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

April 27, 2011

Ubiquiti Networks
91 E. Tasman
San Jose, CA 95134

Dear Robert Pera,

Enclosed is the EMC Wireless test report for compliance testing of the Ubiquiti Networks, NanoStationM5 as tested to the requirements for Indian Market.

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\EMCS82947-IND)

Electromagnetic Compatibility Criteria
Test Report

for the

Ubiquiti Networks
NanoStationM5

Tested under
Class B Digital Devices
&
Intentional Radiators

MET Report: EMCS82947-IND

April 27, 2011

Prepared For:

Ubiquiti Networks
91 E. Tasman
San Jose, CA 95134

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

Electromagnetic Compatibility Criteria
Test Report

for the

Ubiquiti Networks
NanoStationM5

Tested under
Class A Digital Devices
&
Intentional Radiators

Manasi Bhandiwad, 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 under normal use and maintenance.

Shawn McMillen,
Wireless Manager, Electromagnetic Compatibility Lab

Report Status Sheet

Version	Report Date	Reason for Revision
∅	April 27, 2011	Initial Issue.

Table of Contents

List of Tables

List of Plots

List of Figures

List of Photographs

List of Terms and Abbreviations

AC	**A**lternating **C**urrent
ACF	**A**ntenna **C**orrection **F**actor
Cal	**Cal**ibration
d	**M**easurement **D**istance
dB	**D**eci**b**els
dBµA	**D**eci**b**els above one **micro**amp
dBµV	**D**eci**b**els above one **micro**volt
dBµA/m	**D**eci**b**els above one **micro**amp **per m**eter
dBµV/m	**D**eci**b**els above one **micro**volt **per m**eter
DC	**D**irect **C**urrent
E	**E**lectric Field
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**ert**z**
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**k**ilo**h**ert**z**
kPa	**k**ilo**pa**scal
kV	**k**ilo**v**olt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**h**ertz
µH	**microh**enry
µ	**microf**arad
µs	**micros**econds
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 NanoStationM5, with the requirements for Digital Devices and Intentional Radiators. All references are to the most current version. The following data is presented in support of the Certification of the NanoStationM5. 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 NanoStationM5, has been **permanently** discontinued.

B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance, in accordance with Ubiquiti Networks, purchase order number US100112. All tests were conducted using measurement procedure ANSI C63.4-2003.

Description	Compliance
Conducted Emission Limits for a Class B Digital Device	Compliant
Occupied Bandwidth	Compliant
RF Output Power	Compliant
Peak Excursion	Compliant
Radiated Spurious Emissions	Compliant
Maximum RF exposure	Compliant
Conducted Spurious Emissions	Compliant
Power Spectral Density	Compliant

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Ubiquiti Networks to perform testing on the NanoStationM5, under Ubiquiti Networks's purchase order number US100112.

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, NanoStationM5.

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

Model(s) Tested:	NanoStationM5	
Model(s) Covered:	NanoStationM5	
EUT Specifications:	Primary Power: 120 VAC, 60 Hz	
	Type of Modulations:	OFDM
	Peak RF Output Power:	a Mode: 16.26 dBm HT10: 15.78 dBm HT20: 15.90 dBm HT40: 15.55 dBm
	EUT Frequency Ranges:	5835 – 5865 MHz
	Occupied Bandwidth:	a Mode: 16.881 MHz HT10: 9.249 MHz HT20: 18.020 MHz HT40: 36.211 MHz
	Antenna Type:	16 dBi integral antenna
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:	Manasi Bhandiwad	
Report Date(s):	April 27, 2011	

Table 1. 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
CFR 47, Part 15, Subpart B	Electromagnetic Compatibility: Criteria for Radio Frequency Devices
CFR 47, Part 15, Subpart E	Unlicensed National Information Infrastructure Devices (UNII)
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
ANSI C63.10-2009	American National Standard for Testing Unlicensed Wireless Devices

Table 2. References

C. Test Site

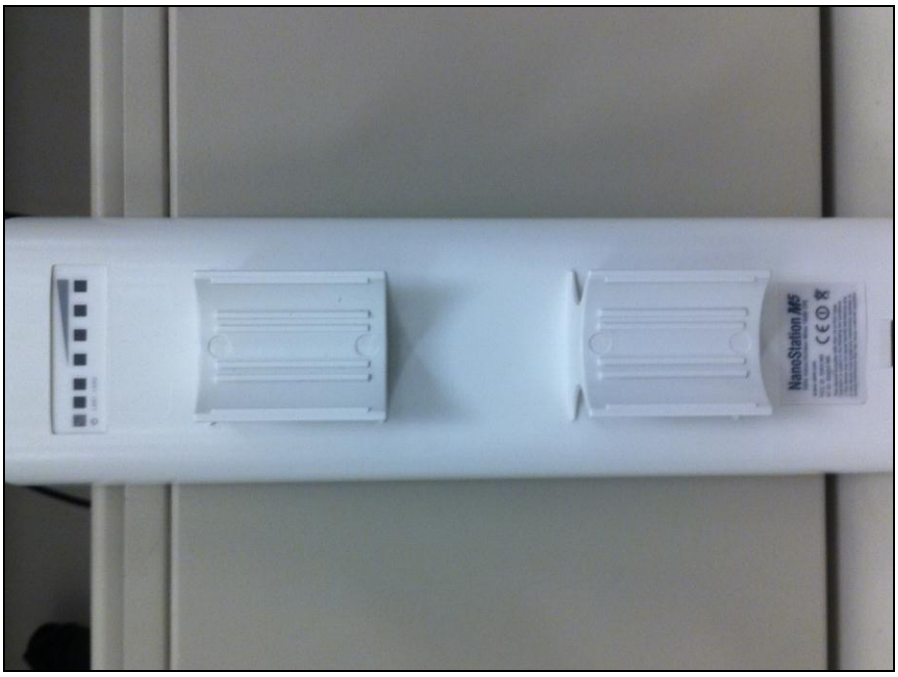
All testing was performed at MET Laboratories, Inc., 914 W. Patapsco Ave., Baltimore, MD 21230. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed in a 3 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 NanoStationM5, Equipment Under Test (EUT), is a 5 GHz Hi Power 2x2 MIMO.

Photograph 1. Ubiquiti Networks NanoStationM5, Front View



Photograph 2. Ubiquiti Networks NanoStationM5, Rear View

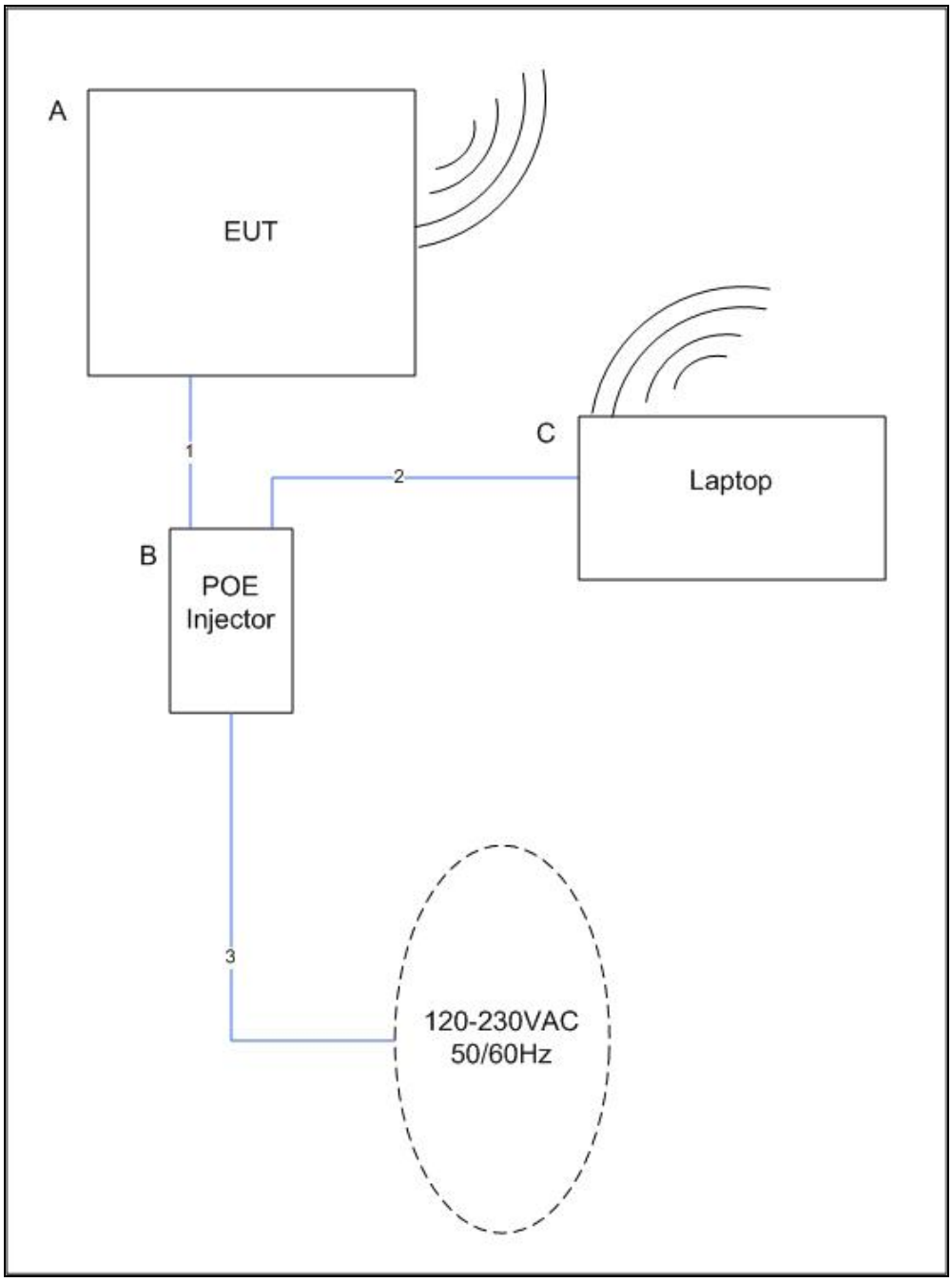


Figure 1. Block Diagram of Test Configuration

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	Serial Number
A	NanoStationM5	NS5	1040T00156D8A77BD
A	NanoStationM5	NS5	1103T002722101B00
A	NanoStationM5	NS5	1104T002722104F5D
B	Power Supply	UBI-POE-15-8	1101-0096733
B	Power Supply	UBI-POE-15-8	1101-0096734

Table 3. Equipment Configuration

F. Support Equipment

Support equipment necessary for the operation and testing of the EUT is included in the following list.

Ref. ID	Name / Description	Manufacturer	Model Number	Serial Number
C	Laptop	Dell	Vostro 1510	4953929473

Table 4. Support Equipment

G. Ports and Cabling Information

Ref. ID	Port Name on EUT	Cable Description	Qty.	Length (m)	Shielded (Y/N)	Termination Point
1	NanoM5 - Main	Ethernet	1	10	Y	PSU – POE port
	NanoM5- Secondary	Ethernet	1	10	Y	Unterminated
1	PSU - POE	Ethernet	1	10	Y	NanoM5 - Main
2	PSU - LAN	Ethernet	1	10	Y	Laptop
3	AC port	AC Cable	1	0.5	Y	100-240VAC Source

Table 5. Ports and Cabling Information

H. Mode of Operation

Transmit 6-54Mbps at 5 GHz.

I. Method of Monitoring EUT Operation

IP connectivity is maintained with the EUT. If IP connectivity is lost, EUT connectivity shall be re-established upon power up or re-boot.

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 Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

Conducted Emissions Limits

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

Frequency range (MHz)	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 6. Conducted Limits for Intentional Radiators

Test Procedure: The EUT was placed on a 0.8 m-high wooden table inside a screen room. 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 C63.4-2003 "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. For the purpose of this testing, the transmitter was turned on. Scans were performed with the transmitter on.

Test Results: The EUT was compliant with this requirement. Measured emissions were below applicable limits.

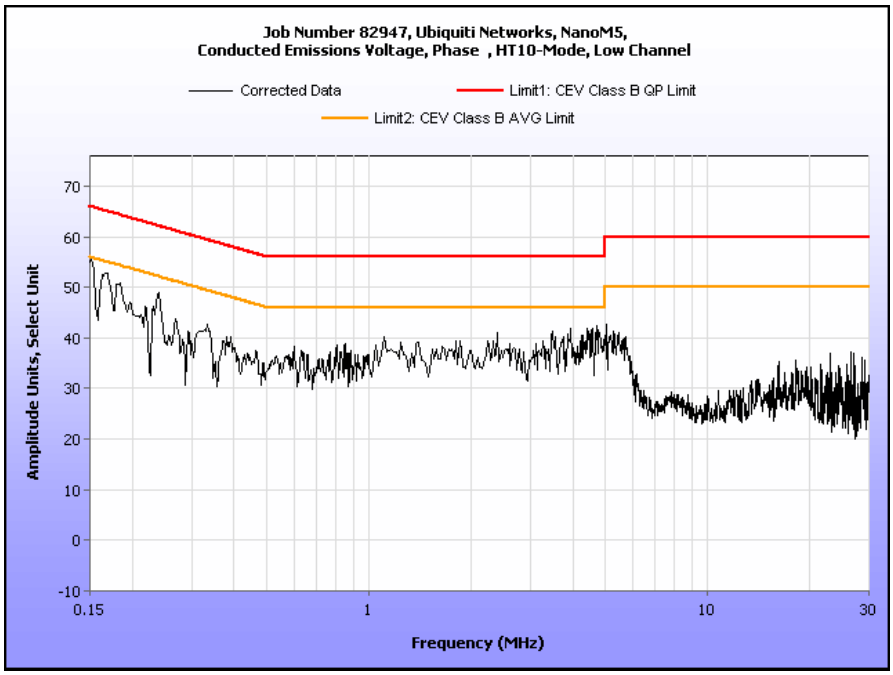
Test Engineer(s): Ben Taylor

Test Date(s): 03/31/11

Conducted Emissions Test Results

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.32	43.71	0.05	43.76	59.71	-15.95	35.84	0.05	35.89	49.71	-13.82
0.1505	52.78	0	52.78	65.97	-13.19	36.57	0	36.57	55.97	-19.4
0.173375	50.78	0	50.78	64.8	-14.02	36.61	0	36.61	54.8	-18.19
1.36	37.08	0.11	37.19	56	-18.81	30.05	0.11	30.16	46	-15.84
2.495	36.01	0.17	36.18	56	-19.82	28.83	0.17	29	46	-17
5.315	32.7	0.32	33.02	60	-26.98	26.35	0.32	26.67	50	-23.33

Table 7. Conducted Emissions - Voltage, Phase Line, Low Channel

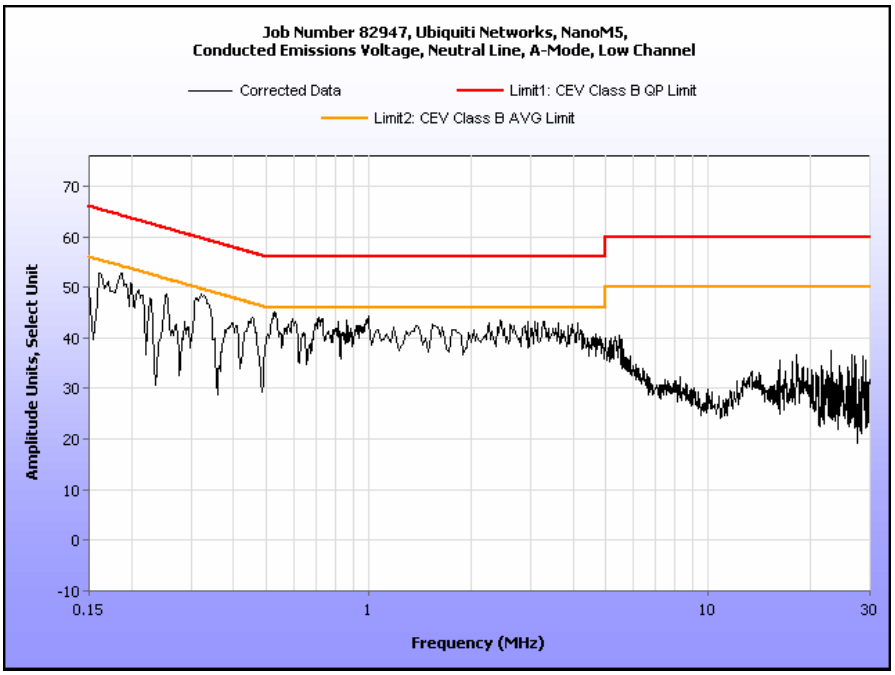


Plot 1. Conducted Emission, Phase Line Plot

Conducted Emissions Test Results

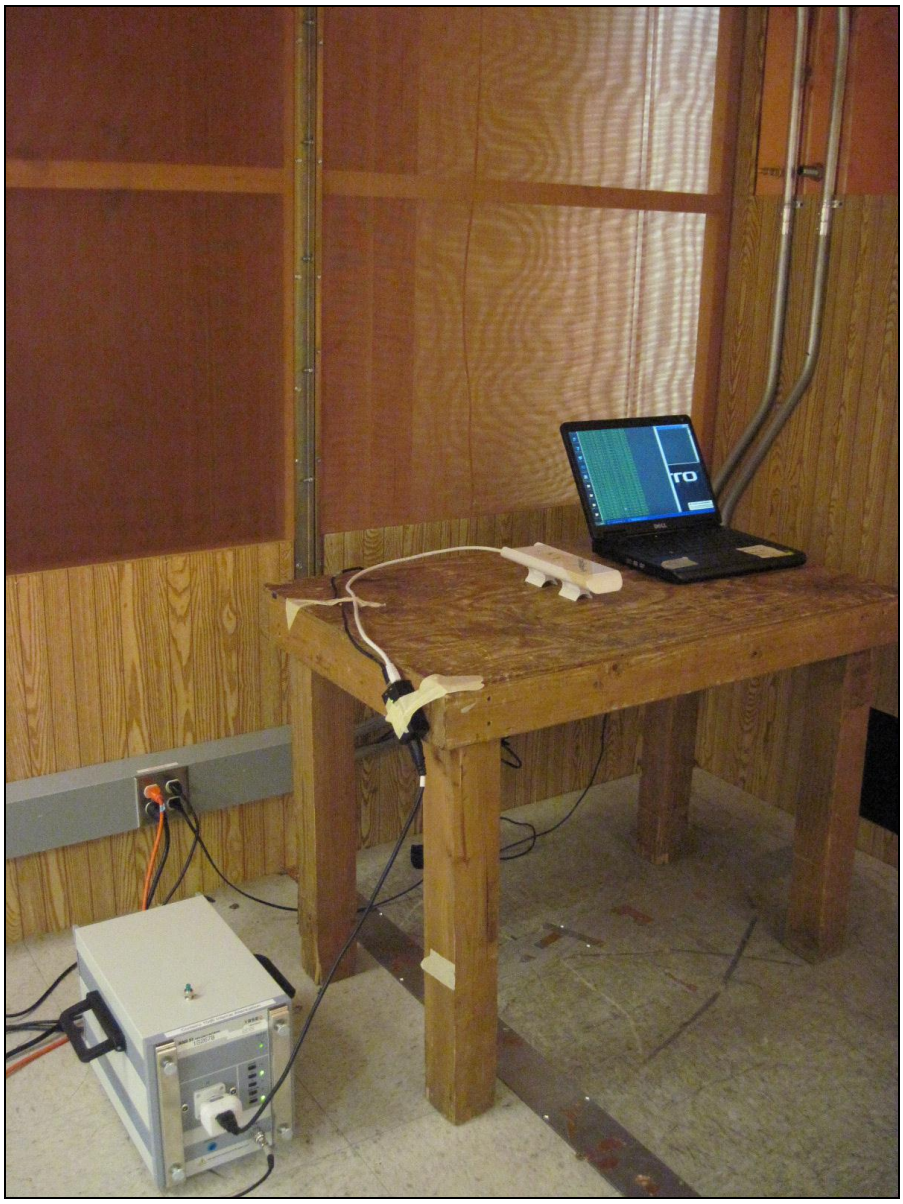
Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.32	43.71	0.05	43.76	59.71	-15.95	35.84	0.05	35.89	49.71	-13.82
0.3685	45.02	0.02	45.04	58.53	-13.49	36.66	0.02	36.68	48.53	-11.85
1.3575	37.11	0.11	37.22	56	-18.78	29.97	0.11	30.08	46	-15.92
4.0175	35.46	0.25	35.71	56	-20.29	27.72	0.25	27.97	46	-18.03
2.9525	35.57	0.19	35.76	56	-20.24	28.51	0.19	28.7	46	-17.3
2.615	34.73	0.17	34.9	56	-21.1	27.62	0.17	27.79	46	-18.21

Table 8. Conducted Emissions - Voltage, Neutral Line, Low Channel



Plot 2. Conducted Emission, Neutral Line Plot

Conducted Emissions Test Setup Photo



Photograph 3. Conducted Emissions, Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

6 dB and 99% Bandwidth

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

The minimum 6dB bandwidth shall be at least 500 kHz.

Test Procedure:

6 dB Occupied Bandwidth:
The transmitter was on and transmitting at the highest output power. 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 performed on the low, mid and high channels. Peak detector was used.

99% Occupied Bandwidth:
The transmitter was on and transmitting at the highest output power. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately 1% of the span, VBW > RBW. The 99% Bandwidth was measured and recorded. The measurements were performed on the low, mid and high channels. Sample detector was used.

Test Results The EUT was compliant with this requirement.

The 6 dB and 99% Bandwidth was determined from the plots on the following pages.

Test Engineer(s): Jeff Pratt

Test Date(s): 03/18/11

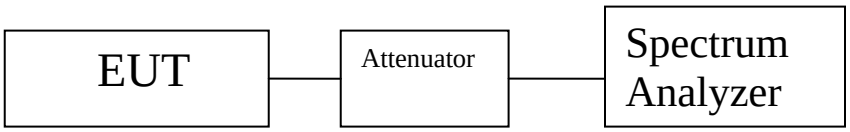


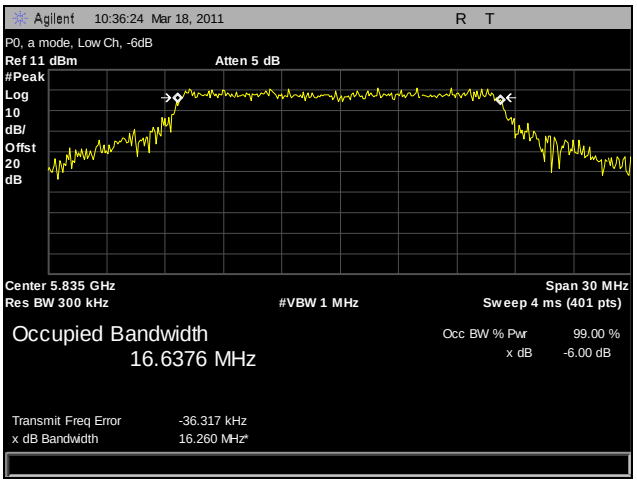
Figure 2. Block Diagram, Occupied Bandwidth Test Setup

Occupied Bandwidth Test Results

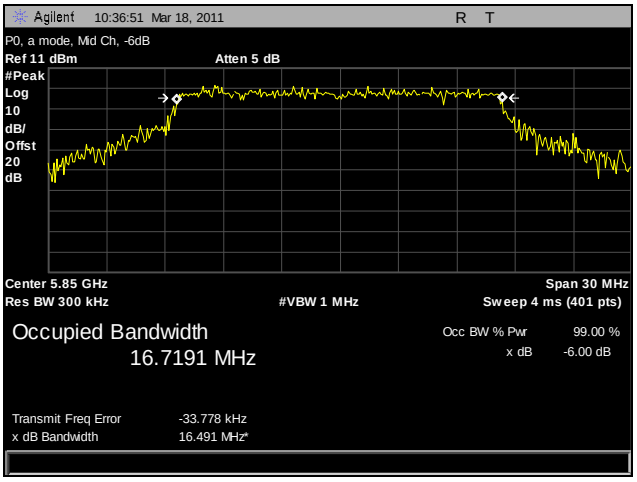
Occupied Bandwidth MHz						
Mode	Carrier Channel	Frequency (MHz)	Port 1 MHz		Port 2 MHz	
			99%	6dB	99%	6dB
a	Low	5835	16.614	16.637	N/A	N/A
	Mid	5850	16.887	16.719		
	High	5865	16.793	16.881		
HT10	Low	5835	9.258	9.223	9.089	9.221
	Mid	5850	9.160	9.145	9.086	9.013
	High	5865	9.161	9.249	9.084	9.218
HT20	Low	5835	17.946	18.020	17.843	17.878
	Mid	5850	17.971	17.843	18.057	17.729
	High	5865	17.906	17.868	17.881	17.824
HT40	-	5850	36.221	36.211	36.193	36.184

Table 9. Occupied Bandwidth, Test Results

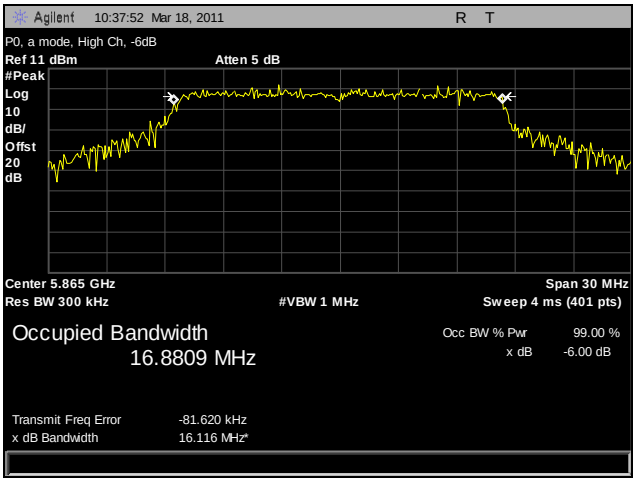
6 dB Occupied Bandwidth Test Results, a Mode, P0



Plot 3. 6 dB Occupied Bandwidth, Low Channel, a Mode, P0

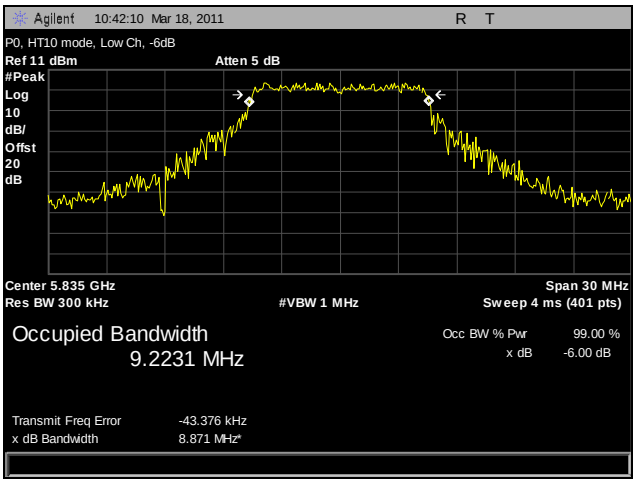


Plot 4. 6 dB Occupied Bandwidth, Mid Channel, a Mode, P0

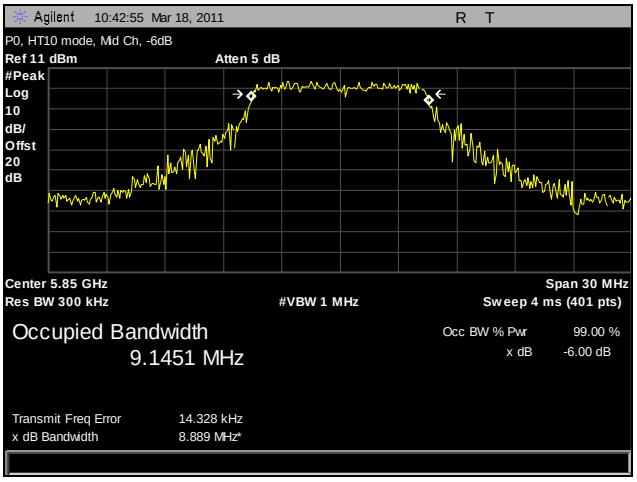


Plot 5. 6 dB Occupied Bandwidth, High Channel, a Mode, P0

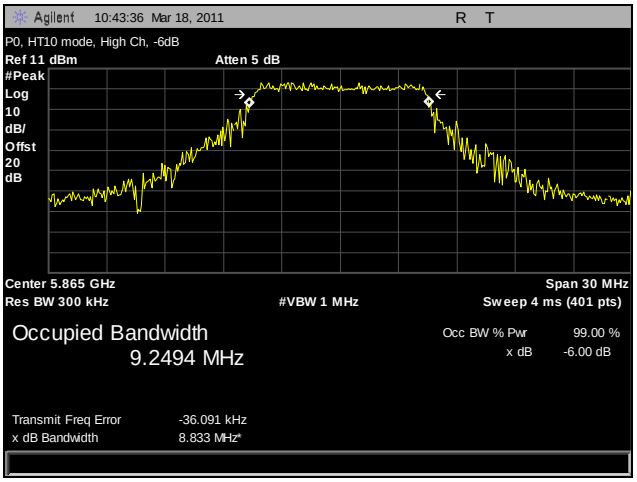
6 dB Occupied Bandwidth Test Results, HT10, P0



Plot 6. 6 dB Occupied Bandwidth, Low Channel, HT10, P0

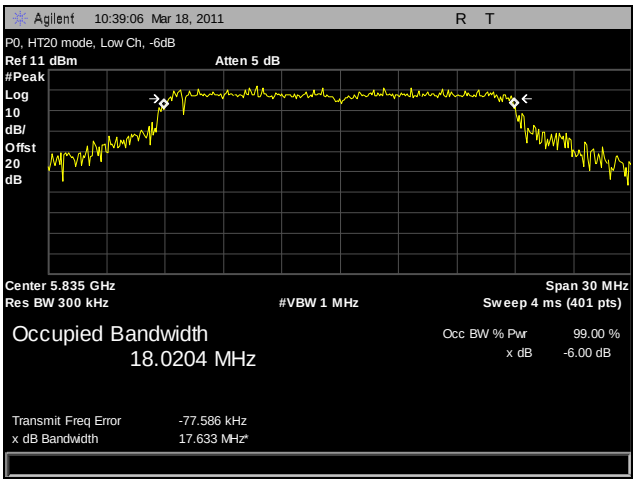


Plot 7. 6 dB Occupied Bandwidth, Mid Channel, HT10, P0

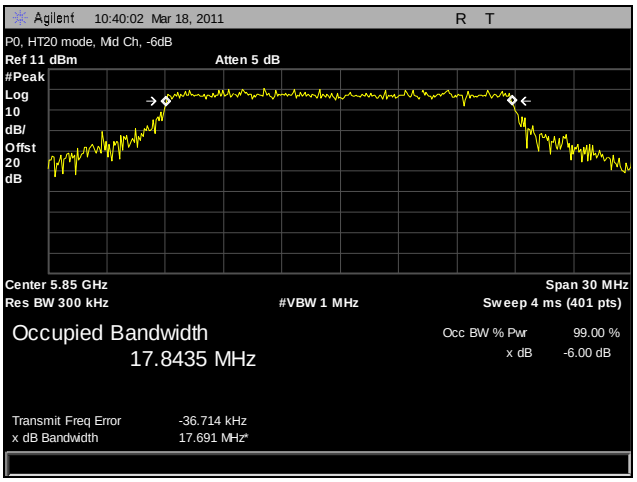


Plot 8. 6 dB Occupied Bandwidth, High Channel, HT10, P0

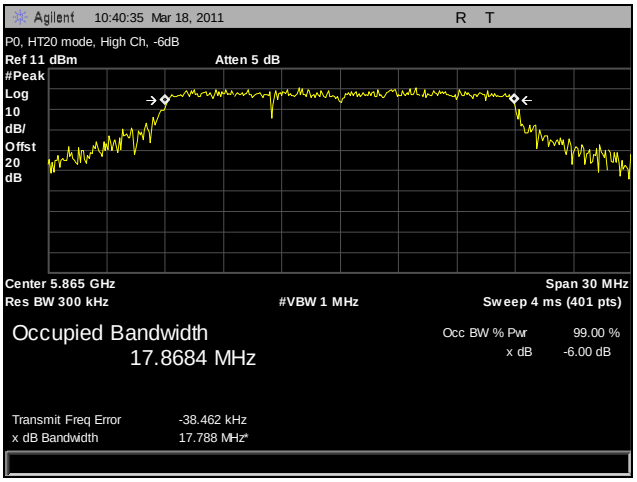
6 dB Occupied Bandwidth Test Results, HT20, P0



Plot 9. 6 dB Occupied Bandwidth, Low Channel, HT20, P0

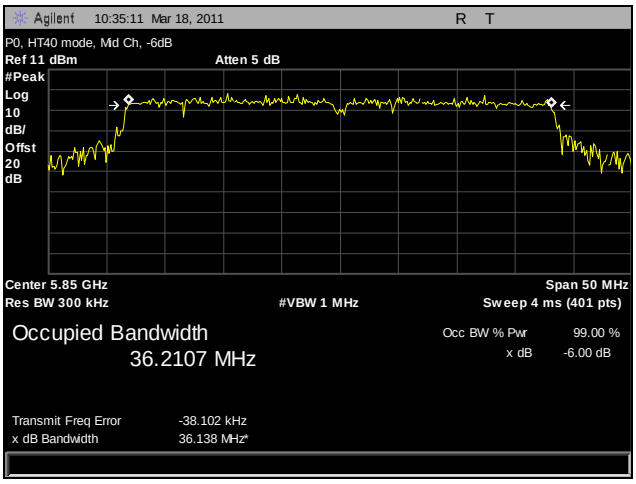


Plot 10. 6 dB Occupied Bandwidth, Mid Channel, HT20, P0



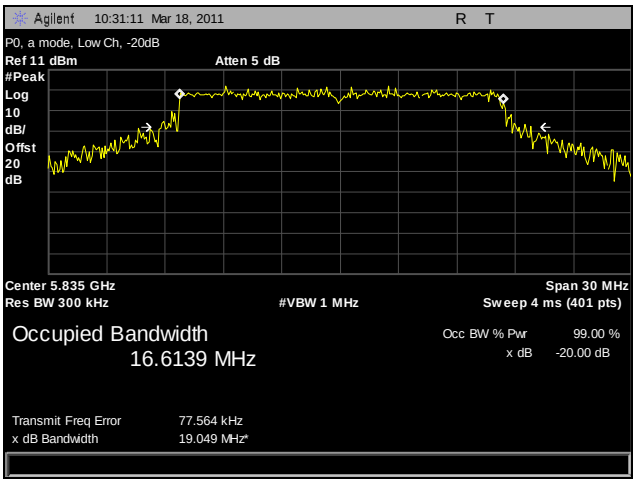
Plot 11. 6 dB Occupied Bandwidth, High Channel, HT20, P0

6 dB Occupied Bandwidth Test Results, HT40, P0

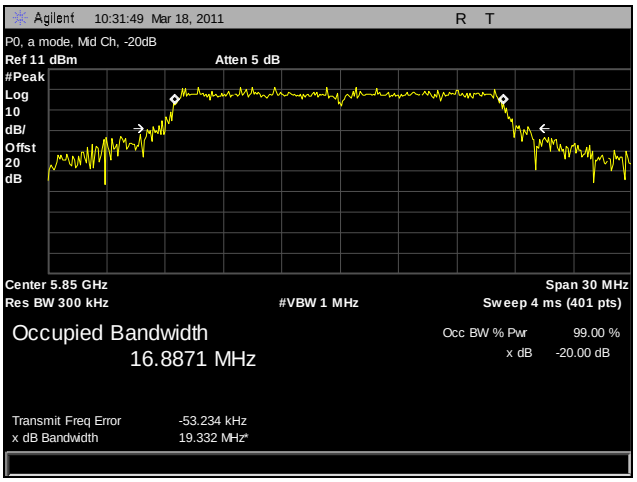


Plot 12. 6 dB Occupied Bandwidth, HT40, P0

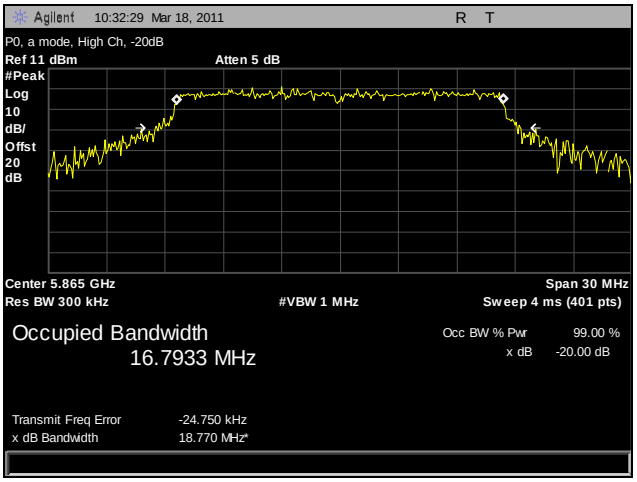
99% Occupied Bandwidth Test Results, a Mode, P0



Plot 13. 99% Occupied Bandwidth, Low Channel, a Mode, P0

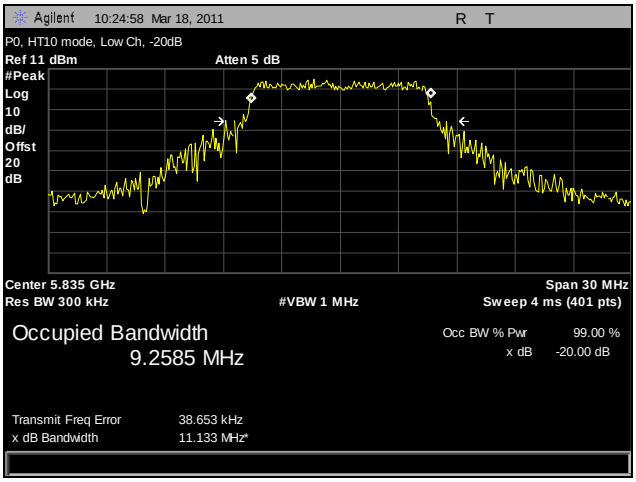


Plot 14. 99% Occupied Bandwidth, Mid Channel, a Mode, P0

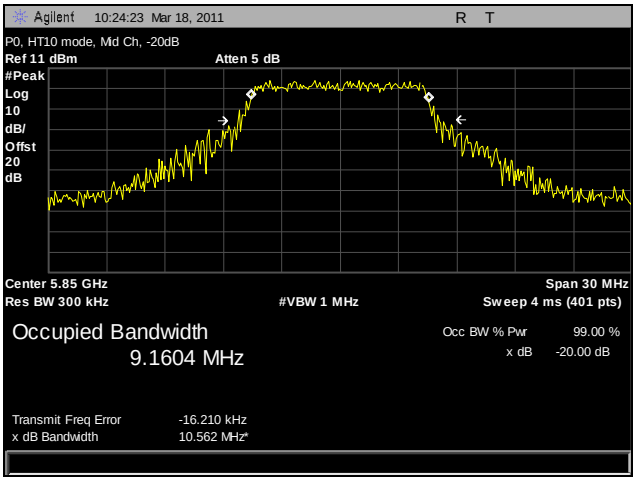


Plot 15. 99% Occupied Bandwidth, High Channel, a Mode, P0

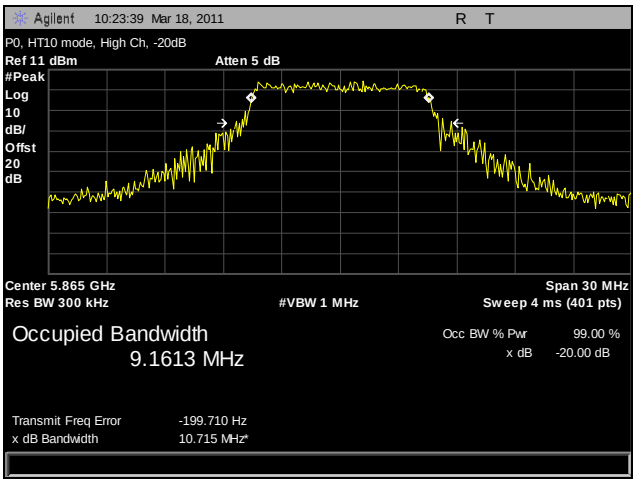
99% Occupied Bandwidth Test Results, HT10, P0



Plot 16. 99% Occupied Bandwidth, Low Channel, HT10, P0

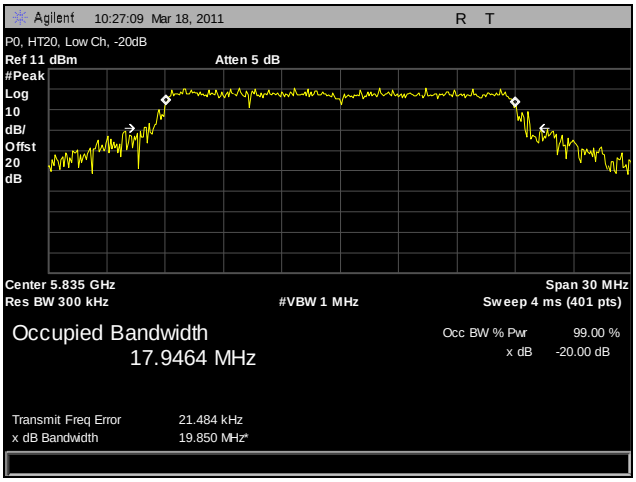


Plot 17. 99% Occupied Bandwidth, Mid Channel, HT10, P0

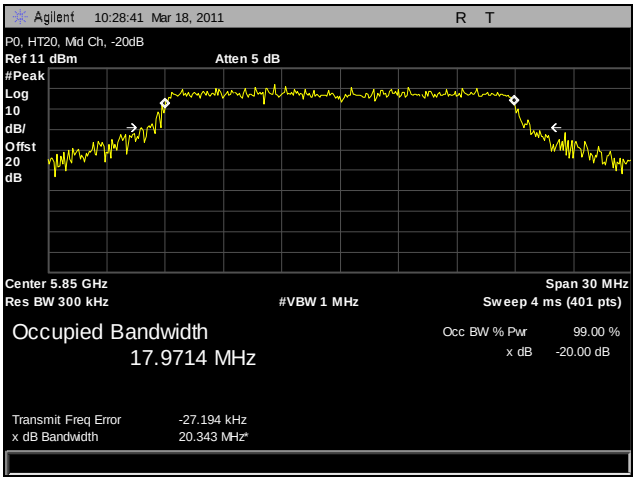


Plot 18. 99% Occupied Bandwidth, High Channel, HT10, P0

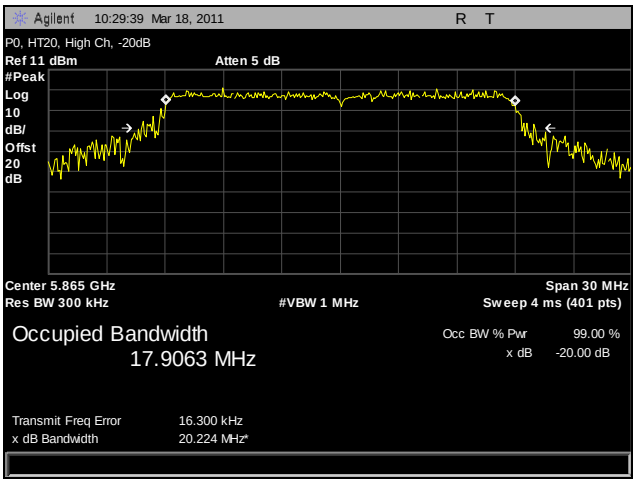
99% Occupied Bandwidth Test Results, HT20, P0



Plot 19. 99% Occupied Bandwidth, Low Channel, HT20, P0

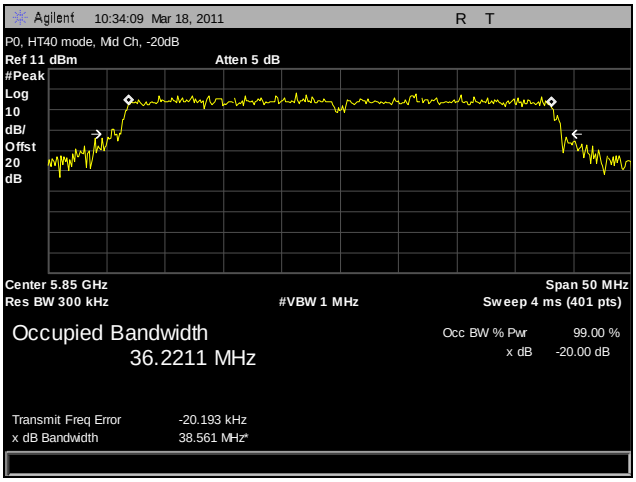


Plot 20. 99% Occupied Bandwidth, Mid Channel, HT20, P0



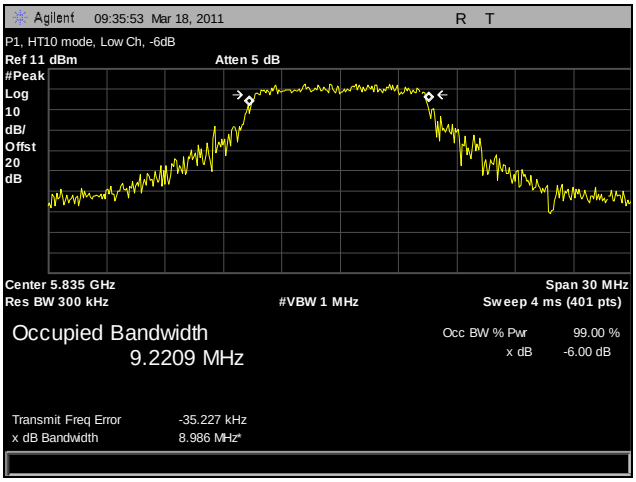
Plot 21. 99% Occupied Bandwidth, High Channel, HT20, P0

99% Occupied Bandwidth Test Results, HT40, P0

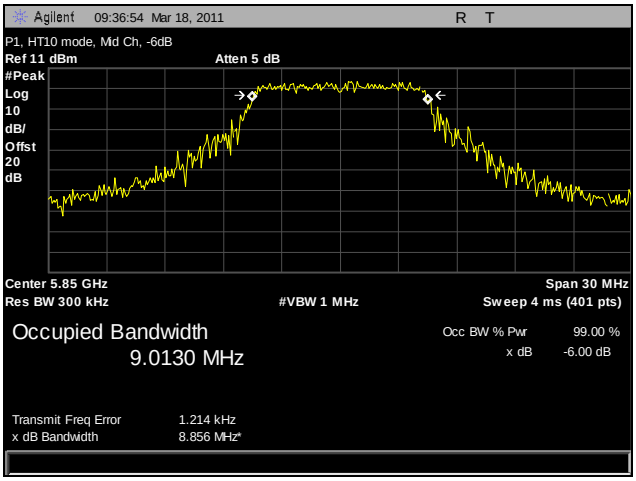


Plot 22. 99% Occupied Bandwidth, HT40, P0

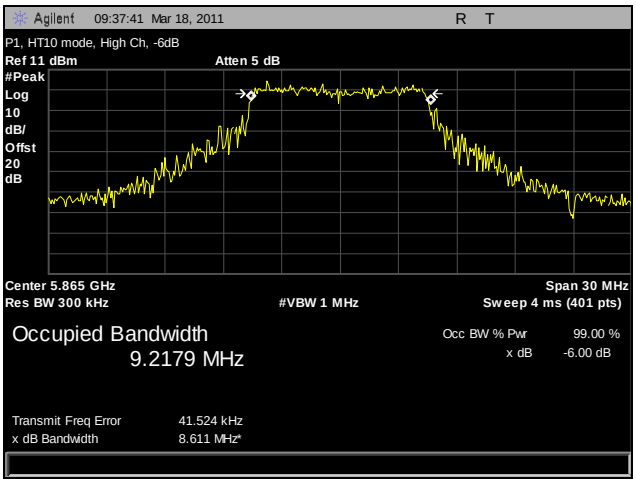
6 dB Occupied Bandwidth Test Results, HT10, P1



Plot 23. 6 dB Occupied Bandwidth, Low Channel, HT10, P1

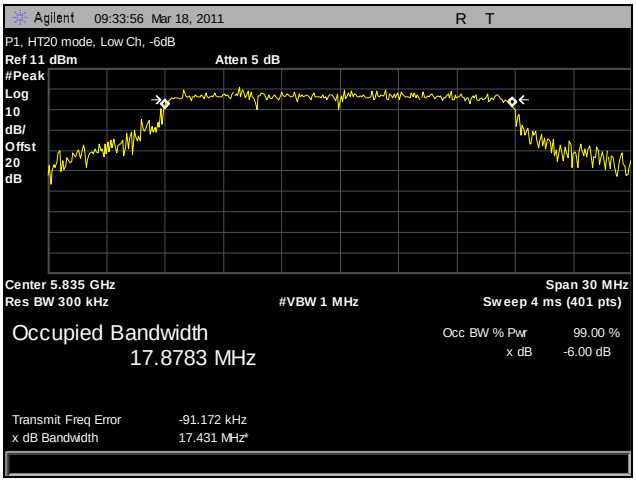


Plot 24. 6 dB Occupied Bandwidth, Mid Channel, HT10, P1

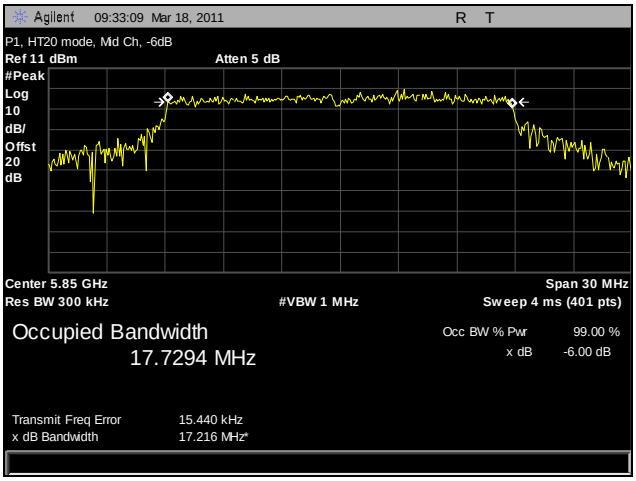


Plot 25. 6 dB Occupied Bandwidth, High Channel, HT10, P1

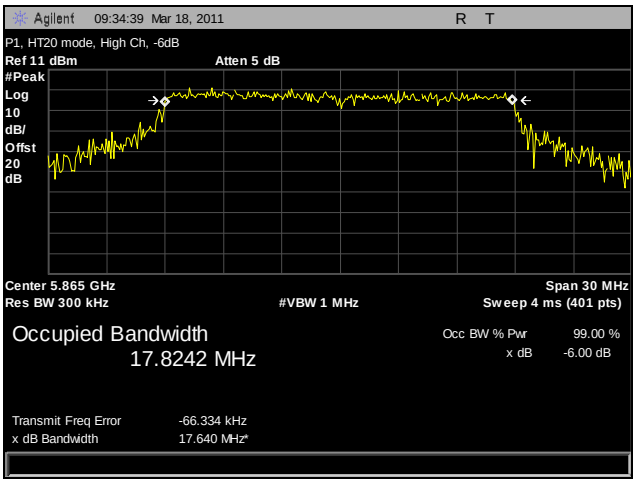
6 dB Occupied Bandwidth Test Results, HT20, P1



Plot 26. 6 dB Occupied Bandwidth, Low Channel, HT20, P1

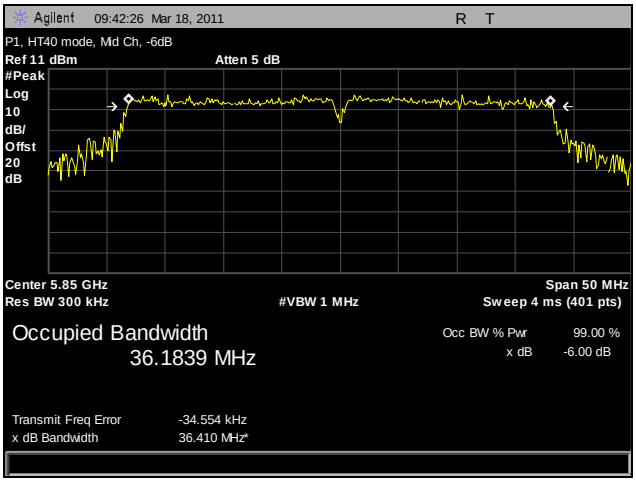


Plot 27. 99% Occupied Bandwidth, Mid Channel, HT20, P1



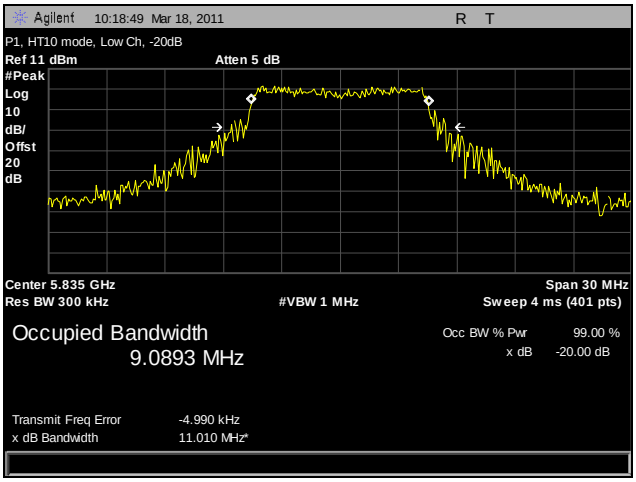
Plot 28. 6 dB Occupied Bandwidth, High Channel, HT20, P1

6 dB Occupied Bandwidth Test Results, HT40, P1

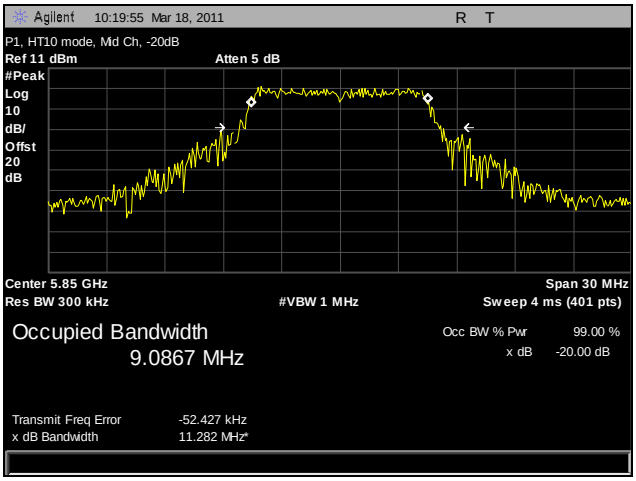


Plot 29. 6 dB Occupied Bandwidth, HT40, P1

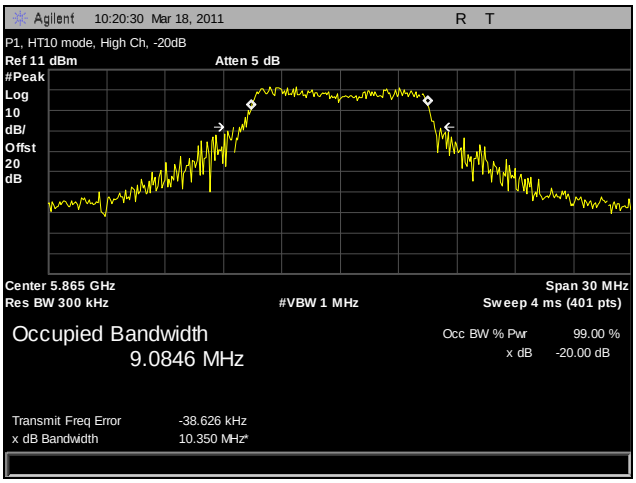
99% Occupied Bandwidth Test Results, HT10, P1



Plot 30. 99% Occupied Bandwidth, Low Channel, HT10, P1

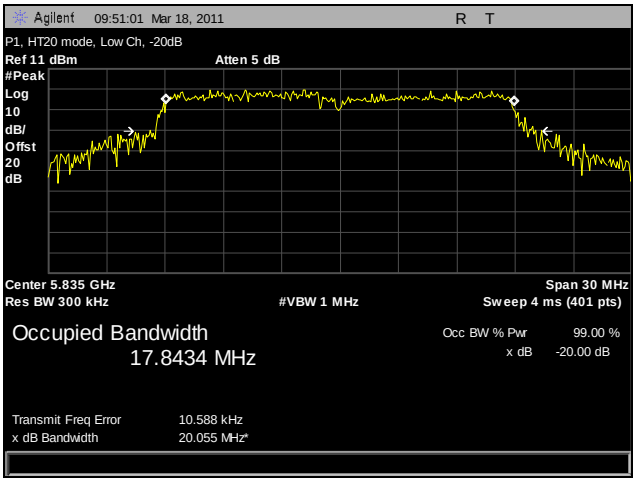


Plot 31. 99% Occupied Bandwidth, Mid Channel, HT10, P1

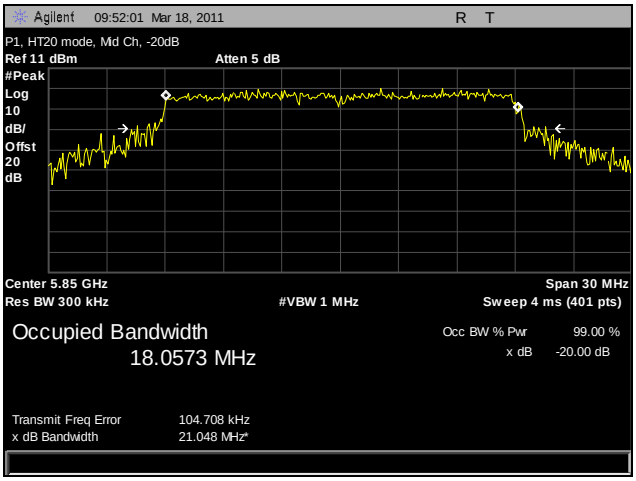


Plot 32. 99% Occupied Bandwidth, High Channel, HT10, P1

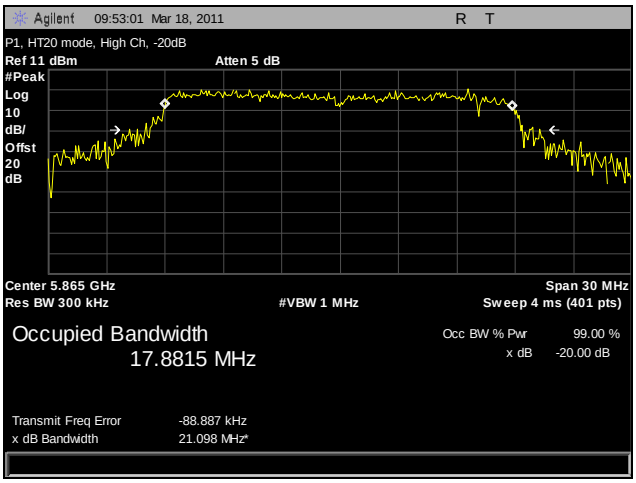
99% Occupied Bandwidth Test Results, HT20, P1



Plot 33. 99% Occupied Bandwidth, Low Channel, HT20, P1

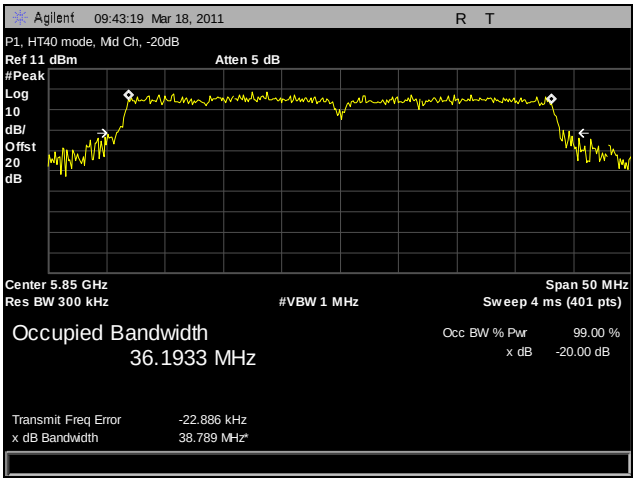


Plot 34. 6 dB Occupied Bandwidth, Mid Channel, HT20, P1



Plot 35. 99% Occupied Bandwidth, High Channel, HT20, P1

99% Occupied Bandwidth Test Results, HT40, P1



Plot 36. 99% Occupied Bandwidth, HT40, P1

Electromagnetic Compatibility Criteria for Intentional Radiators

Peak Power Output and Peak Excursion

Test Requirements: The maximum peak output power of the intentional radiator shall not exceed the following:

Digital Transmission Systems (MHz)	Output Limit
5825–5875	36 dBm EIRP

Table 10. Output Power Requirements

Test Procedure: The EUT was connected to a Spectrum Analyzer. The power was measured on three channels.

Test Results: The EUT was compliant with the Peak Power Output limits.

Test Engineer(s): Manasi Bhandiwad

Test Date(s): 03/21/11

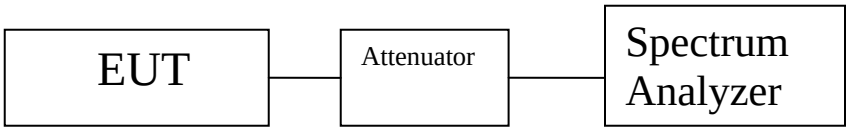


Figure 3. Peak Power Output Test Setup

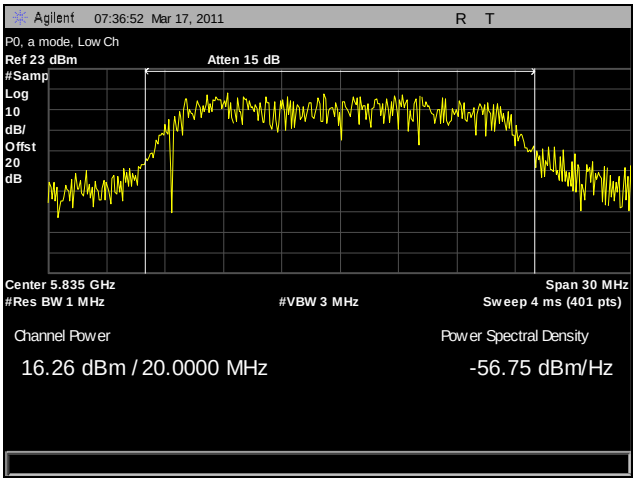
RF Power Output Test Results

Peak Conducted Output Power dBm							
Mode	**Carrier Channel**	**Frequency (MHz)**	**Port 1 dBm**	**Port 2 dBm**	**Summed Peak Output Power dBm**	**Limit dBm**	**Margin dBm**
a	Low	5835	16.26	N/A	16.26	20	-3.74
	Mid	5850	15.46	N/A	15.46	20	-4.54
	High	5865	16.09	N/A	16.09	20	-3.91
HT10	Low	5835	15.78	12.40	17.42	20	-2.58
	Mid	5850	15.20	11.64	16.79	20	-3.21
	High	5865	15.67	12.12	17.26	20	-2.74
HT20	Low	5835	15.49	11.60	16.98	20	-3.02
	Mid	5850	15.79	11.54	17.18	20	-2.82
	High	5865	15.90	11.22	17.17	20	-2.83
HT40	-	5850	15.55	12.42	17.27	20	-2.73

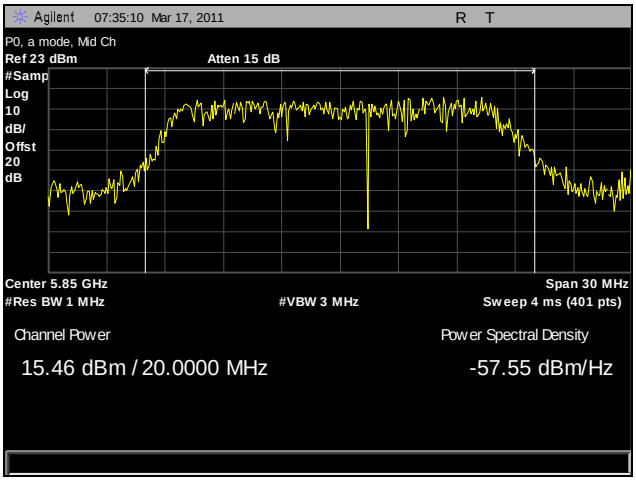
Table 11. RF Output Power, Test Results

The transmitter was connected directly to a spectrum analyzer through an attenuator. The power level was set to the maximum level on the EUT. The RBW was set to 1 MHz and VBW was set to 3 MHz. The method of measurement number from the FCC public notice DA 02-2138 was used.

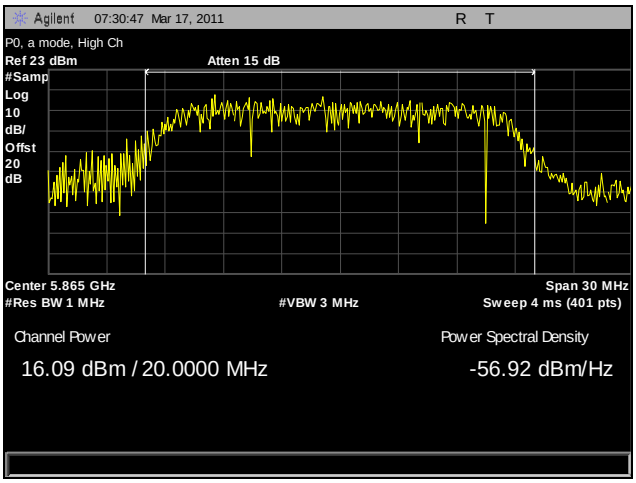
RF Output Power Test Results, a Mode, P0



Plot 37. Peak Output Power, Low Channel, a Mode, P0

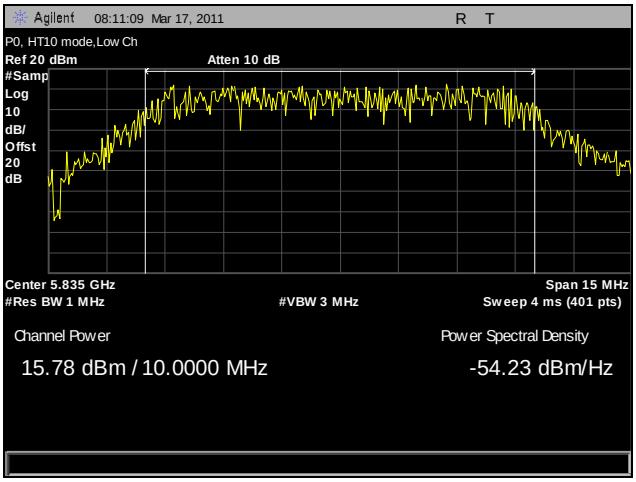


Plot 38. Peak Output Power, Mid Channel, a Mode, P0

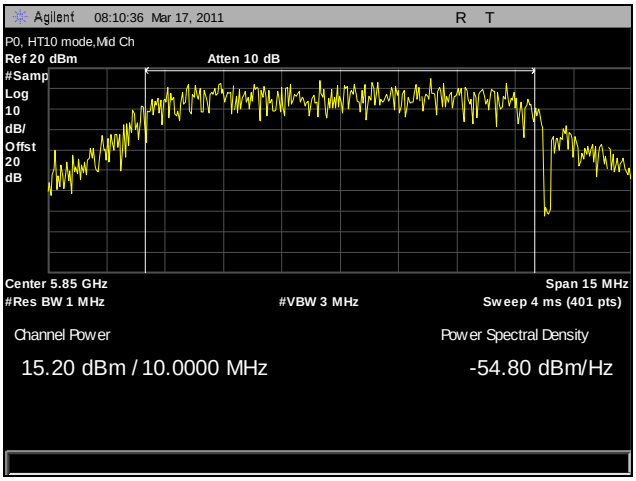


Plot 39. Peak Output Power, High Channel, a Mode, P0

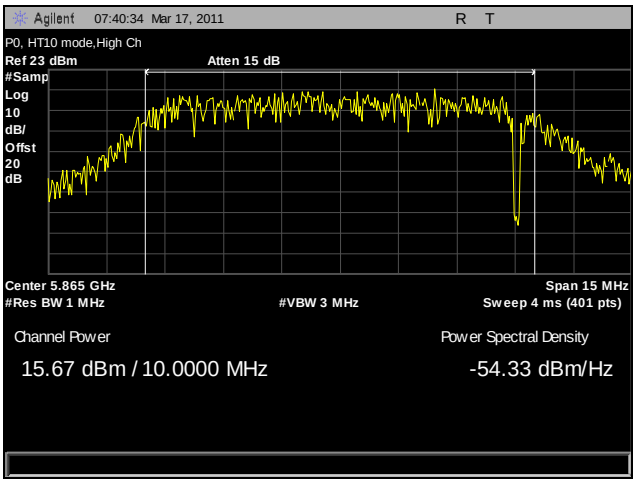
RF Output Power Test Results, HT10, P0



Plot 40. Peak Output Power, Low Channel, HT10, P0

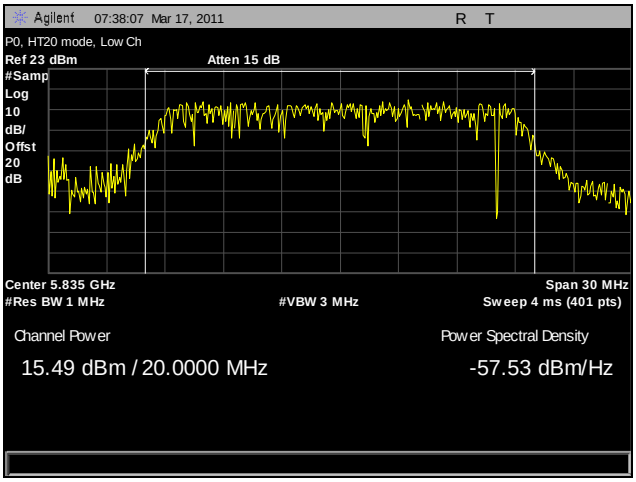


Plot 41. Peak Output Power, Mid Channel, HT10, P0

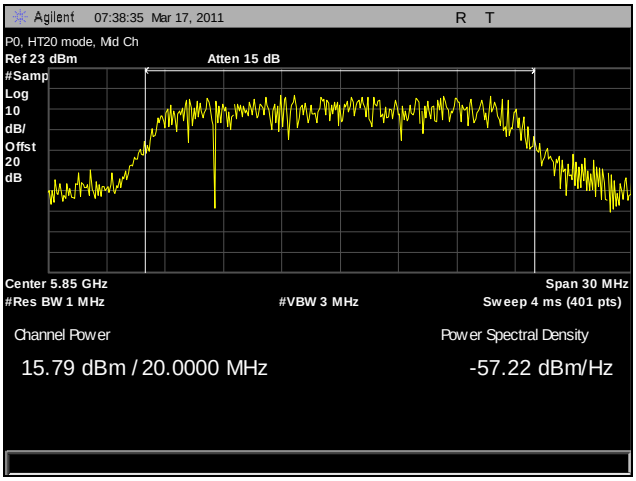


Plot 42. Peak Output Power, High Channel, HT10, P0

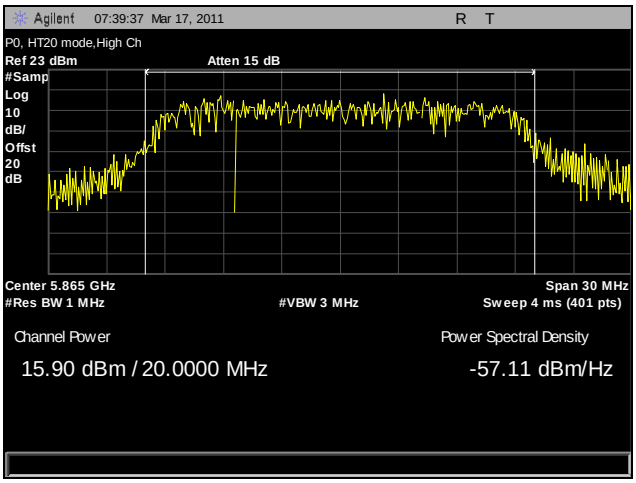
RF Output Power Test Results, HT20, P0



Plot 43. Peak Output Power, Low Channel, HT20, P0

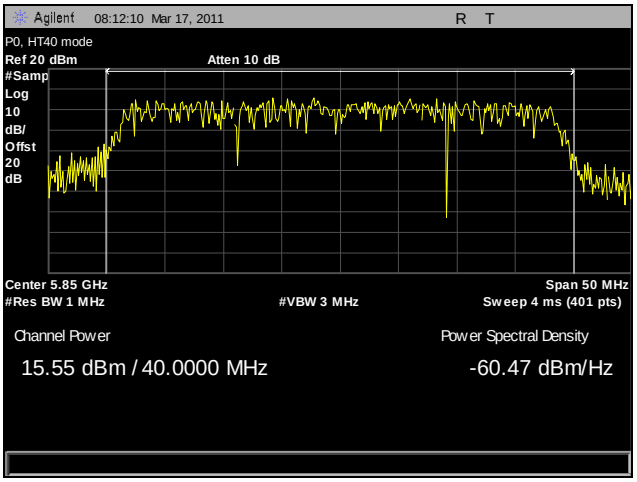


Plot 44. Peak Output Power, Mid Channel, HT20, P0



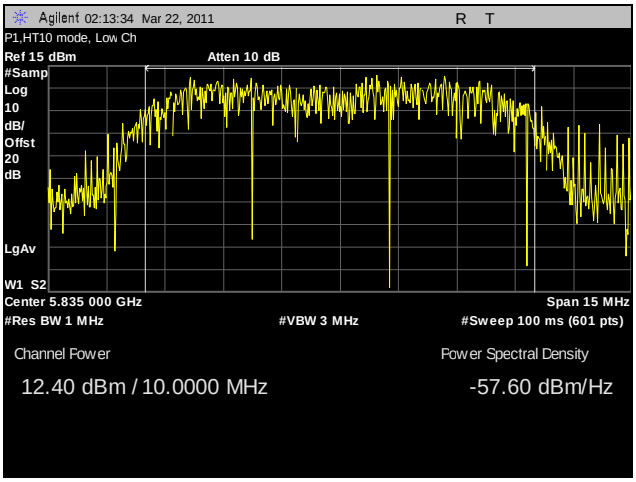
Plot 45. Peak Output Power, High Channel, HT20, P0

RF Output Power Test Results, HT40, P0

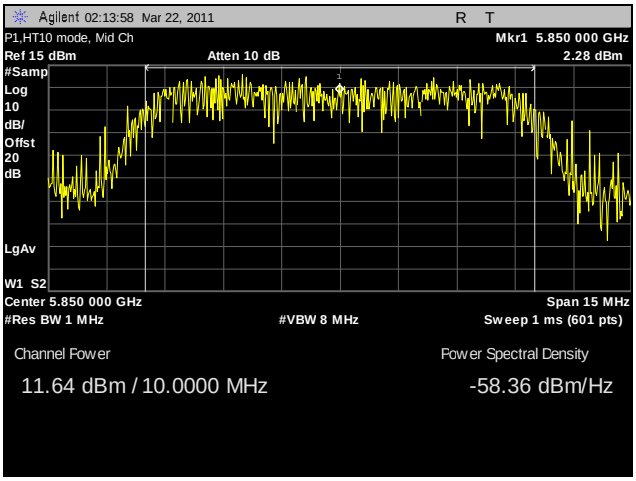


Plot 46. Peak Output Power, HT40, P0

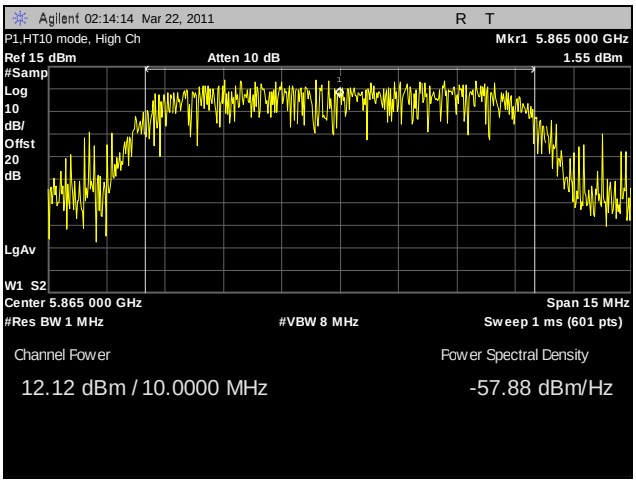
RF Output Power Test Results, HT10, P1



Plot 47. Peak Output Power, Low Channel, HT10, P1

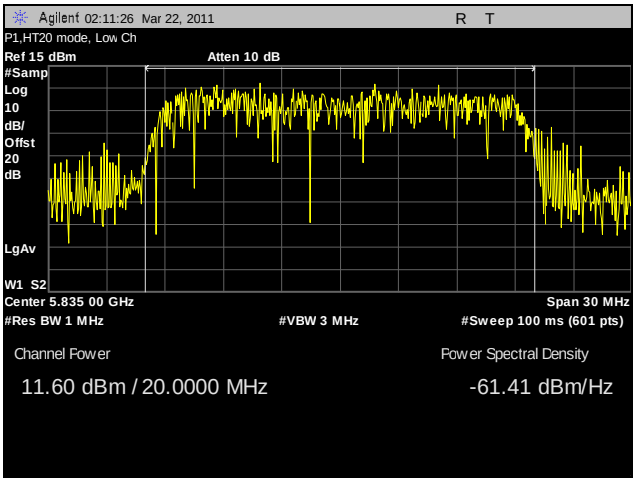


Plot 48. Peak Output Power, Mid Channel, HT10, P1

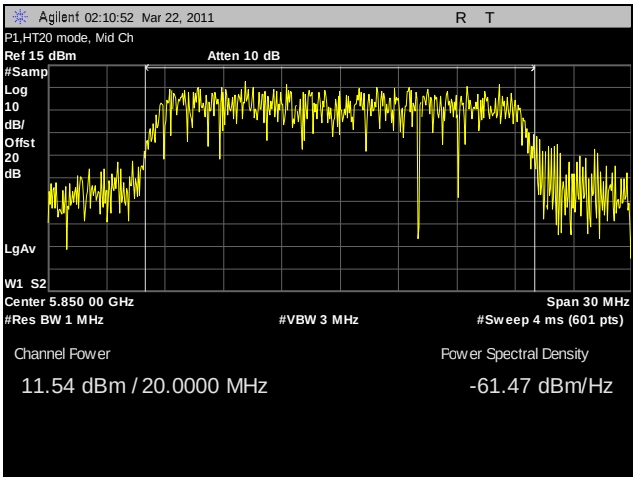


Plot 49. Peak Output Power, High Channel, HT10, P1

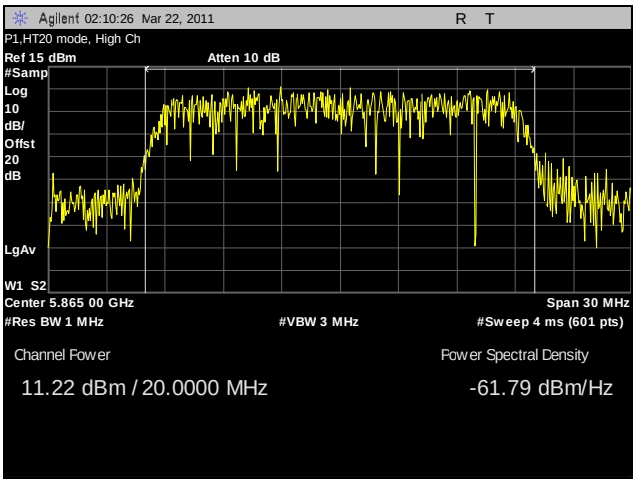
RF Output Power Test Results, HT20, P1



Plot 50. Peak Output Power, Low Channel, HT20, P1

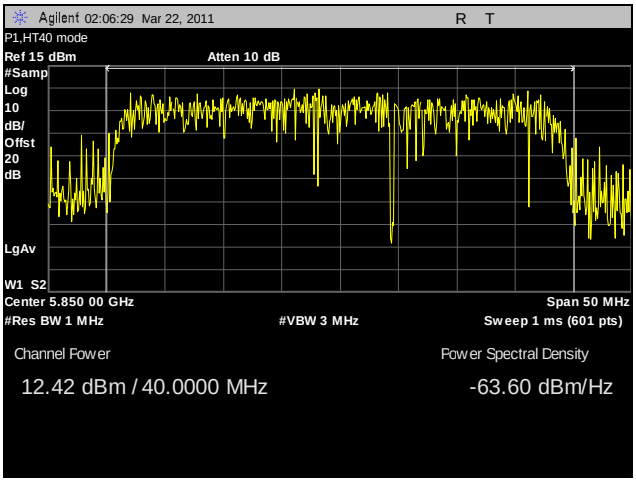


Plot 51. Peak Output Power, Mid Channel, HT20, P1



Plot 52. Peak Output Power, High Channel, HT20, P1

RF Output Power Test Results, HT40, P1



Plot 53. Peak Output Power, HT40, P1

Electromagnetic Compatibility Criteria for Intentional Radiators

Peak Excursion Ratio

Test Requirements: The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the maximum conducted output power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

Test Procedure: The EUT was connected directly to the spectrum analyzer through an attenuator. The span was set to view the entire emission bandwidth. Since method #1 of FCC public notice DA 02-2138 was used for peak conducted output transmit power, the second trace was created using method #1.

Test Results: Equipment was compliant with the peak excursion ratio limits.

Test Engineer(s): Jeff Pratt

Test Date(s): 03/18/11

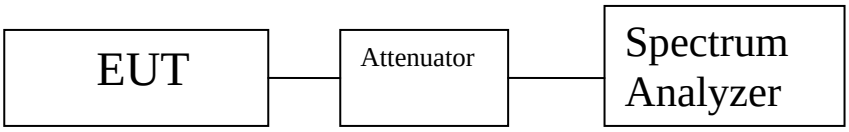
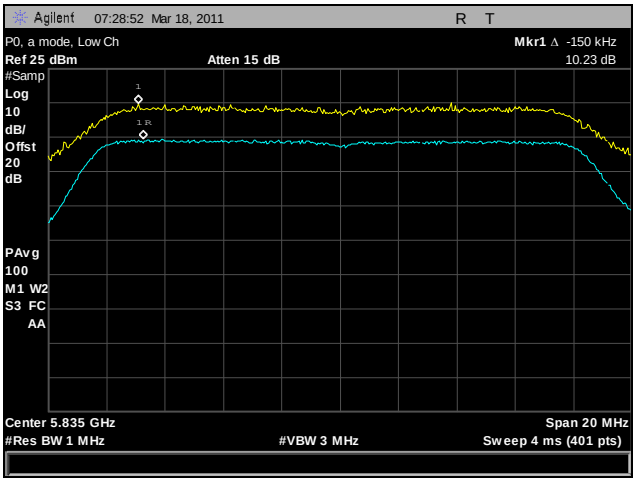


Figure 4. Peak Excursion Ration Test Setup

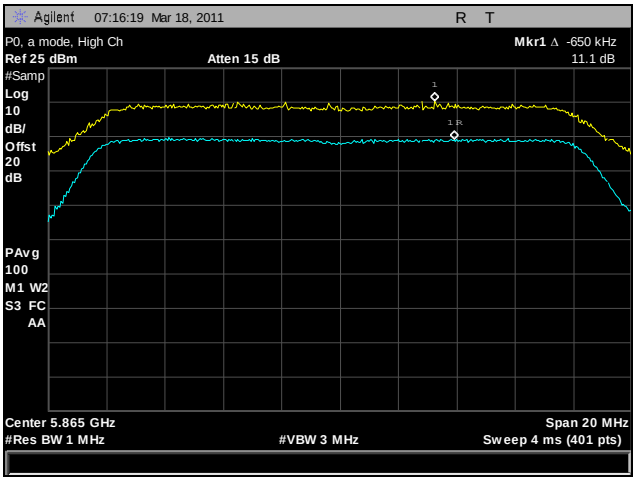
Peak Excursion dB Limit =13dB				
Mode	**Carrier Channel**	**Frequency (MHz)**	**Port 1 dB**	**Port 2 dB**
a	Low	5835	10.23	N/A
	Mid	5850	11.10	N/A
	High	5865	9.79	N/A
HT10	Low	5835	10.72	12.91
	Mid	5850	10.58	11.98
	High	5865	10.69	12.79
HT20	Low	5835	9.04	10.81
	Mid	5850	8.45	9.94
	High	5865	8.30	11.01
HT40	-	5850	9.33	10.79

Table 12. Peak Excursion Ratio

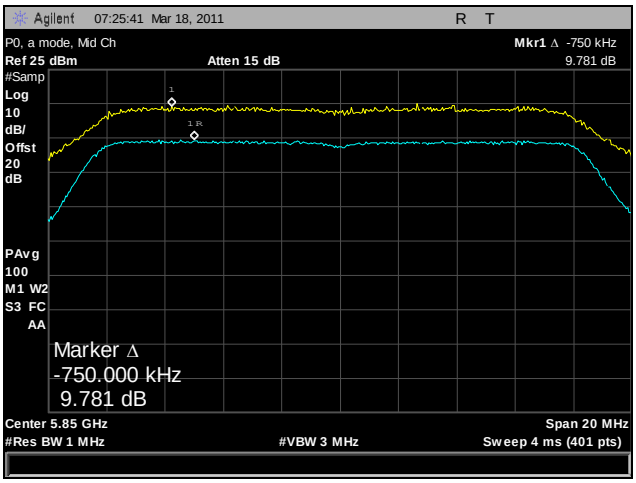
Peak Excursion Ration Test Results, a Mode, P0



Plot 54. Peak Excursion, Low Channel, a Mode, P0

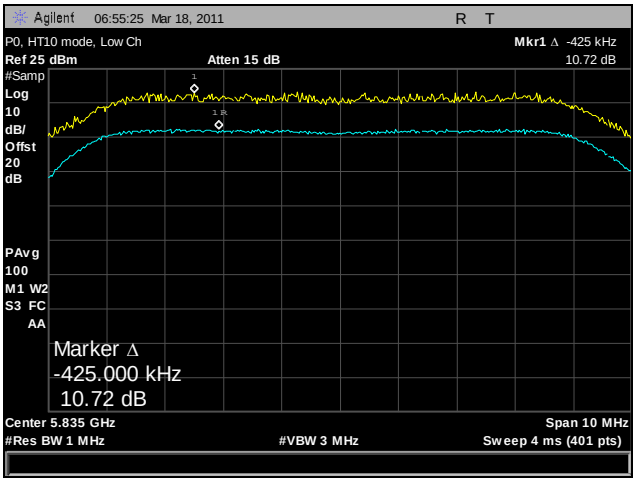


Plot 55. Peak Excursion, Mid Channel, a Mode, P0

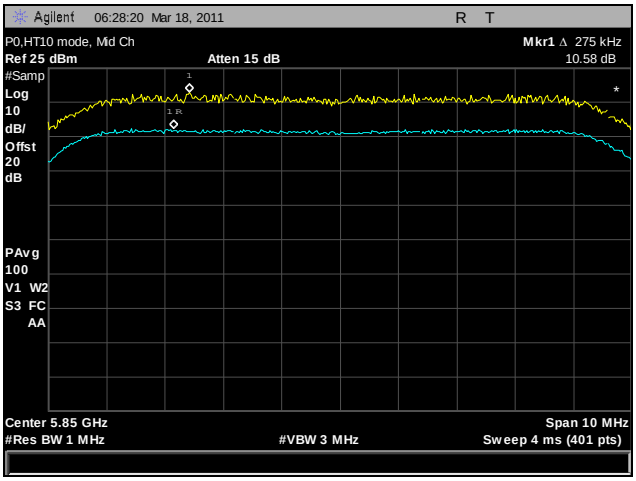


Plot 56. Peak Excursion, High Channel, a Mode, P0

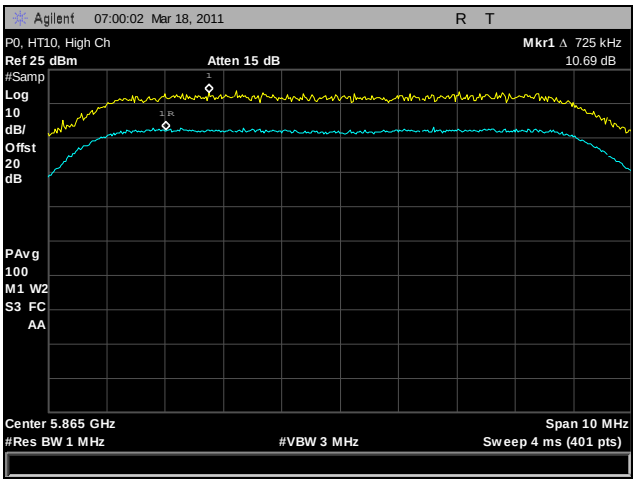
Peak Excursion Ration Test Results, HT10, P0



Plot 57. Peak Excursion, Low Channel, HT10, P0

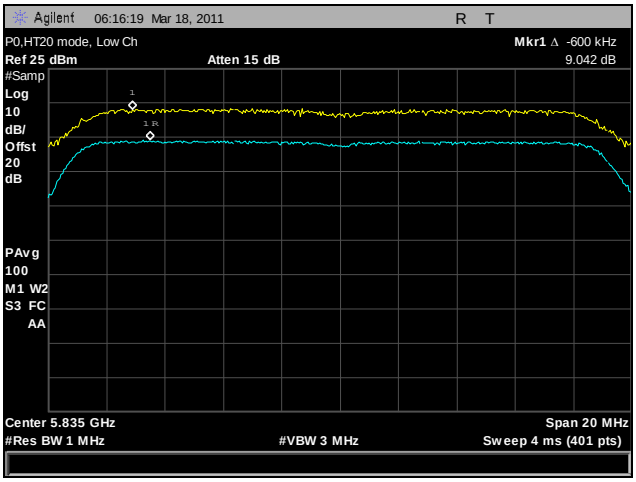


Plot 58. Peak Excursion, Mid Channel, HT10, P0

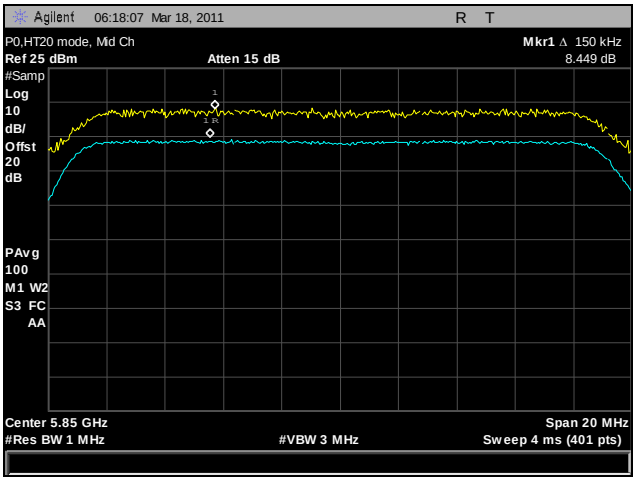


Plot 59. Peak Excursion, High Channel, HT10, P0

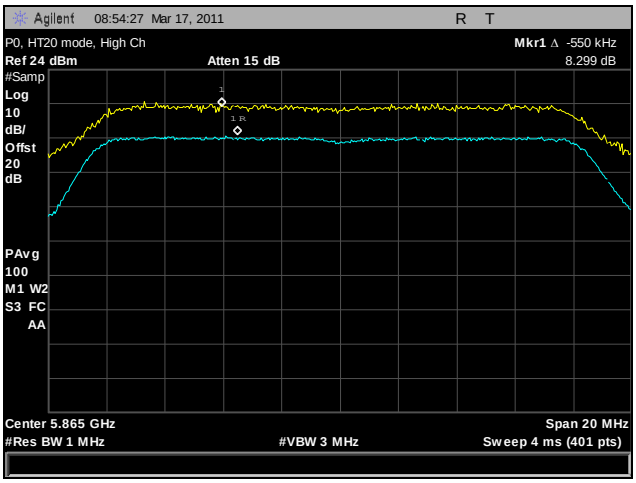
Peak Excursion Ration Test Results, HT20, P0



Plot 60. Peak Excursion, Low Channel, HT20, P0

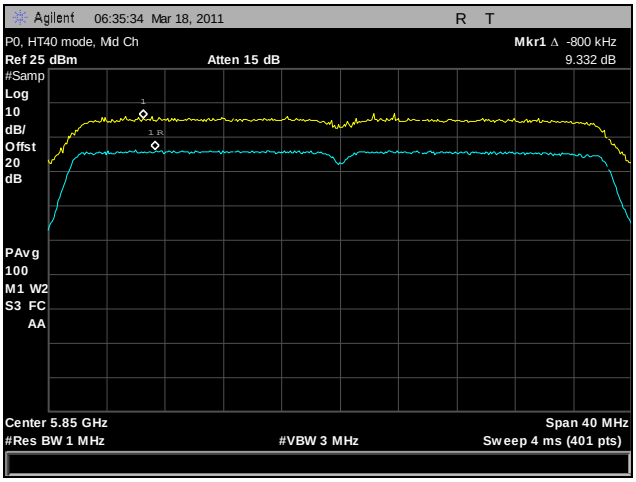


Plot 61. Peak Excursion, Mid Channel, HT20, P0



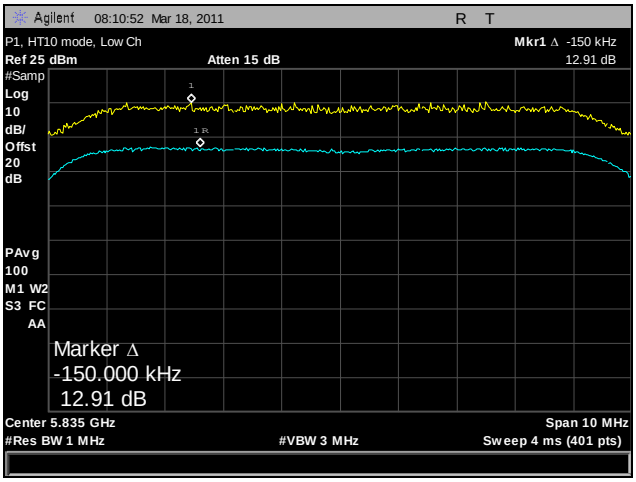
Plot 62. Peak Excursion, High Channel, HT20, P0

Peak Excursion Ration Test Results, HT40, P0

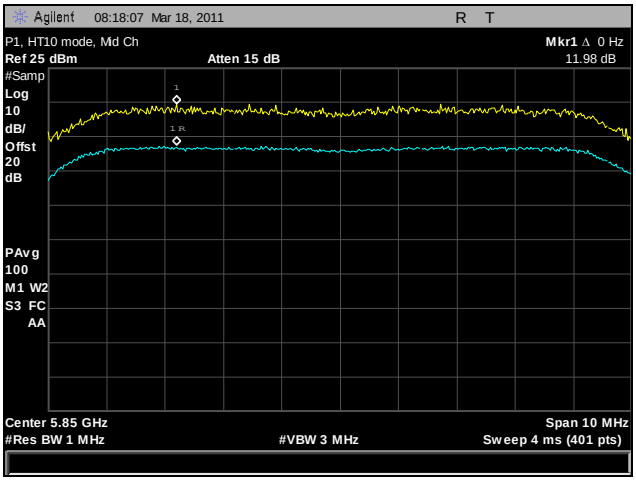


Plot 63. Peak Excursion, HT40, P0

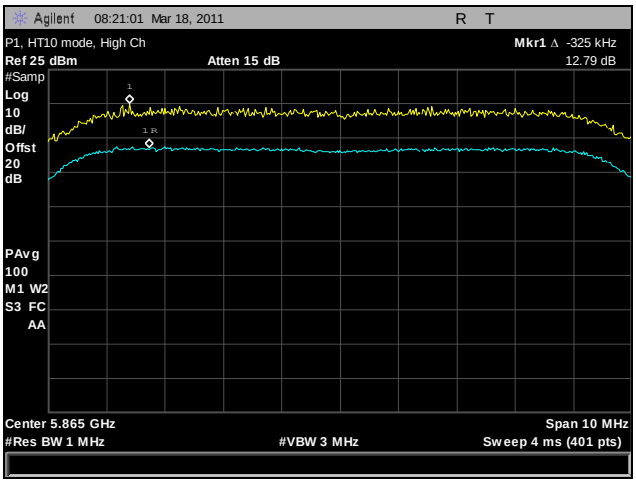
Peak Excursion Ration Test Results, HT10, P1



Plot 64. Peak Excursion, Low Channel, HT10, P1

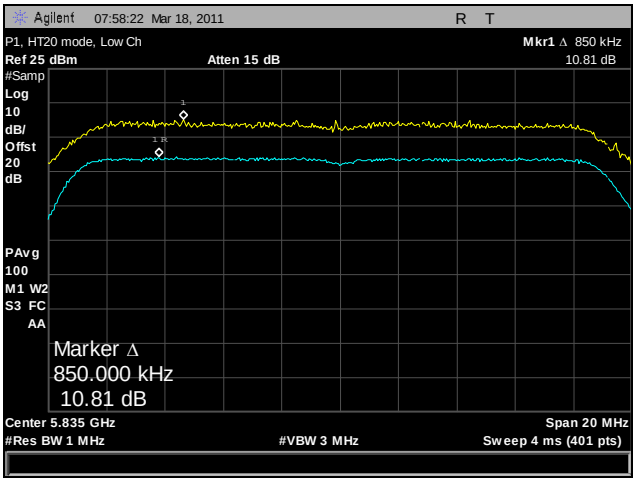


Plot 65. Peak Excursion, Mid Channel, HT10, P1

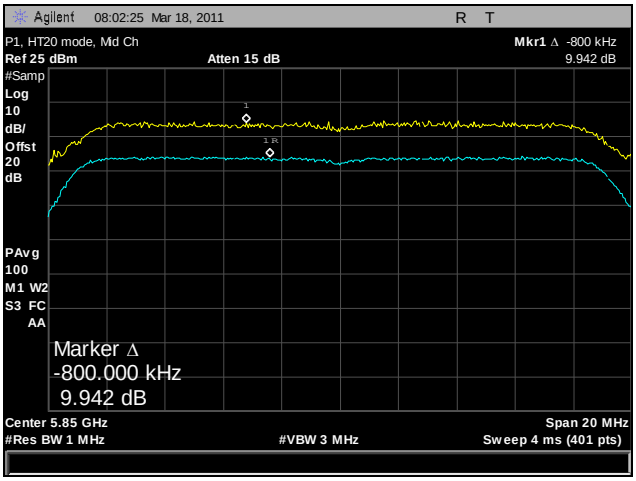


Plot 66. Peak Excursion, High Channel, HT10, P1

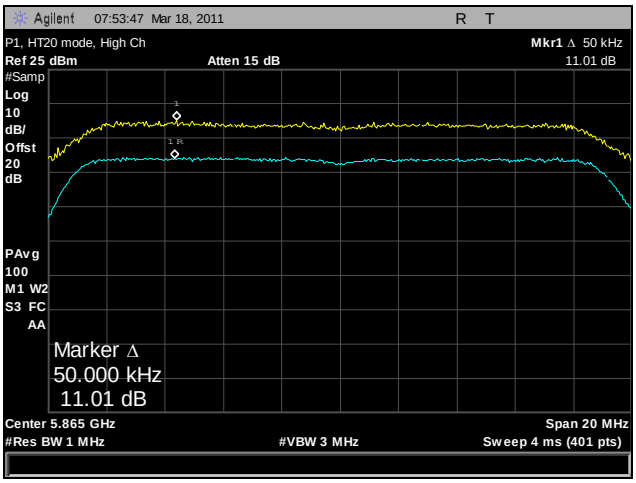
Peak Excursion Ration Test Results, HT20, P1



Plot 67. Peak Excursion, Low Channel, HT20, P1

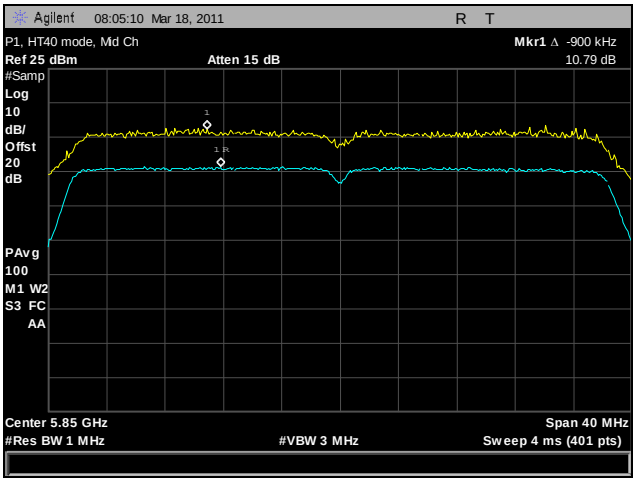


Plot 68. Peak Excursion, Mid Channel, HT20, P1



Plot 69. Peak Excursion, High Channel, HT20, P1

Peak Excursion Ration Test Results, HT40, P1



Plot 70. Peak Excursion, HT40, P1

Electromagnetic Compatibility Criteria for Intentional Radiators

Radiated Spurious Emissions Requirements and Band Edge

Test Requirements: Emissions outside the frequency band.

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 is not required. In addition, radiated emissions which fall in the restricted bands, must also comply with the radiated emission limits.

Test Requirement(s): Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 13.

Frequency (MHz)	Radiated Emission Limits (dBµV) @ 3m
30 - 88	40.00
88 - 216	43.50
216 - 960	46.00
Above 960	54.00

Table 13. Radiated Emissions Limits

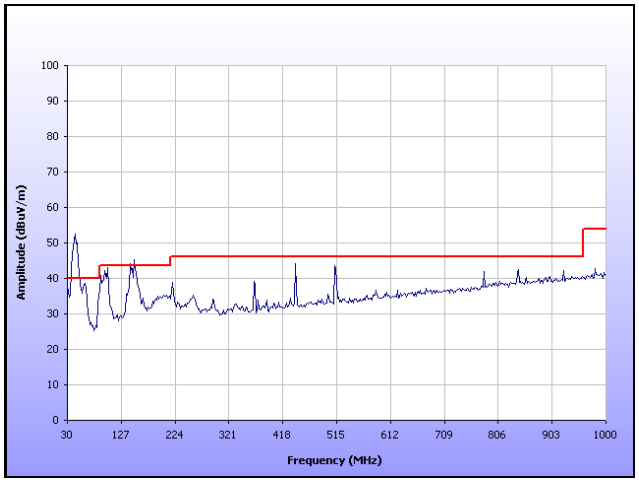
Test Procedures: The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line.

Test Results: The EUT was compliant with the Radiated Spurious Emission limits. In the 30 MHz – 1 GHz range, the emissions on all the channels – low, mid, and high are over the limits. However, it has been identified that these emissions which exceed the limits are digital emissions. This is further evident from the 30 MHz – 1 GHz plots for the low, mid and high channel in the receiver mode.

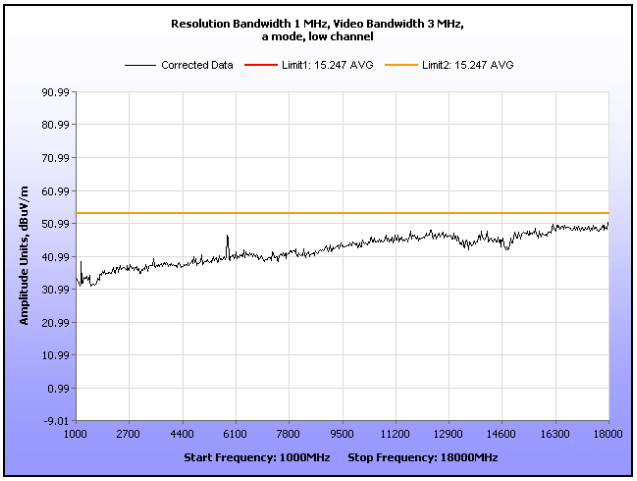
Test Engineer(s): Ben Taylor

Test Date(s): 04/18/11

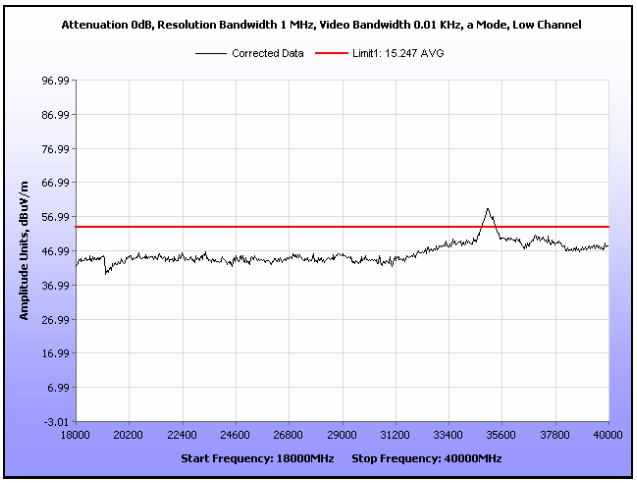
Radiated Spurious Emissions Test Results, a Mode



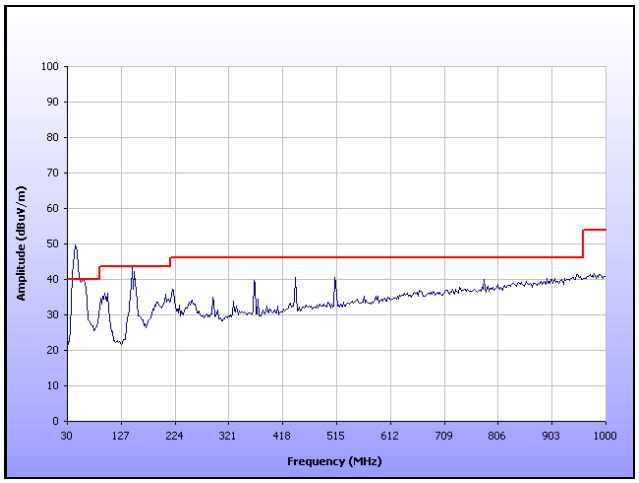
Plot 71. Radiated Spurious Emissions, Low Channel, a Mode, 30 MHz – 1 GHz



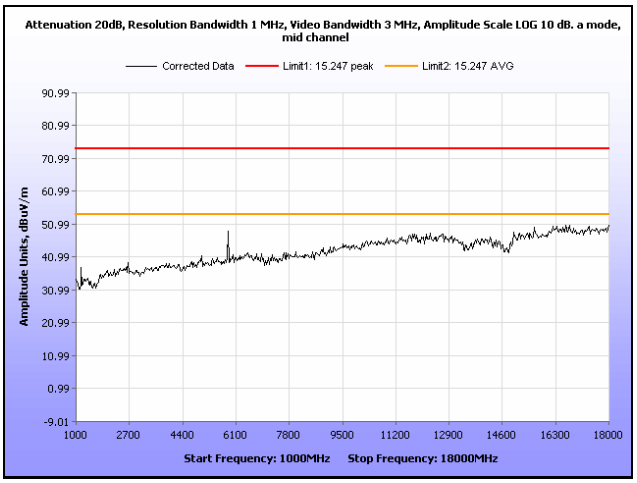
Plot 72. Radiated Spurious Emissions, Low Channel, a Mode, 1 GHz – 18 GHz



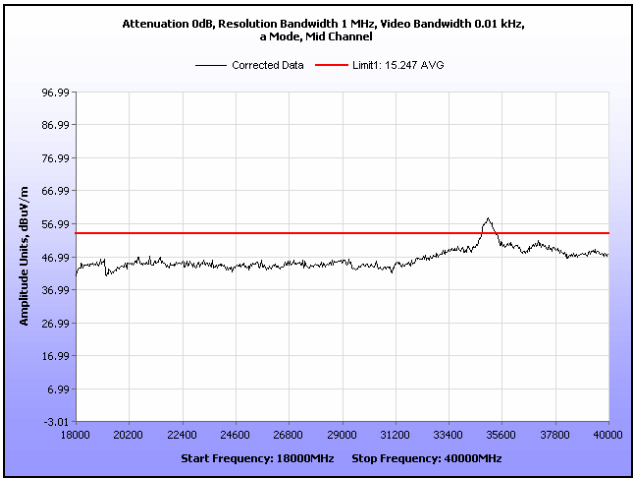
Plot 73. Radiated Spurious Emissions, Low Channel, a Mode, 18 GHz – 40 GHz



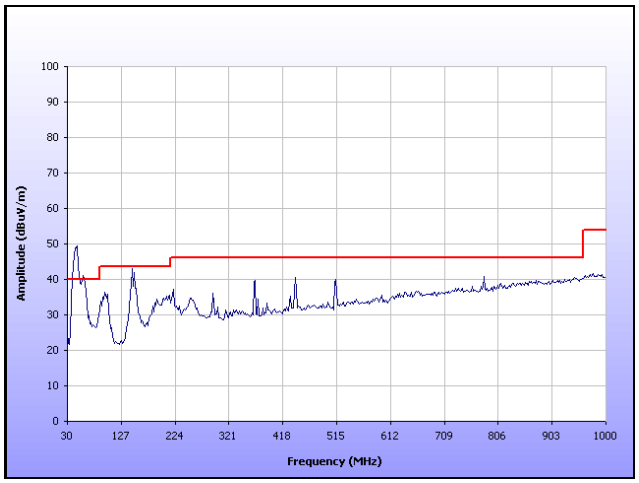
Plot 74. Radiated Spurious Emissions, Mid Channel, a Mode, 30 MHz – 1 GHz



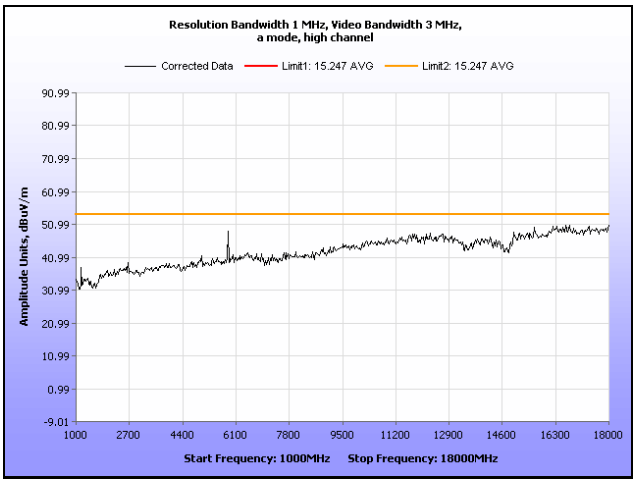
Plot 75. Radiated Spurious Emissions, Mid Channel, a Mode, 1 GHz – 18 GHz



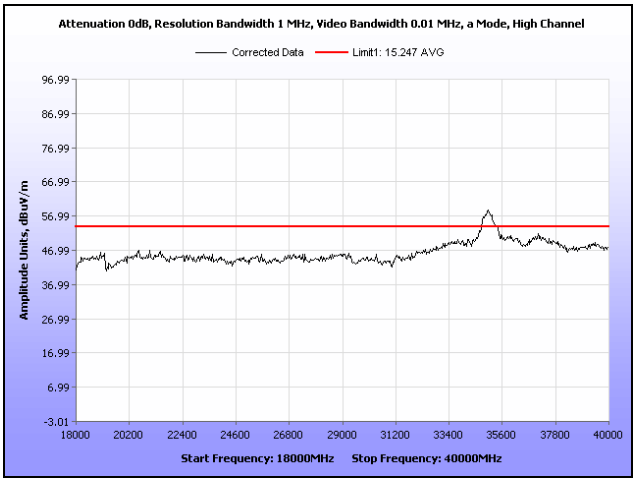
Plot 76. Radiated Spurious Emissions, Mid Channel, a Mode, 18 GHz – 40 GHz



Plot 77. Radiated Spurious Emissions, High Channel, a Mode, 30 MHz – 1 GHz

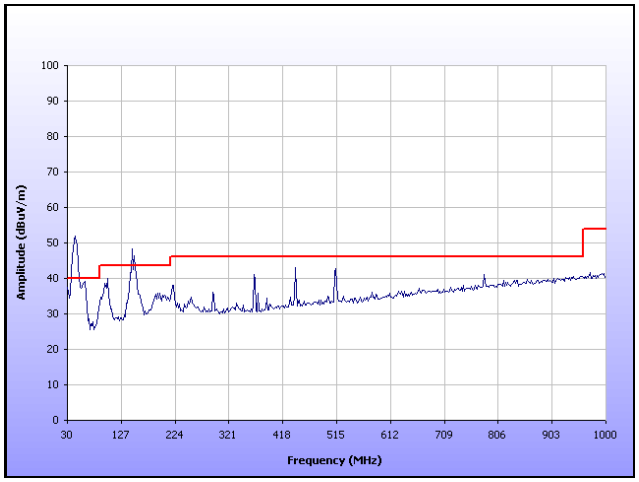


Plot 78. Radiated Spurious Emissions, High Channel, a Mode, 1 GHz – 18 GHz

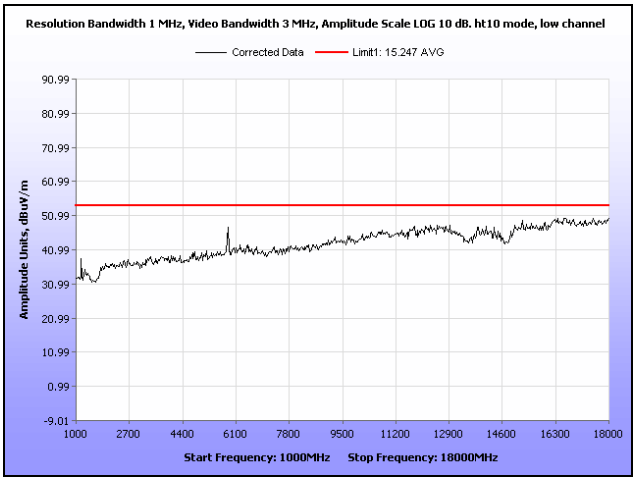


Plot 79. Radiated Spurious Emissions, High Channel, a Mode, 18 GHz – 40 GHz

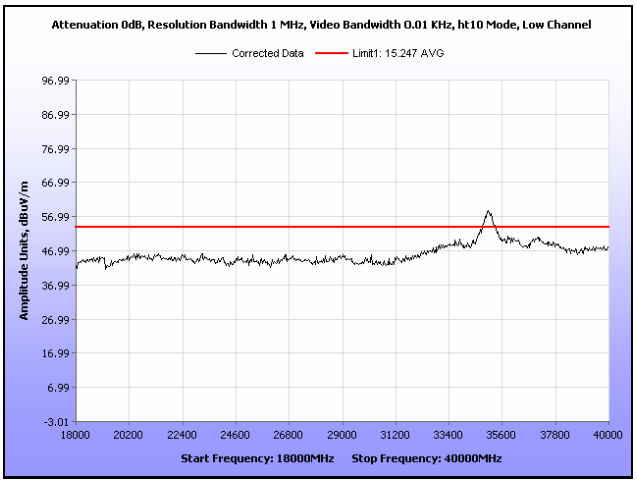
Radiated Spurious Emissions Test Results, HT10



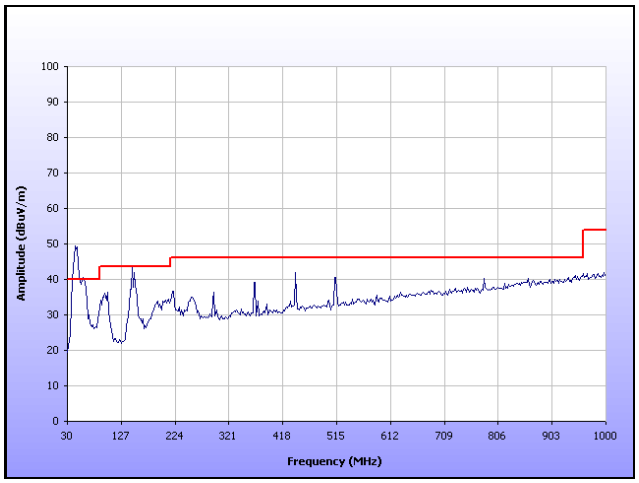
Plot 80. Radiated Spurious Emissions, Low Channel, HT10, 30 MHz – 1 GHz



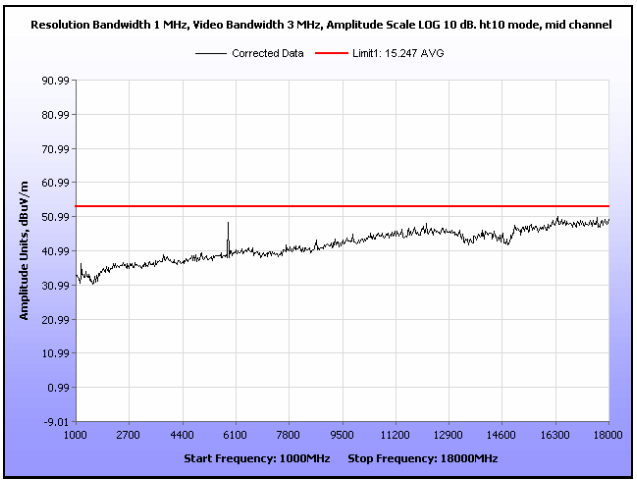
Plot 81. Radiated Spurious Emissions, Low Channel, HT10, 1 GHz – 18 GHz



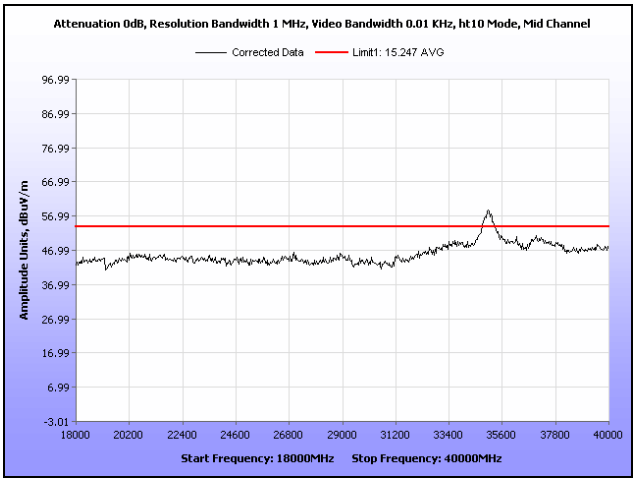
Plot 82. Radiated Spurious Emissions, Low Channel, HT10, 18 GHz – 40 GHz



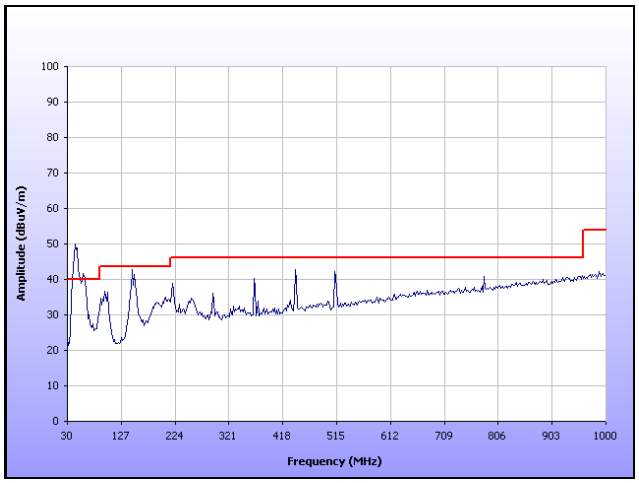
Plot 83. Radiated Spurious Emissions, Mid Channel, HT10, 30 MHz – 1 GHz



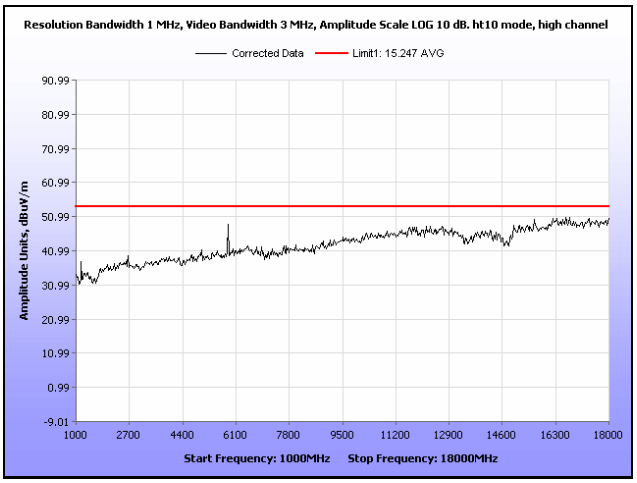
Plot 84. Radiated Spurious Emissions, Mid Channel, HT10, 1 GHz – 18 GHz



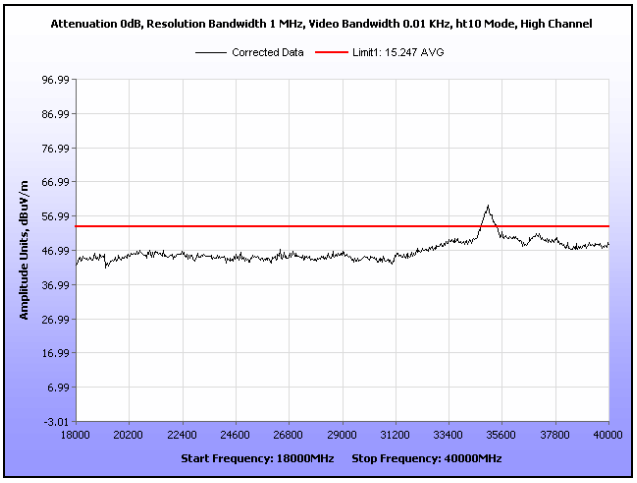
Plot 85. Radiated Spurious Emissions, Mid Channel, HT10, 18 GHz – 40 GHz



Plot 86. Radiated Spurious Emissions, High Channel, HT10, 30 MHz – 1 GHz

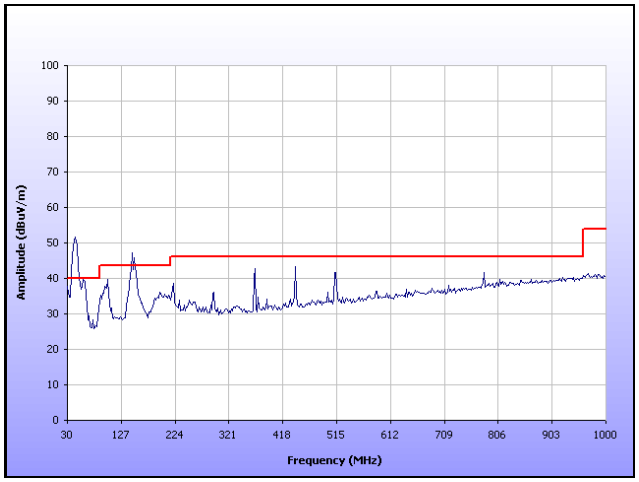


Plot 87. Radiated Spurious Emissions, High Channel, HT10, 1 GHz – 18 GHz

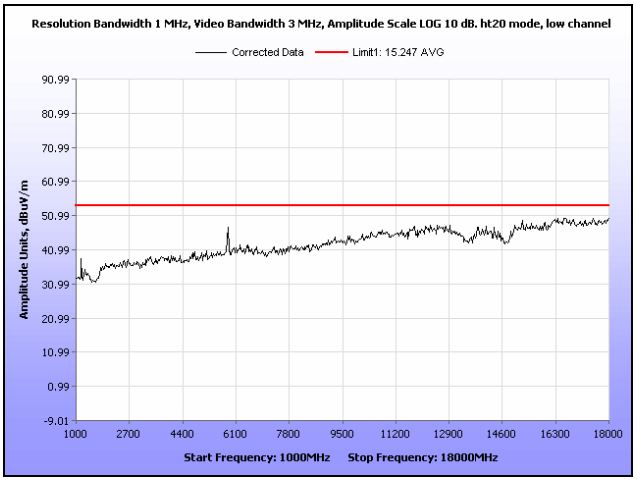


Plot 88. Radiated Spurious Emissions, High Channel, HT10, 18 GHz – 40 GHz

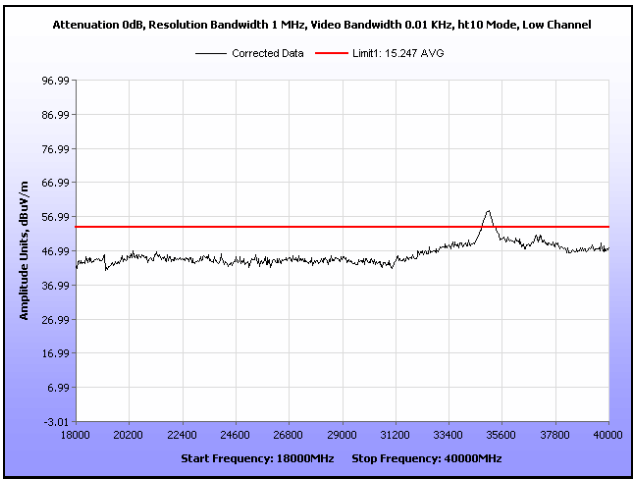
Radiated Spurious Emissions Test Results, HT20



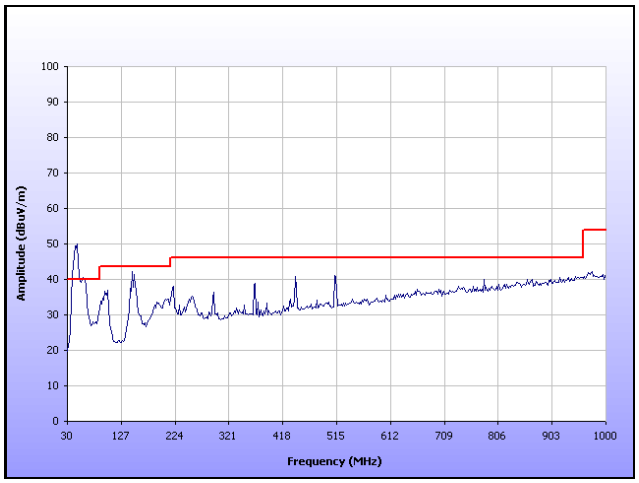
Plot 89. Radiated Spurious Emissions, Low Channel, HT20, 30 MHz – 1 GHz



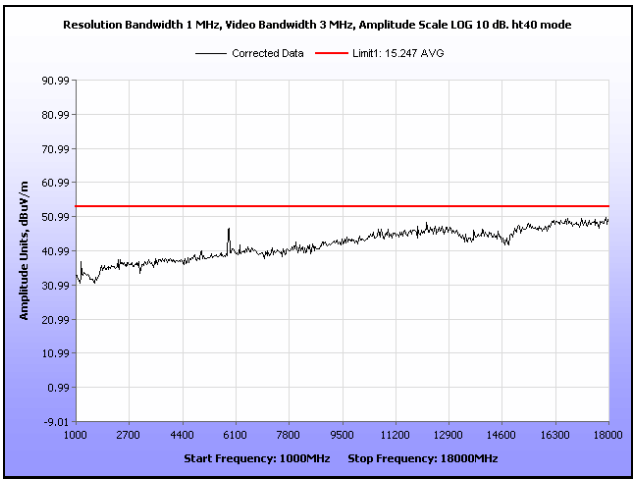
Plot 90. Radiated Spurious Emissions, Low Channel, HT20, 1 GHz – 18 GHz



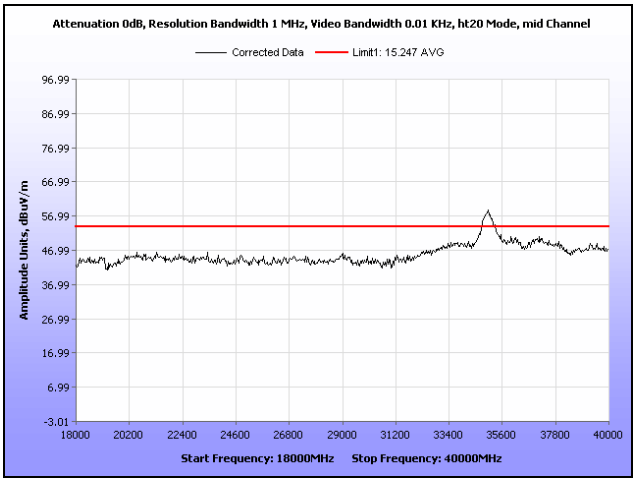
Plot 91. Radiated Spurious Emissions, Low Channel, HT20, 18 GHz – 40 GHz



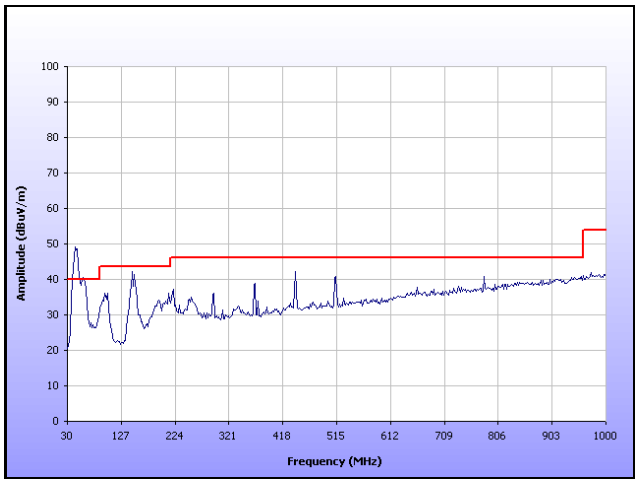
Plot 92. Radiated Spurious Emissions, Mid Channel, HT20, 30 MHz – 1 GHz



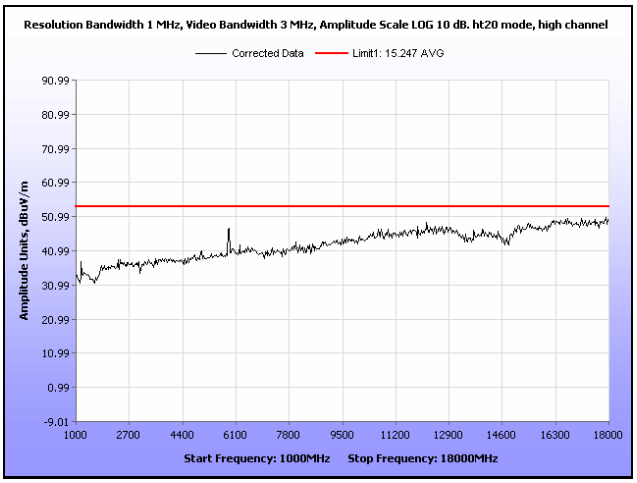
Plot 93. Radiated Spurious Emissions, Mid Channel, HT20, 1 GHz – 18 GHz



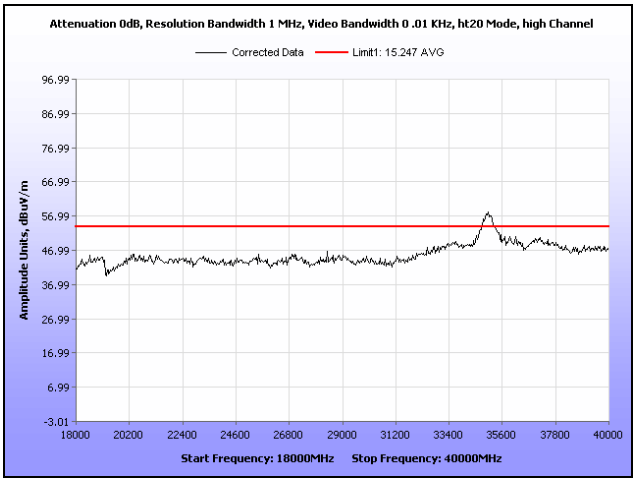
Plot 94. Radiated Spurious Emissions, Mid Channel, HT20, 18 GHz – 40 GHz



Plot 95. Radiated Spurious Emissions, High Channel, HT20, 30 MHz – 1 GHz

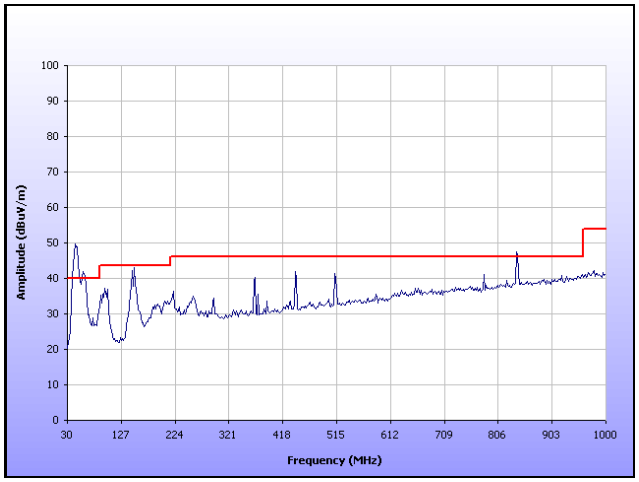


Plot 96. Radiated Spurious Emissions, High Channel, HT20, 1 GHz – 18 GHz

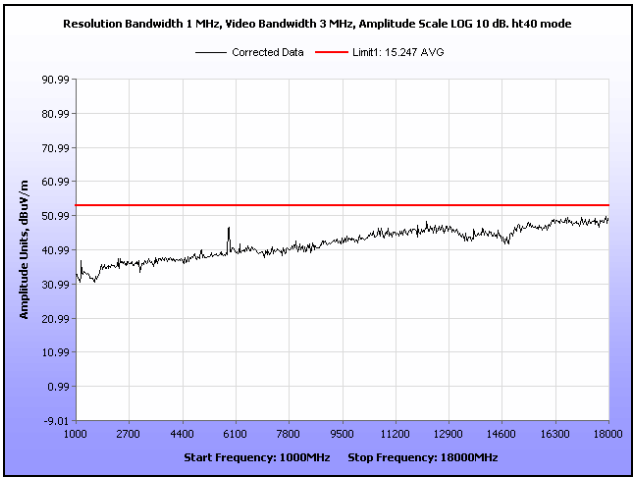


Plot 97. Radiated Spurious Emissions, High Channel, HT20, 18 GHz – 40 GHz

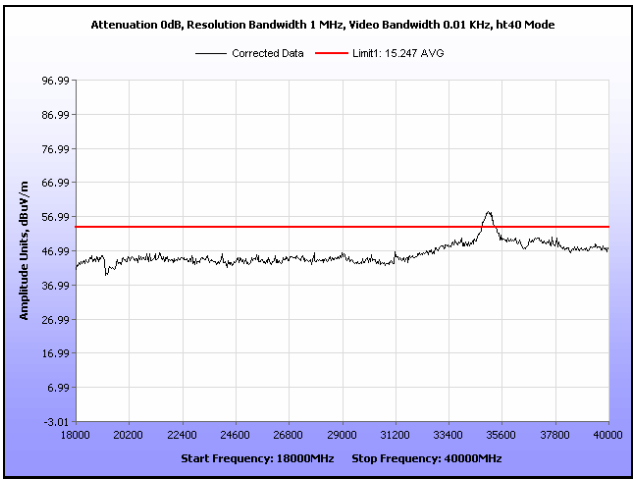
Radiated Spurious Emissions Test Results, HT40



Plot 98. Radiated Spurious Emissions, HT40, 30 MHz – 1 GHz

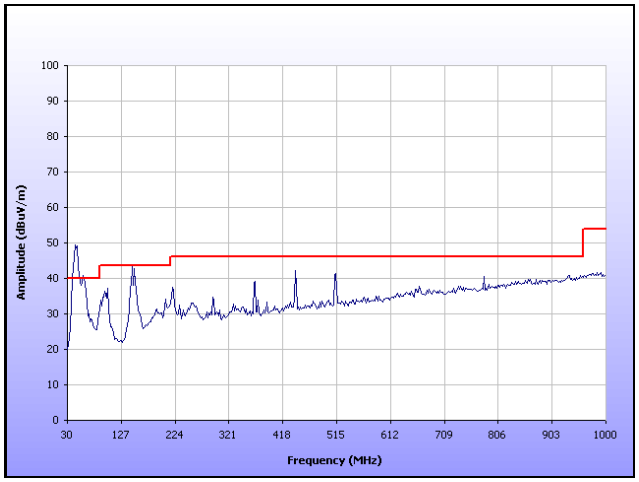


Plot 99. Radiated Spurious Emissions, HT40, 1 GHz – 18 GHz

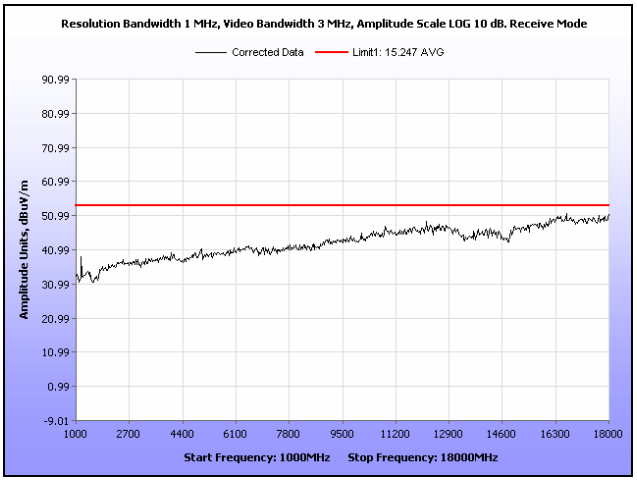


Plot 100. Radiated Spurious Emissions, HT40, 18 GHz – 40 GHz

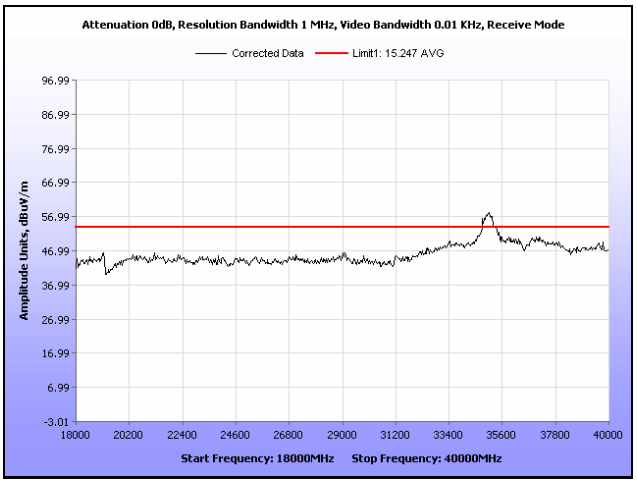
Radiated Spurious Emissions Test Results



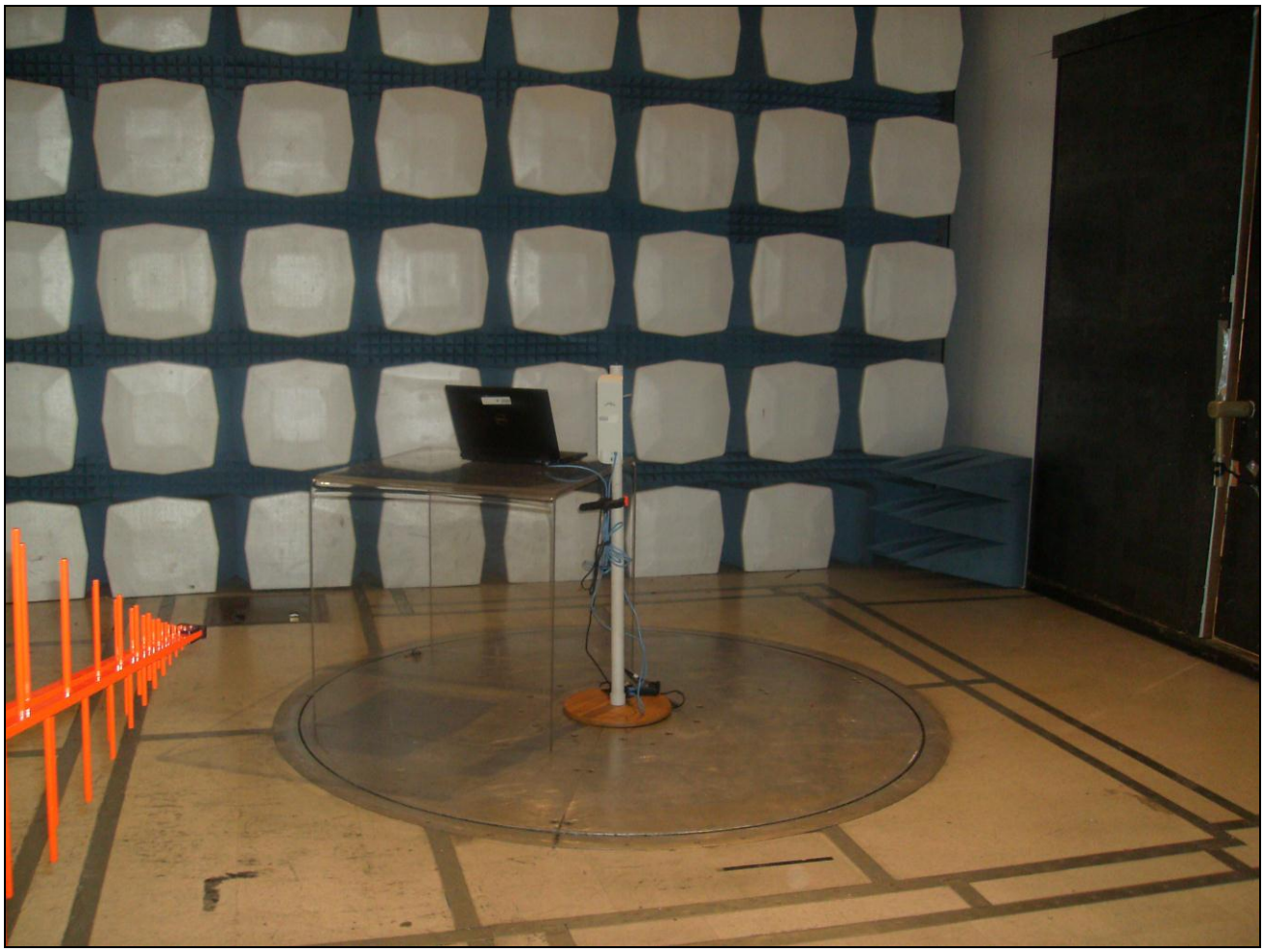
Plot 101. Radiated Spurious Emissions, Receive Mode, 30 MHz – 1 GHz



Plot 102. Radiated Spurious Emissions, Receive Mode, 1 GHz – 18 GHz



Plot 103. Radiated Spurious Emissions, Receive Mode, 18 GHz – 40 GHz



Photograph 4. Radiated Emissions, Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

RF Conducted Spurious Emissions Requirements and Band Edge

Test Requirement: 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, provided the transmitter demonstrates compliance with the peak conducted power limits.

Test Procedure: For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated; 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.

Since the EUT had an integral antenna, conducted measurements could not be performed. Measurements needed to be taken radiated. An antenna was located 3 m away from the EUT and plots were taken. The EUT was rotated through all three orthogonal axes. The plots were corrected for both antenna correction factor and cable lost.

See following pages for detailed test results with RF Conducted Spurious Emissions.

Test Results: The EUT was compliant with the Conducted Spurious Emission limits. Measured emissions were below applicable limits.

Test Engineer(s): Manasi Bhandiwad

Test Date(s): 04/18/11

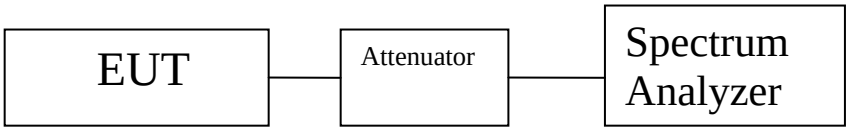
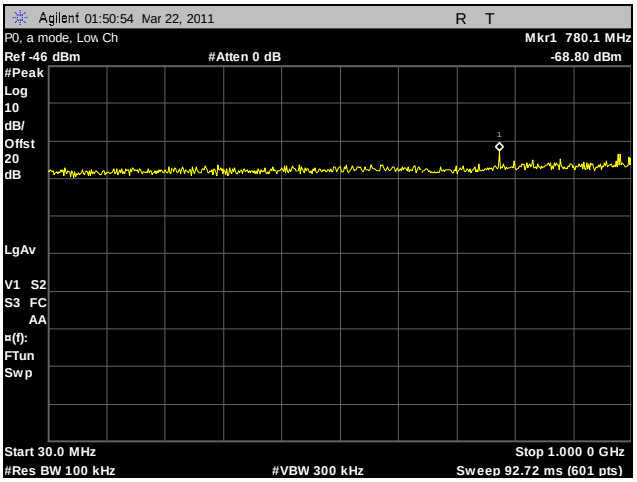
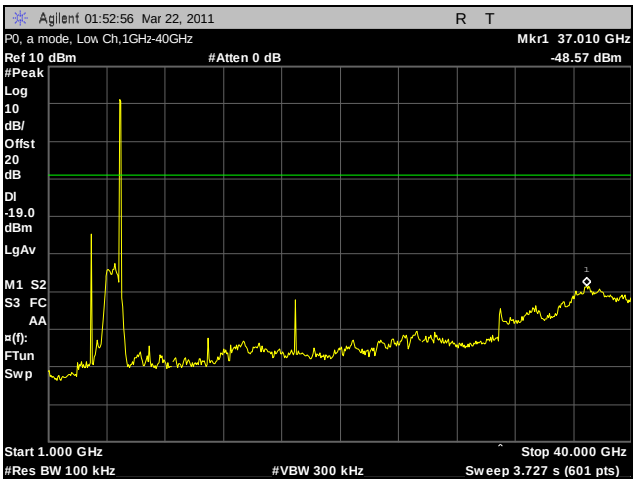


Figure 5. Block Diagram, Conducted Spurious Emissions Test Setup

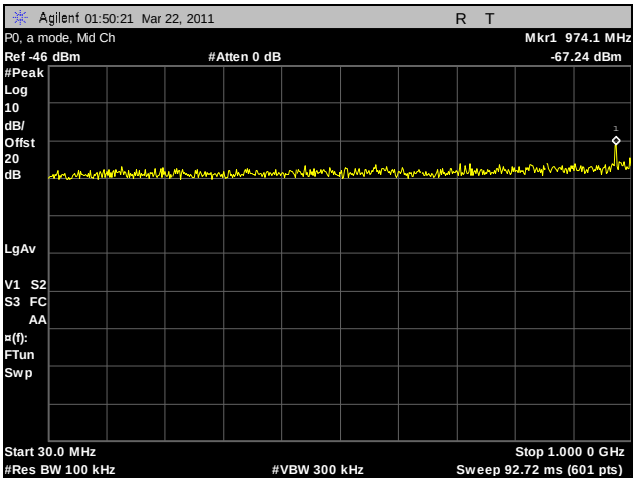
Conducted Spurious Emissions Test Results, a Mode, P0



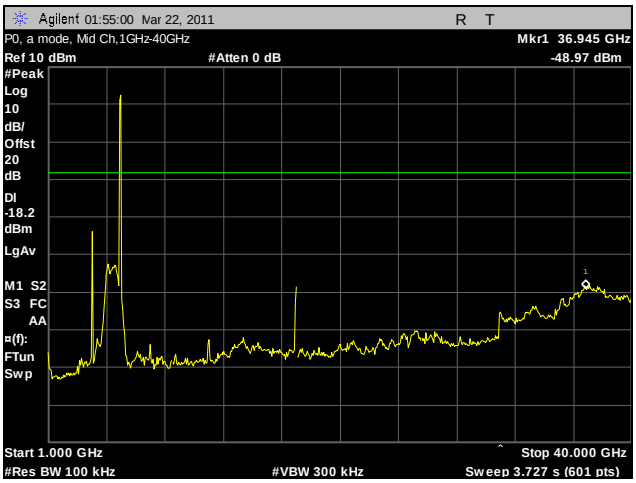
Plot 104. Conducted Spurious Emissions, Low Channel, a Mode, 30 MHz – 1 GHz, P0



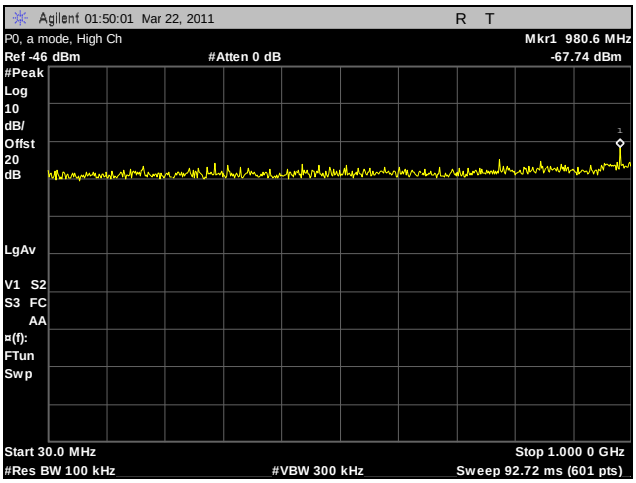
Plot 105. Conducted Spurious Emissions, Low Channel, a Mode, 1 GHz – 40 GHz, P0



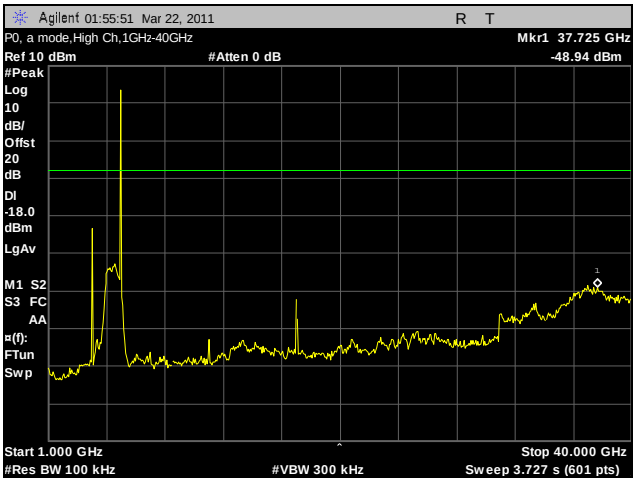
Plot 106. Conducted Spurious Emissions, Mid Channel, a Mode, 30 MHz – 1 GHz, P0



Plot 107. Conducted Spurious Emissions, Mid Channel, a Mode, 1 GHz – 40 GHz, P0

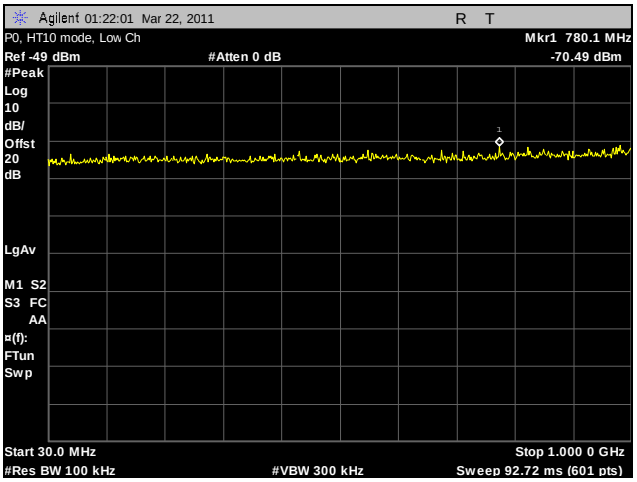


Plot 108. Conducted Spurious Emissions, High Channel, a Mode, 30 MHz – 1 GHz, P0

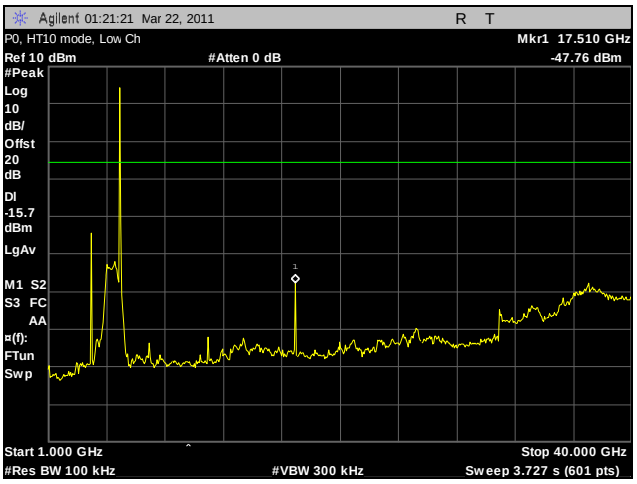


Plot 109. Conducted Spurious Emissions, High Channel, a Mode, 1 GHz – 40 GHz, P0

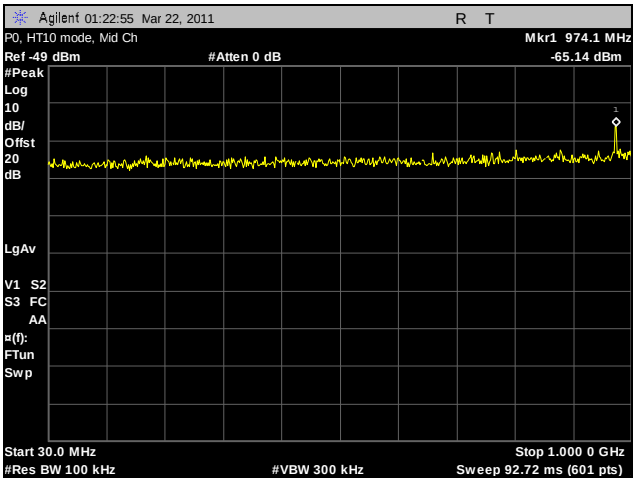
Conducted Spurious Emissions Test Results, HT10, P0



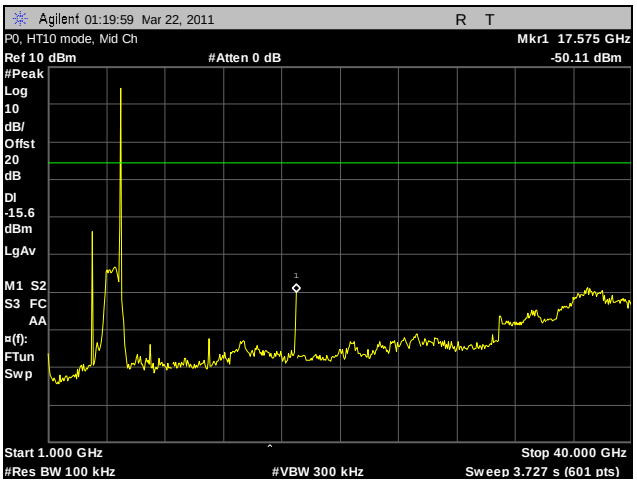
Plot 110. Conducted Spurious Emissions, Low Channel, HT10, 30 MHz – 1 GHz, P0



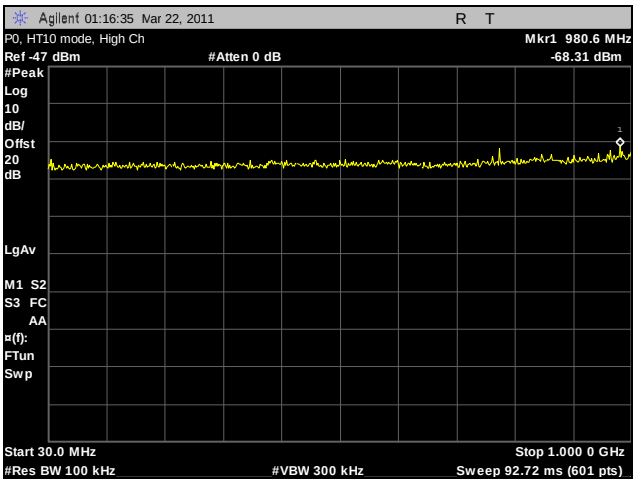
Plot 111. Conducted Spurious Emissions, Low Channel, HT10, 1 GHz – 40 GHz, P0



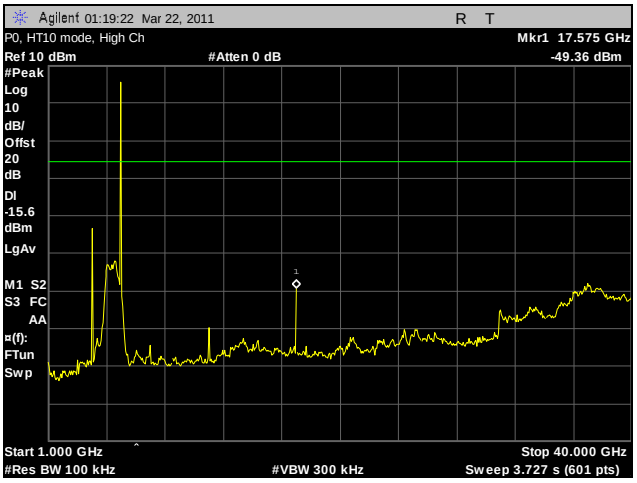
Plot 112. Conducted Spurious Emissions, Mid Channel, HT10, 30 MHz – 1 GHz, P0



Plot 113. Conducted Spurious Emissions, Mid Channel, HT10, 1 GHz – 40 GHz, P0

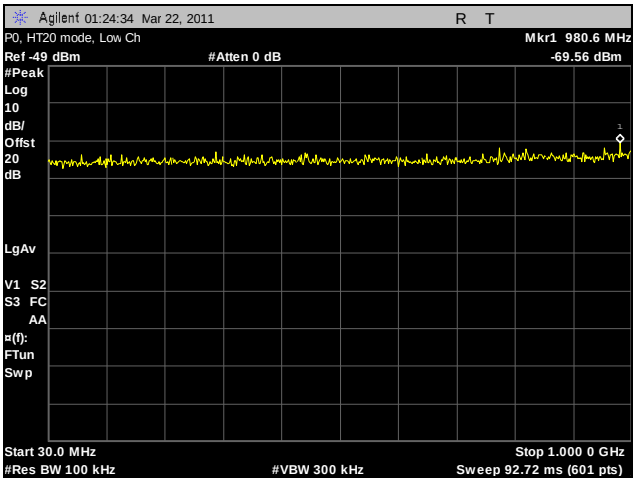


Plot 114. Conducted Spurious Emissions, High Channel, HT10, 30 MHz – 1 GHz, P0

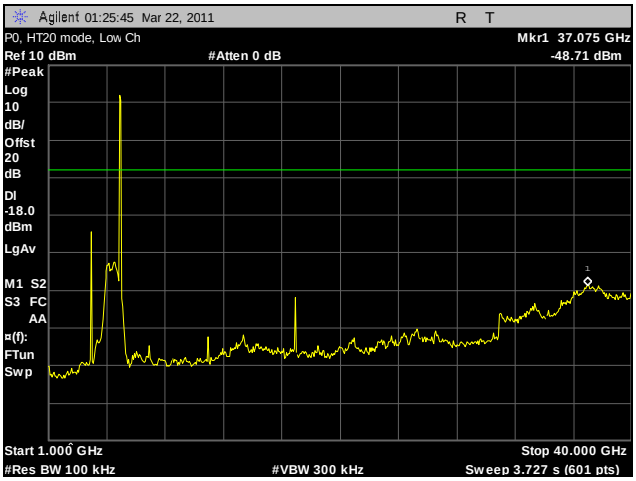


Plot 115. Conducted Spurious Emissions, High Channel, HT10, 1 GHz – 40 GHz, P0

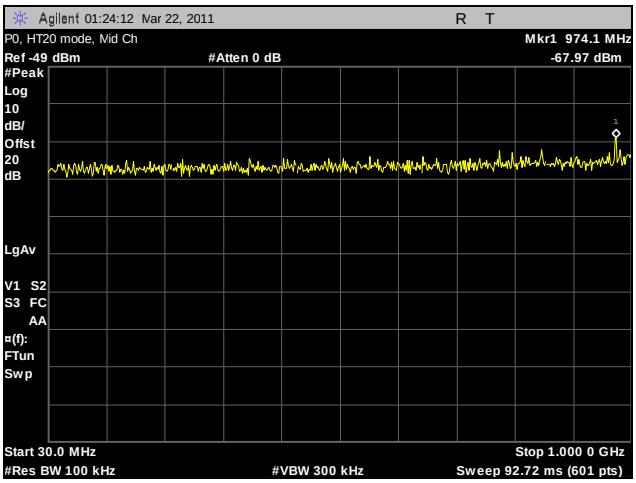
Conducted Spurious Emissions Test Results, HT20, P0



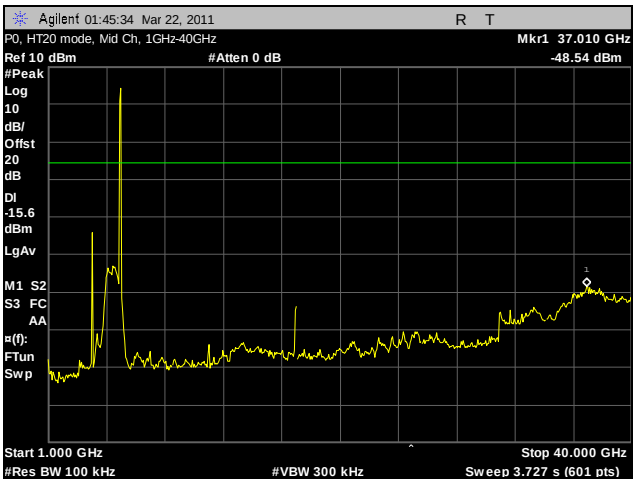
Plot 116. Conducted Spurious Emissions, Low Channel, HT20, 30 MHz – 1 GHz, P0



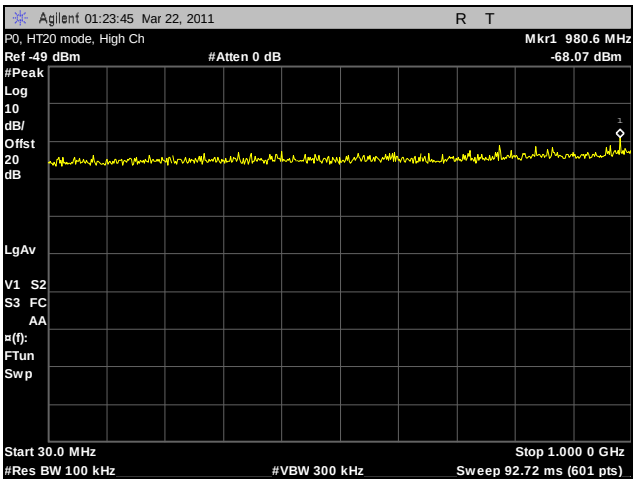
Plot 117. Conducted Spurious Emissions, Low Channel, HT20, 1 GHz – 40 GHz, P0



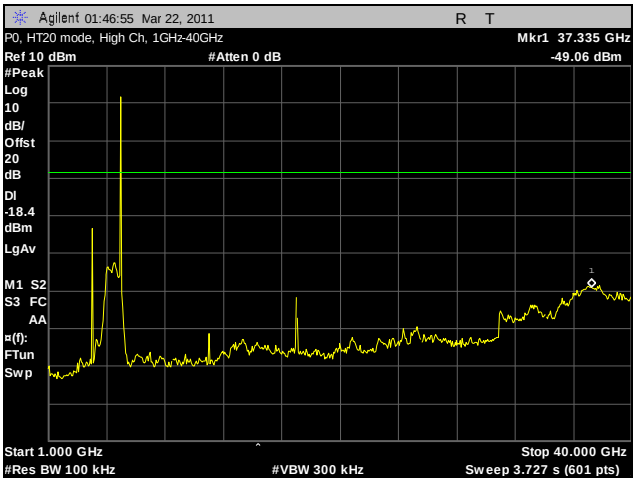
Plot 118. Conducted Spurious Emissions, Mid Channel, HT20, 30 MHz – 1 GHz, P0



Plot 119. Conducted Spurious Emissions, Mid Channel, HT20, 1 GHz – 40 GHz, P0

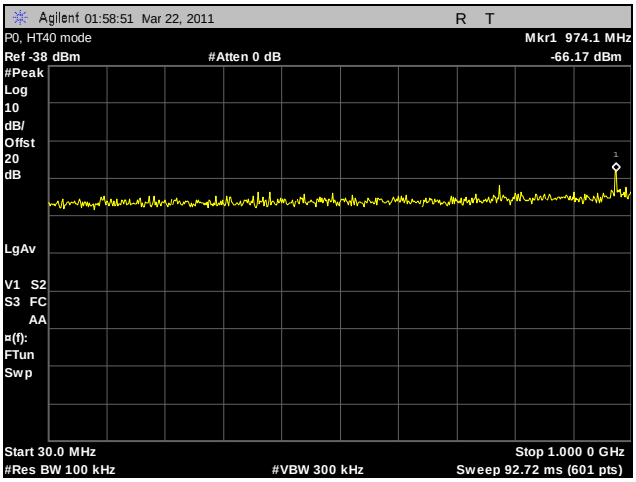


Plot 120. Conducted Spurious Emissions, High Channel, HT20, 30 MHz – 1 GHz, P0

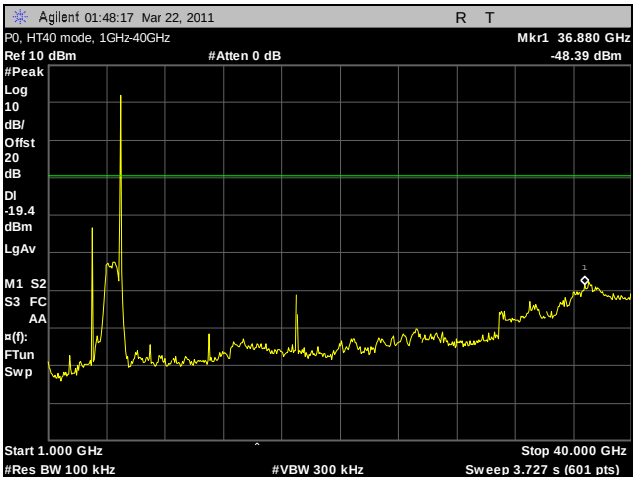


Plot 121. Conducted Spurious Emissions, High Channel, HT20, 1 GHz – 40 GHz, P0

Conducted Spurious Emissions Test Results, HT40, P0

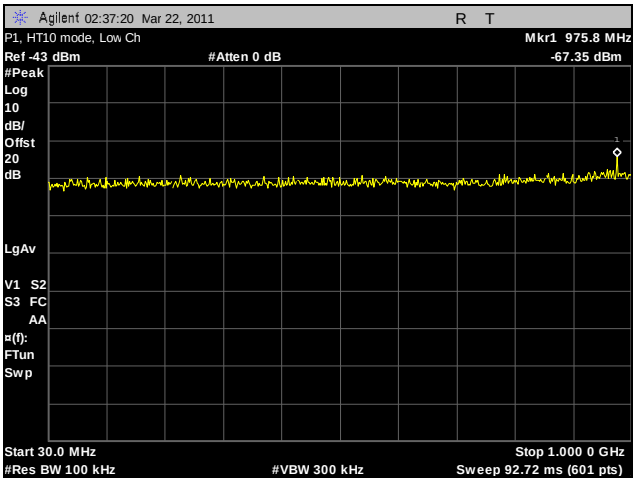


Plot 122. Conducted Spurious Emissions, HT40, 30 MHz – 1 GHz, P0

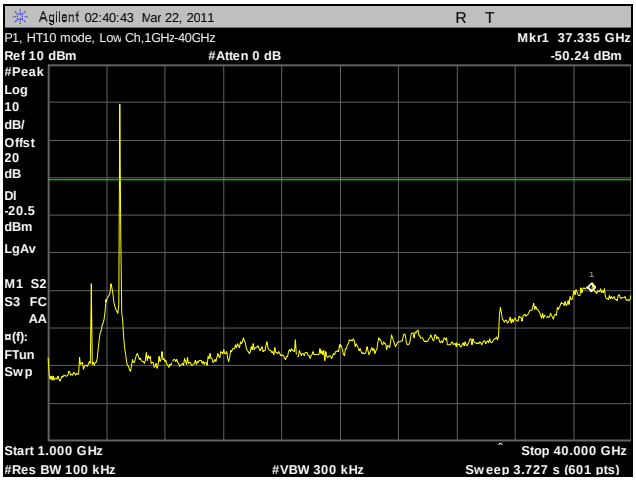


Plot 123. Conducted Spurious Emissions, HT40, 1 GHz – 40 GHz, P0

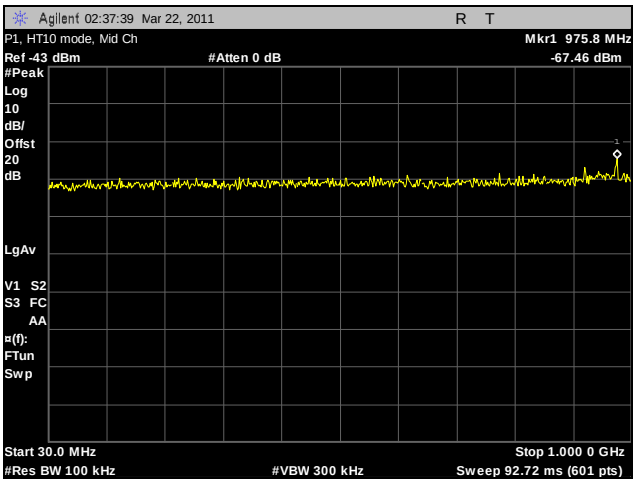
Conducted Spurious Emissions Test Results, HT10, P1



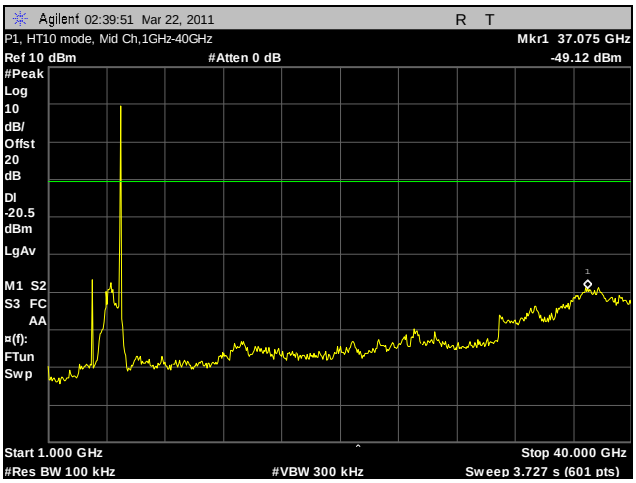
Plot 124. Conducted Spurious Emissions, Low Channel, HT10, 30 MHz – 1 GHz, P1



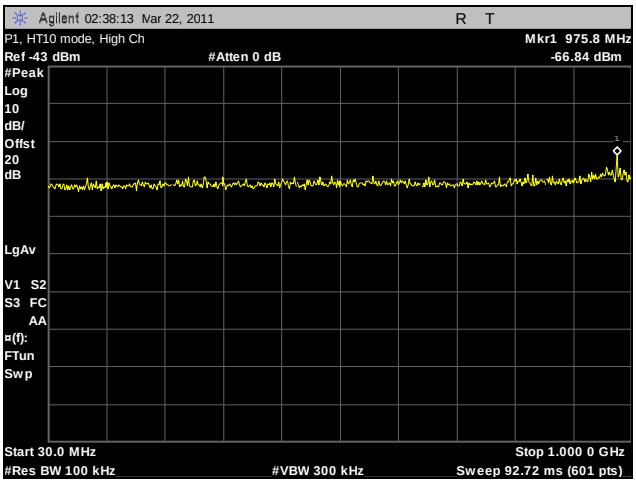
Plot 125. Conducted Spurious Emissions, Low Channel, HT10, 1 GHz – 40 GHz, P1



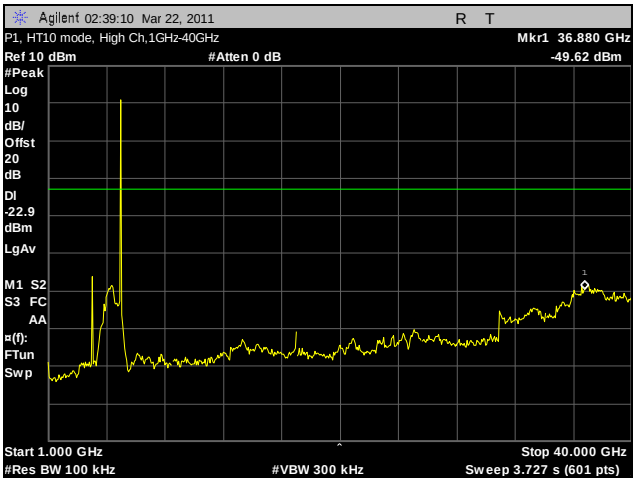
Plot 126. Conducted Spurious Emissions, Mid Channel, HT10, 30 MHz – 1 GHz, P1



Plot 127. Conducted Spurious Emissions, Mid Channel, HT10, 1 GHz – 40 GHz, P1

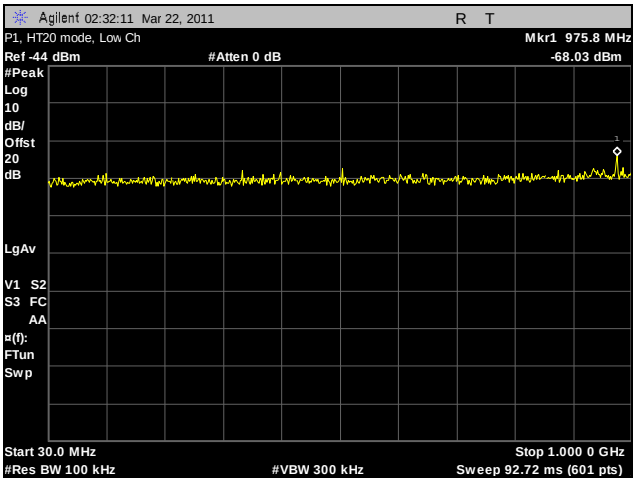


Plot 128. Conducted Spurious Emissions, High Channel, HT10, 30 MHz – 1 GHz, P1

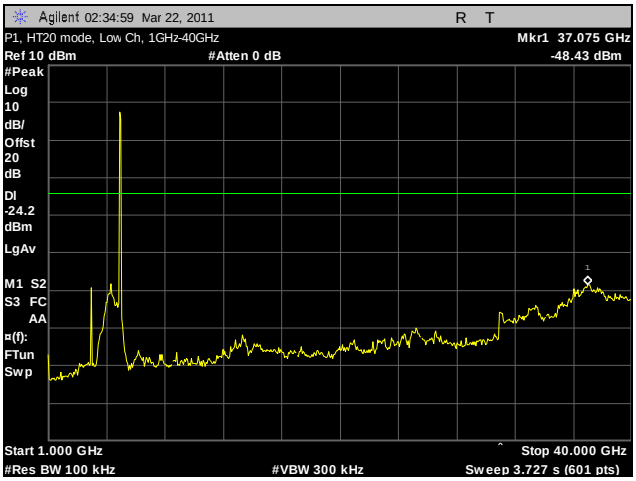


Plot 129. Conducted Spurious Emissions, High Channel, HT10, 1 GHz – 40 GHz, P1

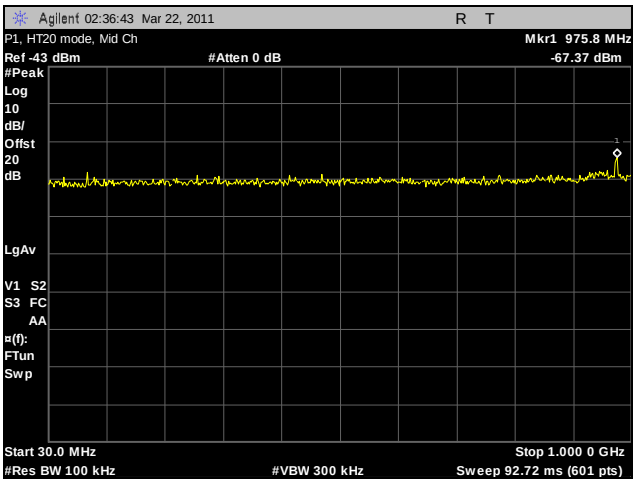
Conducted Spurious Emissions Test Results, HT20, P1



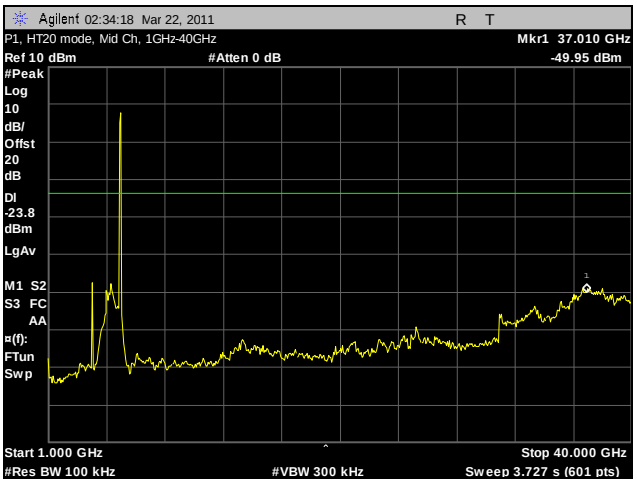
Plot 130. Conducted Spurious Emissions, Low Channel, HT20, 30 MHz – 1 GHz, P1



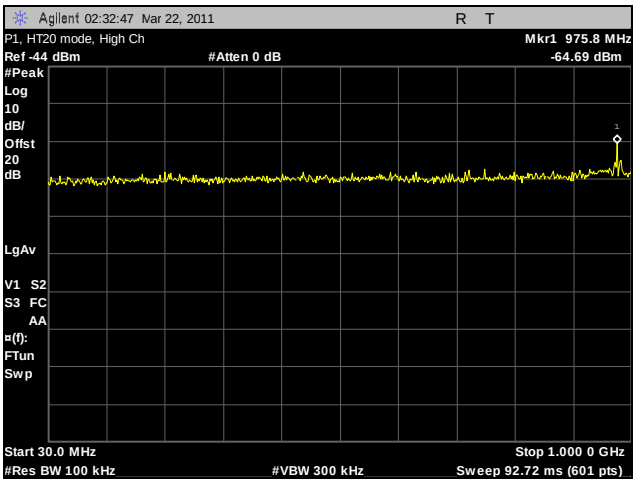
Plot 131. Conducted Spurious Emissions, Low Channel, HT20, 1 GHz – 40 GHz, P1



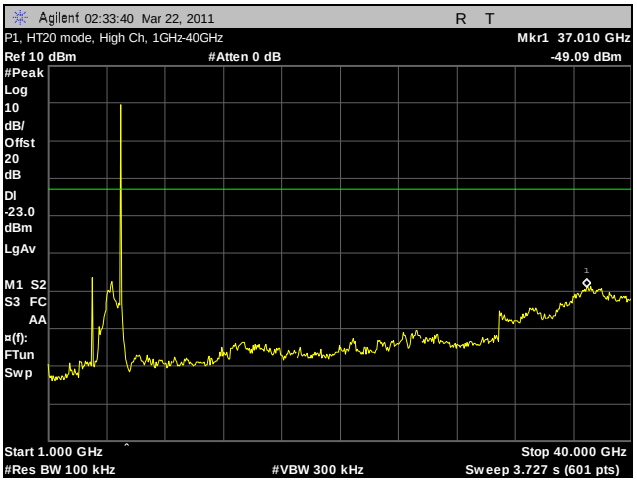
Plot 132. Conducted Spurious Emissions, Mid Channel, HT20, 30 MHz – 1 GHz, P1



Plot 133. Conducted Spurious Emissions, Mid Channel, HT20, 1 GHz – 40 GHz, P1

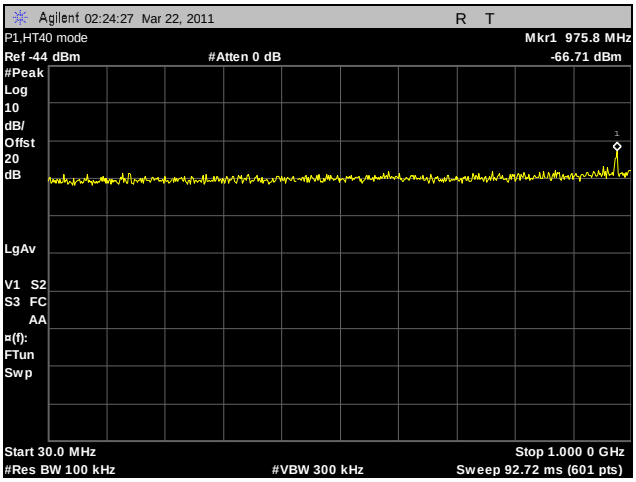


Plot 134. Conducted Spurious Emissions, High Channel, HT20, 30 MHz – 1 GHz, P1

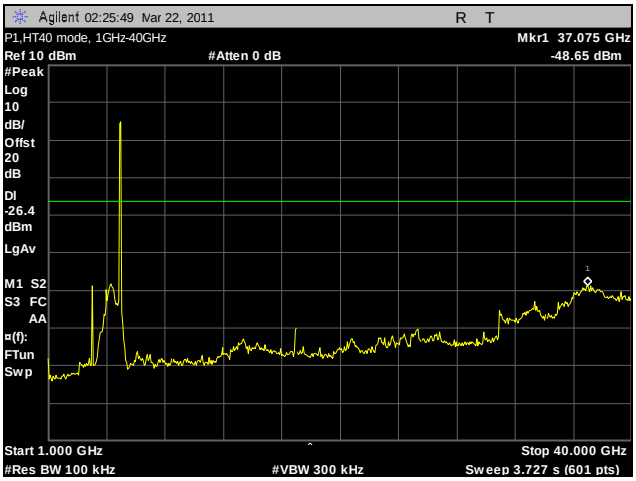


Plot 135. Conducted Spurious Emissions, High Channel, HT20, 1 GHz – 40 GHz, P1

Conducted Spurious Emissions Test Results, HT40, P1

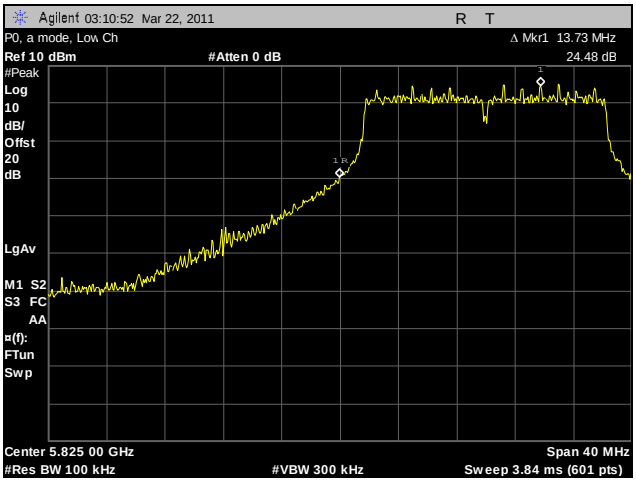


Plot 136. Conducted Spurious Emissions, HT40, 30 MHz – 1 GHz, P1

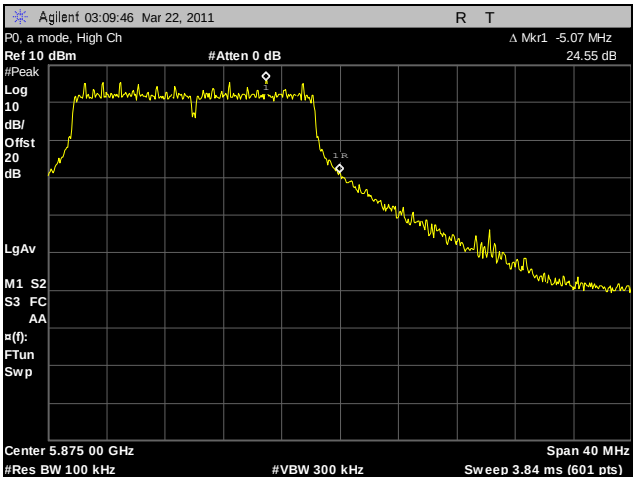


Plot 137. Conducted Spurious Emissions, HT40, 1 GHz – 40 GHz, P1

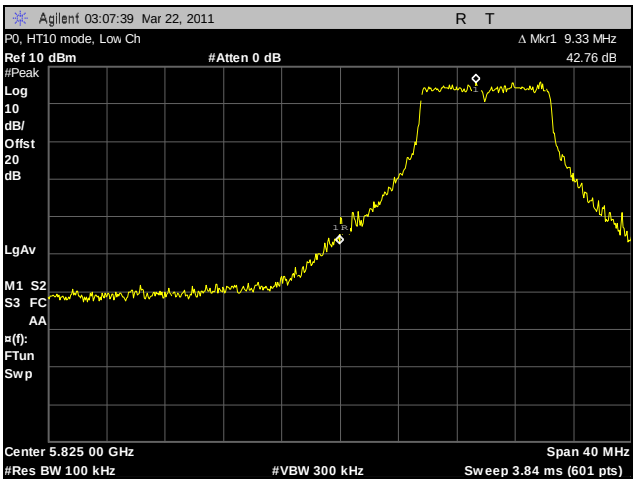
Conducted Band Edge Test Results, P0



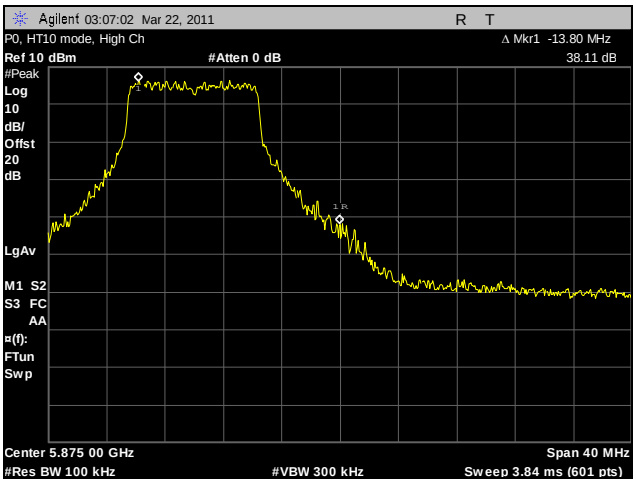
Plot 138. Conducted Spurious Emissions, Low Channel, a Mode, P0, 20 dBc



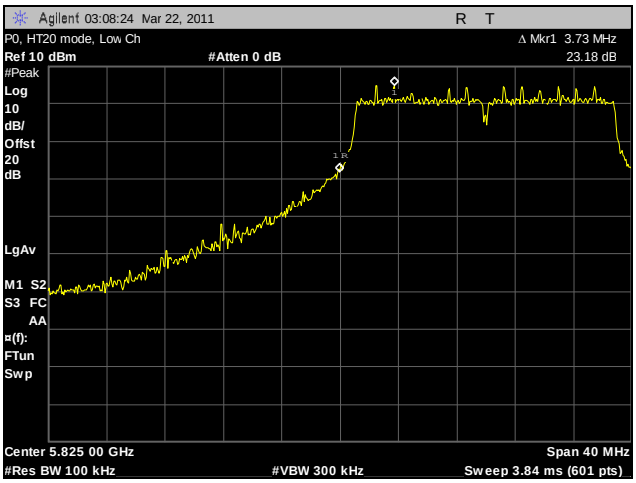
Plot 139. Conducted Spurious Emissions, High Channel, a Mode, P0, 20 dBc



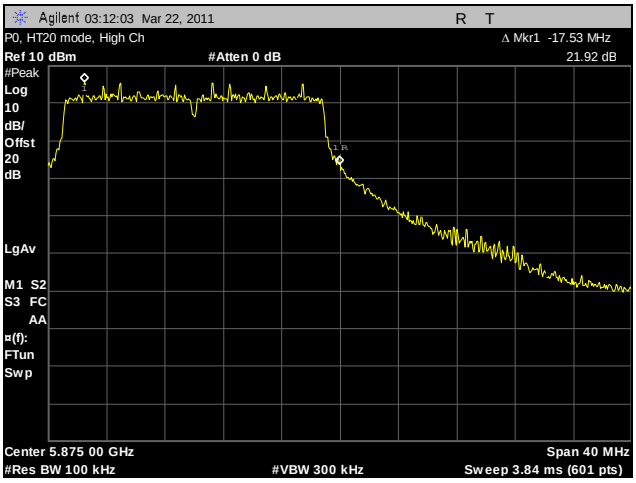
Plot 140. Conducted Spurious Emissions, Low Channel, HT10, P0, 20 dBc



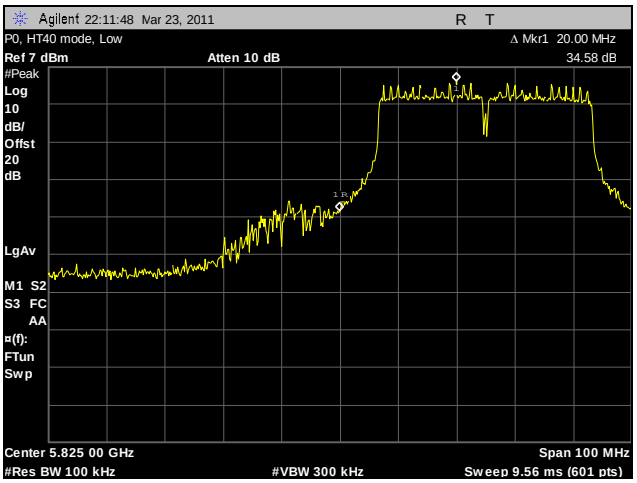
Plot 141. Conducted Spurious Emissions, High Channel, HT10, P0, 20 dBc



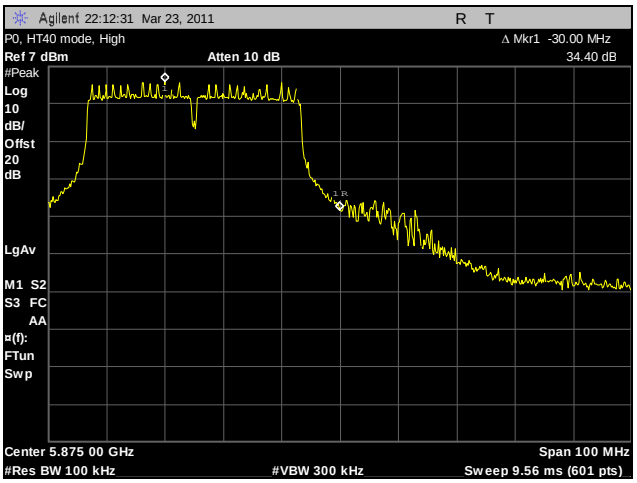
Plot 142. Conducted Spurious Emissions, Low Channel, HT20, P0, 20 dBc



Plot 143. Conducted Spurious Emissions, High Channel, HT20, P0, 20 dBc

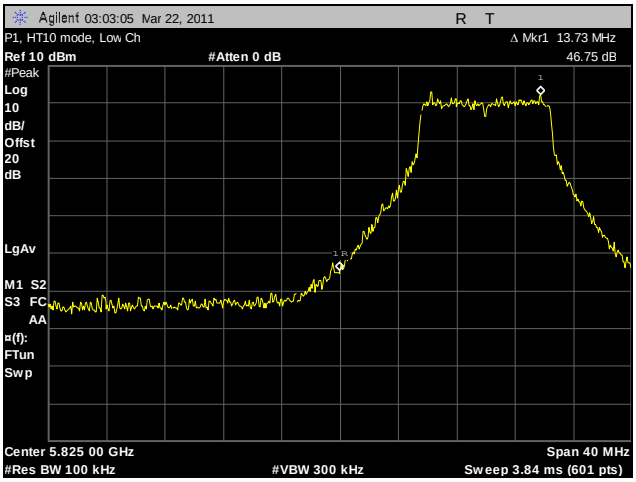


Plot 144. Conducted Spurious Emissions, Low Channel, HT40, P0, 20 dBc

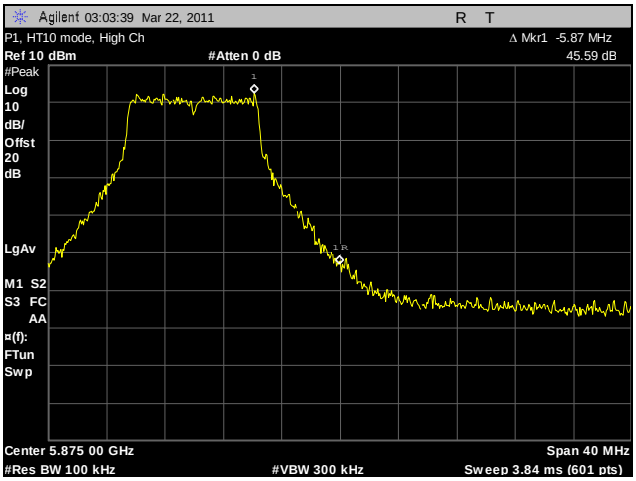


Plot 145. Conducted Spurious Emissions, High Channel, HT40, P0, 20 dBc

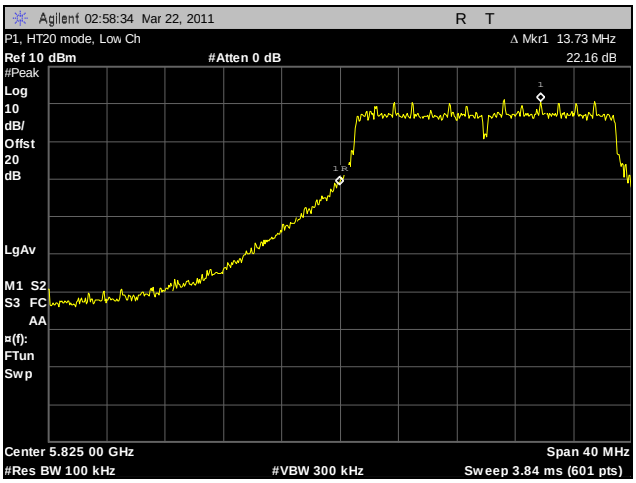
Conducted Band Edge Test Results, P1



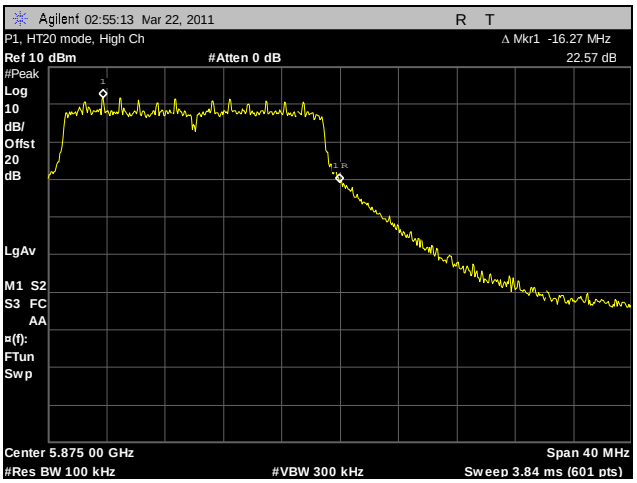
Plot 146. Conducted Spurious Emissions, Low Channel, HT10, P1, 20 dBc



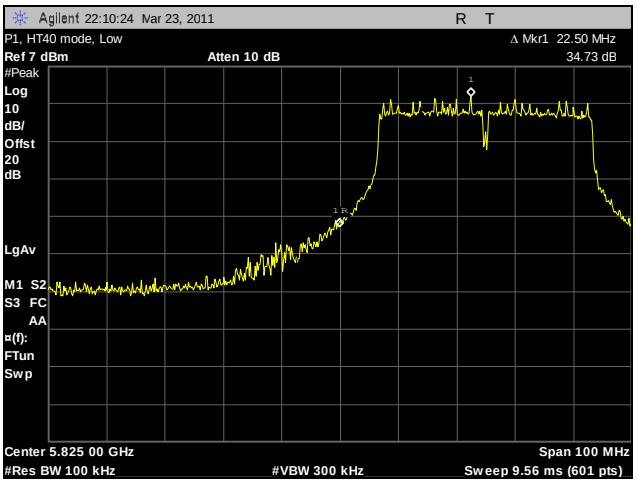
Plot 147. Conducted Spurious Emissions, High Channel, HT10, P1, 20 dBc



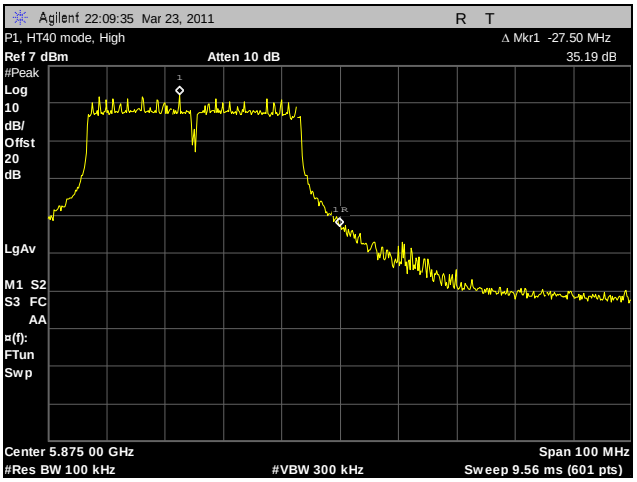
Plot 148. Conducted Spurious Emissions, Low Channel, HT20, P1, 20 dBc



Plot 149. Conducted Spurious Emissions, High Channel, HT20, P1, 20 dBc



Plot 150. Conducted Spurious Emissions, Low Channel, HT40, P1, 20 dBc



Plot 151. Conducted Spurious Emissions, High Channel, HT40, P1, 20 dBc

Electromagnetic Compatibility Criteria for Intentional Radiators

Peak Power Spectral Density

Test Requirements: For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 17dBm in any 1 MHz band during any time interval of continuous transmission.

Test Procedure: The transmitter was connected directly to a Spectrum Analyzer through an attenuator. The power level was set to the maximum level on the EUT. The RBW was set to 1MHz and the VBW was set to 3MHz. The method of measurement #2 from the FCC Public Notice DA 02-2138 was used.

Test Results: The EUT was compliant with the peak power spectral density limits.

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

Test Engineer: Manasi Bhandiwad

Test Date: 03/21/11

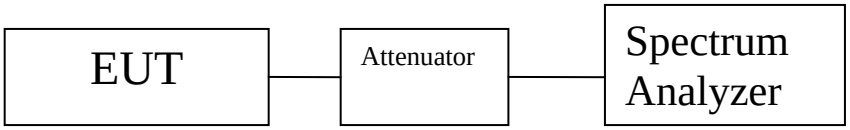


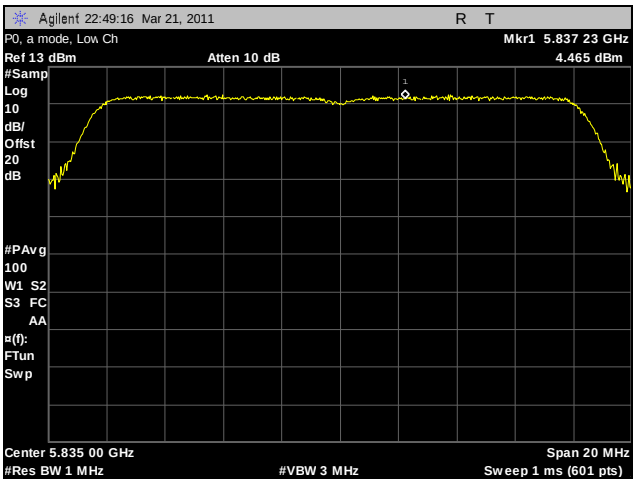
Figure 6. Block Diagram, Peak Power Spectral Density Test Setup

Peak Power Spectral Density Test Results

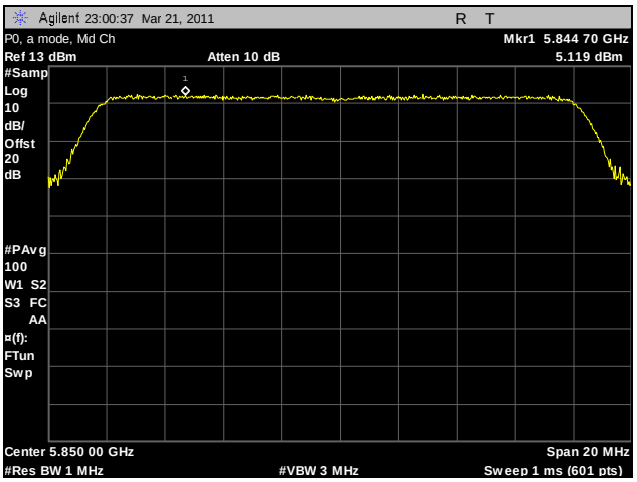
Peak Power Spectral Density dBm Limit = 7 dBm						
Mode	**Carrier Channel**	**Frequency (MHz)**	**Port 1 dBm**	**Margin**	**Port 2 dBm**	**Margin**
a	Low	5835	4.46	-2.54	N/A	N/A
	Mid	5850	5.12	-1.88		
	High	5865	4.60	-2.40		
HT10	Low	5835	4.96	-2.04	6.89	-0.11
	Mid	5850	4.44	-2.56	3.31	-3.69
	High	5865	4.73	-2.27	2.42	-4.58
HT20	Low	5835	4.29	-2.71	-0.30	-7.30
	Mid	5850	4.46	-2.54	-0.45	-0.45
	High	5865	4.98	-2.02	0.02	-6.98
HT40	-	5850	1.16	-4.84	-2.38	-9.38

Table 14. Spectral Density, Test Results

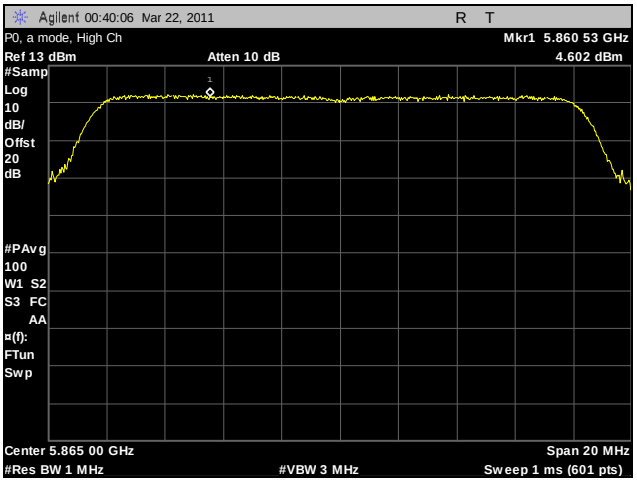
Peak Power Spectral Density, a Mode, P0



Plot 152. Peak Power Spectral Density, Low Channel, a Mode, P0

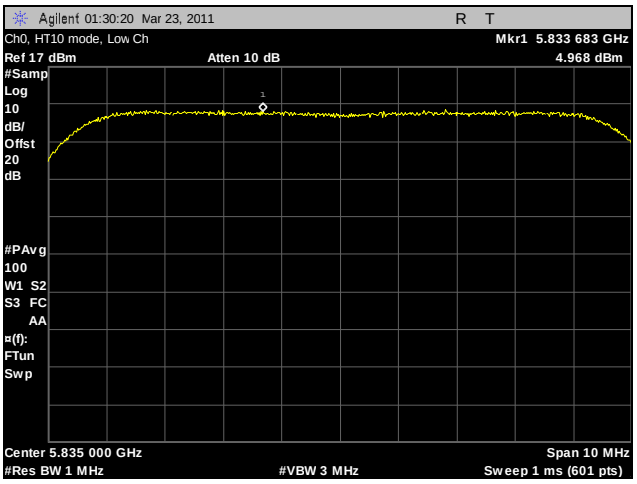


Plot 153. Peak Power Spectral Density, Mid Channel, a Mode, P0

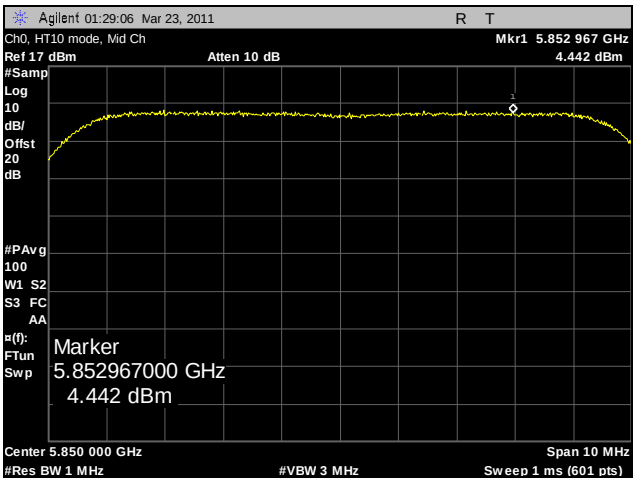


Plot 154. Peak Power Spectral Density, High Channel, a Mode, P0

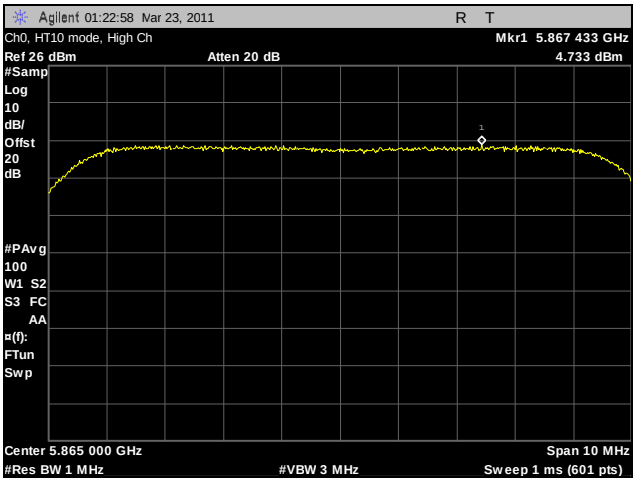
Peak Power Spectral Density, HT10, P0



Plot 155. Peak Power Spectral Density, Low Channel, HT10, P0

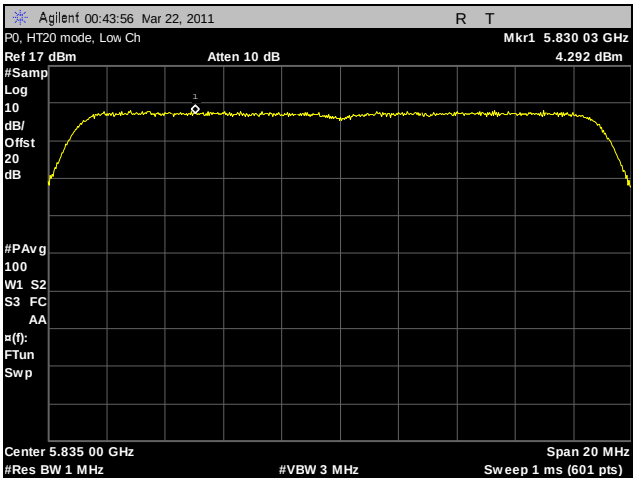


Plot 156. Peak Power Spectral Density, Mid Channel, HT10, P0

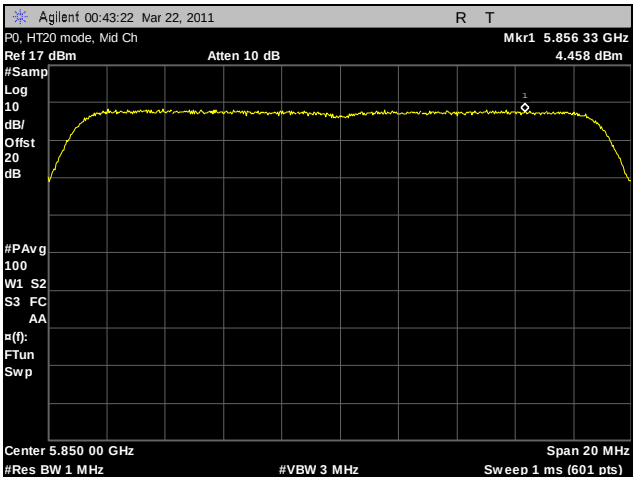


Plot 157. Peak Power Spectral Density, High Channel, HT10, P0

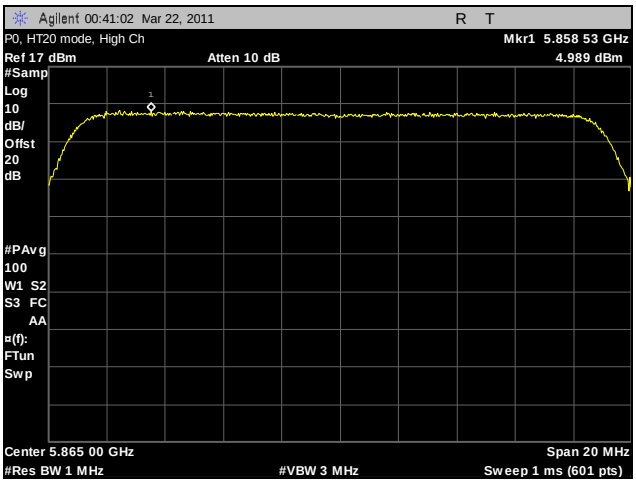
Peak Power Spectral Density, HT20, P0



Plot 158. Peak Power Spectral Density, Low Channel, HT20, P0

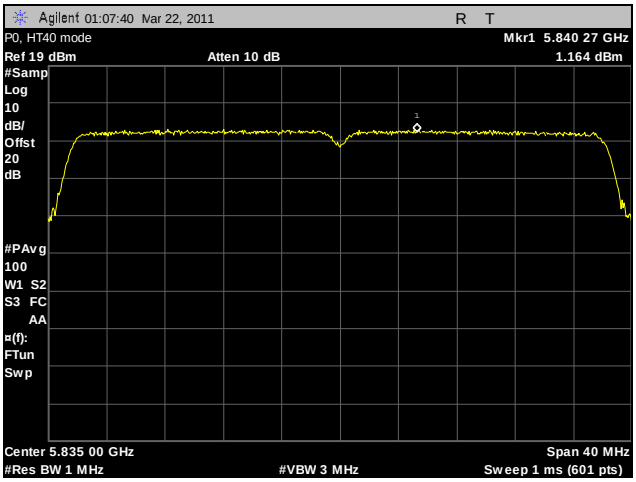


Plot 159. Peak Power Spectral Density, Mid Channel, HT20, P0



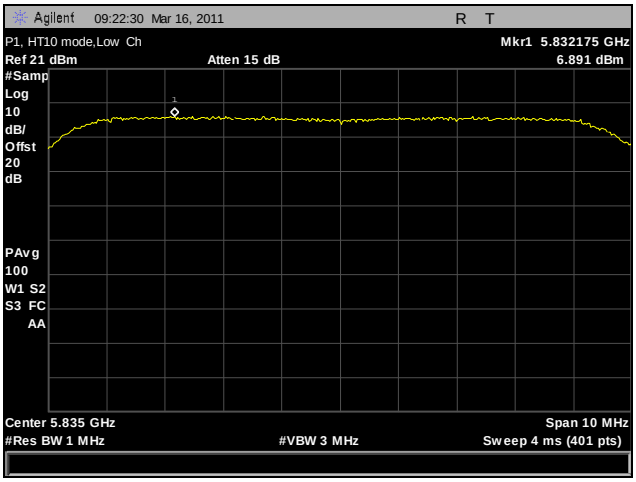
Plot 160. Peak Power Spectral Density, High Channel, HT20, P0

Peak Power Spectral Density, HT40, P0

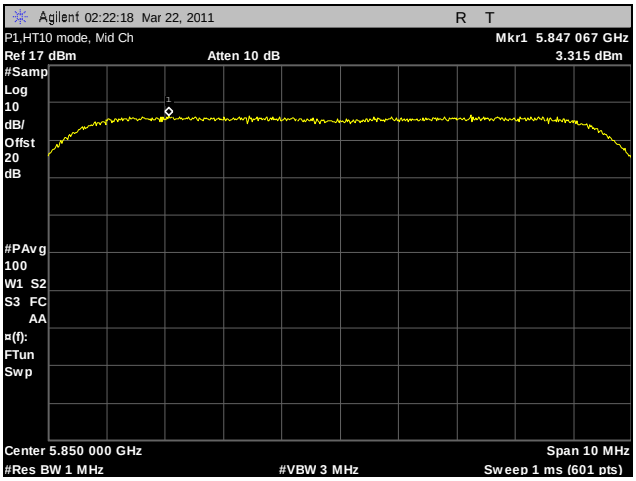


Plot 161. Peak Power Spectral Density, HT40, P0

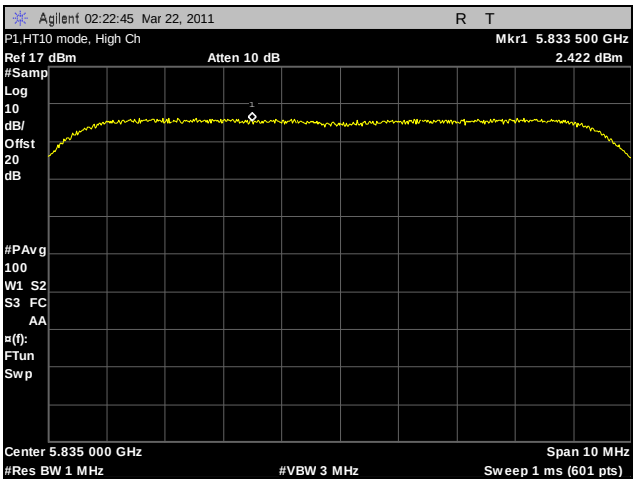
Peak Power Spectral Density, HT10, P1



Plot 162. Peak Power Spectral Density, Low Channel, HT10, P1

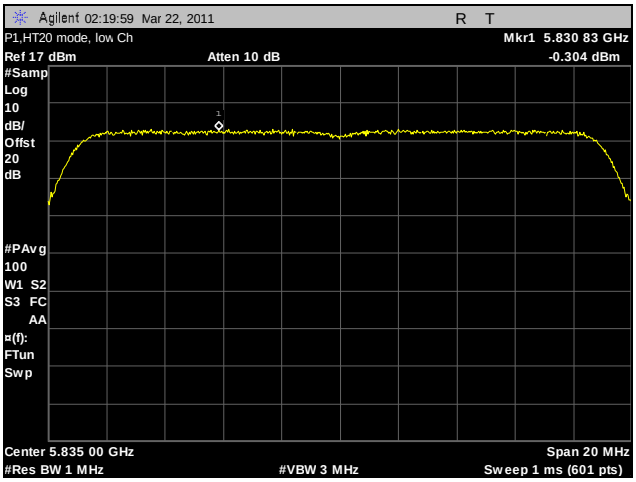


Plot 163. Peak Power Spectral Density, Mid Channel, HT10, P1

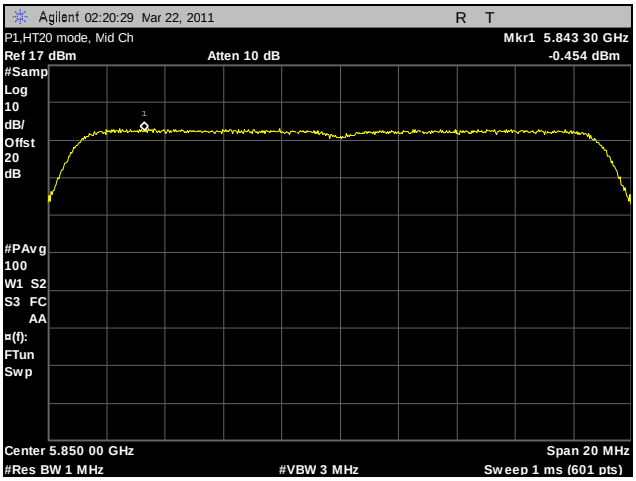


Plot 164. Peak Power Spectral Density, High Channel, HT10, P1

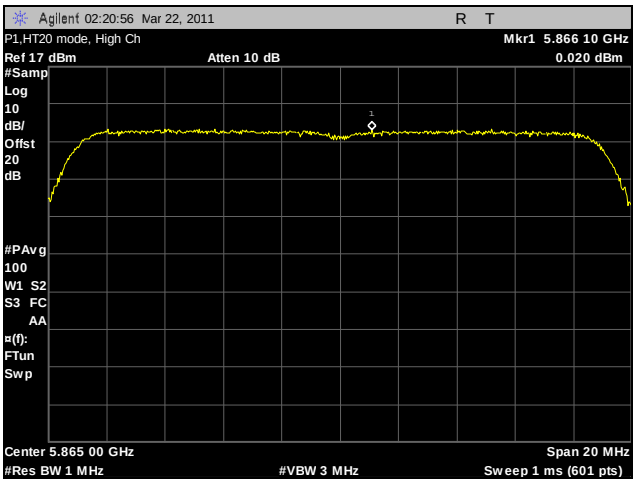
Peak Power Spectral Density, HT20, P1



Plot 165. Peak Power Spectral Density, Low Channel, HT20, P1

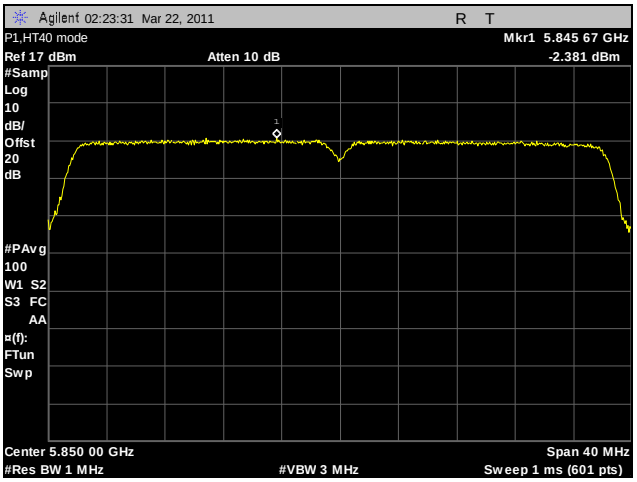


Plot 166. Peak Power Spectral Density, Mid Channel, HT20, P1



Plot 167. Peak Power Spectral Density, High Channel, HT20, P1

Peak Power Spectral Density, HT40, P1



Plot 168. Peak Power Spectral Density, HT40, P1

Electromagnetic Compatibility Criteria for Intentional Radiators

Maximum Permissible Exposure

RF Exposure Requirements: 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: 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.

Test Results: $S = PG / 4\pi R^2$

Gain of the antenna =16dBi

$S = 0.335 mW/Cm^2$

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
1T4409	EMI RECEIVER	ROHDE & SCHWARZ	ESIB7	5/25/2010	5/25/2011
1T4568	RADIATING NOISE SOURCE	MET LABORATORIES	N/A	SEE NOTE	
1T4300	SEMI-ANECHOIC CHAMBER # 1	EMC TEST SYSTEMS	NONE	8/23/2010	8/23/2013
1T4751	ANTENNA - BILOG	SUNOL SCIENCES	JB6	11/3/2010	11/3/2011
1T4612	SPECTRUM ANALYZER	AGILENT	E4407B	9/27/2010	9/27/2011
1T4565	LISN (24 AMP)	SOLAR ELECTRONICS	9252-50-R-24-BNC	10/28/2010	10/28/2011
1T4564	LISN (24 AMP)	SOLAR ELECTRONICS	9252-50-R-24-BNC	10/6/2010	10/6/2011
1T4758	THERMO-HYGROMETER	CONTROL COMPANY	4040	5/21/2010	5/21/2012

Table 15. Test Equipment List

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

End of Report

