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

February 25, 2011

Fortress Technologies
2 Technology Park Drive
Westford, MA 01886

Dear John Pacheco,

Enclosed is the EMC Wireless Class II Permissive Change test report for compliance testing of the Fortress Technologies, Fortress Infrastructure Mesh Point ES440 (containing M25 and M5 Radios) as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Title 47 of the CFR, Part 15.407 and Industry Canada RSS-210, Annex 9, 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: (\Fortress Technologies\EMC28898-UNII 2 Rev. 1)

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Electromagnetic Compatibility Criteria
Test Report

for the

Fortress Technologies
Model Fortress Infrastructure Mesh Point ES440 (containing M25 and M5 Radios)

Tested under
the Certification Rules
contained in
Title 47 of the CFR, Part 15.407
and
Industry Canada RSS-210, Annex 9
for Intentional Radiators

MET Report: EMC28898-UNII 2 Rev. 1

February 25, 2011

Prepared For:

Fortress Technologies
2 Technology Park Drive
Westford, MA 01886

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

Electromagnetic Compatibility Criteria
Class II Permissive Change Test Report

for the

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Model Fortress Infrastructure Mesh Point ES440 (containing M25 and M5 Radios)

the Certification Rules
contained in
Title 47 of the CFR, Part 15.407
and
Industry Canada RSS-210, Annex 9
for Intentional Radiators

Dusmantha Tennakoon, Project Engineer
Electromagnetic Compatibility Lab

Jennifer Warnell
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Part 15.407, of the FCC Rules and RSS-210 Annex 9 of the Industry Canada Rules under normal use and maintenance.

Shawn McMillen, Wireless Manager
Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	January 25, 2010	Initial Issue.
1	February 25, 2011	Corrections to Band Edge plots.

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List of Terms and Abbreviations

AC	**A**lternating **C**urrent
ACF	**A**ntenna **C**orrection **F**actor
Cal	**Cal**ibration
d	**M**easurement **D**istance
dB	**D**eci**b**els
dBµA	**D**eci**b**els above one **micro**amp
dBµV	**D**eci**b**els above one **micro**volt
dBµA/m	**D**eci**b**els above one **micro**amp **per m**eter
dBµV/m	**D**eci**b**els above one **micro**volt **per m**eter
DC	**D**irect **C**urrent
E	**E**lectric Field
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
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 Fortress Technologies Fortress Infrastructure Mesh Point ES440 (containing M25 and M5 Radios), with the requirements of FCC Part §15.407 and Industry Canada RSS-210 Annex 9. 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 Fortress Infrastructure Mesh Point ES440 (containing M25 and M5 Radios). Fortress Technologies should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Fortress Infrastructure Mesh Point ES440 (containing M25 and M5 Radios), 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 FCC Part §15.407 and Industry Canada RSS-210, Annex 9, in accordance with Fortress Technologies, quote number 1FOR2402. All tests were conducted using measurement procedure ANSI C63.4-2003.

FCC Reference	Industry Canada Reference	Description	Results
15.203	RSS-GEN 7.1.4	Antenna Requirements	Compliant
15.207	RSS-GEN 7.2.2; RSS-210 2.2	AC Conducted Emissions 150KHz – 30MHz	Compliant
15.403 (i)	A8.2	26dB Occupied Bandwidth	Compliant
15.407 (a)(2)	A9.2(2)	Conducted Transmitter Output Power	Compliant
15.407 (a)(2)	A9.2(2)	Power Spectral Density	Compliant
15.407 (a)(6)	N/A	Peak Excursion	Compliant
15.407 (b)(2), (3)	A9.3(2)(3)	Undesirable Emissions (15.205/15.209 - General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Compliant
15.407(f)	RSS-GEN	RF Exposure	Compliant
15.407(g)	2.1	Frequency Stability	Compliant
N/A	RSS-Gen(4.8)	Receiver Spurious Emissions	Compliant
15.407 (h)(1)	A9.4	Transmit Power Control	N/A-device operates with e.i.r.p of less than 500 mW
15.407 (h)(2)(ii)	A9.4	Channel Availability Check Time	Compliant
15.407 (h)(2)(iii)	A9.4	Channel Move Time and Channel Closing Time	Compliant
15.407 (h)(2)(iv)	A9.4	Non-Occupancy Period	Compliant
15.407 (h)(2)	A9.4	Radar Detection function of Dynamic Frequency Selection (DFS)	Compliant

Table 1. Executive Summary of EMC Part 15.407 & RSS-210 Annex 9 ComplianceTesting

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Fortress Technologies to perform testing on the Fortress Infrastructure Mesh Point ES440, under Fortress Technologies' quote number 1FOR2402.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Fortress Technologies Fortress Infrastructure Mesh Point ES440.

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

Model(s) Tested:	Fortress Infrastructure Mesh Point ES440	
Model(s) Covered:	Fortress Infrastructure Mesh Point ES440	
EUT Specifications:	Primary Power: 120 VAC, 60 Hz	
	FCC ID: WYK-ES440 IC ID: 8190A-ES440	
	Type of Modulations:	OFDM
	Emission Designators:	D7D
	Equipment Code:	NII
	Peak RF Output Power:	18.6 mW
	EUT Frequency Ranges:	5260-5320MHz; 5500-5700MHz
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:	Dusmantha Tennakoon	
Report Date(s):	February 25, 2011	

Table 2. EUT Summary

B. References

RSS-210, Issue 7, June 2007	Low-power License-exempt Radiocommunications Devices (All Frequency Bands): Category I Equipment
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

Table 3. 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.

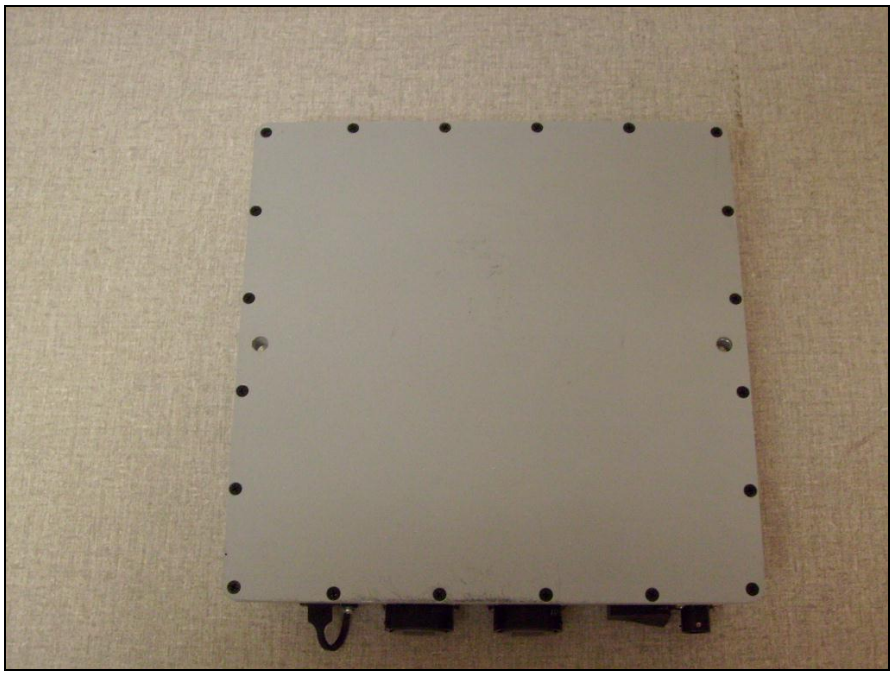
Radiated Emissions measurements were performed in a 3 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

D. Description of Test Sample

The Fortress Technologies Fortress Infrastructure Mesh Point ES440, Equipment Under Test (EUT), is a dual radio access point/bridge. It embeds two COTS high power radios and two Ethernet ports in a ruggedized enclosure. The radio operates in accordance to the 802.11a and 802.11g standards.

The ES440 is intended to provided outdoor mobile connectivity in a secure manner both wired and wirelessly.

Photograph 1. Top View of EUT



Photograph 2. Rear View of EUT

E. Equipment Configuration

Ref. ID	Name / Description	Model Number	Serial Number
1	Fortress Infrastructure Mesh Point	ES440	109480969

Table 4. Equipment Configuration

F. Support Equipment

Support equipment was not necessary for the operation and testing of the Fortress Infrastructure Mesh Point ES440.

G. Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty.	Termination Box ID & Port Name
N/A	Ant (1 & 2)	Antenna	2	Spectrum Analyzer
N/A	AC Pwr	Provides power	1	External AC Charger

Table 5. Ports and Cabling Information

H. Mode of Operation

The ES440 can operate in 802.11a and 802.11g modes. These modes may be configured using the UI of the product. Additionally, these modes may be entered by using ART, the Atheros Radio Test tool. This is a standard tool provide by Atheros for directly manipulating and configuring their chips during testing and manufacturing.

I. 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.

J. Disposition of EUT

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

III. Electromagnetic Compatibility Criteria for Intentional Radiators – M25

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement – M25

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 unit is professionally installed. Therefore, the EUT as tested is compliant with the criteria of §15.203.

Frequency	Gain/Model	Manufacturer
5 GHz	9 dBi / EC09-5500	Mobile Mark Communications

Test Engineer(s): Dusmantha Tennakoon

Test Date(s): 12/03/09

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207 Conducted Emissions Limits – M25

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

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

Table 6. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Test Procedure: The EUT was placed on a non-metallic table, 80 cm above the ground plane 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.

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

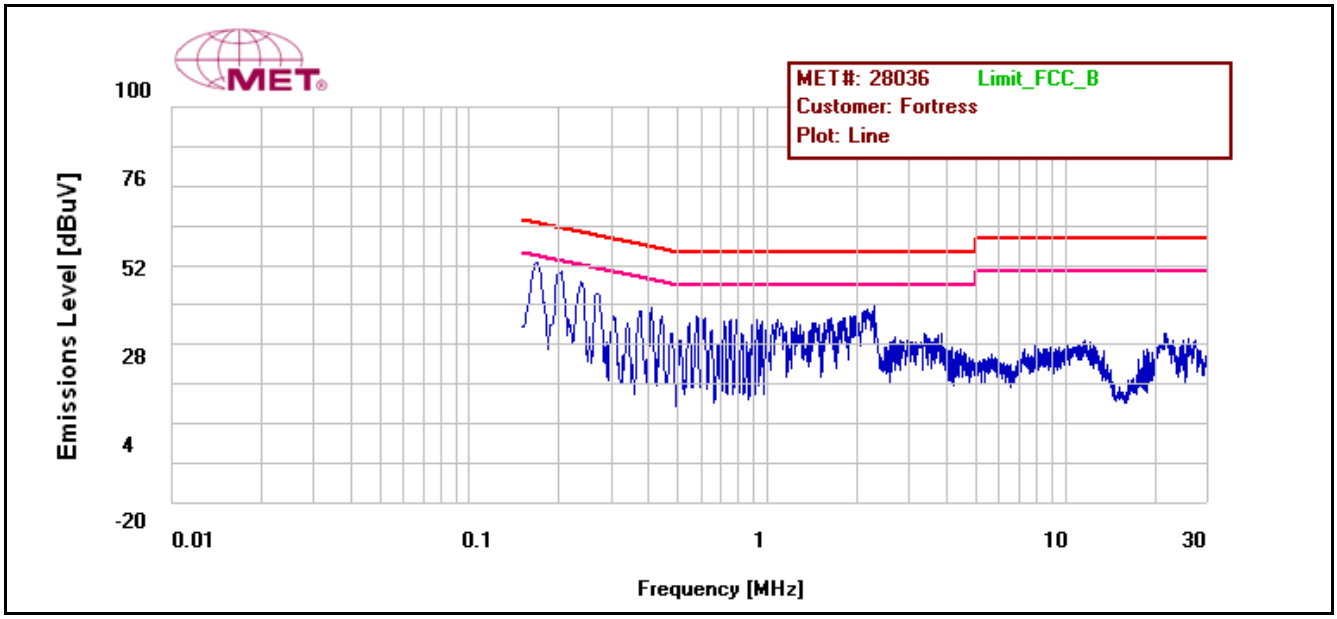
Test Engineer(s): Anderson Soungpanya

Test Date(s): 11/24/09

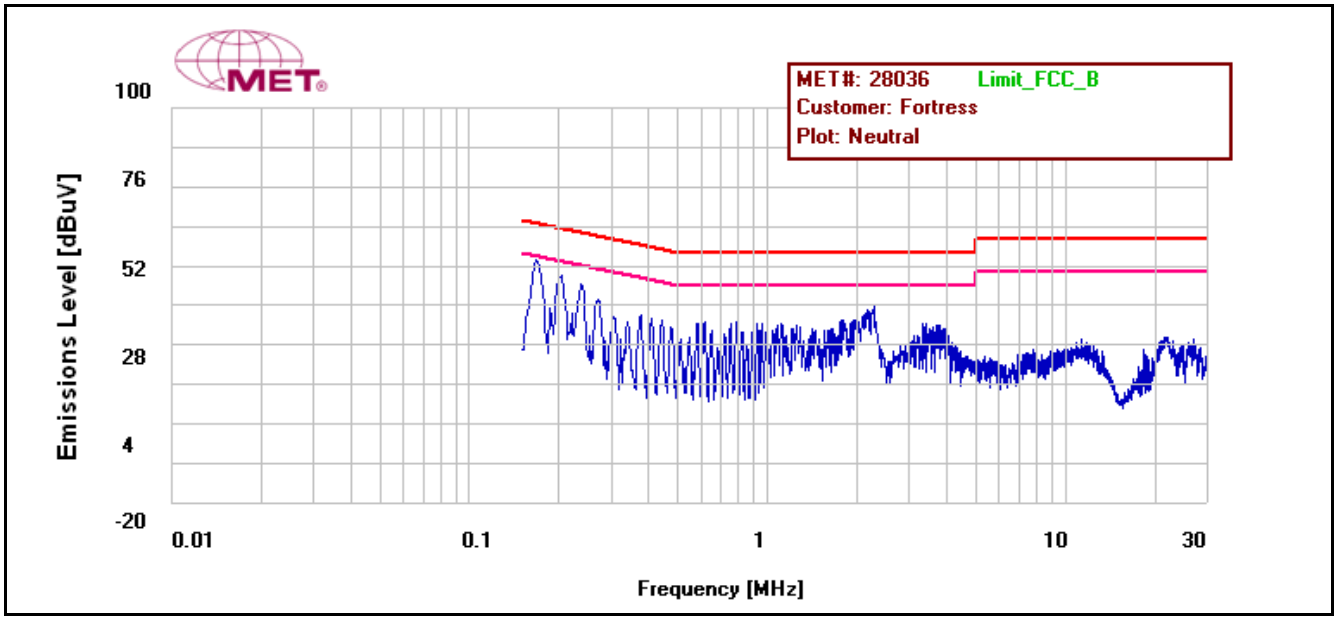
Conducted Emissions - Voltage, AC Power

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Line	.169	51.96	65.012	-13.052	Pass	43.66	55.012	-11.352	Pass
Line	.204	49.33	63.453	-14.123	Pass	44.43	53.453	-9.023	Pass
Line	2.24	36.64	56	-19.36	Pass	23.51	46	-22.49	Pass
Neutral	.170	52.95	64.963	-12.013	Pass	43.35	54.963	-11.613	Pass
Neutral	.203	48.34	63.494	-15.154	Pass	41.74	53.494	-11.754	Pass
Neutral	2.24	38.13	56	-17.87	Pass	30.45	46	-15.55	Pass

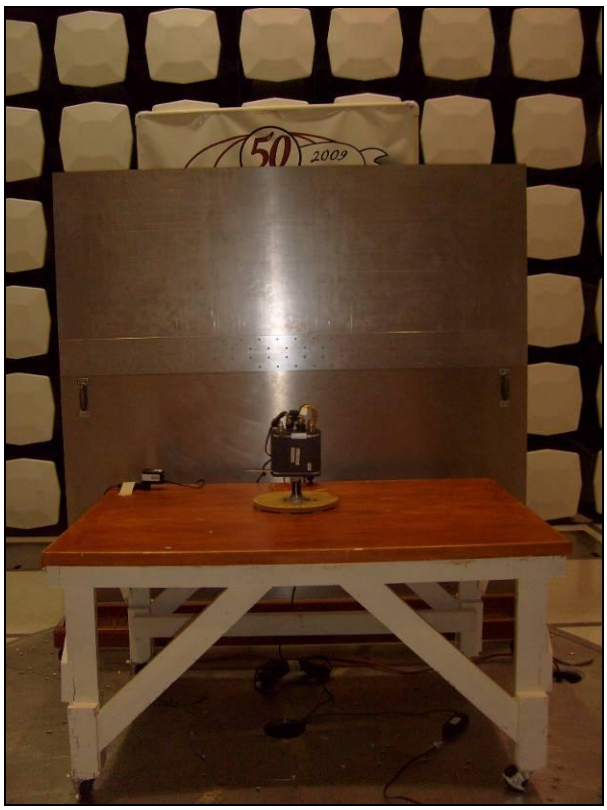
Table 7. Conducted Emissions - Voltage, AC Power, Test Results, M25 Radio



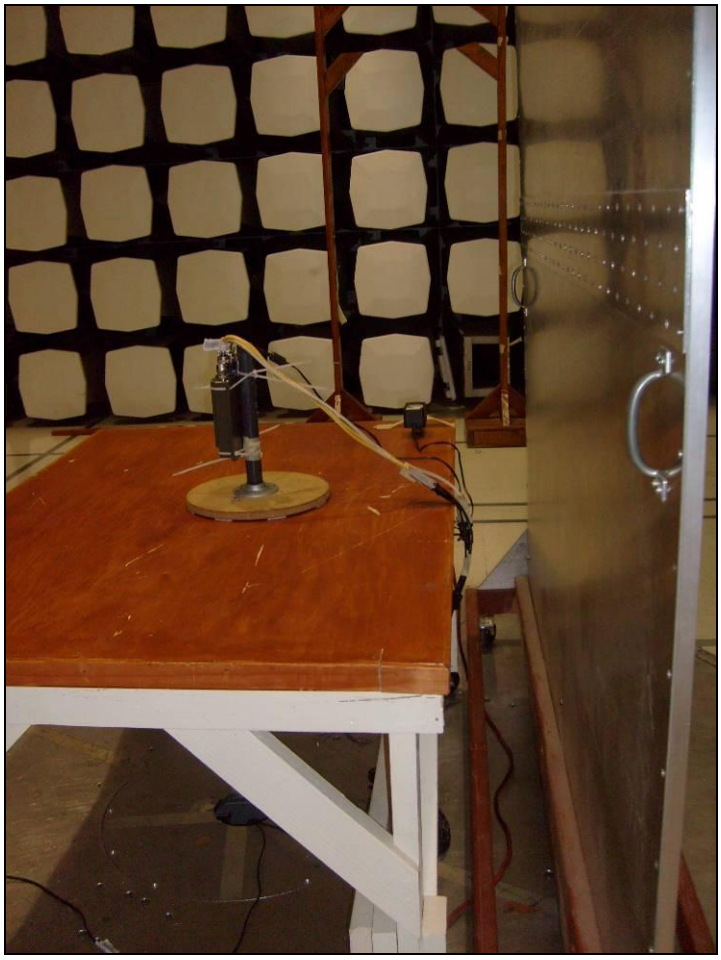
Plot 1. Conducted Emission, Phase Line Plot, M25 Radio



Plot 2. Conducted Emission, Neutral Line Plot, M25 Radio



Photograph 3. Conducted Emissions, Test Setup, M25 Radio



Photograph 4. Conducted Emissions, Test Setup, Side View, M25 Radio

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15. 403(c) 26dB Bandwidth – M25

Test Requirements: **§ 15.403 (i):** For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. Determination of the emissions bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolution bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.

Test Procedure: The transmitter was set to low, mid and high operating frequencies at the highest output power and connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately equal to 1% of the total emission bandwidth, VBW > RBW. The 26 dB Bandwidth was measured and recorded.

Test Results The 26 dB Bandwidth was compliant with the requirements of this section and was determined from the plots on the following pages.

Frequency (MHz)	99% Bandwidth (MHz)	26 dB Bandwidth (MHz)
5260	16.9355	25.298
5300	16.8046	24.510
5320	16.7706	24.075
5500	16.7826	24.277
5600	16.8667	25.142
5700	16.8484	25.910

Table 8. Occupied Bandwidth, Test Results, M25 Radio

Test Engineer(s): Dusmantha Tennakoon

Test Date(s): 12/03/09

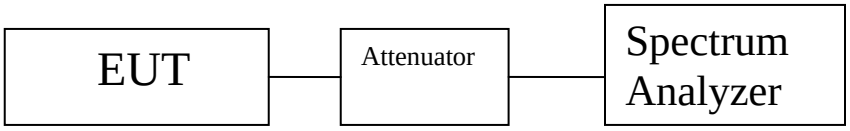
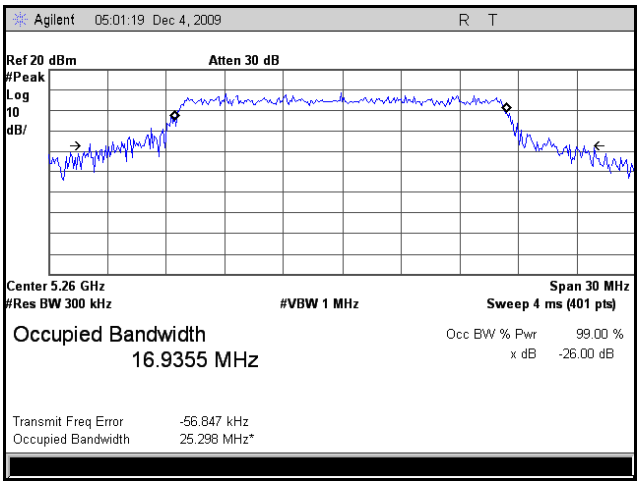
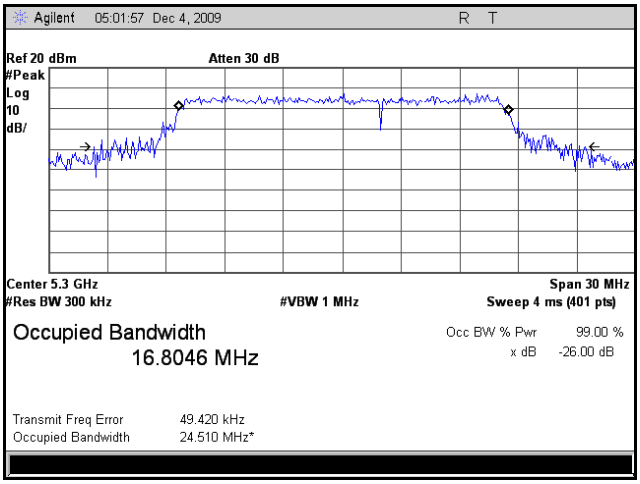


Figure 1. Occupied Bandwidth, Test Setup

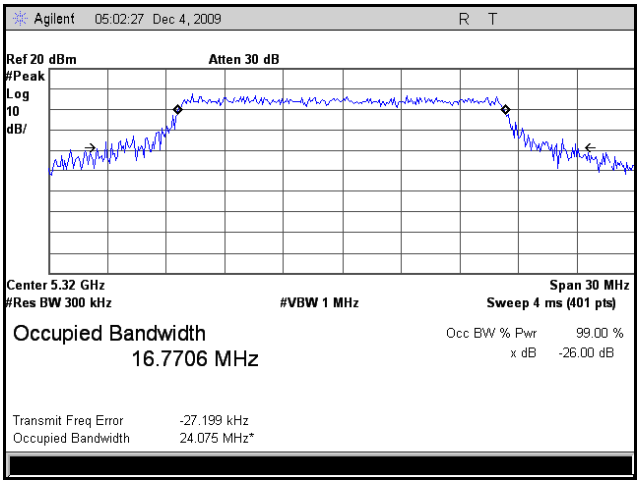
Occupied Bandwidth Test Results



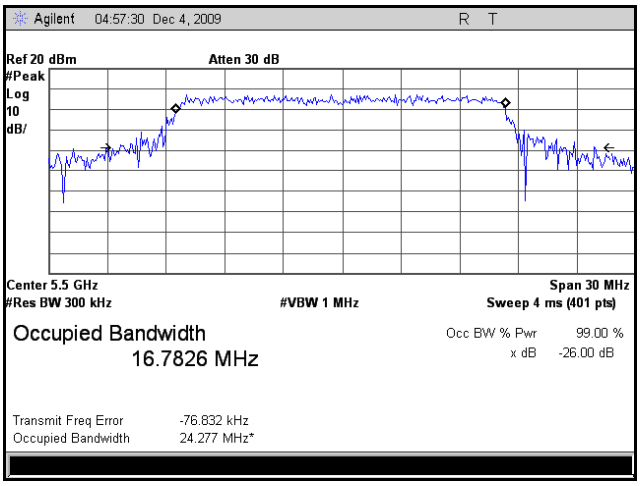
Plot 3. Occupied Bandwidth, 5260 MHz, M25 Radio



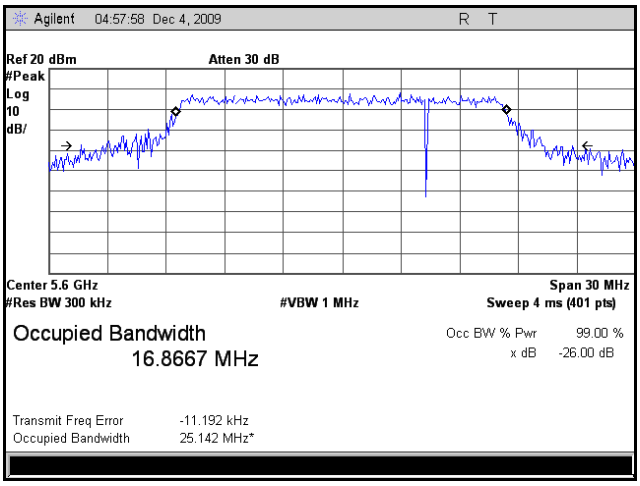
Plot 4. Occupied Bandwidth, 5300 MHz, M25 Radio



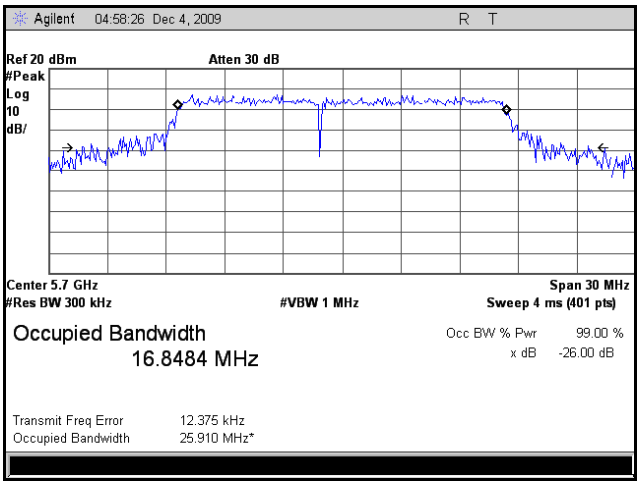
Plot 5. Occupied Bandwidth, 5320 MHz, M25 Radio



Plot 6. Occupied Bandwidth, 5500 MHz, M25 Radio



Plot 7. Occupied Bandwidth, 5600 MHz, M25 Radio



Plot 8. Occupied Bandwidth, 5700 MHz, M25 Radio

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15. 407(a)(2) RF Power Output – M25

Test Requirements: **§15.407(a) (2):** The maximum output power of the intentional radiator shall not exceed the following:

Digital Transmission Systems (MHz)	Output Limit
5150-5250	50mW
5250-5350	250mW
5470–5725	250mW
5725–5825	1W

Table 9. Output Power Requirements from §15.407

§15.407(a) (2): For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10log B, where B is the 26 dB emission bandwidth in megahertz.

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

Test Results: Equipment was compliant with the Peak Power Output limits of **§ 15.407(a)(2)**.

Test Engineer(s): Dusmantha Tennakoon

Test Date(s): 12/03/09

Frequency (MHz)	Conducted Power (dBm)	Conducted Power (mW)	Limit (W)
5260	16.49	44.56	250mW
5300	16.31	42.75	250mW
5320	16.29	42.55	250mW
5500	16.74	47.20	250mW
5600	16.84	48.30	250mW
5700	16.39	43.55	250mW

Table 10. RF Power Output, Test Results, M25 Radio

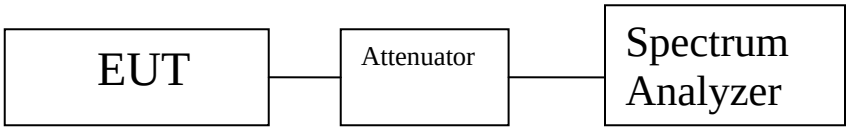
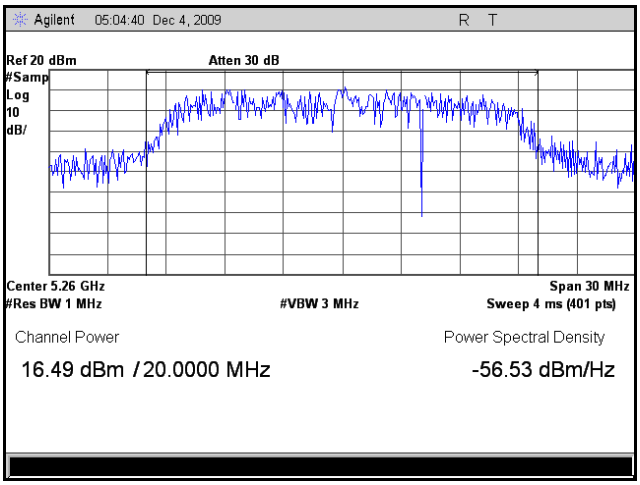
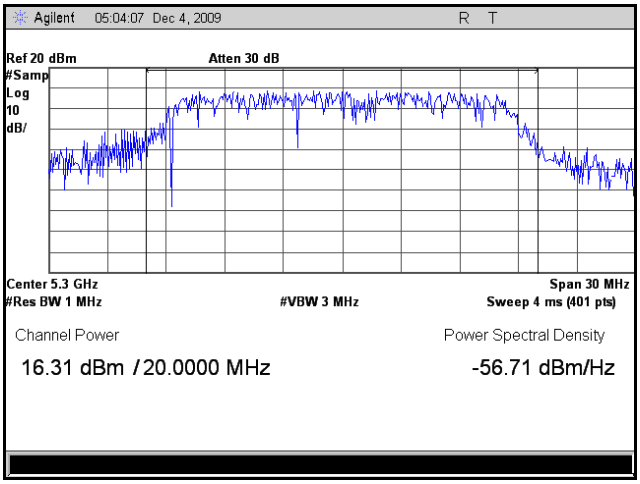


Figure 2. Power Output Test Setup

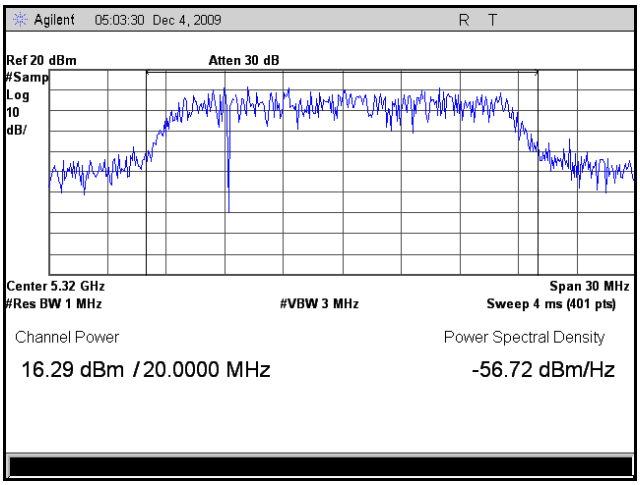
RF Output Power Test Results



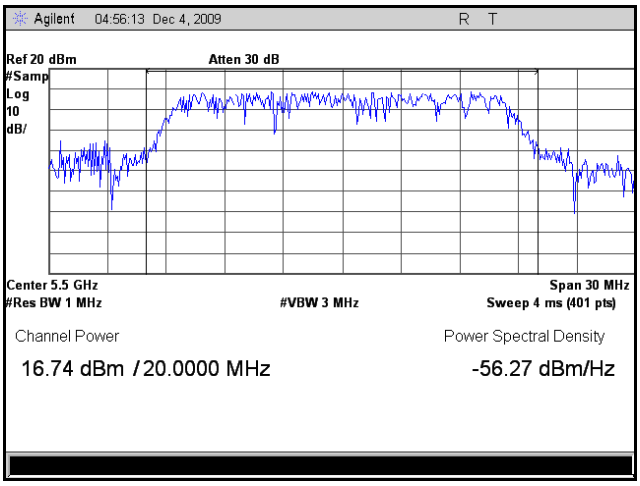
Plot 9. RF Power Output, 5260 MHz, M25 Radio



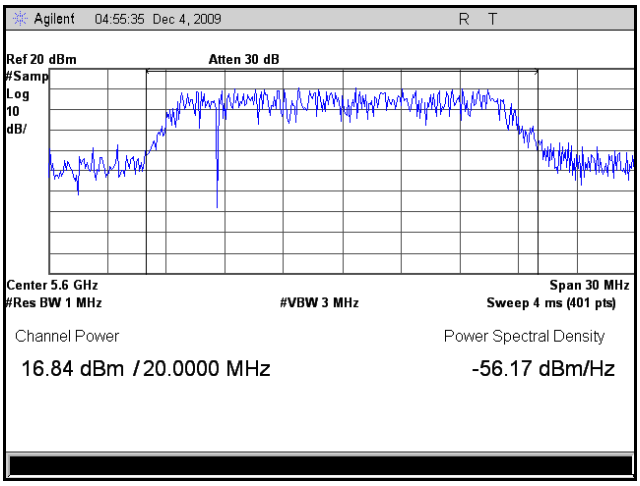
Plot 10. RF Power Output, 5300 MHz, M25 Radio



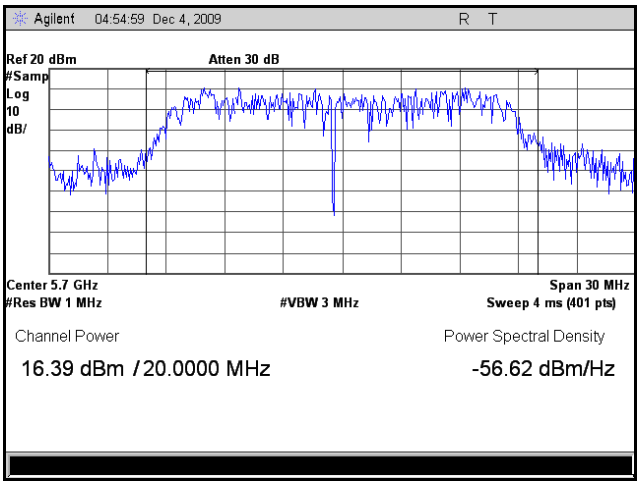
Plot 11. RF Power Output, 5320 MHz, M25 Radio



Plot 12. RF Power Output, 5500 MHz, M25 Radio



Plot 13. RF Power Output, 5600 MHz, M25 Radio



Plot 14. RF Power Output, 5700 MHz, M25 Radio

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(a)(2) Peak Power Spectral Density – M25

Test Requirements: **§ 15.407(a)(2):** In addition, the peak power spectral density shall not exceed 11 dBm in any 1 megahertz band.

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: Equipment was compliant with the peak power spectral density limits of **§ 15.407 (a)(2).** The peak power spectral density was determined from plots on the following page(s).

Test Engineer(s): Dusmantha Tennakoon

Test Date(s): 12/03/09

Frequency (MHz)	PSD (dBm)
5260	5.730
5300	5.252
5320	5.532
5500	5.704
5600	5.757
5700	5.214

Table 11. Power Spectral Density, Test Results, M25 Radio

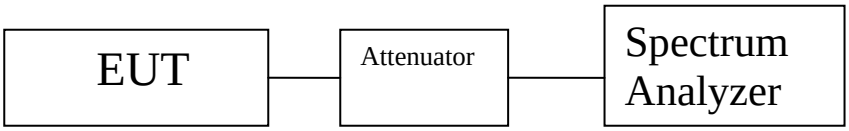
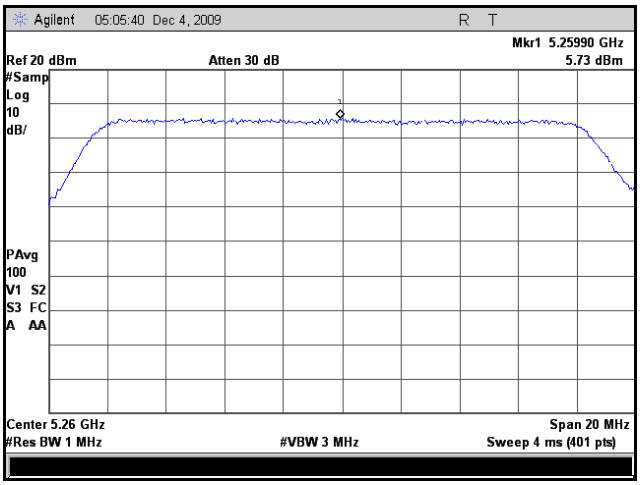
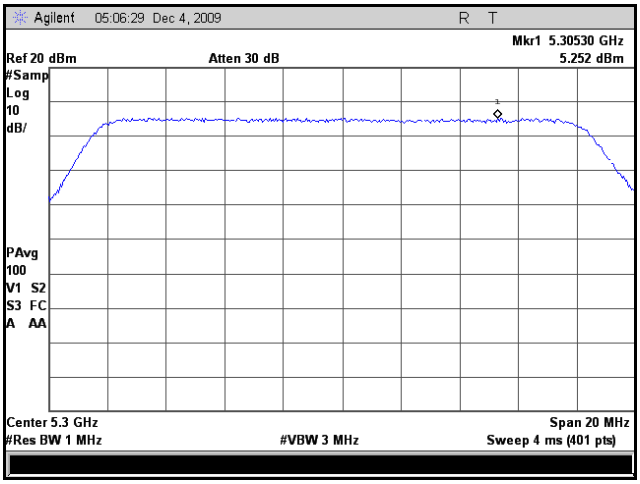


Figure 3. Power Spectral Density Test Setup

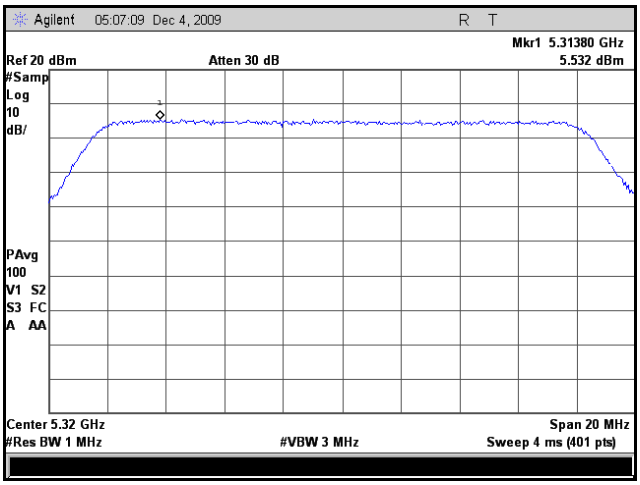
Power Spectral Density Test Results



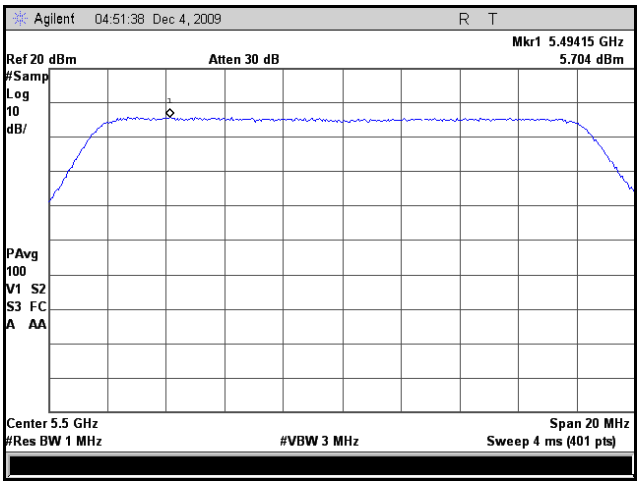
Plot 15. Power Spectral Density, 5260 MHz, M25 Radio



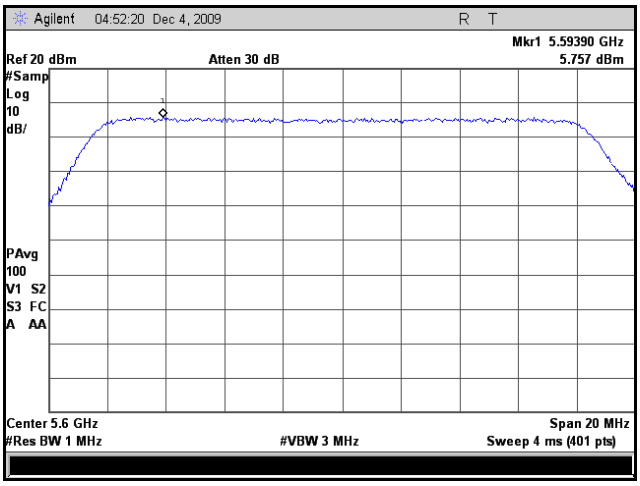
Plot 16. Power Spectral Density, 5300 MHz, M25 Radio



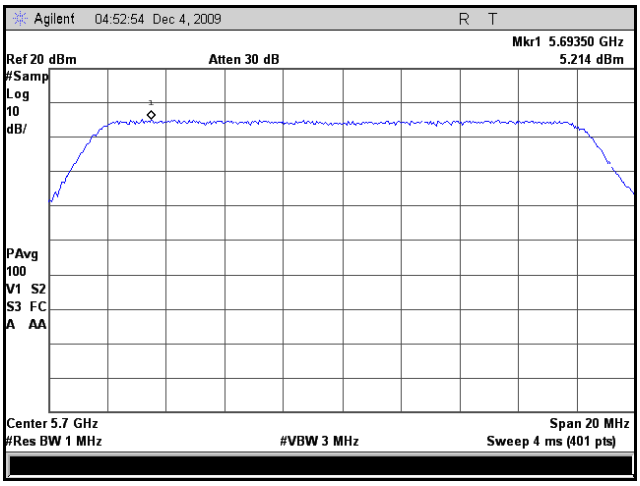
Plot 17. Power Spectral Density, 5320 MHz, M25 Radio



Plot 18. Power Spectral Density, 5500 MHz, M25 Radio



Plot 19. Power Spectral Density, 5600 MHz, M25 Radio



Plot 20. Power Spectral Density, 5700 MHz, M25 Radio

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(a)(6) Peak Excursion Ratio – M25

Test Requirements: **§ 15.407(a)(6):** 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 cabling and attenuation. The 1st trace on the spectrum analyzer was set to RBW=1MHz, VBW=3MHz. The peak detector mode was used and the trace max held. The 2nd trace on the spectrum analyzer was set according to measurement method #1 from the FCC Public Notice DA 02-2138 for making conducted power measurements.

Test Results: Equipment was compliant with the peak excursion ratio limits of **§ 15.407(a)(6).** The peak excursion ratio was determined from plots on the following page(s).

Test Engineer(s): Dusmantha Tennakoon

Test Date(s): 12/03/09

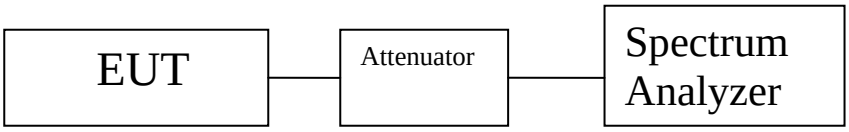
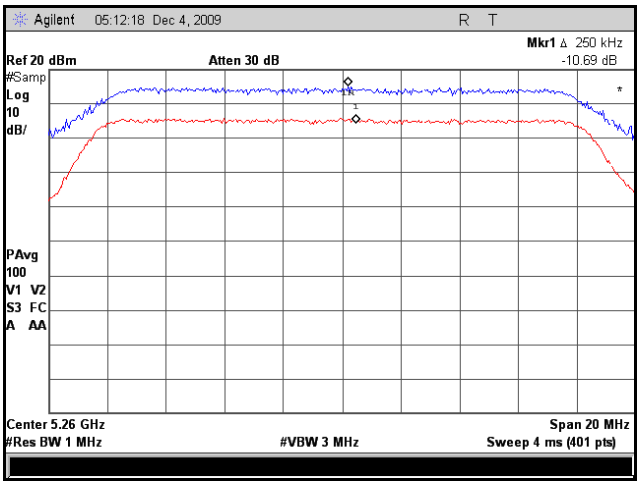
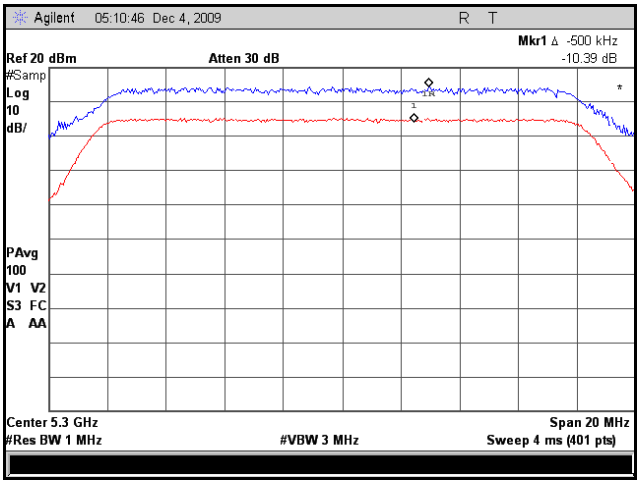


Figure 4. Peak Excursion Ration Test Setup

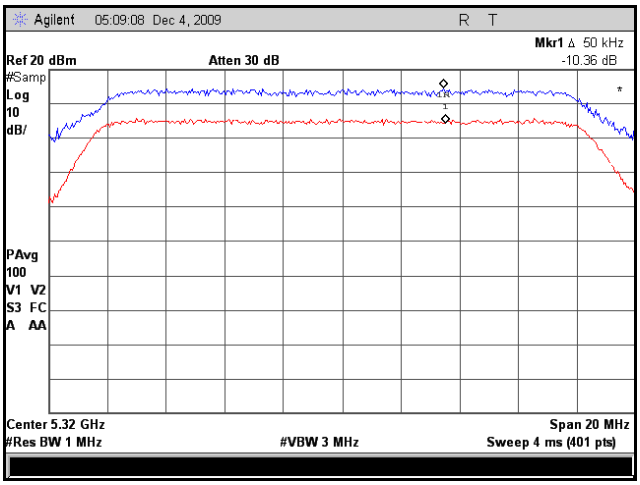
Peak Excursion Test Results



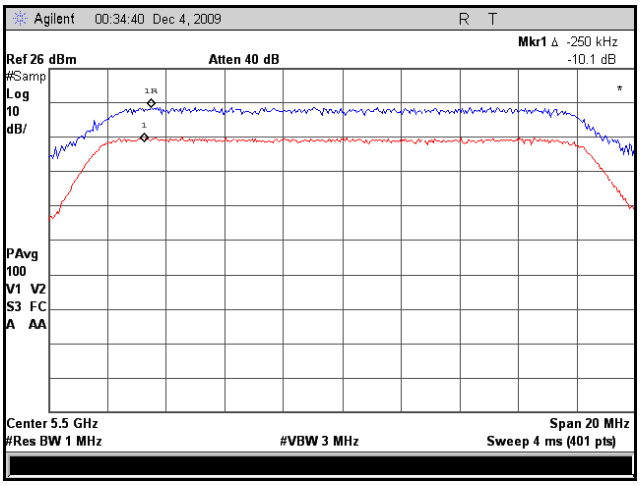
Plot 21. Peak Excursion Ratio, 5260 MHz, M25 Radio



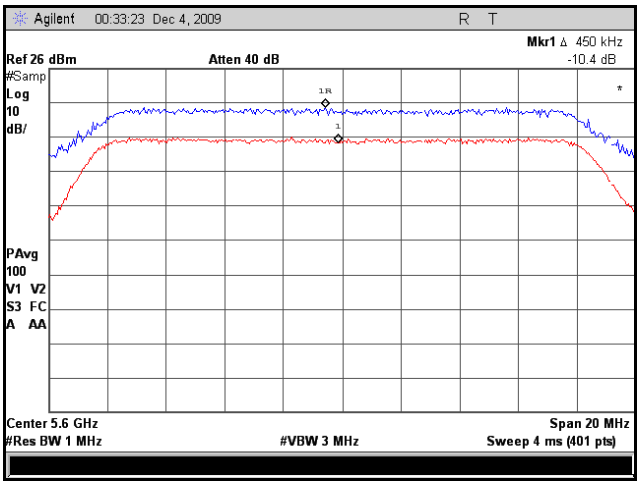
Plot 22. Peak Excursion Ratio, 5300 MHz, M25 Radio



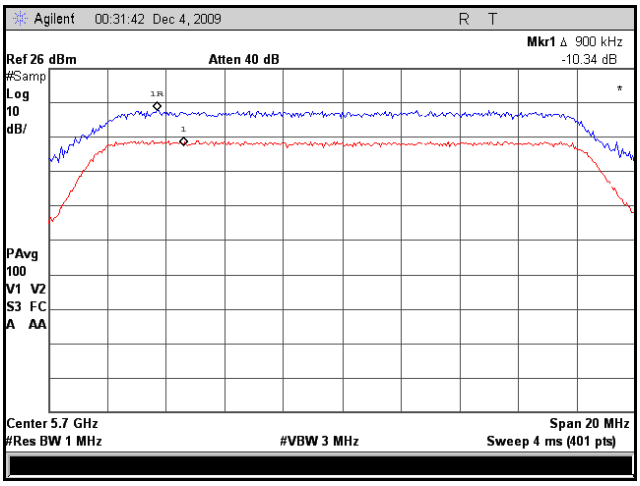
Plot 23. Peak Excursion Ratio, 5320 MHz, M25 Radio



Plot 24. Peak Excursion Ratio, 5500 MHz, M25 Radio



Plot 25. Peak Excursion Ratio, 5600 MHz, M25 Radio



Plot 26. Peak Excursion Ratio, 5700 MHz, M25 Radio

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(b) Undesirable Emissions – M25

Test Requirements: **§ 15.407(b)(2), (b)(3), (b)(7):** Emissions outside the frequency band.

§ 15.407(b)(2): For transmitters operating in the 5.25–5.35 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of –27 dBm/MHz. Devices operating in the 5.25–5.35 GHz band that generate emissions in the 5.15–5.25 GHz band must meet all applicable technical requirements for operation in the 5.15–5.25 GHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of –27 dBm/MHz in the 5.15–5.25 GHz band.

§ 15.407(b)(3): For transmitters operating in the 5.47–5.725 GHz band: all emissions outside of the 5.47–5.725 GHz band shall not exceed an EIRP of −27 dBm/MHz.

§ 15.407(b)(7): The provisions of Section 15.205 of this part apply to intentional radiators operating under this section.

Test Procedure: The transmitter was placed on a stand inside in a semi-anechoic chamber. Measurements were performed with the EUT rotated 360 degrees and varying the adjustable antenna mast height to determine worst case orientation for maximum emissions.

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

For measurements above 1 GHz, measurements were made with a Peak detector with 1 MHz resolution bandwidth. Where the spurious emissions fell into a restricted band, measurements were also made with an average detector to make sure they complied with 15.209 limits. Emissions were explored up to 40 GHz.
The equation, **EIRP= E + 20 log D – 104.8** was used to convert an EIRP limit to a field strength limit.
E = field strength (dBUv/m)
D = Reference measurement distance

Test Results: The EUT was compliant with the Radiated Emission limits for Intentional Radiators. See following pages for detailed test results.

Note: Plot 29, Plot 30, Plot 36, Plot 37, Plot 43, Plot 44, Plot 50, Plot 51, Plot 57, Plot 58, Plot 64, and Plot 65 have been corrected to 3m.

Test Engineer(s): Dusmantha Tennakoon

Test Date(s): 12/22/09

§ 15.407(b)(4): Harmonic and Spurious Emissions Requirements – Radiated

Channel (MHz)	Frequency (GHz)	Measured value (corrected) @ 1m dBuV/m	Limit @ 1m	Margin	Remark
5260	5.15	71.77	77.8	-6.03	Peak
	5.359	59.43	63.5	-4.07	Avg
	5.3579	73.87	83.5	-9.63	Peak
	5.4915	72.48	77.8	-5.32	Peak
	17.89	67.52	77.8	-10.28	Peak
5300	5.1251	71.5	77.8	-6.3	Peak
	5.3619	59.72	63.5	-3.78	Avg
	5.357	73.87	83.5	-9.63	Peak
	5.4884	71.43	77.8	-6.37	Peak
	17.89	67.32	77.8	-10.48	Peak
5320	5.1334	70.93	77.8	-6.87	Peak
	5.35	63.13	63.5	-0.37	Avg
	5.3511	83.19	83.5	-0.31	Peak
	5.5344	71.87	77.8	-5.93	Peak
	17.9175	67.87	77.8	-9.93	Peak
5500	5.1844	73.29	77.8	-4.51	Peak
	5.46	60.03	63.5	-3.47	Avg
	5.4591	80.27	83.5	-3.23	Peak
	6.581	71.01	77.8	-6.79	Peak
	17.89	67.17	77.8	-10.63	Peak
5600	5.1757	75.49	77.8	-2.31	Peak
	5.3619	62.16	63.5	-1.34	Avg
	5.3648	75.66	83.5	-7.84	Peak
	6.5631	71.82	77.8	-5.98	Peak
	17.89	67.32	77.8	-10.48	Peak
5700	5.2628	75.06	77.8	-2.74	Peak
	5.3626	61.85	63.5	-1.65	Avg
	5.3562	74.58	83.5	-8.92	Peak
	5.735	72.82	77.8	-4.98	Peak
	17.9175	68.11	77.8	-9.69	Peak

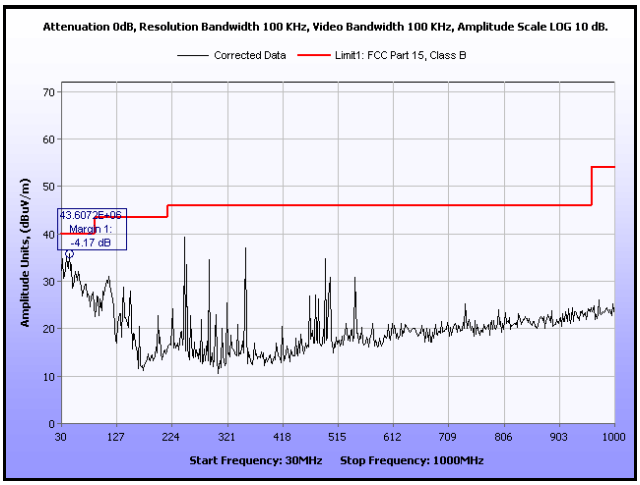
Table 12. Radiated Spurs, Test Results, M25 Radio

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

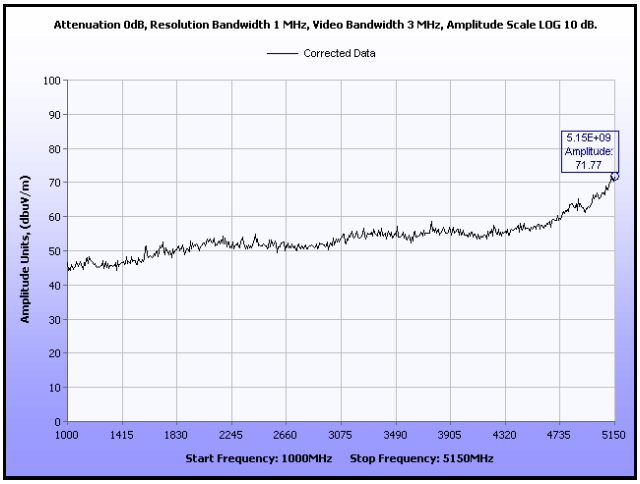
Limit Calculations:

-27 dBm/MHz
EIRP = E0 + 20log (D) – 104.8
E0 = -27+104.8 (measurements made at 1m)
E0 =77.8 dBuV/m

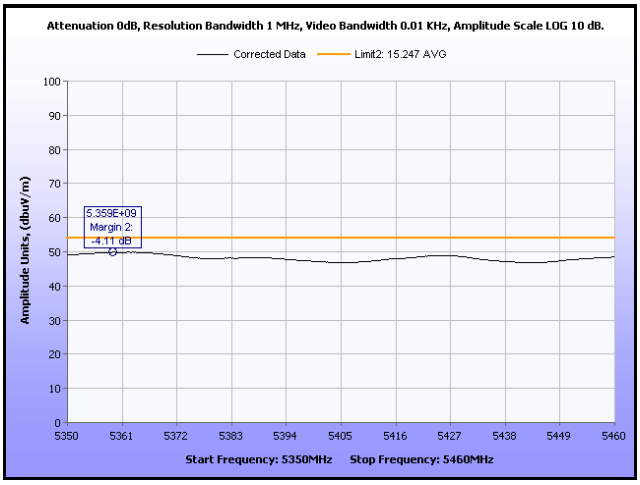
Radiated Spurious Emissions Test Results



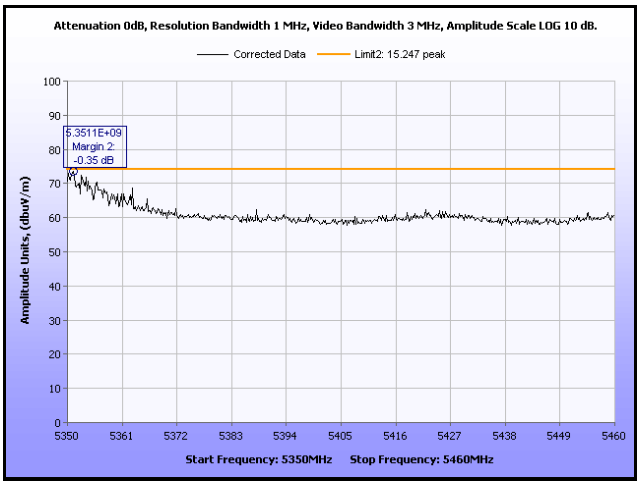
Plot 27. Radiated Spurs, 30 MHz – 1 GHz, Channel 5260 MHz, M25 Radio



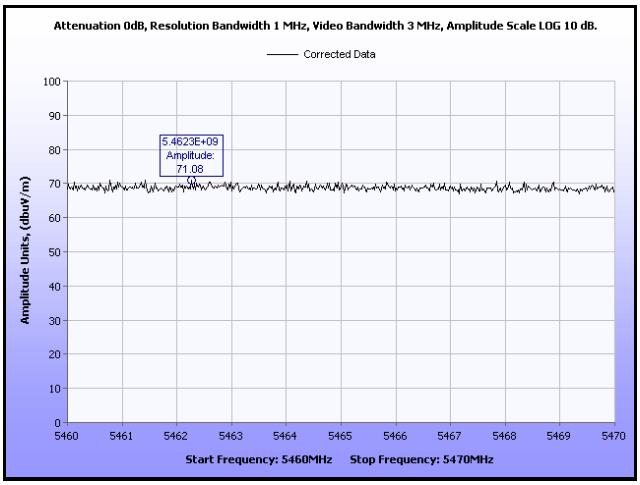
Plot 28. Radiated Spurs, 1 GHz – 5.15 GHz, Channel 5260 MHz, M25 Radio



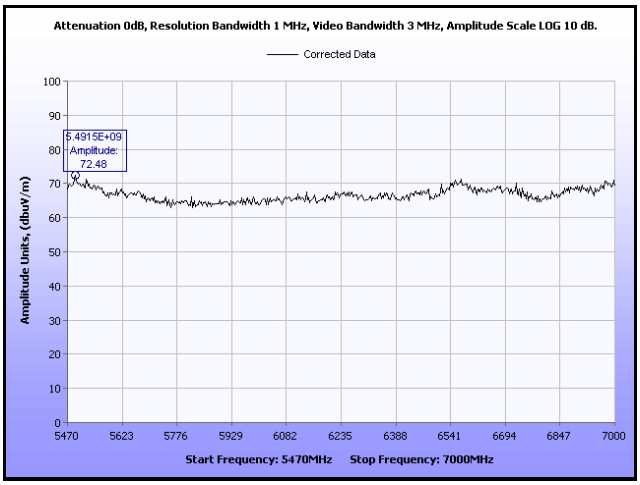
Plot 29. Radiated Spurs, 5.35 GHz – 5.46 MHz, Average, Channel 5260 MHz, M25 Radio



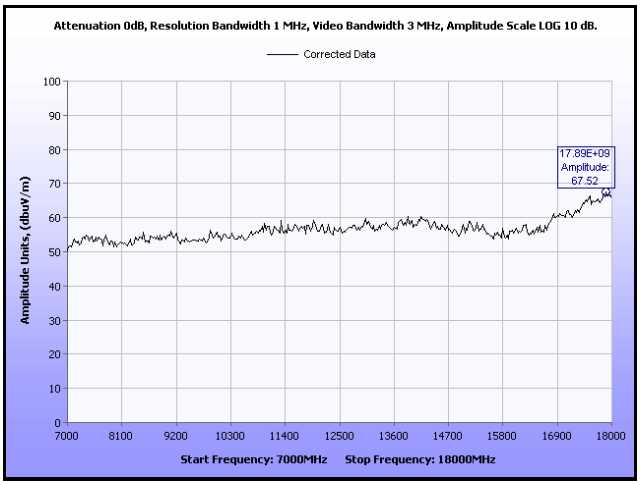
Plot 30. Radiated Spurs, 5.35 GHz – 5.46 MHz, Peak, Channel 5260 MHz, M25 Radio



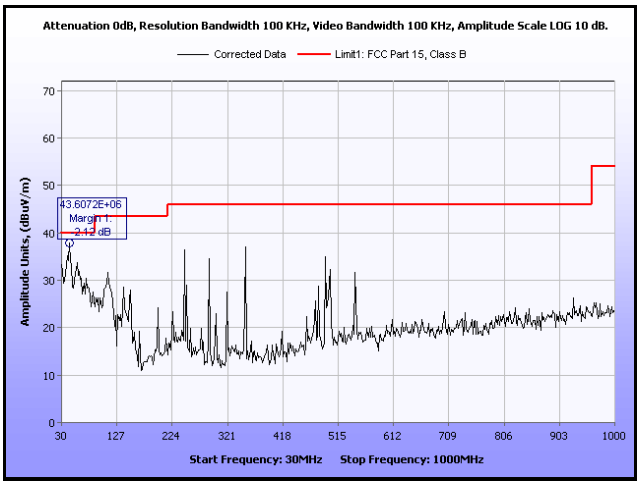
Plot 31. Radiated Spurs, 5.46 GHz – 5.47 MHz, Channel 5260 MHz, M25 Radio



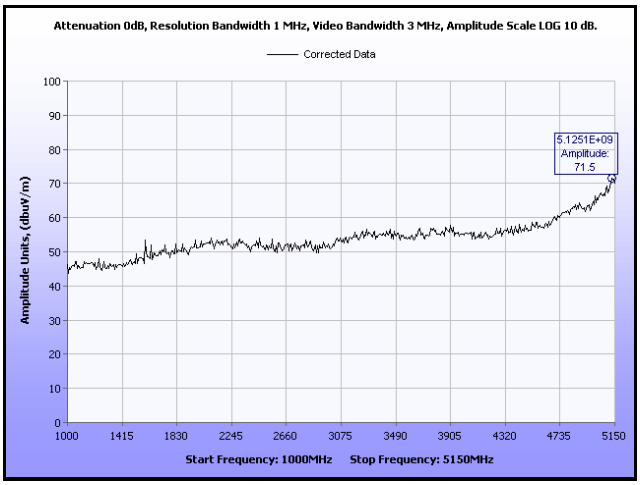
Plot 32. Radiated Spurs, 5.47 GHz – 7 MHz, Channel 5260 MHz, M25 Radio



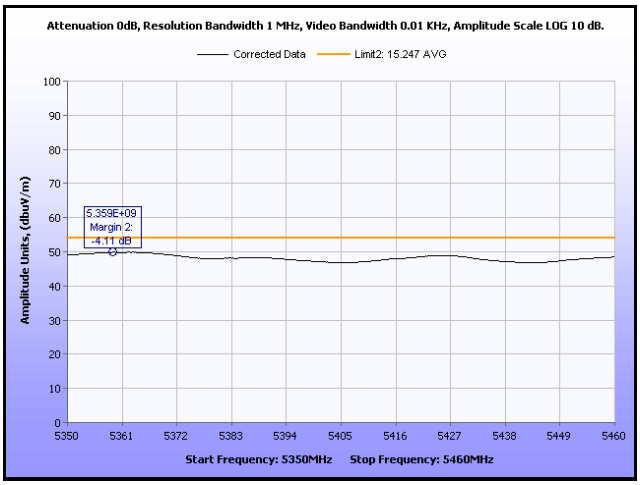
Plot 33. Radiated Spurs, 7 GHz – 18 MHz, Channel 5260 MHz, M25 Radio



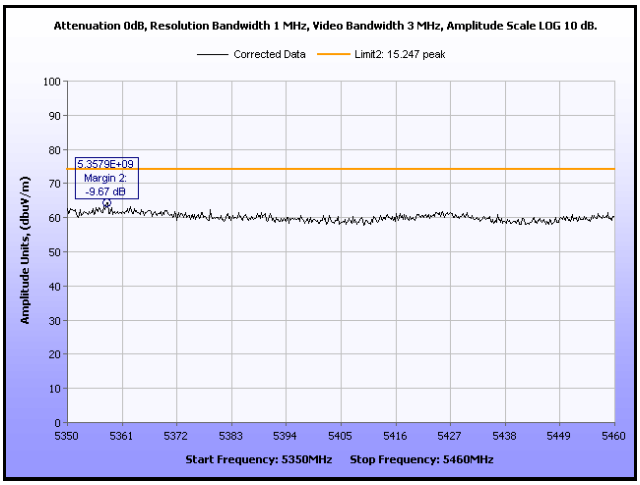
Plot 34. Radiated Spurs, 30 MHz – 1 GHz, Channel 5300 MHz, M25 Radio



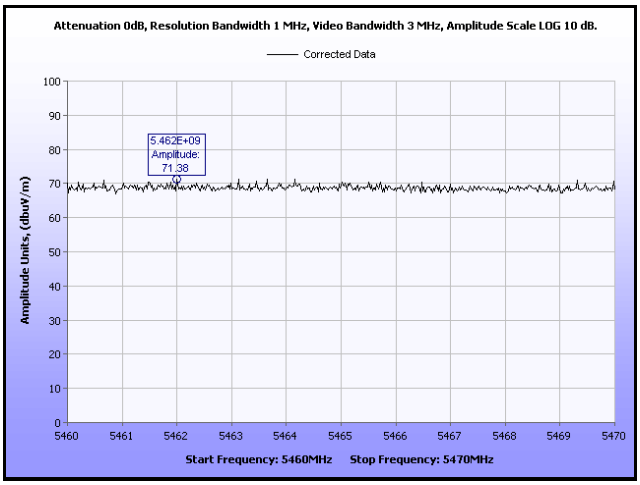
Plot 35. Radiated Spurs, 1 GHz – 5.15 GHz, Channel 5300 MHz, M25 Radio



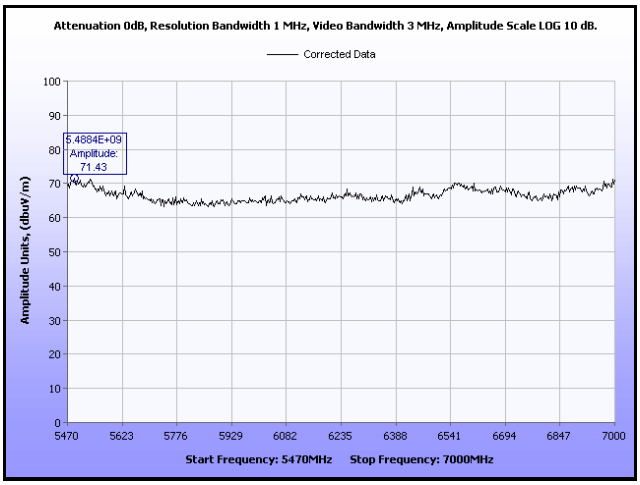
Plot 36. Radiated Spurs, 5.35 GHz – 5.46 GHz, Average, Channel 5300 MHz, M25 Radio



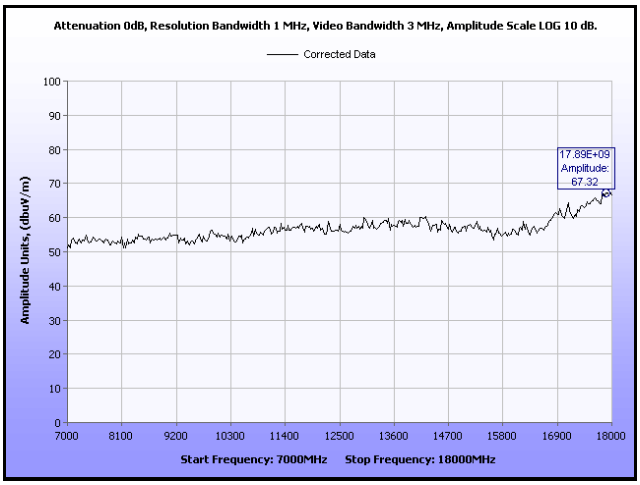
Plot 37. Radiated Spurs, 5.35 GHz – 5.46 GHz, Peak, Channel 5300 MHz, M25 Radio



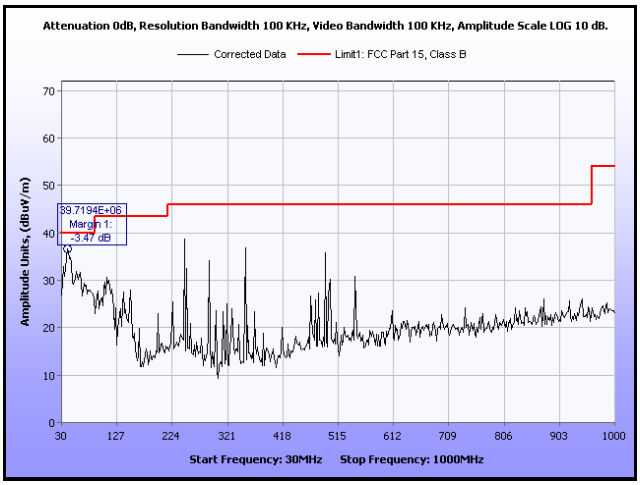
Plot 38. Radiated Spurs, 5.46 GHz – 5.47 GHz, Channel 5300 MHz, M25 Radio



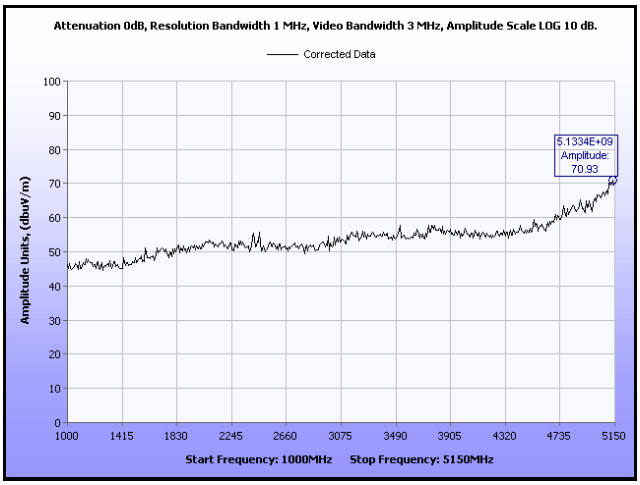
Plot 39. Radiated Spurs, 5.47 GHz – 7 GHz, Channel 5300 MHz, M25 Radio



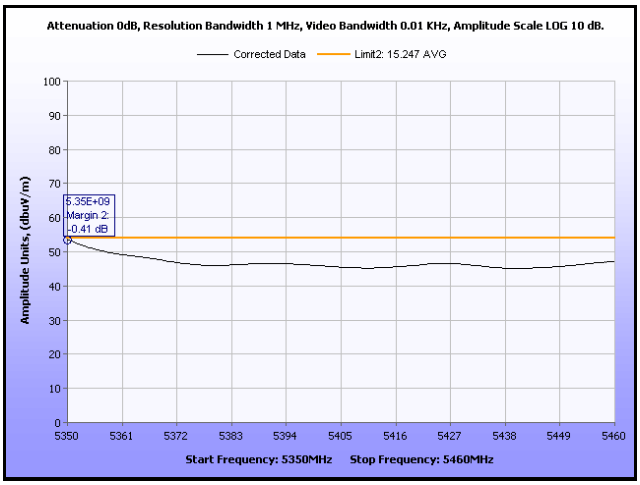
Plot 40. Radiated Spurs, 7 GHz – 18 GHz, Channel 5300 MHz, M25 Radio



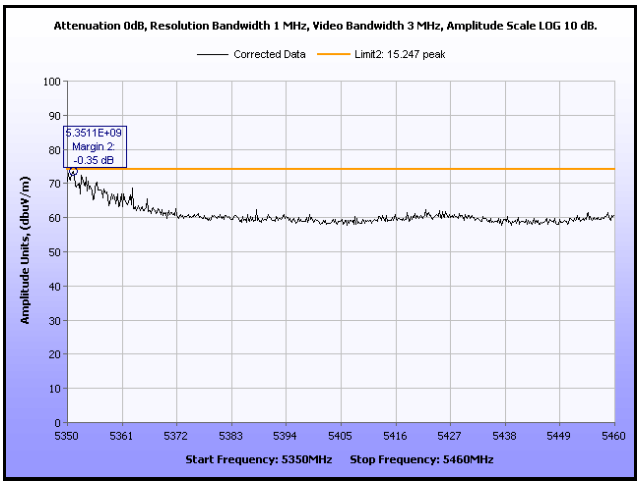
Plot 41. Radiated Spurs, 30 MHz – 1 GHz, Channel 5320 MHz, M25 Radio



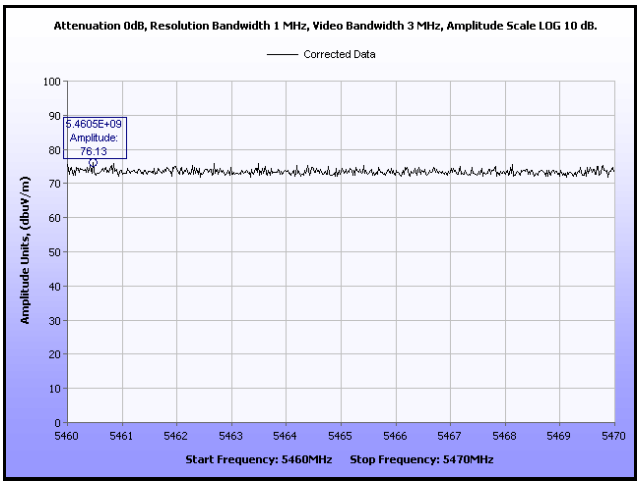
Plot 42. Radiated Spurs, 1 GHz – 5.15 GHz, Channel 5320 MHz, M25 Radio



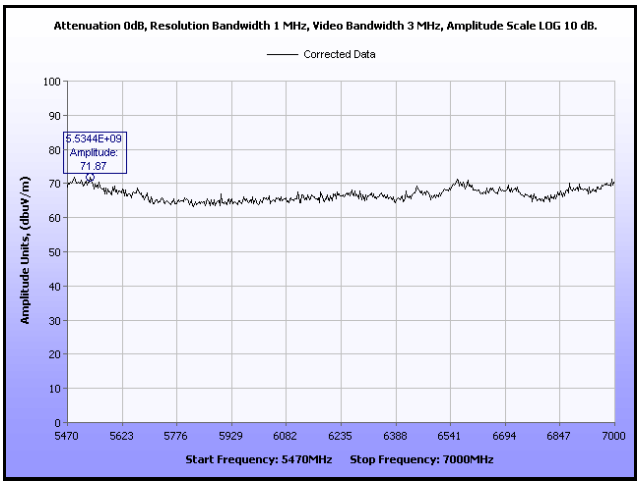
Plot 43. Radiated Spurs, 5.350 GHz – 5.46 MHz, Average, Channel 5320 MHz, M25 Radio



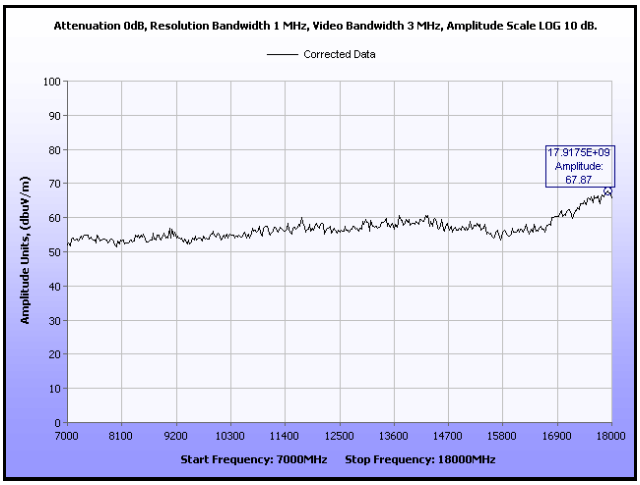
Plot 44. Radiated Spurs, 5.350 GHz – 5.46 MHz, Peak, Channel 5320 MHz, M25 Radio



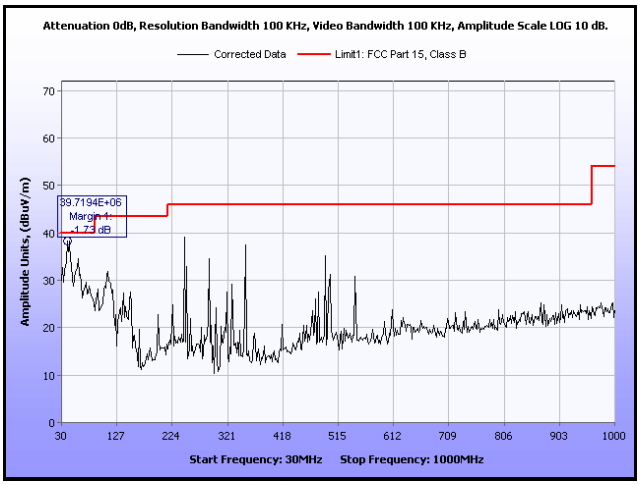
Plot 45. Radiated Spurs, 5.46 GHz – 5.47 GHz, Channel 5320 MHz, M25 Radio



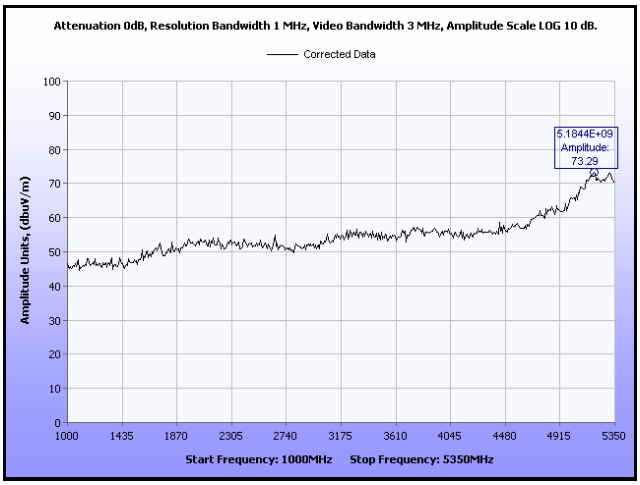
Plot 46. Radiated Spurs, 5.47 GHz – 7 GHz, Channel 5320 MHz, M25 Radio



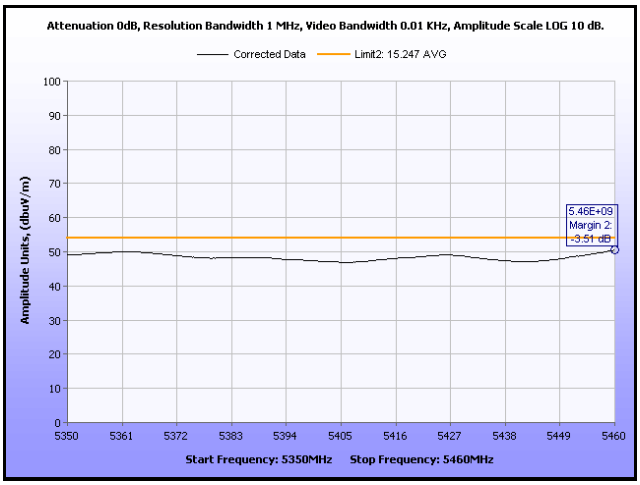
Plot 47. Radiated Spurs, 7 GHz – 18 GHz, Channel 5320 MHz, M25 Radio



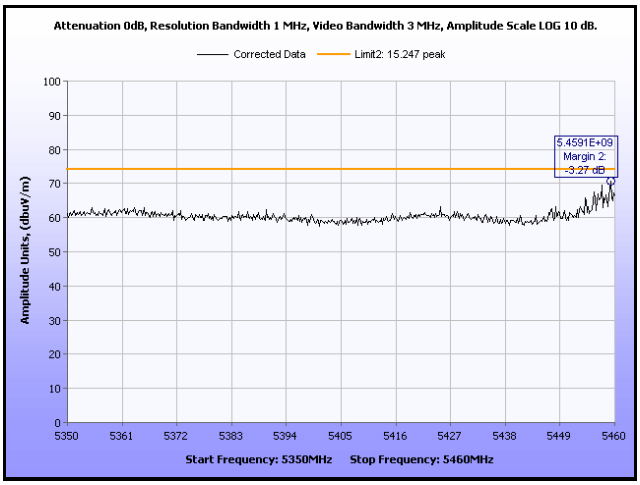
Plot 48. Radiated Spurs, 30 MHz – 1 GHz, Channel 5500 MHz, M25 Radio



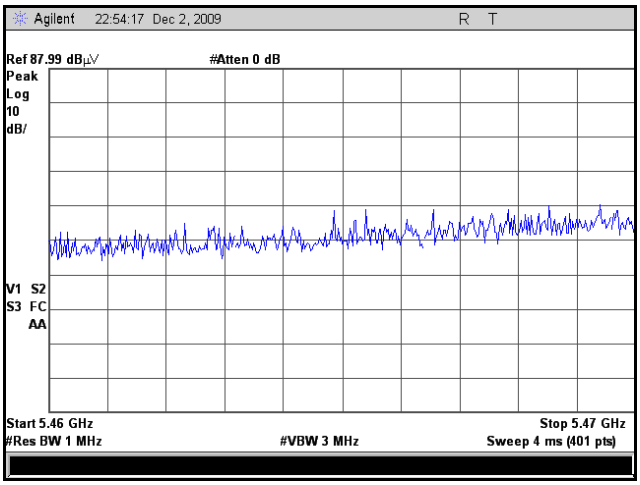
Plot 49. Radiated Spurs, 1 GHz – 5.35GHz, Channel 5500 MHz, M25 Radio



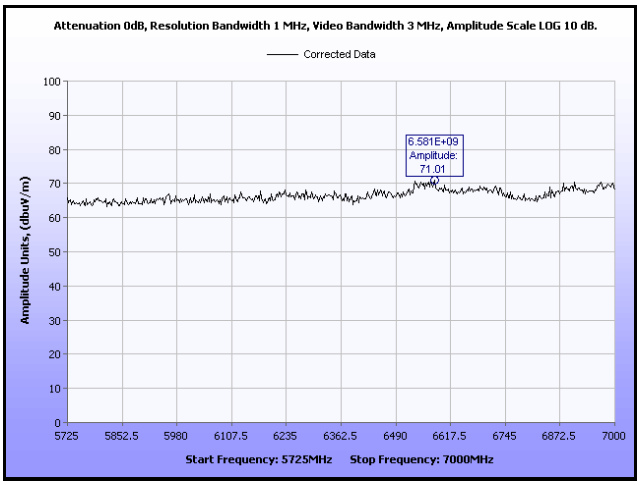
Plot 50. Radiated Spurs, 5.35 GHz – 5.46 GHz, Average, Channel 5500 MHz, M25 Radio



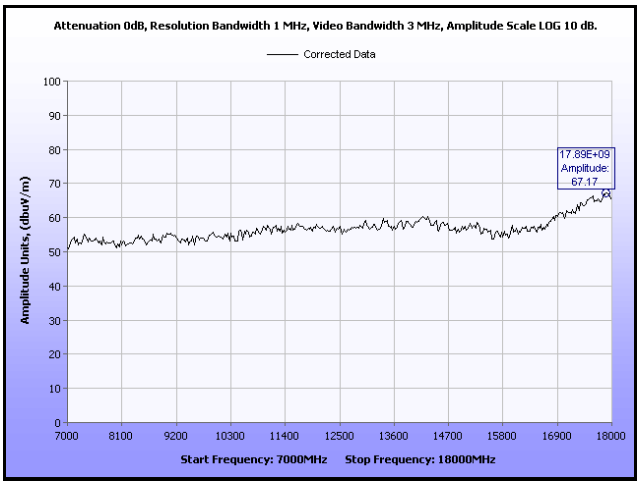
Plot 51. Radiated Spurs, 5.35 GHz – 5.46 GHz, Peak, Channel 5500 MHz, M25 Radio



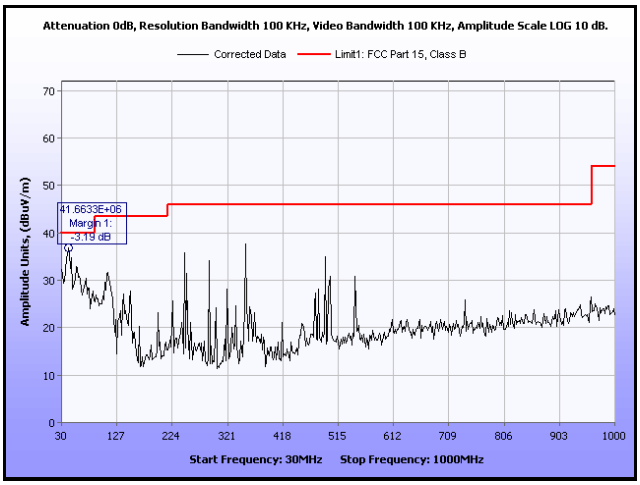
Plot 52. Radiated Spurs, 5.46 GHz – 5.47 GHz, Channel 5500 MHz, M25 Radio



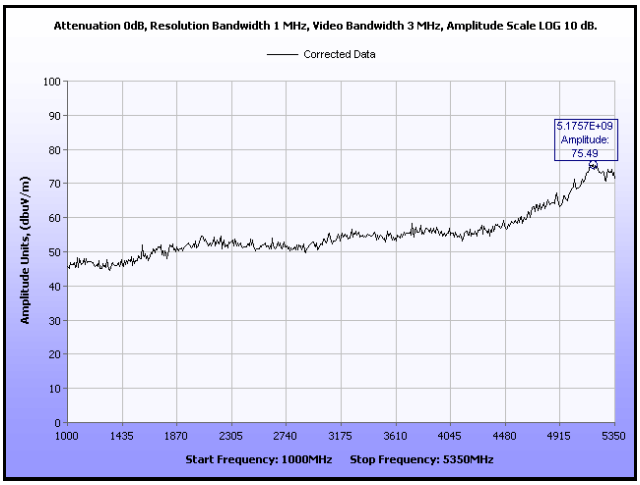
Plot 53. Radiated Spurs, 5.725 GHz – 7 GHz, Channel 5500 MHz, M25 Radio



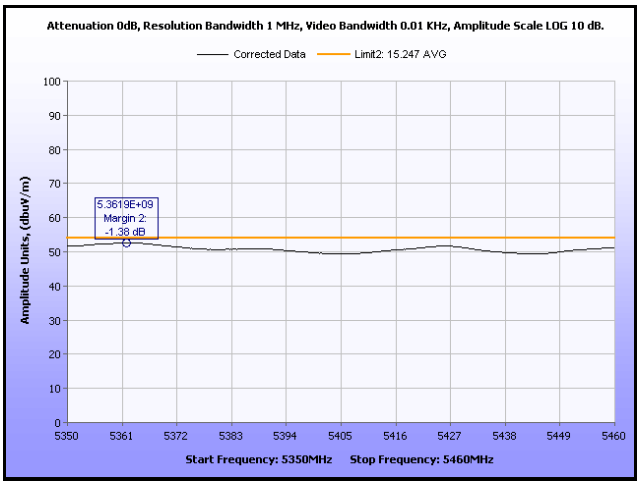
Plot 54. Radiated Spurs, 7 GHz – 18 GHz, Channel 5500 MHz, M25 Radio



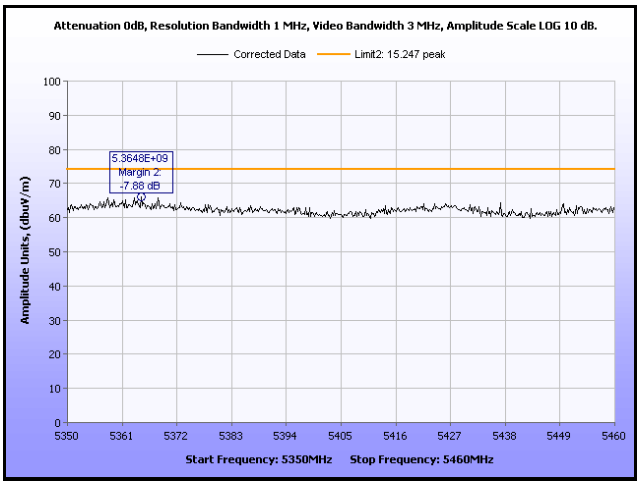
Plot 55. Radiated Spurs, 30 MHz – 1 GHz, Channel 5600 MHz, M25 Radio



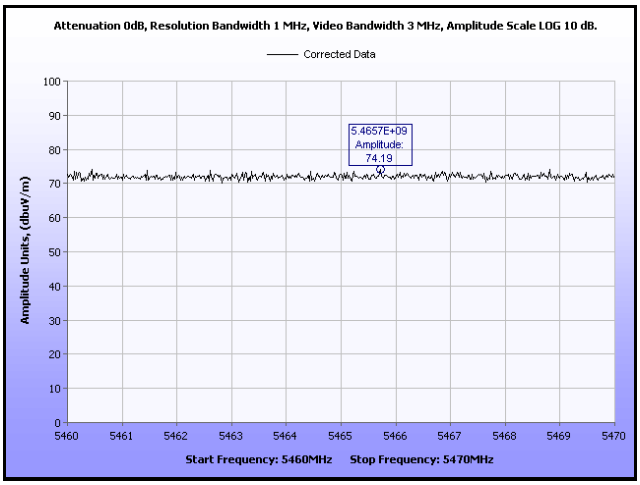
Plot 56. Radiated Spurs, 1 GHz – 5.35 GHz, Channel 5600 MHz, M25 Radio



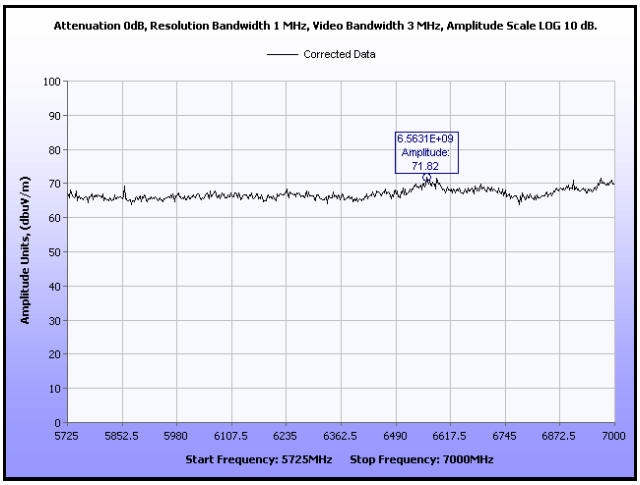
Plot 57. Radiated Spurs, 5.35 GHz – 5.46 GHz, Average, Channel 5600 MHz, M25 Radio



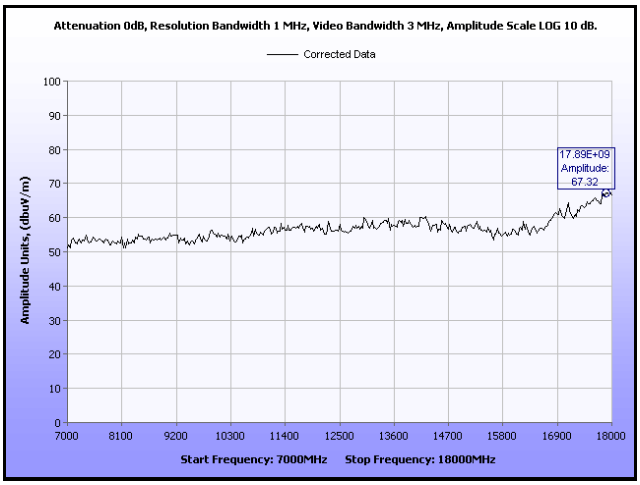
Plot 58. Radiated Spurs, 5.35 GHz – 5.46 GHz, Peak, Channel 5600 MHz, M25 Radio



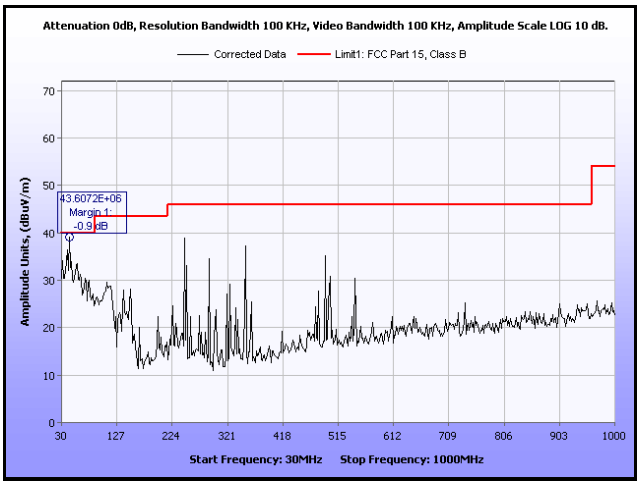
Plot 59. Radiated Spurs, 5.46 GHz – 5.47 GHz, Channel 5600 MHz, M25 Radio



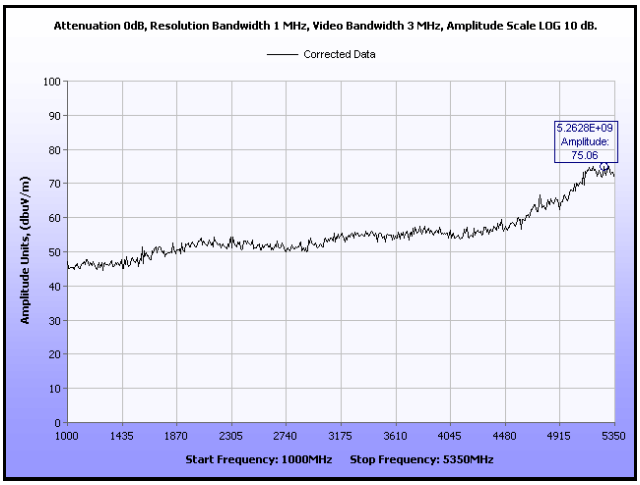
Plot 60. Radiated Spurs, 5.725 GHz – 7 GHz, Channel 5600 MHz, M25 Radio



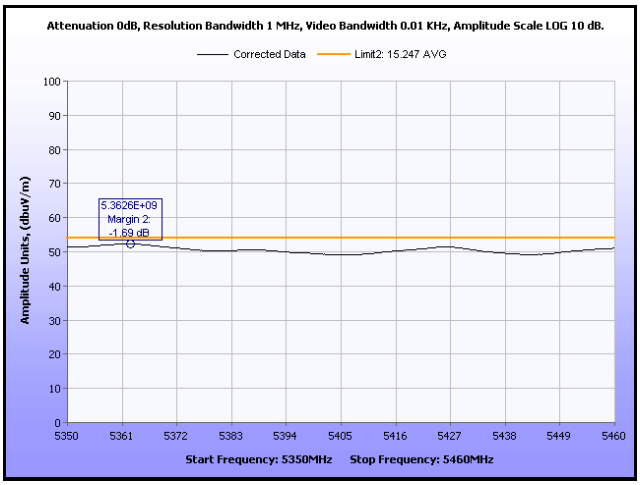
Plot 61. Radiated Spurs, 7 GHz – 18 GHz, Channel 5600 MHz, M25 Radio



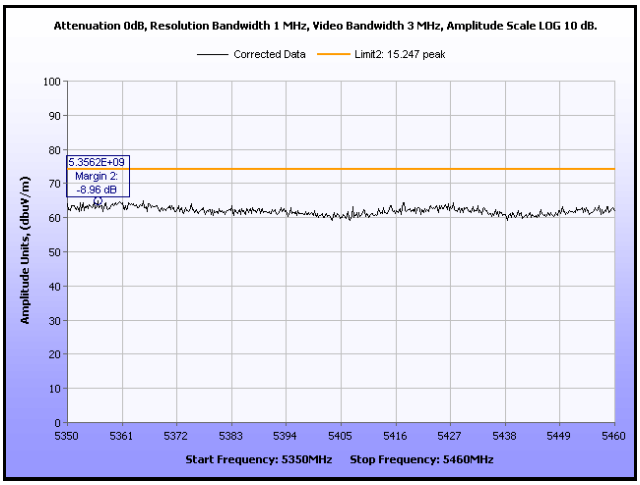
Plot 62. Radiated Spurs, 30 MHz – 1 GHz, Channel 5700 MHz, M25 Radio



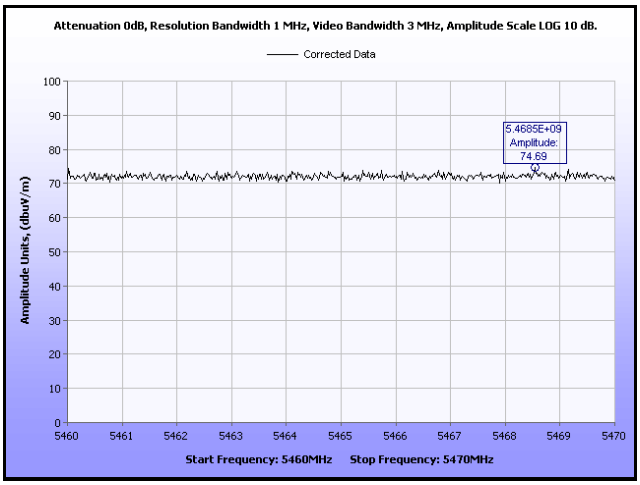
Plot 63. Radiated Spurs, 1 GHz – 5.35 GHz, Channel 5700 MHz, M25 Radio



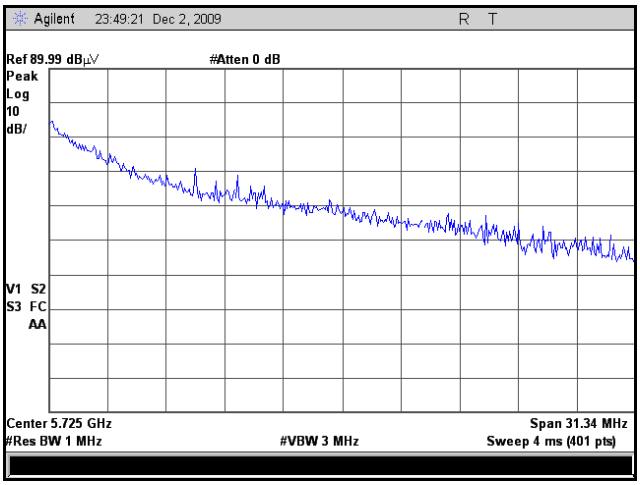
Plot 64. Radiated Spurs, 5.35 GHz – 5.46 GHz, Average, Channel 5700 MHz, M25 Radio



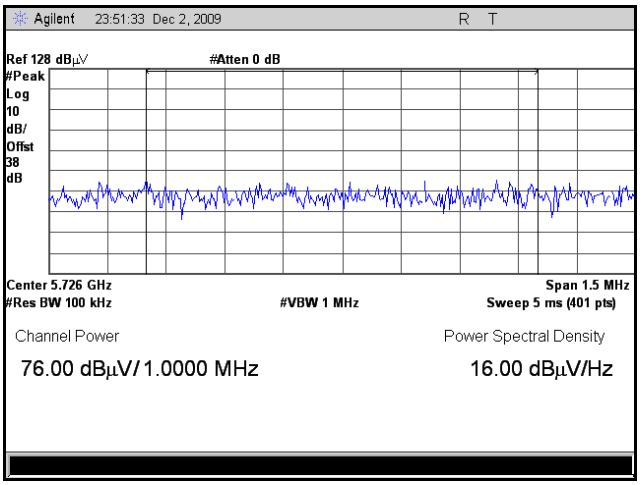
Plot 65. Radiated Spurs, 5.35 GHz – 5.46 GHz, Peak, Channel 5700 MHz, M25 Radio



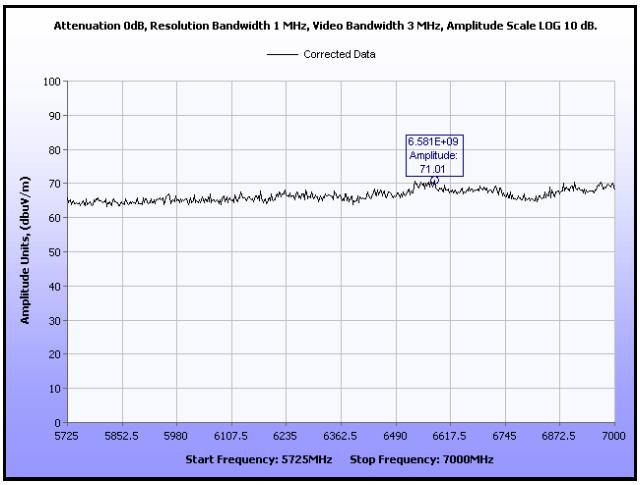
Plot 66. Radiated Spurs, 5.46 GHz – 5.47 GHz, Channel 5700 MHz, M25 Radio



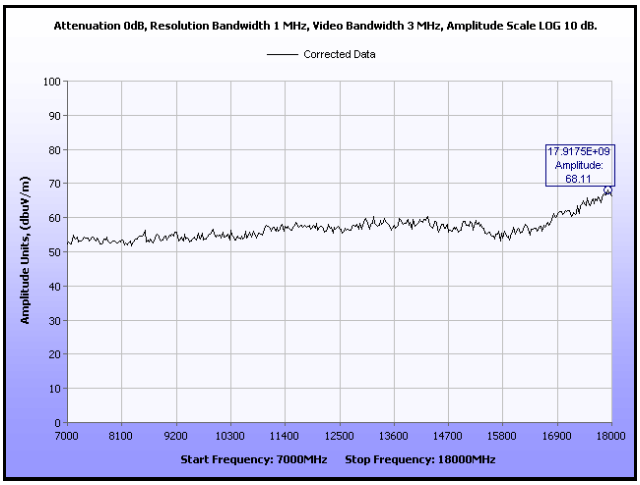
Plot 67. Radiated Spurs, 5.725 GHz – 5.735 GHz, Peak Determination, Channel 5700 MHz, M25 Radio



Plot 68. Radiated Spurs, 5.725 GHz – 5.735 GHz, Integration, Channel 5700 MHz, M25 Radio

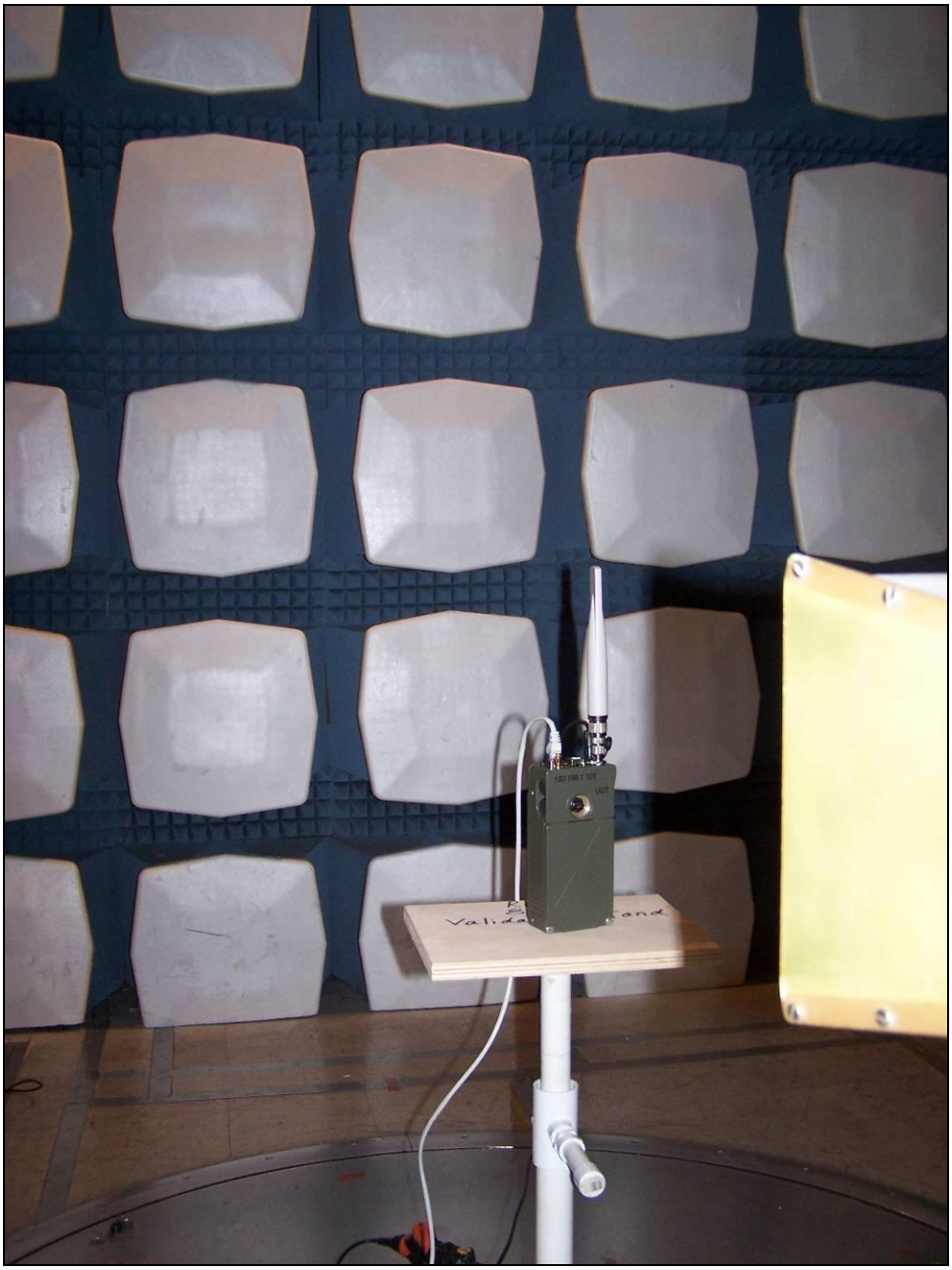


Plot 69. Radiated Spurs, 5.725 GHz – 7 GHz, Channel 5700 MHz, M25 Radio



Plot 70. Radiated Spurs, 7 GHz – 18 GHz, Channel 5700 MHz, M25 Radio

Radiated Spurious Test Setup Photograph



Photograph 5. Radiated Spurious, Test Setup, M25 Radio

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(g) Frequency Stability – M25

Test Requirements: **§ 15.407(g):** Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the users manual.

Test Procedure: The EUT was connected directly to a spectrum analyzer through an attenuator. The resolution band width of the spectrum analyzer was set to 10 KHz. The 1st trace of the Spectrum Analyzer was used as a reference at 20°C. A 2nd trace was used to show the drift of the carrier at extreme conditions. A delta marker was used to find the drift at a given extreme condition. All transmit frequencies are derived from one oscillator. Therefore, only one channel was investigated for frequency stability.

Test Results: The EUT was compliant with the requirements of **§15.407(g)**.

Test Engineer(s): Len Knight

Test Date(s): 10/09/09

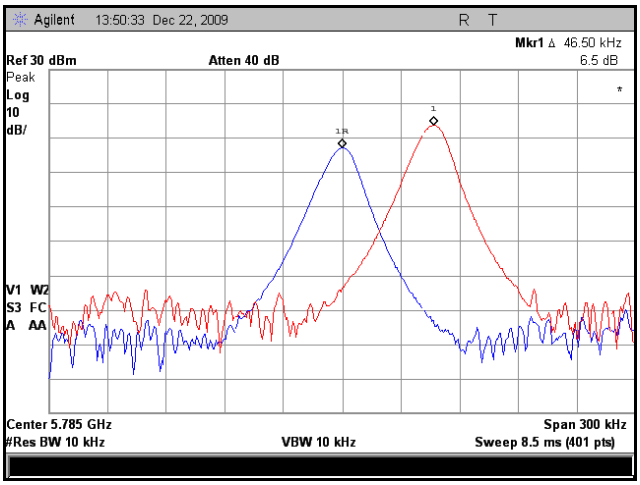
Temperature (centigrade)	Drift (kHz)	Drift (ppm)
55	32.3	5.6
50	27.0	4.7
40	10.5	1.8
30	0.0	0
20	ref	ref
10	3.0	0.5
0	15.0	2.6
-10	24.8	4.3
-20	46.5	8

Table 13. Frequency Stability, Reference 5785 MHz at 23°C, Test Results, M25 Radio

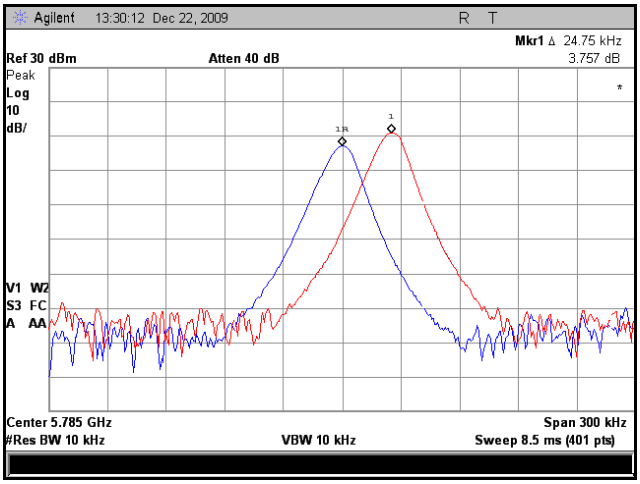
Voltage Variation		
Voltage (VAC)	**Drift (kHz)**	**Drift (ppm)**
102	0	0
138	-1	-0.2

Table 14. Frequency Stability, Reference 5785 MHz at 120 VAC and 20°C, Test Results, M25 Radio

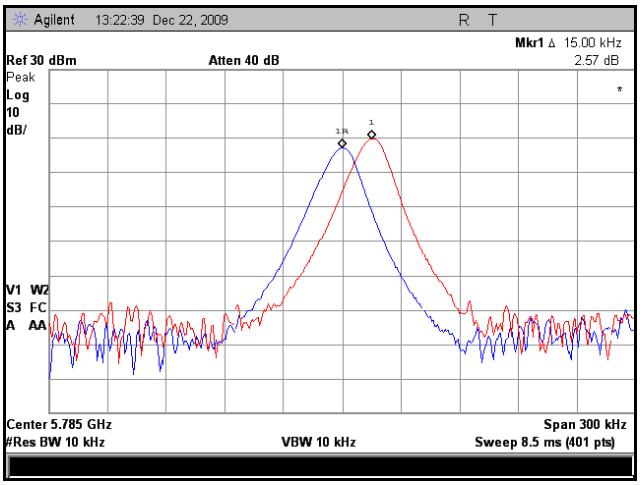
Frequency Stability Test Results



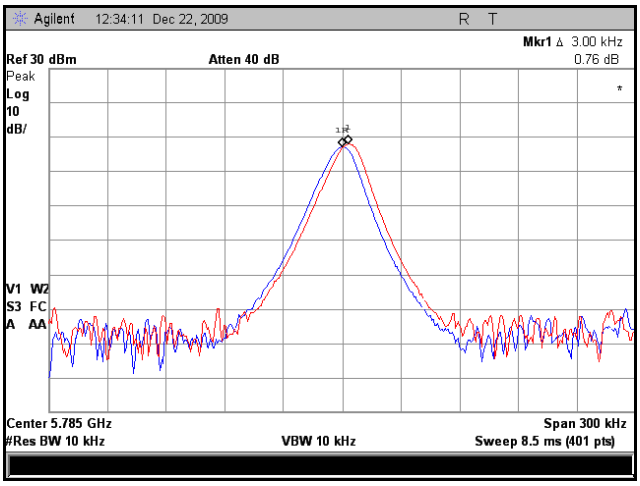
Plot 71. Frequency Stability, -20°C, M25 Radio



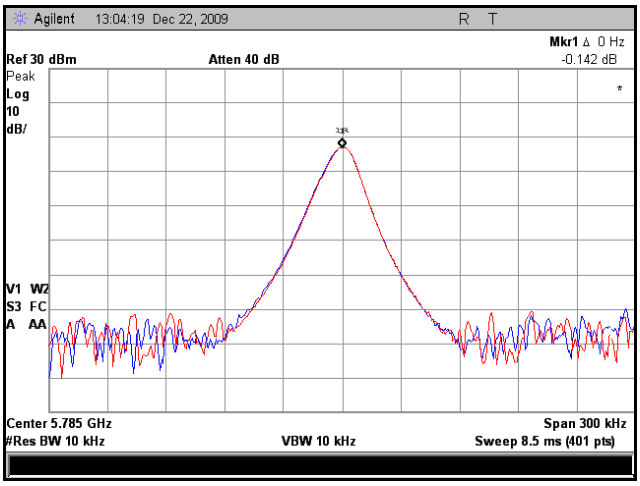
Plot 72. Frequency Stability, -10°C, M25 Radio



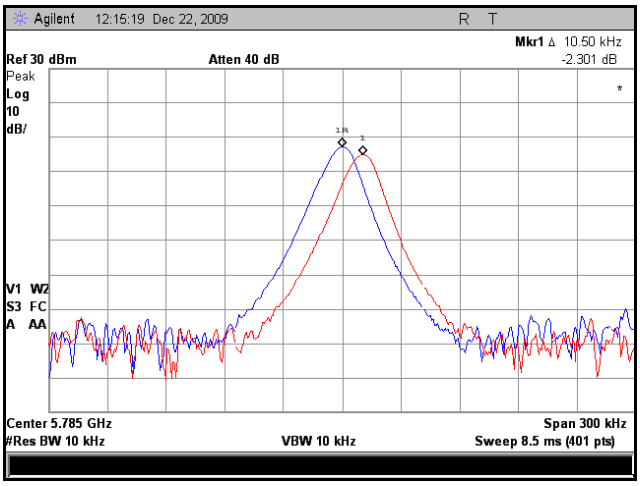
Plot 73. Frequency Stability, 0°C, M25 Radio



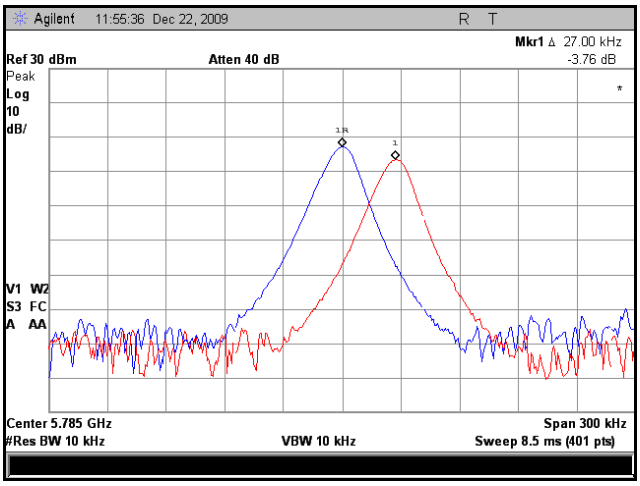
Plot 74. Frequency Stability, 10°C, M25 Radio



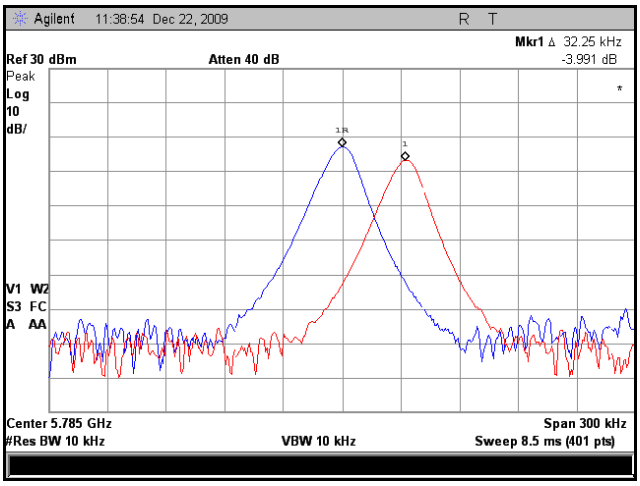
Plot 75. Frequency Stability, 30°C, M25 Radio



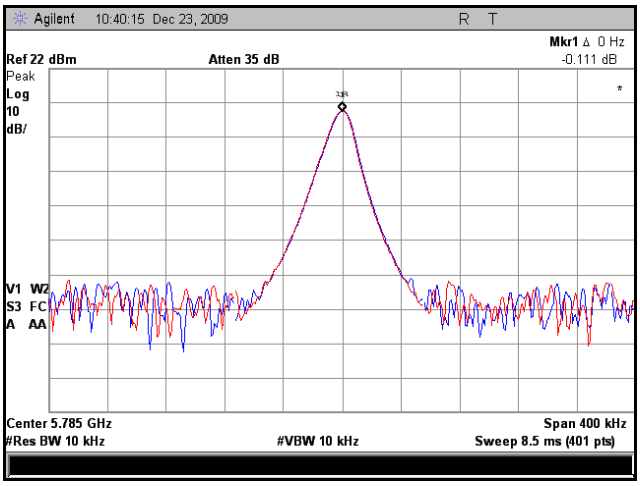
Plot 76. Frequency Stability, 40°C, M25 Radio



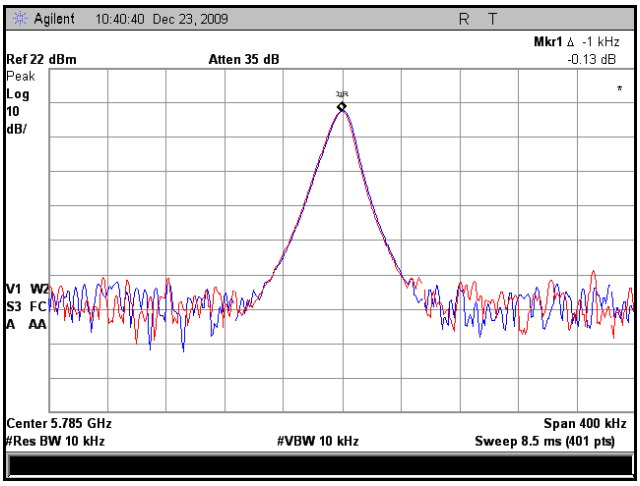
Plot 77. Frequency Stability, 50°C, M25 Radio



Plot 78. Frequency Stability, 55°C, M25 Radio



Plot 79. Frequency Stability, 102 VAC, M25 Radio



Plot 80. Frequency Stability, 138 VAC, M25 Radio

Frequency Stability Test Photograph

Photograph 6. Frequency Stability, Test Setup, M25 Radio

Electromagnetic Compatibility Criteria for Intentional Radiators

RSS-GEN Receiver Spurious – M25

Test Requirement: If the device has a detachable antenna of known antenna impedance, then the antenna conducted method is permitted in lieu of a radiated measurement.

If a conducted measurement is made, no spurious output signals appearing at the antenna terminals shall exceed 2 nanowatts per any 4 kHz spurious frequency in the band 30 – 1000 MHz, or 5 nanowatts above 1 GHz.

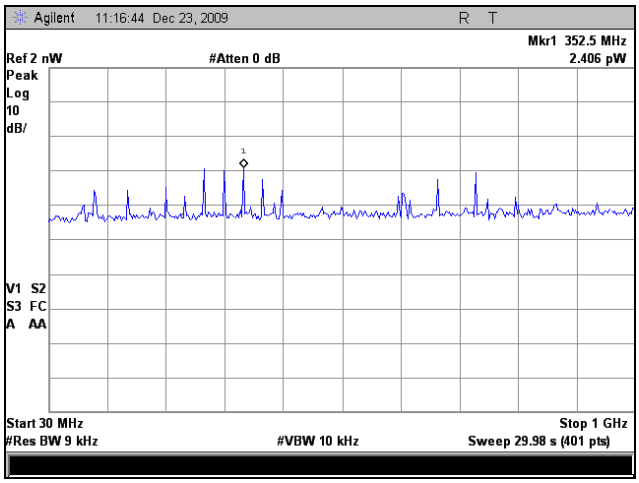
Test Procedure: The EUT was directly connected to a spectrum analyzer. Testing was performed when the EUT was receiving on channel 5300 MHz and 5600 MHz.

Results: The EUT as tested is compliant with the requirements of RSS-GEN.

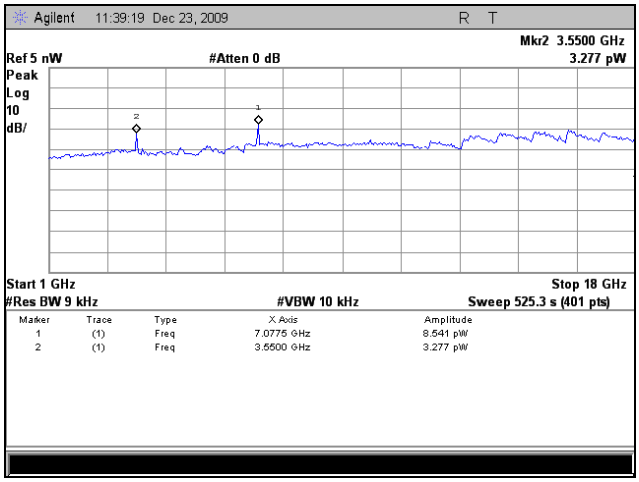
Test Engineer(s): Dusmantha Tennakoon

Test Date(s): 12/23/09

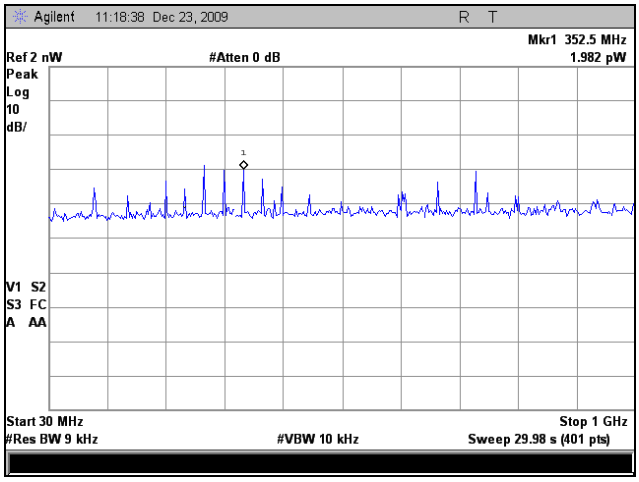
Receiver Spurious Emissions Test Results



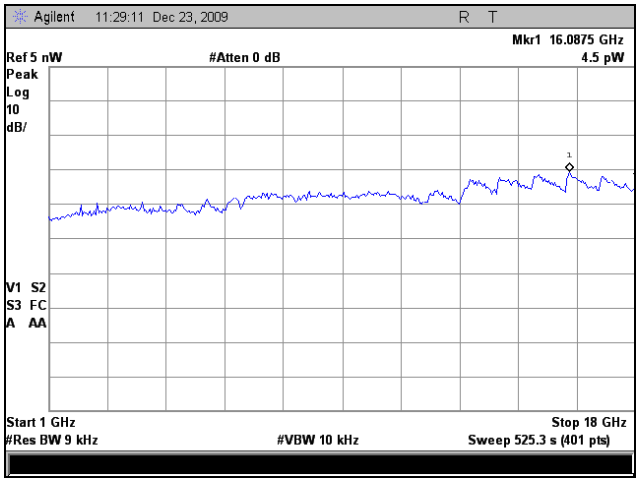
Plot 81. Receiver Spurious Emission, 30 MHz – 1 GHz, Channel 5300, M25 Radio



Plot 82. Receiver Spurious Emission, 1 GHz – 18 GHz, Channel 5300, M25 Radio

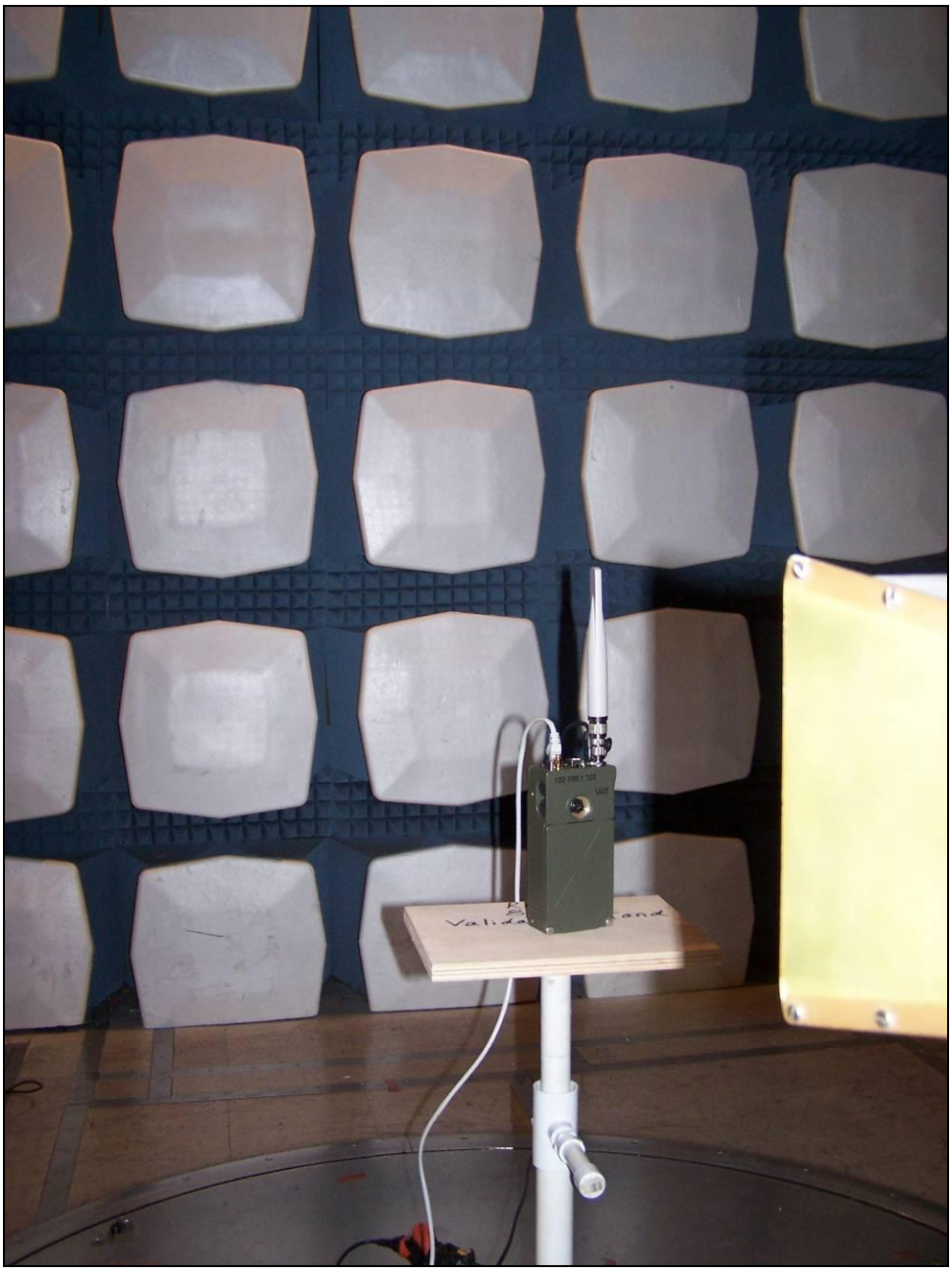


Plot 83. Receiver Spurious Emission, 30 MHz – 1 GHz, Channel 5600, M25 Radio



Plot 84. Receiver Spurious Emission, 1 GHz – 18 GHz, Channel 5600, M25 Radio

Receiver Spurious Emissions Test Setup Photograph



Photograph 7. Receiver Spurious Emissions, Test Setup, M25 Radio

IV. Electromagnetic Compatibility Criteria for Intentional Radiators – M5

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement – M5

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 unit is professionally installed. Therefore, the EUT as tested is compliant with the criteria of §15.203.

Frequency	Gain/Model	Manufacturer
5 GHz	9 dBi / EC09-5500	Mobile Mark Communications

Test Engineer(s): Dusmantha Tennakoon

Test Date(s): 12/04/09

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207 Conducted Emissions Limits – M5

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

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

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

Test Procedure: The EUT was placed on a non-metallic table, 80 cm above the ground plane 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.

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

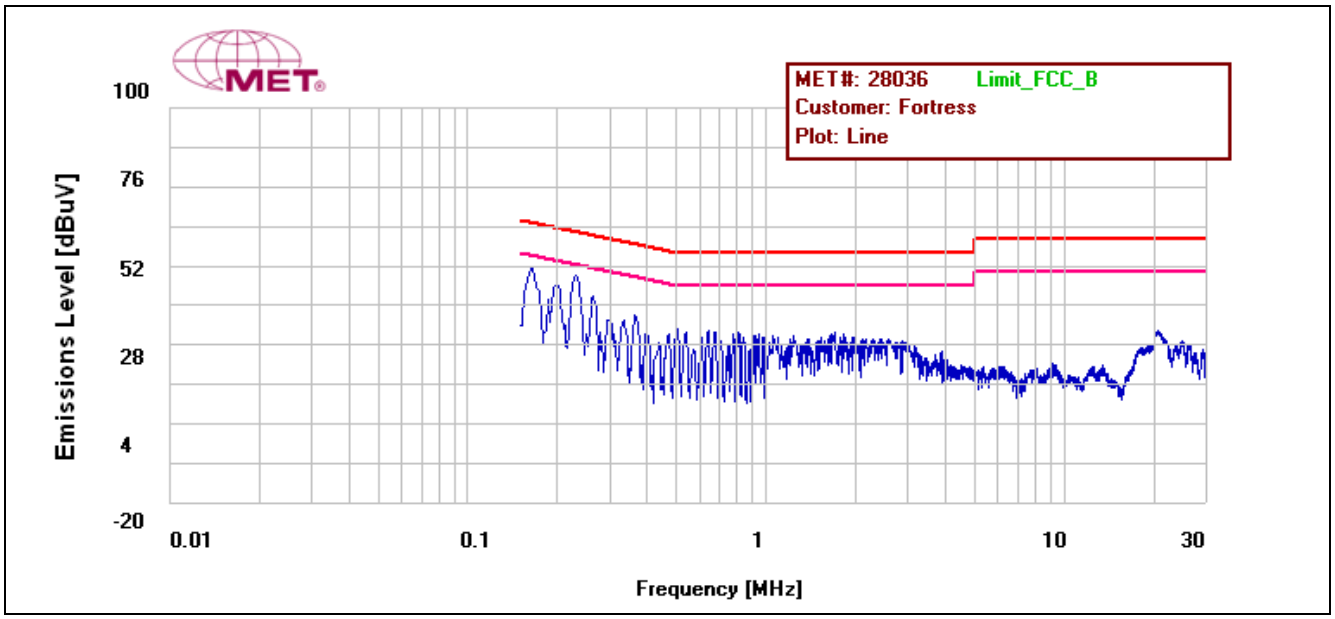
Test Engineer(s): Anderson Soungpanya

Test Date(s): 11/24/09

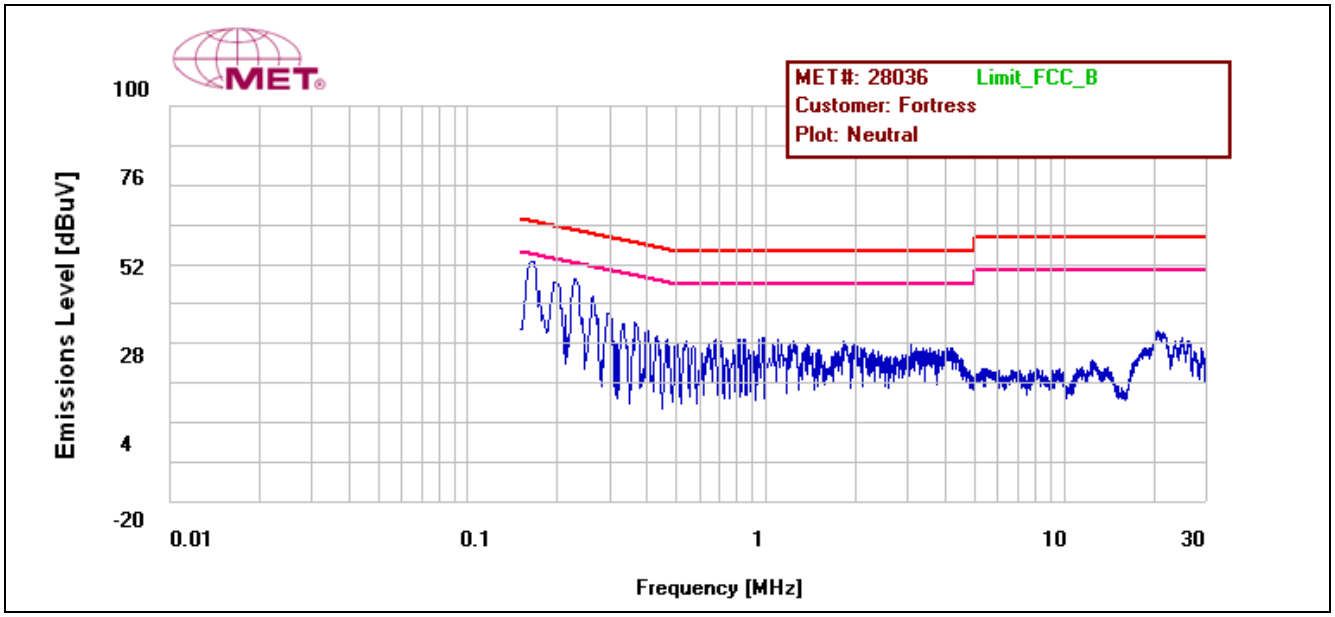
Conducted Emissions - Voltage, AC Power

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Line	0.169	50.65	65.012	-14.37	Pass	42.36	55.01	-12.65	Pass
Line	0.204	48.02	63.453	-15.44	Pass	43.13	53.45	-10.32	Pass
Line	2.24	35.33	56	-20.67	Pass	22.21	46.00	-23.78	Pass
Neutral	0.17	51.64	64.963	-13.33	Pass	42.05	54.96	-12.91	Pass
Neutral	0.203	47.03	63.494	-16.47	Pass	40.44	53.49	-13.05	Pass
Neutral	2.24	36.82	56	-19.18	Pass	29.15	46.00	-16.84	Pass

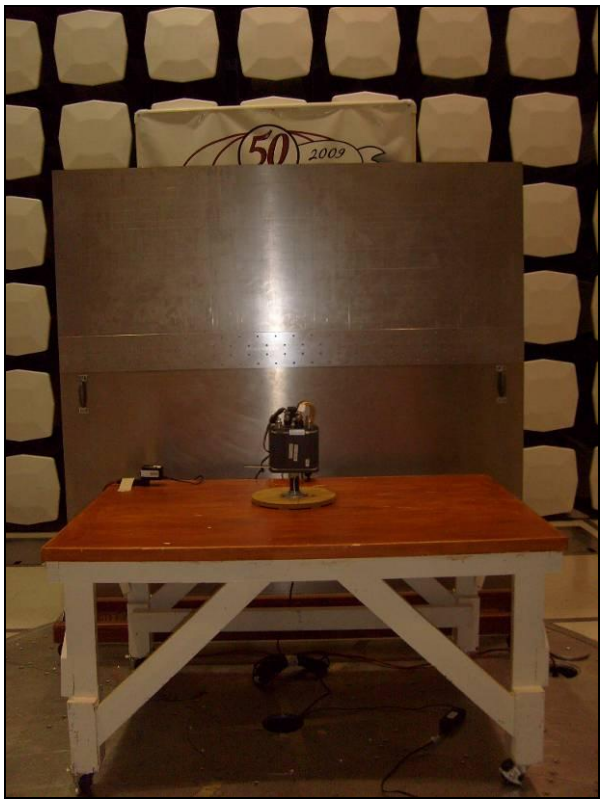
Table 16. Conducted Emissions - Voltage, AC Power, Test Results, M5 Radio



Plot 85. Conducted Emission, Phase Line Plot, M5 Radio



Plot 86. Conducted Emission, Neutral Line Plot, M5 Radio



Photograph 8. Conducted Emissions, Test Setup, M5 Radio

Photograph 9. Conducted Emissions, Test Setup, Side View, M5 Radio

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15. 403(c) 26dB Bandwidth – M5

Test Requirements: **§ 15.403 (i):** For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. Determination of the emissions bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolution bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.

Test Procedure: The transmitter was set to low, mid and high operating frequencies at the highest output power and connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately equal to 1% of the total emission bandwidth, VBW > RBW. The 26 dB Bandwidth was measured and recorded.

Test Results The 26 dB Bandwidth was compliant with the requirements of this section and was determined from the plots on the following pages.

Frequency (MHz)	99% Bandwidth (MHz)	26 dB Bandwidth (MHz)
5260	16.8493	23.551
5300	16.8413	23.776
5320	16.7958	24.612
5500	16.9020	25.539
5600	16.8465	25.011
5700	16.8059	26.511

Table 17. Occupied Bandwidth, Test Results, M5 Radio

Test Engineer(s): Dusmantha Tennakoon

Test Date(s): 12/04/09

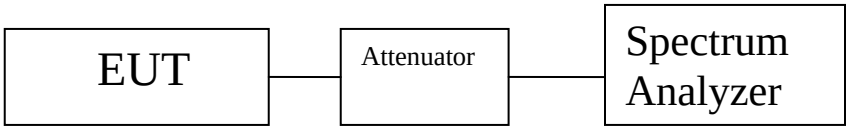
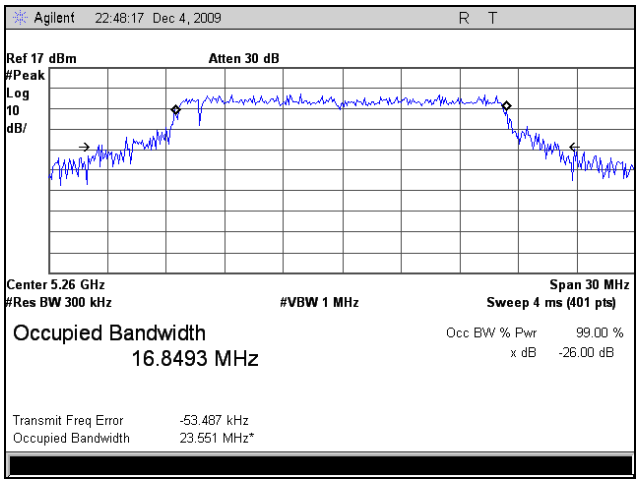
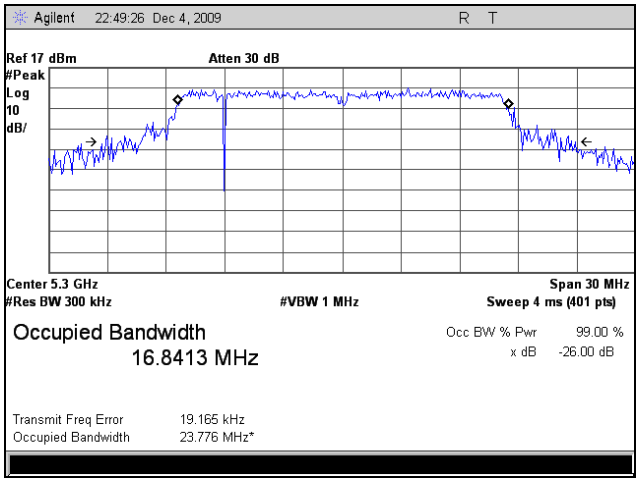


Figure 5. Occupied Bandwidth, Test Setup

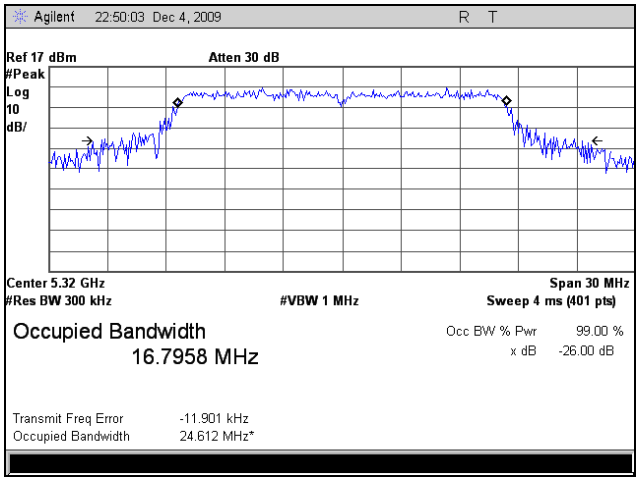
Occupied Bandwidth Test Results



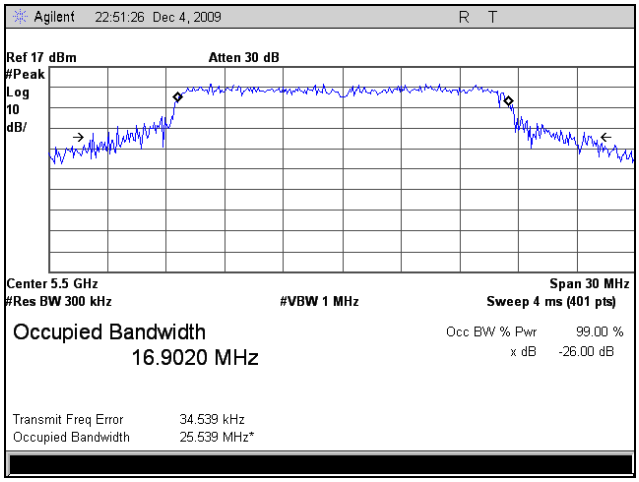
Plot 87. Occupied Bandwidth, 5260 MHz, M5 Radio



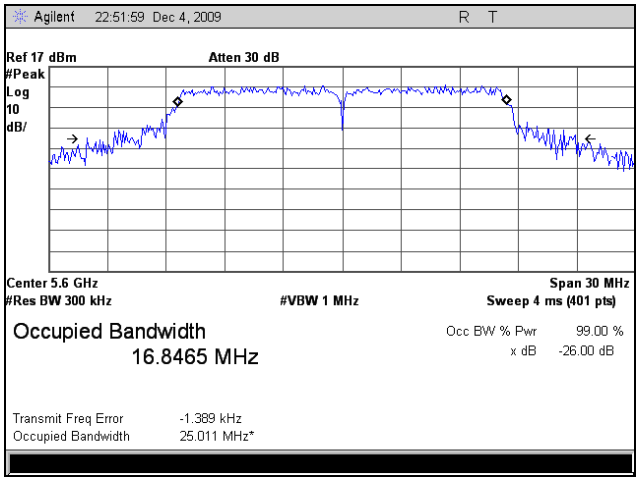
Plot 88. Occupied Bandwidth, 5300 MHz, M5 Radio



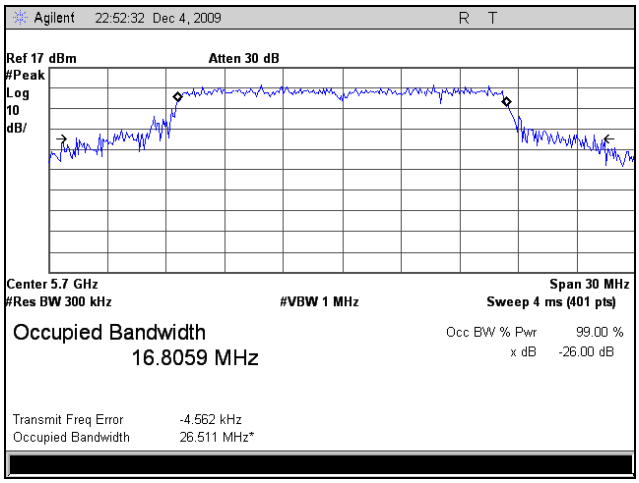
Plot 89. Occupied Bandwidth, 5320 MHz, M5 Radio



Plot 90. Occupied Bandwidth, 5500 MHz, M5 Radio



Plot 91. Occupied Bandwidth, 5600 MHz, M5 Radio



Plot 92. Occupied Bandwidth, 5700 MHz, M5 Radio

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15. 407(a)(2) RF Power Output – M5

Test Requirements: **§15.407(a) (2):** The maximum output power of the intentional radiator shall not exceed the following:

Digital Transmission Systems (MHz)	Output Limit
5150-5250	50mW
5250-5350	250mW
5470–5725	250mW
5725–5825	1W

Table 18. Output Power Requirements from §15.407

§15.407(a) (2): For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10log B, where B is the 26 dB emission bandwidth in megahertz.

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

Test Results: Equipment was compliant with the Peak Power Output limits of **§ 15.407(a)(2)**.

Test Engineer(s): Dusmantha Tennakoon

Test Date(s): 12/04/09

Frequency (MHz)	Conducted Power (dBm)	Conducted Power (mW)	Limit (W)
5260	13.55	22.64	250mW
5300	16.69	46.66	250mW
5320	15.75	37.58	250mW
5500	16.39	43.55	250mW
5600	16.30	42.65	250mW
5700	17.14	51.76	250mW

Table 19. RF Power Output, Test Results, M5 Radio

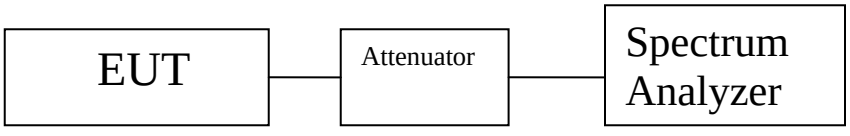
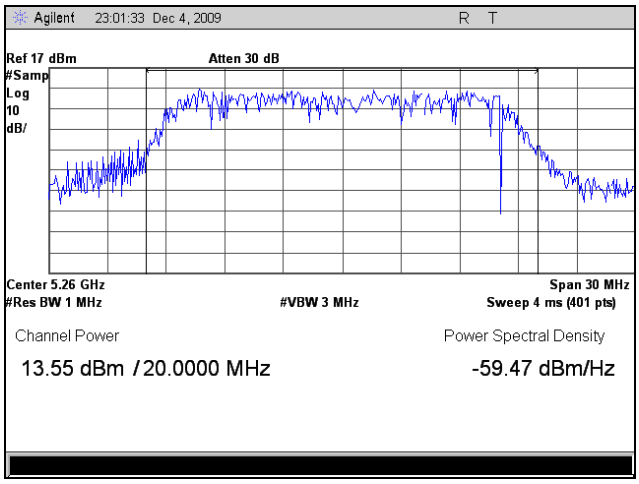
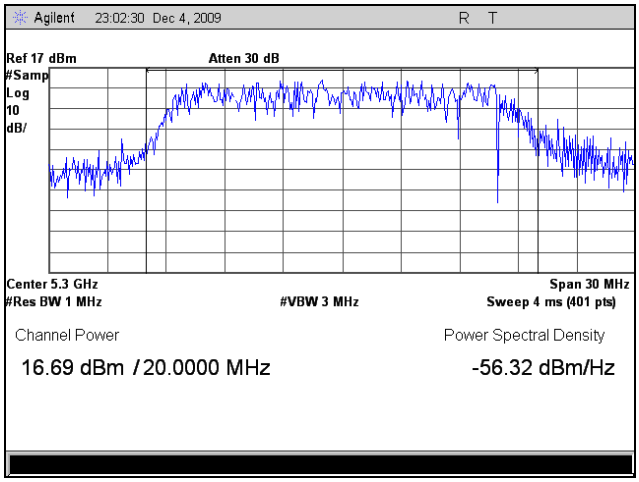


Figure 6. Power Output Test Setup

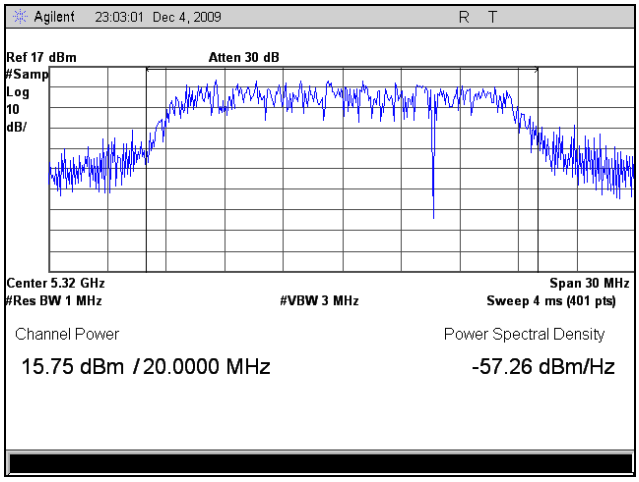
RF Output Power Test Results



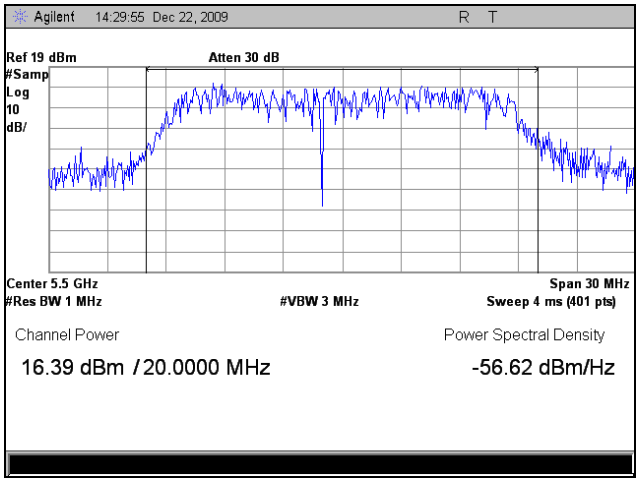
Plot 93. RF Power Output, 5260 MHz, M5 Radio



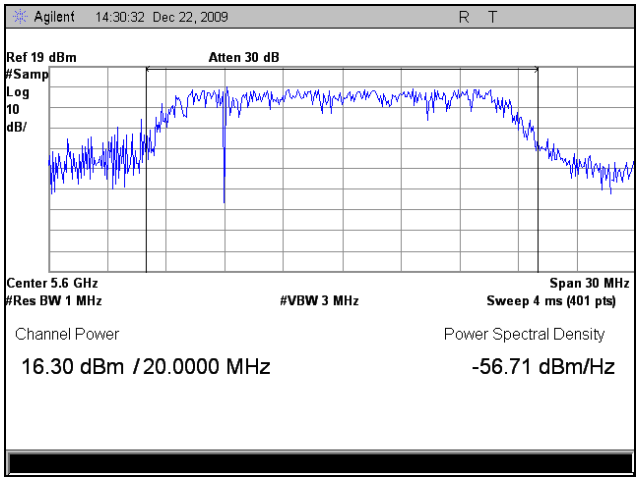
Plot 94. RF Power Output, 5300 MHz, M5 Radio



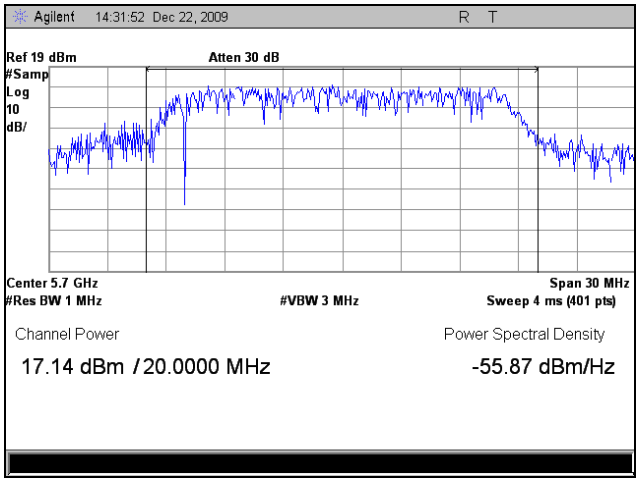
Plot 95. RF Power Output, 5320 MHz, M5 Radio



Plot 96. RF Power Output, 5500 MHz, M5 Radio



Plot 97. RF Power Output, 5600 MHz, M5 Radio



Plot 98. RF Power Output, 5700 MHz, M5 Radio

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(a)(2) Peak Power Spectral Density – M5

Test Requirements: **§ 15.407(a)(2):** In addition, the peak power spectral density shall not exceed 11 dBm in any 1 megahertz band.

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: Equipment was compliant with the peak power spectral density limits of **§ 15.407 (a)(2).** The peak power spectral density was determined from plots on the following page(s).

Test Engineer(s): Dusmantha Tennakoon

Test Date(s): 12/04/09

Frequency (MHz)	PSD (dBm)
5260	2.896
5300	5.811
5320	5.039
5500	7.706
5600	6.822
5700	7.444

Table 20. Power Spectral Density, Test Results, M5 Radio

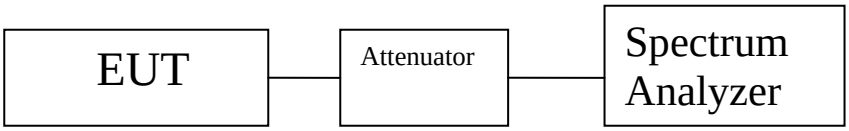
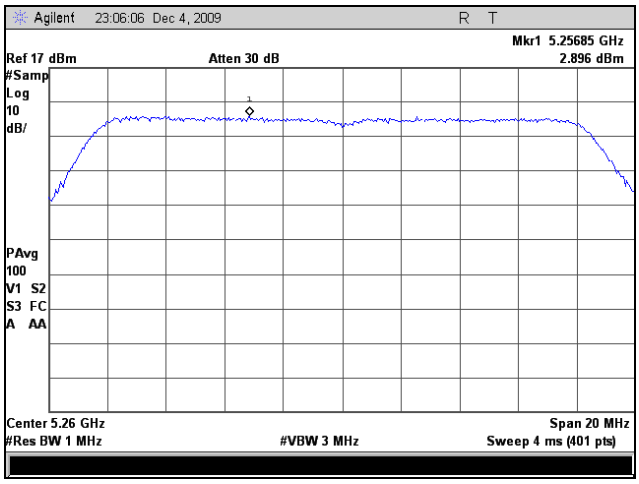
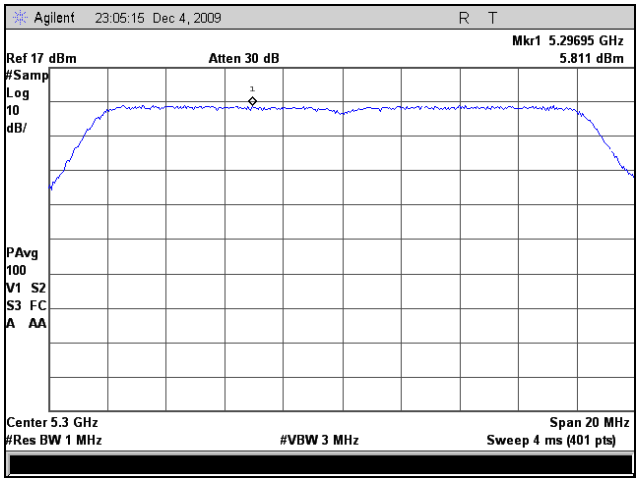


Figure 7. Power Spectral Density Test Setup

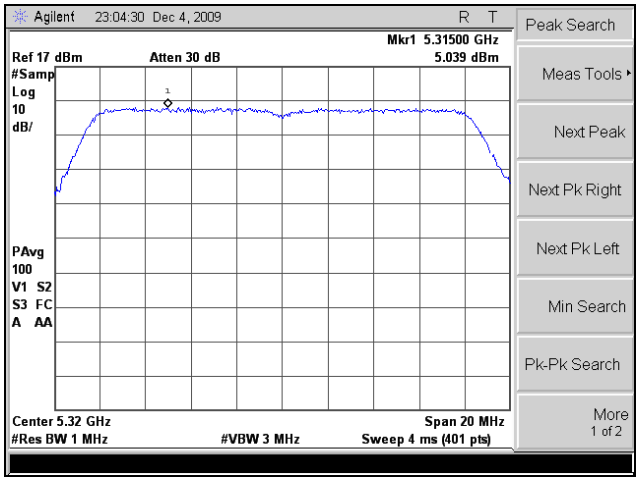
Power Spectral Density Test Results



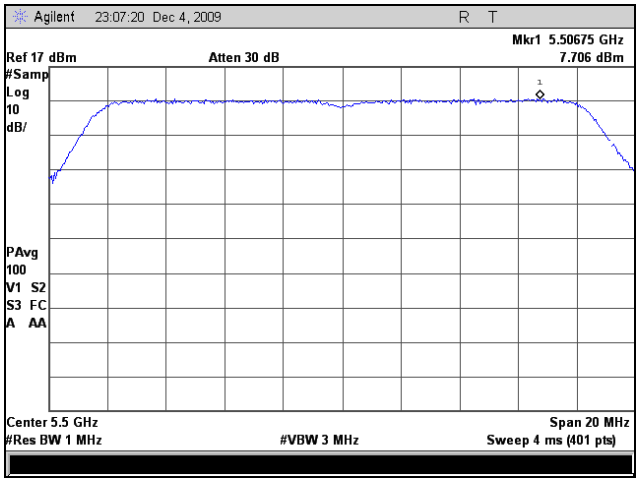
Plot 99. Power Spectral Density, 5260 MHz, M5 Radio



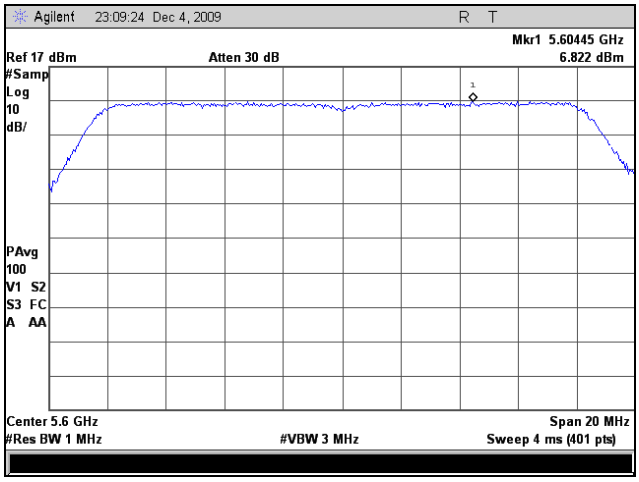
Plot 100. Power Spectral Density, 5300 MHz, M5 Radio



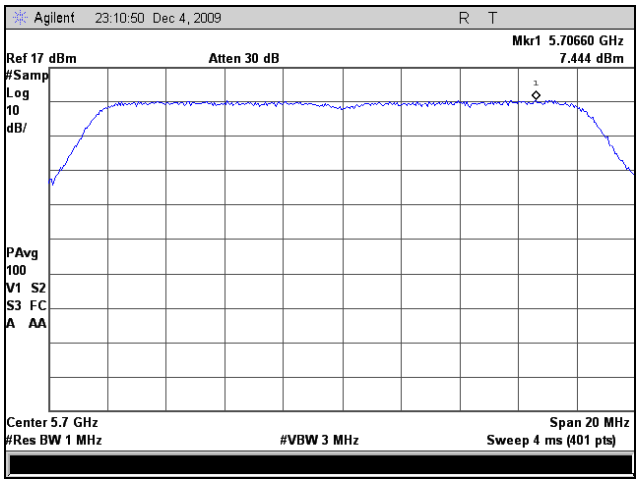
Plot 101. Power Spectral Density, 5320 MHz, M5 Radio



Plot 102. Power Spectral Density, 5500 MHz, M5 Radio



Plot 103. Power Spectral Density, 5600 MHz, M5 Radio



Plot 104. Power Spectral Density, 5700 MHz, M5 Radio

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(a)(6) Peak Excursion Ratio – M5

Test Requirements: **§ 15.407(a)(6):** 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 cabling and attenuation. The 1st trace on the spectrum analyzer was set to RBW=1MHz, VBW=3MHz. The peak detector mode was used and the trace max held. The 2nd trace on the spectrum analyzer was set according to measurement method #1 from the FCC Public Notice DA 02-2138 for making conducted power measurements.

Test Results: Equipment was compliant with the peak excursion ratio limits of **§ 15.407(a)(6).** The peak excursion ratio was determined from plots on the following page(s).

Test Engineer(s): Dusmantha Tennakoon

Test Date(s): 12/04/09

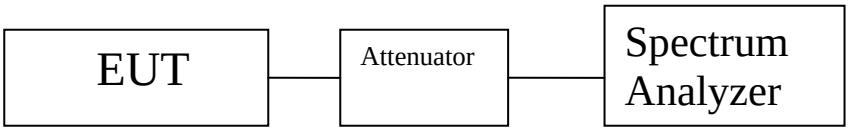
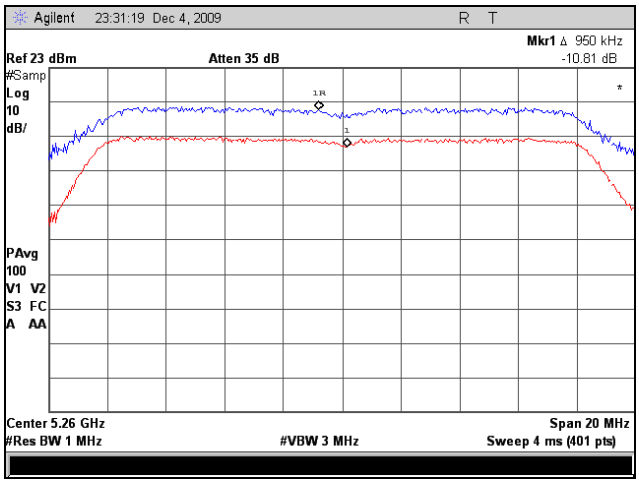
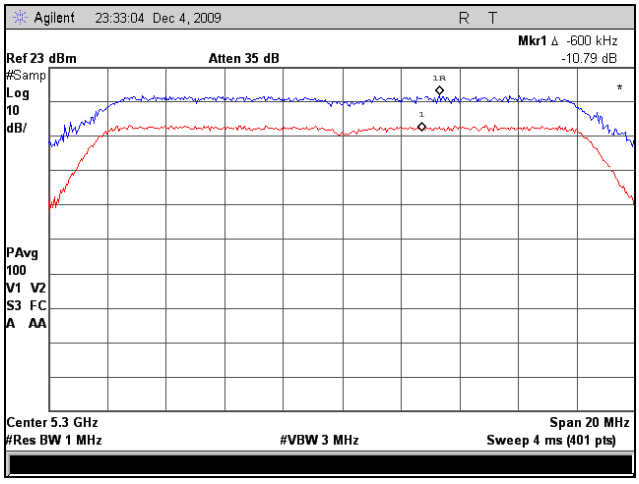


Figure 8. Peak Excursion Ration Test Setup

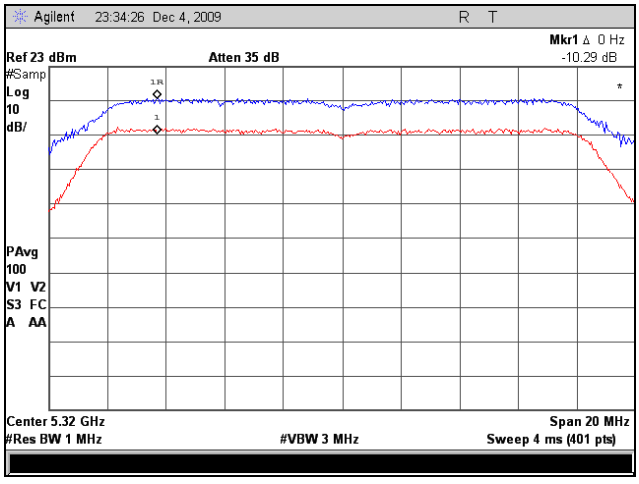
Peak Excursion Test Results



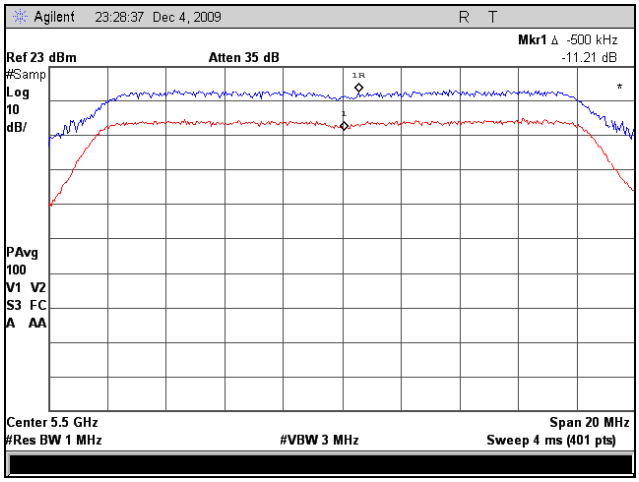
Plot 105. Peak Excursion Ratio, 5260 MHz, M5 Radio



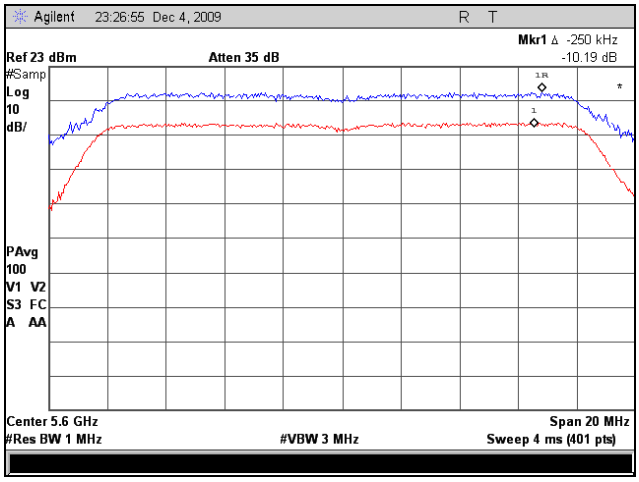
Plot 106. Peak Excursion Ratio, 5300 MHz, M5 Radio



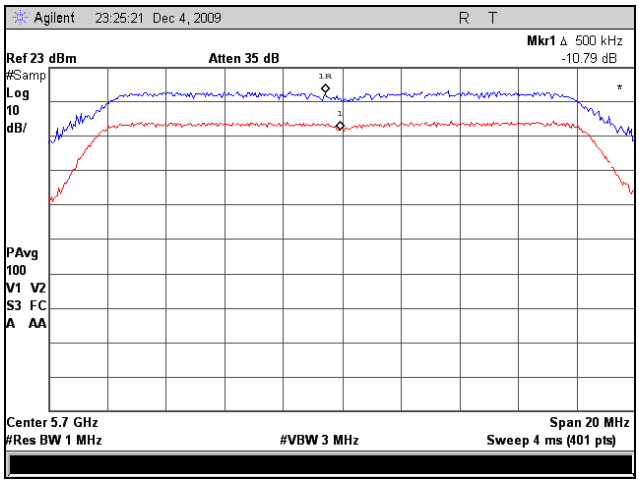
Plot 107. Peak Excursion Ratio, 5320 MHz, M5 Radio



Plot 108. Peak Excursion Ratio, 5500 MHz, M5 Radio



Plot 109. Peak Excursion Ratio, 5600 MHz, M5 Radio



Plot 110. Peak Excursion Ratio, 5700 MHz, M5 Radio

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(b) Undesirable Emissions – M5

Test Requirements: **§ 15.407(b)(2), (b)(3), (b)(7):** Emissions outside the frequency band.

§ 15.407(b)(2): For transmitters operating in the 5.25–5.35 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of –27 dBm/MHz. Devices operating in the 5.25–5.35 GHz band that generate emissions in the 5.15–5.25 GHz band must meet all applicable technical requirements for operation in the 5.15–5.25 GHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of –27 dBm/MHz in the 5.15–5.25 GHz band.

§ 15.407(b)(3): For transmitters operating in the 5.47–5.725 GHz band: all emissions outside of the 5.47–5.725 GHz band shall not exceed an EIRP of −27 dBm/MHz.

§ 15.407(b)(7): The provisions of Section 15.205 of this part apply to intentional radiators operating under this section.

Test Procedure: The transmitter was placed on a stand inside in a semi-anechoic chamber. Measurements were performed with the EUT rotated 360 degrees and varying the adjustable antenna mast height to determine worst case orientation for maximum emissions.

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

For measurements above 1 GHz, measurements were made with a Peak detector with 1 MHz resolution bandwidth. Where the spurious emissions fell into a restricted band, measurements were also made with an average detector to make sure they complied with 15.209 limits. Emissions were explored up to 40 GHz.
The equation, **EIRP= E + 20 log D – 104.8** was used to convert an EIRP limit to a field strength limit.
E = field strength (dBUv/m)
D = Reference measurement distance

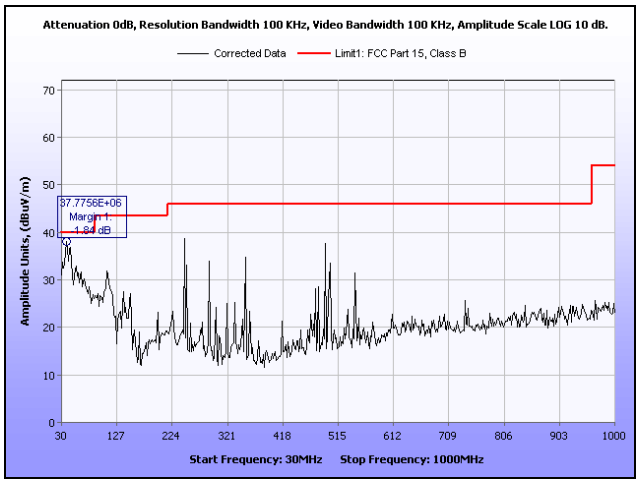
Test Results: The EUT was compliant with the Radiated Emission limits for Intentional Radiators. See following pages for detailed test results.

Note: Plot 113, Plot 114, Plot 120, Plot 121, Plot 129, Plot 130, Plot 137, Plot 138, Plot 146, Plot 147, Plot 155, and Plot 156 have been corrected to 3m.

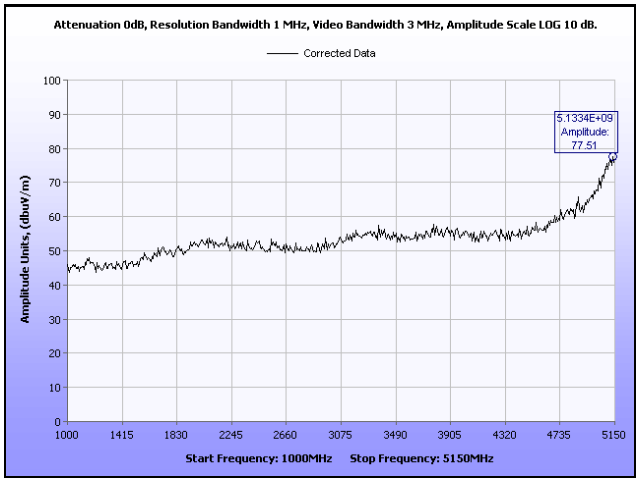
Test Engineer(s): Dusmantha Tennakoon

Test Date(s): 12/29/09

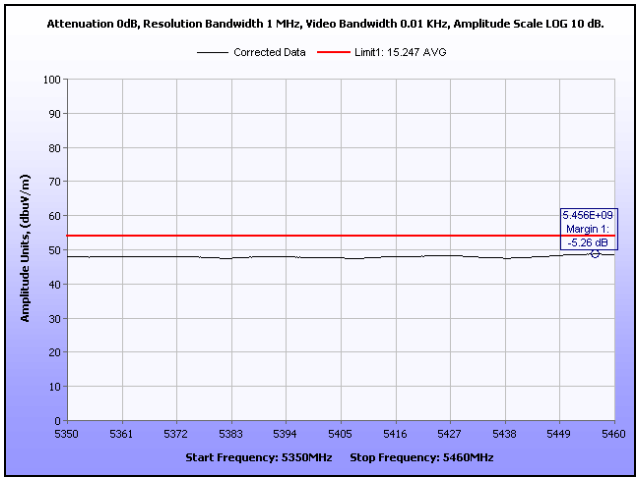
Radiated Spurious Emissions Test Results



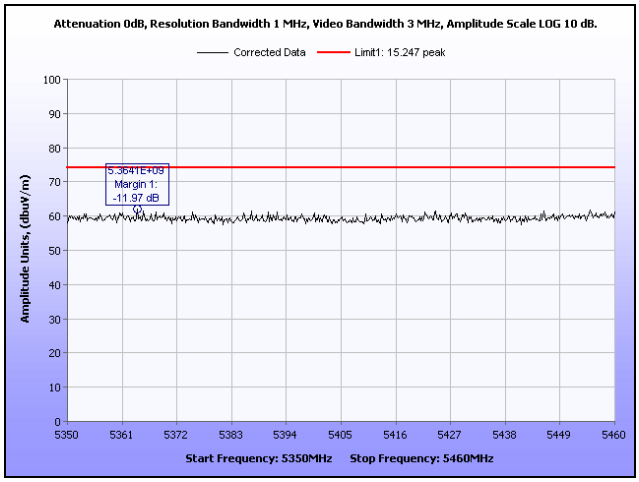
Plot 111. Radiated Spurs, 30 MHz – 1 GHz, Channel 5260 MHz, M5 Radio



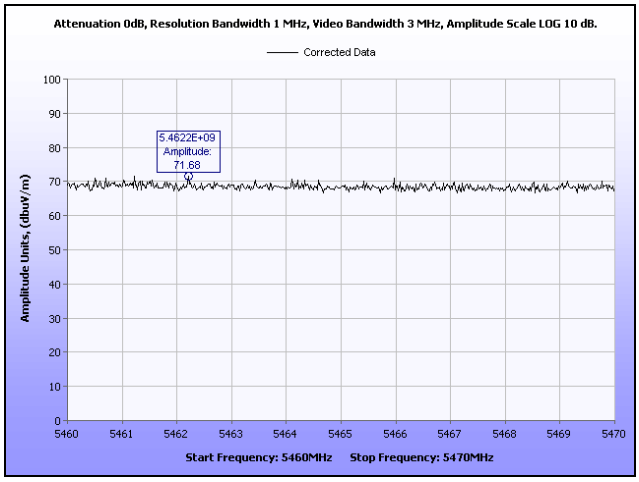
Plot 112. Radiated Spurs, 1 GHz – 5.15 GHz, Channel 5260 MHz, M5 Radio



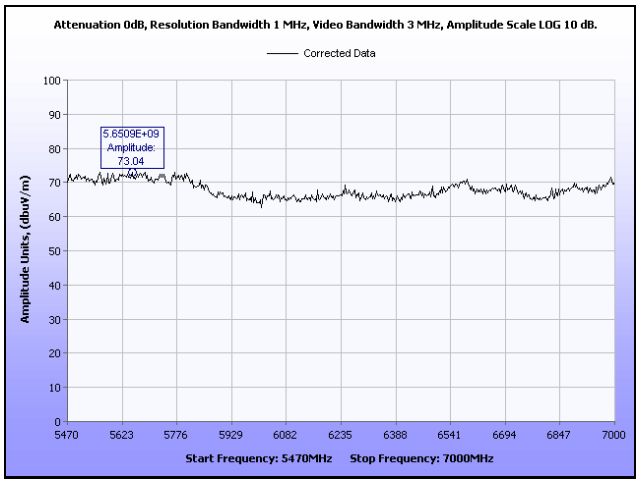
Plot 113. Radiated Spurs, 5.35 GHz – 5.46 MHz, Average, Channel 5260 MHz, M5 Radio



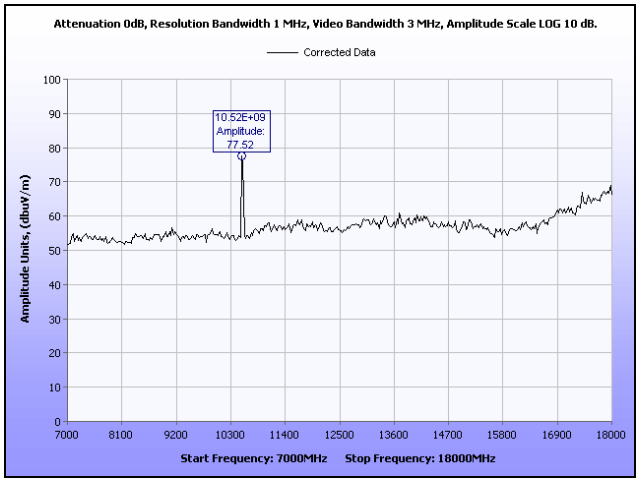
Plot 114. Radiated Spurs, 5.35 GHz – 5.46 MHz, Peak, Channel 5260 MHz, M5 Radio



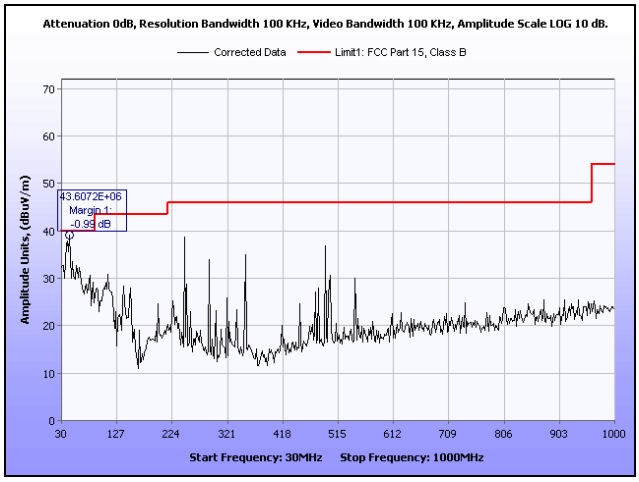
Plot 115. Radiated Spurs, 5.46 GHz – 5.47 MHz, Channel 5260 MHz, M5 Radio



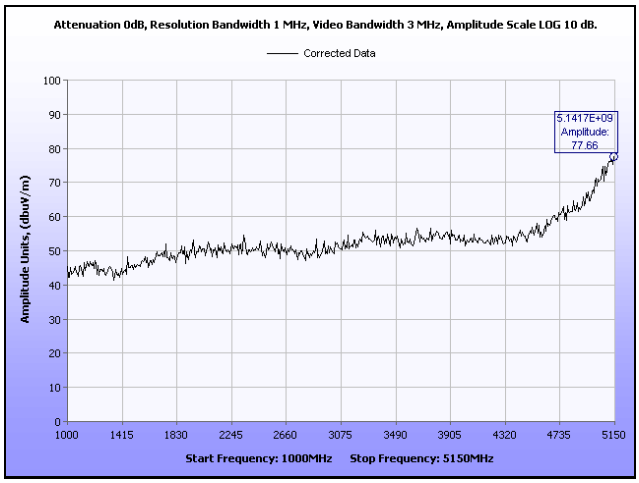
Plot 116. Radiated Spurs, 5.47 GHz – 7 MHz, Channel 5260 MHz, M5 Radio



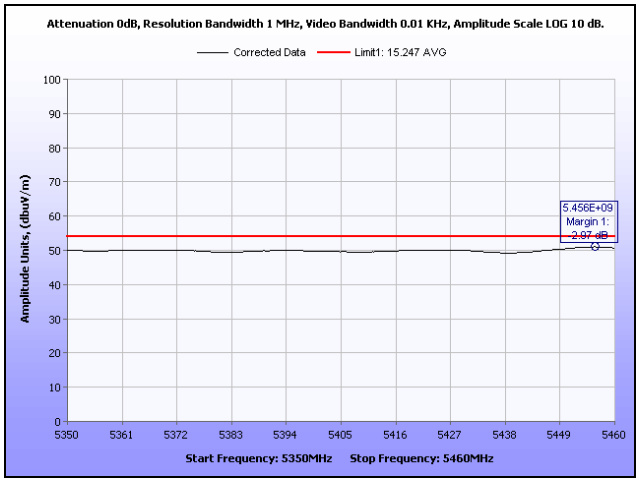
Plot 117. Radiated Spurs, 7 GHz – 18 MHz, Channel 5260 MHz, M5 Radio



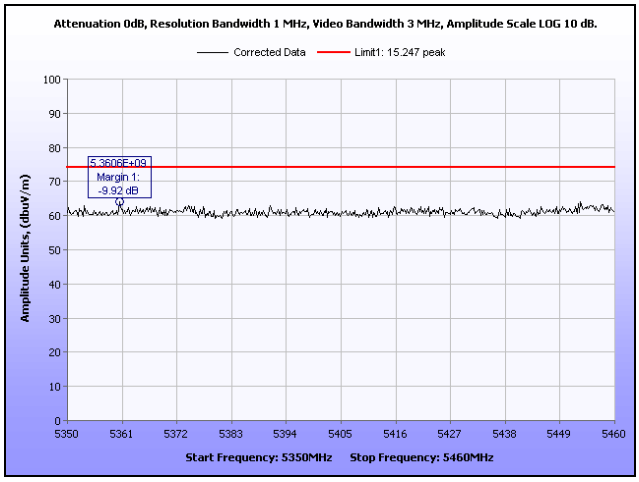
Plot 118. Radiated Spurs, 30 MHz – 1 GHz, Channel 5300 MHz, M5 Radio



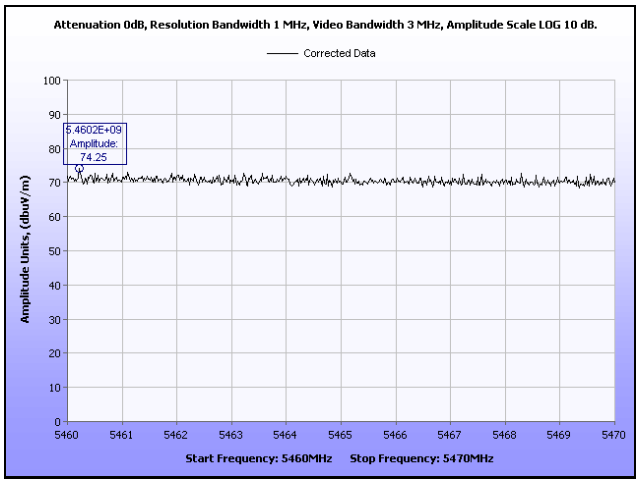
Plot 119. Radiated Spurs, 1 GHz – 5.15 GHz, Channel 5300 MHz, M5 Radio



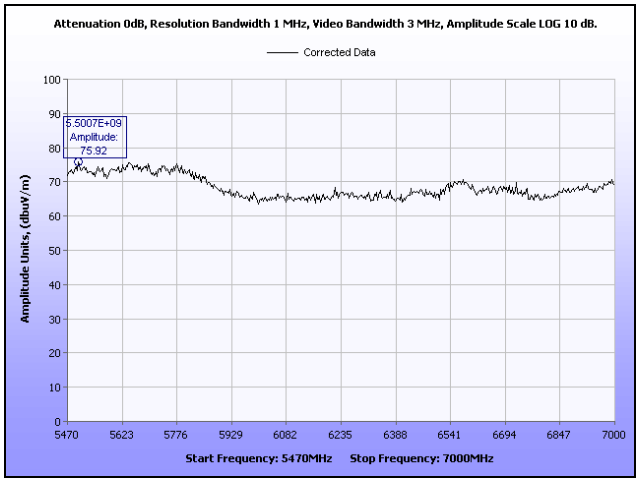
Plot 120. Radiated Spurs, 5.35 GHz – 5.46 GHz, Average, Channel 5300 MHz, M5 Radio



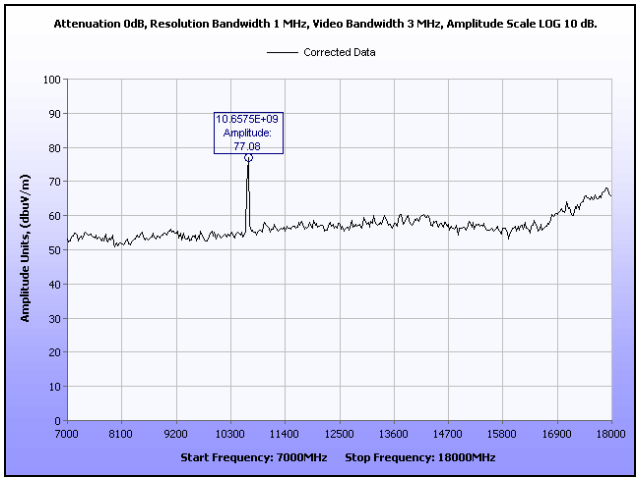
Plot 121. Radiated Spurs, 5.35 GHz – 5.46 GHz, Peak, Channel 5300 MHz, M5 Radio



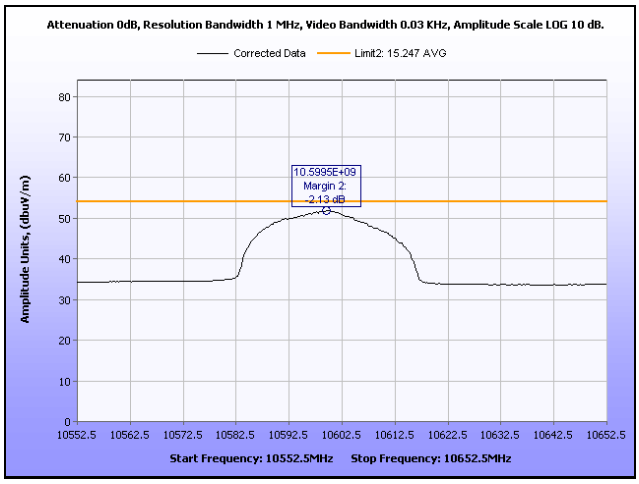
Plot 122. Radiated Spurs, 5.46 GHz – 5.47 GHz, Channel 5300 MHz, M5 Radio



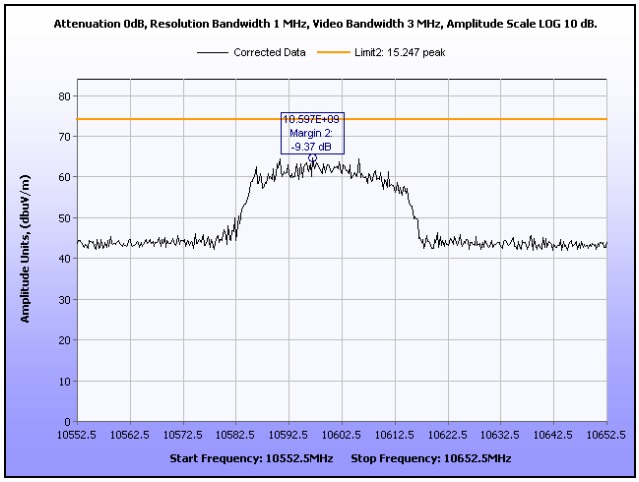
Plot 123. Radiated Spurs, 5.47 GHz – 7 GHz, Channel 5300 MHz, M5 Radio



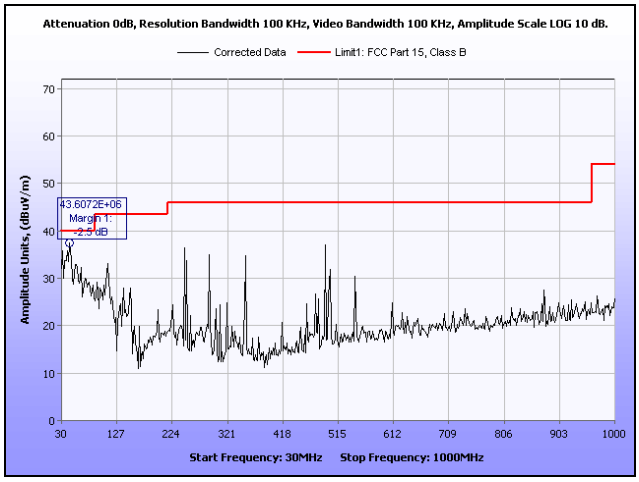
Plot 124. Radiated Spurs, 7 GHz – 18 GHz, Channel 5300 MHz, M5 Radio



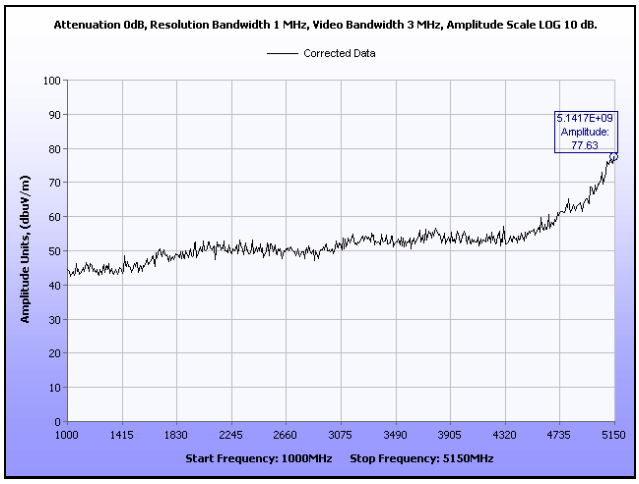
Plot 125. Radiated Spurs, Channel 5300 MHz, 2nd Harmonic, Average, M5 Radio



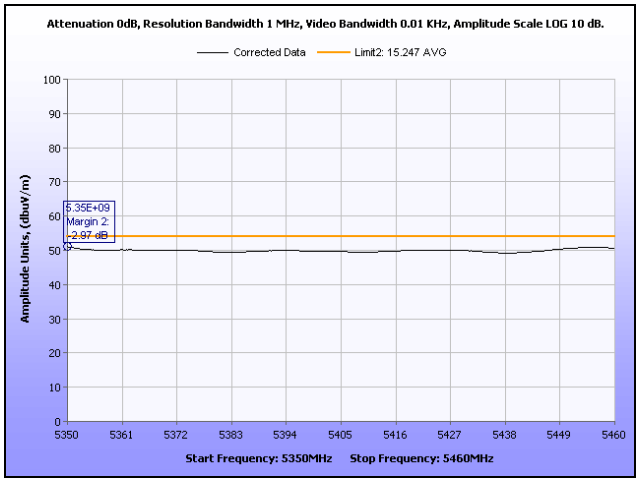
Plot 126. Radiated Spurs, Channel 5300 MHz, 2nd Harmonic, Peak, M5 Radio



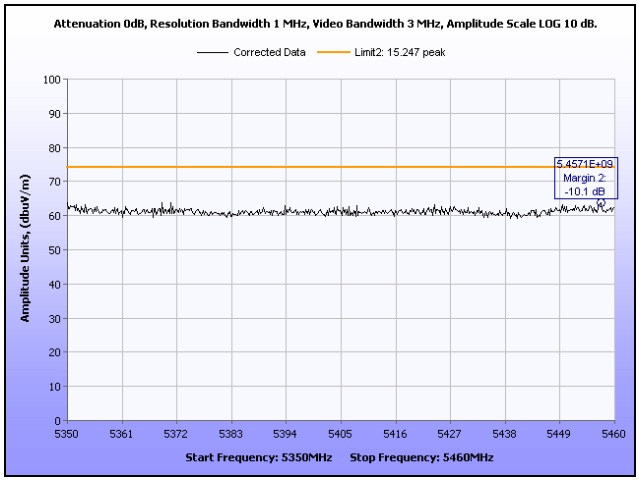
Plot 127. Radiated Spurs, 30 MHz – 1 GHz, Channel 5320 MHz, M5 Radio



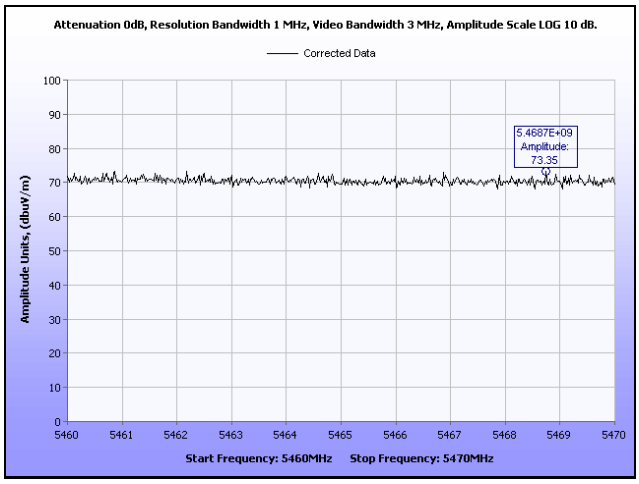
Plot 128. Radiated Spurs, 1 GHz – 5.15 GHz, Channel 5320 MHz, M5 Radio



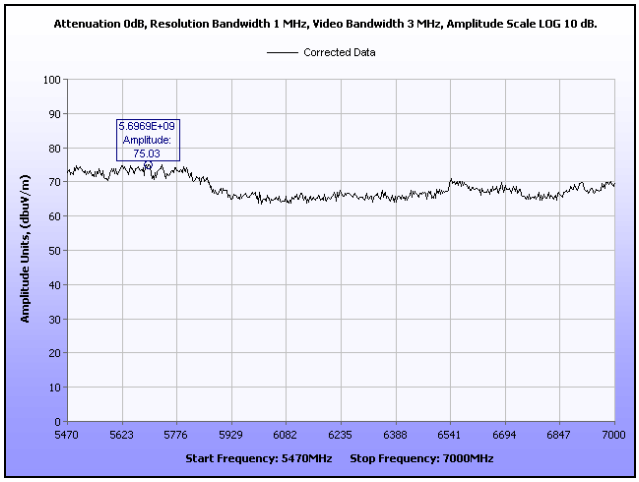
Plot 129. Radiated Spurs, 5.350 GHz – 5.46 MHz, Average, Channel 5320 MHz, M5 Radio



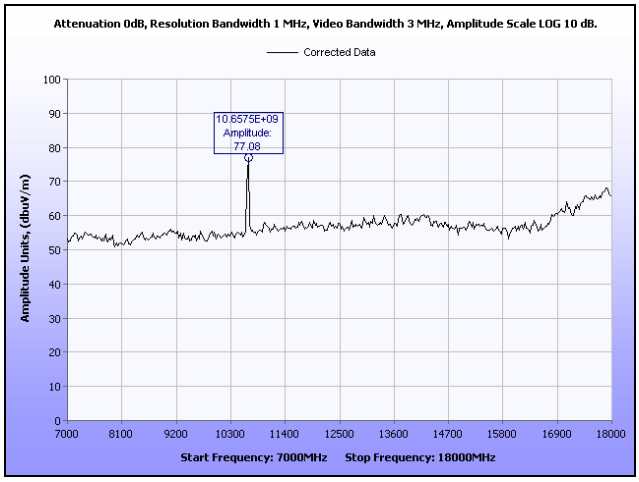
Plot 130. Radiated Spurs, 5.350 GHz – 5.46 MHz, Peak, Channel 5320 MHz, M5 Radio



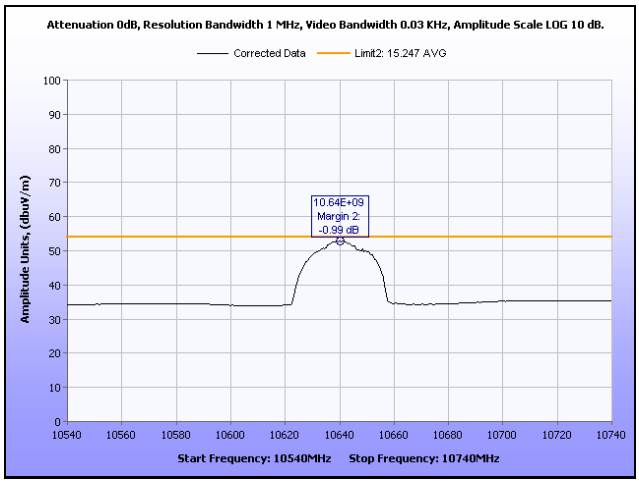
Plot 131. Radiated Spurs, 5.46 GHz – 5.47 GHz, Channel 5320 MHz, M5 Radio



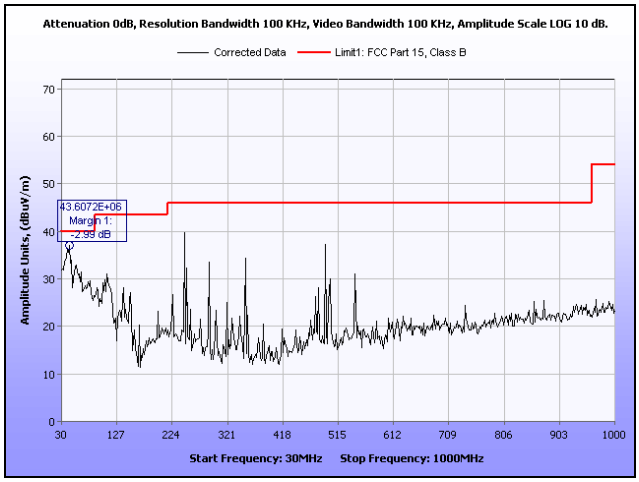
Plot 132. Radiated Spurs, 5.47 GHz – 7 GHz, Channel 5320 MHz, M5 Radio



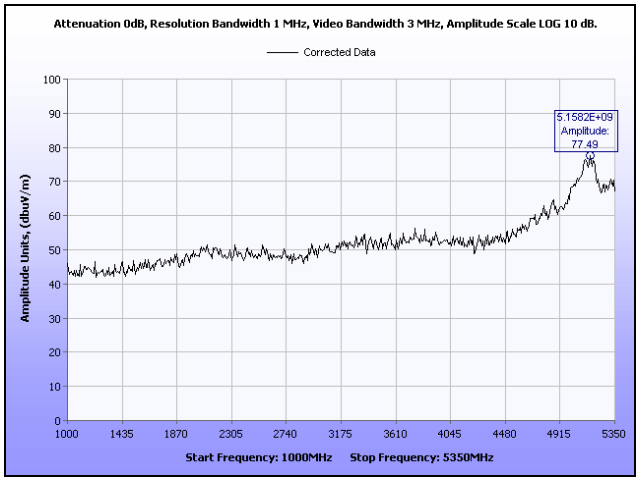
Plot 133. Radiated Spurs, 7 GHz – 18 GHz, Channel 5320 MHz, M5 Radio



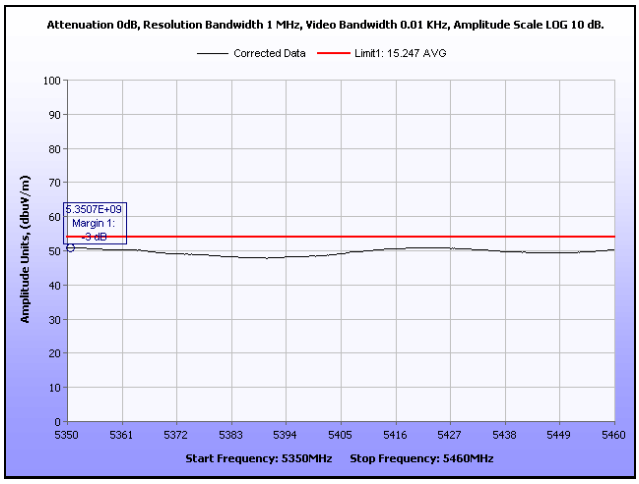
Plot 134. Radiated Spurs, Channel 5320 MHz, 2nd Harmonic, Average, M5 Radio



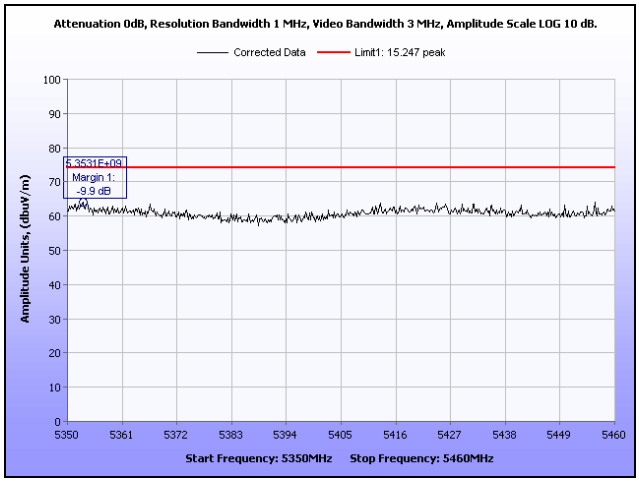
Plot 135. Radiated Spurs, 30 MHz – 1 GHz, Channel 5500 MHz, M5 Radio



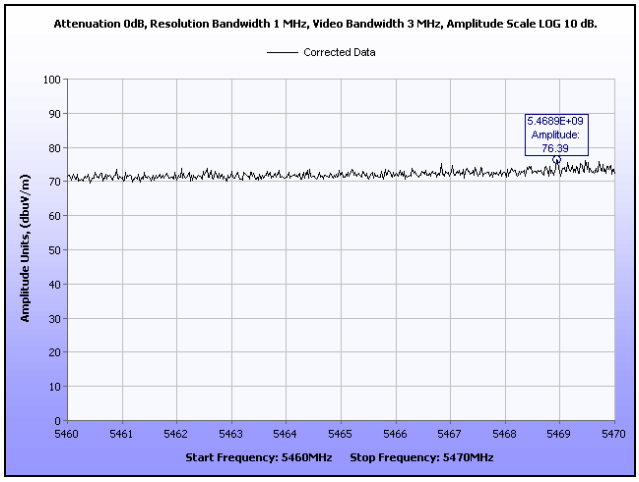
Plot 136. Radiated Spurs, 1 GHz – 5.35GHz, Channel 5500 MHz, M5 Radio



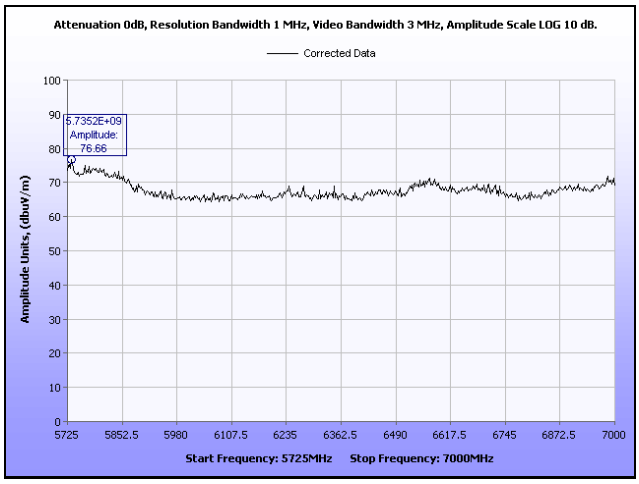
Plot 137. Radiated Spurs, 5.35 GHz – 5.46 GHz, Average, Channel 5500 MHz, M5 Radio



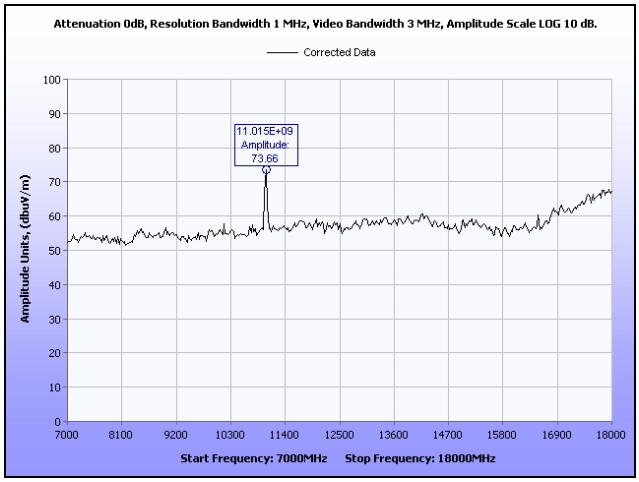
Plot 138. Radiated Spurs, 5.35 GHz – 5.46 GHz, Peak, Channel 5500 MHz, M5 Radio



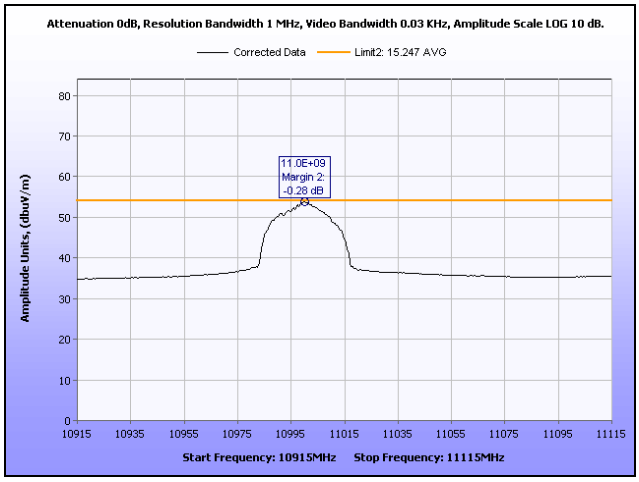
Plot 139. Radiated Spurs, 5.46 GHz – 5.47 GHz, Channel 5500 MHz, M5 Radio



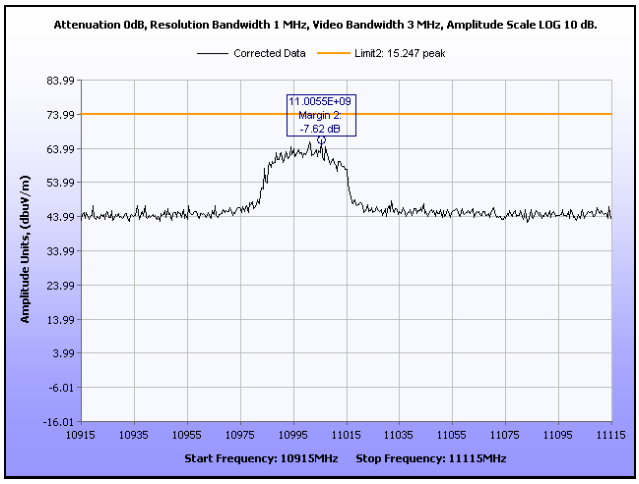
Plot 140. Radiated Spurs, 5.725 GHz – 7 GHz, Channel 5500 MHz, M5 Radio



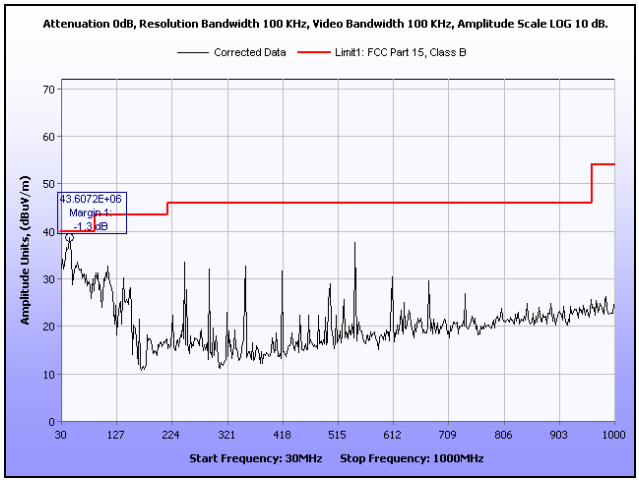
Plot 141. Radiated Spurs, 7 GHz – 18 GHz, Channel 5500 MHz, M5 Radio



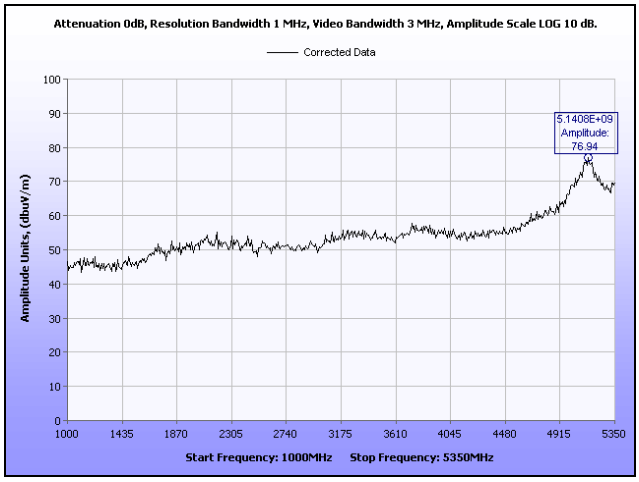
Plot 142. Radiated Spurs, Channel 5500 MHz, 2nd Harmonic, Average, M5 Radio



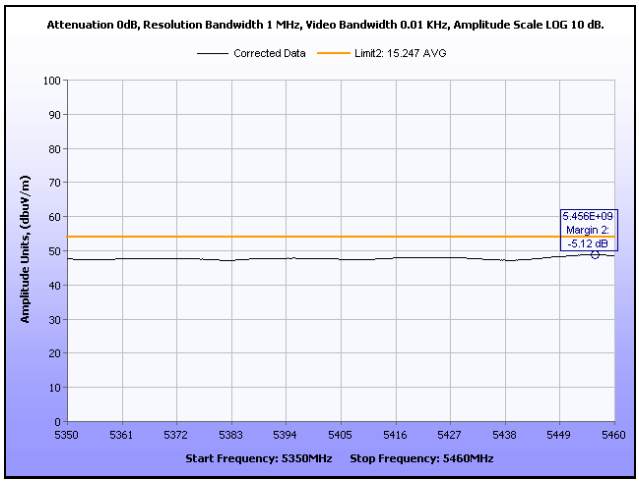
Plot 143. Radiated Spurs, Channel 5500 MHz, 2nd Harmonic, Peak, M5 Radio



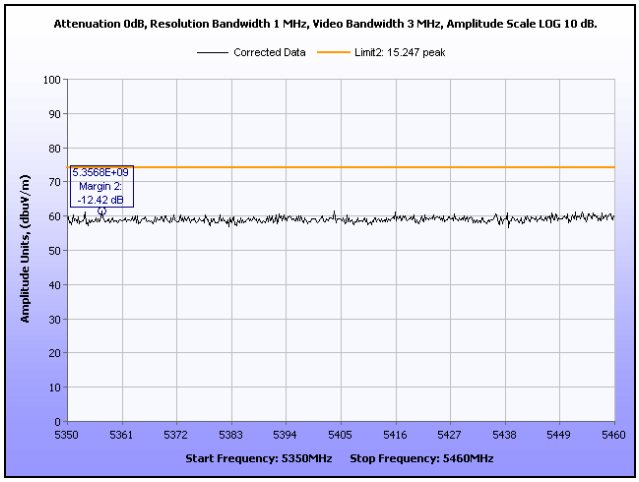
Plot 144. Radiated Spurs, 30 MHz – 1 GHz, Channel 5600 MHz, M5 Radio



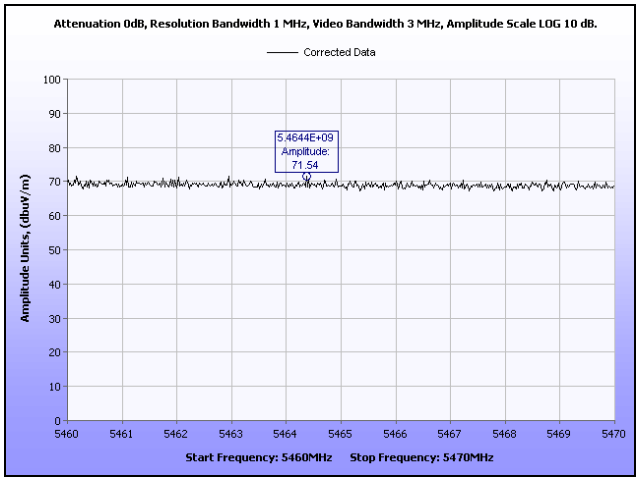
Plot 145. Radiated Spurs, 1 GHz – 5.35 GHz, Channel 5600 MHz, M5 Radio



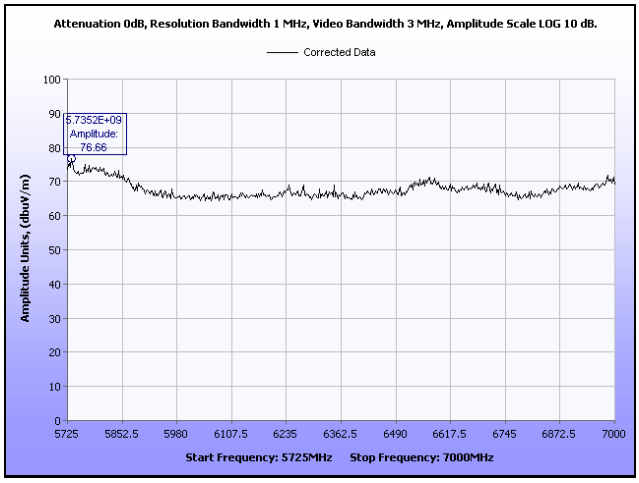
Plot 146. Radiated Spurs, 5.35 GHz – 5.46 GHz, Average, Channel 5600 MHz, M5 Radio



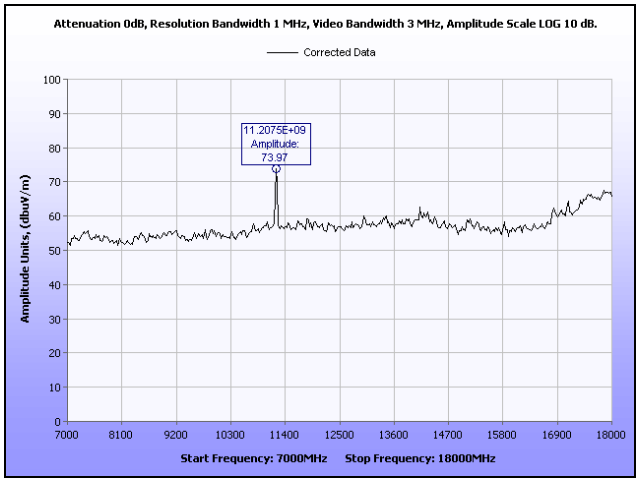
Plot 147. Radiated Spurs, 5.35 GHz – 5.46 GHz, Peak, Channel 5600 MHz, M5 Radio



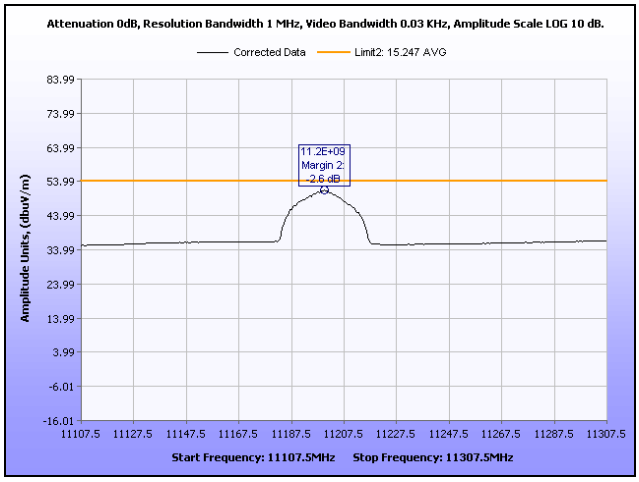
Plot 148. Radiated Spurs, 5.46 GHz – 5.47 GHz, Channel 5600 MHz, M5 Radio



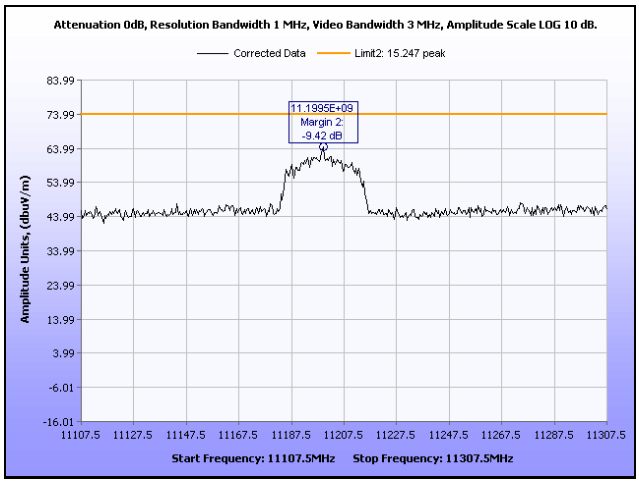
Plot 149. Radiated Spurs, 5.725 GHz – 7 GHz, Channel 5600 MHz, M5 Radio



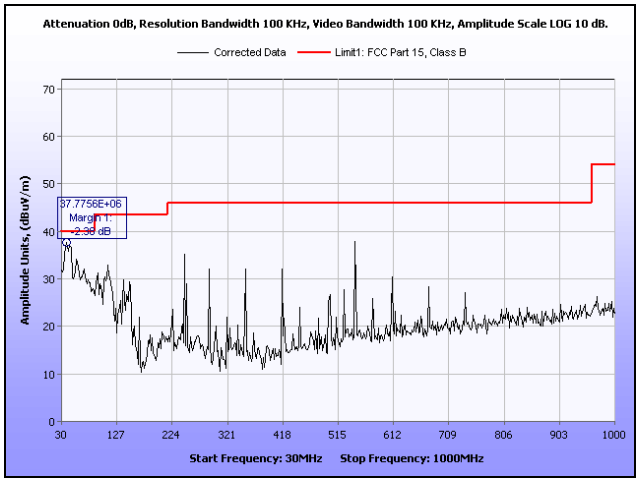
Plot 150. Radiated Spurs, 7 GHz – 18 GHz, Channel 5600 MHz, M5 Radio



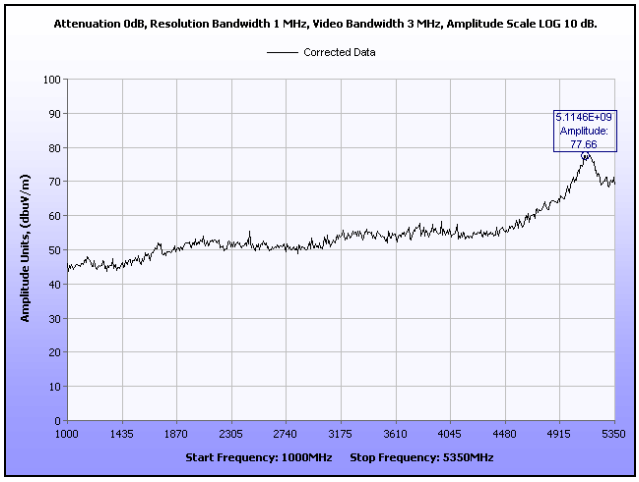
Plot 151. Radiated Spurs, Channel 5600 MHz, 2nd Harmonic, Average, M5 Radio



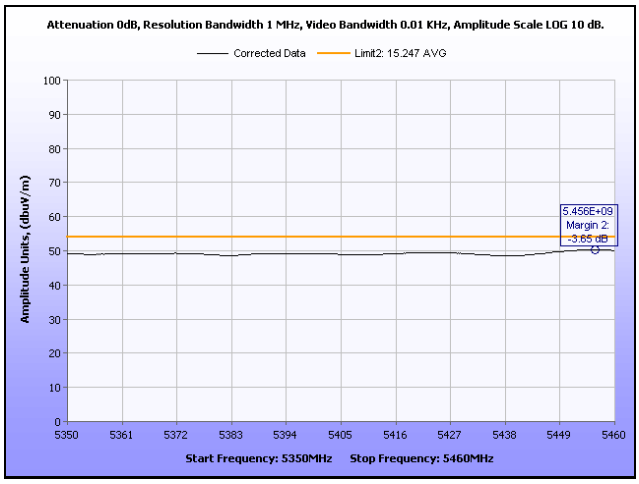
Plot 152. Radiated Spurs, Channel 5600 MHz, 2nd Harmonic, Peak, M5 Radio



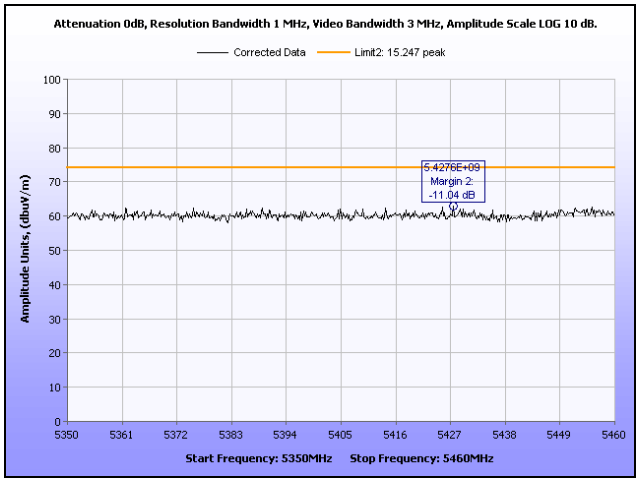
Plot 153. Radiated Spurs, 30 MHz – 1 GHz, Channel 5700 MHz, M5 Radio



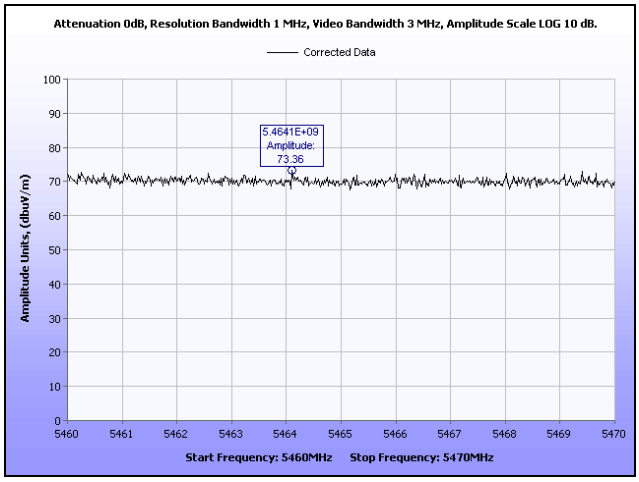
Plot 154. Radiated Spurs, 1 GHz – 5.35 GHz, Channel 5700 MHz, M5 Radio



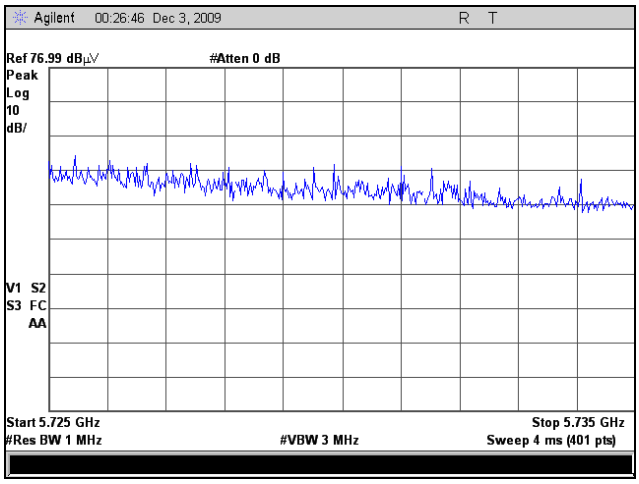
Plot 155. Radiated Spurs, 5.35 GHz – 5.46 GHz, Average, Channel 5700 MHz, M5 Radio



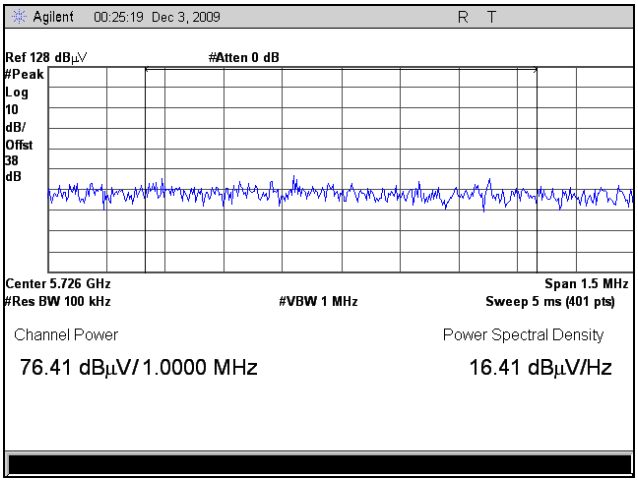
Plot 156. Radiated Spurs, 5.35 GHz – 5.46 GHz, Peak, Channel 5700 MHz, M5 Radio



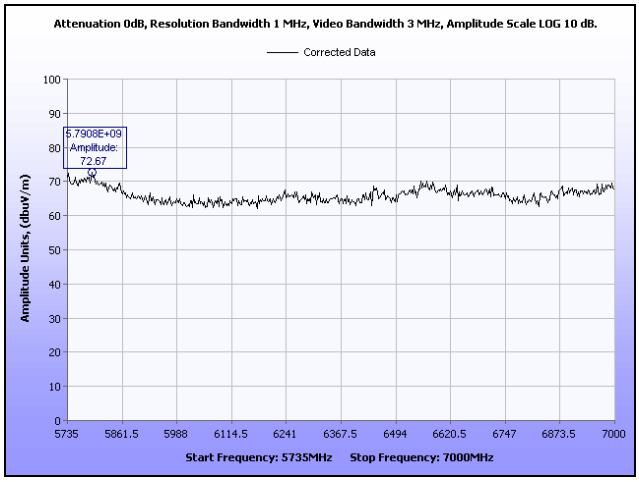
Plot 157. Radiated Spurs, 5.46 GHz – 5.47 GHz, Channel 5700 MHz, M5 Radio



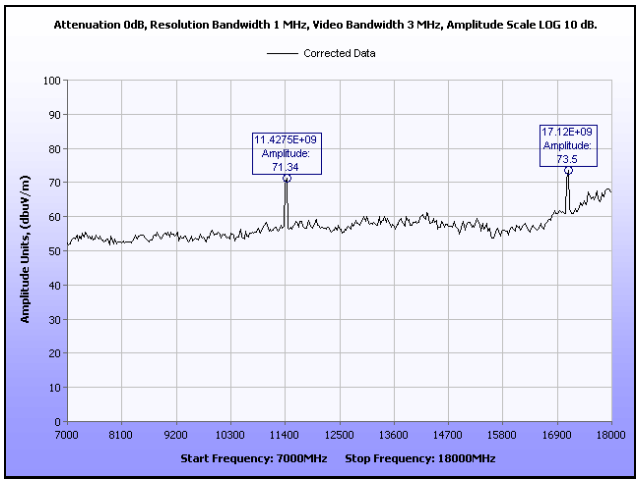
Plot 158. Radiated Spurs, 5.725 GHz – 5.735 GHz, Peak Determination, Channel 5700 MHz, M5 Radio



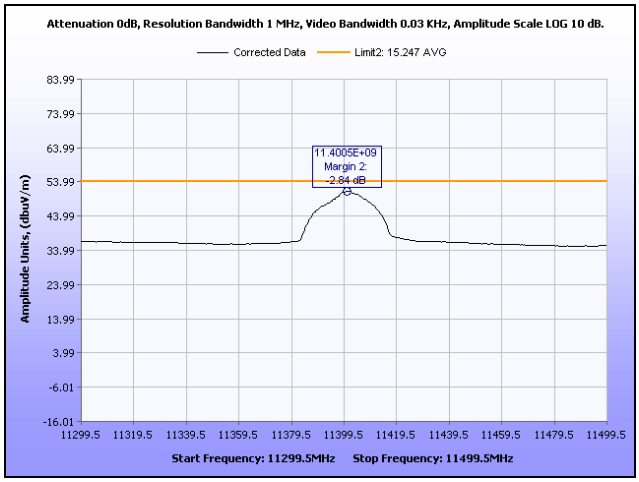
Plot 159. Radiated Spurs, 5.725 GHz – 5.735 GHz, Integration, Channel 5700 MHz, M5 Radio



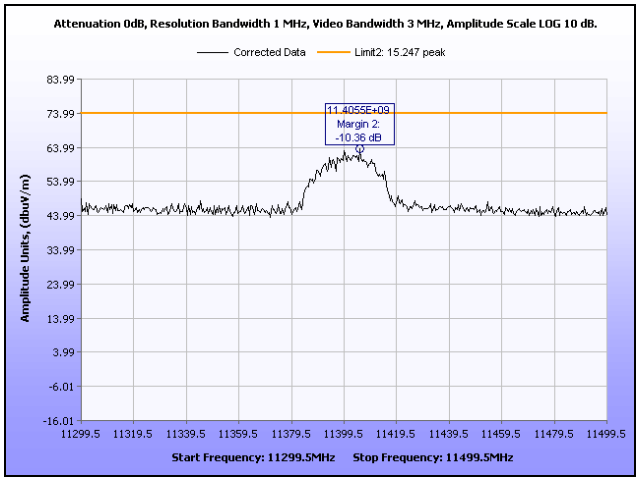
Plot 160. Radiated Spurs, 5.725 GHz – 7 GHz, Channel 5700 MHz, M5 Radio



Plot 161. Radiated Spurs, 7 GHz – 18 GHz, Channel 5700 MHz, M5 Radio

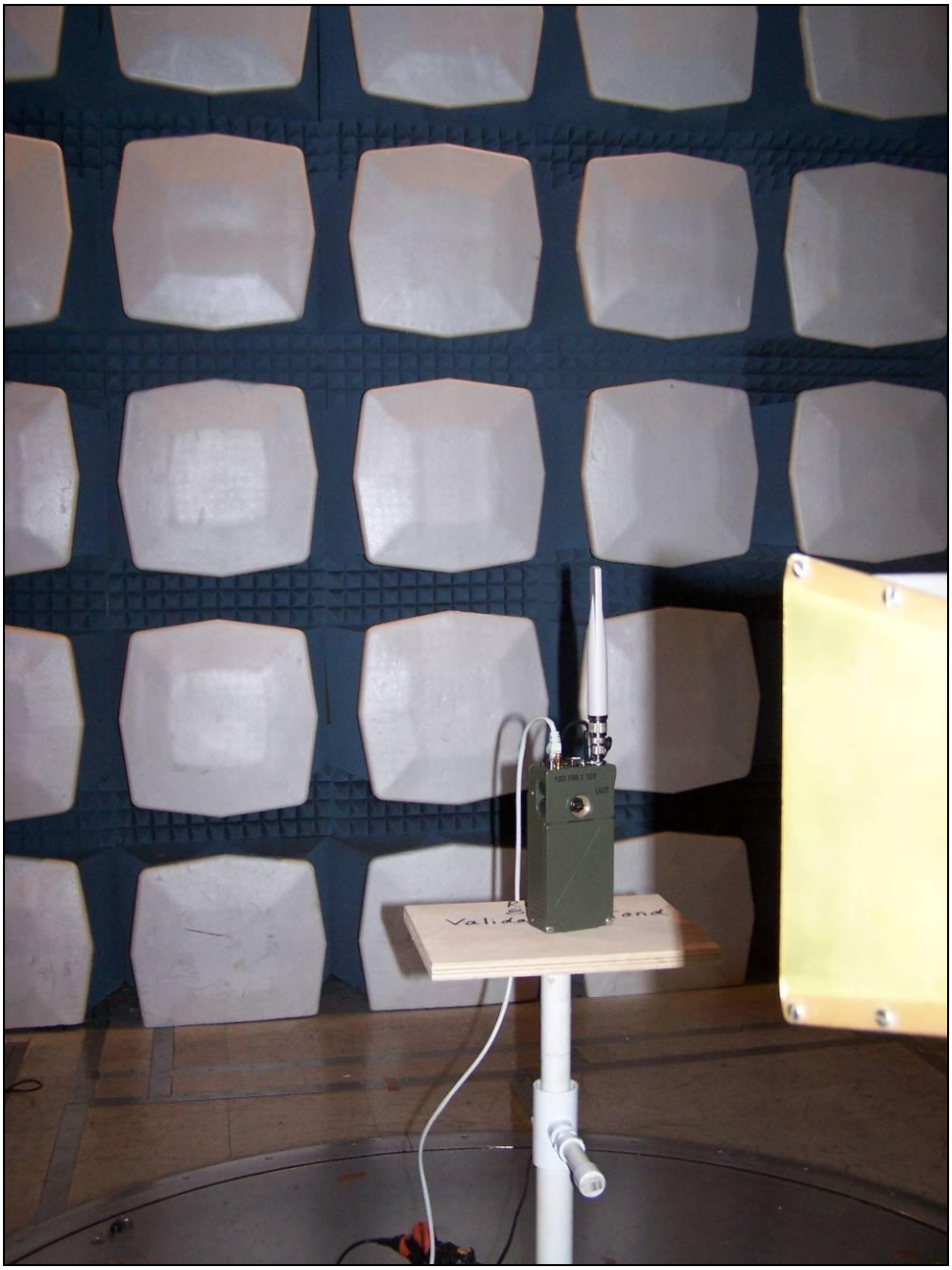


Plot 162. Radiated Spurs, Channel 5700 MHz, 2nd Harmonic, Average, M5 Radio



Plot 163. Radiated Spurs, Channel 5700 MHz, 2nd Harmonic, Peak, M5 Radio

Radiated Spurious Test Setup Photograph



Photograph 10. Radiated Spurious, Test Setup, M5 Radio

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(g) Frequency Stability – M5

Test Requirements: **§ 15.407(g):** Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the users manual.

Test Procedure: The EUT was connected directly to a spectrum analyzer through an attenuator. The resolution band width of the spectrum analyzer was set to 10 KHz. The 1st trace of the Spectrum Analyzer was used as a reference at 20°C. A 2nd trace was used to show the drift of the carrier at extreme conditions. A delta marker was used to find the drift at a given extreme condition. All transmit frequencies are derived from one oscillator. Therefore, only one channel was investigated for frequency stability.

Test Results: The EUT was compliant with the requirements of **§15.407(g)**.

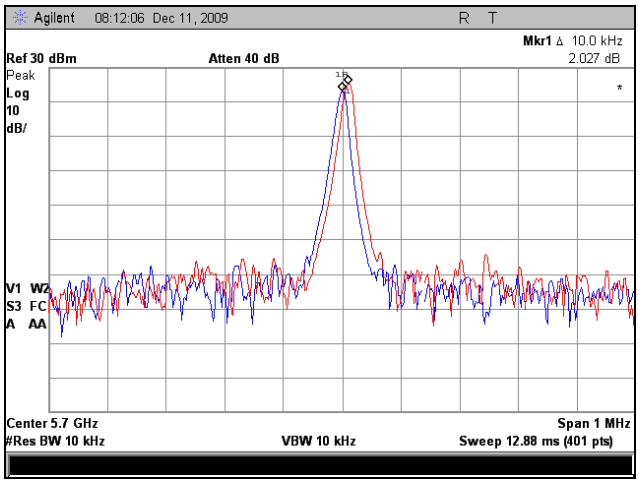
Test Engineer(s): Dusmantha Tennakoon

Test Date(s): 12/22/09

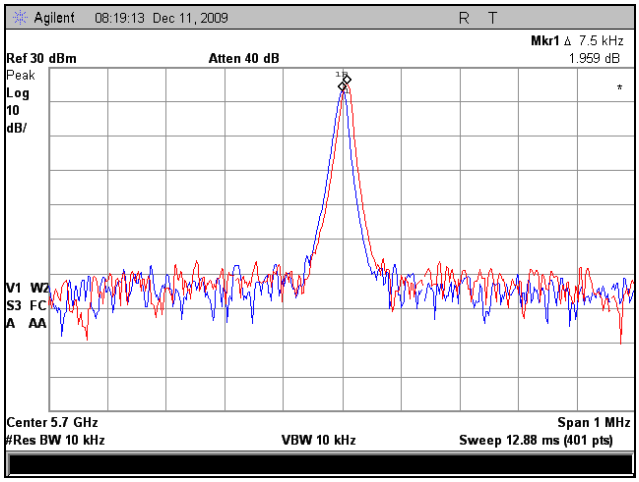
Temperature (centigrade)	Drift (kHz)	Drift (ppm)
55	130.0	228
50	100.0	175.4
40	52.5	92.1
30	12.5	21.9
20	ref	ref
10	-7.5	-13.1
0	-2.5	4.4
-10	7.5	-13.1
-20	10.0	17.5

Table 21. Frequency Stability, Reference 5785 MHz at 23°C, Test Results, M5 Radio

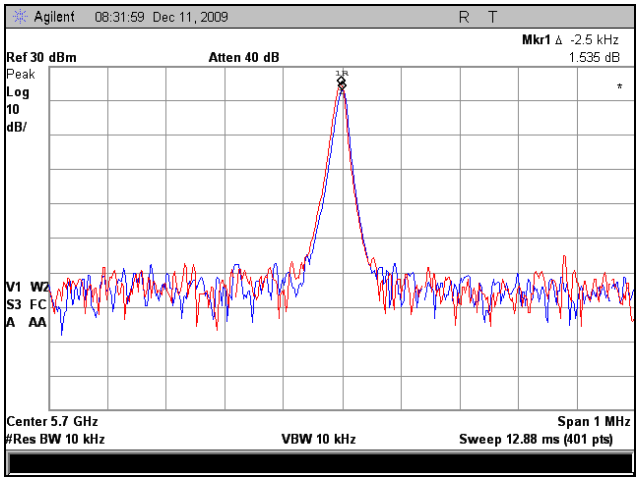
Frequency Stability Test Results



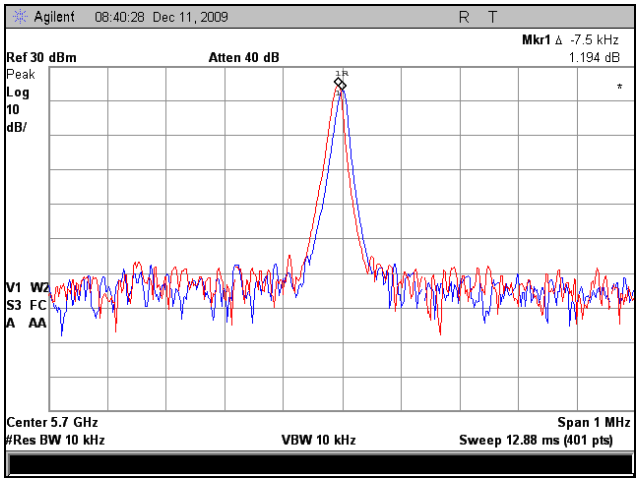
Plot 164. Frequency Stability, -20°C, M5 Radio



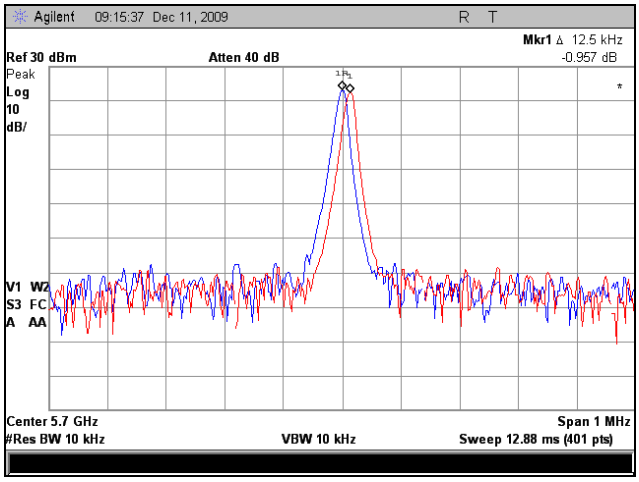
Plot 165. Frequency Stability, -10°C, M5 Radio



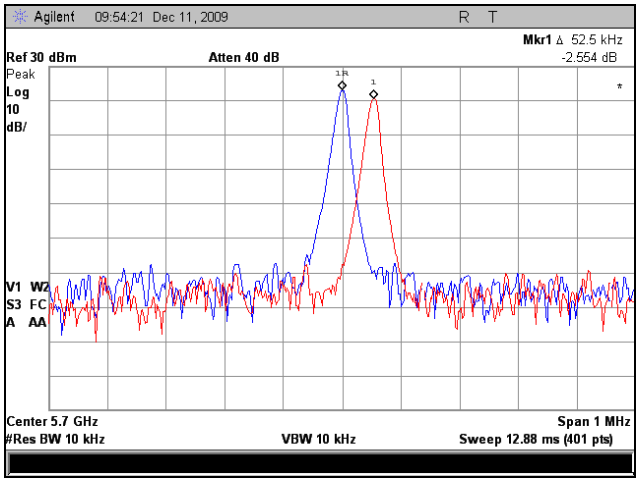
Plot 166. Frequency Stability, 0°C, M5 Radio



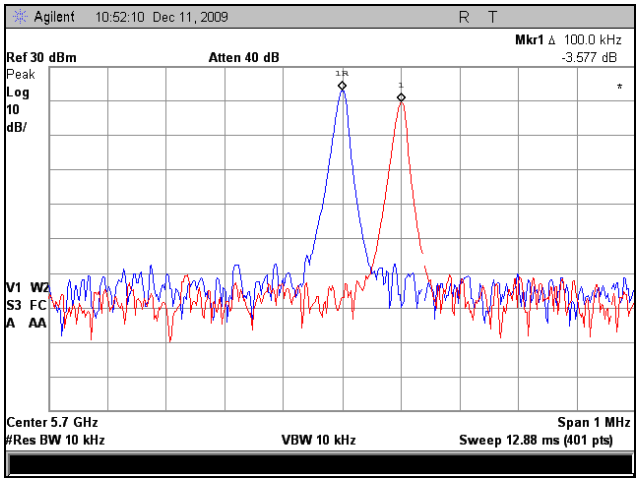
Plot 167. Frequency Stability, 10°C, M5 Radio



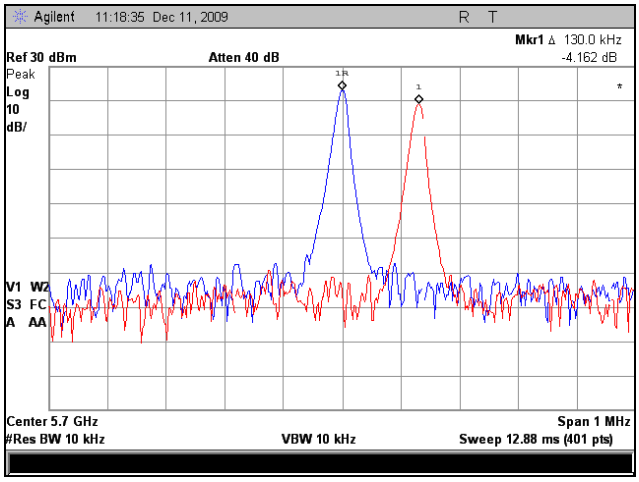
Plot 168. Frequency Stability, 30°C, M5 Radio



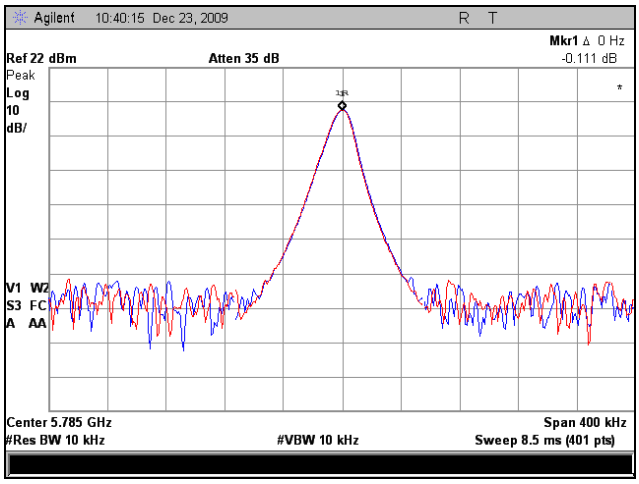
Plot 169. Frequency Stability, 40°C, M5 Radio



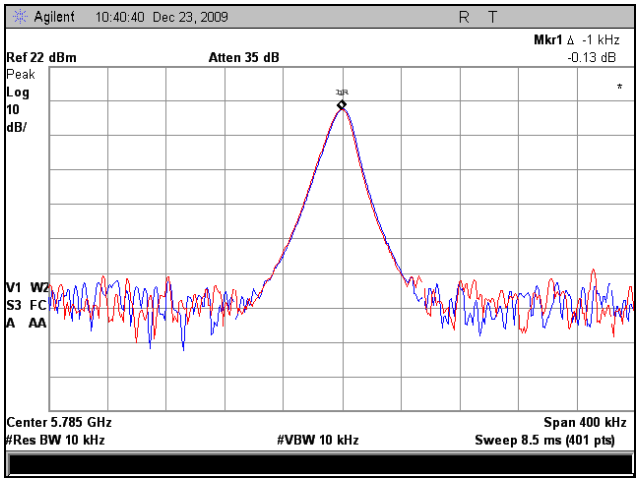
Plot 170. Frequency Stability, 50°C, M5 Radio



Plot 171. Frequency Stability, 55°C, M5 Radio



Plot 172. Frequency Stability, 102 VAC, M5 Radio



Plot 173. Frequency Stability, 138 VAC, M5 Radio

Frequency Stability Test Photograph

Photograph 11. Frequency Stability, Test Setup, M5 Radio

Electromagnetic Compatibility Criteria for Intentional Radiators

RSS-GEN Receiver Spurious – M5

Test Requirement: If the device has a detachable antenna of known antenna impedance, then the antenna conducted method is permitted in lieu of a radiated measurement.

If a conducted measurement is made, no spurious output signals appearing at the antenna terminals shall exceed 2 nanowatts per any 4 kHz spurious frequency in the band 30 – 1000 MHz, or 5 nanowatts above 1 GHz.

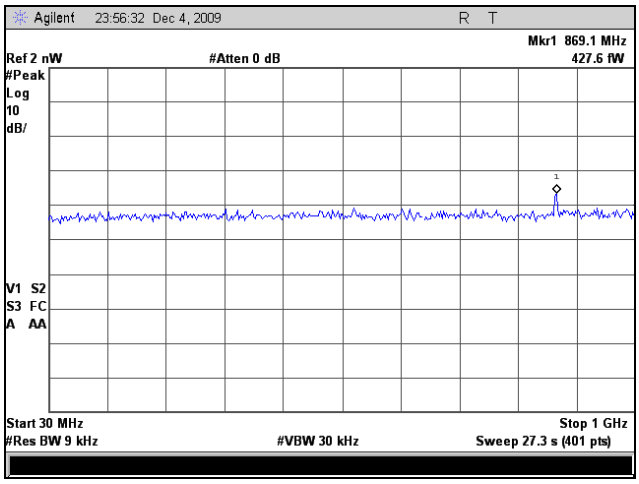
Test Procedure: The EUT was directly connected to a spectrum analyzer. Testing was performed when the EUT was receiving on channel 5300 MHz and 5600 MHz.

Results: The EUT as tested is compliant with the requirements of RSS-GEN.

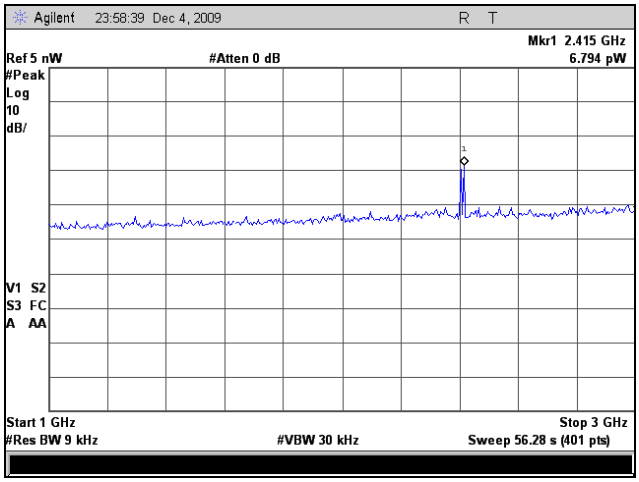
Test Engineer(s): Dusmantha Tennakoon

Test Date(s): 12/22/09

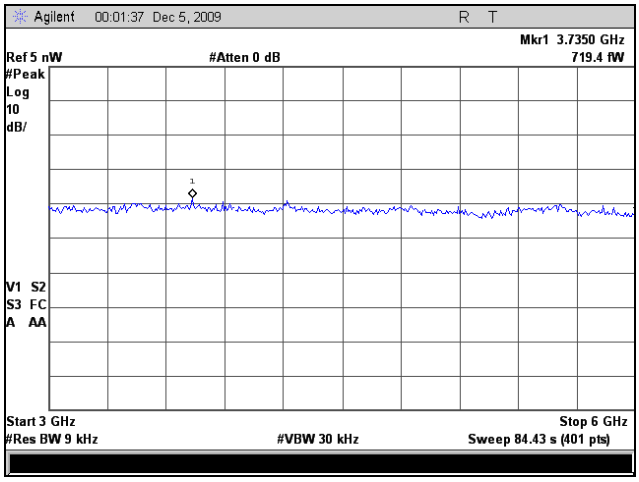
Receiver Spurious Emissions Test Results



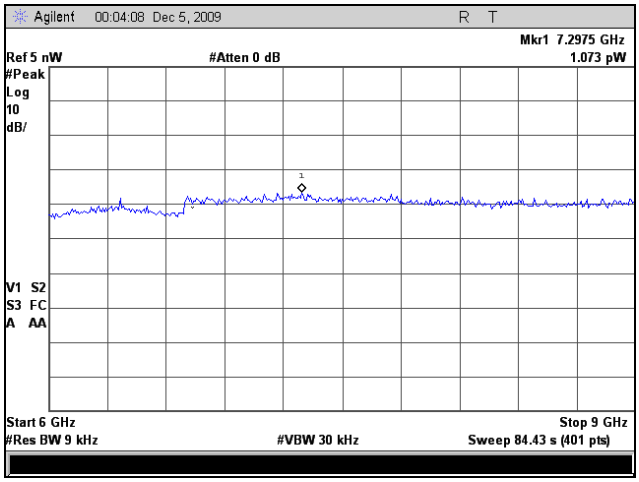
Plot 174. Receiver Spurious Emission, 30 MHz – 1 GHz, Channel 5300, M5 Radio



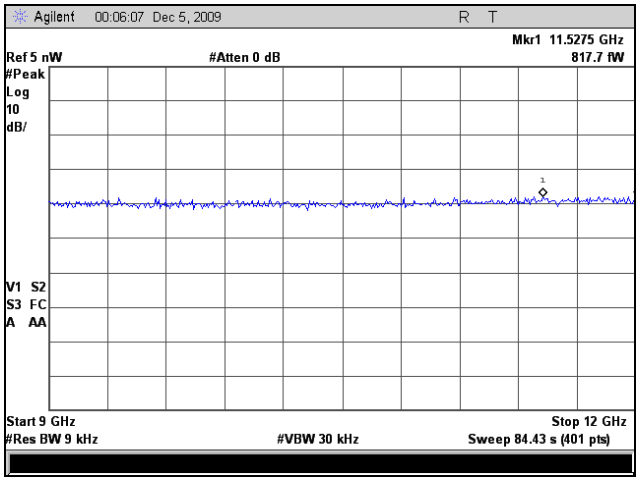
Plot 175. Receiver Spurious Emission, 1 GHz – 3 GHz, Channel 5300, M5 Radio



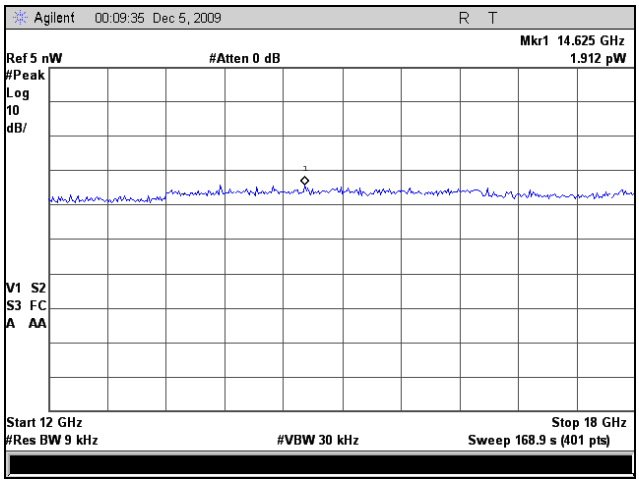
Plot 176. Receiver Spurious Emission, 3 GHz – 6 GHz, Channel 5300, M5 Radio



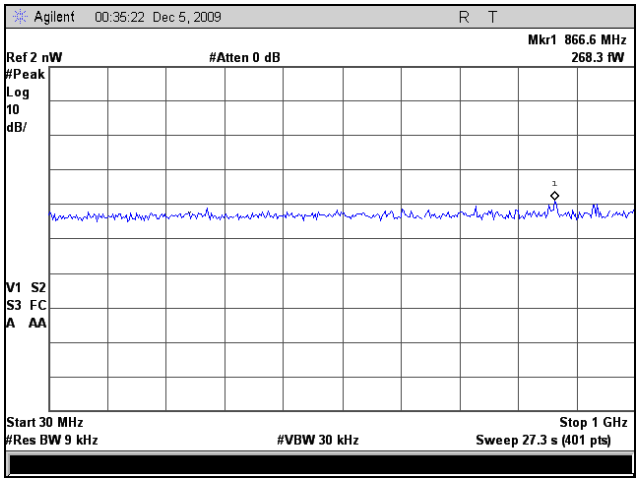
Plot 177. Receiver Spurious Emission, 6 GHz – 9 GHz, Channel 5300, M5 Radio



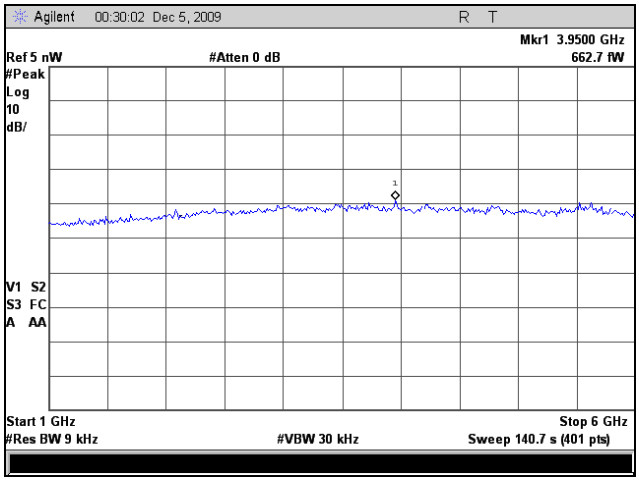
Plot 178. Receiver Spurious Emission, 9 GHz – 12 GHz, Channel 5300, M5 Radio



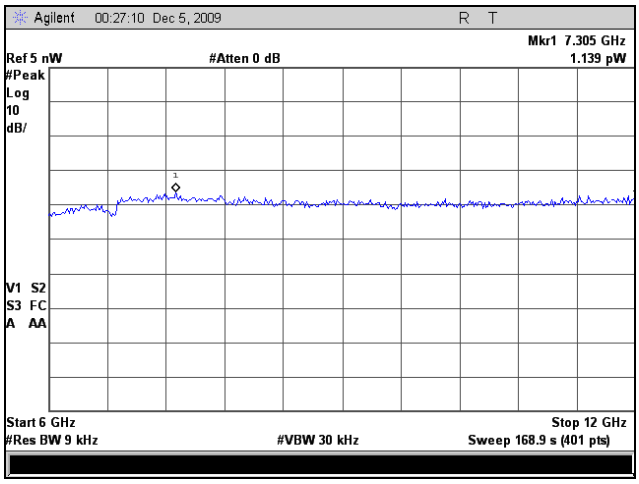
Plot 179. Receiver Spurious Emission, 12 GHz – 18 GHz, Channel 5300, M5 Radio



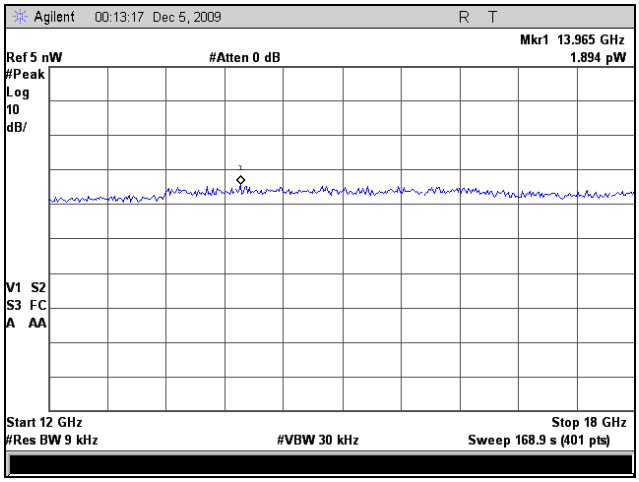
Plot 180. Receiver Spurious Emission, 30 MHz – 1 GHz, Channel 5600, M5 Radio



Plot 181. Receiver Spurious Emission, 1 GHz – 6 GHz, Channel 5600, M5 Radio

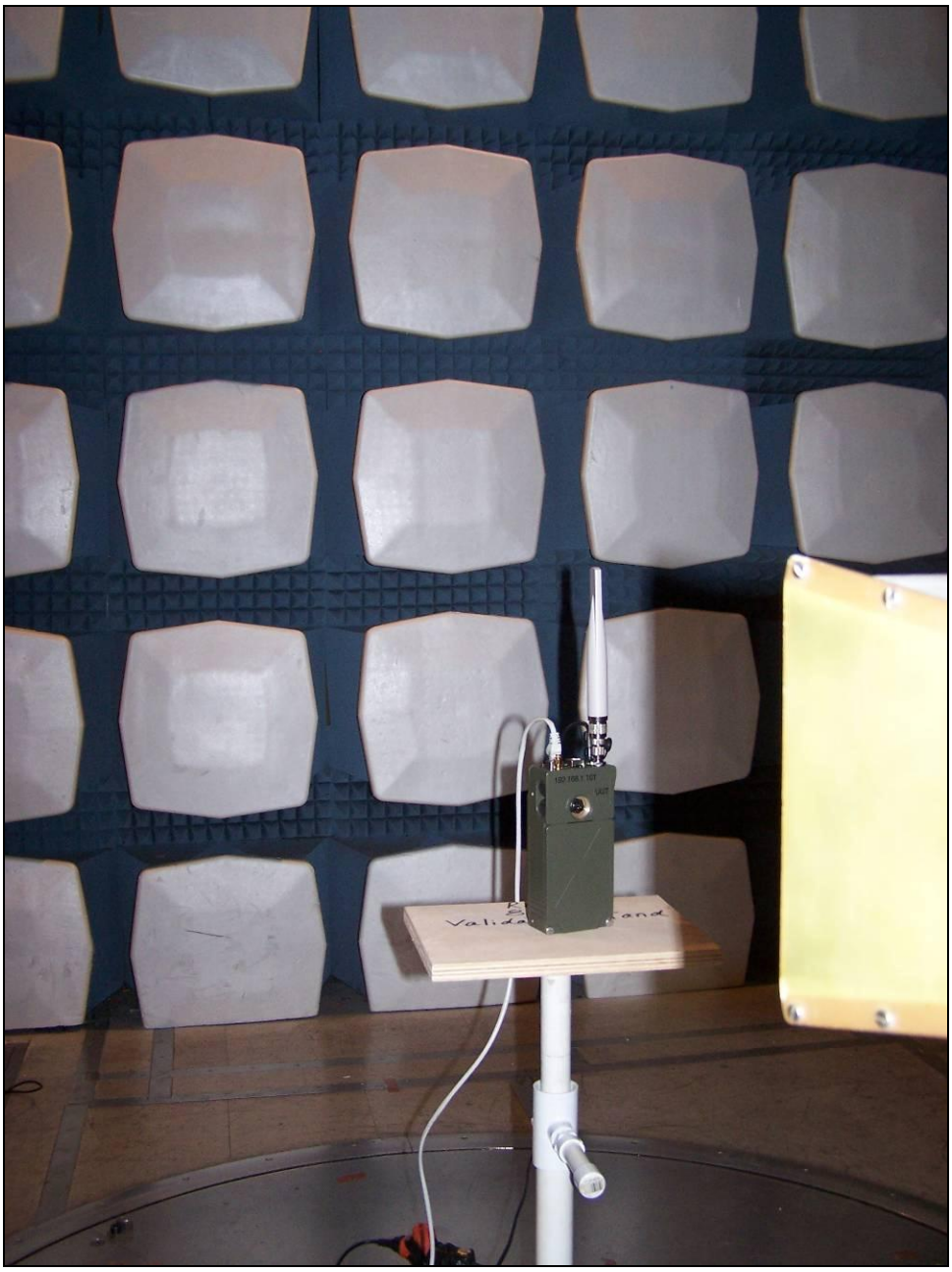


Plot 182. Receiver Spurious Emission, 6 GHz – 12 GHz, Channel 5600, M5 Radio



Plot 183. Receiver Spurious Emission, 12 GHz – 18 GHz, Channel 5600, M5 Radio

Receiver Spurious Emissions Test Setup Photograph



Photograph 12. Receiver Spurious Emissions, Test Setup, M5 Radio

V. MPE Calculation – M25 and M5

§ 15.407(f) 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 frequency is 5260 – 5320 MHz & 5500-5700 MHz;. **Limit for Uncontrolled exposure: 1 mW/cm^2.**

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

$$S = P G / 4\pi R^2$$

where,
S = Power Density mW/m^2
P = Power (mW)
R = Distance to the center of radiation of the antenna
G = Maximum antenna gain

Maximum antenna gain for EUT = 9 dBi = 7.9

M25 Radio:

5260 – 5320 MHz:

P = 16.49 dBm = 44.6 mW (highest reported power)
R = 20 cm
G = 7.9

$S1 = 44.6*7.9 / 4(3.1416)(20)^2$

$S1 = 0.07$ mW/cm^2

Therefore, EUT meets the Uncontrolled Exposure limit at 20cm.

5500 – 5700 MHz:

P = 16.84 dBm = 48.3 mW (highest reported power)
R = 20 cm
G = 7.9

$S2 = 48.3*7.9 / 4(3.1416)(20)^2$

$S2 = 0.076$ mW/cm^2

Therefore, EUT meets the Uncontrolled Exposure limit at 20cm.

M5 Radio:

5260 – 5320 MHz:

P = 16.69 dBm = 46.7 mW (highest reported power)
R = 20 cm
G = 7.9

S 3= 46.7*7.9 / 4(3.1416)$(20)^2$

S 3= 0.073 mW/cm^2

Therefore, EUT meets the Uncontrolled Exposure limit at 20cm.

5500 – 5700 MHz:

P = 17.14 dBm = 51.8 mW (highest reported power)
R = 20 cm
G = 7.9

S4 = 51.8*7.9 / 4(3.1416)$(20)^2$

S4 = 0.081 mW/cm^2

Therefore, EUT meets the Uncontrolled Exposure limit at 20cm.

Co-location:

S	Power density (mW/cm²)	General Population Limit (mW/cm²)	S as a fraction of the limit (%)
S1	0.07	1	7
S3	0.073	1	7.3

S	Power density (mW/cm²)	General Population Limit (mW/cm²)	S as a fraction of the limit (%)
S1	0.07	1	7
S4	0.081	1	8.1

S	Power density (mW/cm²)	General Population Limit (mW/cm²)	S as a fraction of the limit (%)
S2	0.076	1	7.6
S3	0.073	1	7.3

S	Power density (mW/cm²)	General Population Limit (mW/cm²)	S as a fraction of the limit (%)
S2	0.076	1	7.6
S4	0.073	1	7.3

The total percentages do not exceed 100 % per OET 65 requirements when the spectral power density is calculated at least 20cm away from the unit.

VI. DFS Requirements and Radar Waveform Description & Calibration – M25 and M5

A. DFS Requirements

Requirement	Operational Mode		
	Master	Client Without Radar Detection	Client With Radar Detection
Non-Occupancy Period	Yes	Not required	Yes
DFS Detection Threshold	Yes	Not required	Yes
Channel Availability Check Time	Yes	Not required	Not required
Uniform Spreading	Yes	Not required	Not required
U-NII Detection Bandwidth	Yes	Not required	Yes

Table 22. Applicability of DFS Requirements Prior to Use of a Channel

Requirement	Operational Mode		
	Master	Client Without Radar Detection	Client With Radar Detection
DFS Detection Threshold	Yes	Not required	Yes
Channel Closing Transmission Time	Yes	Yes	Yes
Channel Move Time	Yes	Yes	Yes
U-NII Detection Bandwidth	Yes	Not required	Yes

Table 23. Applicability of DFS Requirements During Normal Operation

Maximum Transmit Power	Value
≥ 200 milliwatt	-64 dBm
< 200 milliwatt	-62 dBm
Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna **Note 2:** Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response.	

Table 24. DFS Detection Thresholds for Master or Client Devices Incorporating DFS

Parameter	Value
Non-occupancy period	Minimum 30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds See Note 1
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. See Notes 1 and 2
U-NII Detection Bandwidth	Minimum 80% of the 99% power bandwidth. See Note 3.

Note 1: The instant that the *Channel Move Time* and the *Channel Closing Transmission Time* begins is as follows:

- For the Short pulse radar Test Signals this instant is the end of the *Burst*.
- For the Frequency Hopping radar Test Signal, this instant is the end of the last radar *Burst* generated.
- For the Long Pulse radar Test Signal this instant is the end of the 12 second period defining the radar transmission.

Note 2: The *Channel Closing Transmission Time* is comprised of 200 milliseconds starting at the beginning of the *Channel Move Time* plus any additional intermittent control signals required facilitating *Channel* changes (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.

Note 3: During the *U-NII Detection Bandwidth* detection test, radar type 1 is used and for each frequency step the minimum percentage of detection is 90%. Measurements are performed with no data traffic.

Table 25. DFS Response Requirement Values

B. Radar Test Waveforms

This section provides the parameters for required test waveforms, minimum percentage of successful detections, and the minimum number of trials that must be used for determining DFS conformance. Step intervals of 0.1 microsecond for Pulse Width, 1 microsecond for PRI, 1 MHz for chirp width and 1 for the number of pulses will be utilized for the random determination of specific test waveforms.

Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (µsec)	PRI (µsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Trials
1	1	1428	18	60%	30
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120

A minimum of 30 unique waveforms are required for each of the short pulse radar types 2 through 4. For short pulse radar type 1, the same waveform is used a minimum of 30 times. If more than 30 waveforms are used for short pulse radar types 2 through 4, then each additional waveform must also be unique and not repeated from the previous waveforms. The aggregate is the average of the percentage of successful detections of short pulse radar types 1-4.

Long Pulse Radar Test Waveform

Radar Type	Pulse Width (µsec)	Chirp Width (MHz)	PRI (µsec)	Number of Pulses per Bursts	Number of Bursts	Minimum Percentage of Successful Detection	Minimum Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

The parameters for this waveform are randomly chosen. Thirty unique waveforms are required for the Long Pulse radar test signal. If more than 30 waveforms are used for the Long Pulse radar test signal, then each additional waveform must also be unique and not repeated from the previous waveforms.

Each waveform is defined as follows:

1) The transmission period for the Long Pulse Radar test signal is 12 seconds.
2) There are a total of 8 to 20 Bursts in the 12 second period, with the number of Bursts being randomly chosen. This number is Burst_Count.
3) Each Burst consists of 1 to 3 pulses, with the number of pulses being randomly chosen. Each Burst within the 12 second sequence may have a different number of pulses.
4) The pulse width is between 50 and 100 microseconds, with the pulse width being randomly chosen. Each pulse within a Burst will have the same pulse width. Pulses in different Bursts may have different pulse widths.
5) Each pulse has a linear FM chirp between 5 and 20 MHz, with the chirp width being randomly chosen. Each pulse within a Burst will have the same chirp width. Pulses in different Bursts may have different chirp widths. The chirp is centered on the pulse. For example, with radar frequency of 5300 MHz and a 20 MHz chirped signal, the chirp starts at 5290 MHz and ends at 5310 MHz.
6) If more than one pulse is present in a Burst, the time between the pulses will be between 1000 and 2000 microseconds, with the time being randomly chosen. If three pulses are present in a Burst, the time between the first and second pulses is chosen independently of the time between the second and third pulses.
7) The 12 second transmission period is divided into even intervals. The number of intervals is equal to Burst_Count. Each interval is of length (12,000,000 / Burst_Count) microseconds. Each interval contains one Burst. The start time for the Burst, relative to the beginning of the interval, is between 1 and [(12,000,000 / Burst_Count) – (Total Burst Length) + (One Random PRI Interval)] microseconds, with the start time being randomly chosen. The step interval for the start time is 1 microsecond. The start time for each Burst is chosen independently.

A representative example of a Long Pulse radar test waveform:

1) The total test signal length is 12 seconds.
2) 8 Bursts are randomly generated for the Burst_Count.
3) Burst 1 has 2 randomly generated pulses.
4) The pulse width (for both pulses) is randomly selected to be 75 microseconds.
5) The PRI is randomly selected to be at 1213 microseconds.
6) Bursts 2 through 8 are generated using steps 3 – 5.
7) Each Burst is contained in even intervals of 1,500,000 microseconds. The starting location for Pulse 1, Burst 1 is randomly generated (1 to 1,500,000 minus the total Burst 1 length + 1 random PRI interval) at the 325,001 microsecond step. Bursts 2 through 8 randomly fall in successive 1,500,000 microsecond intervals (i.e. Burst 2 falls in the 1,500,001 – 3,000,000 microsecond range).

Graphical Representation of a Long Pulse radar Test Waveform

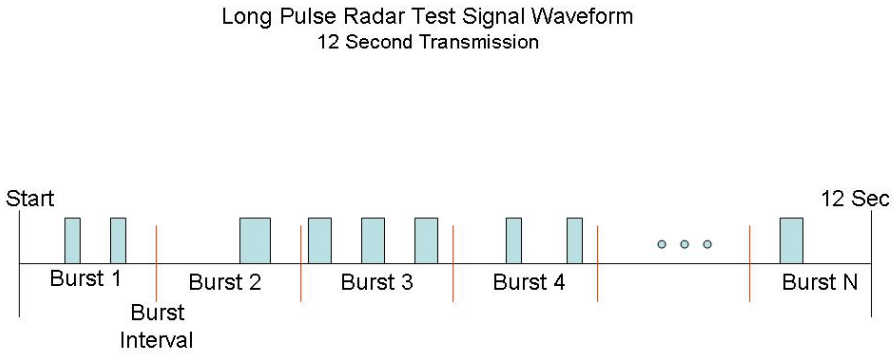


Figure 9. Long Pulse Radar Test Signal Waveform

Frequency Hopping Radar Test Waveform

Radar Type	Pulse Width (µsec)	PRI (µsec)	Pulses per Hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Minimum Percentage of Successful Detection	Minimum Trials
6	1	333	9	.333	300	70%	30

For the Frequency Hopping Radar Type, the same *Burst* parameters are used for each waveform. The hopping sequence is different for each waveform and a 100-length segment is selected1 from the hopping sequence defined by the following algorithm:

The first frequency in a hopping sequence is selected randomly from the group of 475 integer frequencies from 5250 – 5724 MHz. Next, the frequency that was just chosen is removed from the group and a frequency is randomly selected from the remaining 474 frequencies in the group. This process continues until all 475 frequencies are chosen for the set. For selection of a random frequency, the frequencies remaining within the group are always treated as equally likely.

C. Radar Waveform Calibration

The following equipment setup was used to calibrate the radiated Radar Waveform. A spectrum analyzer was used to establish the test signal level for each radar type. During this process there were no transmissions by either the Master or Client Device. The spectrum analyzer was switched to the zero span (Time Domain) mode at the frequency of the Radar Waveform generator. Peak detection was utilized. The spectrum analyzer's resolution bandwidth (RBW) was set to 3 MHz and the video bandwidth (VBW) was set to 3 MHz. The calibration setup is diagrammed in Figure 10, and the radar test signal generator is shown in Photograph 13.

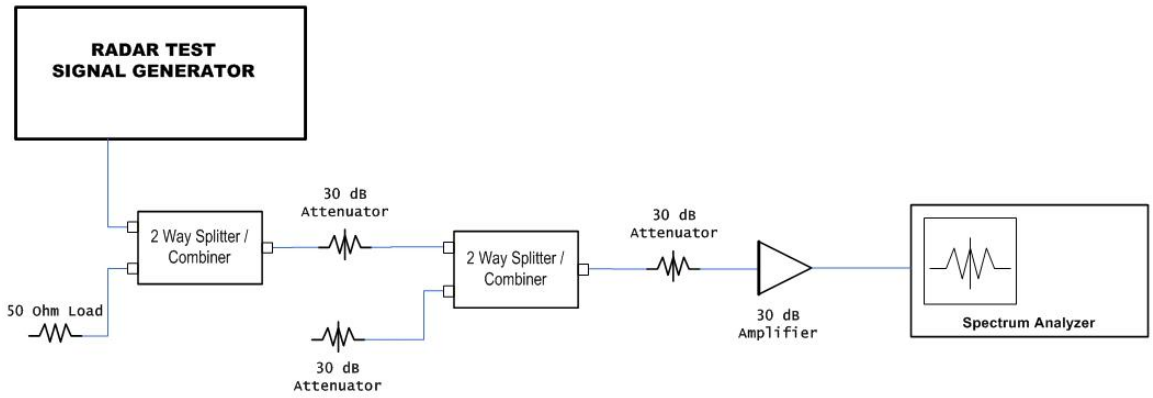
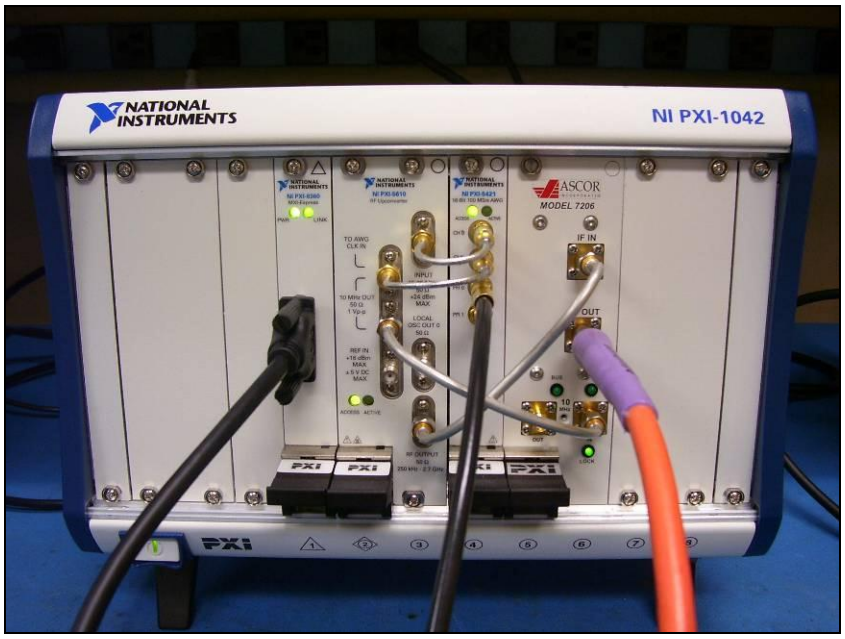
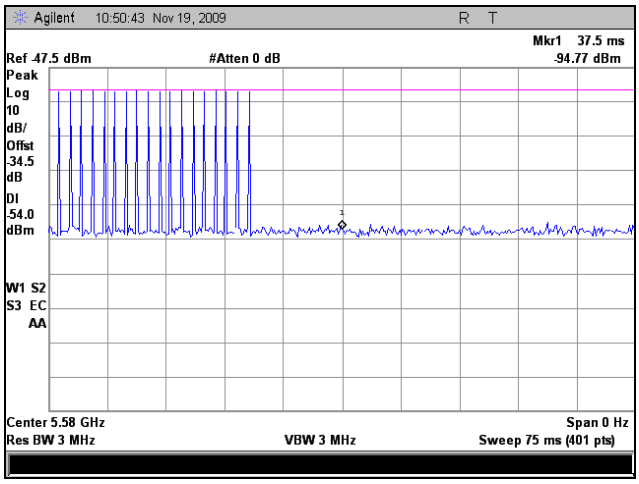


Figure 10. Calibration Test setup

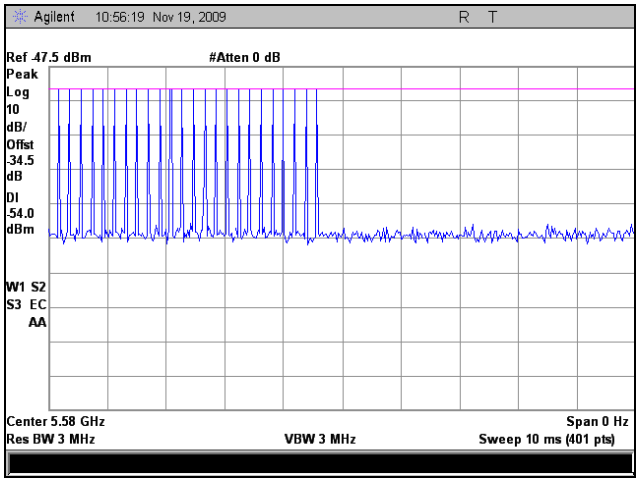


Photograph 13. DFS Radar Test Signal Generator

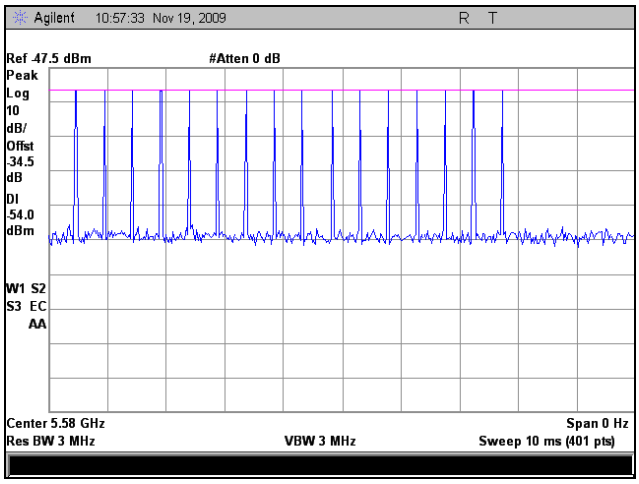
Radar Waveform Calibration



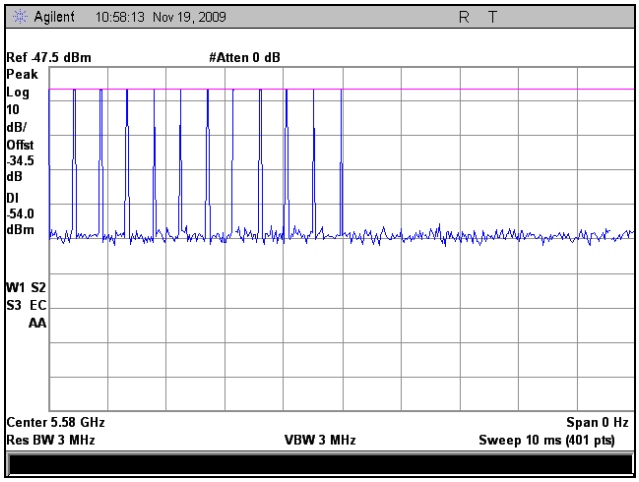
Plot 184. Radar Type 1 Calibration, 5580 MHz



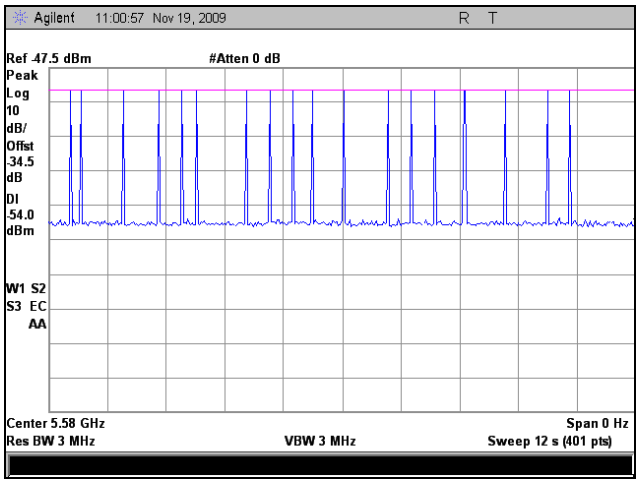
Plot 185. Radar Type 2 Calibration, 5580 MHz



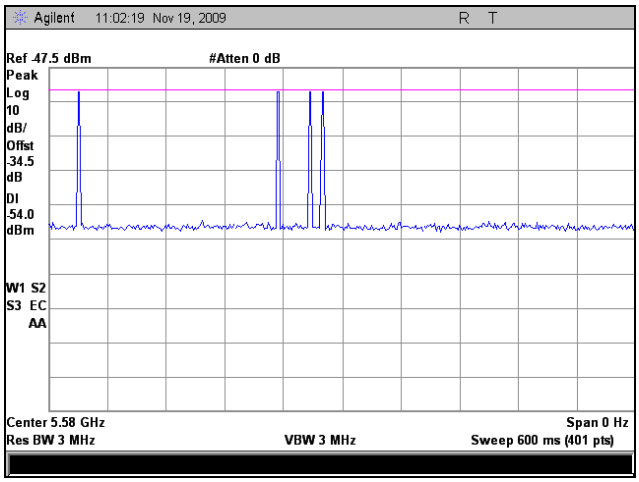
Plot 186. Radar Type 3 Calibration, 5580 MHz



Plot 187. Radar Type 4 Calibration, 5580 MHz



Plot 188. Radar Type 5 Calibration, 5580 MHz



Plot 189. Radar Type 6 Calibration, 5580 MHz

VII. DFS Test Procedure and Test Results – M25

A. DFS Test Setup – M25

The 5600 – 5650 MHz bands were disabled.

1. A spectrum analyzer is used as a monitor to verify that the Unit Under Test (UUT) has vacated the Channel within the Channel Closing Transmission Time and Channel Move Time, and does not transmit on a Channel during the Non-Occupancy Period after the detection and subsequent Channel move. It is also used to monitor UUT transmissions during the Channel Availability Check Time.
2. The test setup, which consists of test equipment and equipment under test (EUT), is diagrammed in Figure 11 and pictured in Photograph 14

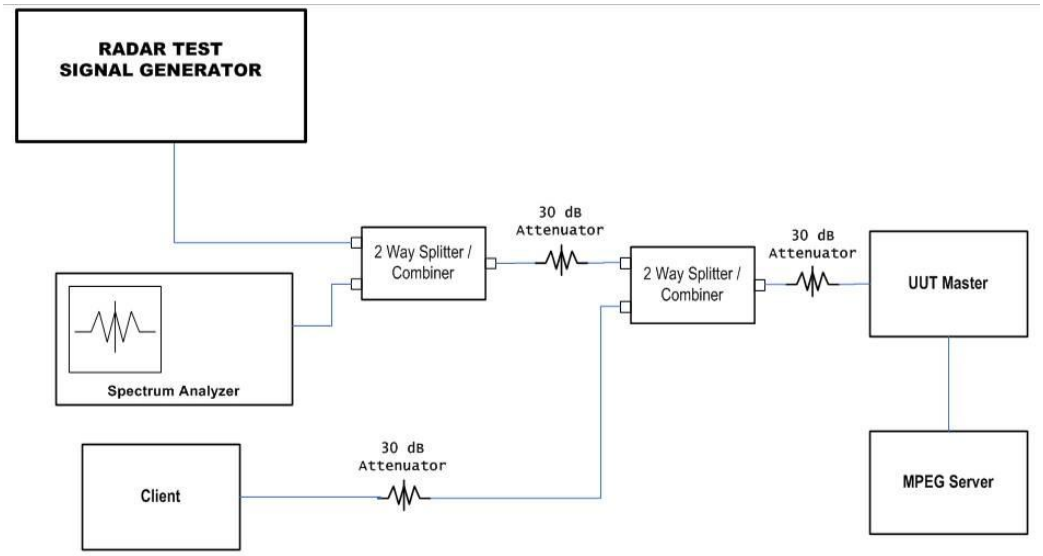
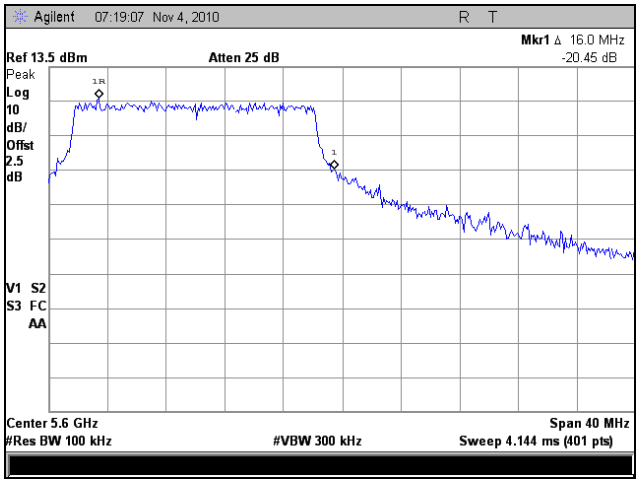
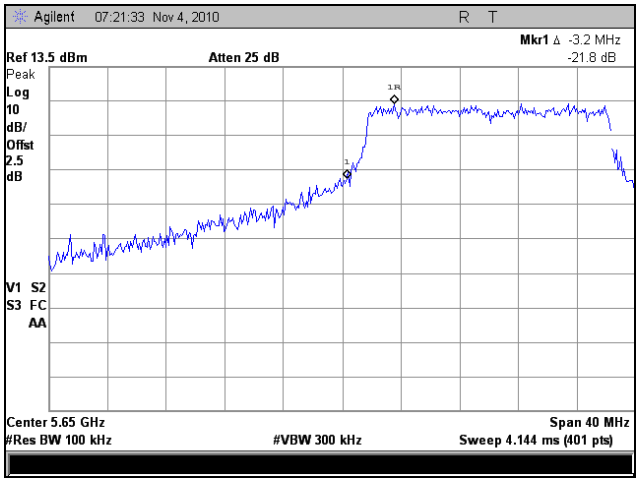


Figure 11. Test Setup Diagram

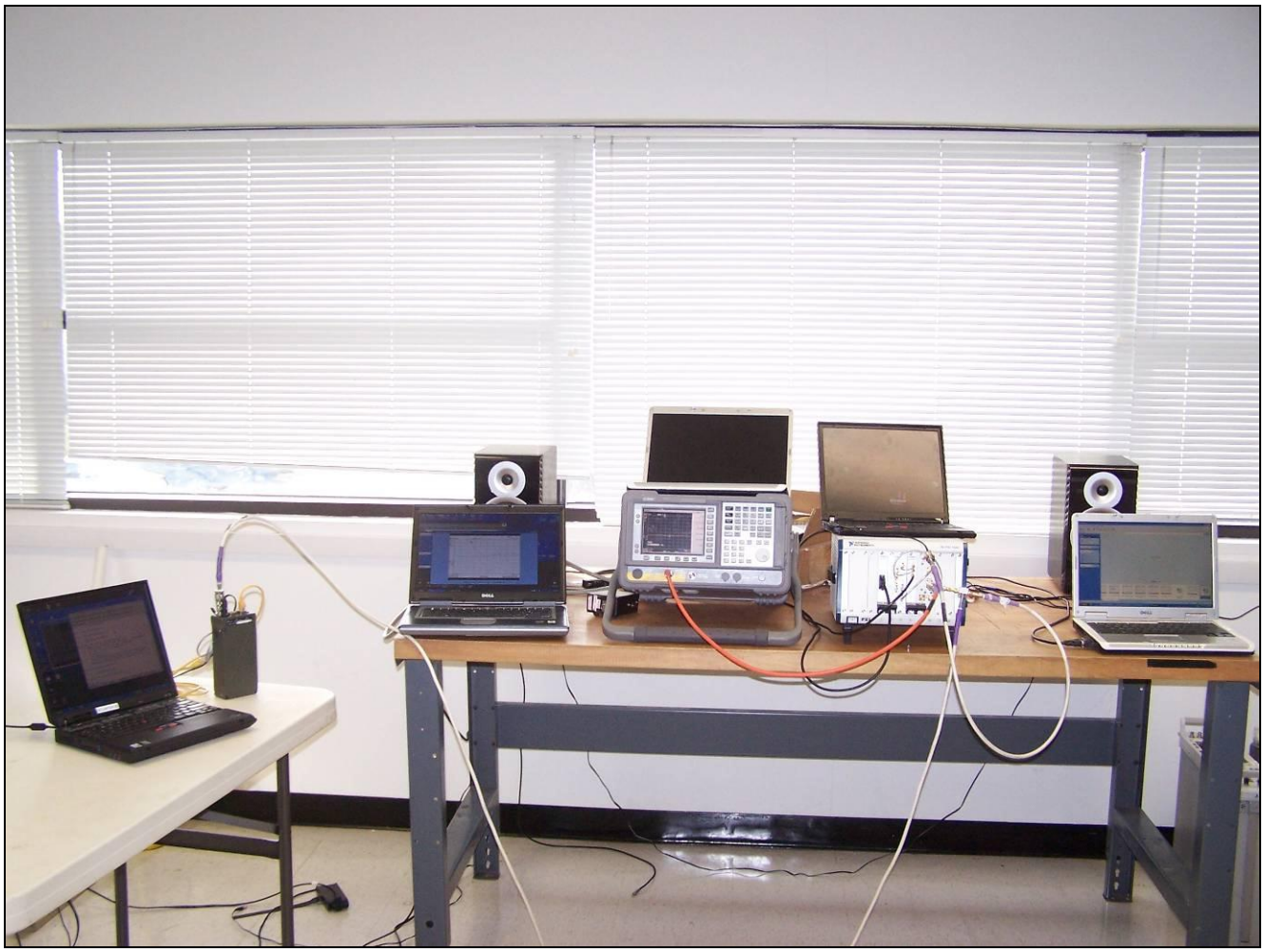
20 dB Band Edge – M25



Plot 190. 20 dB Band Edge, 5590 MHz



Plot 191. 20 dB Band Edge, 5660 MHz



Photograph 14. Test Setup Photo

B. Description of Master Device – M25

1. Operating Frequency Range – 5260-5320 MHz and 5500-5700 MHz
2. Modes of Operation – Master Device
3. Highest and Lowest EIRP – Highest = 16.84 dBm;
4. Antenna gain – Omni, 9dBi
5. Antenna impedance – 50 Ohms
6. Antenna gain verification – Use antenna datasheet
7. Test file that is transmitted is the designated MPEG test file that streams full motion video at 30 frames per second from the Master to the Client
8. TPC not required for UNII devices with less than 500 mW EIRP
9. Time for master to complete its power-on-cycle is about 3min
10. The EUT's uniform channel spreading is as follows: The master uses a simple incrementing algorithm: if radar is detected, the next sequential channel is used. For example, if one is on channel 100 and radar is detected, then it will be changed to 104. If radar is then detected on 104, it is changed to 108. When the last channel is reached, we start again at the beginning in a circular fashion.

C. UNII Detection Bandwidth – M25

Test Requirement(s): **§ 15.407** A minimum 80% of the UNII 99% transmission power bandwidth is required.

Test Procedure: All UNII channels for this device have identical channel bandwidths.

A single burst of the short pulse radar type 1 is produced at 5580 MHz, at the -63dBm test level. The UUT is set up as a standalone device (no associated client, and no data traffic).

A single radar burst is generated for a minimum of 10 trials, and the response of the UUT is recorded. The UUT must detect the radar waveform 90% or more of the time.

The radar frequency is increased in 1 MHz steps, repeating the above test sequence, until the detection rate falls below 90%. The highest frequency at which detection is greater than or equal to 90% is denoted F_H.

The radar frequency is decreased in 1 MHz steps, repeating the above test sequence, until the detection rate falls below 90%. The lowest frequency at which detection is greater than or equal to 90% is denoted F_L.

The U-NII Detection Bandwidth is calculated as follows:

$$\text{U-NII Detection Bandwidth} = F_H - F_L$$

Test Engineer: Dusmantha Tennakoon

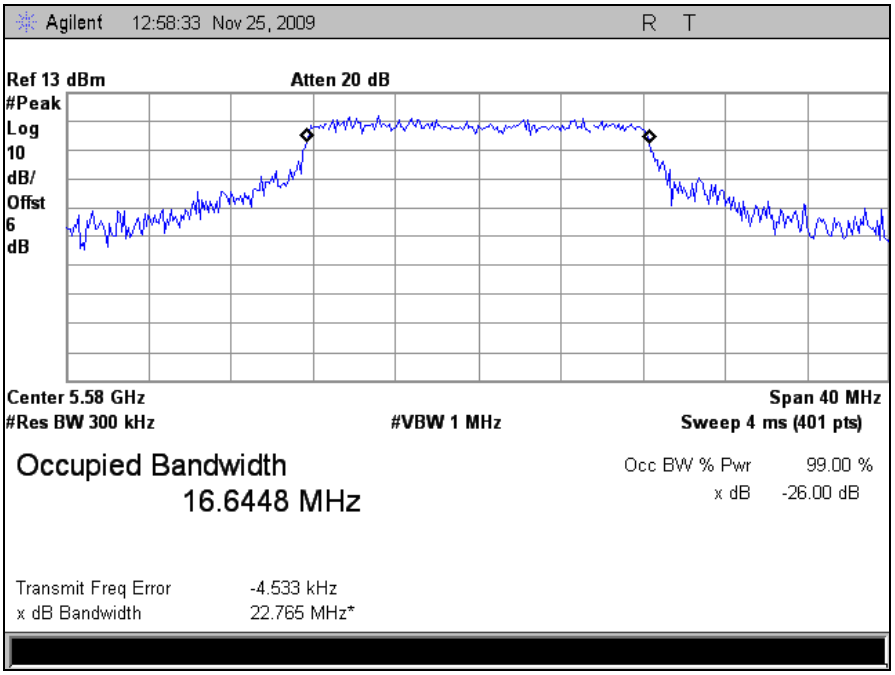
Test Date: 11/25/09

UNII Detection Bandwidth – Test Results

EUT Frequency=5580MHz											
	DFS Detection Trials (1=Detection, Blank= No Detection)										
Radar Frequency (MHz)	1	2	3	4	5	6	7	8	9	10	Detection Rate (%)
5568	1	0	0	1	0	1	1	0	0	1	50
5569 (Fl)	1	1	0	1	0	1	1	1	1	1	80
5570	1	1	1	1	1	1	1	1	1	1	100
5571	1	1	1	1	1	1	1	1	1	1	100
5572	1	1	1	1	1	1	1	1	1	1	100
5573	1	1	0	1	1	1	1	1	1	1	90
5574	1	1	1	1	1	1	1	1	1	1	100
5575	1	1	1	1	1	1	1	1	1	1	100
5576	1	1	1	1	1	1	1	1	1	1	100
5577	1	1	1	1	1	1	1	1	1	1	100
5578	1	1	1	1	1	1	1	1	1	1	100
5579	1	1	1	1	1	1	1	1	1	1	100
5580	1	1	1	1	1	1	1	1	1	1	100
5581	1	1	1	1	1	1	1	1	1	1	100
5582	1	1	1	1	1	1	1	1	1	1	100
5583	1	1	1	1	1	1	1	1	1	1	100
5584	1	1	1	1	1	1	1	1	1	1	100
5585	1	1	1	1	1	1	1	1	1	1	100
5586	1	1	1	1	1	1	1	1	1	1	100
5587	0	1	1	1	1	1	1	1	1	1	90
5588	1	1	1	1	1	1	1	1	1	1	100
5589	1	1	1	1	1	1	1	1	1	1	100
5590	0	1	1	1	1	1	1	1	1	1	90
5591(Fh)	0	1	1	1	1	1	1	1	1	1	90
5592	0	1	0	0	1	0	1	0	0	1	40
Detection Bandwidth = Fh-Fl = 22 MHz											
EUT 99% Bandwidth = 16.6 MHz											
16.6 MHz*80% = 13.28 MHz ; Therefore, the detection bandwidth > 13.28 MHz											

Table 26. UNII Detection Bandwidth, Test Results, 5580 MHz, M25 Radio

UNII Detection Bandwidth Plots



Plot 192. Occupied Bandwidth, 5580 MHz, M25 Radio

D. Initial Channel Availability Check Time – M25

Test Requirements: **§ 15.407** The Initial Channel Availability Check Time tests that the UUT does not emit beacon, control, or data signals on the test channel until the power-up sequence has been completed and the U-NII device has checked for radar waveforms, for one minute, on the test channel. This test does not use any of the radar waveforms and only needs to be performed once.

The UUT should not make any transmissions over the test channel, for at least 1 minute after completion of its power-on cycle.

Test Procedure: The U-NII device is powered on and instructed to operate at 5580 MHz. At the same time the UUT is powered on, the spectrum analyzer is set to 5580MHz with a zero span and a 200 sec. sweep time. The analyzer is triggered at the same time power is applied to the U-NII device.

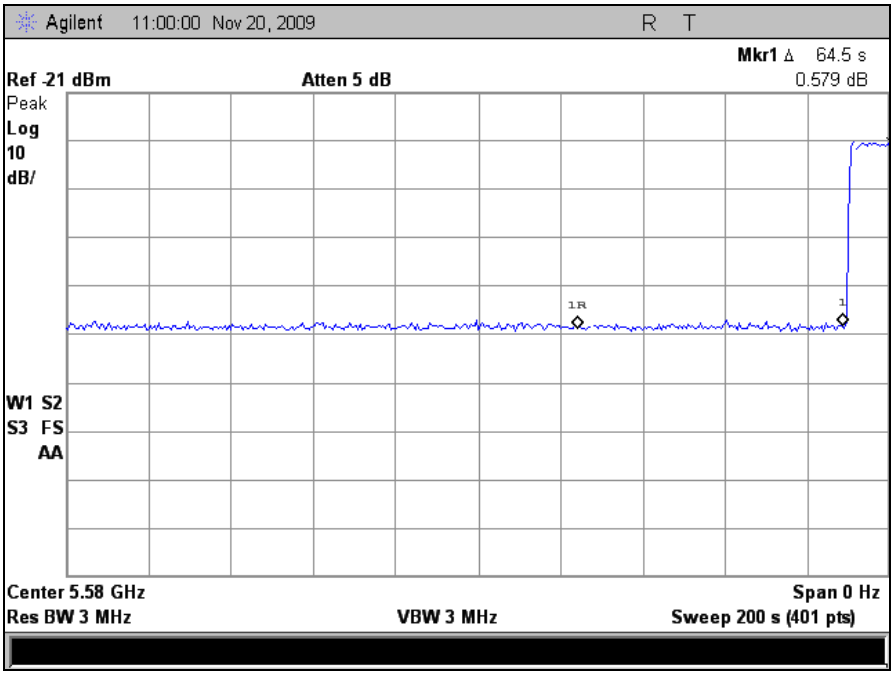
Test Results: Marker 1R on Plot 193 indicates the start of the channel availability check time. Initial beacon/data transmission is indicated by marker 1.

The Equipment was compliant with § 15.407 Initial Channel Availability Check Time.

Test Engineer: Dusmantha Tennakoon

Test Date: 11/25/09

Initial Channel Availability Check Time Test Results



Plot 193. Initial Channel Availability Check Time 60 sec, M25 Radio

E. Radar Burst at the Beginning of Channel Availability Check Time – M25

Test Requirements: **§ 15.407** A Radar Burst at the Beginning of the Channel Availability Check Time tests that the UUT does not emit beacon, control, or data signals on the test Channel if it has detected a radar burst during that time period until the power-up sequence has been completed and the U-NII device checks for Radar Waveforms for one minute on the test Channel. The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold + 1 dB occurs at the beginning of the Channel Availability Check Time.

Test Procedure: The UUT is powered on at T0. T1 denotes the instant when the UUT has completed its power-up sequence. The Channel Availability Check Time commences at instant T1 and will end no sooner than T1 + 60 seconds.

A single Burst of short pulse radar type 1 will commence within a 6 second window starting at T1.

Visual indication of the UUT of successful detection of the radar Burst will be recorded and reported. Observation of transmission at 5580MHz will continue for 2.5 minutes after the radar Burst has been generated.

Verify that during the 2.5 minute measurement window, no UUT transmissions occur at 5580MHz.

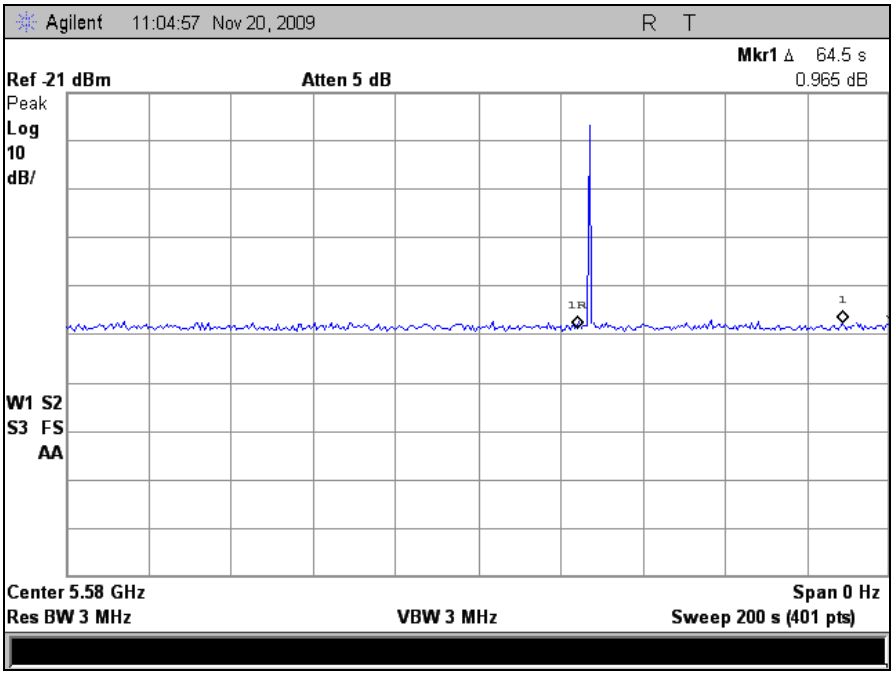
Test Results Plot 194 below indicates that there were no UUT transmissions during the 2.5 minute measurement window when a radar burst was injected 6 seconds into the CACT. Therefore, the UUT detected the presence of a radar during the CACT and moved away from that channel.

The equipment was compliant with § 15.407 Radar Burst at the Beginning of the Channel Availability Check Time.

Test Engineer: Dusmantha Tennakoon

Test Date: 11/25/09

Radar Burst at the Beginning of Channel Availability Check Time Test Results



Plot 194. Radar Burst at the Beginning of CACT, 6 sec (5580MHz) , M25 Radio

F. Radar Burst at the End of Channel Availability Check Time – M25

Test Requirements: **§ 15.407** A Radar Burst at the End of the Channel Availability Check Time tests that the UUT does not emit beacon, control, or data signals on the test Channel if it has detected a radar burst during that time period until the power-up sequence has been completed and the U-NII device checks for Radar Waveforms for one minute on the test Channel. The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold + 1 dB occurs at the end of the Channel Availability Check Time.

Test Procedure: The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold + 1 dB occurs at the end of the Channel Availability Check Time.

The UUT is powered on at T0. T1 denotes the instant when the UUT has completed its power-up sequence. The Channel Availability Check Time commences at instant T1 and will end no sooner than T1 + 60 seconds.

A single Burst of short pulse of radar type 1 will commence within a 6 second window starting at T1+ 54 seconds.

Visual indication on the UUT of successful detection of the radar Burst will be recorded and reported. Observation of emissions at 5580MHz will continue for 2.5 minutes after the radar Burst has been generated.

Verify that during the 2.5 minute measurement window no UUT transmissions occurred at 5580MHz.

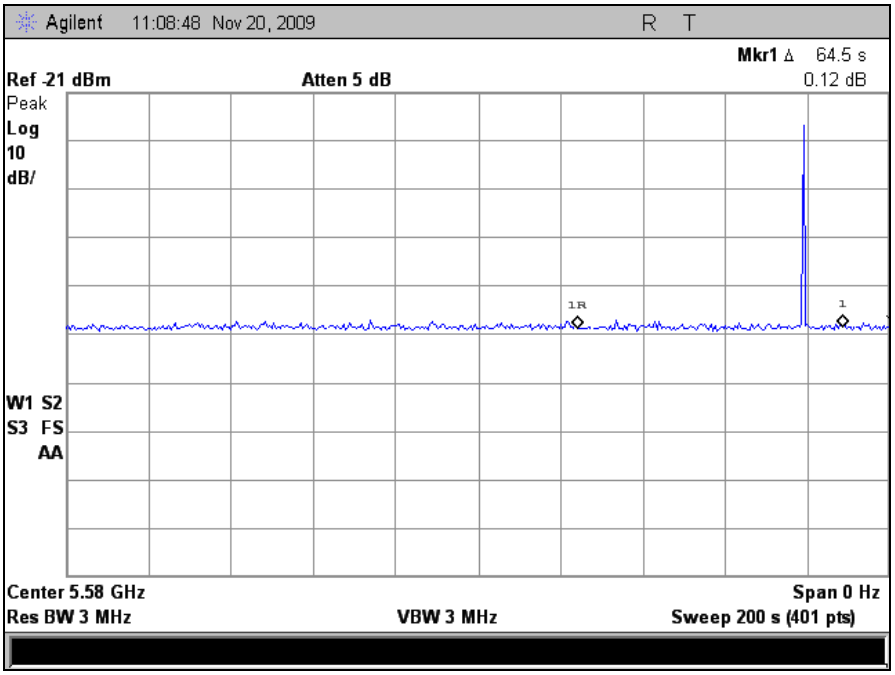
Test Results: Plot 195 indicates that no UUT transmissions occurred during the 2.5 minute measurement window when a radar burst was injected 6 seconds before the end of the CACT. Therefore, the UUT detected the presence of a radar and moved away from that channel.

The equipment was compliant with § 15.407 Radar Burst at the End of the Channel Availability Check Time.

Test Engineer: Dusmantha Tennakoon

Test Date: 11/25/09

Radar Burst at the End of Channel Availability Check Time Test Results



Plot 195. Radar Burst at the End of CACT, 54 sec (5580MHz), M25 Radio

G. In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time, and Non-Occupancy Period – M25

Test Requirements:

§ 15.407 (Refer to DFS Response Requirement Values table in section III-A of this report.) The UUT shall continuously monitor for radar transmissions in the operating test channel. When a radar burst occurs in the test channel, it has 10 seconds to move to another channel. This 10 second window is termed Channel Move Time (CMT).

When a radar burst occurs, the UUT has 200 milliseconds, plus an aggregate of 60 milliseconds, to cease transmission in the operating test channel. This 200 ms + 60 ms requirement is termed Channel Closing Transmission Time (CCT).

After radar burst and subsequent move to another channel, the UUT shall not resume transmission, on the channel it moved from, for a period of 30 minutes. This requirement is termed Non-Occupancy Period (NOP).

Test Procedure:

These tests define how the following DFS parameters are verified during In-Service Monitoring: Channel Closing Transmission Time, Channel Move Time, and Non-Occupancy Period.

The steps below define the procedure to determine the above mentioned parameters when a radar Burst with a level equal to the DFS Detection Threshold + 1dB is generated on the Operating Channel of the U-NII device.

A U-NII device operating as a Client Device will associate with the UUT (Master) at 5580 MHz. Stream the MPEG test file from the Master Device to the Client Device on the selected Channel for the entire period of the test.

At time T0 the Radar Waveform generator sends a Burst of pulses for each of the radar types.

Observe the transmissions of the UUT at the end of the radar Burst on the Operating Channel for duration greater than 10 seconds. Measure and record the transmissions from the UUT during the observation time (Channel Move Time). Compare the Channel Move Time and Channel Closing Transmission Time results to the limits defined in the *DFS Response Requirement Values table*.

Test Results:

The EUT was compliant with § 15.407 In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time, and Non-Occupancy Period.

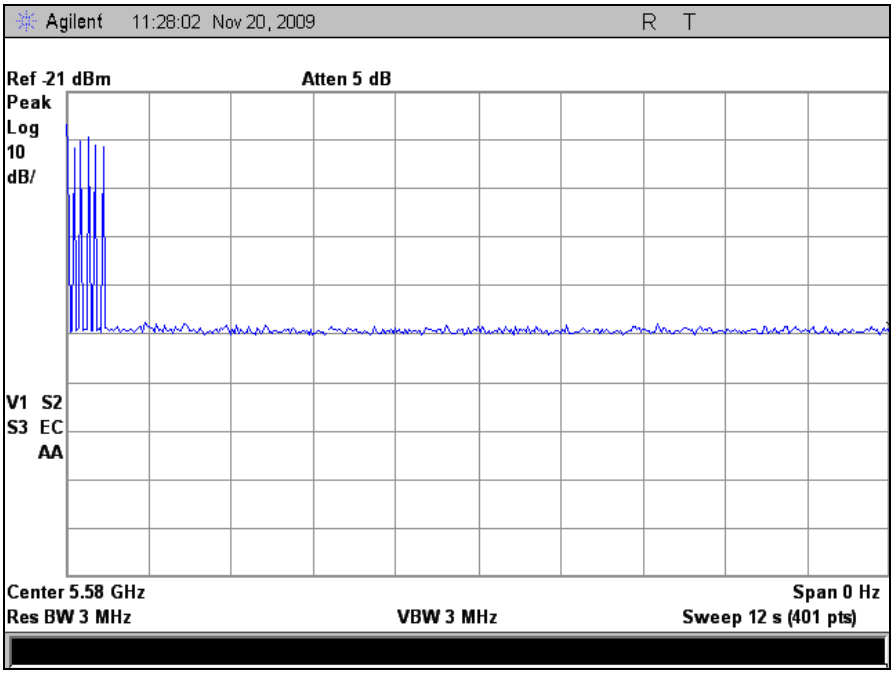
Test Engineer:

Dusmantha Tennakoon

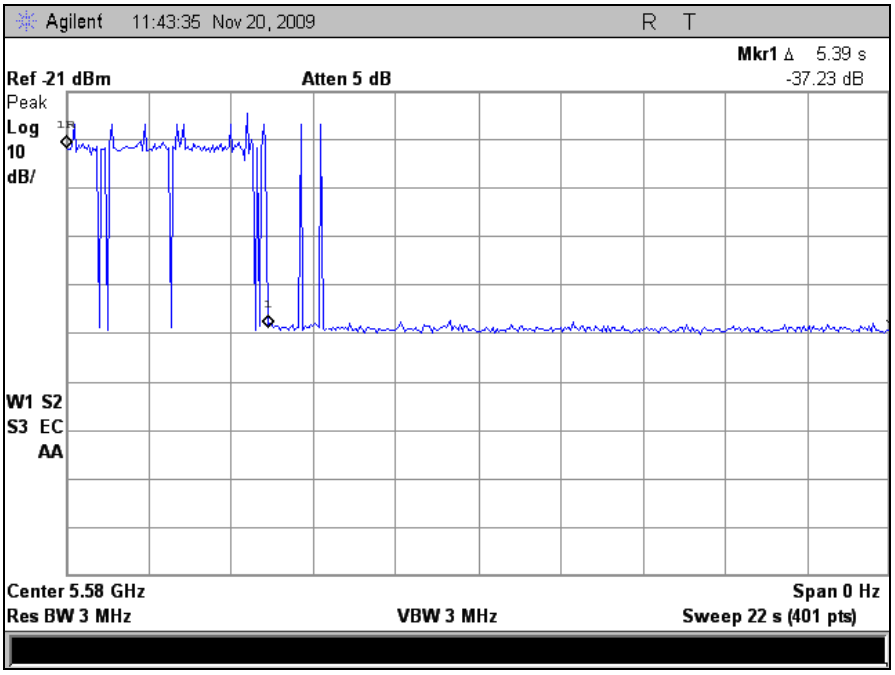
Test Date:

11/25/09

Channel Move Time Test Results

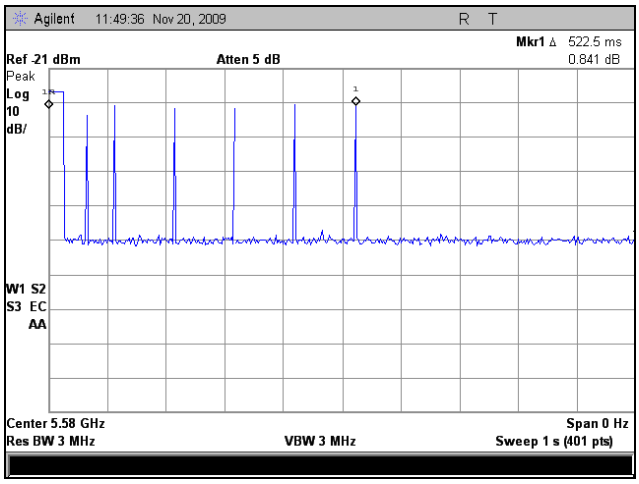


Plot 196. Channel Move Time for Radar Type 1, 12 seconds, 5580 MHz, M25 Radio

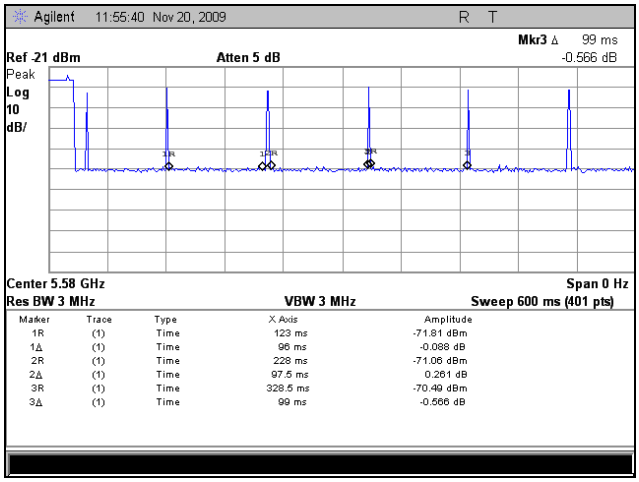


Plot 197. Channel Move Time for Radar Type 5, 22 seconds, 5580 MHz, M25 Radio

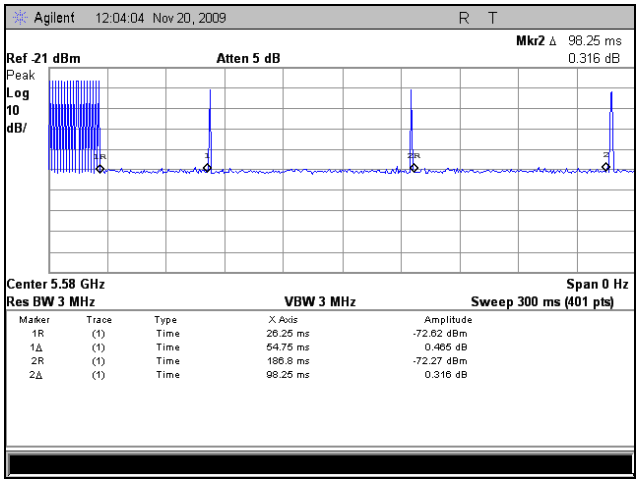
Channel Closing Transmission Time Test Results



Plot 198. Channel Closing Transmission Time, 1000 milliseconds, 5580 MHz, M25 Radio

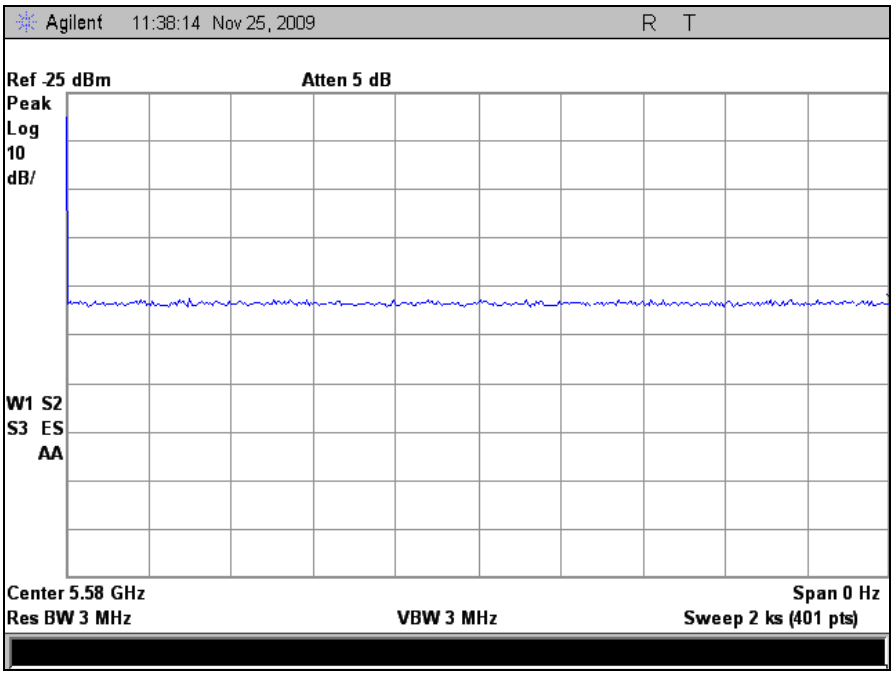


Plot 199. Channel Closing Transmission Time, 600 milliseconds, 5580 MHz, M25 Radio



Plot 200. Channel Closing Transmission Time, 300 milliseconds, 5580 MHz, M25 Radio

Non-Occupancy Period – Plot



Plot 201. Non-Occupancy Period, 30minutes, M25 Radio

H. Statistical Performance Check – M25

Test Requirements: **§ 15.407** During In-Service Monitoring, the EUT requires a minimum percentage of successful radar detections from all required radar waveforms at a level equal to the DFS Detection Threshold + 1dB.

Test Procedure: Stream the MPEG test file from the Master Device to the Client Device on the selected Channel for the entire period of the test. The Radar Waveform generator sends the individual waveform for each of the radar types 1-6 at -63dbm. Statistical data is gathered to determine the ability of the device to detect the radar test waveforms. The device can utilize a test mode to demonstrate when detection occurs to prevent the need to reset the device between trial runs. The percentage of successful detection is calculated by:

$$\frac{TotalWaveformDetections}{TotalWaveformTrials} \times 100$$

The Minimum number of trails, minimum percentage of successful detection and the average minimum percentage of successful detection are found in the Radar Test Waveforms section.

Test Results: The equipment was compliant with § 15.407 Statistical Performance Check. The aggregate detection percentage of radar types 1-4 is greater than 80% as can be seen in the following tables.

Test Engineer: Dusmantha Tennakoon

Test Date: 11/25/09

Statistical Performance Check – Radar Type 1

Radar Type	Trial #	Pulses per Burst	Pulse Width (µsec)	PRI (µsec)	Detection
					1 = Yes, 0 = No
1	1	18	1	1428	1
	2	18	1	1428	1
	3	18	1	1428	1
	4	18	1	1428	1
	5	18	1	1428	1
	6	18	1	1428	1
	7	18	1	1428	1
	8	18	1	1428	1
	9	18	1	1428	1
	10	18	1	1428	1
	11	18	1	1428	1
	12	18	1	1428	1
	13	18	1	1428	1
	14	18	1	1428	1
	15	18	1	1428	1
	16	18	1	1428	1
	17	18	1	1428	1
	18	18	1	1428	1
	19	18	1	1428	1
	20	18	1	1428	1
	21	18	1	1428	1
	22	18	1	1428	1
	23	18	1	1428	1
	24	18	1	1428	1
	25	18	1	1428	1
	26	18	1	1428	1
	27	18	1	1428	1
	28	18	1	1428	1
	29	18	1	1428	1
	30	18	1	1428	1
	Detection Percentage				100% (> 60%)

Table 27. Statistical Performance Check – Radar Type 1, 5580 MHz, M25 Radio

Statistical Performance Check – Radar Type 2

Radar Type	Trial #	Pulse Width 1 to 5 µsec	PRI 150 to 230 µsec	Pulses per Burst 23 to 29	Detection 1 = Yes, 0 = No
2	1	4.1	203	26	1
	2	1.4	160	28	1
	3	3	194	28	1
	4	1.4	174	25	1
	5	1.6	218	25	1
	6	4.2	215	27	1
	7	3.5	214	24	1
	8	3	155	23	1
	9	3.2	180	23	1
	10	1.3	201	25	1
	11	4.9	213	24	1
	12	4.7	207	25	1
	13	3.1	194	28	1
	14	4.1	203	23	1
	15	1.9	169	25	1
	16	1	208	26	1
	17	2.7	192	29	1
	18	1.4	186	23	1
	19	1.9	188	29	1
	20	2	221	23	1
	21	2.3	183	24	1
	22	2.2	230	26	1
	23	2	211	28	1
	24	3.6	218	29	1
	25	2.5	210	28	1
	26	4.8	205	27	1
	27	1.7	153	28	1
	28	3.4	169	27	1
	29	2.9	217	29	1
	30	3.5	182	28	1
	Detection Percentage				100% (> 60%)

Table 28. Statistical Performance Check – Radar Type 2, 5580 MHz, M25 Radio

Statistical Performance Check – Radar Type 3

Radar Type	Trial #	Pulse Width 6 to 10 µsec	PRI 200 to 500 µsec	Pulses per Burst 16 to 18	Detection 1 = Yes, 0 = No
3	1	9.7	448	18	0
	2	8.1	451	18	1
	3	7.4	287	16	0
	4	5.9	433	18	1
	5	9.9	424	17	1
	6	7.2	435	18	1
	7	8.2	477	17	1
	8	9.2	475	17	1
	9	6.3	317	16	1
	10	6.7	274	17	1
	11	5	337	17	1
	12	8.5	398	18	1
	13	5.7	476	18	1
	14	9.6	368	17	1
	15	9	421	17	1
	16	5.1	457	16	1
	17	6.2	394	17	1
	18	7.1	389	17	1
	19	6.1	443	18	1
	20	5.1	429	16	1
	21	9.2	267	16	1
	22	5.9	266	18	1
	23	7.6	353	18	1
	24	6.5	449	17	1
	25	8.6	371	16	1
	26	9.8	329	16	1
	27	6.8	338	18	1
	28	5.6	346	18	1
	29	9.9	453	17	1
	30	6.7	288	18	1
	Detection Percentage				**93.3% (> 60%)**

Table 29. Statistical Performance Check – Radar Type 3, 5580 MHz, M25 Radio

Statistical Performance Check – Radar Type 4

Radar Type	Trial #	Pulse Width 11 to 20 µsec	PRI 200 to 500 µsec	Pulses per Burst 12 to 16	Detection 1 = Yes, 0 = No
4	1	11.9	362	15	1
	2	18.1	267	16	1
	3	12.3	452	14	0
	4	19.2	492	14	0
	5	11.4	277	14	1
	6	11.4	437	12	1
	7	11	342	16	1
	8	11	311	12	1
	9	19.2	485	16	1
	10	10.8	318	14	1
	11	16.2	329	15	1
	12	16.7	363	15	1
	13	11.9	251	16	1
	14	19.6	282	13	1
	15	14.7	394	15	1
	16	16.4	500	15	1
	17	12.1	443	16	1
	18	19.6	360	15	1
	19	11.9	374	16	1
	20	12.2	471	12	1
	21	13.9	349	14	1
	22	19.4	369	15	1
	23	14.8	300	13	0
	24	17.3	261	12	1
	25	16.9	368	15	1
	26	19.1	325	15	1
	27	14.5	404	14	1
	28	15.5	439	14	0
	29	14.7	399	15	1
	30	13.1	254	15	1
	Detection Percentage				**86.6% (> 60%)**

Table 30. Statistical Performance Check – Radar Type 4, 5580 MHz, M25 Radio

Statistical Performance Check – Radar Type 5

Radar Type	Trial #	Filename*	Detection
			1 = Yes, 0 = No
5	1	bin5-trial 1	0
	2	bin5-trial 2	0
	3	bin5-trial 3	1
	4	bin5-trial 4	1
	5	bin5-trial 5	1
	6	bin5-trial 6	1
	7	bin5-trial 7	1
	8	bin5-trial 8	1
	9	bin5-trial 9	1
	10	bin5-trial 10	0
	11	bin5-trial 11	0
	12	bin5-trial 12	1
	13	bin5-trial 13	1
	14	bin5-trial 14	0
	15	bin5-trial 15	1
	16	bin5-trial 16	1
	17	bin5-trial 17	1
	18	bin5-trial 18	0
	19	bin5-trial 19	1
	20	bin5-trial 20	1
	21	bin5-trial 21	0
	22	bin5-trial 22	1
	23	bin5-trial 23	1
	24	bin5-trial 24	0
	25	bin5-trial 25	1
	26	bin5-trial 26	1
	27	bin5-trial 27	1
	28	bin5-trial 28	1
	29	bin5-trial 29	1
	30	bin5-trial 30	1
	Detection Percentage		**73.3% (> 60%)**

Table 31. Statistical Performance Check – Radar Type 5, 5580 MHz, M25 Radio

Note: See Appendix for Bin 5 test data.

Statistical Performance Check – Radar Type 6

Radar Type	Trial #	Frequency (MHz)	Pulses/Hop	Pulse Width (µsec)	PRI (µsec)	Detection
						1 = Yes, 0 = No
6	1	5580	9	1	333	1
	2	5580	9	1	333	1
	3	5580	9	1	333	1
	4	5580	9	1	333	1
	5	5580	9	1	333	1
	6	5580	9	1	333	1
	7	5580	9	1	333	1
	8	5580	9	1	333	1
	9	5580	9	1	333	1
	10	5580	9	1	333	1
	11	5580	9	1	333	1
	12	5580	9	1	333	1
	13	5580	9	1	333	1
	14	5580	9	1	333	1
	15	5580	9	1	333	1
	16	5580	9	1	333	1
	17	5580	9	1	333	1
	18	5580	9	1	333	1
	19	5580	9	1	333	1
	20	5580	9	1	333	1
	21	5580	9	1	333	1
	22	5580	9	1	333	1
	23	5580	9	1	333	1
	24	5580	9	1	333	1
	25	5580	9	1	333	1
	26	5580	9	1	333	1
	27	5580	9	1	333	1
	28	5580	9	1	333	1
	29	5580	9	1	333	1
	30	5580	9	1	333	1
	Detection Percentage					100% (> 60%)

Table 32. Statistical Performance Check – Radar Type 6, 5580 MHz, M25 Radio

VIII. DFS Test Procedure and Test Results – M5

A. DFS Test Setup – M5

1. A spectrum analyzer is used as a monitor to verify that the Unit Under Test (UUT) has vacated the Channel within the Channel Closing Transmission Time and Channel Move Time, and does not transmit on a Channel during the Non-Occupancy Period after the detection and subsequent Channel move. It is also used to monitor UUT transmissions during the Channel Availability Check Time.
2. The test setup, which consists of test equipment and equipment under test (EUT), is diagrammed in Figure 11 and pictured in Photograph 14

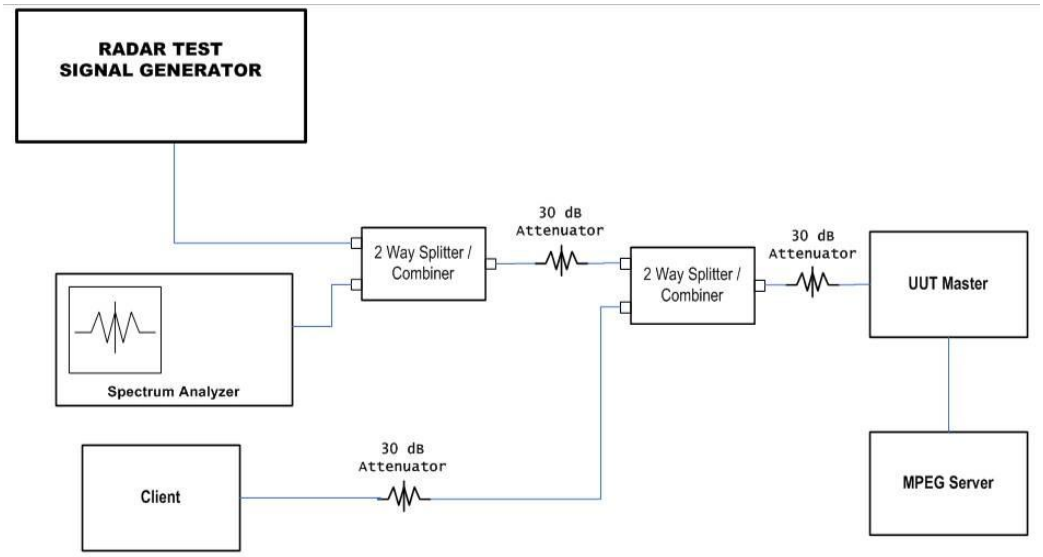
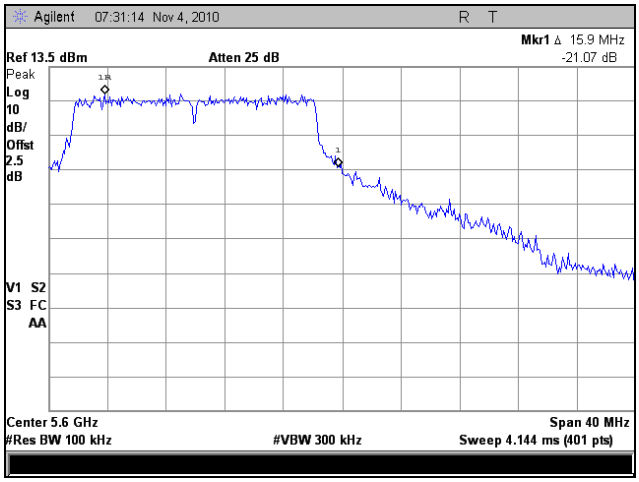
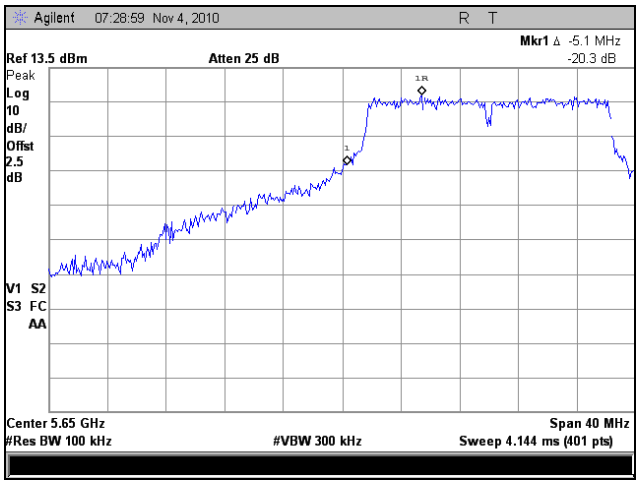


Figure 12. Test Setup Diagram

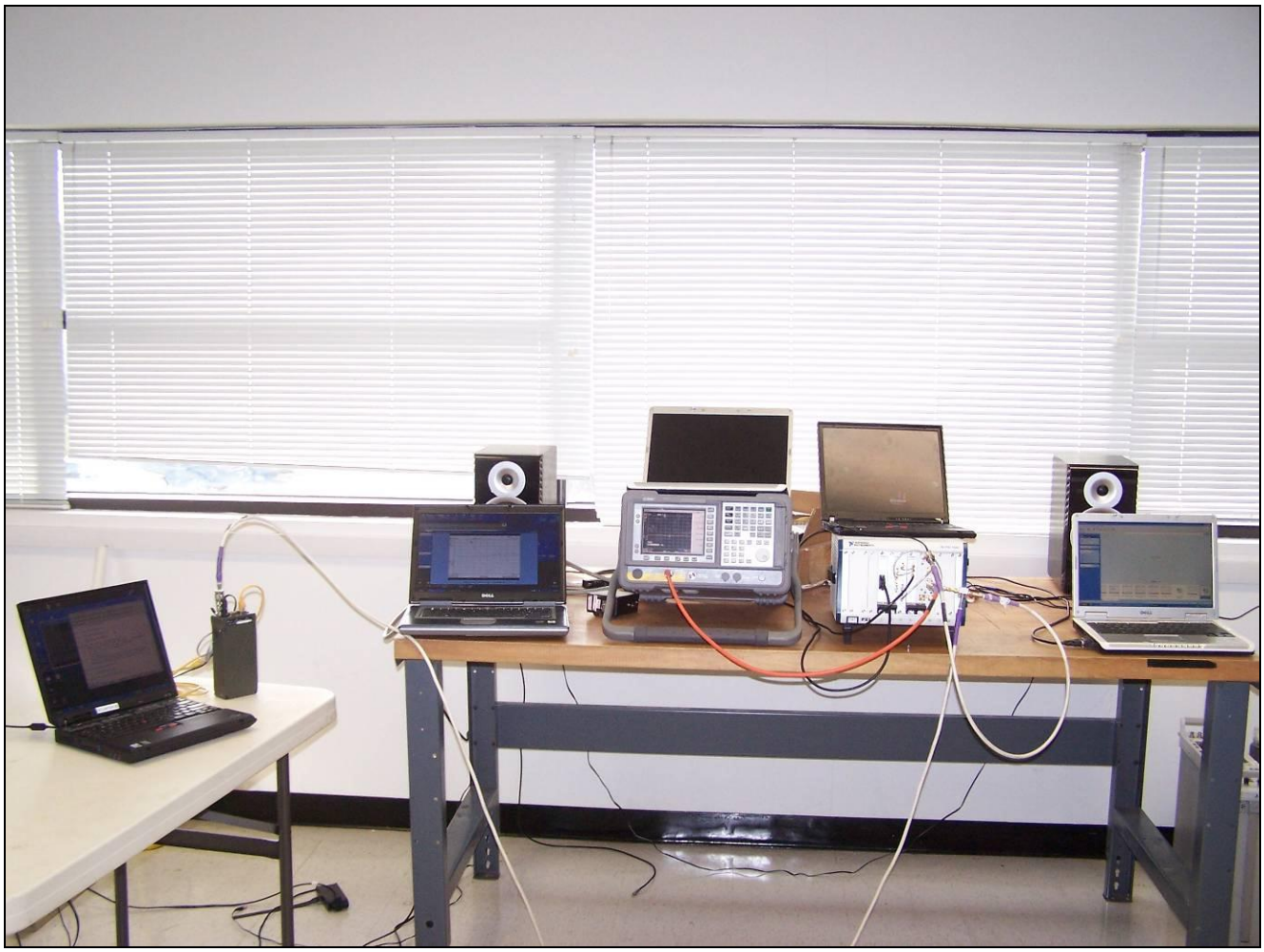
20 dB Band Edge – M5



Plot 202. 20 dB Band Edge, 5590 MHz



Plot 203. 20 dB Band Edge, 5660 MHz



Photograph 15. Test Setup Photo

B. Description of Master Device – M5

1. Operating Frequency Range – 5260-5320 MHz and 5500-5700 MHz
2. Modes of Operation – Master Device
3. Highest and Lowest EIRP – Highest = 17.14dBm;
4. Antenna gain – Omni, 9dBi
5. Antenna impedance – 50 Ohms
6. Antenna gain verification – Use antenna datasheet
7. Test file that is transmitted is the designated MPEG test file that streams full motion video at 30 frames per second from the Master to the Client
8. TPC not required for UNII devices with less than 500 mW EIRP
9. Time for master to complete its power-on-cycle is about 3min
10. The EUT's uniform channel spreading is as follows: The master uses a simple incrementing algorithm: if radar is detected, the next sequential channel is used. For example, if one is on channel 100 and radar is detected, then it will be changed to 104. If radar is then detected on 104, it is changed to 108. When the last channel is reached, we start again at the beginning in a circular fashion.

C. UNII Detection Bandwidth – M5

Test Requirement(s): **§ 15.407** A minimum 80% of the UNII 99% transmission power bandwidth is required.

Test Procedure: All UNII channels for this device have identical channel bandwidths.

A single burst of the short pulse radar type 1 is produced at 5530 MHz, at the -63dBm test level. The UUT is set up as a standalone device (no associated client, and no data traffic).

A single radar burst is generated for a minimum of 10 trials, and the response of the UUT is recorded. The UUT must detect the radar waveform 90% or more of the time.

The radar frequency is increased in 1 MHz steps, repeating the above test sequence, until the detection rate falls below 90%. The highest frequency at which detection is greater than or equal to 90% is denoted F_H.

The radar frequency is decreased in 1 MHz steps, repeating the above test sequence, until the detection rate falls below 90%. The lowest frequency at which detection is greater than or equal to 90% is denoted F_L.

The U-NII Detection Bandwidth is calculated as follows:

$$\text{U-NII Detection Bandwidth} = F_H - F_L$$

Test Engineer: Dusmantha Tennakoon

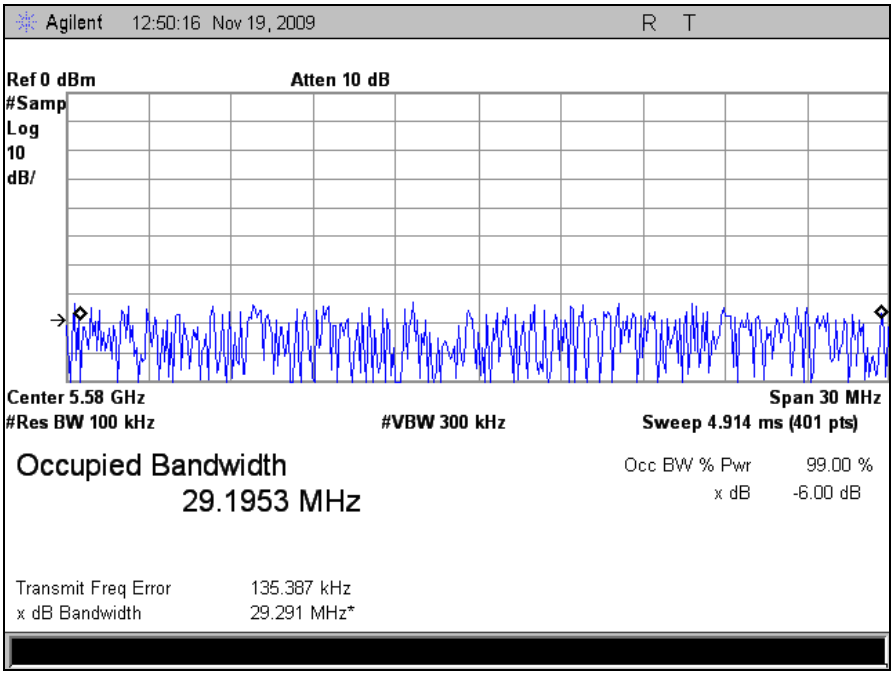
Test Date: 11/30/09

UNII Detection Bandwidth – Test Results

EUT Frequency=5300MHz											
	DFS Detection Trials (1=Detection, Blank= No Detection)										
Radar Frequency (MHz)	1	2	3	4	5	6	7	8	9	10	Detection Rate (%)
5568	0	0	0	0	0	0	0	0	0	0	0%
5569 (Fl)	1	0	0	0	0	0	0	0	0	0	10%
5570	1	1	1	1	1	1	1	1	1	1	100%
5571	1	1	1	1	1	0	1	1	1	1	90%
5572	1	1	1	1	1	0	1	1	1	1	90%
5573	1	1	0	1	1	1	1	1	1	1	90%
5574	1	1	1	1	1	1	1	1	1	1	100%
5575	1	1	1	1	1	1	1	1	1	1	100%
5576	1	1	1	1	1	1	1	1	1	1	100%
5577	1	1	1	1	1	1	1	1	1	1	100%
5578	1	1	1	1	1	1	1	1	1	1	100%
5579	1	1	1	1	1	1	1	1	1	1	100%
5580	1	0	1	1	1	1	1	1	1	1	100%
5581	1	1	1	1	1	1	1	1	1	1	100%
5582	1	1	1	1	1	1	1	1	1	1	100%
5583	1	1	1	1	1	1	1	1	1	1	100%
5584	1	1	1	1	1	1	1	1	1	1	100%
5585	1	1	1	1	1	1	1	1	1	1	100%
5586	1	1	1	1	1	1	1	1	1	1	100%
5587	1	1	1	1	1	1	1	1	1	1	100%
5588	1	1	1	1	1	1	1	1	1	1	100%
5589	1	1	1	1	1	1	1	1	1	1	100%
5590	1	1	1	1	1	1	1	1	1	1	100%
5591(Fh)	0	0	0	1	1	1	0	1	1	0	40%
5592	0	0	0	0	0	0	0	0	0	0	0%
Detection Bandwidth = Fh-Fl =											
EUT 99% Bandwidth = xxxMHz											
xxxMHz*80% = xxxMHz											

Table 33. UNII Detection Bandwidth, Test Results, 5530 MHz, M5 Radio

UNII Detection Bandwidth Plots



Plot 204. Occupied Bandwidth, 5530 MHz, M5 Radio

D. Initial Channel Availability Check Time – M5

Test Requirements: **§ 15.407** The Initial Channel Availability Check Time tests that the UUT does not emit beacon, control, or data signals on the test channel until the power-up sequence has been completed and the U-NII device has checked for radar waveforms, for one minute, on the test channel. This test does not use any of the radar waveforms and only needs to be performed once.

The UUT should not make any transmissions over the test channel, for at least 1 minute after completion of its power-on cycle.

Test Procedure: The U-NII device is powered on and instructed to operate at 5580 MHz. At the same time the UUT is powered on, the spectrum analyzer is set to 5580MHz with a zero span and a 200 sec. sweep time. The analyzer is triggered at the same time power is applied to the U-NII device.

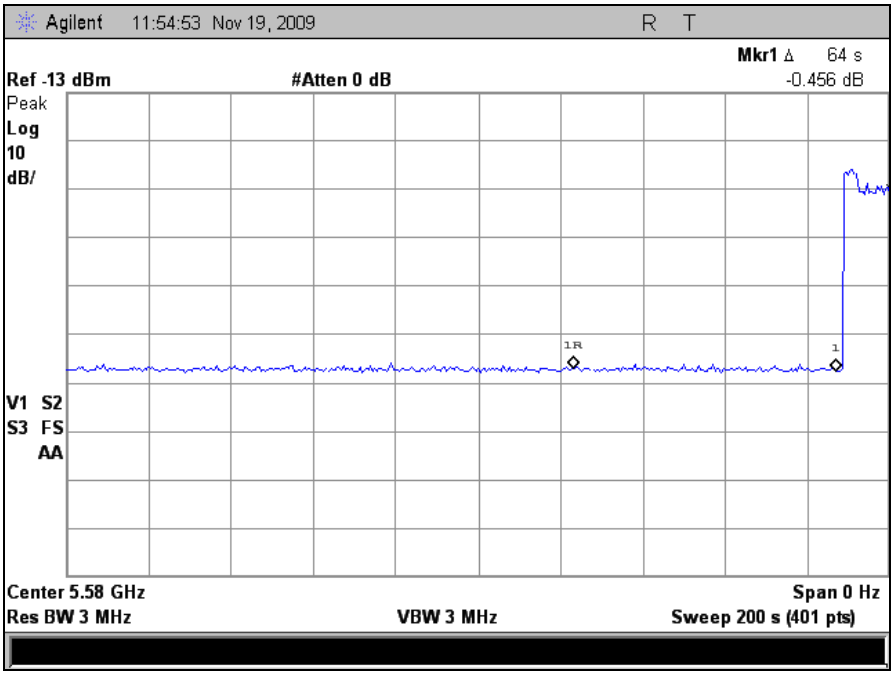
Test Results: Marker 1R on Plot 205 indicates the start of the channel availability check time. Initial beacon/data transmission is indicated by marker 1.

The Equipment was compliant with § 15.407 Initial Channel Availability Check Time.

Test Engineer: Dusmantha Tennakoon

Test Date: 11/30/09

Initial Channel Availability Check Time Test Results



Plot 205. Initial Channel Availability Check Time 60 sec, M5 Radio

E. Radar Burst at the Beginning of Channel Availability Check Time – M5

Test Requirements: **§ 15.407** A Radar Burst at the Beginning of the Channel Availability Check Time tests that the UUT does not emit beacon, control, or data signals on the test Channel if it has detected a radar burst during that time period until the power-up sequence has been completed and the U-NII device checks for Radar Waveforms for one minute on the test Channel. The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold + 1 dB occurs at the beginning of the Channel Availability Check Time.

Test Procedure: The UUT is powered on at T0. T1 denotes the instant when the UUT has completed its power-up sequence. The Channel Availability Check Time commences at instant T1 and will end no sooner than T1 + 60 seconds.

A single Burst of short pulse radar type 1 will commence within a 6 second window starting at T1.

Visual indication of the UUT of successful detection of the radar Burst will be recorded and reported. Observation of transmission at 5580MHz will continue for 2.5 minutes after the radar Burst has been generated.

Verify that during the 2.5 minute measurement window, no UUT transmissions occur at 5580MHz.

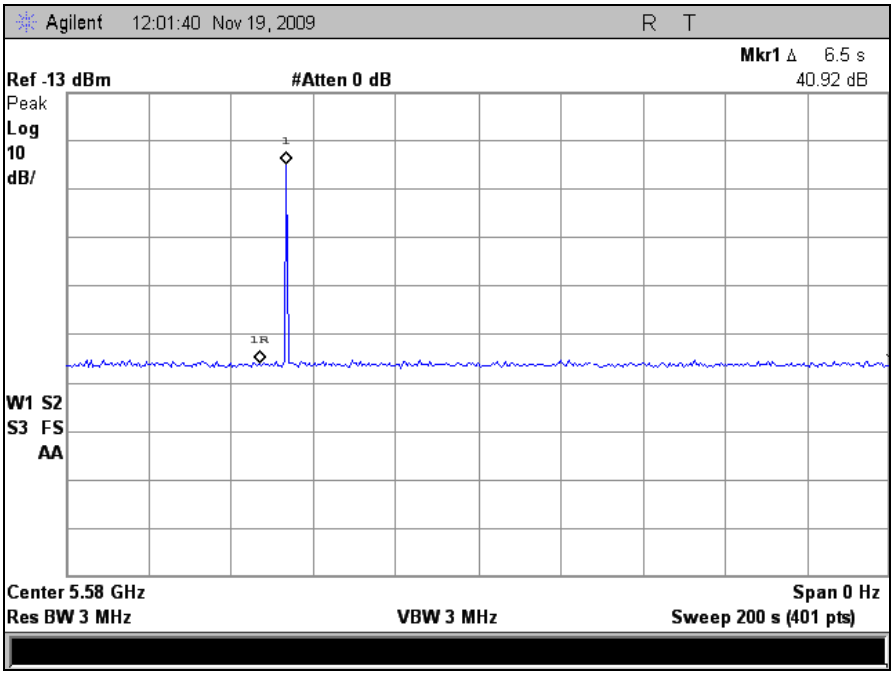
Test Results Plot 206 below indicates that there were no UUT transmissions during the 2.5 minute measurement window when a radar burst was injected 6 seconds into the CACT. Therefore, the UUT detected the presence of a radar during the CACT and moved away from that channel.

The equipment was compliant with § 15.407 Radar Burst at the Beginning of the Channel Availability Check Time.

Test Engineer: Dusmantha Tennakoon

Test Date: 11/30/09

Radar Burst at the Beginning of Channel Availability Check Time Test Results



Plot 206. Radar Burst at the Beginning of CACT, 6 sec (5580MHz) , M5 Radio

F. Radar Burst at the End of Channel Availability Check Time – M25

Test Requirements: **§ 15.407** A Radar Burst at the End of the Channel Availability Check Time tests that the UUT does not emit beacon, control, or data signals on the test Channel if it has detected a radar burst during that time period until the power-up sequence has been completed and the U-NII device checks for Radar Waveforms for one minute on the test Channel. The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold + 1 dB occurs at the end of the Channel Availability Check Time.

Test Procedure: The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold + 1 dB occurs at the end of the Channel Availability Check Time.

The UUT is powered on at T0. T1 denotes the instant when the UUT has completed its power-up sequence. The Channel Availability Check Time commences at instant T1 and will end no sooner than T1 + 60 seconds.

A single Burst of short pulse of radar type 1 will commence within a 6 second window starting at T1+ 54 seconds.

Visual indication on the UUT of successful detection of the radar Burst will be recorded and reported. Observation of emissions at 5580MHz will continue for 2.5 minutes after the radar Burst has been generated.

Verify that during the 2.5 minute measurement window no UUT transmissions occurred at 5580MHz.

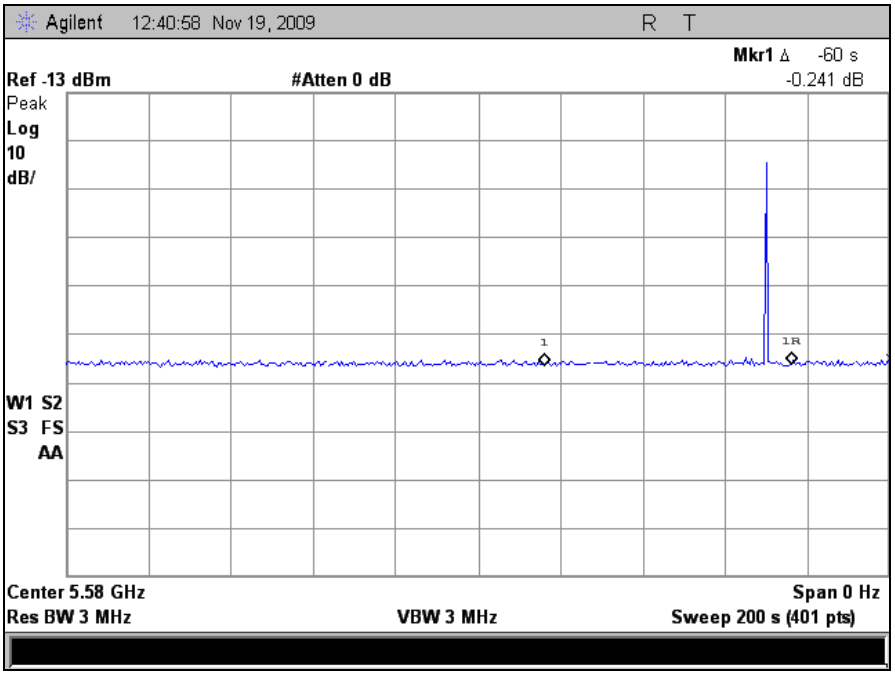
Test Results: Plot 207 indicates that no UUT transmissions occurred during the 2.5 minute measurement window when a radar burst was injected 6 seconds before the end of the CACT. Therefore, the UUT detected the presence of a radar and moved away from that channel.

The equipment was compliant with § 15.407 Radar Burst at the End of the Channel Availability Check Time.

Test Engineer: Dusmantha Tennakoon

Test Date: 11/30/09

Radar Burst at the End of Channel Availability Check Time Test Results



Plot 207. Radar Burst at the End of CACT, 54 sec (5580MHz), M5 Radio

G. In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time, and Non-Occupancy Period – M5

Test Requirements:

§ 15.407 (Refer to DFS Response Requirement Values table in section III-A of this report.) The UUT shall continuously monitor for radar transmissions in the operating test channel. When a radar burst occurs in the test channel, it has 10 seconds to move to another channel. This 10 second window is termed Channel Move Time (CMT).

When a radar burst occurs, the UUT has 200 milliseconds, plus an aggregate of 60 milliseconds, to cease transmission in the operating test channel. This 200 ms + 60 ms requirement is termed Channel Closing Transmission Time (CCT).

After radar burst and subsequent move to another channel, the UUT shall not resume transmission, on the channel it moved from, for a period of 30 minutes. This requirement is termed Non-Occupancy Period (NOP).

Test Procedure:

These tests define how the following DFS parameters are verified during In-Service Monitoring: Channel Closing Transmission Time, Channel Move Time, and Non-Occupancy Period.

The steps below define the procedure to determine the above mentioned parameters when a radar Burst with a level equal to the DFS Detection Threshold + 1dB is generated on the Operating Channel of the U-NII device.

A U-NII device operating as a Client Device will associate with the UUT (Master) at 5580 MHz. Stream the MPEG test file from the Master Device to the Client Device on the selected Channel for the entire period of the test.

At time T0 the Radar Waveform generator sends a Burst of pulses for each of the radar types.

Observe the transmissions of the UUT at the end of the radar Burst on the Operating Channel for duration greater than 10 seconds. Measure and record the transmissions from the UUT during the observation time (Channel Move Time). Compare the Channel Move Time and Channel Closing Transmission Time results to the limits defined in the *DFS Response Requirement Values table*.

Test Results:

The EUT was compliant with § 15.407 In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time, and Non-Occupancy Period.

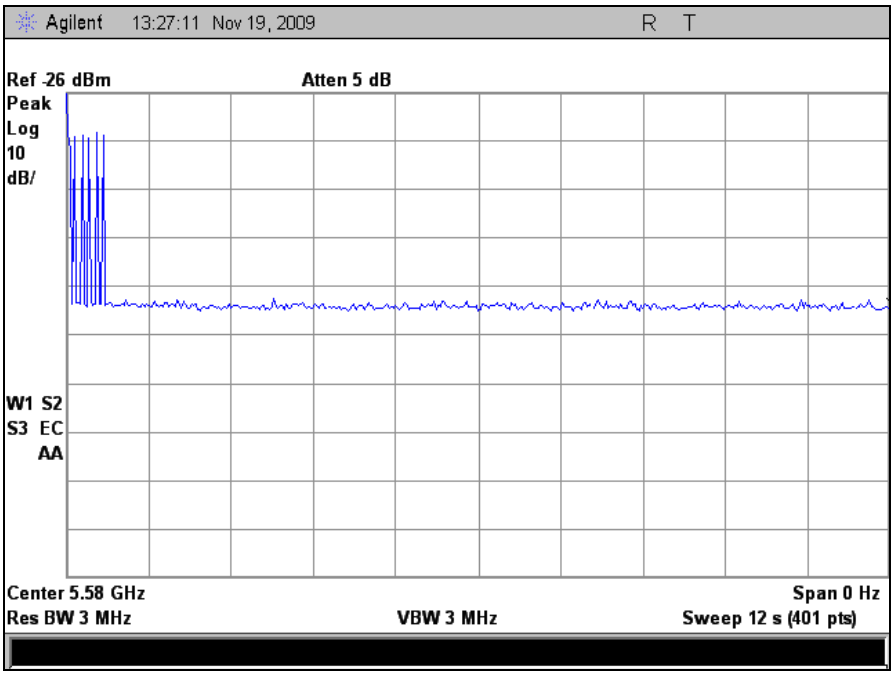
Test Engineer:

Dusmantha Tennakoon

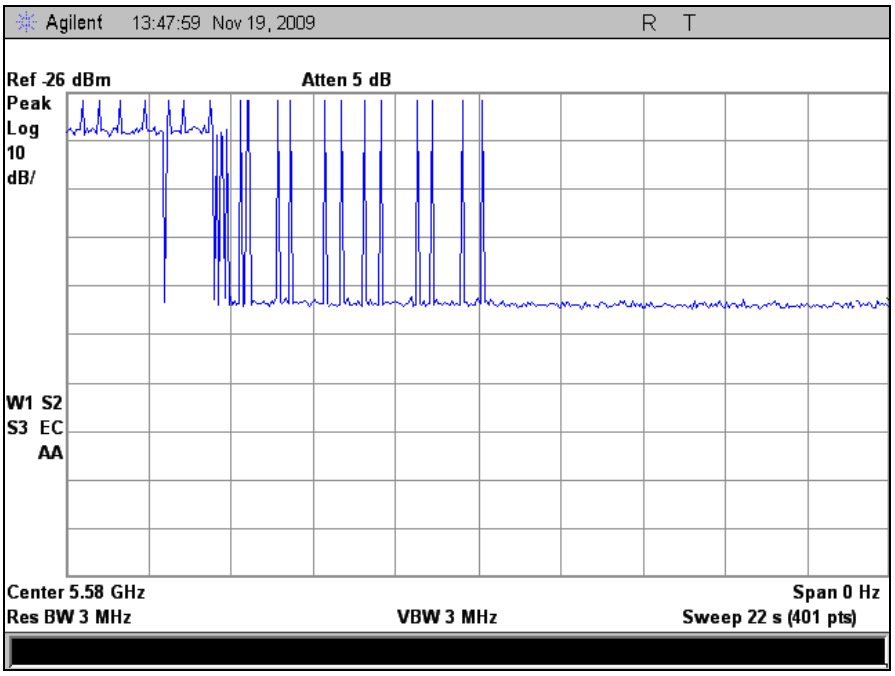
Test Date:

11/30/09

Channel Move Time Test Results

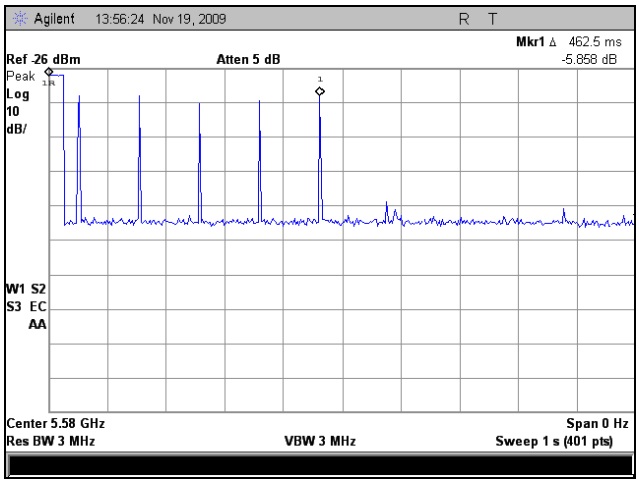


Plot 208. Channel Move Time for Radar Type 1, 12 seconds, 5580 MHz, M5 Radio

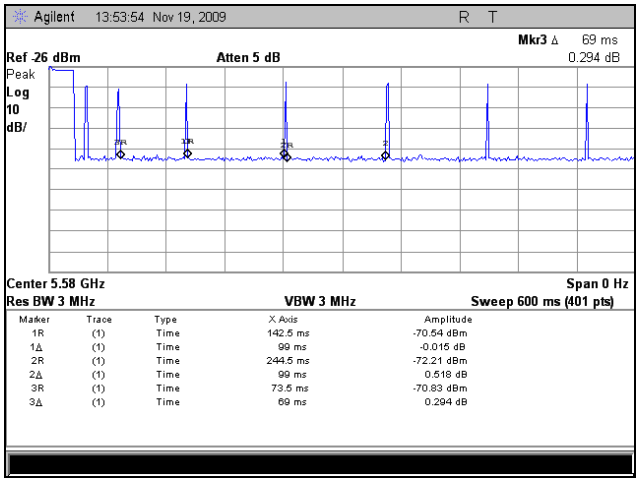


Plot 209. Channel Move Time for Radar Type 5, 22 seconds, 5580 MHz, M5 Radio

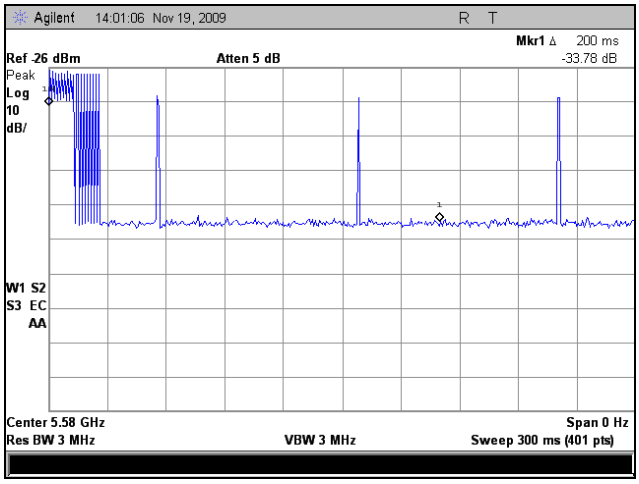
Channel Closing Transmission Time Test Results



Plot 210. Channel Closing Transmission Time, 1000 milliseconds, 5580 MHz, M5 Radio

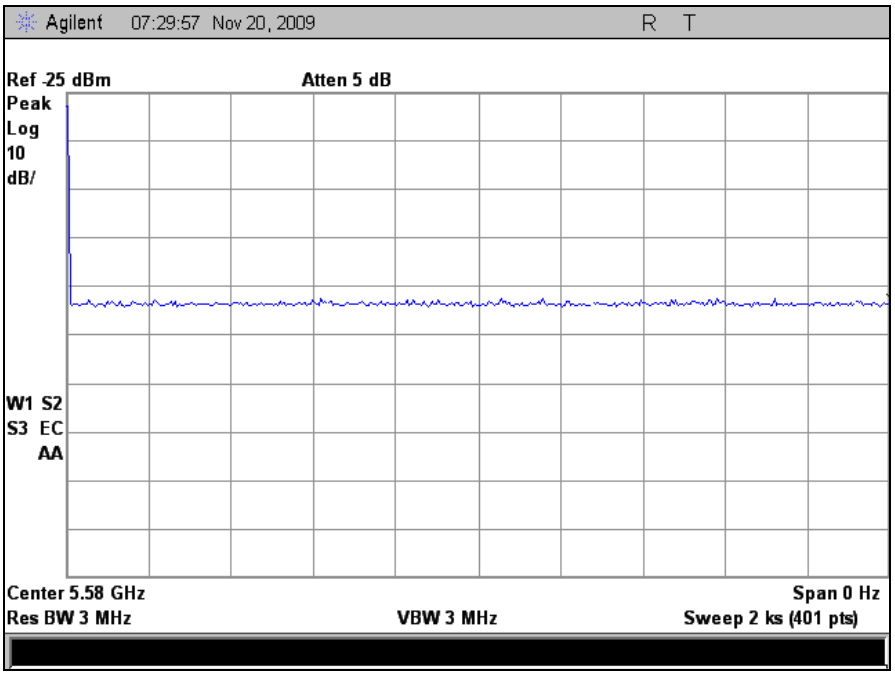


Plot 211. Channel Closing Transmission Time, 600 milliseconds, 5580 MHz, M5 Radio



Plot 212. Channel Closing Transmission Time, 300 milliseconds, 5580 MHz, M5 Radio

Non-Occupancy Period – Plot



Plot 213. Non-Occupancy Period, 30minutes, M5 Radio

H. Statistical Performance Check – M5

Test Requirements: **§ 15.407** During In-Service Monitoring, the EUT requires a minimum percentage of successful radar detections from all required radar waveforms at a level equal to the DFS Detection Threshold + 1dB.

Test Procedure: Stream the MPEG test file from the Master Device to the Client Device on the selected Channel for the entire period of the test. The Radar Waveform generator sends the individual waveform for each of the radar types 1-6 at -63dbm. Statistical data is gathered to determine the ability of the device to detect the radar test waveforms. The device can utilize a test mode to demonstrate when detection occurs to prevent the need to reset the device between trial runs. The percentage of successful detection is calculated by:

$$\frac{TotalWaveformDetections}{TotalWaveformTrials} \times 100$$

The Minimum number of trails, minimum percentage of successful detection and the average minimum percentage of successful detection are found in the Radar Test Waveforms section.

Test Results: The equipment was compliant with § 15.407 Statistical Performance Check. The aggregate detection percentage of radar types 1-4 is greater than 80% as can be seen in the following tables.

Test Engineer: Dusmantha Tennakoon

Test Date: 11/30/09

Statistical Performance Check – Radar Type 1

Radar Type	Trial #	Pulses per Burst	Pulse Width (µsec)	PRI (µsec)	Detection
					1 = Yes, 0 = No
1	1	18	1	1428	1
	2	18	1	1428	1
	3	18	1	1428	1
	4	18	1	1428	1
	5	18	1	1428	1
	6	18	1	1428	1
	7	18	1	1428	1
	8	18	1	1428	1
	9	18	1	1428	1
	10	18	1	1428	1
	11	18	1	1428	1
	12	18	1	1428	1
	13	18	1	1428	1
	14	18	1	1428	1
	15	18	1	1428	1
	16	18	1	1428	1
	17	18	1	1428	1
	18	18	1	1428	1
	19	18	1	1428	1
	20	18	1	1428	1
	21	18	1	1428	1
	22	18	1	1428	1
	23	18	1	1428	1
	24	18	1	1428	1
	25	18	1	1428	1
	26	18	1	1428	1
	27	18	1	1428	1
	28	18	1	1428	1
	29	18	1	1428	1
	30	18	1	1428	1
	Detection Percentage				100% (> 60%)

Table 34. Statistical Performance Check – Radar Type 1, 5580 MHz, M5 Radio

Statistical Performance Check – Radar Type 2

Radar Type	Trial #	Pulse Width 1 to 5 µsec	PRI 150 to 230 µsec	Pulses per Burst 23 to 29	Detection 1 = Yes, 0 = No
2	1	4.1	203	26	1
	2	1.4	160	28	1
	3	3	194	28	1
	4	1.4	174	25	1
	5	1.6	218	25	1
	6	4.2	215	27	1
	7	3.5	214	24	1
	8	3	155	23	1
	9	3.2	180	23	1
	10	1.3	201	25	1
	11	4.9	213	24	1
	12	4.7	207	25	1
	13	3.1	194	28	1
	14	4.1	203	23	1
	15	1.9	169	25	1
	16	1	208	26	1
	17	2.7	192	29	1
	18	1.4	186	23	1
	19	1.9	188	29	1
	20	2	221	23	1
	21	2.3	183	24	1
	22	2.2	230	26	1
	23	2	211	28	1
	24	3.6	218	29	1
	25	2.5	210	28	1
	26	4.8	205	27	1
	27	1.7	153	28	1
	28	3.4	169	27	1
	29	2.9	217	29	1
	30	3.5	182	28	1
	Detection Percentage				100% (> 60%)

Table 35. Statistical Performance Check – Radar Type 2, 5580 MHz, M5 Radio

Statistical Performance Check – Radar Type 3

Radar Type	Trial #	Pulse Width 6 to 10 µsec	PRI 200 to 500 µsec	Pulses per Burst 16 to 18	Detection 1 = Yes, 0 = No
3	1	9.7	448	18	1
	2	8.1	451	18	1
	3	7.4	287	16	1
	4	5.9	433	18	1
	5	9.9	424	17	1
	6	7.2	435	18	1
	7	8.2	477	17	1
	8	9.2	475	17	0
	9	6.3	317	16	1
	10	6.7	274	17	1
	11	5	337	17	1
	12	8.5	398	18	1
	13	5.7	476	18	1
	14	9.6	368	17	1
	15	9	421	17	0
	16	5.1	457	16	1
	17	6.2	394	17	1
	18	7.1	389	17	1
	19	6.1	443	18	1
	20	5.1	429	16	1
	21	9.2	267	16	1
	22	5.9	266	18	1
	23	7.6	353	18	1
	24	6.5	449	17	1
	25	8.6	371	16	1
	26	9.8	329	16	1
	27	6.8	338	18	1
	28	5.6	346	18	0
	29	9.9	453	17	0
	30	6.7	288	18	1
	Detection Percentage				**86.6% (> 60%)**

Table 36. Statistical Performance Check – Radar Type 3, 5580 MHz, M5 Radio

Statistical Performance Check – Radar Type 4

Radar Type	Trial #	Pulse Width 11 to 20 µsec	PRI 200 to 500 µsec	Pulses per Burst 12 to 16	Detection 1 = Yes, 0 = No
4	1	11.9	362	15	0
	2	18.1	267	16	0
	3	12.3	452	14	0
	4	19.2	492	14	1
	5	11.4	277	14	1
	6	11.4	437	12	1
	7	11	342	16	0
	8	11	311	12	1
	9	19.2	485	16	1
	10	10.8	318	14	1
	11	16.2	329	15	1
	12	16.7	363	15	1
	13	11.9	251	16	1
	14	19.6	282	13	0
	15	14.7	394	15	1
	16	16.4	500	15	1
	17	12.1	443	16	1
	18	19.6	360	15	1
	19	11.9	374	16	1
	20	12.2	471	12	1
	21	13.9	349	14	1
	22	19.4	369	15	1
	23	14.8	300	13	1
	24	17.3	261	12	1
	25	16.9	368	15	1
	26	19.1	325	15	1
	27	14.5	404	14	1
	28	15.5	439	14	1
	29	14.7	399	15	1
	30	13.1	254	15	1
	Detection Percentage				**83.3% (> 60%)**

Table 37. Statistical Performance Check – Radar Type 4, 5580 MHz, M5 Radio

Statistical Performance Check – Radar Type 5

Radar Type	Trial #	Filename*	Detection
			1 = Yes, 0 = No
5	1	bin5-trial 1	0
	2	bin5-trial 2	1
	3	bin5-trial 3	1
	4	bin5-trial 4	1
	5	bin5-trial 5	1
	6	bin5-trial 6	1
	7	bin5-trial 7	1
	8	bin5-trial 8	1
	9	bin5-trial 9	0
	10	bin5-trial 10	1
	11	bin5-trial 11	1
	12	bin5-trial 12	0
	13	bin5-trial 13	1
	14	bin5-trial 14	1
	15	bin5-trial 15	1
	16	bin5-trial 16	1
	17	bin5-trial 17	1
	18	bin5-trial 18	1
	19	bin5-trial 19	1
	20	bin5-trial 20	0
	21	bin5-trial 21	0
	22	bin5-trial 22	1
	23	bin5-trial 23	1
	24	bin5-trial 24	1
	25	bin5-trial 25	0
	26	bin5-trial 26	0
	27	bin5-trial 27	1
	28	bin5-trial 28	1
	29	bin5-trial 29	0
	30	bin5-trial 30	1
	Detection Percentage		**73.3% (> 60%)**

Table 38. Statistical Performance Check – Radar Type 5, 5580 MHz, M5 Radio

Note: See Appendix for Bin 5 test data.

Statistical Performance Check – Radar Type 6

Radar Type	Trial #	Frequency (MHz)	Pulses/Hop	Pulse Width (µsec)	PRI (µsec)	Detection
						1 = Yes, 0 = No
6	1	5580	9	1	333	1
	2	5580	9	1	333	1
	3	5580	9	1	333	1
	4	5580	9	1	333	1
	5	5580	9	1	333	1
	6	5580	9	1	333	1
	7	5580	9	1	333	1
	8	5580	9	1	333	1
	9	5580	9	1	333	1
	10	5580	9	1	333	1
	11	5580	9	1	333	1
	12	5580	9	1	333	1
	13	5580	9	1	333	1
	14	5580	9	1	333	1
	15	5580	9	1	333	1
	16	5580	9	1	333	1
	17	5580	9	1	333	1
	18	5580	9	1	333	1
	19	5580	9	1	333	1
	20	5580	9	1	333	1
	21	5580	9	1	333	1
	22	5580	9	1	333	1
	23	5580	9	1	333	1
	24	5580	9	1	333	1
	25	5580	9	1	333	1
	26	5580	9	1	333	1
	27	5580	9	1	333	1
	28	5580	9	1	333	1
	29	5580	9	1	333	1
	30	5580	9	1	333	1
	Detection Percentage					100% (> 60%)

Table 39. Statistical Performance Check – Radar Type 6, 5580 MHz, M5 Radio

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
1T4303	ANTENNA; BILOG	SCHAFNER - CHASE EMC	CBL6140A	07/29/2009	07/29/2010
1T4414	MICROWAVE PRE-AMPLIFIER	AH SYSTEMS	PAM-0118	SEE NOTE	
1T4300	SEMI-ANECHOIC CHAMBER # 1	EMC TEST SYSTEMS	NONE	08/24/2007	08/24/2010
1T4409	EMI RECEIVER	ROHDE & SCHWARZ	ESIB7	05/07/2009	05/07/2010
1T4548	AC POWER SOURCE	CALIFORNIA INSTRUMENTS	1251P	SEE NOTE	
1T2511	ANTENNA; HORN	EMCO	3115	08/21/2009	08/21/2010
1T4592	RF FILTER KIT	VARIOUS	N/A	SEE NOTE	
1T4505	TEMPERATURE CHAMBER	TEST EQUITY	115	10/01/2009	11/01/2010
1T4612	ESA-E SERIES SPECTRUM ANALYZER	AGILENT	E4407B	09/09/2009	09/09/2010
1T2665	HORN ANTENNA	EMCO	3115	07/06/2009	07/06/2010

Table 40. Test Equipment List

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

MET Asset	Equipment	Manufacturer	Last Cal Date	Cal Due Date
1S2243	NI PXI-1042 8-SLOT 3U CHASSIS	NATIONAL INSTRUMENTS	SEE NOTE	
1S2602	NI PXI-5421 16-BIT 100MS/S ARBITRARY WAVEFORM GENERATOR	NATIONAL INSTRUMENTS	SEE NOTE	
1S2278	NI PXI-5610 2.7GHZ RF UPCONVERTER	NATIONAL INSTRUMENTS	SEE NOTE	
1S2069	UPCONVERTER, 7206 PXI 4.9 TO 6GHZ	ASCOR	SEE NOTE	
N/A	SPLITTER/COMBINER, ZFSC-2-9G (QTY 2)	MINI-CIRCUITS	SEE NOTE	
N/A	30DB ATTENUATOR, BW-S30W2 (QTY 2)	PASTERNAK	SEE NOTE	
N/A	10DB ATTENUATOR, BW-S10W2 (QTY 2)	PASTERNAK	SEE NOTE	
1S2523	PRE-AMPLIFIER, 8449B	AGILENT	SEE NOTE	
1S2583	SPECTRUM ANALYZER, E447A	AGILENT	01/12/2009	01/12/2010
1S2460	SPECTRUM ANALYZER, E4407B	AGILENT	04/14/2009	04/14/2010

Table 41. DFS Equipment List

Note: Functionally verified test 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.

VI. Appendix

New3RandParmBin5.txt

Waveform Num = 1
Num of Bursts = 19
Burst Interval (us) = 631579.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
1	219592	1	5.0	69	1144	0	0	219592	0	631578
2	842868	2	12.0	54	1549	1741	0	1063604	631579	1263157
3	220113	1	12.0	69	1943	0	0	1287007	1263158	1894736
4	1227594	1	9.0	80	1503	0	0	2516544	1894737	2526315
5	568825	3	19.0	50	1830	1069	1044	3086872	2526316	3157894
6	86858	1	15.0	71	1231	0	0	3177673	3157895	3789473
7	923342	3	15.0	65	1023	1248	1750	4102246	3789474	4421052
8	504813	3	10.0	70	1600	1948	1010	4611080	4421053	5052631
9	684536	3	6.0	67	1710	1391	1636	5300174	5052632	5684210
10	848401	3	18.0	90	1908	1049	1956	6153312	5684211	6315789
11	434958	2	19.0	74	1558	1496	0	6593183	6315790	6947368
12	625046	3	11.0	69	1067	1980	1893	7221283	6947369	7578947
13	413160	3	9.0	57	1624	1900	1187	7639383	7578948	8210526
14	895958	3	10.0	59	1739	1206	1395	8540052	8210527	8842105
15	501180	3	16.0	70	1591	1818	1296	9045572	8842106	9473684
16	432626	3	20.0	62	1252	1219	1412	9482903	9473685	10105263
17	660047	1	10.0	55	1709	0	0	10146833	10105264	10736842
18	634981	2	17.0	95	1171	1281	0	10783523	10736843	11368421
19	649331	3	12.0	96	1230	1232	1269	11435306	11368422	12000000

Total number of pulses in waveform = 44

Waveform Num = 2
Num of Bursts = 12

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New3RandParmBin5.txt

Burst Interval (us) = 1000000.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
1	286710	3	10.0	79	1849	1396	1098	286710	0	999999
2	1681000	1	6.0	52	1013	0	0	1972053	1000000	1999999
3	403567	3	18.0	51	1006	1244	1817	2376633	2000000	2999999
4	701451	2	20.0	71	1978	1962	0	3082151	3000000	3999999
5	1205852	2	14.0	66	1806	1937	0	4291943	4000000	4999999
6	1117951	1	14.0	77	1726	0	0	5413637	5000000	5999999
7	853688	1	10.0	93	1711	0	0	6269051	6000000	6999999
8	954490	2	11.0	81	1572	1886	0	7225252	7000000	7999999
9	1115883	3	16.0	87	1383	1808	1672	8344593	8000000	8999999
10	1498936	3	5.0	80	1152	1071	1557	9848392	9000000	9999999
11	346054	2	20.0	85	1809	1351	0	10198226	10000000	10999999
12	1718324	3	5.0	77	1140	1041	1400	11919710	11000000	11999999

Total number of pulses in waveform = 26

Waveform Num = 3
Num of Bursts = 11
Burst Interval (us) = 1090909.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
1	767352	3	5.0	100	1404	1764	1588	767352	0	1090908
2	724801	1	6.0	54	1774	0	0	1496909	1090909	2181817
3	845897	1	8.0	89	1953	0	0	2344580	2181818	3272726
4	1281256	1	13.0	70	1099	0	0	3627789	3272727	4363635
5	1506281	2	12.0	83	1807	1862	0	5135169	4363636	5454544
6	657302	1	18.0	66	1836	0	0	5796140	5454545	6545453

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7	1216071	2	8.0	58	1990	1046	0	7014047	6545454	7636362
8	1304832	3	5.0	83	1648	1322	1906	8321915	7636363	8727271
9	882122	3	7.0	91	1937	1081	1576	9208913	8727272	9818180
10	688110	2	14.0	64	1345	1541	0	9901617	9818181	10909089
11	1349407	3	6.0	85	1618	1854	1277	11253910	10909090	11999998

Total number of pulses in waveform = 22

Waveform Num = 4
Num of Bursts = 11
Burst Interval (us) = 1090909.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
1	511430	2	19.0	84	1620	1578	0	511430	0	1090908
2	1293530	2	14.0	69	1607	1304	0	1808158	1090909	2181817
3	972369	2	5.0	51	1375	1990	0	2783438	2181818	3272726
4	805592	3	17.0	72	1245	1278	1913	3592395	3272727	4363635
5	1842234	3	13.0	84	1556	1555	1045	5439065	4363636	5454544
6	1009468	1	9.0	93	1111	0	0	6452689	5454545	6545453
7	1089810	1	8.0	53	1590	0	0	7543610	6545454	7636362
8	686190	3	10.0	67	1783	1813	1915	8231390	7636363	8727271
9	1440730	3	19.0	89	1160	1007	1683	9677631	8727272	9818180
10	272626	2	16.0	86	1657	1090	0	9954107	9818181	10909089
11	1851717	2	17.0	95	1614	1767	0	11808571	10909090	11999998

Total number of pulses in waveform = 24

Waveform Num = 5
Num of Bursts = 16
Burst Interval (us) = 750000.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)

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1	241760	1	12.0	58	1422	0	0	241760	0	749999
2	989389	3	12.0	53	1066	1116	1998	1232571	750000	1499999
3	737926	1	13.0	75	1458	0	0	1974677	1500000	2249999
4	659222	2	11.0	51	1381	1232	0	2635357	2250000	2999999
5	413551	3	9.0	54	1908	1474	1048	3051521	3000000	3749999
6	1092922	1	15.0	93	1576	0	0	4148873	3750000	4499999
7	475727	2	10.0	67	1229	1208	0	4626176	4500000	5249999
8	876941	1	13.0	60	1192	0	0	5505554	5250000	5999999
9	517442	3	9.0	74	1815	1479	1628	6024188	6000000	6749999
10	1241780	2	8.0	61	1207	1436	0	7270890	6750000	7499999
11	670132	2	11.0	54	1473	1255	0	7943665	7500000	8249999
12	760391	1	15.0	50	1550	0	0	8706784	8250000	8999999
13	945398	3	14.0	51	1363	1028	1040	9653732	9000000	9749999
14	833093	2	8.0	83	1285	1927	0	10490256	9750000	10499999
15	451742	2	13.0	90	1148	1541	0	10945210	10500000	11249999
16	1039690	3	16.0	75	1121	1706	1552	11987589	11250000	11999999

Total number of pulses in waveform = 32

Waveform Num = 6
Num of Bursts = 15
Burst Interval (us) = 800000.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
1	258477	3	17.0	91	1485	1935	1582	258477	0	799999
2	574767	1	18.0	84	1315	0	0	838246	800000	1599999
3	862229	2	8.0	94	1973	1440	0	1701790	1600000	2399999
4	1300161	3	17.0	93	1212	1358	1373	3005364	2400000	3199999

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5	353576	3	7.0	76	1511	1843	1310	3362883	3200000	3999999
6	778704	2	14.0	58	1623	1157	0	4146251	4000000	4799999
7	1050927	1	14.0	72	1653	0	0	5199958	4800000	5599999
8	1099426	2	20.0	58	1428	1653	0	6301037	5600000	6399999
9	247681	3	15.0	82	1863	1871	1654	6551799	6400000	7199999
10	712412	1	15.0	64	1677	0	0	7269599	7200000	7999999
11	1473540	3	11.0	85	1886	1481	1089	8744816	8000000	8799999
12	797846	1	11.0	72	1169	0	0	9547118	8800000	9599999
13	420032	1	9.0	83	1766	0	0	9968319	9600000	10399999
14	501962	2	5.0	99	1949	1140	0	10472047	10400000	11199999
15	1510192	3	15.0	66	1632	1095	1229	11985328	11200000	11999999

Total number of pulses in waveform = 31

Waveform Num = 7
Num of Bursts = 14
Burst Interval (us) = 857143.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
1	307961	2	17.0	72	1995	1772	0	307961	0	857142
2	1308784	2	18.0	91	1784	1705	0	1620512	857143	1714285
3	200286	2	11.0	65	1712	1986	0	1824287	1714286	2571428
4	861732	1	16.0	100	1348	0	0	2689717	2571429	3428571
5	833932	2	19.0	100	1621	1675	0	3524997	3428572	4285714
6	1019198	2	10.0	72	1430	1000	0	4547491	4285715	5142857
7	1044831	3	19.0	94	1283	1507	1819	5594752	5142858	6000000
8	875121	2	17.0	63	1652	1756	0	6474482	6000001	6857143
9	1211007	3	13.0	85	1828	1002	1676	7688897	6857144	7714286

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	678781								
10		2	9.0	65	1417	1185	0	8372184	7714287	8571429
	392751								
11		1	10.0	92	1241	0	0	8767537	8571430	9428572
	1289116								
12		1	20.0	88	1018	0	0	10057894	9428573	10285715
	853304								
13		2	14.0	75	1900	1115	0	10912216	10285716	11142858
	426227								
14		1	16.0	94	1350	0	0	11341458	11142859	12000001

Total number of pulses in waveform = 26

Waveform Num = 8
Num of Bursts = 20
Burst Interval (us) = 600000.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
	273174									
1		2	10.0	52	1334	1432	0	273174	0	599999
	886250									
2		2	14.0	91	1228	1500	0	1162190	600000	1199999
	319420									
3		3	9.0	58	1620	1510	1648	1484338	1200000	1799999
	475653									
4		3	14.0	95	1304	1238	1341	1964769	1800000	2399999
	738724									
5		3	5.0	56	1845	1872	1454	2707376	2400000	2999999
	462704									
6		3	14.0	76	1092	1307	1641	3175251	3000000	3599999
	974579									
7		3	17.0	63	1709	1583	1627	4153870	3600000	4199999
	188062									
8		3	8.0	54	1761	1196	1251	4346851	4200000	4799999
	488935									
9		2	19.0	85	1850	1890	0	4839994	4800000	5399999
	1137881									
10		1	16.0	84	1118	0	0	5981615	5400000	5999999
	412708									
11		1	20.0	51	1698	0	0	6395441	6000000	6599999
	515415									
12		3	14.0	74	1644	1162	1764	6912554	6600000	7199999
	656866									
13		3	19.0	75	1948	1475	1183	7573990	7200000	7799999
	493272									
14		3	13.0	54	1802	1325	1969	8071868	7800000	8399999
	361598									
15		3	12.0	79	1180	1833	1041	8438562	8400000	8999999

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898255									
16	2	11.0	96	1960	1519	0	9340871	9000000	9599999
748203									
17	3	15.0	90	1097	1604	1841	10092553	9600000	10199999
396360									
18	3	17.0	71	1935	1280	1702	10493455	10200000	10799999
633318									
19	3	20.0	58	1789	1807	1777	11131690	10800000	11399999
308644									
20	2	13.0	88	1394	1611	0	11445707	11400000	11999999

Total number of pulses in waveform = 51

Waveform Num = 9
Num of Bursts = 17
Burst Interval (us) = 705882.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
	693913									
1		2	6.0	100	1855	1813	0	693913	0	705881
	619287									
2		3	13.0	91	1009	1582	1991	1316868	705882	1411763
	114664									
3		1	8.0	92	1195	0	0	1436114	1411764	2117645
	1037992									
4		2	7.0	59	1411	1842	0	2475301	2117646	2823527
	475362									
5		1	6.0	70	1328	0	0	2953916	2823528	3529409
	1264079									
6		1	9.0	63	1232	0	0	4219323	3529410	4235291
	304463									
7		1	17.0	52	1421	0	0	4525018	4235292	4941173
	474903									
8		1	14.0	92	1862	0	0	5001342	4941174	5647055
	1319972									
9		1	8.0	95	1353	0	0	6323176	5647056	6352937
	311435									
10		2	19.0	63	1776	1625	0	6635964	6352938	7058819
	479397									
11		2	18.0	76	1774	1472	0	7118762	7058820	7764701
	1222887									
12		3	6.0	66	1295	1312	1758	8344895	7764702	8470583
	738043									
13		1	6.0	63	1221	0	0	9087303	8470584	9176465
	652713									
14		2	19.0	92	1996	1787	0	9741237	9176466	9882347
	244339									
15		1	9.0	80	1266	0	0	9989359	9882348	10588229

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	869859								
16		1	8.0	66	1843	0	0	10860484	10588230	11294111
	858966								
17		2	7.0	100	1050	1897	0	11721293	11294112	11999993

Total number of pulses in waveform = 27

Waveform Num = 10
Num of Bursts = 11
Burst Interval (us) = 1090909.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
	350902									
1		3	18.0	70	1940	1586	1886	350902	0	1090908
	1022782									
2		3	9.0	62	1423	1882	1375	1379096	1090909	2181817
	1789903									
3		1	19.0	96	1263	0	0	3173679	2181818	3272726
	1130666									
4		2	13.0	85	1753	1828	0	4305608	3272727	4363635
	884913									
5		3	18.0	97	1870	1142	1877	5194102	4363636	5454544
	770055									
6		1	16.0	91	1403	0	0	5969046	5454545	6545453
	725033									
7		2	8.0	91	1346	1081	0	6695482	6545454	7636362
	1343348									
8		1	15.0	84	1478	0	0	8041257	7636363	8727271
	870797									
9		2	19.0	66	1013	1544	0	8913532	8727272	9818180
	1728921									
10		1	14.0	73	1823	0	0	10645010	9818181	10909089
	1139366									
11		1	14.0	92	1103	0	0	11786199	10909090	11999998

Total number of pulses in waveform = 20

Waveform Num = 11
Num of Bursts = 13
Burst Interval (us) = 923077.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
	805568									
1		1	18.0	57	1268	0	0	805568	0	923076
	328073									
2		2	14.0	56	1338	1737	0	1134909	923077	1846153
	1334592									
3		3	19.0	82	1429	1182	1282	2472576	1846154	2769230

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4	630528	1	11.0	98	1595	0	0	3106997	2769231	3692307
5	1353208	3	18.0	53	1243	1147	1619	4461800	3692308	4615384
6	967731	2	18.0	70	1989	1237	0	5433540	4615385	5538461
7	672807	3	13.0	66	1884	1026	1104	6109573	5538462	6461538
8	551912	2	19.0	99	1815	1095	0	6665499	6461539	7384615
9	1316006	3	9.0	52	1678	1698	1492	7984415	7384616	8307692
10	497345	1	6.0	54	1621	0	0	8486628	8307693	9230769
11	1052450	1	17.0	66	1092	0	0	9540699	9230770	10153846
12	632952	2	18.0	98	1293	1949	0	10174743	10153847	11076923
13	1778199	2	17.0	97	1090	1469	0	11956184	11076924	12000000

Total number of pulses in waveform = 26

Waveform Num = 12
Num of Bursts = 15
Burst Interval (us) = 800000.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
1	509686	3	5.0	53	1229	1900	1433	509686	0	799999
2	848588	3	18.0	52	1186	1914	1549	1362836	800000	1599999
3	870513	1	13.0	91	1512	0	0	2237998	1600000	2399999
4	685339	3	11.0	64	1718	1422	1044	2924849	2400000	3199999
5	974673	1	5.0	76	1514	0	0	3903706	3200000	3999999
6	865250	1	6.0	92	1779	0	0	4770470	4000000	4799999
7	298970	1	9.0	94	1292	0	0	5071219	4800000	5599999
8	603699	3	18.0	53	1163	1793	1607	5676210	5600000	6399999
9	1233508	3	17.0	73	1365	1699	1359	6914281	6400000	7199999
10	293039	1	9.0	65	1544	0	0	7211743	7200000	7999999

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	1157841								
11		3	11.0	81	1486	1482	1591	8371128	8000000	8799999
	884792								
12		3	18.0	64	1450	1643	1882	9260479	8800000	9599999
	717490								
13		3	20.0	71	1344	1033	1244	9982944	9600000	10399999
	527347								
14		1	8.0	65	1369	0	0	10513912	10400000	11199999
	1249350								
15		3	20.0	53	1326	1906	1891	11764631	11200000	11999999

Total number of pulses in waveform = 33

Waveform Num = 13
Num of Bursts = 8
Burst Interval (us) = 1500000.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
	872401									
1		1	14.0	50	1908	0	0	872401	0	1499999
	1947891									
2		1	11.0	82	1970	0	0	2822200	1500000	2999999
	1637522									
3		1	20.0	61	1259	0	0	4461692	3000000	4499999
	463070									
4		3	11.0	87	1036	1071	1762	4926021	4500000	5999999
	2099320									
5		3	11.0	73	1738	1337	1209	7029210	6000000	7499999
	1470229									
6		3	11.0	57	1948	1166	1217	8503723	7500000	8999999
	1568460									
7		3	10.0	80	1011	1217	1117	10076514	9000000	10499999
	1451373									
8		3	6.0	53	1023	1973	1430	11531232	10500000	11999999

Total number of pulses in waveform = 18

Waveform Num = 14
Num of Bursts = 9
Burst Interval (us) = 1333333.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
	987387									
1		3	10.0	80	1747	1073	1301	987387	0	1333332
	1154592									
2		3	5.0	58	1498	1840	1010	2146100	1333333	2666665
	645097									
3		1	20.0	88	1298	0	0	2795545	2666666	3999998

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4	1972653	1	18.0	51	1476	0	0	4769496	3999999	5333331
5	1438563	3	10.0	50	1954	1606	1614	6209535	5333332	6666664
6	1324199	3	9.0	61	1913	1601	1719	7538908	6666665	7999997
7	515810	2	19.0	87	1764	1640	0	8059951	7999998	9333330
8	2572944	1	7.0	84	1659	0	0	10636299	9333331	10666663
9	702502	3	17.0	51	1226	1700	1130	11340460	10666664	11999996

Total number of pulses in waveform = 20

Waveform Num = 15
Num of Bursts = 12
Burst Interval (us) = 1000000.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
1	861720	2	18.0	70	1477	1039	0	861720	0	999999
2	1005976	2	7.0	52	1401	1523	0	1870212	1000000	1999999
3	1005084	3	19.0	71	1194	1552	1181	2878220	2000000	2999999
4	486648	2	11.0	74	1844	1190	0	3368795	3000000	3999999
5	1198188	1	20.0	88	1985	0	0	4570017	4000000	4999999
6	1016368	3	19.0	67	1909	1976	1125	5588370	5000000	5999999
7	853610	1	7.0	95	1289	0	0	6446990	6000000	6999999
8	1106097	3	5.0	58	1699	1938	1519	7554376	7000000	7999999
9	789834	1	15.0	98	1392	0	0	8349366	8000000	8999999
10	1481309	3	7.0	66	1247	1473	1514	9832067	9000000	9999999
11	192570	2	16.0	77	1493	1260	0	10028871	10000000	10999999
12	1778014	3	5.0	87	1404	1310	1555	11809638	11000000	11999999

Total number of pulses in waveform = 26

Waveform Num = 16
Num of Bursts = 14

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Burst Interval (us) = 857143.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
	617660									
1		1	17.0	71	1371	0	0	617660	0	857142
	477803									
2		3	16.0	68	1838	1755	1246	1096834	857143	1714285
	951780									
3		1	12.0	86	1639	0	0	2053453	1714286	2571428
	1281343									
4		1	19.0	65	2000	0	0	3336435	2571429	3428571
	505211									
5		3	6.0	83	1818	1873	1787	3843646	3428572	4285714
	616910									
6		3	10.0	76	1230	1031	1476	4466034	4285715	5142857
	988901									
7		3	10.0	58	1706	1014	1431	5458672	5142858	6000000
	985521									
8		3	17.0	63	1731	1418	1237	6448344	6000001	6857143
	906365									
9		1	5.0	63	1562	0	0	7359095	6857144	7714286
	417905									
10		1	16.0	54	1037	0	0	7778562	7714287	8571429
	884068									
11		1	6.0	83	1059	0	0	8663667	8571430	9428572
	924433									
12		3	16.0	72	1326	1787	1413	9589159	9428573	10285715
	1248267									
13		3	6.0	80	1553	1970	1975	10841952	10285716	11142858
	330169									
14		3	16.0	58	1012	1426	1737	11177619	11142859	12000001

Total number of pulses in waveform = 30

Waveform Num = 17
Num of Bursts = 19
Burst Interval (us) = 631579.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
	457643									
1		2	10.0	84	1804	1933	0	457643	0	631578
	708168									
2		1	15.0	84	1061	0	0	1169548	631579	1263157
	259000									
3		2	17.0	71	1037	1857	0	1429609	1263158	1894736
	826738									
4		1	11.0	91	1177	0	0	2259241	1894737	2526315

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5	627463	3	6.0	62	1466	1388	1167	2887881	2526316	3157894
6	568690	3	14.0	85	1265	1562	1015	3460592	3157895	3789473
7	565005	1	14.0	57	1494	0	0	4029439	3789474	4421052
8	617846	2	19.0	84	1102	1163	0	4648779	4421053	5052631
9	459131	1	9.0	96	1036	0	0	5110175	5052632	5684210
10	867897	1	6.0	75	1827	0	0	5979108	5684211	6315789
11	945106	3	9.0	91	1754	1784	1784	6926041	6315790	6947368
12	149552	2	14.0	50	1268	1803	0	7080915	6947369	7578947
13	899324	2	13.0	71	1637	1896	0	7983310	7578948	8210526
14	786773	1	20.0	96	1173	0	0	8773616	8210527	8842105
15	138323	2	15.0	61	1600	1257	0	8913112	8842106	9473684
16	1123743	2	10.0	53	1606	1617	0	10039712	9473685	10105263
17	288117	3	16.0	64	1703	1867	1464	10331052	10105264	10736842
18	593398	3	10.0	68	1482	1680	1680	10929484	10736843	11368421
19	679731	3	15.0	91	1403	1559	1290	11614057	11368422	12000000

Total number of pulses in waveform = 38

Waveform Num = 18
Num of Bursts = 20
Burst Interval (us) = 600000.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
1	535554	2	17.0	98	1601	1995	0	535554	0	599999
2	115117	2	20.0	84	1919	1817	0	654267	600000	1199999
3	581991	1	11.0	73	1207	0	0	1239994	1200000	1799999
4	840374	1	19.0	71	1149	0	0	2081575	1800000	2399999
5	474611	2	9.0	85	1121	1656	0	2557335	2400000	2999999

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6	558009	1	8.0	53	1426	0	0	3118121	3000000	3599999
7	902486	2	13.0	69	1595	1294	0	4022033	3600000	4199999
8	327662	1	5.0	86	1720	0	0	4352584	4200000	4799999
9	582102	1	13.0	71	1362	0	0	4936406	4800000	5399999
10	663245	2	9.0	91	1634	1563	0	5601013	5400000	5999999
11	700647	2	14.0	81	1784	1090	0	6304857	6000000	6599999
12	878144	1	17.0	69	1996	0	0	7185875	6600000	7199999
13	424620	1	13.0	53	1672	0	0	7612491	7200000	7799999
14	228994	1	6.0	90	1583	0	0	7843157	7800000	8399999
15	970597	3	12.0	62	1023	1336	1339	8815337	8400000	8999999
16	328014	1	12.0	51	1526	0	0	9147049	9000000	9599999
17	968967	3	16.0	82	1262	1697	1475	10117542	9600000	10199999
18	124756	1	19.0	73	1516	0	0	10246732	10200000	10799999
19	926030	3	18.0	97	1847	1049	1145	11174278	10800000	11399999
20	496931	3	12.0	97	1331	1675	1679	11675250	11400000	11999999

Total number of pulses in waveform = 34

Waveform Num = 19
Num of Bursts = 15
Burst Interval (us) = 800000.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
1	99847	3	15.0	62	1453	1148	1612	99847	0	799999
2	1043012	1	17.0	74	1856	0	0	1147072	800000	1599999
3	584269	1	16.0	73	1533	0	0	1733197	1600000	2399999
4	1381984	2	9.0	88	1652	1452	0	3116714	2400000	3199999
5	804914	2	9.0	65	1993	1844	0	3924732	3200000	3999999

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6	830140	3	7.0	63	1997	1323	1283	4758709	4000000	4799999
7	446995	1	10.0	73	1801	0	0	5210307	4800000	5599999
8	929669	1	9.0	61	1616	0	0	6141777	5600000	6399999
9	821184	3	7.0	82	1797	1974	1436	6964577	6400000	7199999
10	733502	1	17.0	86	1484	0	0	7703286	7200000	7999999
11	320482	2	18.0	66	1640	1898	0	8025252	8000000	8799999
12	959497	1	19.0	84	1678	0	0	8988287	8800000	9599999
13	1196465	1	8.0	78	1729	0	0	10186430	9600000	10399999
14	891722	2	10.0	63	1563	1989	0	11079881	10400000	11199999
15	134163	1	14.0	77	1545	0	0	11217596	11200000	11999999

Total number of pulses in waveform = 25

Waveform Num = 20
Num of Bursts = 18
Burst Interval (us) = 666667.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
1	481807	2	20.0	96	1145	1868	0	481807	0	666666
2	478834	2	13.0	55	1319	1700	0	963654	666667	1333333
3	625551	1	7.0	82	1819	0	0	1592224	1333334	2000000
4	522409	1	9.0	56	1193	0	0	2116452	2000001	2666667
5	1022818	2	19.0	93	1231	1705	0	3140463	2666668	3333334
6	618259	2	14.0	72	1747	1410	0	3761658	3333335	4000001
7	558897	3	17.0	66	1379	1877	1301	4323712	4000002	4666668
8	763376	2	18.0	59	1803	1367	0	5091645	4666669	5333335
9	375650	2	7.0	85	1782	1688	0	5470465	5333336	6000002
10	1116050	1	12.0	86	1050	0	0	6589985	6000003	6666669

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11	577636	3	17.0	71	1458	1416	1285	7168671	6666670	7333336
12	177132	3	13.0	72	1588	1074	1725	7349962	7333337	8000003
13	1114987	1	17.0	78	1157	0	0	8469336	8000004	8666670
14	795941	3	7.0	70	1339	1910	1740	9266434	8666671	9333337
15	679168	1	16.0	80	1507	0	0	9950591	9333338	10000004
16	643689	2	18.0	67	1802	1645	0	10595787	10000005	10666671
17	516714	1	7.0	59	1924	0	0	11115948	10666672	11333338
18	319836	3	11.0	83	1957	1002	1555	11437708	11333339	12000005

Total number of pulses in waveform = 35

Waveform Num = 21
Num of Bursts = 19
Burst Interval (us) = 631579.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
1	176662	2	7.0	79	1315	1991	0	176662	0	631578
2	598059	2	5.0	98	1620	1995	0	778027	631579	1263157
3	729009	2	16.0	90	1485	1531	0	1510651	1263158	1894736
4	537844	1	12.0	68	1058	0	0	2051511	1894737	2526315
5	836611	1	13.0	72	1974	0	0	2889180	2526316	3157894
6	684312	1	9.0	91	1902	0	0	3575466	3157895	3789473
7	714431	1	8.0	71	1232	0	0	4291799	3789474	4421052
8	653404	3	10.0	91	1812	1376	1038	4946435	4421053	5052631
9	562110	3	17.0	54	1123	1269	1844	5512771	5052632	5684210
10	241909	1	19.0	73	1725	0	0	5758916	5684211	6315789
11	655865	2	8.0	60	1513	1131	0	6416506	6315790	6947368
12	806842	2	16.0	51	1848	1608	0	7225992	6947369	7578947

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	549550								
13		3	6.0	96	1929	1378	1107	7778998	7578948	8210526
	592995								
14		2	10.0	63	1476	1768	0	8376407	8210527	8842105
	707727								
15		3	19.0	87	1215	1861	1447	9087378	8842106	9473684
	652906								
16		1	18.0	78	1803	0	0	9744807	9473685	10105263
	804541								
17		3	7.0	76	1069	1313	1835	10551151	10105264	10736842
	231172								
18		1	12.0	55	1090	0	0	10786540	10736843	11368421
	1115064								
19		1	20.0	68	1977	0	0	11902694	11368422	12000000

Total number of pulses in waveform = 35

Waveform Num = 22
Num of Bursts = 19
Burst Interval (us) = 631579.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
	110551									
1		2	8.0	51	1609	1945	0	110551	0	631578
	795820									
2		3	6.0	91	1537	1595	1090	909925	631579	1263157
	367464									
3		3	13.0	76	1636	1964	1566	1281611	1263158	1894736
	1018566									
4		2	10.0	53	1698	1864	0	2305343	1894737	2526315
	307587									
5		2	10.0	80	1844	1577	0	2616492	2526316	3157894
	953705									
6		3	20.0	89	1580	1075	1489	3573618	3157895	3789473
	574416									
7		2	13.0	61	1594	1441	0	4152178	3789474	4421052
	768706									
8		3	20.0	58	1890	1463	1801	4923919	4421053	5052631
	131019									
9		2	18.0	89	1789	1072	0	5060092	5052632	5684210
	1098625									
10		3	16.0	99	1450	1593	1923	6161578	5684211	6315789
	306607									
11		2	13.0	95	1938	1239	0	6473151	6315790	6947368
	598759									
12		3	6.0	91	1613	1260	1142	7075087	6947369	7578947
	867522									
13		2	5.0	67	1654	1672	0	7946624	7578948	8210526

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14	748574	1	17.0	92	1384	0	0	8698524	8210527	8842105
15	583779	2	16.0	85	1474	1590	0	9283687	8842106	9473684
16	356212	2	20.0	70	1104	1218	0	9642963	9473685	10105263
17	958624	2	10.0	75	1264	1443	0	10603909	10105264	10736842
18	208616	1	11.0	97	1265	0	0	10815232	10736843	11368421
19	716512	3	16.0	58	1699	1906	1973	11533009	11368422	12000000

Total number of pulses in waveform = 43

Waveform Num = 23
Num of Bursts = 18
Burst Interval (us) = 666667.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
1	383006	2	14.0	87	1245	1255	0	383006	0	666666
2	666498	3	7.0	51	1133	1003	1886	1052004	666667	1333333
3	862629	3	11.0	94	1942	1385	1715	1918655	1333334	2000000
4	288905	1	18.0	71	1731	0	0	2212602	2000001	2666667
5	715550	3	9.0	72	1625	1714	1796	2929883	2666668	3333334
6	617964	1	5.0	61	1788	0	0	3552982	3333335	4000001
7	977448	3	19.0	63	1178	1721	1589	4532218	4000002	4666668
8	313285	1	7.0	78	1343	0	0	4849991	4666669	5333335
9	555598	1	6.0	53	1603	0	0	5406932	5333336	6000002
10	654296	1	20.0	58	1275	0	0	6062831	6000003	6666669
11	1090305	1	11.0	97	1309	0	0	7154411	6666670	7333336
12	711630	1	9.0	84	1532	0	0	7867350	7333337	8000003
13	458079	3	12.0	51	1231	1302	1783	8326961	8000004	8666670
14	960595	1	8.0	99	1560	0	0	9291872	8666671	9333337

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	168335								
15		1	15.0	81	1823	0	0	9461767	9333338	10000004
	830018								
16		3	8.0	73	1700	1195	1584	10293608	10000005	10666671
	1014818								
17		1	5.0	56	1181	0	0	11312905	10666672	11333338
	66029								
18		3	16.0	86	1937	1586	1649	11380115	11333339	12000005

Total number of pulses in waveform = 33

Waveform Num = 24
Num of Bursts = 10
Burst Interval (us) = 1200000.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
	55960									
1		1	13.0	61	1197	0	0	55960	0	1199999
	1571161									
2		1	19.0	83	1886	0	0	1628318	1200000	2399999
	873797									
3		1	5.0	64	1360	0	0	2504001	2400000	3599999
	1201072									
4		1	18.0	50	1525	0	0	3706433	3600000	4799999
	1262107									
5		2	12.0	94	1432	1563	0	4970065	4800000	5999999
	1095307									
6		2	6.0	67	1722	1997	0	6068367	6000000	7199999
	2270627									
7		2	18.0	80	1964	1228	0	8342713	7200000	8399999
	595270									
8		3	19.0	61	1908	1334	1097	8941175	8400000	9599999
	1583449									
9		2	17.0	59	1915	1238	0	10528963	9600000	10799999
	1124107									
10		1	5.0	88	1412	0	0	11656223	10800000	11999999

Total number of pulses in waveform = 16

Waveform Num = 25
Num of Bursts = 12
Burst Interval (us) = 1000000.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
	994085									
1		1	11.0	81	1134	0	0	994085	0	999999
	678254									
2		3	19.0	71	1534	1648	1839	1673473	1000000	1999999

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3	397691	3	11.0	79	1300	1042	1689	2076185	2000000	2999999
4	1574424	1	12.0	73	1305	0	0	3654640	3000000	3999999
5	950492	2	14.0	54	1372	1907	0	4606437	4000000	4999999
6	1320991	3	18.0	74	1548	1152	1052	5930707	5000000	5999999
7	253820	1	9.0	87	1153	0	0	6188279	6000000	6999999
8	1038393	3	12.0	76	1484	1109	1744	7227825	7000000	7999999
9	1385133	3	10.0	70	1901	1147	1333	8617295	8000000	8999999
10	1128790	2	16.0	100	1413	1506	0	9750466	9000000	9999999
11	1218251	2	17.0	63	1635	1666	0	10971636	10000000	10999999
12	632795	3	17.0	52	1806	1163	1310	11607732	11000000	11999999

Total number of pulses in waveform = 27

Waveform Num = 26
Num of Bursts = 11
Burst Interval (us) = 1090909.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
1	227588	3	10.0	75	1247	1820	1540	227588	0	1090908
2	1834945	3	13.0	95	1409	1868	1199	2067140	1090909	2181817
3	1160068	2	16.0	93	1621	1527	0	3231684	2181818	3272726
4	388200	3	16.0	79	1294	1821	1350	3623032	3272727	4363635
5	929080	1	14.0	93	1293	0	0	4556577	4363636	5454544
6	1519832	1	15.0	60	1870	0	0	6077702	5454545	6545453
7	1420924	1	20.0	89	1669	0	0	7500496	6545454	7636362
8	143749	3	12.0	63	1153	1457	1940	7645914	7636363	8727271
9	1545211	2	6.0	63	1240	1376	0	9195675	8727272	9818180
10	1134293	2	16.0	87	1241	1902	0	10332584	9818181	10909089

	1197815								
11		1	12.0	69	1191	0	0	11533542	10909090	11999998

Total number of pulses in waveform = 22

Waveform Num = 27
Num of Bursts = 17
Burst Interval (us) = 705882.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
	108974									
1		2	5.0	59	1749	1406	0	108974	0	705881
	640167									
2		3	10.0	73	1819	1708	1128	752296	705882	1411763
	1282987									
3		3	18.0	55	1766	1333	1950	2039938	1411764	2117645
	743015									
4		1	13.0	70	1813	0	0	2788002	2117646	2823527
	182749									
5		3	7.0	82	1893	1350	1770	2972564	2823528	3529409
	927531									
6		3	5.0	54	1475	1112	1725	3905108	3529410	4235291
	634374									
7		3	5.0	79	1886	1808	1476	4543794	4235292	4941173
	1065564									
8		2	10.0	71	1414	1139	0	5614528	4941174	5647055
	606158									
9		2	12.0	92	1217	1226	0	6223239	5647056	6352937
	599420									
10		1	10.0	68	1293	0	0	6825102	6352938	7058819
	475701									
11		3	13.0	68	1869	1179	1696	7302096	7058820	7764701
	615488									
12		3	5.0	95	1900	1305	1342	7922328	7764702	8470583
	761103									
13		2	7.0	86	1156	1735	0	8687978	8470584	9176465
	1098736									
14		2	15.0	80	1060	1674	0	9789605	9176466	9882347
	252035									
15		2	11.0	66	1991	1544	0	10044374	9882348	10588229
	604324									
16		1	18.0	53	1058	0	0	10652233	10588230	11294111
	1199233									
17		1	5.0	61	1124	0	0	11852524	11294112	11999993

Total number of pulses in waveform = 37

Waveform Num = 28
Num of Bursts = 16

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Burst Interval (us) = 750000.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
1	109715	1	5.0	76	1779	0	0	109715	0	749999
2	785366	1	10.0	95	1175	0	0	896860	750000	1499999
3	689645	1	8.0	61	1216	0	0	1587680	1500000	2249999
4	695982	2	20.0	78	1496	1766	0	2284878	2250000	2999999
5	1193715	1	15.0	50	1075	0	0	3481855	3000000	3749999
6	835319	1	18.0	76	1554	0	0	4318249	3750000	4499999
7	654948	3	20.0	86	1027	1844	1548	4974751	4500000	5249999
8	662768	2	14.0	99	1793	1352	0	5641938	5250000	5999999
9	1045579	2	11.0	53	1640	1998	0	6690662	6000000	6749999
10	305336	1	19.0	51	1219	0	0	6999636	6750000	7499999
11	950402	3	19.0	99	1414	1727	1026	7951257	7500000	8249999
12	609102	1	13.0	66	1949	0	0	8564526	8250000	8999999
13	950202	1	20.0	64	1940	0	0	9516677	9000000	9749999
14	498730	2	14.0	95	1056	1736	0	10017347	9750000	10499999
15	501574	2	5.0	99	1110	1654	0	10521713	10500000	11249999
16	1154882	1	7.0	90	1019	0	0	11679359	11250000	11999999

Total number of pulses in waveform = 25

Waveform Num = 29
Num of Bursts = 14
Burst Interval (us) = 857143.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
1	783258	1	13.0	53	1826	0	0	783258	0	857142
2	370541	1	13.0	91	1240	0	0	1155625	857143	1714285

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3	1094372	2	9.0	92	1119	1773	0	2251237	1714286	2571428
4	405560	3	7.0	98	1811	1157	1196	2659689	2571429	3428571
5	1607442	1	18.0	56	1543	0	0	4271295	3428572	4285714
6	71188	1	7.0	50	1793	0	0	4344026	4285715	5142857
7	1608551	1	18.0	65	1919	0	0	5954370	5142858	6000000
8	826341	2	14.0	52	1766	1143	0	6782630	6000001	6857143
9	626600	3	18.0	97	1219	1499	1681	7412139	6857144	7714286
10	1144594	3	20.0	90	1441	1714	1514	8561132	7714287	8571429
11	729034	3	6.0	83	1194	1808	1146	9294835	8571430	9428572
12	811851	2	17.0	87	1122	1521	0	10110834	9428573	10285715
13	955986	1	7.0	70	1436	0	0	11069463	10285716	11142858
14	226909	1	16.0	91	1621	0	0	11297808	11142859	12000001

Total number of pulses in waveform = 25

Waveform Num = 30
Num of Bursts = 11
Burst Interval (us) = 1090909.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(us)
1	309023	1	16.0	65	1269	0	0	309023	0	1090908
2	1585696	3	14.0	87	1690	1646	1944	1895988	1090909	2181817
3	425771	1	12.0	97	1471	0	0	2327039	2181818	3272726
4	1596016	3	18.0	64	1527	1930	1129	3924526	3272727	4363635
5	621145	2	9.0	83	1382	1566	0	4550257	4363636	5454544
6	1167313	1	5.0	67	1650	0	0	5720518	5454545	6545453
7	1794120	1	12.0	97	1069	0	0	7516288	6545454	7636362
8	768600	1	10.0	78	1907	0	0	8285957	7636363	8727271

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9	770837	1	13.0	51	1861	0	0	9058701	8727272	9818180
10	967915	1	18.0	86	1783	0	0	10028477	9818181	10909089
11	1825741	1	20.0	58	1606	0	0	11856001	10909090	11999998

Total number of pulses in waveform = 16

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