RHEIN TECH LABORATORIES, INC.

Engineering Solutions & Electromagnetic Compatibility Services

FCC & IC Class 2 Permissive Change Report

Harris Corporation
RF Communications Division
1680 University Avenue
Rochester, NY 14610

Model: Unity XG-100M MultiBand Mobile Radio

FCC ID: AQZ-XG-100M00
IC: 122D-XG100M00

August 30, 2012

Standards Referenced for this Report	
Part 2: 2011	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
Part 90: 2011	Private Land Mobile Radio Services
TIA-EIA-603-C August 2004	Land Mobile FM or PM Communications Equipment – Measurement and Performance Standards
ANSI/TIA/EIA–102.CAAA; 2002	Digital C4FM/CQPSK Transceiver Measurement Methods
ANSI/TIA/EIA–102.BAAA–1998	Project 25 FDMA Common Air Interface—New Technology Standards Project—Digital Radio Technical Standards
Industry Canada RSS-119 Issue 11	Land Mobile and Fixed Radio Transmitters and Receivers Operating in the Frequency Range 27.41- 960 MHz

Frequency Range (MHz)	Rated Transmit Power (W) (Conducted)	Frequency Tolerance (ppm)	Emission Designator (Transmit Mode)
806–824 851–869	0.5 - 37.2	0.5	11K9F1D/E 2-level FSK, digitized data or voice, EDACS (NPSPAC)
809–824 854–869	0.5 - 37.2	0.5	14K2F1D/E 2-level FSK, digitized data or voice, EDACS (WB)

Report Prepared By: Daniel Baltzell

Document Number: 2012258

These tests are accredited and meet the requirements of ISO/IEC 17025 as verified by ANSI-ASQ National Accreditation Board/ACLASS. Refer to certificate and scope of accreditation AT-1445.

Table of Contents

Table of Figures

Table of Tables

Table of Plots

Table of Appendixes

Table of Photographs

1 Test Result Summary

Test	FCC Reference	Result
Field Strength of Spurious Radiation	2.1053(a), 90.543(c)	Complies

Test	FCC Reference	IC Reference	Result
RF Power Output	2.1046(a), 90.541(b), 90.542(a)(6)	RSS-119 5.4	Complies
Spurious Emissions at Antenna Terminals	2.1046(a), 90.541(b), 90.542(a)(6)	RSS-119 5.4	Complies
Field Strength of Spurious Radiation	2.1053(a), 90.543(f)	RSS-119 5.5, 5.8	Complies
Occupied Bandwidth/Emission Masks	2.1049(c)(1), 90.543(d)	RSS-119 5.5, 5.8	Complies
Receiver/Unintentional Emissions	15.109	RSS-Gen/ TIA-603-C-2004 2.1.1	Complies

2 General Information

The following Class 2 Permissive Change Report is prepared on behalf of Harris Corporation in accordance with the Federal Communications Commission and Industry Canada rules and regulations. The Equipment Under Test (EUT) was Unity XG-100M Multiband Radio; FCC ID: AQZ-XG-100M00, IC: 122D-XG100M00.

The purpose of this Class 2 Permissive Change is to incorporate the EDACS mode of operation in the mobile radio:

1.) EDACS, a trunking mode of operation, was present in the product during original filing and is now being enabled for customer needs and demand.
2.) No components have been added or deleted, and the PCB has not changed.
3.) Output power remains the same, the trunking protocol of EDACS becomes available for configuration.
4.) No new modulation is used, nor new transmitted waveforms; FM and FSK continues to be used. No MPE assessment is needed.

All measurements contained in this application were conducted in accordance with the applicable sections of FCC Rules and Regulations CFR 47 Parts 2 and 90. Calibration checks are performed regularly on the instruments, and all accessories including high pass filter, coaxial attenuator, preamplifier and cables.

2.1 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located on the parking lot of Rhein Tech Laboratories, Inc. 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report submitted to, and approved by, the Federal Communications Commission to perform AC line conducted and radiated emissions testing.

2.2 Related Submittal(s)/Grant(s)

The original FCC certification was granted May 24, 2011 with a Class II permissive change application granted on October 24, 2011, and December 15, 2011. The original IC certification was granted May 25, 2011, with a reassessment application granted on October 26, 2011.

2.3 Grant Notes

None.

3 Tested System Details

The test sample was received on August 23, 2012. Listed below are the identifiers and descriptions of all equipment, cables, and internal devices used with the EUT for this testing, as applicable.

The device is capable of multiple modes of operation and modulation types using ASCII commands sent via serial interface.

Table 3-1: Equipment Under Test (EUT)

Part	Manufacturer	Model	PN/SN	FCC ID	RTL Bar Code
XG-100M Unity Mobile Radio	Harris Corporation	CT-013892-001 Rev B	A40201000227	AQZ-XG-100M00	20368

Table 3-2: Auxiliary Equipment

Part	Manufacturer	Model	PN/SN	FCC ID	RTL Bar Code
Audio Input/PTT Switch	Harris	N/A	N/A	N/A	17930
13.8 VDC Power Supply	Samlex America, Inc.	SEC 1223	03061-3J04-00763	DoC	17707
Power Cable	Harris	CA-012365-001	N/A	N/A	N/A

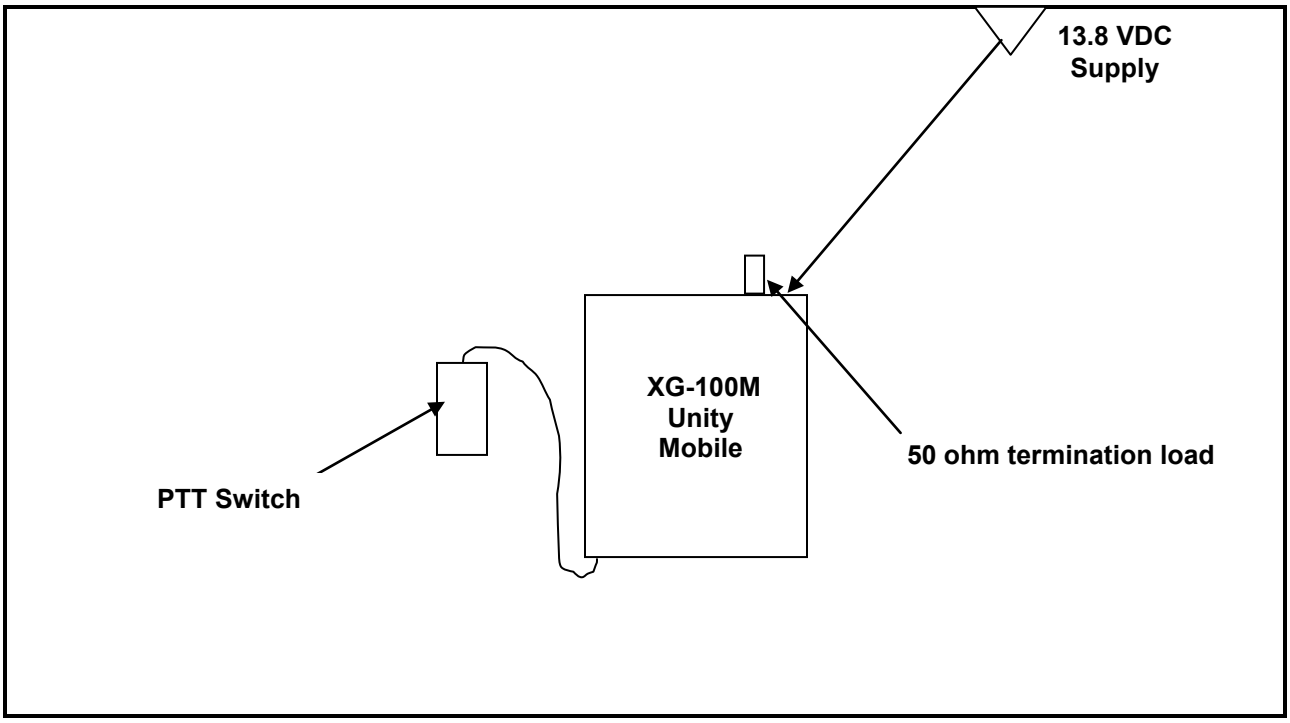


Figure 3-1: Configuration of Tested System

4 FCC Rules and Regulations §90.1215(a) and §2.1046(a): Peak Output Power

4.1 Test Procedure

ANSI TIA-603-2004, section 2.2.1.

The EUT was connected via an appropriate 50 ohm attenuator to a signal analyzer. Attenuator loss was accounted for.

4.2 Test Data

Table 4-1: RF Power Output: Unmodulated Carrier Output Power

Frequency (MHz)	RF Power Measured (Watt)*
806.0125	39.0
815.0000	39.2
823.9875	39.3
851.0125	39.6
860.0000	39.6
868.9875	39.4

*** conducted antenna port power**

Table 4-2: RF Power Output (Rated Power)

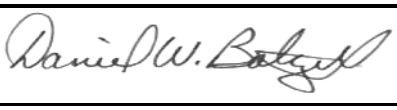
Frequency (MHz)	High Power Rated (W)
806-870	37.2

*** conducted antenna port power**

Table 4-3: Test Equipment for Testing RF Power Output - Conducted

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901583	Agilent Technologies	N9010A	EXA Signal Analyzer (10 Hz-26.5 GHz)	MY51250846	3/13/13
901537	Aeroflex	48-40-34	40 dB Attenuator	CB6628	10/14/12
17707	Samlex America, Inc	SEC 1223	13.8 VDC Power Supply	03061-3J04-00763	N/A

Test Personnel:

Daniel W. Baltzell		August 24, 2012
Test Engineer	Signature	Date of Test

5 FCC Rules and Regulations §2.1051: Spurious Emissions at Antenna Terminals; §90.210: Emissions Masks; RSS-119 §4.2: Transmitter Unwanted Emissions

5.1 Test Procedure

ANSI TIA-603-C-2004, Section 2.2.13.

The transmitter is terminated with a 50 Ω load and interfaced with a signal analyzer. The device uses digital modulation modulated to its maximum extent using a pseudo random data sequence of 9600 bps for EDACS (2-level FSK) Trunking Protocol mode.

5.2 Test Data

Frequency range of measurement per Part 2.1057: 9 kHz to 10xFc.

Limit: P(dBm) – (43 + 10xLOG P(W))

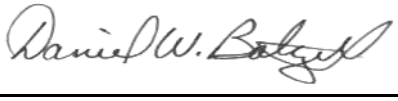
The worst case (unwanted emissions) channels are shown. The magnitude of emissions attenuated more than 20 dB below the FCC limit need not be recorded.

All channels were attenuated more than 20 dB below the limit and per 2.1051 are not reported.

Table 5-1: Test Equipment for Testing Conducted Spurious Emissions

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901583	Agilent Technologies	N9010A	EXA Signal Analyzer (10 Hz-26.5 GHz)	MY51250846	3/13/13
900930	Hewlett Packard	85662A	Spectrum Analyzer Display Section	3144A20839	2/6/13
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz-22 GHz)	3138A07771	2/6/13
901537	Aeroflex	48-40-34	40 dB Attenuator	CB6628	10/14/12
17707	Samlex America, Inc	SEC 1223	13.8 VDC Power Supply	03061-3J04-00763	N/A

Test Personnel:

Daniel W. Baltzell		August 24, 2012
Test Engineer	Signature	Date of Test

6 FCC Rules and Regulations §2.1049(c)(1); §90.210; RSS-119 5.8: Occupied Bandwidth

6.1 Test Procedure

ANSI/TIA/EIA-603-2004, section 2.2.11 and TIA/EIA-102.CAAA-2002 section 2.2.5

Device with digital modulation: Modulated to its maximum extent using a pseudo-random data sequence.

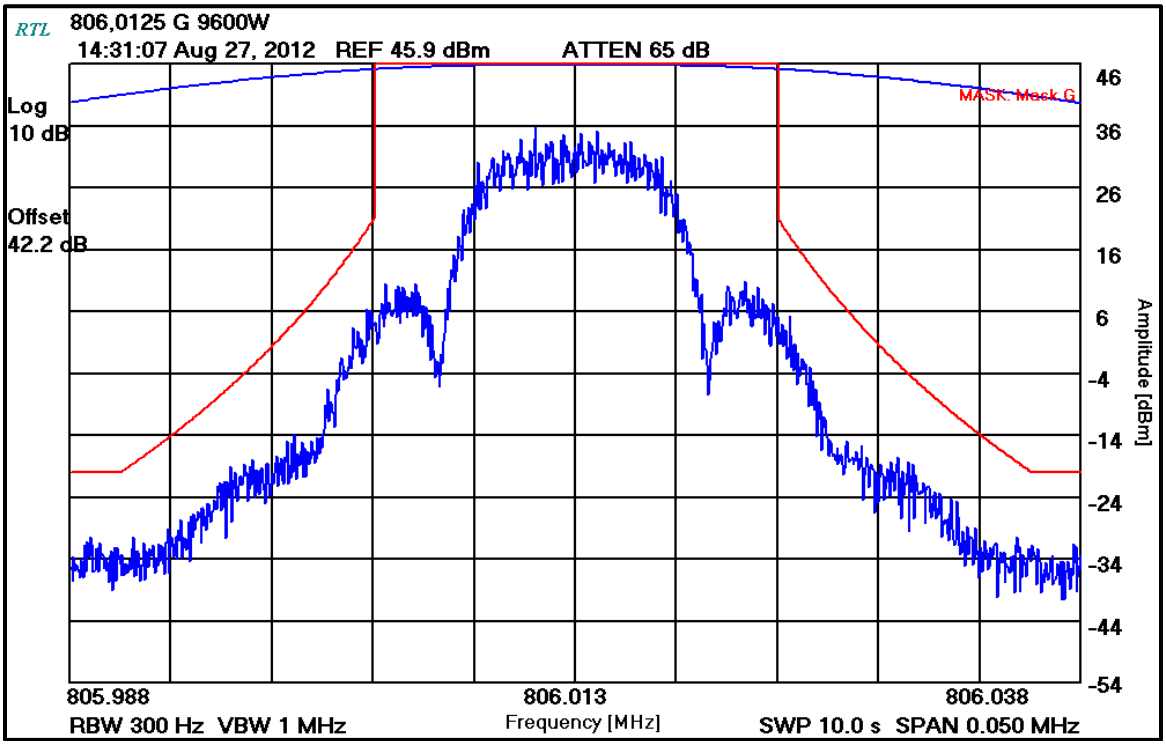
FCC §90.210

Applicable Emission Masks		
Frequency Band (MHz)	**Mask for Equipment with Audio Low Pass Filter**	**Mask for Equipment without Audio Low Pass Filter**
Below 25 [1]	A or B	A or C
25–50	B	C
72–76	B	C
150–174 [2]	B, D, or E	C, D, or E
150 Paging-only	B	C
220–222	F	F
421–512 [2]	B, D, or E	C, D, or E
450 Paging-only	B	G
806–809/851–854	B	H
809–824/854–869 [3]	B	G
896–901/935–940	I	J
902–928	K	K
929–930	B	G
4940–4990 MHz	L or M	L or M
5850–5925 [4]		
All other bands	B	C

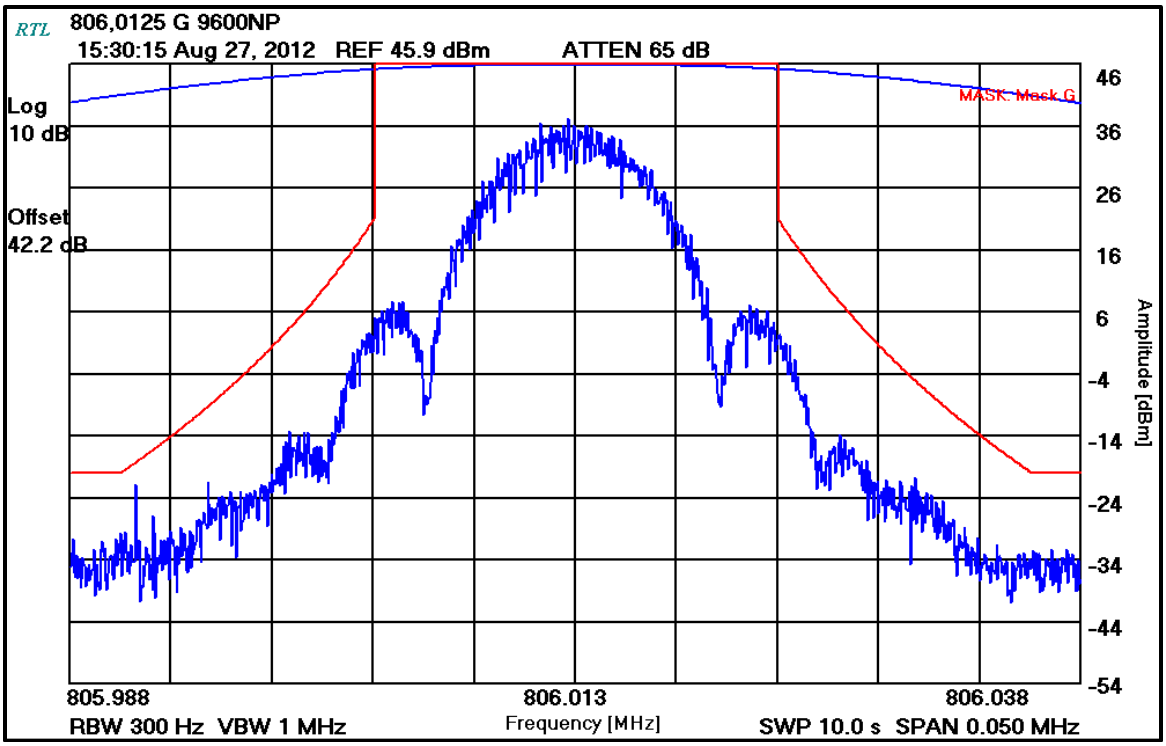
[1] Equipment using single sideband J3E emission must meet the requirements of Emission Mask A. Equipment using other emissions must meet the requirements of Emission Mask B or C, as applicable.
[2] Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth must meet the requirements of Emission Mask E.
[3] Equipment used in this licensed to EA or non-EA systems shall comply with the emission mask provisions of §90.691.
[4] DSRCS Roadside Unit equipment in the 5850–5925 MHz band is governed under subpart M of this part.

6.2 Test Data

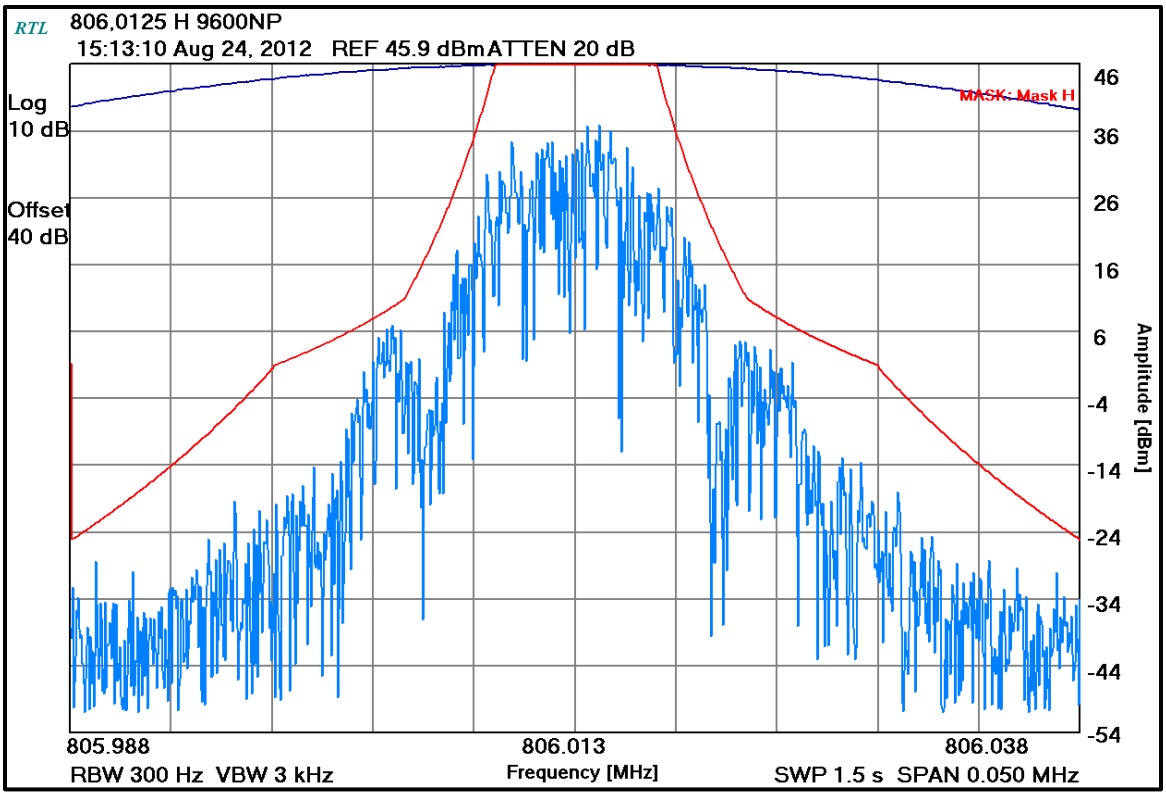
Plot 6-1: Occupied Bandwidth – TX 9600W; 806.0125 MHz; Mask G



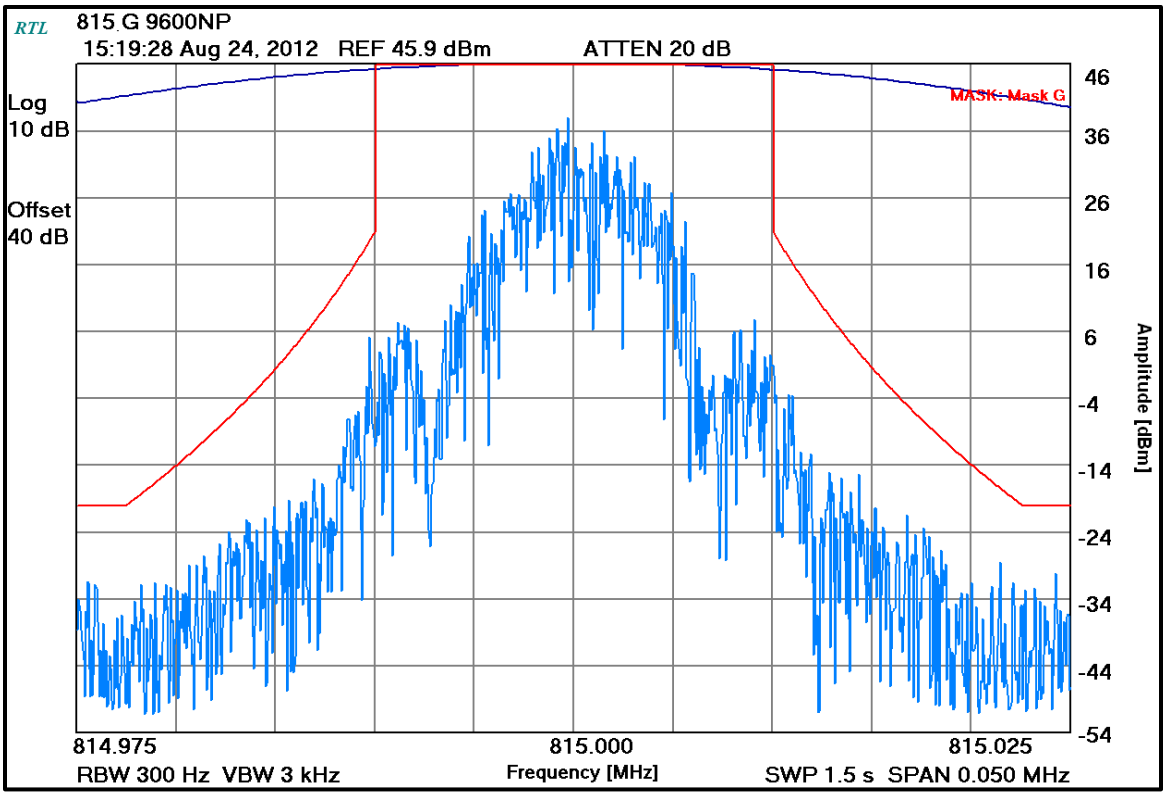
Plot 6-2: Occupied Bandwidth – TX 9600NP; 806.0125 MHz; Mask G



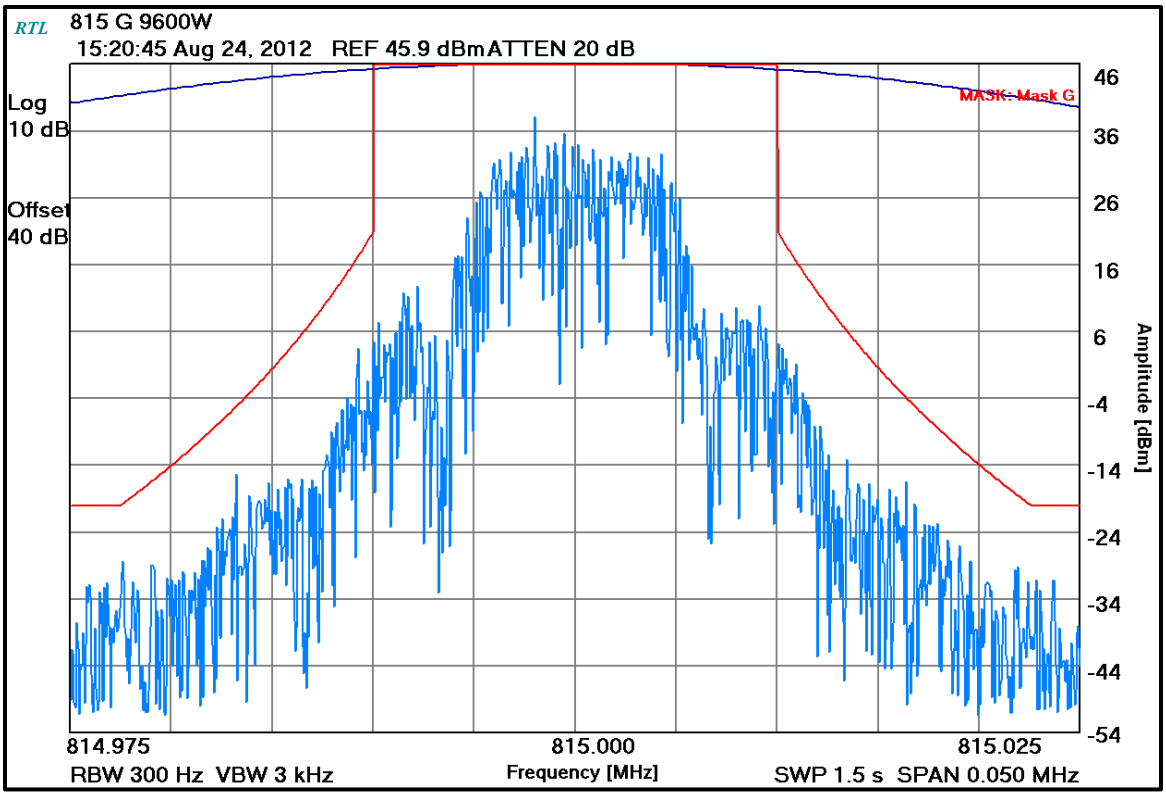
Plot 6-3: Occupied Bandwidth – TX 9600NP; 806.0125 MHz; Mask H



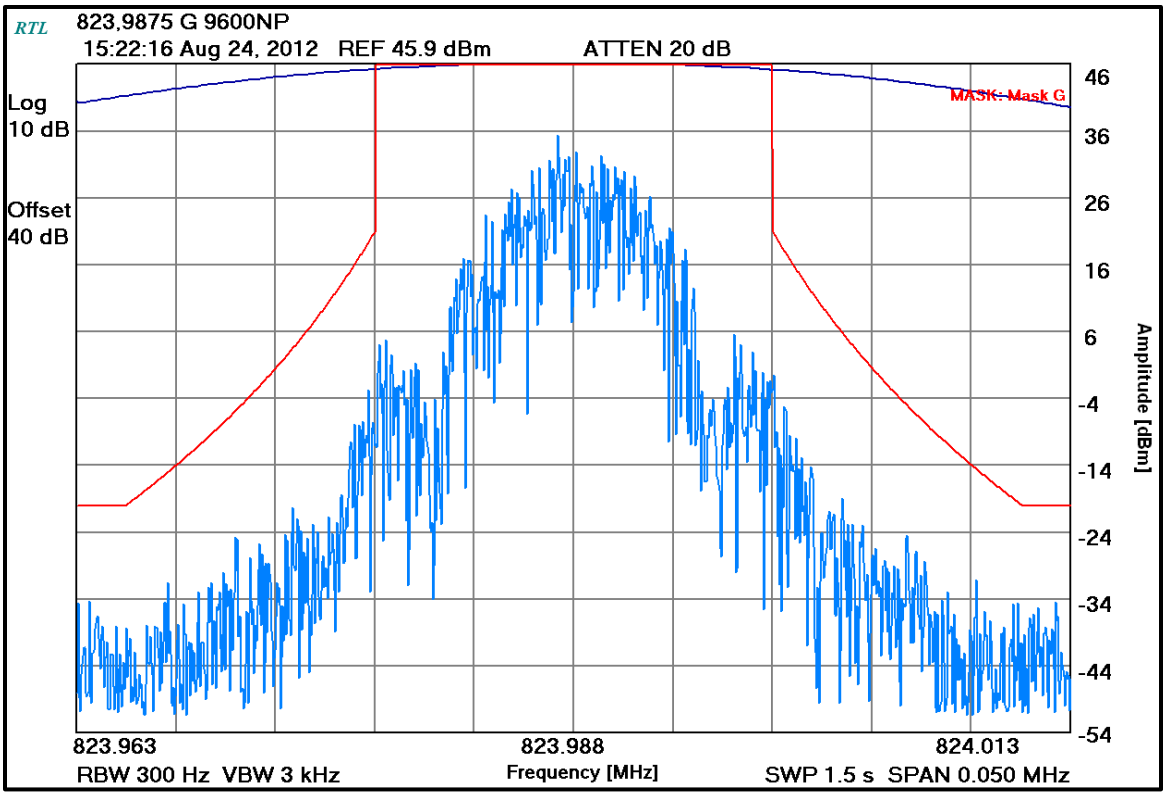
Plot 6-4: Occupied Bandwidth – TX 9600NP; 815 MHz; Mask G



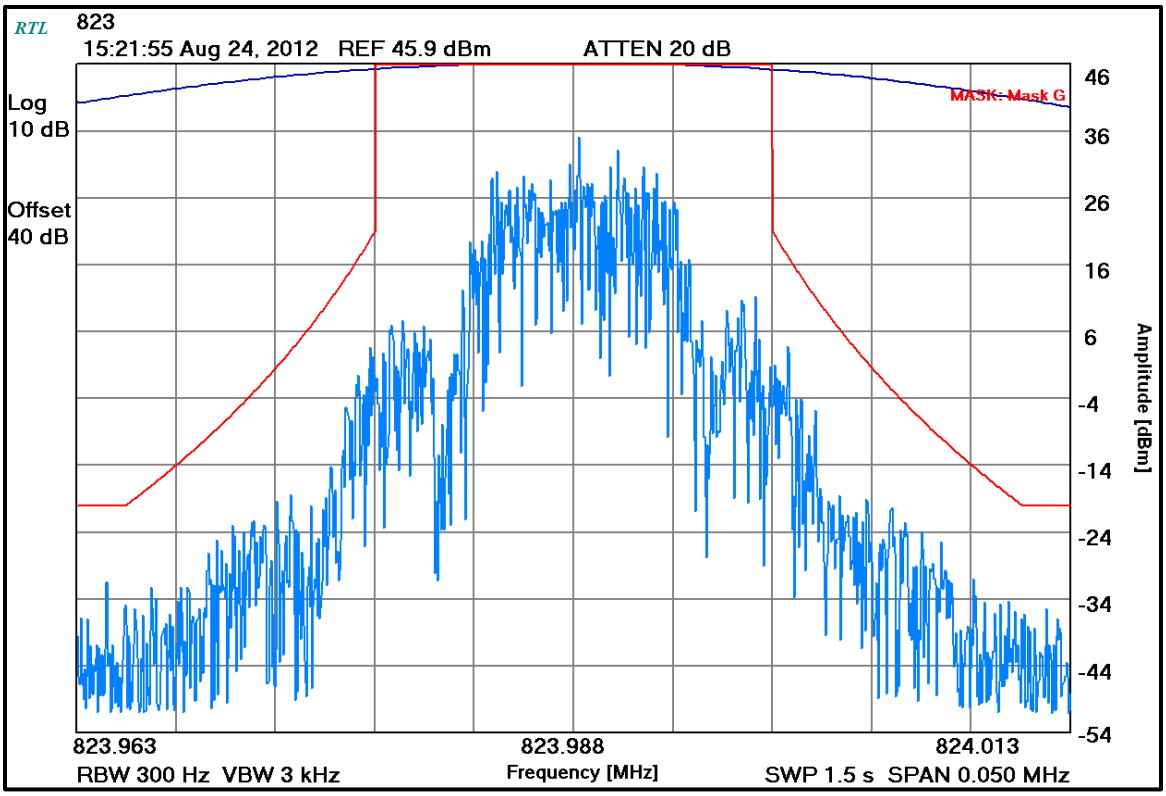
Plot 6-5: Occupied Bandwidth – TX 9600W; 815 MHz; Mask G



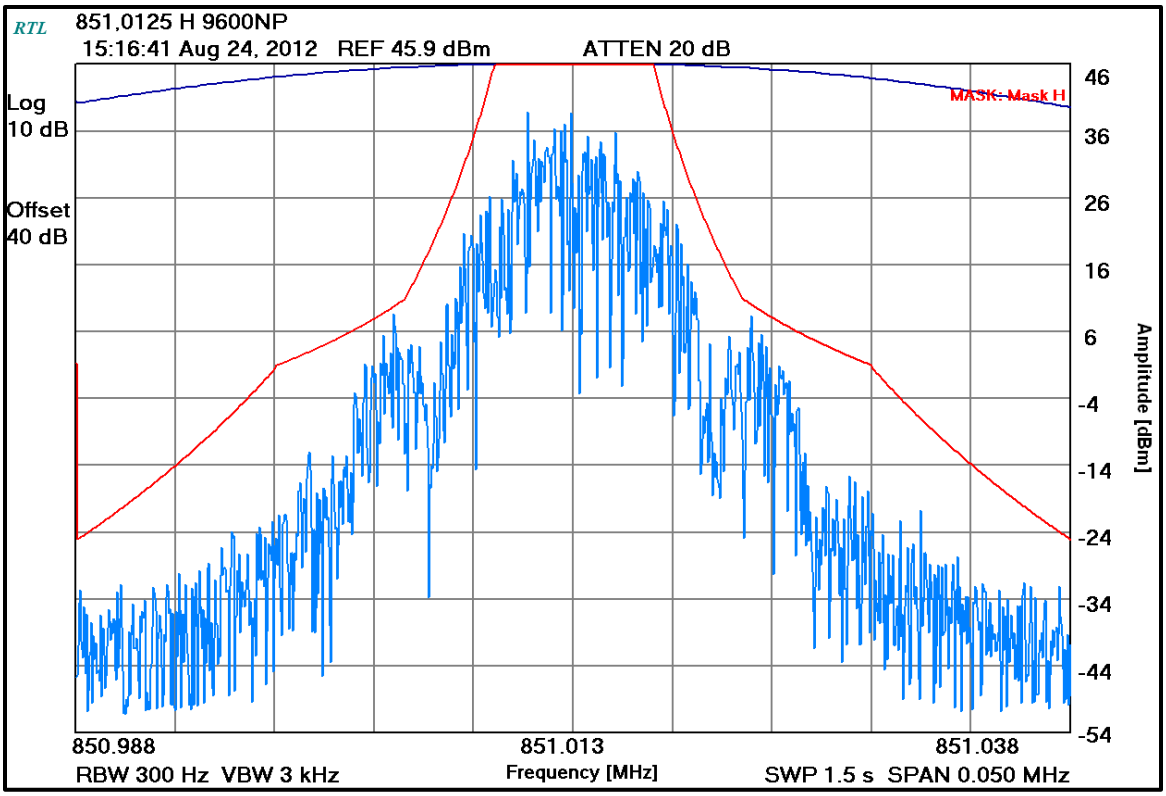
Plot 6-6: Occupied Bandwidth – TX 9600NP; 823.9875 MHz; Mask G



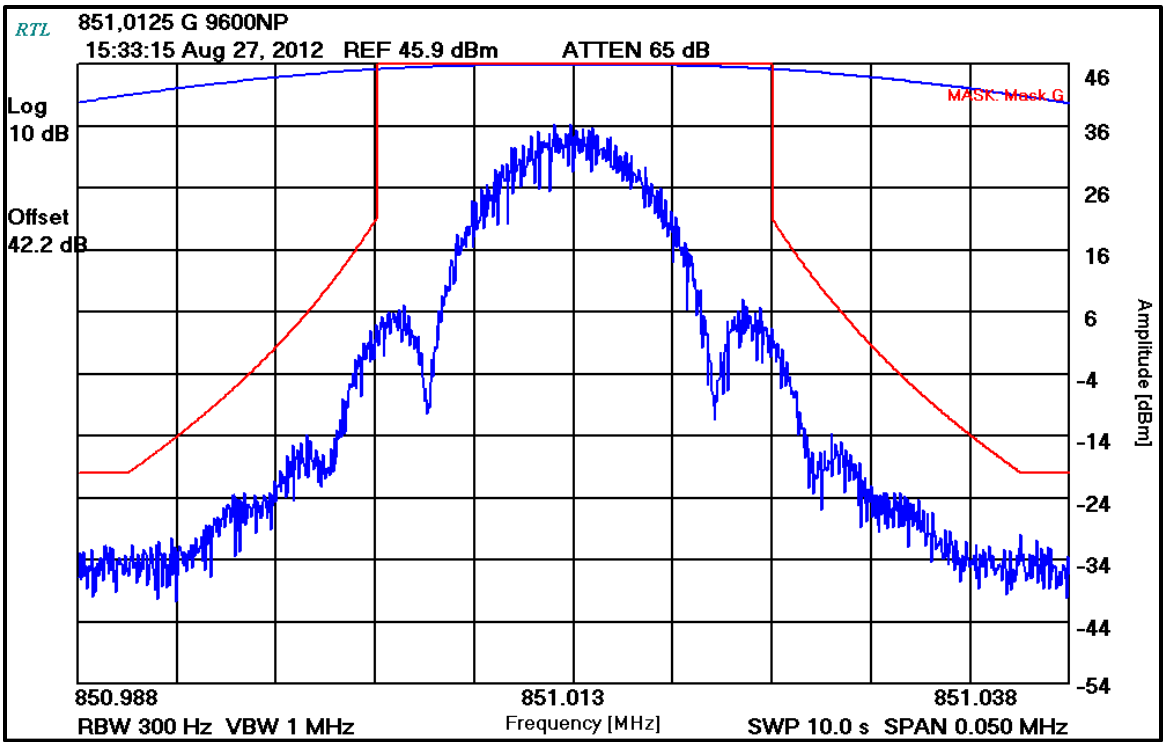
Plot 6-7: Occupied Bandwidth – TX 9600W; 823.9875 MHz; Mask G



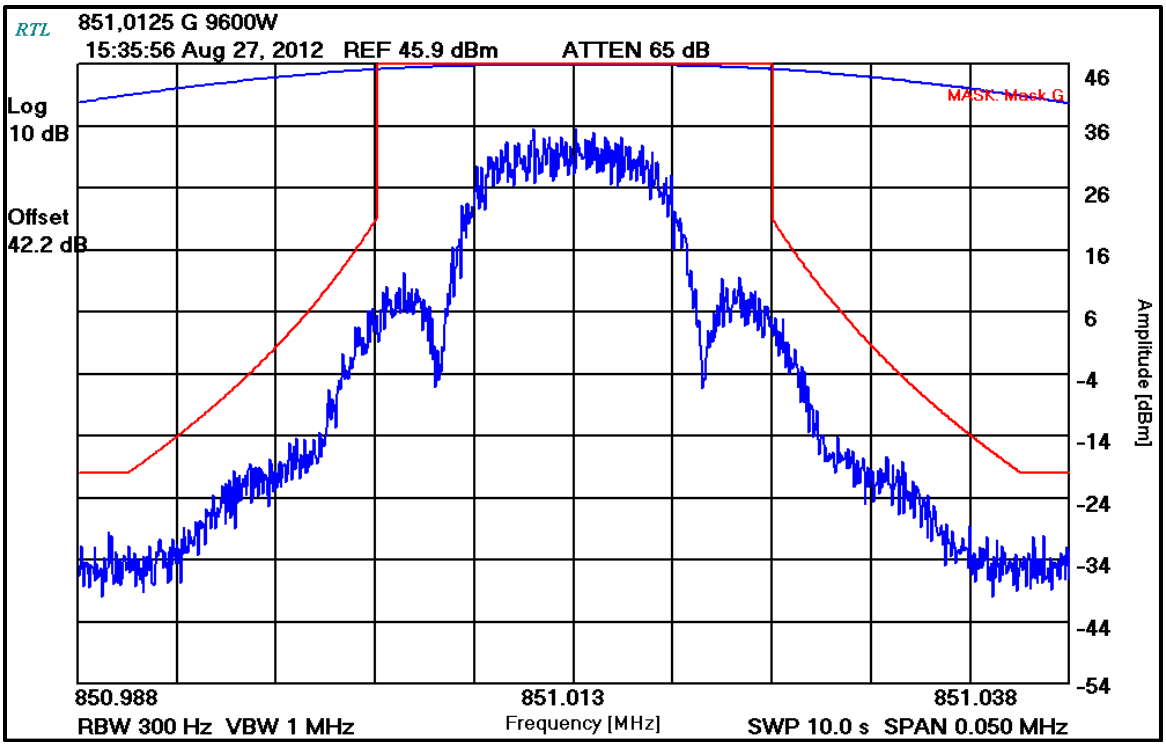
Plot 6-8: Occupied Bandwidth – TX 9600NP; 851.0125 MHz; Mask H



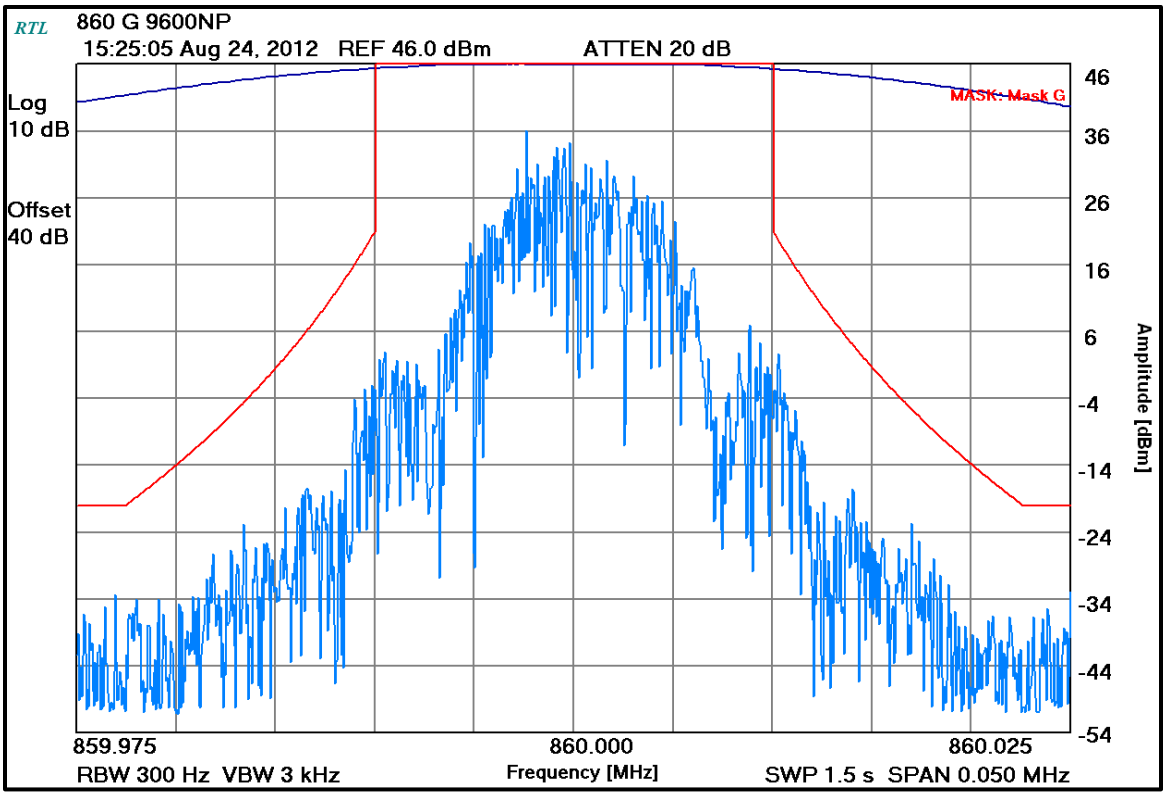
Plot 6-9: Occupied Bandwidth – TX 9600NP; 851.0125 MHz; Mask G



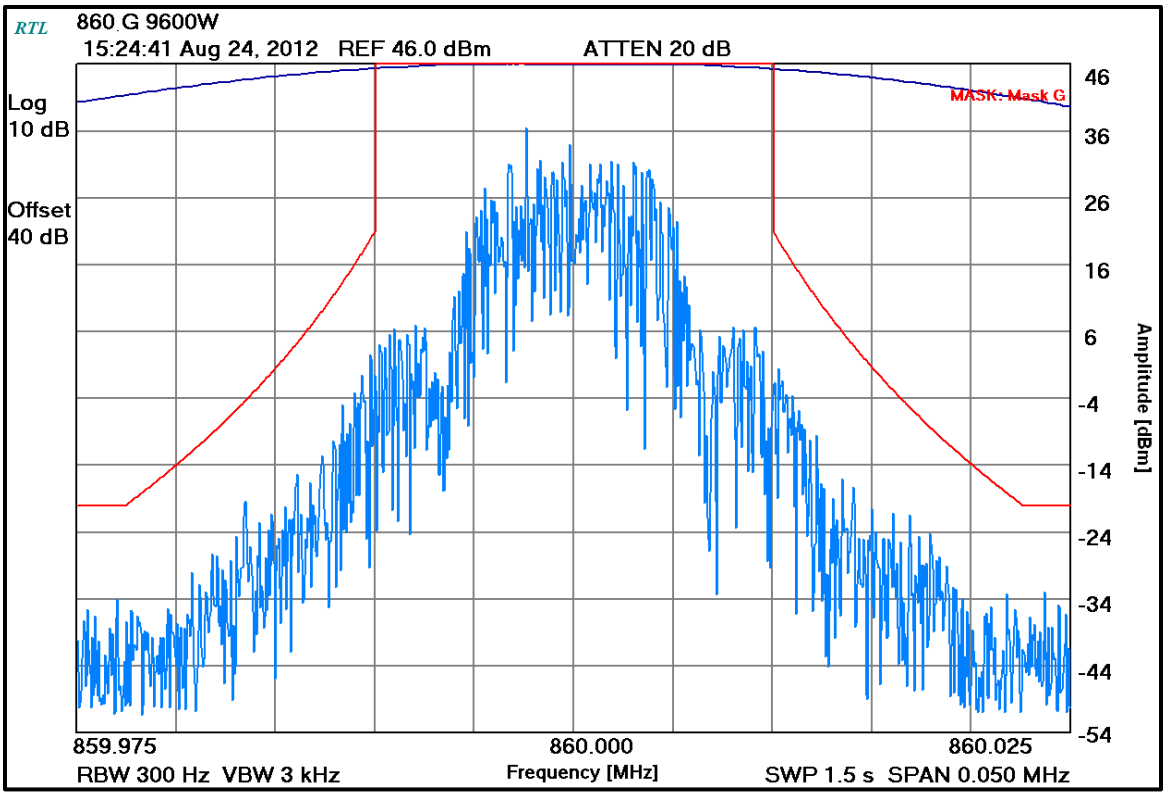
Plot 6-10: Occupied Bandwidth – TX 9600W; 851.0125 MHz; Mask G



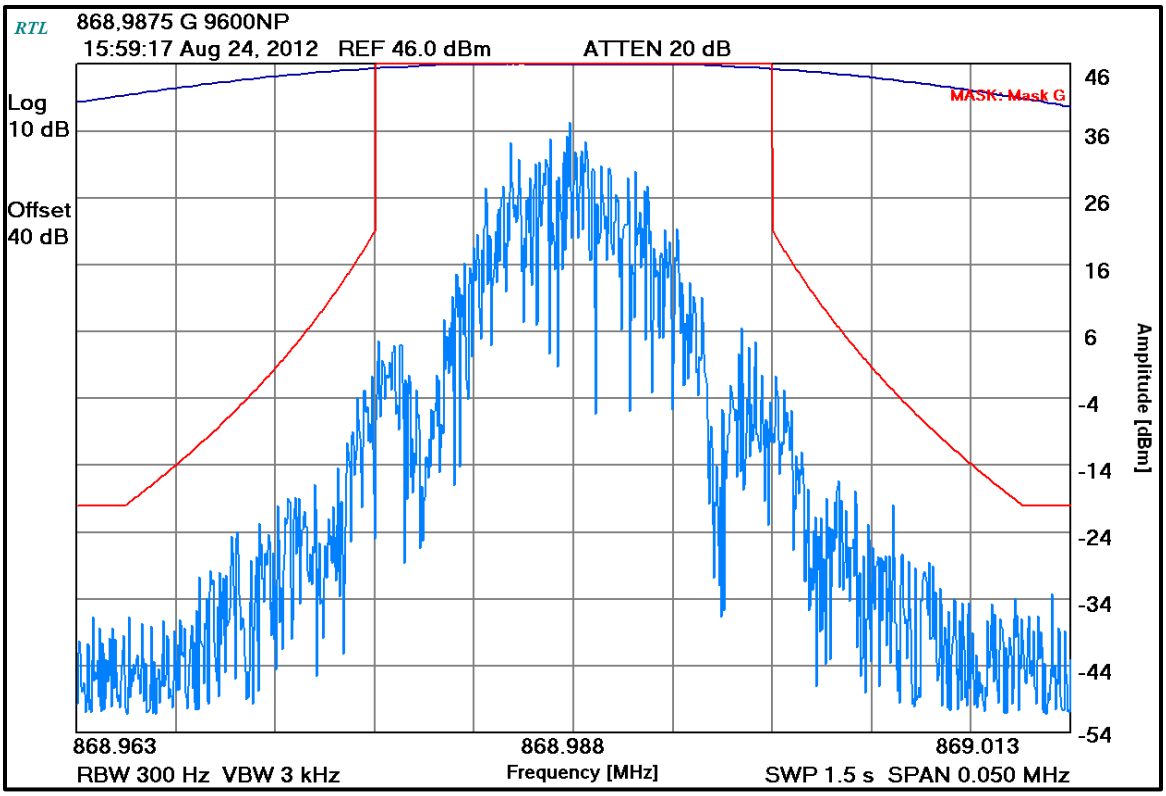
Plot 6-11: Occupied Bandwidth – TX 9600NP; 860 MHz; Mask G



Plot 6-12: Occupied Bandwidth – TX 9600W; 860 MHz; Mask G



Plot 6-13: Occupied Bandwidth – TX 9600NP; 868.9875 MHz; Mask G



Plot 6-14: Occupied Bandwidth – TX 9600W; 868.9875 MHz; Mask G

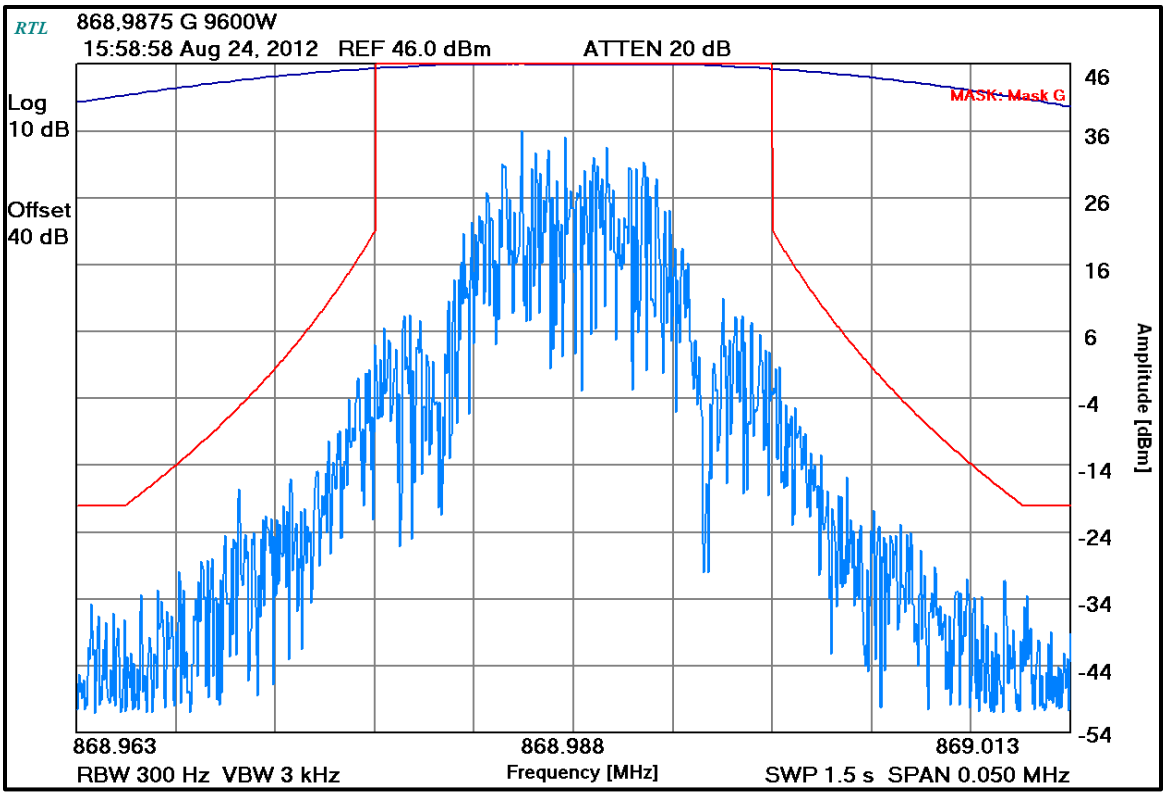
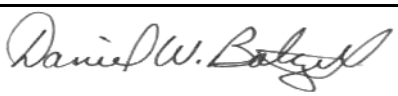


Table 6-1: Test Equipment for Testing Occupied Bandwidth

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900930	Hewlett Packard	85662A	Spectrum Analyzer Display Section	3144A20839	2/6/13
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz-22 GHz)	3138A07771	2/6/13
901537	Aeroflex	48-40-34	40 dB Attenuator	CB6628	10/14/12
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	6/3/13

Test Personnel:

Daniel W. Baltzell		August 24/27, 2012
Test Engineer	Signature	Date of Test

7 RSS-Gen; TIA-603-C-2004 2.1.1: Receiver/Unintentional Radiated Emissions

7.1 Radiated Emissions Measurements

7.1.1 Site and Test Description

Before final radiated emissions measurements were made on the OATS, the EUT was scanned indoors at both one and three meter distances. This was done in order to determine its emission spectrum signal. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process was repeated during final radiated emission measurements on the OATS, at each frequency, in order to ensure that maximum emission amplitudes were measured. Final radiated emissions measurements were made on the OATS at a distance of 3 meters. The EUT was placed on a non-conductive turntable. At each frequency, the EUT was rotated 360°, and the antenna was raised and lowered from 1 to 4 meters in order to determine the emissions maximum levels. Measurements were taken using both horizontal and vertical antenna polarization. The spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated
in the quasi-peak detection mode. No video filter less than 10 times the resolution bandwidth was used. The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

7.1.2 Field Strength Calculations

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FI(dB\mu V/m) = SAR(dB\mu V) + SCF(dB/m)$$

FI = Field Intensity

SAR = Spectrum Analyzer Reading

SCF = Site Correction Factor

The Site Correction Factor (SCF) used in the above equation is determined empirically, and is expressed in the following equation:

$$SCF(dB/m) = -PG(dB) + AF(dB/m) + CL(dB)$$

SCF = Site Correction Factor

PG = Pre-Amplifier Gain

AF = Antenna Factor

CL = Cable Loss

The field intensity in microvolts per meter can then be determined according to the following equation:

$$FI(\mu V/m) = 10^{FI(dB\mu V/m)/20}$$

For example, assume a signal frequency of 125 MHz has a received level measured as 49.3 dBuV. The total Site Correction Factor (antenna factor plus cable loss minus preamplifier gain) for 125 MHz is –11.5 dB/m. The actual radiated field strength is calculated as follows:

$$49.3dB\mu V - 11.5dB/m = 37.8dB\mu V/m$$

$$10^{37.8/20} = 10^{1.89} = 77.6\mu V/m$$

7.1.3 Test Limits

Radiated Emissions Limits	
Frequency (MHz)	**At 3m (dBμV/m)**
30-88	40.0
88-216	43.5
216-960	46.0
>1000	54

7.1.4 Radiated Emissions Data

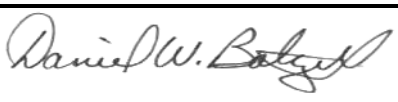
Table 7-1: Radiated Emissions Test Data

Temperature: 74°F Humidity: 81%										
Emission Frequency (MHz)	**Test Detector**	**Antenna Polarity (H/V)**	**Turntable Azimuth (deg)**	**Antenna Height (m)**	**Analyzer Reading (dBuV)**	**Site Correction Factor (dB/m)**	**Emission Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Pass/ Fail**
132.708	Qp	H	270	2.0	39.9	-19.6	20.3	43.5	-23.2	Pass
162.205	Qp	V	90	1.0	40.3	-20.8	19.5	43.5	-24.0	Pass
216.000	Qp	H	270	1.8	51.2	-20.6	30.6	43.5	-12.9	Pass
221.188	Qp	H	90	2.0	43.4	-20.5	22.9	46.0	-23.1	Pass
250.675	Qp	H	0	1.0	48.9	-17.0	31.9	46.0	-14.1	Pass
263.995	Qp	H	280	1.8	43.6	-15.8	27.8	46.0	-18.2	Pass
307.215	Qp	H	270	1.0	42.7	-15.9	26.8	46.0	-19.2	Pass
309.661	Qp	H	290	1.0	47.2	-15.9	31.3	46.0	-14.7	Pass
311.997	Qp	H	120	1.0	52.6	-15.8	36.8	46.0	-9.2	Pass
480.003	Qp	H	270	1.0	46.3	-10.8	35.5	46.0	-10.5	Pass
709.487	Qp	V	90	1.0	37.2	-7.2	30.0	46.0	-16.0	Pass

Table 7-2: Test Equipment Used for Testing Radiated Emissions

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900905	Rhein Tech Laboratories	PR-1040	Amplifier	900905	8/20/13
900791	Chase	CBL6111B	Bilog Antenna (30 MHz–2000 MHz)	N/A	1/31/13
900913	Hewlett Packard	85462A	EMI Receiver RF Section, (9 kHz-6.5 GHz)	3325A00159	8/17/13
N/A	Rhein Tech Laboratories	Automated Emissions Tester	Emissions Testing Software	Rev. 14.0.2	N/A

Test Personnel:

Daniel W. Baltzell		August 25, 2012
Test Engineer	Signature	Date of Test

8 FCC Rules and Regulations §90.210(g) and §2.1053(a): Field Strength of Spurious Radiation; RSS-119 §4.2: Unwanted Emissions

8.1 Test Procedure

ANSI TIA-603-C-2004, section 2.2.12.

The device uses digital modulation modulated to its maximum extent using a pseudo-random data sequence of 9600 bps for EDACS (2-Level FSK) Trunking Protocol mode.

The spurious emissions levels were measured and the device under test was replaced by a substitution antenna connected to a signal generator. This maximized signal generator level was then corrected by subtracting the cable loss from the substitution antenna to the signal generator, and the gain of the antenna was further corrected to a half wave dipole.

8.2 Test Data

8.2.1 CFR 47 Part 90.210 Requirements

The worst-case emissions test data are shown. The magnitude of emissions attenuated more than 20 dB below the FCC limit need not be reported per FCC 2.1057(c).

Limit: P(dBm) – (43 + 10xLOG P(W))

Table 8-1: Field Strength of Spurious Radiation - 823.9875 MHz

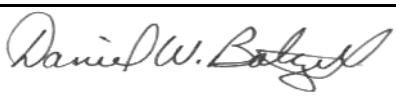
Conducted Power= 45.9 dBm; 39.3 W; Limit: 43+10LogP= 58.9 dBc

Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss to Transmit Antenna (dB)	Antenna Gain (dBd)	EIRP (dBc)	Margin (dB)
1647.9750	25.5	-37.6	1.0	6.6	77.9	-19.0
2471.9625	38.2	-41.7	1.3	7.1	81.7	-22.8
3295.9500	25.8	-51.7	1.5	7.3	91.7	-32.8
4119.9375	14.7	-55.9	1.6	8.0	95.4	-36.5
4943.9250	20.5	-51.9	1.8	8.6	91.0	-32.1
5767.9125	5.4	-65.7	1.8	8.9	104.5	-45.6
6591.9000	10.8	-94.1	1.9	9.7	132.2	-73.3
7415.8875	23.3	-79.5	1.9	8.8	118.5	-59.6
8239.8750	21.7	-77.4	1.9	9.4	115.8	-56.9

Table 8-2: Test Equipment for Testing Field Strength of Spurious Radiation

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900928	Hewlett Packard	83752A	Synthesized Sweeper, (0.01-20 GHz)	3610A00866	2/18/13
900791	Chase	CBL6111B	Bilog Antenna (30 MHz–2000 MHz)	N/A	1/31/13
900772	EMCO	3161-02	Horn Antenna (2-4 GHz)	9804-1044	4/19/14
900321	EMCO	3161-03	Horn Antenna (4.0-8.2 GHz)	9508-1020	4/19/14
900323	EMCO	3160-07	Horn Antenna (8.2-12.4 GHz)	9605-1054	4/19/14
901262	ETS	3160-9	Double ridged Guide Antenna (1-18 GHz)	6748	5/11/14
901592	Insulated Wire Inc.	KPS-1503-3600-KPR	SMK RF Cables 20'	NA	8/16/13
901593	Insulated Wire Inc.	KPS-1503-360-KPR	SMK RF Cables 36"	NA	8/16/13
901594	Insulated Wire Inc.	KPS-1503-360-KPR	SMK RF Cables 36"	NA	8/16/13
900932	Hewlett Packard	8449B OPT H02	Preamplifier 1-26.5 GHz	3008A00505	8/10/13
900905	Rhein Tech Laboratories	PR-1040	OATS 1 Preamplifier 40dB (30 MHz–2 GHz)	1006	8/20/13
901583	Agilent Technologies	N9010A	EXA Signal Analyzer (10 Hz-26.5 GHz)	MY51250846	3/13/13

Test Personnel:

Daniel W. Baltzell		August 25, 2012
Test Engineer	Signature	Date of Test

9 Conclusion

The data in this measurement report shows that the Harris Corporation Model XG-100M, FCC ID: AQZ-XG100M00, IC: 122D-XG100M00, complies with all the applicable requirements of FCC Parts 90 and 2, and Industry Canada RSS-119.