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
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December 20, 2013

Full Spectrum Inc.
2452 Embarcadero Way
Palo Alto, CA 94303

Dear Gonzalo Casado,

Enclosed is the EMC Wireless test report for compliance testing of the Full Spectrum Inc., Full Spectrum BS1000 as tested to the requirements of the FCC Certification rules under Title 47 of the CFR Part 27 for Broadband Radio Service (BRS) Devices.

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 contact me.

Sincerely yours,
MET LABORATORIES, INC.

Jennifer Warnell
Documentation Department

Reference: (\Full Spectrum Inc.\EMC38223-FCC27 Rev. 5)

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Electromagnetic Compatibility Criteria
Test Report

for the

Full Spectrum Inc.
Model Full Spectrum BS1000

Tested under
FCC Certification Rules
Title 47 of the CFR, Part 27

MET Report: EMC38223-FCC27 Rev. 5

December 20, 2013

Prepared For:

Full Spectrum Inc.
2452 Embarcadero Way
Palo Alto, CA 94303

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

Electromagnetic Compatibility Criteria
Test Report

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FCC Certification Rules
Title 47 of the CFR, Part 27

Jeff Pratt
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.

Asad Bajwa, Director
Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	May 22, 2013	Initial Issue.
1	May 24, 2013	Revised to reflect engineer corrections.
2	November 21, 2013	Revised to reflect amended company name.
3	December 3, 2013	Revised to reflect engineer corrections.
4	December 18, 2013	Revised to reflect engineer corrections.
5	December 20, 2013	Editorial correction.

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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**er**z**
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**k**ilo**h**er**z**
kPa	**k**ilo**pa**scal
kV	**k**ilo**v**olt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**h**ertz
µH	**microh**enry
µ	**microf**arad
µs	**micros**econds
NEBS	**N**etwork **E**quipment-**B**uilding **S**ystem
PRF	**P**ulse **R**epetition **F**requency
RF	**R**adio **F**requency
RMS	**R**oot-**M**ean-**S**quare
TWT	**T**raveling **W**ave **T**ube
V/m	**V**olts **per m**eter
VCP	**V**ertical **C**oupling **P**lane

I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Full Spectrum Inc. Full Spectrum BS1000, with the requirements of Part 27. 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 Full Spectrum BS1000. Full Spectrum Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Full Spectrum BS1000, has been **permanently** discontinued.

B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 27, in accordance with Full Spectrum Inc., purchase order number 1007.

Reference	Description	Compliance
§2.1046; §27.50(d)	RF Power Output	Compliant
§2.1049	Occupied Bandwidth	Compliant - Both available bandwidths are less than 1MHz.
§27.53	Band-Edge Channel Power	Compliant
§2.1051; §27.53(c)	Spurious Emissions at Antenna Terminals	Compliant
§2.1053; §27.53(c)	Radiated Spurious Emissions	Compliant
§2.1055	Frequency Stability over Temperature Variations	Compliant

Table 1. Executive Summary of EMC ComplianceTesting

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by AT4 Wireless to perform testing on the Full Spectrum BS1000, under AT4 Wireless' purchase order number 1007.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Full Spectrum Inc., Full Spectrum BS1000.

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

Model(s) Tested	BS1000	
Model(s) Covered:	BS1000	
EUT Specifications:	Primary Power: 120 VAC, 60 Hz	
	Equipment Code:	TNB
	Avg. RF Output Power:	500 kHz: 19.91 dBm 700 kHz: 20.07 dBm
	EUT Frequency Range:	Only two discrete frequencies are used, 757.5MHz and 787.5MHz, but no frequencies between them.
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:	Jeff Pratt	
Date(s):	December 20, 2013	

Table 2. EUT Summary Table

B. References

CFR 47, Part 27	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 27: Rules and Regulations for Advanced Wireless Services
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
ISO/IEC 17025:2005	General Requirements for the Competence of Testing and Calibration Laboratories
EIA/TIA-603-A-2001	Land Mobile FM or PM Communication Equipment Measurement and Performance Standards

Table 3. Standard References

C. Test Site

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

D. Description of Test Sample

Photograph 1. Full Spectrum Inc., Inc., Full Spectrum BS1000

E. 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.

F. Disposition of EUT

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

III. Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 27.50(b) RF Power Output

Test Requirement(s): §27.50(b)

§27.50(b)(1): Fixed and base stations transmitting a signal in the 757-758MHz and 775-776MHz bands must not exceed an effective radiated power (ERP) of 1000 watts and an antenna height of 305m height above average terrain (HAAT), except that antenna heights greater than 305m HAAT are permitted if power levels are reduced below 1000 watts ERP in accordance with Table 1 of this section.

§27.50(b)(9): Control stations and mobile stations transmitting in the 746-757MHz, 758-763MHz, 776-793MHz, and 805-806MHz bands and fixed stations transmitting in the 787-788MHz and 805-806MHz bands are limited to 30 watts ERP.

§27.50(b)(11): For transmissions in the 757-758MHz, 775-776MHz, 787-788MHz, and 805-806MHz bands, maximum composite transmit power shall be measured over any interval of continuous transmission using instrumentation calibrated in terms of RMS-equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, etc., so as to obtain a true maximum composite measurement for the emission in question over the full bandwidth of the channel.

Test Procedures: *RF power output measurement* was made at the RF output terminal using a spectrum analyzer. Measurement procedures as outlined in KDB 971168 D01 Licensed DTS Guidance v02 were used.

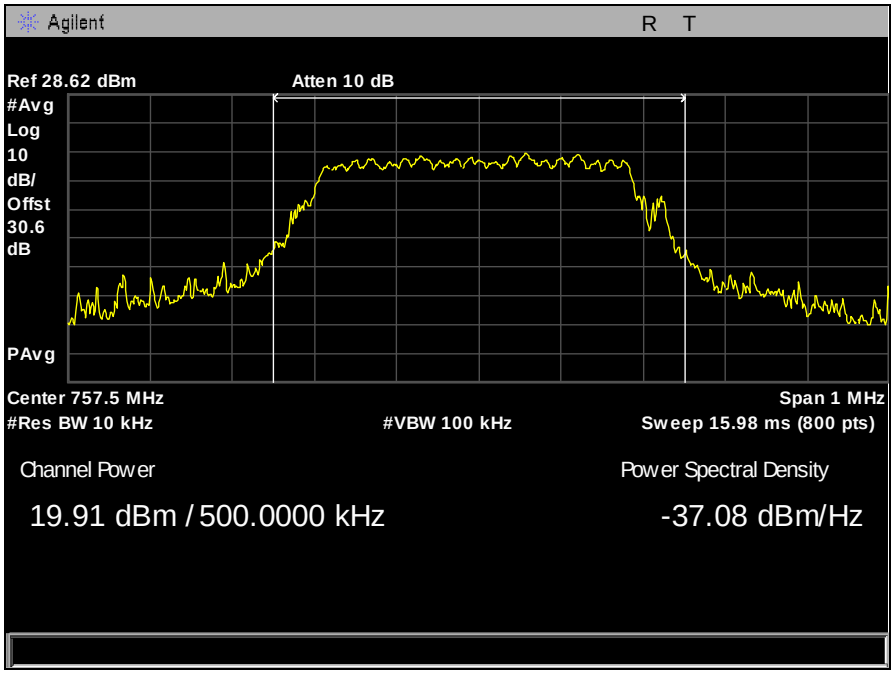
Test Results: Equipment complies with 47CFR 27.50(b).

The following page show measurements of RF Power output which is recorded below.

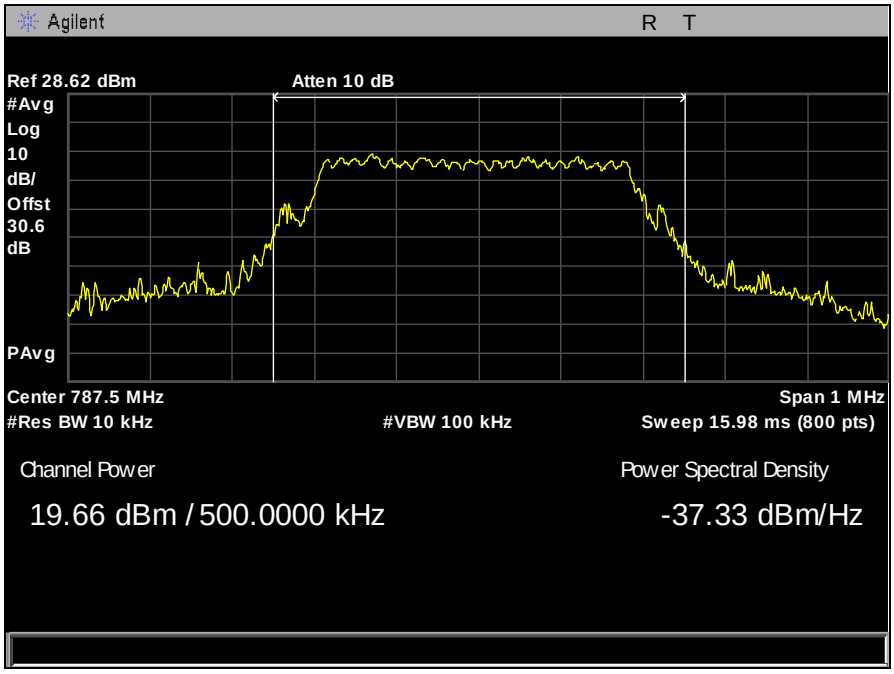
Test Engineer(s): Jeff Pratt

Test Date(s): 05/14/13 – 05/15/13

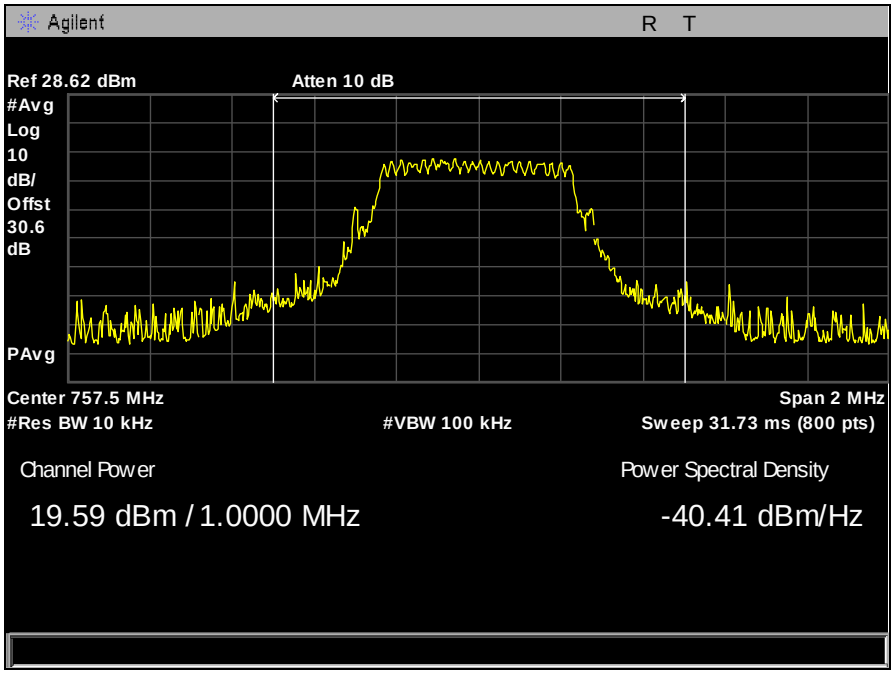
Figure 1. Peak Power Output Test Setup



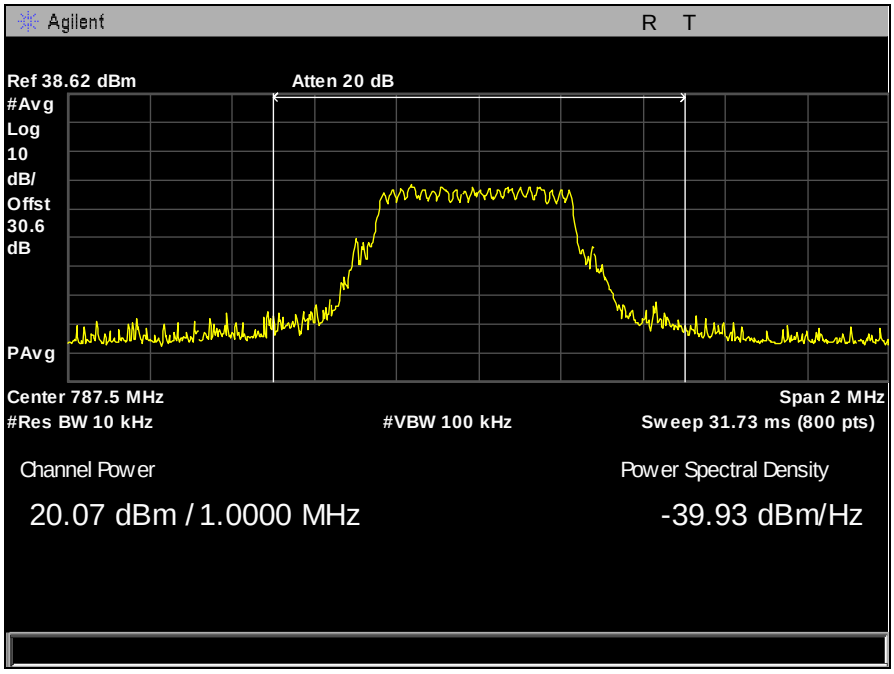
Plot 1. RF Output Power, 757.5 MHz, 500 kHz



Plot 2. RF Output Power, 787.5 MHz, 500 kHz



Plot 3. RF Output Power, 757.5 MHz, 700 kHz



Plot 4. RF Output Power, 787.5 MHz, 700 kHz

§ 2.1049 Occupied Bandwidth

Test Requirement(s): **§ 2.1049 Measurements required: Occupied bandwidth:** The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the specified conditions of § 2.1049 (a) through (i) as applicable.

Test Procedures: As required by 47 CFR 2.1049, *occupied bandwidth measurements* were made with a Spectrum Analyzer connected to the RF ports. Measurement procedures as outlined in KDB 971168 D01 Licensed DTS Guidance v02 were used.

Test Results: Equipment complies with Section 2.1049. The following pages show measurements of 99% Occupied Bandwidth plots.

Test Engineer(s): Jeff Pratt and Poona Saber

Test Date(s): 05/15/13 & 11/05/13

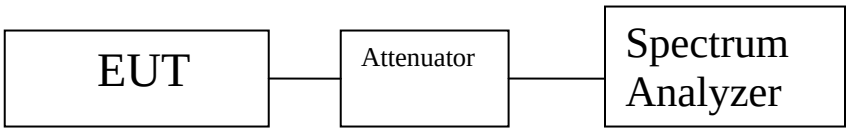
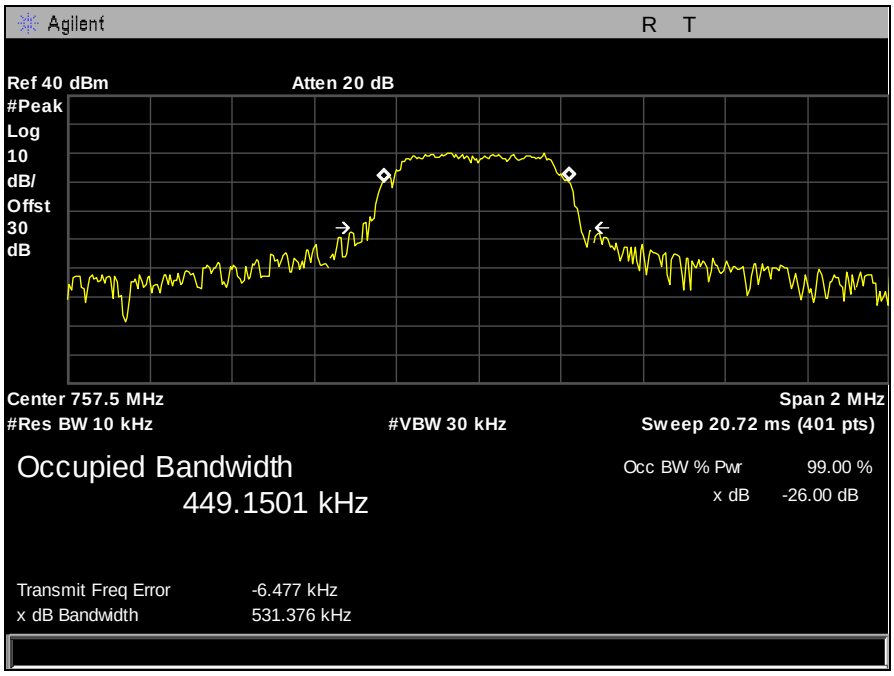
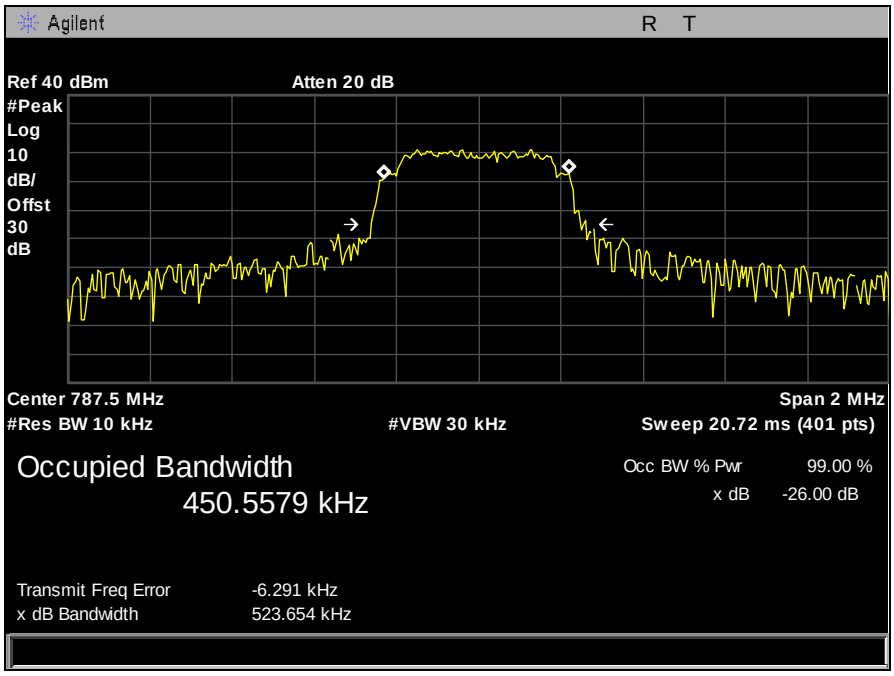


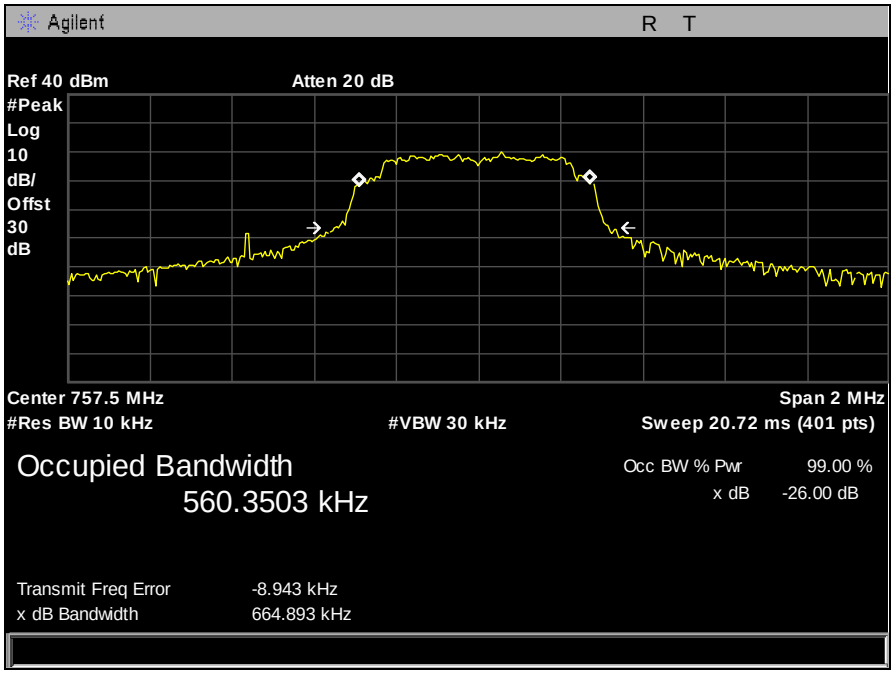
Figure 2. Occupied Bandwidth Test Setup



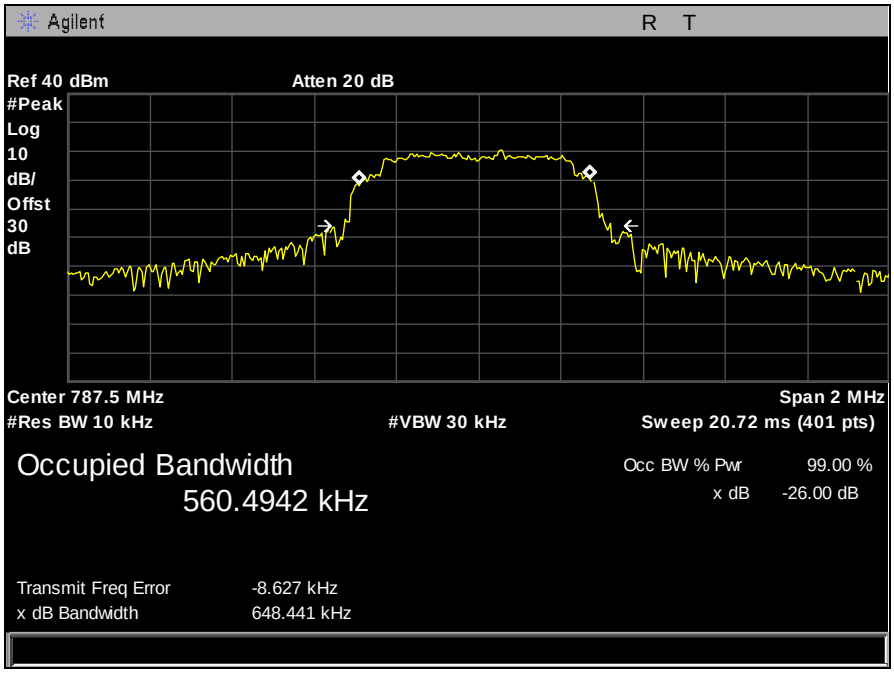
Plot 5. 99% Occupied Bandwidth, 757.5 MHz, 500 kHz



Plot 6. 99% Occupied Bandwidth, 787.5 MHz, 500 kHz



Plot 7. 99% Occupied Bandwidth, 757.5 MHz, 700 kHz



Plot 8. 99% Occupied Bandwidth, 787.5 MHz, 700 kHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 27.53(c) Radiated Spurious Emissions

Test Requirement(s): **§ 2.1053 and 27.53(c) Measurements required: Field strength of spurious radiation.**

§ 2.1053 (a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of § 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antennas.

§27.53(c)(1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;
§27.53(c)(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;
§27.53(c)(3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;
§27.53(c)(4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations;
§27.53(c)(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;
§27.53(c)(6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6**.25 kHz segment.**

§27.53(f) For operations in the 746-763 MHz, 775-793 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

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

Radiated emission measurements were performed inside a 3 meter semi-anechoic chamber (equivalent to an Open Area Test Site). The distance between the EUT and the test antenna was 3 meters for below 1 GHz and 1m for frequencies above 1 GHz. The EUT's RF ports were connected to a dummy load. For measurements in the 1559-1610 MHz band the EUT was connected to a typical antenna that maybe used with the EUT. The intensities of the radiated emissions were maximized by rotating the turntable 360 degrees and varying the receive antenna from 1 to 4m. Measurements were made with the receive antenna in both horizontal and vertical polarizations. Measurements were first made using a peak detector. Any emissions close to or exceeding the limit at a given frequency were re-measured using an average detector and compared to the limit. Emissions that came close to the limit with an average detector were finally measured using substitution method.

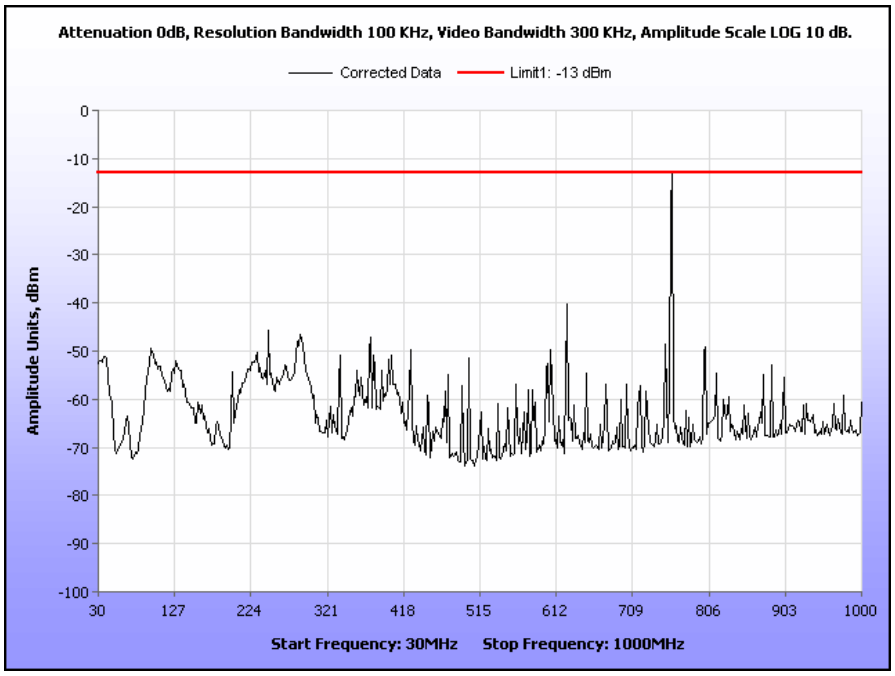
Test Results: Equipment complies with Section 2.1053. The following plots have been corrected.

Test Engineer: Jeff Pratt

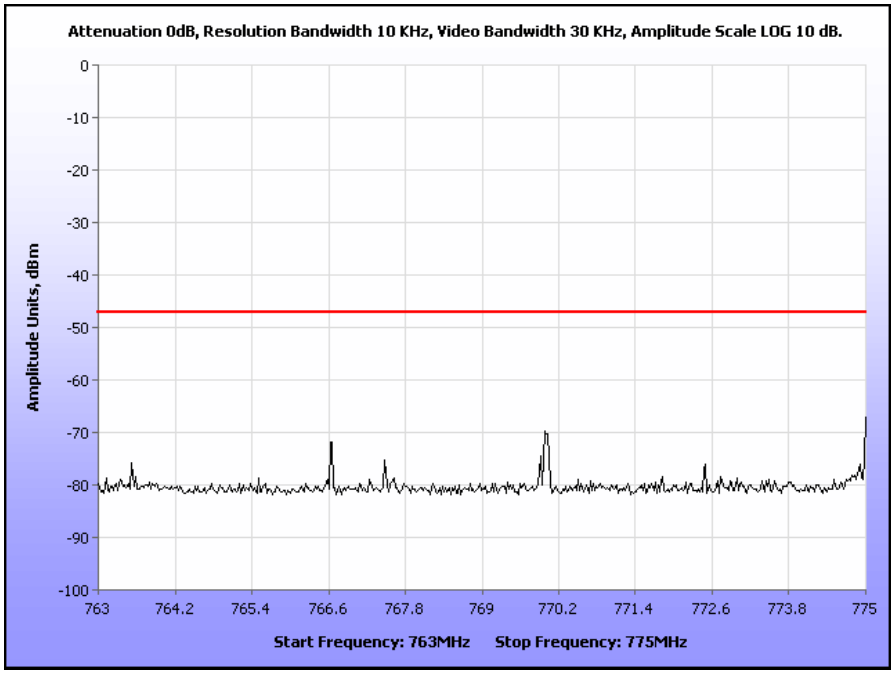
Test Date(s): 05/14/13 & 12/12/13

Fundamental (MHz)	Emission (MHz)	Power into Substitution Antenna (dBm)	Substitution Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)
757.5 (500 kHz)	1515	-32.8	4.6	-28.2	-13
757.5 (700 kHz)	1515	-33.4	4.6	-28.8	-13
787.5 (500 kHz)	1575	-52.5	4.7	-47.8	-40
787.5 (700 kHz)	1575	-51	4.7	-46.3	-40

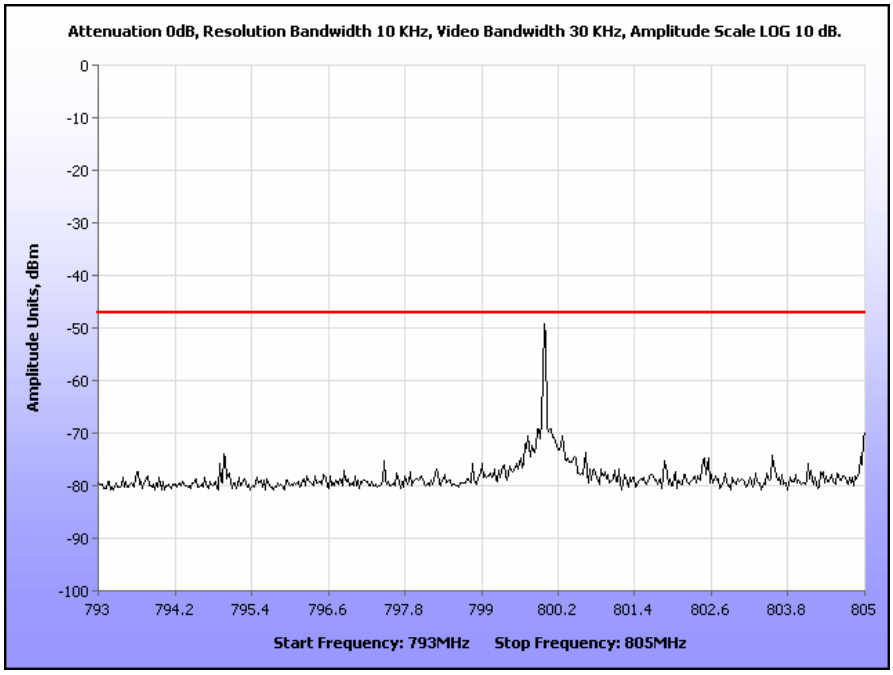
Table 4. Radiated Spurious Emissions, Test Results



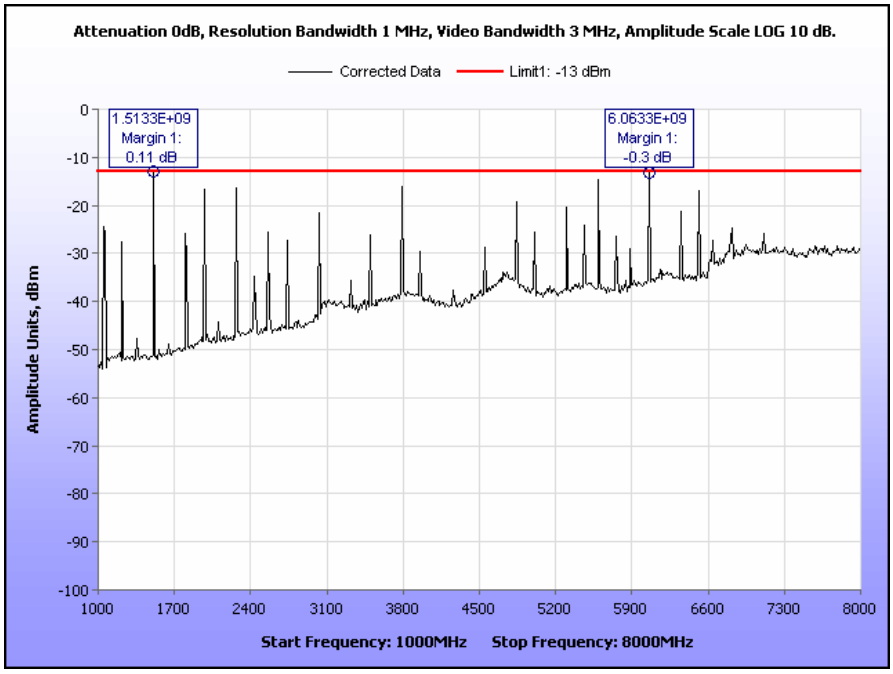
Plot 9. Radiated Spurious Emissions, 757.5 MHz, 500 kHz, 30 MHz – 1 GHz



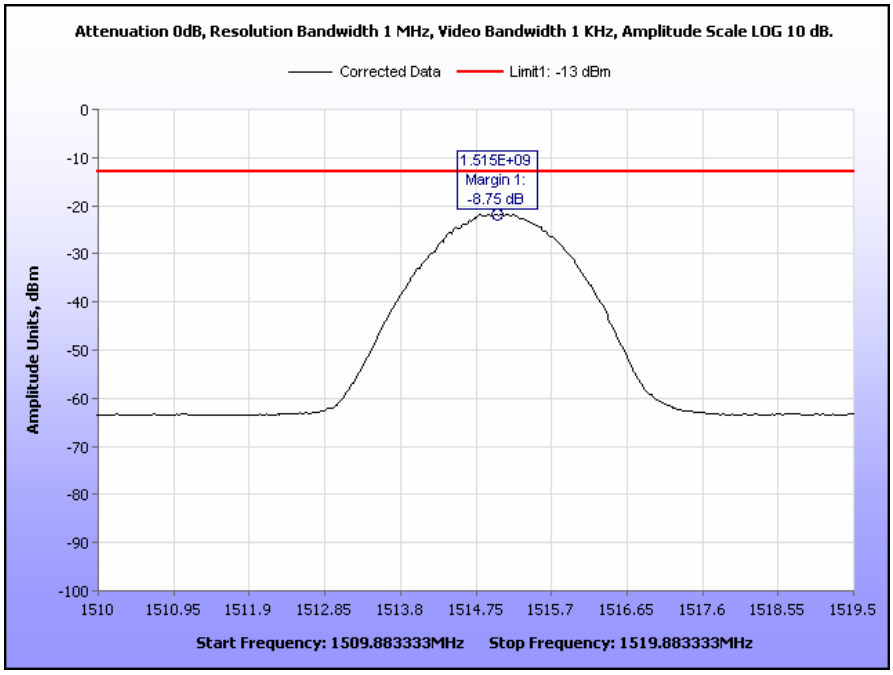
Plot 10. Radiated Spurious Emissions, 757.5 MHz, 500 kHz, 763 MHz – 775 MHz



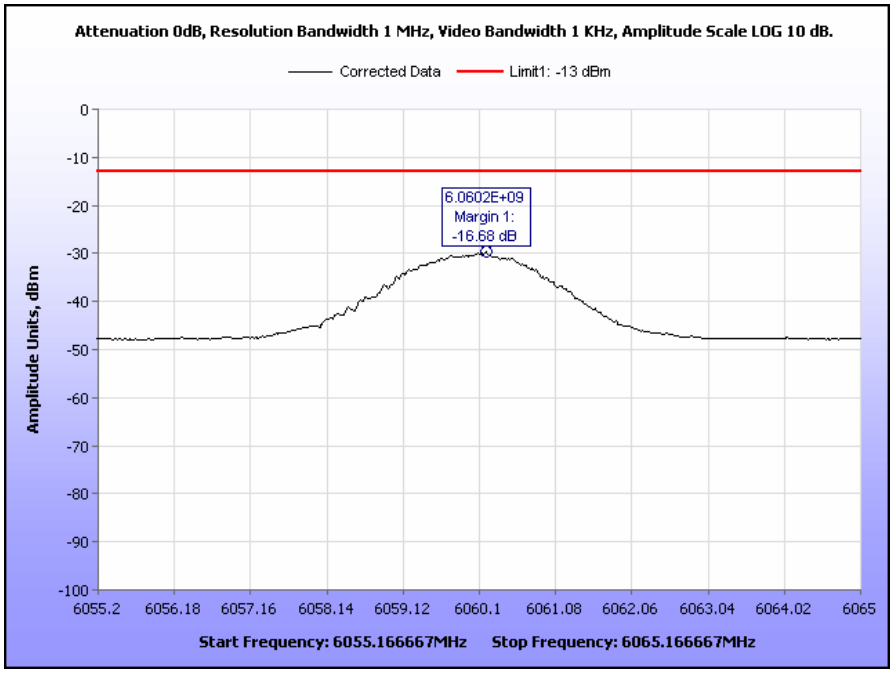
Plot 11. Radiated Spurious Emissions, 757.5 MHz, 500 kHz, 793 MHz – 805 MHz



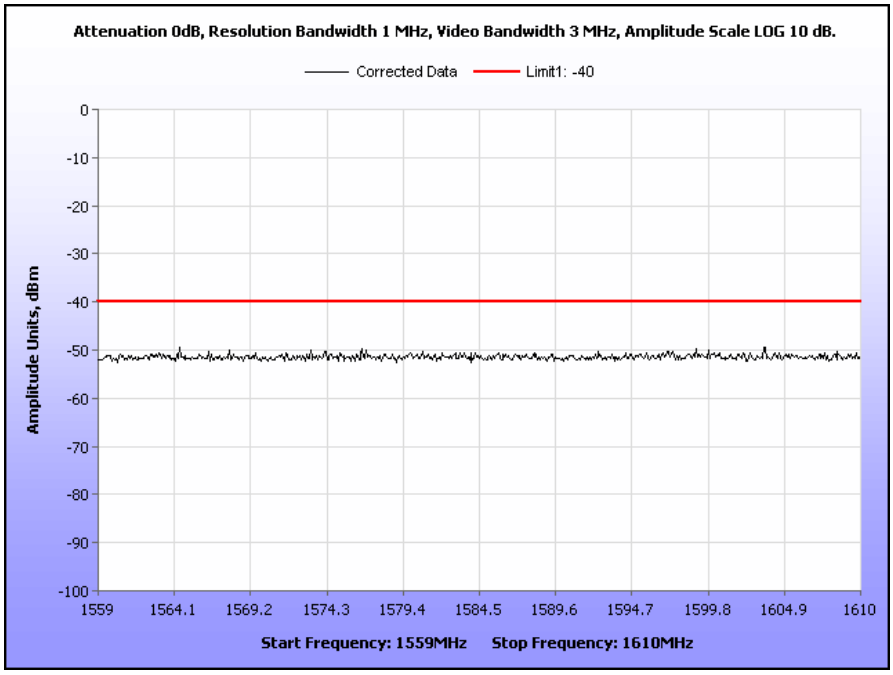
Plot 12. Radiated Spurious Emissions, 757.5 MHz, 500 kHz, 1 GHz – 8 GHz



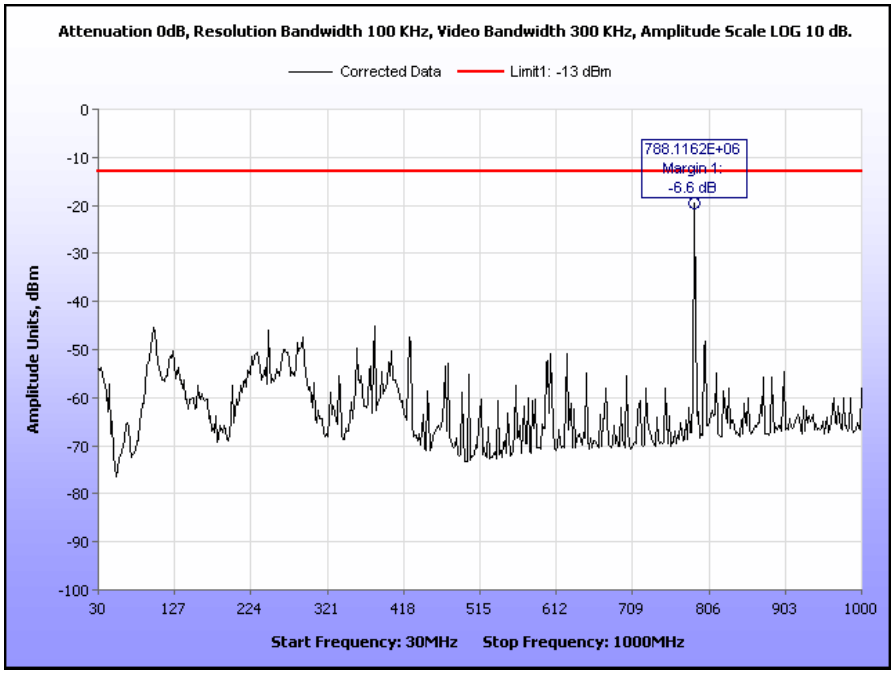
Plot 13. Radiated Spurious Emissions, 757.5 MHz, 500 kHz, 2nd Harmonic



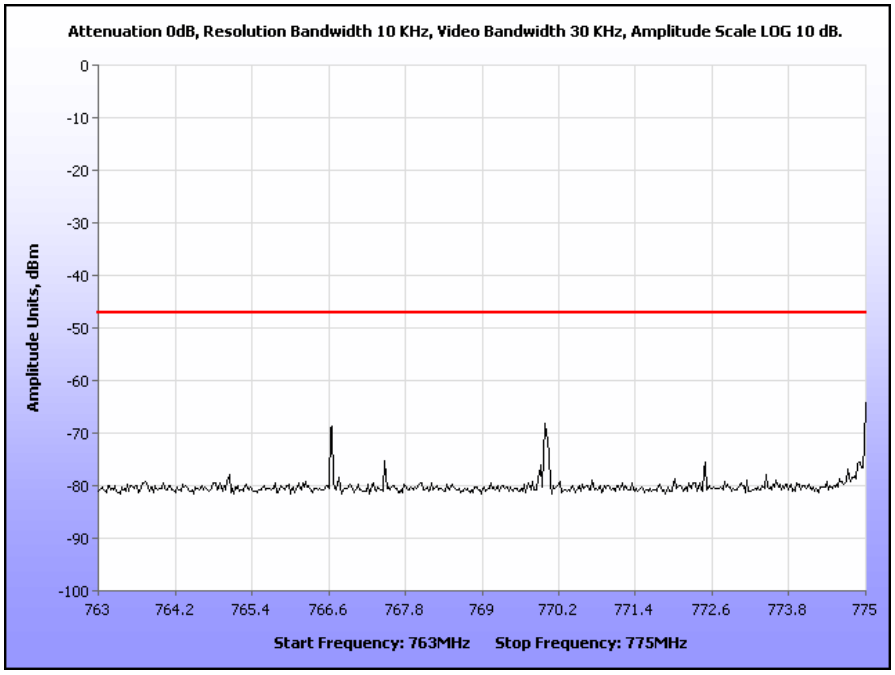
Plot 14. Radiated Spurious Emissions, 757.5 MHz, 500 kHz, 8th Harmonic



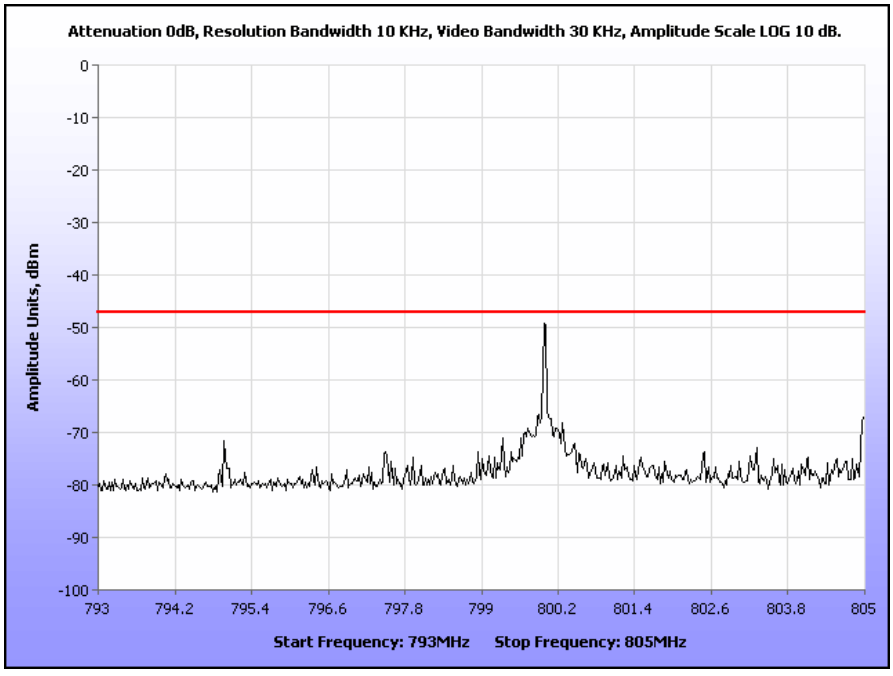
Plot 15. Radiated Spurious Emissions, 757.5 MHz, 500 kHz, 1559 MHz – 1610 MHz



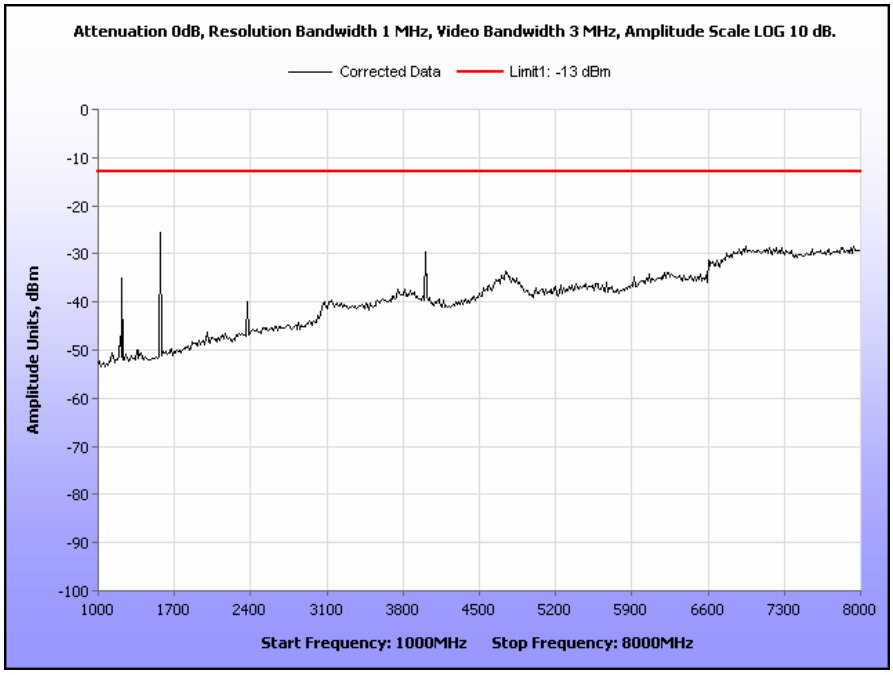
Plot 16. Radiated Spurious Emissions, 787.5 MHz, 500 kHz, 30 MHz – 1 GHz



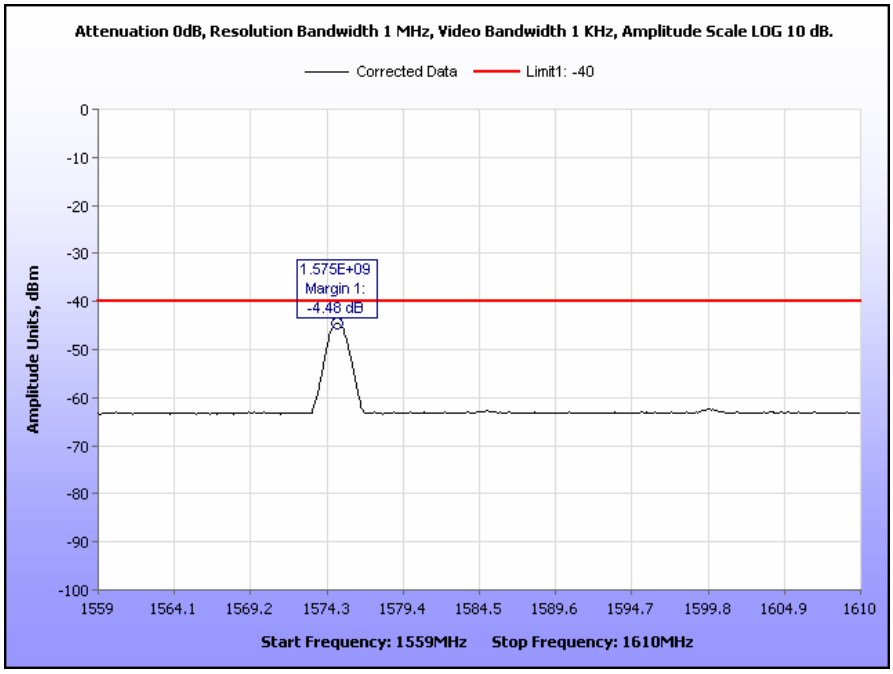
Plot 17. Radiated Spurious Emissions, 787.5 MHz, 500 kHz, 763 MHz – 775 MHz



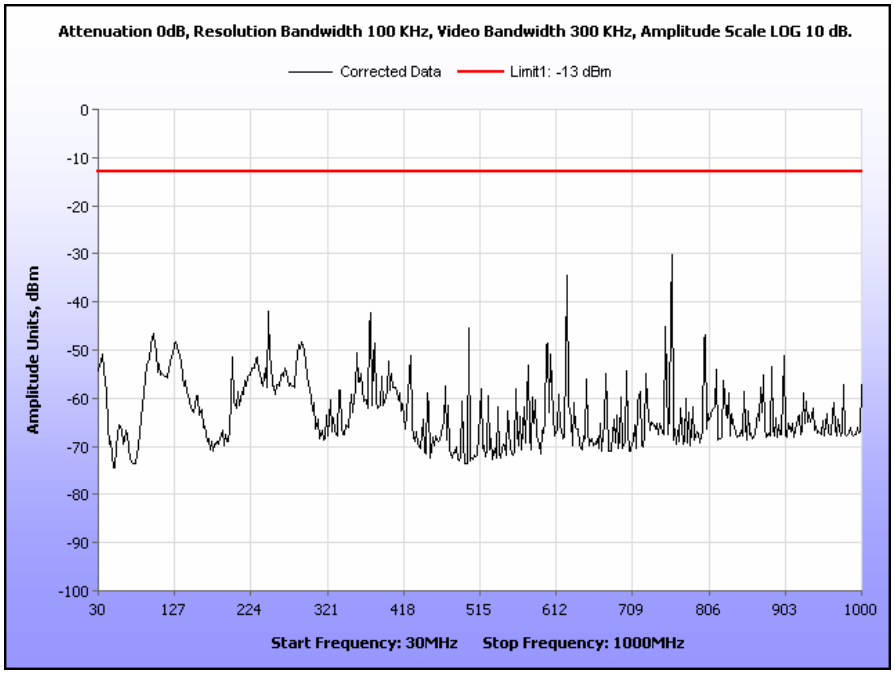
Plot 18. Radiated Spurious Emissions, 787.5 MHz, 500 kHz, 793 MHz – 805 MHz



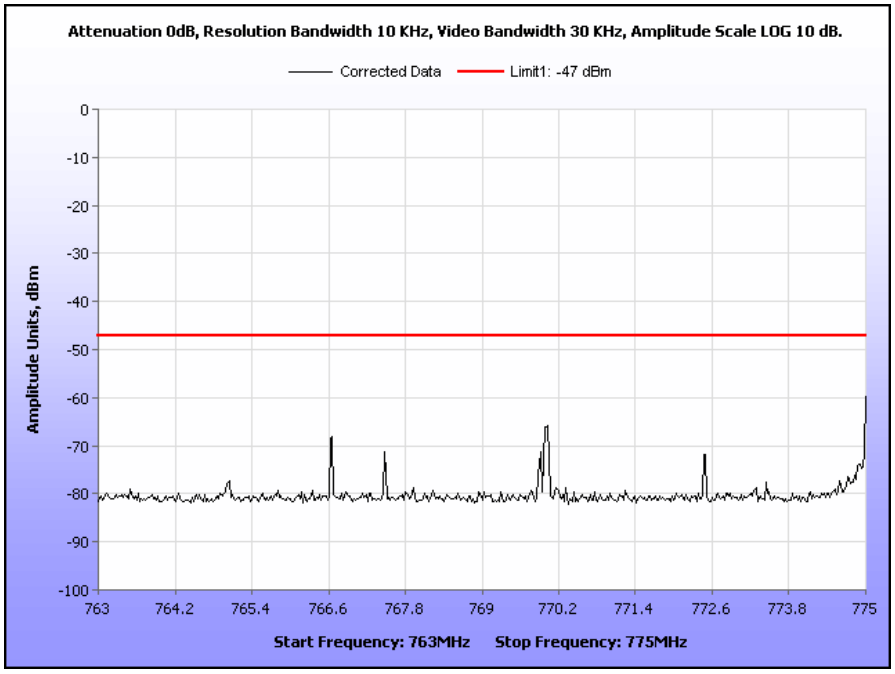
Plot 19. Radiated Spurious Emissions, 787.5 MHz, 500 kHz, 1 GHz – 8 GHz



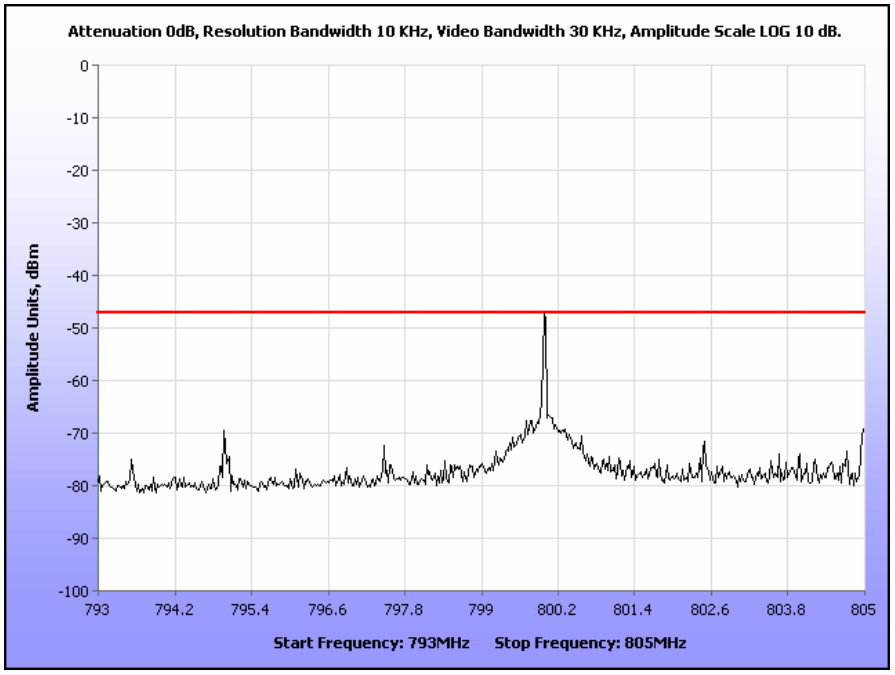
Plot 20. Radiated Spurious Emissions, 787.5 MHz, 500 kHz, 1559 MHz – 1610 MHz



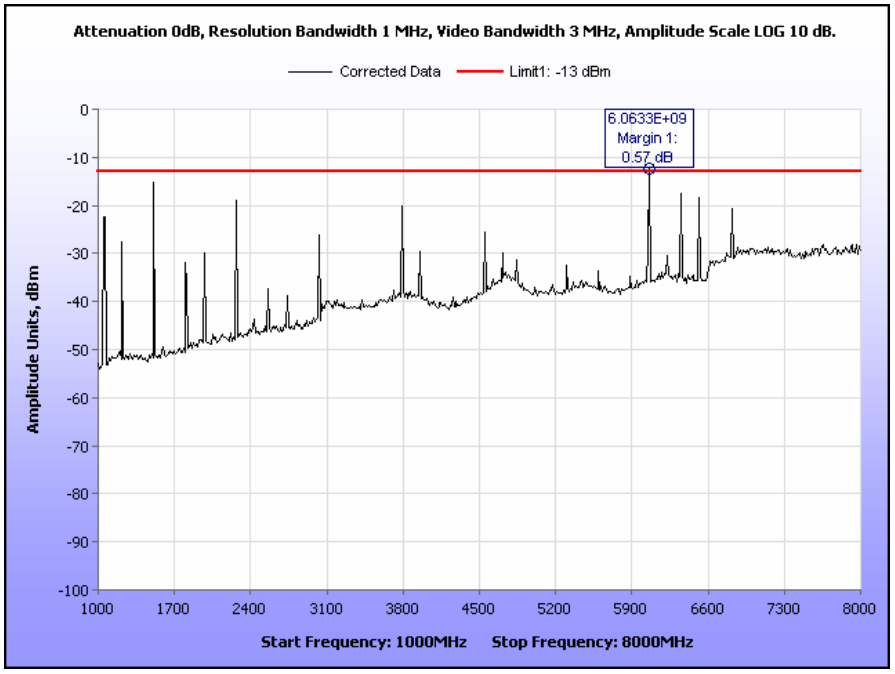
Plot 21. Radiated Spurious Emissions, 757.5 MHz, 700 kHz, 30 MHz – 1 GHz



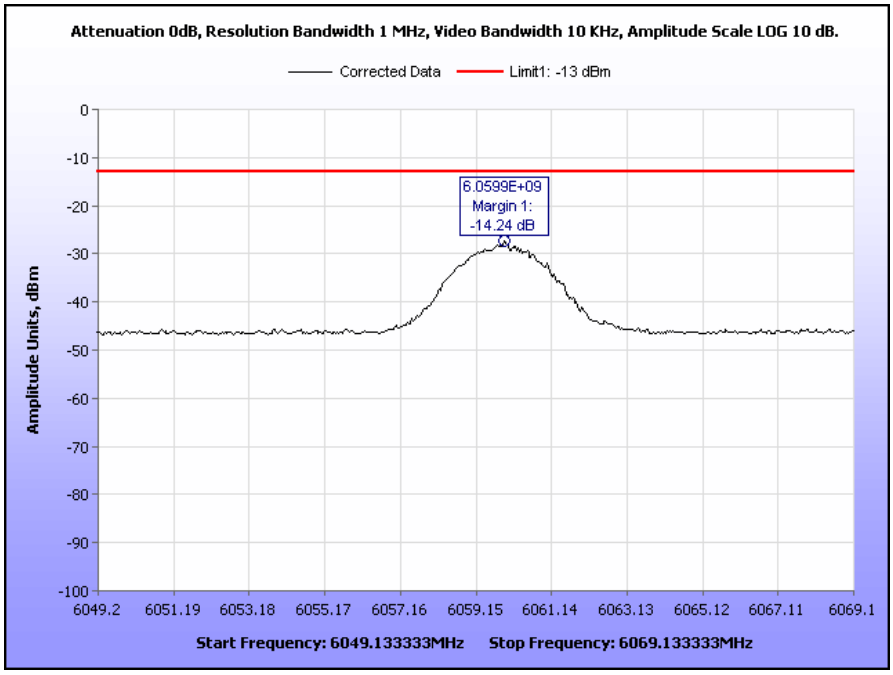
Plot 22. Radiated Spurious Emissions, 757.5 MHz, 700 kHz, 763 MHz – 775 MHz



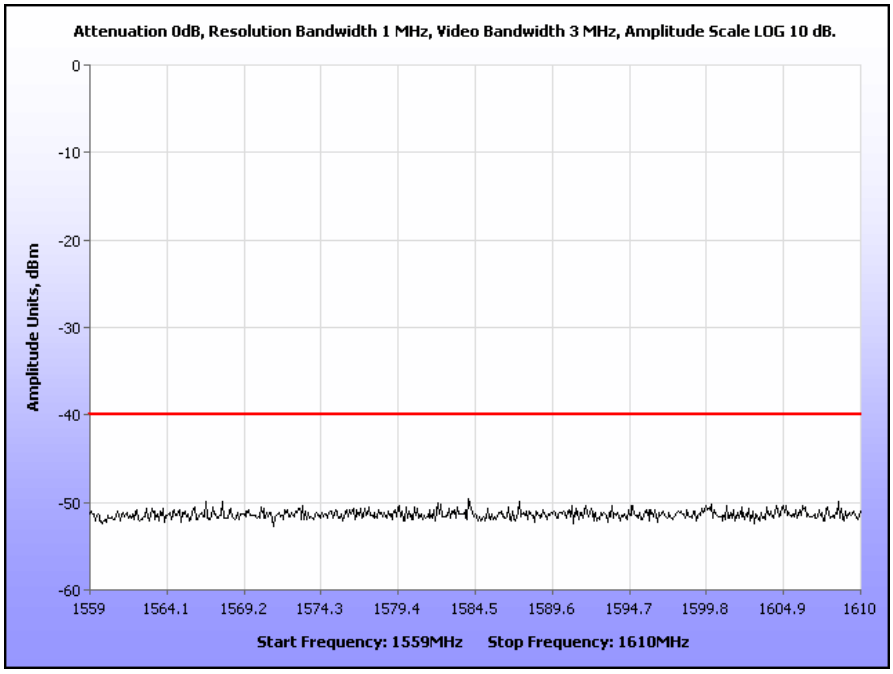
Plot 23. Radiated Spurious Emissions, 757.5 MHz, 700 kHz, 793 MHz – 805 MHz



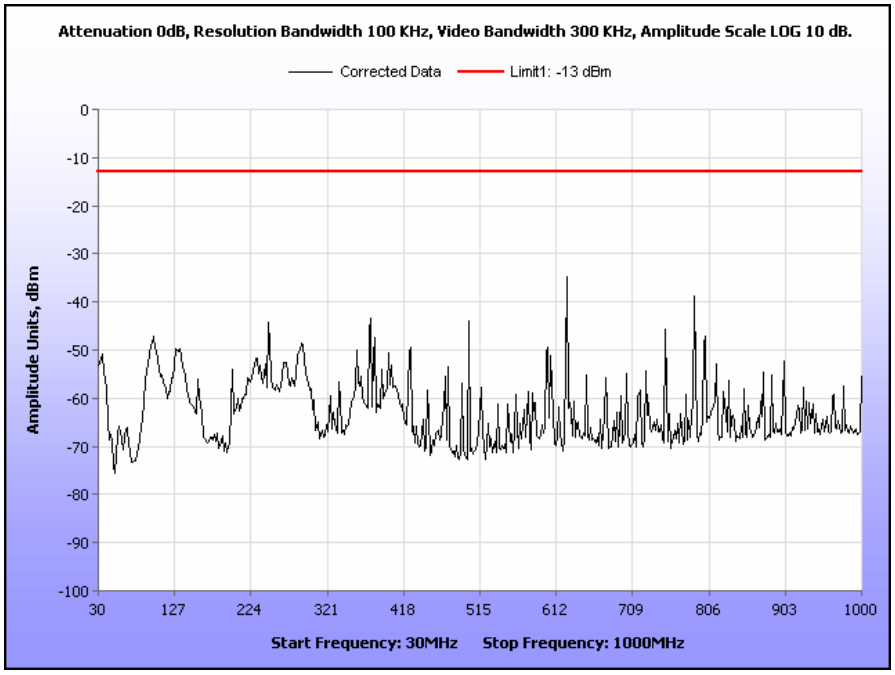
Plot 24. Radiated Spurious Emissions, 757.5 MHz, 700 kHz, 1 GHz – 8 GHz



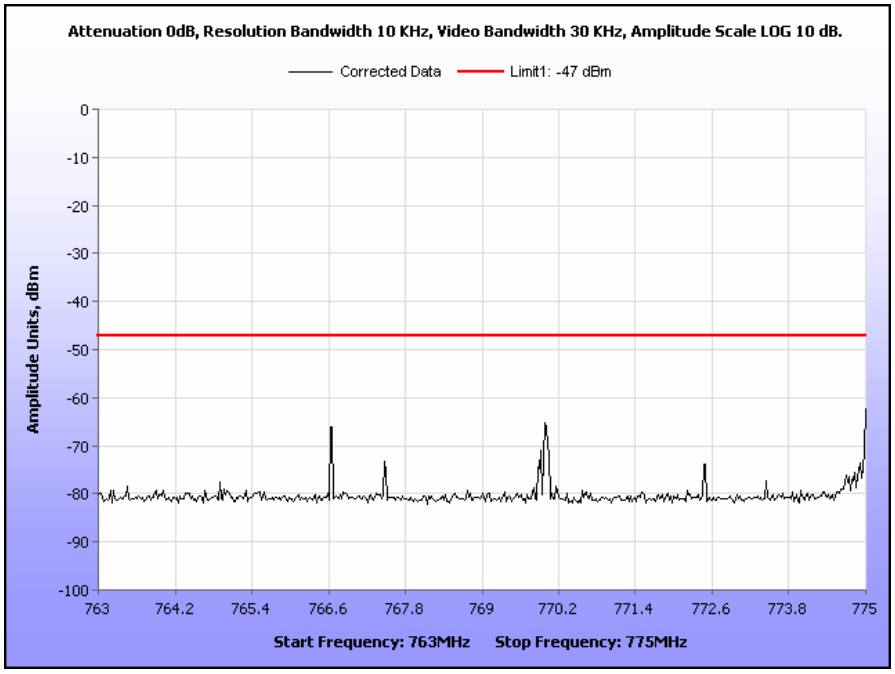
Plot 25. Radiated Spurious Emissions, 757.5 MHz, 700 kHz, 8th Harmonic



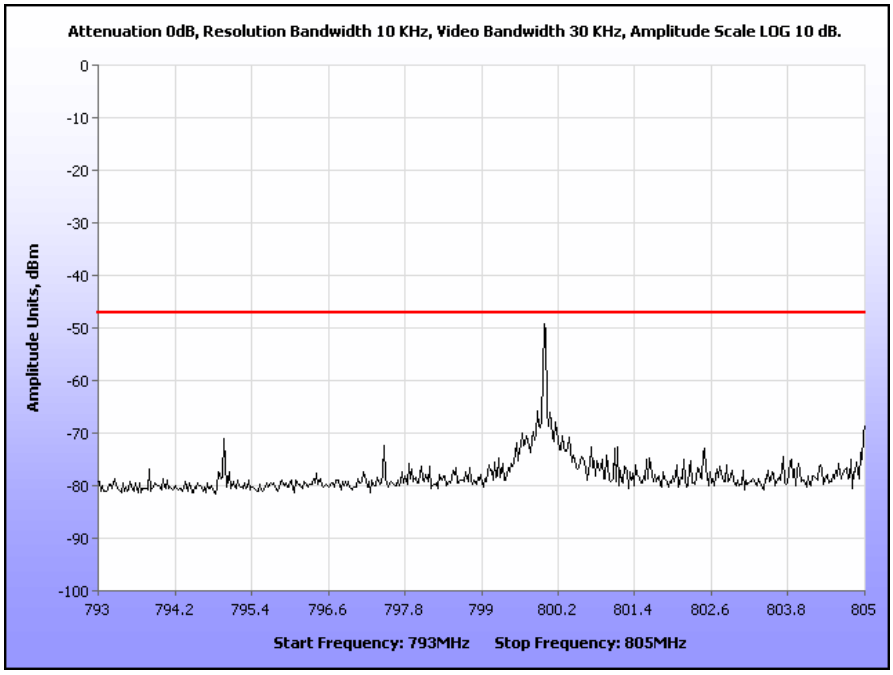
Plot 26. Radiated Spurious Emissions, 757.5 MHz, 700 kHz, 1559 MHz – 1610 MHz



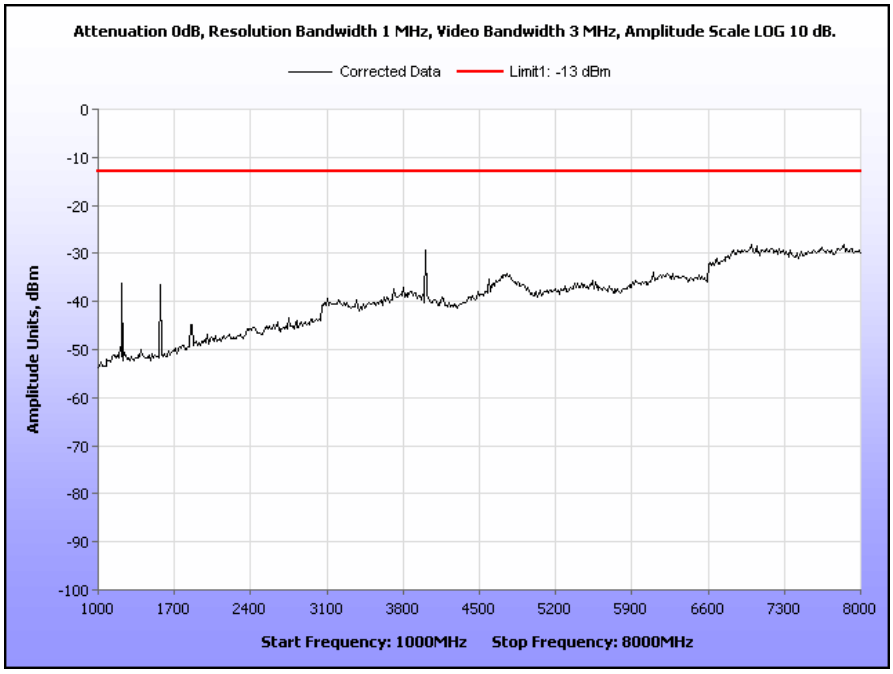
Plot 27. Radiated Spurious Emissions, 787.5 MHz, 700 kHz, 30 MHz – 1 GHz



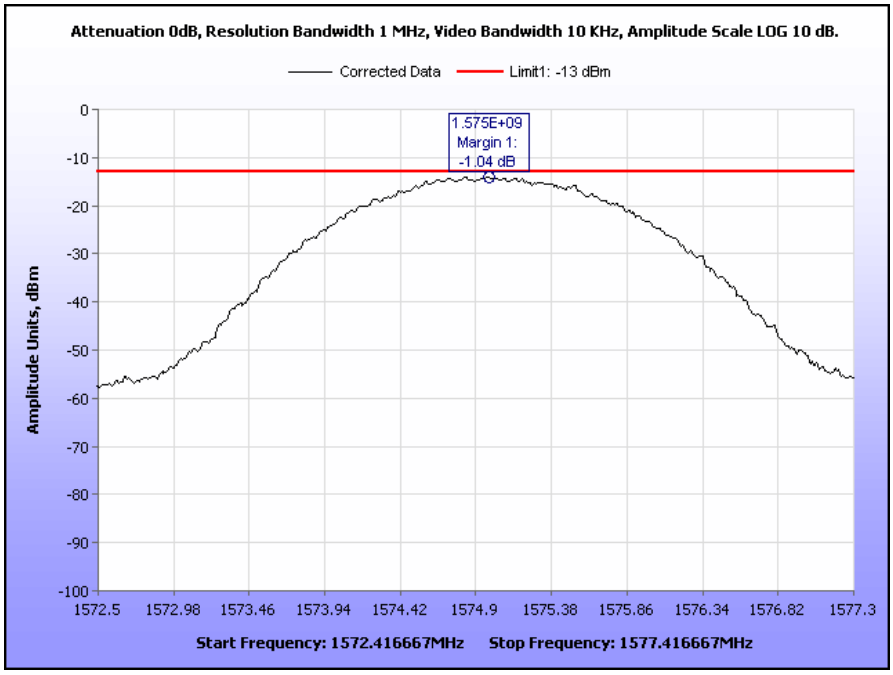
Plot 28. Radiated Spurious Emissions, 787.5 MHz, 700 kHz, 763 MHz – 775 MHz



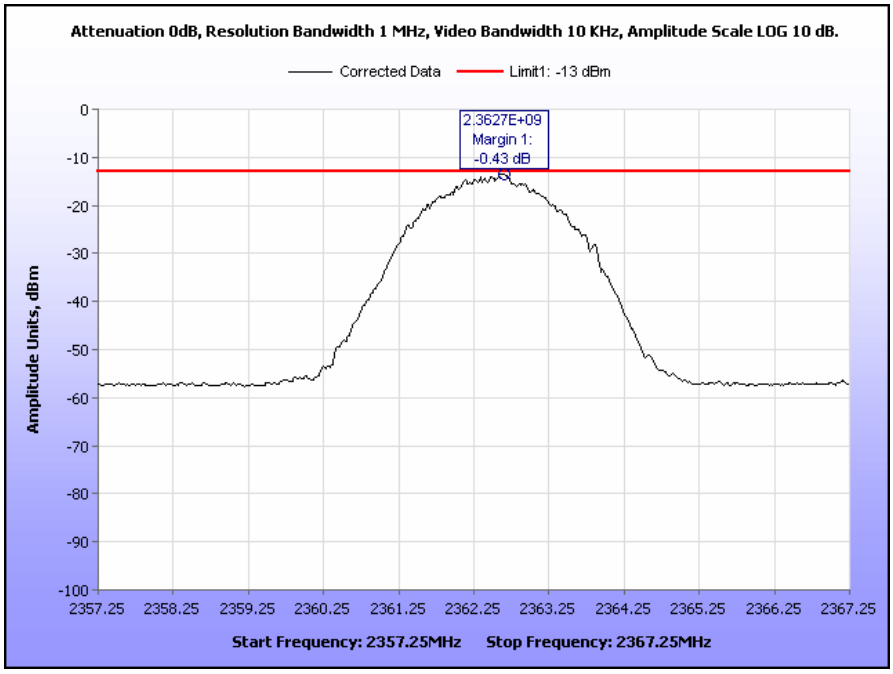
Plot 29. Radiated Spurious Emissions, 787.5 MHz, 700 kHz, 793 MHz – 805 MHz



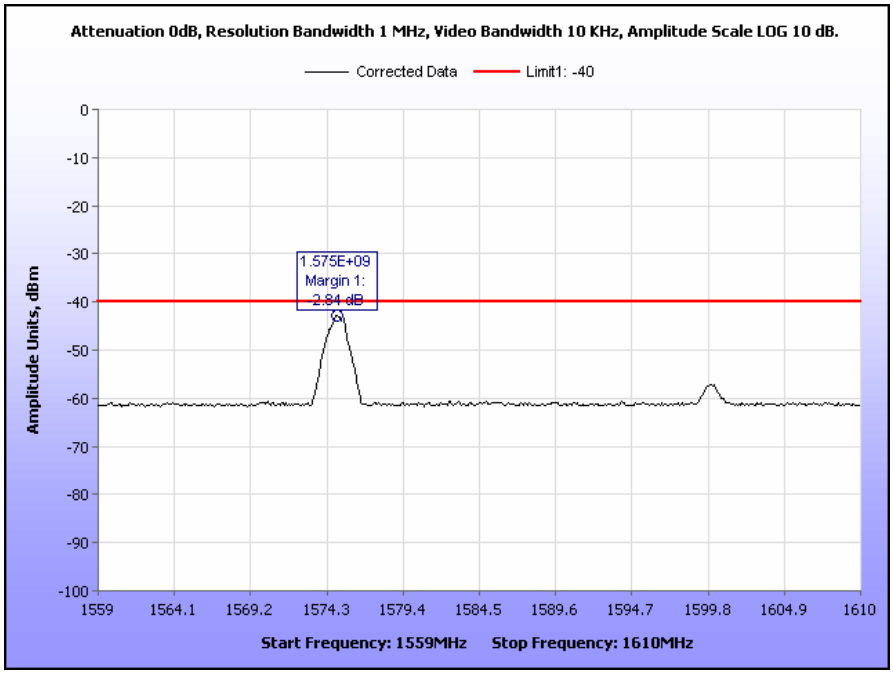
Plot 30. Radiated Spurious Emissions, 787.5 MHz, 700 kHz, 1 GHz – 8 GHz



Plot 31. Radiated Spurious Emissions, 787.5 MHz, 700 kHz, 2nd Harmonic



Plot 32. Radiated Spurious Emissions, 787.5 MHz, 700 kHz, 3rd Harmonic

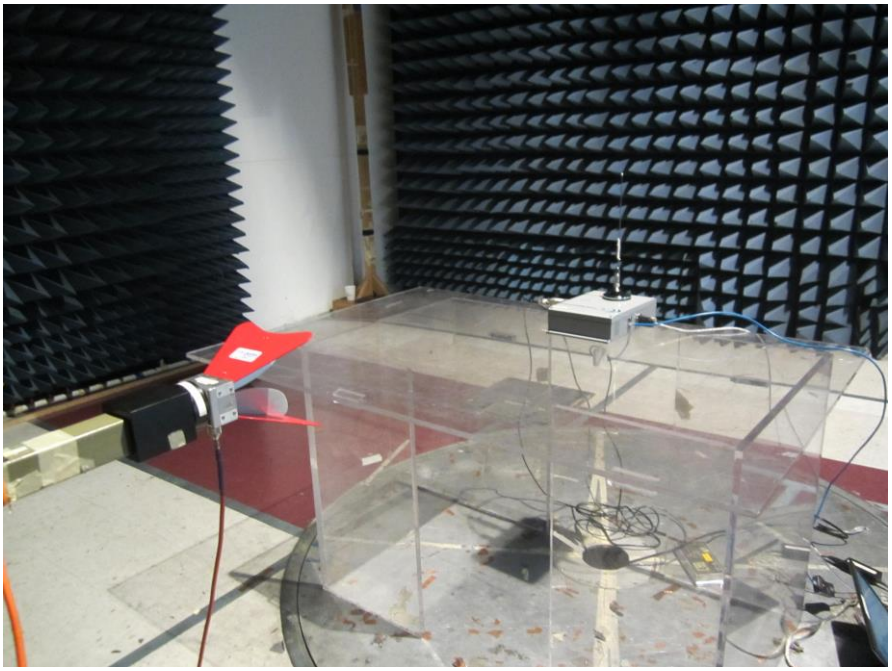


Plot 33. Radiated Spurious Emissions, 787.5 MHz, 700 kHz, 1559 MHz – 1610 MHz

Electromagnetic Compatibility Criteria for Intentional Radiators

Photograph 2. Radiated Emissions, Test Setup, Below 1 GHz

Photograph 3. Radiated Emissions, Test Setup, Above 1 GHz



Photograph 4. Radiated emissions, 1559-1663 MHz with representative antenna

Photograph 5. Radiated Emissions, Test Setup, Substitution Method

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 27.53(c) Spurious Emissions at Antenna Terminals

Test Requirement(s):

§ 27.53(c) Measurements required: Spurious emissions at antenna terminals: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate.

§ 27.53(c)(1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;
§ 27.53(c)(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;
§ 27.53(c)(3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;
§ 27.53(c)(4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations;
§ 27.53(c)(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;
§ 27.53(c)(6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

Test Procedures:

The EUT was connected directly to a spectrum analyzer through an attenuator. It was set to transmit on each frequency at each bandwidth. Emissions were investigated in the frequency range from 30MHz to the 10th harmonic of the fundamental. Measurements were made using a peak detector with a 100 kHz RBW and a 300kHz VBW to show compliance with c(1) & c(2). To show compliance with c(3) an average detector was used. Any emissions that came close to the limit was investigated further to show the spectral energy in a 6.25 kHz band.

Test Results:

Equipment complies with and 27.53(c). The following pages show measurements of Spurious Emission plots

Test Engineer(s):

Jeff Pratt

Test Date(s):

05/14/13 – 05/15/13& 12/12/13

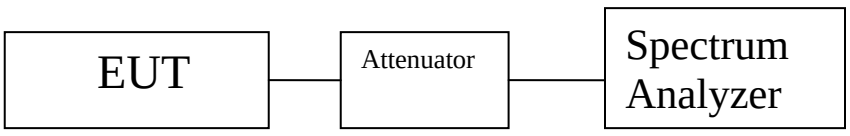
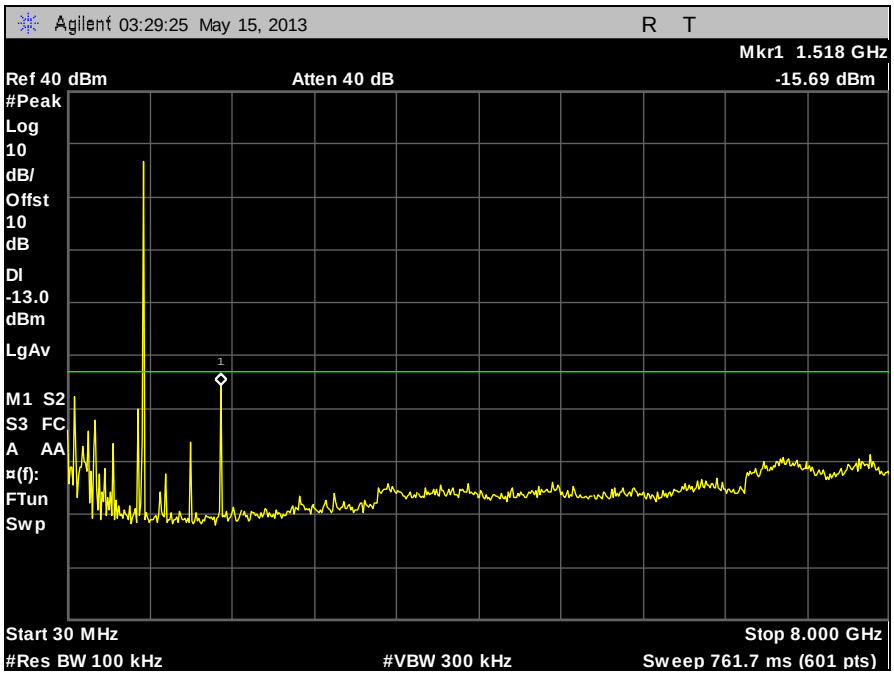
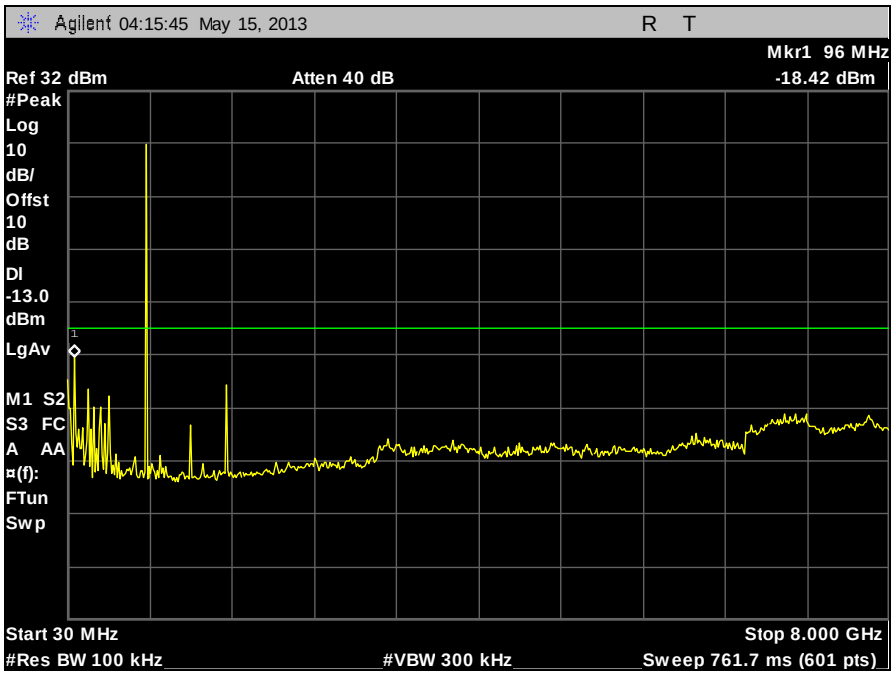


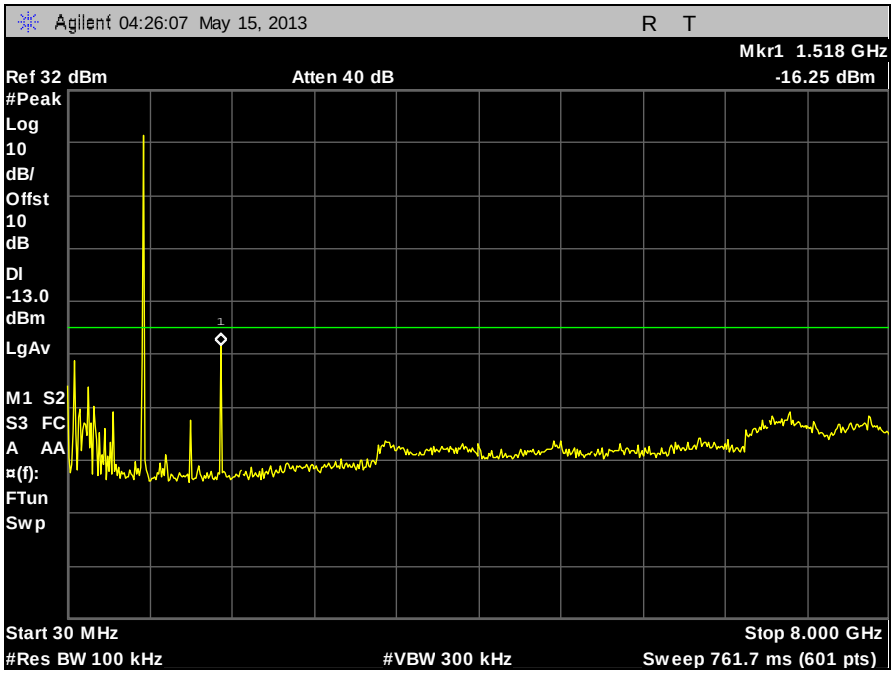
Figure 3. Spurious Emissions at Antenna Terminals Test Setup



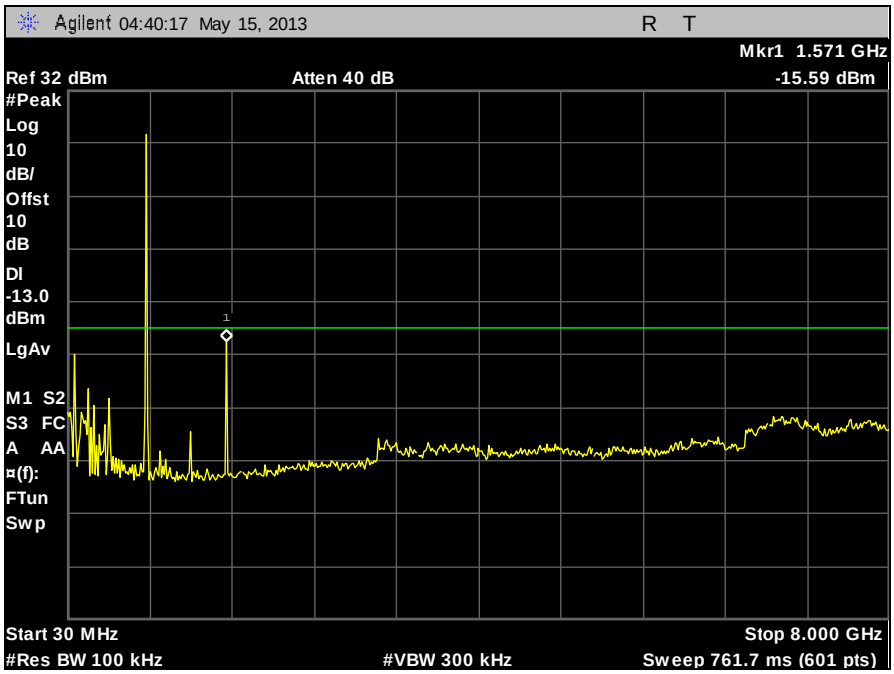
Plot 34. Spurious Emissions at Antenna Terminal, 757.5 MHz, 500 kHz, 30 MHz – 8 GHz



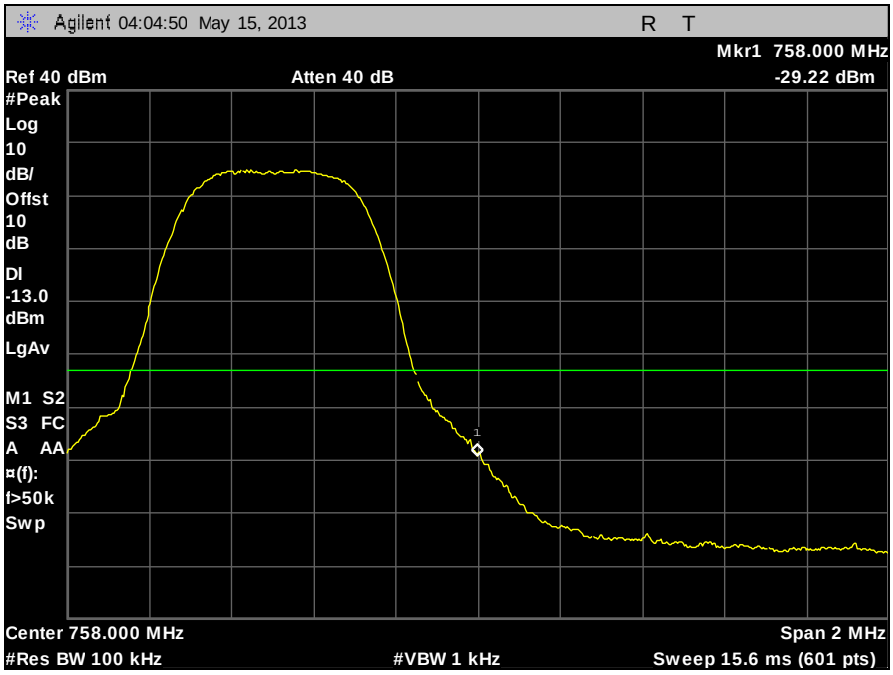
Plot 35. Spurious Emissions at Antenna Terminal, 787.5 MHz, 500 kHz, 30 MHz – 8 GHz



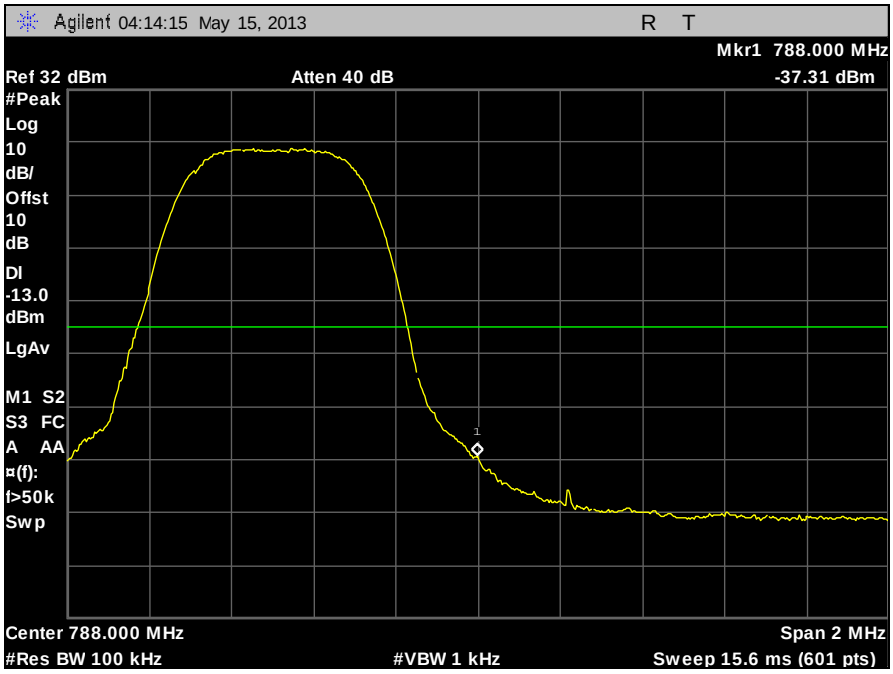
Plot 36. Spurious Emissions at Antenna Terminal, 757.5 MHz, 700 kHz, 30 MHz – 8 GHz



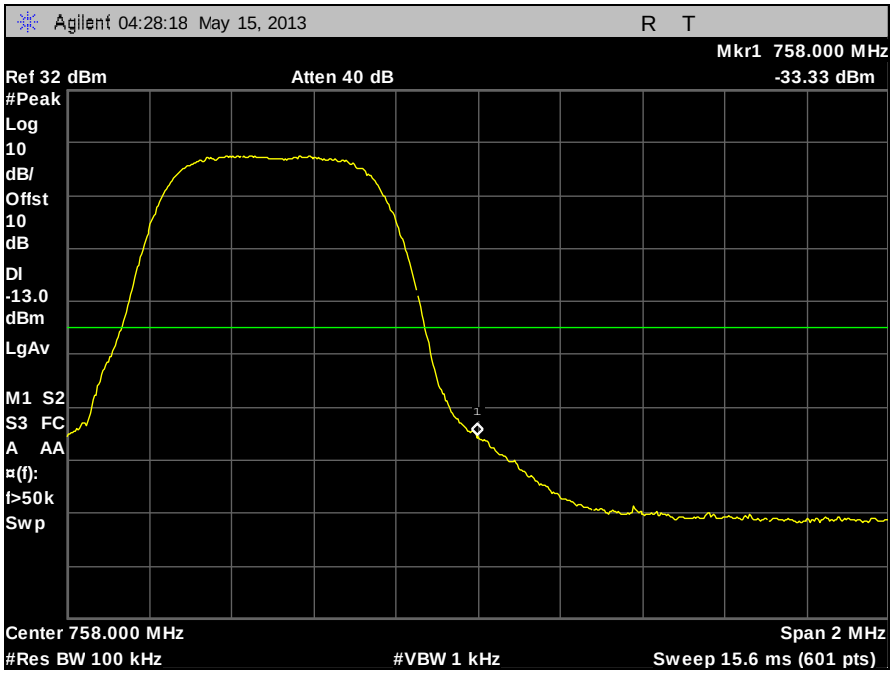
Plot 37. Spurious Emissions at Antenna Terminal, 787.5 MHz, 700 kHz, 30 MHz – 8 GHz



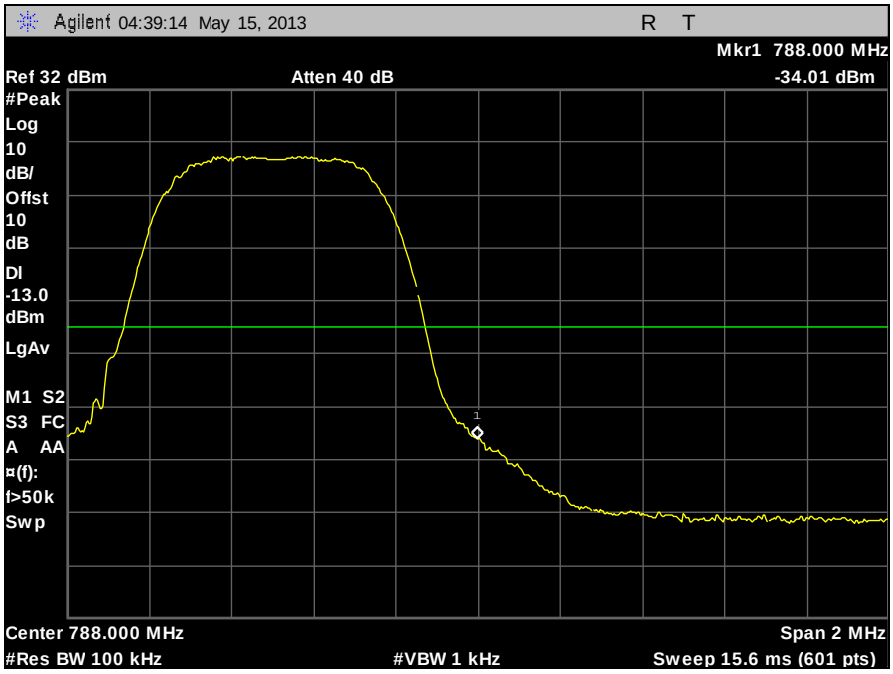
Plot 38. Band Edge, 757.5 MHz, 500 kHz



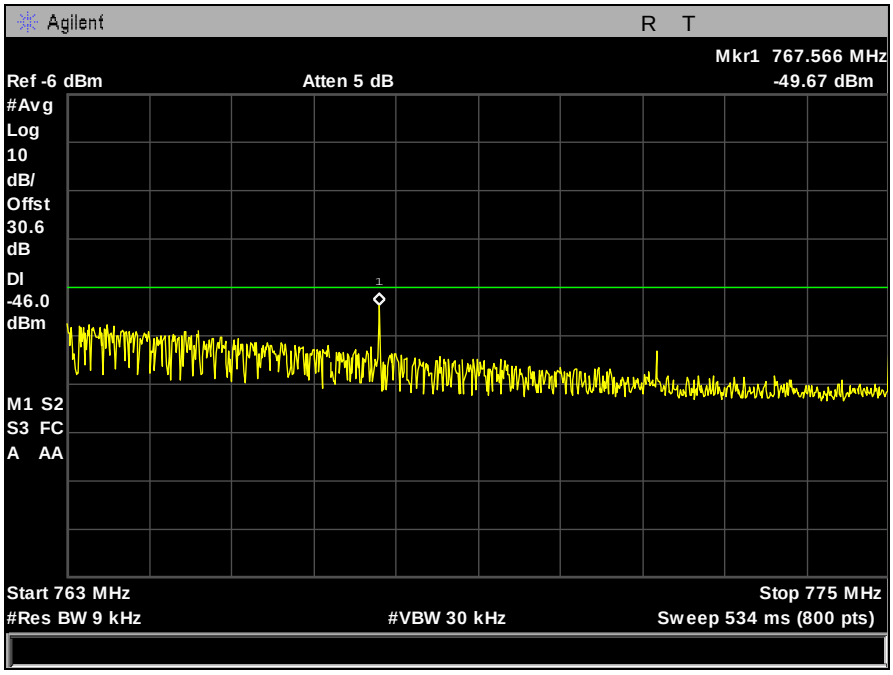
Plot 39. Band Edge, 787.5 MHz, 500 kHz



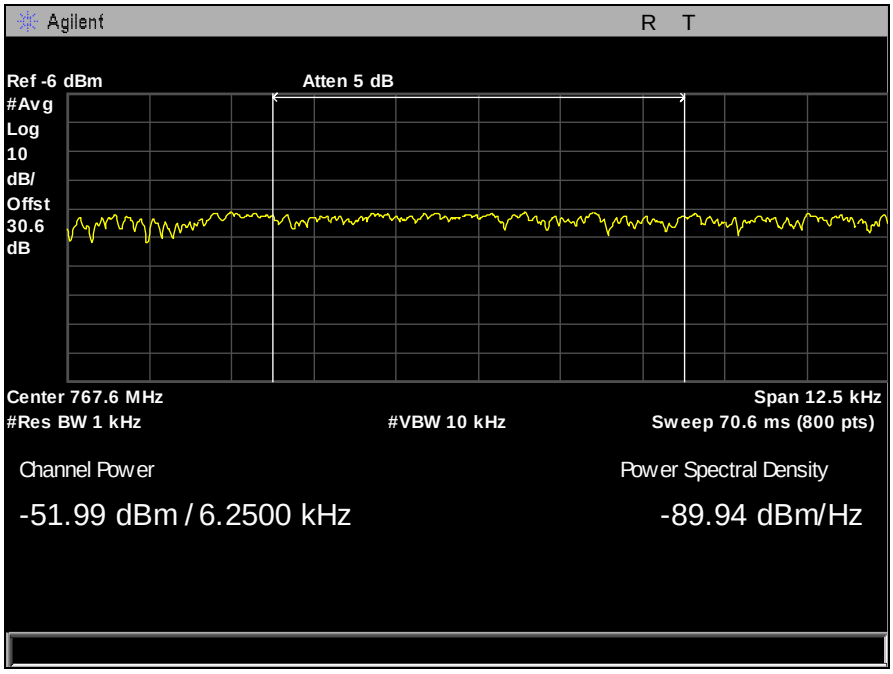
Plot 40. Band Edge, 757.5 MHz, 700 kHz



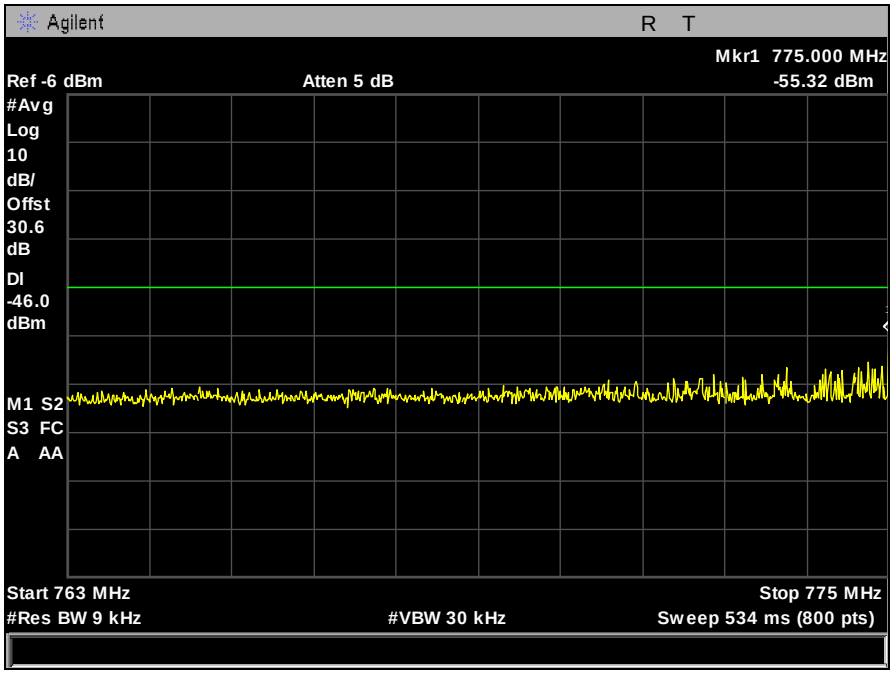
Plot 41. Band Edge, 787.5 MHz, 700 kHz



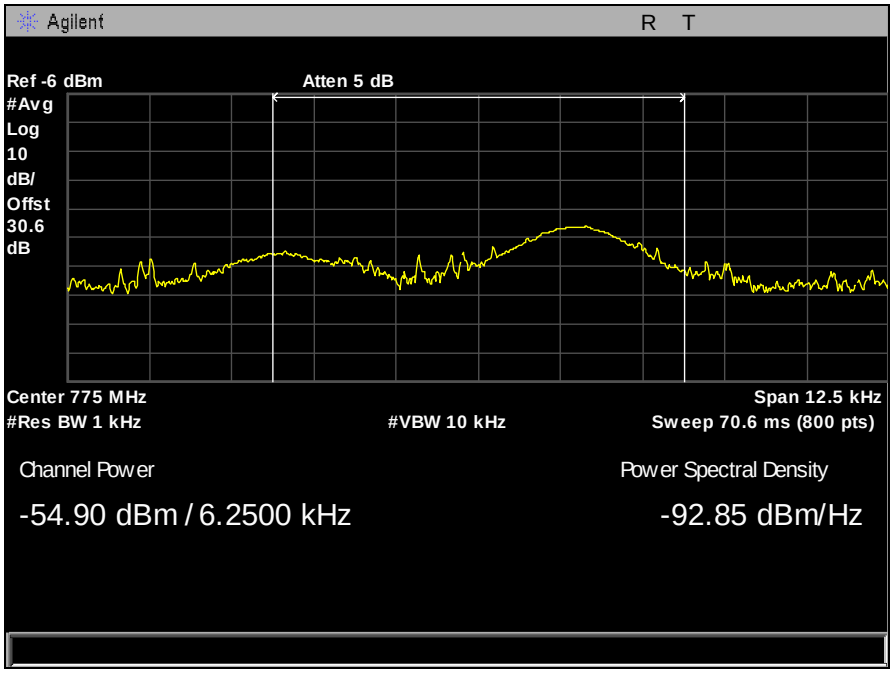
Plot 42. Spurious Emissions at Antenna Terminal, 757.5 MHz, 500 kHz, 763 -775 MHz



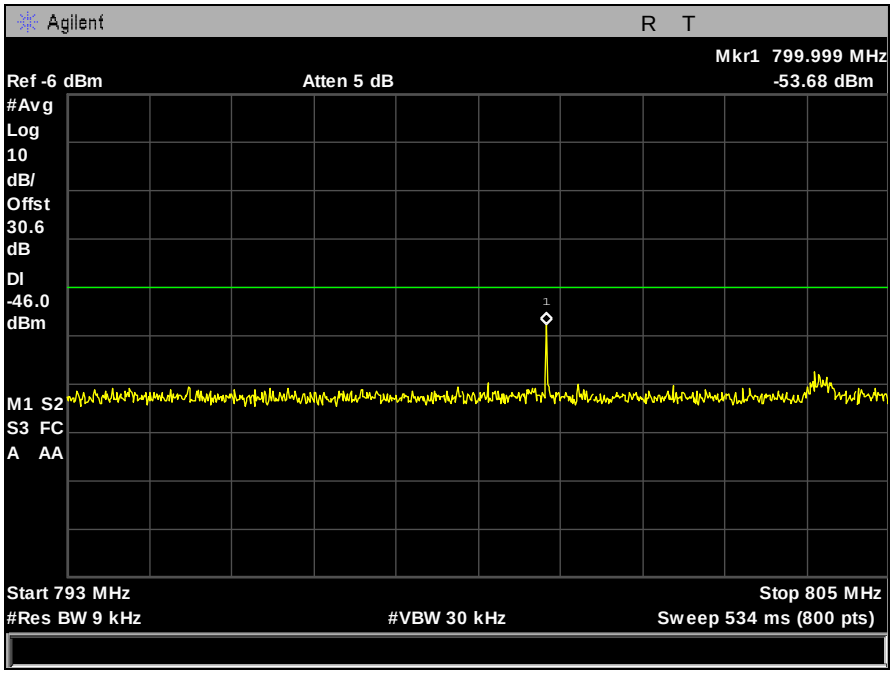
Plot 43. Spurious Emissions at Antenna Terminal, 757.5 MHz, 500 kHz, 763 -775 MHz, Spectral Energy in a 6.25 kHz Band



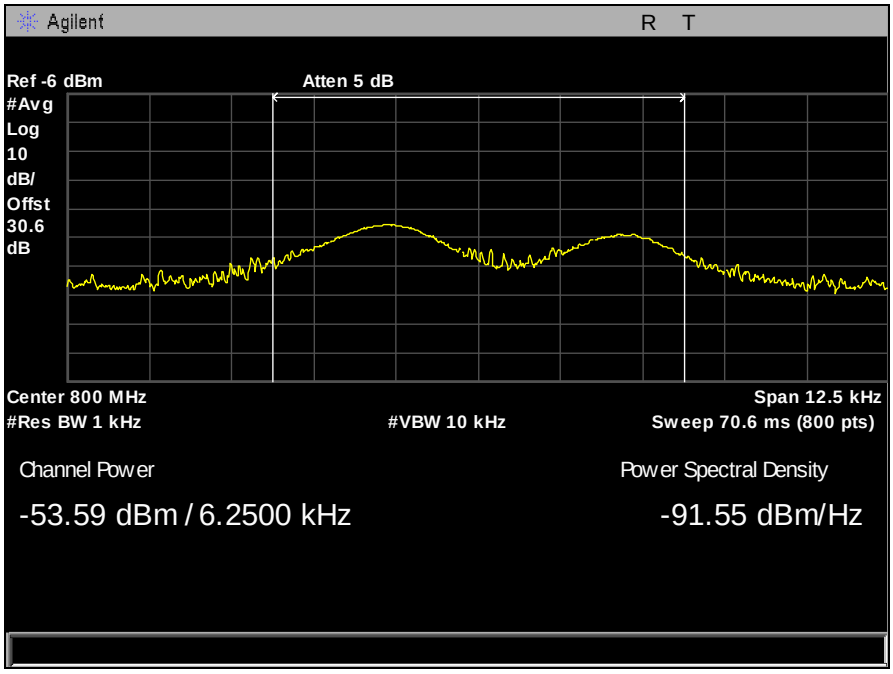
Plot 44. Spurious Emissions at Antenna Terminal, 787.5 MHz, 500 kHz, 763 -775 MHz



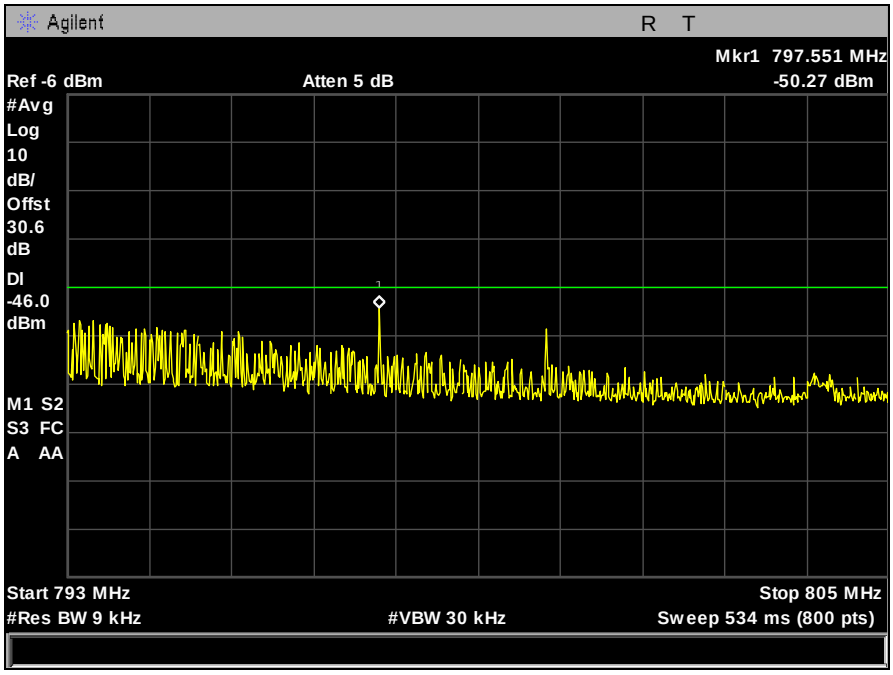
Plot 45. Spurious Emissions at Antenna Terminal, 787.5 MHz, 500 kHz, 763 -775 MHz, Spectral Energy in a 6.25 kHz Band



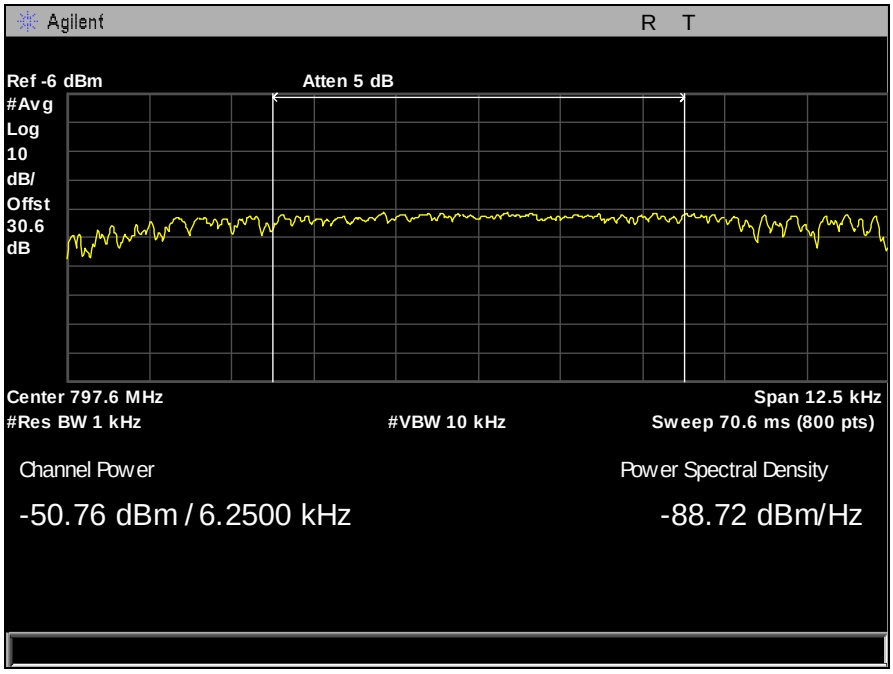
Plot 46. Spurious Emissions at Antenna Terminal, 757.5 MHz, 500 kHz, 793 -805 MHz



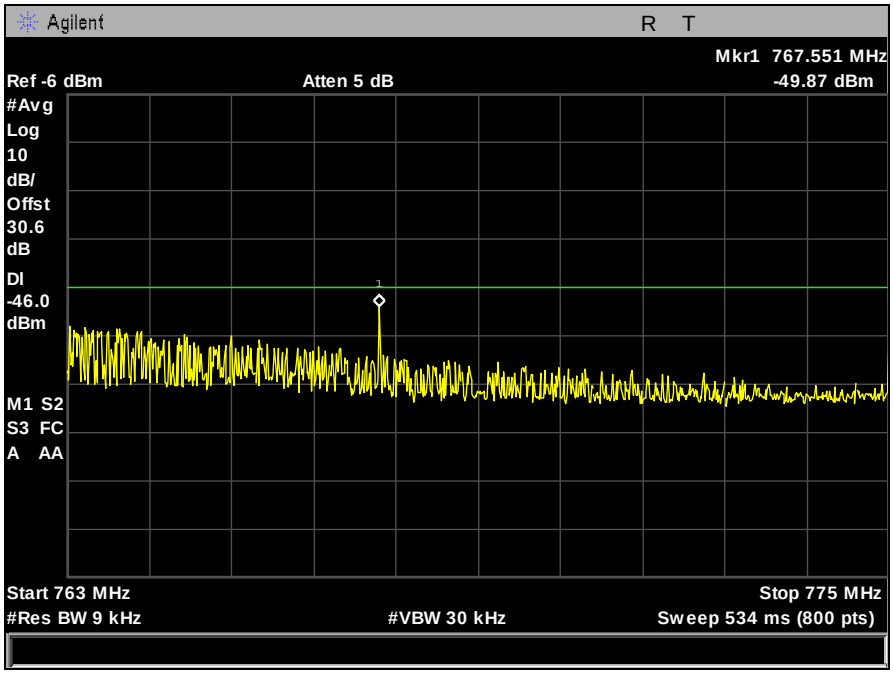
Plot 47. Spurious Emissions at Antenna Terminal, 757.5 MHz, 500 kHz, 793 -805 MHz, Spectral Energy in a 6.25 kHz Band



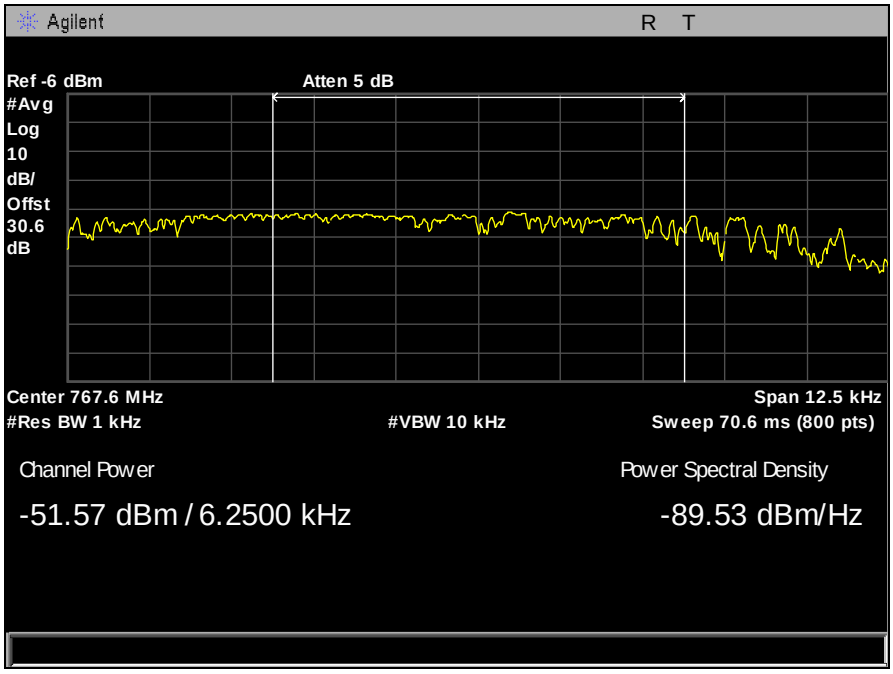
Plot 48. Spurious Emissions at Antenna Terminal, 787.5 MHz, 500 kHz, 793 -805 MHz



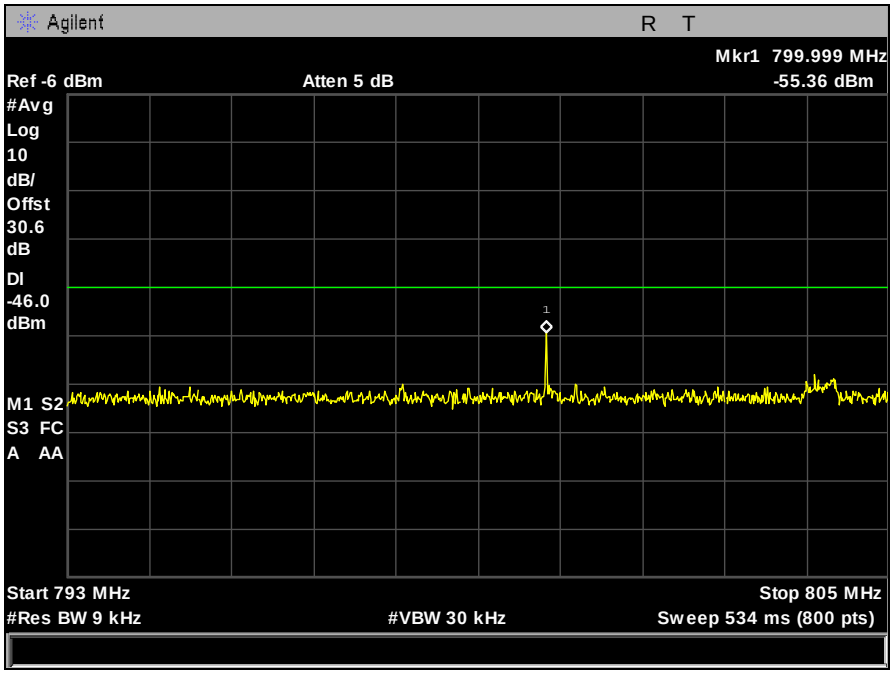
Plot 49. Spurious Emissions at Antenna Terminal, 787.5 MHz, 500 kHz, 793 -805 MHz, Spectral Energy in a 6.25 kHz Band



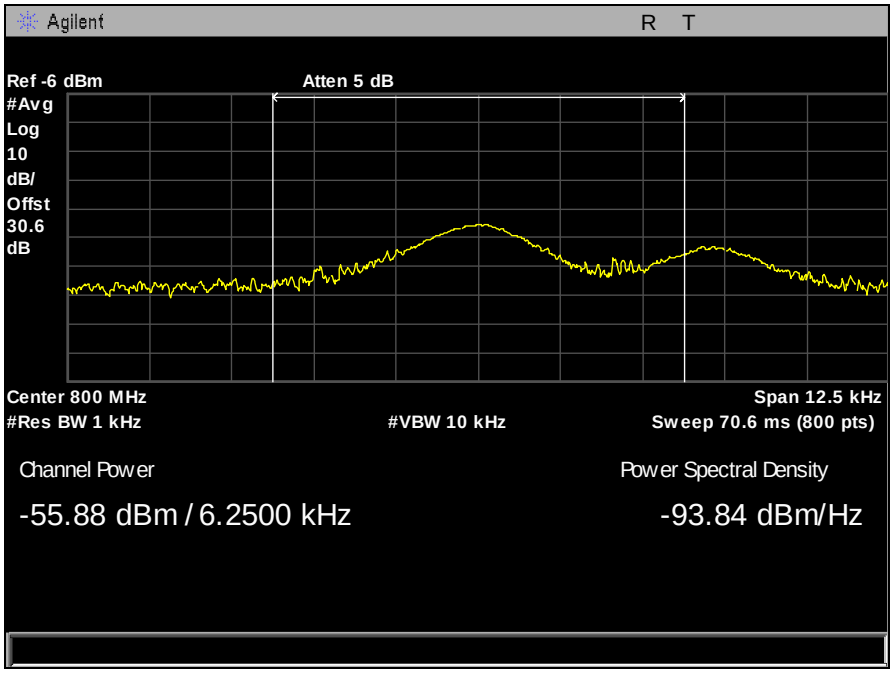
Plot 50. Spurious Emissions at Antenna Terminal, 757.5 MHz, 700 kHz, 763 -775 MHz



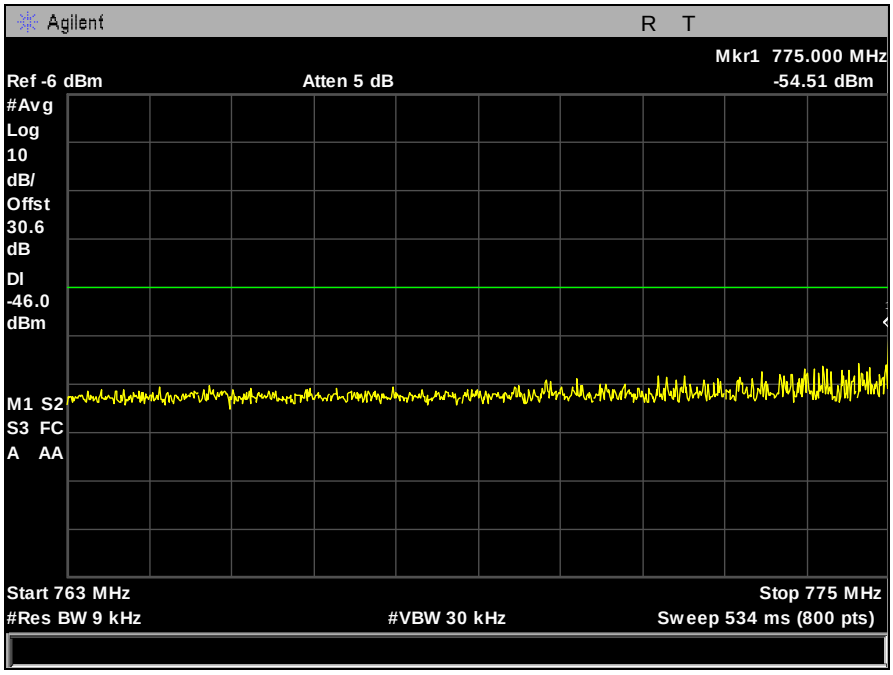
Plot 51. Spurious Emissions at Antenna Terminal, 757.5 MHz, 700 kHz, 763 -775 MHz, Spectral Energy in a 6.25 kHz Band



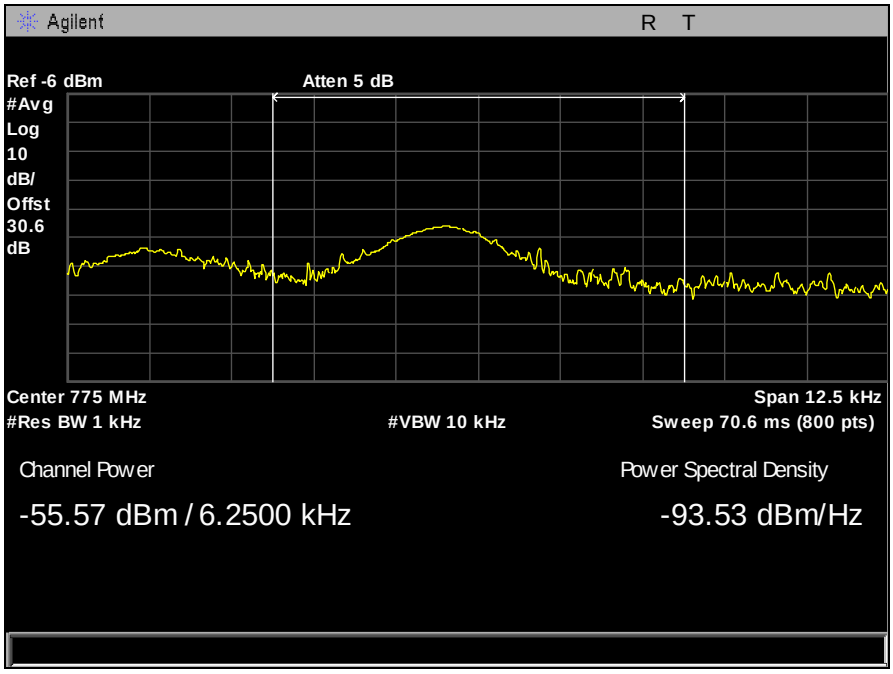
Plot 52. Spurious Emissions at Antenna Terminal, 757.5 MHz, 700 kHz, 793 -805 MHz



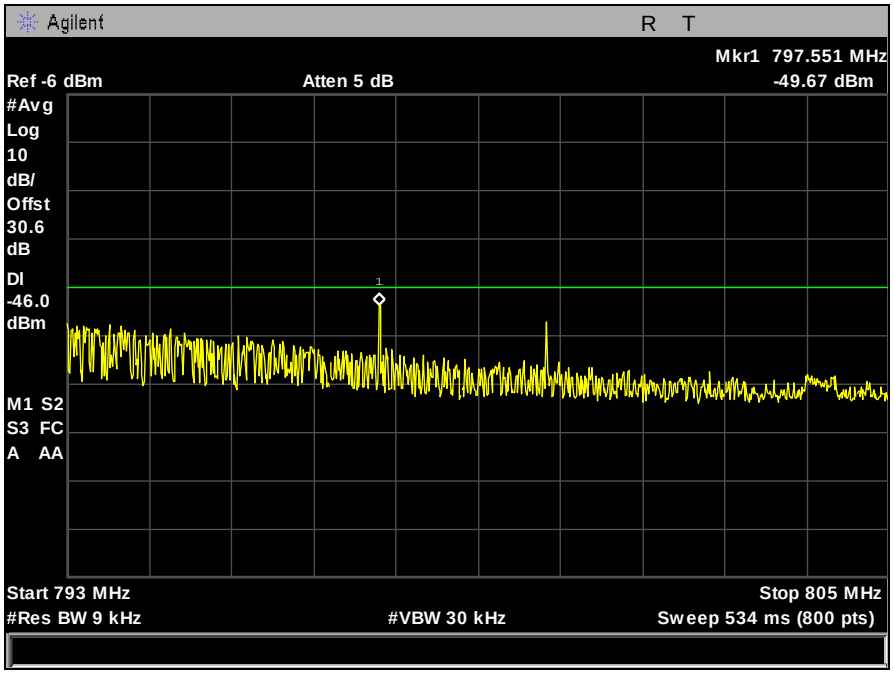
Plot 53. Spurious Emissions at Antenna Terminal, 757.5 MHz, 700 kHz, 793 -805 MHz, Spectral Energy in a 6.25 kHz Band



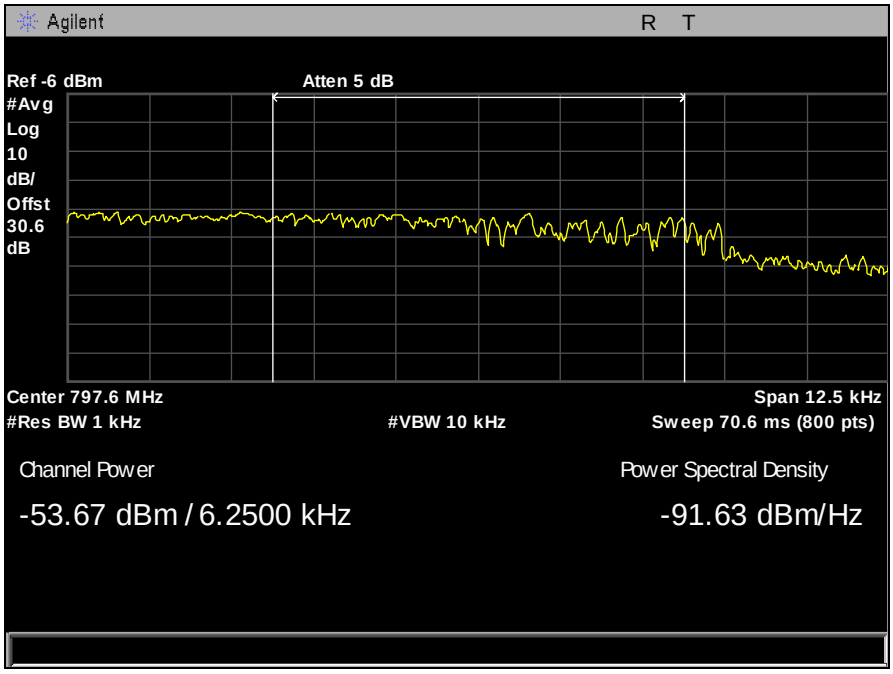
Plot 54. Spurious Emissions at Antenna Terminal, 787.5 MHz, 700 kHz, 763 -775 MHz



Plot 55. Spurious Emissions at Antenna Terminal, 787.5 MHz, 700 kHz, 763 -775 MHz, Spectral Energy in a 6.25 kHz Band



Plot 56. Spurious Emissions at Antenna Terminal, 787.5 MHz, 700 kHz, 793 -805 MHz



Plot 57. Spurious Emissions at Antenna Terminal, 787.5 MHz, 700 kHz, 793 -805 MHz, Spectral Energy in a 6.25 kHz Band

Electromagnetic Compatibility Criteria for Intentional Radiators

§2.1055 Frequency Stability

Test Requirement(s): **§2.1055 and 27.54**

§27.54: The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

Test Procedures: As required by 47 CFR 2.1055, *Frequency Stability measurements* were made at the RF output terminals using an attenuator and a spectrum analyzer.

The EUT was setup in an Environmental chamber with the support equipment outside the chamber. The EUT was set to transmit on 787.5MHz with a nominal bandwidth of 700kHz. The frequencies above and below the peak of the carrier were recorded and the nominal center frequency was calculated using the following equation: Fc=(Fl+Fh)/2. The reference center frequency was calculated at +20C and 120V. The temperature was varied in increments of no more than 10 degrees in the range -30C to +50C, and at 20C, the AC mains voltage was varied between 85% and 115% of nominal; the center frequency was calculated as described above for each case. The drift in kHz was calculated to ensure that the fundamental emission stayed within the authorized frequency band.

Test Results: Equipment is compliant with Section 27.54.
Test Engineer: Poona Saber

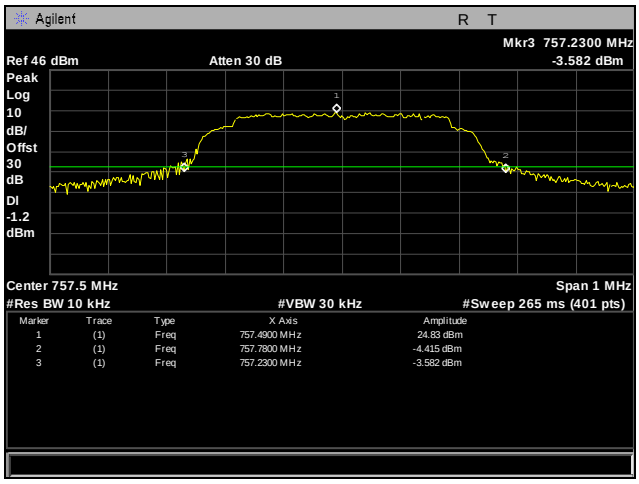
Test Date(s): 12/02/13

787.5MHz		Reference Center Frequency		787.492666	
Temperature (°C)	Voltage (V)	Low Frequency (MHz)	High Frequency (MHz)	Center Frequency (MHz)	Drift (kHz)
-30	120	787.2375	787.765	787.50125	-1.25
-20	120	787.235	787.7575	787.49625	-6.25
-10	120	787.2425	787.75	787.49625	-6.25
0	120	787.24	787.755	787.4975	-5
10	120	787.2425	787.765	787.50375	1.25
20	120	787.2375	787.7675	787.5025	0
20	102	787.2226	787.7673	787.4949	2.3
20	138	787.218	787.768	787.493	0.33
30	120	787.24	787.7575	787.49875	-3.75
40	120	787.2325	787.7725	787.5025	0
50	120	787.2375	787.7575	787.4975	-5

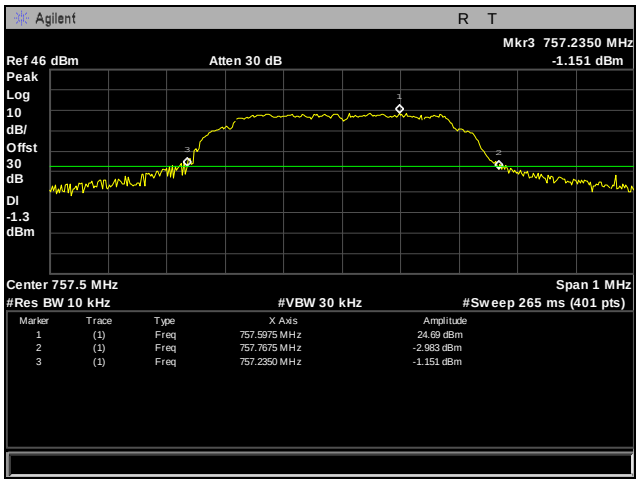
Table 5. Frequency Stability, Test Results, 787.5 MHz

757.5MHz		Reference Center Frequency		757.5025	
Temperature (°C)	Voltage (V)	Low Frequency (MHz)	High Frequency (MHz)	Center Frequency (MHz)	Drift (kHz)
-30	120	757.23	757.78	757.505	2.5
-20	120	757.235	757.7675	757.50125	-1.25
-10	120	757.225	757.755	757.49	-12.5
0	120	757.2325	757.7725	757.5025	0
10	120	757.2375	757.7575	757.4975	-5
20	120	757.24	757.765	757.5025	0
20	102	787.2228	787.7654	787.4945	2.4
20	138	787.228	787.753	787.463	0.31
30	120	757.24	757.775	757.5075	5
40	120	757.2375	757.7825	757.51	7.5
50	120	757.2225	757.775	757.49875	-3.75

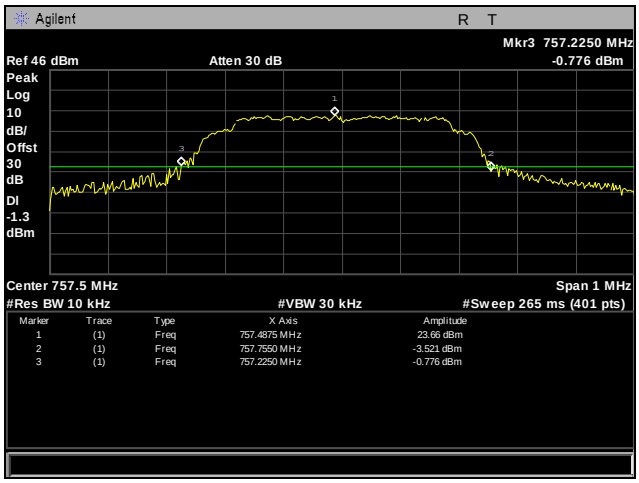
Table 6. Frequency Stability, Test Results, 757.5 MHz



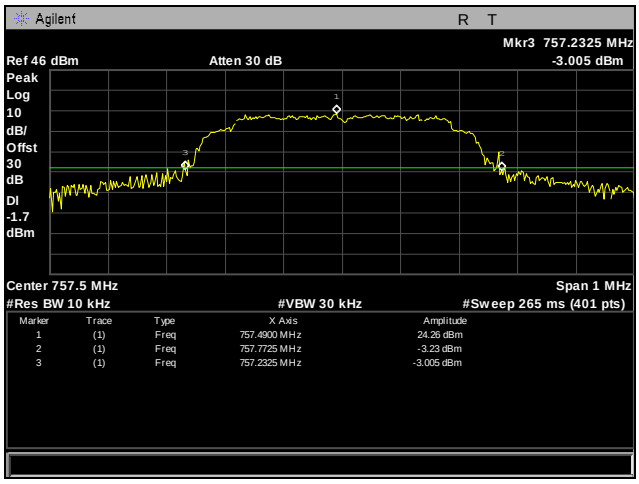
Plot 58. Frequency Stability, -30°C, 120V, 757.5 MHz



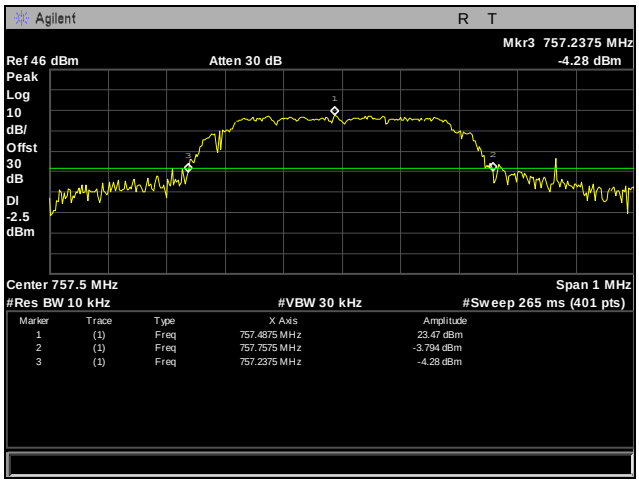
Plot 59. Frequency Stability, -20°C, 120V, 757.5 MHz



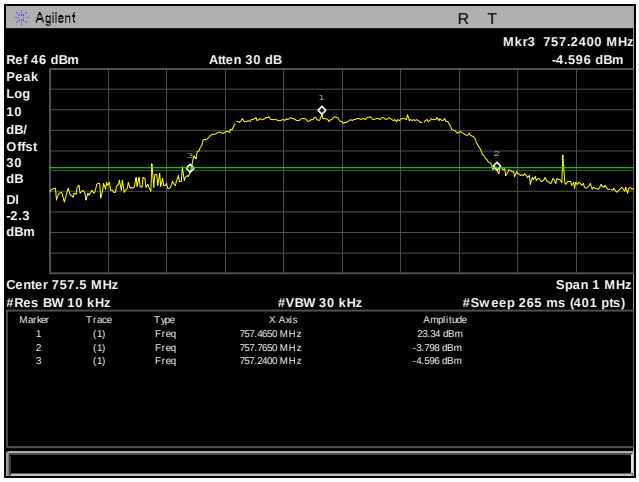
Plot 60. Frequency Stability, -10°C, 120V, 757.7 MHz



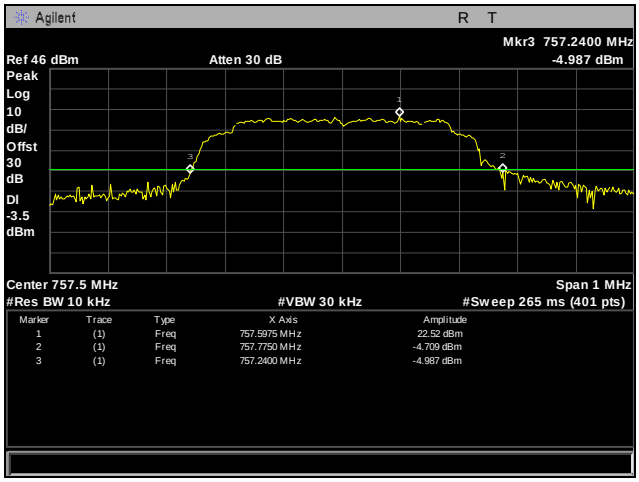
Plot 61. Frequency Stability, 0°C, 120V, 757.5 MHz



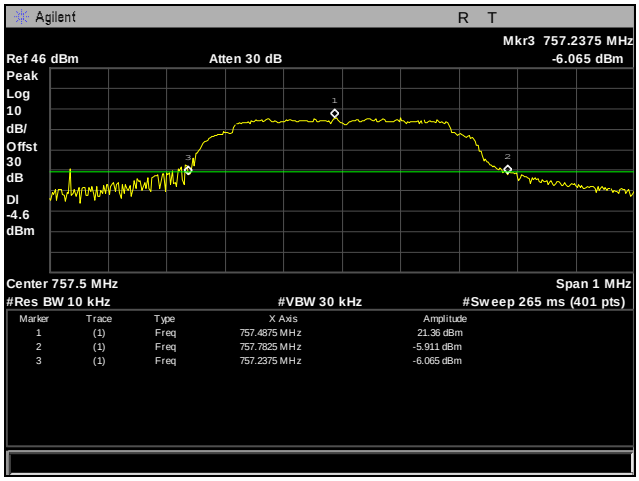
Plot 62. Frequency Stability, 10°C, 120V, 757.5 MHz



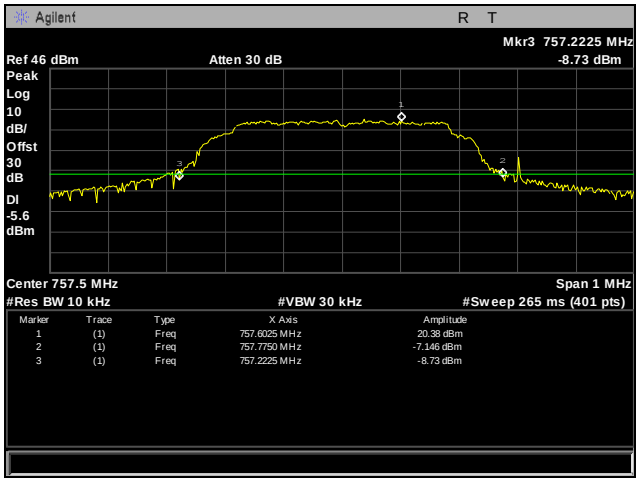
Plot 63. Frequency Stability, 20°C, 120V, 757.5 MHz



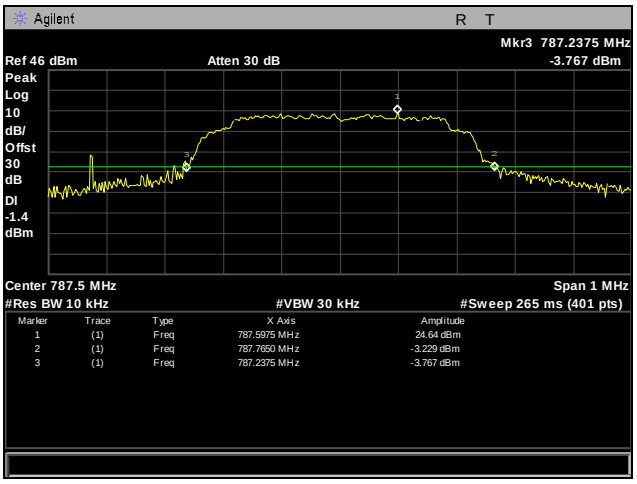
Plot 64. Frequency Stability, 30°C, 120V, 757.5 MHz



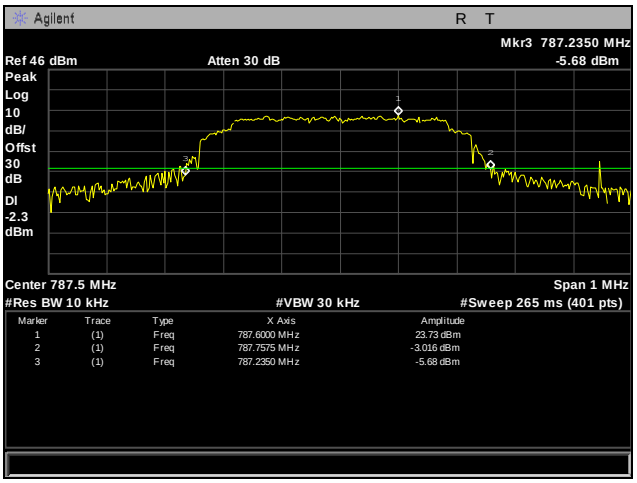
Plot 65. Frequency Stability, 40°C, 120V, 757.5 MHz



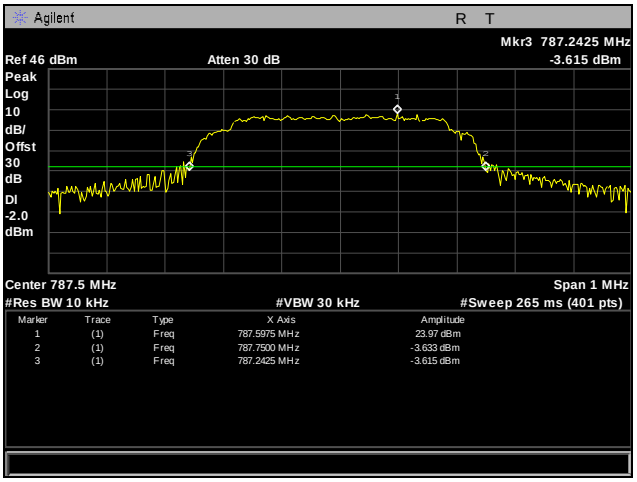
Plot 66. Frequency Stability, 50°C, 120V, 757.5 MHz



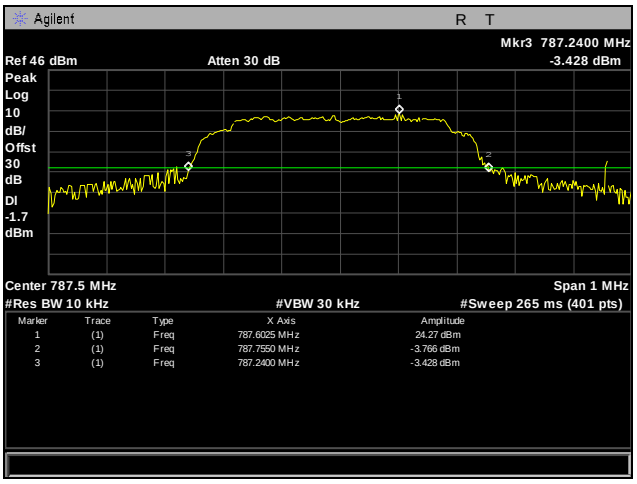
Plot 67. Frequency Stability, -30°C, 120V, 787.5 MHz



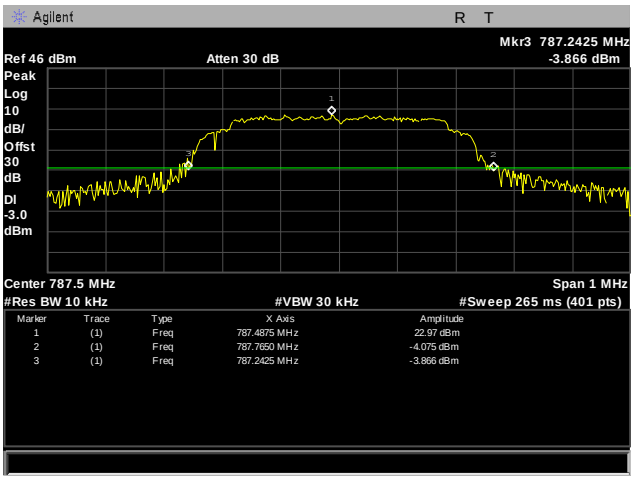
Plot 68. Frequency Stability, -20°C, 120V, 787.5 MHz



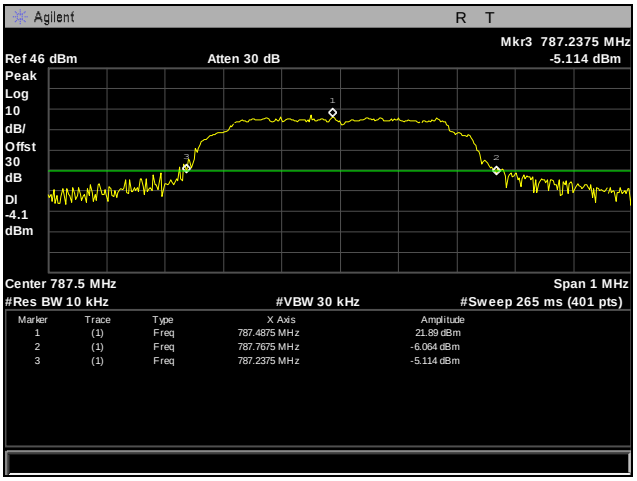
Plot 69. Frequency Stability, -10°C, 120V, 787.5 MHz



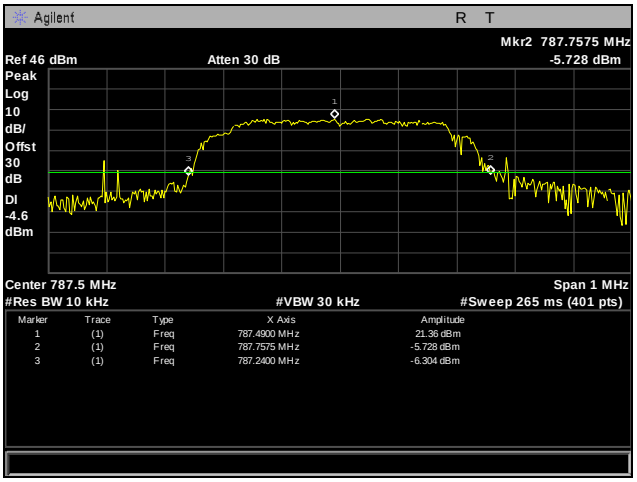
Plot 70. Frequency Stability, 0°C, 120V, 787.5 MHz



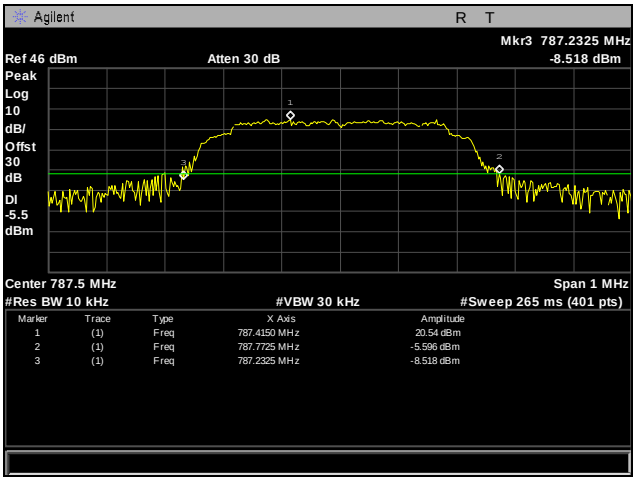
Plot 71. Frequency Stability, 10°C, 120V, 787.5 MHz



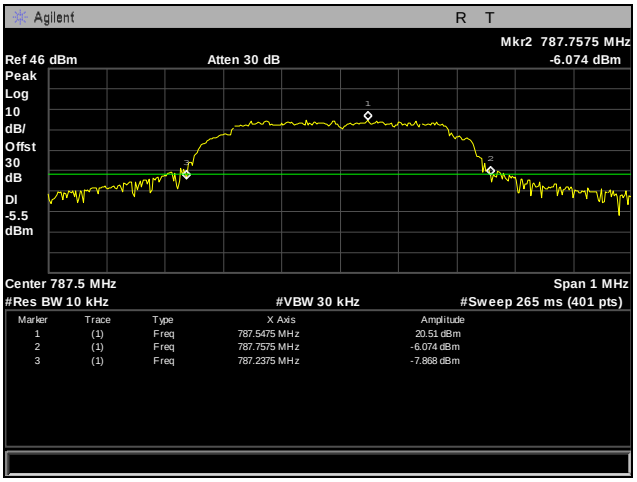
Plot 72. Frequency Stability, 20°C, 120V, 787.5 MHz



Plot 73. Frequency Stability, 30°C, 120V, 787.5 MHz



Plot 74. Frequency Stability, 40°C, 120V, 787.5 MHz



Plot 75. Frequency Stability, 50°C, 120V, 787.5 MHz

IV. Test Equipment

Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2005.

MET #	Equipment	Manufacturer	Model#	Cal Date	Cal Due
1T4771	PSA SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4446A	2/15/2013	8/15/2013
1T4612	SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4407B	5/23/2012	11/23/2013
1T4751	ANTENNA – BILOG	SUNOL SCIENCES	JB6	1/8/2013	7/8/2014
1T4300	SEMI-ANECHOIC CHAMBER #1 (FCC)	EMC TEST SYSTEMS	NONE	7/24/2012	7/24/2015
1T4814	COMB GENERATOR	COM-POWER	CGO-5100	SEE NOTE	
1T2511	ANTENNA; HORN	EMCO	3115	3/28/2013	9/28/2014
1T4409	EMI RECEIVER	ROHDE & SCHWARZ	ESIB7	7/16/2012	7/16/2013
1T4505	TEMPERATURE CHAMBER	TEST EQUITY	115	12/2/2012	12/2/2013

Table 7. Test Equipment List

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

V. Certification & User's Manual Information

Certification & User's Manual Information

A. Certification Information

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

§ 2.801 Radio-frequency device defined.

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

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

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

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

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

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

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

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

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

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

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

(i) Compliance testing;

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

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

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

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

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

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

Certification & User's Manual Information

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

§ 2.901 Basis and Purpose

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

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

§ 2.907 Certification.

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

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

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

Certification & User's Manual Information

§ 2.948 Description of measurement facilities.

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

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

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

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

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

Certification & User's Manual Information

Label and User's Manual Information

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

§ 15.19 Labeling requirements.

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

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

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

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

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

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

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

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

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

§ 15.21 Information to user.

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

Verification & User's Manual Information

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

§ 15.105 Information to the user.

(a) For a Class 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.

End of Report

