MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*

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3162 BELICK STREET ● SANTA CLARA, CALIFORNIA 95054 ● PHONE (408) 748-3585 ● FAX (510) 489-6372
13501 MCCALLEN PASS ● AUSTIN, TX 78753 ● PHONE (512) 287-2500 ● FAX (512) 287-2513

July 5, 2016

Amimon
2 Maskit St Building D, 2nd Floor
Herzelia, Israel 46733

Dear Gabi Nocham,

Enclosed is the EMC Wireless test report for compliance testing of the Amimon, AMNCVTX01 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, Subpart E (UNII 3).

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: (\Amimon\ EMC89646A-FCC407 UNII 3 Rev. 2)

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Electromagnetic Compatibility Criteria
Test Report

for the

Amimon
Model AMNCVTX01

Tested under
The FCC Certification Rules
contained in
Title 47 of the CFR
15.407 Subpart E

MET Report: EMC89646A-FCC407 UNII 3 Rev. 2

July 5, 2016

Prepared For:

Amimon
2 Maskit St Building D, 2nd Floor
Herzelia, Israel 46733

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

Electromagnetic Compatibility Criteria
Test Report

for the

Amimon
Model AMNCVTX01

Tested under
The FCC Certification Rules
contained in
Title 47 of the CFR
15.407 Subpart E

Hadid Jones, 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 Parts 15B, 15.407, of the FCC Rules under normal use and maintenance.

Asad Bajwa,
Director, Electromagnetic Compatibility Lab

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Report Status Sheet

Revision	Report Date	Reason for Revision
∅	June 7, 2016	Initial Issue.
1	June 27, 2016	Engineer corrections.

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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

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I. Executive Summary

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A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Amimon AMNCVTX01, with the requirements of Part 15, §15.407. 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 AMNCVTX01. Amimon should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the AMNCVTX01, has been **permanently** discontinued.

B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.407, in accordance with Amimon, purchase order number 16000358. All tests were conducted using measurement procedure ANSI C63.4-2014.

FCC Reference	Description	Results
§15.203	Antenna Requirement	Compliant
§15.403(i)	26 dB Bandwidth	Compliant
§15.407 (a)(3)	Maximum Conducted Output Power	Compliant
§15.407 (a)(3)	Maximum Power Spectral Density	Compliant
§15.407 (b)(4)& (6 - 7)	Undesirable Emissions	Compliant
§15.407(b)(6)	Conducted Emission Limits	Compliant
§15.407(e)	6 dB Bandwidth	Compliant
§15.407(f)	RF Exposure	Compliant

Table 1. Executive Summary of EMC Part 15.407 ComplianceTesting

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II. Equipment Configuration

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A. Overview

MET Laboratories, Inc. was contracted by Amimon to perform testing on the AMNCVTX01, under Amimon's purchase order number 16000358.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Amimon AMNCVTX01.

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

Model(s) Tested:	AMNCVTX01	
Model(s) Covered:	AMNCVTX01	
EUT Specifications:	Primary Power: 120 VAC, 60 Hz	
	FCC ID: VQSAMNCVTX01	
	Type of Modulations:	OFDM
	Equipment Code:	NII
	Max. RF Output Power:	23.9 dBm
	EUT Frequency Ranges:	5740 – 5820 MHz
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	
Type of Filing:	Original	
Evaluated by:	Hadid Jones	
Report Date(s):	July 5, 2016	

Table 2. EUT Summary

B. References

CFR 47, Part 15, Subpart E	Unlicensed National Information Infrastructure Devices (UNII)
ANSI C63.4:2014	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
ISO/IEC 17025:2005	General Requirements for the Competence of Testing and Calibration Laboratories
ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices

Table 3. References

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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 Amimon AMNCVTX01, Equipment Under Test (EUT), is designed to modulate and transmit downstream video and audio content over the wireless medium and receive a control channel over the wireless upstream. The modulation uses a 40, 20 or 10 MHz bandwidth and is carried over the 5GHz unlicensed band.

E. Equipment Configuration

Ref. ID	Name / Description	Model Number	Part Number	Serial Number	Revision
--	Camera Vision TX device	AMNCVTX01	--	--	--

Table 4. Equipment Configuration

F. Support Equipment

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

Ref. ID	Name / Description	Manufacturer	Model Number
1	S-Bus + Telemetry terminated cable	Amimon	--
2	DC Power cable	Amimon	--
3	USB Cable	Wanshih	--
4	HDMI Type A-C cable	Wanshih	
5	HDMI Media streamer	WD	--
6	PC	Dell	--

Table 5. Support Equipment

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G. Ports and Cabling Information

Ref. ID	Port Name on EUT	Cable Description	Qty.	Length (m)	Shielded (Y/N)	Termination Point
J2, J3 or J1, J4	Antenna ports	--	2 or 2	--	--	2 MMCX (J2 J3) or 2 UFL (J1, J4)
J5	B2b	--	1	--	--	--
J6	Power in	--	1	--	No	--
J7	uUSB Port		1		Yes	--
J8	Input of MIPI signal		1		Yes	--
J9	DC supply to peripheral camera	--	--	--	--	--
J11	UART	--	--	--	--	--

Table 6. Ports and Cabling Information

H. Mode of Operation

The AMNCVTX01 can be set into Test-Mode, simulating a continuous (100% duty-cycle) transmission mode of video test pattern. The frequency and power of operation may be programmed by the LAB using a PC tool and a serial communication connector.

I. Method of Monitoring EUT Operation

Slow blinking (on-off once during 1sec) blue LED indicates that board is functioning.

Fast blinking (on-off 3-4 times during 1sec) same LED, means that the board is out of calibration.

When this LED is not blinking this means that board has a certain problem.

Using the SW tool to configure the board, when configuration ended successfully a clear green indication appears, while a red bad indication appears when the desired configuration fails.

J. Modifications

a) Modifications to EUT

No modifications were made to the EUT.

b) Modifications to Test Standard

No modifications were made to the test standard.

K. Disposition of EUT

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

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III. Electromagnetic Compatibility Criteria for Intentional Radiators

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

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

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

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

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

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

Results: The EUT as tested is compliant the criteria of §15.203. The EUT has a unique reverse polarity antenna.

Test Engineer(s): Hadid Jones

Test Date(s): 01/12/16

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15. 403(i) 26 dB Bandwidth

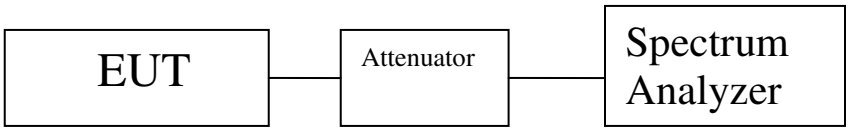
Test Requirements: **§ 15.403(i):** For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of 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.

Test Engineer(s): Hadid Jones

Test Date(s): 02/16/16



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OBW 10MHz		
Frequency MHz	**-26db Channel 0**	**-26db Channel 1**
5740	19.00	9.50
5780	16.00	15.20
5820	15.25	10.60
20MHz bw		
Frequency MHz	**-26db Channel 0**	**-26db Channel 1**
5745	46.83	33.75
5785	39.87	32.79
5825	36.09	20.32
40MHz bw		
Frequency MHz	**-26db Channel 0**	**-26db Channel 1**
5755	102	80.86
5795	90.2	82.65

Table 7. Occupied Bandwidth, Test Results

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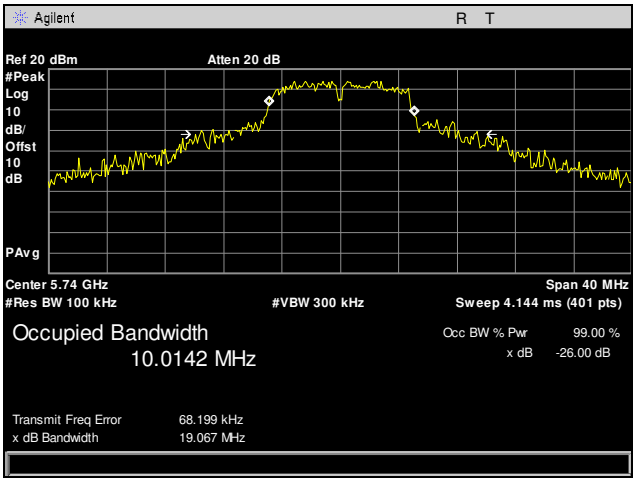
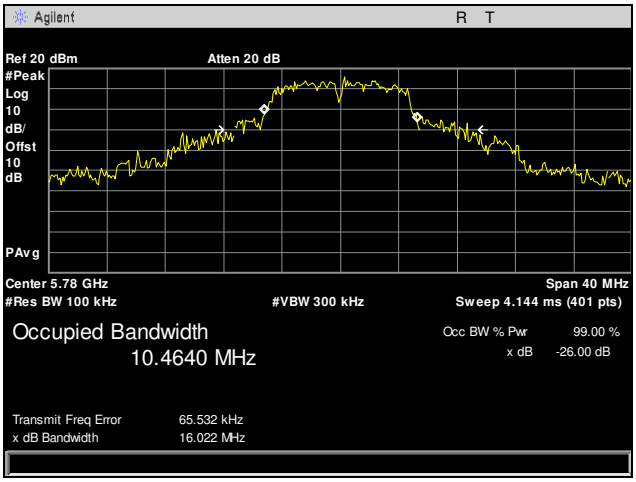
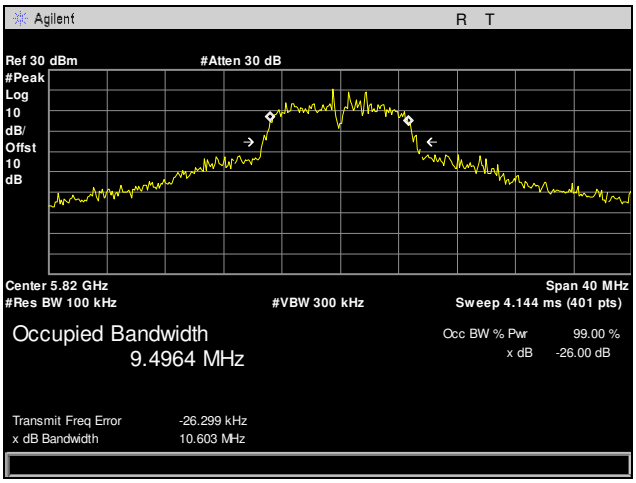
Occupied Bandwidth, 10 MHz, Channel 0



Plot 1. Occupied Bandwidth, Low Channel, 10 MHz, Channel 0



Plot 2. Occupied Bandwidth, Mid Channel, 10 MHz, Channel 0



Plot 3. Occupied Bandwidth, High Channel, 10 MHz, Channel 1

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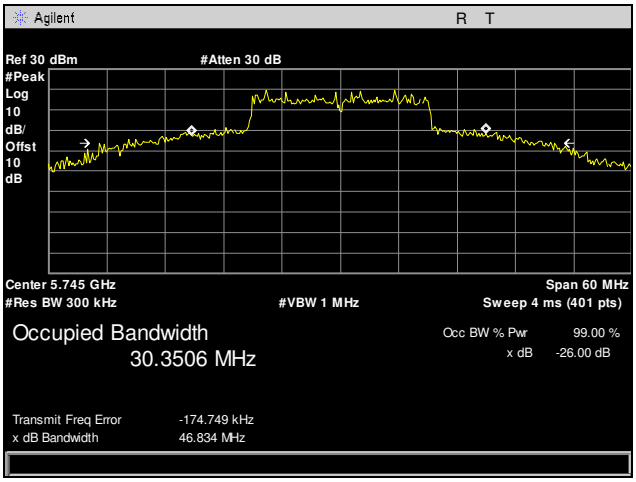
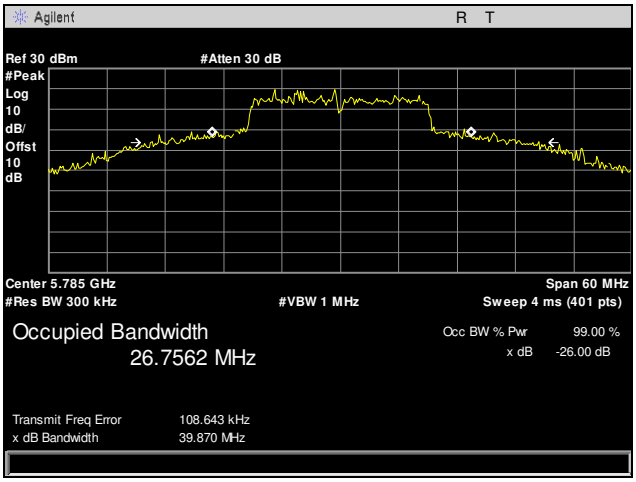
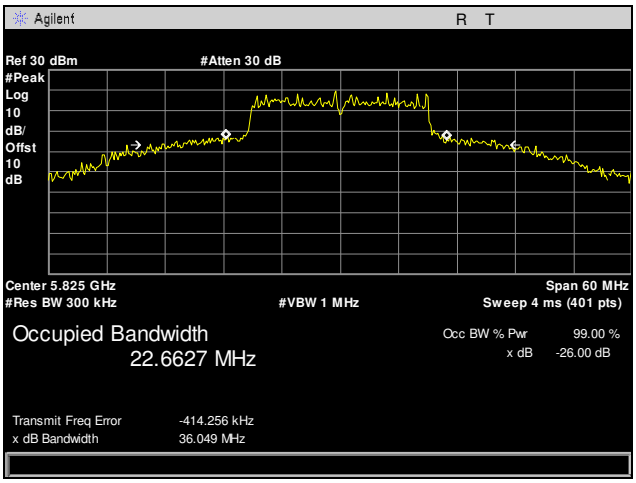
Occupied Bandwidth, 20 MHz, Channel 0



Plot 4. Occupied Bandwidth, Low Channel, 20 MHz, Channel 0



Plot 5. Occupied Bandwidth, Mid Channel, 20 MHz, Channel 0



Plot 6. Occupied Bandwidth, High Channel, 20 MHz, Channel 0

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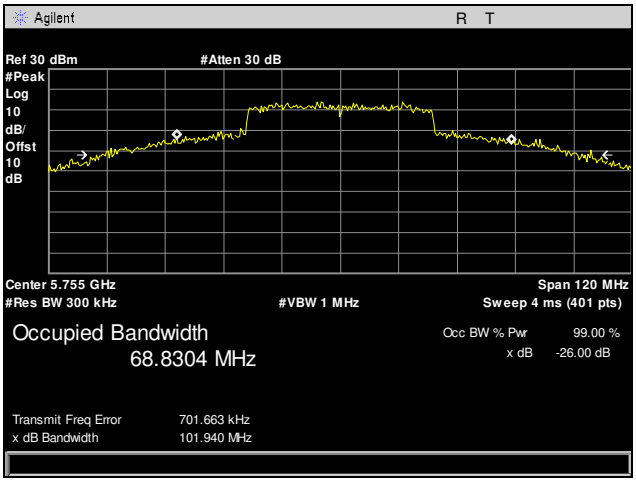
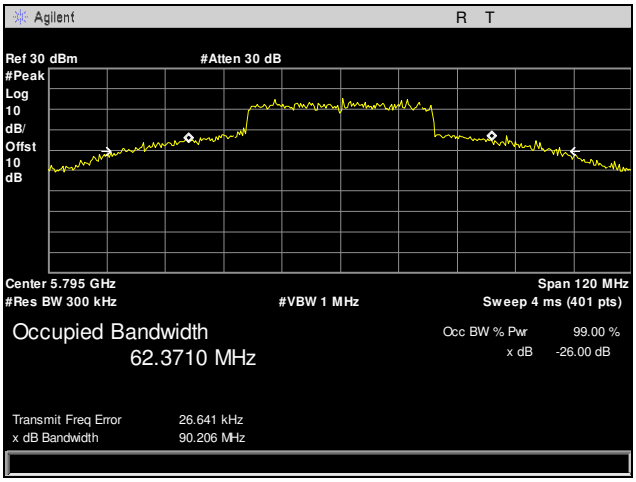
Occupied Bandwidth, 40 MHz, Channel 0



Plot 7. Occupied Bandwidth, Low Channel, 40 MHz, Channel 0



Plot 8. Occupied Bandwidth, High Channel, 40 MHz, Channel 0

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Electromagnetic Compatibility Criteria for Intentional Radiators

§15. 407(a)(3) Maximum Conducted Output Power

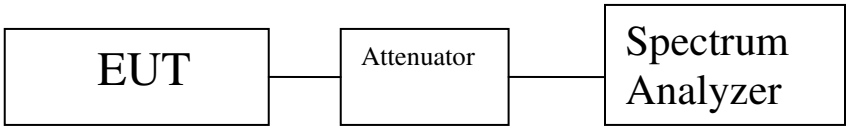
Test Requirements: **§15.407(a)(3):** For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.
If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power.

Test Procedure: The EUT was connected to a spectrum analyzer through a cable and attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels. Its power was measured according to measurement method SA-1, as described in 789033 D02 General UNII Test Procedures v01.

Test Results: The EUT as tested is compliant with the requirements of this section.

Test Engineer(s): Hadid Jones

Test Date(s): 02/13/16



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Maximum Output Power 10MHz Band						
Frequency (MHz)	Conducted Power CH0 (dBm)	Conducted Power CH1 (dBm)	Conducted Power Total (dBm)	Conducted Power Limit (dBm)	Conducted Power Margin (dB)	Total Antenna Gain (dBi)
5740	20.99	19.19	23.2	30	**-6.8**	2
5780	20.73	19.13	23.0	30	**-7.0**	2
5820	19.95	18.74	22.4	30	**-7.6**	2
Maximum Output Power 20MHz Band						
Frequency (MHz)	Conducted Power CH0 (dBm)	Conducted Power CH1 (dBm)	Conducted Power Total (dBm)	Conducted Power Limit (dBm)	Conducted Power Margin (dB)	Total Antenna Gain (dBi)
5745	19.8	19.2	22.5	30	**-7.5**	2
5785	20.9	19.5	23.3	30	**-6.7**	2
5825	19.7	18.3	22.1	30	**-7.9**	2
Maximum Output Power 40MHz Band						
Frequency (MHz)	Conducted Power CH0 (dBm)	Conducted Power CH1 (dBm)	Conducted Power Total (dBm)	Conducted Power Limit (dBm)	Conducted Power Margin (dB)	Total Antenna Gain (dBi)
5755	16.9	18.1	20.6	30	**-9.4**	2
5795	20.9	20.9	23.9	30	**-6.1**	2

Table 8. Output Power, Test Results

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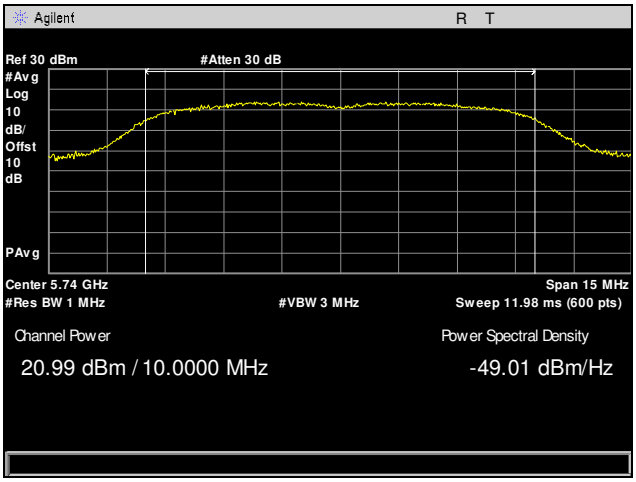
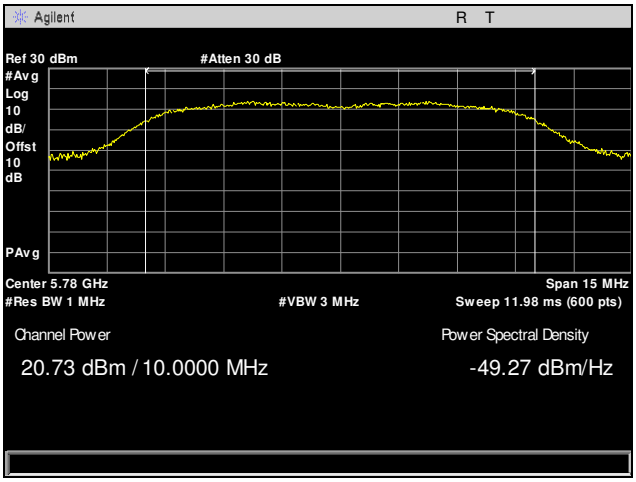
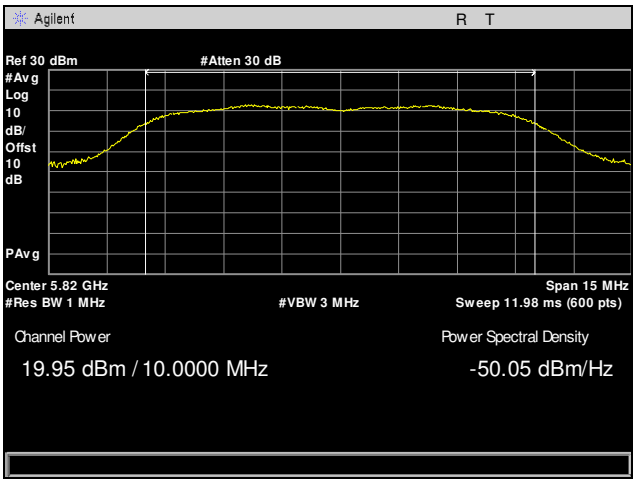
Output Power, 10 MHz, Channel 0



Plot 9. Output Power, Low Channel, 10 MHz, Channel 0



Plot 10. Output Power, Mid Channel, 10 MHz, Channel 0



Plot 11. Output Power, High Channel, 10 MHz, Channel 0

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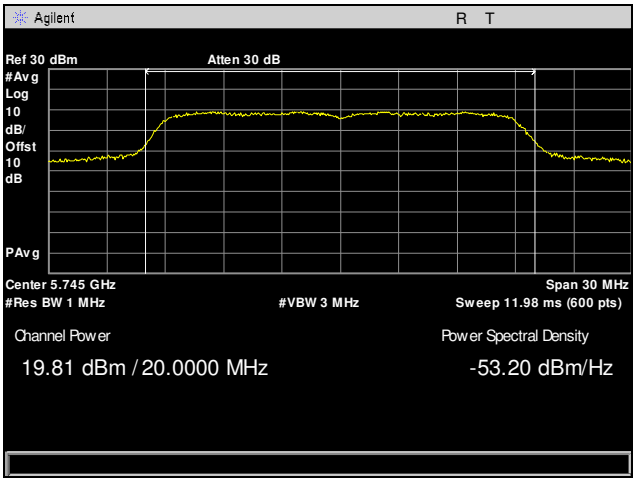
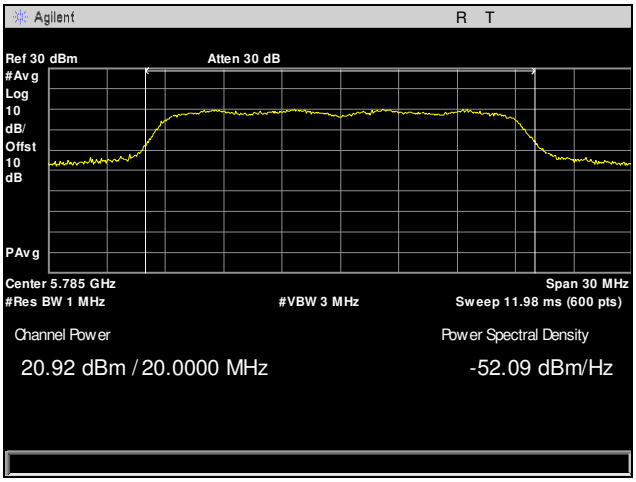
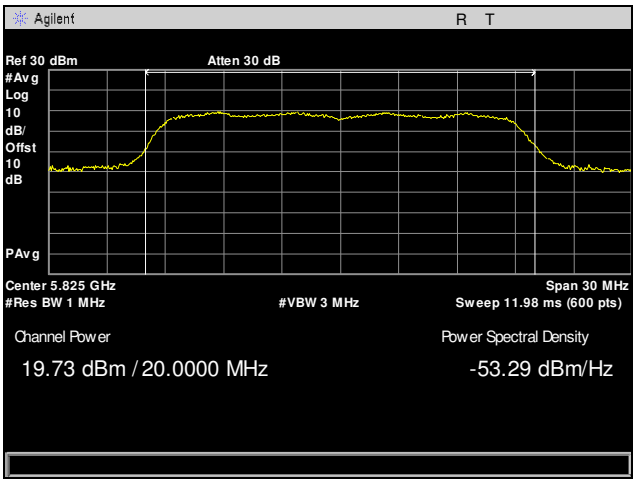
Output Power, 20 MHz, Channel 0



Plot 12. Output Power, Low Channel, 20 MHz, Channel 0



Plot 13. Output Power, Mid Channel, 20 MHz, Channel 0



Plot 14. Output Power, High Channel, 20 MHz, Channel 0

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Electromagnetic Compatibility Criteria for Intentional Radiators

§15.407(a)(3) Maximum Power Spectral Density

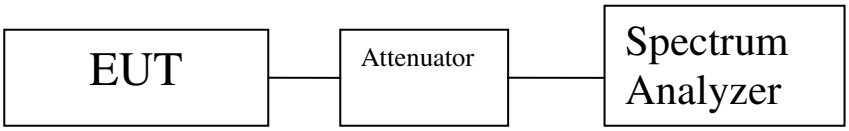
Test Requirements: **§15.407(a)(3):** In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band.
If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power.

Test Procedure: The EUT was connected to a spectrum analyzer through a cable and attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels. Its power was measured according KDB 789033 D02 General UNII Test Procedures v01. A 1 MHz RBW was used during testing, as this provides a worst-case scenario.

Test Results: The EUT as tested is compliant with the requirements of this section.

Test Engineer(s): Hadid Jones

Test Date(s): 02/17/16



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PSD 10MHz Band (FCC)						
Frequency (MHz)	**Conducted PSD ch0(dBm)**	**Conducted PSD ch1(dBm)**	**Conducted PSD Total(dBm)**	**Conducted PSD Limit(dBm)**	**Conducted PSD Margin(dB)**	**Antenna Gain(dBi)**
5740	13.2	13.63	16.4	30	**-13.6**	2
5780	13.4	12.86	16.1	30	**-13.9**	2
5820	13.09	12.76	15.9	30	**-14.1**	2
PSD 20MHz Band (FCC)						
Frequency (MHz)	**Conducted PSD ch0(dBm)**	**Conducted PSD ch1(dBm)**	**Conducted PSD Total(dBm)**	**Conducted PSD Limit(dBm)**	**Conducted PSD Margin(dB)**	**Antenna Gain(dBi)**
5745	8.32	7.62	11.0	30	**-19.0**	2
5785	10.35	11.75	14.1	30	**-15.9**	2
5825	10.31	10.91	13.6	30	**-16.4**	2
PSD 40MHz Band (FCC)						
Frequency (MHz)	**Conducted PSD ch0(dBm)**	**Conducted PSD ch1(dBm)**	**Conducted PSD Total(dBm)**	**Conducted PSD Limit(dBm)**	**Conducted PSD Margin(dB)**	**Antenna Gain(dBi)**
5755	2.69	2.13	5.4	30	**-24.6**	2
5795	6.50	4.61	8.7	30	**-21.3**	2

Table 9. Peak Spectral Power, Test Results

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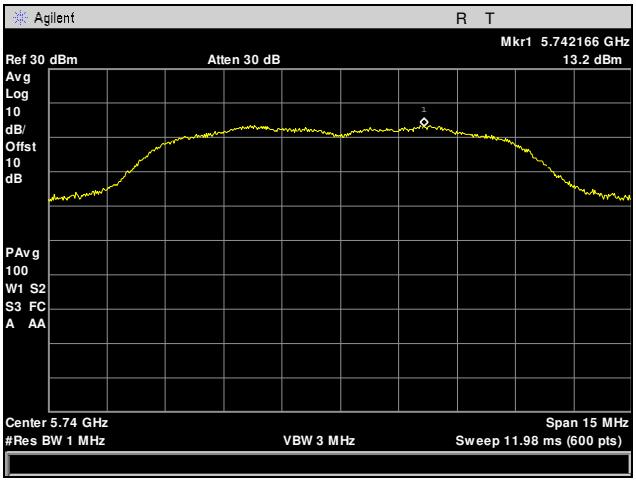
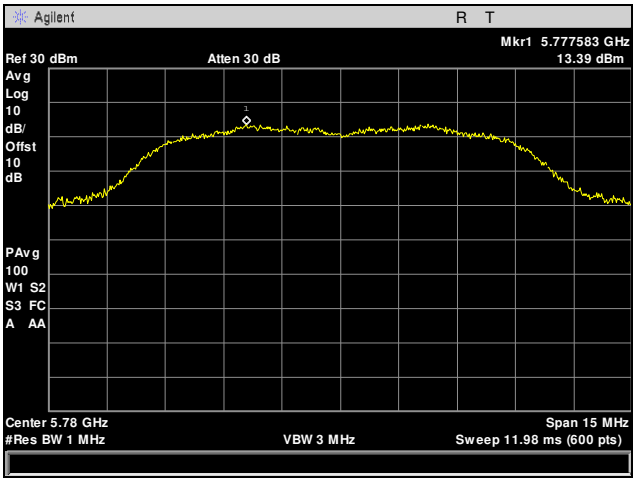
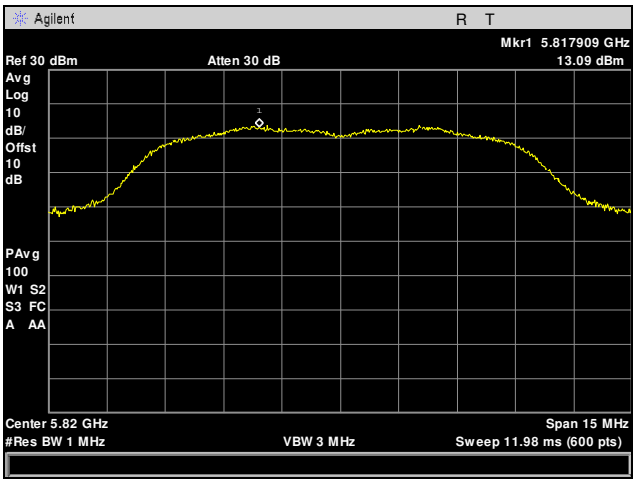
Peak Spectral Density, 10 MHz, Channel 0



Plot 15. Peak Spectral Density, Low Channel, 10 MHz, Channel 0



Plot 16. Peak Spectral Density, Mid Channel, 10 MHz, Channel 0



Plot 17. Peak Spectral Density, High Channel, 10 MHz, Channel 0

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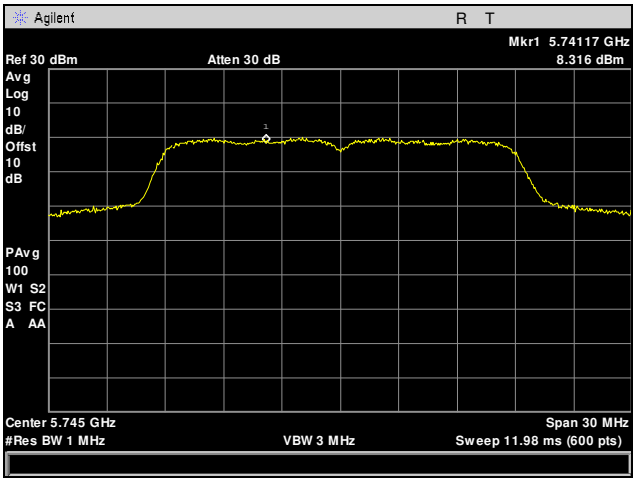
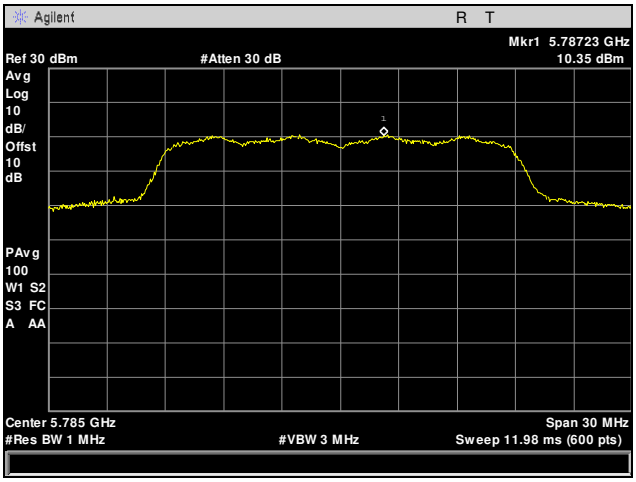
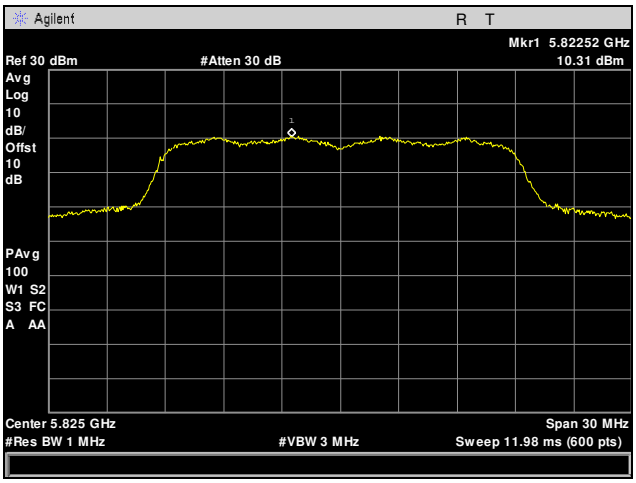
Peak Spectral Density, 20 MHz, Channel 0



Plot 18. Peak Spectral Density, Low Channel, 20 MHz, Channel 0



Plot 19. Peak Spectral Density, Mid Channel, 20 MHz, Channel 0



Plot 20. Peak Spectral Density, High Channel, 20 MHz, Channel 0

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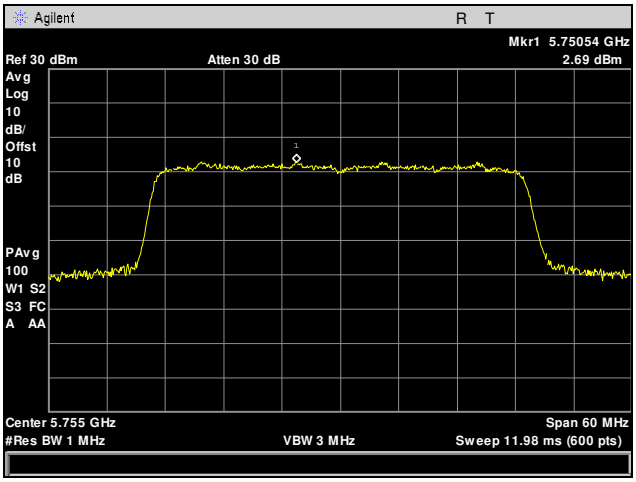
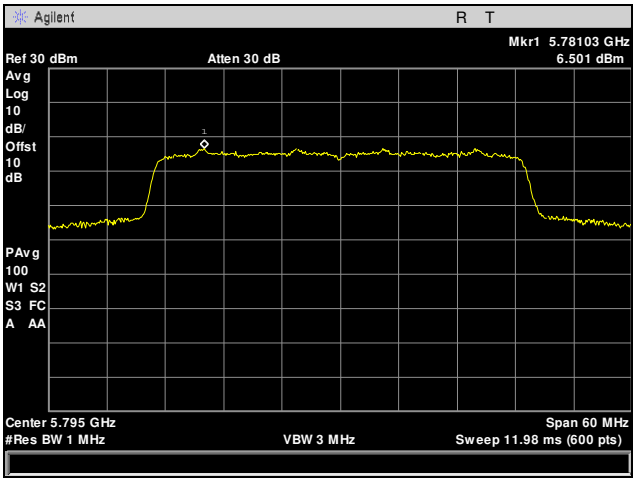
Peak Spectral Density, 40 MHz, Channel 0



Plot 21. Peak Spectral Density, Low Channel, 40 MHz, Channel 0



Plot 22. Peak Spectral Density, High Channel, 40 MHz, Channel 0

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Electromagnetic Compatibility Criteria for Intentional Radiators

§15.407(b)(4) & (6 – 7) Undesirable Emissions

Test Requirements:

§ 15.407(b)(4): For transmitters operating in the 5.725-5.85 GHz band: All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of −17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. of −27 dBm/MHz.

§ 15.407(b)(6): Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in Section 15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in Section 15.207.

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

Test Procedure:

The EUT was placed on a non-conducting stand on a turntable in a chamber. To find the maximum emission the EUT was set to transmit on low, mid, and high channels. Additionally, the turntable was rotated 360 degrees, the EUT was oriented through its three orthogonal axes, and the receive antenna height was varied in order to maximize emissions.

For frequencies from 30 MHz to 1 GHz, measurements were first made using a peak detector with a 100 kHz resolution bandwidth. Emissions which exceeded the limits were re-measured using a quasi-peak detector with a 120 kHz resolution bandwidth.

Above 1 GHz, measurements were made pursuant the method described in FCC KDB 789033 D02 General UNII Test Procedure New Rules v01. The equation, **EIRP= E + 20 log D – 104.8** was used to convert field strength to EIRP (**E** = field strength (dBμV/m) and **D** = Reference measurement distance**).**

For emissions above 1 GHz and in restricted bands, measurements of the field strength were made with a peak detector and an average detector and compared with the limits of 15.209.

As an alternative, according to FCC KDB 789033 D02 General UNII Test Procedure New Rules v01, all emissions above 1 GHz that comply with the peak and average limits of 15.209 satisfy the requirements of unwanted emissions in 15.407.

Test Results:

For below 1 GHz, the EUT was compliant with the requirements of this section.

For above 1 GHz, the EUT was compliant with the requirements of this section.

Note: For the 30-1000MHz and 7-18GHz ranges the worse case configuration was reported i.e. 40MHz bw.

Test Engineer(s): Hadid Jones

Test Date(s): 01/26/16

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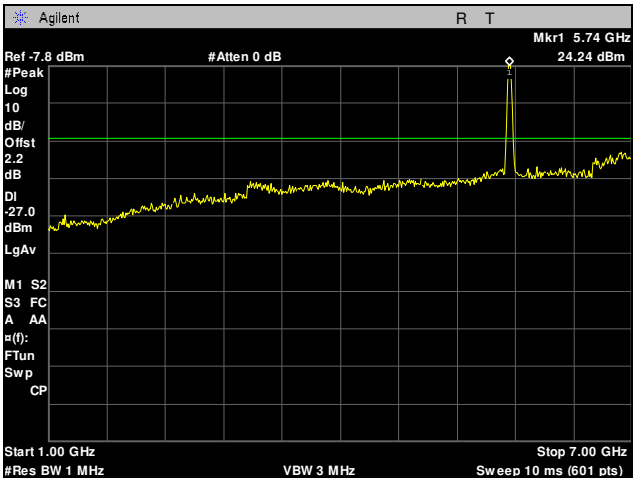
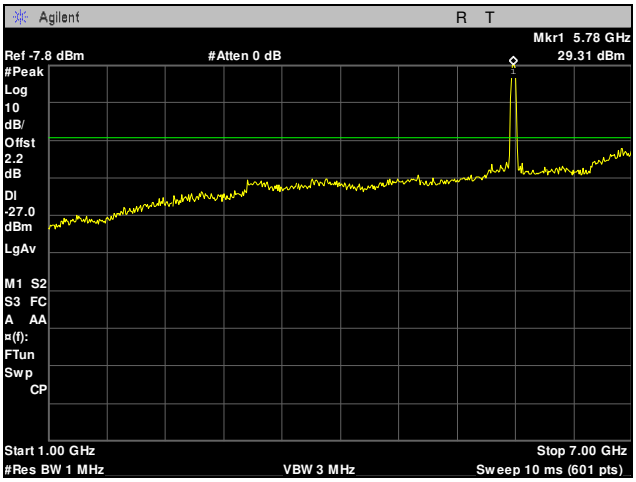
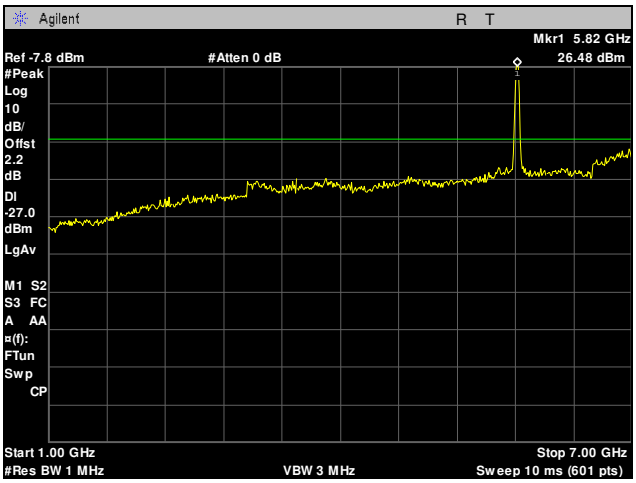
Radiated Spurious Emissions, 10 MHz



Plot 23. Radiated Spurious Emissions, Low Channel, 10 MHz, 1 GHz – 7 GHz



Plot 24. Radiated Spurious Emissions, Mid Channel, 10 MHz, 1 GHz – 7 GHz



Plot 25. Radiated Spurious Emissions, High Channel, 10 MHz, 1 GHz – 7 GHz

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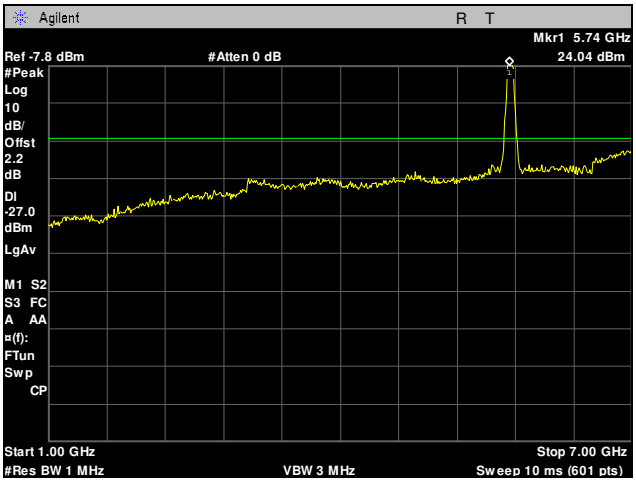
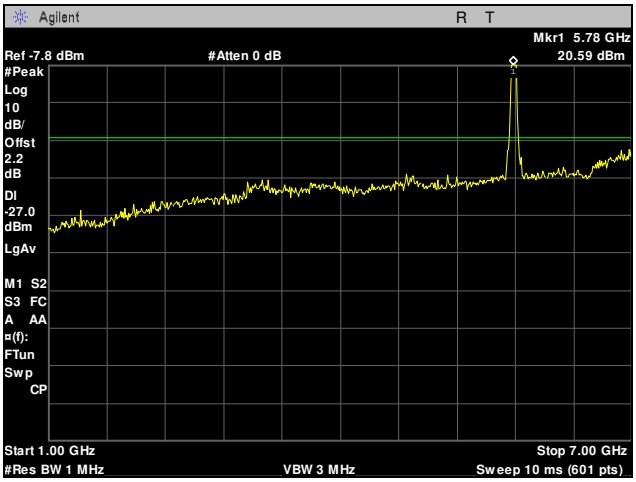
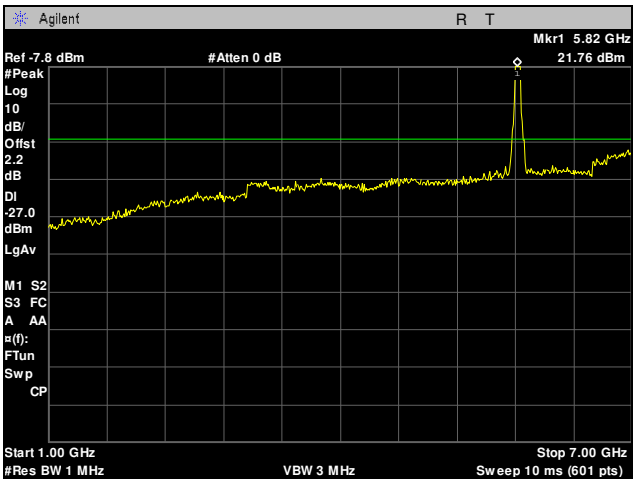
Radiated Spurious Emissions, 20 MHz



Plot 26. Radiated Spurious Emissions, Low Channel, 20 MHz, 1 GHz – 7 GHz



Plot 27. Radiated Spurious Emissions, Mid Channel, 20 MHz, 1 GHz – 7 GHz



Plot 28. Radiated Spurious Emissions, High Channel, 20 MHz, 1 GHz – 7 GHz

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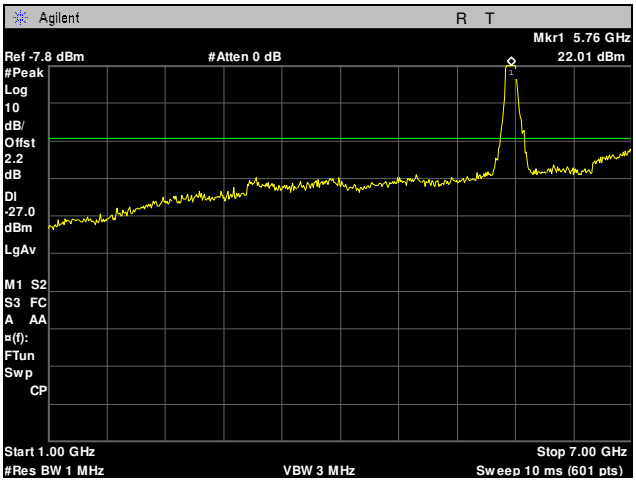
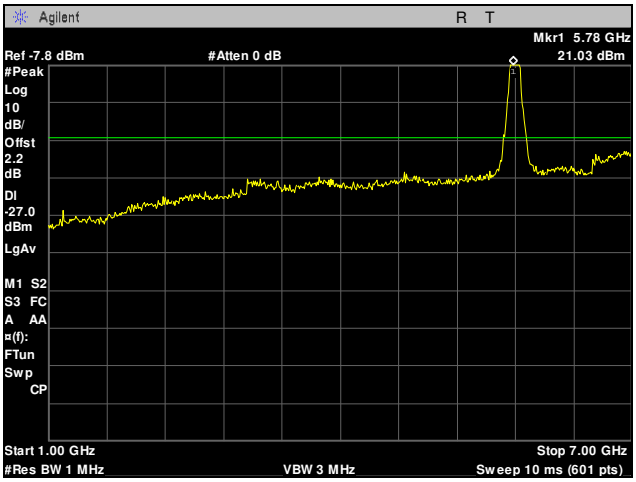
Radiated Spurious Emissions, 40 MHz



Plot 29. Radiated Spurious Emissions, Low Channel, 40 MHz, 1 GHz – 7 GHz



Plot 30. Radiated Spurious Emissions, High Channel, 40 MHz, 1 GHz – 7 GHz

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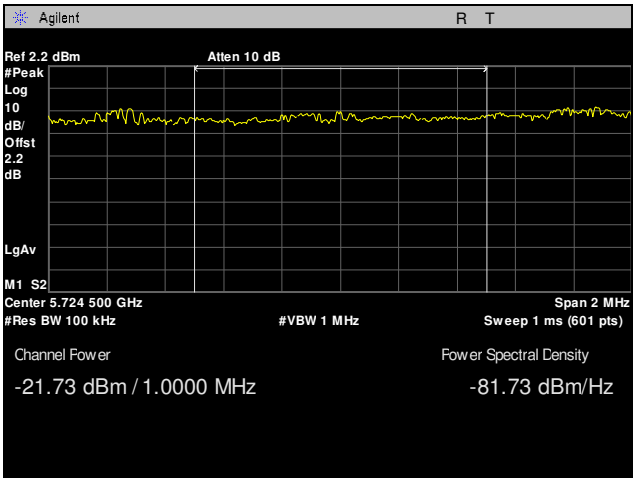
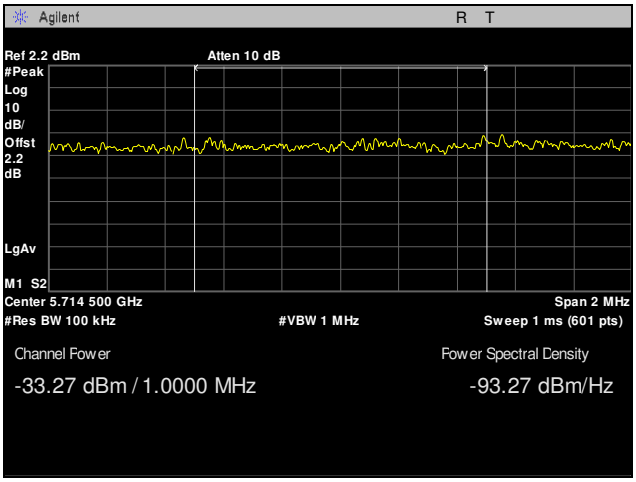
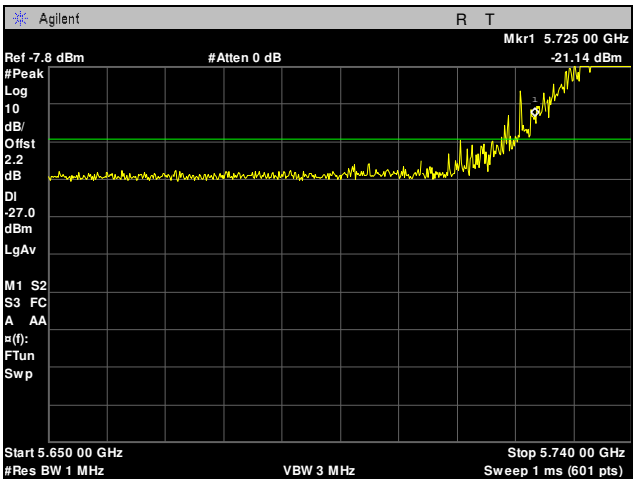
Radiated Band Edge, 10 MHz



Plot 31. Radiated Band Edge, Low Channel, 10 MHz, -17 Peak Integration



Plot 32. Radiated Band Edge, Low Channel, 10 MHz, -27 Peak Integration



Plot 33. Radiated Band Edge, Low Channel, 10 MHz, Peak

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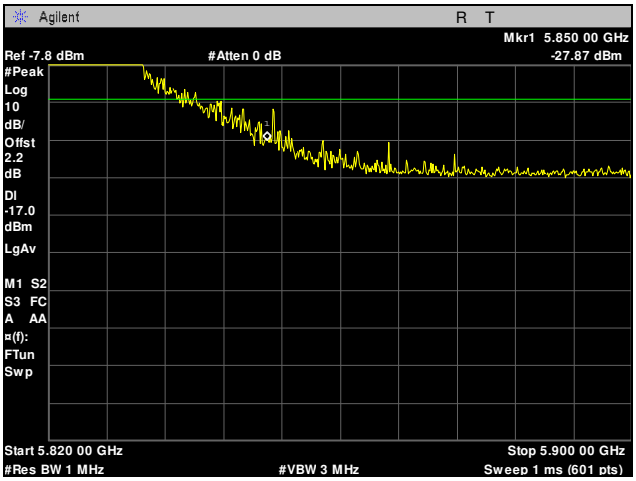
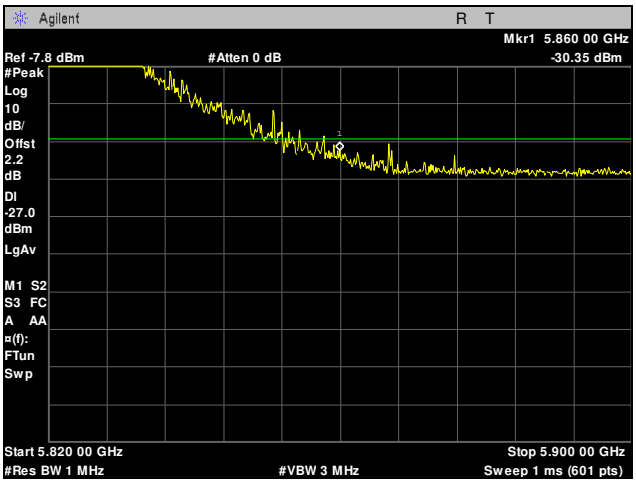


Plot 34. Radiated Band Edge, High Channel, 10 MHz, -17 Peak



Plot 35. Radiated Band Edge, High Channel, 10 MHz, -27 Peak

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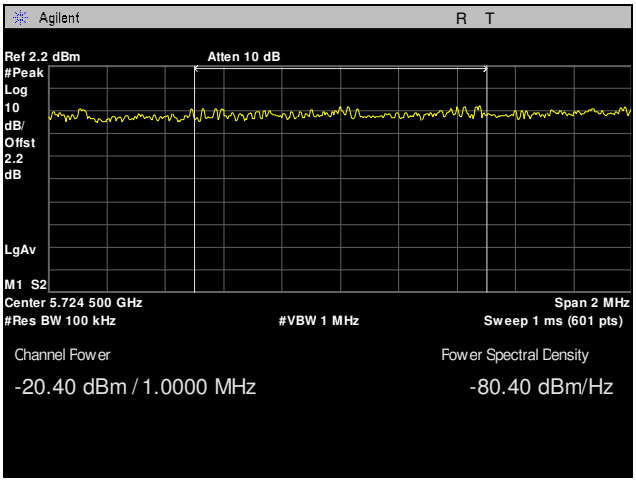
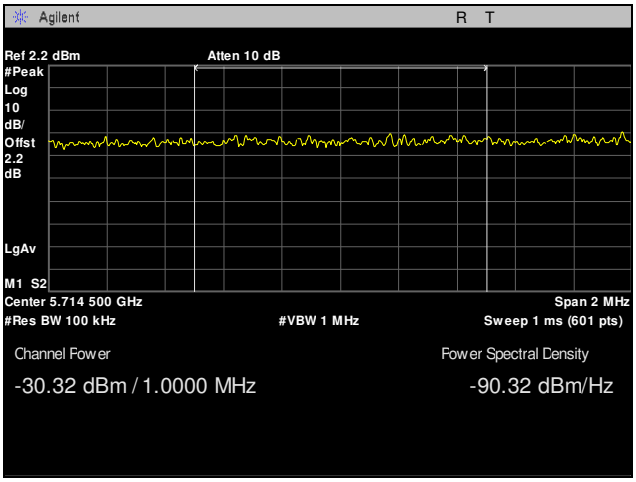
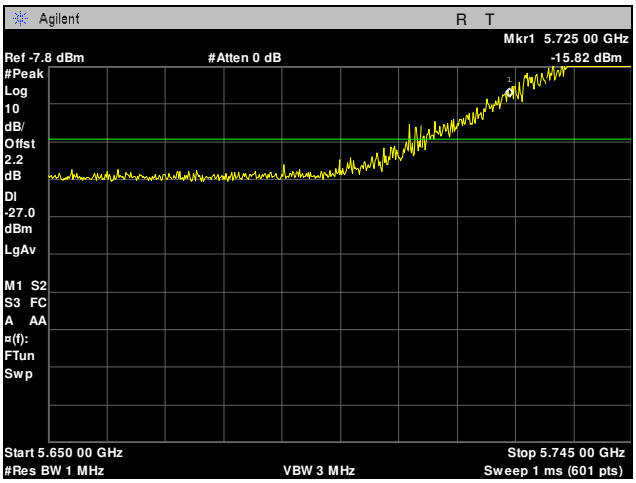
Radiated Band Edge, 20 MHz



Plot 36. Radiated Band Edge, Low Channel, 20 MHz, -17 Peak Integration



Plot 37. Radiated Band Edge, Low Channel, 20 MHz, -27 Peak Integration



Plot 38. Radiated Band Edge, Low Channel, 20 MHz, Peak

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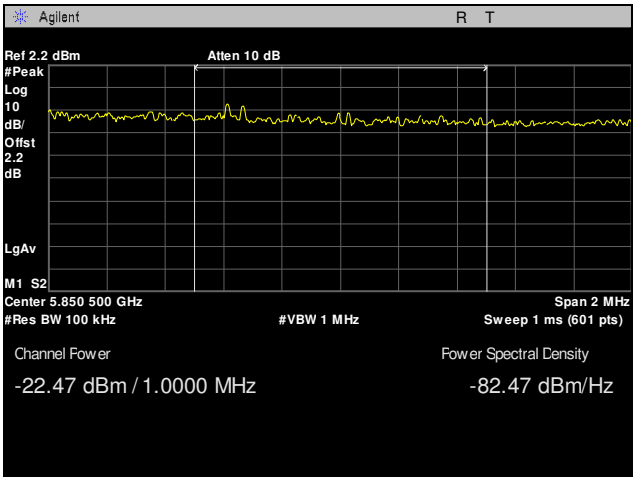
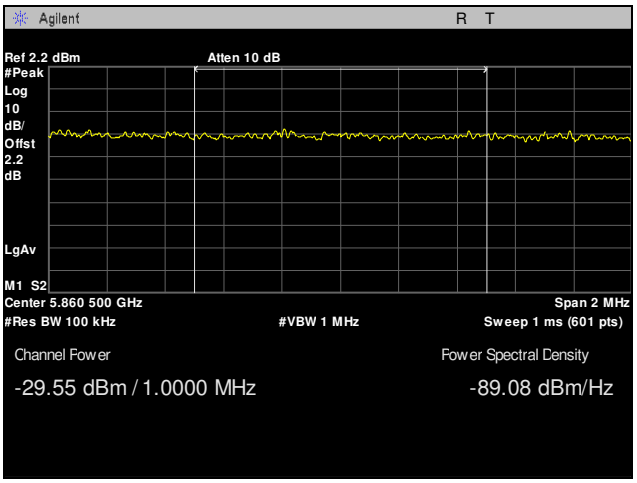
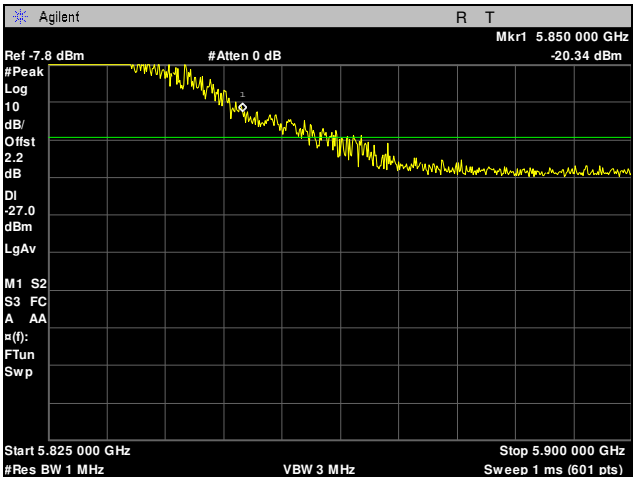


Plot 39. Radiated Band Edge, High Channel, 20 MHz, -17 Peak Integration



Plot 40. Radiated Band Edge, High Channel, 20 MHz, -27 Peak Integration



Plot 41. Radiated Band Edge, High Channel, 20 MHz, Peak

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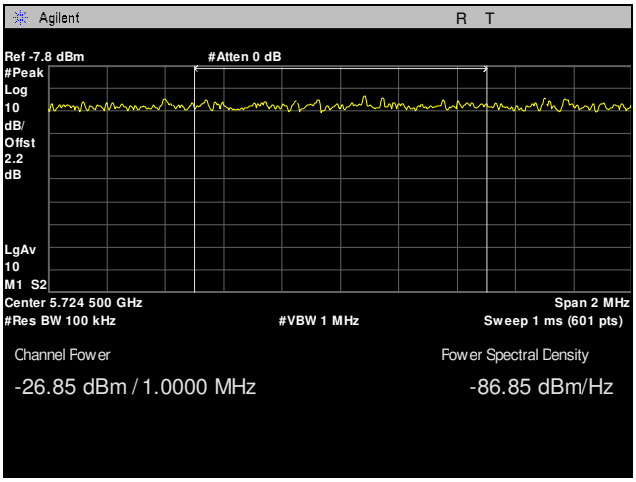
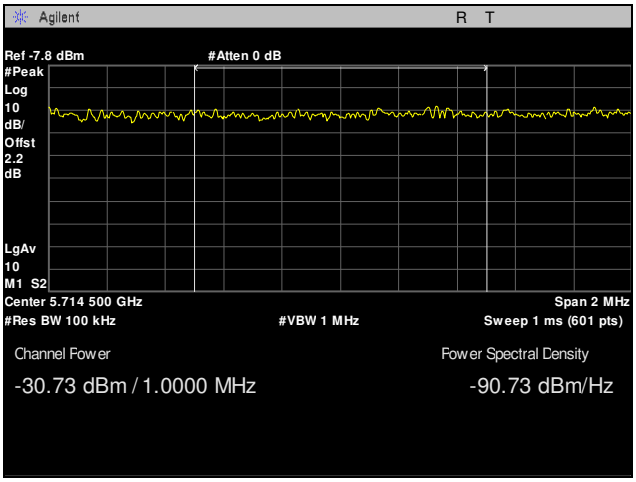
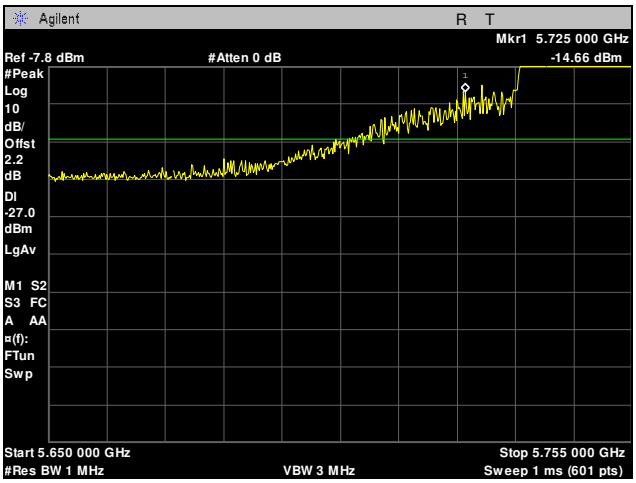
Radiated Band Edge, 40 MHz



Plot 42. Radiated Band Edge, Low Channel, 40 MHz, -17 Peak Integration



Plot 43. Radiated Band Edge, Low Channel, 40 MHz, -27 Peak Integration



Plot 44. Radiated Band Edge, Low Channel, 40 MHz, Peak

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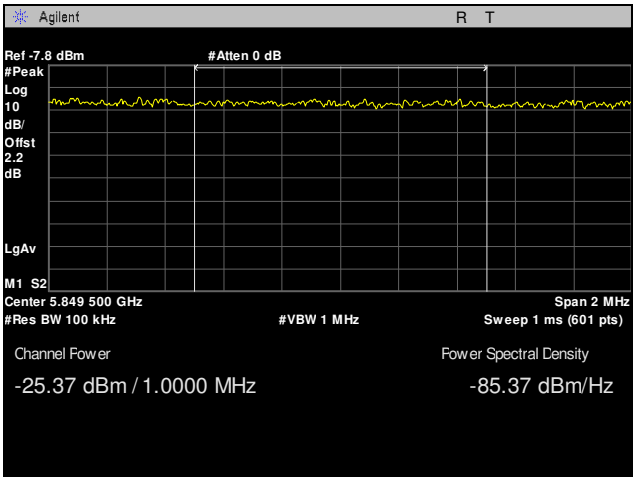
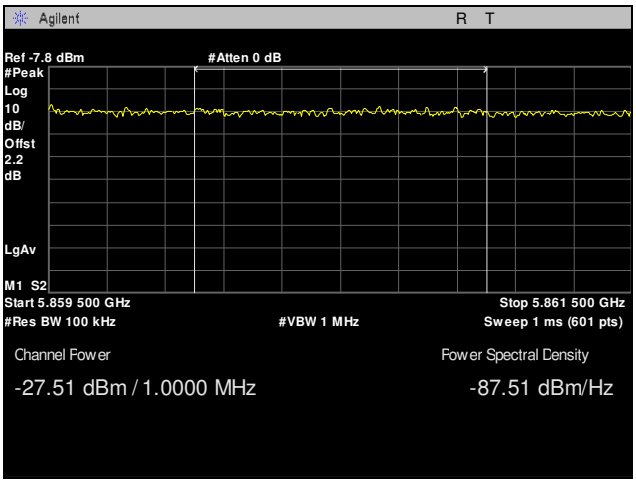
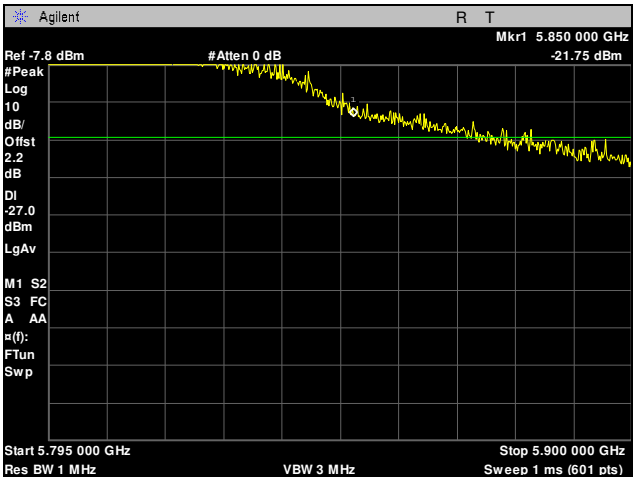


Plot 45. Radiated Band Edge, High Channel, 40 MHz, -17 Peak Integration



Plot 46. Radiated Band Edge, High Channel, 40 MHz, -27 Peak Integration



Plot 47. Radiated Band Edge, High Channel, 40 MHz, Peak

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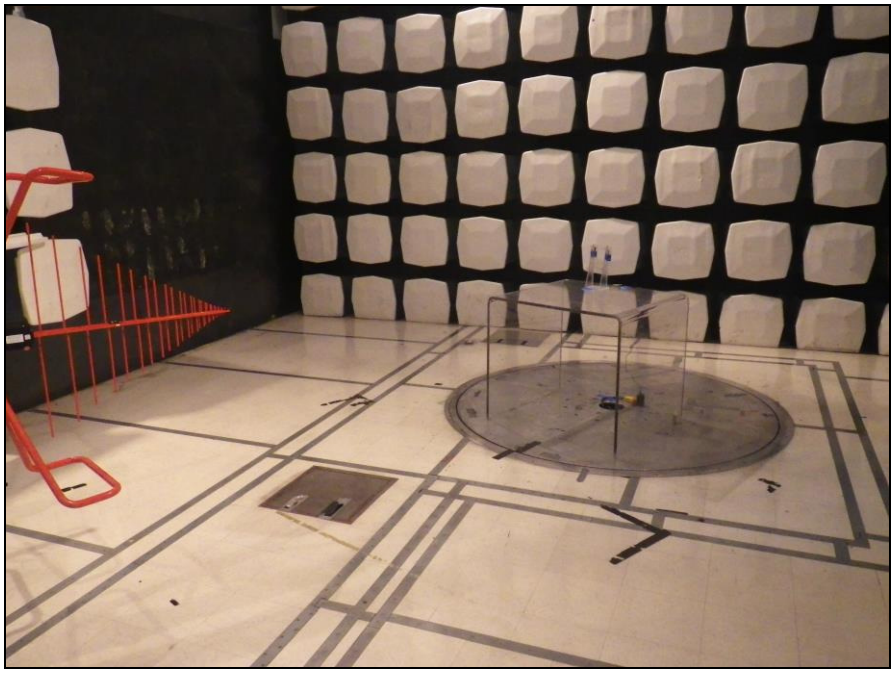
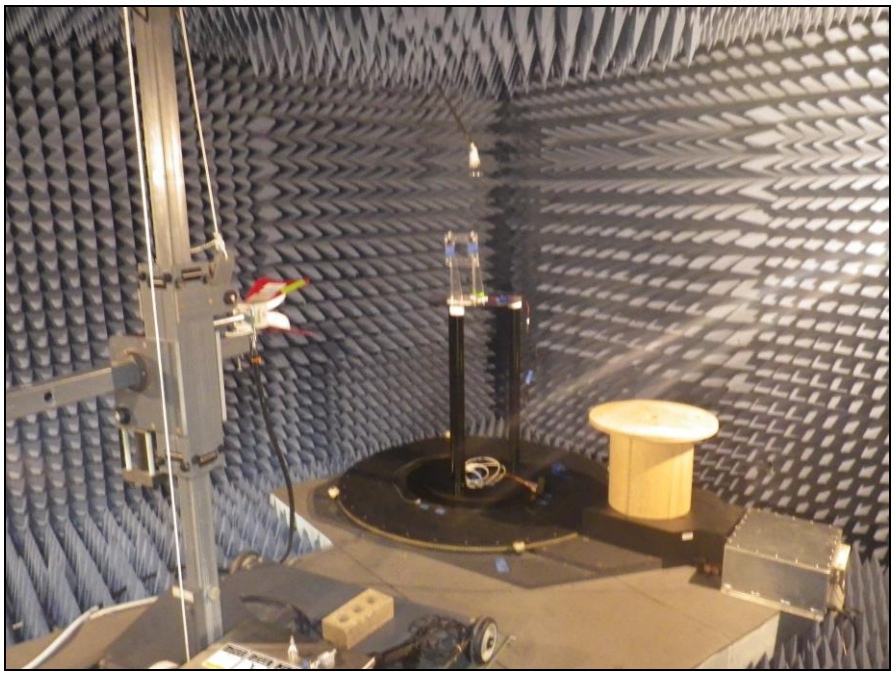


Photograph 1. Radiated Test Setup, Below 1 GHz



Photograph 2. Radiated Test Setup, Above 1 GHz

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(b)(6) Conducted Emissions

Test Requirement(s): **§ 15.407 (b)(6):** Any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.

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

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

Table 10. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Test Procedure: The EUT was placed on a non-metallic table inside a screen room. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 µH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.4-2014 "Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz"*. Scans were performed with the transmitter on.

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

Test Engineer(s): Hadid Jones

Test Date(s): 12/19/15

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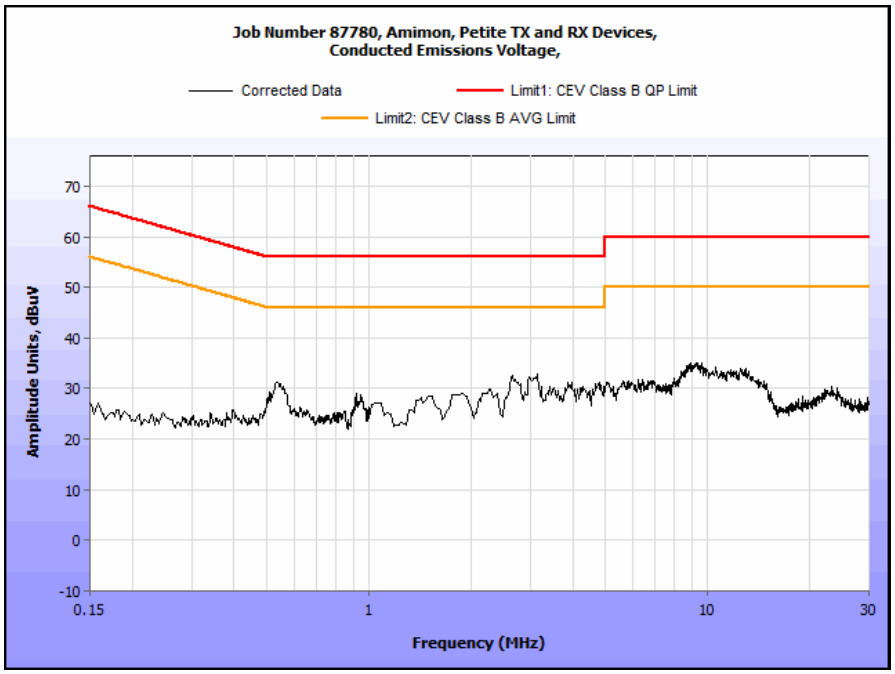
Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz)

Frequency (MHz)	Uncorrected Meter Reading (dBµV) QP	Cable Loss (dB)	Corrected Measurement (dBµV) QP	Limit (dBµV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBµV) Avg.	Cable Loss (dB)	Corrected Measurement (dBµV) AVG	Limit (dBµV) AVG	Margin (dB) AVG
0.536	18.3	0	18.3	56	-37.7	13.07	0	13.07	46	-32.93
0.949	12.58	0	12.58	56	-43.42	6.53	0	6.53	46	-39.47
2.721	17.44	0	17.44	56	-38.56	11.14	0	11.14	46	-34.86
3.04	18.18	0	18.18	56	-37.82	11.88	0	11.88	46	-34.12
9.1	19.7	0	19.7	60	-40.3	13.01	0	13.01	50	-36.99
12.95	18.73	0	18.73	60	-41.27	12.66	0	12.66	50	-37.34

Table 11. Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz)



Plot 48. Conducted Emission, Phase Line Plot

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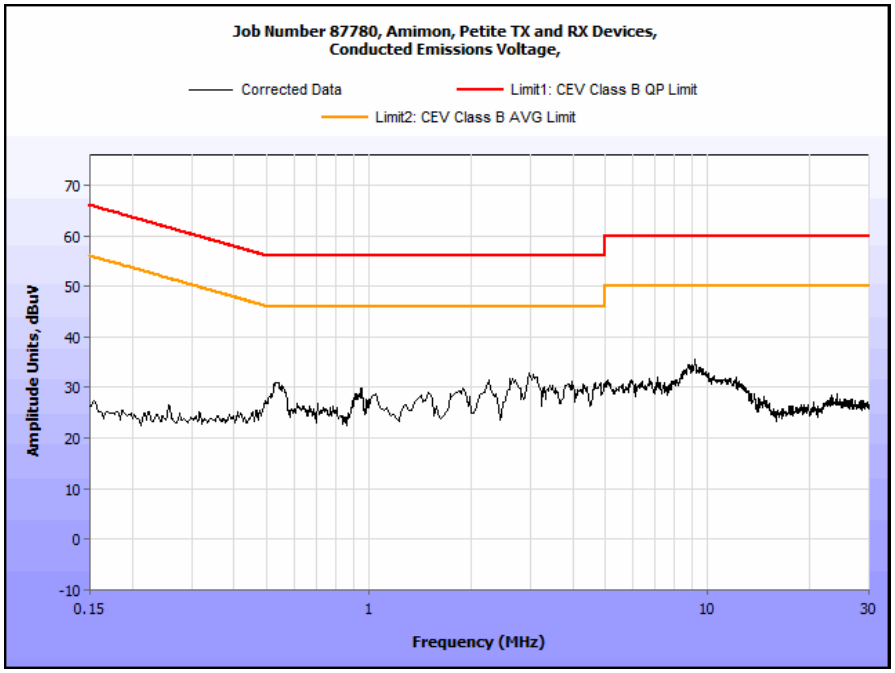
Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz)

Frequency (MHz)	Uncorrected Meter Reading (dBµV) QP	Cable Loss (dB)	Corrected Measurement (dBµV) QP	Limit (dBµV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBµV) Avg.	Cable Loss (dB)	Corrected Measurement (dBµV) AVG	Limit (dBµV) AVG	Margin (dB) AVG
0.534	18.08	0	18.08	56	-37.92	12.6	0	12.6	46	-33.4
0.913	13.5	0	13.5	56	-42.5	7.8	0	7.8	46	-38.2
1.032	14.95	0	14.95	56	-41.05	9.39	0	9.39	46	-36.61
2.78	17.56	0	17.56	56	-38.44	10.65	0	10.65	46	-35.35
3.094	18.32	0	18.32	56	-37.68	11.67	0	11.67	46	-34.33
8.91	19.51	0	19.51	60	-40.49	13.09	0	13.09	50	-36.91

Table 12. Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz)



Plot 49. Conducted Emission, Neutral Line Plot

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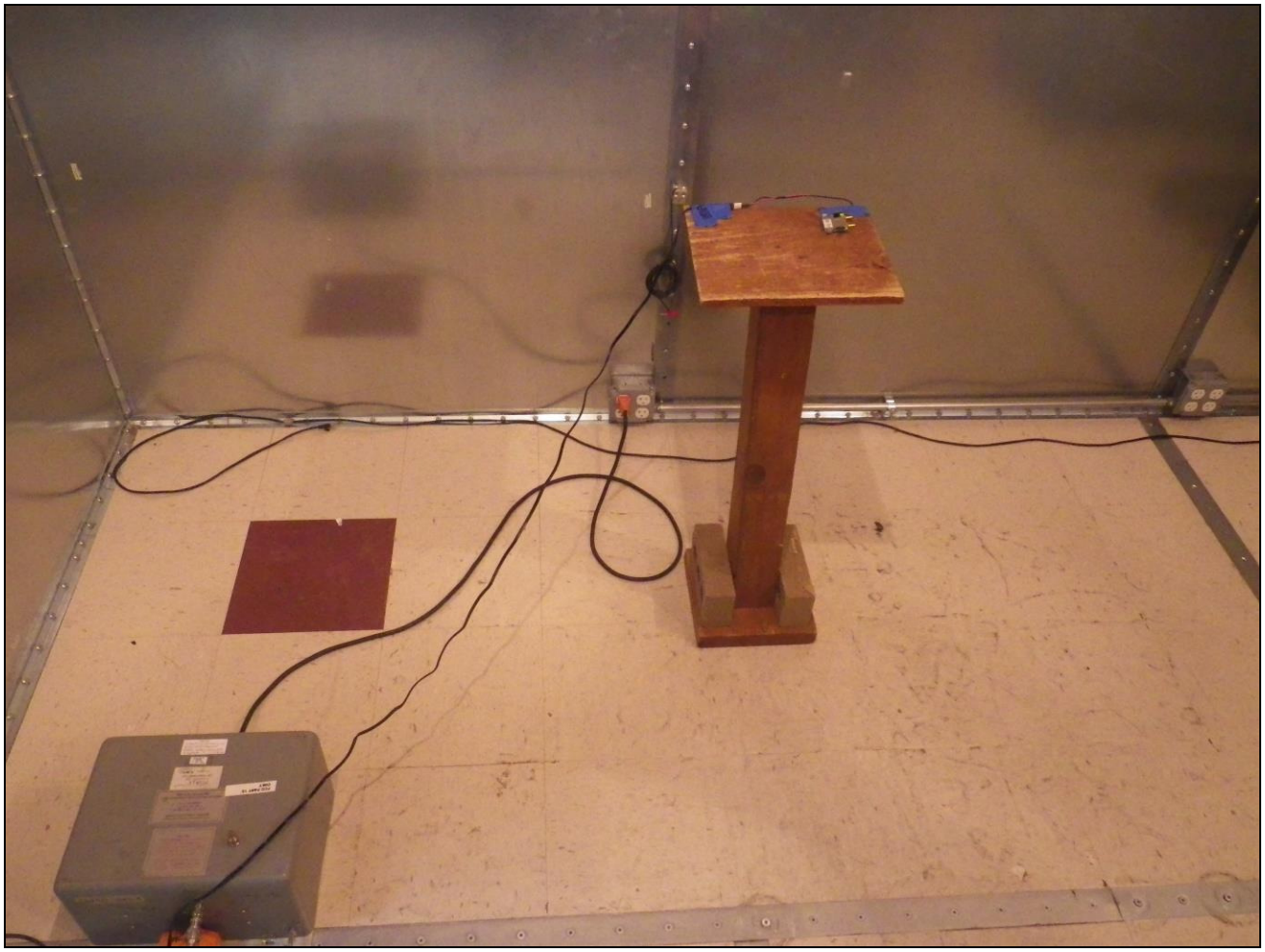
Conducted Emission Limits Test Setup



Photograph 3. Conducted Emissions, Test Setup

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15. 407(e) 6 dB Bandwidth

Test Requirements: **§ 15.407(e):** Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

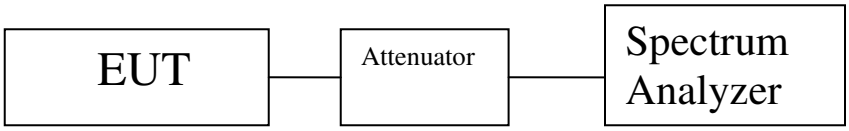
Test Procedure: The transmitter was set to low, mid, and high operating frequencies at the highest output power and connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately equal to 1% of the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

Test Results The 6 dB Bandwidth was compliant with the requirements of this section.

The -26dB bw is >> than 500kHz.

Test Engineer(s): Hadid Jones

Test Date(s): 01/04/16



OBW 10MHz	
Frequency MHz	**6 dB**
5740	Compliant
5780	Compliant
5820	Compliant
OBW 20MHz	
Frequency MHz	**6 dB**
5745	Compliant
5785	Compliant
5825	Compliant
OBW 40MHz	
Frequency MHz	**6 dB**
5755	Compliant
5795	Compliant

Table 13. 6 dB Occupied Bandwidth, Test Results

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(f) Maximum Permissible Exposure

Test Requirement(s): **§15.407(f):** U-NII devices are subject to the radio frequency radiation exposure requirements specified in §1.1307(b), §2.1091 and §2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a "general population/uncontrolled" environment.

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: EUT's operating frequencies @ 5725 - 5850 MHz; **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

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

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

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

Test Results:

FCC									
Frequency (MHz)	**Con. Pwr. (dBm)**	**Con. Pwr. (mW)**	**Ant. Gain (dBi)**	**Ant. Gain numeric**	**Pwr. Density (mW/cm^2)**	**Limit (mW/cm^2)**	**Margin**	**Distance (cm)**	**Result**
5795	24	251.189	2	1.585	0.0792	1	0.9208	20	Pass

The safe distance where Power Density is less than the MPE Limit listed above was found to be 20 cm.

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IV. Test Equipment

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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 ASSET #	EQUIPMENT	MANUFACTURER	MODEL	LAST CAL DATE	CAL DUE DATE
1T4612	SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4407B	09/01/2015	03/01/2017
1T4871	VECTOR SIGNAL GENERATOR	AGILENT TECHNOLOGIES	N5172B	06/16/2014	12/16/2015
1T8818	SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4407B	12/16/2015	12/16/2016
1T4300B	SEMI-ANECHOIC 3M CHAMBER # 1 D (2043A-1) (IC)	EMC TEST SYSTEMS	NONE	01/11/2015	01/11/2018
1T4409	EMI RECEIVER	ROHDE & SCHWARZ	ESIB7	10/29/2014	10/29/2016
1T4753	ANTENNA - BILOG	SUNOL SCIENCES	JB6	03/09/2015	09/09/2016
1T4483	ANTENNA; HORN	ETS-LINDGREN	3117	10/08/2015	04/08/2017
1T4771	PSA SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4446A	11/25/2014	05/25/2016

Table 14. Test Equipment List

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

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V. Certification & User's Manual Information

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Certification & User's Manual Information

L. 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.

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(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.

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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.

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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.

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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.

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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.

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End of Report

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