



FCC PART 15 CERTIFICATION TEST REPORT

for the

PERIN HEALTH PATCH

FCC ID: 2BKSW-PHP-0124

WLL REPORT# 18921-01 REV 1

Prepared for:

**Perin Health Devices
21241 Ventura Blvd., Suite 272
Woodland Hills, CA 91364**

Prepared By:

**Washington Laboratories, Ltd.
4840 Winchester Blvd. Suite #5
Frederick, Maryland 21703**



Testing Certificate AT-1448



FCC Part 15 Certification Test Report

for the

Perin Health Devices

Perin Health Patch

FCC ID: 2BKSW-PHP-0124

October 21, 2024

WLL Report# 18921-01 Rev 1

Prepared by:

Ryan Mascaro
RF Test Engineer

Reviewed by:

Steven D. Koster
President



Abstract

This report has been prepared on behalf of Perin Health Devices 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). This certification test report documents the test configuration and test results for the Perin Health Devices, Perin Health Patch. The information provided in this report is only applicable to device herein documented as the EUT.

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 Perin Health Devices, Perin Health Patch [FCC ID: 2BKSW-PHP-0124] complies with the requirements for a Digital Transmission System (DTS) transmitter device under FCC Part 15.247.

| Revision History | Description of Change | Date |
|------------------|--------------------------------------|------------------|
| Rev 0 | Initial Release | October 21, 2024 |
| Rev 1 | Removed hybrid transmitter reference | October 28, 2024 |



Table of Contents

| | |
|---|-----|
| Abstract | iii |
| Table of Contents | iv |
| List of Tables | v |
| List of Figures | vi |
| 1 Introduction | 7 |
| 1.1 Compliance Statement | 7 |
| 1.2 Test Scope | 7 |
| 1.3 Contract Information | 7 |
| 1.4 Test and Support Personnel | 7 |
| 1.5 Test Location | 7 |
| 2 Equipment Under Test | 8 |
| 2.1 EUT Identification | 8 |
| 2.2 EUT Description | 8 |
| 2.3 Test Configuration and Algorithm | 9 |
| 3 Test Results | 11 |
| 3.1 Deviations to the Test Standard | 11 |
| 3.2 Occupied Bandwidth, Digital Transmission System | 12 |
| 3.3 Conducted Peak Output Power | 16 |
| 3.4 Power Spectral Density | 20 |
| 3.5 Conducted Band-edge Testing | 24 |
| 3.6 Conducted Unwanted Spurious Emissions | 27 |
| 3.7 Radiated Emissions | 40 |
| 4 Test Equipment | 51 |
| 5 Measurements | 52 |
| 5.2 Measurement Uncertainty | 52 |
| 5.3 Environmental Conditions | 53 |



List of Tables

| | |
|--|----|
| Table 1: Device Summary | 8 |
| Table 2: System Configuration List..... | 9 |
| Table 3: Support Equipment | 10 |
| Table 4: Cable Configuration..... | 10 |
| Table 5: Testing and Results Summary | 11 |
| Table 6: Occupied Bandwidth Results..... | 12 |
| Table 7: Conducted Output Power Results | 16 |
| Table 8: Power Spectral Density..... | 20 |
| Table 9: Radiated Emissions Test Data, Low Channel..... | 43 |
| Table 10: Radiated Emissions Test Data, Center Channel | 45 |
| Table 11: Radiated Emissions Test Data, High Channel..... | 47 |
| Table 12: Test Equipment List..... | 51 |
| Table 13: Expanded Uncertainty List | 53 |



List of Figures

| | |
|---|----|
| Figure 1: Occupied Bandwidth, Low Channel | 13 |
| Figure 2: Occupied Bandwidth, Center Channel | 14 |
| Figure 3: Occupied Bandwidth, High Channel..... | 15 |
| Figure 4: Peak Output Power, Low Channel | 17 |
| Figure 5: Peak Output Power, Center Channel | 18 |
| Figure 6: Peak Output Power, High Channel..... | 19 |
| Figure 7: Power Spectral Density, Low Channel..... | 21 |
| Figure 8: Power Spectral Density, Center Channel | 22 |
| Figure 9: Power Spectral Density, High Channel | 23 |
| Figure 10: Low Channel Band-Edge | 25 |
| Figure 11: High Channel Band-Edge..... | 26 |
| Figure 12: Low Channel Conducted Spurious Plot 1 | 28 |
| Figure 13: Low Channel Conducted Spurious Plot 2 | 29 |
| Figure 14: Low Channel Conducted Spurious Plot 3 | 30 |
| Figure 15: Low Channel Conducted Spurious Plot 4 | 31 |
| Figure 16: Center Channel Conducted Spurious Plot 1 | 32 |
| Figure 17: Center Channel Conducted Spurious Plot 2 | 33 |
| Figure 18: Center Channel Conducted Spurious Plot 3 | 34 |
| Figure 19: Center Channel Conducted Spurious Plot 4 | 35 |
| Figure 20: High Channel Conducted Spurious Plot 1 | 36 |
| Figure 21: High Channel Conducted Spurious Plot 2..... | 37 |
| Figure 22: High Channel Conducted Spurious Plot 3..... | 38 |
| Figure 23: High Channel Conducted Spurious Plot 4..... | 39 |
| Figure 24: Radiated Emissions Test Data, Low Channel (12GHz to 25GHz) | 49 |
| Figure 25: Radiated Emissions Test Data, High Channel (12GHz to 25GHz)..... | 50 |



1 Introduction

1.1 Compliance Statement

The Perin Health Devices, Perin Health Patch complies with the requirements for a Digital Transmission System (DTS) transmitter device under FCC Part 15.247 and ISED Canada RSS-247 Issue 3 (8/2023).

1.2 Test Scope

Tests for radiated and conducted (at antenna terminal) emissions were performed. All measurements were performed in accordance with ANSI C63.10-2020 “ANSI Procedures for Compliance Testing of Unlicensed Wireless Devices”. The measurement equipment conforms to ANSI C63.2 “Specifications for Electromagnetic Noise and Field Strength Instrumentation”. The modules were tested “stand alone” as required for modular testing and approval.

1.3 Contract Information

| | |
|------------------------|--------------------|
| Customer: | Phase Margin, Inc. |
| Purchase Order Number: | 50% Deposit Terms |
| Quotation Number: | 74846 |

1.4 Test and Support Personnel

| | |
|------------------------------|----------------------------------|
| Washington Laboratories, LTD | Ryan Mascaro and Randon McIlwain |
| Customer Representative | Ian McLane, Ph.D. |

1.5 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Frederick, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The ISED Canada 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

| | |
|----------------------------------|---|
| Applicant: | Perin Health Devices |
| FCC ID: | 2BKSW-PHP-0124 |
| Model: | Perin Health Patch |
| HW Version: | 80060 V1.2 |
| SW Version: | 1.7.3.2 |
| FCC Rule Parts: | § 15.247 |
| Frequency Range: | 2402 to 2480 MHz |
| Peak Output Power: | -4.387 dBm (0.0004 W) |
| Antenna Type: | PCB Chip Antenna, Peak Gain: 0.5 dBi |
| FCC Emission Designator: | 716KG1D |
| 6dB Occupied Bandwidth: | 716.2 kHz (worst-case) |
| Protocol: | Bluetooth Low Energy (BLE) |
| Data Rate: | 1 Mbps |
| Keying: | Automatic |
| Type of Information: | Digital |
| Number of Channels: | 40 |
| Interface Cables: | N/A |
| Power Source & Voltage: | 3 VDC battery (disposable) |
| Worst-Case TX Spurious Emission: | 4804MHz, 45.2dBuV/m (Average) (see Table 9) |
| Testing Dates: | 9/19/2024 to 10/2/2024 |

2.2 EUT Description

The EUT is a patient coupled, wearable, Bluetooth LE medical device.



2.3 Test Configuration and Algorithm

The Perin Health Patch 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 or hop/sweep as needed. 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/sweeping mode. For radiated emissions above 1GHz, the EUT was set to transmit at the each of the low, center, and high Channels. Only the worst-case emissions are provided throughout this report.

Additionally, for EUT transmit power/gain setting: please note that the test-mode software was set to a value of “0”. This setting was maintained for all testing.

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: System Configuration List

| EUT | Description | Part Number | Serial Number | Rev. # |
|--------------|------------------|-------------|---------------|--------|
| Health Patch | Conducted | -- | -- | D4 |
| Health Patch | Conducted | -- | -- | D4 |
| Health Patch | Radiated, Low | -- | -- | D4 |
| Health Patch | Radiated, Center | -- | -- | D4 |
| Health Patch | Radiated, High | -- | -- | D4 |
| Health Patch | Production 1 | -- | -- | D4 |
| Health Patch | Production 2 | -- | -- | D4 |



Table 3: Support Equipment

| Name / Description | Manufacturer | Model Number | Calibration Data |
|----------------------|--------------|--------------|------------------|
| Tablet (for pairing) | -- | -- | -- |

Table 4: Cable Configuration

| Ref. ID | EUT Port Name | Cable Description | Qty. | Length (m) | Shielded | Termination Port ID |
|------------|------------------|----------------------|------|---------------|----------|------------------------|
| -- | -- | -- | -- | -- | -- | -- |



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 subsections.

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 | N/A |

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 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, modulated signal, with channel hopping disabled.

Table 6: Occupied Bandwidth Results

| Frequency | 6dB Bandwidth | Result |
|--------------------------|---------------|--------|
| Low Channel, 2402 MHz | 716.2 kHz | Pass |
| Center Channel, 2440 MHz | 723.6 kHz | Pass |
| High Channel, 2480 MHz | 719.4 kHz | Pass |



Figure 1: Occupied Bandwidth, Low Channel

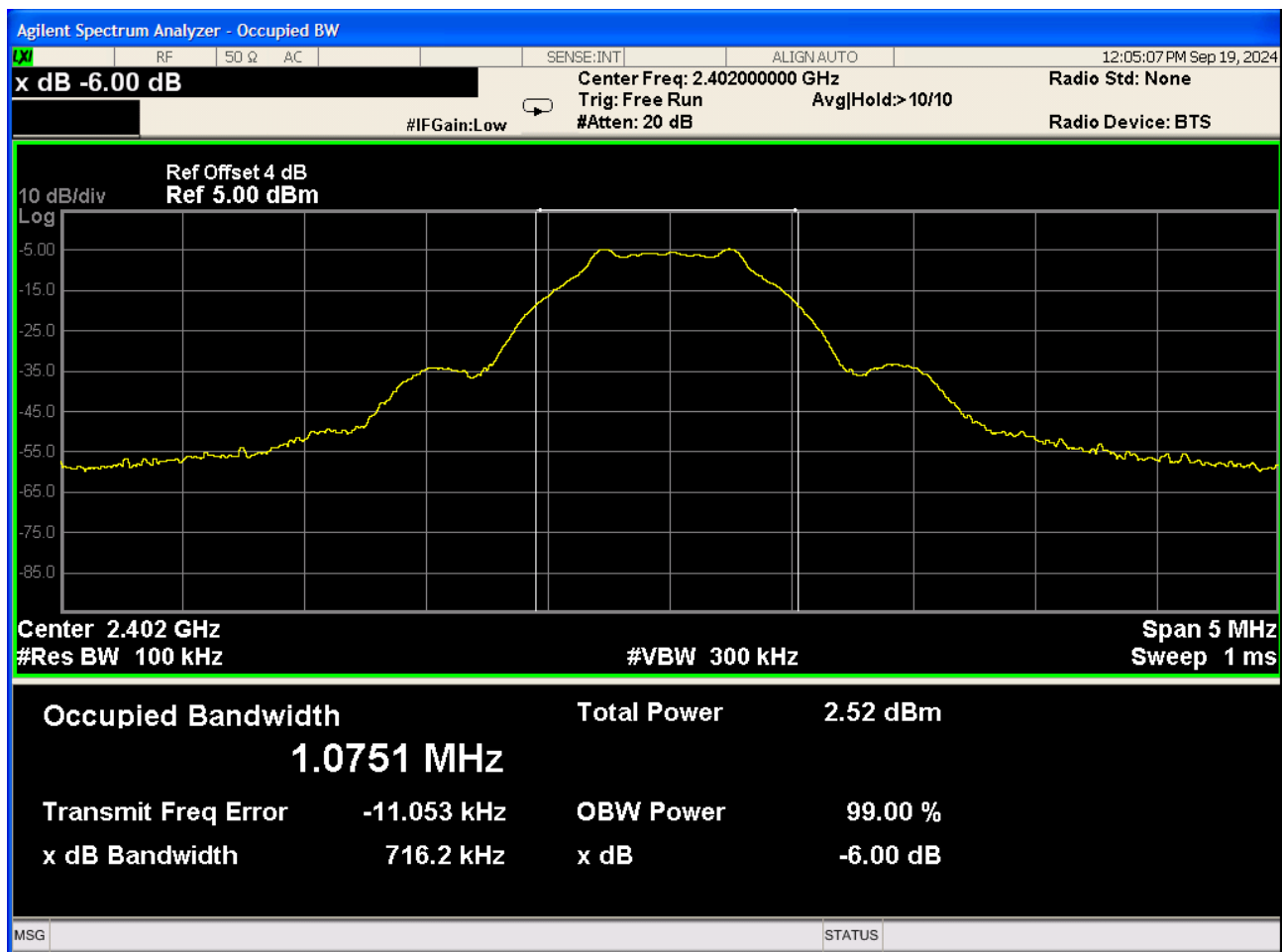




Figure 2: Occupied Bandwidth, Center Channel

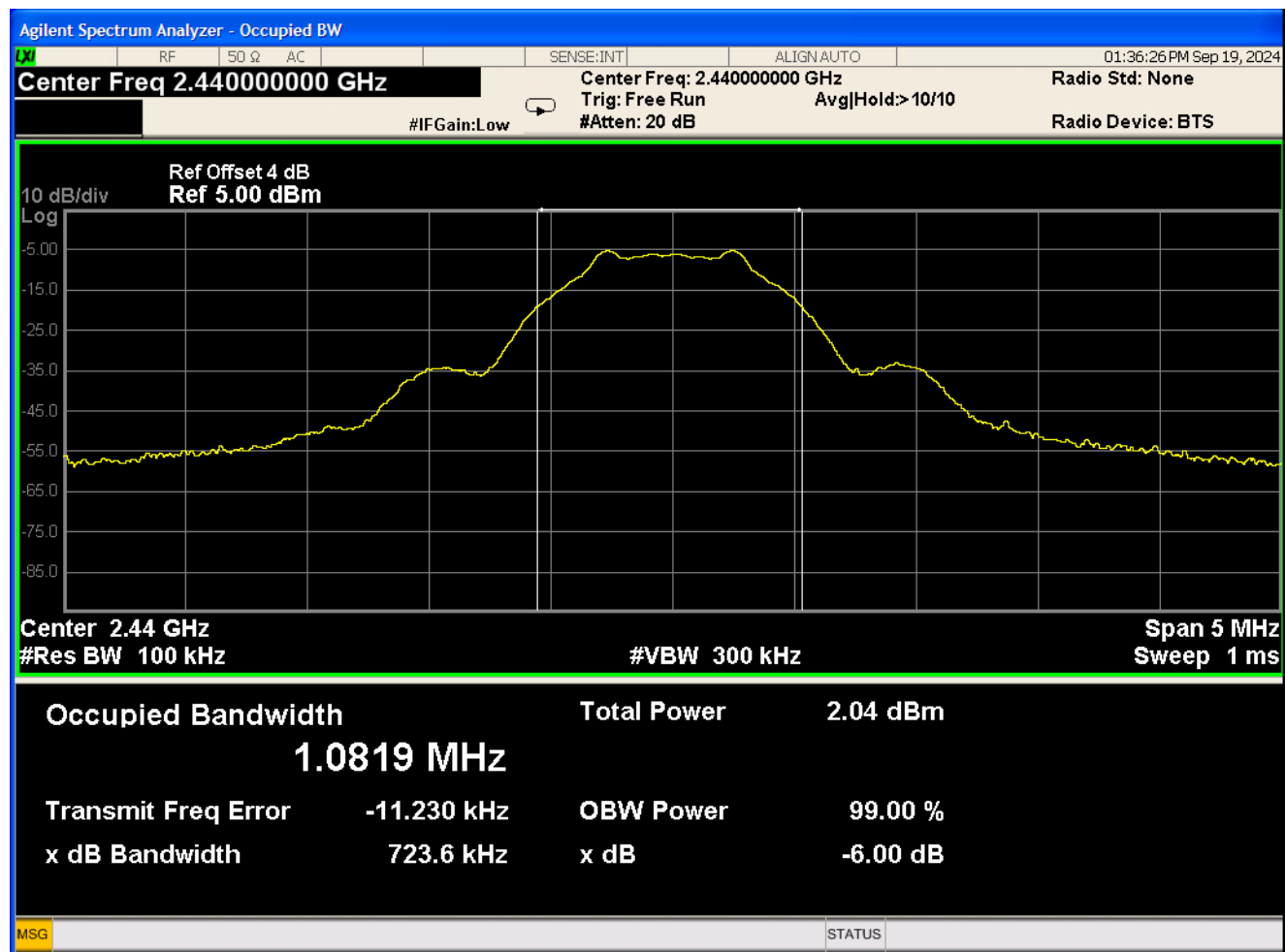
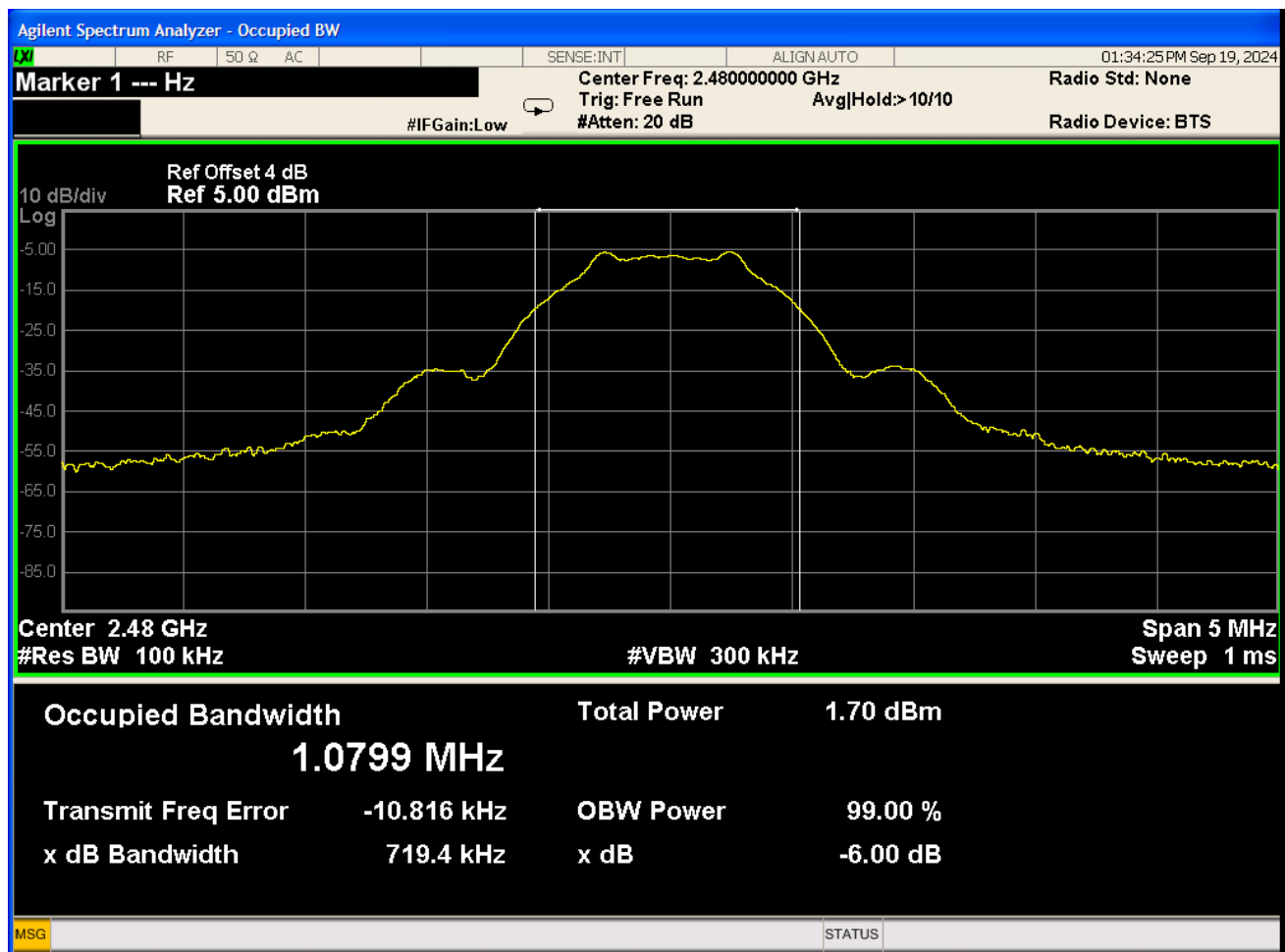




Figure 3: Occupied Bandwidth, High Channel





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, modulated signal, with channel hopping disabled.

The EUT employs a PCB trace antenna with a peak gain of 0.5 dBi.

Table 7: Conducted Output Power Results

| Frequency | Power (dBm) | EIRP (dBm) | Result |
|--------------------------|-------------|------------|--------|
| Low Channel, 2402 MHz | -4.387 | -3.887 | Pass |
| Center Channel, 2440 MHz | -4.851 | -4.351 | Pass |
| High Channel, 2480 MHz | -5.164 | -4.664 | Pass |



Figure 4: Peak Output Power, Low Channel

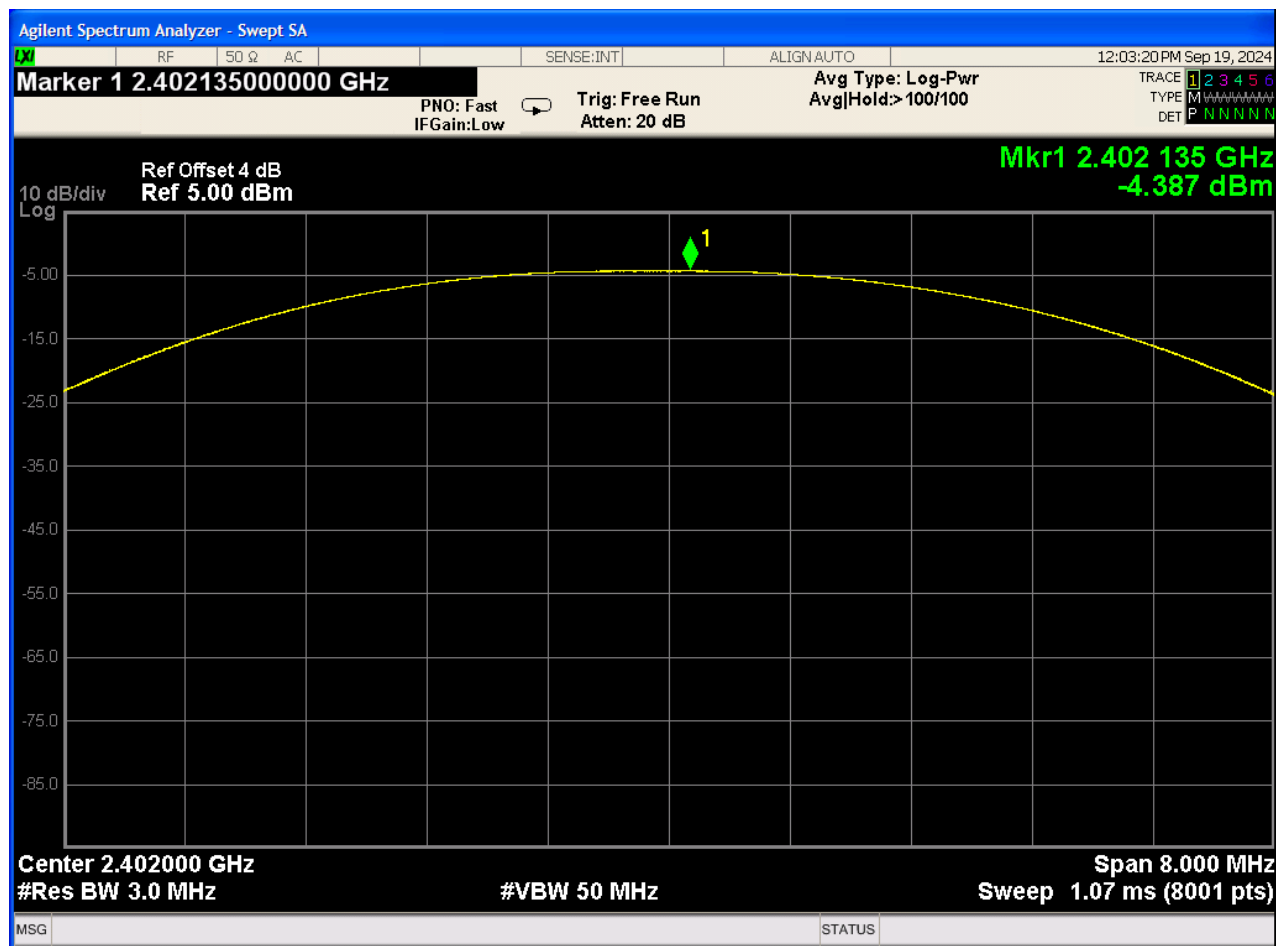




Figure 5: Peak Output Power, Center Channel

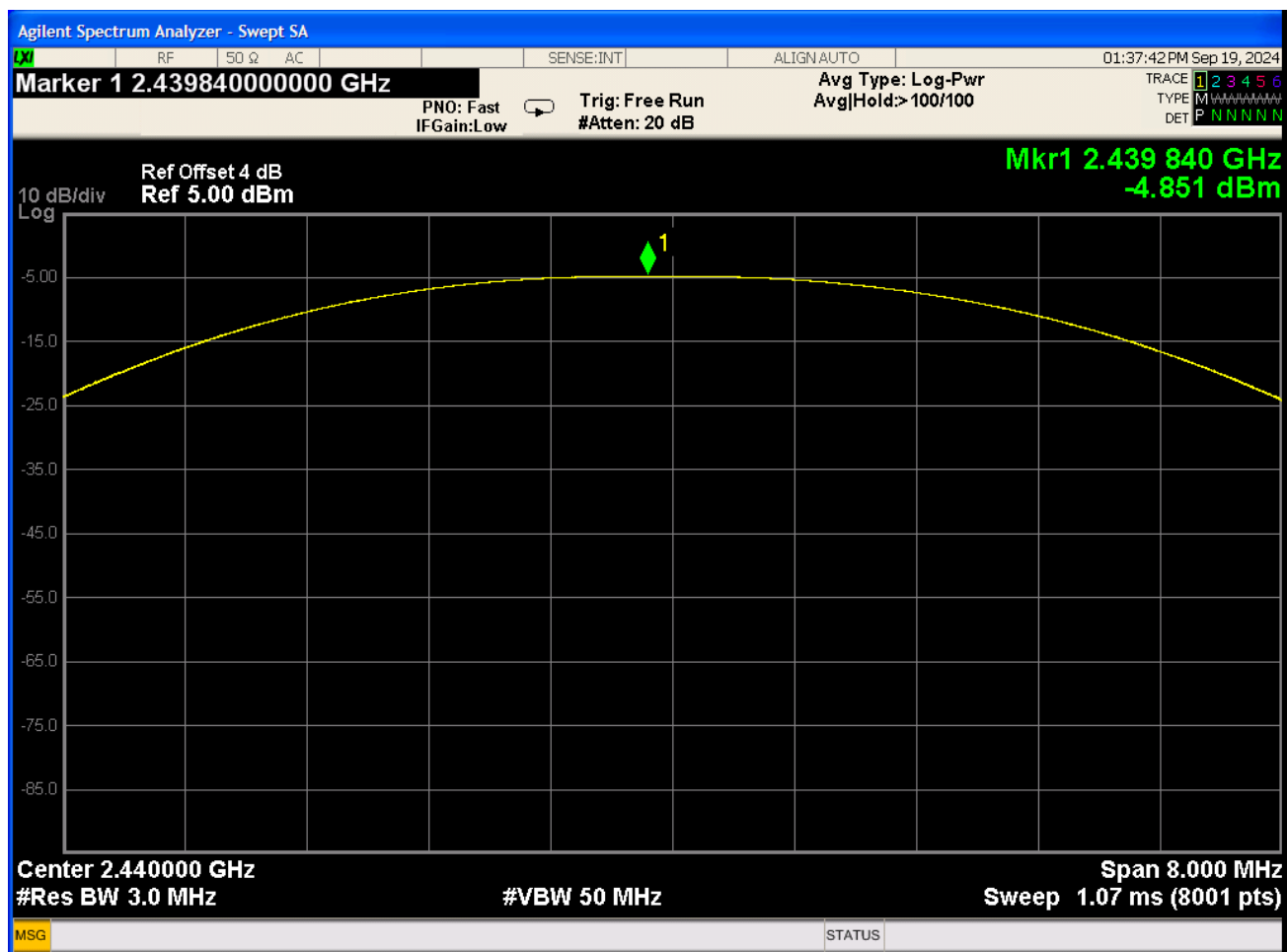
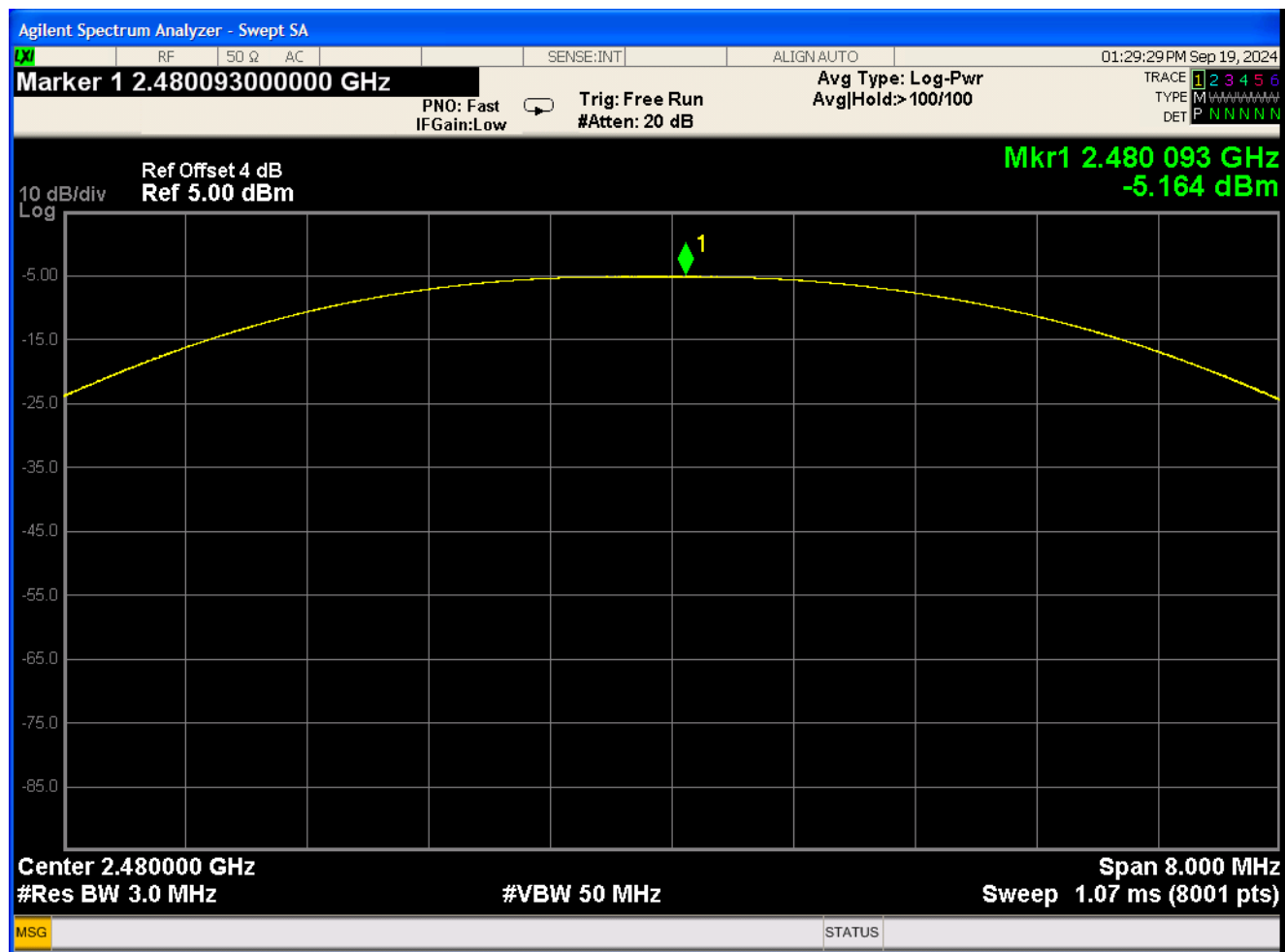




Figure 6: Peak Output Power, High Channel





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, modulated signal, with channel hopping disabled.

Table 8: Power Spectral Density

| Frequency | Power (dBm) | Limit (dBm) | Result |
|--------------------------|-------------|-------------|--------|
| Low Channel, 2402 MHz | -4.812 | 8 | Pass |
| Center Channel, 2440 MHz | -5.341 | 8 | Pass |
| High Channel, 2480 MHz | -5.626 | 8 | Pass |



Figure 7: Power Spectral Density, Low Channel

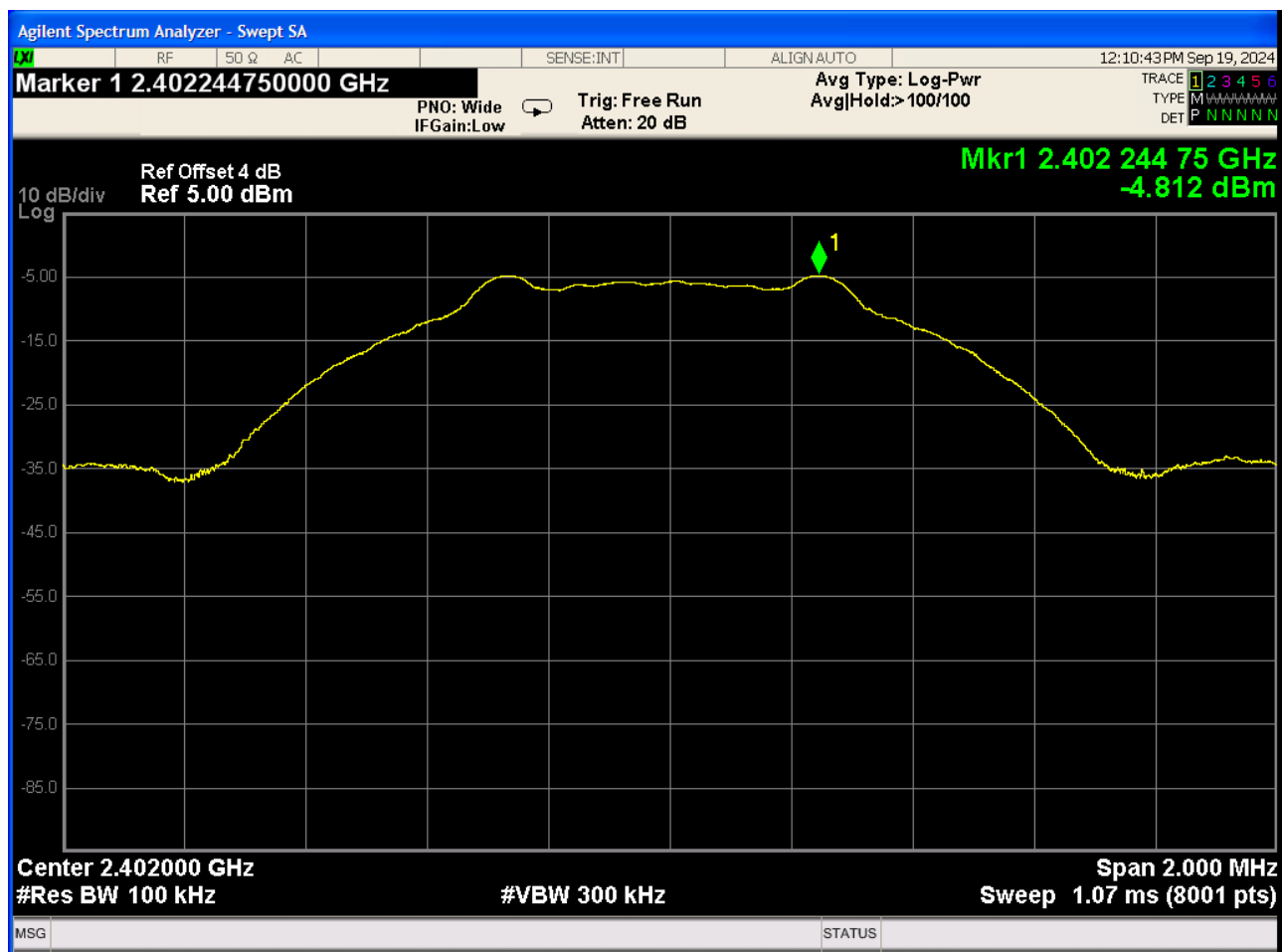




Figure 8: Power Spectral Density, Center Channel

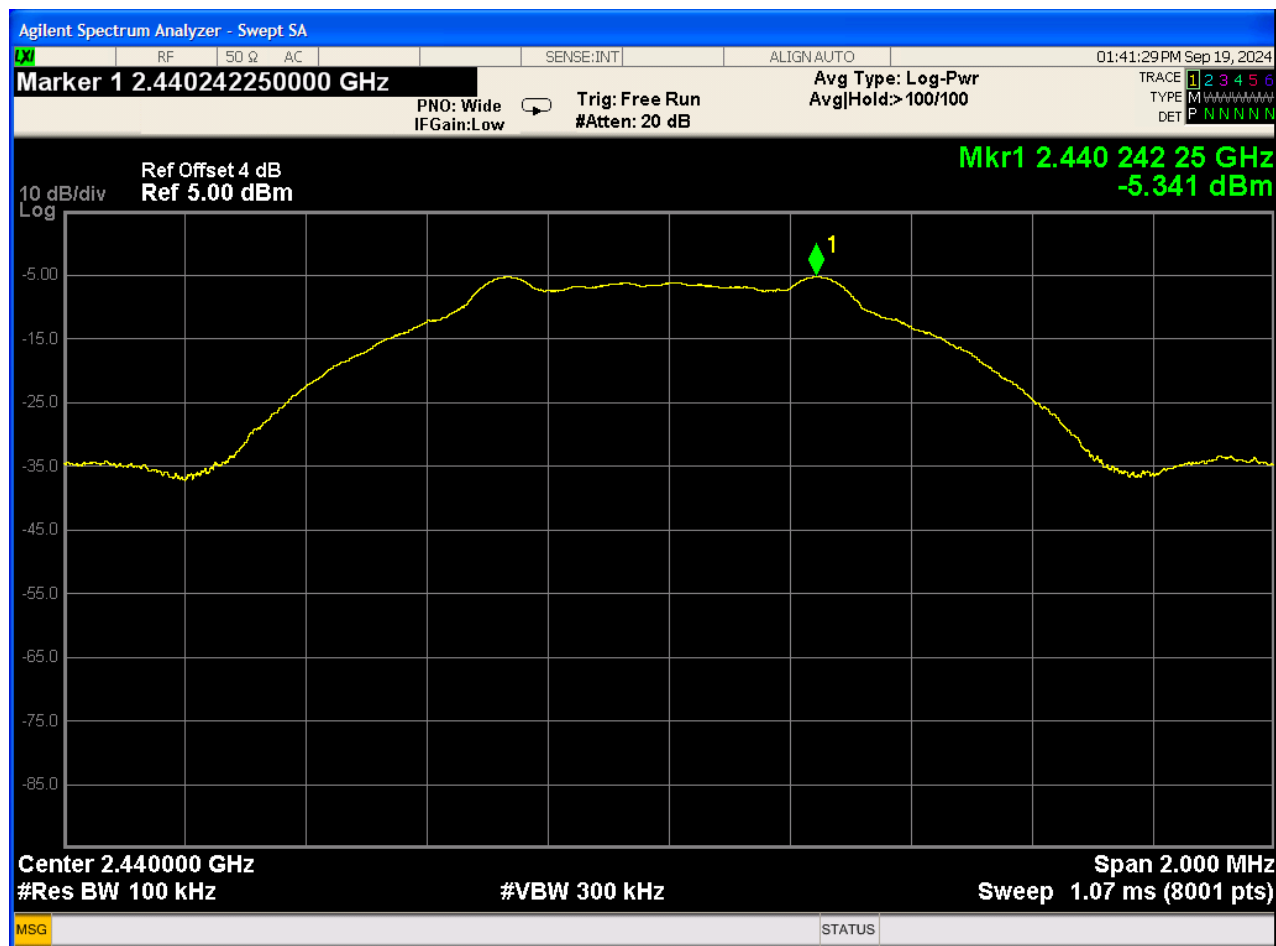
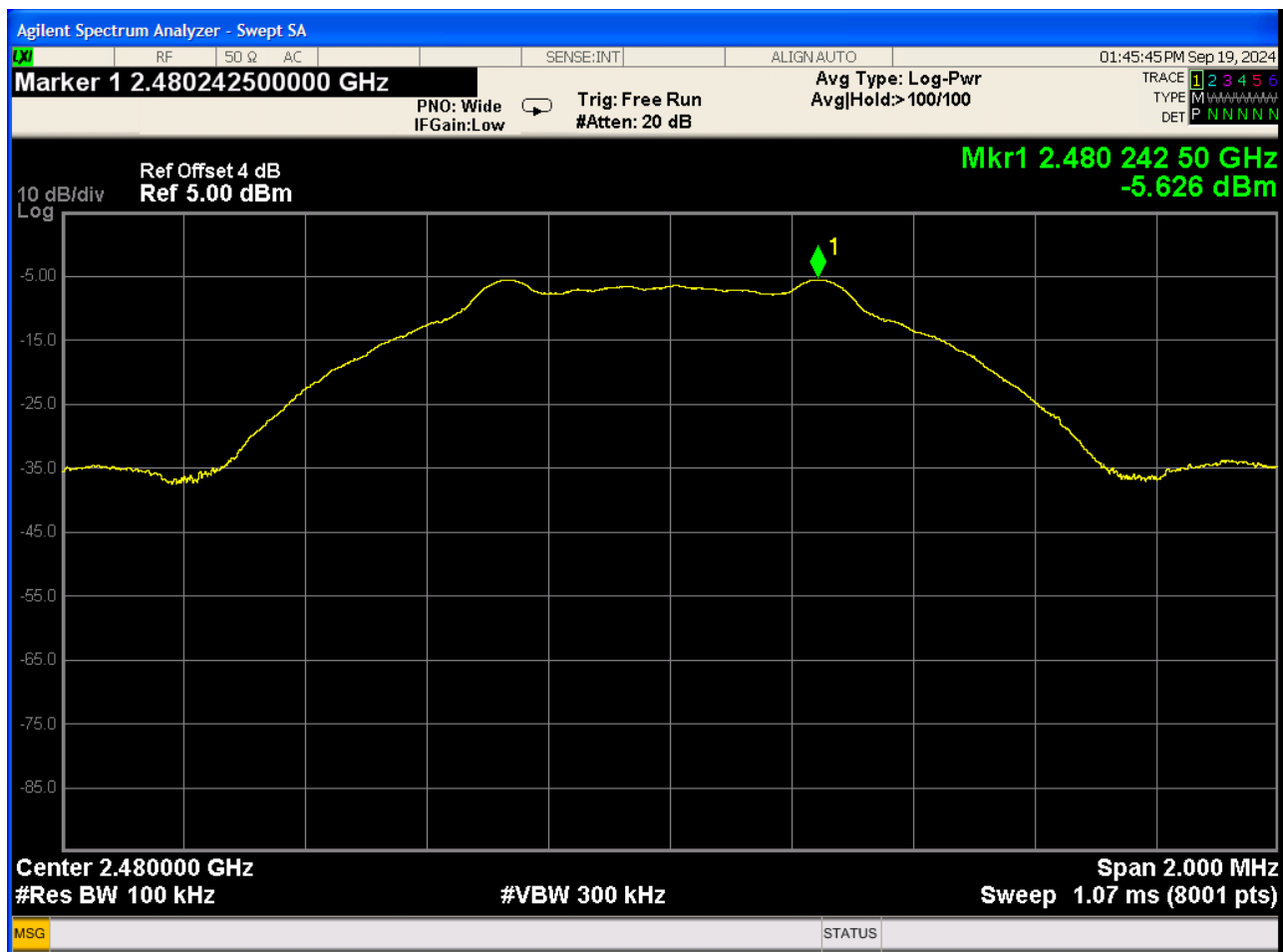




Figure 9: Power Spectral Density, High Channel





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, 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 10: Low Channel Band-Edge

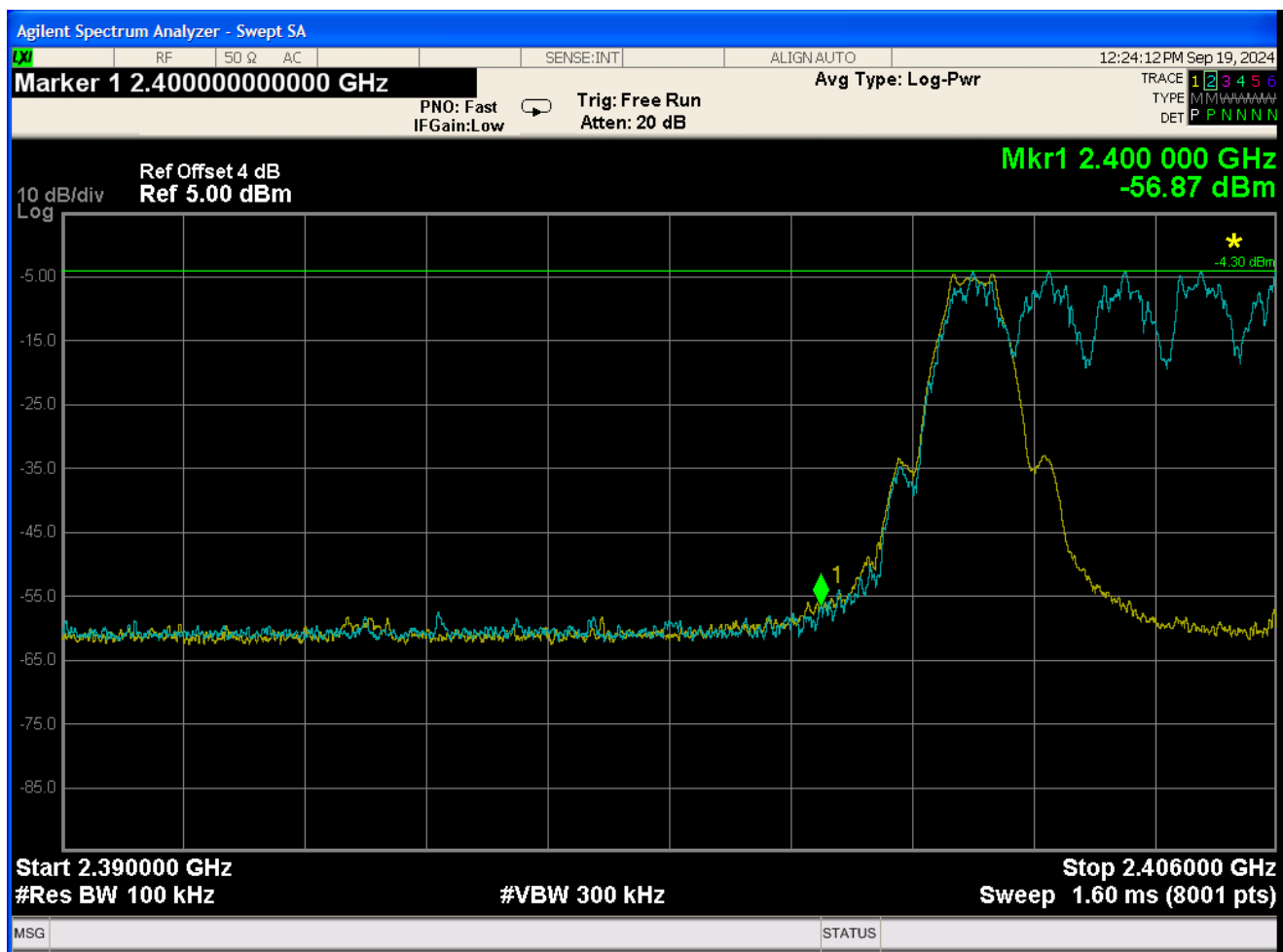
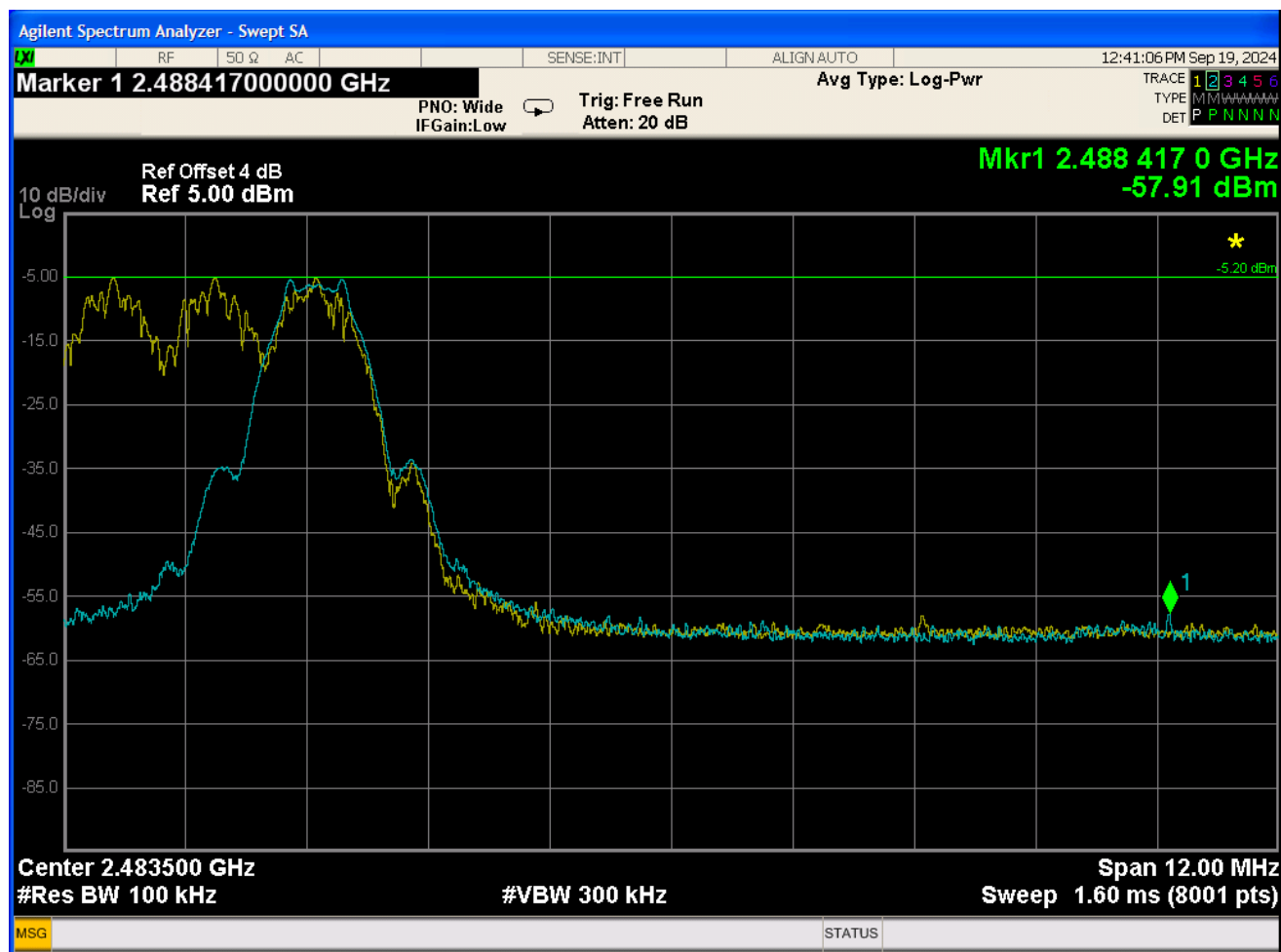


Figure 11: High Channel Band-Edge





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, modulated signal. The EUT was evaluated in two modes, channel hopping enabled and channel hopping disabled.



Figure 12: Low Channel Conducted Spurious Plot 1

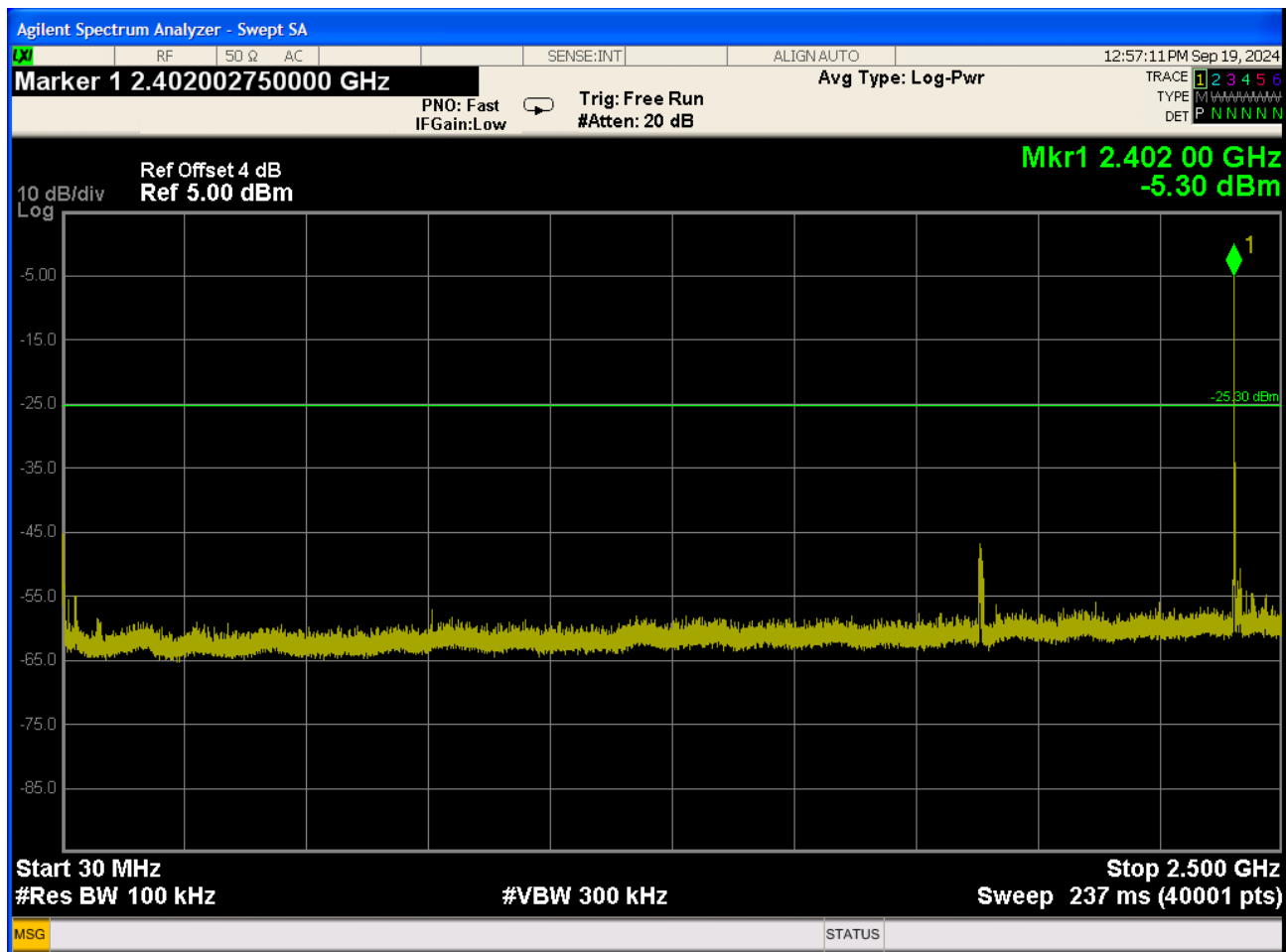




Figure 13: Low Channel Conducted Spurious Plot 2

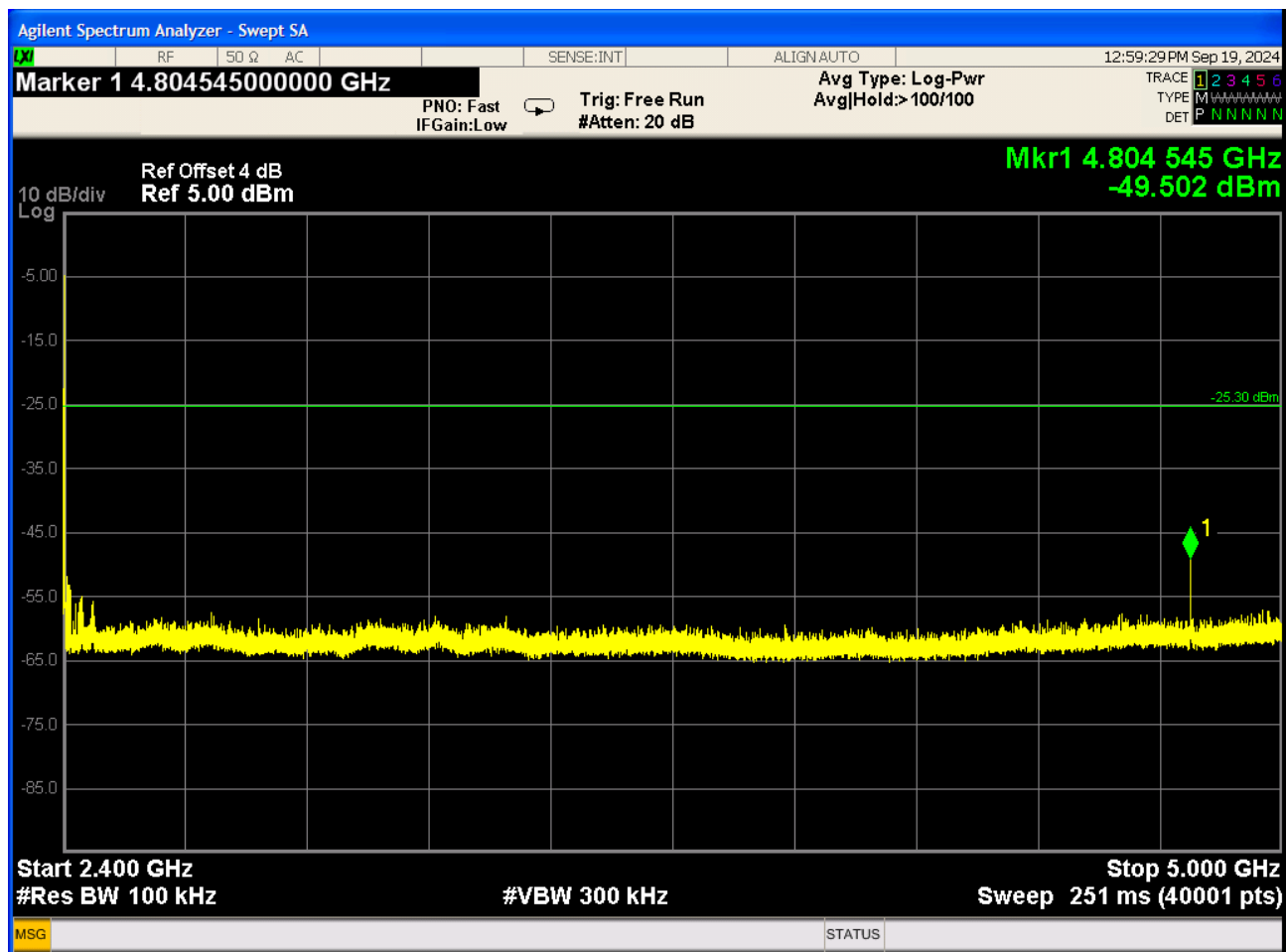




Figure 14: Low Channel Conducted Spurious Plot 3

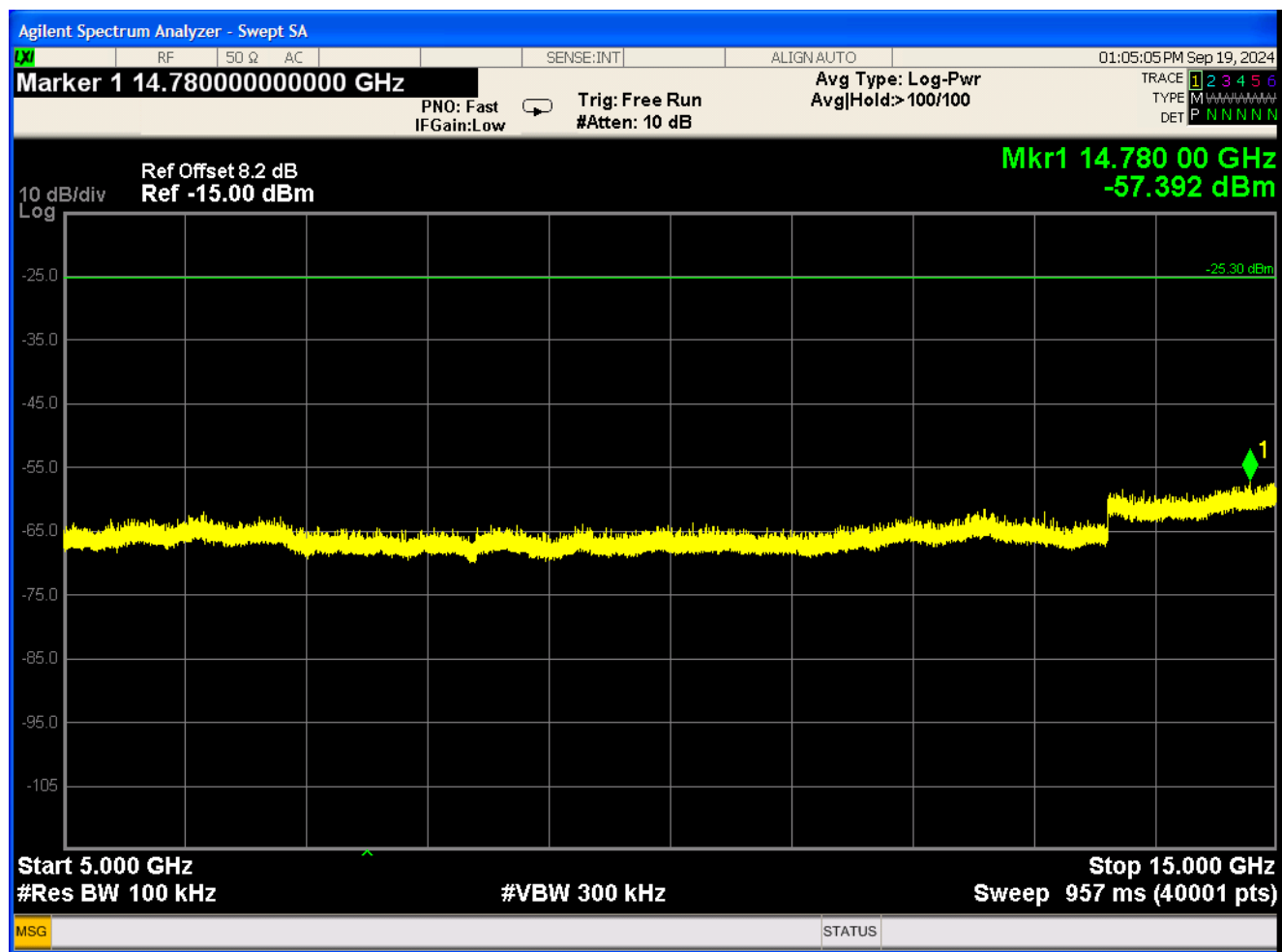




Figure 15: Low Channel Conducted Spurious Plot 4

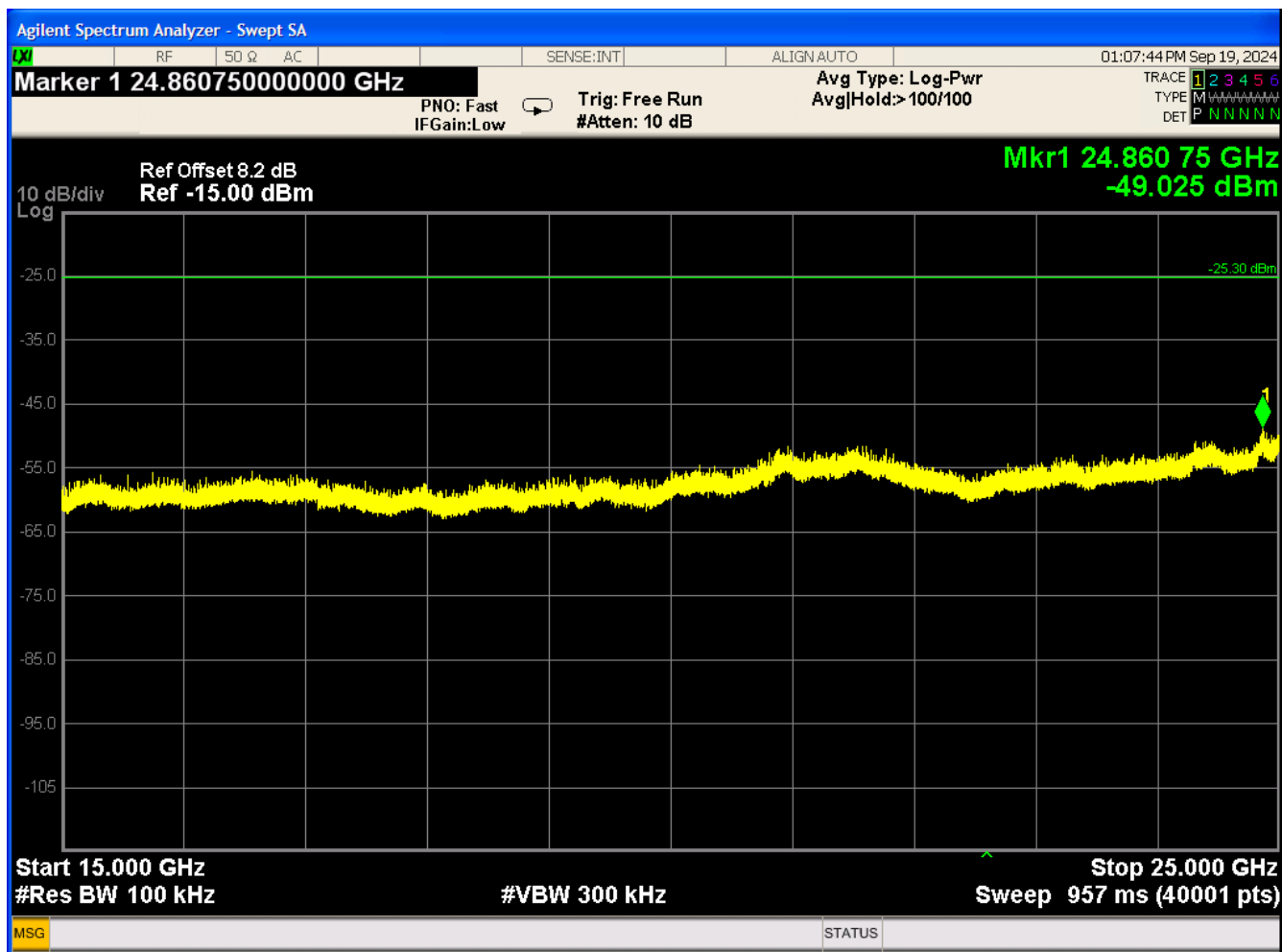




Figure 16: Center Channel Conducted Spurious Plot 1

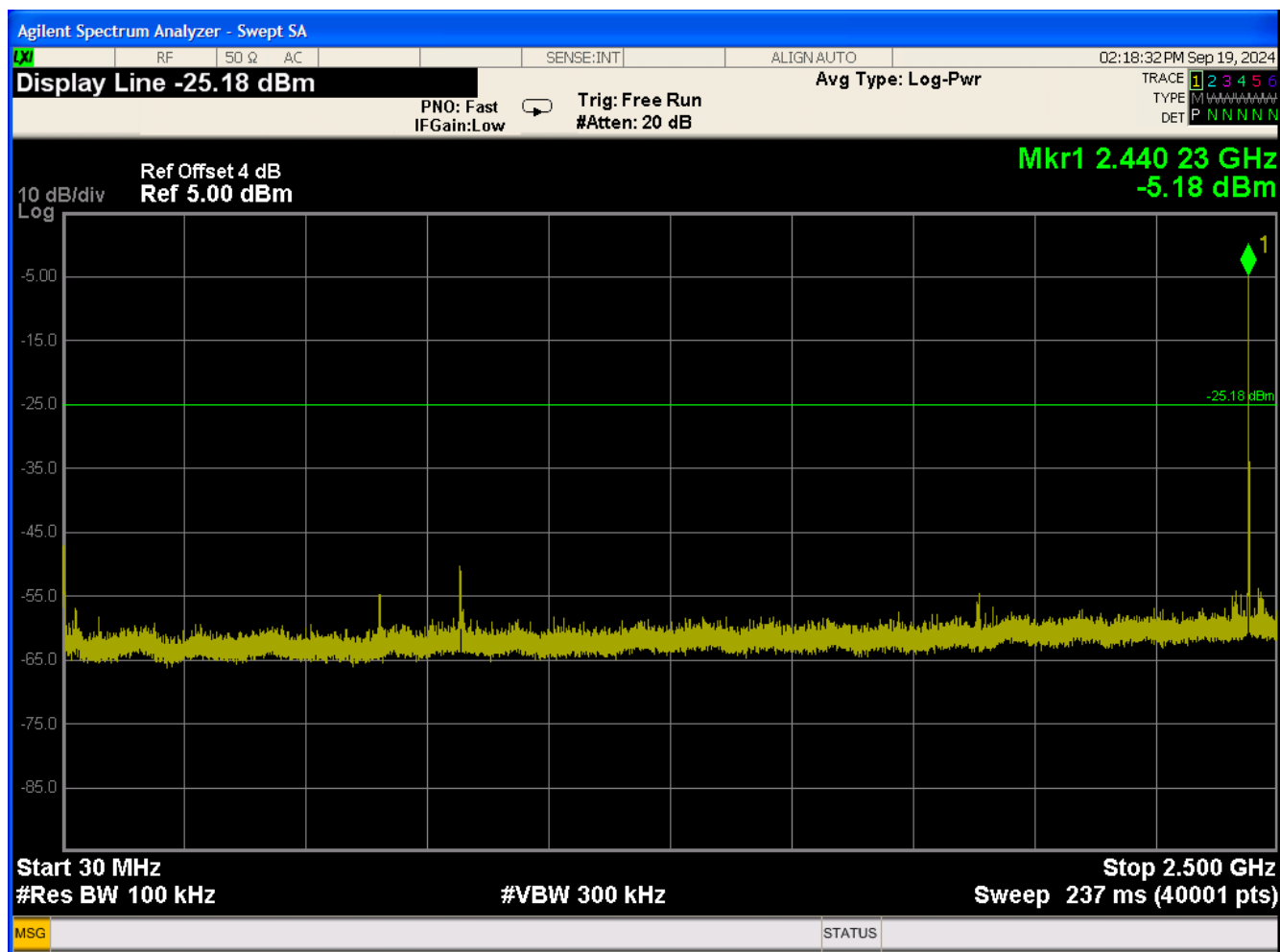




Figure 17: Center Channel Conducted Spurious Plot 2

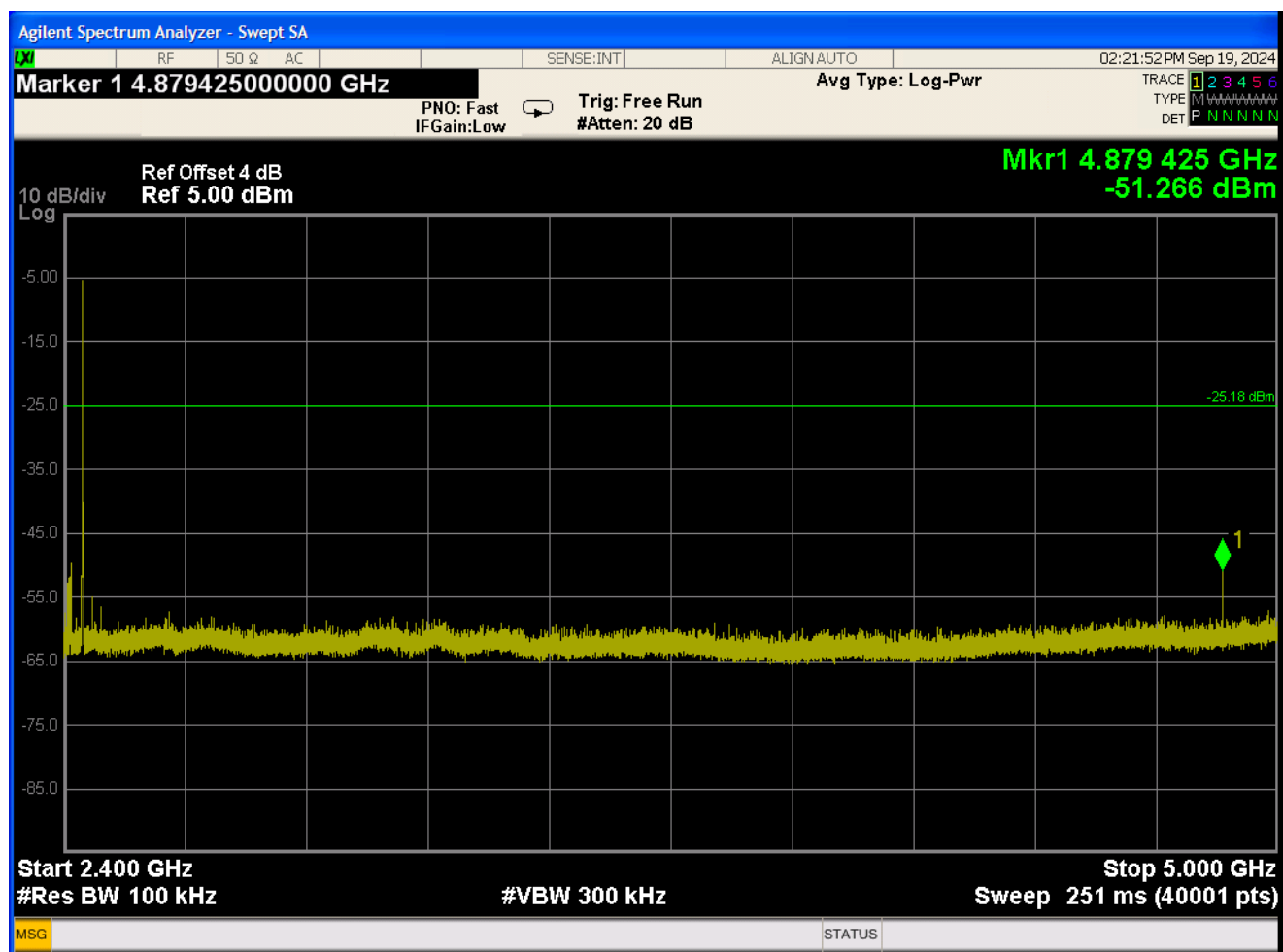


Figure 18: Center Channel Conducted Spurious Plot 3

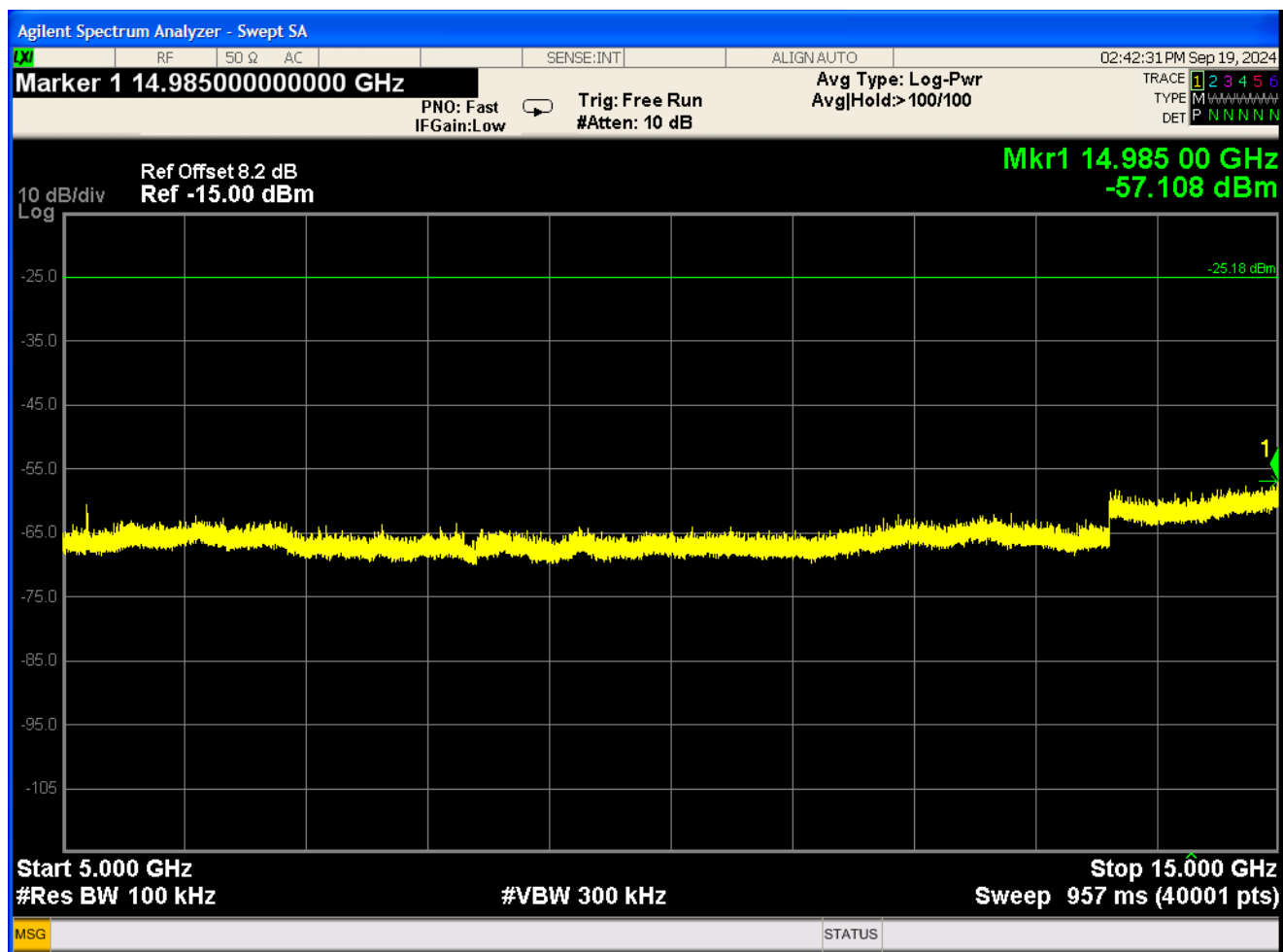




Figure 19: Center Channel Conducted Spurious Plot 4

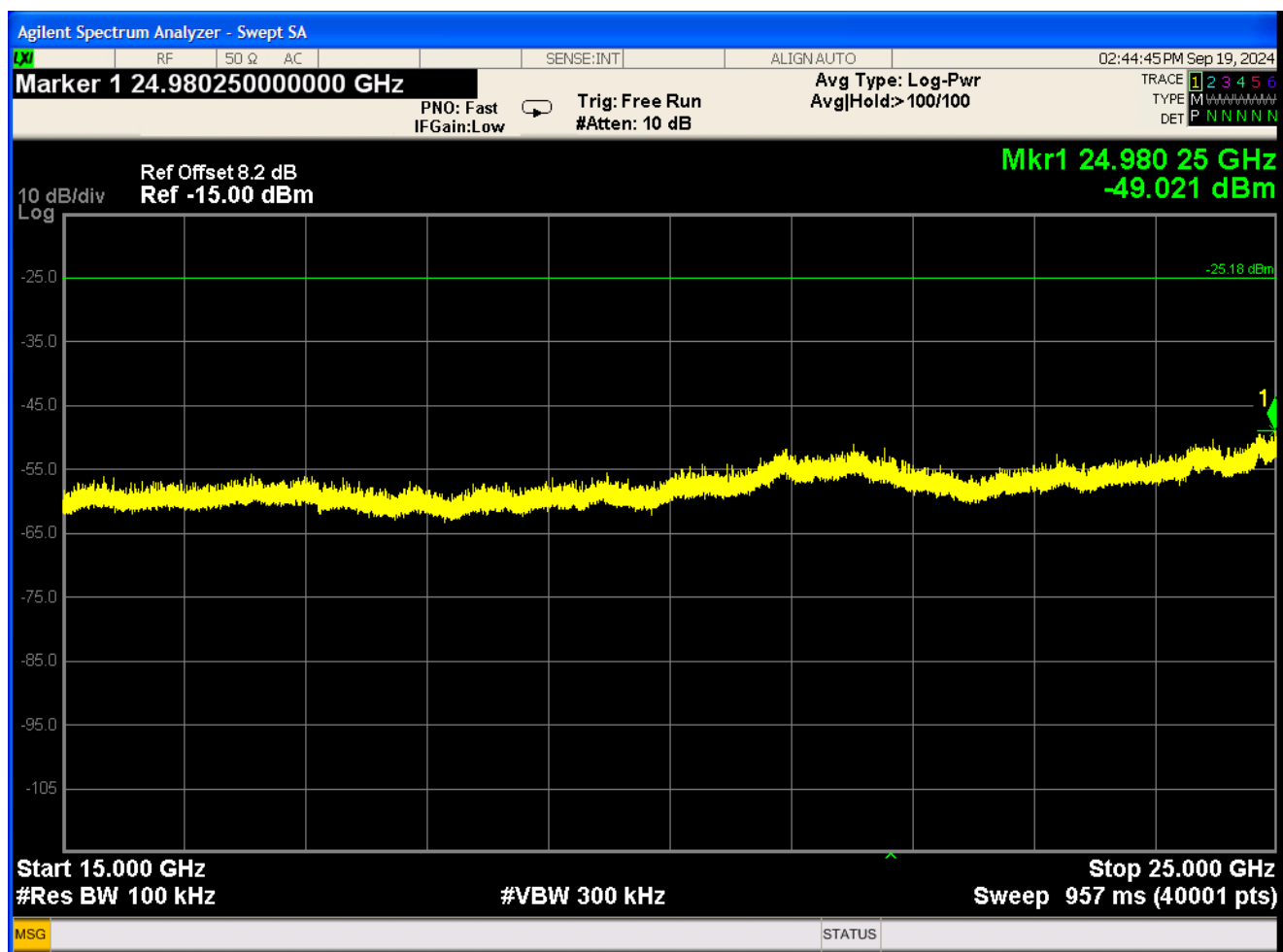




Figure 20: High Channel Conducted Spurious Plot 1

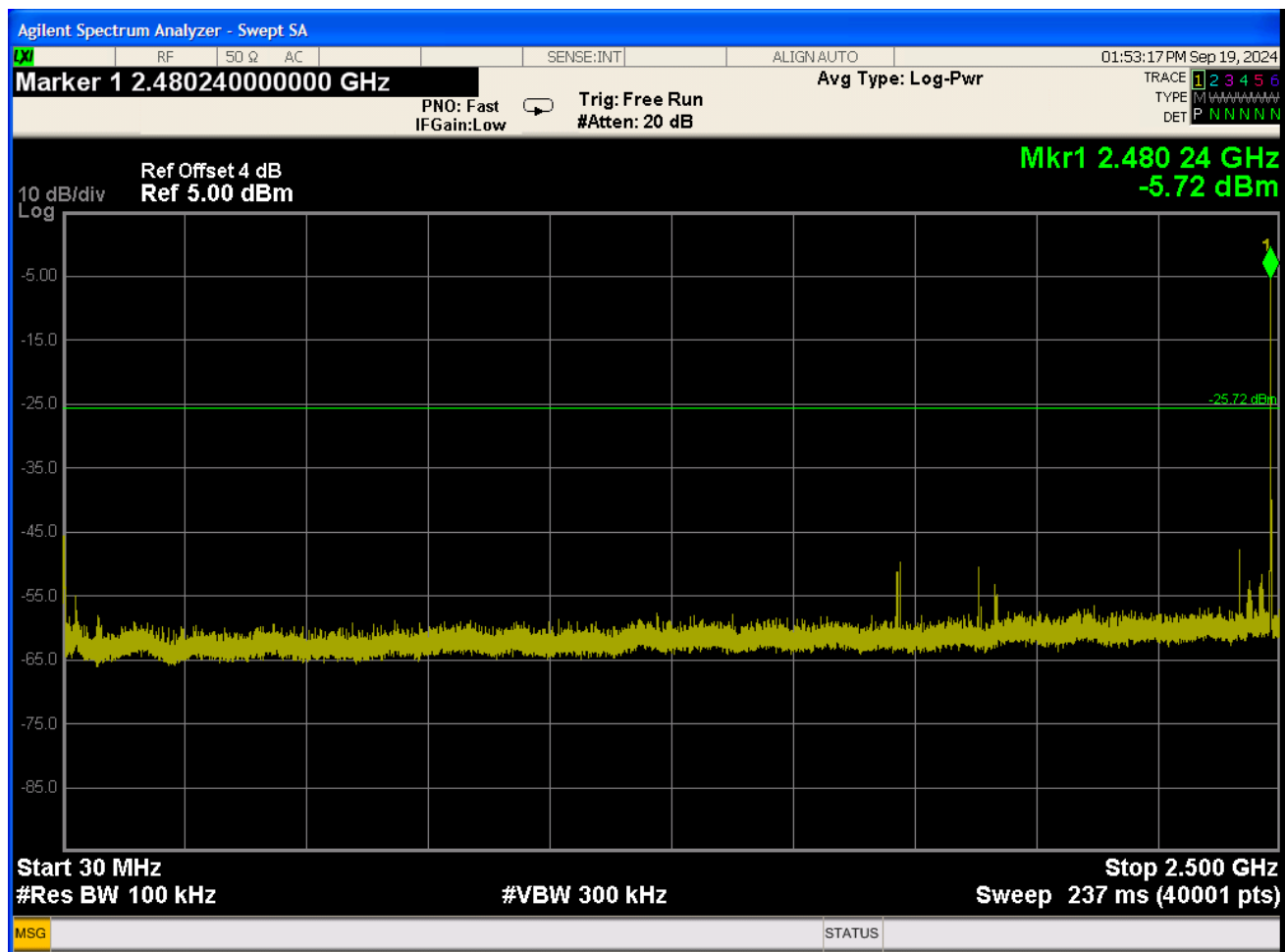




Figure 21: High Channel Conducted Spurious Plot 2

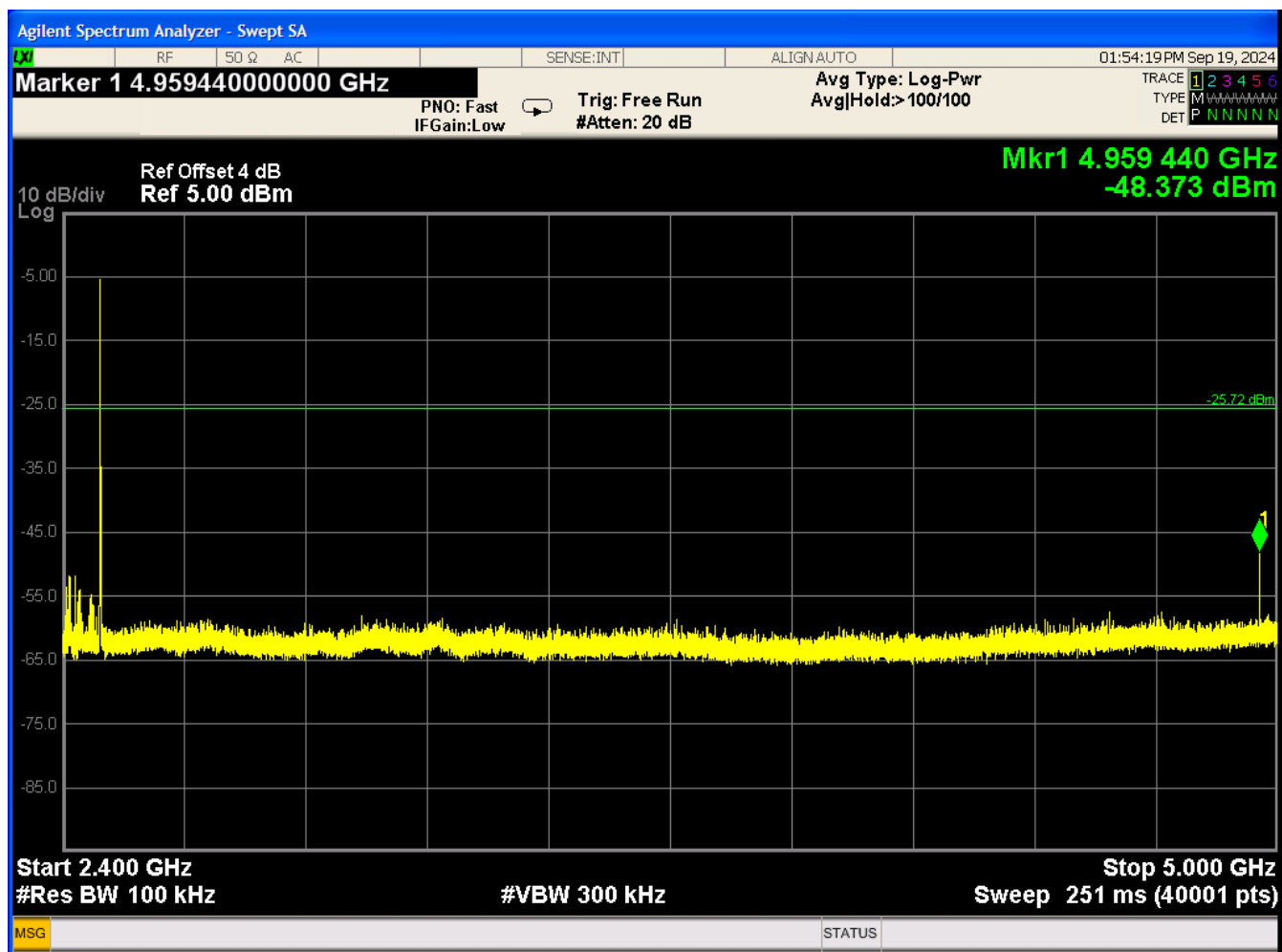




Figure 22: High Channel Conducted Spurious Plot 3

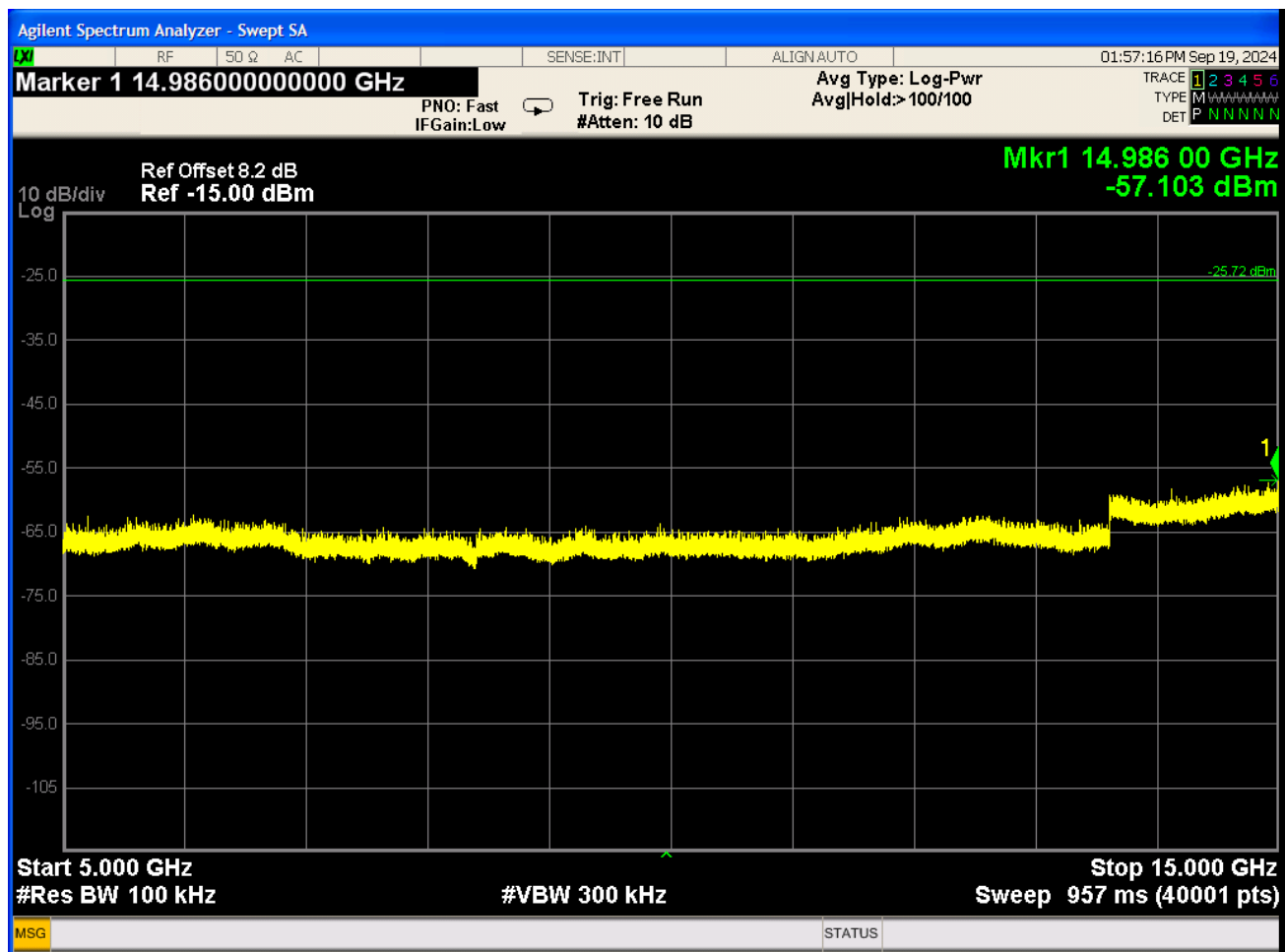




Figure 23: High Channel Conducted Spurious Plot 4





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 A (10 meter) | Class B (3 meter) |
| 30 – 88 MHz | 90 μ V/m | 100 μ V/m |
| 88 – 216 MHz | 150 μ V/m | 150 μ V/m |
| 216 – 960 MHz | 210 μ V/m | 200 μ V/m |
| > 960 MHz | 300 μ V/m | 500 μ V/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 25 GHz were measured. Both the horizontal and vertical field components were measured.

The output from the antenna was connected, via a preamplifier, to the input of the spectrum analyzer. The detector function was set to quasi-peak or peak, as appropriate. Above 1GHz average measurement are recorded. The measurement bandwidth of the spectrum analyzer system was set to at least 120 kHz, with all post-detector filtering no less than 10 times the measurement bandwidth. Frequencies above 1GHz were performed using a measurement bandwidth of 1 MHz with a video bandwidth setting of 10 Hz for the average measurement.

3.7.3 Test Results Summary

The EUT complies with the Radiated Emissions requirements of this section.



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 dB μ V to obtain the Radiated Electric Field in dB μ V/m. This logarithm amplitude is converted to a linear amplitude, then compared to the FCC limit.

Example:

Spectrum Analyzer Voltage: VdB μ V

Antenna Correction Factor: AFdB/m

Cable Correction Factor: CFdB

Pre-Amplifier Gain (if applicable): GdB

Electric Field: EdB μ V/m = V dB μ V + AFdB/m + CFdB - GdB

To convert to linear units of measure: EdB μ V/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, modulated signal as follows:

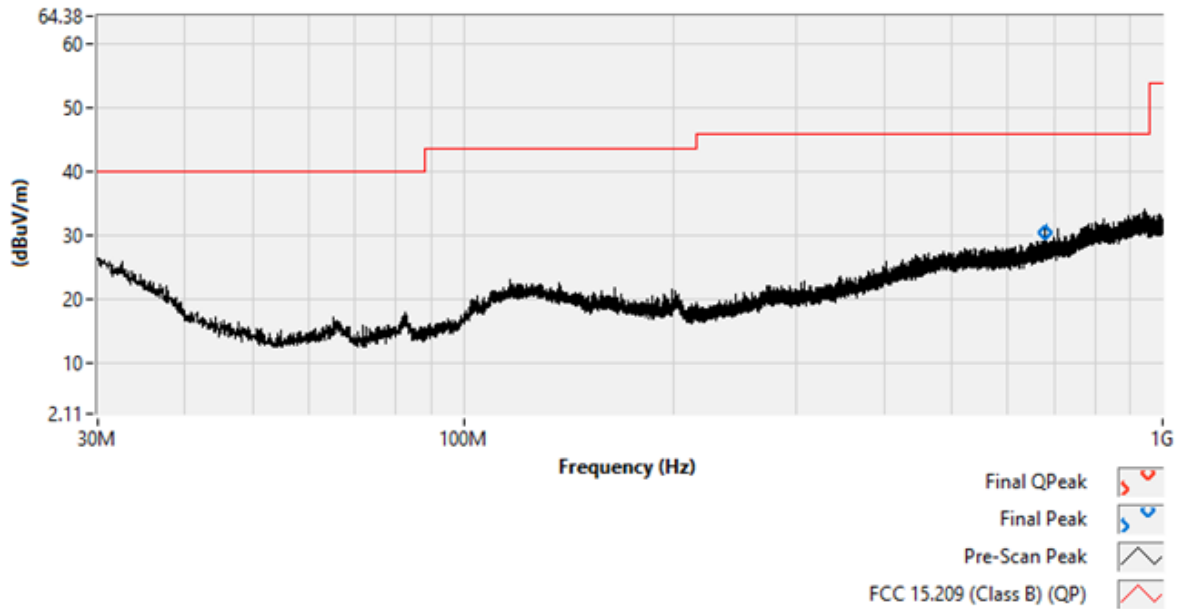
- a) for testing of 30 MHz to 1 GHz, the EUT was set to a transmitter enabled mode, the BLE transceiver was set to sweep the 2.4GHz ISM band, in an active advertising mode.
- b) for testing of 1 GHz to 25 GHz, the EUT was set to a transmitter enabled mode, the BLE transceiver was set to dwell on the low, center, and high channels.

The 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) | QP Limit (dBuV/m) | Delta (dB) | Turn Table (deg) | Antenna (cm) |
|-----------------|----------|---------------------|-------------------|------------|------------------|--------------|
| 673.978 | Peak | 31.007 | 46 | -14.993 | 280 | Vert, 100 |
| | QP | -- | 46 | -- | -- | -- |

Pre-scan and Final Data (Vertical)



Pre-scan and Final Data (Horizontal)

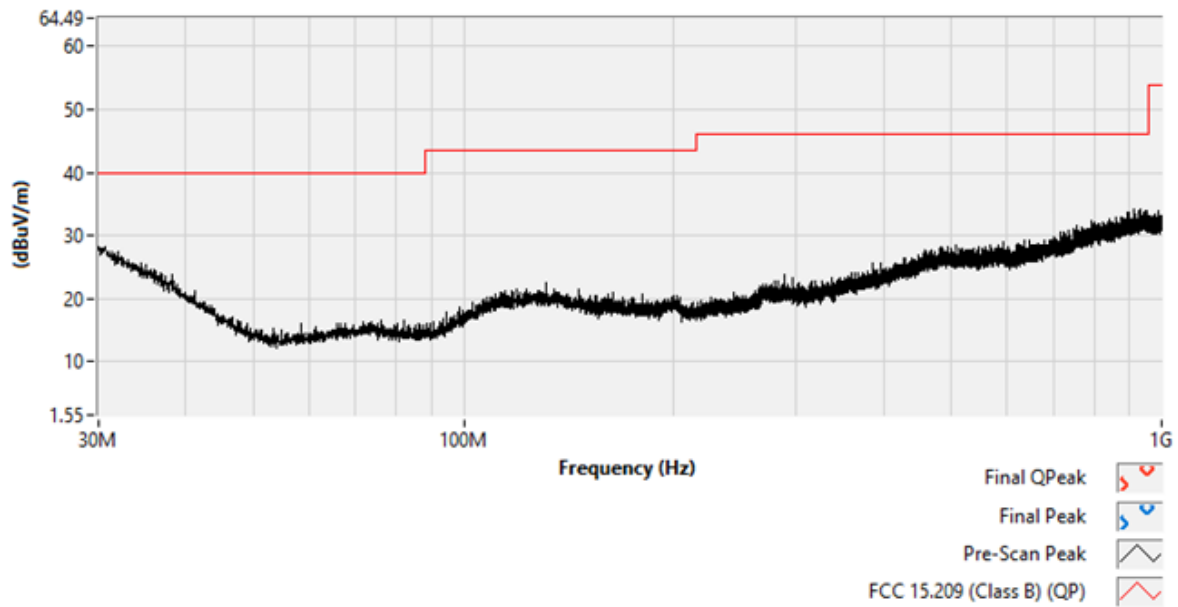


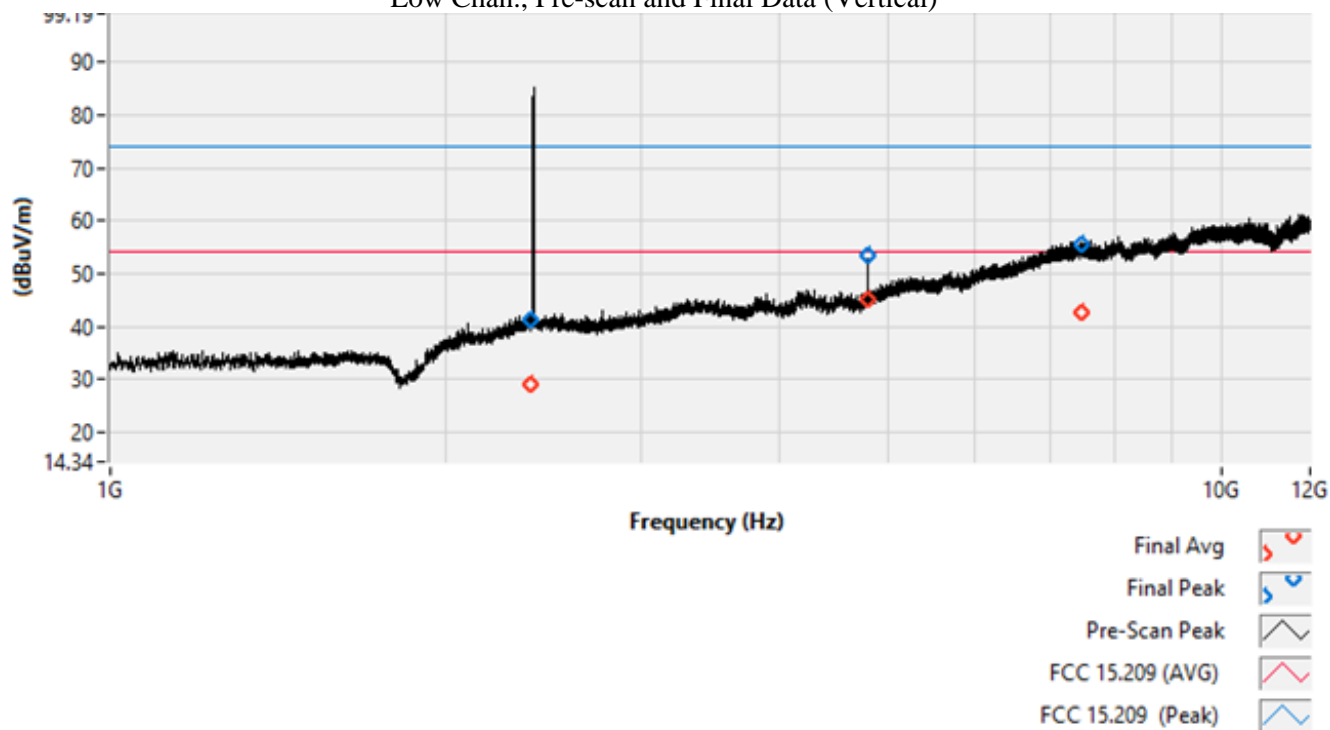


Table 9: Radiated Emissions Test Data, Low Channel

| Frequency (GHz) | Detector | Corr. Meas (dBuV/m) | Limit (dBuV/m) | Delta (dB) | Turn Table (deg) | Antenna (cm) |
|-----------------|----------|---------------------|----------------|------------|------------------|--------------|
| 2.390 | Peak | 41.579 | 74 | -32.421 | 314 | Horiz, 140 |
| | Avg | 28.909 | 54 | -25.091 | 280 | Vert, 220 |
| 2.400 | Peak | 85.133 | -- | -- | 314 | Horiz, 140 |
| 4.804 | Peak | 53.500 | 54 | -20.5 | 280 | Vert, 220 |
| | Avg | 45.202 | 74 | -8.798 | 280 | Vert, 220 |
| 7.481 | Peak | 55.632 | 54 | -18.368 | 280 | Vert, 220 |
| | Avg | 42.676 | 74 | -11.324 | 280 | Vert, 220 |
| 11.801 | Peak | 60.75 | 54 | -13.25 | 314 | Horiz, 140 |
| | Avg | 48.211 | 74 | -5.789 | 314 | Horiz, 140 |



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



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

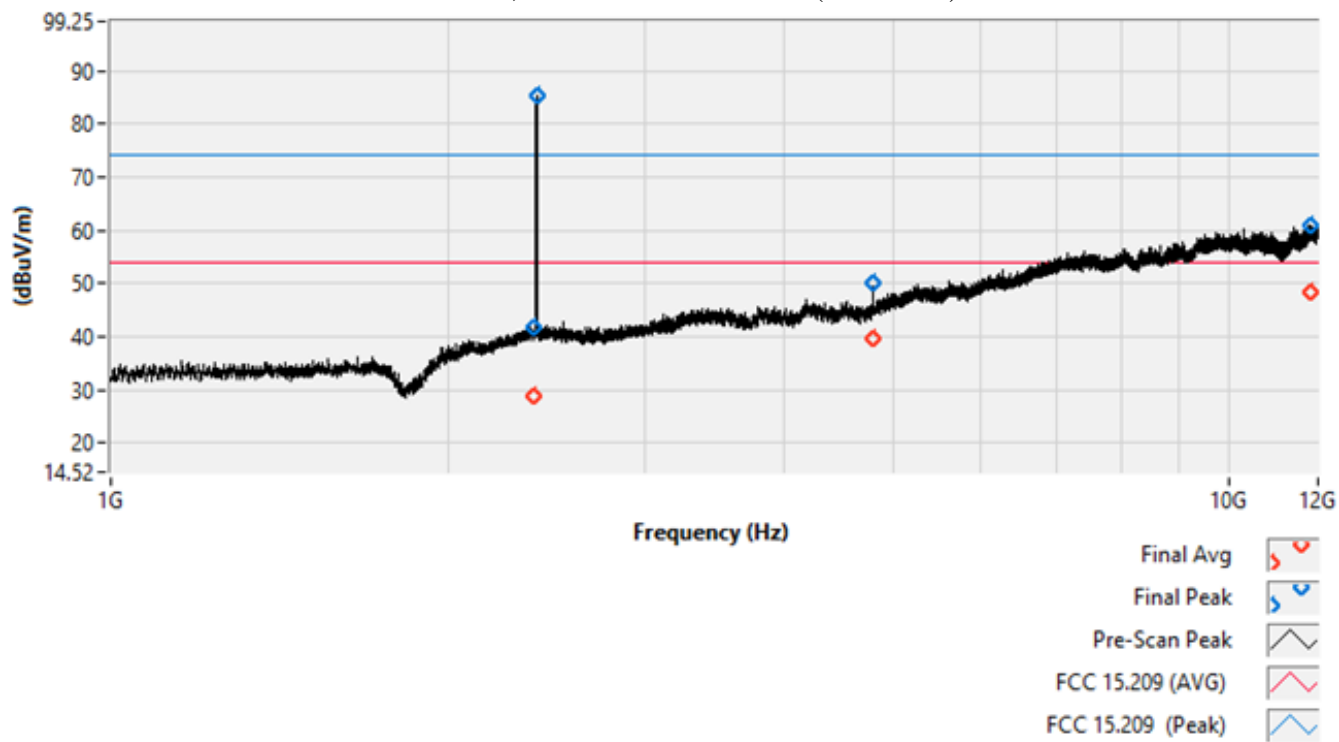


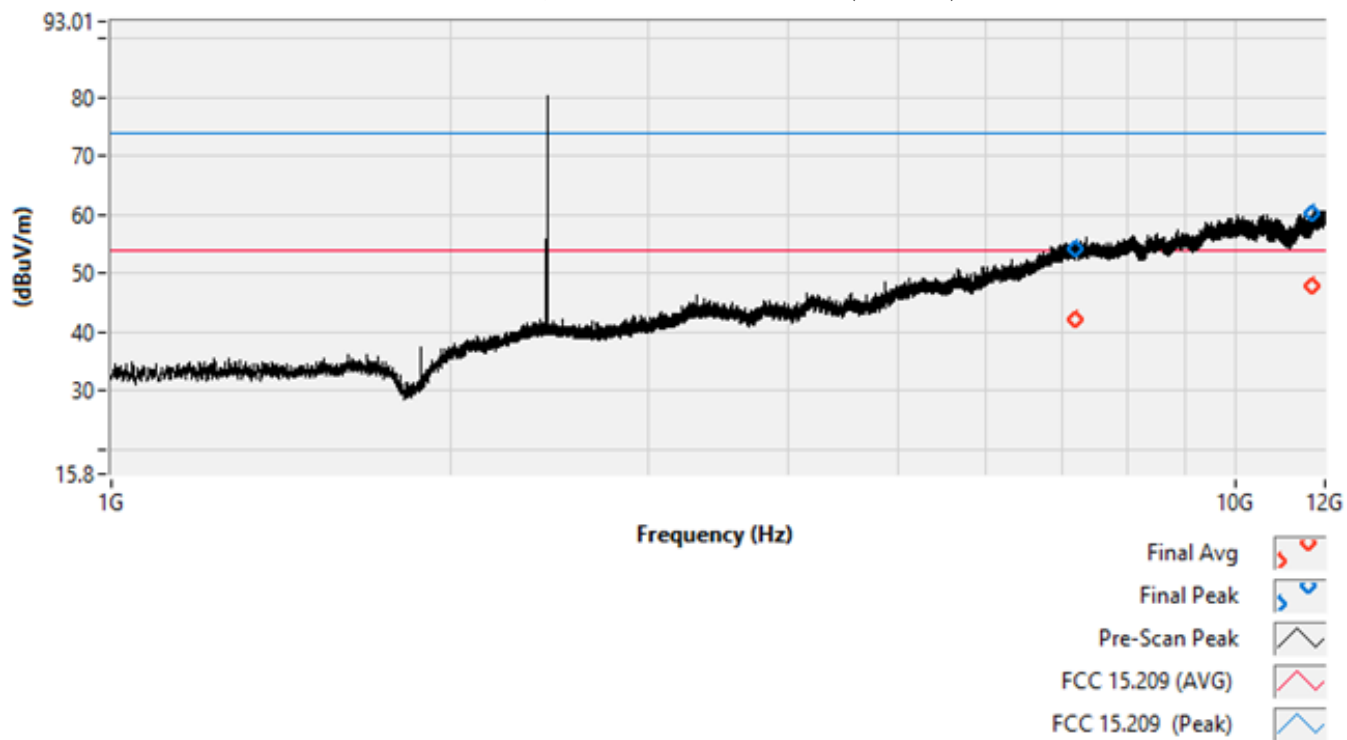


Table 10: Radiated Emissions Test Data, Center Channel

| Frequency (GHz) | Detector | Corr. Meas (dBuV/m) | Limit (dBuV/m) | Delta (dB) | Turn Table (deg) | Antenna (cm) |
|--------------------|----------|------------------------|-------------------|---------------|------------------------|-----------------|
| 2.44 | Peak | 80.276 | -- | -- | 314 | Horiz, 140 |
| 7.19 | Peak | 55.065 | 74 | -18.935 | 314 | Horiz, 140 |
| | Avg | 42.158 | 54 | -11.842 | 280 | Vert, 220 |
| 11.69 | Peak | 60.602 | 74 | -13.398 | 314 | Horiz, 140 |
| | Avg | 48.062 | 54 | -5.938 | 314 | Horiz, 140 |



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



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

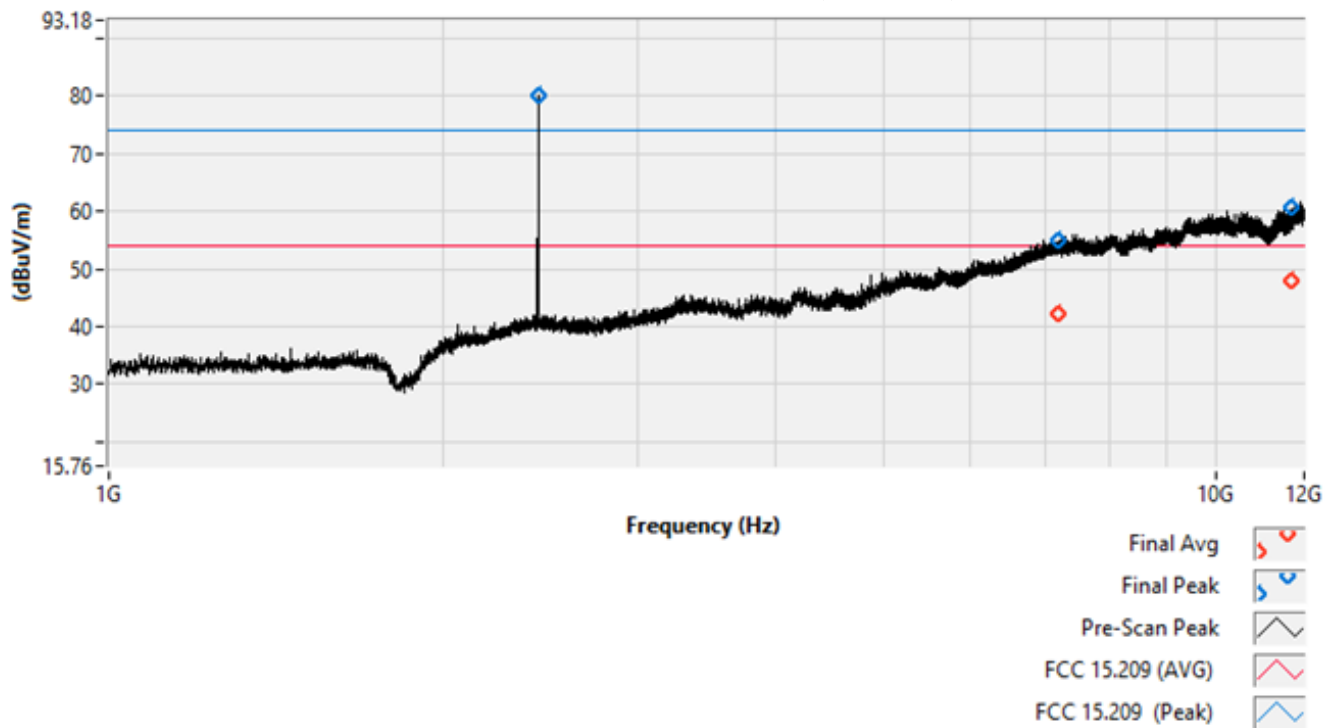


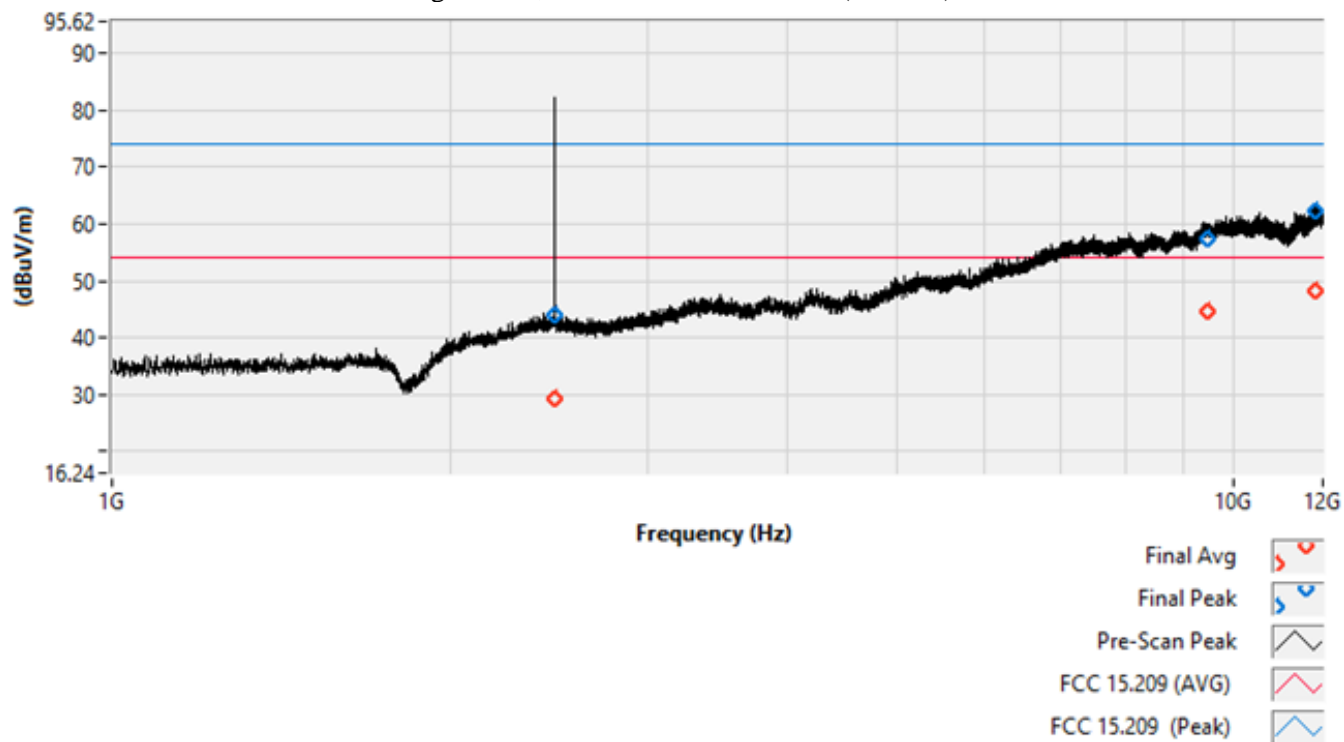


Table 11: Radiated Emissions Test Data, High Channel

| Frequency (GHz) | Detector | Meas (dBuV/m) | Limit (dBuV/m) | Delta (dB) | Turn Table (deg) | Antenna (cm) |
|--------------------|----------|------------------|-------------------|---------------|------------------------|-----------------|
| 2.480 | Peak | 82.649 | -- | -- | 314 | Horiz, 140 |
| 2.4835 | Peak | 43.935 | 74 | -30.065 | 280 | Vert, 220 |
| | Avg | 29.472 | 54 | -24.528 | 314 | Horiz, 140 |
| 4.961 | Peak | 53.862 | 74 | -20.138 | 314 | Horiz, 140 |
| | Avg | 40.443 | 54 | -13.557 | 314 | Horiz, 140 |
| 9.46 | Peak | 57.87 | 74 | -16.13 | 314 | Horiz, 140 |
| | Avg | 44.83 | 54 | -9.17 | 314 | Horiz, 140 |
| 11.835 | Peak | 62.218 | 74 | -11.782 | 280 | Vert, 220 |
| | Avg | 48.383 | 54 | -5.617 | 314 | Horiz, 140 |



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



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

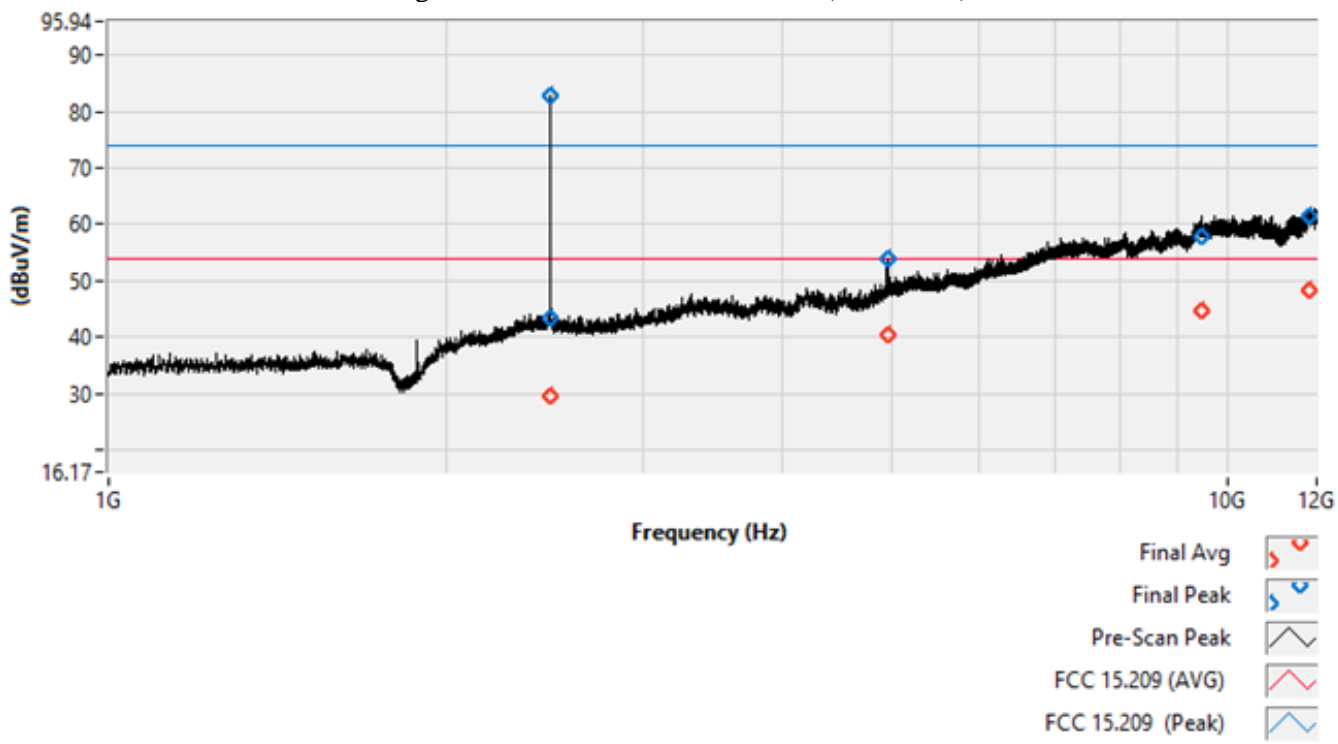
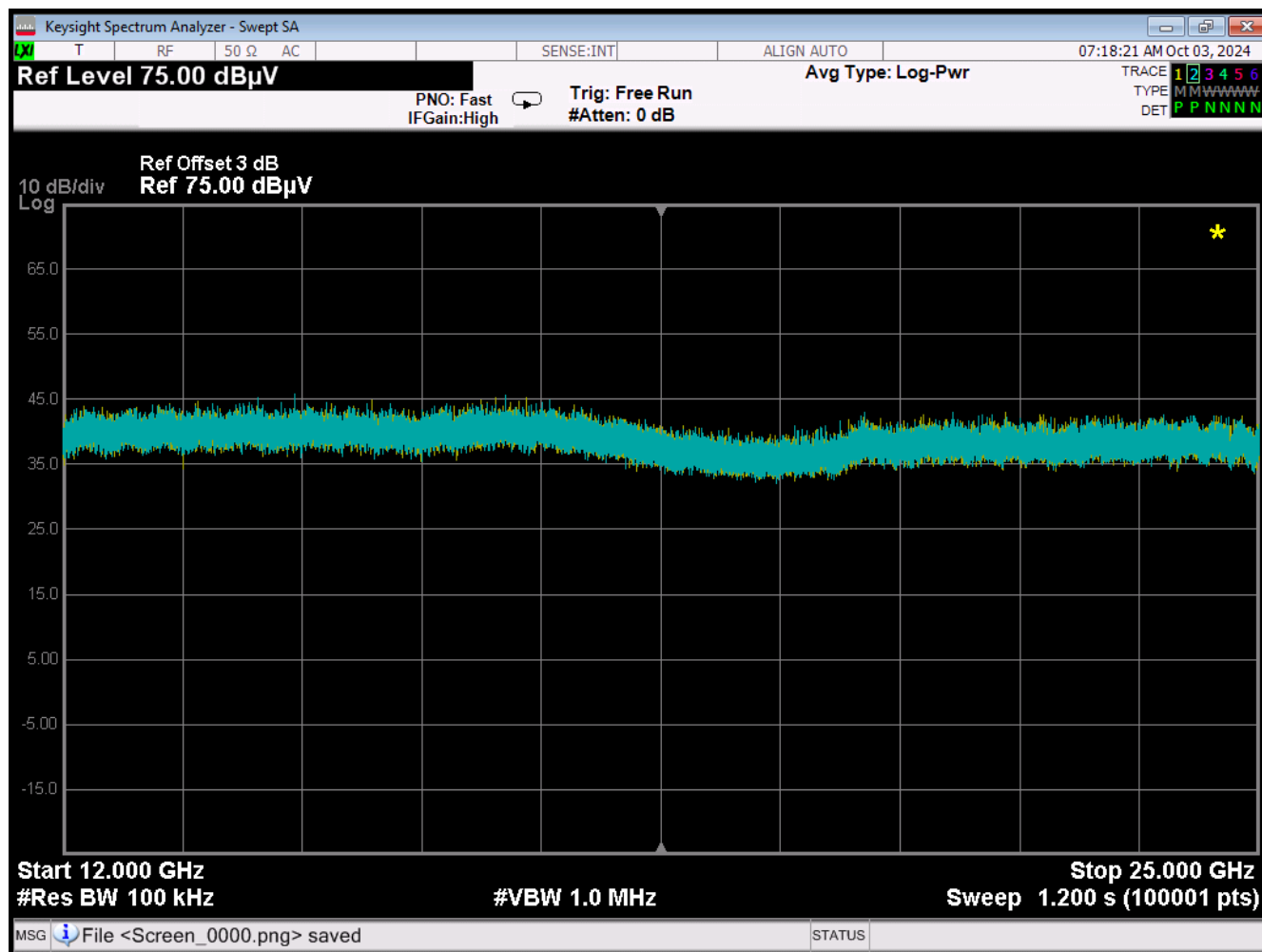




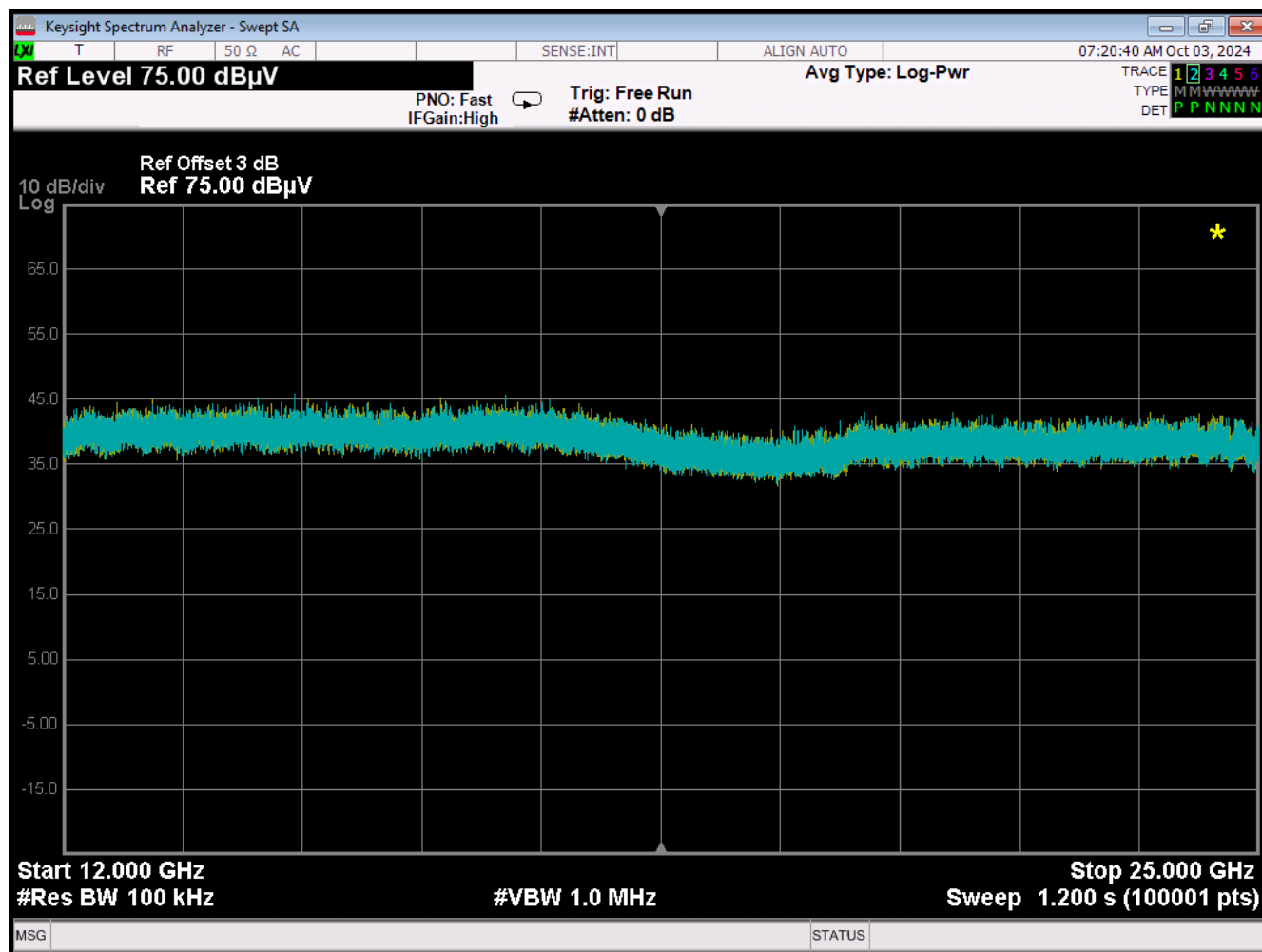
Figure 24: Radiated Emissions Test Data, Low Channel (12GHz to 25GHz)



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



Figure 25: Radiated Emissions Test Data, High Channel (12GHz to 25GHz)



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



4 Test Equipment

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

Table 12: Test Equipment List

| Test Name: Radiated Emissions | | Test Date(s): 9/19/2024 to 10/2/2024 | |
|--------------------------------------|---------------------------|--------------------------------------|-----------------|
| Asset # | Manufacturer/Model | Description | Cal. Due |
| 00942 | AGILENT, MXA | SPECTRUM ANALYZER | 12/19/2024 |
| 00644 | SUNOL SCIENCES CORP. | ANTENNA, LOGPERIOD | 11/7/2024 |
| 00004 | ARA, DRG-118/A | ANTENNA, HORN | 6/7/2027 |
| 00066 | AGILENT | RF PRE-AMPLIFIER | 8/21/2025 |
| 00065 | ELECTRO-METRICS | RF PRE-AMPLIFIER | 8/23/2025 |
| 00806 | MINI-CIRCUITS, 3061 | HF COAX CABLE, SMA | 12/26/2024 |
| 00825 | CABLE ASSOCIATES | SMA, COAXIAL CABLE | 6/14/2025 |
| 00731 | NARDA 4779-3 | 2W, 3DB ATTENUATOR | 6/20/2025 |
| 00977 | JUNKOSHA, USA MX-322 | 6M COAXIAL CABLE, SMA/N | 12/26/2024 |

| Test Name: Conducted RF Emissions | | Test Date: 9/19/2024 to 10/2/2024 | |
|--|---------------------------|-----------------------------------|-----------------|
| Asset # | Manufacturer/Model | Description | Cal. Due |
| 00993 | KEYSIGHT N9020B | MXA SIGNAL ANALYZER | 11/6/2025 |
| 00885 | UTIFLEX UFA2108 | HF COXIAL CABLE | 6/25/2025 |
| 00992 | KEYSIGHT N5173B | EXG SIGNAL GENERATOR | 11/27/2024 |
| N/A | WEINSCHEL, 3.5MM | 3dB ATTENUATOR | Cal. Before Use |



5 Measurements

5.1.1 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 (Sep-2020) American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

5.2 Measurement Uncertainty

All results reported herein relate only to the equipment tested. The basis for uncertainty calculation uses ANSI/NCSL Z540-2-1997 (R2002) with a type B evaluation of the standard uncertainty. Elements contributing to the standard uncertainty are combined using the method described in Equation 1. to arrive at the total standard uncertainty. The standard uncertainty is multiplied by the coverage factor to determine the expanded uncertainty which is generally accepted for use in commercial, industrial, and regulatory applications and when health and safety are concerned (see Equation 2). A coverage factor was selected to yield a 95% confidence in the uncertainty estimation.

Equation 1: Standard Uncertainty

$$u_c = \pm \sqrt{\frac{a^2}{div_a^2} + \frac{b^2}{div_b^2} + \frac{c^2}{div_c^2} + \dots}$$

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 13: 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 % |