Washington Laboratories, Ltd

FCC Certification Test Report
For

Rohde and Schwarz
Series 4200 UHF Radio
FCC ID: KVW-6146600012

January 23, 2019

Prepared for:

Rohde and Schwarz
6821 Benjamin Franklin Drive
Columbia, MD, 21046 USA

Prepared By:

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7560 Lindbergh Drive
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For the
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Series 4200 UHF Radio

WLL JOB# **15767**

Prepared by:

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Reviewed by:

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CEO

Abstract

This report has been prepared on behalf of Rohde and Schwarz to support the attached Application for Equipment Authorization. The test report and application are submitted for a UHF device under Part 87 part of the FCC Rules and Regulations. This Federal Communication Commission (FCC) Certification Test Report documents the test configuration and test results for a Rohde and Schwarz Series 4200 UHF Radio.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by the American Association for Laboratory Accreditation (A2LA) under Certificate 2675.01.as an independent FCC test laboratory.

The Rohde and Schwarz Series 4200 UHF Radio complies with the limits under Part 87 of the FCC Rules and Regulations.

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1 Introduction

1.1 Compliance Statement

The Rohde and Schwarz Series 4200 UHF Radio complies with the limits for a UHF device under Part 87 of the FCC Rules and Regulations.

1.2 Test Scope

Tests for radiated and conducted emissions were performed. All measurements were performed according to the 2003 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	Rohde and Schwarz 6821 Benjamin Franklin Drive Columbia, MD, 21046 USA
Purchase Order Number:	4950067186
Quotation Number:	70976

1.4 Test Dates

Testing was performed on the following date(s): 9/24/2018 – 1/23/2019

1.5 Test and Support Personnel

Washington Laboratories, Ltd.	Nikolas Allen
Client Representative	Andrew Lloyd

1.6 Abbreviations

A	**A**mpere
ac	**a**lternating **c**urrent
AM	**A**mplitude **M**odulation
Amps	**Amp**ere**s**
b/s	**b**its per **s**econd
BW	**B**and**w**idth
CE	**C**onducted **E**mission
cm	**c**enti**m**eter
CW	**C**ontinuous **W**ave
dB	**d**eci**b**el
dc	**d**irect **c**urrent
EMI	**E**lectro**m**agnetic **I**nterference
EUT	**E**quipment **U**nder **T**est
FM	**F**requency **M**odulation
G	giga - prefix for 10^9 multiplier
Hz	**H**ertz
IF	**I**ntermediate **F**requency
k	kilo - prefix for 10^3 multiplier
M	Mega - prefix for 10^6 multiplier
m	**m**eter
µ	micro - prefix for 10^{-6} multiplier
NB	**N**arrow**b**and
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
RE	**R**adiated **E**missions
RF	**R**adio **F**requency
rms	**r**oot-**m**ean-**s**quare
SN	**S**erial Number
S/A	**S**pectrum **A**nalyzer
V	**V**olt

2 Equipment Under Test

2.1 EUT Identification & Description

The Rohde and Schwarz Series 4200 UHF Radio is a programmable radio that can tune over the frequency range of 235MHz to 322MHz. In this application, the device is only intended for voice communications.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Rohde and Schwarz
FCC ID Number	KVW-6146600012
EUT Name:	Series 4200 UHF radio
Model:	Series 4200 UHF Radio
FCC Rule Parts:	§87
Frequency Range:	235 – 322 MHz
Maximum Output Power:	49.89 W
Modulation:	AM
Necessary Bandwidth:	6.8 kHz
Keying:	Manual
Type of Information:	Voice
Number of Channels:	Multiple
Power Output Level	Fixed
Antenna Type	BNC Connector
Frequency Tolerance:	<100 ppm
Emission Type(s):	A3E
Interface Cables:	None
Power Source & Voltage:	120Vac

2.2 Test Configuration

The Series 4200 UHF Radio was configured to transmit at full power and with audio modulation.

2.3 Testing Algorithm

Worst case emission levels are provided in the test results data.

2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by the American Association for Laboratory Accreditation (A2LA) under Certificate 2675.01.as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

Land Mobile FM or PM Communications Equipment Measurement and Performance Standards (ANSI/TIA/EIA-603-93)

2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is ±2.3 dB. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

$$\text{Total Uncertainty} = (A^2 + B^2 + C^2)^{1/2}/(n-1)$$

where:

A = Antenna calibration uncertainty, in dB = 2 dB

B = Spectrum Analyzer uncertainty, in dB = 1 dB

C = Site uncertainty, in dB = 4 dB

n = number of factors in uncertainty calculation = 3

Thus, Total Uncertainty = $0.5\ (2^2 + 1^2 + 4^2)^{1/2} = \pm 2.3$ dB.

3 Test Equipment

Table 2 shows a list of the test equipment used for measurements along with the calibration information.

Table 2: Test Equipment List

Test Name:	**Radiated Emissions**	Test Date:	**9/28/2018**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
528	AGILENT - E4446A	3HZ - 44GHZ ANALYZER SPECTRUM	12/19/2018
644	SUNOL SCIENCES CORPORATION - JB1 925-833-9936	BICONALOG ANTENNA	1/16/2020
4	ARA - DRG-118/A	ANTENNA DRG 1-18GHZ	12/14/2018
66	B&Z (HP) - BZ-01002650-401545-282525	HF PRE-AMPLIFIER 1-26.5GHZ (MODIFIED)	2/12/2019
276	ELECTRO-METRICS - BPA-1000	RF PRE-AMPLIFIER	2/7/2019
837	WLL - RG223	BNC COAXIAL CABLE (1M)	04/12/2019

Test Name:	**Bench**	Test Date:	**1/23/2019**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
Rental	Keysight – N9020	10HZ - 50GHZ ANALYZER SPECTRUM	9/24/2019

4 Test Results

4.1 RF Power Output: (FCC Part 87 and §2.1046)

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer. The analyzer offset was adjusted to compensate for the attenuator and other losses in the system.

Band-reject and or high pass filters were installed to suppress the carrier to assure that measuring instrumentation would remain linear and that dynamic range requirements were met.

Table 3. RF Power Output

Frequency	Level	Level [W]	Limit	Pass/Fail
Low Channel: 235.0083 MHz	46.98 dBm	49.89	50 W	Pass
Mid Channel: 278.5 MHz	46.85 dBm	48.41	50 W	Pass
High Channel:321.9916 MHz	46.95 dBm	49.54	50 W	Pass

4.2 Modulation Characteristics: (FCC Part 87 §2.1047); Audio Filter Response and Modulation Limiting

The audio Frequency Response was measured and recorded. A plot of the response is shown in the following figure.

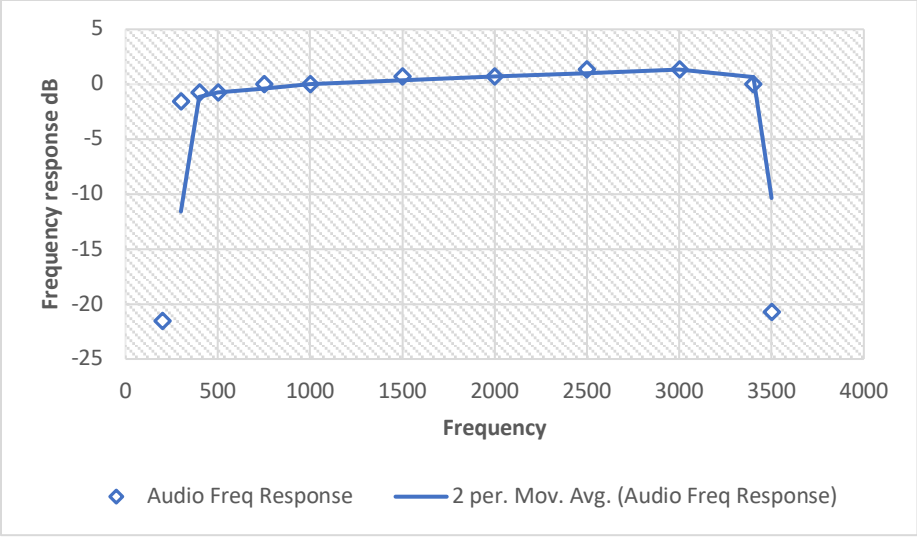

Figure 1. Audio Frequency Response

Table 4 summarizes the modulation parameters.

Table 4. Modulation Parameters

Freq	Ref 1kHz	Ref to freq	Audio Freq Response
200	0.12	0.01	-21.58362492
300	0.12	0.1	-1.583624921
400	0.12	0.11	-0.755771218
500	0.12	0.11	-0.755771218
750	0.12	0.12	0
1000	0.12	0.12	0
1500	0.12	0.13	0.695242125
2000	0.12	0.13	0.695242125
2500	0.12	0.14	1.338935793
3000	0.12	0.14	1.338935793
3400	0.12	0.12	0
3500	0.12	0.011	-20.75577122

4.3 Occupied Bandwidth: (FCC Part §2.1049)

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer.

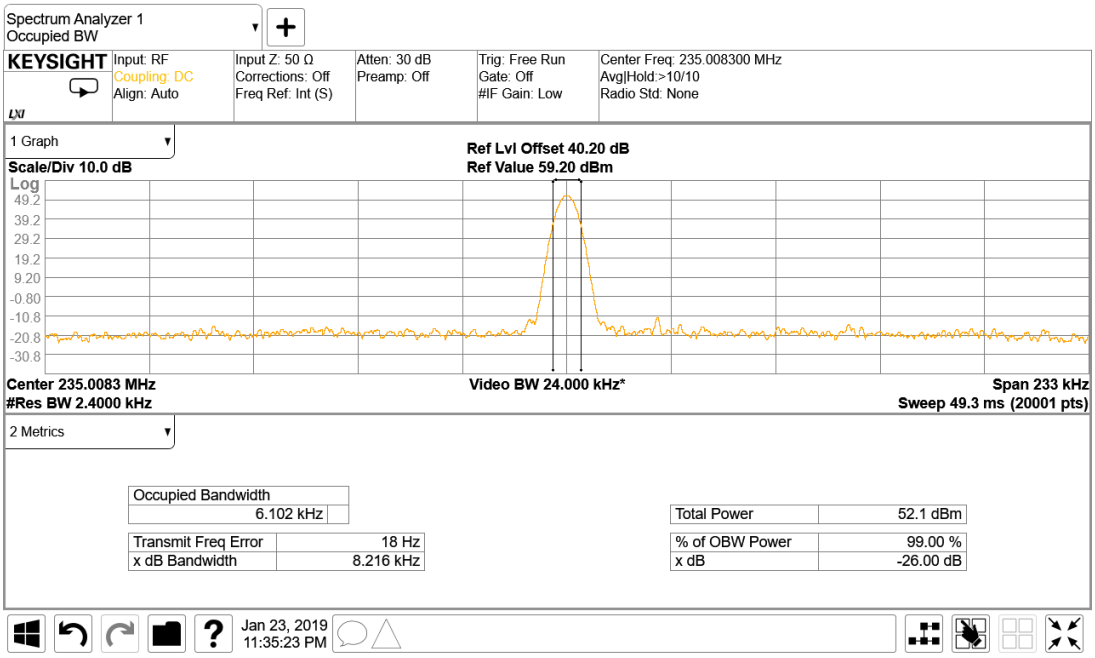

Figure 2: Occupied Bandwidth Low Channel

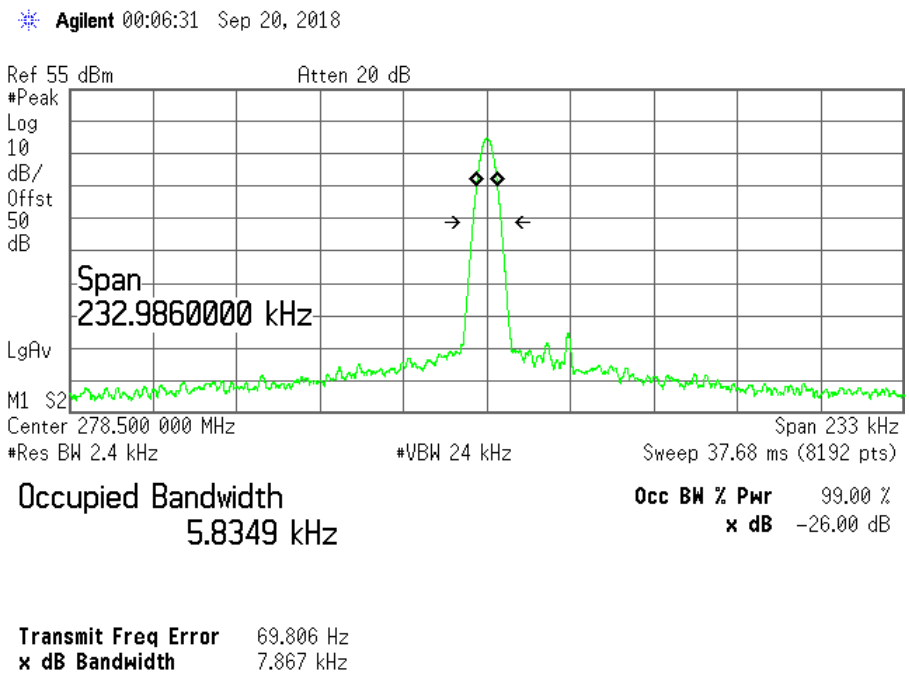

Figure 3. Occupied Bandwidth Center Channel

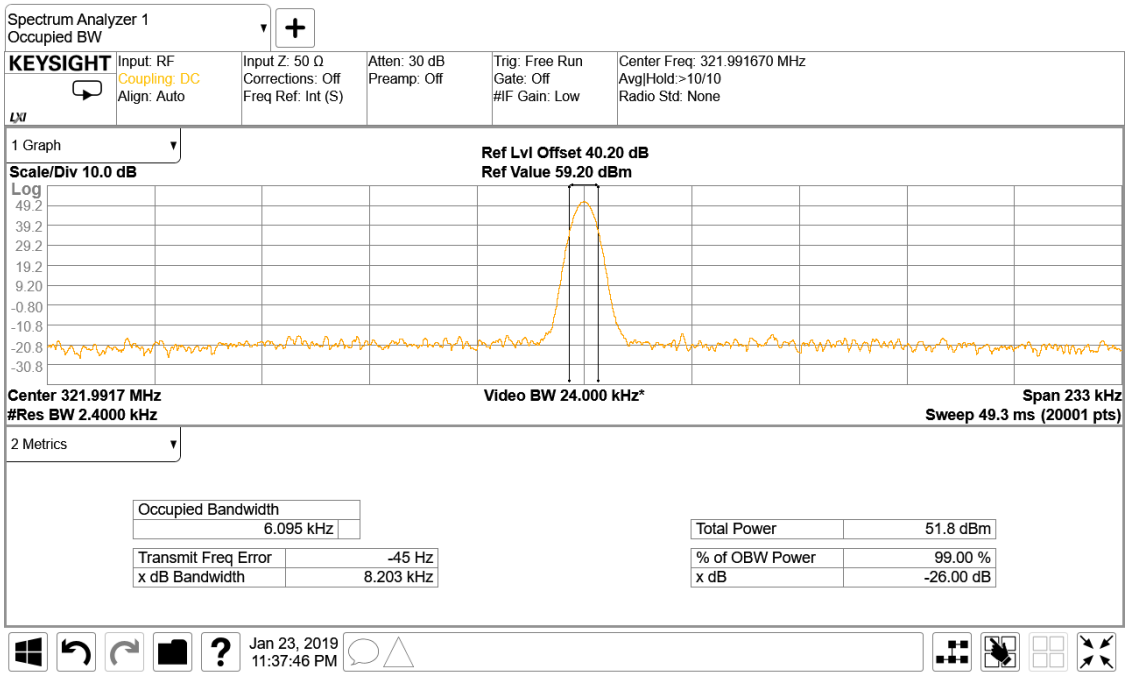

Figure 4: Occupied Bandwidth High Channel

Table 5 provides a summary of the Occupied Bandwidth Results.

Table 5. Occupied Bandwidth Results

Frequency	Bandwidth kHz	Limit	Pass/Fail
Low Channel: 235.0083MHz	6.1020	50kHz	Pass
Mid Channel: 278.5000 MHz	5.8349	50kHz	Pass
High Channel: 321.9916 MHz	6.0950	50kHz	Pass

4.4 Spurious Emissions at Antenna Terminals (FCC §87.139 and §2.1051)

The EUT must comply with requirements for spurious emissions at antenna terminals with modulated signal.

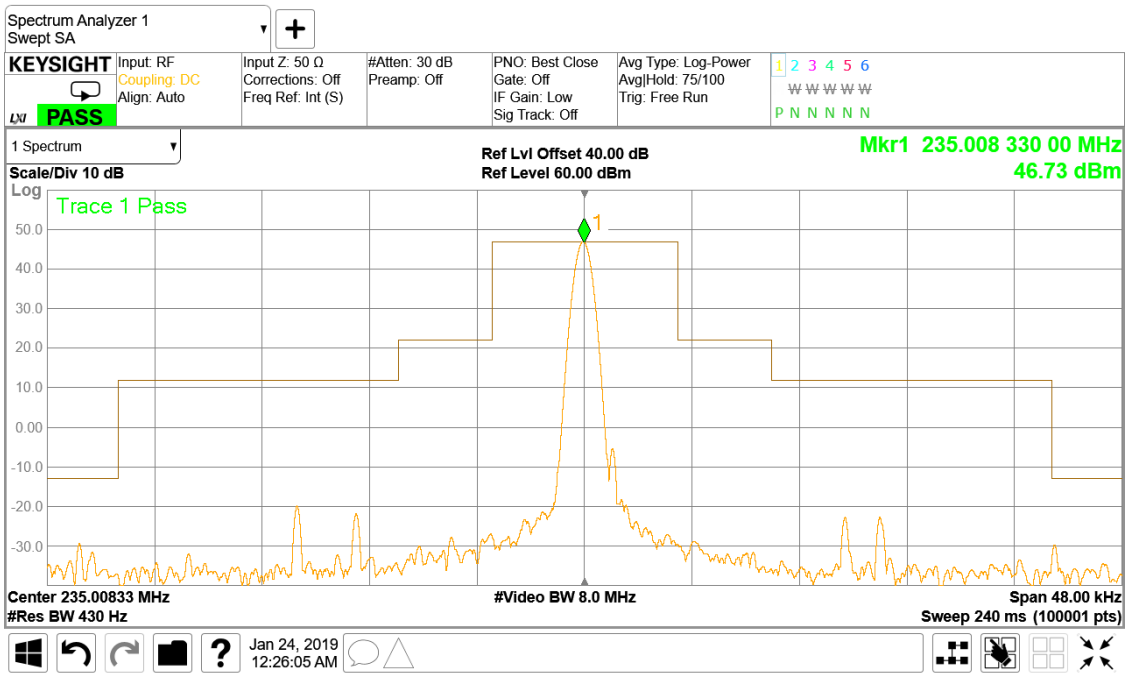

Figure 5. Conducted Spurious Emissions, Low Channel Mask

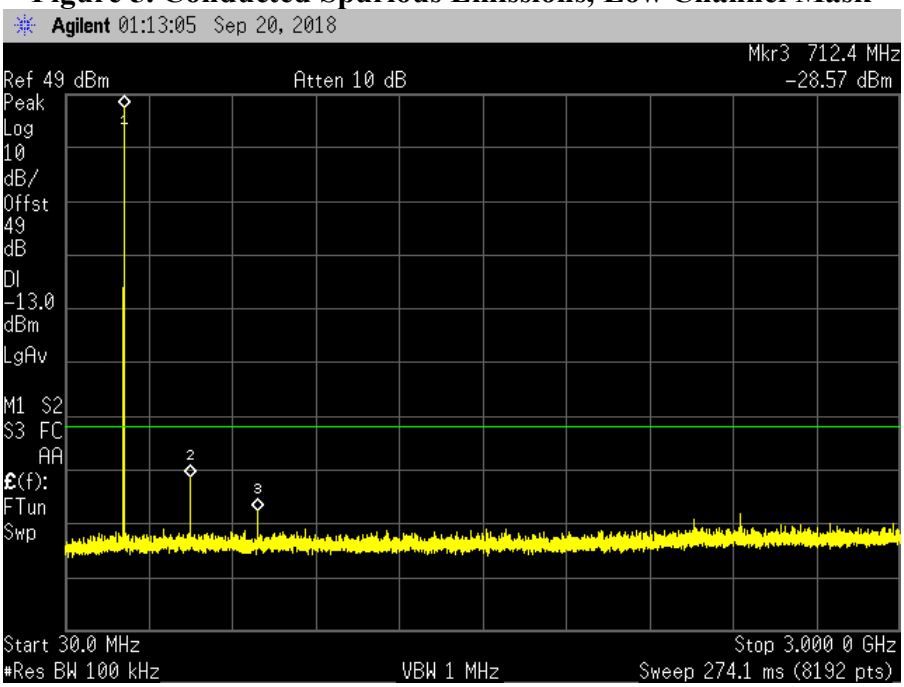

Figure 6. Conducted Spurious Emissions, Low Channel 30 M – 3000 MHz

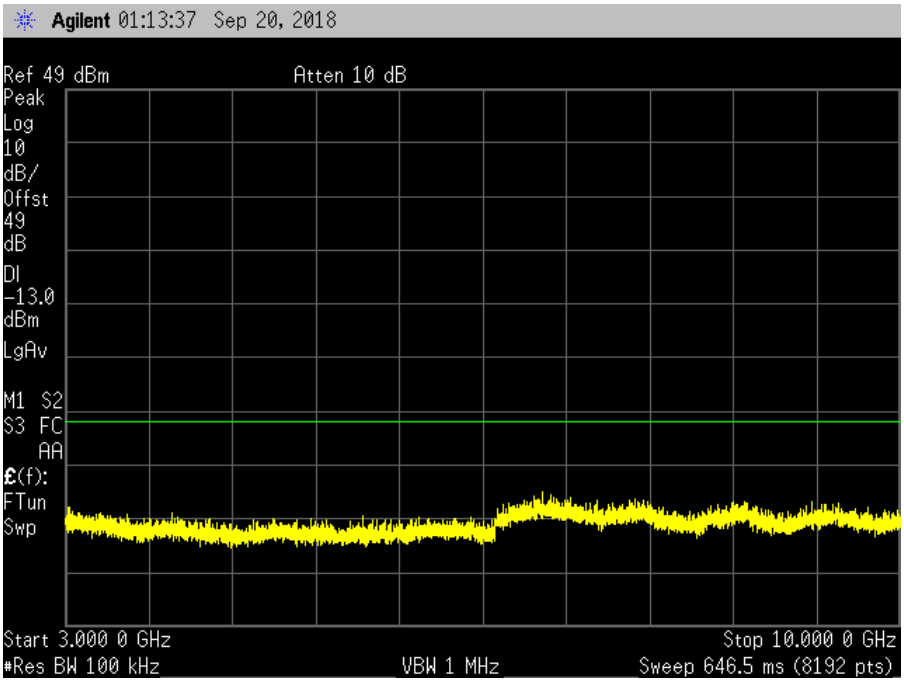

Figure 7. Conducted Spurious Emissions, Low Channel 3000 M – 10000 MHz

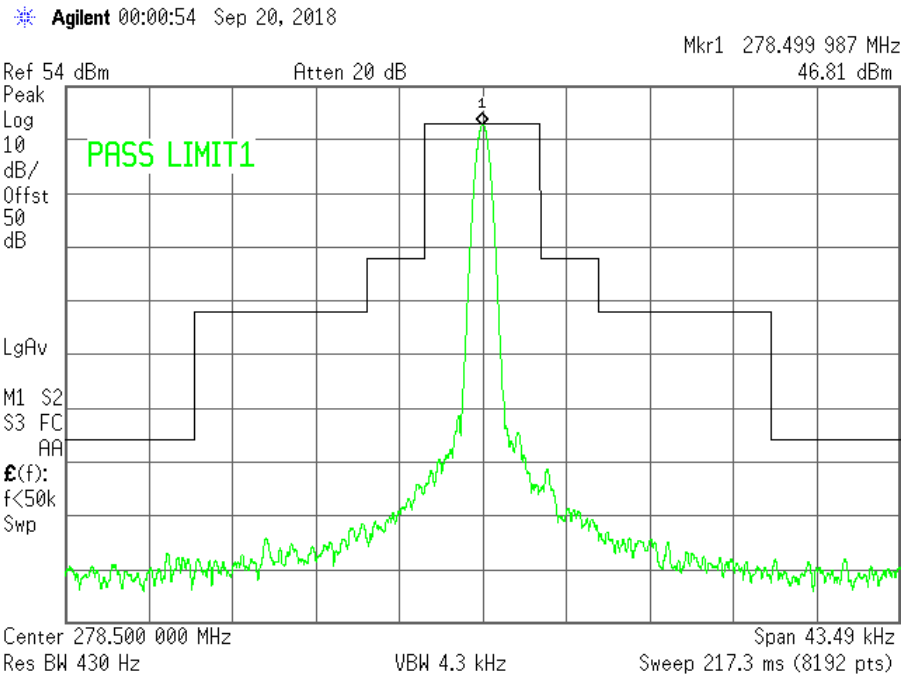

Figure 8. Conducted Spurious Emissions, Center Channel Mask

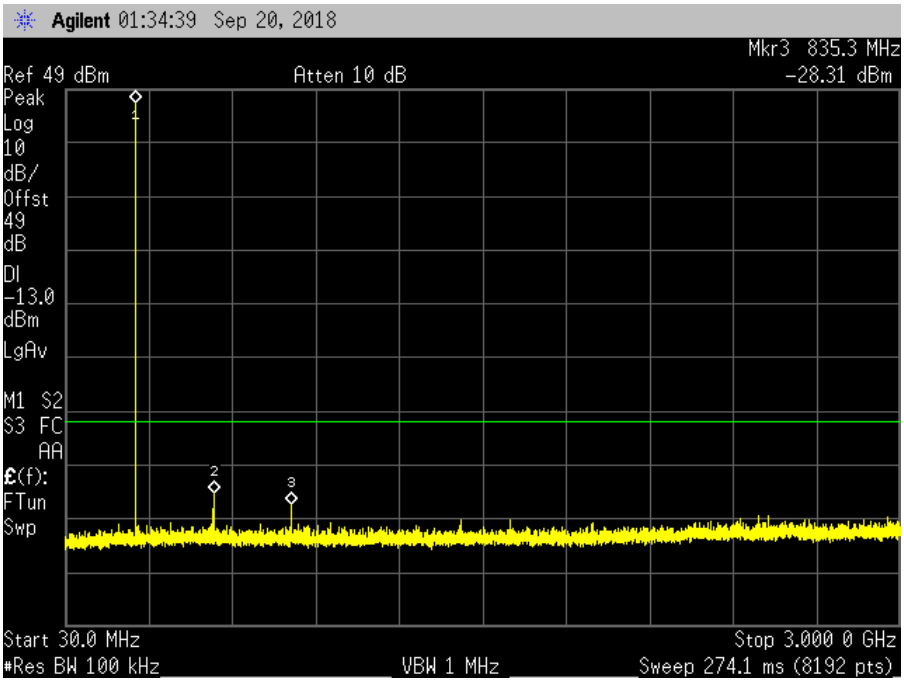

Figure 9. Conducted Spurious Emissions, Center Channel 30 M – 3000 MHz

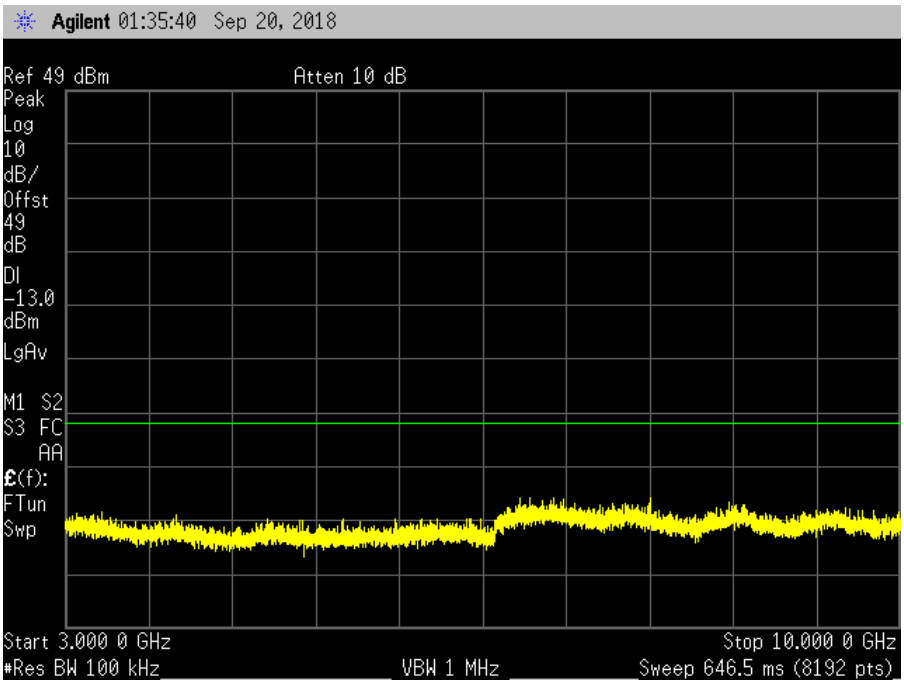

Figure 10. Conducted Spurious Emissions, Center Channel 3000 M – 10000 MHz

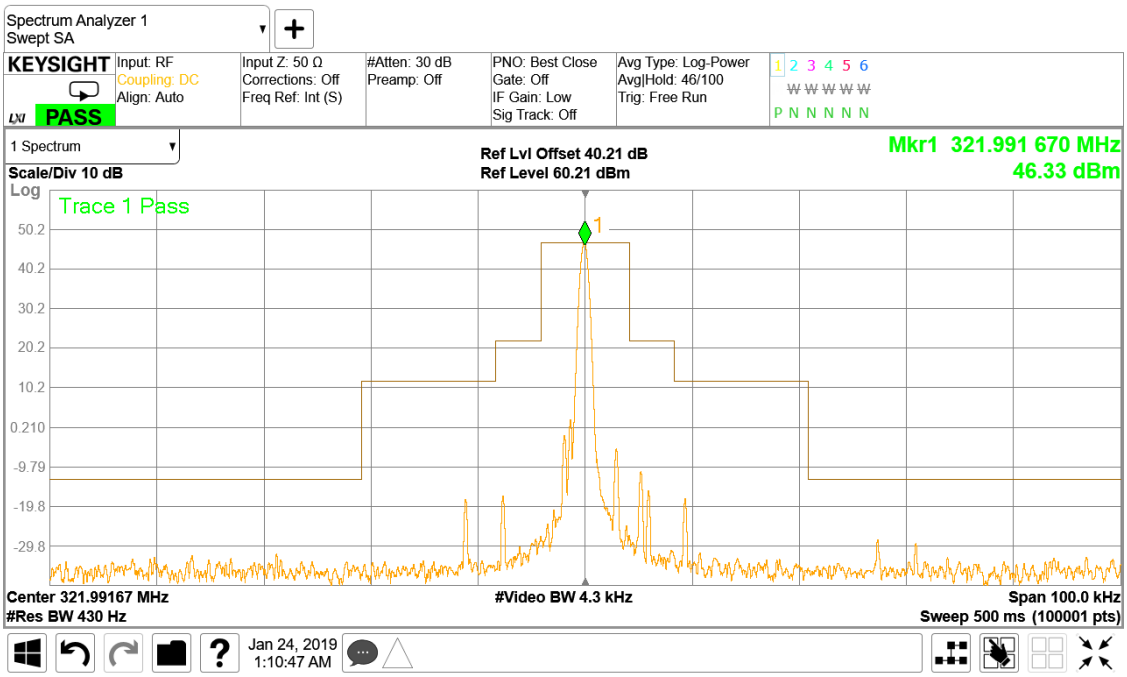

Figure 11. Conducted Spurious Emissions, High Channel Mask

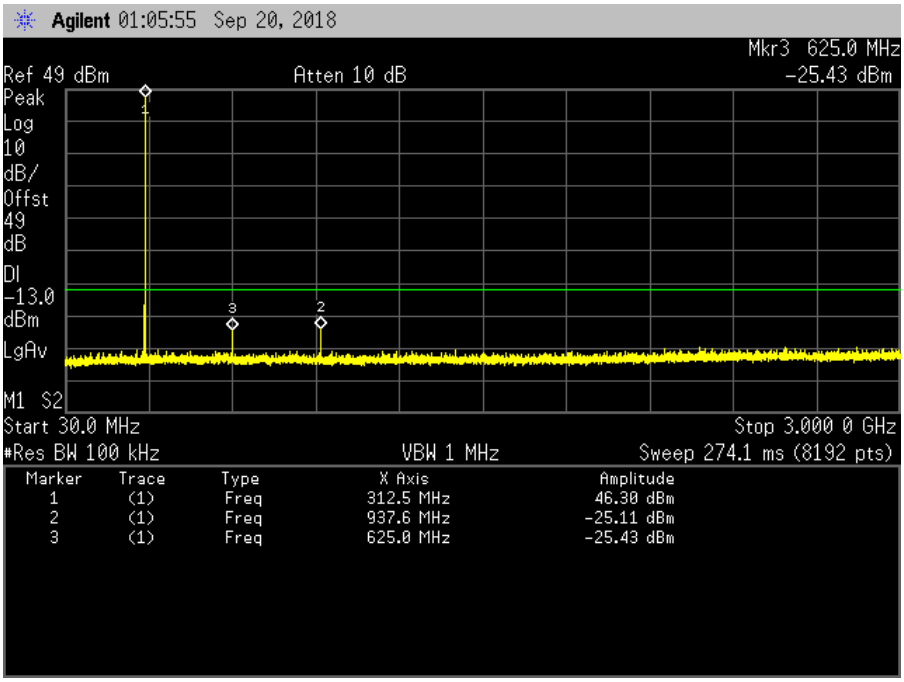

Figure 12. Conducted Spurious Emissions, High Channel 30 M-3000 MHz

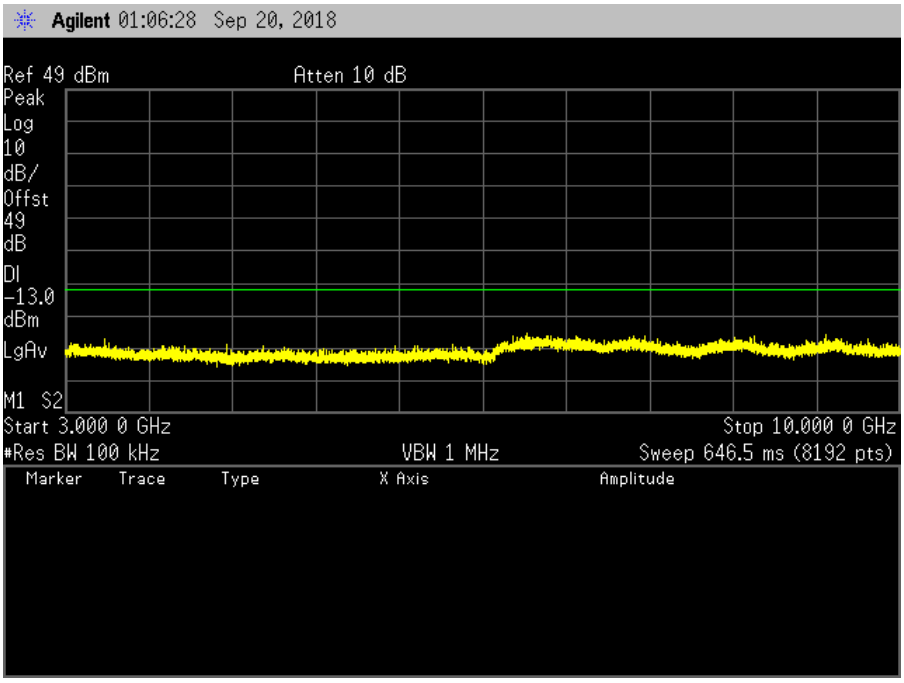

Figure 13. Conducted Spurious Emissions, 3000 M – 10000 MHz

4.5 Radiated Spurious Emissions: (FCC Part 87 and §2.1053)

The EUT must comply with requirements for case radiated emissions. The limits are -13 dBm for all spurious emissions.

4.5.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The peripherals were placed on the table in accordance with ANSI C63.4-2003. Cables were varied in position to produce maximum emissions. The antenna terminal was terminated with sufficient attenuation. Both the horizontal and vertical field components were measured**. The unit was set to the low channel at constant modulation to represent the worst-case scenario.**

Table 6: Radiated Emission Test Data

Frequency (MHz)	Polarity (H/V)	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (dBuV/m)	EIRP dBm	Limit (dBm)	Margin (dB)	Peak or Average
46.54	V	90.0	1.0	49.3	-15.2	34.1	-61.2	-13.0	-48.2	Peak
223.65	V	180.0	1.0	42.0	-13.5	28.6	-66.7	-13.0	-53.7	Peak
278.50	V	90.0	1.0	41.9	-10.8	31.1	-64.2	-13.0	-51.2	Peak
557.00	V	0.0	1.0	44.9	-8.2	36.7	-58.6	-13.0	-45.6	Peak
504.30	V	90.0	1.0	30.5	-8.3	22.1	-73.1	-13.0	-60.1	Peak
536.96	V	90.0	1.0	47.5	-8.2	39.2	-56.0	-13.0	-43.0	Peak
1392.50	V	270.0	1.0	53.1	-24.8	28.2	-67.0	-13.0	-54.0	Peak
1392.50	V	270.0	1.0	42.8	-24.8	18.0	-77.3	-13.0	-64.3	AVG
1725.44	V	90.0	1.0	59.1	-25.0	34.1	-61.1	-13.0	-48.1	Peak
1725.44	V	90.0	1.0	47.8	-25.0	22.8	-72.4	-13.0	-59.4	AVG
51.14	H	270.0	4.0	45.2	-17.2	28.0	-67.3	-13.0	-54.3	Peak
234.85	H	0.0	4.0	34.8	-12.8	21.9	-73.3	-13.0	-60.3	Peak
250.39	H	0.0	4.0	39.3	-12.6	26.7	-68.6	-13.0	-55.6	Peak
264.81	H	90.0	4.0	37.5	-11.6	25.9	-69.4	-13.0	-56.4	Peak
374.81	H	270.0	4.0	39.2	-8.9	30.3	-64.9	-13.0	-51.9	Peak
546.50	H	180.0	4.0	45.6	-8.2	37.4	-57.9	-13.0	-44.9	Peak
1090.29	H	90.0	4.0	60.7	-25.2	35.5	-59.7	-13.0	-46.7	Peak
1090.29	H	90.0	4.0	43.7	-25.2	18.5	-76.8	-13.0	-63.8	AVG

4.6 Frequency Stability: (FCC Part §2.1055)

Frequency as a function of temperature and voltage variation shall be maintained within the FCC-prescribed tolerances.

The temperature stability was measured with the unit in an environmental chamber used to vary the temperature of the sample. The sample was held at each temperature step to allow the temperature of the sample to stabilize.

The EUT is powered by AC. The voltage was varied by plus and minus 15% of the nominal voltage.

The frequency stability of the transmitter was examined at the voltage extremes and for the temperature range of -30°C to +50°C. The carrier frequency was measured while the EUT was in the temperature chamber. The reference frequency of the EUT was measured at the ambient room temperature with the frequency counter. The following are the reference frequencies at ambient for the Middle channel (center of the band).

Mid Channel: 273.4948 MHz

Table 7. Frequency Deviation as a Function of Temperature

Temperature (Centigrade)	Frequency (MHz)	Deviation (Hz)	Limit (+/- Hz)	Pass/Fail
20(ambient)	273.494800	0	5470	**NA**
-30	273.497700	2900	5470	Pass
-20	273.496700	1900	5470	Pass
-10	273.499100	4300	5470	Pass
0	273.499600	4800	5470	Pass
10	273.498200	3400	5470	Pass
20	273.494600	-200	5470	Pass
30	273.498200	3400	5470	Pass
40	273.498700	3900	5470	Pass
50	273.498700	3900	5470	Pass

Table 8. Frequency Deviation as a Function of Voltage

Voltage	Frequency (MHz)	Deviation (Hz)	Limit (+/- Hz)	Pass/Fail
Nominal Voltage	273.494800	0	5470	**NA**
115% of Nominal Voltage (138VAC)	273.499100	4300	5470	Pass
85% of Nominal Voltage (102VAC)	273.499500	4700	5470	Pass

Maximum deviation was 4800Hz. This represents a tolerance of 4800/273.5E6 = 17.55E-6 or 17.5 ppm.