FCC CERTIFICATION TEST REPORT

for the

POWERCAST CORPORATION

FCC ID: YESPCR91502-M

WLL REPORT# 18024-01 REV 2

Prepared for:

Powercast Corporation

620 Alpha Drive

Pittsburgh, Pennsylvania 15238

Prepared By:

Washington Laboratories, Ltd.

4840 Winchester Boulevard. STE# 5

Frederick, Maryland 21703

Testing Certificate AT-1448

FCC Certification Test Report

for the

Powercast Corporation

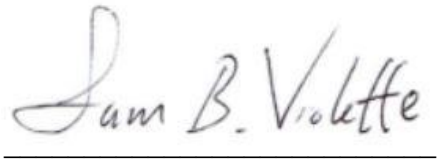
PCR91502-M

FCC ID: YESPCR91502-M

March 2, 2023

WLL Report# 18024-01 Rev 2

Prepared by:



Samuel B. Violette
Vice President

Reviewed by:

Steve Koster
President

Abstract

This report has been prepared on behalf of Powercast Corporation 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 of the FCC Rules. This Certification Test Report documents the test configuration and test results for the Powercast Corporation PCR91502-M. The information provided in this report is only applicable to device herein documented, as the EUT.

Final (worst-case) radiated emissions testing was performed in the Free-space Anechoic Chamber Test-site (FACT) 3m Chamber of Washington Laboratories, Ltd., located at 4840 Winchester Boulevard, Suite #5, Frederick, MD 21703. Other investigations of radiated emissions were performed on the 3-meter Open Area Test Site (OATS) 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 Powercast Corporation PCR91502-M complies with the requirements for a Frequency Hopping Spread Spectrum (FHSS) Transmitter device under FCC Part 15.247.

Revision History	Description of Change	Date
Rev 0	Initial Release	March 2, 2023
Rev 1	TCB Comments, Dated: 3/21/2023	March 31, 2023
Rev 2	TCB Comments, Dated: 4/10/2023	April 11, 2023

Table of Contents

List of Tables

List of Figures

1 Introduction

1.1 Compliance Statement

The Powercast Corporation PCR91502-M complies with the requirements for a Frequency Hopping Spread Spectrum Transmitter device under FCC Part 15.247.

1.2 Test Scope

Tests for radiated and conducted (at antenna terminal) emissions were performed. All measurements were performed in accordance with ANSI C63.10. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	Powercast Corporation
Purchase Order Number:	20230203-927-r
Quotation Number:	73731

1.4 Test and Support Personnel

Washington Laboratories, LTD	Sam Violette
Customer Representative	Eric Biel

1.5 Deviations to the Standard

There were no deviations to the requirements established in the specification.

2 Equipment Under Test

2.1 EUT Identification & Description

Table 1: Device Summary

Manufacturer:	Powercast Corporation
FCC ID:	YESPCR91502-M
EUT Model:	PCR91502-M
FCC Rule Parts:	§15.247, 15.212
Frequency Range:	902-928MHz
20dB Occupied Bandwidth:	156 kHz, modulated
Keying:	FHSS (PRBS), ASK
Number of Channels:	50
Power Output Level:	29.8 dBm
Antenna Type (as tested):	See Section 2.5 of this report.
Interface Cables:	USB / UART
Power Source & Voltage:	+5 VDC (as tested)
Highest TX emission	5.2 GHz: 49.5 dBuV/m @ 3m
Testing Dates:	2/22/2023 – 2/23/2023, & 3/31/2023

The Powercast Corporation PCR91502-M is a RAIN UHF RFID Reader module. The module is intended to be integrated into other electronic product designs in order to enable RAIN RFID functionality. The reader module's air interface protocol adheres to EPCglobal® UHF Class 1 Gen 2 / ISO 18000-63 RFID. It is designed to interface to other embedded electronics systems via USB or UART communication lines and is powered from externally applied 5V DC power. The RFID module communicates with and powers RFID tag devices. A Gen2 compliant tag device communicates back to the reader via RF backscattering. The reader operates in the 902-928MHz ISM frequency band. Operational power and communication is provided to the reader module using header J5. The module can support up to four antennas via I-PEX MHF / UMCC connectors at ports J1 through J4. The PCR91502-M module has on board LEDs to display status of the reader and tag devices.

2.2 Test Configuration

Table 2: System Configuration List

Name / Description	Model Number	Part Number	Serial Number	Revision
RFID Module	PCR91502-M	Not Provided	Not Provided	Not Provided

2.3 Support Equipment

Table 3: Support Equipment

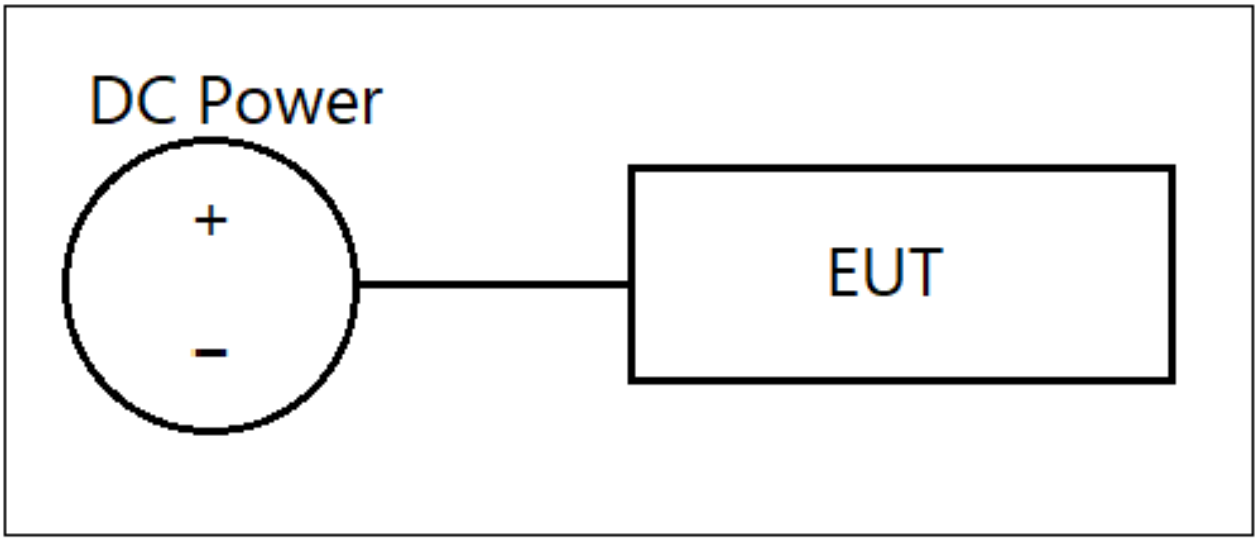
Item	Manufacturer	Model Number
Laptop	Lenovo	20T802BUS
Breakout Support PCB	Powercast	Not Supplied

2.4 Interface Cables

Table 4: Cable Configuration

Port Identification	Connector Type	Cable Length	Shielded (Y/N)	Termination Point
J1	Antenna 1 port	1	N/A	N/A
J2	Antenna 2 port	1	N/A	N/A
J3	Antenna 3 port	1	N/A	N/A
J4	Antenna 4 port	1	N/A	N/A
J5	Communications / Power Header	1	N/A	N/A

Figure 1: EUT Basic Configuration (Example Only)



2.5 Testing Algorithm

The PCR91502-M was configured for testing by the applicant. The output of the transmitter was controlled via the support laptop. The worst-case emissions are reported.

The EUT is being certified with three antennas. As part of the testing process, the EUT was evaluated and investigated for radiated spurious emissions, when using each of the approved antennas. In this regard, the EUT transmitter portion, and the radiating element, were varied in position to determine the worst-case orientation. The EUT position that produced the highest spectrum analyzer readings was maintained during subsequent tests.

The applicant supplied antennas are as follows:

Table 5: Description of Certified Antennas

Approved Antenna	Manufacturer	Part Number	Maximum Gain
1	Pasternack	PE510M1013	3 dBi
2	Laird	PAR90209H	6 dBi
3	Powercast	PAP-ANT-H1-915	6 dBi

Please note that one or more of these antennas may be circularly polarized. The relationship between linear polarization (H/V) and circular polarization (RHCP/LHCP) is a difference of 3.0 dB. Isotropic gain (dBi) can be calculated from the following equation: dBi = dBiC – 3dB. For example, if a RHCP antenna has 9 dBiC of gain, then the equivalent isotropic gain is 6 dBi. Therefore, the maximum gain that shall be employed by the EUT antenna(s) is 6 dBi.

2.6 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Frederick, 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 number for Washington Laboratories, Ltd. is 3035A. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Testing Certificate AT-1448 as an independent FCC test laboratory.

2.7 Deviations to the Standard

There were no deviations to the requirements established in the specification.

2.8 Measurements

2.8.1 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

2.9 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

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

Where

uc	= standard uncertainty
a, b, c,..	= individual uncertainty elements
Diva, 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

$$U = ku_c$$

Where:

U = expanded uncertainty
k = coverage factor
k ≤ 2 for 95% coverage (ANSI/NCSL Z540-2 Annex G)
uc = 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 6 below.

Table 6: 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 7 shows a list of the test equipment used for measurements along with the calibration information.

Table 7: Test Equipment List

Test Name:	**Benchtop Conducted Emissions**	Test Date: 2/22/2023, 2/23/2023, & 3/31/2023	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00942	AGILENT, N9020A	MXA SPECTRUM ANALYZER	12/19/2023

Test Name:	**Radiated Emissions**	Test Date: 2/23/2023 & 3/31/2023	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00942	AGILENT, N9020A	MXA SPECTRUM ANALYZER	12/19/2023
00644	SUNOL SCIENCES CORP.	BICONALOG ANTENNA	11/14/2024
00626	ARA, DRG-118/A	HORN ANTENNA	8/20/2023
00977	JUNKOSHA, MWX322	ARMORED COAX. CABLE	12/28/2023
00806	MINI-CIRCUITS	SMA COAXIAL CABLE	5/5/2023
00834	ULTIFLEX, UFA 2108	SMA COAXIAL CABLE	12/28/2023
00276	ELECTRO-METRICS	RF PRE-AMPLIFIER	5/5/2023
00066	B&Z (HP), BZ-01002650	PRE-AMPLIFIER	5/5/2023
00742	PENN ENG., WR284	WAVEGUIDE PASS FILTER	Cal. Before Use
00281	ITC. 21A-3A1	WAVEGUIDE PASS FILTER	Cal. Before Use
00721	WEINSCHEL, DS109	TUNABLE ATTENUATOR	Cal. Before Use

Test Name:	**AC Mains Conducted Emissions**	Test Date: 2/23/2023	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00942	AGILENT, N9020A	MXA SPECTRUM ANALYZER	12/19/2023
00895	HP, 11947A	TRANSIENT LIMITER	2/14/2024
00125	SOLAR, LISN	8028-50-TS-24-BNC	9/14/2023
00126	SOLAR, LISN	8028-50-TS-24-BNC	9/14/2023
00330	WLL, BNC CABLE	CE SITE 1 CABLE	5/6/2023

4 Test Results

The below table provides the results of testing for compliance with a Frequency Hopping Spread Spectrum device in accordance with FCC Part 15.247.

Table 8: Test Summary Table

FCC Rule Part	Description	Result
15.247 (a)(1)	20dB Bandwidth	Pass
15.247 (b)	Transmit Output Power	Pass
15.247 (a)(1)	Channel Separation	Pass
15.247 (a)(1)	Number of Channels	Pass
15.247 (a)(1)	Time of Occupancy	Pass
15.247 (d)	Occupied BW / Out-of-Band Emissions (Band Edge @ 20dB below)	Pass
15.205 15.209	General Field Strength Limits (Restricted Bands & RE Limits)	Pass
15.207	AC Conducted Emissions	Pass

4.1 Time of Occupancy

Requirement: For systems having a 20 dB bandwidth that is greater than 250 kHz, the transmitter shall have a time of occupancy 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 to 902.75 MHz. The results are shown in the plots below.

Test Method: ANSI C63.10, Section 7.8.3, Time of Occupancy

Table 9: Duty Cycle/Time of Occupancy Results

Test	Result	Limit	Pass/Fail
Dwell time per Hop	182ms	NA	NA
Time of Occupancy	364ms	0.4s/20 sec	Pass

Figure 2: Dwell Time per 400ms

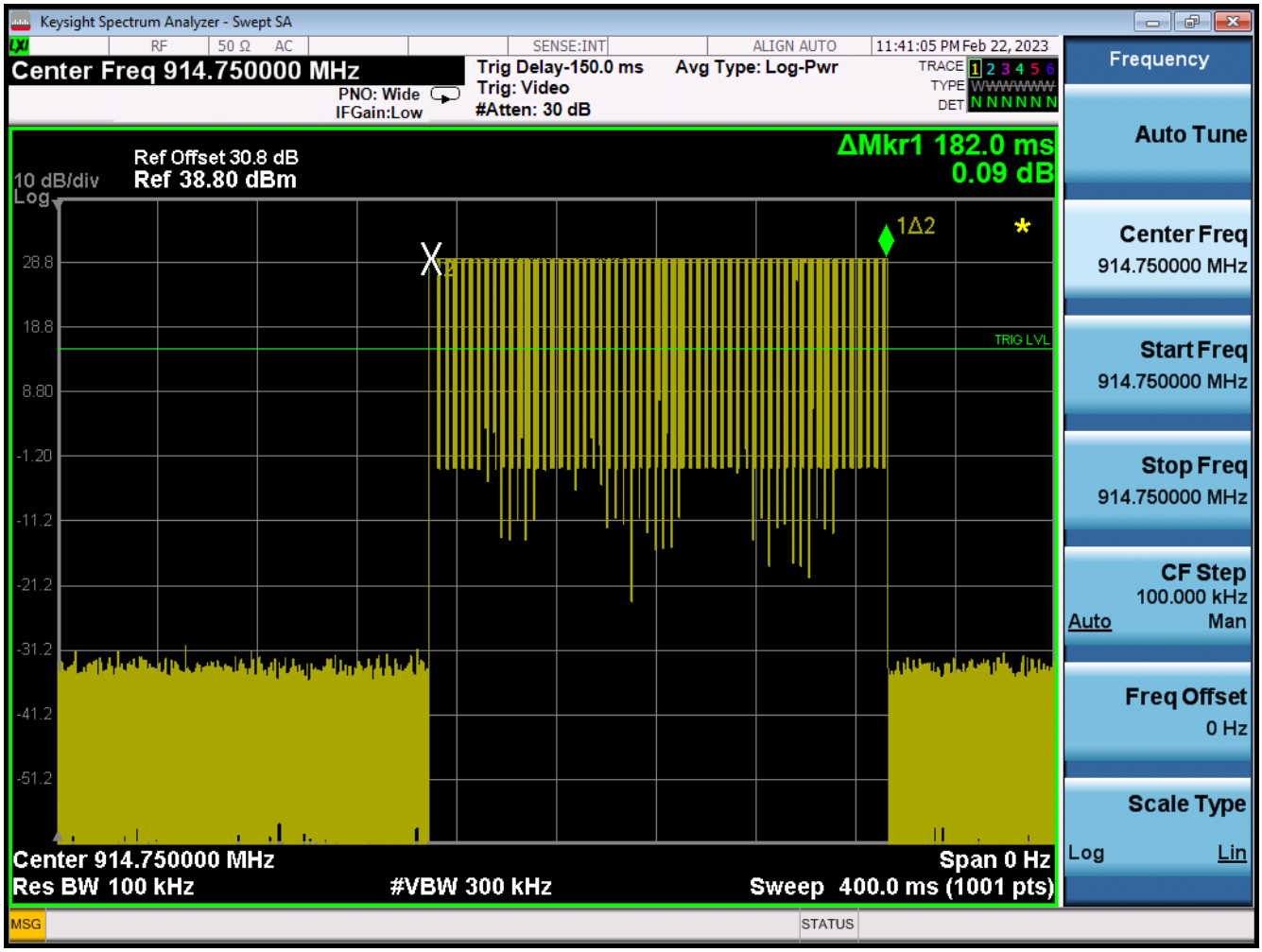
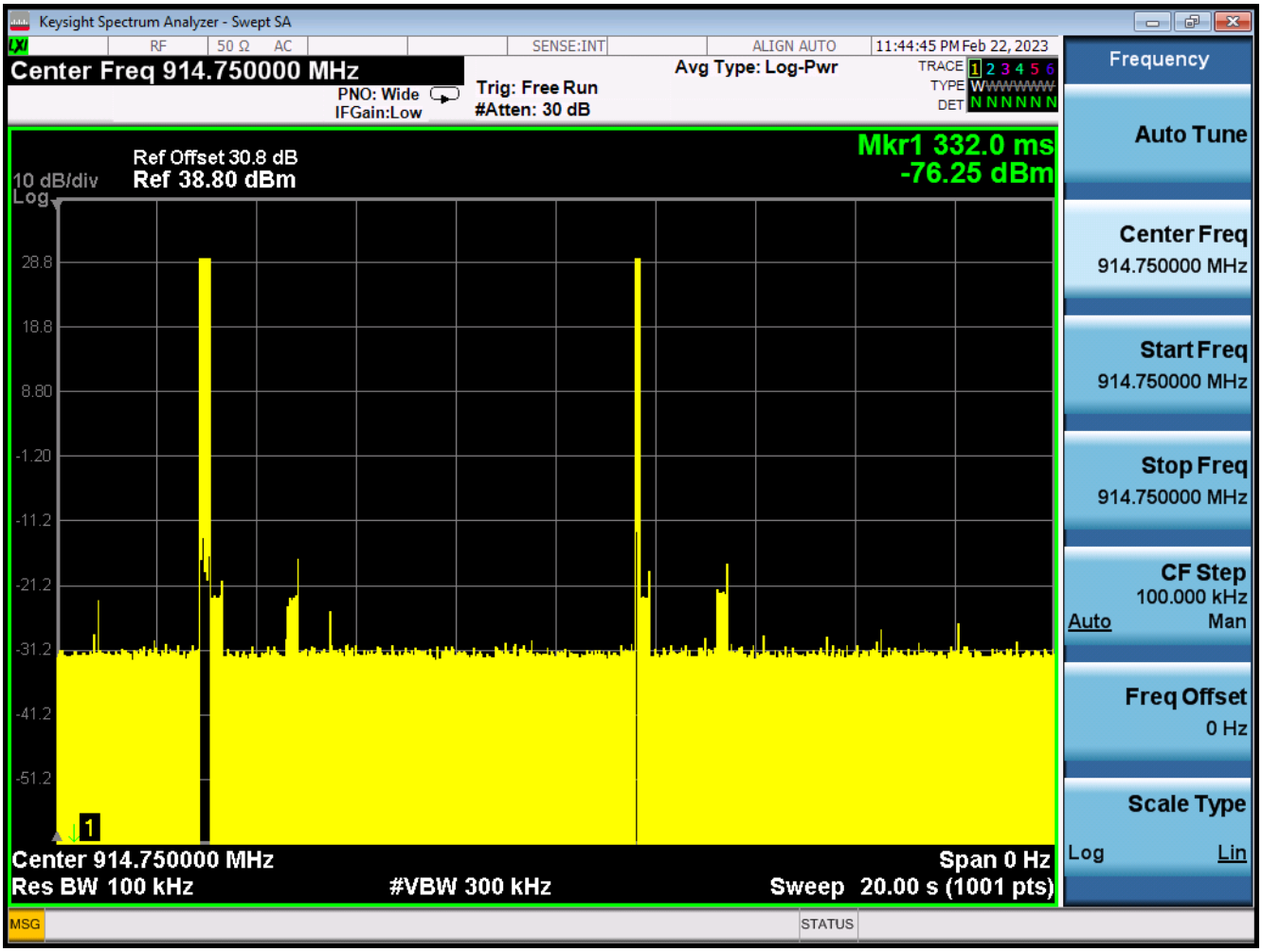


Figure 3: Time of Occupancy



4.2 RF Power Output: (FCC Part 15.27 (b)(2)(4))

Requirement: The maximum peak conducted output power shall not exceed 1 Watt (30 dBm), and the EIRP shall not exceed 4W, if the hopset uses 50 or more hopping channels.

Test Method: ANSI C63.10, Section 7.8.5 Output Power Test Procedure for FHSS

Table 10: RF Power Output

TX Freq. (MHz)	Power Conducted (dBm)	Power Conducted (Watts)	Limit (Watts)	Margin (Watts)	Results
902.75	29.6	0.9120	1	-0.0880	Pass
914.75	29.3	0.8511	1	-0.1489	Pass
927.25	29.8	0.9550	1	-0.0450	Pass

4.3 Occupied Bandwidth: (FCC Part §2.1049)

Requirement: 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.

Test Method: ANSI C63.10, Section 6.9.2 Occupied Bandwidth

Table 11 provides a summary of the Occupied Bandwidth Results.

Table 11: Occupied Bandwidth Results

Frequency (MHz)	Bandwidth (kHz)	Limit (kHz)	Results
Low Channel: 902.749	156.0	500	Pass
Mid Channel: 914.749	155.2	500	Pass
High Channel: 927.249	155.9	500	Pass

Figure 4: Occupied Bandwidth, Low Channel

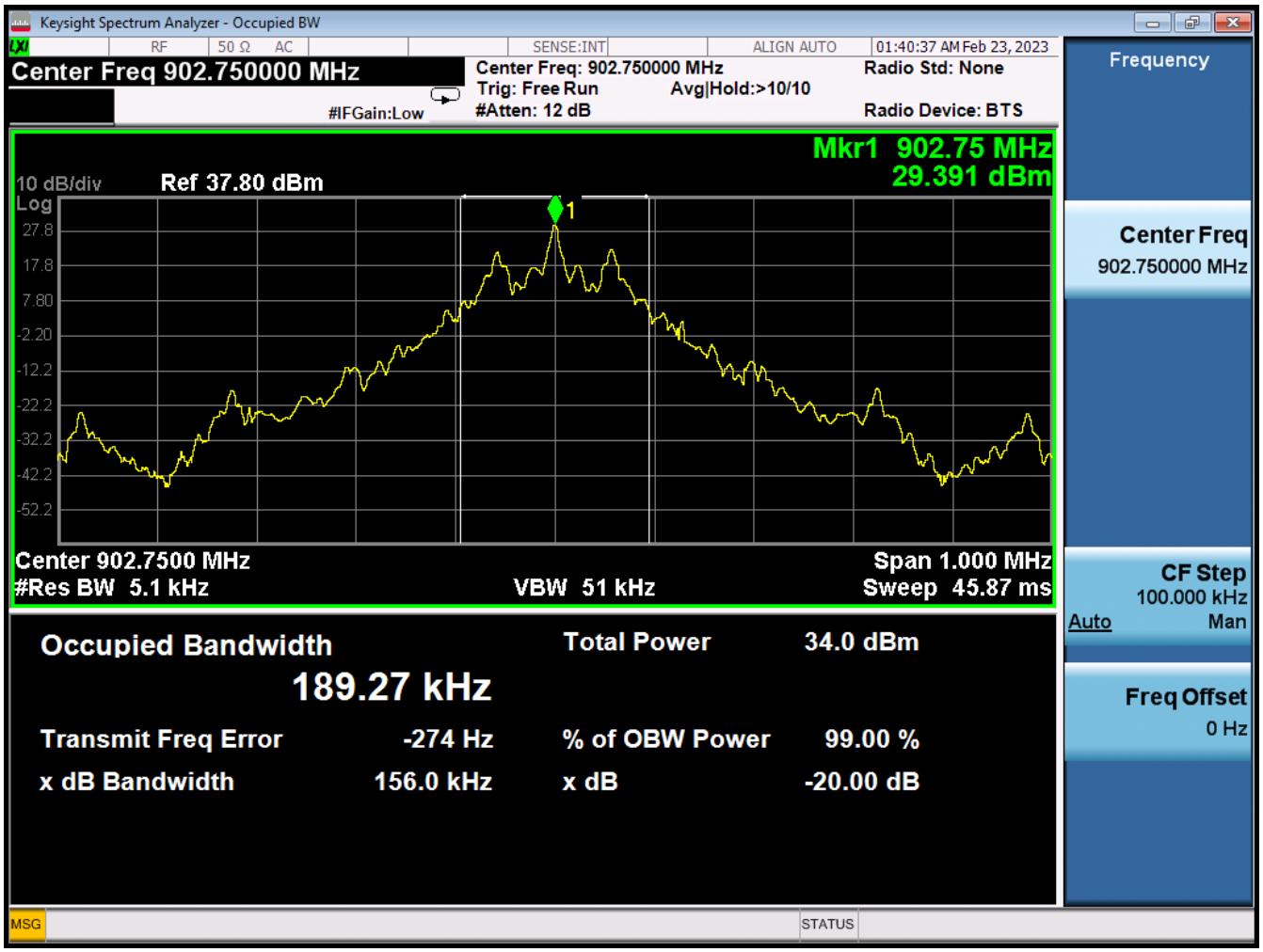


Figure 5: Occupied Bandwidth, Mid Channel

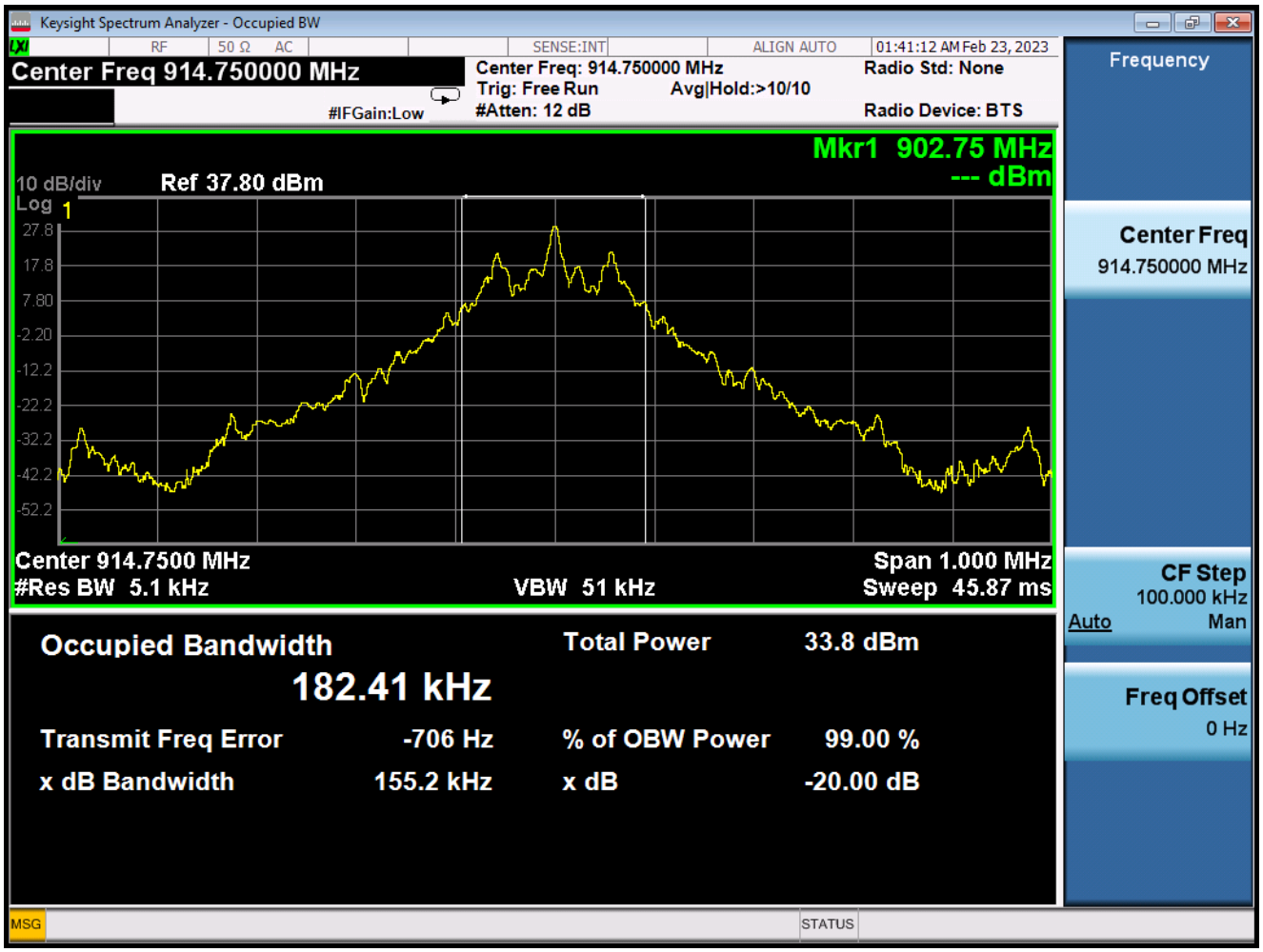
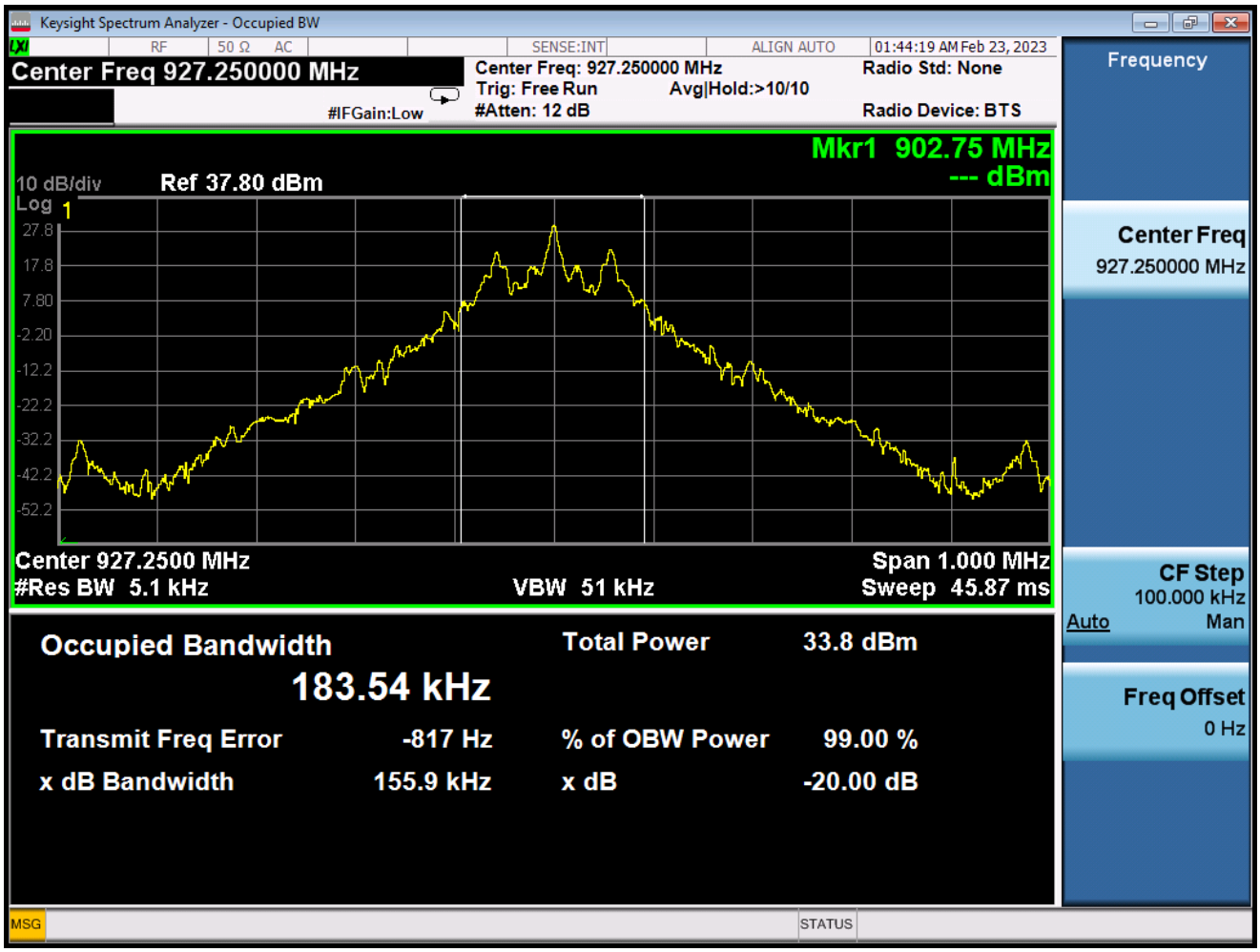


Figure 6: Occupied Bandwidth, High Channel



4.4 Channel Spacing and Number of Hop Channels (FCC Part §15.247(a)(1)

Requirements: 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 EUT has a maximum 20dB bandwidth measurement of 156 kHz; so, the channel spacing must be more than 156 kHz. In addition, for a 2.4GHz transmitter the number of hopping channels shall be stated.

The EUT antenna was removed, and the cable was connected directly into a spectrum analyzer through a 30 dB attenuator. An offset was programmed into the spectrum analyzer to compensate for the loss of the external attenuator & cable. The spectrum analyzer resolution bandwidth was set to 100 kHz and the video bandwidth was set to 300 kHz. The channel spacing of 2 adjacent channels was measured.

Also, the number of hopping channels was measured from 902-928MHz using a RBW/VBW setting of 100/300 kHz.

The following are plots of the channel spacing and number of hopping channels data. The channel spacing was measured to be 498 kHz and the number of channels used is 50.

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

Test Method: ANSI C63.10, Section 7.8.2, Carrier Frequency Separation
ANSI C63.10, Section 7.8.3, Number of Hopping Frequencies
ANSI C63.10, Section 7.8.3, Time of Occupancy

Table 12: Channel Spacing and Number of Channels Results

Frequency	Result	Requirement	Pass/Fail
Channel Spacing	498.3kHz	25 kHz (minimum)	Pass
Number of channels	50 channels	50 Channels (minimum)	Pass

Figure 7: Channel Spacing

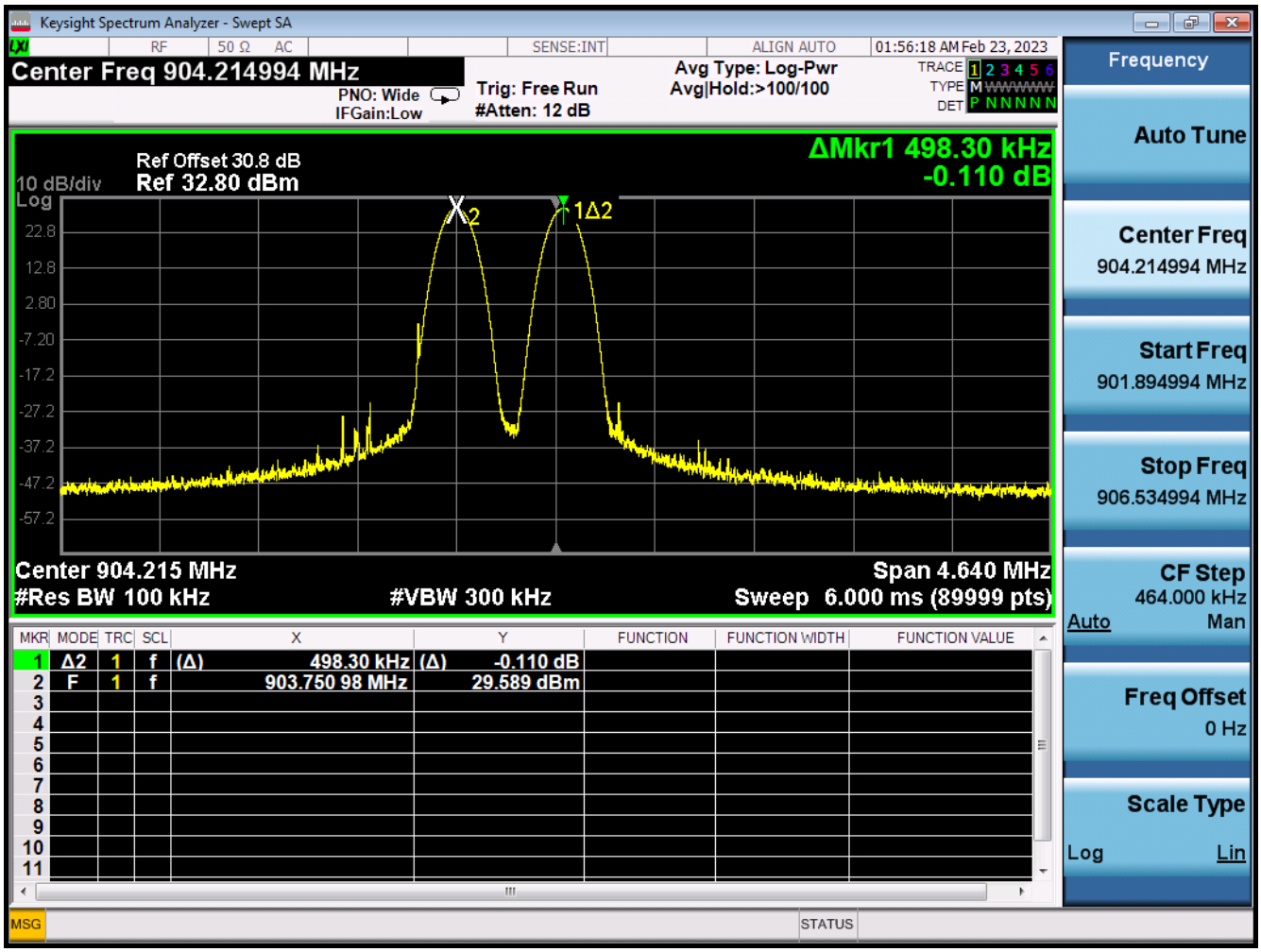
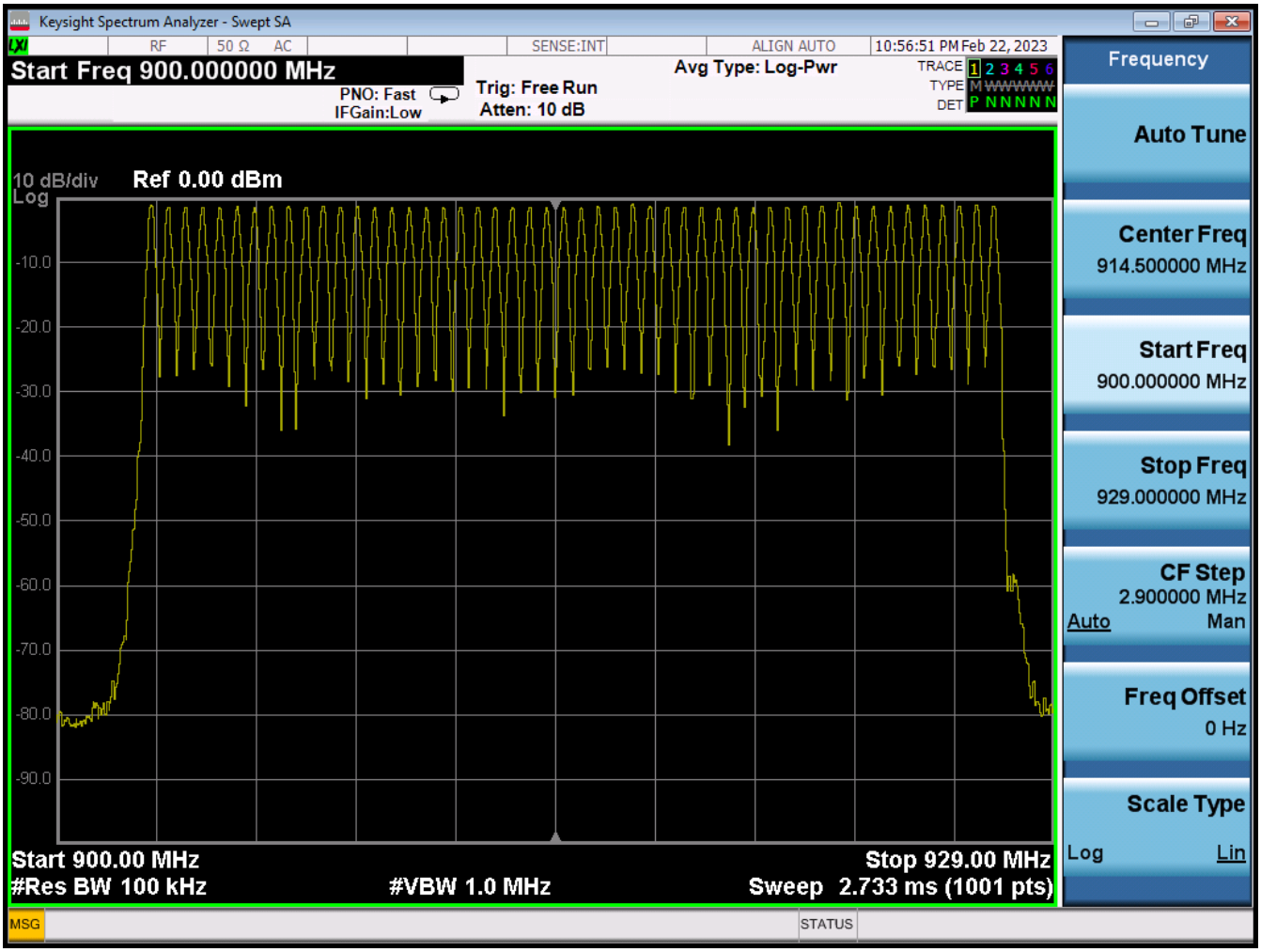


Figure 8: Number of Hopping Channels



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 30 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 1MHz 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 10 MHz up to the tenth harmonic of the carrier.

The following are plots of the conducted spurious emissions data.

Figure 9: Conducted Spurious Emissions, Active Hopping Mode (All Channels)

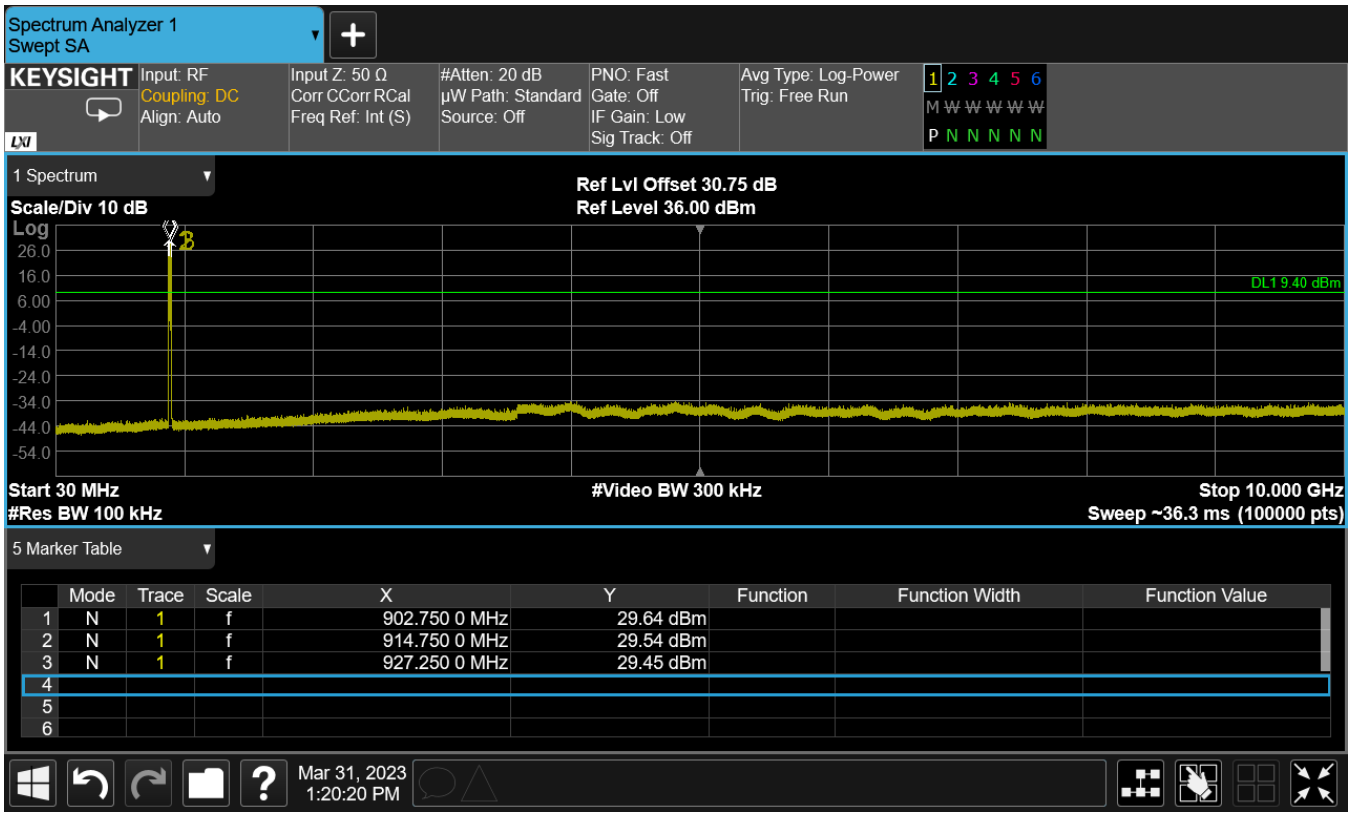


Figure 10: Conducted Spurious Emissions, Low Channel (Plot 1)

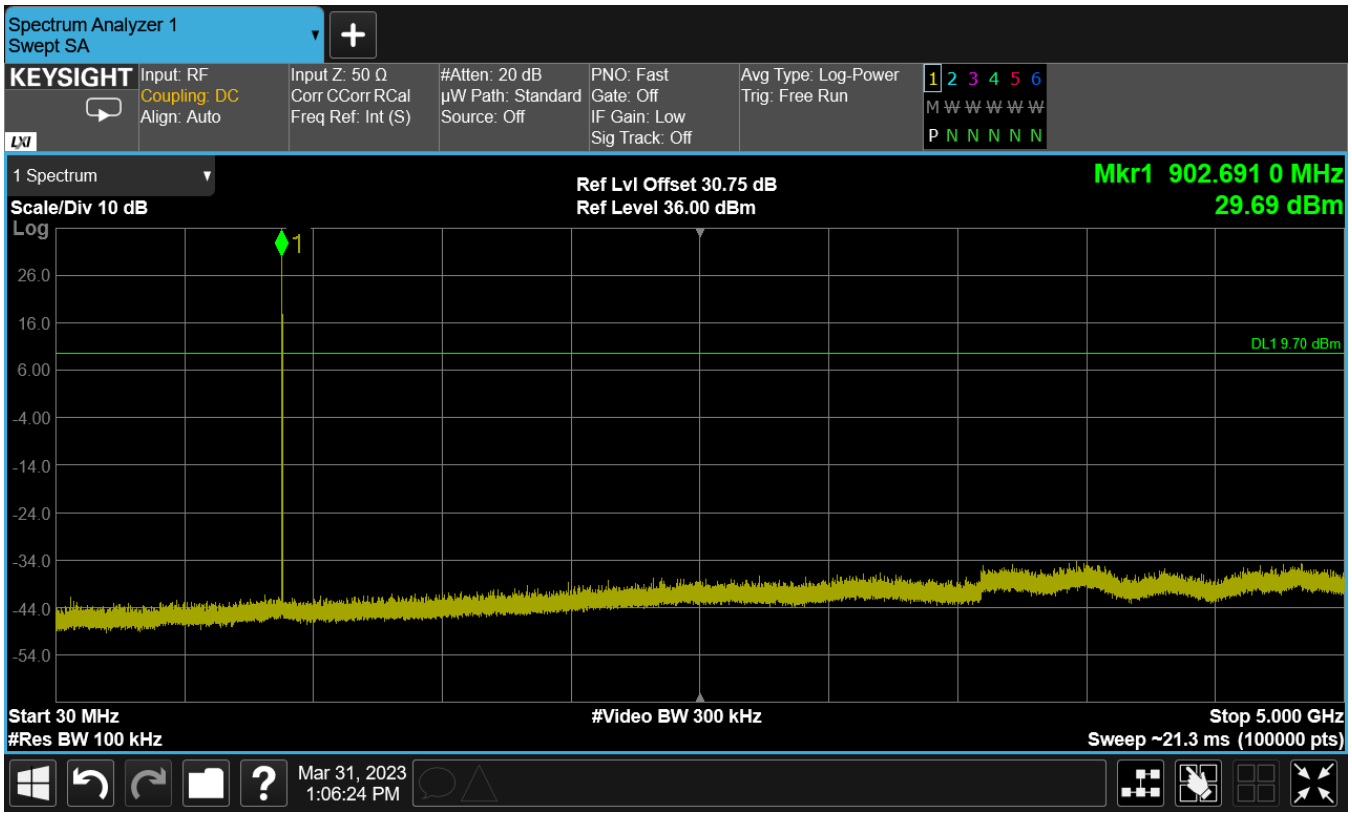


Figure 11: Conducted Spurious Emissions, Low Channel (Plot 2)

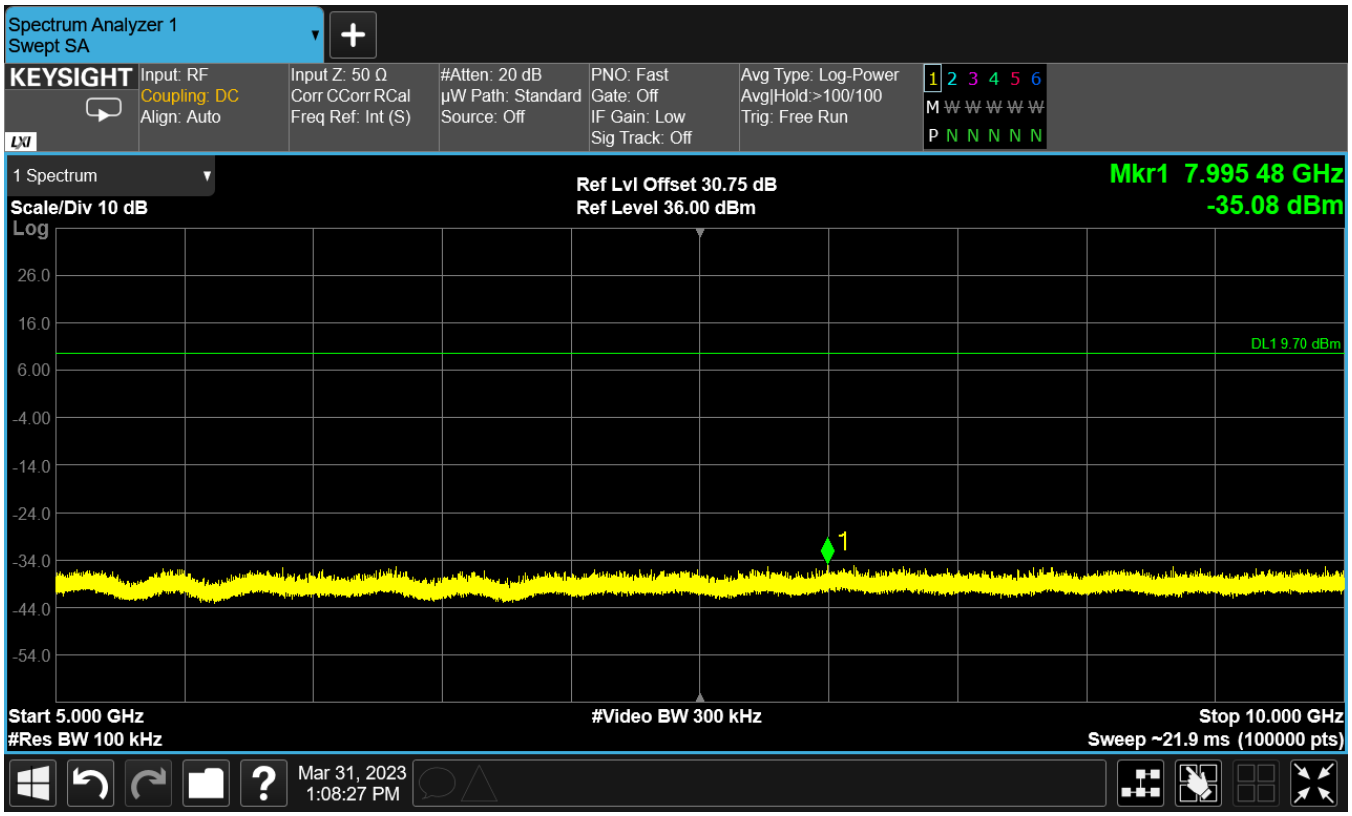


Figure 12: Conducted Spurious Emissions, Center Channel (Plot 1)

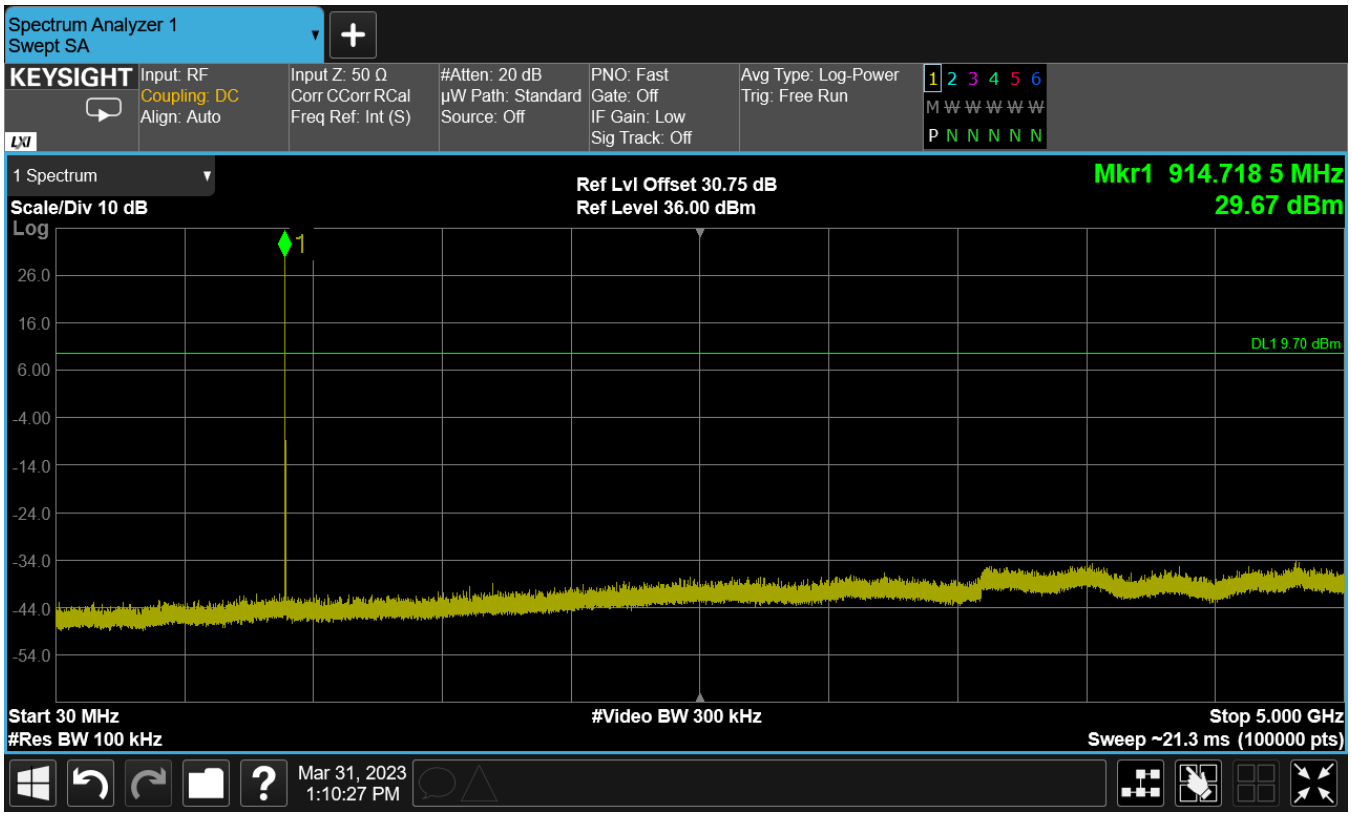


Figure 13: Conducted Spurious Emissions, Center Channel (Plot 2)

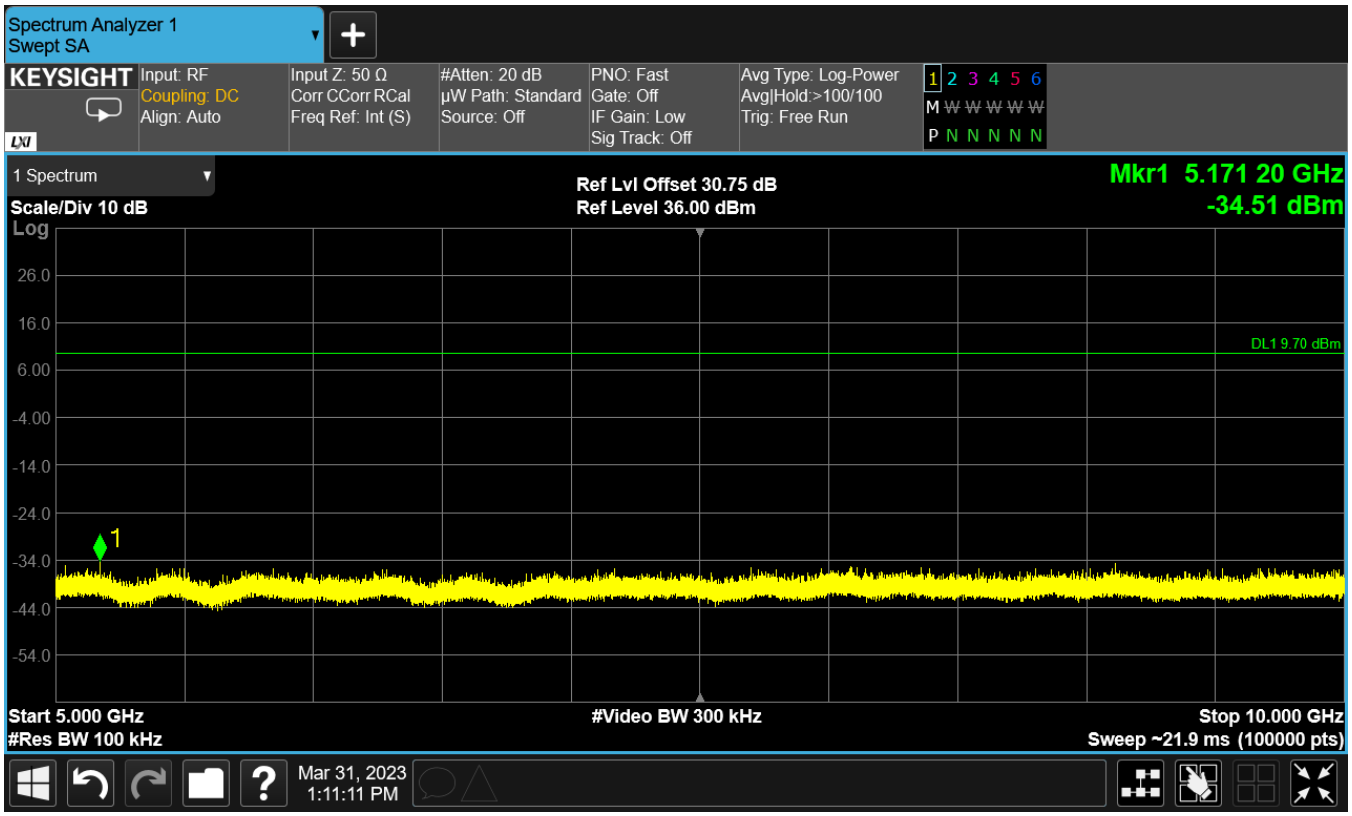


Figure 14: Conducted Spurious Emissions, High Channel (Plot 1)

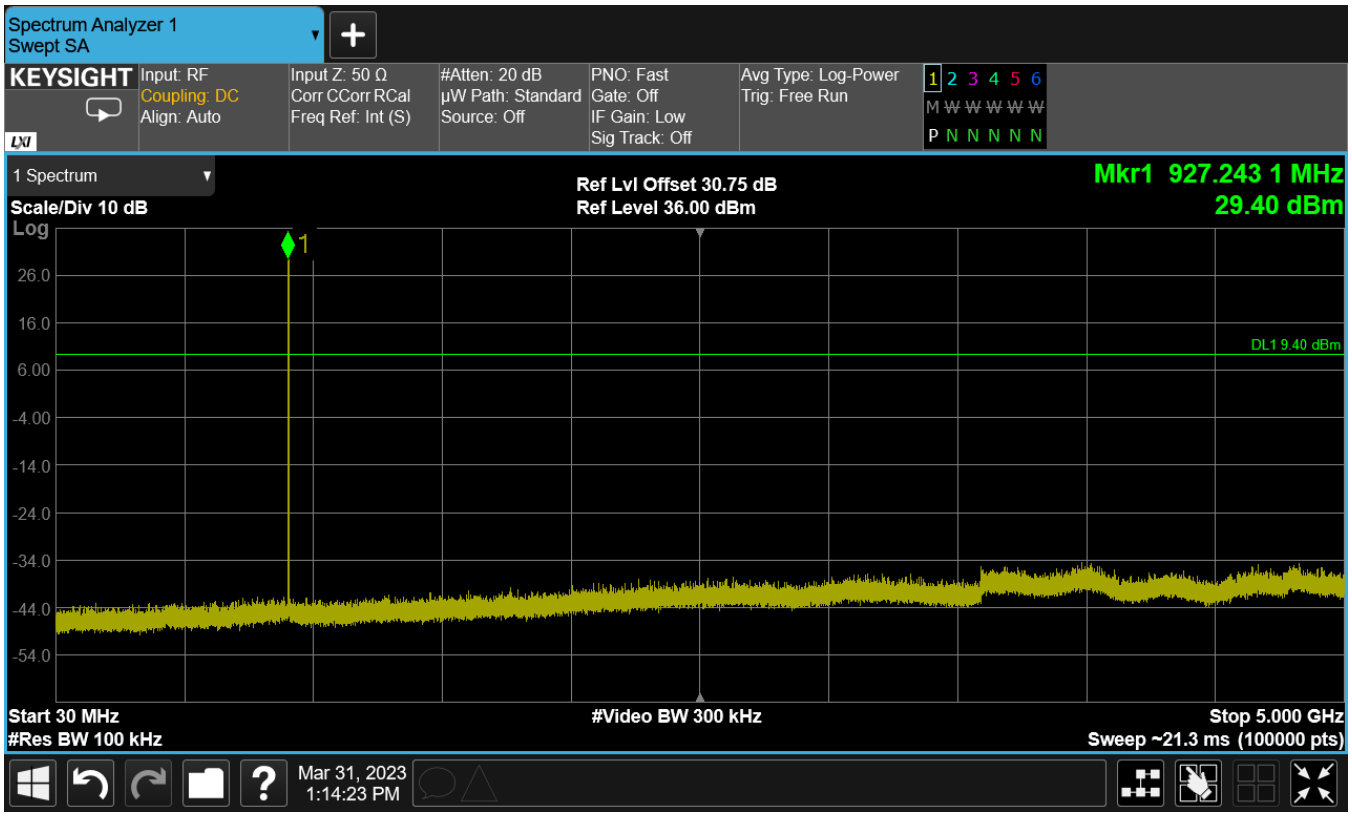
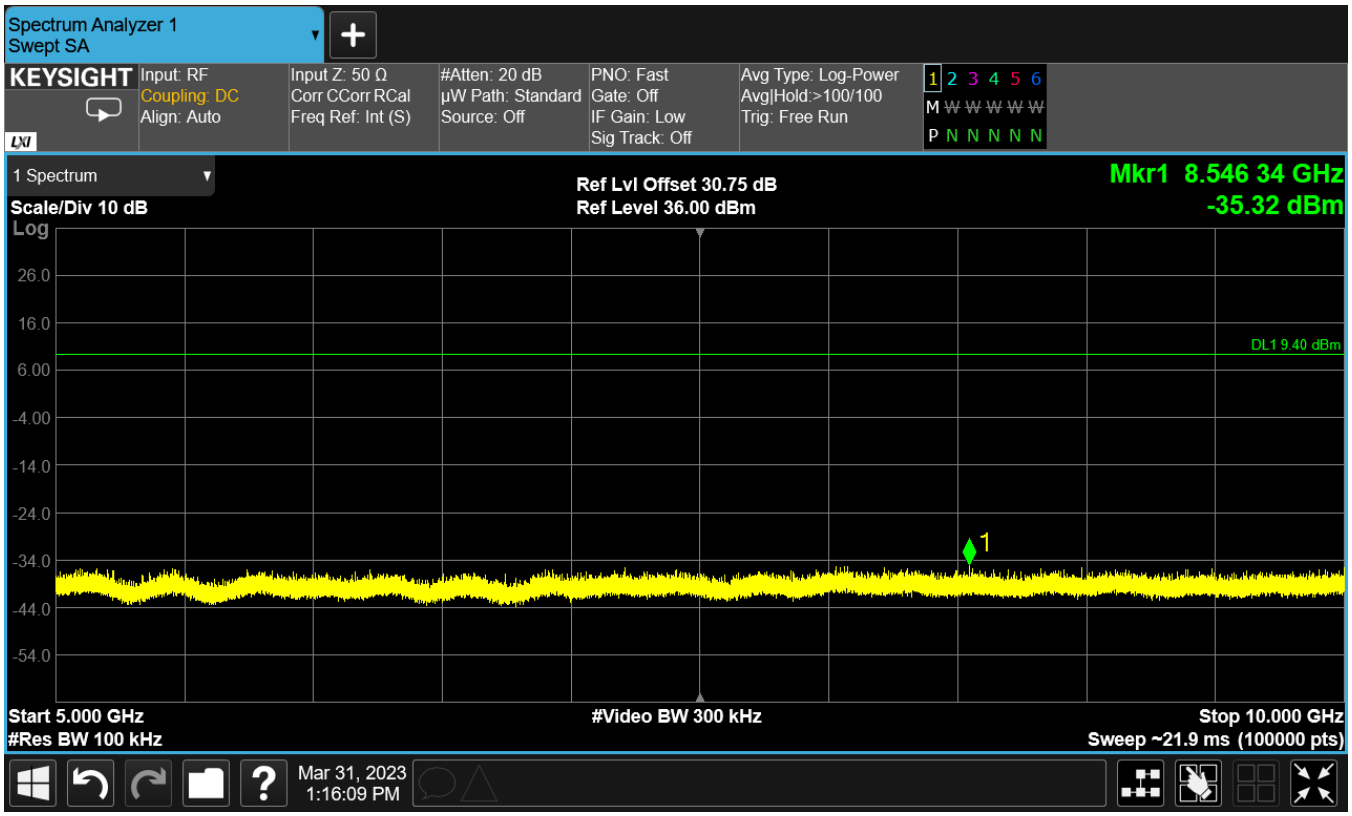


Figure 15: Conducted Spurious Emissions, High Channel (Plot 2)



4.6 Band Edge Compliance

In accordance with FCC Public Notice DA-00-705 close-up plots of the upper and lower channels in both hopping and non-hopping modes 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.

The following are plots of the conducted spurious emissions data.

Figure 16: Lower Band-edge, Hopping Mode

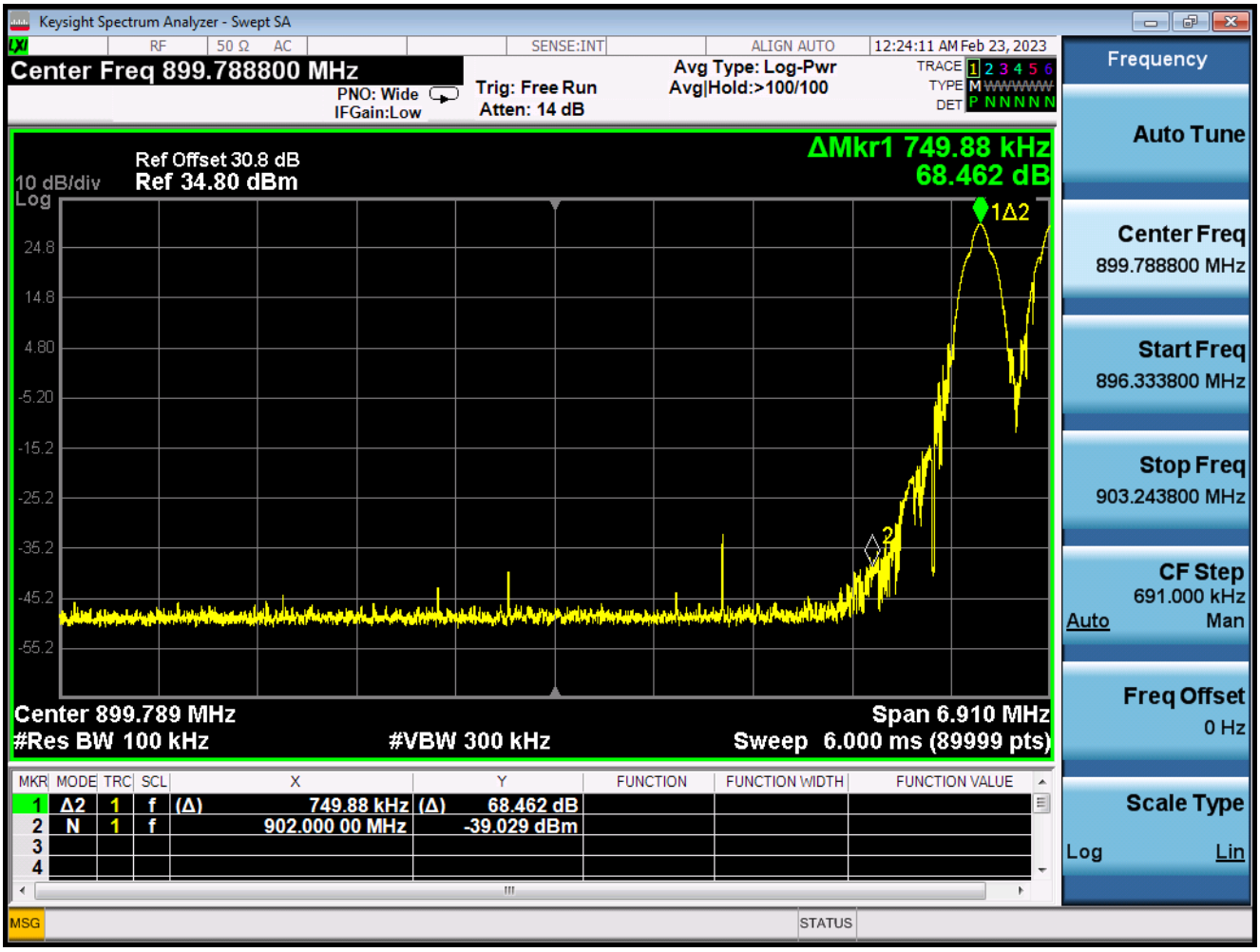


Figure 17: Low Channel, Lower Band-edge

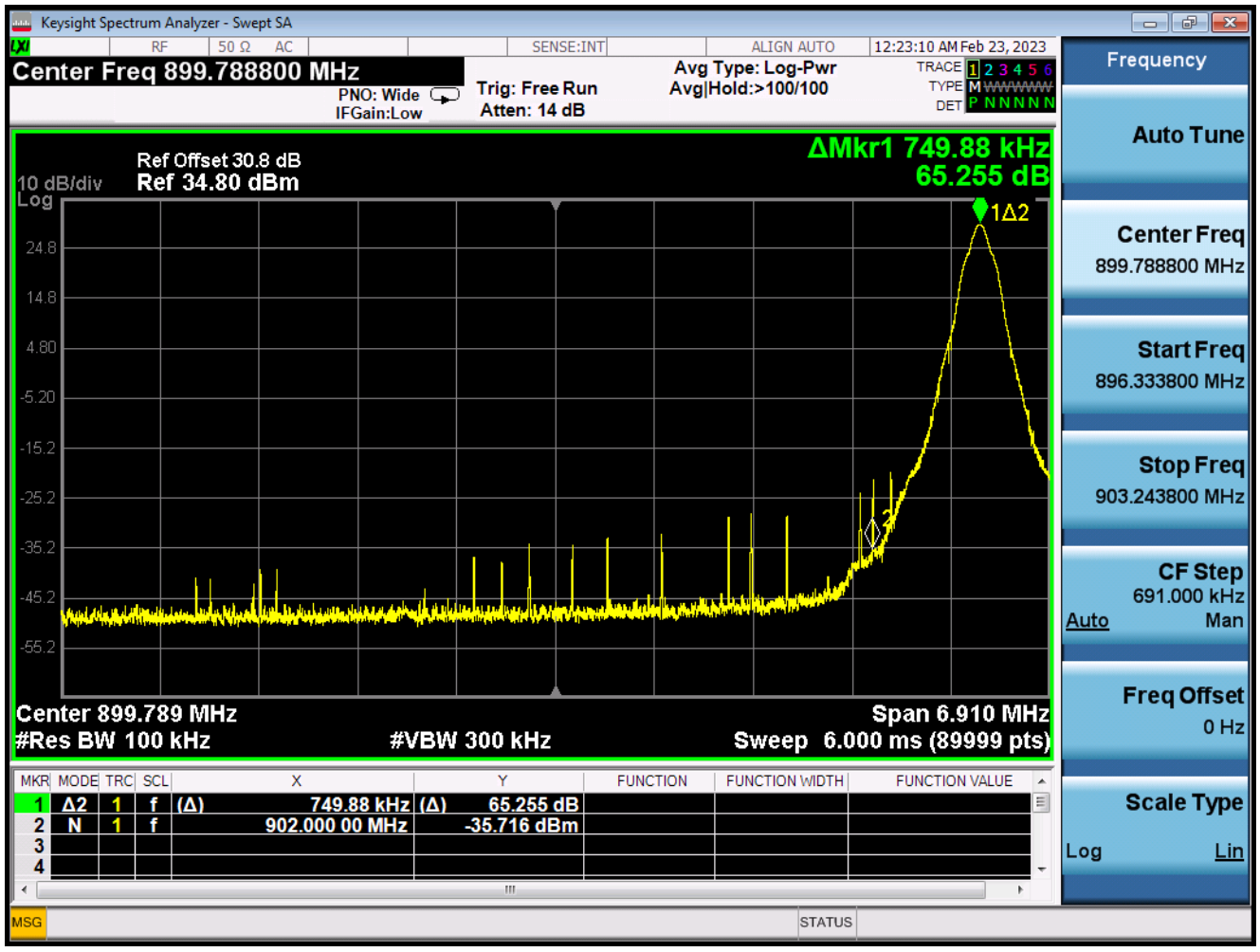


Figure 18: High Channel, Upper Band-edge

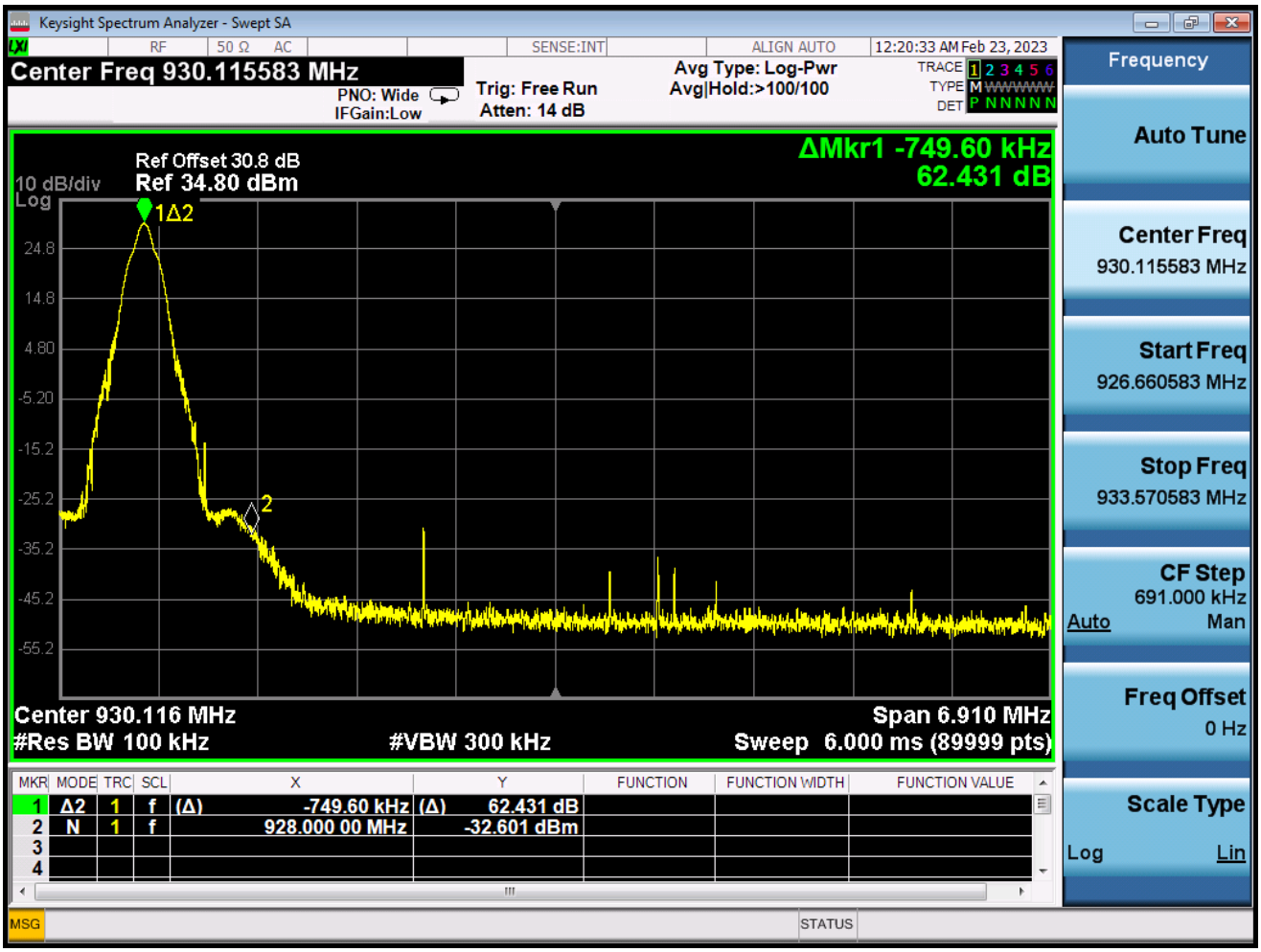


Figure 19: Band-edge, Hopping Mode

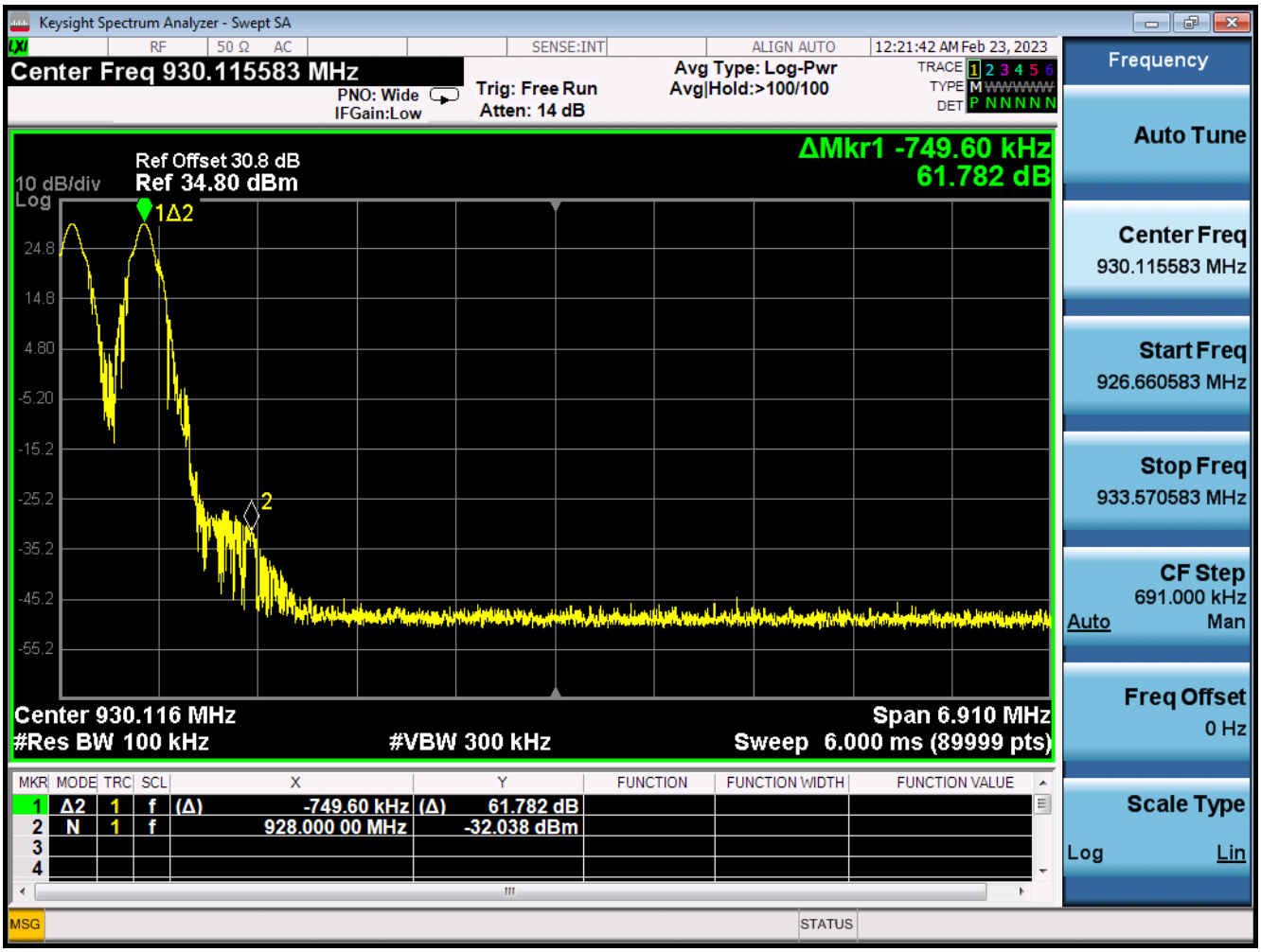
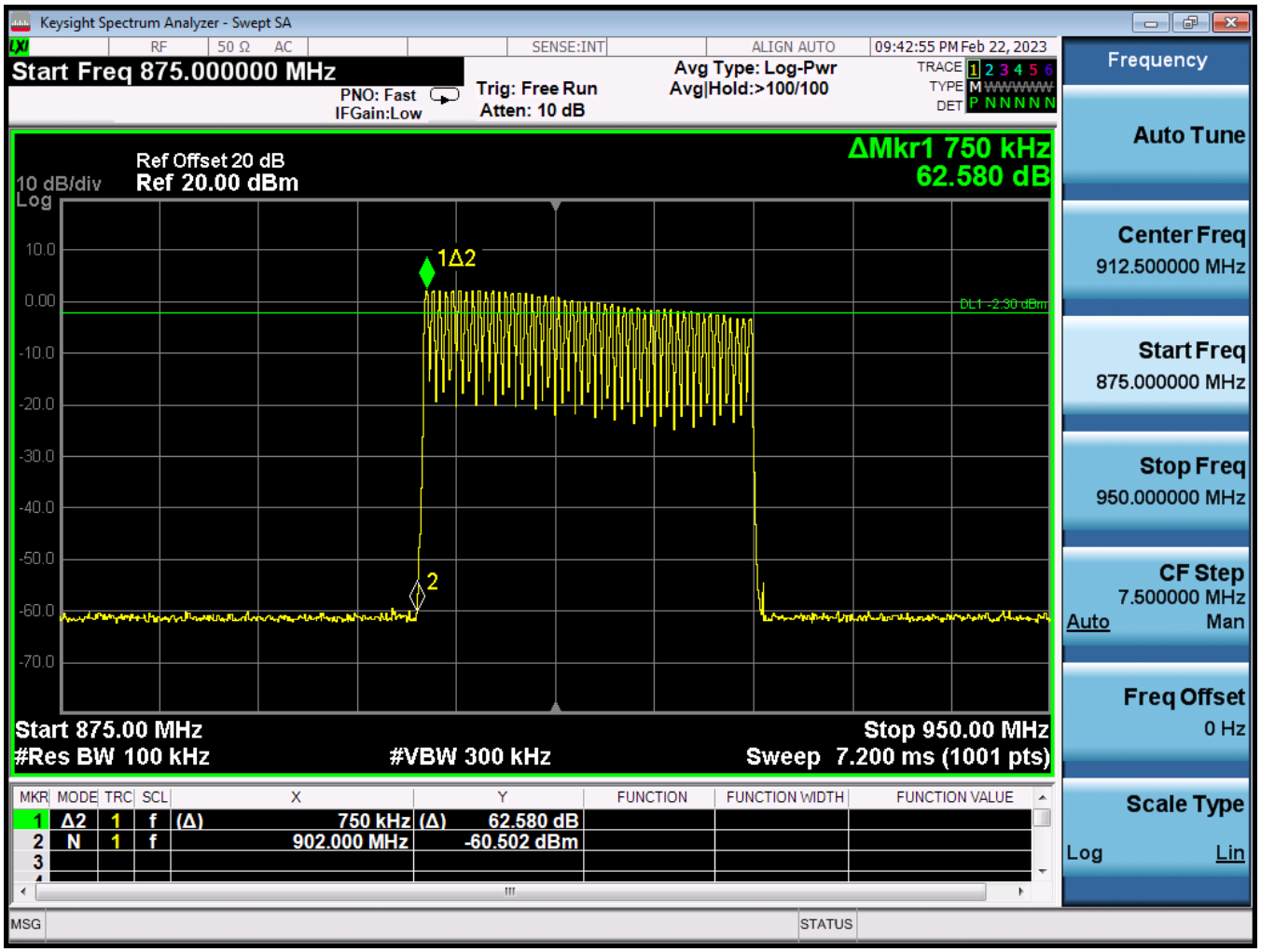
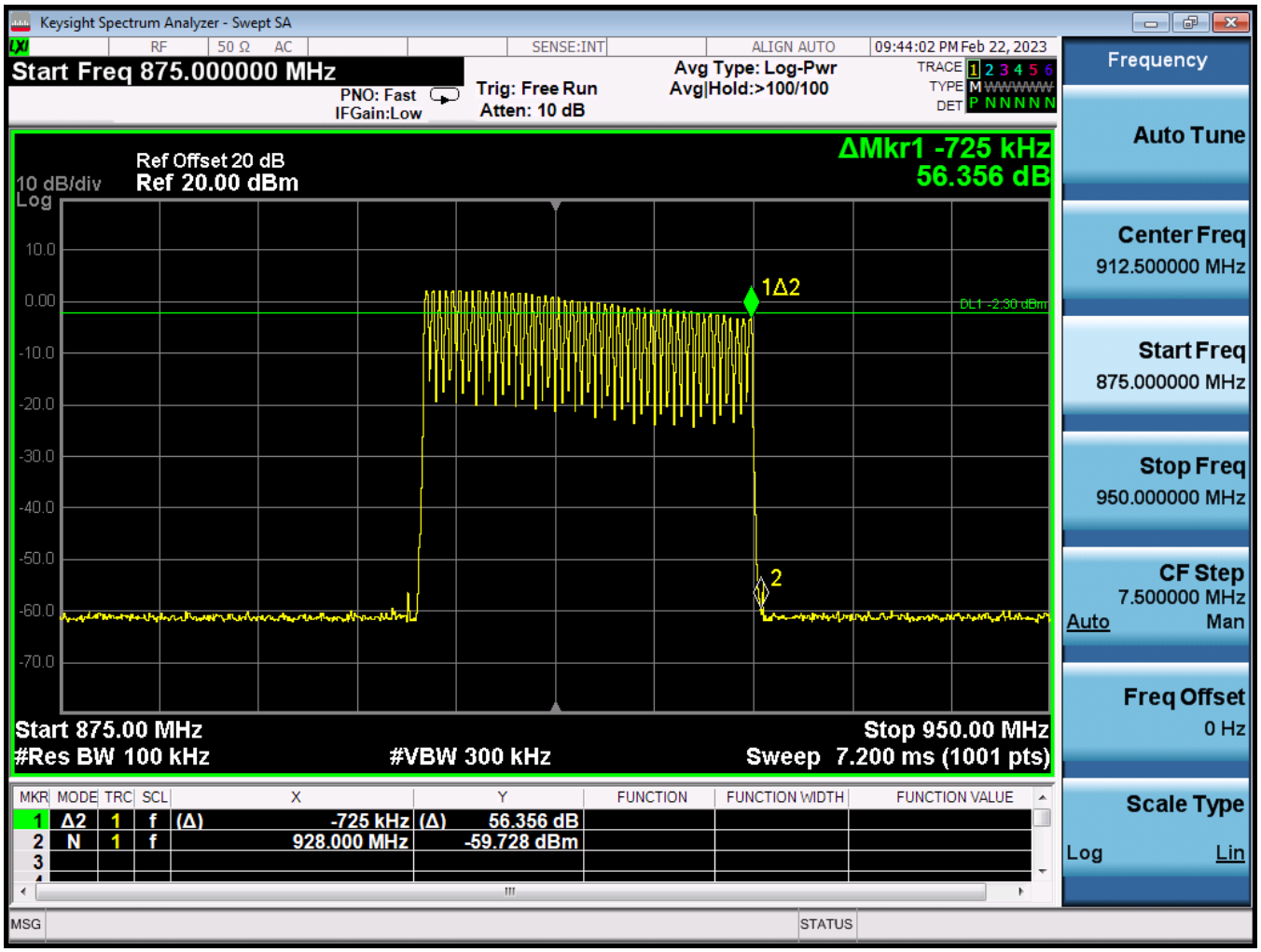


Figure 20:Lower Band-edge, Radiated, Hopping Mode



Values are uncorrected in SA, for relative comparison.

Figure 21: High Band-edge, Radiated, Hopping Mode



Values are uncorrected in SA, for relative comparison.

4.7 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.

4.7.1 Test Procedure

The EUT was placed on non-conductive motorized turntable for radiated testing on a 3-meter 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 EUT was investigated with all three transmitting antennas, and all three orthogonal planes (x, y, and z) were evaluated for the EUT position that produced the highest radiated field strength. In this regard, the EUT transmitter portion, and the radiating element, were varied in position to determine the worst-case orientation. The EUT position that produced the highest spectrum analyzer readings was maintained during the test, and the EUT was scanned from 30 MHz to 10 GHz, which covers the tenth harmonic. In this regard, each of the EUT antennas were mounted in accordance with the applicant's installation procedures. The PE510M1013 Omnidirectional antenna was mounted in a Y-Axis (vertical). The PAR90209H Circularly Polarized antenna was mounted in a Y-Axis (vertical). The PAP-ANT-H1-915 Linearly Polarized antenna was mounted in an X-Axis (horizontal). Each of these orthogonal planes produced the worst-case emissions and correlate to the table data provided on Page 46 though 48 of this report.

The emissions were measured using the following resolution bandwidths:

Table 13: Spectrum Analyzer Settings

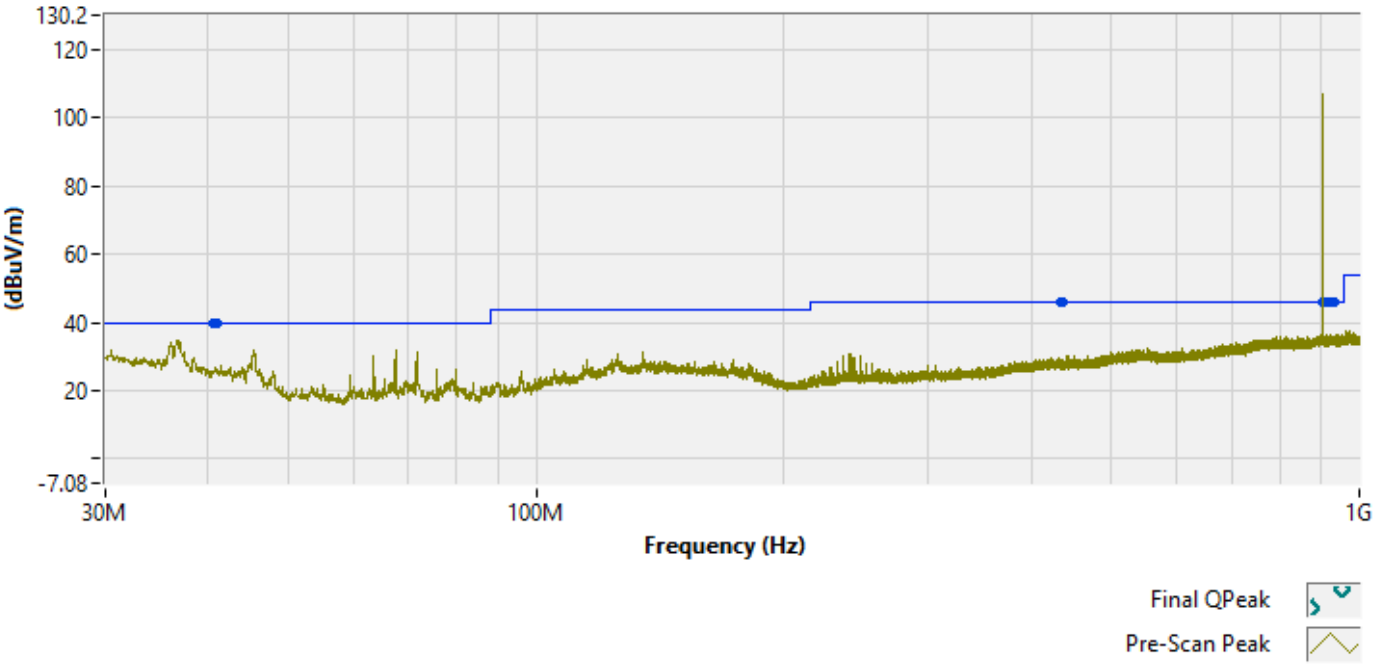
Frequency Range	Resolution Bandwidth	Video Bandwidth
30 MHz – 1000 MHz	120 kHz	> 500 kHz
>1000 MHz	1 MHz	< 30 Hz (Avg.), 1 MHz (Peak)

The EUT complies with the requirements of this test.

There were no EUT emissions detected in the frequency range of 2 GHz to 10 GHz.

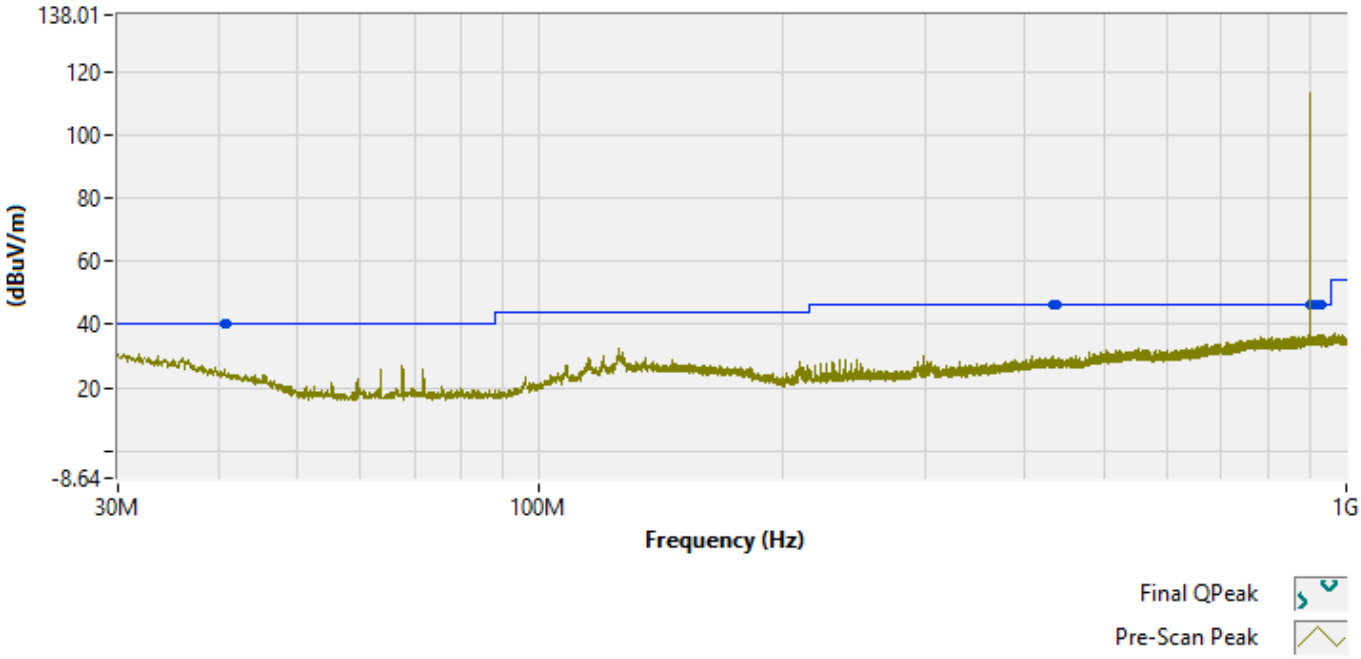
The final test data is provided below.

Figure 22: Worst-Case Radiated Emissions Test Data, 30 MHz to 1000 MHz (Vertical)



* note: unwanted emissions from the EUT, in the frequency range of 30MHz to 1000 MHz, are not impacted by the use of the various transmitting antennas. Moreover, tuning the Low, Center, and/or High channels had no impact on the unwanted emissions in this frequency range. That is, when the EUT employs any of the antennas outlined in this test report, and is tuned to transmit on any of the fundamental center frequencies, the EMI signature does not change. Therefore, the emissions in this range appear to be digital, and not correlated to the transmitter.

Figure 23: Worst-Case Radiated Emissions Test Data, 30 MHz to 1000 MHz (Horizontal)



* note: unwanted emissions from the EUT, in the frequency range of 30MHz to 1000 MHz, are not impacted by the use of the various transmitting antennas. Moreover, tuning the Low, Center, and/or High channels had no impact on the unwanted emissions in this frequency range. That is, when the EUT employs any of the antennas outlined in this test report, and is tuned to transmit on any of the fundamental center frequencies, the EMI signature does not change. Therefore, the emissions in this range appear to be digital, and not correlated to the transmitter.

Figure 24: Worst-Case Radiated Emissions Test Data, 1 GHz to 10 GHz (Vertical)

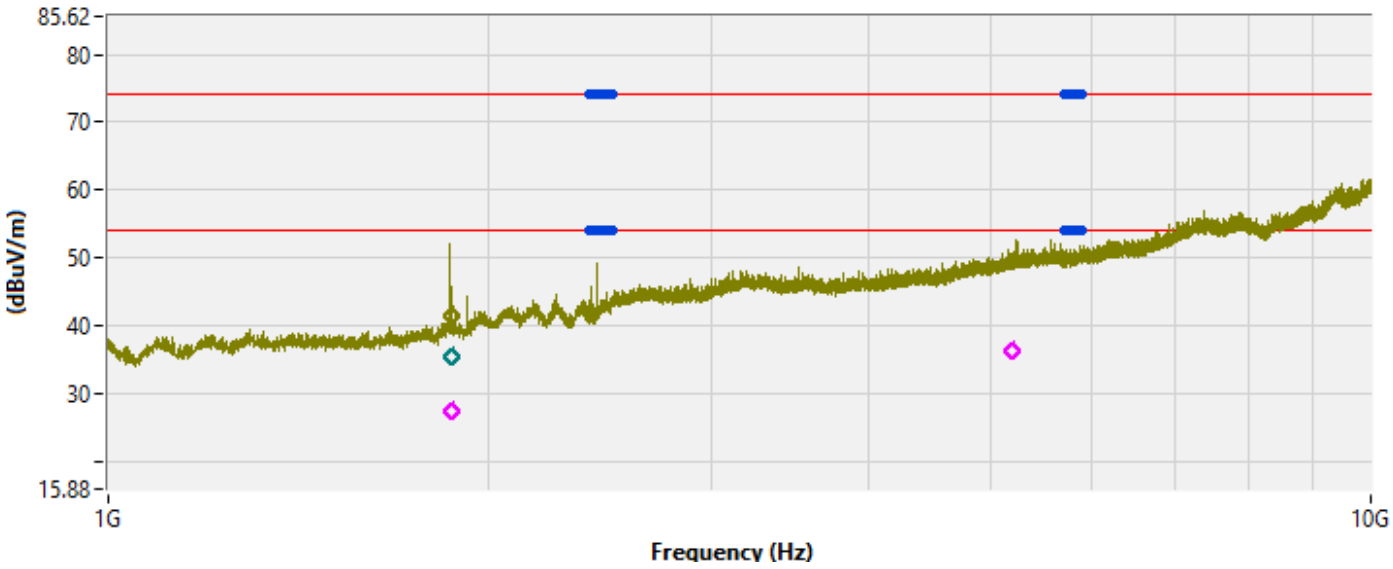


Figure 25: Worst-Case Radiated Emissions Test Data, 1 GHz to 10 GHz (Horizontal)

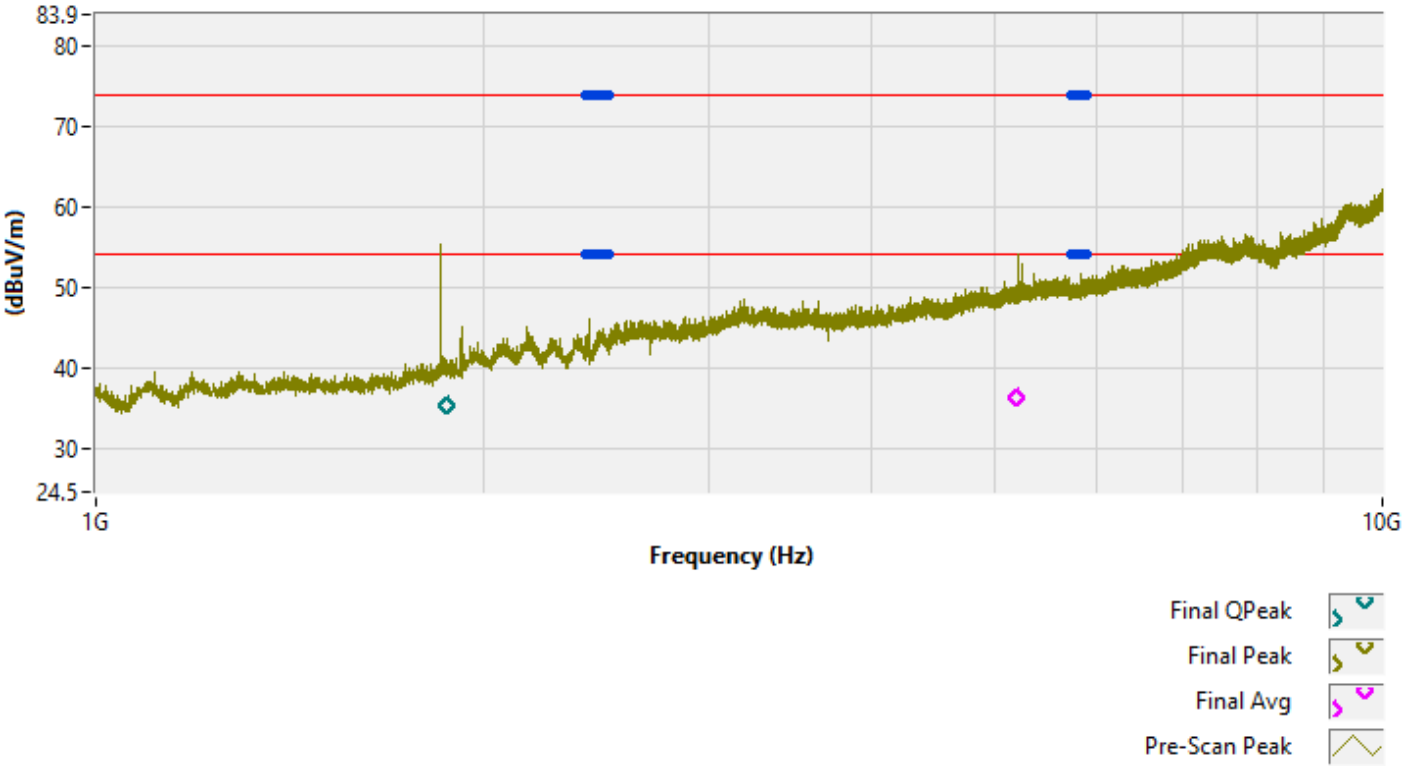


Table 14: Radiated Emissions, Antenna: PAP-ANT-H1-915 (6 dBi)

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)	Detector	Comments
1805.50	V	10.0	1.5	46.9	-4.1	138.8	5000.0	-31.1	Peak	LC
1805.50	V	10.0	1.5	35.1	-4.1	35.7	500.0	-22.9	AVG	LC
1829.50	V	0.0	1.5	47.0	-3.8	144.8	5000.0	-30.8	Peak	CC
1829.50	V	0.0	1.5	35.0	-3.8	36.4	500.0	-22.8	AVG	CC
1854.50	V	0.0	1.5	47.3	-3.5	155.2	5000.0	-30.2	Peak	HC
1854.50	V	0.0	1.5	35.5	-3.5	39.9	500.0	-22.0	AVG	HC
2708.25	V	0.0	1.5	44.0	1.5	187.4	5000.0	-28.5	Peak	NF
2708.25	V	0.0	1.5	31.2	1.5	42.9	500.0	-21.3	AVG	NF
2744.25	V	0.0	1.5	44.8	1.6	207.8	5000.0	-27.6	Peak	NF
2744.25	V	0.0	1.5	32.0	1.6	47.6	500.0	-20.4	AVG	NF
2781.75	V	0.0	1.5	43.1	1.7	172.8	5000.0	-29.2	Peak	NF
2781.75	V	0.0	1.5	30.5	1.7	40.5	500.0	-21.8	AVG	NF
1805.50	H	10.0	1.5	56.3	-4.1	407.3	5000.0	-21.8	Peak	LC
1805.50	H	10.0	1.5	49.3	-4.1	183.6	500.0	-8.7	AVG	LC
1829.50	H	0.0	1.5	56.1	-3.8	412.7	5000.0	-21.7	Peak	CC
1829.50	H	0.0	1.5	50.0	-3.8	204.5	500.0	-7.8	AVG	CC
1854.50	H	0.0	1.5	56.5	-3.5	447.5	5000.0	-21.0	Peak	HC
1854.50	H	0.0	1.5	49.0	-3.5	188.7	500.0	-8.5	AVG	HC
2708.25	H	0.0	1.5	44.0	1.5	187.4	5000.0	-28.5	Peak	NF
2708.25	H	0.0	1.5	31.2	1.5	42.9	500.0	-21.3	AVG	NF
2744.25	H	0.0	1.5	44.5	1.6	200.8	5000.0	-27.9	Peak	NF
2744.25	H	0.0	1.5	31.3	1.6	43.9	500.0	-21.1	AVG	NF
2781.75	H	0.0	1.5	43.0	1.7	170.8	5000.0	-29.3	Peak	NF
2781.75	H	0.0	1.5	30.0	1.7	38.2	500.0	-22.3	AVG	NF

* LC = Low Channel, CC = Center Channel, HC = High Channel

* NF indicates that EUT emissions were not detected, and the measurement was taken at the noise floor.

Table 15: Radiated Emissions, Antenna: PAR90209H (6 dBi)

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)	Detector	Comments
1805.50	V	10.0	1.5	55.3	-4.1	365.1	5000.0	-22.7	Peak	LC
1805.50	V	10.0	1.5	46.9	-4.1	138.8	500.0	-11.1	AVG	LC
1829.50	V	0.0	1.5	56.2	-3.8	417.5	5000.0	-21.6	Peak	CC
1829.50	V	0.0	1.5	47.9	-3.8	160.6	500.0	-9.9	AVG	CC
1854.50	V	0.0	1.5	51.9	-3.5	263.5	5000.0	-25.6	Peak	HC
1854.50	V	0.0	1.5	42.5	-3.5	89.3	500.0	-15.0	AVG	HC
2708.25	V	0.0	1.5	43.9	1.5	185.3	5000.0	-28.6	Peak	NF
2708.25	V	0.0	1.5	31.0	1.5	42.0	500.0	-21.5	AVG	NF
2744.25	V	0.0	1.5	44.7	1.6	205.5	5000.0	-27.7	Peak	NF
2744.25	V	0.0	1.5	31.9	1.6	47.1	500.0	-20.5	AVG	NF
2781.75	V	0.0	1.5	43.0	1.7	170.8	5000.0	-29.3	Peak	NF
2781.75	V	0.0	1.5	30.3	1.7	39.6	500.0	-22.0	AVG	NF
1805.50	H	10.0	1.5	56.8	-4.1	433.9	5000.0	-21.2	Peak	LC
1805.50	H	10.0	1.5	47.2	-4.1	143.7	500.0	-10.8	AVG	LC
1829.50	H	0.0	1.5	57.6	-3.8	490.5	5000.0	-20.2	Peak	CC
1829.50	H	0.0	1.5	48.7	-3.8	176.1	500.0	-9.1	AVG	CC
1854.50	H	0.0	1.5	52.5	-3.5	282.4	5000.0	-25.0	Peak	HC
1854.50	H	0.0	1.5	43.0	-3.5	94.6	500.0	-14.5	AVG	HC
2708.25	H	0.0	1.5	43.8	1.5	183.1	5000.0	-28.7	Peak	NF
2708.25	H	0.0	1.5	31.2	1.5	42.9	500.0	-21.3	AVG	NF
2744.25	H	0.0	1.5	44.6	1.6	203.1	5000.0	-27.8	Peak	NF
2744.25	H	0.0	1.5	31.0	1.6	42.4	500.0	-21.4	AVG	NF
2781.75	H	0.0	1.5	43.2	1.7	174.8	5000.0	-29.1	Peak	NF
2781.75	H	0.0	1.5	30.5	1.7	40.5	500.0	-21.8	AVG	NF

* LC = Low Channel, CC = Center Channel, HC = High Channel

* NF indicates that EUT emissions were not detected, and the measurement was taken at the noise floor.

Table 16: Radiated Emissions, Antenna: PE510M1013 (3 dBi)

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)	Detector	Comments
1805.50	V	10.0	1.5	52.3	-4.1	257.3	5000.0	-25.8	Peak	LC
1805.50	V	10.0	1.5	43.9	-4.1	98.3	500.0	-14.1	AVG	LC
1829.50	V	0.0	1.5	53.3	-3.8	299.0	5000.0	-24.5	Peak	CC
1829.50	V	0.0	1.5	44.0	-3.8	102.5	500.0	-13.8	AVG	CC
1854.50	V	0.0	1.5	48.6	-3.5	180.2	5000.0	-28.9	Peak	HC
1854.50	V	0.0	1.5	39.9	-3.5	66.2	500.0	-17.6	AVG	HC
2708.25	V	0.0	1.5	45.8	1.5	230.8	5000.0	-26.7	Peak	NF
2708.25	V	0.0	1.5	32.0	1.5	47.1	500.0	-20.5	AVG	NF
2744.25	V	0.0	1.5	44.7	1.6	205.5	5000.0	-27.7	Peak	NF
2744.25	V	0.0	1.5	31.8	1.6	46.5	500.0	-20.6	AVG	NF
2781.75	V	0.0	1.5	43.0	1.7	170.8	5000.0	-29.3	Peak	NF
2781.75	V	0.0	1.5	30.2	1.7	39.1	500.0	-22.1	AVG	NF
1805.50	H	10.0	1.5	46.7	-4.1	135.6	5000.0	-31.3	Peak	LC
1805.50	H	10.0	1.5	34.1	-4.1	31.8	500.0	-23.9	AVG	LC
1829.50	H	0.0	1.5	46.0	-3.8	129.0	5000.0	-31.8	Peak	CC
1829.50	H	0.0	1.5	34.0	-3.8	32.4	500.0	-23.8	AVG	CC
1854.50	H	0.0	1.5	45.9	-3.5	132.1	5000.0	-31.6	Peak	HC
1854.50	H	0.0	1.5	33.8	-3.5	32.8	500.0	-23.7	AVG	HC
2708.25	H	0.0	1.5	44.4	1.5	196.2	5000.0	-28.1	Peak	NF
2708.25	H	0.0	1.5	31.5	1.5	44.4	500.0	-21.0	AVG	NF
2744.25	H	0.0	1.5	44.0	1.6	189.6	5000.0	-28.4	Peak	NF
2744.25	H	0.0	1.5	31.0	1.6	42.4	500.0	-21.4	AVG	NF
2781.75	H	0.0	1.5	44.1	1.7	193.9	5000.0	-28.2	Peak	NF
2781.75	H	0.0	1.5	30.9	1.7	42.4	500.0	-21.4	AVG	NF

* LC = Low Channel, CC = Center Channel, HC = High Channel

* NF indicates that EUT emissions were not detected, and the measurement was taken at the noise floor.

4.8 AC Conducted Emissions (FCC Part §15.207)

4.8.1 Requirements

Test Arrangement: Tabletop

Compliance Standard: FCC Class B

FCC Compliance Limits		
Frequency	**Quasi-peak**	**Average**
0.15 - 0.5MHz	66 to 56 dBµV	56 to 46 dBµV
0.5 - 5MHz	56 dBµV	46 dBµV
5 - 30MHz	60 dBµV	50 dBµV

4.8.2 Test Procedure

The EUT was placed on an 80 cm high 1 X 1.5 m non-conductive table above a ground plane. Power to the EUT was provided indirectly through the support laptop. The laptop was provided power though a Solar Corporation 50 Ω/50 µH Line Impedance Stabilization Network bonded to a 3 X 2 meter ground plane. The LISN has its AC input supplied from a filtered AC power source. Power was supplied to the peripherals through a second LISN. The peripherals were placed on the table in accordance with ANSI C63.4-2003. Power and data cables were moved about to obtain maximum emissions.

The 50 Ω output of the LISN was connected to the input of the spectrum analyzer and the emissions in the frequency range of 150 kHz to 30 MHz were measured. The detector function was set to quasi-peak, peak, or average as appropriate, and the resolution bandwidth during testing was at least 9 kHz, with all post-detector filtering no less than 10 times the resolution bandwidth. For average measurements the post-detector filter was set to 10 Hz.

At frequencies where quasi-peak or peak measurements comply with the average limit, no average measurements need be performed.

The Conducted emissions level to be compared to the FCC limit is calculated as shown in the following example.

Example:

Spectrum Analyzer Voltage:	VdBµV
LISN Correction Factor:	LISN dB
Cable Correction Factor:	CF dB
Electric Field:	EdBµV = V dBµV + LISN dB + CF dB

4.8.3 Test Data

The EUT complies with the Class B Conducted Emissions requirements.

The EUT was indirectly coupled to the AC public mains network, as the transmitter was powered via +5VDC from the USB port of the support laptop.

This is the only test where a laptop computer was used to power the EUT. For all other tests, the EUT was powered by an adjustable power supply. In no case did the support laptop, or DC power supply affect the results of any test.

Conducted Emissions was tested with the 915 MHz radio in the “transmit on” state.

The following tables provide the test results for phase and neutral line power line conducted emissions.

Table 17: AC Powerline Conducted Emissions Data – Transmit On

NEUTRAL (LISN 1)										
Frequency (MHz)	**Level QP (dBµV)**	**Level AVG (dBµV)**	**Cable Loss (dB)**	**LISN Corr (dB)**	**Level QP Corr (dBµV)**	**Level Avg Corr (dBµV)**	**Limit QP (dBµV)**	**Limit AVG (dBµV)**	**Margin QP (dB)**	**Margin AVG (dB)**
0.243	39.7	18.4	9.9	0.4	50.1	28.8	62.0	52.0	-11.9	-20.2
0.450	36.1	17.2	9.9	0.3	46.4	27.5	56.9	46.9	-10.5	-19.4
0.661	32.9	19.2	9.9	0.3	43.1	29.4	56.0	46.0	-12.9	-16.6
3.907	30.9	20.7	10.3	0.4	41.6	31.4	56.0	46.0	-14.4	-14.6
13.648	37.4	30.4	10.7	0.9	49.0	42.0	60.0	50.0	-11.0	-8.0
14.821	29.3	22.6	10.7	0.9	40.9	34.2	60.0	50.0	-19.1	-15.8
26.960	27.4	15.7	10.9	2.7	41.0	29.3	60.0	50.0	-19.0	-20.7
28.250	21.6	11.7	10.9	2.9	35.5	25.6	60.0	50.0	-24.5	-24.4

PHASE / L1 (LISN 2)										
Frequency (MHz)	**Level QP (dBµV)**	**Level AVG (dBµV)**	**Cable Loss (dB)**	**LISN Corr (dB)**	**Level QP Corr (dBµV)**	**Level Avg Corr (dBµV)**	**Limit QP (dBµV)**	**Limit AVG (dBµV)**	**Margin QP (dB)**	**Margin AVG (dB)**
0.201	45.7	37.0	9.9	0.3	56.0	47.3	63.6	53.6	-7.6	-6.3
0.270	44.3	34.8	9.9	0.3	54.5	45.1	61.1	51.1	-6.6	-6.1
0.332	36.5	25.5	9.9	0.3	46.7	35.7	59.4	49.4	-12.7	-13.7
0.490	26.2	9.5	9.9	0.3	36.4	19.7	56.2	46.2	-19.8	-26.5
1.942	32.8	19.8	10.1	0.3	43.1	30.1	56.0	46.0	-12.9	-15.9
13.615	27.6	20.8	10.7	0.7	39.0	32.2	60.0	50.0	-21.0	-17.8
20.640	23.8	16.8	10.8	1.0	35.6	28.6	60.0	50.0	-24.4	-21.4
29.478	28.5	21.7	10.9	2.8	42.2	35.4	60.0	50.0	-17.8	-14.6