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

914 WEST PATAPSCO AVENUE • BALTIMORE, MARYLAND 21230-3432 • PHONE (410) 354-3300 • FAX (410) 354-3313
33439 WESTERN AVENUE • UNION CITY, CALIFORNIA 94587 • PHONE (510) 489-6300 • FAX (510) 489-6372
3162 BELICK STREET • SANTA CLARA, CA 95054 • PHONE (408) 748-3585 • FAX (510) 489-6372
13301 MCCALLEN PASS • AUSTIN, TEXAS 78753 • PHONE (512) 287-2500 • FAX (512) 287-2513

April 10, 2018

Harris RF Communications
PO Box 9001
Melbourne, Florida 329029001

Dear Thomas Camper,

Enclosed is the EMC Wireless Class II Permissive Change test report for compliance testing of the Harris RF Communications, MASTR V, MASV-HTXMV, SV-HCXMV as tested to the requirements of the FCC Certification rules under Title 47 of the CFR Part 22 Subpart C for Public Mobile Service, and Part 80 for Stations in the Maritime 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 contact me.

Sincerely yours,
MET LABORATORIES, INC.

Joel Huna
Documentation Department

Reference: (\Harris RF Communications\EMC94801-FCC22_80 Rev. 2)

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Electromagnetic Compatibility Criteria
Class II Permissive Change Test Report

for the

Harris RF Communications
Model MASTR V, MASV-HTXMV, SV-HCXMV

Verified under
FCC Certification Rules
Title 47 of the CFR, Part 22 Subpart C
for Public Mobile Service
and
Title 47 of the CFR, Part 80
for Stations in the Maritime Services

MET Report: EMC94801-FCC22_80 Rev. 2

April 10, 2018

Prepared For:

Harris RF Communications
PO Box 9001
Melbourne, Florida 329029001

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

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Hadid Jones, Project Engineer
Electromagnetic Compatibility Lab

Joel Huna
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Part 22 Subpart C and Part 80of the FCC Rules under normal use and maintenance.

John Mason, Director
Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	August 25, 2017	Initial Issue.
1	April 4, 2018	Customer Corrections.
2	April 10, 2018	Customer Corrections.

Table of Contents

List of Tables

List of Terms and Abbreviations

AC	**A**lternating **C**urrent
ACF	**A**ntenna **C**orrection **F**actor
Cal	**Cal**ibration
d	**M**easurement **D**istance
dB	**D**eci**b**els
dBµA	**D**eci**b**els above one **micro**amp
dBµV	**D**eci**b**els above one **micro**volt
dBµA/m	**D**eci**b**els above one **micro**amp **per m**eter
dBµV/m	**D**eci**b**els above one **micro**volt **per m**eter
DC	**D**irect **C**urrent
E	**E**lectric Field
DSL	**D**igital **S**ubscriber **L**ine
ESD	**E**lectro**s**tatic **D**ischarge
EUT	**E**quipment **U**nder **T**est
f	**F**requency
FCC	**F**ederal **C**ommunications **C**ommission
GRP	**G**round **R**eference **P**lane
H	Magnetic Field
HCP	**H**orizontal **C**oupling **P**lane
Hz	**H**ert**z**
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**k**ilo**h**ert**z**
kPa	**k**ilo**pa**scal
kV	**k**ilo**v**olt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**h**ertz
µH	**microh**enry
µ	**microf**arad
µs	**micros**econds
NEBS	**N**etwork **E**quipment-**B**uilding **S**ystem
PRF	**P**ulse **R**epetition **F**requency
RF	**R**adio **F**requency
RMS	**R**oot-**M**ean-**S**quare
TWT	**T**raveling **W**ave **T**ube
V/m	**V**olts **per m**eter
VCP	**V**ertical **C**oupling **P**lane

I. Executive Summary

A. Purpose of Test

An EMC Class II Permissive Change evaluation was performed to determine compliance of the Harris RF Communications MASTR V, MASV-HTXMV, SV-HCXMV, with the requirements of Part 22 Subpart C and Part 80. 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 MASTR V, MASV-HTXMV, SV-HCXMV. Harris RF Communications should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the MASTR V, MASV-HTXMV, SV-HCXMV, 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 22 Subpart C and Part 80, in accordance with Harris RF Communications, purchase order number 1182708.

Reference	Description	Compliance
§2.1046; §22.565; §80.215	RF Power Output	Compliant
§2.1055, §22.355; §80.209	Frequency Stability	Provided Separately by the Applicant.
§2.1051; §22.359; §80.211	Spurious Emissions at Antenna Terminals	Compliant
§2.1053; §22.359; §80.211	Field Strength of Spurious Radiated Emissions	Compliant
§2.1049; §22.359(b); §80.205	Occupied Bandwidth	Compliant
--	RF Exposure	Not Applicable / Rf Exposure compliance is addressed at the time of licensing, as required by the FCC Bureau(s), including antenna co-location requirements of Section 1.1307(b)(3).

Table 1. Executive Summary of EMC ComplianceTesting

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Harris RF Communications to perform testing on the MASTR V, MASV-HTXMV, SV-HCXMV, under Harris RF Communications' purchase order number 1182708.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Harris RF Communications, MASTR V, MASV-HTXMV, SV-HCXMV.

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

Model(s) Tested:	MASTR V, MASV-HTXMV, SV-HCXMV	
Model(s) Covered:	MASTR V, MASV-HTXMV, SV-HCXMV	
EUT Specifications:	Primary Power: 110 VAC 60 Hz	
	FCC ID: OWDTR-0065-E	
	Type of Modulations:	C4FM, WCQPSK, HDQPSK
	Equipment Code:	TNB
	Max Peak and Output Power:	50.56 dBm
	EUT Frequency Ranges:	150.0125 – 173.9875 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	
Evaluated by:	Hadid Jones	
Date(s):	April 10, 2018	

B. References

CFR 47, Part 22, Subpart H	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 22: Rules and Regulations for Cellular Devices.
CFR 47, Part 24, Subpart E	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 24: Rules and Regulations for Personal Communications Services
ANSI C63.4:20014	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.26: 2015	Compliance Testing of Transmitters Used in Licensed Radio Services
ISO/IEC 17025:2005	General Requirements for the Competence of Testing and Calibration Laboratories
EIA/TIA-603-D-2010	Land Mobile FM or PM Communication Equipment Measurement and Performance Standards
KDB 971168 v02r02	MEASUREMENT GUIDANCE FOR CERTIFICATION OF LICENSED DIGITAL TRANSMITTERS

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 10 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 Harris RF Communications MASTR V, MASV-HTXMV, SV-HCXMV, Equipment Under Test (EUT), is a Radio Base Station/Repeater designed for communications in the Land Mobile Radio environment. The primary communication users are Public Safety, Utility and Military Commercial Of The Shelf.

E. Equipment Configuration

The EUT was set up as outlined in Figure 1, Block Diagram of Test Setup. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

Ref. ID	Name / Description	Model Number	Serial Number
Tx #1	Transmit Module #1	EA-555008-002	HR0802210002
Tx #2	Transmit Module #2	EA-555008-002	HR0802210005
Tx #3	Transmit Module #3	EA-555008-002	HR0802210003
Tx #4	Transmit Module #4	EA-555008-002	HR0802210001
PA #1	Linear Power Amplifier #1	EA-555010-102 & 009-002	CR0102279950
PA #2	Linear Power Amplifier #2	EA-555010-102 & 009-002	CR0102279968
PA #3	Linear Power Amplifier #3	EA-555010-102 & 009-002	CR0102279952
PA #4	Linear Power Amplifier #4	EA-555010-102 & 009-002	CR0102279970
Rx #1	Receive Module #1	EA-555007-002	HR0702110003
Rx #2	Receive Module #2	EA-555007-002	HR0702110002
Rx #3	Receive Module #3	EA-555007-002	HR0702110001
Rx #4	Receive Module #4	EA-555007-002	HR0702110000
BB #1	Baseband Module #1	EA-555005	EP5199D03340
BB #2	Baseband Module #2	EA-555005	EP5199D03335
TC #1	Traffic Controller #1	EA-555004-001	HR0401L12550
TC #2	Traffic Controller #2	EA-555004-001	HR0401L12537
TC #3	Traffic Controller #3	EA-555004-001	HR0401L12546
TC #4	Traffic Controller #4	EA-555004-001	HR0401L12570
ES #1	E-Switch (Primary)	EA-555012	HR1201E11527
ES #2	E-Switch (Redundant)	EA-555012	HR1201E11550
PS #1	Power Supply #1	EA-555011-001	LN0710100342
PS #2	Power Supply #2	EA-555011-001	LN0710100355
PS #3	Power Supply #3	EA-555011-001	LN0710100253
PS #4	Power Supply #4	EA-555011-001	LN0710100392

Table 2. Equipment Configuration (Conducted Measurement)

F. Support Equipment

Harris RF Communications supplied support equipment necessary for the operation and testing of the MASTR V, MASV-HTXMV, SV-HCXMV. All support equipment supplied is listed in the following Support Equipment List.

Ref. ID	Name / Description	Manufacturer	Model Number	Serial Number
	Handheld Barcode Scanner	HP	LS2208-SR20361RSBRE	none
	100 Watt Dummy Load (qty 4)			none

Table 3. Support Equipment

G. 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
Tx #1	RF Out	Coaxial Cable	1	1	Y	PA #1 RF In
Tx #2	RF Out	Coaxial Cable	1	1	Y	PA #2 RF In
Tx #3	RF Out	Coaxial Cable	1	1	Y	PA #3 RF In
Tx #4	RF Out	Coaxial Cable	1	1	Y	PA #4 RF In
PA #1	RF In	Coaxial Cable	1	1	Y	Tx #1 RF Out
PA #1	Control	15 Conductor	1	1	Y	Backplane, J21
PA #2	RF In	Coaxial Cable	1	1	Y	Tx #2 RF Out
PA #2	Control	15 Conductor	1	1	Y	Backplane, J22
PA #3	RF In	Coaxial Cable	1	1	Y	Tx #3 RF Out
PA #3	Control	15 Conductor	1	1	Y	Backplane, J23
PA #4	RF In	Coaxial Cable	1	1	Y	Tx #4 RF Out
PA #4	Control	15 Conductor	1	1	Y	Backplane, J24
PS #1	HPA	28 VDC Power	1	0.5	N	PA #1, POWER
PS #1	Shelf	5V/12V DC Power	1	1	N	Backplane, J30
PS #2	HPA	28 VDC Power	1	0.5	N	PA #2, POWER
PS #2	Shelf	5V/12V DC Power	1	1	N	Backplane, J31
PS #3	HPA	28 VDC Power	1	0.5	N	PA #3, POWER
PS #4	HPA	28 VDC Power	1	0.5	N	PA #4, POWER

Table 4. 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
PA #1	RF Out	Coaxial Cable	1	3	Y	100W Dummy Load
PA #2	RF Out	Coaxial Cable	1	1	Y	100W Dummy Load
PA #3	RF Out	Coaxial Cable	1	1	Y	100W Dummy Load
PA #4	RF Out	Coaxial Cable	1	1	Y	100W Dummy Load
Rx #1	RF In	none, terminated	1	-	Y	50Ω Dummy Load
Rx #1	Audio	none, bench test only	0	-	-	-
Rx #2	RF In	none, terminated	1	-	Y	50Ω Dummy Load
Rx #2	Audio	none, bench test only	0	-	-	-
Rx #3	RF In	none, terminated	1	-	Y	50Ω Dummy Load
Rx #3	Audio	none, bench test only	0	-	-	-
Rx #4	RF In	none, terminated	1	-	Y	50Ω Dummy Load

Table 5. External Ports and Cabling 1

Rx #4	Audio	none, bench test only	0	-	-	-
BB #1	M-LAN	Ethernet Cable, CAT5	1	3	N	none
BB #1	Simulcast	15-Conductor Cable	2	3	Y	none
BB #1	COMM	none, test/local control	0	-	-	-
BB #1	Ref In	none, terminated	1	-	Y	50Ω Dummy Load
BB #2	M-LAN	Ethernet Cable, CAT5	1	3	N	none
BB #2	Simulcast	15-Conductor Cable	2	3	Y	none
BB #2	COMM	none, test/local control	0	-	-	-
BB #2	Ref In	none, terminated	1	-	Y	50Ω Dummy Load
TC #1	M-LAN	Ethernet Cable, CAT5	1	3	N	none
TC #1	P-LAN	Ethernet Cable, CAT5	1	3	N	none
TC #1	COMM	none, test/local prog	0	-	-	-
TC #2	M-LAN	Ethernet Cable, CAT5	1	3	N	none
TC #2	P-LAN	Ethernet Cable, CAT5	1	3	N	none
TC #2	COMM	none, test/local prog	0	-	-	-
TC #3	M-LAN	Ethernet Cable, CAT5	1	3	N	none
TC #3	P-LAN	Ethernet Cable, CAT5	1	3	N	none
TC #3	COMM	none, test/local prog	0	-	-	-
TC #4	M-LAN	Ethernet Cable, CAT5	1	3	N	none
TC #4	P-LAN	Ethernet Cable, CAT5	1	3	N	none
TC #4	COMM	none, test/local prog	0	-	-	-
PS #1	A/C In	A/C Power Cord	1	1	N	110 VAC Power
PS #1	5V,12V VDC AUX	none, unused	0	-	-	-
PS #2	A/C In	A/C Power Cord	1	1	N	110 VAC Power
PS #2	5V,12V VDC AUX	none, unused	0	-	-	-
PS #3	A/C In	A/C Power Cord	1	1	N	110 VAC Power
PS #3	5V,12V VDC AUX	none, unused	0	-	-	-
PS #4	A/C In	A/C Power Cord	1	1	N	110 VAC Power
PS #4	5V,12V VDC AUX	none, unused	0	-	-	-
TP	Test Port	none, unused	0	-	-	on Backplane

Table 6. External Ports and Cabling 2

H. Mode of Operation

The MASTR V can generate internal Test Patterns for each modulation mode, selecting the mode and enabling the transmitter is controller with a Bar Code Scanner connected via a standard Laptop PC to M-LAN port of the Baseband Module. No special software is required; all the commands can be sent using a Telnet session.

There are three modes of operation:

P24 Phase 1 – modulation C4FM

P25 Linear Simulcast – modulation WCQPSK

P25 Phase II – modulation HDQPSK

A description of how to enable each mode and the transmitter is contained in Attachment #3a, 3b.

I. Method of Monitoring EUT Operation

A "STATUS" LED is part of each of the following modules: TX Module, PA Module, Rx Module, Baseband Module, Traffic Controller and E-Switch. A Red indication on the "STATUS" LED indicates that the modules is not functioning properly and the associated channel is taken "Out of Service."

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 Harris RF Communications upon completion of testing.

III. Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 2.1046 RF Power Output

Test Requirements: **§ 2.1046 Measurements required: RF power output:**

§ 2.1046 (a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c)(8).The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

§ 22.913 Power and antenna height limits.

§ 22.913(a): The Effective radiated power (ERP) of base transmitters and cellular repeaters must not exceed 500 watts.

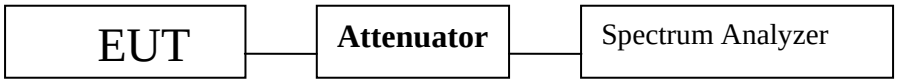
Test Procedures: The EUT was tested according to the average power integration procedures of ANSI C63.26 5.2.4.4.1. The power measurement function of spectrum analyzer was used and configured in the following manner.

(a) Frequency = channel cf
(b) Span = 2-5 x the OBW
(c) RBW = 1-5 % of the OBW
(d) VBW 1-3 x the RBW
(e) Sweep Time = Auto
(f) Detector = Average

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

Test Engineer(s): Hadid Jones

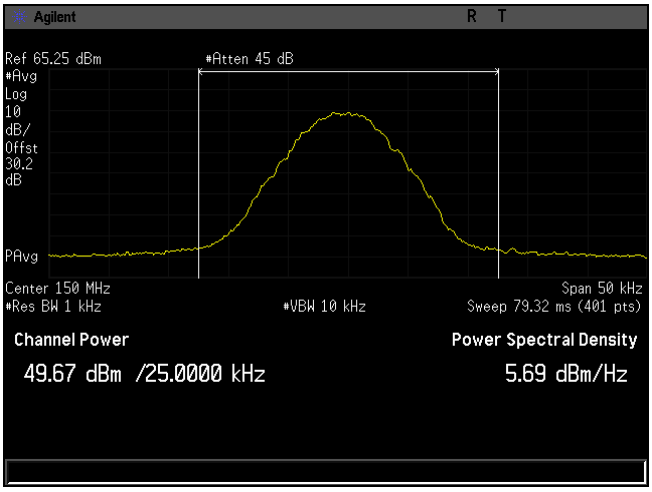
Test Date(s): June 15, 2017



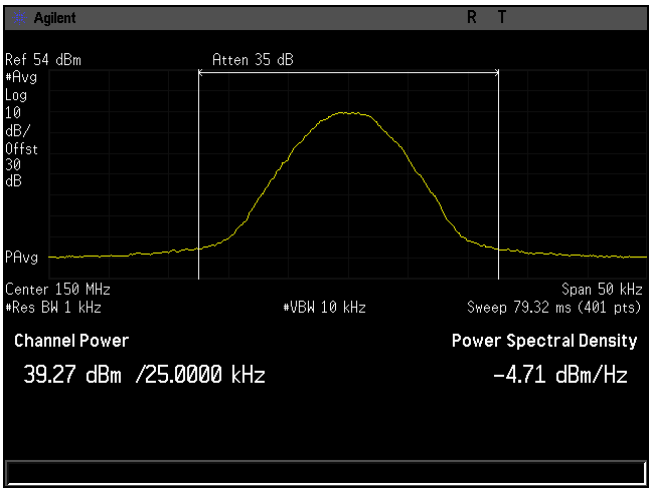
Block Diagram 1. RF Power Output Test Setup

Frequency (MHz)	Modulation	Power (dBm)	
		10 Watt (40dBm)	100 Watt (50dBm)
150.0125	c4fm	39.27	49.67
	cqpsk	39.90	50.00
	hdqpsk	39.03	50.21
156.0125	c4fm	39.33	49.30
	cqpsk	40.20	49.59
	hdqpsk	39.10	49.60
160.0125	c4fm	39.24	49.50
	cqpsk	39.21	50.40
	hdqpsk	40.71	49.83
173.9875	c4fm	40.00	50.56
	cqpsk	40.04	49.65
	hdqpsk	40.00	49.71

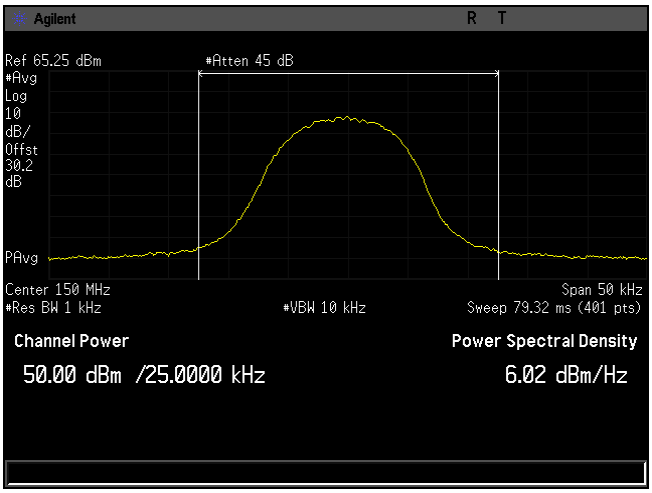
Table 7. RF Power Output, Test Results



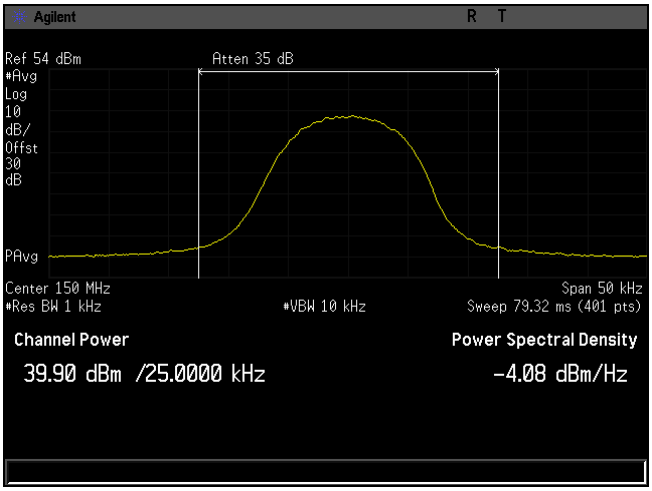
Plot 1. RF Power Output, 150MHz, C4FM, 100W



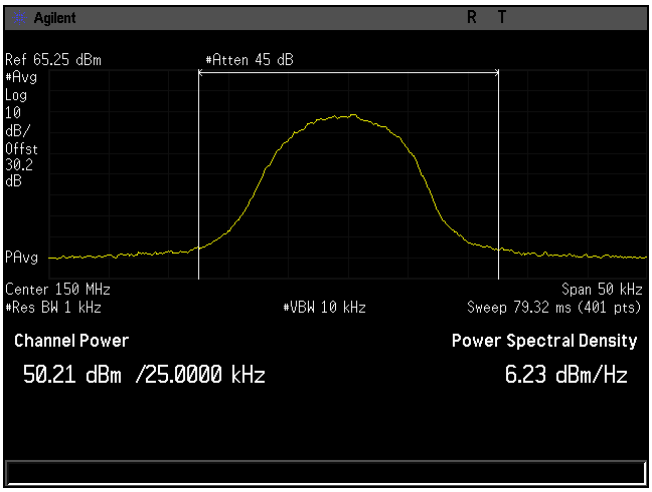
Plot 2. RF Power Output, 150MHz, C4FM, 10W



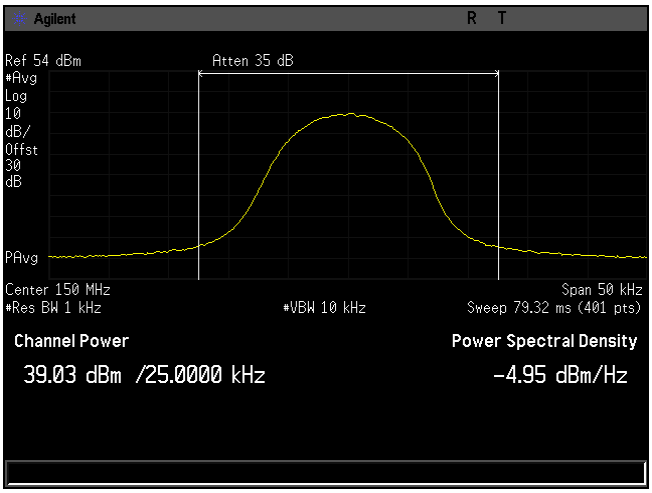
Plot 3. RF Power Output, 150MHz, CQPSK, 100W



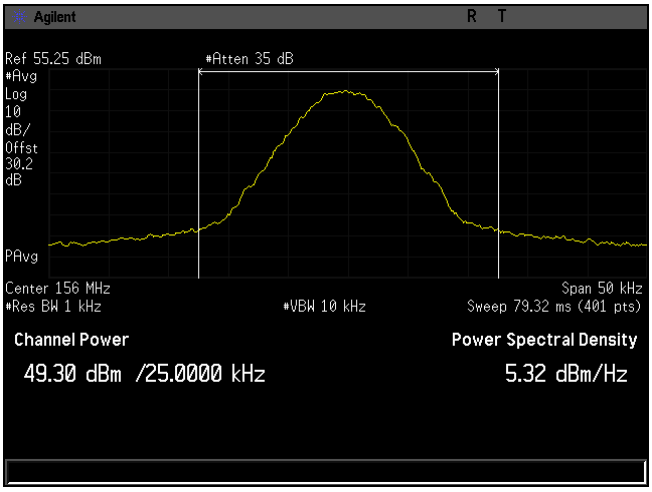
Plot 4. RF Power Output, 150MHz, CQPSK, 10W



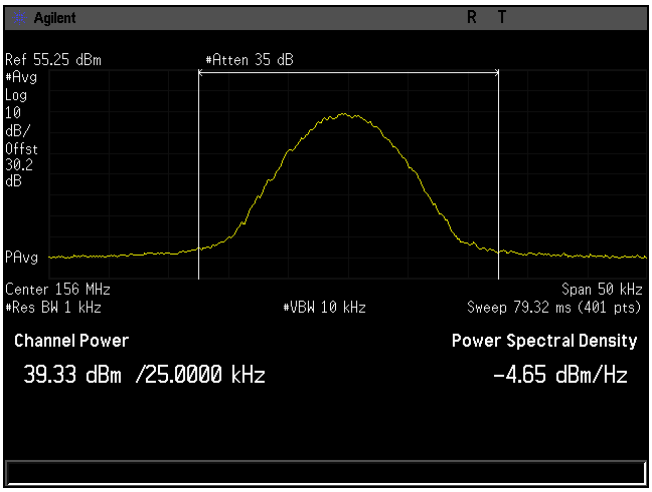
Plot 5. RF Power Output, 150MHz, HDQPSK, 100W



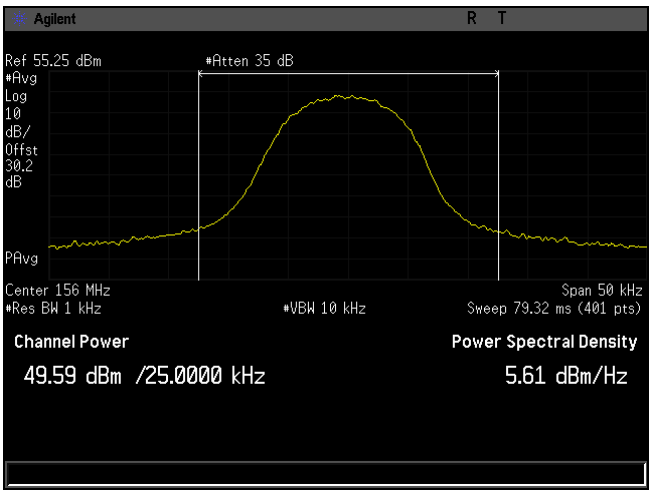
Plot 6. RF Power Output, 150MHz, HDQPSK, 10W



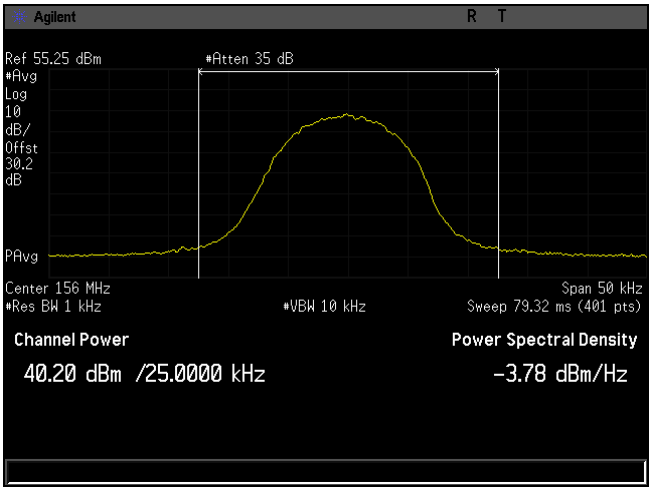
Plot 7. RF Power Output, 156MHz, C4FM, 100W



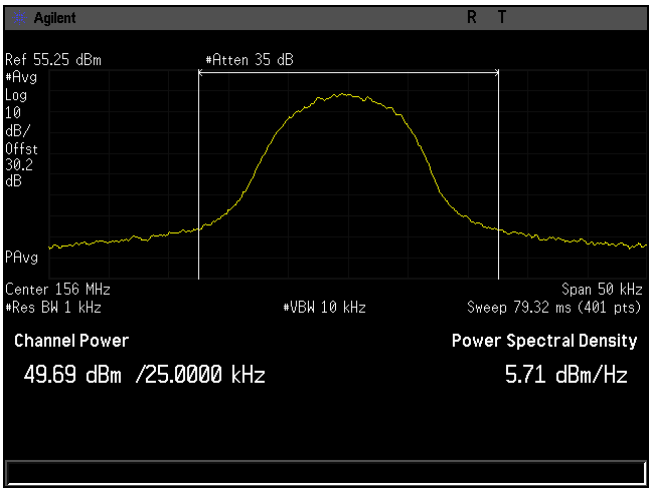
Plot 8. RF Power Output, 156MHz, C4FM, 10W



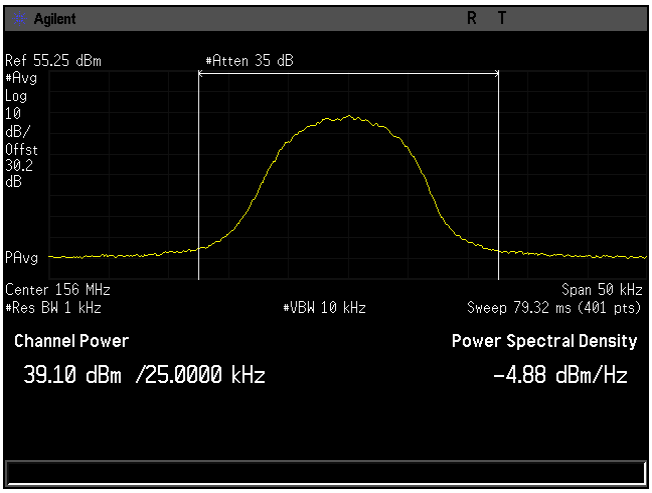
Plot 9. RF Power Output, 156MHz, CQPSK, 100W



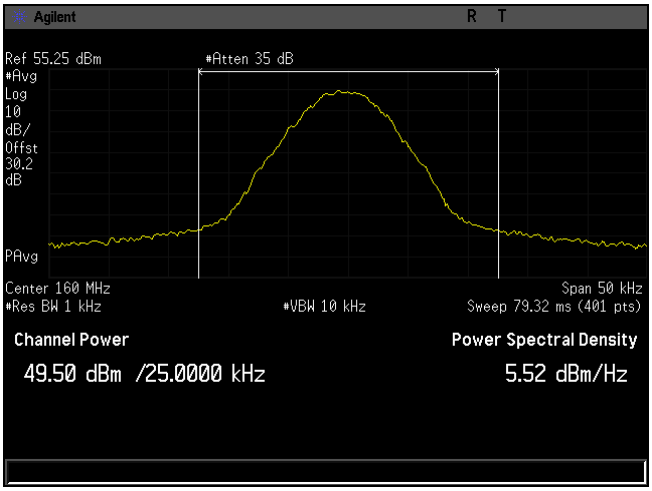
Plot 10. RF Power Output, 156MHz, CQPSK, 10W



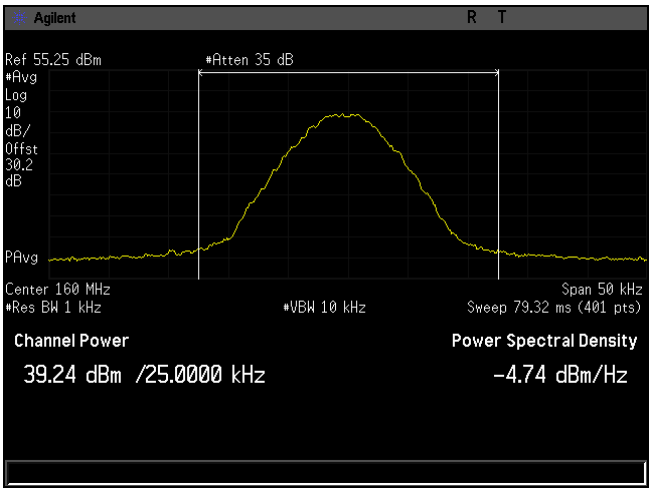
Plot 11. RF Power Output, 156MHz, HDQPSK, 100W



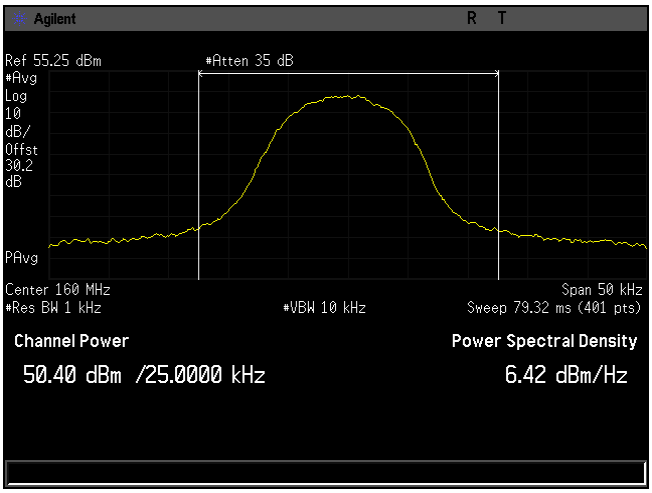
Plot 12. RF Power Output, 156MHz, HDQPSK, 10W



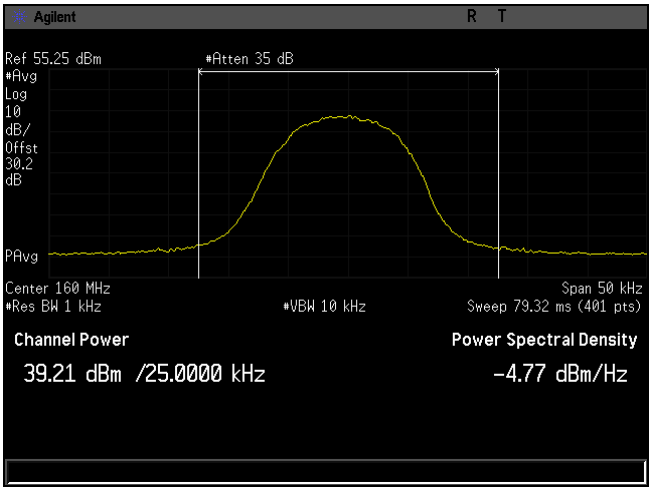
Plot 13. RF Power Output, 160MHz, C4FM, 100W



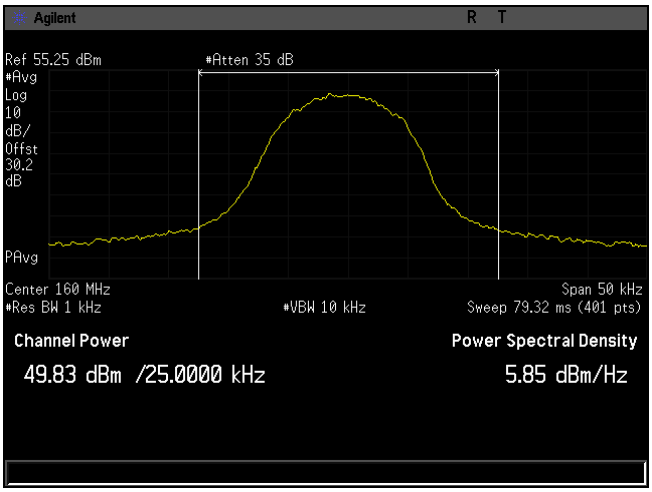
Plot 14. RF Power Output, 160MHz, C4FM, 10W



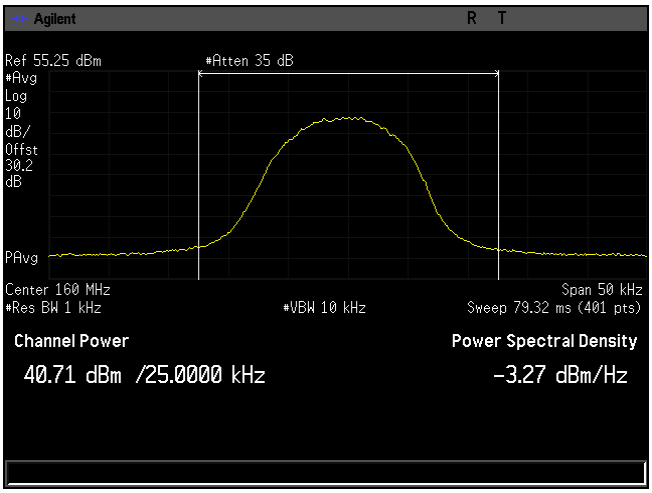
Plot 15. RF Power Output, 160MHz, CQPSK, 100W



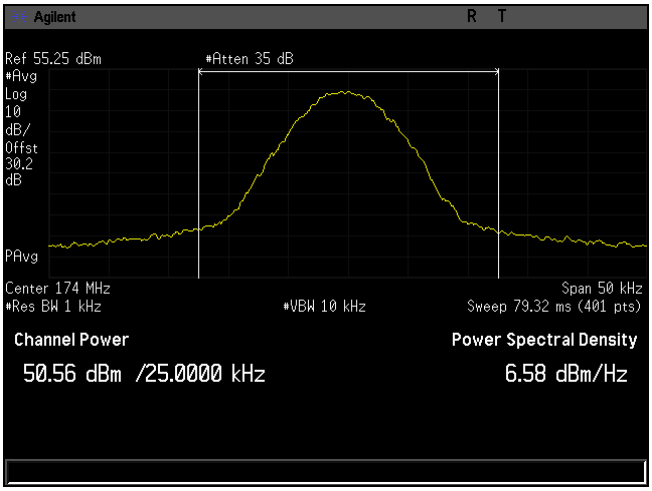
Plot 16. RF Power Output, 160MHz, CQPSK, 10W



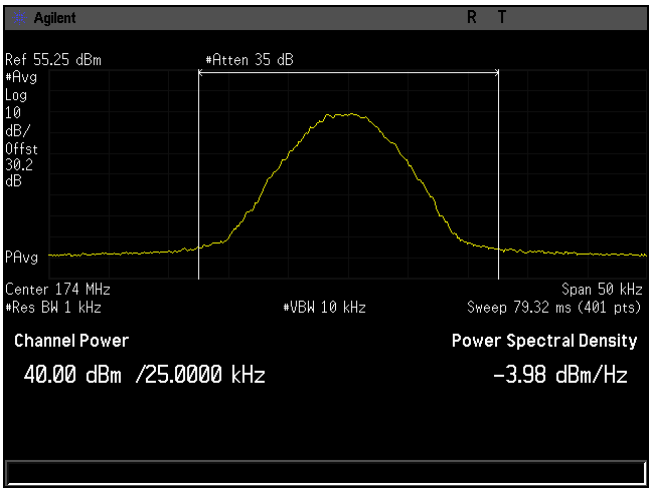
Plot 17. RF Power Output, 160MHz, HDQPSK, 100W



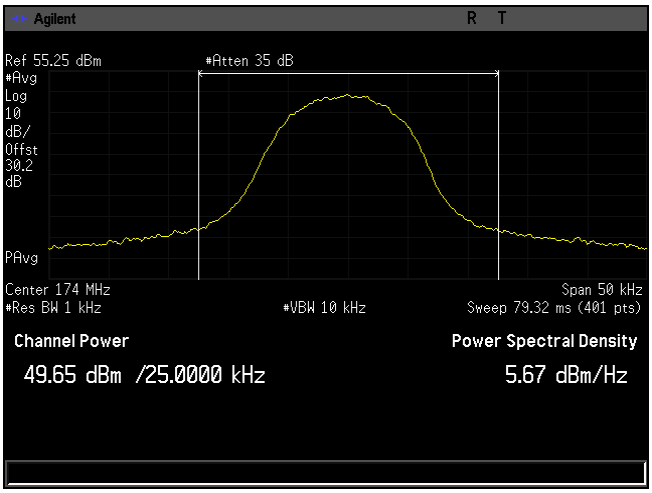
Plot 18. RF Power Output, 160MHz, HDQPSK, 10W



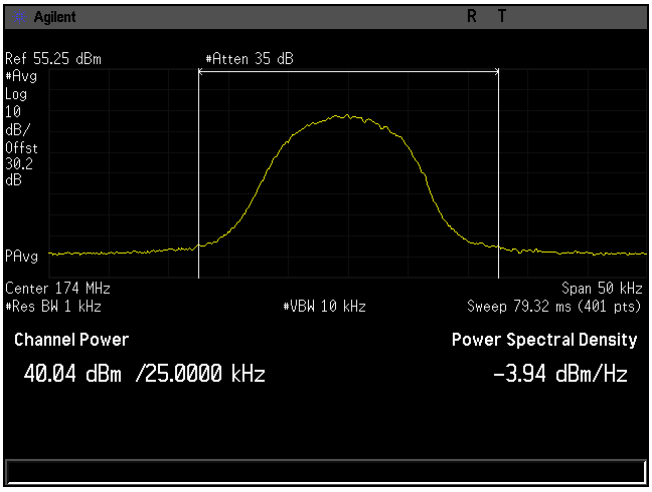
Plot 19. RF Power Output, 174MHz, C4FM, 100W



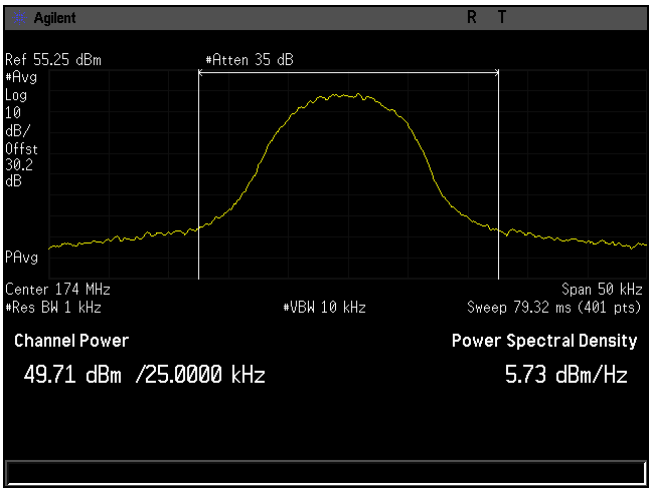
Plot 20. RF Power Output, 174MHz, C4FM, 10W



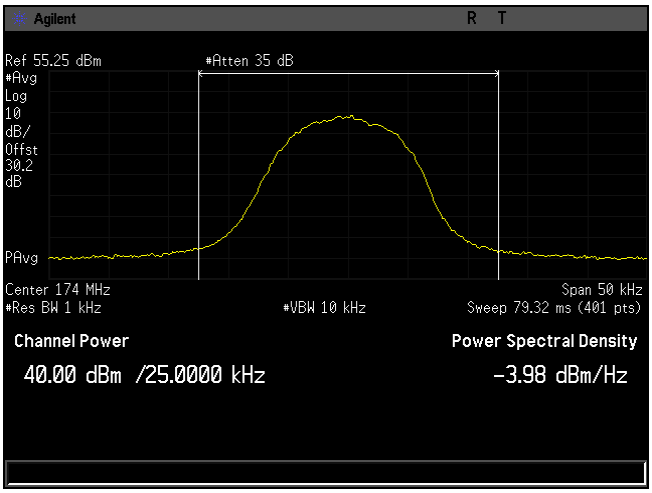
Plot 21. RF Power Output, 174MHz, CQPSK, 100W



Plot 22. RF Power Output, 174MHz, CQPSK, 10W



Plot 23. RF Power Output, 174MHz, HDQPSK, 100W



Plot 24. RF Power Output, 174MHz, HDQPSK, 10W

§ 2.1049 Occupied Bandwidth

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

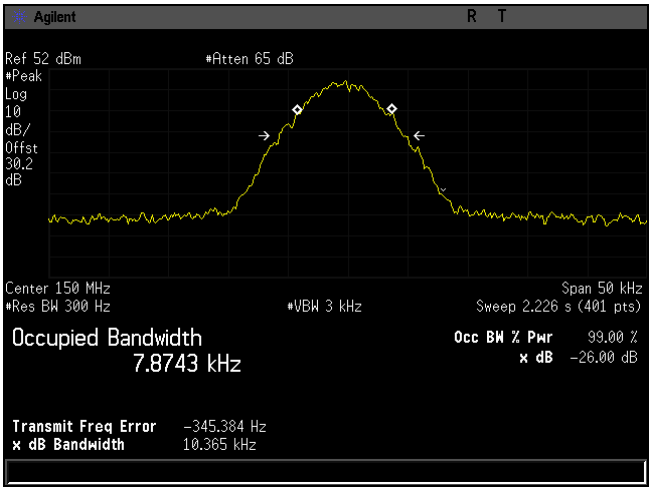
Test Procedures: The EUT was tested according to relative measurement procedure of ANSI C63.26 5.4.3 The OBW measurement function of the spectrum analyzer was used and configured in the following manner.

(a) Frequency = channel cf
(b) Span = 2-5 x the OBW
(c) RBW = 1-5 % of the OBW
(d) VBW 1-3 x the RBW
(e) Sweep Time = Auto
(f) Detector = peak
(g) –X dB = 26

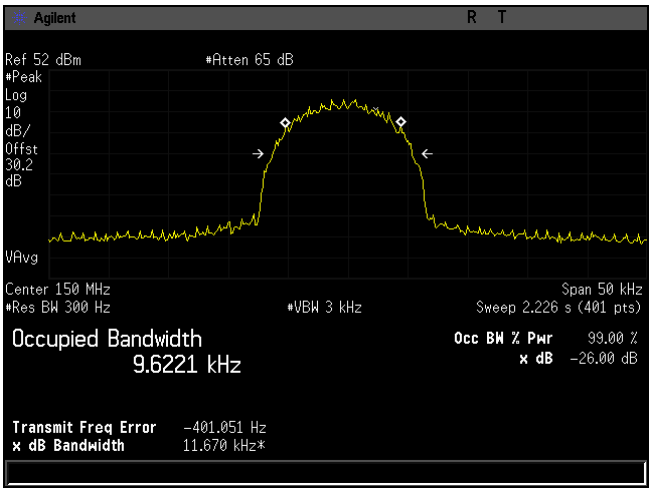
Test Results: The EUT was compliant with the requirements of this section.

Test Engineer(s): Hadid Jones

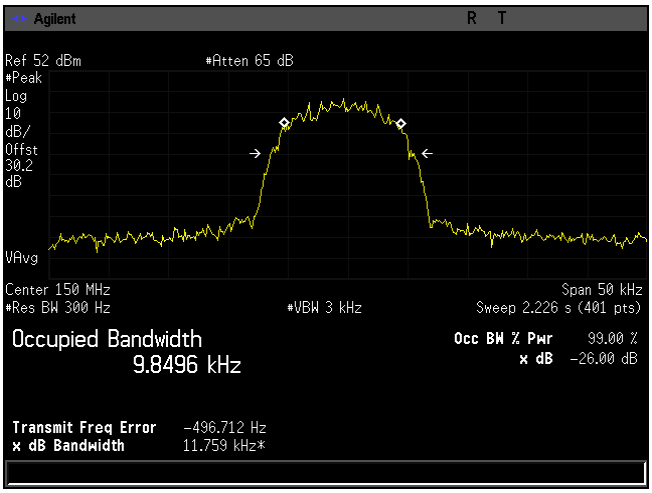
Test Date(s): June 22, 2017



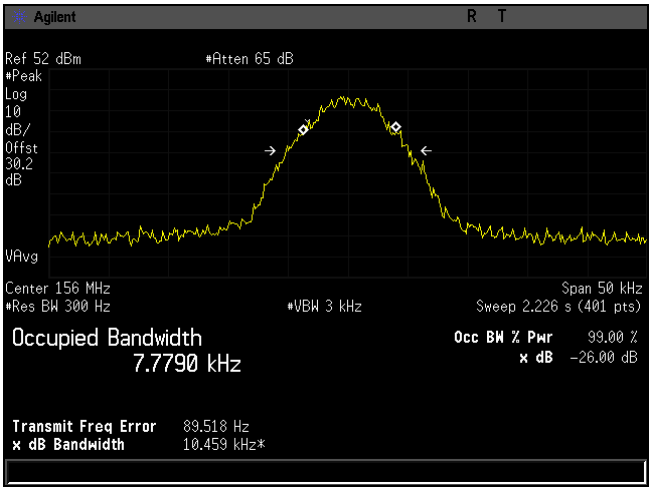
Plot 25. Occupied Bandwidth, 150.0125MHz, C4FM, 100W



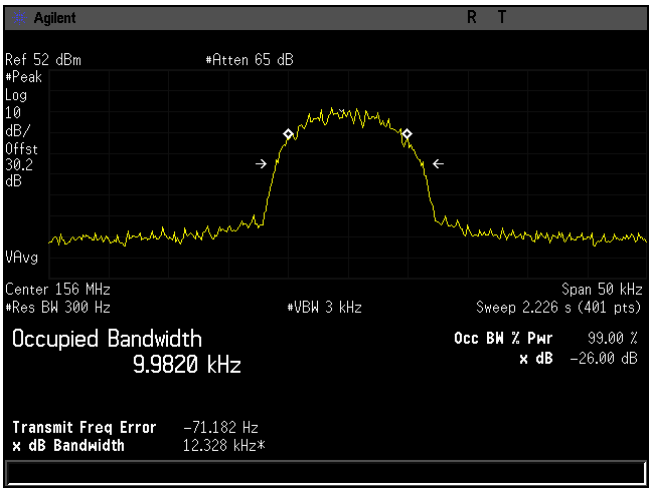
Plot 26. Occupied Bandwidth, 150.0125MHz, CQPSK, 100W



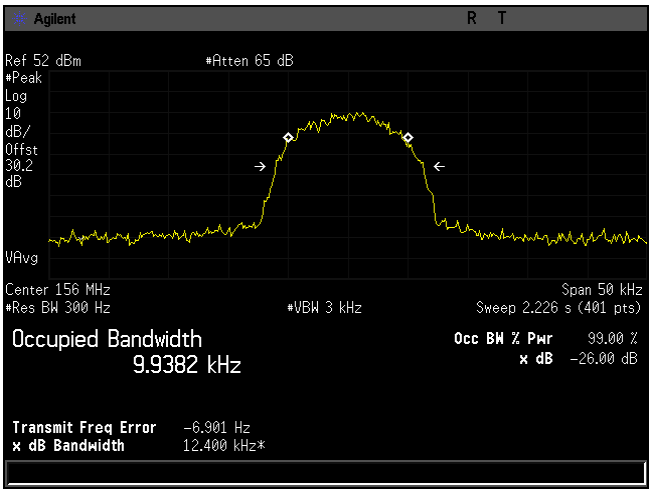
Plot 27. Occupied Bandwidth, 150.0125MHz, HDQPSK, 100W



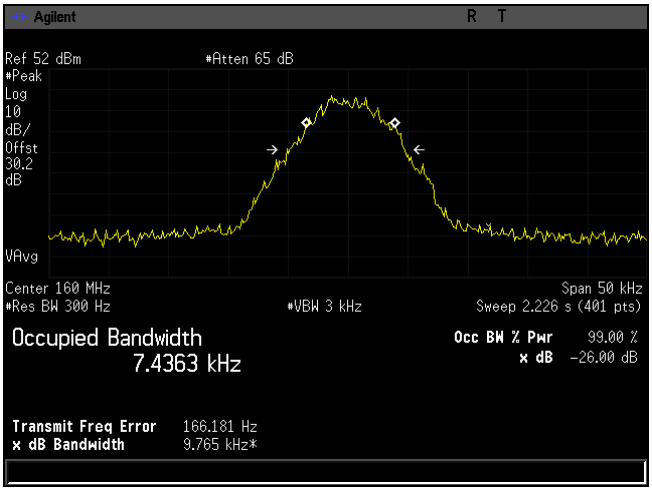
Plot 28. Occupied Bandwidth, 156.0125MHz, C4FM, 100W



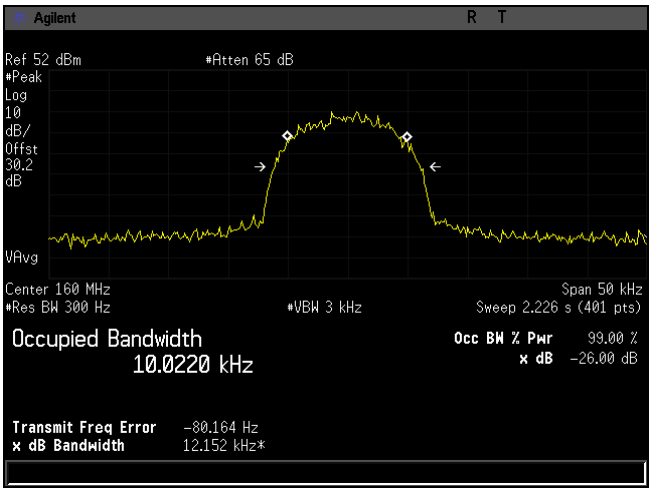
Plot 29. Occupied Bandwidth, 156.0125MHz, CQPSK, 100W



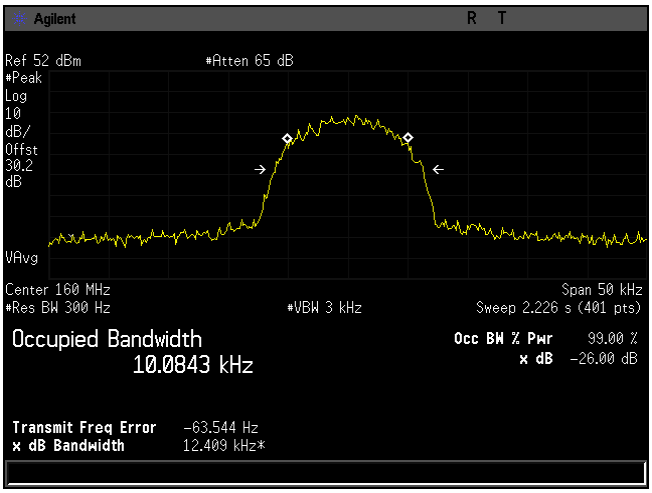
Plot 30. Occupied Bandwidth, 156.0125MHz, HDQPSK, 100W



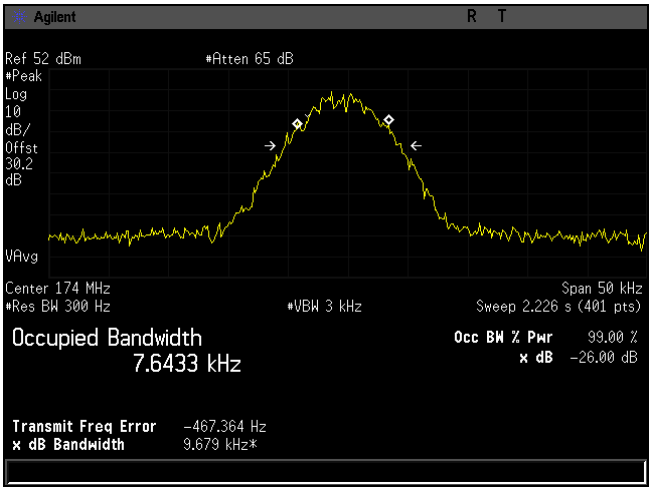
Plot 31. Occupied Bandwidth, 160.0125MHz, C4FM, 100W



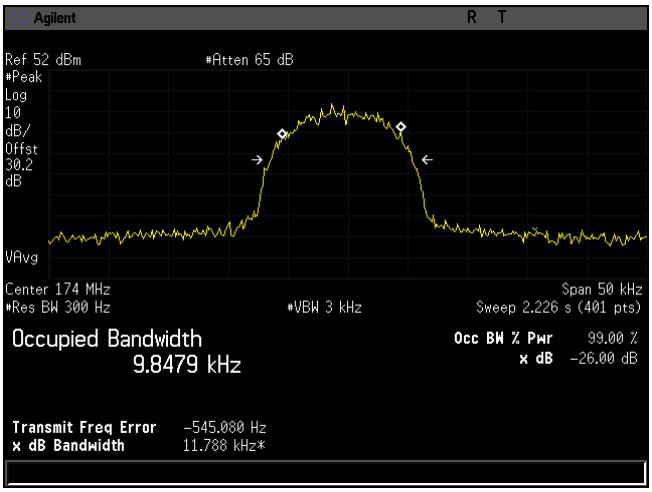
Plot 32. Occupied Bandwidth, 160.0125MHz, CQPSK, 100W



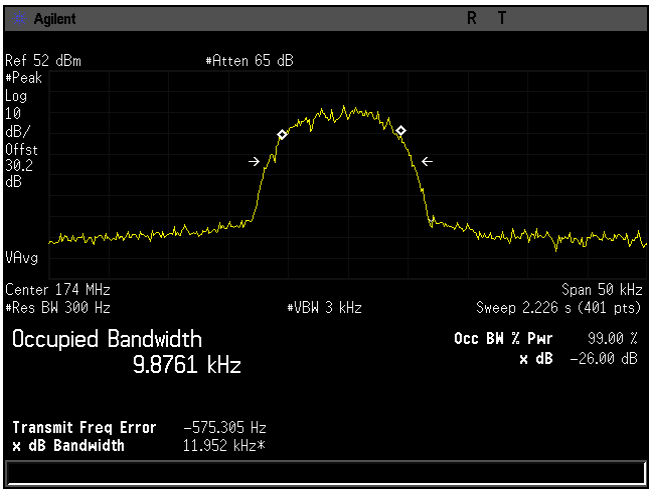
Plot 33. Occupied Bandwidth, 160.0125MHz, HDQPSK, 100W



Plot 34. Occupied Bandwidth, 173.9875MHz, C4FM, 100W



Plot 35. Occupied Bandwidth, 173.9875MHz, CQPSK, 100W



Plot 36. Occupied Bandwidth, 173.9875MHz, HDQPSK, 100W

§ 80.211 Emission Mask

Test Requirement(s): (1) On any frequency removed from the assigned frequency by more than 50 percent, up to and including 100 percent of the authorized bandwidth: At least 25 dB;

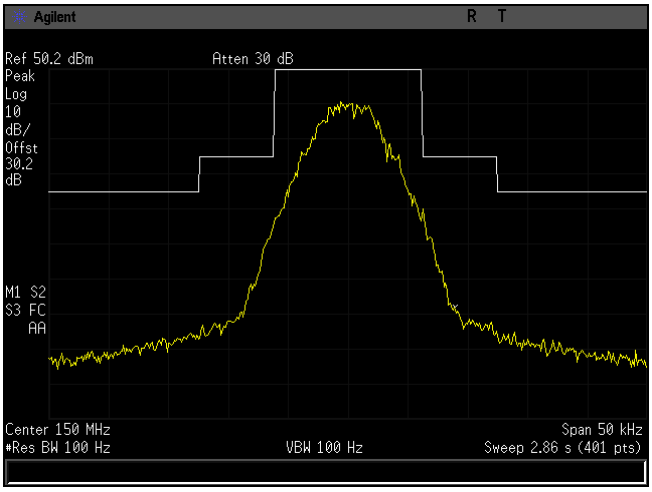
(2) On any frequency removed from the assigned frequency by more than 100 percent: at least 30 dB.

Test Procedures: As required by 47 CFR §2.1051, *Spurious Emissions at Antenna Terminals*, specifically the *Emissions Limitations* as defined in *Part 80.211 (f)(1).* Measurements were made with a Spectrum Analyzer connected to the RF ports of the transmitter, with suitable attenuation.

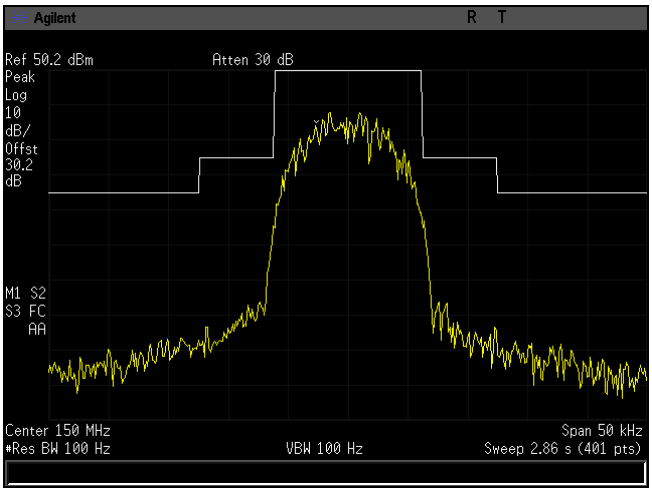
Test Results: The EUT was compliant with the requirements of this section.

Test Engineer(s): Hadid Jones

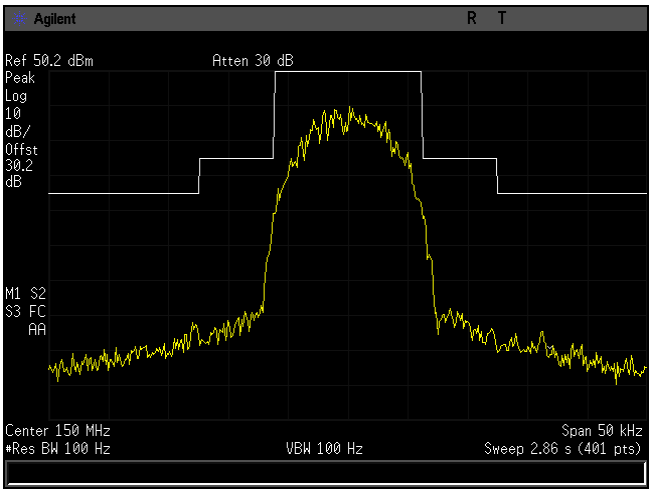
Test Date(s): June 22, 2017



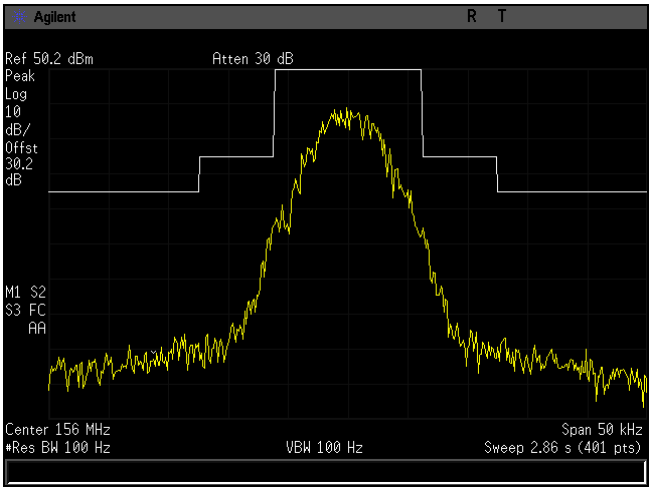
Plot 37. Emissions Mask, 150M, C4FM, 100W



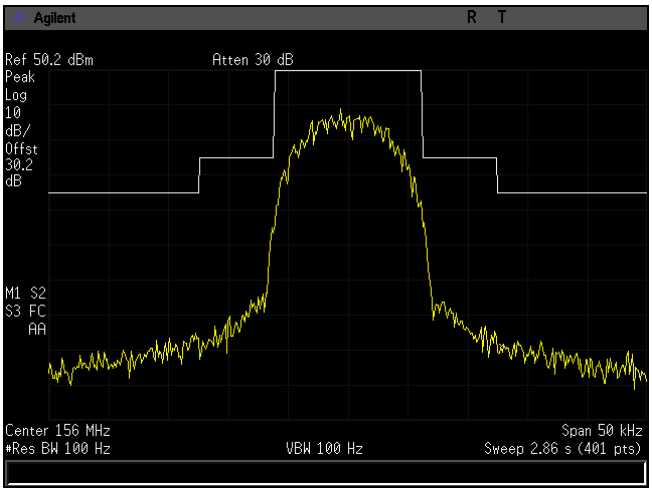
Plot 38. Emissions Mask, 150M, CQPSK, 100W



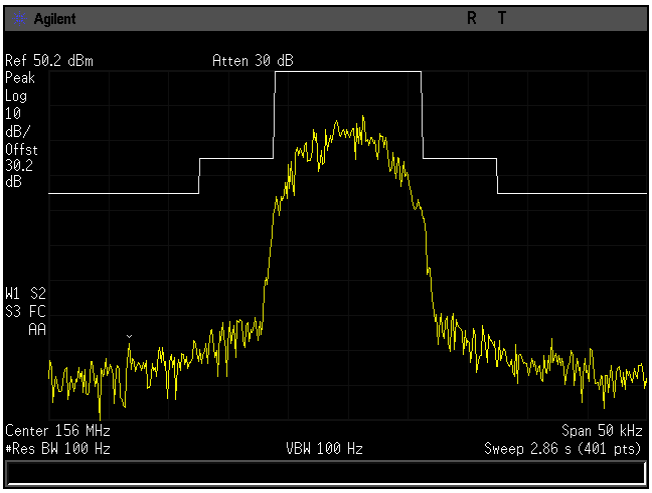
Plot 39. Emissions Mask, 150M, HDQPSK, 100W



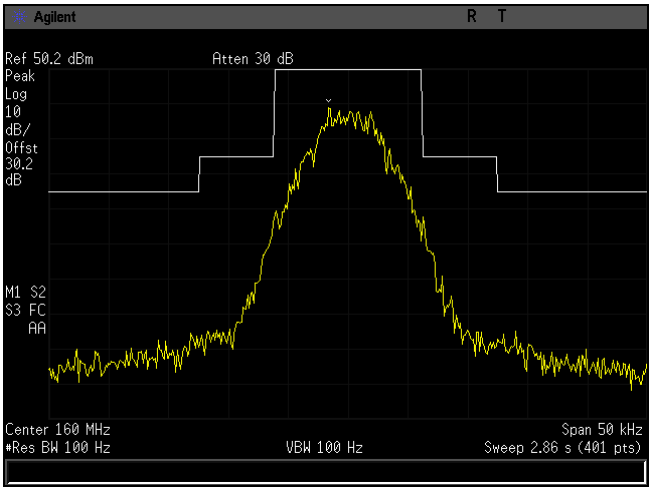
Plot 40. Emissions Mask, 156M, C4FM, 100W



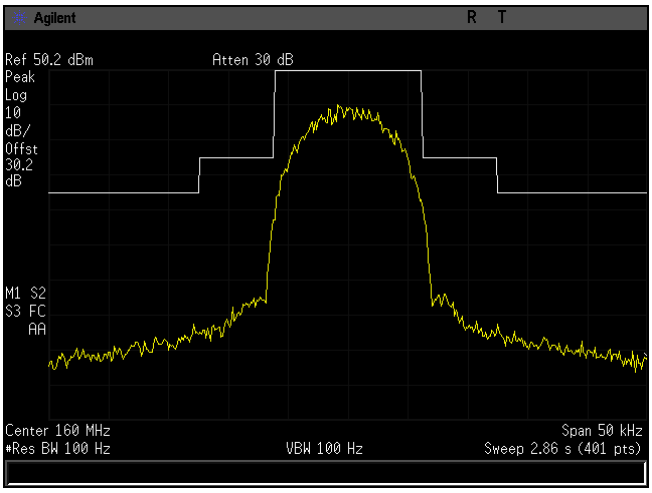
Plot 41. Emissions Mask, 156M, CQPSK, 100W



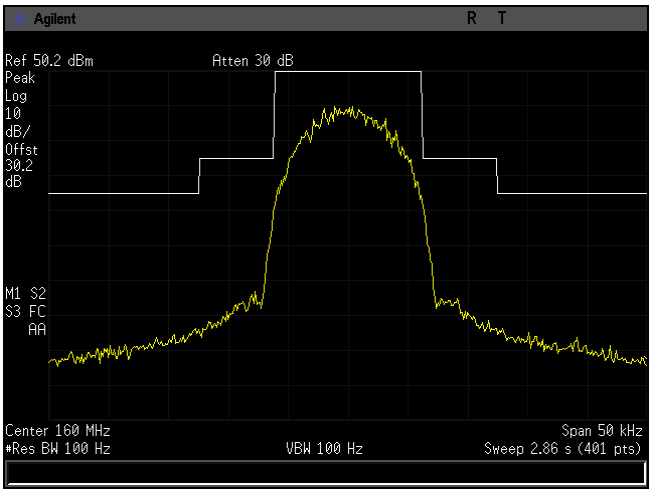
Plot 42. Emissions Mask, 156M, HDQPSK, 100W



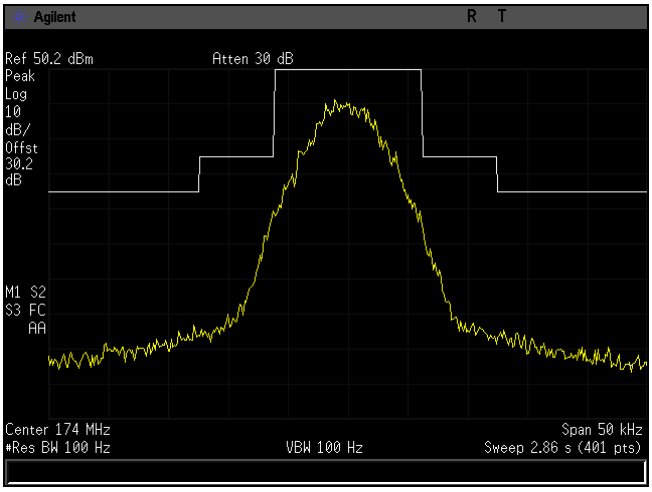
Plot 43. Emissions Mask, 160M, C4FM, 100W



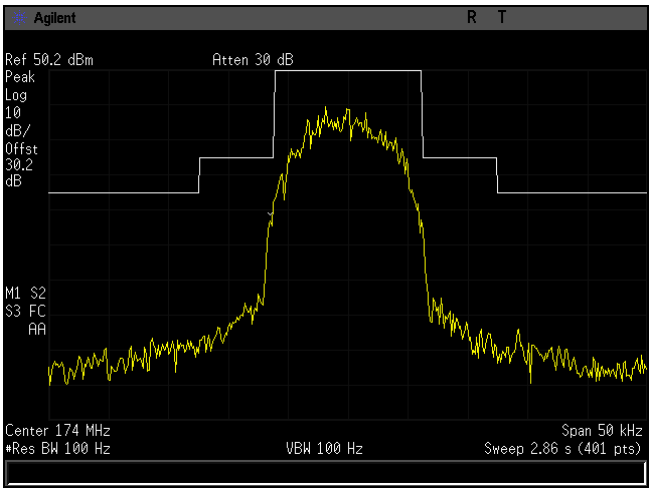
Plot 44. Emissions Mask, 160M, CQPSK, 100W



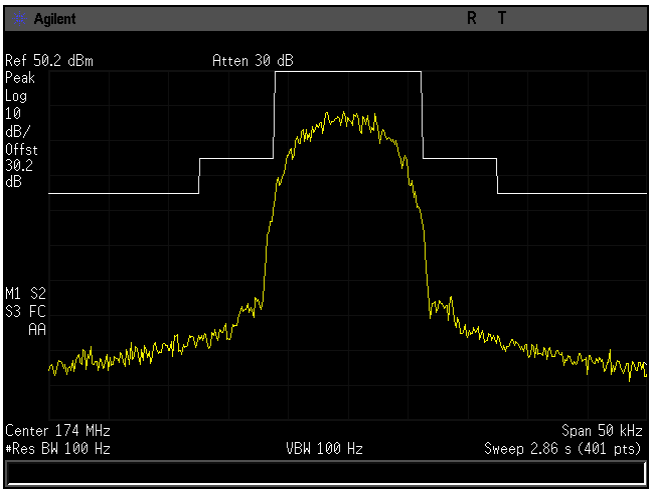
Plot 45. Emissions Mask, 160M, HDQPSK, 100W



Plot 46. Emissions Mask, 174M, C4FM, 100W



Plot 47. Emissions Mask, 174M, CQPSK, 100W



Plot 48. Emissions Mask, 174M, HDQPSK, 100W

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 2.1053 Radiated Spurious Emissions

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

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

Test Procedures: The EUT was tested according to field strength method of ANSI C63.26 5.5.4.The spectrum analyzer was used and configured in the following manner:

(a) Frequency Range = Lowest Generated – 10^{th} Harmonic
(b) RBW = 1MHz
(c) VBW 1-3 x the RBW
(d) Detector = Average

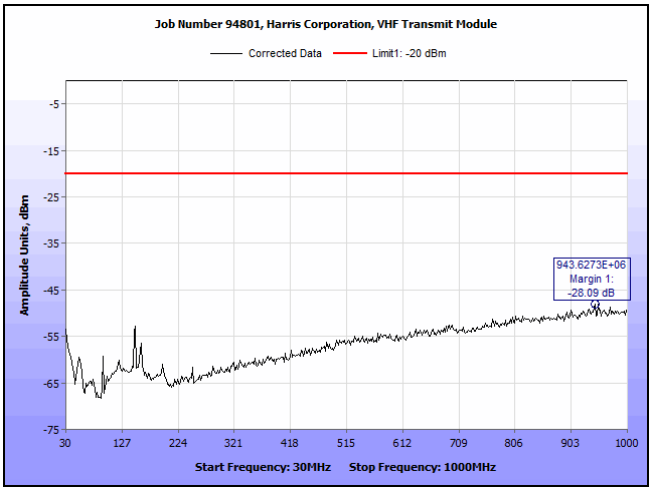
Radiated emission measurements were performed inside a 3 meter chamber that satisfies the site requirements of ANSI C63.4-2014. The EUT was place on an rf transparent 80 cm table for measurements below 1GHz and an rf transparent 1.5 meter table for measurements above 1GHz. The EUT's RF ports were terminated to 50ohm load. The EUT was tested using all modulations and at the low, mid, and high channels. The EUT was rotated about 360^0 and the receiving antenna scanned from 1-4m in order to capture the maximum emission. The plots are corrected for cable loss, antenna correction factor, and distance correction. The field strength was mathematically corrected to an E.I.R.P.

Emissions below 30MHz and above 18GHz were more than 20dB below the limit. The worse-case configurations are reported.

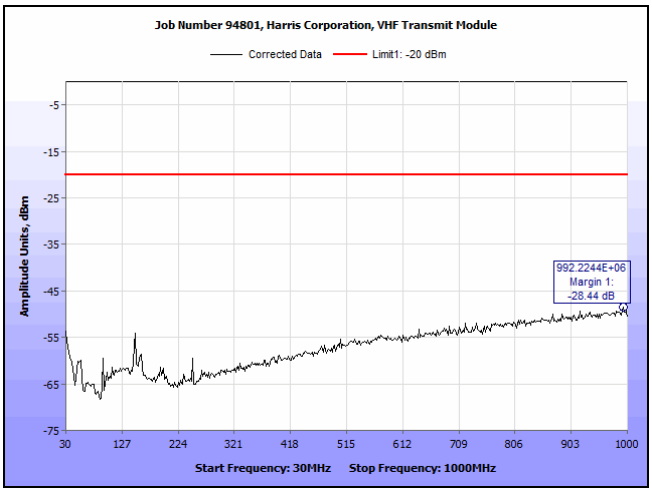
Test Results: The EUT was compliant with the requirements of this section.

Test Engineer: Hadid Jones

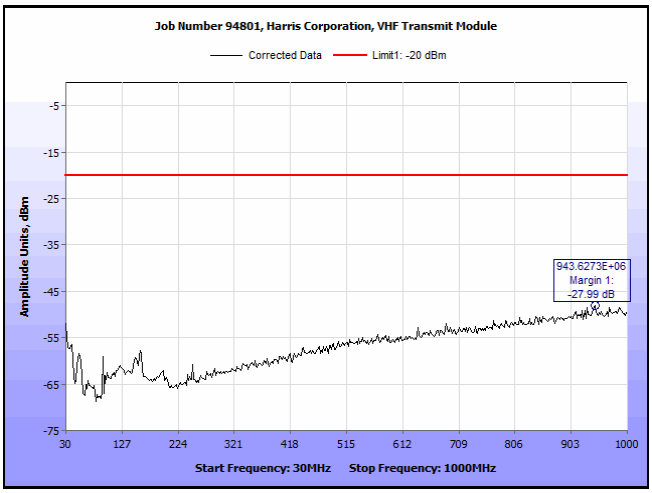
Test Date(s): July 10, 2017



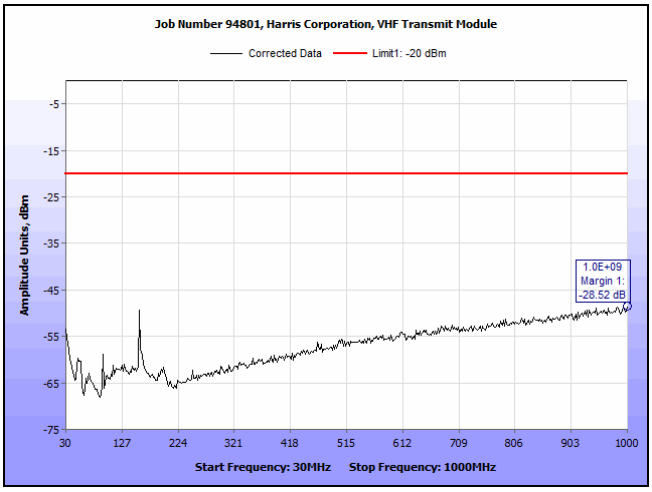
Plot 49. Spurious Radiated Emissions, 30-1000MHz, 150MHz Channel, C4FM, 100W



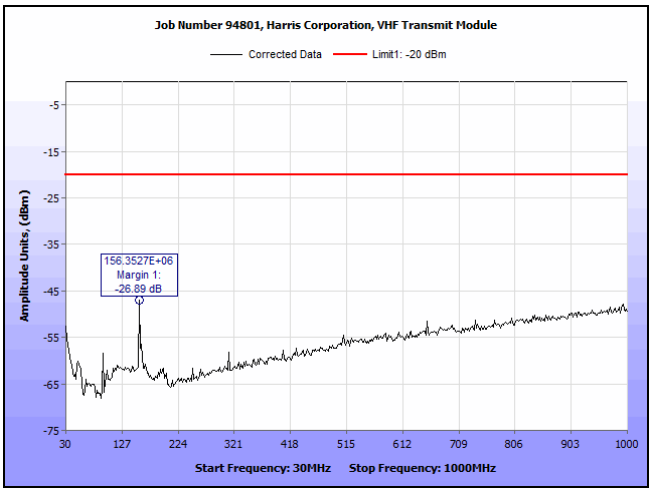
Plot 50. Spurious Radiated Emissions, 30-1000MHz, 150MHz Channel, CQPSK, 100W



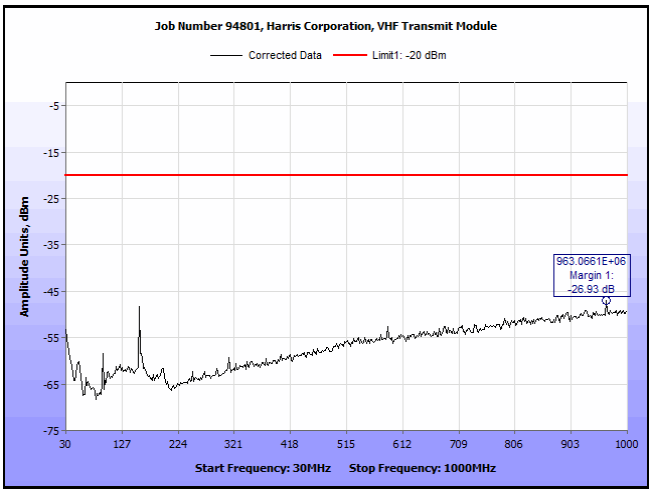
Plot 51. Spurious Radiated Emissions, 30-1000MHz, 150MHz Channel, HDQPSK, 100W



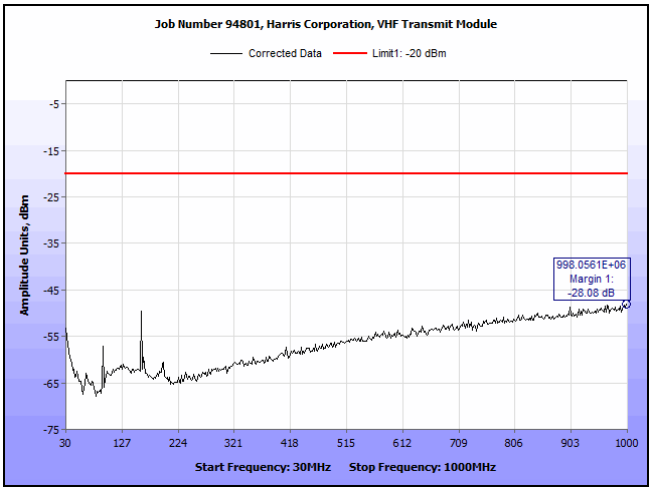
Plot 52. Spurious Radiated Emissions, 30-1000MHz, 156MHz Channel, C4FM, 100W



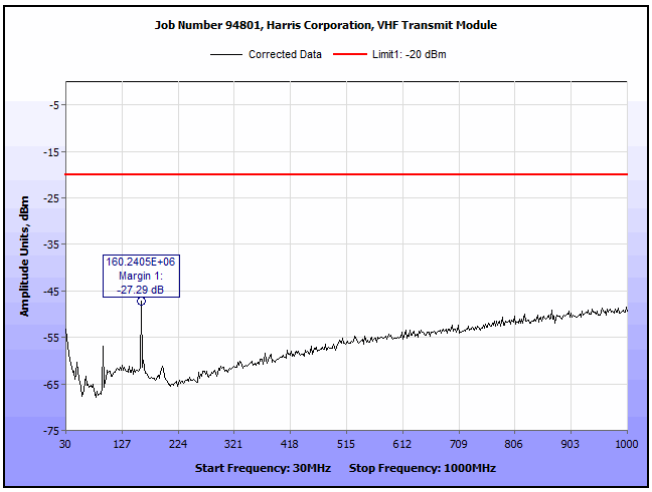
Plot 53. Spurious Radiated Emissions, 30-1000MHz, 156MHz Channel, CQPSK, 100W



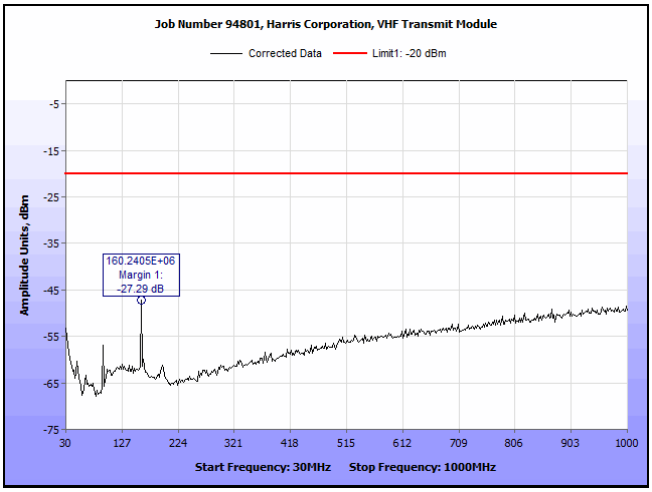
Plot 54. Spurious Radiated Emissions, 30-1000MHz, 156MHz Channel, HDQPSK, 100W



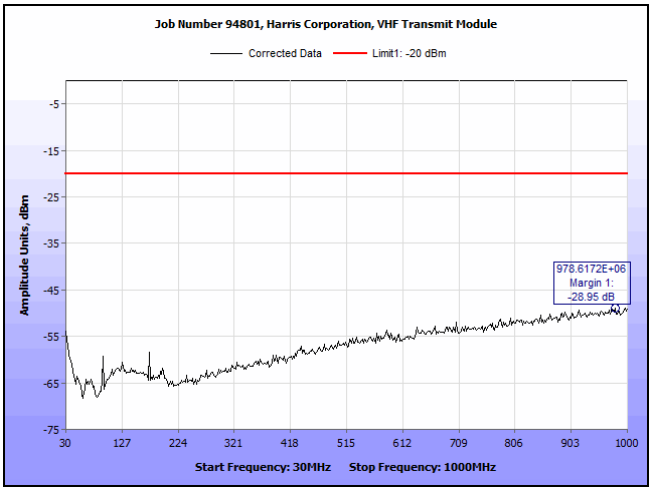
Plot 55. Spurious Radiated Emissions, 30-1000MHz, 160MHz Channel, C4FM, 100W



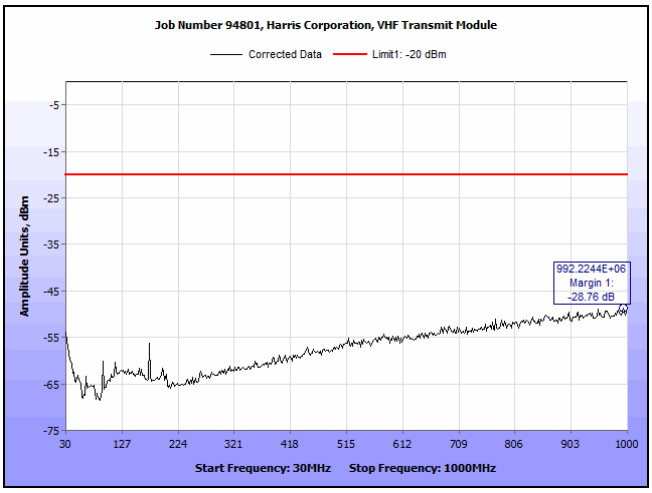
Plot 56. Spurious Radiated Emissions, 30-1000MHz, 160MHz Channel, CQPSK, 100W



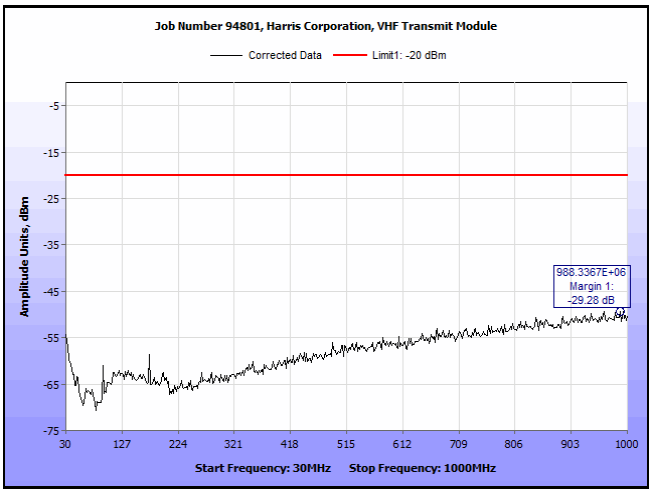
Plot 57. Spurious Radiated Emissions, 30-1000MHz, 160MHz Channel, HDQPSK, 100W



Plot 58. Spurious Radiated Emissions, 30-1000MHz, 174MHz Channel, C4FM, 100W



Plot 59. Spurious Radiated Emissions, 30-1000MHz, 174MHz Channel, CQPSK, 100W



Plot 60. Spurious Radiated Emissions, 30-1000MHz, 174MHz Channel, HDQPSK, 100W

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 2.1051 Spurious Emissions at Antenna Terminals

Test Requirement(s): **§ 2.1051 Measurements required: Spurious emissions at antenna terminals:** The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

Test Procedures: The EUT was tested according to the unwanted emissions procedures of ANSI C63.26 5.7.3.The spectrum analyzer was used and configured in the following manner:

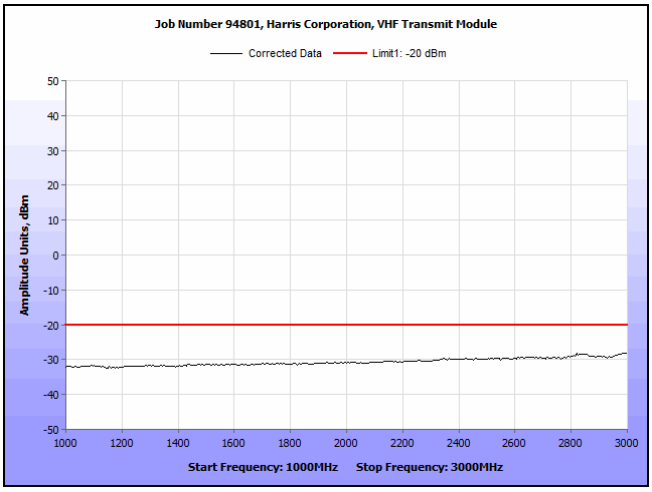
(a) Frequency Range = 30MHz – 10th Harmonic
(b) RBW = 1% of the OBW, or greater
(c) VBW 1-3 x the RBW
(d) Detector = Average
(e) Sweet Time = Auto

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

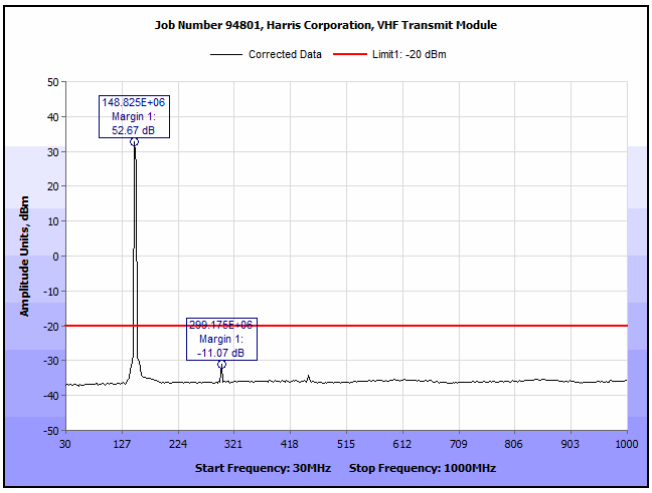
All configurations were evaluated. The worse-case data is reported.

Test Engineer(s): Hadid Jones

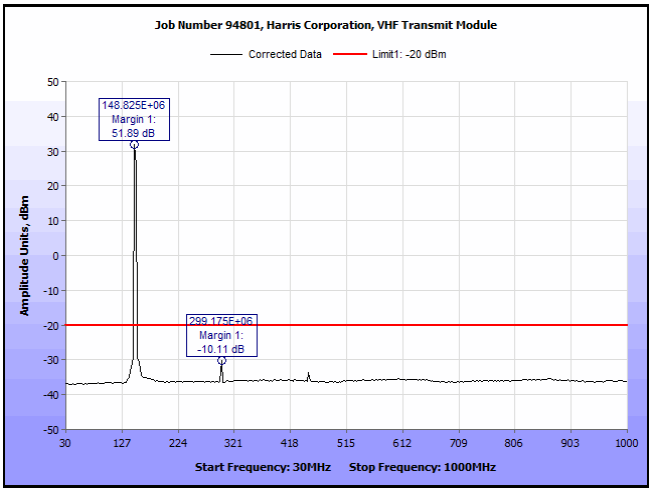
Test Date(s): June 22, 2017



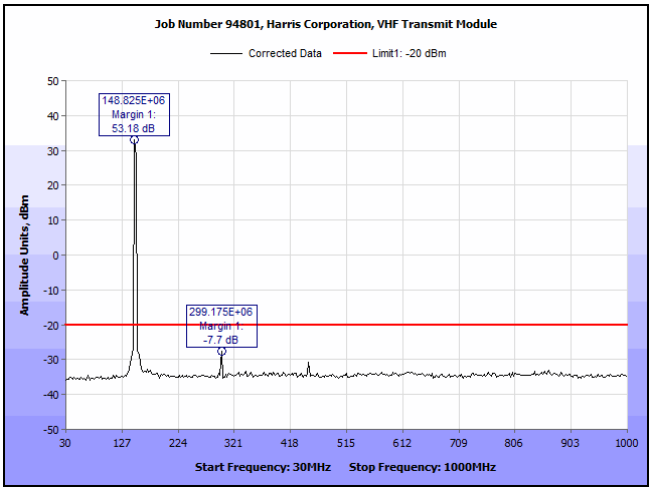
Plot 61. Spurious Emissions at Antenna Terminals, Above 1GHz, 156MHz HDQPSK, 100W



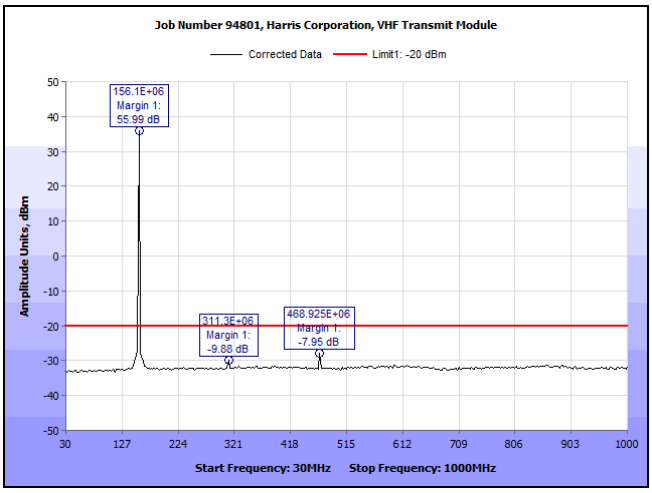
Plot 62. Spurious Emissions at Antenna Terminals, Below 1GHz, 150MHz C4FM, 100W



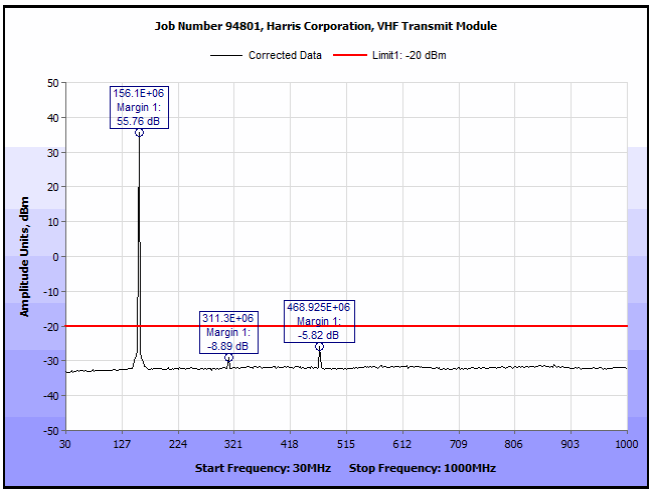
Plot 63. Spurious Emissions at Antenna Terminals, Below 1GHz, 150MHz CQPSK, 100W



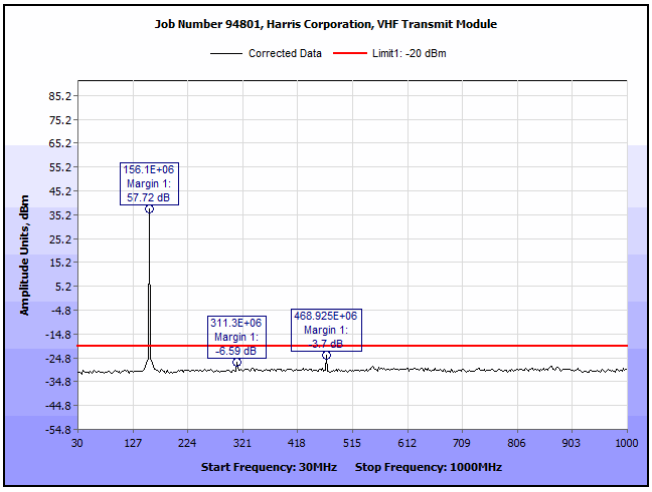
Plot 64. Spurious Emissions at Antenna Terminals, Below 1GHz, 150MHz HDQPSK, 100W



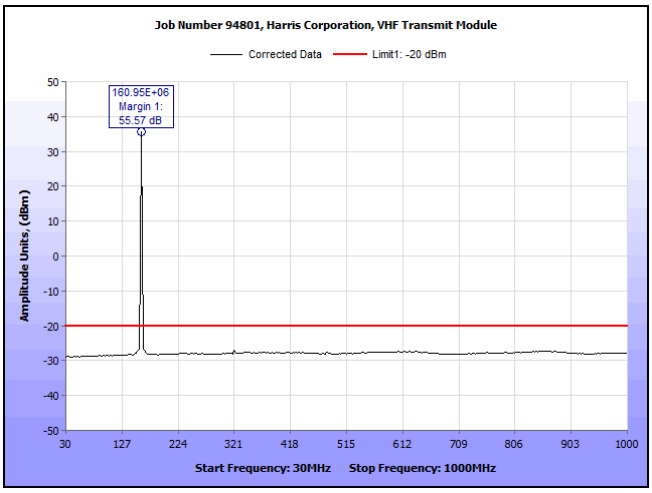
Plot 65. Spurious Emissions at Antenna Terminals, below 1GHz, 156MHz C4FM, 100W



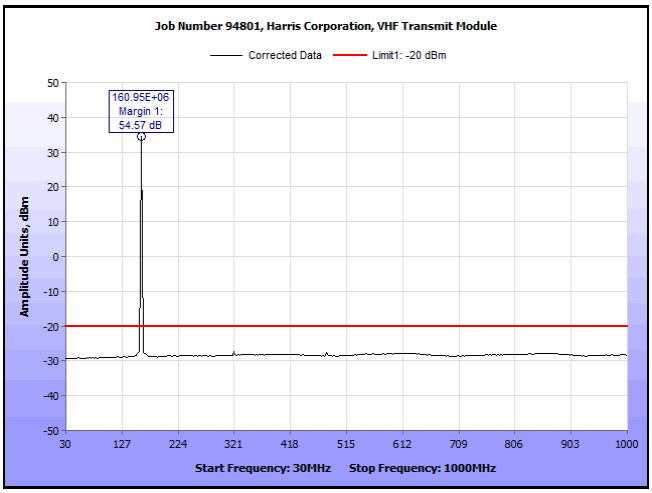
Plot 66. Spurious Emissions at Antenna Terminals, below 1GHz, 156MHz CQPSK, 100W



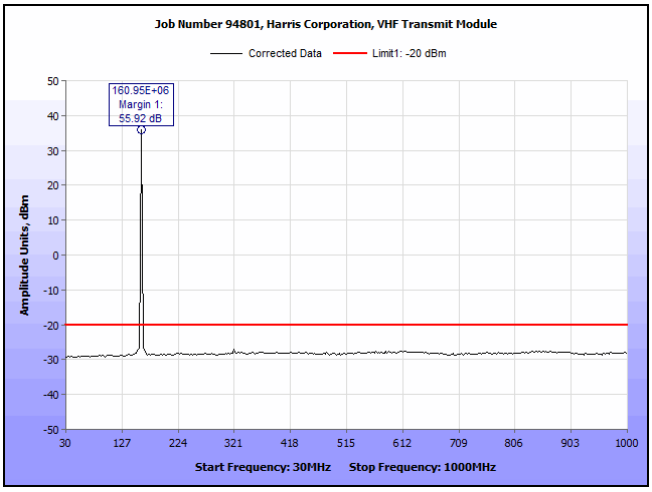
Plot 67. Spurious Emissions at Antenna Terminals, below 1GHz, 156MHz HDQPSK, 100W



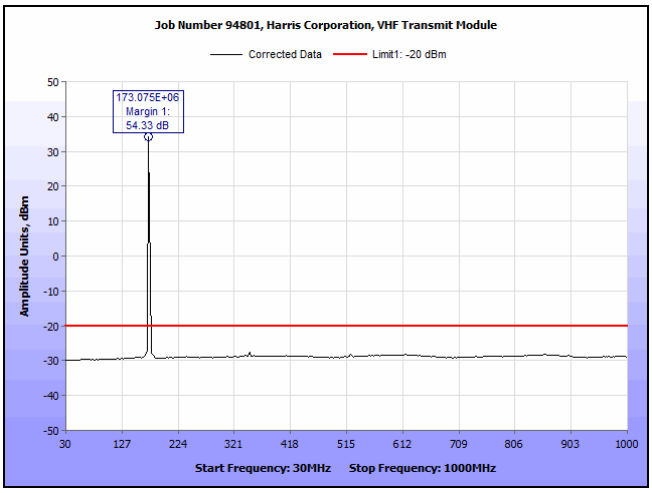
Plot 68. Spurious Emissions at Antenna Terminals, below 1GHz, 160MHz C4FM, 100W



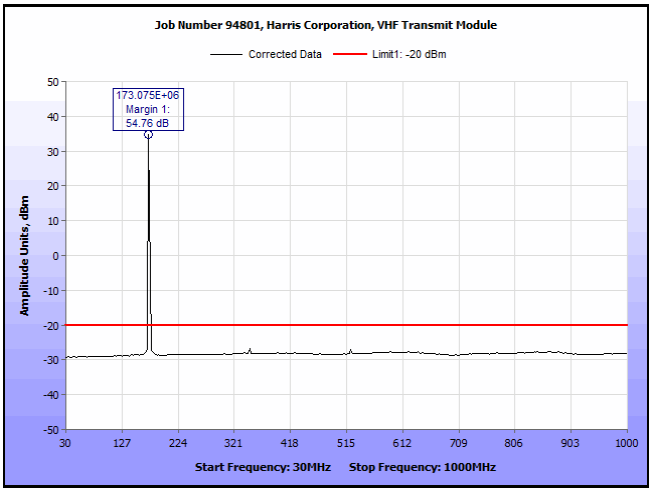
Plot 69. Spurious Emissions at Antenna Terminals, below 1GHz, 160MHz CQPSK, 100W



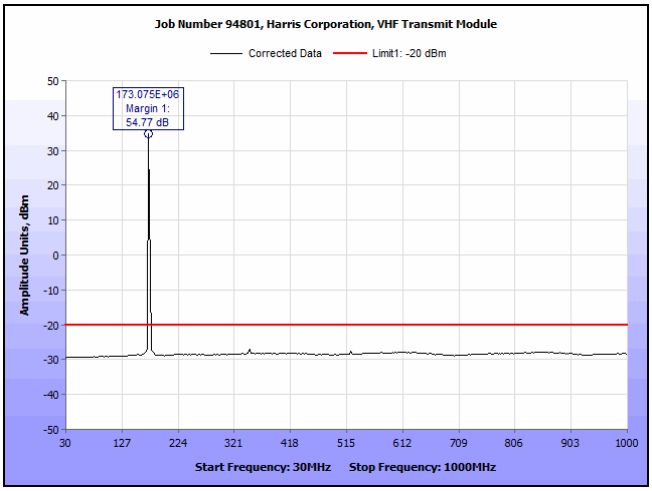
Plot 70. Spurious Emissions at Antenna Terminals, below 1GHz, 160MHz HDQPSK, 100W



Plot 71. Spurious Emissions at Antenna Terminals, below 1GHz, 174MHz C4FM, 100W



Plot 72. Spurious Emissions at Antenna Terminals, below 1GHz, 174MHz CQPSK, 100W



Plot 73. Spurious Emissions at Antenna Terminals, below 1GHz, 174MHz HDQPSK, 100W

IV. Test Equipment

Test Equipment

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

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1T8818	Spectrum Analyzer	Agilent Technologies	E4407B	2/24/2017	2/24/2018
1T4753	Antenna - Bilog	Sunol Sciences	JB6	10/24/2016	4/24/2018
1T4563	LISN (10 AMP)	Solar Electronics Company	9322-50-R-10-BNC	3/13/2017	9/13/2018
1T4300	SEMI-ANECHOIC CHAMBER # 1 (NSA)	EMC TEST SYSTEMS	NONE	2/6/2015	2/6/2018
1T4409	EMI Receiver	Rohde & Schwarz	ESIB7	12/7/2016	12/7/2018
1T4269	Antenna: Loop	EMCO	10/28/1917	1/11/2016	7/11/2017
1T4483	Antenna; Horn	ETS-Lindgren	7/13/1908	4/19/2017	10/19/2018
1T4771	PSA Spectrum Analyzer	Agilent Technologies	E4446A	8/10/2016	2/10/2018

Table 8. Test Equipment

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

V. Certification & User's Manual Information

Certification & User's Manual Information

A. Certification Information

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

§ 2.801 Radio-frequency device defined.

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

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

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

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

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

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

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

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

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

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

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

(i) Compliance testing;

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

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

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

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

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

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

Certification & User's Manual Information

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

§ 2.901 Basis and Purpose

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

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

§ 2.907 Certification.

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

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

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

Certification & User's Manual Information

§ 2.948 Description of measurement facilities.

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

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

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

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

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

Certification & User's Manual Information

1. Label and User's Manual Information

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

§ 15.19 Labeling requirements.

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

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

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

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

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

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

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

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

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

§ 15.21 Information to user.

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

Verification & User's Manual Information

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

§ 15.105 Information to the user.

(a) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

> Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
>
> – Reorient or relocate the receiving antenna.
>
> – Increase the separation between the equipment and receiver.
>
> – Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
>
> – Consult the dealer or an experienced radio/TV technician for help.

End of Report

