MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
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13501 MCCALLEN PASS • AUSTIN, TEXAS 78753 • PHONE (512) 287-2500 • FAX (512) 287-2513

October 19, 2016

Rajant Corporation
400 East King Street
Malvern, PA 19335

Dear Keith Sullivan,

Enclosed is the EMC test report for compliance testing of the Rajant Corporation, Rajant dBii F36N PRO 3663.4MHz Mini-PCI Radio Module, tested to the requirements of Title 47 of the Code of Federal Regulations (CFR), Part 90 Subpart Z for Land Mobile Radio Services.

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: (\Rajant Corporation\EMC88968-FCC90Z Rev. 8)

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Electromagnetic Compatibility Criteria
Test Report

For the

Rajant Corporation
Model Rajant dBii F36N PRO 3663.4MHz Mini-PCI Radio Module

Tested under

The FCC Verification Rules
Contained in Title 47 of the CFR, Part 90, Subpart Z
for Private Land Mobile Radio Services

MET Report: EMC88968-FCC90Z Rev. 8

October 19, 2016

Prepared For:
Rajant Corporation
400 East King Street
Malvern, PA 19335

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

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MET Report: EMC88968-FCC90Z Rev. 8

Djed Mouada
Electromagnetic Compatibility Lab

Arsalan Hasan
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 / is not capable of operation in accordance with the requirements of Part 90, Subpart Z of the FCC Rules under normal use and maintenance.

Asad Bajwa, Director
Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	May 18, 2016	Initial Issue.
1	July 13, 2016	Additional BW added to report.
2	July 22, 2016	Editorial corrections.
3	July 27, 2016	Updated List of Plots.
4	August 24, 2016	Editorial corrections.
5	September 2, 2016	Engineer corrections.
6	September 6, 2016	Corrections to EIRP table and added MPE.
7	October 19, 2016	Re-tested Power and PSD.
8	October 19, 2016	Editorial correction in Table 2.

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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
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

Executive Summary

1. Testing Summary

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 90, Subpart Z.

Title 47 of the CFR, Part 90, Subpart Z, Reference and Test Description	Compliance / Comments
§90.1319(b) Policies governing the use of the 3650–3700 MHz band.	Compliant
§2.1046; §90.1321(c) RF Power Output	Compliant
§2.1046; §90.1321(c) Peak Power Spectral Density	Compliant
§2.1049 Occupied Bandwidth	Compliant
§2.1051; §90.1323(a) Spurious Emissions at Antenna Terminals	Compliant
§2.1053; Radiated Spurious Emissions	Compliant
§90.210 Emissions Mask	Compliant
Frequency Stability §2.1055, §90.213	Compliant

Table 1. Test Summary

Equipment Configuration

2. Equipment Configuration

2.1. Overview

MET Laboratories, Inc. was contracted by Rajant Corporation to perform testing on the Rajant dBii F36N PRO 3663.4MHz Mini-PCI Radio Module.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Rajant Corporation., Rajant dBii F36N PRO 3663.4MHz Mini-PCI Radio Module.

An EMC evaluation to determine compliance of the Rajant dBii F36N PRO 3663.4MHz Mini-PCI Radio Module with the requirements of Part 90, Subpart Z, was conducted. (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 Rajant dBii F36N PRO 3663.4MHz Mini-PCI Radio Module. Rajant Corporation should retain a copy of this document and it should be kept on file for at least five years after the manufacturing of the EUT has been **permanently** discontinued. The results obtained relate only to the item(s) tested.

Model(s) Tested:	Rajant dBii F36N PRO 3663.4MHz Mini-PCI Radio Module		
Model(s) Covered:	Rajant dBii F36N PRO 3663.4MHz Mini-PCI Radio Module		
EUT Specifications:	Primary Power: 12VDC Battery		
	FCC ID: VJA-F36NPRO		
	Type of Modulations:	OFDM	
		2 dBi Antenna	4 dBi Antenna
	Max RF Output Power: E.I.R.P	27.7083 dBm	28.4893 dBm
	Equipment Code:	TNB	
	EUT Frequency Ranges:	3663.4 MHz - 3688.4 MHz (20MHz BW) 3655.9 MHz - 3693.4 MHz (10MHz BW)	
Analysis:	The results obtained relate only to the item(s) tested.		
Environmental Test Conditions:	Temperature: 15-35° C		
	Relative Humidity: 30-60%		
	Barometric Pressure: 860-1060 mbar		
Evaluated by:	Arsalan Hasan		
Report Date(s):	October 19, 2016		

Table 2. EUT Specifications

2.2. 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 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.

2.3. Description of Test Sample

The Rajant Corporation Rajant dBii F36N PRO 3663.4MHz Mini-PCI Radio Module, is a high powered radio module operating on 3663.4 MHz with integrated Lightning & ESD protection. The radio module is designed for reliable fixed, portable and bodyworn wireless data networking applications.

2.4. Equipment Configuration

Ref. ID	Name / Description	Model Number	Part Number
A	Mini-PCI Radio	F36N-PRO	F36N-PRO
B	PC TEL 3.650 GHz Stubby Antenna w Integrated TNC(M) Connector	75-100155-036_ODD	75-100155-036
C	MP Antenna 3.65 GHz Omni	08-ANT-0980-NM	08-ANT-0980-NM

Table 3. Equipment Configuration

2.5. Support Equipment

Ref. ID	Name / Description	Manufacturer	Model Number
D	Modular Host	Rajant	ME4-Modular Host
E	Mini-PCI Extender, Short	ADEXELEC	MPCIFLEX-01, 3”
F	Mini-PCI Extender, Longer	ADEXELEC	MPCIFLEX-01, 5”
G	ABS Plastic Antenna Support	Rajant	None, Custom Fabrication
H	Test PC	Lenovo	G50
P	AC/DC Power Supply	Laptop Supply	Lenovo

Table 4. Support Equipment

2.6.Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty.	Length (m)	Shielded (Y/N)	Termination Box ID & Port ID
J	Mini-PCI	Connects EUT to Modular Host	1	8”	NO	--
K	RF Chain 0	EUT RF Chain 0 Output	1	5”	YES	CH0
L	RF CHAIN 1	EUT RF Chain 1 Output	1	5”	YES	CH1
M	DATA+PWR	POWER+DATA From AC/DC POE	1	360”	YES	--
N	Data In	Connects PC to POE input	1	36”	YES	--

Table 5. Ports and Cabling Information

2.7. Mode of Operation

The following radio modes will be evaluated 802.11n 2x2:2 MIMO and for 802.11a. In each mode, a data pattern with high duty cycle will be used to produce a nearly continuous signal at the radio outputs.

2.8. Method of Monitoring EUT Operation

Direct observation of the output on each RF chain is required to verify the operation of the radio in the intended mode.

2.9. Modifications

2.9.1. Modifications to EUT

No modifications were made to the EUT.

2.9.2. Modifications to Test Standard

No modifications were made to the EUT.

2.10. Disposition of EUT

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

Electromagnetic Compatibility Criteria for Intentional Radiators

3. Electromagnetic Compatibility RF Power Output Requirements

3.1. RF Power Output

Test Requirement(s): **§2.1046 and §90. 1321 (c)**

Test Procedures: A laptop was connected to EUT to control the RF power output and frequency. The EUT was directly connected to a Spectrum Analyzer with an attenuator in-between. The EUT power was adjusted to produce maximum output power as specified in the owner's manual. Measurements were performed at the low, mid and high channels for each of the EUT's bandwidths and modulations.

Limits: For mobile and portable stations the EIRP limit is 1W / 25MHz.

Test Results: Equipment complies with 90.1321(c) for mobile and portable Stations. The module may be used with two types of antennas; 2 dBi and a 4 dBi.

Test Engineer(s): Djed Mouada

Test Date(s): 10/17/16

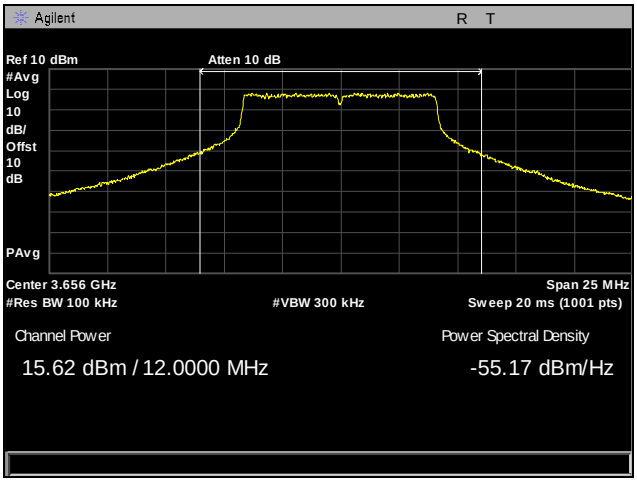
Channel	BW	Frequency	Antenna A Power	Antenna B Power	Sum	2+10log(2)	EIRP	Limit	Margin
Low	20	3.6634	17.59	19.94	21.932	5.010299957	26.9423	28.785	1.8427
Mid	20	3.6784	17.76	20.32	22.236	5.010299957	27.2463	28.785	1.5387
High	20	3.6884	18.82	20.41	22.698	5.010299957	27.7083	28.785	1.0767
Low	10	3.6559	15.62	18	19.981	5.010299957	24.9913	25.355	0.3637
Mid	10	3.6734	14.1	18.62	19.934	5.010299957	24.9443	25.355	0.4107
High	10	3.6934	13.79	18.63	19.862	5.010299957	24.8723	25.355	0.4827

Table 6. RF Output Power, Test Results, 2 dBi Antenna

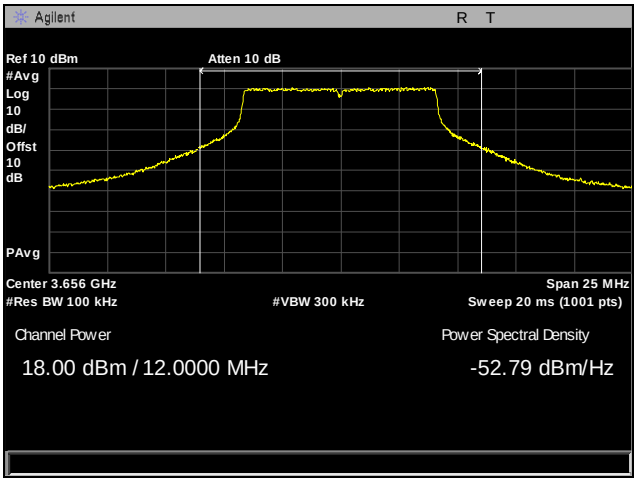
Channel	BW	Frequency	Antenna A Power	Antenna B Power	Sum	4+10log(2)	EIRP	Limit	Margin
Low	20	3.6634	17.73	18.9	21.365	7.010299957	28.3753	28.785	0.4097
Mid	20	3.6784	17.29	19.34	21.445	7.010299957	28.4553	28.785	0.3297
High	20	3.6884	17.94	18.94	21.479	7.010299957	28.4893	28.785	0.2957
Low	10	3.6559	14.24	15.15	17.729	7.010299957	24.7393	25.355	0.6157
Mid	10	3.6734	14.2	15.43	17.869	7.010299957	24.8793	25.355	0.4757
High	10	3.6934	14.48	15.56	18.064	7.010299957	25.0743	25.355	0.2807

Table 6. RF Output Power, Test Results, 4 dBi Antenna

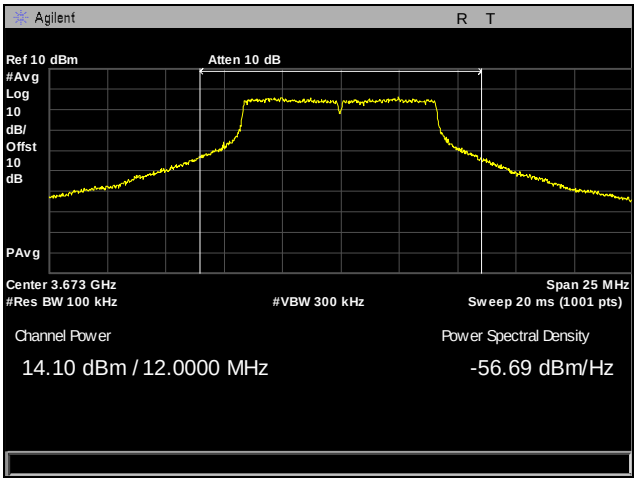
RF Output Power for 2dBi Antenna (10 MHz Bandwidth)



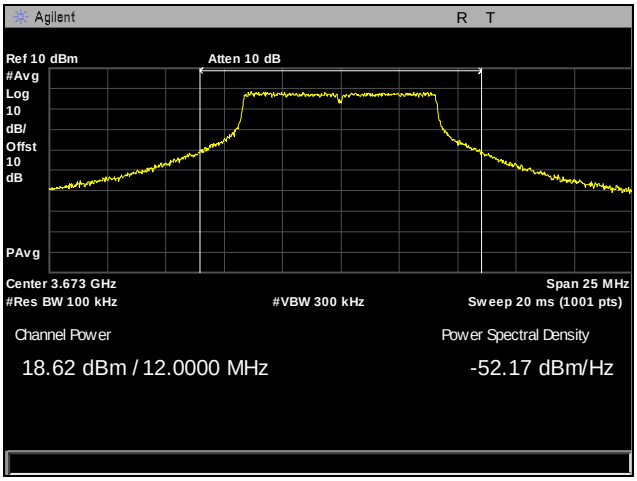
Plot 1. Measured Power, Low Channel, BW 10 MHz, Chain 0, 2 dBi Antenna



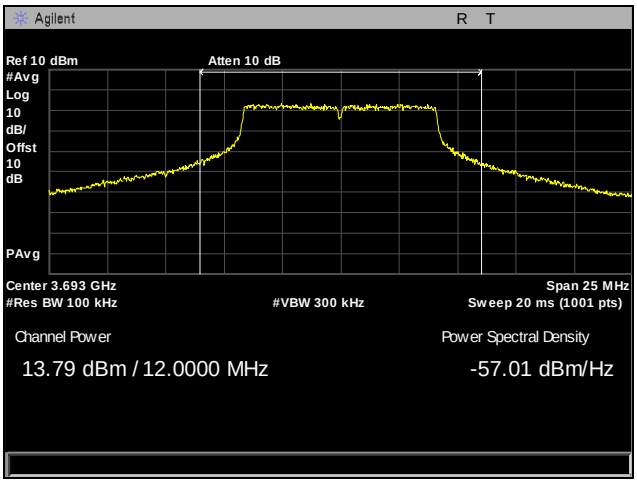
Plot 2. Measured Power, Low Channel, BW 10 MHz, Chain 1, 2 dBi Antenna



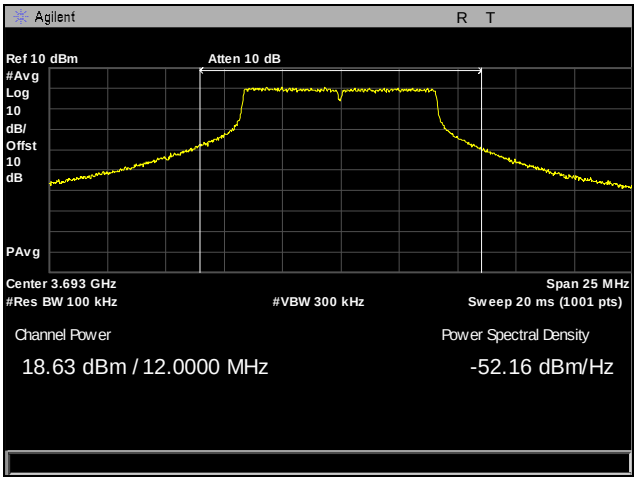
Plot 3. Measured Power, Mid Channel, BW 10 MHz, Chain 0, 2 dBi Antenna



Plot 4. Measured Power, Mid Channel, BW 10 MHz, Chain 1, 2 dBi Antenna

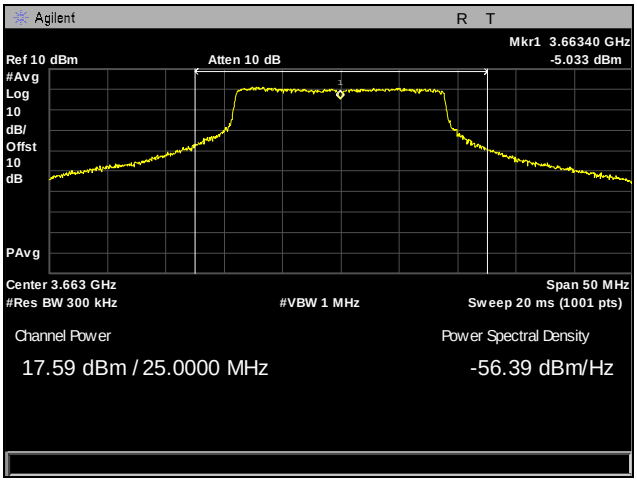


Plot 5. Measured Power, High Channel, BW 10 MHz, Chain 0, 2 dBi Antenna

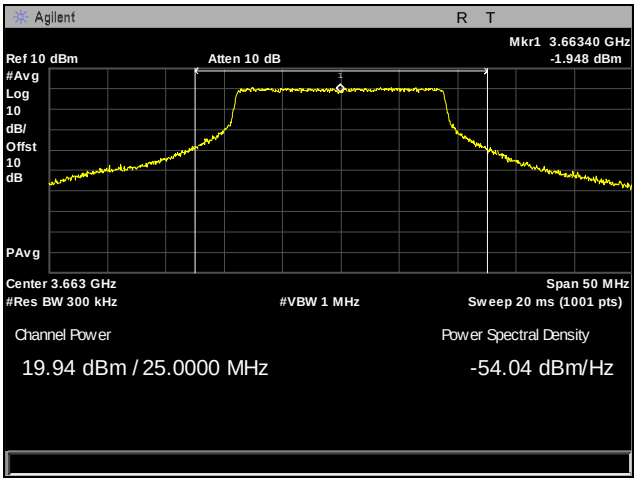


Plot 6. Measured Power, High Channel, BW 10 MHz, Chain 1, 2 dBi Antenna

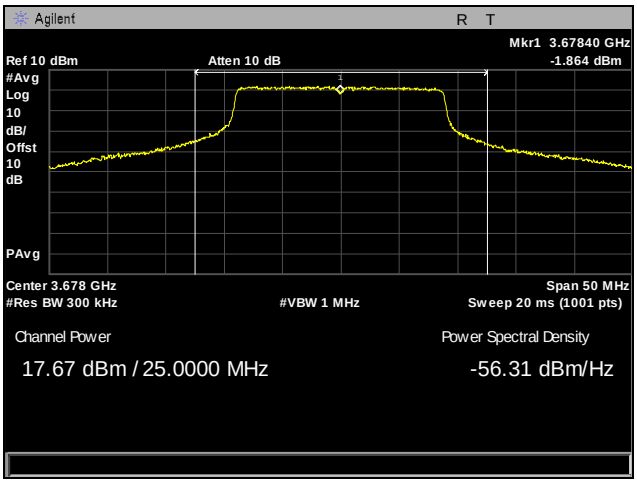
RF Output Power for 2dBi Antenna (20 MHz Bandwidth)



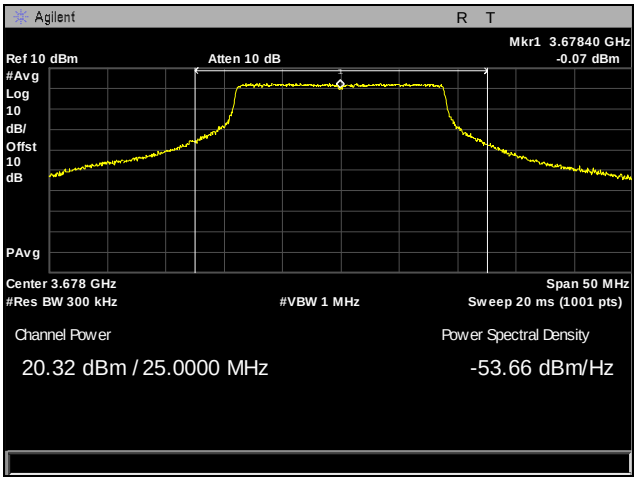
Plot 7. Measured Power, Low Channel, BW 20 MHz, Chain 0, 2 dBi Antenna



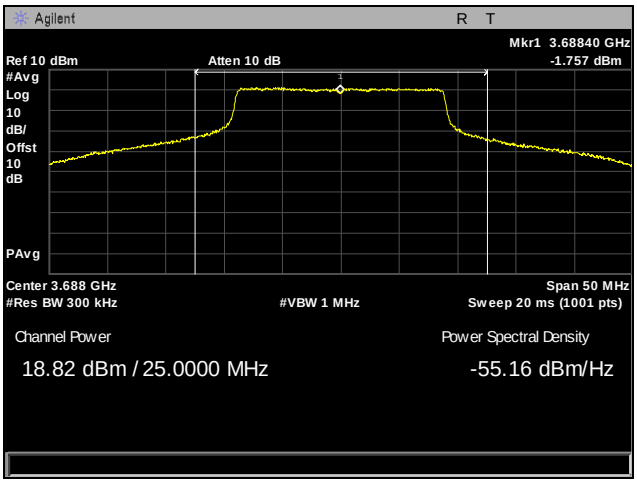
Plot 8. Measured Power, Low Channel, BW 20 MHz, Chain 1, 2 dBi Antenna



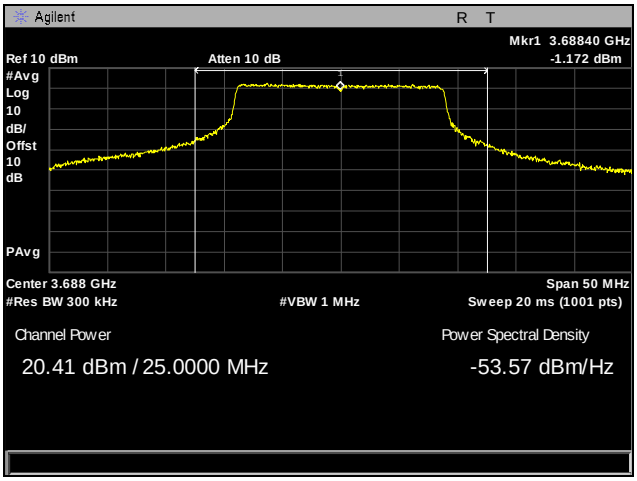
Plot 9. Measured Power, Mid Channel, BW 20 MHz, Chain 0, 2 dBi Antenna



Plot 10. Measured Power, Mid Channel, BW 20 MHz, Chain 1, 2 dBi Antenna

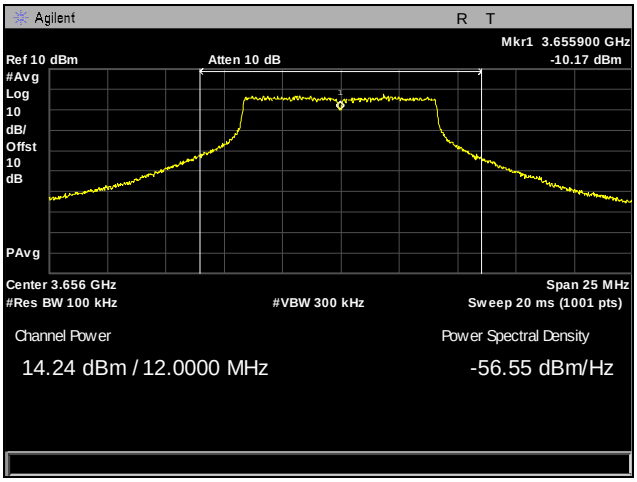


Plot 11. Measured Power, High Channel, BW 20 MHz, Chain 0, 2 dBi Antenna

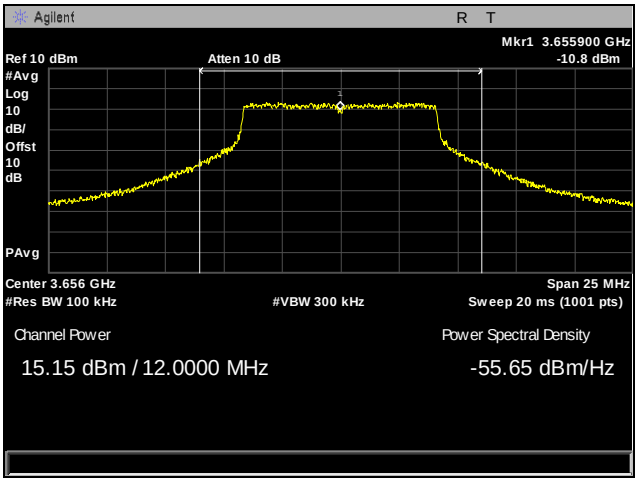


Plot 12. Measured Power, High Channel, BW 20 MHz, Chain 1, 2 dBi Antenna

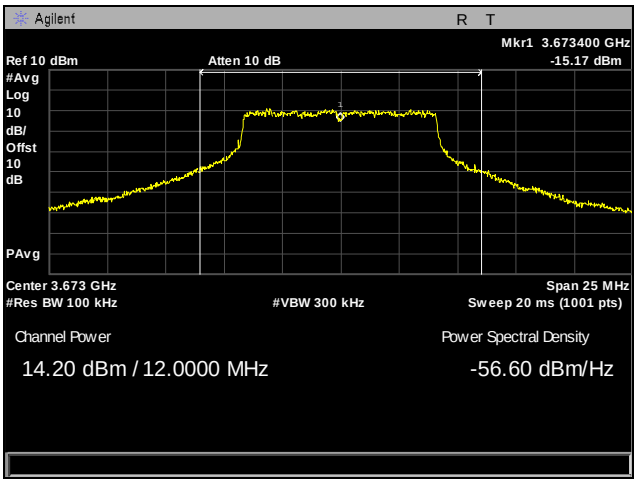
RF Output Power for 4 dBi Antenna (10 MHz Bandwidth)



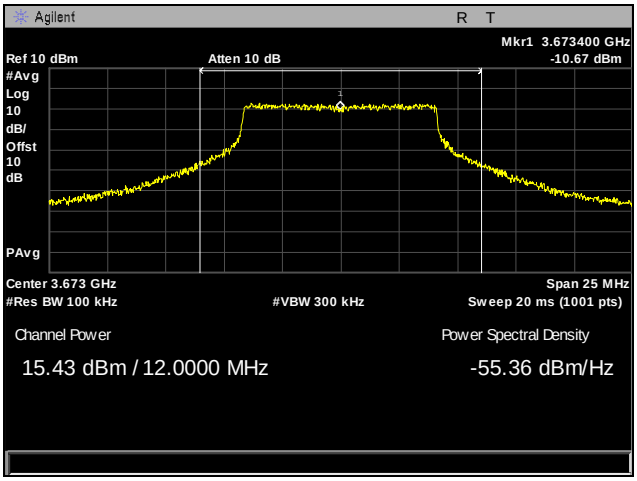
Plot 13. Measured Power, Low Channel, BW 10 MHz, Chain 0, 4 dBi Antenna



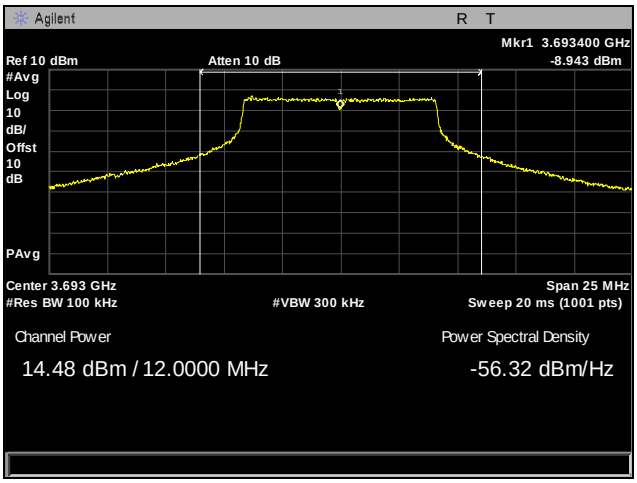
Plot 14. Measured Power, Low Channel, BW 10 MHz, Chain 1, 4 dBi Antenna



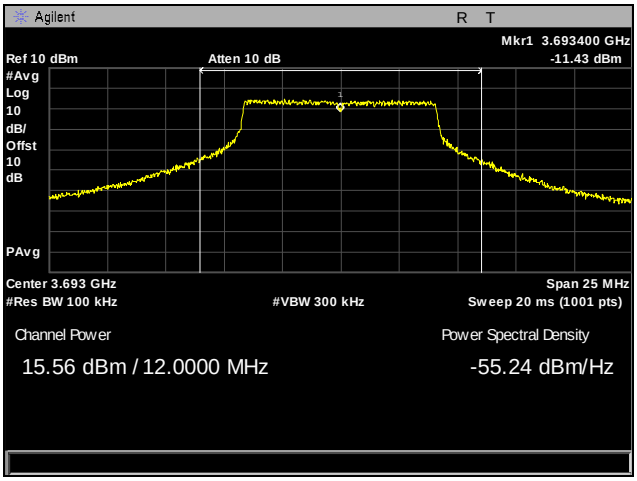
Plot 15. Measured Power, Mid Channel, BW 10 MHz, Chain 0, 4 dBi Antenna



Plot 16. Measured Power, Mid Channel, BW 10 MHz, Chain 1, 4 dBi Antenna

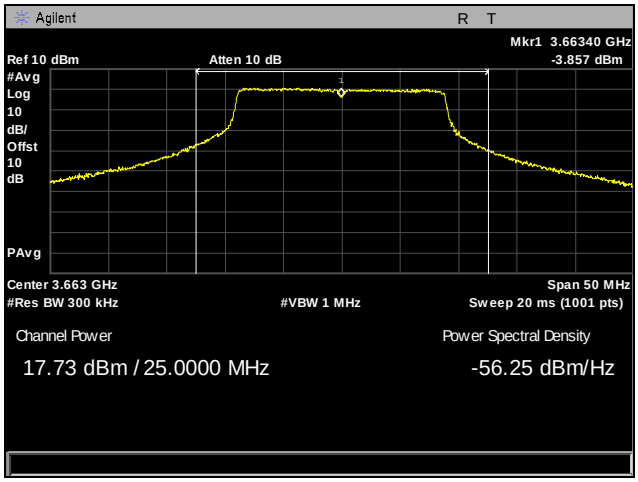


Plot 17. Measured Power, High Channel, BW 10 MHz, Chain 0, 4 dBi Antenna

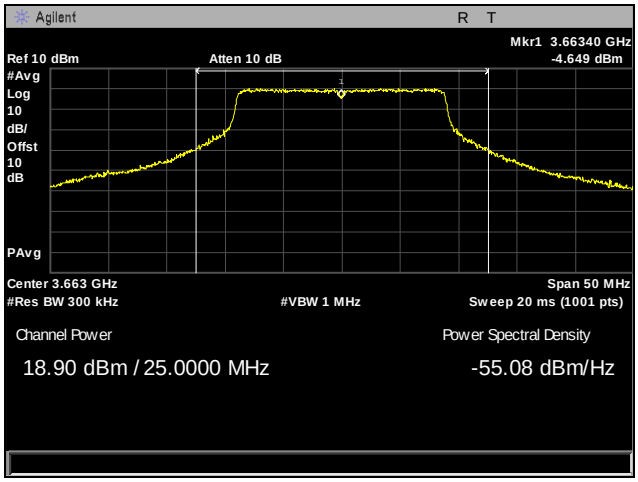


Plot 18. Measured Power, High Channel, BW 10 MHz, Chain 1, 4 dBi Antenna

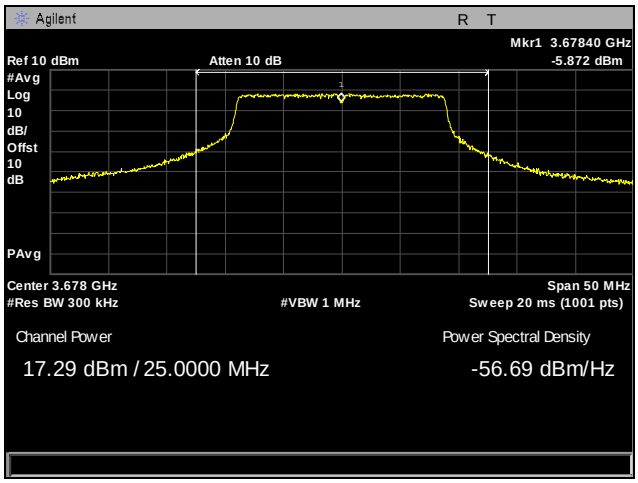
RF Output Power for 4 dBi Antenna (20 MHz Bandwidth)



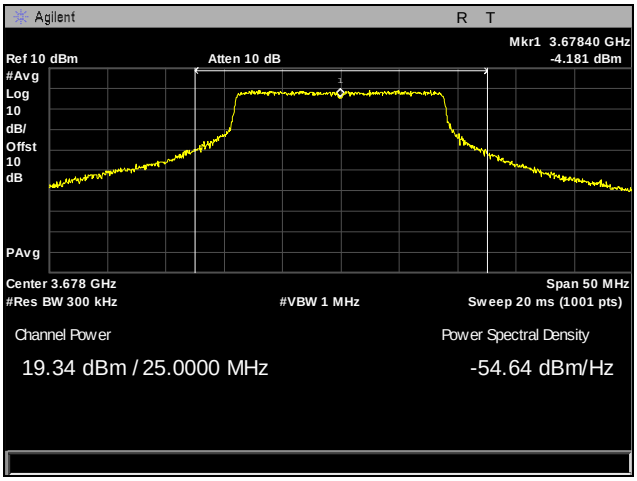
Plot 19. Measured Power, Low Channel, BW 20 MHz, Chain 0, 4 dBi Antenna



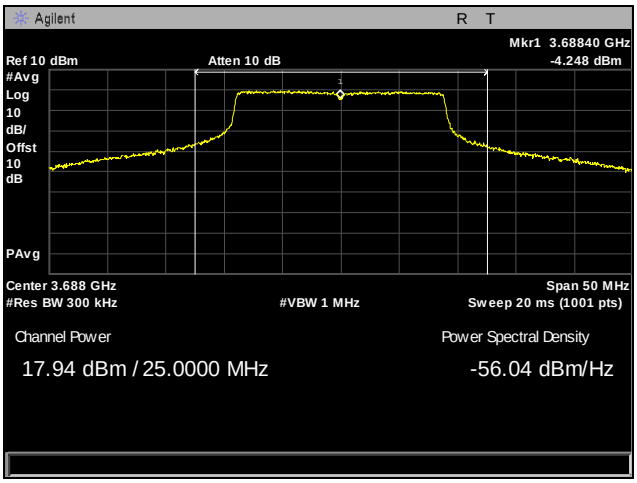
Plot 20. Measured Power, Low Channel, BW 20 MHz, Chain 1, 4 dBi Antenna



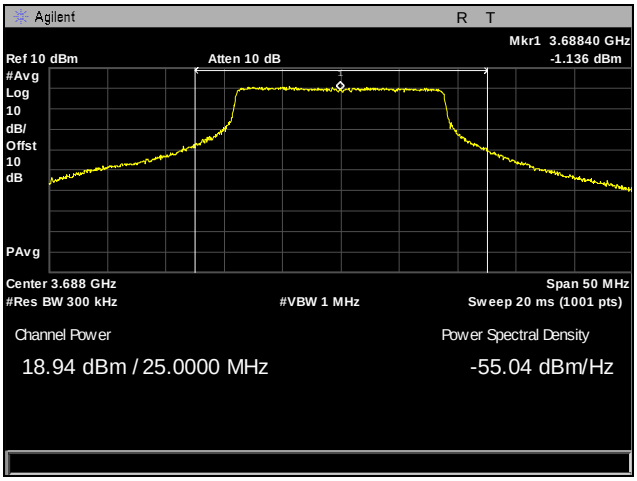
Plot 21. Measured Power, Mid Channel, BW 20 MHz, Chain 0, 4 dBi Antenna



Plot 22. Measured Power, Mid Channel, BW 20 MHz, Chain 1, 4 dBi Antenna



Plot 23. Measured Power, High Channel, BW 20 MHz, Chain 0, 4 dBi Antenna



Plot 24. Measured Power, High Channel, BW 20 MHz, Chain 1, 4 dBi Antenna

3.2. Peak Power Spectral Density

Test Requirement(s): **§90. 1321 (c)**

Test Procedures: laptop was connected to EUT to control the RF power output and frequency. The EUT was directly connected to a Spectrum Analyzer with an attenuator inserted in between. The Spectrum Analyzer was set to a RBW = 1 MHz and a VBW > 1MHz. A sample detector was selected on the spectrum analyzer along with power averaging. The Peak Power Spectral Density was determined by detecting the highest emission within the EUT's occupied bandwidth. Measurements were performed at the low, mid and high channels for each of the EUT's bandwidths and modulations.

Limits: For mobile and portable stations the radiated Peak Power Spectral Density limit is 16dBm or 40mW

Test Results: Equipment complies with 90.1321(c) for mobile and portable Stations.

Test Engineer(s): Djed Mouada

Test Date(s): 10/17/16

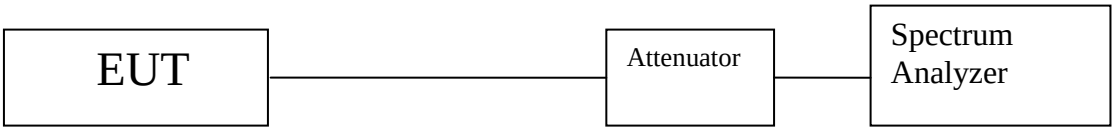


Figure 1. PPSD Test Setup

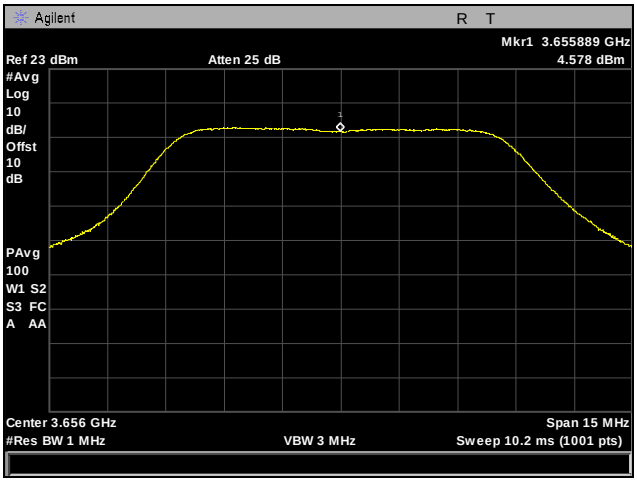
Channel	BW	Frequency	Antenna 0 PSD	Antenna 1 PSD	Sum	2+10log(2)	PSD	Limit
Low	20	3.6634	6.43	7.621	10.076	5.0103	15.0863	16
Mid	20	3.6784	5.562	7.91	9.903	5.0103	14.9133	16
High	20	3.6884	5.037	9.497	10.826	5.0103	15.8363	16
Low	10	3.6559	4.578	7.64	9.384	5.0103	14.3943	16
Mid	10	3.6734	4.797	9.25	10.581	5.0103	15.5913	16
High	10	3.6934	4.64	9.29	10.57	5.0103	15.5803	16

Table 7. Peak Power Spectral Density, Test Results, 2 dBi Antenna

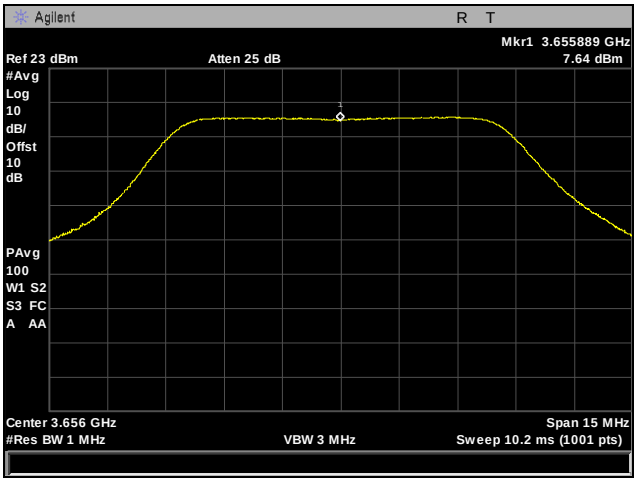
Channel	BW	Frequency	Antenna 0 PSD	Antenna 1 PSD	Sum	4+10log(2)	PSD	Limit
Low	20	3.6634	4.689	5.826	8.305	7.0103	15.3153	16
Mid	20	3.6784	3.234	6.908	8.459	7.0103	15.4693	16
High	20	3.6884	4.708	6.466	8.686	7.0103	15.6963	16
Low	10	3.6559	4.629	6.08	8.425	7.0103	15.4353	16
Mid	10	3.6734	4.935	6.315	8.69	7.0103	15.7003	16
High	10	3.6934	3.69	6.348	8.23	7.0103	15.2403	16

Table 7. Peak Power Spectral Density, Test Results, 4 dBi Antenna

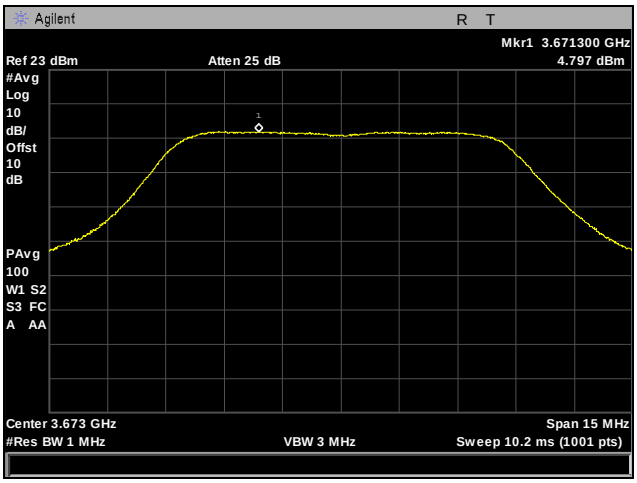
Power Spectral Density (2 dBi Antenna) (10 MHz)



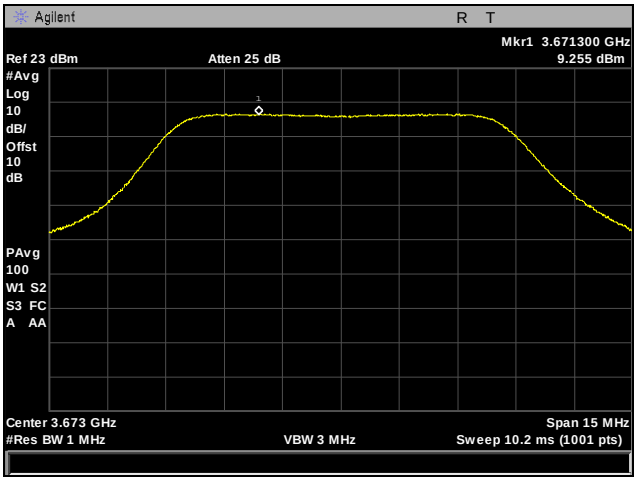
Plot 25. Power Spectral Density, Low Channel, BW 10 MHz, Chain 0, 2 dBi Antenna



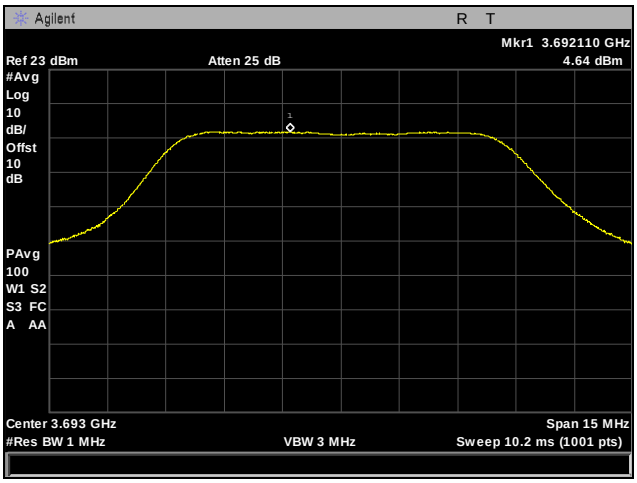
Plot 26. Power Spectral Density, Low Channel, BW 10 MHz, Chain 1, 2 dBi Antenna



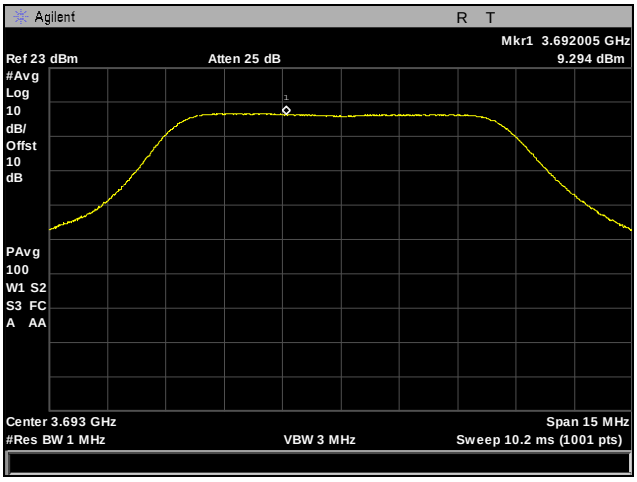
Plot 27. Power Spectral Density, Mid Channel, BW 10 MHz, Chain 0, 2 dBi Antenna



Plot 28. Power Spectral Density, Mid Channel, BW 10 MHz, Chain 1, 2 dBi Antenna

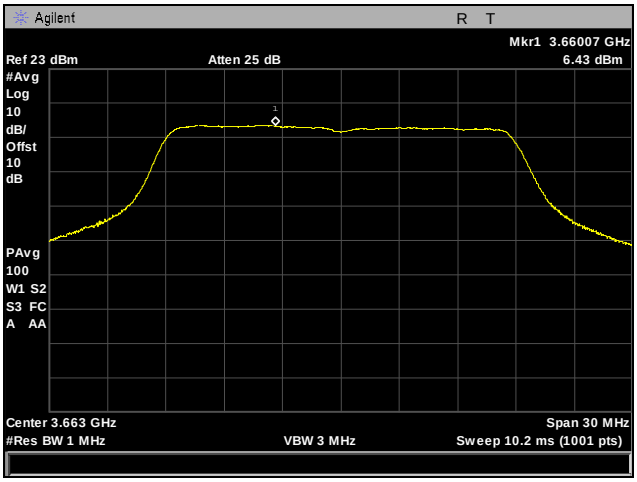


Plot 29. Power Spectral Density, High Channel, BW 10 MHz, Chain 0, 2 dBi Antenna

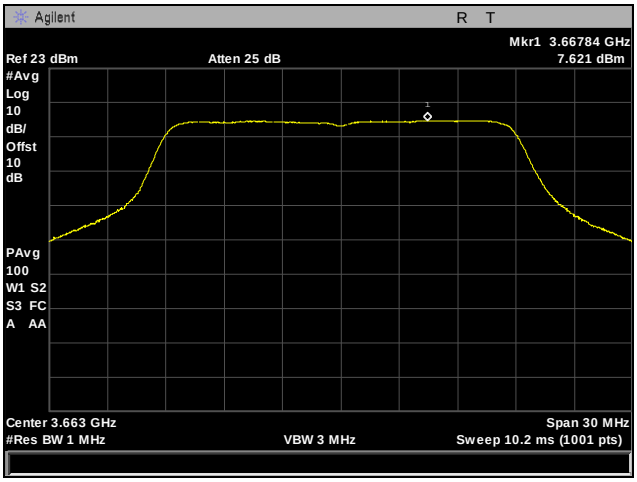


Plot 30. Power Spectral Density, High Channel, BW 10 MHz, Chain 1, 2 dBi Antenna

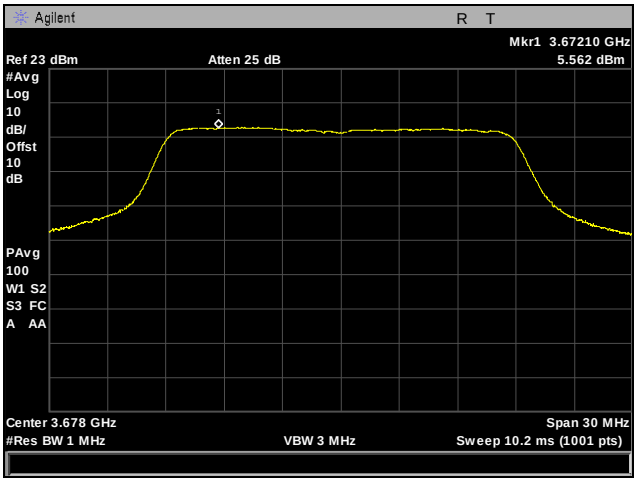
Power Spectral Density (2 dBi Antenna) (20 MHz)



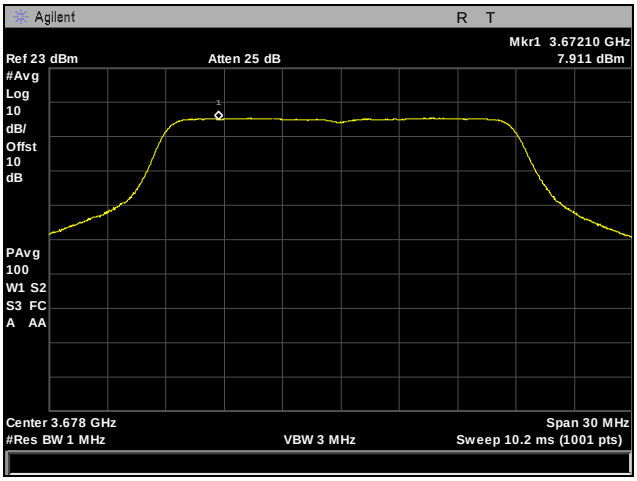
Plot 31. Power Spectral Density, Low Channel, BW 20 MHz, Chain 0, 2 dBi Antenna



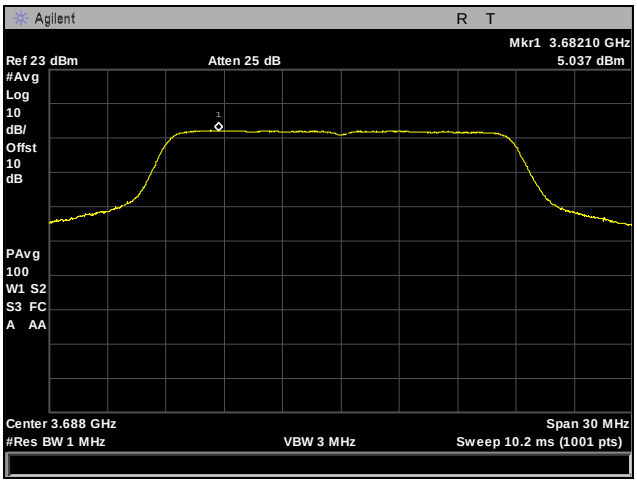
Plot 32. Power Spectral Density, Low Channel, BW 20 MHz, Chain 1, 2 dBi Antenna



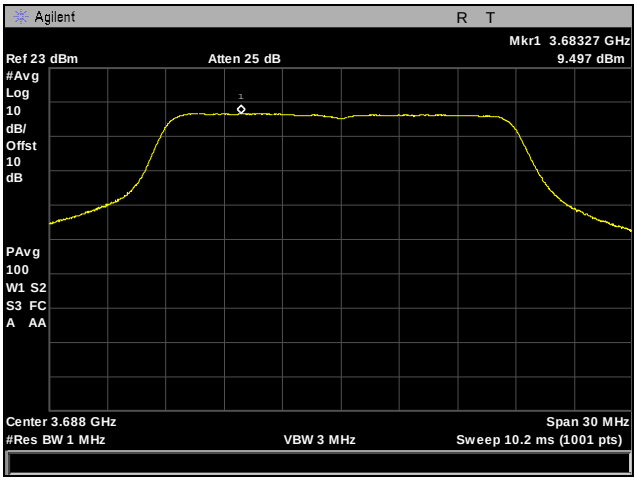
Plot 33. Power Spectral Density, Mid Channel, BW 20 MHz, Chain 0, 2 dBi Antenna



Plot 34. Power Spectral Density, Mid Channel, BW 20 MHz, Chain 1, 2 dBi Antenna

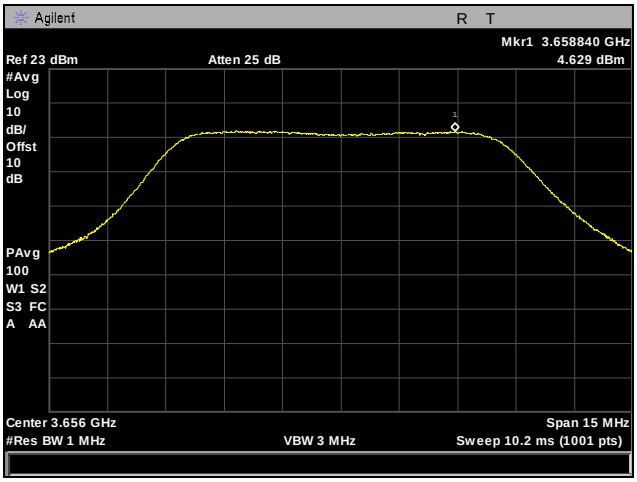


Plot 35. Power Spectral Density, High Channel, BW 20 MHz, Chain 0, 2 dBi Antenna

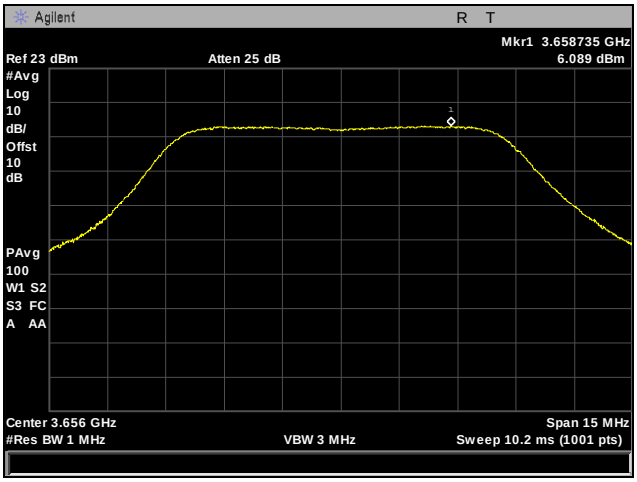


Plot 36. Power Spectral Density, High Channel, BW 20 MHz, Chain 1, 2 dBi Antenna

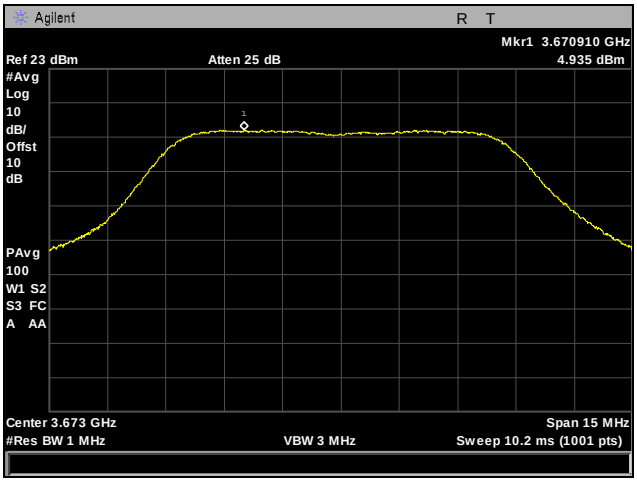
Power Spectral Density (4 dBi Antenna) (10 MHz)



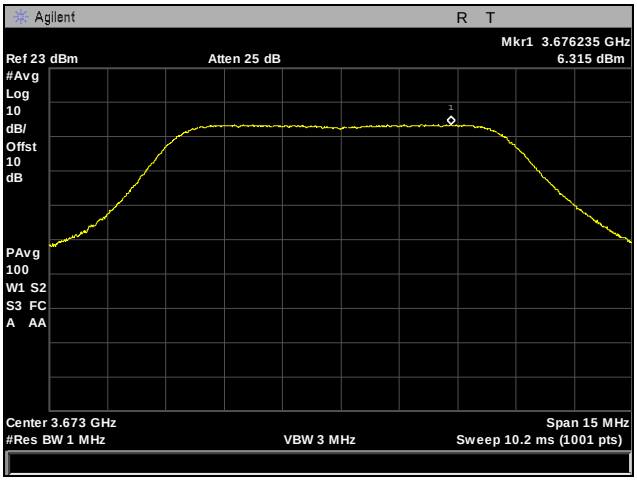
Plot 37. Power Spectral Density, Low Channel, BW 10 MHz, Chain 0, 4 dBi Antenna



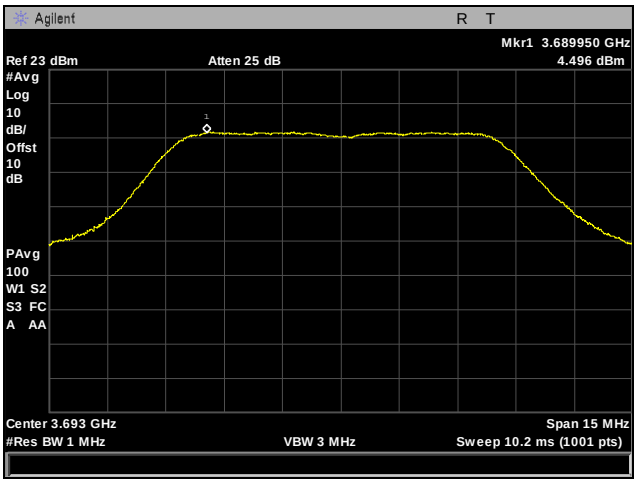
Plot 38. Power Spectral Density, Low Channel, BW 10 MHz, Chain 1, 4 dBi Antenna



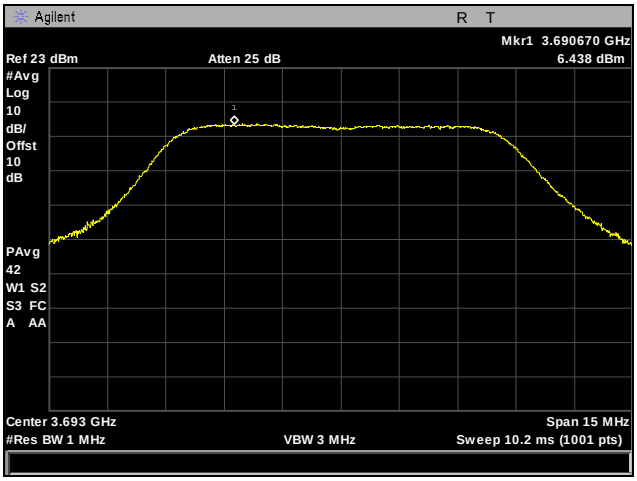
Plot 39. Power Spectral Density, Mid Channel, BW 10 MHz, Chain 0, 4 dBi Antenna



Plot 40. Power Spectral Density, Mid Channel, BW 10 MHz, Chain 1, 4 dBi Antenna

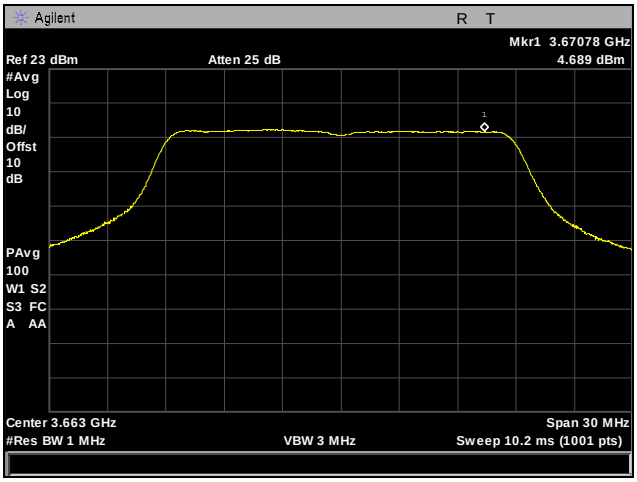


Plot 41. Power Spectral Density, High Channel, BW 10 MHz, Chain 0, 4 dBi Antenna

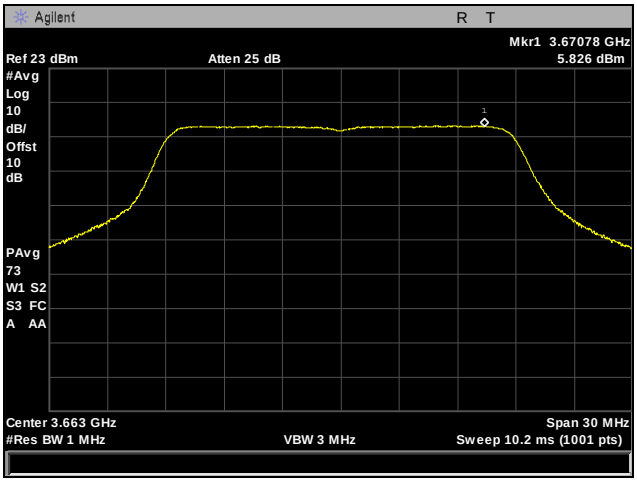


Plot 42. Power Spectral Density, High Channel, BW 10 MHz, Chain 1, 4 dBi Antenna

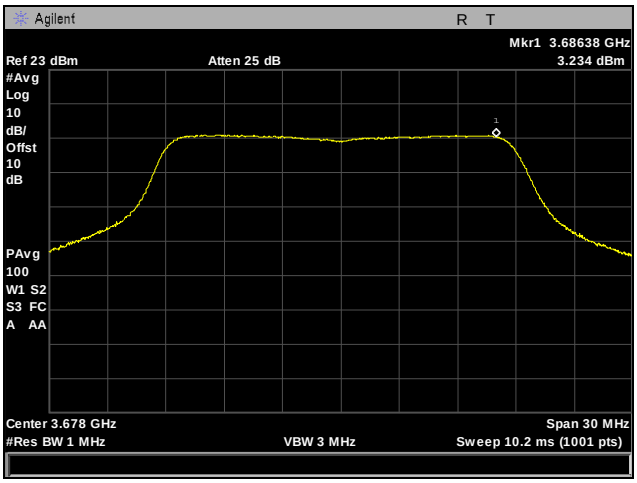
Power Spectral Density (4 dBi Antenna) (20 MHz)



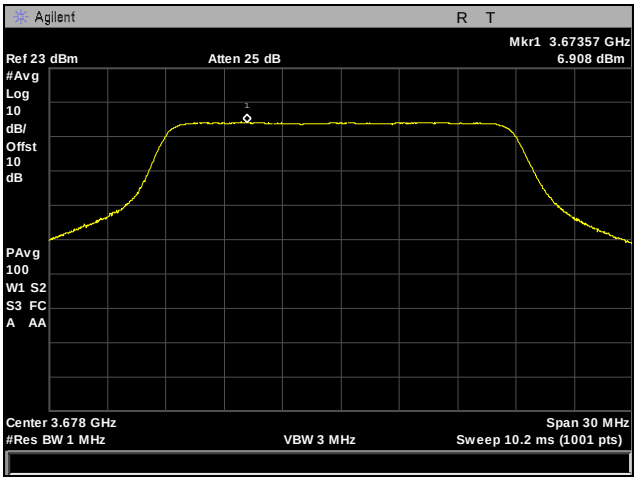
Plot 43. Power Spectral Density, Low Channel, BW 20 MHz, Chain 0, 4 dBi Antenna



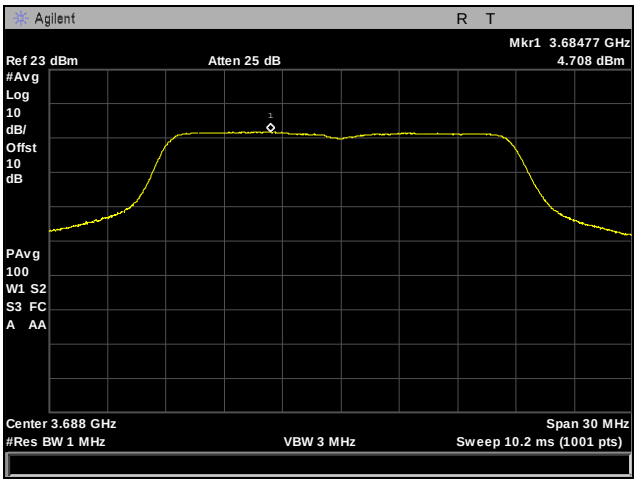
Plot 44. Power Spectral Density, Low Channel, BW 20 MHz, Chain 1, 4 dBi Antenna



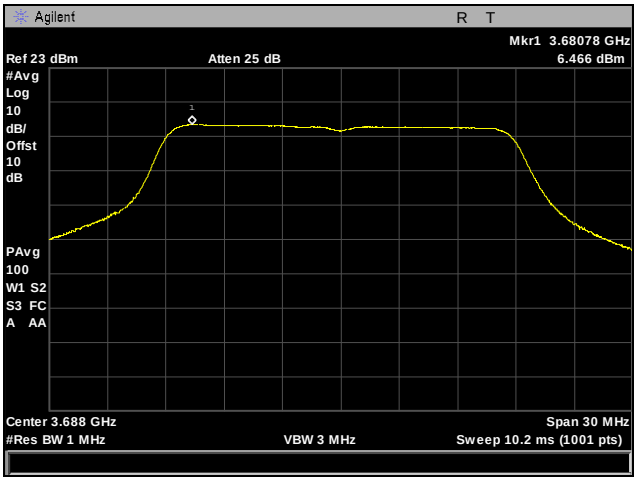
Plot 45. Power Spectral Density, Mid Channel, BW 20 MHz, Chain 0, 4 dBi Antenna



Plot 46. Power Spectral Density, Mid Channel, BW 20 MHz, Chain 1, 4 dBi Antenna



Plot 47. Power Spectral Density, High Channel, BW 20 MHz, Chain 0, 4 dBi Antenna



Plot 48. Power Spectral Density, High Channel, BW 20 MHz, Chain 1, 4 dBi Antenna

4. Electromagnetic Compatibility Occupied Bandwidth Requirements

4.1. Occupied Bandwidth

Test Requirement(s): **§2.1049**

Test Procedures: A laptop was connected to EUT to control the RF power output and frequency. The EUT was directly connected to a Spectrum Analyzer with an attenuator inserted in-between. The Spectrum Analyzer's channel bandwidth measurement option was used to measure the EUT's occupied bandwidth. Measurements were performed at the low, mid and high channels for each of the EUT's bandwidths.

Test Results: Equipment complies with Section 2.1049.

Test Engineer(s): Arsalan Hasan

Test Date(s): 06/30/2016

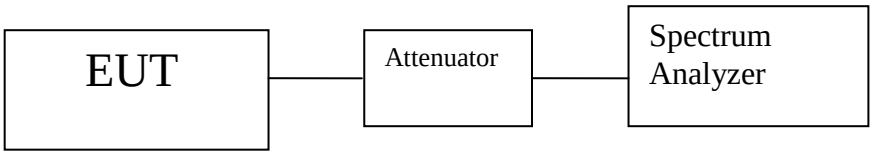
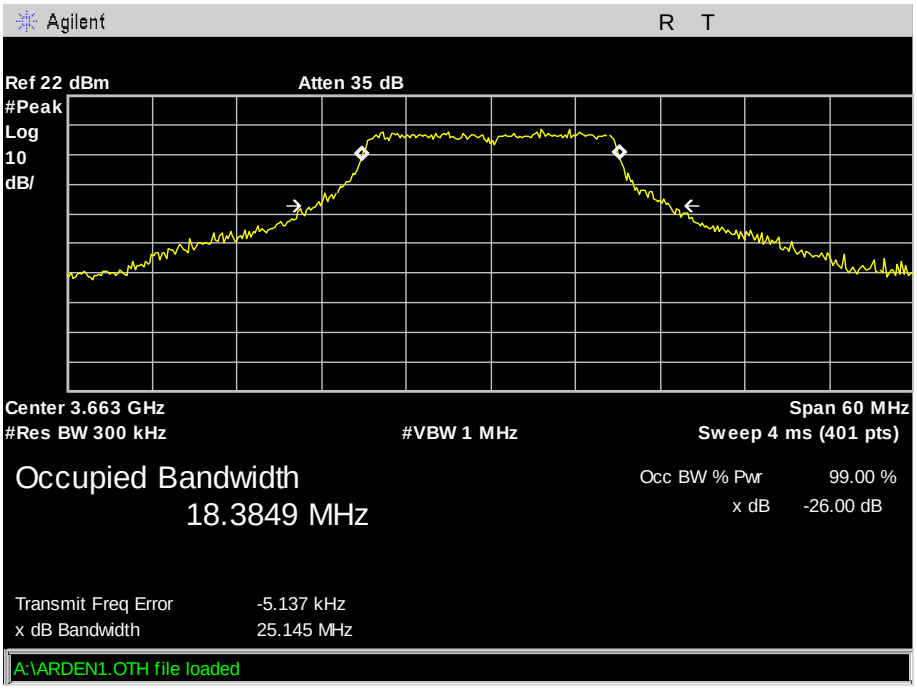
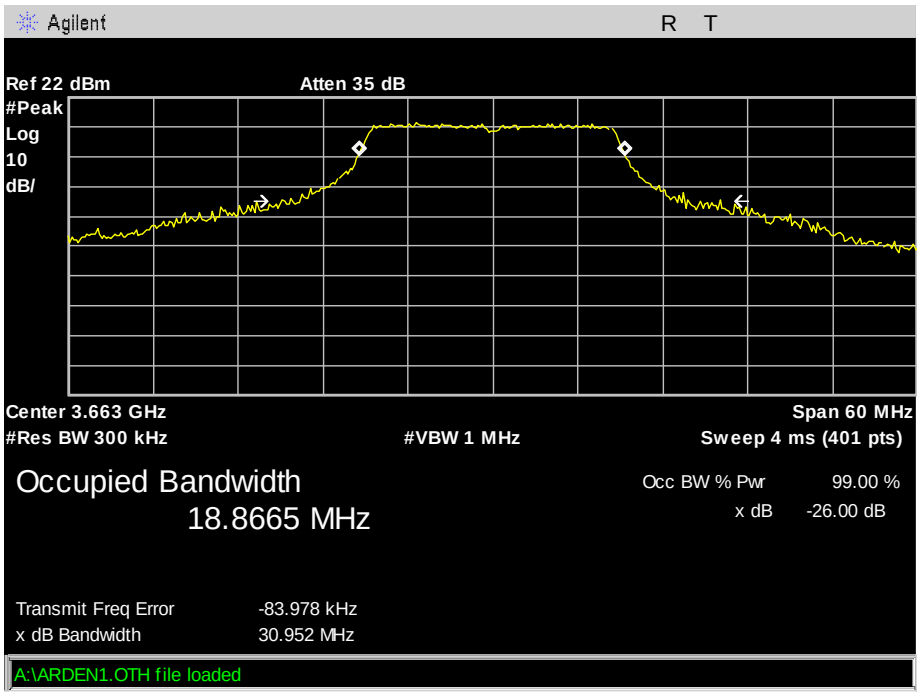


Figure 2. Occupied Bandwidth Test Setup

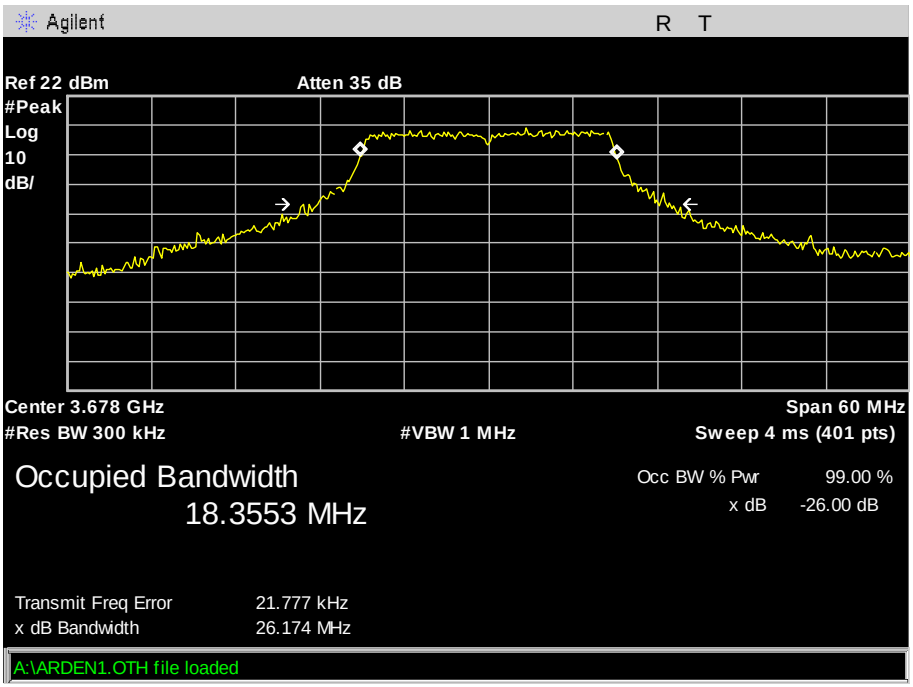
Occupied Bandwidth (20MHz Bandwidth) 2dBi



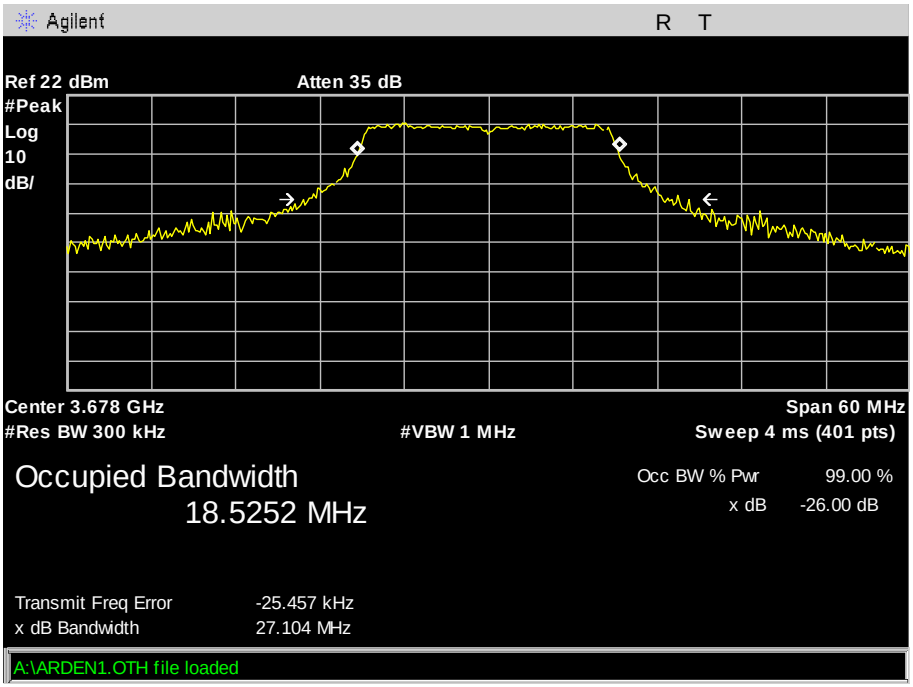
Plot 49. Occupied Bandwidth - Low - 3663.4MHz - BW20MHz - Chain0



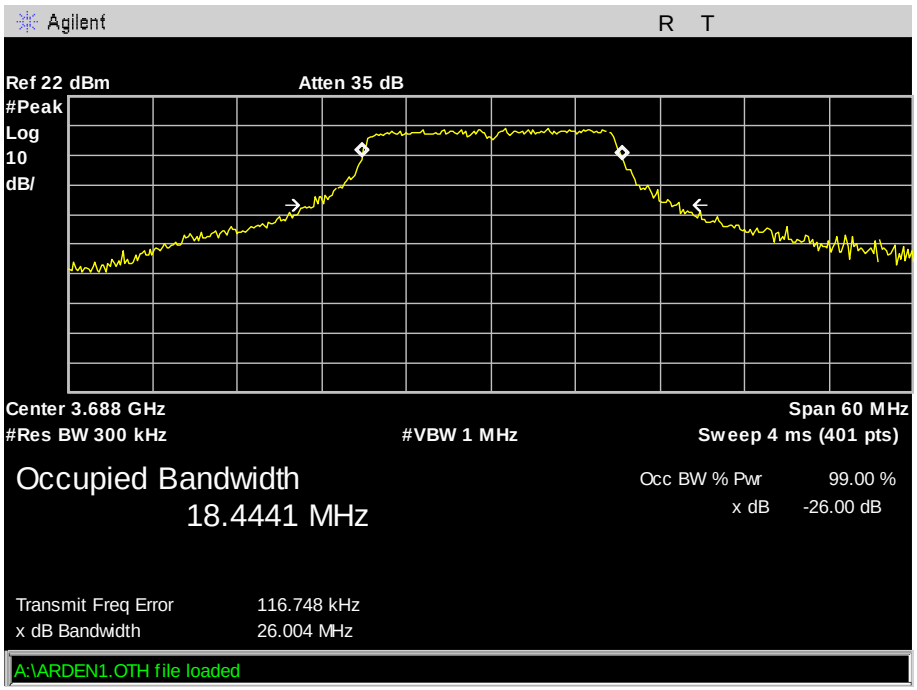
Plot 50. Occupied Bandwidth - Low - 3663.4MHz - BW20MHz - Chain1



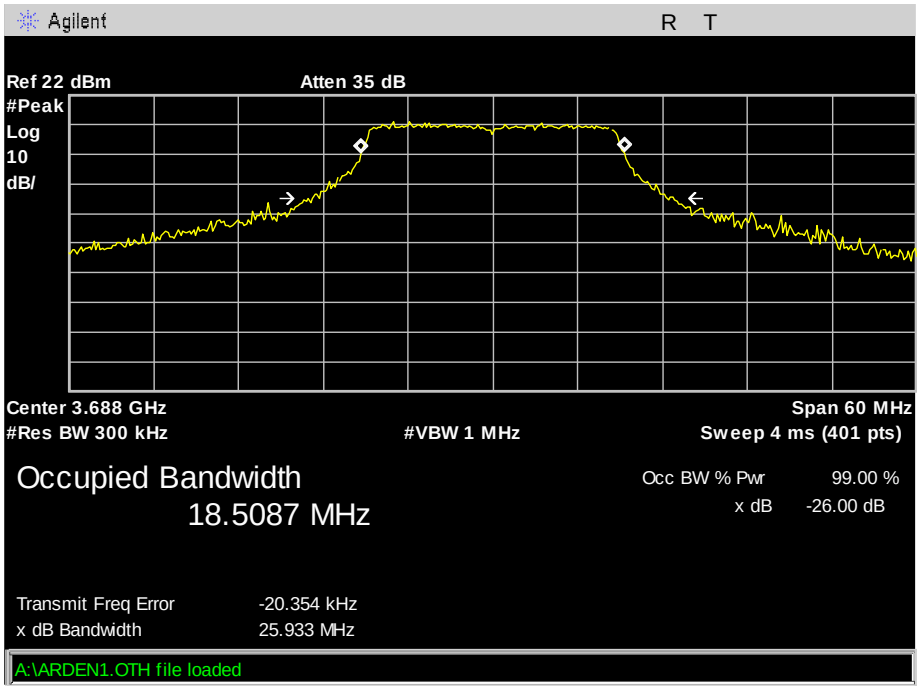
Plot 51. Occupied Bandwidth - Mid - 3678.4MHz - BW20MHz - Chain0



Plot 52. Occupied Bandwidth - Mid - 3678.4MHz - BW20MHz - Chain1

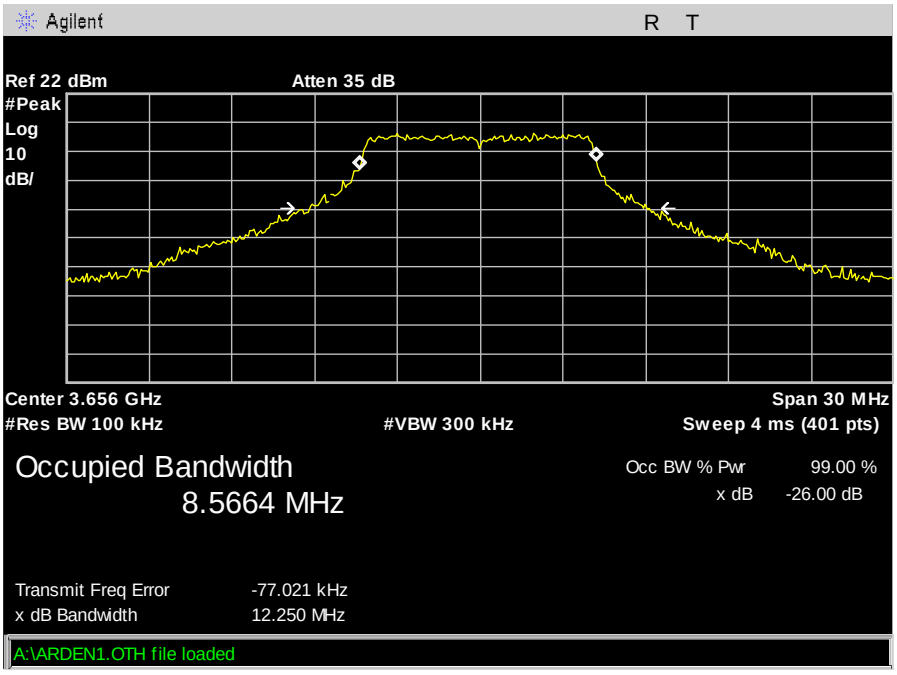


Plot 53. Occupied Bandwidth - High - 3688.4MHz - BW20MHz - Chain0

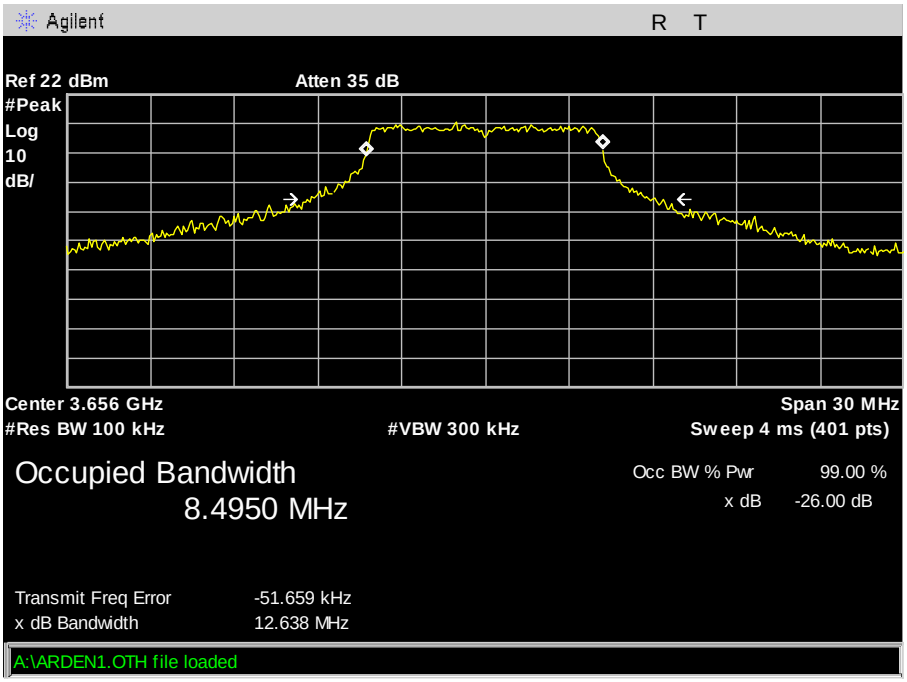


Plot 54. Occupied Bandwidth - High - 3688.4MHz - BW20MHz - Chain1

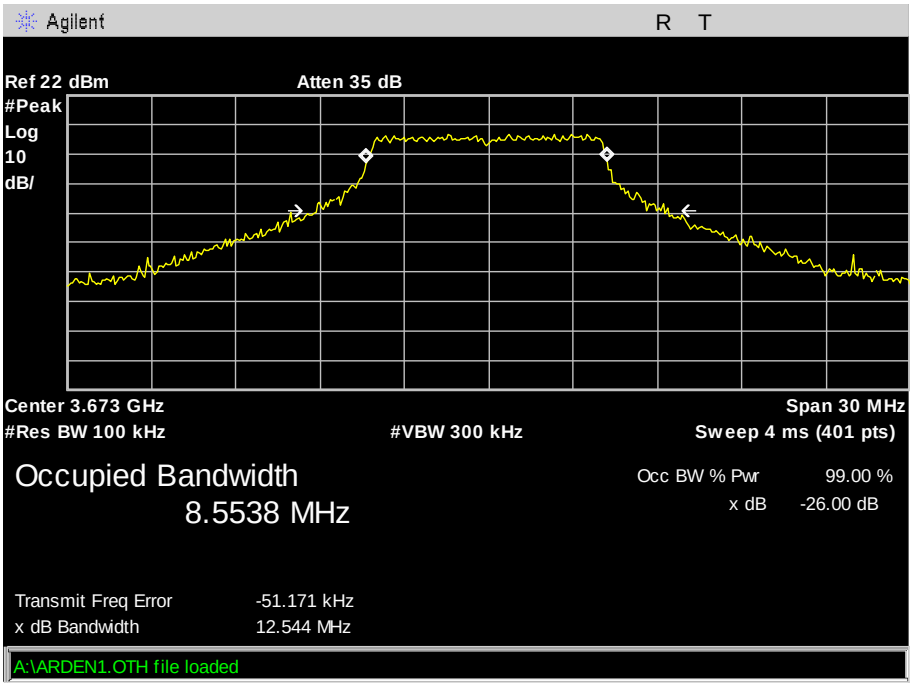
Occupied Bandwidth (10MHz Bandwidth) 2dBi



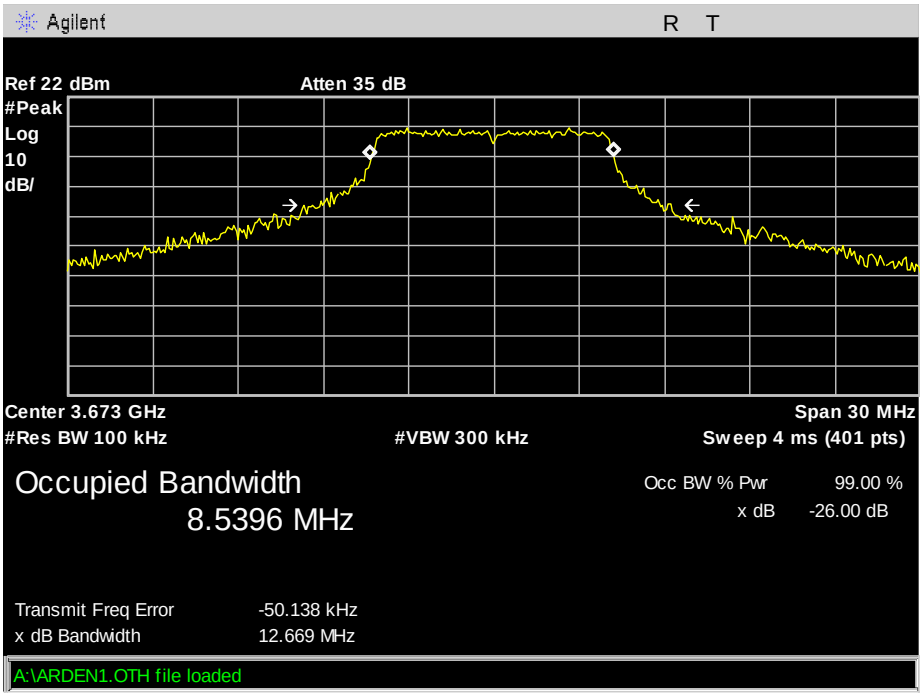
Plot 55. Occupied Bandwidth - Low - 3655.9MHz - BW10MHz - Chain0



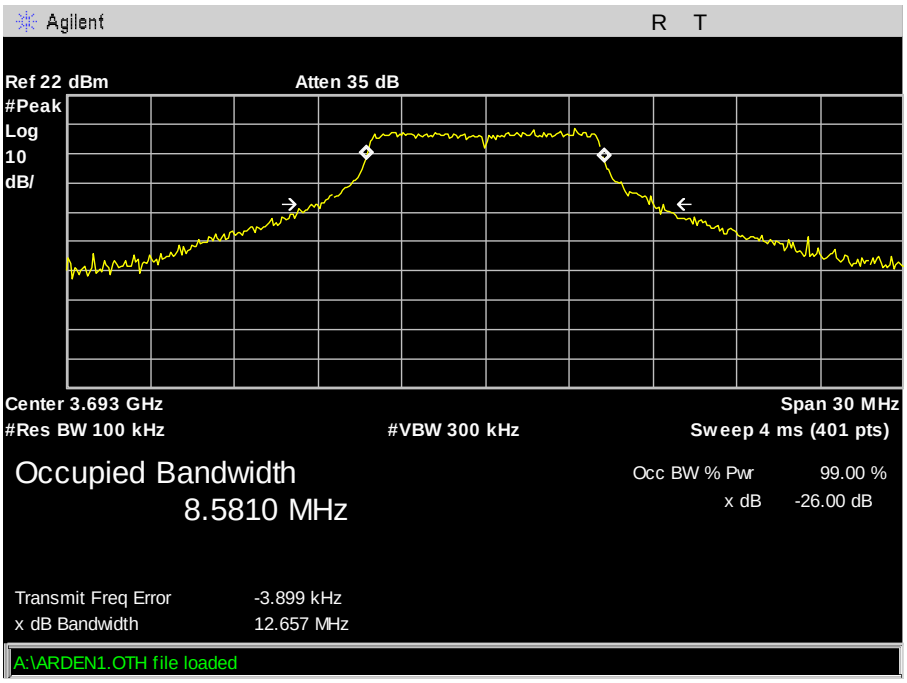
Plot 56. Occupied Bandwidth - Low - 3655.9MHz - BW10MHz - Chain1



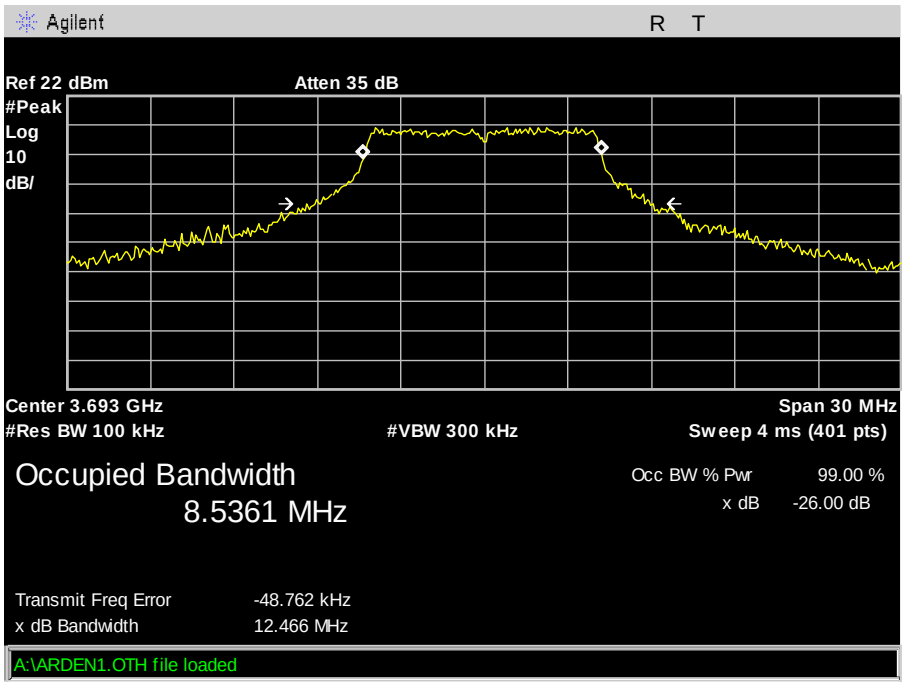
Plot 57. Occupied Bandwidth - Mid - 3673.4MHz - BW10MHz - Chain0



Plot 58. Occupied Bandwidth - Mid - 3673.4MHz - BW10MHz - Chain1

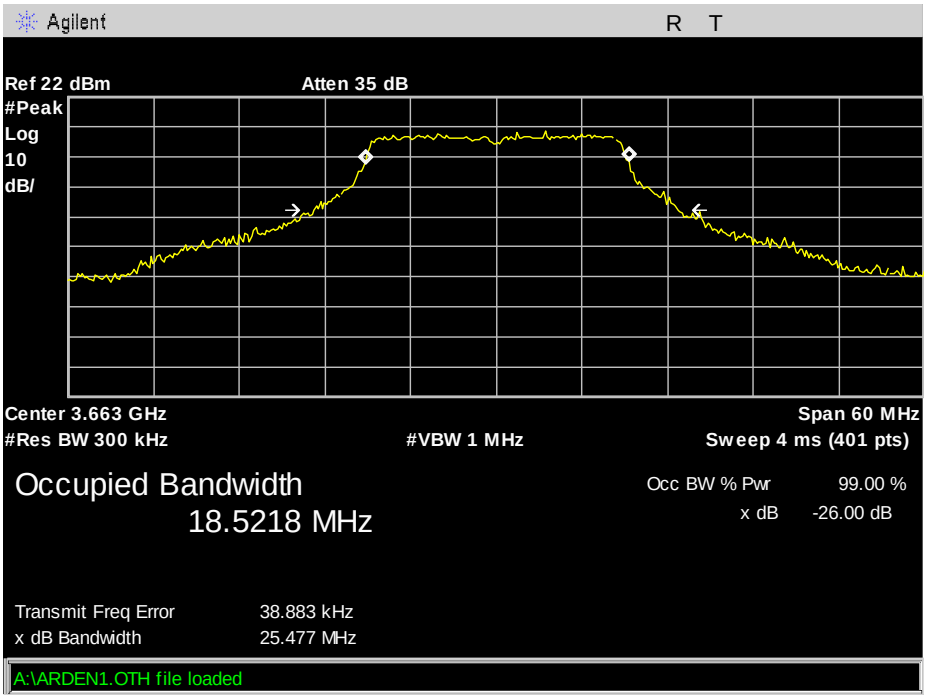


Plot 59. Occupied Bandwidth - High - 3693.4MHz - BW10MHz - Chain0

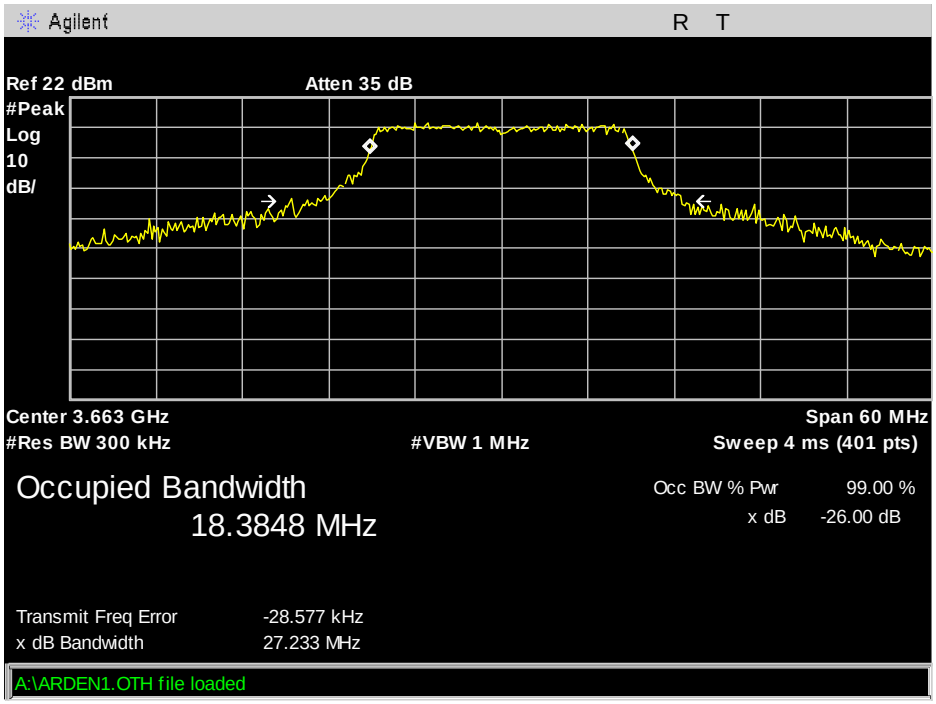


Plot 60. Occupied Bandwidth - High - 3693.4MHz - BW10MHz - Chain1

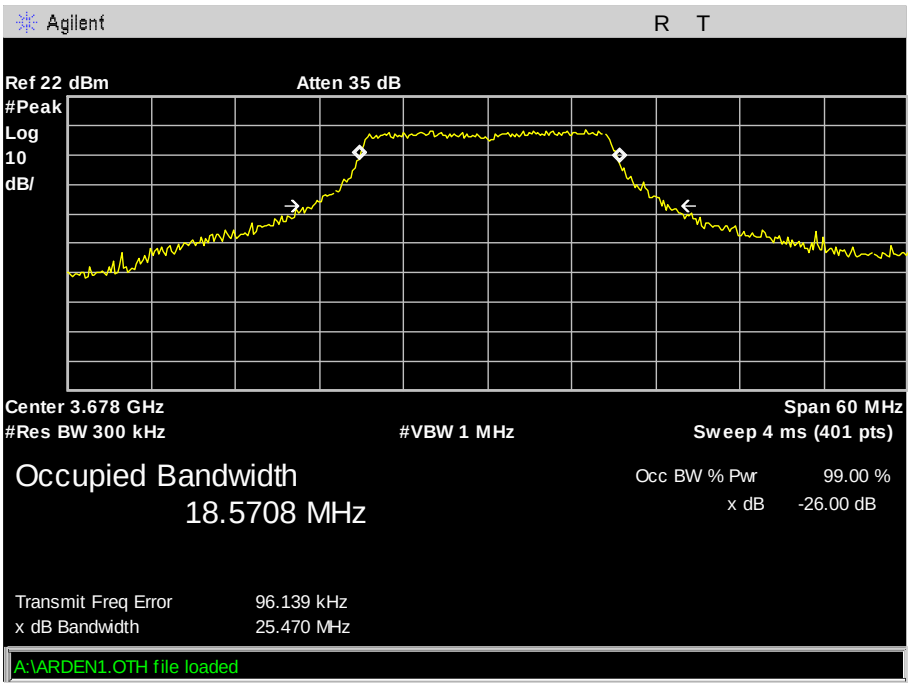
Occupied Bandwidth (20MHz Bandwidth) 4dBi



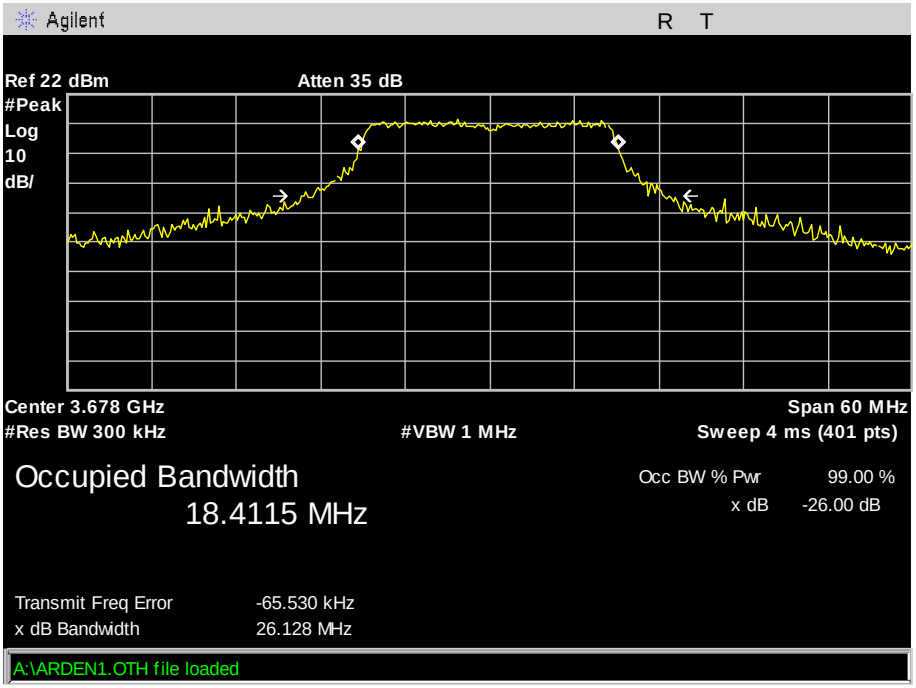
Plot 61. Occupied Bandwidth - Low - 3663.4MHz - BW20MHz - Chain0



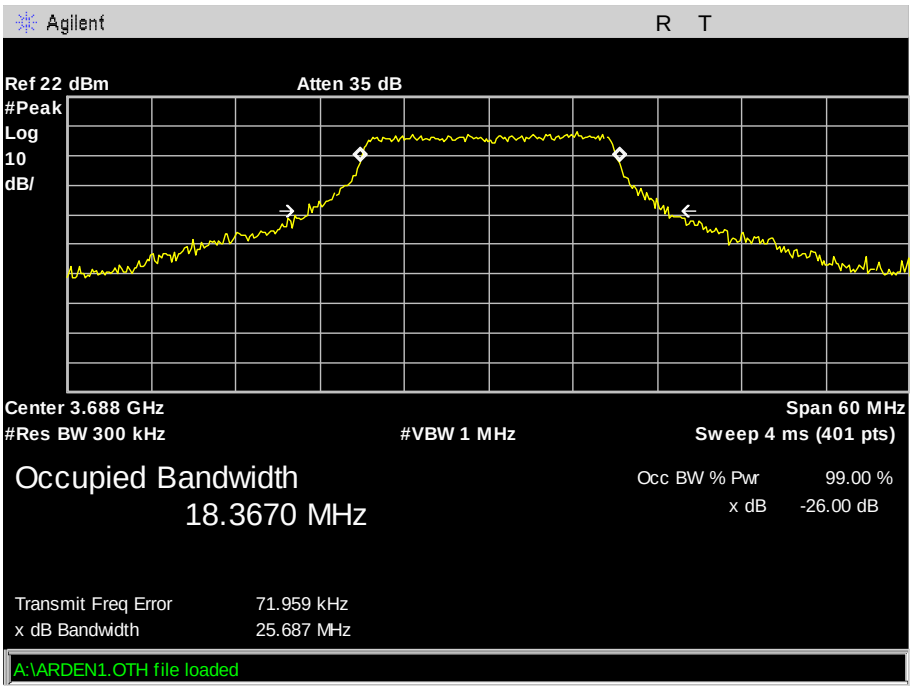
Plot 62. Occupied Bandwidth - Low - 3663.4MHz - BW20MHz - Chain1



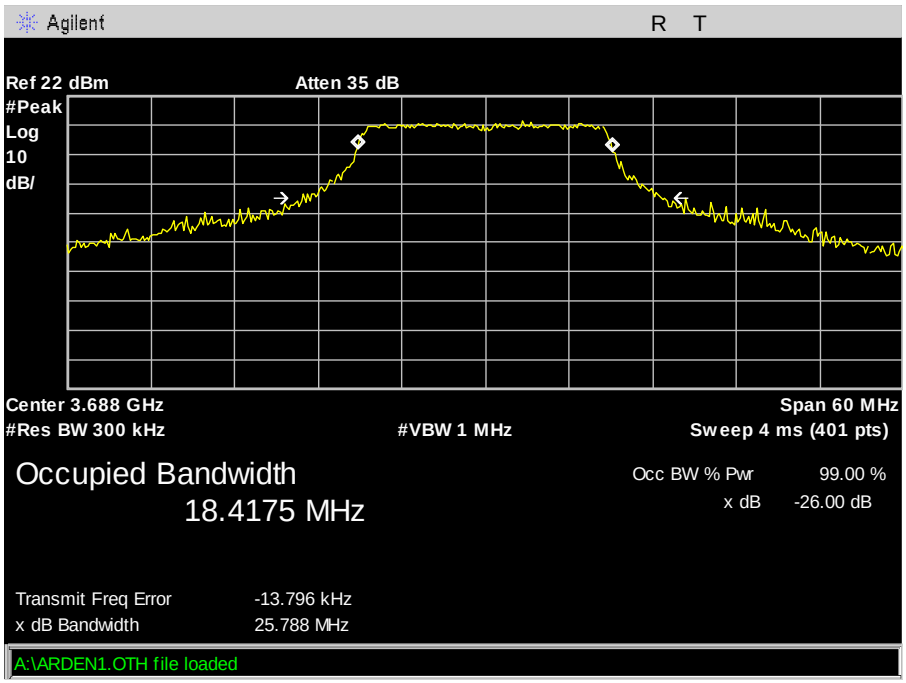
Plot 63. Occupied Bandwidth - Mid - 3678.4MHz - BW20MHz - Chain0



Plot 64. Occupied Bandwidth - Mid - 3678.4MHz - BW20MHz - Chain1

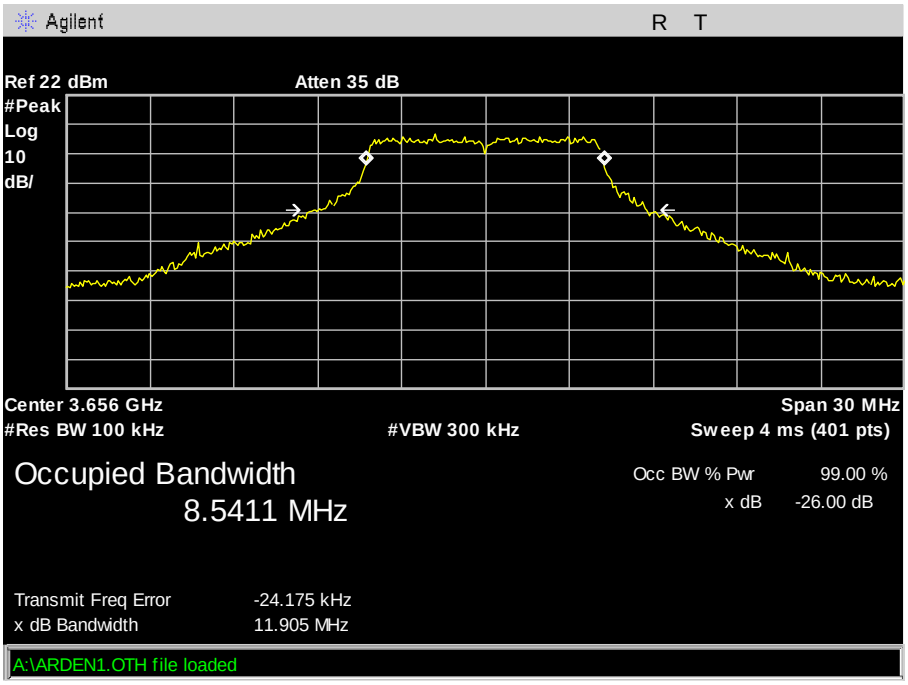


Plot 65. Occupied Bandwidth - High - 3688.4MHz - BW20MHz - Chain0

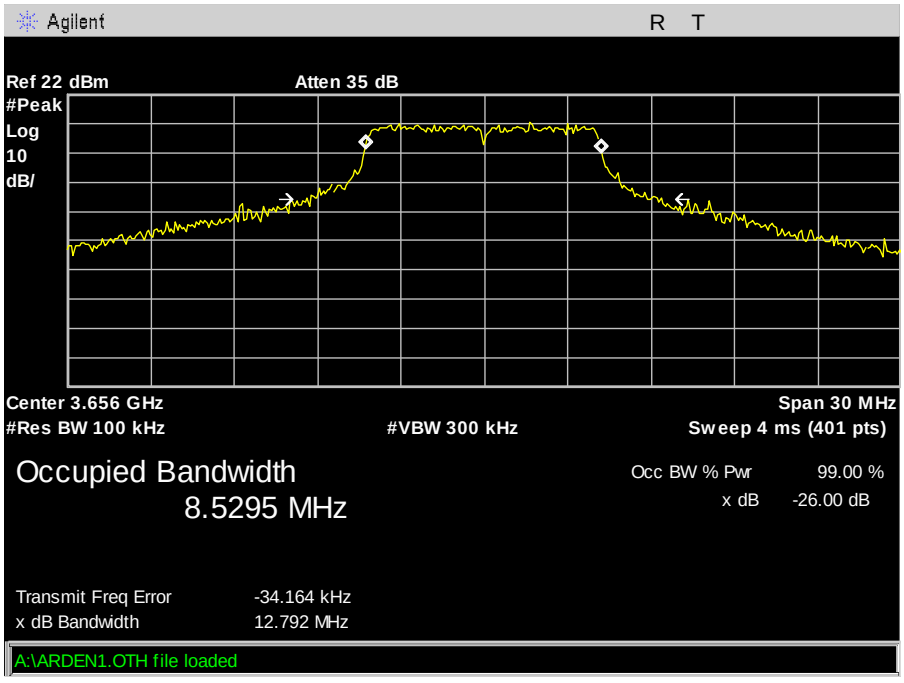


Plot 66. Occupied Bandwidth - High - 3688.4MHz - BW20MHz - Chain1

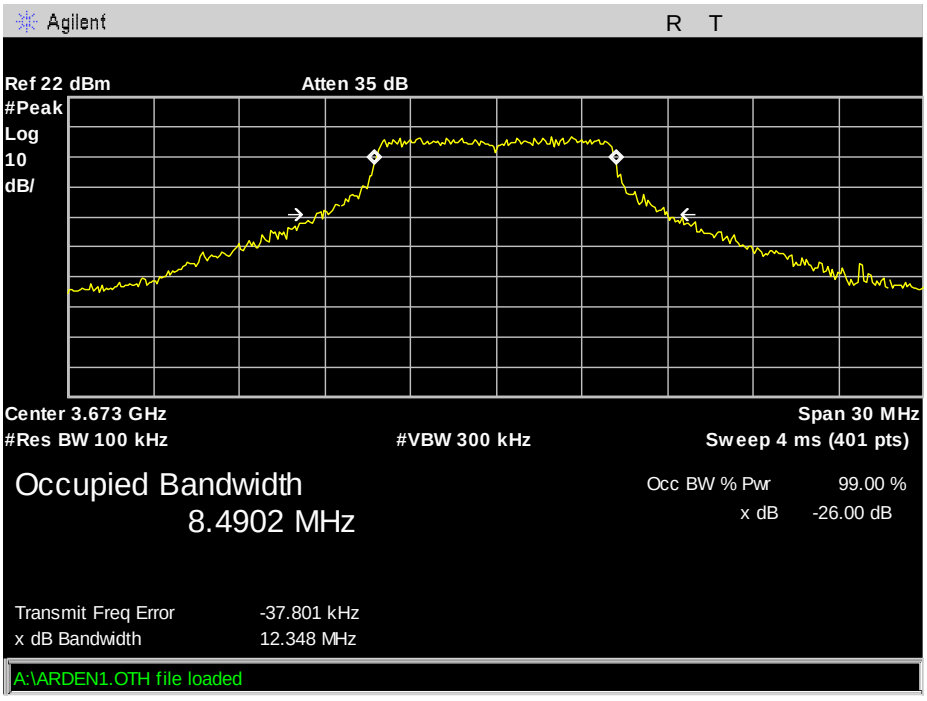
Occupied Bandwidth (10MHz Bandwidth) 4dBi



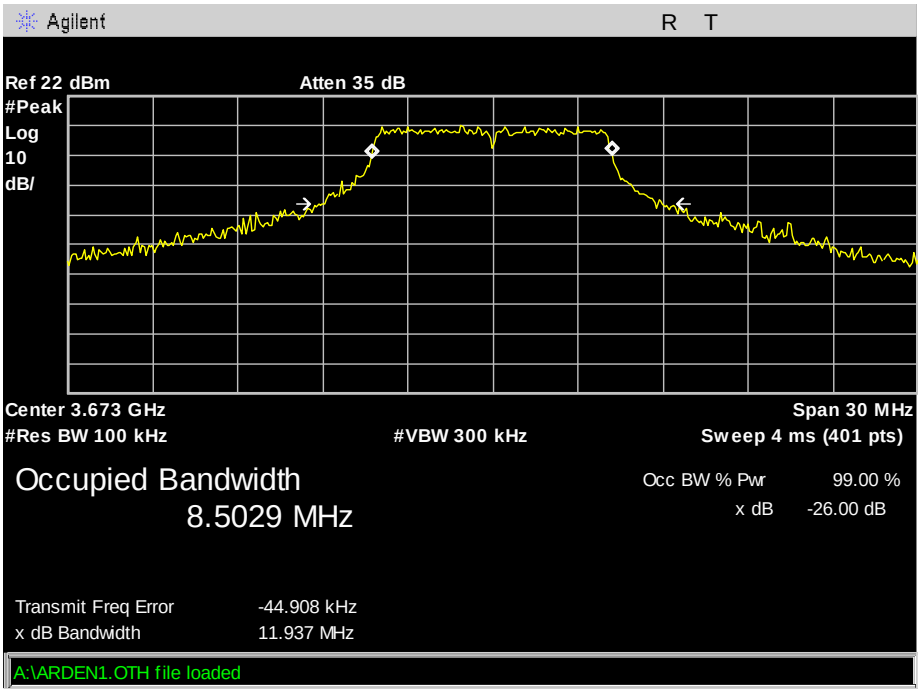
Plot 67. Occupied Bandwidth - Low - 3655.9MHz - BW10MHz - Chain0



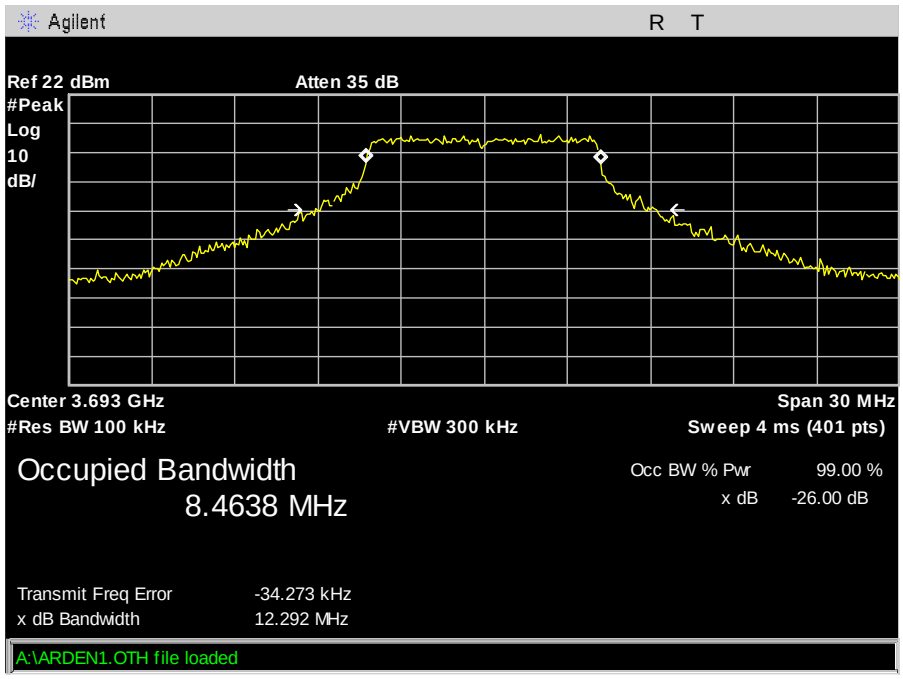
Plot 68. Occupied Bandwidth - Low - 3655.9MHz - BW10MHz - Chain1



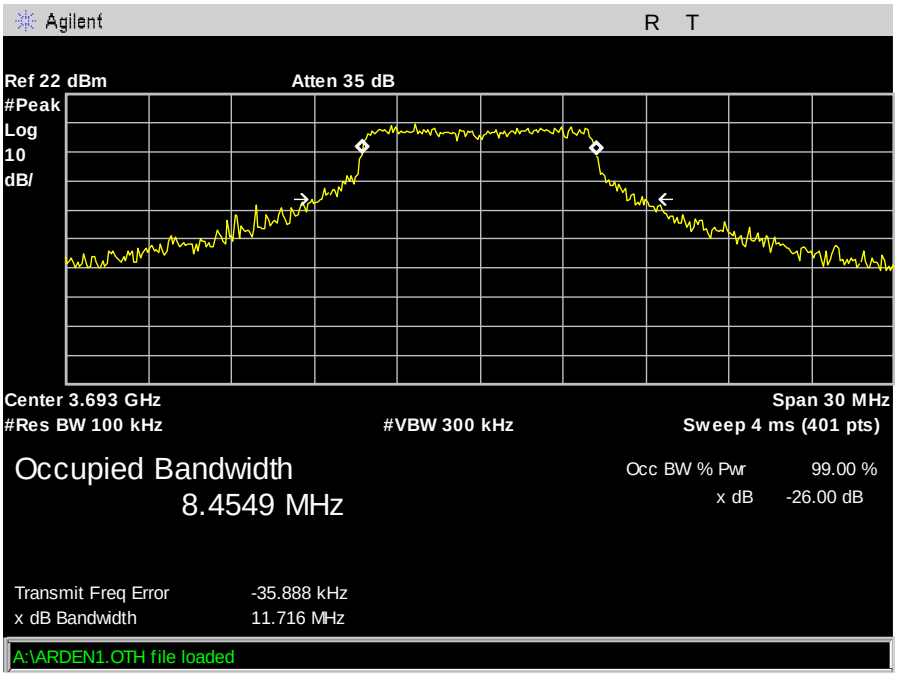
Plot 69. Occupied Bandwidth - Mid - 3673.4MHz - BW10MHz - Chain0



Plot 70. Occupied Bandwidth - Mid - 3673.4MHz - BW10MHz - Chain1



Plot 71. Occupied Bandwidth - High - 3693.4MHz - BW10MHz - Chain0



Plot 72. Occupied Bandwidth - High - 3693.4MHz - BW10MHz - Chain1

5. Electromagnetic Compatibility Spurious Emissions at Antenna Terminal Requirements

5.1. Spurious Emissions at Antenna Terminals

Test Requirement(s): **§2.1051, §90.1323(a), §90.210**

Test Procedures: A laptop was connected to EUT to control the RF power output and frequency channel. The EUT was connected to a Spectrum Analyzer through a broad band attenuator. The Spectrum Analyzer was set to a RBW = 1 MHz and a VBW > 1MHz. Measurements were made at the low, mid and high channels.

Emissions mask B was used.

Limits: The power of any emission outside the licensee's frequency band of operation shall be attenuated below the transmitters power (P) by at least 43 + 10log (P) dB.

Test Results: Equipment complies with Section 2.1051 and 90.1323(a).

Test Engineer(s): Arsalan Hasan

Test Date(s): 06/30/2016

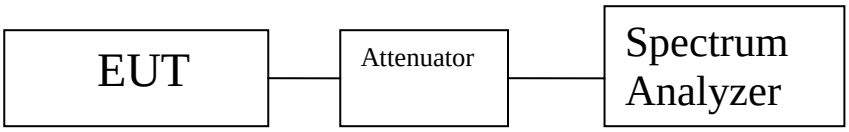
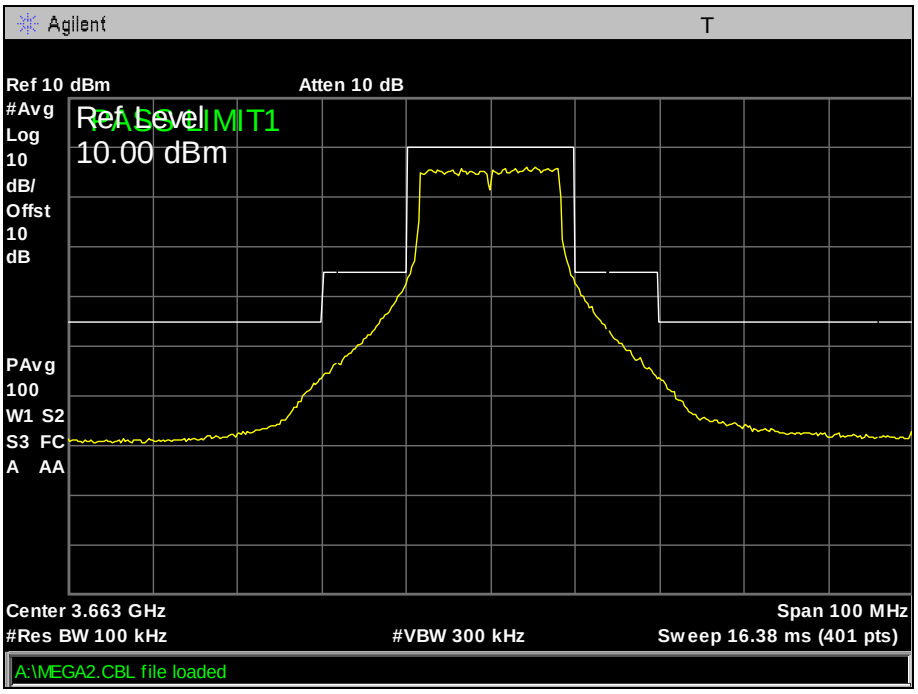
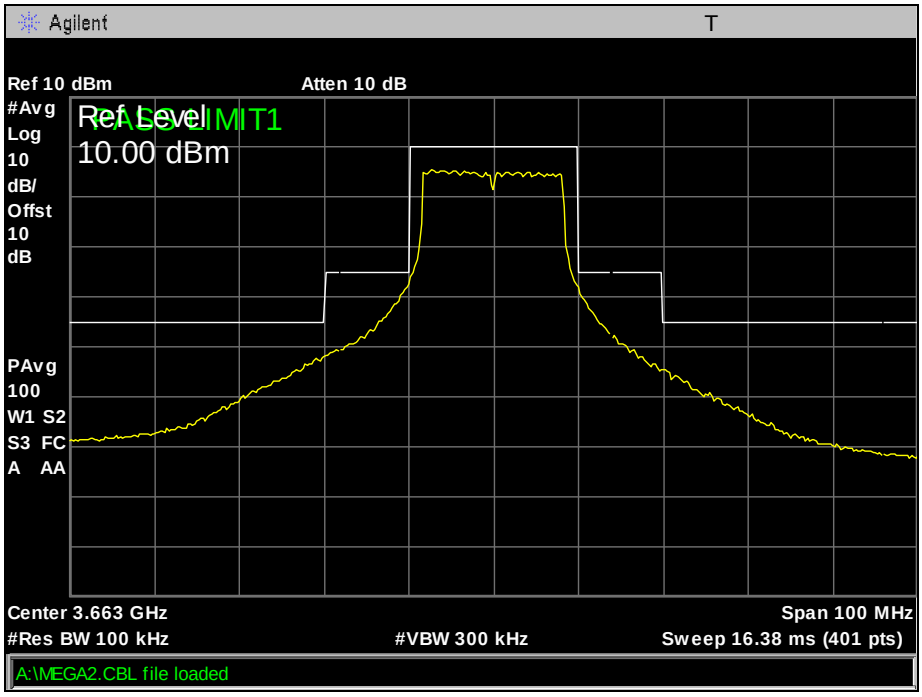


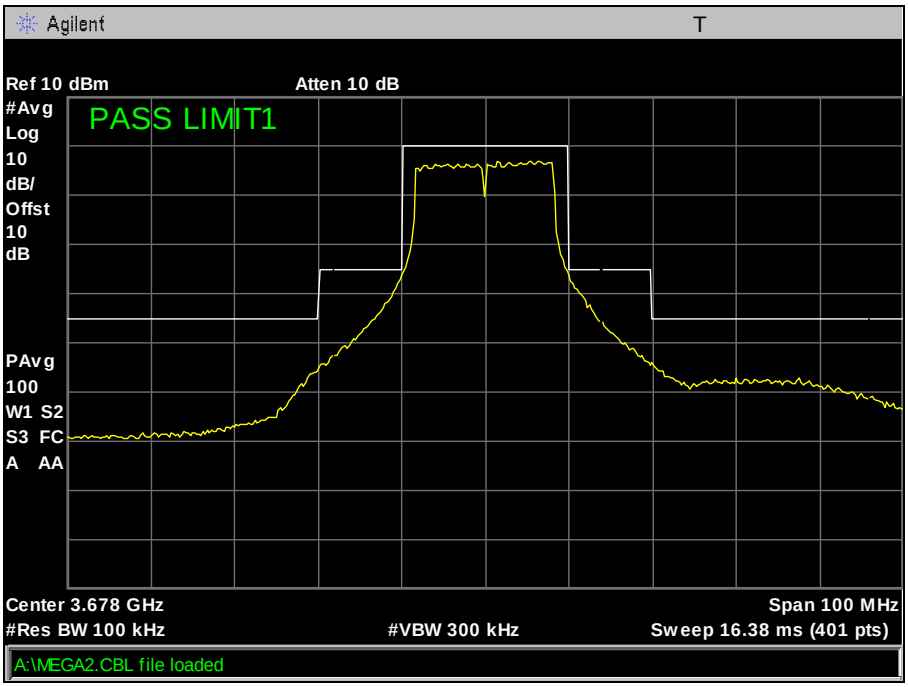
Figure 3. Spurious Emissions at Antenna Terminals Test Setup



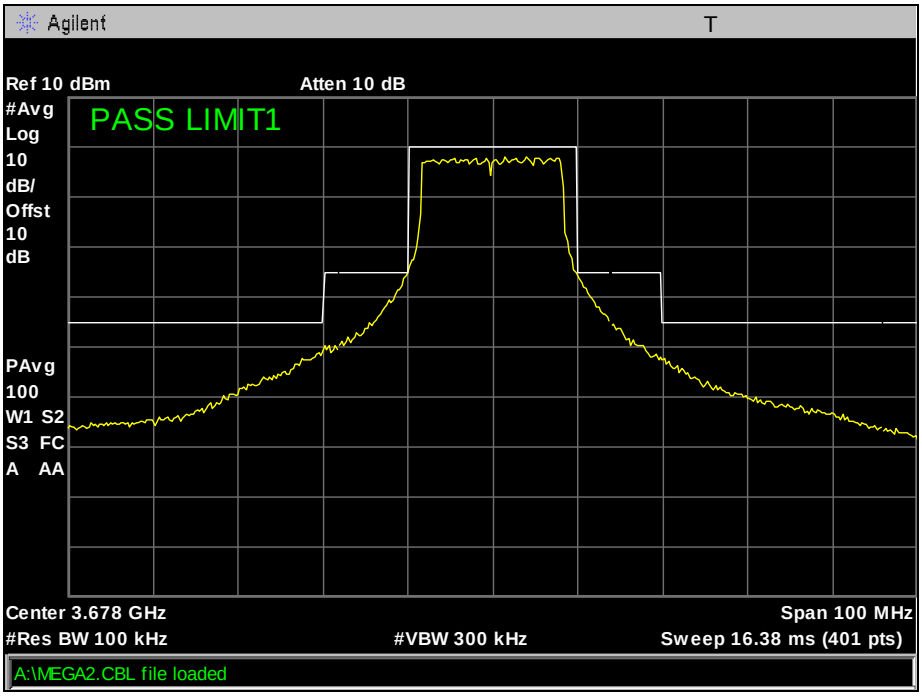
Plot 73. Emission Mask - Low - 3663.4MHz - BW20MHz - Chain0



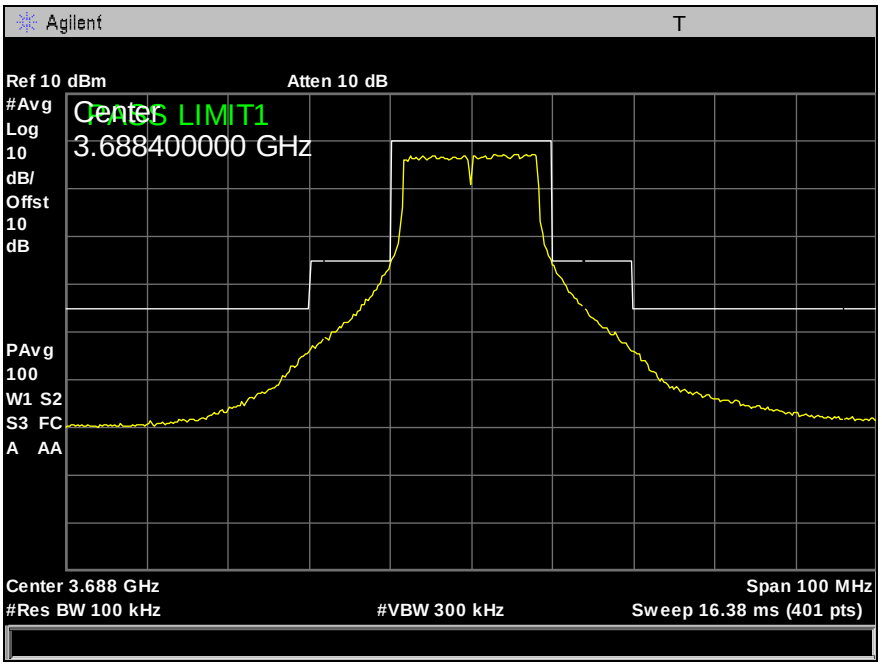
Plot 74. Emission Mask - Low - 3663.4MHz - BW20MHz - Chain1



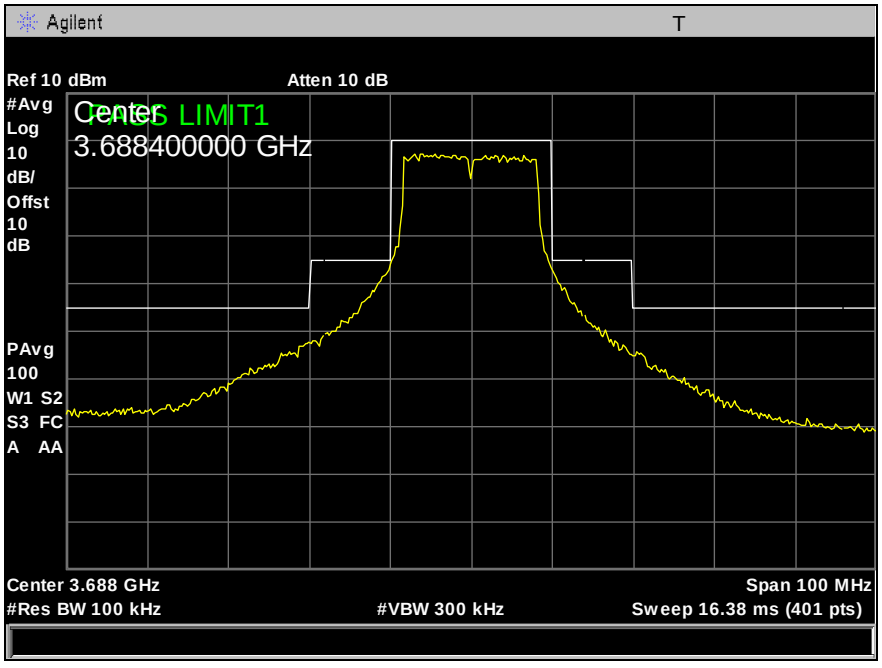
Plot 75. Emission Mask - Mid - 3678.4MHz - BW20MHz - Chain0



Plot 76. Emission Mask - Mid - 3678.4MHz - BW20MHz - Chain1

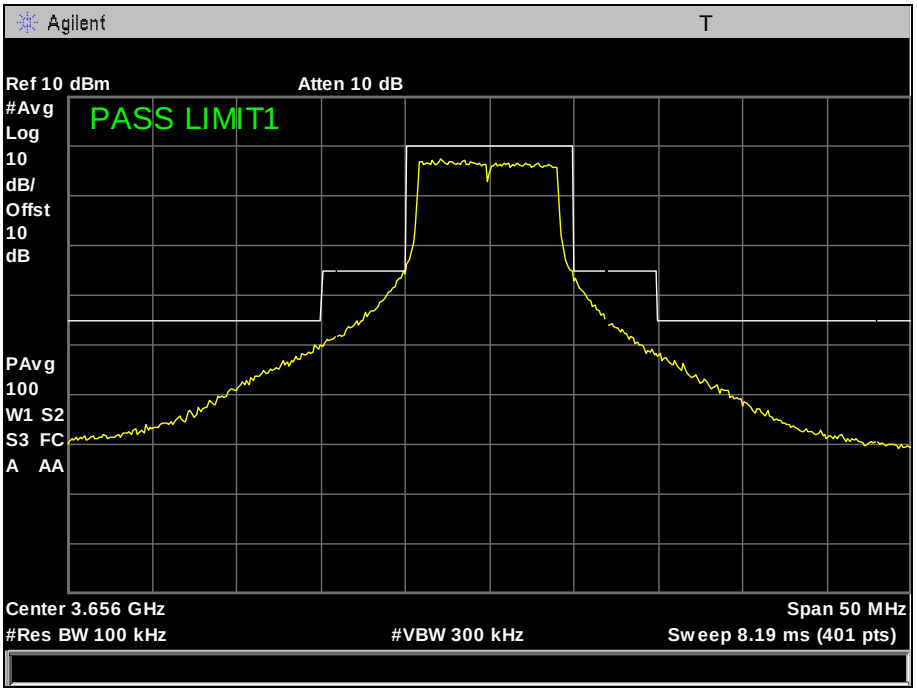


Plot 77. Emission Mask - High - 3688.4MHz - BW20MHz - Chain0

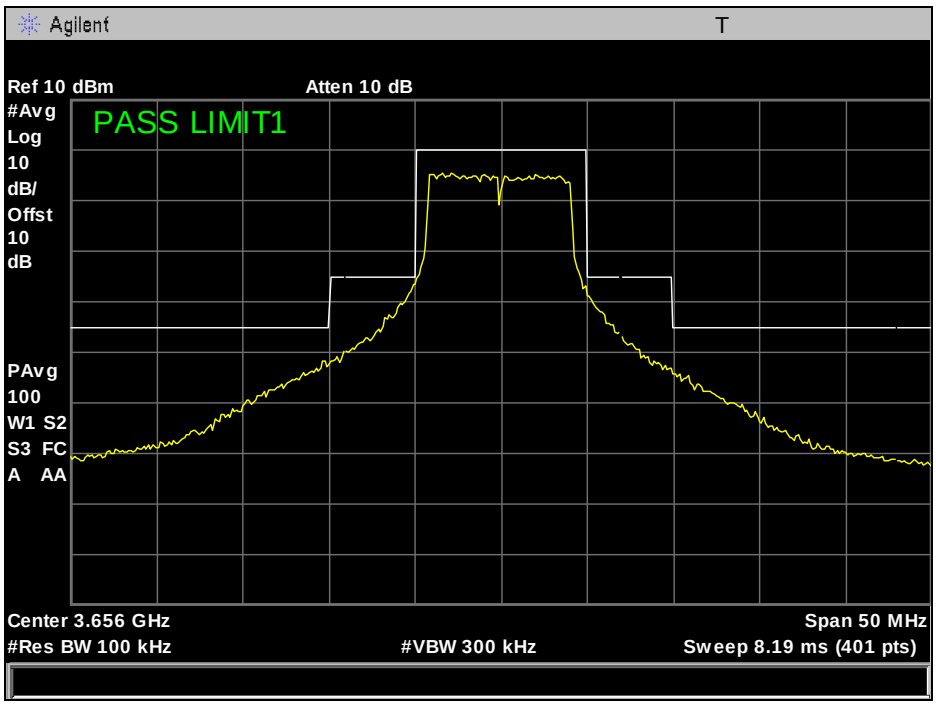


Plot 78. Emission Mask - High - 3688.4MHz - BW20MHz - Chain1

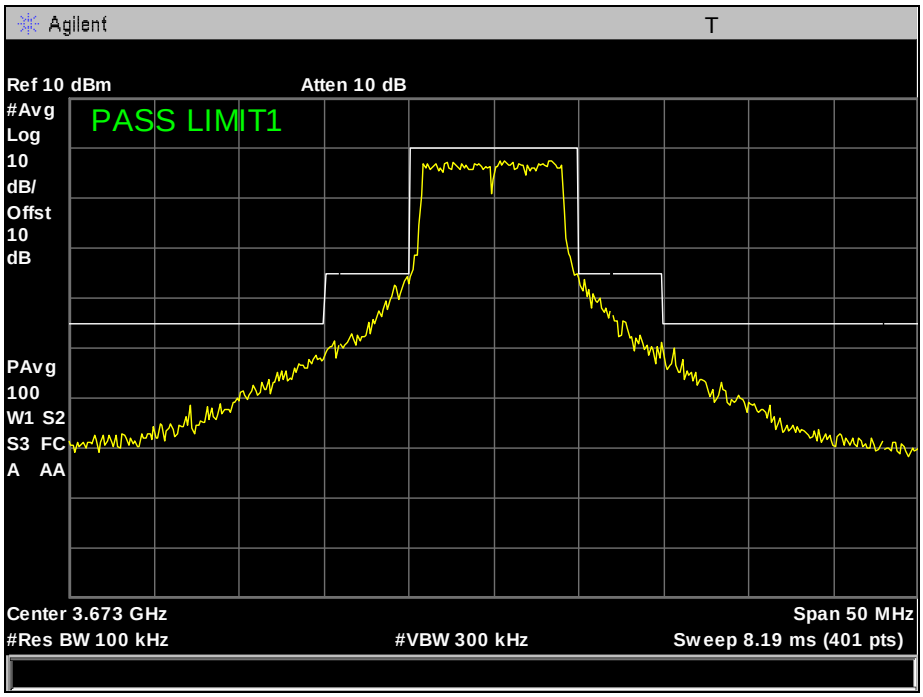
Emissions Mask (10MHz Bandwidth)



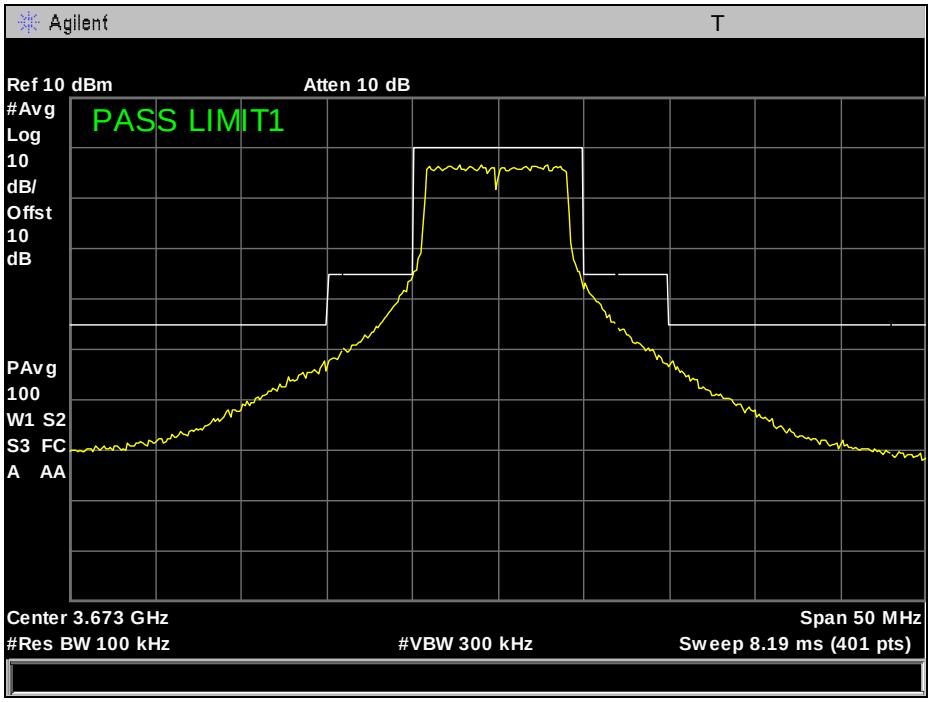
Plot 79. Emission Mask - Low - 3655.9MHz - BW10MHz - Chain0



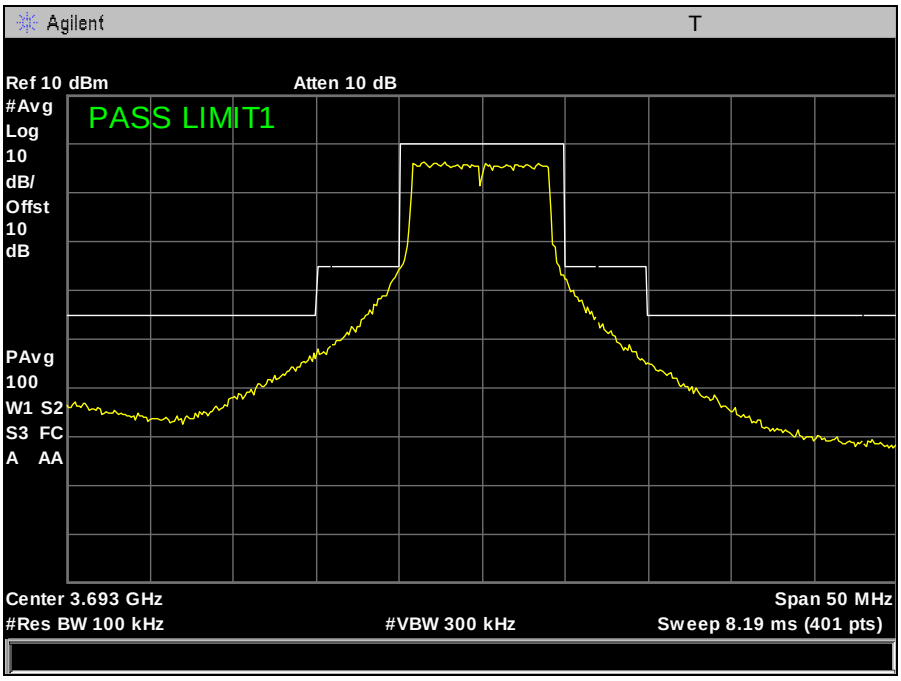
Plot 80. Emission Mask - Low - 3655.9MHz - BW10MHz - Chain1



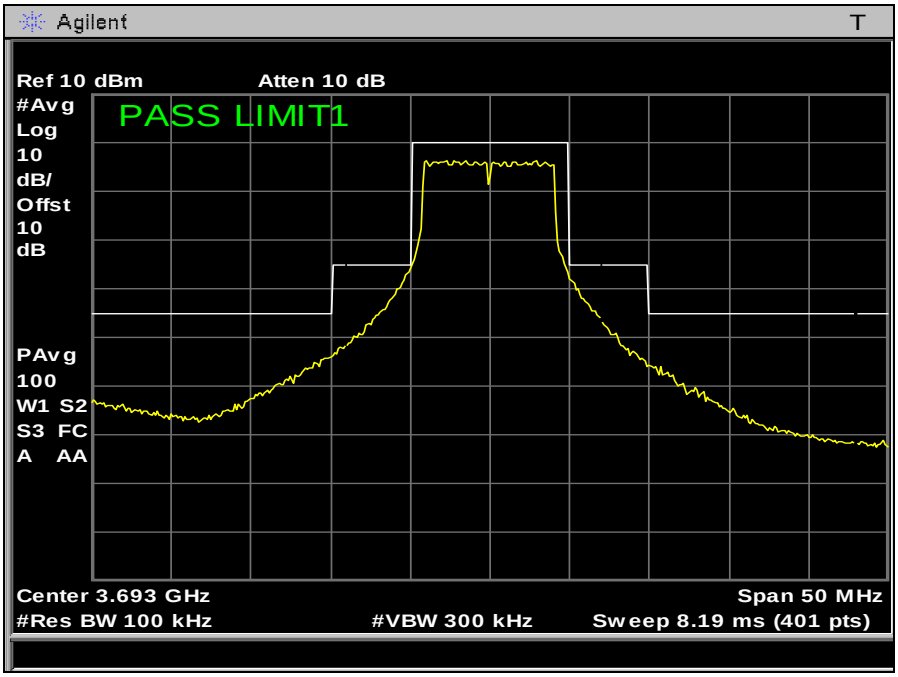
Plot 81. Emission Mask - Mid - 3673.4MHz - BW10MHz - Chain0



Plot 82. Emission Mask - Mid - 3673.4MHz - BW10MHz - Chain1

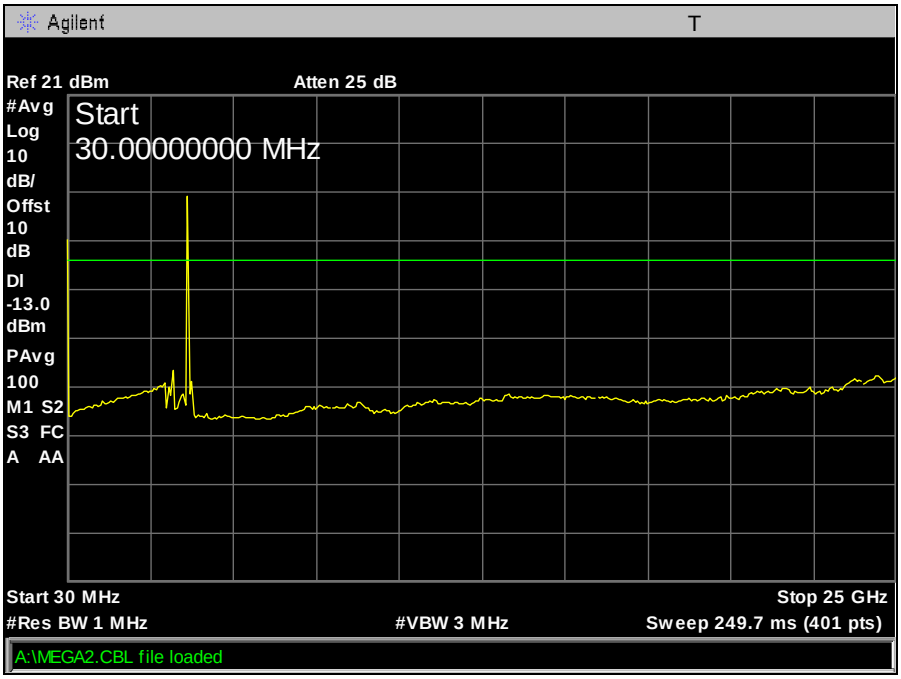


Plot 83. Emission Mask - High - 3693.4MHz - BW10MHz - Chain0

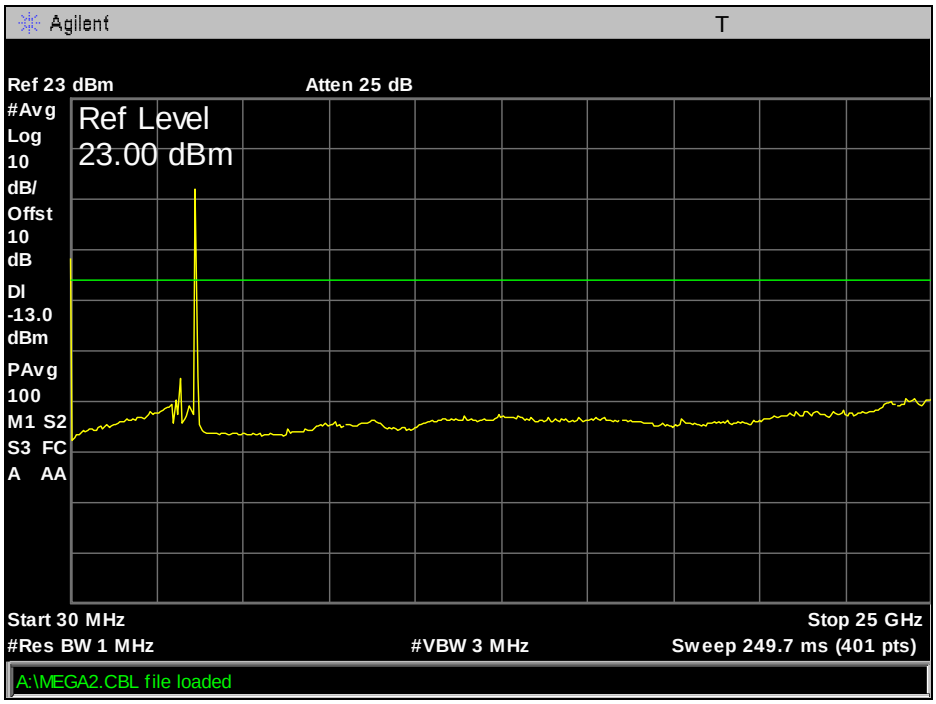


Plot 84. Emission Mask - High - 3693.4MHz - BW10MHz - Chain1

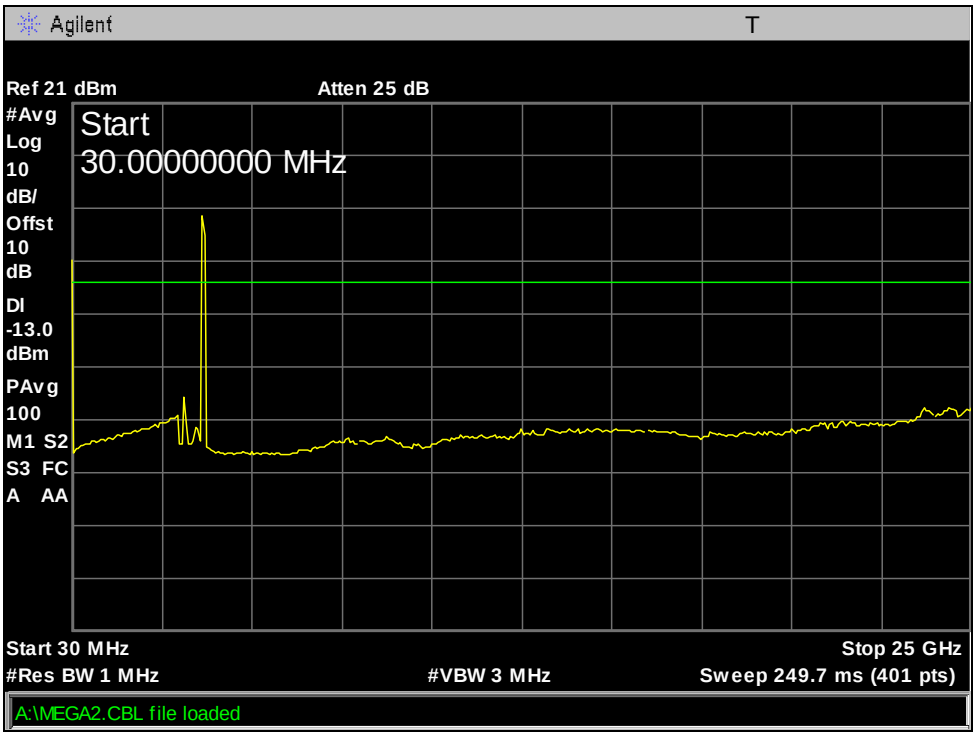
Conducted Spurious Emissions (20MHz Bandwidth)



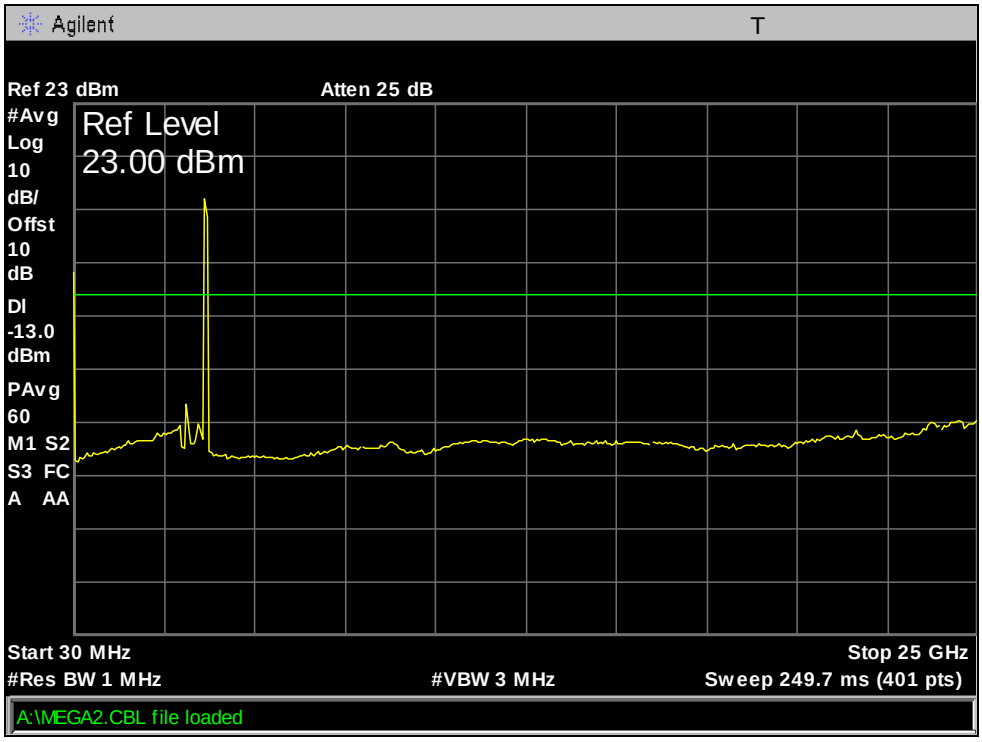
Plot 85.. Conducted Spurious Emissions - Low - 3663.4MHz - BW20MHz - Chain0



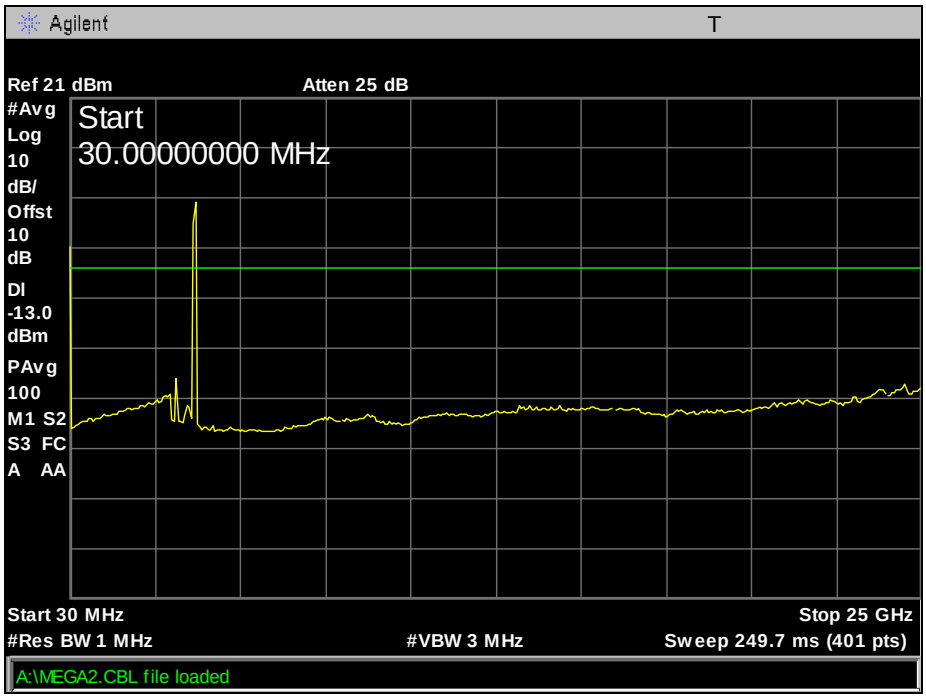
Plot 86. Conducted Spurious Emissions - Low - 3663.4MHz - BW20MHz - Chain1



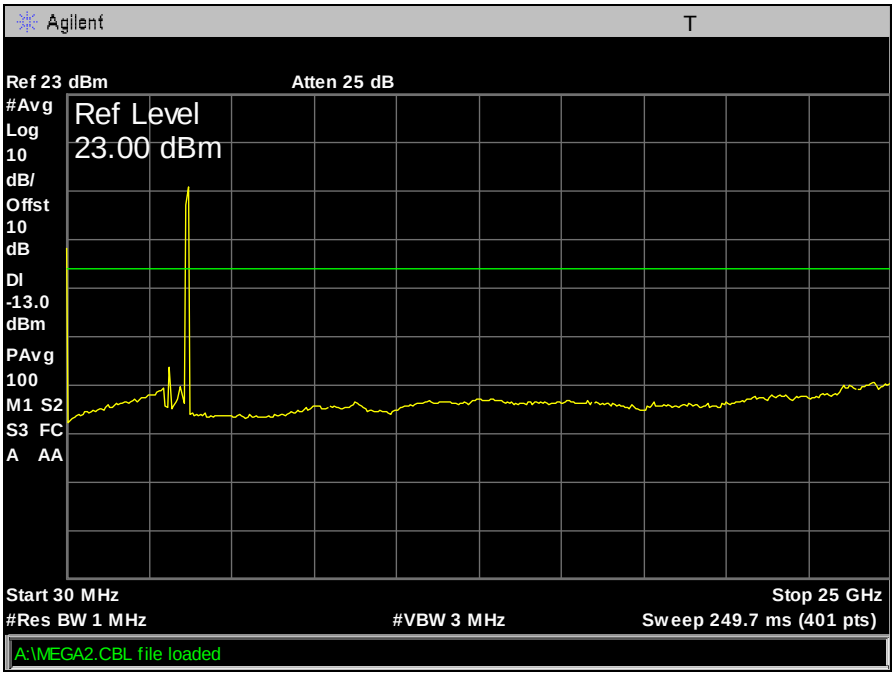
Plot 87. Conducted Spurious Emissions - Mid - 3678.4MHz - BW20MHz - Chain0



Plot 88. Conducted Spurious Emissions - Mid - 3678.4MHz - BW20MHz - Chain1

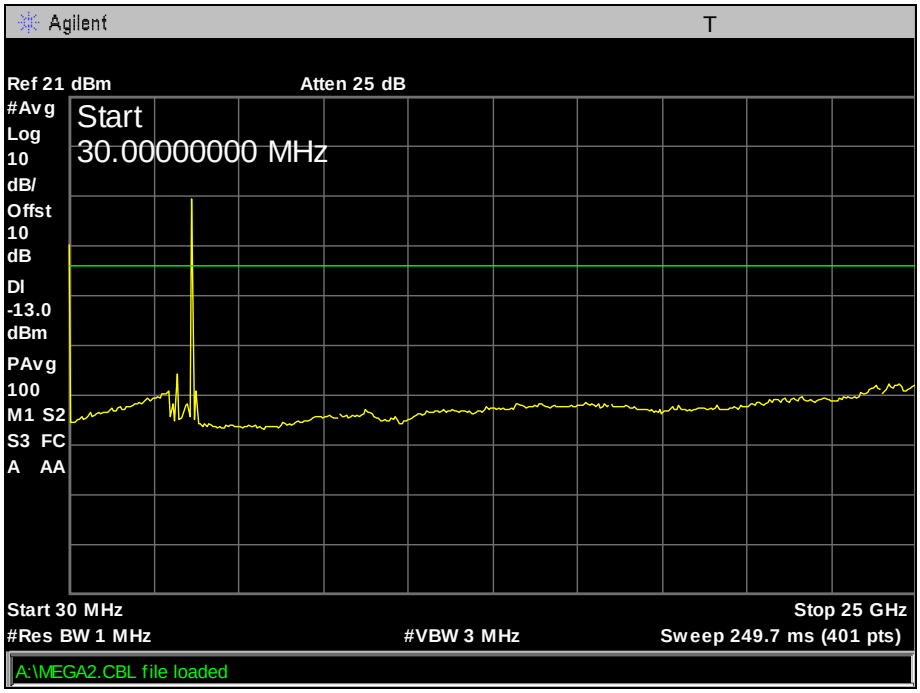


Plot 89. Conducted Spurious Emissions - High - 3688.4MHz - BW20MHz - Chain0

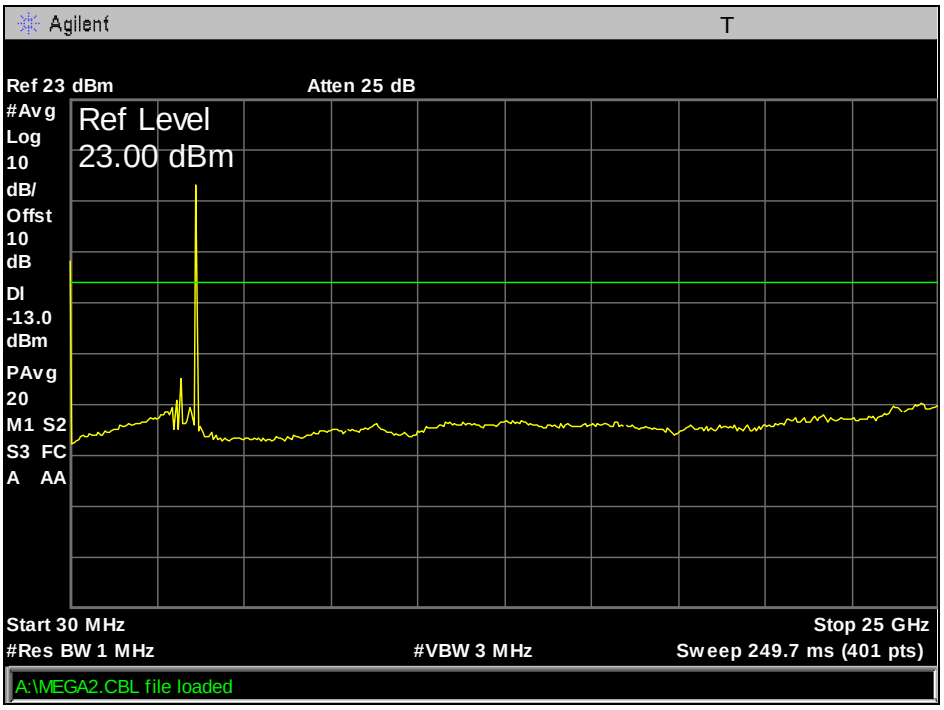


Plot 90. Conducted Spurious Emissions - High - 3688.4MHz - BW20MHz - Chain1

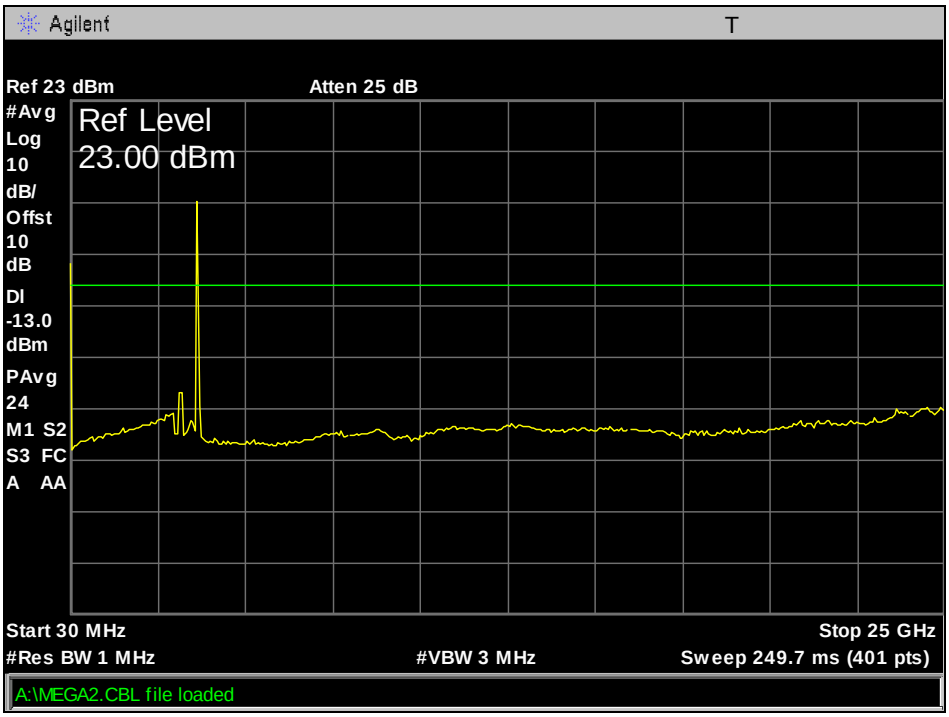
Conducted Spurious Emissions (10MHz Bandwidth)



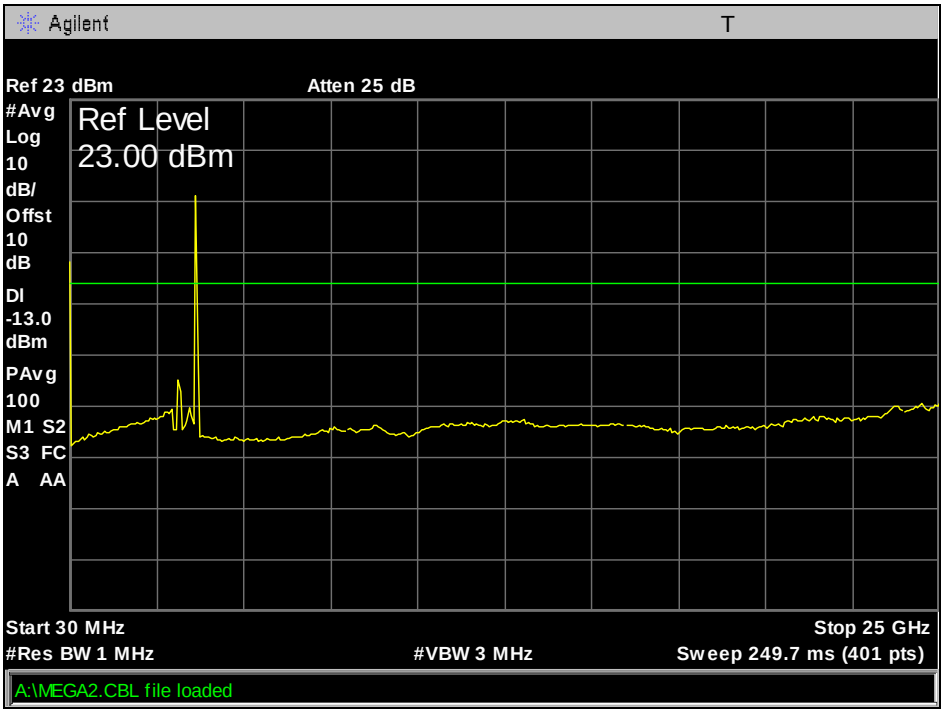
Plot 91. Conducted Spurious Emissions - Low - 3655.9MHz - BW10MHz - Chain0



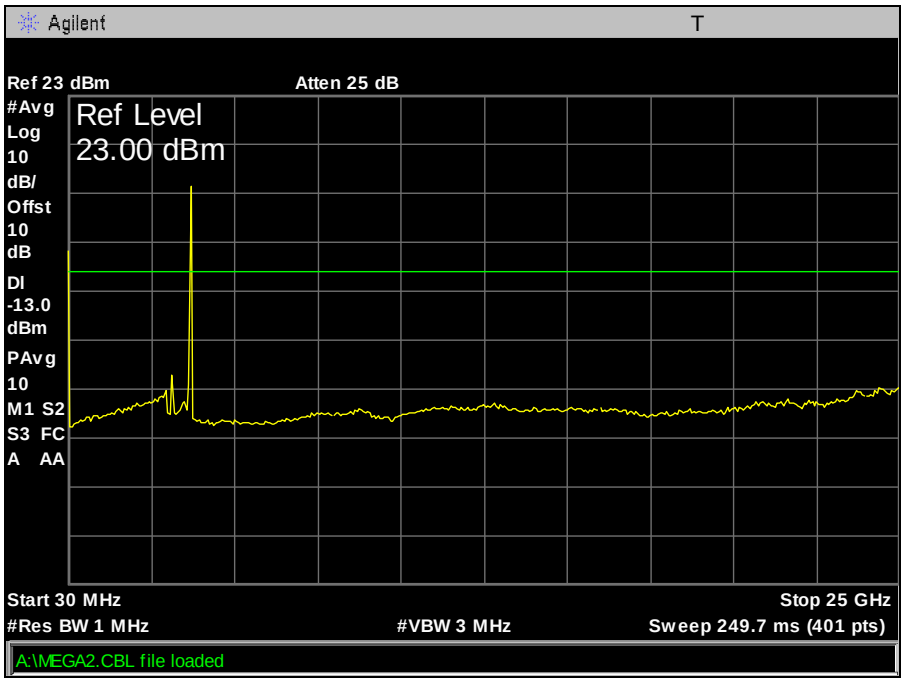
Plot 92. Conducted Spurious Emissions - Low - 3655.9MHz - BW10MHz - Chain1



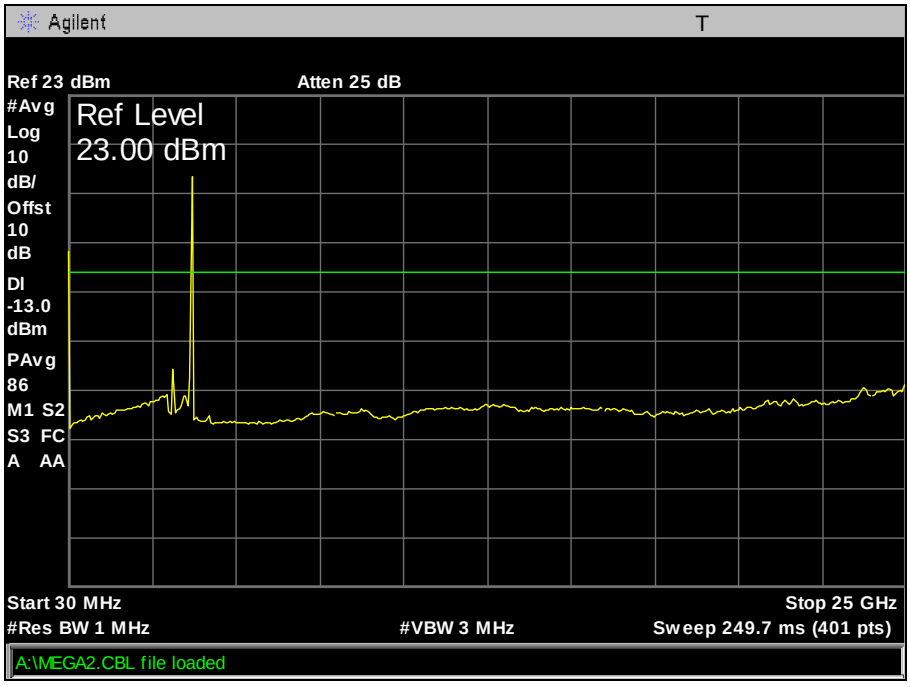
Plot 93. Conducted Spurious Emissions - Mid - 3673.4MHz - BW10MHz - Chain0



Plot 94. Conducted Spurious Emissions - Mid - 3673.4MHz - BW10MHz - Chain1



Plot 95. Conducted Spurious Emissions - High - 3693.4MHz - BW10MHz - Chain0



Plot 96. Conducted Spurious Emissions - High - 3693.4MHz - BW10MHz - Chain1

5.2. Radiated Emissions (Substitution Method)

Test Requirement(s): **§2.1053 and ANSI/TIA-603-D:2010**

Test Procedures: As required by 47 CFR 2.1053, *field strength of radiated spurious measurements* were made in accordance with the procedures of **ANSI/TIA-603-D:2010** "Land Mobile FM or PM Communications Equipment Measurement and Performance Standards".

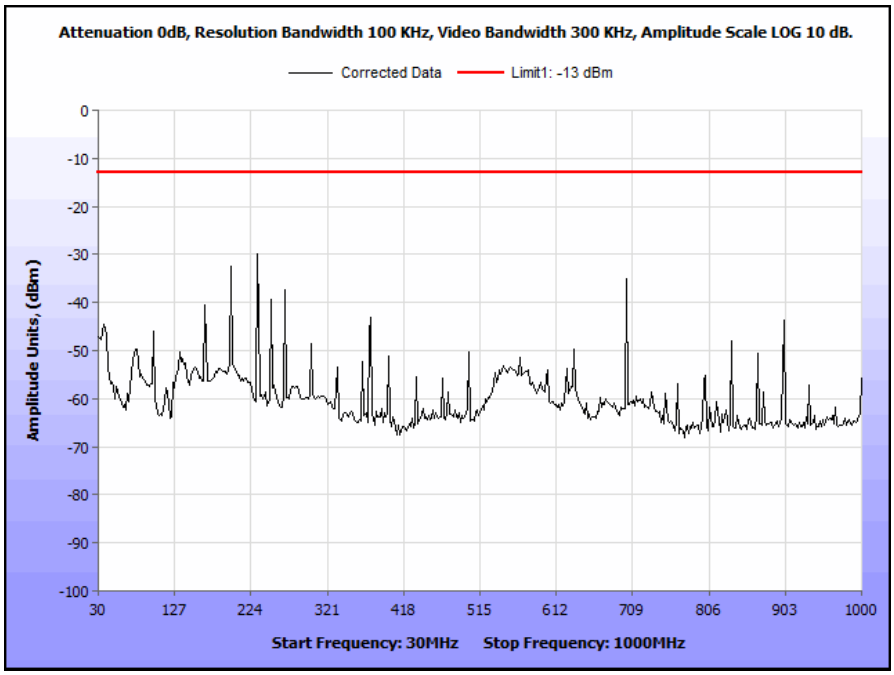
Radiated emission measurements were performed inside a 3 meter semi-anechoic chamber. The EUT was set at a distance of 3m from the receiving antenna. The EUT's RF ports were terminated to 50ohm load. The EUT was set to transmit at the low, mid and high channels of the transmitter frequency range. There are two power settings and this radiated spurious test was performed with the higher power setting. The EUT was rotated about 360^0 and the receiving antenna scanned from 1-4m in order to capture the maximum emission. For harmonic frequencies falling in restricted bands the corrected field strength was performed using antenna factor and cable loss method. For all other notable spurious emissions a calibrated antenna source was positioned in place of the EUT and the previously recorded signal was duplicated. The maximum EIRP of the emission was calculated by adding the forward power to the calibrated source plus its appropriate gain value. These steps were carried out with the receiving antenna in both vertical and horizontal polarization. Harmonic emissions up to the 10^{th} or 40GHz, which ever was the lesser, were investigated.

Test Results: Equipment complies with the radiated emissions requirement.

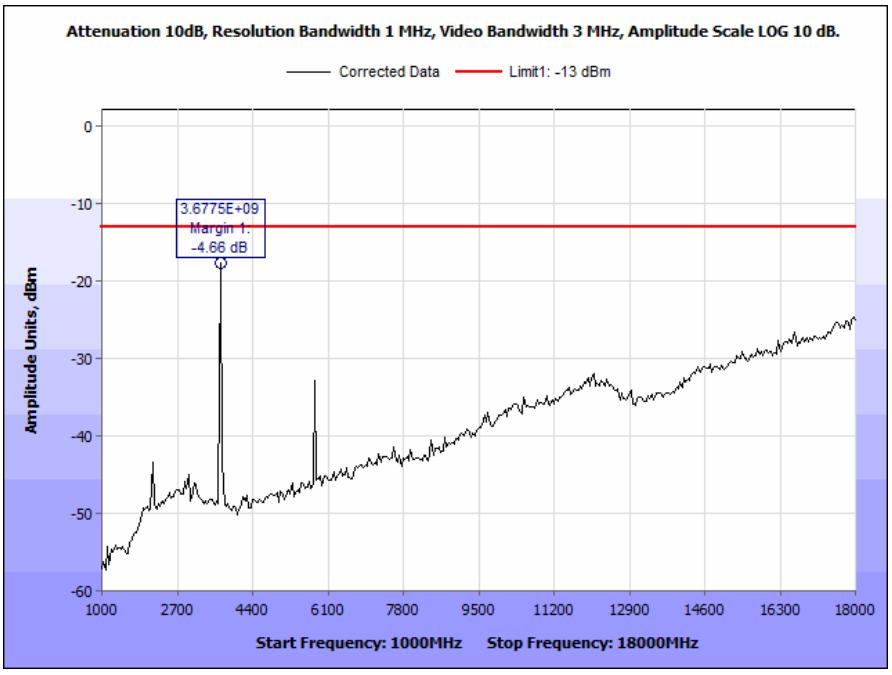
Test Engineer(s): Djed Mouada

Test Date(s): 07/01/2016

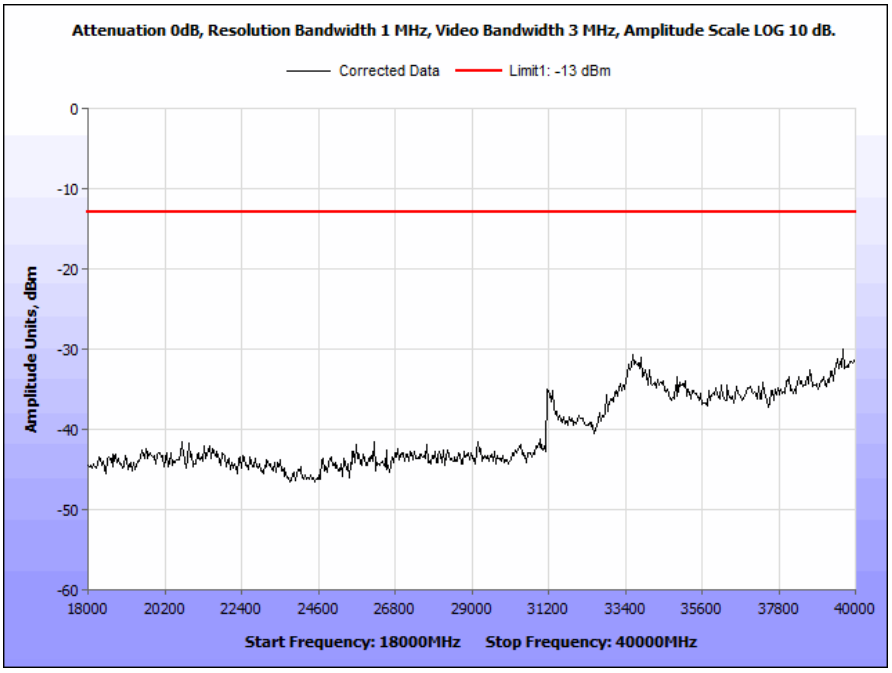
Low Channel (20MHz)



Plot 97. Radiated Emissions, 20MHz BW, Low Channel, 30MHz-1GHz

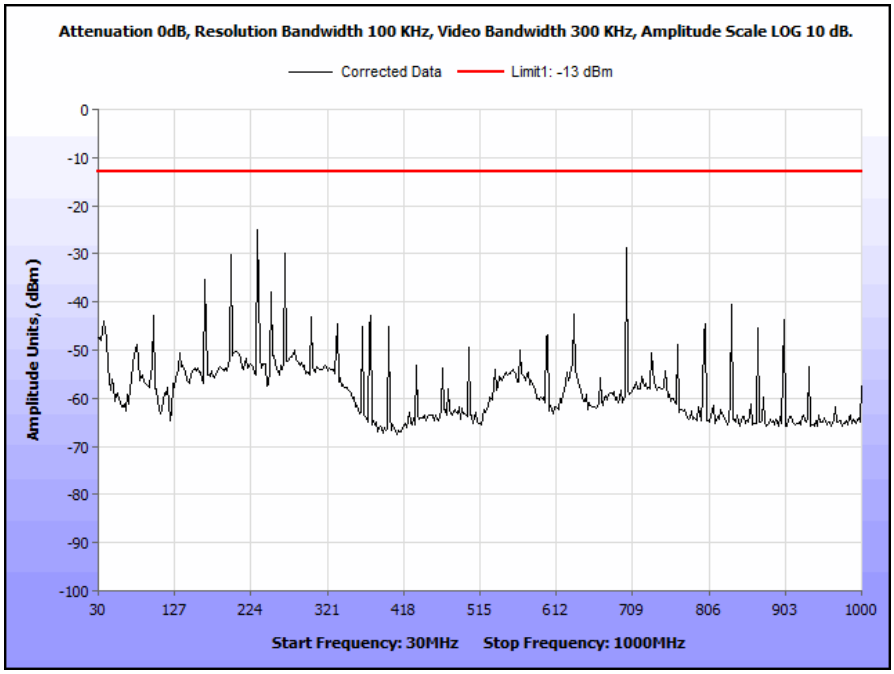


Plot 98. Radiated Emissions, 20MHz BW, Low Channel 1-18GHz

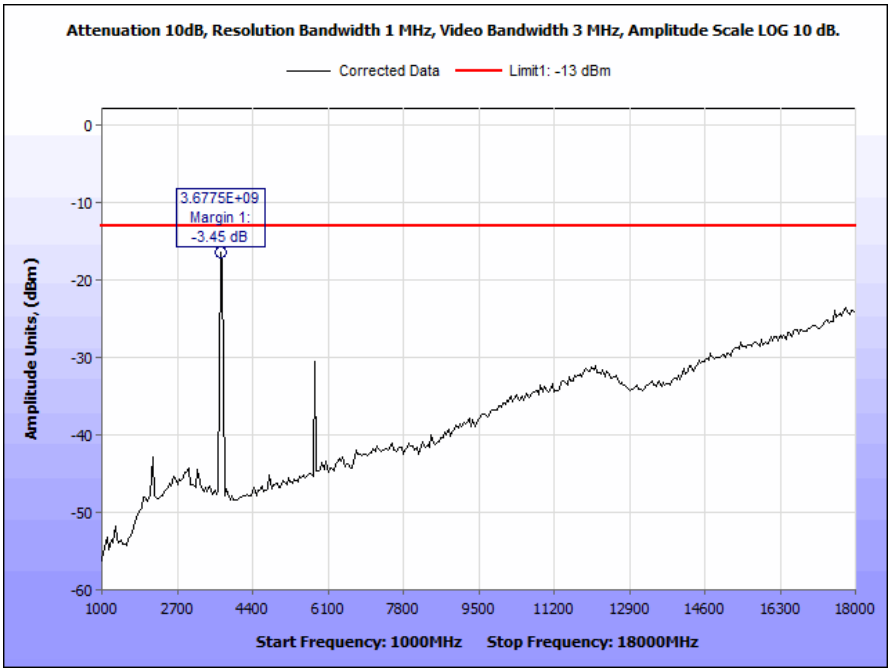


Plot 99. Spurious TX Emissions 20 MHz BW, Low Channel 18GHz - 40GHz

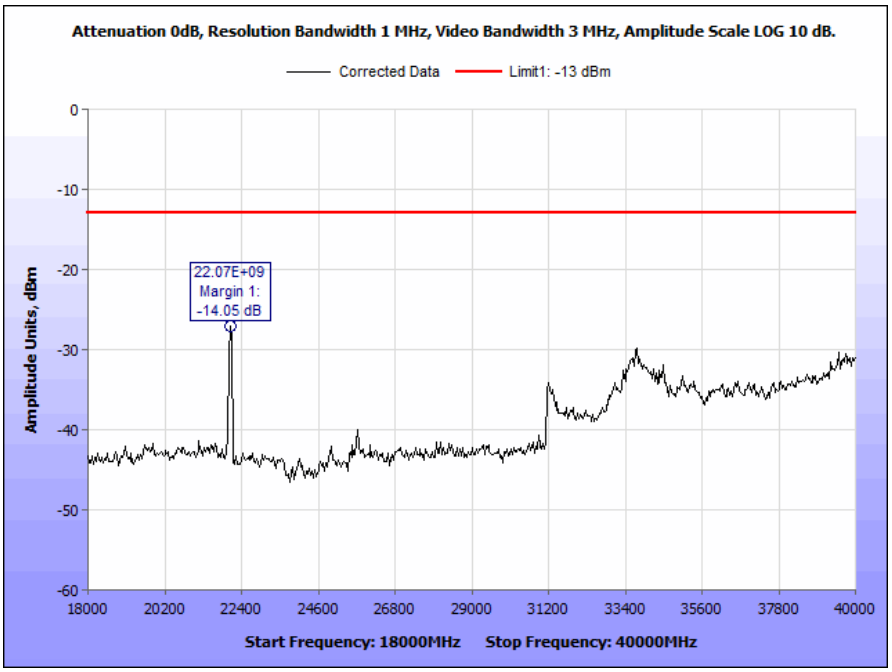
Mid Channel (20MHz)



Plot 100. Radiated Emissions, 20MHz BW, Mid Channel 30MHz-1GHz

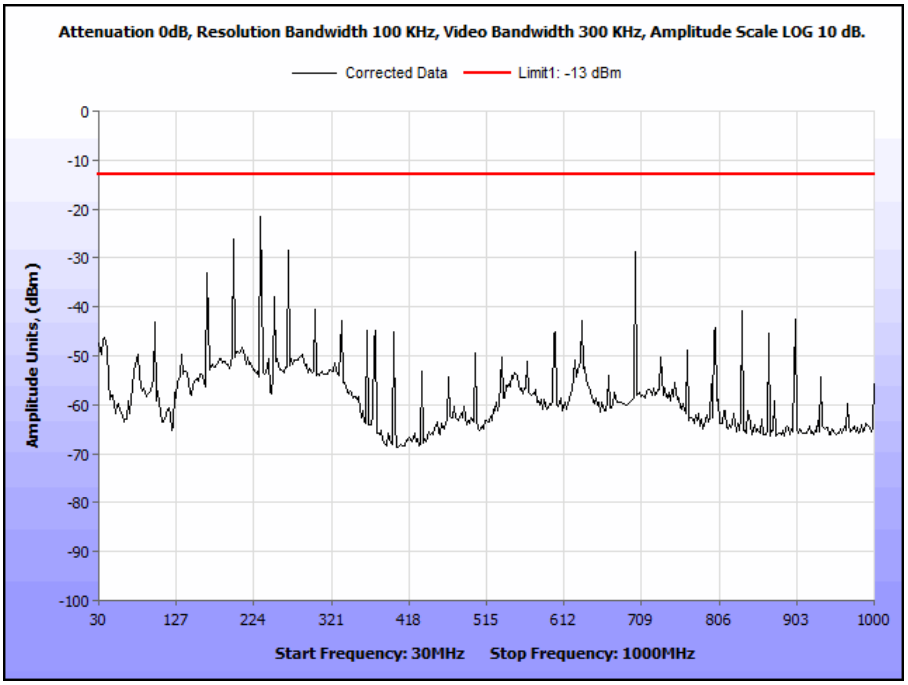


Plot 101. Radiated Emissions, 20MHz BW, Mid Channel 1-18GHz

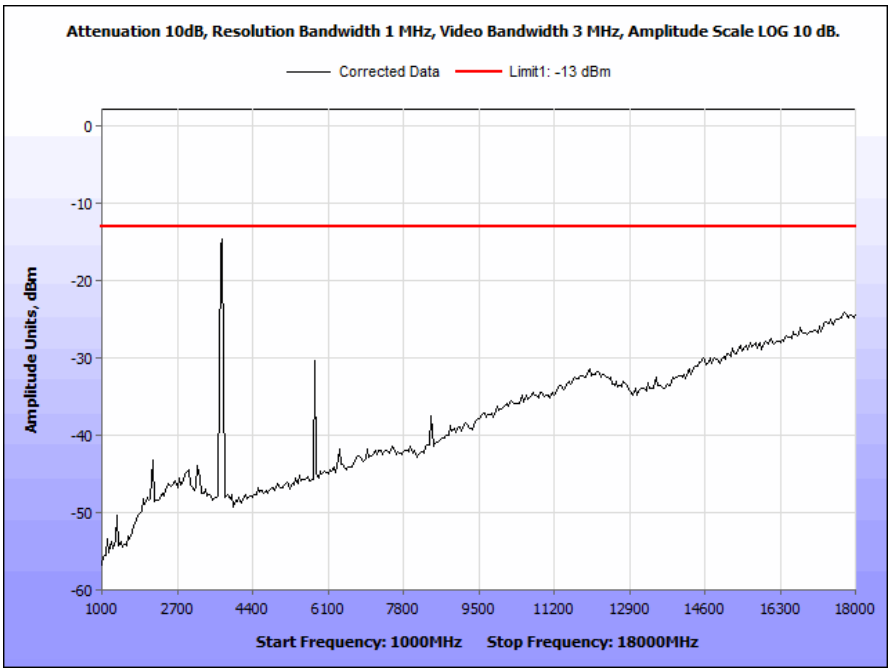


Plot 102. Spurious TX Emissions 20 MHz BW, Mid Channel 18GHz - 40GHz

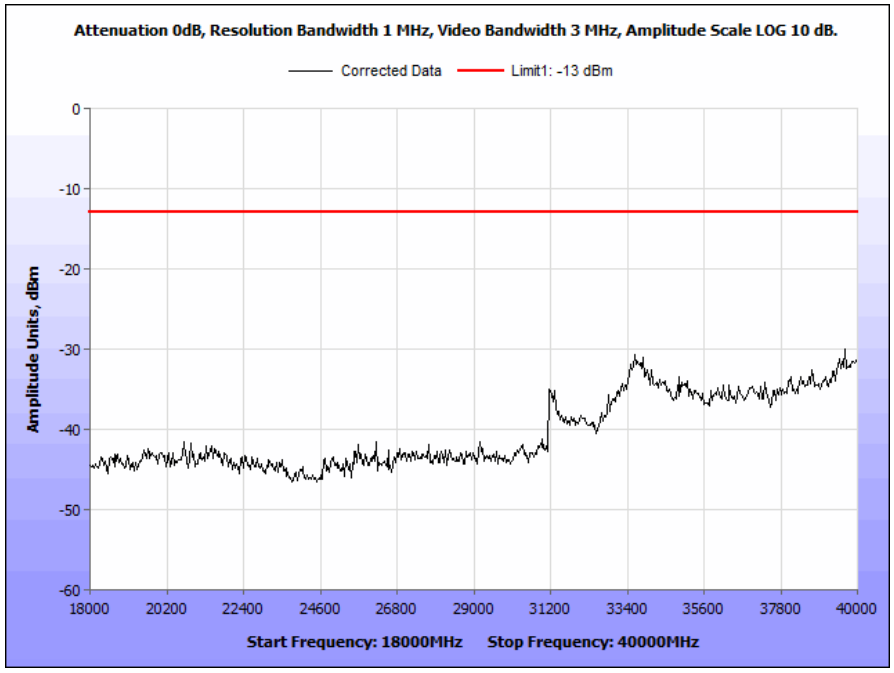
High Channel (20MHz)



Plot 103. Radiated Emissions, 20MHz BW, High Channel 30MHz-1GHz

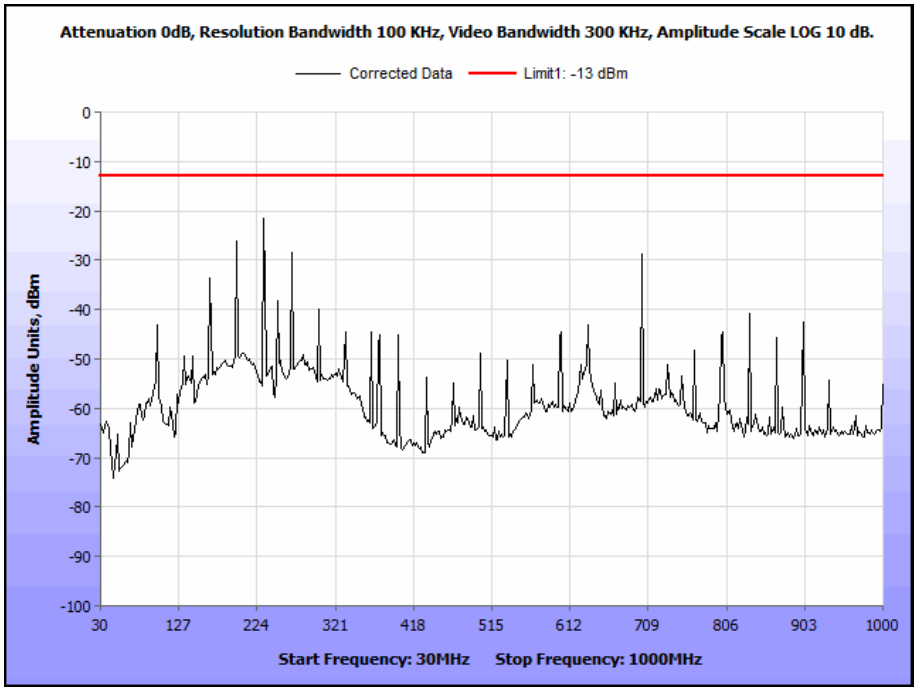


Plot 104. Radiated_Emissions_20MHz_BW_High_Channel_1-18GHz

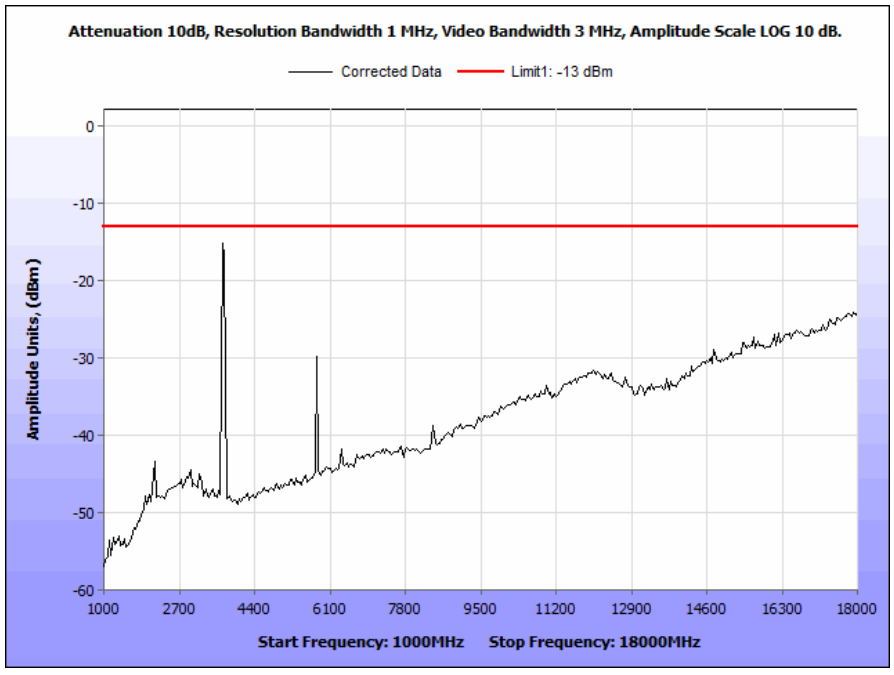


Plot 105. Spurious TX Emissions 20 MHz BW, High Channel 18GHz - 40GHz

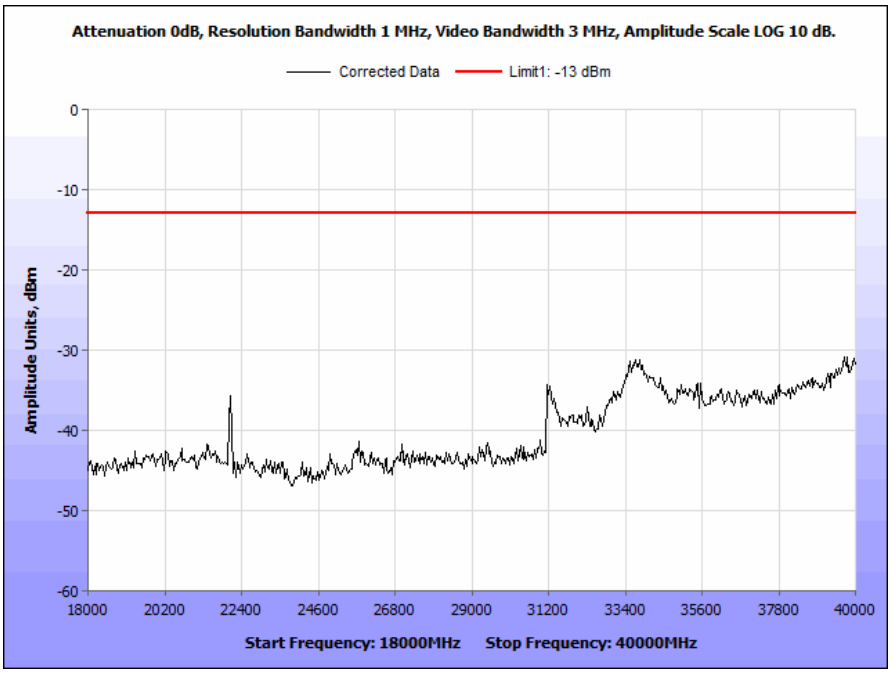
Low Channel (10MHz)



Plot 106. Radiated Emissions, 10MHz BW, Low Channel 30MHz-1GHz

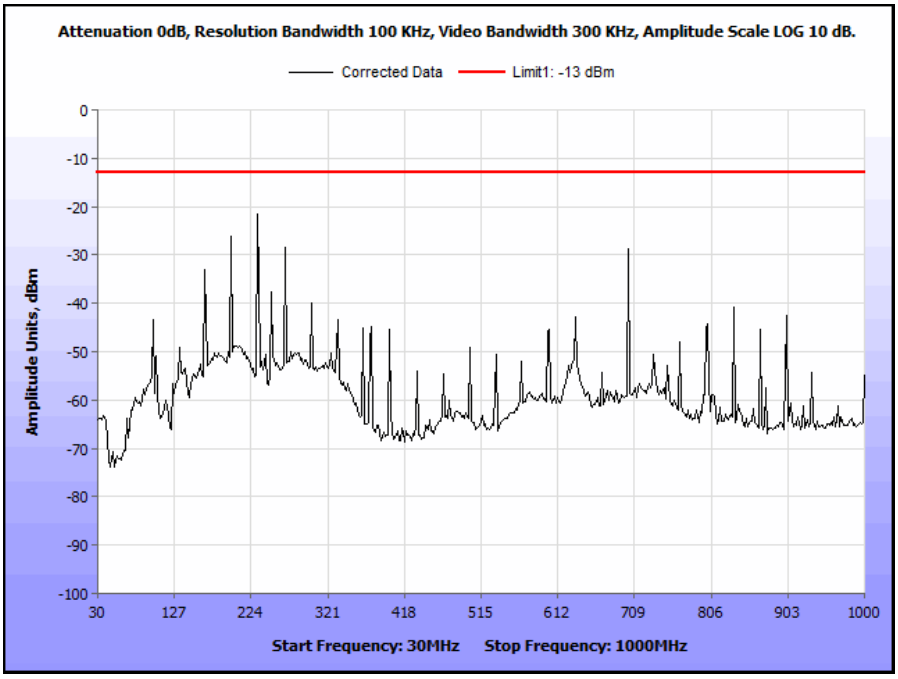


Plot 107. Radiated Emissions, 10MHz BW, Low Channel 1-18GHz

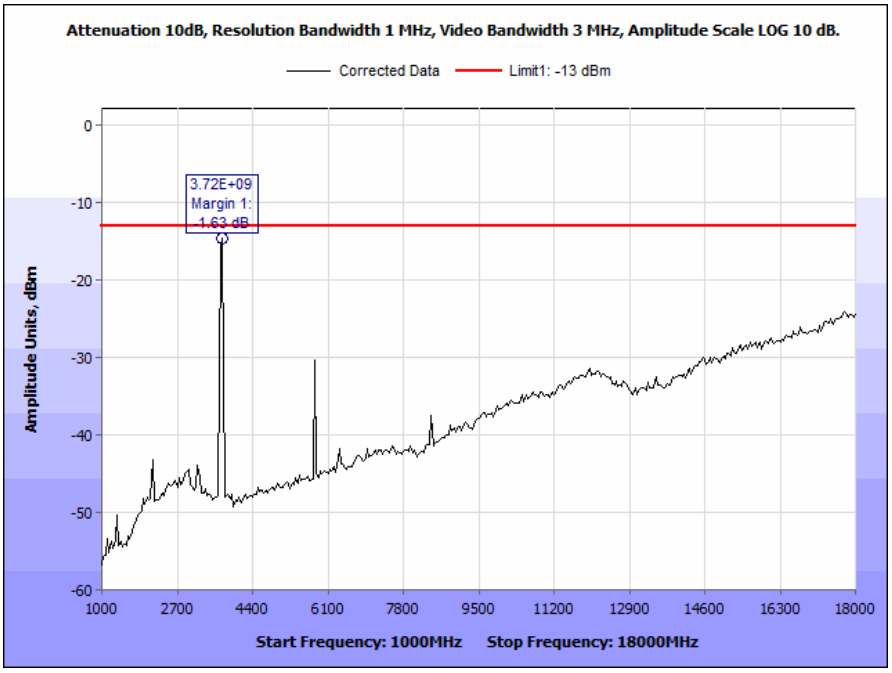


Plot 108. Spurious TX Emissions 10 MHz BW, Low Channel 18GHz - 40GHz

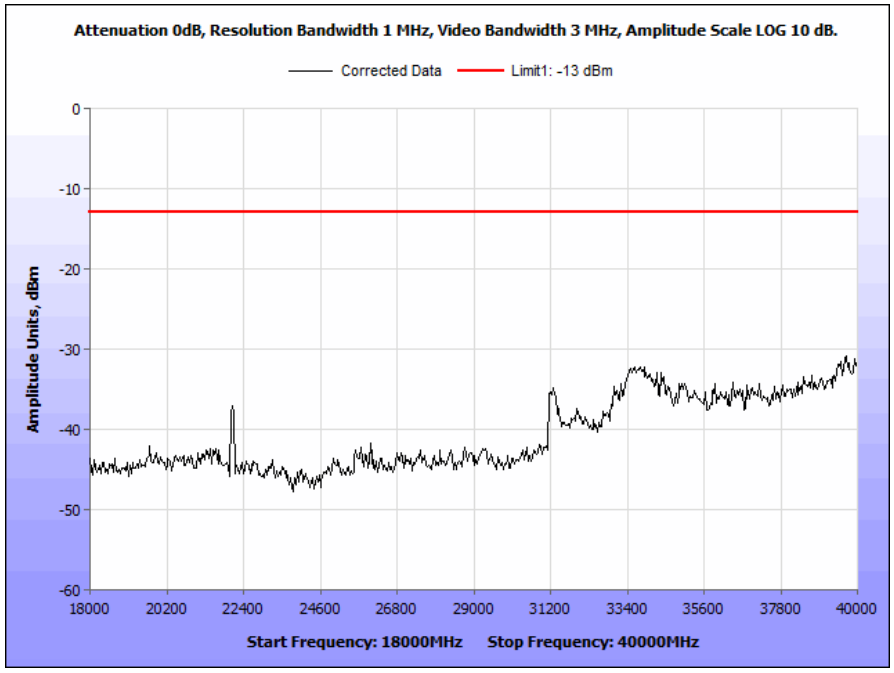
Mid Channel (10MHz)



Plot 109. Radiated Emissions 10MHz BW, Mid Channel 30MHz-1GHz

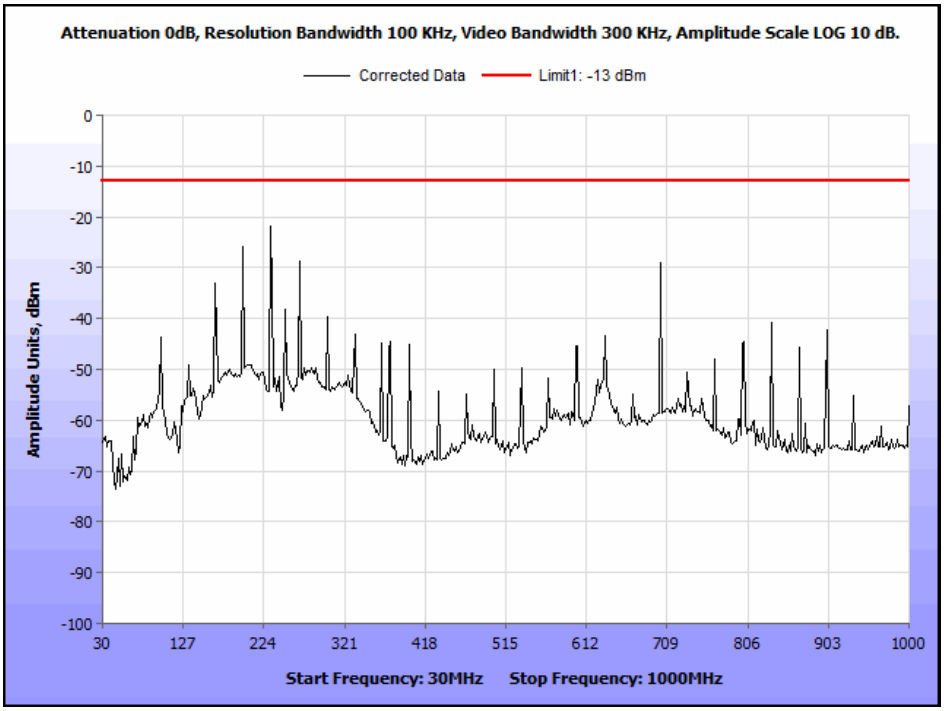


Plot 110. Radiated Emissions, 10MHz BW, Mid Channel 1-18GHz

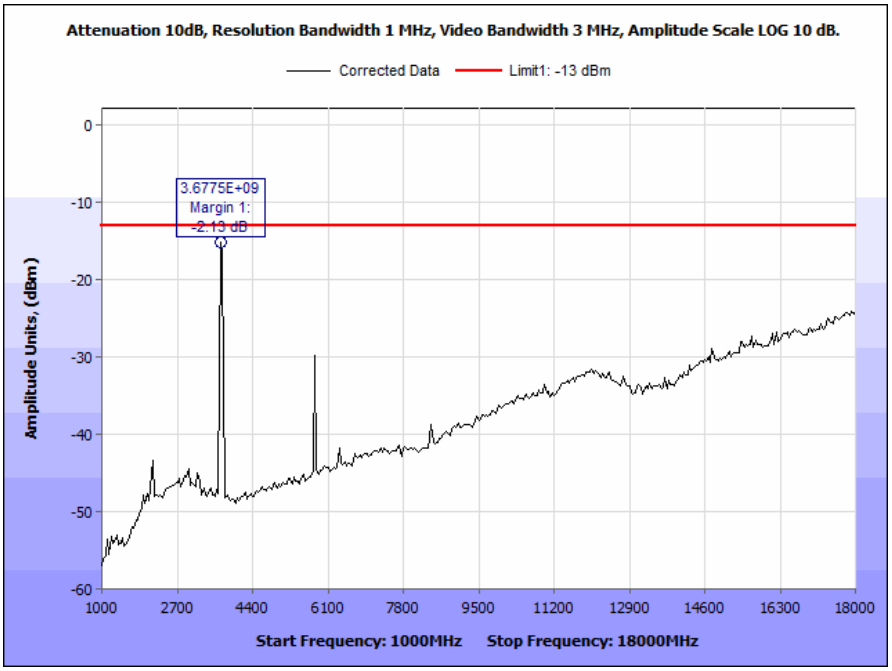


Plot 111. Spurious TX Emissions 10 MHz BW, Mid Channel 18GHz - 40GHz

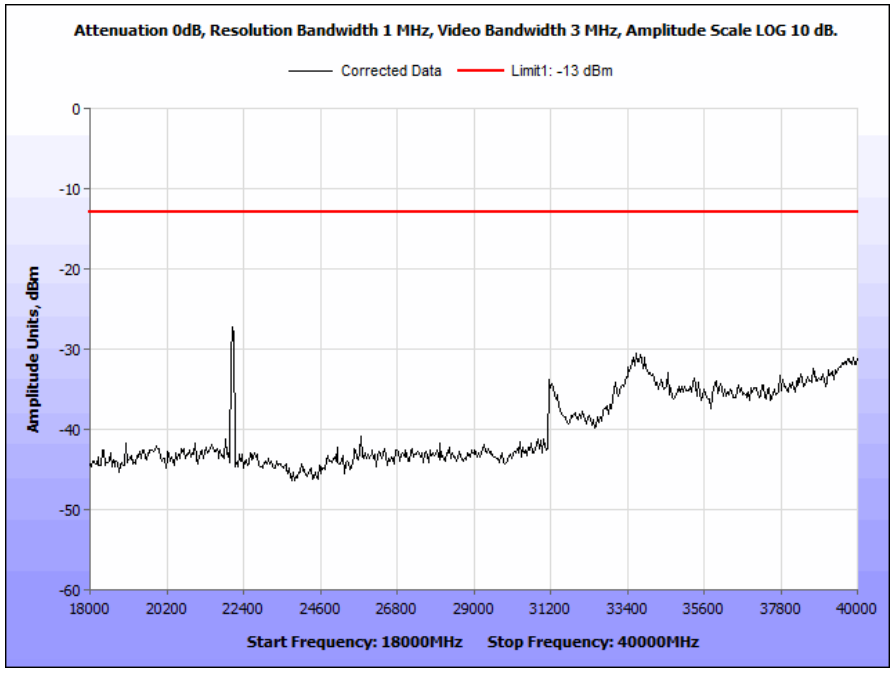
High Channel (10MHz)



Plot 112. Radiated Emissions, 10MHz BW, High Channel 30MHz-1GHz

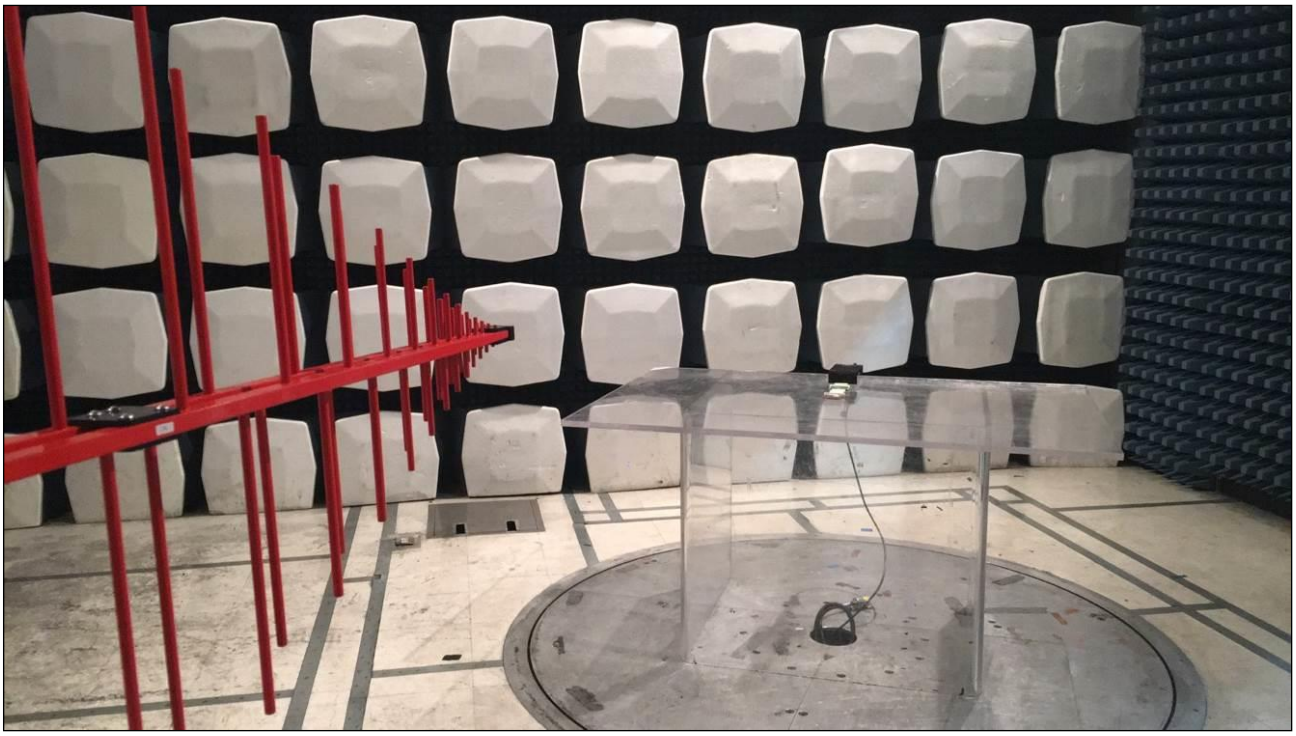


Plot 113 Radiated Emissions, 10MHz BW, High Channel 1-18GHz

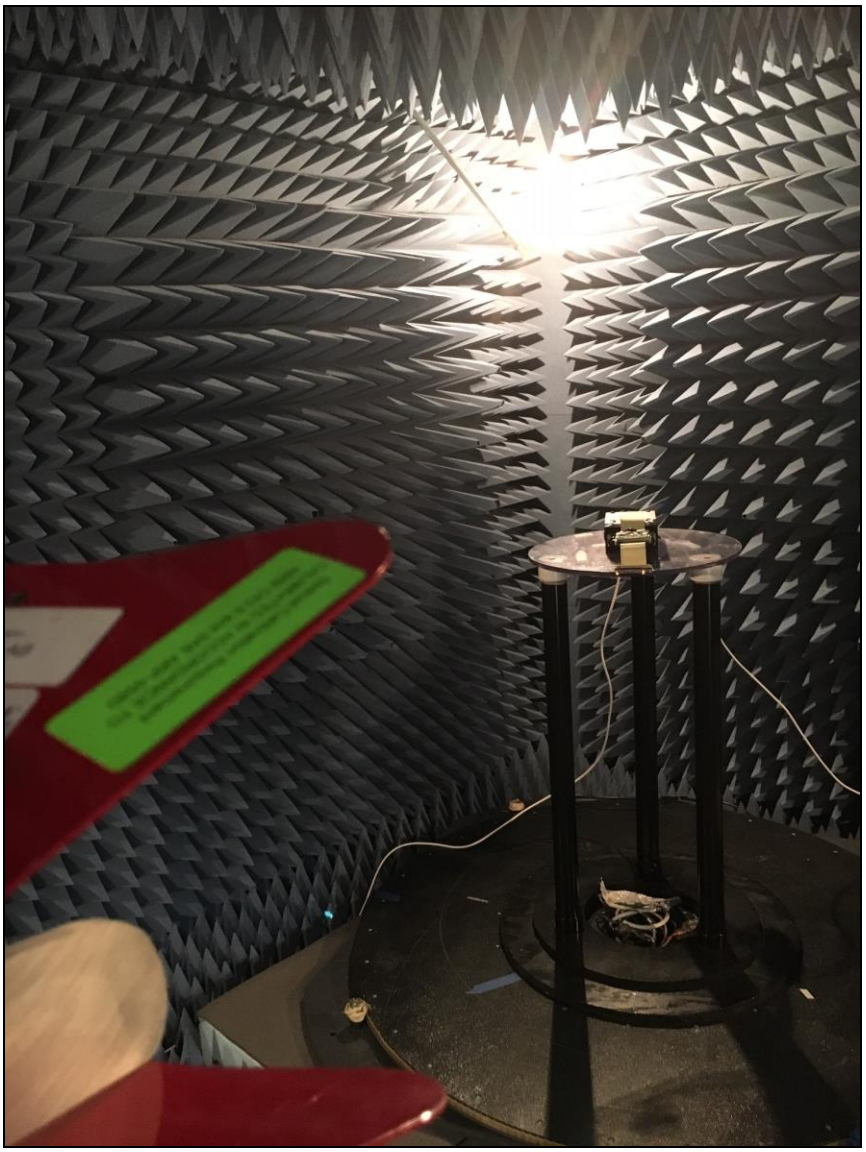


Plot 114. Spurious TX Emissions 10 MHz BW, High Channel 18GHz - 40GHz

Radiated Emissions Spurious Test Setup



Photograph 1. Radiated Emission Spurious Test Setup, Below 1 GHz



Photograph 2. Radiated Emission Spurious Test Setup, 1 GHz – 18 GHz

Photograph 3. Radiated Emission Spurious Test Setup, 18 GHz – 40 GHz

6. Electromagnetic Compatibility Frequency Stability Requirements

6.1. Frequency Stability

Test Requirement(s): **§2.1055 and §90.213**

Test Procedures: Testing for this frequency stability was not performed as data was used from original grant report.

Test Results: Equipment complies with Section 2.1055 and 90.213.
Note: Test results were obtained from original grant report (FCCID VKV-F36N)
See attached Report.

Test Engineer(s): Djed Mouada

Test Date(s): 04/21/16

7. Electromagnetic Compatibility Frequency Stability Requirements

7.1. RF Exposure Requirements

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).

FCC									
Frequency (MHz)	**EIRP (dBm)**	**EIRP (mW)**	**Ant. Gain (dBi)**	**Ant. Gain numeric**	**Pwr. Density (mW/cm^2)**	**Limit (mW/cm^2)**	**Margin**	**Distance (cm)**	**Result**
3693.4	28.8573	768.652	5.01	3.17	0.48469	1	0.51531	20	Pass
3678.4	29.9273	983.4	7.01	5.023	0.98279	1	0.01721	20	Pass

The module is qualified with two antennas, 2 dBi and 4 dBi. The 4dBi is for use on a mobile / non-body worn application under the following conditions:
1) Antennas are not co-located (20 cm minimum separation)
2) User is 20 cm away from the equipment

Test Equipment

8. 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
1T6658	SPECTRUM ANALYZER	AGILENT	E4407B	12/09/2015	12/09/2016
1T4497	SIGNAL GENERATOR	AGILENT TECHNOLOGIES	E4432B	10/06/2014	04/06/2016
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
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
1T4751	ANTENNA - BILOG	SUNOL SCIENCES	JB6	2/26/2016	8/26/2017
331T4442	PRE-AMPLIFIER, MICROWAVE	MITEQ	AFS42-01001800-30-10P	SEE NOTE	

Table 7. Test Equipment

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

Certification & User's Manual Information

9. Certification Label & User's Manual Information

9.1. 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 provision that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart Y — 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, whichever is applicable.

§ 2.902 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.

§ 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.

9.2. 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.

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.

End of Report

