FCC & ISED CANADA CERTIFICATION TEST REPORT

FOR THE

FCC ID: YJ7DCR025B

IC ID: 9082A-DCR025B

WLL REPORT # 18466-01 REV 1

Prepared for:

Stanley Black & Decker, Inc.
701 E. Joppa Road
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Prepared By:

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Testing Certificate AT-1448

FCC & ISED Canada Certification Test Report

for the

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January 17, 2024

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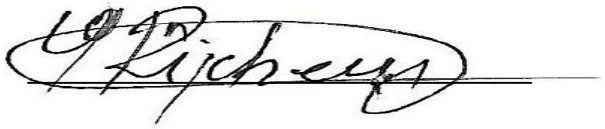


Richard Quarcoo

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 a Jobsite Bluetooth Radio model DCR025. 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., DCR025. The information provided in this report is only applicable to device herein documented, as the EUT.

The radiated emissions portion of the testing was performed in the Free-space Anechoic Chamber Test-site (FACT) 3m Chamber of Washington Laboratories, Ltd., located at 4840 Winchester Boulevard, Suite #5. Frederick, MD 21703. 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.

The Stanley Black & Decker, Inc., DCR025 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	January 17, 2024
Rev 1	Edited per ACB Comments	February 20, 2024
Rev 2	Edited to update Canada RSS-247 to Issue 3	February 26, 2024

Table of Contents

List of Tables

List of Figures

1 Introduction

1.1 Compliance Statement

The Stanley Black & Decker, Inc., DCR025 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 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 for a FHSS device; full test results are shown in subsequent report sub-sections.

1.3 Testing Algorithm

The Jobsite Bluetooth Radio model DCR025 was provided to the test laboratory, in two sample configurations: (1) a conducted (at the antenna port) sample and (2) a wireless radiated (PCB trace antenna) sample. The EUT low, center, and high channels were tunable through the support laptop's interface. Prior to all testing, the transmitter power was adjusted [via software] to the maximum allowable setting withing the support software, indicated by a numerical value of "3". This setting achieved the reported peak transmit output power denoted in Table 2. 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.

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:	V605123
Quotation Number:	74382

1.6 Test and Support Personnel

Washington Laboratories, LTD	Richard Quarcoo
Customer Representative	Cedric Valiente

1.7 Test Dates

11/9/2023 – 1/3/2024 & (also see Section 4 of this report)

Table 1: Certification Testing Summary and Compliance Results

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	Bandedge 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; manufactured by Phihong Technology Co. , LTD. The EUT does not have an antenna connector.

2 Test Results

2.1 Transmitter Output Power

For frequency hopping systems operating in the 2400 MHz to 2483.5 MHz band, that employ at least 75 non-overlapping hopping channels, the maximum conducted output power (measured at the antenna port) shall not exceed 30 dBm (1 Watt). For all other frequency hopping systems, inclusive of the EUT, in the 2400 MHz to 2483.5 MHz band the maximum conducted output power (measured at the antenna port) shall not exceed 21 dBm (125 mW). Additionally, ISED Canada requires that the EIRP shall not exceed 4 Watts, except as provided in RSS-247, Section 5.4(e).

2.1.1 Measurement Method and Results

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

0.36 + 1.54 = 1.90 dBm EIRP (calculated), which is far below the 4W limit for Canada.

Table 2: Transmitter Output Power – Test Results

Modulation	Mode (Data Rate)	Frequency (MHz)	Peak Power (dBm)
GFSK	DH5 (1Mbps)	2402 MHz	-2.57
		2441 MHz	-5.15
		2480 MHz	-3.37
π/4DQPSK	2DH5 (2Mbps)	2402 MHz	-1.73
		2441 MHz	-2.34
		2480 MHz	-0.43
8DPSK	3DH5 (3Mbps)	2402 MHz	-1.60
		2441 MHz	-1.55
		2480 MHz	0.36

Figure 1: GFSK (1Mbps) – Low Channel, Peak Power Output

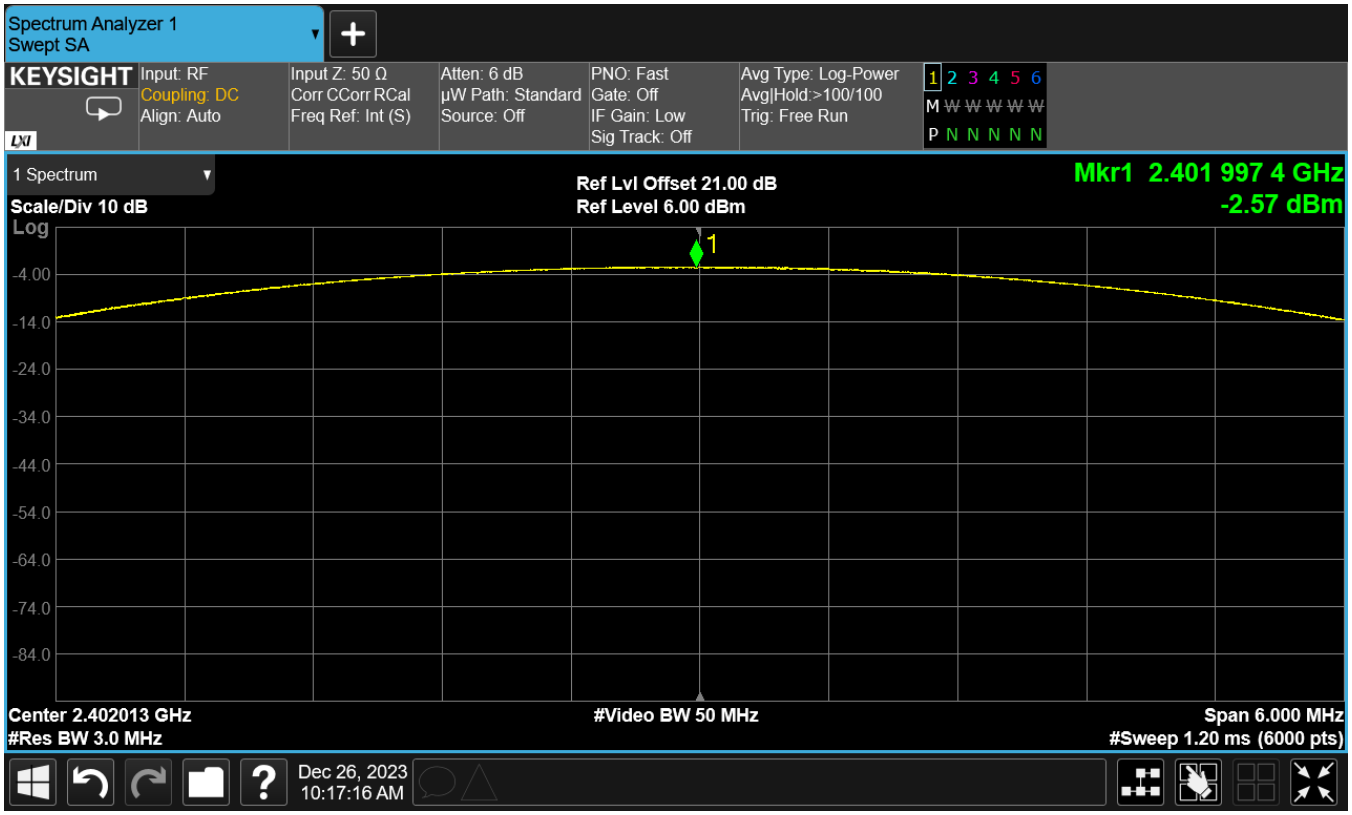


Figure 2: GFSK (1Mbps) – Center Channel, Peak Power Output

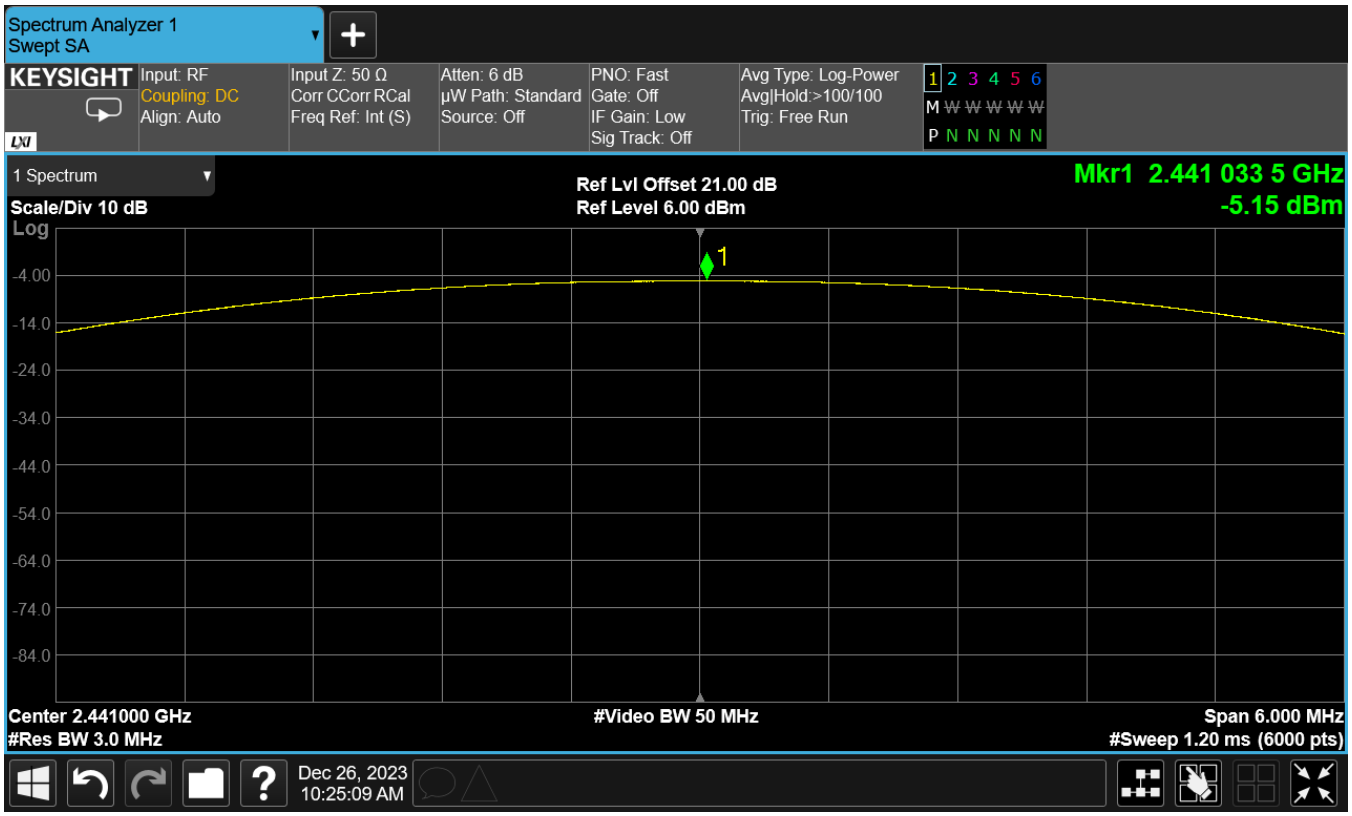


Figure 3: GFSK (1Mbps) – High Channel, Peak Power Output

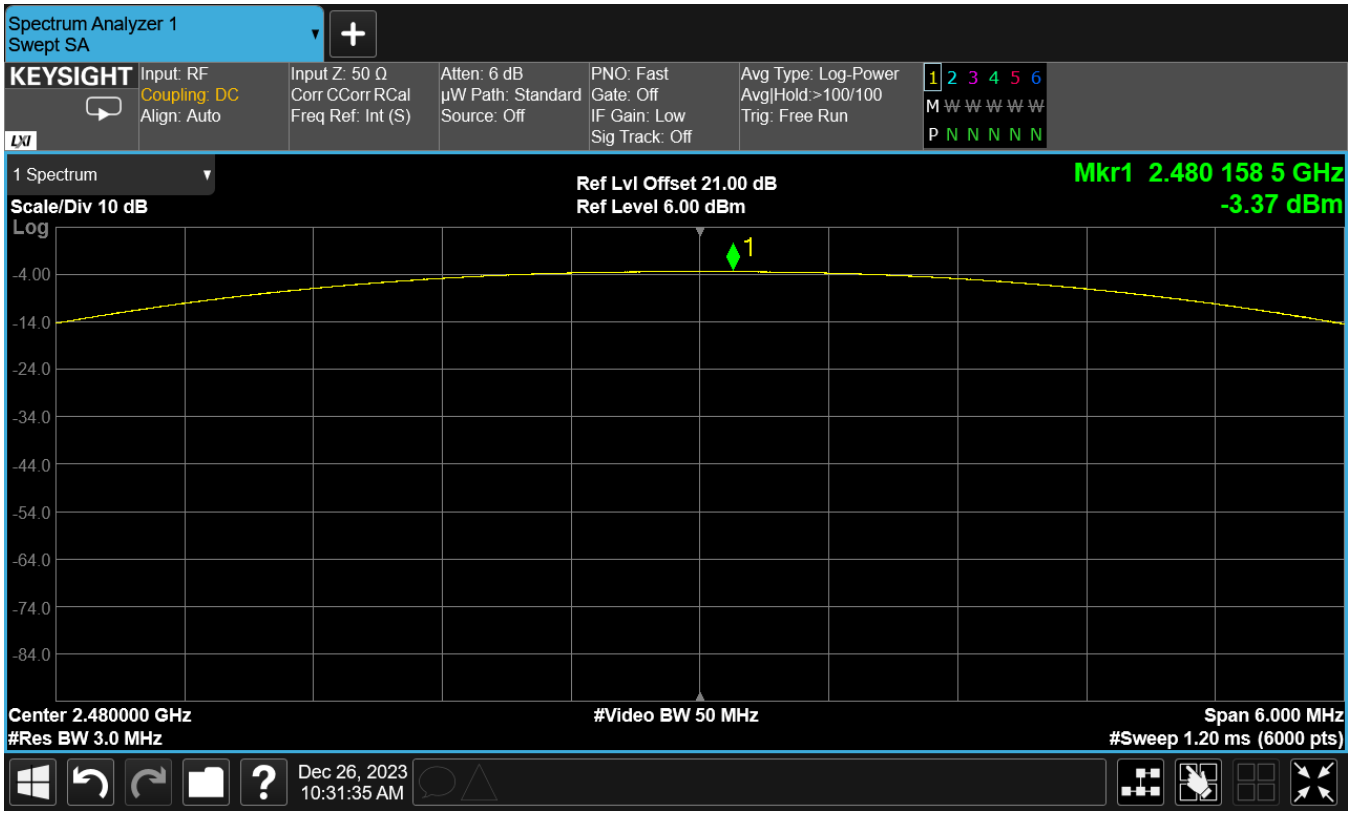


Figure 4: π/4DQPSK (2Mbps) – Low Channel, Peak Power Output

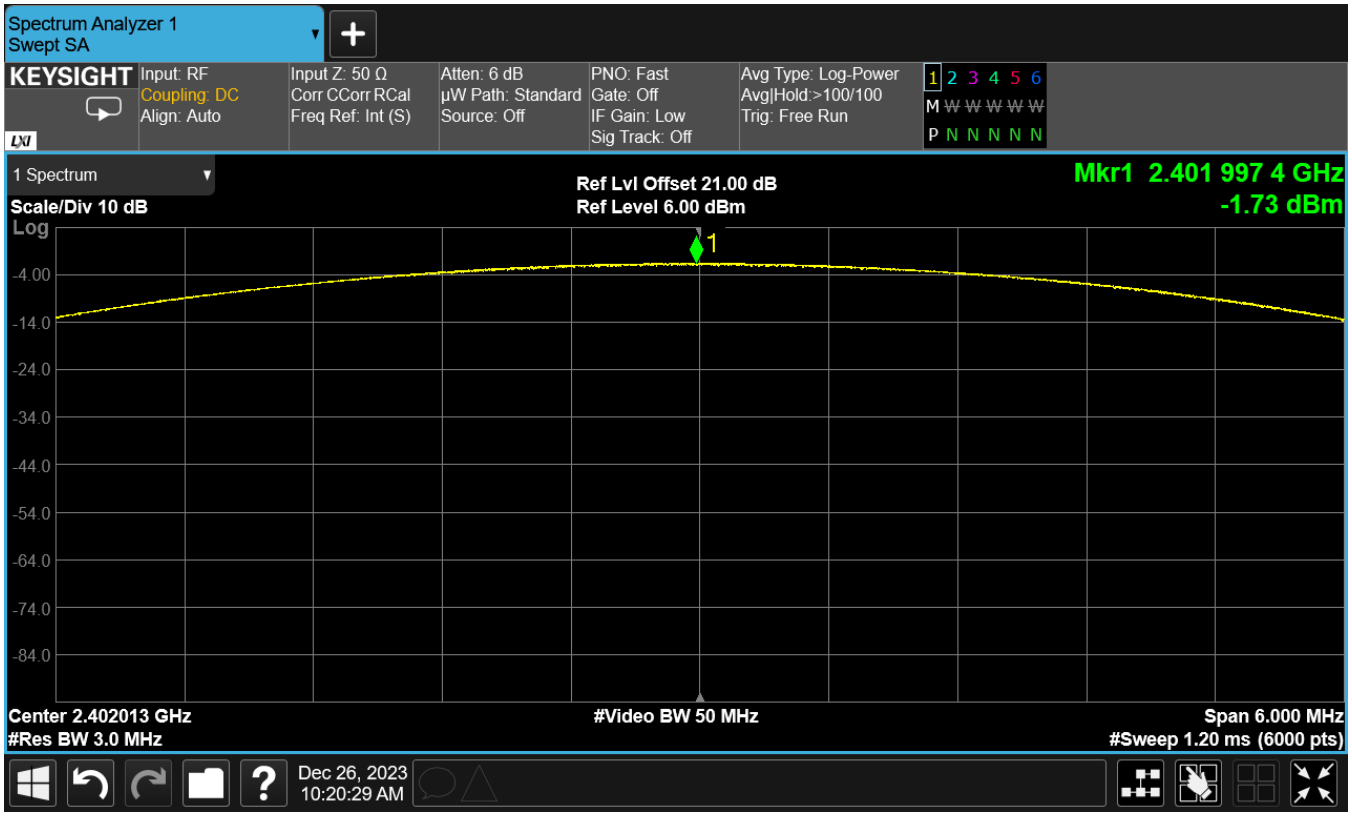


Figure 5: π/4DQPSK (2Mbps) – Center Channel, Peak Power Output

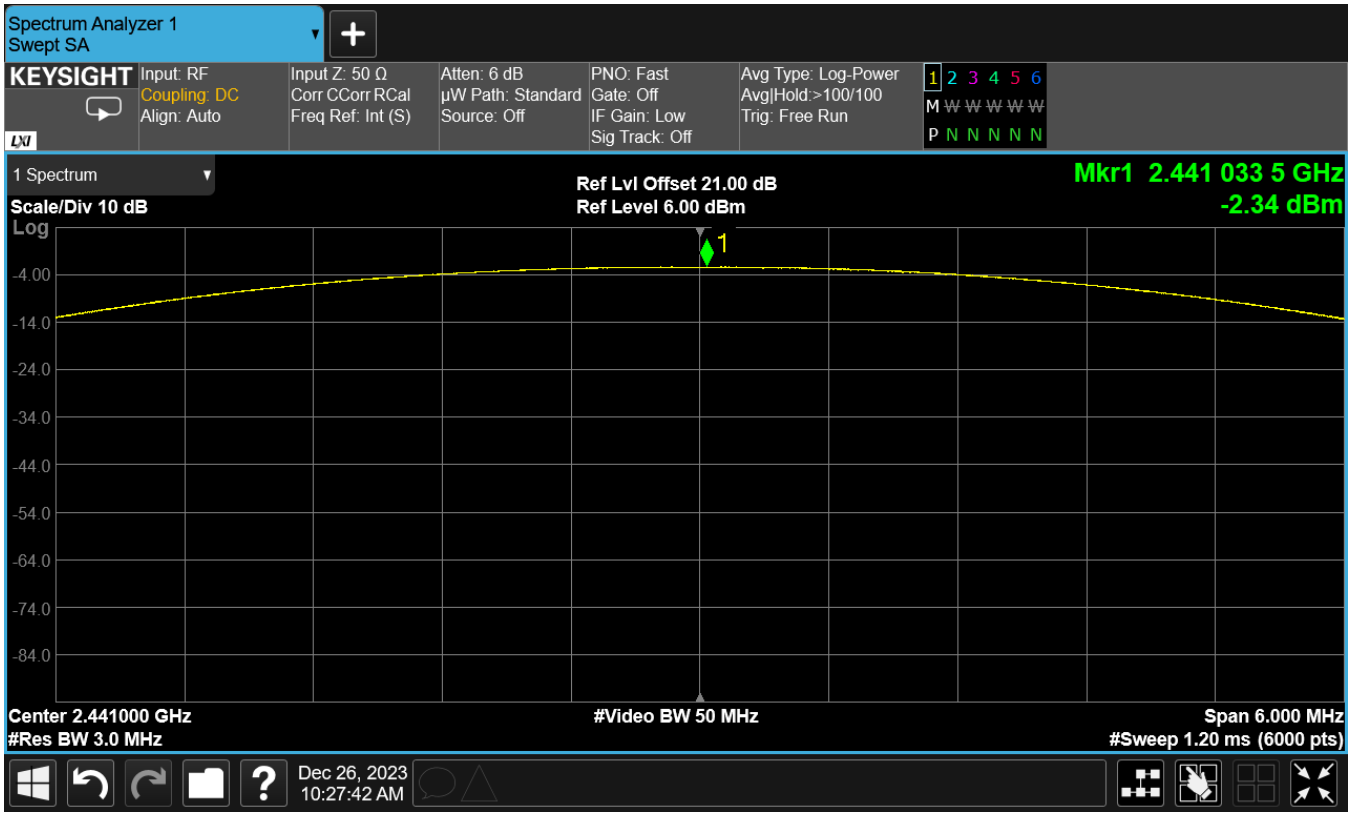


Figure 6: π/4DQPSK (2Mbps) – High Channel, Peak Power Output

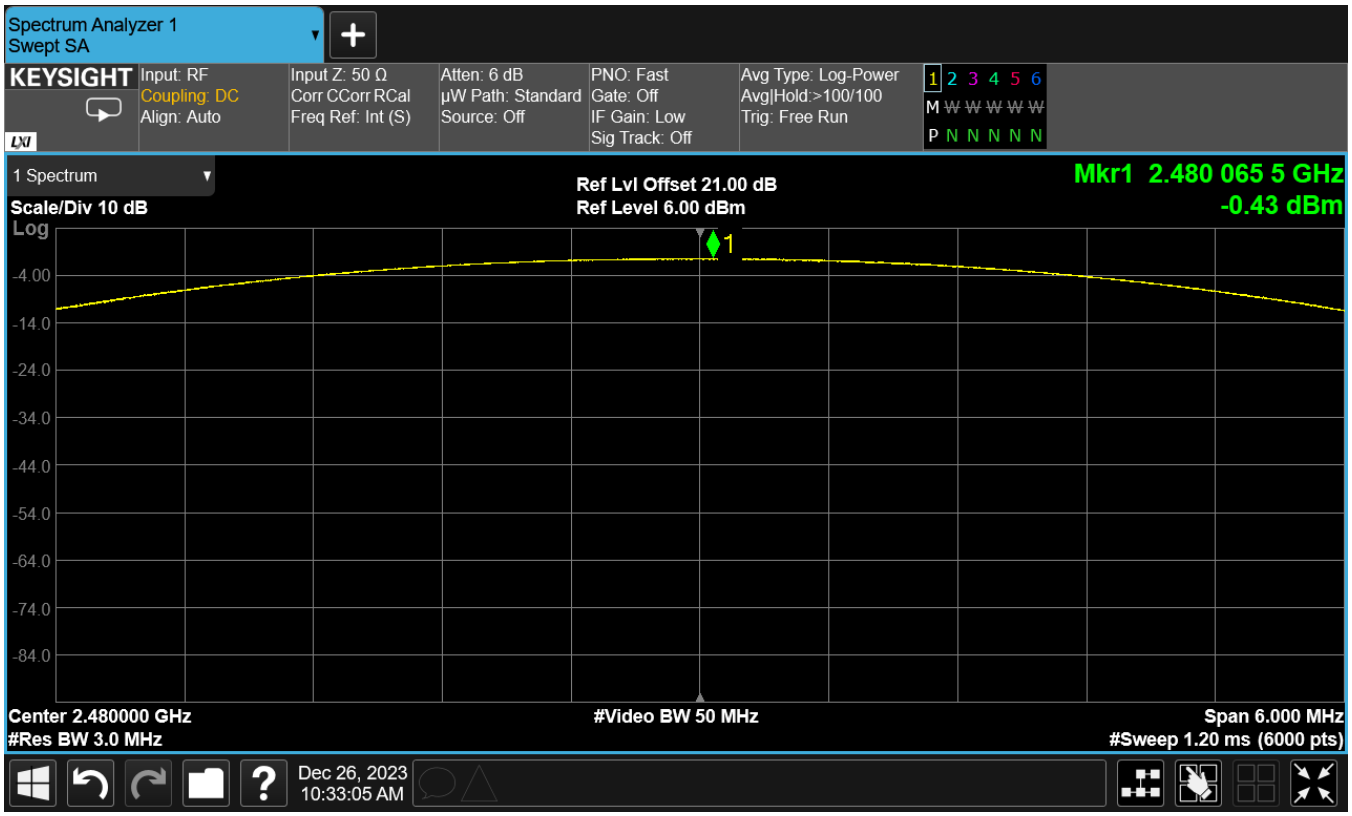


Figure 7: 8DPSK (3Mbps) – Low Channel, Peak Power Output

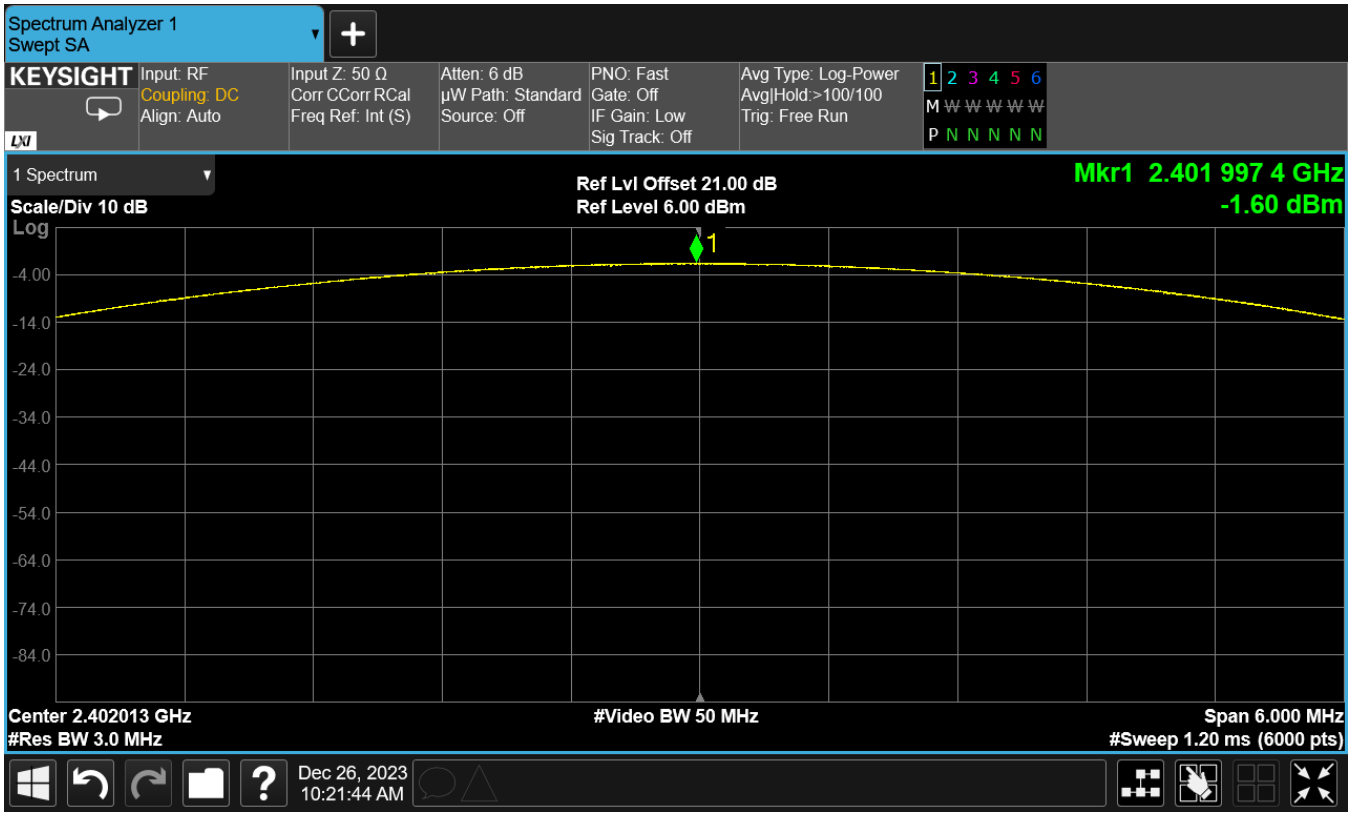


Figure 8: 8DPSK (3Mbps) – Center Channel, Peak Power Output

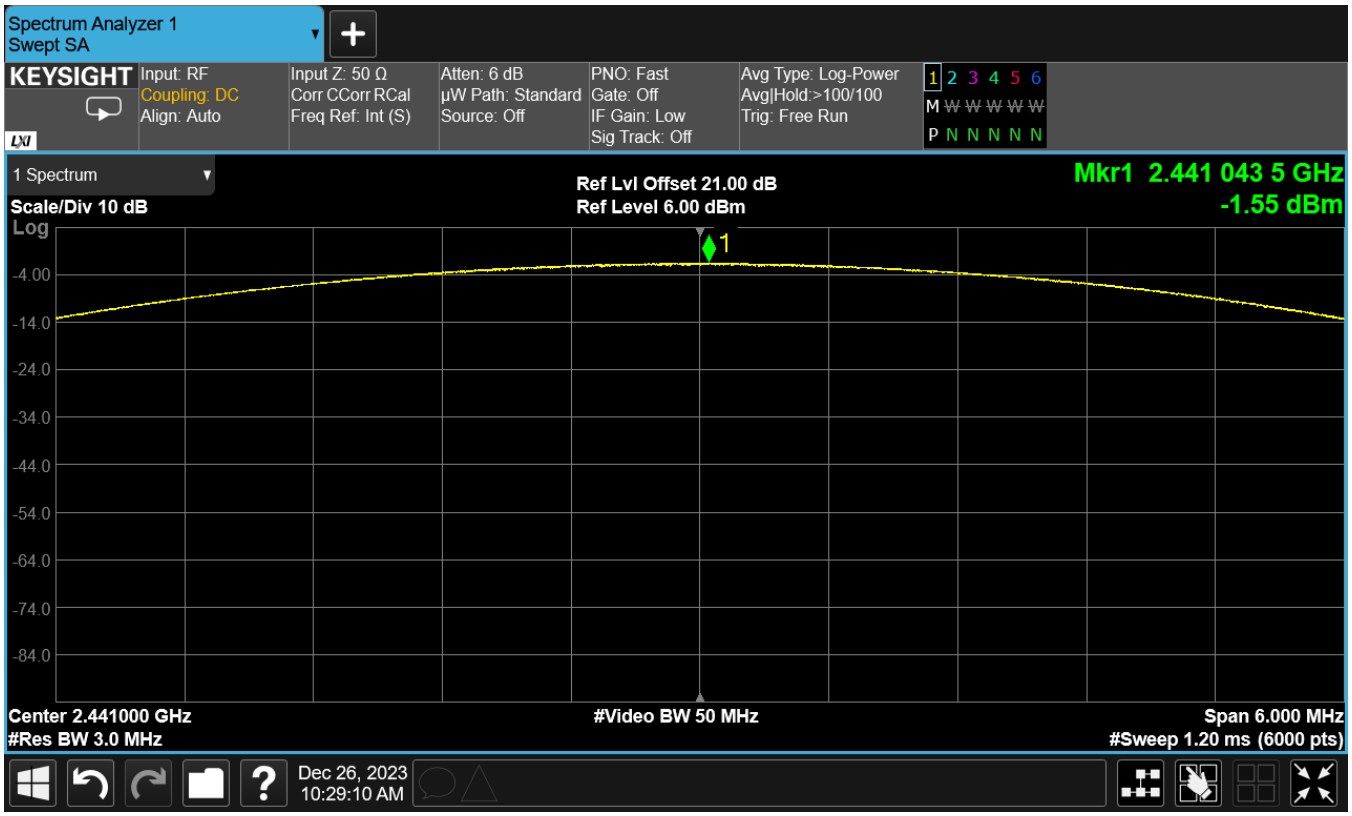
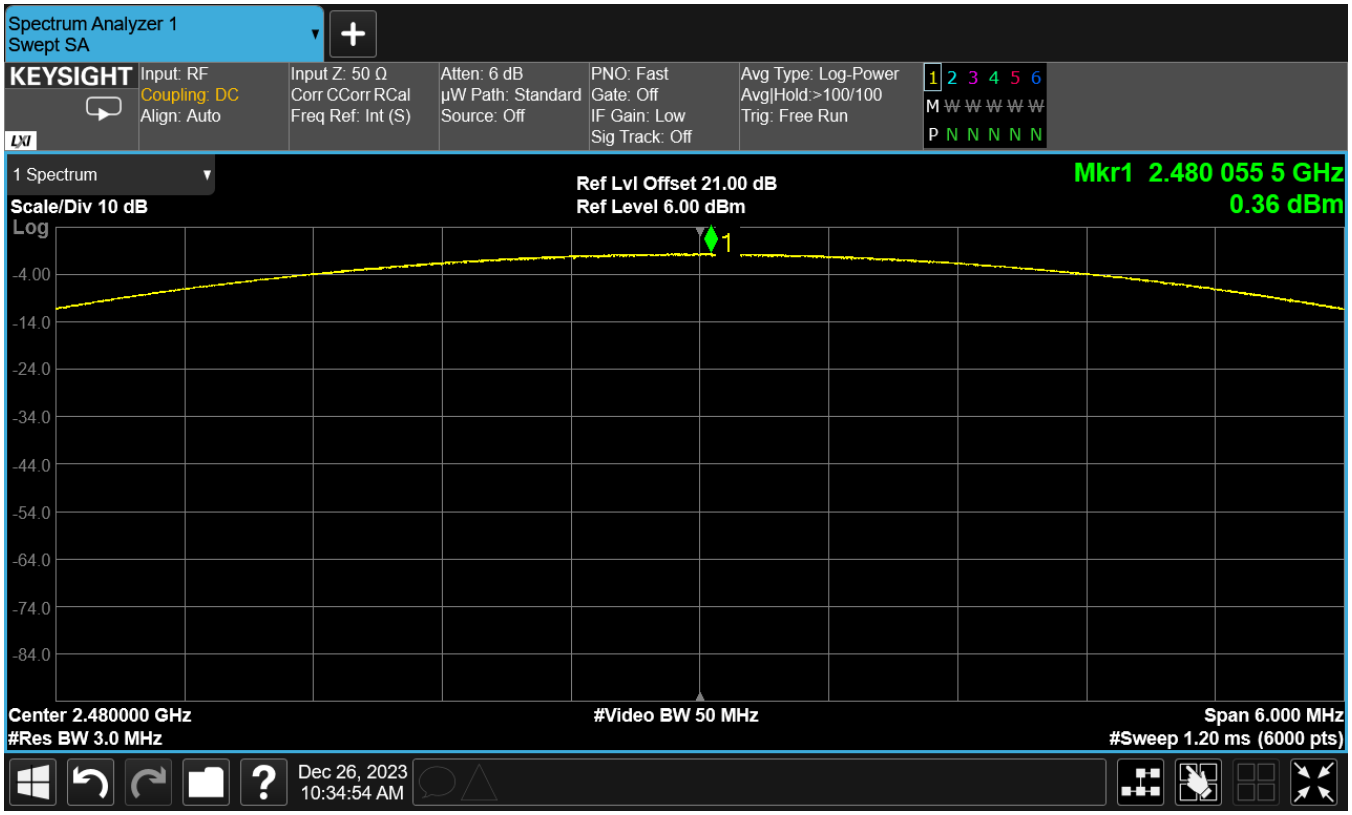


Figure 9: 8DPSK (3Mbps) – High Channel, Peak Power Output



2.2 Channel Occupied Bandwidth

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

For Frequency Hopping Spread Spectrum Systems, FCC Part 15.247 requires the maximum 20 dB bandwidth not exceed 500 kHz.

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

Table 3 provides a summary of the Occupied Bandwidth Results.

2.2.1 Measurement Method and Results

This test was performed as specified in ANSI C63.10 (2013), Section 6.9.2

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

Table 3: Channel Occupied Bandwidth – Test Results

Modulation	Mode (Data Rate)	Frequency (MHz)	20dB Bandwidth	99% Bandwidth
GFSK	DH5 (1Mbps)	2402 MHz	0.93MHz	0.86MHz
		2441 MHz	0.93MHz	0.86MHz
		2480 MHz	0.93MHz	0.86MHz
π/4DQPSK	2DH5 (2Mbps)	2402 MHz	1.32 MHz	1.19 MHz
		2441 MHz	1.32 MHz	1.19 MHz
		2480 MHz	1.32 MHz	1.19 MHz
8DPSK	3DH5 (3Mbps)	2402 MHz	1.29 MHz	1.18 MHz
		2441 MHz	1.29 MHz	1.18 MHz
		2480 MHz	1.29 MHz	1.18 MHz

Figure 10: GFSK (1Mbps) – Low Channel, Occupied Bandwidth

Figure 11: GFSK (1Mbps) – Center Channel, Occupied Bandwidth

Figure 12: GFSK (1Mbps) – High Channel, Occupied Bandwidth

Figure 13: π/4DQPSK (2Mbps) – Low Channel, Occupied Bandwidth

Figure 14: π/4DQPSK (2Mbps) – Center Channel, Occupied Bandwidth

Figure 15: π/4DQPSK (2Mbps) – High Channel, Occupied Bandwidth

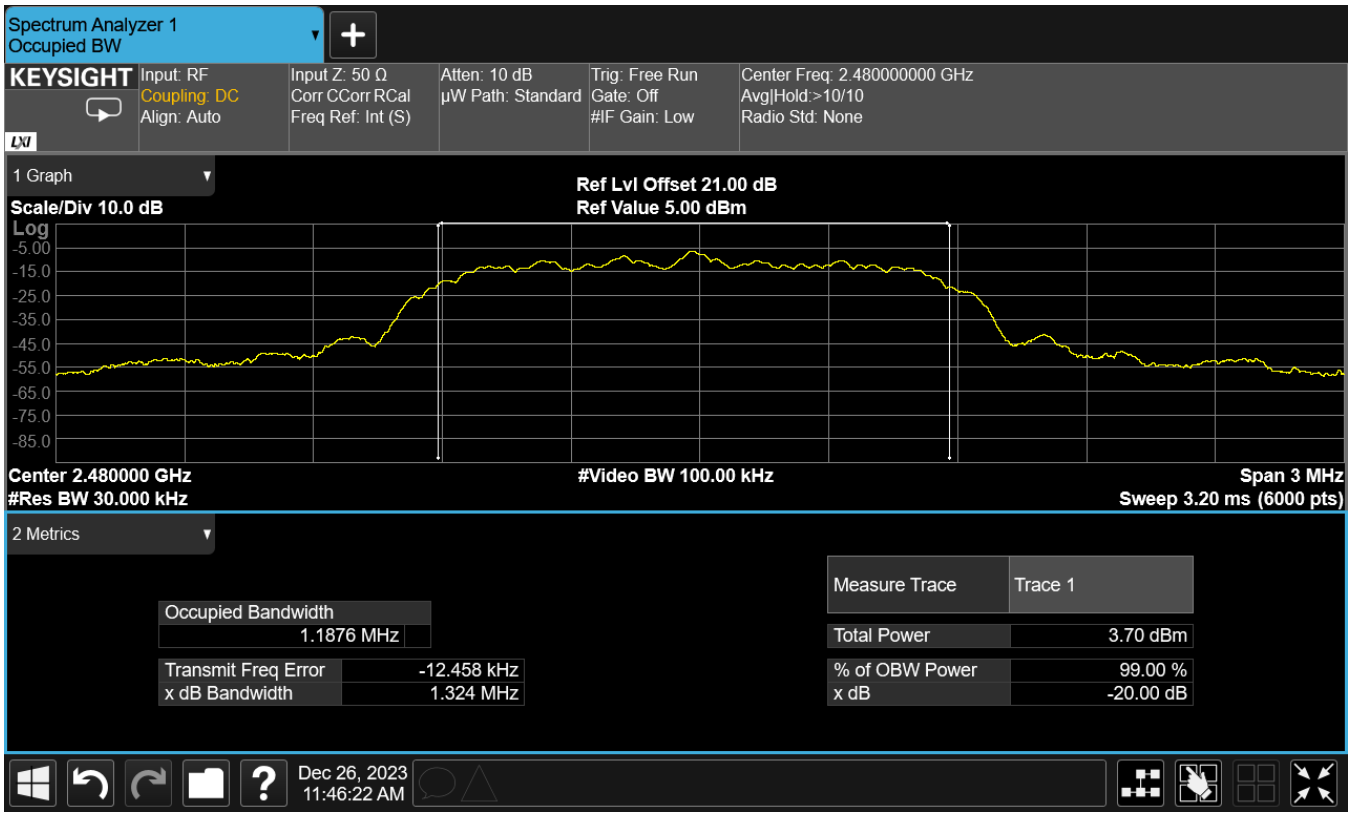
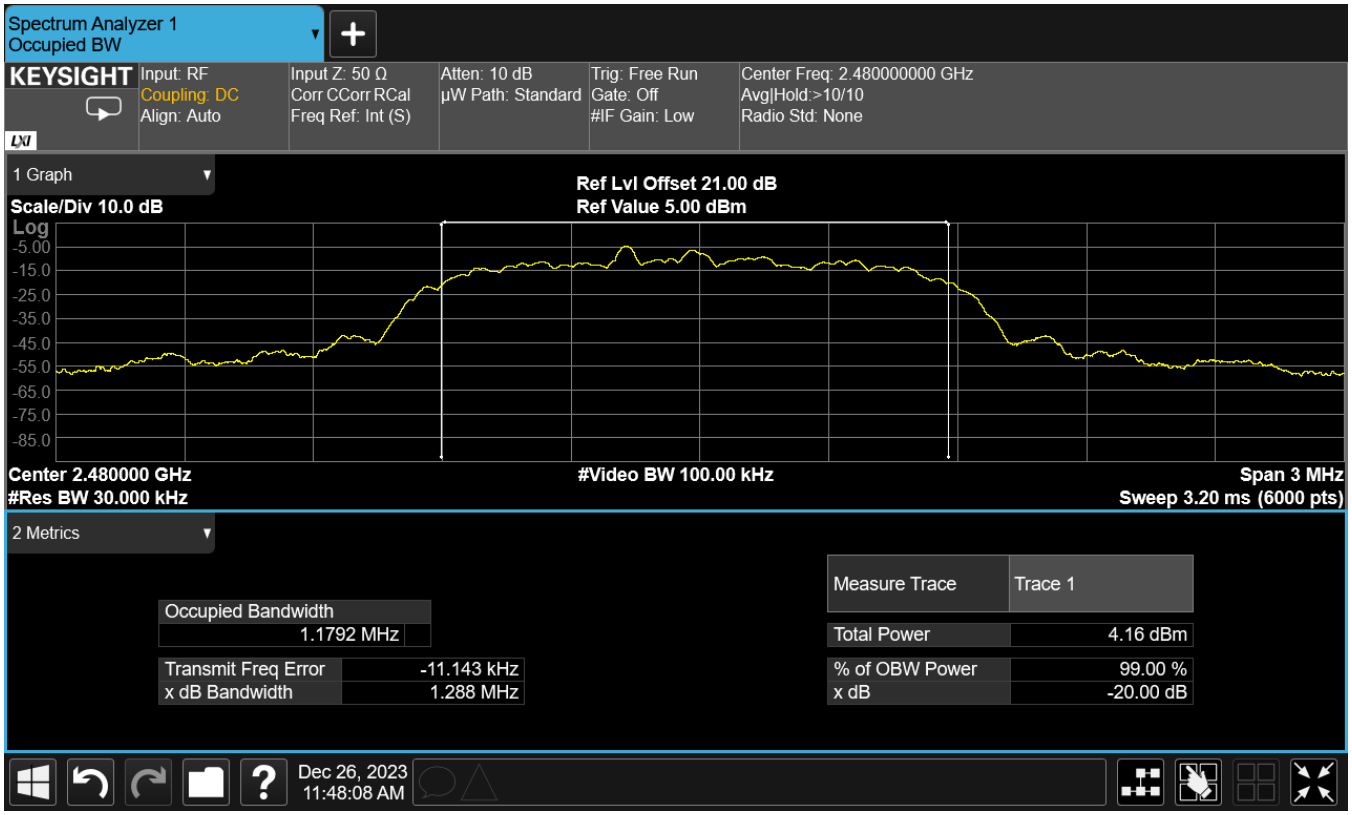


Figure 16: 8DPSK (3Mbps) – Low Channel, Occupied Bandwidth

Figure 17: 8DPSK (3Mbps) – Center Channel, Occupied Bandwidth

Figure 18: 8DPSK (3Mbps) – High Channel, Occupied Bandwidth



2.3 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.

2.3.1 Measurement Method and Results

This test was performed as specified in ANSI C63.10 (2013), Section 7.8.1 and 7.8.3

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

Table 4: Number of Channels Used – Test Results

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

Figure 19: GFSK (1Mbps) – Number of Channels Used, Plot 1

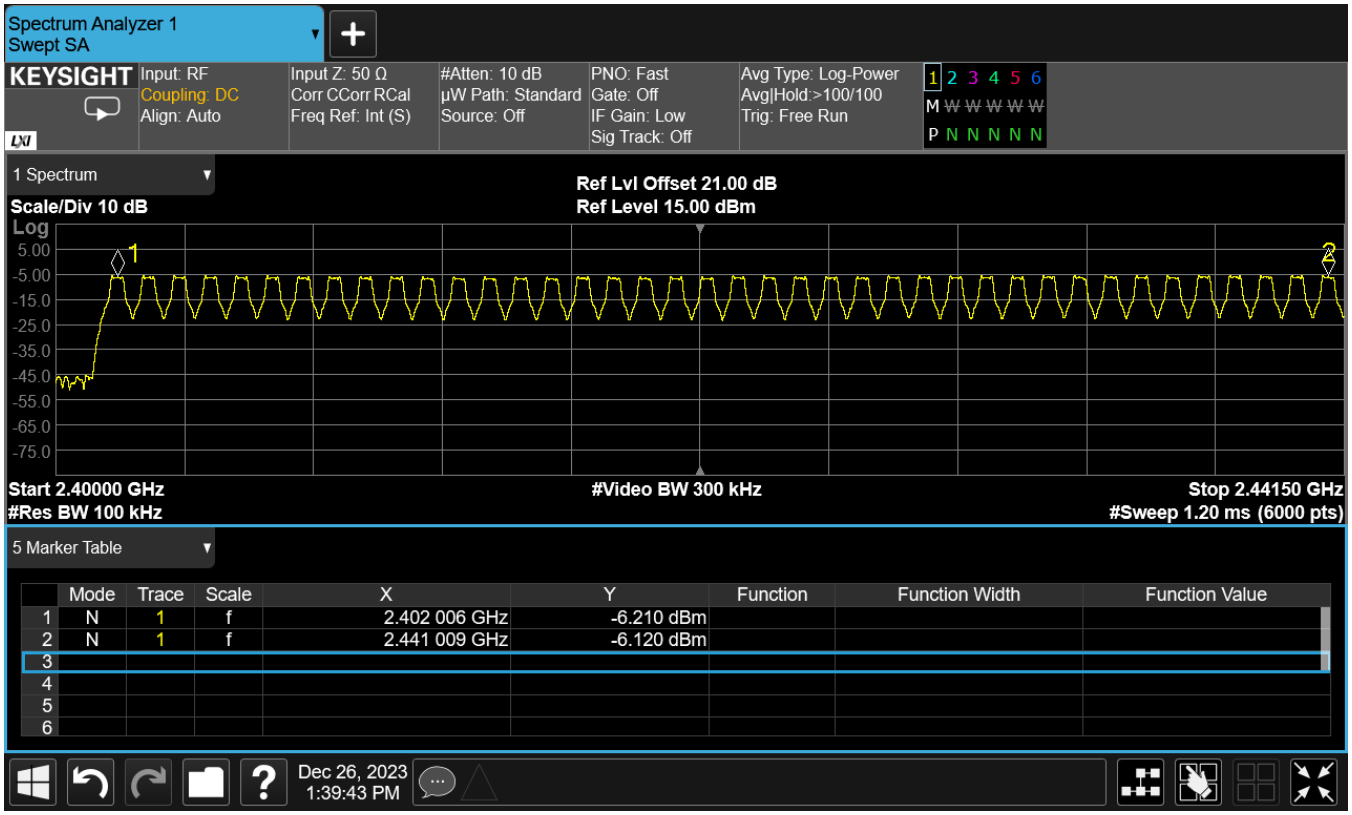


Figure 20: GFSK (1Mbps) – Number of Channels Used, Plot 2

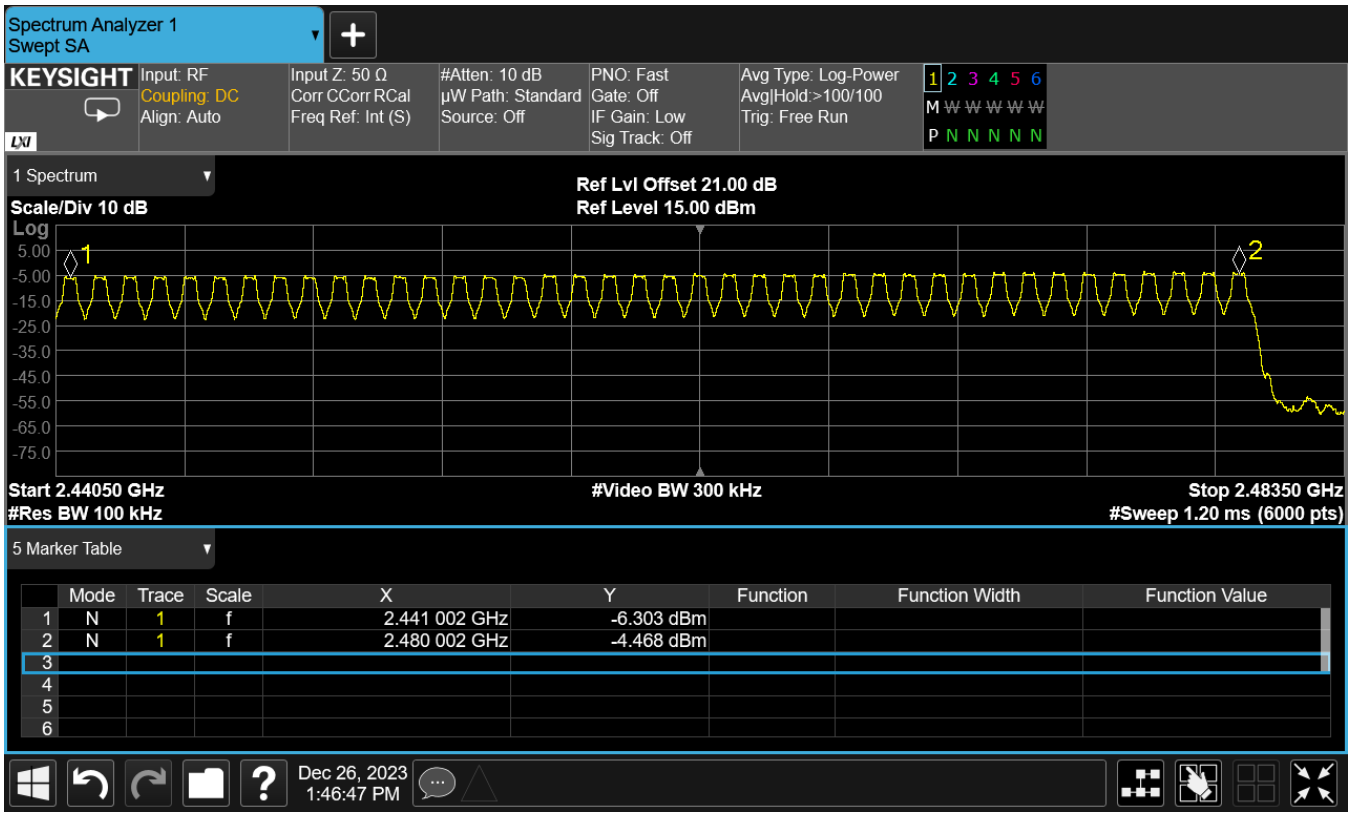


Figure 21: π/4DQPSK (2Mbps) – Number of Channels Used, Plot 1

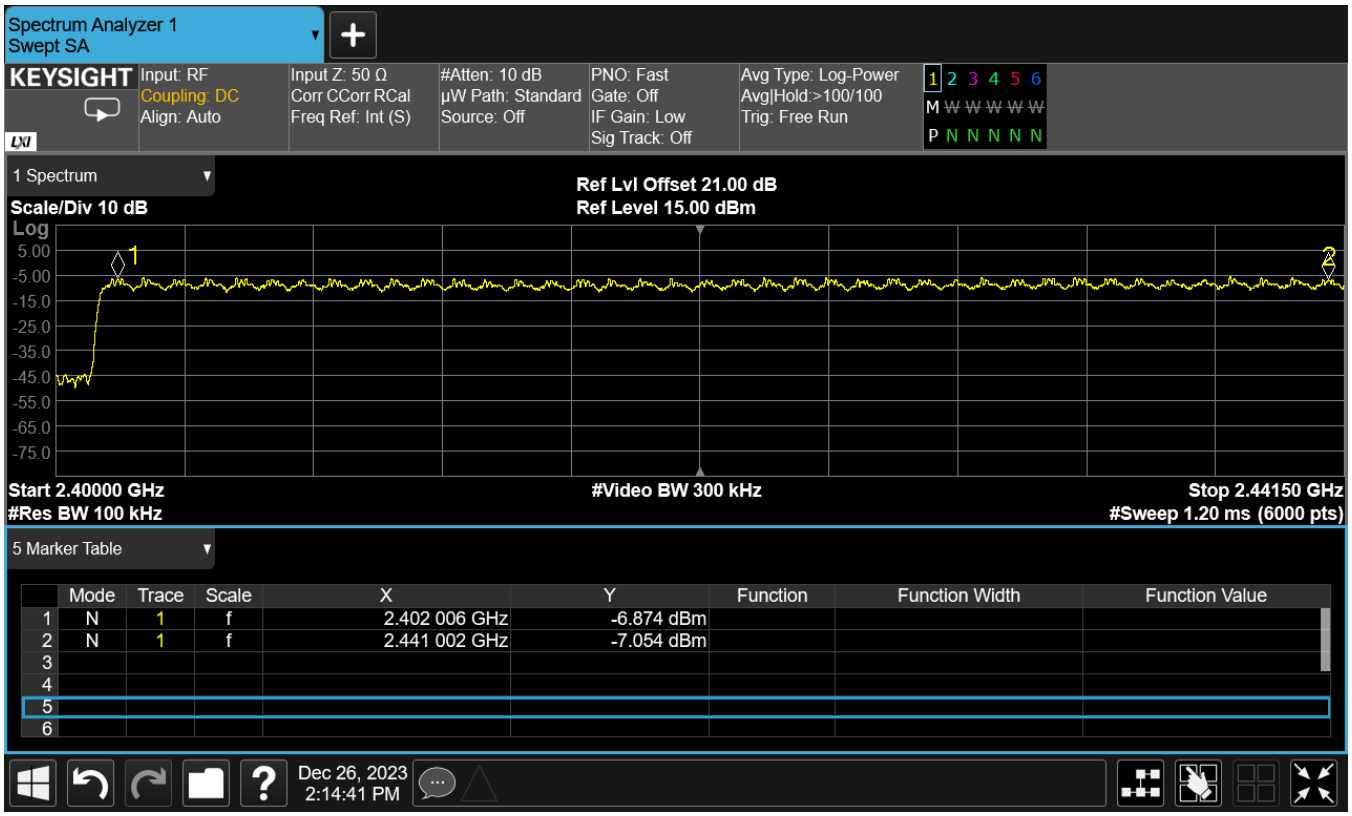


Figure 22: π/4DQPSK (2Mbps) – Number of Channels Used, Plot 2

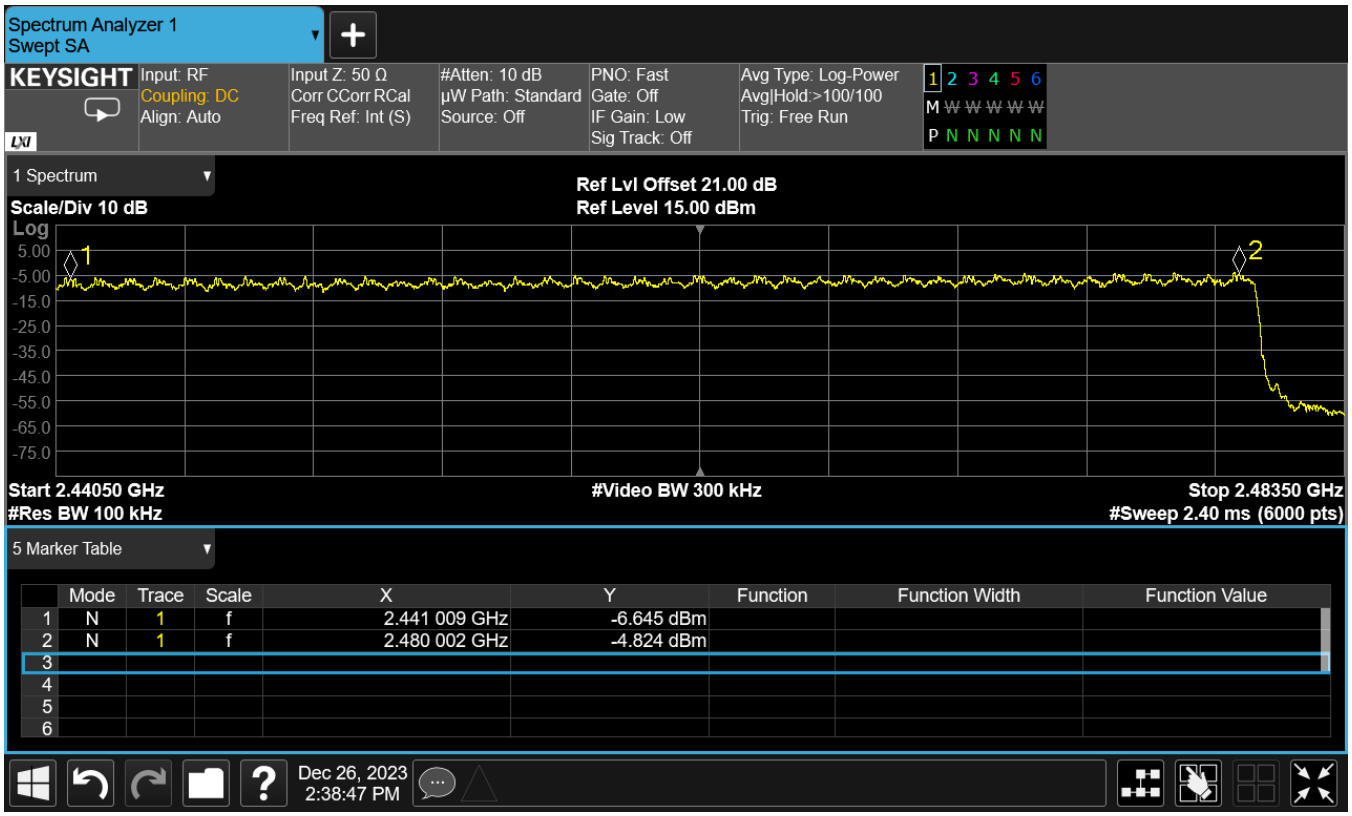


Figure 23: 8DPSK (3Mbps) – Number of Channels Used, Plot 1

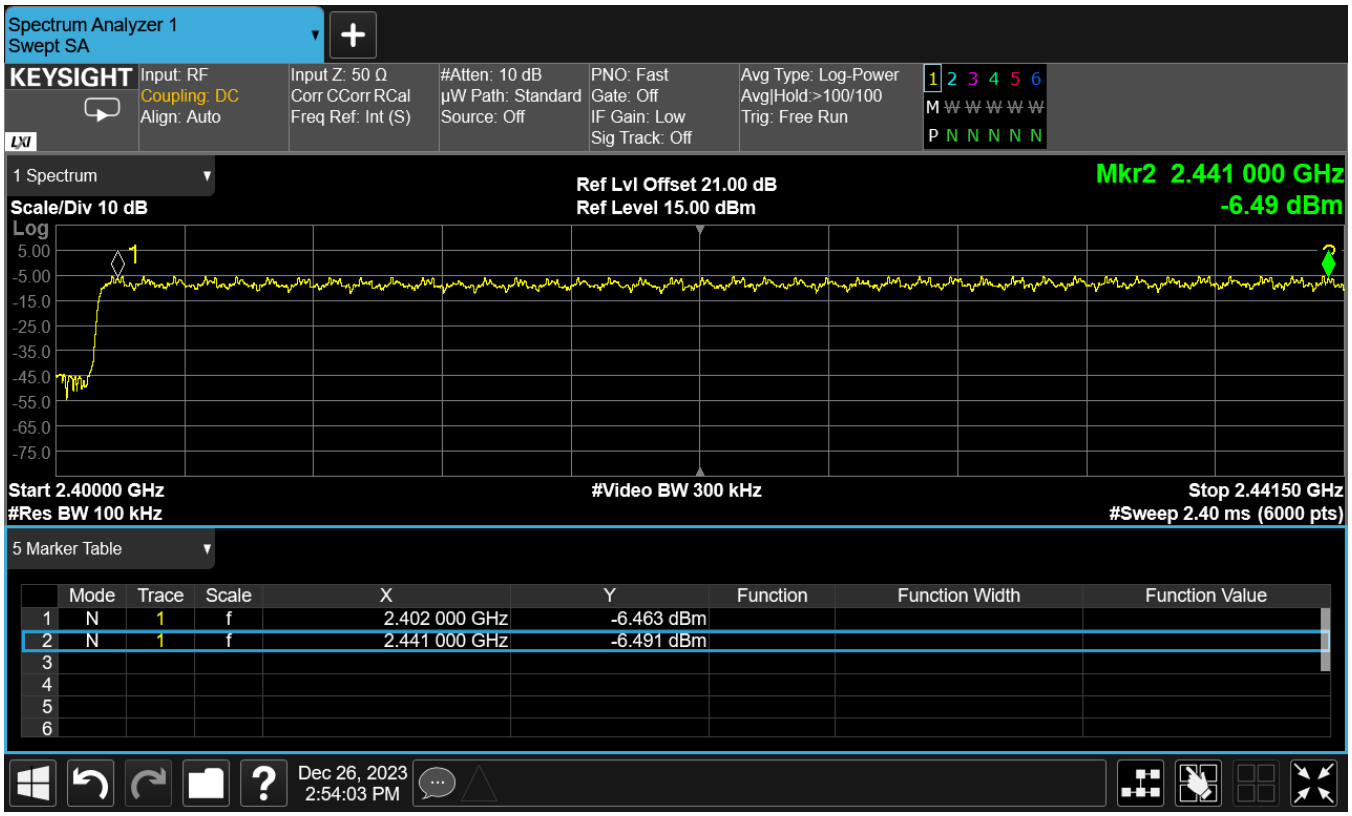
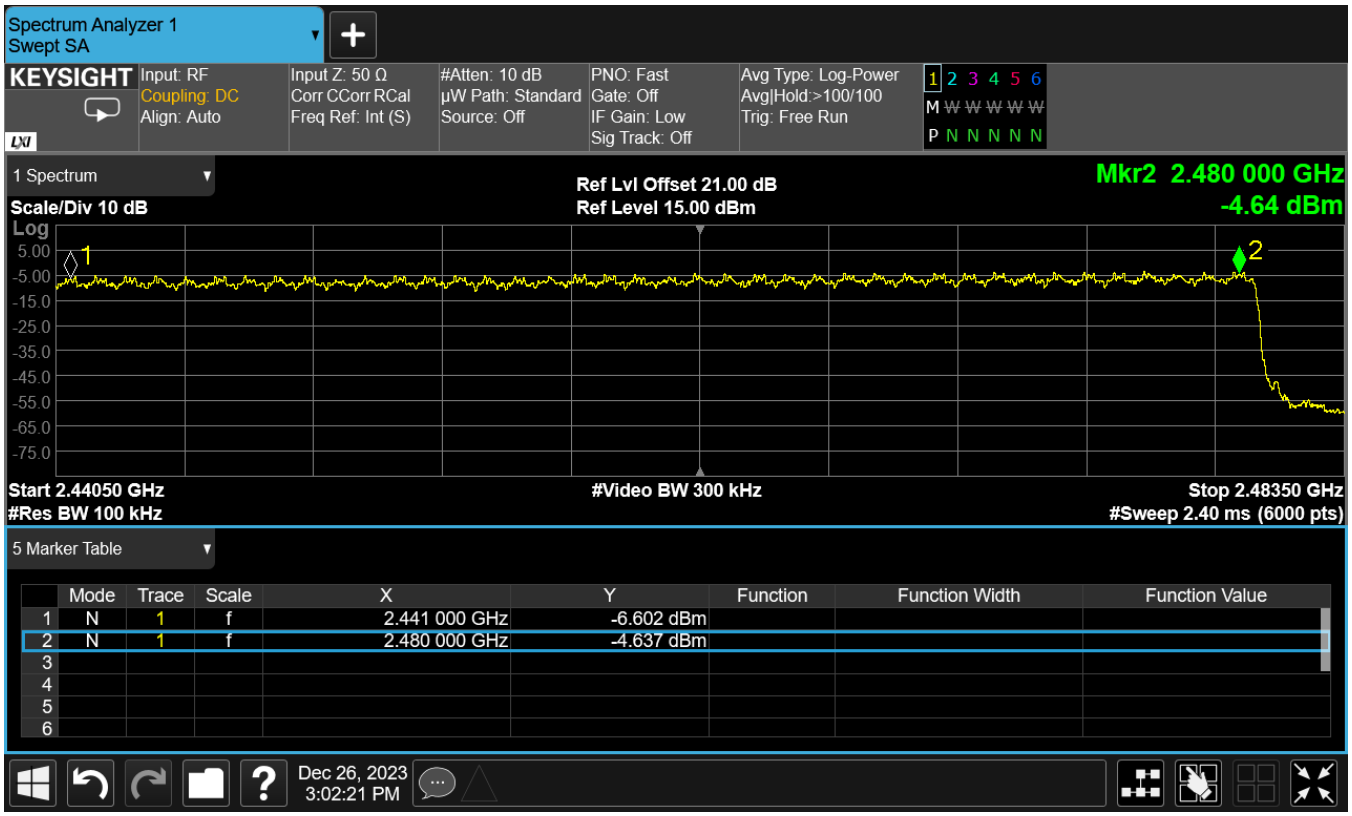


Figure 24: 8DPSK (3Mbps) – Number of Channels Used, Plot 2



2.4 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.

2.4.1 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 prescribed in this section shall be defined as follows:

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

Time of Occupancy Limit = 0.4s/31.6s

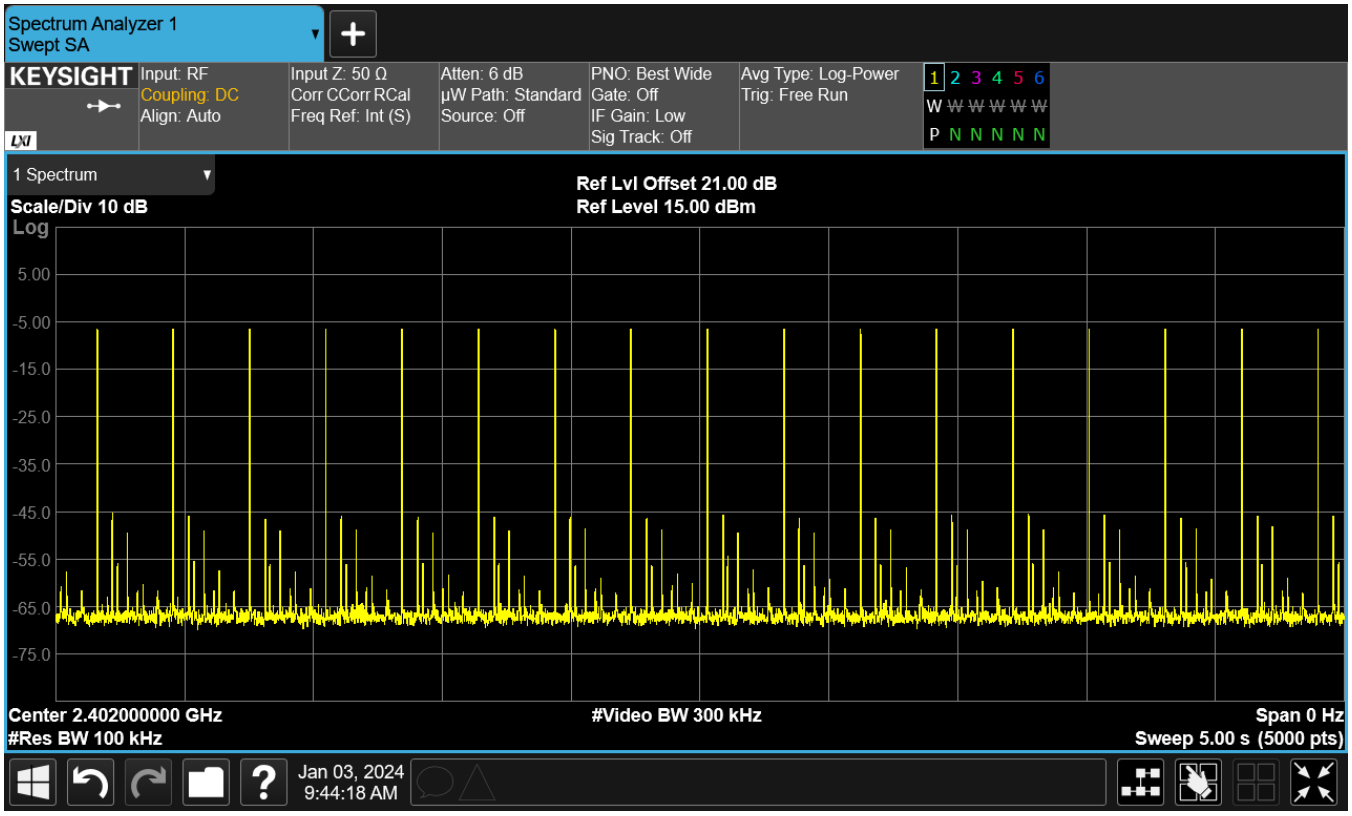
A multiplier factor of 6.32 shall be employed to extrapolate the total average time of occupancy of any channel over a 31.6 second period. This factor is based on a 5 second transmitter evaluation.

5 * 6.32 = 31.6

Table 5: Time of Occupancy – Test Results

Modulation	Transmissions in 5 seconds	Transmissions in 31.6 seconds	Single Transmission Period	EUT Occupancy Dwell	Occupancy Limit
GFSK	17	107	2.945 ms	316 ms	400 ms
π/4DQPSK	17	107	2.945 ms	316 ms	400 ms
8DPSK	17	107	2.945 ms	316 ms	400 ms

Figure 25: GFSK Transmitter 5-Second Evaluation (Hopping)



* 17 individual transmitter hops transpire in a given 5-second evaluation period. See next plot above for detailed measurement.

Figure 26: GFSK Transmitter Evaluation (Hopping) – Single Dwell Time

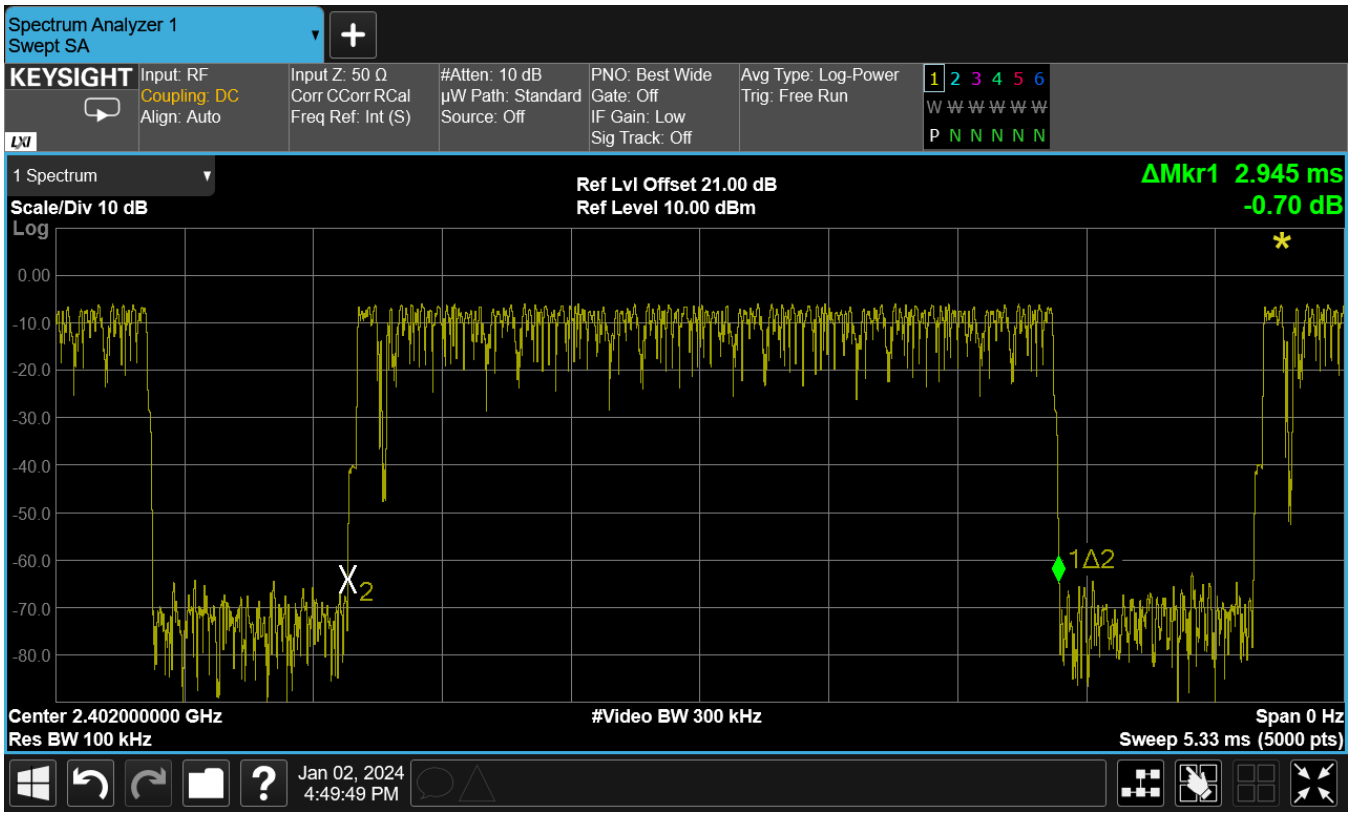
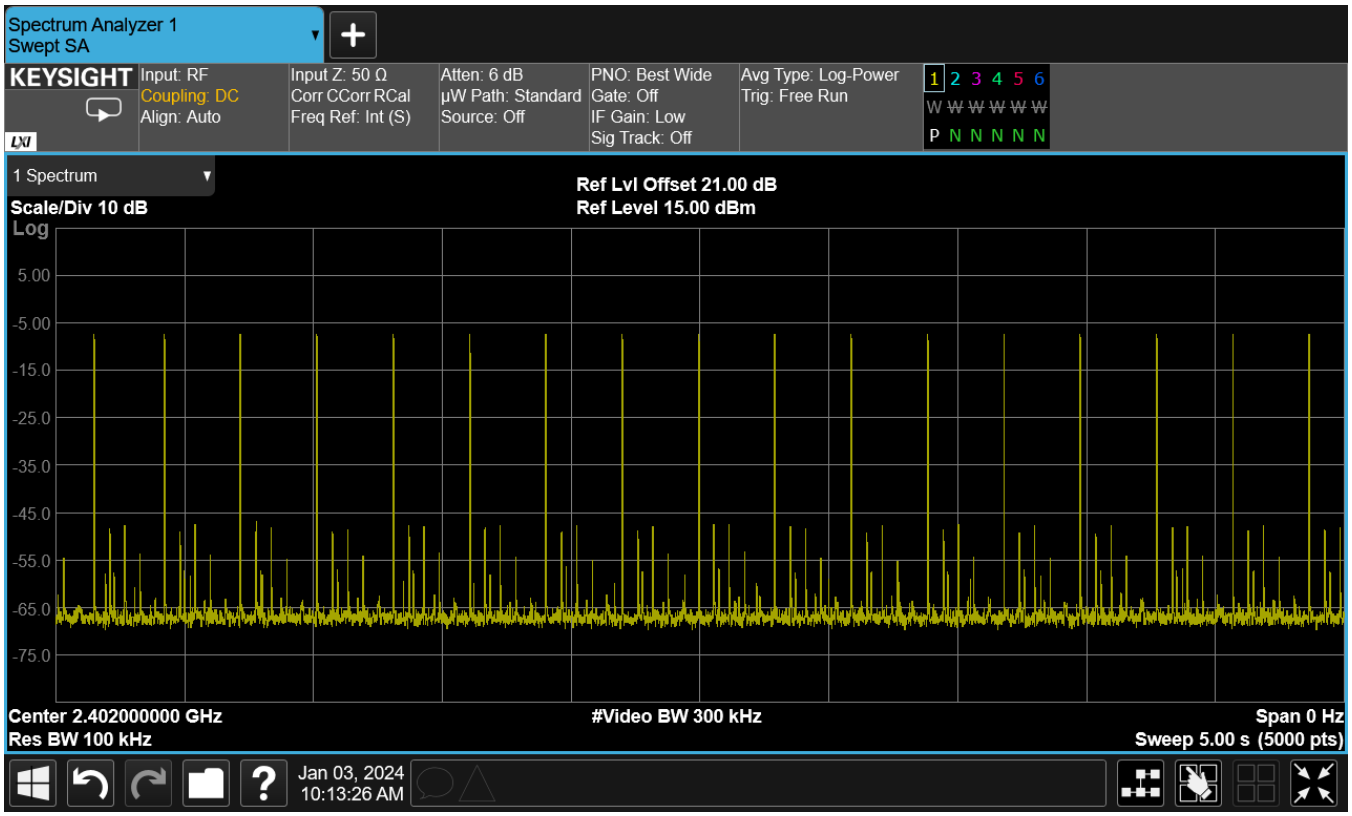


Figure 27: π/4DQPSK Transmitter 5-Second Evaluation (Hopping)



* 17 individual transmitter hops transpire in a given 5-second evaluation period.

Figure 28: π/4DQPSK Transmitter Evaluation (Hopping) – Single Dwell Time

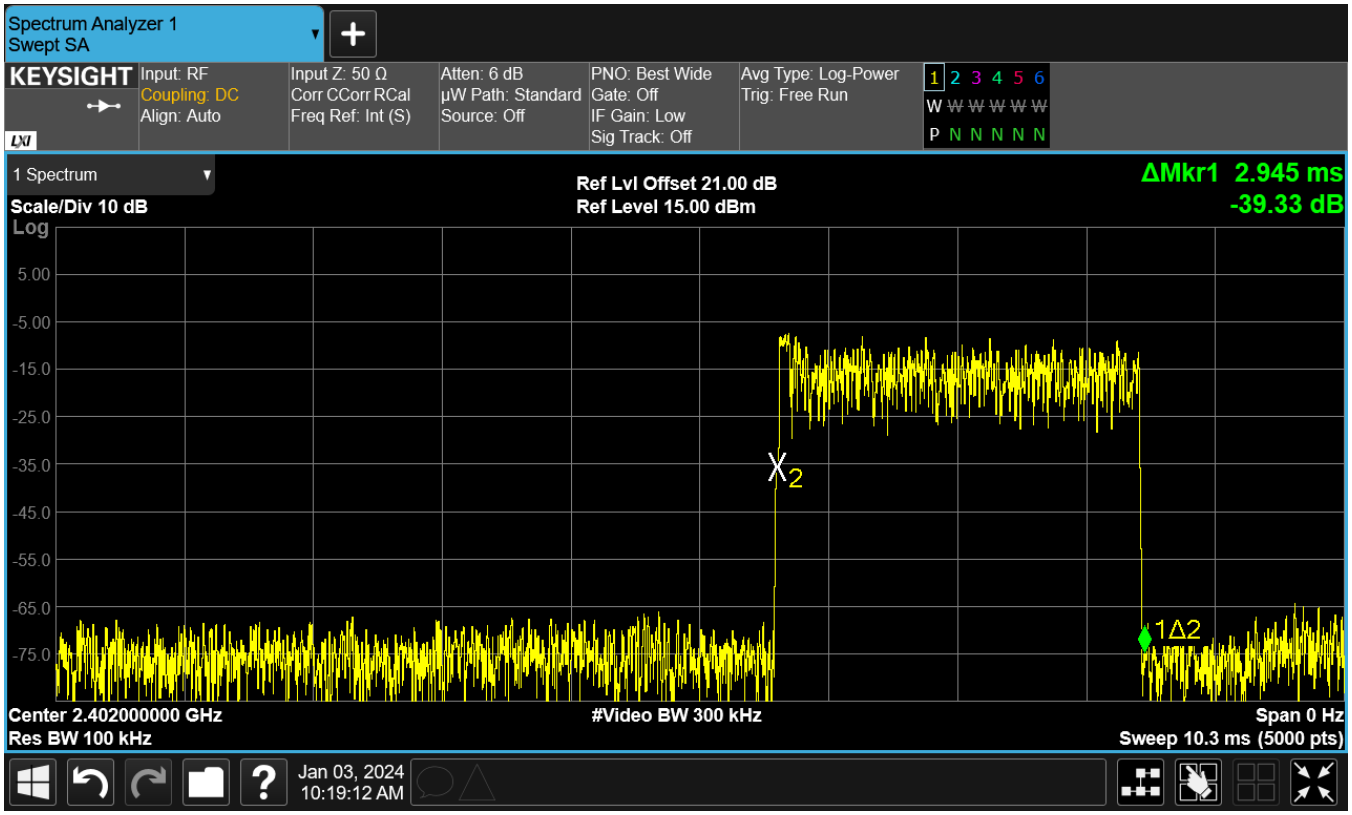
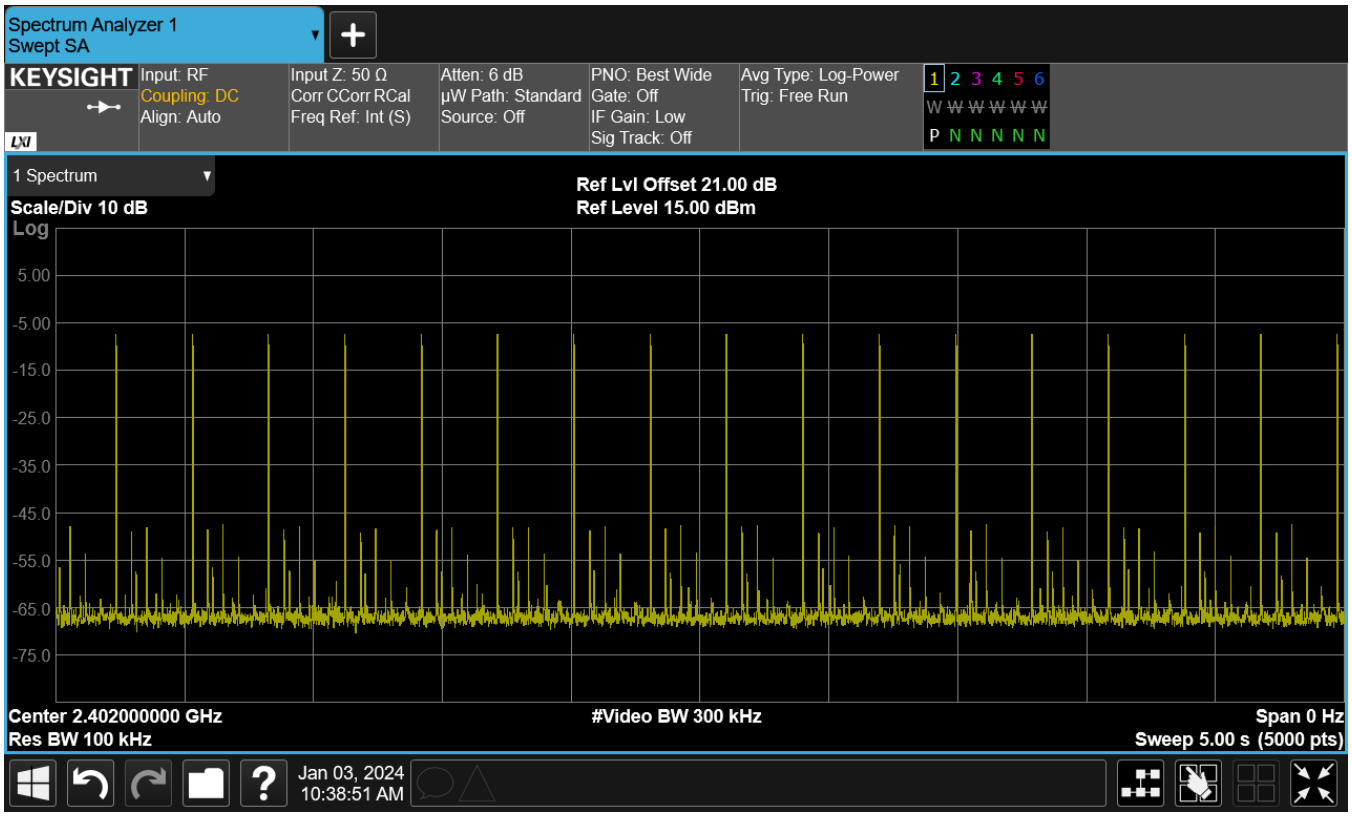
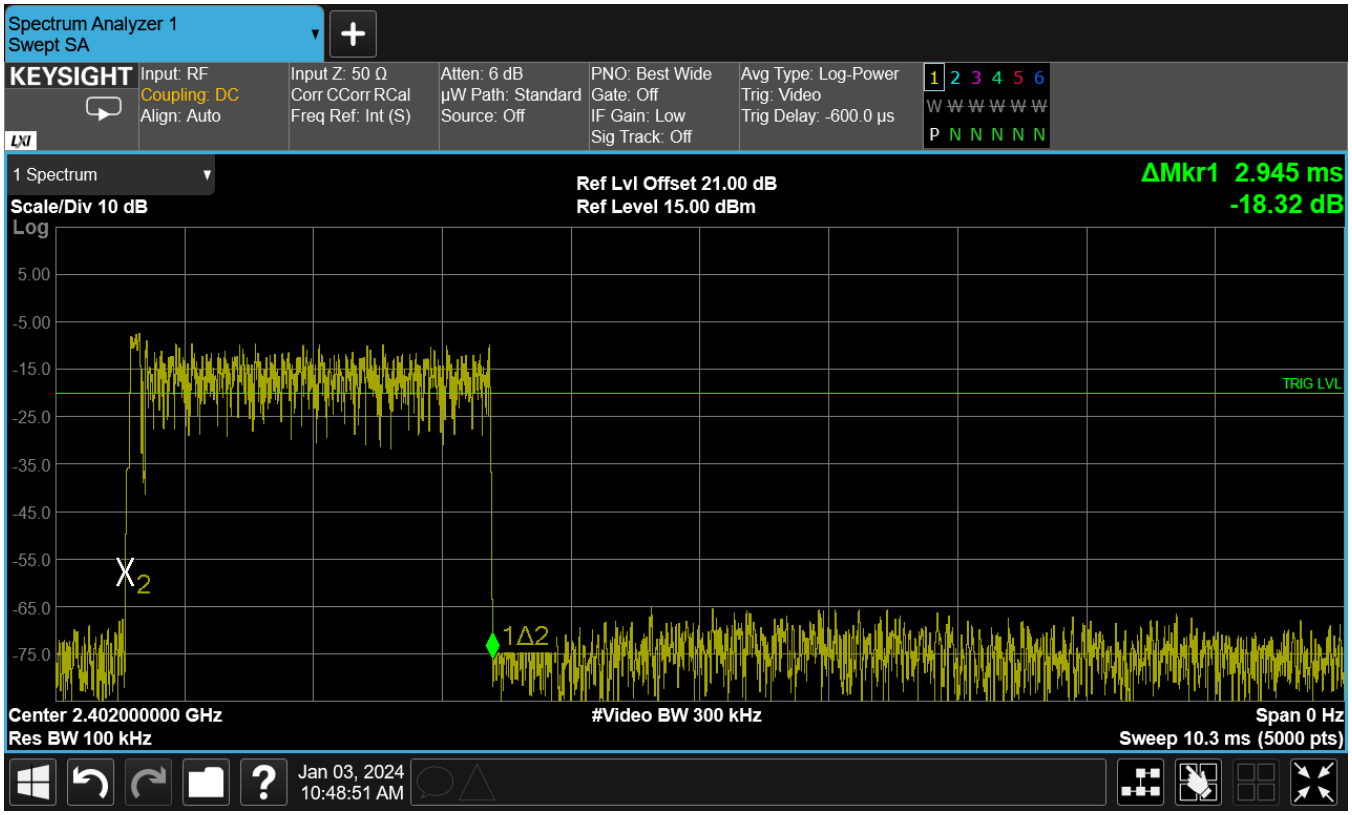


Figure 29: 8DPSK Transmitter 5-Second Evaluation (Hopping)



* 17 individual transmitter hops transpire in a given 5-second evaluation period.

Figure 30: 8DPSK Transmitter Evaluation (Hopping) – Single Dwell Time



2.5 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.

2.5.1 Measurement Method and Results

This test was performed as specified in ANSI C63.10 (2013), Section 7.8.2

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

The minimum separation requirement is based on two-thirds of the 20 dB bandwidth.

The EUT was evaluated at the low, center, and high channels, and a few other random channels that the transmitter employs. All of the hopping channel carriers are separated by exactly 1.0 MHz, regardless of the modulation mode.

Table 6: Channel Carrier Separation – Test Results

Modulation	Mode (Data Rate)	20dB Bandwidth	Minimum Separation Requirement	EUT Carrier Separation
GFSK	DH5 (1Mbps)	0.93MHz	0.62 MHz	1.0 MHz
π/4DQPSK	2DH5 (2Mbps)	1.19 MHz	0.79 MHz	1.0 MHz
8DPSK	3DH5 (3Mbps)	1.29 MHz	0.86 MHz	1.0 MHz

Figure 31: GFSK (1Mbps) – Channel Separation

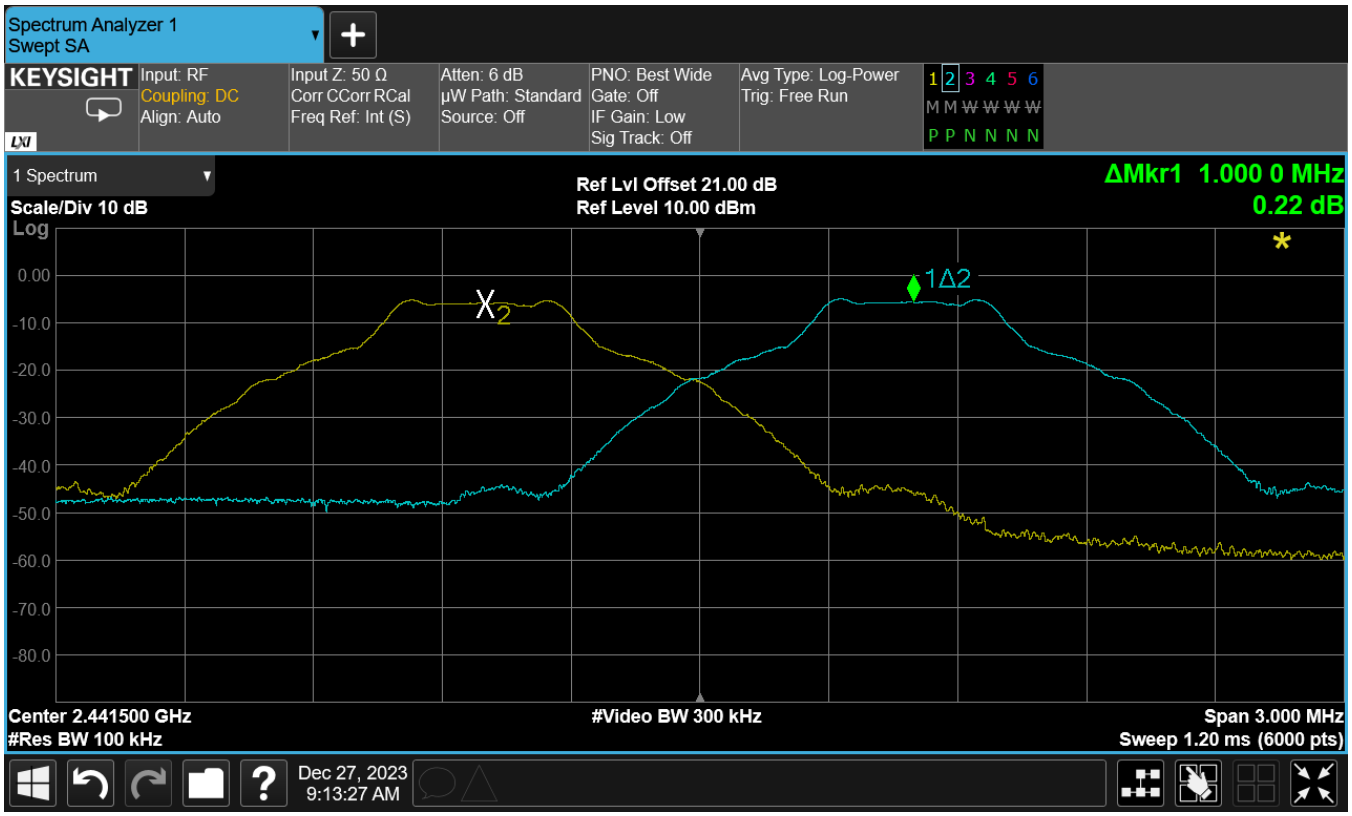


Figure 32: π/4DQPSK (2Mbps) – Channel Separation

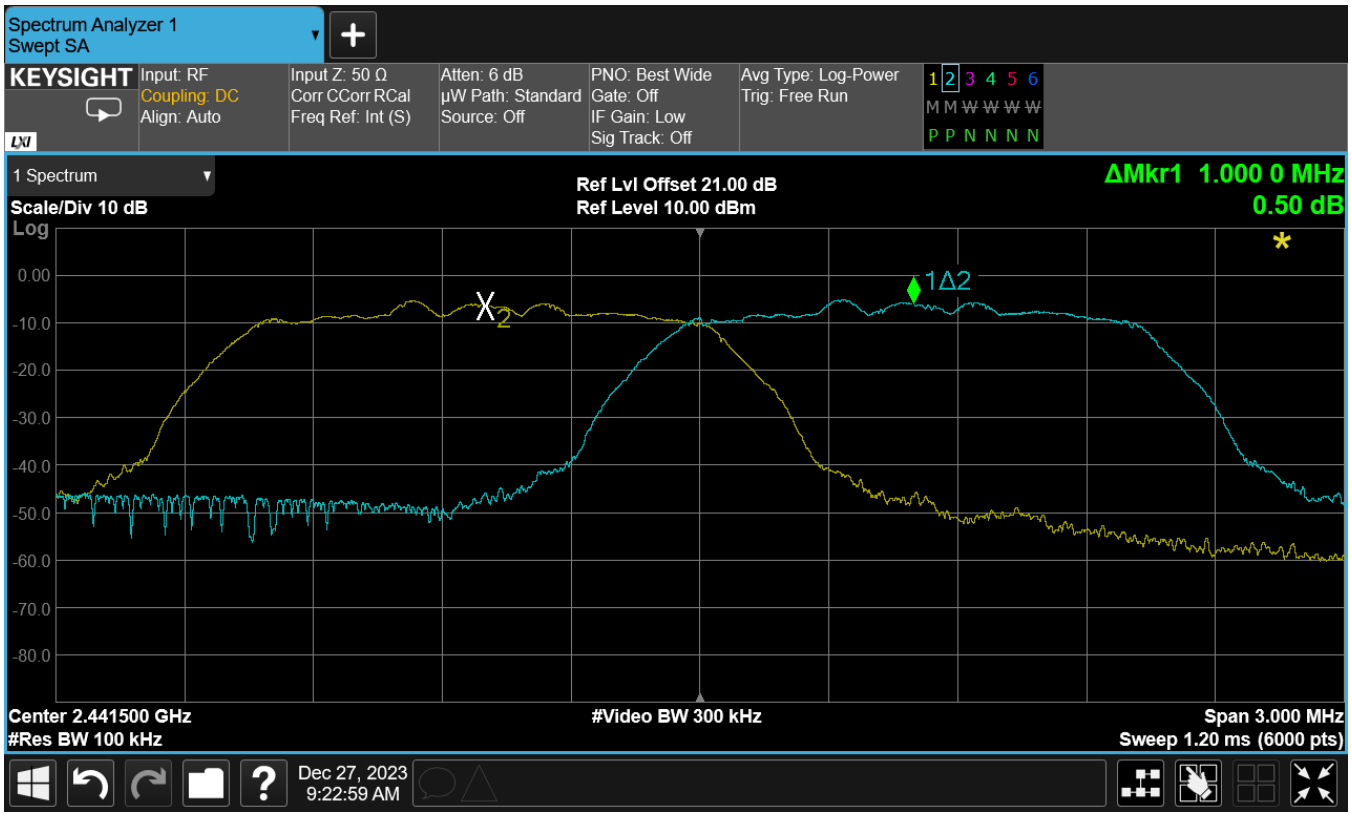
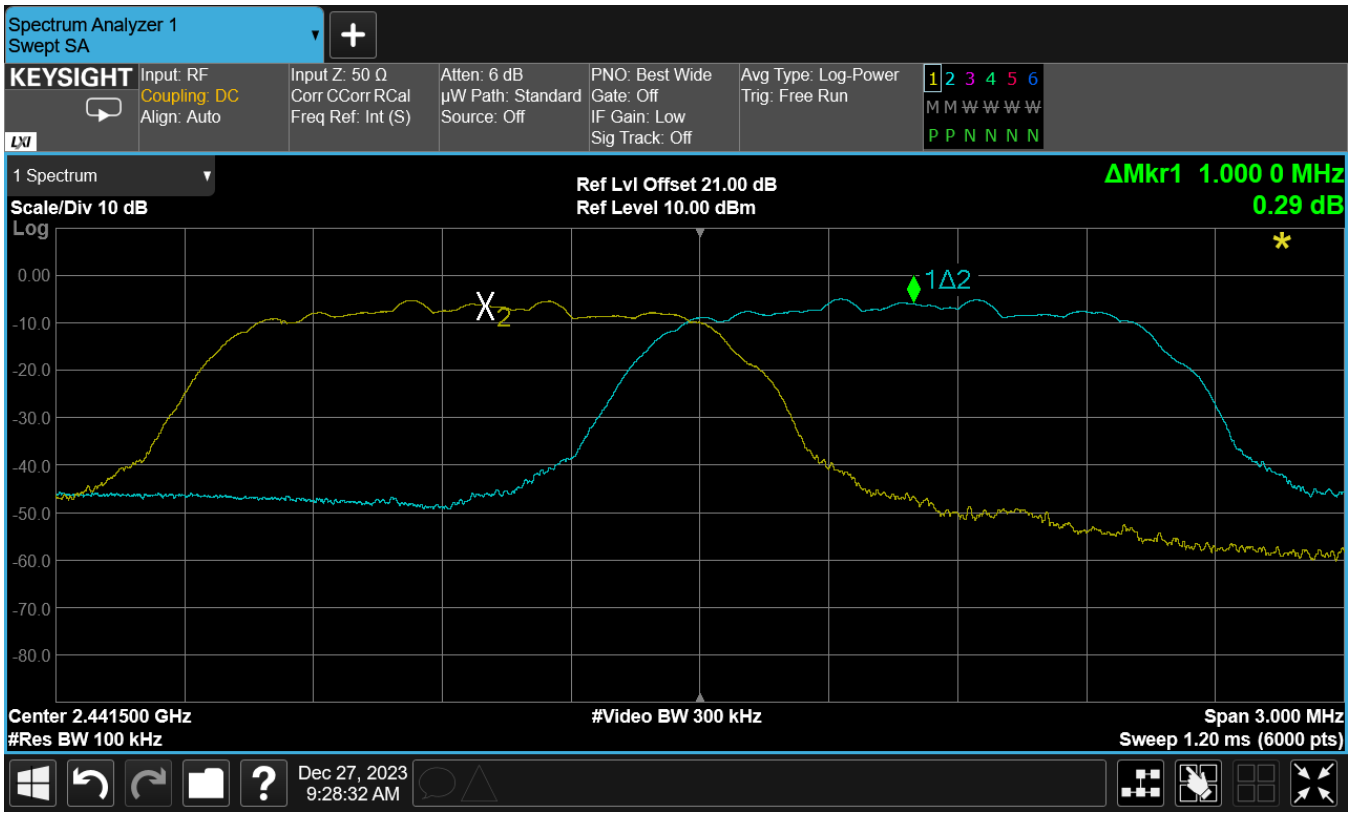


Figure 33: 8DPSK (3Mbps) – Channel Separation



2.6 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.

2.6.1 Measurement Method and Results

This test was performed as specified in ANSI C63.10 (2013), Section 7.8.1 and 7.8.6.

The EUT was configured both in the non-hopping mode and in a fully modulated mode, with the hopping enabled. The hopping mode was worst case and that data is presented here.

Table 7: Bandedge Compliance – Test Results

Modulation	Mode (Data Rate)	Low Channel (2402 MHz)	High Channel (2480 MHz)
GFSK	DH5 (1Mbps)	40.45 dB	52.50 dB
π/4DQPSK	2DH5 (2Mbps)	39.21 dB	53.76 dB
8DPSK	3DH5 (3Mbps)	39.17 dB	54.69 dB

Figure 34: GFSK (1Mbps) – Lower Band Edge

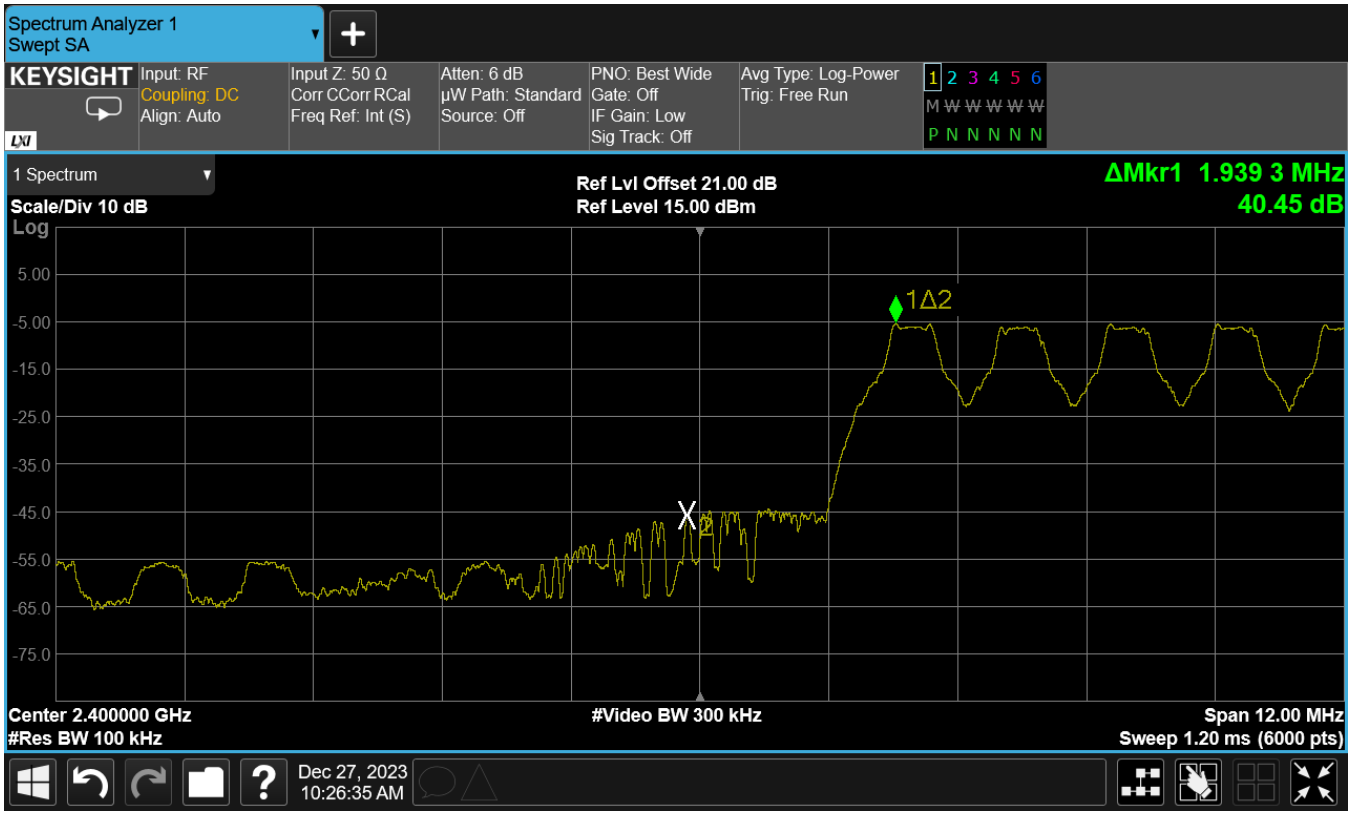


Figure 35: GFSK (1Mbps) – Upper Band Edge

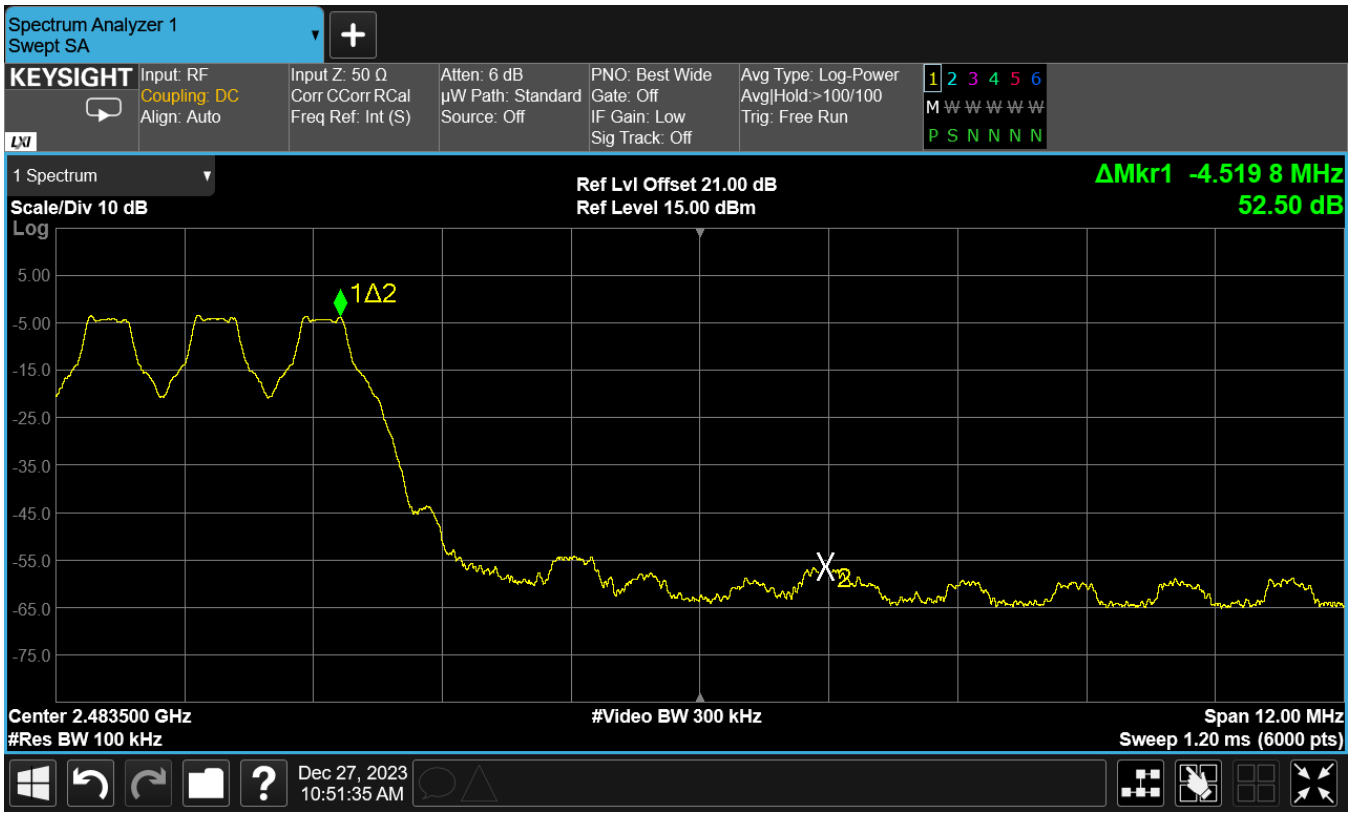


Figure 36: π/4DQPSK (2Mbps) – Lower Band Edge

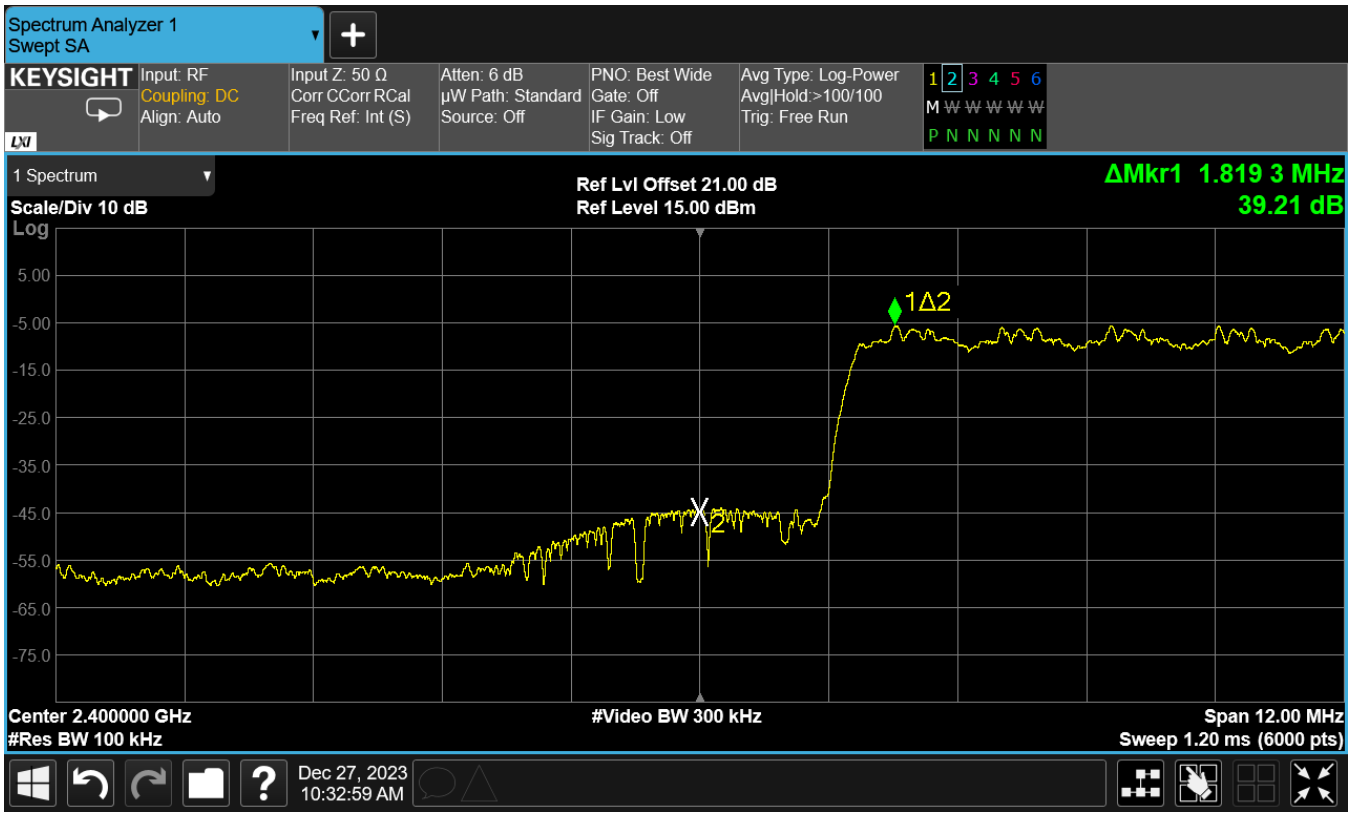


Figure 37: π/4DQPSK (2Mbps) – Upper Band Edge

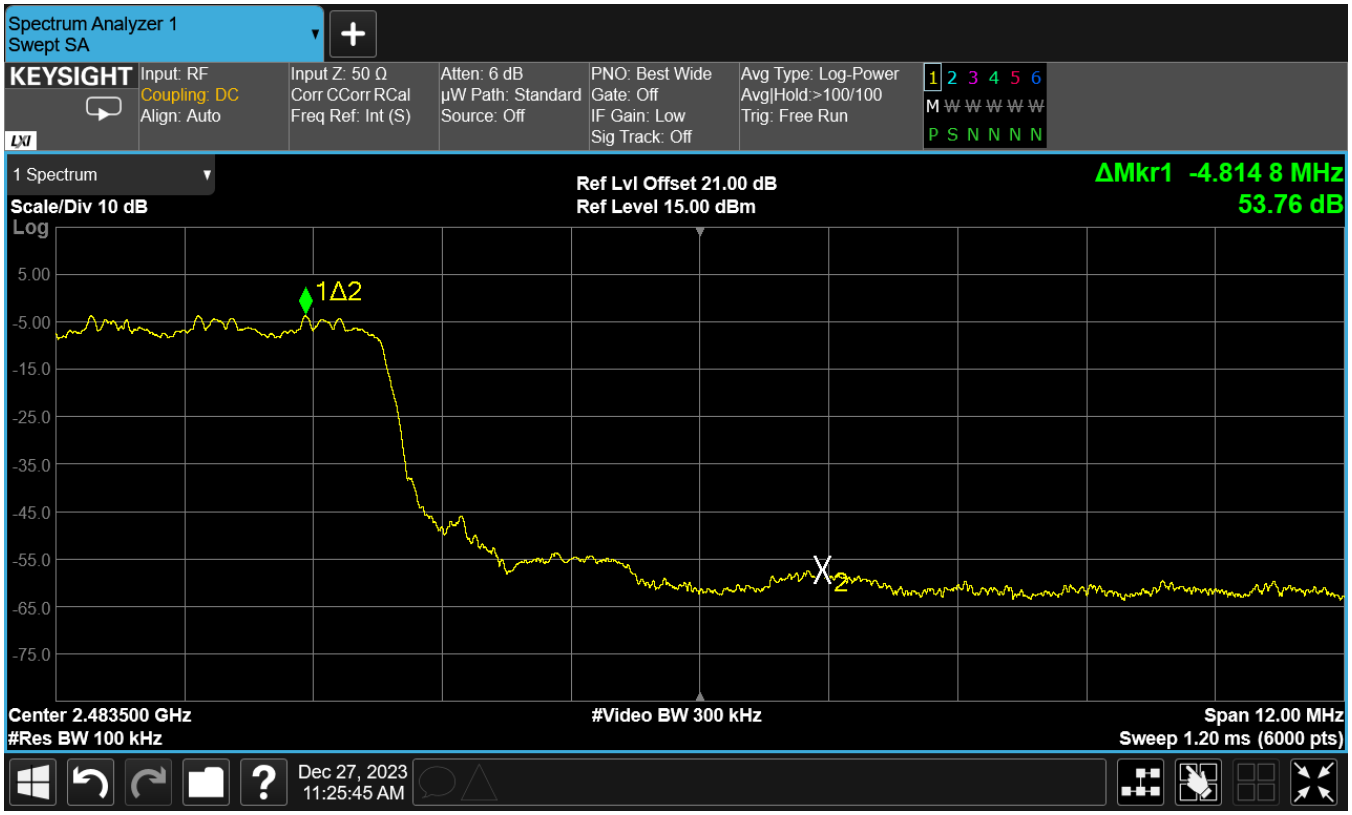


Figure 38: 8DPSK (3Mbps) – Lower Band Edge

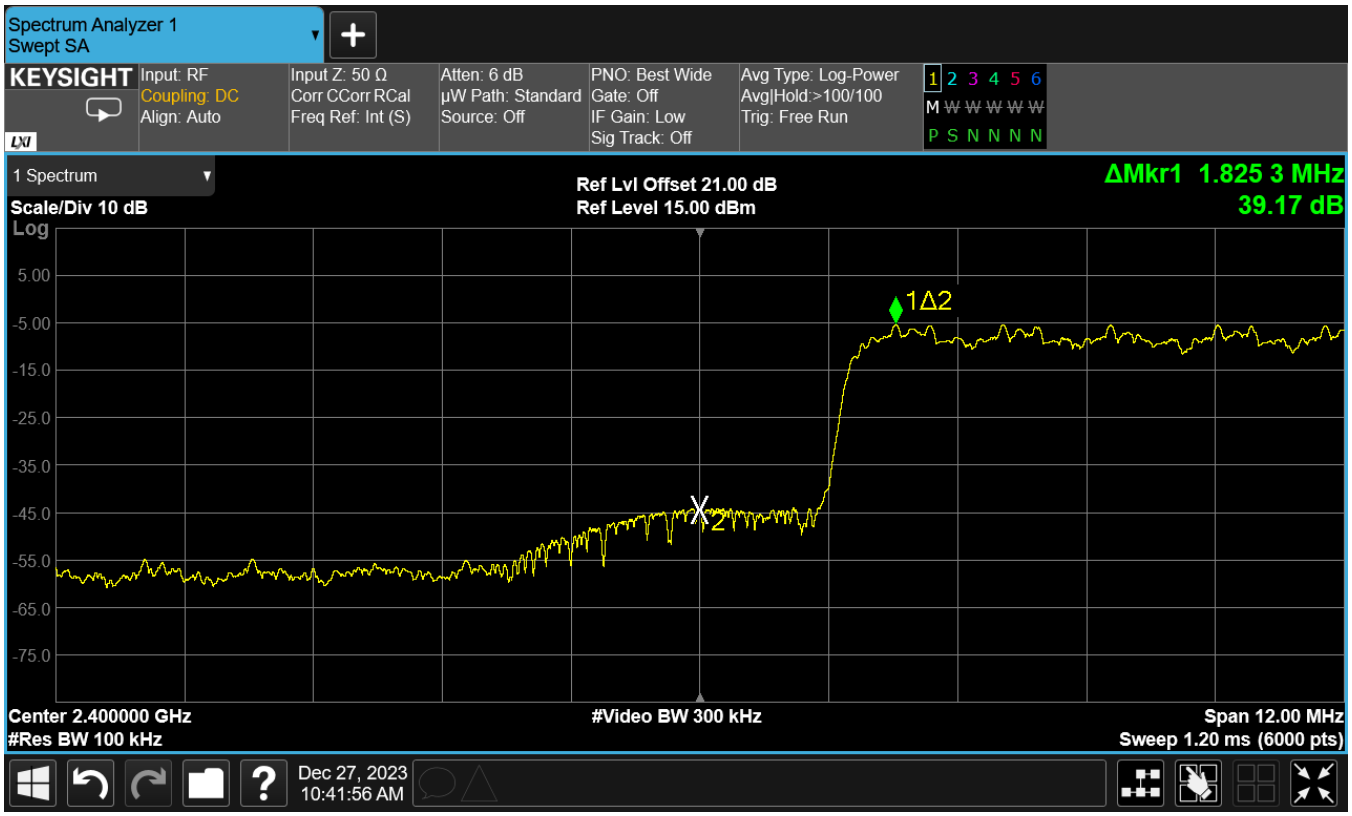
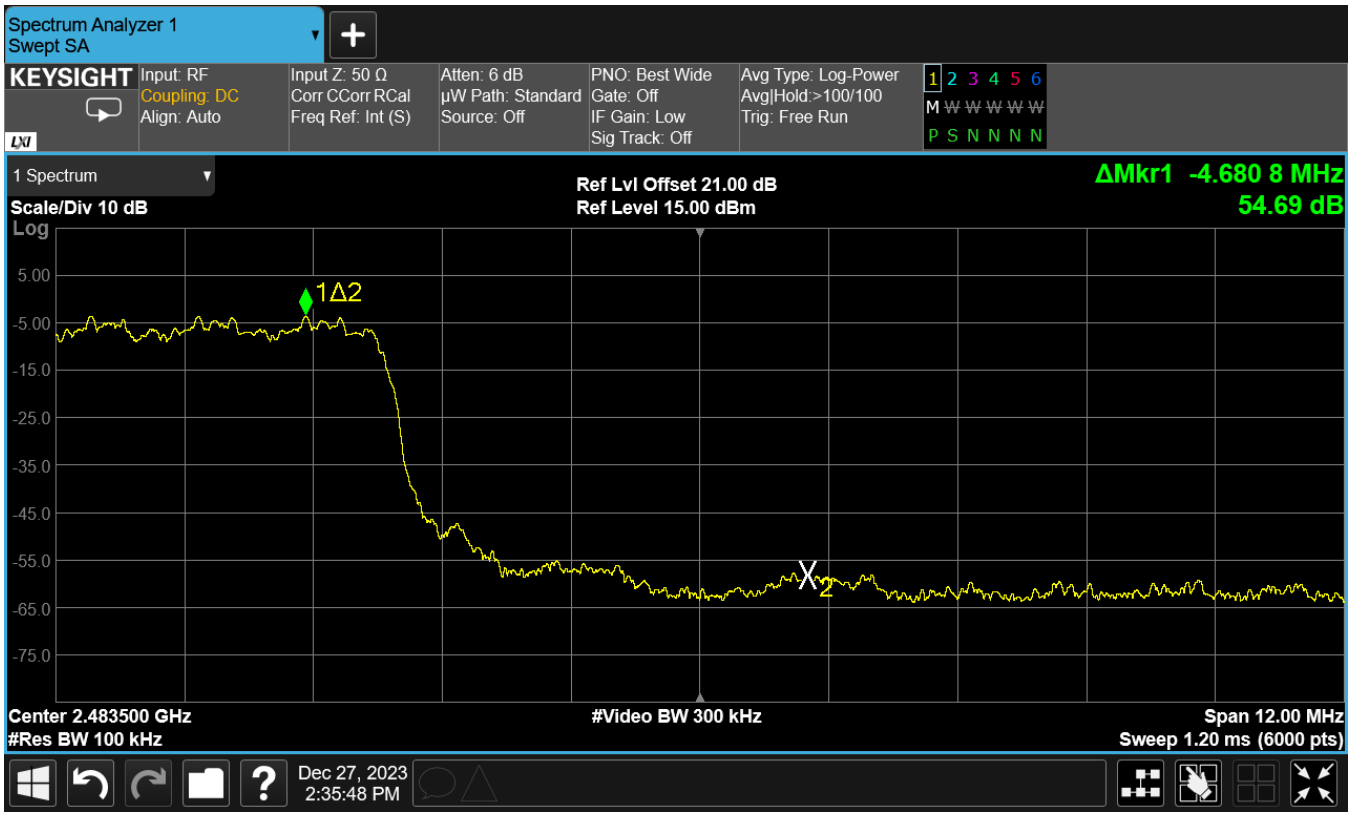


Figure 39: 8DPSK (3Mbps) – Upper Band Edge



2.7 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.

2.7.1 Measurement Method and Results

This test was performed as specified in ANSI C63.10 (2013), Section 7.8.8 and 11.11.

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

The amplitude of the EUT carrier frequency was measured to determine the emissions limit (20 dB below the carrier frequency amplitude). The emissions outside of the allocated frequency band were then scanned from 30 MHz to 25 GHz, to include the 10th harmonic of the fundamental

The reduced testing procedures outlined in ANSI C63.10 (2013), Section 5.6.2 and 5.6.2.2 were also employed.

The spurious emission test data correlating to the center channel of all three modulation modes is provided below.

The worst-case mode (GFSK) was utilized to provide the spurious emission test data for the low and high channels.

The EUT complies with the requirements for spurious emissions at the antenna port.

The final test data is provided in the following plots.

Figure 40: GFSK (1Mbps) Low Channel, Conducted Spurious – Plot 1

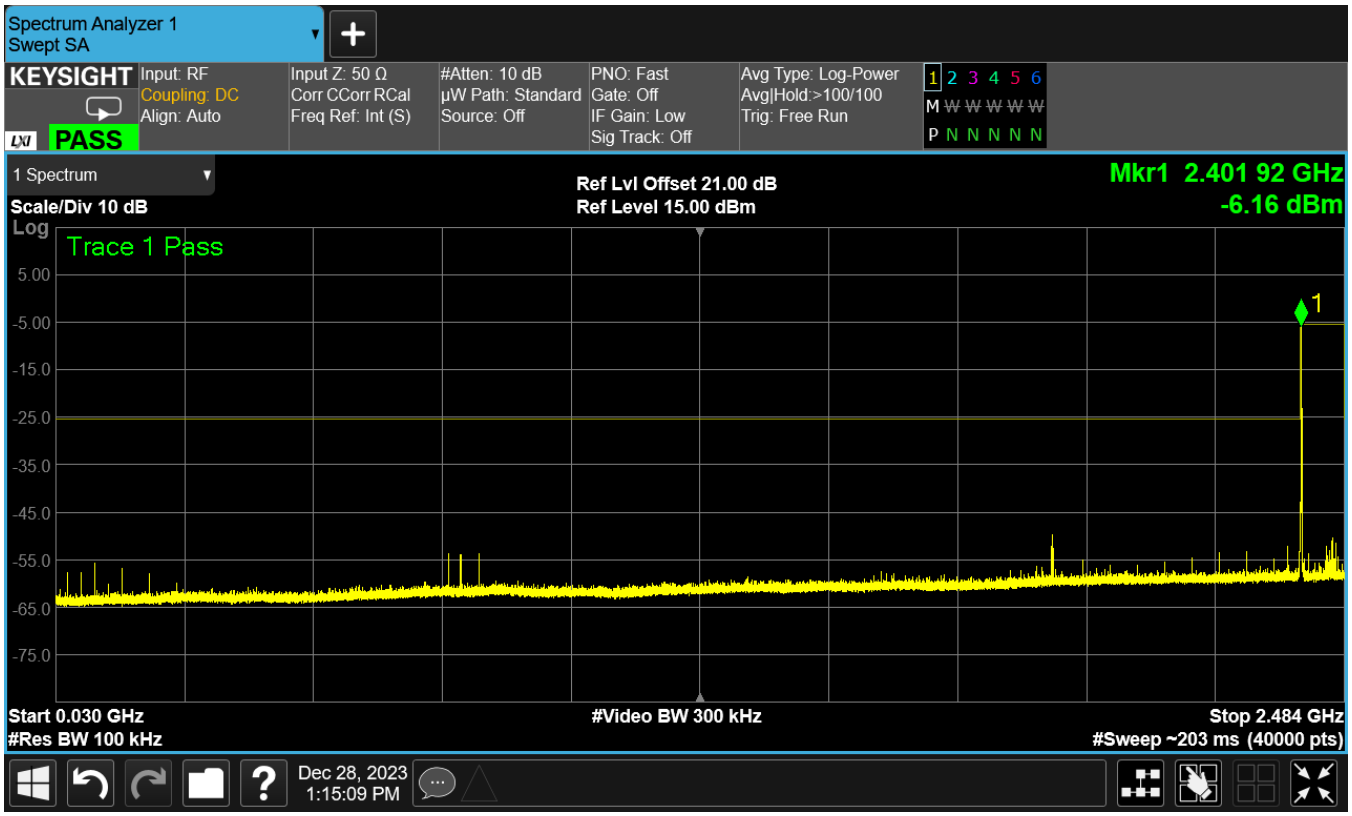


Figure 41: GFSK (1Mbps) Low Channel, Conducted Spurious – Plot 2

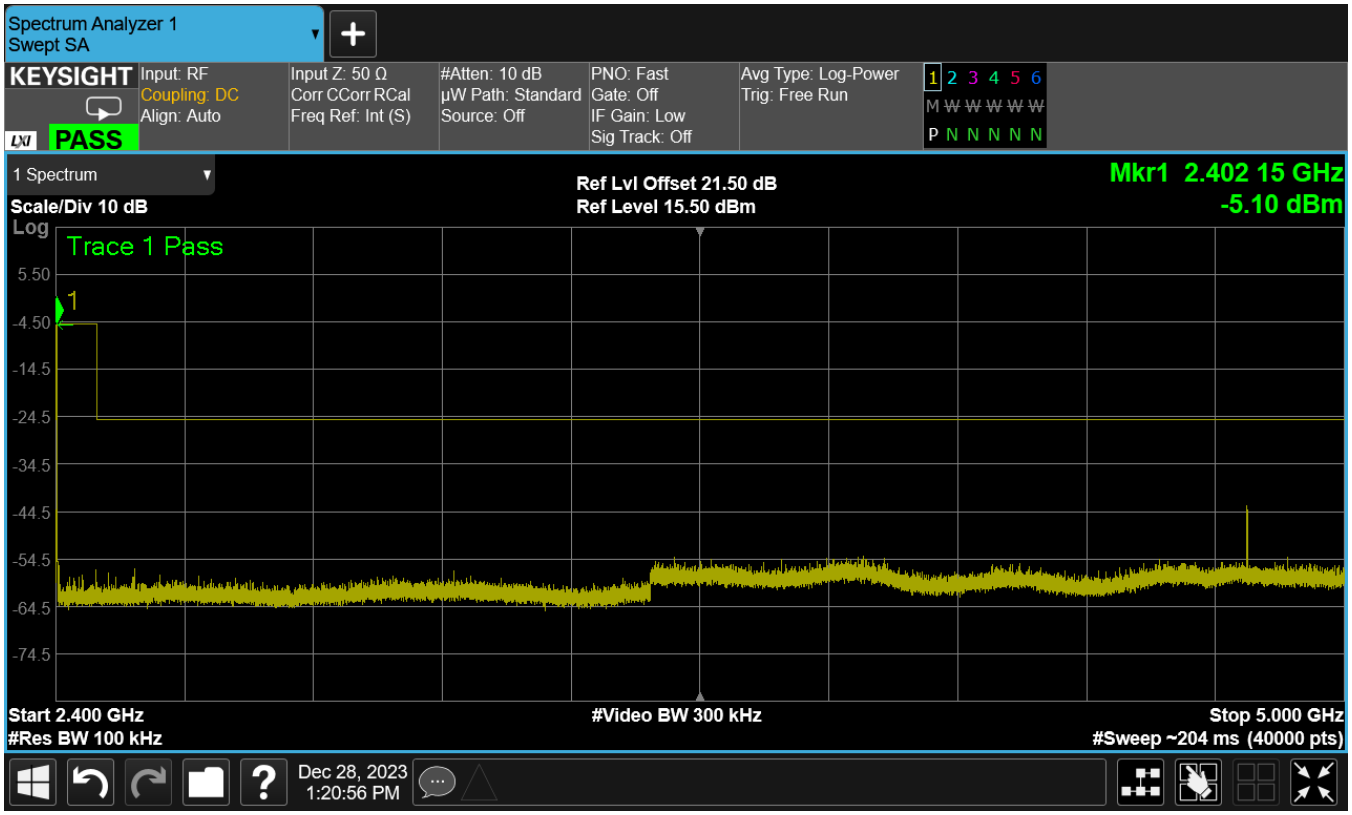


Figure 42: GFSK (1Mbps) Low Channel, Conducted Spurious – Plot 3

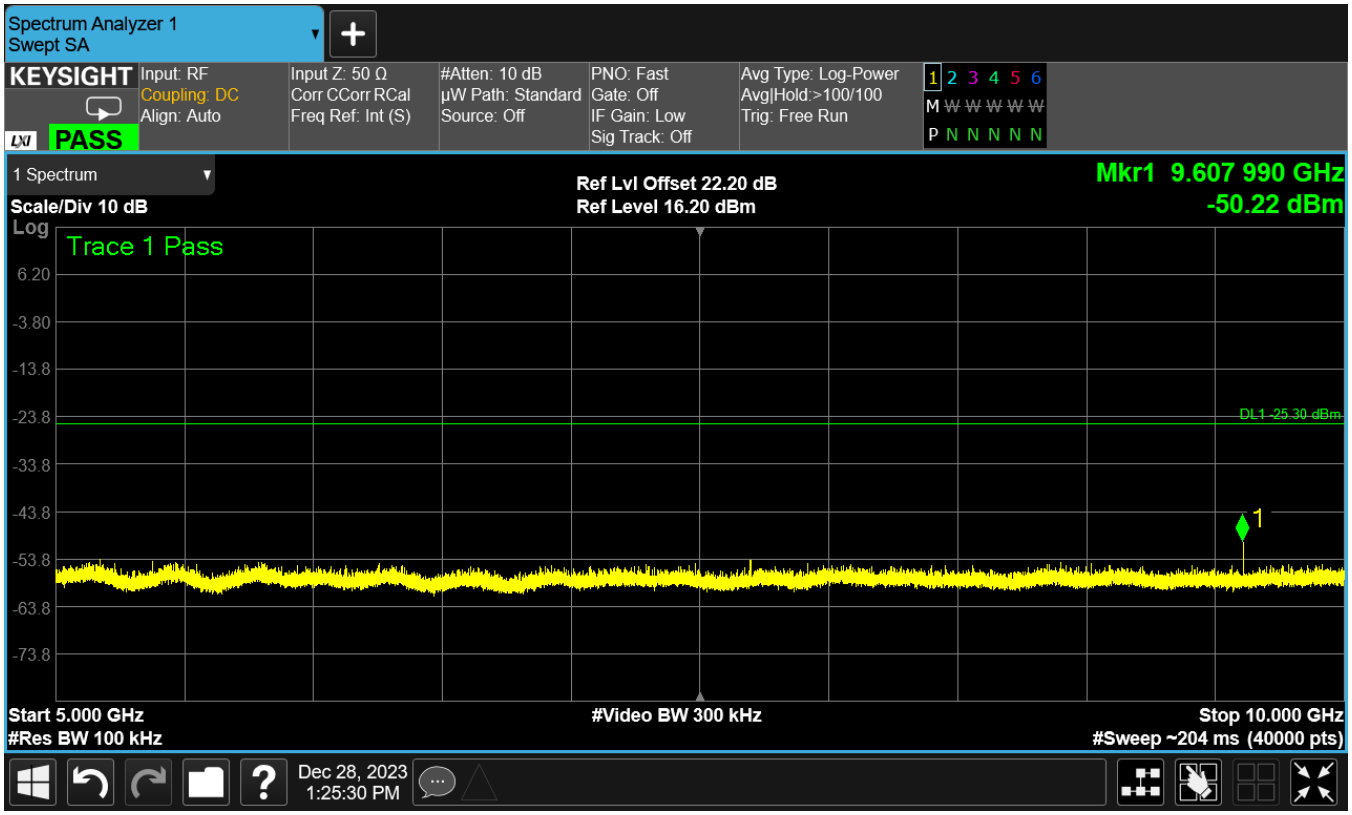


Figure 43: GFSK (1Mbps) Low Channel, Conducted Spurious – Plot 4

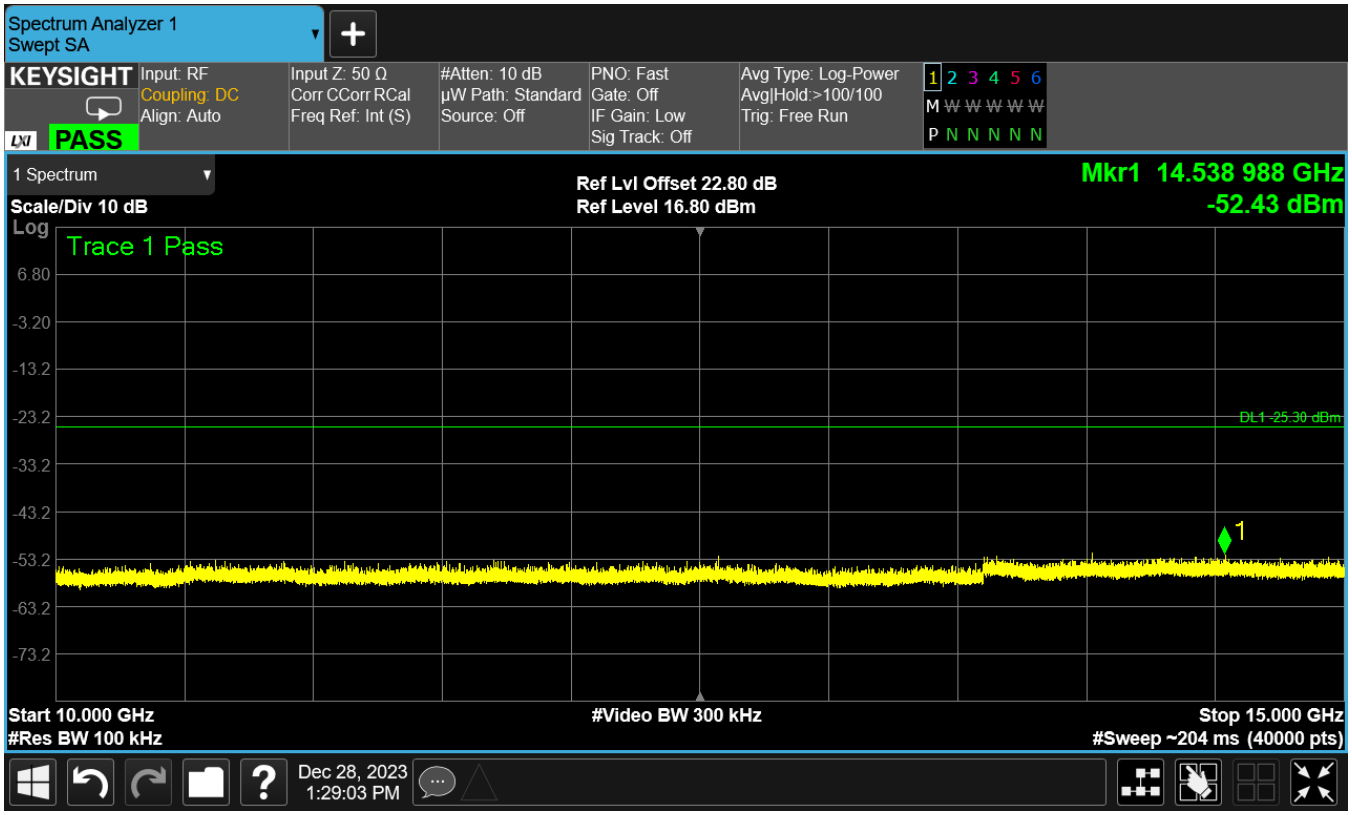


Figure 44: GFSK (1Mbps) Low Channel, Conducted Spurious – Plot 5

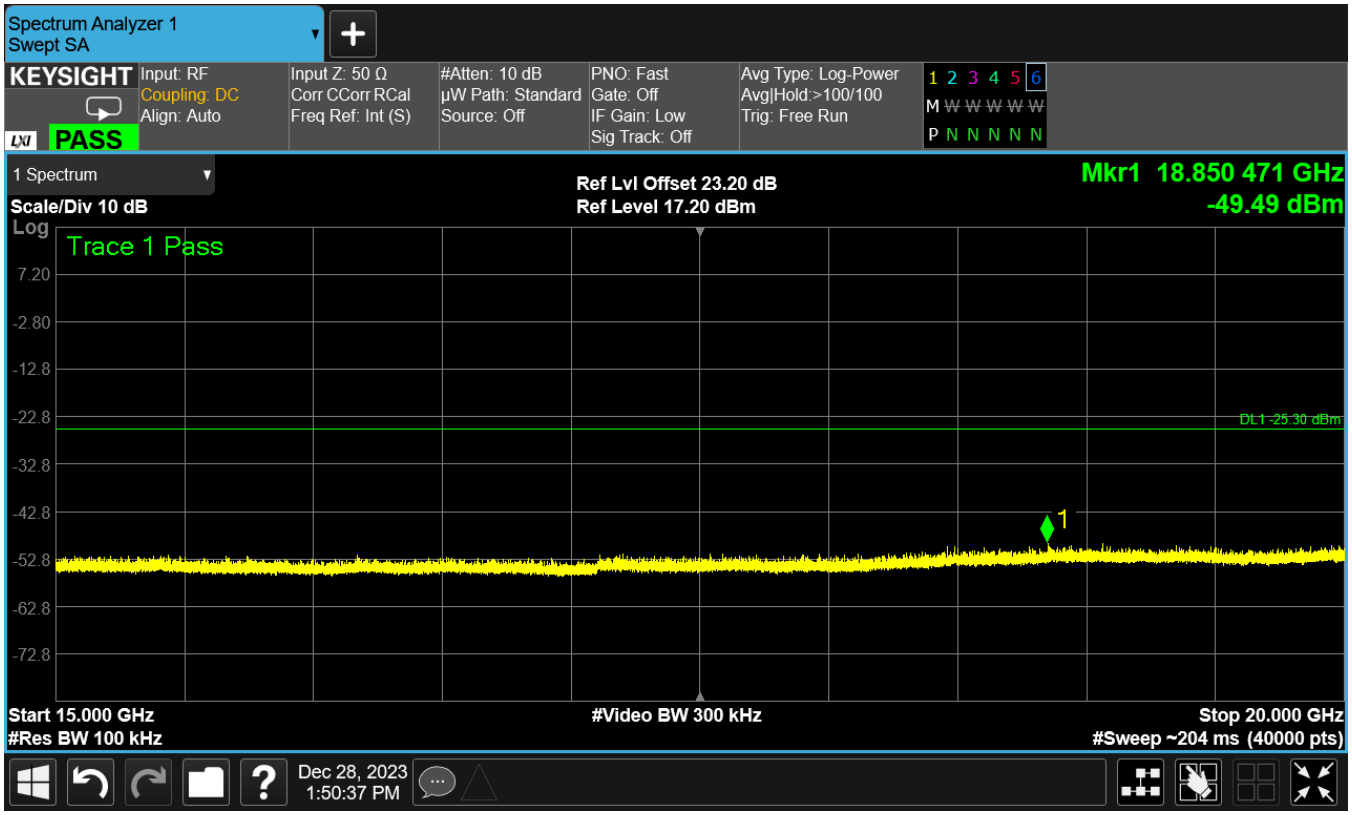


Figure 45: GFSK (1Mbps) Low Channel, Conducted Spurious – Plot 6

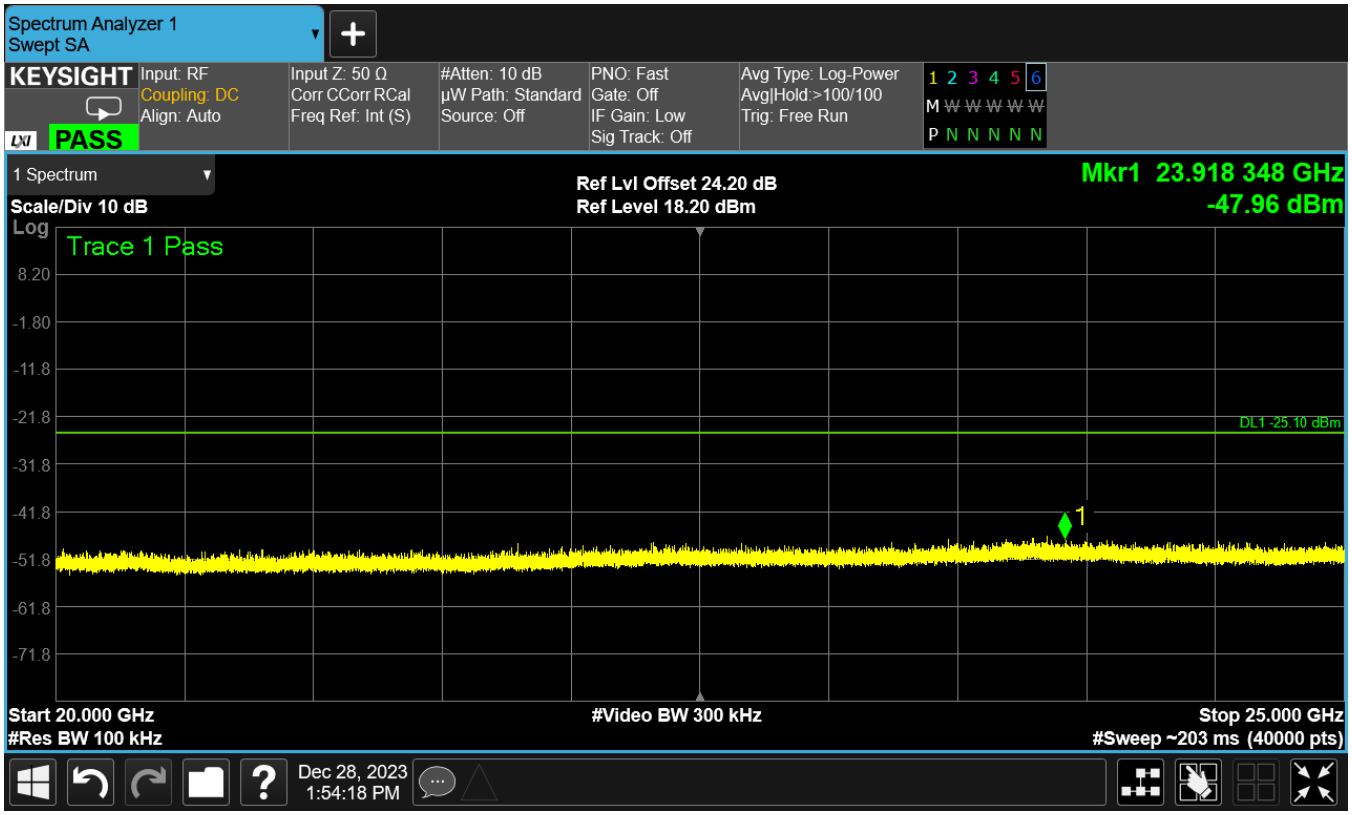


Figure 46: GFSK (1Mbps) Center Channel, Conducted Spurious – Plot 1

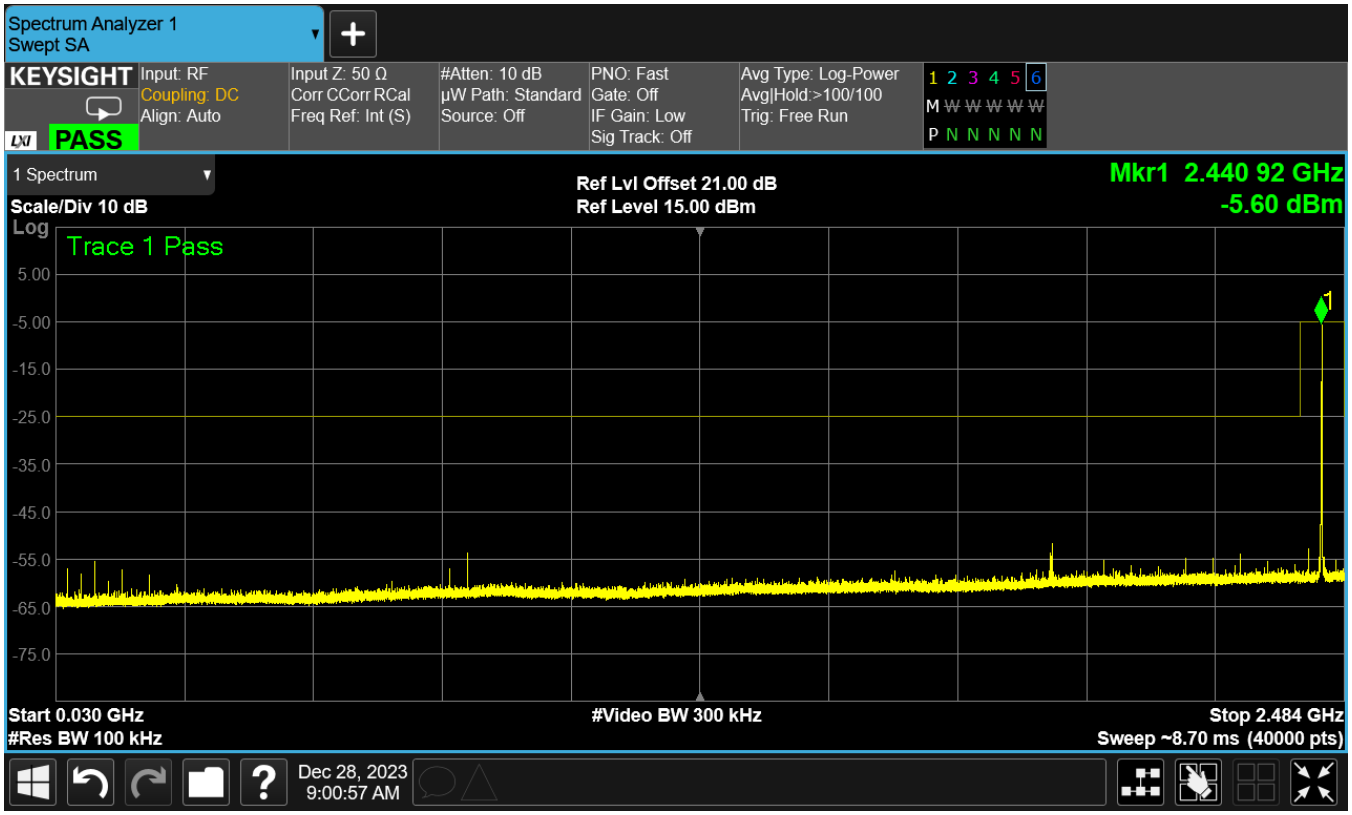


Figure 47: GFSK (1Mbps) Center Channel, Conducted Spurious – Plot 2

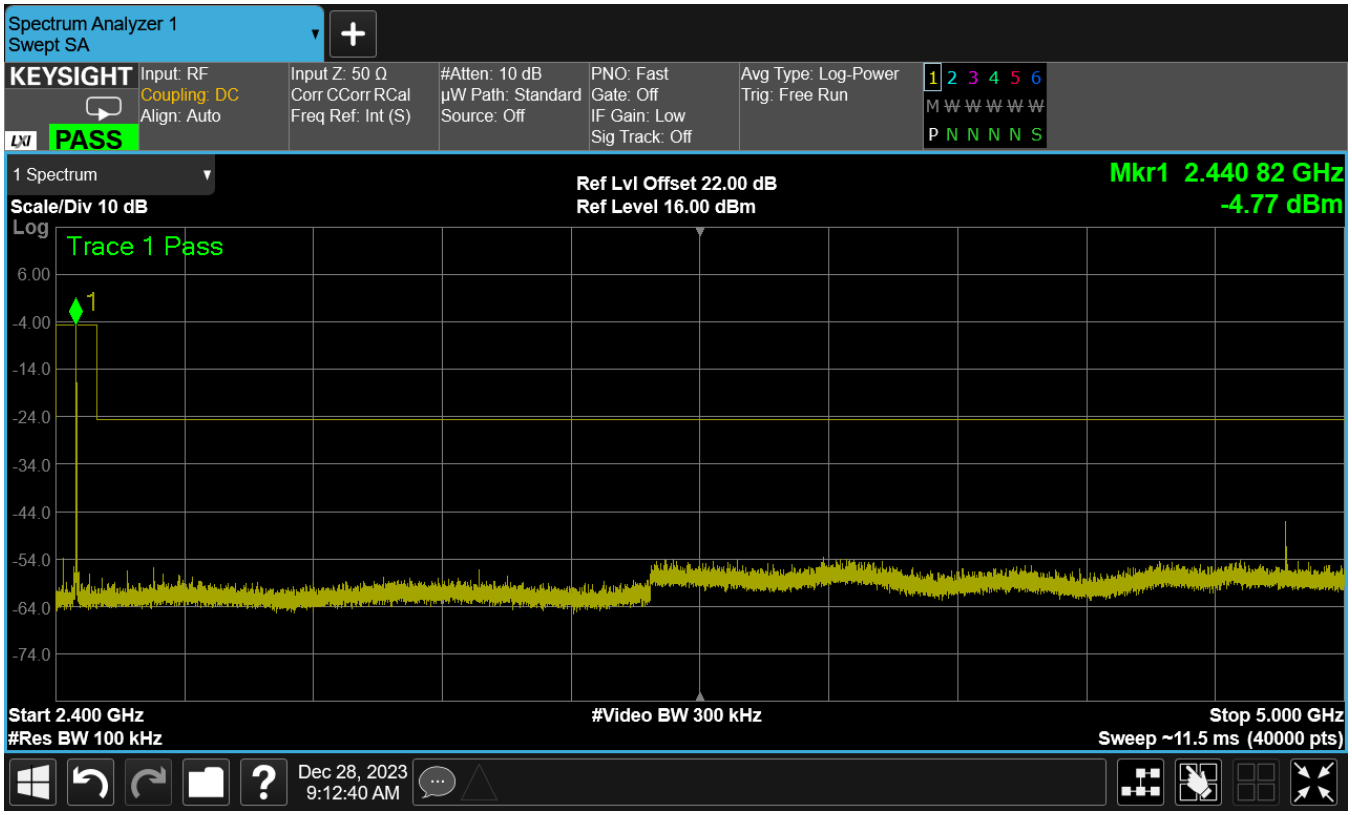


Figure 48: GFSK (1Mbps) Center Channel, Conducted Spurious – Plot 3

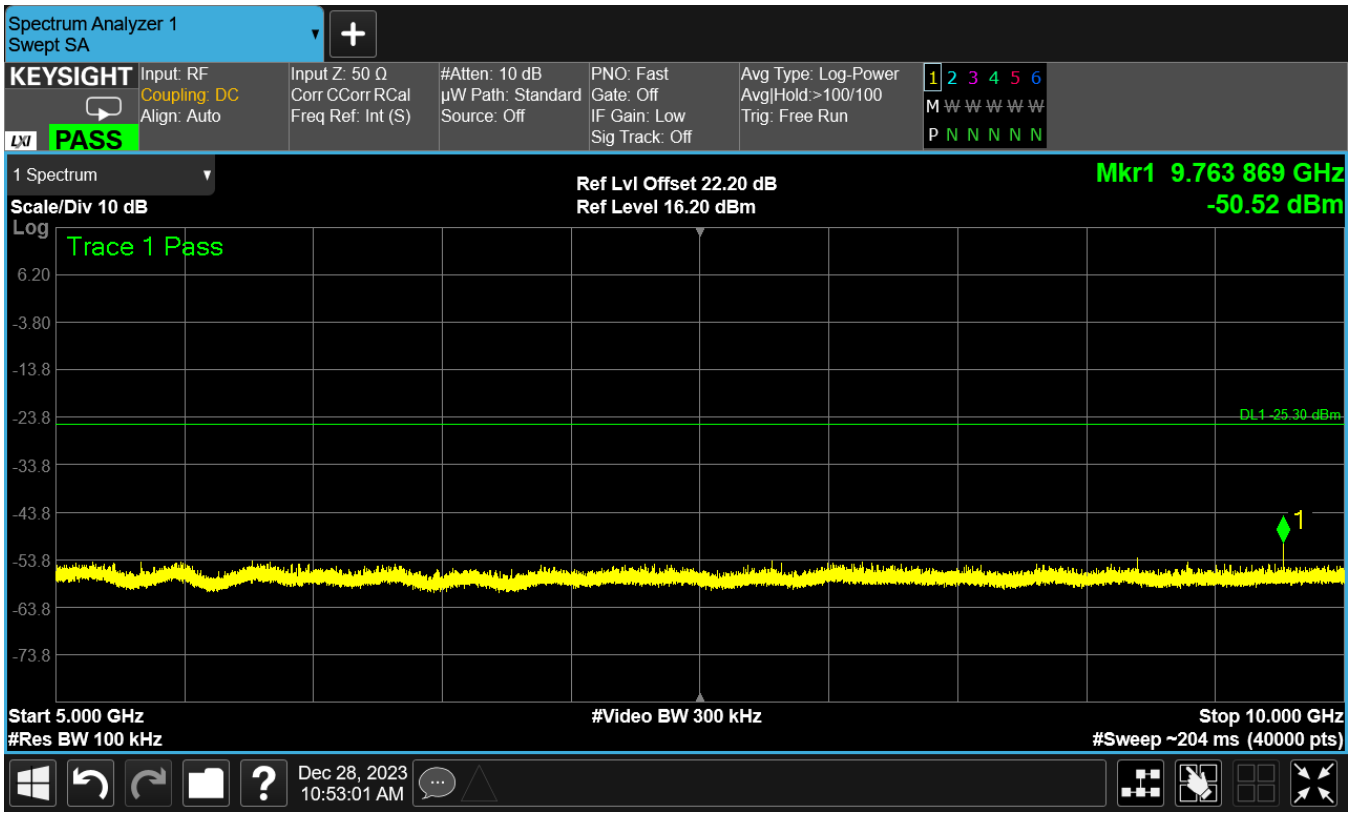


Figure 49: GFSK (1Mbps) Center Channel, Conducted Spurious – Plot 4

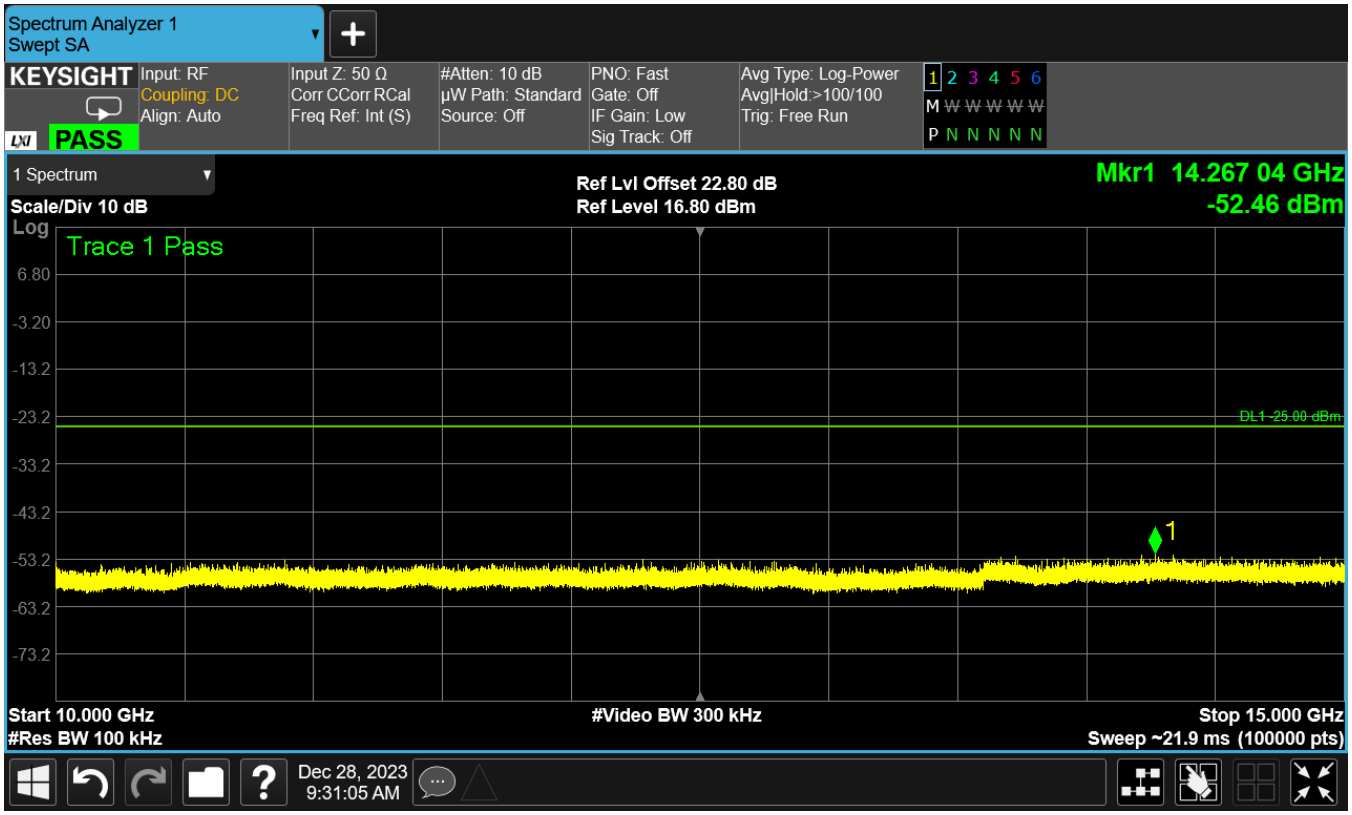


Figure 50: GFSK (1Mbps) Center Channel, Conducted Spurious – Plot 5

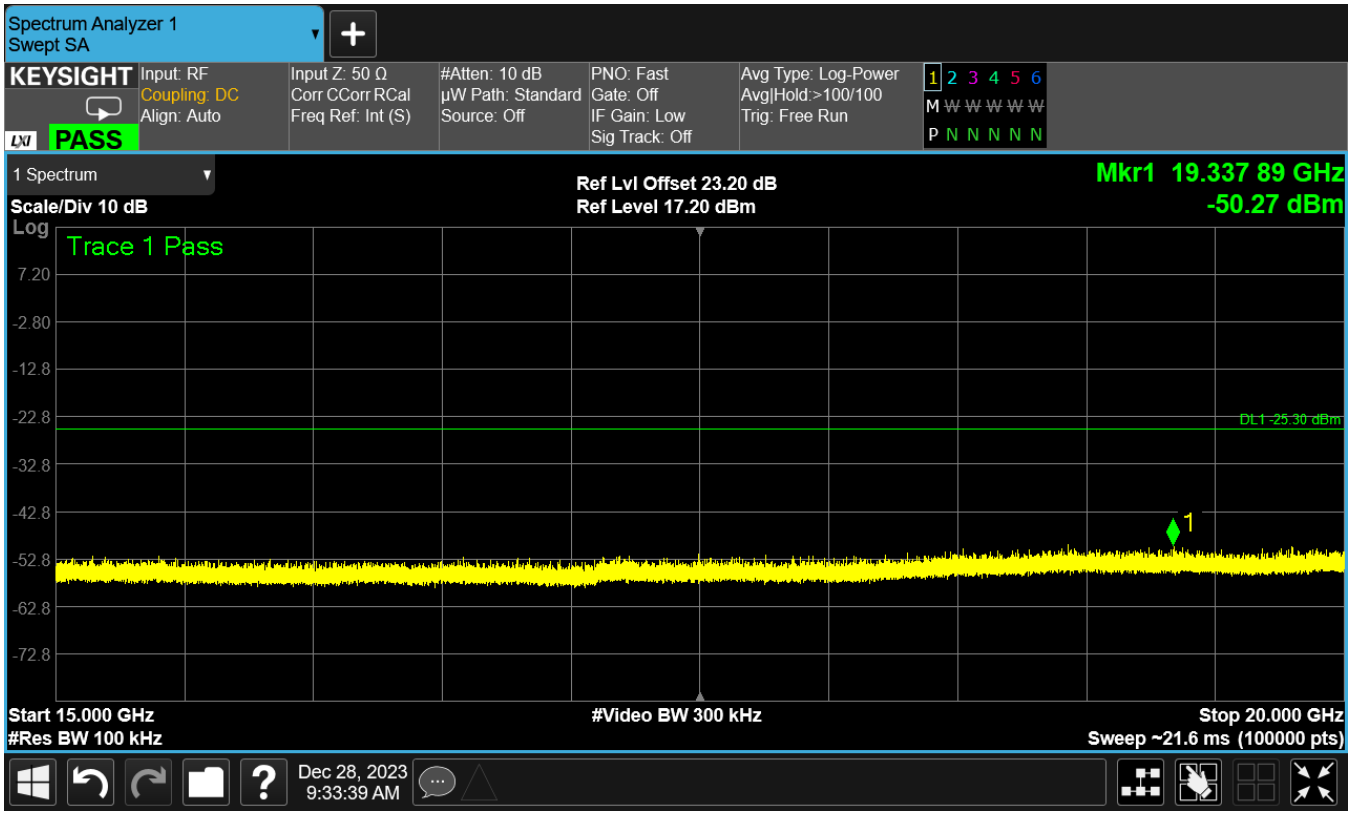


Figure 51: GFSK (1Mbps) Center Channel, Conducted Spurious – Plot 6

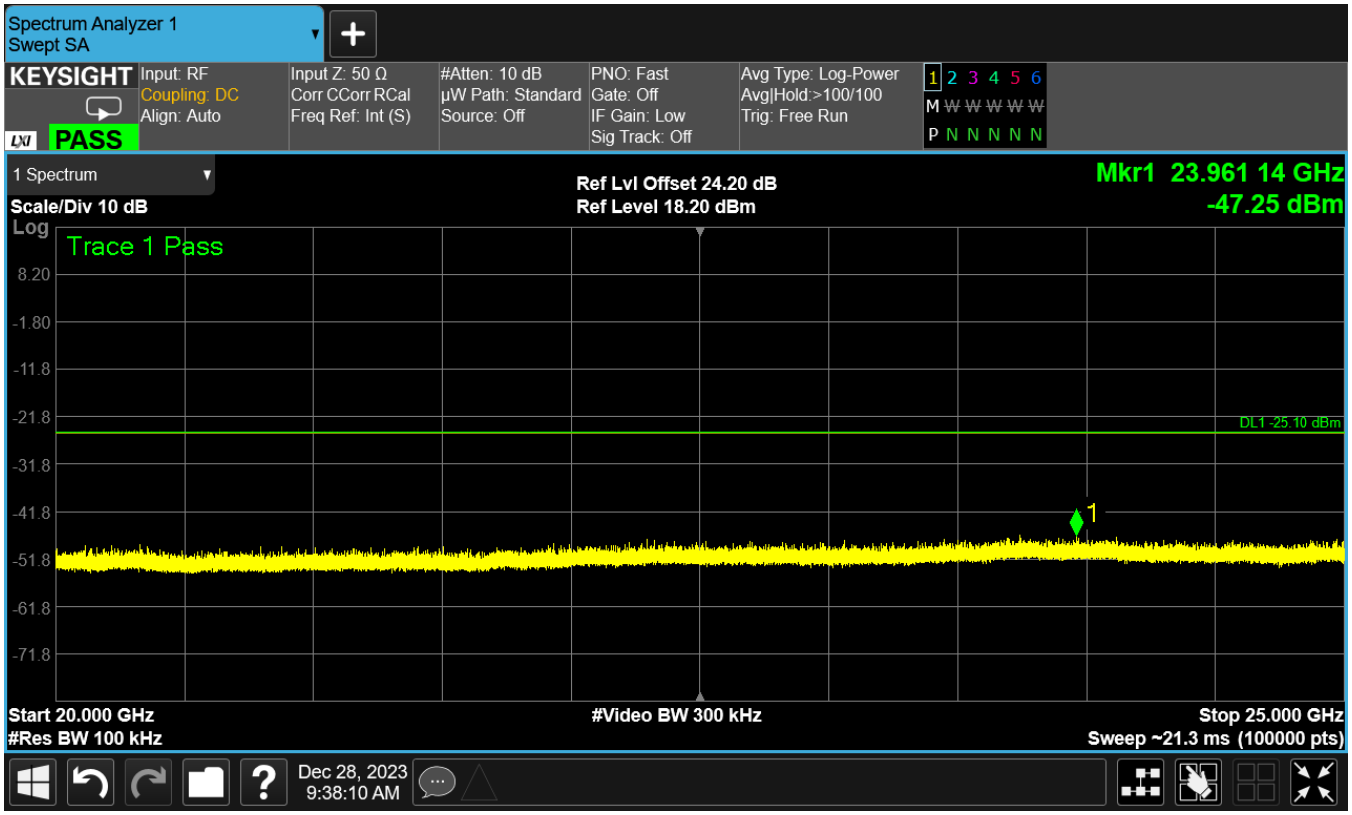


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Figure 52: GFSK (1Mbps) High Channel, Conducted Spurious – Plot 1

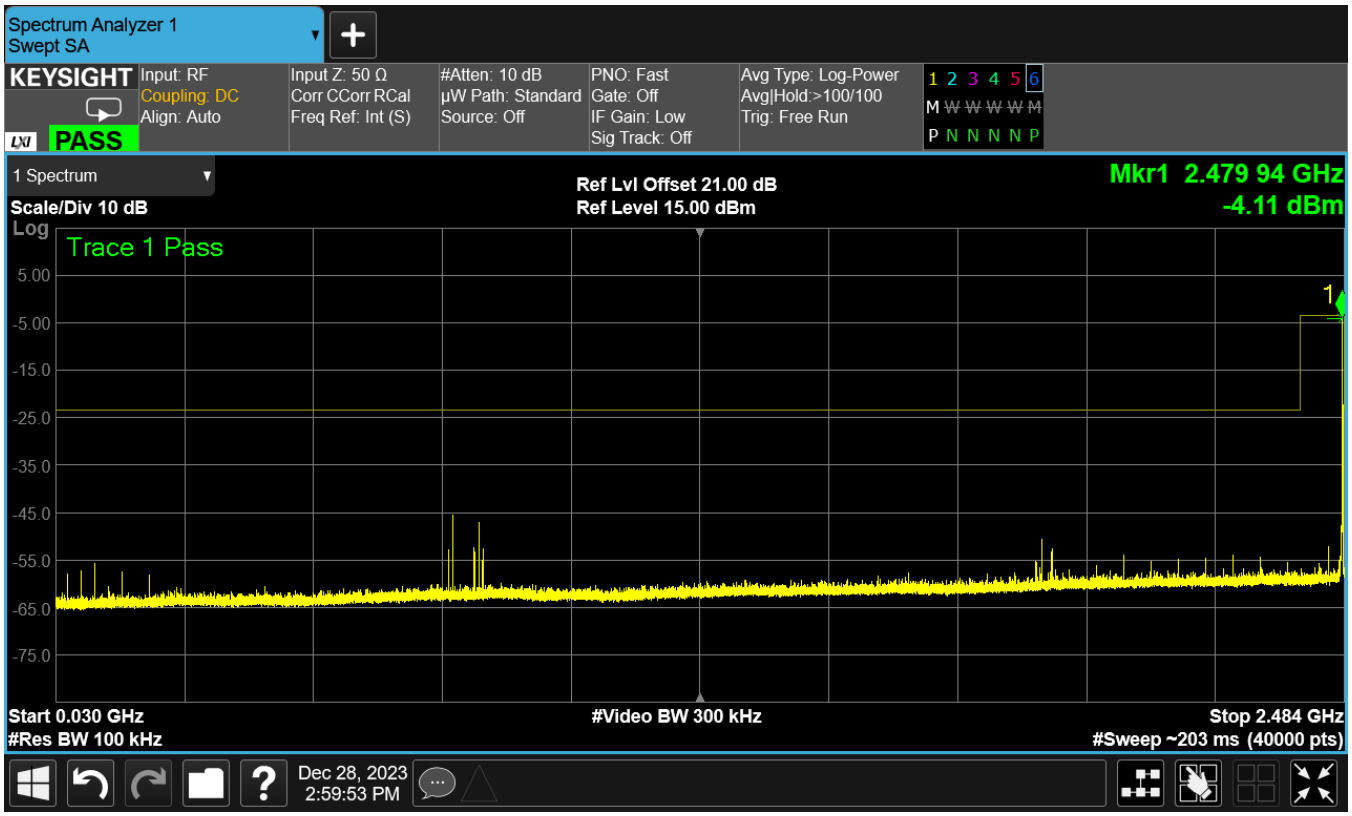


Figure 53: GFSK (1Mbps) High Channel, Conducted Spurious – Plot 2

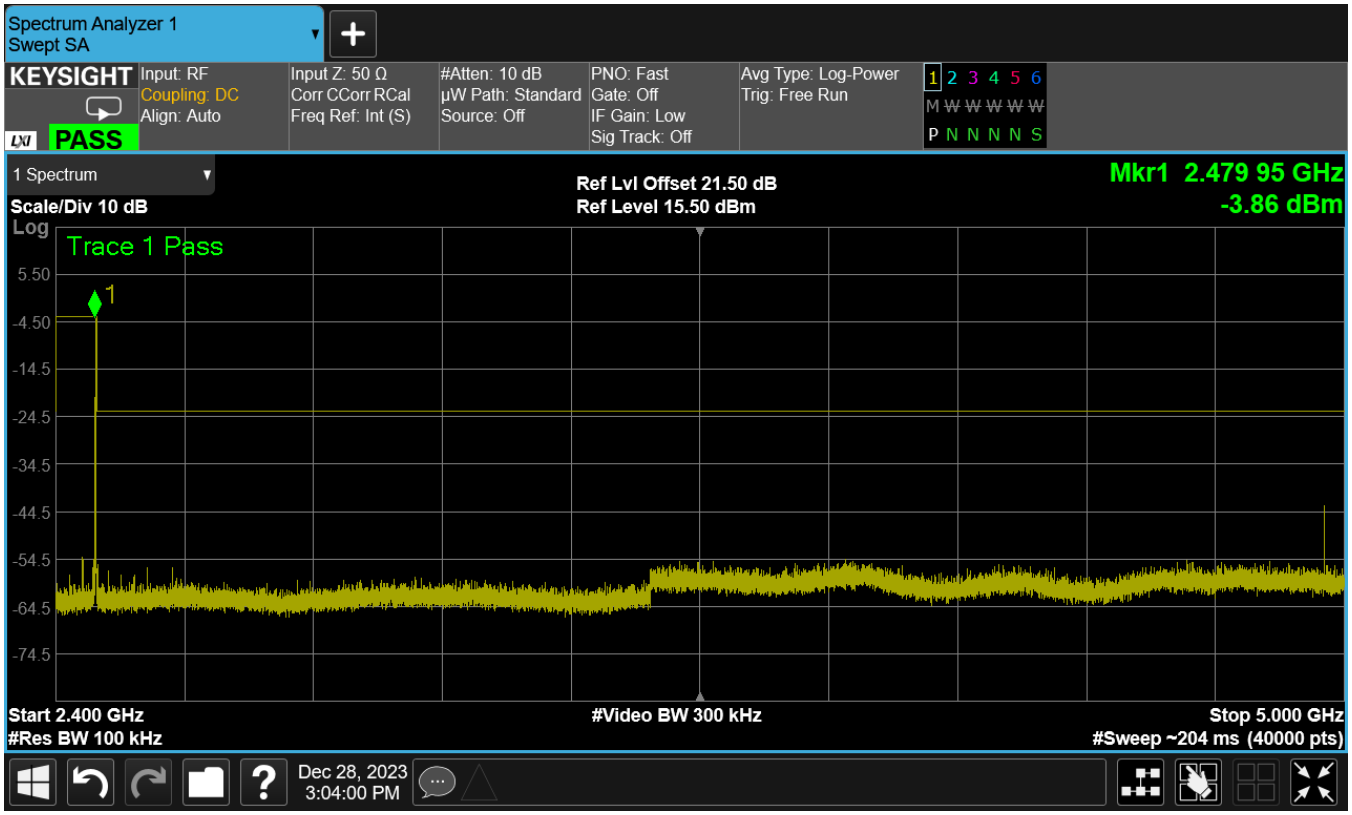


Figure 54: GFSK (1Mbps) High Channel, Conducted Spurious – Plot 3

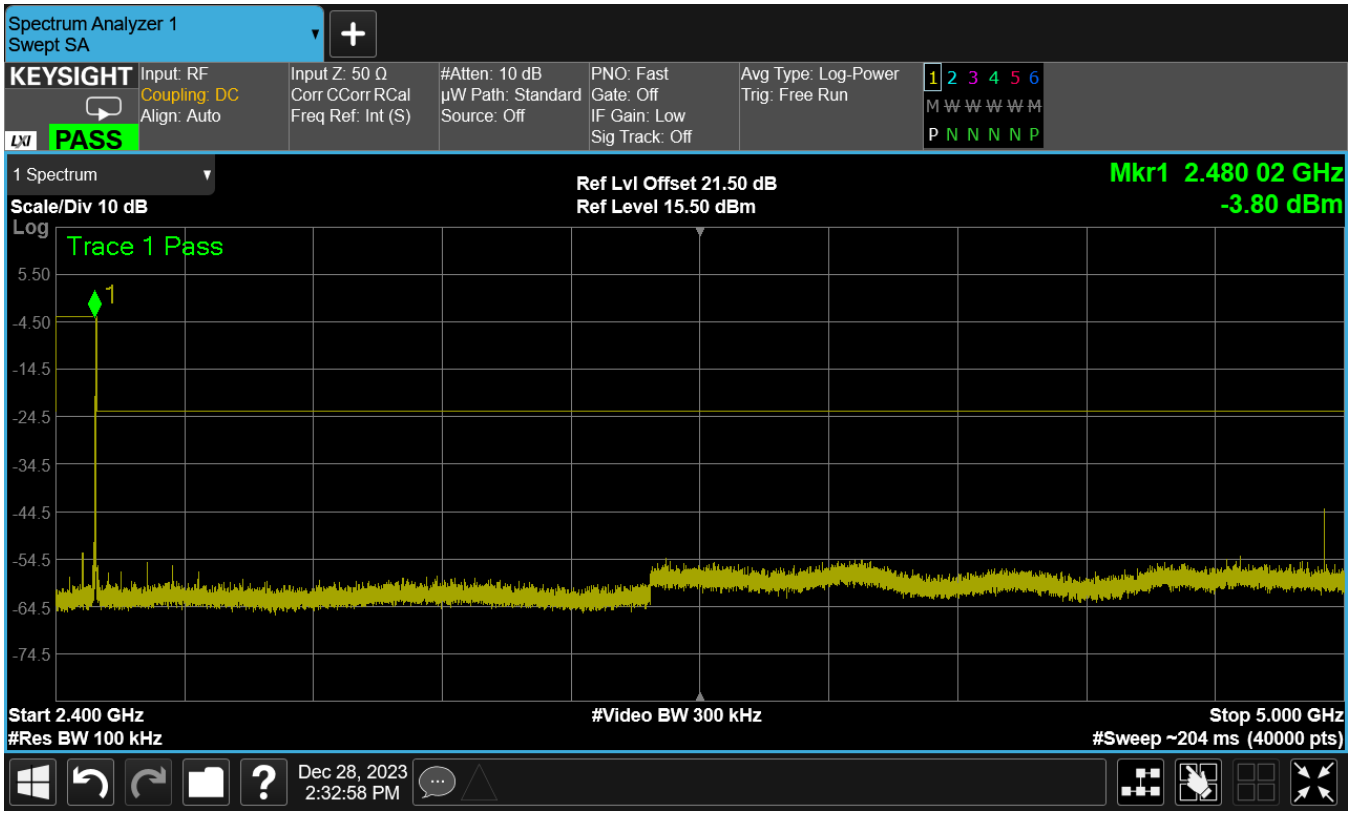


Figure 55: GFSK (1Mbps) High Channel, Conducted Spurious – Plot 4

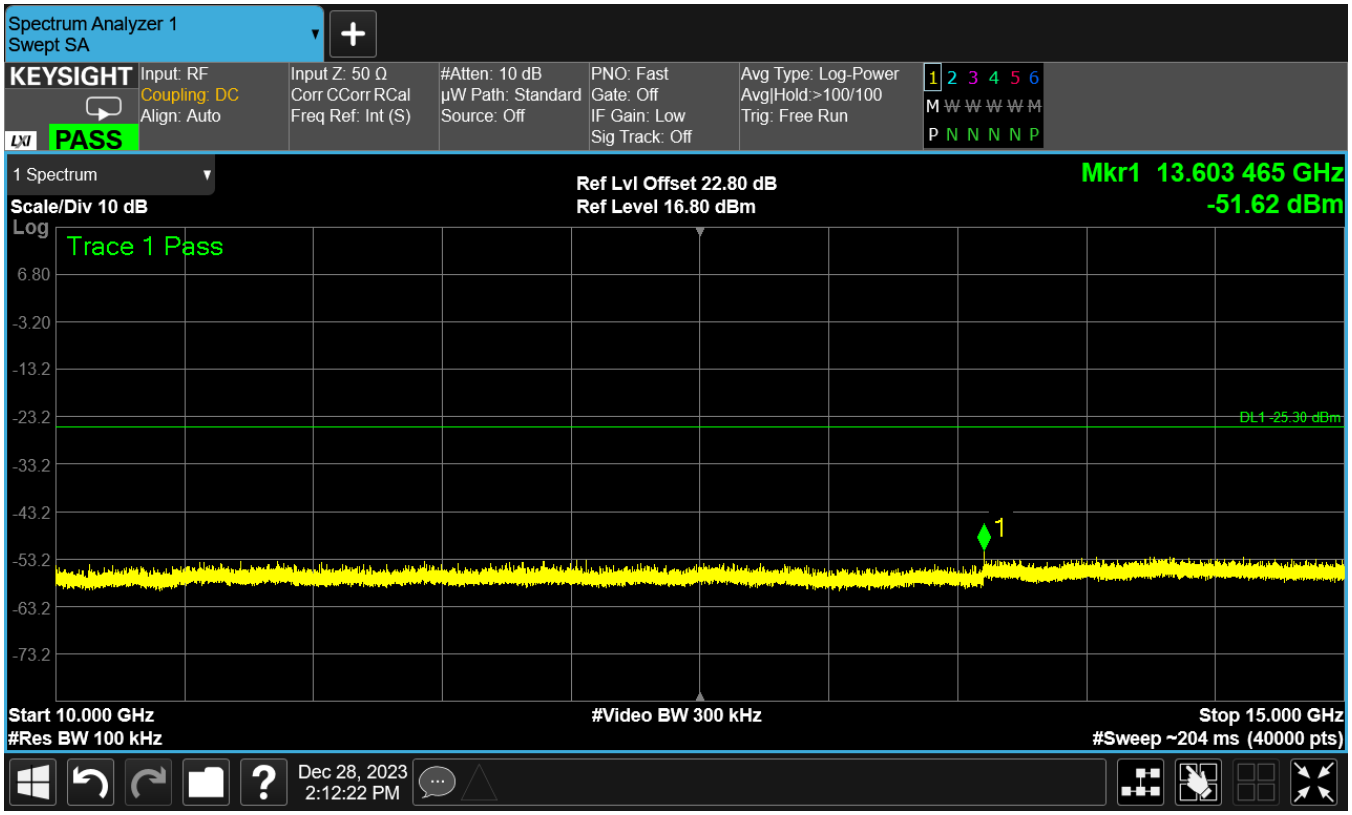


Figure 56: GFSK (1Mbps) High Channel, Conducted Spurious – Plot 5

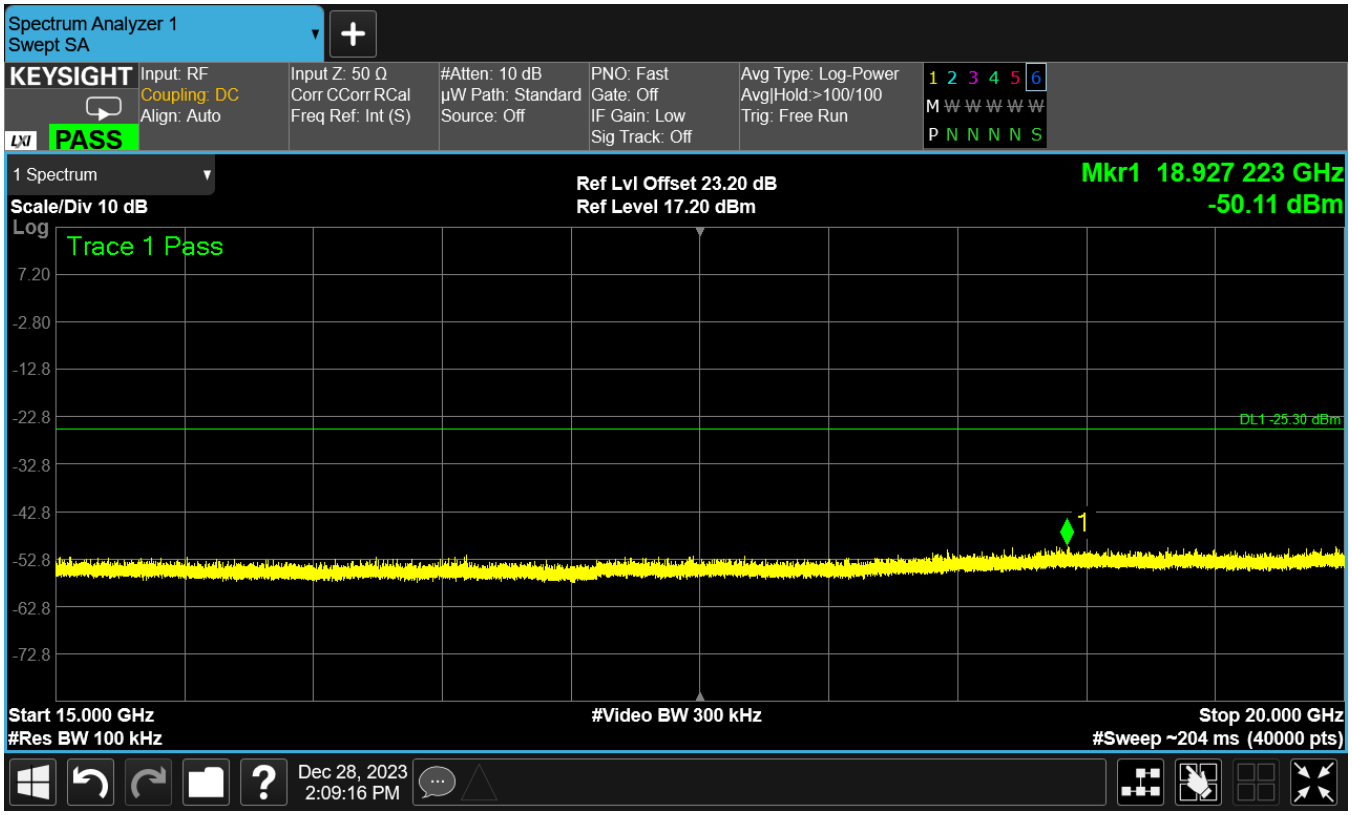


Figure 57: GFSK (1Mbps) High Channel, Conducted Spurious – Plot 6

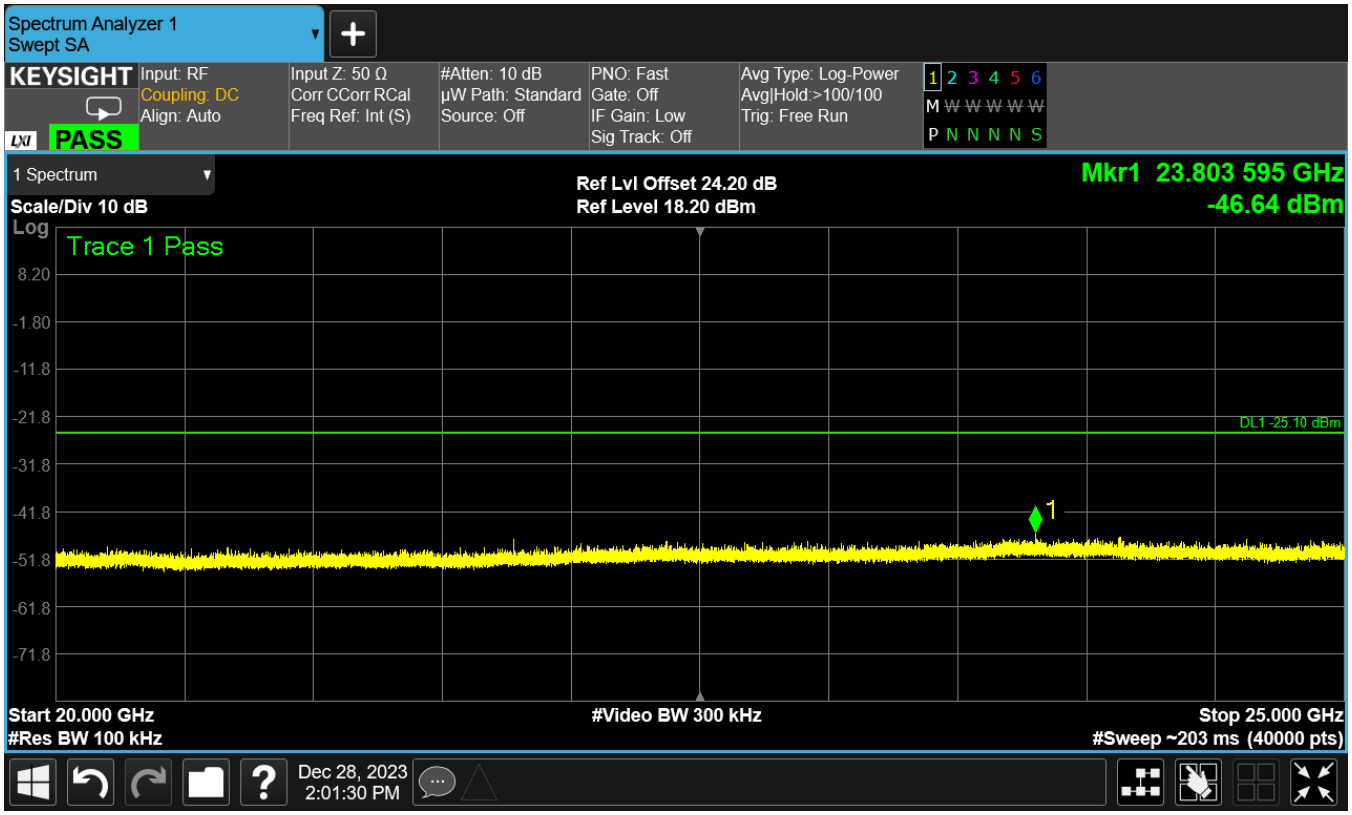


Figure 58: π/4DQPSK (2Mbps) Center Channel, Conducted Spurious – Plot 1

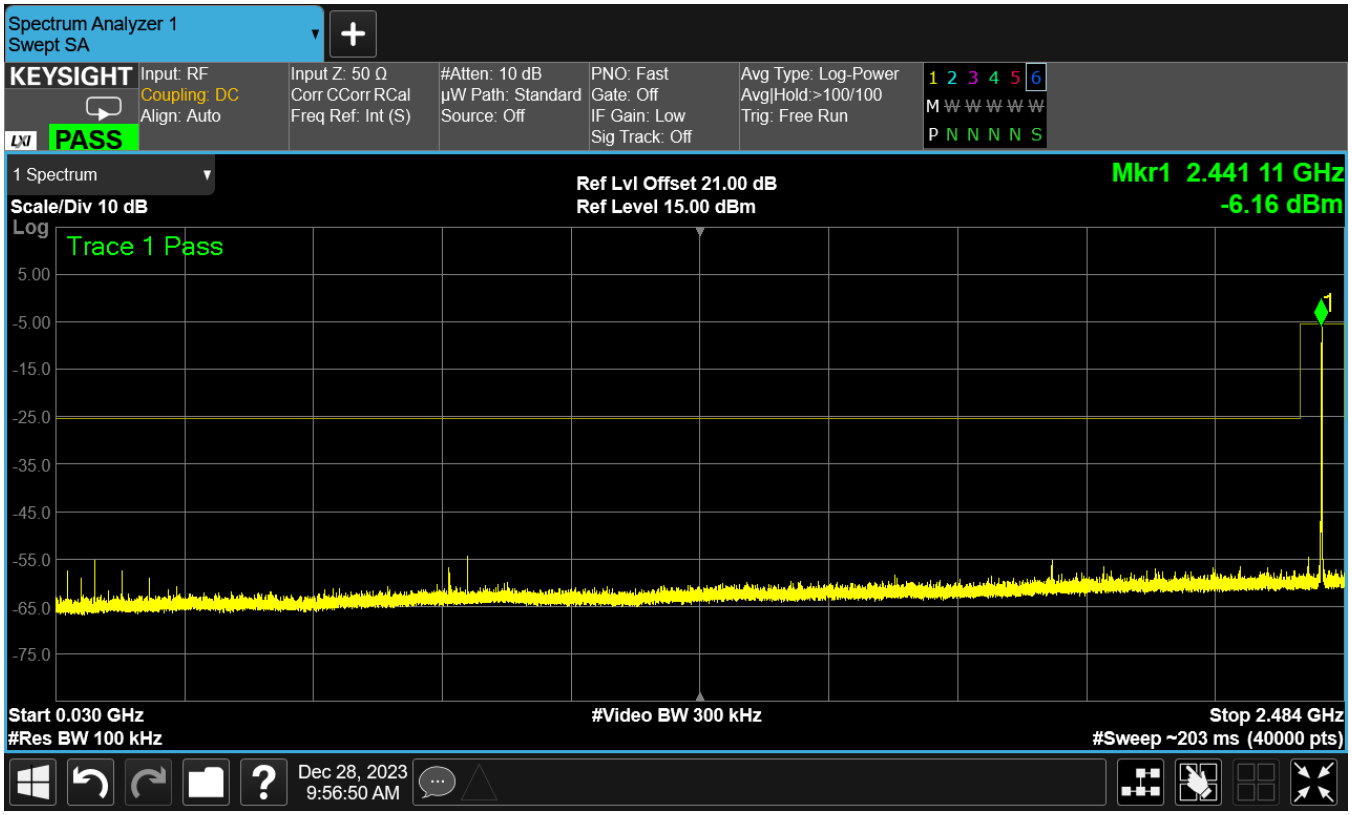


Figure 59: π/4DQPSK (2Mbps) Center Channel, Conducted Spurious – Plot 2

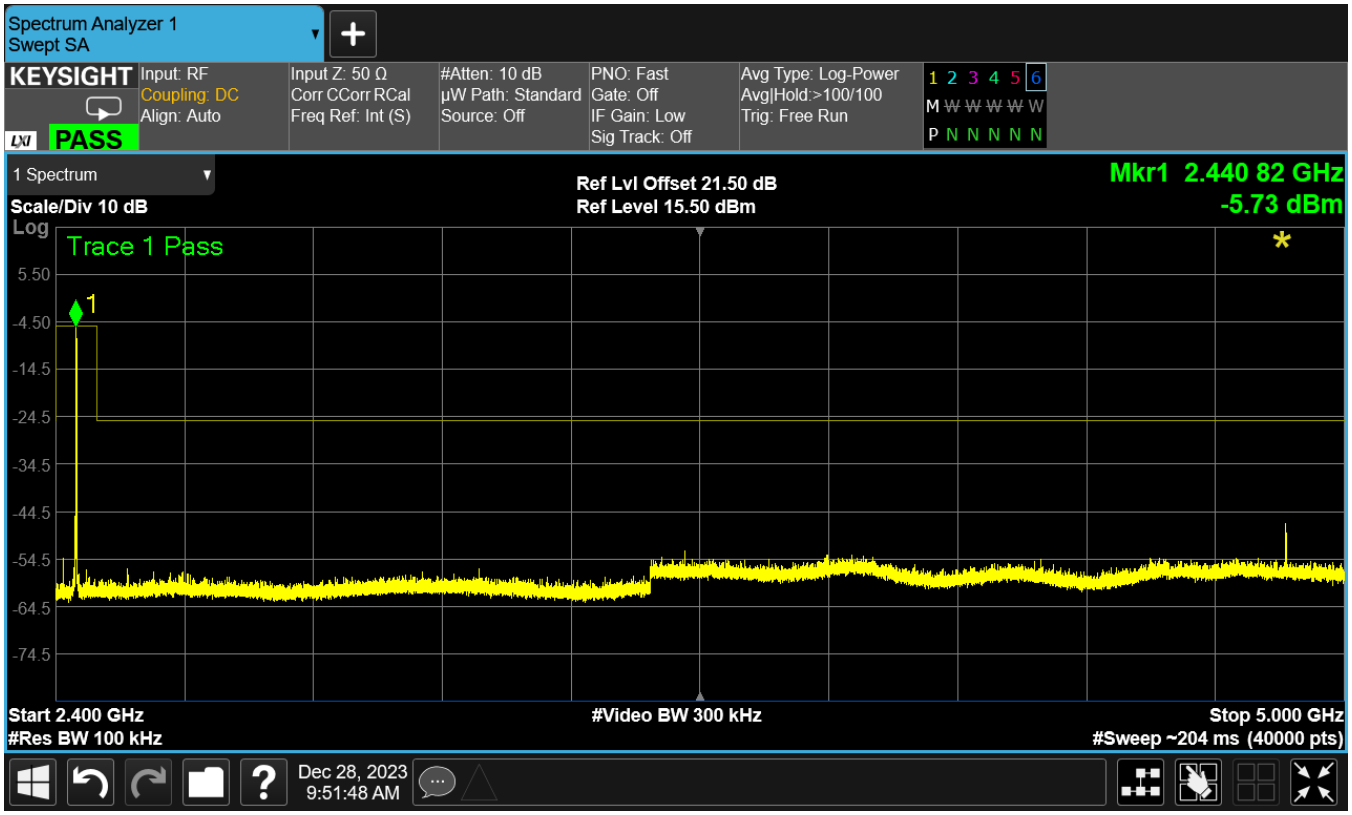


Figure 60: π/4DQPSK (2Mbps) Center Channel, Conducted Spurious – Plot 3

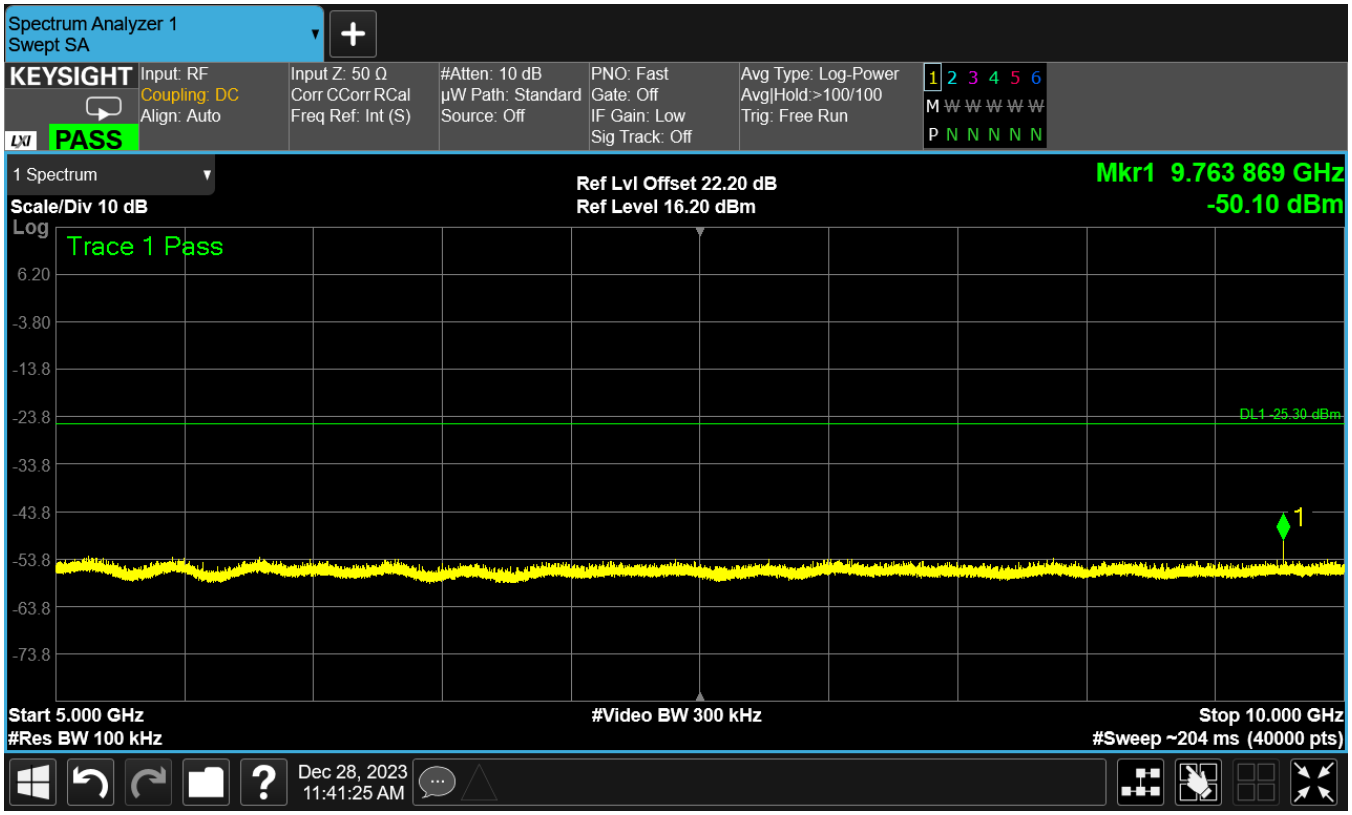


Figure 61: π/4DQPSK (2Mbps) Center Channel, Conducted Spurious – Plot 4

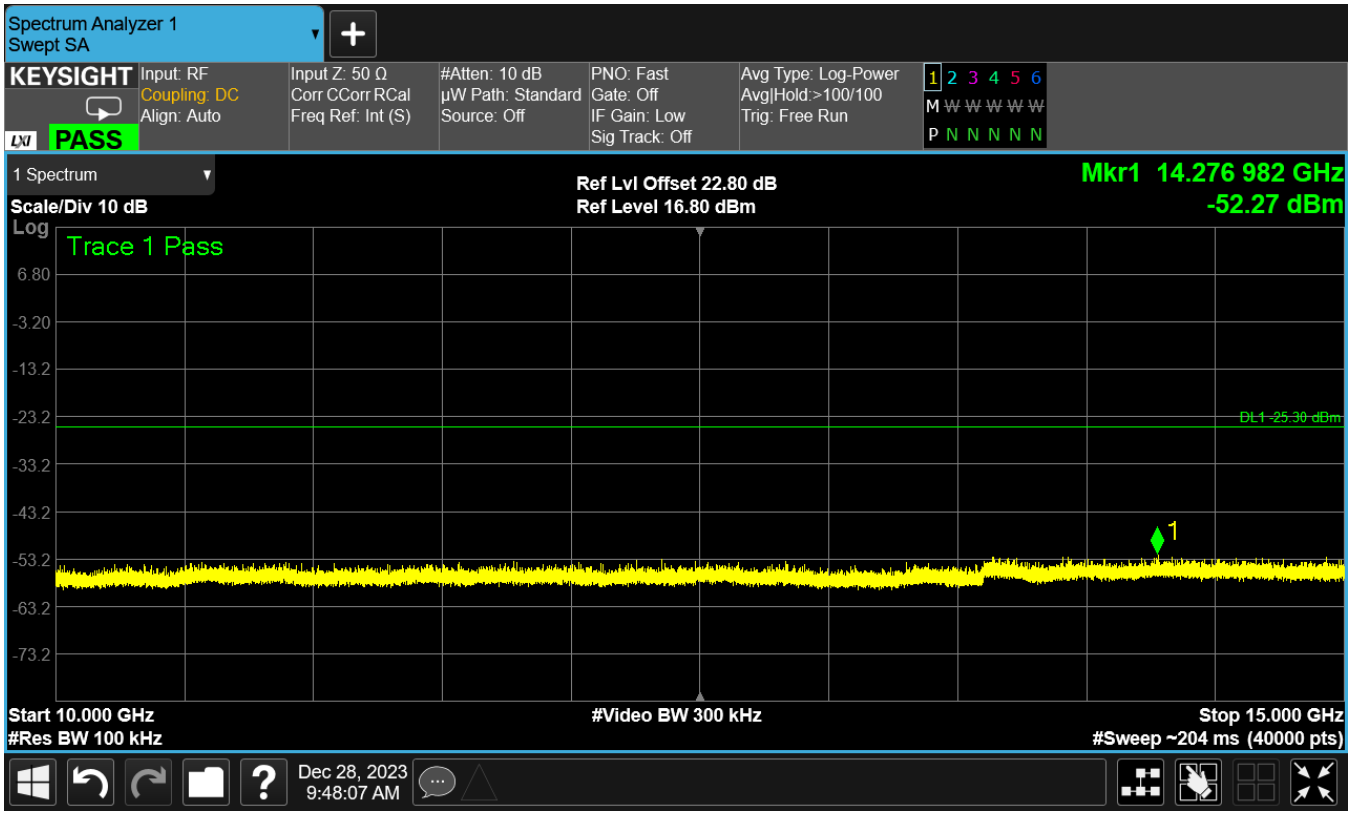


Figure 62: π/4DQPSK (2Mbps) Center Channel, Conducted Spurious – Plot 5

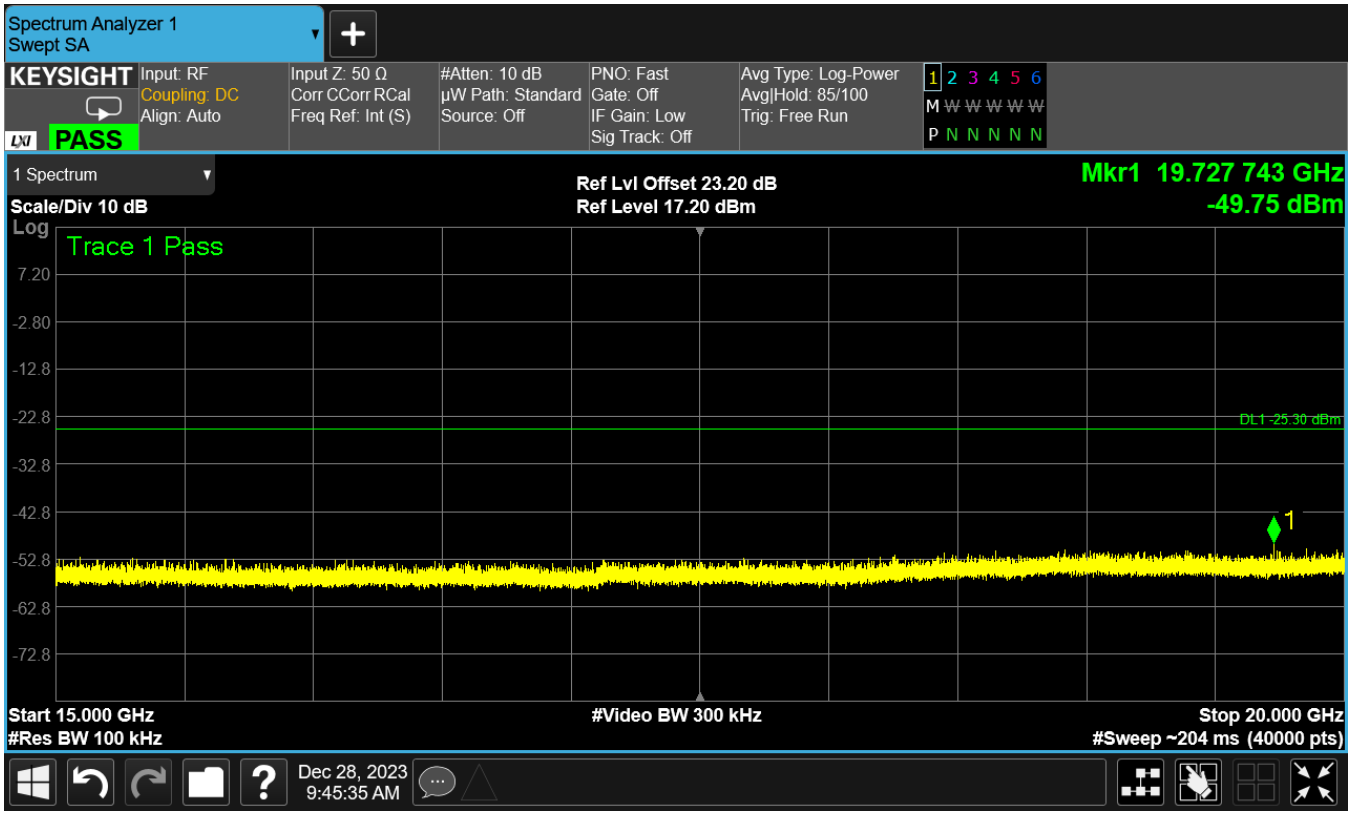


Figure 63: π/4DQPSK (2Mbps) Center Channel, Conducted Spurious – Plot 6

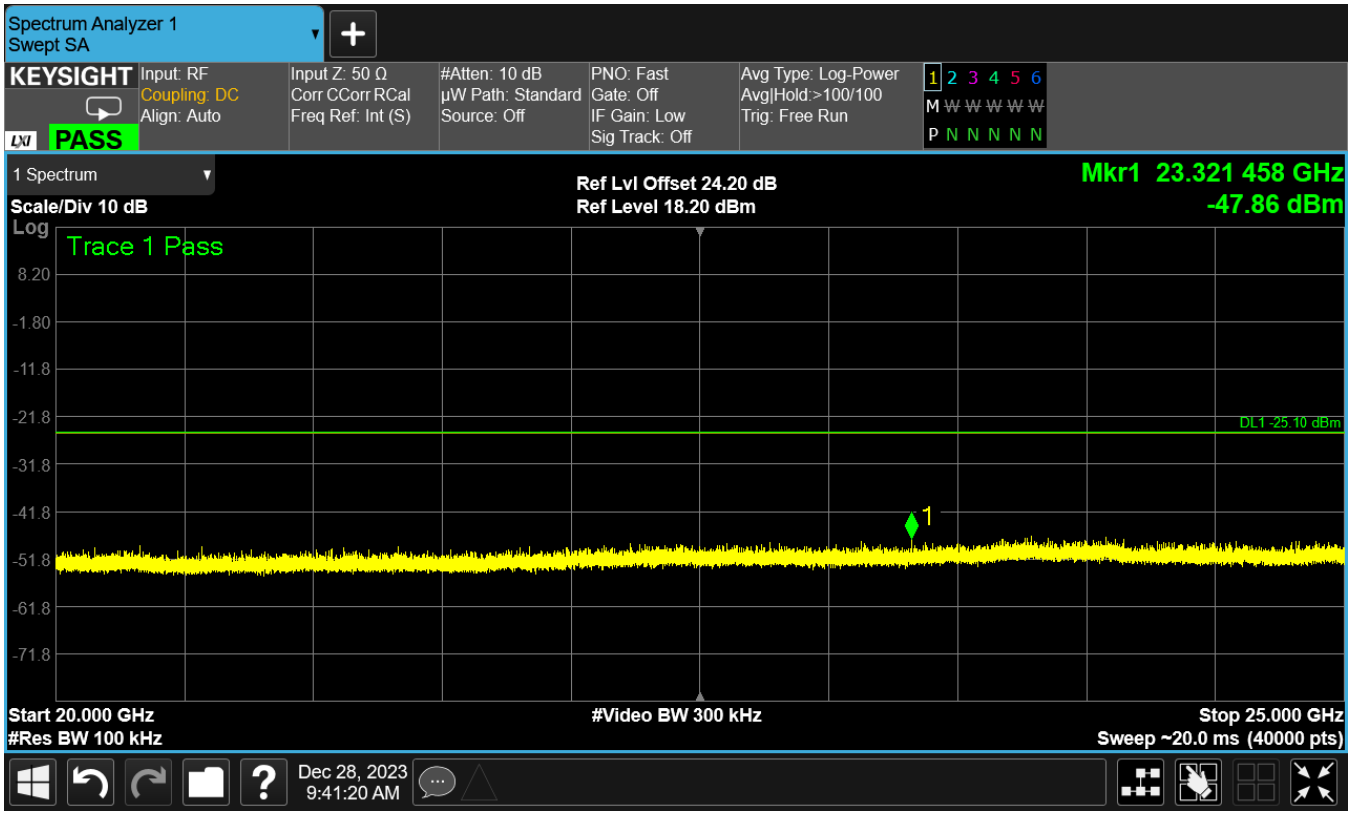


Figure 64: 8DPSK (3Mbps) Center Channel, Conducted Spurious – Plot 1

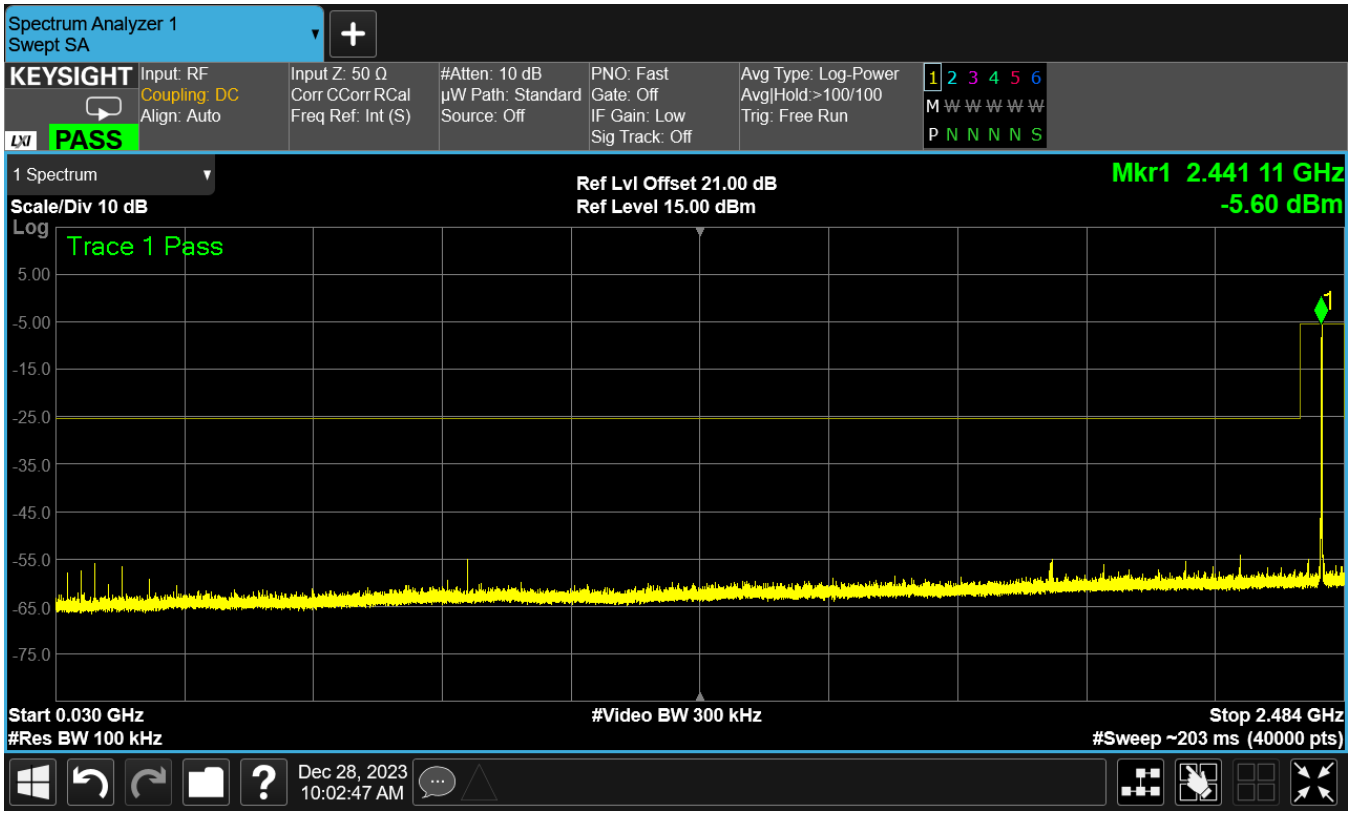


Figure 65: 8DPSK (3Mbps) Center Channel, Conducted Spurious – Plot 2

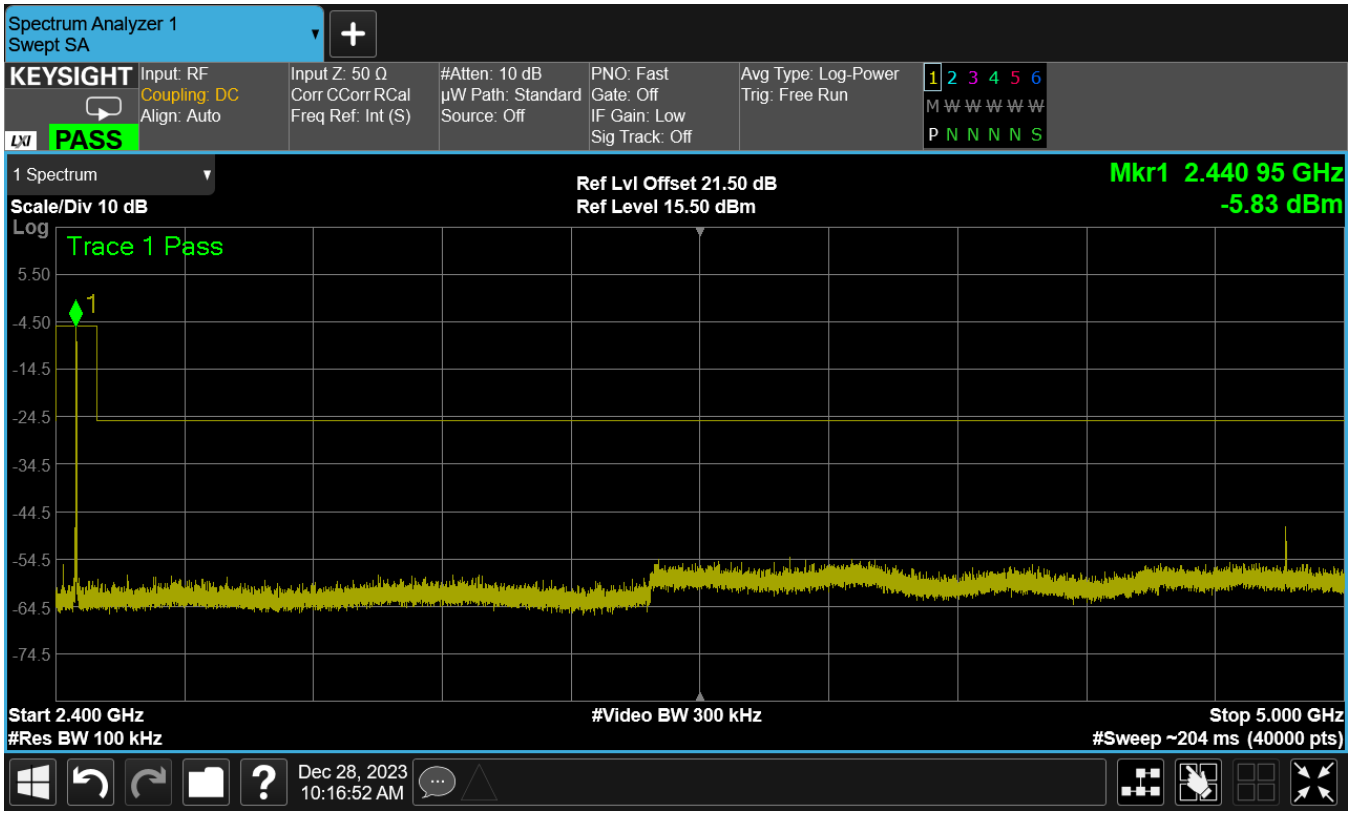


Figure 66: 8DPSK (3Mbps) Center Channel, Conducted Spurious – Plot 3

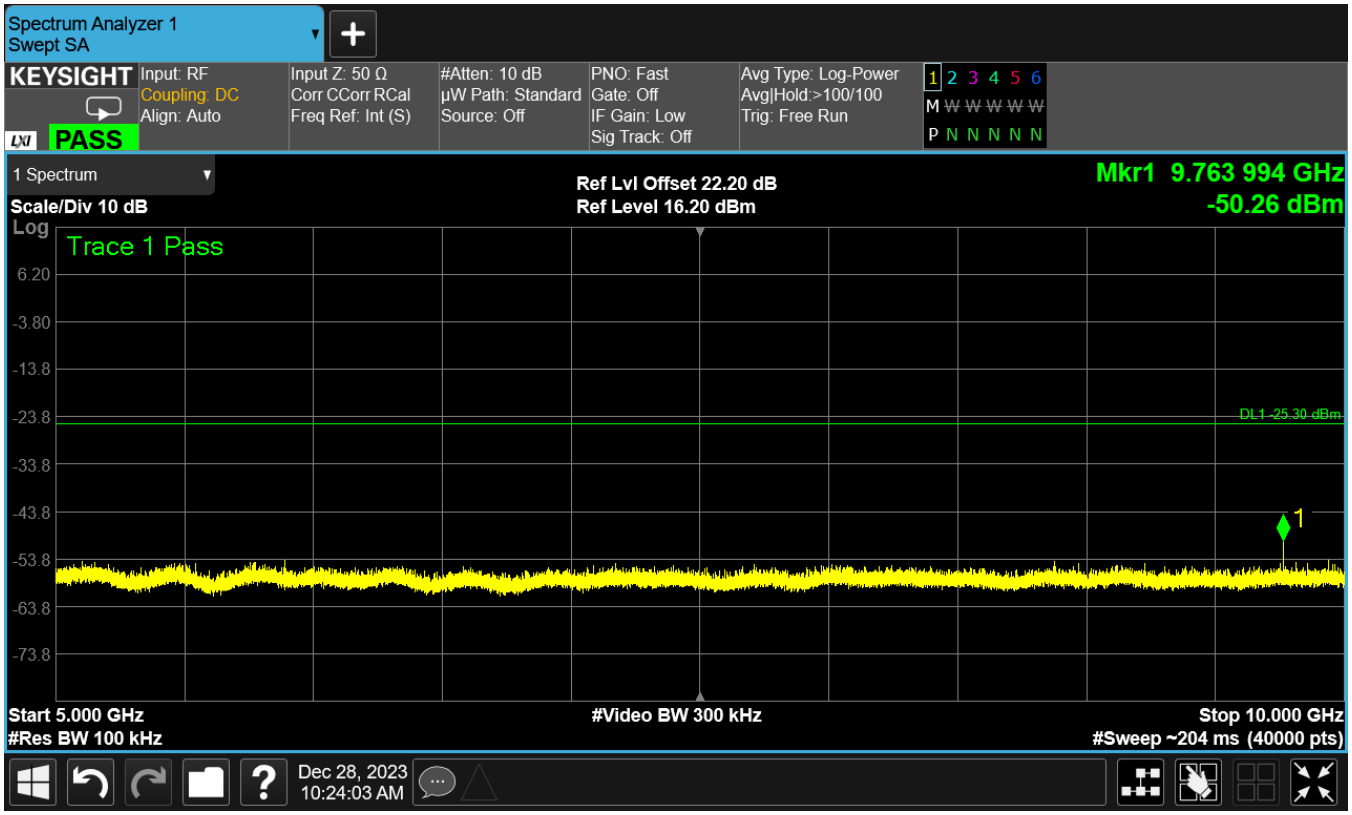


Figure 67: 8DPSK (3Mbps) Center Channel, Conducted Spurious – Plot 4

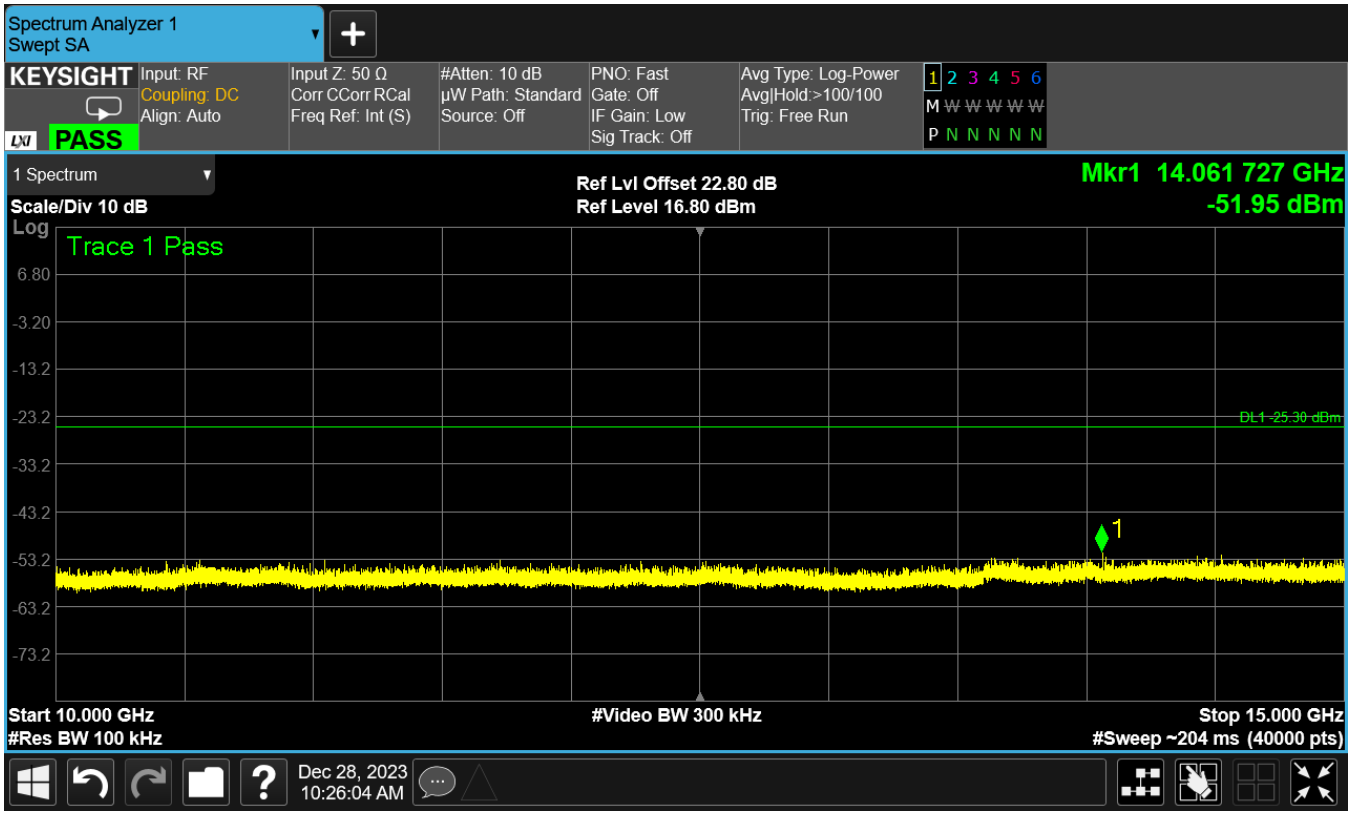


Figure 68: 8DPSK (3Mbps) Center Channel, Conducted Spurious – Plot 5

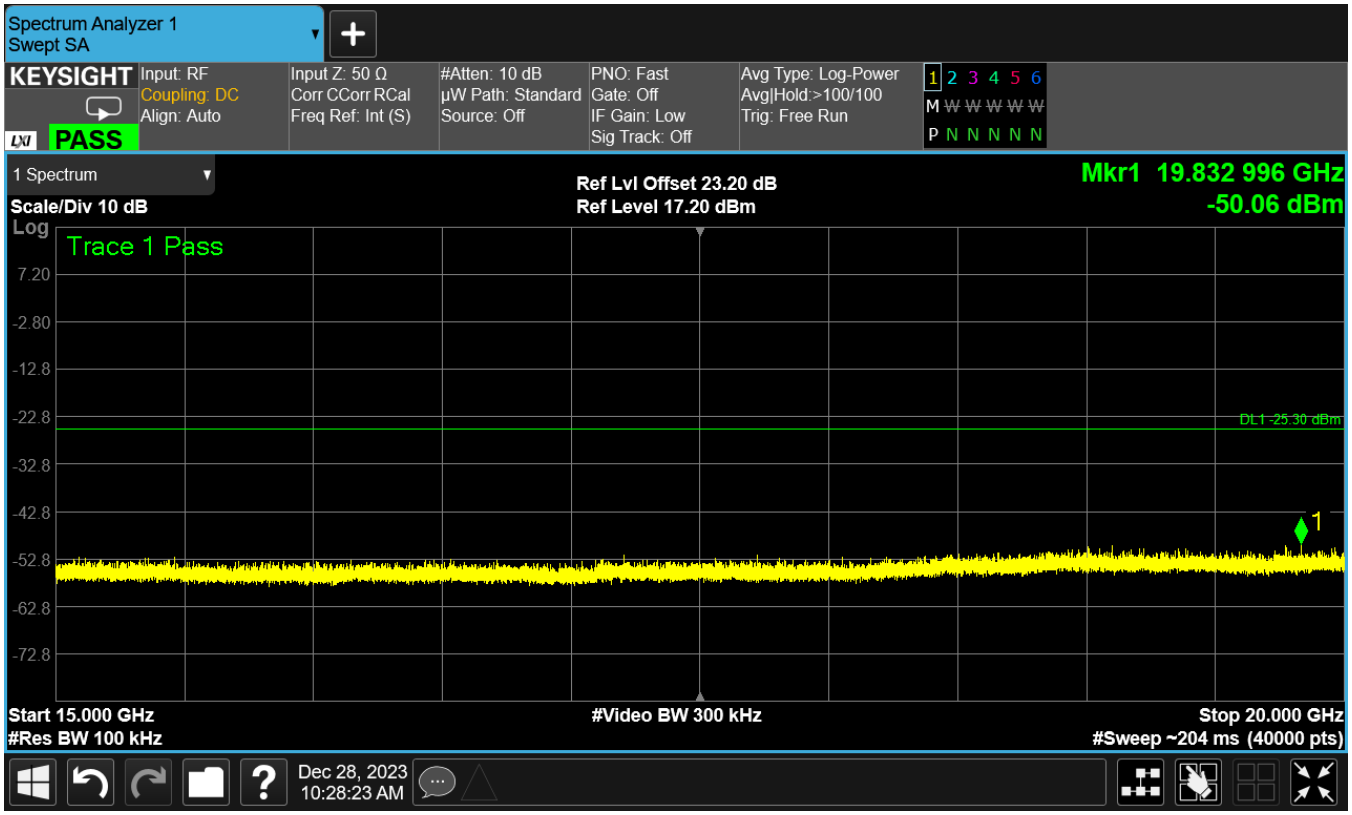
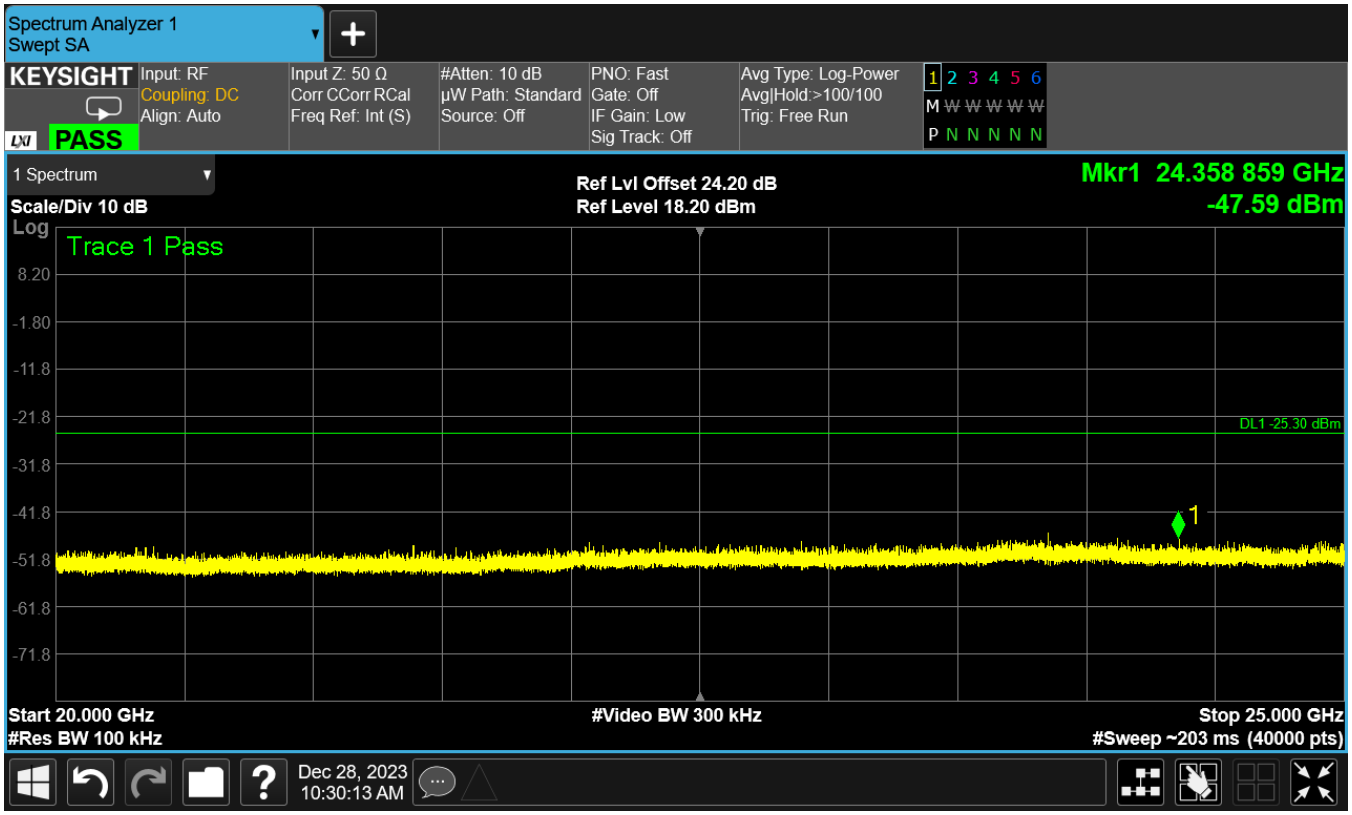


Figure 69: 8DPSK (3Mbps) Center Channel, Conducted Spurious – Plot 6



2.8 General Field Strength Requirements – Radiated Emissions

2.8.1 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)

2.8.2 Test Procedure Summary

The requirements of FCC Part 15, RSS-Gen, and ICES-003 call for the EUT to be placed on a 1m X 1.5m non-conductive motorized turntable at a height of 80cm for radiated testing of frequencies up to 1000 MHz, and a height of 1.5m for testing of frequencies above 1000 MHz. Please note that the radiated emissions measured during this testing were performed at a distance of 3-meters.

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 using a spectrum analyzer peak detector function. The highest amplitude (worst-case) emissions noted during the pre-scan were selected for final compliance measurements.

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 30 MHz to 25 GHz 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.

The detector function was set to quasi-peak for 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.

To ensure that the support laptop did not interfere with radiated measurements of frequencies above 1GHz, the applicant has completely disabled the WiFi capabilities within the computer's bios. For measurements of frequencies below 1000 MHz, the laptop and the AC/DC power supply were shielded from the test site via the use of EMF/EMI Faraday Blankets. Overall, the support laptop, and power supply, did not impact the 3m radiated emissions testing due to the shielding effectiveness of these protective materials.

2.8.3 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 FCC limits, based on $D_{Measure}$:	3m Limit = 10m Limit + 20LOG (10/3)

Environmental Conditions During Radiated Emissions Testing

Ambient Temperature:	18 °C
Relative Humidity:	52 %

2.8.4 Measurement Method and Results

The reduced testing procedures outlined in ANSI C63.10 (2013), Section 5.6.2 and 5.6.2.2 were employed. The radiated spurious emission test data correlating to the center channel of all three modulation modes is provided below. The worst-case mode, with regard to peak power output, (GFSK) was utilized to provide the radiated spurious emission test data for the low and high channels.

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

The EUT was tested while positioned in the worst-case orientation, based the three-axes orthogonal plane evaluation of the fundamental field strength at 3-meters.

The EUT complies with the requirements this section.

There were no emissions detected in the frequency range of 18 GHz – 25 GHz as shown in Table 8.

Table 8: Radiated Emissions, Corrected Field Strength, 18-25GHz

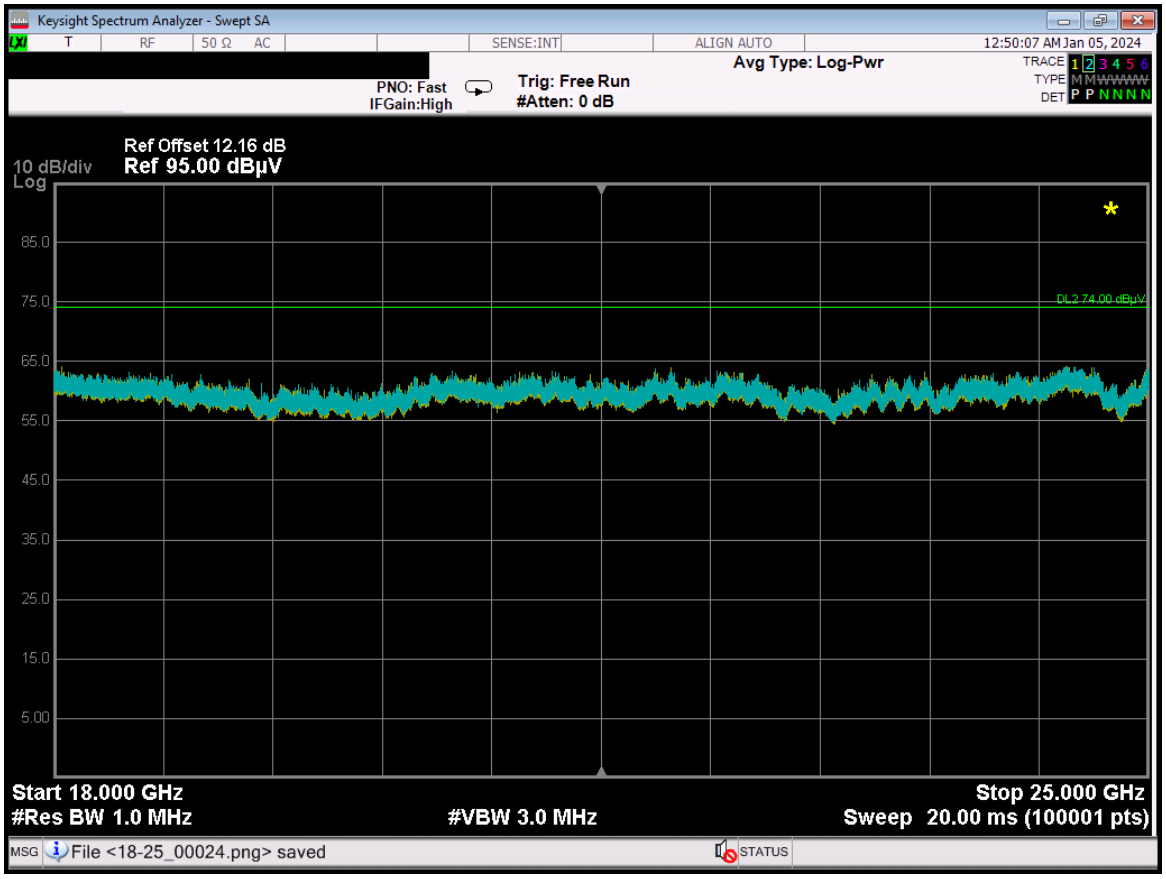


Table 9: Radiated Emissions Test Data – 30 MHz to 1000 MHz

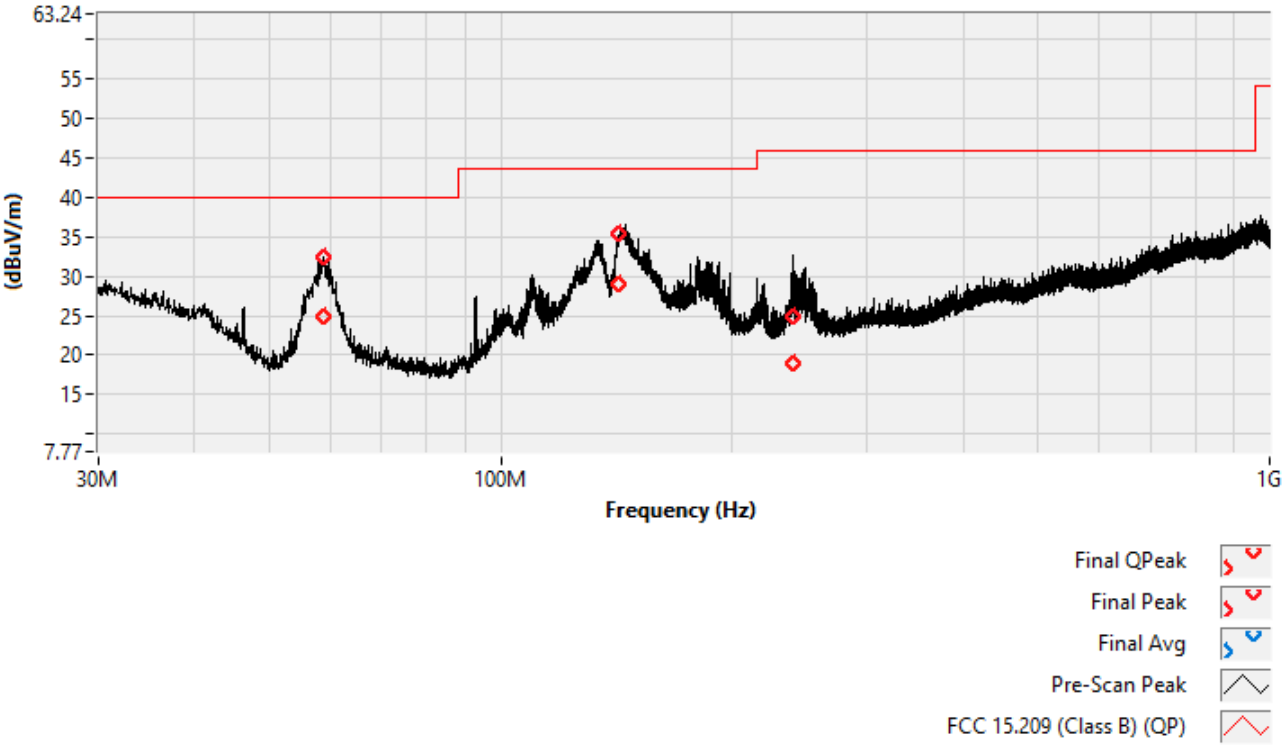
Limit (1): FCC 15.209 (Class B) (QP)

Frequency (Hz)	Detector	Meas (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Turn Table (deg)	Antenna (cm)
46.6M	Peak	26.082	--	--	180	Horiz, 220
	QPeak	20.406	(1) 40	-19.594	180	Horiz, 220
58.9M	Peak	32.377	--	--	180	Vert, 100
	QPeak	24.976	(1) 40	-15.024	180	Vert, 100
142.012M	Peak	39.08	--	--	180	Horiz, 120
	QPeak	31.151	(1) 43.5	-12.349	180	Horiz, 220
217M	Peak	31.717	--	--	0	Horiz, 120
	QPeak	22.279	(1) 46	-23.721	0	Horiz, 120
240M	Peak	25.001	--	--	0	Vert, 120

For measurements of frequencies below 1000 MHz, the EUT was tuned to the center channel (2441 MHz) and set to a fully modulated mode using GFSK. Changing the modulation type, or carrier center frequency, had no impact on the emissions in the frequency range of 30 MHz to 1000 MHz.

The plots provided on the following page, represent the 3m radiated emissions test data that correlate to the tabular data provided in Table 9. (30 MHz to 1000 MHz).

Pre-scan and Final Data (Vertical) – Below 1GHz



Pre-scan and Final Data (Horizontal) – Below 1GHz

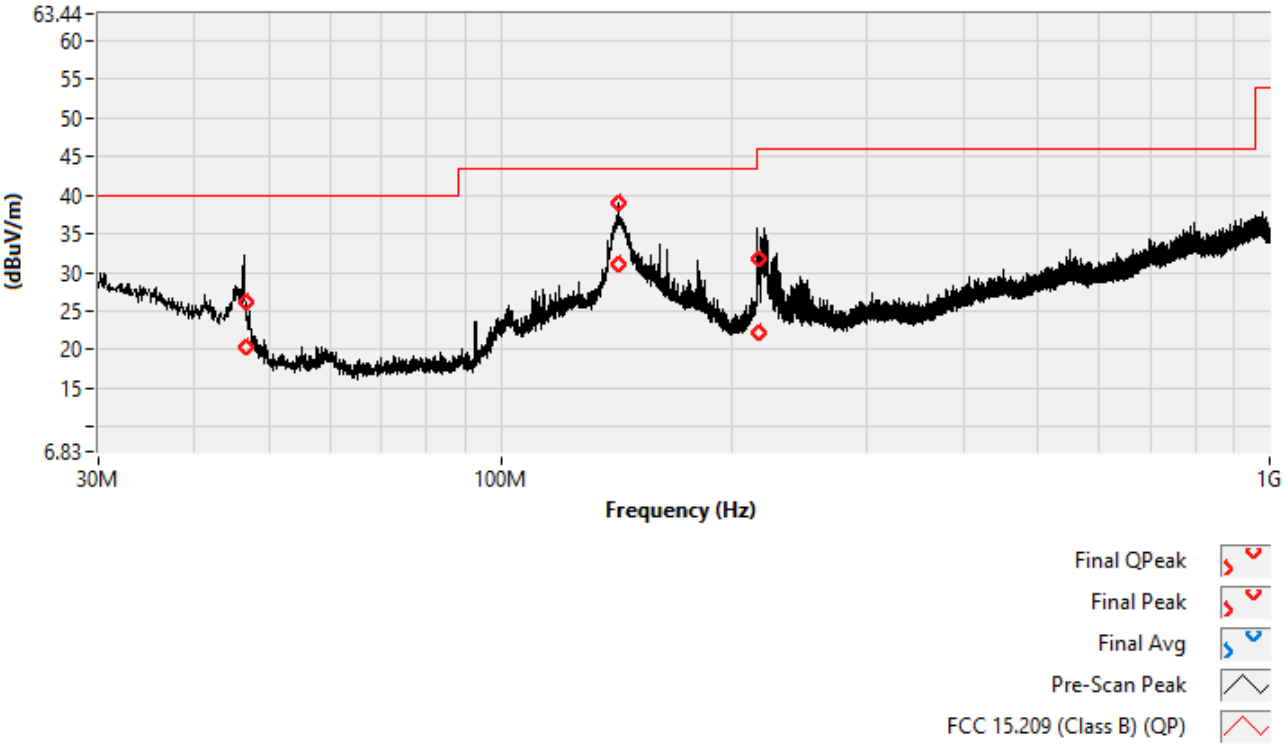


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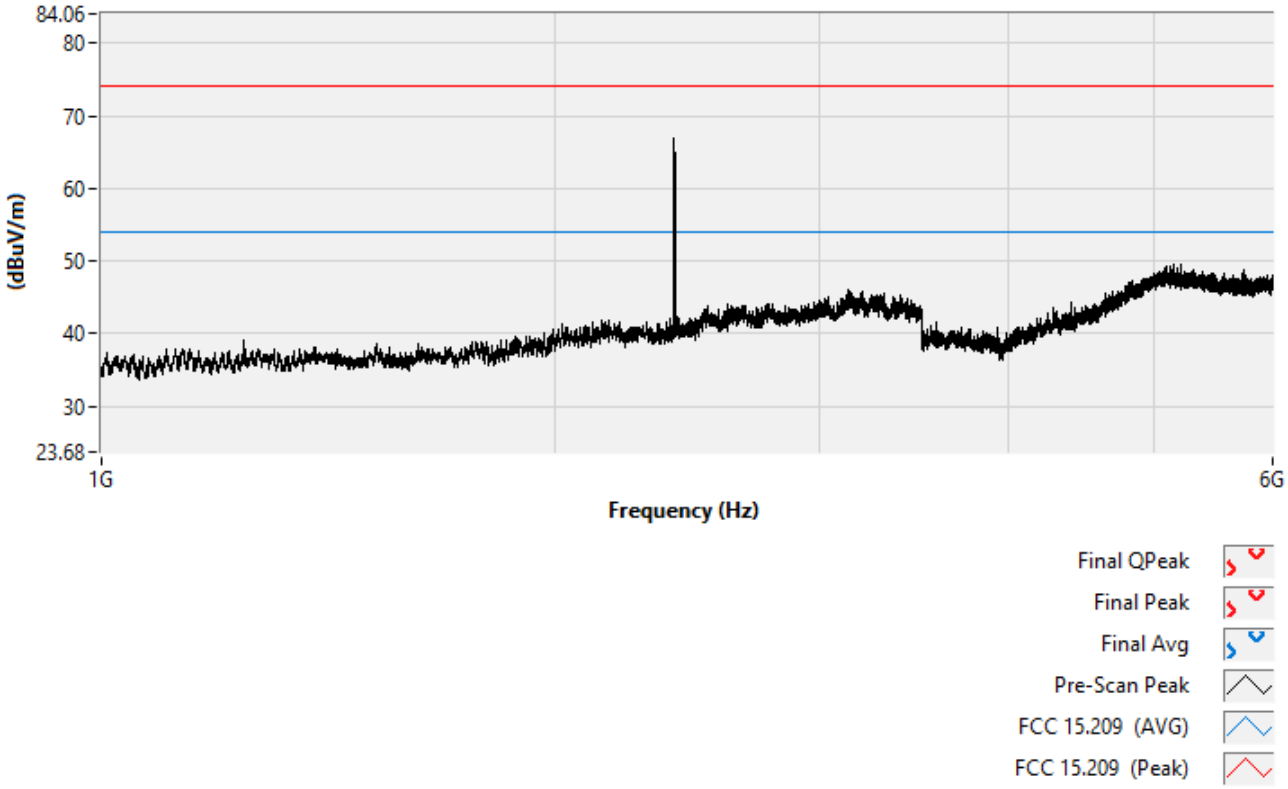
Table 10: Radiated Emissions Test Data – 1 GHz to 25 GHz (GFSK, Low Channel)

Limit (1): FCC 15.209 (Peak)
Limit (2): FCC 15.209 (AVG)

Frequency (GHz)	Detector	Meas (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Turn Table (deg)	Antenna (cm)
2.21	Peak	48.171	(1) 74	-25.829	180	Horiz, 155
	Avg	24.597	(2) 54	-29.403	180	Horiz, 155
4.964	Peak	48.847	(1) 74	-25.153	0	Vert, 155
	Avg	35.453	(2) 54	-18.547	0	Vert, 155
7.252	Peak	63.2	(1) 74	-10.8	180	Horiz, 150
	Avg	40.658	(2) 54	-13.342	0	Horiz, 155
13.98	Peak	63.186	(1) 74	-10.814	0	Vert, 155
	Avg	49.523	(2) 54	-4.477	0	Horiz, 155
14.065	Peak	65.078	(1) 74	-8.922	180	Horiz, 150
	Avg	50.264	(2) 54	-3.736	180	Horiz, 155
17.99	Peak	61.833	(1) 74	-12.167	180	Horiz, 155
	Avg	48.729	(2) 54	-5.271	0	Vert, 155

The plots provided on the following page, represent the 3m radiated emissions test data that correlate to the tabular data provided in Table 10. (GFSK, Low Channel).

Pre-scan and Final Data (Vertical) – GFSK, Low Channel



Pre-scan and Final Data (Horizontal) – GFSK, Low Channel

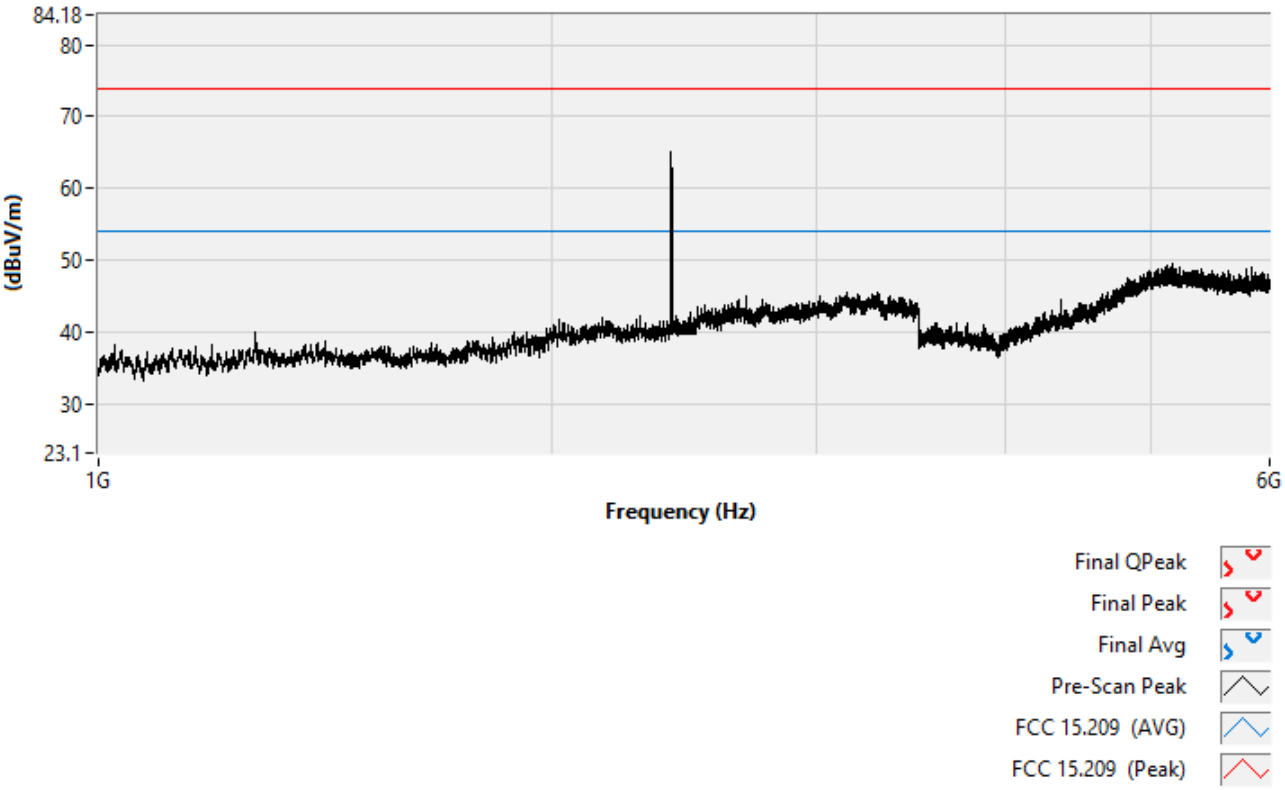


Figure 70: GFSK (1Mbps) Low Channel – 6 GHz to 12 GHz (Corrected Field Strength)

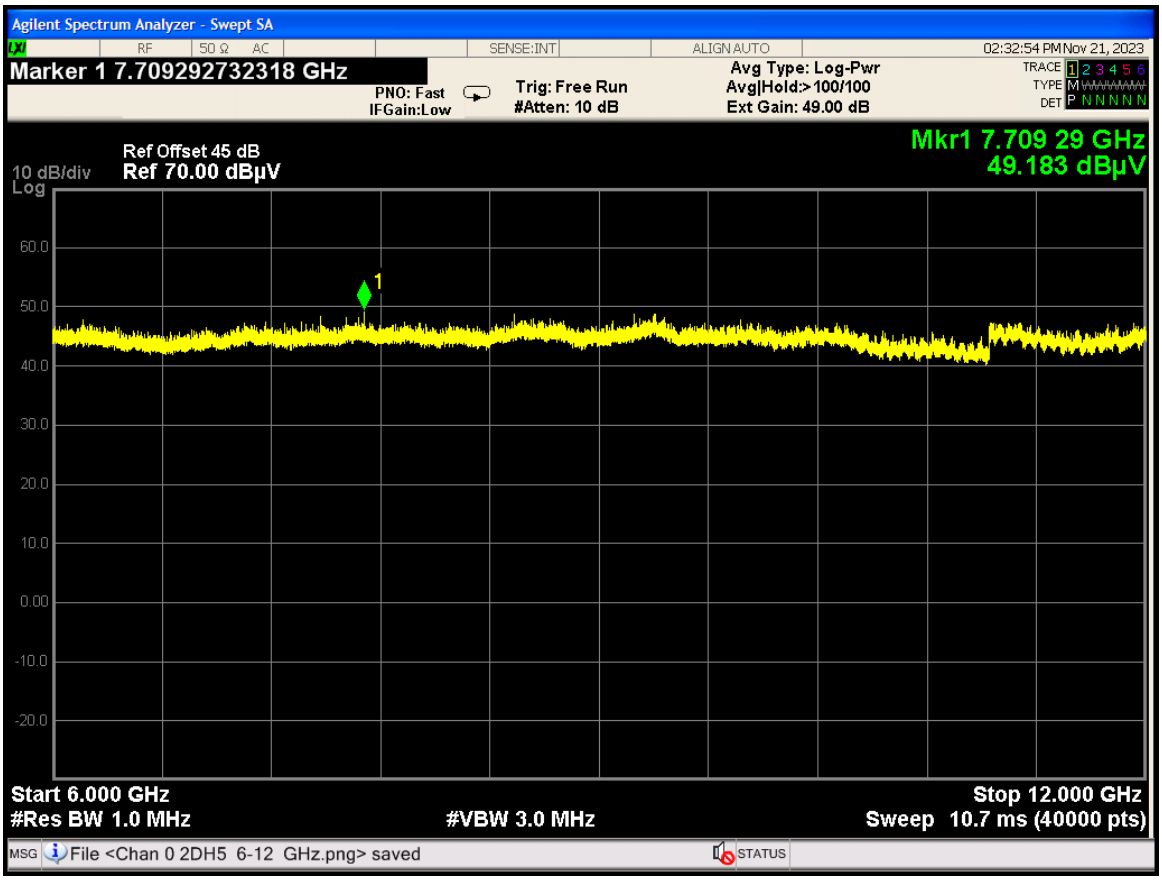


Figure 71: GFSK (1Mbps) Low Channel – 12 GHz to 18 GHz (Corrected Field Strength)

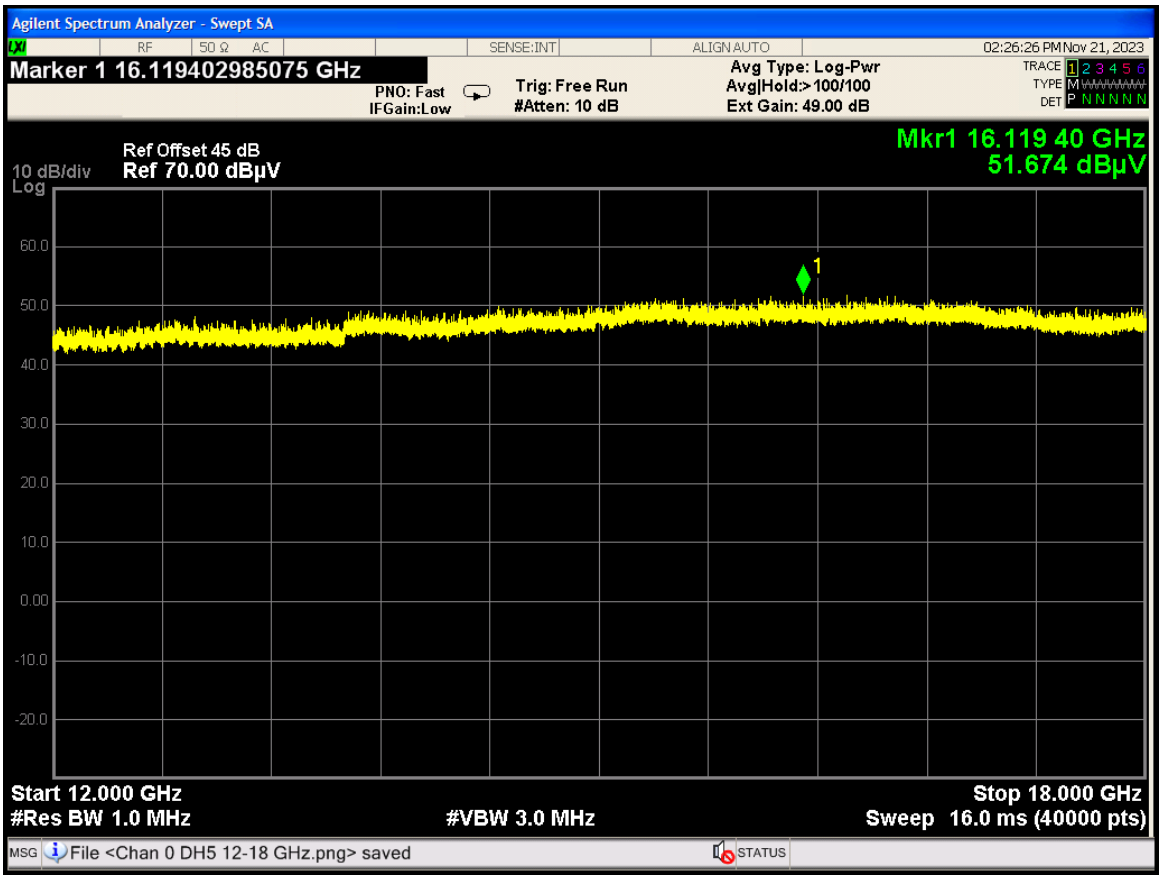
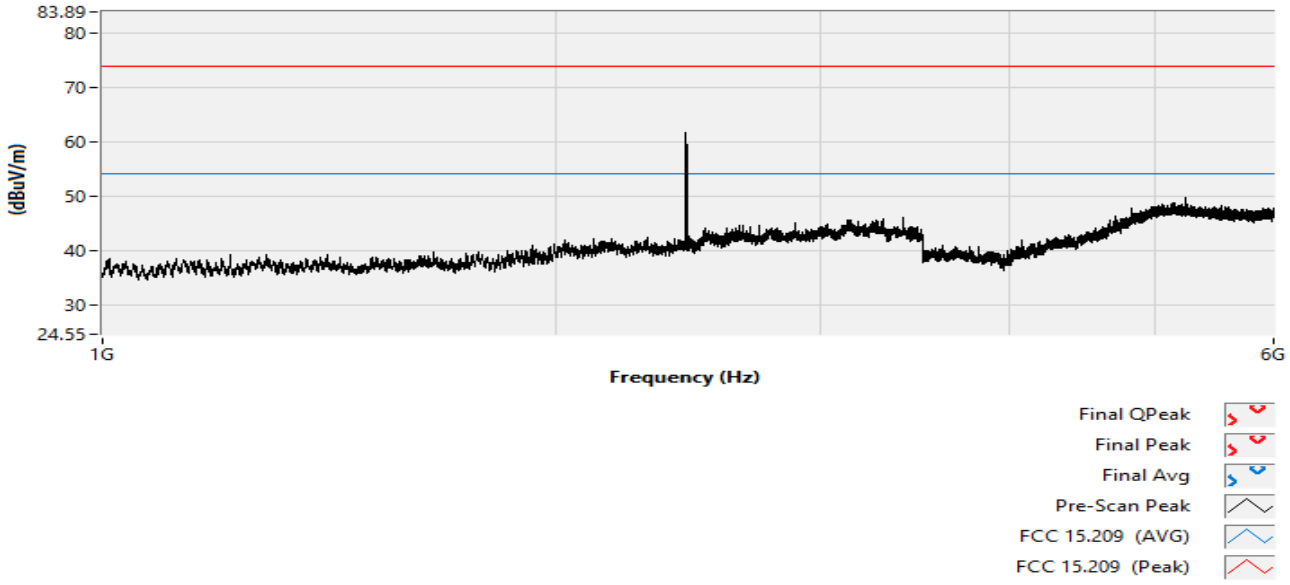


Table 11: Radiated Emissions Test Data – 1 GHz to 25 GHz (GFSK, Center Channel)

Pre-scan and Final Data (Vertical) – GFSK, Center Channel



Pre-scan and Final Data (Horizontal) – GFSK, Center Channel

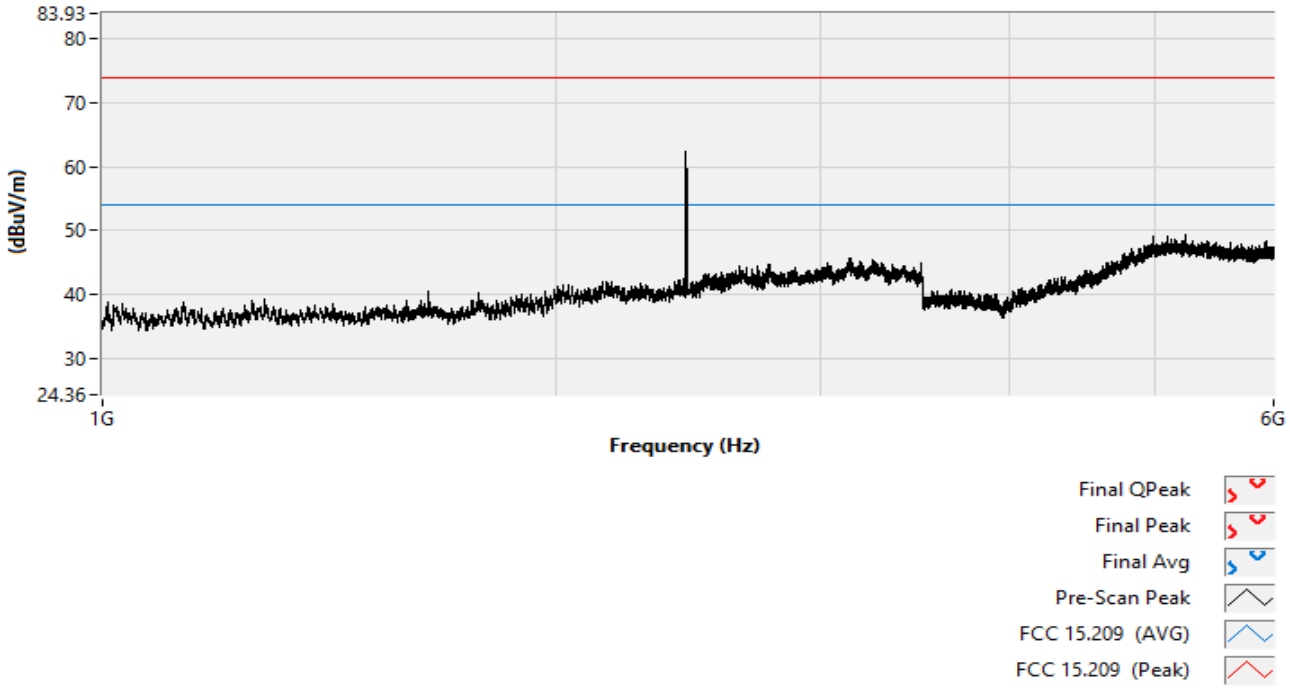


Figure 72: GFSK (1Mbps) Center Channel – 6 GHz to 12 GHz (Corrected Field Strength)

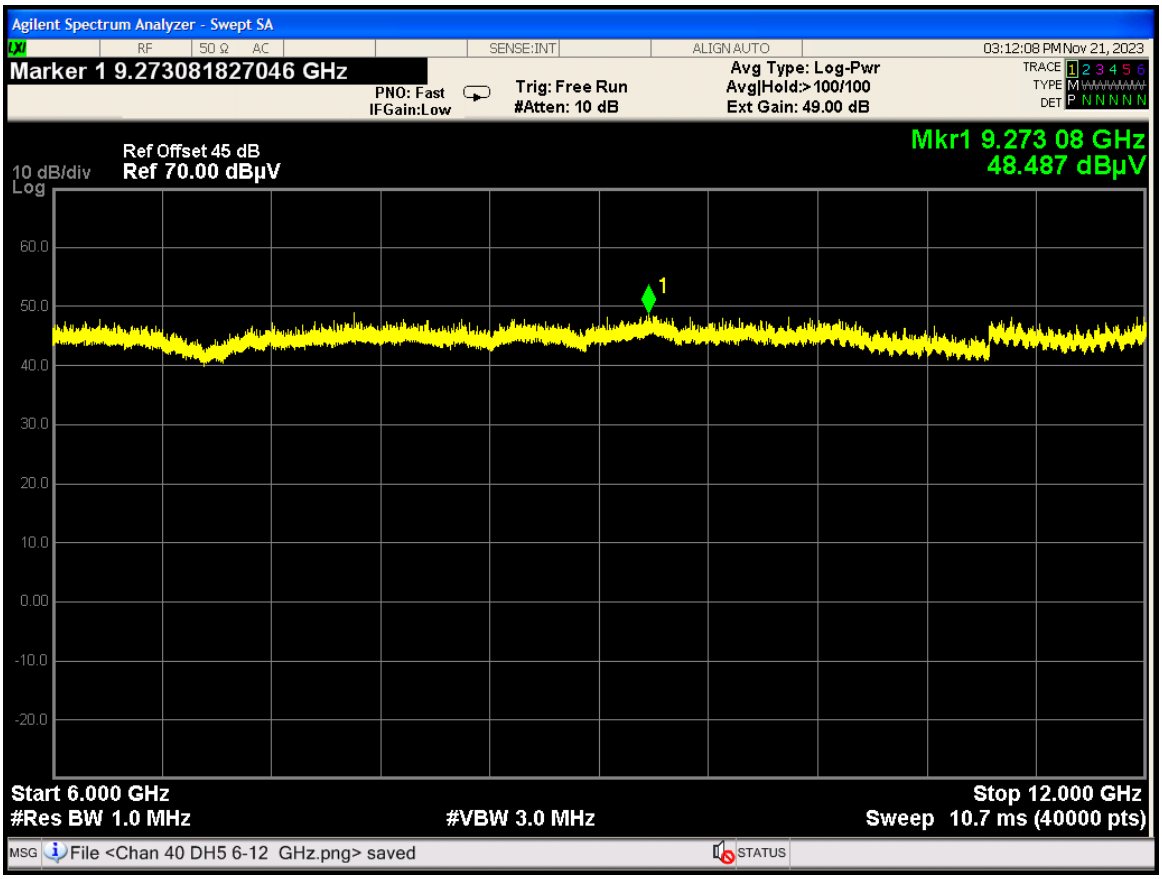


Figure 73: GFSK (1Mbps) Center Channel – 12 GHz to 18 GHz (Corrected Field Strength)

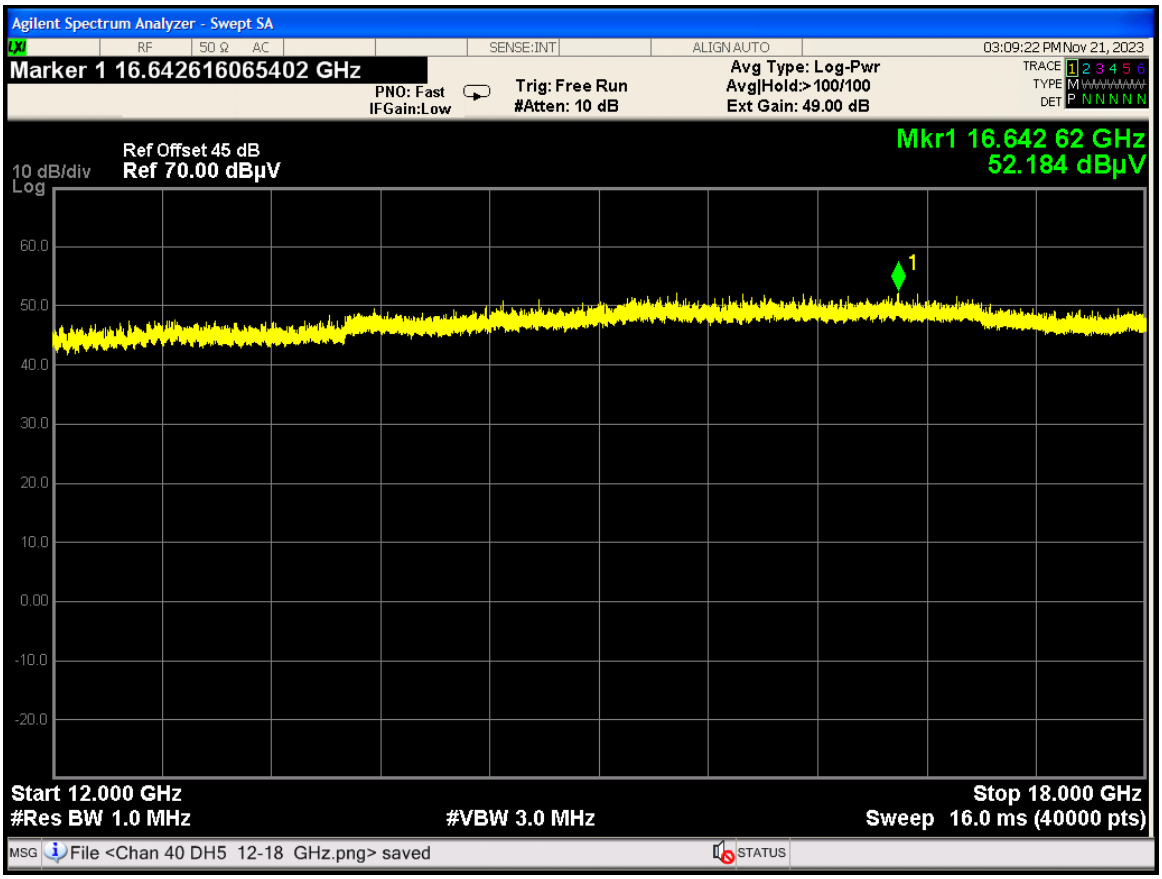
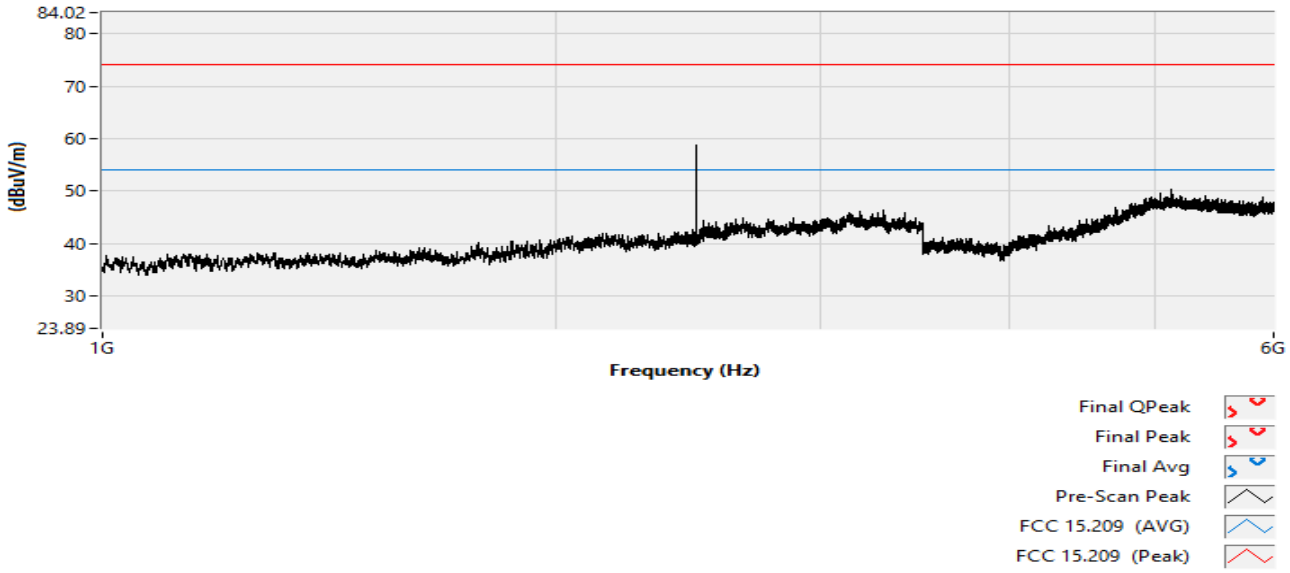


Table 12: Radiated Emissions Test Data – 1 GHz to 25 GHz (GFSK, High Channel)

Pre-scan and Final Data (Vertical) – GFSK, High Channel



Pre-scan and Final Data (Horizontal) – GFSK, High Channel

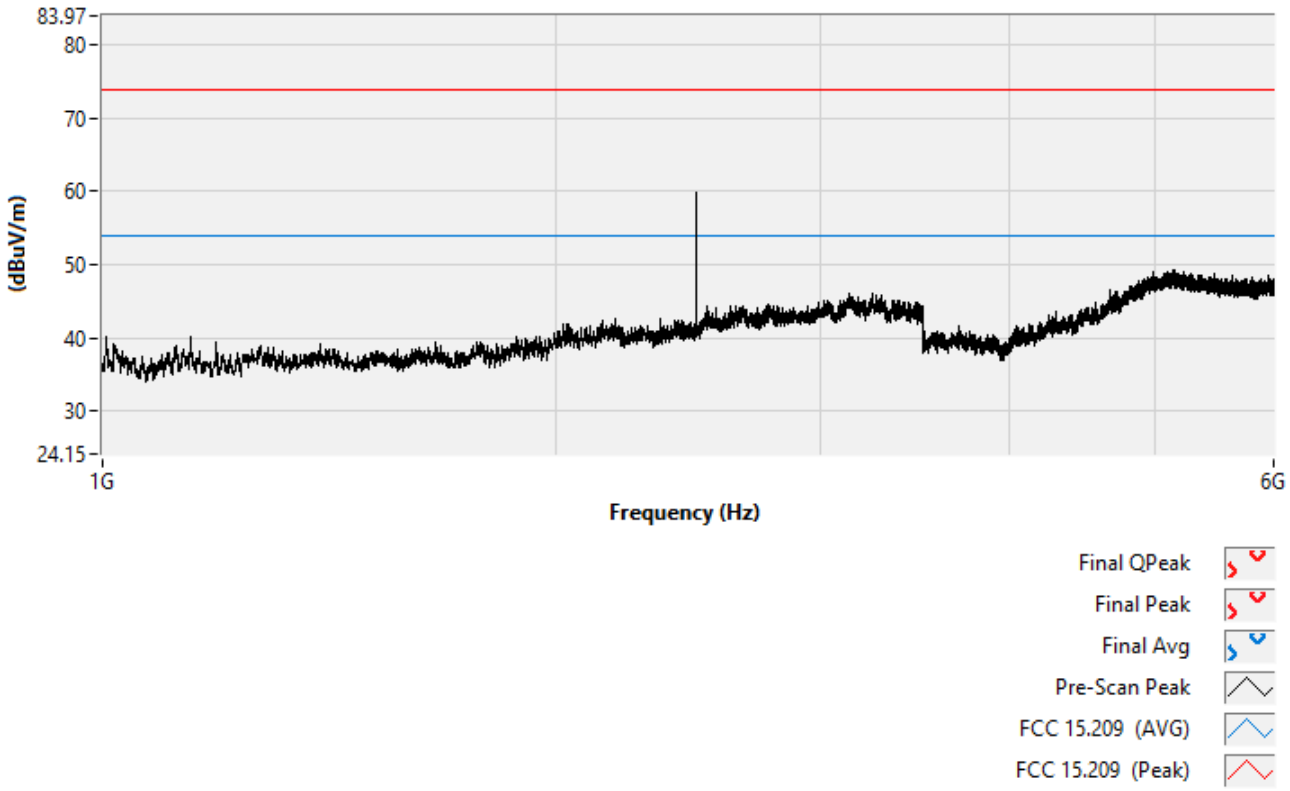


Figure 74: GFSK (1Mbps) High Channel – 6 GHz to 12 GHz (Corrected Field Strength)

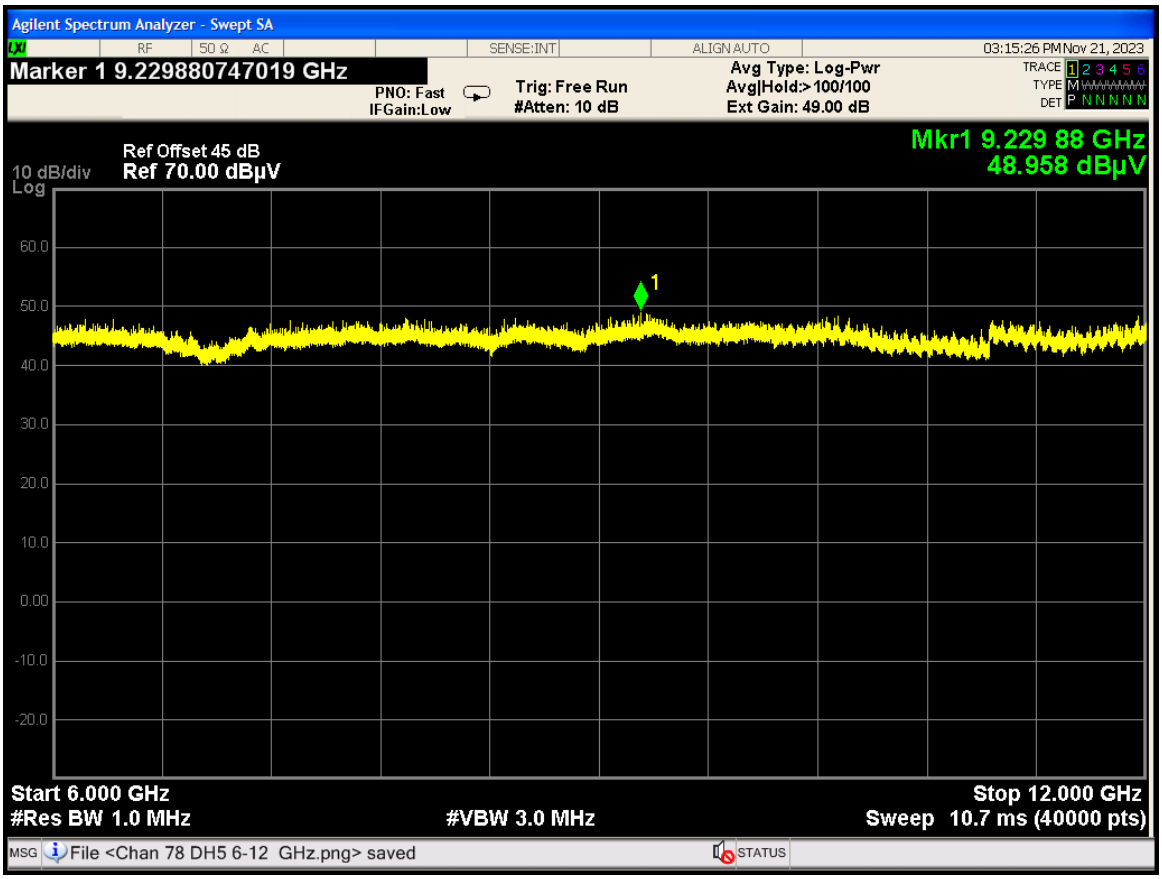


Figure 75: GFSK (1Mbps) High Channel – 12 GHz to 18 GHz (Corrected Field Strength)

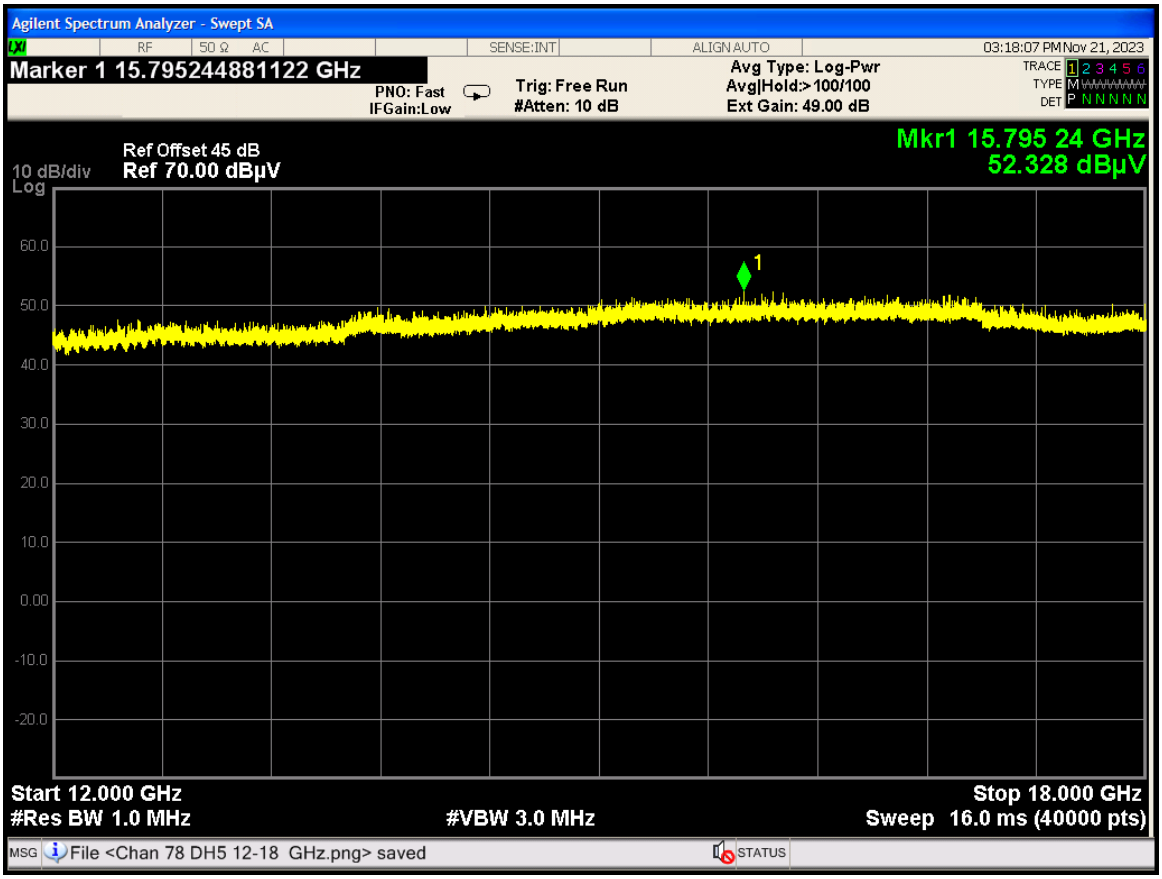


Figure 76: π/4DQPSK (2Mbps) Center Channel – 6 GHz to 12 GHz (Corrected Field Strength)

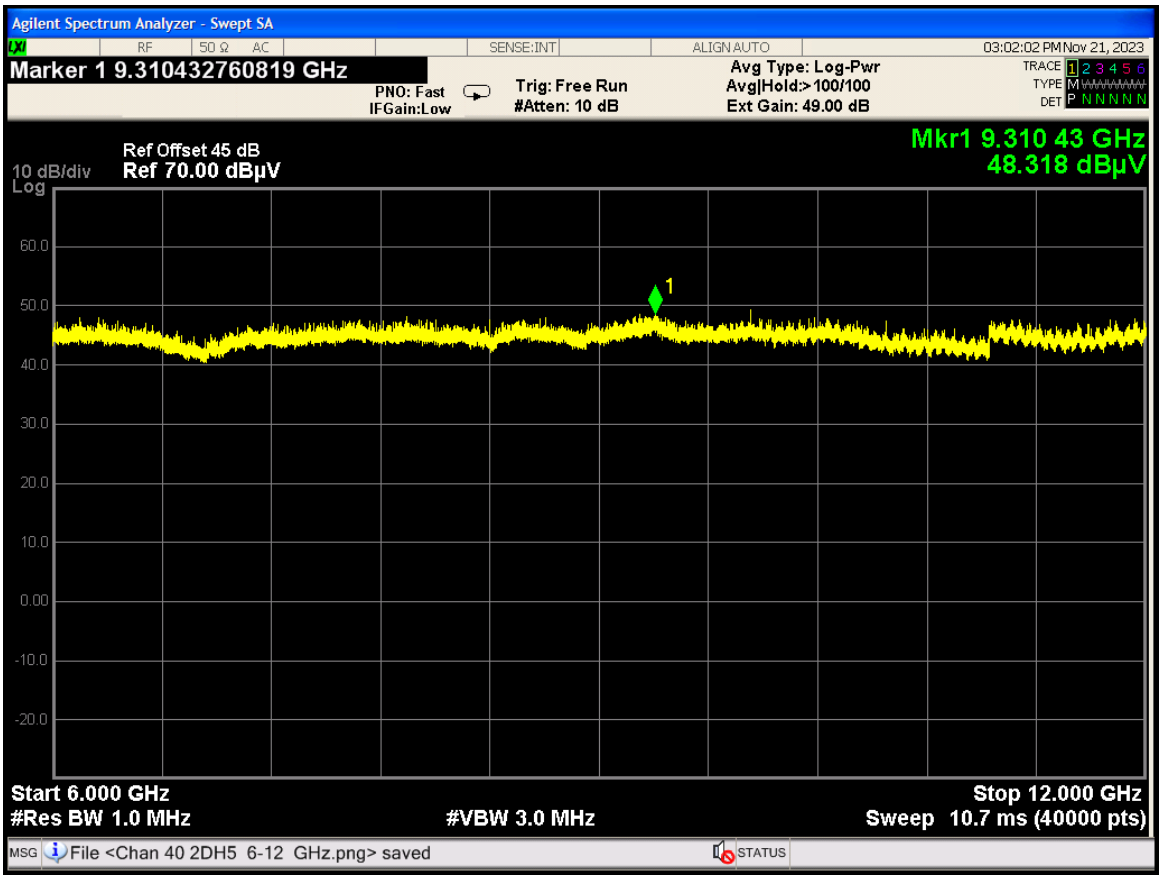


Figure 77: π/4DQPSK (2Mbps) Center Channel – 12 GHz to 18 GHz (Corrected Field Strength)

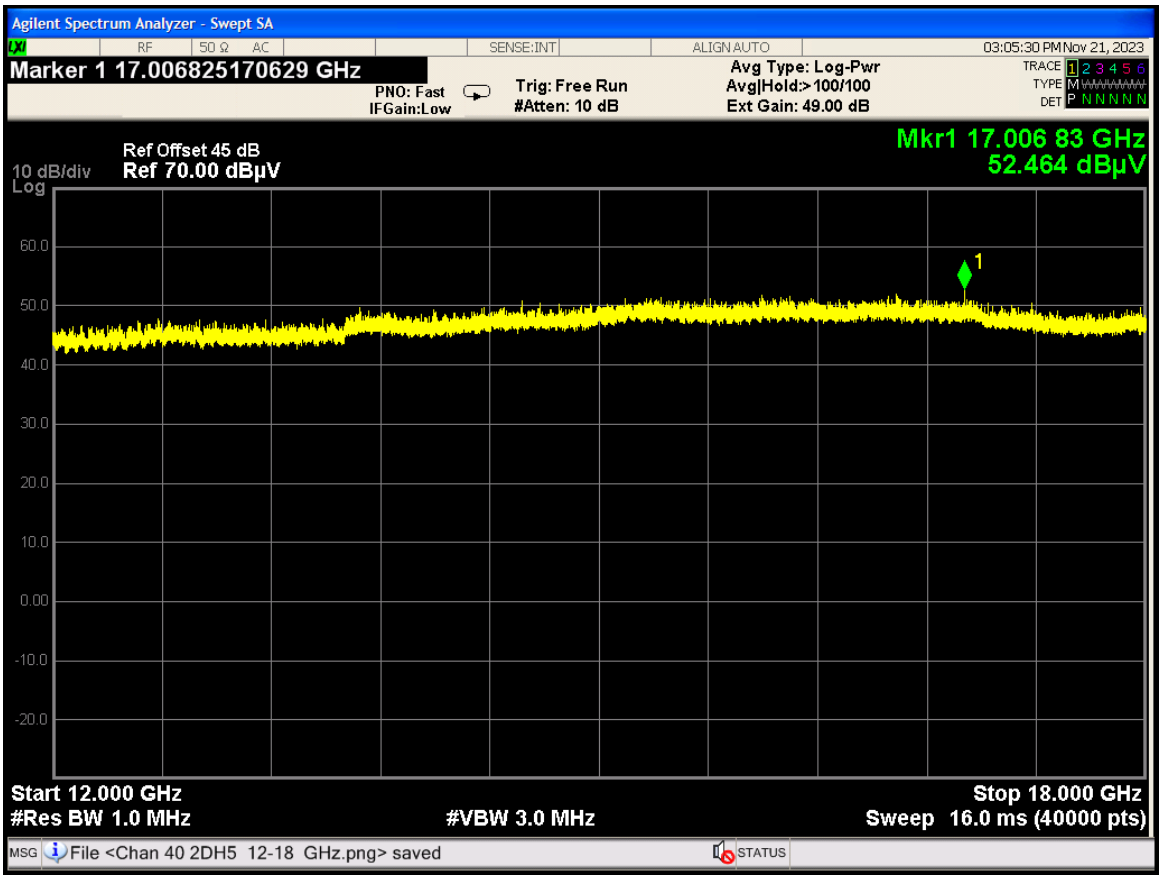


Figure 78: 8DPSK (3Mbps) Center Channel – 6 GHz to 12 GHz (Corrected Field Strength)

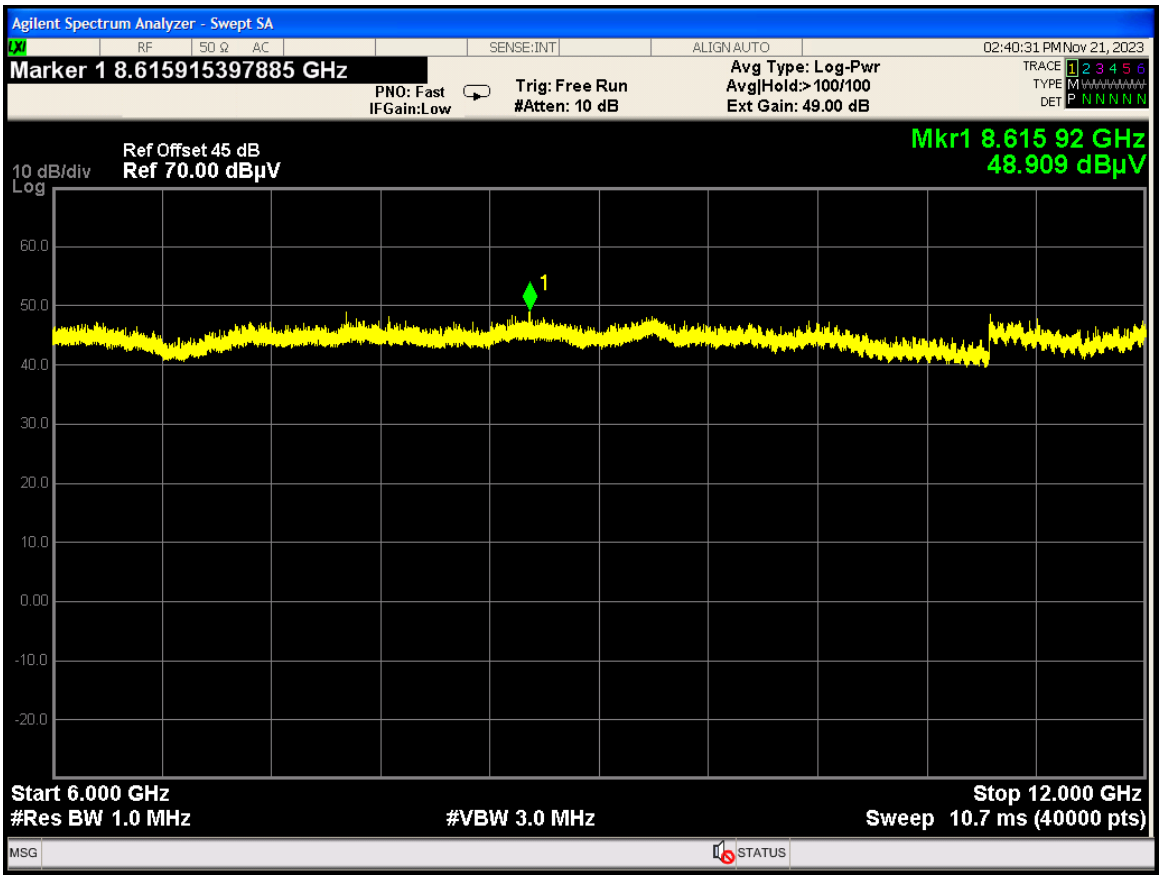
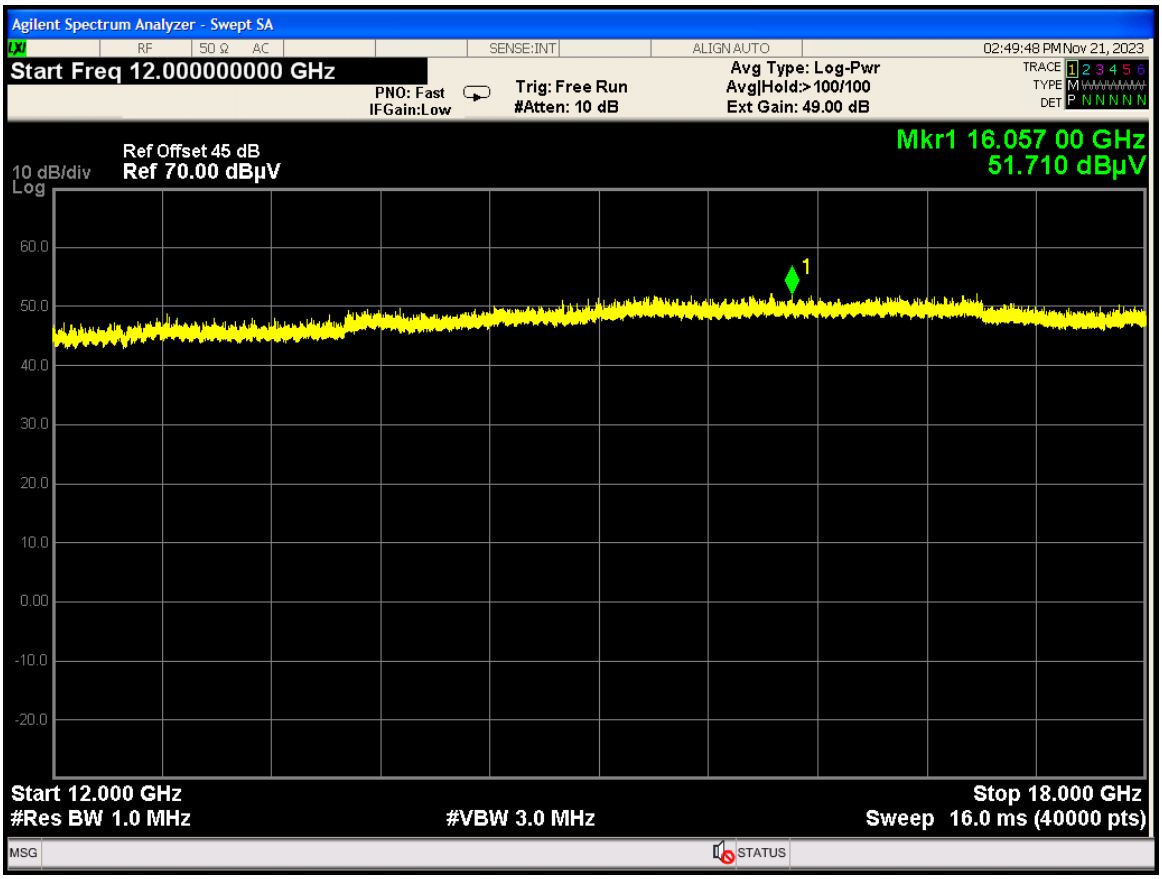


Figure 79: 8DPSK (3Mbps) Center Channel – 12 GHz to 18 GHz (Corrected Field Strength)



2.9 AC Powerline Conducted Emissions

2.9.1 Requirements

Compliance Standard: FCC Part 15.207

Frequency Range	15.207 Limits	
	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

2.9.2 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.

Environmental Conditions During Conducted Emissions Testing

Ambient Temperature:	18 °C
Relative Humidity:	42 %

2.9.3 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

2.9.4 Test Data

The EUT complies with the 15.207 Conducted Emissions requirements.

The Conducted Emissions test data is provided in the table below.

The EUT was coupled to the AC mains network indirectly, through the support laptop.

Table 13: AC Power Conducted Emissions Test Data

NEUTRAL										
Frequency (MHz)	**Level QP (dBµV)**	**Level AVG (dBµV)**	**Cable Loss (dB)**	**LISN Corr (dB)**	**Level QP Corr (dBµV)**	**Level Avg Corr (dBµV)**	**Limit QP (dBµV)**	**Limit AVG (dBµV)**	**Margin QP (dB)**	**Margin AVG (dB)**
0.158	52.0	26.9	9.9	0.6	62.5	37.4	65.6	55.6	-3.0	-15.2
0.164	51.1	26.3	9.9	0.6	61.6	36.8	65.3	55.3	-3.6	-18.4
0.200	39.6	23.1	9.9	0.5	50.1	33.5	63.6	53.6	-13.6	-20.1
0.235	35.4	23.1	9.9	0.4	45.8	33.5	62.3	52.3	-16.5	-18.8
0.293	33.5	19.0	9.9	0.4	43.8	29.3	60.4	50.4	-16.7	-21.2
0.820	36.8	31.1	9.9	0.3	47.0	41.3	56.0	46.0	-9.0	-4.7

PHASE / L1										
Frequency (MHz)	**Level QP (dBµV)**	**Level AVG (dBµV)**	**Cable Loss (dB)**	**LISN Corr (dB)**	**Level QP Corr (dBµV)**	**Level Avg Corr (dBµV)**	**Limit QP (dBµV)**	**Limit AVG (dBµV)**	**Margin QP (dB)**	**Margin AVG (dB)**
0.152	51.4	26.8	9.9	0.5	61.8	37.2	65.9	55.9	-4.1	-18.7
0.181	46.7	23.8	9.9	0.4	57.0	34.1	64.4	54.4	-7.4	-20.4
0.200	42.3	21.6	9.9	0.4	52.6	31.9	63.6	53.6	-11.0	-21.7
0.228	36.9	31.3	9.9	0.3	47.2	41.6	62.5	52.5	-15.3	-10.9
0.266	32.1	17.5	9.9	0.3	42.3	27.7	61.2	51.2	-18.9	-23.5
0.336	28.0	15.8	9.9	0.3	38.2	26.0	59.3	49.3	-21.1	-23.3

3 Equipment Under Test

3.1 EUT Identification & Description

The Stanley Black & Decker, Inc., DCR025 is a Jobsite Bluetooth Radio that operates in the 2.4 GHz band.

3.2 Test Configuration

For the purposes of testing, the DCR025 was powered with 120 Vac.

Table 14: Radio Device Summary

Manufacturer and Applicant:	Stanley Black & Decker, Inc.	
FCC ID:	YJ7DCR025B	
IC ID:	9082A-DCR025B	
HVIN:	DCR025	
FCC Rule Part:	§15.247	
TX Frequency Range:	2402 MHz – 2480 MHz	
Maximum Peak Output Power:	0.36 dBm (1.086 mW)	
Modulation:	GFSK, π/4DQPSK, 8DPSK	
Date Rate:	1Mbps, 2Mbps, 3Mbps	
Number of Channels:	79	
FCC Emission Designator:	1M23F1D (recommended or TCB to correct)	
ISED Emission Designator:	1M13F1D (recommended or TCB to correct)	
Keying:	Automatic	
Type of Information:	BT V5.2 (A2DP, AVRCP, HFP)	
Antenna Manufacturer:	Stanley Black & Decker, Inc.	
Antenna Type:	PCB Trace, “Meander Line” (Peak Gain: 1.54 dBi)	
Antenna Connector:	N/A	
Calculated EIRP:	1.90 dBm	
Interface Cables:	See Table 18	
Software/Firmware:	Normal Operation, No Special Settings	
Pulsed Transmitter:	No	
Duty Cycle:	Hopping Stopped	73% (72.85ms/100ms)
	Hopping Active	74% (297.9ms/400ms)
Power Source & Voltage:	+5VDC from USB (+4.2VDC Final to TX Module)	
Highest TX Spurious Emission:	23.80 GHz (Conducted) -46.64 dBm (Peak)	

Figure 80: EUT Block Diagram – Testing Configuration

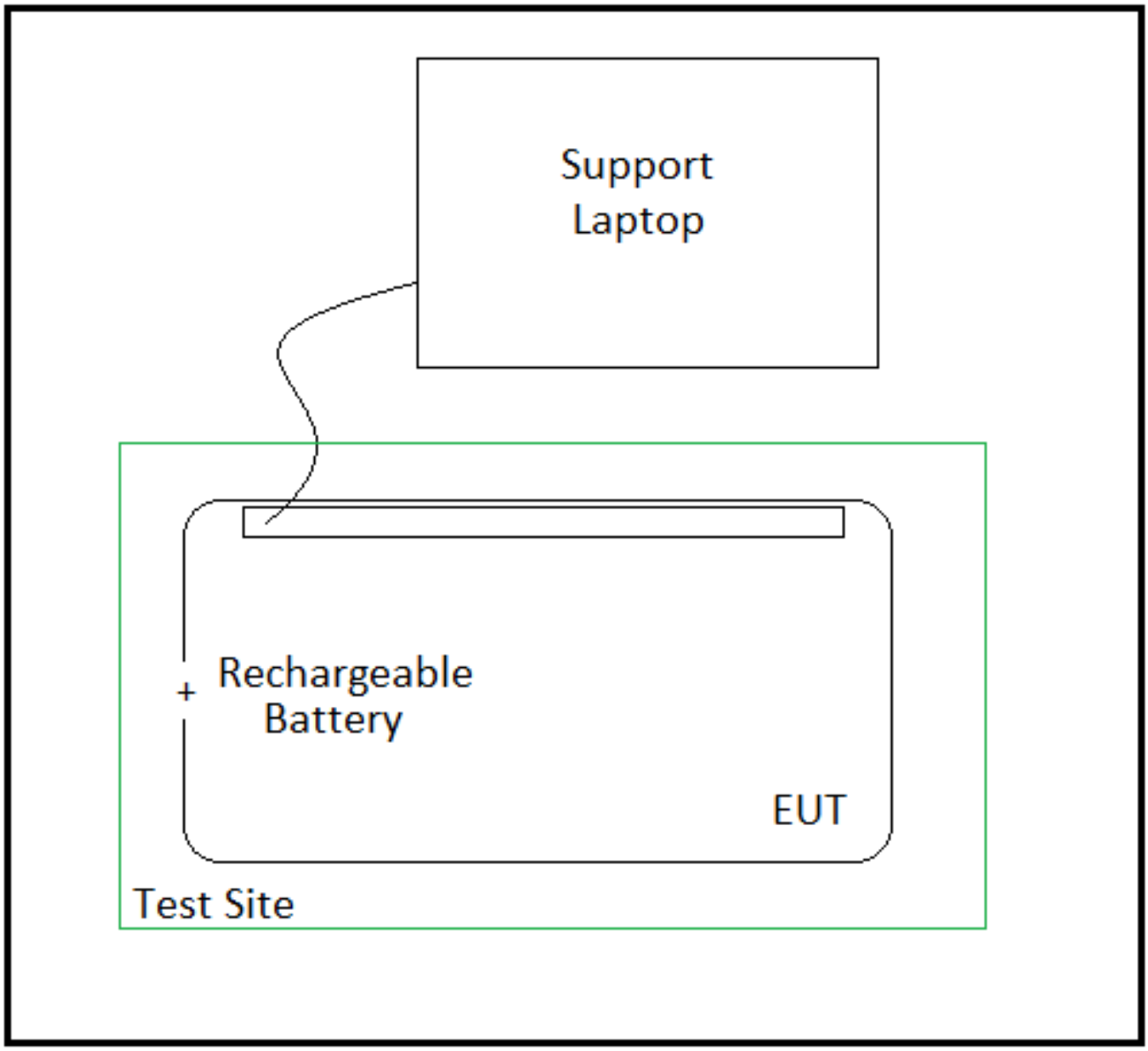


Table 15: System Configuration List

Description	Model (HVIN)	Part Number	Serial Number	Revision
Jobsite Bluetooth Radio	DCR025	N/A	N/A	N/A
Jobsite Bluetooth Radio	DCR025	N/A	N/A	N/A
Jobsite Bluetooth Radio	DCR025	N/A	N/A	N/A

Table 16: Support Equipment

Item	Model/Part Number	Serial Number
Laptop	Support Only to Fix Frequencies	N/A

Table 17: Cable Configuration

Port Identification	Connector Type	Cable Length	Shielded (Y/N)	Termination Point
Charging Port	USB-C	< 3m	No	+5DVC Source

3.3 Measurements

3.3.1 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 (6/2013) American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

3.4 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 18 below.

Table 18: Expanded Uncertainty List

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

4 Test Equipment

Table 19: Test Equipment List

Test Name:	**Conducted Emissions**	Test Date(s):	**01/02/2024**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00823	AGILENT N9010A	EXA SPECTRUM ANALYZER	6/7/2024
00053	HP 11947A	LIMITER TRANSIENT	2/14/2024
00125	SOLAR 8028-50-TS-24-BNC	LISN	5/25/2024
00126	SOLAR 8028-50-TS-24-BNC	LISN	5/25/2024
Test Name:	**Radiated Emissions**	Test Date(s):11/21/2023 & 1/4/2024	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00823	AGILENT N9010A	EXA SPECTRUM ANALYZER	6/7/2024
00644	SUNOL SCIENCES CORPORATION JB1 925-833-9936	BICONALOG ANTENNA	11/7/2024
00626	ARA DRG-118/A	ANTENNA HORN	6/19/2024
00065	HP 8447D	RF PRE-AMPLIFIER	5/9/2024
00066	B&Z (HP) BZ-01002650-401545-282525	HF PRE-AMPLIFIER 1-26.5GHZ MODIFIED	5/24/2024
Test Name:	**Benchtop RF Emissions**	Test Date(s): 12/26/2023-1/3/2024	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00993	KEYSIGHT N9020B	MXA SIGNAL ANALYZER	11/6/2025
00869	MINI-CIRCUITS CBL-2FT-SMSM	HF COAXIAL CABLE	6/11/2024