FCC & ISED CANADA CERTIFICATION TEST REPORT

FOR THE

DCR006A JOBSITE BLUETOOTH SPEAKER

FCC ID: YJ7DCR006AB

IC ID: 9082A-DCR006AB

WLL REPORT # 18902-01 REV 0

Prepared for:

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701 E. Joppa Road
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Prepared By:

Washington Laboratories, Ltd.
4840 Winchester Boulevard. Suite 5
Frederick, Maryland 21703

Testing Certificate AT-1448

FCC & ISED Canada Certification Test Report

for the

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July 22, 2025

WLL Report# 18902-01 Rev 0

Prepared by:

Ryan Mascaro
RF Test Engineer

Reviewed by:

Samuel Violette
Vice President

Abstract

This report has been prepared on behalf of Stanley Black & Decker, Inc. to support the attached application for a 2.4GHz Bluetooth Transmitter. The test report and application are submitted for a Frequency Hopping Spread Spectrum (FHSS) Transmitter under Part 15.247 of the FCC Rules and under Innovation Science and Economic Development (ISED) Canada RSS-247, Issue 3 (8/2023). This test report documents the test configuration and test results for the Stanley Black & Decker, Inc., DCR006A Jobsite Bluetooth Speaker. The information provided in this report is only applicable to the device herein documented, as the EUT.

Radiated emissions testing above 30MHz was performed in the Free-space Anechoic Chamber Test-site (FACT) 3m Chamber of Washington Laboratories, Ltd., located at 4840 Winchester Blvd. Suite 5. Frederick, Maryland 21703. 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 has been accepted by the FCC and approved by the ANSI-ASQ National Accreditation Board (ANAB) under Certificate AT-1448, as an independent test laboratory. Washington Laboratories and the test data provided herein are accredited and meet the requirements of ISO/IEC 17025. The Washington Laboratories, Ltd. is recognized by ISED Canada under testing laboratory number 3035A.

The Stanley Black & Decker, Inc., DCR006A Jobsite Bluetooth Speaker complies with the requirements for a FHSS Bluetooth Transmitter under Part 15.247 of the FCC Rules and under Innovation Science and Economic Development (ISED) Canada RSS-247, Issue 3 (8/2023).

Revision History	Description of Change	Date
Rev 0	Initial Release	July 22, 2025

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1 Introduction

1.1 Compliance Statement

The Stanley Black & Decker, Inc., DCR006A Jobsite Bluetooth Speaker complies with the requirements for a FHSS Bluetooth Transmitter under Part 15.247 of the FCC Rules and under Innovation Science and Economic Development (ISED) Canada RSS-247, Issue 3 (8/2023).

1.2 Test Scope

Tests for radiated and conducted (at antenna terminal) emissions were performed. All measurements were performed in accordance with the 2020 version C63.10 "ANSI Procedures for Compliance Testing of Unlicensed Wireless Devices". The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation. Table 1 provides the series and results of testing for compliance, with full test results provided in subsequent report sub-sections.

1.3 Testing Algorithm

For certification, the DCR006A Jobsite Bluetooth Speaker was provided to the test laboratory, in two sample configurations: (1) a conducted (at the antenna port) sample and (2) a wireless radiated sample (PCB trace antenna). Both EUT samples were controlled through a support laptop interface. Prior to all testing, the transmitter power was set/fixed (via software) to the desired power setting, indicated by a numerical value of "3". This setting was maintained for all testing. The EUT was tested in a manner that produced the worst-case emission levels, which are provided in the test results data section(s) of this report. For testing of AC powerline emissions, and radiated emissions below 1GHz, the BT transmitter was set to hop/sweep the ISM band. For radiated spurious testing above 1GHz, the EUT was set to transmit at the low, center, and high channels. Only the worst-case emissions are reported.

1.4 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. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Testing Certificate AT-1448 as an independent test laboratory. The Washington Laboratories, Ltd. ISED Canada number is 3035A.

1.5 Contract Information

Customer:	Stanley Black & Decker, Inc.
Purchase Order Number:	M868924
Quotation Number:	74835

1.6 Test and Support Personnel

Washington Laboratories, LTD	Ryan Mascaro and Richard Quarcoo
Customer Representative	Kirwan Magdamo

1.7 Test Dates

6/10/2025 to 7/10/2025 (also see Section 5 of this report)

1.8 Customer Supplied Data or EUT Information

Please note that the applicant has provided the information on the transmitting antenna (type and gain). The test laboratory is not responsible for verifying the accuracy of this information.

1.9 Software Employed by the Test Laboratory

The following test and measurement software were used by the Laboratory:

(1) Amplifier Research, EMCWare Software Suite v7.0.4

(2) Keysight 2019, Update Rev. A.25.08

(3) Keysight 2023, Update Rev. A.33.03

1.10 Deviations to the Standard or Test Plan

There were no deviations to the requirements of the standard(s).

2 Equipment Under Test

2.1 EUT Identification & Description

The EUT is a portable Bluetooth stereo audio system with Bluetooth 5.0 Simplex mode (BDR/EDR). It is powered by an AC-to-DC power adapter or an external Li-ion battery. Its main functions are Bluetooth audio playing (A2DP), audio-in, USB charging. The Bluetooth module is Rayson BTM-A2819 with a PCB meander line antenna. The DCR006A uses the 2.4GHz ISM band for communication, in the frequency range 2402MHz to 2480MHz, spread spectrum. The EUT does not support BLE.

2.2 Test Configuration

The EUT was evaluated and tested under the following input power scenarios: AC/DC power adapter only, Battery Only 20VDC, and AC/DC power adapter with 20V battery docked to the EUT simultaneously. During all testing, the USB (port 7) and auxiliary port (port 6) of the EUT were populated with use-case cabling. The support laptop was not introduced onto the testing site.

Figure 1: EUT Diagram (Example Only)

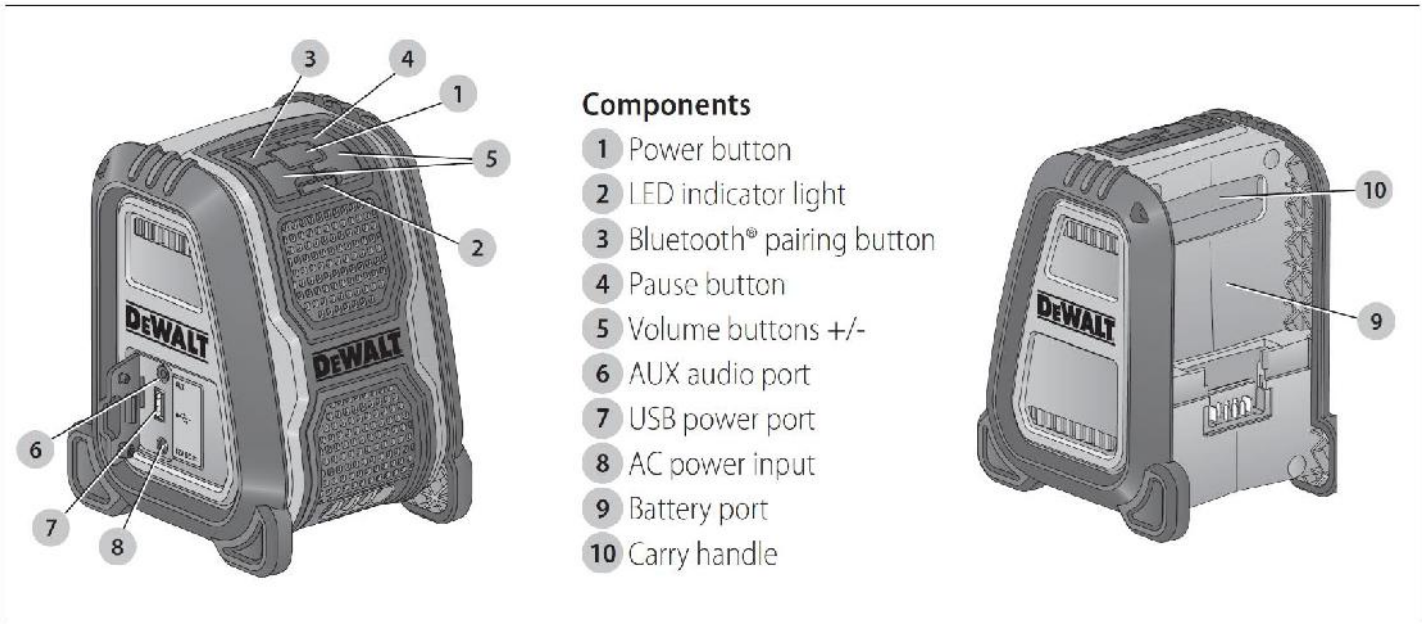


Table 1: EUT Device Summary

Manufacturer and Applicant:	Stanley Black & Decker, Inc.
FCC ID:	YJ7DCR006AB
IC ID:	9082A-DCR006AB
HVIN:	PQ2D
Serial Number of Unit Tested:	*Not Specified*
FCC Rule Part:	§15.247
TX Frequency Range:	2402 MHz to 2480 MHz
Maximum Peak Output Power:	2.40 dBm (0.00174 Watts)
Tune-Up Tolerance:	±0.5dB
TX Antenna Type:	PCB Trace, Meander Line (Peak Gain: +1.54dBi)
20dB Bandwidth:	1327.0 kHz
99% Bandwidth:	1188.7 kHz
Modulation:	GFSK, π/4DQPSK, 8DPSK
Date Rate:	1Mbps, 2Mbps, 3Mbps,
Number of Channels:	79
FCC Emission Designator:	1M33F1D
ISED Emission Designator:	1M19F1D
Keying:	Automatic
Protocol and Timing:	Source Based
Type of Information:	Bluetooth 5.0
Transmitting Category:	Mobile
Highest Spurious Emission:	4.960GHz, 47.04 dBuV/m AVG
EUT Power Source & Voltage:	Primary: 120VAC, 60Hz (AC/DC Adapter)
	Secondary: 12VDC or 20VDC (battery pack)

Table 2: EUT Device Configuration List

EUT Description	Model	Part Number	Serial Number	Revision
Bluetooth Speaker	DCR006A	N/A	N/A	N/A

Table 3: EUT Port and Cable Configuration

Ref. ID	EUT Port Name	Cable/Port Description	Qty.	Length (meters)	Shielded	Termination
8	AC/DC PWR Input	AC-DC adapter cord	1	1.8	No	120VAC
6	AUX	*No cable provided at POS*	0	N/A	N/A	N/A
7	USB	*No cable provided at POS*	0	N/A	N/A	N/A
9	Battery	*No battery provided at POS*	0	N/A	N/A	N/A

Table 4: Support Equipment

Item	Description for Test Mode	SW Name/Version
Laptop	Support Only to Fix Frequencies	N/A
USB-UART cable	Software to Control EUT	Actions/BT-FCCv2.21

3 Test Results

Table 5: Certification Testing Summary

FCC Rule Part	ISED Canada Rule Part	Test Description	Result
15.247(b)(1)	RSS-247; 5.4(b)	Transmit Output Power	Pass
15.247(a)(1) 2.1049	RSS-247; 5.1(a)	Channel Occupied Bandwidth	Pass
15.247 (a)(1)(iii)	RSS-247; 5.1(d)	Number of Channels Used	Pass
15.247 (a)(1)(iii)	RSS-247; 5.1(d)	Time of Occupancy (Dwell Time)	Pass
15.247(a)(1)	RSS-247; 5.1(b)	Channel Carrier Separation	Pass
15.247(d) DA 00-705	RSS-247; 5.5	Band edge Compliance (20dB)	Pass
15.247(d)	RSS-247; 5.5	Conducted Spurious Emissions	Pass
15.205(a) 15.209(a)	RSS-Gen; 8.9 RSS-Gen; 8.10	General Field Strength Requirements	Pass
15.205	RSS-Gen; 6.8	Antenna Requirement	Pass †
15.207	RSS-Gen; 8.8	AC Powerline Conducted Emissions	Pass

† the EUT employs a PCB meander trace antenna, the EUT does not have an antenna connector.

3.1 Transmitter Output Power

For frequency hopping systems operating in the 2400MHz to 2483.5MHz band employing at least 75 non-overlapping hopping channels, the maximum conducted output power (measured at the antenna port) shall not exceed 30 dBm (1 Watt).

3.1.1 Measurement Method and Results

This test was performed as specified in ANSI C63.10 (2020), Section 7.8.5.

The EUT was configured in a fully modulated mode, with the hopping stopped.

The EUT employs a PCB trace antenna with a maximum gain of +1.54 dBi.

2.40 + 1.54 = 3.94 dBm EIRP (calculated), which is far below the 4W limit.

Table 6: Antenna Port Conducted, Transmitter Output Power Test Results

Input Voltage	Modulation Mode (Data Rate)	Channel Frequency (MHz)	Peak Output Power (dBm)
AC/DC Adapter	BDR, DH5 (1Mbps) GFSK	2402 MHz	-0.67
		2440 MHz	-1.48
		2480 MHz	-1.11
AC/DC Adapter	EDR, 2DH5 (2Mbps) π/4DQPSK	2402 MHz	1.80
		2440 MHz	1.00
		2480 MHz	1.39
AC/DC Adapter	EDR, 3DH5 (3Mbps) 8DPSK	2402 MHz	2.28
		2440 MHz	1.51
		2480 MHz	1.96
20VDC Battery	BDR, DH5 (1Mbps) GFSK	2402 MHz	-0.55
		2440 MHz	-1.45
		2480 MHz	-1.09
20VDC Battery	EDR, 2DH5 (2Mbps) π/4DQPSK	2402 MHz	1.88
		2440 MHz	1.09
		2480 MHz	1.42
20VDC Battery	EDR, 3DH5 (3Mbps) 8DPSK	2402 MHz	**2.40**
		2440 MHz	1.61
		2480 MHz	1.92

Figure 2: Peak Conducted Output Power, 1Mbps, AC/DC Adapter

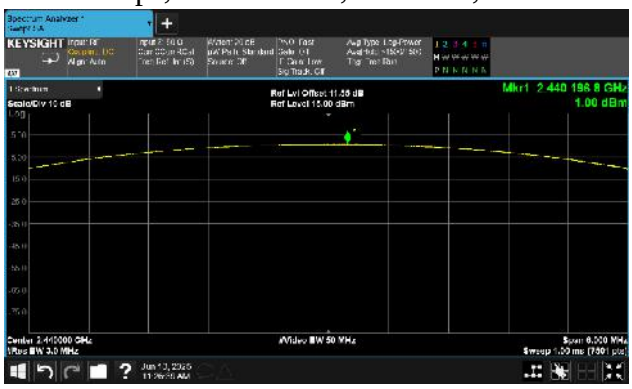
1Mbps, Center Chan, 120VAC, PWR

1Mbps, High Chan, 120VAC, PWR

1Mbps, Low Chan, 120VAC, PWR

Figure 3: Peak Conducted Output Power, 2Mbps, AC/DC Adapter

2Mbps, Center Chan, 120VAC, PWR



2Mbps, High Chan, 120VAC, PWR

2Mbps, Low Chan, 120VAC, PWR

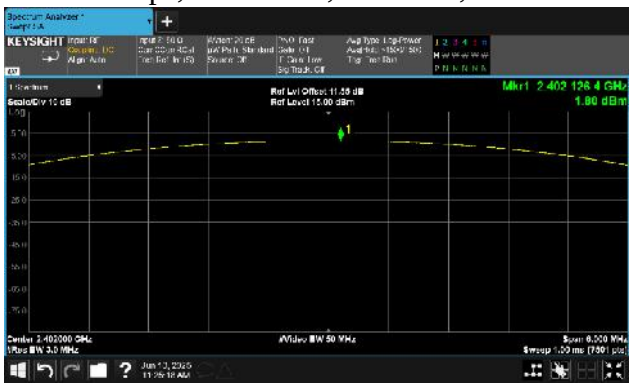


Figure 4: Peak Conducted Output Power, 3Mbps, AC/DC Adapter

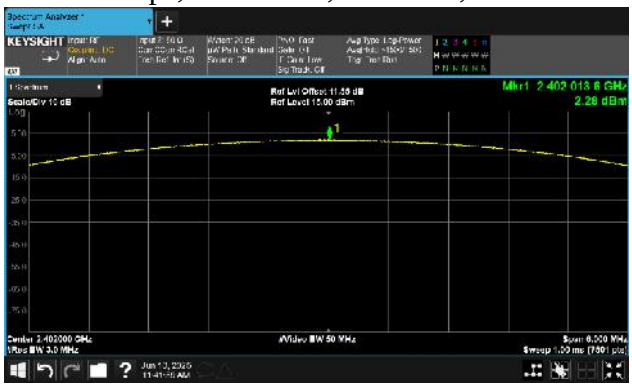
3Mbps, Center Chan, 120VAC, PWR 	3Mbps, High Chan, 120VAC, PWR 
3Mbps, Low Chan, 120VAC, PWR 	

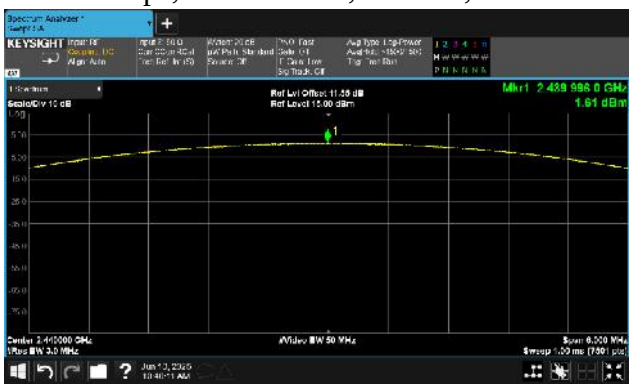
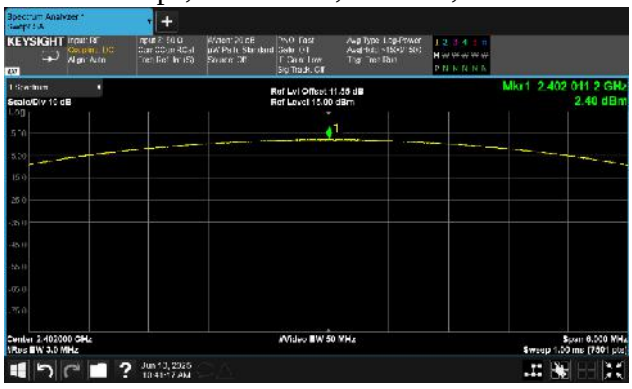
Figure 5: Peak Conducted Output Power, 1Mbps, 20V Battery

1Mbps, Center Chan, 20VDC, PWR 	1Mbps, High Chan, 20VDC, PWR 
1Mbps, Low Chan, 20VDC, PWR 	

Figure 6: Peak Conducted Output Power, 2Mbps, 20V Battery

2Mbps, Center Chan, 20VDC, PWR 	2Mbps, High Chan, 20VDC, PWR 
2Mbps, Low Chan, 20VDC, PWR 	

Figure 7: Peak Conducted Output Power, 3Mbps, 20V Battery

3Mbps, Center Chan, 20VDC, PWR 	3Mbps, High Chan, 20VDC, PWR 
3Mbps, Low Chan, 20VDC, PWR 	

3.2 Channel Occupied Bandwidth

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

3.2.1 Measurement Method and Results

This test was performed as specified in ANSI C63.10 (2020), Section 7.8.6.

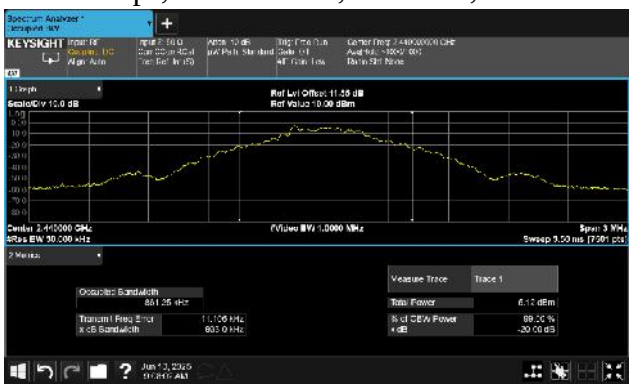
The EUT was configured in a fully modulated mode, with the hopping stopped.

Table 7: Channel Occupied Bandwidth Test Results

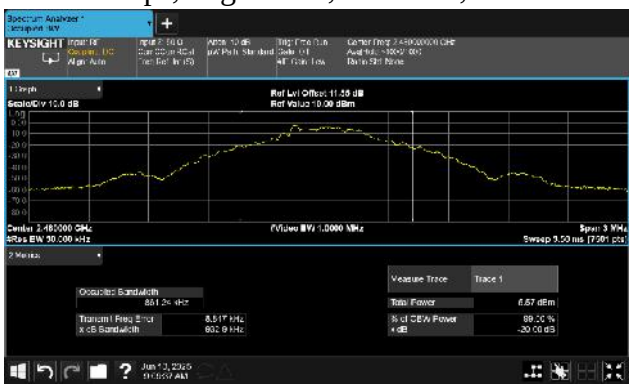
Input Voltage	Modulation Mode (Data Rate)	Channel Frequency (MHz)	20dB OBW (kHz)	99% OBW (kHz)
AC/DC Adapter	BDR, DH5 (1Mbps) GFSK	2402 MHz	932.3	858.74
		2440 MHz	933.0	861.25
		2480 MHz	932.9	861.24
AC/DC Adapter	EDR, 2DH5 (2Mbps) π/4DQPSK	2402 MHz	1324.0	1187.7
		2440 MHz	**1327.0**	1182.0
		2480 MHz	1285.0	1180.5
AC/DC Adapter	EDR, 3DH5 (3Mbps) 8DPSK	2402 MHz	1284.0	1180.2
		2440 MHz	1286.0	1182.0
		2480 MHz	1285.0	1180.5
20VDC Battery	BDR, DH5 (1Mbps) GFSK	2402 MHz	932.4	859.86
		2440 MHz	933.5	862.92
		2480 MHz	935.0	863.83
20VDC Battery	EDR, 2DH5 (2Mbps) π/4DQPSK	2402 MHz	1326.0	1188.6
		2440 MHz	1325.0	1188.7
		2480 MHz	1326.0	**1188.7**
20VDC Battery	EDR, 3DH5 (3Mbps) 8DPSK	2402 MHz	1283.0	1181.4
		2440 MHz	1285.0	1180.7
		2480 MHz	1284.0	1180.4

Figure 8: Channel Occupied Bandwidth, 1Mbps, AC/DC Adapter

1Mbps, Center Chan, 120VAC, OBW



1Mbps, High Chan, 120VAC, OBW



1Mbps, Low Chan, 120VAC, OBW

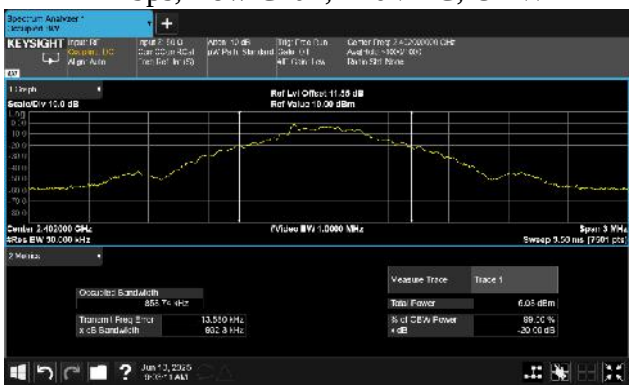
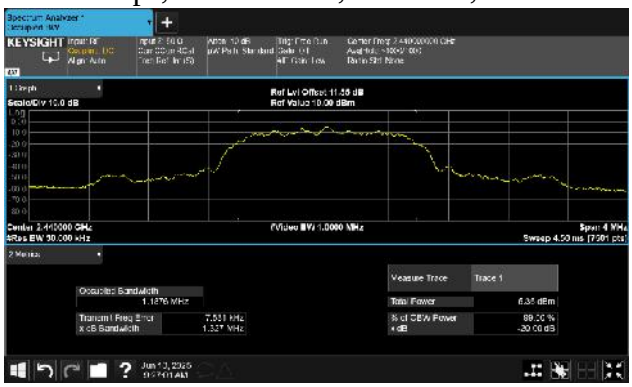
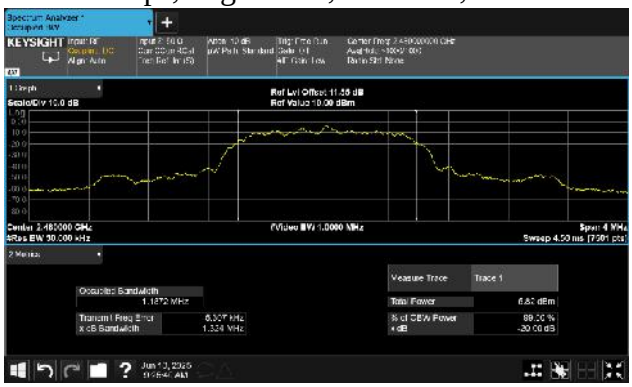


Figure 9: Channel Occupied Bandwidth, 2Mbps, AC/DC Adapter

2Mbps, Center Chan, 120VAC, OBW



2Mbps, High Chan, 120VAC, OBW



2Mbps, Low Chan, 120VAC, OBW

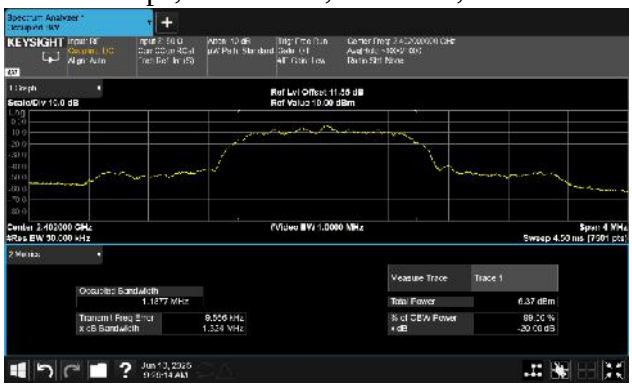
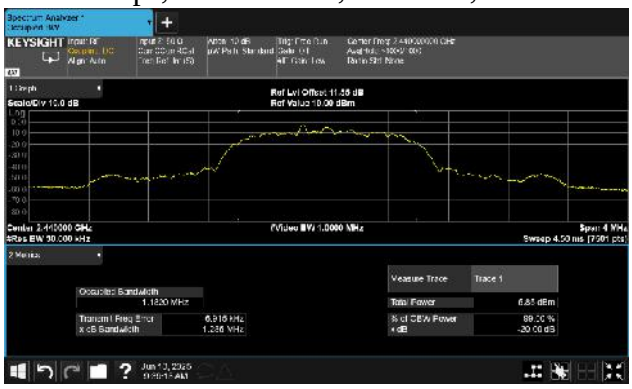
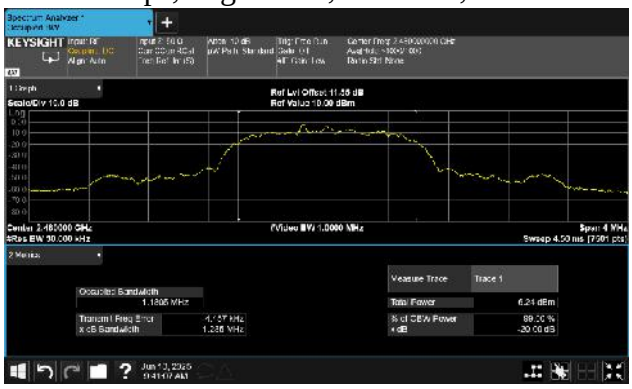


Figure 10: Channel Occupied Bandwidth, 3Mbps, AC/DC Adapter

3Mbps, Center Chan, 120VAC, OBW



3Mbps, High Chan, 120VAC, OBW



3Mbps, Low Chan, 120VAC, OBW

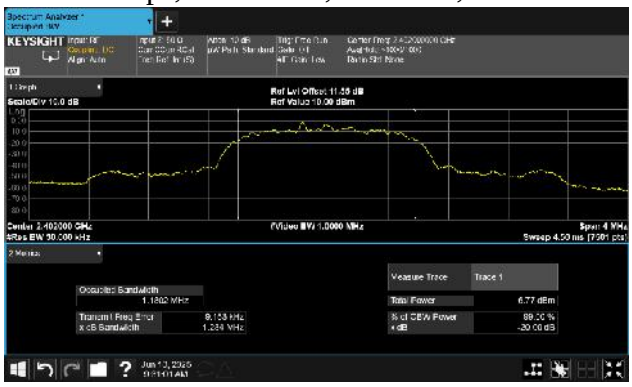
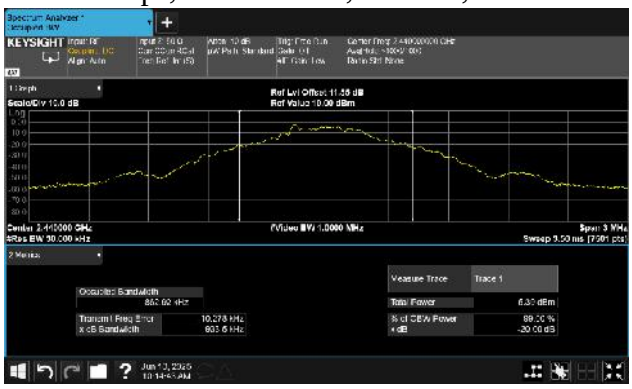
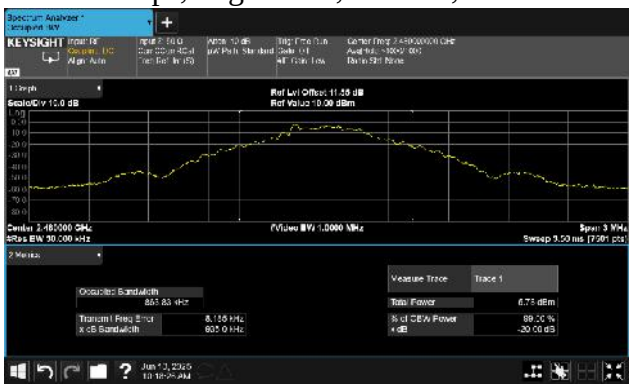


Figure 11: Channel Occupied Bandwidth, 1Mbps, 20V Battery

1Mbps, Center Chan, 20VDC, OBW



1Mbps, High Chan, 20VDC, OBW



1Mbps, Low Chan, 20VDC, OBW

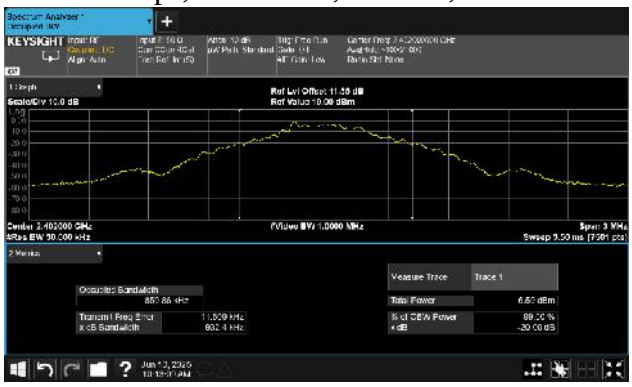
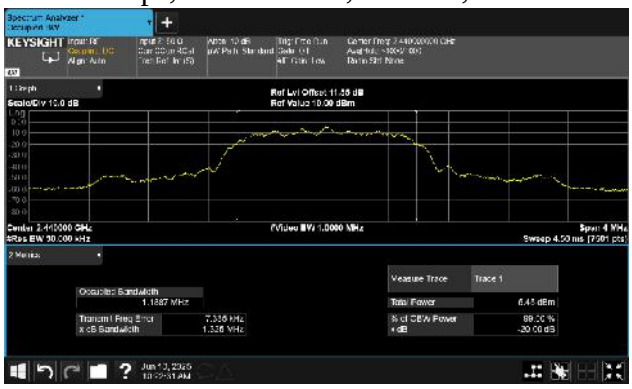
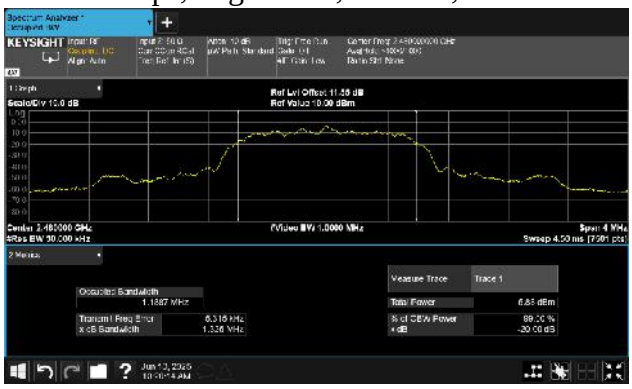


Figure 12: Channel Occupied Bandwidth, 2Mbps, 20V Battery

2Mbps, Center Chan, 20VDC, OBW



2Mbps, High Chan, 20VDC, OBW



2Mbps, Low Chan, 20VDC, OBW

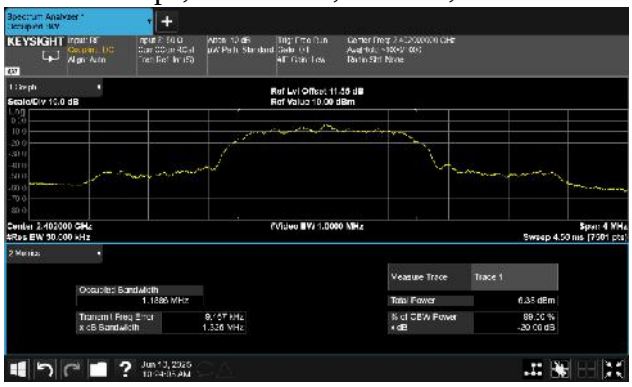
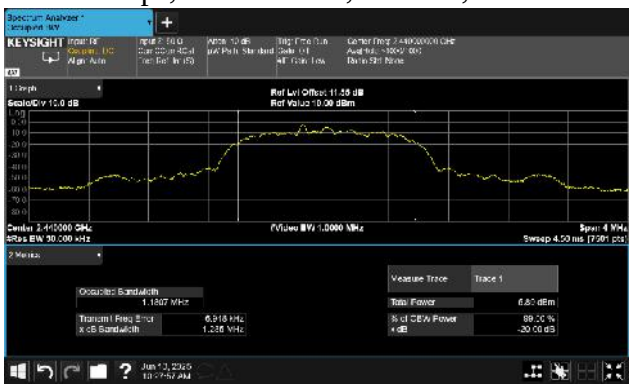
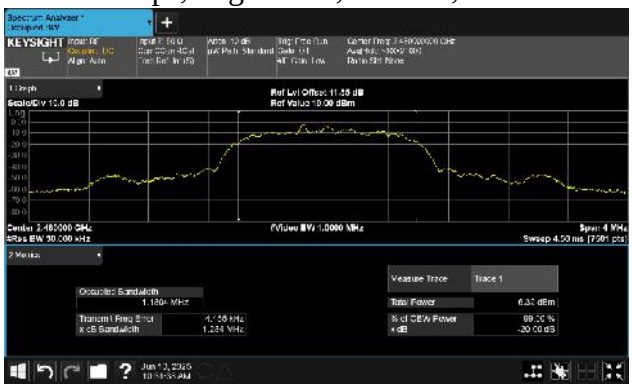


Figure 13: Channel Occupied Bandwidth, 3Mbps, 20V Battery

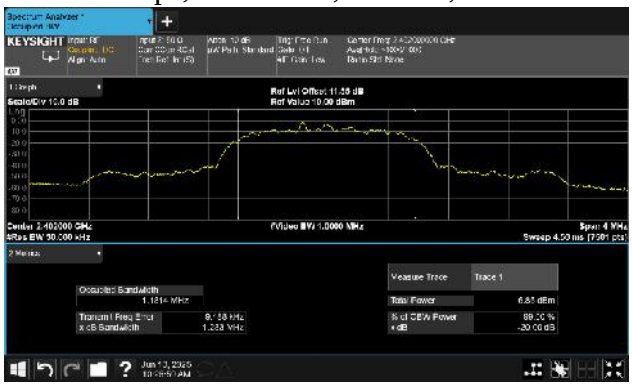
3Mbps, Center Chan, 20VDC, OBW



3Mbps, High Chan, 20VDC, OBW



3Mbps, Low Chan, 20VDC, OBW



3.3 Number of Channels Used

Frequency hopping systems in the 2400 MHz to 2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 400 ms within a period of 400 ms multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

3.3.1 Measurement Method and Results

This test was performed as specified in ANSI C63.10 (2020), Section 7.8.1 and 7.8.3

The EUT was configured in a fully modulated mode, with the hopping enabled.

Table 8: Number of Channels Used Test Results

Modulation	Mode (Data Rate)	EUT Channels Used	Requirement
GFSK	BDR, DH5 (1Mbps)	79 Channels	15 Channels
π/4DQPSK	EDR, 2DH5 (2Mbps)	79 Channels	15 Channels
8DPSK	EDR, 3DH5 (3Mbps)	79 Channels	15 Channels

Figure 14: All Data Modes, Number of Channels Used, Plot 1

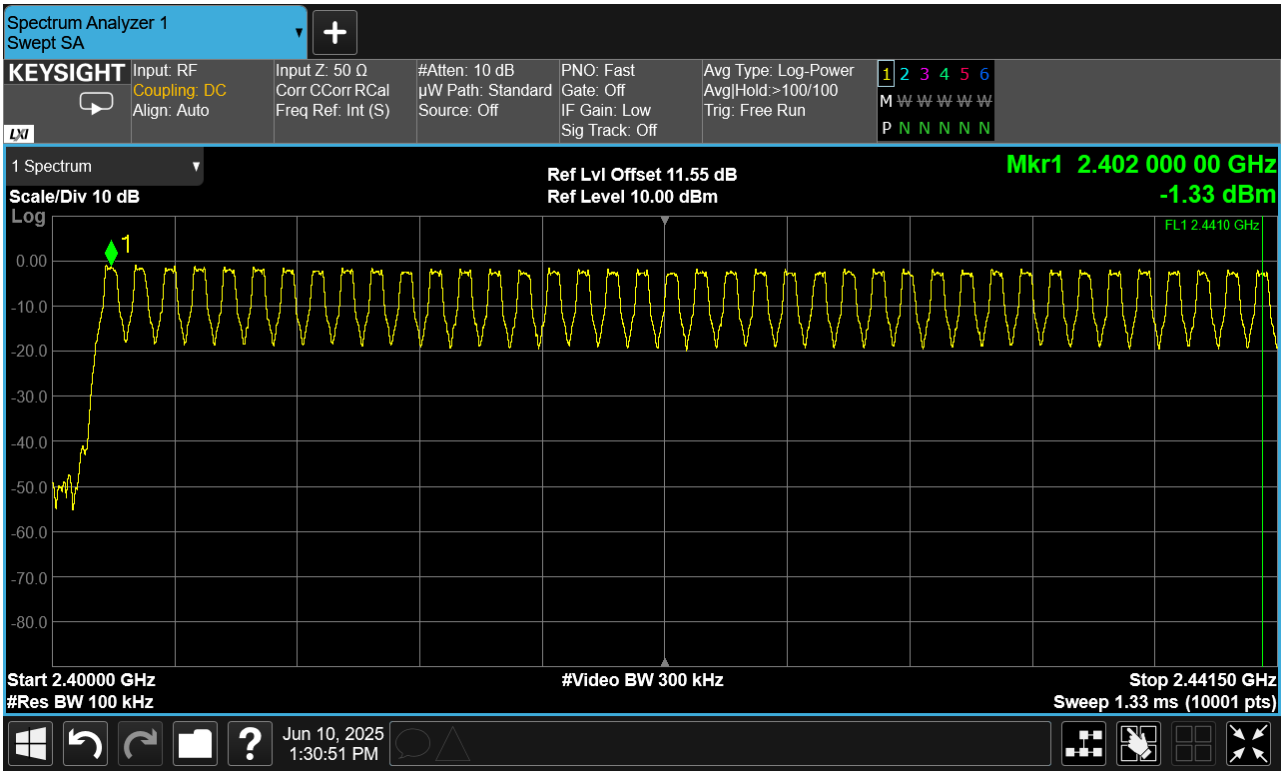
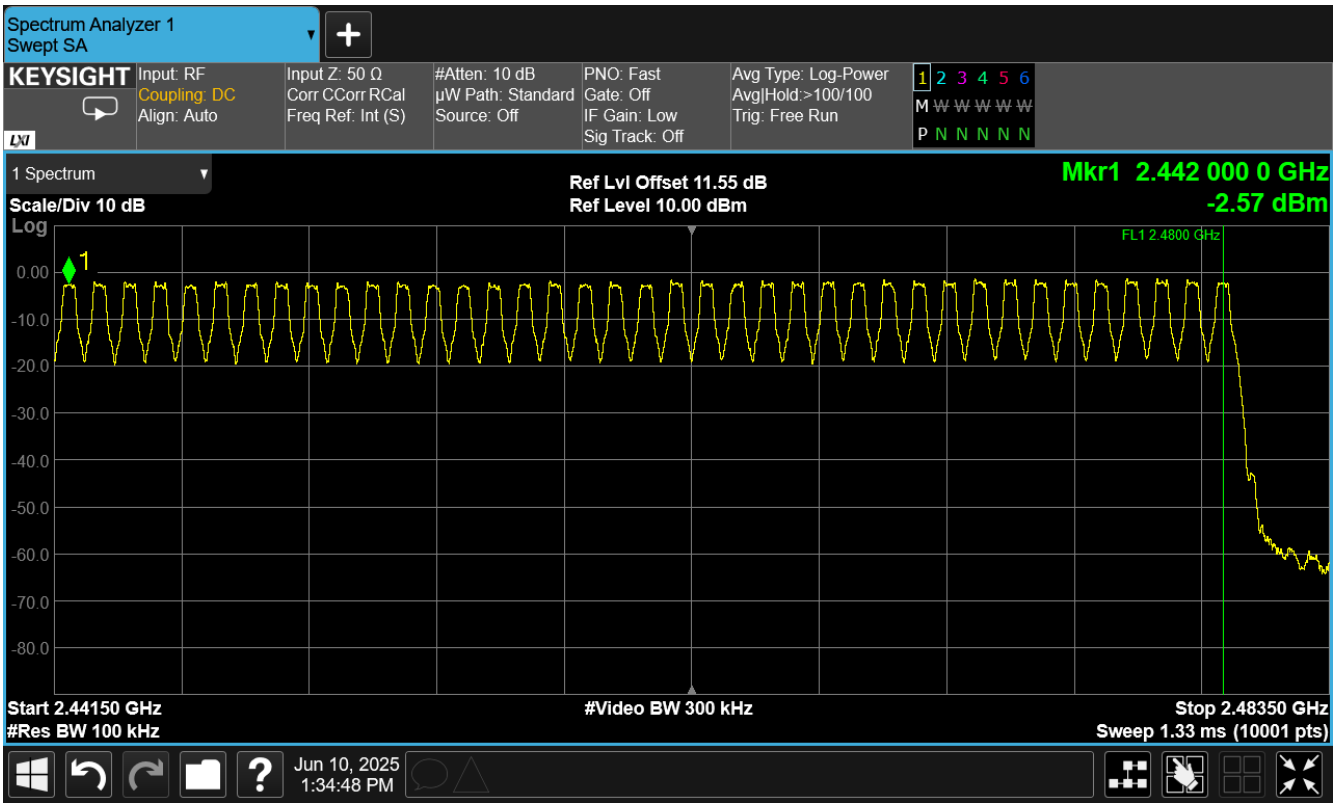


Figure 15: All Data Modes, Number of Channels Used, Plot 2



3.4 Time of Occupancy (Dwell Time)

Frequency hopping systems in the 2400 MHz to 2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 400 ms within a period of 400 ms multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

3.4.1 Measurement Method and Results

This test was performed as specified in ANSI C63.10 (2013), Section 7.8.4.

The EUT was configured in a fully modulated mode, with the hopping enabled.

The limits for this section are as follows:

79_{CHAN} * 0.4 second = 31.6 second period

Time of Occupancy Limit = 0.4s/31.6s

A multiplier factor of 6.32 shall be employed to extrapolate the total average time of occupancy of any channel over a 31.6 second period. This factor is based on a 5 second transmitter evaluation.

5 * 6.32 = 31.6

Table 9: Time of Occupancy Test Results

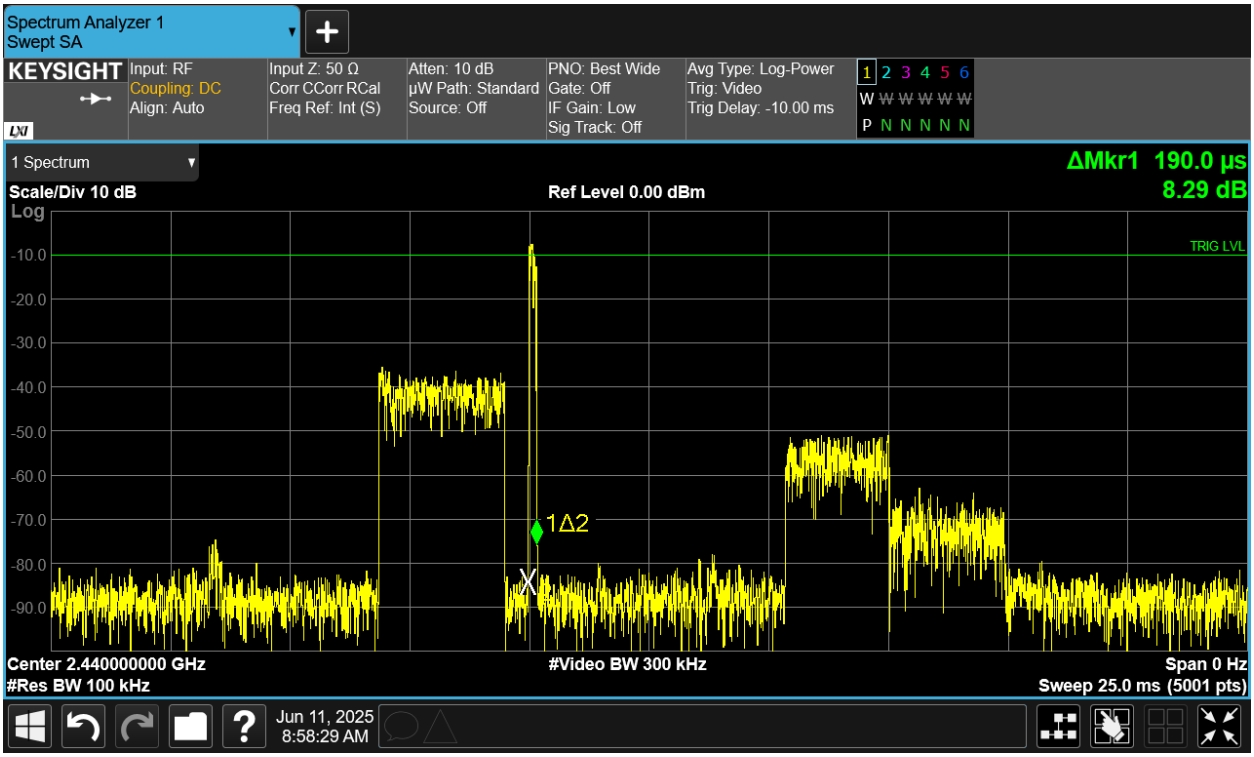
EUT Transmitter	Transmissions in 5 seconds	Transmissions in 31.6 seconds	Single Transmission Period	EUT Occupancy Result	Occupancy Limit
All Modes	29	184.15	190 uS	34.99 mS	400 mS

Please note that the EUT was evaluated at all data rates and input voltages. The low, center, and high channels were investigated. The test results are identical for all modes and channels. The worst-case average time of occupancy is 34.99 mS in any period of 400 mS.

Figure 16: All Data Modes, Time of Occupancy, Plot 1

* in any mode, there are 29 full-power transmitter hops in a given 5-second evaluation period.

Figure 17: All Data Modes, Time of Occupancy, Plot 2



* a single full-power transmitter hop measures 190.0 us

3.5 Channel Carrier Separation

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400 MHz to 2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. Each frequency must be used equally on the average by each transmitter.

3.5.1 Measurement Method and Results

This test was performed as specified in ANSI C63.10 (2020), Section 7.8.2

The EUT was configured in a fully modulated mode, with the hopping enabled.

All of the hopping channel carriers are separated by exactly 1.0 MHz, regardless of position in the band.

The minimum separation requirement is based on two-thirds of the 20dB occupied bandwidth because the EUT transmitter output power is less than 125 mW.

Table 10: Channel Carrier Separation Test Results

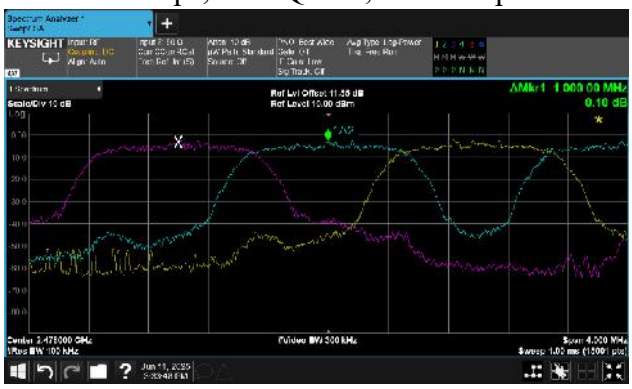
EUT Transmitter	Worst-Case 20dB OBW	Minimum Separation Requirement	EUT Carrier Separation Result
All Modes	1.327 MHz	884.7 kHz	1.0 MHz

Please note that the EUT was evaluated at all data rates and input voltages. The low, center, and high channels were investigated, and a few other random channels that the transmitter employs. The test results are identical for all modes and channels. All hopping channel carriers are separated by exactly 1.0 MHz.

Figure 18: All Data Modes, Channel Separation Results

1Mbps, GFSK, Chan. Sep.

2Mbps, π/4DQPSK, Chan. Sep.



3Mbps, 8DPSK, Chan. Sep.

3.6 Bandedge Compliance (Antenna Port Conducted)

In any 100 kHz bandwidth, outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

3.6.1 Measurement Method and Results

This test was performed as specified in ANSI C63.10 (2020), Section 7.8.7.2

The EUT was configured in a fully modulated mode. The EUT was investigated in both a hopping enabled mode and a hopping disabled mode. The deviation in the results between the hopping modes is negligible. The worst-case data is provided below.

Table 11: Antenna Port Conducted, Bandedge Test Results

Modulation	Mode (Data Rate)	Low Channel (2402 MHz)	High Channel (2480 MHz)
GFSK	BDR, DH5 (1Mbps)	45.49 dB	57.40 dB
π/4DQPSK	EDR, 2DH5 (2Mbps)	43.48 dB	58.06 dB
8DPSK	EDR, 3DH5 (3Mbps)	44.25 dB	57.52 dB

Figure 19: GFSK (1Mbps), Band Edge Test Results

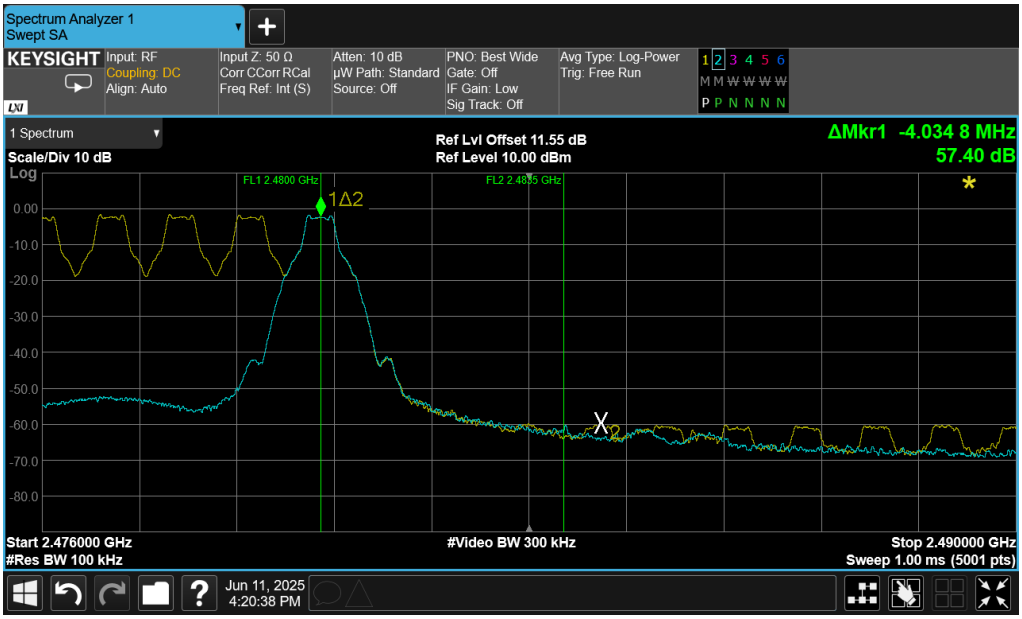
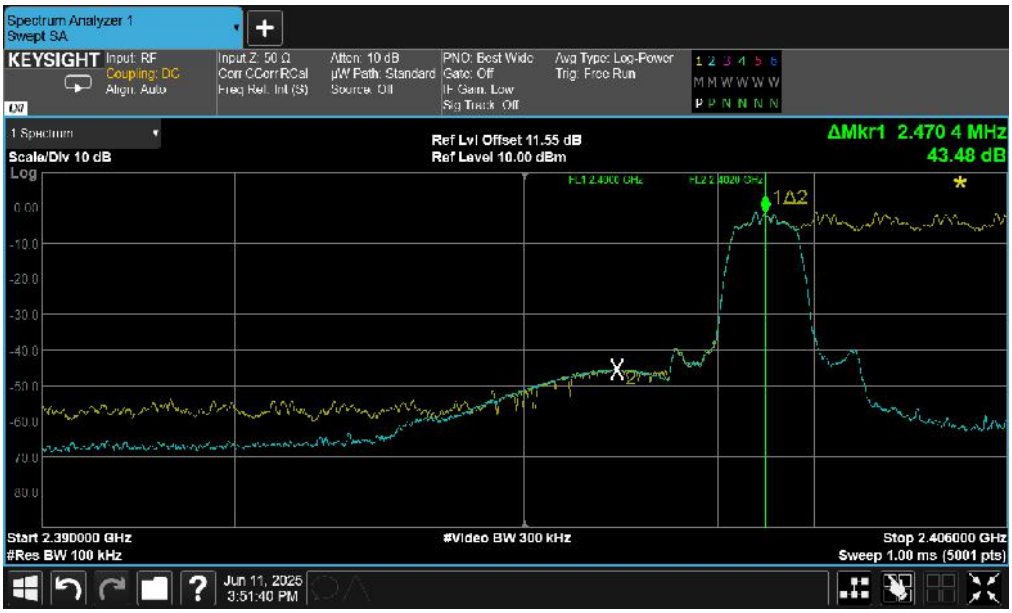


Figure 20: π/4DQPSK (2Mbps), Band Edge Test Results



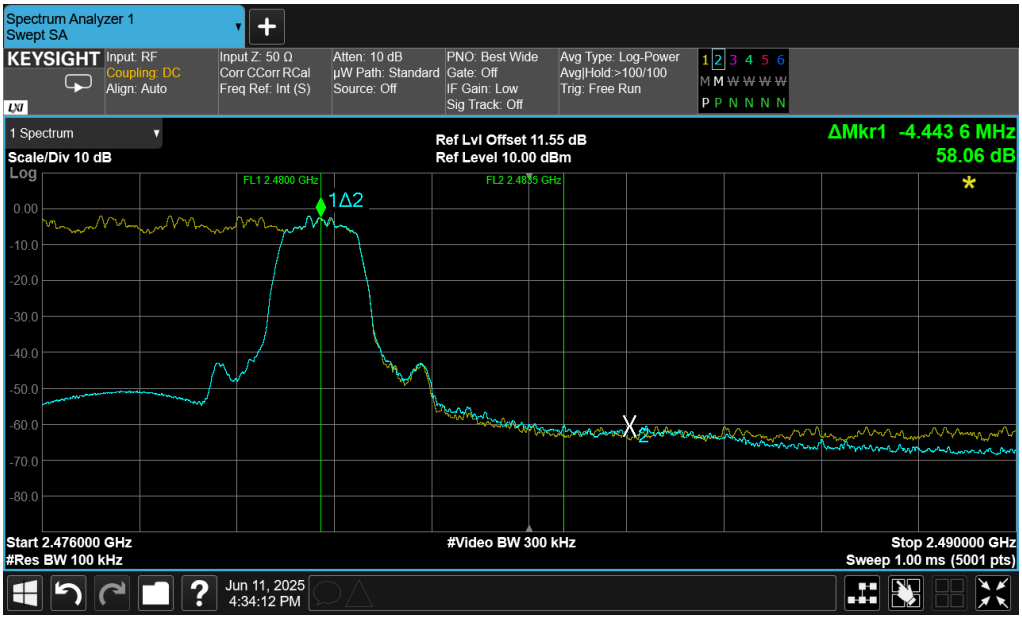
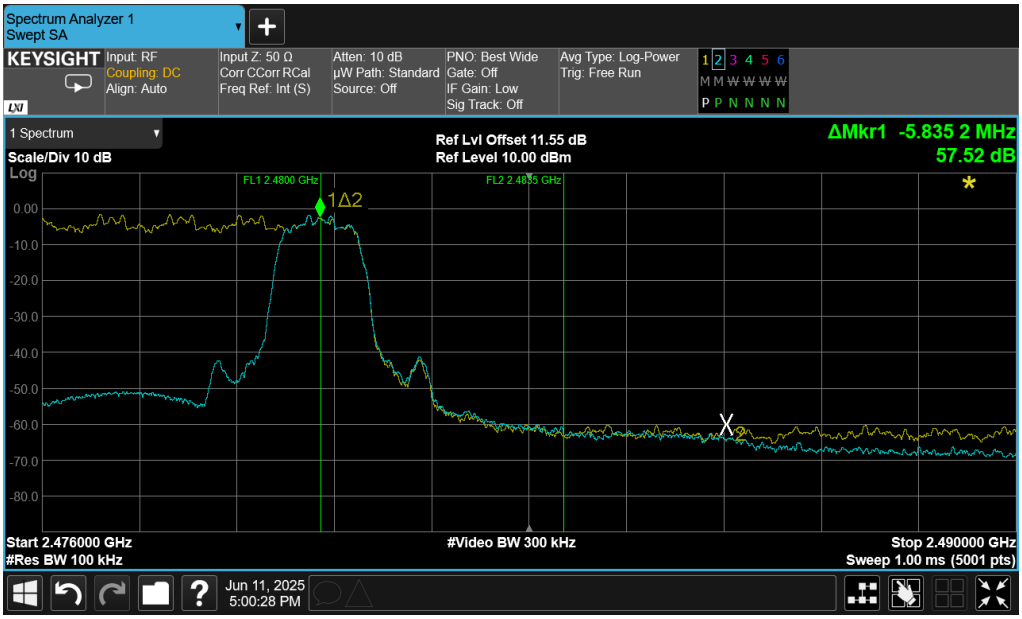


Figure 21: 8DPSK (3Mbps), Band Edge Test Results



3.7 Conducted Spurious Emissions

In any 100 kHz bandwidth, outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

3.7.1 Measurement Method and Results

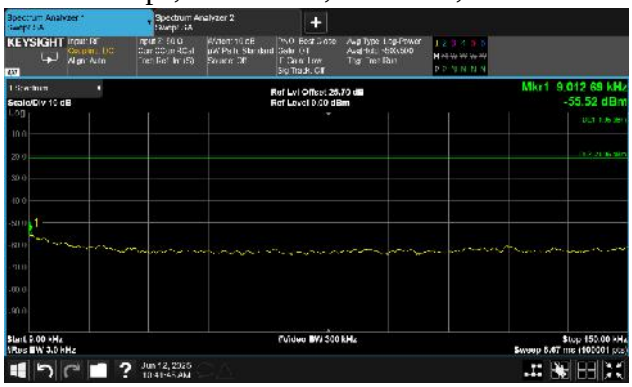
This test was performed as specified in ANSI C63.10 (2020), Section 7.8.7 and 11.11. The EUT was configured in a fully modulated mode, with the hopping stopped. The amplitude of the EUT carrier was measured to determine the emissions limit (20 dB below the carrier frequency amplitude). The emissions outside of the allocated frequency band were then scanned from 9kHz to 25GHz, which covers the 10th harmonic of the fundamental. The EUT was evaluated at all data rates and input voltages. The low, center, and high channels were investigated. The test results are very comparable for all modes and channels. The EUT is fully compliant and meets the requirements for spurious emissions at the antenna port.

Table 12: Antenna Port Conducted, Spurious Emissions Results Summary

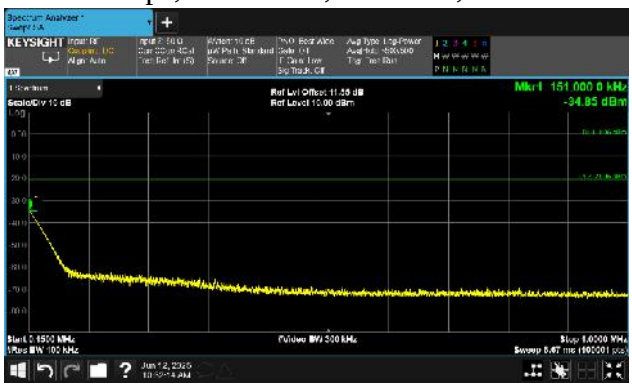
Input Voltage	Modulation Mode (Data Rate)	Channel Frequency (MHz)	Investigated and Scanned	Result
AC/DC Adapter	BDR, DH5 (1Mbps) GFSK	2402 MHz	Yes	Compliant
		2440 MHz	Yes	Compliant
		2480 MHz	Yes	Compliant
AC/DC Adapter	EDR, 2DH5 (2Mbps) π/4DQPSK	2402 MHz	Yes	Compliant
		2440 MHz	Yes	Compliant
		2480 MHz	Yes	Compliant
AC/DC Adapter	EDR, 3DH5 (3Mbps) 8DPSK	2402 MHz	Yes	Compliant
		2440 MHz	Yes	Compliant
		2480 MHz	Yes	Compliant
20VDC Battery	BDR, DH5 (1Mbps) GFSK	2402 MHz	Yes	Compliant
		2440 MHz	Yes	Compliant
		2480 MHz	Yes	Compliant
20VDC Battery	EDR, 2DH5 (2Mbps) π/4DQPSK	2402 MHz	Yes	Compliant
		2440 MHz	Yes	Compliant
		2480 MHz	Yes	Compliant
20VDC Battery	EDR, 3DH5 (3Mbps) 8DPSK	2402 MHz	Yes	Compliant
		2440 MHz	Yes	Compliant
		2480 MHz	Yes	Compliant

Figure 22: Conducted Spurious Emissions, Low Channel, 1Mbps, AC/DC Adapter

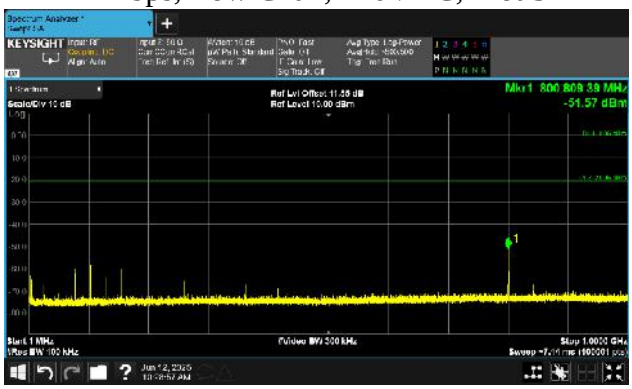
1Mbps, Low Chan, 120VAC, Plot 1



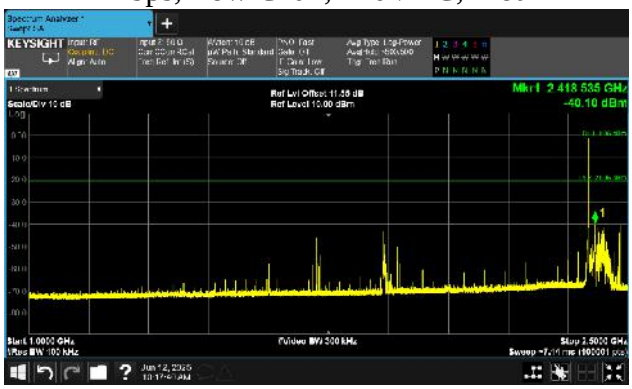
1Mbps, Low Chan, 120VAC, Plot 2



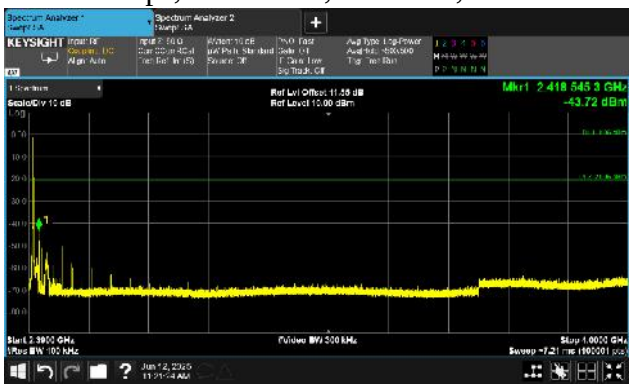
1Mbps, Low Chan, 120VAC, Plot 3



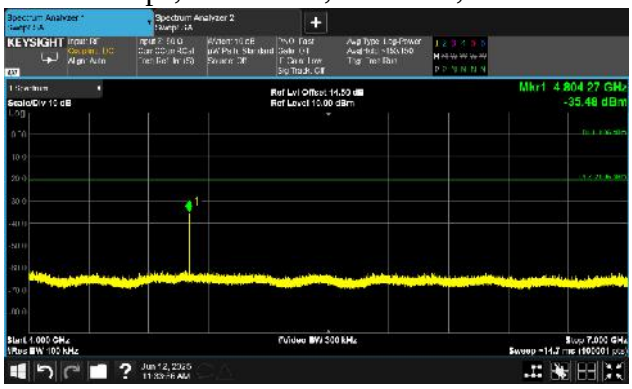
1Mbps, Low Chan, 120VAC, Plot 4



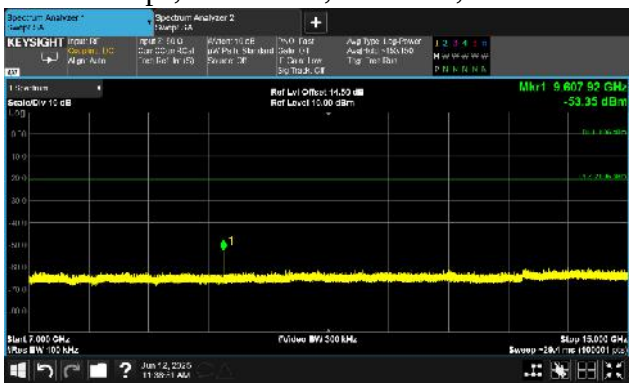
1Mbps, Low Chan, 120VAC, Plot 5



1Mbps, Low Chan, 120VAC, Plot 6



1Mbps, Low Chan, 120VAC, Plot 7



1Mbps, Low Chan, 120VAC, Plot 8

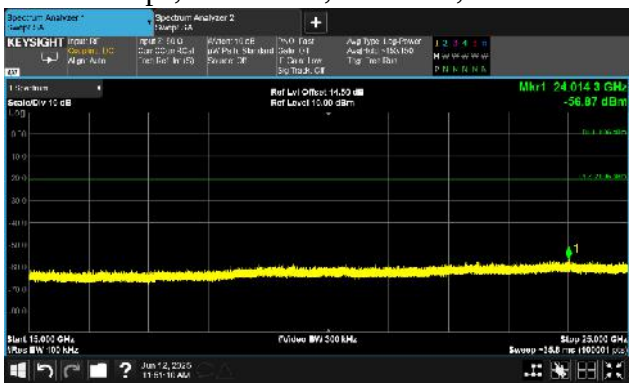
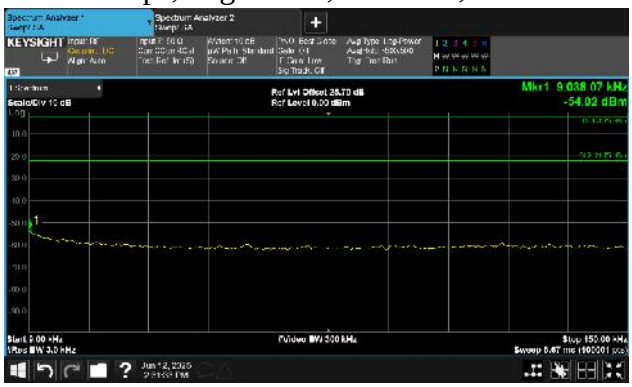
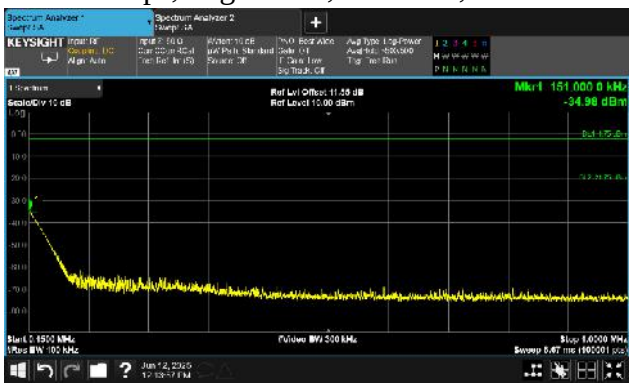


Figure 23: Conducted Spurious Emissions, High Channel, 1Mbps, AC/DC Adapter

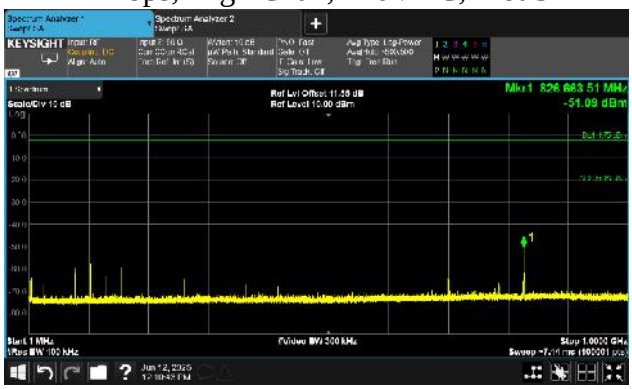
1Mbps, High Chan, 120VAC, Plot 1



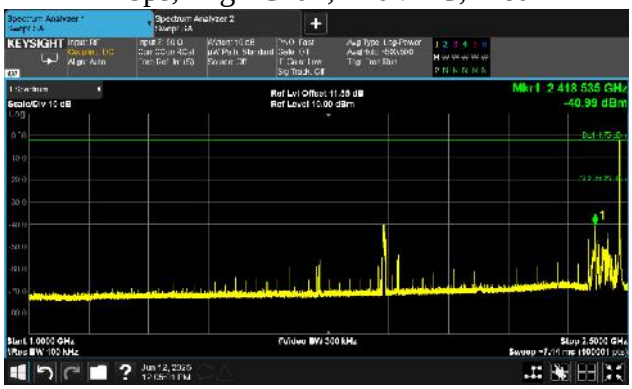
1Mbps, High Chan, 120VAC, Plot 2



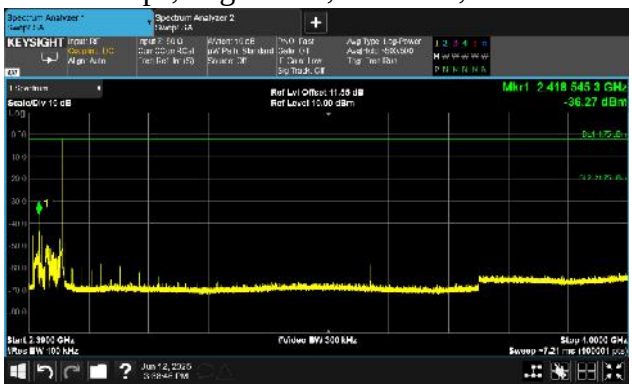
1Mbps, High Chan, 120VAC, Plot 3



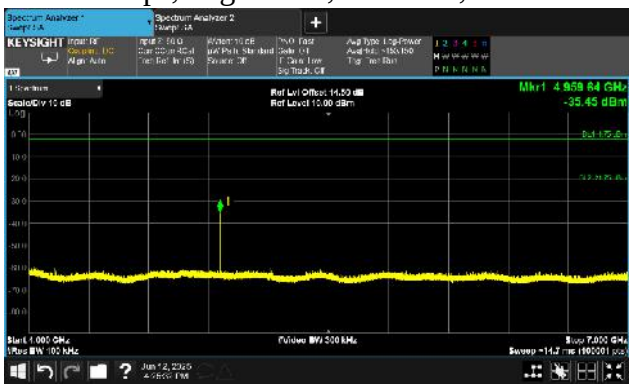
1Mbps, High Chan, 120VAC, Plot 4



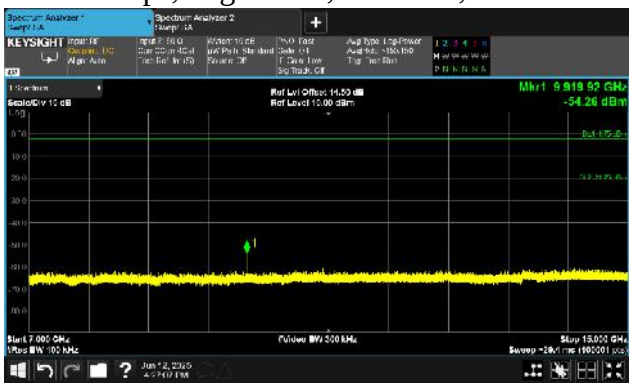
1Mbps, High Chan, 120VAC, Plot 5



1Mbps, High Chan, 120VAC, Plot 6



1Mbps, High Chan, 120VAC, Plot 7



1Mbps, High Chan, 120VAC, Plot 8

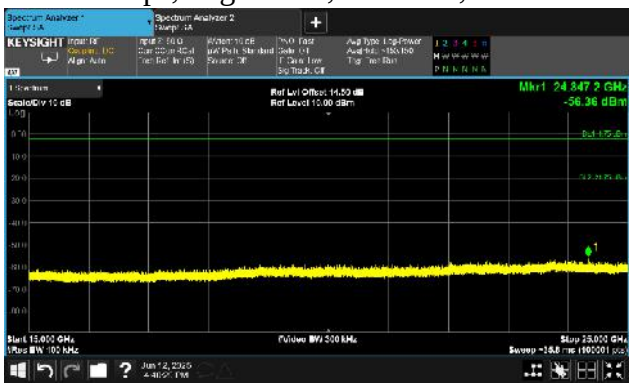
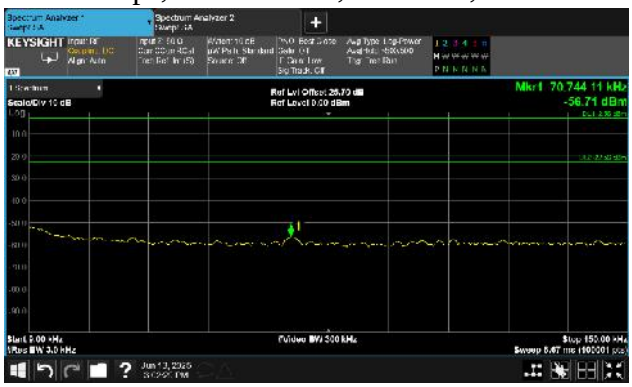
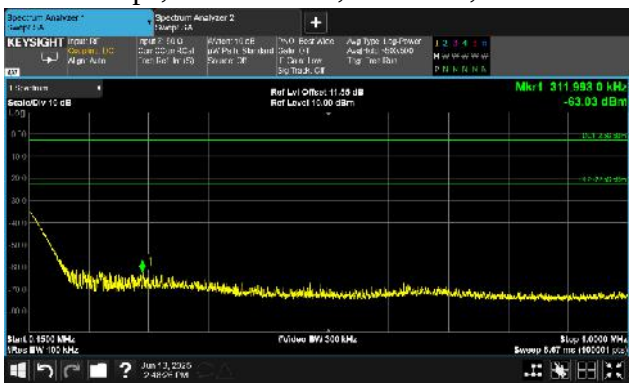


Figure 24: Conducted Spurious Emissions, Center Channel, 2Mbps, AC/DC Adapter

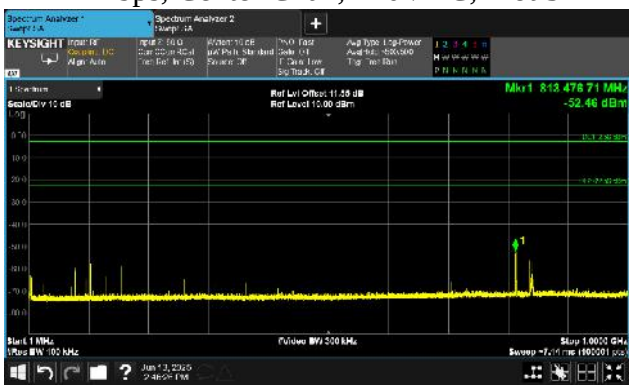
2Mbps, Center Chan, 120VAC, Plot 1



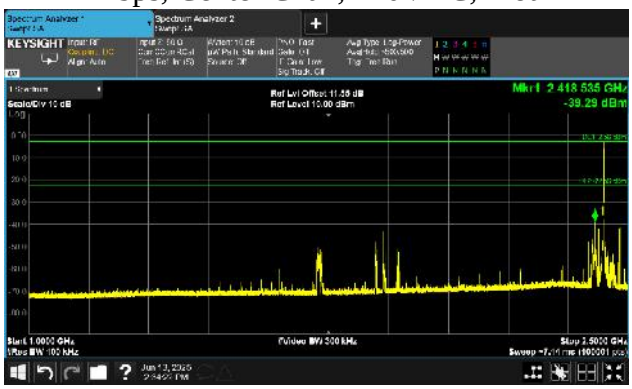
2Mbps, Center Chan, 120VAC, Plot 2



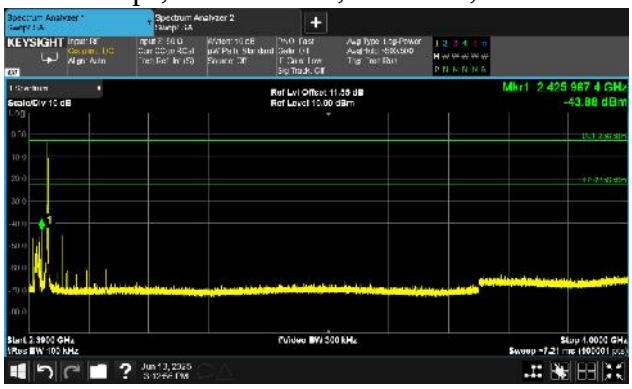
2Mbps, Center Chan, 120VAC, Plot 3



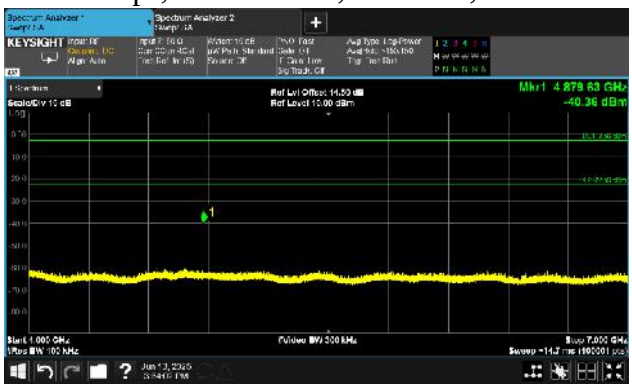
2Mbps, Center Chan, 120VAC, Plot 4



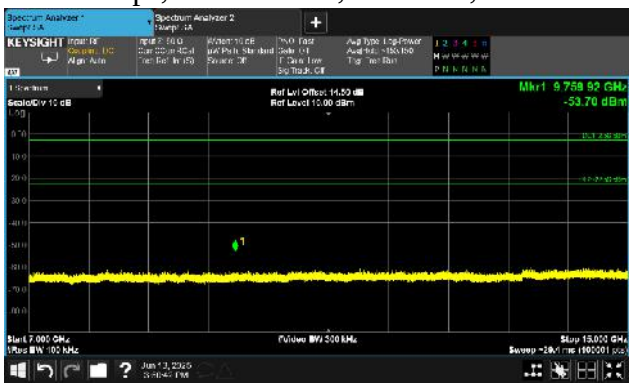
2Mbps, Center Chan, 120VAC, Plot 5



2Mbps, Center Chan, 120VAC, Plot 6



2Mbps, Center Chan, 120VAC, Plot 7



2Mbps, Center Chan, 120VAC, Plot 8

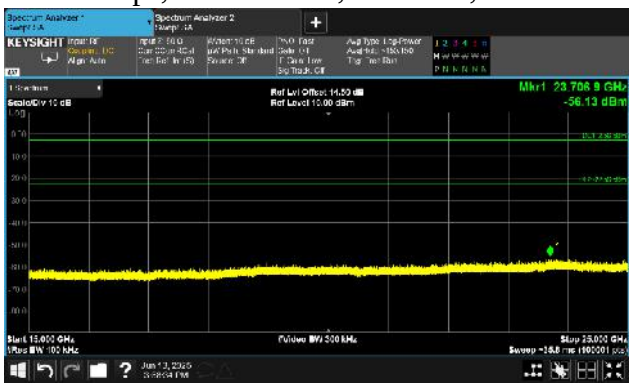
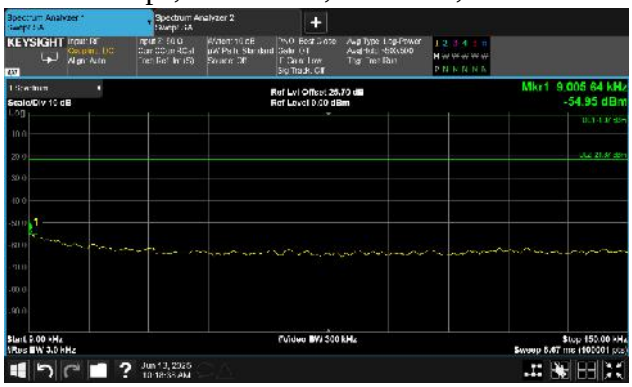
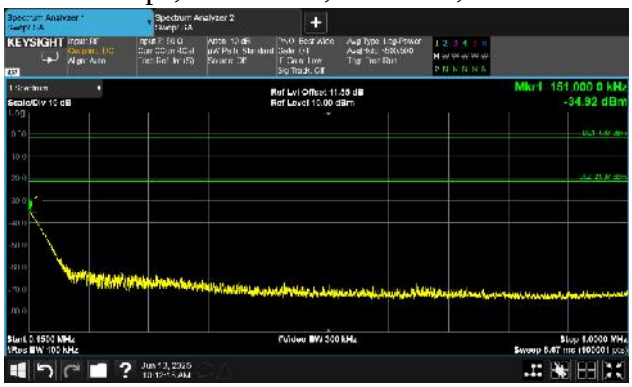
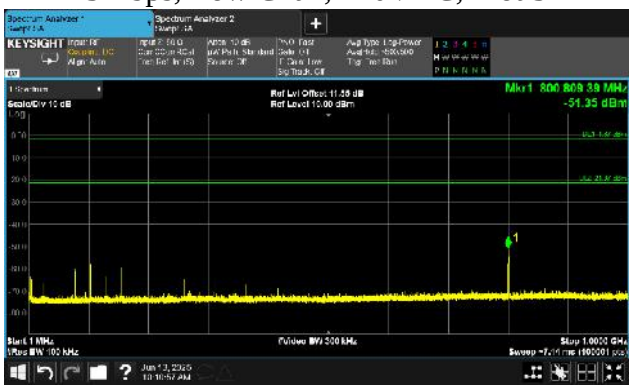
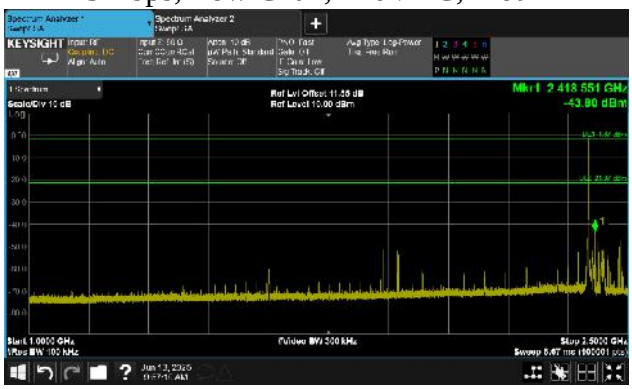
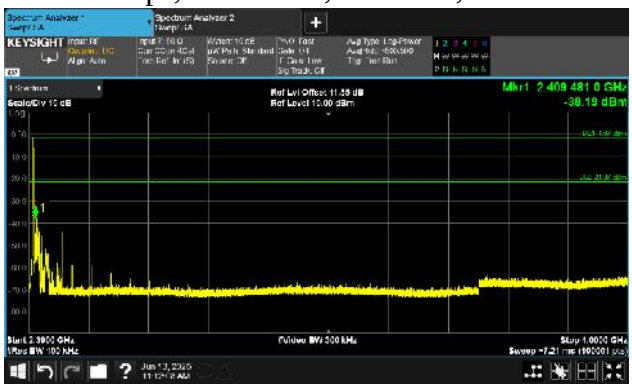


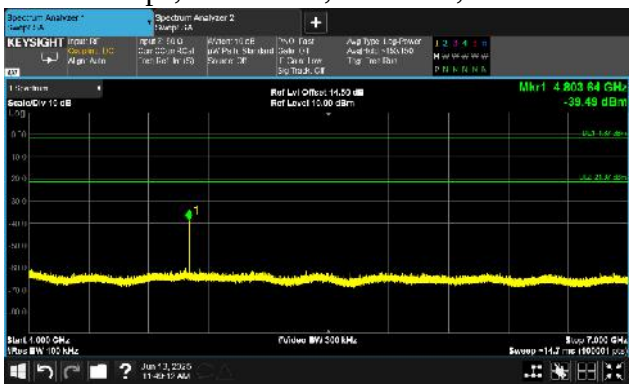
Figure 25: Conducted Spurious Emissions, Low Channel, 3Mbps, AC/DC Adapter

3Mbps, Low Chan, 120VAC, Plot 1	3Mbps, Low Chan, 120VAC, Plot 2
	
3Mbps, Low Chan, 120VAC, Plot 3	3Mbps, Low Chan, 120VAC, Plot 4
	

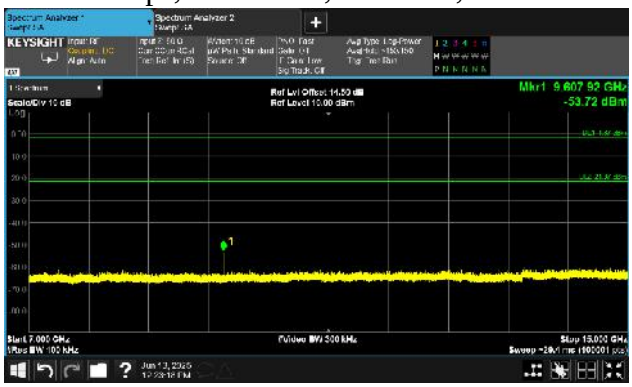
3Mbps, Low Chan, 120VAC, Plot 5



3Mbps, Low Chan, 120VAC, Plot 6



3Mbps, Low Chan, 120VAC, Plot 7



3Mbps, Low Chan, 120VAC, Plot 8

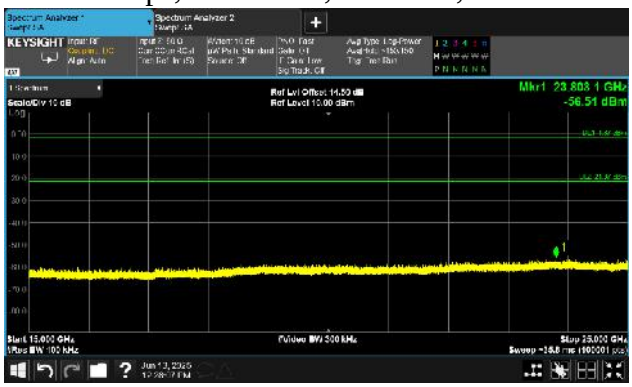
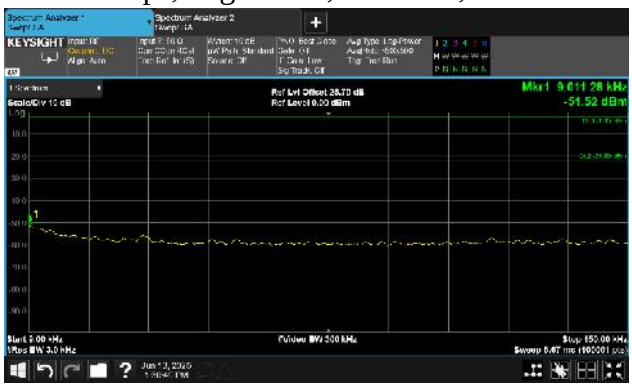
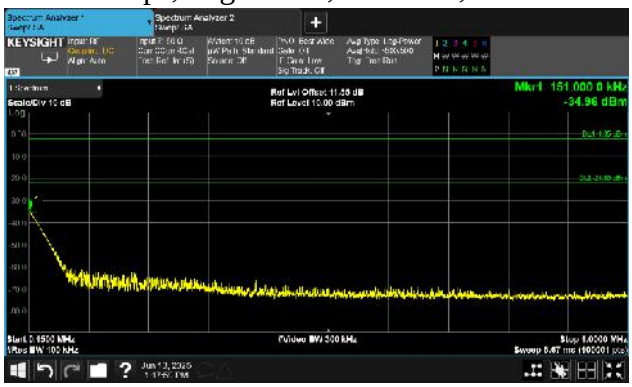
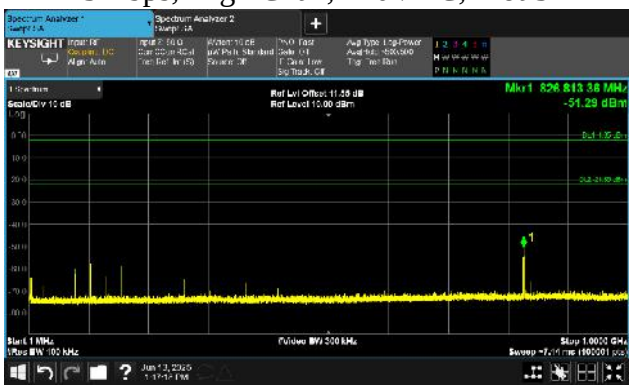
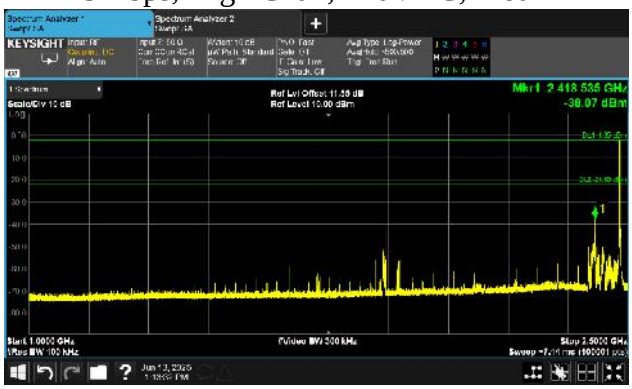
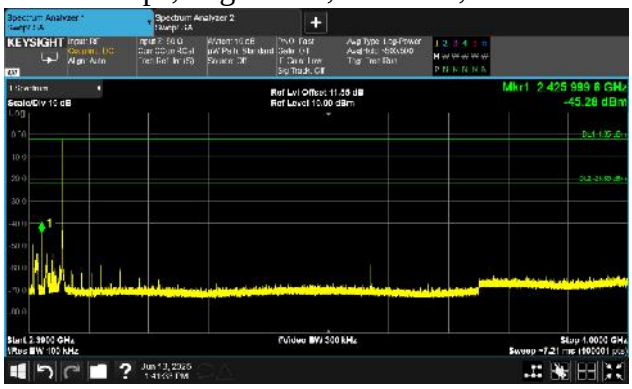


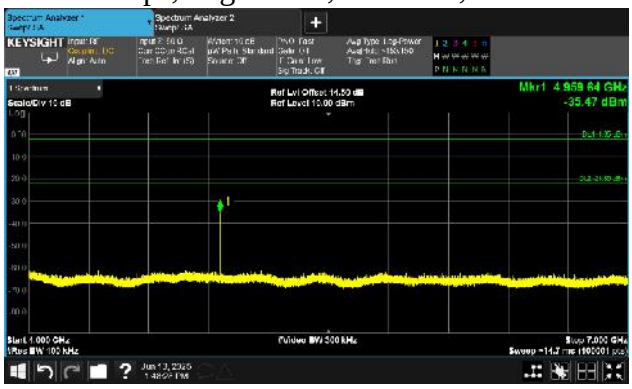
Figure 26: Conducted Spurious Emissions, High Channel, 3Mbps, AC/DC Adapter

3Mbps, High Chan, 120VAC, Plot 1	3Mbps, High Chan, 120VAC, Plot 2
	
3Mbps, High Chan, 120VAC, Plot 3	3Mbps, High Chan, 120VAC, Plot 4
	

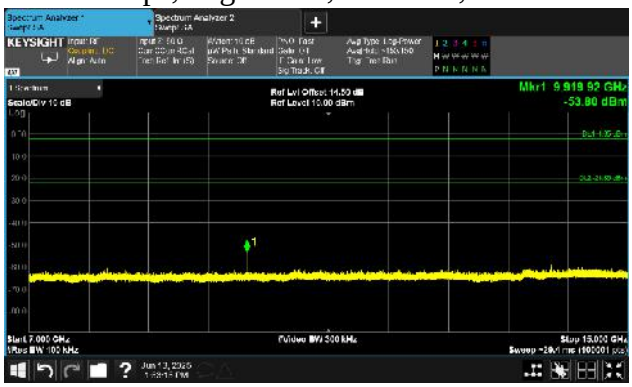
3Mbps, High Chan, 120VAC, Plot 5



3Mbps, High Chan, 120VAC, Plot 6



3Mbps, High Chan, 120VAC, Plot 7



3Mbps, High Chan, 120VAC, Plot 8

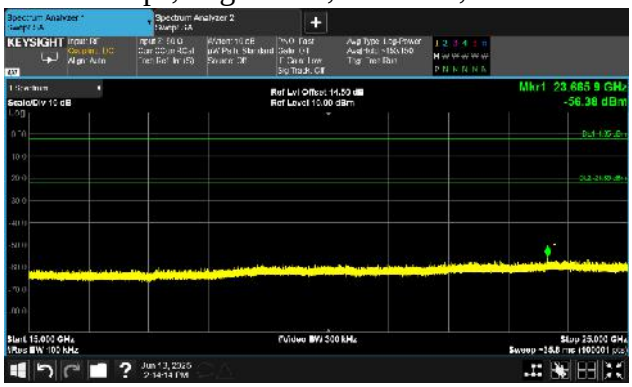
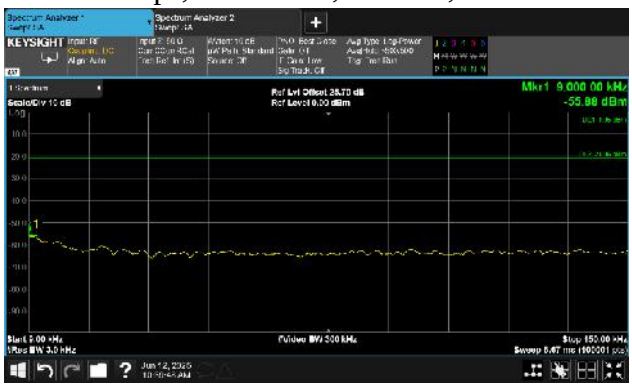
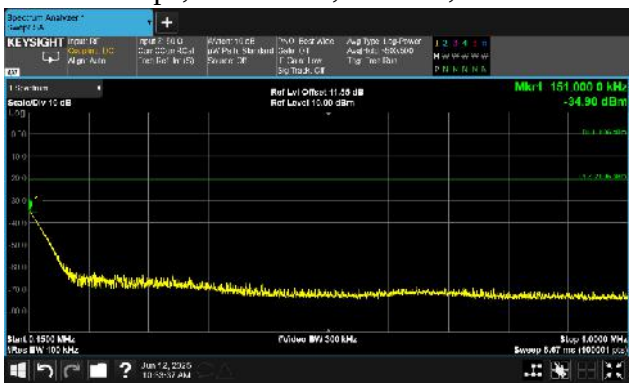
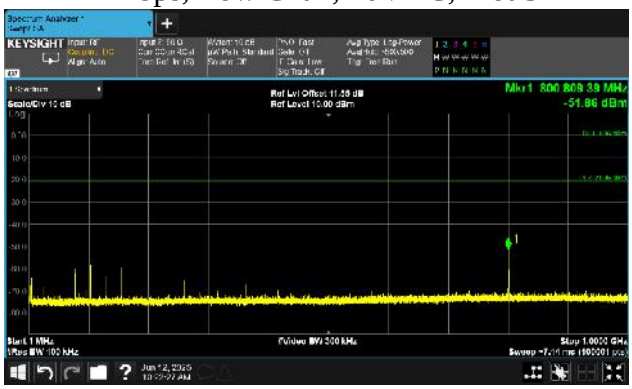
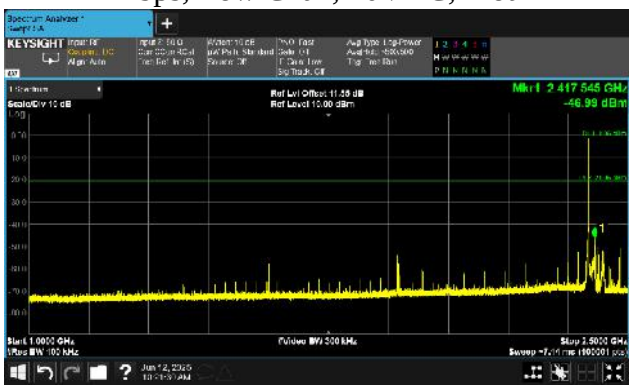
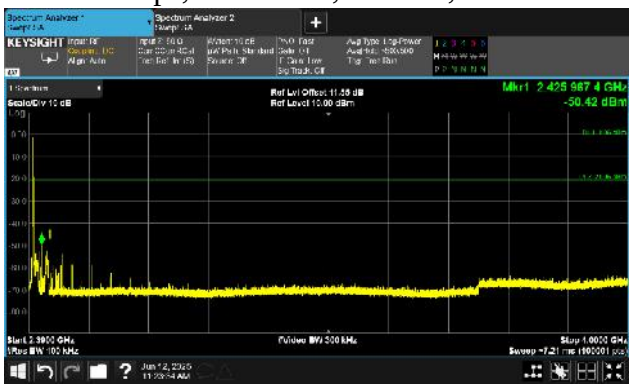


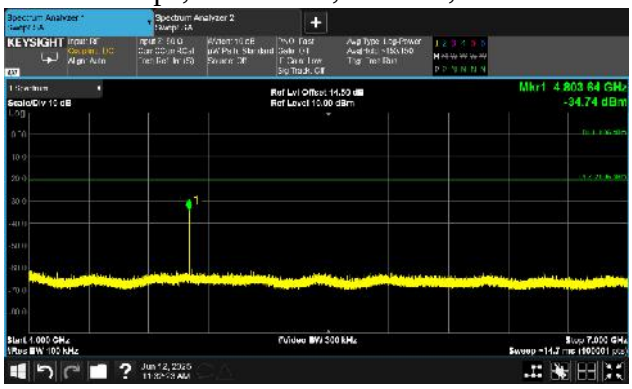
Figure 27: Conducted Spurious Emissions, Low Channel, 1Mbps, 20V Battery

1Mbps, Low Chan, 20VDC, Plot 1	1Mbps, Low Chan, 20VDC, Plot 2
	
1Mbps, Low Chan, 20VDC, Plot 3	1Mbps, Low Chan, 20VDC, Plot 4
	

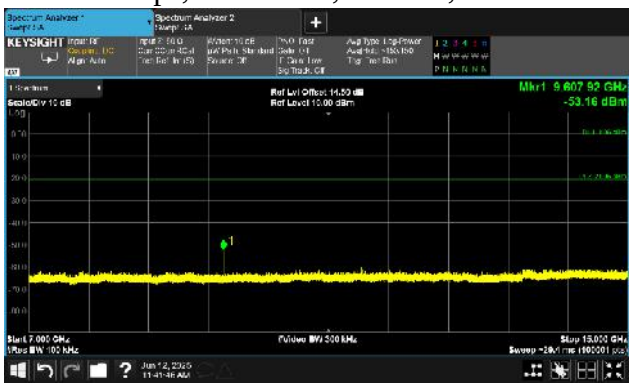
1Mbps, Low Chan, 20VDC, Plot 5



1Mbps, Low Chan, 20VDC, Plot 6



1Mbps, Low Chan, 20VDC, Plot 7



1Mbps, Low Chan, 20VDC, Plot 8

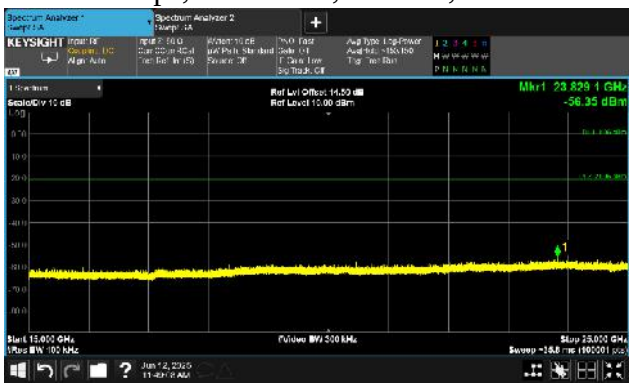
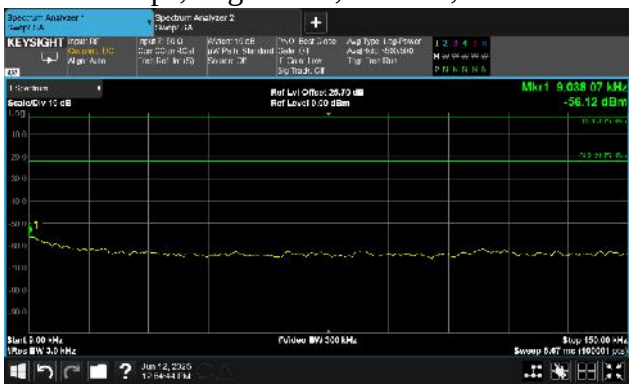
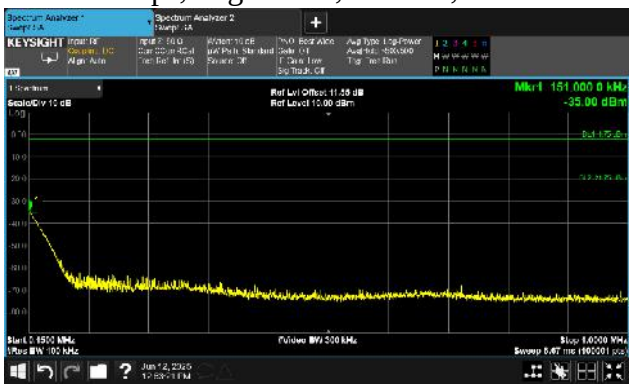


Figure 28: Conducted Spurious Emissions, High Channel, 1Mbps, 20V Battery

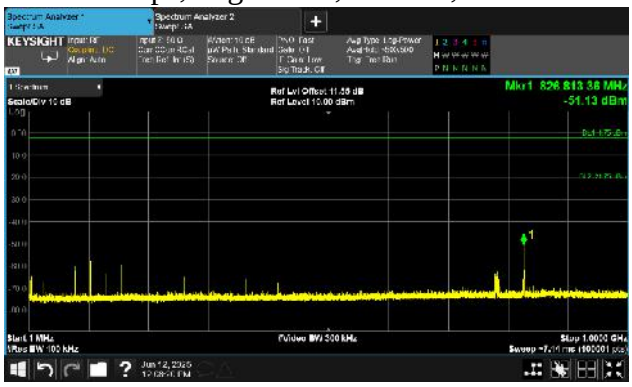
1Mbps, High Chan, 20VDC, Plot 1



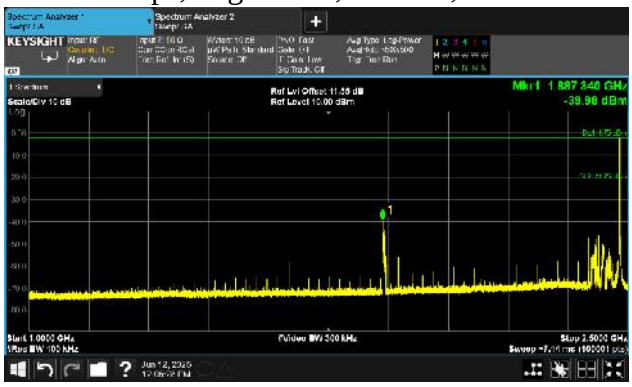
1Mbps, High Chan, 20VDC, Plot 2



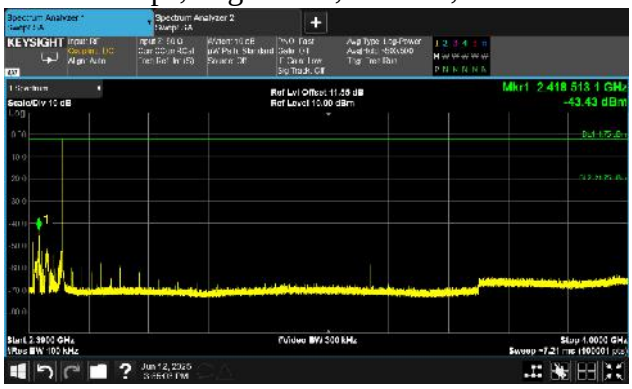
1Mbps, High Chan, 20VDC, Plot 3



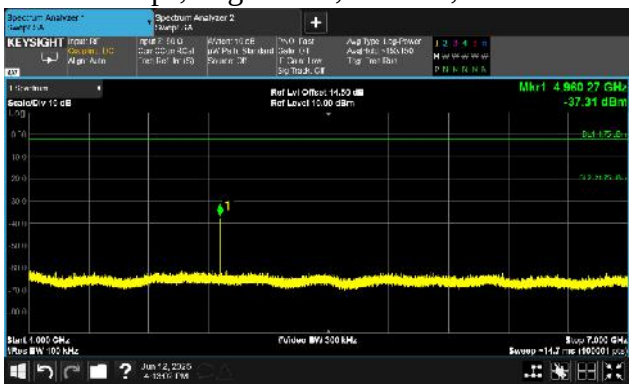
1Mbps, High Chan, 20VDC, Plot 4



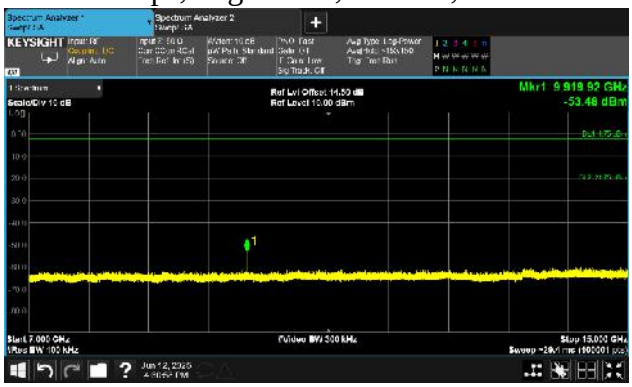
1Mbps, High Chan, 20VDC, Plot 5



1Mbps, High Chan, 20VDC, Plot 6



1Mbps, High Chan, 20VDC, Plot 7



1Mbps, High Chan, 20VDC, Plot 8

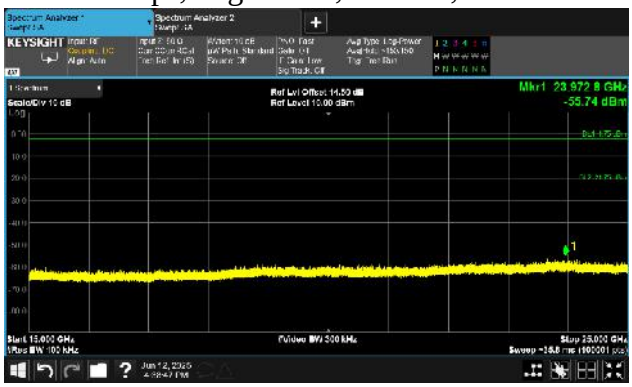
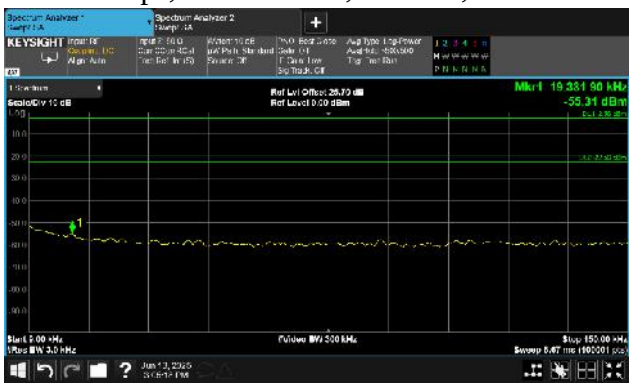
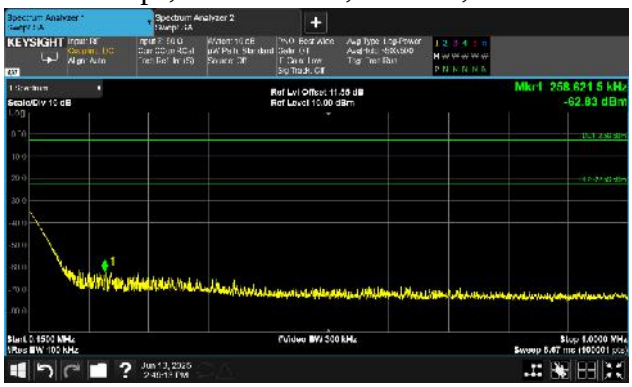


Figure 29: Conducted Spurious Emissions, Center Channel, 2Mbps, 20V Battery

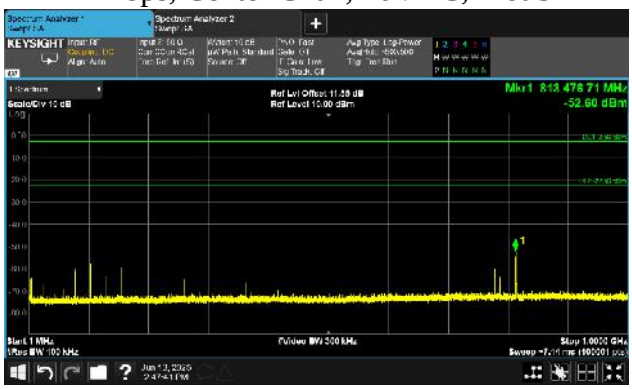
2Mbps, Center Chan, 20VDC, Plot 1



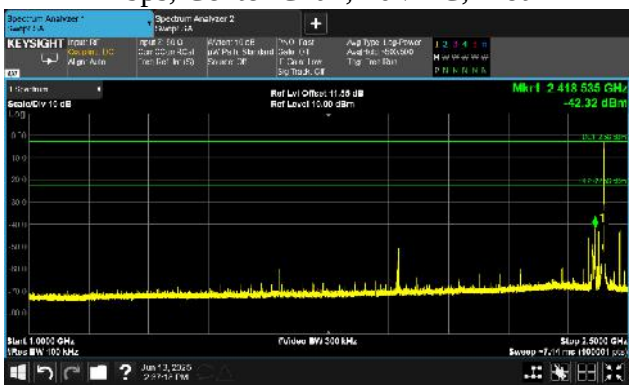
2Mbps, Center Chan, 20VDC, Plot 2



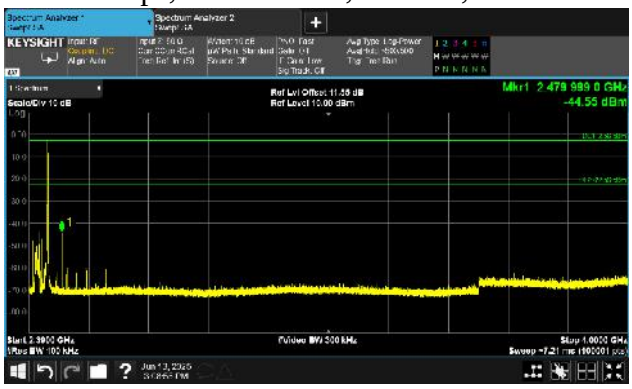
2Mbps, Center Chan, 20VDC, Plot 3



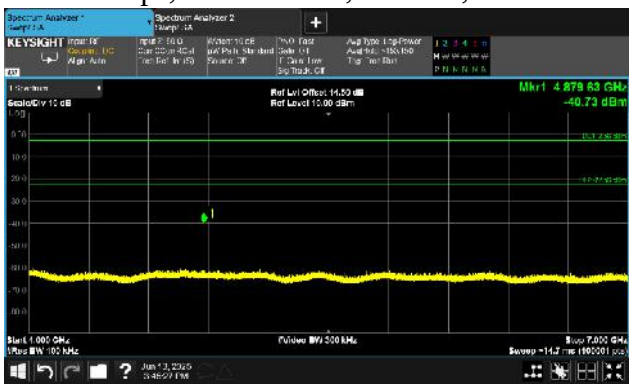
2Mbps, Center Chan, 20VDC, Plot 4



2Mbps, Center Chan, 20VDC, Plot 5



2Mbps, Center Chan, 20VDC, Plot 6



2Mbps, Center Chan, 20VDC, Plot 7

2Mbps, Center Chan, 20VDC, Plot 8

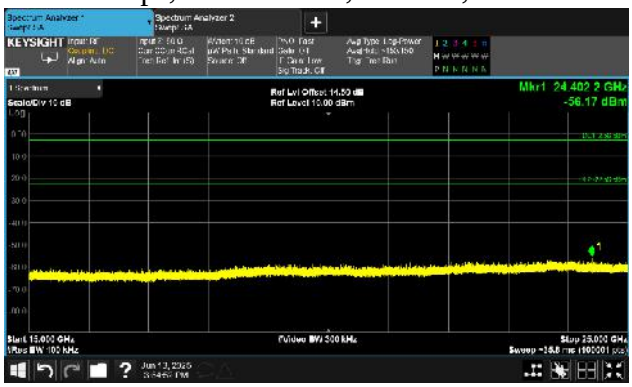
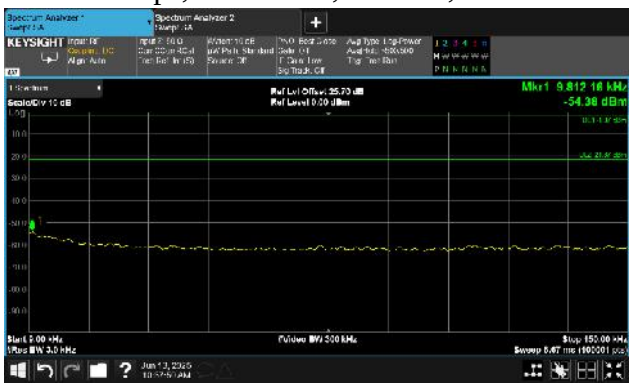
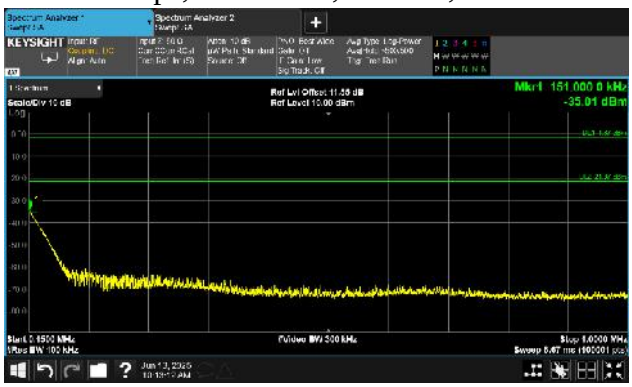


Figure 30: Conducted Spurious Emissions, Low Channel, 3Mbps, 20V Battery

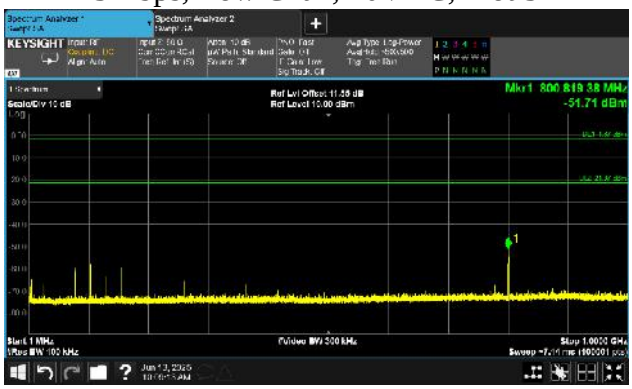
3Mbps, Low Chan, 20VDC, Plot 1



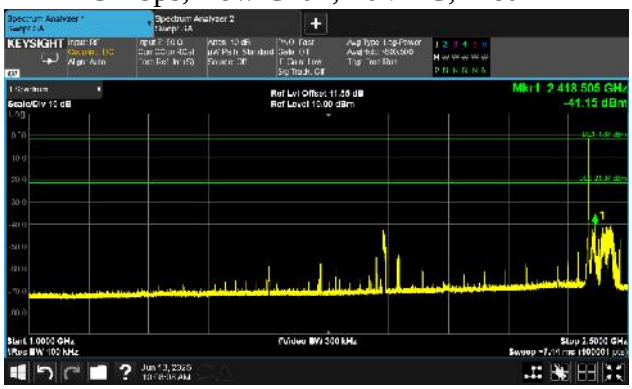
3Mbps, Low Chan, 20VDC, Plot 2



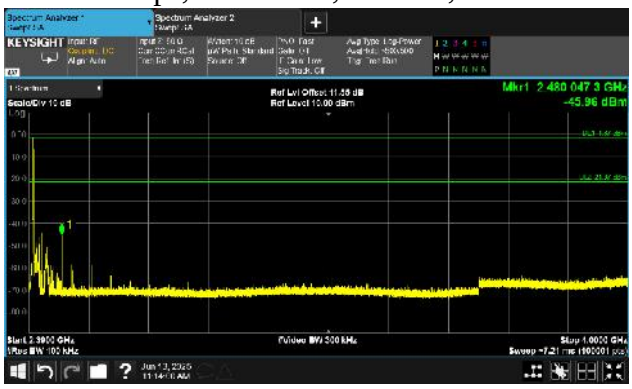
3Mbps, Low Chan, 20VDC, Plot 3



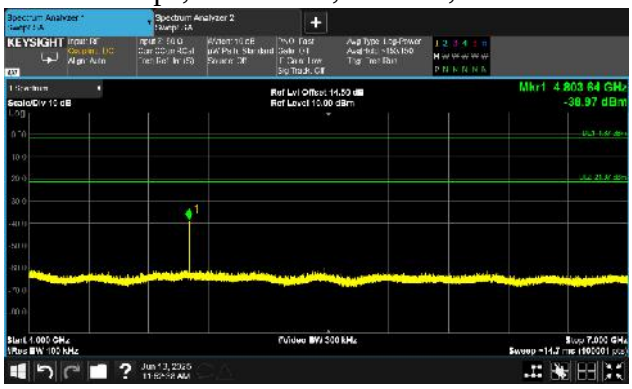
3Mbps, Low Chan, 20VDC, Plot 4



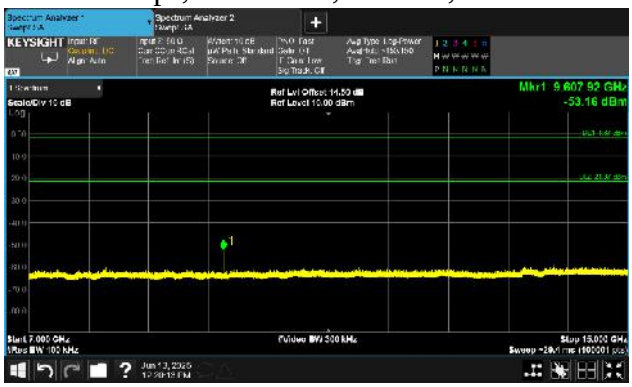
3Mbps, Low Chan, 20VDC, Plot 5



3Mbps, Low Chan, 20VDC, Plot 6



3Mbps, Low Chan, 20VDC, Plot 7



3Mbps, Low Chan, 20VDC, Plot 8

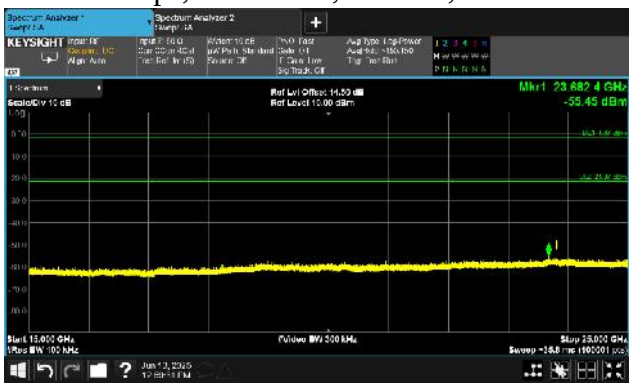
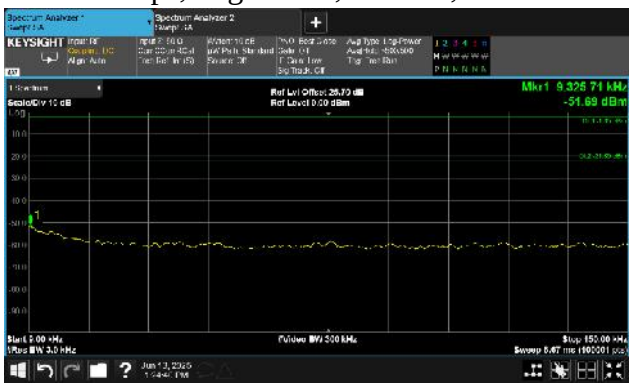
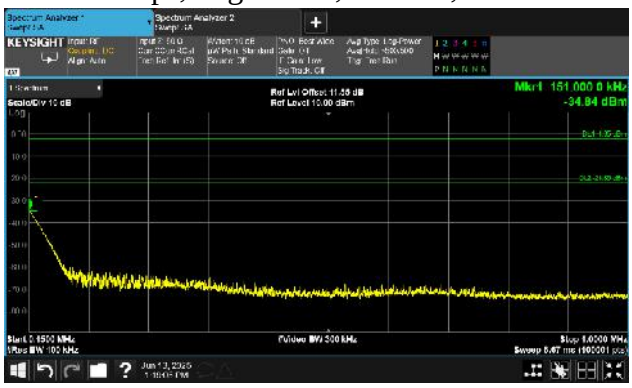


Figure 31: Conducted Spurious Emissions, High Channel, 1Mbps, 20V Battery

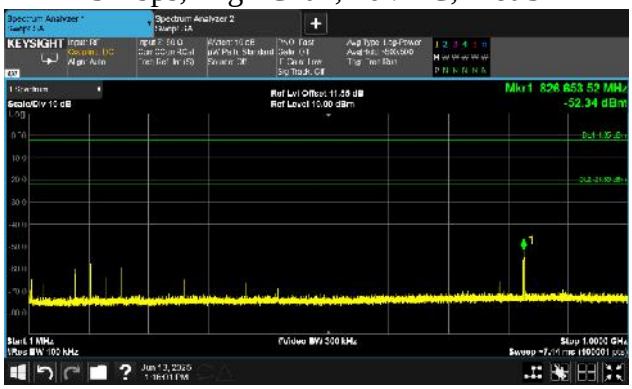
3Mbps, High Chan, 20VDC, Plot 1



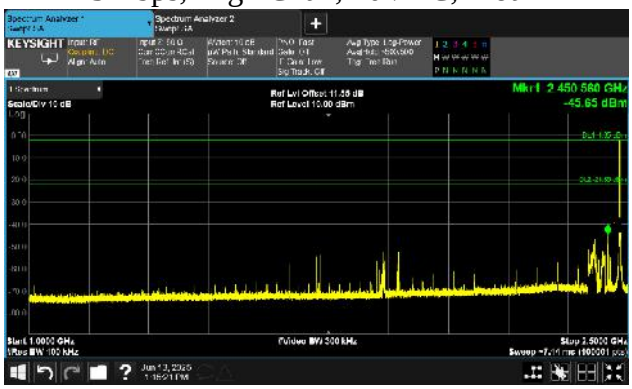
3Mbps, High Chan, 20VDC, Plot 2



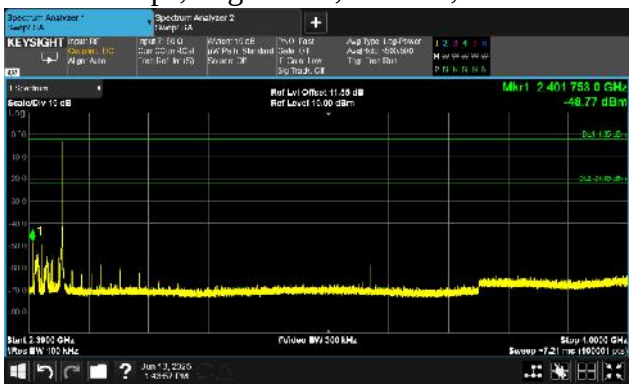
3Mbps, High Chan, 20VDC, Plot 3



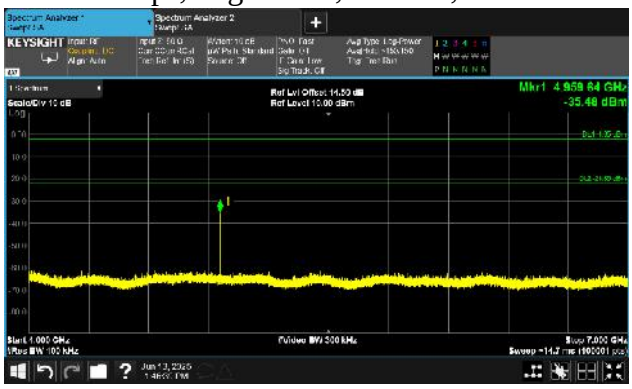
3Mbps, High Chan, 20VDC, Plot 4



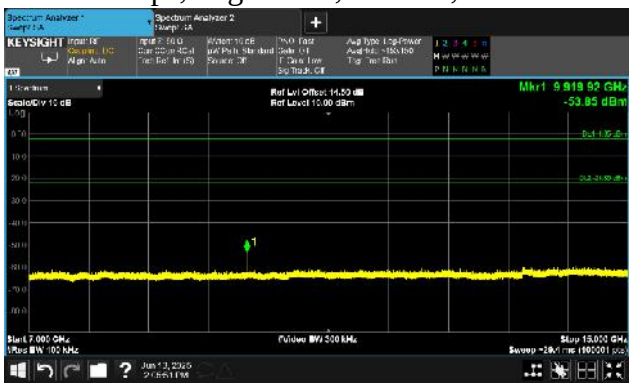
3Mbps, High Chan, 20VDC, Plot 5



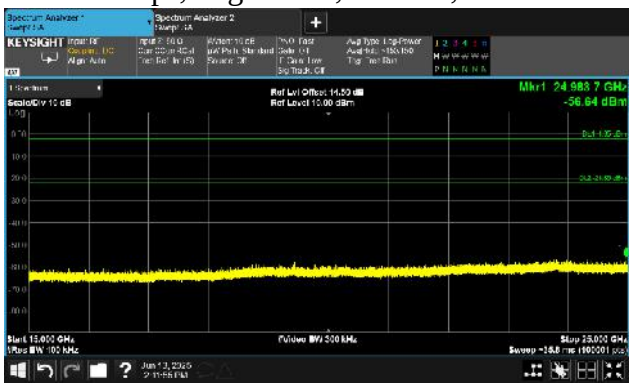
3Mbps, High Chan, 20VDC, Plot 6



3Mbps, High Chan, 20VDC, Plot 7



3Mbps, High Chan, 20VDC, Plot 8



3.8 General Field Strength Requirements, Radiated Emissions

3.8.1 Requirements

Compliance Standard: FCC Part 15.205 and 15.209

FCC Compliance Limits		
Frequency Range	**3m Limit**	
30 – 88 MHz	100 µV/m (QP)	
88 – 216 MHz	150 µV/m (QP)	
216 – 960 MHz	200 µV/m (QP)	
> 960 MHz	500 µV/m (AVG)	5000 µV/m (Peak)

3.8.2 Test Procedure Summary

All testing in this section was performed at a distance of 3-meters. For radiated testing between 9kHz and 30MHz the EUT was placed on an 80 cm high non-conductive turn-table and scanned for emissions using an active loop receiver antenna, mounted at a fixed-height of 1-meter. The loop antenna was rotated about its vertical and horizontal axis in accordance with ANSI C63.10-2020, clause 6.4.6 and 6.11.2 and the EUT orthogonal plane was varied (x, y, z,).

For radiated testing above 30MHz, but less than 1GHz, the EUT was placed on a 1m X 1.5m non-conductive motorized turntable at a height of 80cm. For frequencies above 1GHz, a test height of 1.5m is employed. An initial pre-scan of the EUT was performed to identify any emissions that exceed, or come within 6dB of, the applicable limit. This pre-scan was performed a with the employment of a spectrum analyzer peak detector function. The highest amplitude (worst-case) emissions noted during the pre-scan were selected for final compliance measurements.

Above 30MHz, the emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Broadband log periodic and double-ridged horn 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 30MHz to 25GHz were evaluated. The EUT 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.

Test Summary Continued: The detector function was set to quasi-peak for final measurements below 1 GHz. 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. For measurements above 1 GHz, both the peak and the average levels are recorded, using a measurement bandwidth of 1 MHz. For average measurements, a video bandwidth setting of 10 Hz was used, in the case of video averaging; otherwise, an EMI AVG detector shall be employed.

The following EUT configurations were scanned and evaluated:

1. AC/DC adapter only
2. 20V battery only
3. AC/DC adapter, + 20V battery

(note: the input power variations have no impact on transmitter emissions)

3.8.3 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 antenna(s) and other measurement equipment. These factors include the antenna factor ((AF)(in dB/m)), cable loss factors ((CF)(in dB)), and the pre-amplifier gain [if applicable] ((G)(in dB)). These correction values are algebraically added to the raw Spectrum Analyzer Voltage (in dBµV) to obtain the corrected radiated electric field, which shall be the final corrected logarithm amplitude ((Corr. Meas.)(in dBµV/m)). This logarithm amplitude is then compared to the FCC limit, which has been converted to a unit of log in dBµV/m.

Example:

Spectrum Analyzer Voltage:	VdBµV (SA)
Antenna Correction Factor:	AFdB/m
Cable Correction Factor:	CFdB
Pre-Amplifier Gain (if applicable):	GdB
Electric Field:	EdBµV/m = V dBµV (SA) + AFdB/m + CFdB - GdB
To convert from linear units of measure:	dBuV/m = 20LOG(uV/m)
To convert limits, based on $D_{Measure}$:	3m Limit = 10m Limit + 20LOG(10/3)

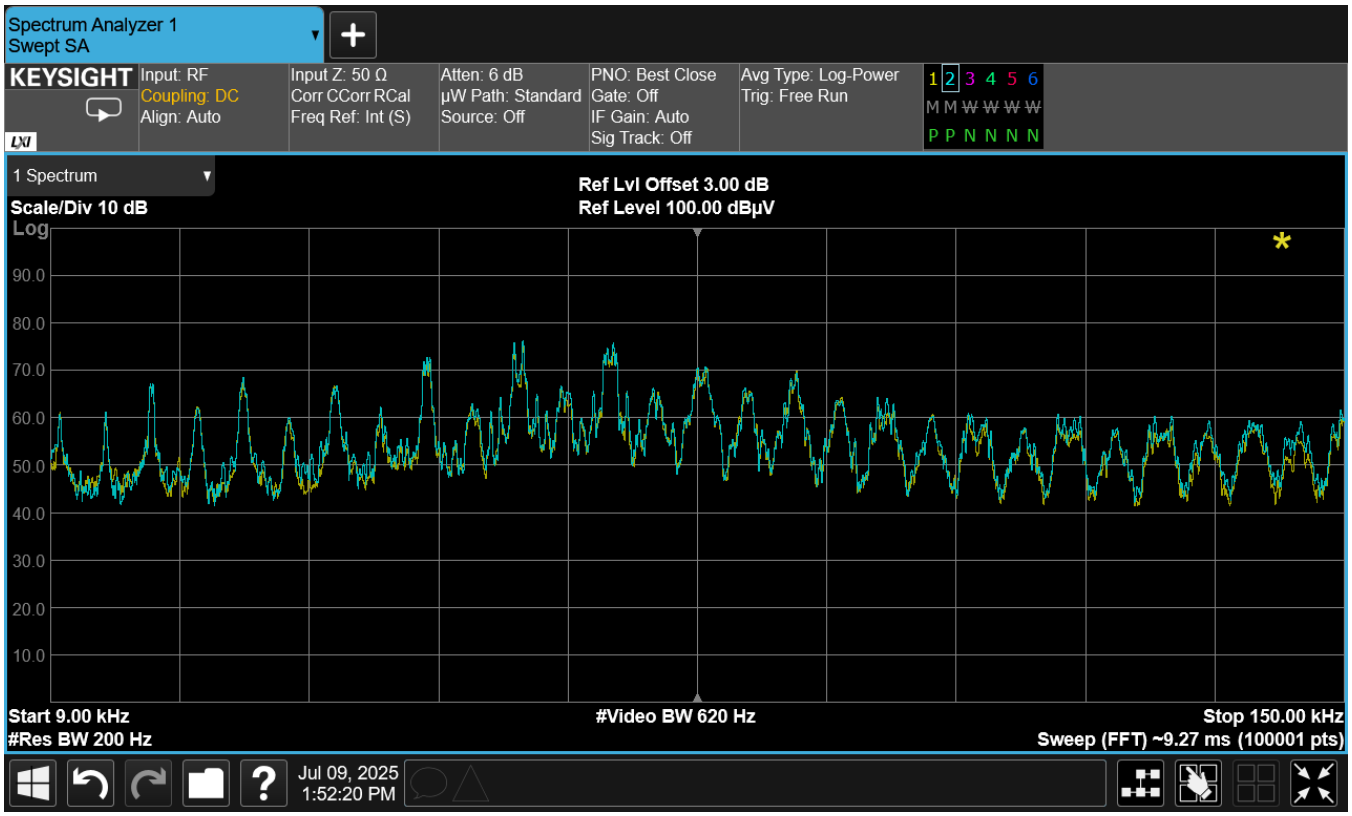
3.8.4 Measurement Method and Results

The EUT was evaluated at all data rates and input voltages. The low, center, and high channels were investigated. The test results are very comparable for all modes and channels. The EUT is fully compliant and meets the requirements for spurious radiated emissions. The frequency range of 9 kHz to 25 GHz was investigated. The EUT was tested while positioned in the worst-case orientation, based on a three-axes (orthogonal plane) evaluation of the fundamental field strength. The EUT position that produced the highest TX field strength, was maintained.

Table 13: Radiated Spurious Emissions Results Summary

Input Voltage	Modulation Mode (Data Rate)	Channel Frequency (MHz)	Investigated and Scanned	Result
AC/DC Adapter	BDR, DH5 (1Mbps) GFSK	2402 MHz	Yes	Compliant
		2440 MHz	Yes	Compliant
		2480 MHz	Yes	Compliant
AC/DC Adapter	EDR, 2DH5 (2Mbps) π/4DQPSK	2402 MHz	Yes	Compliant
		2440 MHz	Yes	Compliant
		2480 MHz	Yes	Compliant
AC/DC Adapter	EDR, 3DH5 (3Mbps) 8DPSK	2402 MHz	Yes	Compliant
		2440 MHz	Yes	Compliant
		2480 MHz	Yes	Compliant
20VDC Battery	BDR, DH5 (1Mbps) GFSK	2402 MHz	Yes	Compliant
		2440 MHz	Yes	Compliant
		2480 MHz	Yes	Compliant
20VDC Battery	EDR, 2DH5 (2Mbps) π/4DQPSK	2402 MHz	Yes	Compliant
		2440 MHz	Yes	Compliant
		2480 MHz	Yes	Compliant
20VDC Battery	EDR, 3DH5 (3Mbps) 8DPSK	2402 MHz	Yes	Compliant
		2440 MHz	Yes	Compliant
		2480 MHz	Yes	Compliant

Figure 32: All Modes, Radiated Test Data, 9kHz to 150kHz, AC/DC Adapter, Worst-Case

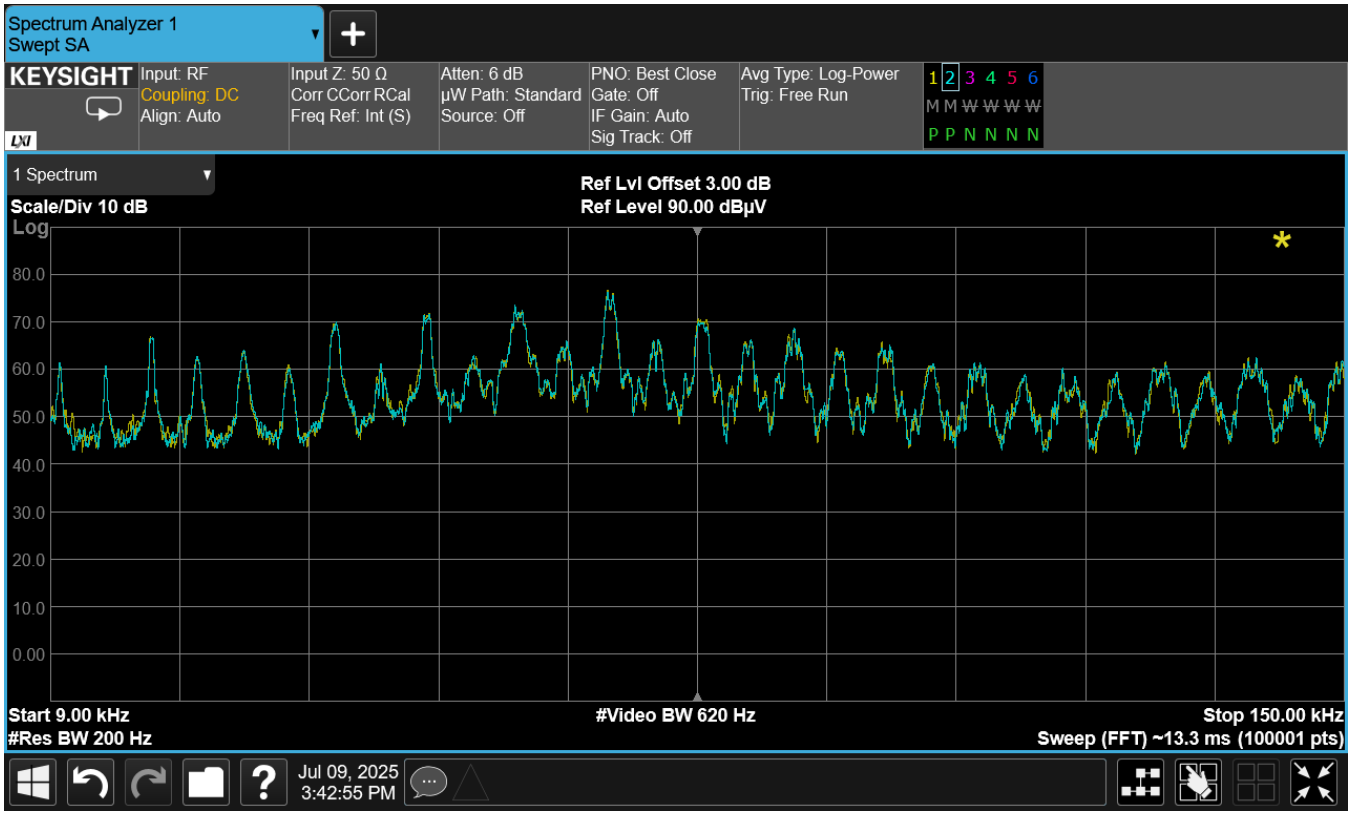


Trace 1 = EUT On

Trace 2 = Ambient

* no emissions detected (near field investigation)

Figure 33: All Modes, Radiated Test Data, 9kHz to 150kHz, 20V Battery, Worst-Case

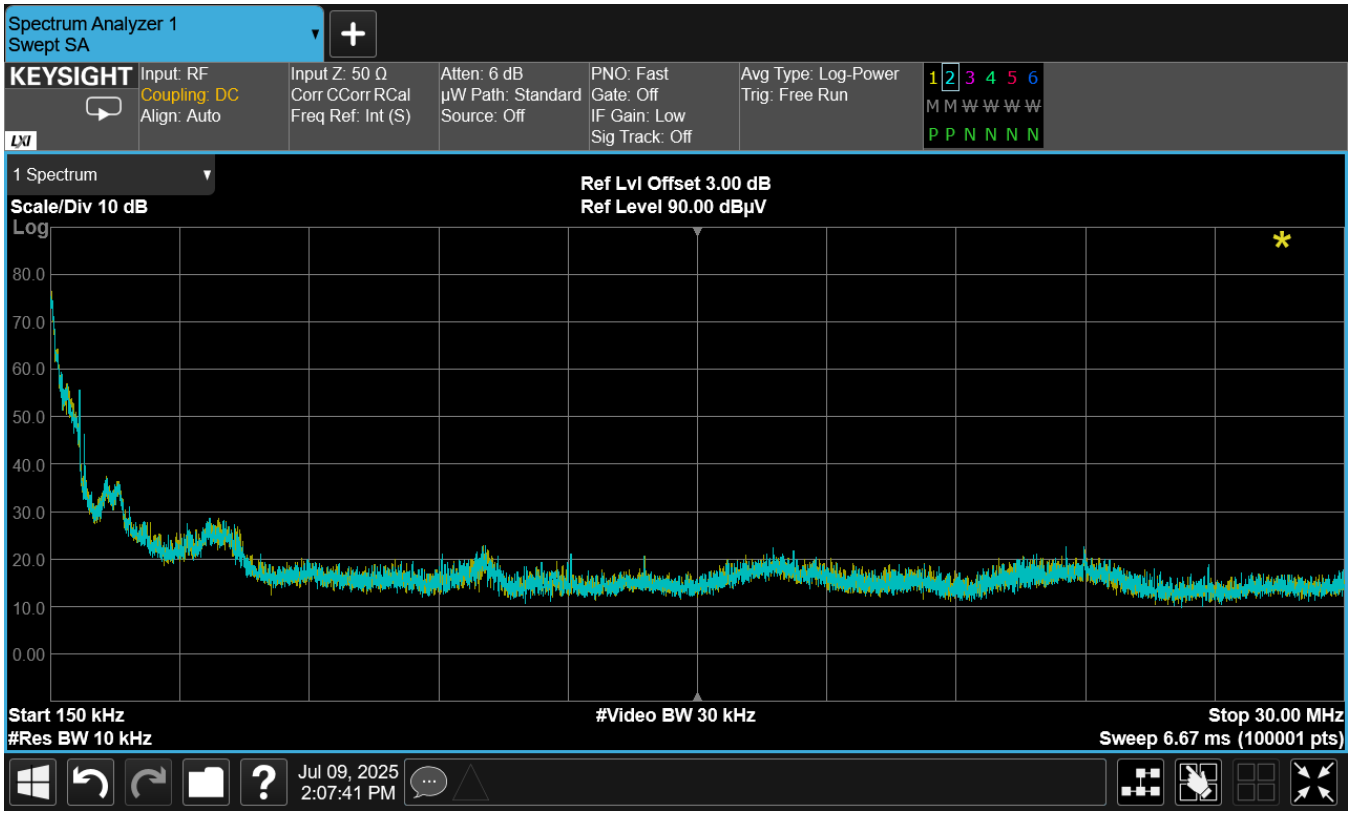


Trace 1 = EUT On

Trace 2 = Ambient

* no emissions detected (near field investigation)

Figure 34: All Modes, Radiated Test Data, 150kHz to 30MHz, AC/DC Adapter, Worst-Case

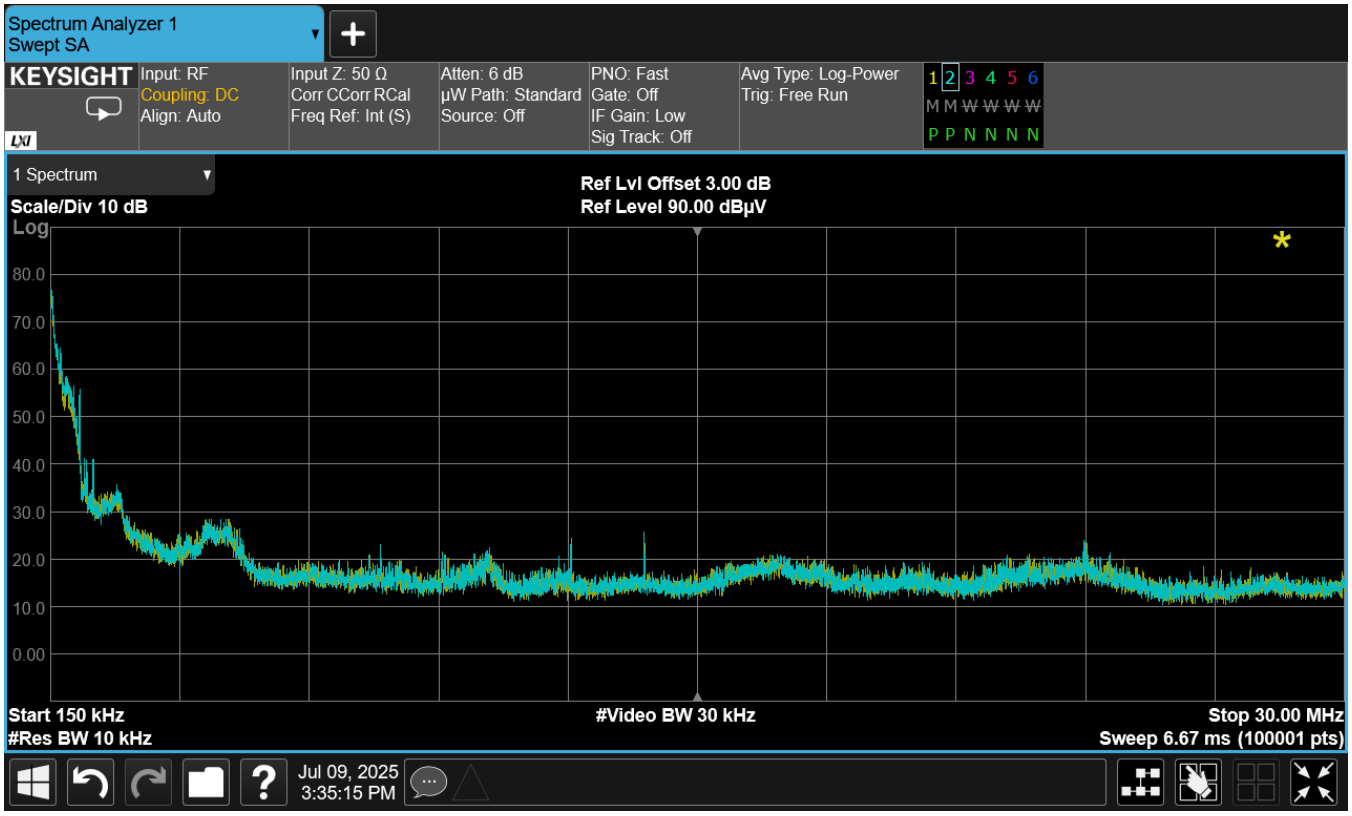


Trace 1 = EUT On

Trace 2 = Ambient

* no emissions detected (near field investigation)

Figure 35: All Modes, Radiated Test Data, 150kHz to 30MHz, 20V Battery, Worst-Case



Trace 1 = EUT On

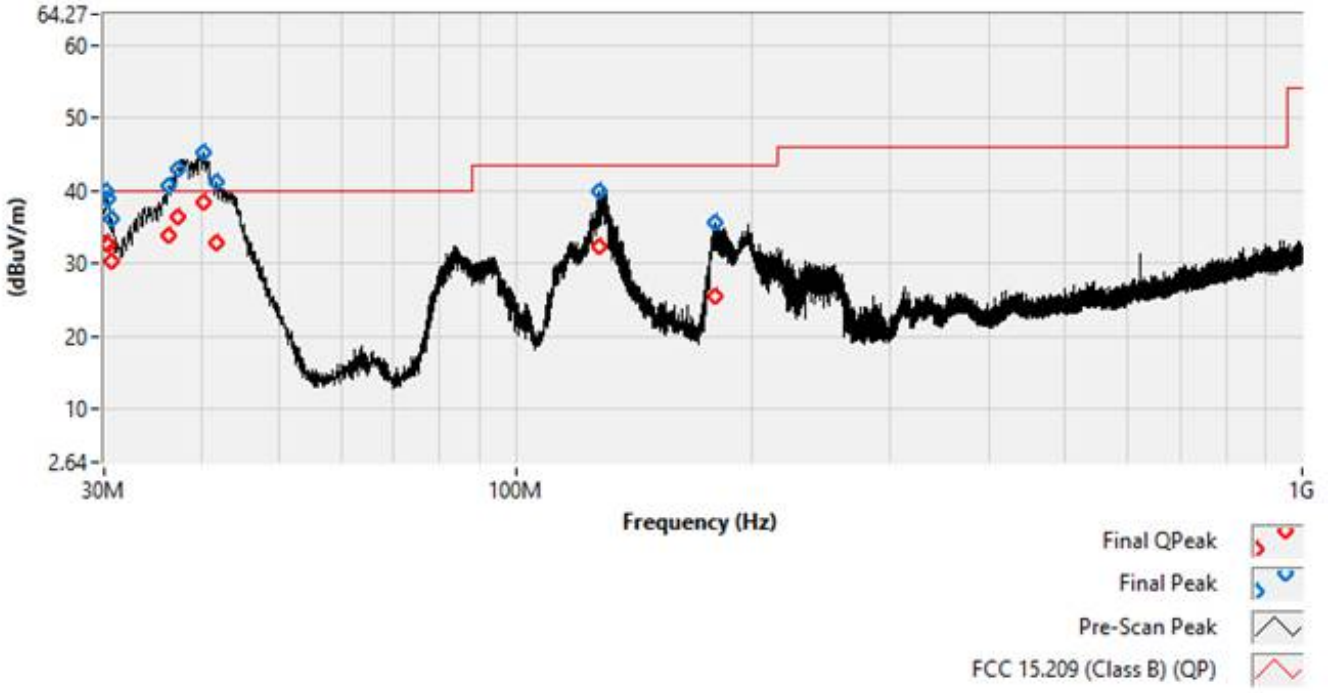
Trace 2 = Ambient

* no emissions detected (near field investigation)

Table 14: Radiated Emissions Test Data, 30MHz to 1GHz, AC/DC Adapter, Worst-Case

Frequency (MHz)	Detector	Corr. Meas (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Turn Table (deg)	Antenna (cm)
30.240	Peak	39.991	--	--	180	Vert, 100
	QP	32.815	40	-7.185	180	Vert, 100
30.360	Peak	39.001	--	--	180	Vert, 100
	QP	32.620	40	-7.380	180	Vert, 100
30.660	Peak	36.027	--	--	180	Vert, 100
	QP	30.333	40	-9.667	180	Vert, 100
36.181	Peak	40.617	--	--	180	Vert, 100
	QP	33.851	40	-6.149	180	Vert, 100
37.141	Peak	43.053	--	--	180	Vert, 100
	QP	36.323	40	-3.677	180	Vert, 100
40.141	Peak	45.168	--	--	180	Vert, 100
	QP	38.480	40	-1.520	180	Vert, 100
41.761	Peak	41.253	--	--	180	Vert, 100
	QP	32.919	40	-7.081	180	Vert, 100
127.870	Peak	39.880	--	--	180	Vert, 100
	QP	32.359	43.5	-11.141	180	Vert, 100
179.595	Peak	35.668	--	--	180	Vert, 100
	QP	25.563	43.5	-17.937	180	Vert, 100

AC/DC Adapter, 3Mbps, Low Chan., Pre-scan and Final Data (Vertical)



AC/DC Adapter, 3Mbps, Low Chan., Pre-scan and Final Data (Horizontal)

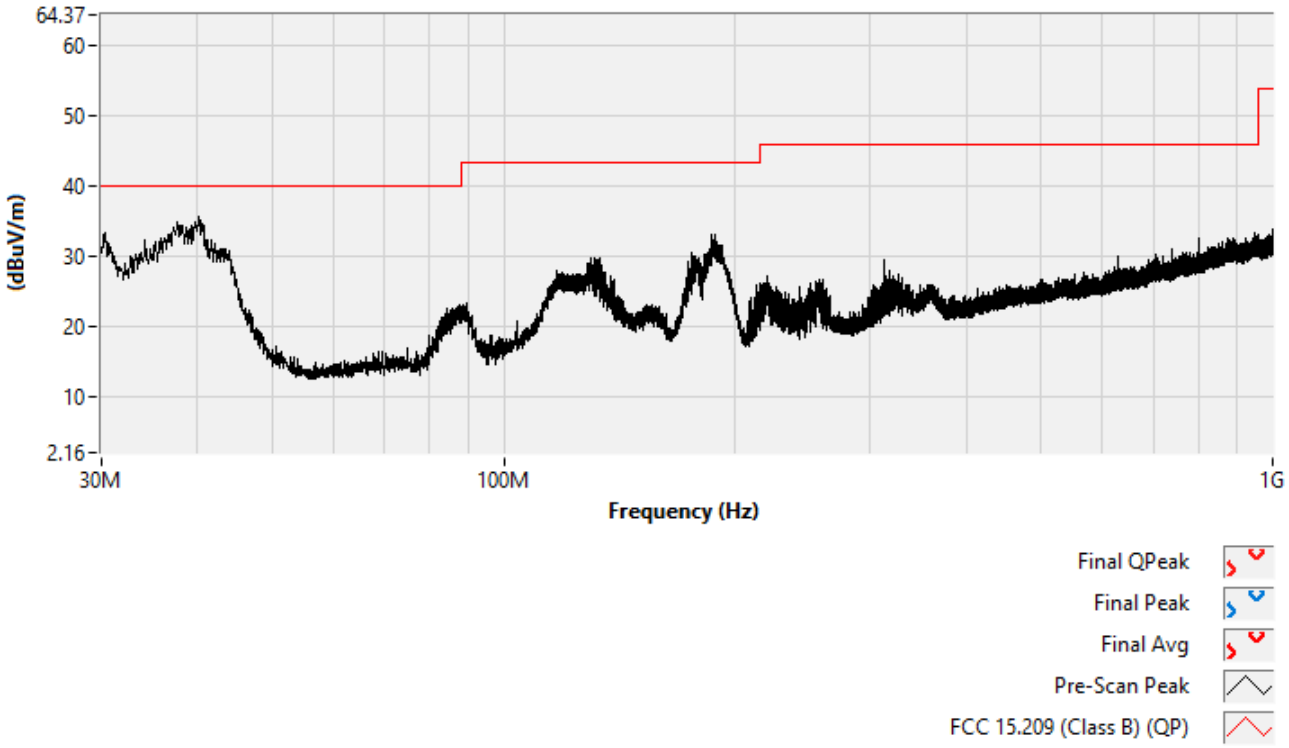
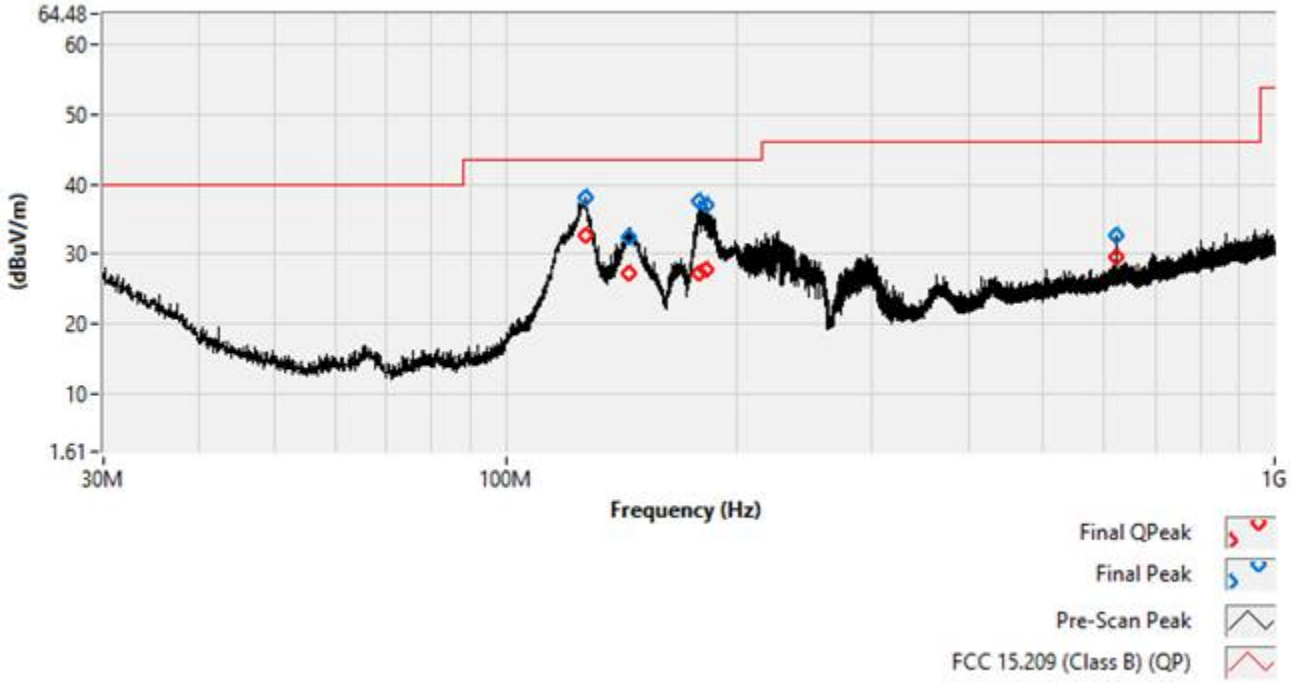


Table 15: Radiated Emissions Test Data, 30MHz to 1GHz, 20V Battery, Worst-Case

Frequency (MHz)	Detector	Corr. Meas (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Turn Table (deg)	Antenna (cm)
127.040	Peak	38.179	--	--	220	Vert, 100
	QP	32.757	43.5	-10.743	220	Vert, 100
144.971	Peak	32.492	--	--	220	Vert, 100
	QP	27.278	43.5	-16.222	220	Vert, 100
178.764	Peak	37.577	--	--	170	Vert, 110
	QP	27.237	43.5	-16.263	170	Vert, 110
182.304	Peak	37.079	--	--	170	Vert, 110
	QP	27.773	43.5	-15.727	170	Vert, 110
624.000	Peak	32.729	--	--	180	Vert, 175
	QP	29.555	46	-16.445	180	Vert, 175
935.998 *	Peak	33.503	--	--	200	Horiz, 115
	QP	29.056	46	-16.944	200	Horiz, 115

* Ambient

20V Battery, 3Mbps, Low Chan., Pre-scan and Final Data (Vertical)



20V Battery, 3Mbps, Low Chan., Pre-scan and Final Data (Horizontal)

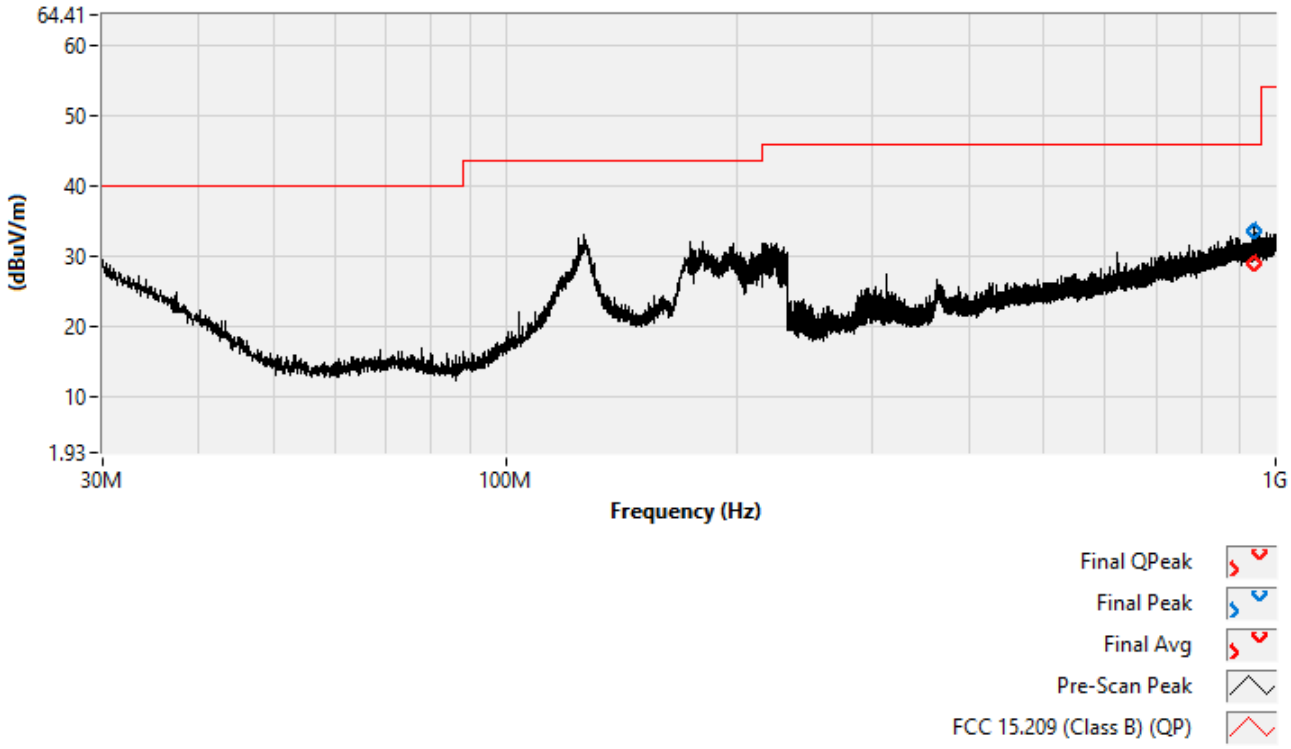
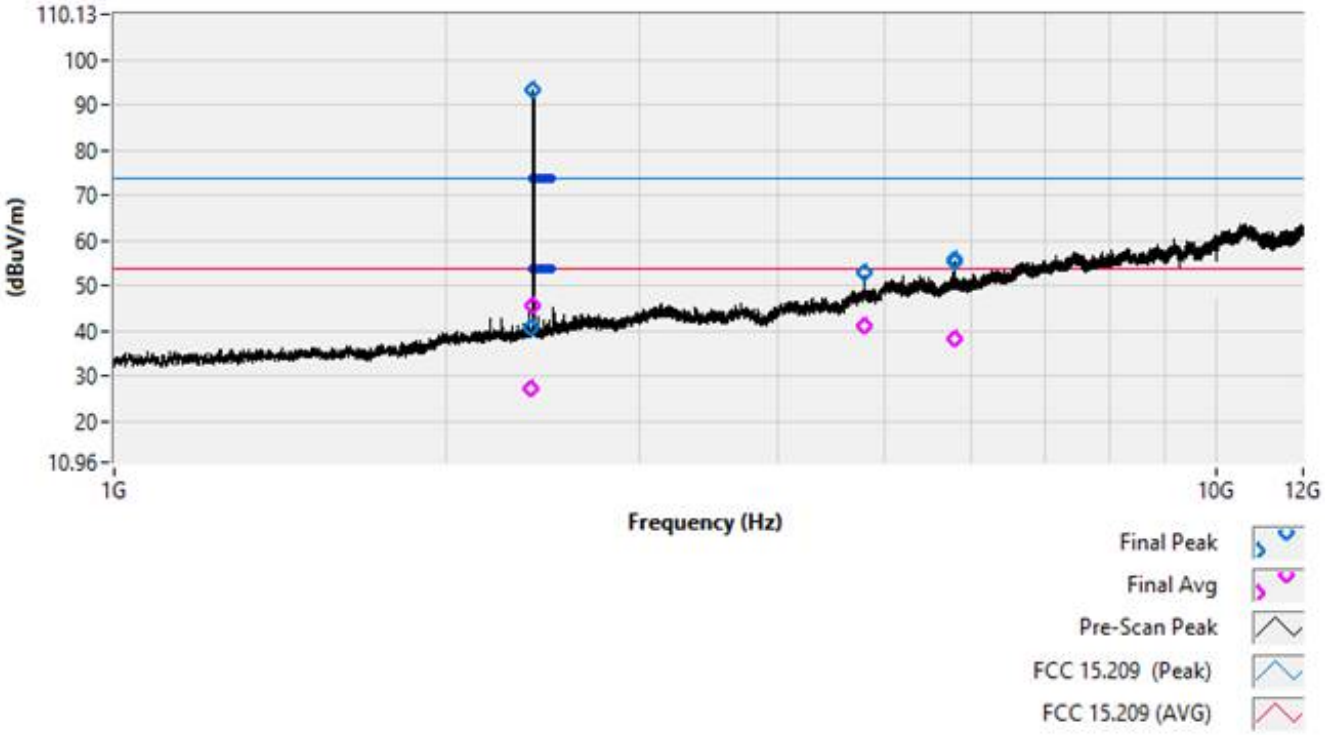


Table 16: Radiated Emissions, 1GHz to 25GHz, AC/DC Adapter, Low Chan., 3Mbps (Worst-Case)

Frequency (GHz)	Detector	Corr. Meas (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Turn Table (deg)	Antenna (cm)
2.390	Peak	40.532	74	-33.468	213	Horiz, 115
	Avg	27.618	54	-26.382	213	Horiz, 115
2.402	Peak	95.105	--	--	213	Horiz, 115
	--	--	--	--	--	--
4.804	Peak	53.147	74	-20.853	252	Vert, 190
	Avg	41.251	54	-12.749	252	Vert, 190
4.804	Peak	57.964	74	-16.036	213	Horiz, 115
	Avg	45.523	54	-8.477	213	Horiz, 115
5.779	Peak	60.161	74	-13.839	213	Horiz, 115
	Avg	38.584	54	-15.416	213	Horiz, 115
5.782	Peak	56.627	74	-17.373	213	Horiz, 115
	Avg	38.628	54	-15.372	213	Horiz, 115
5.788	Peak	55.984	74	-18.016	252	Vert, 190
	Avg	38.289	54	-15.711	252	Vert, 190
5.792	Peak	55.586	74	-18.414	252	Vert, 190
	Avg	38.428	54	-15.572	252	Vert, 190
5.792	Peak	56.518	74	-17.482	213	Horiz, 115
	Avg	38.619	54	-15.381	213	Horiz, 115
11.080 *	Peak	60.771	74	-13.229	213	Horiz, 115
	Avg	46.771	54	-7.229	213	Horiz, 115

* Ambient

AC/DC Adapter, Low Chan., 3Mbps, Pre-scan and Final Data (Vertical)



AC/DC Adapter, Low Chan., 3Mbps, Pre-scan and Final Data (Horizontal)

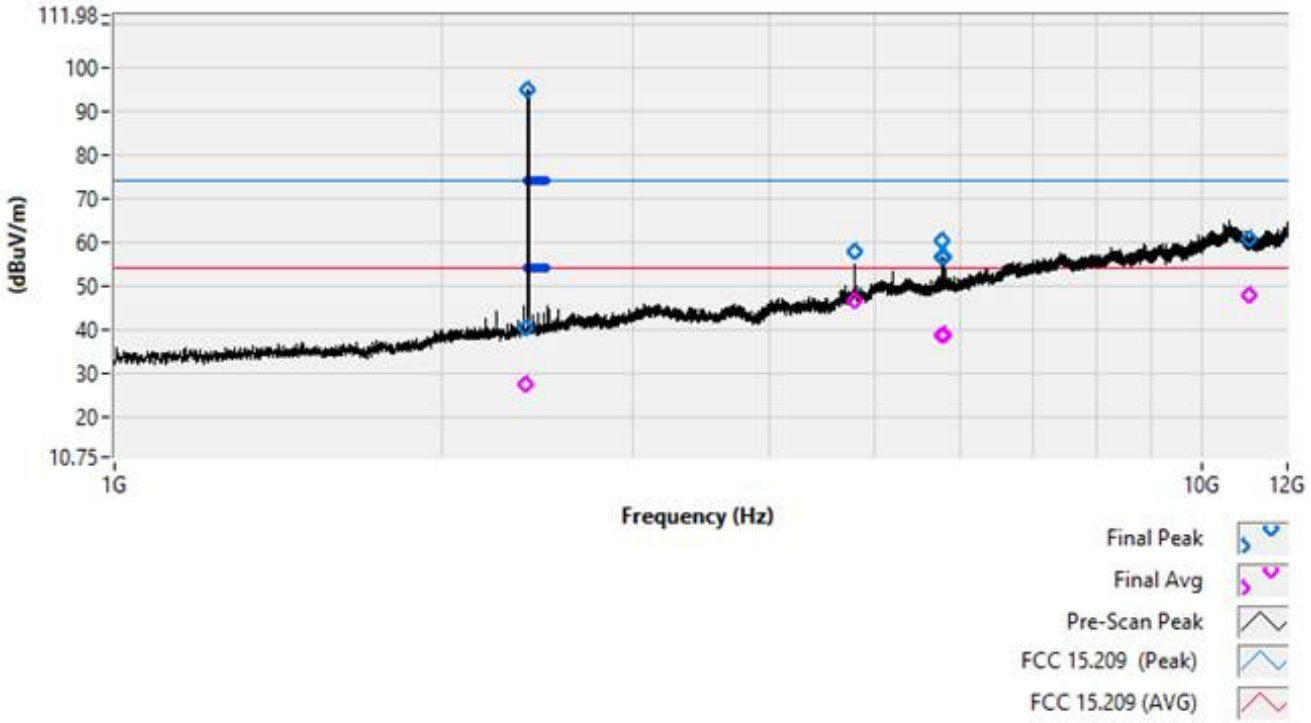
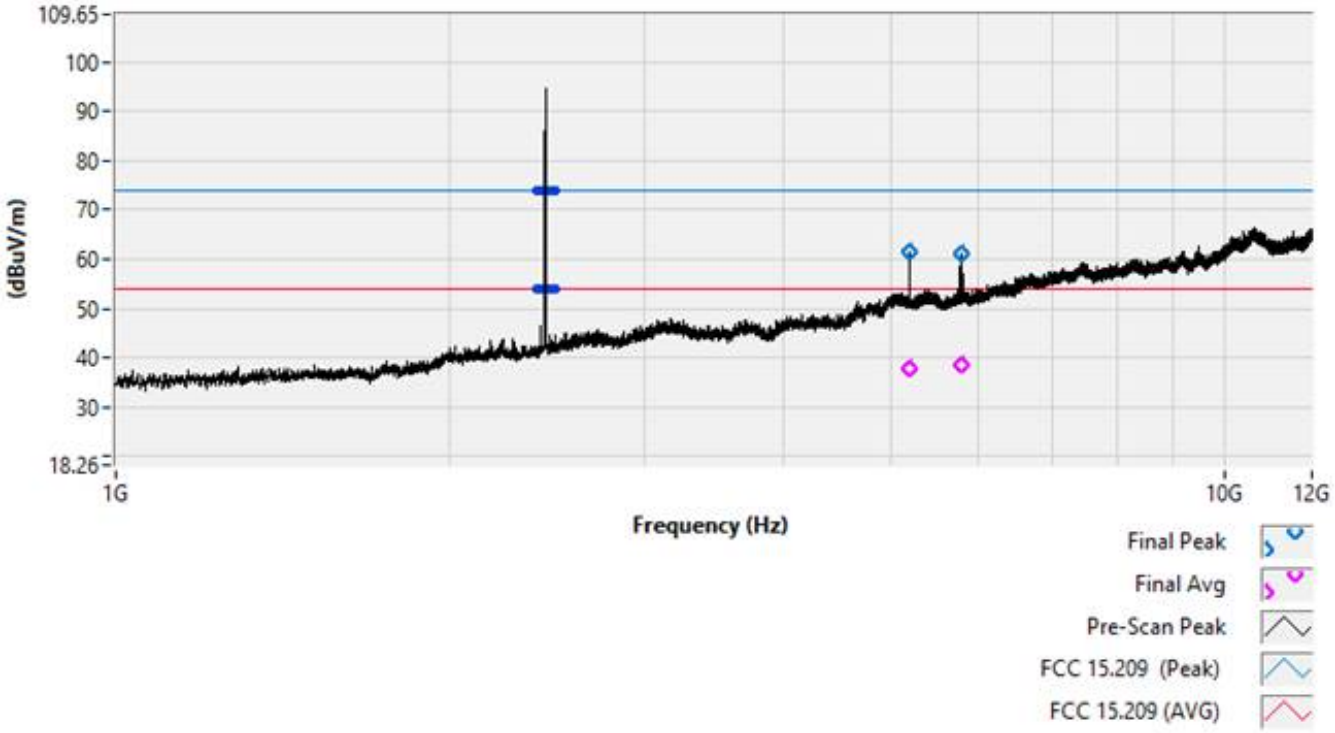


Table 17: Radiated Emissions, 1GHz to 25GHz, AC/DC Adapter, Center Chan., 3Mbps (Worst-Case)

Frequency (GHz)	Detector	Corr. Meas (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Turn Table (deg)	Antenna (cm)
2.440	Peak	94.960	--	--	213	Horiz, 115
	--	--	--	--	--	--
4.881	Peak	53.729	74	-20.271	213	Horiz, 115
	Avg	37.148	54	-16.852	213	Horiz, 115
5.203	Peak	62.071	74	-11.929	213	Horiz, 115
	Avg	37.998	54	-16.002	255	Horiz, 220
5.205	Peak	61.687	74	-12.313	252	Vert, 185
	Avg	37.744	54	-16.256	252	Vert, 185
5.784	Peak	61.301	74	-12.699	252	Vert, 185
	Avg	38.681	54	-15.319	252	Vert, 185
5.785	Peak	61.218	74	-12.782	213	Horiz, 115
	Avg	38.677	54	-15.323	255	Horiz, 220

AC/DC Adapter, Center Chan., 3Mbps, Pre-scan and Final Data (Vertical)



AC/DC Adapter, Center Chan., 3Mbps, Pre-scan and Final Data (Horizontal)

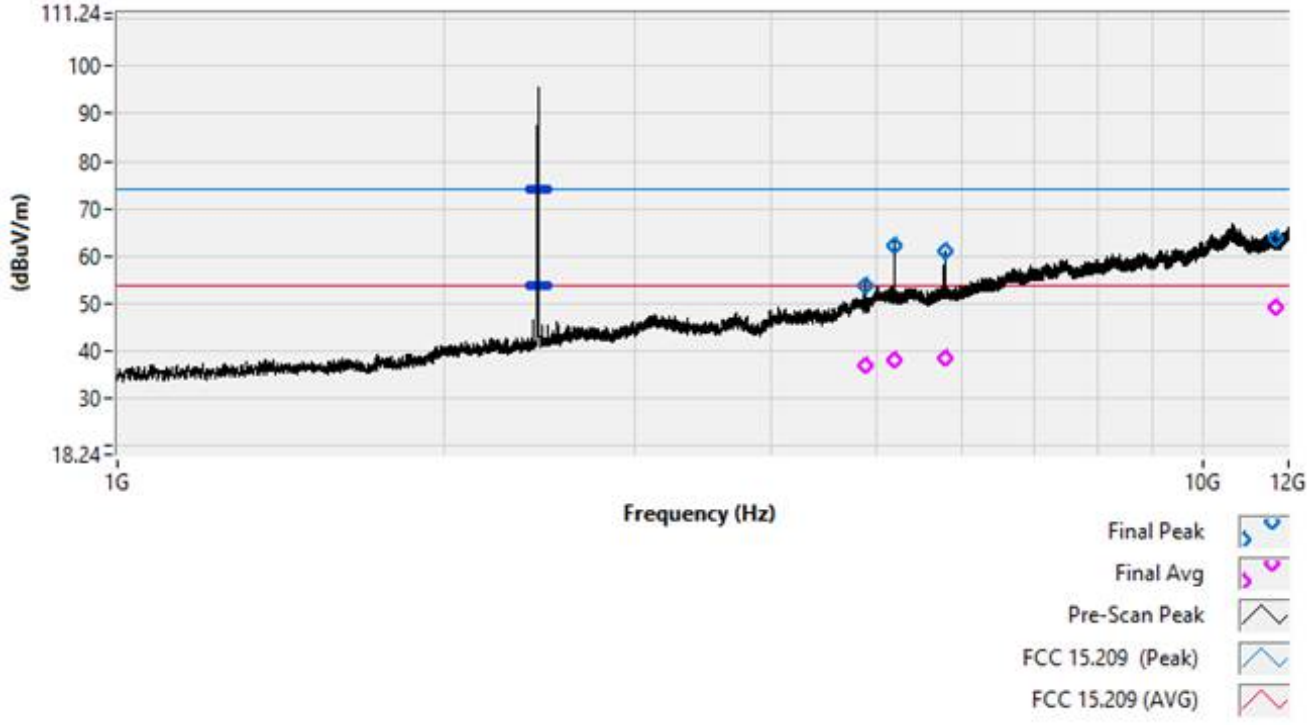
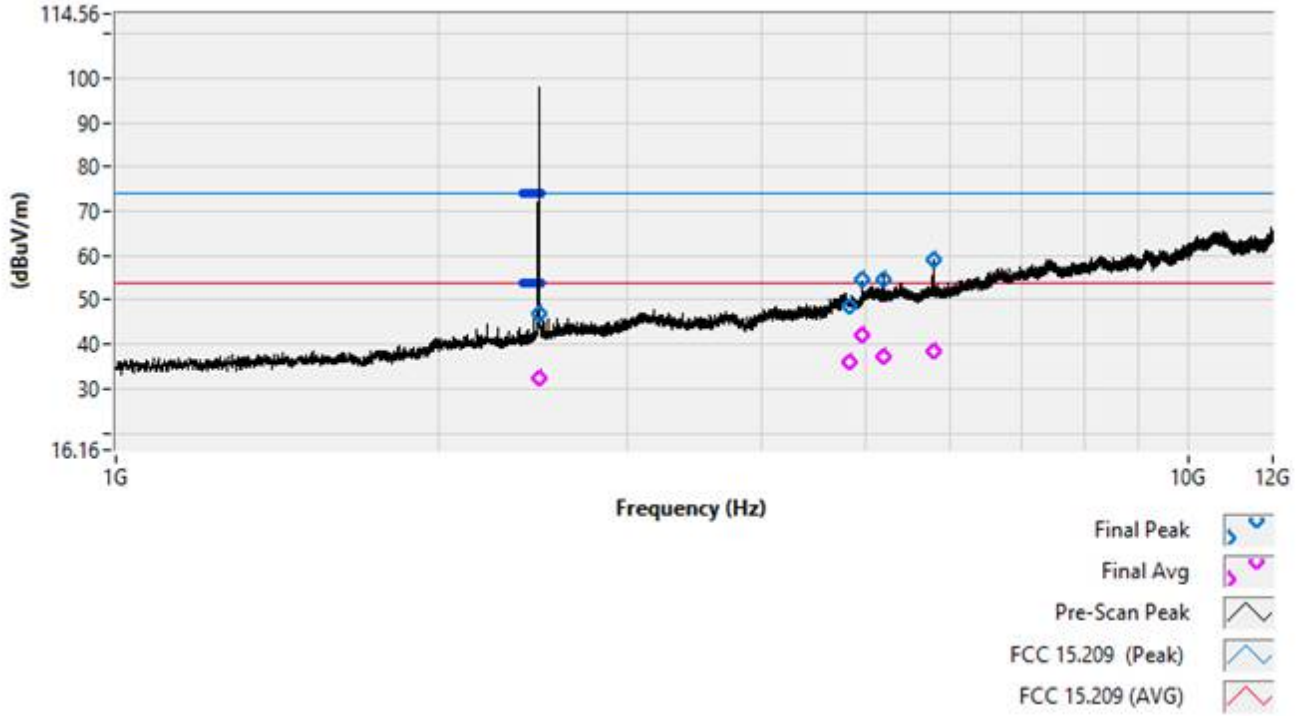


Table 18: Radiated Emissions, 1GHz to 25GHz, AC/DC Adapter, High Chan., 3Mbps (Worst-Case)

Frequency (GHz)	Detector	Corr. Meas (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Turn Table (deg)	Antenna (cm)
2.480	Peak	99.999	--	--	219	Horiz, 115
	--	--	--	--	--	--
2.4835	Peak	48.182	74	-25.818	219	Horiz, 115
	Avg	33.321	54	-20.679	219	Horiz, 115
4.960	Peak	58.687	74	-15.313	219	Horiz, 115
	Avg	47.014	54	-6.986	219	Horiz, 115
5.200	Peak	55.749	74	-18.251	219	Horiz, 115
	Avg	37.413	54	-16.587	219	Horiz, 115
5.786	Peak	60.154	74	-13.846	219	Horiz, 115
	Avg	38.319	54	-15.681	219	Horiz, 115
10.990 *	Peak	62.645	74	-11.355	219	Horiz, 115
	Avg	48.142	54	-5.858	219	Horiz, 115

* Ambient

AC/DC Adapter, High Chan., 3Mbps, Pre-scan and Final Data (Vertical)



AC/DC Adapter, High Chan., 3Mbps, Pre-scan and Final Data (Horizontal)

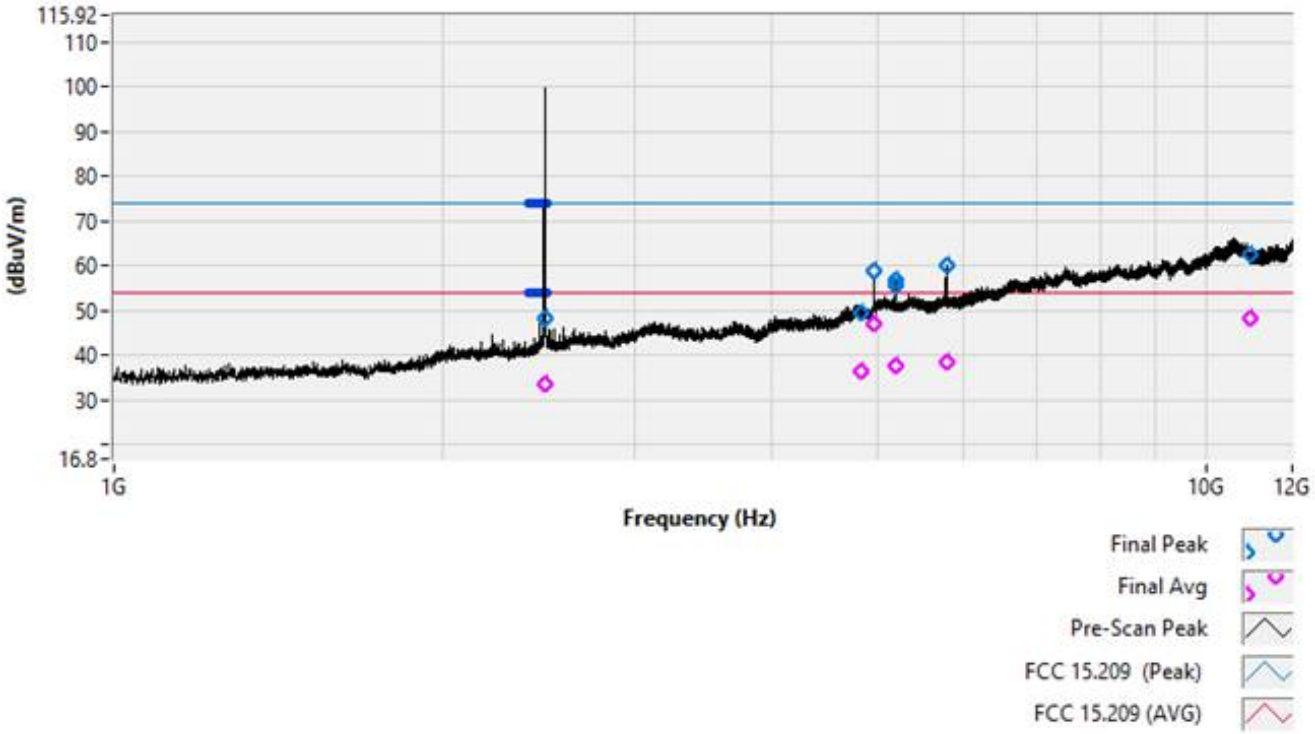
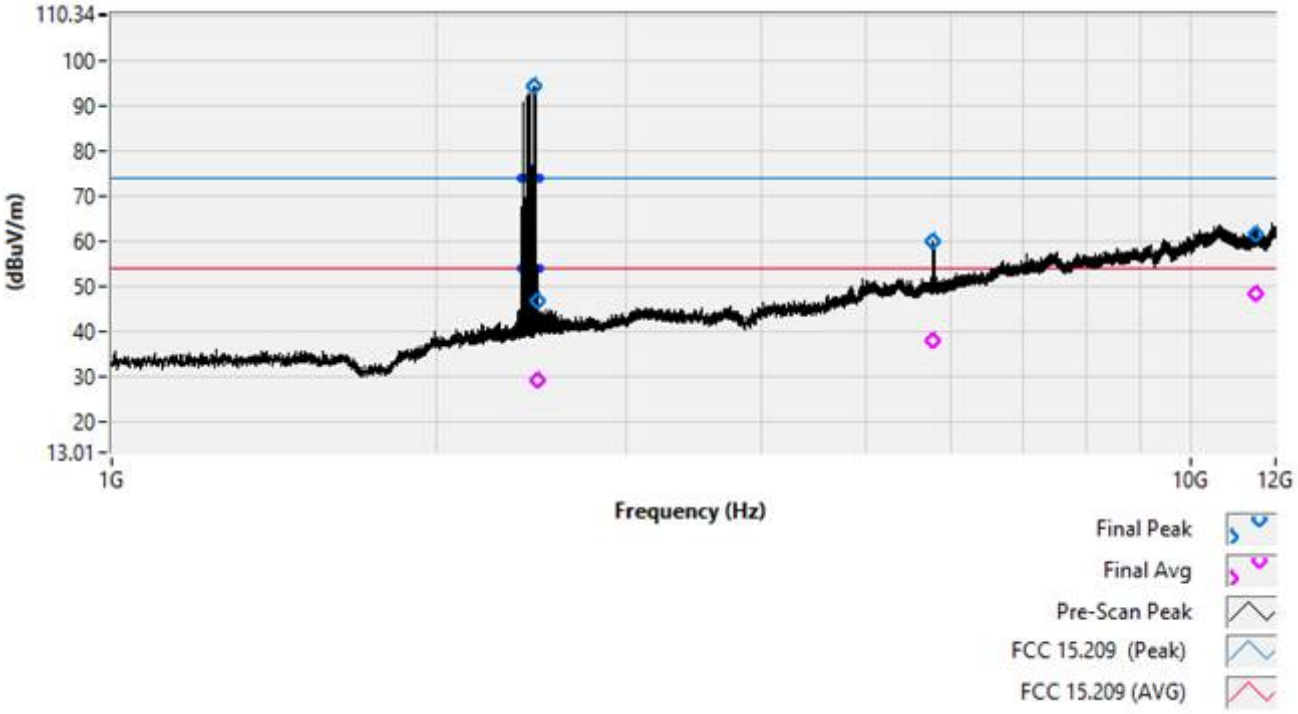


Table 19: Radiated Emissions, 1GHz to 25GHz, 20V Battery, Hopping Mode, 1Mbps

Frequency (GHz)	Detector	Corr. Meas (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Turn Table (deg)	Antenna (cm)
2.4835	Peak	47.931	74	-26.069	213	Horiz, 115
	Avg	29.266	54	-24.734	213	Horiz, 115
4.954	Peak	55.289	74	-18.711	213	Horiz, 115
	Avg	36.947	54	-17.053	213	Horiz, 115
5.781	Peak	59.883	74	-14.117	252	Vert, 190
	Avg	37.840	54	-16.160	213	Vert, 115
11.500 *	Peak	61.393	74	-12.607	213	Vert, 115
	Avg	47.420	54	-6.580	213	Vert, 115

* Ambient

20V Battery, Hopping Mode, 1Mbps, Pre-scan and Final Data (Vertical)



20V Battery, Hopping Mode, 1Mbps, Pre-scan and Final Data (Horizontal)

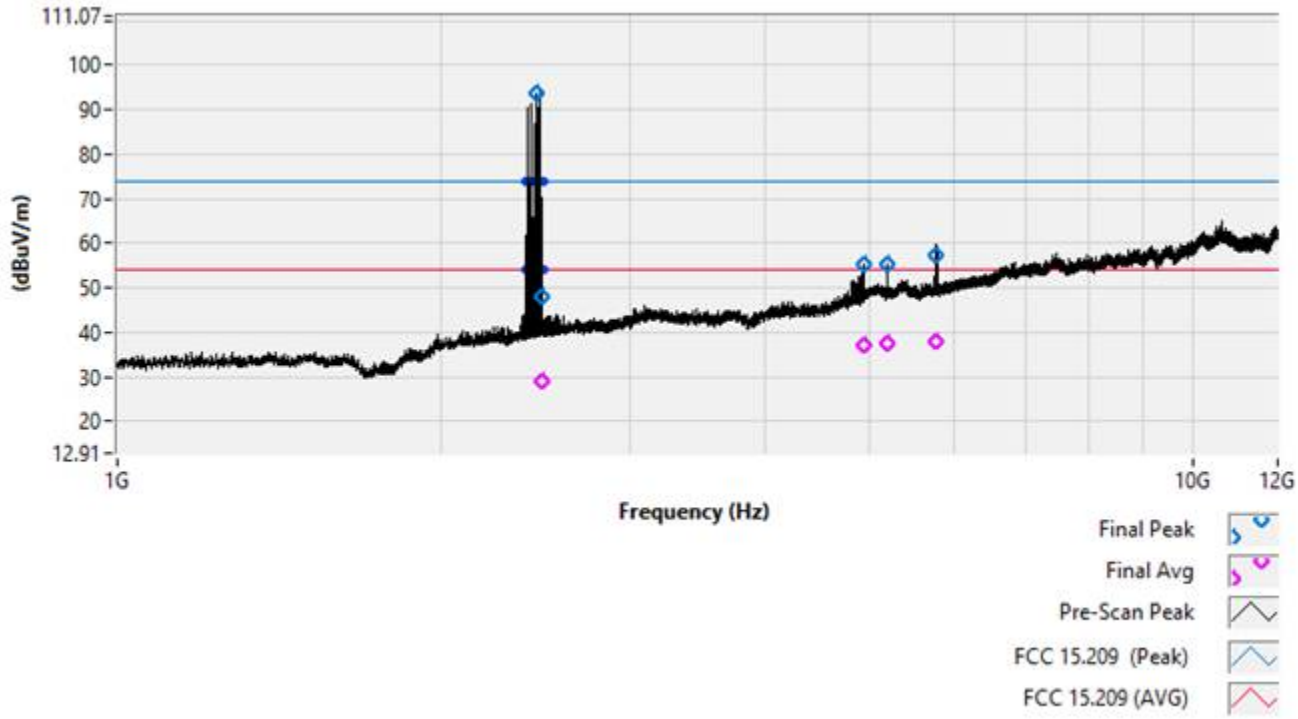
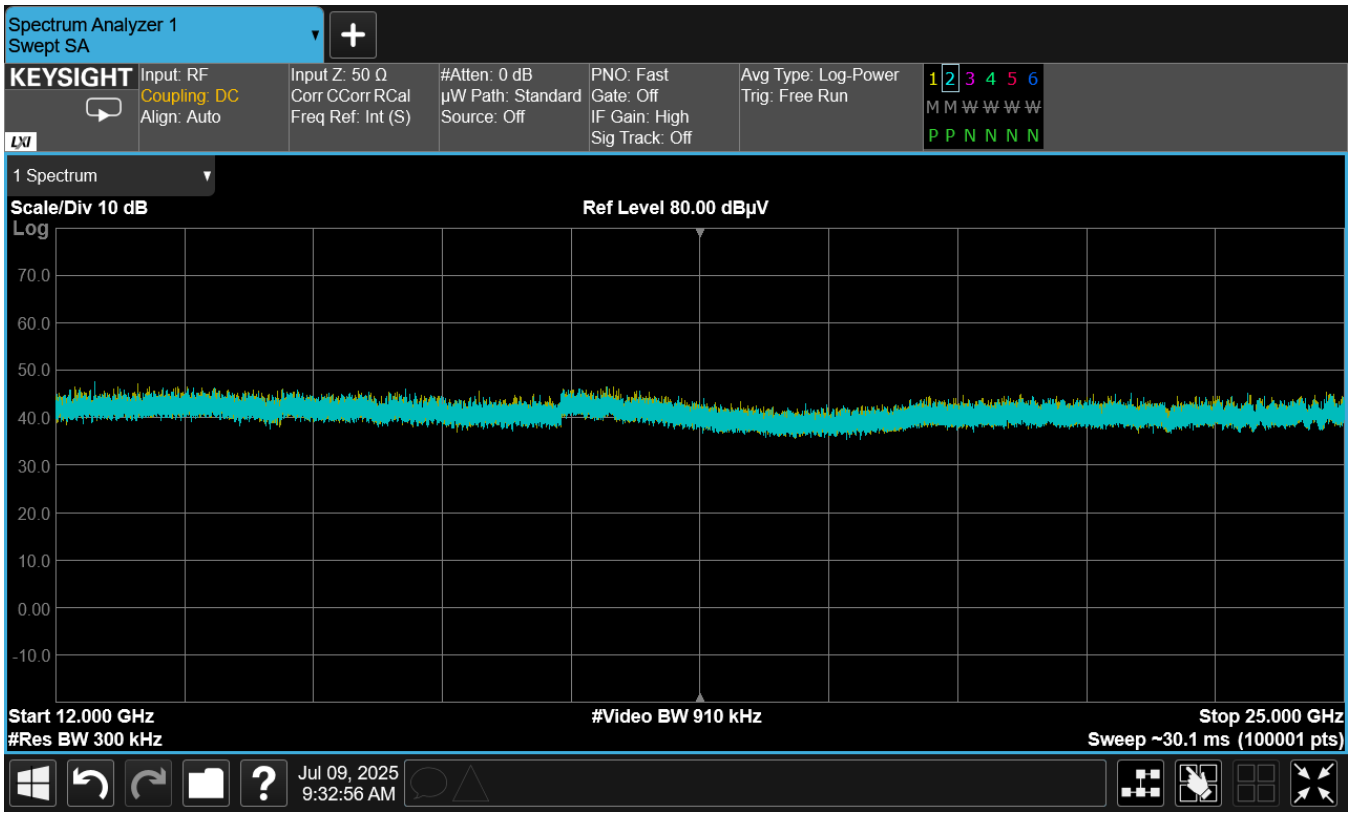


Figure 36: All Modes, Radiated Test Data, 12GHz to 25GHz, AC/DC Adapter, Worst-Case

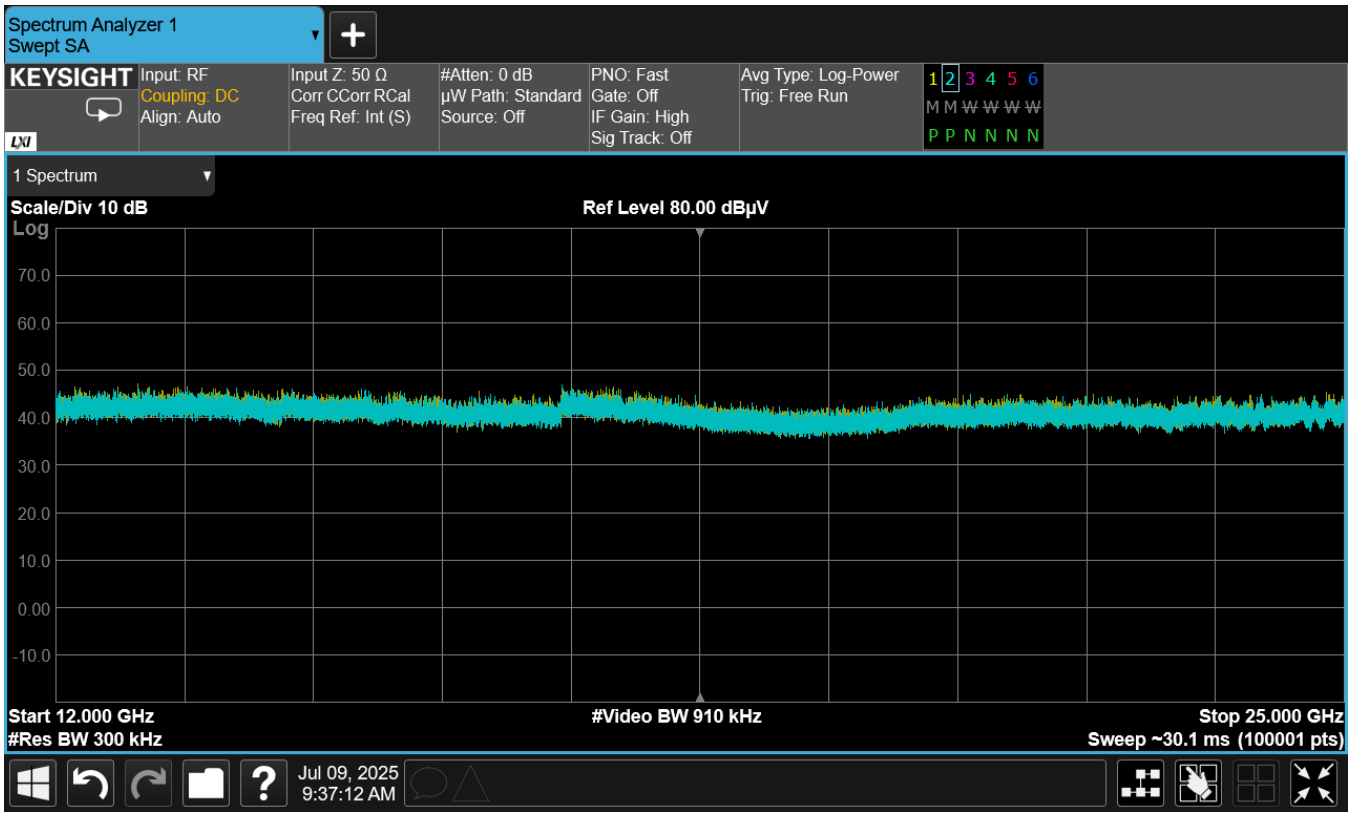


Trace 1 = EUT On

Trace 2 = Ambient

* no emissions detected (3-meters)

Figure 37: All Modes, Radiated Test Data, 12GHz to 25GHz, 20V Battery, Worst-Case



Trace 1 = EUT On

Trace 2 = Ambient

* no emissions detected (3-meters)

3.9 AC Powerline Conducted Emissions

3.9.1 Requirements

Compliance Standard: FCC Part 15.207

FCC Compliance Limits		
Frequency Range	Class B Digital Device	
	Quasi-peak	Average
0.15 – 0.5 MHz	66 to 56 dBµV	56 to 46 dBµV
0.5 – 5 MHz	56 dBµV	46 dBµV
0.5 – 30 MHz	60 dBµV	50 dBµV

3.9.2 Test Procedure

The requirements of FCC Part 15 and ICES-003 call for the EUT to be placed on an 80cm-high 1 X 1.5-meter non-conductive table above a ground plane. Power to the EUT was provided through 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. 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.

These emissions must meet the limits specified in §15.207 for quasi-peak and average measurements.

3.9.3 Conducted Data Reduction and Reporting

The comparison between the Conducted emissions level and the FCC limit is calculated as shown in the following example:

Spectrum Analyzer Voltage:	VdBµV(raw)
LISN Correction Factor:	LISN dB
Cable Correction Factor:	CF dB
Voltage:	VdBµV = V dBµV (raw) + LISN dB + CF dB

3.9.4 Test Data

The EUT complies with the AC power conducted emissions requirements.

The following EUT configurations were tested and evaluated:

4. AC/DC adapter only, Tx Off
5. AC/DC adapter only, Tx On, 3Mbps, Low Chan.
6. AC/DC adapter, Tx On, 2Mbps, Hopping Mode
7. AC/DC adapter, + 20V battery docked in Port 9, Tx On, 3Mbps, Low Chan.
8. AC/DC adapter, + 20V battery docked in Port 9, Tx On, 1Mbps, Hopping Mode

The EUT was scanned and tested more than 10 times. The EUT was evaluated at all data rates and input voltages. The low, center, and high channels were investigated. The test results are very comparable for all modes and channels. The EUT is fully compliant and meets the requirements for AC powerline emissions.

Table 20: AC Power Conducted Emissions Test Data, Line/Phase (Worst-Case)

Frequency (kHz)	Detector	Corr. Meas (dBuV)	Limit (dBuV)	Delta (dB)
154.497	Peak	55.793	--	--
	QP	46.169	65.755	-19.586
	Avg	30.702	55.755	-25.053
167.989	Peak	45.314	--	--
	QP	43.671	65.059	-21.388
	Avg	28.595	55.059	-26.464
190.476	Peak	50.780	--	--
	QP	41.885	64.016	-22.131
	Avg	26.115	54.016	-27.901
257.936	Peak	49.505	--	--
	QP	34.085	61.498	-27.413
	Avg	22.187	51.498	-29.311
365.873	Peak	26.213	--	--
	QP	25.007	58.594	-33.587
	Avg	15.447	48.594	-33.147
631.217	Peak	36.516	--	--
	QP	32.510	56	-23.49
	Avg	23.956	46	-22.044
635.714	Peak	35.988	--	--
	QP	31.373	56	-24.627
	Avg	22.685	46	-23.315

Figure 38: All Modes, AC Power Emissions Test Data, Line/Phase (Worst-Case)

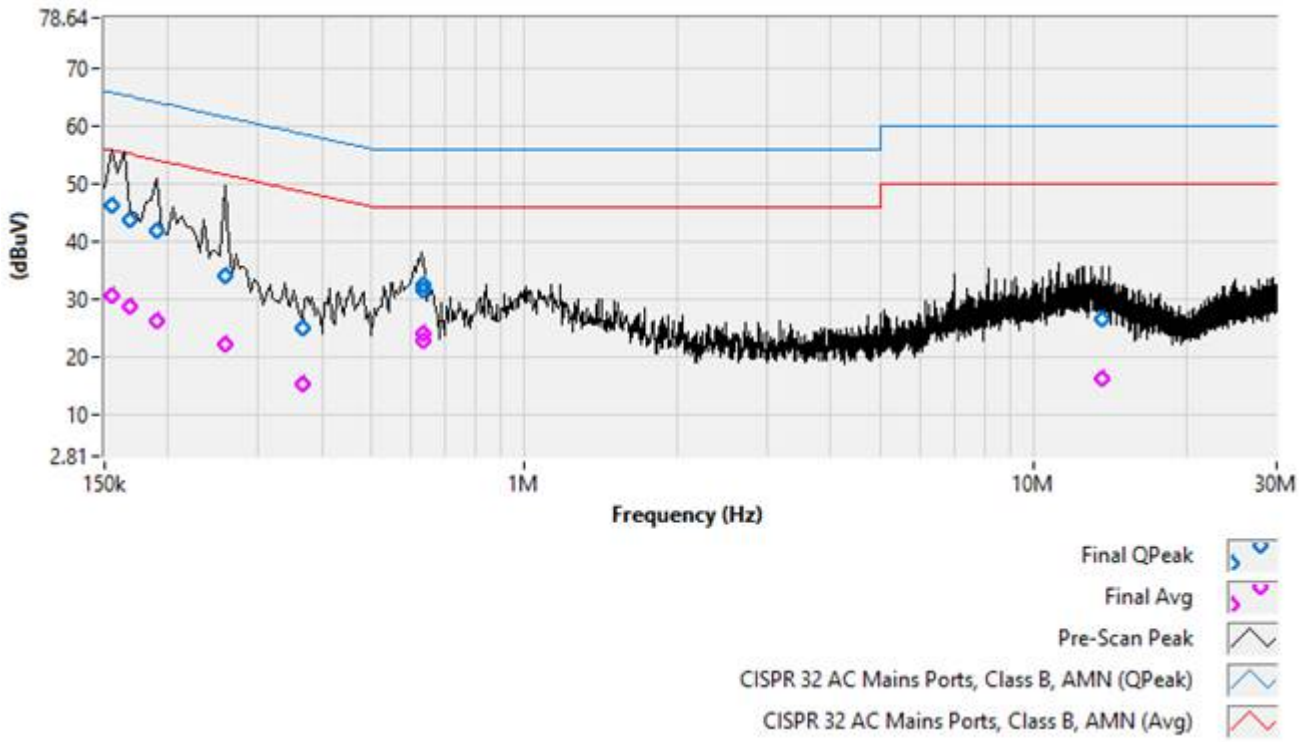
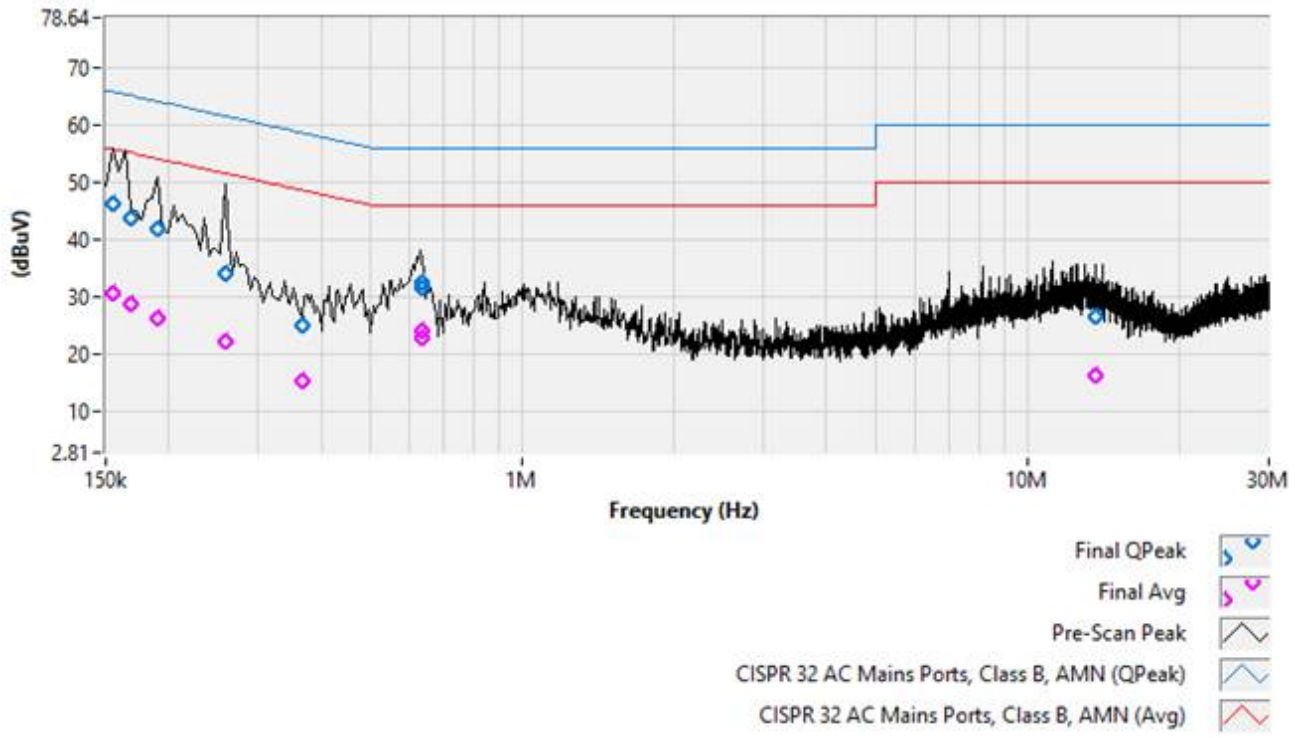


Table 21: AC Power Conducted Emissions Test Data, Neutral (Worst-Case)

Frequency (kHz)	Detector	Corr. Meas (dBuV)	Limit (dBuV)	Delta (dB)
154.497	Peak	55.793	--	--
	QP	46.169	65.755	-19.586
	Avg	30.702	55.755	-25.053
167.989	Peak	45.314	--	--
	QP	43.671	65.059	-21.388
	Avg	28.595	55.059	-26.464
190.476	Peak	50.78	--	--
	QP	41.885	64.016	-22.131
	Avg	26.115	54.016	-27.901
257.936	Peak	49.505	--	--
	QP	34.085	61.498	-27.413
	Avg	22.187	51.498	-29.311
631.217	Peak	36.516	--	--
	QP	32.510	56.000	-23.490
	Avg	23.956	46.000	-22.044
635.714	Peak	35.988	--	--
	QP	31.373	56.000	-24.627
	Avg	22.685	46.000	-23.315

Figure 39: All Modes, AC Power Emissions Test Data, Neutral (Worst-Case)



4 Measurements

4.1.1 References

ANSI C63.2 (1/2016) Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 (1/2014) 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 (9/2020) American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

4.2 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 22 below.

Table 22: Expanded Uncertainty List

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

4.3 Environmental Conditions During Testing

Ambient Temperature:	16 °C
Relative Humidity:	44 %

5 Test Equipment

Table 23: Test Equipment List

Test Name:	**Benchtop RF Emissions**	Test Date: 6/10/2025 to 6/13/2025	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00823	AGILENT, N9010A	EXA SPECTRUM ANALYZER	6/21/2026
00942	AGILENT, MXA-N9020A	SPECTRUM ANALYZER	12/26/2026
00869	ULTIFLEX, UFA 2108	SMA COAXIAL CABLE	6/6/2026
N/A	WEINSCHEL, DC-25GHz	10dB ATTENUATOR	Cal. Before Use
N/A	WEINSCHEL, DC-18GHz	20dB ATTENUATOR	Cal. Before Use

Test Name:	**Radiated Emissions**	Test Date: 7/2/2025 to 7/9/2025	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00823	AGILENT, N9010A	EXA SPECTRUM ANALYZER	6/21/2026
00942	AGILENT, MXA-N9020A	SPECTRUM ANALYZER	12/26/2026
00825	CABLE ASSOC. MTC1010	SMA COAXIAL CABLE	6/17/2026
00934	HP/AGILENT 8648D	SIGNAL GENERATOR	1/2/2026
00806	MINI-CIRCUITS, CBL-SMA	6FT COAXIAL CABLE	6/17/2026
00865	STORM 874-0101-036	LOW LOSS COAXIAL CABLE	6/6/2026
00731	NARDA 4779-3	2W, 3DB ATTENUATOR	6/6/2025
00276	ELECTRO-METRICS	RF PRE-AMPLIFIER	4/18/2026
00066	HP, BZ-01545-282525	HF PRE-AMPLIFIER	8/21/2025

Test Name:	**AC Mains Conducted Emissions**	Test Date: 7/10/2025	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00942	AGILENT MXA-N9020A	SPECTRUM ANALYZER	12/26/2026
00053	HP, 11947A	TRANSIENT LIMITER	1/16/2026
00125	SOLAR, LISN	8028-50-TS-24-BNC	4/1/2026
00126	SOLAR, LISN	8028-50-TS-24-BNC	4/1/2026
00330	WLL, BNC CABLE	CE SITE 1 CABLE	7/15/2026