

Washington Laboratories, Ltd.

FCC PART 15.249 CERTIFICATION TEST REPORT

for the

BHA100

FCC ID: 2ABRG-BHA100

IC ID: 11714A-BHA100

REPORT# 15891-01-01 REV 1

Prepared for:

Kaz USA, Inc.

400 Donald Lynch Blvd.

Marlboro, MA 01752

Prepared By:

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Gaithersburg, Maryland 20879





FCC Part 15.249 Certification Test Report
for the
Kaz USA, Inc.
BHA100

FCC ID: 2ABRG-BHA100

ISED ID: 11714A-BHA100

JANUARY 31, 2020

WLL REPORT# 15891-01-01 REV 1

Prepared by:

A handwritten signature in black ink that reads "John P. Repella".

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Steven D. Koster
President



ABSTRACT

This report has been prepared on behalf of Kaz USA, Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for an Intentional Radiator under Part 15.249 (10/2015) of the FCC Rules and Regulations and Spectrum Management and Telecommunications Policy and under RSS-210 Issue 10, 10/2016 of Innovation, Science and Economic Development Canada (ISED). This Certification Test Report documents the test configuration and test results for the Kaz USA, Inc. BHA100.

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. The ISED Canada OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Certificate AT-1448 as an independent FCC test laboratory.

The Kaz USA, Inc. BHA100 complies with the limits for a Digital Transmission System (DTS) Transmitter device under FCC Part 15.249 and Innovation, Science and Economic Development Canada (ISED) RSS-210.

Revision History	Description of Change	Date
Rev 0	Initial Release	January 31, 2020
Rev 1	ACB Comments	June 12, 2020



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1 INTRODUCTION

1.1 COMPLIANCE STATEMENT

The Kaz USA, Inc. BHA100 complies with the limits for a Digital Transmission System (DTS) device under FCC Part 15.249 (10/2015) and ISED Canada RSS-210 Issue 10 2016.

1.2 TEST SCOPE

Tests for radiated and conducted emissions were performed. All measurements were performed in accordance with 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: Kaz USA, Inc.
Address 400 Donald Lynch Blvd.
Marlboro, MA 01752

Purchase Order Number: 93988
Quotation Number: 71112

1.4 TEST DATES

Testing was performed on the following date(s): 12/20/2018, 12/21/2018 & 12/28/2018

1.5 TEST AND SUPPORT PERSONNEL

Washington Laboratories, LTD John P. Repella
Customer Representative Edwin De Leon



1.6 ABBREVIATIONS

A	Ampere
ac	alternating current
AM	Amplitude Modulation
Amps	Amperes
b/s	bits per second
BW	BandWidth
CE	Conducted Emission
cm	Centimeter
CW	Continuous Wave
dB	deciBel
dc	direct current
EMI	Electromagnetic Interference
EUT	Equipment Under Test
FM	Frequency Modulation
G	giga – prefix for 10 ⁹ multiplier
Hz	Hertz
IF	Intermediate Frequency
k	kilo – prefix for 10 ³ multiplier
LISN	Line Impedance Stabilization Network
M	Mega – prefix for 10 ⁶ multiplier
m	Meter
μ	micro – prefix for 10 ⁻⁶ multiplier
NB	Narrowband
QP	Quasi-Peak
RE	Radiated Emissions
RF	Radio Frequency
rms	root-mean-square
SN	Serial Number
S/A	Spectrum Analyzer
V	Volt



2 EQUIPMENT UNDER TEST

2.1 EUT IDENTIFICATION & DESCRIPTION

Table 1: Device Summary

Item	
Manufacturer:	Kaz USA, Inc.
FCC ID:	2ABRG-BHA100
ISED ID:	11714A-BHA100
Model:	BHA100
Serial Number of Unit Tested	N/A
FCC Rule Parts:	§15.249
ISED Rule Parts:	RSS-210
Frequency Range:	2402-2480MHz
Maximum Conducted Output Power:	0.708mW (-1.5dBm)
Maximum Output Power with Antenna:	0.0177mW (-17.5dBm), 5156 μ V/m @ 3m
Modulation:	GFSK
Occupied Bandwidth (99%):	1.0667 MHz
FCC Emission Designator:	1M07X1E
Keying:	Automatic, Manual
Type of Information:	Data
Number of Channels:	40
Power Output Level	Fixed
Highest TX Spurious Emission:	346.4uV/m @4960.27MHz
Highest RX Spurious Emission:	20.4uV/m @ 36.83MHz
Antenna Connector	None
Antenna Type	Trace/Wire
Antenna Gain	-16dBi
Interface Cables:	USB for configuration only
Maximum Data Rate	2000 kbps
Power Source & Voltage:	312 Hearing Aid Battery



The Kaz USA, Inc. BHA100 is a Bluetooth LE transmitter.

2.2 TEST CONFIGURATION

The BHA100 was configured in a standalone condition pairing with a companion device for configuration and control.

2.3 TESTING ALGORITHM

The BHA100 was tested on a low, center and high channel in the operational band. The device was controlled wirelessly via customer supplied iPad mini running Clarity RF Test software to set the channel, modulation and transmit time.

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. The ISED Canada OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Testing Certificate AT-1448 as an independent FCC test laboratory.

2.5 MEASUREMENTS

2.5.1 References

ANSI C63.2 (Jan-2016) Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 (Jan 2014) 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

ANSI C63.10 (Jun 2013) American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices



2.6 MEASUREMENT UNCERTAINTY

All results reported herein relate only to the equipment tested. The basis for uncertainty calculation uses ANSI/NCSL Z540-2-1997 (R2002) with a type B evaluation of the standard uncertainty. Elements contributing to the standard uncertainty are combined using the method described in Equation 1 to arrive at the total standard uncertainty. The standard uncertainty is multiplied by the coverage factor to determine the expanded uncertainty which is generally accepted for use in commercial, industrial, and regulatory applications and when health and safety are concerned (see Equation 2). A coverage factor was selected to yield a 95% confidence in the uncertainty estimation.

Equation 1: Standard Uncertainty

$$u_c = \pm \sqrt{\frac{a^2}{div_a^2} + \frac{b^2}{div_b^2} + \frac{c^2}{div_c^2} + \dots}$$

Where u_c = standard uncertainty
 a, b, c, \dots = individual uncertainty elements
 $Div_{a, b, c}$ = the individual uncertainty element divisor based on the probability distribution

Divisor = 1.732 for rectangular distribution
 Divisor = 2 for normal distribution
 Divisor = 1.414 for trapezoid distribution

Equation 2: Expanded Uncertainty

$$U = k u_c$$

Where U = expanded uncertainty
 k = coverage factor
 $k \leq 2$ for 95% coverage (ANSI/NCSL Z540-2 Annex G)
 u_c = standard uncertainty

The measurement uncertainty complies with the maximum allowed uncertainty from CISPR 16-4-2. Measurement uncertainty is not used to adjust the measurements to determine compliance. The expanded uncertainty values for the various scopes in the WLL accreditation are provided in Table 2 below.

Table 2: Expanded Uncertainty List

Scope	Standard(s)	Expanded Uncertainty
Conducted Emissions	CISPR11, CISPR22, CISPR32, CISPR14, FCC Part 15	±2.63 dB
Radiated Emissions	CISPR11, CISPR22, CISPR32, CISPR14, FCC Part 15	±4.55 dB



Parameter	Uncertainty	Actual (+/-)
Radio Frequency	$\pm 1 \times 10^{-7}$	$\pm 8.64\text{E-}08$ parts
RF Power conducted (up to 160 W)	± 0.75 dB	± 0.3 dB
Conducted RF Power variations	± 0.75 dB	± 0.3 dB

3 TEST EQUIPMENT

Table 3 shows a list of the test equipment used for measurements along with the calibration information.

Table 3: Test Equipment List

Test Name:	Radiated Emissions	Test Date:	12/27/2018
Asset #	Manufacturer/Model	Description	Cal. Due
66	HP/8449	HF PRE-AMP 1-26.5GHz (MODIFIED)	02/12/2019
276	ELECTRO-METRICS/BPA-1000	RF PRE-AMPLIFIER	02/07/2019
382	SUNOL SCIENCES CORPORATION/JB1	ANTENNA BICONLOG	03/21/2020
4	ARA - DRG-118/A	ANTENNA DRG 1-18GHZ	12/31/2018
823	AGILENT – EXA9010A	10Hz – 26.5GHz ANALYZER SPECTRUM	04/21/2019

Test Name:	Frequency Stability	Test Date:	12/20/2018
Asset #	Manufacturer/Model	Description	Cal. Due
728	AGILENT/8564EC	SPECTRUM ANALYZER	12/26/2018
776	TENNY/TJR-A-WS4	1.22 CUFT	06/01/2019
886	EVENTEK/KPS3010D	0-30V 0-10AMP DC SUPPLY	CAL IN TEST
771	TEKTRONIX/ TDS1012C	O-Scope	12/31/2018



4 TEST RESULTS

The Table Below shows the results of testing for compliance with a Digital Transmission System (DTS) device in accordance with FCC Part 15.249 08/2018, RSS-210 Issue 10 & RSS-Gen Issue 5. Full test results are shown in subsequent sub-sections.

Table 4: Test Summary Table

Frequency Hopping Spread Spectrum - TX Test Summary			
FCC Rule Part	IC Rule Part	Description	Result
2.1049	RSS-GEN Section 4.6(1)	Occupied Bandwidth	Pass
15.249 (a) 15.209	RSS-210 A2.9 (a)	General Field Strength Limits	Pass
15.207	RSS-GEN Section 7.2.4	AC Conducted Emissions	N/A
15.249	RSS-GEN Section 6.11	Frequency Stability	Pass
Frequency Hopping Spread Spectrum - RX/Digital Test Summary			
FCC Rule Part	IC Rule Part	Description	Result
15.207	RSS-Gen 7.2.4	AC Conducted Emissions	N/A
15.209	RSS-210 Section 2.5 RSS-GEN Section 4.1	General Field Strength Limits	Pass



4.1 OCCUPIED BANDWIDTH: (FCC PART §2.1049, RSS-GEN 4.6.1)

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

At full modulation, the occupied bandwidth was measured as shown.

Table 5 provides a summary of the Occupied Bandwidth Results.

Table 5: Occupied Bandwidth Results

Frequency	Bandwidth 20 dB (MHz)	Bandwidth 99%(MHz)
Low Channel: 2402MHz	1.199	1.066
Mid Channel: 2442MHz	1.199	1.063
High Channel: 2480MHz	1.202	1.067



Figure 1: Occupied Bandwidth, Low Channel

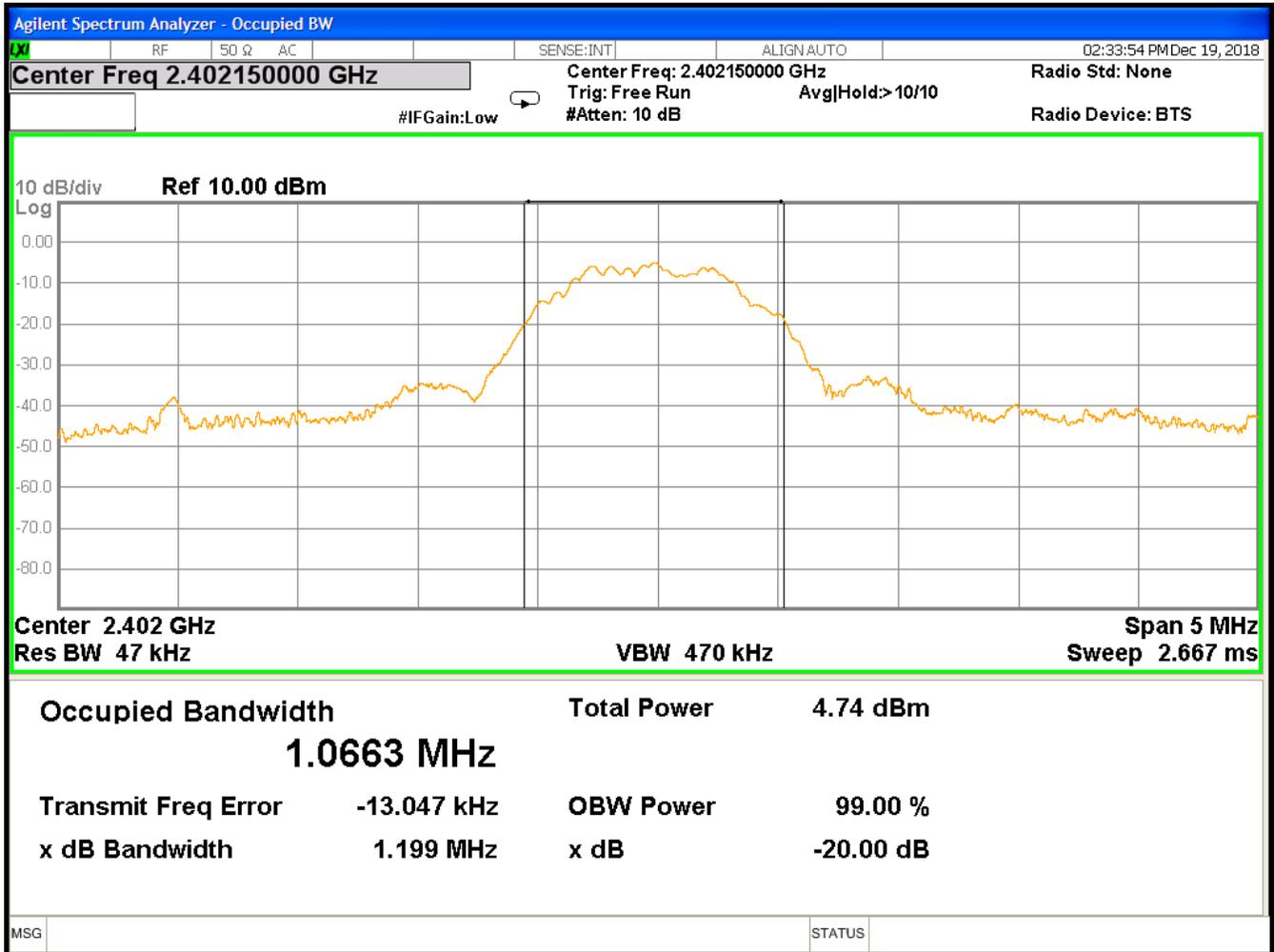




Figure 2: Occupied Bandwidth, Mid Channel

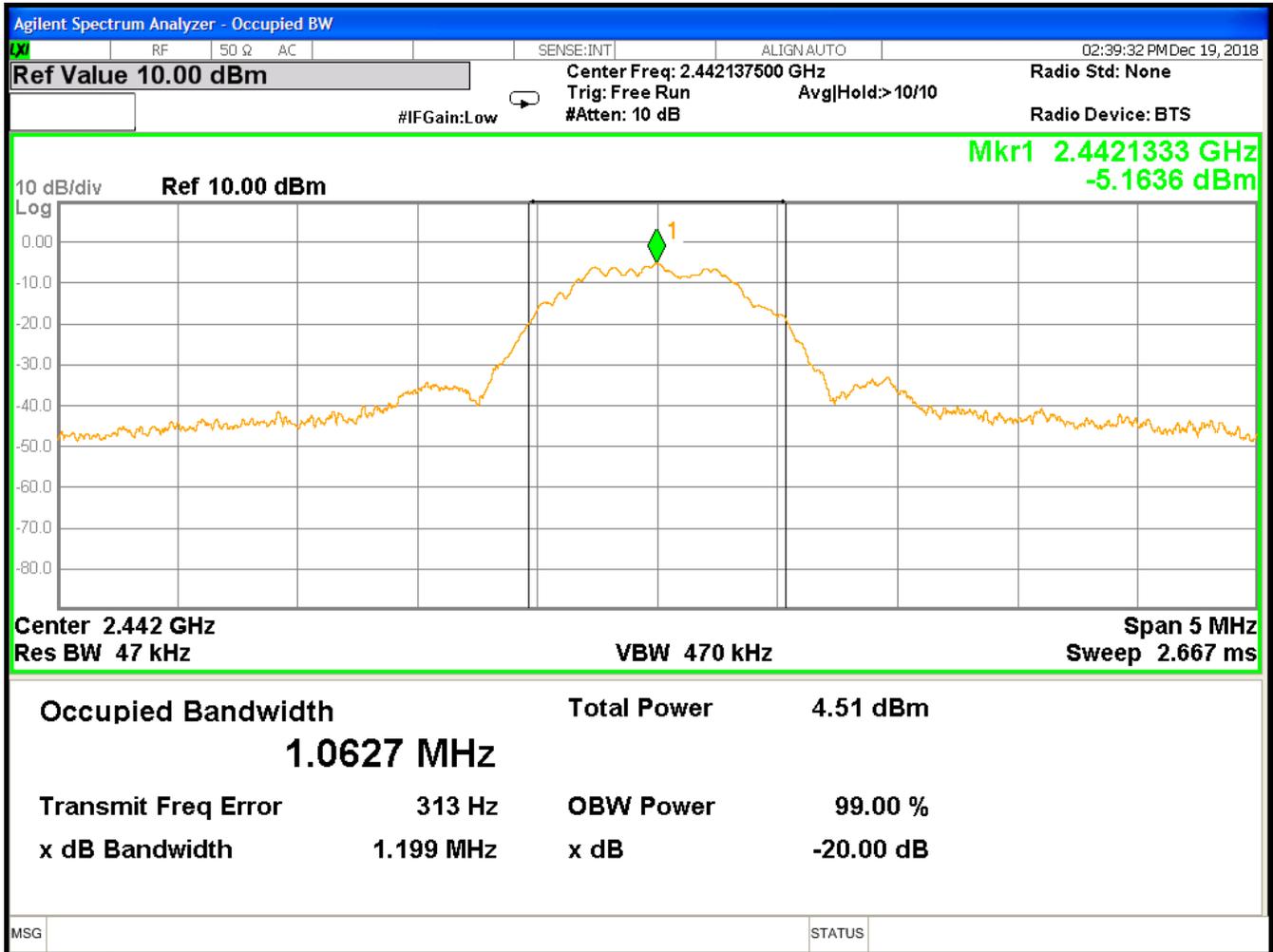
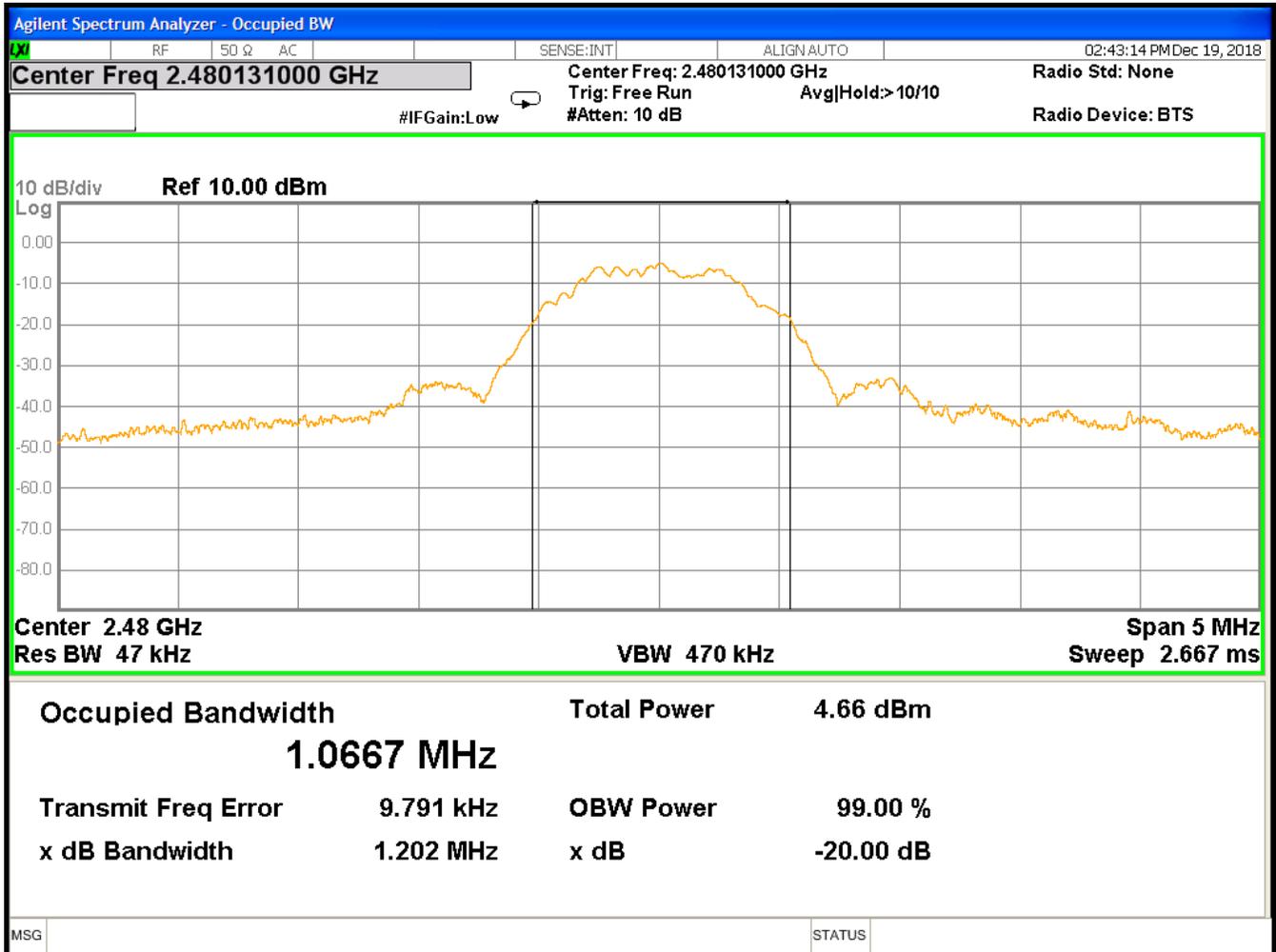




Figure 3: Occupied Bandwidth, High Channel





4.3 CONDUCTED OUTPUT POWER

4.3.1 Test Data

The following plots represent the conducted power results from the attached connector for each of the Low, Center and High Channels at maximum power. The antenna gain is not added. The readings were taken from a spectrum analyzer with all interconnecting cables/attenuators accounted for. Unit set to transmit a continuous wave for peak power

Figure 4: Low Channel Conducted Power

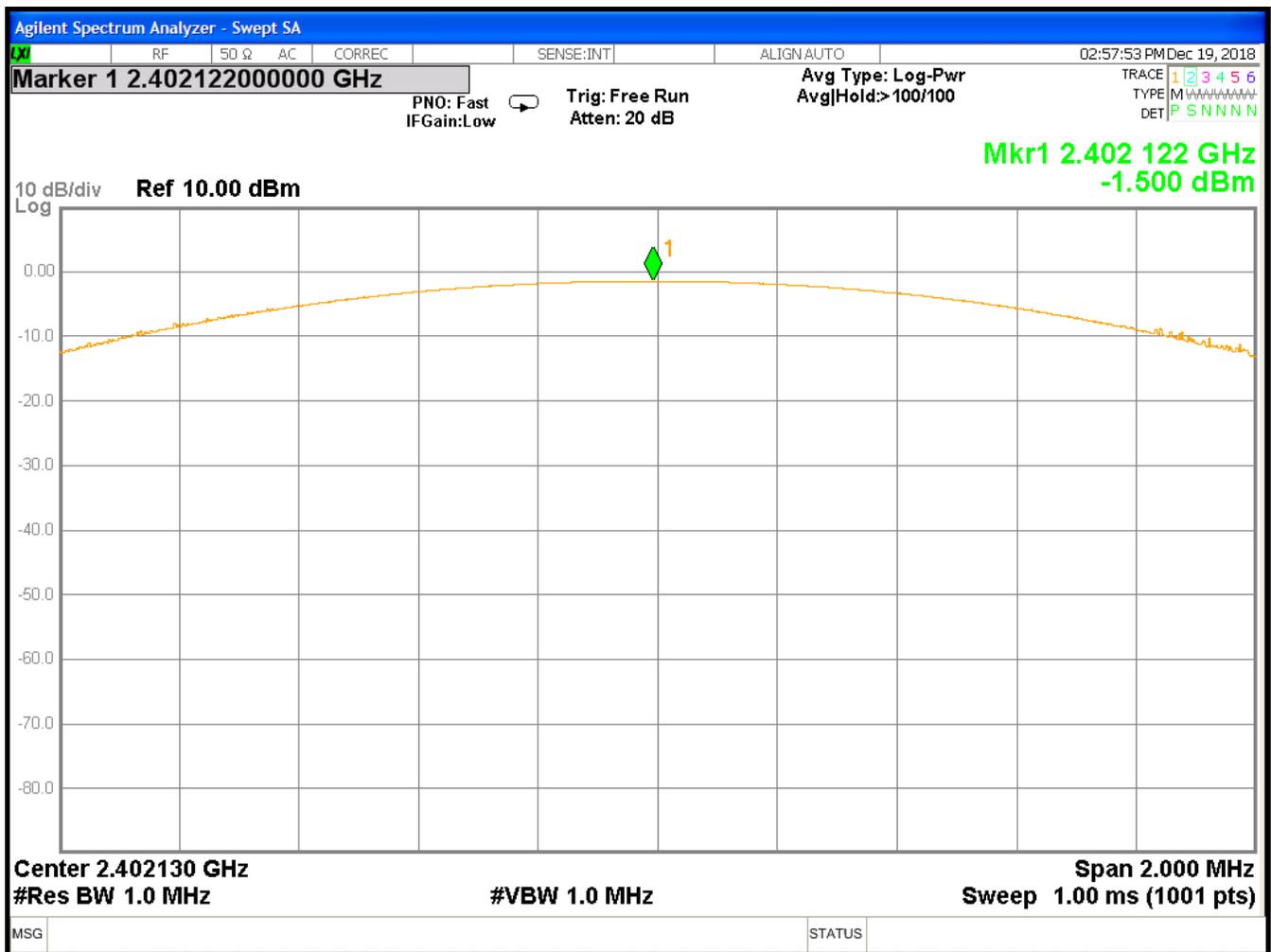




Figure 5: Center Channel Conducted Power

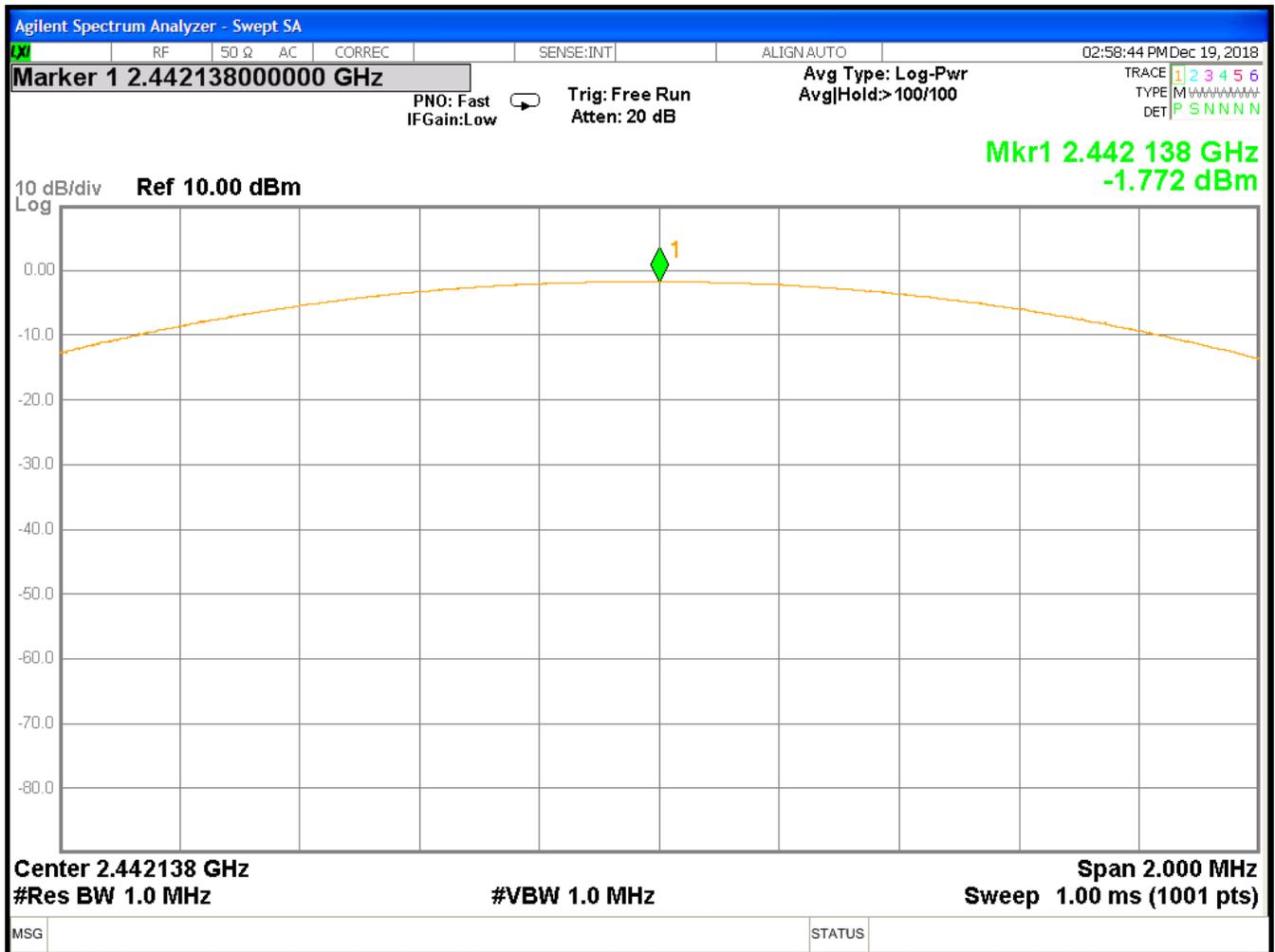
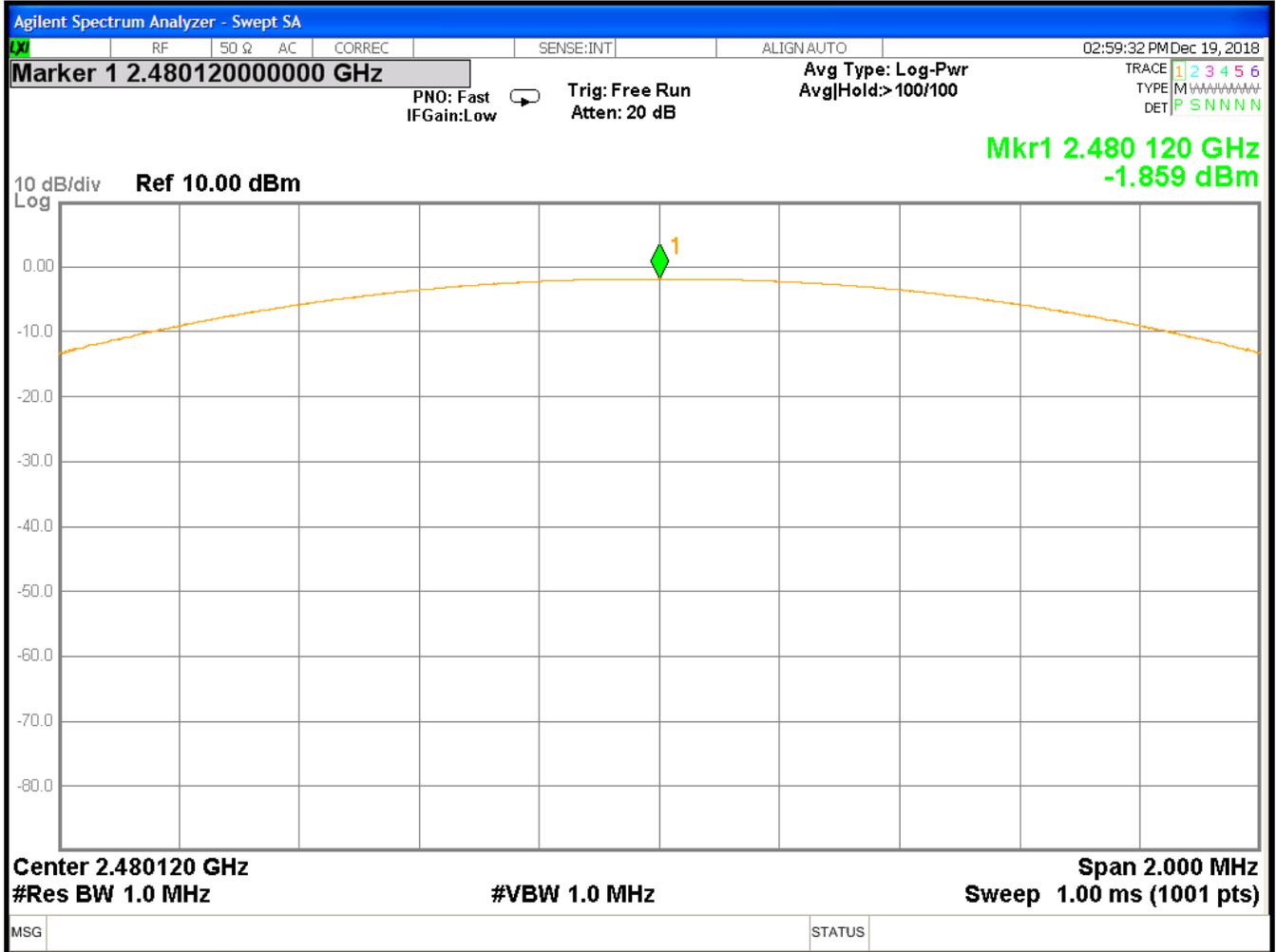


Figure 6: High Channel Conducted Power





4.4 RADIATED SPURIOUS EMISSIONS: (FCC PART §15.249(A), RSS210 A2.9)

The EUT must comply with the requirements for radiated spurious emissions that fall within the restricted bands. These emissions must meet the limits specified in §15.209 and §15.35(b) for peak measurements.

4.4.1 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 output of the antenna was connected to the input of the spectrum analyzer and the emissions in the frequency range of 30 MHz to 25 GHz were measured. The peripherals were placed on the table in accordance with ANSI C63.4-2014. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured. All measurements were made in peak mode and because they show compliance no average reading needed to be taken.

The emissions were measured using the following resolution bandwidths:

Table 6: Spectrum Analyzer Settings

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	120kHz	>100 kHz
>1000 MHz	1 MHz	<10 Hz (Avg.), 1MHz (Peak)

Table 7: Radiated Emission Test Data, Low Frequency Data (<1GHz)

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
36.83	V	0.00	1.00	35.30	-9.1	20.4	100.0	-13.8	
48.12	V	0.00	1.00	41.37	-16.8	16.9	100.0	-15.4	
143.92	V	90.00	1.00	37.40	-12.0	18.5	150.0	-18.2	
239.99	V	180.00	1.00	33.17	-12.3	11.0	200.0	-25.2	
287.92	V	180.00	1.00	31.44	-9.9	11.9	200.0	-24.5	
36.83	H	0.00	3.80	34.15	-9.1	17.9	100.0	-14.9	
48.12	H	0.00	3.80	37.23	-16.8	10.5	100.0	-19.6	
143.92	H	90.00	2.50	33.52	-12.0	11.8	150.0	-22.0	
239.99	H	180.00	2.50	35.01	-12.3	13.6	200.0	-23.3	



287.92	H	180.00	2.00	32.35	-9.9	13.2	200.0	-23.6	
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Table 8: Radiated Emission Test Data >1GHz, Low, Middle & High Channels

Frequency MHz	Polarity H/V	Azimuth Degree	Ant. Height m	SA Level dBuV	Corr Factors dB	Corr Level uV/m	Limit uV/m	Margin dB	Comments
2400.00	V	0.00	1.00	31.00	-16.8	5.1	500.0	-39.7	PEAK-NF
2402.00	V	0.00	1.00	89.40	-16.8	4280.7	50000.0	-21.3	
2483.50	V	0.00	1.00	30.80	-16.2	5.4	500.0	-39.4	PEAK-NF
4804.27	V	0.00	1.00	57.45	-7.8	304.7	500.0	-4.3	
7206.39	V	0.00	1.00	50.49	-1.9	269.4	500.0	-5.4	
2440.00	V	90.00	1.00	90.57	-16.3	5155.7	50000.0	-19.7	
4880.25	V	90.00	1.00	58.11	-7.6	336.7	500.0	-3.4	
7320.41	V	90.00	1.00	52.14	-1.9	323.9	500.0	-3.8	
2480.13	V	90.00	1.00	90.11	-15.9	5147.0	50000.0	-19.7	
4960.27	V	90.00	1.00	58.05	-7.3	346.4	500.0	-3.2	
7440.27	V	90.00	1.00	49.41	-2.0	235.3	500.0	-6.5	
2400.00	V	0.00	1.00	31.10	-16.8	5.2	500.0	-39.6	PEAK-NF
2402.00	H	45.00	1.50	79.13	-16.8	1312.2	50000.0	-31.6	
2483.50	V	0.00	1.00	31.00	-16.2	5.5	500.0	-39.2	PEAK-NF
4804.27	H	45.00	1.50	52.66	-7.8	175.5	500.0	-9.1	
7206.39	H	45.00	1.50	49.40	-1.9	237.6	500.0	-6.5	
2440.00	H	45.00	1.50	77.51	-16.3	1146.3	50000.0	-32.8	
4880.25	H	45.00	1.50	54.08	-7.6	211.7	500.0	-7.5	
7320.41	H	45.00	1.50	49.11	-1.9	228.5	500.0	-6.8	
2480.13	H	45.00	1.40	78.60	-15.9	1367.9	50000.0	-31.3	
4960.27	H	45.00	1.40	53.50	-7.3	205.1	500.0	-7.7	
7440.27	H	45.00	1.40	49.82	-2.0	246.7	500.0	-6.1	



4.4.2 Band Edge Plots

On each operating frequency measured, band-edge emissions shall be reported by providing plots of the measuring instrument display. The axes, the scale units per division, and the limit shall be clearly labeled in the test report.

4.4.2.1 Test Methodology

Emissions for the band edge were performed in an antenna port conducted manner. The marker delta method was used to measure the band edge. The spectrum analyzer span was setup to encompass both the peak of the fundamental emission and the band-edge emission under investigation. The instrument RBW to 1% of the total span (but never less than 30 kHz), with a VBW equal to or greater than three times the RBW (The spectrum analyzer resolution bandwidth was set to 100 kHz and the video bandwidth was set to 300 kHz). The peak levels of the fundamental emission and the relevant band-edge emission are determined. The amplitude delta between the peak of the fundamental and the peak of the band-edge emission is then shown in the plot.

Figure 7: Low Channel Band Edge

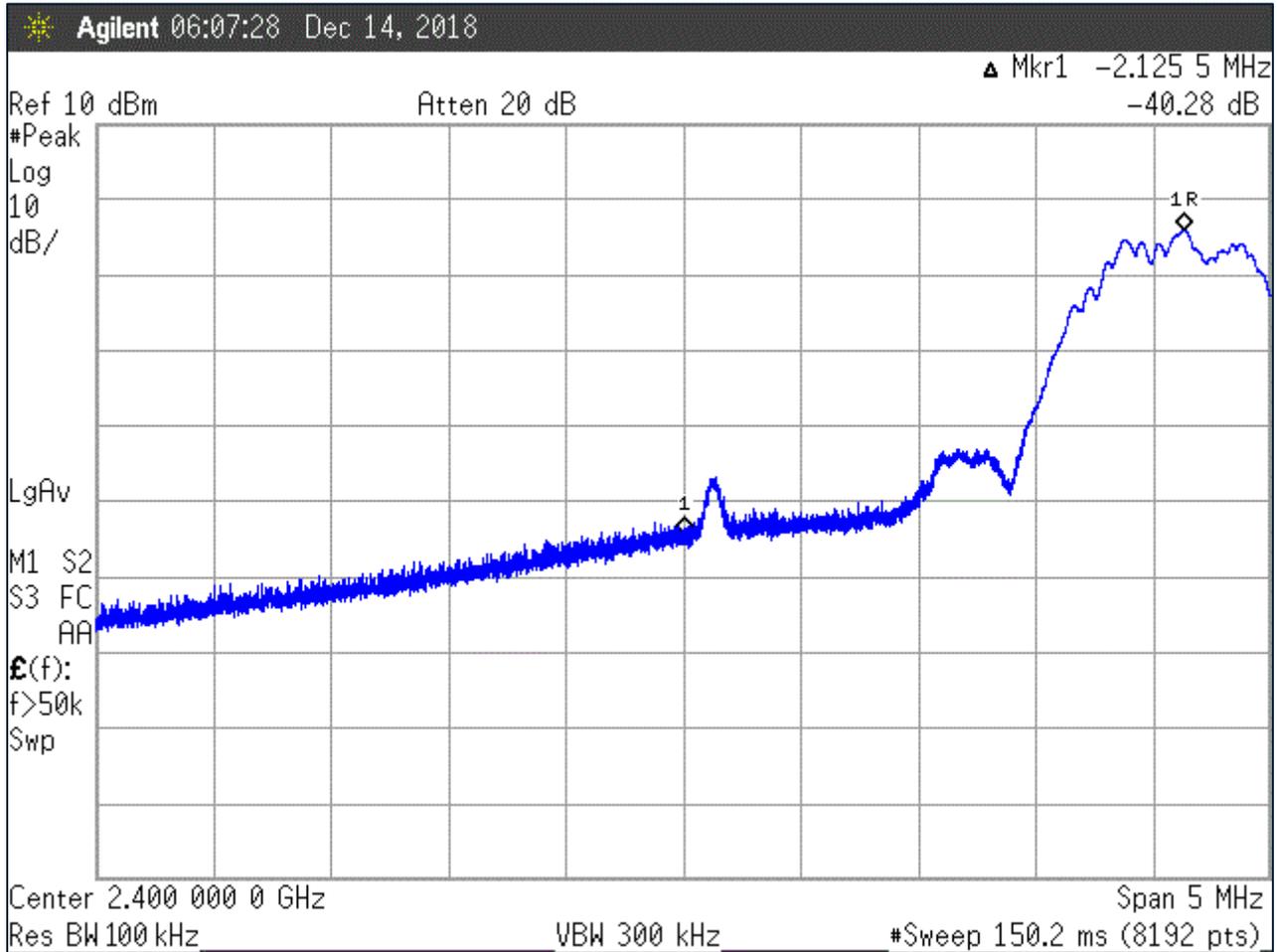
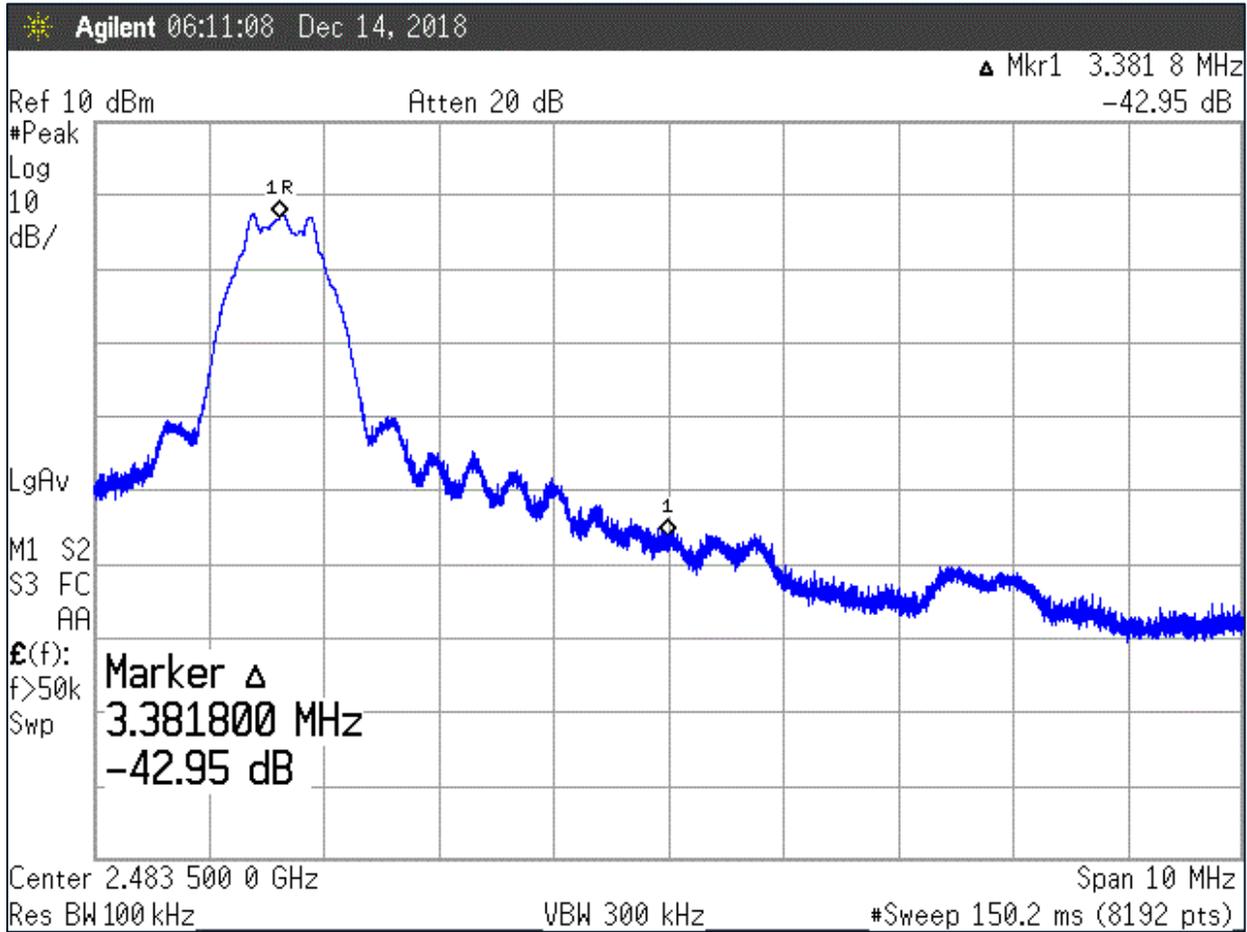


Figure 8: High Channel Band Edge





4.5 RECEIVER RADIATED SPURIOUS EMISSIONS: (RSS-210 SECT 2.6)

The EUT must comply with the requirements for radiated spurious emissions that fall within the restricted bands. These emissions must meet the limits specified in §15.109 and §15.35(b) for peak measurements.

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 C63.4-2014. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured. The emissions were measured using the following resolution bandwidths:

Table 9: Spectrum Analyzer Settings

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	120kHz	>100 kHz
>1000 MHz	1 MHz	10 Hz (Avg.), 1MHz (Peak)

Average measurements above 1GHz were made with the Spectrum analyzer set to the linear mode with a Video bandwidth of 10Hz, and the resultant reading mathematically converted to dBuV. Correction factors were then applied, and the resulting value was compared to the limit.

Table 10: Radiated Emission Test Data, Receiver

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
36.83	V	0.00	1.00	35.30	-9.1	20.4	100.0	-13.8	
48.12	V	0.00	1.00	41.37	-16.8	16.9	100.0	-15.4	
143.92	V	90.00	1.00	37.40	-12.0	18.5	150.0	-18.2	
239.99	V	180.00	1.00	33.17	-12.3	11.0	200.0	-25.2	
287.92	V	180.00	1.00	31.44	-9.9	11.9	200.0	-24.5	
36.83	H	0.00	3.80	34.15	-9.1	17.9	100.0	-14.9	
48.12	H	0.00	3.80	37.23	-16.8	10.5	100.0	-19.6	
143.92	H	90.00	2.50	33.52	-12.0	11.8	150.0	-22.0	
239.99	H	180.00	2.50	35.01	-12.3	13.6	200.0	-23.3	
287.92	H	180.00	2.00	32.35	-9.9	13.2	200.0	-23.6	



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. Per §15.249(b)(2) the frequency tolerance shall be maintained within 0.01% of the reference frequency.

4.6.1 Test Procedure

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 transmitter was allowed to stabilize for 1 minute after power was applied and then the measurement was made.

The frequency stability of the transmitter was examined at the voltage extremes and for the temperature range of -20°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 a spectrum analyzer using the frequency counter function.

The frequency stabilities can be maintained to a lesser temperature range provided that the transmitter is automatically inhibited from operating outside the lesser temperature range.

The RF carrier frequency shall not depart from the reference frequency (reference frequency is the frequency at 22°C and rated supply voltage) in excess of .01% (24401 Hz)

The EUT is powered by a size 312 1.45Vdc battery. For the purposes of this testing, the battery was replaced with a dc power supply providing a nominal voltage of 1.3Vdc.

4.6.2 Test Results

The EUT complies with the temperature stability requirements of FCC §15.249. Test results are given in Table 11.



Table 11: Frequency Stability Data

Temperature (C)	Frequency (MHz)	Deviation (Hz)	Limit (+/-Hz)	Pass/Fail
22(ambient)	2440.128165	0	24401	NA
-20	2440.122194	-5971	24401	Pass
-10	2440.129454	1289	24401	Pass
0	2440.132254	4089	24401	Pass
10	2440.131210	3045	24401	Pass
20	2440.128591	426	24401	Pass
30	2440.124856	-3309	24401	Pass
40	2440.122104	-6061	24401	Pass
50	2440.121393	-6772	24401	Pass

Voltage	Frequency (MHz)	Deviation (Hz)	Limit (+/-Hz)	Pass/Fail
Nominal Voltage	2440.128165	0	24401	NA
110% of Nom V (1.43Vdc)	2440.128235	70	24401	Pass
85% of Nom V (1.1Vdc)	2440.128198	33	24401	Pass



Photograph 1: Antenna Port & Frequency Stability Test Configuration





Photograph 2: Radiated Emissions Test Setup < 1 GHz





Photograph 3: Radiated Emissions Test Setup > 1 GHz

