FCC & ISED CANADA CERTIFICATION TEST REPORT

for the

PROTEUS MODULE, NA382408

FCC ID: YJ7NA382408

IC ID: 9082A-NA382408

WLL REPORT# 18779-01 REV 1

Prepared for:

Stanley Black & Decker, Inc.

701 East Joppa Road

Towson, Maryland 21286

Prepared By:

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Testing Certificate AT-1448

FCC & ISED Canada Certification Test Report

for the

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FCC ID: YJ7NA382408

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July 31, 2024

WLL Report# 18779-01 Rev 1

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 Regulations (current at the time of testing) 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., Model: NA382408. This BLE module is a limited single-modular transmitter. The information provided in this report is only applicable to device herein documented as the EUT. The EUT may be referred to as the Proteus module or NA382408.

Radiated 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 Certificate AT-1448 as an independent FCC test laboratory. The ISED Canada number for Washington Laboratories is 3035A.

The Stanley Black & Decker, Inc., NA382408 [FCC ID: YJ7NA382408] 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). The device is a limited single-modular transmitter.

Revision History	Description of Change	Date
Rev 0	Initial Release	July 31, 2024
Rev 1	TCB Comments, dated: 8/8/2024	August 9, 2024

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1 Introduction

Compliance Statement

The Stanley Black & Decker, Inc., NA382408 [FCC ID: YJ7NA382408] 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). The device is a limited single-modular transmitter.

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.

Contract Information

Customer:	Stanley Black & Decker, Inc.
Purchase Order Number:	M867824
Quotation Number:	74680

Test and Support Personnel

Washington Laboratories, LTD	Ryan Mascaro
Customer Representative	Kirwan Magdamo

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 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:	YJ7NA382408
IC ID:	9082A-NA382408
EUT Model:	NA382408
FCC Rule Parts:	§ 15.247
ISED Rule Parts:	RSS-247
ISED HVIN:	NA382408
Frequency Range:	2402 to 2480 MHz
Peak Output Power:	-0.87 dBm (0.0008 Watts)
Antenna Type:	Ceramic Chip, PCB Mounted with +2.93 dBi of Gain
FCC Emission Designator:	647KG1D
IC Emission Designator:	1M11G1D
6dB Occupied Bandwidth:	646.7 kHz
99% Occupied Bandwidth:	1097.0 kHz
Protocol:	Bluetooth Low Energy (BLE)
Modulation and Data Rate:	GFSK, 1Mbps
Keying:	Automatic
Type of Information:	Digital
Number of Channels:	≤ 40
Interface Cables:	N/A (only support cables for testing)
Power Source & Voltage:	60VDC (supplied via host during final integration)
Worst-Case TX Spurious Emission:	83.165 MHz, 31.9 dBuV/m QP (test data here)
Software/Firmware Version:	Not Declared by Applicant
Testing Dates:	6/27/2024 to 7/15/2024

2.2 EUT Description

The Proteus NA382408 is a Bluetooth Low Energy (BLE) transceiver module. The device is intended to be powered via 60VDC, supplied from the host, when present. Please note the EUT device being certified is a limited single-modular transmitter. The module was tested stand-alone, as required for modular testing and approval. The EUT was provided in a plastic protective housing, only to cover and protect the PCB. The plastic housing simply protects the PCB from being shorted during testing. The EUT module is a complete PCB assembly with terminals and straps, containing the BLE transceiver chip set and a PCB mounted ceramic antenna. The BLE transceiver only employs a 1Mbps mode. Enhanced data rates of 2Mb and 3Mb are not used. Figure 1 and Figure 2 provide images of the limited module assembly.

Figure 1: NA382408 Assembly, View 1

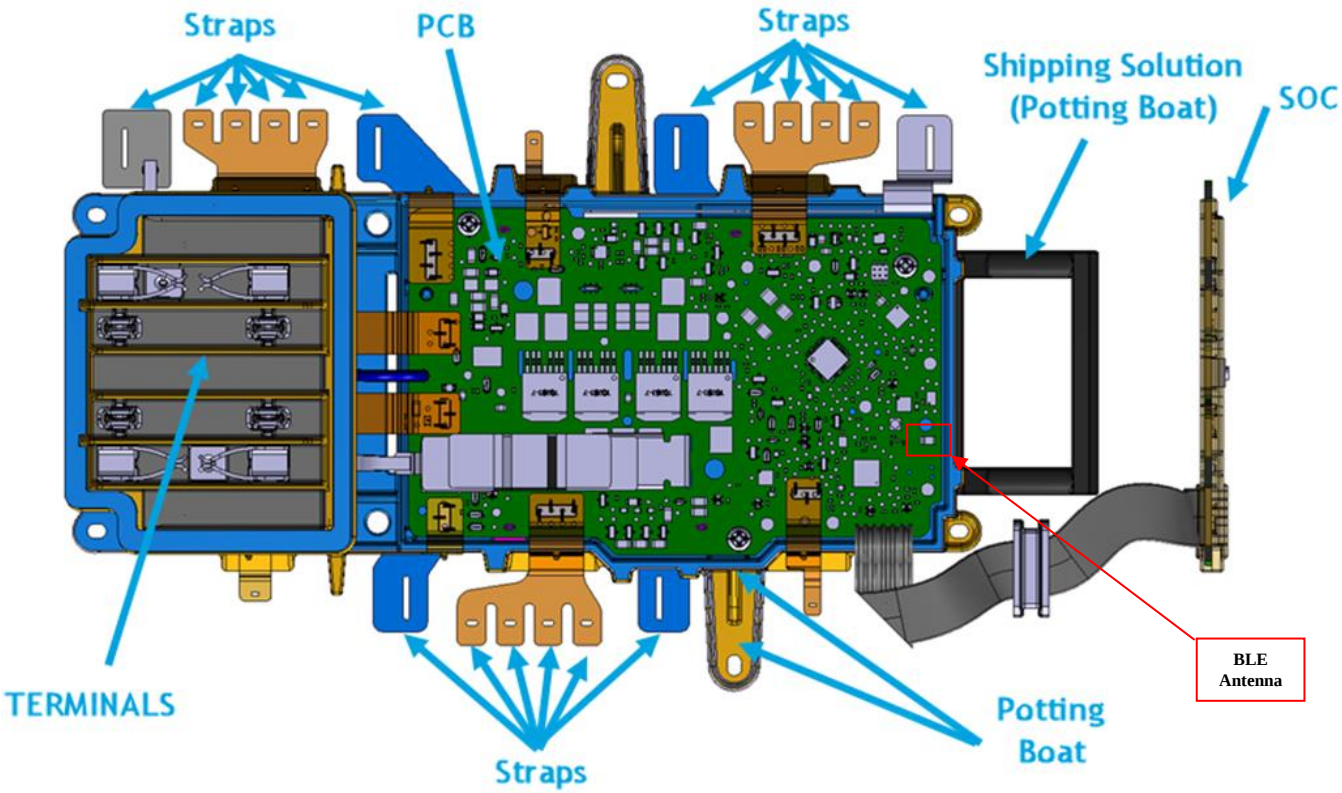
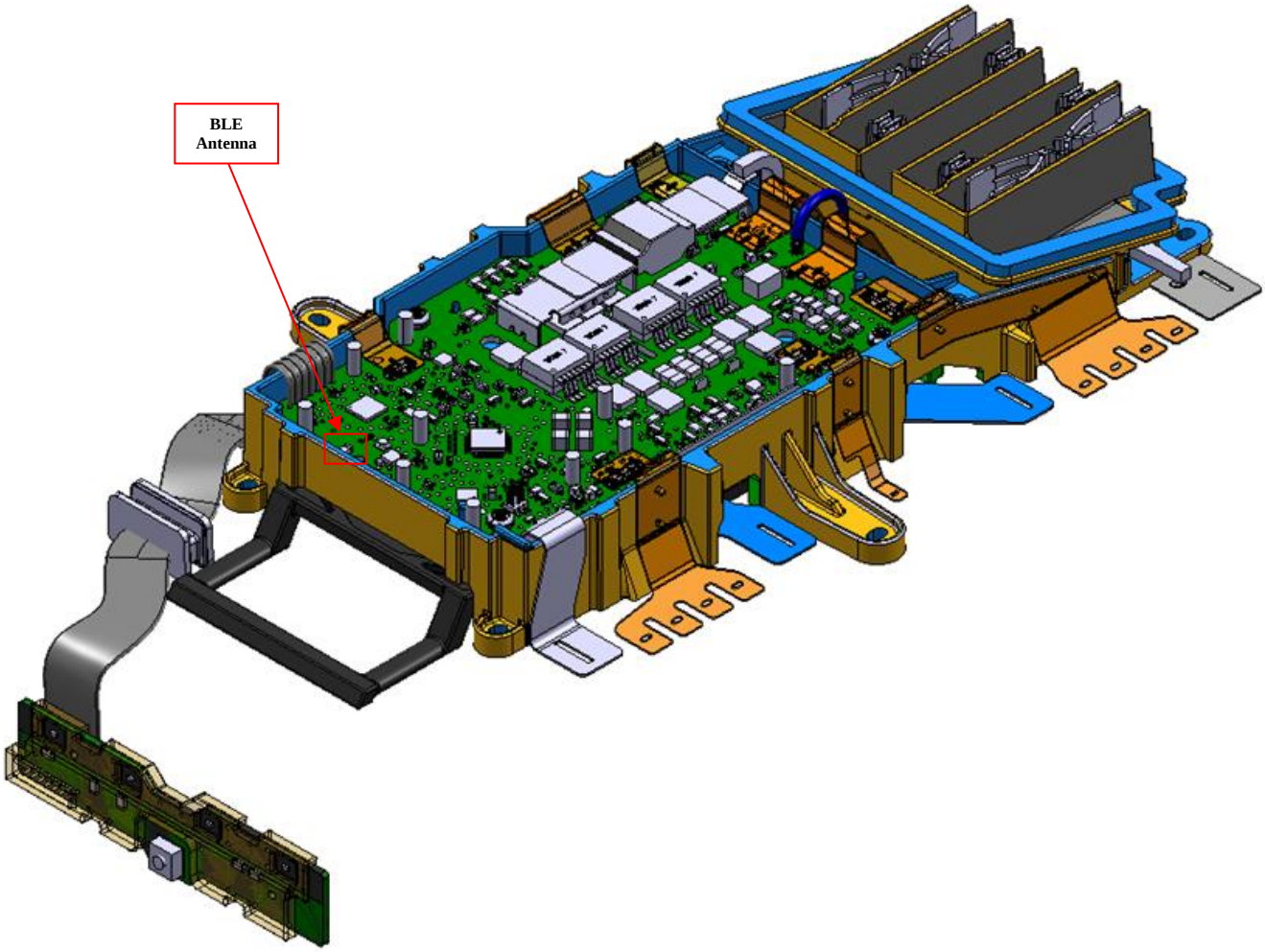


Figure 2: NA382408 Assembly, View 2



2.3 Test Configuration and Algorithm

The NA382408 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 methods of measurement, the BLE radio was observed through the uFl antenna port. For radiated emissions below 1GHz, the EUT was set to transmit in a hopping enabled mode. For radiated emissions above 1GHz, the EUT was set to transmit at the each of the Low, Center, and High Channels. For AC power line emissions testing, please see Section 3.9 of this report. Only the worst-case emissions are provided throughout this report. The test-mode software was set a fixed power level value setting of "0dBm". This setting was maintained for all testing and produced the desired output power, as reported. 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: EUT System Configuration List

Name / Description	Model Number	Part Number	Serial Number	Rev. #
Proteus Module	-	NA382408	--	--

Table 3: Support Equipment

Name / Description	Manufacturer	Model Number	Calibration Data
60V Power Supply	BK Precision	--	N/A

Table 4: Cable Configuration

Ref. ID	EUT Port Name	Cable Description	Qty.	Length (m)	Shielded	Termination Port ID
1	60VDC	multi-strand AWG	2	< 3m	No	PS
2	CMD	USB, UART	1	< 3m	Yes	Laptop

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

Digital Transmission System			
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 Conducted Emissions	Pass

3.1 Deviations to the Test Standard

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

3.2 Occupied Bandwidth, Digital Transmission System

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.

3.2.1 Measurement Method

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

3.2.2 Test Data

The EUT test data is provided below.

The EUT was configured to transmit a 1Mbps, GFSK modulated signal, with channel hopping disabled.

Table 6: Occupied Bandwidth Results

Frequency	6dB Bandwidth	99% Bandwidth	Result
Low Channel, 2402 MHz	735.8 kHz	1.091 MHz	Pass
Center Channel, 2440 MHz	752.7 kHz	1.090 MHz	Pass
High Channel, 2480 MHz	646.7 kHz	1.097 MHz	Pass

Figure 3: Occupied Bandwidth, Low Channel

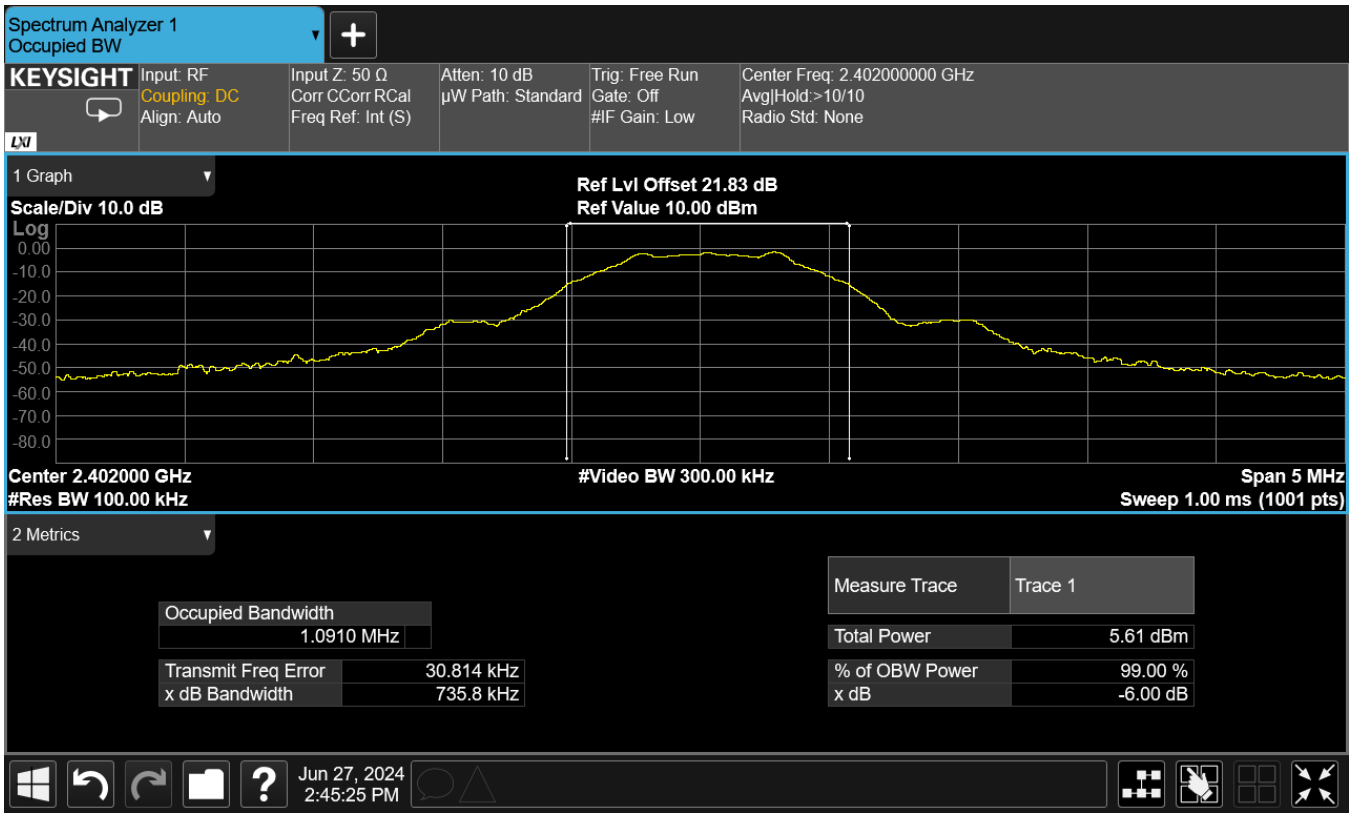


Figure 4: Occupied Bandwidth, Center Channel

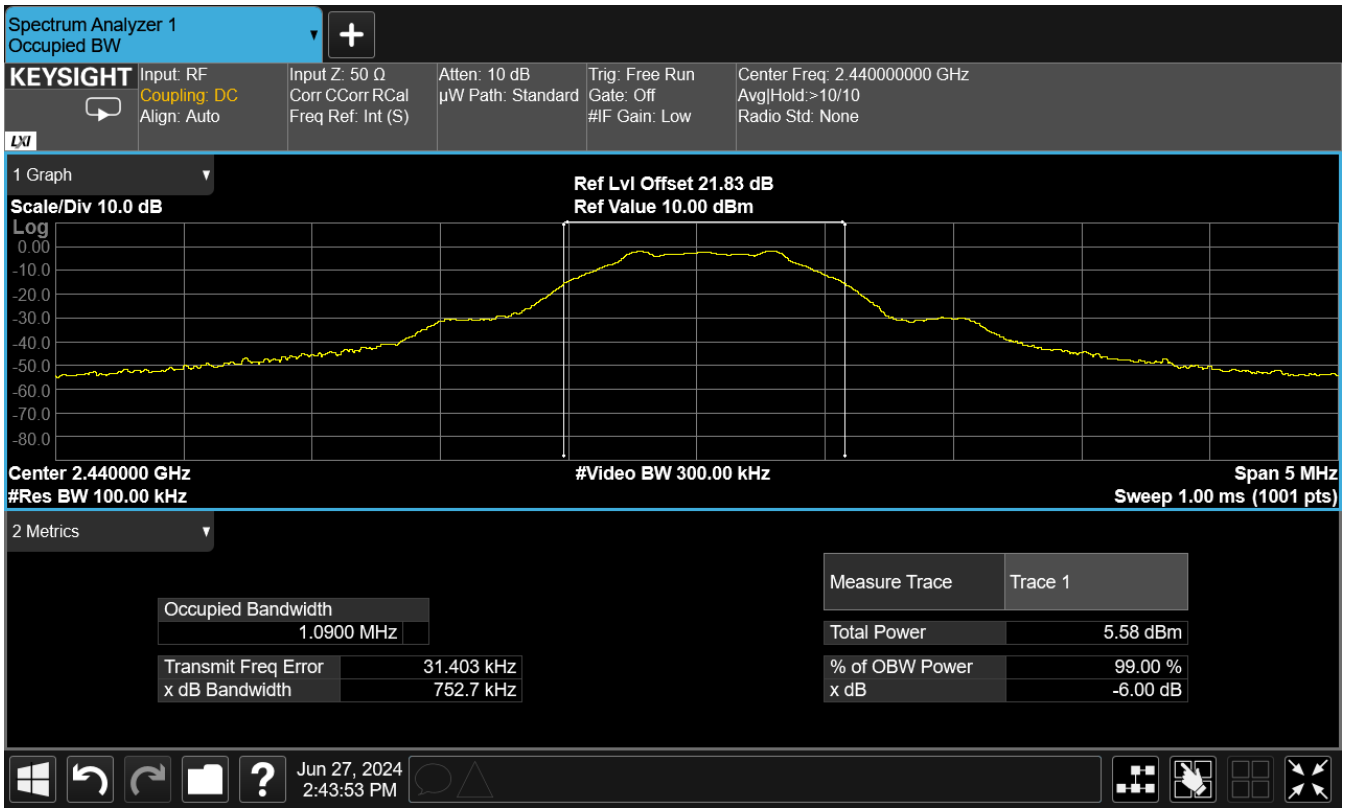
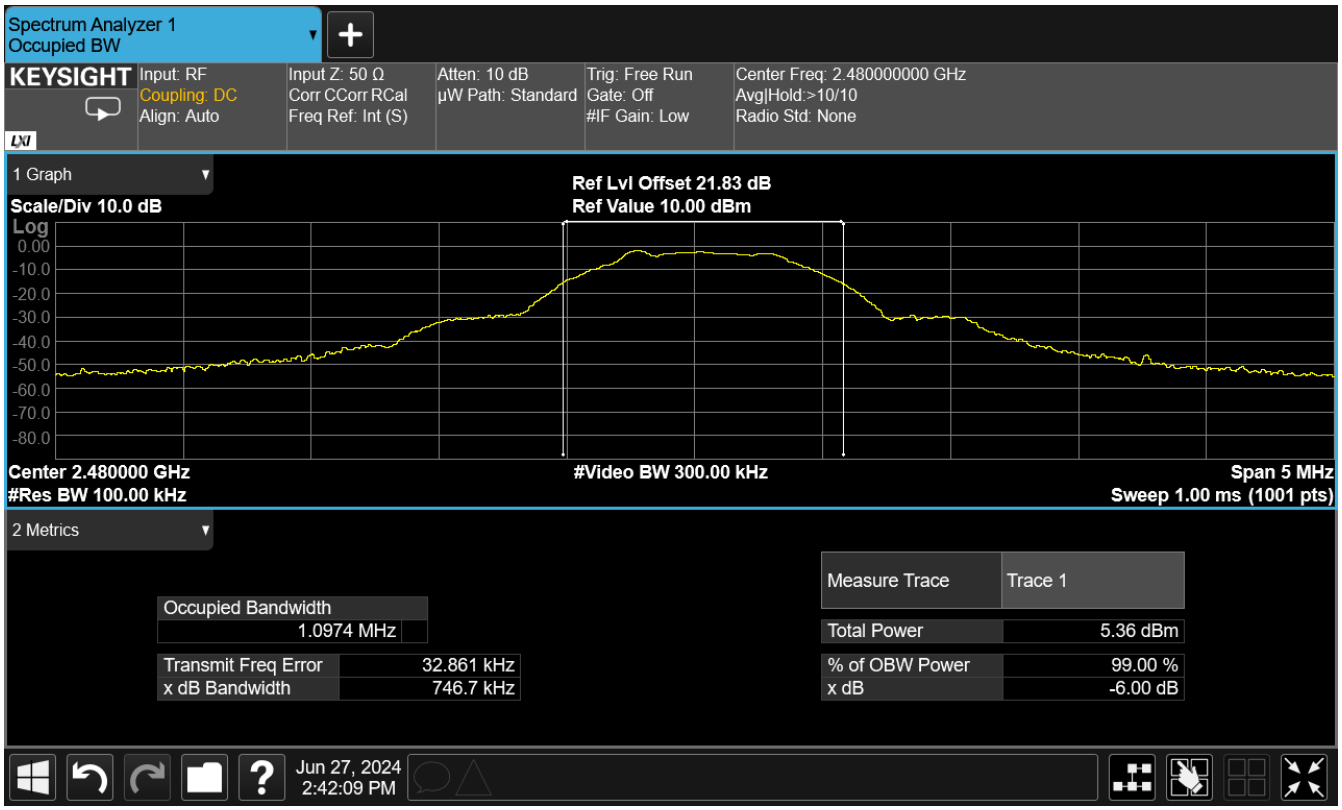


Figure 5: Occupied Bandwidth, High Channel



3.3 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.

3.3.1 Measurement Method

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

3.3.2 Test Data

The EUT test data is provided below.

The EUT was configured to transmit a 1Mbps, GFSK modulated signal, with channel hopping disabled.

The EUT employs a PCB trace antenna with a peak gain of +2.93 dBi.

Table 7: Conducted Output Power Results

Frequency	Power (dBm)	EIRP (dBm)	Result
Low Channel, 2402 MHz	-0.87	2.06	Pass
Center Channel, 2440 MHz	-1.17	1.76	Pass
High Channel, 2480 MHz	-1.29	1.64	Pass

Figure 6: Peak Output Power, Low Channel

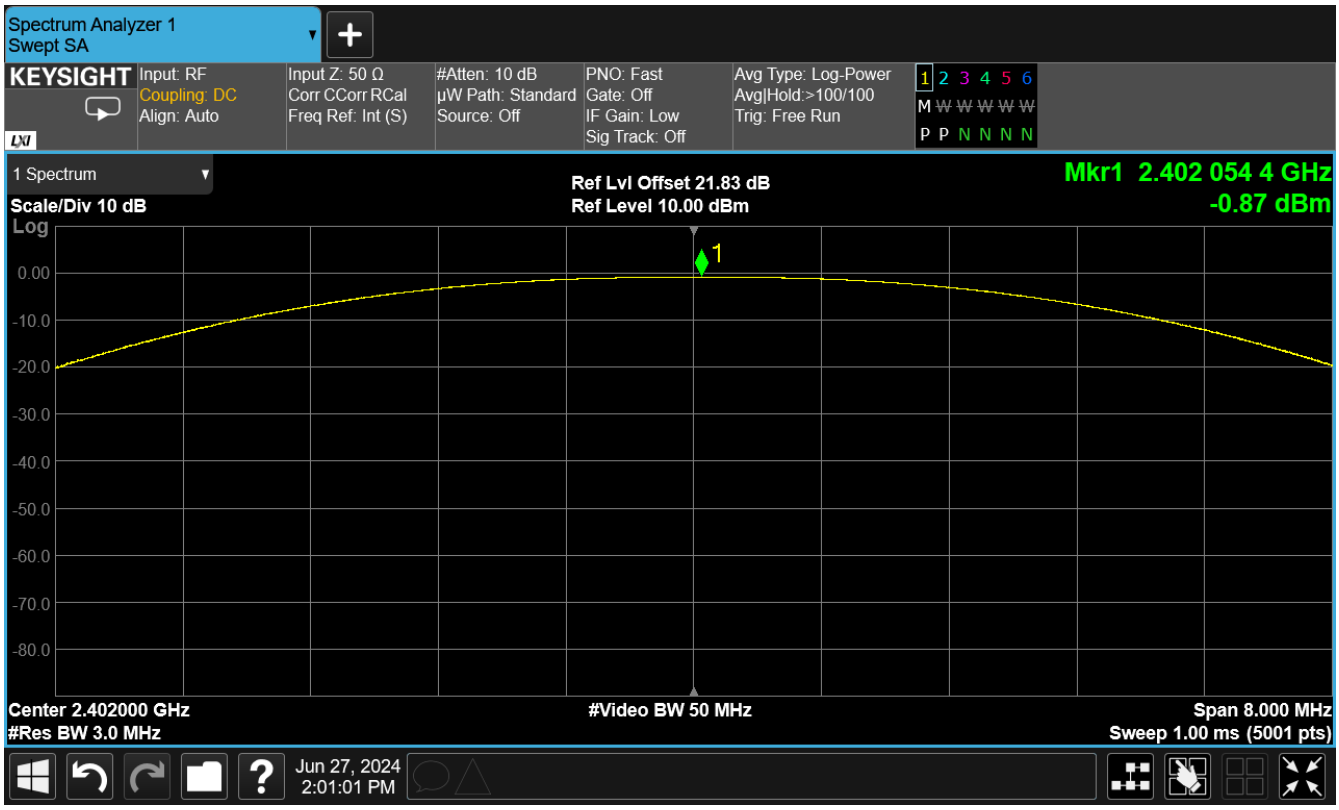


Figure 7: Peak Output Power, Center Channel

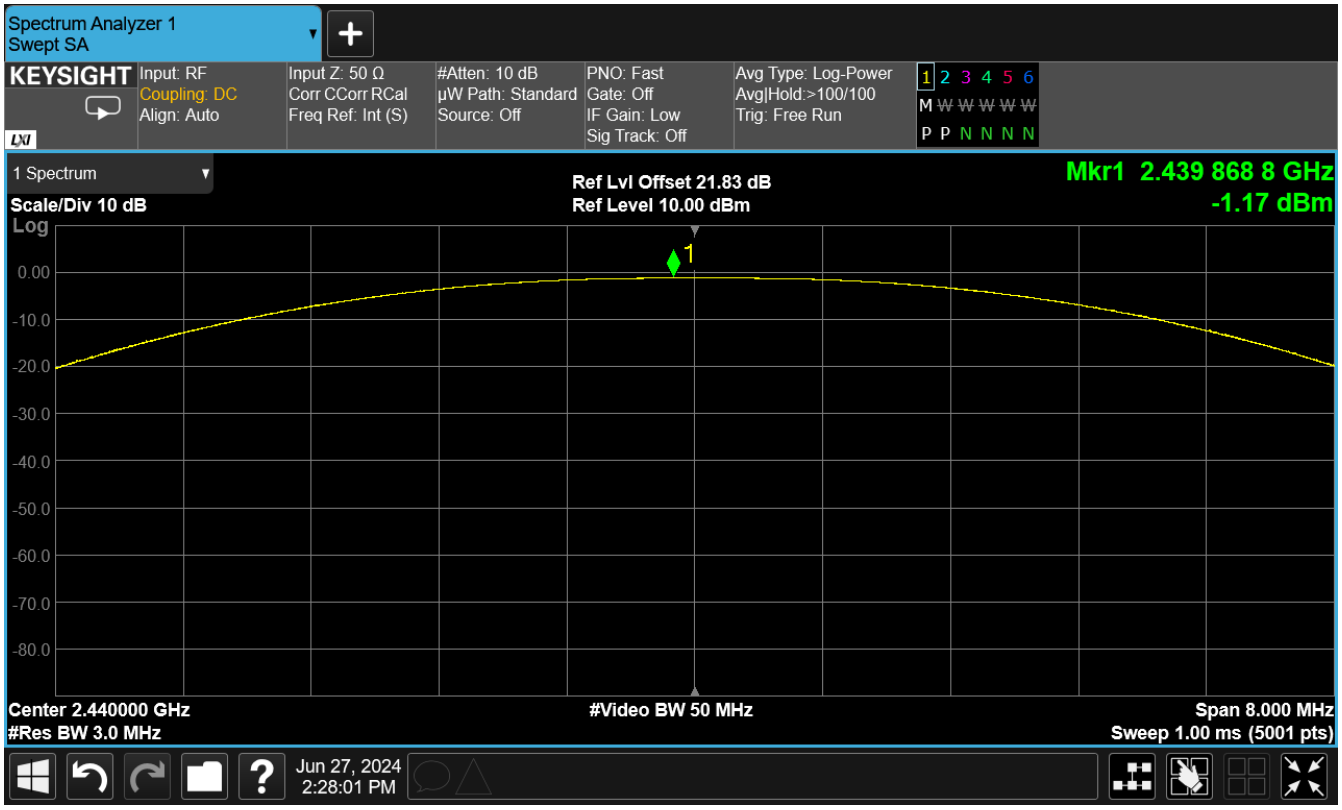
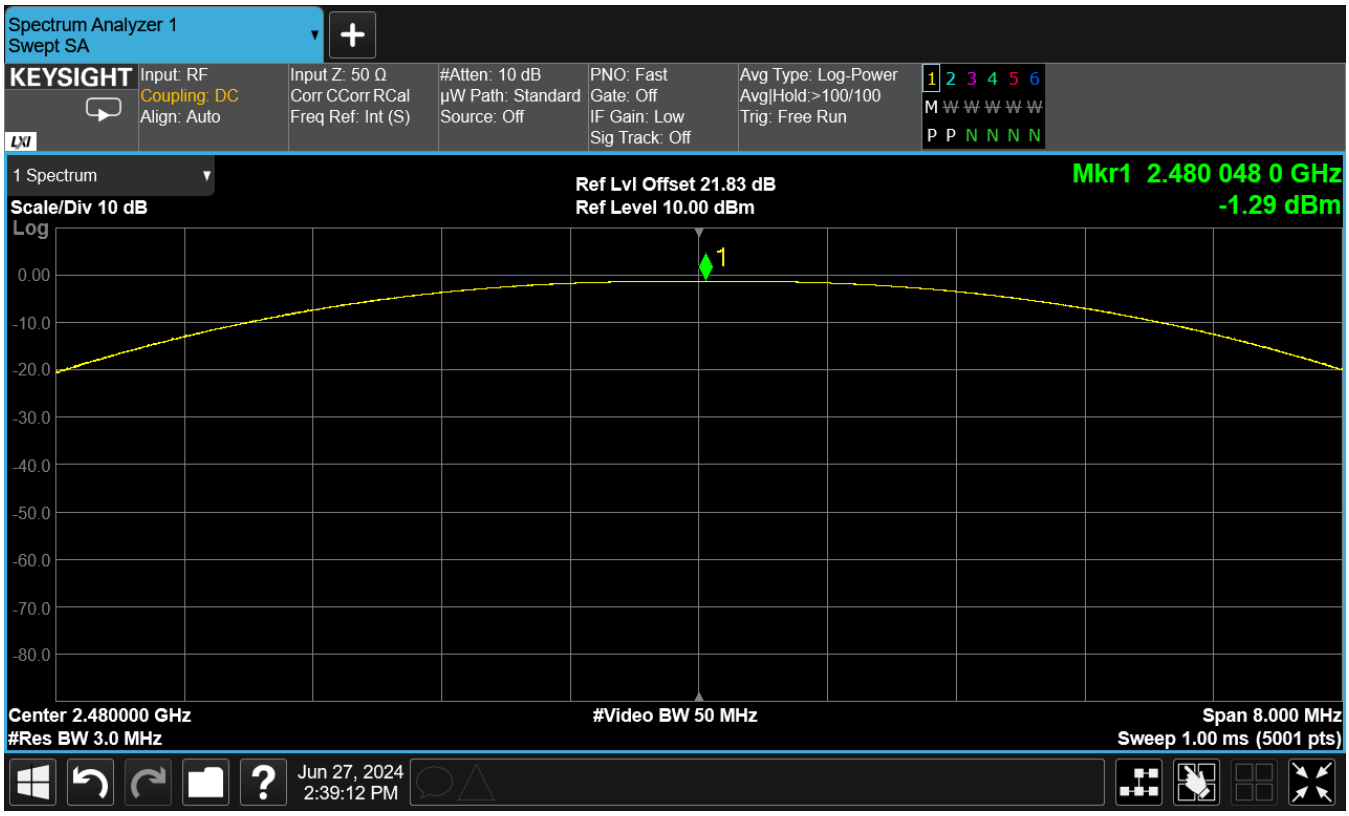


Figure 8: Peak Output Power, High Channel



3.4 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.

3.4.1 Measurement Method

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

3.4.2 Test Data

The EUT test data is provided below.

The EUT was configured to transmit a 1Mbps, GFSK modulated signal, with channel hopping disabled.

Table 8: Power Spectral Density

Frequency	Power (dBm)	Limit (dBm)	Result
Low Channel, 2402 MHz	-1.66	8	Pass
Center Channel, 2440 MHz	-1.75	8	Pass
High Channel, 2480 MHz	-2.22	8	Pass

Figure 9: Power Spectral Density, Low Channel

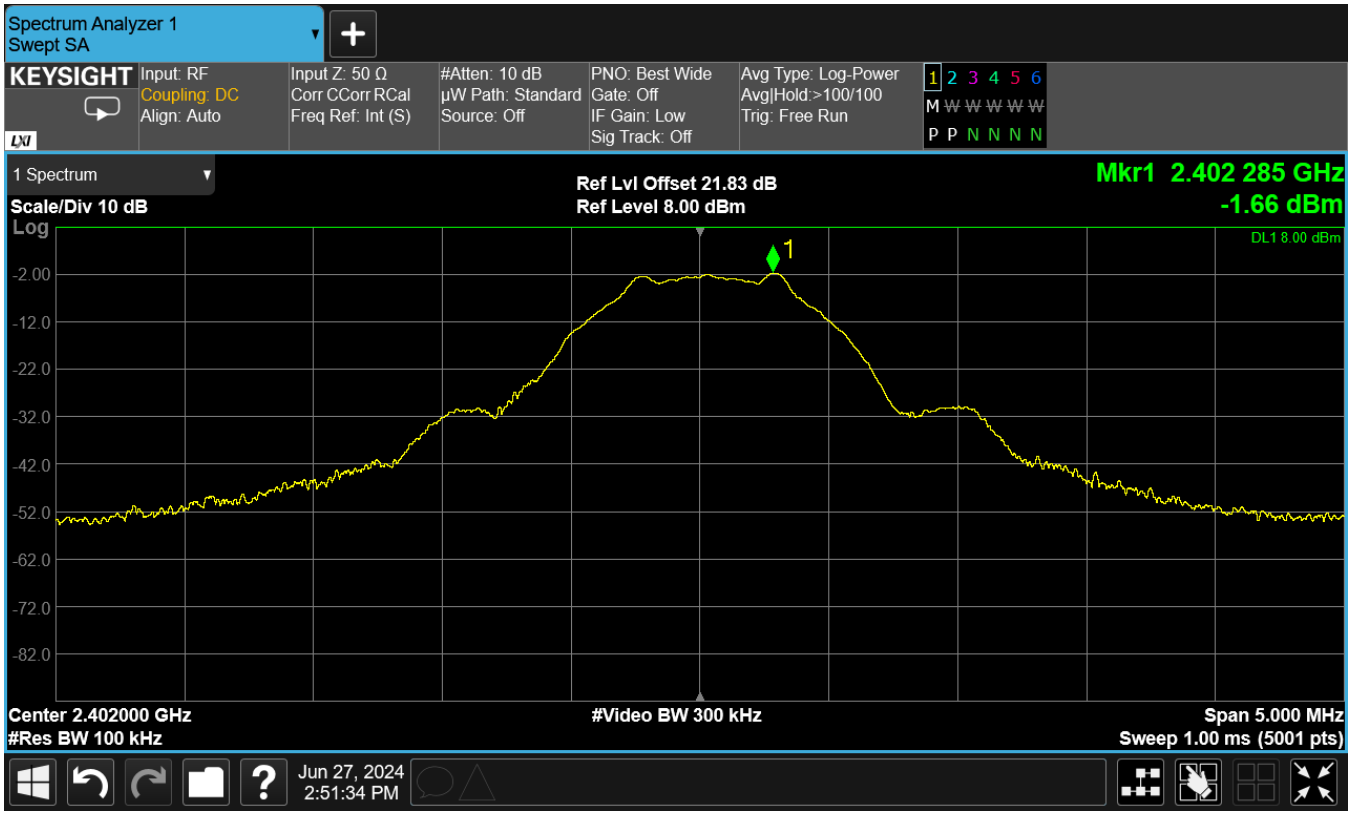


Figure 10: Power Spectral Density, Center Channel

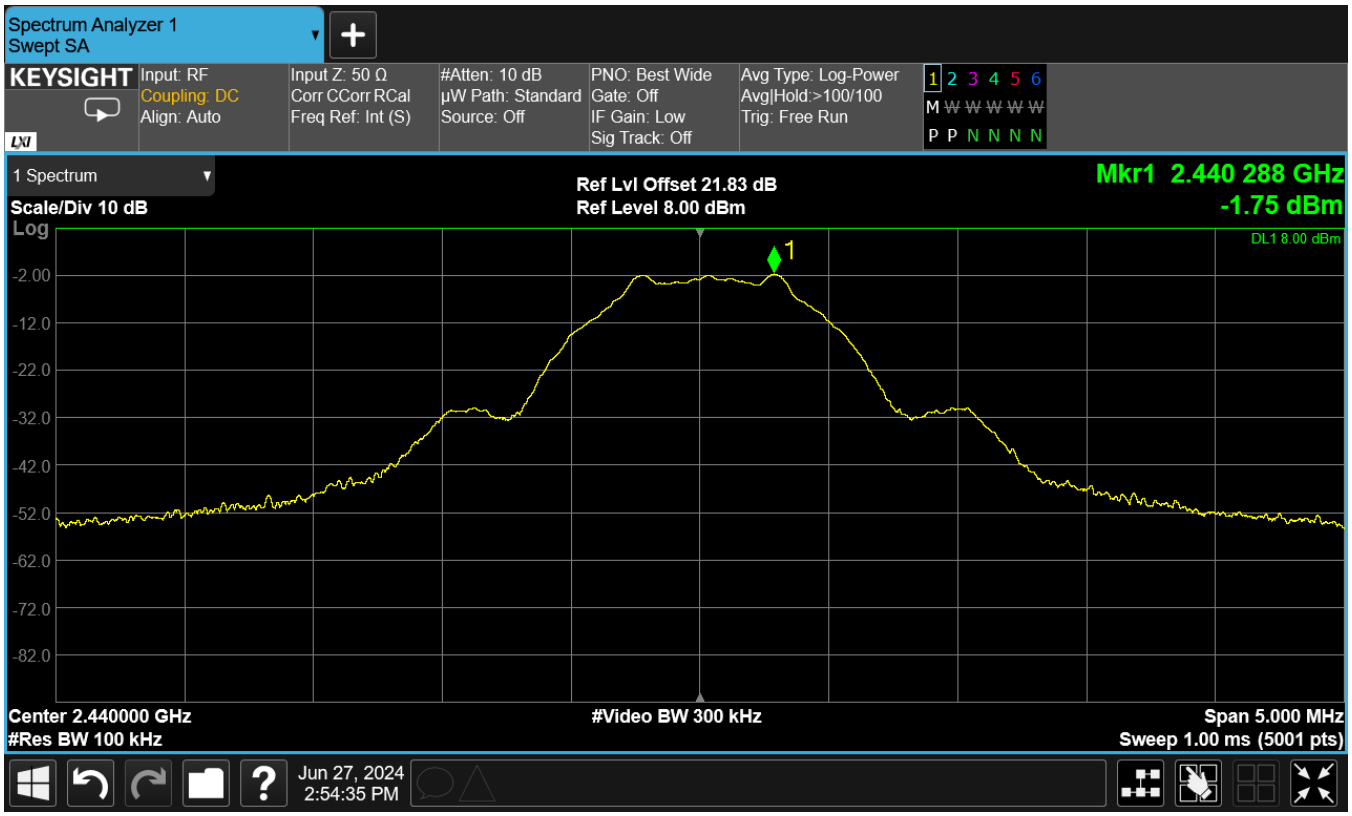
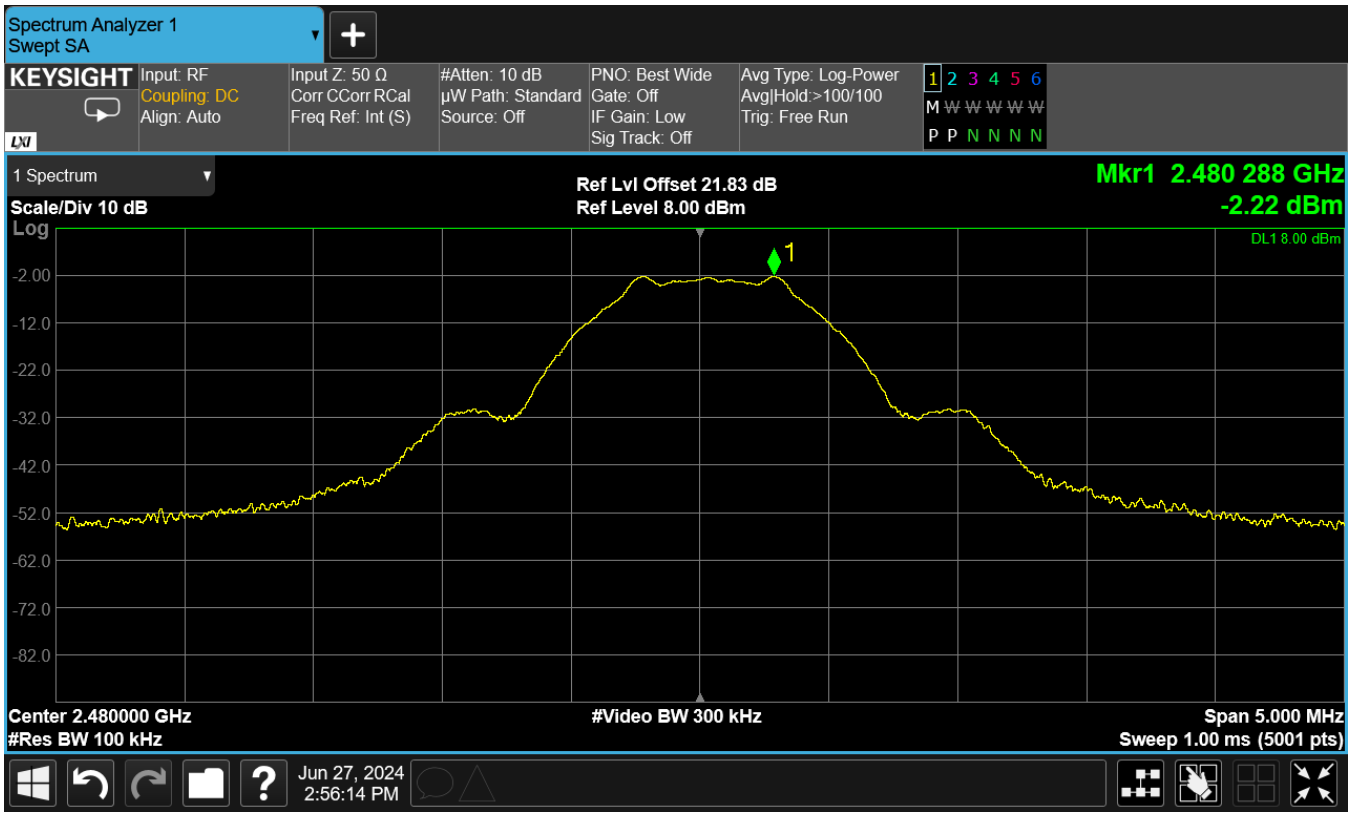


Figure 11: Power Spectral Density, High Channel



3.5 Conducted Band-edge Testing

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.

3.5.1 Measurement Method

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

3.5.2 Test Data

The EUT test data is provided below.

The EUT was configured to transmit a 1Mbps, GFSK modulated signal. The EUT was evaluated in two modes, channel hopping enabled and channel hopping disabled. The hopping function had no impact on the results of this test.

Figure 12: Low Channel Band-Edge

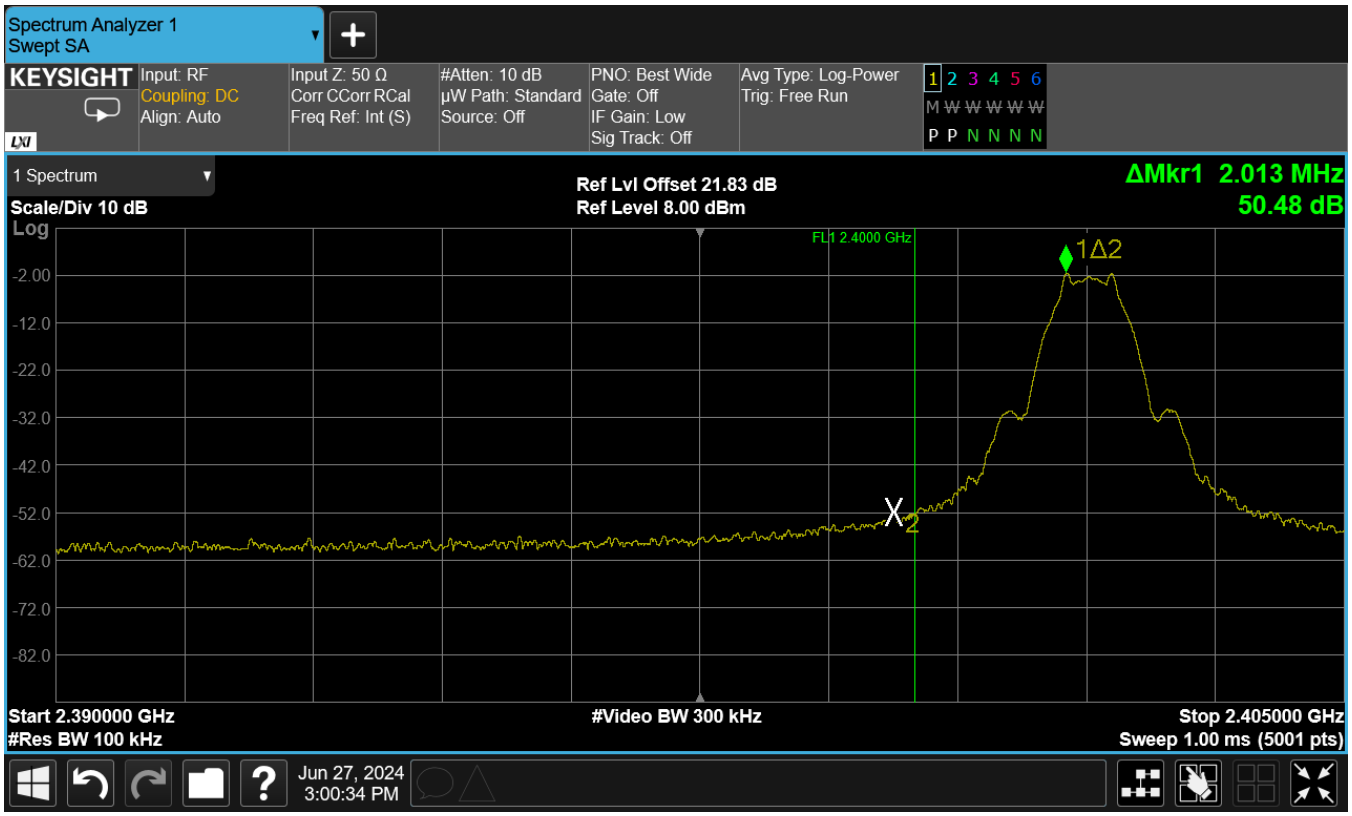
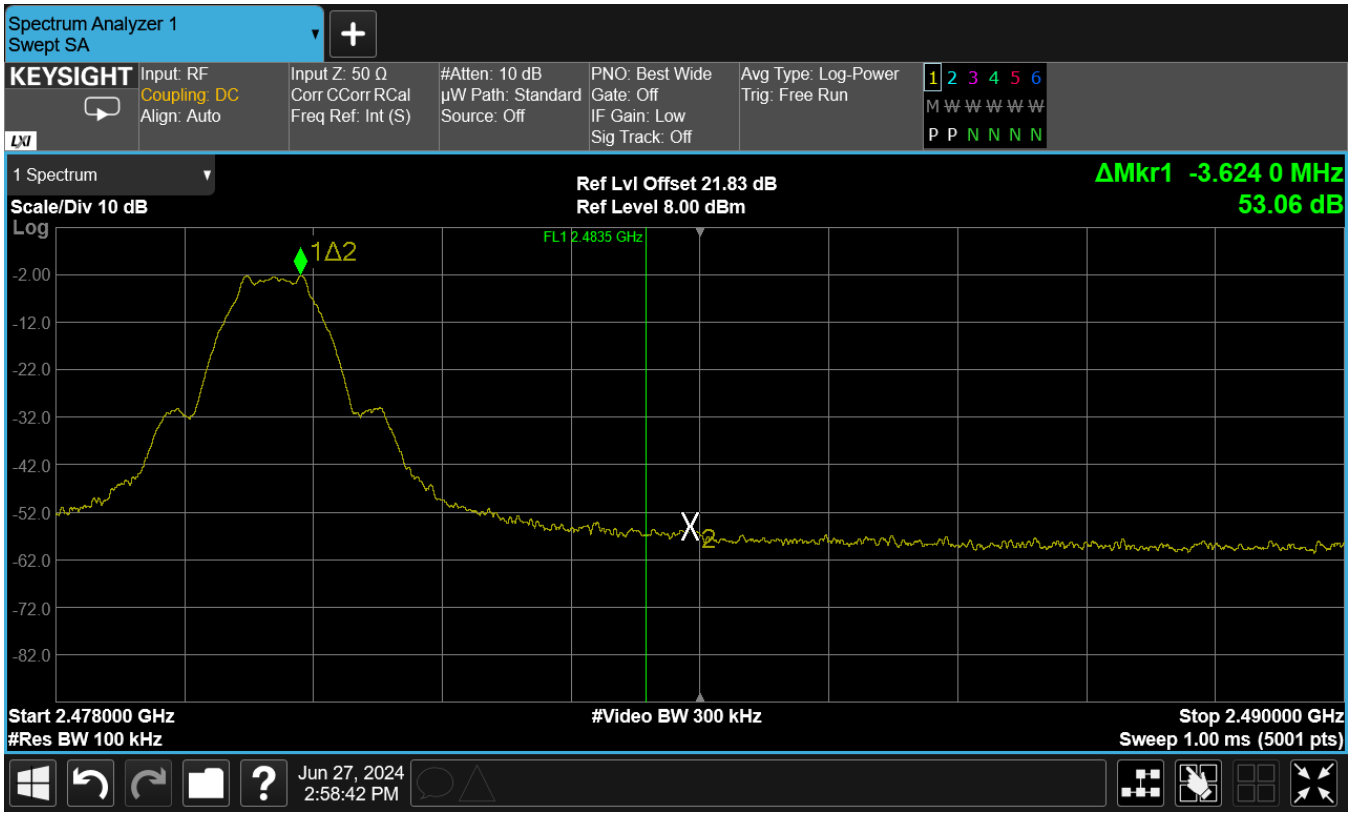


Figure 13: High Channel Band-Edge



3.6 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.

3.6.1 Measurement Method

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

3.6.2 Test Data

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

The EUT was configured to transmit a 1Mbps, GFSK modulated signal and dwell at the low, center, and high channel frequencies.

The final data is provided below.

Figure 14: Low Channel Conducted Spurious Plot 1

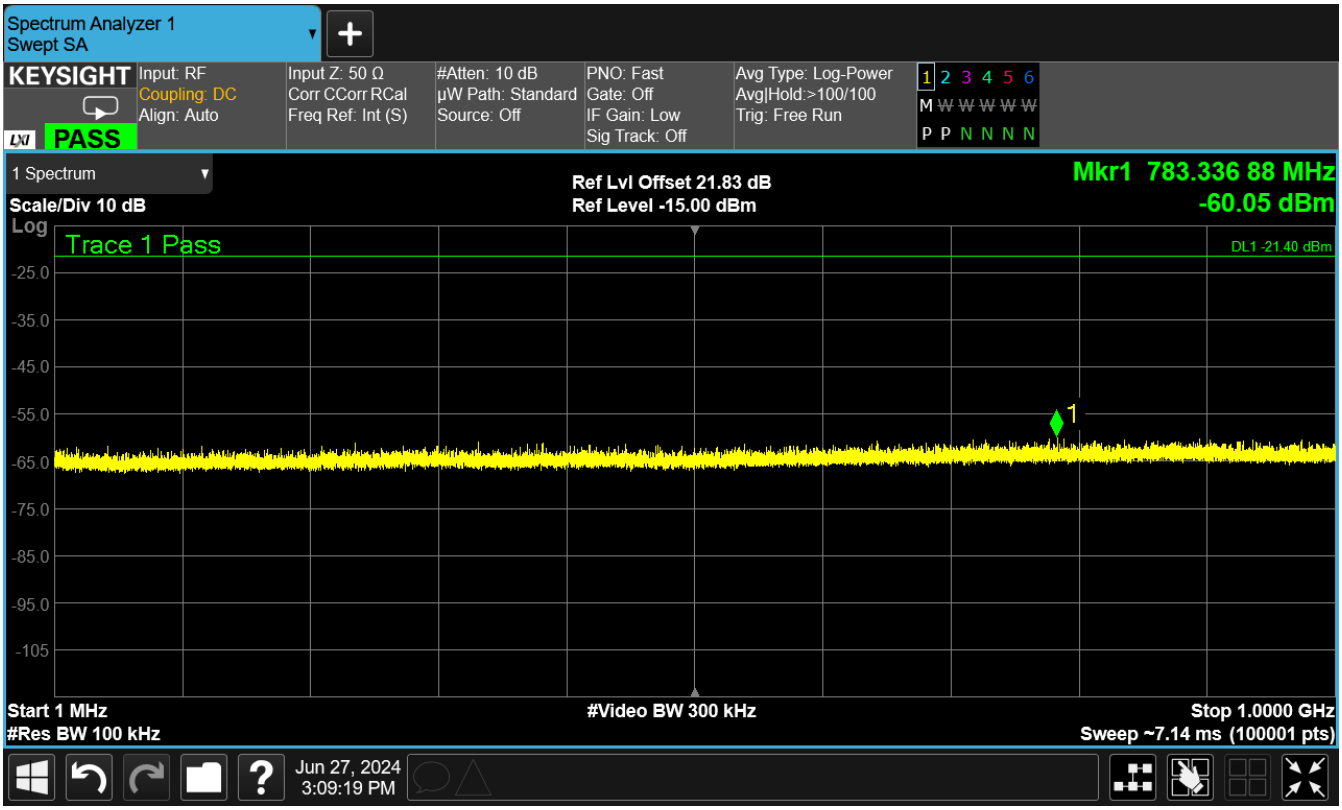


Figure 15: Low Channel Conducted Spurious Plot 2

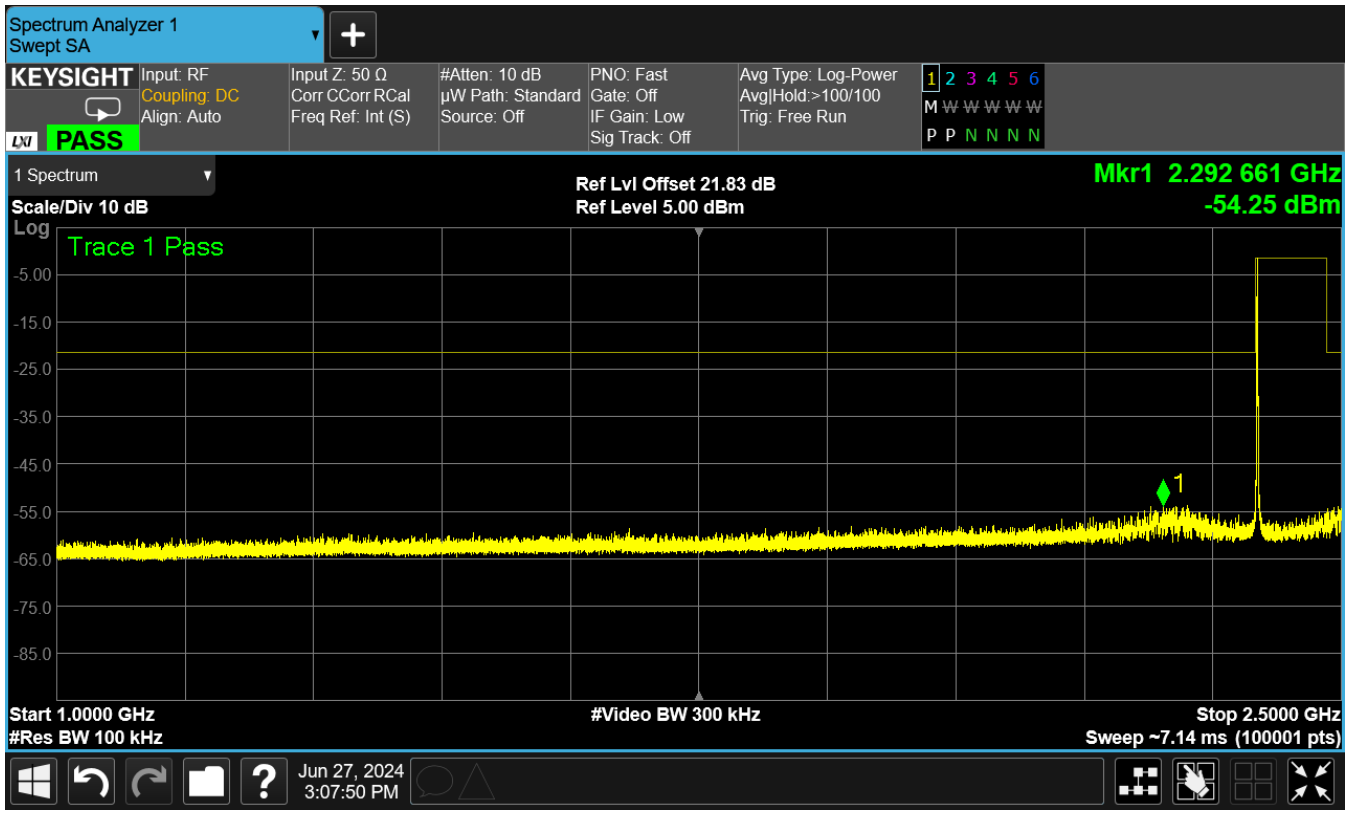


Figure 16: Low Channel Conducted Spurious Plot 3

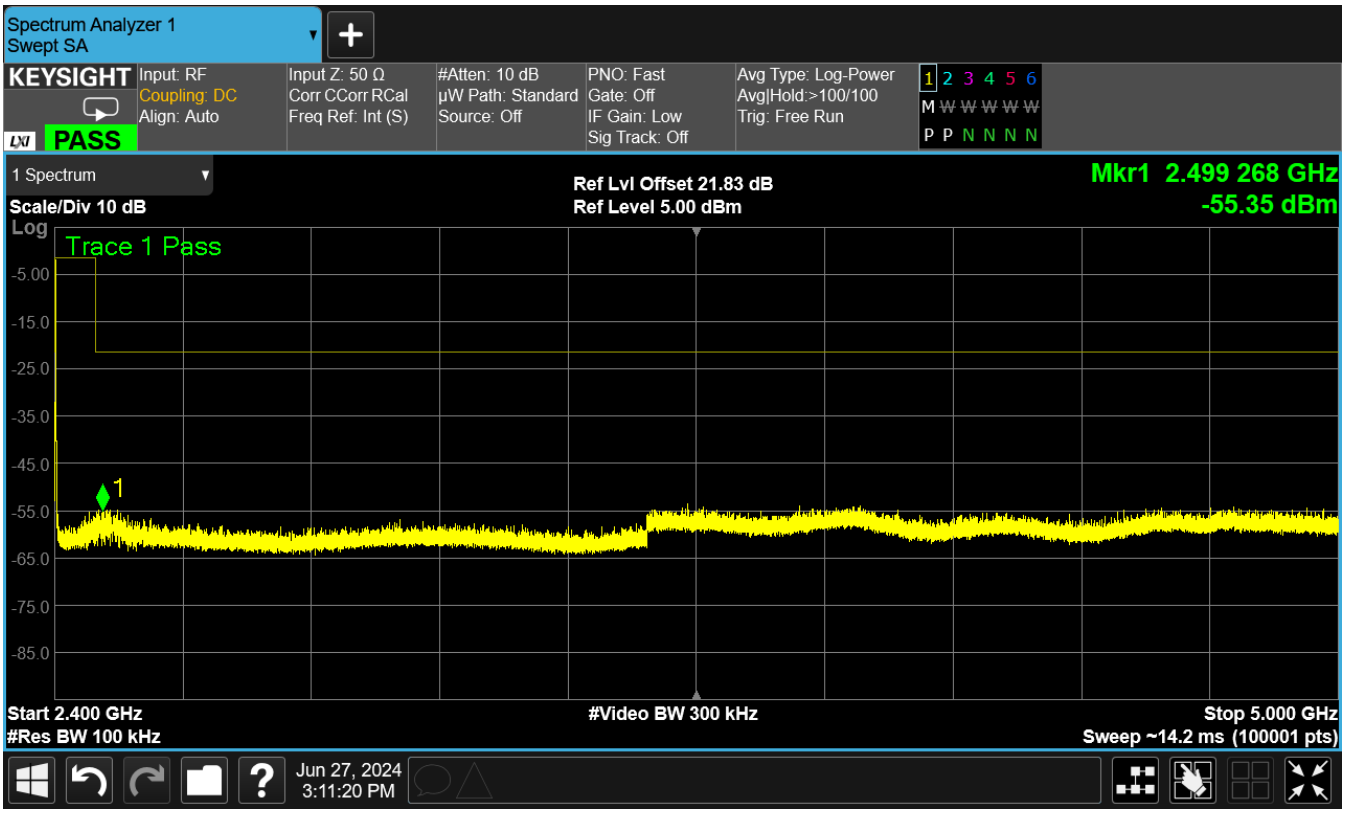


Figure 17: Low Channel Conducted Spurious Plot 4

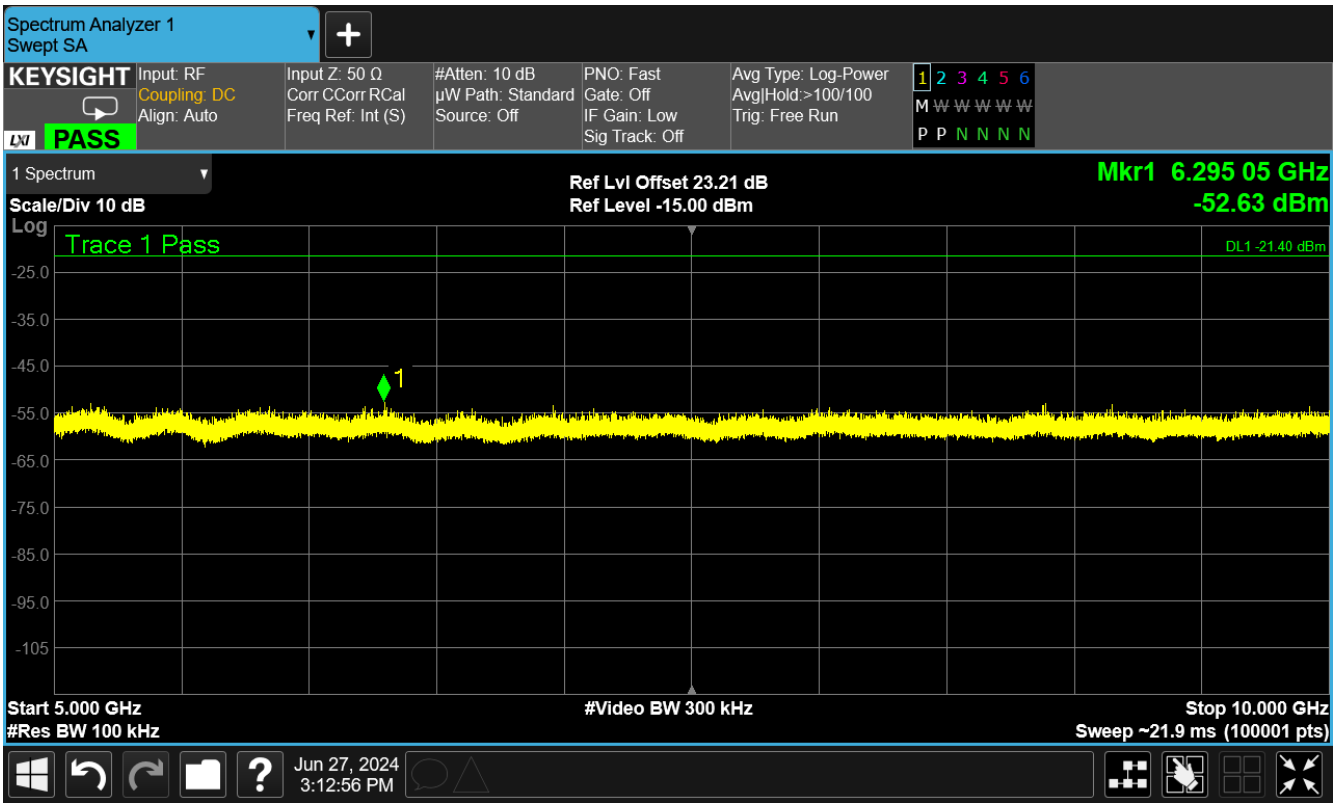


Figure 18: Low Channel Conducted Spurious Plot 5

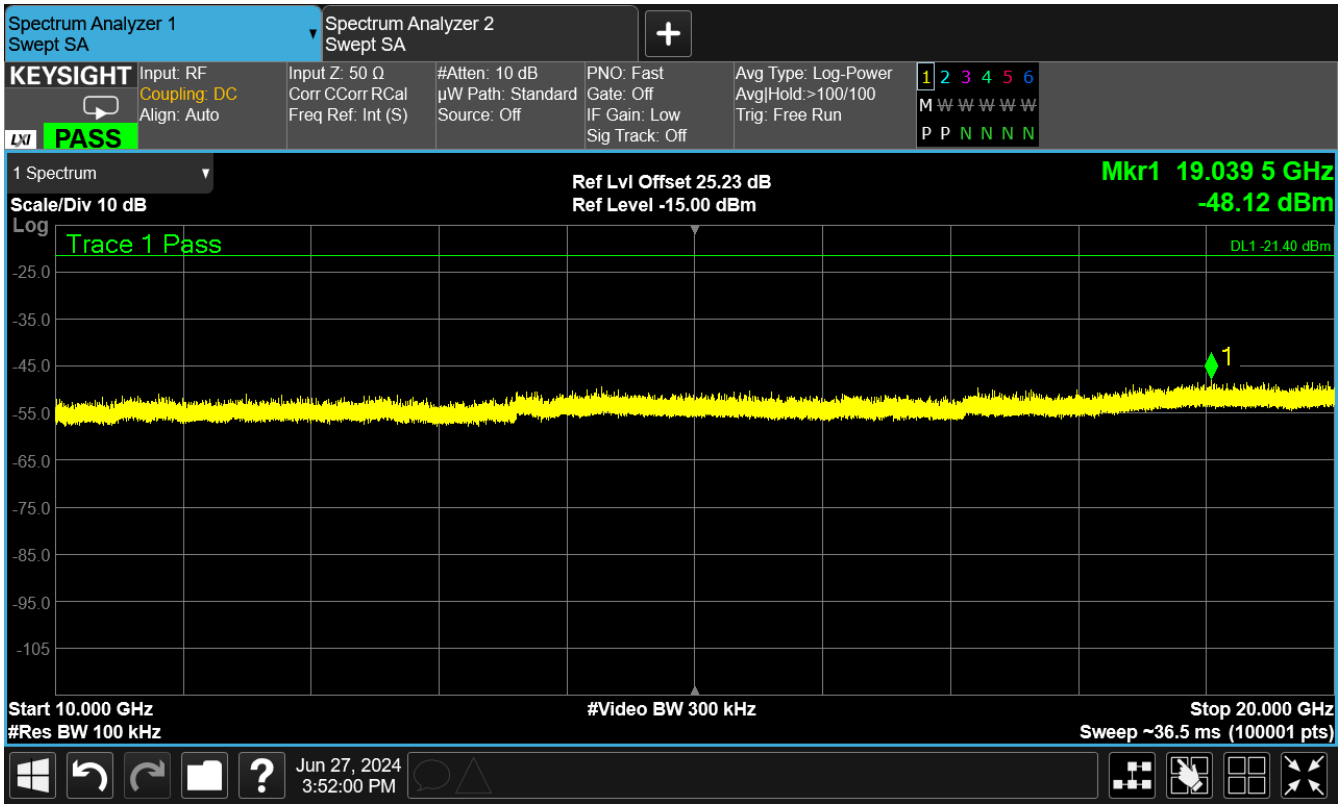


Figure 19: Low Channel Conducted Spurious Plot 6

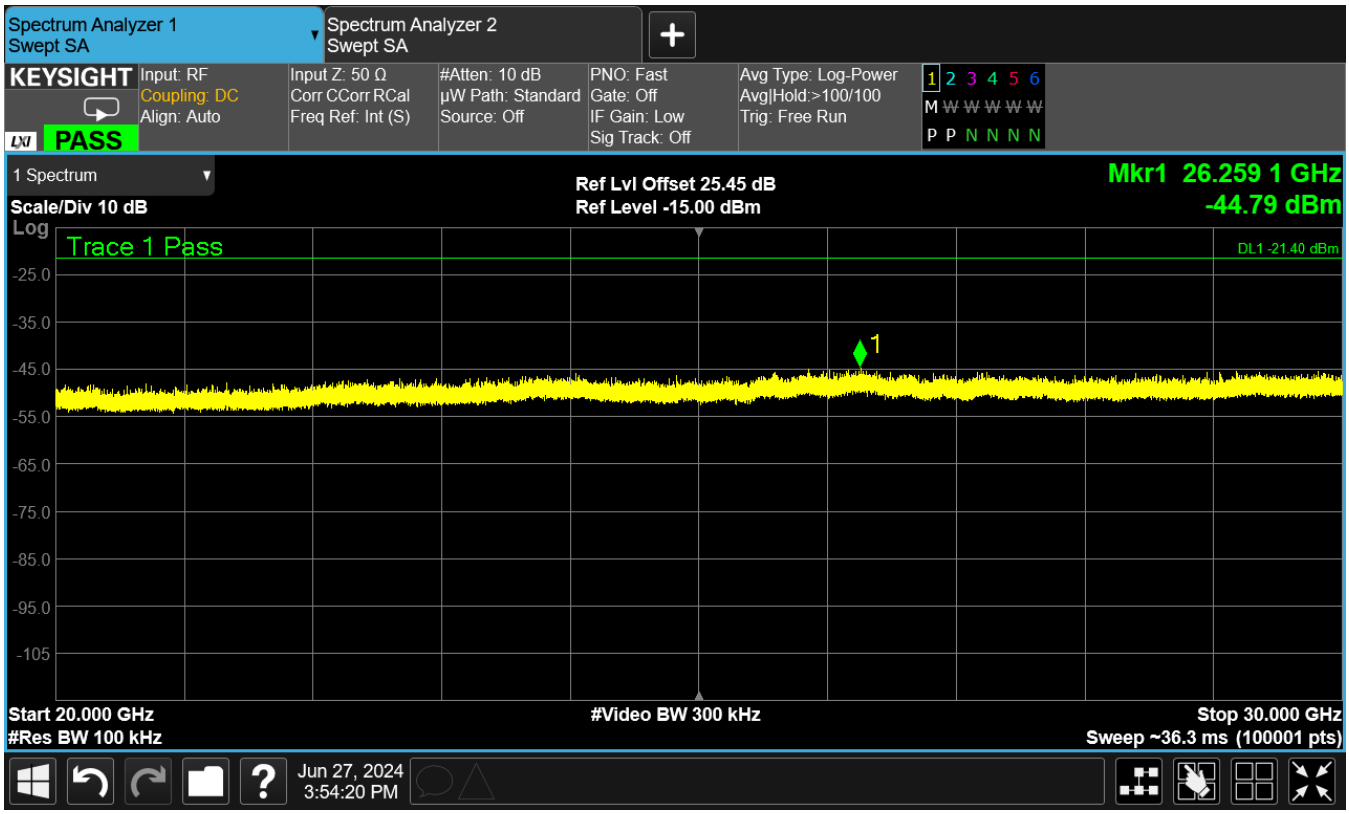


Figure 20: Center Channel Conducted Spurious Plot 1

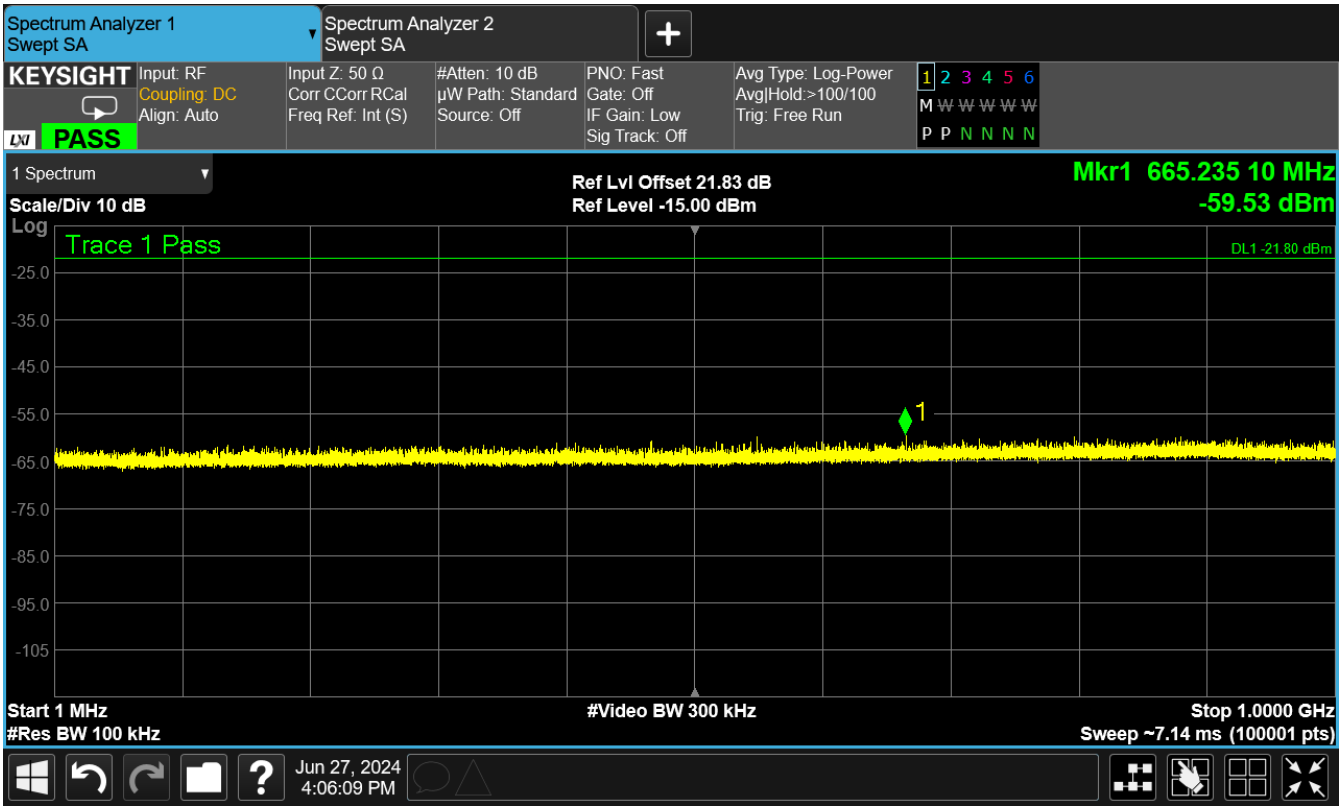


Figure 21: Center Channel Conducted Spurious Plot 2

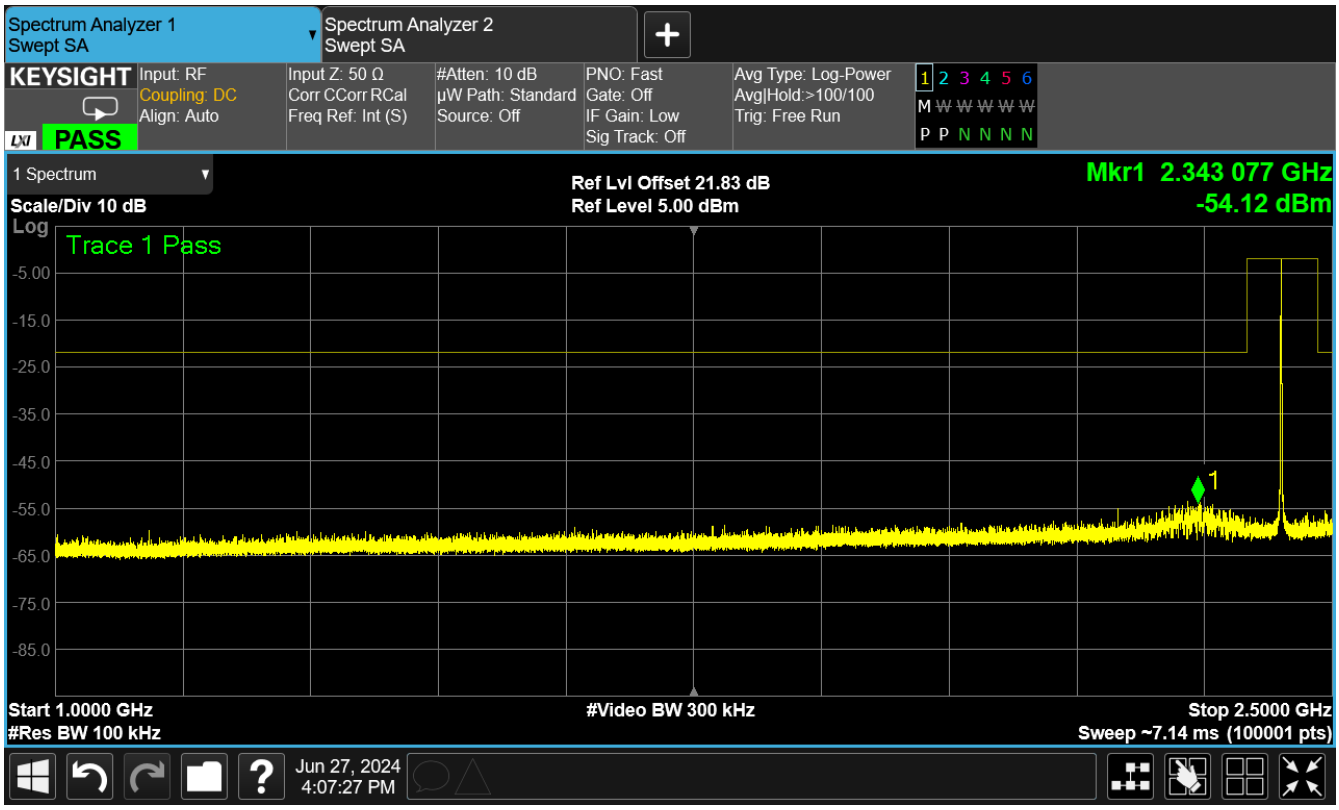


Figure 22: Center Channel Conducted Spurious Plot 3

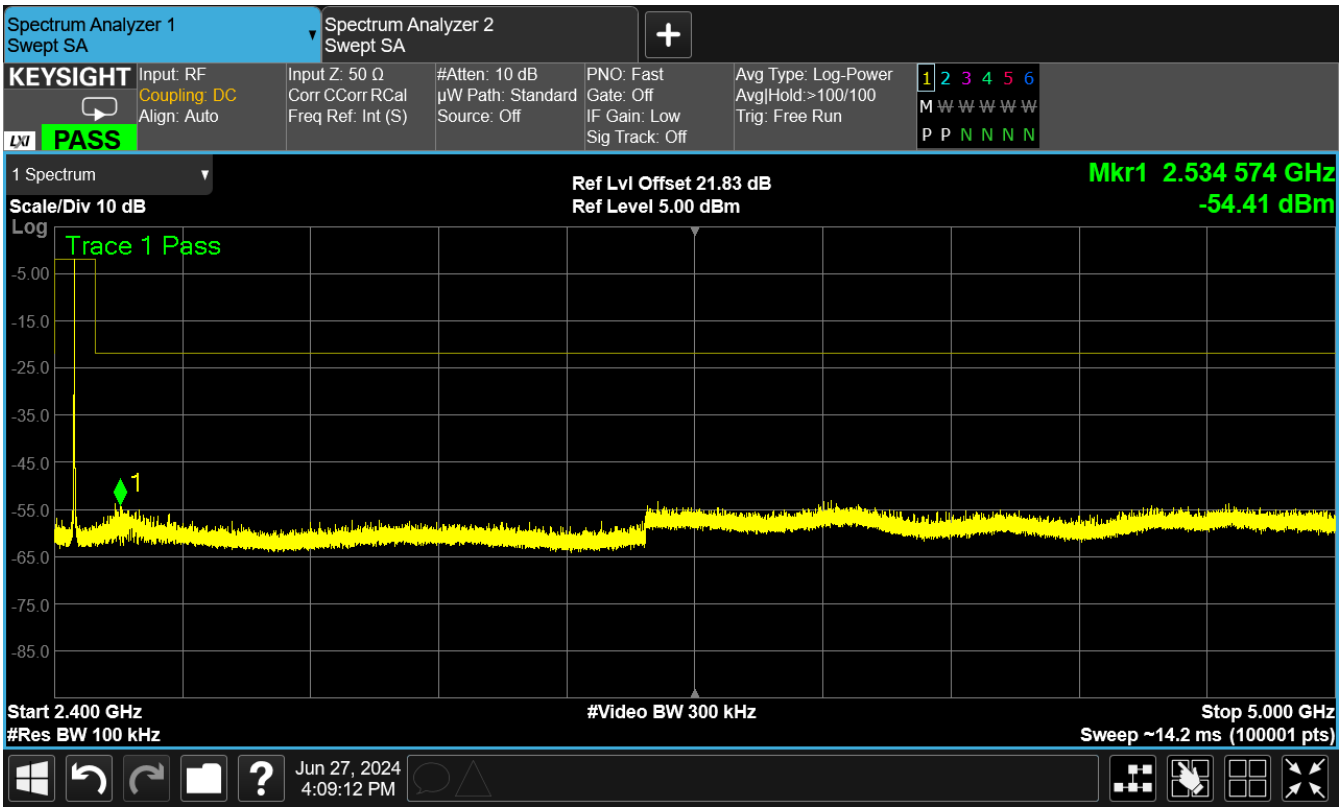


Figure 23: Center Channel Conducted Spurious Plot 4

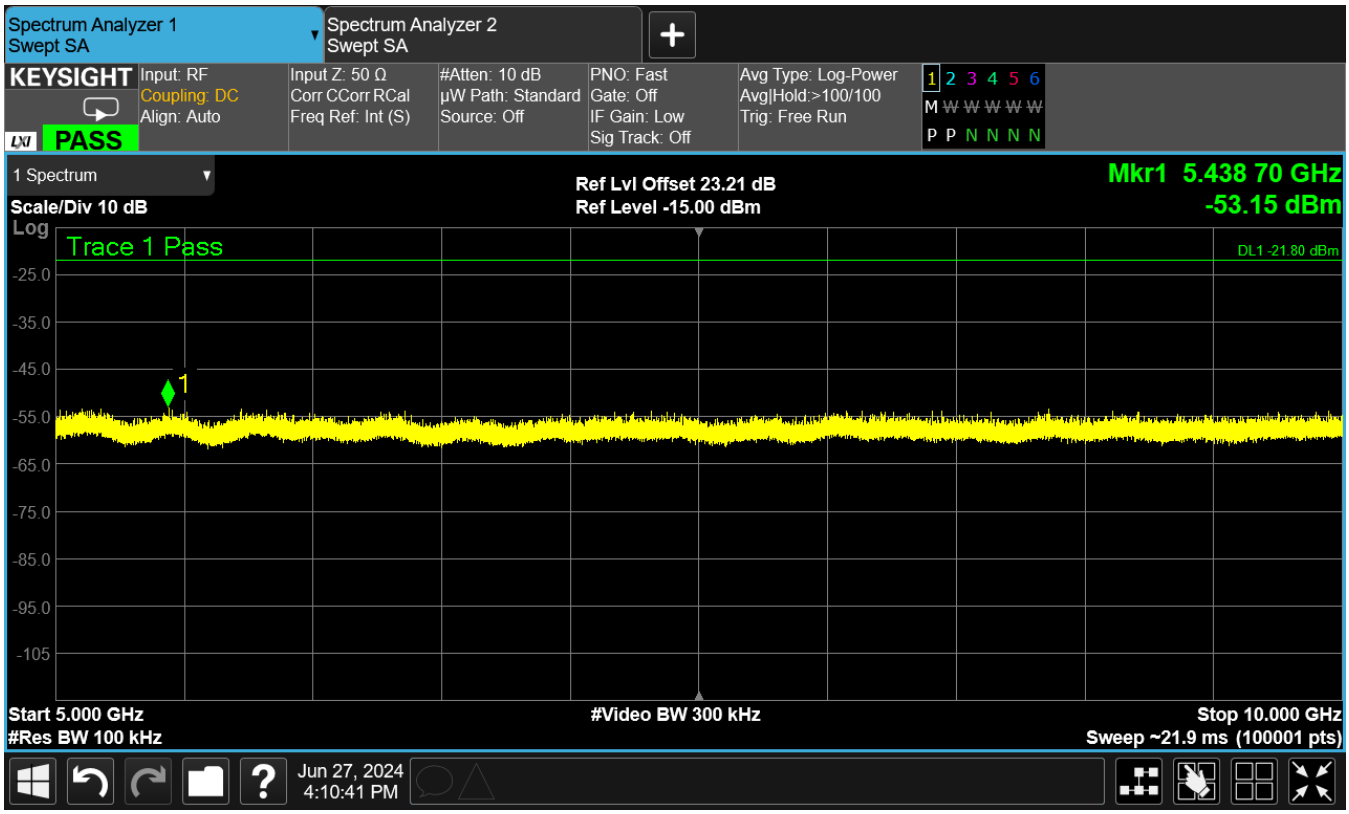


Figure 24: Center Channel Conducted Spurious Plot 5

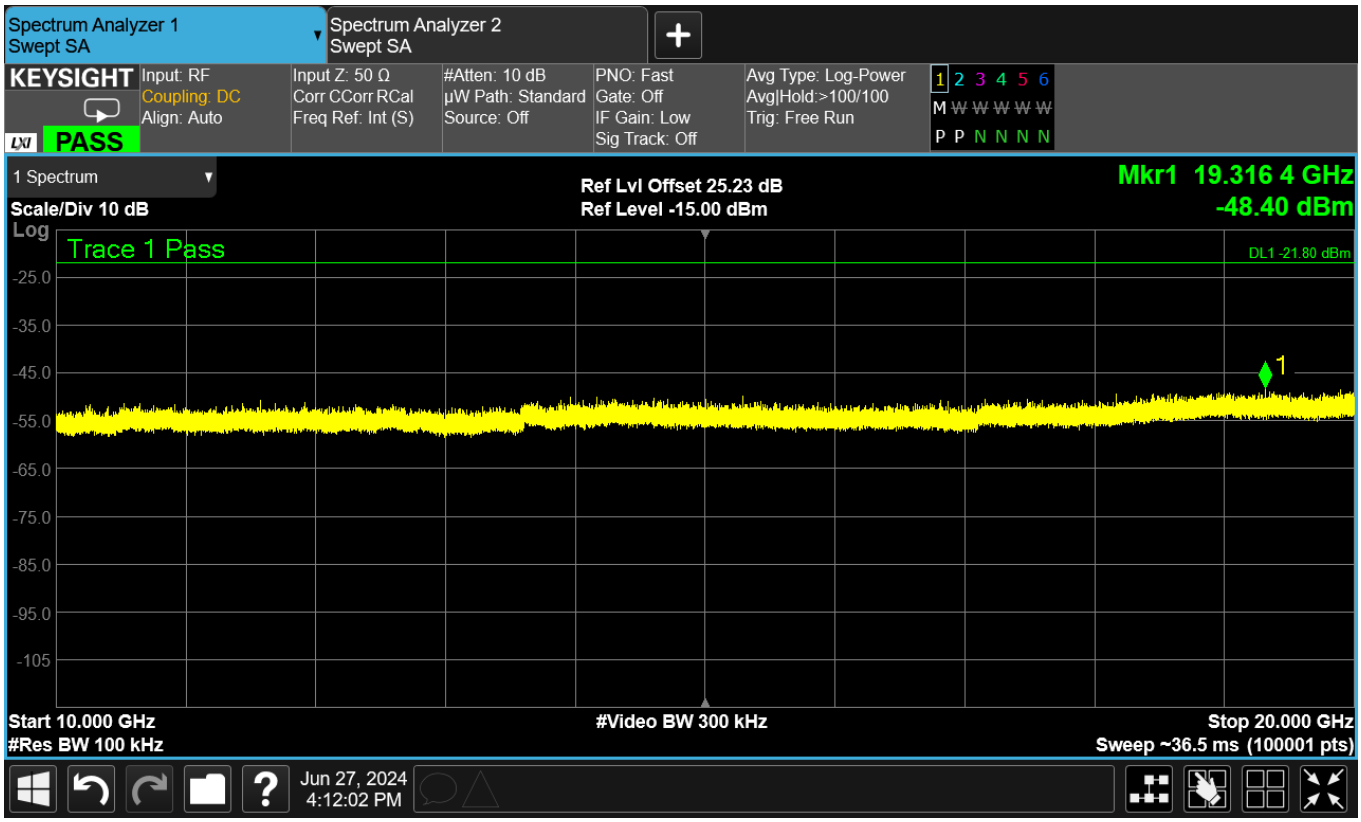


Figure 25: Center Channel Conducted Spurious Plot 6

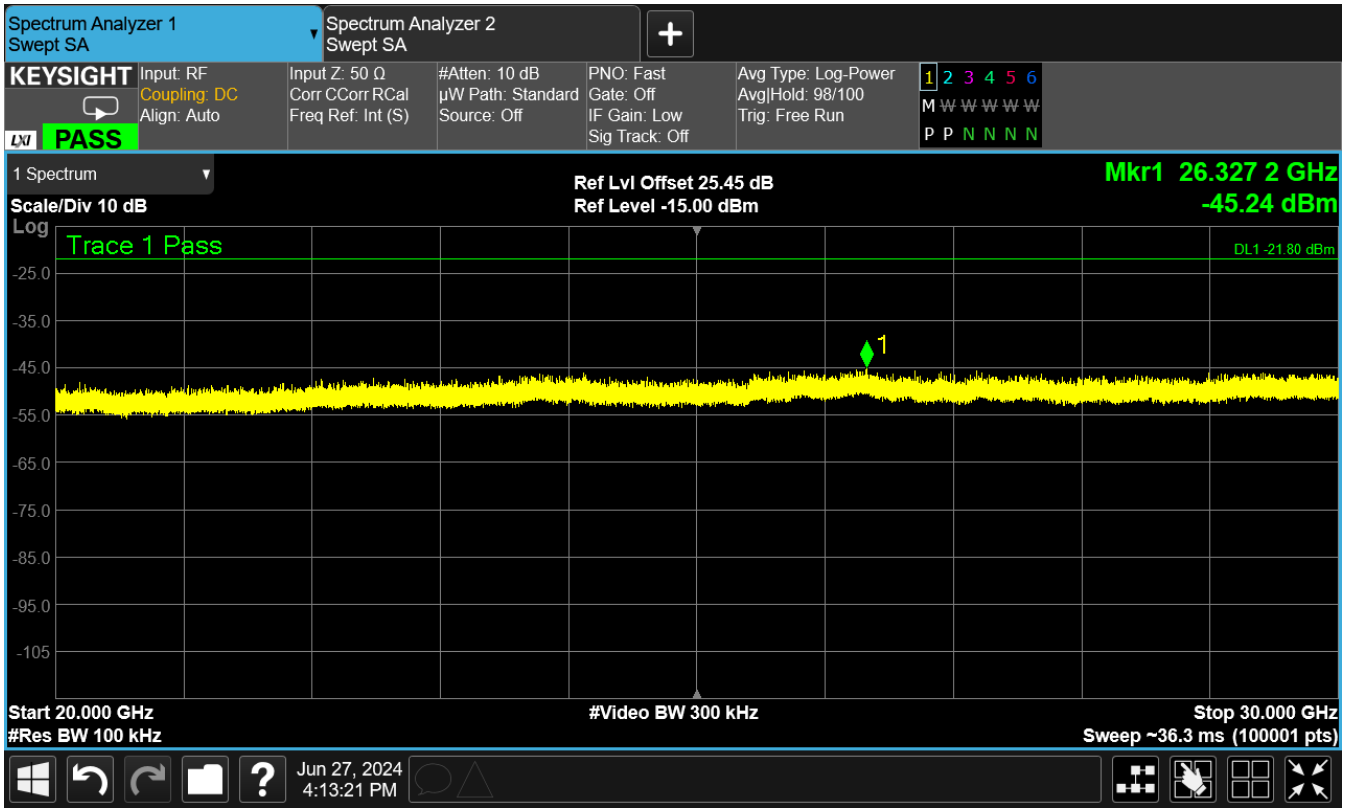


Figure 26: High Channel Conducted Spurious Plot 1

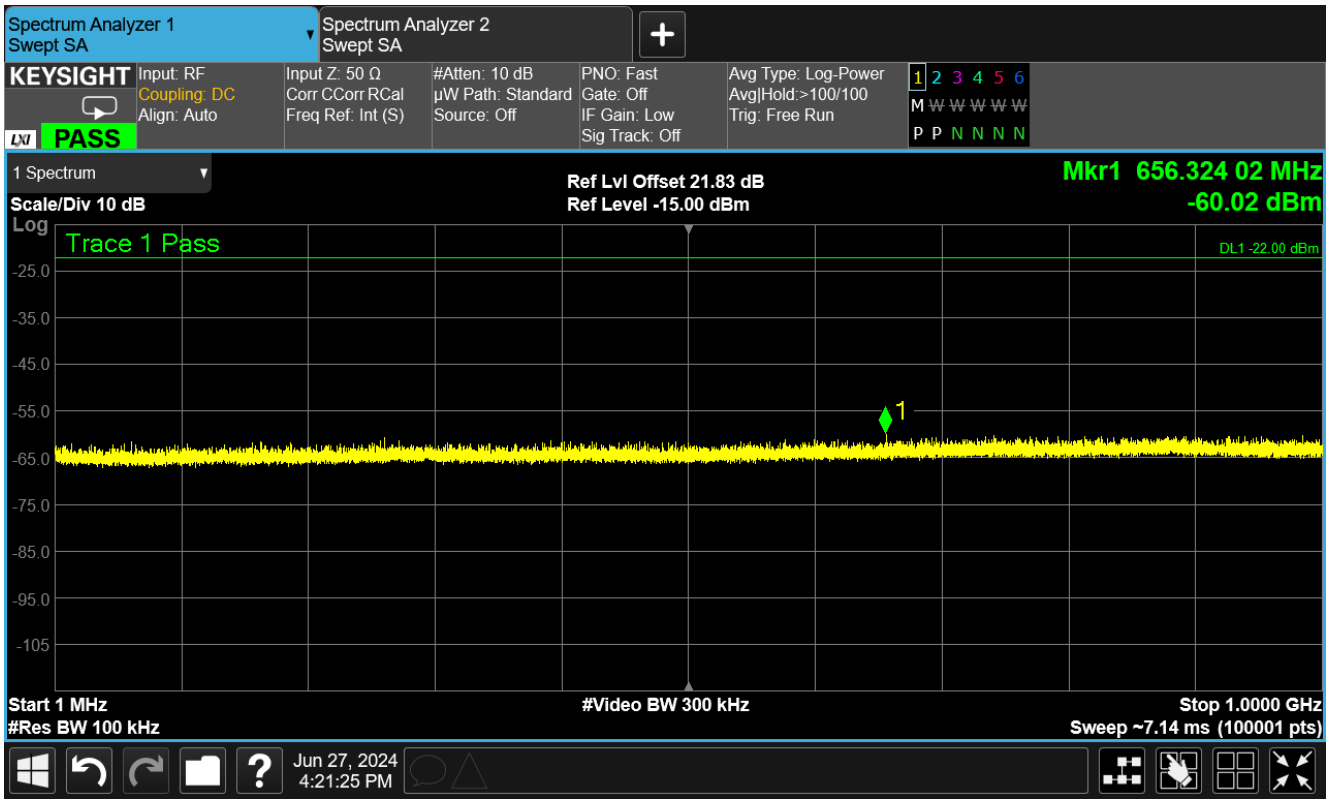


Figure 27: High Channel Conducted Spurious Plot 2

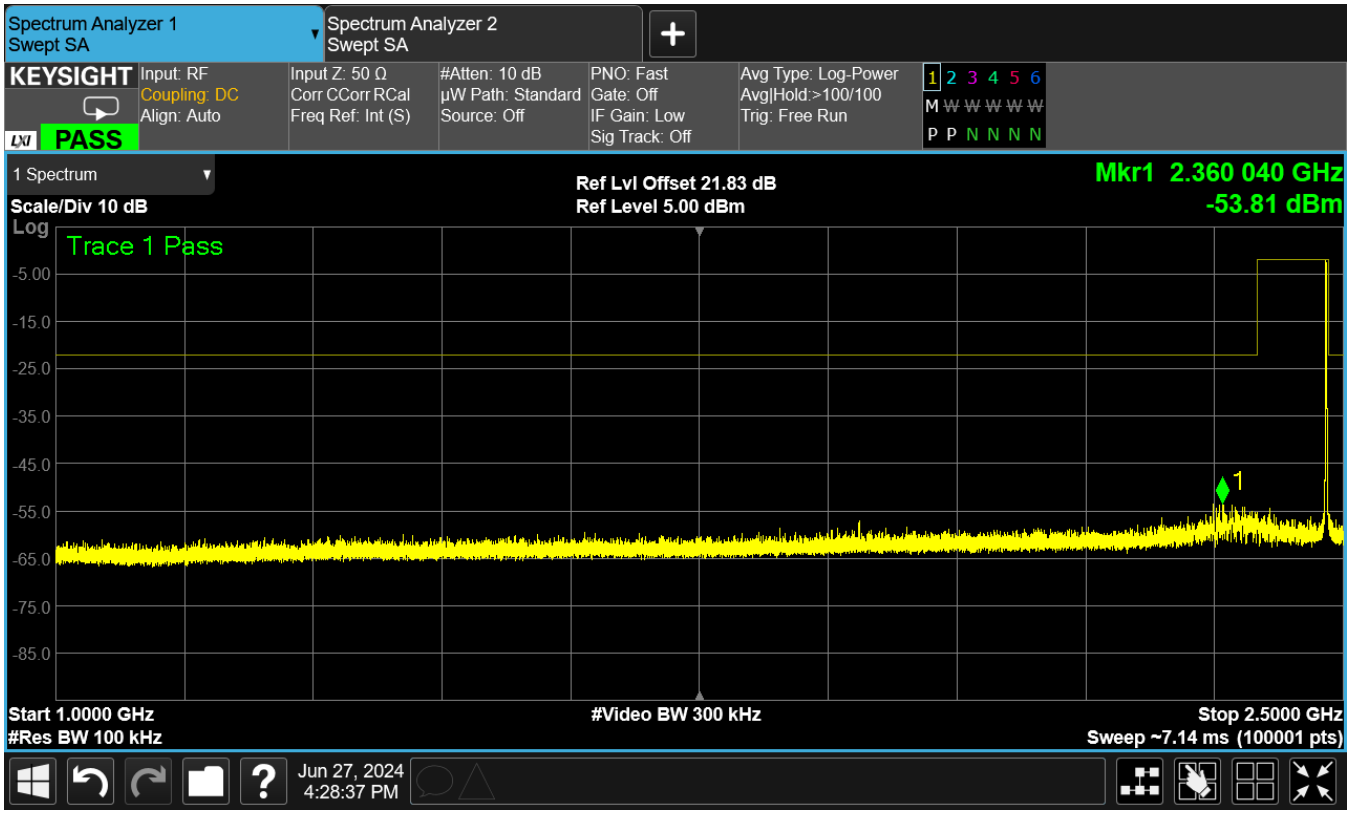


Figure 28: High Channel Conducted Spurious Plot 3

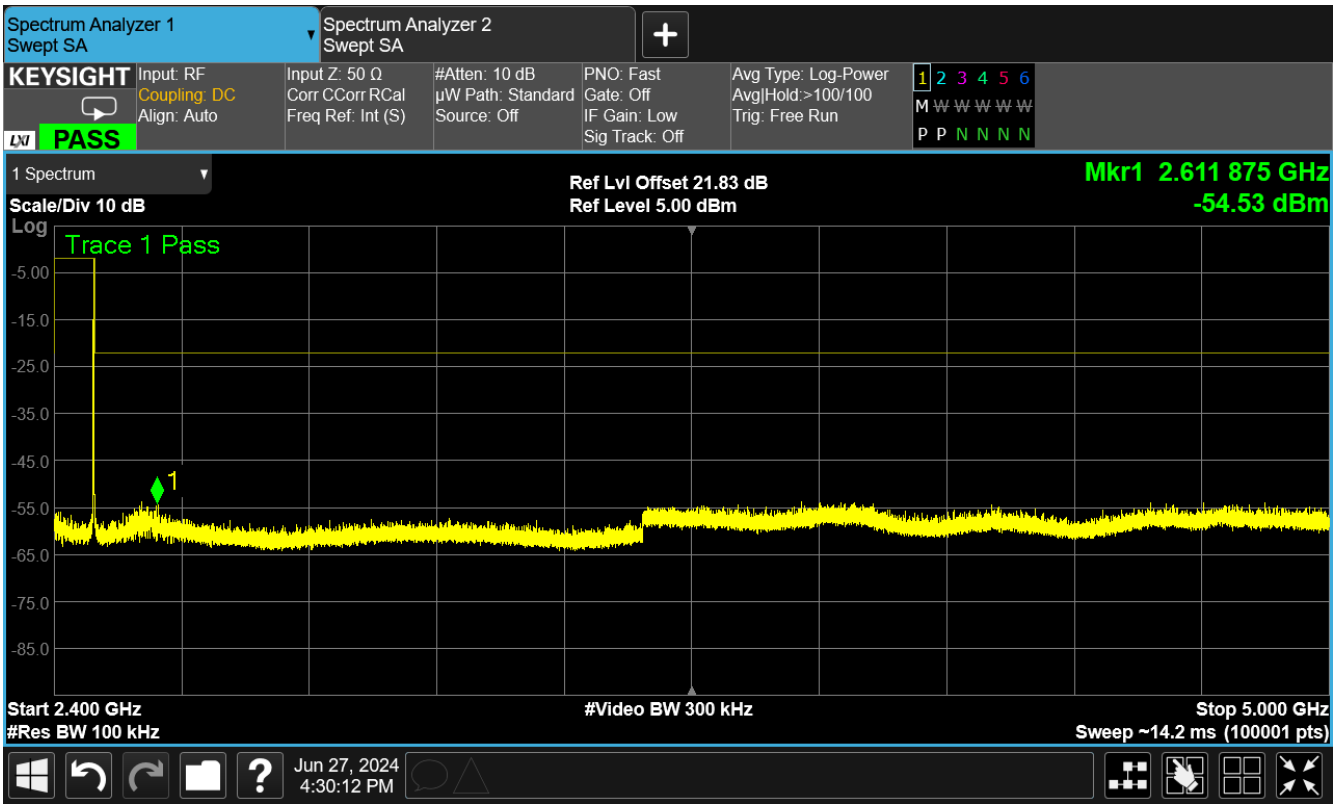


Figure 29: High Channel Conducted Spurious Plot 4

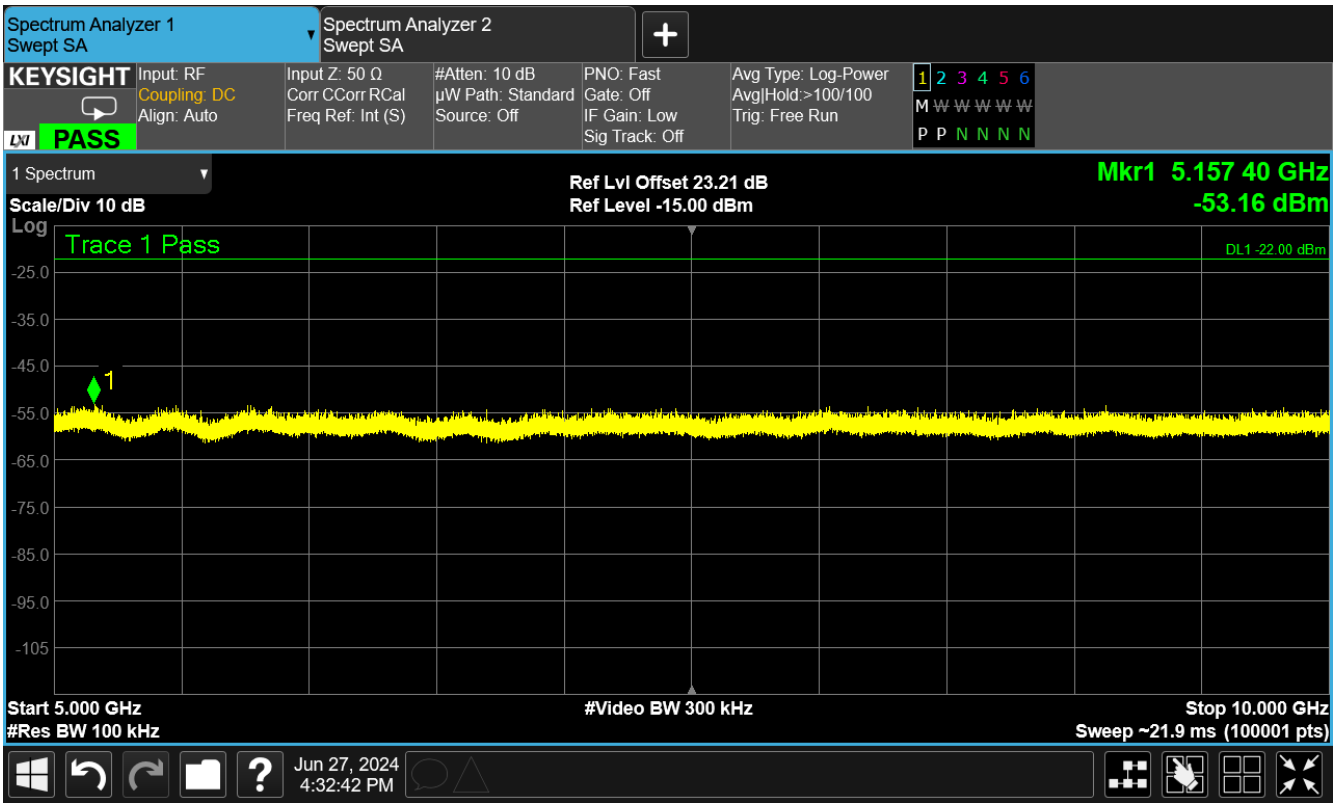


Figure 30: High Channel Conducted Spurious Plot 5

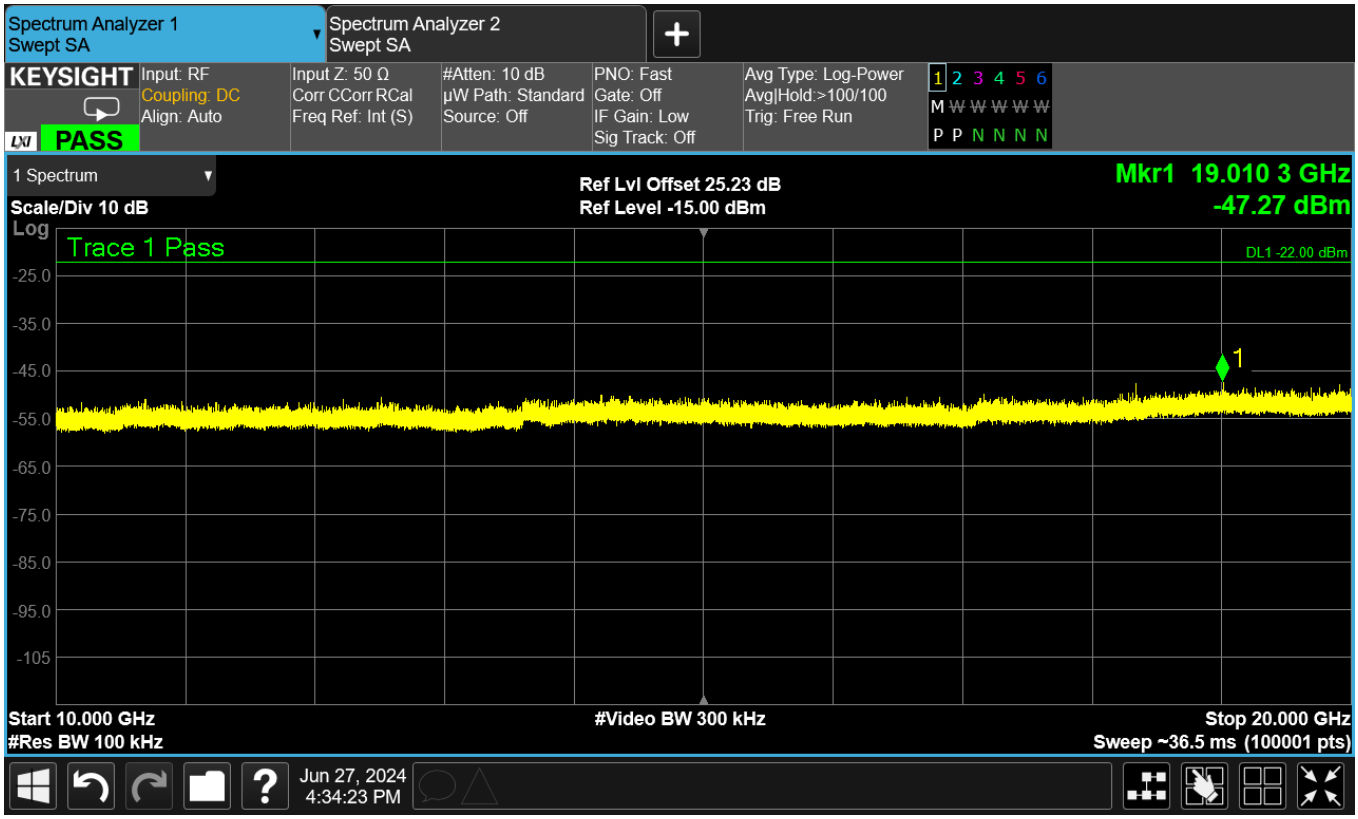
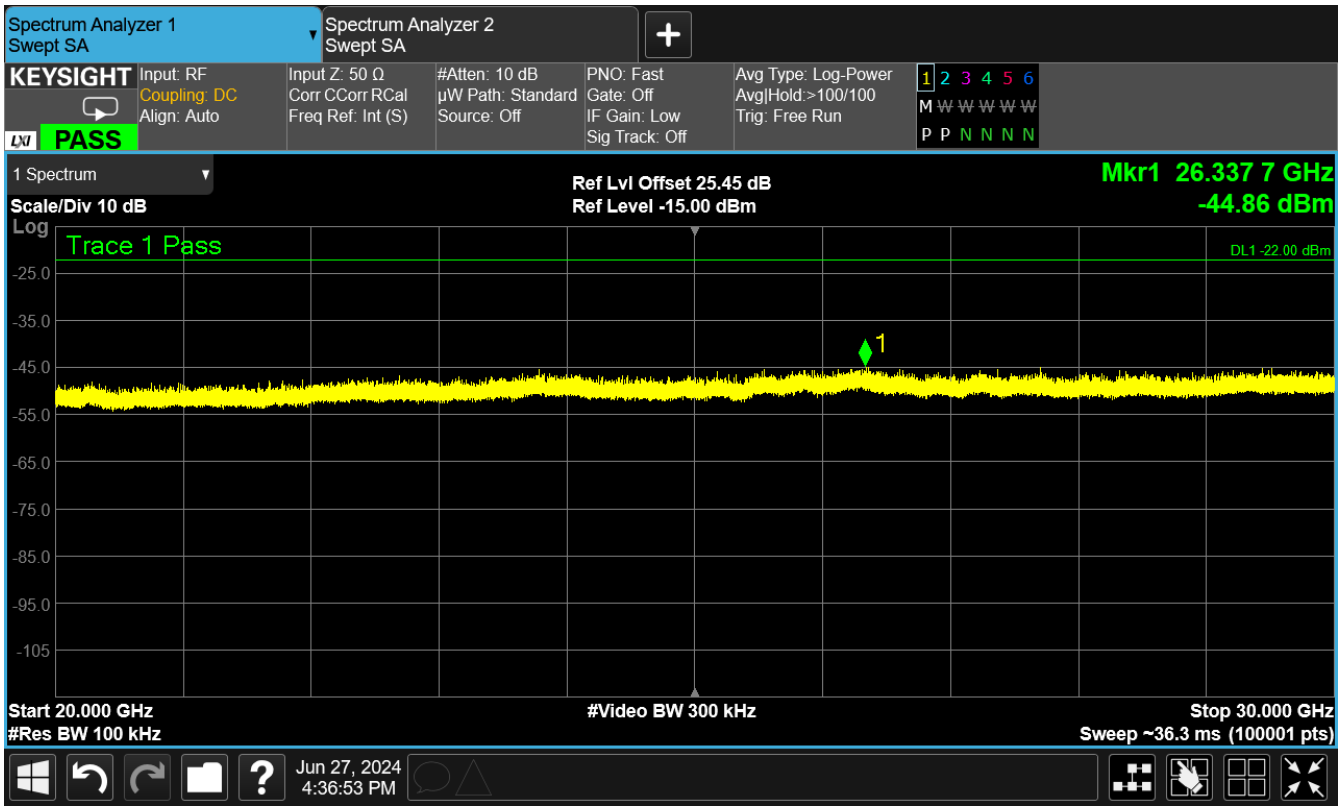


Figure 31: High Channel Conducted Spurious Plot 6



3.7 Radiated Emissions

3.7.1 Requirements

Compliance Standard: FCC Part 15.247, 15.209, 15.205

Radiated Emissions, Compliance Limits	
Frequency Range	Limit (distance)
	Class B (3 meter)
30 – 88 MHz	100 µV/m
88 – 216 MHz	150 µV/m
216 – 960 MHz	200 µV/m
> 960 MHz	500 µV/m

3.7.2 Test Procedure

The requirements of FCC Part 15 and ICES-003 call for the EUT to be placed on an 80 cm high 1 X 1.5 meters non-conductive motorized turntable for radiated testing on a 3-meter open air test site.

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 26.5 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.

3.7.3 Test Results Summary

The EUT complies with the Class B Radiated Emissions requirements.

There are no EUT emissions detected in the range of 6 GHz to 26.5 GHz.

3.7.4 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

3.7.5 Test Data

The EUT is fully compliant, and the test data 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 configured to transmit a 1Mbps, GFSK modulated signal as follows:

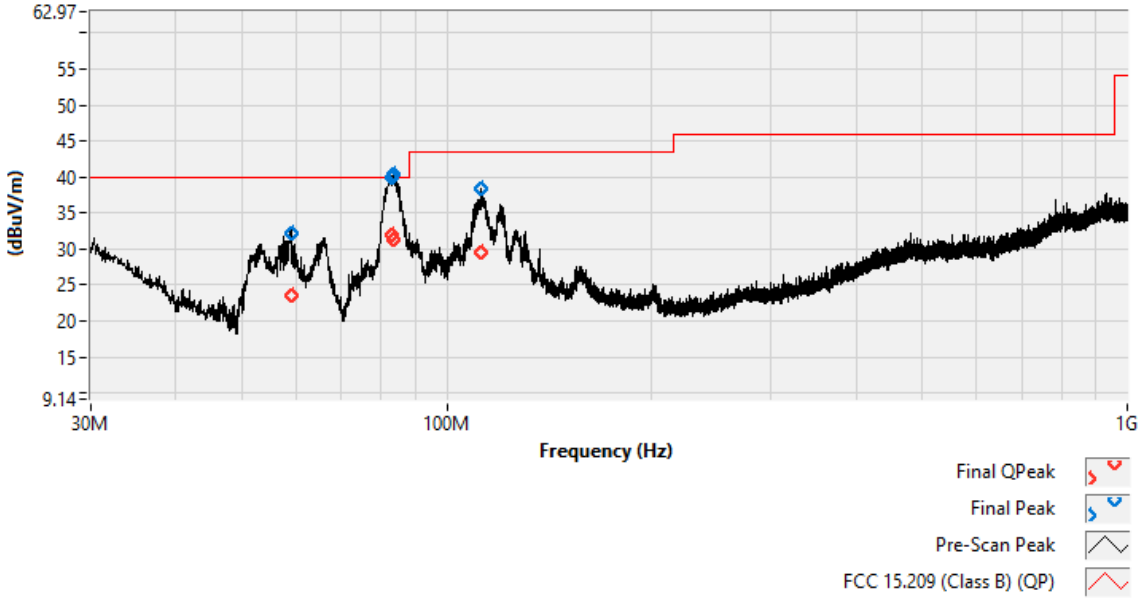
a) for testing of 30 MHz to 1 GHz, the EUT was set to a transmitter enabled mode, the BLE transceiver was set to sweep the 2.4GHz ISM band, in an active advertising mode.

b) for testing of 1 GHz to 26.5 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 following page provides the 30MHz-1GHz test data. Please accept this data to cover the digital portion under the provisions of 15.109(a).

Frequency (MHz)	Detector	Corr. Meas (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Table (deg)	Antenna (cm)
83.165	Peak	39.923	--	--	180	Vert, 125
	QP	31.944	40	-8.056	180	Vert, 125
112.508	Peak	38.364	--	--	45	Vert, 115
	QP	29.579	43.5	-13.921	45	Vert, 115

Pre-scan and Final Data (Vertical)



Pre-scan and Final Data (Horizontal)

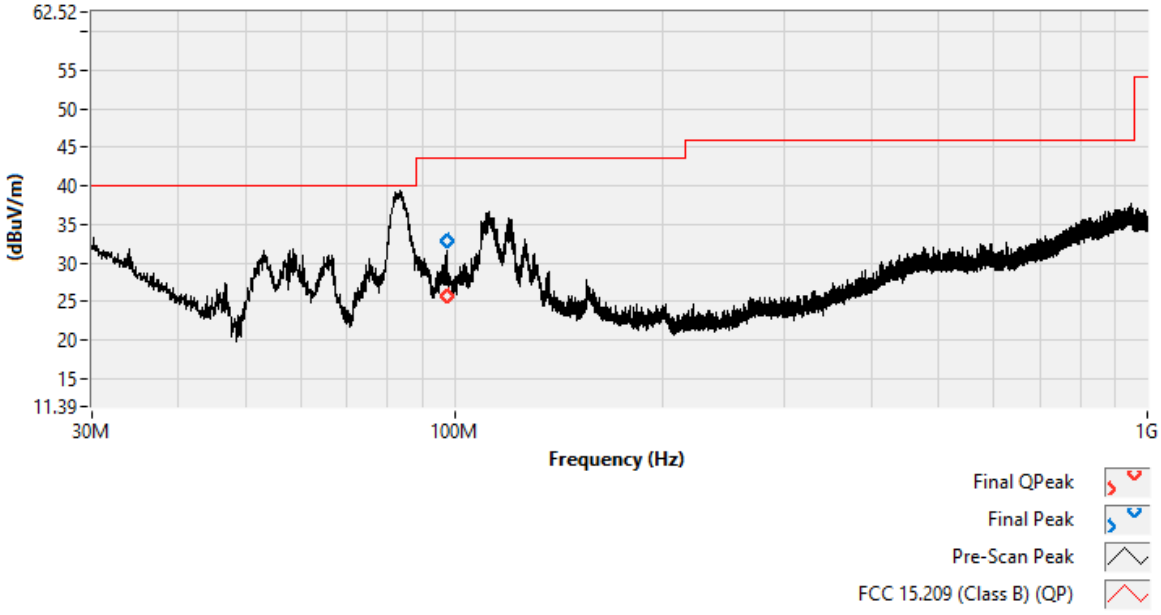
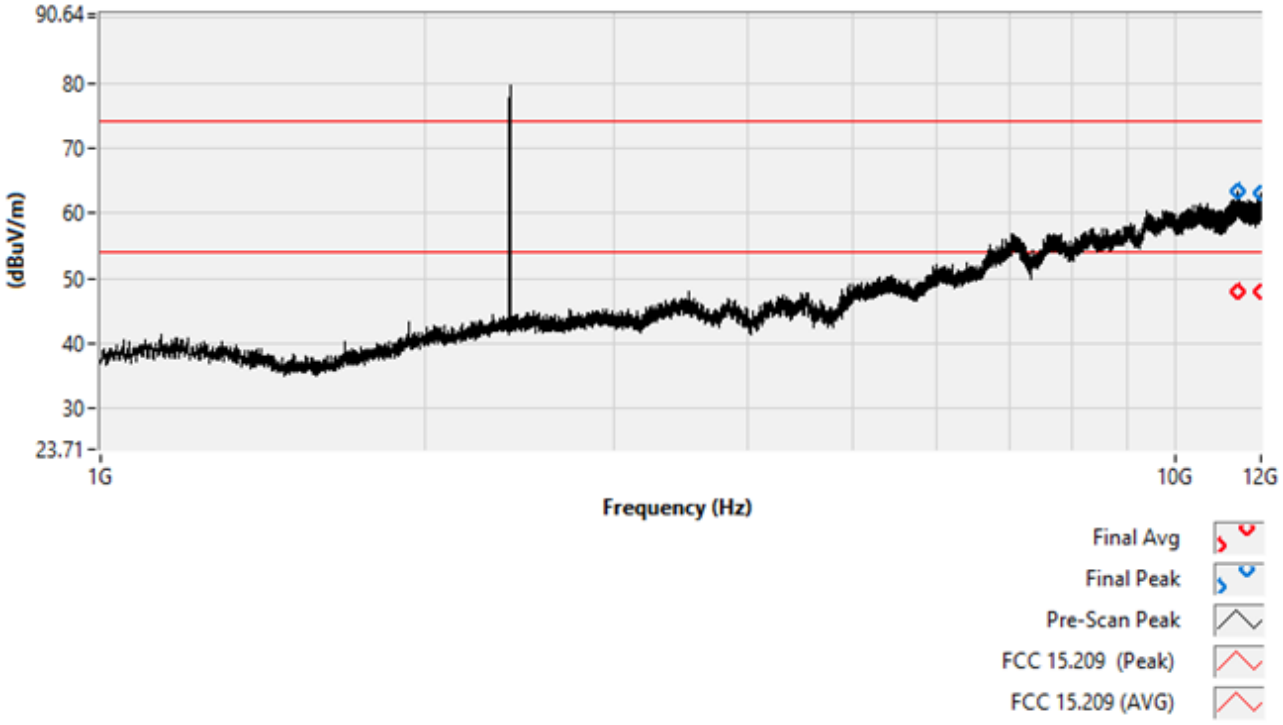


Table 9: Radiated Emissions Test Data, Low Channel

Frequency (Hz)	Detector	Corr. Meas (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Turn Table (deg)	Antenna (cm)
2390.00 [1]	Peak	42.695	74	-31.305	285	Horiz, 168
	AVG	29.843	54	-24.157	285	Horiz, 168
2402.00 [2]	Peak	90.35	--	--	285	Horiz, 168
	AVG	84.46	--	--	285	Horiz, 168
7045.00 [3]	Peak	57.244	74	-16.756	285	Horiz, 168
	AVG	40.027	54	-13.973	285	Horiz, 168
8314.00 [3]	Peak	58.402	74	-15.598	285	Horiz, 168
	AVG	43.982	54	-10.018	285	Horiz, 168
9913.00 [3]	Peak	60.471	74	-13.529	285	Horiz, 168
	AVG	46.39	54	-7.61	285	Horiz, 168
11430.00 [3]	Peak	63.24	74	-10.76	77	Vert, 155
	AVG	47.822	54	-6.178	77	Vert, 155
1200.00 [3]	Peak	63.086	74	-10.914	77	Vert, 155
	AVG	47.869	54	-6.131	77	Vert, 155

[1] Restricted BE
[2] Low Chan TX
[3] Ambient

Low Chan., Pre-scan and Final Data (Vertical)



Low Chan., Pre-scan and Final Data (Horizontal)

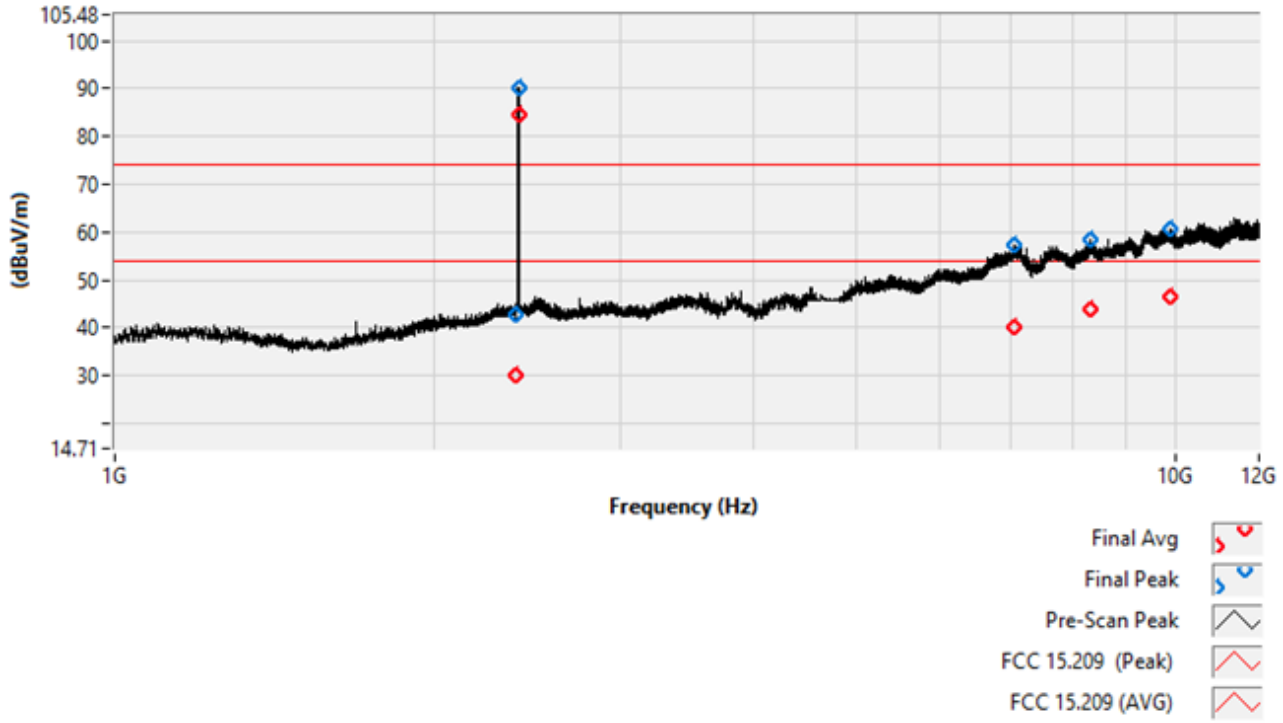
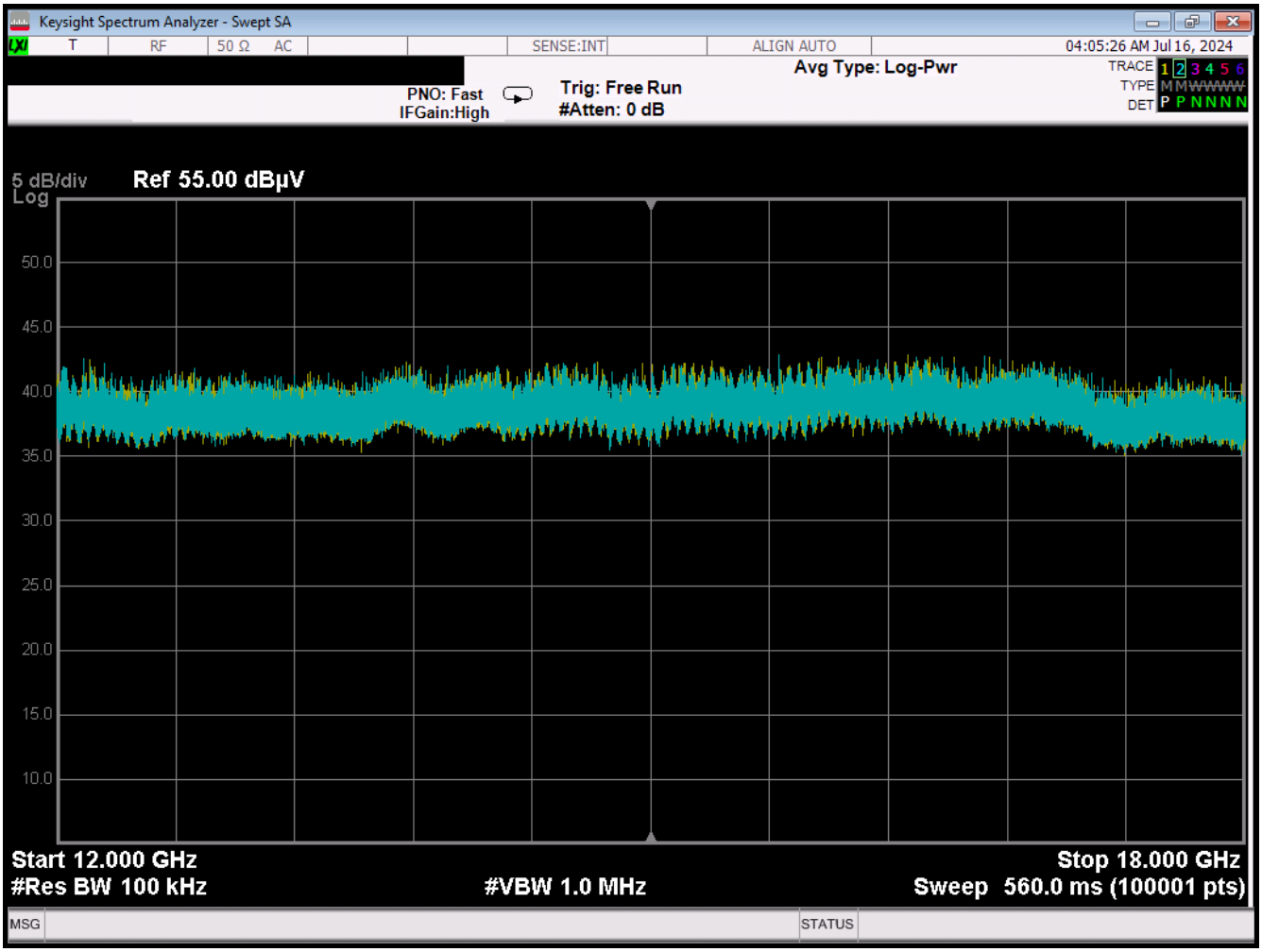
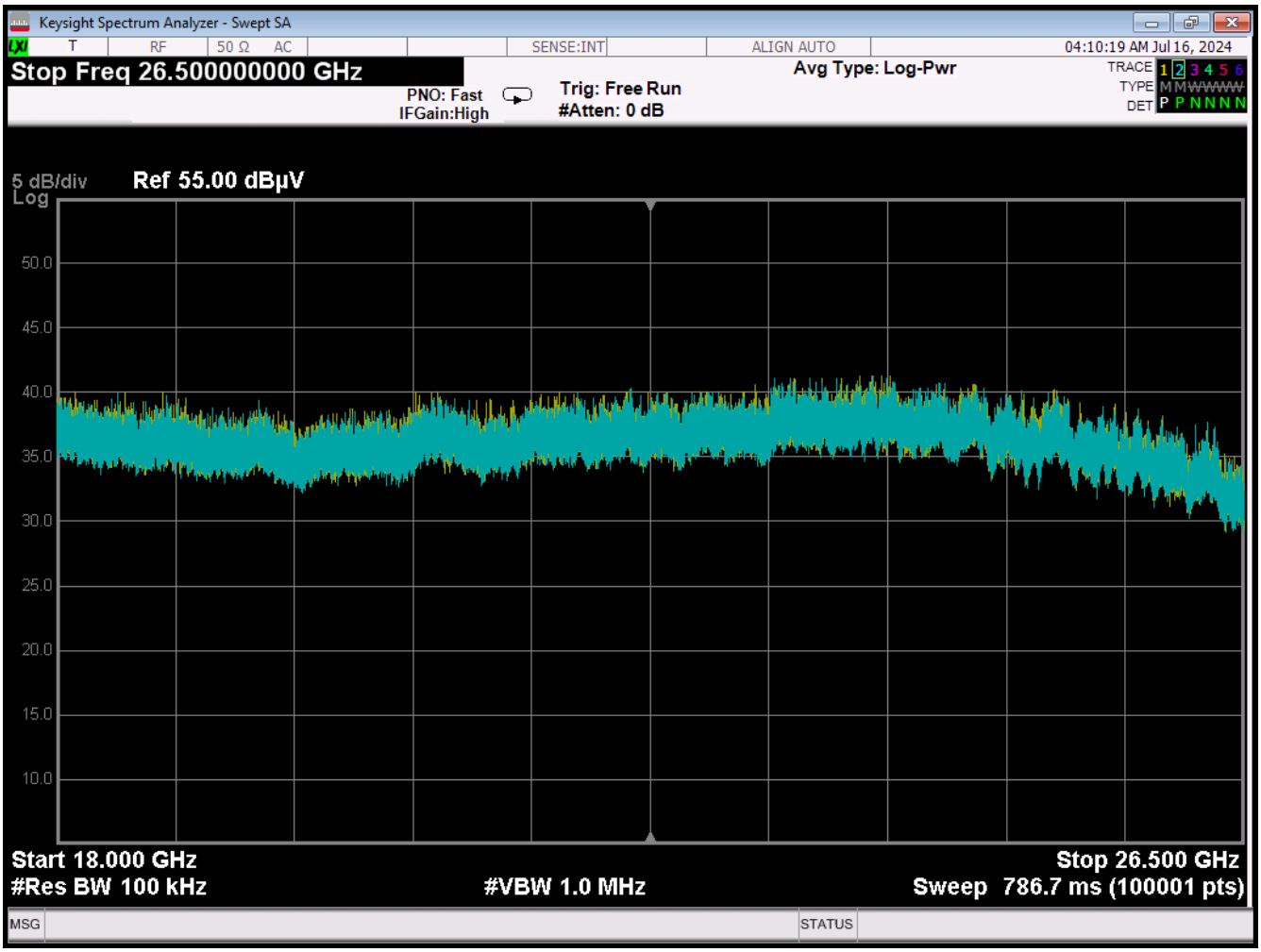


Figure 32: Radiated Emissions Test Data, Low Channel (12GHz to 18GHz)



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

Figure 33: Radiated Emissions Test Data, Low Channel (18GHz to 26.5GHz)



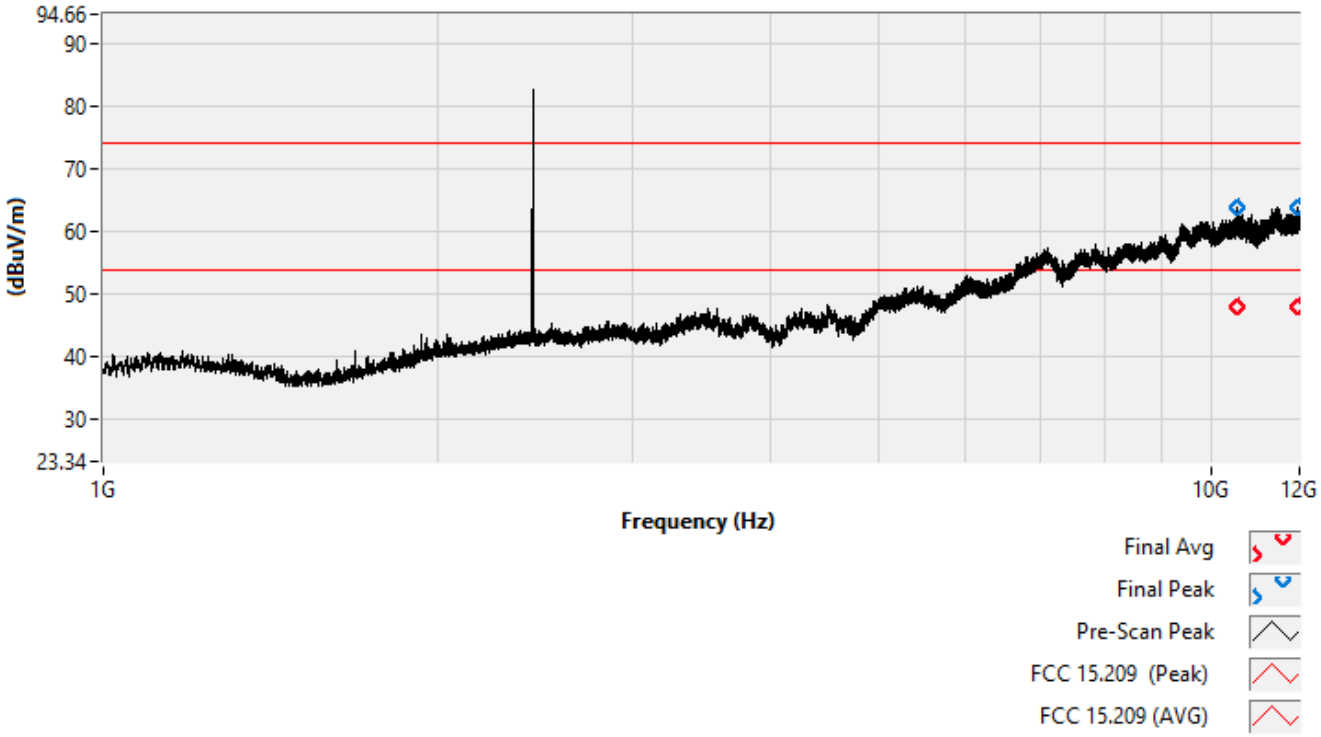
- EUT emissions are not detected in this frequency range.
- Trace 1 = EUT TX On
- Trace 2 = Ambient

Table 10: Radiated Emissions Test Data, Center Channel

Frequency (MHz)	Detector	Corr. Meas (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Turn Table (deg)	Antenna (cm)
2440.0 [1]	Peak	90.421	--	--	285	Horiz, 168
	AVG	77.815	--	--	285	Horiz, 168
7139.00 [2]	Peak	57.586	74	-16.414	285	Horiz, 168
	AVG	42.693	54	-11.307	285	Horiz, 168
8290.00 [2]	Peak	58.684	74	-15.316	285	Horiz, 168
	AVG	43.402	54	-10.598	285	Horiz, 168
9767.00 [2]	Peak	61.322	74	-12.678	285	Horiz, 168
	AVG	46.169	54	-7.831	285	Horiz, 168
10543.00 [2]	Peak	63.850	74	-10.150	75	Vert, 150
	AVG	48.096	54	-5.904	75	Vert, 150
11954.00 [2]	Peak	63.96	74	-10.04	75	Vert, 150
	AVG	47.889	54	-6.111	75	Vert, 150

[1] Center Chan. Tx
[2] Ambient

Center Chan., Pre-scan and Final Data (Vertical)



Center Chan., Pre-scan and Final Data (Horizontal)

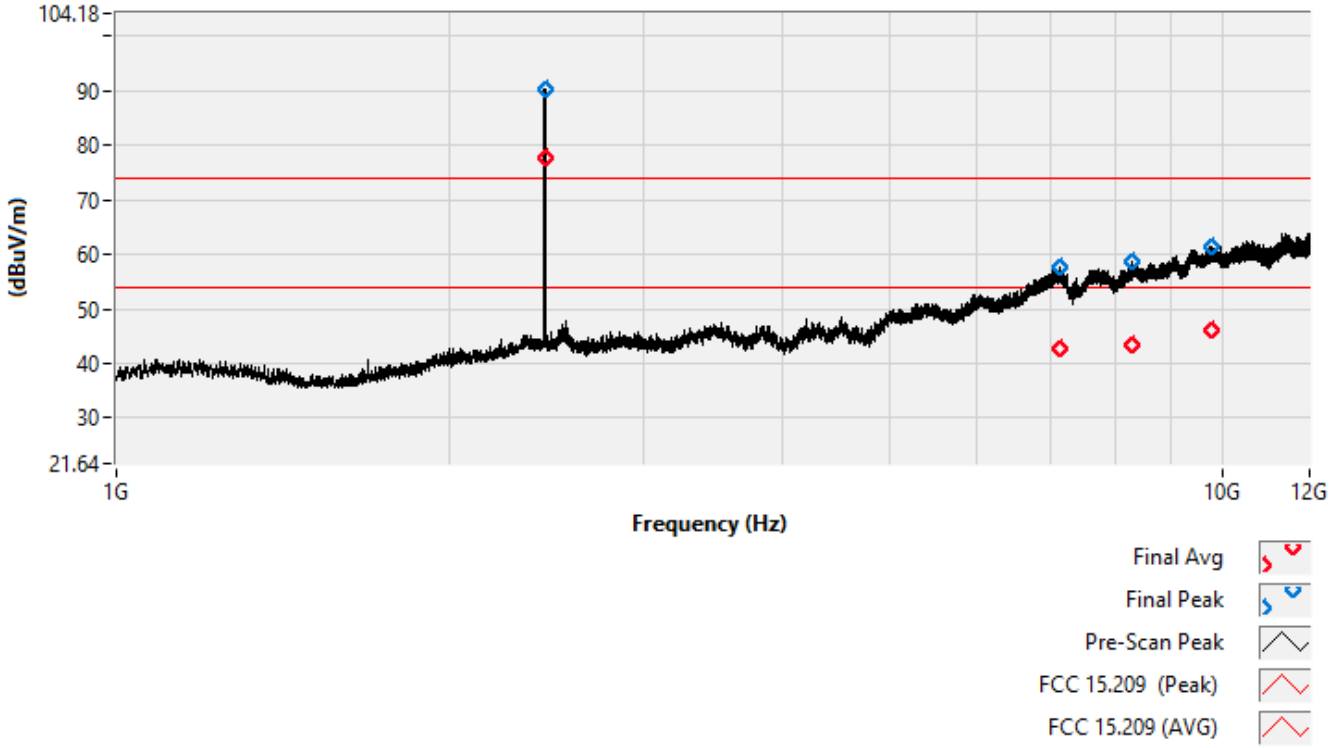
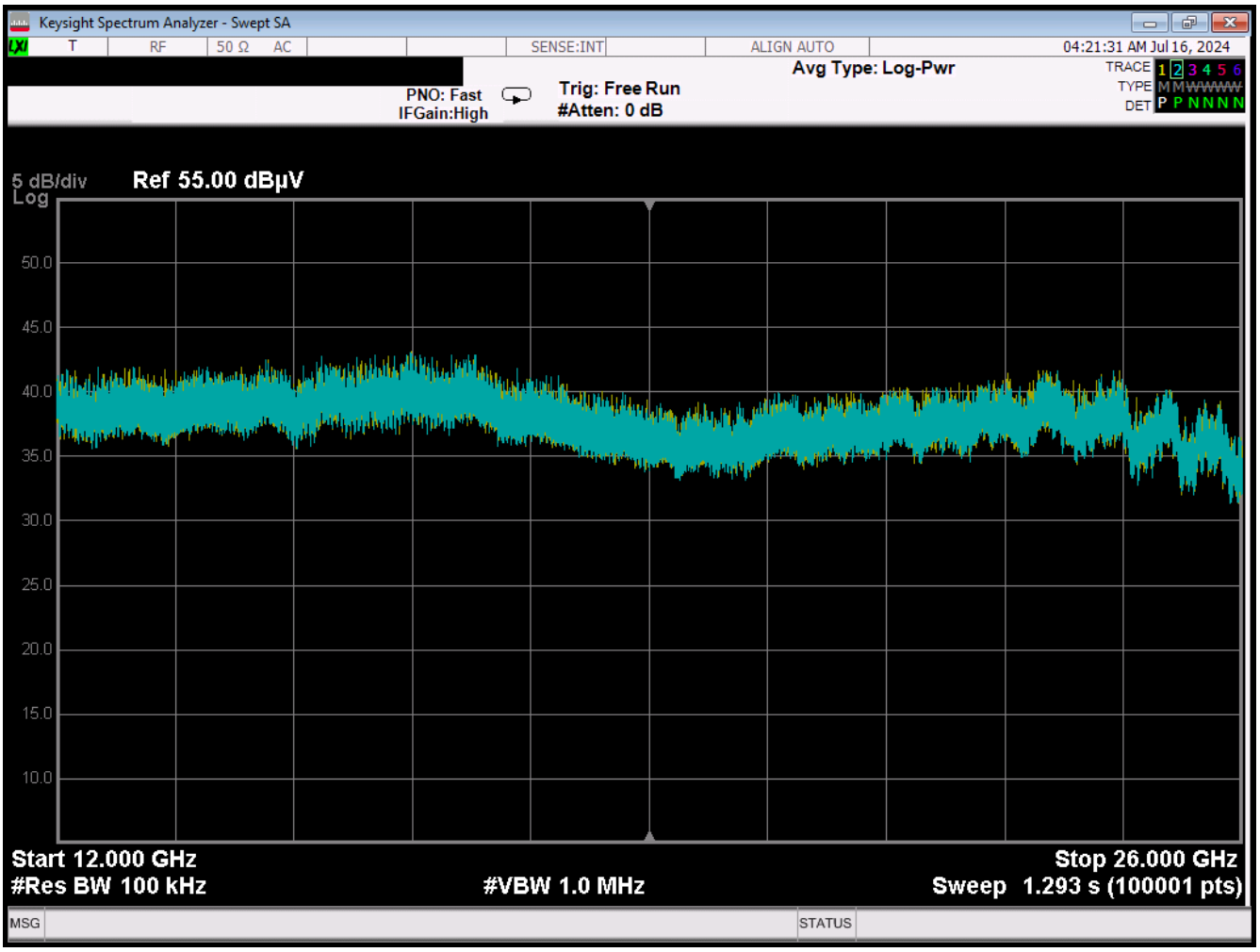


Figure 34: Radiated Emissions Test Data, Center Channel (12GHz to 26GHz)



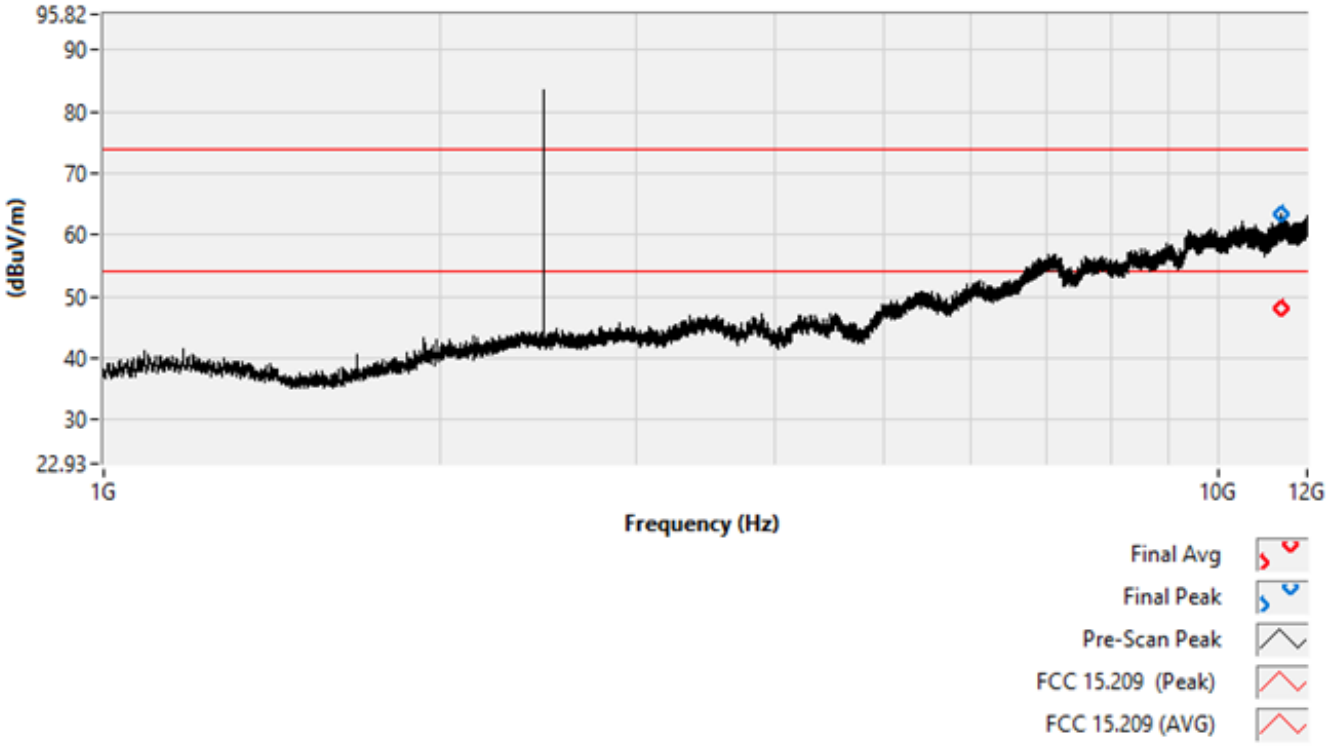
- EUT emissions are not detected in this frequency range.
- Trace 1 = EUT TX On
- Trace 2 = Ambient

Table 11: Radiated Emissions Test Data, High Channel

Frequency (MHz)	Detector	Corr. Meas (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Turn Table (deg)	Antenna (cm)
2480.0 [1]	Peak	90.818			285	Horiz, 168
	AVG	85.029			285	Horiz, 168
2483.5 [2]	Peak	44.627	74	-29.373	285	Horiz, 168
	AVG	32.00	54	-22.00	285	Horiz, 168
7105.0 [3]	Peak	57.027	74	-16.973	285	Horiz, 168
	AVG	41.646	54	-12.354	285	Horiz, 168
8062.0 [3]	Peak	57.209	74	-16.791	285	Horiz, 168
	AVG	41.608	54	-12.392	285	Horiz, 168
9827.0 [3]	Peak	61.405	74	-12.595	285	Horiz, 168
	AVG	45.989	54	-8.011	285	Horiz, 168
11373.0 [3]	Peak	63.385	74	-10.615	180	Vert, 145
	AVG	48.264	54	-5.736	180	Vert, 145
11415.0 [3]	Peak	64.241	74	-9.759	285	Horiz, 168
	AVG	48.637	54	-5.363	285	Horiz, 168

[1] High Chan TX
[2] Restricted BE
[3] Ambient

High Chan., Pre-scan and Final Data (Vertical)



High Chan., Pre-scan and Final Data (Horizontal)

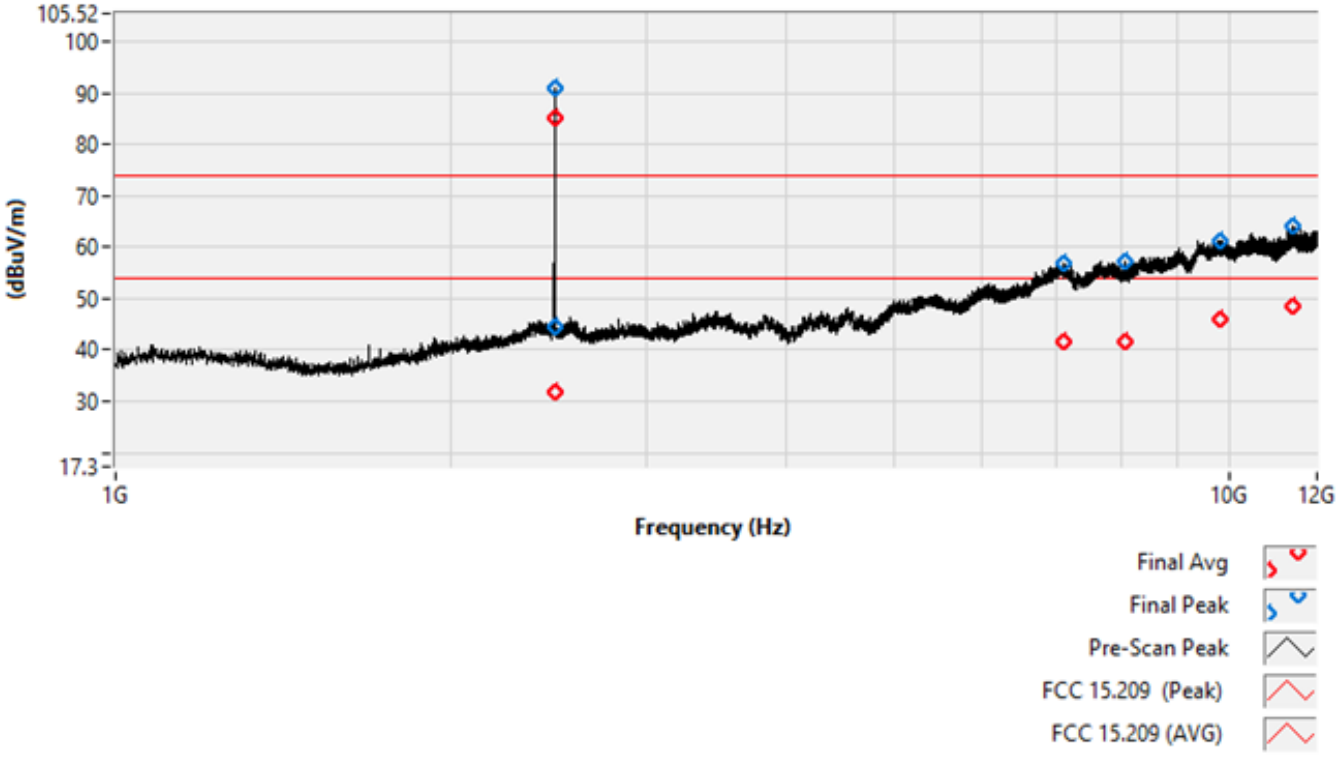
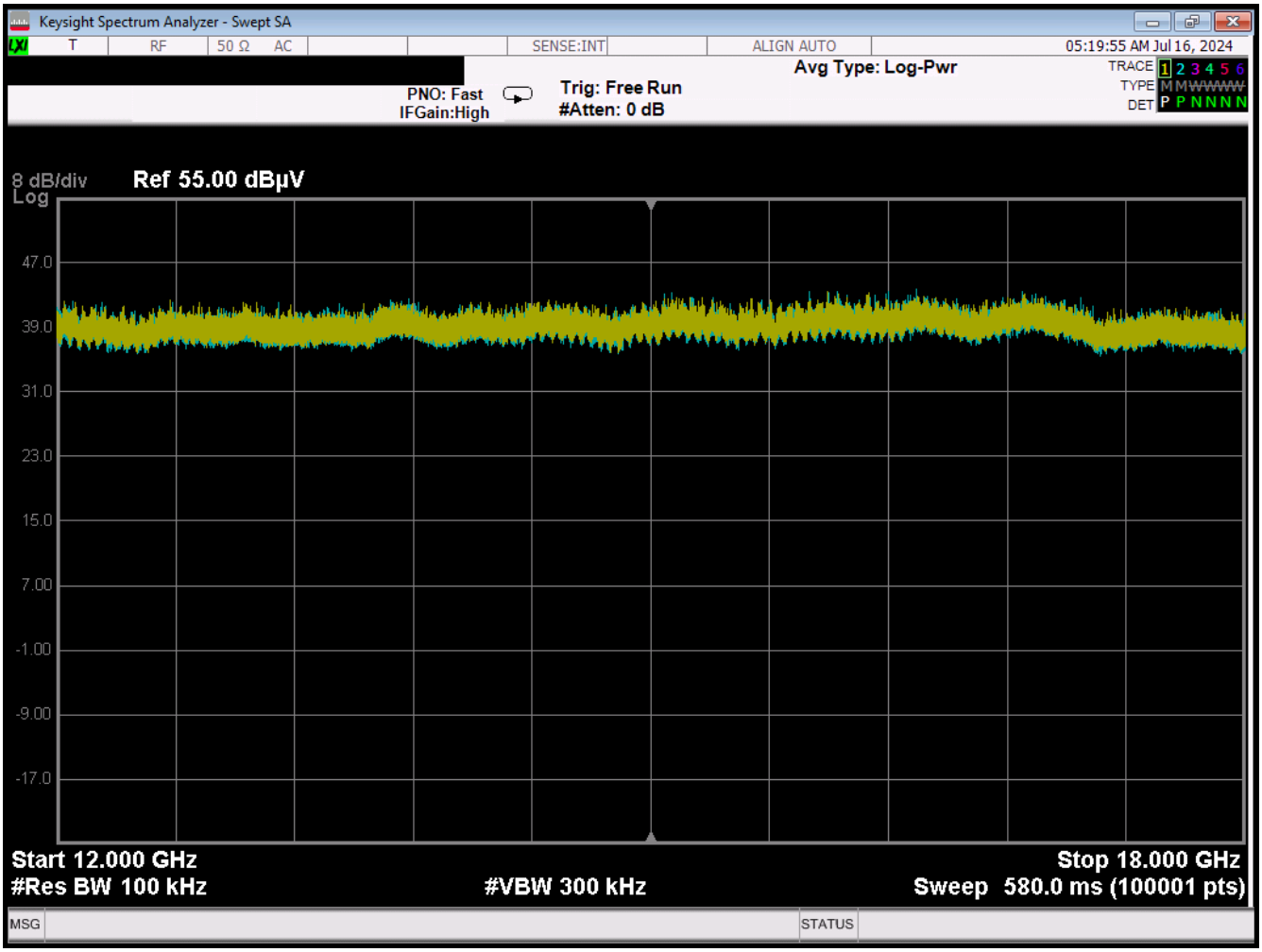
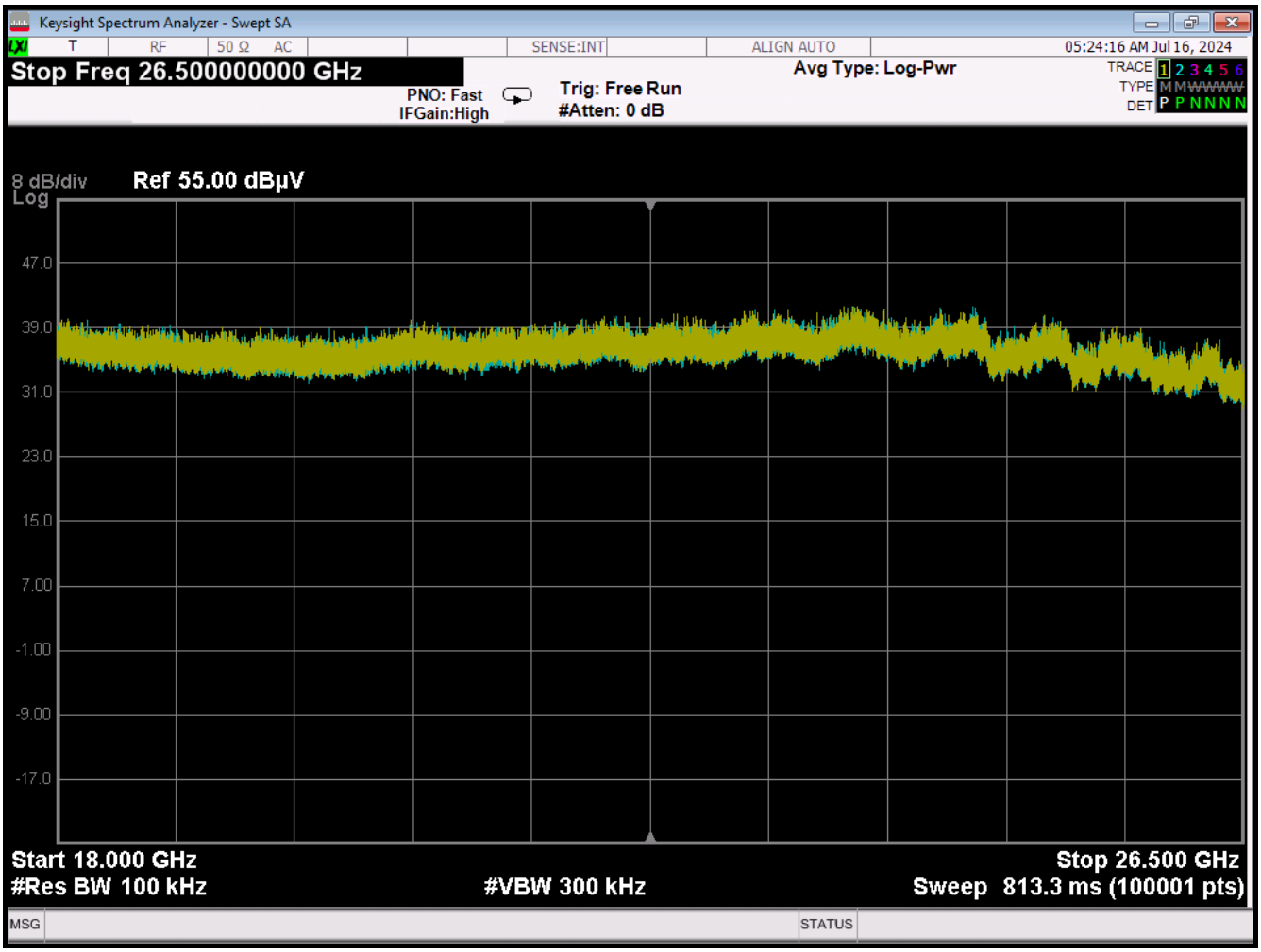


Figure 35: Radiated Emissions Test Data, High Channel (12GHz to 18GHz)



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

Figure 36: Radiated Emissions Test Data, High Channel (18GHz to 26.5GHz)



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

3.8 AC Powerline Conducted Emissions

3.8.1 Requirements

Compliance Standard: FCC Part 15.207

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

3.8.2 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.

Environmental Conditions During AC Conducted Emissions Testing

Ambient Temperature:	21 °C
Relative Humidity:	55 %

3.8.3 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

3.8.4 Test Data

The EUT complies with the Class B conducted powerline emissions requirements.

The NA382408 module indirectly couples to the AC mains network via the Proteus battery-pack charger.

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

The final data is provided below. All peak emissions meet the average limit.

Table 12: AC Power Conducted Emissions Test Data

NEUTRAL									
Frequency (MHz)	**SA Level PK (dBµV)**	**Cable Loss (dB)**	**LISN Factor (dB)**	**Corr. Level PK (dBµV)**	**Limit QP (dBµV)**	**Limit AVG (dBµV)**	**Margin QP (dB)**	**Margin AVG (dB)**	**Comments**
0.150	31.8	10.04	0.6	42.5	66.0	56.0	-23.5	-13.5	Peak meets AVG
0.180	31.3	10.04	0.5	41.8	64.5	54.5	-22.7	-12.7	Peak meets AVG
0.565	30.4	10.04	0.3	40.7	56.0	46.0	-15.3	-5.3	Peak meets AVG
1.061	26.3	10.04	0.3	36.6	56.0	46.0	-19.4	-9.4	Peak meets AVG
2.577	24.2	10.04	0.3	34.6	56.0	46.0	-21.4	-11.4	Peak meets AVG
2.896	23.9	10.04	0.4	34.3	56.0	46.0	-21.7	-11.7	Peak meets AVG
25.509	20.4	10.26	2.4	33.0	60.0	50.0	-27.0	-17.0	Peak meets AVG
PHASE / L1									
Frequency (MHz)	**SA Level PK (dBµV)**	**Cable Loss (dB)**	**LISN Factor (dB)**	**Corr. Level PK (dBµV)**	**Limit QP (dBµV)**	**Limit AVG (dBµV)**	**Margin QP (dB)**	**Margin AVG (dB)**	**Comments**
0.155	30.3	10.04	0.4	40.8	65.7	55.7	-24.9	-14.9	Peak meets AVG
0.234	27.3	10.04	0.3	37.7	62.3	52.3	-24.6	-14.6	Peak meets AVG
0.449	26.3	10.04	0.3	36.6	56.9	46.9	-20.3	-10.3	Peak meets AVG
0.566	27.7	10.04	0.3	38.0	56.0	46.0	-18.0	-8.0	Peak meets AVG
1.012	24.6	10.04	0.3	34.9	56.0	46.0	-21.1	-11.1	Peak meets AVG
2.964	23.4	10.04	0.3	33.8	56.0	46.0	-22.2	-12.2	Peak meets AVG
26.059	21.2	10.27	2.2	33.6	60.0	50.0	-26.4	-16.4	Peak meets AVG

4 Test Equipment

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

Table 13: Test Equipment List

Test Name:	**Radiated Emissions**	Test Date(s): 6/27/2024 to 7/15/2024	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00942	AGILENT, MXA	SPECTRUM ANALYZER	12/19/2024
00993 [1]	KEYSIGHT N9020B	MXA SIGNAL ANALYZER	11/6/2025
00382	SUNOL SCIENCES CORP. JB1	LOGPERIOD ANTENNA	6/12/2027
00004	ARA DRG-118/A	HORN ANTENNA	6/7/2027
00066	AGILENT	RF PRE-AMPLIFIER	3/29/2025
00065	ELECTRO-METRICS	RF PRE-AMPLIFIER	3/29/2025
00825	CABLE ASSOCIATES	MTC1010, SMA CABLE	6/14/2025
00847	ASTROLABS, 16301	K-48TG SMA CABLE	6/20/2025
00731	NARDA, 4779-3	3DB ATTENUATOR	6/20/2025
00806	MINI-CIRCUITS, 3061	6FT SMA CABLE	12/26/2024

Test Equipment List, Continued

Test Name:	**Conducted RF Emissions**	Test Date: 6/27/2024 to 7/15/2024	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00993 [1]	KEYSIGHT N9020B	MXA SIGNAL ANALYZER	11/6/2025
00637	MOLEX, 025799-0001	SMA COAXIAL CABLE	9/1/2024
00826	MEGAPHASE, TM40-K1K5	HF COXIAL CABLE	7/17/2024
00992	KEYSIGHT N5173B	EXG SIGNAL GENERATOR	11/27/2024
N/A	WEINSCHEL, 3.5MM	20dB ATTENUATOR	Cal. Before Use

Test Name:	**AC Powerline Emissions**	Test Date: 7/8/2024	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00993 [1]	KEYSIGHT N9020B	MXA SIGNAL ANALYZER	11/6/2025
00125	SOLAR 8028-50-TS-24-BNC	LISN	4/18/2025
00126	SOLAR 8028-50-TS-24-BNC	LISN	4/18/2025
00053	HP 11947A	LIMITER TRANSIENT	1/11/2025
00330	WLL, RG-223	CE SITE CABLE, BNC	6/25/2025

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

5 Measurements

References

ANSI C63.2 (Jan-2016) Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 (Jan 2014) American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

ANSI C63.10 (Jun 2013) American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

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 14: 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

5.3 Environmental Conditions

Environmental Conditions During All Measurements

Ambient Temperature:	17.2 °C
Relative Humidity:	49 %