FCC & ISED CANADA CERTIFICATION TEST REPORT

FOR THE

DCR010C, BLUETOOTH SPEAKER

FCC ID: YJ7DCR010C

IC ID: 9082A-DCR010C

WLL REPORT # 18552-01 REV 3

Prepared for:

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Testing Certificate AT-1448

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FCC & ISED Canada Certification Test Report

for the

Stanley Black & Decker, Inc.

FCC ID: YJ7DCR010C

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June 7, 2024

WLL Report# 18552-01 Rev 3

Prepared by:

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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 2.4GHz Bluetooth Transmitter. The test report and application are submitted for a Frequency Hopping Spread Spectrum (FHSS) Transmitter under Part 15.247 of the FCC Rules and under Innovation Science and Economic Development (ISED) Canada RSS-247, Issue 3 (8/2023). This test report documents the test configuration and test results for the Stanley Black & Decker, Inc., DCR010C. The information provided in this report is only applicable to the 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., DCR010C 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	June 7, 2024
Rev 1	TCB Comments; dated: 6/18/24	June 20, 2024
Rev 2	Addition of EDR-2/3 Modes	July 17, 2024
Rev 3	Per TCB: remove “-“ from FCC ID	July 20, 2024

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1 Introduction

1.1 Compliance Statement

The Stanley Black & Decker, Inc., DCR010C (FCC ID: YJ7DCR010C) complies with the requirements for a FHSS Bluetooth Transmitter under Part 15.247 of the FCC Rules and under Innovation Science and Economic Development (ISED) Canada RSS-247, Issue 3 (8/2023).

1.2 Test Scope

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

1.3 Testing Algorithm

The DCR010C, Bluetooth Speaker was provided to the test laboratory, in three (3) sample configurations: (1) a conducted (at the antenna port) sample and (2) a wireless radiated (PCB trace antenna) sample with test software, and (3) a production sample with classic BT. For EUT samples #1 and #2: the low, center, and high channels were tunable through the support laptop's interface. Prior to all testing, the transmitter power was set/fixed [via software] to the desired power setting, indicated by a numerical value of "+2". 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. For testing of AC powerline emissions, and radiated emissions below 1000MHz, the production sample was used for testing. The wireless BT link was exercised by pairing the speaker to a smartphone and streaming music. For the radiated portion, the smartphone companion was kept behind the receive antenna in the corner of the chamber, and it was confirmed (through a quick investigation) that the support peripheral did not adversely impact the result of the test.

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:	V607324
Quotation Number:	74513

1.6 Test and Support Personnel

Washington Laboratories, LTD	Ryan Mascaro
Customer Representative	Kirwan Magdamo

1.7 Testing Dates

From 5/13/2024 to 7/15/2024.

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 custom PCB trace antenna; designed and manufactured by the Applicant. The EUT does not have an antenna connector.

2 Equipment Under Test

2.1 EUT Identification & Description

The Stanley Black & Decker, Inc., DCR010C is a Bluetooth speaker that operates in the 2.4 GHz band. The BT transceiver has ranging output power over the ISM band, with power decreasing as frequency increases. The power level setting however is fixed via software. This setting is numerical value of "+2" in the test software. Please also note that the manufacturer's production tune-up tolerance is ±1.12 dB.

2.2 Test Configuration

For the purposes of testing, the DCR010C was powered by 120VAC, 60Hz. The support laptop was connected to the EUT via a USB-UART cable. The EUT is depicted in below.

Figure 1: EUT Diagram, Device Specifications

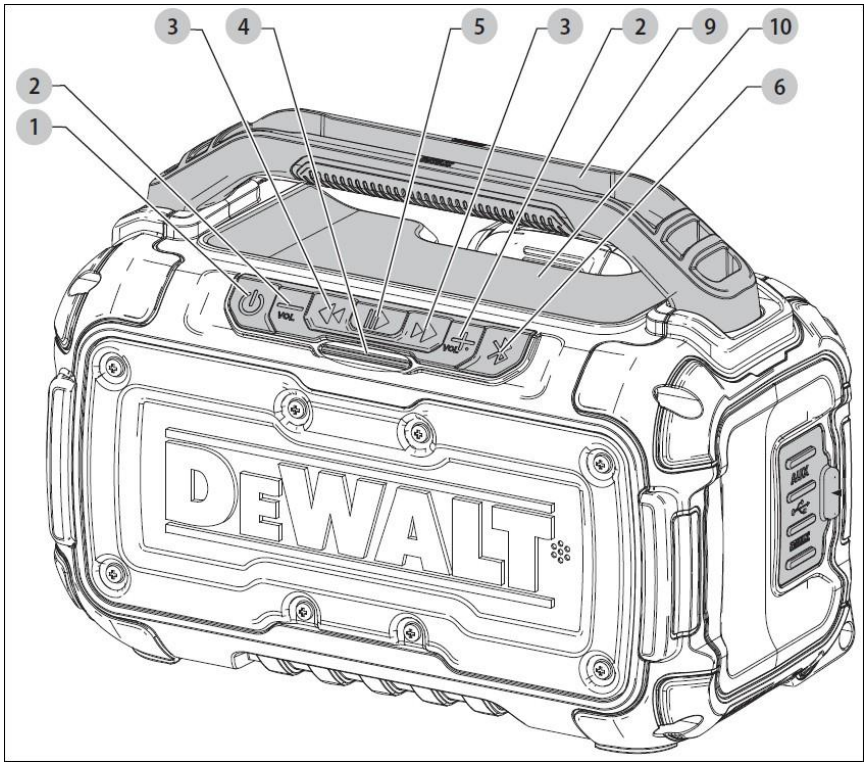


Table 2: Radio Device Summary

Manufacturer and Applicant:	Stanley Black & Decker, Inc.
FCC ID:	YJ7DCR010C
IC ID:	9082A-DCR010C
HVIN (for ISED):	TW1D
Serial Number of Unit Tested:	200
FCC Rule Part:	§15.247
TX Frequency Range:	2402 MHz to 2480 MHz
Maximum Peak Output Power:	8.84 dBm (7.66 mW)
20dB Bandwidth:	1.013 MHz (worst-case)
99% Bandwidth:	1.209 MHz (worst-case)
Modulation:	GFSK, π/4DQPSK, 8DPSK
Date Rate:	1, 2, and 3 Mbps
Number of Channels:	79
FCC Emission Designator:	1M0F1D
ISED Emission Designator:	1M2F1D
Keying:	Automatic
Type of Information:	Bluetooth
Antenna Manufacturer:	Stanley Black & Decker, Inc.
Antenna Type:	PCB Trace, “Meander Line” (Peak Gain: +3.34 dBi)
Antenna Connector:	N/A
Calculated EIRP:	12.02 dBm (based on declared gain)
Interface Cables:	See Table 16
Software/Firmware:	“+2 dBm” power setting
Pulsed Transmitter:	No
Power Source & Voltage:	Primary: 120VAC, 60Hz
	Secondary: 12VDC or 20VDC (battery pack)
RSS-102, Annex A:	0.043 W/m^2 (based on 20cm calculation)
Highest TX Spurious Emission:	4.804 GHz (Conducted) -19.18 dBm (Peak)
	2.392 GHz (3m, Radiated); 42.74 dBuV/m (AVG)

Figure 2: Testing Configuration Diagram (Example Only)

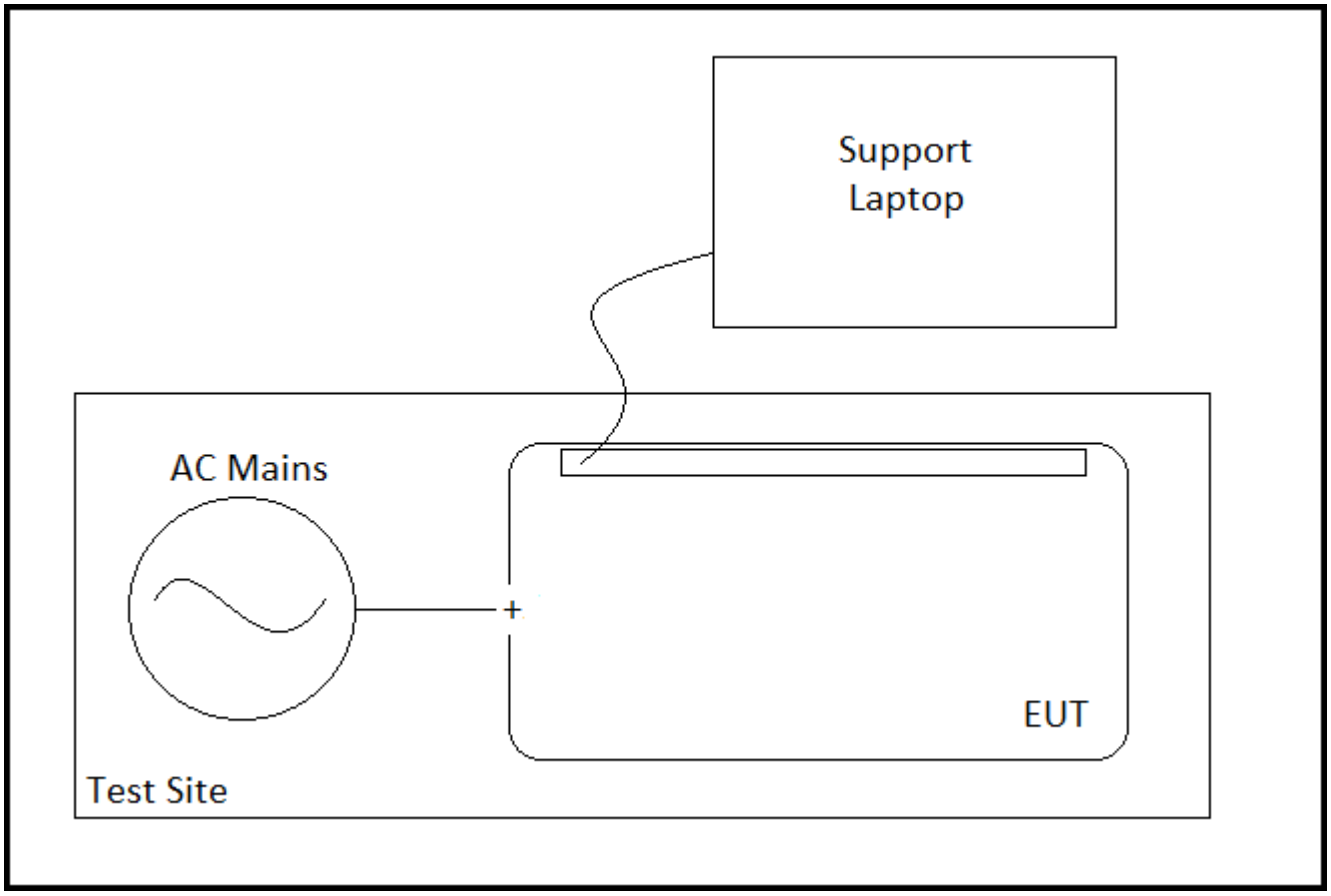


Table 3: System Configuration List

Description	Model (HVIN)	Part Number	Serial Number	Revision
Bluetooth Speaker	DCR010C	WB-2833	200	N/A

Table 4: Support Equipment

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

Table 5: Cable Configuration

Port Identification	Connector Type	Cable Length	Shielded (Y/N)	Termination Point
AC Power	2-prong	< 3m	No	120VAC
CMD	UART	< 3m	Yes	Support Laptop

3 Test Results

3.1 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).

3.1.1 Measurement Method and Results

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

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

The EUT employs a PCB trace antenna with a maximum gain of +3.34 dBi.

8.68 + 3.34 = 12.02 dBm EIRP (calculated), which is far below the 4W limit for Canada.

Table 6: Transmitter Output Power, Test Results

Modulation	Mode (Data Rate)	Frequency (MHz)	Peak Power (dBm)
GFSK	DH5 (1Mbps)	2402 MHz	7.76
		2440 MHz	5.19
		2480 MHz	2.04
π/4DQPSK	2DH5 (2Mbps)	2402 MHz	8.68
		2440 MHz	6.00
		2480 MHz	2.81
8DPSK	3DH5 (3Mbps)	2402 MHz	8.84
		2440 MHz	6.34
		2480 MHz	3.26

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

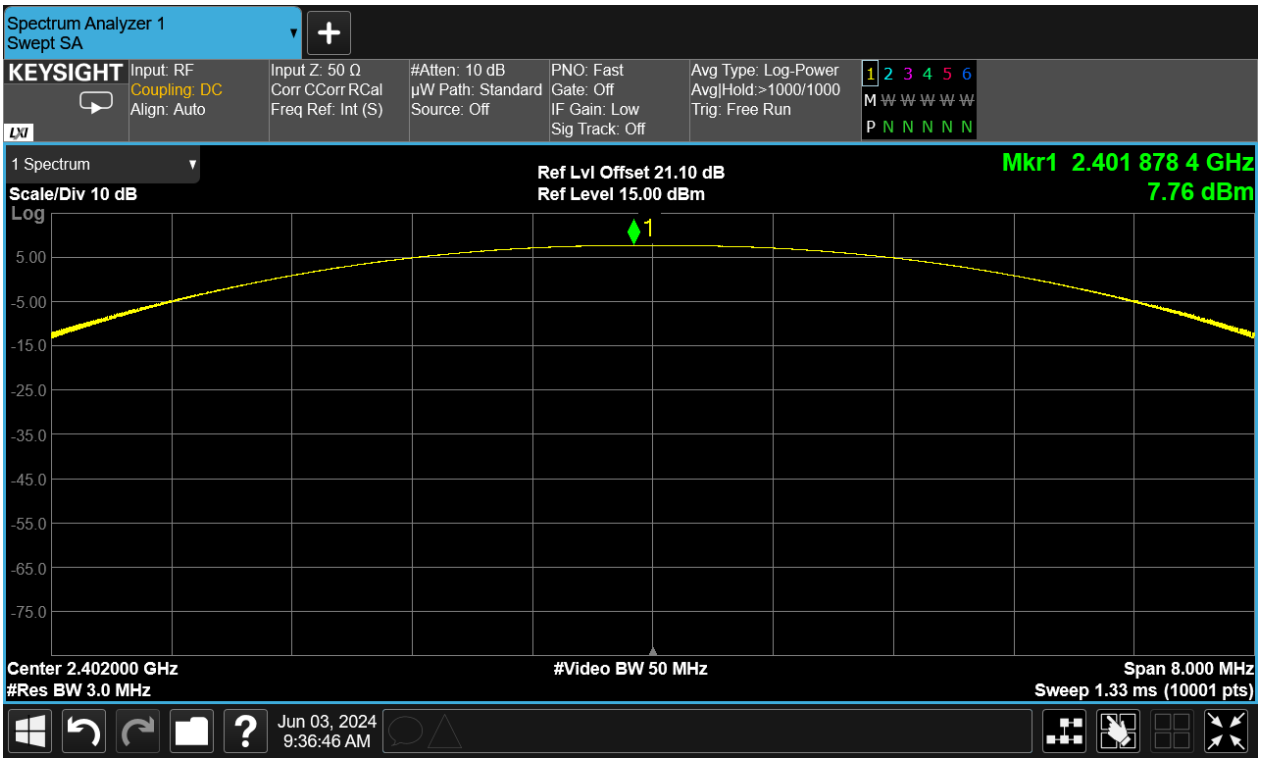


Figure 4: GFSK (1Mbps) – Center Channel, Peak Power Output

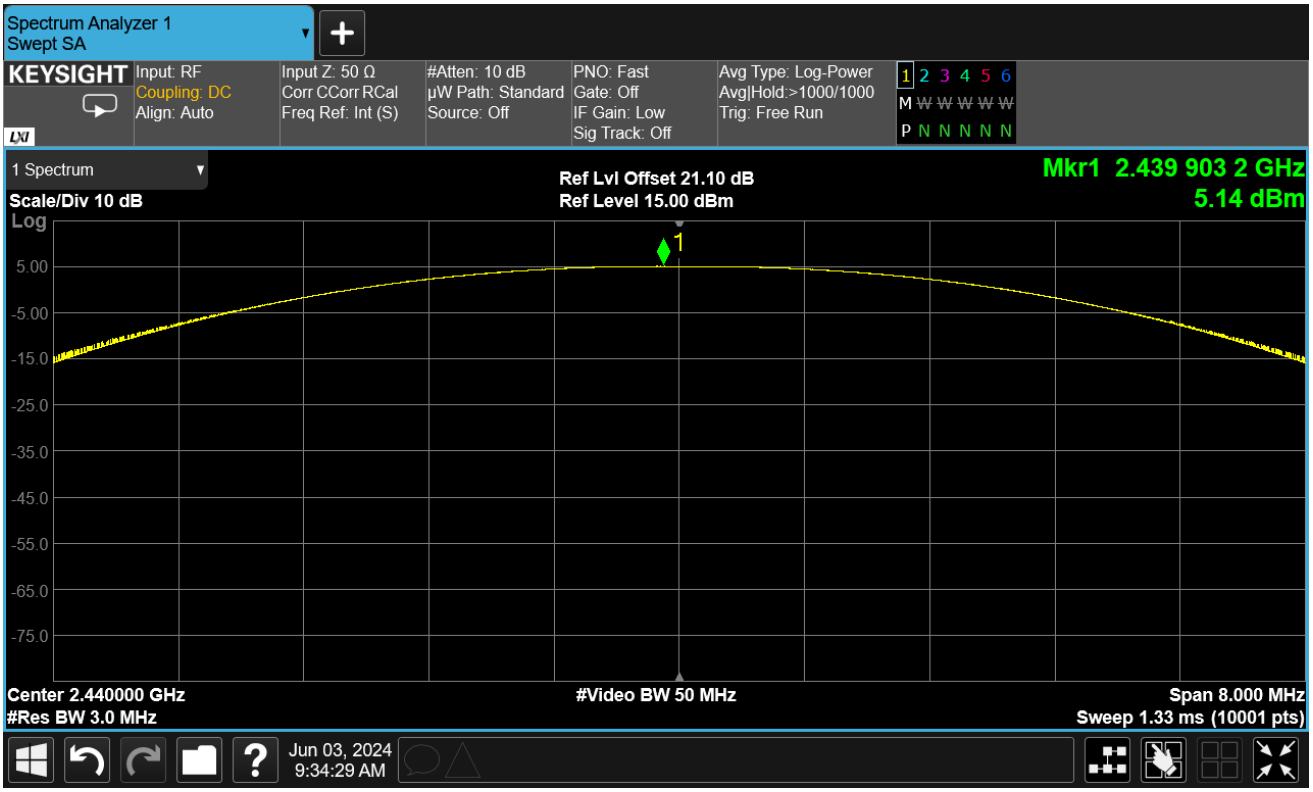


Figure 5: GFSK (1Mbps) – High Channel, Peak Power Output

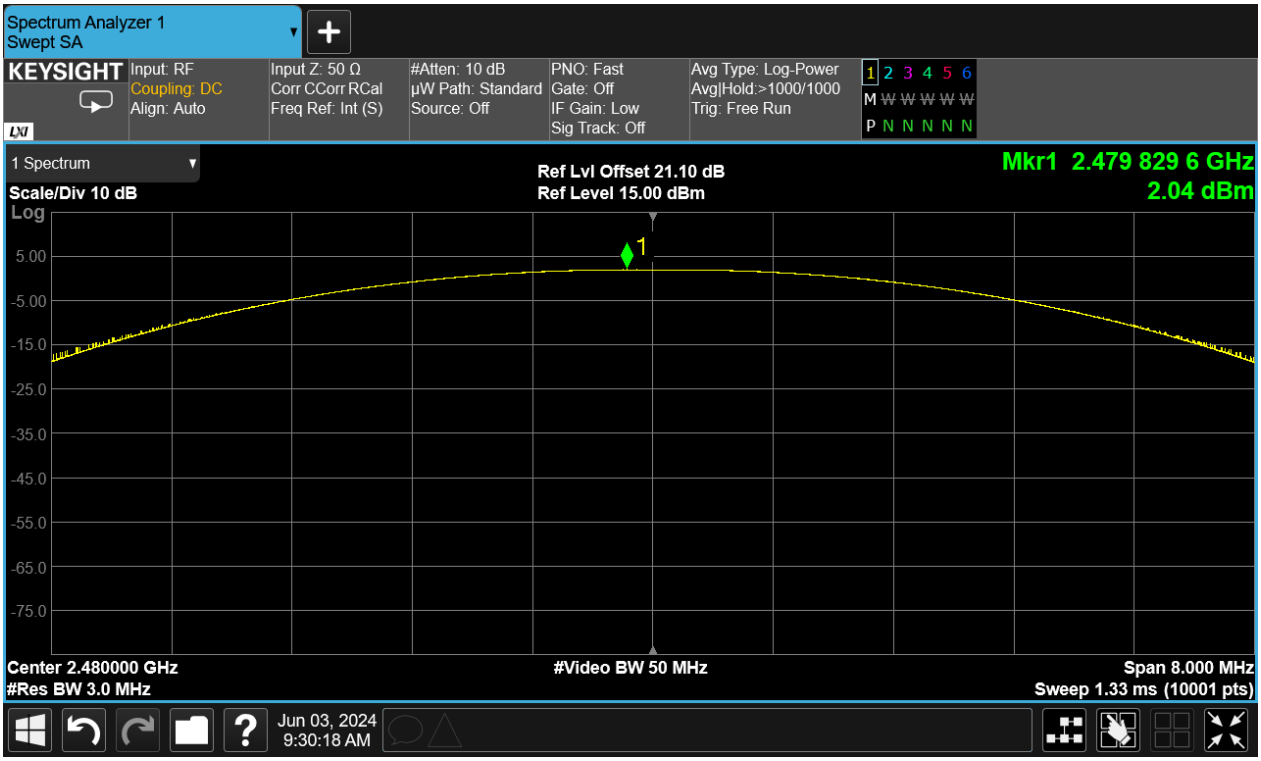


Figure 6: π/4DQPSK (2Mbps) – Low Channel, Peak Power Output

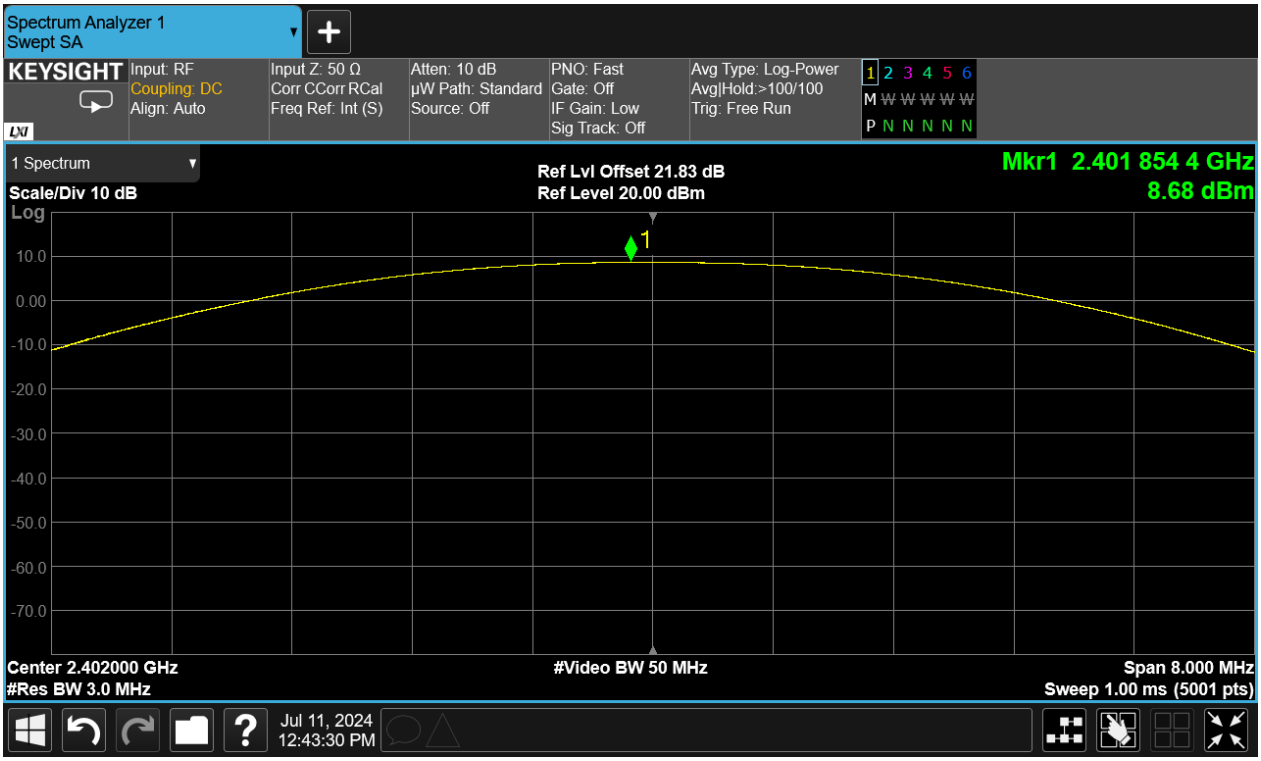


Figure 7: π/4DQPSK (2Mbps) – Center Channel, Peak Power Output

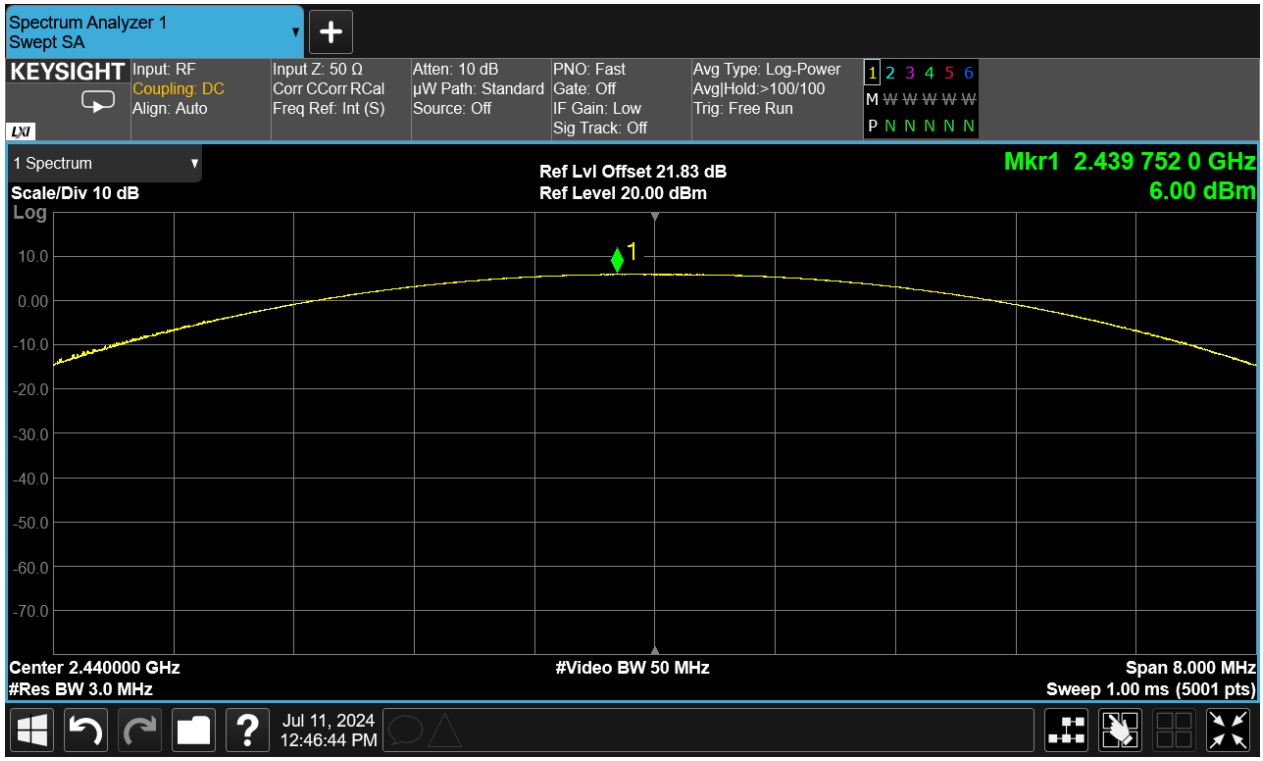


Figure 8: π/4DQPSK (2Mbps) – High Channel, Peak Power Output

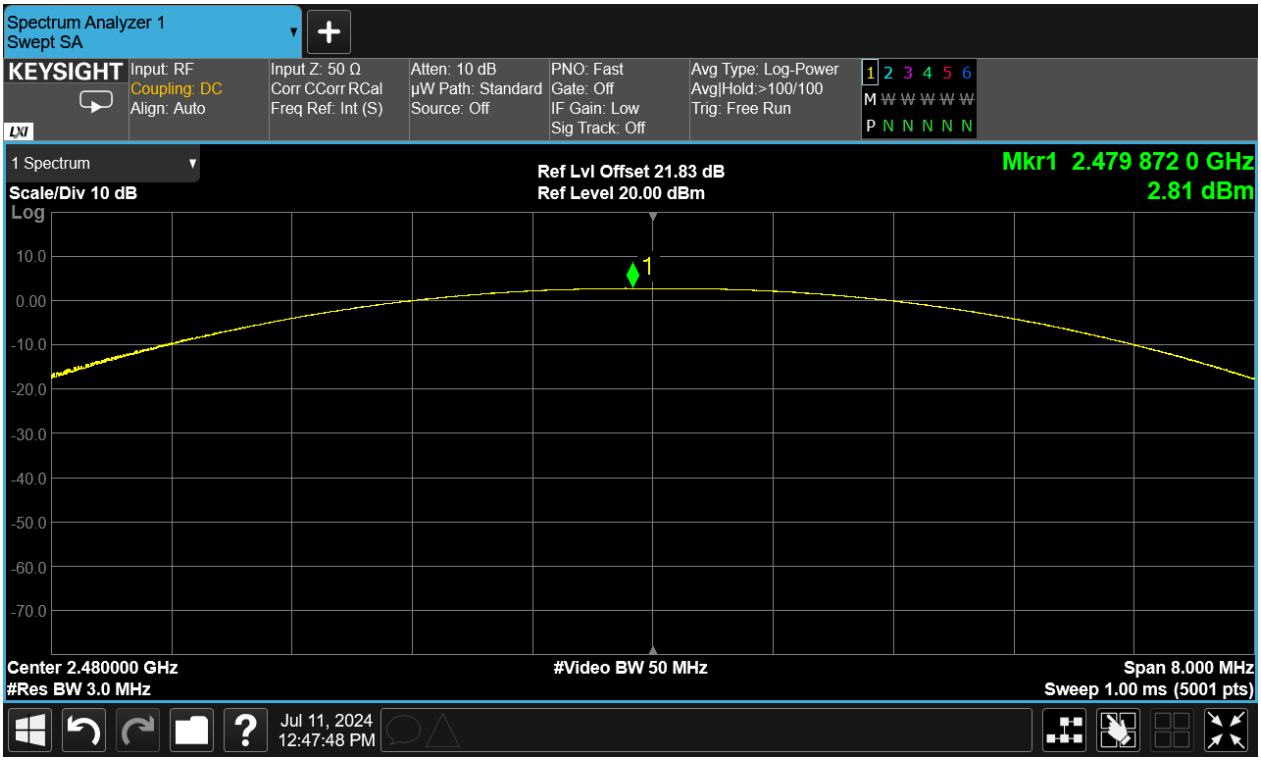


Figure 9: 8DPSK (3Mbps) – Low Channel, Peak Power Output

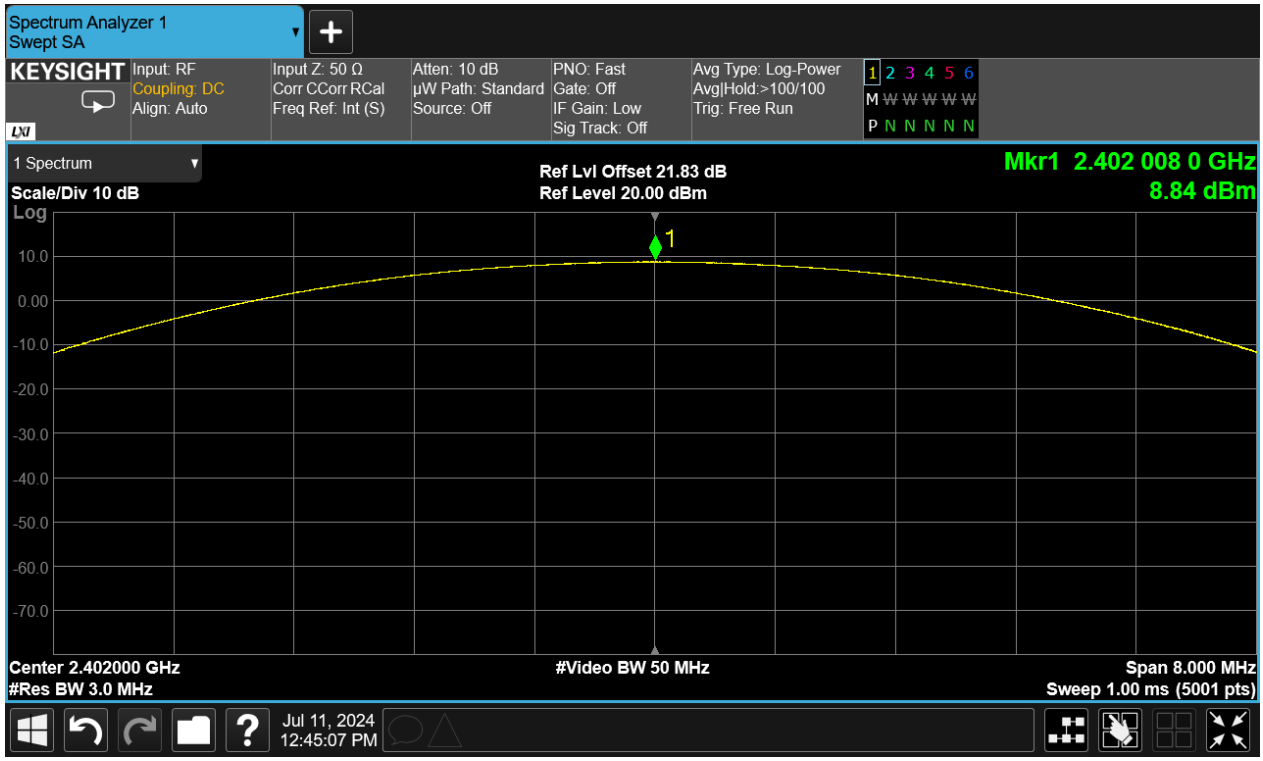


Figure 10: 8DPSK (3Mbps) – Center Channel, Peak Power Output

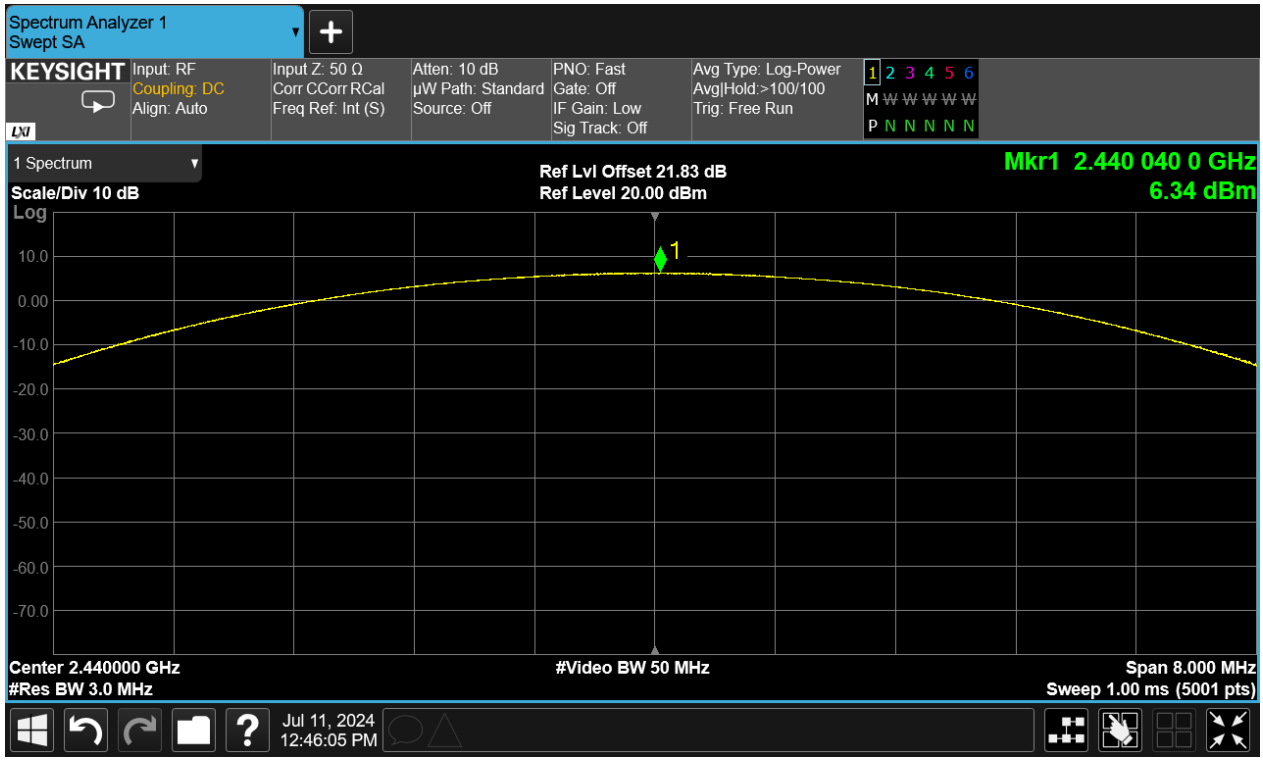
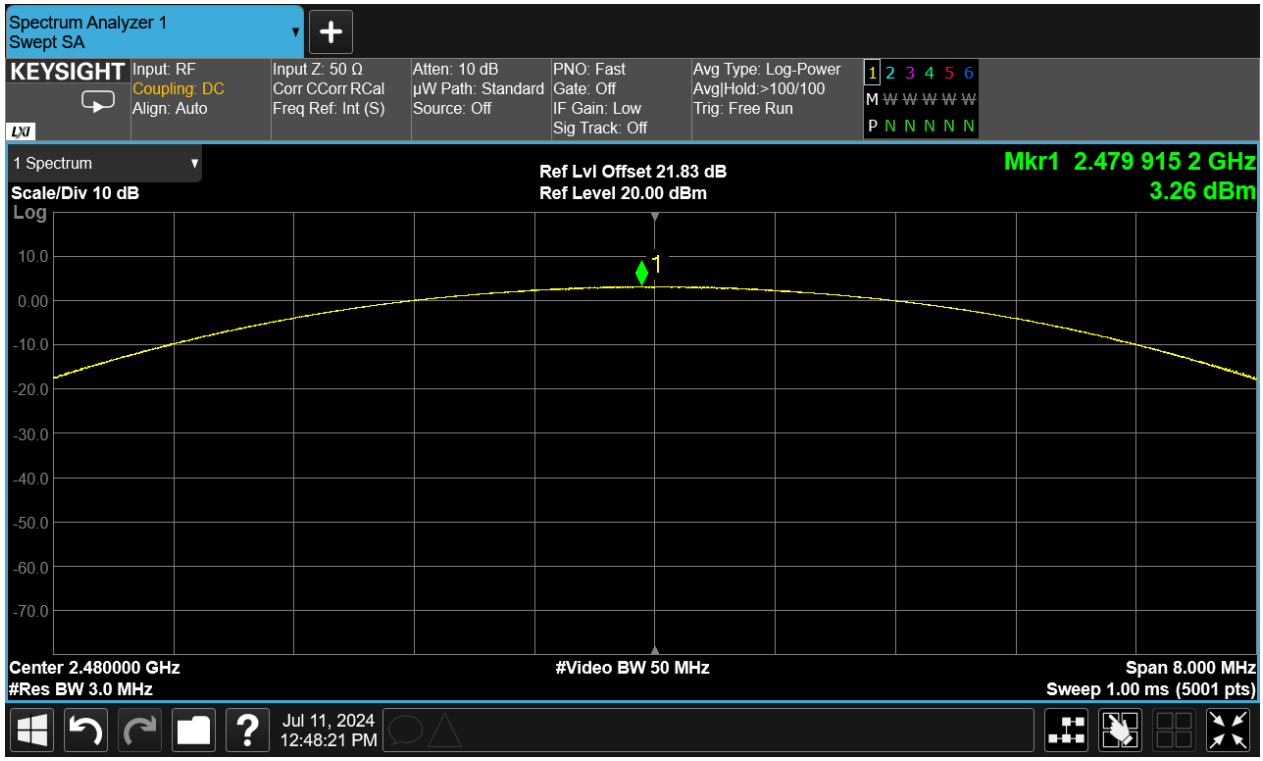


Figure 11: 8DPSK (3Mbps) – High Channel, Peak Power Output



3.2 Channel Occupied Bandwidth

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400 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.

The occupied bandwidth of a frequency hopping channel is the 20dB emission bandwidth, measured with the hopping stopped. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies.

3.2.1 Measurement Method and Results

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

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

Table 7: Channel Occupied Bandwidth, Test Results

Modulation	Mode (Data Rate)	Frequency (MHz)	20dB Bandwidth	99% Bandwidth
GFSK	DH5 (1Mbps)	2402 MHz	1.032 MHz	897.4 kHz
		2440 MHz	1.044 MHz	899.0 kHz
		2480 MHz	1.013 MHz	890.4 kHz
π/4DQPSK	2DH5 (2Mbps)	2402 MHz	1.321 MHz	1.209 MHz
		2440 MHz	1.311 MHz	1.199 MHz
		2480 MHz	1.316 MHz	1.196 MHz
8DPSK	3DH5 (3Mbps)	2402 MHz	1.321 MHz	1.199 MHz
		2440 MHz	1.328 MHz	1.196 MHz
		2480 MHz	1.313 MHz	1.192 MHz

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

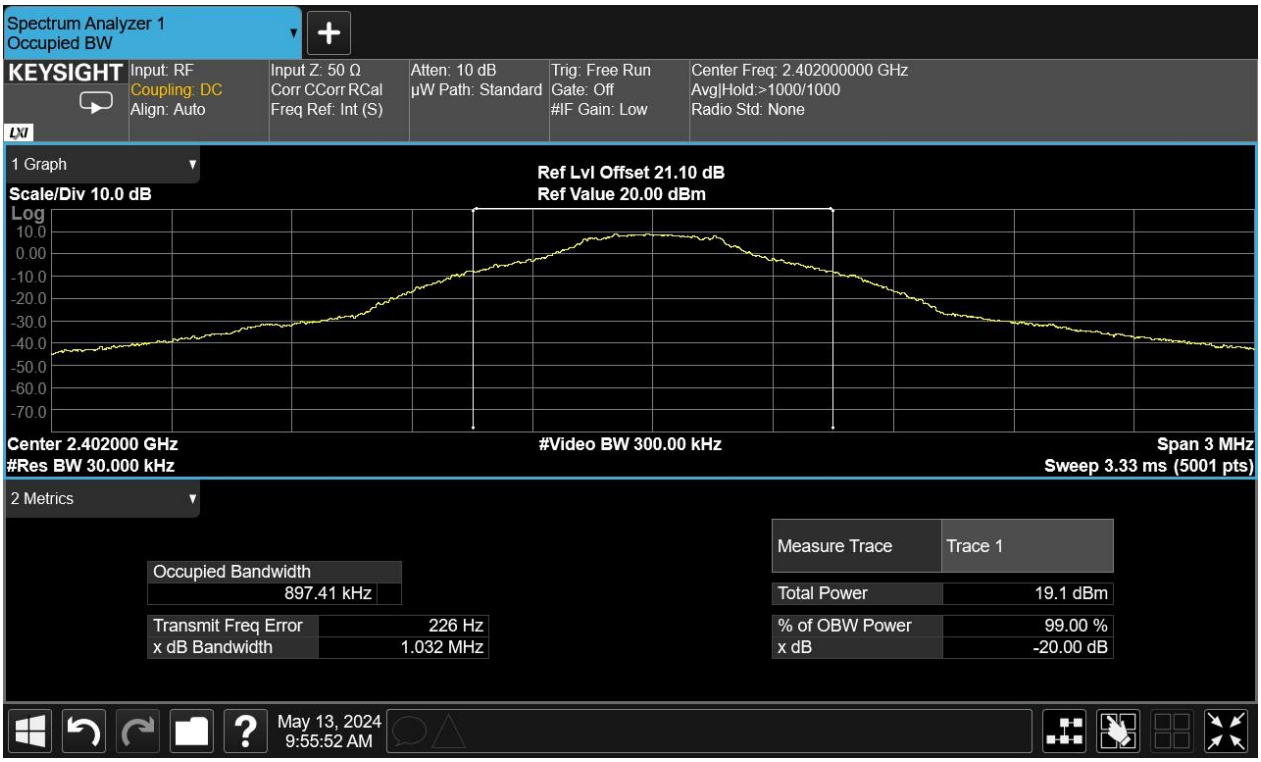


Figure 13: GFSK (1Mbps) – Center Channel, Occupied Bandwidth

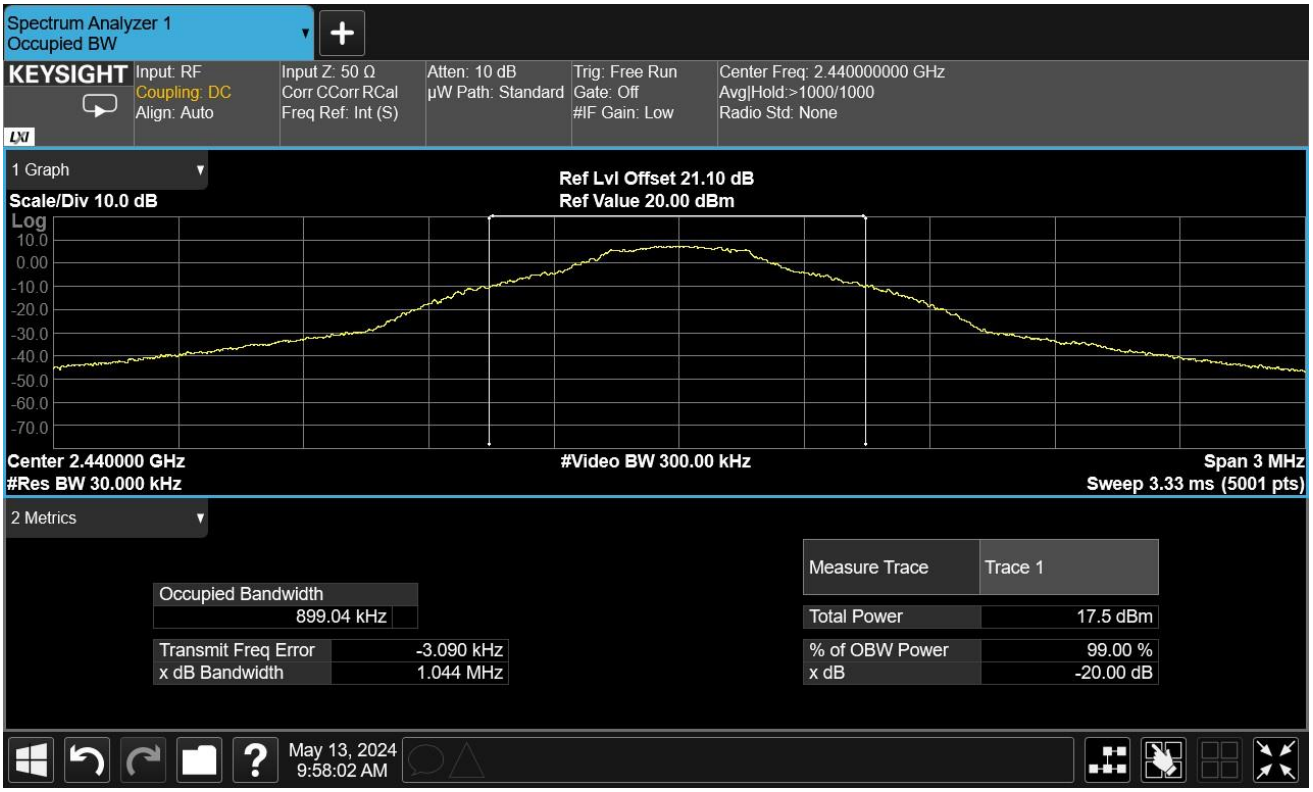


Figure 14: GFSK (1Mbps) – High Channel, Occupied Bandwidth

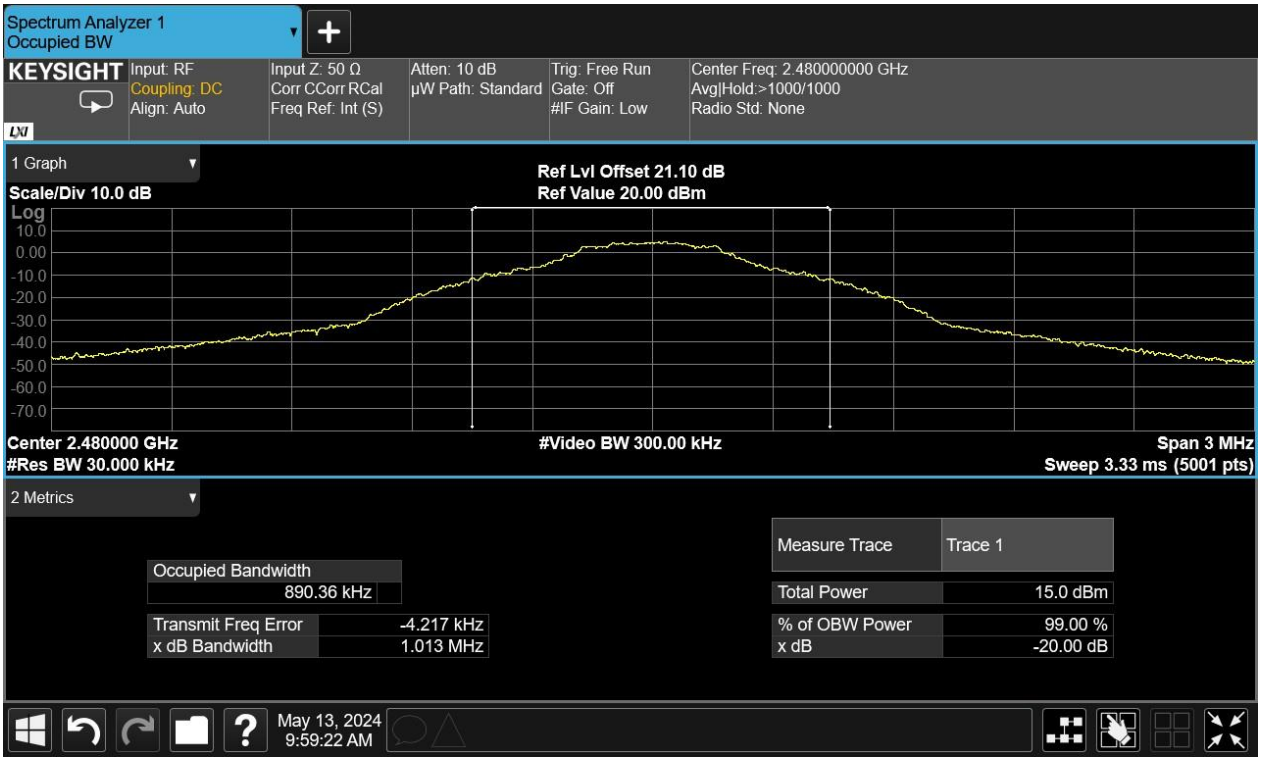


Figure 15: π/4DQPSK (2Mbps) – Low Channel, Occupied Bandwidth

Figure 16: π/4DQPSK (2Mbps) – Center Channel, Occupied Bandwidth

Figure 17: π/4DQPSK (2Mbps) – High Channel, Occupied Bandwidth

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

Figure 19: 8DPSK (3Mbps) – Center Channel, Occupied Bandwidth

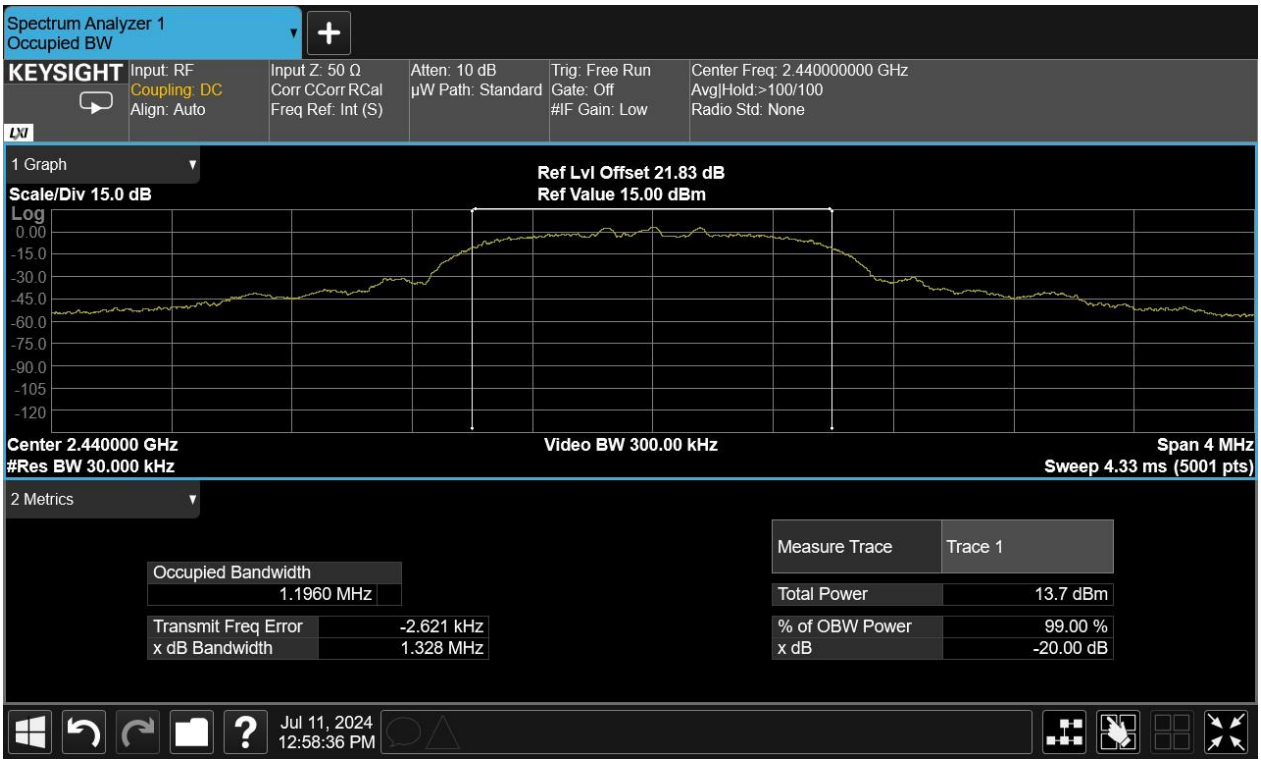
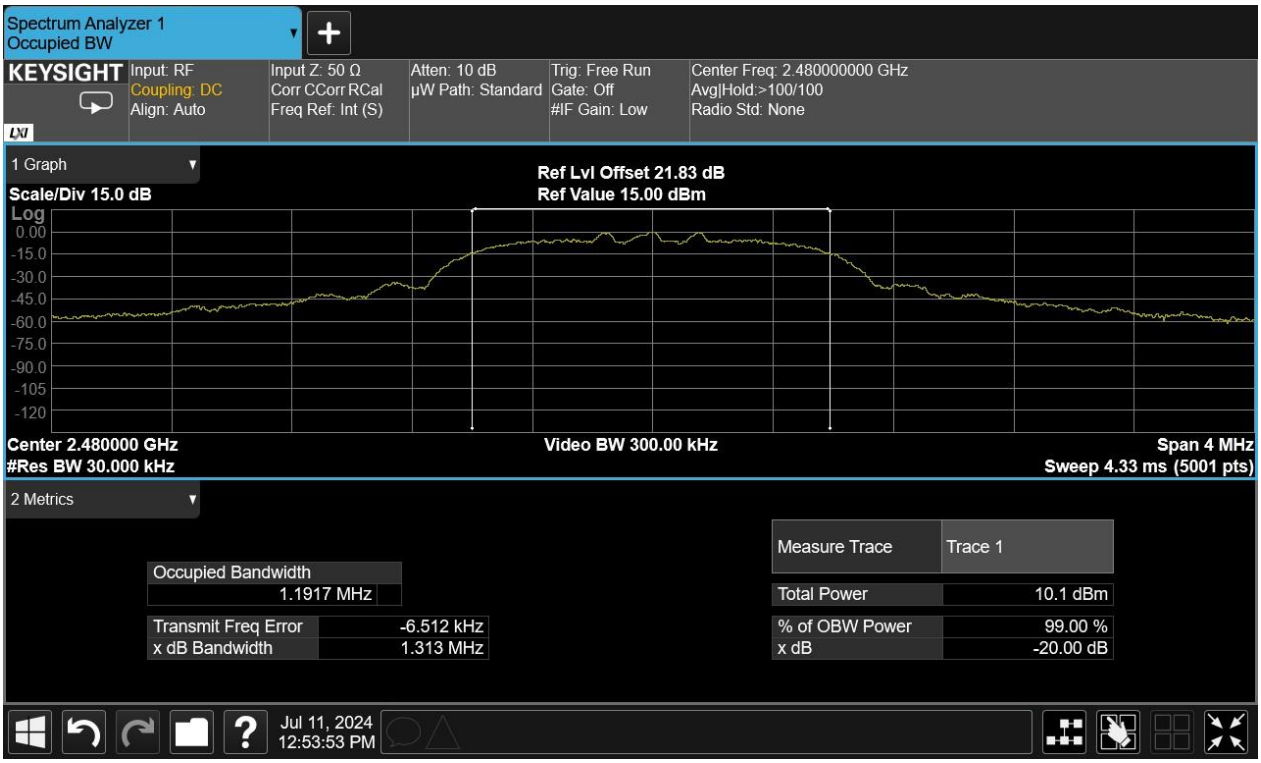


Figure 20: 8DPSK (3Mbps) – High Channel, Occupied Bandwidth



3.3 Number of Channels Used

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

3.3.1 Measurement Method and Results

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

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

Table 8: Number of Channels Used – Test Results

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

Figure 21: GFSK (1Mbps) – Number of Channels Used, Plot 1

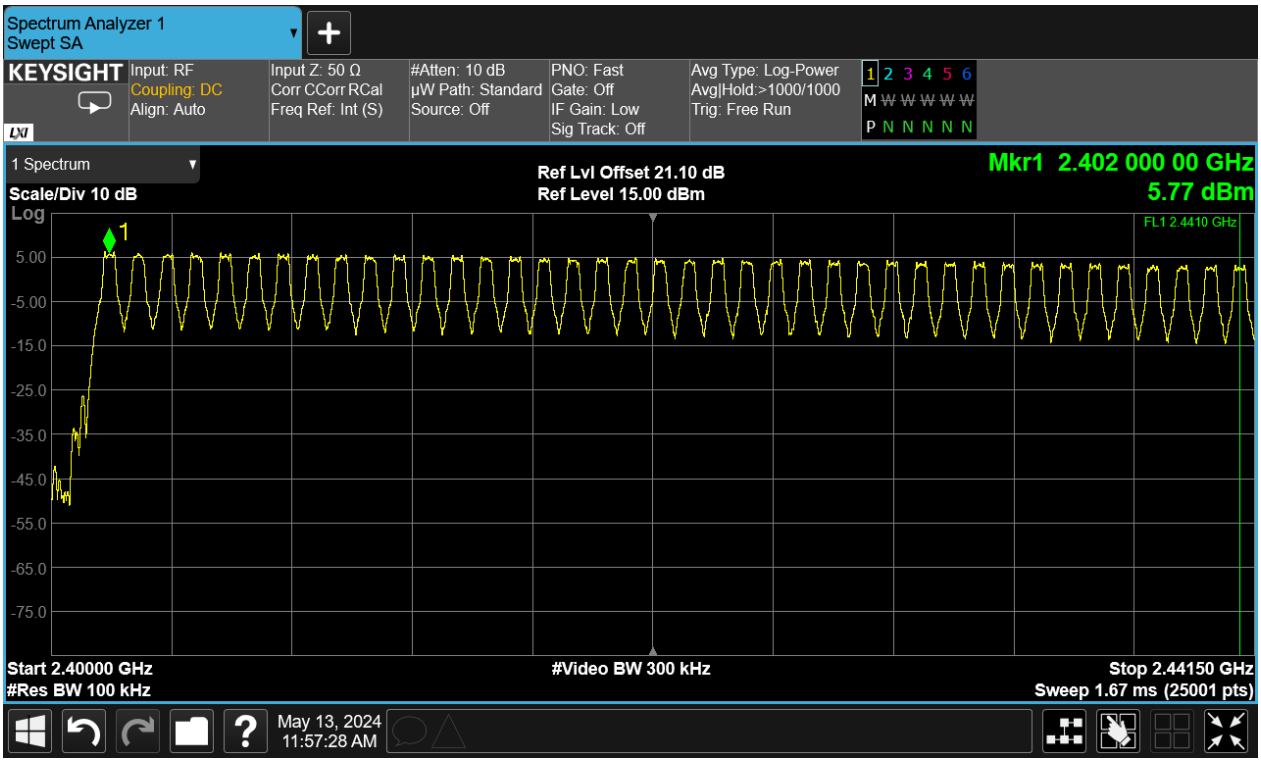


Figure 22: GFSK (1Mbps) – Number of Channels Used, Plot 2

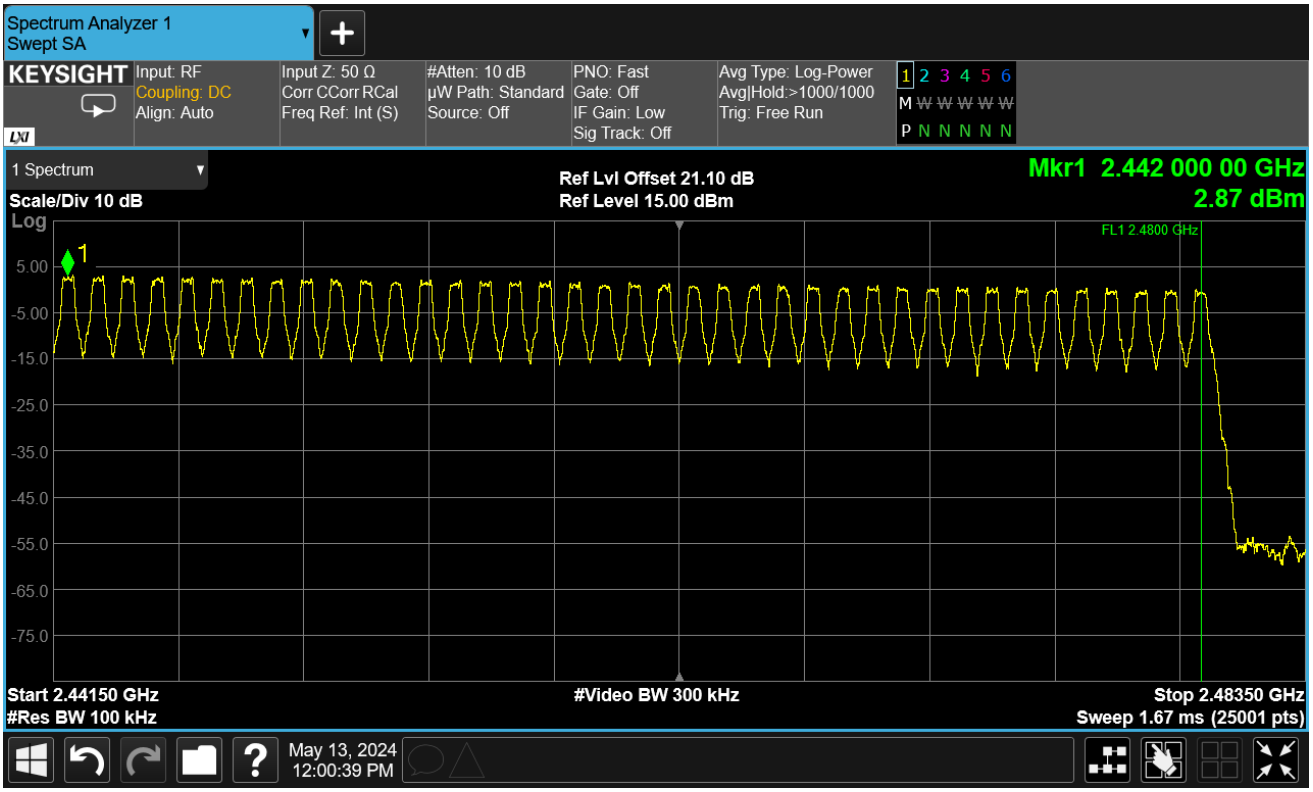


Figure 23: π/4DQPSK (2Mbps) – Number of Channels Used, Plot 1

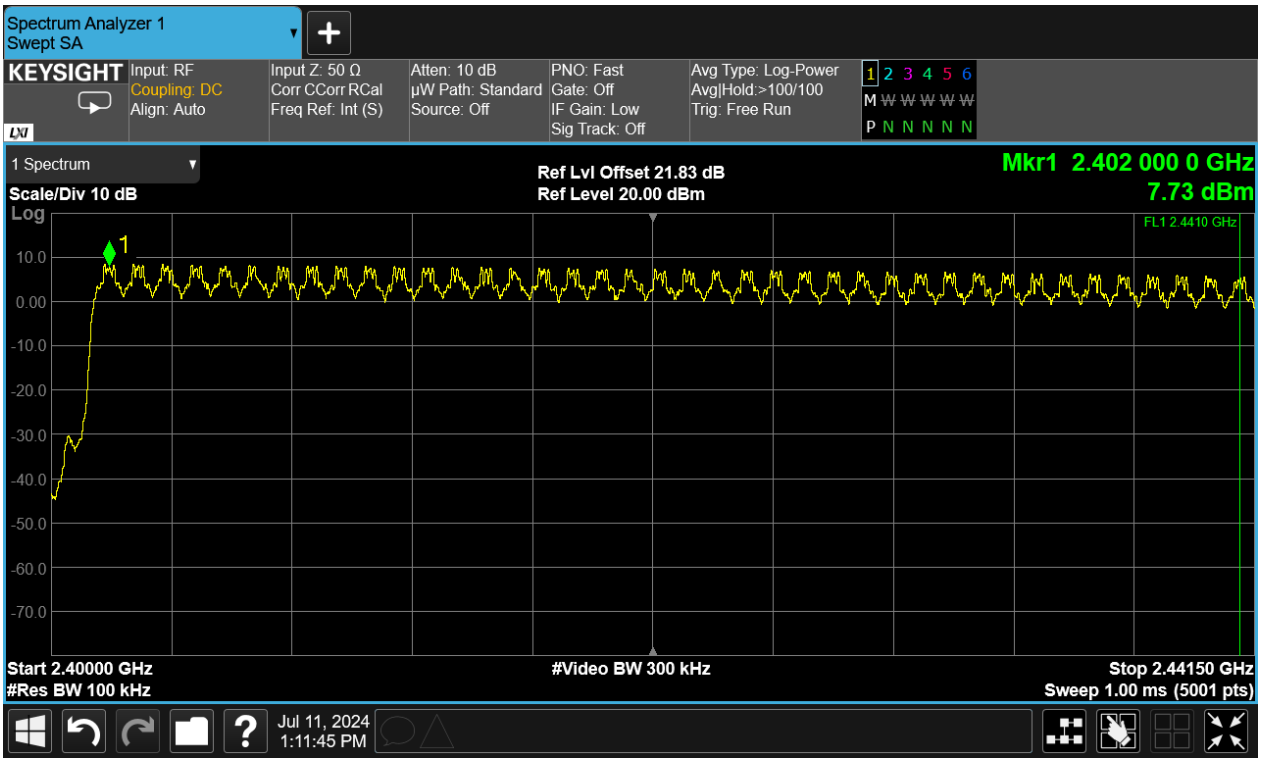


Figure 24: π/4DQPSK (2Mbps) – Number of Channels Used, Plot 2

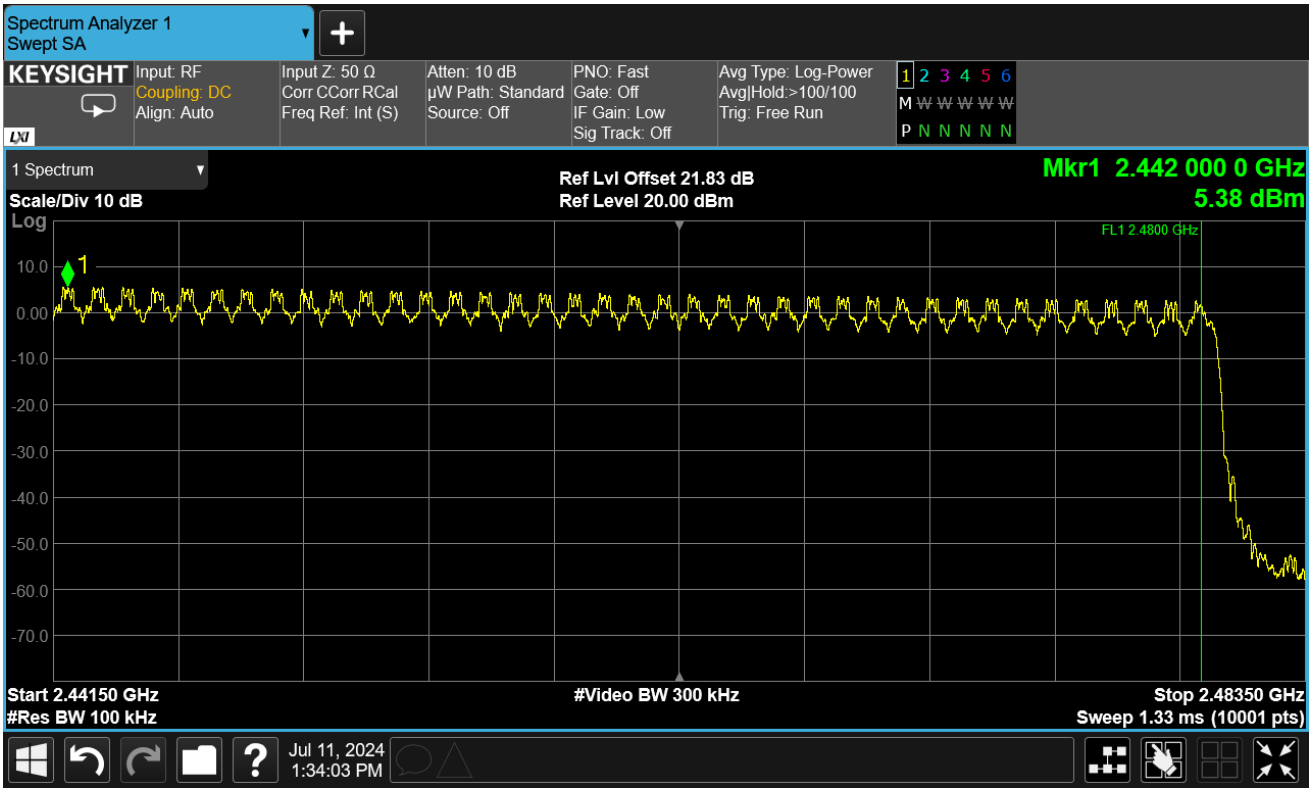


Figure 25: 8DPSK (3Mbps) – Number of Channels Used, Plot 1

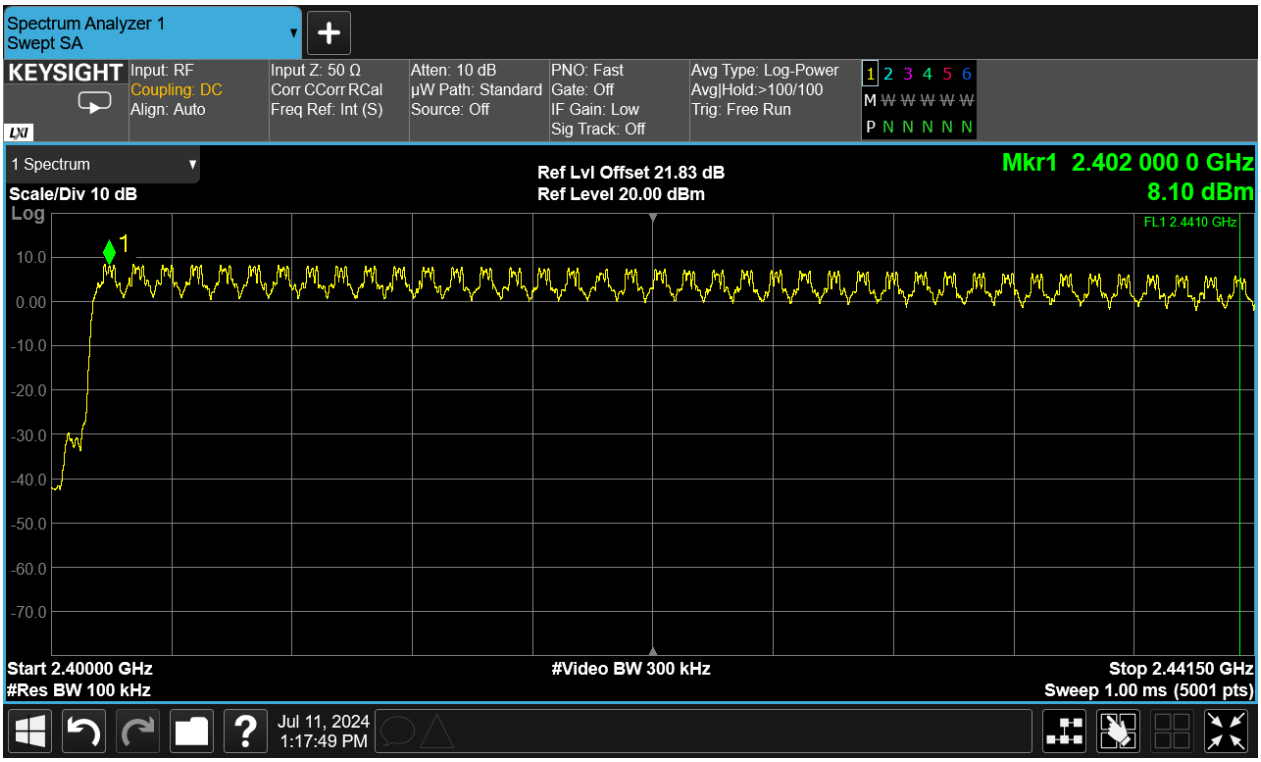
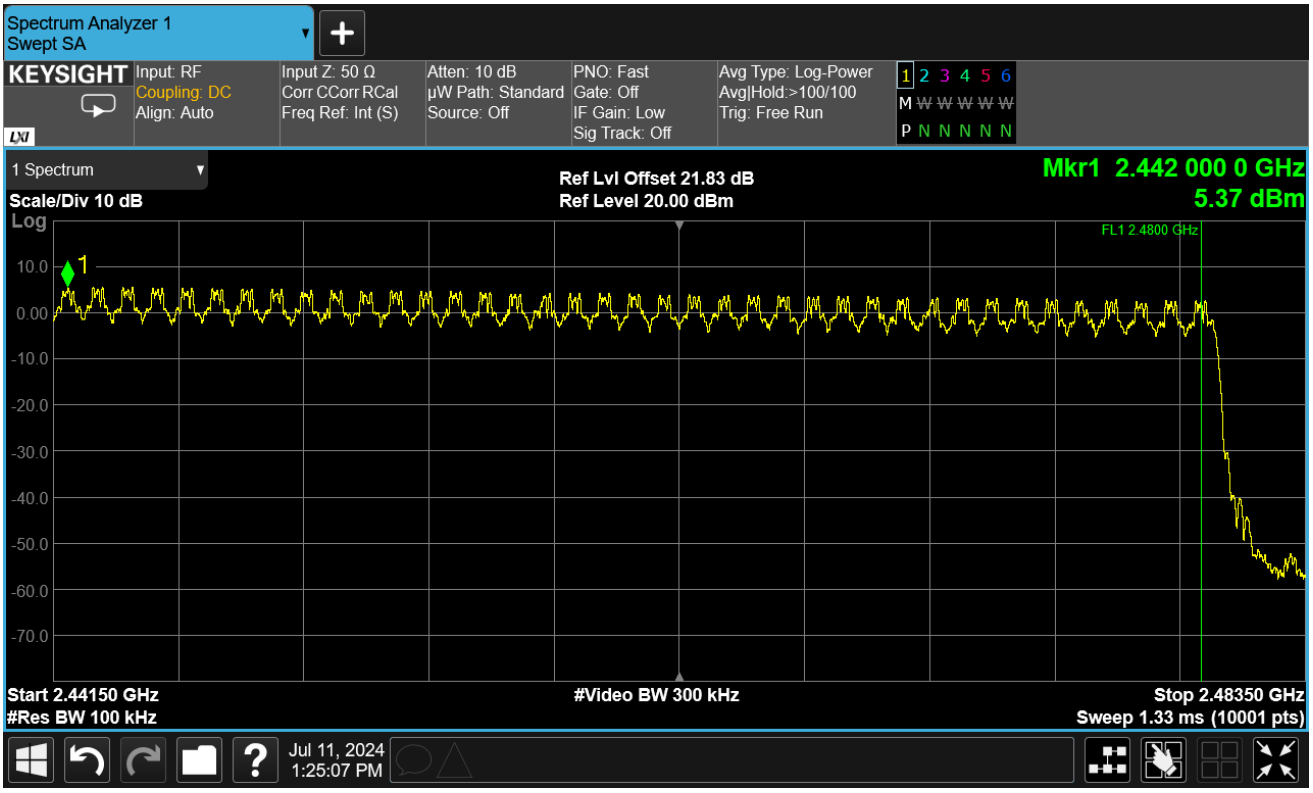


Figure 26: 8DPSK (3Mbps) – Number of Channels Used, Plot 2



3.4 Time of Occupancy (Dwell Time)

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

3.4.1 Measurement Method and Results

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

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

The limits 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.

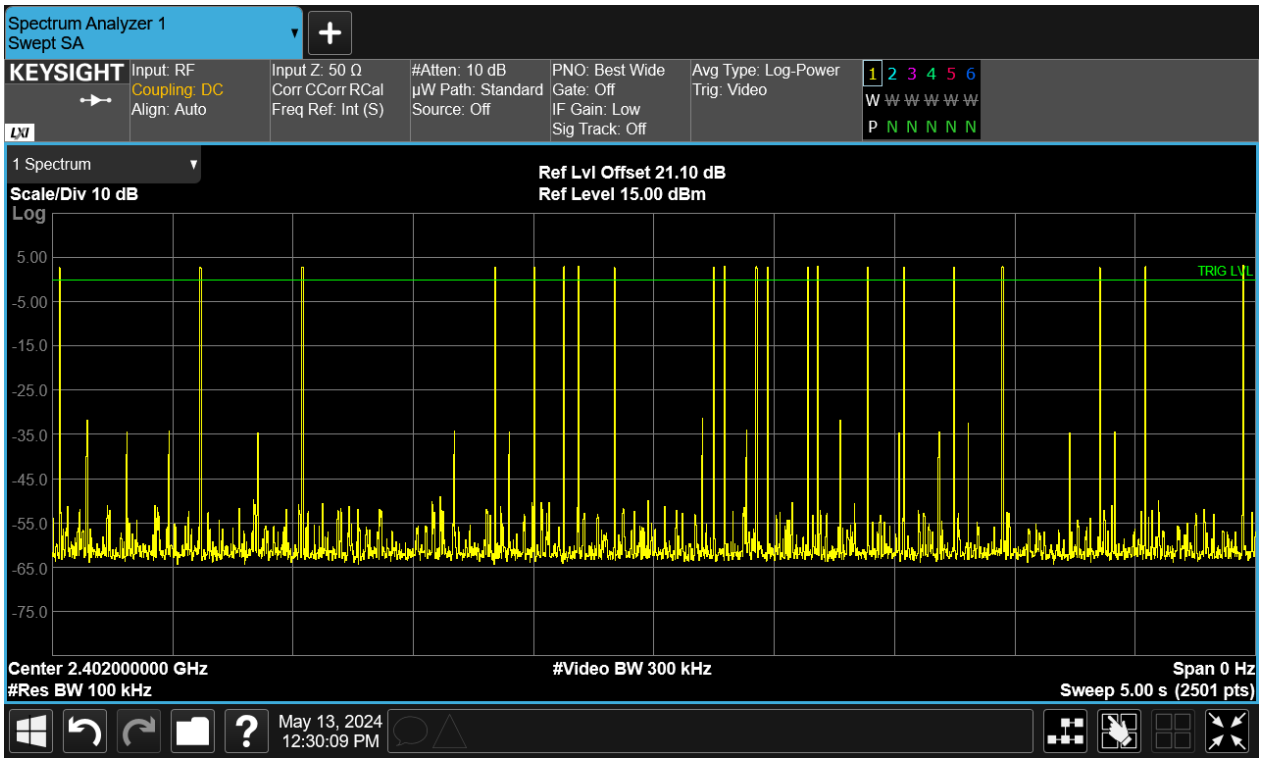
5 * 6.32 = 31.6

Table 9: Time of Occupancy – Test Results

Modulation	Transmissions in 5 seconds	Transmissions in 31.6 seconds	Single Transmission Period	EUT Occupancy Dwell	Occupancy Limit
GFSK	21	132.72	3.0 ms	398.16 ms	400 ms
π/4DQPSK	21	132.72	3.0 ms	398.16 ms	400 ms
8DPSK	21	132.72	3.0 ms	398.16 ms	400 ms

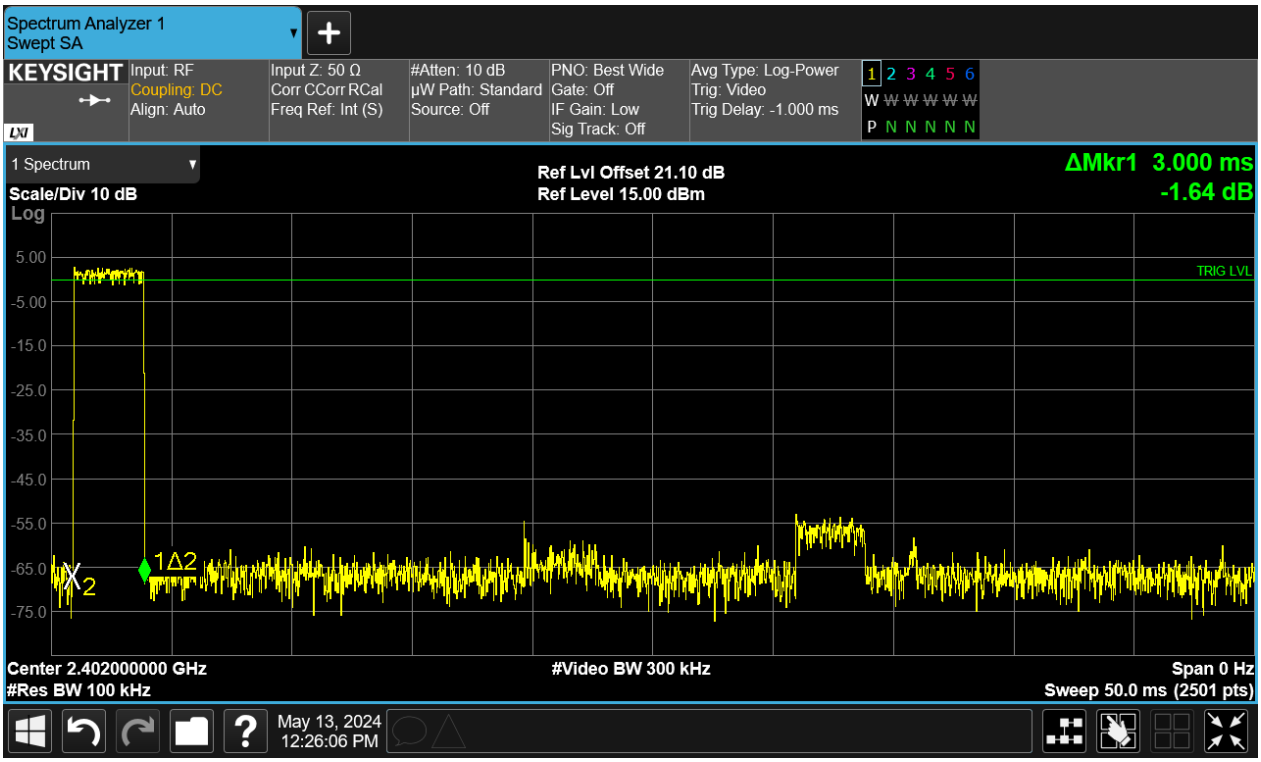
The EUT was evaluated at the low, center, and high channels. The results are identical for any EUT transmitter channel. The worst-case average time of occupancy on any channel is 398.16 ms, in any period of 400 ms.

Figure 27: GFSK Transmitter 5-Second Evaluation (Hopping)



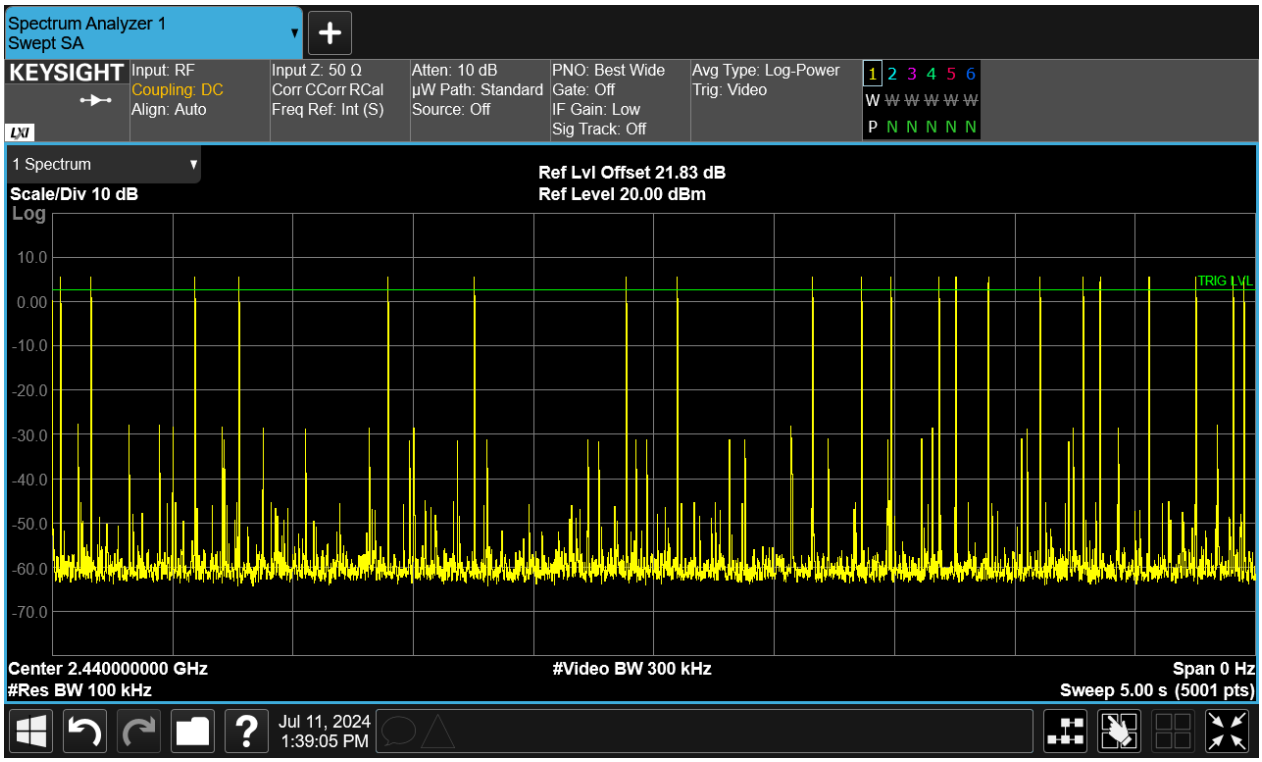
* in this case, there are 21 full-power transmitter hops in a given 5-second evaluation period.

Figure 28: GFSK Transmitter Evaluation (Hopping) – Single Dwell Time



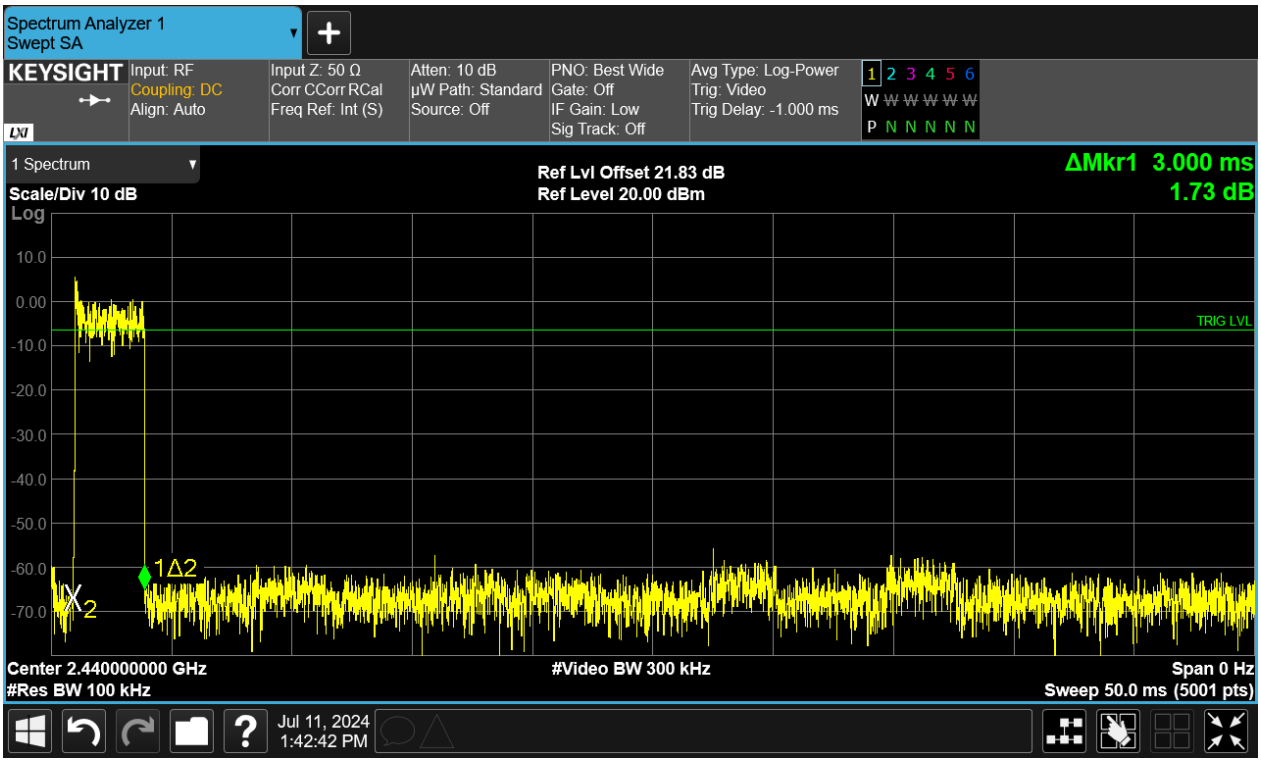
* any given transmitter hop measures 3.0 ms

Figure 29: π/4DQPSK Transmitter 5-Second Evaluation (Hopping)



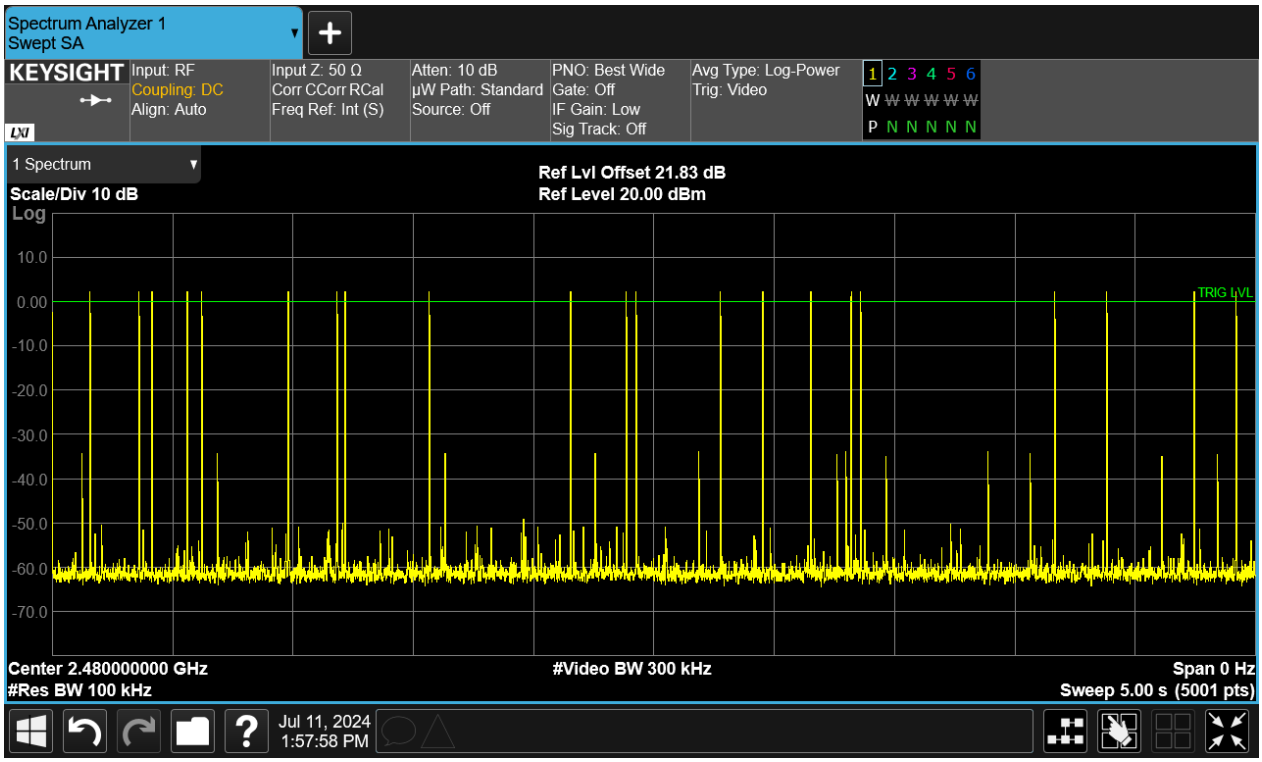
* in this case, there are 21 full-power transmitter hops in a given 5-second evaluation period.

Figure 30: π/4DQPSK Transmitter Evaluation (Hopping) – Single Dwell Time



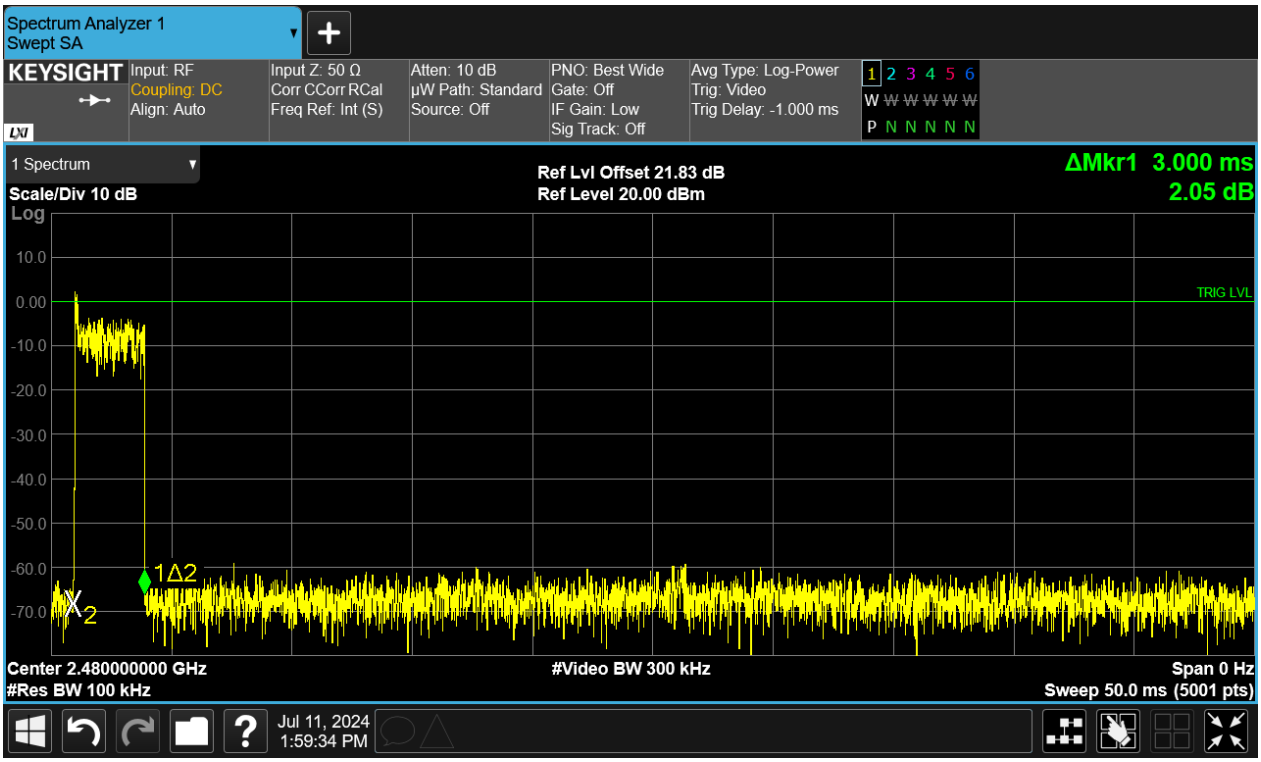
* any given transmitter hop measures 3.0 ms

Figure 31: 8DPSK Transmitter 5-Second Evaluation (Hopping)



* in this case, there are 21 full-power transmitter hops in a given 5-second evaluation period.

Figure 32: 8DPSK Transmitter Evaluation (Hopping) – Single Dwell Time



* any given transmitter hop measures 3.0 ms

3.5 Channel Carrier Separation

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

3.5.1 Measurement Method and Results

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

Where the device shares the same channel plan (carrier frequencies and number of channels) across multiple data rates or modulation schemes, then the carrier separation need only be measured for one of those modulation schemes or data rates.

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

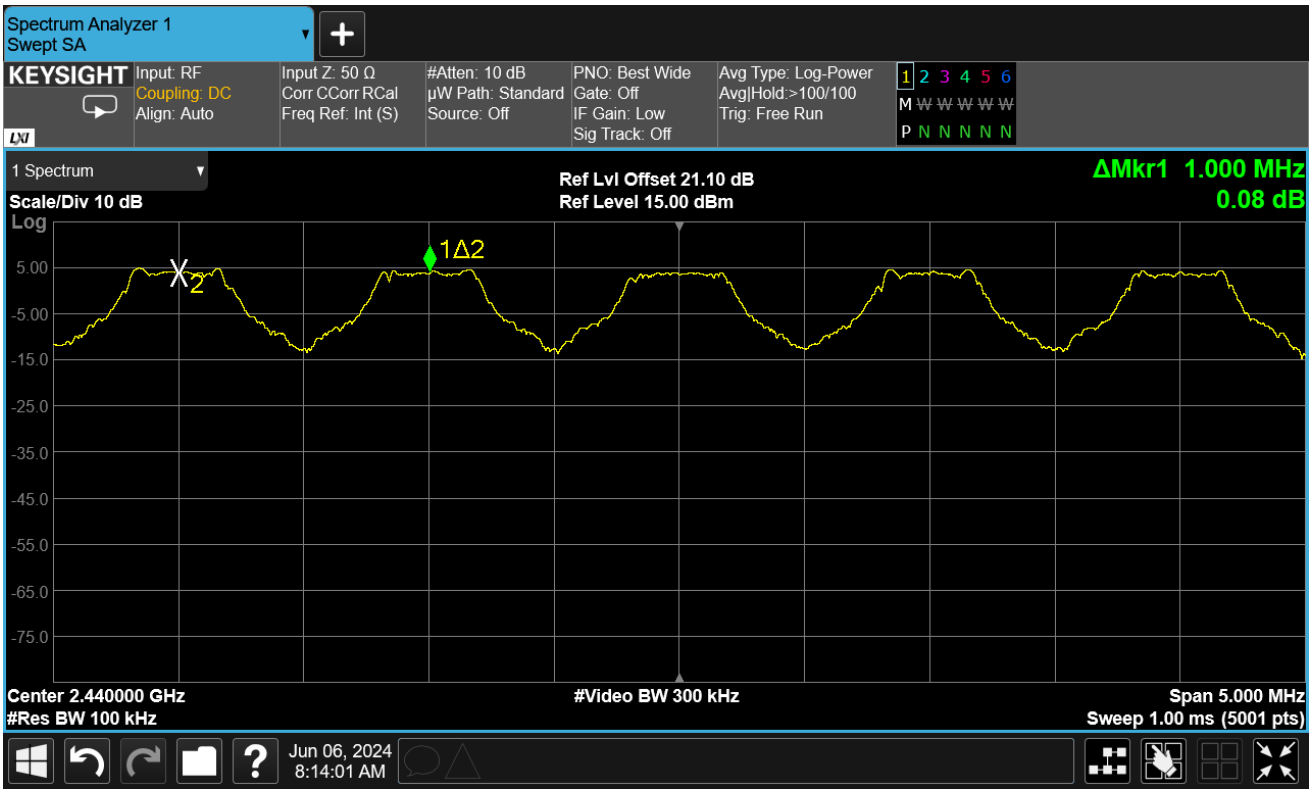
The minimum separation requirement is based on two-thirds of the 20 dB bandwidth.

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 position in the band.

Table 10: Channel Carrier Separation – Test Results

Modulation	Mode (Data Rate)	20dB Bandwidth	Minimum Separation Requirement	EUT Carrier Separation
GFSK	DH5 (1Mbps)	1.044 MHz	696.0 kHz	1.0 MHz

Figure 33: GFSK (1Mbps) – Channel Separation



3.6 Bandedge Compliance (Antenna Port Conducted)

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

3.6.1 Measurement Method and Results

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

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

Table 11: Bandedge Compliance, Test Results

Modulation	Mode (Data Rate)	Low Channel (2402 MHz)	High Channel (2480 MHz)
GFSK	DH5 (1Mbps)	49.59 dB	54.56 dB
π/4DQPSK	2DH5 (2Mbps)	49.59 dB	54.56 dB
8DPSK	3DH5 (3Mbps)	49.59 dB	54.23 dB

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

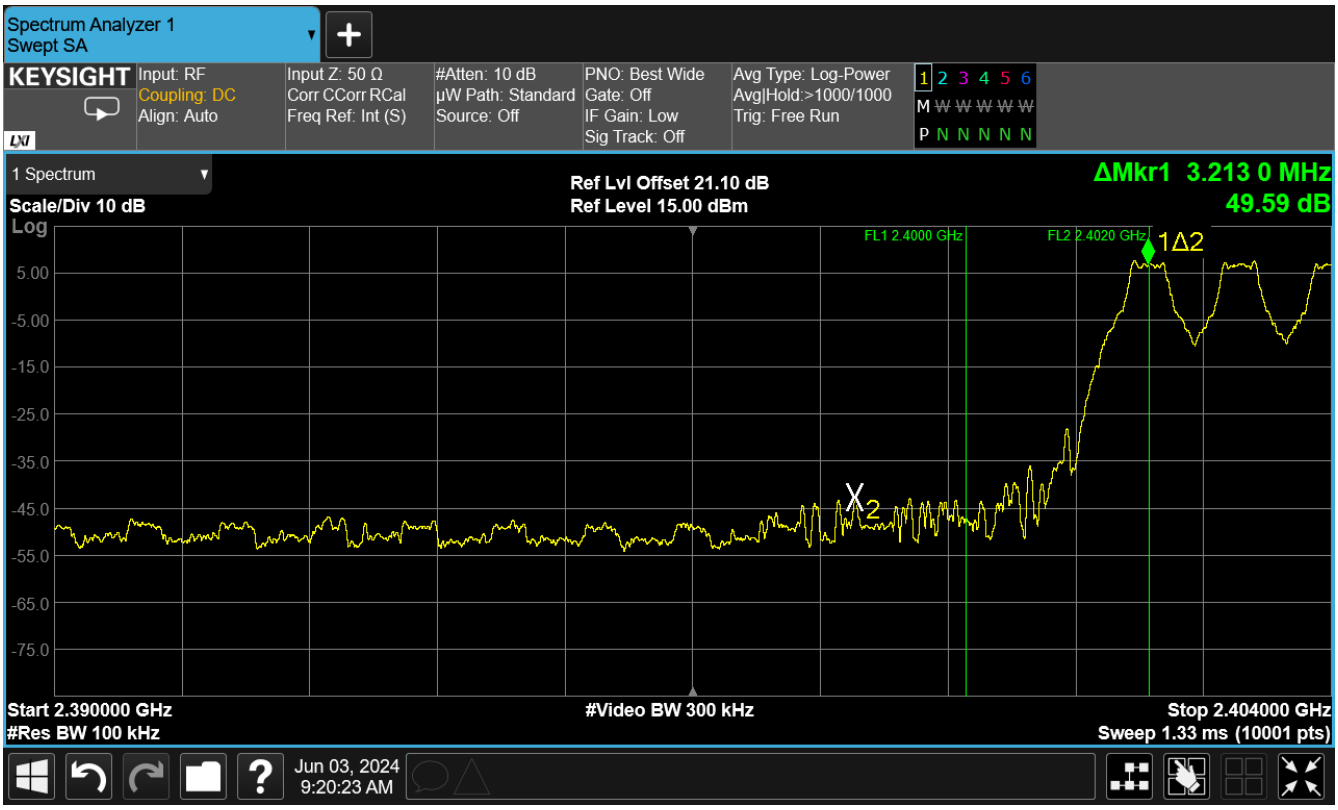


Figure 35: GFSK (1Mbps) – Upper Band Edge

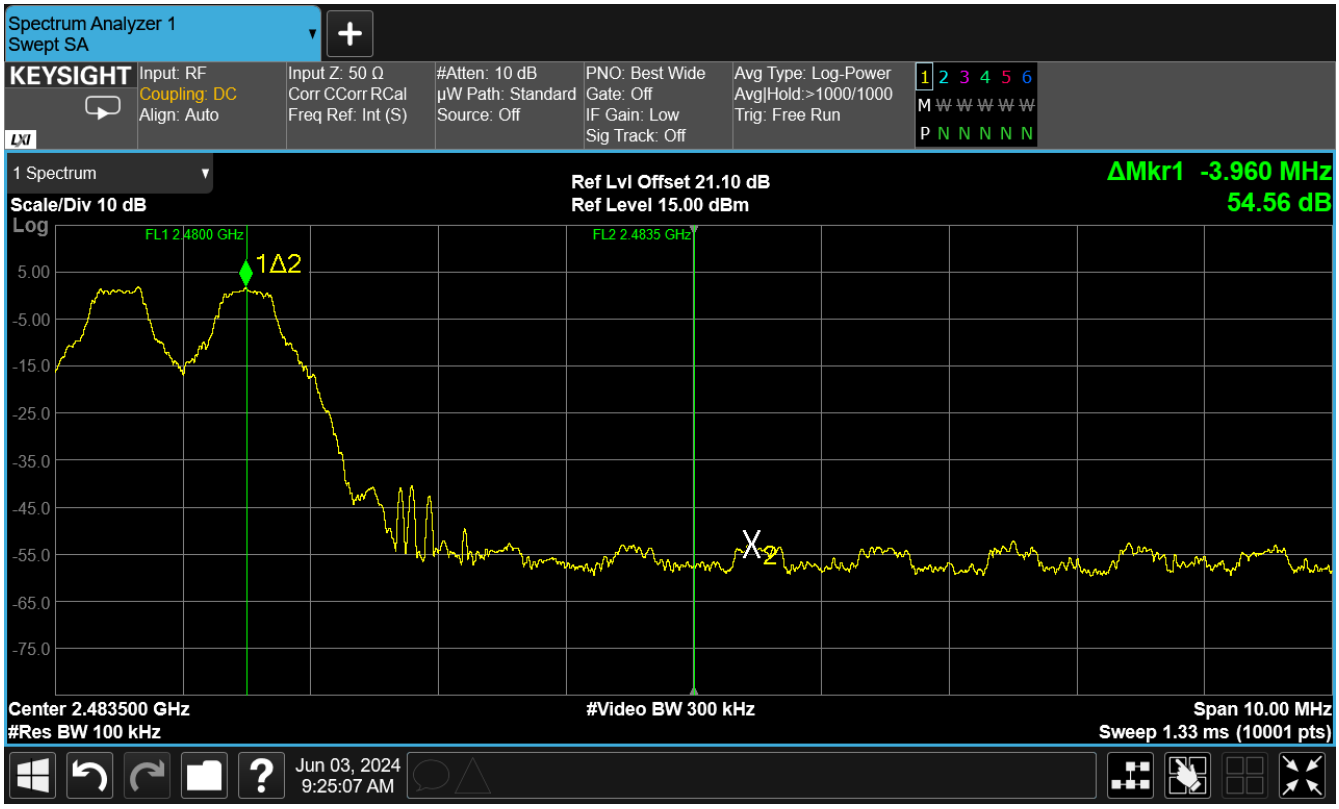


Figure 36: π/4DQPSK (2Mbps) – Lower Band Edge

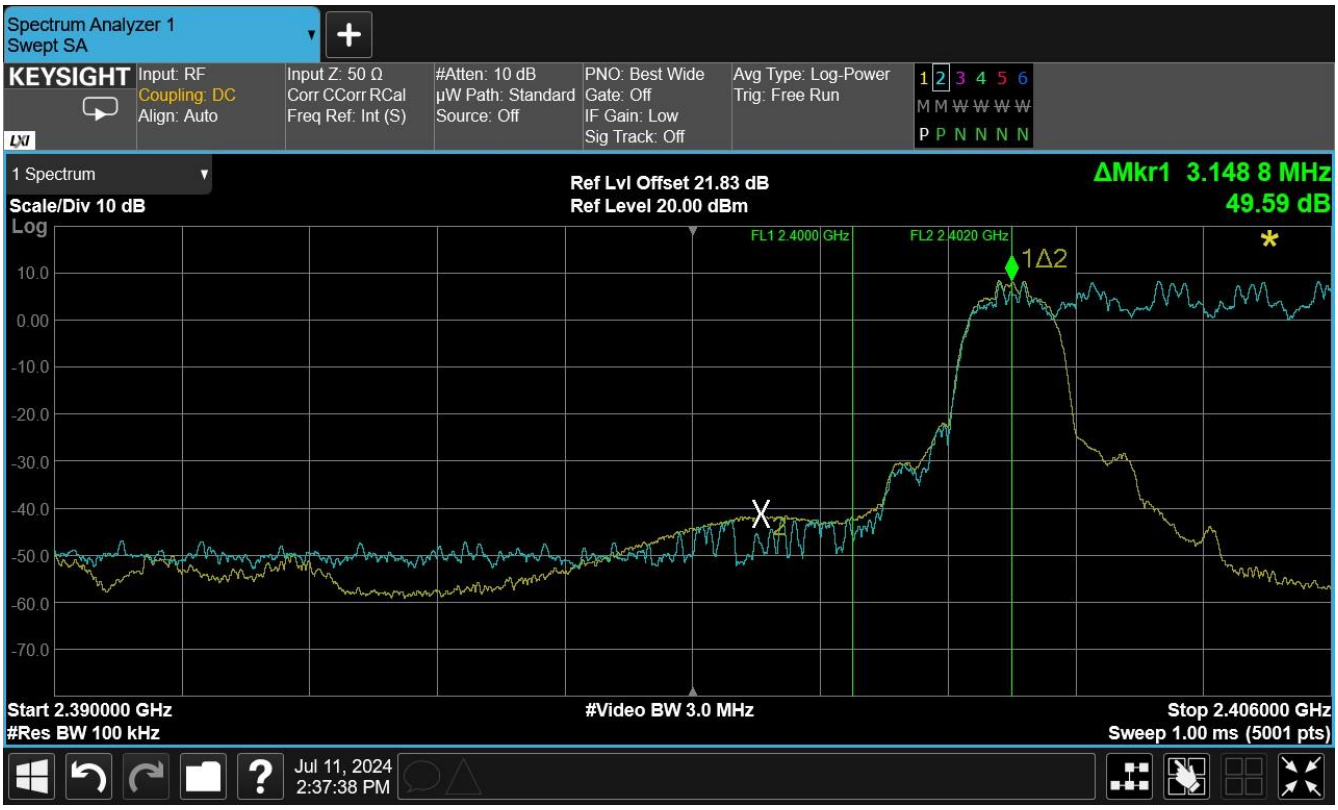


Figure 37: π/4DQPSK (2Mbps) – Upper Band Edge

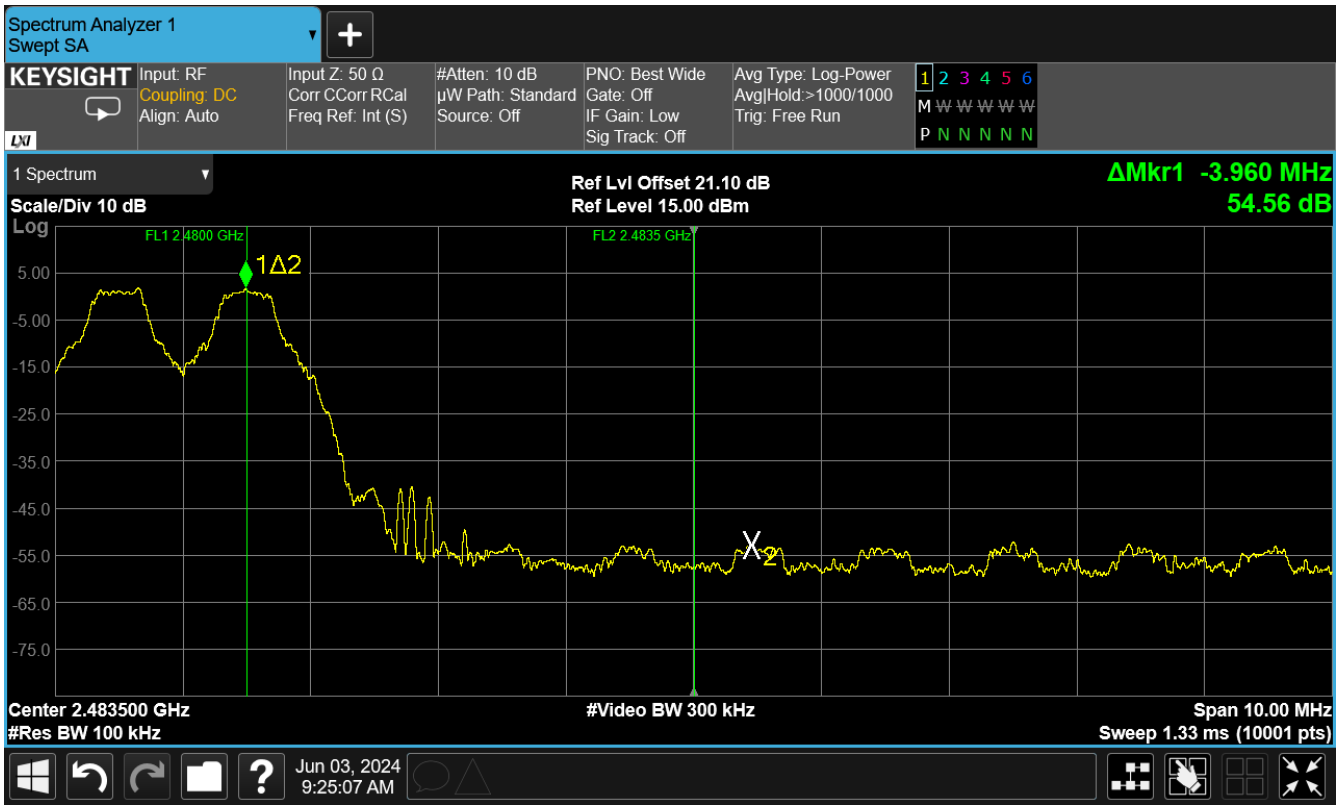


Figure 38: 8DPSK (3Mbps) – Lower Band Edge

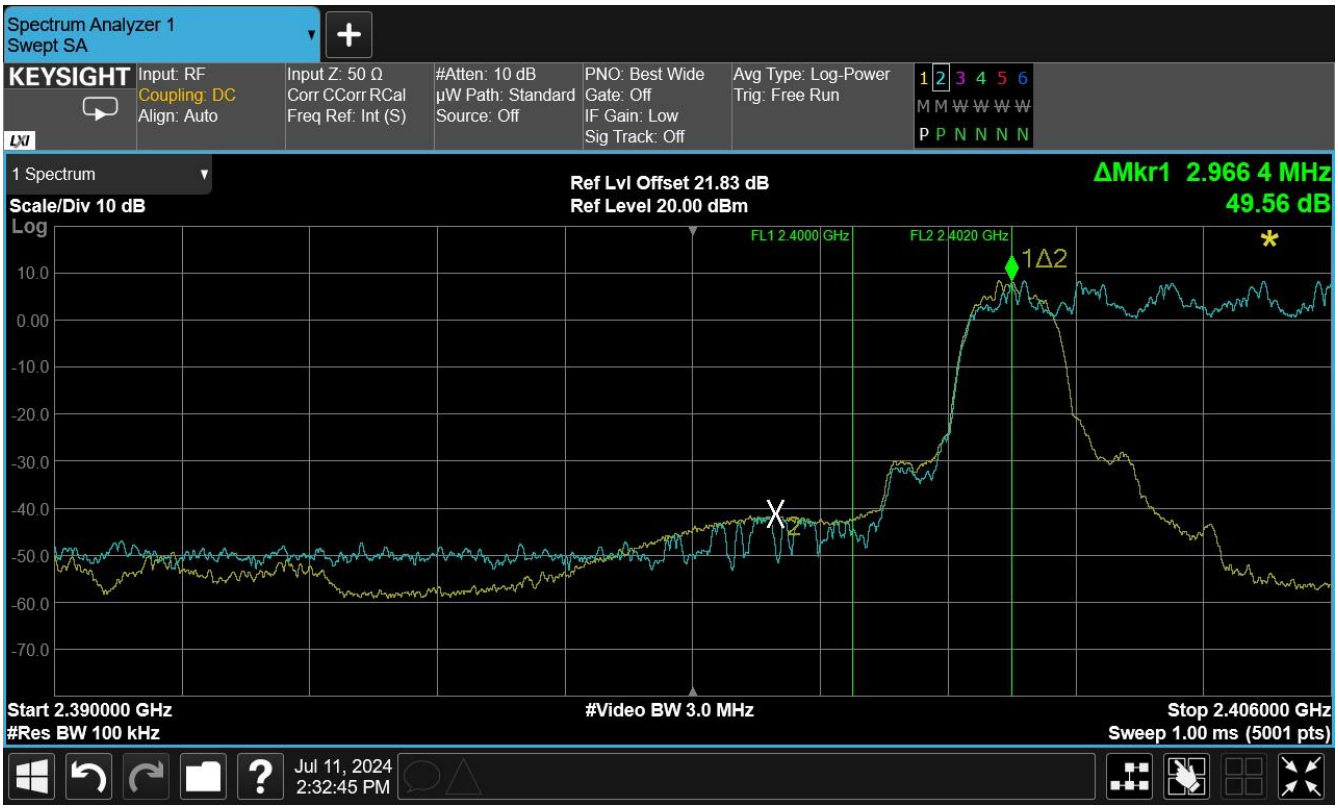
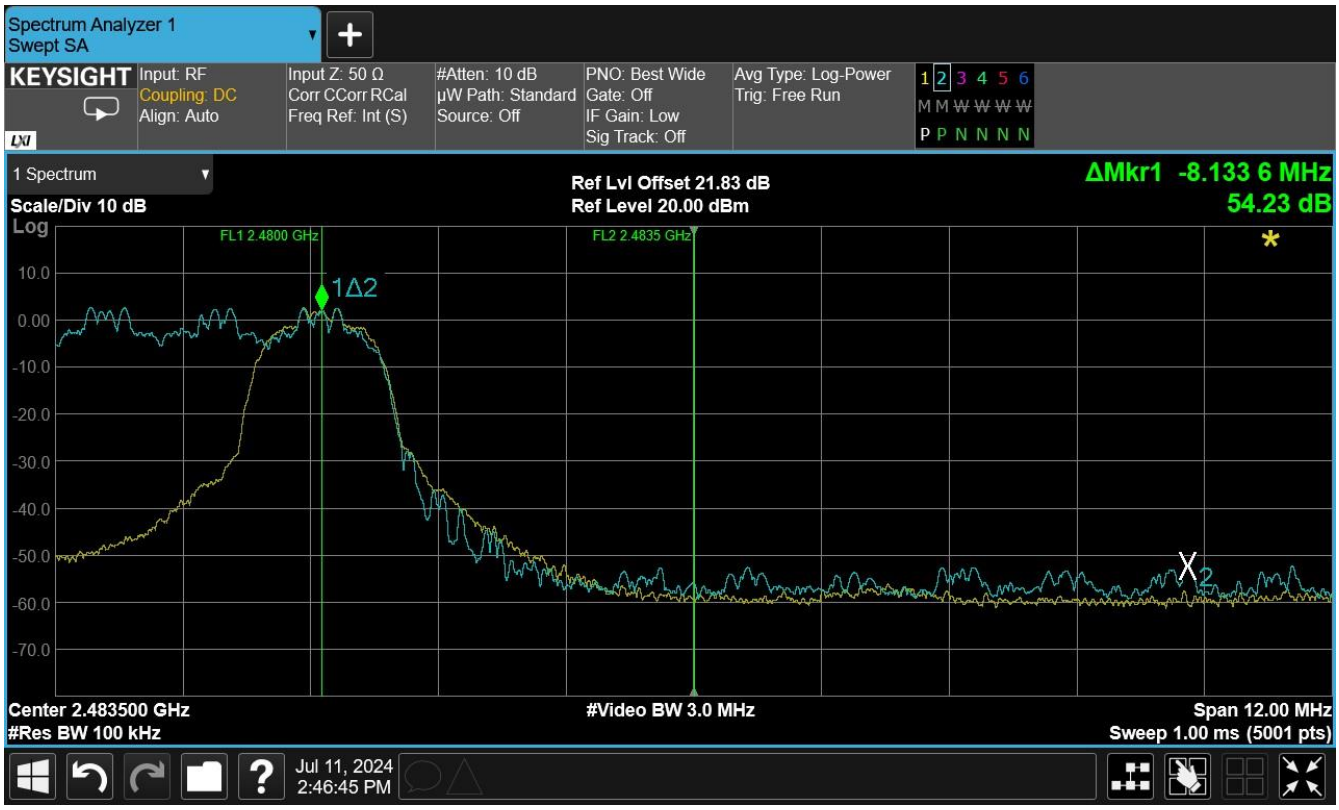


Figure 39: 8DPSK (3Mbps) – Upper Band Edge



3.7 Conducted Spurious Emissions

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

3.7.1 Measurement Method and Results

This test was performed as specified in ANSI C63.10 (2020), Section 7.8.7 and 11.11.

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

The amplitude of the EUT carrier 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 1 MHz to 30 GHz, to include the 10th harmonic of the fundamental

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

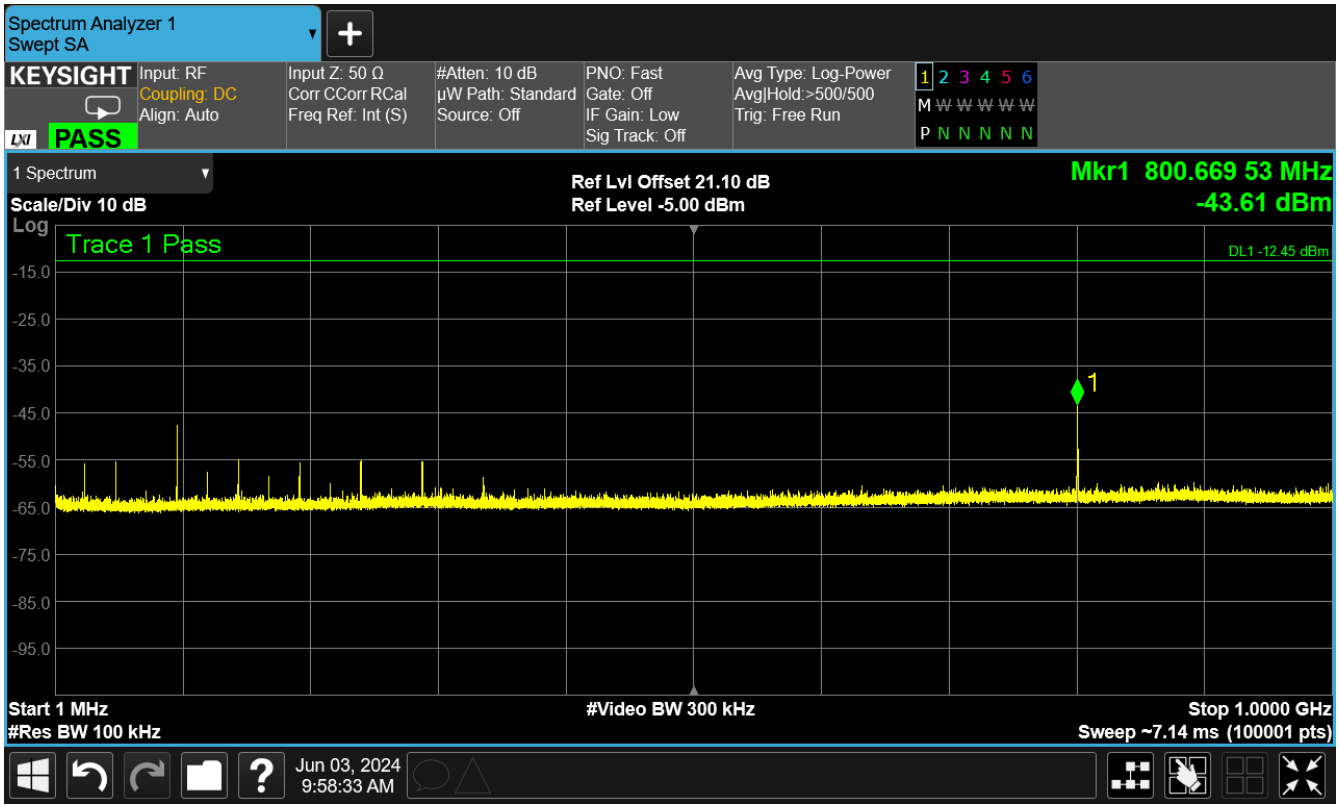


Figure 41: GFSK (1Mbps) Low Channel, Conducted Spurious – Plot 2

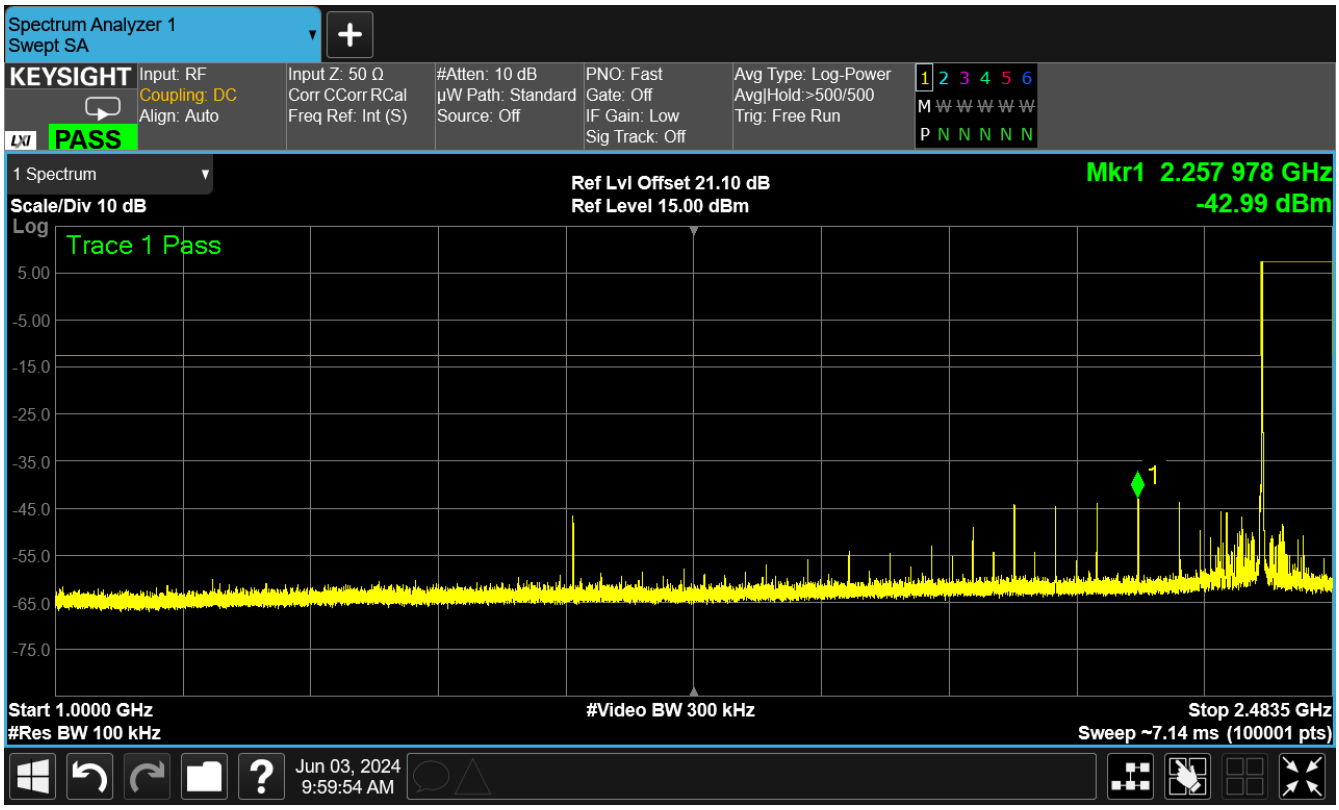


Figure 42: GFSK (1Mbps) Low Channel, Conducted Spurious – Plot 3

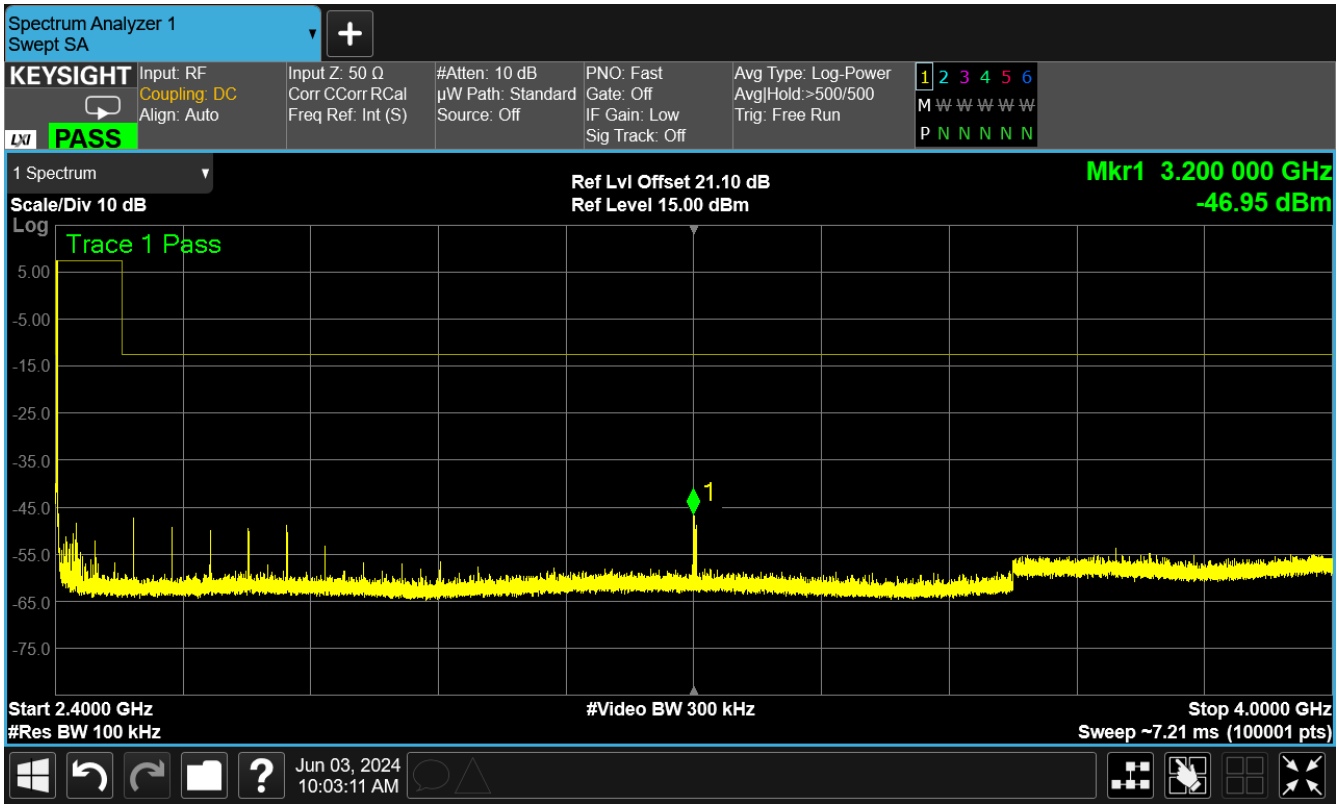


Figure 43: GFSK (1Mbps) Low Channel, Conducted Spurious – Plot 4

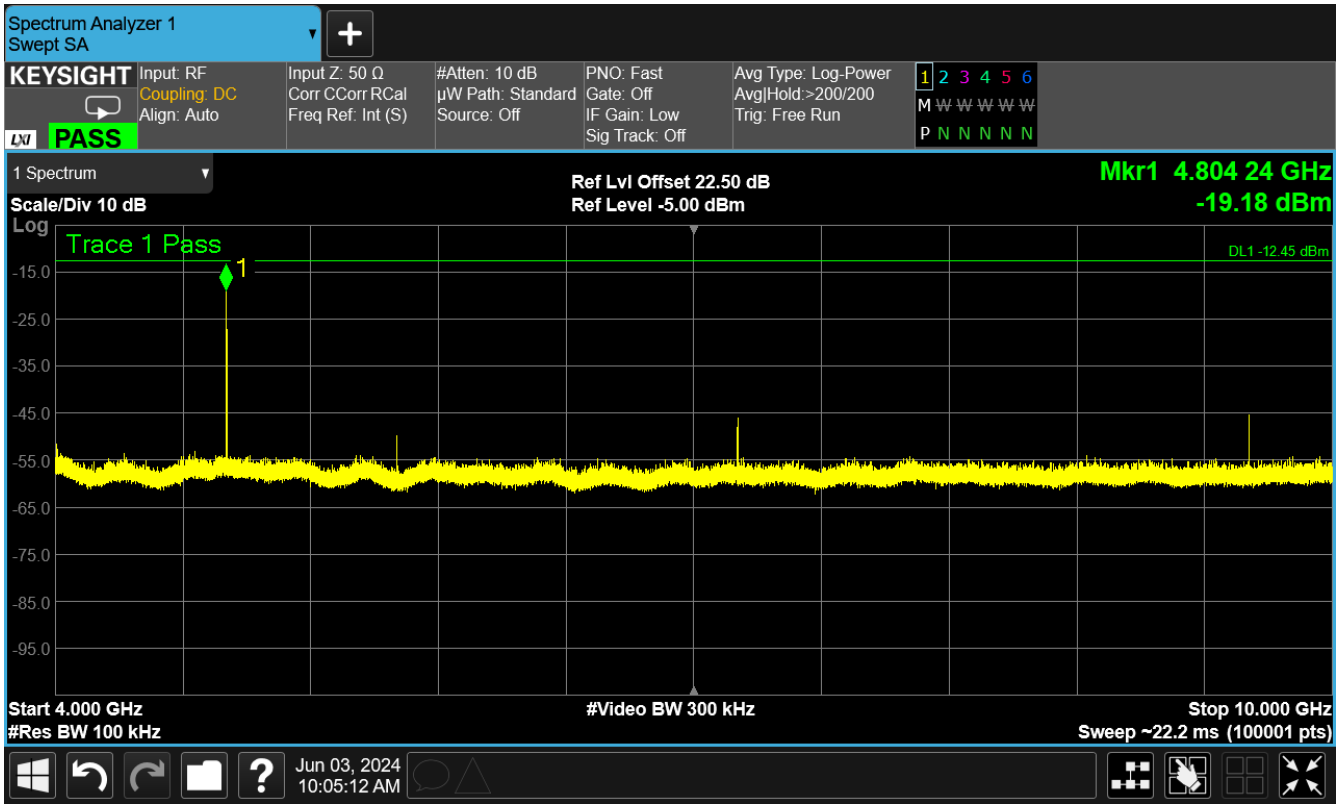


Figure 44: GFSK (1Mbps) Low Channel, Conducted Spurious – Plot 5

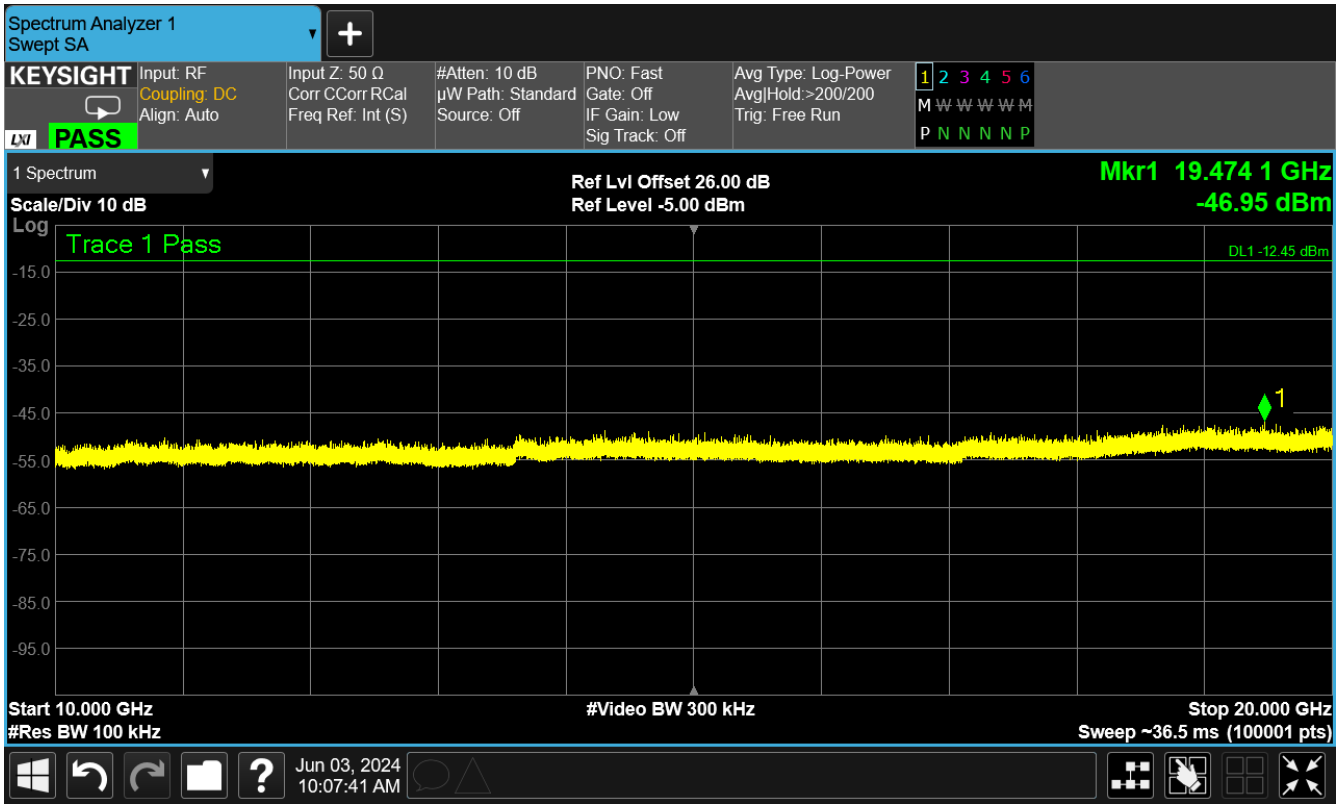


Figure 45: GFSK (1Mbps) Low Channel, Conducted Spurious – Plot 6

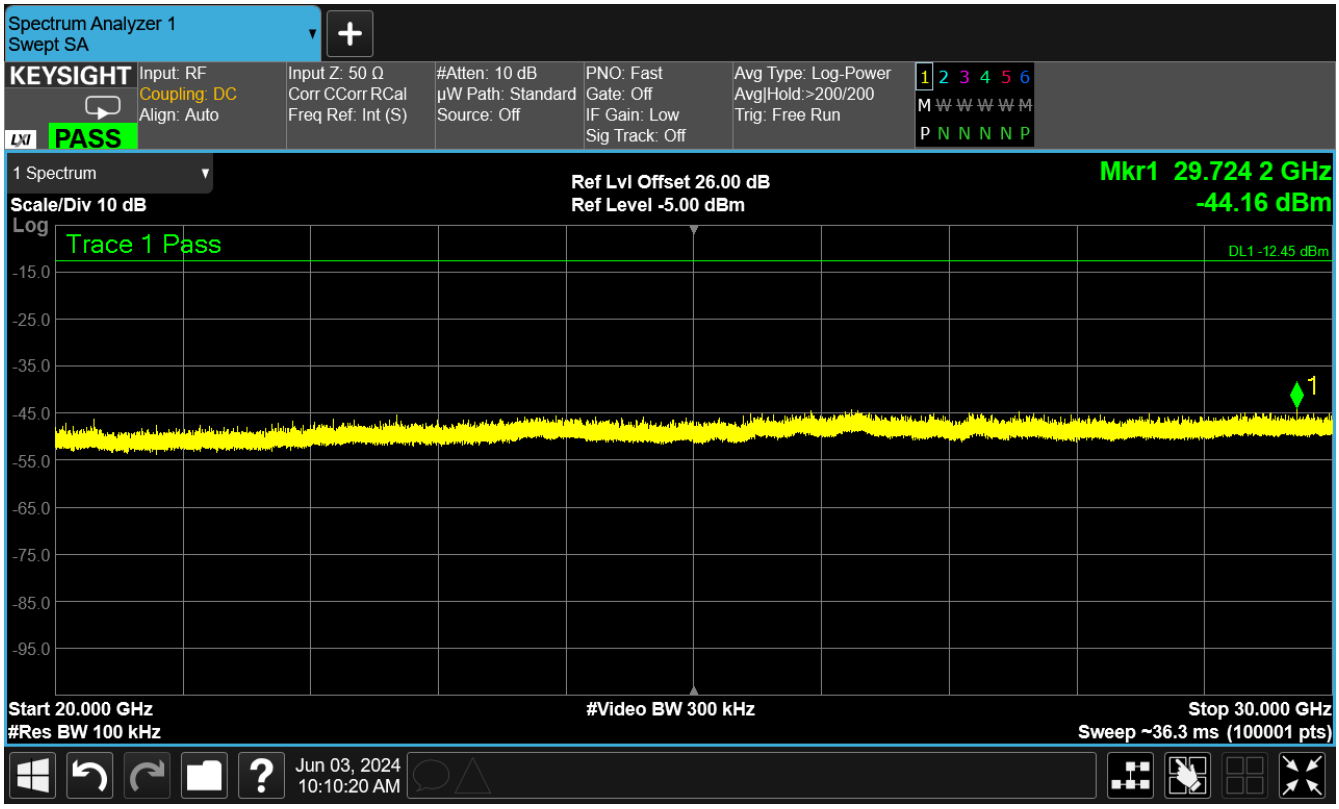


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Figure 46: GFSK (1Mbps) Center Channel, Conducted Spurious – Plot 1

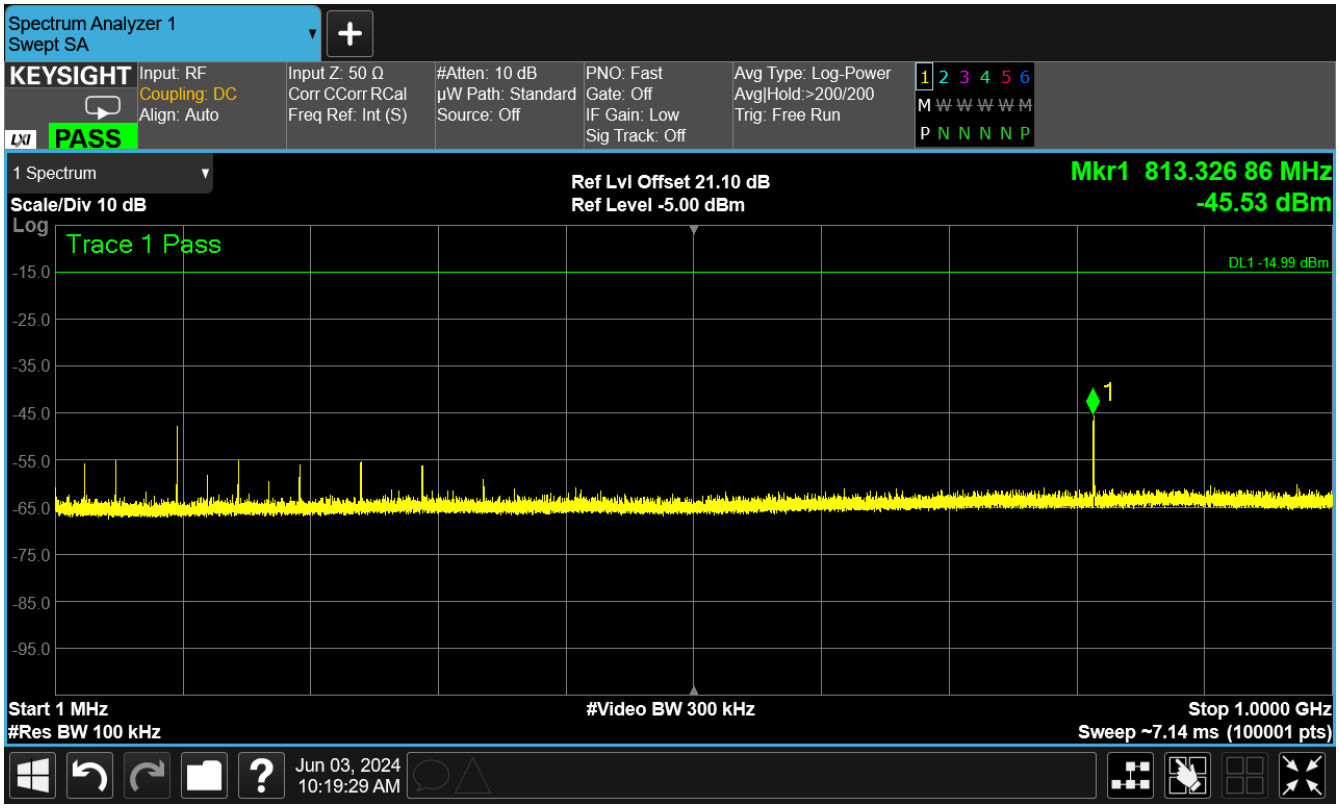

Figure 47: GFSK (1Mbps) Center Channel, Conducted Spurious – Plot 2

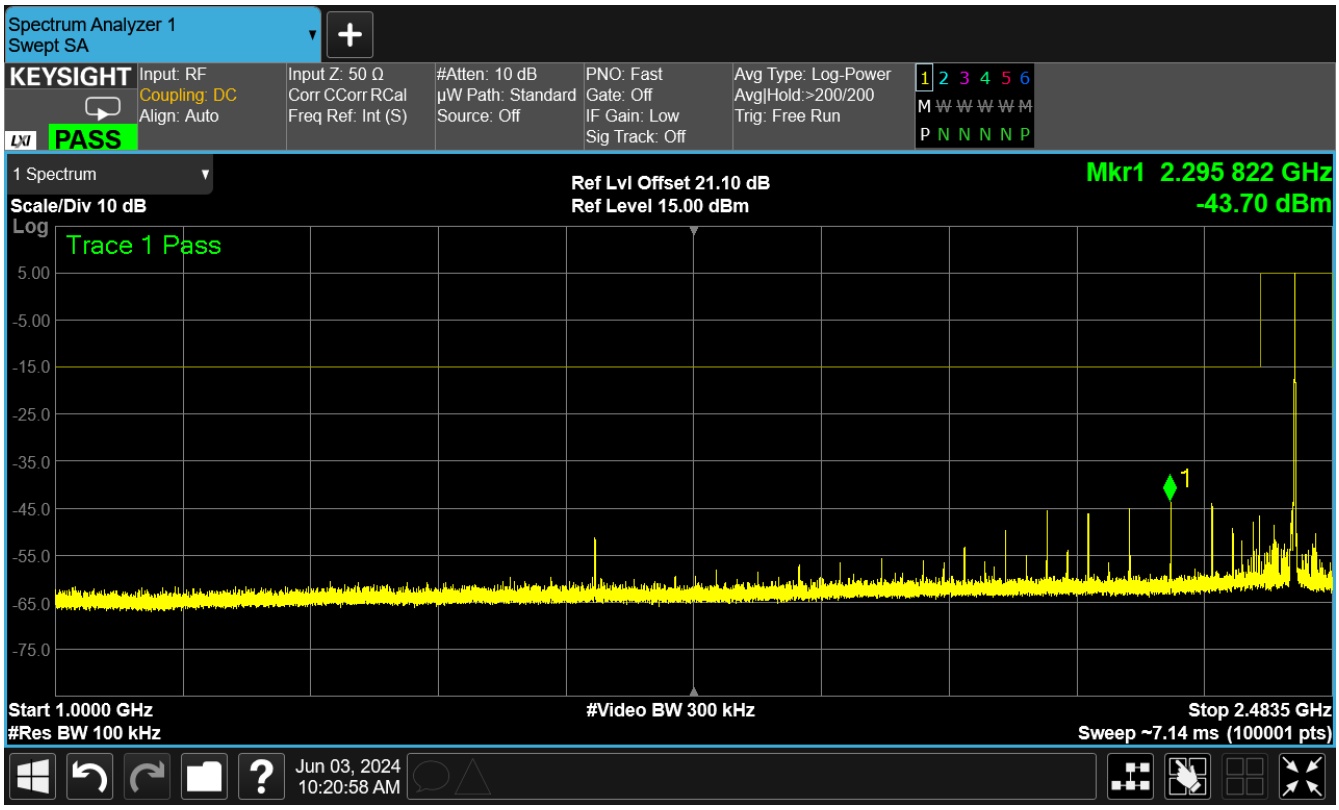

Figure 48: GFSK (1Mbps) Center Channel, Conducted Spurious – Plot 3

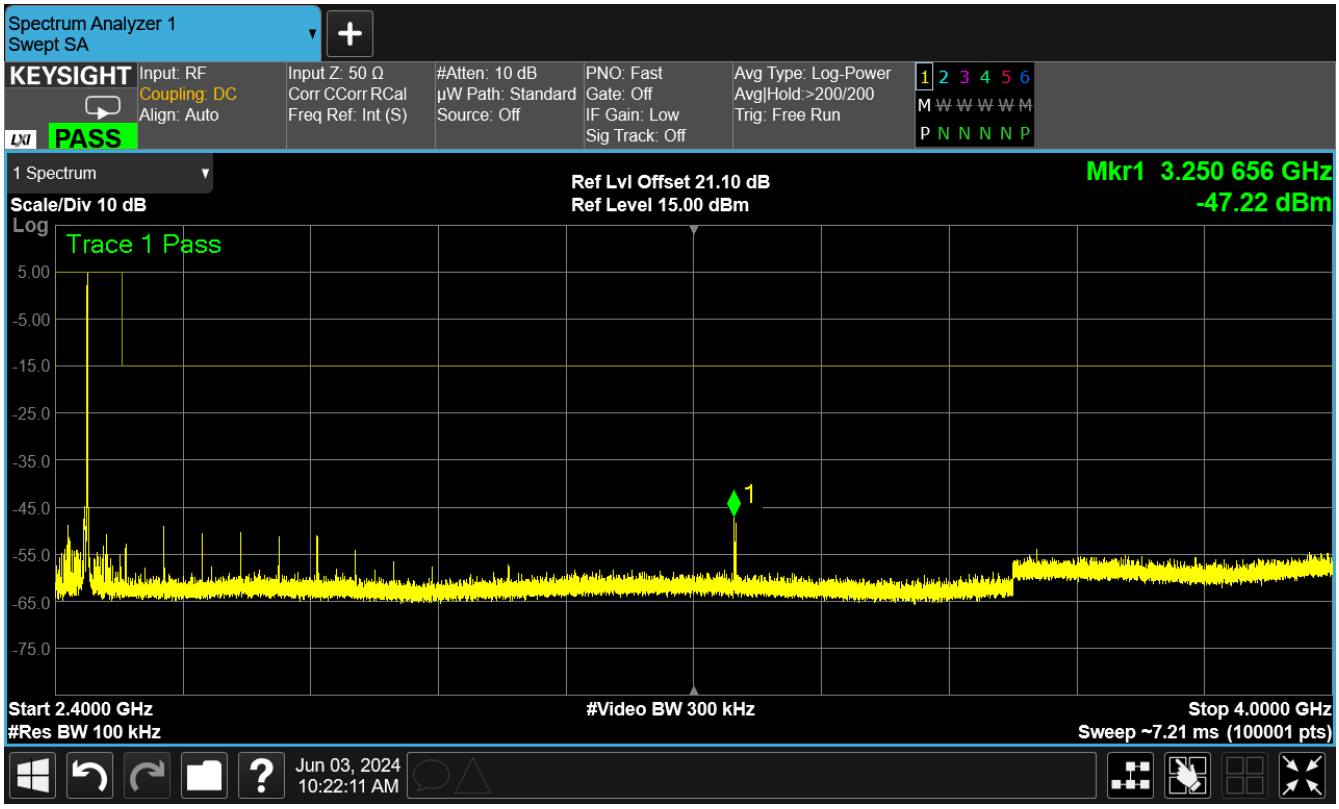

Figure 49: GFSK (1Mbps) Center Channel, Conducted Spurious – Plot 4

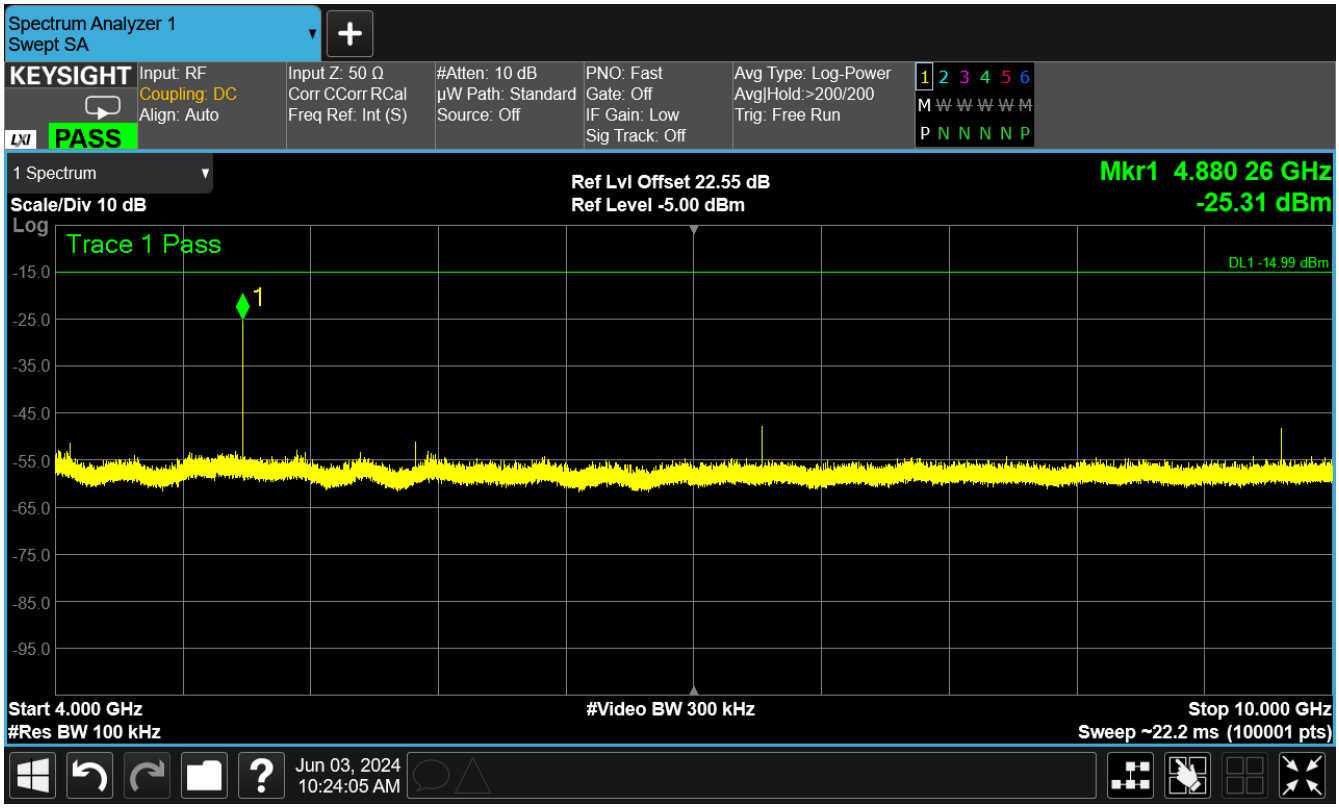

Figure 50: GFSK (1Mbps) Center Channel, Conducted Spurious – Plot 5

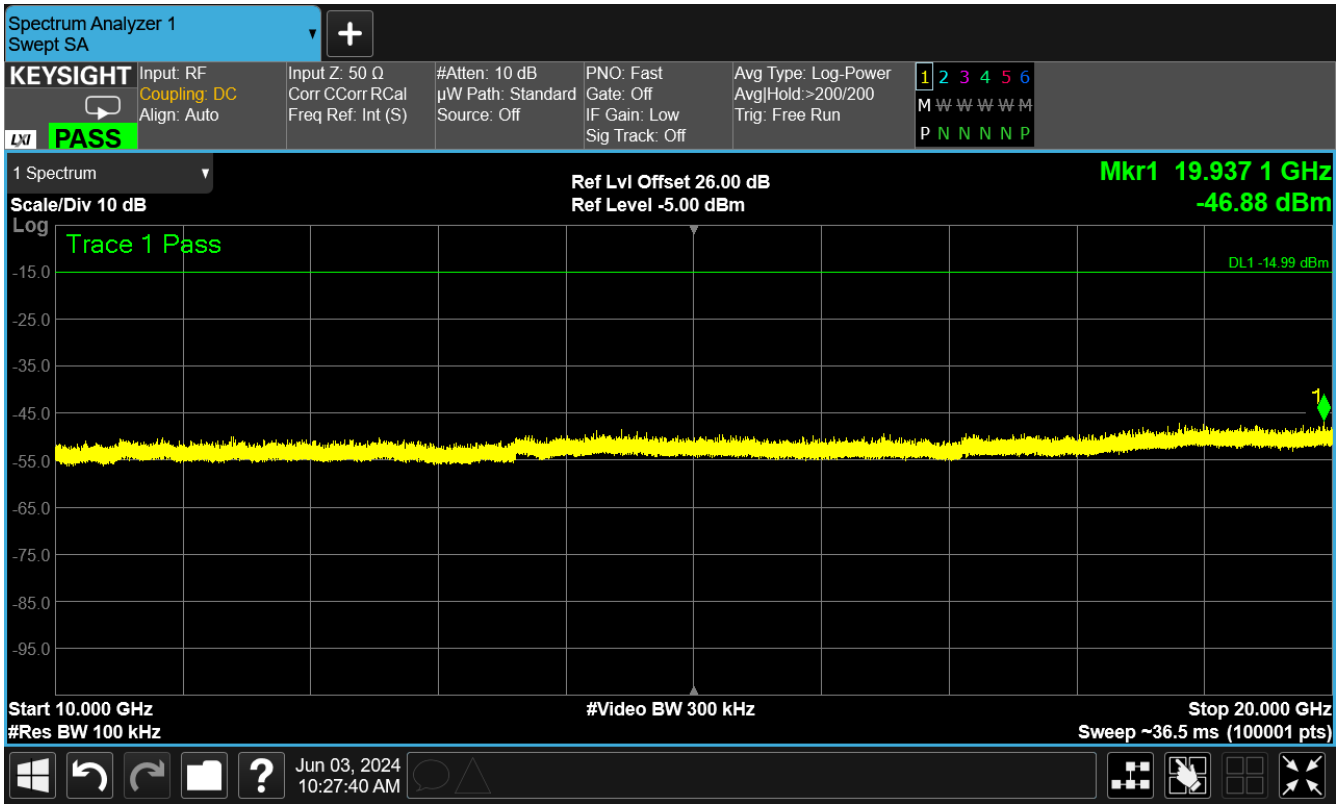

Figure 51: GFSK (1Mbps) Center Channel, Conducted Spurious – Plot 6

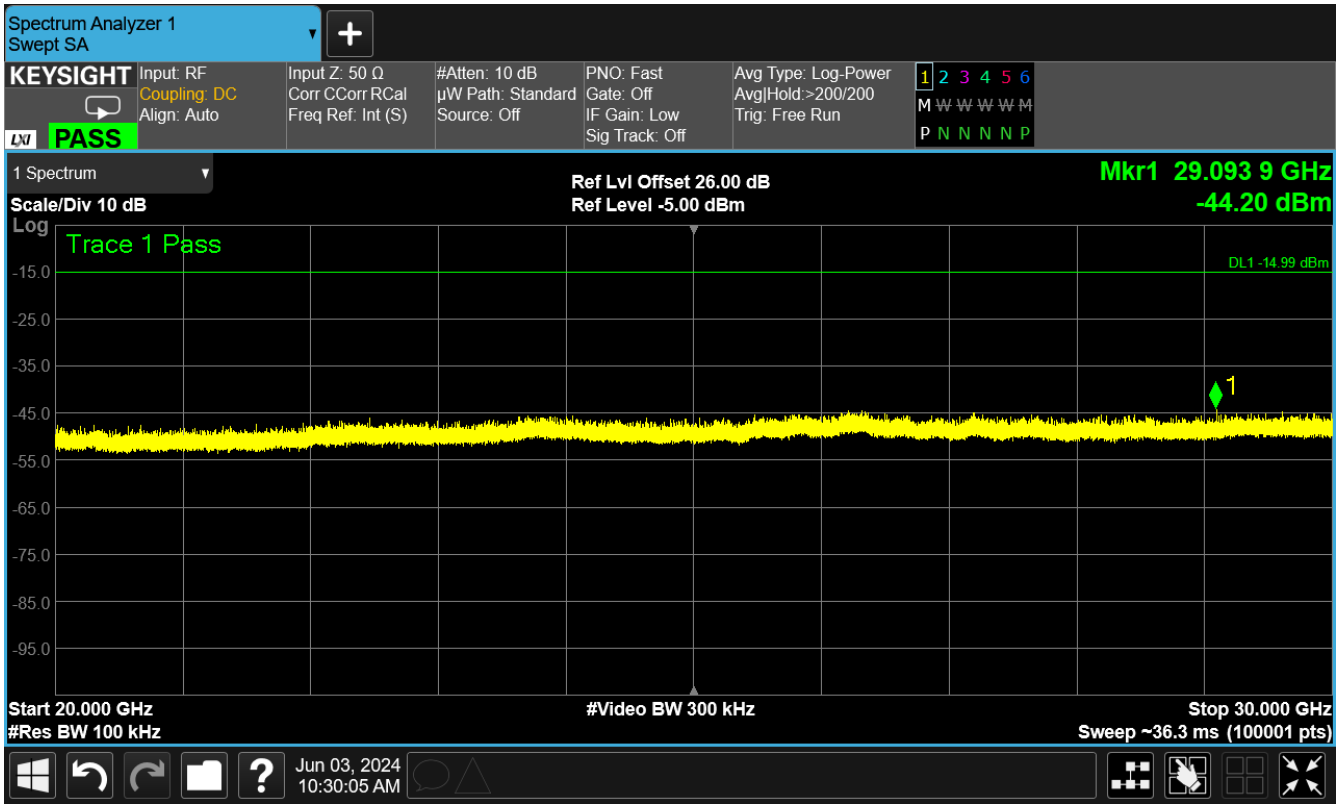

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Figure 52: GFSK (1Mbps) High Channel, Conducted Spurious – Plot 1

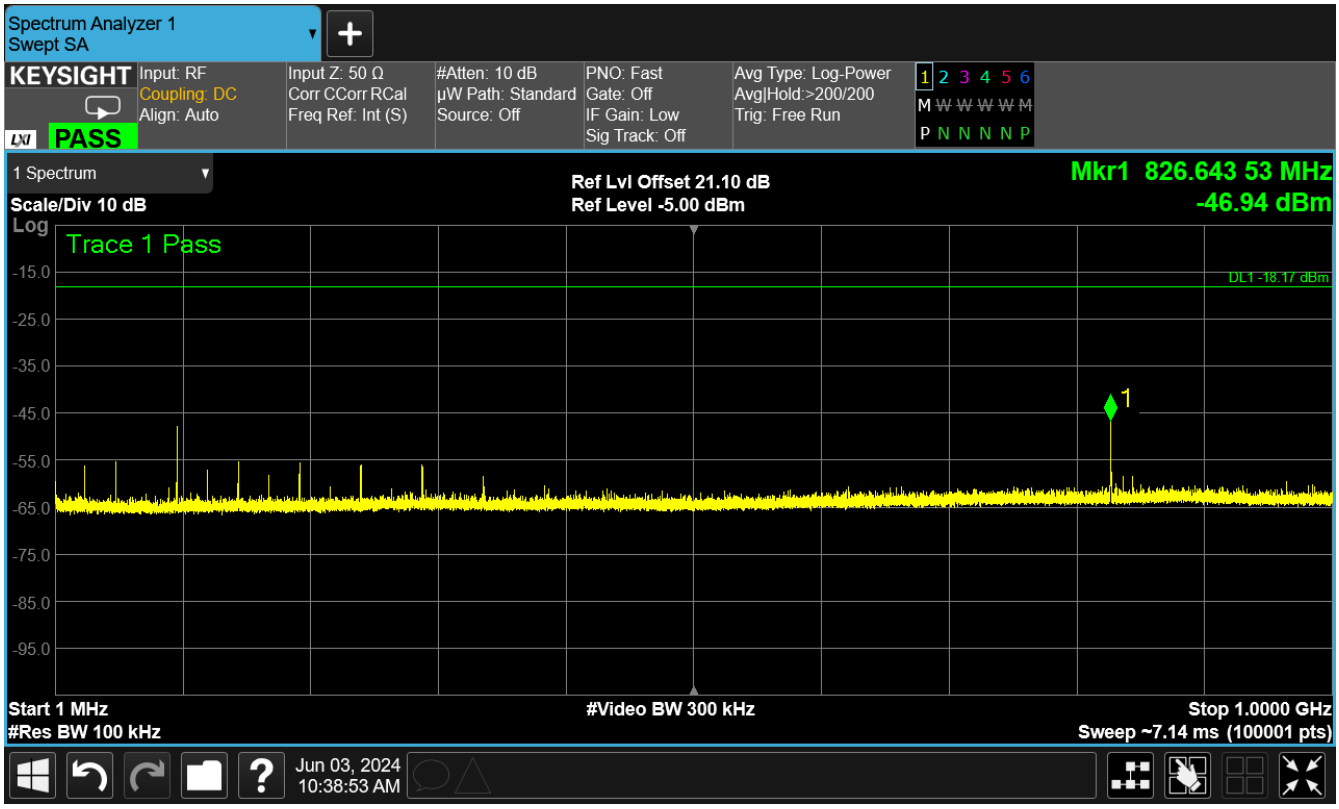
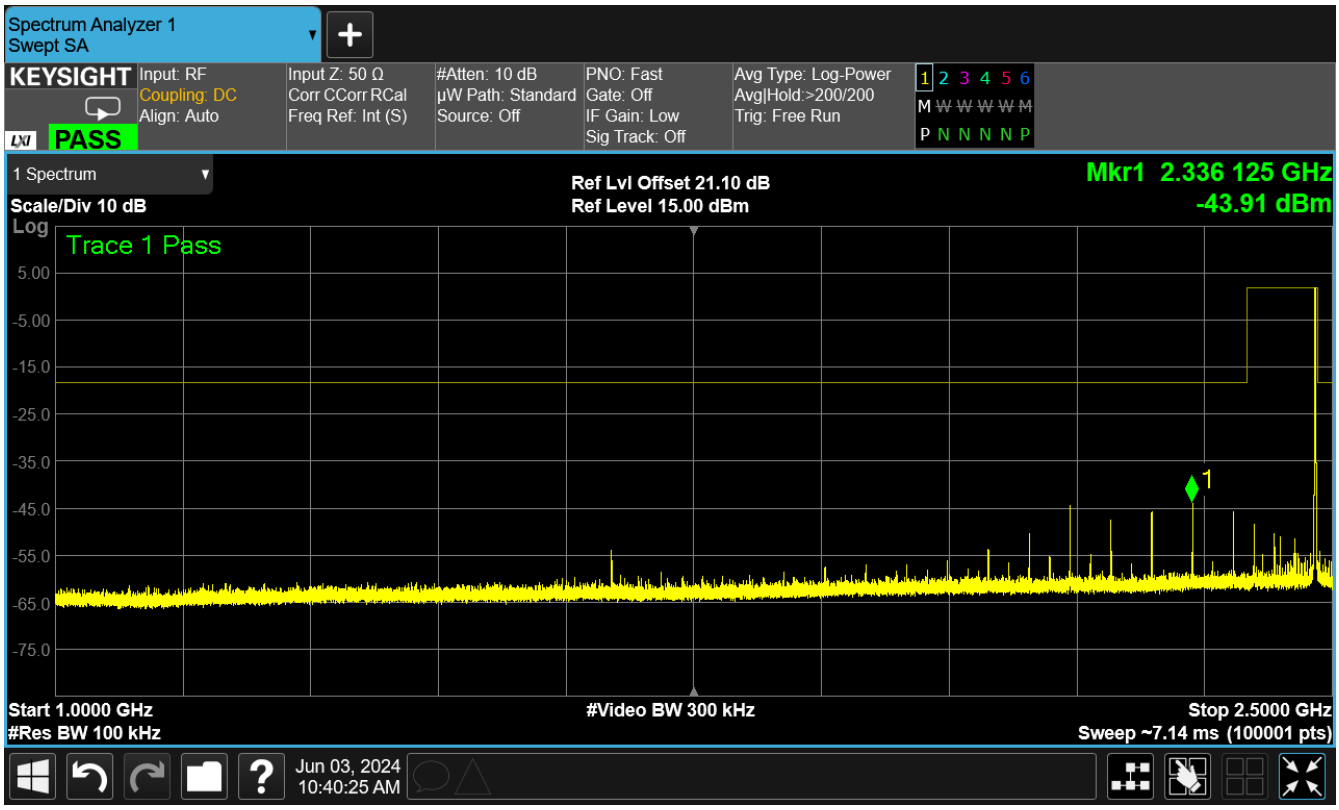
Figure 53: GFSK (1Mbps) High Channel, Conducted Spurious – Plot 2