FCC & ISED CANADA CERTIFICATION TEST REPORT

for the

NA557427 BLE MODULE

FCC ID: YJ7-NA557427

IC ID: 9082A-NA557427

WLL REPORT# 19110-01 REV 2

Prepared for:

Stanley Black & Decker, Inc.

701 East Joppa Road

Towson, Maryland 21286

Prepared By:

Washington Laboratories, Ltd.

4840 Winchester Blvd., Suite 5

Frederick, Maryland 21703

Testing Certificate AT-1448

FCC & ISED Canada Certification Test Report

for the

Stanley Black & Decker, Inc.

NA557427 BLE Module

FCC ID: YJ7-NA557427

ISED ID: 9082A-NA557427

May 26, 2025

WLL Report# 19110-01 Rev 2

Prepared by:

Ryan Mascaro
RF Test Engineer

Reviewed by:

Steven D. Koster
President

Abstract

This report has been prepared on behalf of Stanley Black & Decker, Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for a Digital Transmission System (DTS) 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 certification test report documents the test configuration and test results for the Stanley Black & Decker, Inc., NA557427 Bluetooth LE, modular transmitter. The information provided in this report is only applicable to the device herein documented as the EUT.

Radiated testing was performed on the 3-meter Open Area Test Site (OATS) of Washington Laboratories, Ltd., located at: 4840 Winchester Boulevard, Suite 5., Frederick, MD 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, Ltd. has been accepted by the FCC and approved by ANAB under Certificate AT-1448 as an independent FCC test laboratory. The ISED Canada number for Washington Laboratories is 3035A.

The Stanley Black & Decker, Inc., NA557427, BLE Module [FCC ID: YJ7-NA557427] complies with the requirements for a Digital Transmission System (DTS) transmitter device under FCC Part 15.247 and ISED Canada RSS-247 Issue 3 (8/2023).

Revision History	Description of Change	Release Date
Rev 0	Initial Release	May 26, 2025
Rev 1	ACB Comments, dated: 5/29/2025	June 11, 2025
Rev 2	Corrections to FCC ID and Input Voltages	June 20, 2025

Table of Contents

List of Tables

List of Figures

1 Introduction

1.1 Compliance Statement

The Stanley Black & Decker, Inc., NA557427, BLE Module [FCC ID: YJ7-NA557427] complies with the requirements for a Digital Transmission System (DTS) transmitter device under FCC Part 15.247 and 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 ANSI C63.10-2020 "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". The modules were tested "stand alone" as required for modular testing and approval.

1.3 Contract Information

Customer:	Stanley Black & Decker, Inc.
Purchase Order Number:	M870325
Quotation Number:	75085

1.4 Test and Support Personnel

Washington Laboratories, LTD	Ryan Mascaro
Customer Representative	Kirwan Magdamo

1.5 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 Equipment Under Test

2.1 EUT Identification

Table 1: Device Summary

Manufacturer:	Stanley Black & Decker, Inc.
FCC ID:	YJ7-NA557427
IC ID:	9082A-NA557427
Part Number:	NA557427
HVIN:	NA557427
Frequency Range:	2402 to 2480 MHz
Peak Output Power:	-0.64 dBm (0.00086W)
Antenna Type:	Ceramic Chip, +2.93dBi peak gain (see Section 2.5.1)
FCC Emission Designator:	706KG1D
IC Emission Designator:	2M86G1D
6dB Occupied Bandwidth:	705.7 kHz
99% Occupied Bandwidth:	2086.2 kHz
Protocol:	Bluetooth Low Energy (BLE)
Modulation and Data Rate:	GFSK (1Mbps)
	π/4DQPSK (2Mbps)
Keying:	Automatic
Type of Information:	Digital
Number of Data Channels:	40
Interface Cables:	N/A
Power Source & Voltage:	5VDC
Worst-Case Spurious Emission:	-43.08 dBm (conducted) @ 2.352 GHz (see Figure 23)
Software/Firmware Version:	Not Specified
Testing Dates:	4/21/2025 to 5/13/2025 & 6/11/2025

2.2 EUT Description

The NA557427 (BLEM) is designed for tracking, locating, enabling/disabling, and customizing DeWalt battery-powered devices via the DeWalt Site Manger app and DeWalt asset gateway.

2.3 Test Configuration and Algorithm

The NA557427 BLE Module was provided in a variety of engineering samples that were configured for testing. The EUT samples were loaded with test-mode software/firmware to allow individual samples to dwell, hop, sweep, and/or receive only as needed for required testing. The EUT was tested in a powered on, steady state. The 2.4GHz BLE radio was exercised as necessary to meet the requirements of the testing. For conducted measurements, the BLE radio was observed through the uFl antenna port. For radiated emissions below 1GHz, the EUT was set to transmit in mode that sweeps through the ISM band. For radiated emissions above 1GHz, the EUT was set to transmit at the each of the Low, Center, and High Channels. Only the worst-case emissions are provided throughout this report. Additionally, for transmit power setting, or transmit gain setting, the test-mode software was set to a value of "0". This setting was maintained for all testing.

2.4 Deviations to the Test Standard

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

2.5 EUT Configuration Details

The EUT was comprised of the following equipment, provided on the following page. All Modules, PCBs, etc. listed were considered as part of the EUT, as tested. Table 2 provides a detail of the EUT samples that were tested.

2.5.1 Customer Supplied, EUT Information

Please note that the customer has provided the information on the transmitting antenna. The test laboratory is not responsible for verifying the accuracy of this information.

Table 2: EUT System Configuration List

Name / Description	Model Number	Part Number	Serial Number	Rev. #
NA557427 Conducted	--	NA557427	COND	D
NA557427 Radiated Low	--	NA557427	2402	D
NA557427 Radiated Mid	--	NA557427	2440	D
NA557427 Radiated High	--	NA557427	2480	D
NA557427 Radiated Hopping	--	NA557427	HOP	D
NA557427 Production	--	NA557427	PROD	D

Table 3: Support Equipment

Name / Description	Manufacturer	Model Number	Calibration Data
USB to UART Cable	FTDI	TTL-232R-5V	--
Laptop	--	--	--
DC Power Supply	--	--	--
Coin Battery	SDB	--	--

Table 4: Cable Configuration

Ref. ID	EUT Port Name	Cable Description	Qty.	Length (m)	Shielded	Termination Port ID
1	J2	V_{IN}, UART TX, GND, UART RX	1	1.8	No	PC
2	J3	Coin Cell Power	1	0.155	Yes	VDC
3	RF OUT	TX Output, Coax.	1	0.50	Yes	EMI Receiver

Figure 1: EUT Testing Arrangement (Example Only)

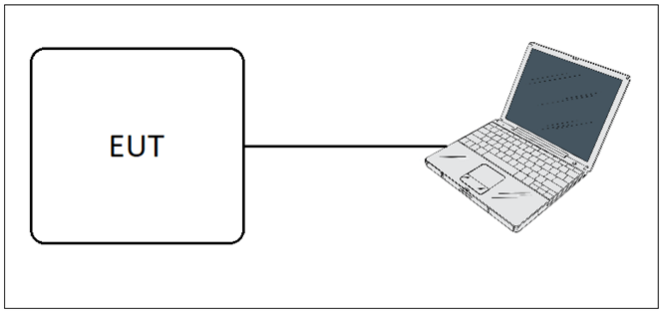
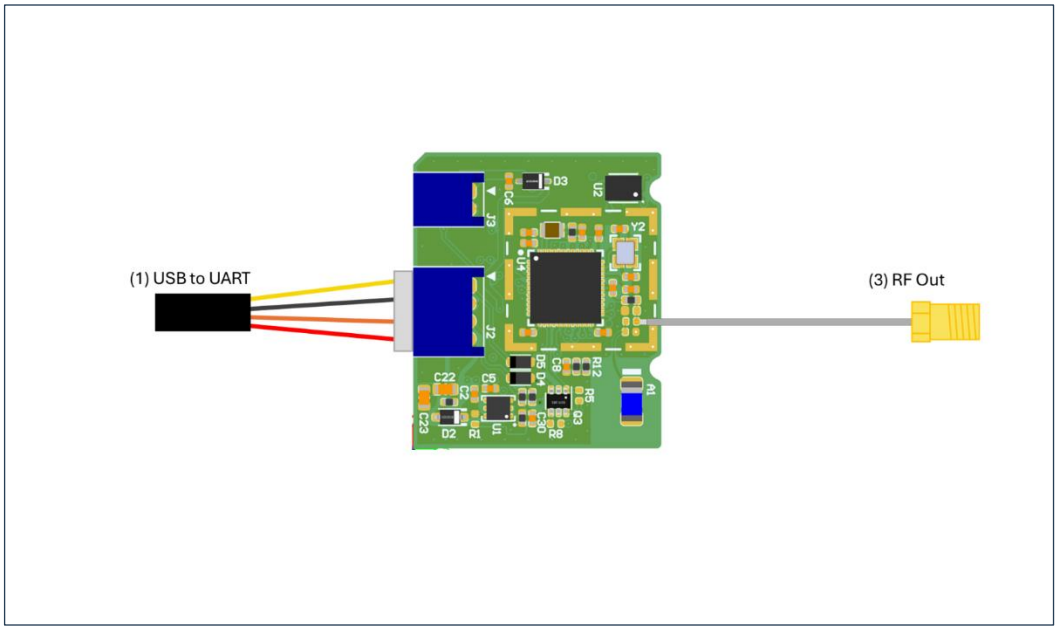


Figure 2: EUT Sample Configuration (Example Only)



3 Test Results

The table below shows the results of testing for compliance with a Digital Transmission System in accordance with FCC Part 15.247 and RSS-247 Issue 3. Full test results are shown in subsequent sub-sections.

Table 5: Testing and Results Summary

FCC Rule Part	IC Rule Part	Description	Result
15.247(a)(2)	RSS-247 [5.2 (a)]	Occupied Channel Bandwidth	Pass
15.247 (b)(3)	RSS-247 [5.4 (d)]	Transmit Output Power	Pass
15.247 (e)	RSS-247 [5.2 (b)]	Power Spectral Density	Pass
15.247 (d)	RSS-247 [5.5]	Out-of-Band Emissions (Band Edge @ 20dB below)	Pass
15.205 15.209	RSS-Gen [8.9/8.10]	General Field Strength Limits (Restricted Bands & RE Limits)	Pass
15.207	RSS-Gen [8.8]	AC Powerline Conducted Emissions	Pass

3.1 DTS Occupied Bandwidth

For a DTS operating in the 2.4GHz band, FCC Rule Part 15.247(a)(2) and RSS-247, 5.2(a) require the minimum 6dB bandwidth be at least 500 kHz. The 99% BW shall also be recorded.

The transmitter occupied bandwidth was measured conducted at the antenna port, by coupling the output of the EUT transmitter to the input of a spectrum analyzer. The measurement level was corrected for any cable and attenuator losses.

3.1.1 Measurement Method

This test was performed in accordance with Clause 11.8.2, Option 2, of ANSI C63.10-2020.

3.1.2 Test Data

The EUT test data is provided below.

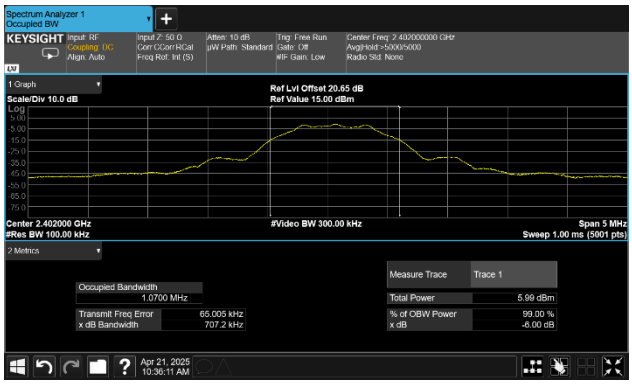
The EUT was configured to transmit a modulated signal, with channel hopping disabled.

Table 6: Occupied Channel Bandwidth Test Results

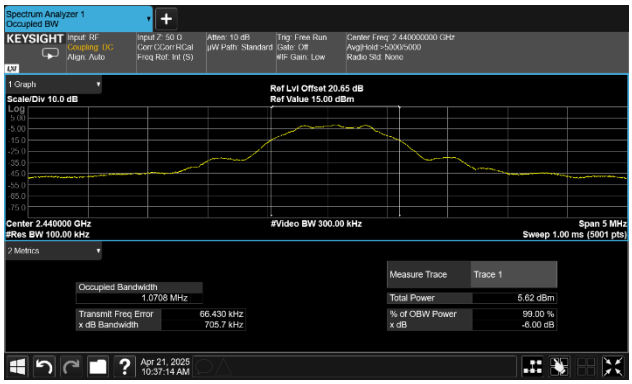
1Mbps, GFSK		**DTS Bandwidth in kHz**					
Channel	Frequency (MHz)			**5V**			
				6dBc	99%		
37	2402			707.2	1070.0		
17	2440			705.7	1070.8		
39	2480			711.8	1073.1		
2Mbps, π/4DQPSK		**DTS Bandwidth in kHz**					
Channel	Frequency (MHz)			**5V**			
				6dBc	99%		
37	2402			1131.0	2077.8		
17	2440			1137.0	2082.3		
39	2480			1139.0	2086.2		

Figure 3: Occupied Bandwidth, 1Mbps (DH5), 5VDC

5V, 1Mbps, Low Chan, OBW



5V, 1Mbps, Center Chan, OBW



5V, 1Mbps, High Chan, OBW

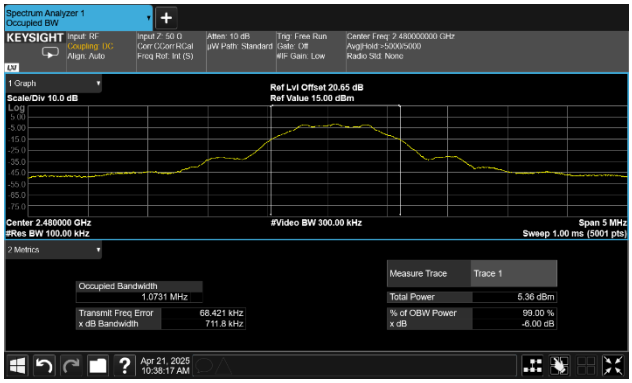
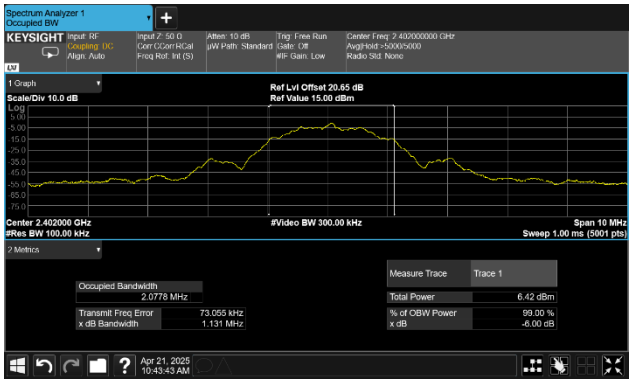
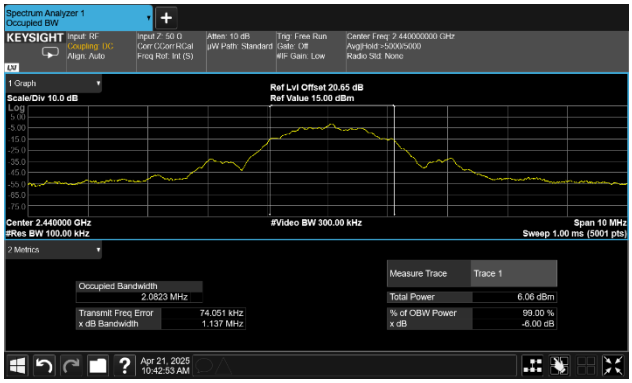


Figure 4: Occupied Bandwidth, 2Mbps (2DH5), 5VDC

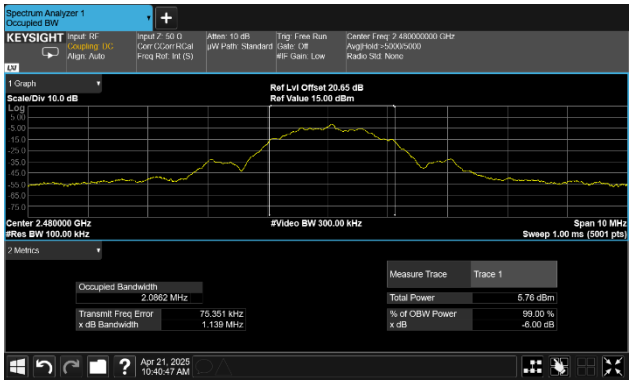
5V, 2Mbps, Low Chan, OBW



5V, 2Mbps, Center Chan, OBW



5V, 2Mbps, High Chan, OBW



3.2 Conducted Peak Output Power

For a DTS operating in the 2.4GHz band, FCC Rule Part 15.247(b)(3) and RSS-247, 5.4(d) require that the maximum peak conducted output power shall not exceed 30 dBm, or 1W. Additionally, the EIRP shall not exceed 36 dBm, or 4W.

The transmitter power was measured conducted at the antenna port, by coupling the output of the EUT transmitter to the input of a spectrum analyzer. The measurement level was corrected for any cable and attenuator losses.

3.2.1 Measurement Method

This test was performed in accordance with Clause 11.9.1.1 of ANSI C63.10-2020.

3.2.2 Test Data

The EUT test data is provided below.

The EUT was configured to transmit a modulated signal, with channel hopping disabled.

The EUT employs a SMT chip antenna with a peak gain of +2.93 dBi.

Table 7: Conducted Output Power and EIRP Test Results

1Mbps, GFSK		**Peak Channel Power in dBm**					
Channel	Frequency (MHz)			**5V**			
				Conducted	EIRP		
37	2402			-0.68	2.25		
17	2440			-1.00	1.93		
39	2480			-1.29	1.64		
2Mbps, π/4DQPSK		**Peak Channel Power in dBm**					
Channel	Frequency (MHz)			**5V**			
				Conducted	EIRP		
37	2402			-0.64	2.29		
17	2440			-0.99	1.94		
39	2480			-1.27	1.66		

Figure 5: Peak Conducted Output Power, 1Mbps (DH5), 5VDC

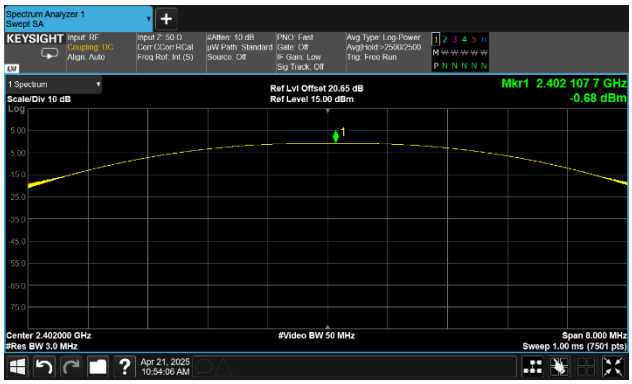
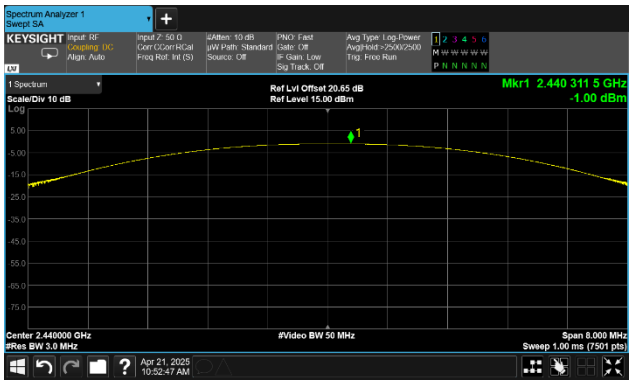
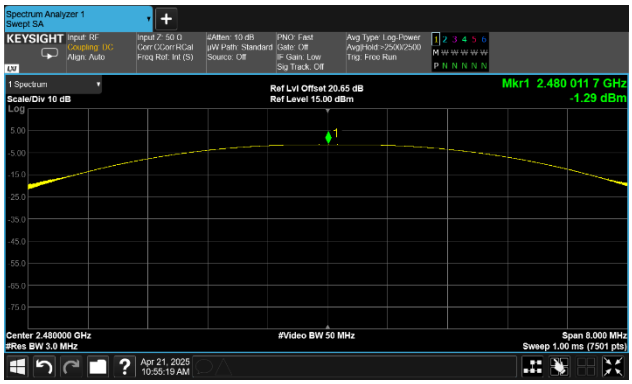
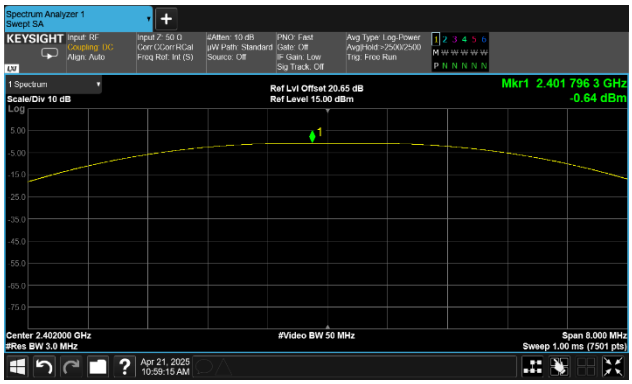
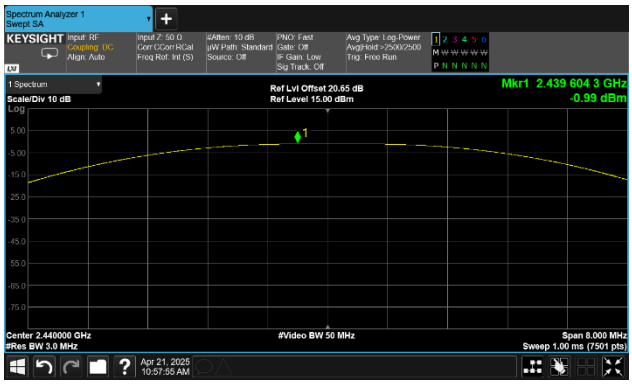
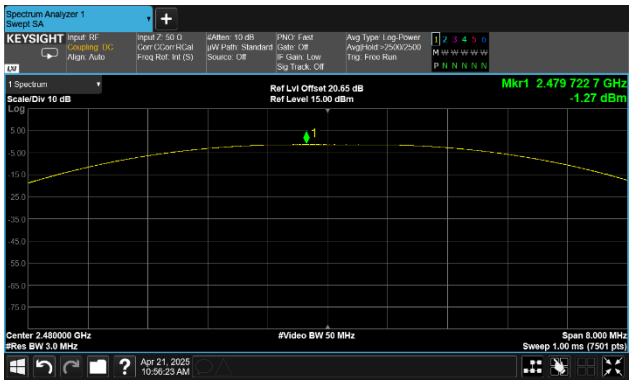
5V, 1Mbps, Low Chan, Power	5V, 1Mbps, Center Chan, Power
	
5V, 1Mbps, High Chan, Power	
	

Figure 6: Peak Conducted Output Power, 2Mbps (2DH5), 5VDC

5V, 2Mbps, Low Chan, Power	5V, 2Mbps, Center Chan, Power
	
5V, 2Mbps, High Chan, Power	
	

3.3 Power Spectral Density

For a DTS operating in the 2.4GHz band, FCC Rule Part 15.247(e) and RSS-247, 5.2(b) require that the maximum peak power spectral density shall not exceed 8 dBm in any 3 kHz band.

The transmitter peak power spectral density was measured conducted at the antenna port, by coupling the output of the EUT transmitter to the input of a spectrum analyzer. The measurement level was corrected for any cable and attenuator losses.

3.3.1 Measurement Method

This test was performed in accordance with Clause 11.10.2 of ANSI C63.10-2020.

3.3.2 Test Data

The EUT test data is provided below.

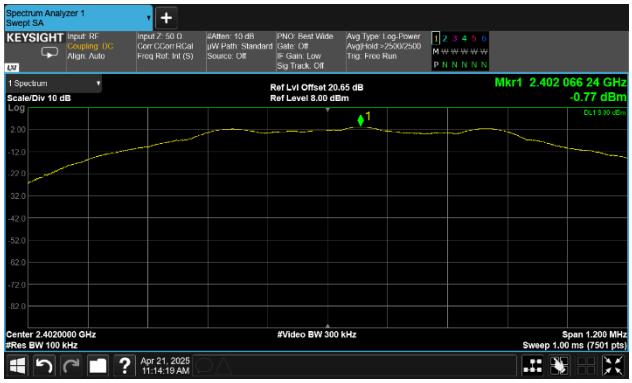
The EUT was configured to transmit a modulated signal, with channel hopping disabled.

Table 8: Power Spectral Density Test Results

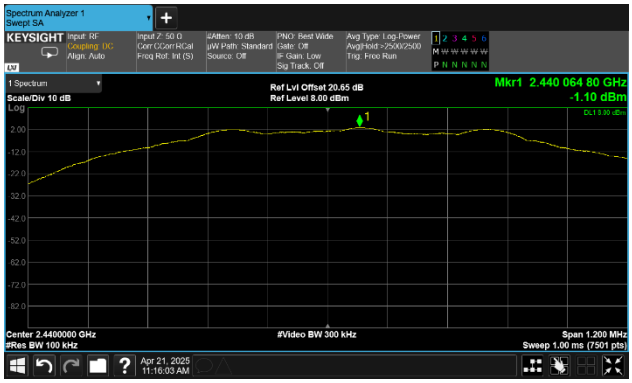
1Mbps, GFSK		**Power Spectral Density in dBm/100kHz**					
Channel	Frequency (MHz)			**5V**			
				PSD	Result		
37	2402			-0.77	Pass		
17	2440			-1.10	Pass		
39	2480			-1.38	Pass		
2Mbps, π/4DQPSK		**Power Spectral Density in dBm/100kHz**					
Channel	Frequency (MHz)			**5V**			
				PSD	Result		
37	2402			-0.74	Pass		
17	2440			-1.08	Pass		
39	2480			-1.38	Pass		

Figure 7: Power Spectral Density, 1Mbps (DH5), 5VDC

5V, 1Mbps, Low Chan, PSD



5V, 1Mbps, Center Chan, PSD



5V, 1Mbps, High Chan, PSD

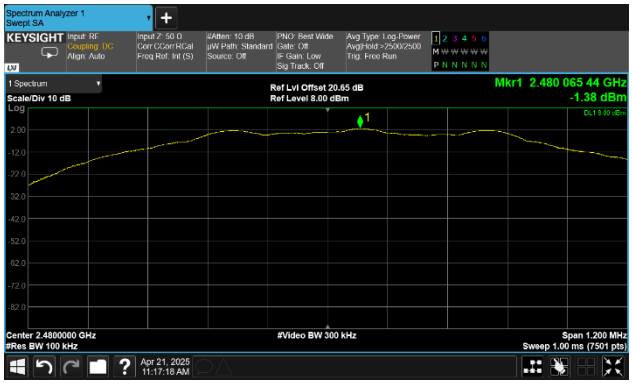
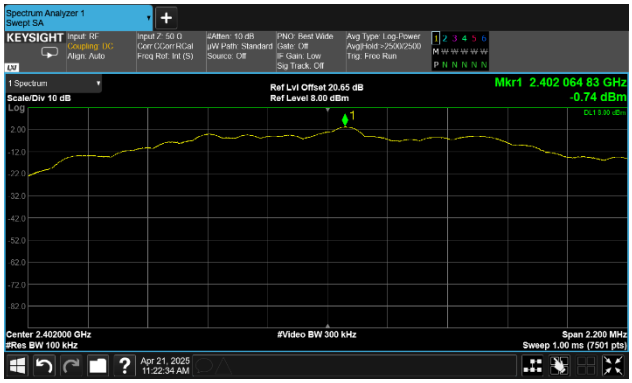
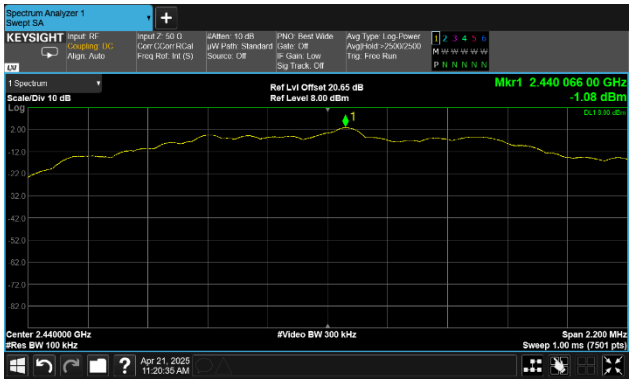


Figure 8: Power Spectral Density, 2Mbps (2DH5), 5VDC

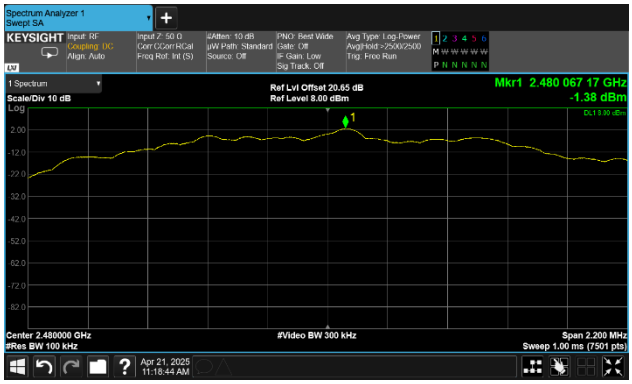
5V, 2Mbps, Low Chan, PSD



5V, 2Mbps, Center Chan, PSD



5V, 2Mbps, High Chan, PSD



3.4 Conducted Band-edge

This section provides close-up band-edge plots of the low and high channel, with respect to the nearest authorized band-edge.

For a DTS operating in the 2.4GHz band, FCC Rule Part 15.247(d) and RSS-247, 5.5 require that in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the unwanted 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.

Band-edge measurements were made conducted at the antenna port, by coupling the output of the EUT transmitter to the input of a spectrum analyzer. The measurement level was corrected for any cable and attenuator losses.

3.4.1 Measurement Method

This test was performed in accordance with Clause 6.10 through Clause 6.10.4 of ANSI C63.10-2020.

3.4.2 Test Data

The EUT test data is provided below.

The EUT was configured to transmit a modulated signal. The EUT was evaluated in two modes, channel hopping enabled and channel hopping disabled. The hopping/sweeping function had no impact on the results of this test. The worst-case band-edge is reported below.

Figure 9: Low Channel Band-Edge, 1Mbps (DH5), 5V

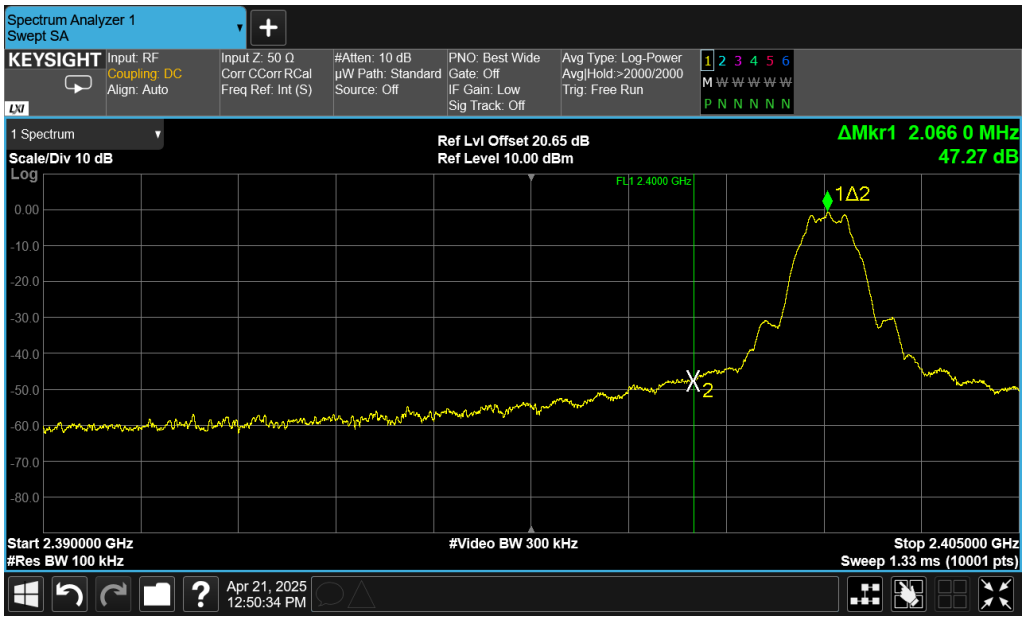


Figure 10: High Channel Band-Edge, 1Mbps (DH5), 5V

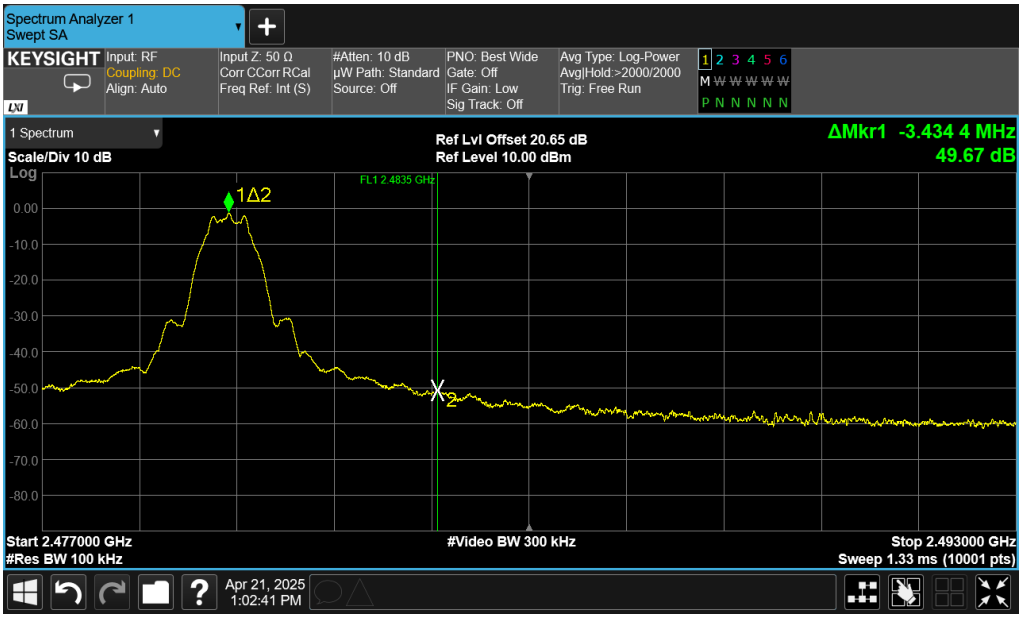


Figure 11: Low Channel Band-Edge, 2Mbps (2DH5), 5V

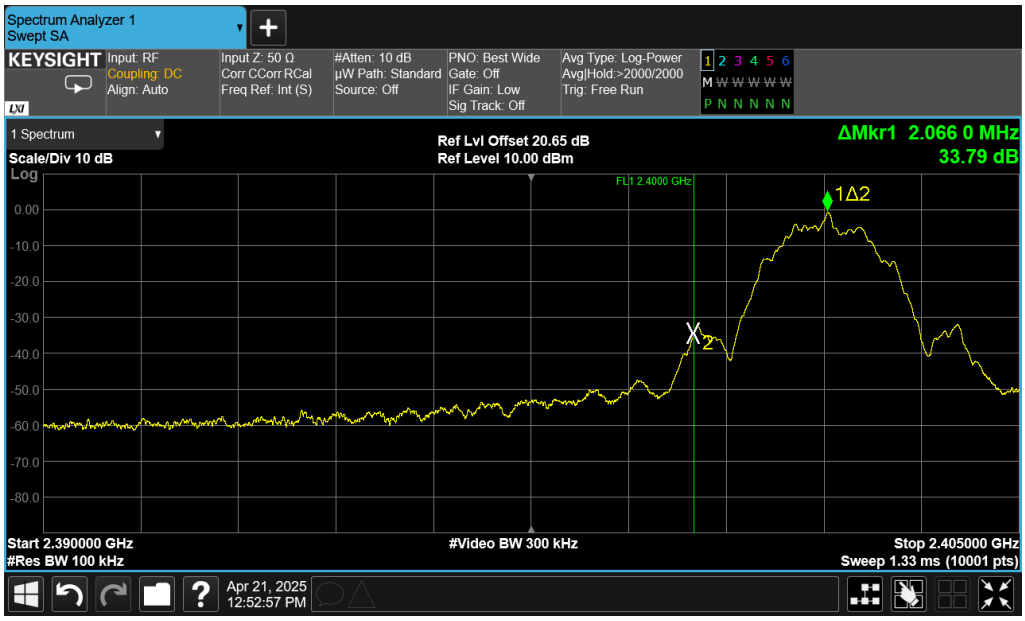
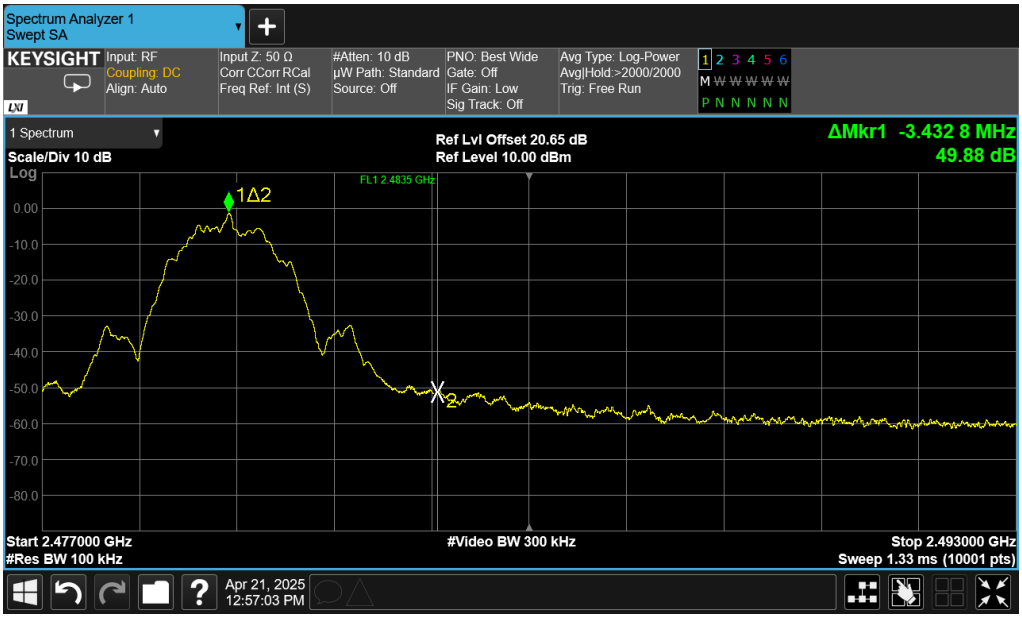


Figure 12: High Channel Band-Edge, 2Mbps (2DH5), 5V



3.5 Conducted Unwanted Spurious Emissions

For a DTS operating in the 2.4GHz band, FCC Rule Part 15.247(d) and RSS-247, 5.5 require that in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the unwanted 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.

The transmitter unwanted spurious emissions were evaluated and measured conducted at the antenna port, by coupling the output of the EUT transmitter to the input of a spectrum analyzer. The measurement level was corrected for any cable and attenuator losses.

3.5.1 Measurement Method

This test was performed in accordance with Clause 11.11 of ANSI C63.10-2020.

3.5.2 Test Data

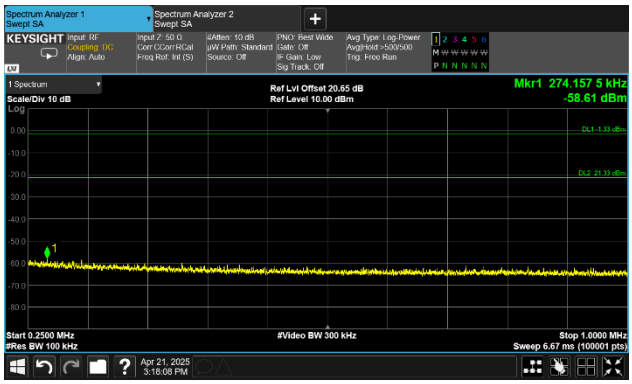
The EUT test data for the low, center, and high channels are provided below.

The EUT was configured to transmit a modulated signal, at both 1Mbps (GFSK) and 2Mbps (π/4DQPSK).

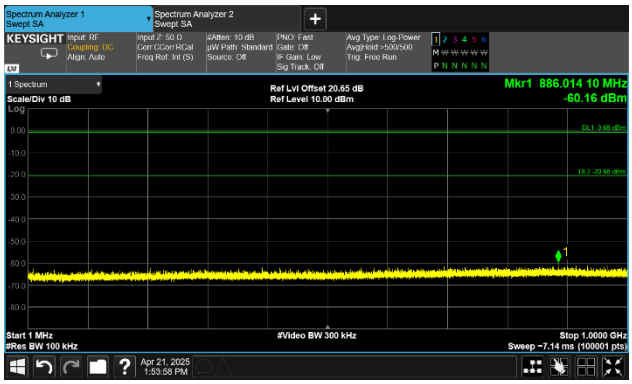
The EUT was scanned from 9kHz to 25GHz. There were no EUT emissions detected in the range of 9kHz to 250kHz.

Figure 13: Low Channel, 1Mbps (GFSK) Conducted Spurious, 5V, 250kHz to 5GHz

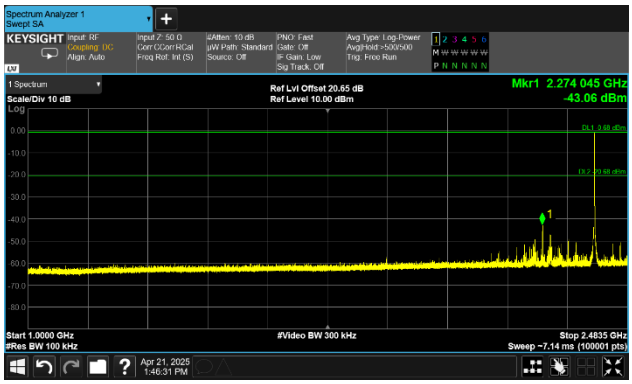
5V, 1Mbps, Low Chan, Spurs, Plot 1



5V, 1Mbps, Low Chan, Spurs, Plot 2



5V, 1Mbps, Low Chan, Spurs, Plot 3



5V, 1Mbps, Low Chan, Spurs, Plot 4

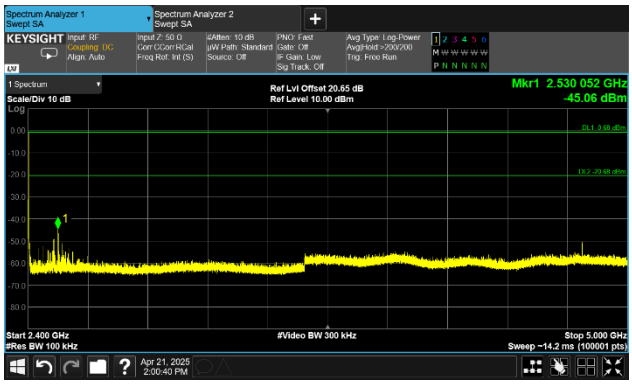


Figure 14: Low Channel, 1Mbps (GFSK) Conducted Spurious, 5V, 5GHz to 25GHz

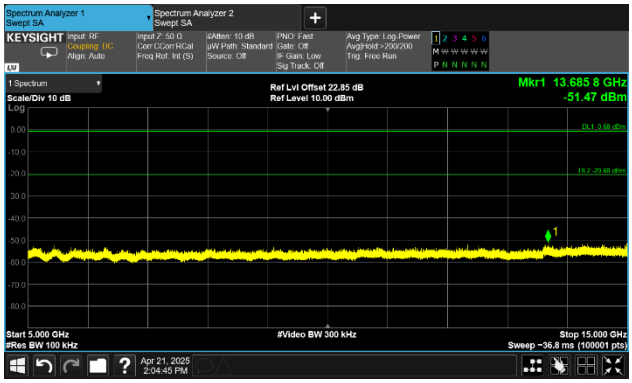
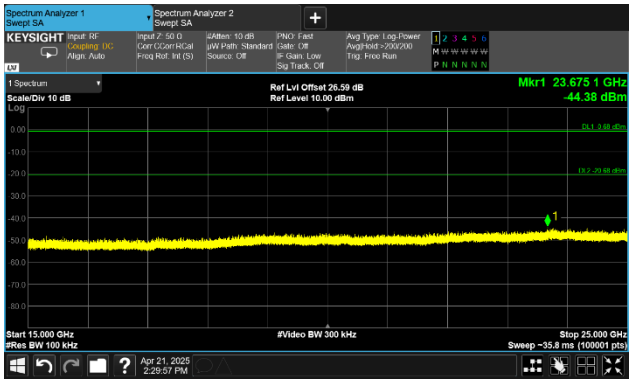
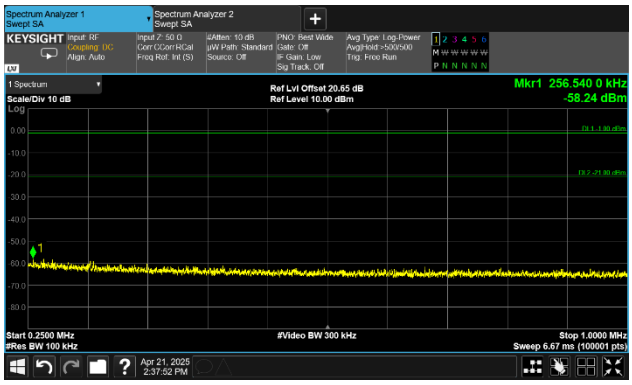
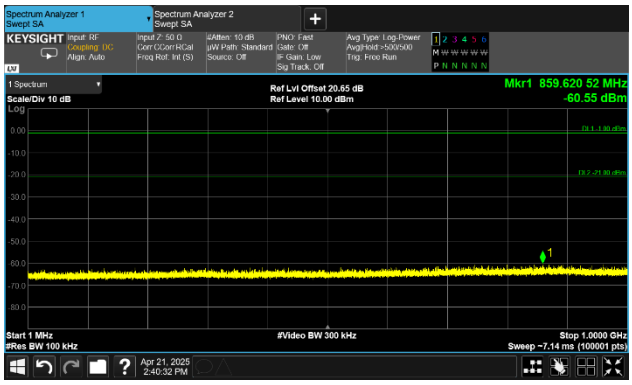
5V, 1Mbps, Low Chan, Spurs, Plot 5	5V, 1Mbps, Low Chan, Spurs, Plot 6
	

Figure 15: Center Channel, 1Mbps (GFSK) Conducted Spurious, 5V, 250kHz to 5GHz

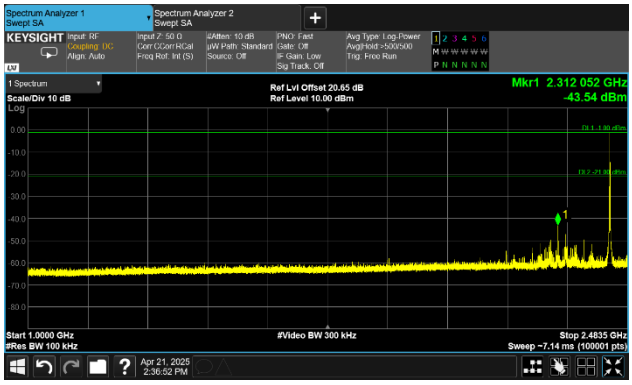
5V, 1Mbps, Center Chan, Spurs, Plot 1



5V, 1Mbps, Center Chan, Spurs, Plot 2



5V, 1Mbps, Center Chan, Spurs, Plot 3



5V, 1Mbps, Center Chan, Spurs, Plot 4

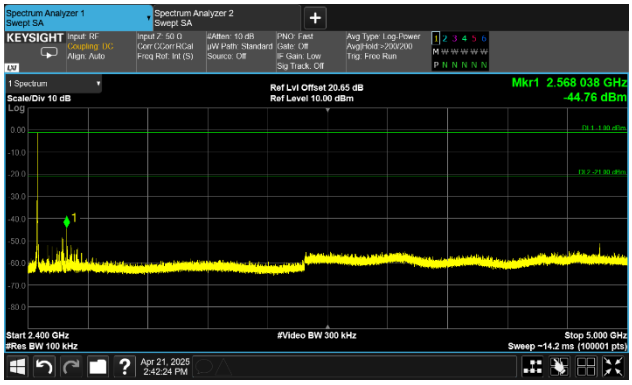


Figure 16: Center Channel, 1Mbps (GFSK) Conducted Spurious, 5V, 5GHz to 25GHz

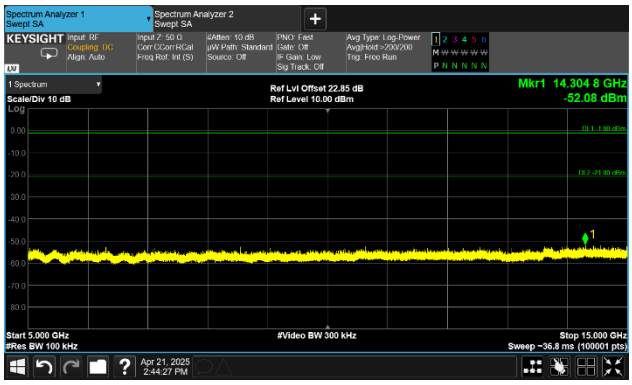
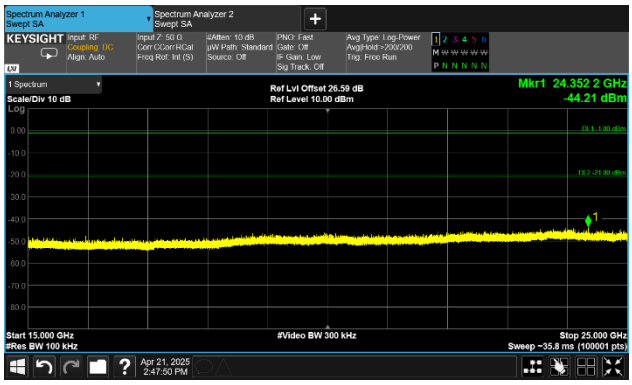
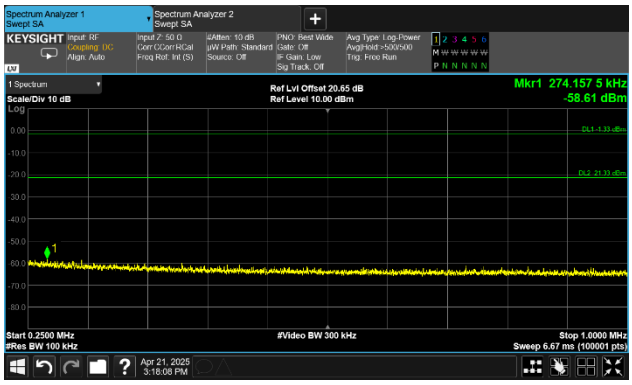
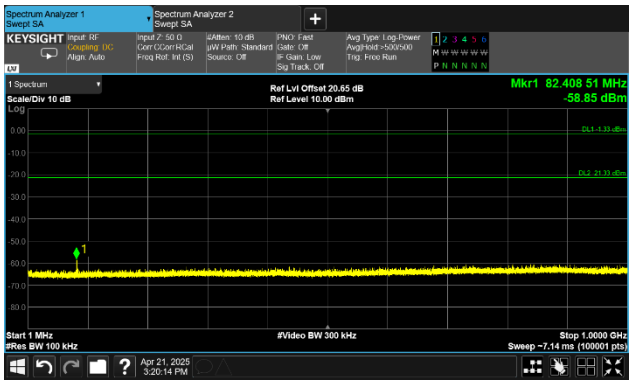
5V, 1Mbps, Center Chan, Spurs, Plot 5	5V, 1Mbps, Center Chan, Spurs, Plot 6
	

Figure 17: High Channel, 1Mbps (GFSK) Conducted Spurious, 5V, 250kHz to 5GHz

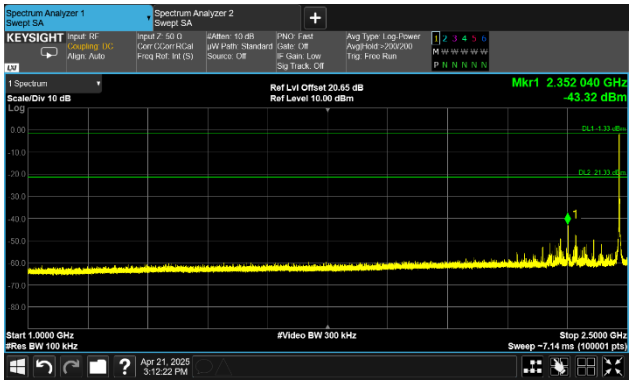
5V, 1Mbps, High Chan, Spurs, Plot 1



5V, 1Mbps, High Chan, Spurs, Plot 2



5V, 1Mbps, High Chan, Spurs, Plot 3



5V, 1Mbps, High Chan, Spurs, Plot 4

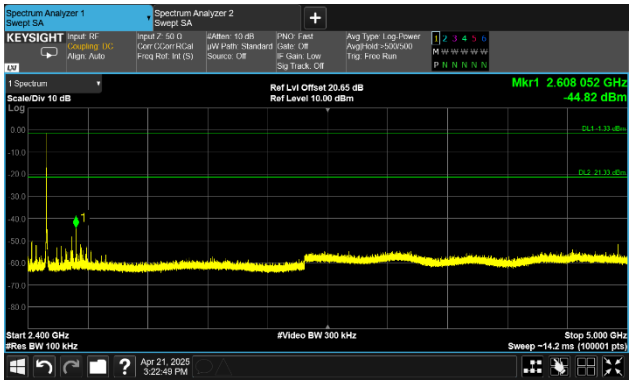


Figure 18: High Channel, 1Mbps (GFSK) Conducted Spurious, 5V, 5GHz to 25GHz

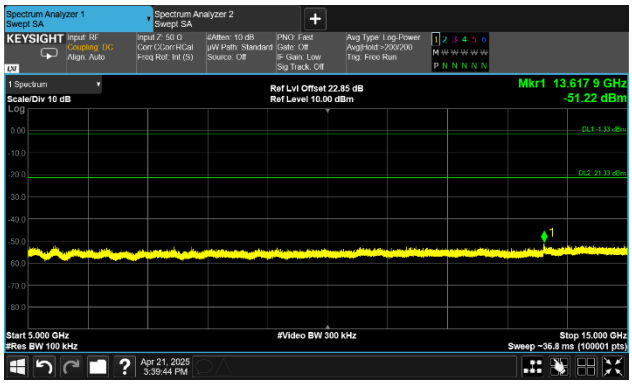
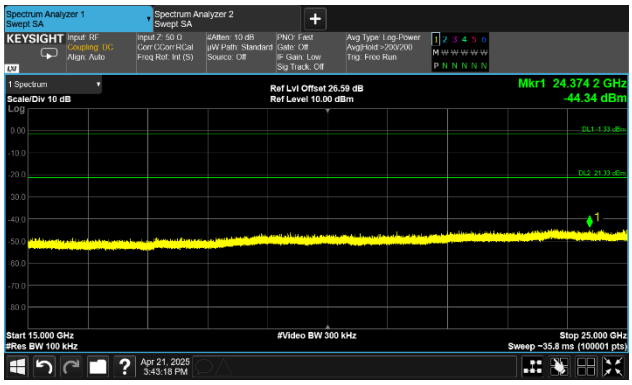
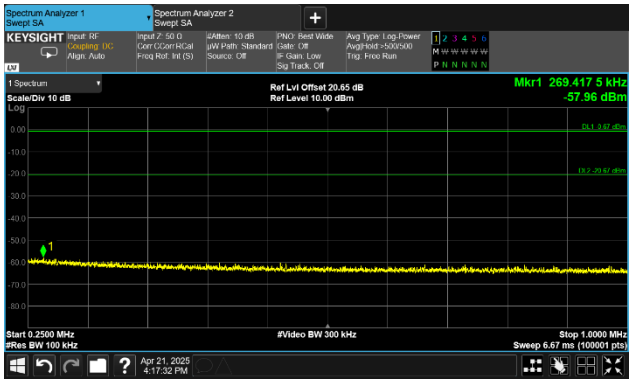
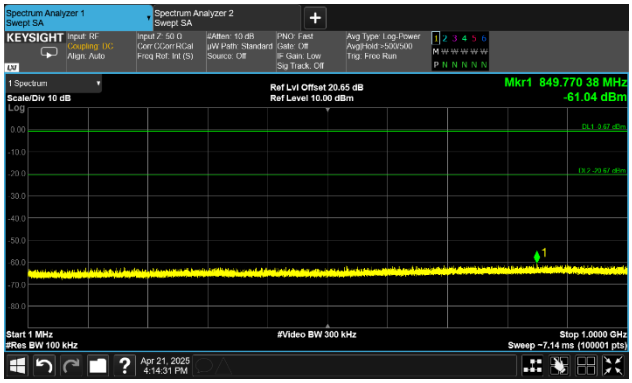
5V, 1Mbps, High High, Spurs, Plot 5	5V, 1Mbps, High Chan, Spurs, Plot 6
	

Figure 19: Low Channel, 2Mbps (π/4DQPSK) Conducted Spurious, 5V, 250kHz to 5GHz

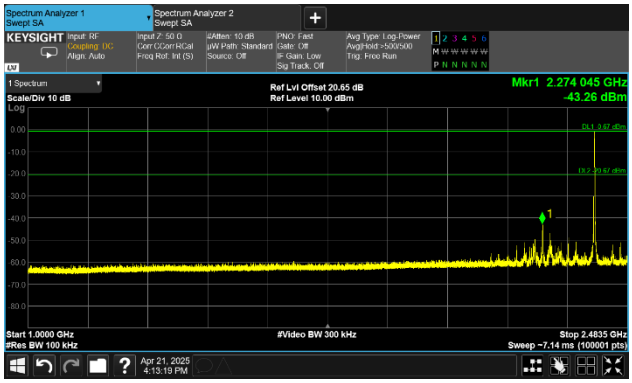
5V, 2Mbps, Low Chan, Spurs, Plot 1



5V, 2Mbps, Low Chan, Spurs, Plot 2



5V, 2Mbps, Low Chan, Spurs, Plot 3



5V, 2Mbps, Low Chan, Spurs, Plot 4

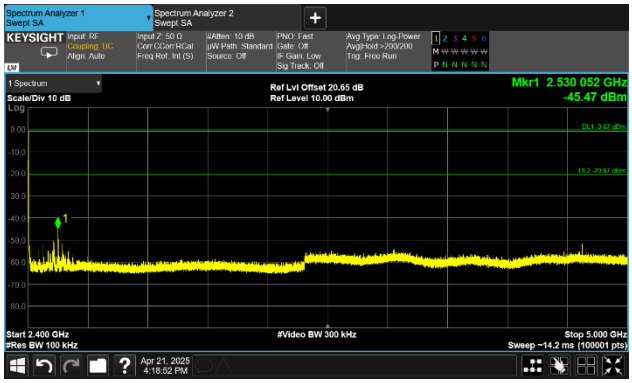


Figure 20: Low Channel, 2Mbps (π/4DQPSK) Conducted Spurious, 5V, 5GHz to 25GHz

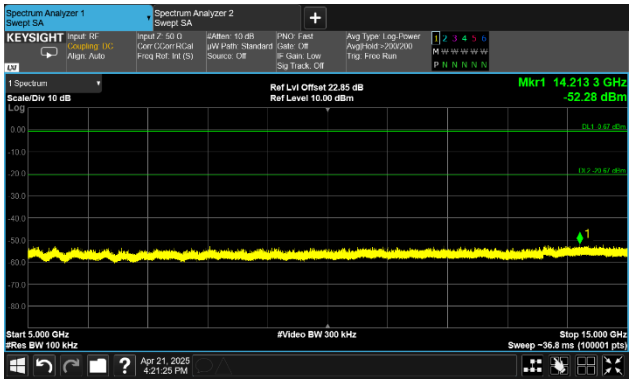
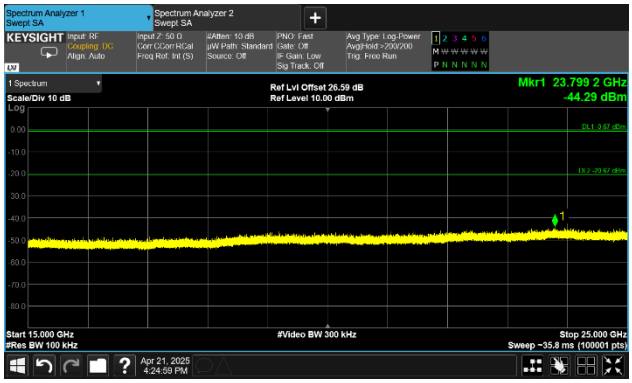
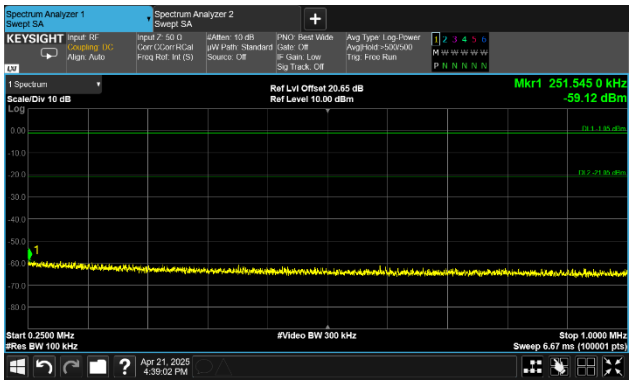
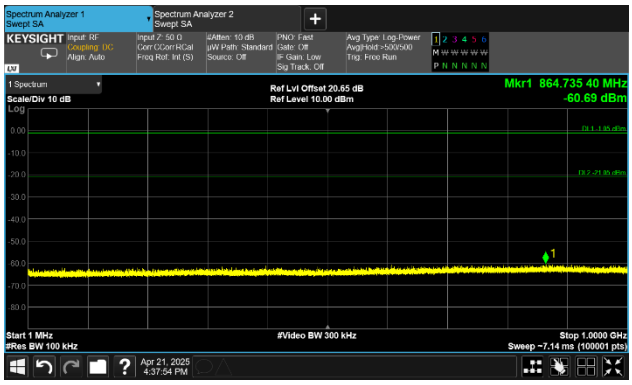
5V, 2Mbps, Low Chan, Spurs, Plot 5	5V, 2Mbps, Low Chan, Spurs, Plot 6
	

Figure 21: Center Channel, 2Mbps (π/4DQPSK) Conducted Spurious, 5V, 250kHz to 5GHz

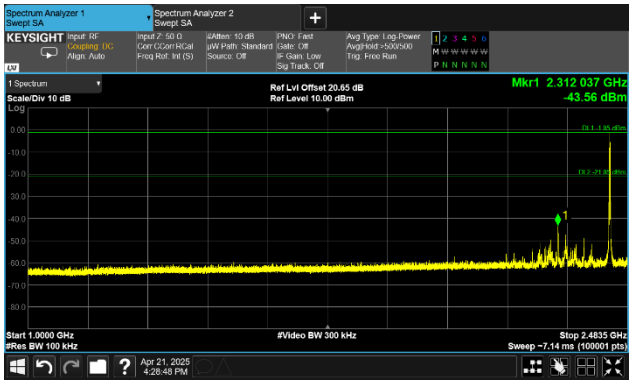
5V, 2Mbps, Center Chan, Spurs, Plot 1



5V, 2Mbps, Center Chan, Spurs, Plot 2



5V, 2Mbps, Center Chan, Spurs, Plot 3



5V, 2Mbps, Center Chan, Spurs, Plot 4

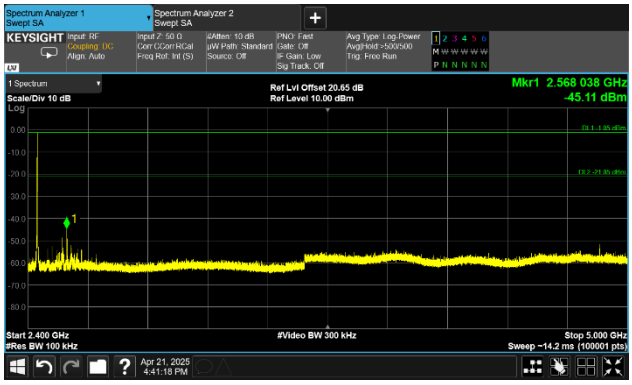


Figure 22: Center Channel, 2Mbps (π/4DQPSK) Conducted Spurious, 5V, 5GHz to 25GHz

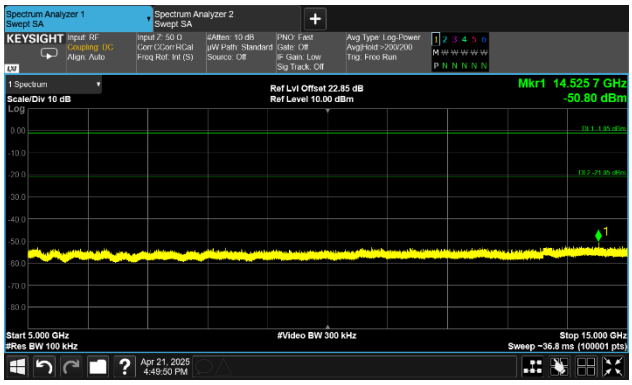
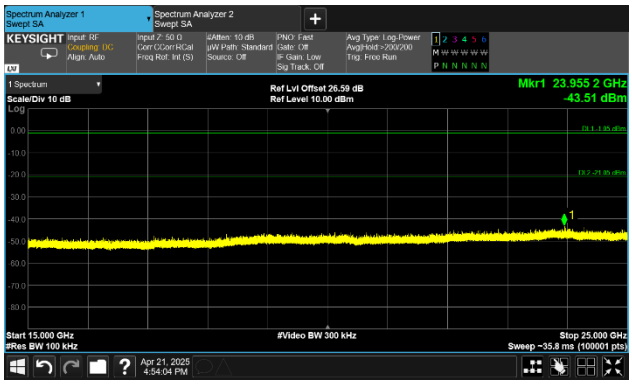
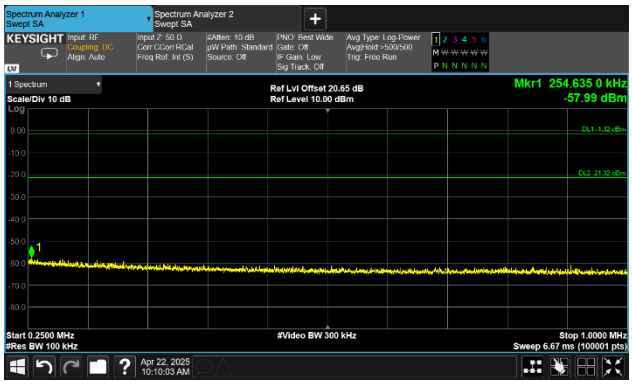
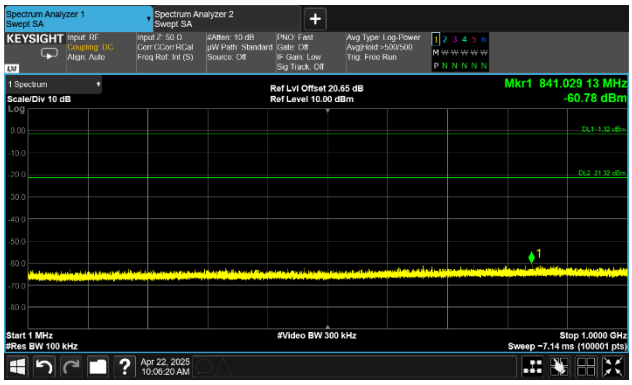
5V, 2Mbps, Center Chan, Spurs, Plot 5	5V, 2Mbps, Center Chan, Spurs, Plot 6
	

Figure 23: High Channel, 2Mbps (π/4DQPSK) Conducted Spurious, 5V, 250kHz to 5GHz

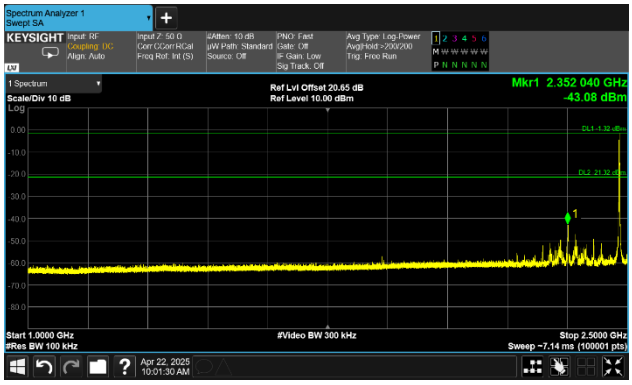
5V, 2Mbps, High Chan, Spurs, Plot 1



5V, 2Mbps, High Chan, Spurs, Plot 2



5V, 2Mbps, High Chan, Spurs, Plot 3



5V, 2Mbps, High Chan, Spurs, Plot 4

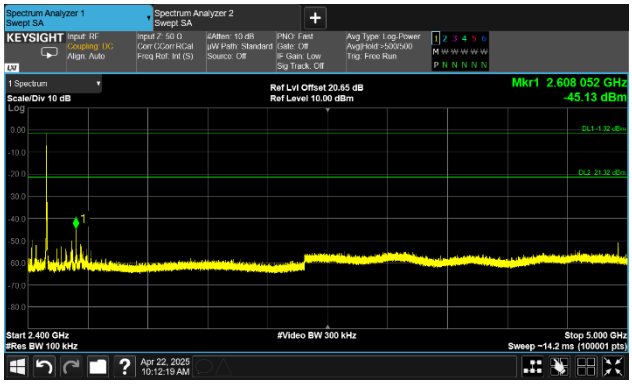
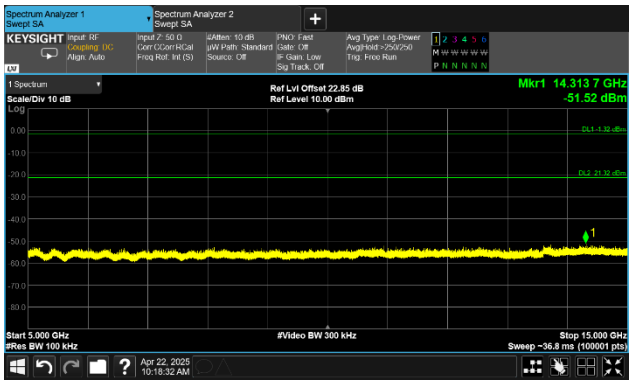
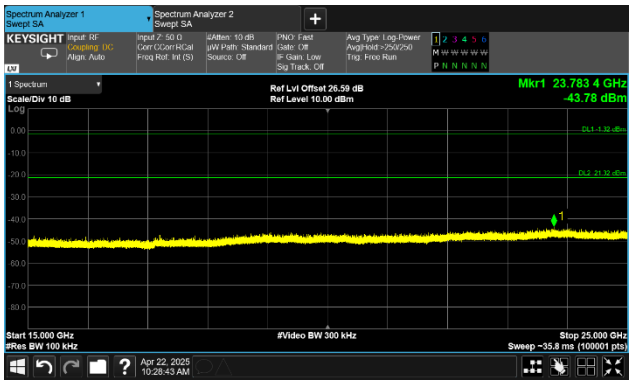


Figure 24: High Channel, 2Mbps (π/4DQPSK) Conducted Spurious, 5V, 5GHz to 25GHz

5V, 2Mbps, High High, Spurs, Plot 5	5V, 2Mbps, High Chan, Spurs, Plot 6
	

3.6 Radiated Emissions

3.6.1 Requirements

Compliance Standard: FCC Part 15.247, 15.209, 15.205

Radiated Emissions, Compliance Limits	
Frequency Range	Class B Equivalent (3-meters)
30 to 88 MHz	100 µV/m
88 to 216 MHz	150 µV/m
216 to 960 MHz	200 µV/m
> 960 MHz	500 µV/m

3.6.2 Test Procedure

For above 30MHz, the requirements of FCC Part 15 call for the EUT to be placed on a 1 X 1.5 meters non-conductive motorized turntable for radiated testing on a 3-meter open air test site. The height of the table is 80cm for testing below 1GHz. The height of the table is 150cm for testing above 1GHz.

The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Bi-conical and log periodic broadband antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The output of the antenna was connected to the input of the spectrum analyzer and the emissions in the frequency range of 30 MHz to 25 GHz were measured. Both the horizontal and vertical field components were measured. The output from the antenna was connected, via a preamplifier, to the input of the spectrum analyzer. The detector function was set to quasi-peak or peak, as appropriate.

Above 1GHz average measurement are recorded. The measurement bandwidth of the spectrum analyzer system was set to at least 120 kHz, with all post-detector filtering no less than 10 times the measurement bandwidth. Frequencies above 1GHz were performed using a measurement bandwidth of 1 MHz with a video bandwidth setting of 10 Hz for the average measurement.

For testing between 9 kHz and 30 MHz, an active loop receiver antenna was 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. Scans in this range were performed in the near field at a distance of 1.5-meters. The EUT module was investigated in all three planes.

3.6.3 Radiated Data Reduction and Reporting

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

Example:

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

3.6.4 Final Test Data and Results Summary

The EUT is fully compliant, and the final test data, for all modes, is provided on the pages below.

A complete investigation of the radiated fundamental field strength was performed. The EUT was evaluated in three orthogonal axes (x, y, z). The EUT position the produced the highest radiated power was maintained during all testing.

The EUT was investigated and scanned for radiated emissions in the range of 9kHz to 25GHz.

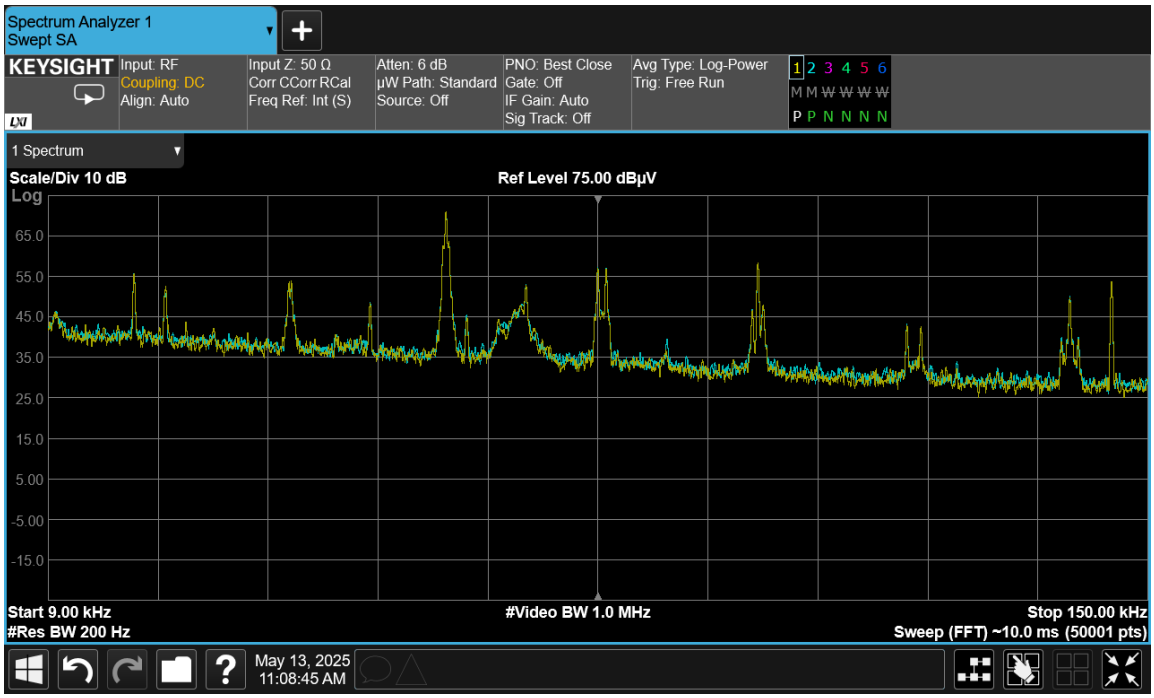
The EUT was configured to transmit a modulated signal as follows:

a) for testing of 9kHz to 1GHz, the EUT was set to a transmitter enabled mode, the BLE transceiver was set to sweep the 2.4GHz ISM band, in an active advertising mode.

b) for testing of 1 GHz to 25 GHz, the EUT was set to a transmitter enabled mode, the BLE transceiver was set to dwell on the low, center, and high channels.

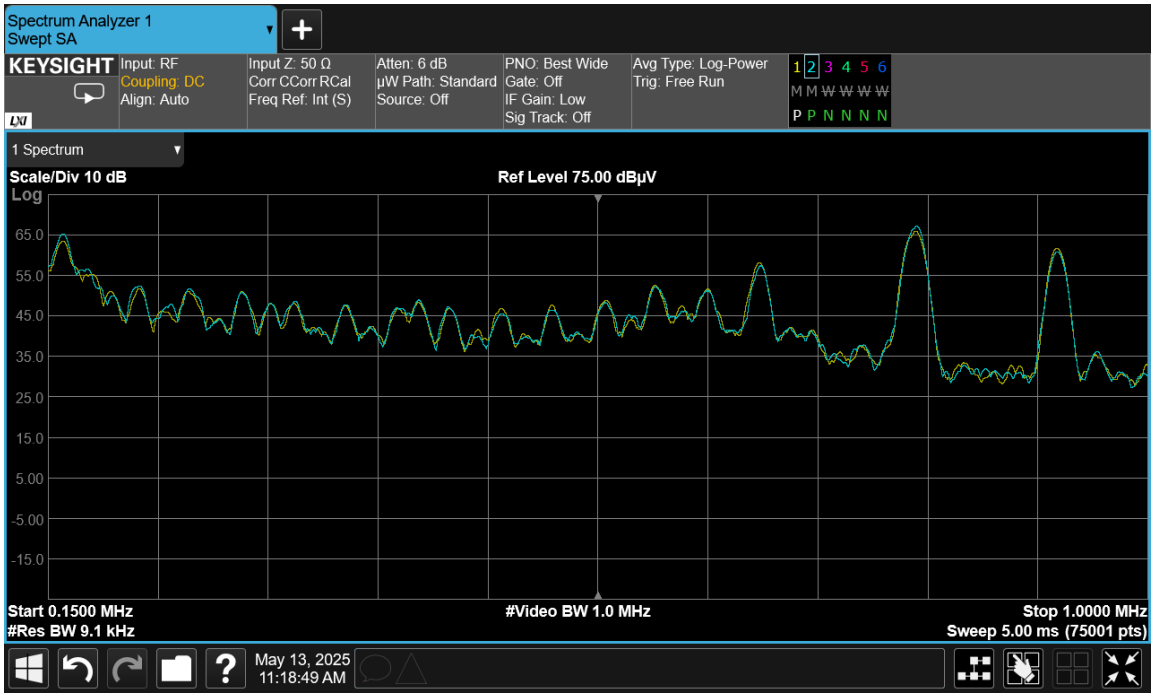
The EUT module was scanned up to 25GHz, which covers the tenth harmonic of the fundamental. The EUT was investigated and tested in both the 1Mbps and 2Mbps modes. In all cases, the only emission detected was the fundamental; and changing the data rate has no impact on EUT emissions in spurious ranges. Additionally, changing the DC input supply voltage has no effect. Therefore, the worst-case data provided below represents both modulation schemes for 1Mbps and 2Mbps.

Figure 25: Radiated Emissions, Representative Data, All Modes, 9kHz to 150kHz



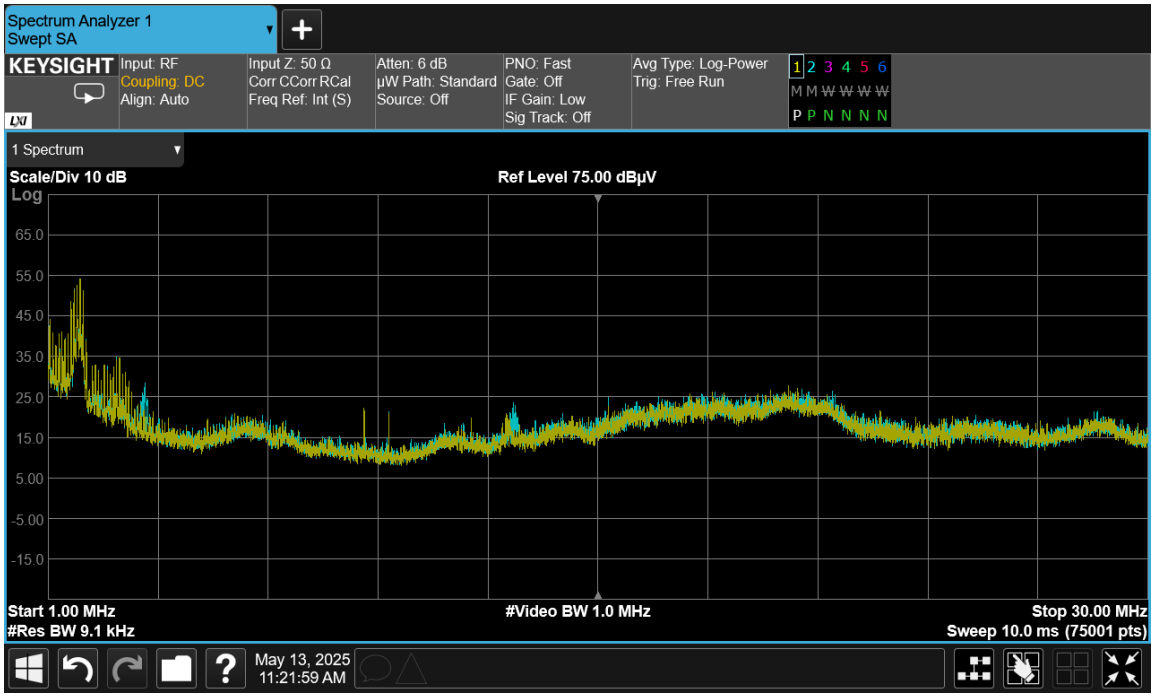
- EUT emissions are not detected in this frequency range.
- Trace 1 = EUT TX On
- Trace 2 = Ambient
- this measurement was made as a near-field pre-scan. all modes were investigated

Figure 26: Radiated Emissions, Representative Data, All Modes, 150kHz to 1MHz



- EUT emissions are not detected in this frequency range.
- Trace 1 = EUT TX On
- Trace 2 = Ambient
- this measurement was made as a near-field pre-scan. all modes were investigated

Figure 27: Radiated Emissions, Representative Data, All Modes, 1MHz to 30MHz



- EUT emissions are not detected in this frequency range.
- Trace 1 = EUT TX On
- Trace 2 = Ambient
- this measurement was made as a near-field pre-scan. all modes were investigated

Table 9: Radiated Emissions Test Data, 30MHz to 1GHz (worst-case)

Frequency (MHz)	Detector	Corr. Meas. (uV/m)	Limit (uV/m)	Delta (dB)	Turn Table (deg)	Antenna (cm)
40.03	QP	16.6	100.0	-15.6	0.0	Vert, 120
510.28	QP	29.6	200.0	-16.6	0.0	Vert, 120
612.80	QP	12.4	200.0	-24.2	0.0	Vert, 120
691.38	QP	16.7	200.0	-21.5	0.0	Vert, 120
772.10	QP	28.7	200.0	-16.9	0.0	Vert, 120
825.53	QP	19.4	200.0	-20.3	0.0	Vert, 120

Note: The frequencies listed in the table above were identified from the EUT via a near-field pre-scan. When tested on a 3-meter site, the emissions are not detected.

Table 10: Radiated Emissions, Low Channel Test Data, 1GHz to 25GHz (worst-case)

Frequency (GHz)	Detector	Corr. Meas. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Turn Table (deg)	Antenna (cm)	Note
2.390	Peak	46.548	74	-27.452	170	Vert, 255	RBE
	AVG	31.682	54	-22.318	170	Vert, 255	
2.402	Peak	86.551	--	--	170	Vert, 255	TX
	AVG	--	--	--	--	--	
2.4835	Peak	44.997	74	-29.003	170	Vert, 255	RBE
	AVG	31.643	54	-22.357	170	Vert, 255	
7.170	Peak	61.452	74	-12.548	90	Horiz, 200	AMB
	AVG	47.688	54	-6.312	90	Horiz, 200	
9.351	Peak	63.032	74	-10.968	90	Horiz, 200	AMB
	AVG	49.841	54	-4.159	90	Horiz, 200	

notes:

RBE = restricted bandedge

TX = fundamental transmitter

AMB = ambient, noise floor

Table 11: Radiated Emissions, Center Channel Test Data, 1GHz to 25GHz (worst-case)

Frequency (GHz)	Detector	Corr. Meas. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Turn Table (deg)	Antenna (cm)	Note
2.390	Peak	44.570	74	-29.430	170	Vert, 255	RBE
	AVG	31.696	54	-22.304	170	Vert, 255	
2.440	Peak	87.009	--	--	170	Vert, 255	TX
	AVG	--	--	--	--	--	
2.4835	Peak	44.631	74	-29.369	170	Vert, 255	RBE
	AVG	31.647	54	-22.353	170	Vert, 255	
3.141	Peak	44.655	74	-29.345	90	Horiz, 200	AMB
	AVG	29.910	54	-24.090	90	Horiz, 200	
4.941	Peak	49.402	74	-24.598	90	Horiz, 200	AMB
	AVG	34.338	54	-19.662	90	Horiz, 200	

notes:

RBE = restricted bandedge

TX = fundamental transmitter

AMB = ambient, noise floor

Table 12: Radiated Emissions, High Channel Test Data, 1GHz to 25GHz (worst-case)

Frequency (GHz)	Detector	Corr. Meas. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Turn Table (deg)	Antenna (cm)	Note
2.390	Peak	44.263	74		170	Vert, 255	RBE
	AVG	31.509	54		170	Vert, 255	
2.480	Peak	80.999	--		170	Vert, 255	TX
	AVG	--	--	--	--	--	
2.4835	Peak	45.402	74	-28.598	170	Vert, 255	RBE
	AVG	31.625	54	-22.375	170	Vert, 255	
7.118	Peak	61.436	74	-12.564	90	Horiz, 200	AMB
	AVG	47.453	54	-6.547	90	Horiz, 200	
9.479	Peak	63.598	74	-10.402	90	Horiz, 200	AMB
	AVG	50.499	54	-3.501	90	Horiz, 200	

notes:

RBE = restricted bandedge

TX = fundamental transmitter

AMB = ambient, noise floor

Figure 28: Radiated Emissions, Representative Data, All Modes, 1GHz to 12GHz

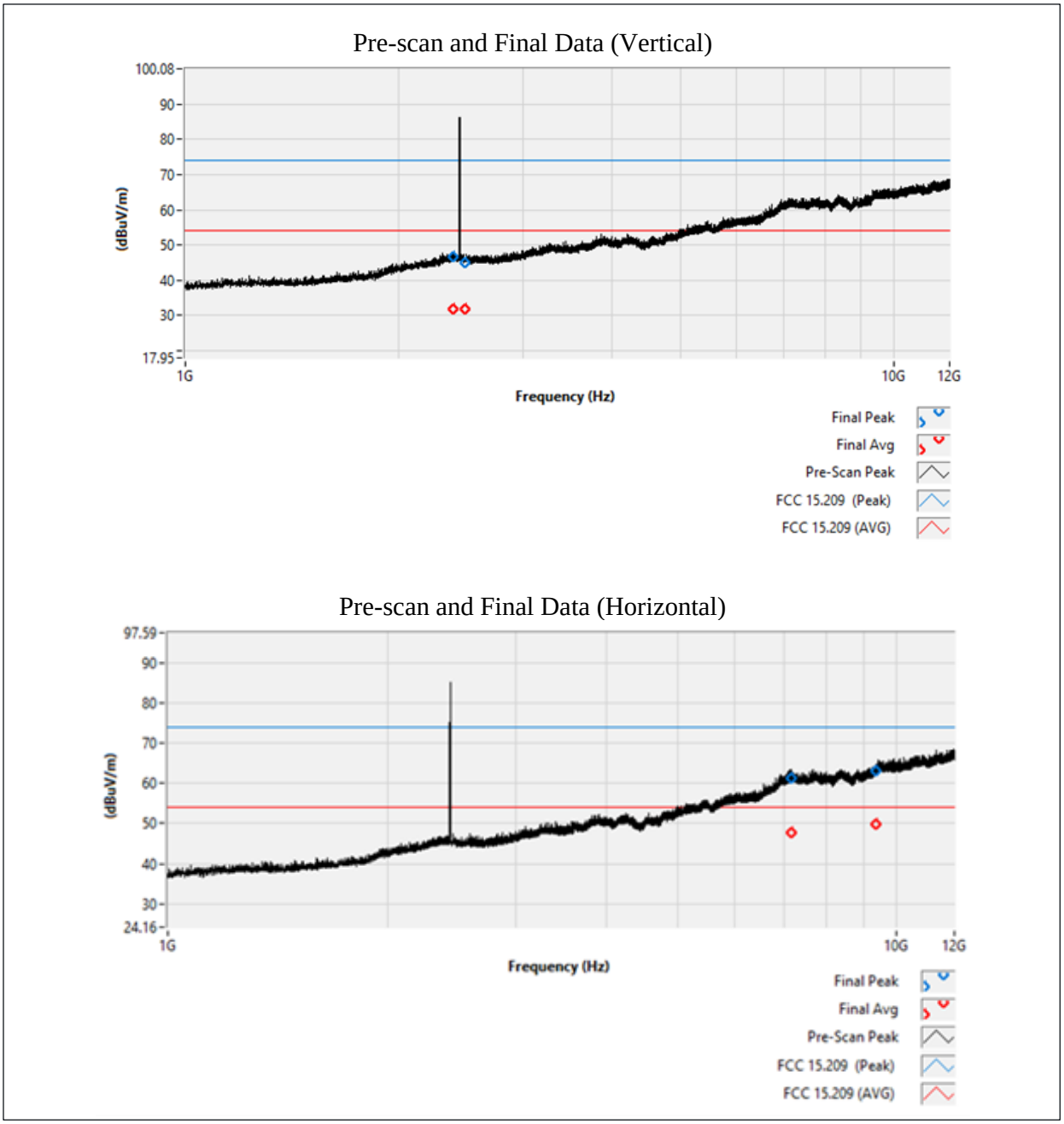
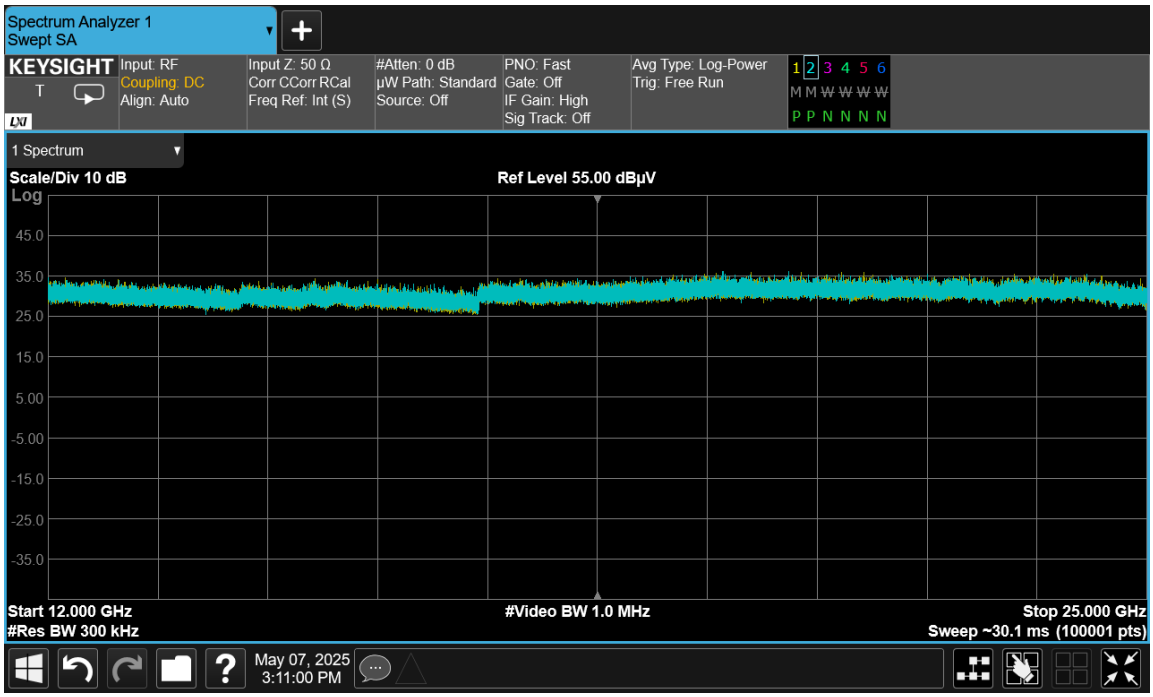


Figure 29: Radiated Emissions, Representative Data, All Modes, 12GHz to 25GHz



- EUT emissions are not detected in this frequency range.
- Trace 1 = EUT TX On
- Trace 2 = Ambient

3.7 AC Powerline Conducted Emissions

3.7.1 Requirements

Compliance Standard: FCC Part 15.207

Frequency Range	15.207 Limits for AC Powerline Emissions	
	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

3.7.2 Test Procedure

The requirements of FCC Part 15 and ICES-003 call for the EUT to be placed on an 80cm-high 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.

3.7.3 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

3.7.4 Test Data

The EUT complies with the Class B Conducted Emissions requirements.

The EUT indirectly couples to the AC mains network via the support laptop.

The EUT was evaluated in both the TX enabled and TX disabled modes.

The worst-case emission test data is provided below (TX enabled, low channel).

Table 13: AC Power Conducted Emissions Test Data, Line 1

Frequency (Hz)	Detector	Meas (dBuV)	Limit (dBuV)	Delta (dB)
150k	Peak	52.714	--	--
	QP	40.650	66	-25.350
	Avg	22.603	56	-33.397
185.979k	Peak	49.799	--	--
	QP	44.464	64.214	-19.750
	Avg	26.898	54.214	-27.317
199.471k	Peak	49.553	--	--
	QP	44.419	63.633	-19.213
	Avg	28.706	53.633	-24.926
212.963k	Peak	46.778	--	--
	QP	40.492	63.089	-22.597
	Avg	23.455	53.089	-29.634
2.833M	Peak	41.106	--	--
	QP	33.465	56	-22.535
	Avg	22.231	46	-23.769
3.149M	Peak	41.343	--	--
	QP	32.089	56	-23.911
	Avg	21.934	46	-24.066

Pre-scan and Final Data, AC Powerline Conducted Emissions, Line 1 (TX On)

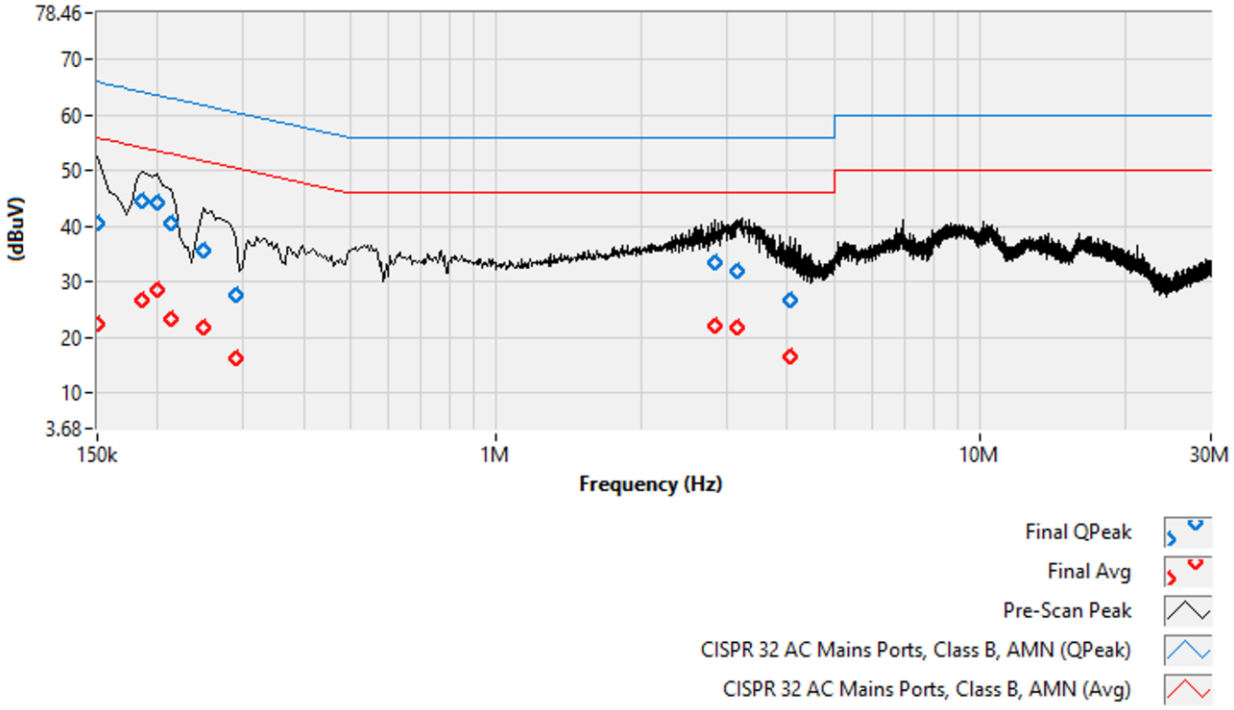
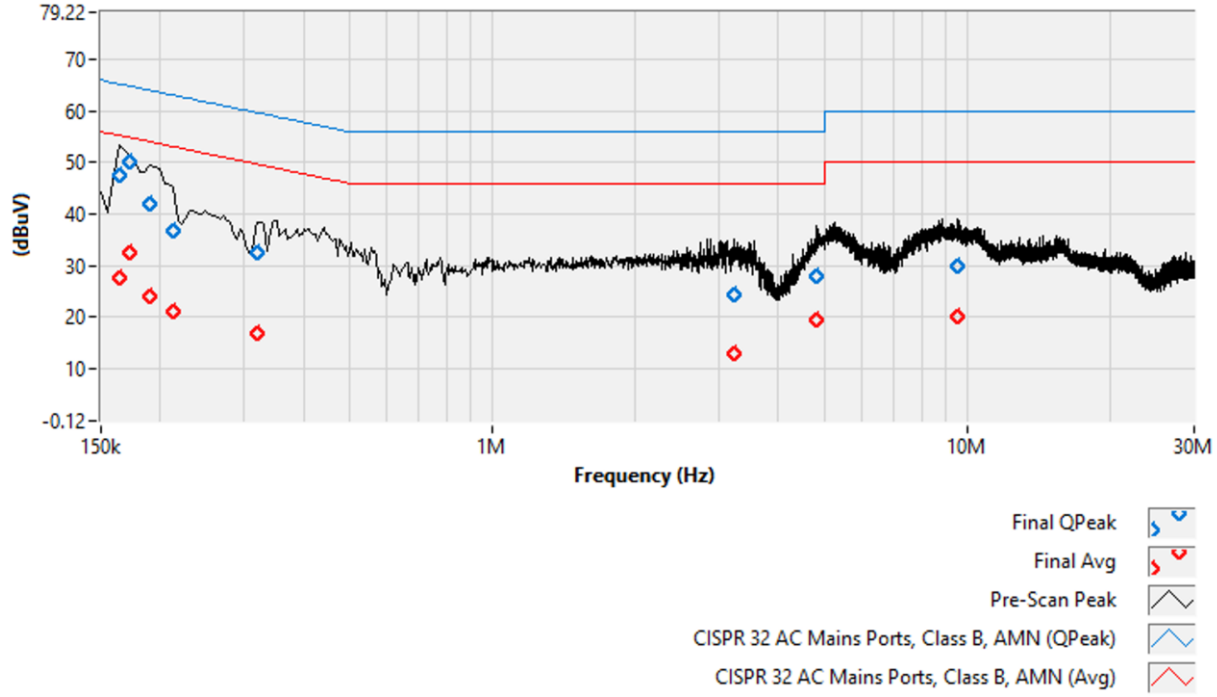


Table 14: AC Power Conducted Emissions Test Data, Neutral

Frequency (Hz)	Detector	Meas (dBuV)	Limit (dBuV)	Delta (dB)
163.492k	Peak	53.349	--	--
	QP	47.506	65.285	-17.779
	Avg	27.691	55.285	-27.594
172.487k	Peak	51.345	--	--
	QP	50.197	64.840	-14.643
	Avg	32.381	54.840	-22.459
190.476k	Peak	49.438	--	--
	QP	41.980	64.016	-22.036
	Avg	24.055	54.016	-29.961
212.963k	Peak	45.358	--	--
	QP	36.884	63.089	-26.205
	Avg	21.087	53.089	-32.002
320.9k	Peak	38.446	--	--
	QP	32.560	59.683	-27.124
	Avg	16.900	49.683	-32.783
4.793M	Peak	37.633	--	--
	QP	27.831	56	-28.169
	Avg	19.524	46	-26.476

Pre-scan and Final Data, AC Powerline Conducted Emissions, Neutral (Tx On)



4 Test Equipment

The table below provides a list of the test equipment used for measurements along with the calibration information.

Table 15: Test Equipment List

Test Name:	**Radiated Emissions**	Testing Dates: 4/24/2025 to 5/13/2025	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00942	AGILENT, MXA	SPECTRUM ANALYZER	12/26/2026
00993	KEYSIGHT, MXA	SPECTRUM ANALYZER	11/6/2025
00382	SUNOL SCIENCES CORP.	ANTENNA, LOGPERIOD	6/12/2027
00004	ARA, DRG-118/A	ANTENNA, HORN	6/7/2027
00066	AGILENT	RF PRE-AMPLIFIER	8/21/2025
00065	ELECTRO-METRICS	RF PRE-AMPLIFIER	8/23/2025
00806	MINI-CIRCUITS, 3061	HF COAX CABLE, SMA	12/18/2025
00825	CABLE ASSOCIATES, MTC10	6-METER COAX CABLE, SMA	6/20/2025
00847	ASTROLABS, K-48TG	HF COAX CABLE, SMA	6/20/2025
00731	NARDA, 4779-3	2W, 3DB ATTENUATOR	6/20/2025

Test Equipment List, Continued

Test Name: **Conducted RF Emissions**		Testing Dates: 4/21/2025 to 5/12/2025	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00993	KEYSIGHT, MXA	SPECTRUM ANALYZER	11/6/2025
00992	KEYSIGHT N5173B	EXG SIGNAL GENERATOR	1/8/2028
00885	ULTIFLEX, UFA2108-0-360	1-METER SMA CABLE	Cal. Before Use
N/A	WEINSCHEL, 3.5MM	20DB ATTENUATOR	Cal. Before Use

Test Name: **AC Powerline Emissions**		Test Date: 6/11/2025	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00993	KEYSIGHT, MXA	SPECTRUM ANALYZER	11/6/2025
00125	SOLAR, 8028-50-TX-24-BNC	LISN1	4/1/2026
00126	SOLAR, 8028-50-TX-24-BNC	LISN2	4/1/2026
00330	WLL-RG223, CESITE1	BNC, COAXIAL CABLE	6/25/2025
00895	HP, 11947A	TRANSIENT LIMITER	1/16/2026

Test and Measurement Software Employed by the Laboratory –

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

(2) Keysight 2019 Update 4.0, Rev. A.25.08

(3) the N9020B, MXA has the following instrument software version installed: A.33.03 (2023)

5 Measurements

5.1.1 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

5.2 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 the table below.

Table 16: 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

5.3 Environmental Conditions

Environmental Conditions During All Measurements

Ambient Temperature:	Between 19.9 and 23.9 °C
Relative Humidity:	Between 45 and 60 %