Washington Laboratories, Ltd.

TEST REPORT

for the

RFW-201

FCC ID: P9X-RFW201

IC ID: 6766A-RFW201

REPORT# 16031-01 REV 0

Prepared for:

Eaton's Cooper Power Systems

540 Gaither Road, Suite 480

Rockville, Maryland 20850

Prepared By:

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Gaithersburg, Maryland 20879

Test Report
for the
Eaton's Cooper Power Systems
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FCC ID: P9X-RFW201
ISED ID: 6766A-RFW201

JUNE 20, 2019

WLL REPORT# 16031-01 REV 0

Prepared by:

Michael Violette, P.E.
CEO

Reviewed by:

Steve Koster
President

ABSTRACT

This report has been prepared on behalf of Eaton's Cooper Power Systems to support the attached Application for Equipment Authorization. The test report and application are submitted for a Frequency Hopping Spread Spectrum (FHSS) Transmitter under Part 15.247 and RSS-247 of the FCC Rules and Regulations and Spectrum Management and Telecommunications Policy. This Certification Test Report documents the test configuration and test results for the Eaton's Cooper Power Systems RFW-201.

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 ANAB under Testing Certificate AT-1448 as an independent FCC test laboratory.
The Eaton's Cooper Power Systems RFW-201 complies with the limits for a Frequency Hopping Spread Spectrum (FHSS) Transmitter device under FCC Part 15.247 and Innovation, Science and Economic Development Canada (ISED) RSS-247.

Revision History	Description of Change	Date
Rev 0	Initial Release	JUNE 20, 2019
Rev 1	Comments addressed	June 25, 2019

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1 INTRODUCTION

1.1 COMPLIANCE STATEMENT

The Eaton's Cooper Power Systems RFW-201 complies with the limits for a Frequency Hopping Spread Spectrum Transmitter device under FCC Part 15.247 and ISED Canada RSS-247.

Note that the output power and OBW measurements collected and reported herein are within measurement tolerances compared to the values submitted for the original certification.

1.2 TEST SCOPE

Tests for radiated and conducted (at antenna terminal) emissions were performed. All measurements were performed in accordance with FCC Public Notice DA-00-705 "Measurement Guidance for Frequency Hopping Spread Spectrum Systems. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 CONTRACT INFORMATION

Customer:	Eaton's Cooper Power Systems
Address	540 Gaither Road, Suite 480 Rockville, Maryland 20850
Purchase Order Number:	4510999093
Quotation Number:	71368

1.4 TEST DATES

Testing was performed on the following date(s): May 2, 2019-May 3, 2019

1.5 TEST AND SUPPORT PERSONNEL

Washington Laboratories, LTD	Michael Violette
Customer Representative	Steven Seymour

1.6 ABBREVIATIONS

A	**A**mpere
ac	**a**lternating **c**urrent
AM	Amplitude Modulation
Amps	Amperes
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	**g**iga – prefix for 10^9 multiplier
Hz	**H**ertz
IF	**I**ntermediate **F**requency
k	**k**ilo – prefix for 10^3 multiplier
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
M	**M**ega – prefix for 10^6 multiplier
m	**M**eter
μ	**m**icro – prefix for 10^{-6} multiplier
NB	**N**arrow**b**and
QP	**Q**uasi-**P**eak
RE	**R**adiated **E**missions
RF	**R**adio **F**requency
rms	**r**oot-**m**ean-**s**quare
SN	**S**erial **N**umber
S/A	**S**pectrum **A**nalyzer
V	**V**olt

2 EQUIPMENT UNDER TEST

2.1 EUT IDENTIFICATION & DESCRIPTION

Table 1: Device Summary

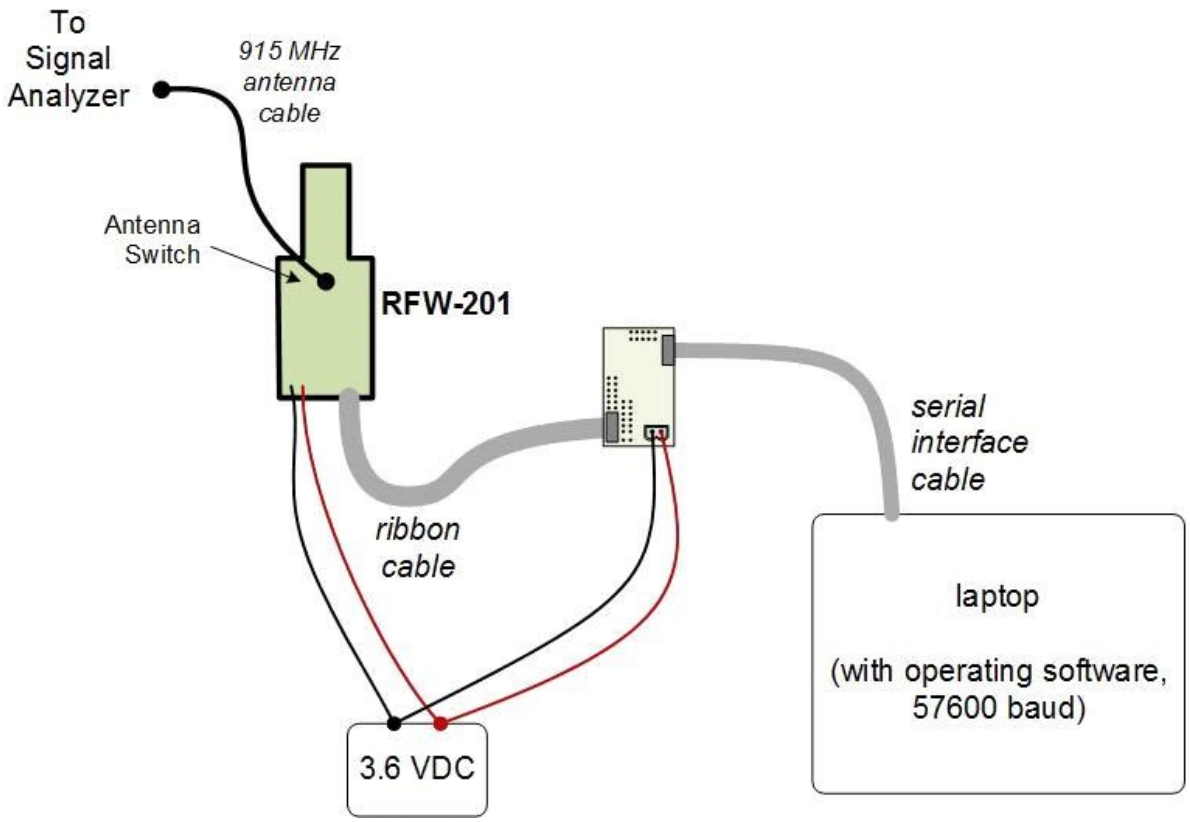
Item	Wireless radio module, or node, designed to be used in water metering products.
Manufacturer:	Eaton's Cooper Power Systems
FCC ID:	P9X-RFW201
ISED ID:	6766A-RFW201
Model:	RFW-201
Serial Number of Unit Tested	N/A
FCC Rule Parts:	§15.247
ISED Rule Parts:	RSS-247
Frequency Range:	902MHz – 928MHz
Maximum Output Power:	87mW (19.4dBm)
Reported Output Power from Grant	0.1W
Modulation:	FSK
Occupied Bandwidth (99%):	308kHz maximum
Emission Designator:	3K08F1D
Keying:	Automatic
Type of Information:	Data
Number of Channels:	50
Power Output Level	Fixed
Highest TX Spurious Emission:	57.5 uV/m @9272 MHz
Highest RX Spurious Emission:	45.4 uV/m @274MHz
Antenna Connector	hard-wired
Antenna Type	Linx ANT-916-HETH (helical), 2.4 dBi
Interface Cables:	For configuration/maintenance only
Maximum Data Rate	8192 kSymbols
Power Source & Voltage:	Battery 3.6 VDC (button cell)

The Eaton's Cooper Power Systems RFW-201 is a wireless radio module, or Node, designed to be used in water metering products.
The Node enables communication of metering data between the meter and a remotely located Gateway or Relay Node device using an RF-mesh network. The RFW-201 contains a 915 MHz radio that operates with a maximum output power of 0.1W.

2.2 TEST CONFIGURATION

There are five selectable FHSS, transmission data rates for the RFW-201 which can be set using the operating software –9.6, 19.2, 38.4, 76.8 kb/s.

Figure 1. Test Configuration



2.3 TESTING ALGORITHM

The RFW-201 performance was measured by its ability to communicate to the RFW-201 using its operating software was programmed for FHSS operation via ?? Worst cast 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. 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
ANSI C63.26 (Dec 2015) American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services

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

Where u_c = standard uncertainty
a, b, c,.. = 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

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

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: **Bench Conducted/ Radiated Emissions**			
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00823	Agilent/EXA 9010A	Spectrum Analyzer	2/20/2020
00644	Sunol Sciences/JB1	Bi-Conilog Antenna	01/16/2020
00522	HP/8449B	Pre-Amplifier	04/03/2020
00276	Electro-Metrics/BPA-1000	Pre-Amplifier	04/03/2020
00425	ARA/DRG-118-A	Double Ridge Horn Antenna	01/03/2020
00849	AH Systems/SAC-18G-16	HF Low Loss RF Cable	01/18/2020

4 TEST RESULTS

The Table Below shows the results of testing for compliance with a Frequency Hopping Spread Spectrum device in accordance with FCC Part 15.247 10/2014 and RSS-247 Issue 1. 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**
15.247 (a)(1)	RSS-247 [5.1a]	20dB Bandwidth	
15.247 (b)	RSS-247 [5.4]	Transmit Output Power	
15.247 (a)(1)	RSS-247 [5.1]	Channel Separation	
15.247 (a)(1)	RSS-247 [5.4]	Number of Channels	
15.247 (a)(1)	RSS-247 [5.1]	Time of Occupancy	
15.247 (d)	RSS-247 [5.5]	Occupied BW / Out-of-Band Emissions (Band Edge @ 20dB below)	
15.205 15.209	RSS-Gen [8.9/8.10]	General Field Strength Limits (Restricted Bands & RE Limits)	
15.207	RSS-Gen [8.8]	AC Conducted Emissions	N/A
Frequency Hopping Spread Spectrum - RX/Digital Test Summary			
FCC Rule Part	**IC Rule Part**	**Description**	**Result**
15.207	RSS-Gen	AC Conducted Emissions	N/A
15.209	RSS-Gen	General Field Strength Limits	Pass

4.1 DUTY CYCLE CORRECTION AND TIME OF OCCUPANCY

In accordance with the FCC Public Notice the spurious radiated emissions measurements may be adjusted if using a duty cycle correction factor if the dwell time per channel of the hopping signal is less than 100 ms.

The duty cycle correction factor is calculated by:

20 x LOG (dwell time/100 ms)

The following figure shows the plot of the dwell time for the transmitter. Based on this plot, the dwell time per hop is 18.69ms. The maximum total dwell time per 100ms is 19ms. This corresponds to a duty cycle correction of 14.6 dB for radiated spurious emissions. However, the duty cycle correction factor was not used in these measurements.

The transmitter shall have a time of occupancy for systems having a 20dB bandwidth greater than 250 kHz of no more than 0.4seconds in any 10 second period.

These tests were conducted with the RF output connected through appropriate attenuators to the input of a spectrum analyzer set to zero span mode. The unit was set to hopping mode with the spectrum analyzer set 0 span.

The time of occupancy in a single hop is 18.69 milli-seconds.

The results are shown in the plots below.

Table 5: Duty Cycle/Time of Occupancy Results

Test	Result	Limit	Pass/Fail
Dwell time per Hop	18.69ms	NA	NA
On times per 10 seconds	Correction	NA	NA
Time of Occupancy	0.09774s/10 sec	0.4s/10 sec	Pass

Figure 2: Duty Cycle Plot

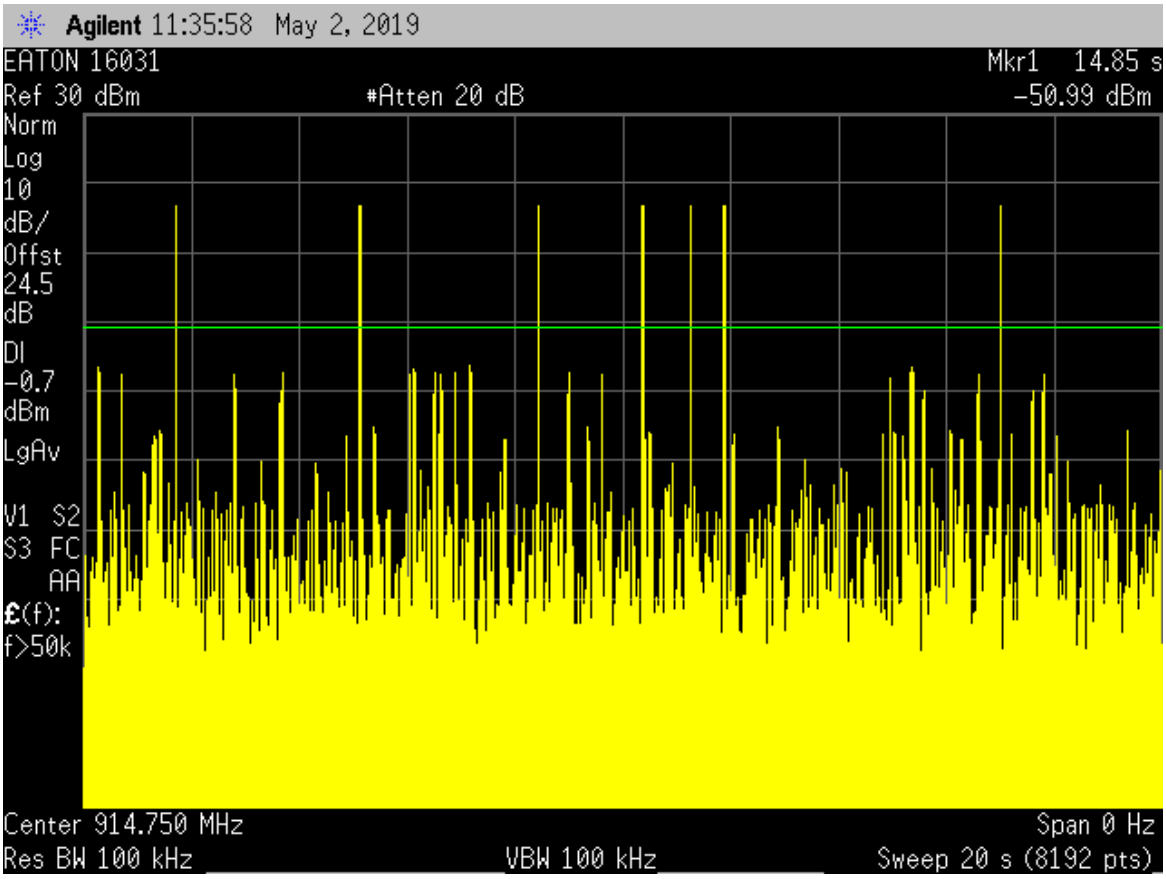
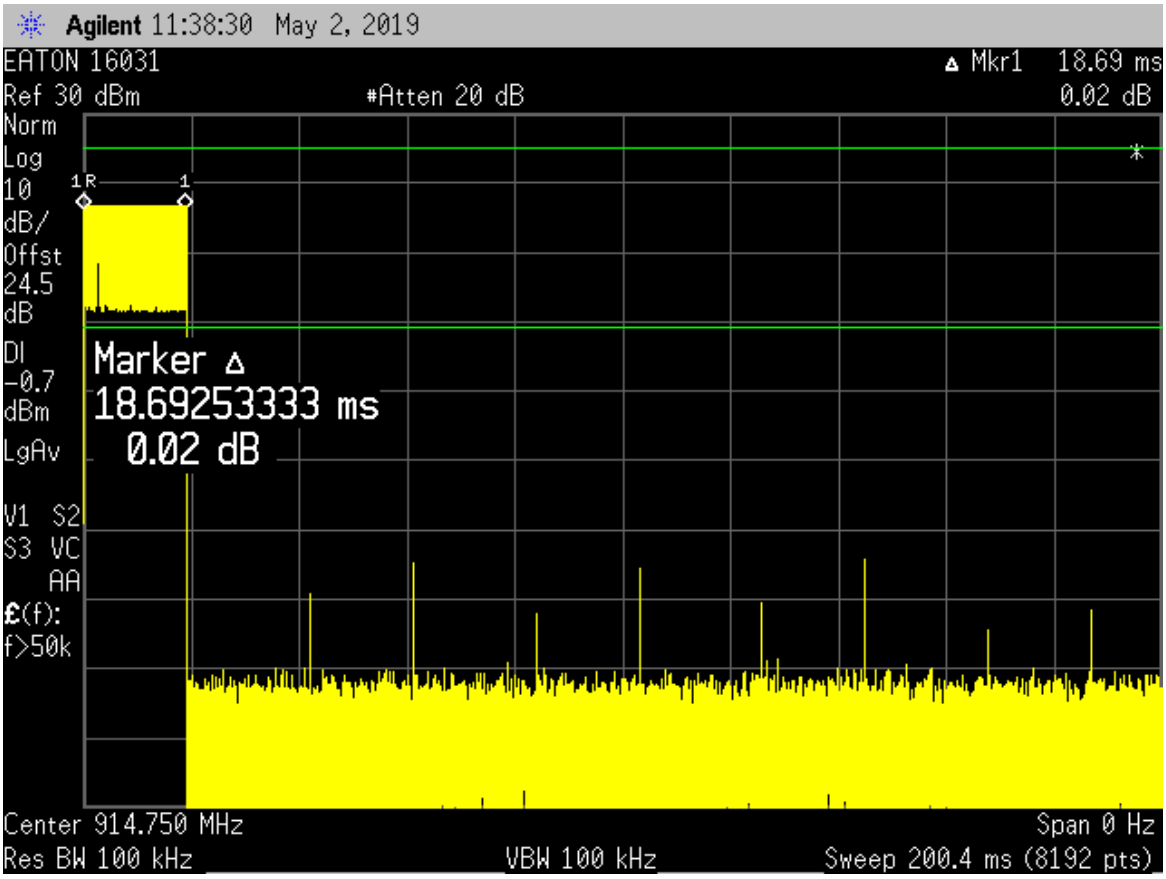


Figure 3: Time of Occupancy



4.2 RF POWER OUTPUT: (FCC PART §2.1046)

To measure the output power the hopping sequence was stopped while the frequency dwelled on a low, high and middle channel. 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.

Table 6: RF Power Output

Frequency	Level (dBm)	Limit (dBm)	Pass/Fail
Low Channel: 902.75MHz	19.2	30	Pass
Mid Channel: 915.75MHz	19.3	30	Pass
High Channel: 927.25MHz	19.4	30	Pass

Figure 4: RF Peak Power, Low Channel

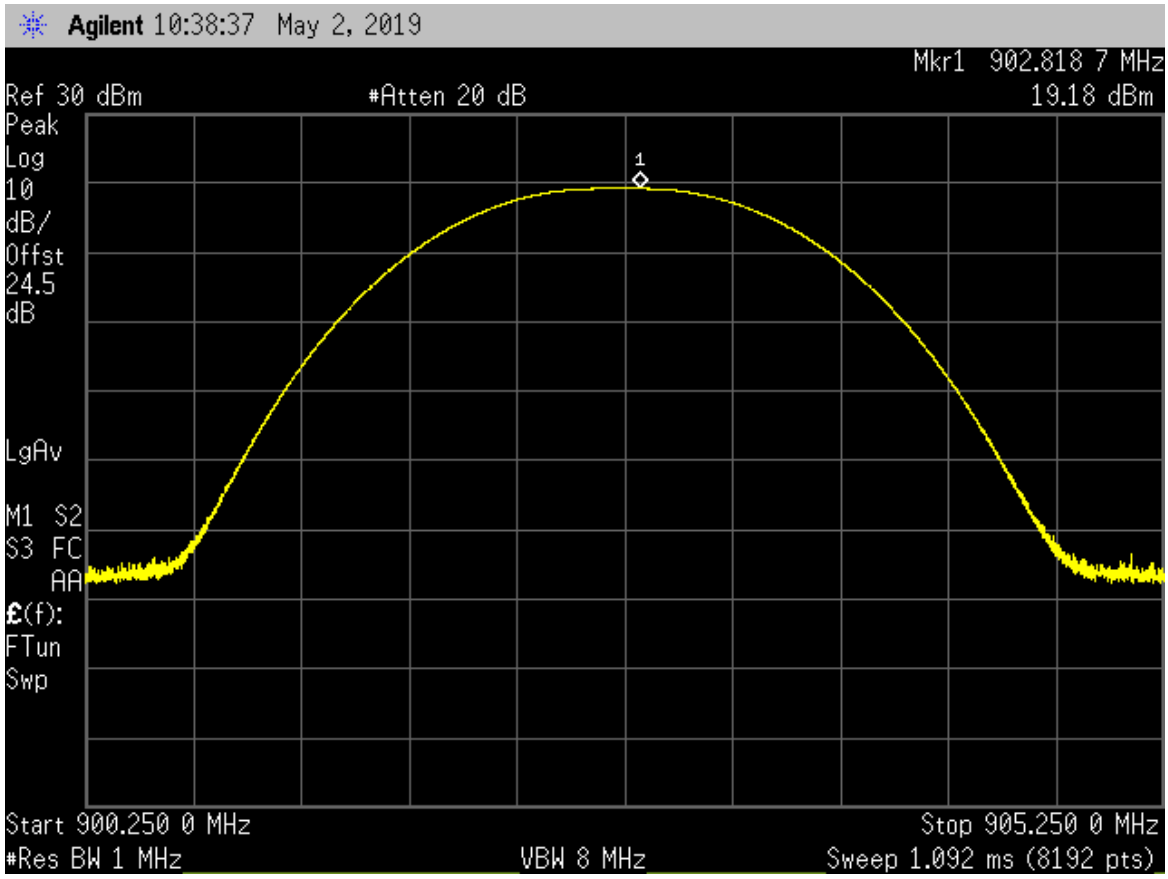


Figure 5: RF Peak Power, Mid Channel

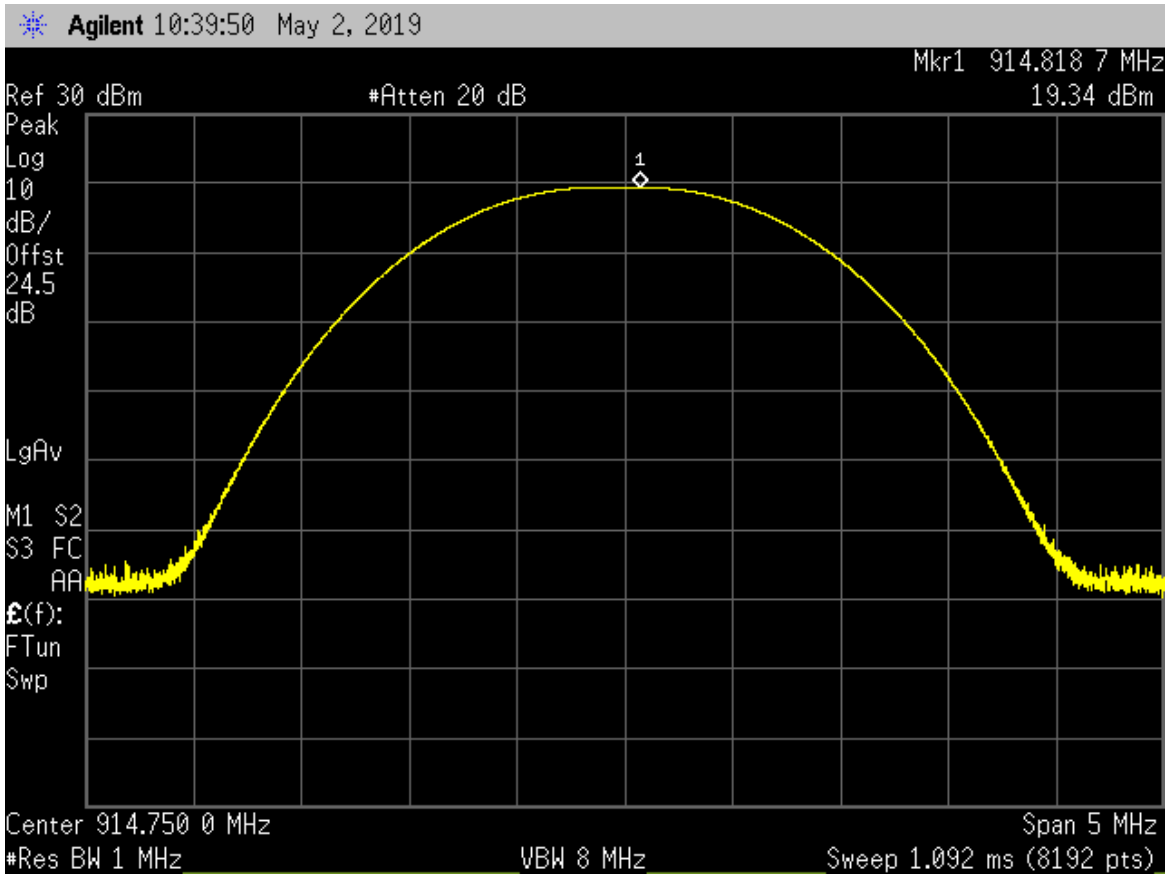
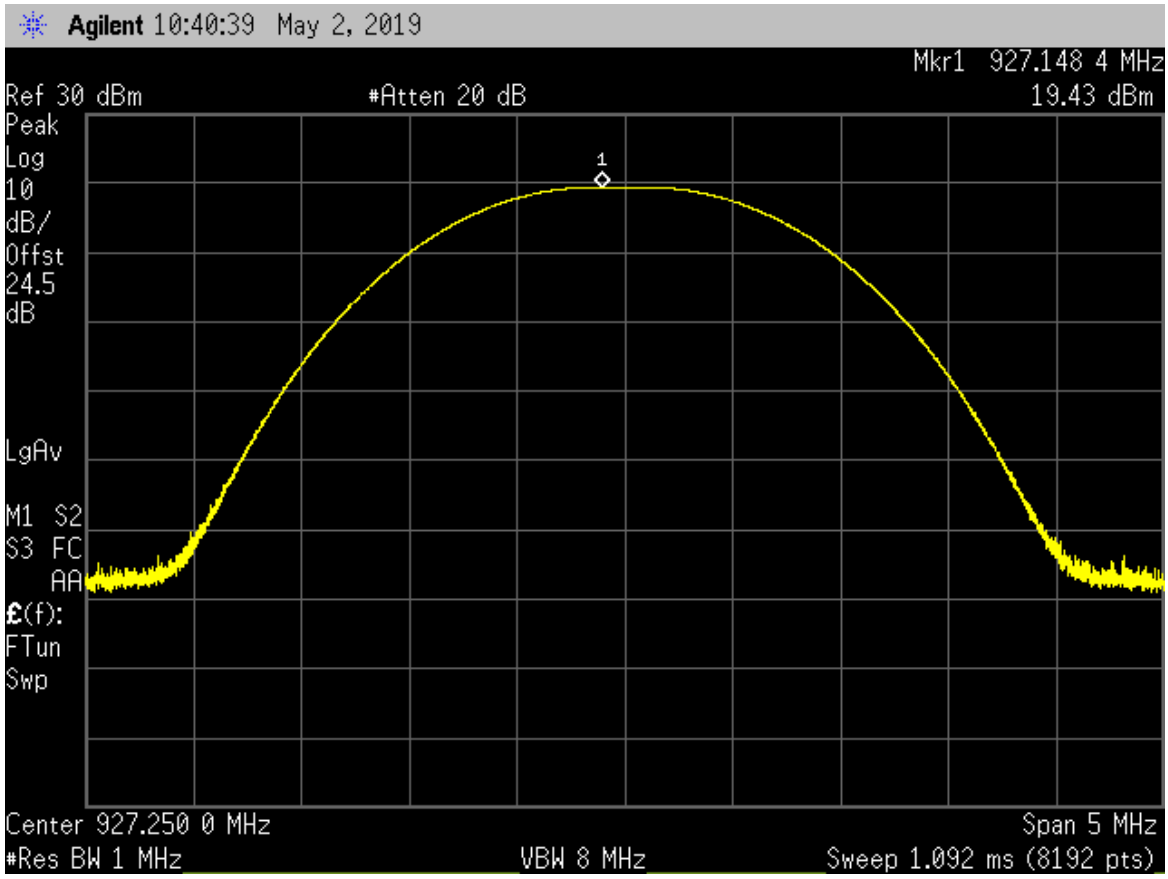


Figure 6: RF Peak Power, High Channel



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.
For Frequency Hopping Spread Spectrum Systems, FCC Part 15.247 requires the maximum 20 dB bandwidth not exceed 500 kHz.
At full modulation, the occupied bandwidth was measured as shown.
Table 7 provides a summary of the Occupied Bandwidth Results.

Table 7: Occupied Bandwidth Results

Frequency	Bandwidth (kHz)	Limit (kHz)	Pass/Fail
Low Channel: 902.75MHz	289.8	500	Pass
Mid Channel: 914.75MHz	308.9	500	Pass
High Channel: 927.25MHz	293.2	500	Pass

Figure 7: Occupied Bandwidth, Low Channel

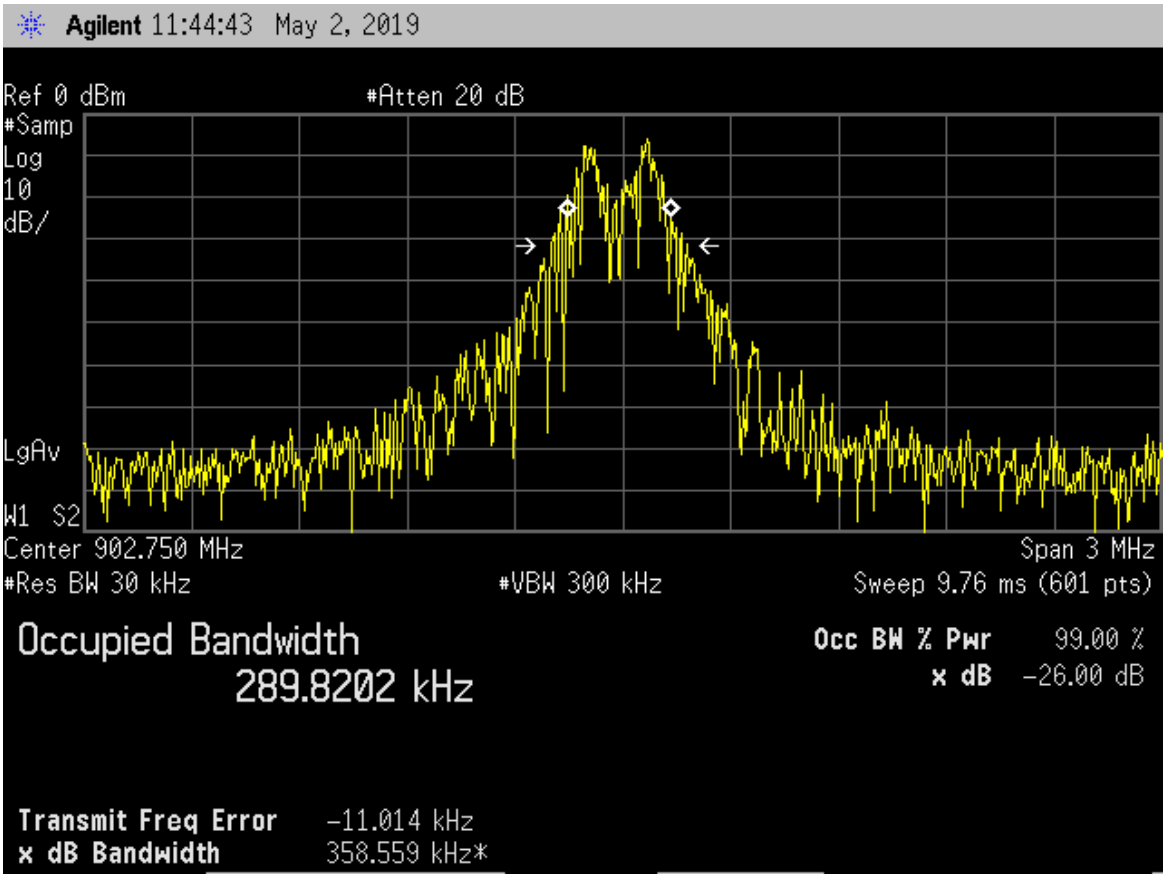


Figure 8: Occupied Bandwidth, Mid Channel

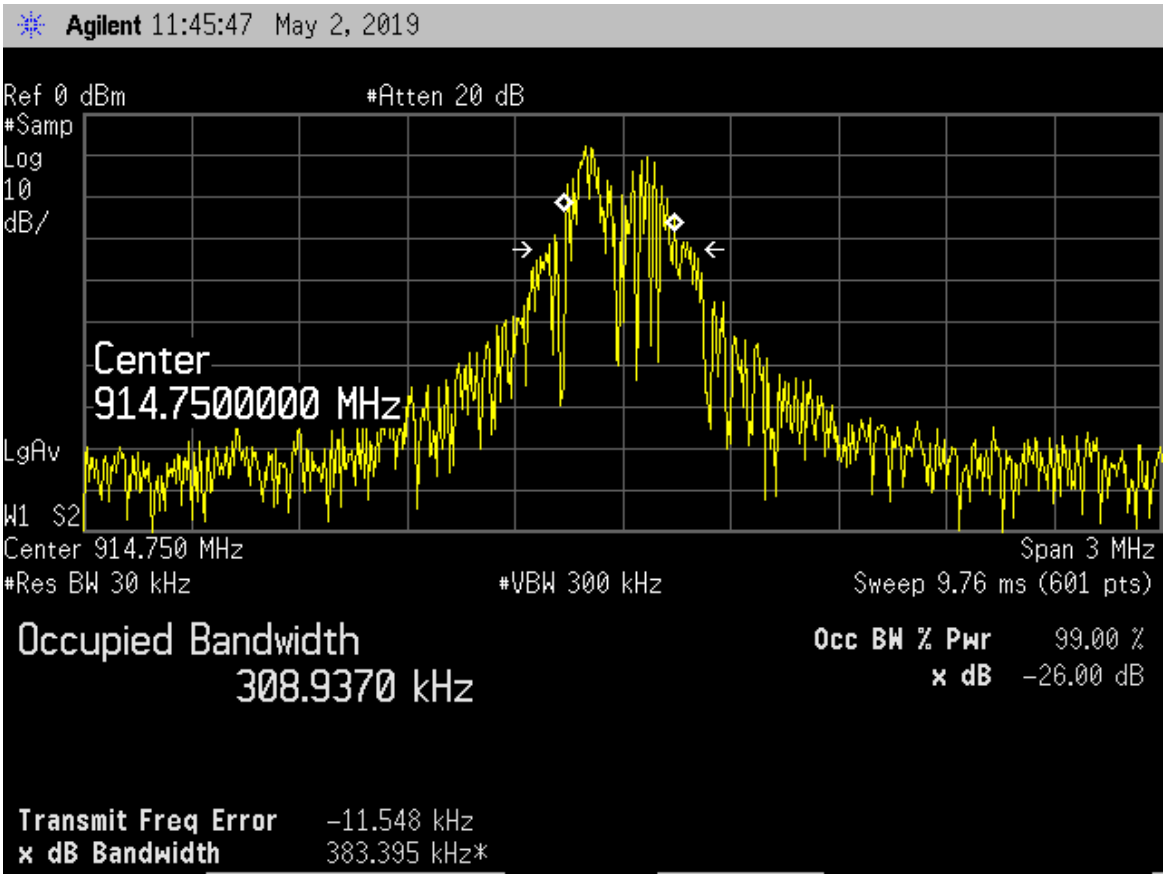
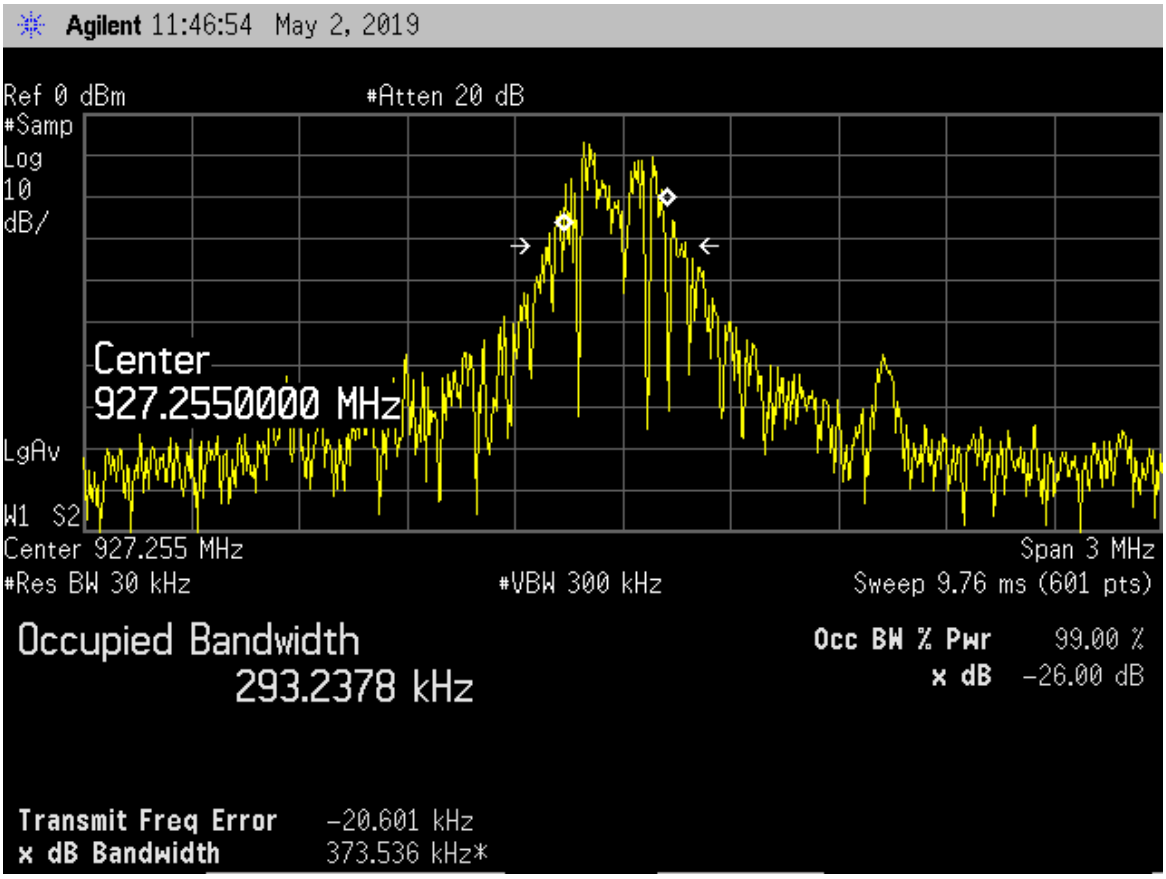


Figure 9: Occupied Bandwidth, High Channel



4.4 CHANNEL SPACING AND NUMBER OF HOP CHANNELS (FCC PART §15247(A)(1)

Per the FCC requirements, frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth, whichever is greater. The maximum 20dB bandwidth measured is 308.9kHz so the channel spacing must be more than 308 kHz.

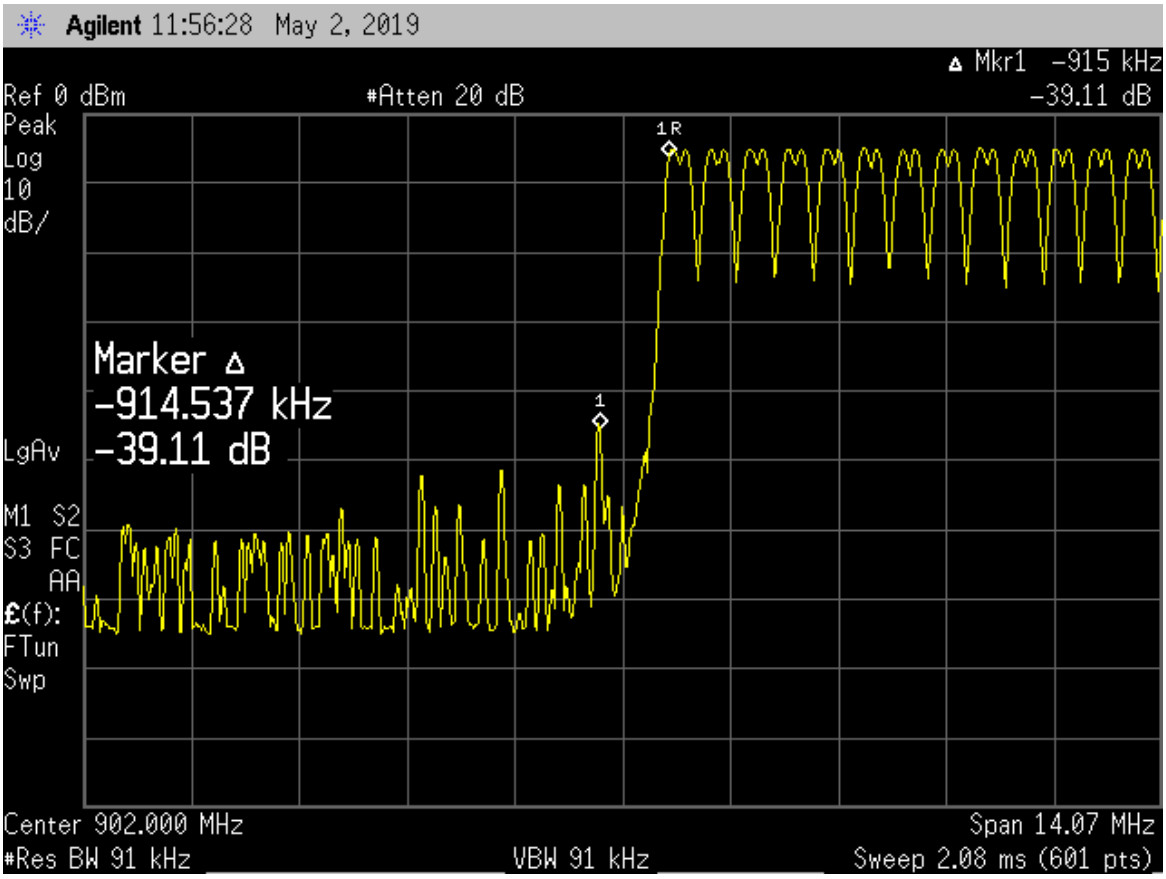
The following are plots of the channel spacing and number of hopping channels data. The channel spacing was measured to be kHz and the number of channels used is 50.

Note: In the following plots, each channel is composed of 2 distinct peaks, typical of the FSK modulation.

Table 8: Channel Spacing and Number of Channels Results

Frequency	Result	Limit	Pass/Fail
Channel Spacing	467 kHz	308 kHz Minimum	Pass
Number of channels	50 channels	25 Channels Minimum	Pass

Figure 10: Channel Spacing



There are three channels in each 1.4 MHz segment shown in the figure above. This results in a channel spacing of 1.4MHz/3 = 467 kHz.

Figure 11: Channel Spacing

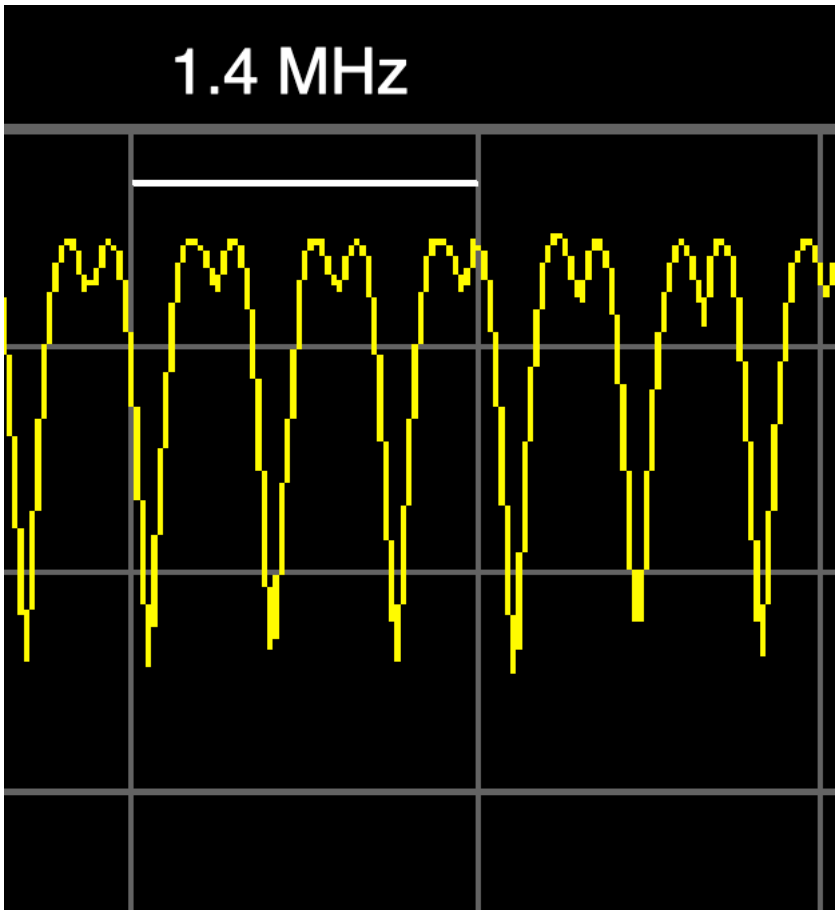
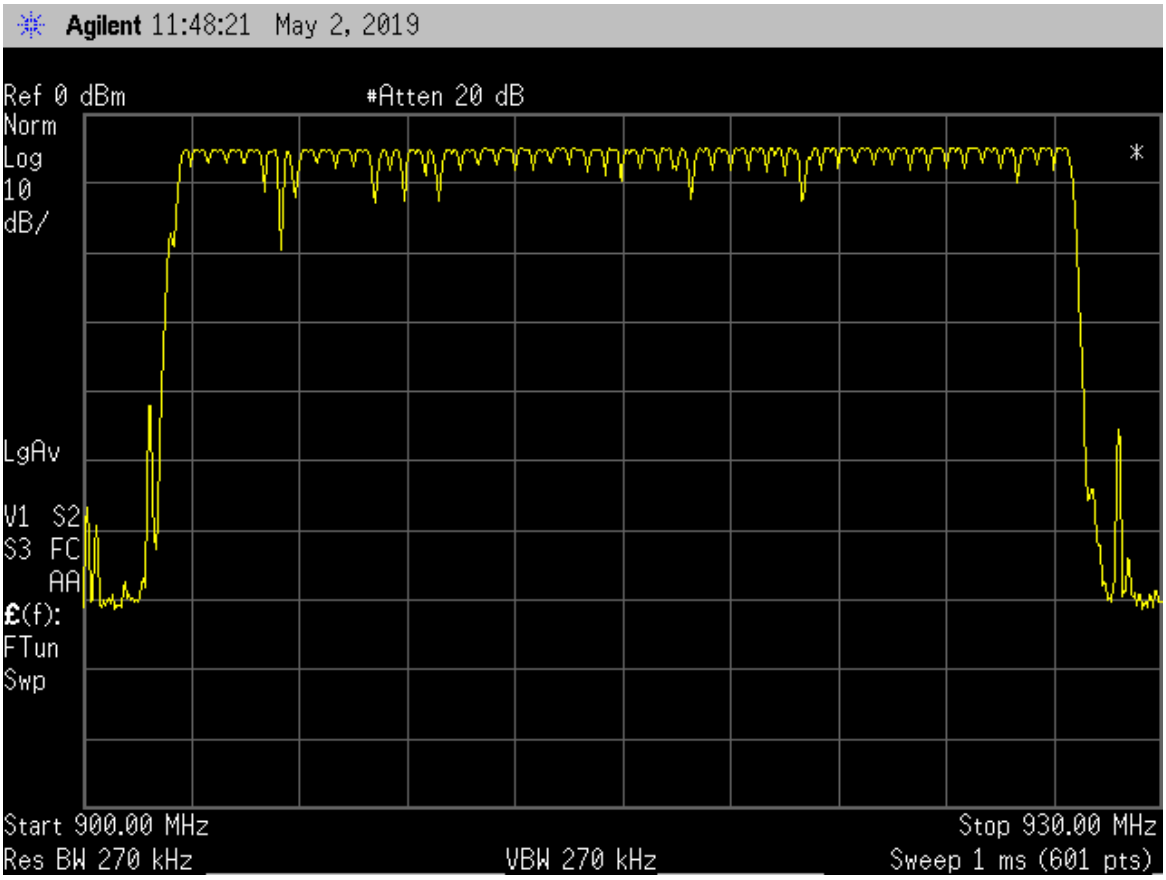


Figure 12: Number of Hopping Channels

Per the following figure, the number of hopping channels exceeds the minimum of 50.



4.5 CONDUCTED SPURIOUS EMISSIONS AT ANTENNA TERMINALS (FCC PART §2.1051)

The EUT must comply with requirements for spurious emissions at antenna terminals. Per §15.247(c) all spurious emissions in any 100 kHz bandwidth outside the frequency band in which the spread spectrum device is operating shall be attenuated 20 dB below the highest power level in a 100 kHz bandwidth within the band containing the highest level of the desired power.

The EUT antenna was removed and the cable was connected directly into a spectrum analyzer through a 10 dB attenuator. An offset was programmed into the spectrum analyzer to compensate for the loss of the external attenuator. The spectrum analyzer resolution bandwidth was set to 100 kHz and the video bandwidth was set to 300 kHz. The amplitude of the EUT carrier frequency was measured to determine the emissions limit (20 dB below the carrier frequency amplitude). The emissions outside of the allocated frequency band were then scanned from 30 MHz up to the tenth harmonic of the carrier.

The following are plots of the conducted spurious emissions data.

Figure 13: Conducted Spurious Emissions, High Power, Low Channel 30 - 1000MHz

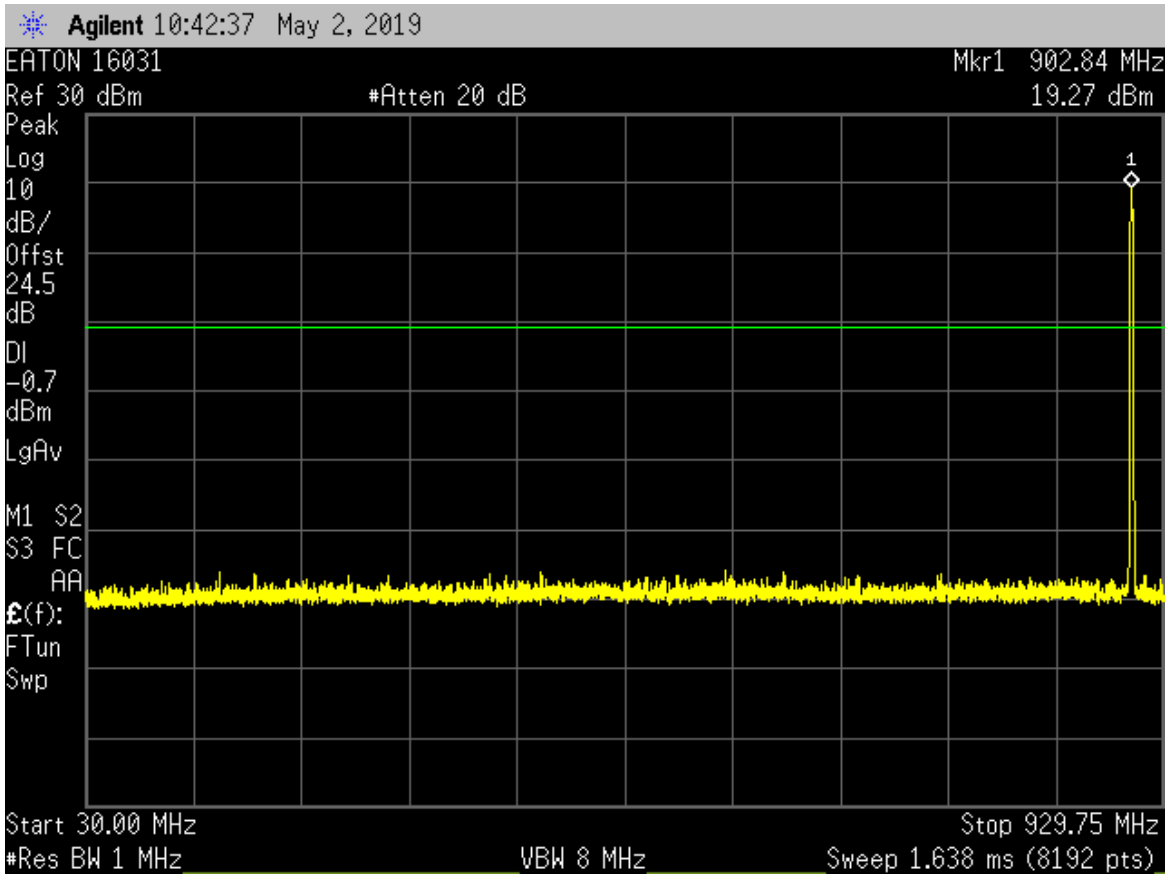


Figure 14: Conducted Spurious Emissions, High Power, Low Channel 1000 – 5000MHz

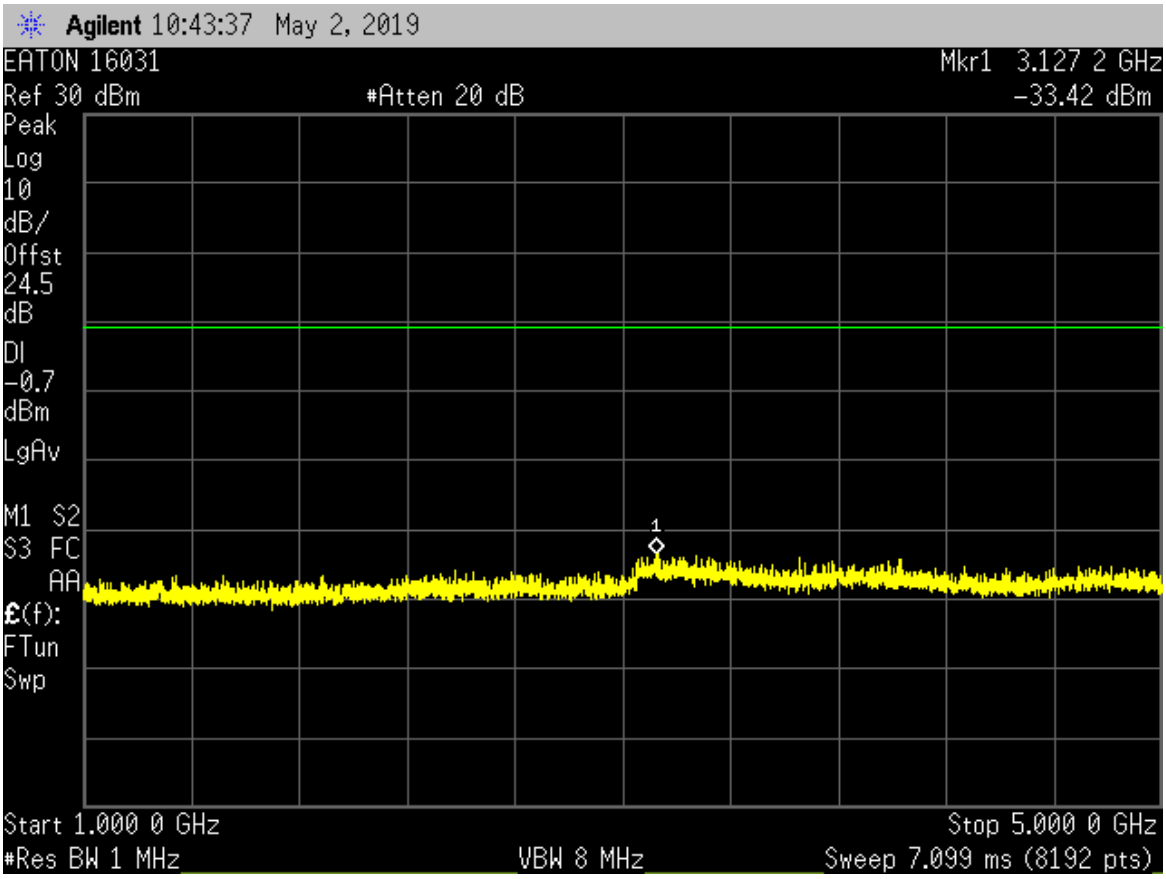


Figure 15: Conducted Spurious Emissions, High Power, Low Channel 5 – 10 GHz

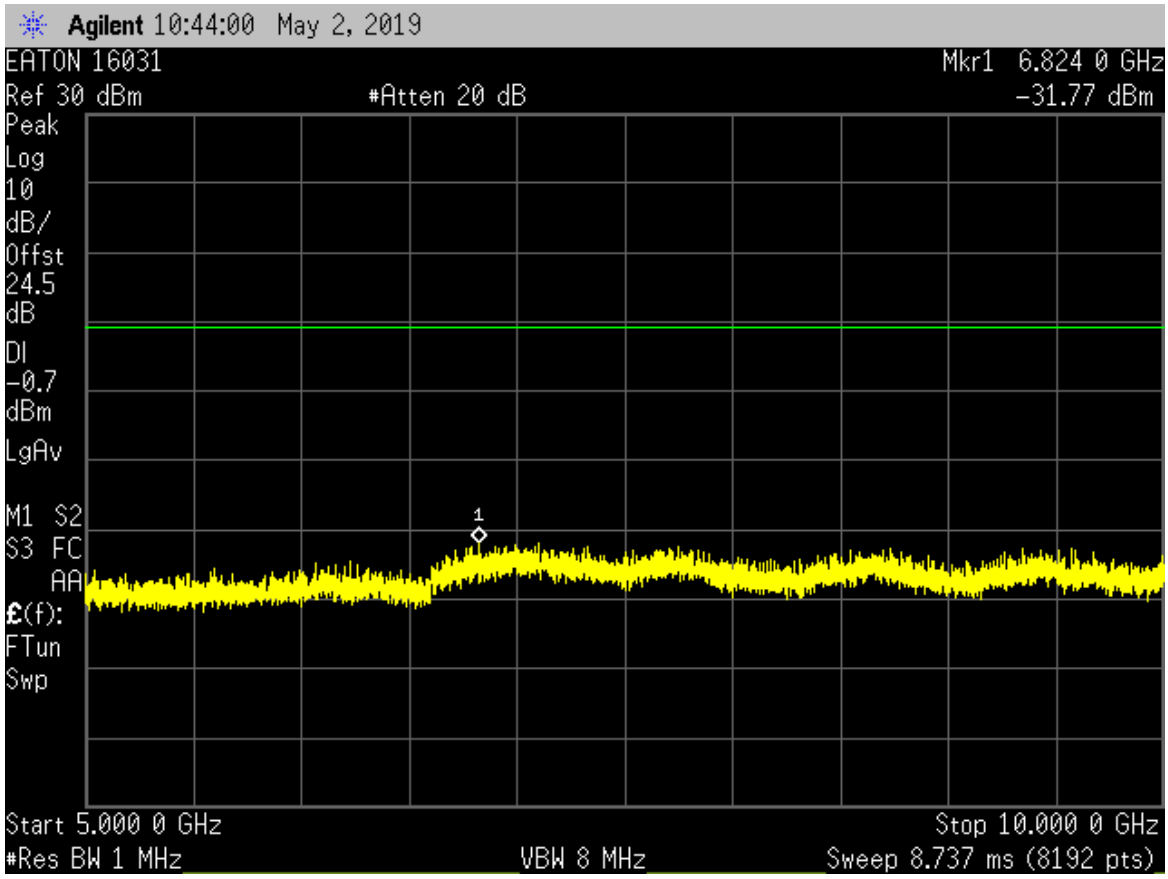


Figure 16: Conducted Spurious Emissions, High Power, Center Channel 30 - 1000MHz

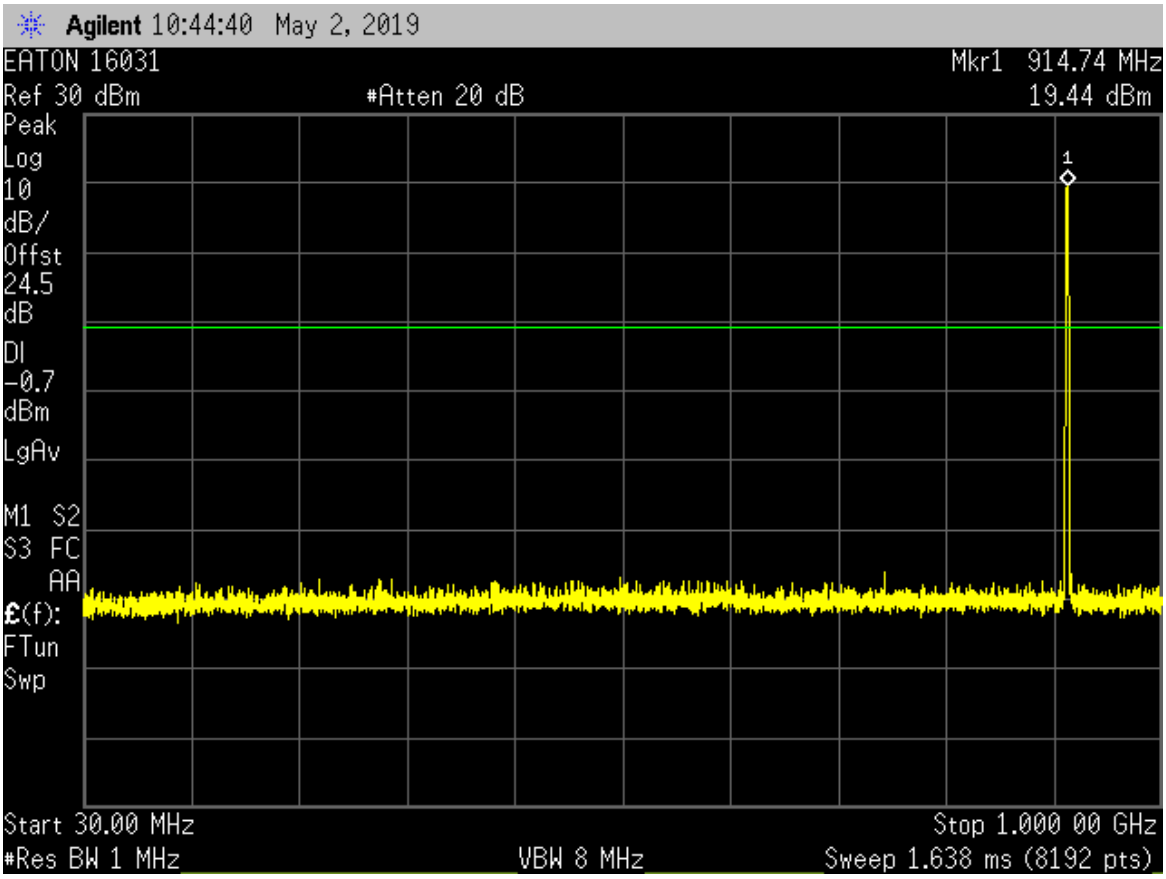


Figure 17: Conducted Spurious Emissions, High Power, Center Channel 1000 – 5000MHz

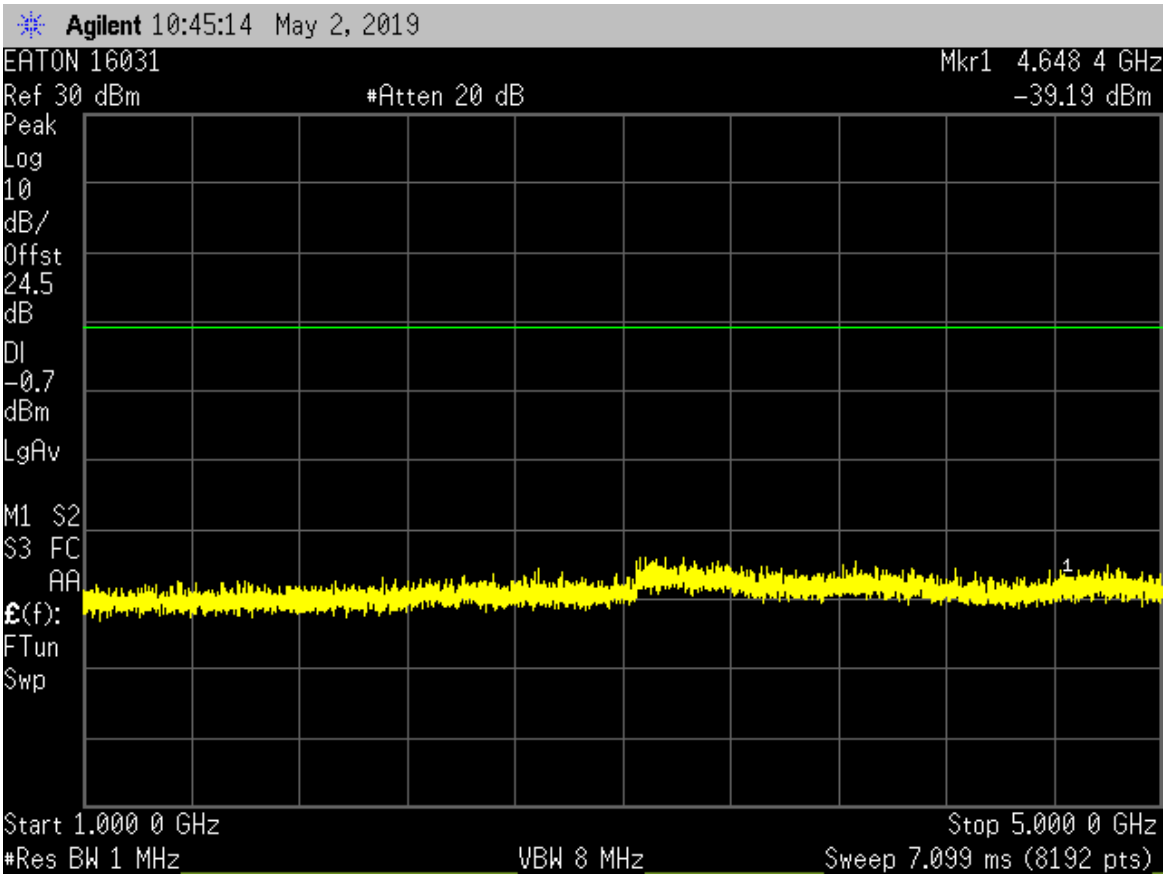


Figure 18: Conducted Spurious Emissions, High Power, Center Channel 5-10 GHz

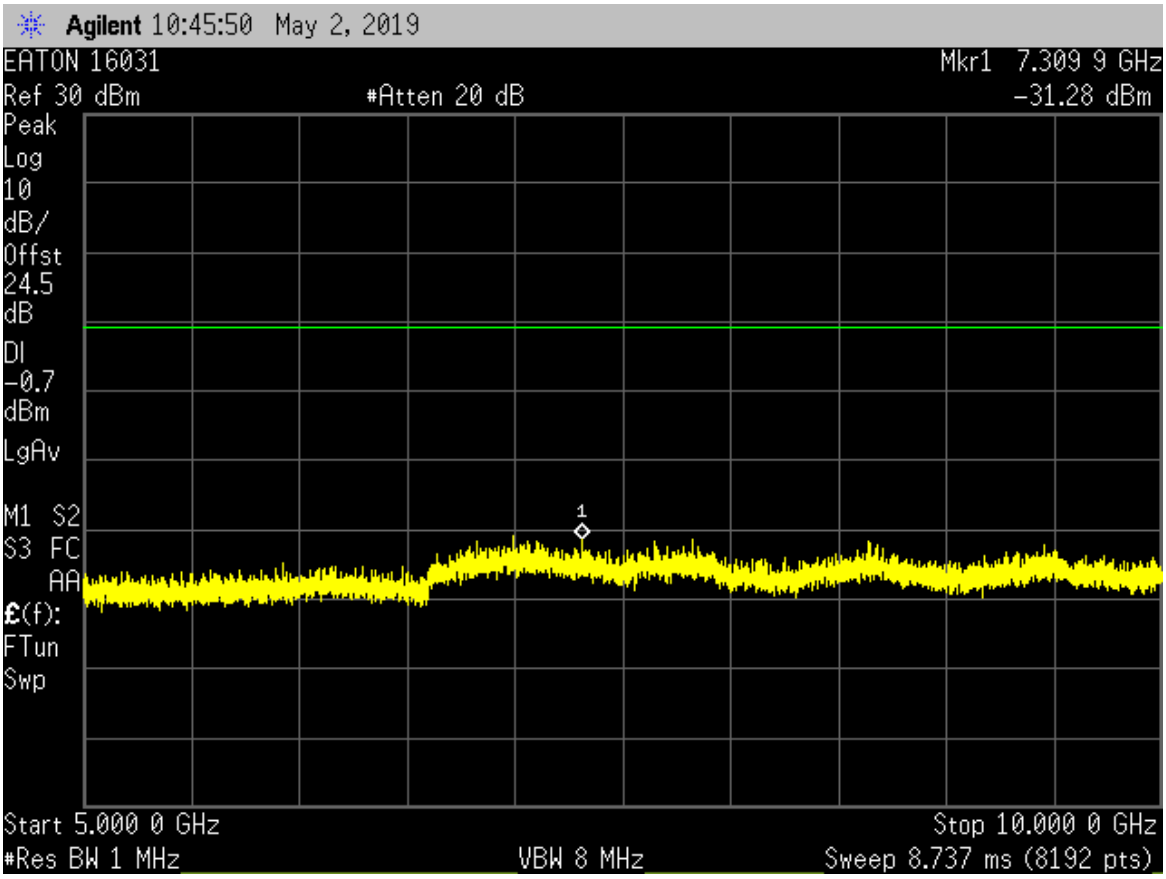


Figure 19: Conducted Spurious Emissions, High Power, High Channel 30 – 1000MHz

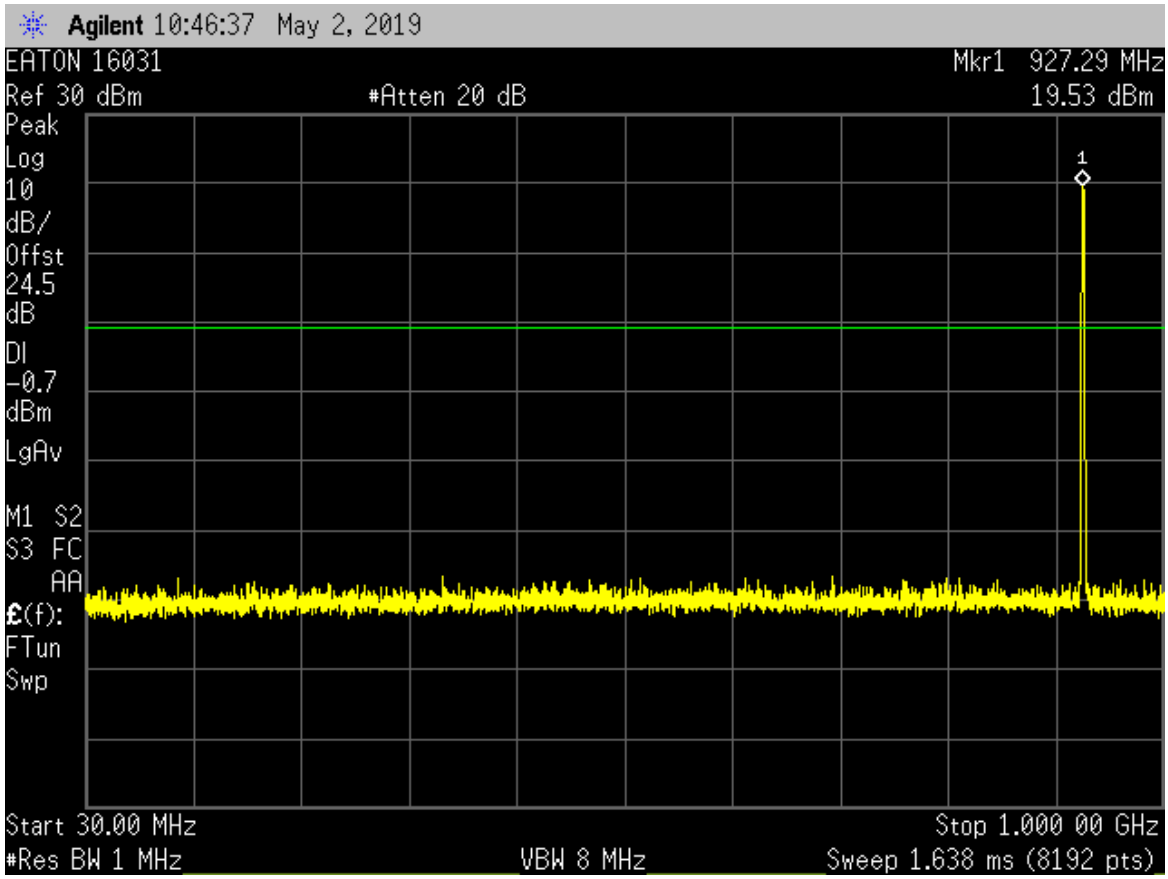


Figure 20: Conducted Spurious Emissions, High Power, High Channel 1000 – 5000MHz

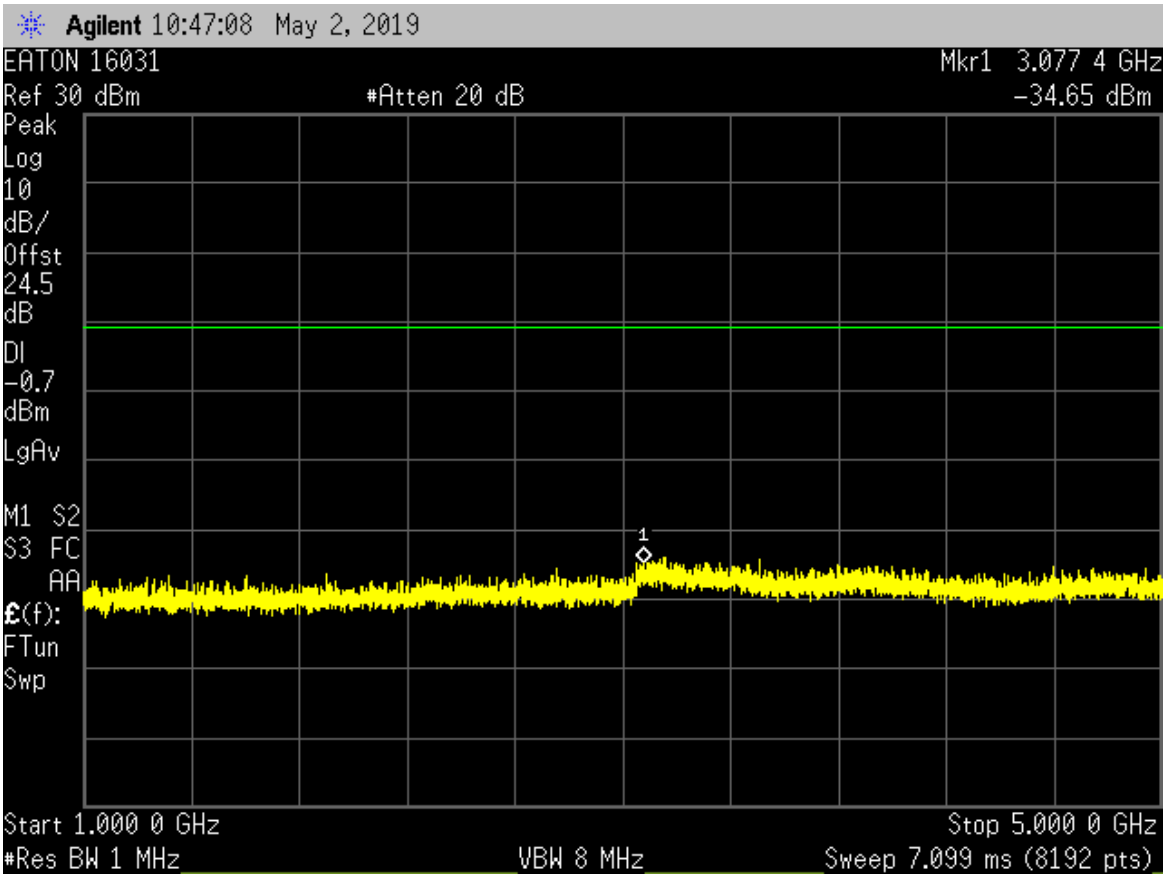
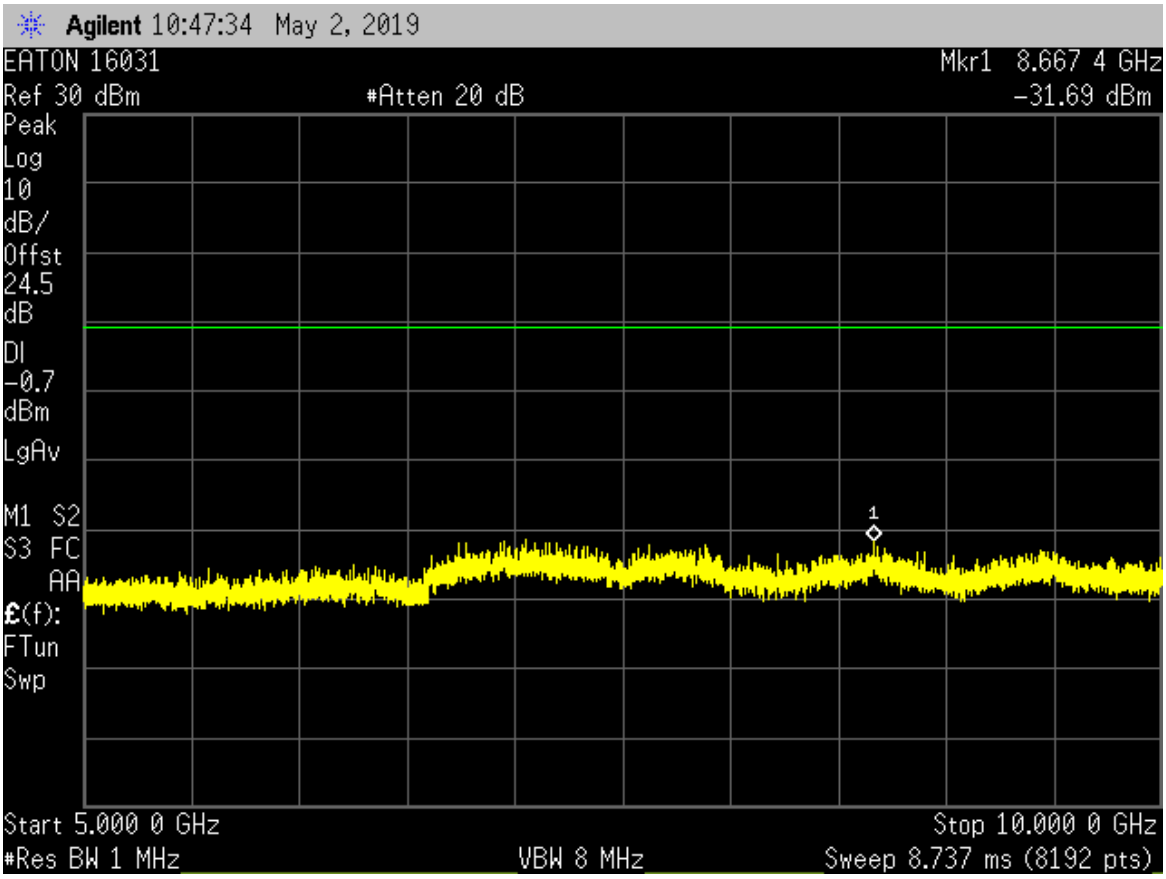


Figure 21: Conducted Spurious Emissions, High Power, High Channel 5-10GHz



Band Edge Compliance
In accordance with FCC Public Notice DA-00-705 close-up plots of the upper and lower channels in hopping mode (worst-case) with respect to the nearest authorized band-edges are provided below. The tests were performed in the same manner as the above conducted spurious emissions tests.

Figure 22: Lower Band Edge, Hopping Mode

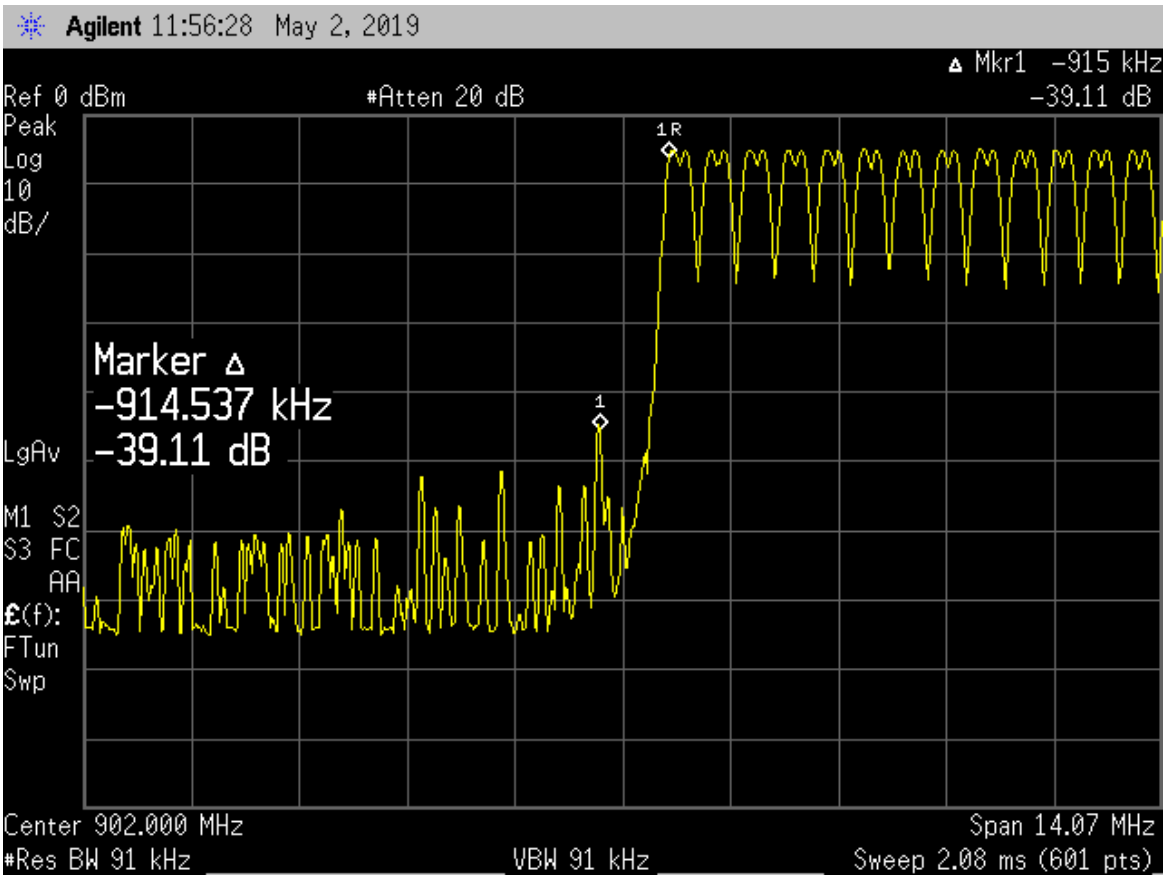
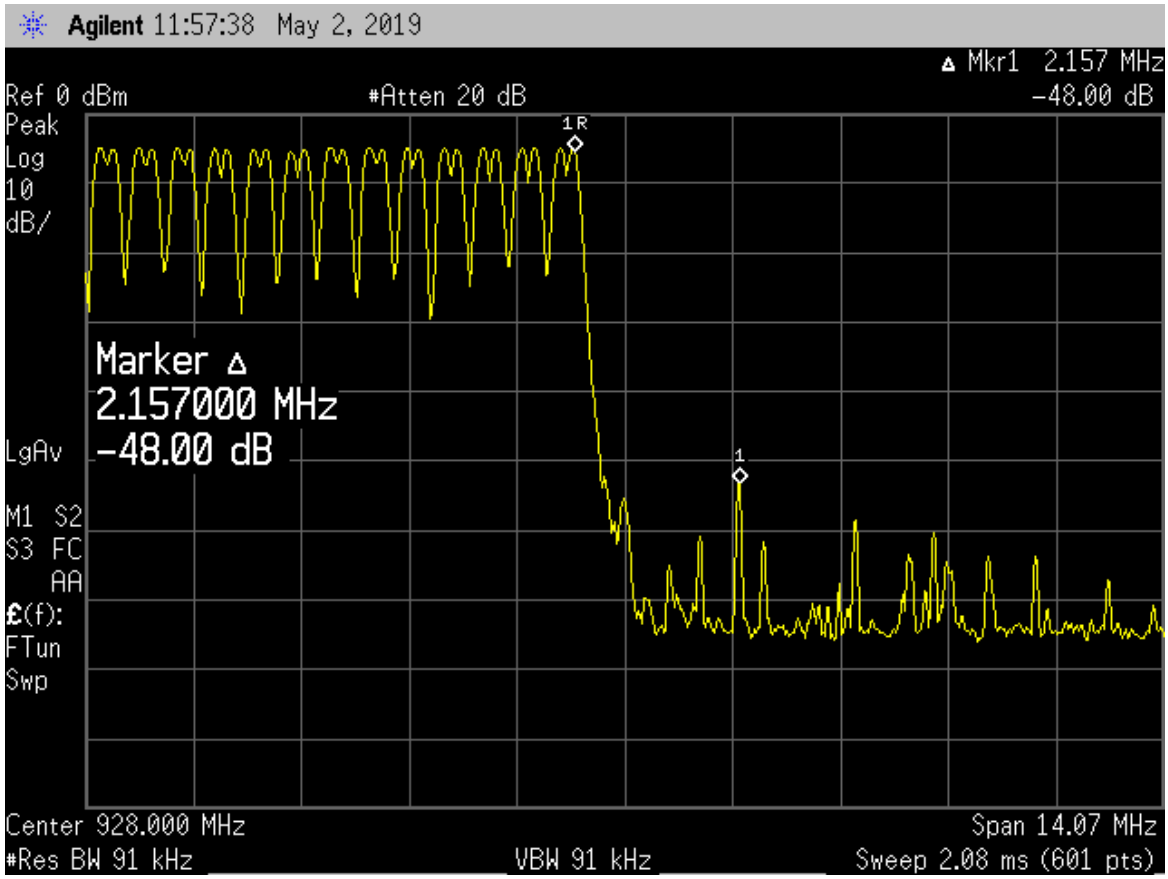


Figure 23: Upper Band Edge, Hopping Mode



4.6 RADIATED SPURIOUS EMISSIONS: (FCC PART §2.1053)

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. All orthogonals were investigated. These data represent worst-case orientation.

4.6.1 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)

4.6.2 Requirements

FCC Compliance Limits		
Frequency Range	Limit (distance)	
	Class A (10 meter)	Class B (3 meter)
30-88 MHz	90 µV/m	100 µV/m
88-216 MHz	150 µV/m	150 µV/m
216-960 MHz	210 µV/m	200 µV/m
>960MHz	300 µV/m	500 µV/m

4.6.3 Test Procedure

The requirements of FCC Part 15 and ICES-003 call for the EUT to be placed on an 80 cm high 1 X 1.5 meters non-conductive 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. Bi-conical and log periodic broadband 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 1 GHz were measured. The peripherals were placed on the table in accordance with ANSI

C63.4. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

The output from the antenna was connected, via a preamplifier, to the input of the spectrum analyzer. The detector function was set to quasi-peak or peak, as appropriate. Above 1GHz average measurement are recorded. The measurement bandwidth of the spectrum analyzer system was set to at least 120 kHz, with all post-detector filtering no less than 10 times the measurement bandwidth. Frequencies above 1GHz were performed using a measurement bandwidth of 1MHz with a video bandwidth setting of 10 Hz for the average measurement.

4.6.4 Radiated Data Reduction and Reporting

To convert the raw spectrum analyzer radiated data into a form that can be compared with the FCC limits, it is necessary to account for various calibration factors that are supplied with the antennas and other measurement accessories. These factors are included into the antenna factor (AF) column of the table and in the cable factor (CF) column of the table. The AF (in dB/m) and the CF (in dB) is algebraically added to the raw Spectrum Analyzer Voltage in dBµV to obtain the Radiated Electric Field in dBµV/m. This logarithm amplitude is converted to a linear amplitude, then compared to the FCC limit.

Example:
Spectrum Analyzer Voltage: VdBµV
Antenna Correction Factor: AFdB/m
Cable Correction Factor: CFdB
Pre-Amplifier Gain (if applicable): GdB
Electric Field: EdBµV/m = V dBµV + AFdB/m + CFdB - GdB
To convert to linear units of measure: EdBµV/m/20 Inv log

4.7 RADIATED EMISSIONS

4.7.1 Requirements

FCC Compliance Limits		
Frequency Range	**Limit (distance)**	
	Class A (10 meter)	**Class B (3 meter)**
30-88 MHz	90 µV/m	100 µV/m
88-216 MHz	150 µV/m	150 µV/m
216-960 MHz	210 µV/m	200 µV/m
>960MHz	300 µV/m	500 µV/m

4.7.2 Test Procedure

The requirements of FCC Part 15 and ICES-003 call for the EUT to be placed on an 80 cm high 1 X 1.5 meters non-conductive 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. Bi-conical and log periodic broadband 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 1 GHz were measured. The peripherals were placed on the table in accordance with ANSI C63.4. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

The output from the antenna was connected, via a preamplifier, to the input of the spectrum analyzer. The detector function was set to quasi-peak or peak, as appropriate. Above 1GHz average measurement are recorded. The measurement bandwidth of the spectrum analyzer system was set to at least 120 kHz, with all post-detector filtering no less than 10 times the measurement bandwidth. Frequencies above 1GHz were performed using a measurement bandwidth of 1MHz with a video bandwidth setting of 10 Hz for the average measurement.

4.7.3 Radiated Data Reduction and Reporting

To convert the raw spectrum analyzer radiated data into a form that can be compared with the FCC limits, it is necessary to account for various calibration factors that are supplied with the antennas and other measurement accessories. These factors are included into the antenna factor (AF) column of the table and in the cable factor (CF) column of the table. The AF (in dB/m) and the CF (in dB) is algebraically added to the raw Spectrum Analyzer Voltage in dBµV to obtain the Radiated Electric Field in dBµV/m. This logarithm amplitude is converted to a linear amplitude, then compared to the FCC limit.

Example:
Spectrum Analyzer Voltage: VdBµV
Antenna Correction Factor: AFdB/m
Cable Correction Factor: CFdB
Pre-Amplifier Gain (if applicable): GdB
Electric Field: EdBµV/m = V dBµV + AFdB/m + CFdB - GdB
To convert to linear units of measure: EdBµV/m/20 Inv log

Table 10: Radiated Emission & Receiver Spurious Emissions, Low Frequency (<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
241.50	V	0.00	41.00	41.00	-12.2	27.6	200.0	-17.2	Peak
265.80	V	180.00	2.00	36.70	-10.9	19.4	200.0	-20.3	Peak
290.10	V	180.00	1.50	37.40	-10.0	23.4	200.0	-18.6	Peak
339.40	V	90.00	1.50	38.50	-8.9	30.0	200.0	-16.5	Peak
366.00	V	0.00	2.00	40.70	-7.9	43.8	200.0	-13.2	Peak
377.00	V	45.00	2.00	38.70	-7.8	35.0	200.0	-15.1	Peak
242.30	H	180.00	1.50	41.60	-12.1	29.8	200.0	-16.5	Peak
256.40	H	0.00	2.00	42.50	-12.2	32.7	200.0	-15.7	Peak
274.40	H	180.00	1.50	43.40	-10.3	45.0	200.0	-13.0	Peak
342.00	H	90.00	1.50	36.40	-8.8	23.9	200.0	-18.5	Peak
385.60	H	0.00	2.00	39.50	-7.8	38.7	200.0	-14.3	Peak
395.80	H	180.00	2.00	35.10	-7.7	23.5	200.0	-18.6	Peak

Table 11: Radiated Emission Test Data, High Frequency Data >1GHz, Low Channel

	Frequency (MHz)	Polarity (H/V)	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Peak or Average
902.75										
	2708.25	V	0	1.5	30.6	-0.1	30.5	54.0	-23.5	AVG
	3611.00	V	0	1.5	31.0	2.1	33.1	54.0	-20.9	AVG
	4513.75	V	0	1.5	30.5	4.4	34.9	54.0	-19.1	AVG
	5416.50	V	90	1.5	29.5	7.5	37.0	54.0	-17.0	AVG
	6319.25	V	90	1.5	30.2	8.2	38.4	54.0	-15.6	AVG
	7222.00	V	180	1.5	29.0	11.5	40.5	54.0	-13.5	AVG
	8124.75	V	0	1.5	29.2	11.4	40.6	54.0	-13.4	AVG
	9027.50	V	0	1.5	30.1	14.1	44.2	54.0	-9.8	AVG
	2708.25	H	90	1.5	39.0	-0.1	38.9	54.0	-15.1	AVG
	3611.00	H	180	1.5	31.6	2.1	33.7	54.0	-20.3	AVG
	4513.75	H	90	1.5	30.2	4.4	34.6	54.0	-19.4	AVG
	5416.50	H	0	1.5	29.6	7.5	37.1	54.0	-16.9	AVG
	6319.25	H	90	1.5	30.8	8.2	39.0	54.0	-15.0	AVG
	7222.00	H	90	1.5	30.3	11.5	41.8	54.0	-12.2	AVG
	8124.75	H	0	1.5	31.0	11.4	42.4	54.0	-11.6	AVG
	9027.50	H	180	1.5	30.7	14.1	44.8	54.0	-9.2	AVG

	Frequency (MHz)	Polarity (H/V)	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Peak or Average
902.75										
	1805.50	V	180	2.0	41.0	-5.7	35.3	74.0	-38.7	Peak
	2708.25	V	0	1.5	45.2	-0.1	45.1	74.0	-28.9	Peak
	3611.00	V	180	1.5	40.0	2.1	42.1	74.0	-31.9	Peak
	4513.75	V	90	1.5	41.6	4.4	46.0	74.0	-28.0	Peak
	5416.50	V	180	1.5	39.0	7.5	46.5	74.0	-27.5	Peak
	6319.25	V	90	1.5	36.0	8.2	44.2	74.0	-29.8	Peak
	7222.00	V	90	1.5	40.0	11.5	51.5	74.0	-22.5	Peak
	8124.75	V	0	1.5	40.2	11.4	51.6	74.0	-22.4	Peak
	9027.50	V	90	1.5	40.4	14.1	54.5	74.0	-19.5	Peak
	1805.50	H	180		42.0	-5.7	36.3	74.0	-37.7	Peak
	2708.25	H	0	1.5	38.0	-0.1	39.9	74.0	-36.1	Peak
	3611.00	H	90	1.5	40.2	2.1	42.3	74.0	-31.7	Peak
	4513.75	H	180	1.5	38.0	4.4	42.4	74.0	-31.6	Peak
	5416.50	H	90	1.5	37.8	7.5	45.3	74.0	-28.7	Peak
	6319.25	H	90	1.5	39.0	8.2	47.2	74.0	-26.8	Peak
	7222.00	H	0	1.5	41.5	11.5	53.0	74.0	-21.0	Peak
	8124.75	H	90	1.5	39.8	11.4	51.2	74.0	-22.8	Peak
	9027.50	H	180	1.5	40.9	14.1	55.0	74.0	-19.0	Peak

Table 12: Radiated Emission Test Data, High Frequency Data >1GHz, Center Channel

	Frequency (MHz)	Polarity (H/V)	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Peak or Average
914.75										
	2744.25	V	0	1.5	36.0	0.0	36.0	54.0	-18.0	AVG
	3659.00	V	0	1.5	31.0	2.2	33.2	54.0	-20.8	AVG
	4573.75	V	90	1.5	32.0	4.5	36.5	54.0	-17.5	AVG
	5488.50	V	180	1.5	31.0	7.5	38.5	54.0	-15.5	AVG
	6403.25	V	90	1.5	30.5	8.2	38.7	54.0	-15.3	AVG
	7318.00	V	90	1.5	31.0	11.2	42.2	54.0	-11.8	AVG
	8232.75	V	0	1.5	30.5	11.7	42.2	54.0	-11.8	AVG
	9147.50	V	90	1.5	31.0	14.5	45.5	54.0	-8.5	AVG
	9147.00	V	180.0	1.5	42.3	14.5	56.8	74.0	-17.2	AVG
	2744.25	H	0	1.5	37.0	0.0	37.0	54.0	-17.0	AVG
	3659.00	H	180	1.5	31.5	2.2	33.7	54.0	-20.3	AVG
	4573.75	H	0	1.5	32.0	4.5	36.5	54.0	-17.5	AVG
	5488.50	H	180	1.5	31.0	7.5	38.5	54.0	-15.5	AVG
	6403.25	H	90	1.5	30.5	8.2	38.7	54.0	-15.3	AVG
	7318.00	H	0	1.5	30.1	11.2	41.3	54.0	-12.7	AVG
	8232.75	H	0	1.5	30.3	11.7	42.0	54.0	-12.0	AVG
	9147.50	H	90	1.5	30.5	14.5	45.0	54.0	-9.0	AVG

	Frequency (MHz)	Polarity (H/V)	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Peak or Average
914.75										
	1829.50	V	180	1.5	45.0	-5.5	39.5	74.0	-34.5	Peak
	2744.25	V	0	1.5	39.5	0.0	39.5	74.0	-34.5	Peak
	3659.00	V	180	1.5	38.4	2.2	40.6	74.0	-33.4	Peak
	4573.75	V	90	1.5	38.4	4.5	42.9	74.0	-31.1	Peak
	5488.50	V	90	1.5	40.0	7.5	47.5	74.0	-26.5	Peak
	6403.25	V	90	1.5	37.3	8.2	45.5	74.0	-28.5	Peak
	7318.00	V	90	1.5	43.0	11.2	54.2	74.0	-19.8	Peak
	8232.75	V	180	1.5	39.0	11.7	50.7	74.0	-23.3	Peak
	9147.50	V	90	1.5	43.0	14.5	57.5	74.0	-16.5	Peak
	1829.50	H	90		41.1	-5.5	35.6	74.0	-38.4	Peak
	2744.25	H	0	1.5	39.6	0.0	39.6	74.0	-34.4	Peak
	3659.00	H	90	1.5	40.0	2.2	42.2	74.0	-31.8	Peak
	4573.75	H	90	1.5	38.5	4.5	43.0	74.0	-31.0	Peak
	5488.50	H	0	1.5	38.0	7.5	45.5	74.0	-28.5	Peak
	6403.25	H	90	1.5	40.2	8.2	48.4	74.0	-25.6	Peak
	7318.00	H	0	1.5	39.6	11.2	50.8	74.0	-23.2	Peak
	8232.75	H	0	1.5	40.6	11.7	52.3	74.0	-21.7	Peak
	9147.50	H	90	1.5	38.8	14.5	53.3	74.0	-20.7	Peak

Table 13: Radiated Emission Test Data, High Frequency Data >1GHz, High Channel

	Frequency (MHz)	Polarity (H/V)	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Peak or Average
927.25										
	2781.75	V	0	1.5	37.0	0.2	37.2	54.0	-16.8	AVG
	3709.00	V	90	1.5	34.0	2.3	36.3	54.0	-17.7	AVG
	4636.25	V	90	1.5	31.0	4.8	35.8	54.0	-18.2	AVG
	5563.50	V	90	1.5	30.5	7.4	37.9	54.0	-16.1	AVG
	6490.75	V	90	1.5	29.0	8.5	37.5	54.0	-16.5	AVG
	7418.00	V	180	1.5	33.0	11.1	44.1	54.0	-9.9	AVG
	8345.25	V	0	1.5	31.0	12.0	43.0	54.0	-11.0	AVG
	9272.50	V	180	1.5	29.0	15.1	44.1	54.0	-9.9	AVG
	2781.75	H	0	1.5	36.0	0.2	36.2	54.0	-17.8	AVG
	3709.00	H	180	1.5	33.0	2.3	35.3	54.0	-18.7	AVG
	4636.25	H	90	1.5	31.0	4.8	35.8	54.0	-18.2	AVG
	5563.50	H	180	1.5	31.0	7.4	38.4	54.0	-15.6	AVG
	6490.75	H	0	1.5	33.0	8.5	41.5	54.0	-12.5	AVG
	7418.00	H	0	1.5	32.0	11.1	43.1	54.0	-10.9	AVG
	8345.25	H	0	1.5	31.0	12.0	43.0	54.0	-11.0	AVG
	9272.50	H	90	1.5	30.0	15.1	45.1	54.0	-8.9	AVG

Frequency (MHz)	Polarity (H/V)	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Peak or Average
927.25	V								
1854.50	V	180		40.0	-5.2	34.8	74.0	-39.2	Peak
2781.75	V	0	1.5	41.0	0.2	41.2	74.0	-32.8	Peak
3709.00	V	90	1.5	40.2	2.3	42.5	74.0	-31.5	Peak
4636.25	V	90	1.5	39.0	4.8	43.8	74.0	-30.2	Peak
5563.50	V	180	1.5	40.2	7.4	47.6	74.0	-26.4	Peak
6490.75	V	0	1.5	41.0	8.5	49.5	74.0	-24.5	Peak
7418.00	V	0	1.5	42.3	11.1	53.4	74.0	-20.6	Peak
8345.25	V	0	1.5	41.0	12.0	53.0	74.0	-21.0	Peak
9272.50	V	180		40.2	15.1	55.3	74.0	-18.7	Peak
1854.50	H	90		41.0	-5.2	35.8	74.0	-38.2	Peak
2781.75	H	0	1.5	42.2	0.2	42.4	74.0	-31.6	Peak
3709.00	H	180	1.5	39.8	2.3	42.1	74.0	-31.9	Peak
4636.25	H	0	1.5	39.0	4.8	43.8	74.0	-30.2	Peak
5563.50	H	90	1.5	42.0	7.4	49.4	74.0	-24.6	Peak
6490.75	H	90	1.5	43.0	8.5	51.5	74.0	-22.5	Peak
7418.00	H	0	1.5	42.0	11.1	53.1	74.0	-20.9	Peak
8345.25	H	0	1.5	40.2	12.0	52.2	74.0	-21.8	Peak
9272.50	H	90	1.5	41.0	15.1	56.1	74.0	-17.9	Peak

4.8 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 for peak measurements.

4.8.1 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 14: 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 15: 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
241.50	V	0.00	41.00	41.00	-12.2	27.6	200.0	-17.2	Peak
265.80	V	180.00	2.00	36.70	-10.9	19.4	200.0	-20.3	Peak
290.10	V	180.00	1.50	37.40	-10.0	23.4	200.0	-18.6	Peak
339.40	V	90.00	1.50	38.50	-8.9	30.0	200.0	-16.5	Peak
366.00	V	0.00	2.00	40.70	-7.9	43.8	200.0	-13.2	Peak
377.00	V	45.00	2.00	38.70	-7.8	35.0	200.0	-15.1	Peak
242.30	H	180.00	1.50	41.60	-12.1	29.8	200.0	-16.5	Peak
256.40	H	0.00	2.00	42.50	-12.2	32.7	200.0	-15.7	Peak
274.40	H	180.00	1.50	43.40	-10.3	45.0	200.0	-13.0	Peak
342.00	H	90.00	1.50	36.40	-8.8	23.9	200.0	-18.5	Peak
385.60	H	0.00	2.00	39.50	-7.8	38.7	200.0	-14.3	Peak
395.80	H	180.00	2.00	35.10	-7.7	23.5	200.0	-18.6	Peak