FCC CERTIFICATION TEST REPORT

for the

MINIMIC

FCC ID: 2BUXT-MM1

WLL REPORT# 19558-01 REV 0

Prepared for:

Analog Devices, Inc.

1 Analog Way

Wilmington, Massachusetts 01887

Prepared By:

Washington Laboratories, Ltd.

4840 Winchester Blvd. Suite 5

Frederick, Maryland 21703

Testing Certificate AT-1448

FCC Certification Test Report

for the

Analog Devices, Inc.

miniMic

FCC ID: 2BUXT-MM1

April 23, 2026

WLL Report# 19558-01 Rev 0

Prepared by:

Ryan Mascaro
RF Test Engineer

Reviewed by:

Steven D. Koster
President

Abstract

This report has been prepared on behalf of Analog Devices, Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for a Digital Transmission System (DTS) Transmitter device 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 Analog Devices, Inc., miniMic. The information provided in this report, along with the results obtained, are only applicable to the item tested herein, documented as the EUT.

Radiated testing above 30MHz 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 has been accepted and designated by the FCC under Test Firm Number US3001. Washington Laboratories is approved by the ANSI National Accreditation Board (ANAB), as an independent test laboratory under ISO/IEC 17025:2017. Please refer to Certificate Number AT-1448.

The Analog Devices, Inc., miniMic complies with the requirements for a Digital Transmission System (DTS) transmitter device under FCC Rule Part 15.247.

Revision History	Description of Change	Date
Rev 0	Initial Release	April 23, 2026

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1 Introduction

1.1 Compliance Statement

The Analog Devices, Inc., miniMic complies with the requirements for a Digital Transmission System (DTS) transmitter device under FCC Rule Part 15.247.

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/Cor 1-2021 "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".

1.3 Contract Information

Customer:	Analog Devices, Inc.
Purchase Order Number:	50% Deposit Terms
Quotation Number:	75700A

1.4 Test and Support Personnel

Washington Laboratories, LTD:	Ryan Mascaro
Manufacturer Representative:	Ahmet Orkun Tomruk and Max Shulaker

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. Washington Laboratories has been accepted and designated by the FCC under Test Firm Number US3001. Washington Laboratories is approved by the ANSI National Accreditation Board (ANAB), as an independent test laboratory under ISO/IEC 17025:2017. Please refer to Certificate Number AT-1448.

2 Equipment Under Test

2.1 EUT Identification

Table 1: Device Summary

Grantee and Manufacturer:	Analog Devices, Inc.		
FCC ID:	2BUXT-MM1		
EUT Model Families:	miniMic Standard		
	miniMic Extended		
Software/Firmware Version:	1.0.0-rc4		
Hardware Version:	PCB	9.1	
	Enclosure	1.0	
FCC Rule Parts:	§ 15.247		
Frequency Range:	2402 MHz to 2480 MHz		
Peak Output Power:	-5.78 dBm (0.0002642 Watts)		
Maximum Antenna Gain:	2.20 dBi (peak)		
Tune-up Tolerance	±1.0 dB		
Peak EIRP, Adjusted for Tune-up:	-2.58 dBm (used for RF Exposure only)		
Antenna Manufacturer and Type:	Johanson, 2450AT45A100E-AEC, Ceramic Chip		
FCC Emission Designator:	702KG1D		
6dB Occupied Bandwidth:	701.7 kHz (worst-case)		
Keying and Type of Information:	Automatic, Audio		
Number of Channels:	40		
Protocol:	BLE		
Modulation:	GFSK		
Data Rate(s):	1Mbps and 2Mbps		
Power Source & Voltage:	miniMic Standard	3.8V Li-ion Battery, 160mAh, LP322028	
	miniMic Extended	3.8V Li-ion Battery, 345mAh, LP622028	
Worst-Case Tx Spurious Emission:	4804.0 MHz	44.673 dBuV/m (AVG)	see Page 63

2.2 EUT Description

The Analog Devices, Inc. miniMic is a 2.4GHz ISM transmitter being certified under the DTS code. The EUT is a digital stethoscope that enables amplification, filtering, recording and transmission of auscultation sounds from various bodily regions including the heart, lungs, bowel, arteries, and veins. It can be used with both pediatric and adult patients. It is intended for use by health care professionals in a clinical environment or by lay users in a nonclinical environment. The device is not intended for use for self-diagnosis and should only be interpreted by health care professionals. The EUT is intended to be used when pressed to the human body. The EUT employs BLE protocols at both 1Mbps and 2Mbps.

The EUT is being certified under two model families and their model numbers (differ only by cosmetic attributes like color and finish) for the optional battery sizes. The internal battery is offered in the Standard configuration, employing a 160mAh battery; and in the Extended configuration employing a 345mAh battery. The batteries vary slightly in size and therefore, the EUT models are slightly different in size. The overall shape, appearance, and use remain the same between models. The smaller housing EUT contains the 160mAh battery (LP322028), while the larger housing EUT contains the 345mAh battery (LP622028).

The EUT battery is intended to be recharged by the end-user-supplied 5VDC power supply. The EUT can couple directly to the AC public mains network via the charger.

The applicant has declared the following:

- the EUT is not marketed with an AC/DC power supply or charger.

- the EUT is not marketed with a USB-C cable.

- the EUT is not designed or intended to be connected to a laptop computer during normal use.

- the EUT can transmit and charge at the same time. This is only intended to be used for software/firmware updates via wireless BLE, once the EUT is plugged in and charging.

- when marketed, the EUT will be loaded with software/firmware to ensure the following: when the device is coupled to any USB-C cable, the medical stethoscope function shall disable and remain disabled until the USB-C cable is removed.

2.3 Test Configuration and Algorithm

The EUT samples were configured for testing and 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 testing.

For conducted measurements, the radio transmitter was observed at the PCB antenna port.

For AC powerline emissions, the EUT was tested in six configurations:

(1) test-mode, continuously transmit, 1Mbps, 2480MHz, GFSK; coupled directly to the AC mains via wall-wart.

(2) test-mode, TX Off, coupled directly to the AC mains via wall-wart.

(3) test-mode, continuously transmit, 1Mbps, 2480MHz, GFSK; coupled indirectly to the AC mains via the support laptop's UART interface.

(4) test-mode, TX Off, coupled indirectly to the AC mains via the support laptop's UART interface.

(5) production mode, BLE paired to mobile phone, streaming data/stethoscope recording; coupled to AC mains via wall-wart.

(6) production mode, BLE Off, Tx Off, EUT Off, coupled to AC mains via wall-wart, charging only

For radiated emissions below 1GHz, the EUT was tested in two configurations:

(1) test-mode, continuously transmit, 1Mbps, 2480MHz, GFSK; coupled to AC mains via wall-wart.

(2) production mode, BLE paired to mobile phone, streaming data/stethoscope recording; coupled to AC mains via wall-wart.

For radiated emissions above 1GHz, the EUT was set to transmit at the each of the low, center, and high channels.

For all radiated emissions, the EUT was investigated both on battery power and on the charger. In some frequency ranges below 1GHz, the AC/DC wall-wart power supply created the worst-case emissions. For this reason, and to ensure the battery did not deplete during testing, the EUT remained coupled to the wall-wart charger for the duration of the test. For the transmit power setting/transmit gain index setting: please note that the test-mode software was set to an index value of "7". This setting was maintained for all testing. For the purposes of testing, the duty cycle of the transmitter was set to near 99%.

The EUT was tested in a GFSK modulated mode at 1Mbps and 2Mbps BLE data rate.

The Digital Emissions from the EUT are covered under a Supplier's Declaration of Conformity.

Only the worst-case transmitter emissions are provided throughout this report

2.4 Customer Supplied Data or EUT Information

The customer has provided the information on the EUT contents and configuration. The customer has also provided the information on the transmitting antenna (type and gain). The test laboratory is not responsible for verifying the accuracy of this information.

2.5 Equipment Configuration

The EUT is comprised of the following equipment. (All Modules, PCBs, etc. listed were considered as part of the EUT, as tested.)

Table 2: Equipment Configuration

Model Family	Manufacturer	Part Number	Serial Number	Revision
miniMic Standard	Analog Devices, Inc	Not Specified	26020006	1
3.8V Battery 160mAh	Not Specified	LP322028	Not Specified	N/A
miniMic Extended	Analog Devices, Inc	Not Specified	26060009	1
3.8V Battery 345mAh	Not Specified	LP622028	Not Specified	N/A

Table 3: Support Equipment

Description	Manufacturer	Model Number
Laptop Computer	N/A	N/A
UART De-Bug Cable	N/A	N/A
USB-C Cable	N/A	N/A
iPhone	Apple	16 (OS v18.6.2)
AC/DC Wall-Wart Power Supply	N/A	N/A

Table 4: EUT Ports and Cabling

Ref. ID	Port	Description	Qty.	Length
1	USB-C Charging Port	Shielded USB-C Cable	1	< 3 meters

2.5.1 EUT Details

The EUT is not sold with a charger or a USB-C cable. The end user is responsible for sourcing their own AC/DC charger and USB-C cable. Since the device is not marketed with the items, the applicant selected generic peripherals to power the device and charge the battery during testing. Please refer to the test setup photograph filing exhibit for details regarding the charger and cable employed during testing. Also please see section 2.3 of this report for the testing approach.

Further details regarding the two model families and their model numbers.

The device model families address the different chassis sizes for the two battery sizes.

The device model numbers only differ by cosmetic attributes, like color and finish.

The table below provides an overview of the various EUT models that are covered under this certification.

Item#	Model Family	Model Name/Number	Description
1	Standard – MM1S	MM1S-STL/BLU	miniMic Standard – Steel – Blue
2	Standard – MM1S	MM1S-STL/PNK	miniMic Standard – Steel – Pink
3	Standard – MM1S	MM1S-STL/MRN	miniMic Standard – Steel – Maroon
4	Standard – MM1S	MM1S-STL/BLK	miniMic Standard – Steel – Black
5	Standard – MM1S	MM1S-BLK/BLK	miniMic Standard – All Black
6	Standard – MM1S	MM1S-RSG/RSG	miniMic Standard – Rose
7	Standard – MM1S	MM1S-GLD/GLD	miniMic Standard – Gold
8	Extended – MM1E	MM1E-STL/BLU	miniMic Extended – Steel – Blue Top
9	Extended – MM1E	MM1E-STL/PNK	miniMic Extended – Steel – Pink Top
10	Extended – MM1E	MM1E-STL/MRN	miniMic Extended – Steel – Maroon Top
11	Extended – MM1E	MM1E-STL/BLK	miniMic Extended – Steel – Black
12	Extended – MM1E	MM1E-BLK/BLK	miniMic Extended – All Black
13	Extended – MM1E	MM1E-RSG/RSG	miniMic Extended – Rose
14	Extended – MM1E	MM1E-GLD/GLD	miniMic Extended – Gold

3 Test Results

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

Table 5: Testing and Results Summary

FCC Rule Part	Description	Result
15.247(a)(2)	Occupied Channel Bandwidth	Pass
15.247 (b)(3)	Transmit Output Power	Pass
15.247 (e)	Power Spectral Density	Pass
15.247 (d)	Out-of-Band Emissions (Band Edge @ 20dB below)	Pass
15.205 15.209	General Field Strength Limits (Restricted Bands & RE Limits)	Pass
15.207	AC Conducted Emissions	Pass

3.1 Deviations to the Test Standard

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

3.2 Testing Dates

The EUT was tested during the following dates: 2/19/2026 to 4/3/2026

3.3 Occupied Bandwidth, Digital Transmission System

For a DTS device operating in the 2.4GHz band, FCC Rule Part 15.247(a)(2) requires 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.

3.3.1 Measurement Method

This test was performed in accordance with Clause 11.8.2, Option 2, of ANSI C63.10-2020/Cor 1-2021.

3.3.2 Test Data

The test data for both EUT models is provided below.

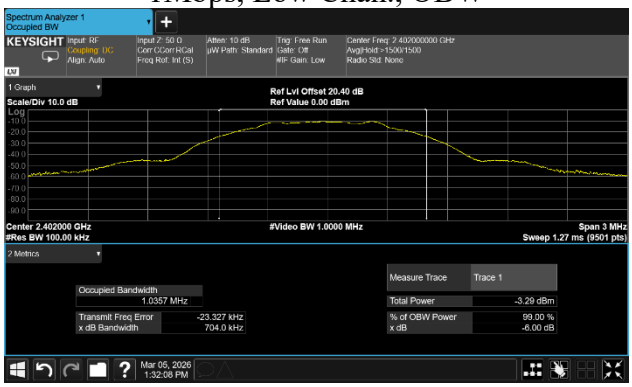
The EUT was configured to transmit a modulated signal, with channel hopping disabled.

Table 6: Occupied Channel Bandwidth, Test Results

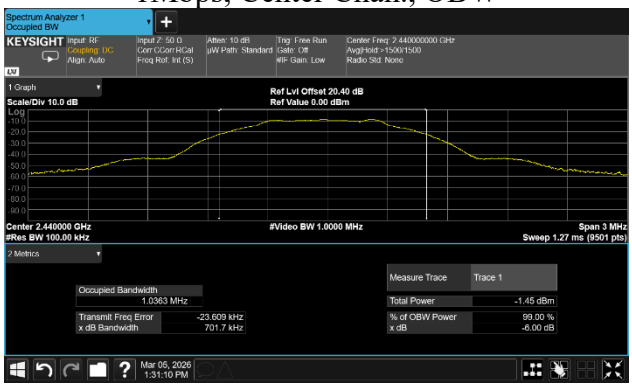
Model	Mode (Data Rate)	Transmit Frequency (MHz)	6dB Bandwidth (kHz)
miniMic Standard	1Mbps	2402	704.0
		2440	701.7
		2480	707.9
miniMic Standard	2Mbps	2402	1325.0
		2440	1318.0
		2480	1282.0
miniMic Extended	1Mbps	2402	707.4
		2440	709.7
		2480	706.8
miniMic Extended	2Mbps	2402	1335.0
		2440	1331.0
		2480	1334.0

Figure 1: Occupied Bandwidth, miniMic Standard, 1Mbps

1Mbps, Low Chan., OBW



1Mbps, Center Chan., OBW



1Mbps, High Chan., OBW

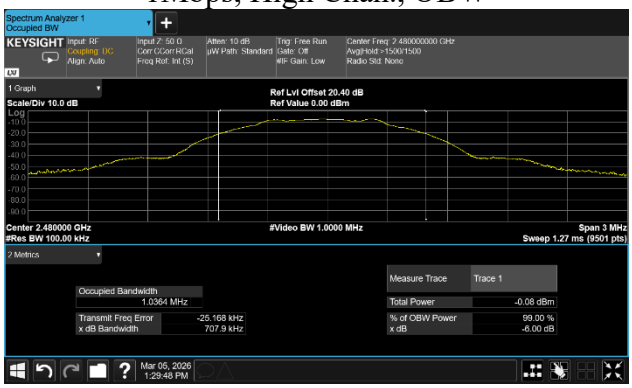
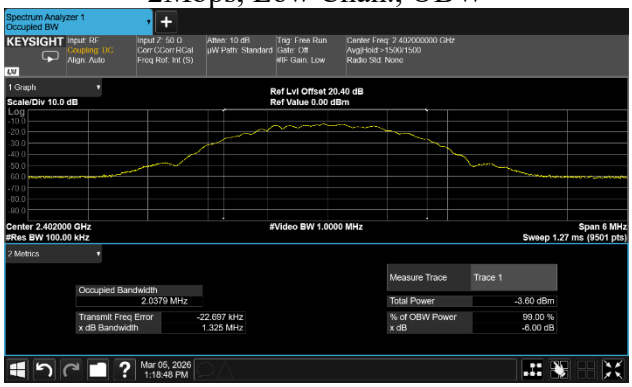
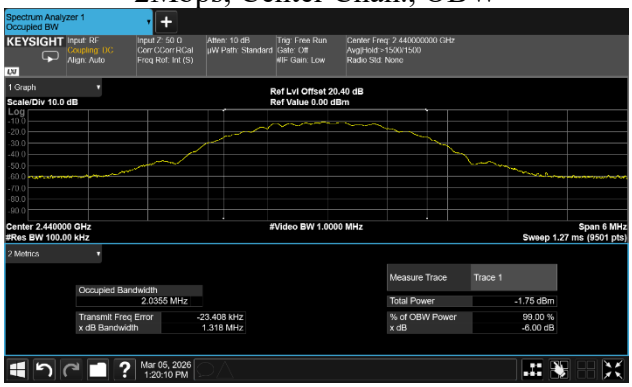


Figure 2: Occupied Bandwidth, miniMic Standard, 2Mbps

2Mbps, Low Chan., OBW



2Mbps, Center Chan., OBW



2Mbps, High Chan., OBW

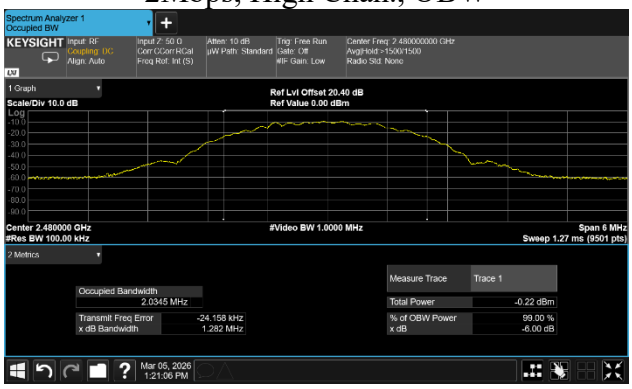
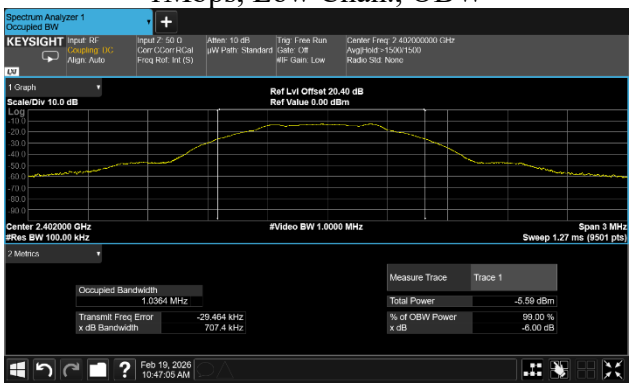
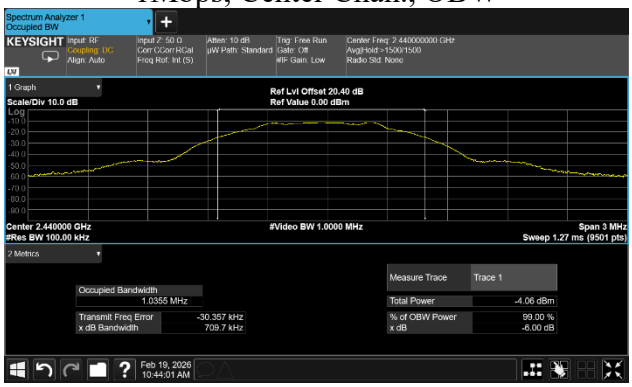


Figure 3: Occupied Bandwidth, miniMic Extended, 1Mbps

1Mbps, Low Chan., OBW



1Mbps, Center Chan., OBW



1Mbps, High Chan., OBW

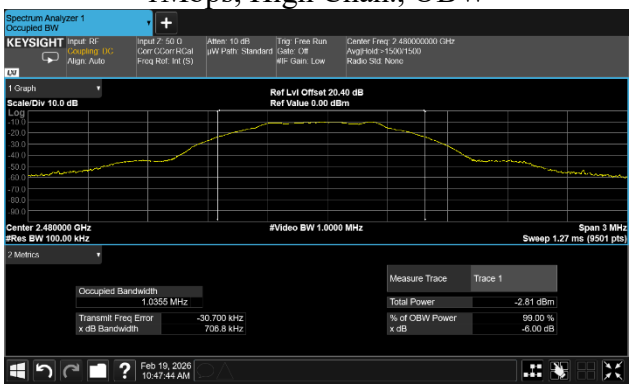
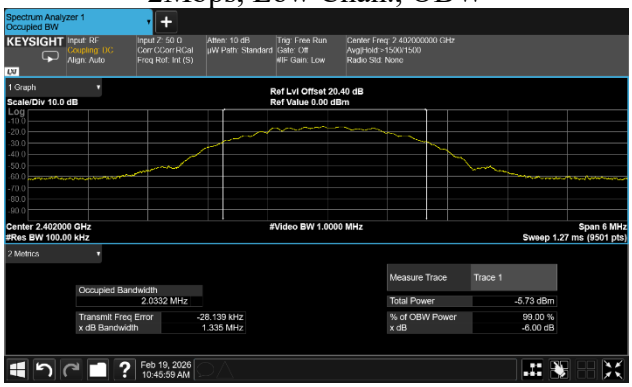
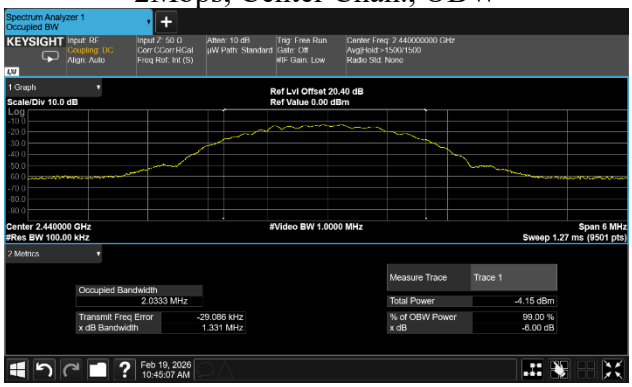


Figure 4: Occupied Bandwidth, miniMic Extended, 2Mbps

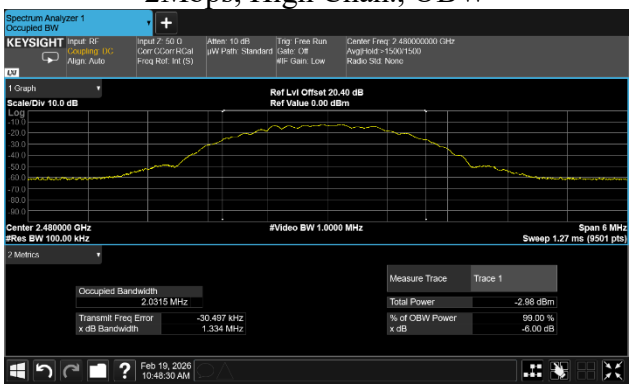
2Mbps, Low Chan., OBW



2Mbps, Center Chan., OBW



2Mbps, High Chan., OBW



3.4 Conducted Peak Output Power

For a DTS device operating in the 2.4GHz band, FCC Rule Part 15.247(b)(3) requires 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.

3.4.1 Measurement Method

This test was performed in accordance with Clause 11.9.1.1 of ANSI C63.10-2020/Cor 1-2021.

3.4.2 Test Data

The test data for both EUT models is provided below.

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

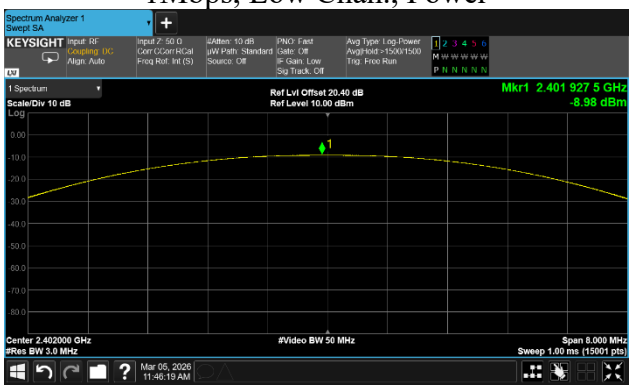
The EUT employs a PCB trace antenna with a peak gain of 2.20 dBi.

Table 7: Conducted Output Power, Test Results

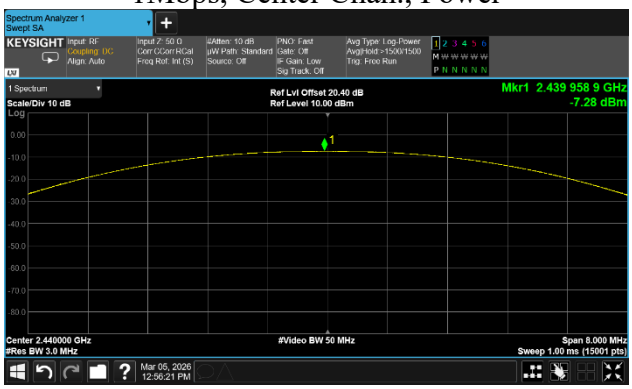
Model	Mode (Data Rate)	Transmit Frequency (MHz)	Peak Power (dBm)	Peak EIRP (dBm)
miniMic Standard	1Mbps	2402	-8.98	-6.78
		2440	-7.28	-5.08
		2480	-5.78	-3.58
miniMic Standard	2Mbps	2402	-9.32	-7.12
		2440	-7.52	-5.32
		2480	-5.95	-3.75
miniMic Extended	1Mbps	2402	-8.79	-6.59
		2440	-7.25	-5.05
		2480	-5.89	-3.69
miniMic Extended	2Mbps	2402	-8.84	-6.64
		2440	-7.36	-5.16
		2480	-5.99	-3.79

Figure 5: Conducted Output Power, miniMic Standard, 1Mbps

1Mbps, Low Chan., Power



1Mbps, Center Chan., Power



1Mbps, High Chan., Power

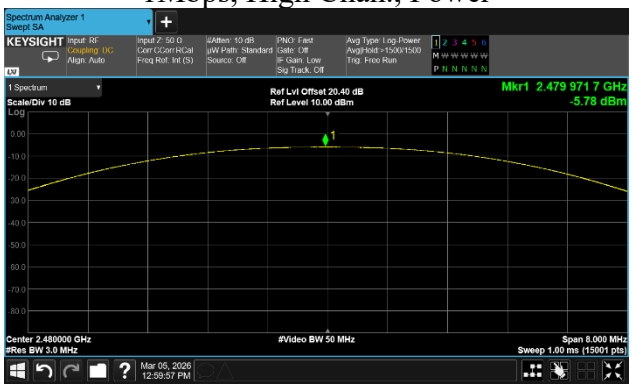
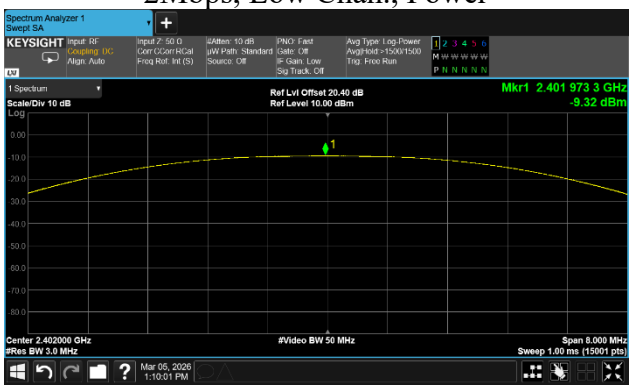
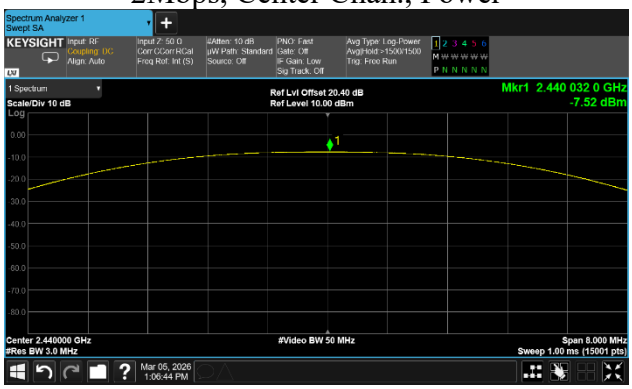


Figure 6: Conducted Output Power, miniMic Standard, 2Mbps

2Mbps, Low Chan., Power



2Mbps, Center Chan., Power



2Mbps, High Chan., Power

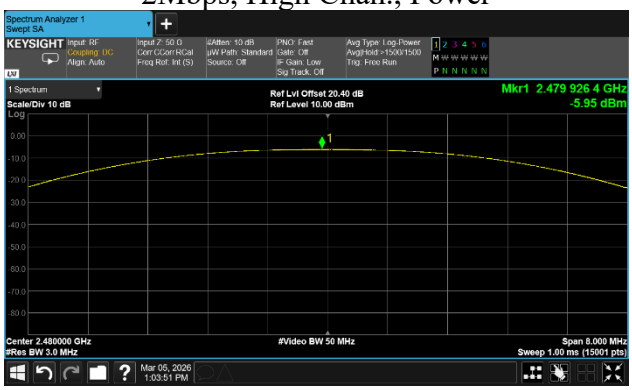
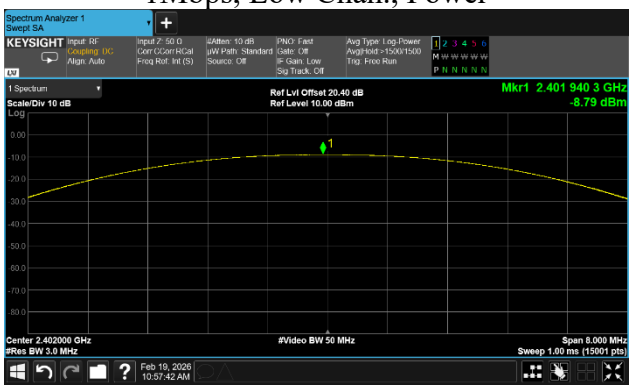
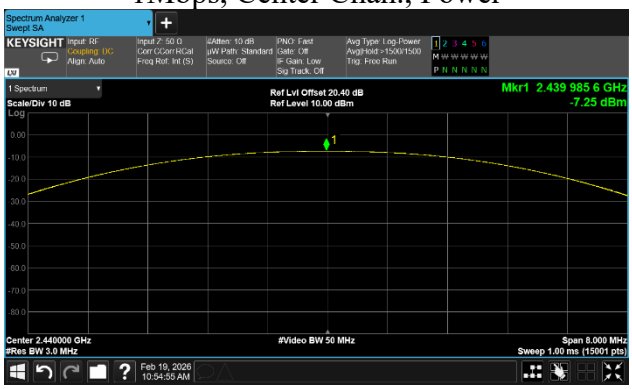


Figure 7: Conducted Output Power, miniMic Extended, 1Mbps

1Mbps, Low Chan., Power



1Mbps, Center Chan., Power



1Mbps, High Chan., Power

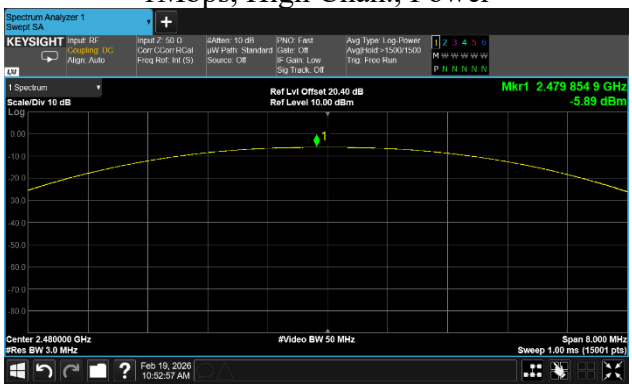
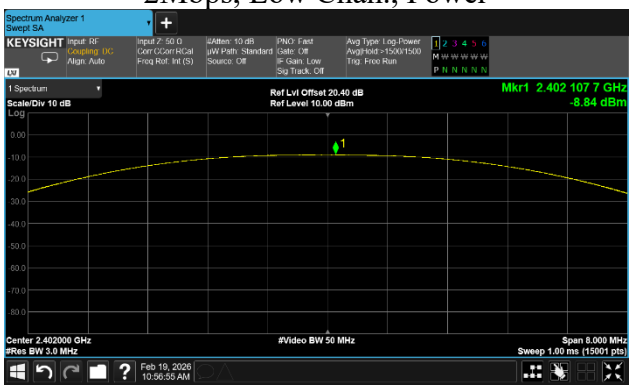
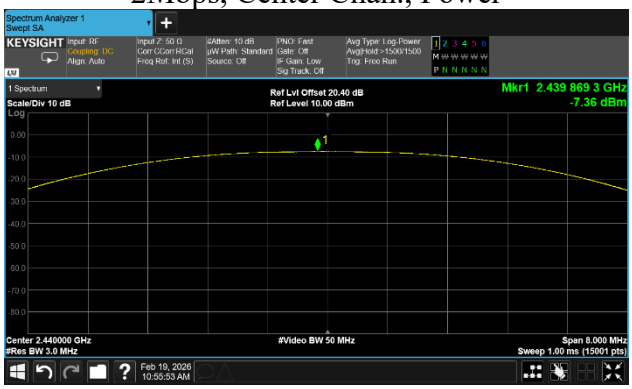


Figure 8: Conducted Output Power, miniMic Extended, 2Mbps

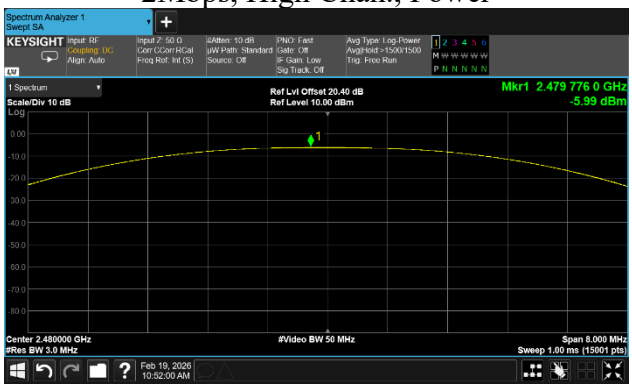
2Mbps, Low Chan., Power



2Mbps, Center Chan., Power



2Mbps, High Chan., Power



3.5 Power Spectral Density

For a DTS operating in the 2.4GHz band, FCC Rule Part 15.247(e) requires 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.

3.5.1 Measurement Method

This test was performed in accordance with Clause 11.10.2 of ANSI C63.10-2020/Cor 1-2021.

Please note that the trace was allowed to stabilize for a period of no less than 61-seconds.

3.5.2 Test Data

The test data for both EUT models is provided below.

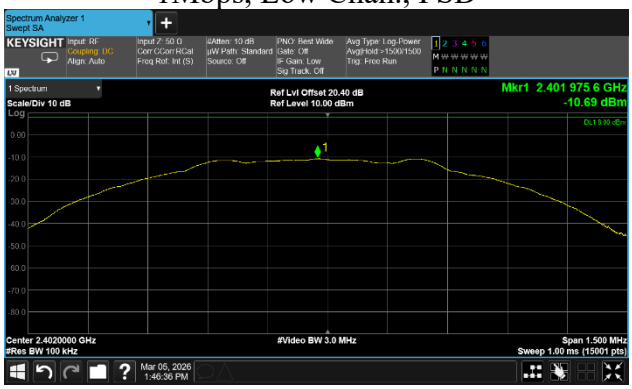
The EUT was configured to transmit a modulated signal, with channel hopping disabled.

Table 8: Power Spectral Density, Test Results

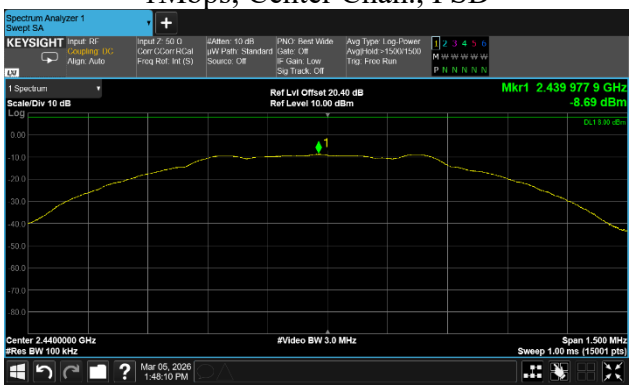
Model	Mode (Data Rate)	Transmit Frequency (MHz)	PSD (dBm/100kHz)	Limit (dBm/3kHz)
miniMic Standard	1Mbps	2402	-10.69	8.0
		2440	-8.69	8.0
		2480	-7.35	8.0
miniMic Standard	2Mbps	2402	-12.82	8.0
		2440	-10.86	8.0
		2480	-9.45	8.0
miniMic Extended	1Mbps	2402	-10.29	8.0
		2440	-8.57	8.0
		2480	-7.31	8.0
miniMic Extended	2Mbps	2402	-12.43	8.0
		2440	-10.76	8.0
		2480	-9.50	8.0

Figure 9: Power Spectral Density, miniMic Standard, 1Mbps

1Mbps, Low Chan., PSD



1Mbps, Center Chan., PSD



1Mbps, High Chan., PSD

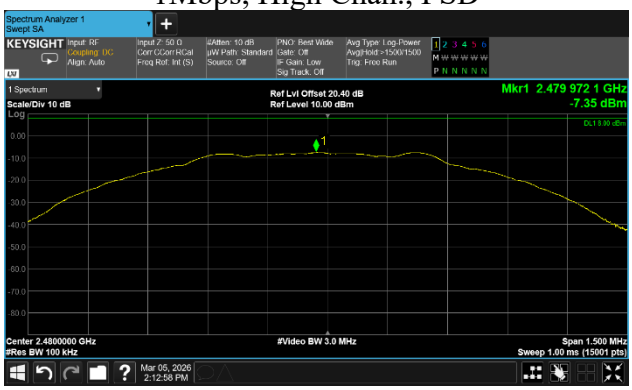
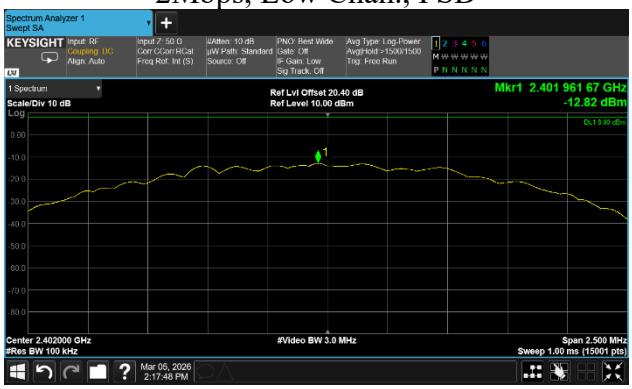
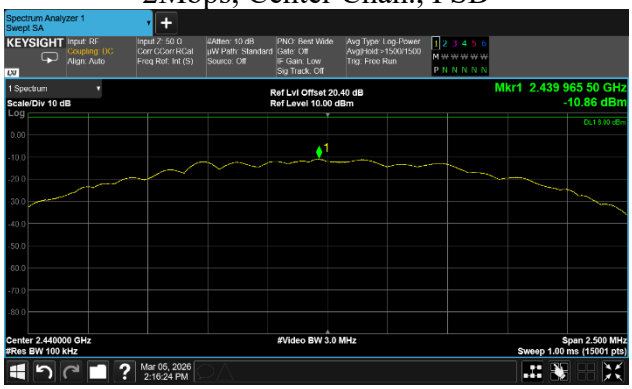


Figure 10: Power Spectral Density, miniMic Standard, 2Mbps

2Mbps, Low Chan., PSD



2Mbps, Center Chan., PSD



2Mbps, High Chan., PSD

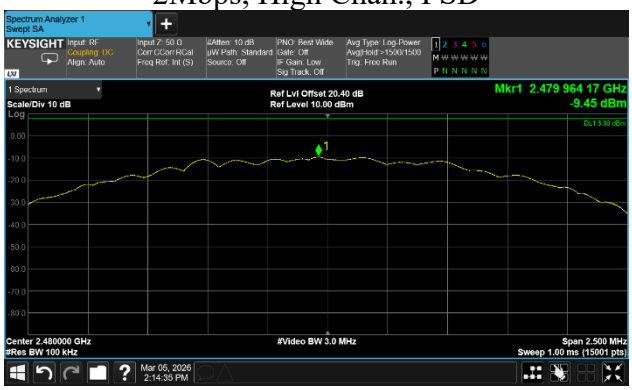
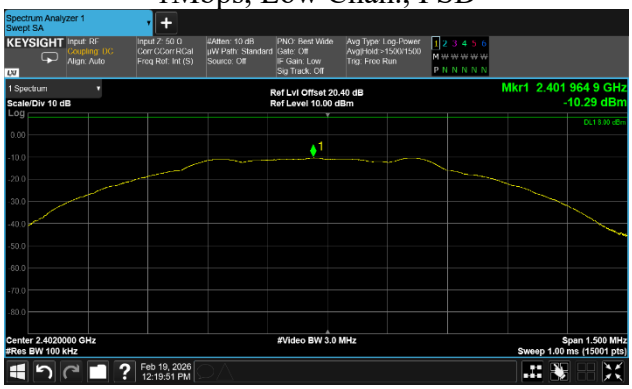
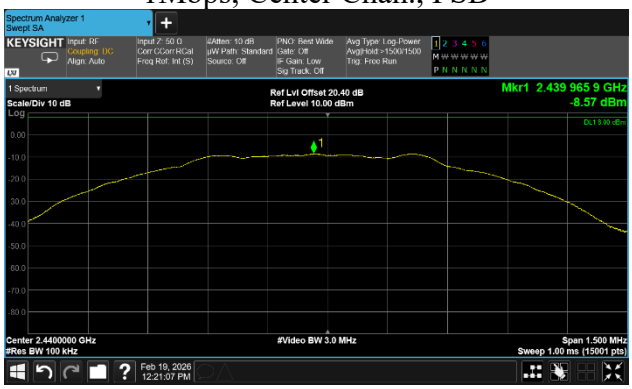


Figure 11: Power Spectral Density, miniMic Extended, 1Mbps

1Mbps, Low Chan., PSD



1Mbps, Center Chan., PSD



1Mbps, High Chan., PSD

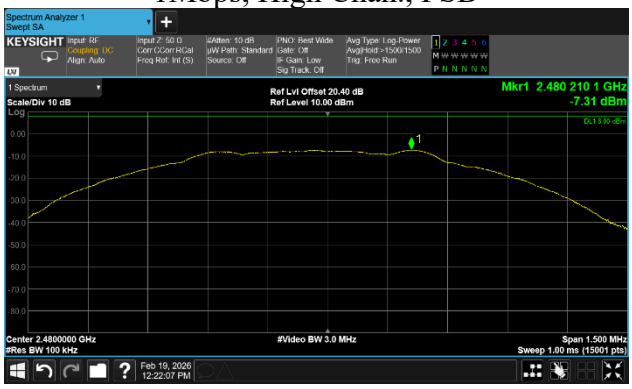
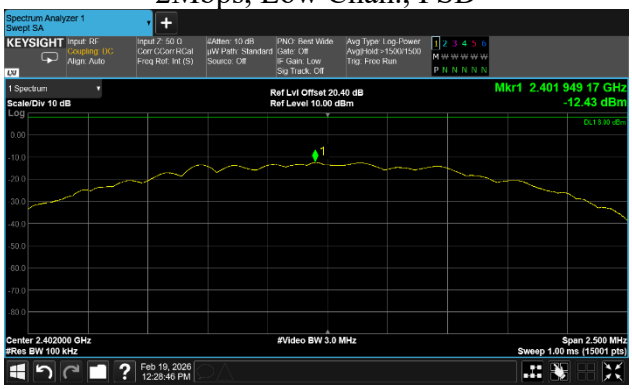
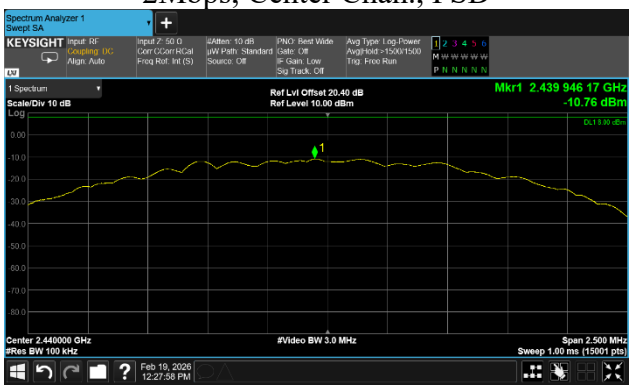


Figure 12: Power Spectral Density, miniMic Extended, 2Mbps

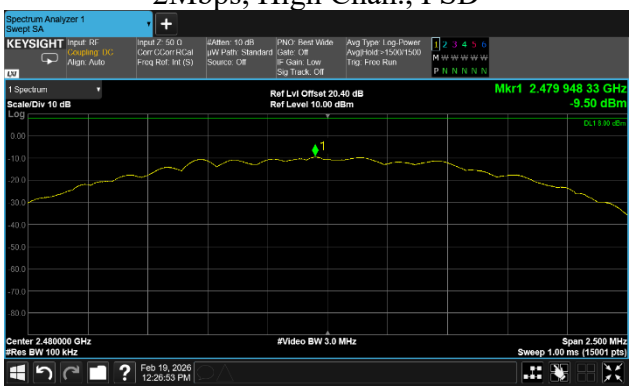
2Mbps, Low Chan., PSD



2Mbps, Center Chan., PSD



2Mbps, High Chan., PSD



3.6 Conducted Bandedge 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) requires 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.

3.6.1 Measurement Method

This test was performed in accordance with Clause 6.10 through Clause 6.10.4 of ANSI C63.10-2020/Cor 1-2021.

3.6.2 Test Data

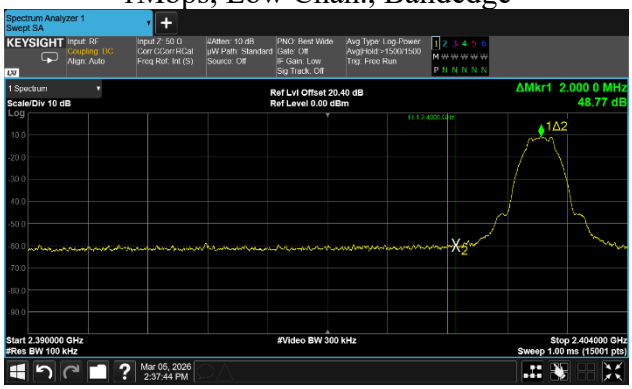
The test data for both EUT models is provided below. Please note, the EUT was not equipped with a hopping enable feature. The EUT was tested with a modulated signal and channel hopping disabled.

Table 9: Conducted Bandedge, Test Results

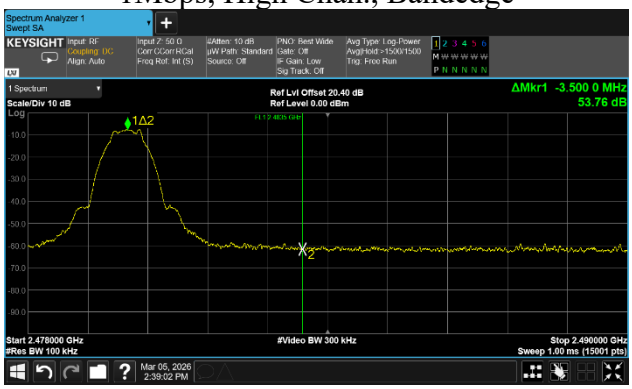
Model	Mode (Data Rate)	Transmit Frequency (MHz)	EUT Bandedge (dBc)	Minimum Requirement (dBc)
miniMic Standard	1Mbps	2402	48.77	20.0
		2480	53.76	20.0
miniMic Standard	2Mbps	2402	42.13	20.0
		2480	49.83	20.0
miniMic Extended	1Mbps	2402	49.46	20.0
		2480	54.23	20.0
miniMic Extended	2Mbps	2402	43.46	20.0
		2480	50.07	20.0

Figure 13: Conducted Bandedge, miniMic Standard, 1Mbps & 2Mbps

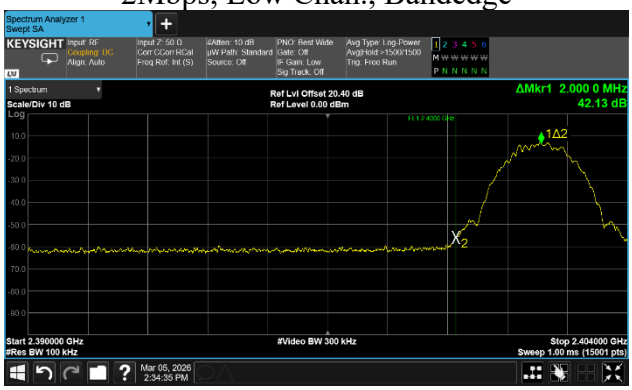
1Mbps, Low Chan., Bandedge



1Mbps, High Chan., Bandedge



2Mbps, Low Chan., Bandedge



2Mbps, High Chan., Bandedge

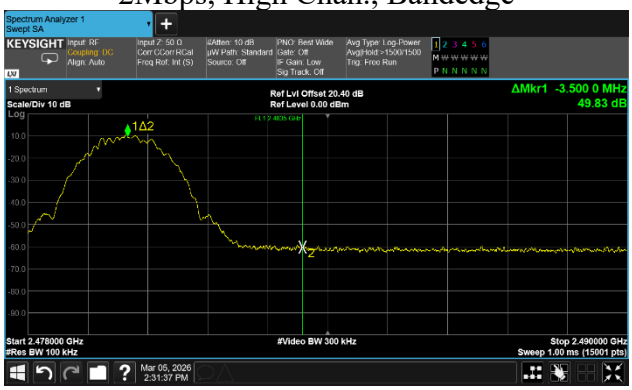
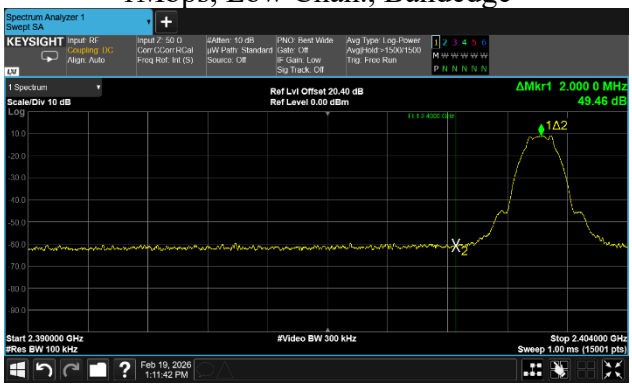
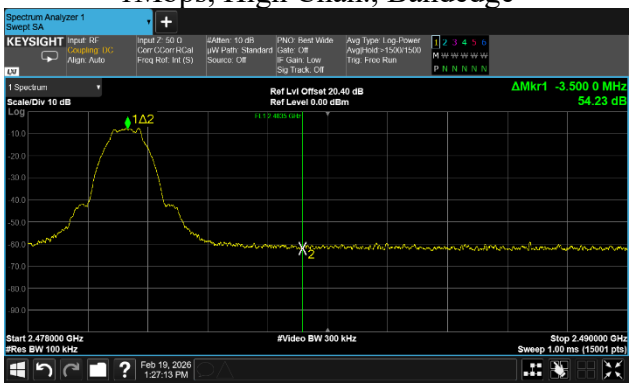


Figure 14: Conducted Bandedge, miniMic Extended, 1Mbps & 2Mbps

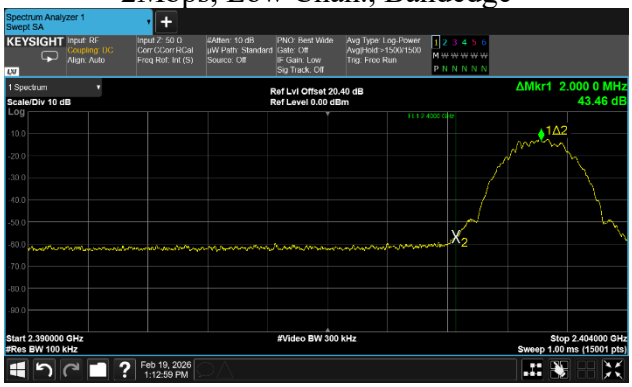
1Mbps, Low Chan., Bandedge



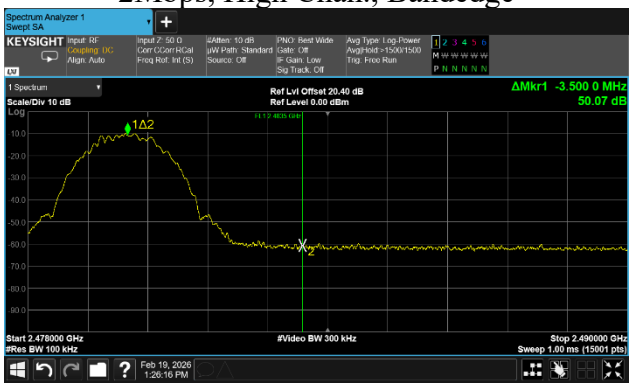
1Mbps, High Chan., Bandedge



2Mbps, Low Chan., Bandedge



2Mbps, High Chan., Bandedge



3.7 Conducted Unwanted Spurious Emissions

For a DTS operating in the 2.4GHz band, FCC Rule Part 15.247(d) requires 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.

3.7.1 Measurement Method

This test was performed in accordance with Clause 11.11 of ANSI C63.10-2020/Cor 1-2021.

3.7.2 Test Data

The EUT was configured to transmit a modulated signal, at both 1Mbps and 2Mbps.

The EUT was tested at the low, center, and high channels.

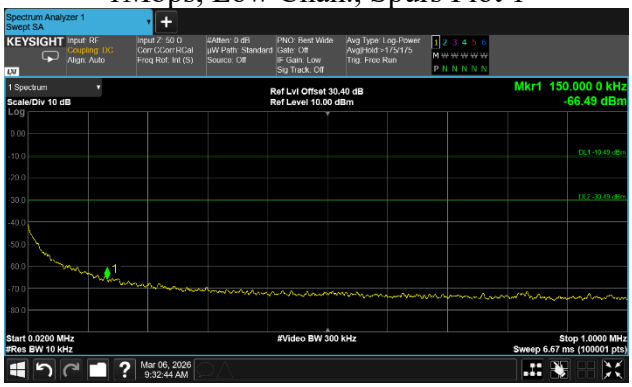
The EUT was tested from 20kHz to 25GHz. This range covers the lowest frequency generated by the EUT. It also covers the tenth harmonic of the fundamental.

For conducted tested below 1MHz only: the RBW setting was reduced to 10kHz to ensure the measurement system remained linear at the lower edge of the investigation band. A reference level offset of +10dB was introduced into the spectrum analyzer as an amplitude correction from 10LOG(100/10). The limit remains the same, as defined by the transmitter, and the emission levels reported are final and corrected.

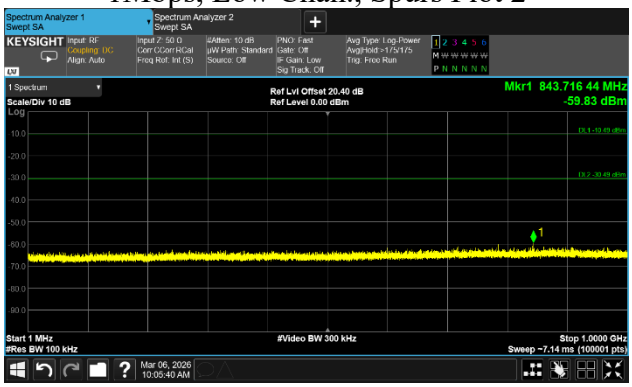
The EUT is fully compliant and the final test data is provided below.

Figure 15: Conducted Spurious Emissions, miniMic Standard, 1Mbps, Low Channel

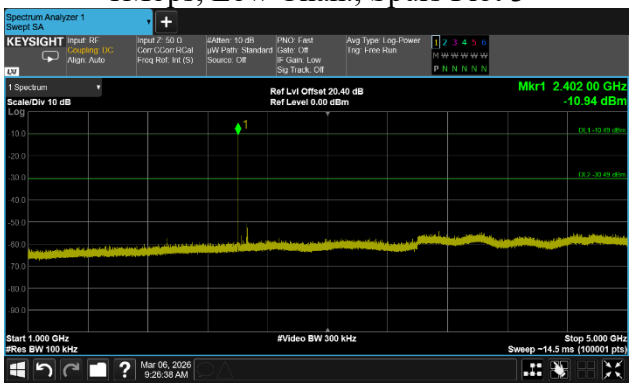
1Mbps, Low Chan., Spurs Plot 1



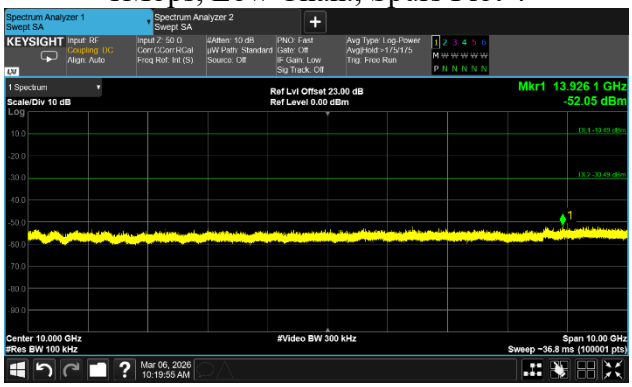
1Mbps, Low Chan., Spurs Plot 2



1Mbps, Low Chan., Spurs Plot 3



1Mbps, Low Chan., Spurs Plot 4



1Mbps, Low Chan., Spurs Plot 5

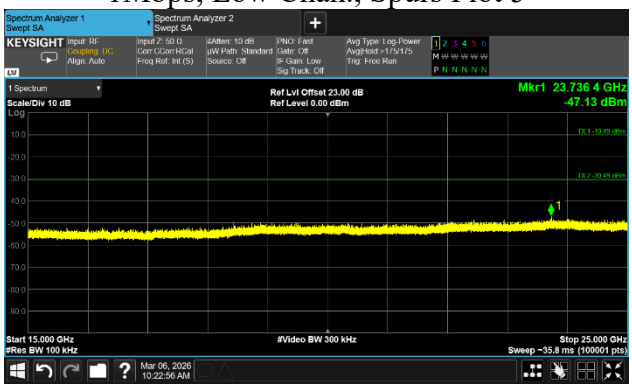
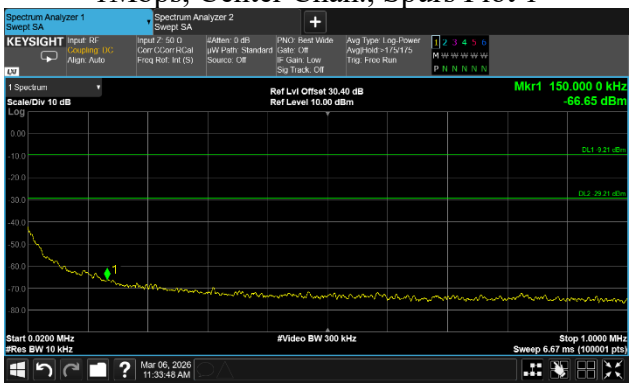
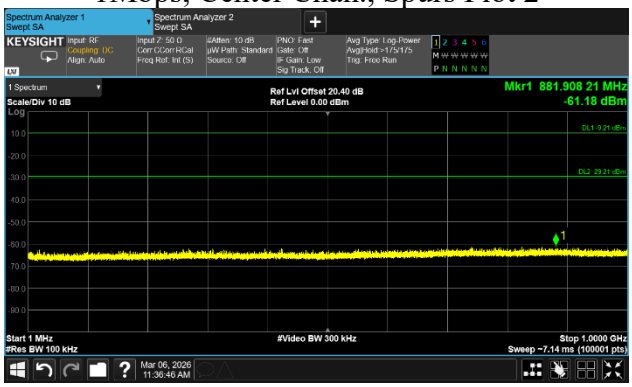


Figure 16: Conducted Spurious Emissions, miniMic Standard, 1Mbps, Center Channel

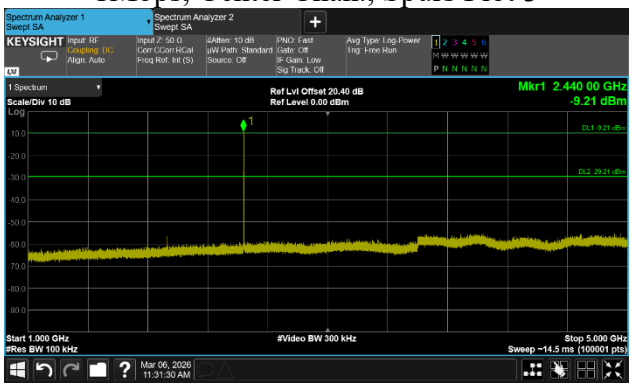
1Mbps, Center Chan., Spurs Plot 1



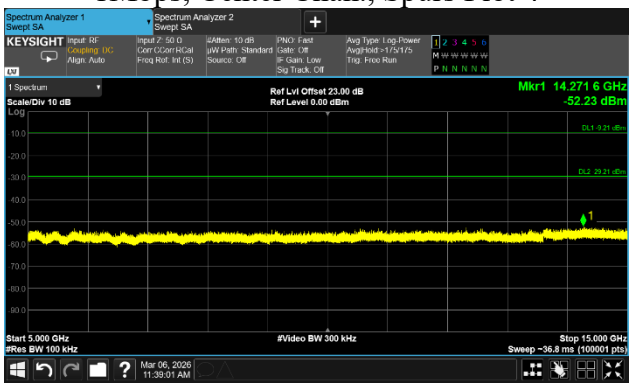
1Mbps, Center Chan., Spurs Plot 2



1Mbps, Center Chan., Spurs Plot 3



1Mbps, Center Chan., Spurs Plot 4



1Mbps, Center Chan., Spurs Plot 5

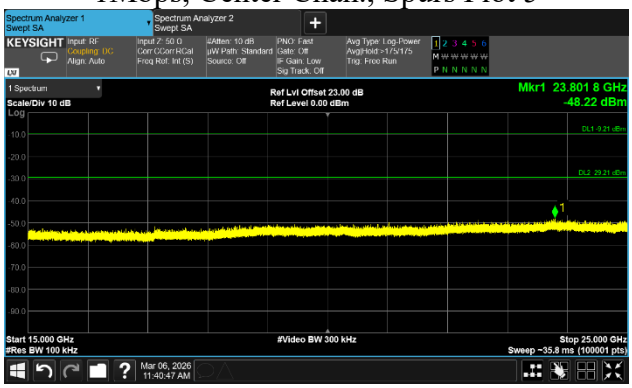
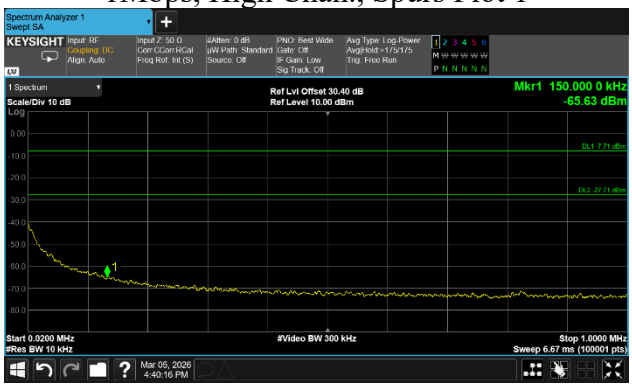
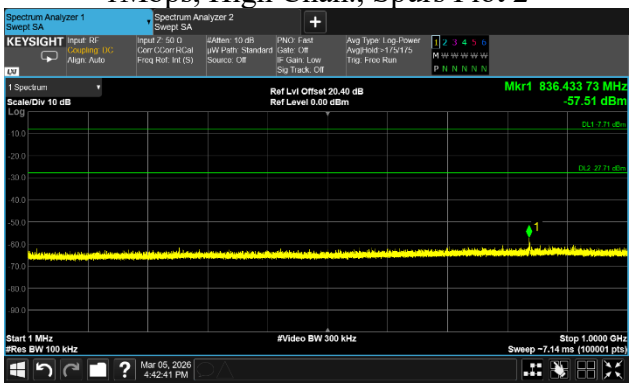


Figure 17: Conducted Spurious Emissions, miniMic Standard, 1Mbps, High Channel

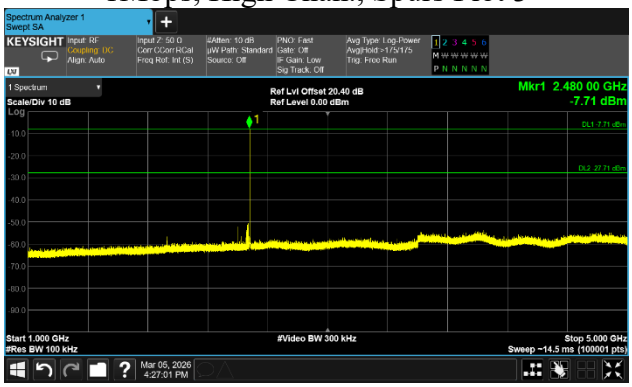
1Mbps, High Chan., Spurs Plot 1



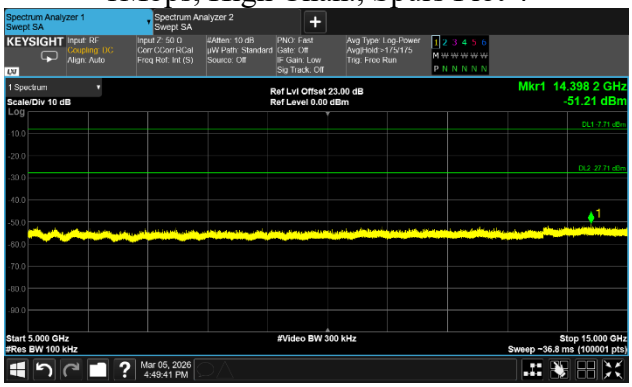
1Mbps, High Chan., Spurs Plot 2



1Mbps, High Chan., Spurs Plot 3



1Mbps, High Chan., Spurs Plot 4



1Mbps, High Chan., Spurs Plot 5

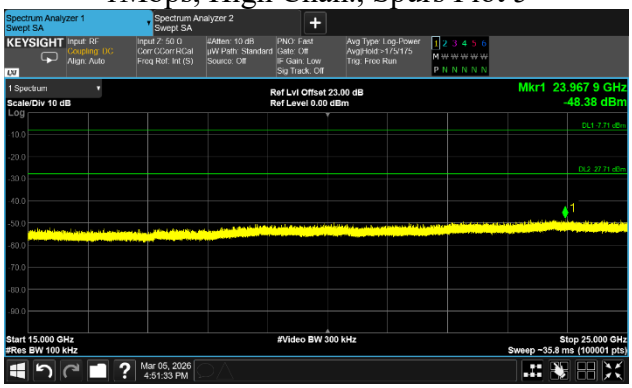
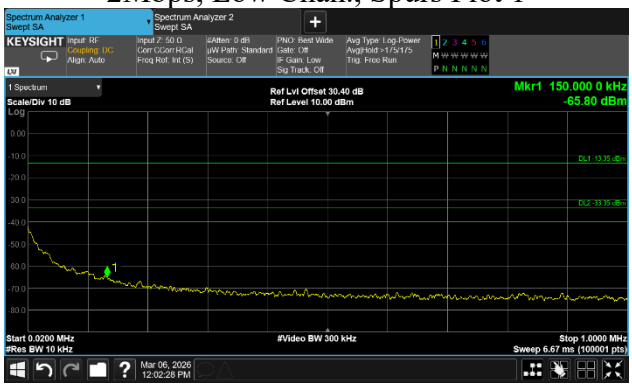
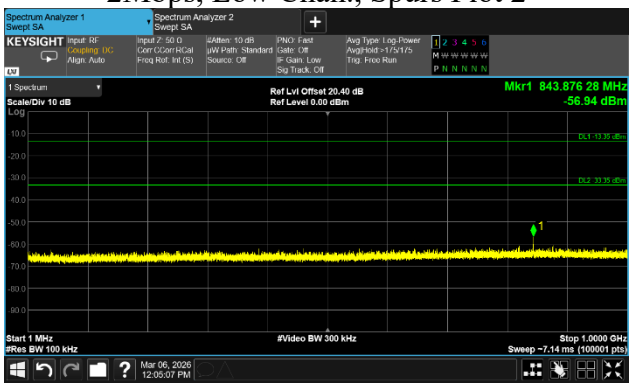


Figure 18: Conducted Spurious Emissions, miniMic Standard, 2Mbps, Low Channel

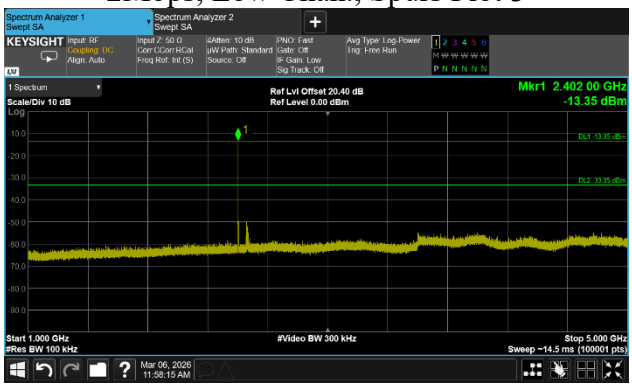
2Mbps, Low Chan., Spurs Plot 1



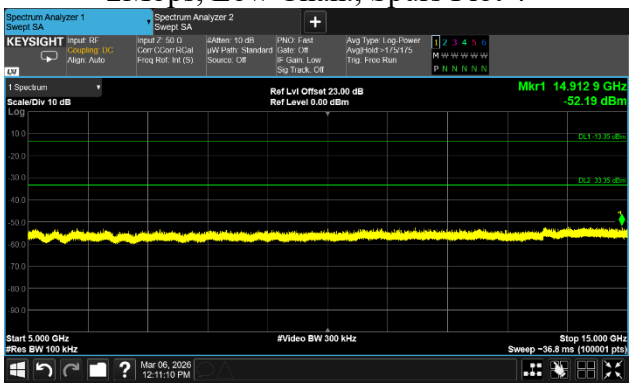
2Mbps, Low Chan., Spurs Plot 2



2Mbps, Low Chan., Spurs Plot 3



2Mbps, Low Chan., Spurs Plot 4



2Mbps, Low Chan., Spurs Plot 5

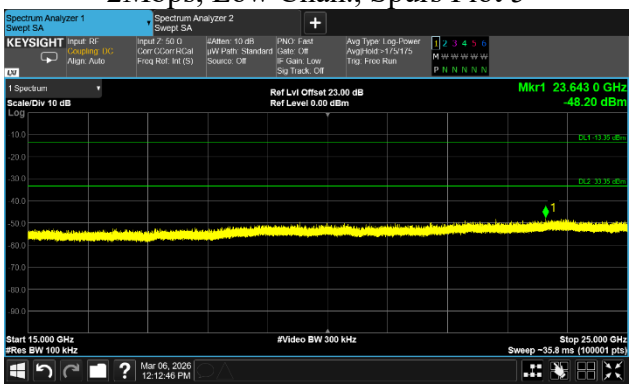
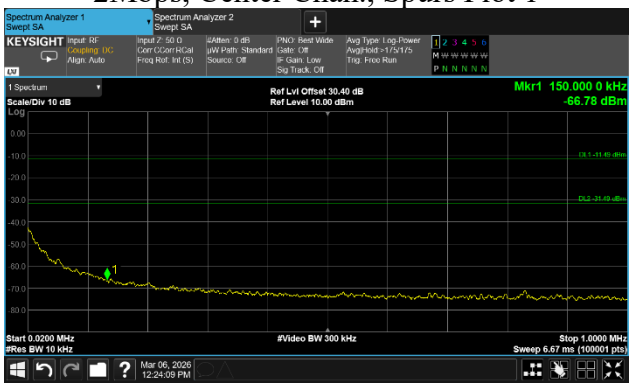
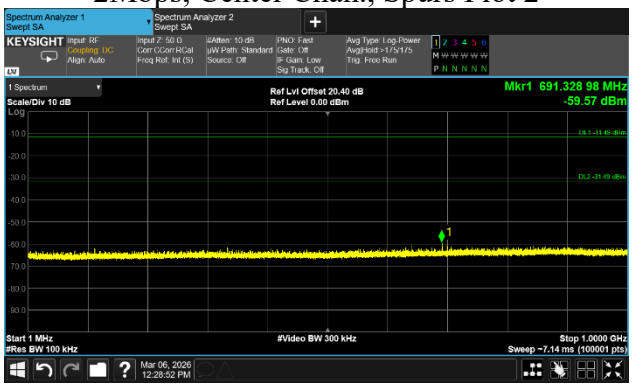


Figure 19: Conducted Spurious Emissions, miniMic Standard, 2Mbps, Center Channel

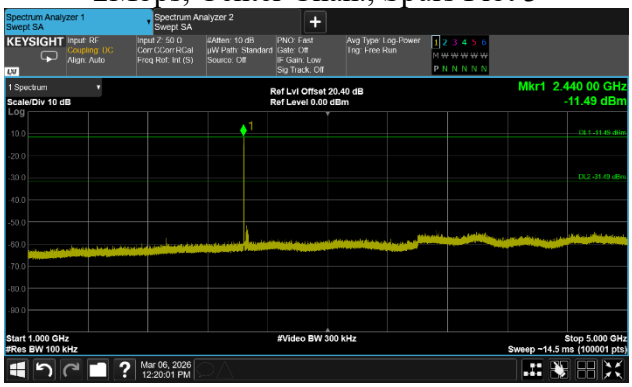
2Mbps, Center Chan., Spurs Plot 1



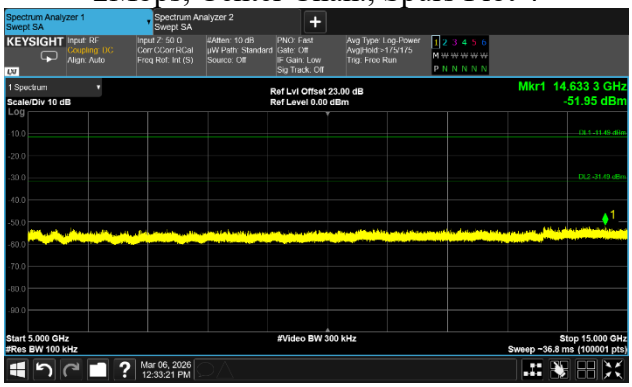
2Mbps, Center Chan., Spurs Plot 2



2Mbps, Center Chan., Spurs Plot 3



2Mbps, Center Chan., Spurs Plot 4



2Mbps, Center Chan., Spurs Plot 5

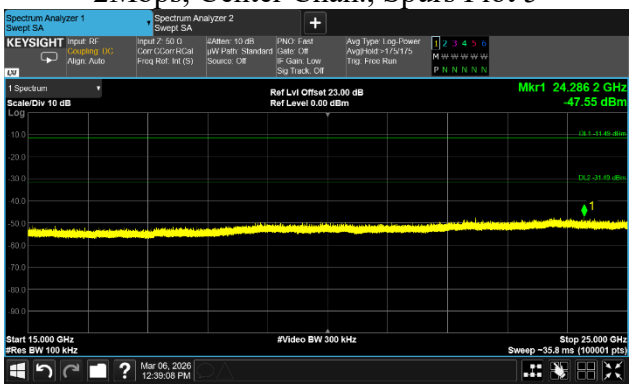
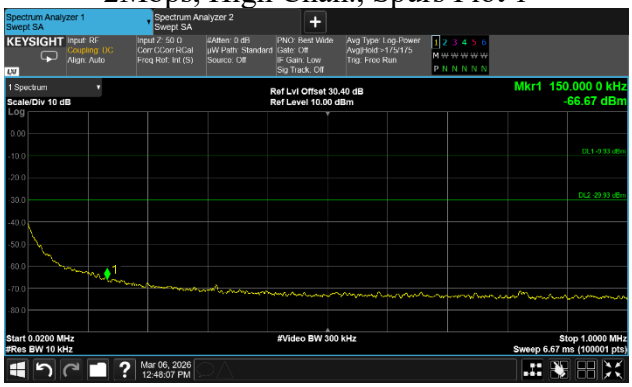
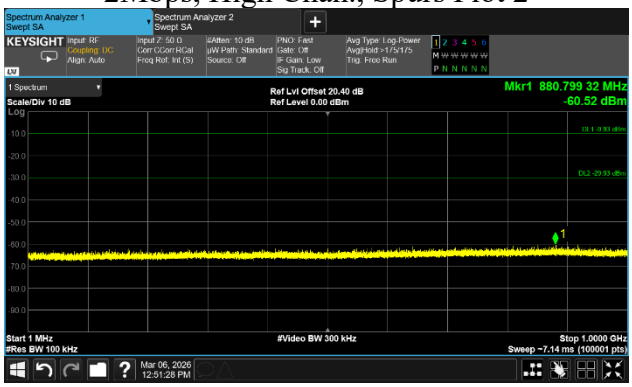


Figure 20: Conducted Spurious Emissions, miniMic Standard, 2Mbps, High Channel

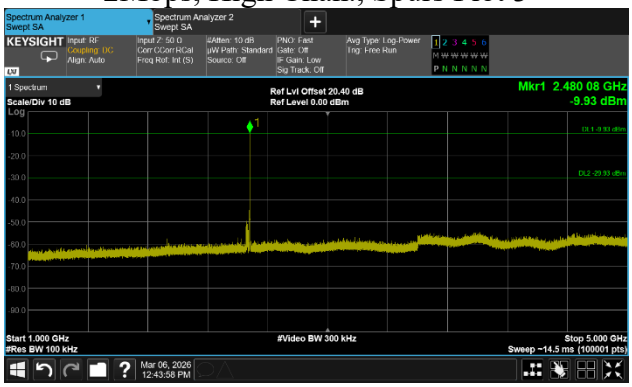
2Mbps, High Chan., Spurs Plot 1



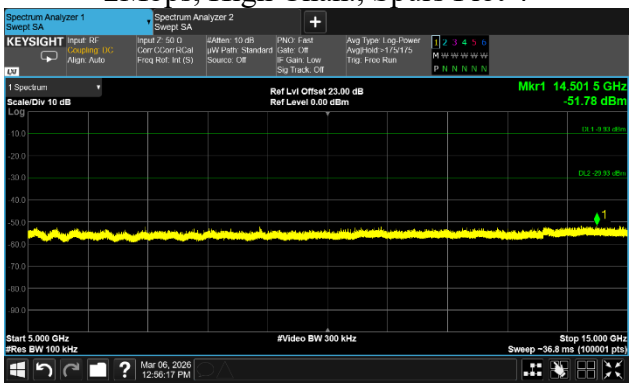
2Mbps, High Chan., Spurs Plot 2



2Mbps, High Chan., Spurs Plot 3



2Mbps, High Chan., Spurs Plot 4



2Mbps, High Chan., Spurs Plot 5

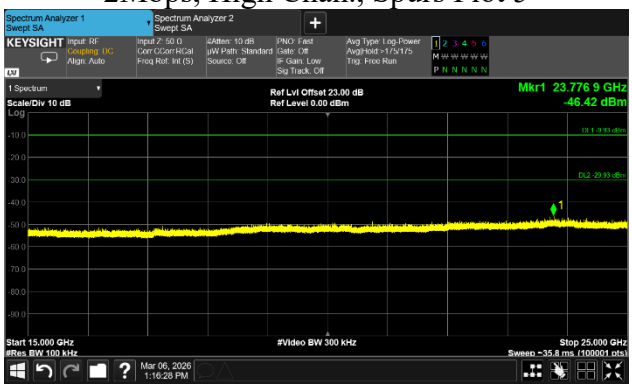
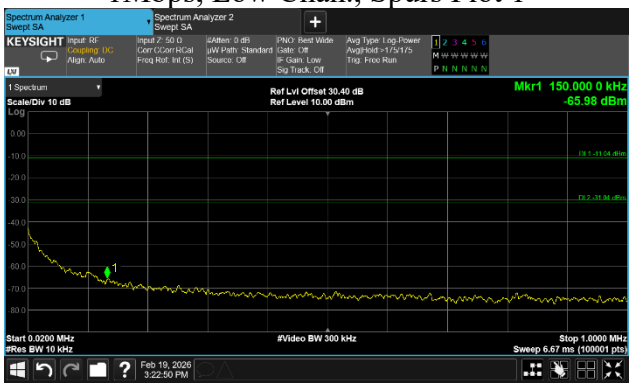
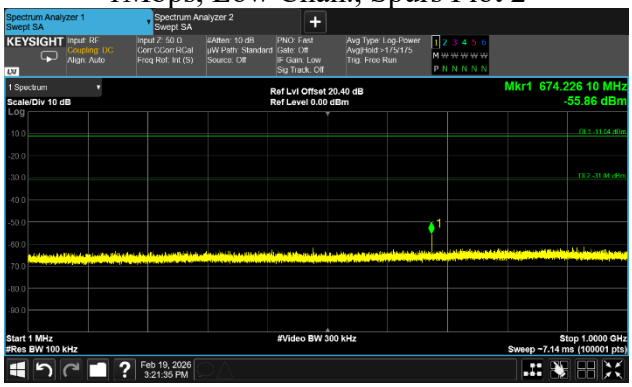


Figure 21: Conducted Spurious Emissions, miniMic Extended, 1Mbps, Low Channel

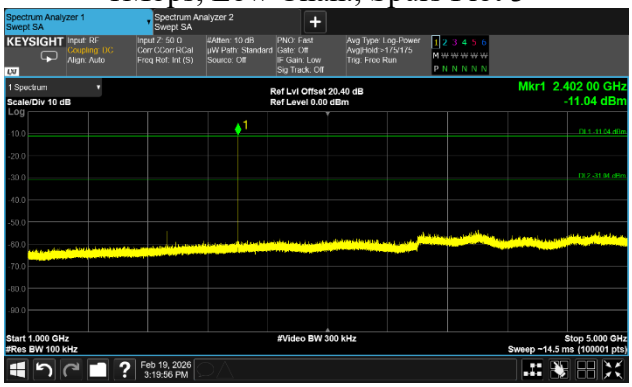
1Mbps, Low Chan., Spurs Plot 1



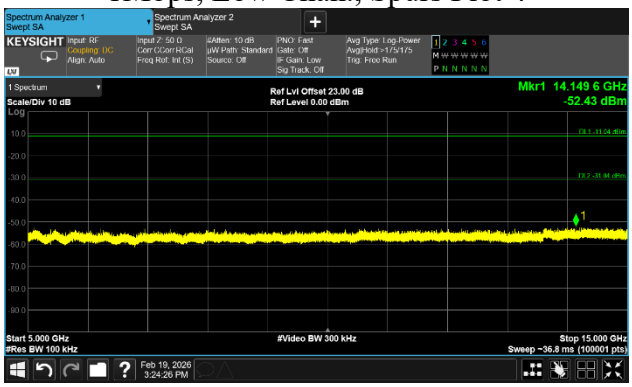
1Mbps, Low Chan., Spurs Plot 2



1Mbps, Low Chan., Spurs Plot 3



1Mbps, Low Chan., Spurs Plot 4



1Mbps, Low Chan., Spurs Plot 5

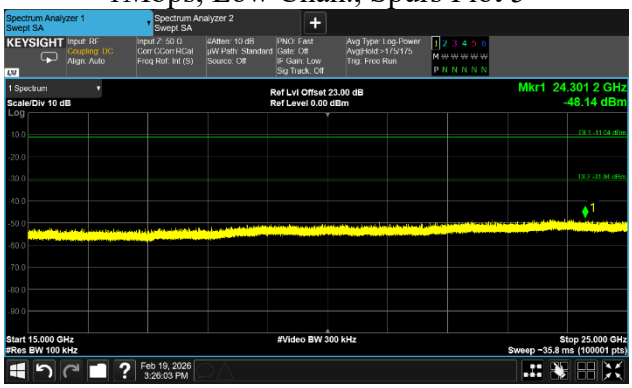
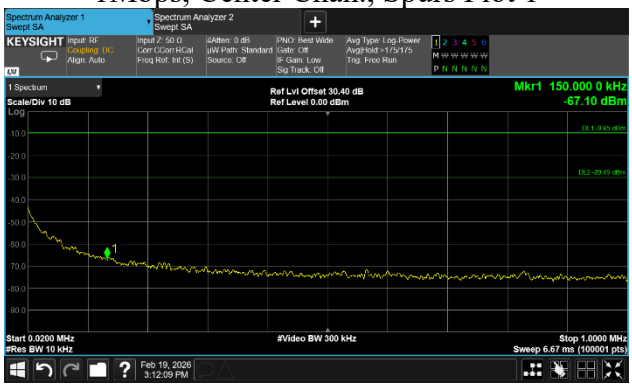
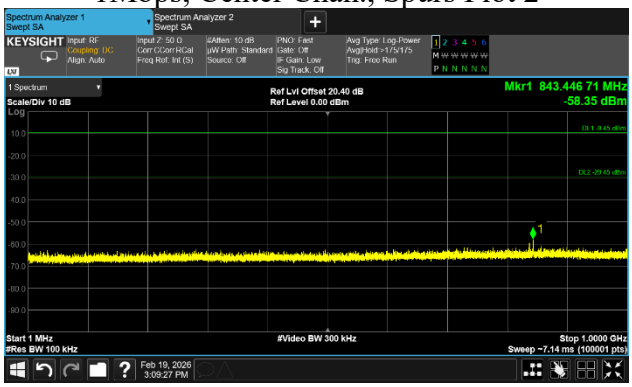


Figure 22: Conducted Spurious Emissions, miniMic Extended, 1Mbps, Center Channel

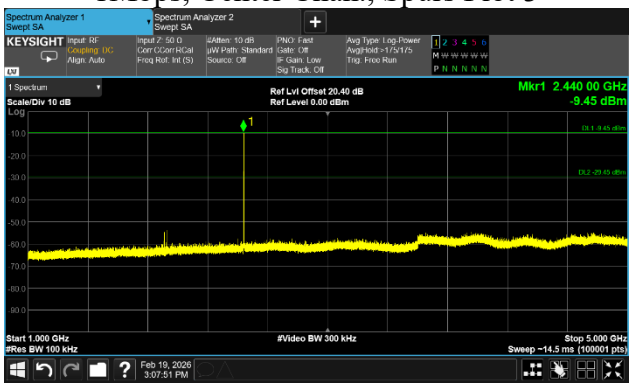
1Mbps, Center Chan., Spurs Plot 1



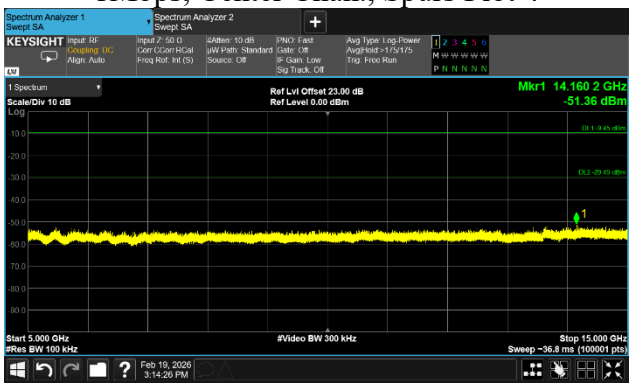
1Mbps, Center Chan., Spurs Plot 2



1Mbps, Center Chan., Spurs Plot 3



1Mbps, Center Chan., Spurs Plot 4



1Mbps, Center Chan., Spurs Plot 5

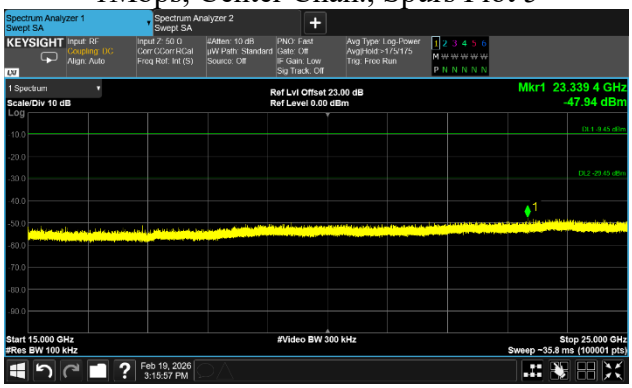
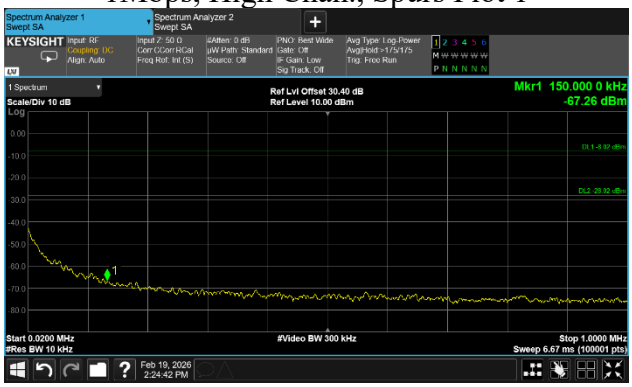
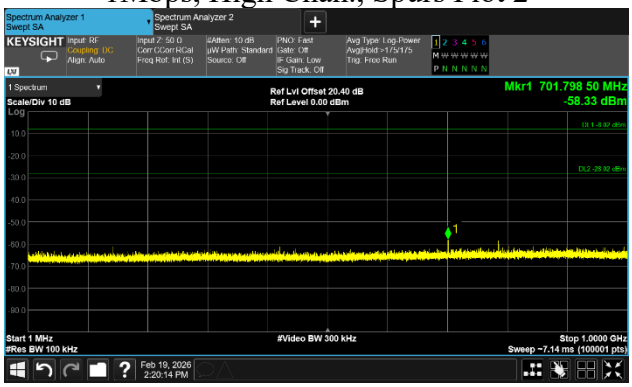


Figure 23: Conducted Spurious Emissions, miniMic Extended, 1Mbps, High Channel

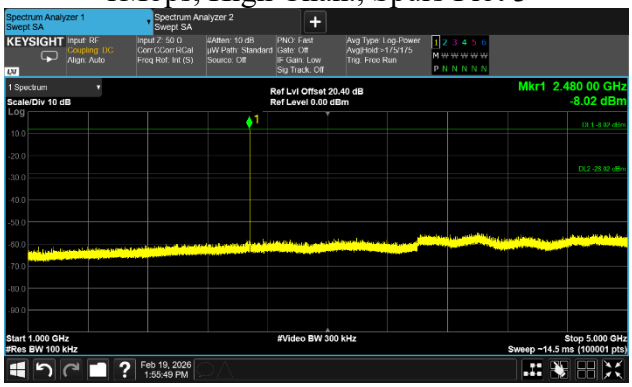
1Mbps, High Chan., Spurs Plot 1



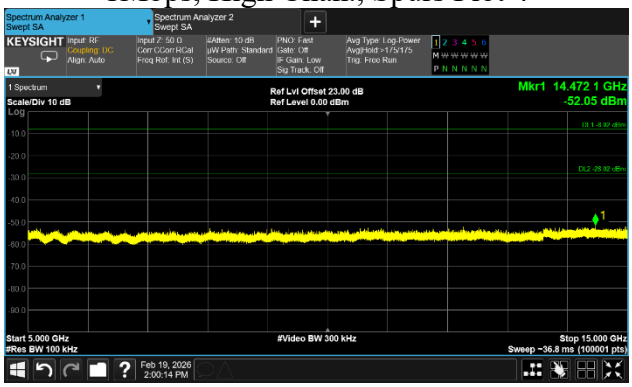
1Mbps, High Chan., Spurs Plot 2



1Mbps, High Chan., Spurs Plot 3



1Mbps, High Chan., Spurs Plot 4



1Mbps, High Chan., Spurs Plot 5

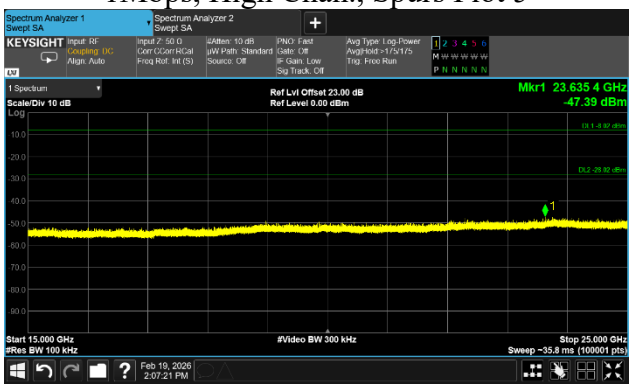
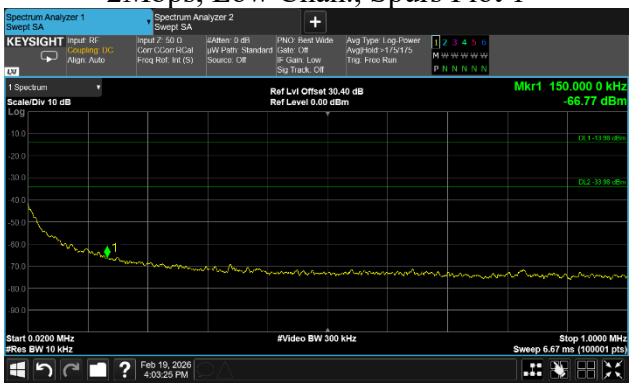
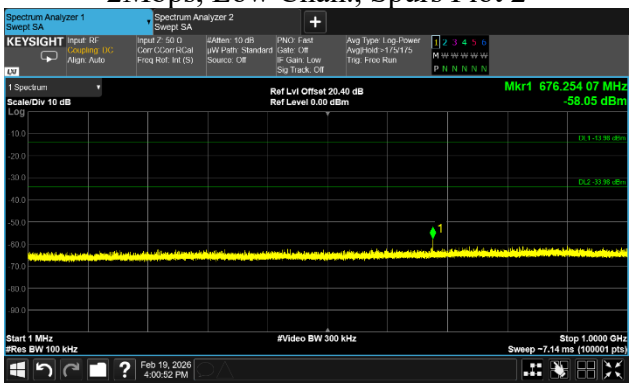


Figure 24: Conducted Spurious Emissions, miniMic Extended, 2Mbps, Low Channel

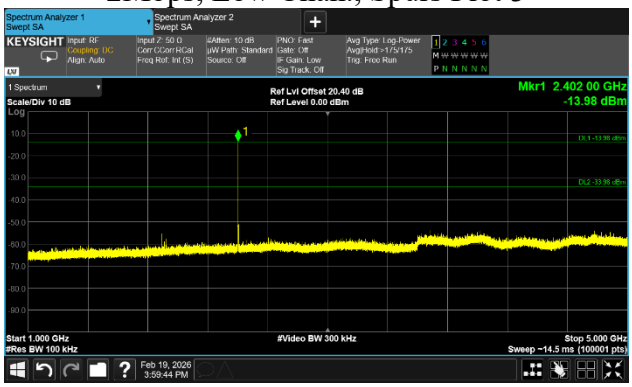
2Mbps, Low Chan., Spurs Plot 1



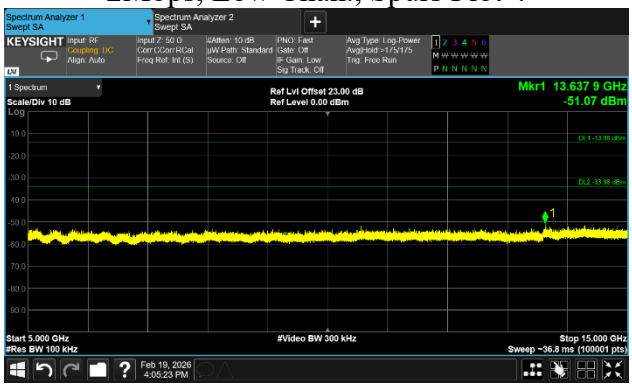
2Mbps, Low Chan., Spurs Plot 2



2Mbps, Low Chan., Spurs Plot 3



2Mbps, Low Chan., Spurs Plot 4



2Mbps, Low Chan., Spurs Plot 5

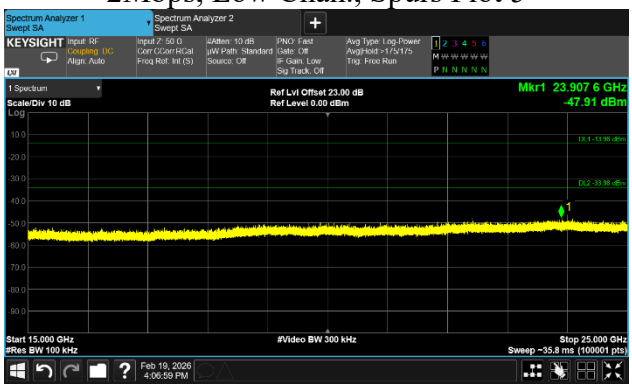
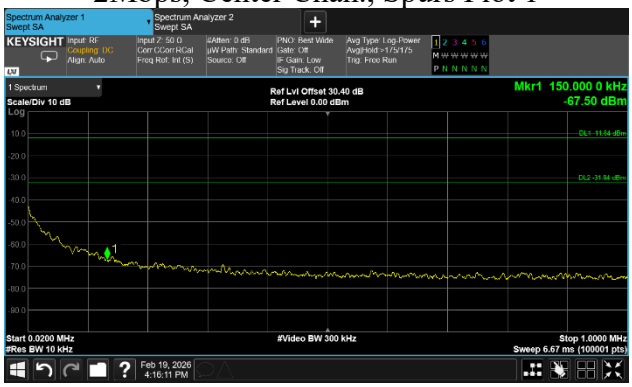
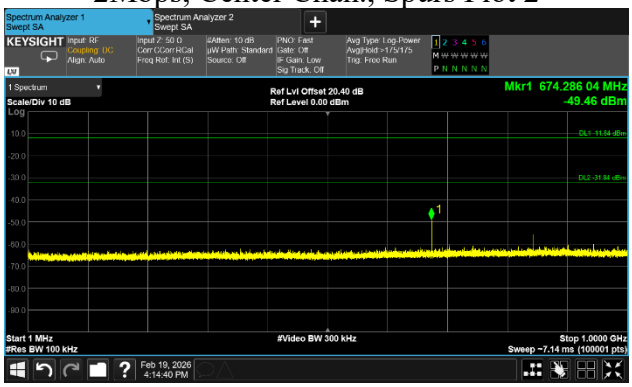


Figure 25: Conducted Spurious Emissions, miniMic Extended, 2Mbps, Center Channel

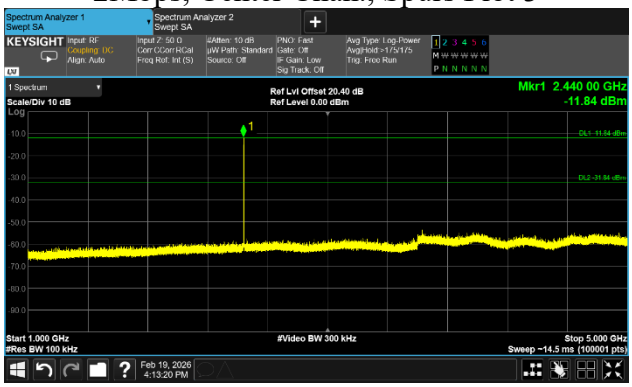
2Mbps, Center Chan., Spurs Plot 1



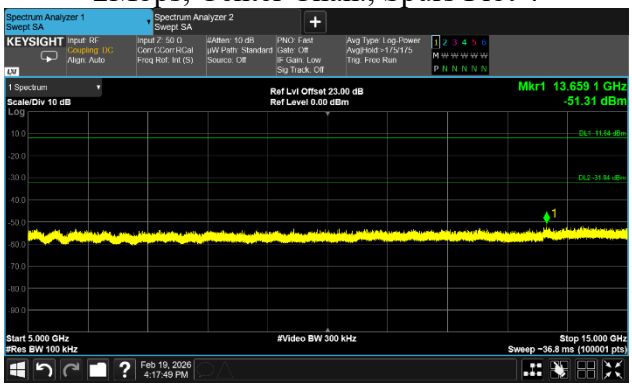
2Mbps, Center Chan., Spurs Plot 2



2Mbps, Center Chan., Spurs Plot 3



2Mbps, Center Chan., Spurs Plot 4



2Mbps, Center Chan., Spurs Plot 5

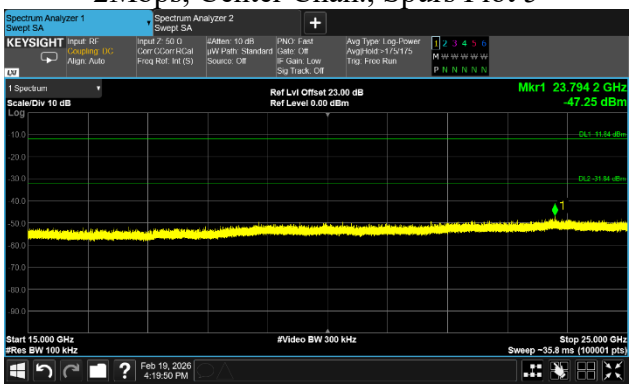
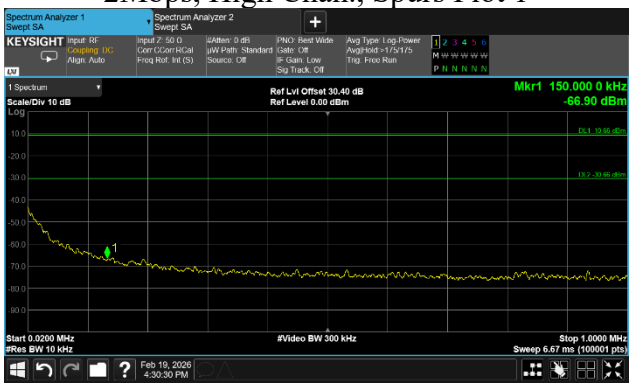
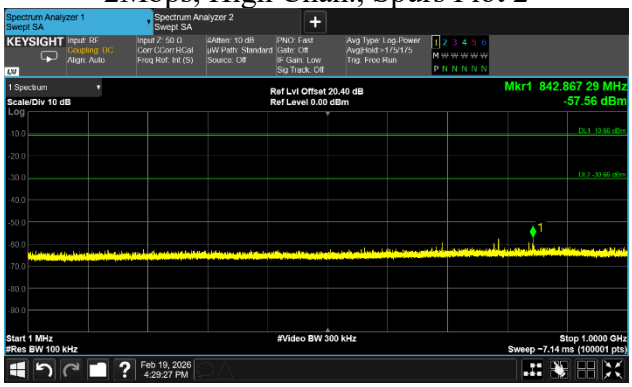


Figure 26: Conducted Spurious Emissions, miniMic Extended, 2Mbps, High Channel

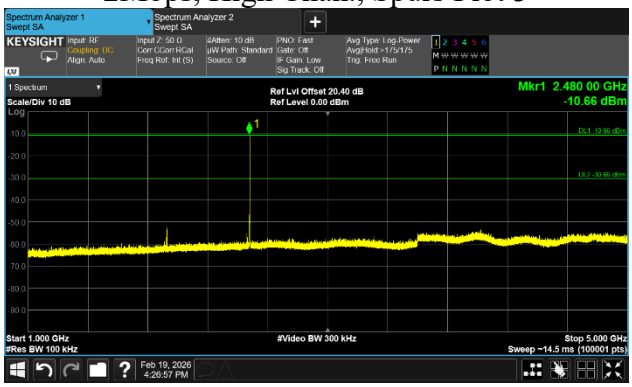
2Mbps, High Chan., Spurs Plot 1



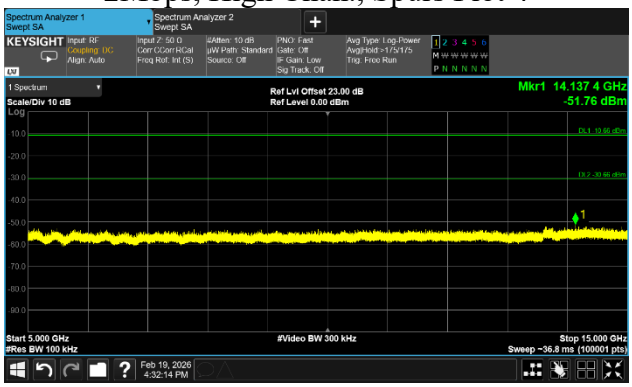
2Mbps, High Chan., Spurs Plot 2



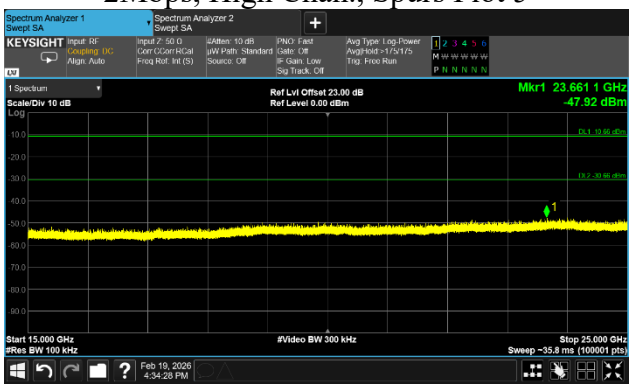
2Mbps, High Chan., Spurs Plot 3



2Mbps, High Chan., Spurs Plot 4



2Mbps, High Chan., Spurs Plot 5



3.8 Radiated Emissions

3.8.1 Requirements

Compliance Standard: FCC Part 15.247, 15.209, 15.205

Radiated Emissions, Compliance Limits		
Frequency Range	3-meter test site	
30 to 88 MHz	100 µV/m (QP)	40.0 dBµV/m (QP)
88 to 216 MHz	150 µV/m (QP)	43.5 dBµV/m (QP)
216 to 960 MHz	200 µV/m (QP)	46.0 dBµV/m (QP)
> 960 MHz	500 µV/m (AVG)	54.0 dBµV/m (AVG)

3.8.2 Test Procedure Summary

For radiated testing between 9kHz and 30MHz the EUT was placed on an 80 cm high non-conductive turntable and scanned for emissions using an active loop receiver antenna, mounted at a fixed-height of 1-meter. The loop antenna was rotated about its vertical and horizontal axis in accordance with ANSI C63.10-2020/Cor 1-2021, clause 6.4.6 and 6.11.2 and the EUT orthogonal plane was varied (x, y, z,). An initial pre-scan of the EUT was performed at a measurement distance of 1-meter. Any emission from the EUT was recorded. The measurement distance was then established at 10-meters and the EUT was again scanned for emissions. The emission frequencies noted during the pre-scan were investigated. Please note that when the test distance is 10-meters: there are no emissions detected from the EUT.

For radiated testing above 30MHz, but less than 1GHz, the EUT was placed on a 1m X 1.5m non-conductive motorized turntable at a height of 80cm. For frequencies above 1GHz, a test height of 1.5m is employed. An initial pre-scan of the EUT was performed to identify any emissions that exceed, or come within 6dB of, the applicable limit. This pre-scan was performed a with the employment of a spectrum analyzer peak detector function. The highest amplitude (worst-case) emissions noted during the pre-scan were selected for final compliance measurements. Above 30MHz, the emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Broadband log periodic and double-ridged horn antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antennas were 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 9 kHz to 25GHz were evaluated. The EUT peripherals were placed on the table in accordance with ANSI C63.4. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

Test Procedure Summary, Continued:

When an EUT emission is detected, the spectrum analyzer detector function was set to quasi-peak for final measurements below 1 GHz. The measurement bandwidth of the spectrum analyzer system was set to at least 120 kHz, with all post-detector filtering no less than 10 times the measurement bandwidth.

For measurements above 1 GHz, both the peak and the average levels are recorded, using a measurement bandwidth of 1 MHz. For average measurements, a video bandwidth setting of 10 Hz was used, in the case of video averaging; otherwise, an EMI AVG detector shall be employed. When testing the BLE fundamental, the EUT was evaluated in three orthogonal planes (x, y, z). The EUT axis and position that produced the highest electric field strength was maintained for all radiated testing.

For final radiated testing between 9kHz and 30MHz, the measurement distance was 10-meters.

For final radiated testing between 30MHz and 18GHz, the measurement distance was 3-meters.

For final radiated testing between 18GHz and 25GHz, the measurement distance was 1-meter.

Please also refer to Section 2.3 of this report for the testing approach.

3.8.3 Radiated Data Reduction and Reporting

To convert the raw spectrum analyzer radiated data into a form that can be compared with the FCC limits, it is necessary to account for various calibration factors that are supplied with the 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:	dBµV
Antenna Correction Factor:	AFdB/m
Cable Correction Factor:	CFdB
Pre-Amplifier Gain:	GdB
Electric Field:	dBµV/m = dBµV + AFdB/m + CFdB - GdB
Convert to linear Unit:	dBµV/m/20 Inv log

3.8.4 Final Test Data

The EUT was tested from 9kHz to 25GHz.

This range covers the lowest frequency generated by the EUT. It also covers the tenth harmonic of the fundamental. A complete investigation of the radiated fundamental field strength was performed.

The EUT was evaluated in three orthogonal axes (x, y, z).

The Z-axis produced the highest radiated power (see test setup photographs for reference).

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

- for final testing of 9kHz to 1GHz, the EUT was set to a transmit at the high channel.
- for final testing of 1GHz to 25GHz, the EUT was set to transmit at the low, center, and high channels.
- both 1Mbps and 2Mbps were tested.

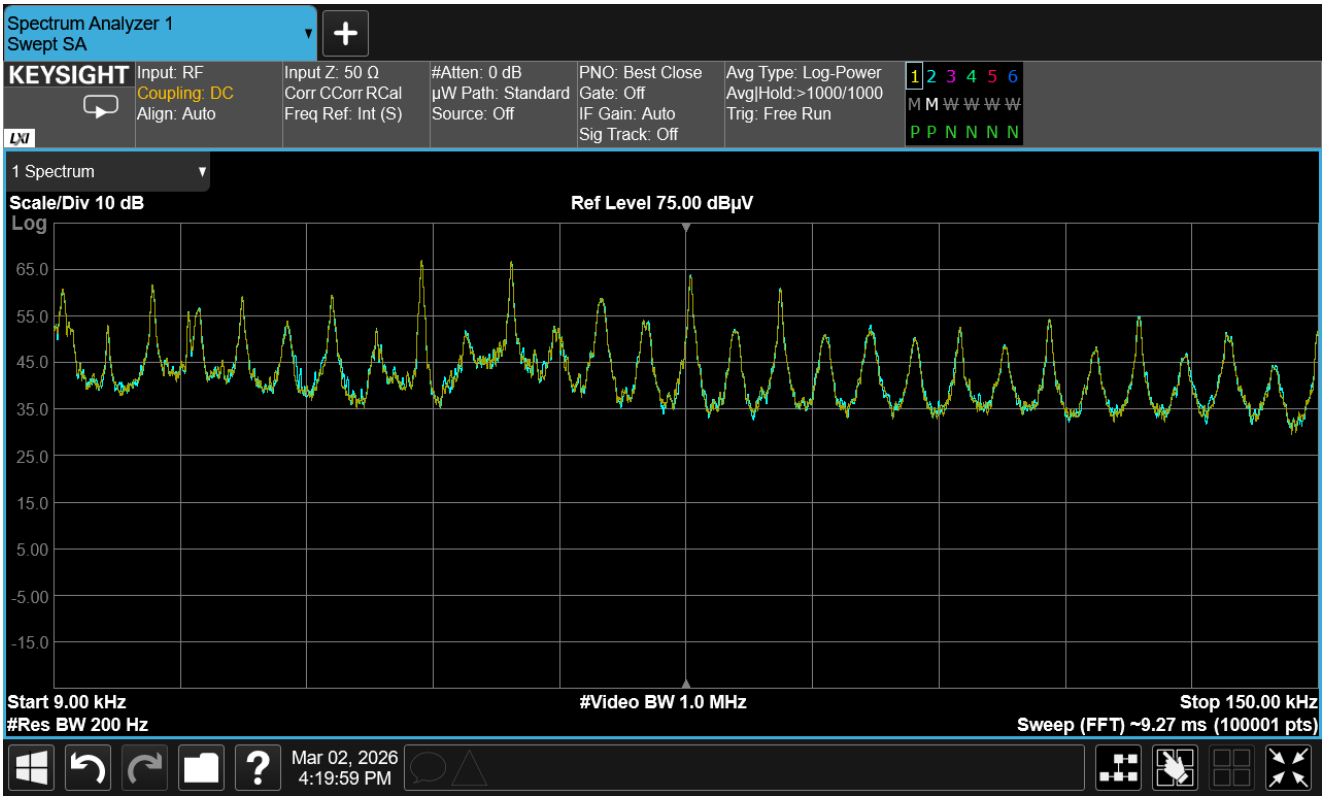
The EUT complies with the Radiated Emissions requirements of 15.247(d), 15.209(a), and 15.205(a).

The Digital Emissions from the EUT are covered under a Supplier's Declaration of Conformity.

The SDOC test report can be made available upon request written request to the Applicant.

The worst-case transmitter emissions are reported on the following pages.

Figure 27: 10-meter Radiated Emissions Test Data, 9kHz to 150kHz



Trace 1 = EUT TX On

Trace 2 = Ambient

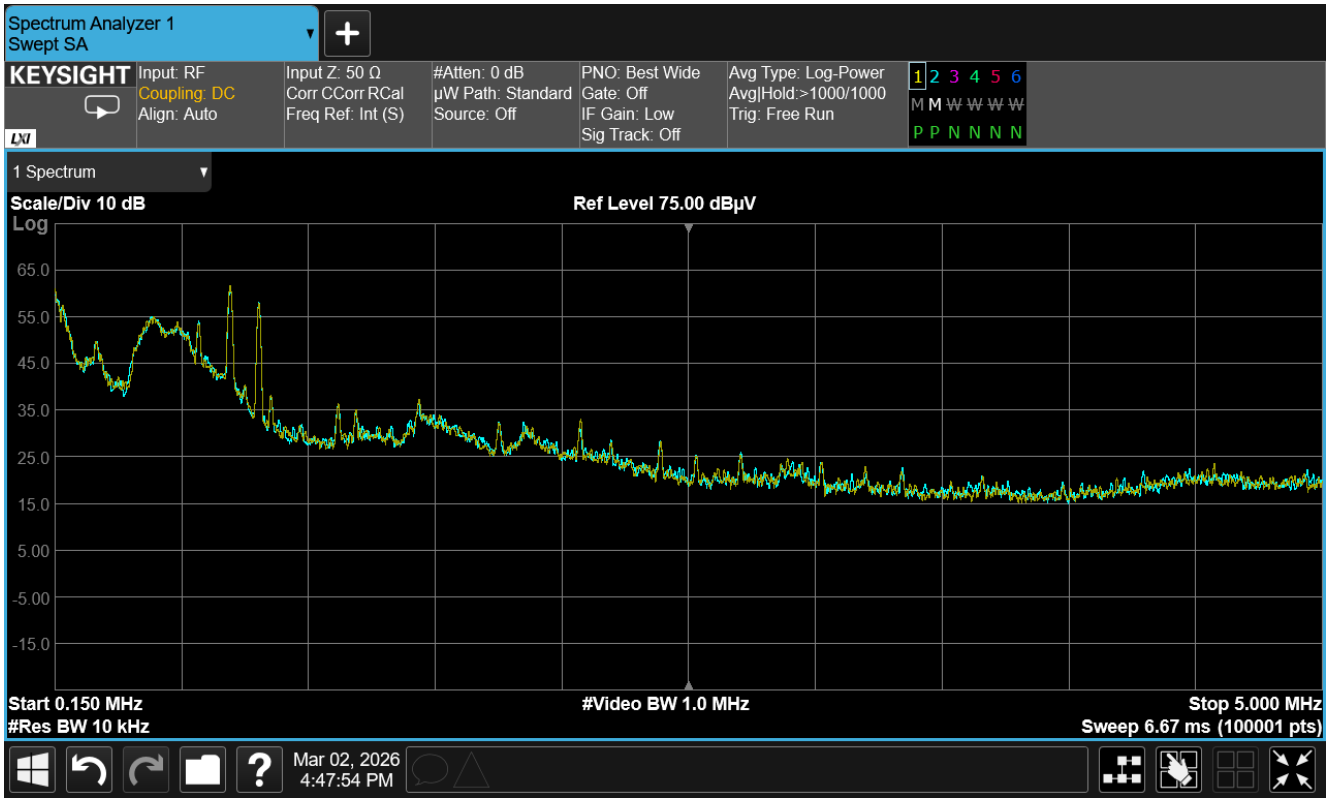
Result = No emissions detected from the EUT.

This data applies to both the Standard and Extended models.

This data applies to both the 1Mbps and 2Mbps modes.

There are no emissions detected from the EUT transmitter device in this range.

Figure 28: 10-meter Radiated Emissions Test Data, 150kHz to 5MHz



Trace 1 = EUT TX On

Trace 2 = Ambient

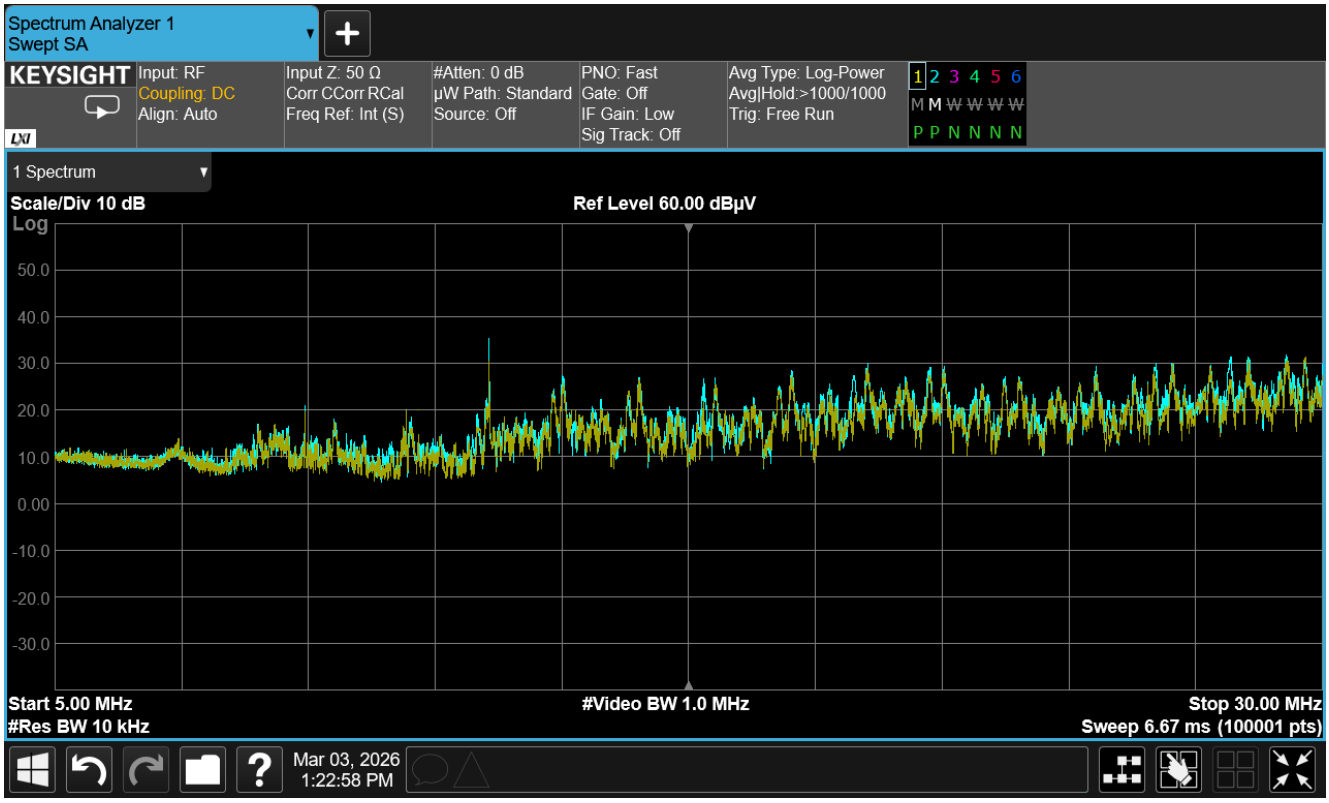
Result = No emissions detected from the EUT.

This data applies to both the Standard and Extended models.

This data applies to both the 1Mbps and 2Mbps modes.

There are no emissions detected from the EUT transmitter device in this range.

Figure 29: 10-meter Radiated Emissions Test Data, 5MHz to 30MHz



Trace 1 = EUT TX On

Trace 2 = Ambient

Result = No emissions detected from the EUT.

This data applies to both the Standard and Extended models.

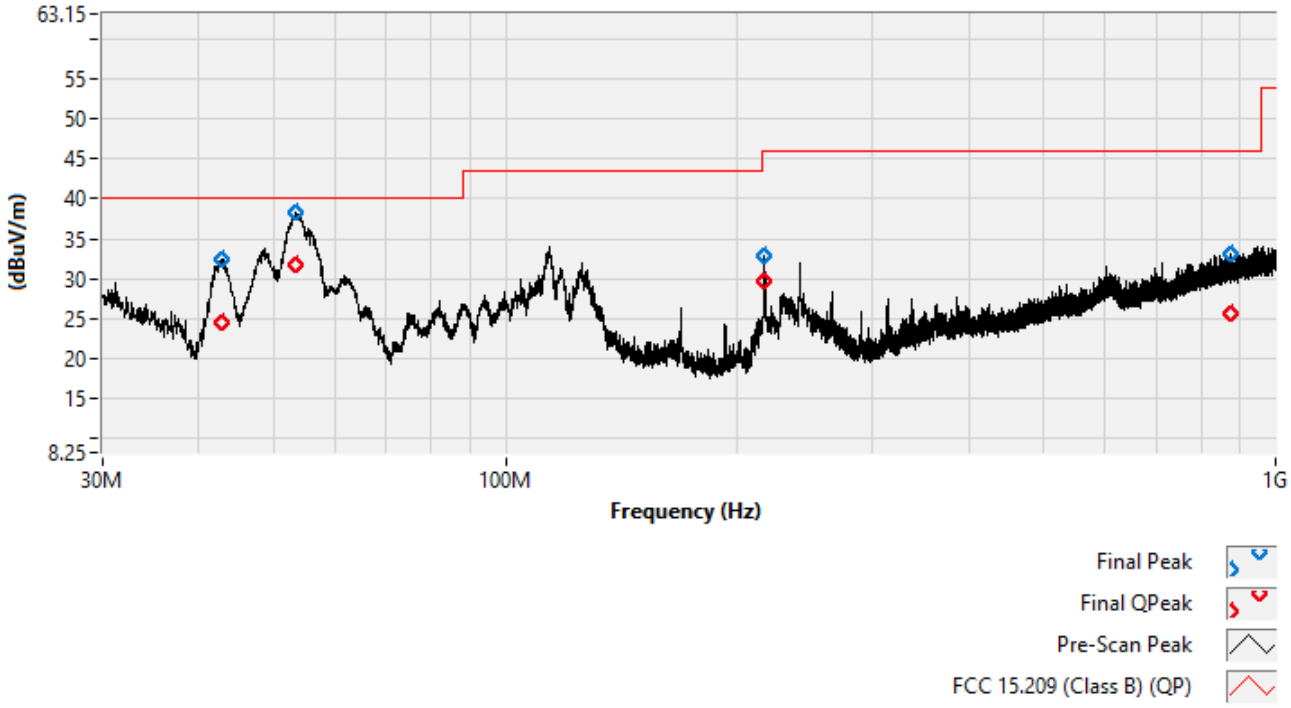
This data applies to both the 1Mbps and 2Mbps modes.

There are no emissions detected from the EUT transmitter device in this range.

Table 10: 3-meter Radiated Emissions Test Data, 30MHz to 1GHz, miniMic Standard

Frequency (MHz)	Detector	Corr. Meas (dBuV/m)	QP Limit (dBuV/m)	Delta (dB)	Turn Table (deg)	Antenna (cm)
42.901	Peak	32.500	--	--	125	Vert, 100
	QP	24.491	40	-15.509	125	Vert, 100
53.462	Peak	38.218	--	--	125	Vert, 100
	QP	31.721	40	-8.279	125	Vert, 100
217.039	Peak	32.808	--	--	125	Vert, 100
	QP	29.711	46	-16.289	125	Vert, 100
872.807	Peak	33.184	--	--	125	Vert, 100
	QP	25.696	46	-20.304	125	Vert, 100
42.901	Peak	32.500	--	--	125	Vert, 100
	QP	24.491	40	-15.509	125	Vert, 100
53.462	Peak	38.218	--	--	125	Vert, 100
	QP	31.721	40	-8.279	125	Vert, 100

miniMic Standard, Pre-scan and Final Data (Vertical)**,** 30MHz to 1GHz



miniMic Standard, Pre-scan and Final Data (Horizontal), 30MHz to 1GHz

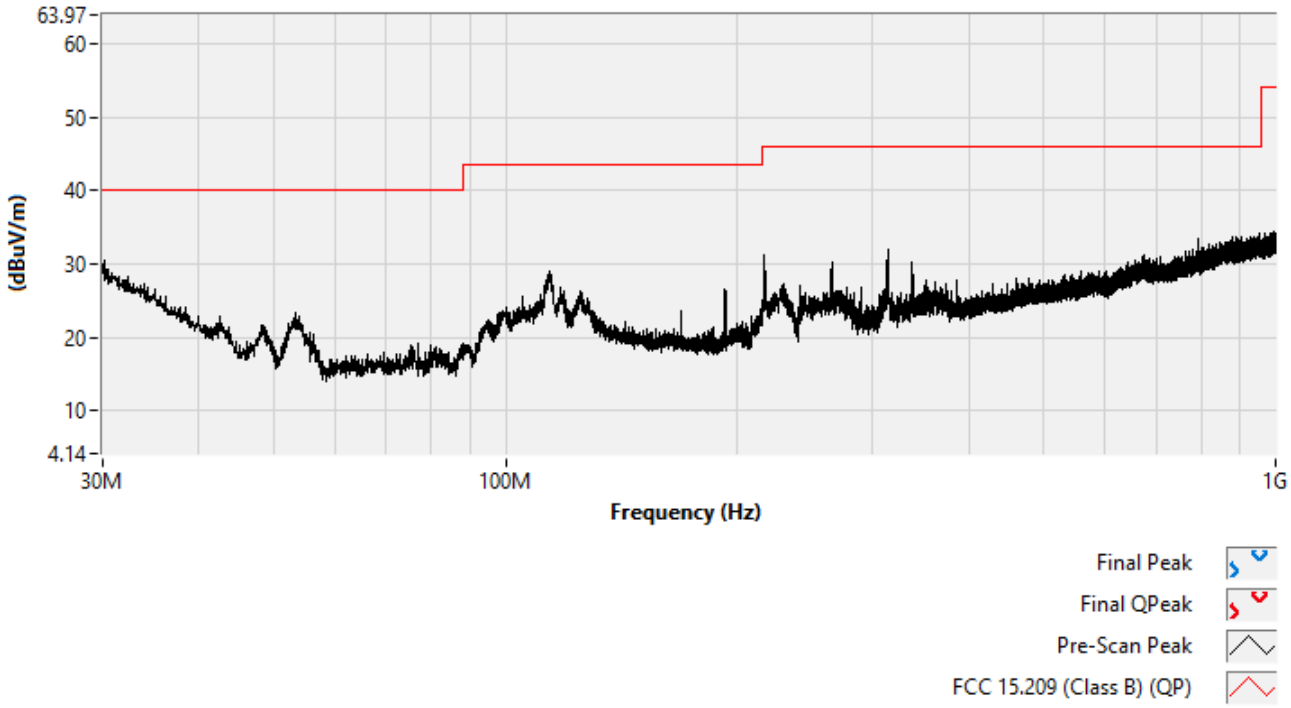
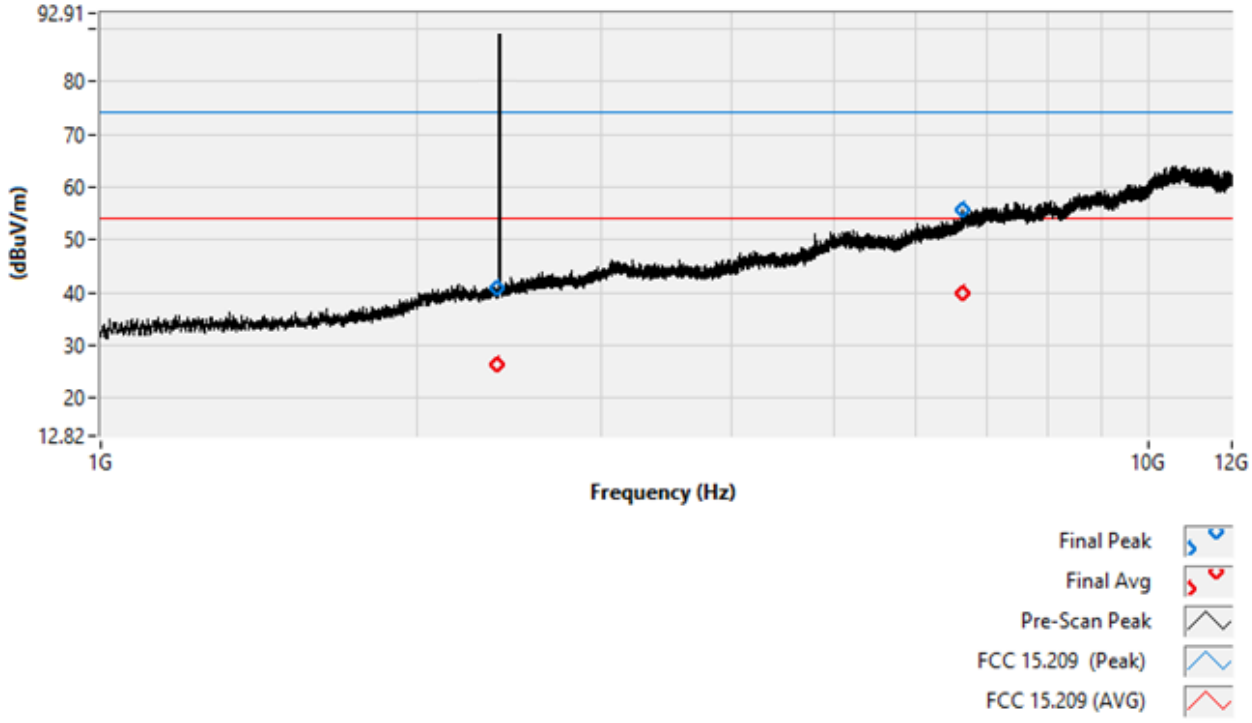


Table 11: 3-meter Radiated Test Data, Low Channel, 1Mbps, 1GHz to 18GHz, miniMic Standard

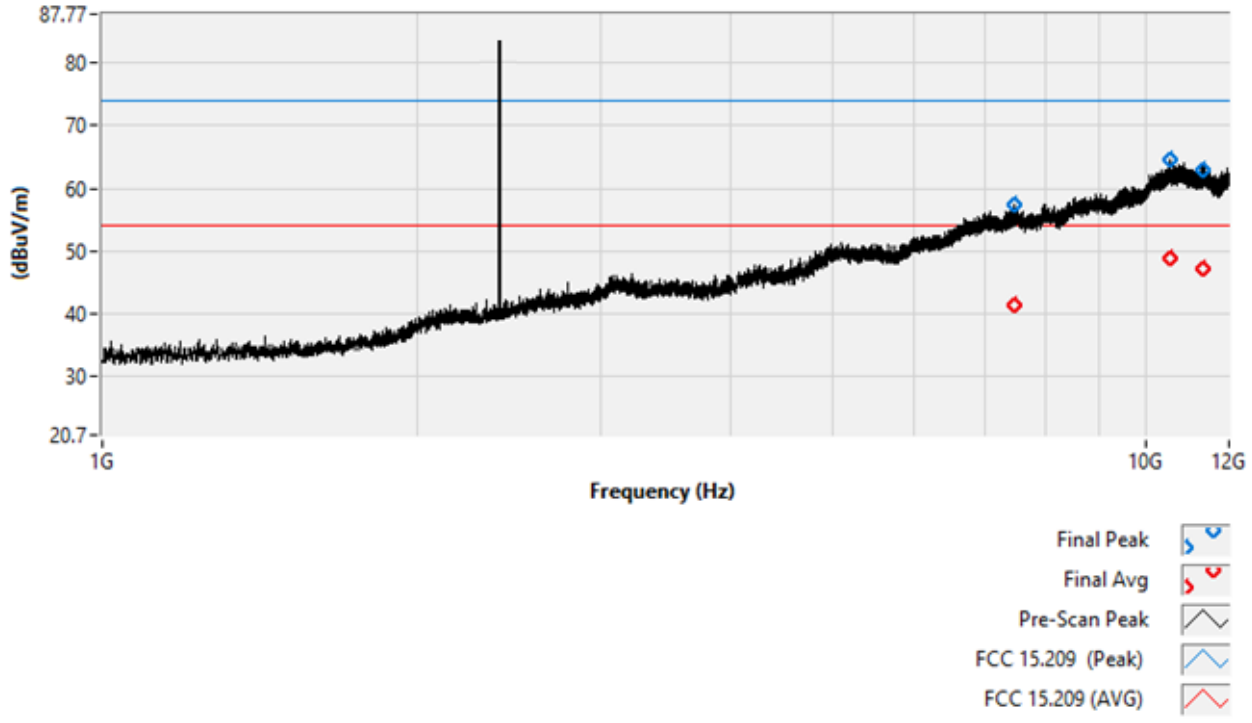
Frequency (MHz)	Detector	Meas (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Turn Table (deg)	Antenna (cm)
2390.0 BE	Peak	40.824	67.990 *	-27.166	200	Vert, 125
	Avg	26.174	54	-27.826	200	Vert, 125
2402.0 TX	Peak	87.990	--	--	200	Vert, 125
	Avg	--	--	--	200	Vert, 125
6648.00	Peak	55.590	74	-18.410	290	Horiz, 200
	Avg	39.725	54	-14.275	290	Horiz, 200
7466.00	Peak	57.504	74	-16.496	290	Horiz, 200
	Avg	41.317	54	-12.683	290	Horiz, 200
10537.00	Peak	64.491	74	-9.509	290	Horiz, 200
	Avg	48.934	54	-5.066	290	Horiz, 200
11317.00	Peak	62.948	74	-11.052	290	Horiz, 200
	Avg	47.327	54	-6.673	290	Horiz, 200
14122.00	Peak	58.927	74	-15.073	200	Vert, 125
	Avg	43.419	54	-10.581	200	Vert, 125
15713.00	Peak	61.061	74	-12.939	290	Horiz, 200
	Avg	45.019	54	-8.981	290	Horiz, 200
17597.00	Peak	65.182	74	-8.818	200	Vert, 125
	Avg	48.622	54	-5.378	200	Vert, 125

* this limit is -20dBc based on the fundamental

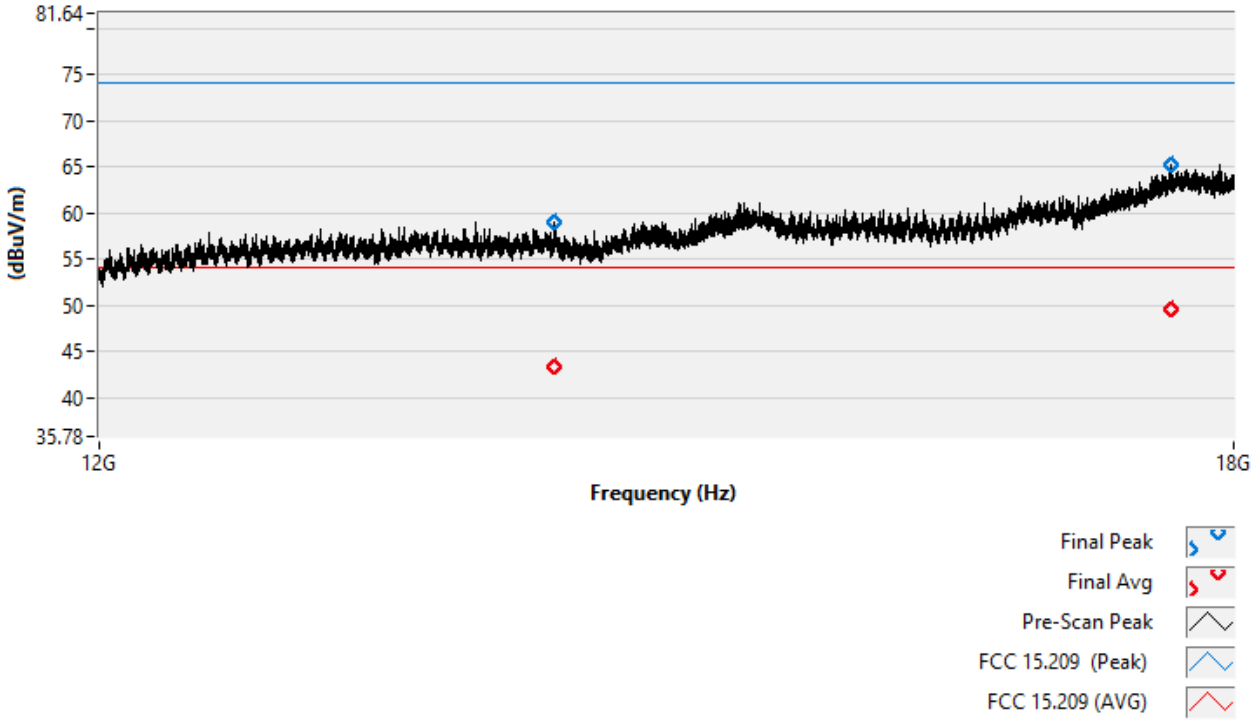
miniMic Standard, Low Channel, 1Mbps, Pre-scan and Final Data (Vertical)**,** 1GHz to 12GHz



miniMic Standard, Low Channel, 1Mbps, Pre-scan and Final Data (Horizontal)**,** 1GHz to 12GHz



miniMic Standard, Low Channel, 1Mbps, Pre-scan and Final Data (Vertical)**,** 12GHz to 18GHz



miniMic Standard, Low Channel, 1Mbps, Pre-scan and Final Data (Horizontal)**,** 12GHz to 18GHz