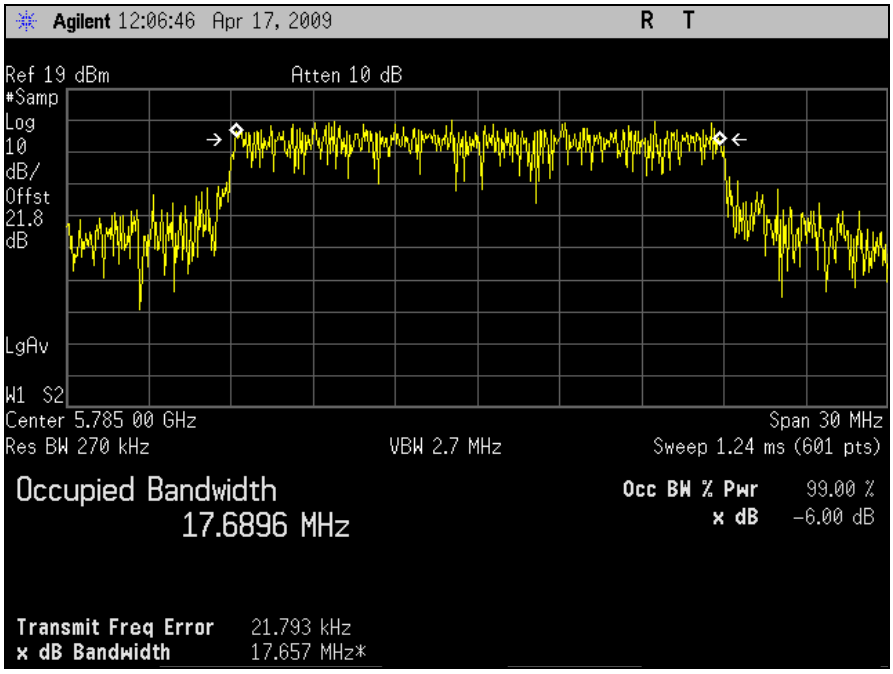
HT40 mode – Port 2			
Carrier Channel	**Frequency (MHz)**	**Measured 6 dB Bandwidth (MHz)**	**Measured 99% Bandwidth (MHz)**
Low	5745	36.253	36.2779
Mid	5785	35.131	36.1766
High	5825	36.084	36.2035

Table 23. Occupied Bandwidth Summary Results for HT40 (Port 2)

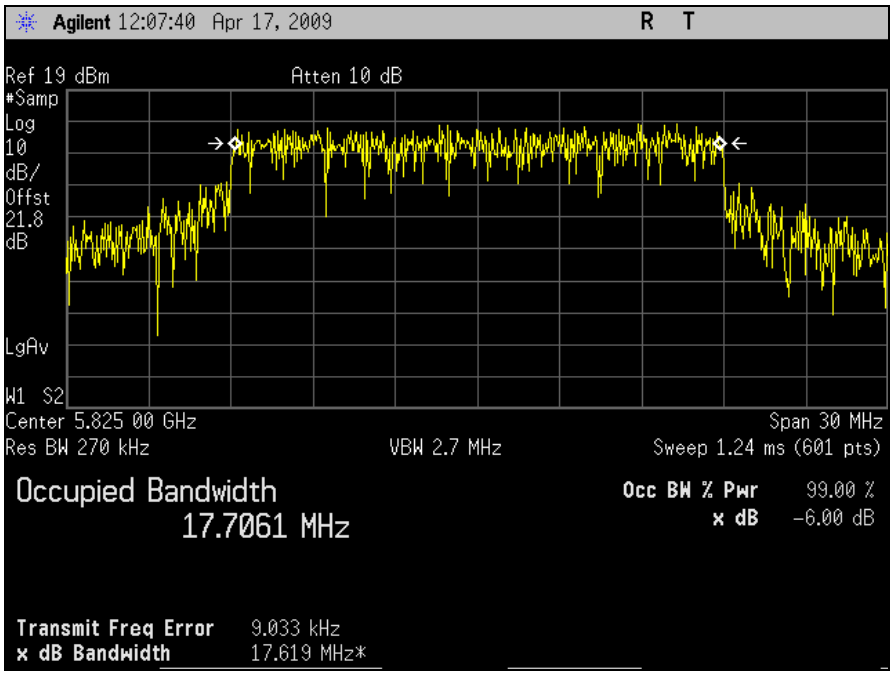
Occupied Bandwidth Test Results – Port 1, HT20



Plot 9. Occupied Bandwidth, Low Channel, -6 dB, Port 1, HT20

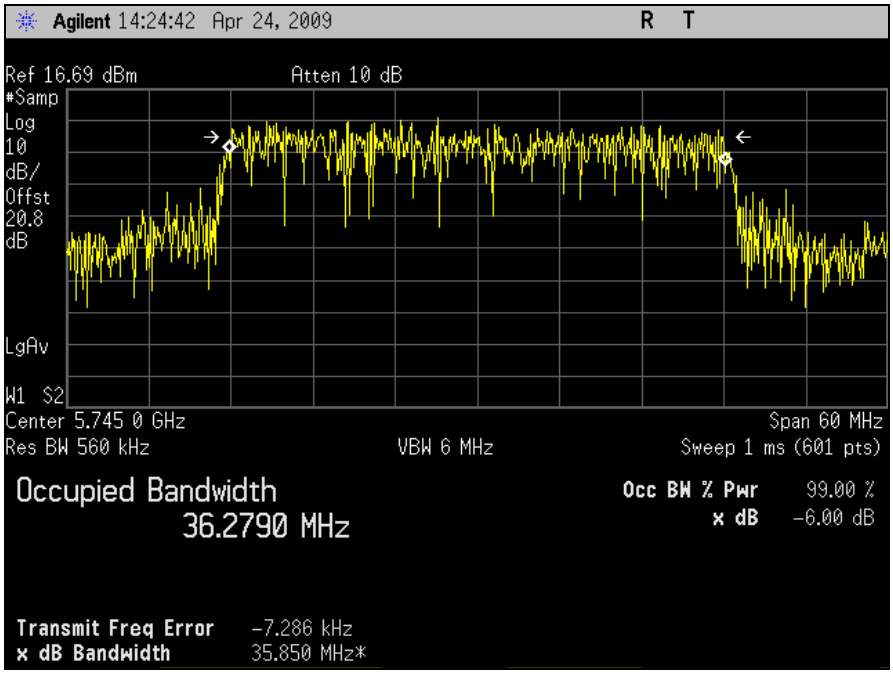


Plot 10. Occupied Bandwidth, Mid Channel, -6 dB, Port 1, HT20

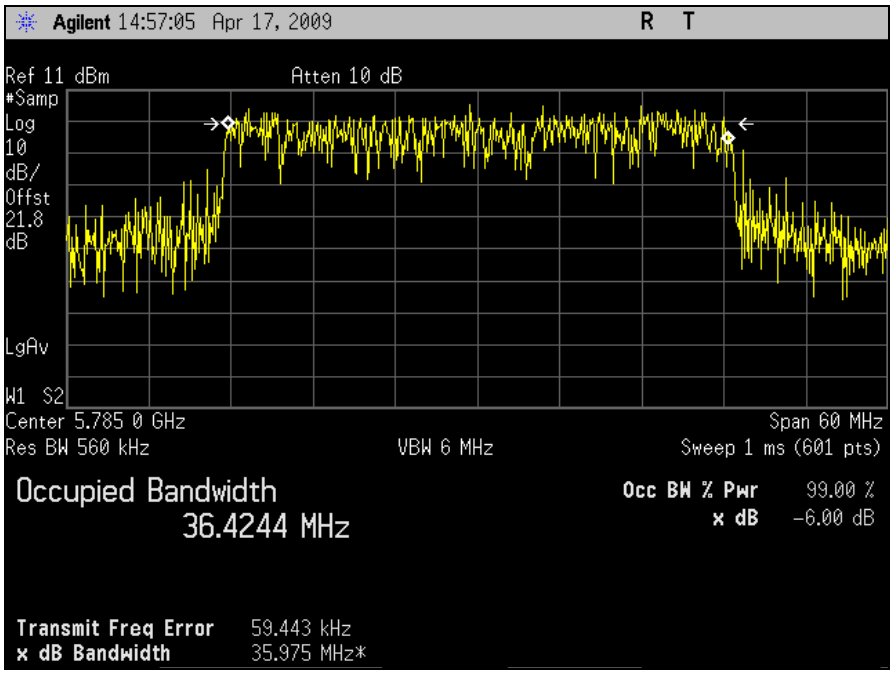


Plot 11. Occupied Bandwidth, High Channel, -6 dB, Port 1, HT20

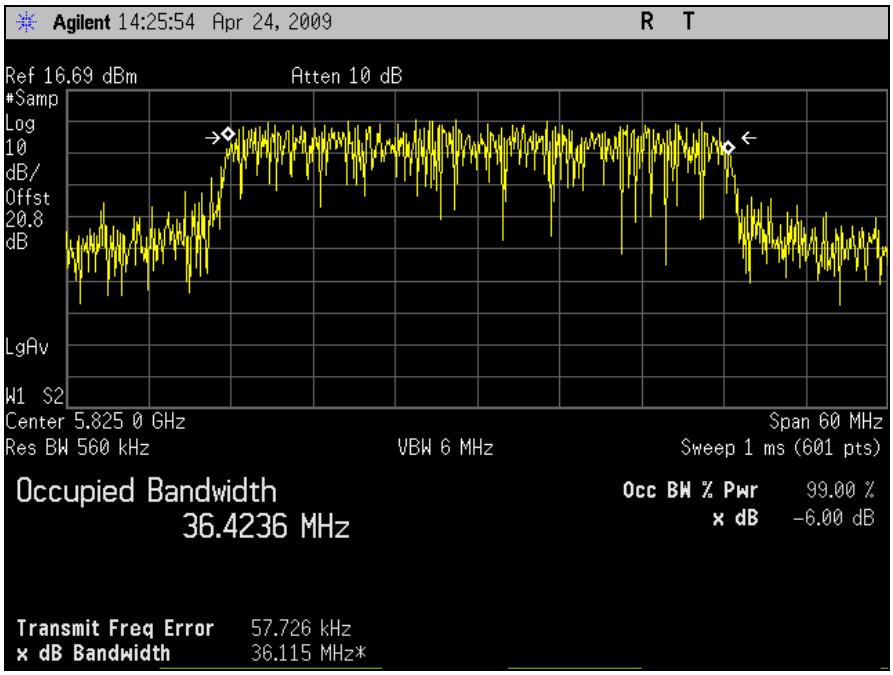
Occupied Bandwidth Test Results – Port 1, HT40



Plot 12. Occupied Bandwidth, Low Channel, -6 dB, Port 1, HT40

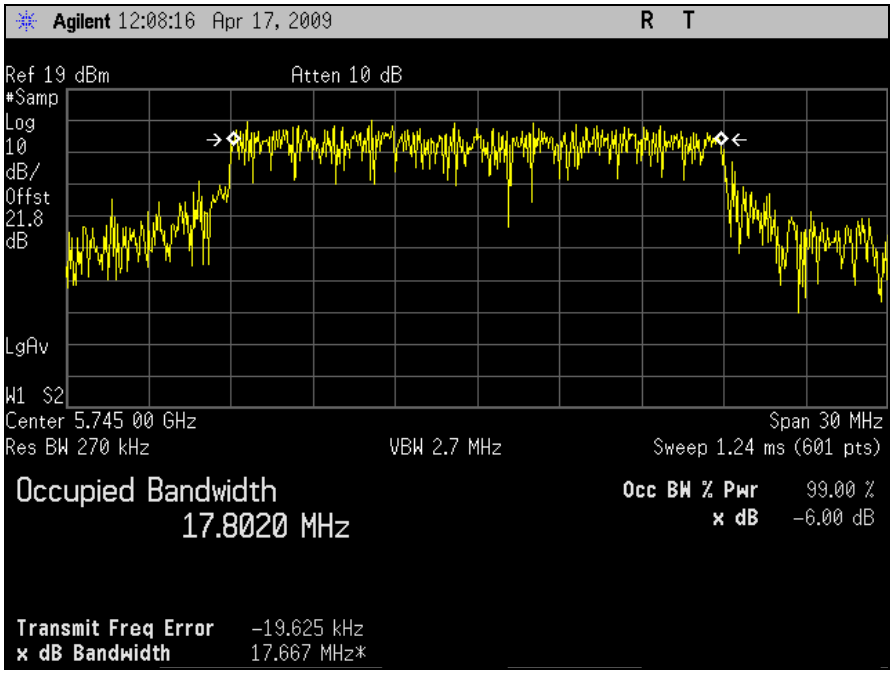


Plot 13. Occupied Bandwidth, Mid Channel, -6 dB, Port 1, HT40

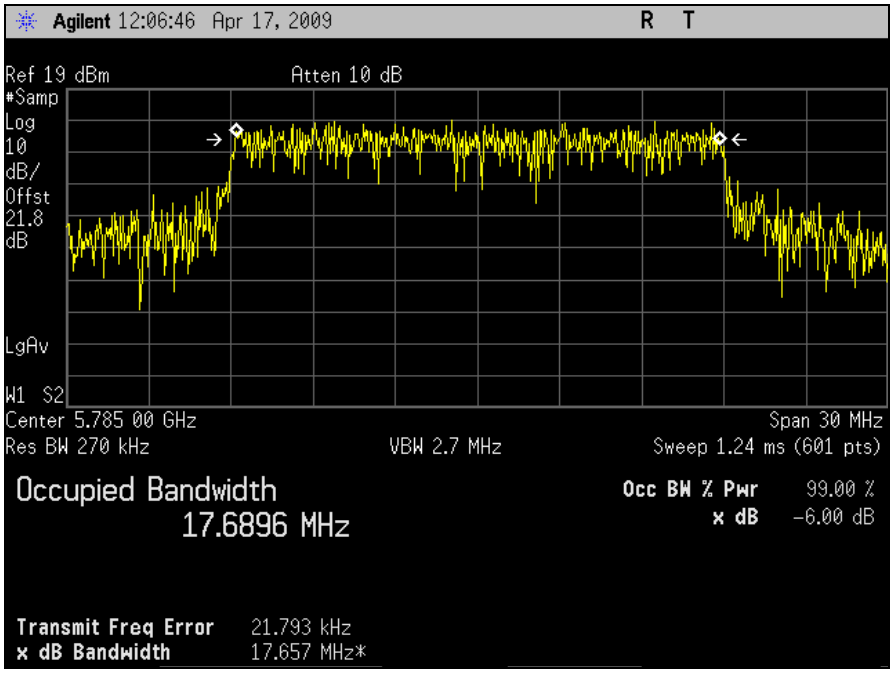


Plot 14. Occupied Bandwidth, High Channel, -6 dB, Port 1, HT40

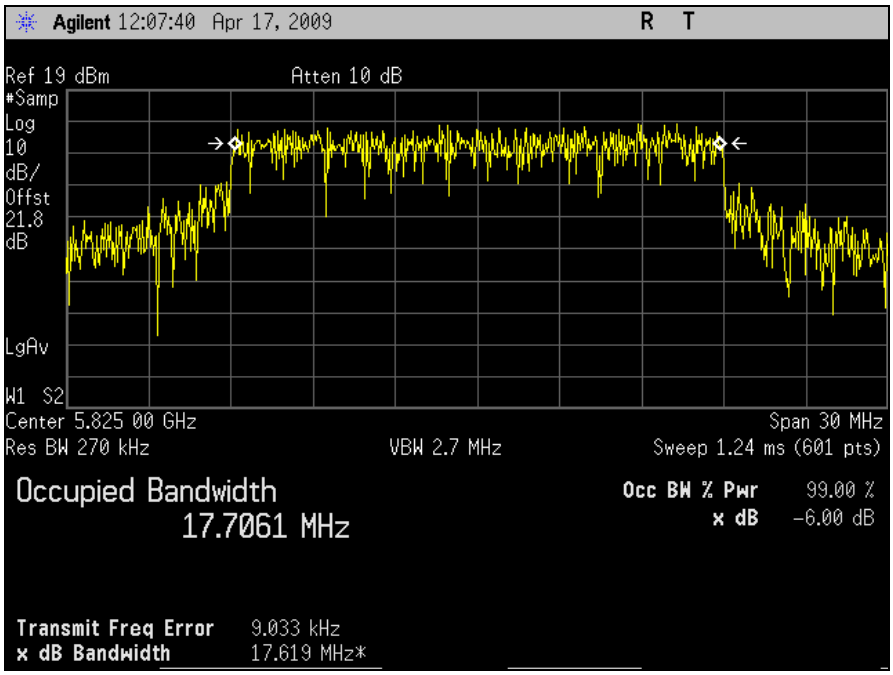
Occupied Bandwidth Test Results – Port 1, 802.11a Mode



Plot 15. Occupied Bandwidth, Low Channel, -6 dB, Port 1, 802.11a Mode

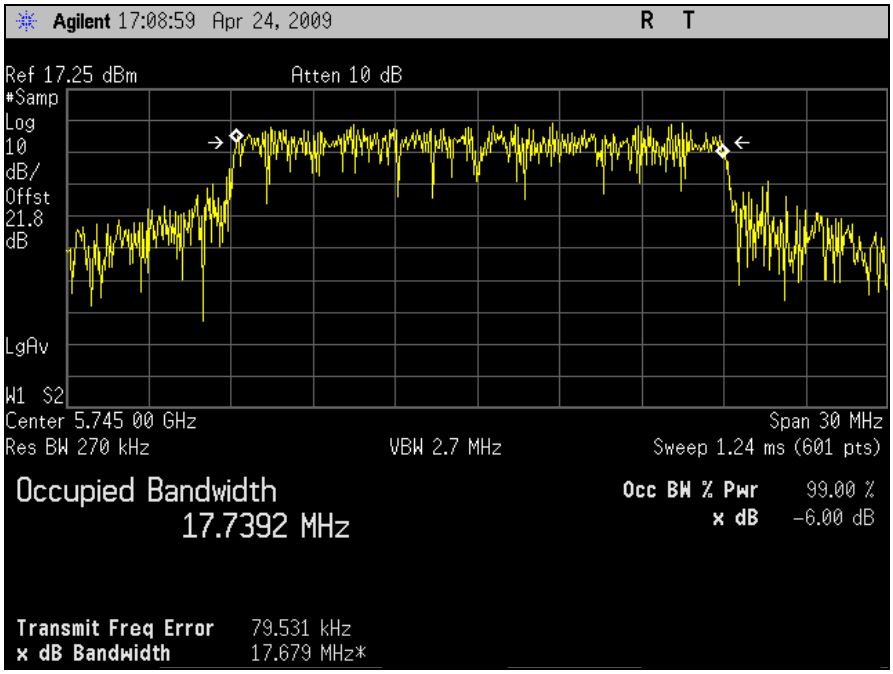


Plot 16. Occupied Bandwidth, Mid Channel, -6 dB, Port 1, 802.11a Mode

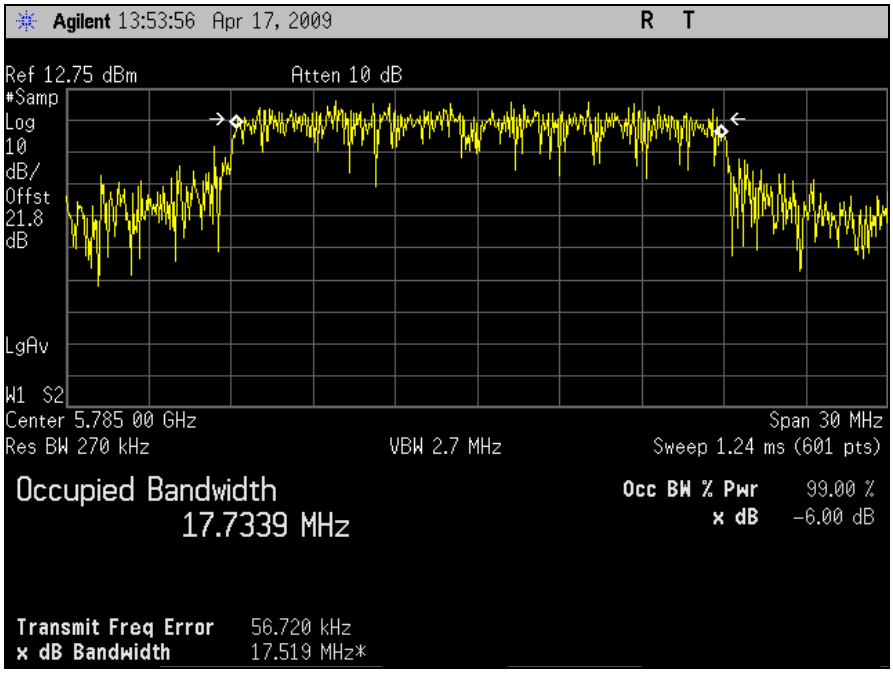


Plot 17. Occupied Bandwidth, High Channel, -6 dB, Port 1, 802.11a Mode

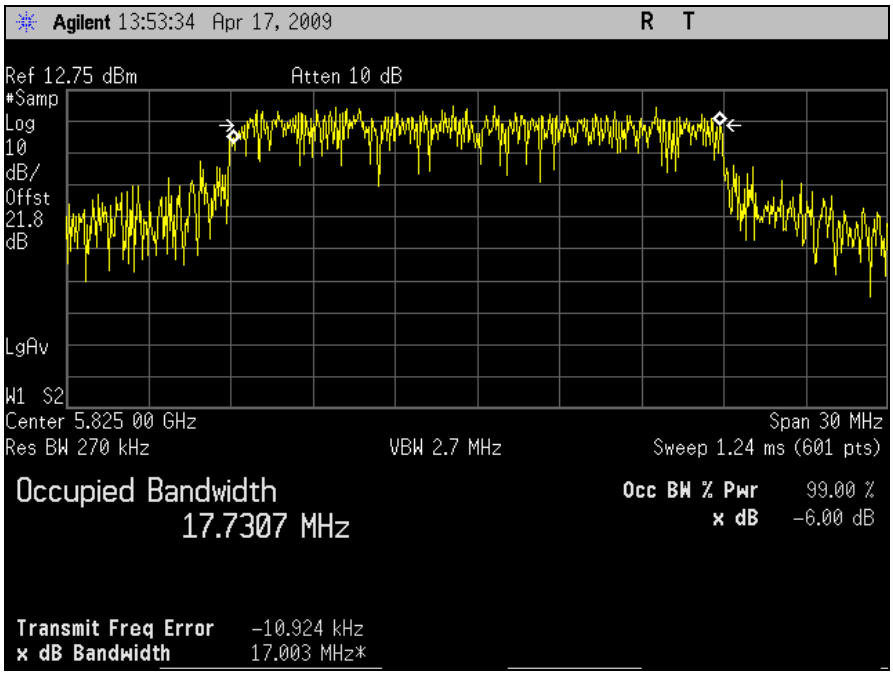
Occupied Bandwidth Test Results – Port 2, HT20



Plot 18. Occupied Bandwidth, Low Channel, -6 dB, Port 2, HT20

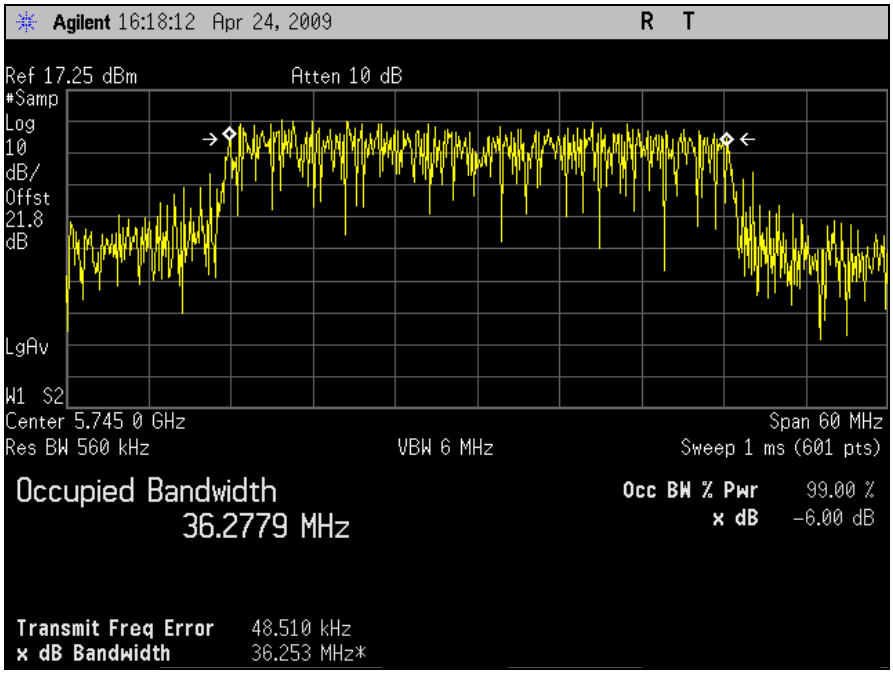


Plot 19. Occupied Bandwidth, Mid Channel, -6 dB, Port 2, HT20

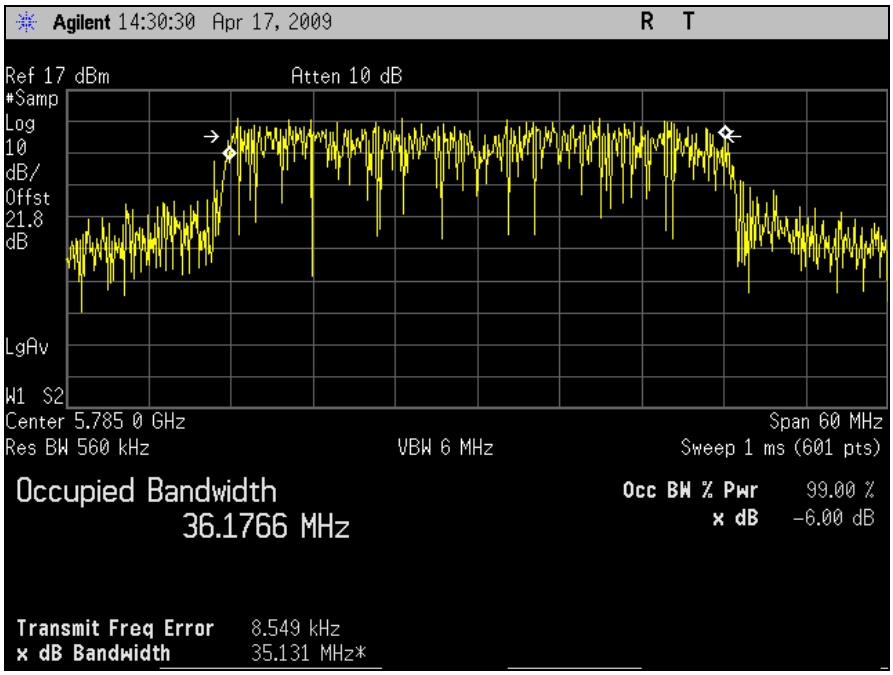


Plot 20. Occupied Bandwidth, High Channel, -6 dB, Port 2, HT20

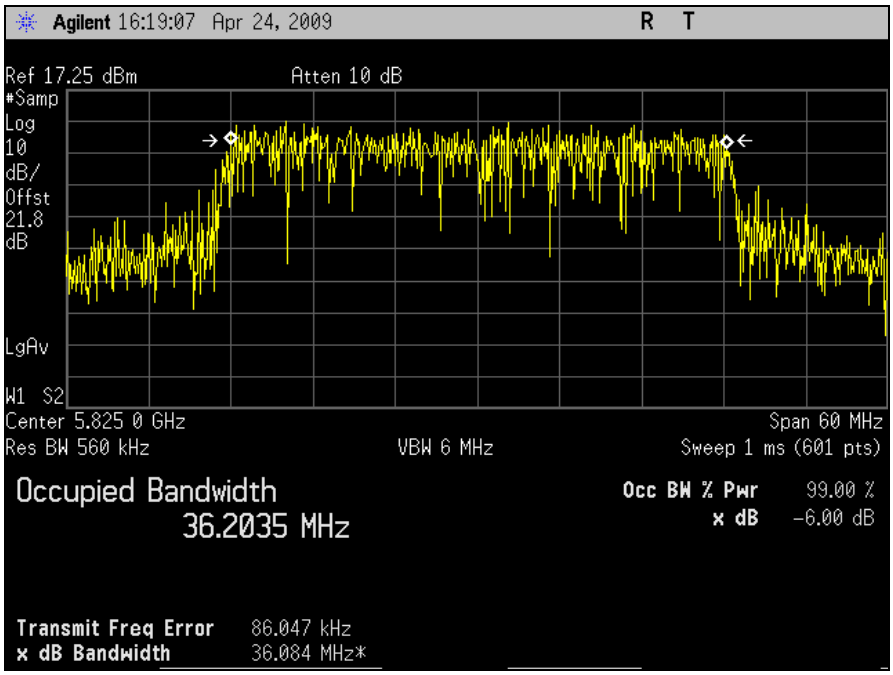
Occupied Bandwidth Test Results – Port 2, HT40



Plot 21. Occupied Bandwidth, Low Channel, -6 dB, Port 2, HT40



Plot 22. Occupied Bandwidth, Mid Channel, -6 dB, Port 2, HT40



Plot 23. Occupied Bandwidth, High Channel, -6 dB, Port 2, HT40

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output and RF Exposure

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

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

Table 24. Output Power Requirements from §15.247

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

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

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

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

Test Procedure: The transmitter was connected to a calibrated Spectrum Analyzer. The EUT was measured at the low, mid and high channels of each band at a data rate which gave the maximum power level.

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

Test Engineer(s): Anderson Soungpanya

Test Date(s): 04/27/09 & 06/30/09

Output Power Test Results

802.11a Mode Port 1		
Carrier Channel	**Frequency (MHz)**	**Measured Peak Output Power dBm**
Low	5745	26.54
Mid	5785	26.09
High	5825	26.79

Table 25. Output Power Test Results, 802.11a Mode, Port 1

HT20 Port 1		
Carrier Channel	**Frequency (MHz)**	**Measured Peak Output Power dBm**
Low	5745	26.06
Mid	5785	25.87
High	5825	26.03

Table 26. Output Power Test Results, HT20, Port 1

HT40 Port 1		
Carrier Channel	**Frequency (MHz)**	**Measured Peak Output Power dBm**
Low	5745	25.83
Mid	5785	25.72
High	5825	25.84

Table 27. Output Power Test Results, HT40, Port 1

HT20 Port 2		
Carrier Channel	**Frequency (MHz)**	**Measured Peak Output Power dBm**
Low	5745	25.89
Mid	5785	26.12
High	5825	25.88

Table 28. Output Power Test Results, HT20, Port 2

HT40 Port 2		
Carrier Channel	**Frequency (MHz)**	**Measured Peak Output Power dBm**
Low	5745	25.78
Mid	5785	25.74
High	5825	25.88

Table 29. Output Power Test Results, HT40, Port 2

802.11n mode					
Carrier Channel	**Frequency (MHz)**	**Port 1 (dBm)**	**Port 2 (dBm)**	**Total (dBm)**	**Total (W)**
Low	5745	26.06	25.89	28.98	0.791
Mid	5785	25.87	26.12	28.99	0.792
High	5825	26.03	25.88	28.96	0.788

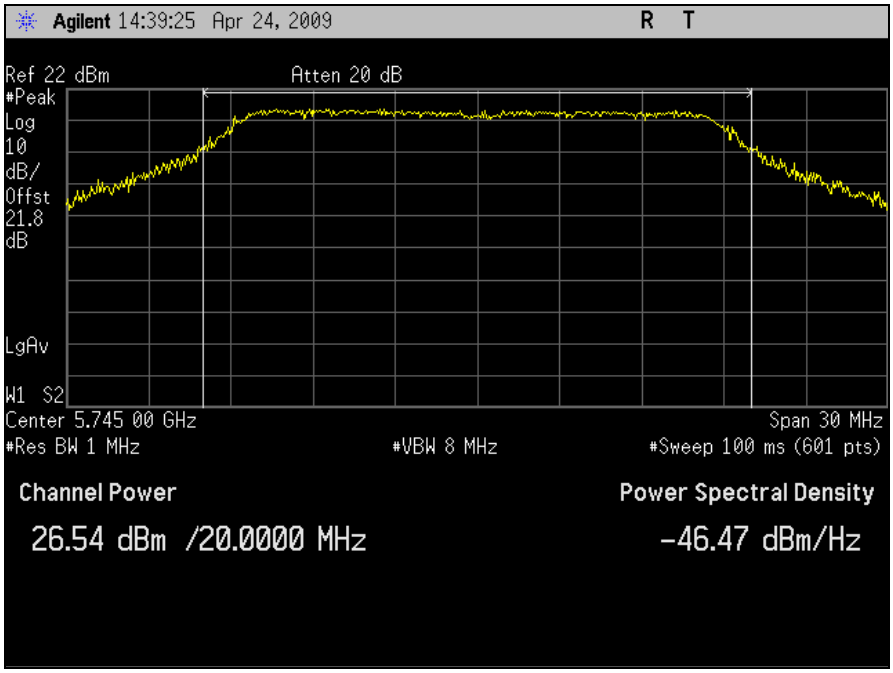
Table 30. RF Output Power Results – All Ports, 802.11n mode (20MHz)

802.11n mode					
Carrier Channel	**Frequency (MHz)**	**Port 1 (dBm)**	**Port 2 (dBm)**	**Total (dBm)**	**Total (W)**
Low	5745	25.83	25.78	28.81	0.761
Mid	5785	25.72	25.74	28.73	0.748
High	5825	25.84	25.88	28.86	0.770

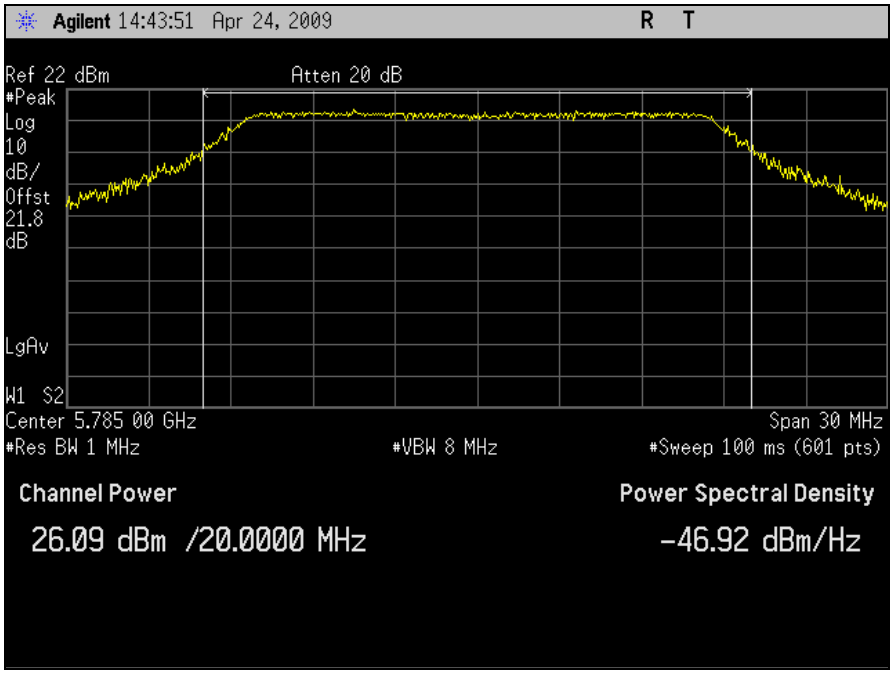
Table 31. RF Output Power Results – All Ports, 802.11n mode (40MHz)

Note: Total Output Power = Port 1 (10^(Output Power/10)/1000) + Port 2 (10^(Output Power/10)/1000)

Output Power Test Results – Port 1, 802.11a Mode



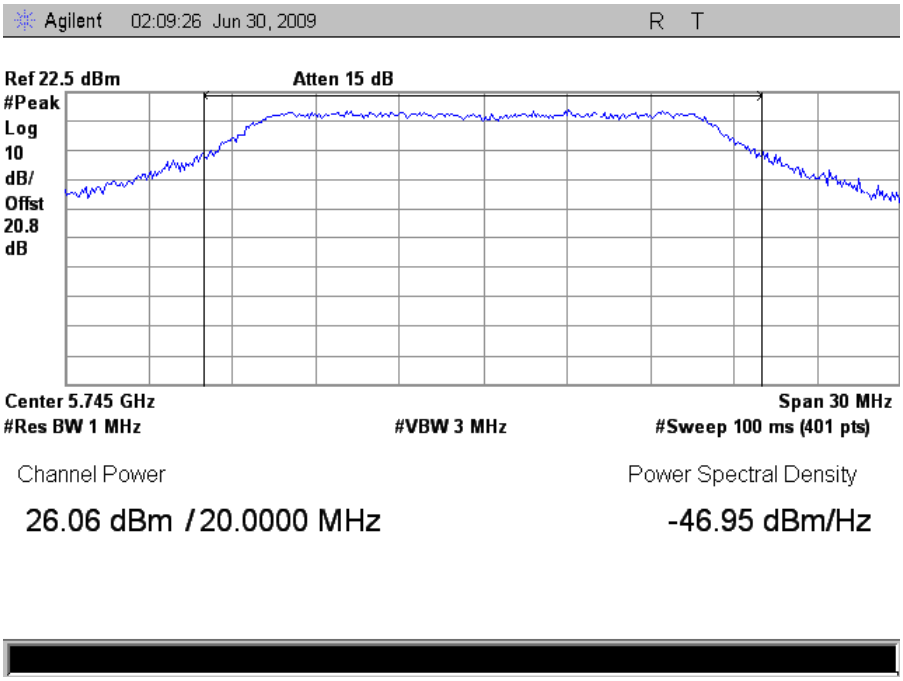
Plot 24. Output Power, Low Channel, Port 1, 802.11a Mode



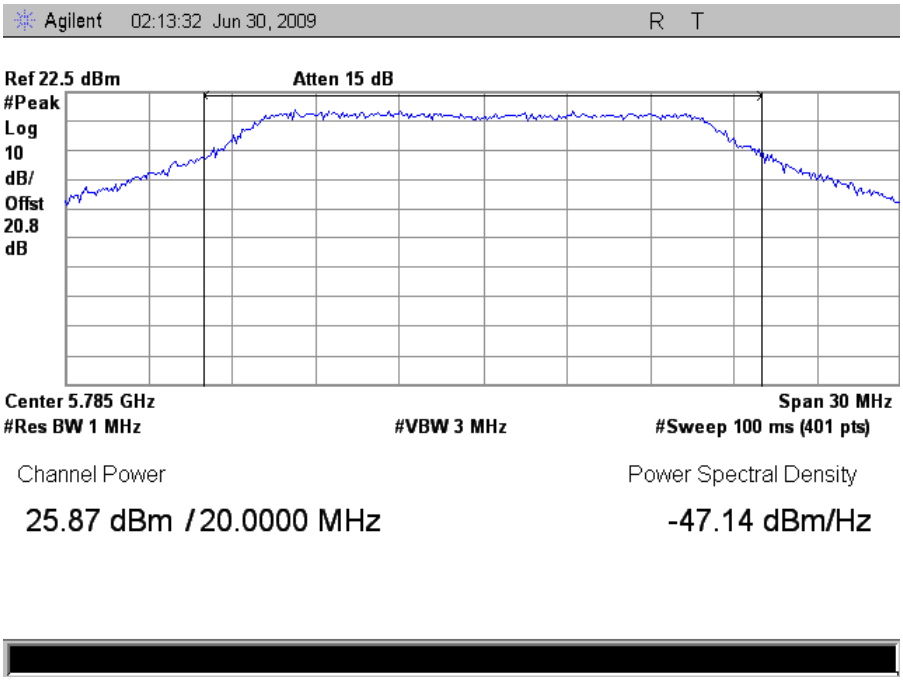
Plot 25. Output Power, Mid Channel, Port 1, 802.11a Mode

Plot 26. Output Power, High Channel, Port 1, 802.11a Mode

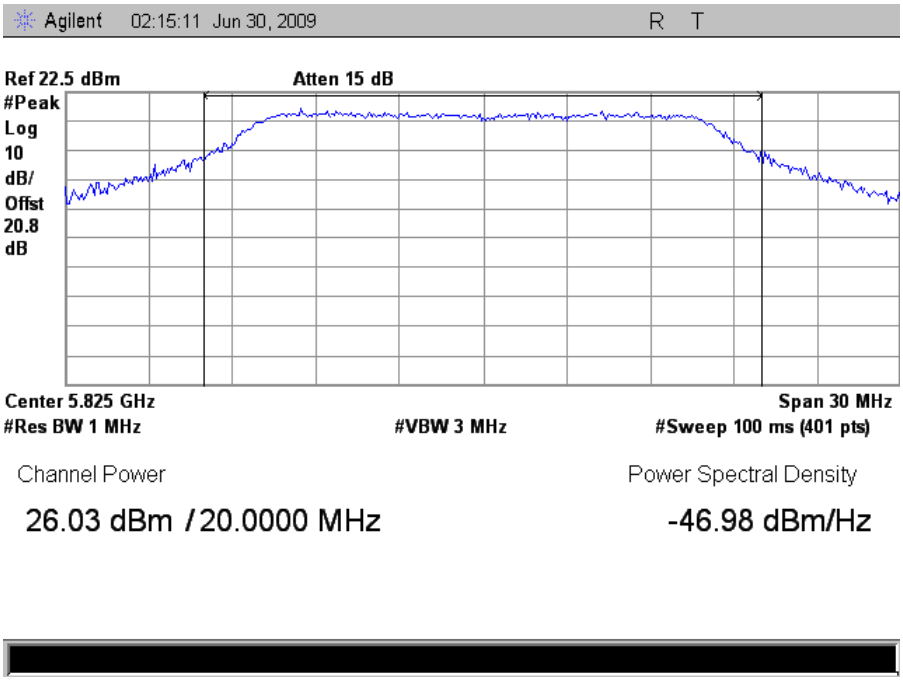
Output Power Test Results – Port 1, HT20



Plot 27. Output Power, Low Channel, Port 1, HT20

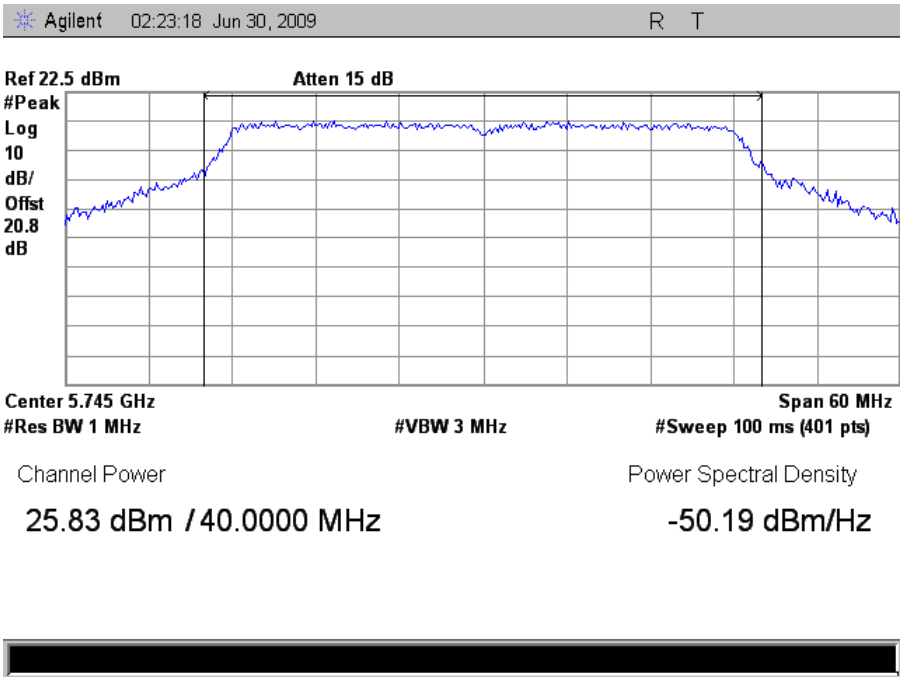


Plot 28. Output Power, Mid Channel, Port 1, HT20

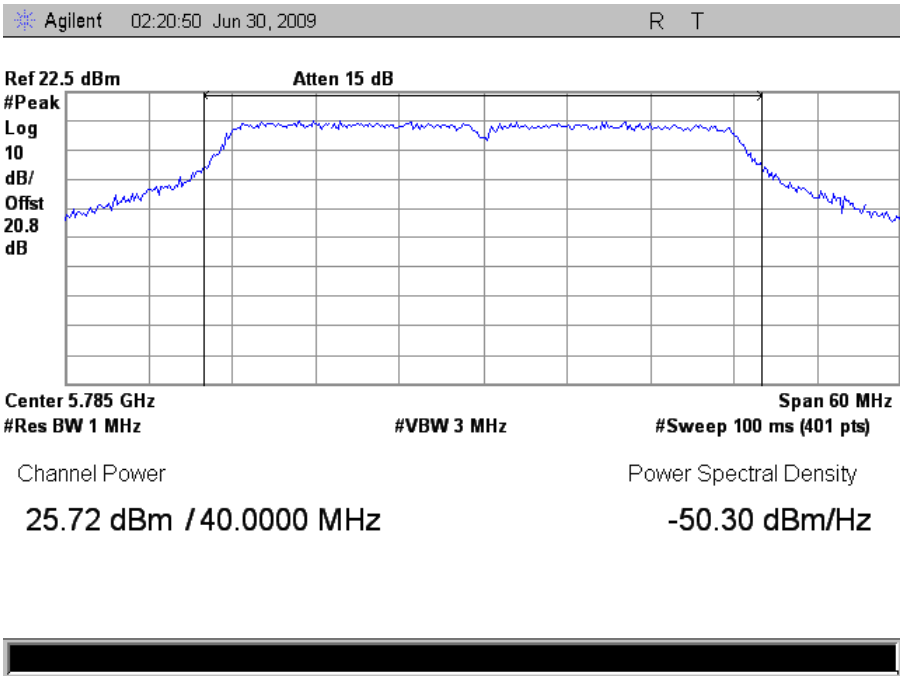


Plot 29. Output Power, High Channel, Port 1, HT20

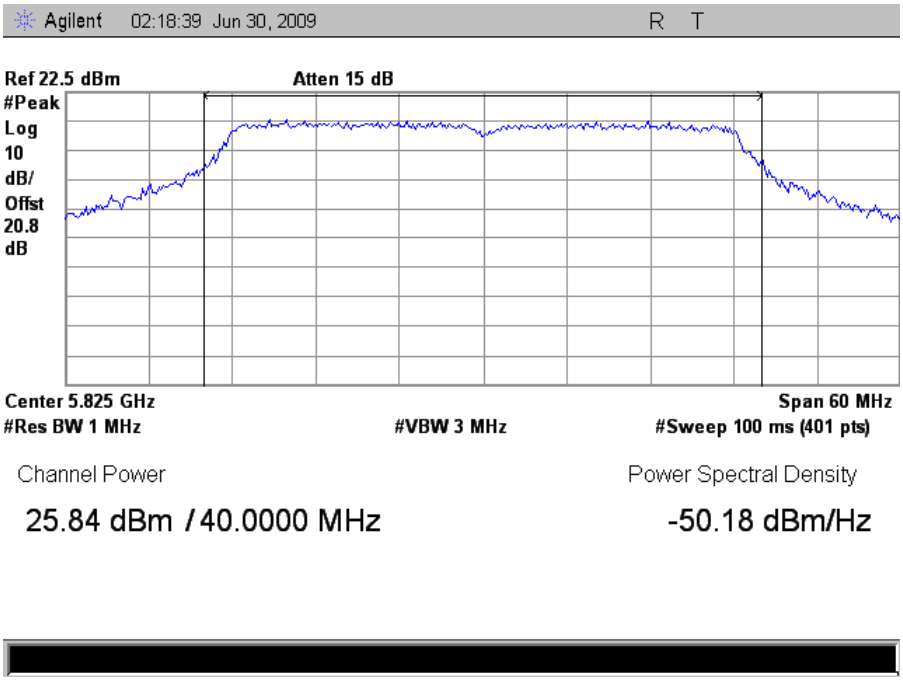
Output Power Test Results – Port 1, HT40



Plot 30. Output Power, Low Channel, Port 1, HT40

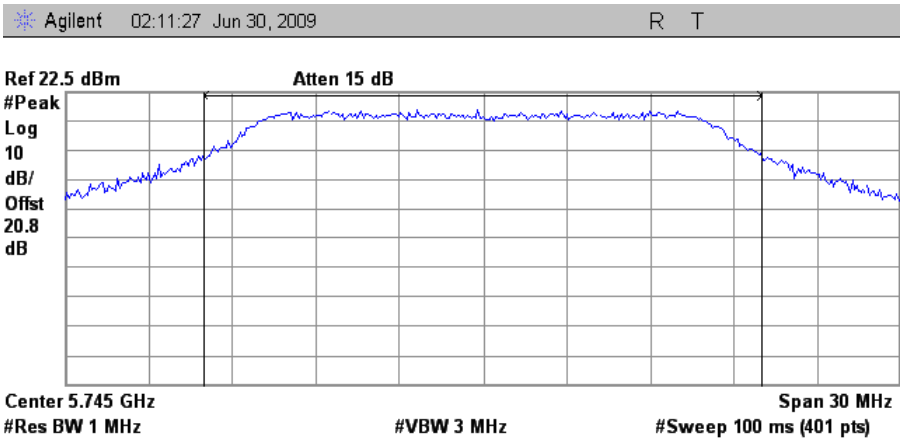


Plot 31. Output Power, Mid Channel, Port 1, HT40

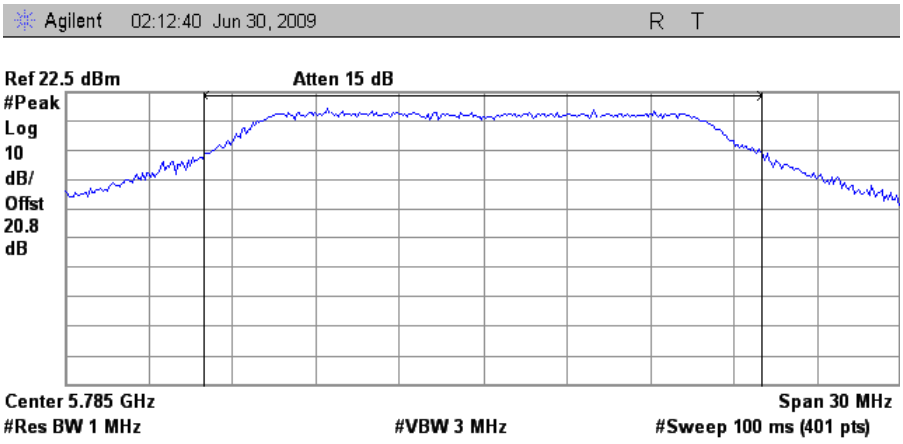


Plot 32. Output Power, High Channel, Port 1, HT40

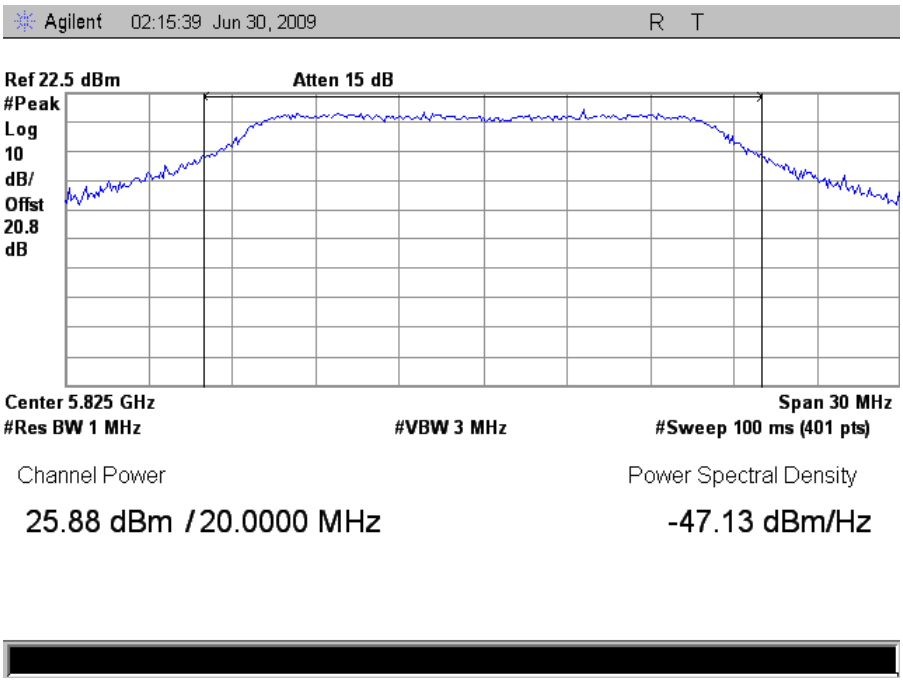
Output Power Test Results – Port 2, HT20



Plot 33. Output Power, Low Channel, Port 2, HT20

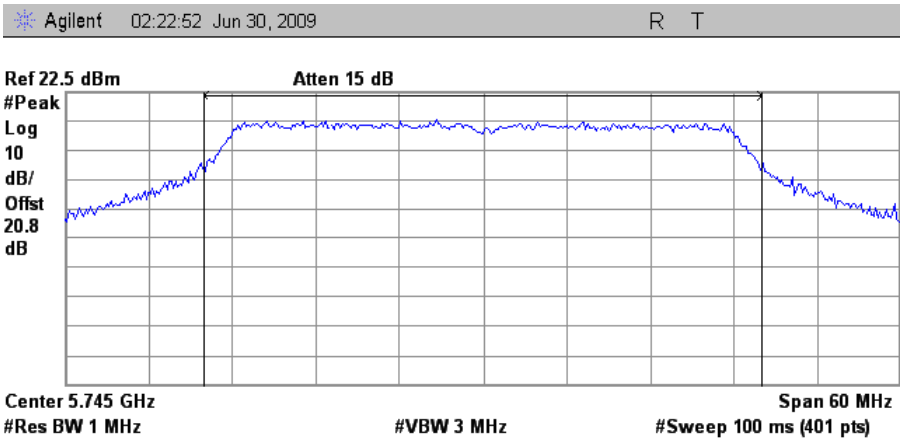


Plot 34. Output Power, Mid Channel, Port 2, HT20

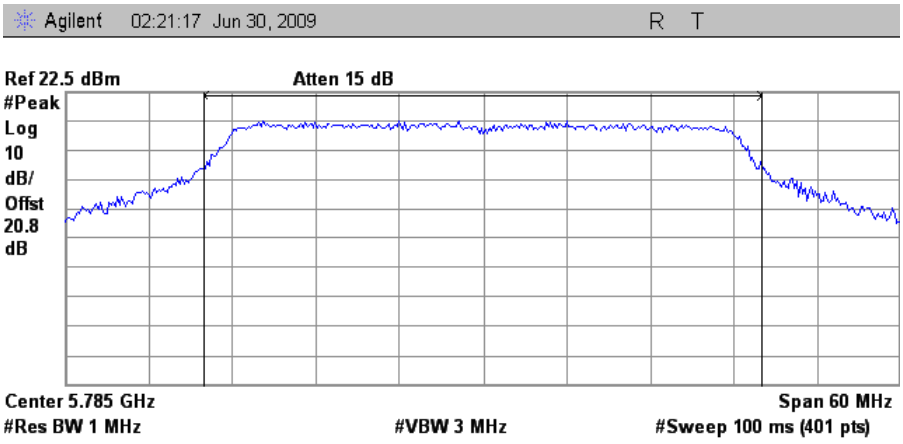


Plot 35. Output Power, High Channel, Port 2, HT20

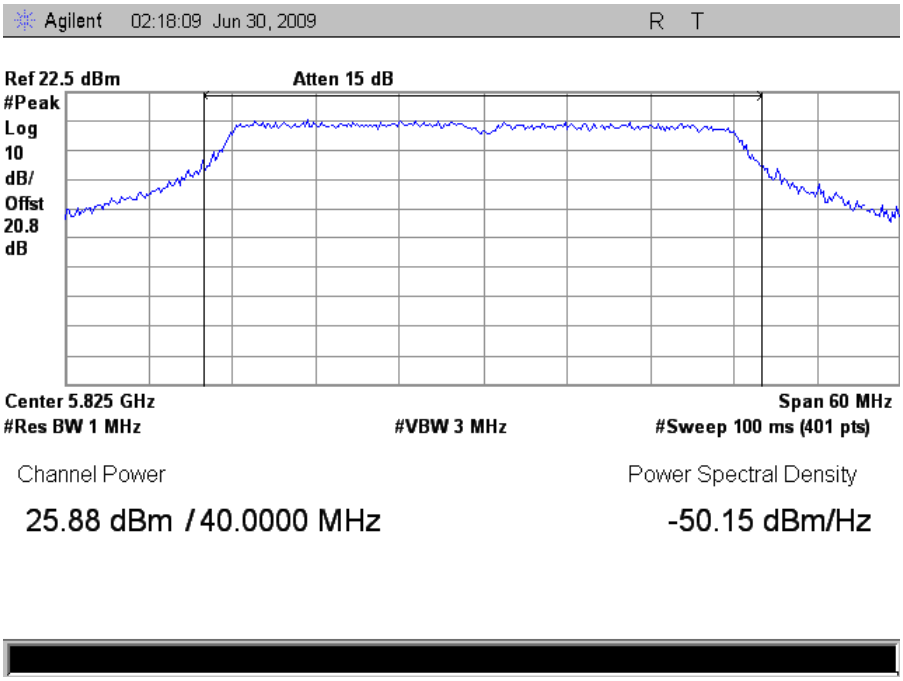
Output Power Test Results – Port 2, HT40



Plot 36. Output Power, Low Channel, Port 2, HT40



Plot 37. Output Power, Mid Channel, Port 2, HT40



Plot 38. Output Power, High Channel, Port 2, HT40

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output and RF Exposure

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

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

MPE Limit Calculation: EUT's operating frequencies @ 5745-5825 MHz; highest conducted power = 26.95 dBm (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

EUT maximum antenna gain = 7dBi Omni Antenna

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

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

where, S = Power Density (1 mW/cm^2)
P = Power Input to antenna (495.45mW)
G = Antenna Gain (5.01 numeric)
R = Distance (20cm)

$S = (495.45*5.01/ 4*3.14*20.0^2) = (2483.13 / 5024)$ = **0.4942 mW/cm^2**@ 20cm separation
$R = (495.45*5.01/ 4*3.14*1.0)^{1/2} = (2483.13/ 12.56)^{1/2}$ = **14.061 cm**

MPE Limit Calculation: EUT's operating frequencies @ 5745-5825 MHz; highest conducted power = 26.95 dBm (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

EUT maximum antenna gain = 20 dBi Sector Antenna

where, S = Power Density (1 mW/cm^2)
P = Power Input to antenna (495.45mW)
G = Antenna Gain (100.00 numeric)
R = Distance (20cm)

$S = (495.45*100/ 4*3.14*20.0^2) = (49545.02/ 5024)$ = **9.862 mW/cm^2**@ 20cm separation
$R = (495.45*100/ 4*3.14*1.0)^{1/2} = (49545.02/ 12.56)^{1/2}$ = **62.806 cm**

MPE Limit Calculation: EUT's operating frequencies @ 5745-5825 MHz; highest conducted power = 26.95 dBm (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

EUT maximum antenna gain = 24dBi Panel Antenna

where, S = Power Density (1 mW/cm^2)
P = Power Input to antenna (495.45mW)
G = Antenna Gain (251.19 numeric)
R = Distance (20cm)

S = (495.45*251.19/ 4*3.14*20.0^2)= (124451.50/ 5024) = **24.771 mW/cm^2**@ 20cm separation
R = (495.45*251.19/ 4*3.14*1.0)$^{1/2}$ = (124451.50/ 12.56) $^{1/2}$ = **99.542cm**

MPE Limit Calculation: EUT's operating frequencies @ 5745-5825 MHz; highest conducted power = 26.95 dBm (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

EUT maximum antenna gain = 30 dBi Grid Antenna

where, S = Power Density (1 mW/cm^2)
P = Power Input to antenna (495.45mW)
G = Antenna Gain (1000.00 numeric)
R = Distance (20cm)

S = (495.45*1000/ 4*3.14*20.0^2)= (495450.20/ 5024) = **98.617 mW/cm^2**@ 20cm separation
R = (495.45*1000/ 4*3.14*1.0)$^{1/2}$ = (495450.20/12.56) $^{1/2}$ = **198.612 cm**

MPE Limit Calculation: EUT's operating frequencies @ 5745-5825 MHz; highest conducted power = 26.95 dBm (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

EUT maximum antenna gain = 30 dBi Dish Antenna

where, S = Power Density (1 mW/cm^2)
P = Power Input to antenna (495.45mW)
G = Antenna Gain (1000.00 numeric)
R = Distance (20cm)

S = (495.45*1000/ 4*3.14*20.0^2)= (495450.20/ 5024) = **98.617 mW/cm^2**@ 20cm separation
R = (495.45*1000/ 4*3.14*1.0)$^{1/2}$ = (495450.20/12.56) $^{1/2}$ = **198.612 cm**

MIMO Mode:

MPE Limit Calculation: EUT's operating frequencies @ 5745-5825 MHz; highest conducted power = 28.99dBm (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

EUT maximum antenna gain = 7dBi Omni Antenna

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

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

where, S = Power Density (1 mW/cm^2)
P = Power Input to antenna (792.5mW)
G = Antenna Gain (5.01 numeric)
R = Distance (20cm)

S = (792.5*5.01/ 4*3.14*20.0^2)= (3971.915 / 5024) = **0.790 mW/cm^2**@ 20cm separation
R = (792.5*5.01/ 4*3.14*1.0)$^{1/2}$ = (3971.915 /12.56) $^{1/2}$ = **17.78 cm**

EUT maximum antenna gain = 30dBi Dish Antenna

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

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

where, S = Power Density (1 mW/cm^2)
P = Power Input to antenna (792.5mW)
G = Antenna Gain (1000 numeric)
R = Distance (20cm)

S = (792.5*1000/ 4*3.14*20.0^2)= (792501.3 / 5024) = **157.74 mW/cm^2**@ 20cm separation
R = (792.5*1000/ 4*3.14*1.0)$^{1/2}$ = (792501.3 /12.56) $^{1/2}$ = **251.19 cm**

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Harmonic Emissions – Radiated and Conducted

Test Requirements: **§15.247(d)**; **§15.205, §15.209:** Emissions outside the frequency band.

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

§15.205(a): Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090–0.110----------	16.42–16.423	399.9–410	4.5–5.15
[1] 0.495–0.505----------	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905----------	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128----------	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775----------	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775----------	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218----------	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825----------	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225----------	123–138	2200–2300	14.47–14.5
8.291–8.294----------	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366----------	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675----------	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475----------	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293----------	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025----------	240–285	3345.8–3358 36.	43–36.5
12.57675–12.57725----------	322–335.4	3600–4400	([2])

Table 32. Restricted Bands of Operation

[1] Until February 1, 1999, this restricted band shall be 0.490 – 0.510 MHz.
[2] Above 38.6

Test Procedure:

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

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

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

EUT Field Strength Final Amplitude = Raw Amplitude – Preamp gain + Antenna Factor + Cable Loss – Distance Correction Factor (1 meter)

For MIMO mode each port was tested one at a time for each polarity and worst case emissions were reported.

Test Results:

The EUT was found compliant with the Radiated Emission limits of **§15.209(a)** for Intentional Radiators. See following pages for detailed test results.

Note: for the MIMO mode both antenna ports were connected to the cross polarized antenna inputs although no test setup photos were given.

Test Engineer(s):

Anderson Soungpanya

Test Date(s):

004/27/09

Electromagnetic Compatibility Criteria for Intentional Radiators

Harmonic Emissions Requirements – Radiated 7dBi Omni Antenna, HT20, MIMO Mode

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 1m (Peak) / (Avg.)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Distance Correction Factor (1m to 3m) (dB)	Limit Detector Peak / Avg.	Limit @ 3 m (dBuV/m)	Delta (dB)
11.49	V	59.34	34.86	39.79	7.95	62.67	-9.54	Peak	74	-11.33
11.49	V	40.32	34.86	39.79	7.95	43.65	-9.54	Avg.	54	-10.35
17.235	V	48.26	34.01	42.82	12.27	59.80	-9.54	Peak	74	-14.20
17.235	V	31.92	34.01	42.82	12.27	43.46	-9.54	Avg.	54	-10.54

Table 33. Radiated Harmonic Emissions Test Results, 7 dBi Omni Antenna, HT20, Low Channel, MIMO Mode

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 1m (Peak) / (Avg.)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Distance Correction Factor (1m to 3m) (dB)	Limit Detector Peak / Avg.	Limit @ 3 m (dBuV/m)	Delta (dB)
11.57	V	62.54	34.91	39.88	7.86	65.83	-9.54	Peak	74	-8.17
11.57	V	46.36	34.91	39.88	7.86	49.65	-9.54	Avg.	54	-4.35
17.355	V	50.23	33.93	43.15	12.97	62.88	-9.54	Peak	74	-11.12
17.355	V	36.09	33.93	43.15	12.97	48.74	-9.54	Avg.	54	-5.26

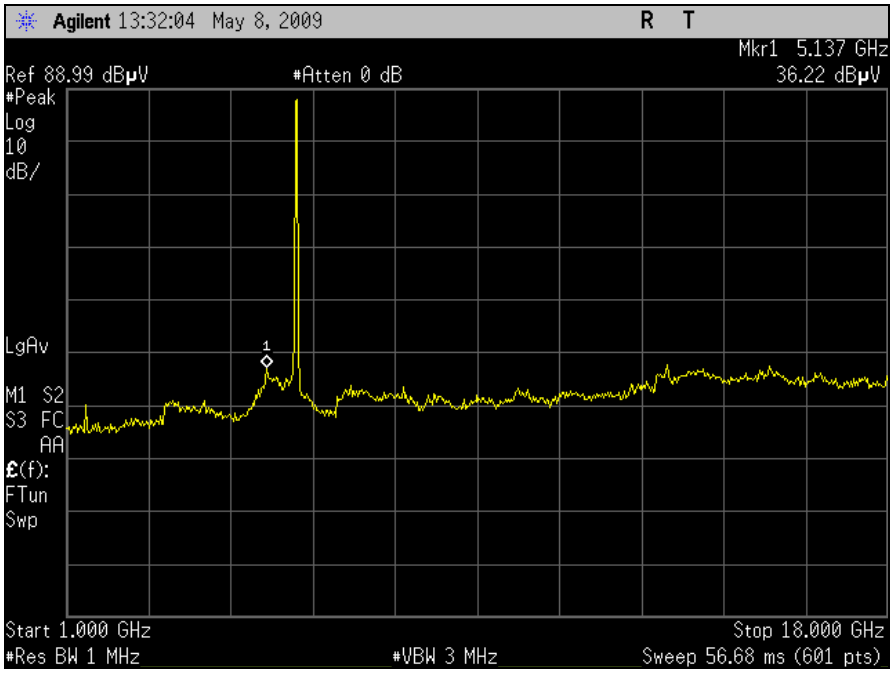
Table 34. Radiated Harmonic Emissions Test Results, 7 dBi Omni Antenna, HT20, Mid Channel, MIMO Mode

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 1m (Peak) / (Avg.)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Distance Correction Factor (1m to 3m) (dB)	Limit Detector Peak / Avg.	Limit @ 3 m (dBuV/m)	Delta (dB)
11.65	V	54.3	34.96	39.94	7.62	57.37	-9.54	Peak	74	-16.63
11.65	V	34.61	34.96	39.94	7.62	37.68	-9.54	Avg.	54	-16.32
17.475	V	45.81	33.89	43.59	13.78	59.74	-9.54	Peak	74	-14.26
17.475	V	30.74	33.89	43.59	13.78	44.67	-9.54	Avg.	54	-9.33

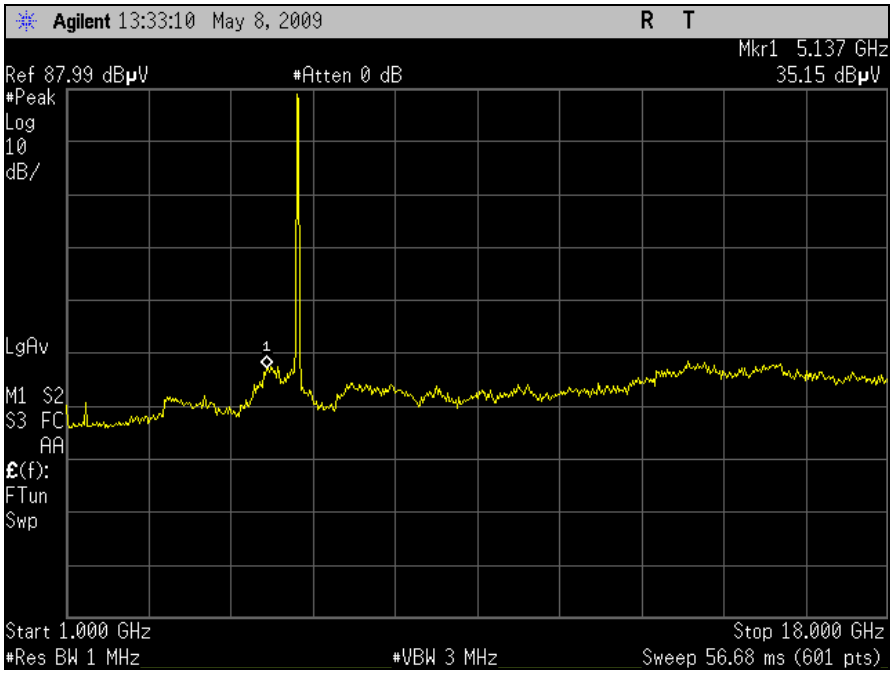
Table 35. Radiated Harmonic Emissions Test Results, 7 dBi Omni Antenna, HT20, High Channel, MIMO Mode

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

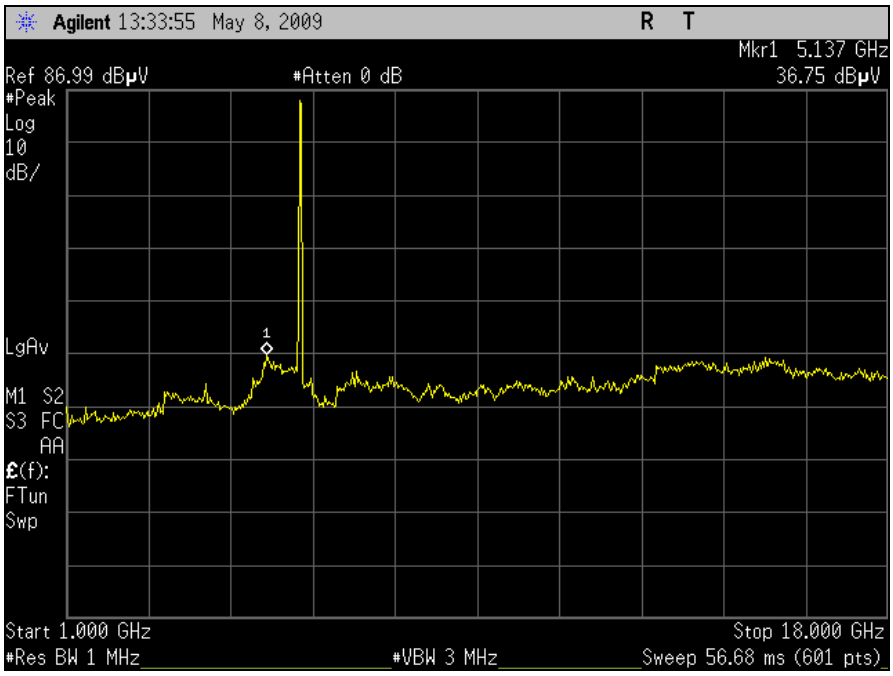
§ 15.247(d) Radiated Spurious Emissions – 7dBi Omni Antenna, HT20, MIMO Mode



Plot 39. Radiated Spurious Emissions, Low Channel, 7 dBi Omni Antenna, HT20, MIMO Mode



Plot 40. Radiated Spurious Emissions, Mid Channel, 7 dBi Omni Antenna, HT20, MIMO Mode



Plot 41. Radiated Spurious Emissions, High Channel, 7 dBi Omni Antenna, HT20, MIMO Mode

Harmonic Emissions Requirements – Radiated 7 dBi Omni Antenna, HT40, MIMO Mode

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 1m (Peak) / (Avg.)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Distance Correction Factor (1m to 3m) (dB)	Limit Detector Peak / Avg.	Limit @ 3 m (dBuV/m)	Delta (dB)
11.49	V	42.71	34.86	39.79	7.95	46.04	-9.54	Peak	74	-27.96
11.49	V	29.76	34.86	39.79	7.95	33.09	-9.54	Avg.	54	-20.91
17.235	V	44.55	34.01	42.82	12.27	56.09	-9.54	Peak	74	-17.91
17.235	V	30.55	34.01	42.82	12.27	42.09	-9.54	Avg.	54	-11.91

Table 36. Radiated Harmonic Emissions, Test Results, Low Channel, 7 dBi Omni Antenna, HT40, MIMO Mode

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 1m (Peak) / (Avg.)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Distance Correction Factor (1m to 3m) (dB)	Limit Detector Peak / Avg.	Limit @ 3 m (dBuV/m)	Delta (dB)
11.57	V	43.22	34.91	39.88	7.86	46.51	-9.54	Peak	74	-27.49
11.57	V	30.09	34.91	39.88	7.86	33.38	-9.54	Avg.	54	-20.62
17.355	V	45.52	33.93	43.15	12.97	58.17	-9.54	Peak	74	-15.83
17.355	V	31.29	33.93	43.15	12.97	43.94	-9.54	Avg.	54	-10.06

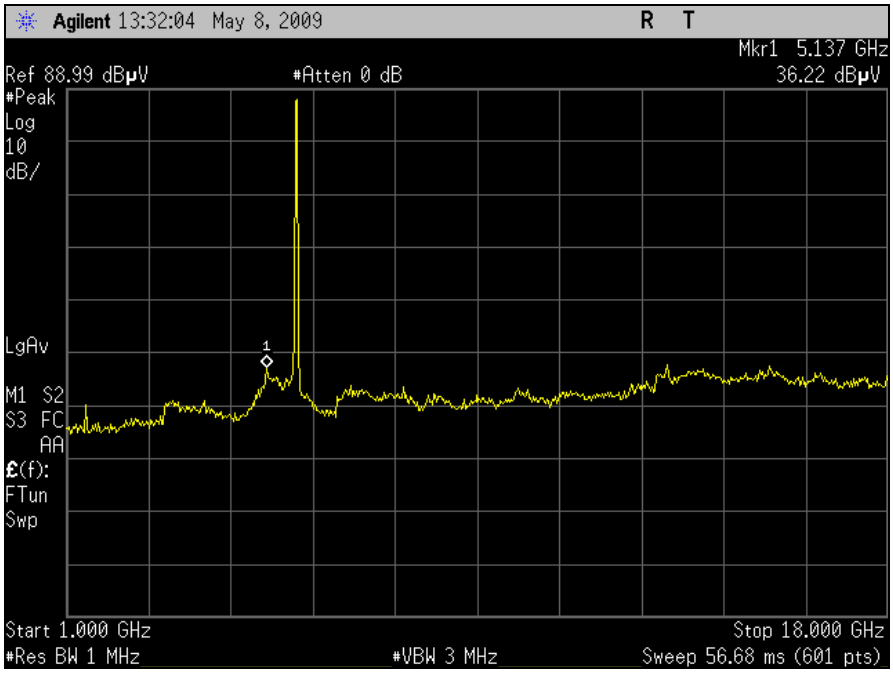
Table 37. Radiated Harmonic Emissions, Test Results, Mid Channel, 7 dBi Omni Antenna, HT40, MIMO Mode

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 1m (Peak) / (Avg.)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Distance Correction Factor (1m to 3m) (dB)	Limit Detector Peak / Avg.	Limit @ 3 m (dBuV/m)	Delta (dB)
11.65	V	47.14	34.96	39.94	7.62	50.21	-9.54	Peak	74	-23.79
11.65	V	31.94	34.96	39.94	7.62	35.01	-9.54	Avg.	54	-18.99
17.475	V	44.71	33.89	43.59	13.78	58.64	-9.54	Peak	74	-15.36
17.475	V	31.66	33.89	43.59	13.78	45.59	-9.54	Avg.	54	-8.41

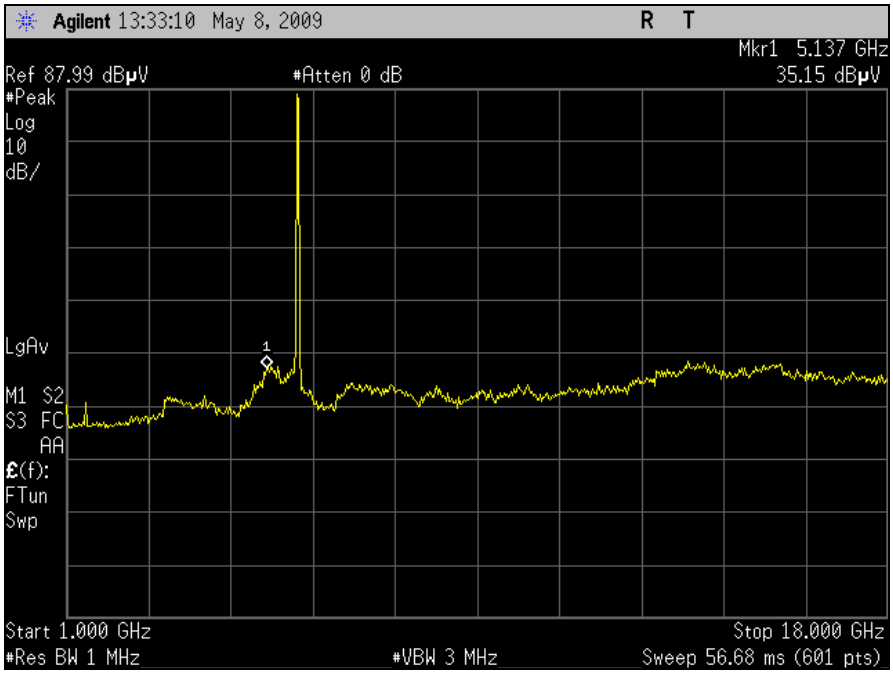
Table 38. Radiated Harmonic Emissions, Test Results, High Channel, 7 dBi Omni Antenna, HT40, MIMO Mode

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

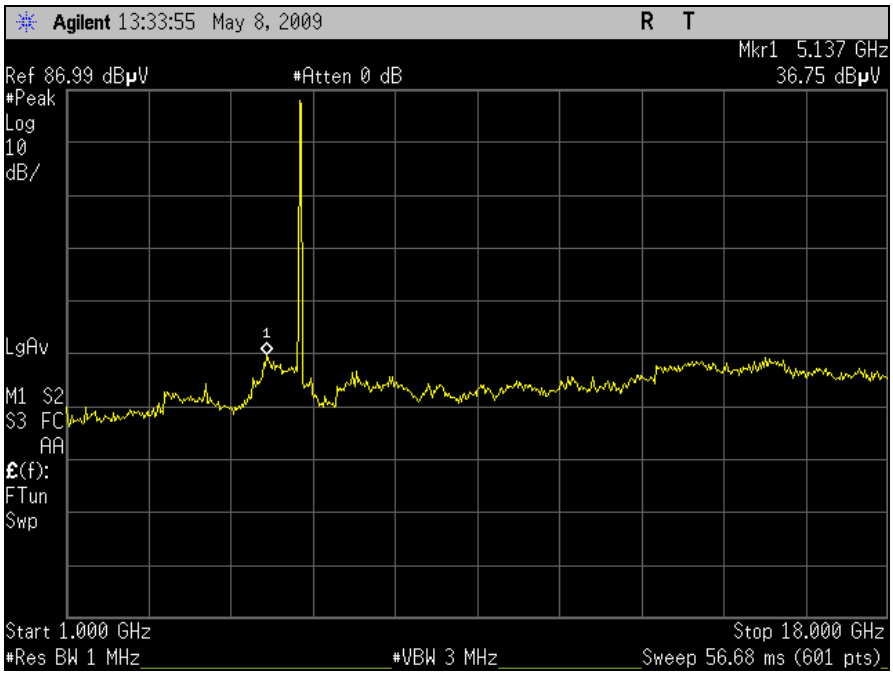
§ 15.247(d) Radiated Spurious Emissions – 7dBi Omni Antenna, HT40, MIMO Mode



Plot 42. Radiated Spurious Emissions, Low Channel, 7 dBi Omni Antenna, HT40, MIMO Mode



Plot 43. Radiated Spurious Emissions, High Channel, 7 dBi Omni Antenna, HT40, MIMO Mode



Plot 44. Radiated Spurious Emissions, High Channel, 7 dBi Omni Antenna, HT40, MIMO Mode

Harmonic Emissions Requirements – Radiated 7 dBi Omni Antenna, 802.11a Mode, Port 1

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 1m (Peak) / (Avg.)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Distance Correction Factor (1m to 3m) (dB)	Limit Detector Peak / Avg.	Limit @ 3 m (dBuV/m)	Delta (dB)
11.49	V	46.93	34.86	39.79	7.95	50.26	-9.54	Peak	74	-23.74
11.49	V	35.34	34.86	39.79	7.95	38.67	-9.54	Avg.	54	-15.33
17.235	V	45.44	34.01	42.82	12.27	56.98	-9.54	Peak	74	-17.02
17.235	V	32.25	34.01	42.82	12.27	43.79	-9.54	Avg.	54	-10.21

Table 39. Radiated Harmonic Emissions, Test Results, Low Channel, 7 dBi Omni Antenna, 802.11a Mode, Port 1

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 1m (Peak) / (Avg.)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Distance Correction Factor (1m to 3m) (dB)	Limit Detector Peak / Avg.	Limit @ 3 m (dBuV/m)	Delta (dB)
11.57	V	48.46	34.91	39.88	7.86	51.75	-9.54	Peak	74	-22.25
11.57	V	40.27	34.91	39.88	7.86	43.56	-9.54	Avg.	54	-10.44
17.355	V	44.47	33.93	43.15	12.97	57.12	-9.54	Peak	74	-16.88
17.355	V	31.06	33.93	43.15	12.97	43.71	-9.54	Avg.	54	-10.29

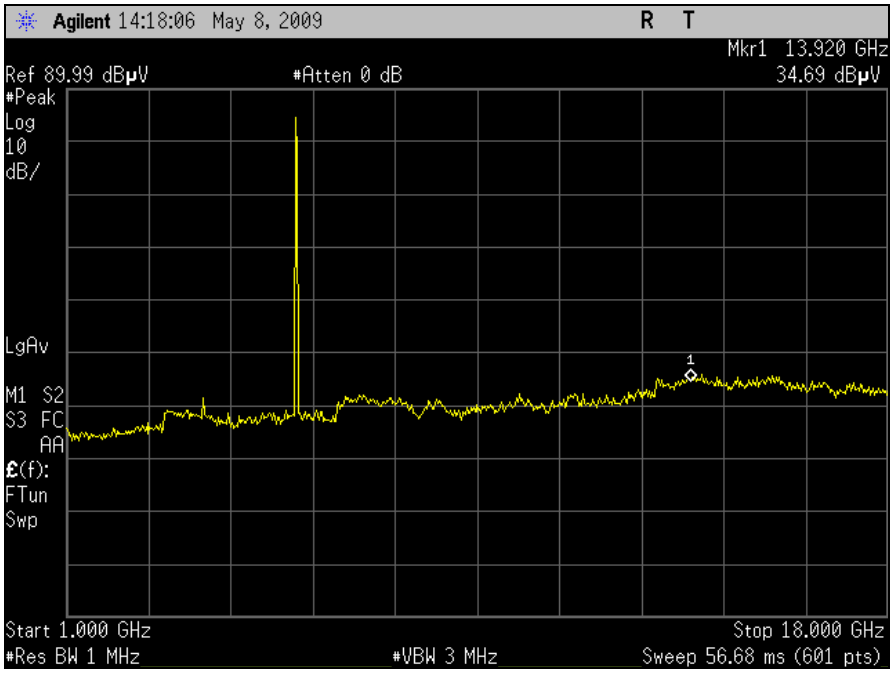
Table 40. Radiated Harmonic Emissions, Test Results, Mid Channel, 7 dBi Omni Antenna, 802.11a Mode, Port 1

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 1m (Peak) / (Avg.)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Distance Correction Factor (1m to 3m) (dB)	Limit Detector Peak / Avg.	Limit @ 3 m (dBuV/m)	Delta (dB)
11.65	V	50.91	34.96	39.94	7.62	53.98	-9.54	Peak	74	-20.02
11.65	V	42.31	34.96	39.94	7.62	45.38	-9.54	Avg.	54	-8.62
17.475	V	45.17	33.89	43.59	13.78	59.10	-9.54	Peak	74	-14.90
17.475	V	31.91	33.89	43.59	13.78	45.84	-9.54	Avg.	54	-8.16

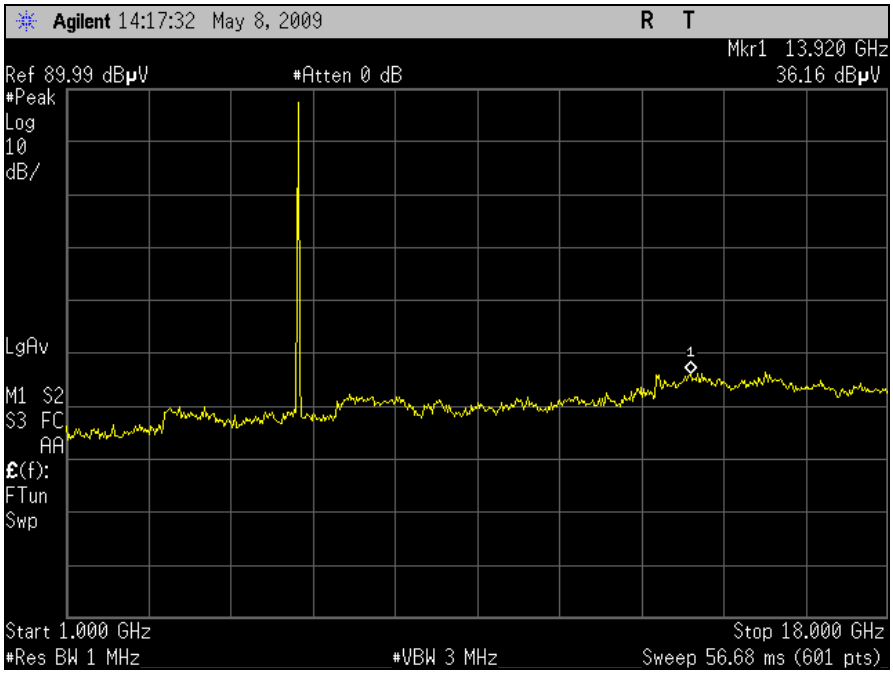
Table 41. Radiated Harmonic Emissions, Test Results, High Channel, 7 dBi Omni Antenna, 802.11a Mode, Port 1

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

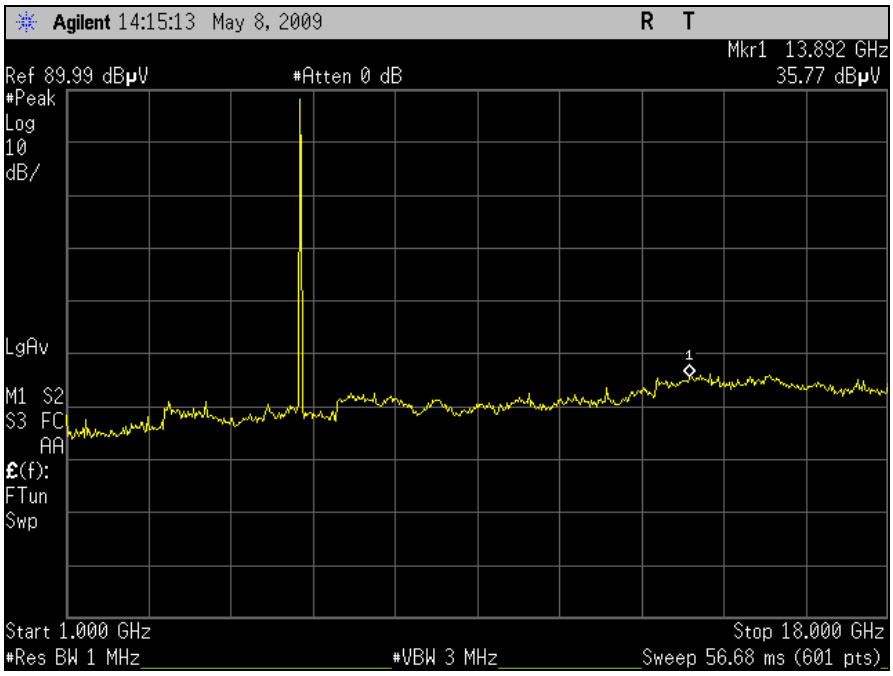
§ 15.247(d) Radiated Spurious Emissions – 7dBi Omni Antenna, 802.11a Mode, Port 1



Plot 45. Radiated Spurious Emissions, Low Channel, 7 dBi Omni Antenna, 802.11a Mode, Port 1



Plot 46. Radiated Spurious Emissions, High Channel, 7 dBi Omni Antenna, 802.11a Mode, Port 1



Plot 47. Radiated Spurious Emissions, High Channel, 7 dBi Omni Antenna, 802.11a Mode, Port 1

Harmonic Emissions Requirements – Radiated 20 dBi Sector Antenna, 802.11a Mode, Port 1

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 1m (Peak) / (Avg.)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Distance Correction Factor (1m to 3m) (dB)	Limit Detector Peak / Avg.	Limit @ 3 m (dBuV/m)	Delta (dB)
11.49	V	44.89	34.86	39.79	7.95	48.22	-9.54	Peak	74	-25.78
11.49	V	32.09	34.86	39.79	7.95	35.42	-9.54	Avg.	54	-18.58
17.235	V	44.21	34.01	42.82	12.27	55.75	-9.54	Peak	74	-18.25
17.235	V	31.19	34.01	42.82	12.27	42.73	-9.54	Avg.	54	-11.27

Table 42. Radiated Harmonic Emissions, Test Results, Low Channel, 20 dBi Sector Antenna, 802.11a Mode, Port 1

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 1m (Peak) / (Avg.)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Distance Correction Factor (1m to 3m) (dB)	Limit Detector Peak / Avg.	Limit @ 3 m (dBuV/m)	Delta (dB)
11.57	V	47.18	34.91	39.88	7.86	50.47	-9.54	Peak	74	-23.53
11.57	V	34.62	34.91	39.88	7.86	37.91	-9.54	Avg.	54	-16.09
17.355	V	44.88	33.93	43.15	12.97	57.53	-9.54	Peak	74	-16.47
17.355	V	32.49	33.93	43.15	12.97	45.14	-9.54	Avg.	54	-8.86

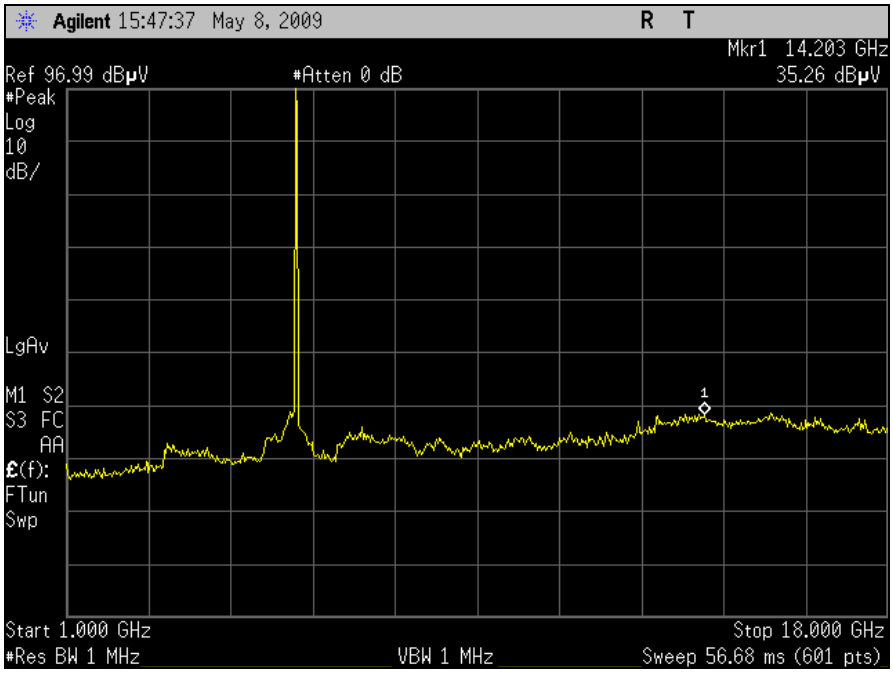
Table 43. Radiated Harmonic Emissions, Test Results, Mid Channel, 20 dBi Sector Antenna, 802.11a Mode, Port 1

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 1m (Peak) / (Avg.)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Distance Correction Factor (1m to 3m) (dB)	Limit Detector Peak / Avg.	Limit @ 3 m (dBuV/m)	Delta (dB)
11.65	V	46.06	34.96	39.94	7.62	49.13	-9.54	Peak	74	-24.87
11.65	V	32.57	34.96	39.94	7.62	35.64	-9.54	Avg.	54	-18.36
17.475	V	44.03	33.89	43.59	13.78	57.96	-9.54	Peak	74	-16.04
17.475	V	31.32	33.89	43.59	13.78	45.25	-9.54	Avg.	54	-8.75

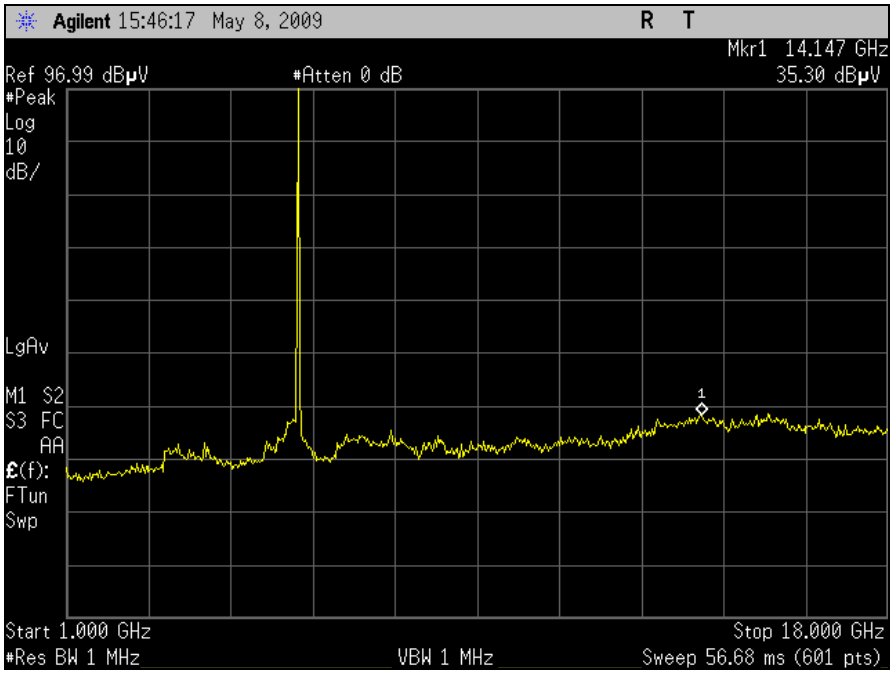
Table 44. Radiated Harmonic Emissions, Test Results, High Channel, 20 dBi Sector Antenna, 802.11a Mode, Port 1

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

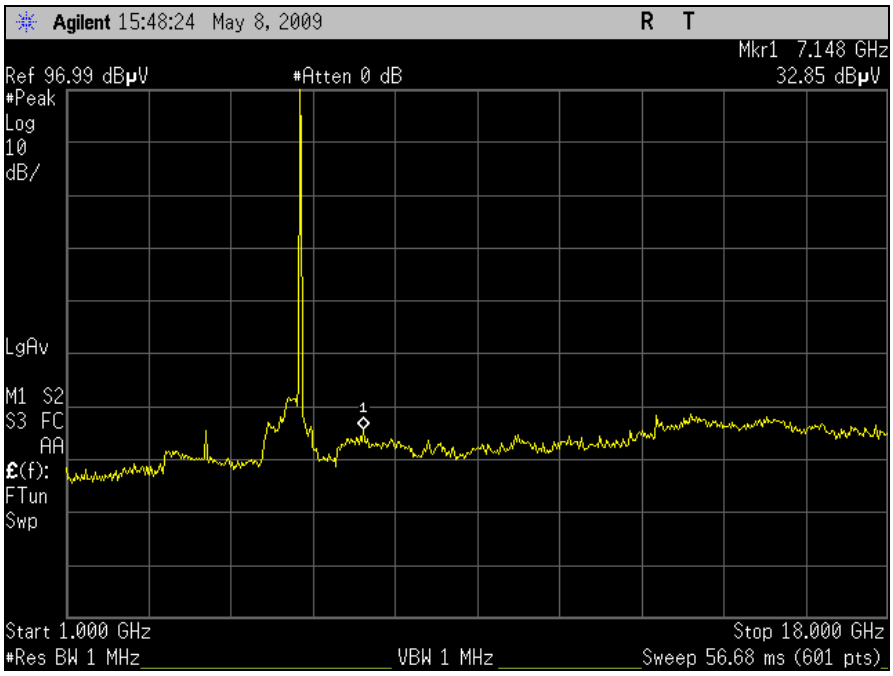
§ 15.247(d) Radiated Spurious Emissions – 20 dBi Sector Antenna, 802.11a Mode, Port 1



Plot 48. Radiated Spurious Emissions, Low Channel, 20 dBi Sector Antenna, 802.11a Mode, Port 1



Plot 49. Radiated Spurious Emissions, High Channel, 20 dBi Sector Antenna, 802.11a Mode, Port 1



Plot 50. Radiated Spurious Emissions, High Channel, 20 dBi Sector Antenna, 802.11a Mode, Port 1

Harmonic Emissions Requirements – Radiated 24 dBi Panel Antenna, 802.11a Mode, Port 1

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 1m (Peak) / (Avg.)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Distance Correction Factor (1m to 3m) (dB)	Limit Detector Peak / Avg.	Limit @ 3 m (dBuV/m)	Delta (dB)
11.49	V	46.64	34.86	39.79	7.95	49.97	-9.54	Peak	74	-24.03
11.49	V	34.14	34.86	39.79	7.95	37.47	-9.54	Avg.	54	-16.53
17.235	V	45.97	34.01	42.82	12.27	57.51	-9.54	Peak	74	-16.49
17.235	V	33.23	34.01	42.82	12.27	44.77	-9.54	Avg.	54	-9.23

Table 45. Radiated Harmonic Emissions, Test Results, Low Channel, 24 dBi Panel Antenna, 802.11a Mode, Port 1

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 1m (Peak) / (Avg.)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Distance Correction Factor (1m to 3m) (dB)	Limit Detector Peak / Avg.	Limit @ 3 m (dBuV/m)	Delta (dB)
11.57	V	44.65	34.91	39.88	7.86	47.94	-9.54	Peak	74	-26.06
11.57	V	31.55	34.91	39.88	7.86	34.84	-9.54	Avg.	54	-19.16
17.355	V	45.69	33.93	43.15	12.97	58.34	-9.54	Peak	74	-15.66
17.355	V	33.28	33.93	43.15	12.97	45.93	-9.54	Avg.	54	-8.07

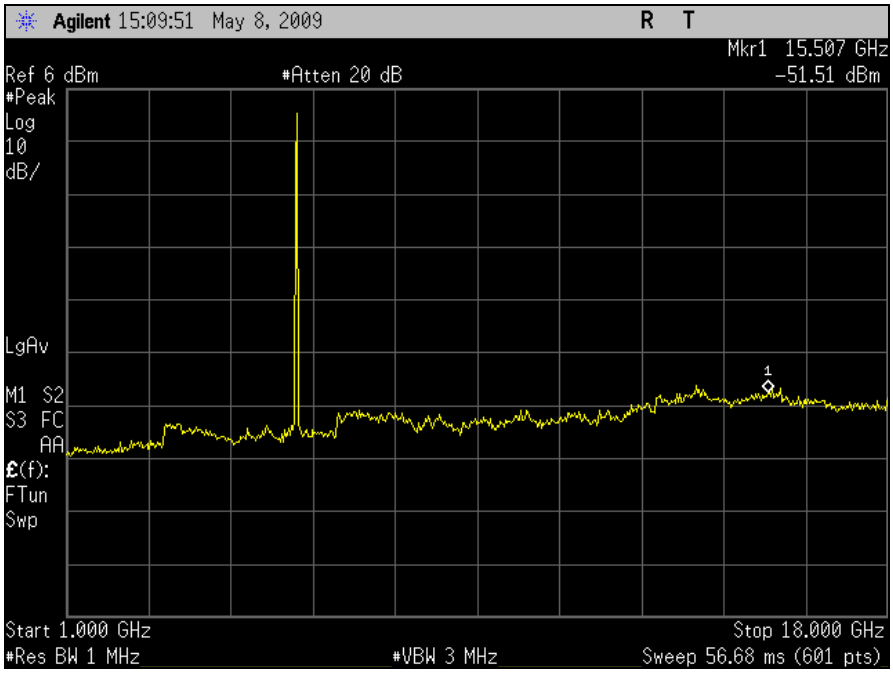
Table 46. Radiated Harmonic Emissions, Test Results, Mid Channel, 24 dBi Panel Antenna, 802.11a Mode, Port 1

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 1m (Peak) / (Avg.)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Distance Correction Factor (1m to 3m) (dB)	Limit Detector Peak / Avg.	Limit @ 3 m (dBuV/m)	Delta (dB)
11.65	V	45.84	34.96	39.94	7.62	48.91	-9.54	Peak	74	-25.09
11.65	V	32.41	34.96	39.94	7.62	35.48	-9.54	Avg.	54	-18.52
17.475	V	47.01	33.89	43.59	13.78	60.94	-9.54	Peak	74	-13.06
17.475	V	35.08	33.89	43.59	13.78	49.01	-9.54	Avg.	54	-4.99

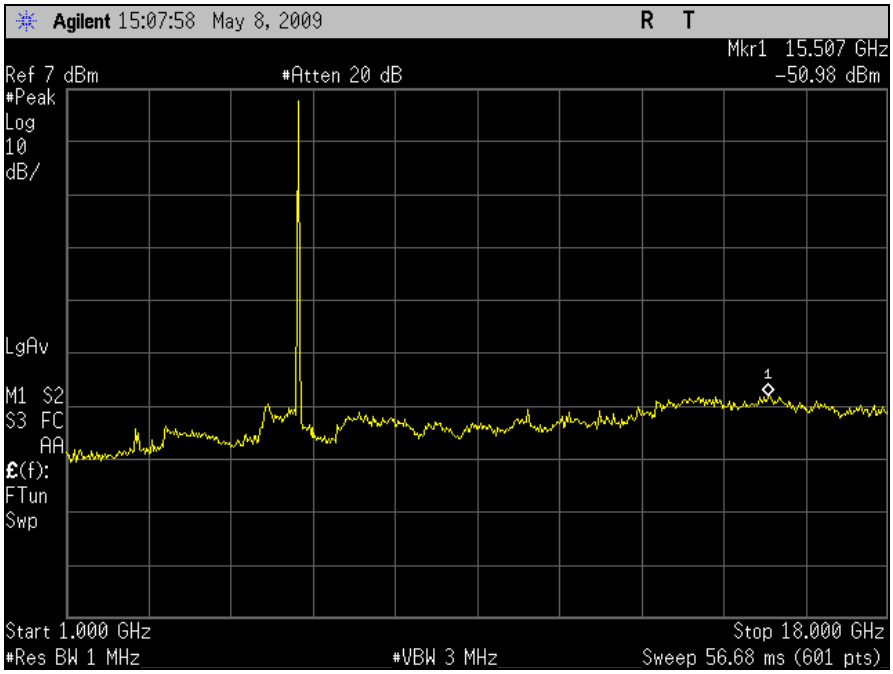
Table 47. Radiated Harmonic Emissions, Test Results, High Channel, 24 dBi Panel Antenna, 802.11a Mode, Port 1

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

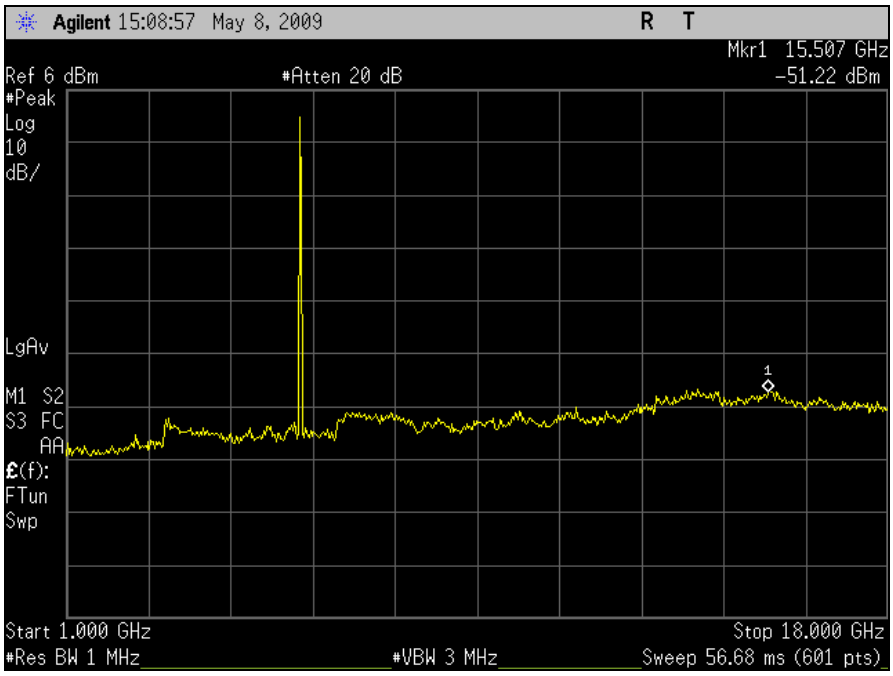
§ 15.247(d) Radiated Spurious Emissions – 24 dBi Panel Antenna, 802.11a Mode, Port 1



Plot 51. Radiated Spurious Emissions, Low Channel, 24 dBi Panel Antenna, 802.11a Mode, Port 1



Plot 52. Radiated Spurious Emissions, High Channel, 24 dBi Panel Antenna, 802.11a Mode, Port 1



Plot 53. Radiated Spurious Emissions, High Channel, 24 dBi Panel Antenna, 802.11a Mode, Port 1

Harmonic Emissions Requirements – Radiated 30 dBi Dish Antenna, 802.11a/n Mode, Port 1

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 1m (Peak) / (Avg.)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Distance Correction Factor (1m to 3m) (dB)	Limit Detector Peak / Avg.	Limit @ 3 m (dBuV/m)	Delta (dB)
11.49	V	47.33	34.86	39.79	7.95	50.66	-9.54	Peak	74	-23.34
11.49	V	33.89	34.86	39.79	7.95	37.22	-9.54	Avg.	54	-16.78
17.235	V	44.45	34.01	42.82	12.27	55.99	-9.54	Peak	74	-18.01
17.235	V	32.5	34.01	42.82	12.27	44.04	-9.54	Avg.	54	-9.96

Table 48. Radiated Harmonic Emissions, Test Results, Low Channel, 30 dBi Dish Antenna, 802.11a/n Mode, Port 1

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 1m (Peak) / (Avg.)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Distance Correction Factor (1m to 3m) (dB)	Limit Detector Peak / Avg.	Limit @ 3 m (dBuV/m)	Delta (dB)
11.57	V	45.99	34.91	39.88	7.86	49.28	-9.54	Peak	74	-24.72
11.57	V	33.21	34.91	39.88	7.86	36.50	-9.54	Avg.	54	-17.50
17.355	V	44.69	33.93	43.15	12.97	57.34	-9.54	Peak	74	-16.66
17.355	V	32.61	33.93	43.15	12.97	45.26	-9.54	Avg.	54	-8.74

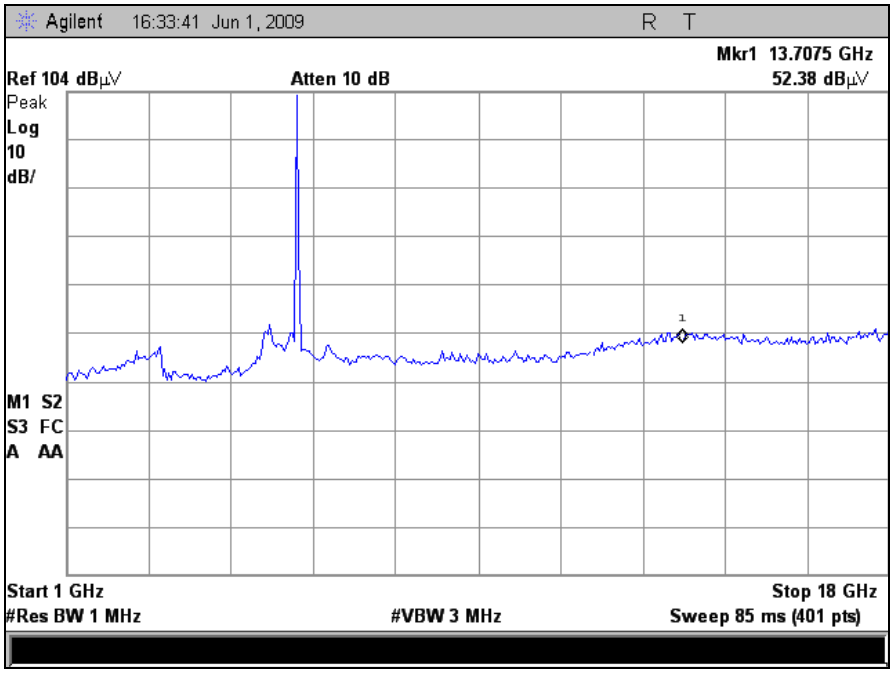
Table 49. Radiated Harmonic Emissions, Test Results, Mid Channel, 30 dBi Dish Antenna, 802.11a/n Mode, Port 1

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 1m (Peak) / (Avg.)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Distance Correction Factor (1m to 3m) (dB)	Limit Detector Peak / Avg.	Limit @ 3 m (dBuV/m)	Delta (dB)
11.65	V	45.35	34.96	39.94	7.62	48.42	-9.54	Peak	74	-25.58
11.65	V	32.92	34.96	39.94	7.62	35.99	-9.54	Avg.	54	-18.01
17.475	V	44.27	33.89	43.59	13.78	58.20	-9.54	Peak	74	-15.80
17.475	V	32.38	33.89	43.59	13.78	46.31	-9.54	Avg.	54	-7.69

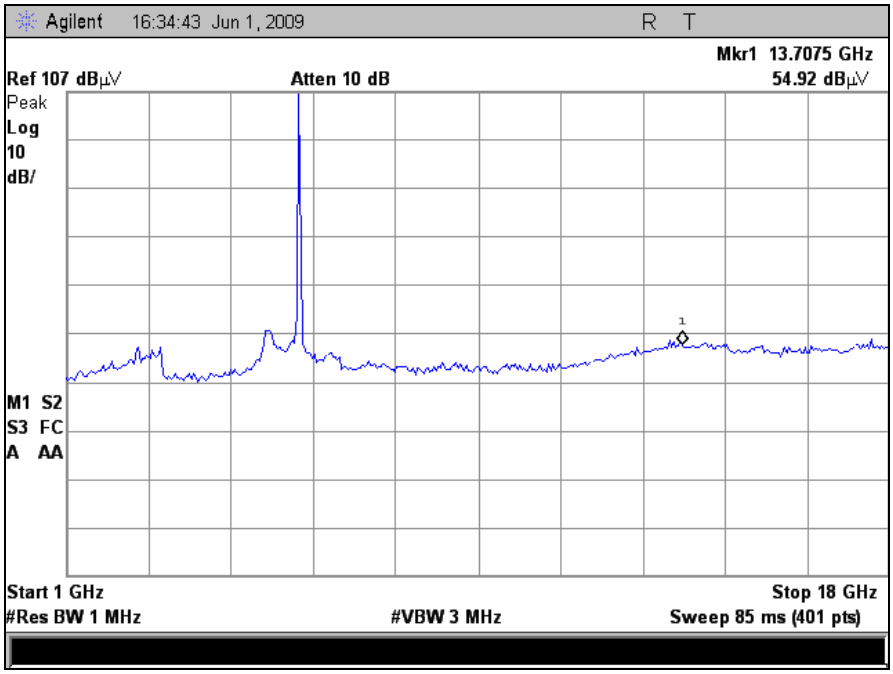
Table 50. Radiated Harmonic Emissions, Test Results, High Channel, 30 dBi Dish Antenna, 802.11a/n Mode, Port 1

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

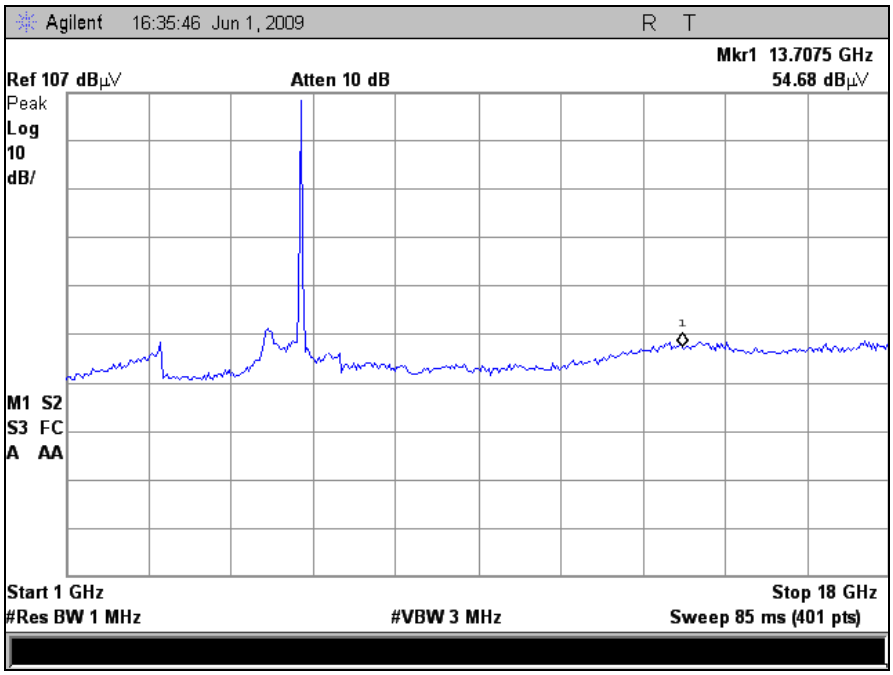
§ 15.247(d) Radiated Spurious Emissions – 30 dBi Dish Antenna, 802.11a/n Mode, Port 1



Plot 54. Radiated Spurious Emissions, Low Channel, 30 dBi Dish Antenna, 802.11a/n Mode, Port 1



Plot 55. Radiated Spurious Emissions, High Channel, 30 dBi Dish Antenna, 802.11a/n Mode, Port 1



Plot 56. Radiated Spurious Emissions, High Channel, 30 dBi Dish Antenna, 802.11a/n Mode, Port 1

Harmonic Emissions Requirements – Radiated 30 dBi Grid Antenna, 802.11a Mode, Port 1

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 1m (Peak) / (Avg.)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Distance Correction Factor (1m to 3m) (dB)	Limit Detector Peak / Avg.	Limit @ 3 m (dBuV/m)	Delta (dB)
11.49	V	44.76	34.86	39.79	7.95	48.09	-9.54	Peak	74	-25.91
11.49	V	32.25	34.86	39.79	7.95	35.58	-9.54	Avg.	54	-18.42
17.235	V	46.34	34.01	42.82	12.27	57.88	-9.54	Peak	74	-16.12
17.235	V	32.83	34.01	42.82	12.27	44.37	-9.54	Avg.	54	-9.63

Table 51. Radiated Harmonic Emissions, Test Results, Low Channel, 30 dBi Grid Antenna, 802.11a Mode, Port 1

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 1m (Peak) / (Avg.)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Distance Correction Factor (1m to 3m) (dB)	Limit Detector Peak / Avg.	Limit @ 3 m (dBuV/m)	Delta (dB)
11.57	V	44.05	34.91	39.88	7.86	47.34	-9.54	Peak	74	-26.66
11.57	V	31.46	34.91	39.88	7.86	34.75	-9.54	Avg.	54	-19.25
17.355	V	47.25	33.93	43.15	12.97	59.90	-9.54	Peak	74	-14.10
17.355	V	34.27	33.93	43.15	12.97	46.92	-9.54	Avg.	54	-7.08

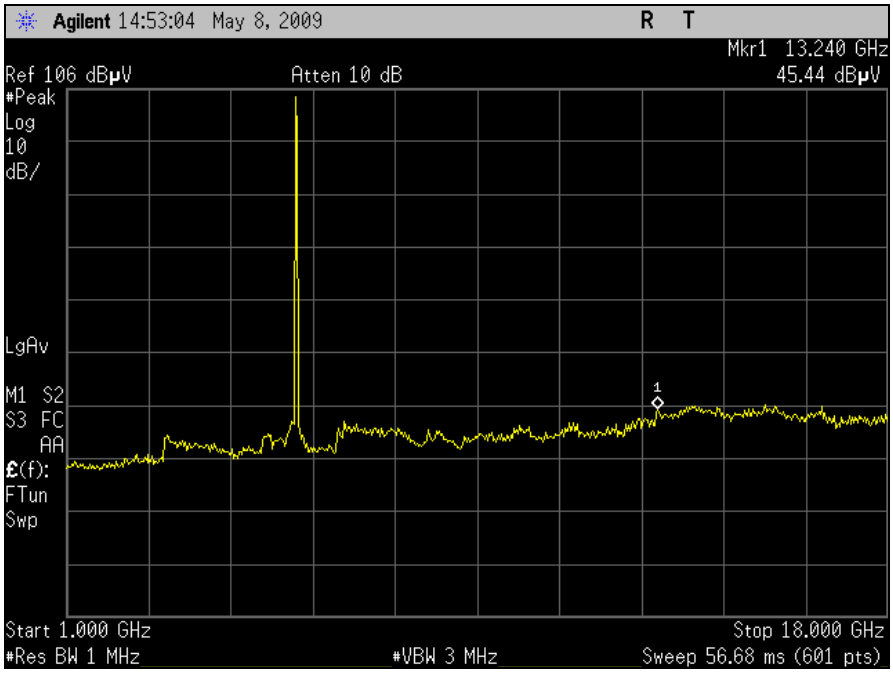
Table 52. Radiated Harmonic Emissions, Test Results, Mid Channel, 30 dBi Grid Antenna, 802.11a Mode, Port 1

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 1m (Peak) / (Avg.)	P. Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Distance Correction Factor (1m to 3m) (dB)	Limit Detector Peak / Avg.	Limit @ 3 m (dBuV/m)	Delta (dB)
11.65	V	45.47	34.96	39.94	7.62	48.54	-9.54	Peak	74	-25.46
11.65	V	31.19	34.96	39.94	7.62	34.26	-9.54	Avg.	54	-19.74
17.475	V	51.51	33.89	43.59	13.78	65.44	-9.54	Peak	74	-8.56
17.475	V	32.26	33.89	43.59	13.78	46.19	-9.54	Avg.	54	-7.81

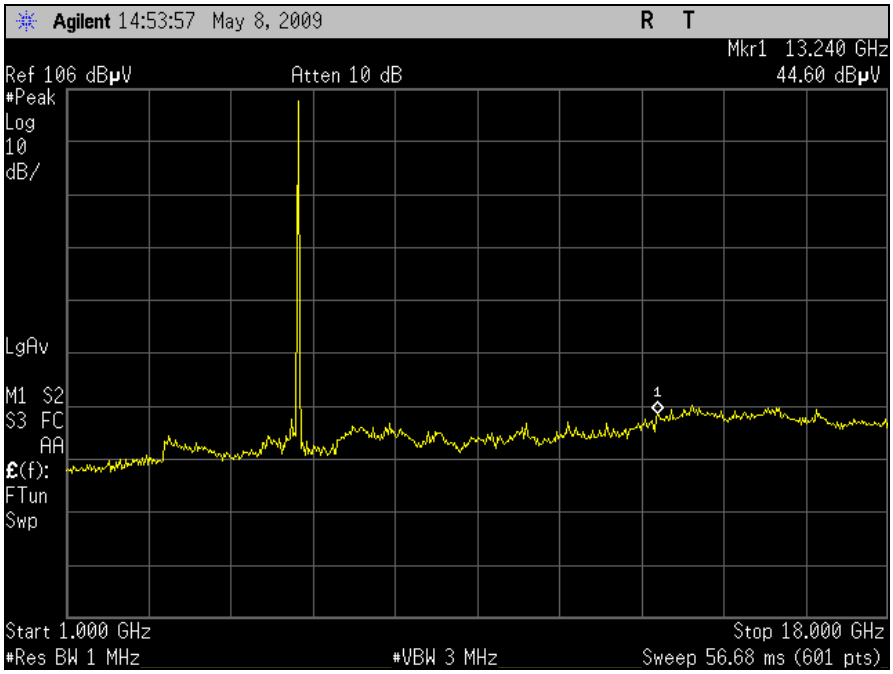
Table 53. Radiated Harmonic Emissions, Test Results, High Channel, 30 dBi Grid Antenna, 802.11a Mode, Port 1

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

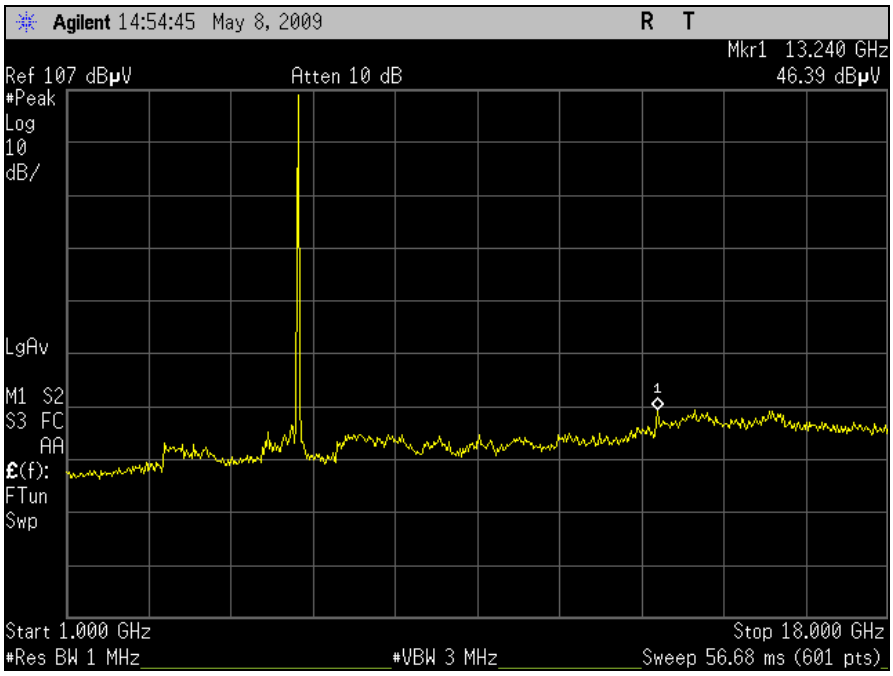
§ 15.247(d) Radiated Spurious Emissions – 30 dBi Grid Antenna, 802.11a Mode, Port 1



Plot 57. Radiated Spurious Emissions, Low Channel, 30 dBi Grid Antenna, 802.11a Mode, Port 1

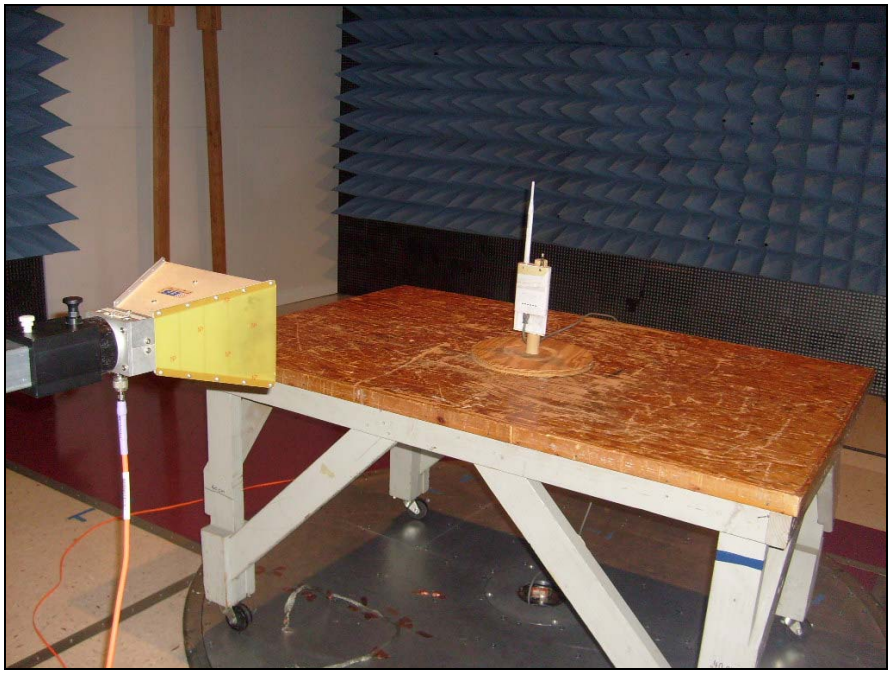


Plot 58. Radiated Spurious Emissions, High Channel, 30 dBi Grid Antenna, 802.11a Mode, Port 1

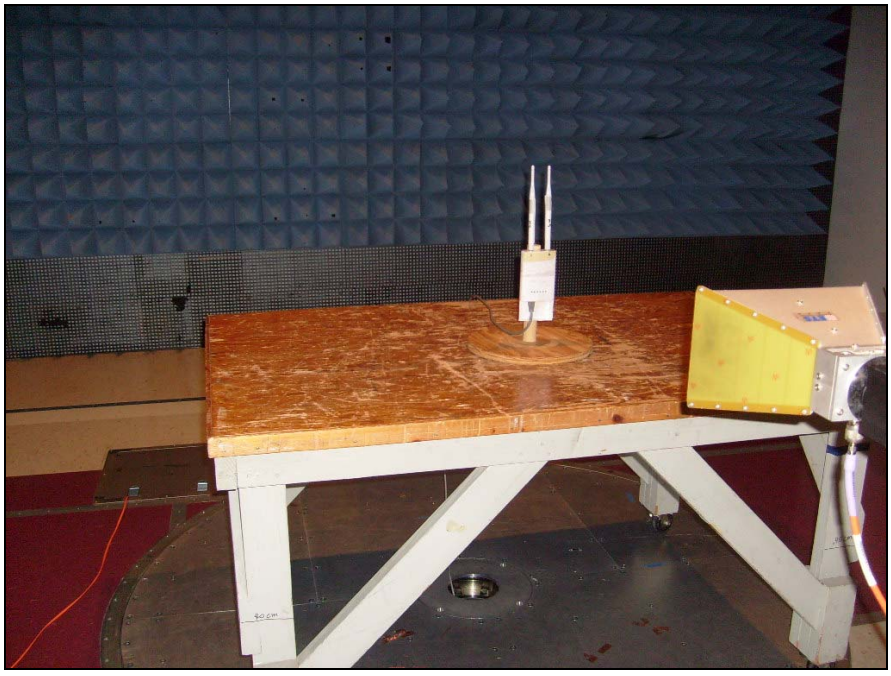


Plot 59. Radiated Spurious Emissions, High Channel, 30 dBi Grid Antenna, 802.11a Mode, Port 1

Radiated Spurious Emissions – Test Setup Photographs



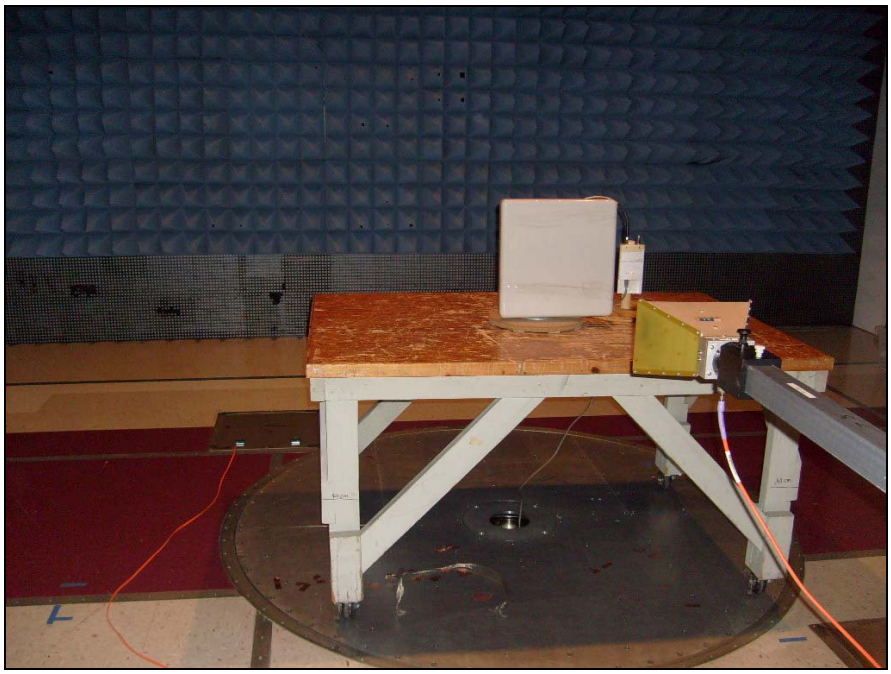
Photograph 6. Test Equipment and Setup for Various Radiated Measurements – Omni Antenna



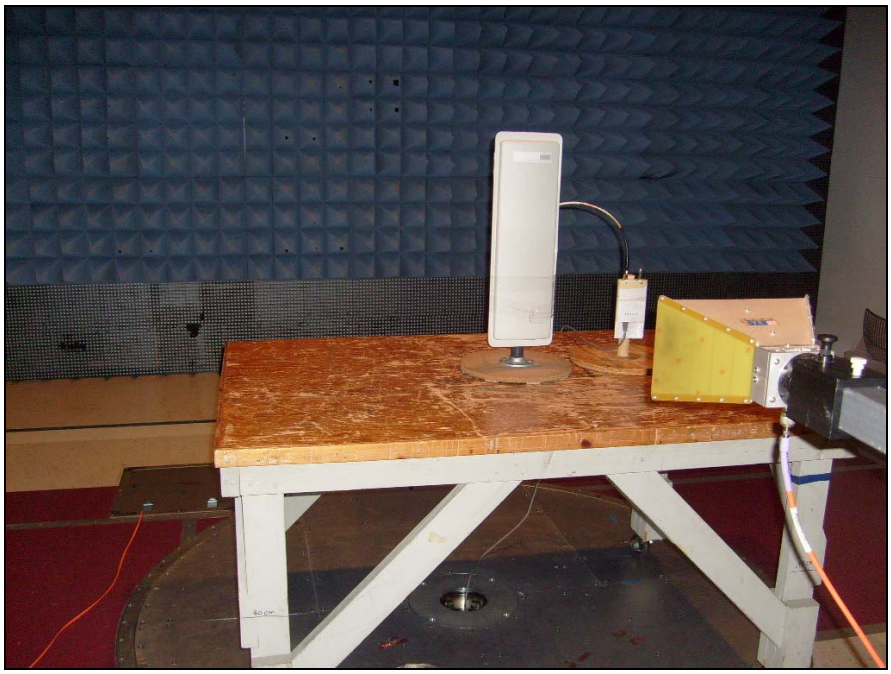
Photograph 7. Test Equipment and Setup for Various Radiated Measurements – Omni Antenna, Combined

Photograph 8. Test Equipment and Setup for Various Radiated Measurements – Dish

Photograph 9. Test Equipment and Setup for Various Radiated Measurements – Grid



Photograph 10. Test Equipment and Setup for Various Radiated Measurements – Panel



Photograph 11. Test Equipment and Setup for Various Radiated Measurements – Sector

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Spurious Emissions Requirements –RF Conducted

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

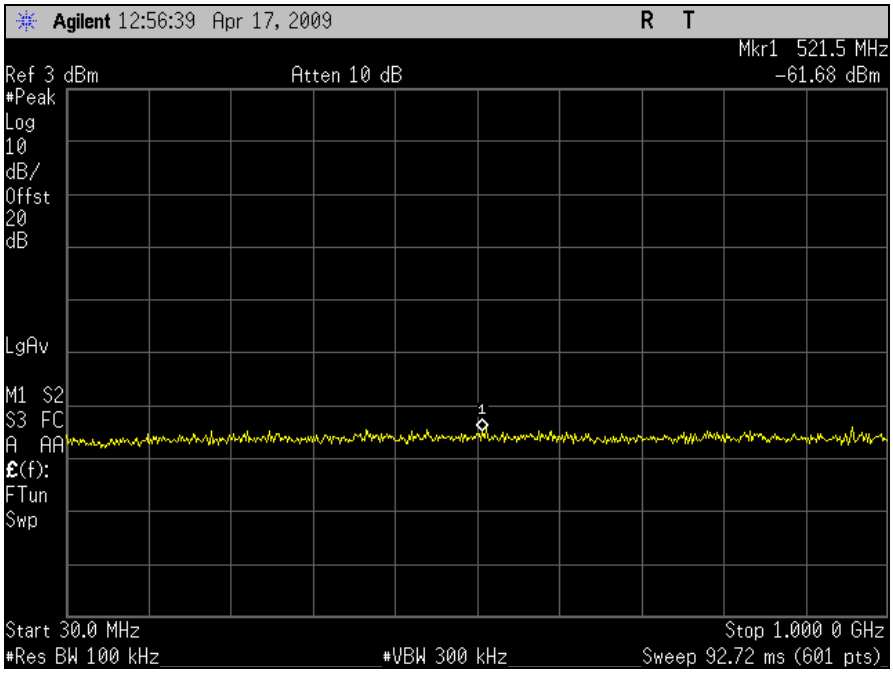
For frequencies 30MHz-40GHz, measurements were made at coupler port of a 20dB attenuator. the attenuator was connected to the EUT's Antenna Port.

Test Results: Equipment complies with the Spurious Emissions Requirements – Radiated and RF Conducted limits of **§ 15.247 (d)**. For Radiated Emissions result, refer to section "§15.209: Radiated Emission Limits". See following pages for detailed test results with RF Conducted Spurious Emissions and §15.205.

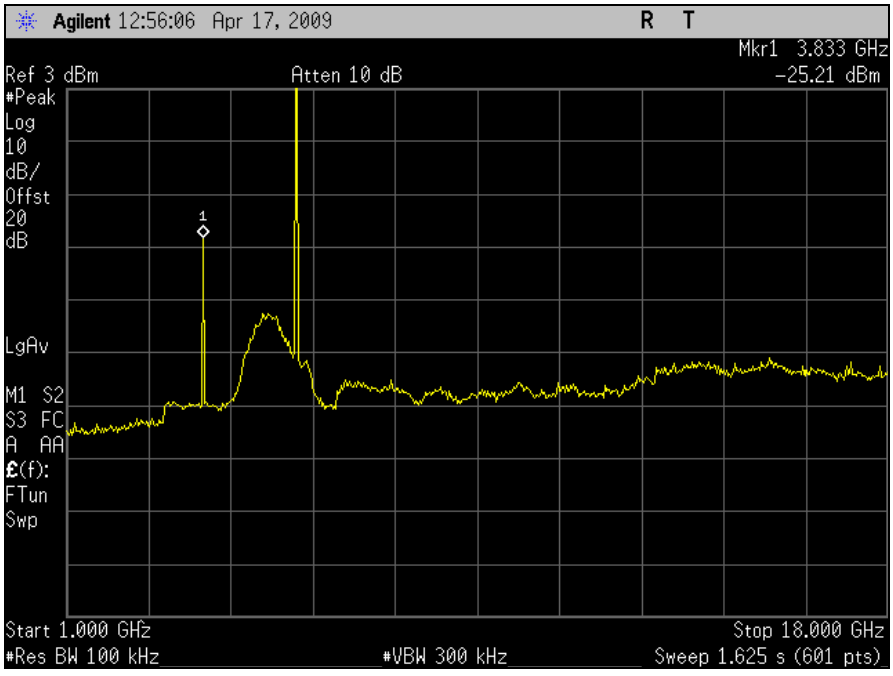
Test Engineer(s): Anderson Soungpanya

Test Date(s): 04/27/09

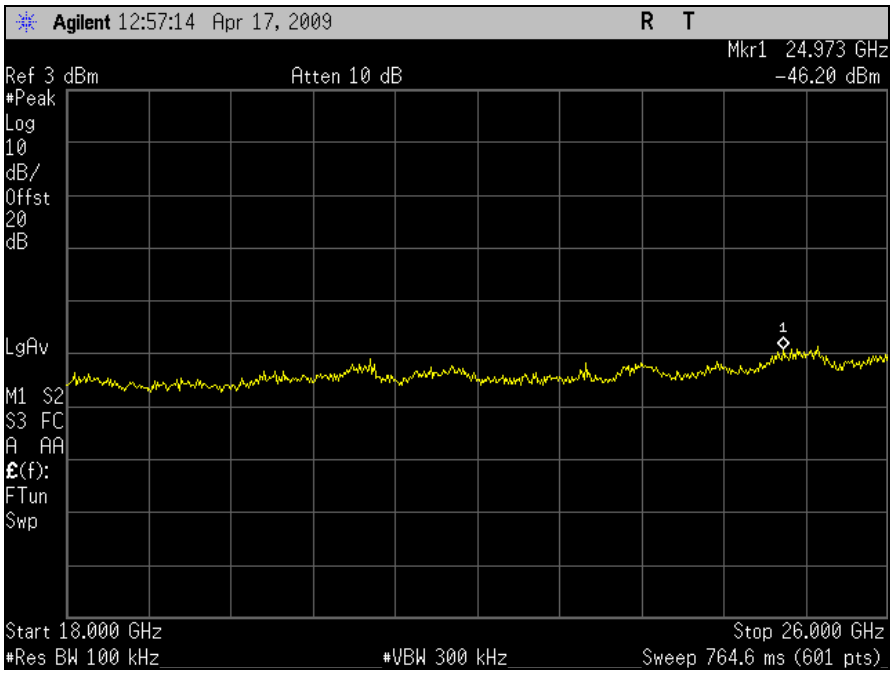
Conducted Emissions – Port 1, HT20



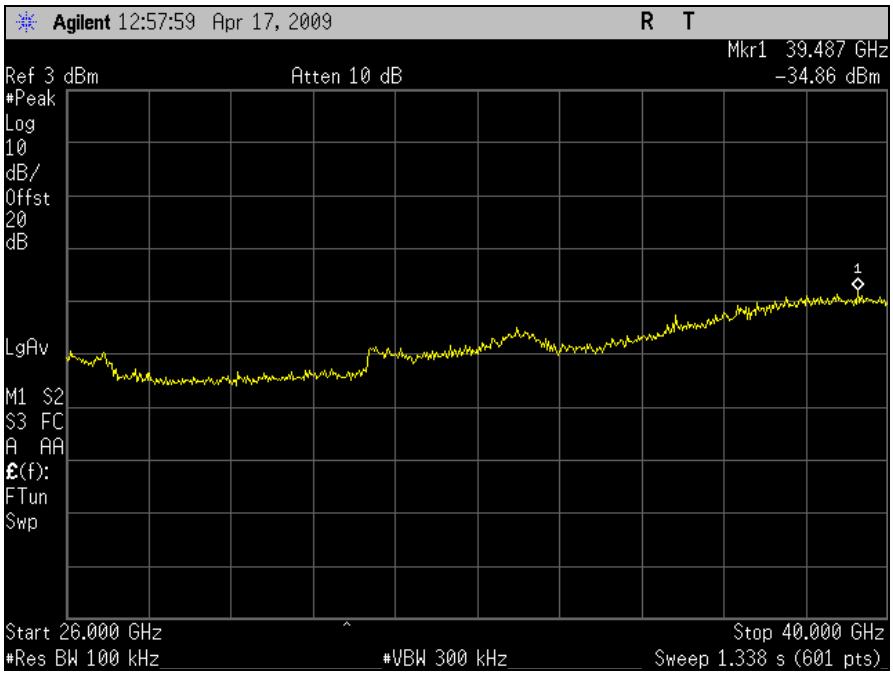
Plot 60. Conducted Emissions, Low Channel, 30 MHz – 1 GHz, Port 1, HT20



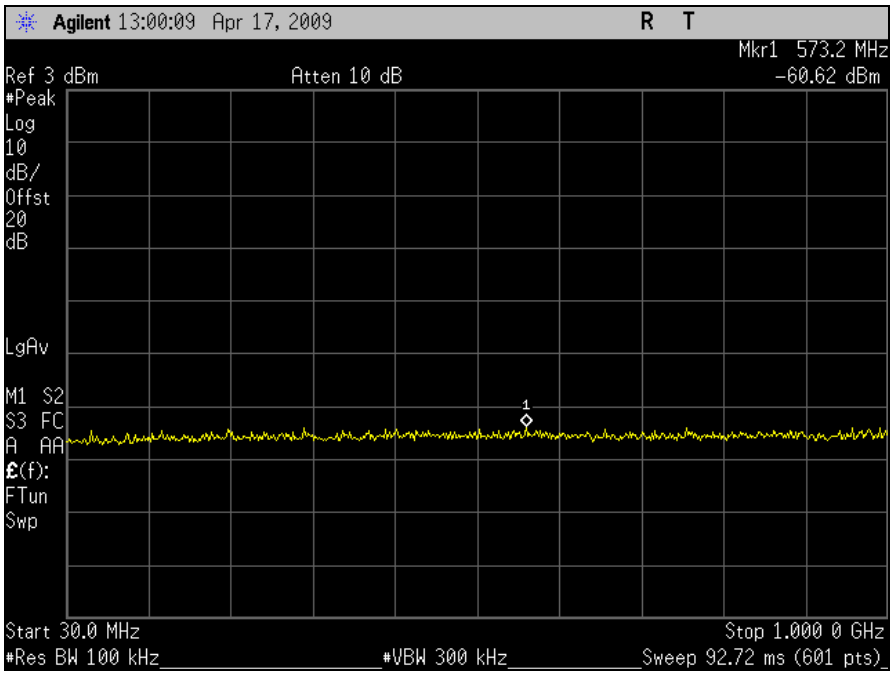
Plot 61. Conducted Emissions, Low Channel, 1 GHz – 18 GHz, Port 1, HT20



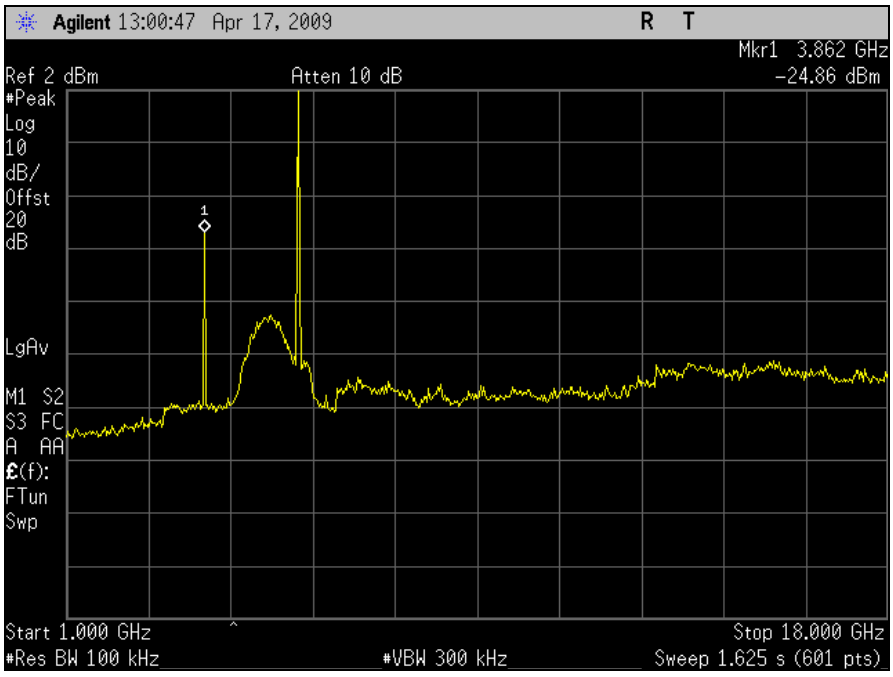
Plot 62. Conducted Emissions, Low Channel, 18 GHz – 26 GHz, Port 1, HT20



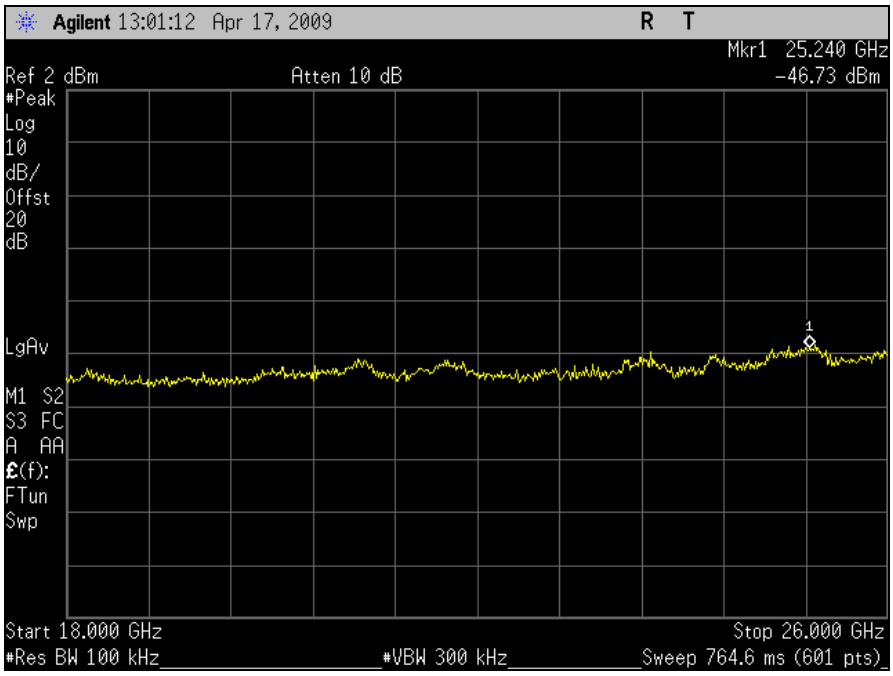
Plot 63. Conducted Emissions, Low Channel, 26 GHz – 40 GHz, Port 1, HT20



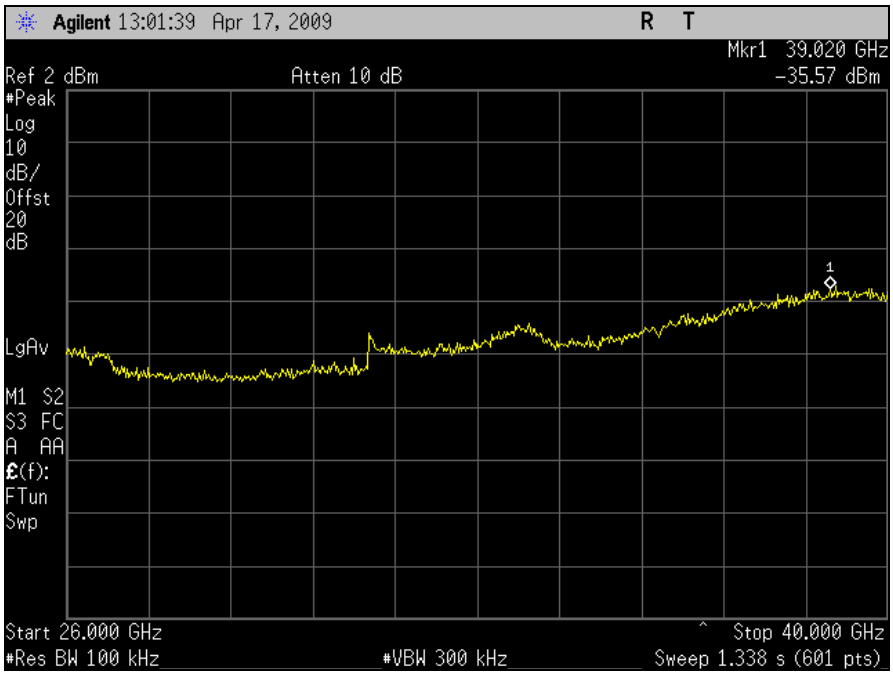
Plot 64. Conducted Emissions, Mid Channel, 30 MHz – 1 GHz, Port 1, HT20



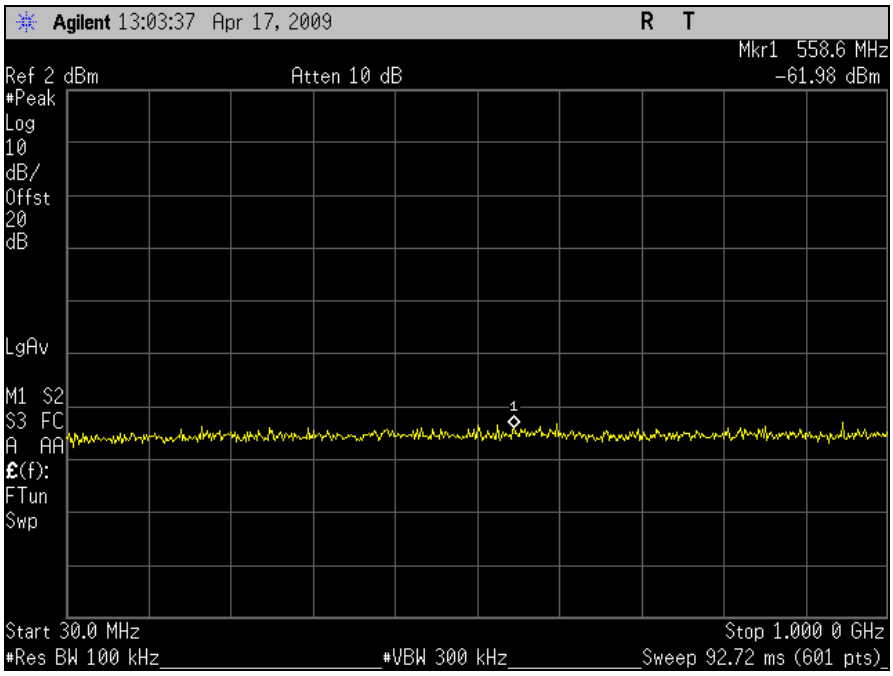
Plot 65. Conducted Emissions, Mid Channel, 1 GHz – 18 GHz, Port 1, HT20



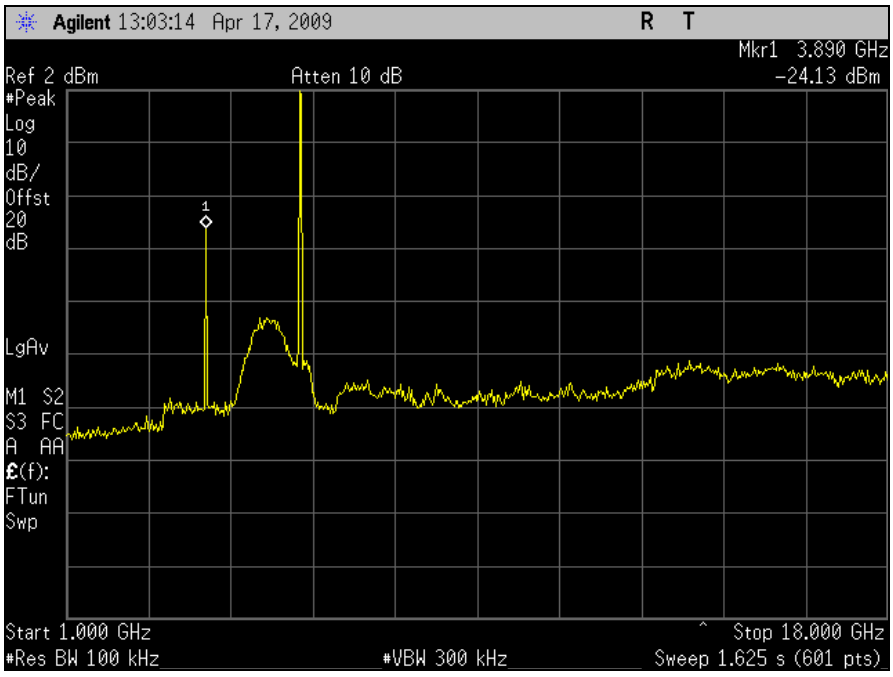
Plot 66. Conducted Emissions, Mid Channel, 1 GHz – 26 GHz, Port 1, HT20



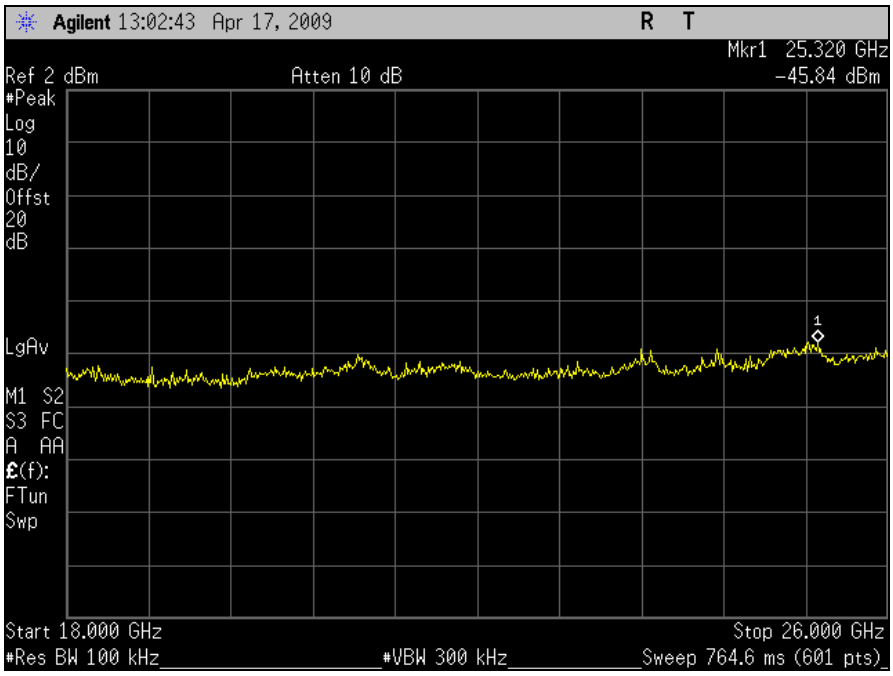
Plot 67. Conducted Emissions, Mid Channel, 26 GHz – 40 GHz, Port 1, HT20



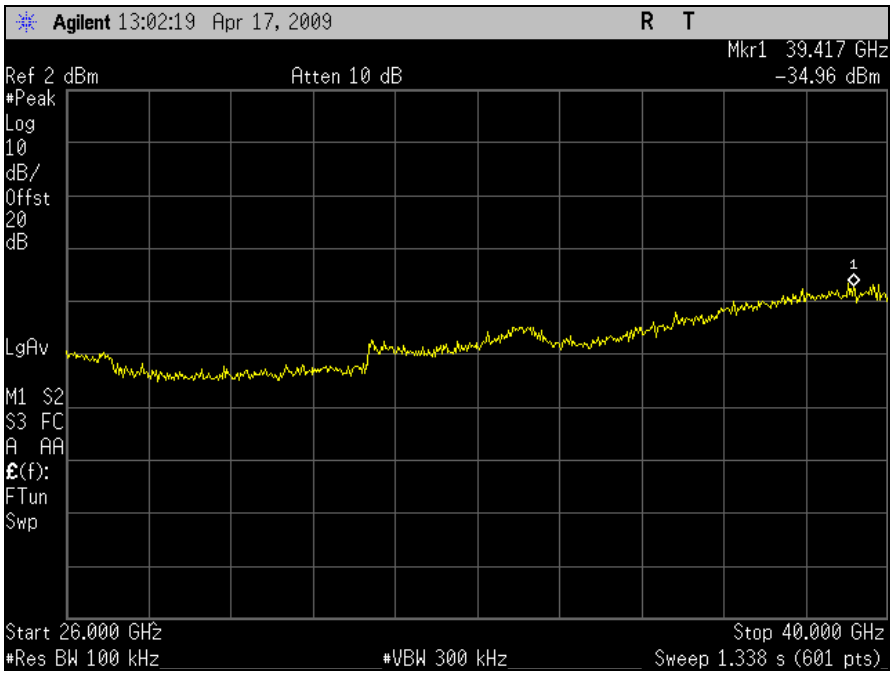
Plot 68. Conducted Emissions, High Channel, 30 MHz – 1 GHz, Port 1, HT20



Plot 69. Conducted Emissions, High Channel, 1 GHz – 18 GHz, Port 1, HT20

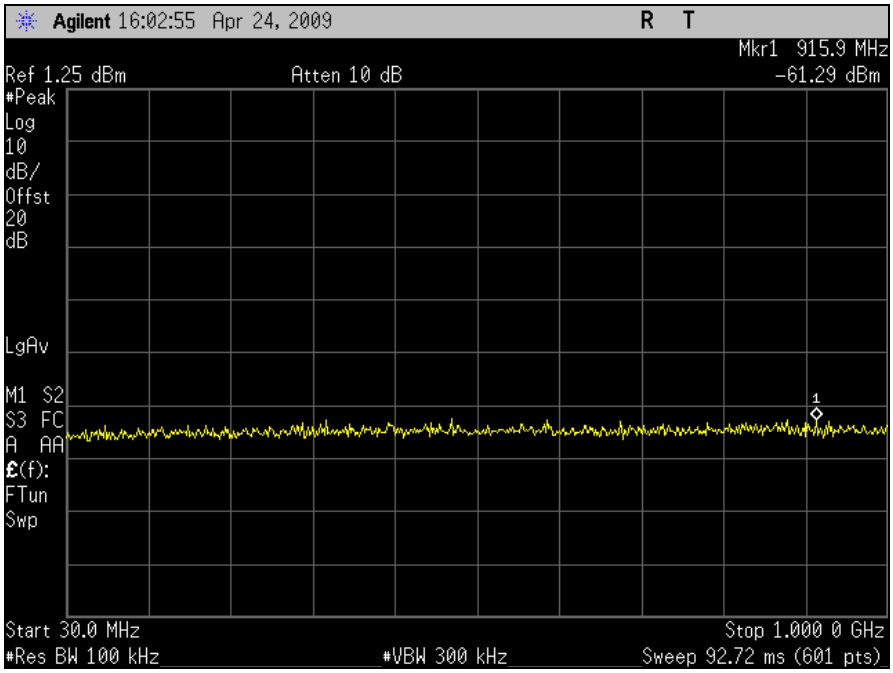


Plot 70. Conducted Emissions, High Channel, 18 GHz – 26 GHz, Port 1, HT20

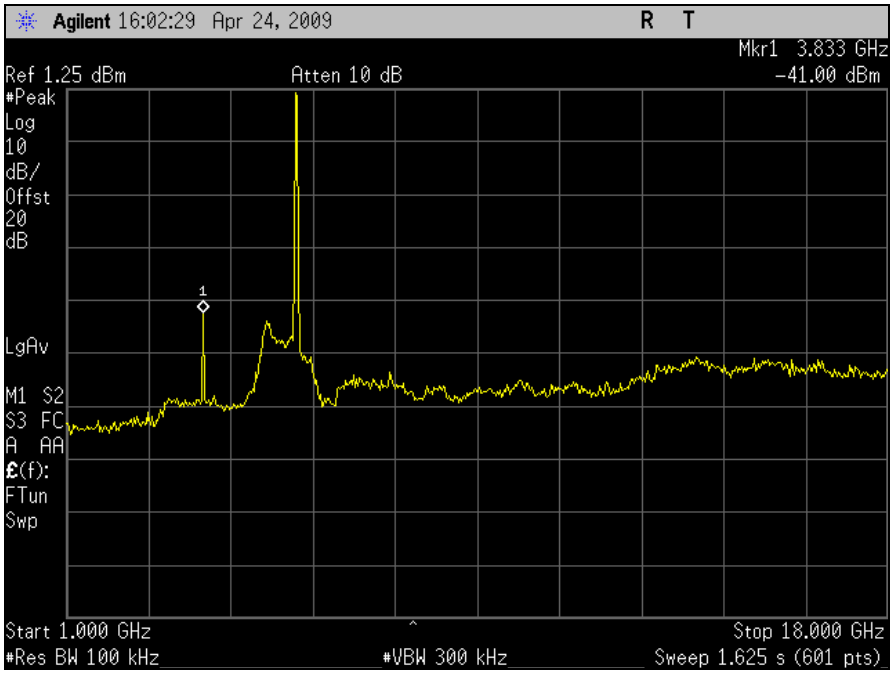


Plot 71. Conducted Emissions, High Channel, 26 GHz – 40 GHz, Port 1, HT20

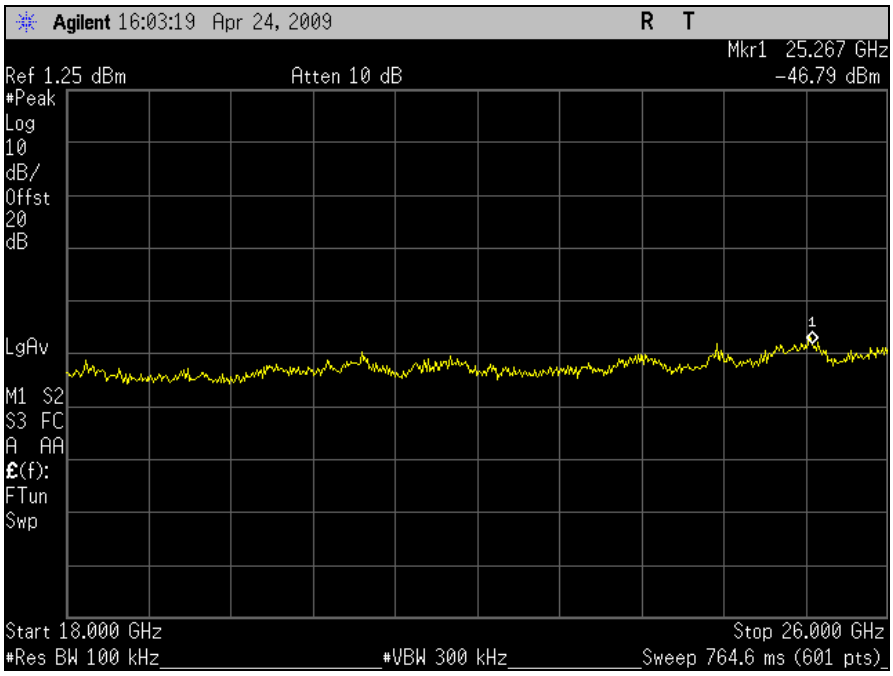
Conducted Emissions – Port 1, HT40



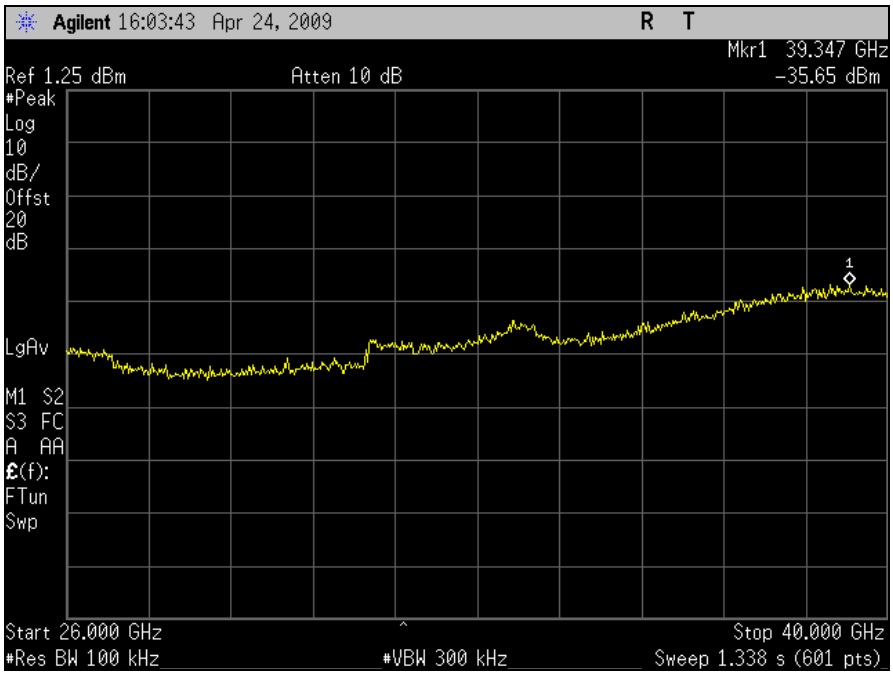
Plot 72. Conducted Emissions, Low Channel, 30 MHz – 1 GHz, Port 1, HT40



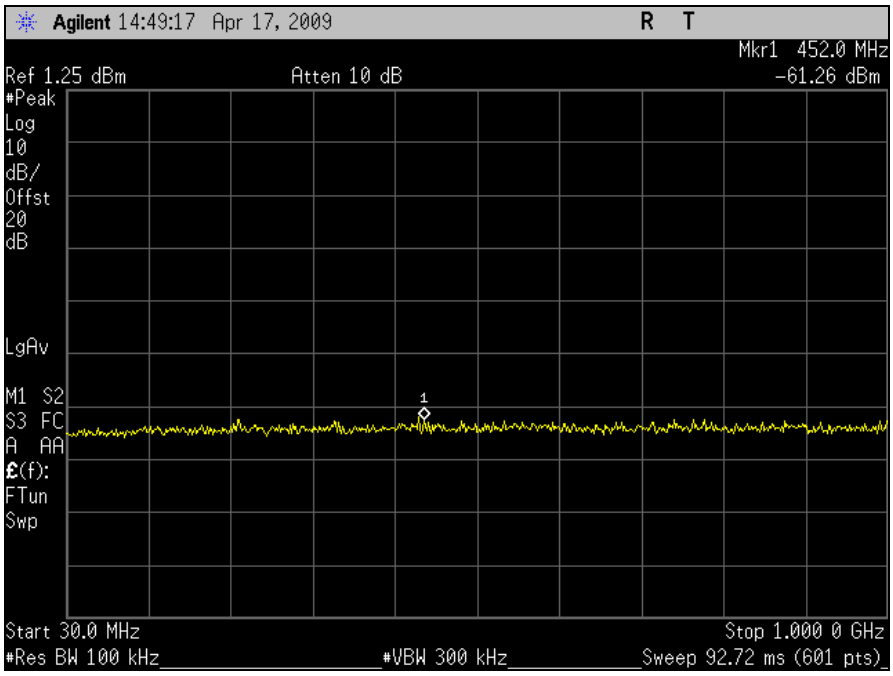
Plot 73. Conducted Emissions, Low Channel, 1 GHz – 18 GHz, Port 1, HT40



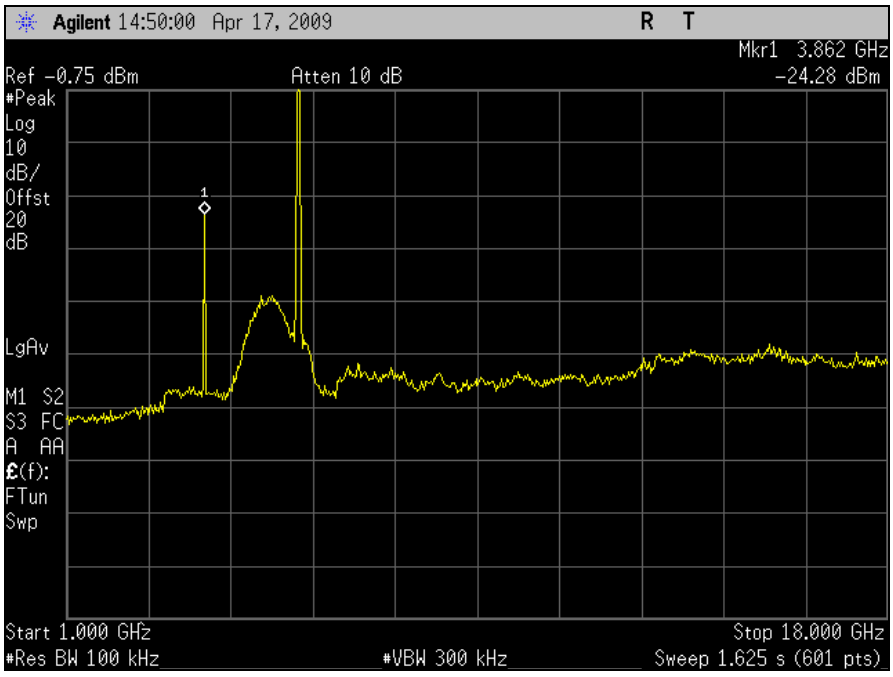
Plot 74. Conducted Emissions, Low Channel, 18 GHz – 26 GHz, Port 1, HT40



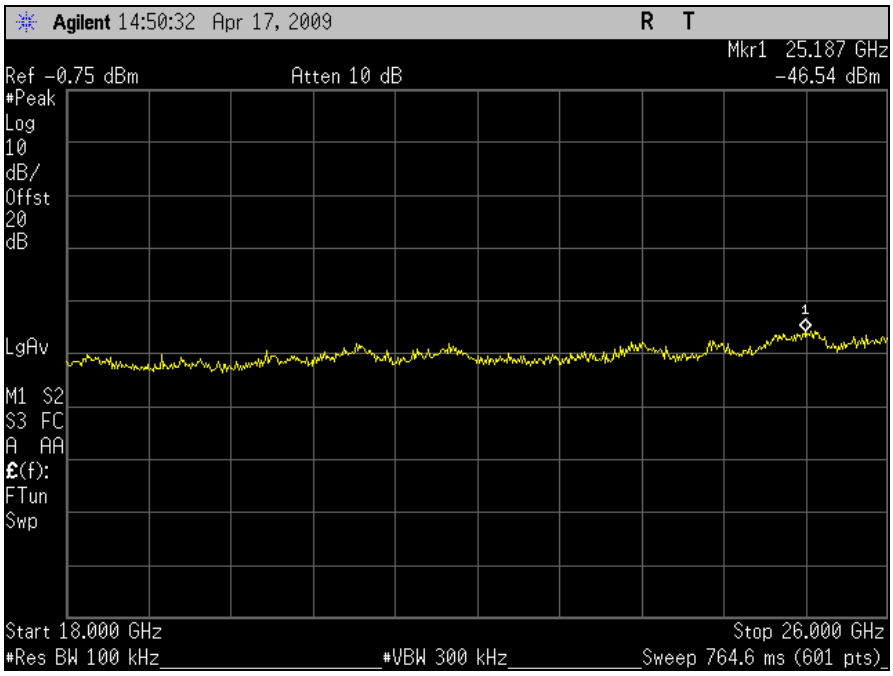
Plot 75. Conducted Emissions, Low Channel, 26 GHz – 40 GHz, Port 1, HT40



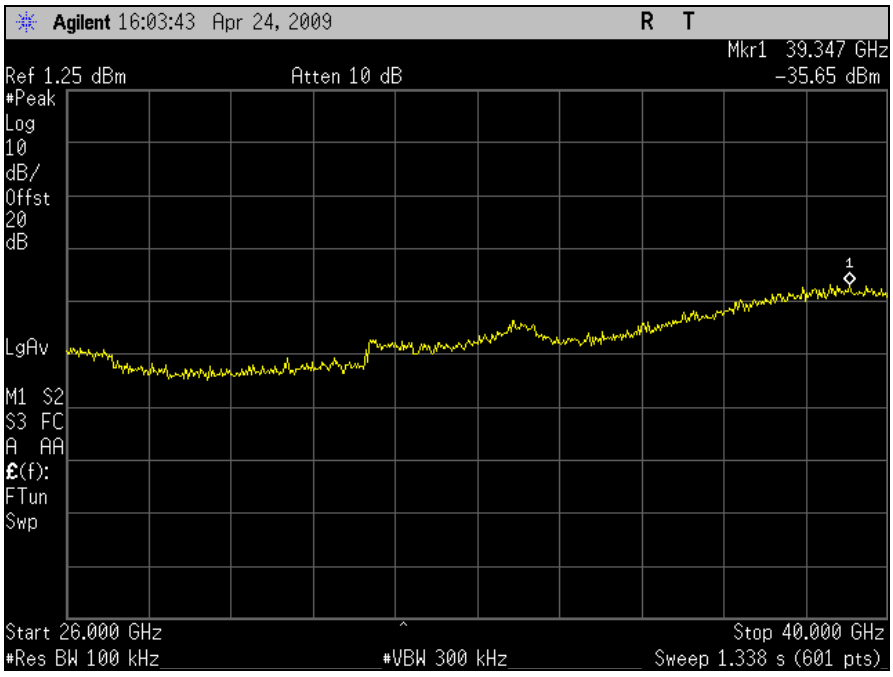
Plot 76. Conducted Emissions, Mid Channel, 30 MHz – 1 GHz, Port 1, HT40



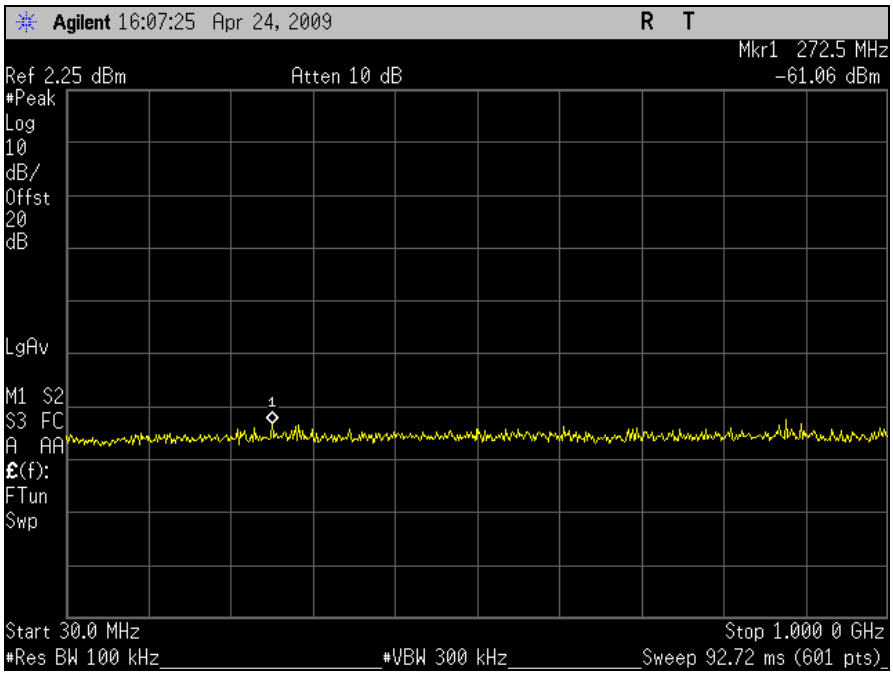
Plot 77. Conducted Emissions, Mid Channel, 1 GHz – 18 GHz, Port 1, HT40



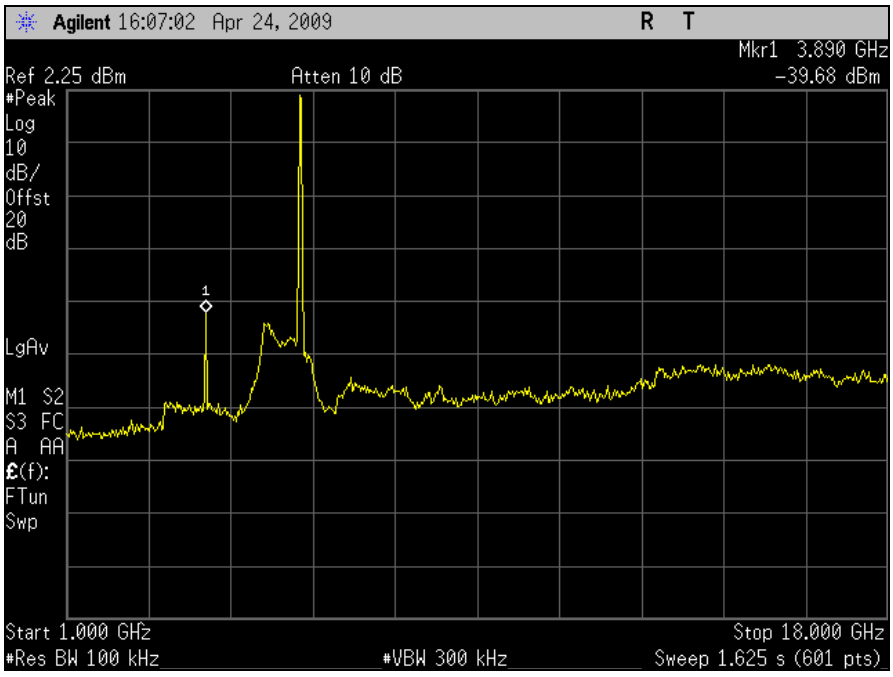
Plot 78. Conducted Emissions, Mid Channel, 18 GHz – 26 GHz, Port 1, HT40



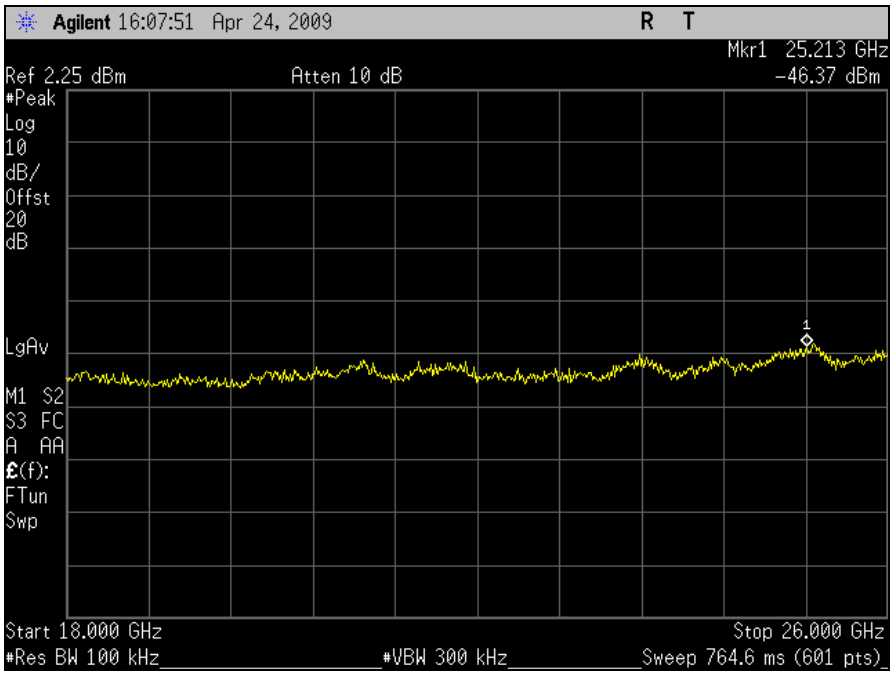
Plot 79. Conducted Emissions, Mid Channel, 26 GHz – 40 GHz, Port 1, HT40



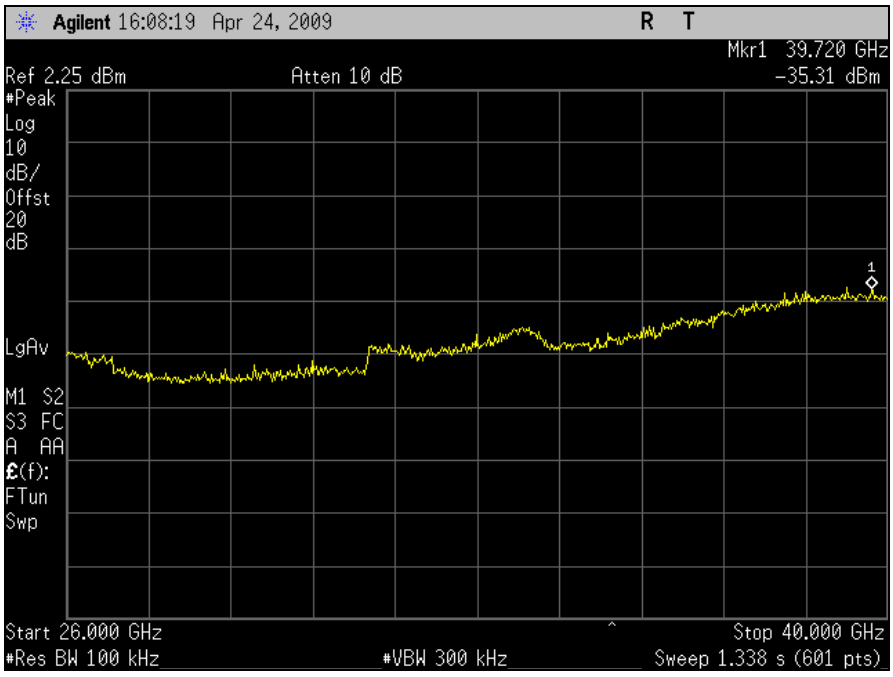
Plot 80. Conducted Emissions, High Channel, 30 MHz – 1 GHz, Port 1, HT40



Plot 81. Conducted Emissions, High Channel, 1 GHz – 18 GHz, Port 1, HT40

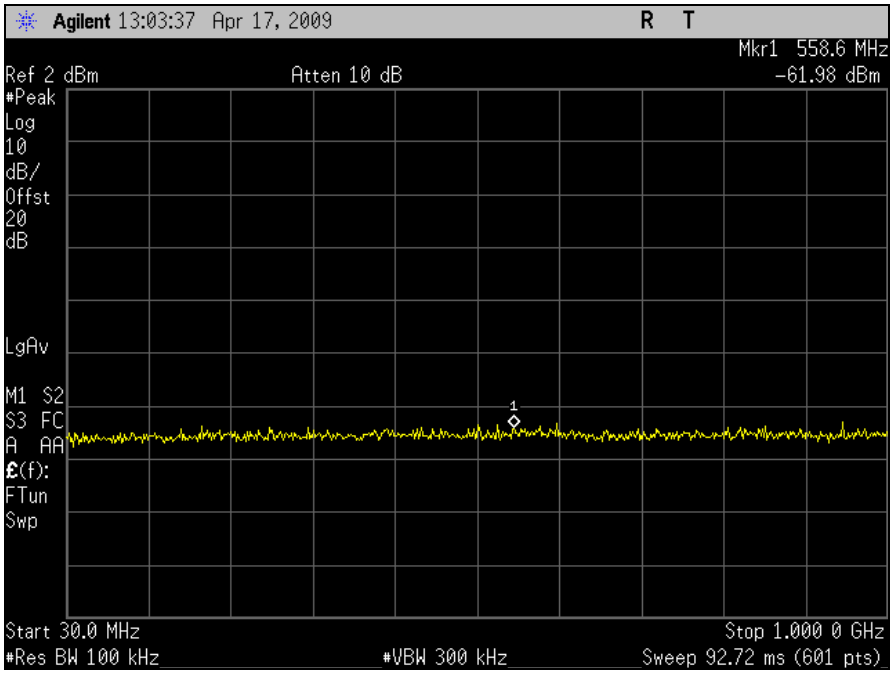


Plot 82. Conducted Emissions, High Channel, 18 GHz – 26 GHz, Port 1, HT40

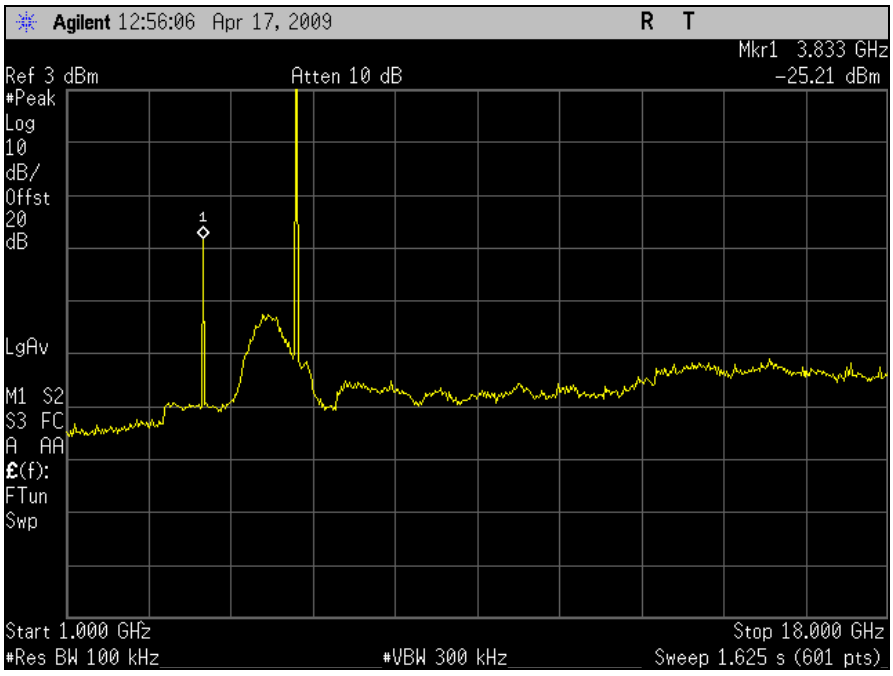


Plot 83. Conducted Emissions, High Channel, 26 GHz – 40 GHz, Port 1, HT40

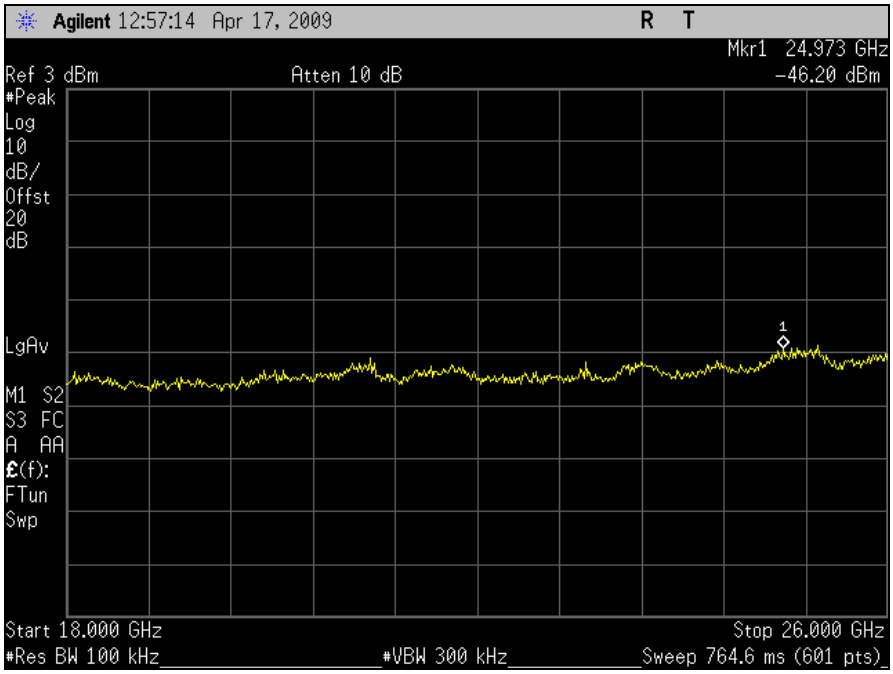
Conducted Emissions – Port 1, 802.11a Mode



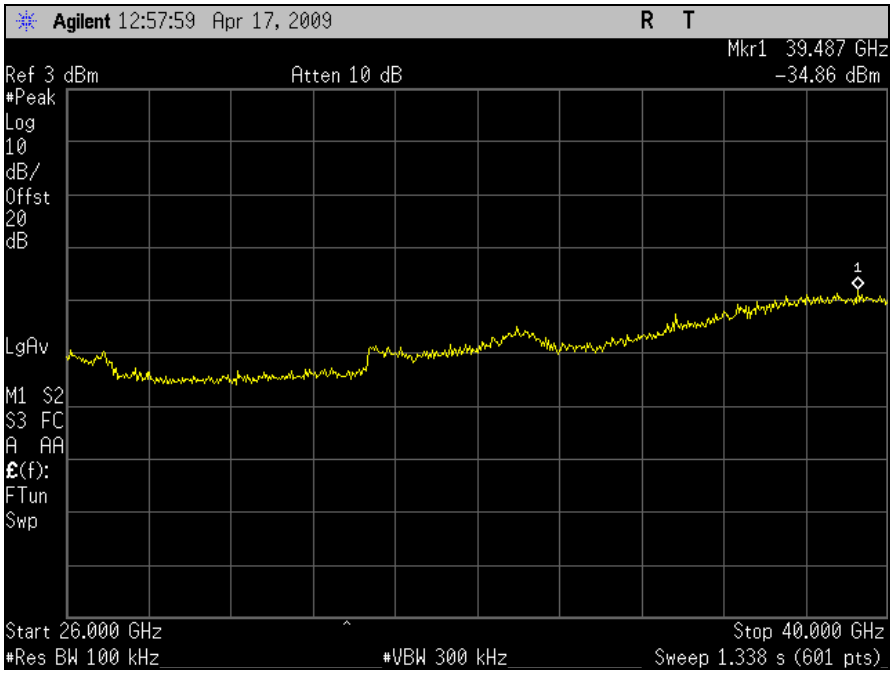
Plot 84. Conducted Emissions, Low Channel, 30 MHz – 1 GHz, Port 1, 802.11a Mode



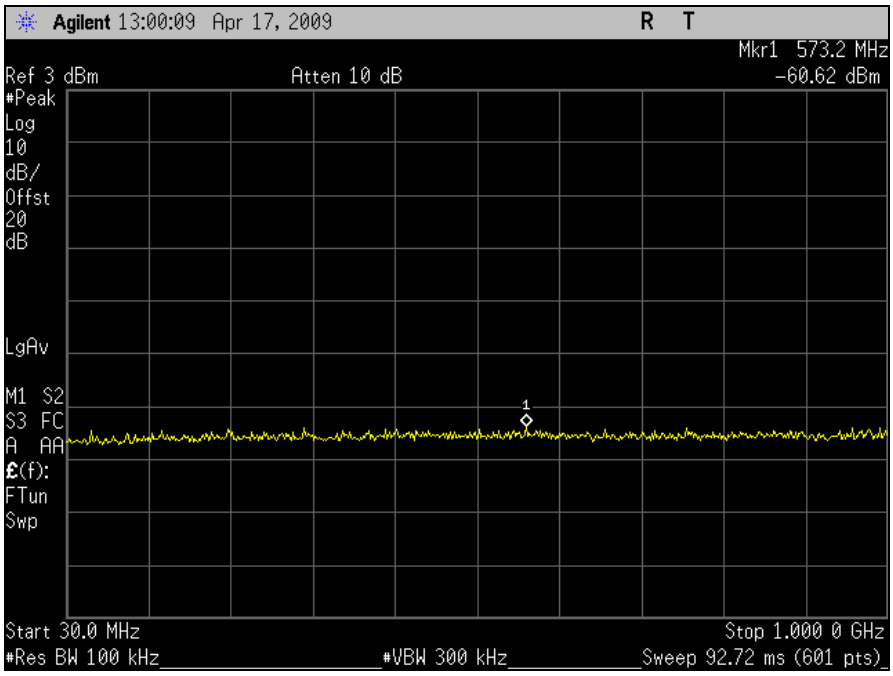
Plot 85. Conducted Emissions, Low Channel, 1 GHz – 18 GHz, Port 1, 802.11a Mode



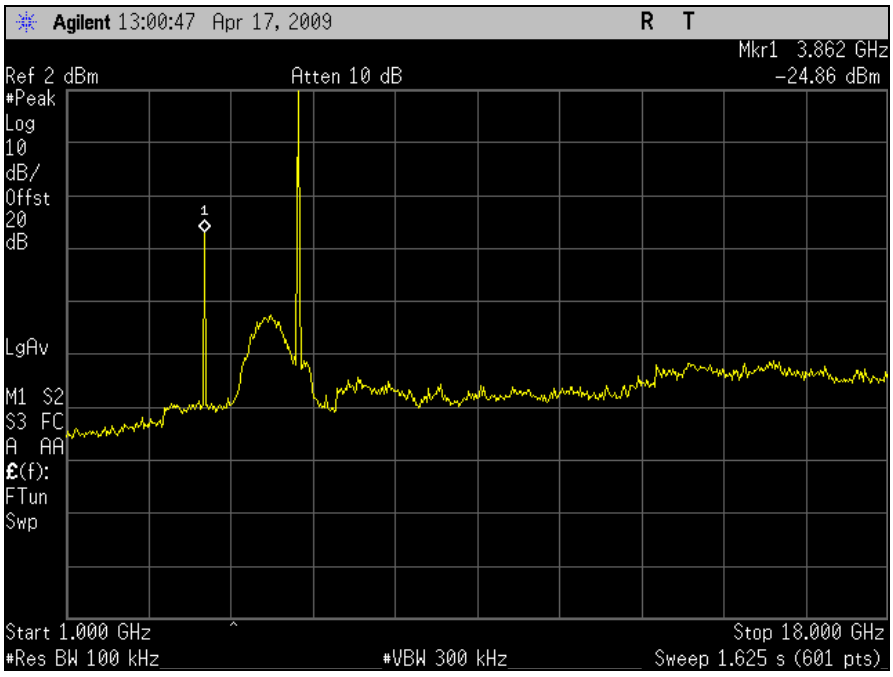
Plot 86. Conducted Emissions, Low Channel, 18 GHz – 26 GHz, Port 1, 802.11a Mode



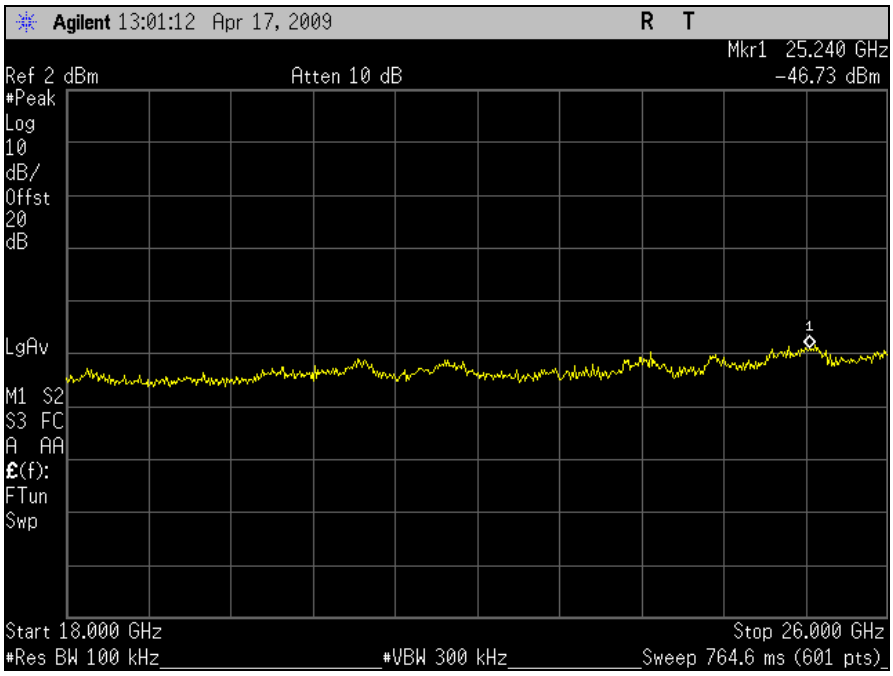
Plot 87. Conducted Emissions, Low Channel, 26 GHz – 40 GHz, Port 1, 802.11a Mode



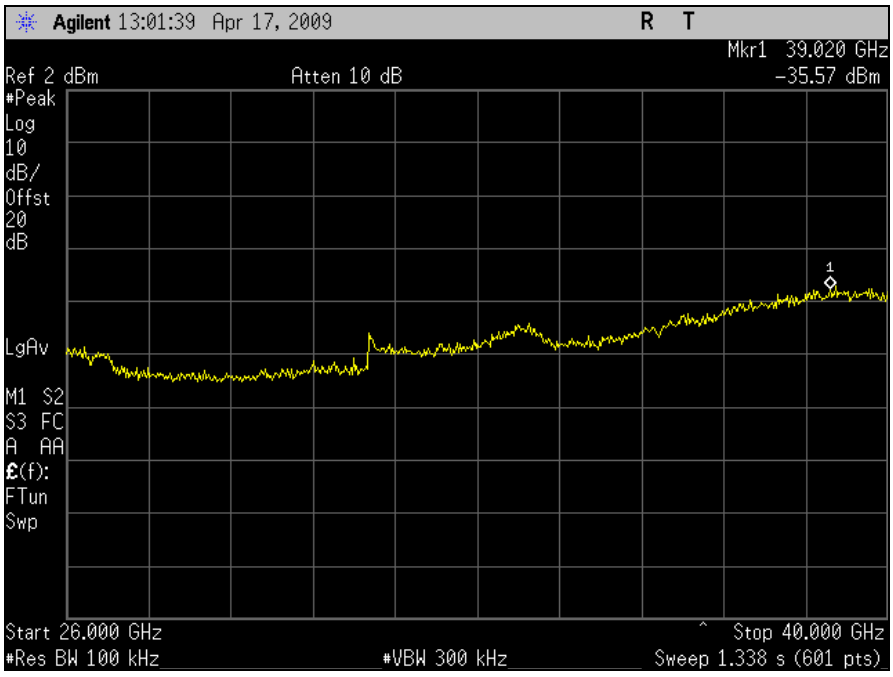
Plot 88. Conducted Emissions, Mid Channel, 30 MHz – 1 GHz, Port 1, 802.11a Mode



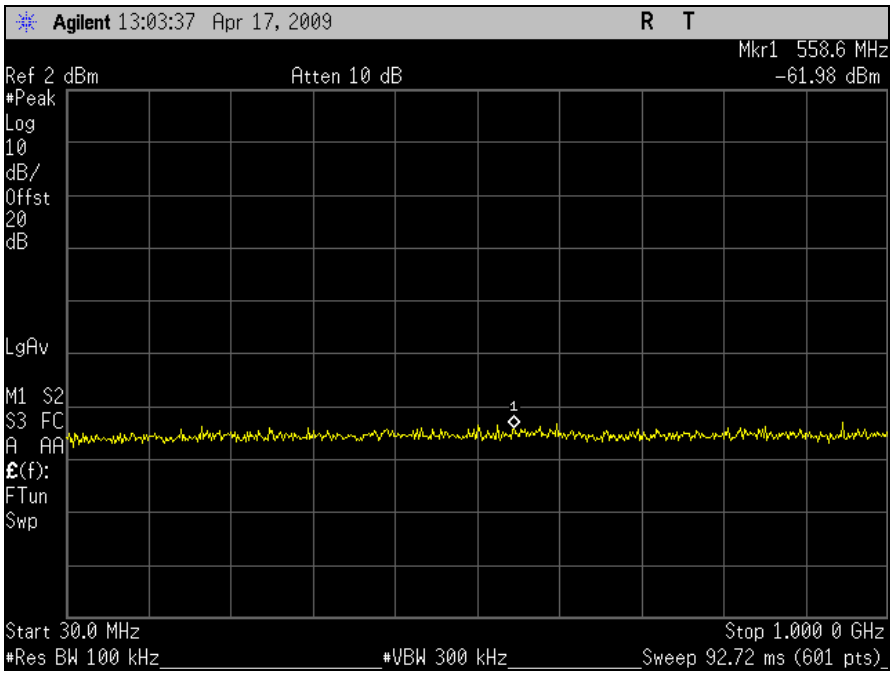
Plot 89. Conducted Emissions, Mid Channel, 1 GHz – 18 GHz, Port 1, 802.11a Mode



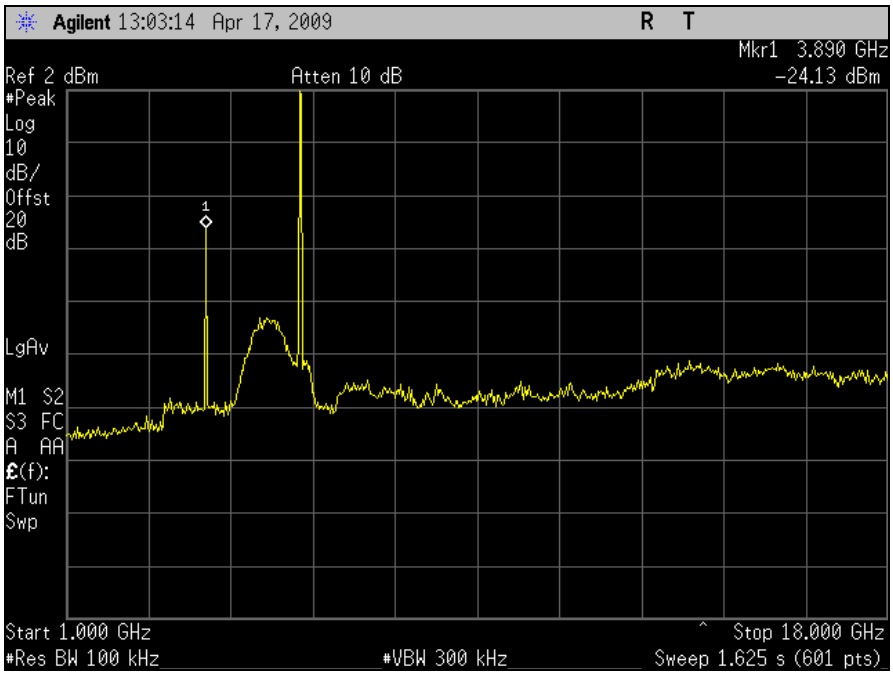
Plot 90. Conducted Emissions, Mid Channel, 18 GHz – 26 GHz, Port 1, 802.11a Mode



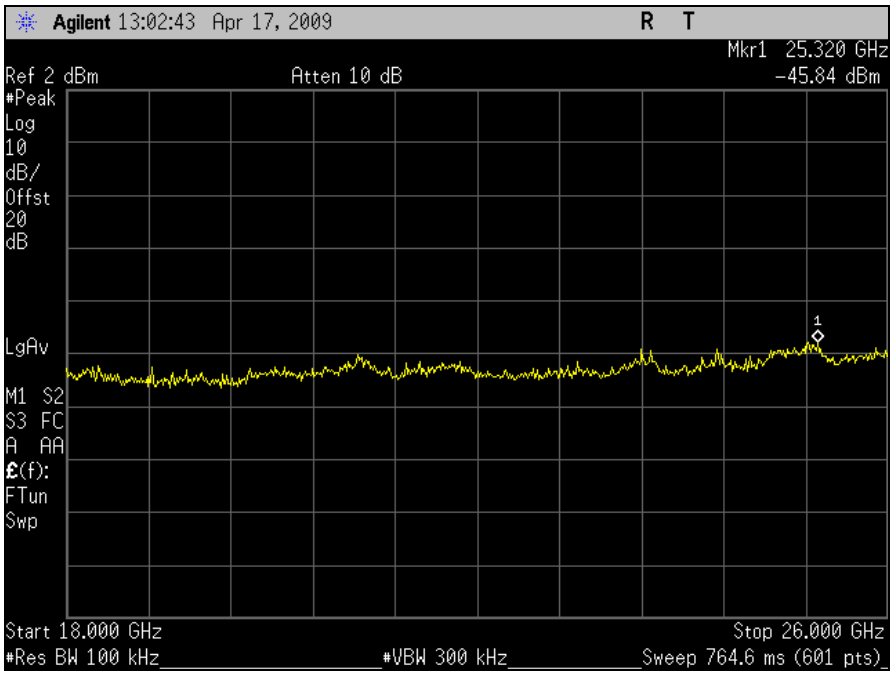
Plot 91. Conducted Emissions, Mid Channel, 26 GHz – 40 GHz, Port 1, 802.11a Mode



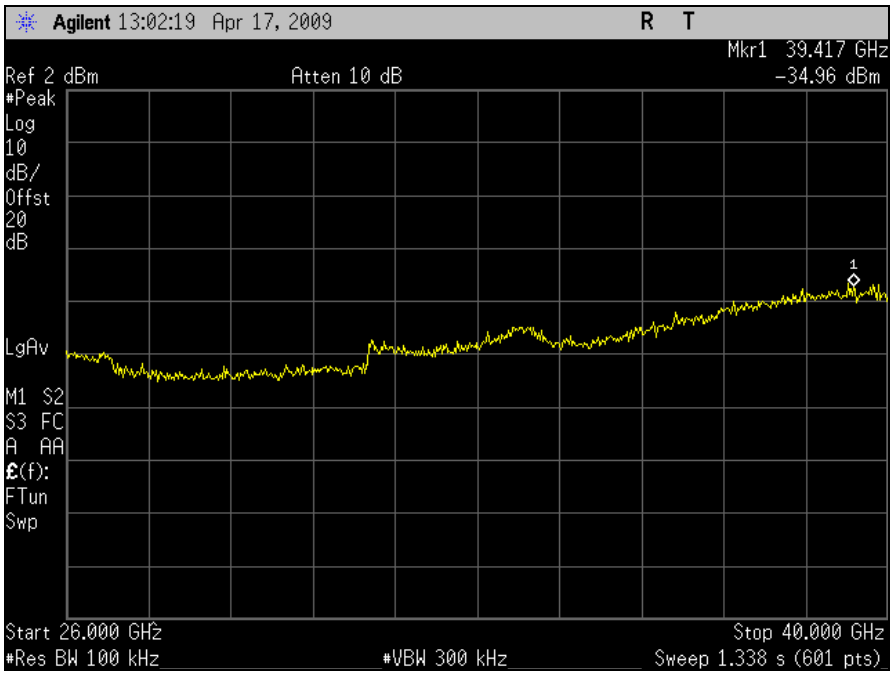
Plot 92. Conducted Emissions, High Channel, 30 MHz – 1 GHz, Port 1, 802.11a Mode



Plot 93. Conducted Emissions, High Channel, 1 GHz – 18 GHz, Port 1, 802.11a Mode

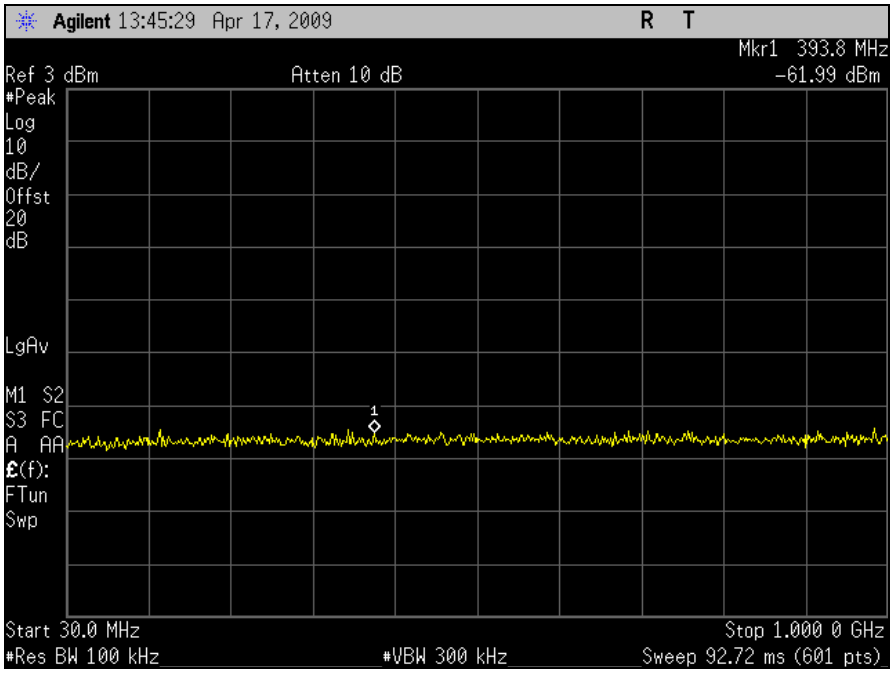


Plot 94. Conducted Emissions, High Channel, 18 GHz – 26 GHz, Port 1, 802.11a Mode

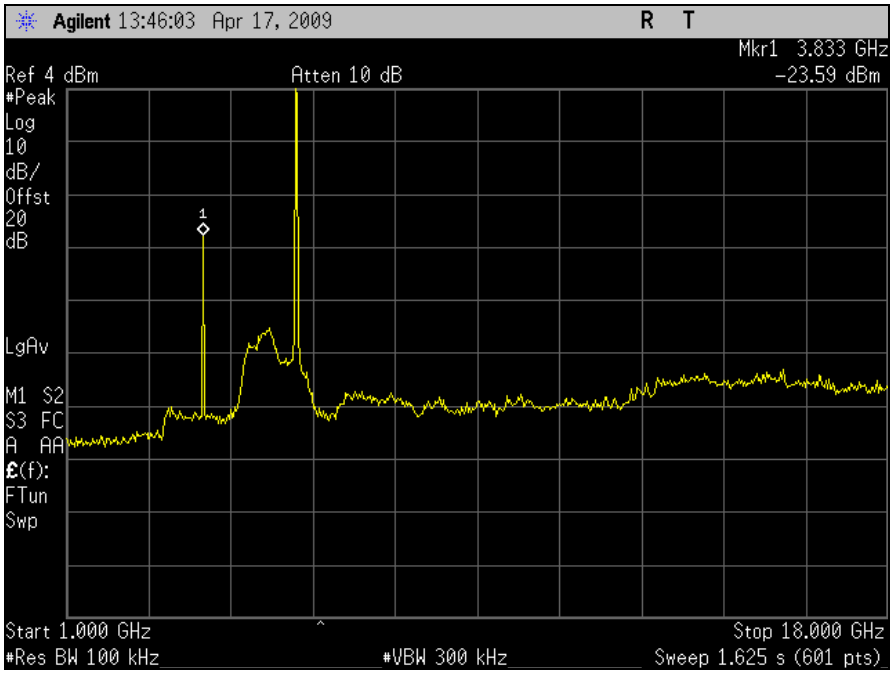


Plot 95. Conducted Emissions, High Channel, 26 GHz – 40 GHz, Port 1, 802.11a Mode

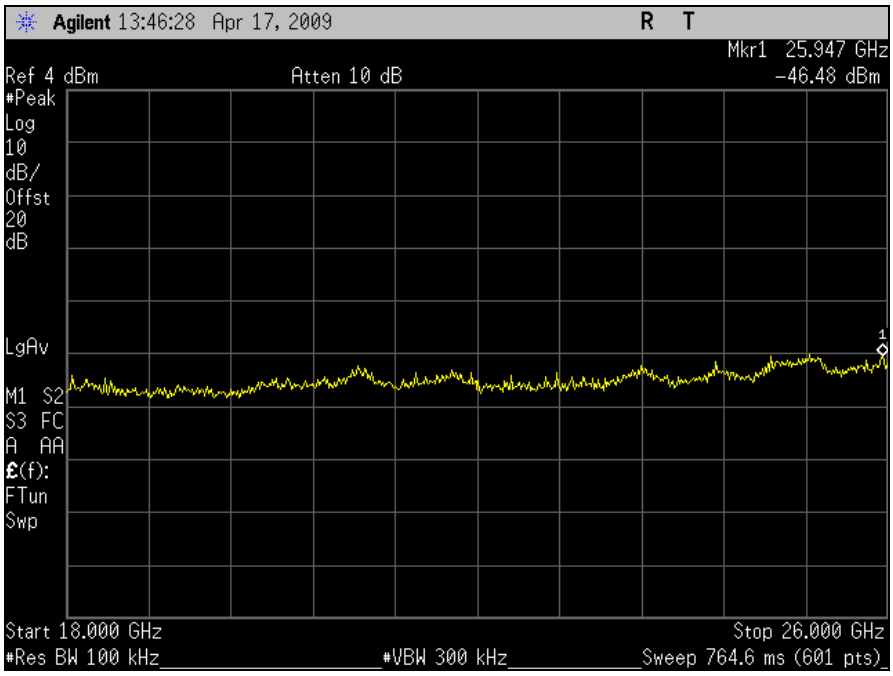
Conducted Emissions – Port 2, HT20



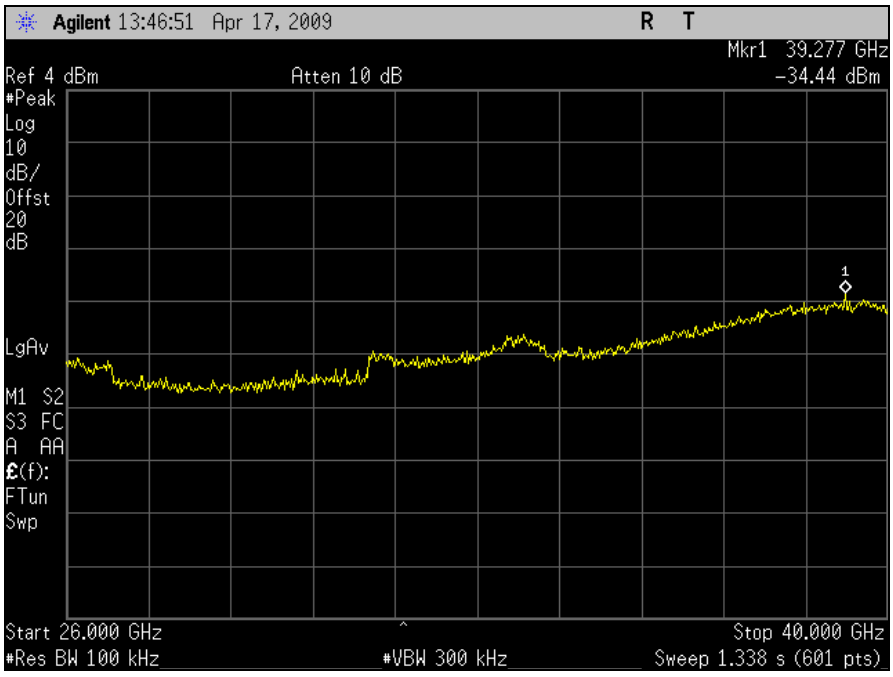
Plot 96. Conducted Emissions, Low Channel, 30 MHz – 1 GHz, Port 2, HT20



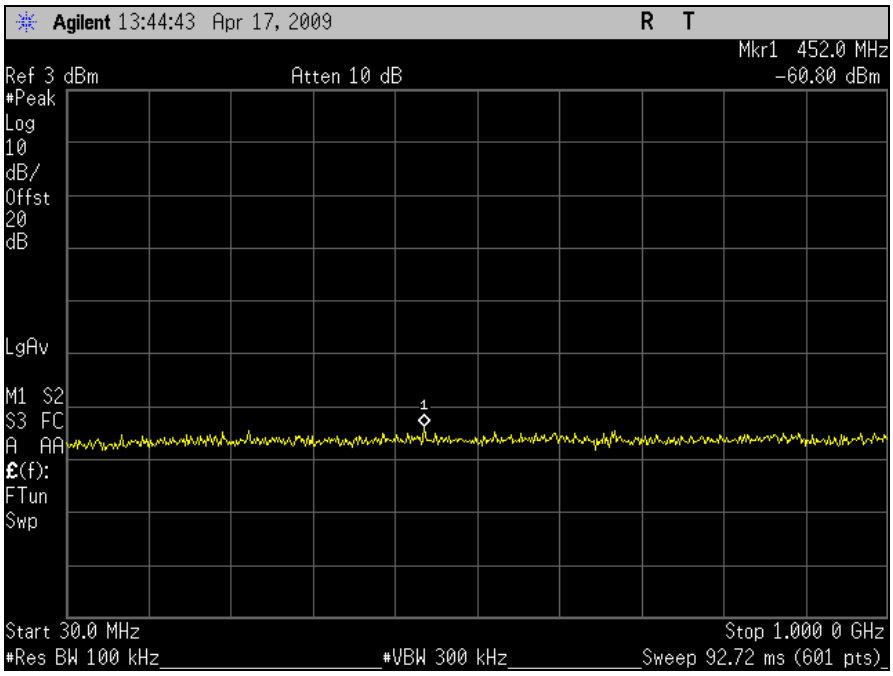
Plot 97. Conducted Emissions, Low Channel, 1 GHz – 18 GHz, Port 2, HT20



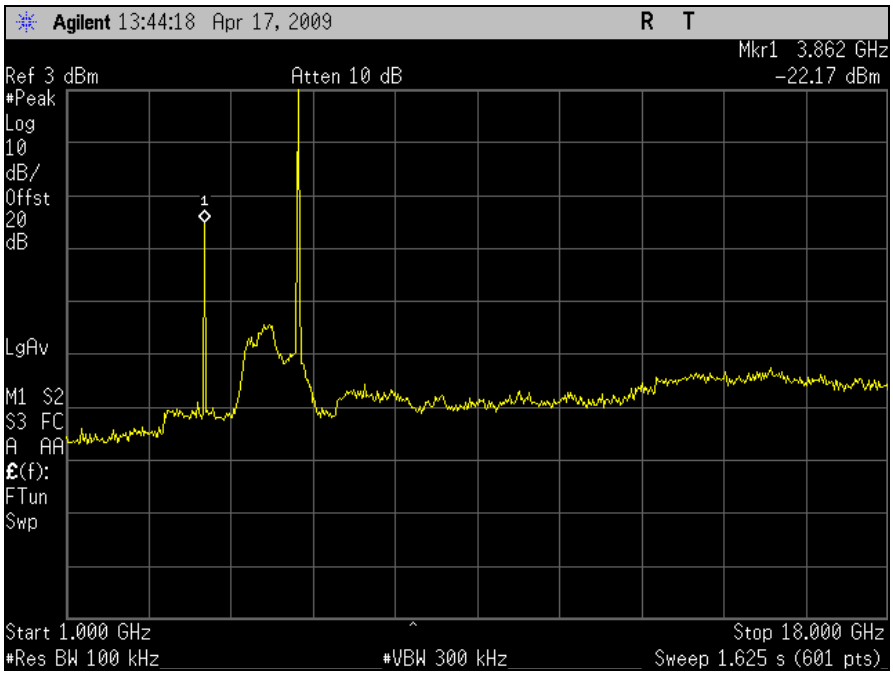
Plot 98. Conducted Emissions, Low Channel, 18 GHz – 26 GHz, Port 2, HT20



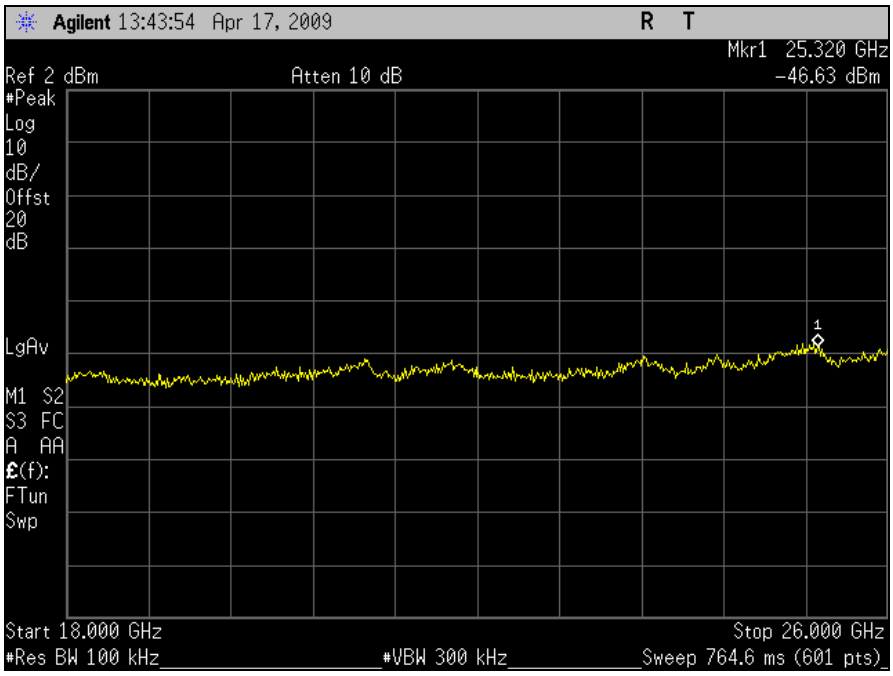
Plot 99. Conducted Emissions, Low Channel, 26 GHz – 40 GHz, Port 2, HT20



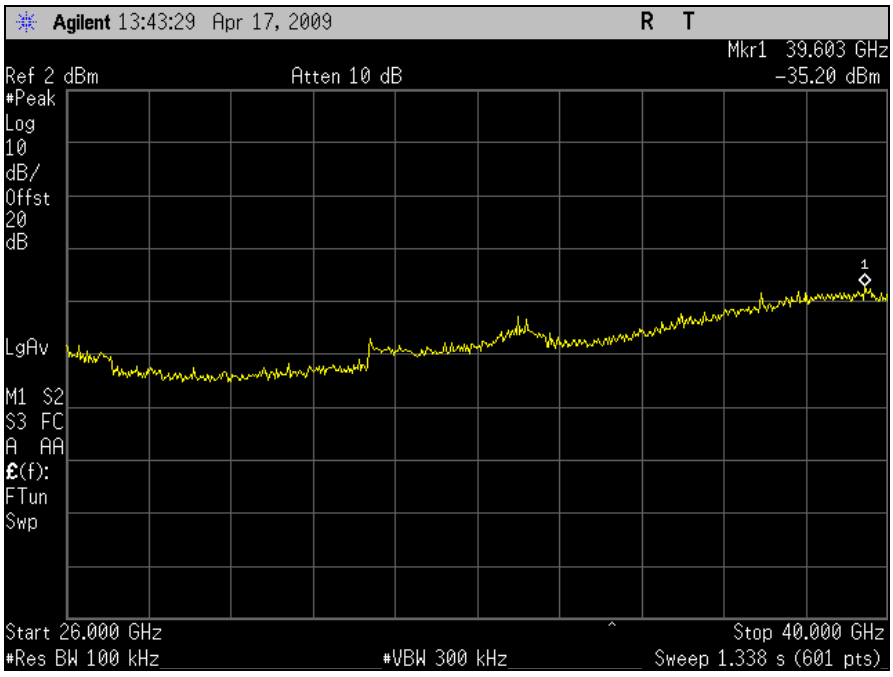
Plot 100. Conducted Emissions, Mid Channel, 30 MHz – 1 GHz, Port 2, HT20



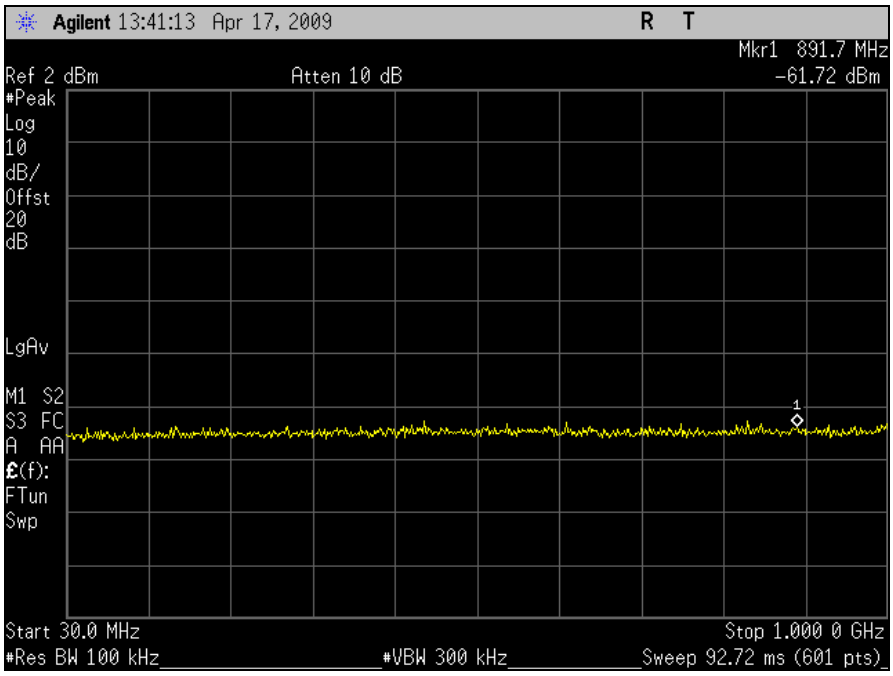
Plot 101. Conducted Emissions, Mid Channel, 1 GHz – 18 GHz, Port 2, HT20



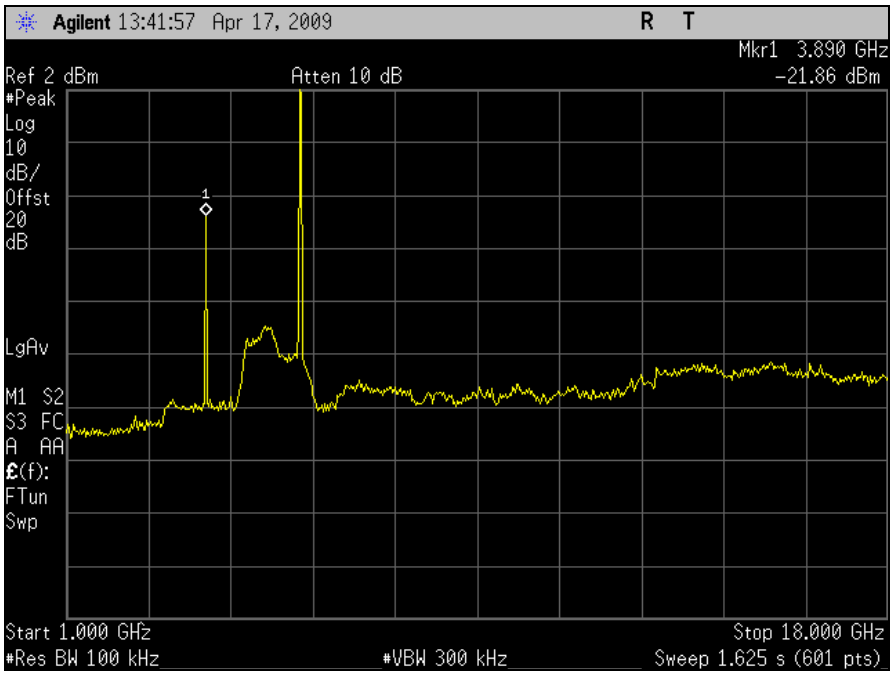
Plot 102. Conducted Emissions, Mid Channel, 18 GHz – 26 GHz, Port 2, HT20



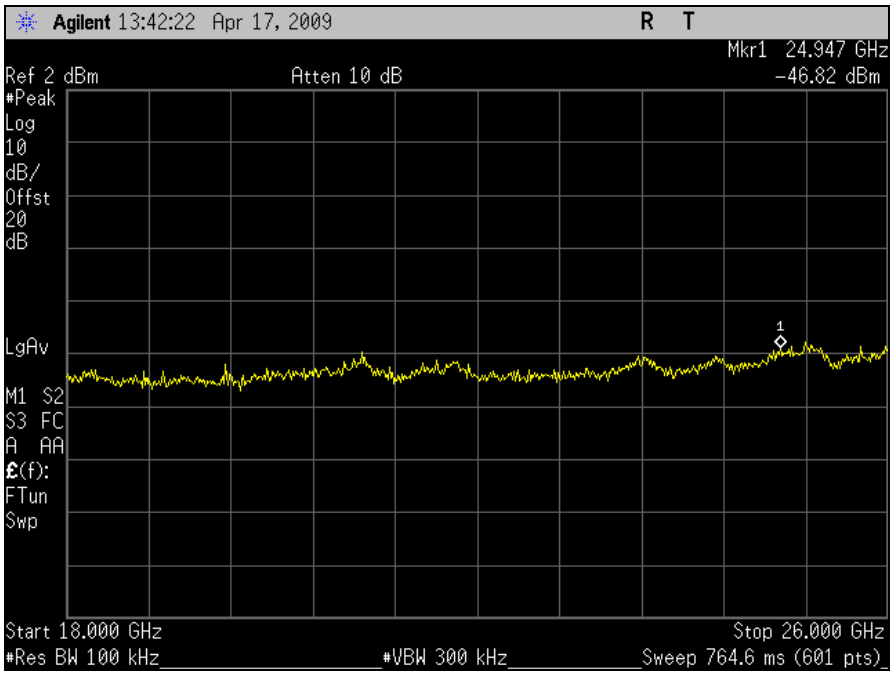
Plot 103. Conducted Emissions, Mid Channel, 26 GHz – 40 GHz, Port 2, HT20



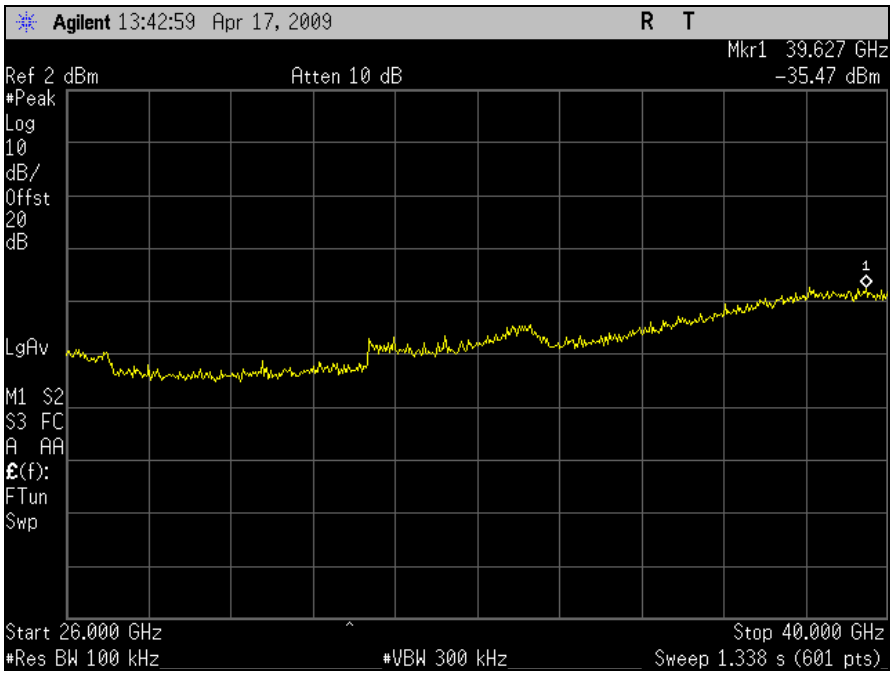
Plot 104. Conducted Emissions, High Channel, 30 MHz – 1 GHz, Port 2, HT20



Plot 105. Conducted Emissions, High Channel, 1 GHz – 18 GHz, Port 2, HT20

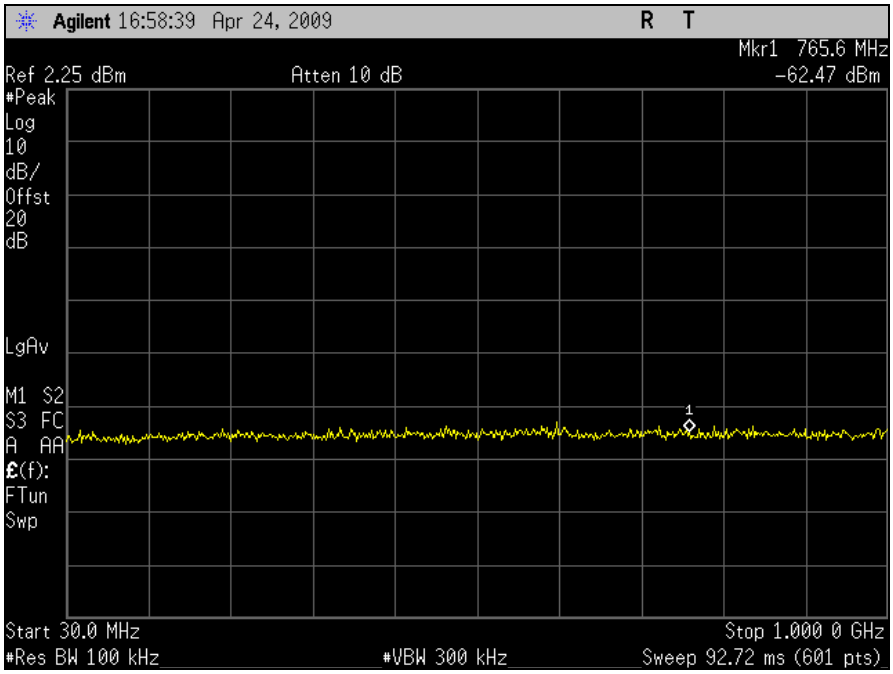


Plot 106. Conducted Emissions, High Channel, 18 GHz – 26 GHz, Port 2, HT20

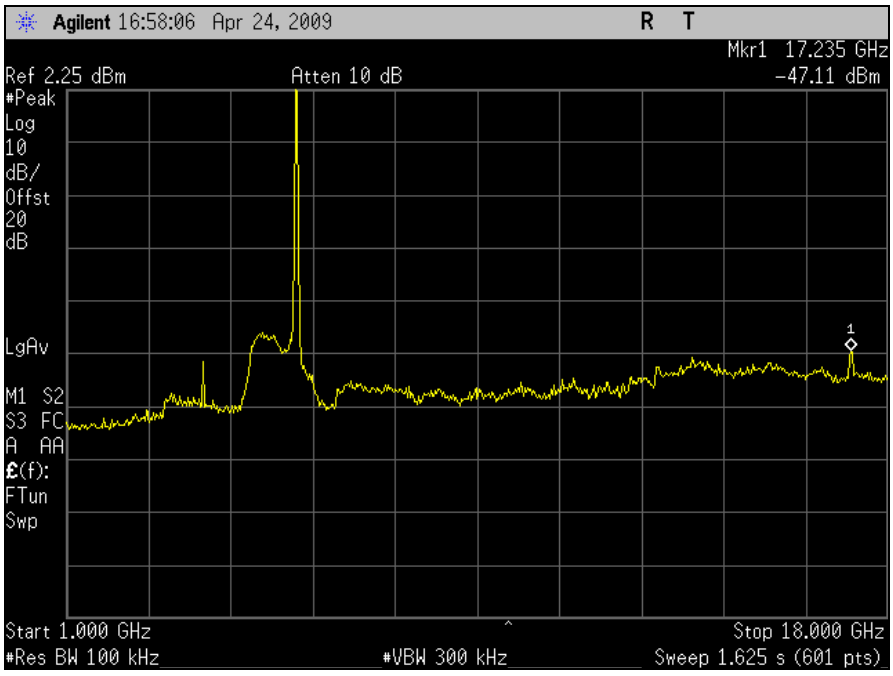


Plot 107. Conducted Emissions, High Channel, 26 GHz – 40 GHz, Port 2, HT20

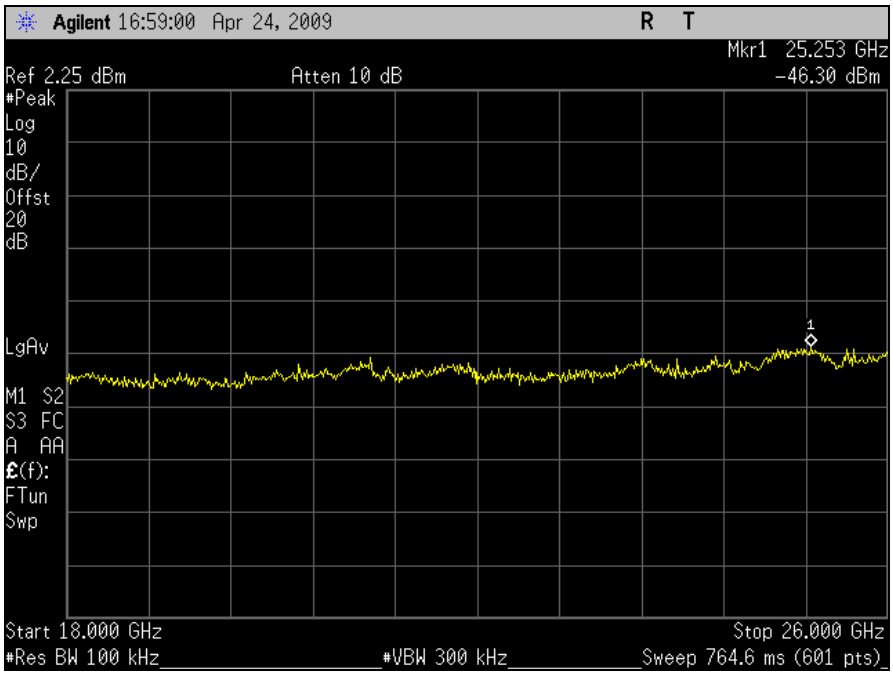
Conducted Emissions – Port 2, HT40



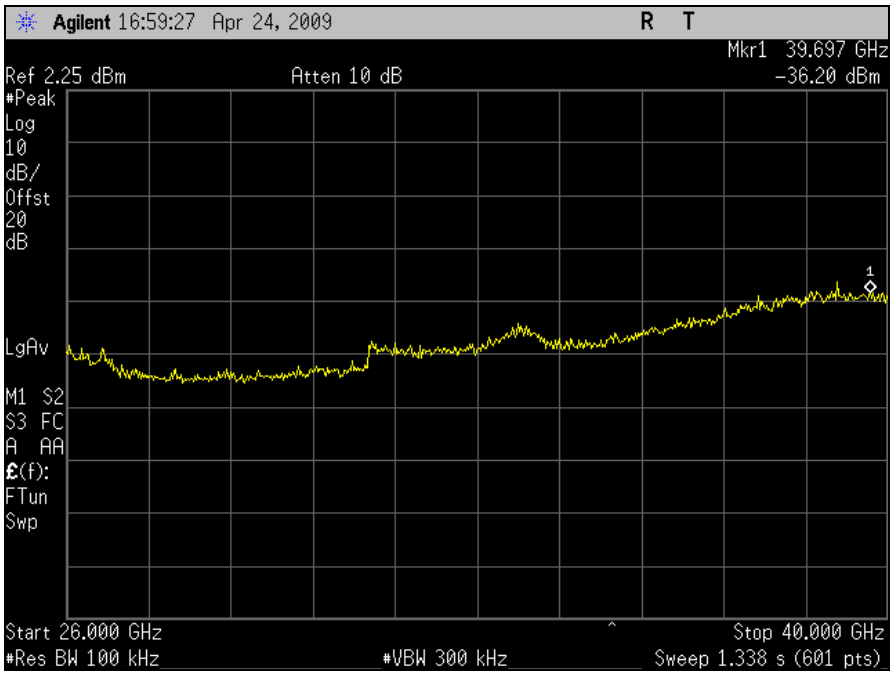
Plot 108. Conducted Emissions, Low Channel, 30 MHz – 1 GHz, Port 2, HT40



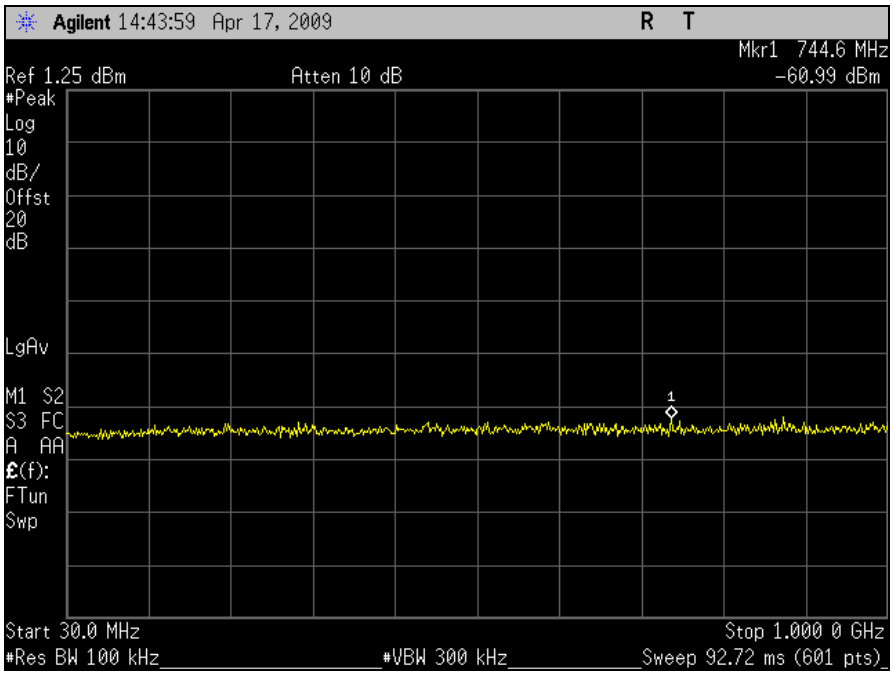
Plot 109. Conducted Emissions, Low Channel, 1 GHz – 18 GHz, Port 2, HT40



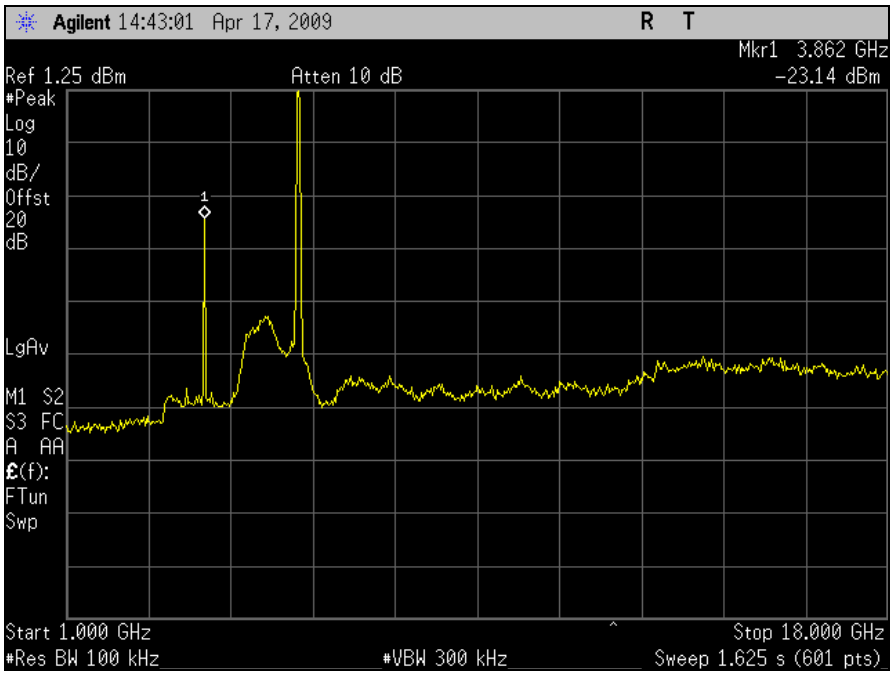
Plot 110. Conducted Emissions, Low Channel, 18 GHz – 26 GHz, Port 2, HT40



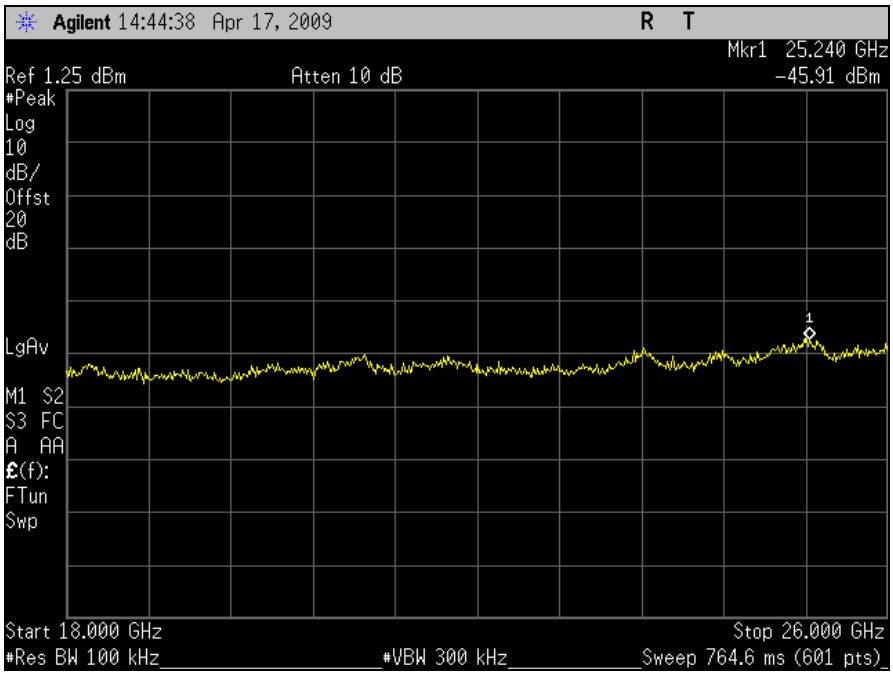
Plot 111. Conducted Emissions, Low Channel, 26 GHz – 40 GHz, Port 2, HT40



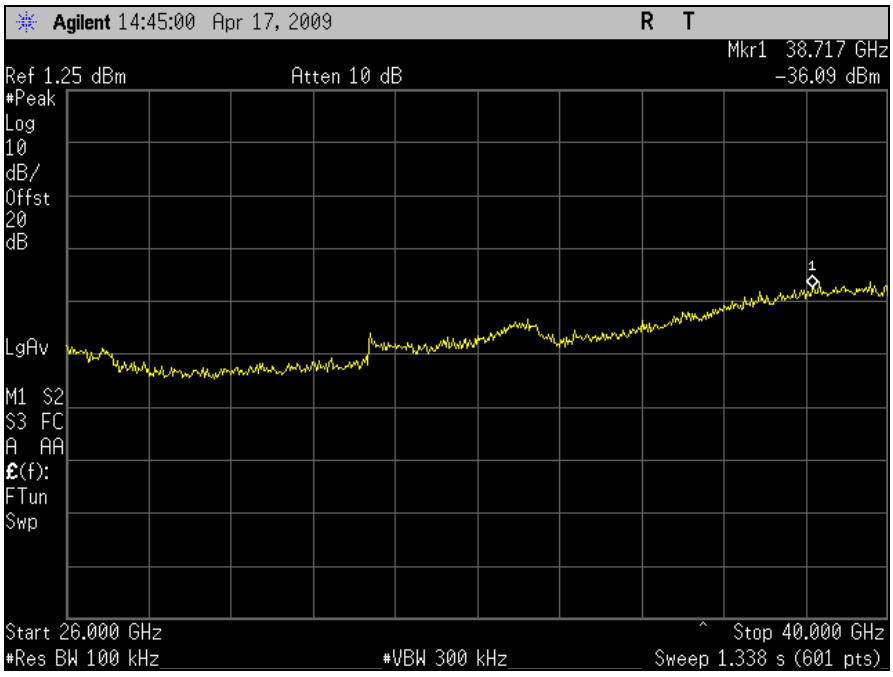
Plot 112. Conducted Emissions, Mid Channel, 30 MHz – 1 GHz, Port 2, HT40



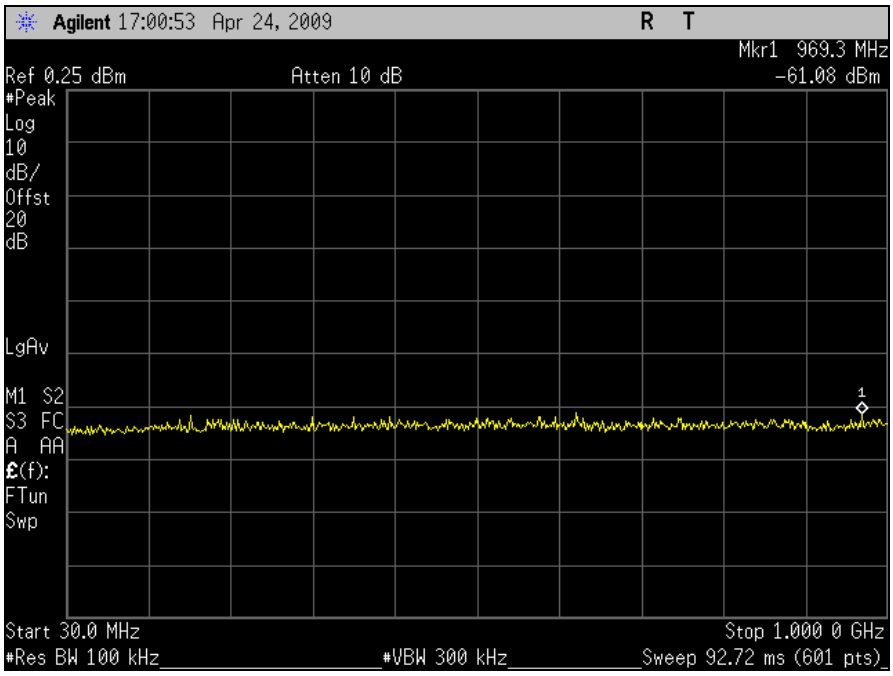
Plot 113. Conducted Emissions, Mid Channel, 1 GHz – 18 GHz, Port 2, HT40



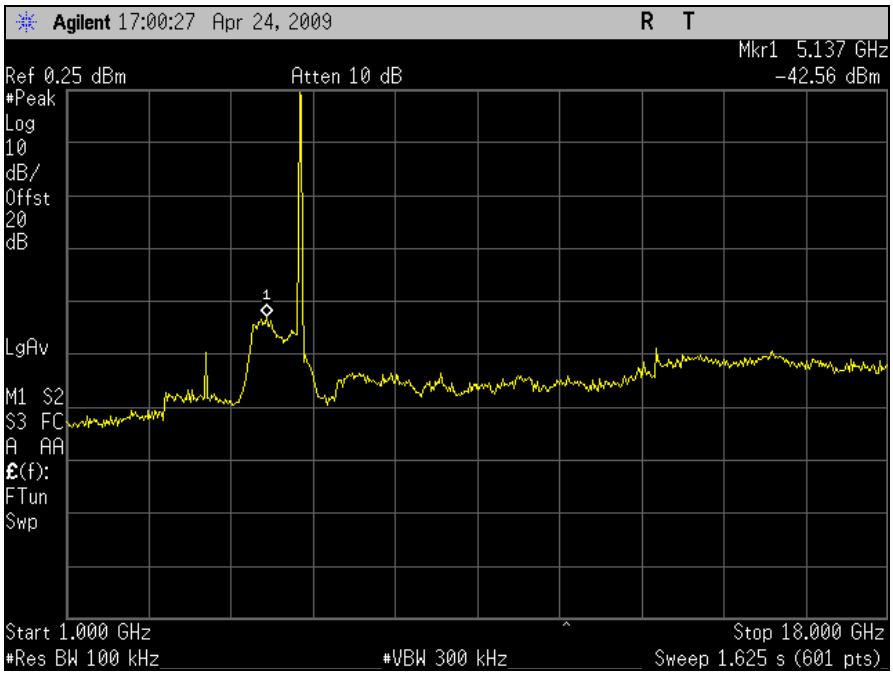
Plot 114. Conducted Emissions, Mid Channel, 18 GHz – 26 GHz, Port 2, HT40



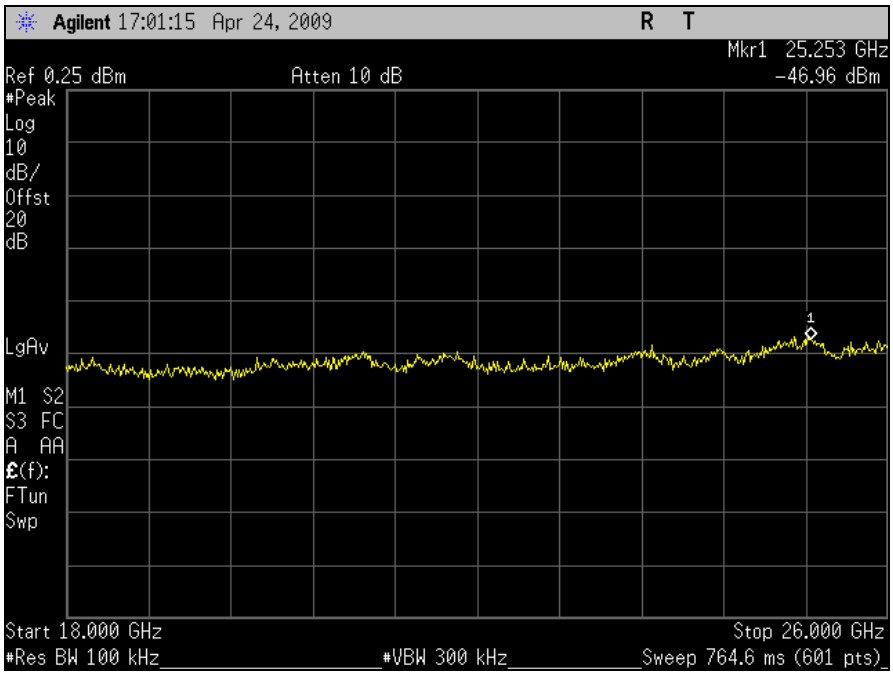
Plot 115. Conducted Emissions, Mid Channel, 26 GHz – 40 GHz, Port 2, HT40



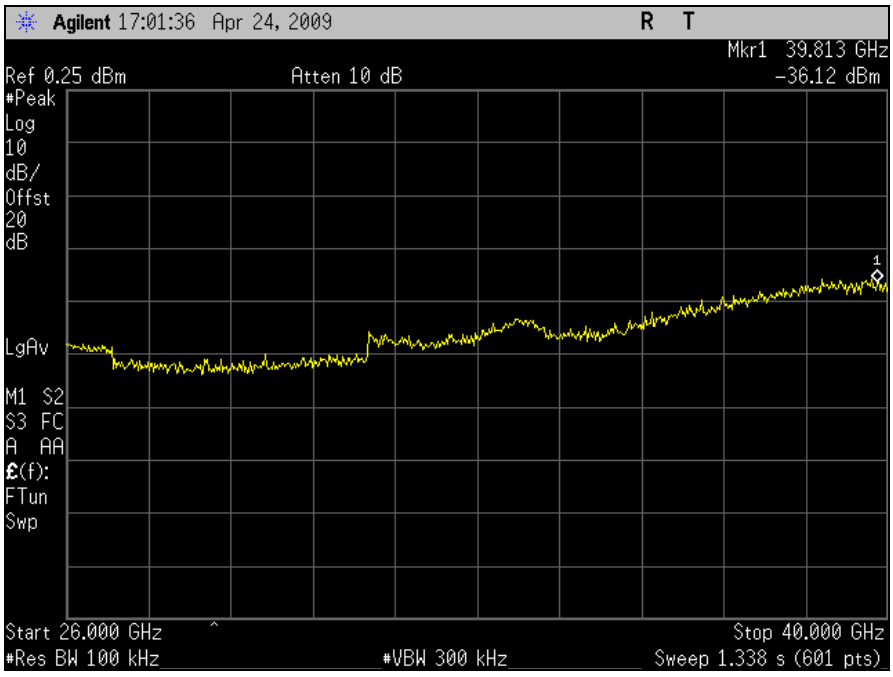
Plot 116. Conducted Emissions, High Channel, 30 MHz – 1 GHz, Port 2, HT40



Plot 117. Conducted Emissions, High Channel, 1 GHz – 18 GHz, Port 2, HT40

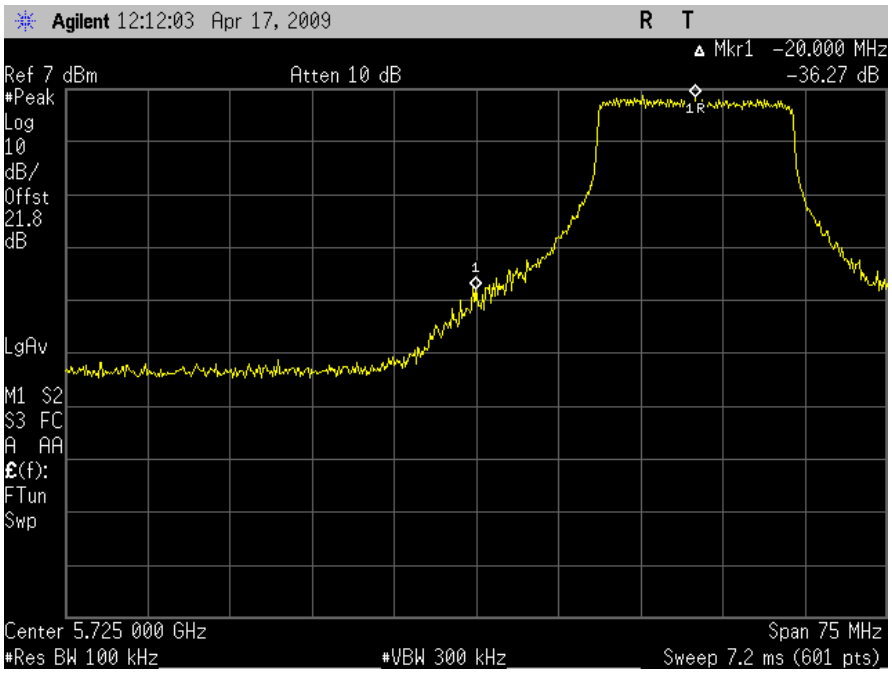


Plot 118. Conducted Emissions, High Channel, 18 GHz – 26 GHz, Port 2, HT40

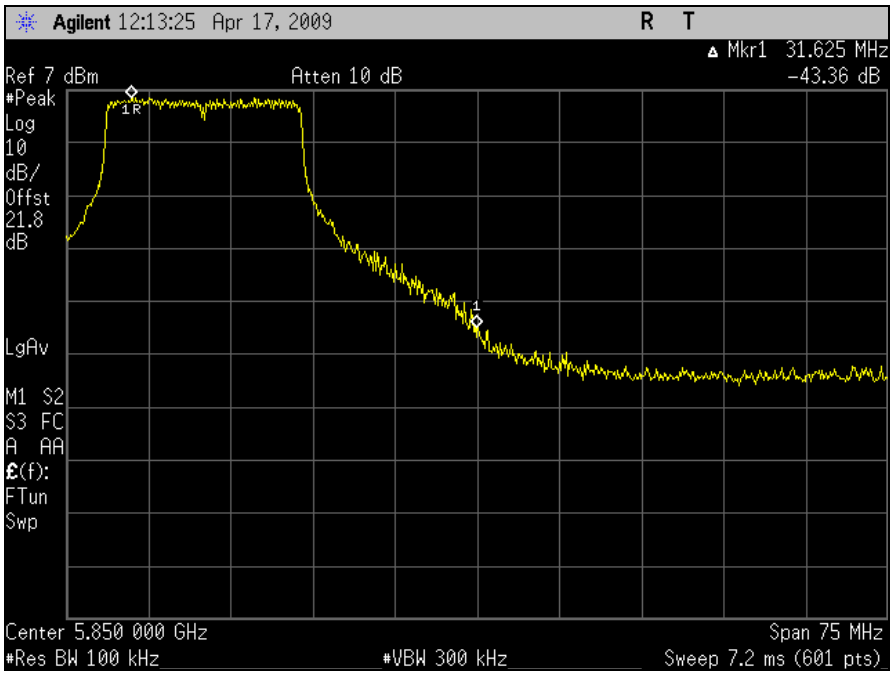


Plot 119. Conducted Emissions, High Channel, 26 GHz – 40 GHz, Port 2, HT40

§ 15.247 Spurious Emissions Requirements –Band Edge (Conducted) – Port 1, HT20

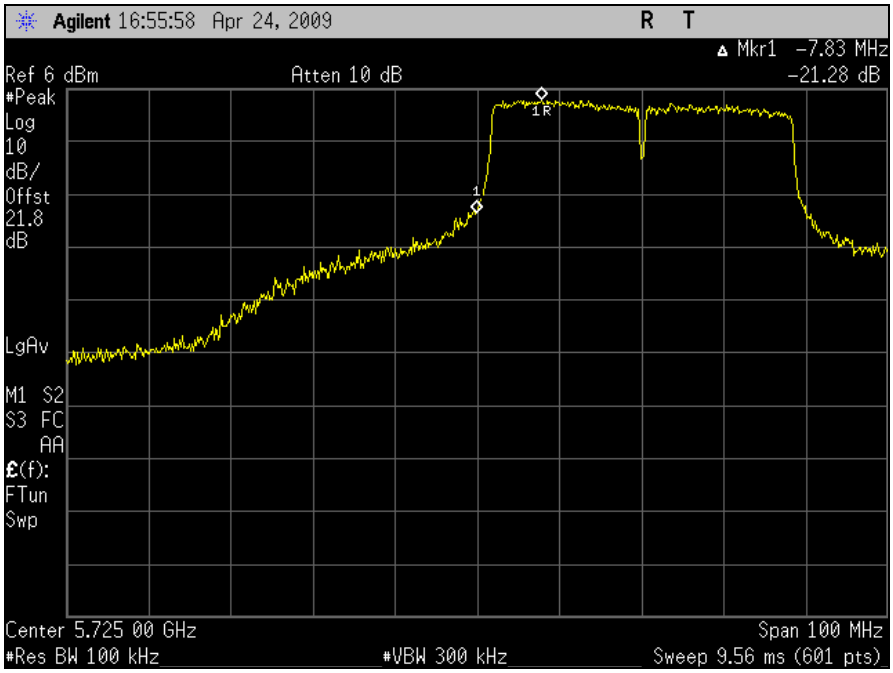


Plot 120. Conducted Band Edge, Low Channel, Port 1, HT20

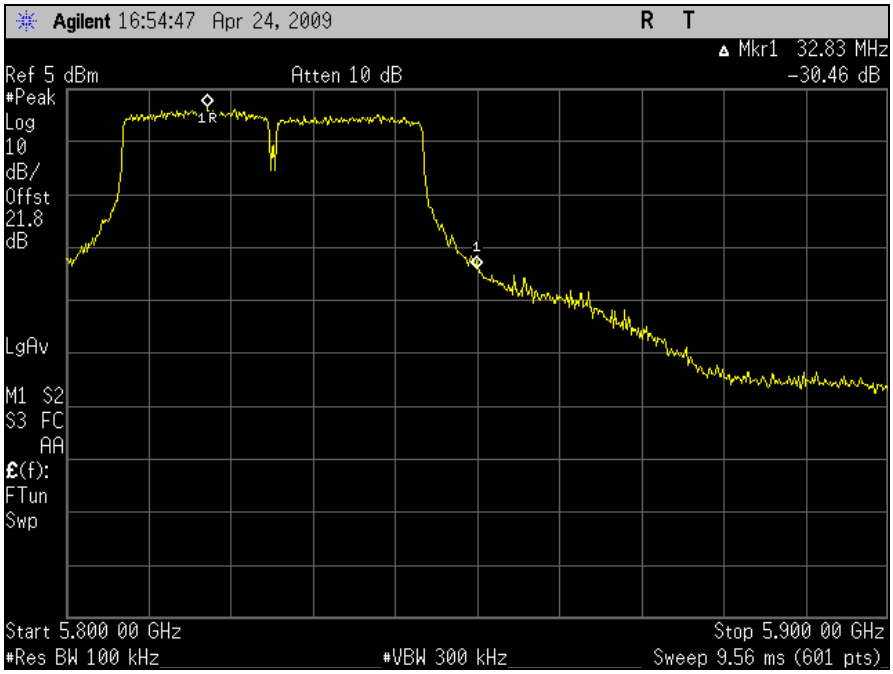


Plot 121. Conducted Band Edge, High Channel, Port 1, HT20

Conducted Band Edge – Port 1, HT40

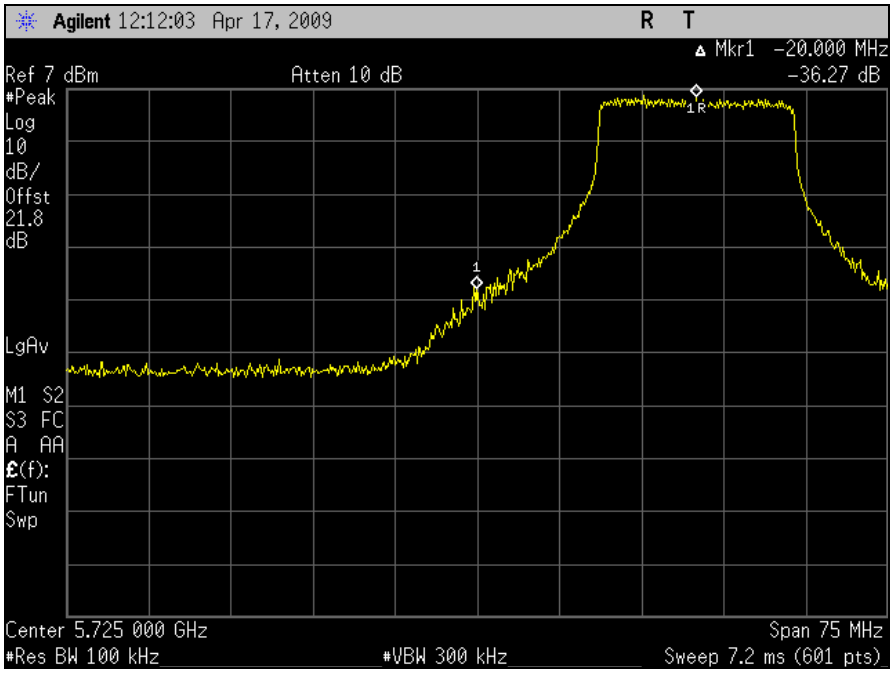


Plot 122. Conducted Band Edge, Low Channel, Port 1, HT40

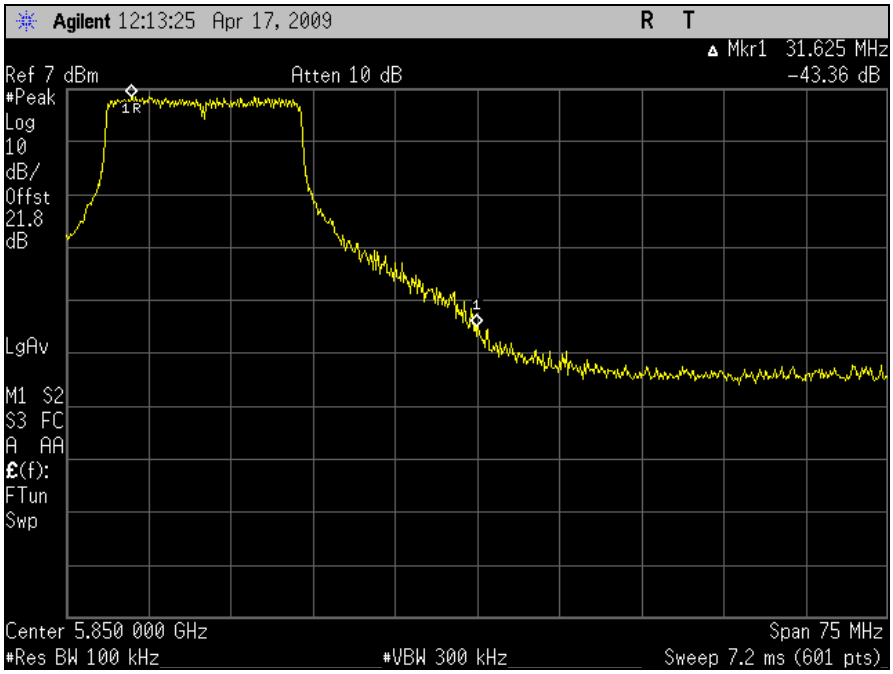


Plot 123. Conducted Band Edge, High Channel, Port 1, HT40

Conducted Band Edge – Port 1, 802.11a Mode

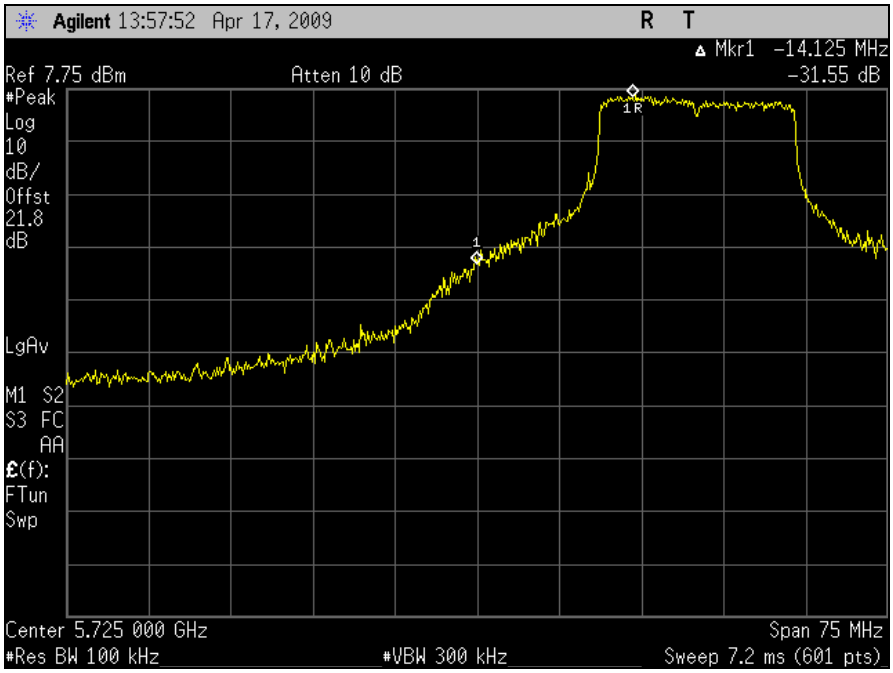


Plot 124. Conducted Band Edge, Low Channel, Port 1, 802.11a Mode

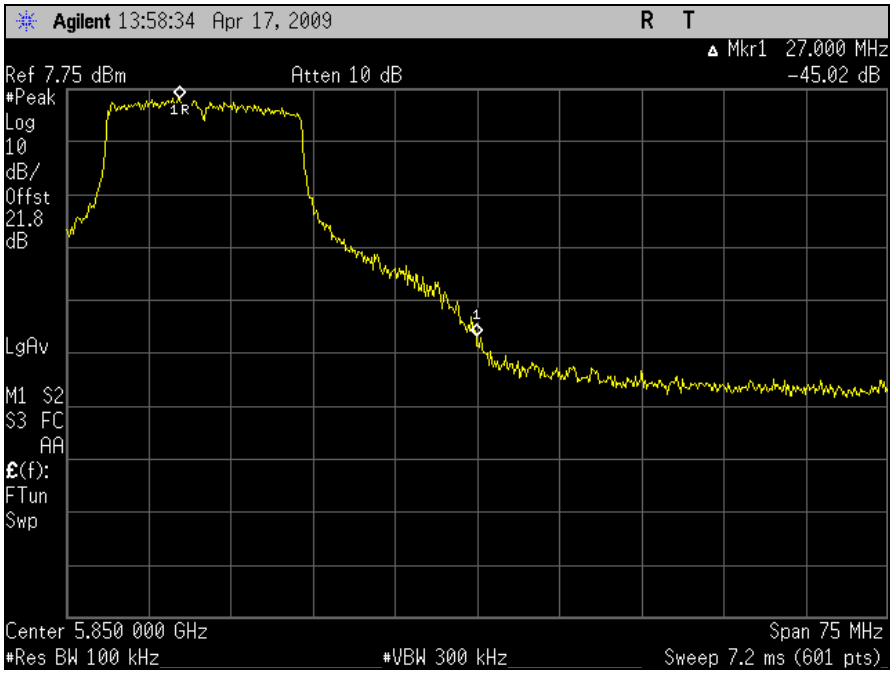


Plot 125. Conducted Band Edge, High Channel, Port 1, 802.11a Mode

Conducted Band Edge – Port 2, HT20

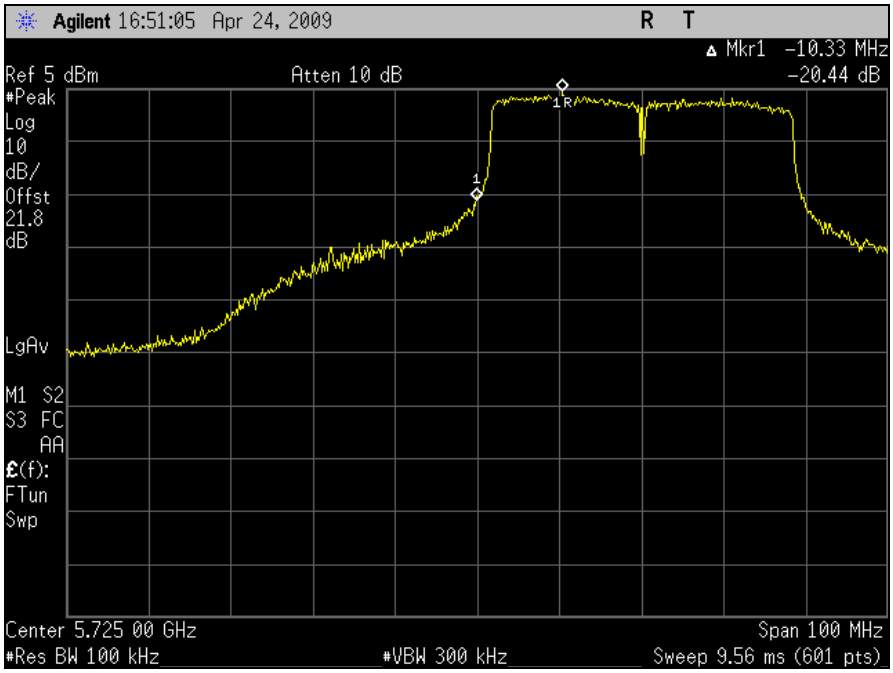


Plot 126. Conducted Band Edge, Low Channel, Port 2, HT20

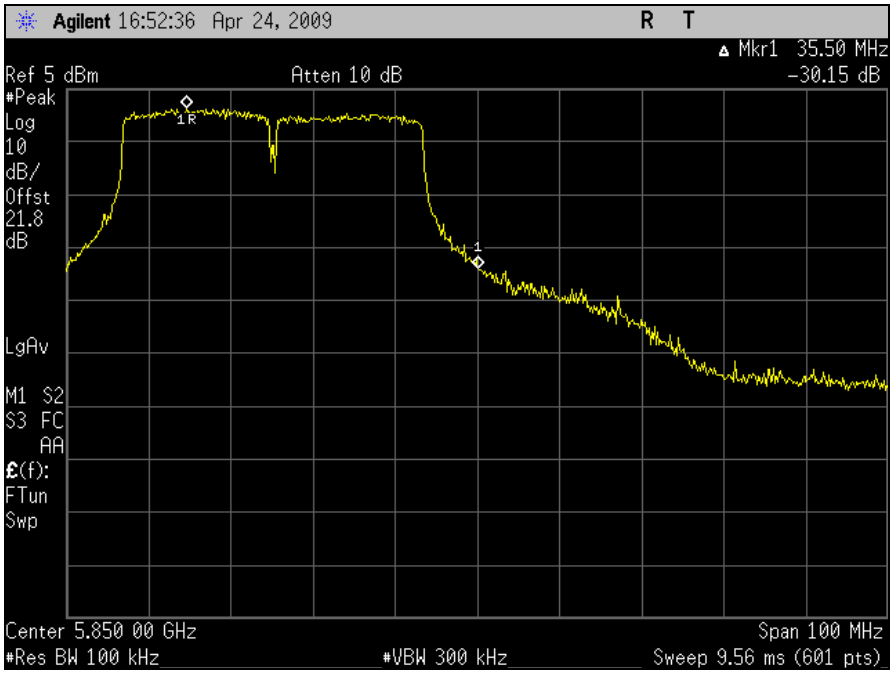


Plot 127. Conducted Band Edge, High Channel, Port 2, HT20

Conducted Band Edge – Port 2, HT40



Plot 128. Conducted Band Edge, Low Channel, Port 2, HT40



Plot 129. Conducted Band Edge, High Channel, Port 2, HT40

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(e) Peak Power Spectral Density

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

Test Procedure: The transmitter was connected directly to a Spectrum Analyzer through a directional couple. The power was monitored at the coupler port with a Peak Power Meter. The power level was set to the maximum level. The RBW was set to 3 kHz and VBW was set to 10 kHz and a SPAN of 1.0 MHz with a 333.3 second sweep on the Spectrum Analyzer. Measurements were carried out at the low, mid and high channels. For MIMO mode a RF combiner was used.

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

Test Engineer: Anderson Soungpanya

Test Date: 04/27/09

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(e) Peak Power Spectral Density

HT20 Port 1				
Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5748	-7.04	8	15.04
Mid	5783	-6.05	8	14.05
High	5822	-4.66	8	12.66

Table 54. Peak Power Spectral Density Test Results, HT20, Port 1

HT40 Port 1				
Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5748	-8.39	8	16.38
Mid	5783	-8.55	8	16.55
High	5822	-8.12	8	16.12

Table 55. Peak Power Spectral Density Test Results, HT40, Port 1

a mode Port 1				
Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5748	-7.04	8	15.04
Mid	5783	-6.05	8	14.05
High	5822	-4.66	8	12.66

Table 56. Peak Power Spectral Density Test Results, A mode, Port 1

HT20 Port 2				
Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5748	-6.60	8	14.60
Mid	5783	-5.40	8	13.40
High	5822	-6.30	8	14.30

Table 57. Peak Power Spectral Density Test Results, HT20, Port 2

HT40 Port 2				
Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5748	-6.55	8	14.55
Mid	5783	-6.61	8	14.61
High	5822	-8.82	8	16.82

Table 58. Peak Power Spectral Density Test Results, HT40, Port 2

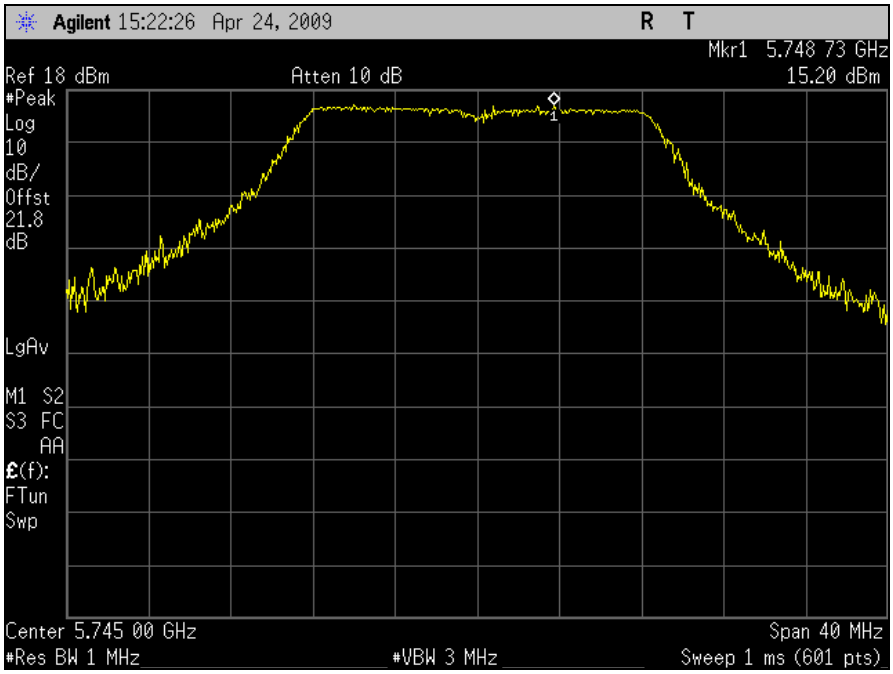
HT20 MIMO Mode				
Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5748	-2.30	8	10.30
Mid	5783	-5.51	8	13.51
High	5822	-4.17	8	12.17

Table 59. Peak Power Spectral Density Test Results, HT20, MIMO Mode

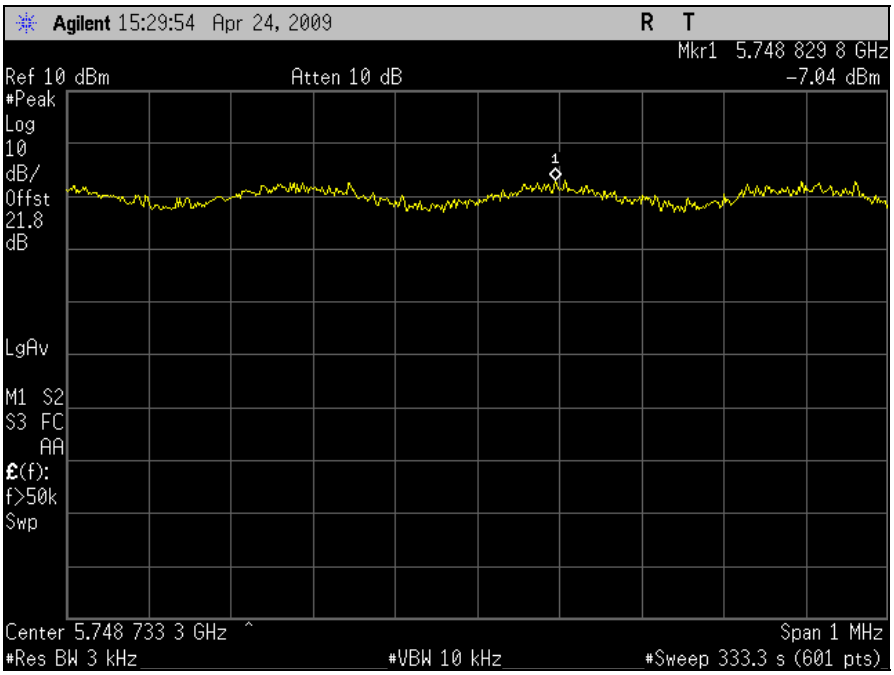
HT40 MIMO Mode				
Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5748	-5.26	8	13.26
Mid	5783	-5.70	8	13.70
High	5822	-6.94	8	14.94

Table 60. Peak Power Spectral Density Test Results, HT40, MIMO Mode

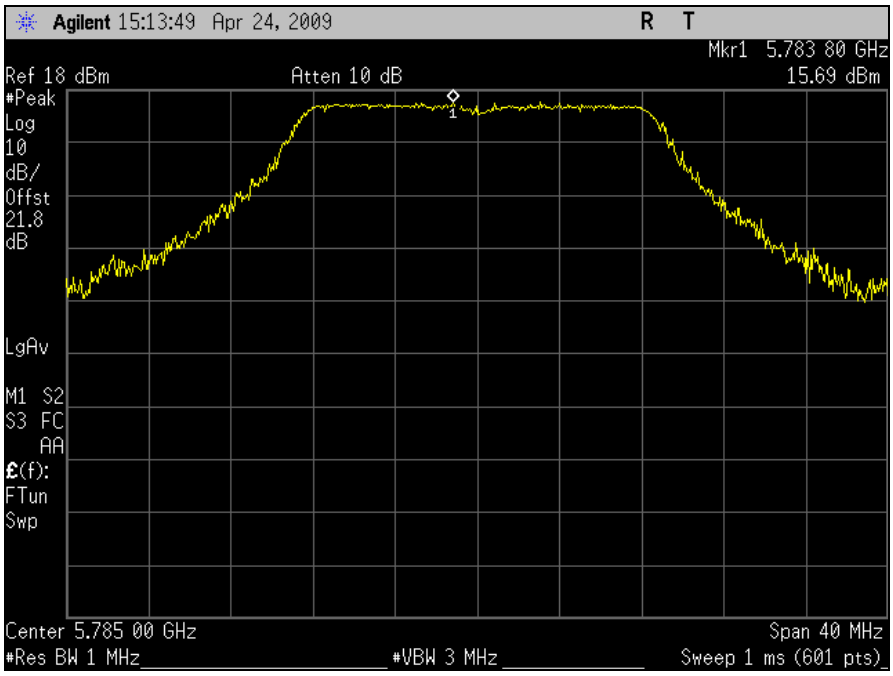
Peak Power Spectral Density Test Results – Port 1, HT20



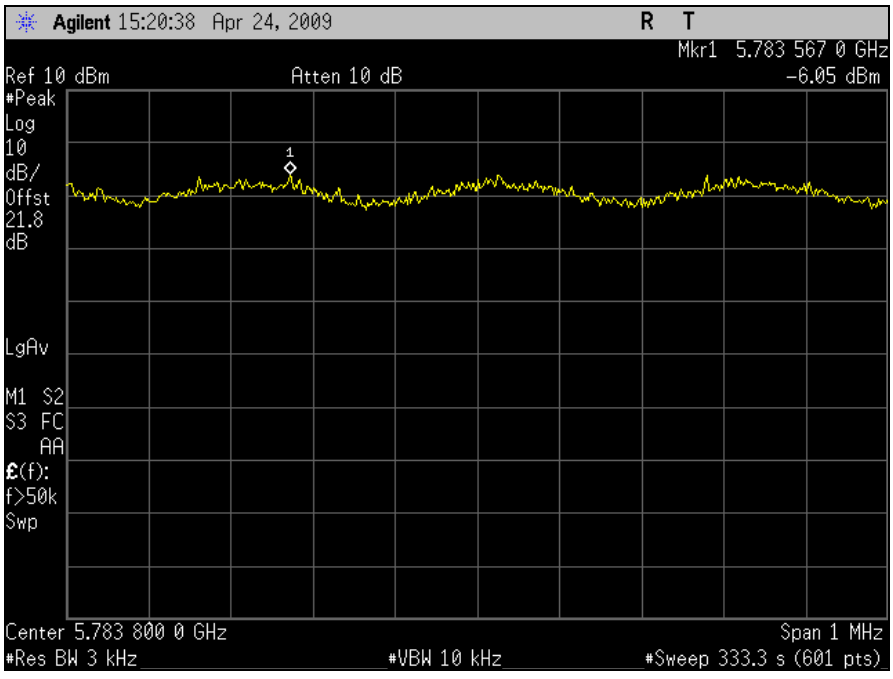
Plot 130. Peak Power Spectral Density, Low Channel, Determination, Port 1, HT20



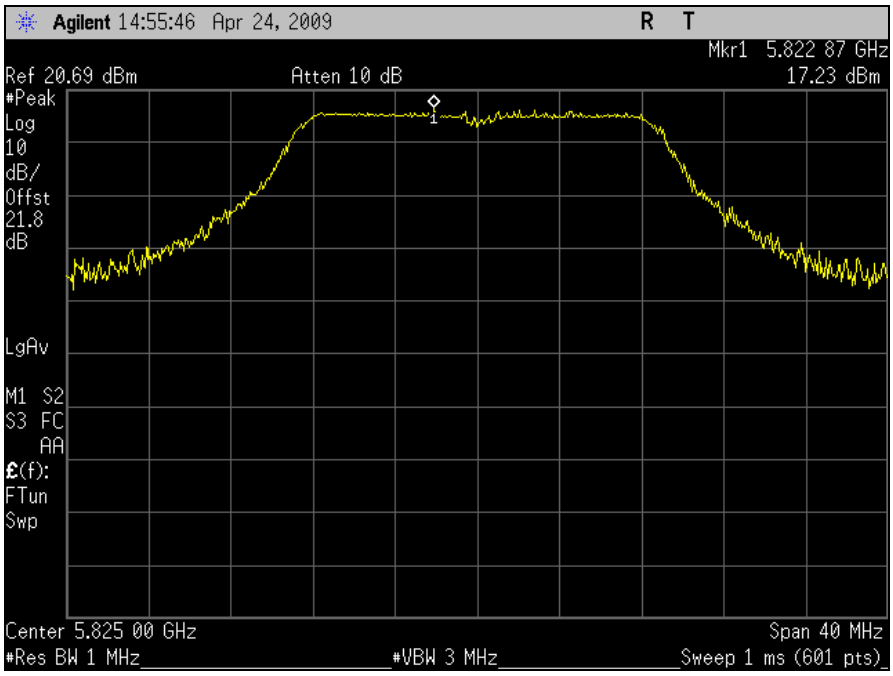
Plot 131. Peak Power Spectral Density, Low Channel, Port 1, HT20



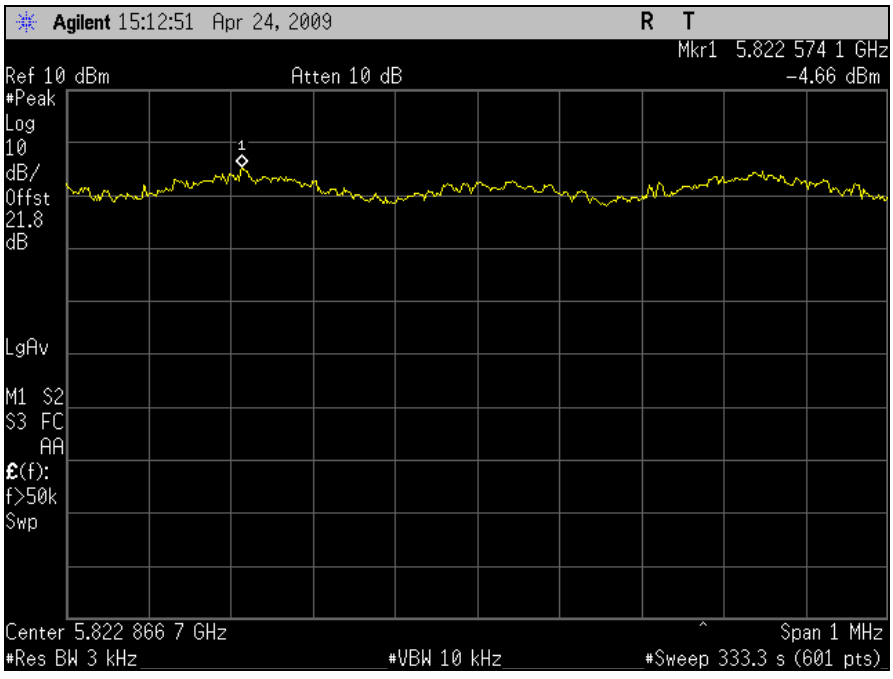
Plot 132. Peak Power Spectral Density, Mid Channel, Determination, Port 1, HT20



Plot 133. Peak Power Spectral Density, Mid Channel, Port 1, HT20

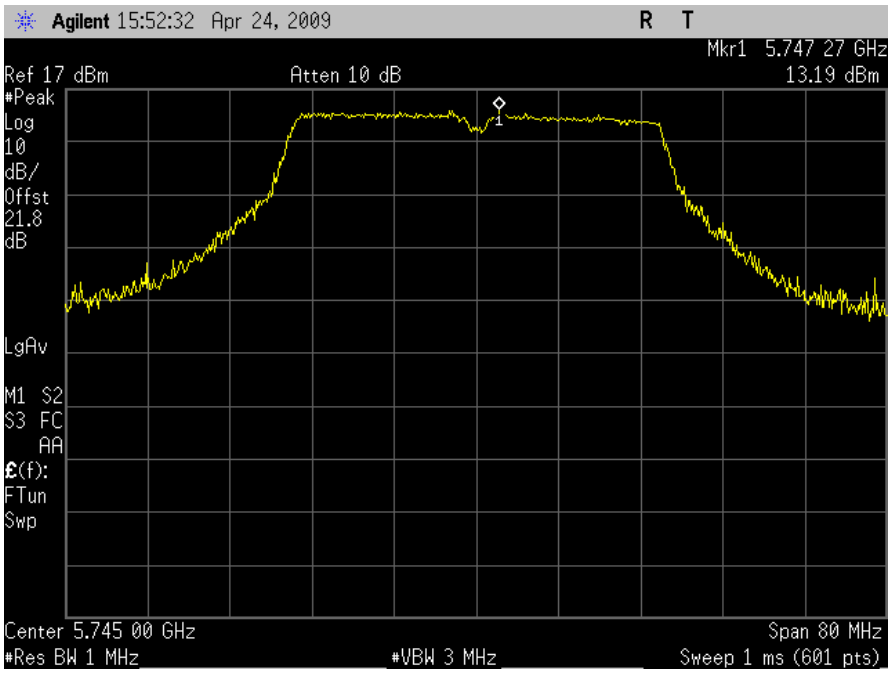


Plot 134. Peak Power Spectral Density, High Channel, Determination, Port 1, HT20

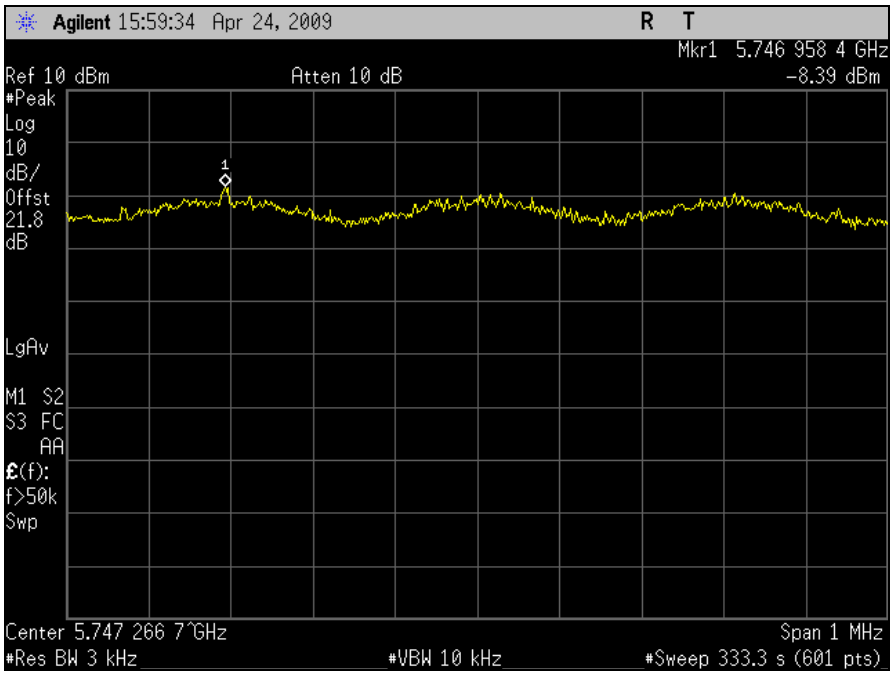


Plot 135. Peak Power Spectral Density, High Channel, Port 1, HT20

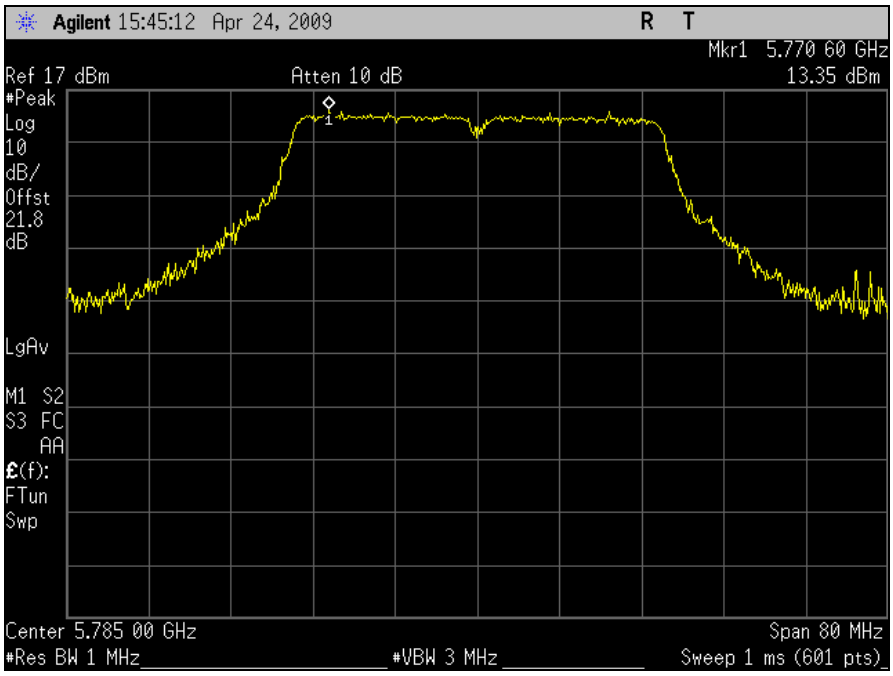
Peak Power Spectral Density Test Results – Port 1, HT40



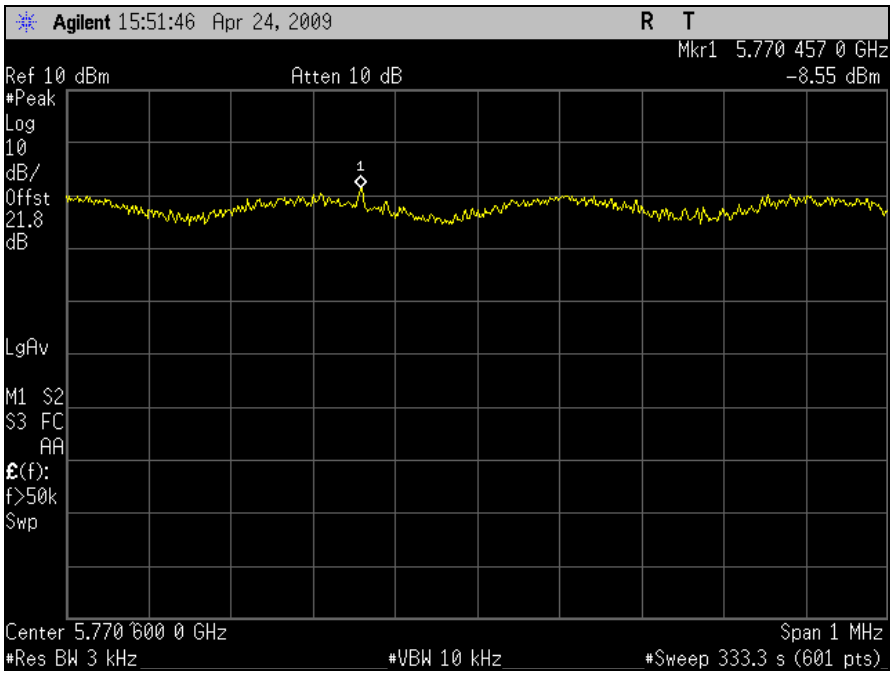
Plot 136. Peak Power Spectral Density, Low Channel, Determination, Port 1, HT40



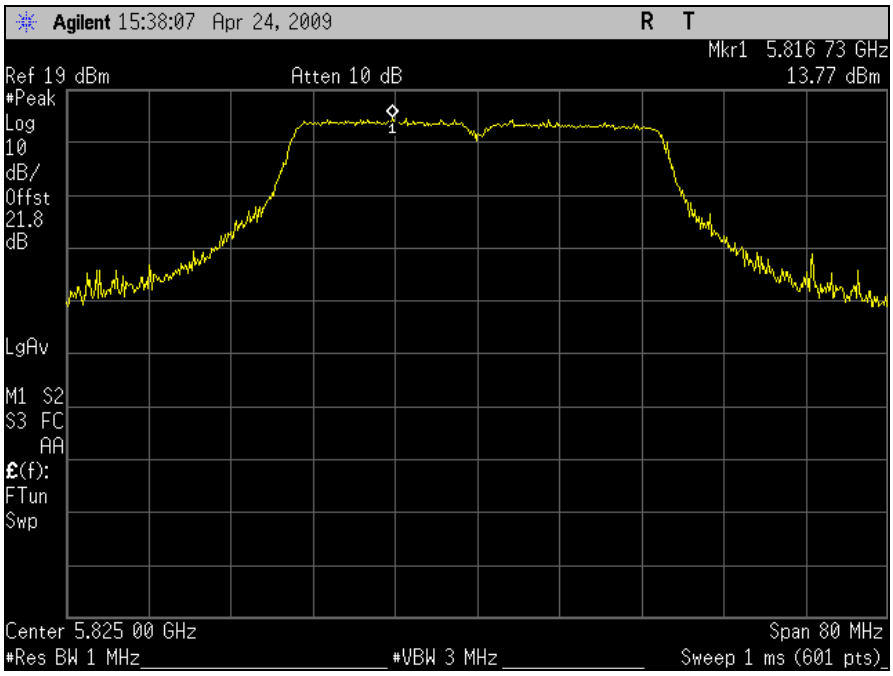
Plot 137. Peak Power Spectral Density, Low Channel, Port 1, HT40



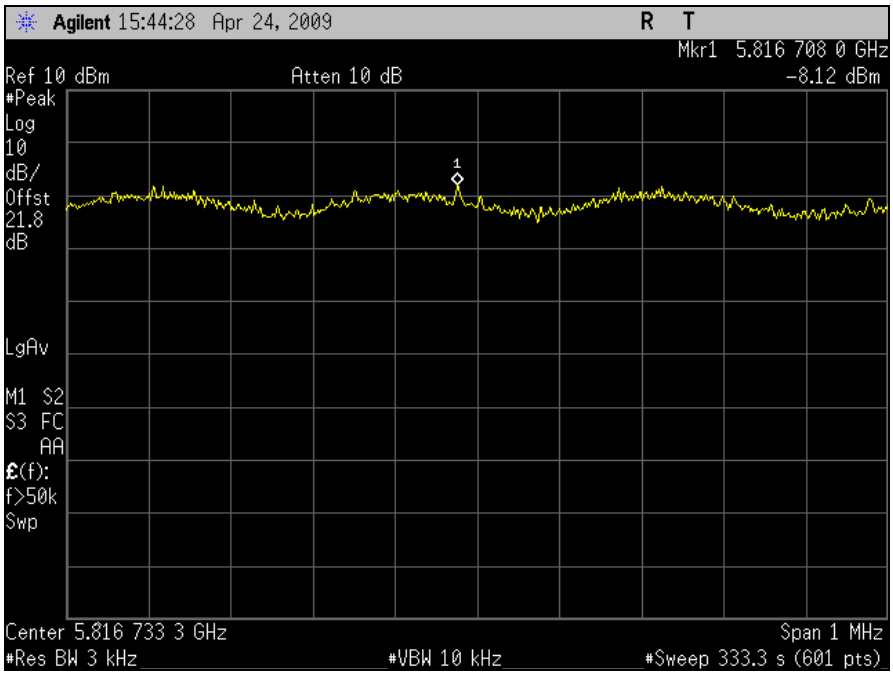
Plot 138. Peak Power Spectral Density, Mid Channel, Determination, Port 1, HT40



Plot 139. Peak Power Spectral Density, Mid Channel, Port 1, HT40

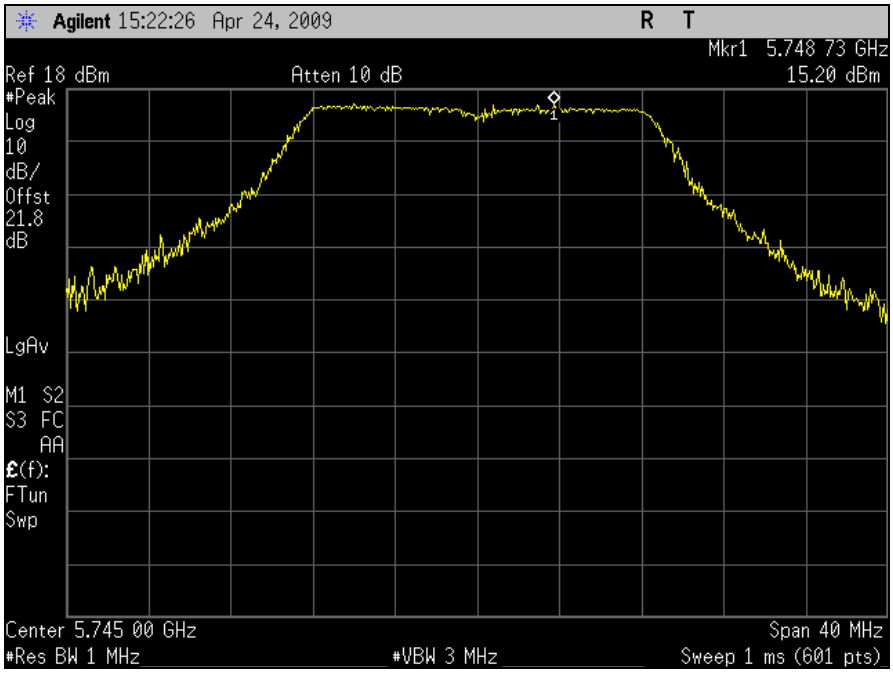


Plot 140. Peak Power Spectral Density, High Channel, Determination, Port 1, HT40

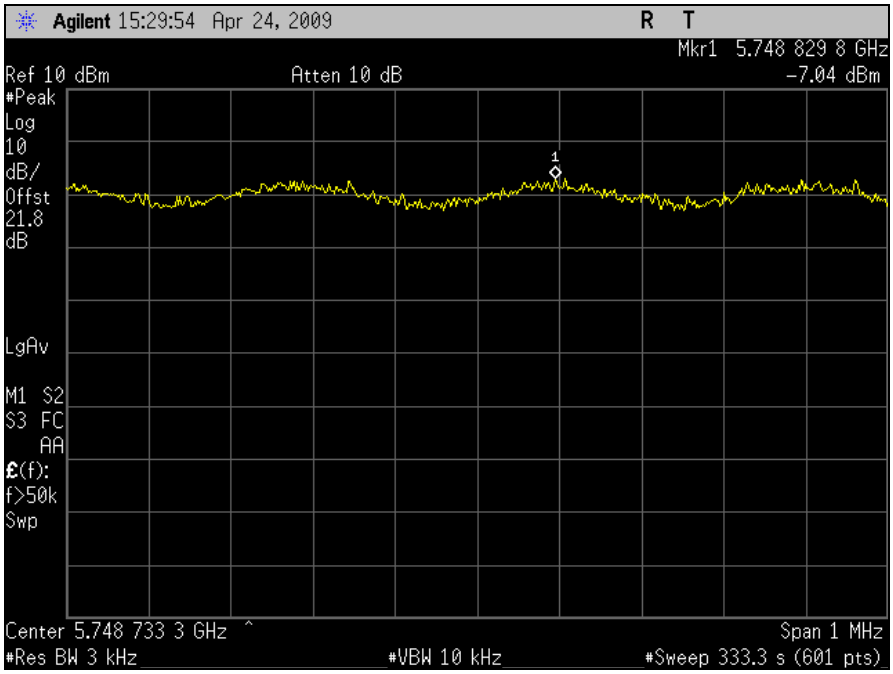


Plot 141. Peak Power Spectral Density, High Channel, Port 1, HT40

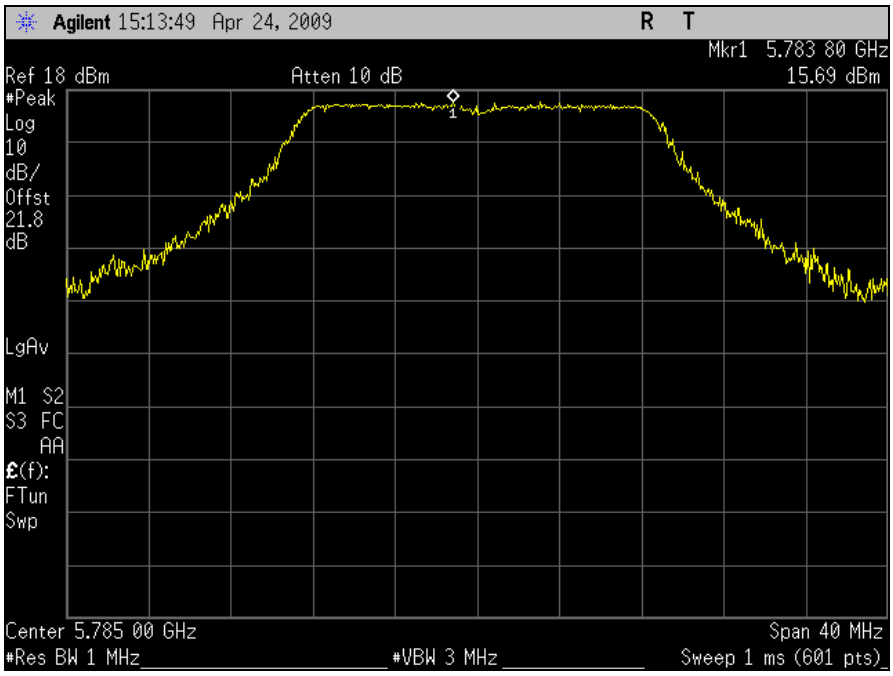
Peak Power Spectral Density Test Results – Port 1, 802.11a Mode



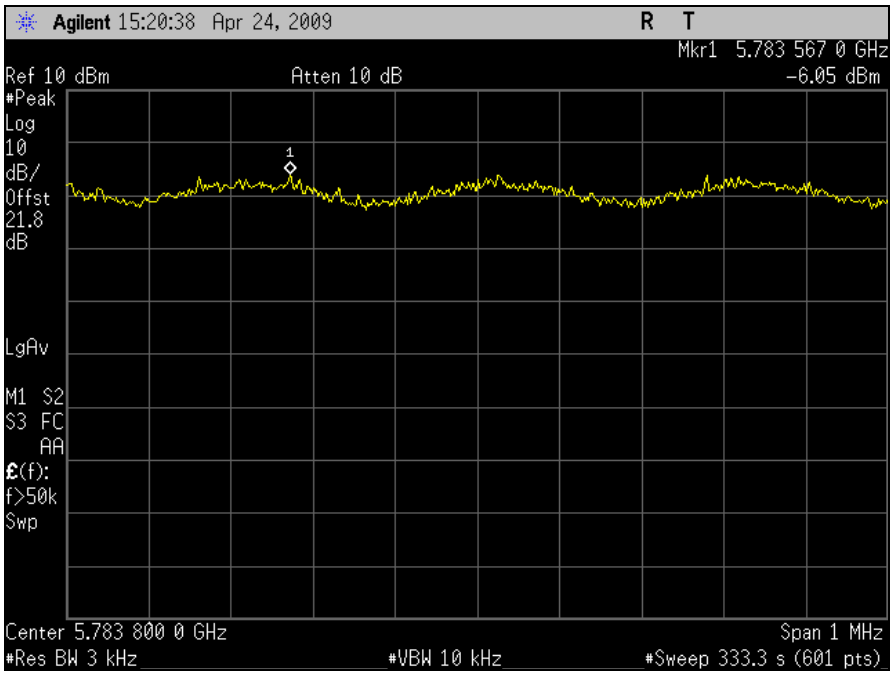
Plot 142. Peak Power Spectral Density, Low Channel, Determination, Port 1, 802.11a Mode



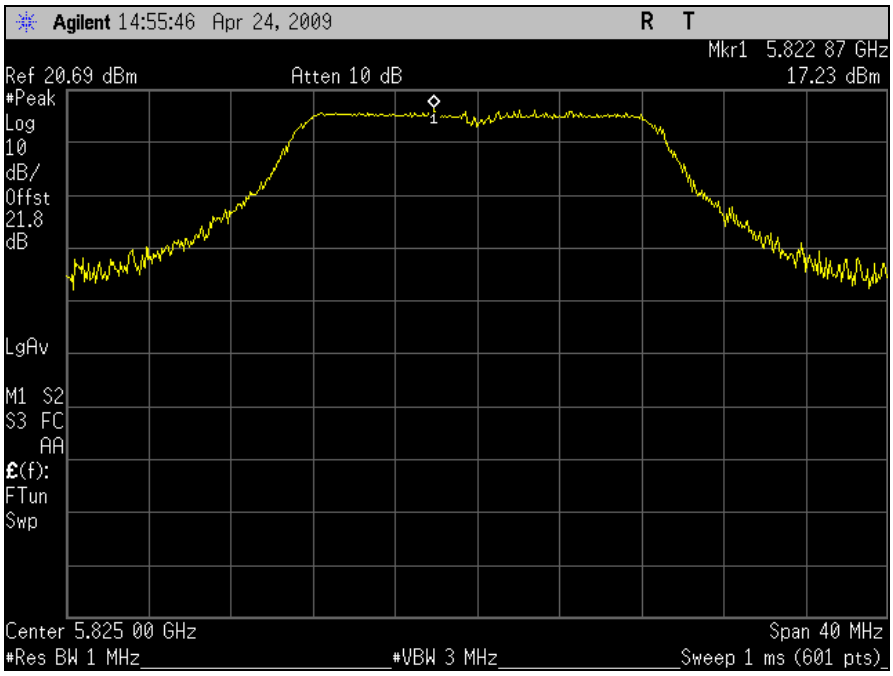
Plot 143. Peak Power Spectral Density, Low Channel, Port 1, 802.11a Mode



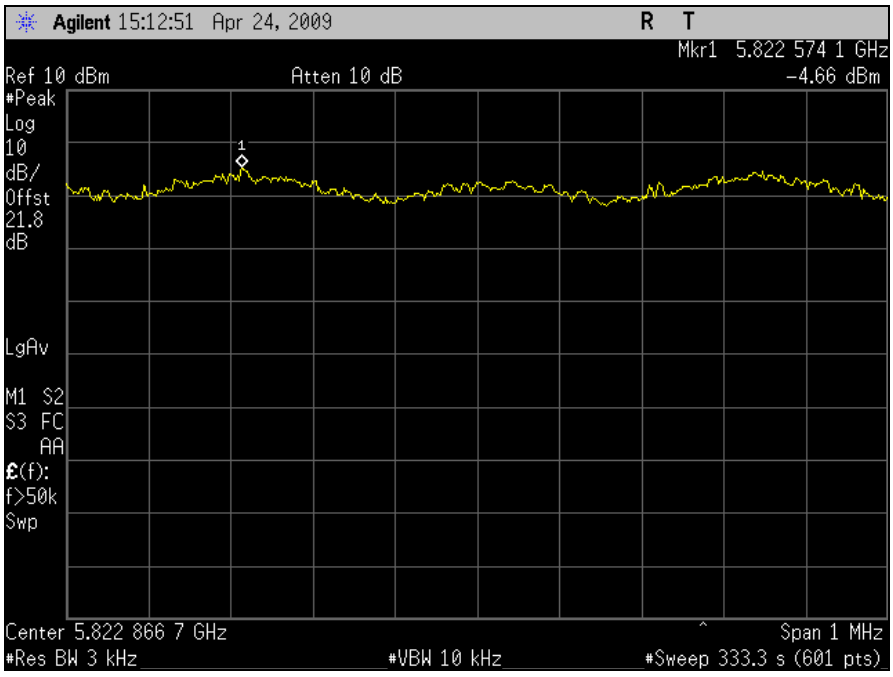
Plot 144. Peak Power Spectral Density, Mid Channel, Determination, Port 1, 802.11a Mode



Plot 145. Peak Power Spectral Density, Mid Channel, Port 1, 802.11a Mode

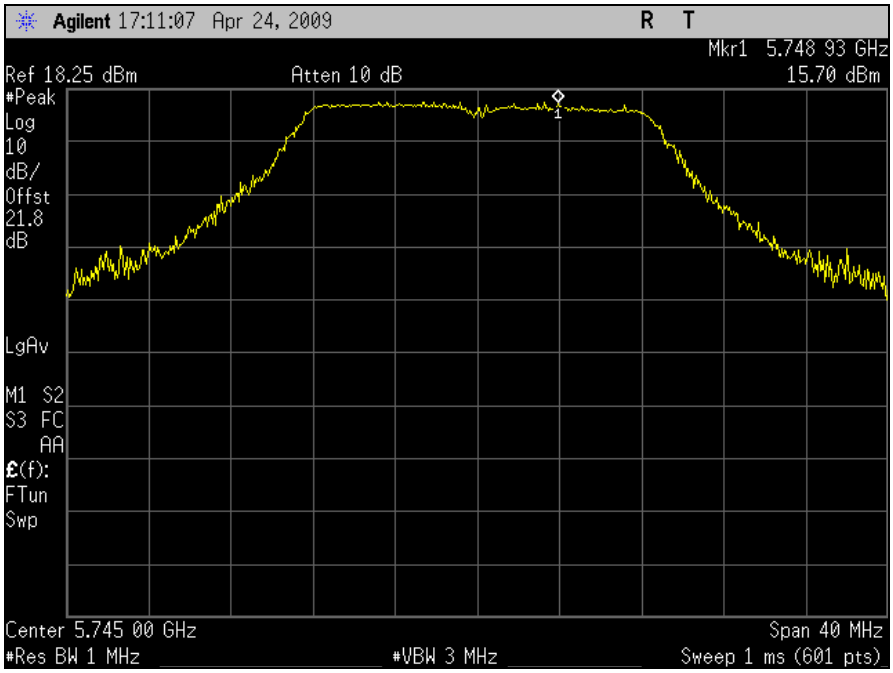


Plot 146. Peak Power Spectral Density, High Channel, Determination, Port 1, 802.11a Mode

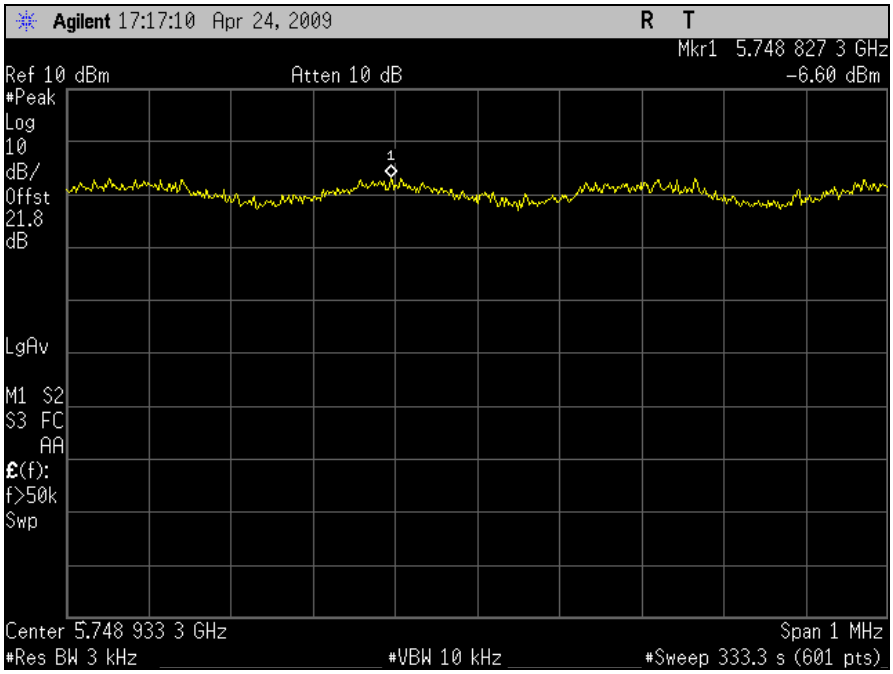


Plot 147. Peak Power Spectral Density, High Channel, Port 1, 802.11a Mode

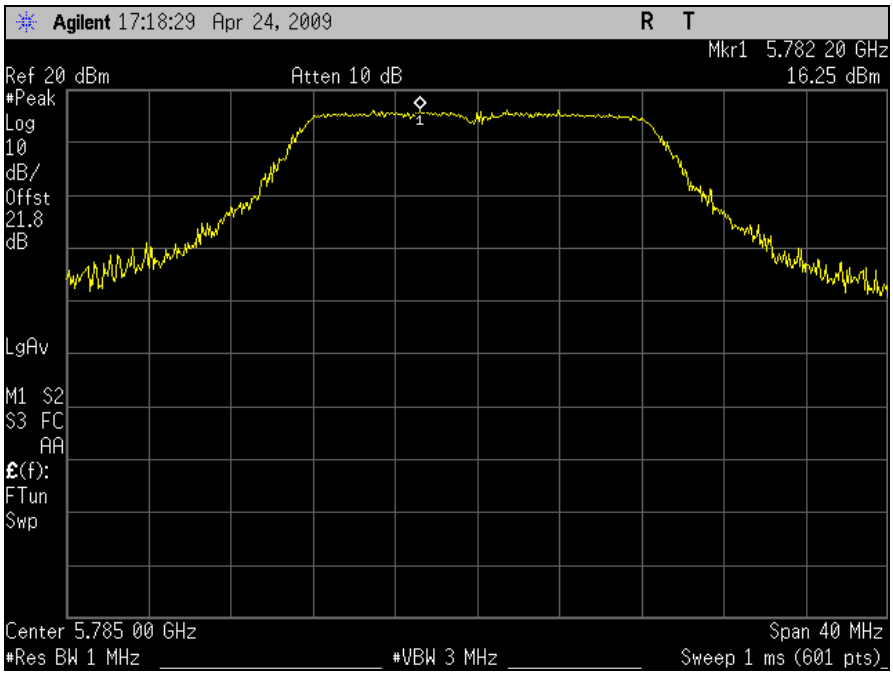
Peak Power Spectral Density Test Results – Port 2, HT20



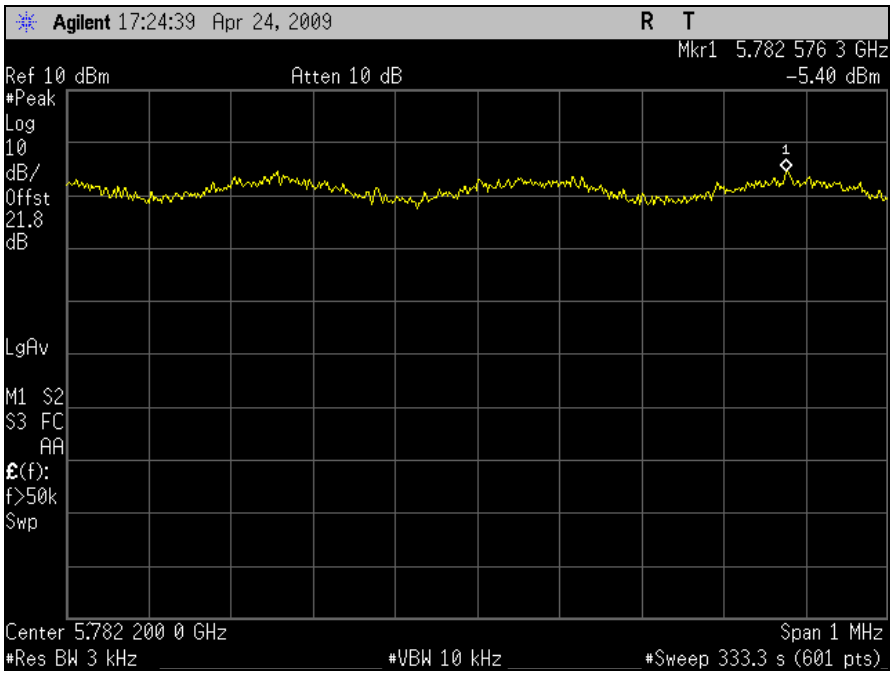
Plot 148. Peak Power Spectral Density, Low Channel, Determination, Port 2, HT20



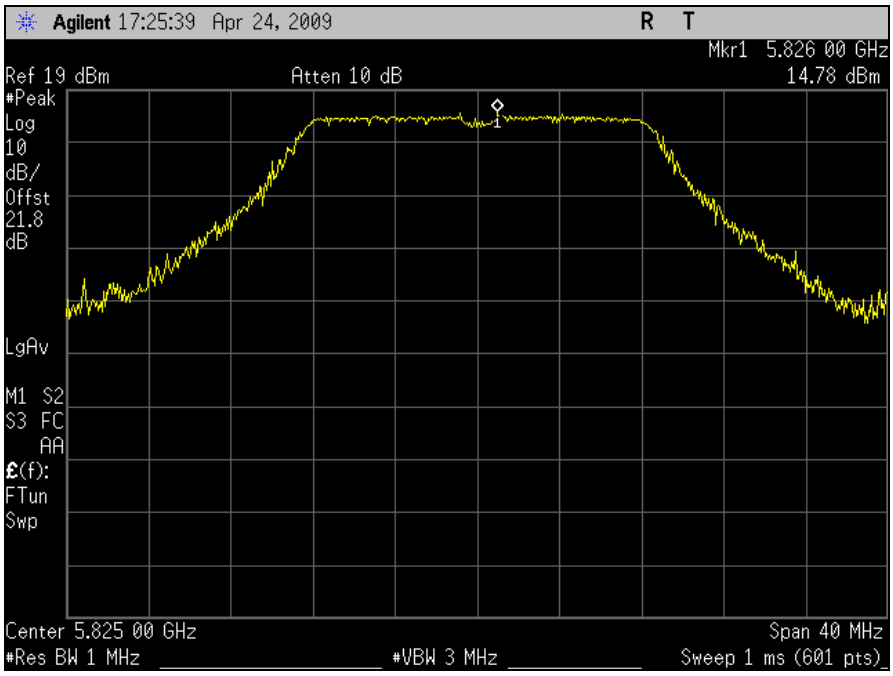
Plot 149. Peak Power Spectral Density, Low Channel, Port 2, HT20



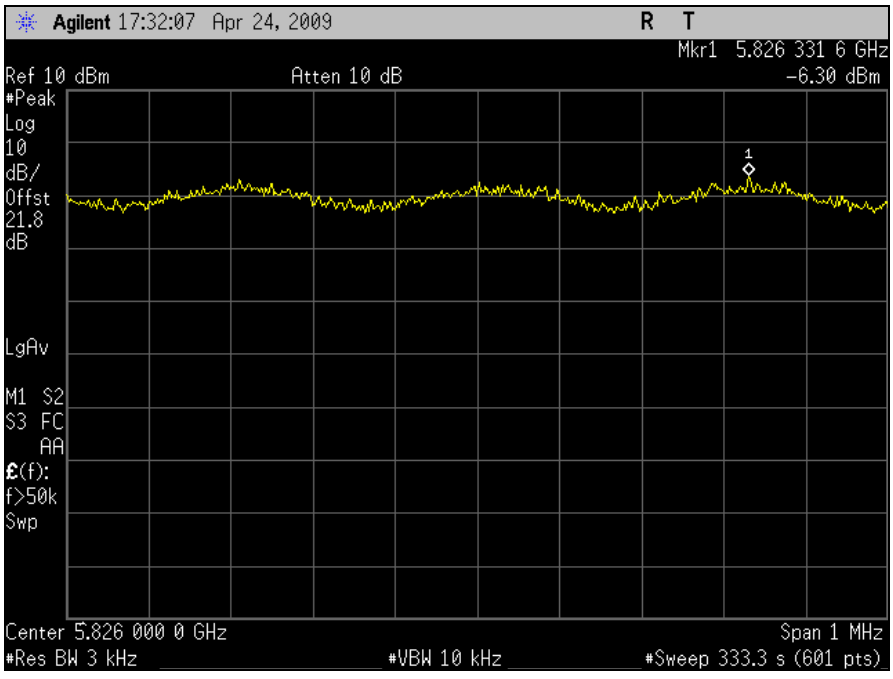
Plot 150. Peak Power Spectral Density, Mid Channel, Determination, Port 2, HT20



Plot 151. Peak Power Spectral Density, Mid Channel, Port 2, HT20

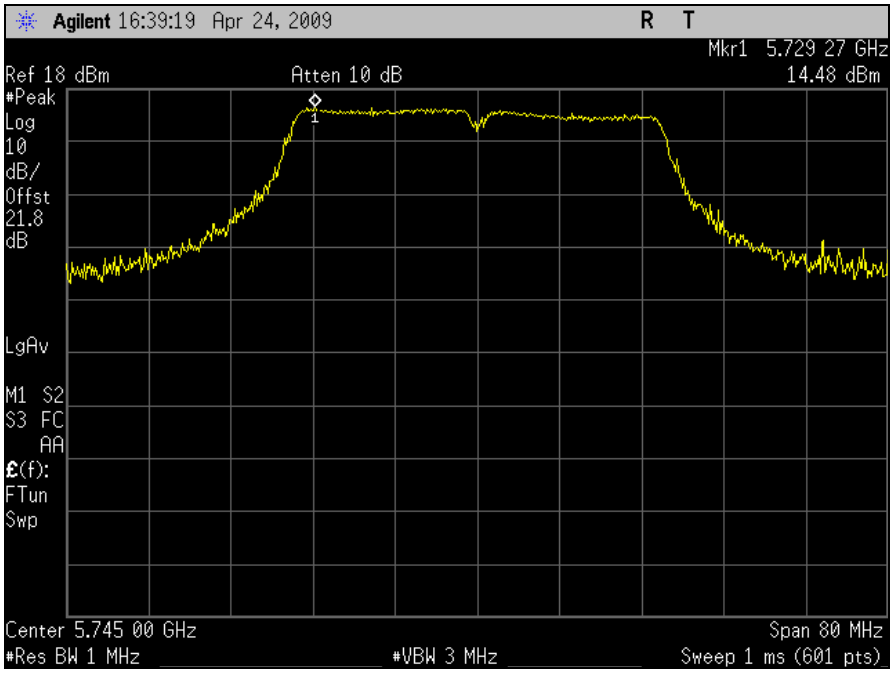


Plot 152. Peak Power Spectral Density, High Channel, Determination, Port 2, HT20

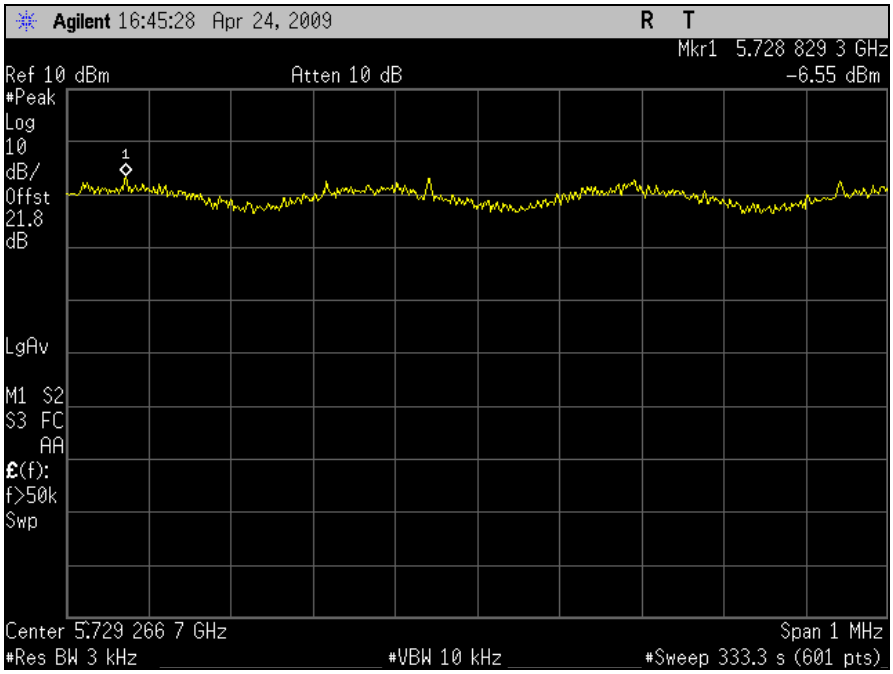


Plot 153. Peak Power Spectral Density, High Channel, Port 2, HT20

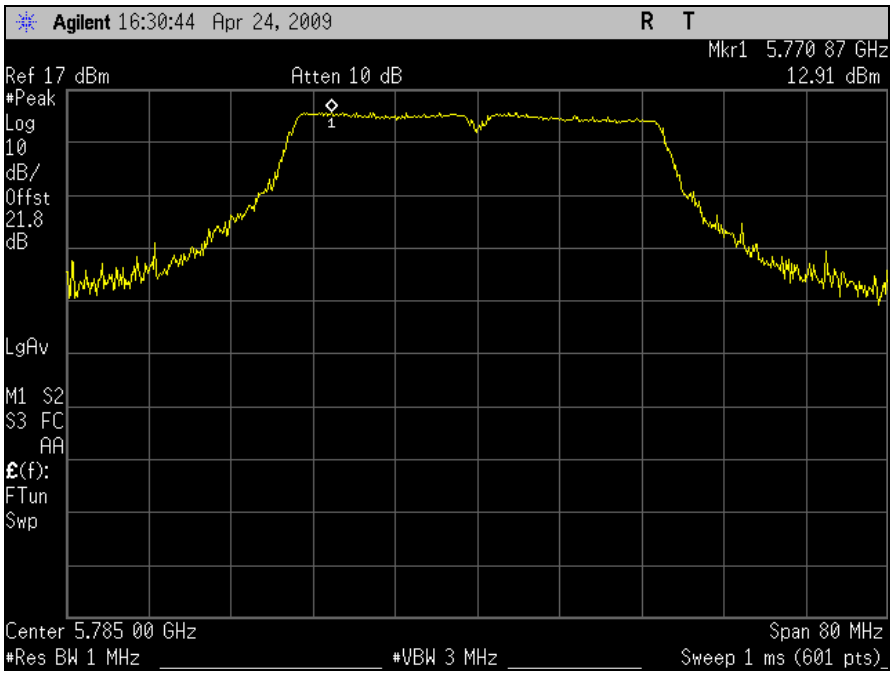
Peak Power Spectral Density Test Results – Port 2, HT40



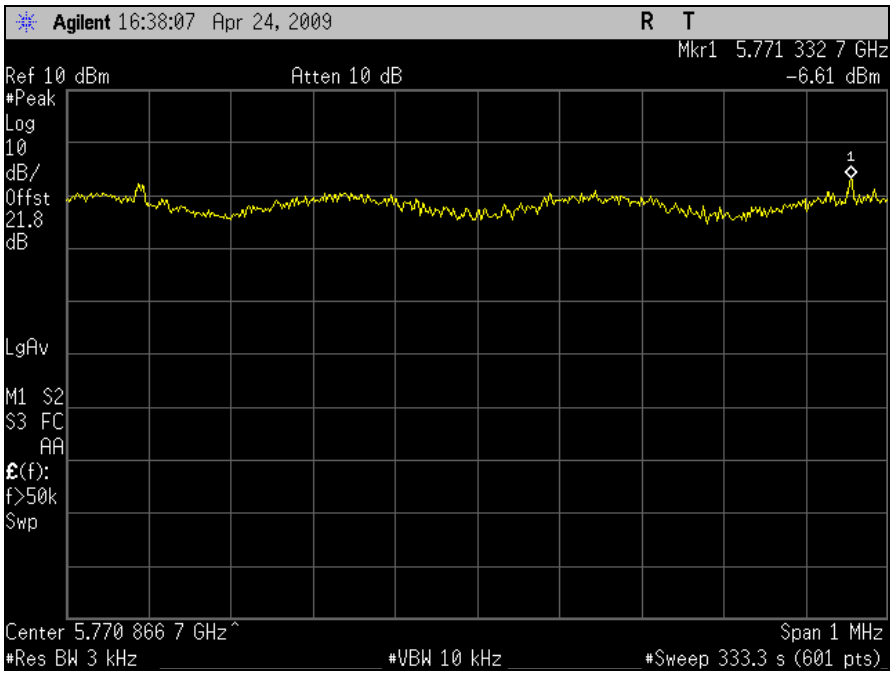
Plot 154. Peak Power Spectral Density, Low Channel, Determination, Port 2, HT40



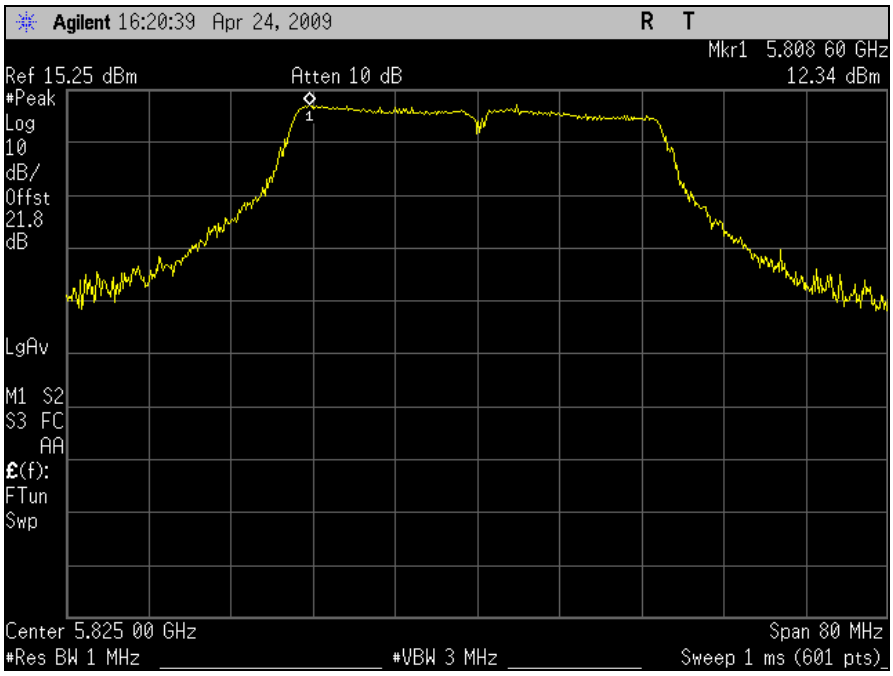
Plot 155. Peak Power Spectral Density, Low Channel, Port 2, HT40



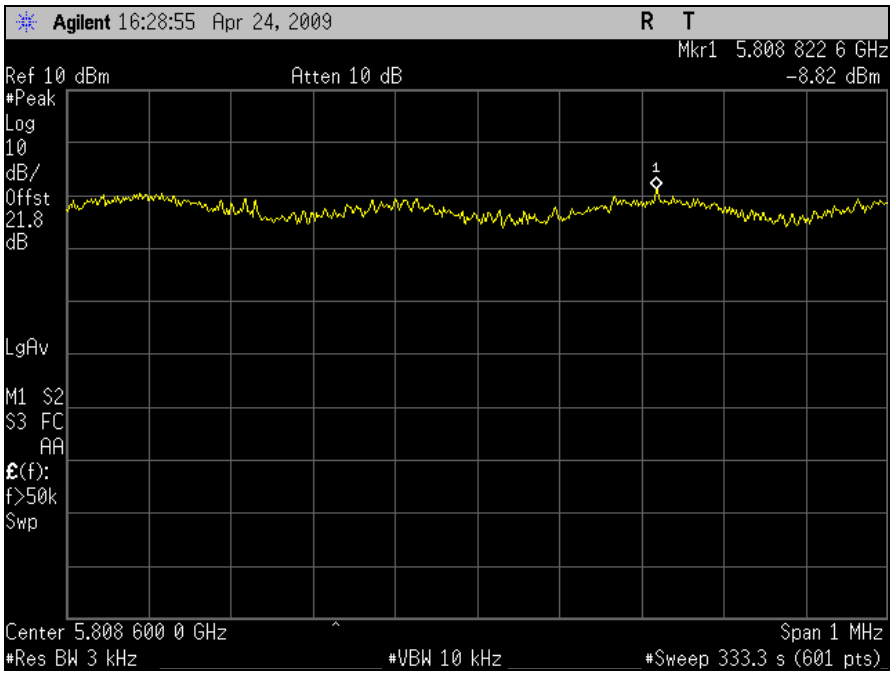
Plot 156. Peak Power Spectral Density, Mid Channel, Determination, Port 2, HT40



Plot 157. Peak Power Spectral Density, Mid Channel, Port 2, HT40

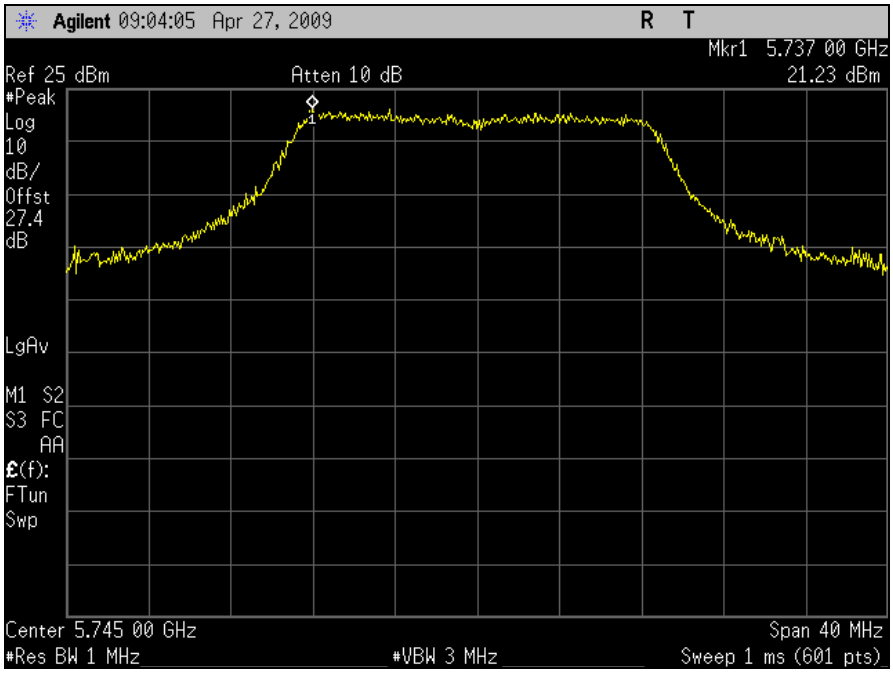


Plot 158. Peak Power Spectral Density, High Channel, Determination, Port 2, HT40

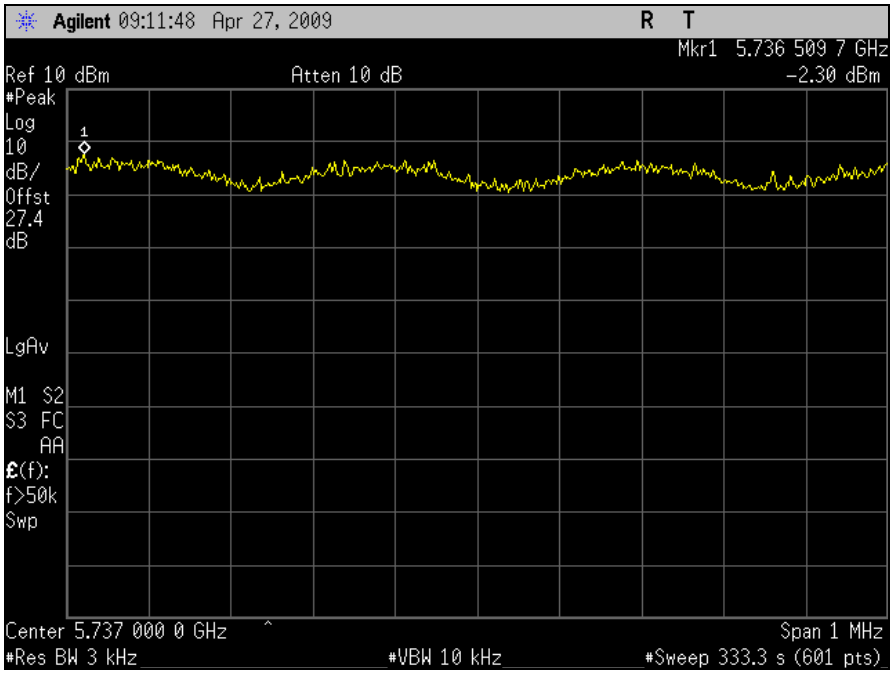


Plot 159. Peak Power Spectral Density, High Channel, Port 2, HT40

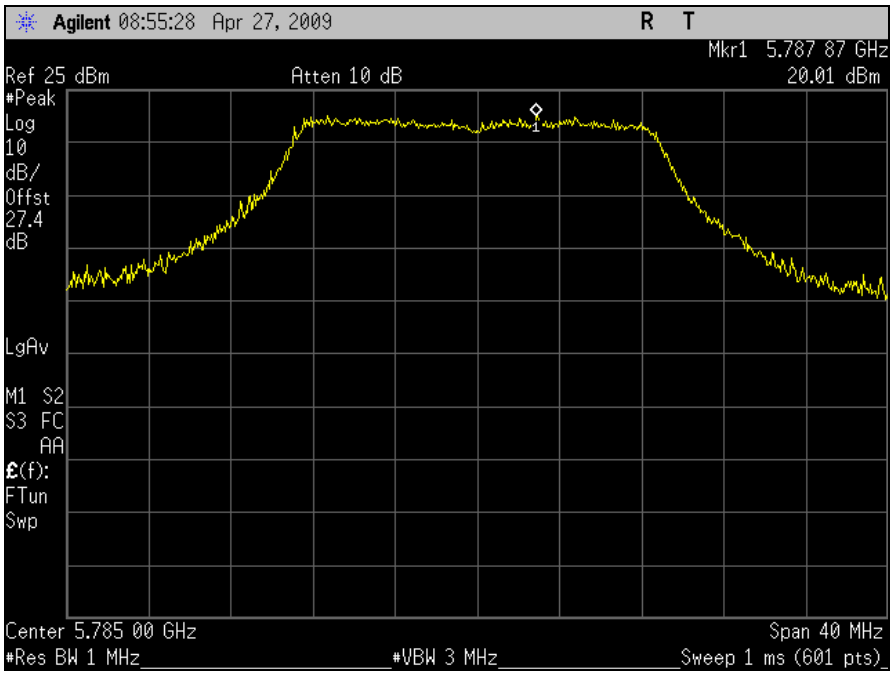
Peak Power Spectral Density Test Results – MIMO Mode, HT20



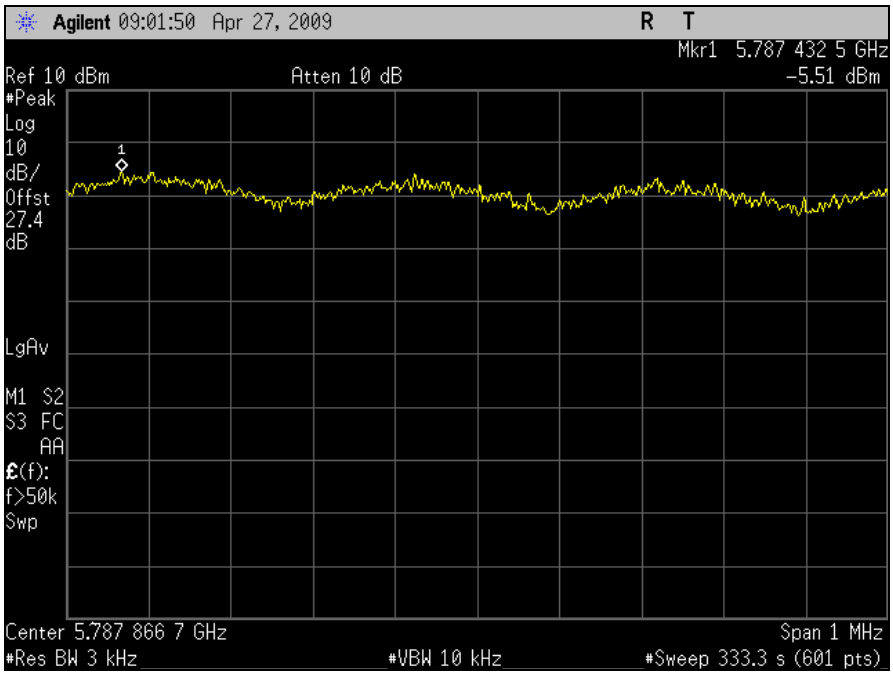
Plot 160. Peak Power Spectral Density, Low Channel, Determination, MIMO Mode, HT20



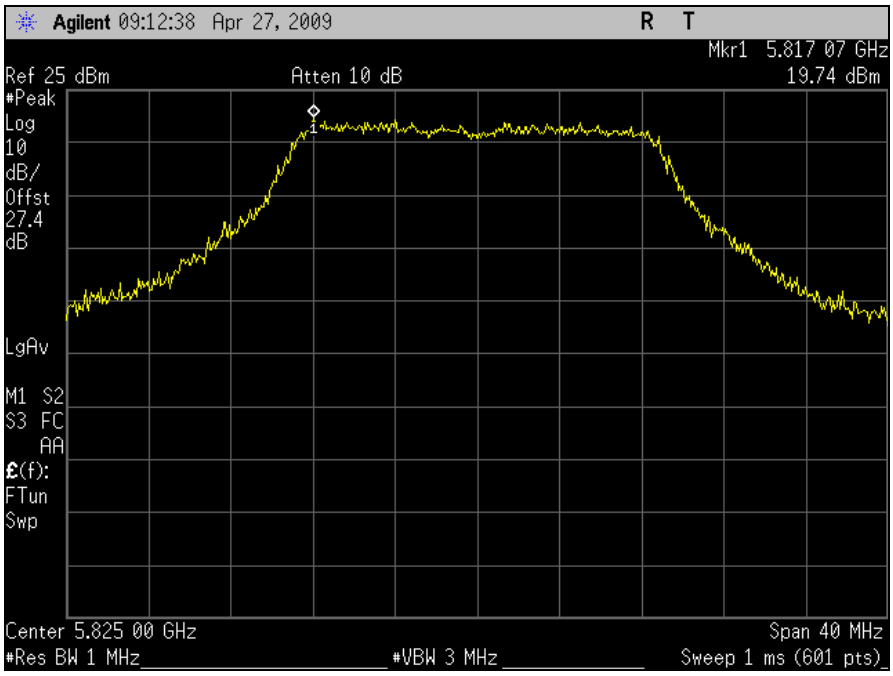
Plot 161. Peak Power Spectral Density, Low Channel, MIMO Mode, HT20



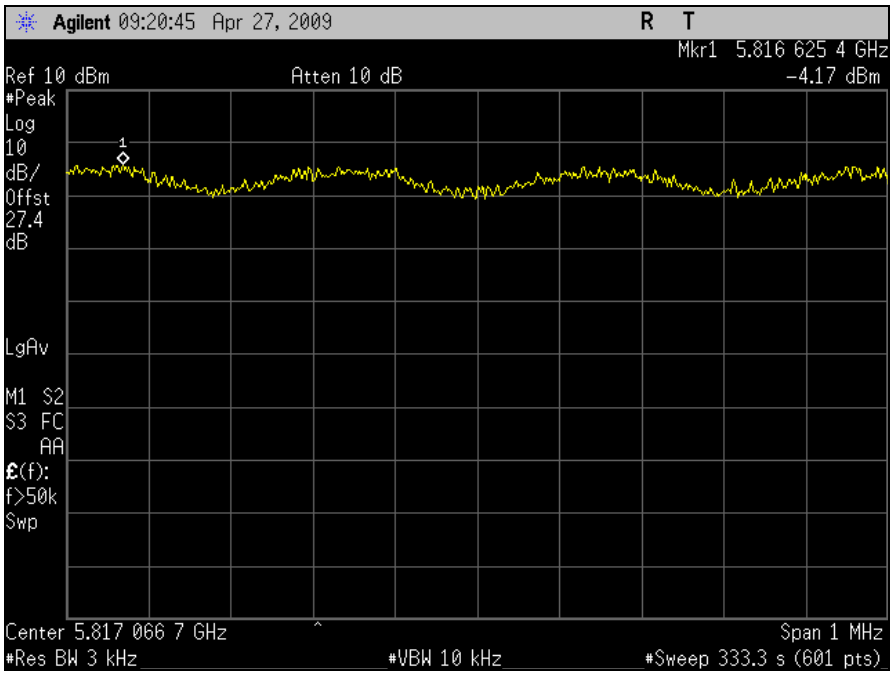
Plot 162. Peak Power Spectral Density, Mid Channel, Determination, MIMO Mode, HT20



Plot 163. Peak Power Spectral Density, Mid Channel, MIMO Mode, HT20

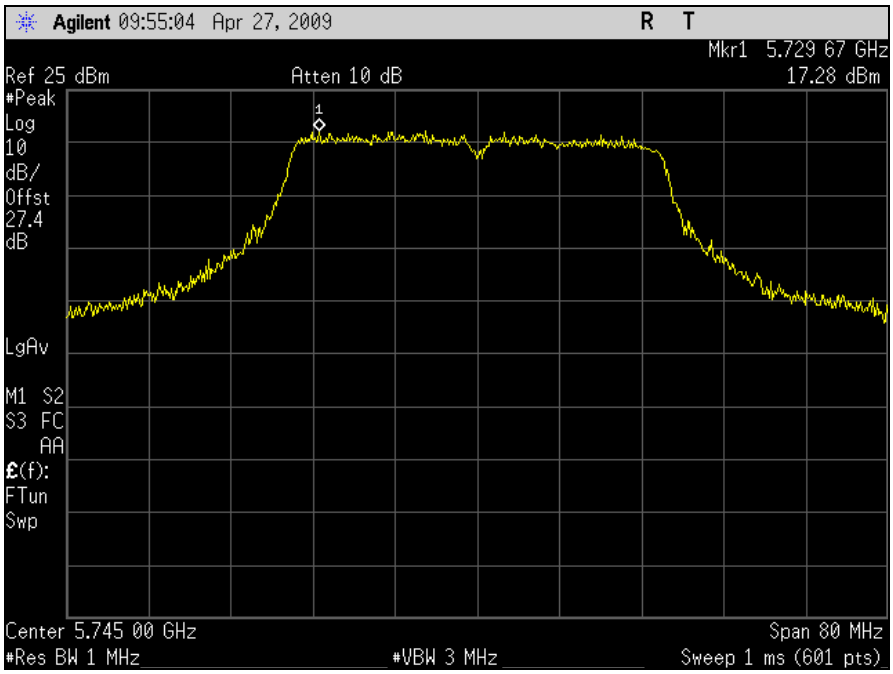


Plot 164. Peak Power Spectral Density, High Channel, Determination, MIMO Mode, HT20

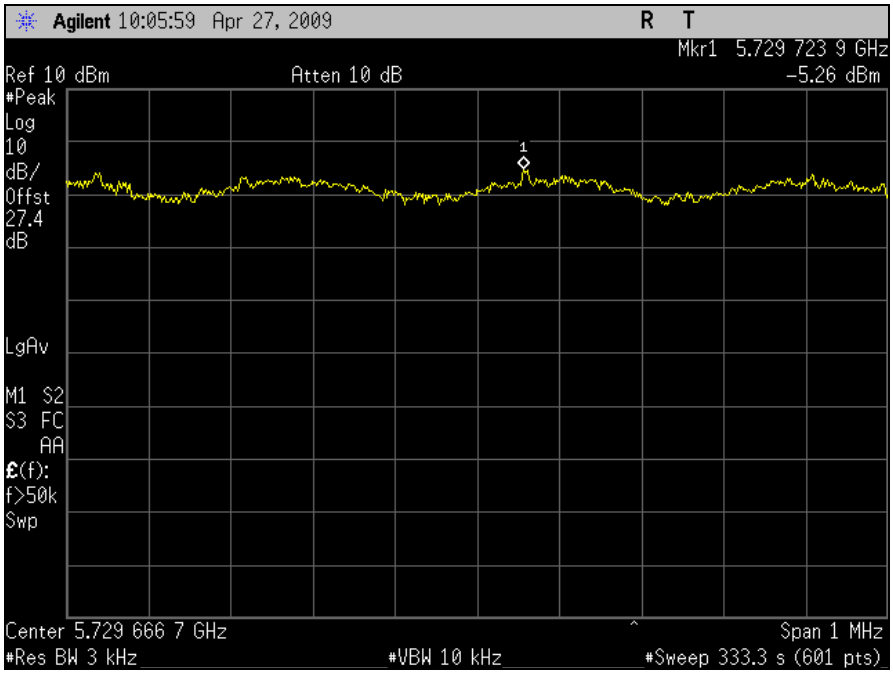


Plot 165. Peak Power Spectral Density, High Channel, MIMO Mode, HT20

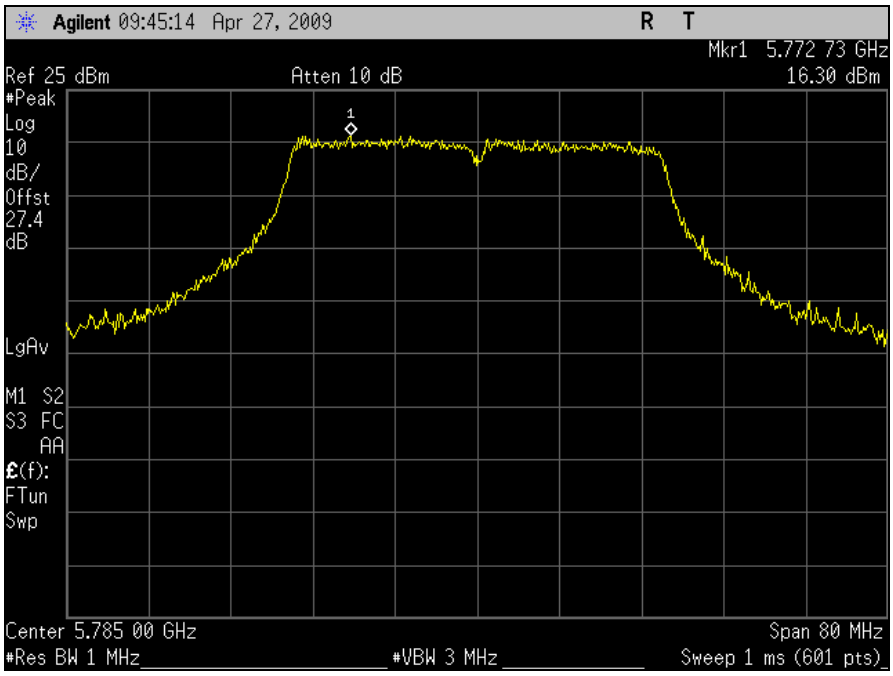
Peak Power Spectral Density Test Results – MIMO Mode, HT40



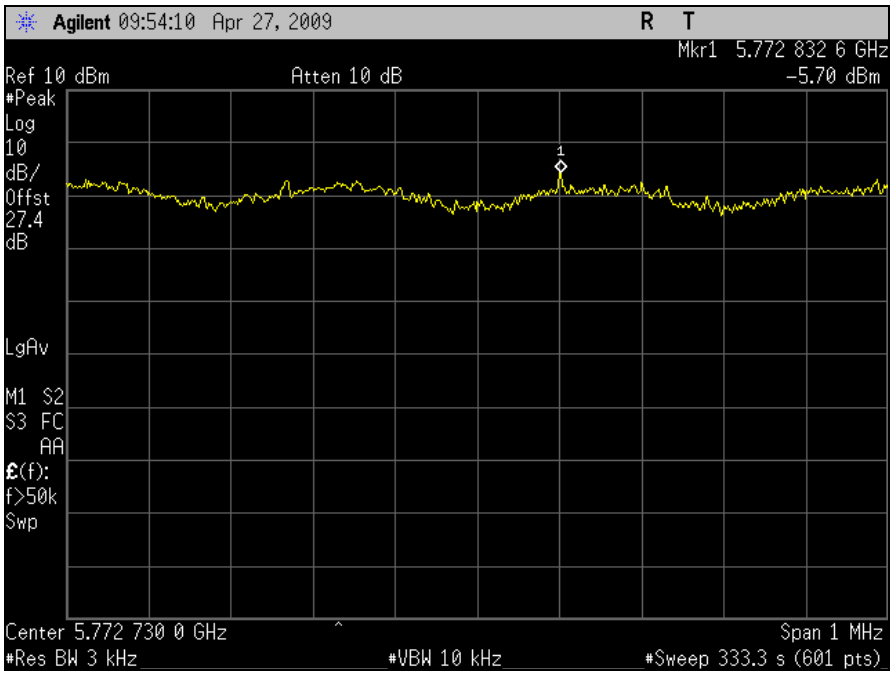
Plot 166. Peak Power Spectral Density, Low Channel, Determination, MIMO Mode, HT40



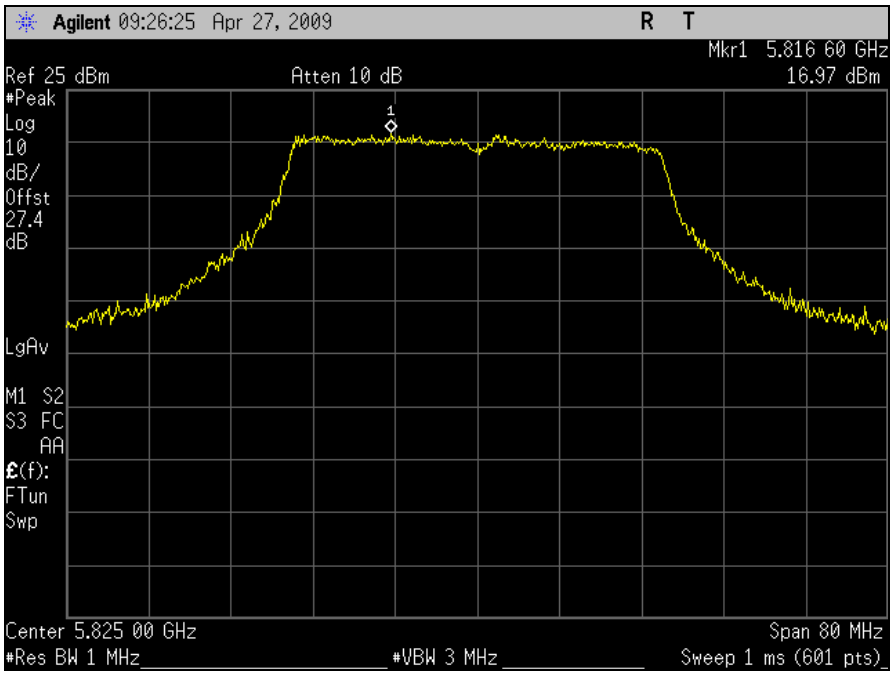
Plot 167. Peak Power Spectral Density, Low Channel, MIMO Mode, HT40



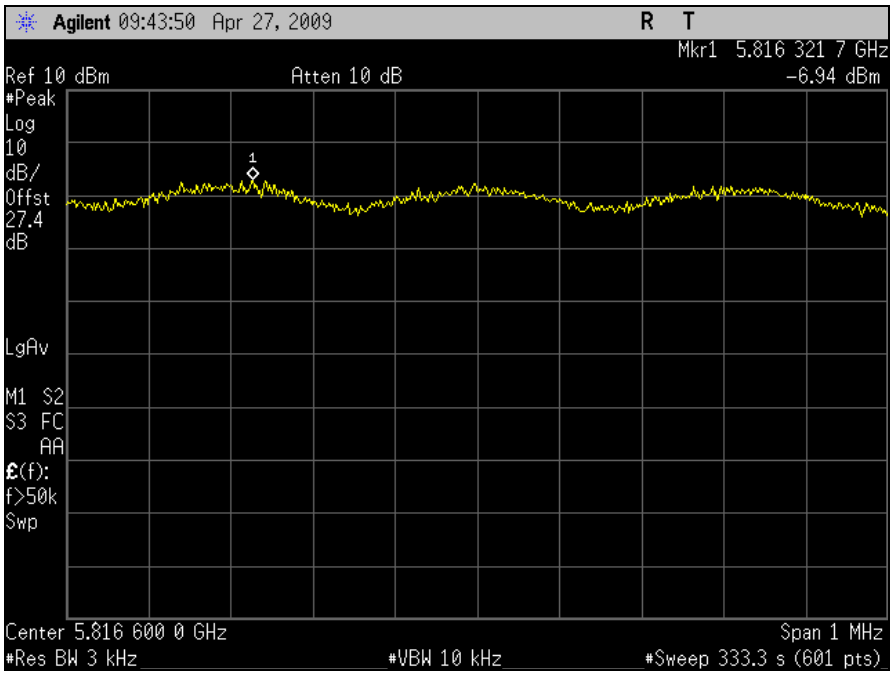
Plot 168. Peak Power Spectral Density, Mid Channel, Determination, MIMO Mode, HT40



Plot 169. Peak Power Spectral Density, Mid Channel, MIMO Mode, HT40



Plot 170. Peak Power Spectral Density, High Channel, Determination, MIMO Mode, HT40



Plot 171. Peak Power Spectral Density, High Channel, MIMO Mode, HT40

IV. Test Equipment

Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ANSI/NCSL Z540-1-1994 and ANSI/ISO/IEC 17025:2000.

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1S2457	HORN ANTENNA (1-18GHZ)	COM-POWER	AHA-118	4/17/09	4/17/10
N/A	2-6GHZ COMBINER	MINI CIRCUITS	ZN4PD-1-63-S+	SEE NOTE	
1S2495	MULTI DEVICE CONTROLLER	ETS EMCO	2090	N/A	N/A
1S2506	FSP SPECTRUM ANALYZER	RHODE & SCHWARZ	1164.4391.30	4/30/08	4/30/09
1S2109	EMI RECEIVER RF SECTION	HEWLETT PACKARD	85462A	11/6/08	11/6/09
1S2108	RF FILTER SECTION	HEWLETT PACKARD	85460A	11/6/08	11/6/09
1S2438	TRANSIENT LIMITER	AGILENT	11947A	SEE NOTE	
1S2372	AC LISN (120VAC 60HZ)	FCC	50A-AC	2/2/09	2/2/10
1S2406	SPECTRUM ANALYZER	AGILENT	E4407	4/14/09	4/14/10
1S2198	HORN ANTENNA	EMCO	3115	9/10/09	9/10/10
1S2121	PREAMP	HEWLETT PACKARD	8449B	10/26/08	10/26/09
1S2509	EMI TEST RECEIVER	RHODE & SCHWARZ	ESU40	4/27/2009	4/27/2010
1S2583	SPECTRUM ANALYZER	AGILENT	E4447A	1/12/09	1/12/10
1S2485	BILOG ANTENNA	TESEQ	CBL-6112D	1/26/09	1/26/10
1S2520	THERMO-HYGROMETER	FISHER SCIENTIFIC	11-661-7D	11/14/2007	11/13/2009
1S2482	5M CHAMBER	PANASHEILD	641431	11/18/08	11/18/09
1S2484	BILOG ANTENNA	TESEQ	CBL 6112D	1/21/2008	7/21/2009
1S2481	10M CHAMBER	ETS-LINDGREN	DKE 8X8 DBL	12/26/2008	12/26/2009
1S2421	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB7	11/6/08	5/15/09
N/A	HIGH PASS FILTER	MICRO-TRONICS	HPM13146	SEE NOTE	
1S2034	COUPLER, DIRECTIONAL 1-20 GHZ	KRYTAR	101020020	SEE NOTE	

Table 61. Test Equipment List

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

V. Certification & User's Manual Information

Certification & User's Manual Information

A. Certification Information

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

§ 2.801 Radio-frequency device defined.

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

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

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

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

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

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

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

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

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

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

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

(i) Compliance testing;

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

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

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

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

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

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

Certification & User's Manual Information

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

§ 2.901 Basis and Purpose

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

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

§ 2.907 Certification.

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

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

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

Certification & User's Manual Information

§ 2.948 Description of measurement facilities.

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

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

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

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

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

Certification & User's Manual Information

Label and User's Manual Information

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

§ 15.19 Labeling requirements.

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

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

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

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

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

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

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

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

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

§ 15.21 Information to user.

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Verification & User's Manual Information

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

§ 15.105 Information to the user.

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

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

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

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

– Reorient or relocate the receiving antenna.

– Increase the separation between the equipment and receiver.

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

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

ICES-003 Procedural & Labeling Requirements

From the Industry Canada Electromagnetic Compatibility Advisory Bulletin entitled, "Implementation and Interpretation of the Interference-Causing Equipment Standard for Digital Apparatus, ICES-003" (EMCAB-3, Issue 2, July 1995):

> "At present, CISPR 22: 2002 and ICES technical requirements are essentially equivalent. Therefore, if you have CISPR 22: 2002 approval by meeting CISPR Publication 22, the only additional requirements are: to attach a note to the report of the test results for compliance, indicating that these results are deemed satisfactory evidence of compliance with ICES-003 of the Canadian Interference-Causing Equipment Regulations; to maintain these records on file for the requisite five year period; and to provide the device with a notice of compliance in accordance with ICES-003."

Procedural Requirements:

According to Industry Canada's Interference Causing Equipment Standard for Digital Apparatus ICES-003 Issue 4, February 2004:

Section 6.1: A record of the measurements and results, showing the date that the measurements were completed, shall be retained by the manufacturer or importer for a period of at least five years from the date shown in the record and made available for examination on the request of the Minister.

Section 6.2: A written notice indicating compliance must accompany each unit of digital apparatus to the end user. The notice shall be in the form of a label that is affixed to the apparatus. Where because of insufficient space or other constraints it is not feasible to affix a label to the apparatus, the notice may be in the form of a statement in the user's manual.

Labeling Requirements:

The suggested text for the notice, in English and in French, is provided below, from the Annex of ICES-003:

> This Class [2] digital apparatus complies with Canadian ICES-003.
>
> Cet appareil numérique de la classe [1] est conforme à la norme NMB-003 du Canada.

[2] Insert either A or B but not both as appropriate for the equipment requirements.

End of Report

