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April 30, 2024

Lutron Electronics
Andrew Vaughn
7200 Suter Rd
Coopersburg, PA 18036

Dear Andrew Vaughn,

Enclosed is the Electromagnetic Compatibility test report for compliance testing of the Lutron Electronics, FCC Wall Switch as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Part 15 Subpart C for Intentional Radiators and RSS-247 for DTS devices, Issue 3, August 2023 for Intentional Radiators.

Thank you for using the services of Eurofins Electrical and Electronic Testing NA, Inc. Please contact me if you have any questions regarding these results or if Eurofins E&E can be of further service to you.

Sincerely,

Michelle Tawmging

Documentation Department
Eurofins Electrical and Electronic Testing NA, Inc.

Reference: (\Lutron Electronics\EMC131030-FCC_RSS 247 BLE Rev. 2)

A2LA ACCREDITED TESTING CERT #0591.01

Electromagnetic Compatibility Criteria
Test Report

for the

Lutron Electronics
FCC Wall Switch

Tested under
the FCC Certification Rules
contained in
15.247 Subpart C for Intentional Radiators

and

RSS-247 for DTS devices, Issue 3, August 2023 for Intentional Radiators

Report: EMC131030-FCC_RSS 247 BLE Rev. 2

April 30, 2024

Prepared For:

Lutron Electronics
7200 Suter Rd
Coopersburg, PA 18036

Prepared By:
Eurofins Electrical and Electronic Testing NA, Inc.
914 W. Patapsco Ave.
Baltimore, MD 21230

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Donald Salguero
EMC Laboratory Engineer

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements.

Michael Griffiths
Manager, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
Ø	March 18, 2024	Initial Issue.
1	April 8, 2024	Updated Table 2; Updated Table 5.
2	April 30, 2024	CAB Identifier Added. Power Settings Added.

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Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Lutron Electronics FCC Wall Switch, with the requirements of Part 15, §15.247 and RSS-247 for DTS devices, Issue 3, August 2023 for Intentional Radiators. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the FCC Wall Switch. Lutron Electronics should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the FCC Wall Switch, has been **permanently** discontinued.

B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.247 and RSS-247 for DTS devices, Issue 3, August 2023 for Intentional Radiators, in accordance with Lutron Electronics, purchase order number 5322518. All tests were conducted using measurement procedure ANSI C63.10-2013.

FCC Reference 47 CFR Part 15.247	IC Reference RSS-247 Issue 3, 2023; RSS-GEN Issue 5: 2021	Description	Compliance
Title 47 of the CFR, Part 15 §15.203	RSS-GEN (6.8)	Antenna Requirement	Compliant
Title 47 of the CFR, Part 15 §15.207(a)	RSS-GEN (8.8)	Conducted Emission Limits	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(2)	RSS-247 (5.2)	6dB Occupied Bandwidth	Compliant
-	RSS-GEN(6.7)	99% Occupied Bandwidth	Compliant
Title 47 of the CFR, Part 15 §15.247(b)	RSS-247(5.4)	Peak Power Output	Compliant
Title 47 of the CFR, Part 15 §15.247(d)	RSS-247(5.5)	Spurious Emissions in Non-restricted Bands	Compliant
Title 47 of the CFR, Part 15 §15.247(d); §15.209; §15.205	RSS-GEN (6.13), (8.9), & (8.10)	Radiated Spurious Emissions Requirements	Compliant
Title 47 of the CFR, Part 15; §15.247(e)	RSS-247(5.2)	Peak Power Spectral Density	Compliant
ANSI C63.10 – 2013; Section 11.6	ANSI C63.10 – 2013; Section 11.6	Duty Cycle	Completed
Title 47 of the CFR, Part 15 §15.247(i)	-	RF Human Exposure, SAR Exclusion	Compliant
-	RSS-102(3.2)	RF Exposure Evaluation of Devices	Compliant

Table 1. Executive Summary

Equipment Configuration

A. Overview

Eurofins Electrical and Electronic Testing NA, Inc. was contracted by Lutron Electronics to perform testing on the FCC Wall Switch, under Lutron Electronics's purchase order number 5322518,

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Lutron Electronics, FCC Wall Switch.

The results obtained relate only to the item(s) tested.

Model(s) Tested:	FCC Wall Switch	
Model(s) Covered:	FCC Wall Switch	
EUT Specifications:	Primary Power: 120V	
	FCC ID: JPZ0154 IC ID: 2851A-JPZ0154	
	Type of Modulations:	O-QPSK, 2-FSK
	Equipment Code:	DTS
	Peak RF Output Power:	7.36 dBm; 5.45 mW
	EUT Frequency Ranges:	2402-2480 MHz
	Transmit Speeds:	1 Mbps, 2Mbps
	Antenna Type:	Integral
	Antenna Gain:	2.5
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35º C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Evaluated by:	Donald Salguero	
Report Date(s):	April 30, 2024	

Table 2. EUT Summary Table

B. References

CFR 47, Part 15, Subpart C	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies
RSS-247, Issue 3, August 2023	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-GEN, Issue 5, February 2021	General Requirements and Information for the Certification of Radio Apparatus
RSS-102, Issue 5, March 2015	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
ISO/IEC 17025:2017	General Requirements for the Competence of Testing and Calibration Laboratories
ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
KDB 558074 v05r02	Guidance For Performing Compliance Measurements On Digital Transmission Systems (DTS) Operating Under Section 15.247

Table 3. References

C. Test Site

All testing was performed at Eurofins Electrical and Electronic Testing NA, Inc., 914 West Patapsco Avenue, Baltimore, MD 21230. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology. Eurofins Electrical and Electronic Testing NA, Inc. has been accredited by the American Association for Laboratory Accreditation (A2LA) (Certificate #: 0591.01) in accordance with ISO/IEC 17025:2017.

The CAB identifier is US0109.

D. Measurement Uncertainty

Test Method	Typical Expanded Uncertainty	K	Confidence Level
Radiated Emissions, (30 MHz – 1 GHz)	±3.20	2	95%
Radiated Emissions, (1 GHz – 6 GHz)	±2.52	2	95%
Conducted Emission Voltage	±2.03	2	95%
RF Frequencies	±4.52 Hz	2	95%
RF Power Conducted Emissions	±2.32 dB	2	95%
RF Power Conducted Spurious Emissions	±2.25 dB	2	95%
RF Power Radiated Emissions	±3.01 dB	2	95%

Table 4. Uncertainty Calculations Summary

E. Equipment Configuration

Name of EUT/Model:	FCC Wall Switch
Description of EUT and Intended Use:	Fan speed wall control
Selected Operation Mode(s):	Continuous operation thru test code
Rational for the selection of the Operation Mode(s):	Allows for highest level of emissions
Susceptibility Criteria:	N/A
Monitoring Method(s):	Led light on EUT
Emissions Class Declaration:	Class B
Configurations:	-
Rated Power Input	
Input Voltage Range:	120V
AC or DC:	AC
Voltage Frequency:	60Hz
Number of Phases:	1
Current:	-
Uses an external AC/DC Adapter:	False
The EUT can be battery powered:	False
Power Input Under Test	
Input Voltage:	120V
Frequency:	60Hz
Physical Description	
EUT Arrangement:	Table Top
System with Multiple Chassis?	False
Size (HxWxD) inches:	4x1.75x1.5
Weight (lbs):	-
Highest Internal Frequency (MHz):	2480 MHz
Other Info	
EUT Software (Internal to EUT):	-
Support Software (used by support PC to exercise EUT):	LutronRadioCertificationGUI
Radio BLE Power Setting:	‘8’ across all channels (1mbps and 2mbps)
Firmware:	-
Transmitter Parameters	
Description of your unit:	DSSS
Modulation Type:	O-QPSK, 2-FSK
Number of Channels:	0
Frequency Range (Mhz):	2402-2480
Antenna Type:	integral
Antenna Gain (db):	2.5

PMN:	RRST–ANF, HRST-ANF, ARST-ANF
HVIN:	FDT5
FVIN:	N/A
HMN:	N/A
Data Rates:	1 Mbps, 2 Mbps
Expected Power Level:	-
Number of Antenna:	1
Number of Intentional Transmitters:	2
Number of Certified Intentional Transmitter Modules:	0
FCC ID:	JPZ0154
IC ID:	2851A-JPZ0154

Table 5. Equipment Details

Name/Description	Model Number	Part Number	Serial Number	Rev. #
FCC Wall Switch (Radiated)	N.A.	N/A	036FD6F6	N.A.
FCC Wall Switch (Conducted)	N.A.	N/A	036FD6EF	N.A.

Table 6. EUT List

Port Name on EUT	Cable Desc. or reason for none	3 Meters or Longer	Length as tested (m)	Max Length (m)	Shielded?	Termination Box ID & Port Name
Mains	power cable	No	2		No	

Table 7. Ports and Cabling

F. Modifications

a) Modifications to EUT

No modifications were made to the EUT.

b) Modifications to Test Standard

No modifications were made to the test standard.

G. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Lutron Electronics upon completion of testing.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

Test Requirement: **§ 15.203:** An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

The structure and application of the EUT were analyzed to determine compliance with Section 15.203 of the Rules. Section 15.203 states that the subject device must meet at least one of the following criteria:

a.) Antenna must be permanently attached to the unit.

b.) Antenna must use a unique type of connector to attach to the EUT.

c.) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

Test Results: The EUT was **compliant** with this requirement. EUT utilizes integral antenna with 2.5dBi gain.

Test Engineer: Donald Salguero

Test Date: March 7, 2024

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207(a) Conducted Emissions Limits

Test Requirement(s): **§ 15.207 (a):** For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency range (MHz)	§ 15.207(a), Conducted Limit (dBµV)	
	Quasi-Peak	Average
* 0.15- 0.5	66 - 56	56 - 46
0.5 - 5	56	46
5 - 30	60	50

Table 8. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Test Procedure: The EUT was placed on a 0.8 m-high wooden table inside a screen room. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 µH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.104-2013*. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω/50 µH LISN as the input transducer to an EMC/field intensity meter. For the purpose of this testing, the transmitter was turned on.

RSS-GEN (8.8) AC Power-Line Conducted Emissions Limits

Test Requirement(s):

RSS-GEN (8.8): Unless stated otherwise in the applicable RSS, for radio apparatus that are designed to be connected to the public utility AC power network, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 kHz to 30 MHz shall not exceed the limits in Table 9, as measured using a 50 µH / 50 Ω line impedance stabilization network. This requirement applies for the radio frequency voltage measured between each power line and the ground terminal of each AC power-line mains cable of the EUT.

For an EUT that connects to the AC power lines indirectly, through another device, the requirement for compliance with the limits in Table 9 shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the EUT. The lower limit applies at the boundary between the frequency ranges. The device used to power the EUT shall be representative of typical applications.

Frequency (MHz)	Conducted Limit (dBµV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56[1]	56 to 46[1]
0.5-5	56	46
5-30	60	50

Table 9. AC Power Line Conducted Emissions Limits

Note 1 - The level decreases linearly with the logarithm of the frequency.

Test Procedure:

The EUT was placed on a non-metallic table inside a screen room. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 µH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.10-2013 "Procedures for Compliance Testing of Unlicensed Wireless Devices"*. Scans were performed with the transmitter on at full power.

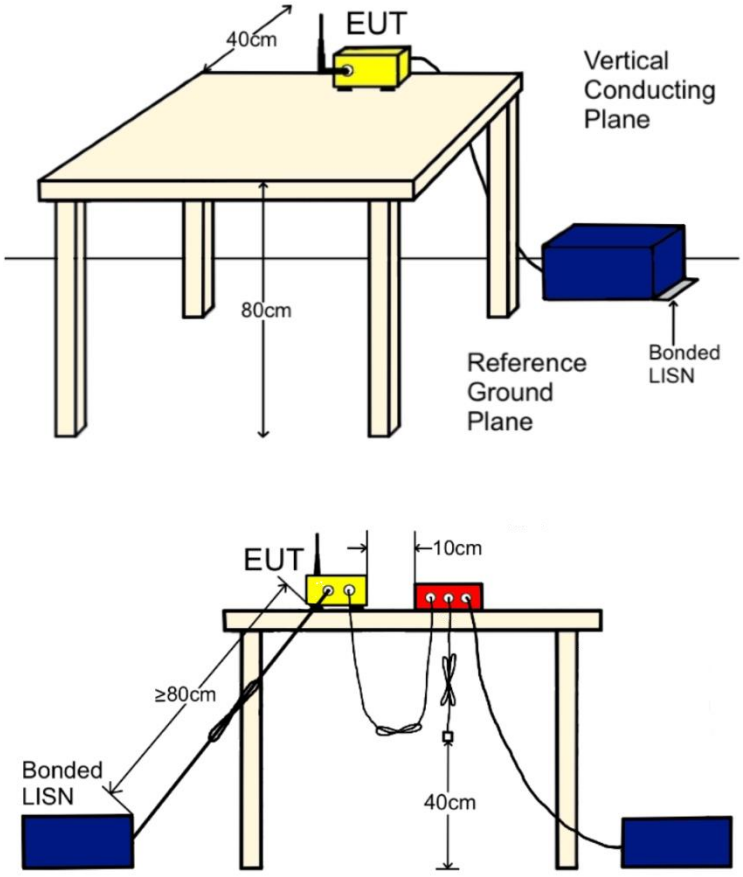


Figure 1. CEV Test Setup

Test Results: The EUT was **compliant** with this requirement.

Test Engineer: Donald Salguero

Test Date: March 7, 2024

Test Data

Conducted Emissions Datasheet			
METrak Number	131030	Test Specification	FCC Part 15, Subpart C, Section 15.207; RSS-GEN, Section 8.8
Customer	Lutron Electronics	Equipment Class	B
EUT Name	Wall Switch	Engineer	Donald Salguero
Model/Part Number	RRST-ANF	Test Date(s)	3/7/2024
Serial Number	036FD6EF	Temperature	20.2°C
Mode of Operation	Continuous	Relative Humidity	23%
Notes:			
Start Frequency	150 kHz	Stop Frequency	30 MHz
Line Under Test	Line		

Frequency	Quasi-Peak Measurement	Correction Factor	Corrected Measurement	Quasi-Peak Limit	Margin	Result
MHz	dBµV	dB	dBµV	dBµV	dB	Pass/Fail
0.15	38.61	10.54	49.15	66	-16.85	PASS
1.99	30.92	10.04	40.97	56	-15.03	PASS
5.974	33.65	10.09	43.75	60	-16.25	PASS
9.954	34.97	10.16	45.13	60	-14.87	PASS
13.938	28.47	10.25	38.72	60	-21.28	PASS
21.902	27.26	10.47	37.73	60	-22.27	PASS
Frequency	**Average Measurement**	**Correction Factor**	**Corrected Measurement**	**Average Limit**	**Margin**	**Result**
MHz	dBµV	dB	dBµV	dBµV	dB	Pass/Fail
0.15	20.19	10.54	30.73	56	-25.271	PASS
8.644	17.68	10.14	27.82	50	-22.18	PASS
9.061	17.69	10.15	27.84	50	-22.163	PASS
9.082	17.67	10.15	27.81	50	-22.187	PASS
9.954	18.17	10.16	28.34	50	-21.663	PASS
12.799	21.51	10.23	31.74	50	-18.261	PASS

Table 10. CE Data [120V60Hz, Line, BLE]

Conducted Emissions Datasheet			
METrak Number	131030	Test Specification	FCC Part 15, Subpart C, Section 15.207; RSS-GEN, Section 8.8
Customer	Lutron Electronics	Equipment Class	B
EUT Name	Wall Switch	Engineer	Donald Salguero
Model/Part Number	RRST-ANF	Test Date(s)	3/7/2024
Serial Number	036FD6EF	Temperature	20.2°C
Mode of Operation	Continuous	Relative Humidity	23%
Notes:			
Start Frequency	150 kHz	Stop Frequency	30 MHz
Line Under Test	Neutral		

Frequency	Quasi-Peak Measurement	Correction Factor	Corrected Measurement	Quasi-Peak Limit	Margin	Result
MHz	dBµV	dB	dBµV	dBµV	dB	Pass/Fail
0.15	39.35	10.53	49.88	66	-16.12	PASS
1.99	31.4	10.07	41.47	56	-14.526	PASS
5.974	33.23	10.12	43.34	60	-16.656	PASS
9.954	34.89	10.19	45.08	60	-14.916	PASS
13.938	28.68	10.27	38.95	60	-21.049	PASS
21.902	28.52	10.48	39.01	60	-20.994	PASS
Frequency	**Average Measurement**	**Correction Factor**	**Corrected Measurement**	**Average Limit**	**Margin**	**Result**
MHz	dBµV	dB	dBµV	dBµV	dB	Pass/Fail
0.154	22.51	10.51	33.01	55.88	-22.866	PASS
0.605	19.64	10.08	29.71	46	-16.288	PASS
0.638	19.27	10.07	29.34	46	-16.663	PASS
0.667	18.6	10.07	28.67	46	-17.334	PASS
0.697	17.48	10.06	27.54	46	-18.456	PASS
12.799	21.45	10.25	31.7	50	-18.3	PASS

Table 11. CE Data [120V60Hz, Neutral, BLE]

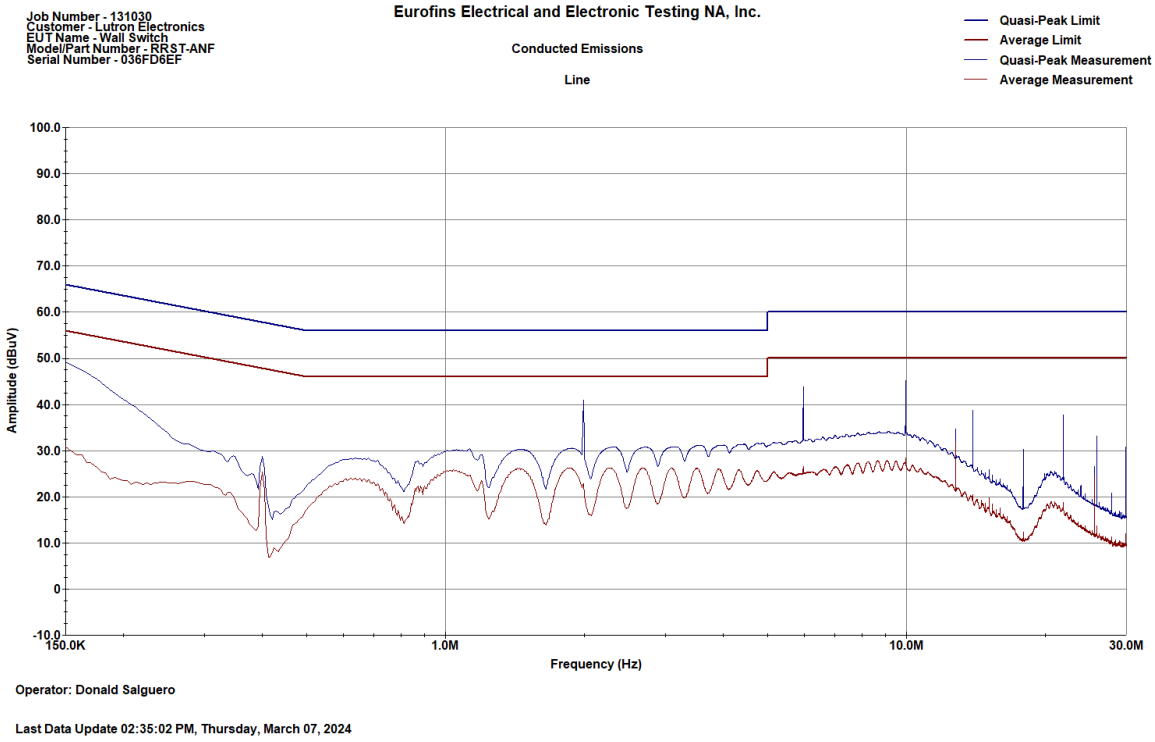


Figure 2. CE Prescan [120V60Hz, Line, BLE]

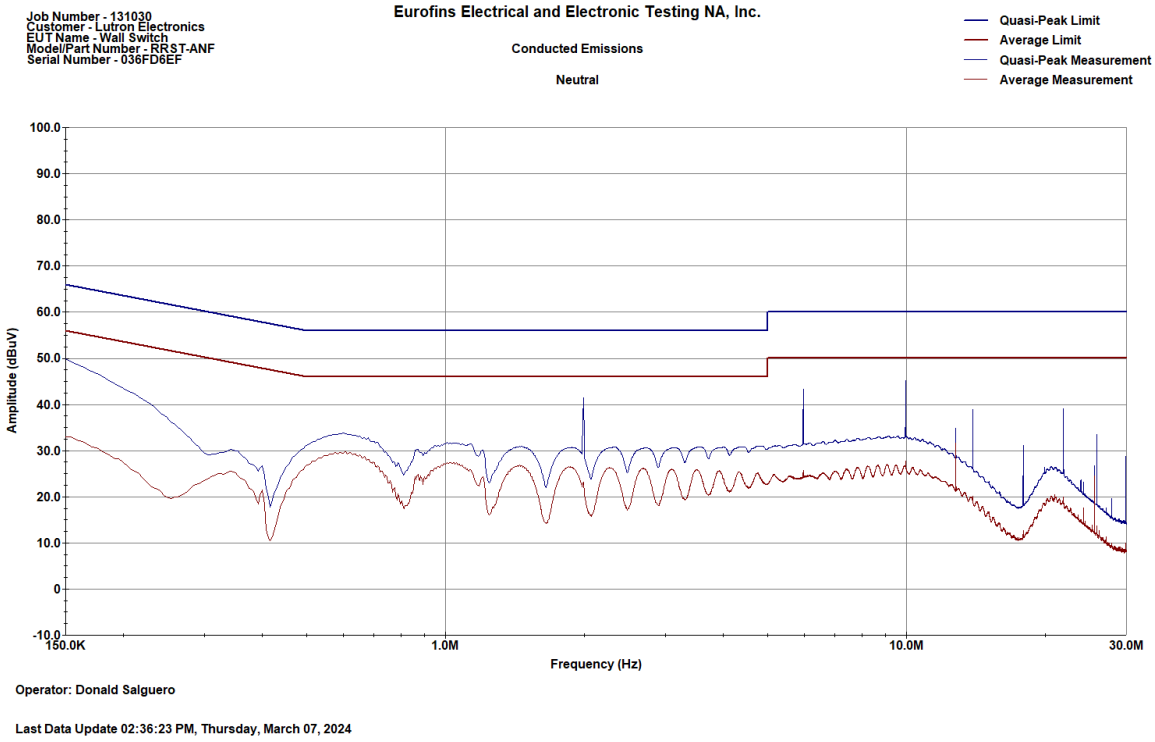
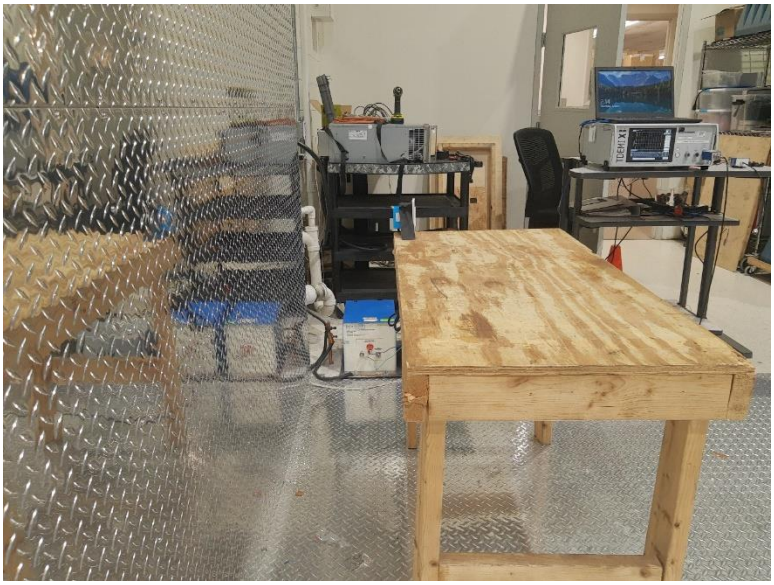
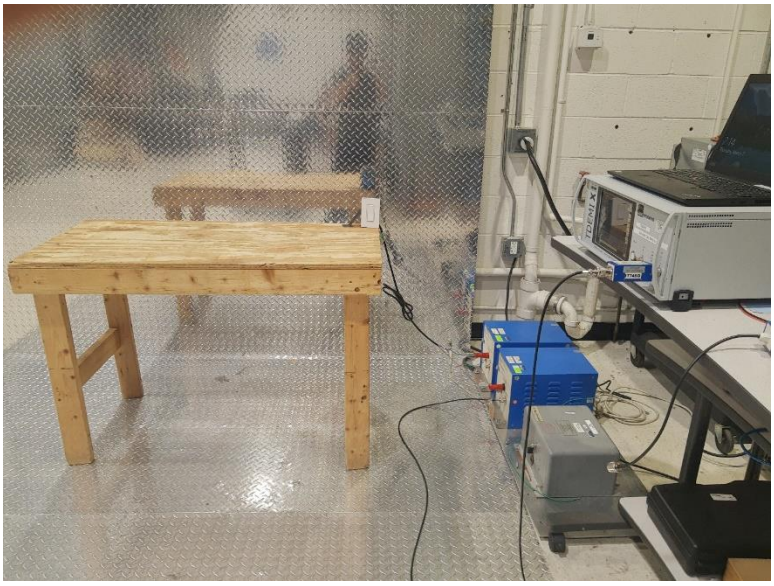


Figure 3. CE Prescan [120V60Hz, Neutral, BLE]

Test Photographs



Photograph 1. CE Setup [Rear]



Photograph 2. CE Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a)(2) 6 dB Bandwidth

Test Requirements: **§ 15.247(a)(2):** Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

For systems using digital modulation techniques, the EUT may operate in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

Test Procedure: The transmitter was on and transmitting at the highest output power. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW = 100kHz, VBW = 3*RBW. The 6 dB Bandwidth was measured and recorded. The measurements were performed on the low, mid and high channels.

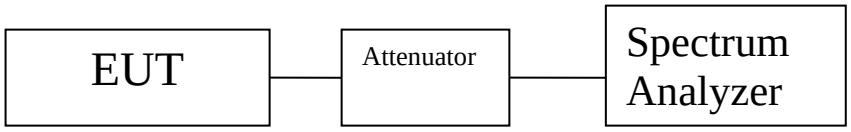


Figure 4. Block Diagram, Occupied Bandwidth Test Setup

RSS-GEN (6.7) 99% Occupied Bandwidth

Test Requirements:

RSS-GEN (6.7): The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.
The following conditions shall be observed for measuring the occupied bandwidth and x dB bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to "Sample". However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or "Max Hold") may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

Test Procedure:

The transmitter was on and transmitting at the highest output power. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately 1% of the total emission bandwidth, VBW > RBW. The 99% Bandwidth was measured and recorded. The measurements were performed on the low, mid and high channels.

RSS-247 (5.2) 6dB Bandwidth

Test Requirements: **RSS-247 (5.2):** The minimum 6 dB bandwidth shall be 500 kHz.

Test Procedure: The EUT was connected to a spectrum analyzer through a cable and an attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels for all its bandwidths. The 6dB bandwidth was measured according to measurement method 11.8.2 Option 2 of ANSI C63.10-2013.

Test Procedure: The transmitter was on and transmitting at the highest output power. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW = 100kHz, VBW = 3*RBW. The 6 dB Bandwidth was measured and recorded. The measurements were performed on the low, mid and high channels.

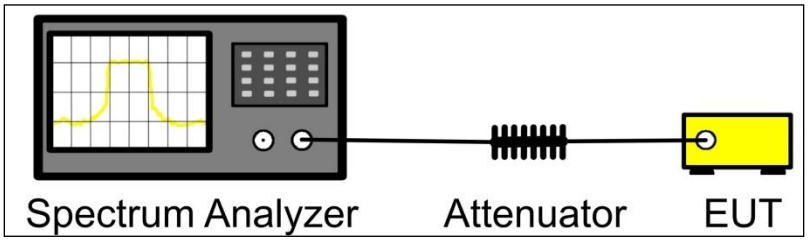


Figure 5. 6dB Bandwidth Test Setup

Test Results: The EUT was **compliant** with this requirement.

Test Engineer: Donald Salguero

Test Date: March 7, 2024

Test Data

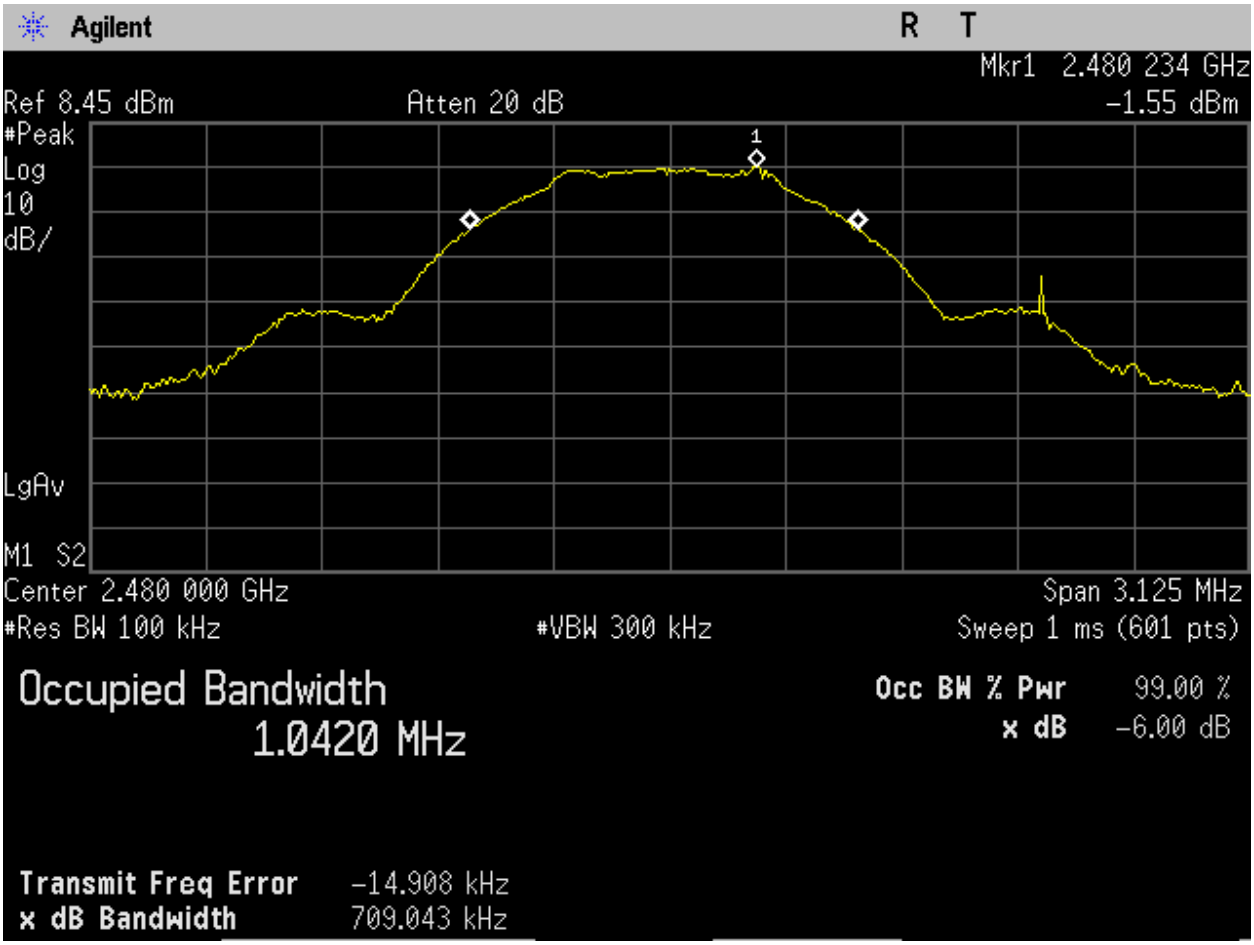


Figure 6. BLE_High Ch_2480MHz_1MBit_Occupied Bandwidth_-6dB_Port 1.

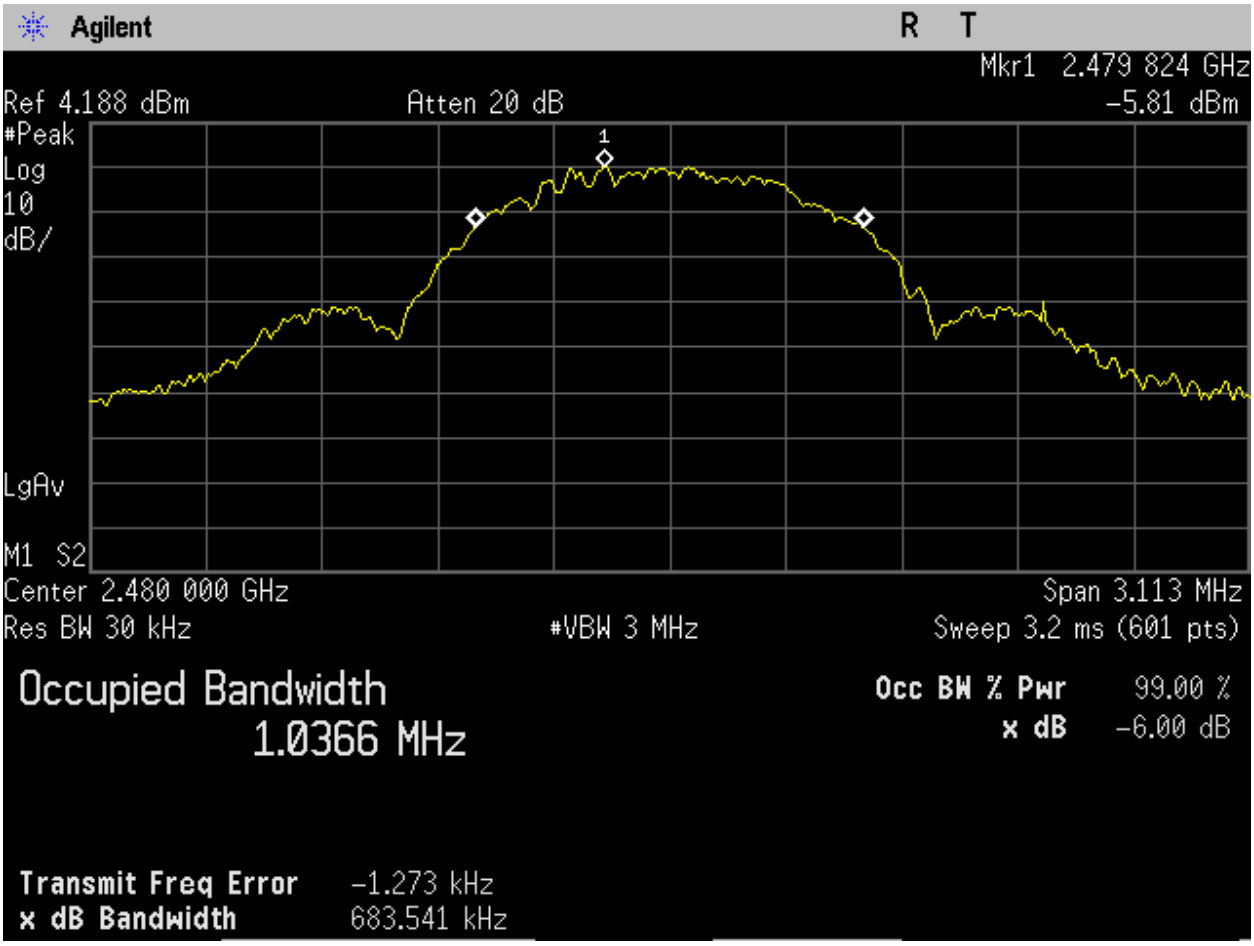


Figure 7. BLE_High Ch_2480MHz_1MBit_Occupied Bandwidth_99 percent_Port 1.

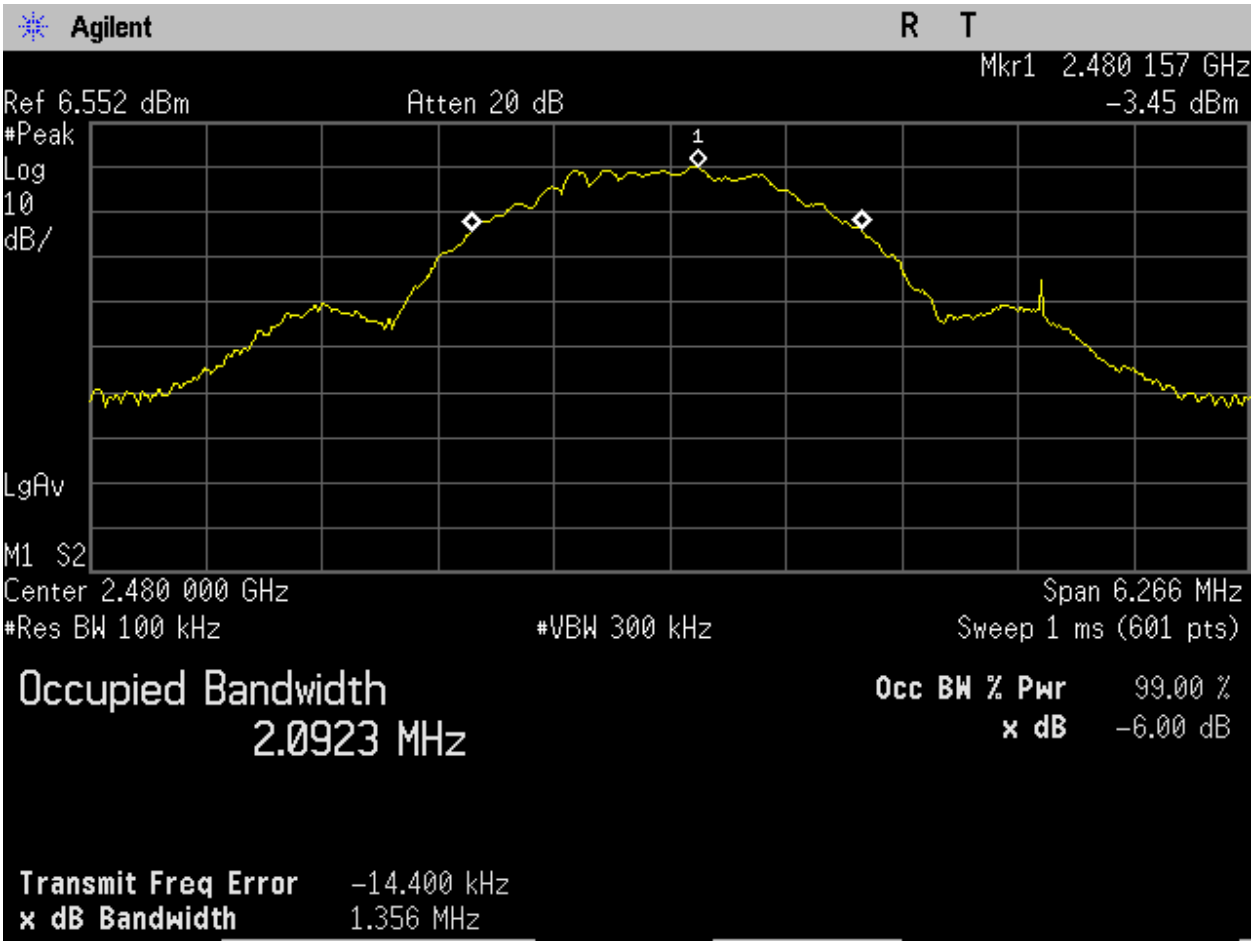


Figure 8. BLE_High Ch_2480MHz_2MBit_Occupied Bandwidth_-6dB_Port 1.

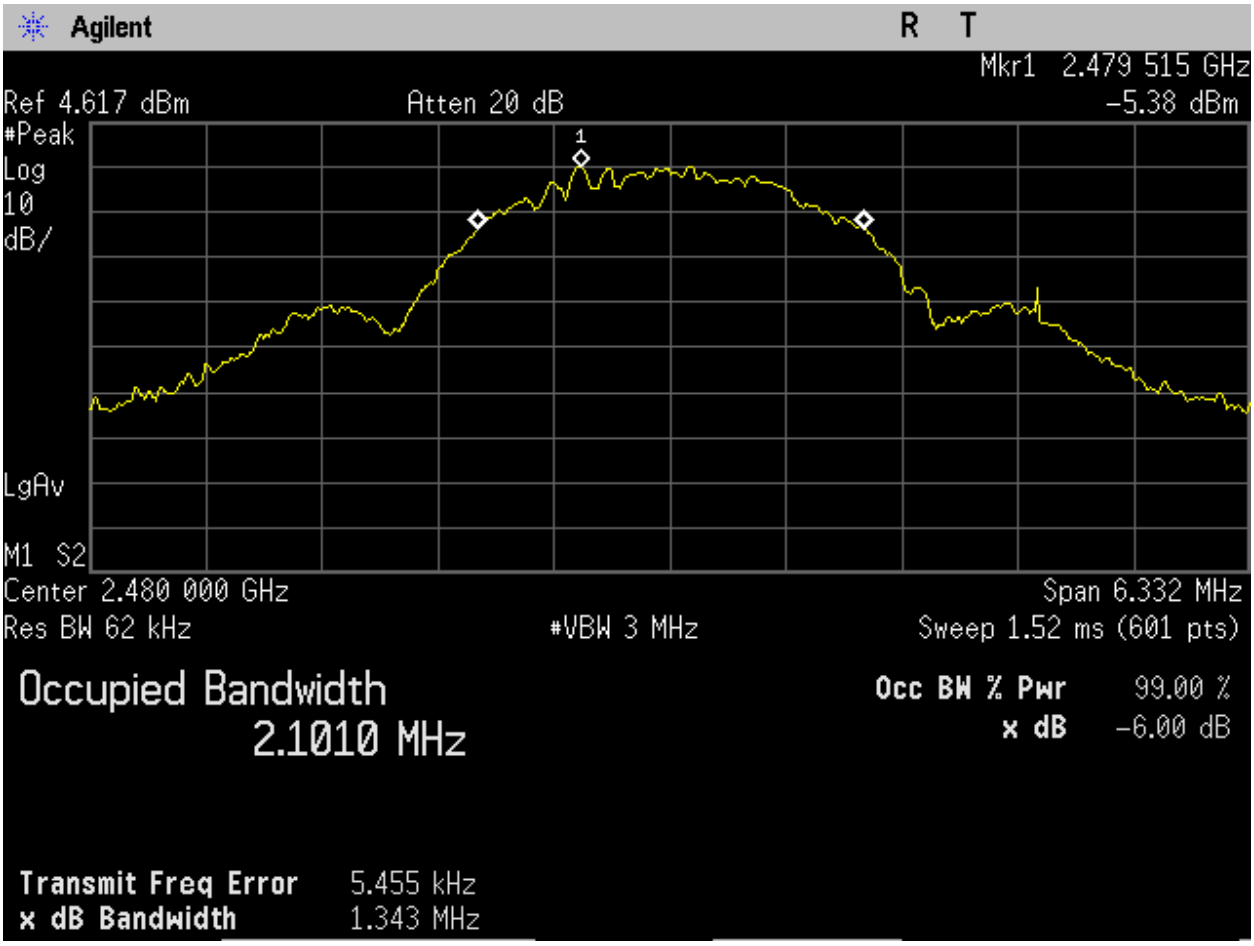


Figure 9. BLE_High Ch_2480MHz_2MBit_Occupied Bandwidth_99 percent_Port 1.

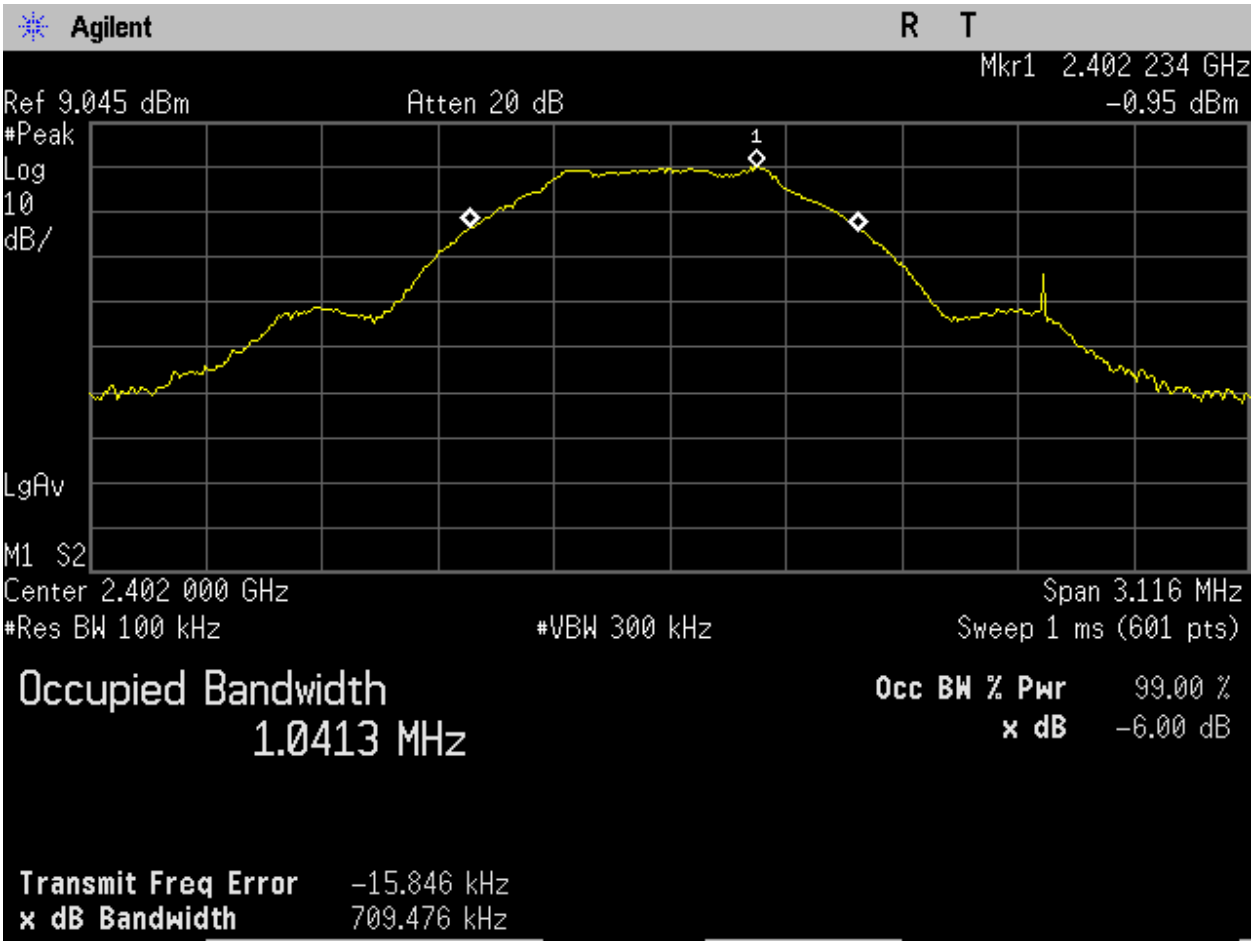


Figure 10. BLE_Low Ch_2402MHz_1MBit_Occupied Bandwidth_-6dB_Port 1.

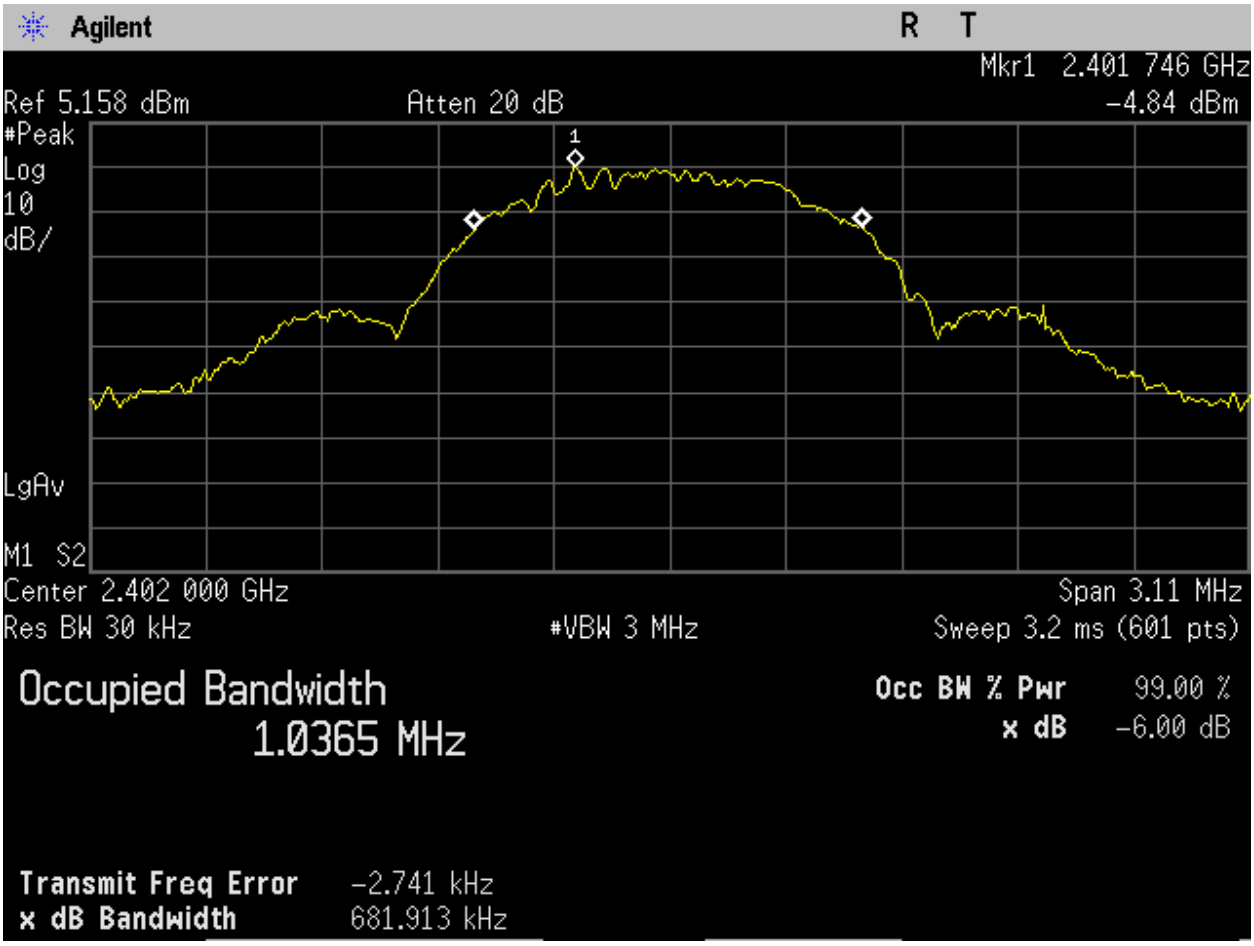


Figure 11. BLE_Low Ch_2402MHz_1MBit_Occupied Bandwidth_99 percent_Port 1.

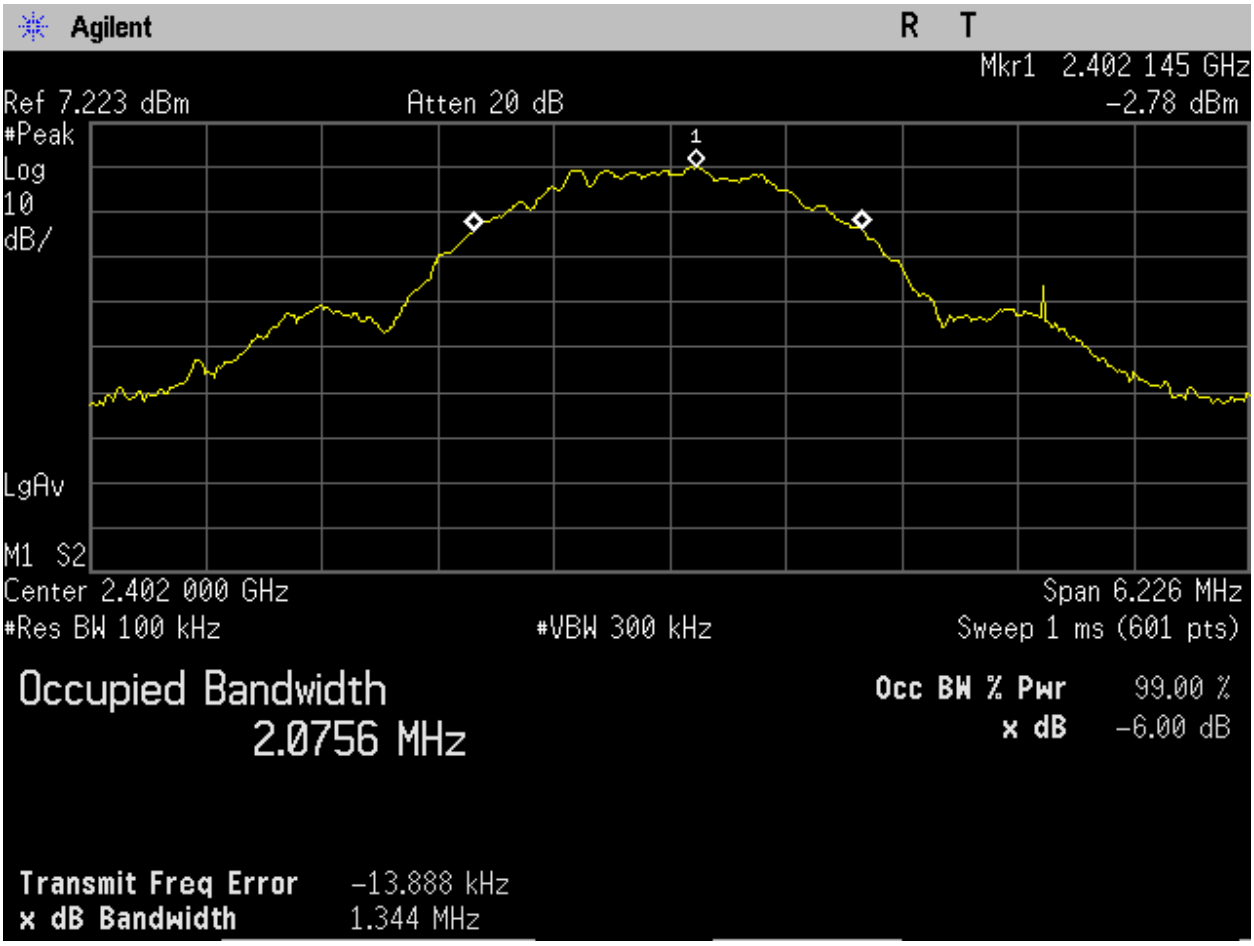


Figure 12. BLE_Low Ch_2402MHz_2MBit_Occupied Bandwidth_-6dB_Port 1.

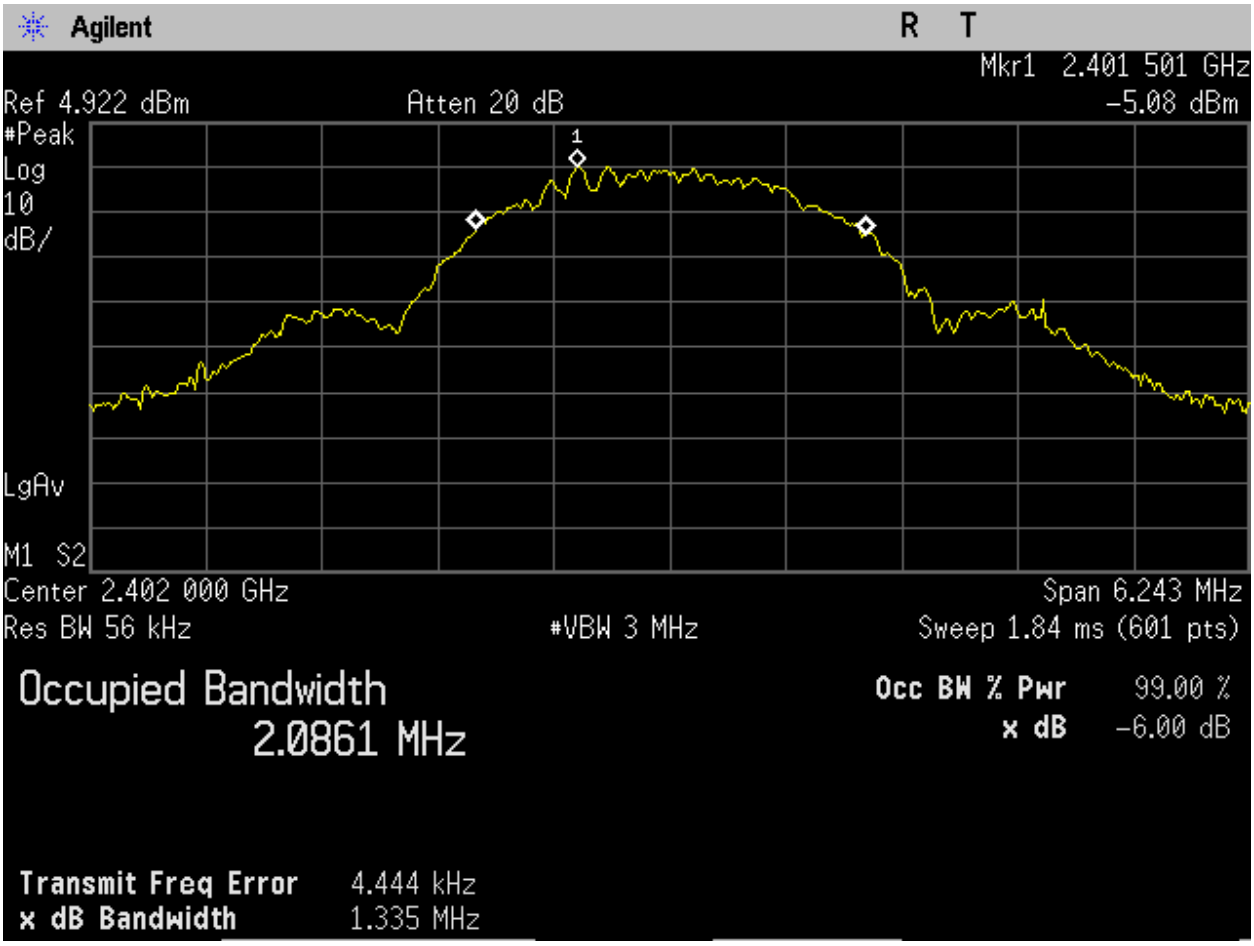


Figure 13. BLE_Low Ch_2402MHz_2MBit_Occupied Bandwidth_99 percent_Port 1.

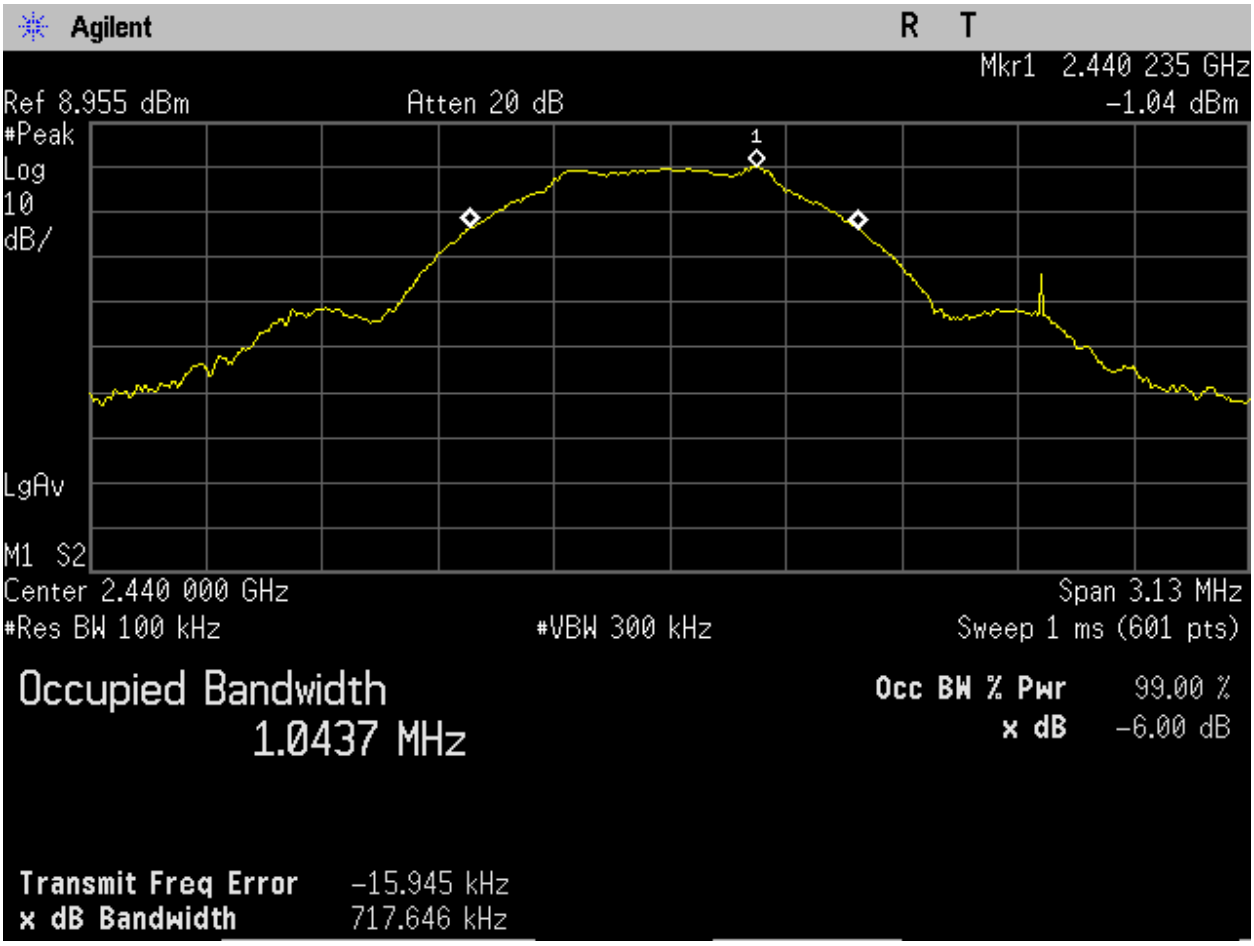


Figure 14. BLE_Mid Ch_2440MHz_1MBit_Occupied Bandwidth_-6dB_Port 1.

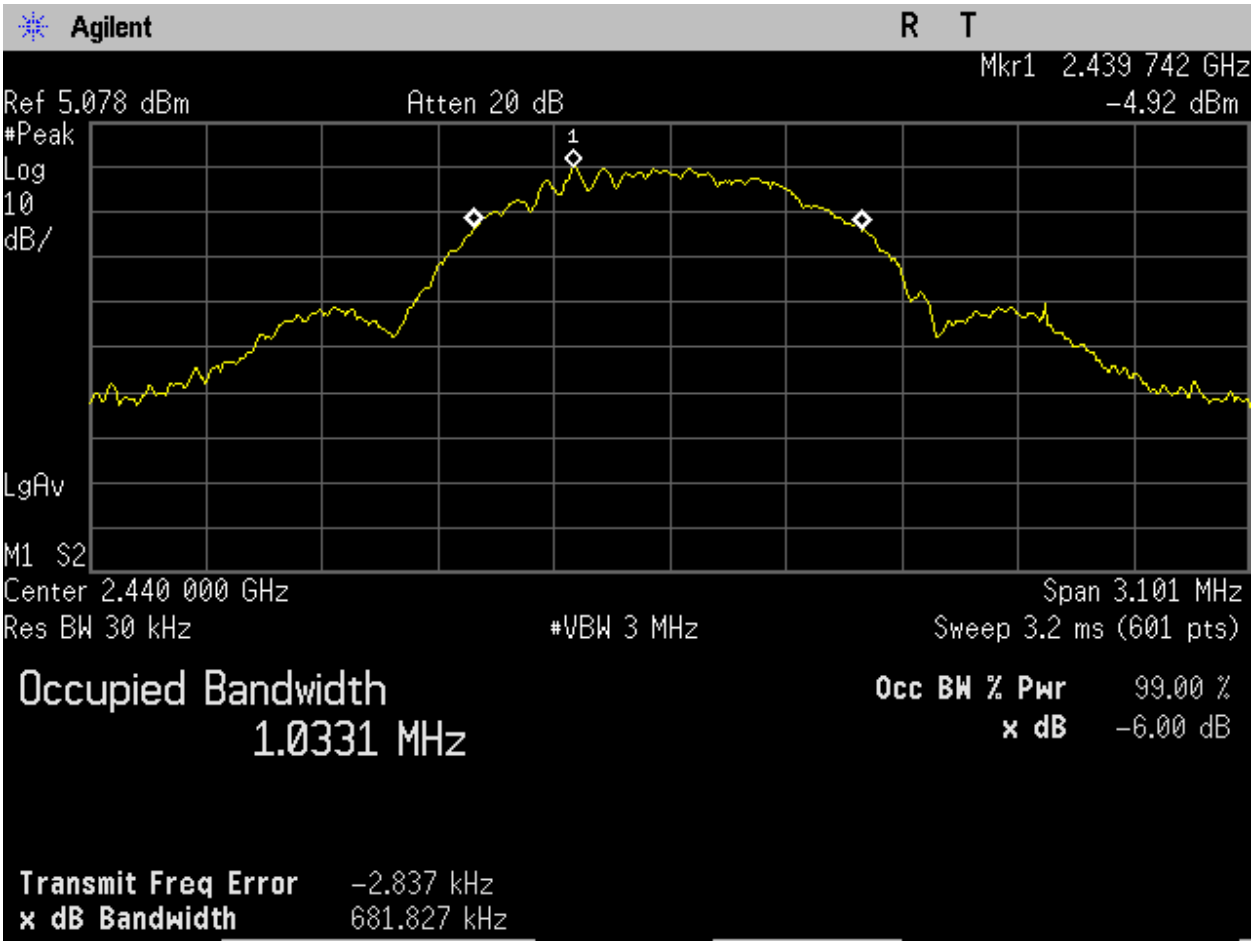


Figure 15. BLE_Mid Ch_2440MHz_1MBit_Occupied Bandwidth_99 percent_Port 1.

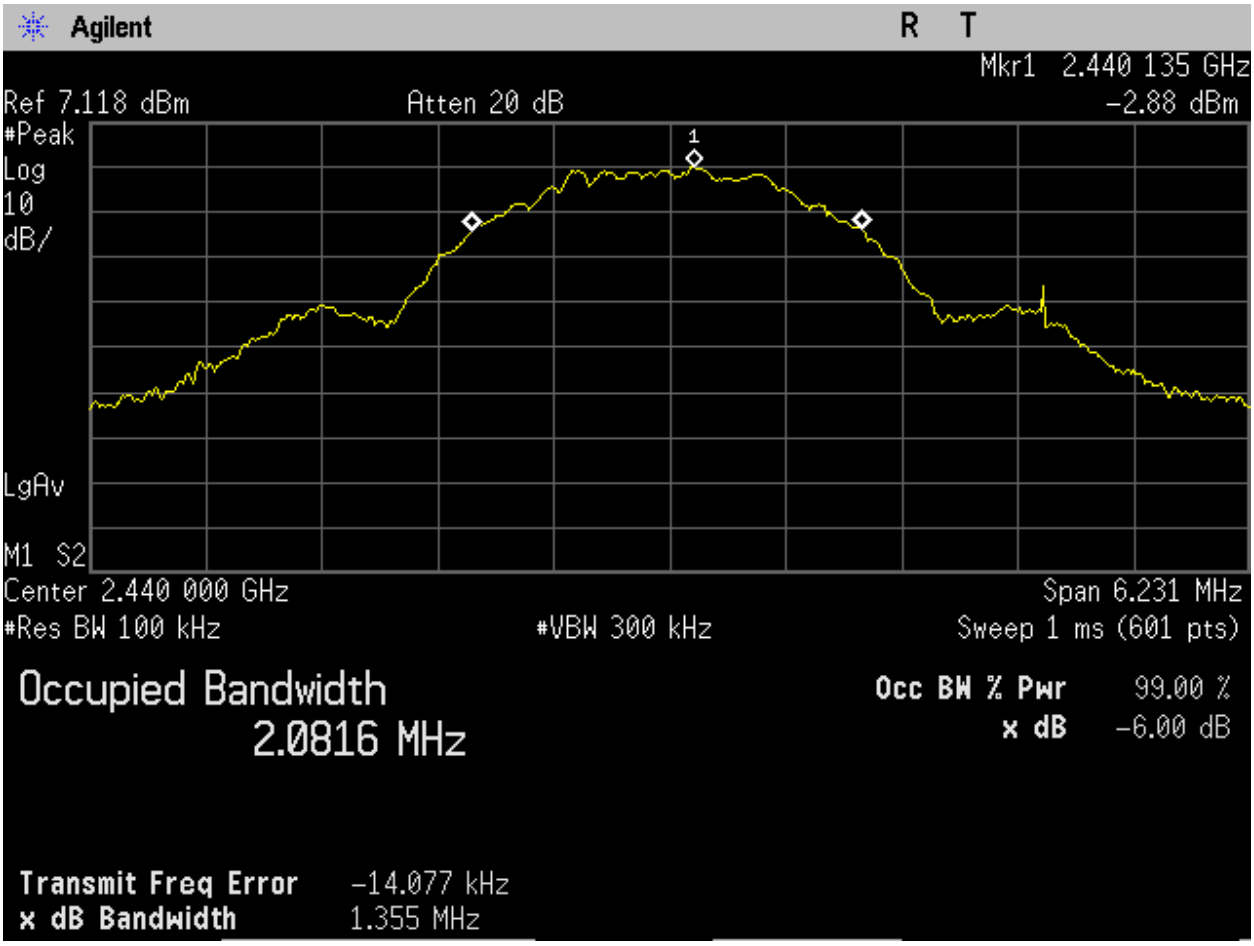


Figure 16. BLE_Mid Ch_2440MHz_2MBit_Occupied Bandwidth_-6dB_Port 1.

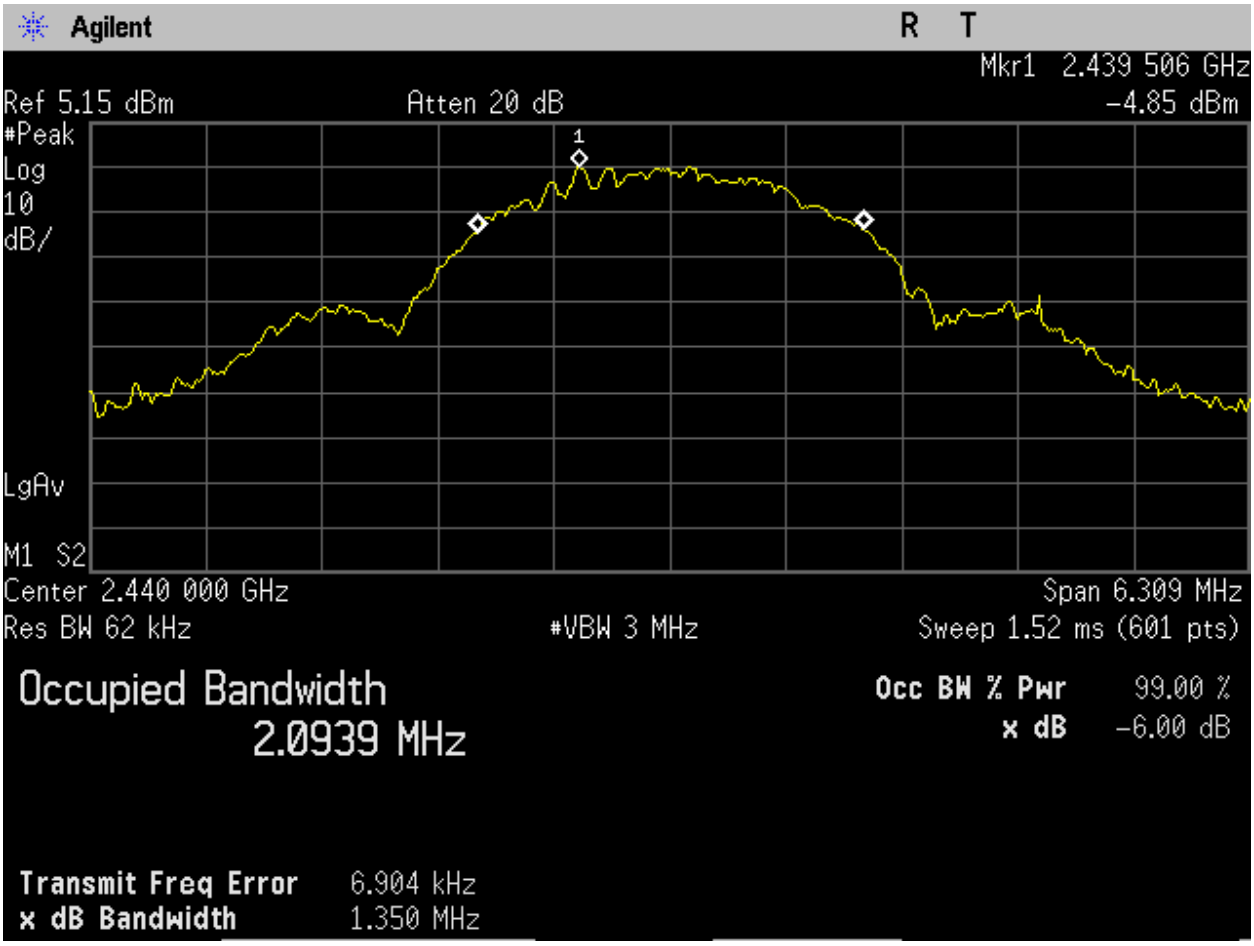


Figure 17. BLE_Mid Ch_2440MHz_2MBit_Occupied Bandwidth_99 percent_Port 1.

Frequency (MHz)	99% Bandwidth (MHz)	-6dB Bandwidth (kHz)	-6dB Bandwidth Limit (kHz)
2402	1.0365	709.476	> 500
2440	1.0331	717.646	> 500
2480	1.0366	709.043	> 500

Table 12. OBW, BLE (1 Mbps) Test Results

Frequency (MHz)	99% Bandwidth (MHz)	-6dB Bandwidth (kHz)	-6dB Bandwidth Limit (kHz)
2402	2.0861	1344.00	> 500
2440	2.0939	1355.00	> 500
2480	2.1010	1356.00	> 500

Table 13. OBW, BLE (2 Mbps) Test Results

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output

Test Requirements: **§15.247(b):** The maximum peak output power of the intentional radiator shall not exceed the following:

Digital Transmission Systems (MHz)	Output Limit (Watts)
2400–2483.5	1.000

Table 14. Output Power Requirements from §15.247(b)

§15.247(c): if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in the 9, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Test Procedure: The EUT was connected to a spectrum analyzer through a cable and an attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels for all its bandwidths at maximum power. Power was measured according to measurement method RBW ≥ DTS Bandwidth, as described in ANSI C63.10-2013, section 11.9.1.1.. Attenuator an cable loss factors were programmed into the spectrum analyzer.

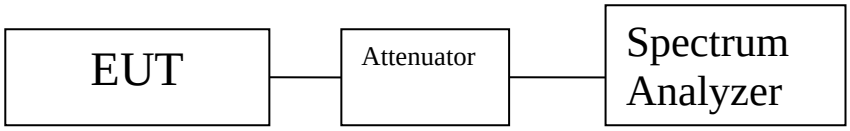


Figure 18. Block Diagram, Peak Conducted Output Power Test Setup

RSS-247 (5.4) Transmitter Output Power

Test Requirements:

RSS-247 (5.4)(4): For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. Except as provided in Section 5.4(5), the e.i.r.p. shall not exceed 4 W.

As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode.

RSS-247 (5.4)(5): Fixed point-to-point systems in the bands 2400-2483.5 MHz and 5725-5850 MHz are permitted to have an e.i.r.p. higher than 4 W provided that the higher e.i.r.p. is achieved by employing higher gain directional antennas and not higher transmitter output powers. Point-to-multipoint systems[1], omnidirectional applications and multiple co-located transmitters transmitting the same information are prohibited from exceeding an e.i.r.p. of 4 W.

RSS-247 (5.4)(6): Transmitters may operate in the band 2400–2483.5 MHz, employing antenna systems that emit multiple directional beams simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers, provided that the emissions comply with the following:

i. Different information must be transmitted to each receiver.
ii. If the transmitter employs an antenna system that emits multiple directional beams but does not emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device (i.e. the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels) shall not exceed the applicable output power limit specified in sections 5.4 (2) and (4).
iii. If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emission beam is subject to the applicable power limit specified in sections 5.4 (2) and (4). If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the applicable limit specified in sections 5.4 (2) and (4). In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the applicable limit specified in sections 5.4 (2) and (4) by more than 8 dB.
iv. Transmitters that transmit a single directional beam shall operate under the provisions of sections 5.4 (2), (4) and (5).

[1] However, remote stations of point-to-multipoint systems shall be permitted to operate at an e.i.r.p. greater than 4 W under the same conditions as for point-to-point systems.

Test Procedure: The EUT was connected to a spectrum analyzer through a cable and an attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels for all its bandwidths at maximum power. Power was measured according to measurement method RBW ≥ DTS Bandwidth, as described in ANSI C63.10-2013, section 11.9.1.1.. Attenuator an cable loss factors were programmed into the spectrum analyzer.

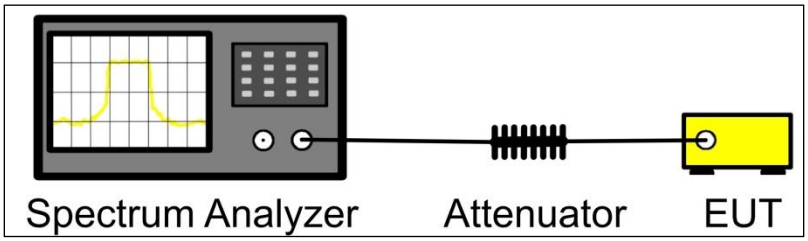


Figure 19. Power Output Test Setup

Test Results: The EUT was **compliant** with this requirement.

Test Engineer: Donald Salguero

Test Date: March 7, 2024

Test Data

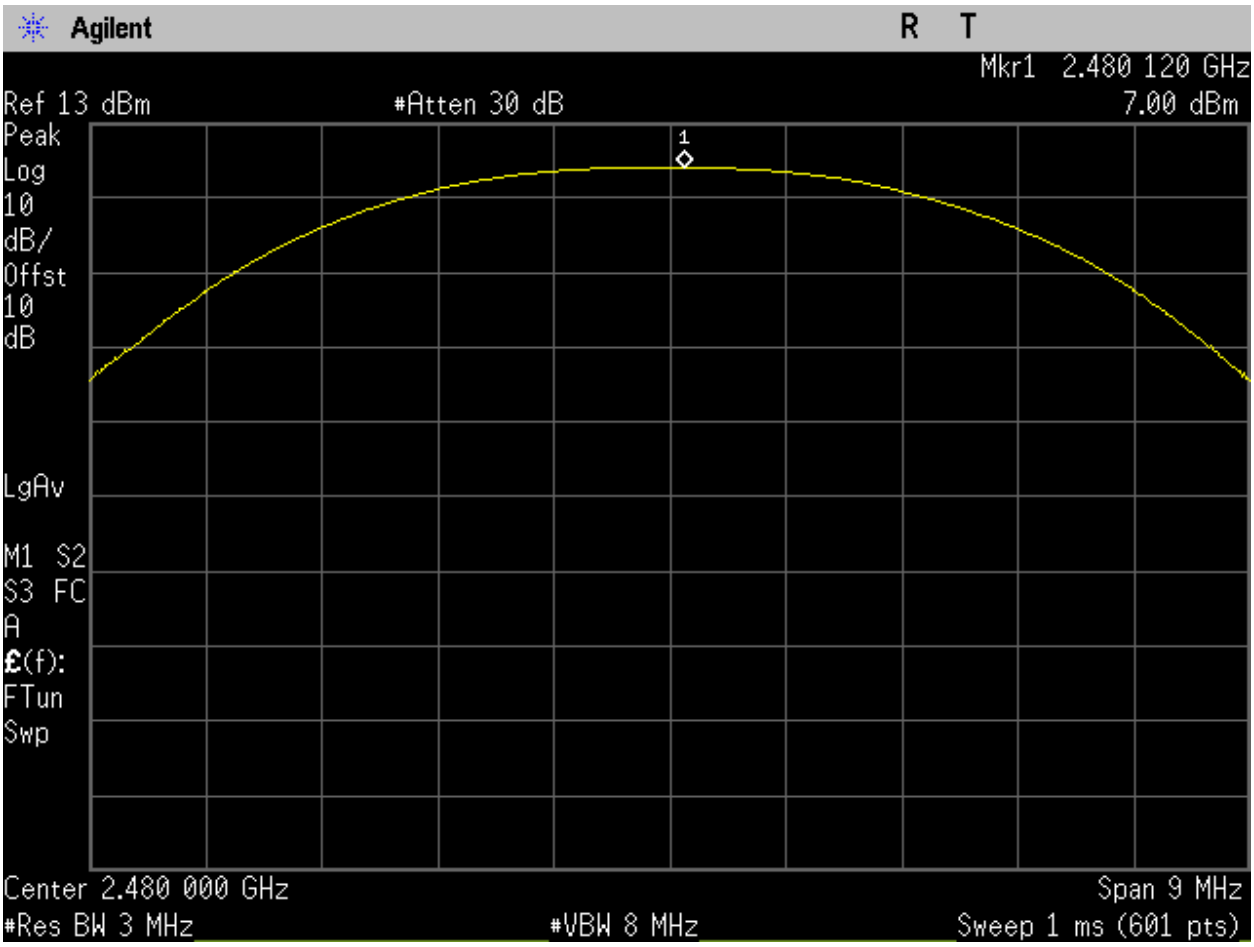


Figure 20. BLE_High Ch_2480MHz_1MBit_Output Power_Port 1.

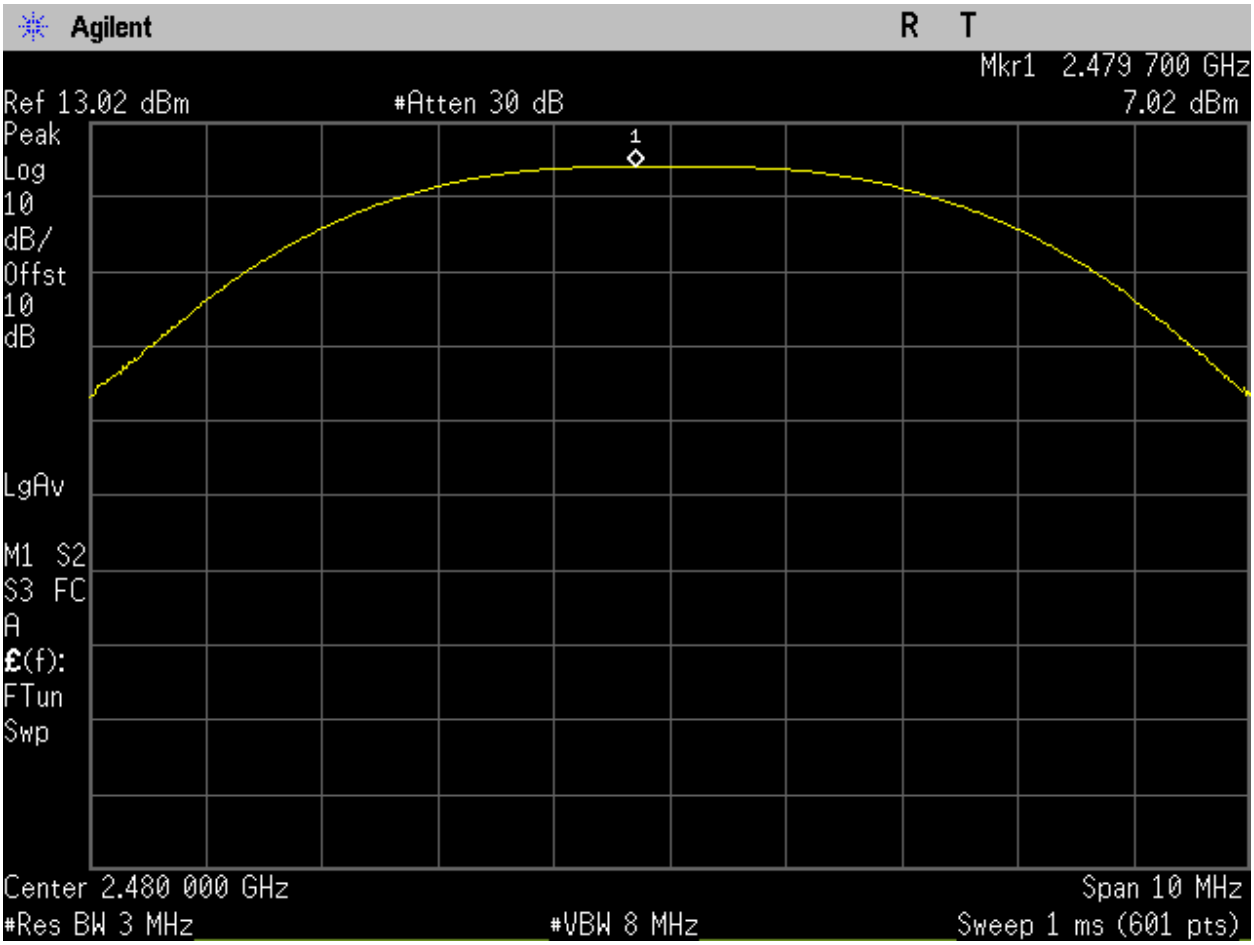


Figure 21. BLE_High Ch_2480MHz_2MBit_Output Power_Port 1.

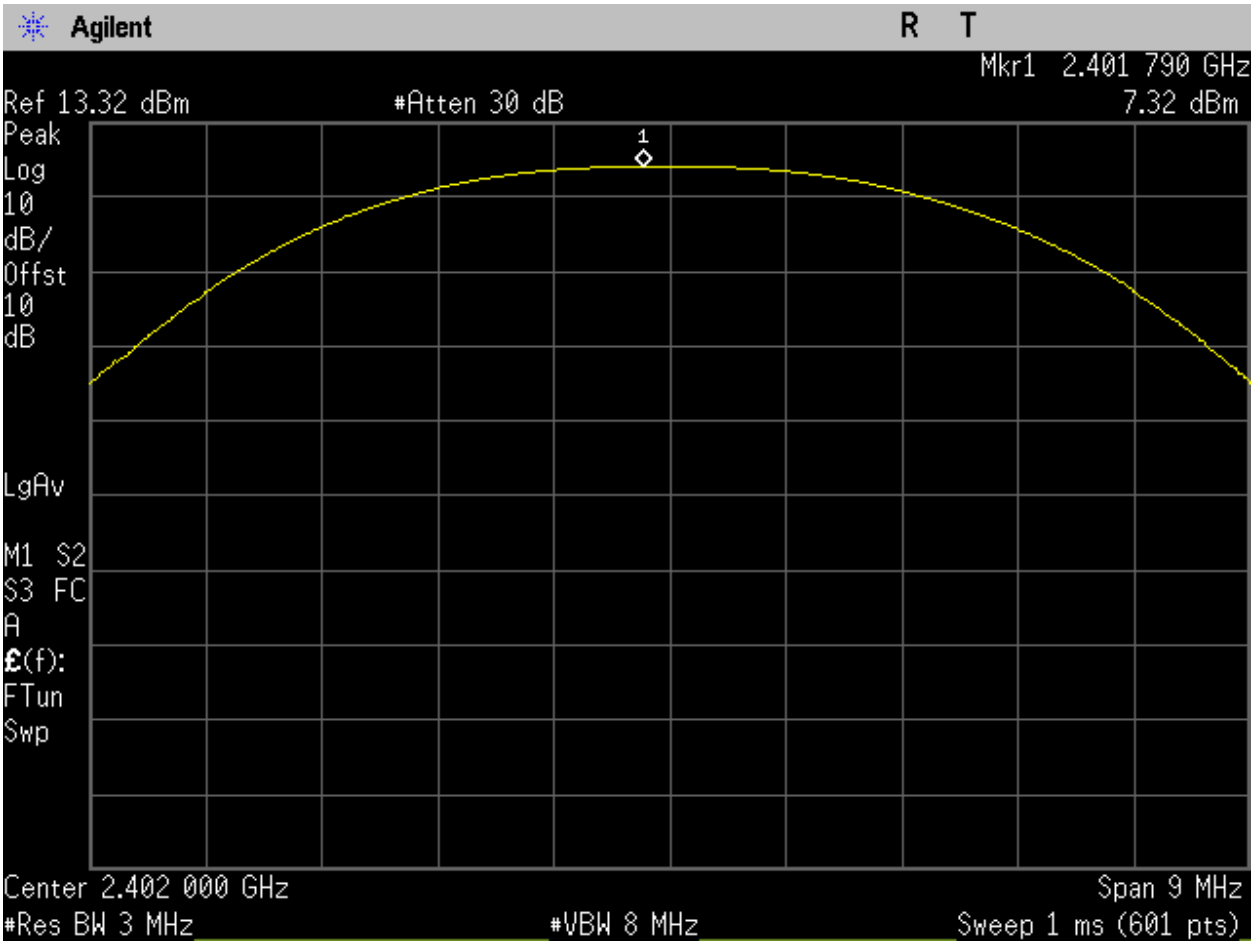


Figure 22. BLE_Low Ch_2402MHz_1MBit_Output Power_Port 1.

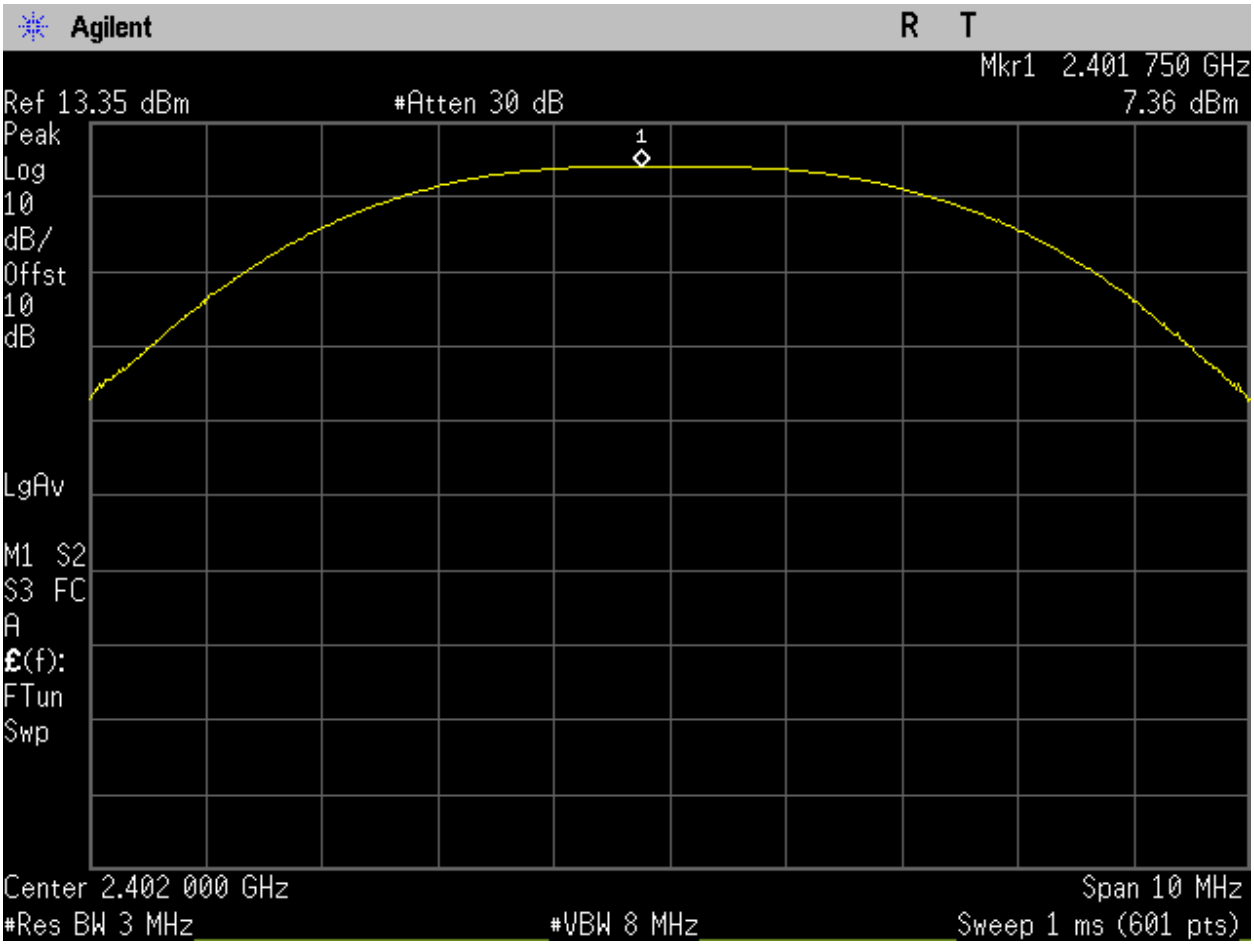


Figure 23. BLE_Low Ch_2402MHz_2MBit_Output Power_Port 1.

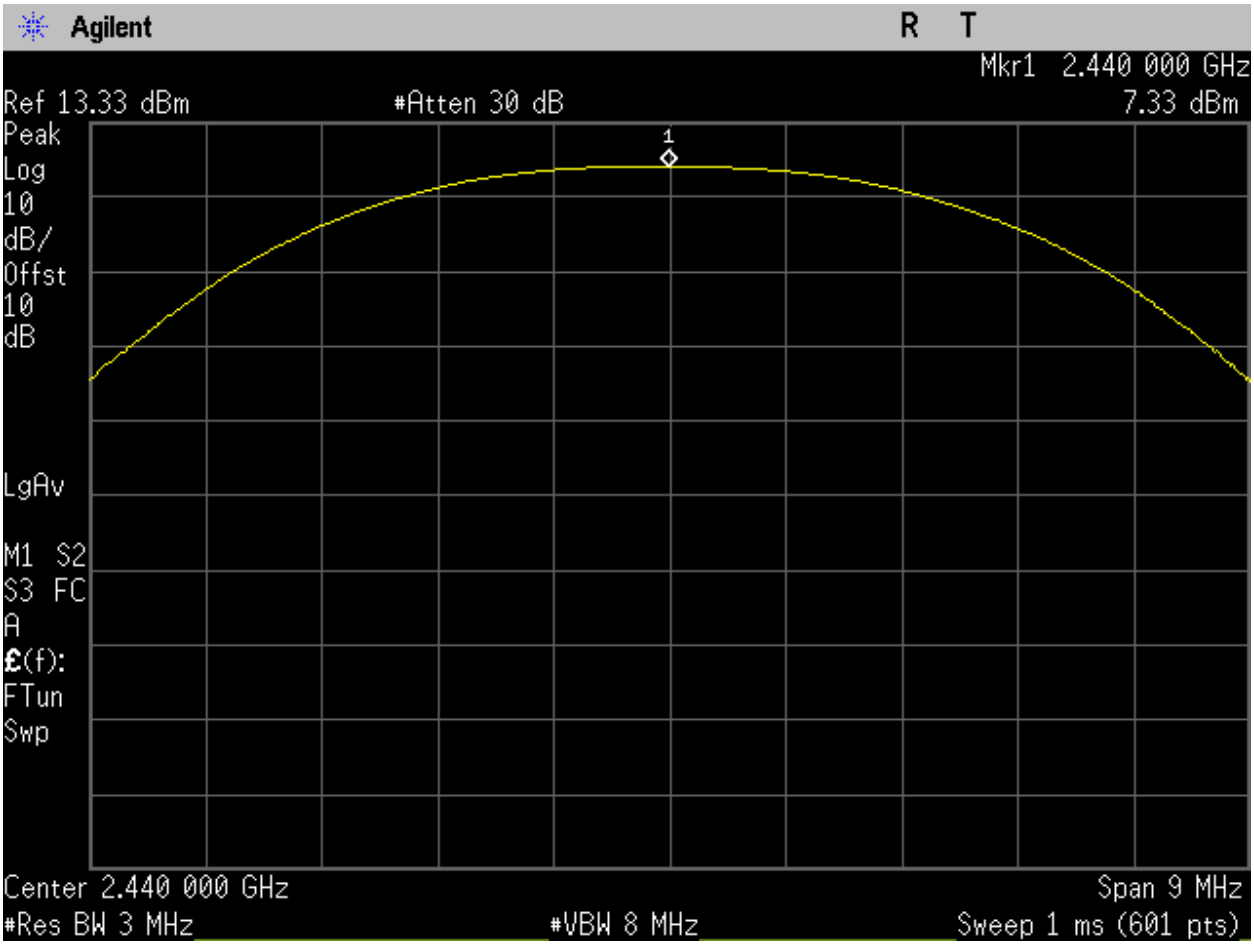


Figure 24. BLE_Mid Ch_2440MHz_1MBit_Output Power_Port 1.

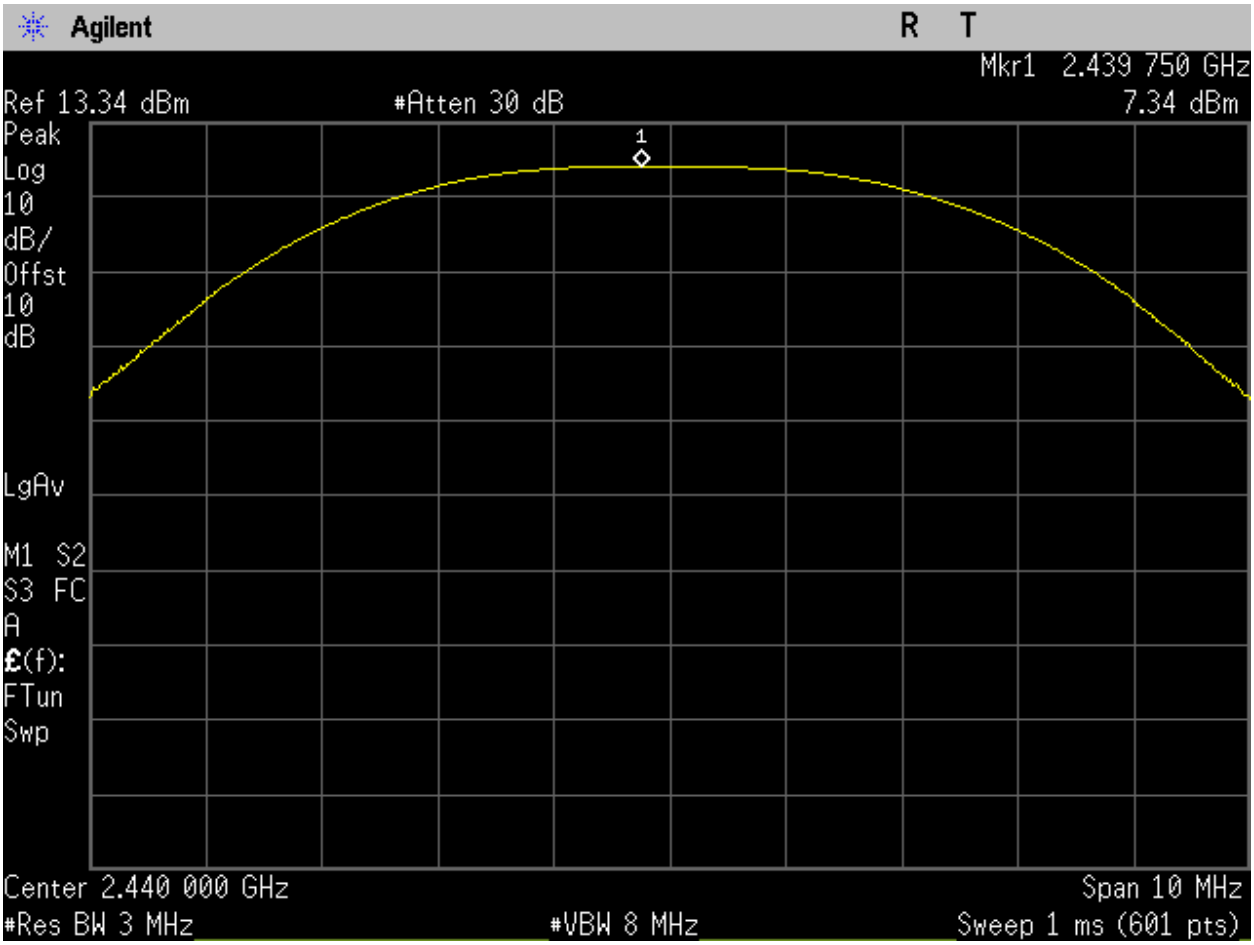


Figure 25. BLE_Mid Ch_2440MHz_2MBit_Output Power_Port 1.

Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
2402	7.32	30	-22.68	2.5	9.82	36	-26.18
2440	7.33	30	-22.67	2.5	9.83	36	-26.17
2480	7.00	30	-23	2.5	9.5	36	-26.5

Table 15. Output Power, BLE (1 Mbps) Test Results

Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
2402	7.36	30	-22.64	2.5	9.86	36	-26.14
2440	7.34	30	-22.66	2.5	9.84	36	-26.16
2480	7.02	30	-22.98	2.5	9.52	36	-26.48

Table 16. Output Power, BLE (2 Mbps) Test Results

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.209 Radiated Spurious Emissions Requirements and Band Edge

Test Requirements: **§15.247(d); §15.205:** Emissions outside the frequency band.

Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a).

§15.205(a): Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090–0.110----------	16.42–16.423	399.9–410	4.5–5.15
[1] 0.495–0.505----------	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905----------	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128----------	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775----------	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775----------	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218----------	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825----------	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225----------	123–138	2200–2300	14.47–14.5
8.291–8.294----------	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366----------	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675----------	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475----------	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293----------	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025----------	240–285	3345.8–3358 36.	43–36.5
12.57675–12.57725----------	322–335.4	3600–4400	([2])

Table 17. Restricted Bands of Operation

[1] Until February 1, 1999, this restricted band shall be 0.490 – 0.510 MHz.
[2] Above 38.6

Test Requirement(s): **§ 15.209 (a):** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 18.

Frequency (MHz)	§ 15.209(a), Radiated Emission Limits (dBµV) @ 3m
30 - 88	40.00
88 - 216	43.50
216 - 960	46.00
Above 960	54.00

Table 18. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)

Test Procedures: The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line. Only noise floor was measured above 18 GHz.

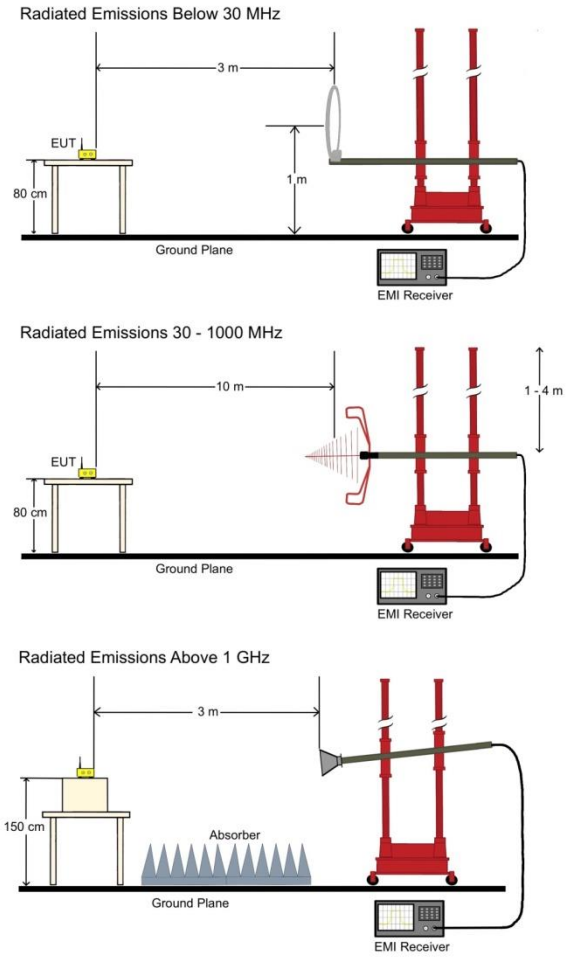


Figure 26. Radiated Emissions Test Setup

RSS-GEN (6.13), (8.9), & (8.10) Radiated Spurious Emissions and Restricted Band

Test Requirements:

RSS-GEN (6.13): In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated in the equipment, whichever is lower, without going below 9 kHz, up to at least the frequency given below:

(a) If the equipment operates below 10 GHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value need not be reported.

When limits are expressed in absolute terms, compliance with the emission limits below 1000 MHz shall be demonstrated using a CISPR quasi-peak detector and the related measurement bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limits can be demonstrated using measuring equipment employing a peak detector function properly adjusted for factors such as pulse desensitization as required, with an equal or greater measurement bandwidth relative to the applicable CISPR quasi-peak bandwidth.

Above 1000 MHz, compliance with the emission limits shall be demonstrated using an average detector with a minimum resolution bandwidth of 1 MHz.

RSS-GEN (8.9): Except when the requirements applicable to a given device state otherwise, emissions from license−exempt transmitters shall comply with the field strength limits shown in the table below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

General Field Strength Limits for License-Exempt Transmitters at Frequencies Above 30 MHz	
Frequency (MHz)	**Field Strength (µV/m at 3 meters)**
30 – 88	100
88 – 216	150
216 – 960	200
Above 960*	500
*Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.	

RSS-GEN (8.10): Restricted bands are designated primarily for safety-of-life services (distress calling and certain aeronautical bands), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following restrictions apply:

1. Fundamental components of modulation of license-exempt radio apparatus shall not fall within the restricted bands except for apparatus complying under RSS-287;
2. Unwanted emissions that fall into restricted bands shall comply with the limits specified in RSS-Gen; and
3. Unwanted emissions that do not fall within the restricted frequency bands shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

Test Procedures: The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line. Only noise floor was measured above 18 GHz.

Radiated Band Edge Measurements

Test Procedures: The transmitter was turned on. Measurements were performed of the low and high Channels. The EUT was rotated orthogonally through all three axes.

Test Results: The EUT was **compliant** with this requirement.

Test Engineer: Donald Salguero

Test Date: March 5 - March 7, 2024

Test Data

Frequency	Polarity	Antenna Height	Turtable Position	Measured	Correction Factor	Corrected Reading	Limit	Margin
GHz	Horizontal/ Vertical	cm	Degrees	dBµV	dB	dBµV/m	dBµV/m	dB
2.39	H	152	332.5	14.02	38.428	52.448	54	-1.552
2.39	V	100	313.6	14.22	38.384	52.604	54	-1.396
2.4835	H	201	274.4	13.57	38.834	52.404	54	-1.596
2.4835	V	121	298.8	13.54	38.784	52.324	54	-1.676

Table 19. BLE (1 Mbps) - Radiated Band Edge, Average Test Results

Frequency	Polarity	Antenna Height	Turtable Position	Measured	Correction Factor	Corrected Reading	Limit	Margin
GHz	Horizontal/ Vertical	cm	Degrees	dBµV	dB	dBµV/m	dBµV/m	dB
2.39	H	152	332.5	26.7	38.428	65.128	74	-8.872
2.39	V	100	313.6	25.01	38.384	63.394	74	-10.606
2.4835	H	201	274.4	24.61	38.834	63.444	74	-10.556
2.4835	V	121	298.8	25.37	38.784	64.154	74	-9.846

Table 20. BLE (1 Mbps) - Radiated Band Edge, Peak Test Results

Frequency	Polarity	Antenna Height	Turtable Position	Measured	Correction Factor	Corrected Reading	Limit	Margin
GHz	Horizontal/ Vertical	cm	Degrees	dBµV	dB	dBµV/m	dBµV/m	dB
2.39	H	127	6.2	14.08	38.428	52.508	54	-1.492
2.39	V	100	309.8	14.03	38.384	52.414	54	-1.586
2.4835	H	138	275.7	14.27	38.834	53.104	54	-0.896
2.4835	V	122	299.3	13.85	38.784	52.634	54	-1.366

Table 21. BLE (2 Mbps) - Radiated Band Edge, Average Test Results

Frequency	Polarity	Antenna Height	Turtable Position	Measured	Correction Factor	Corrected Reading	Limit	Margin
GHz	Horizontal/ Vertical	cm	Degrees	dBµV	dB	dBµV/m	dBµV/m	dB
2.39	H	127	6.2	25.62	38.428	64.048	74	-9.952
2.39	V	100	309.8	25.28	38.384	63.664	74	-10.336
2.4835	H	138	275.7	25.04	38.834	63.874	74	-10.126
2.4835	V	122	299.3	25.14	38.784	63.924	74	-10.076

Table 22. BLE (2 Mbps) - Radiated Band Edge, Peak Test Results

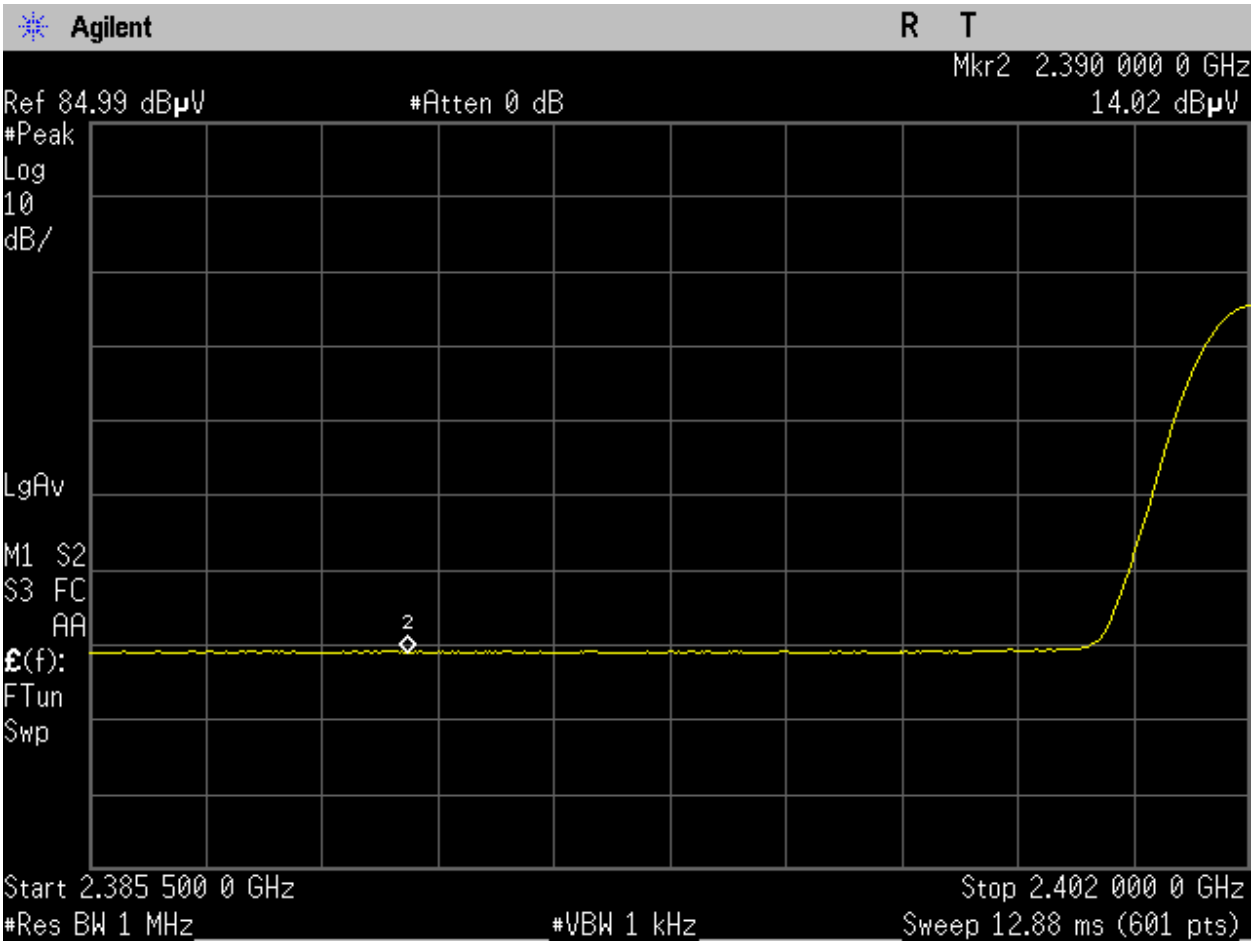


Figure 27. BLE (1 Mbps)_2390MHz band edge_H_AVG.

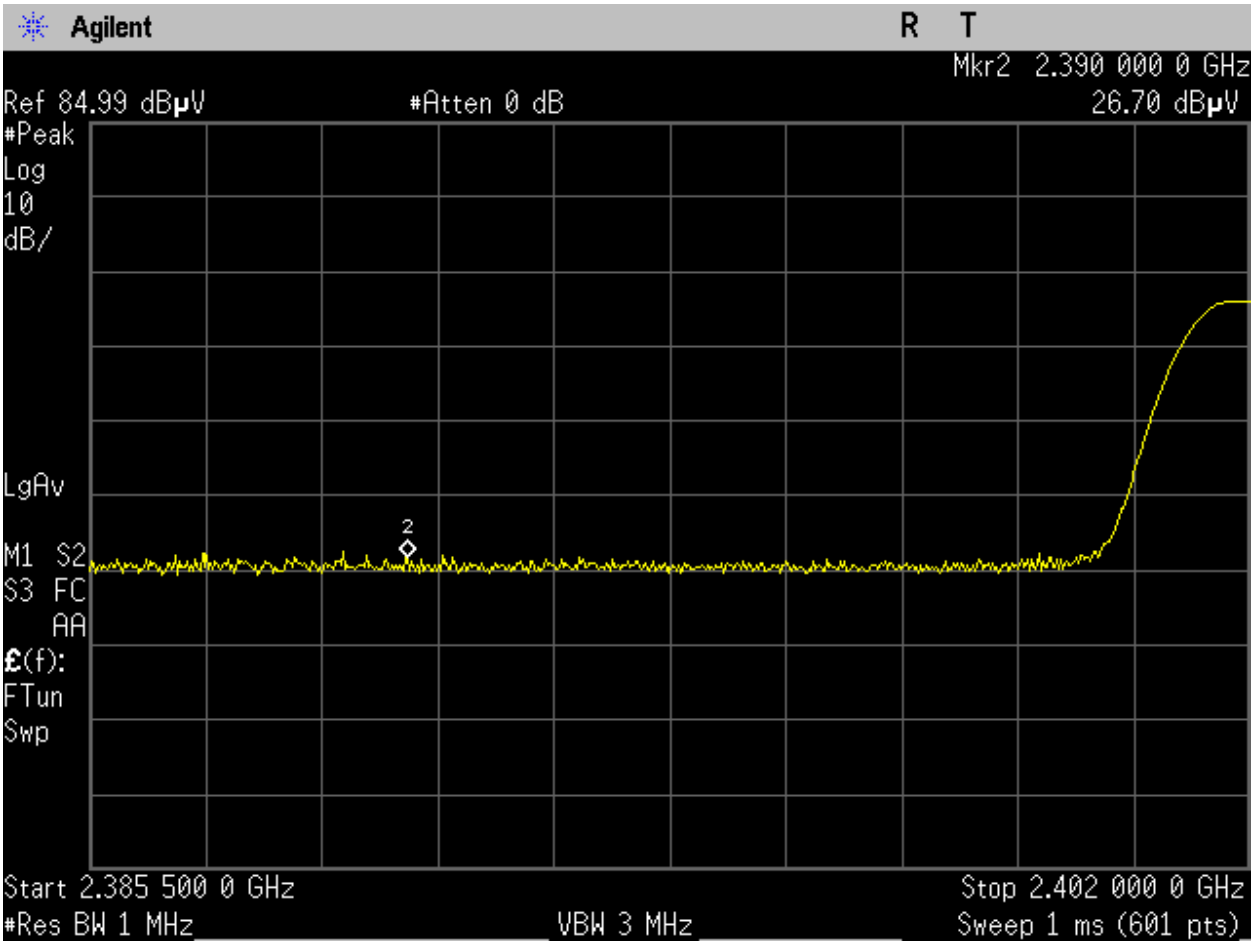


Figure 28. BLE (1 Mbps)_2390MHz band edge_H_PK.

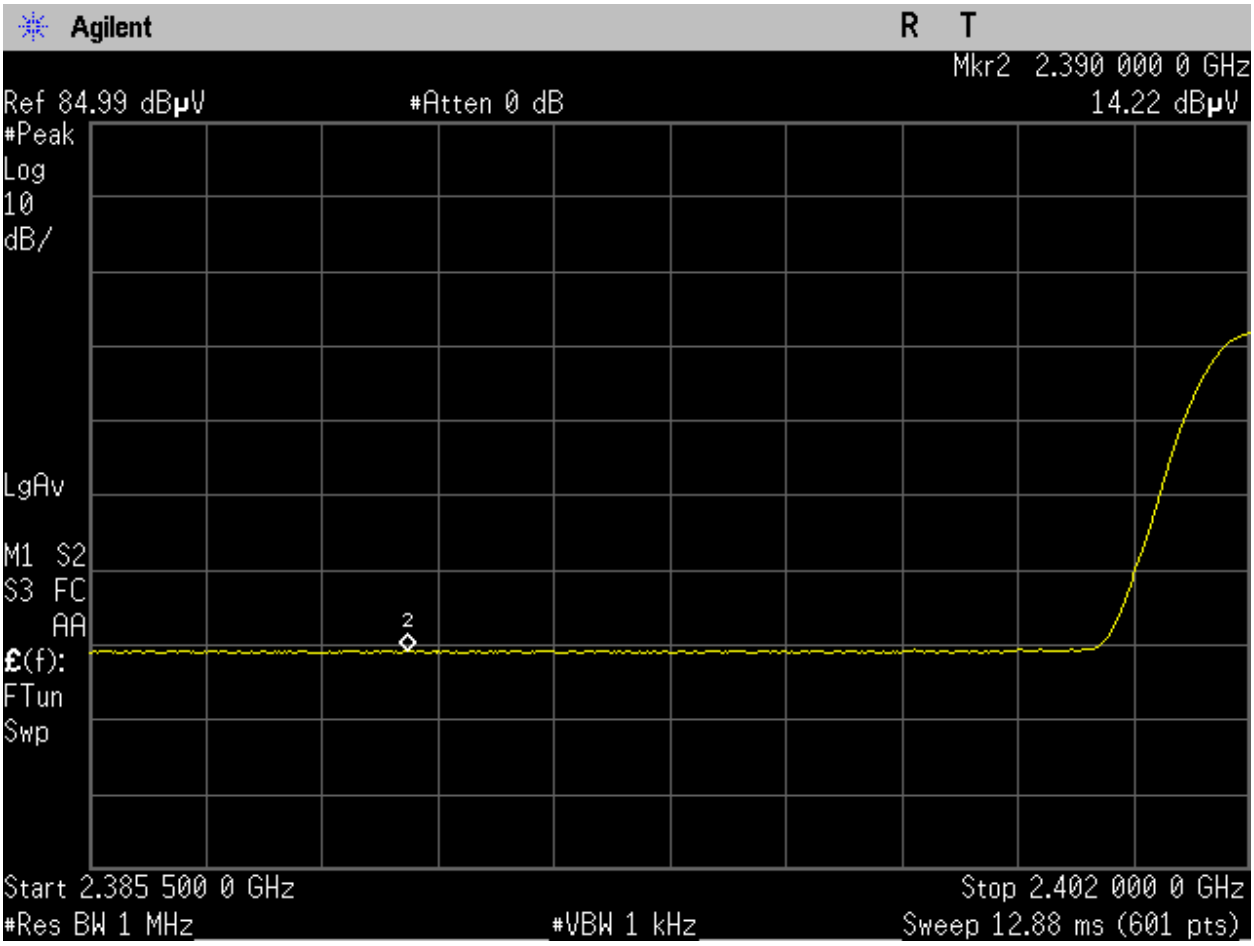


Figure 29. BLE (1 Mbps)_2390MHz band edge_V_AVG.

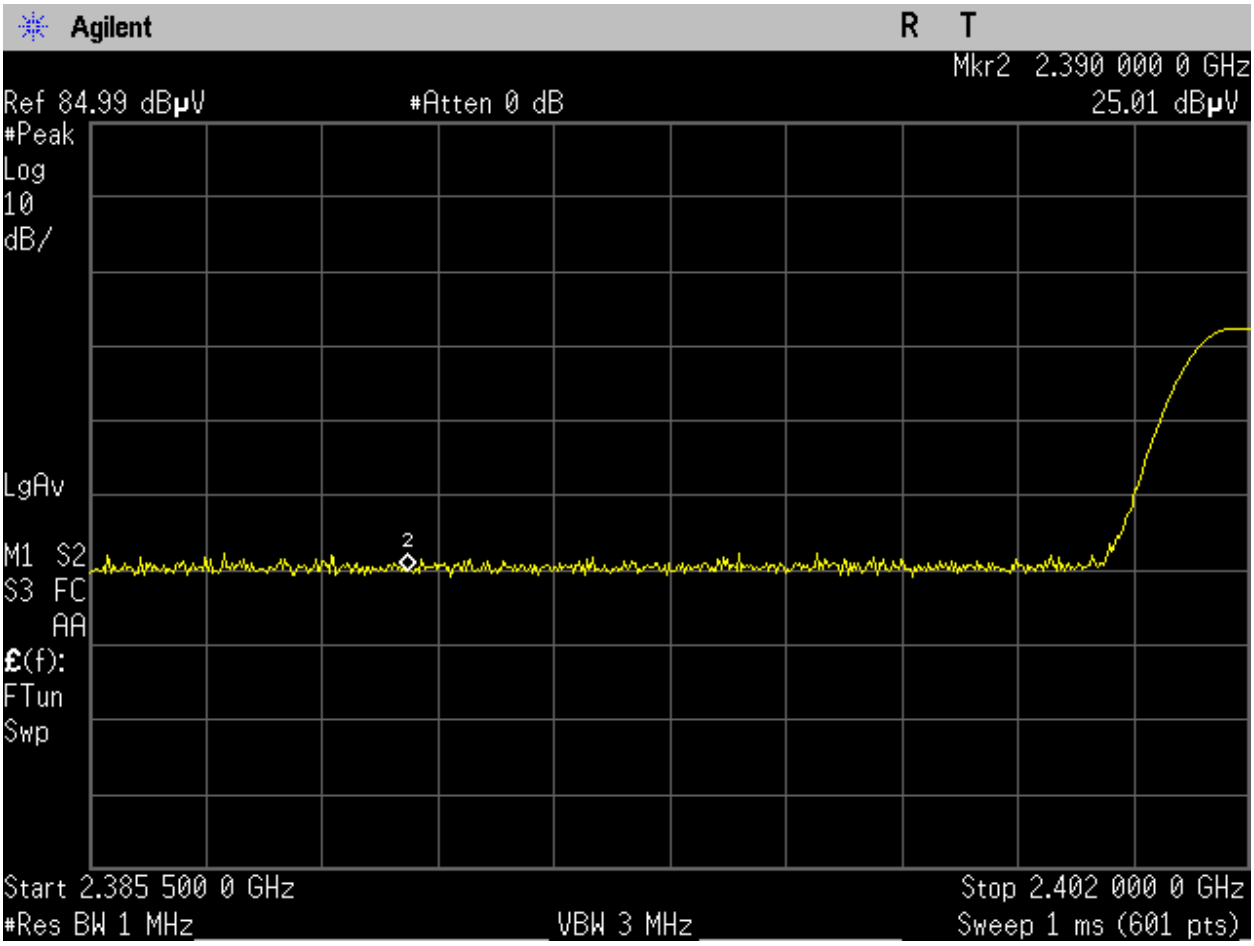


Figure 30. BLE (1 Mbps)_2390MHz band edge_V_PK.

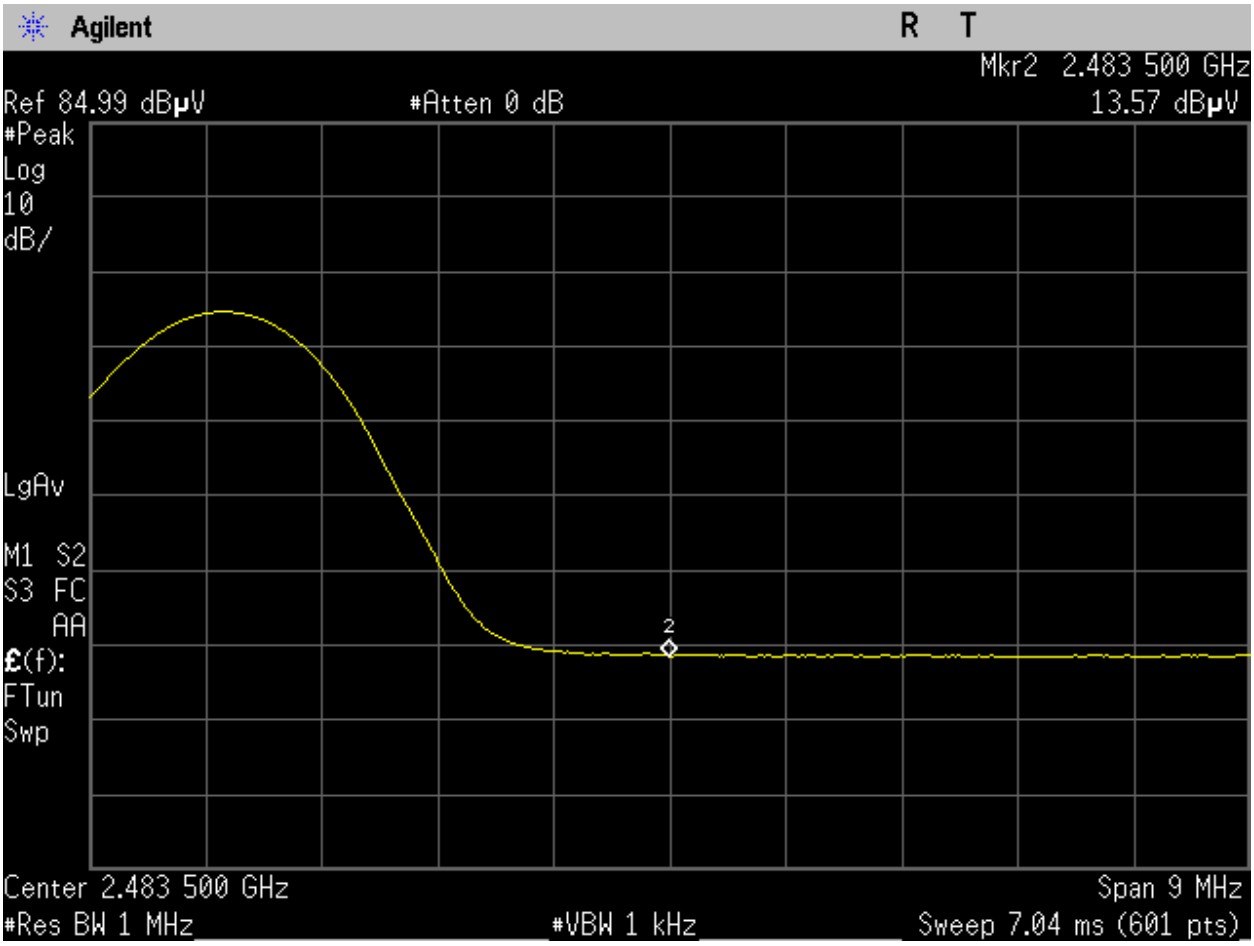


Figure 31. BLE (1 Mbps)_2483.5MHz band edge_H_AVG.

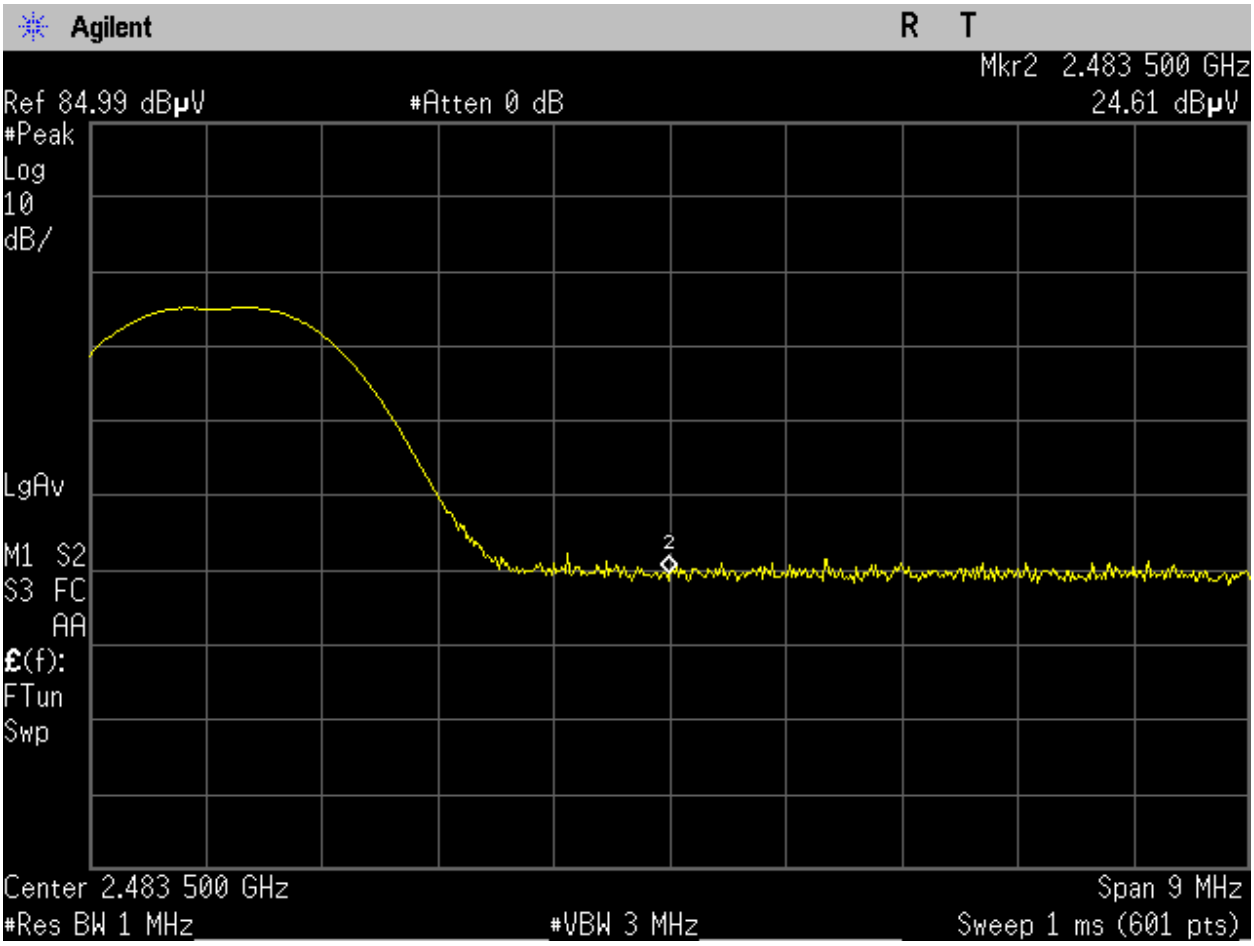


Figure 32. BLE (1 Mbps)_2483.5MHz band edge_H_PK.

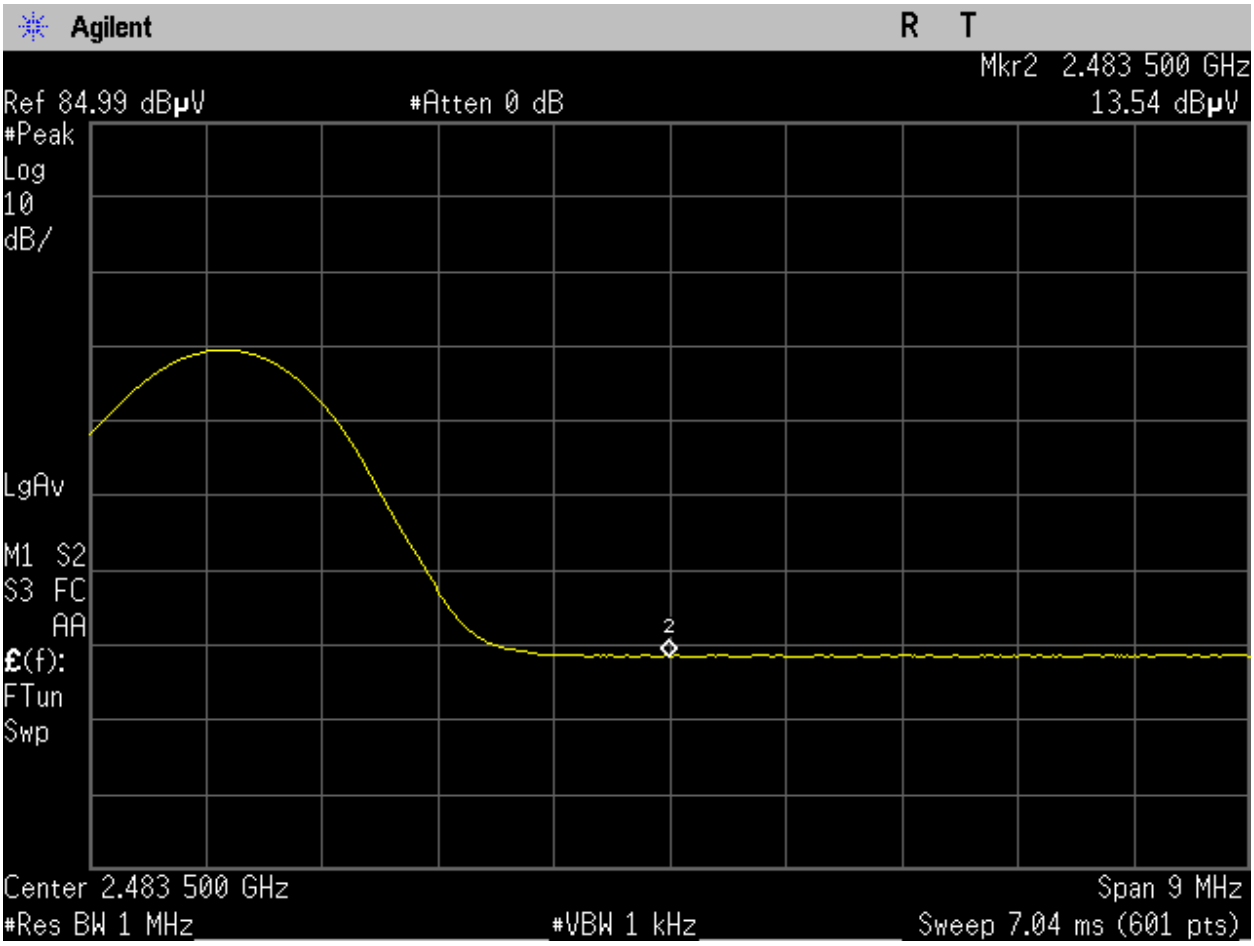


Figure 33. BLE (1 Mbps)_2483.5MHz band edge_V_AVG.

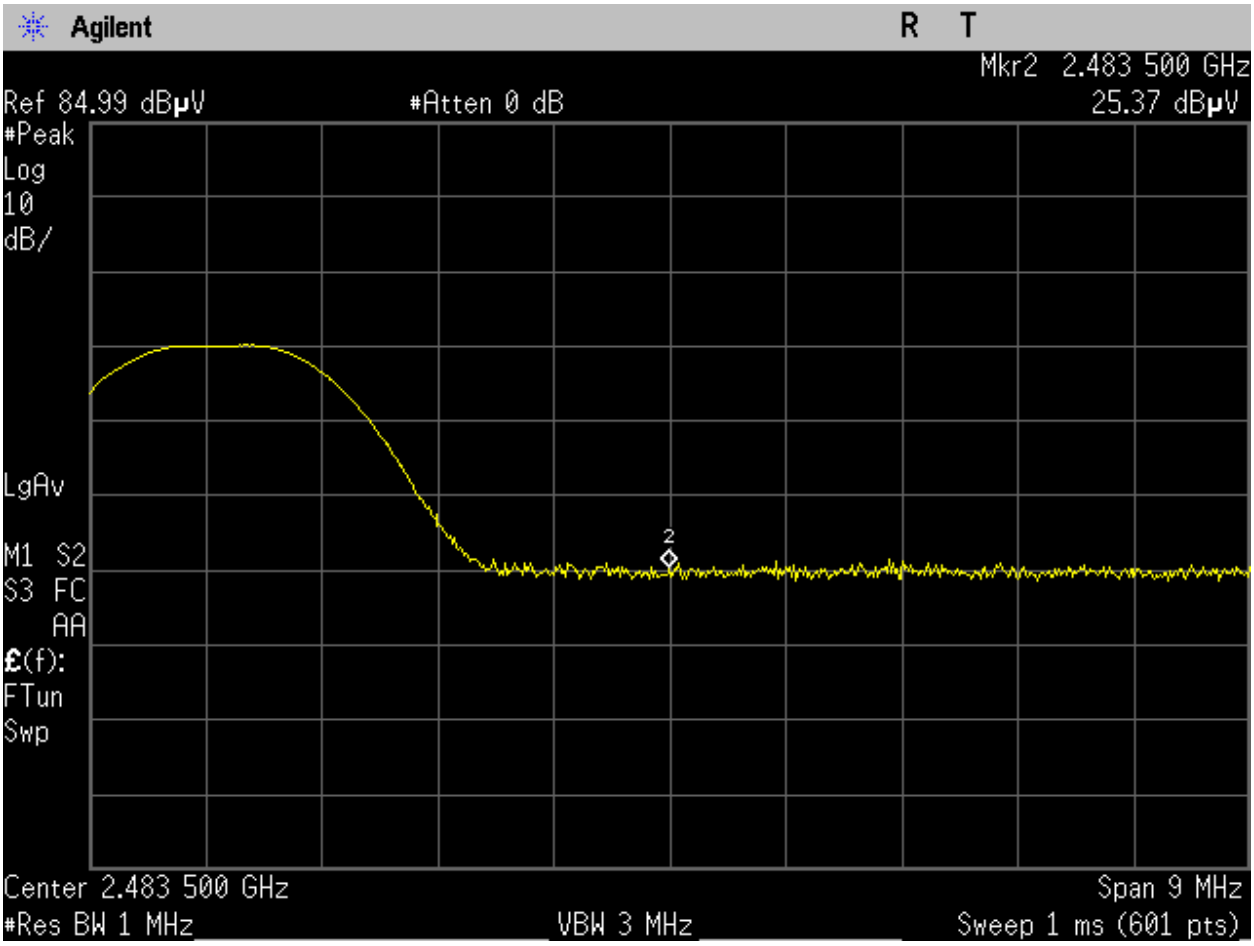


Figure 34. BLE (1 Mbps)_2483.5MHz band edge_V_PK.

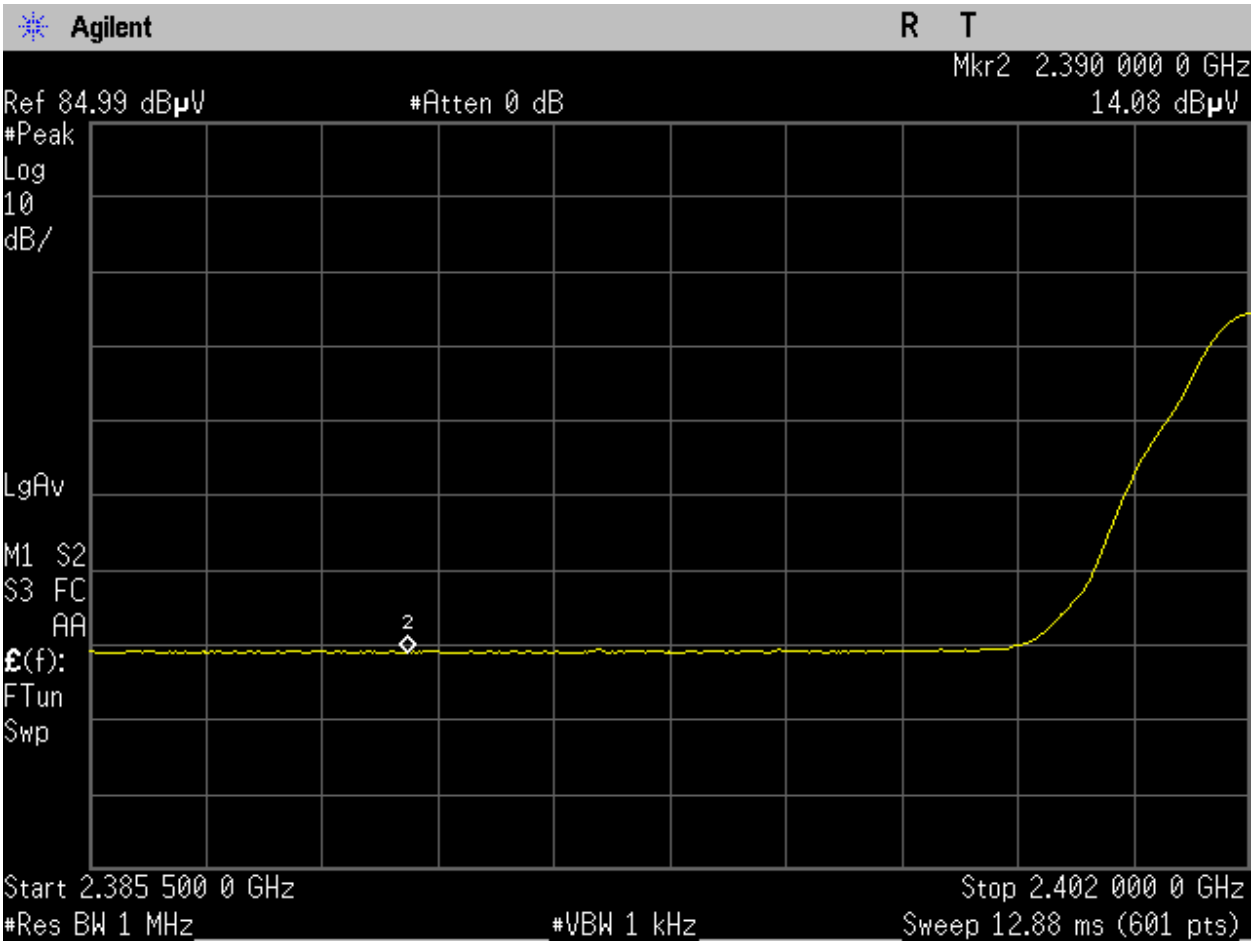


Figure 35. BLE (2 Mbps)_2390MHz band edge_H_AVG.

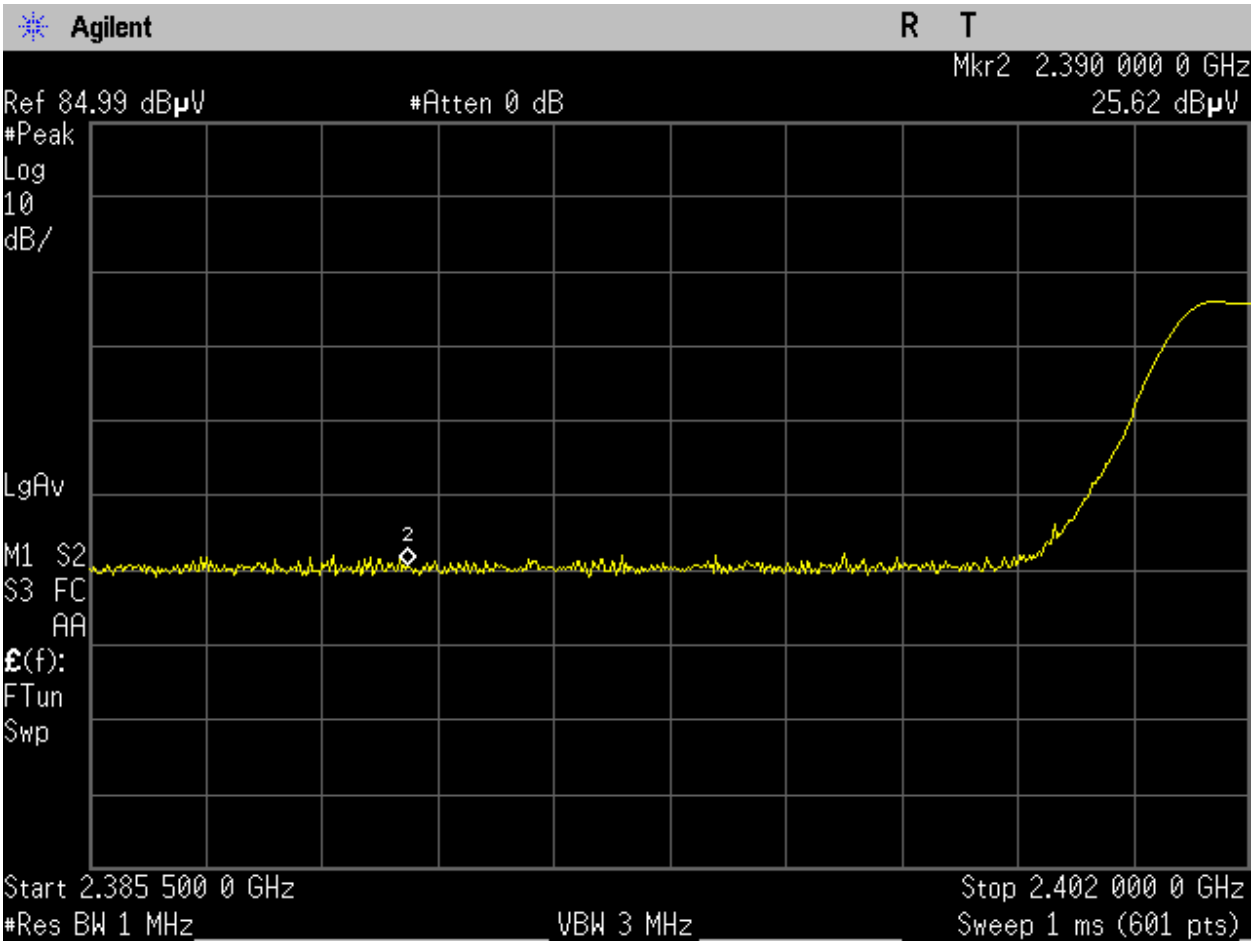


Figure 36. BLE (2 Mbps)_2390MHz band edge_H_PK.

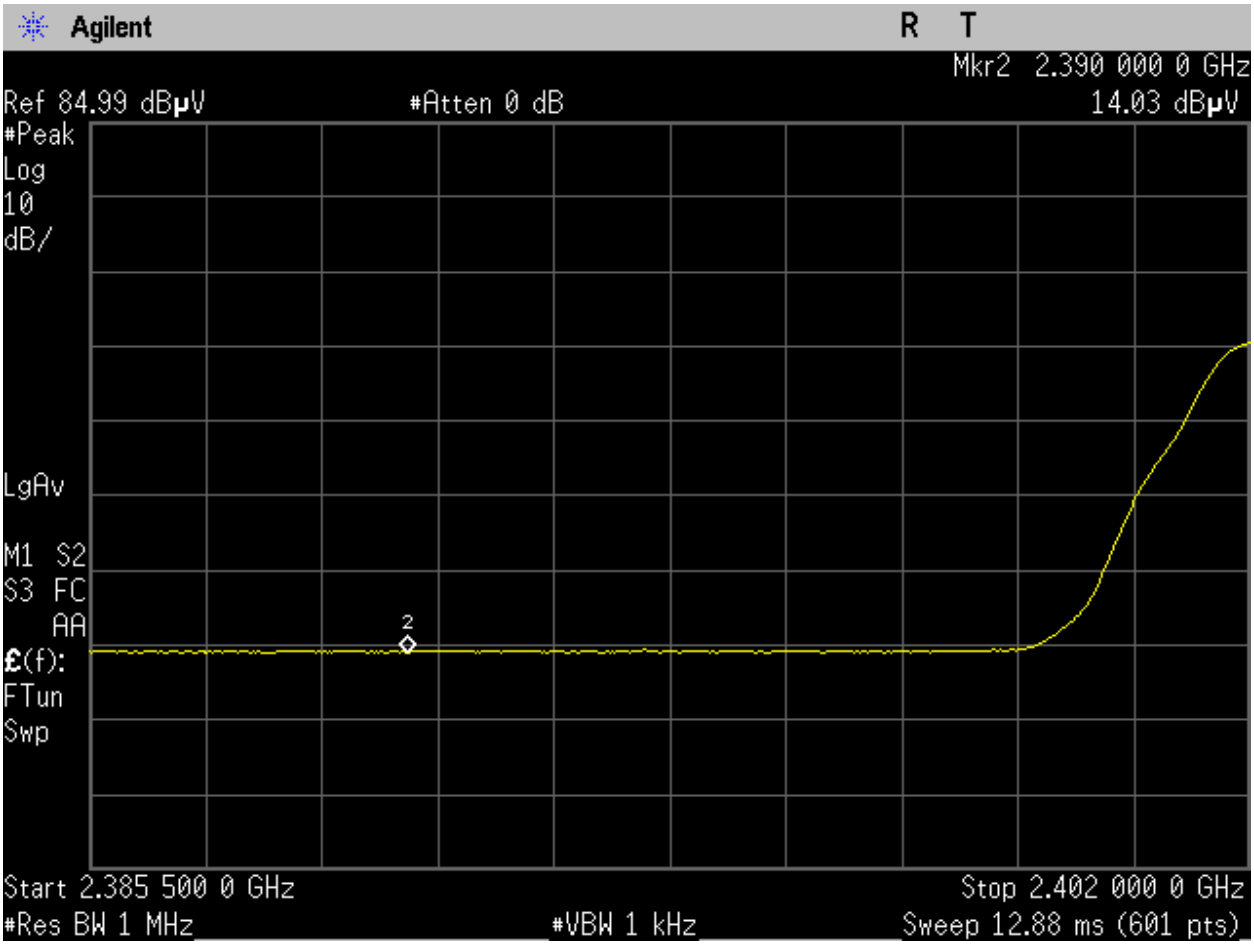


Figure 37. BLE (2 Mbps)_2390MHz band edge_V_AVG.

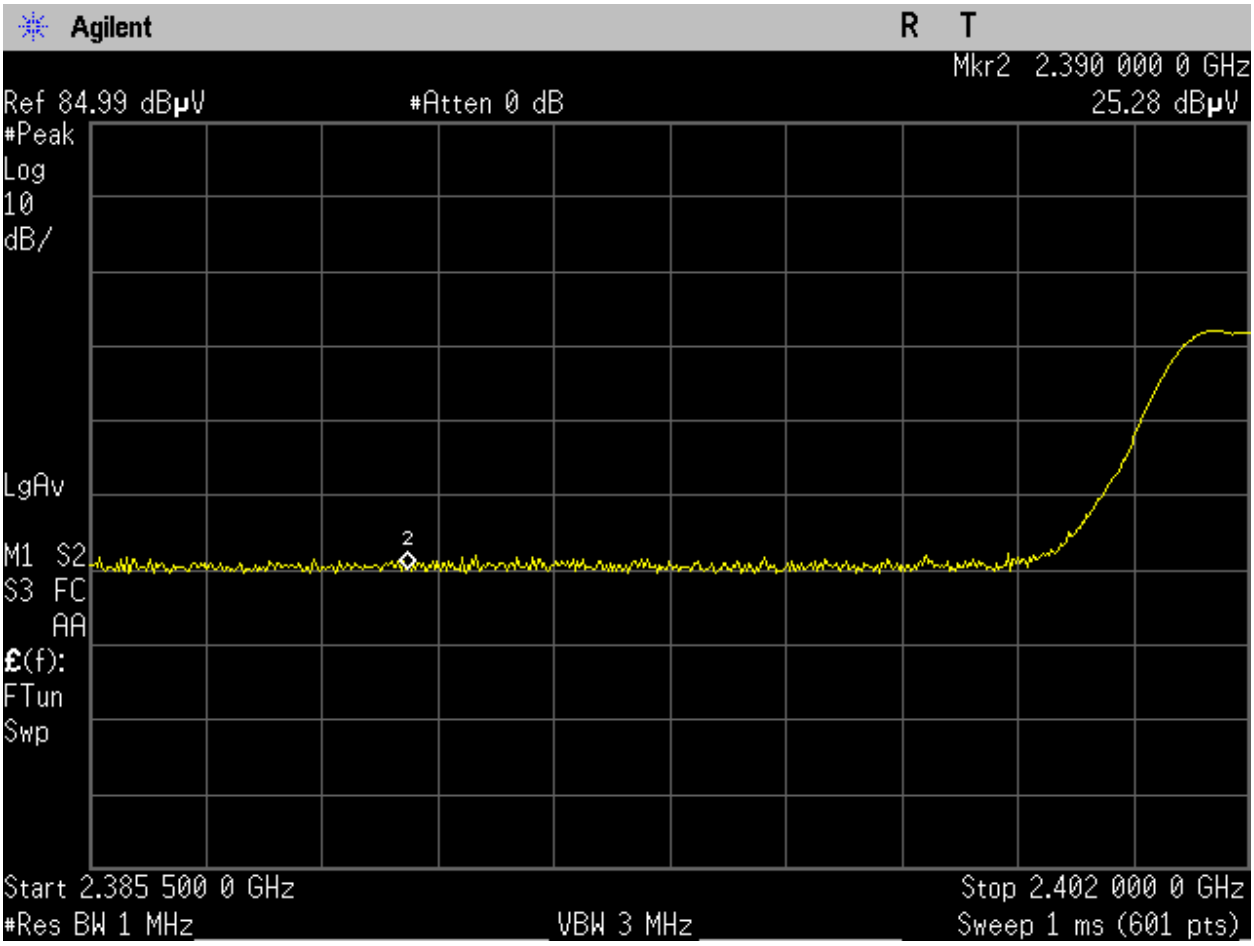


Figure 38. BLE (2 Mbps)_2390MHz band edge_V_PK.

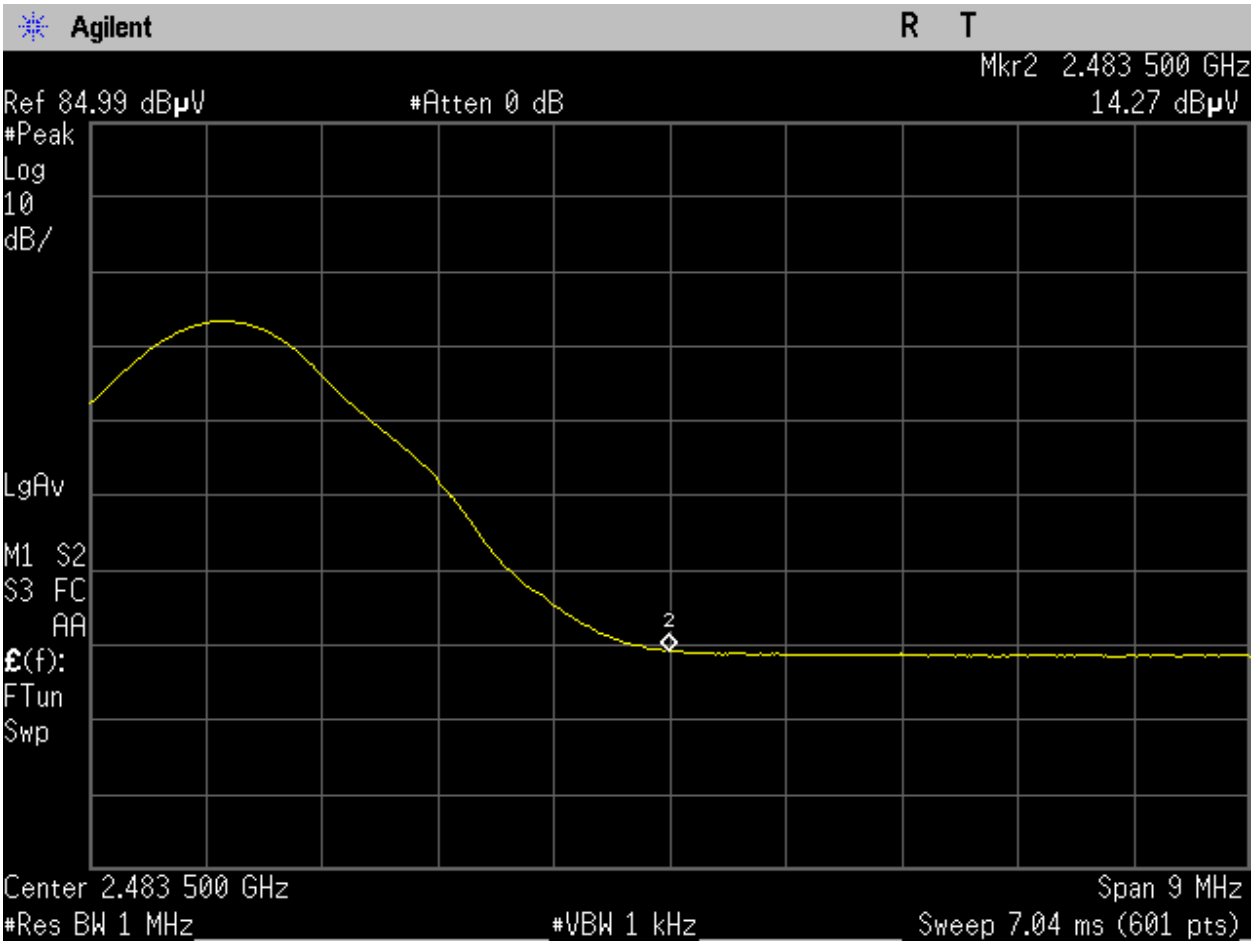


Figure 39. BLE (2 Mbps)_2483.5MHz band edge_H_AVG.

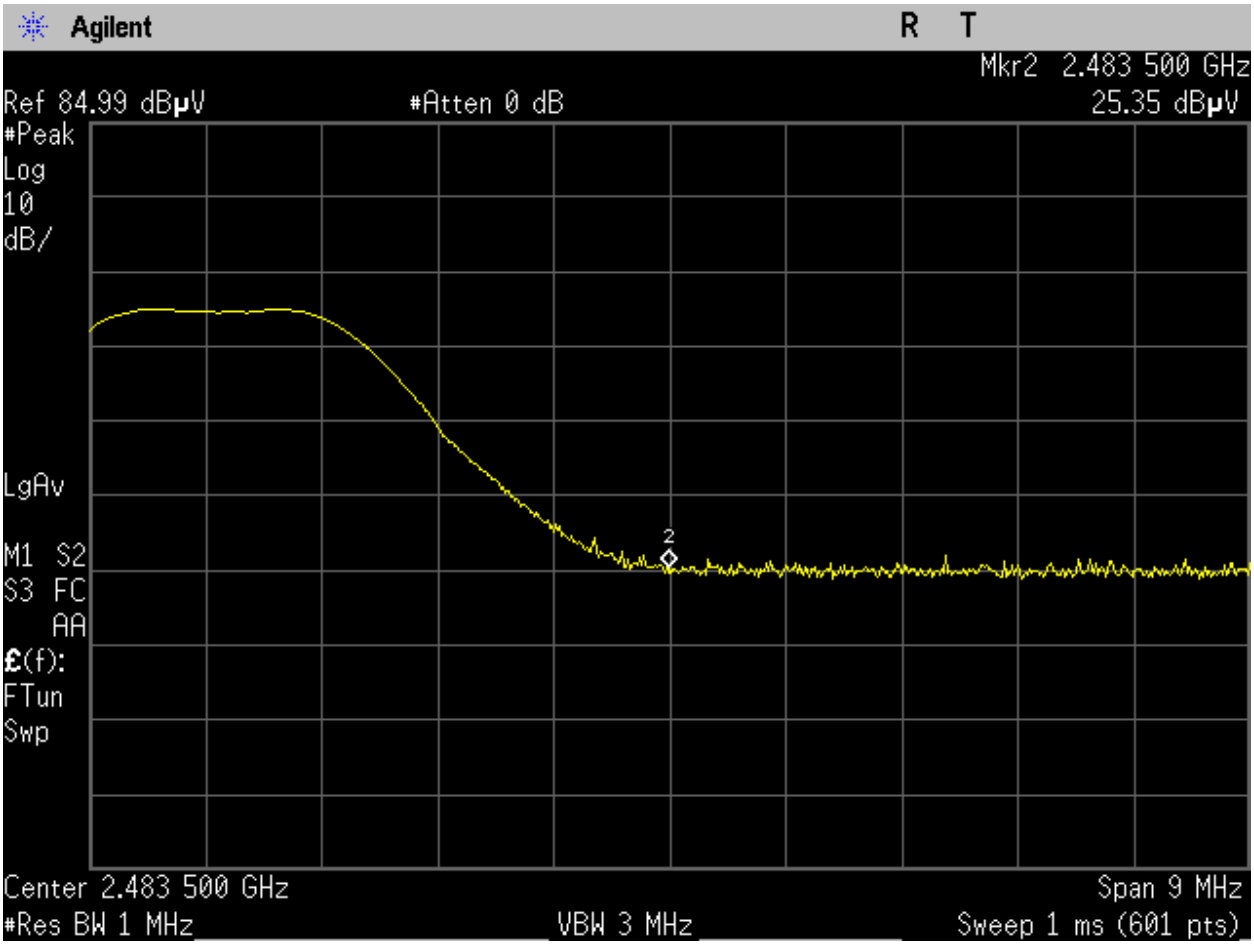


Figure 40. BLE (2 Mbps)_2483.5MHz band edge_H_PK.

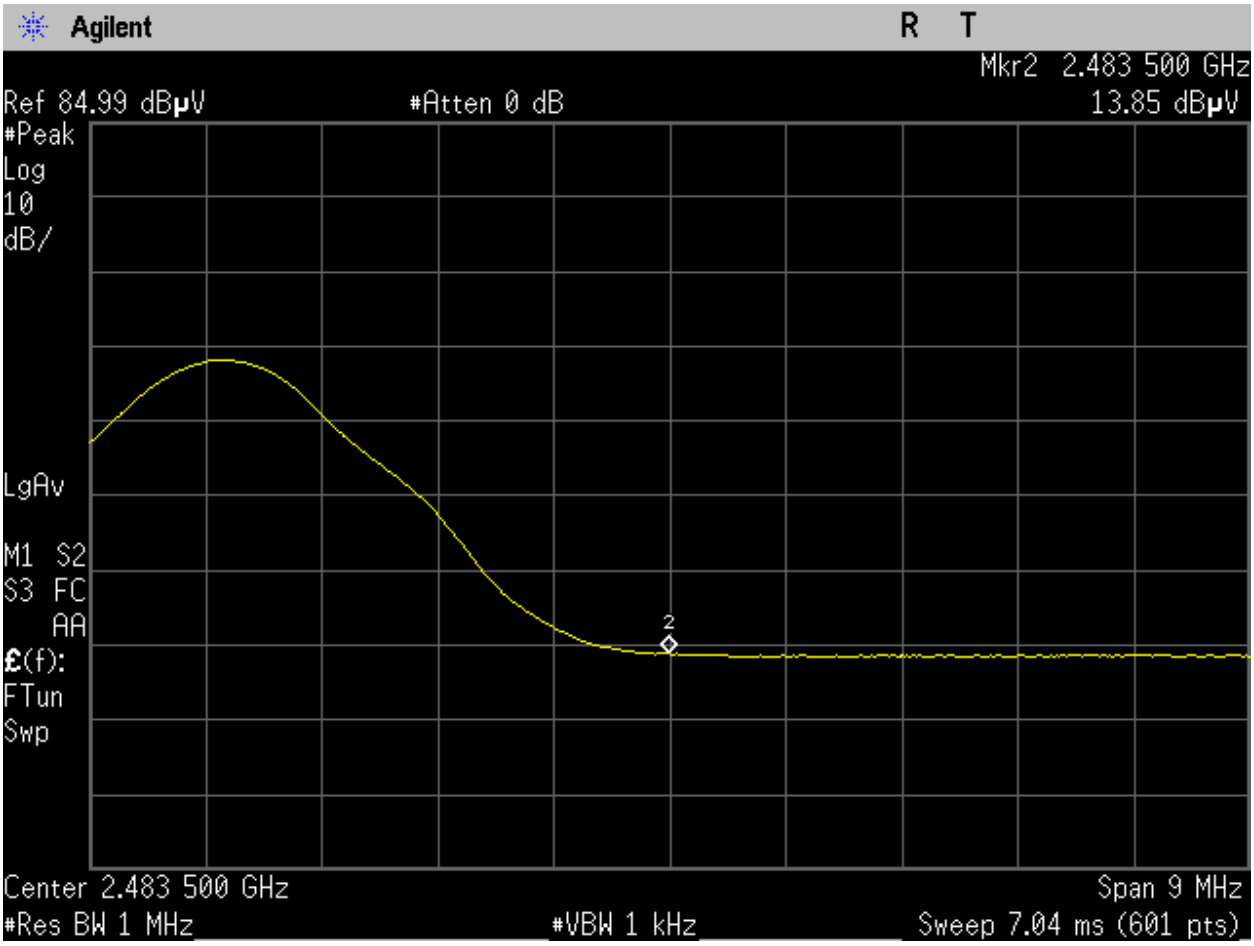


Figure 41. BLE (2 Mbps)_2483.5MHz band edge_V_AVG.

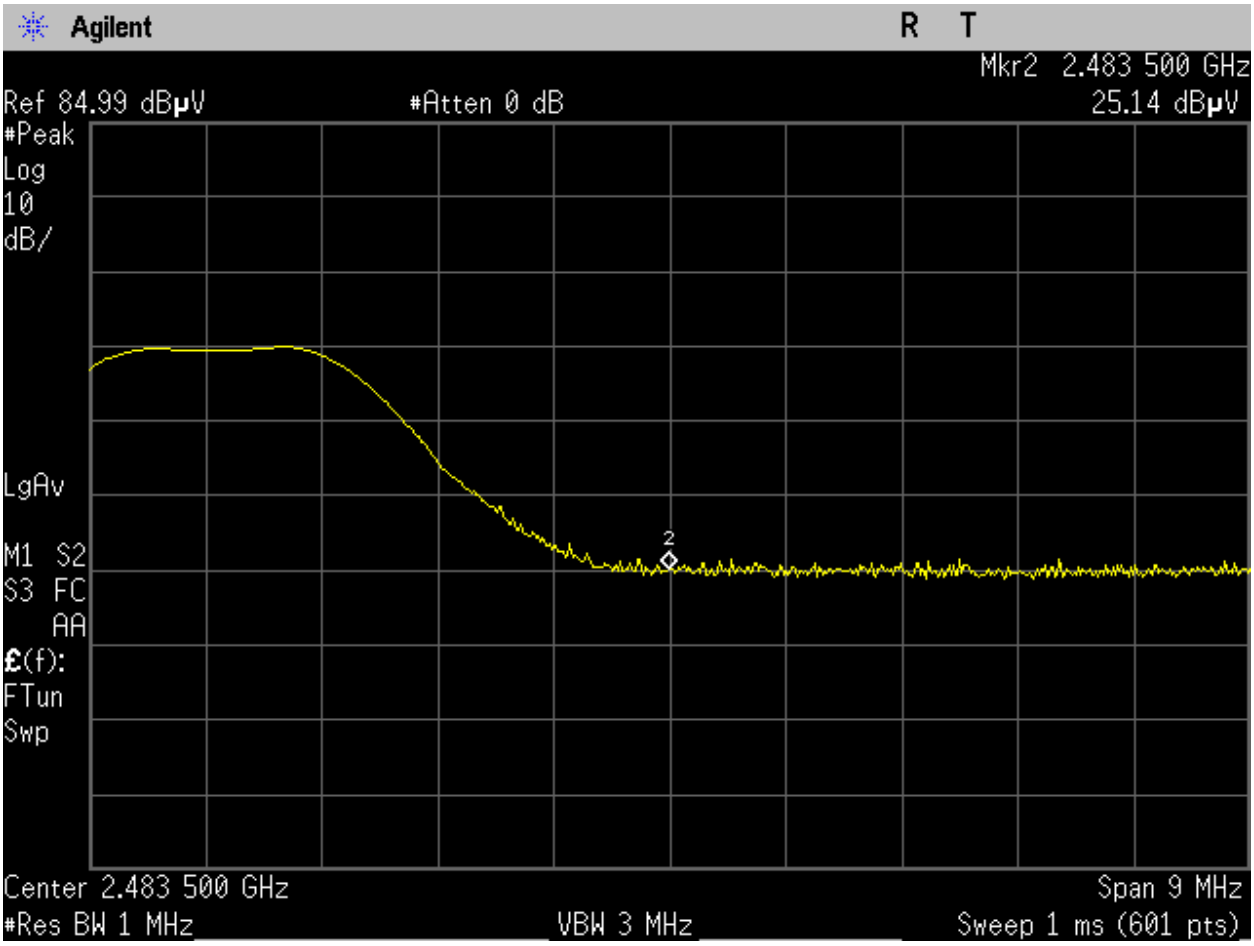


Figure 42. BLE (2 Mbps)_2483.5MHz band edge_V_PK.

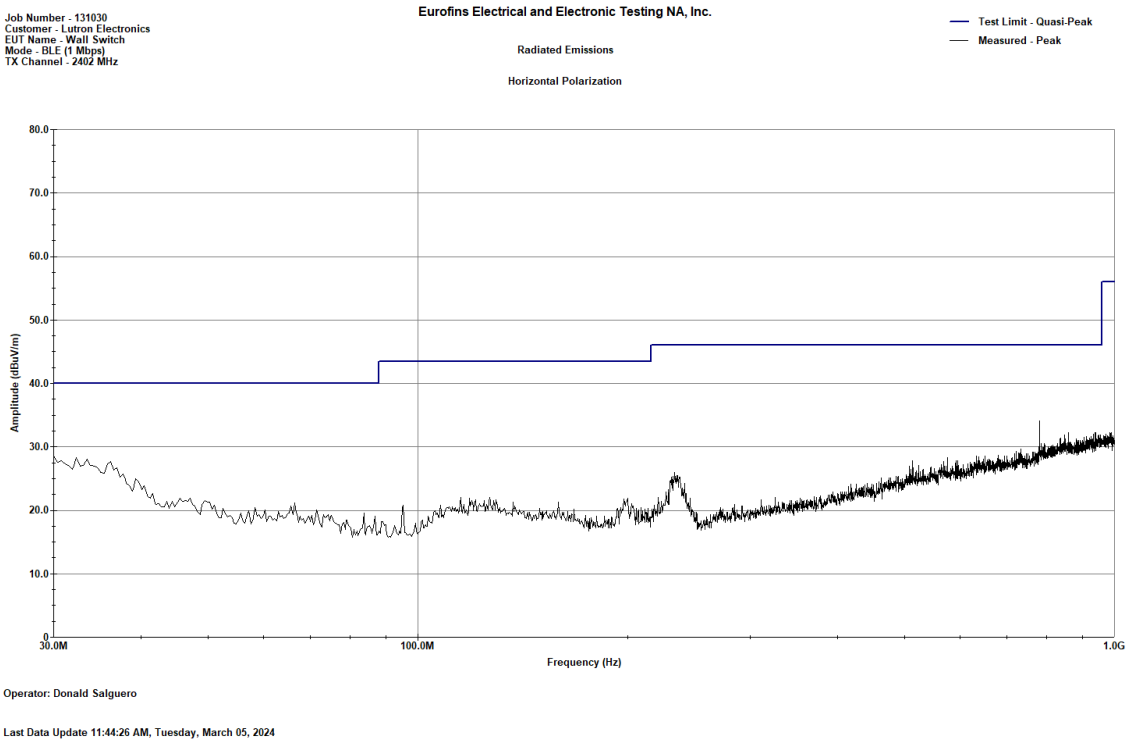


Figure 43. BLE (1 Mbps)_2402MHz_Radiated Emissions, 30 MHz to 1 GHz-_H

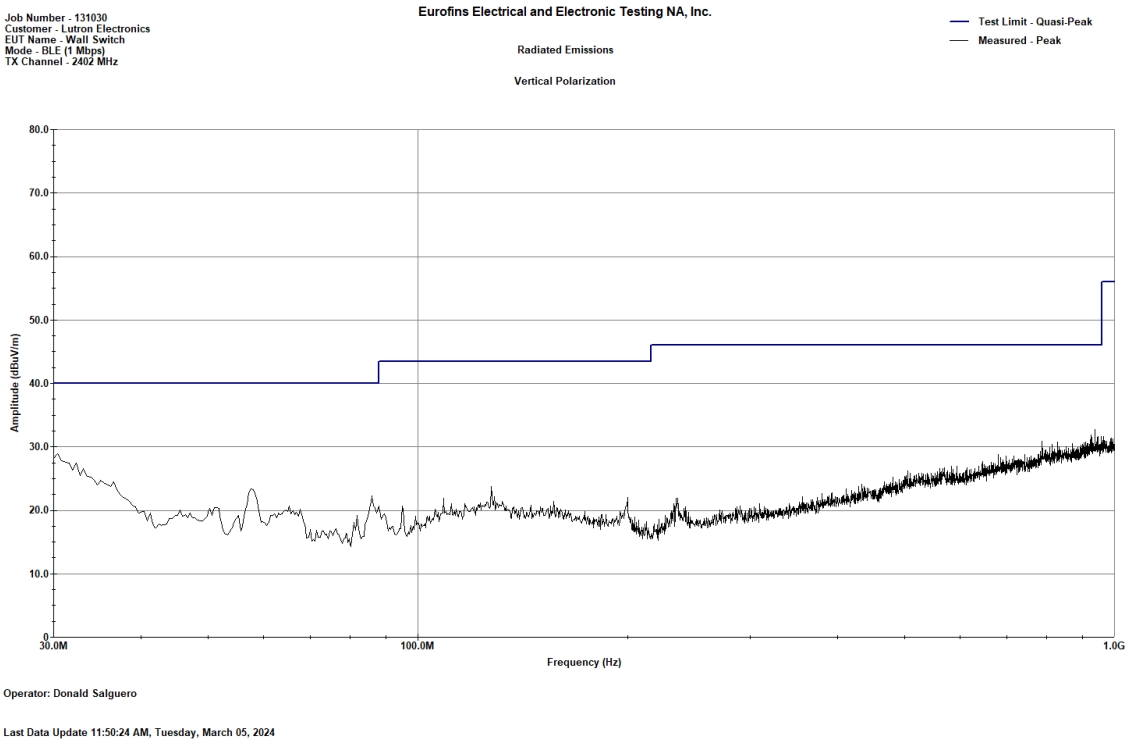


Figure 44. BLE (1 Mbps)_2402MHz_Radiated Emissions, 30 MHz to 1 GHz-_V

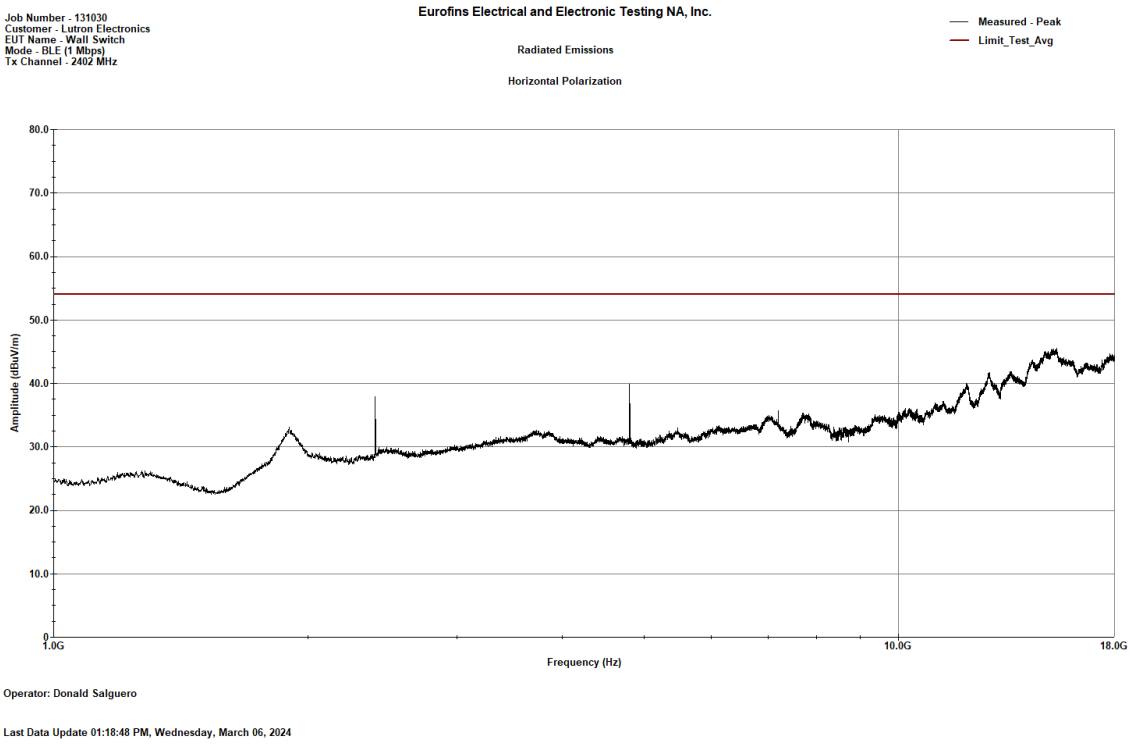


Figure 45. BLE (1 Mbps)_2402MHz_Radiated Emissions, Average, 1 - 18 GHz-_H

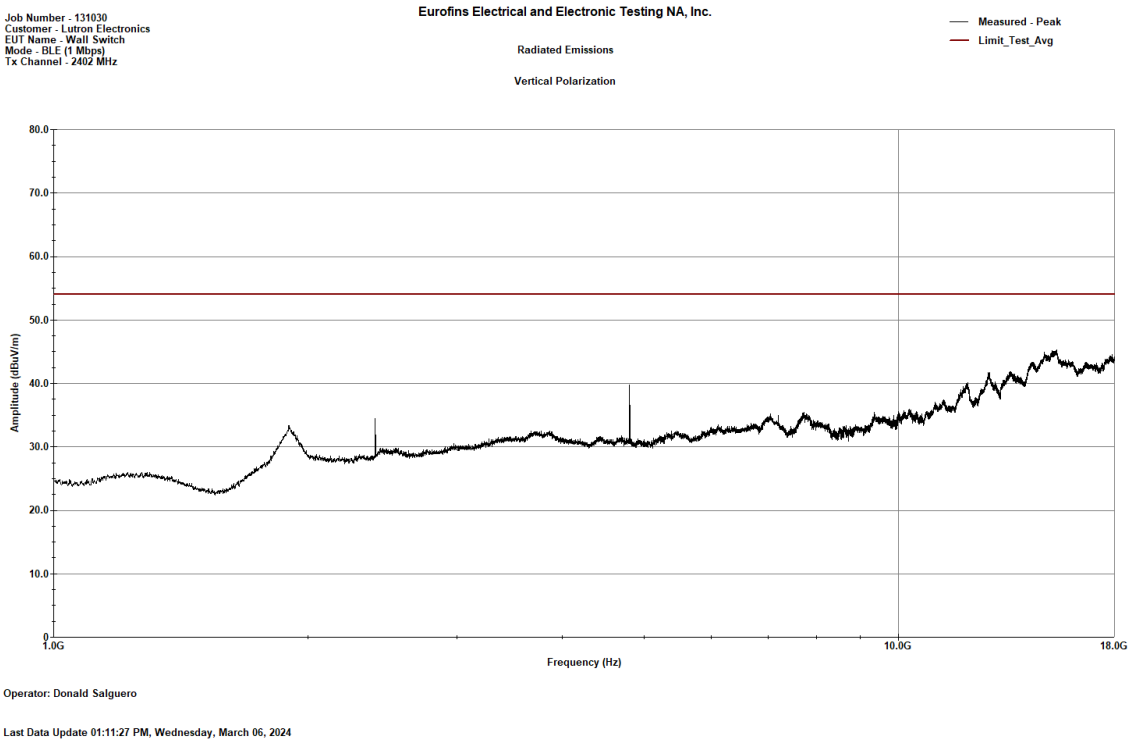


Figure 46. BLE (1 Mbps)_2402MHz_Radiated Emissions, Average, 1 - 18 GHz-_V

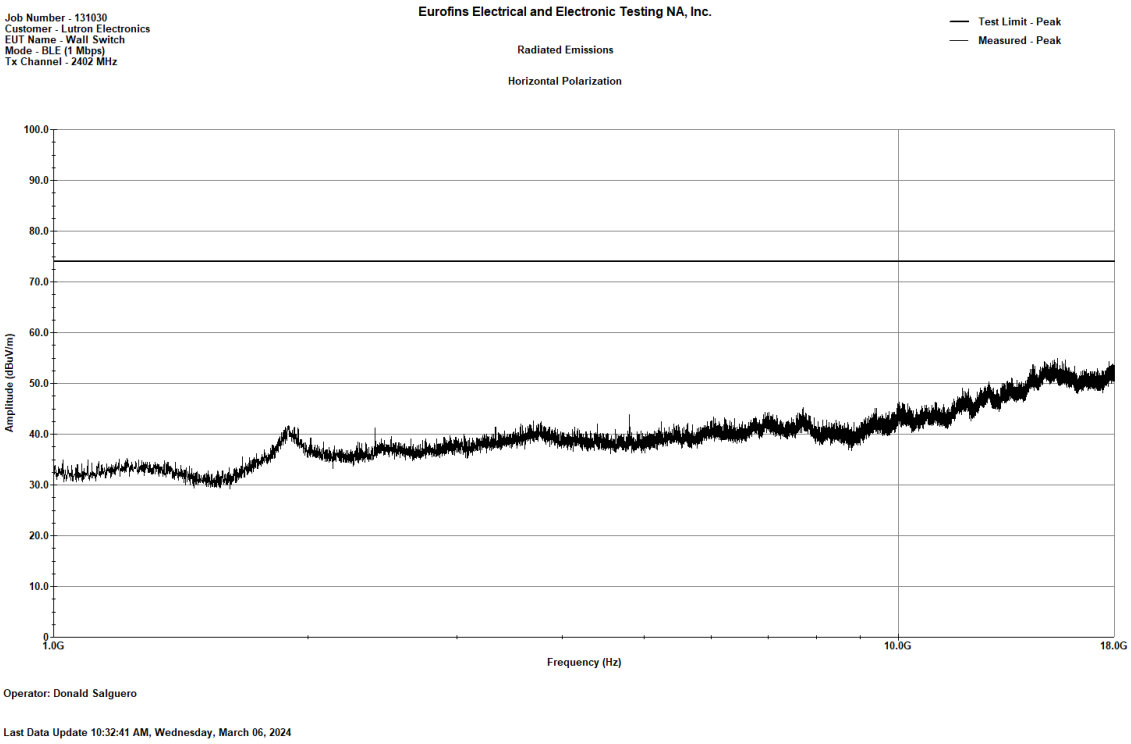


Figure 47. BLE (1 Mbps)_2402MHz_Radiated Emissions, Peak, 1 - 18 GHz-_H

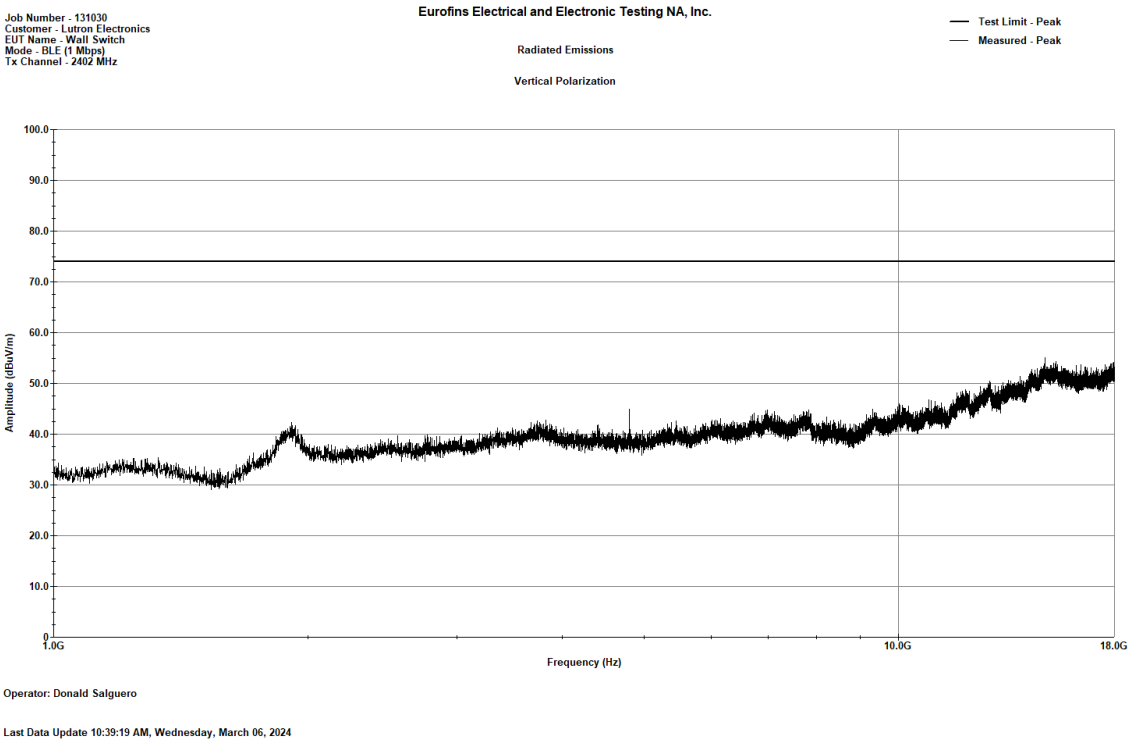


Figure 48. BLE (1 Mbps)_2402MHz_Radiated Emissions, Peak, 1 - 18 GHz-_V

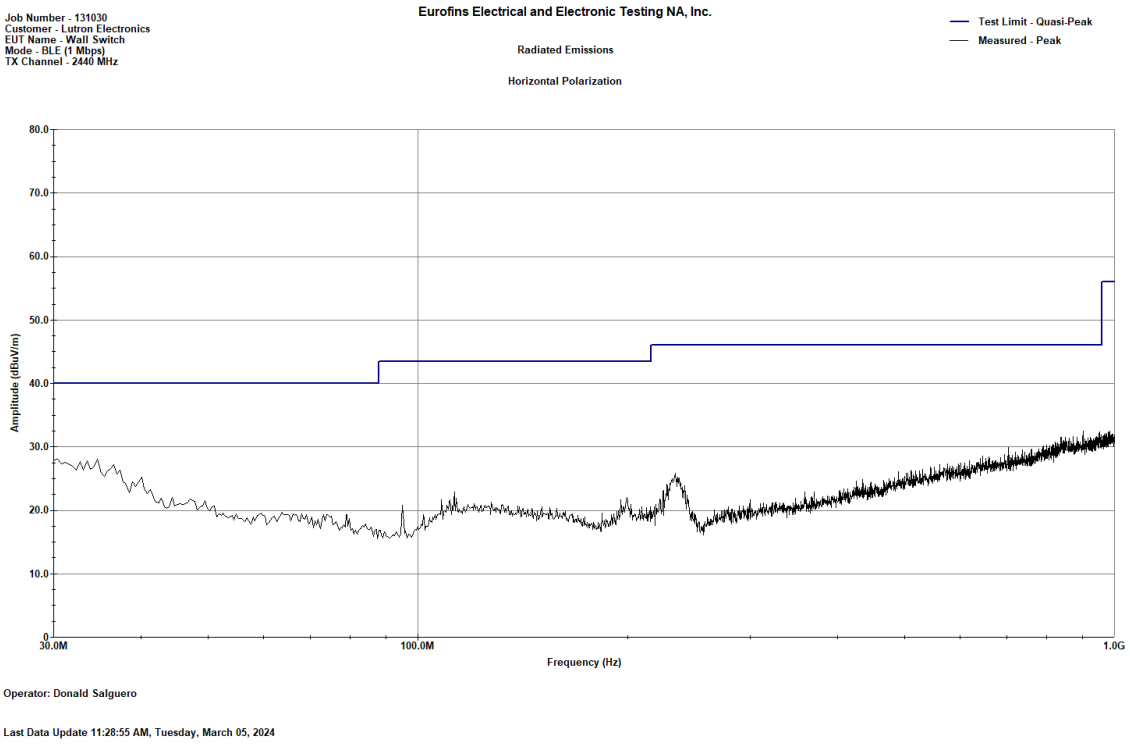


Figure 49. BLE (1 Mbps)_2440MHz_Radiated Emissions, 30 MHz to 1 GHz-_H

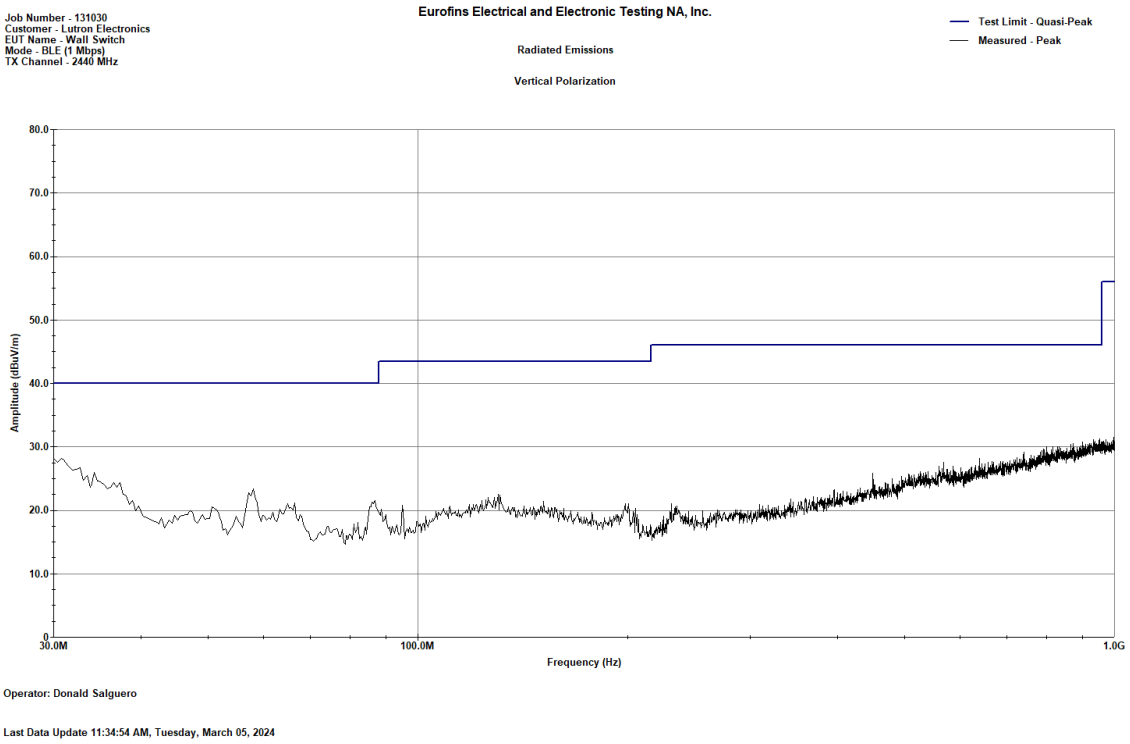


Figure 50. BLE (1 Mbps)_2440MHz_Radiated Emissions, 30 MHz to 1 GHz-_V

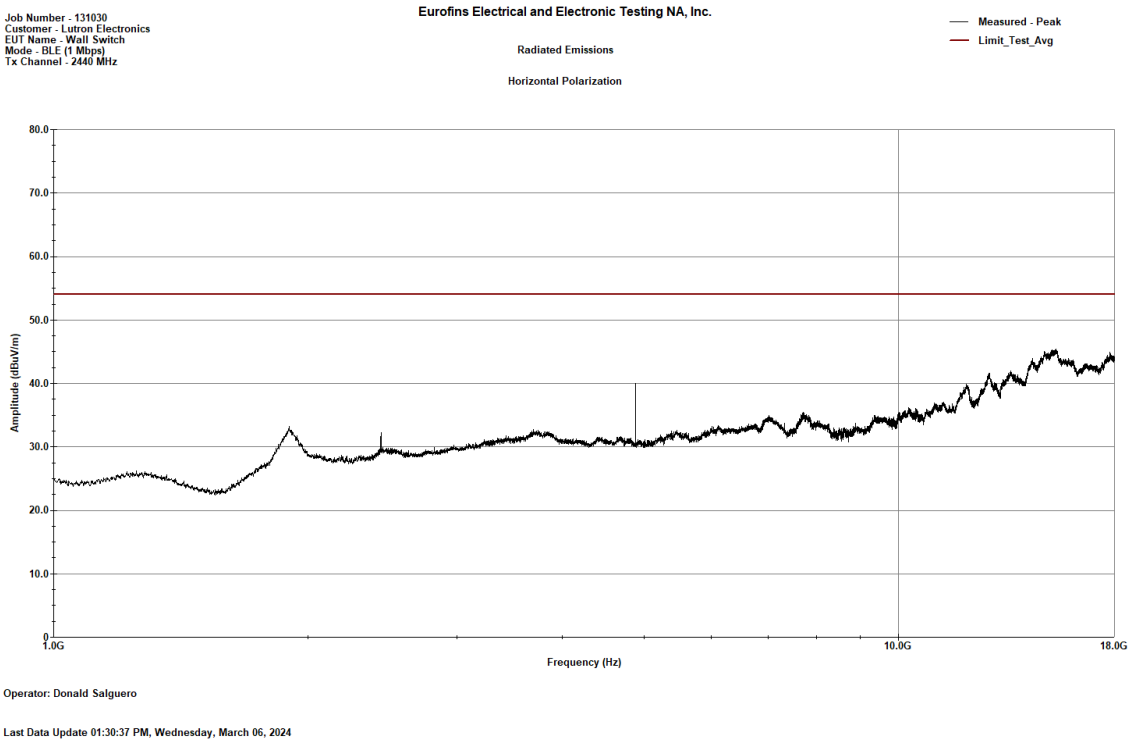


Figure 51. BLE (1 Mbps)_2440MHz_Radiated Emissions, Average, 1 - 18 GHz-_H

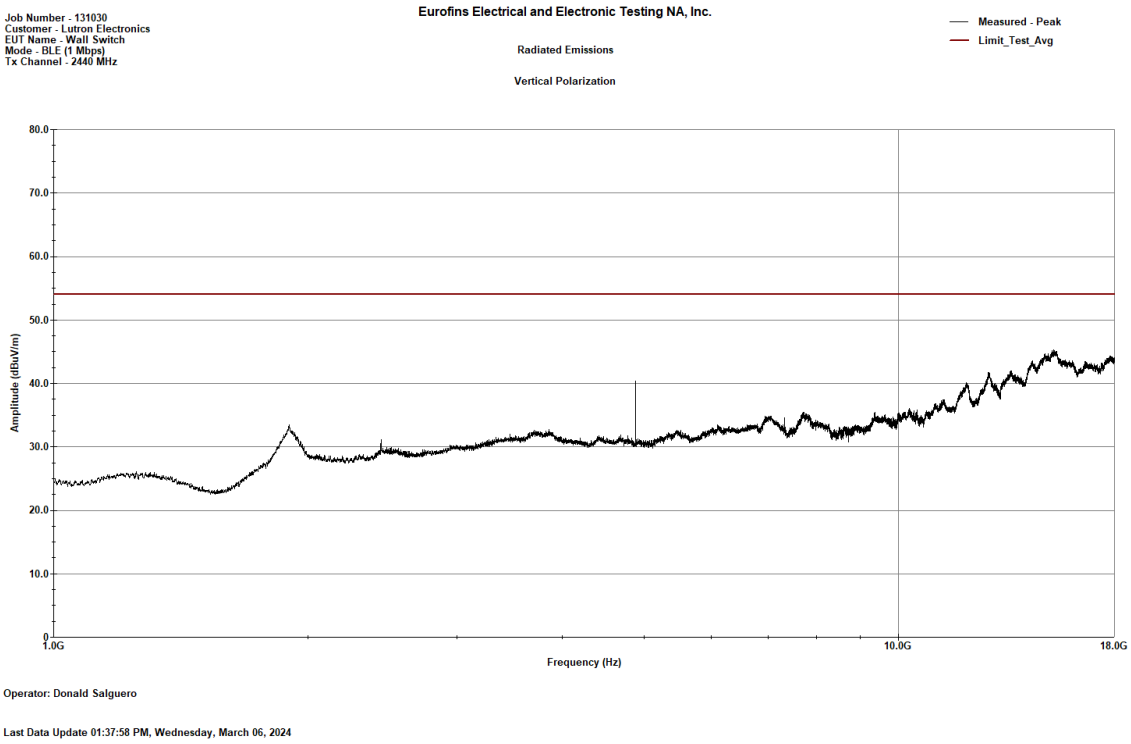


Figure 52. BLE (1 Mbps)_2440MHz_Radiated Emissions, Average, 1 - 18 GHz-_V

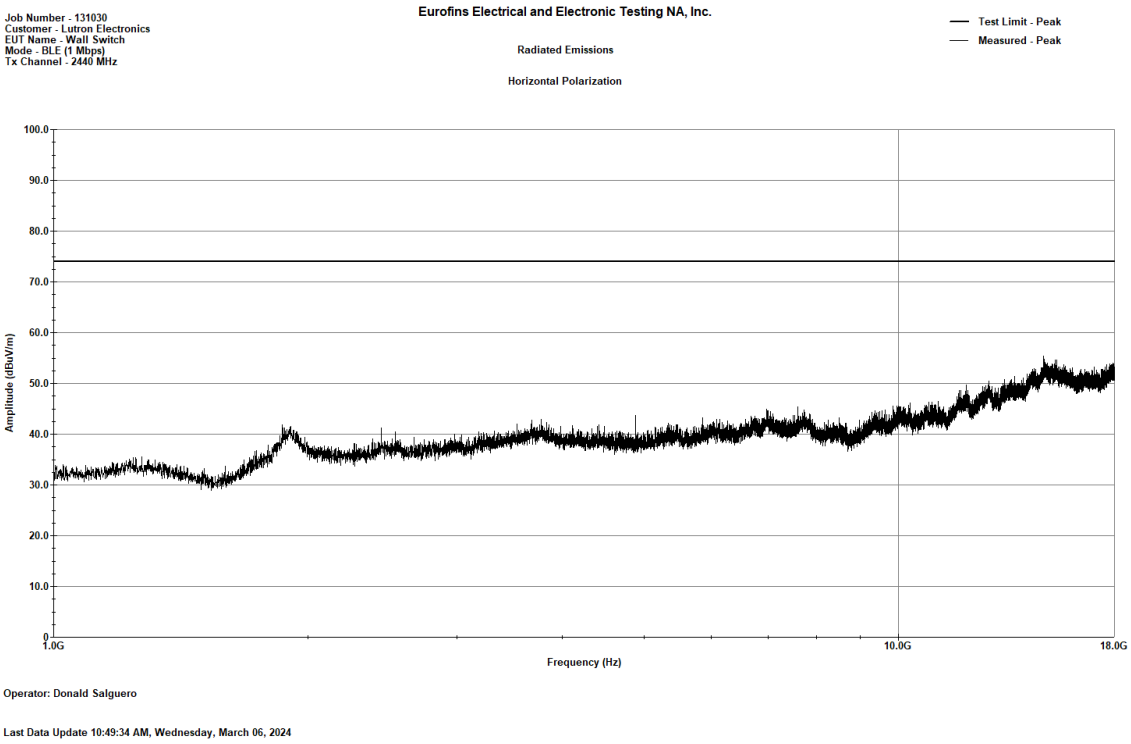


Figure 53. BLE (1 Mbps)_2440MHz_Radiated Emissions, Peak, 1 - 18 GHz-_H

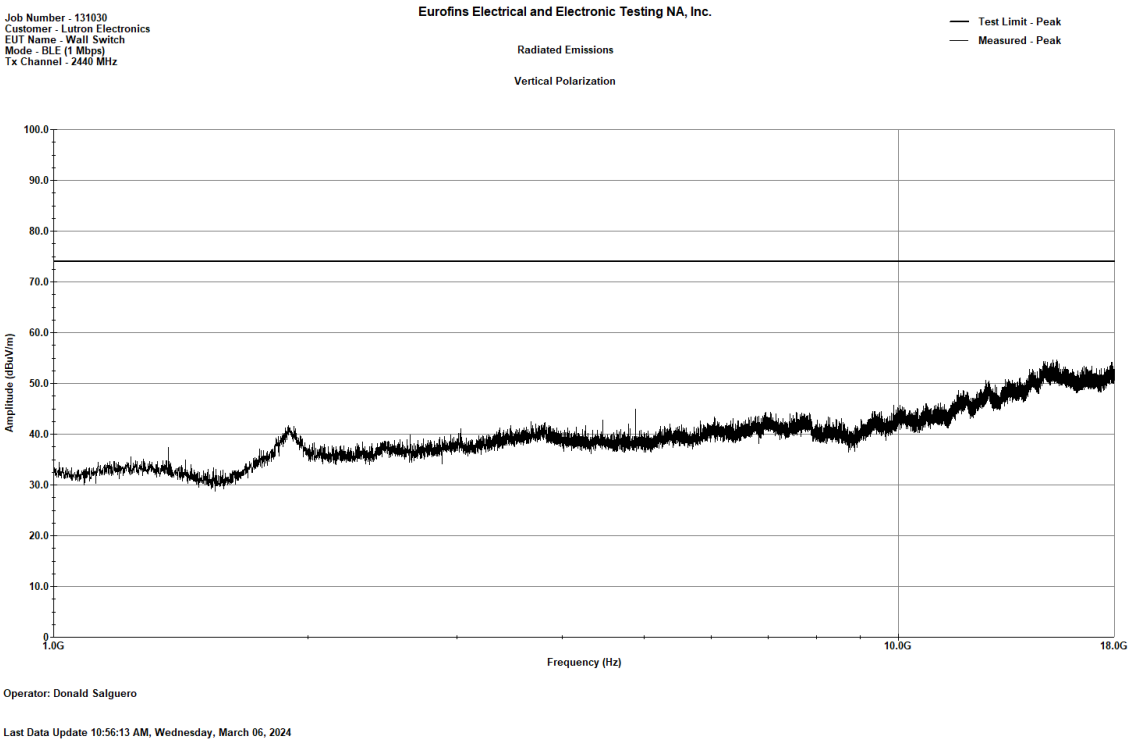


Figure 54. BLE (1 Mbps)_2440MHz_Radiated Emissions, Peak, 1 - 18 GHz-_V

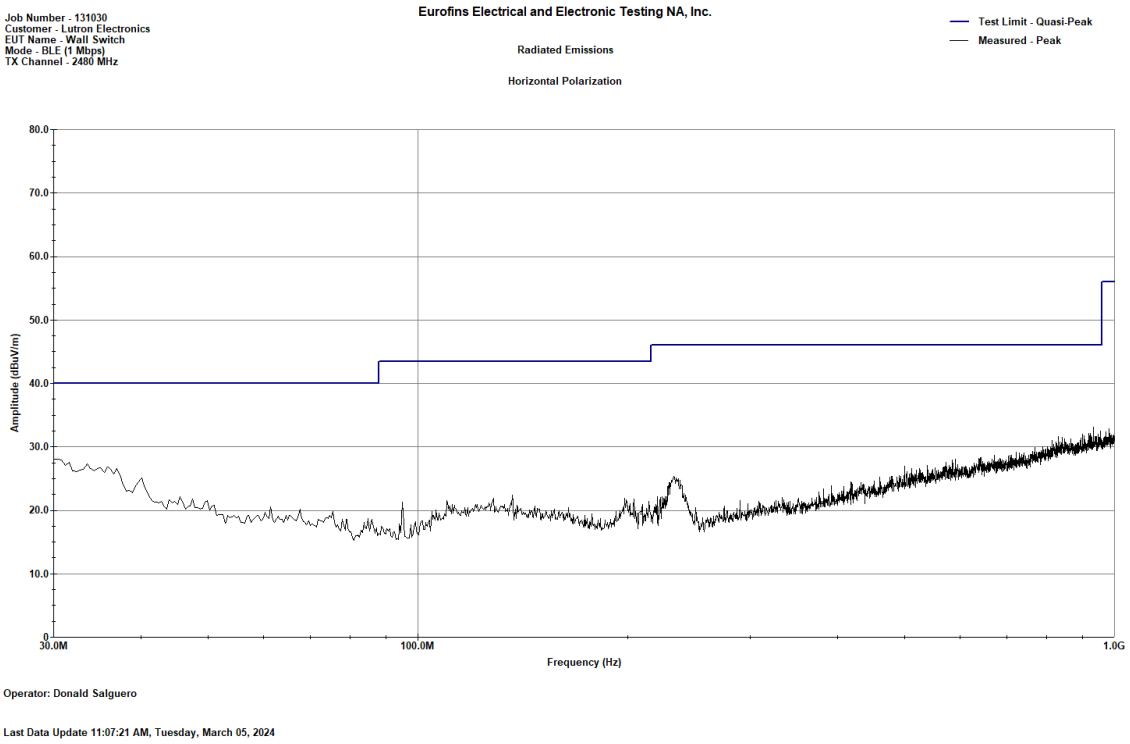


Figure 55. BLE (1 Mbps)_2480MHz_Radiated Emissions, 30 MHz to 1 GHz-_H

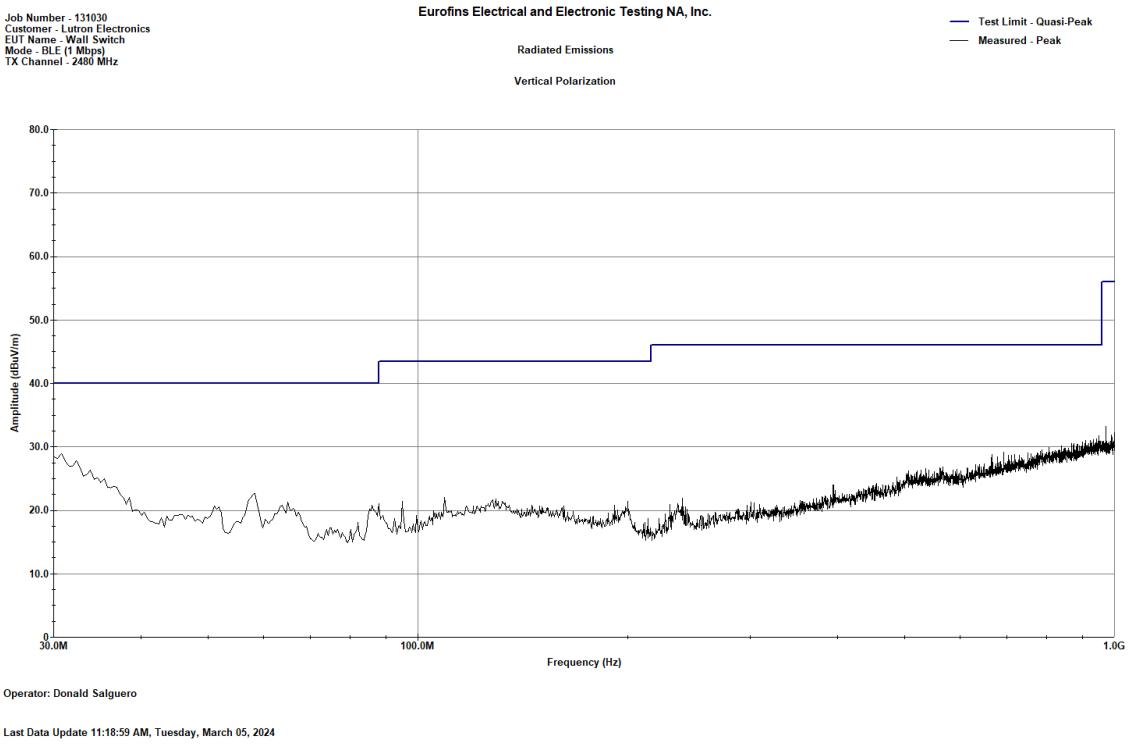


Figure 56. BLE (1 Mbps)_2480MHz_Radiated Emissions, 30 MHz to 1 GHz-_V

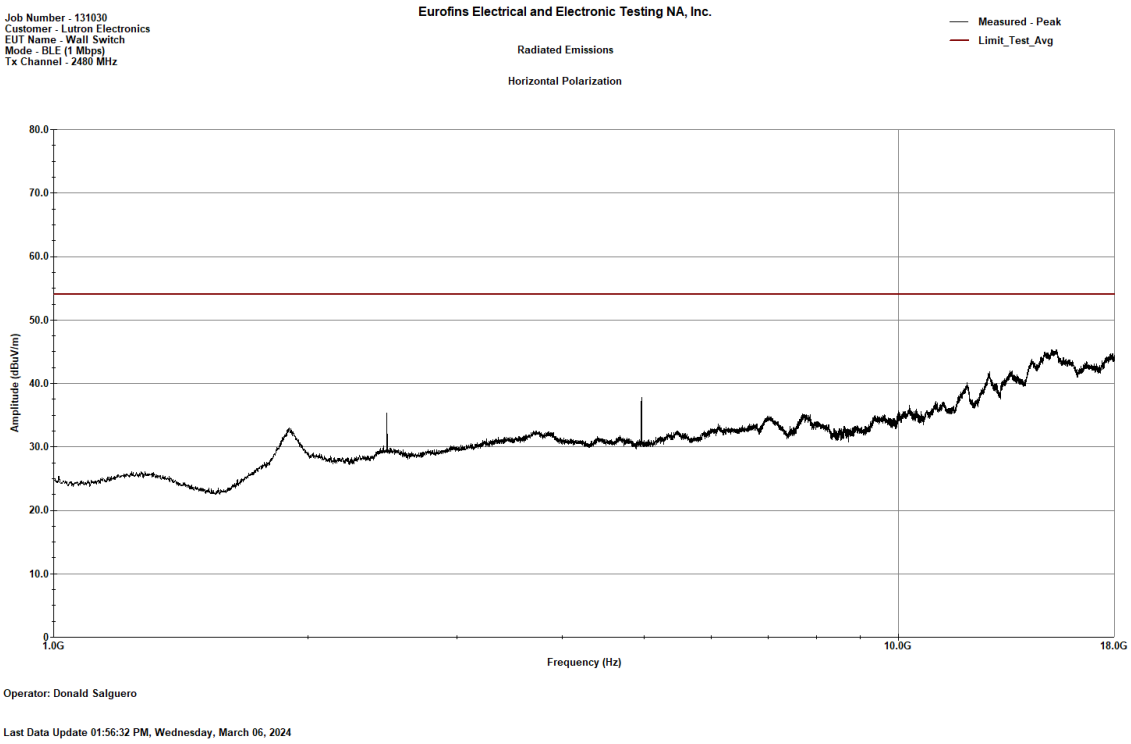


Figure 57. BLE (1 Mbps)_2480MHz_Radiated Emissions, Average, 1 - 18 GHz-_H

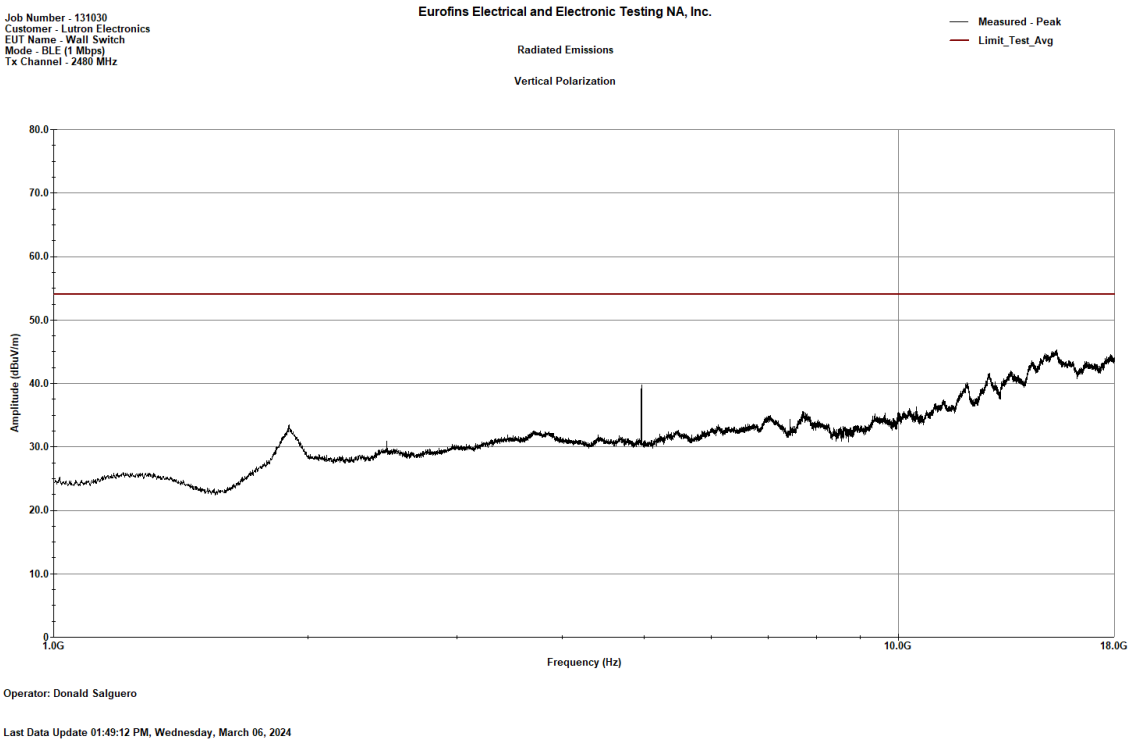


Figure 58. BLE (1 Mbps)_2480MHz_Radiated Emissions, Average, 1 - 18 GHz-_V

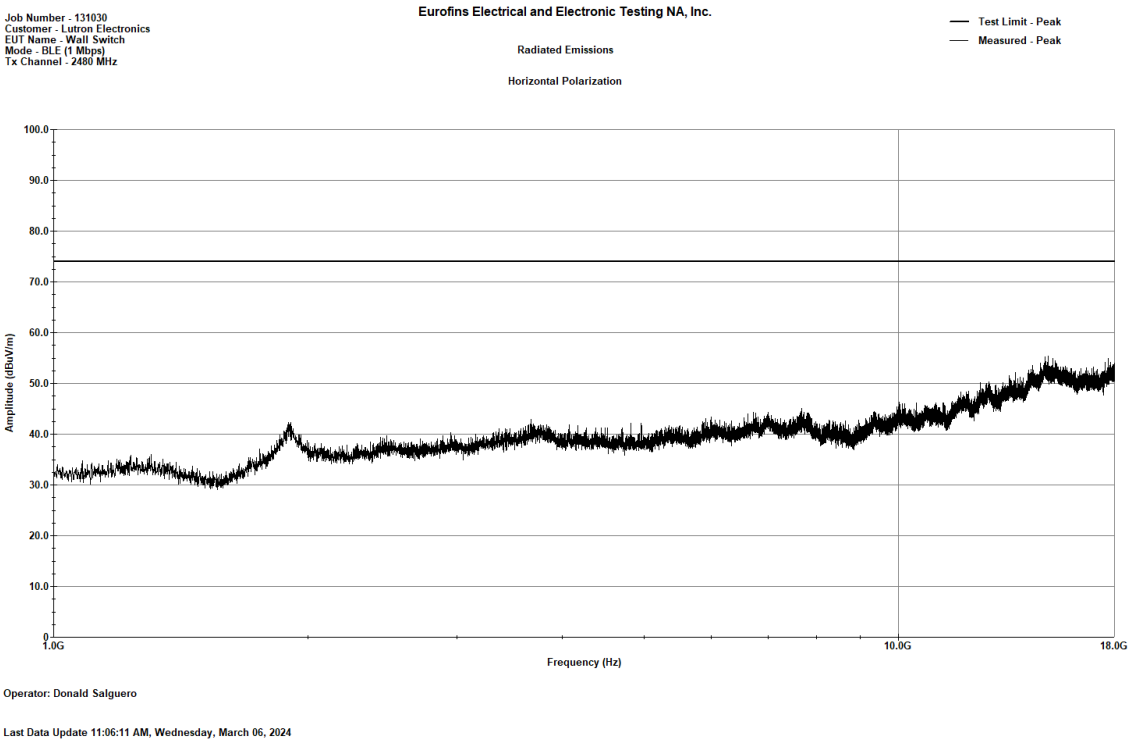


Figure 59. BLE (1 Mbps)_2480MHz_Radiated Emissions, Peak, 1 - 18 GHz-_H

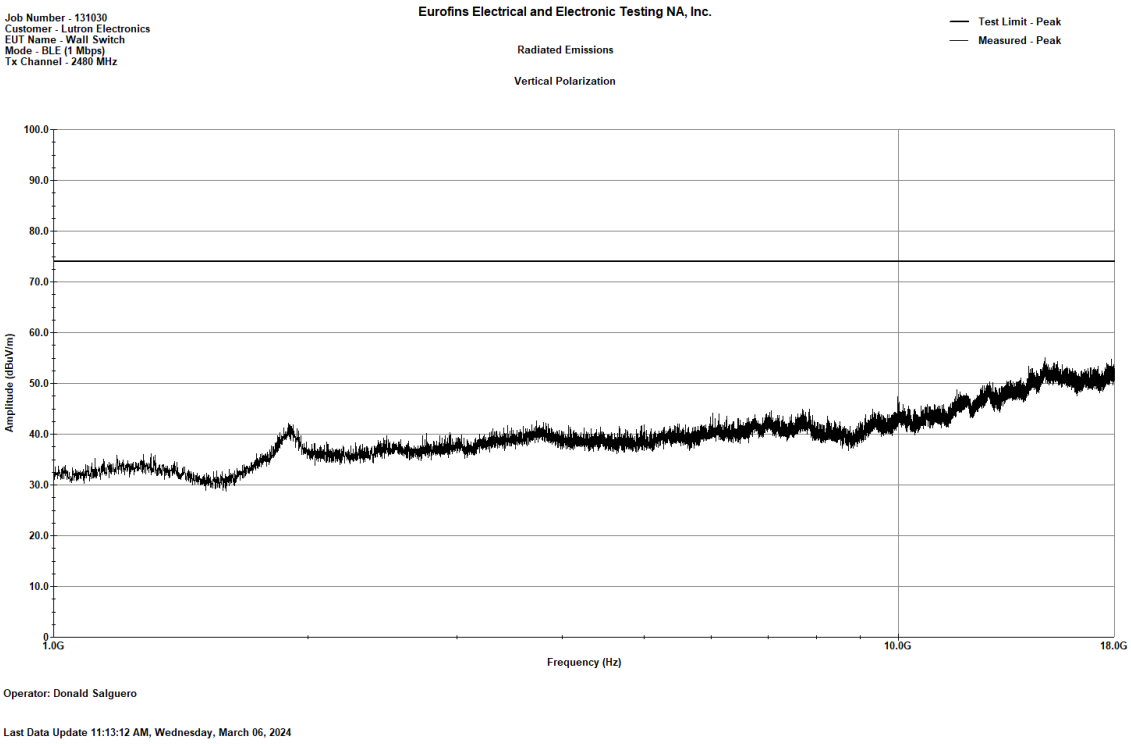


Figure 60. BLE (1 Mbps)_2480MHz_Radiated Emissions, Peak, 1 - 18 GHz-_V

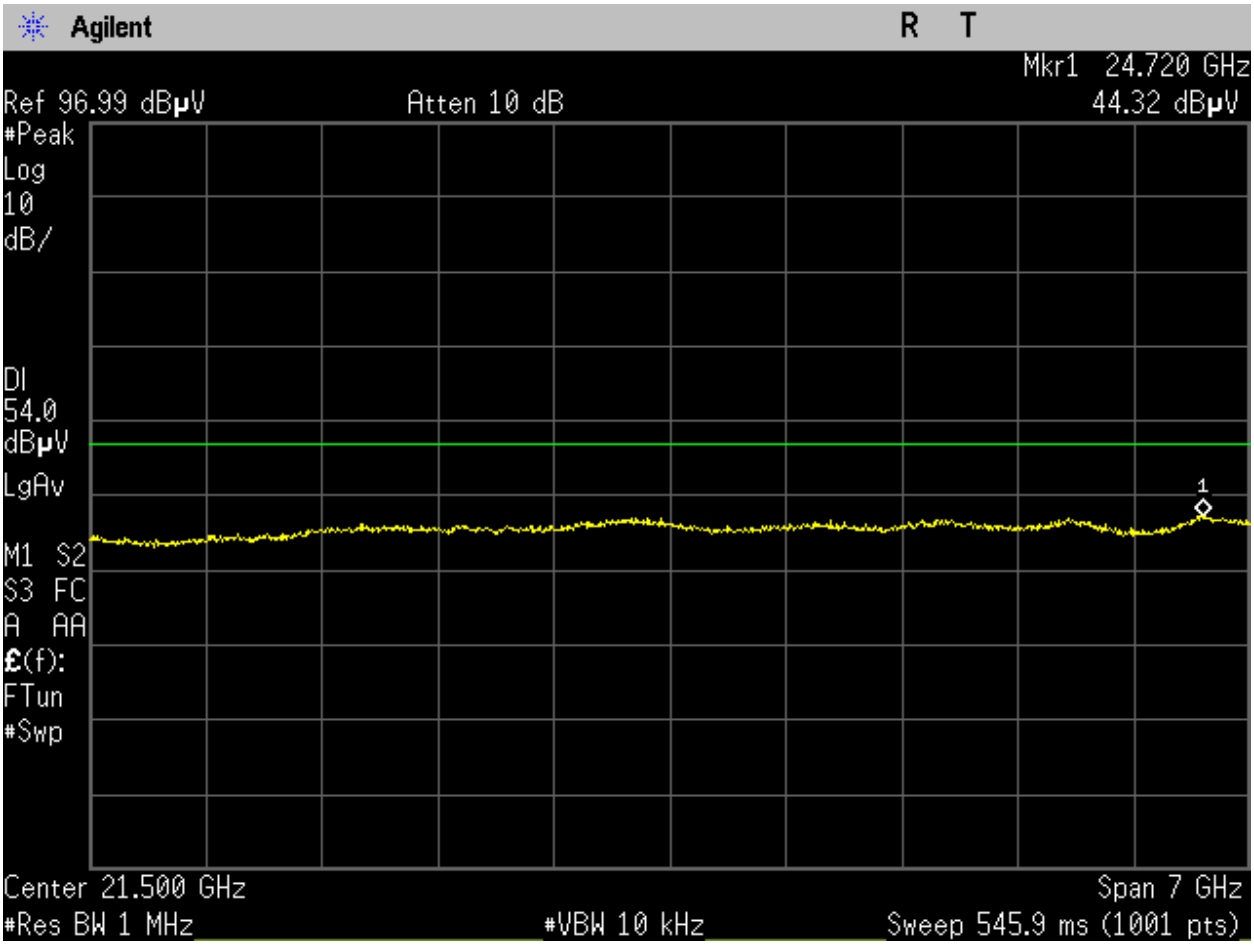


Figure 61. BLE (1 Mbps)_Radiated Spurious Emissions, Average_H_18-25GHz.

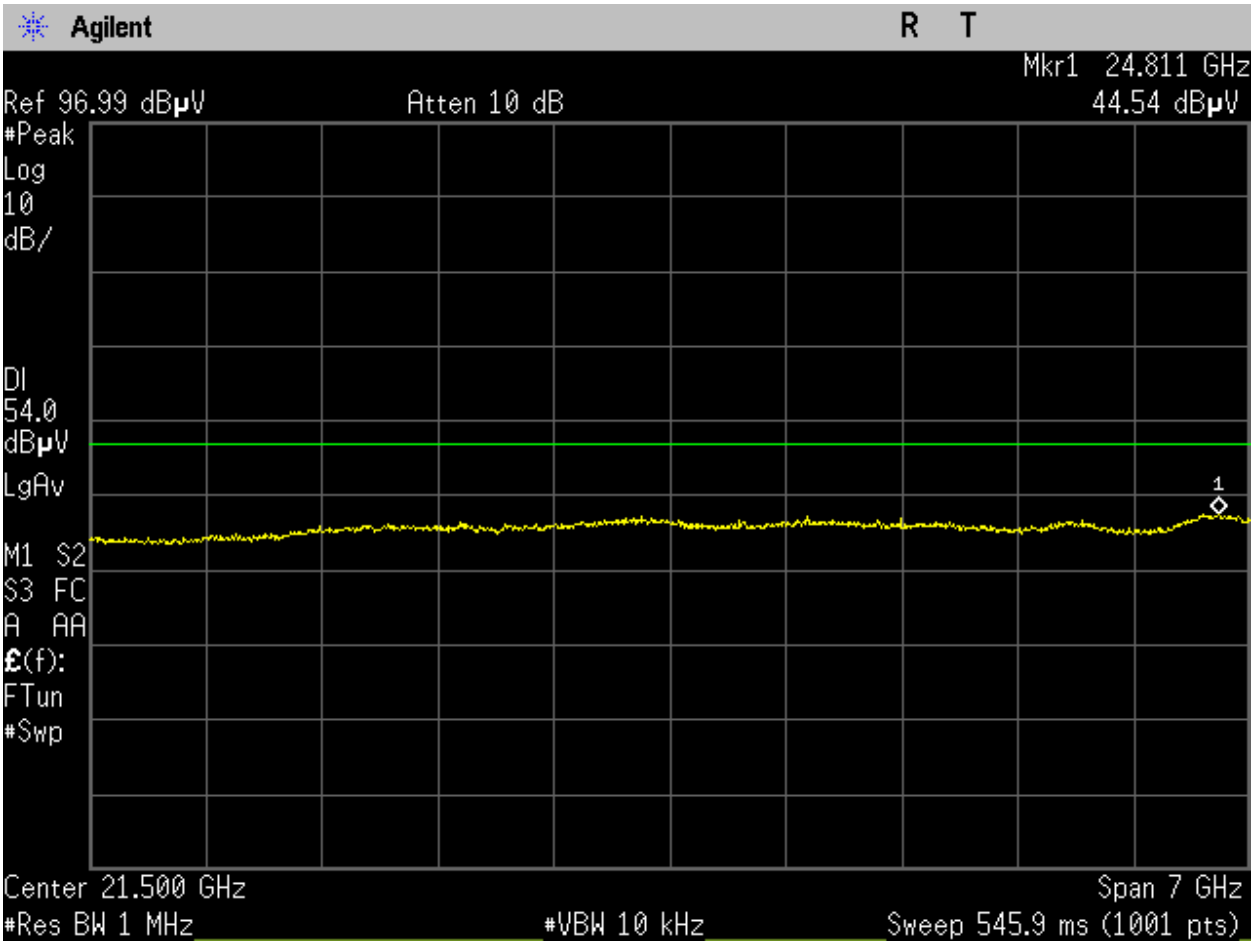


Figure 62. BLE (1 Mbps)_Radiated Spurious Emissions, Average_V_18-25GHz.

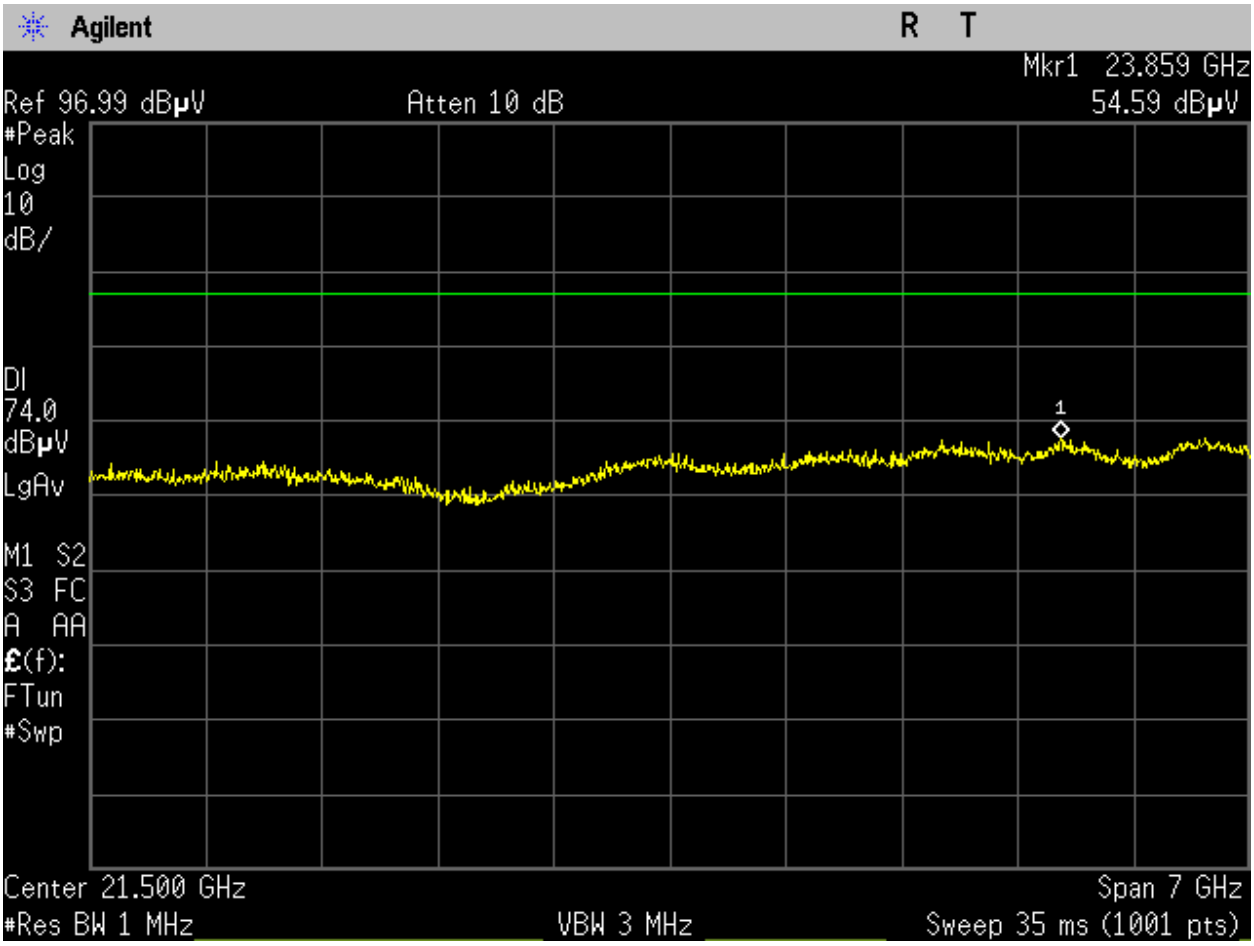


Figure 63. BLE (1 Mbps)_Radiated Spurious Emissions, Peak_H_18-25GHz.

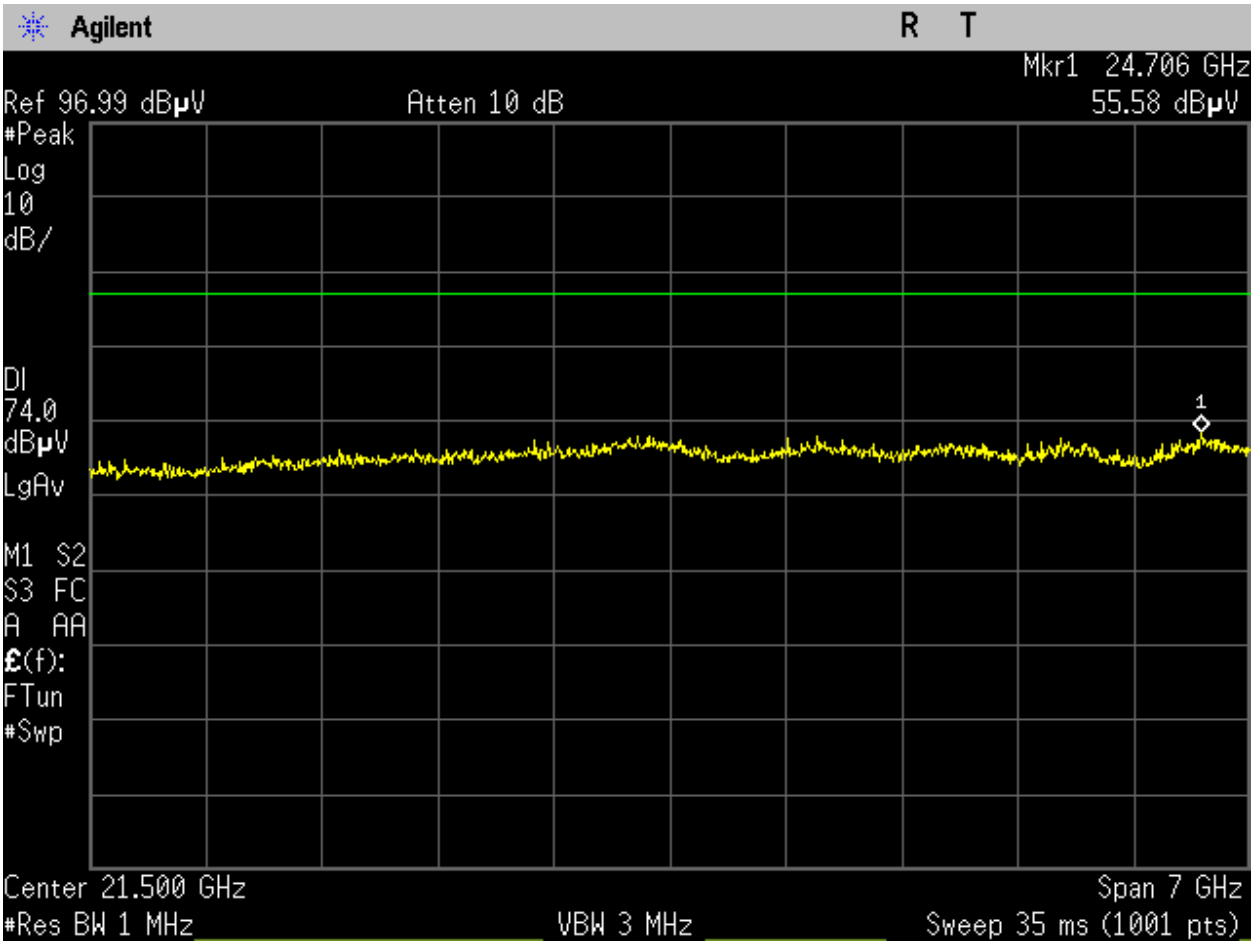


Figure 64. BLE (1 Mbps)_Radiated Spurious Emissions, Peak_V_18-25GHz.

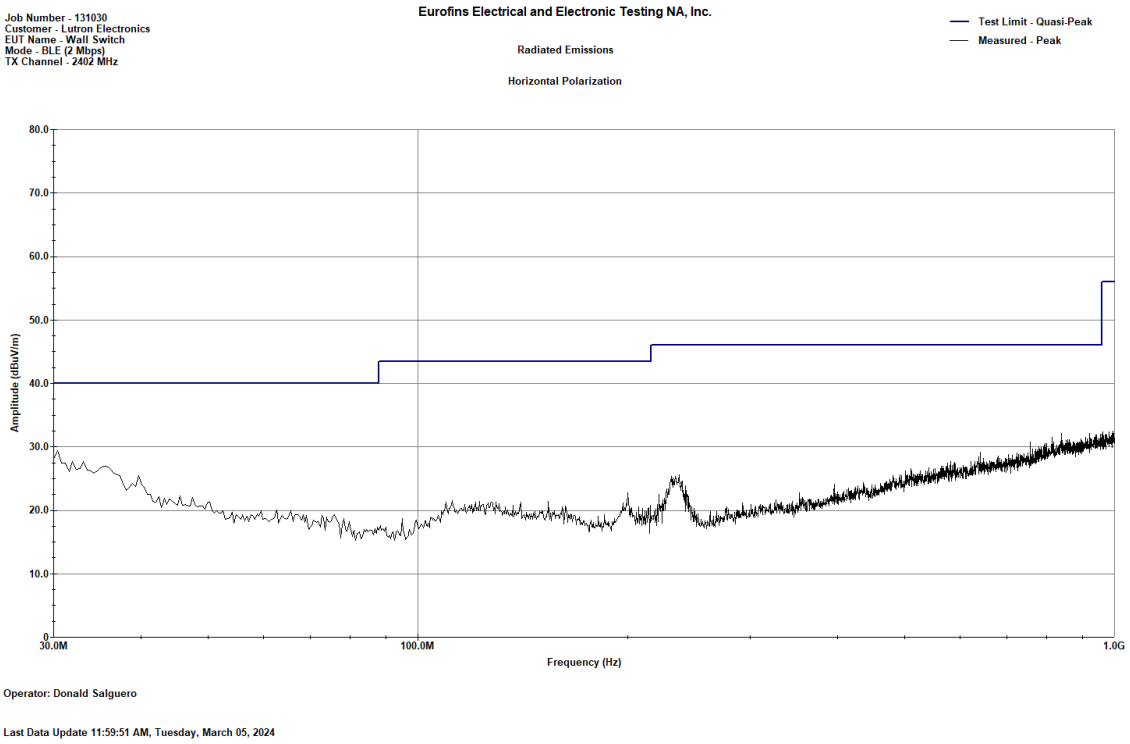


Figure 65. BLE (2 Mbps)_2402MHz_Radiated Emissions, 30 MHz to 1 GHz-_H

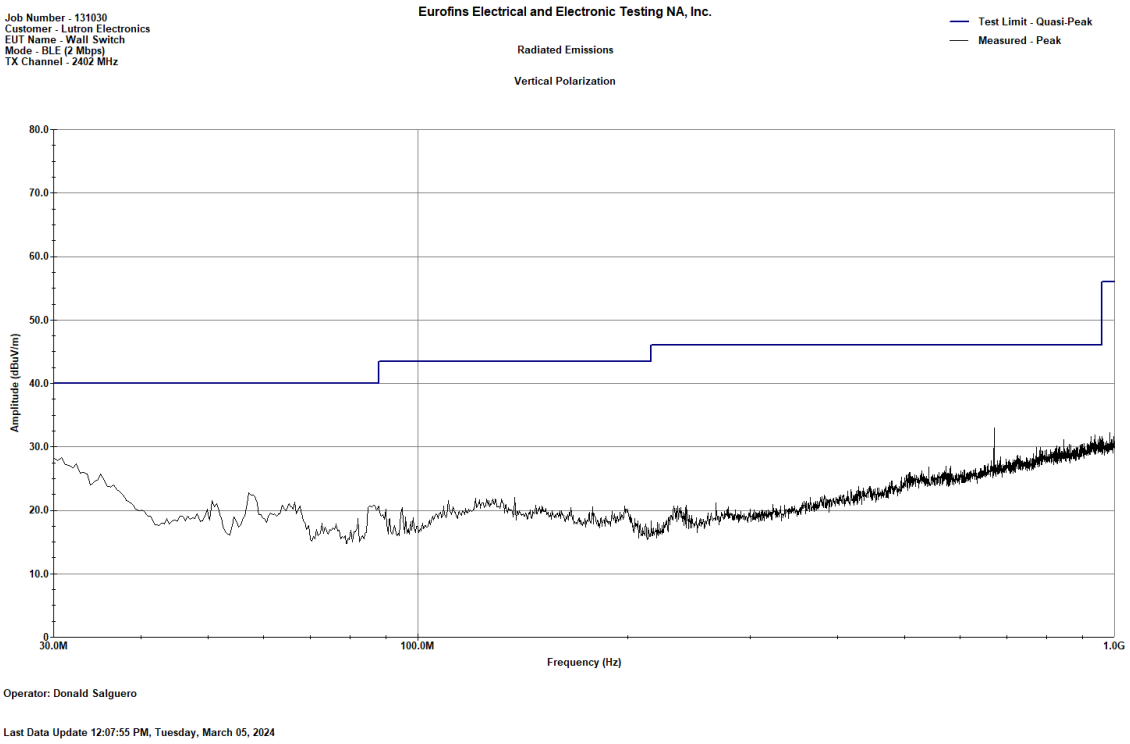


Figure 66. BLE (2 Mbps)_2402MHz_Radiated Emissions, 30 MHz to 1 GHz-_V

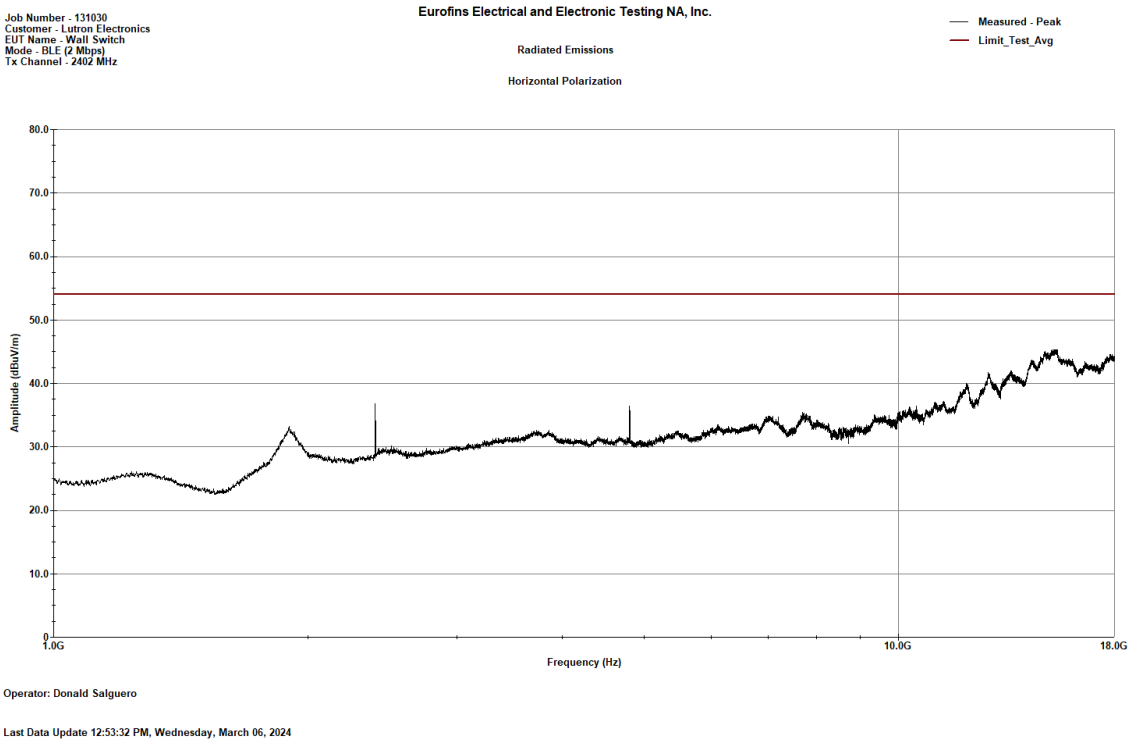


Figure 67. BLE (2 Mbps)_2402MHz_Radiated Emissions, Average, 1 - 18 GHz-_H

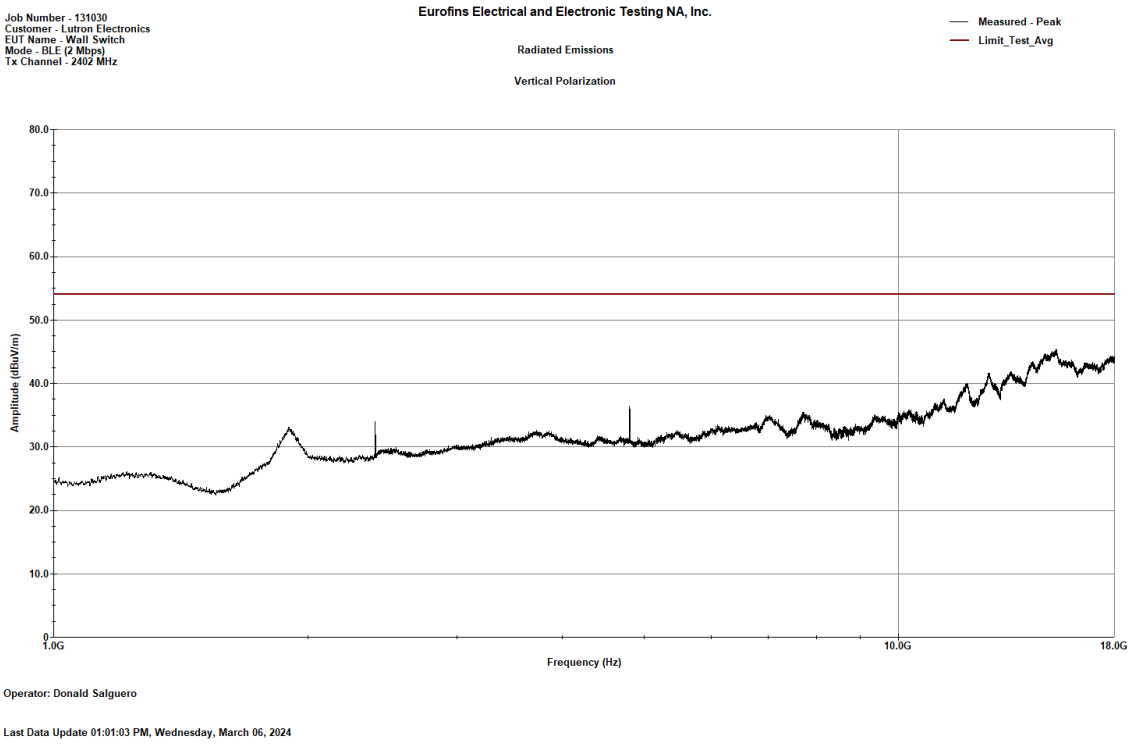


Figure 68. BLE (2 Mbps)_2402MHz_Radiated Emissions, Average, 1 - 18 GHz-_V

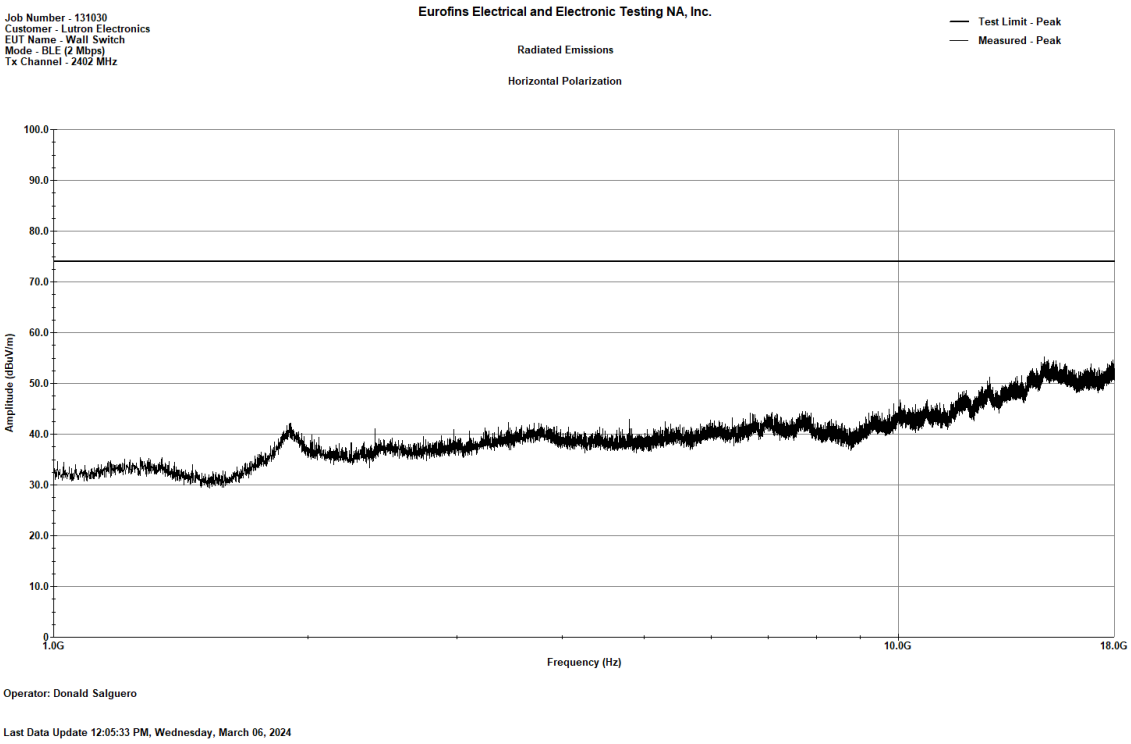


Figure 69. BLE (2 Mbps)_2402MHz_Radiated Emissions, Peak, 1 - 18 GHz-_H

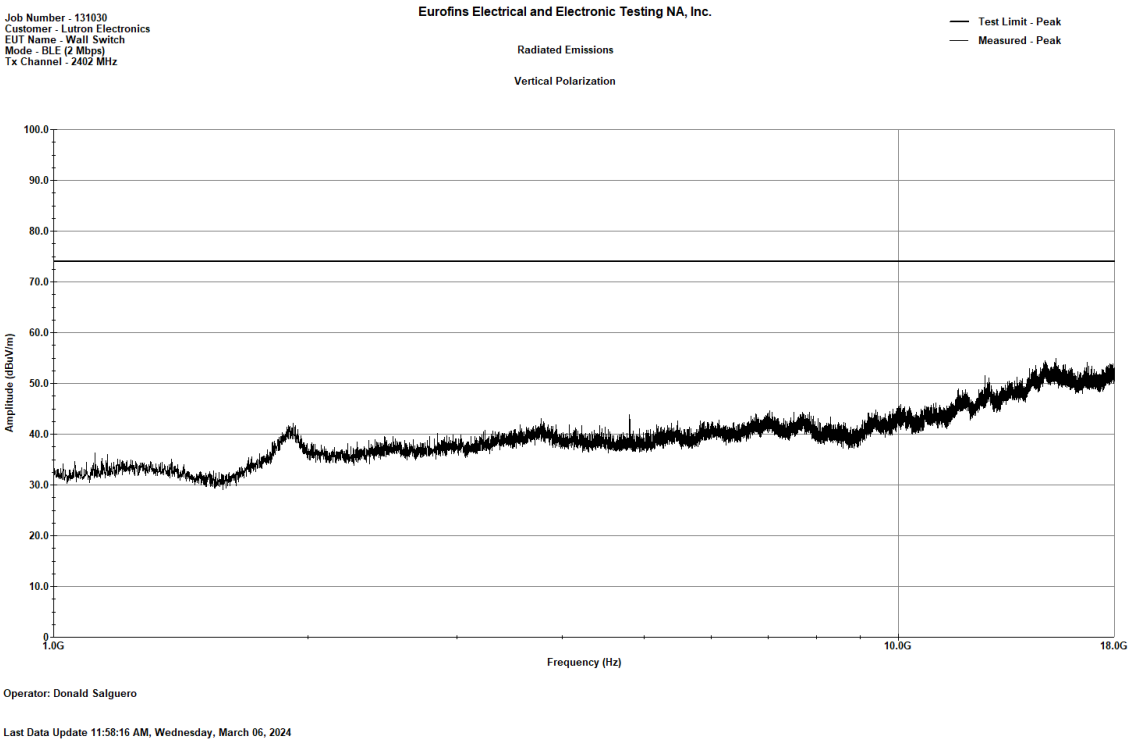


Figure 70. BLE (2 Mbps)_2402MHz_Radiated Emissions, Peak, 1 - 18 GHz-_V

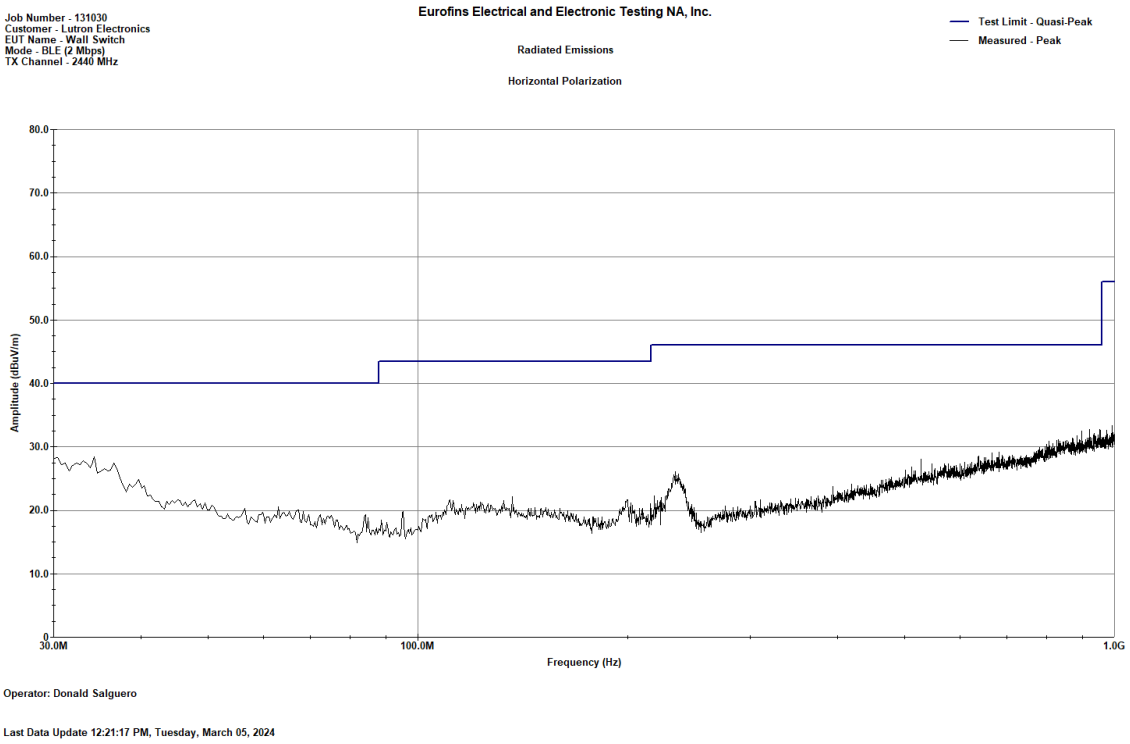


Figure 71. BLE (2 Mbps)_2440MHz_Radiated Emissions, 30 MHz to 1 GHz-_H

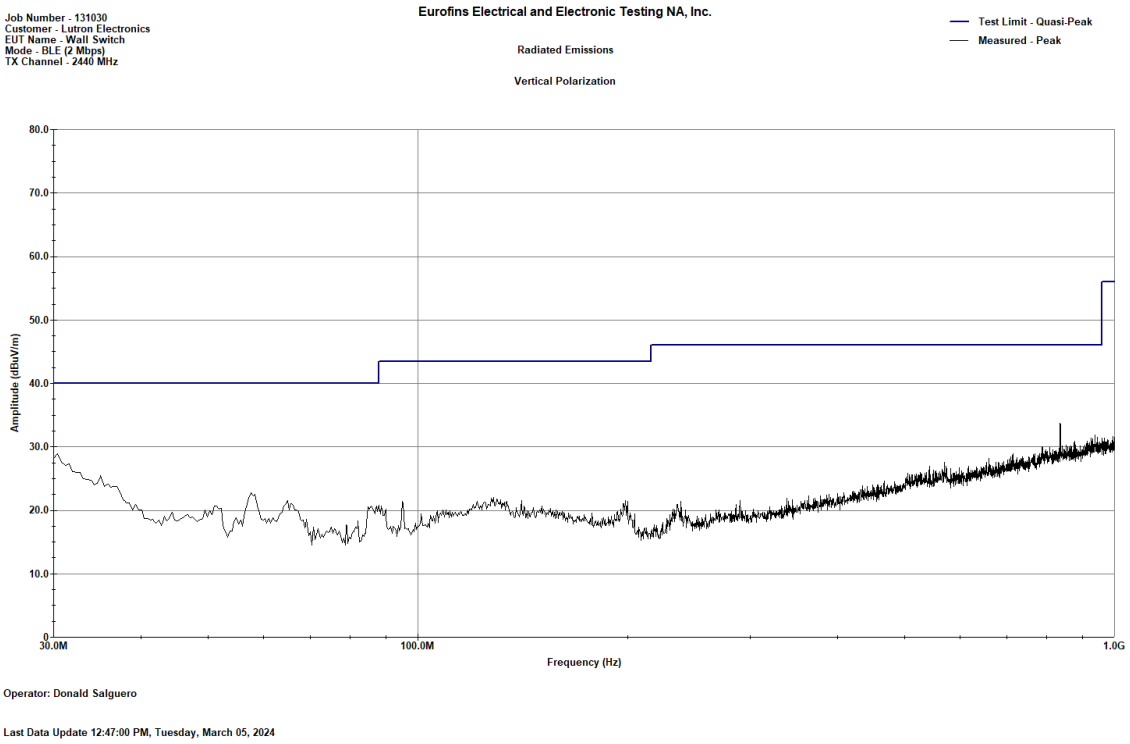


Figure 72. BLE (2 Mbps)_2440MHz_Radiated Emissions, 30 MHz to 1 GHz-_V

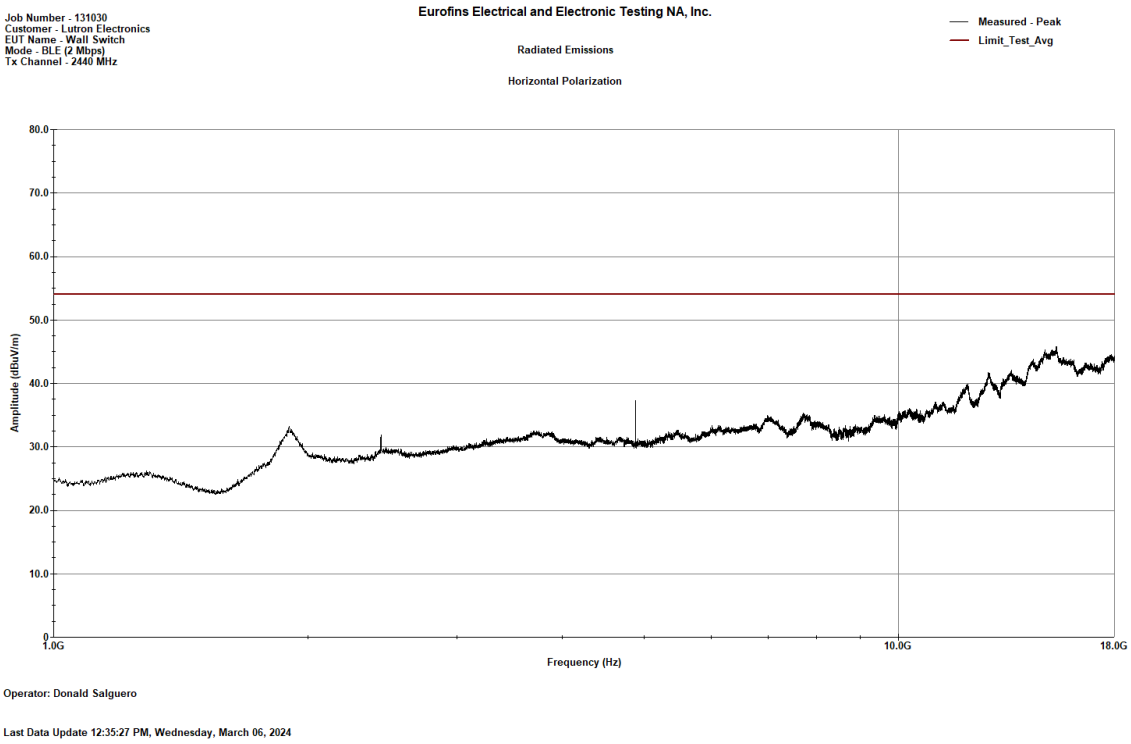


Figure 73. BLE (2 Mbps)_2440MHz_Radiated Emissions, Average, 1 - 18 GHz-_H

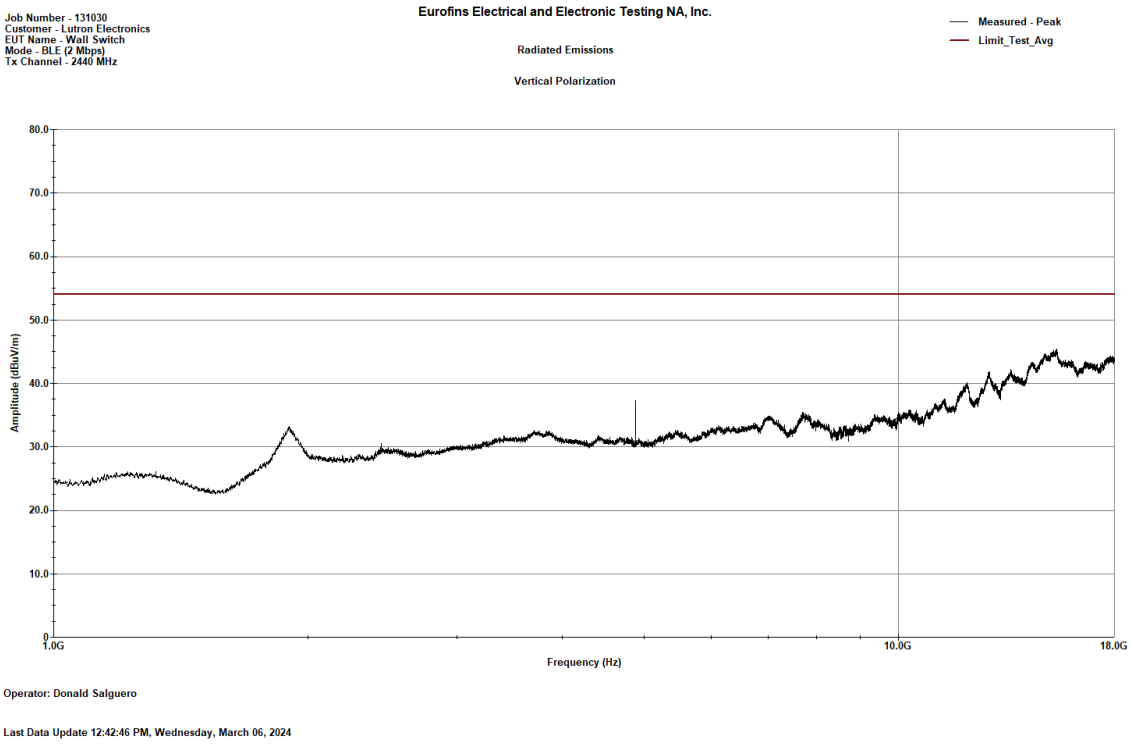


Figure 74. BLE (2 Mbps)_2440MHz_Radiated Emissions, Average, 1 - 18 GHz-_V

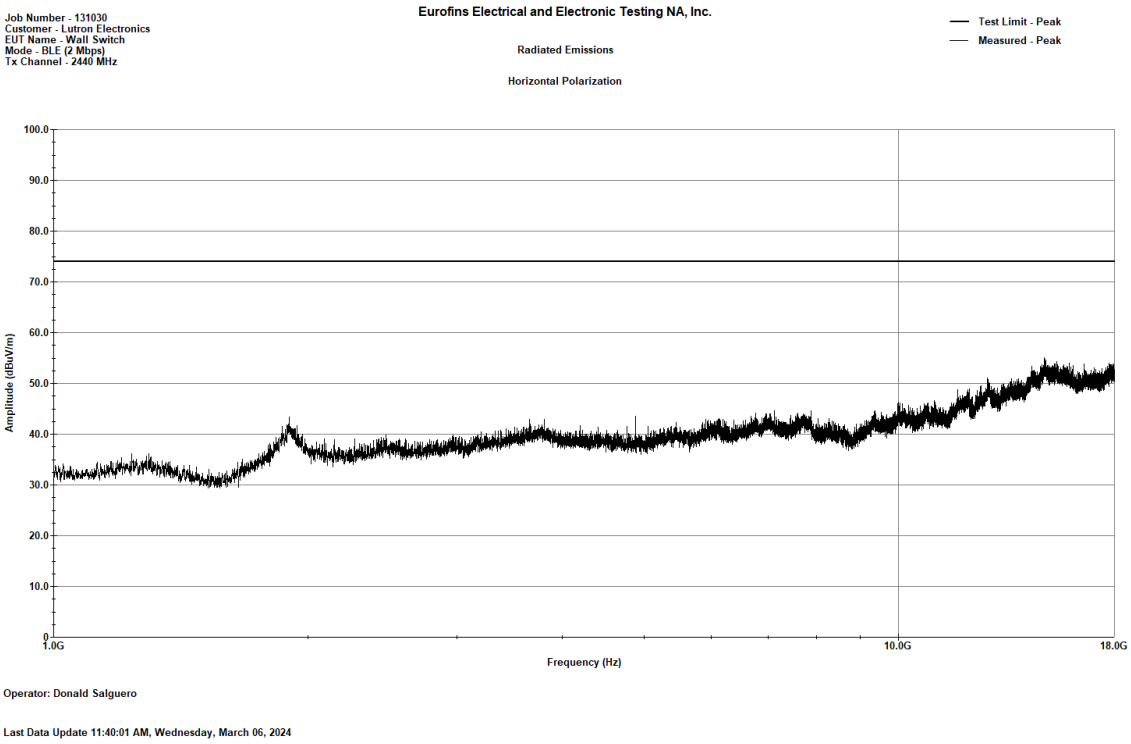


Figure 75. BLE (2 Mbps)_2440MHz_Radiated Emissions, Peak, 1 - 18 GHz-_H

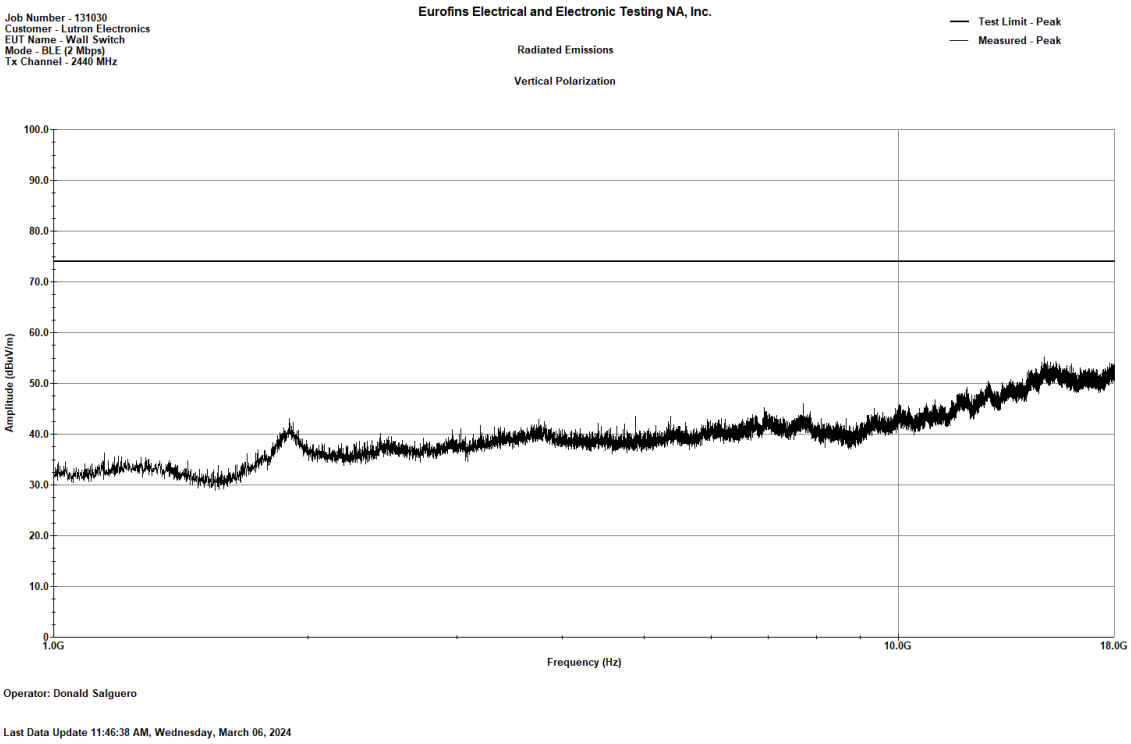


Figure 76. BLE (2 Mbps)_2440MHz_Radiated Emissions, Peak, 1 - 18 GHz-_V

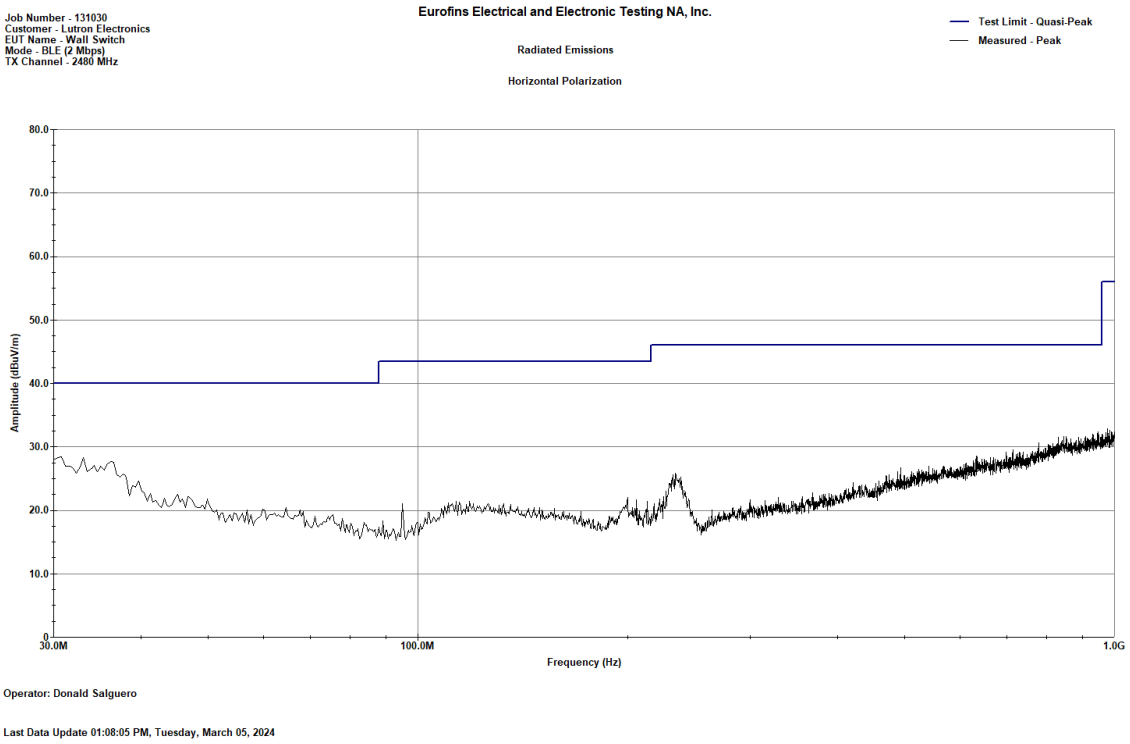


Figure 77. BLE (2 Mbps)_2480MHz_Radiated Emissions, 30 MHz to 1 GHz-_H

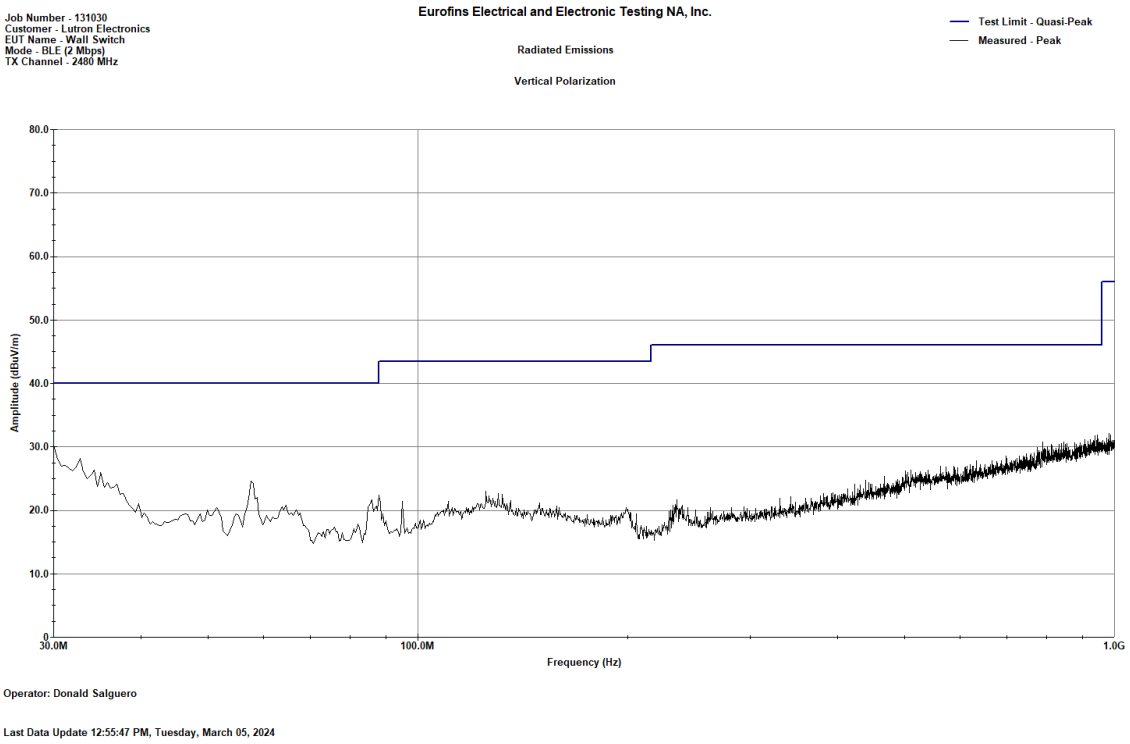


Figure 78. BLE (2 Mbps)_2480MHz_Radiated Emissions, 30 MHz to 1 GHz-_V

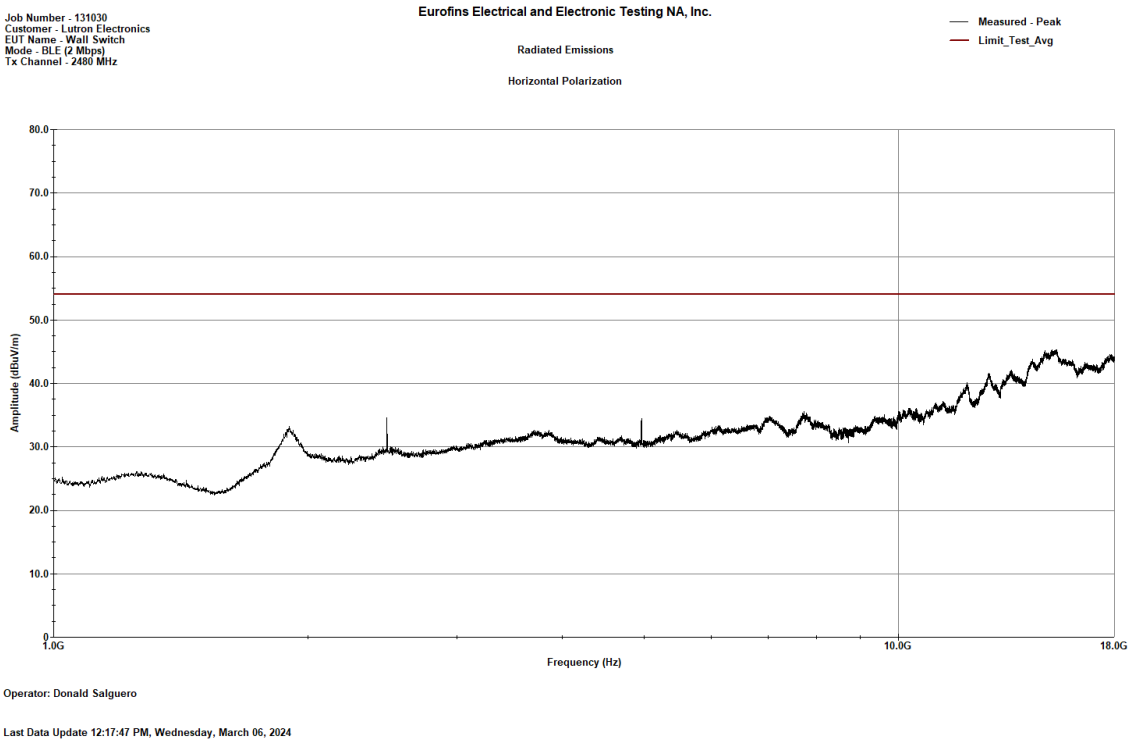


Figure 79. BLE (2 Mbps)_2480MHz_Radiated Emissions, Average, 1 - 18 GHz-_H

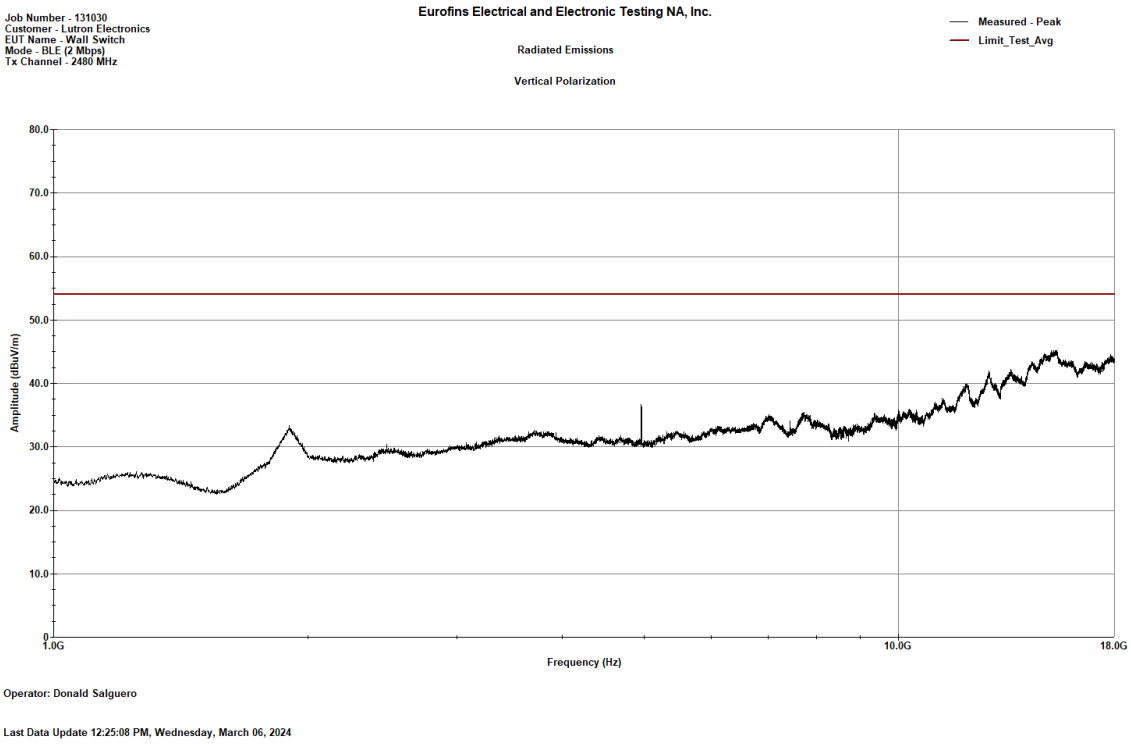


Figure 80. BLE (2 Mbps)_2480MHz_Radiated Emissions, Average, 1 - 18 GHz-_V

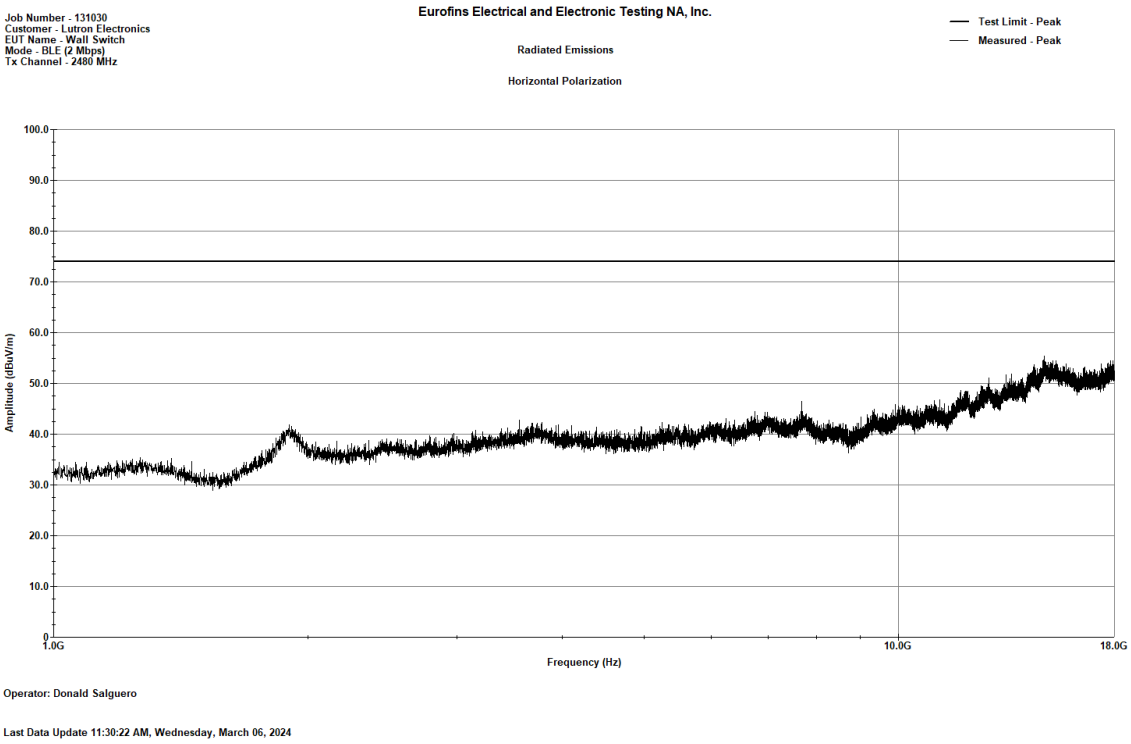


Figure 81. BLE (2 Mbps)_2480MHz_Radiated Emissions, Peak, 1 - 18 GHz-_H

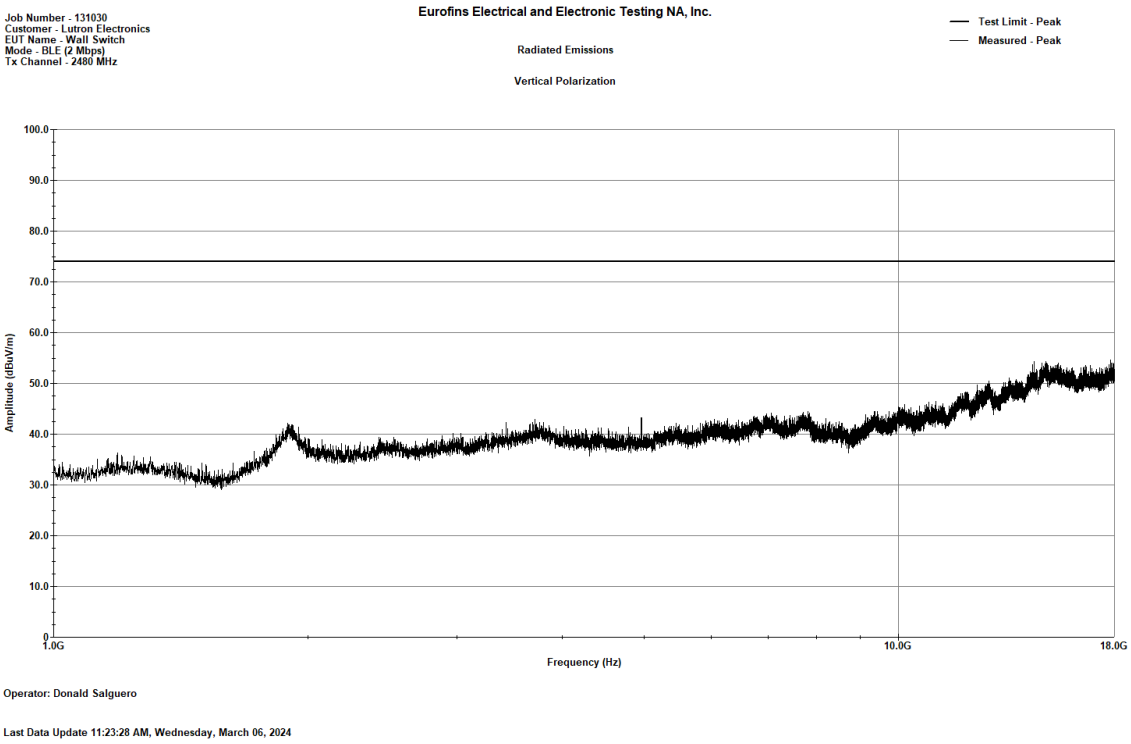


Figure 82. BLE (2 Mbps)_2480MHz_Radiated Emissions, Peak, 1 - 18 GHz-_V

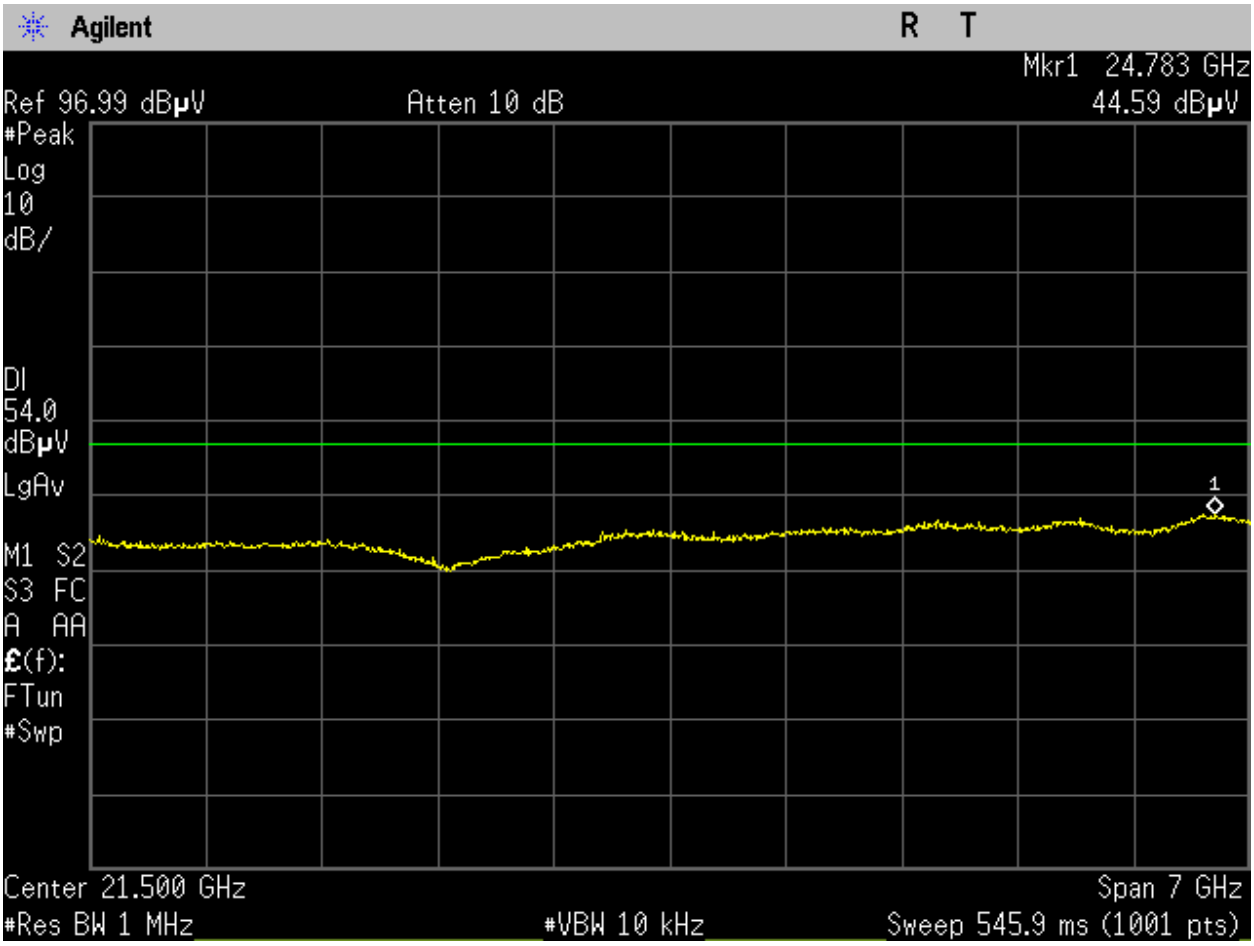


Figure 83. BLE (2 Mbps)_Radiated Spurious Emissions, Average_H_18-25GHz.

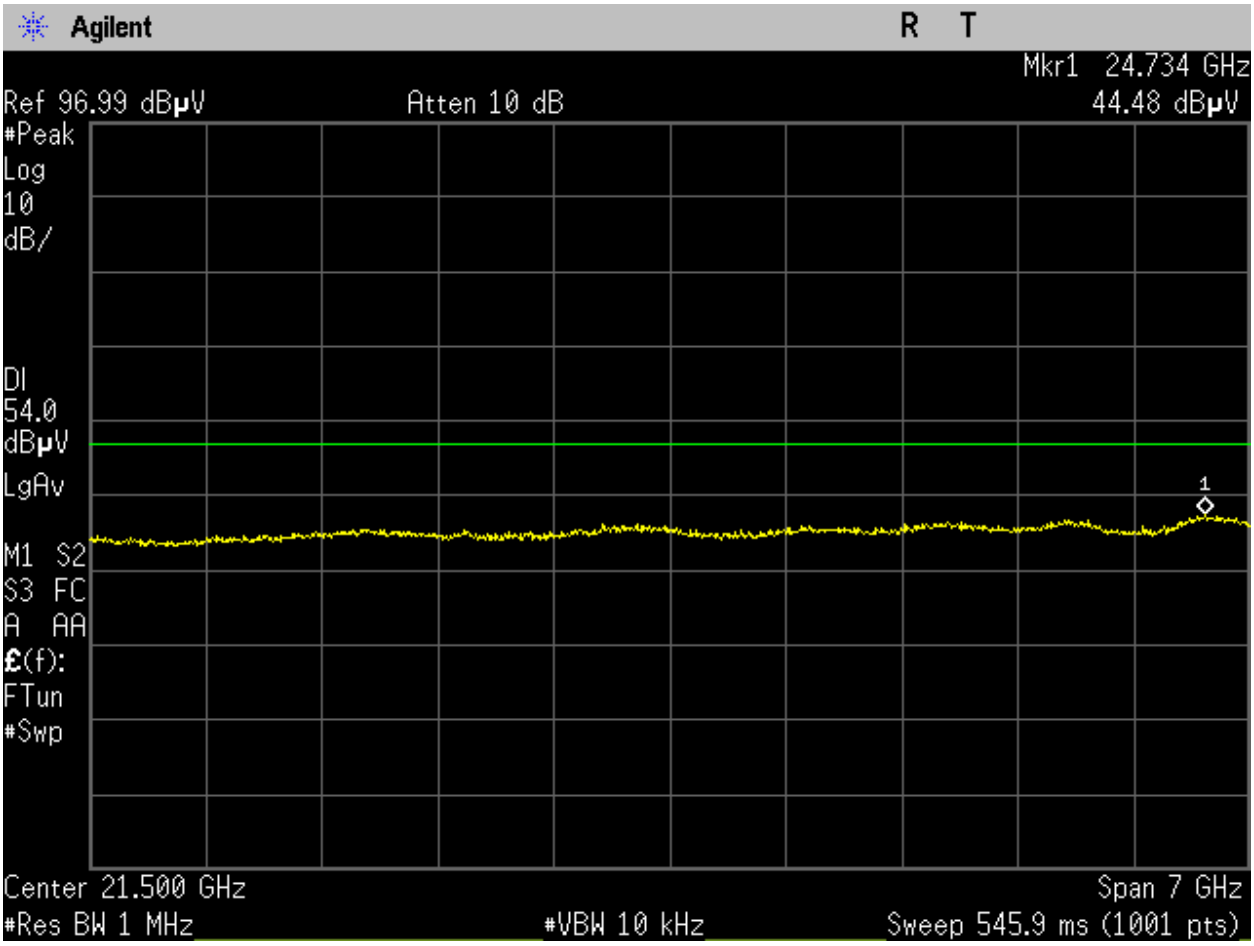


Figure 84. BLE (2 Mbps)_Radiated Spurious Emissions, Average_V_18-25GHz.

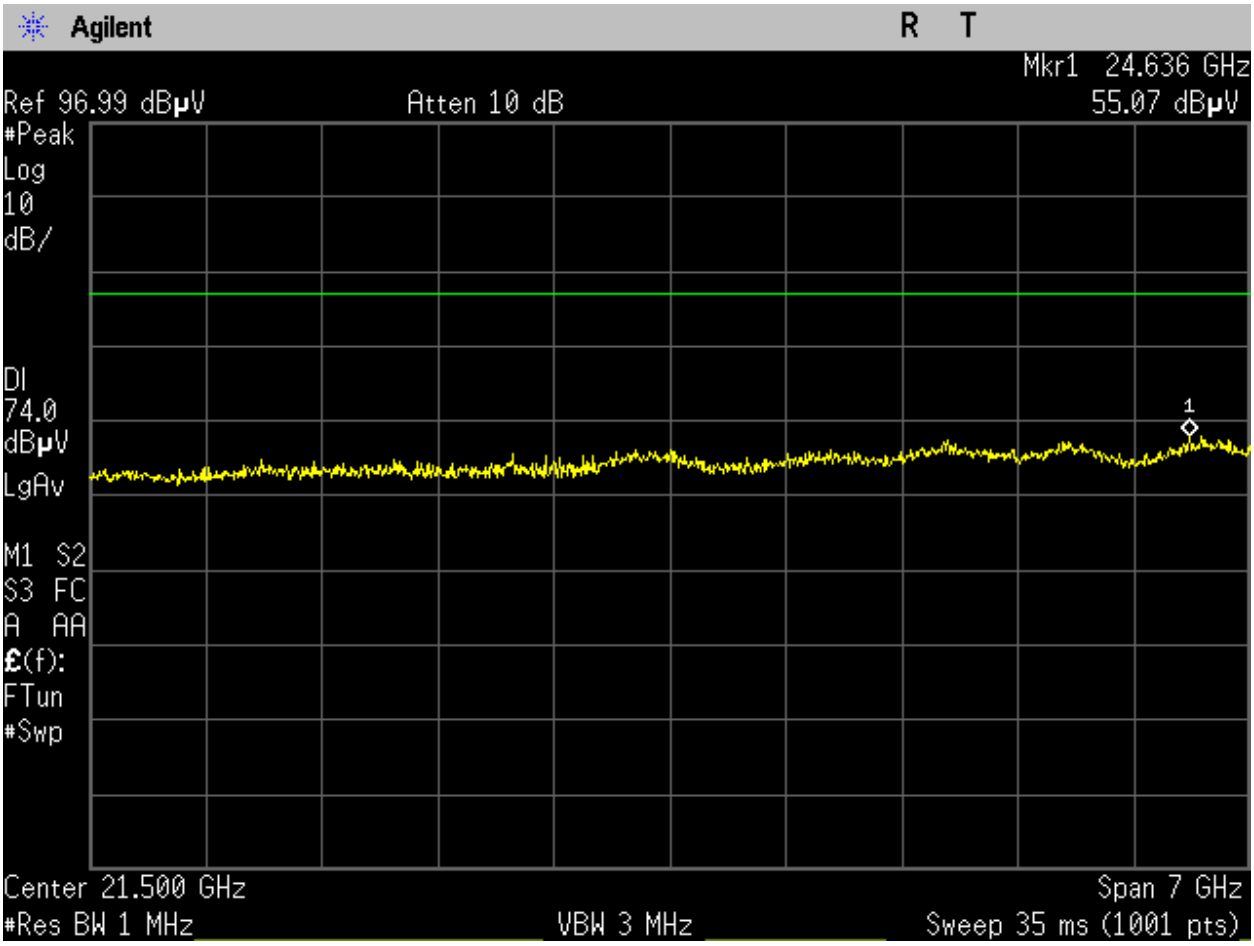


Figure 85. BLE (2 Mbps)_Radiated Spurious Emissions, Peak_H_18-25GHz.

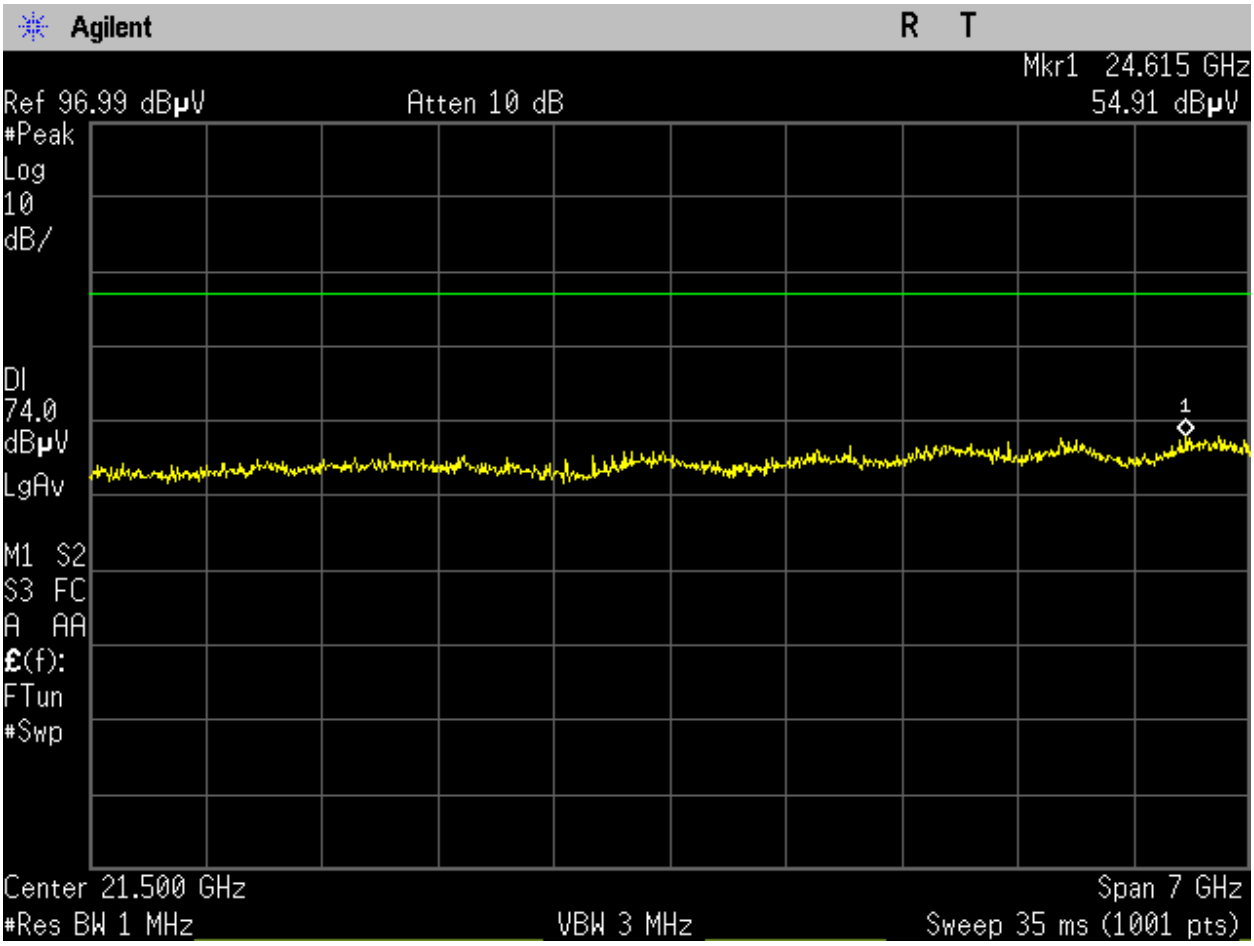
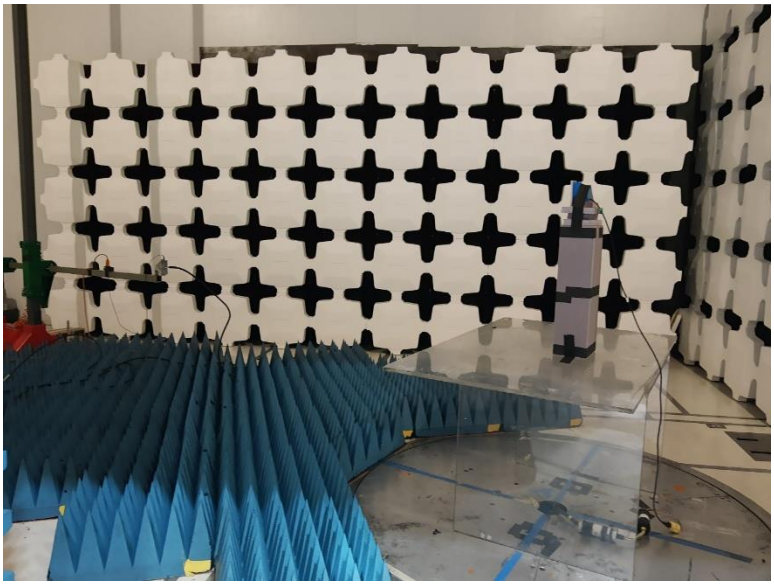
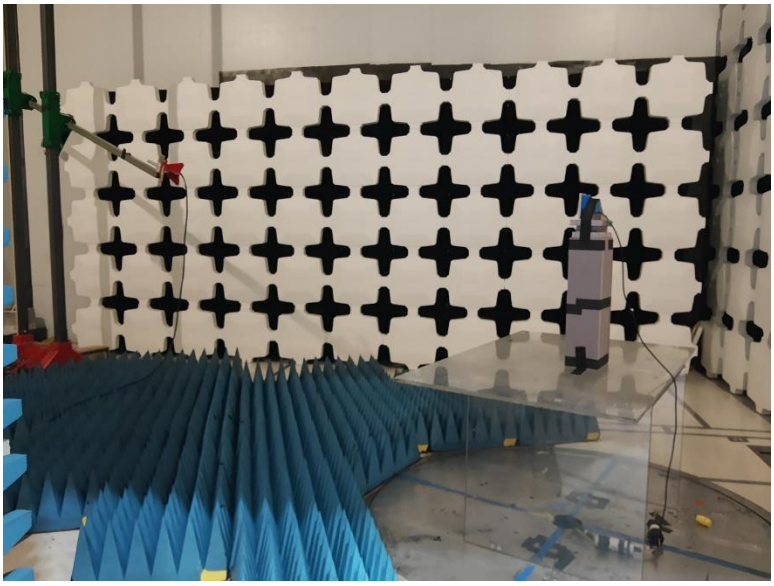


Figure 86. BLE (2 Mbps)_Radiated Spurious Emissions, Peak_V_18-25GHz.

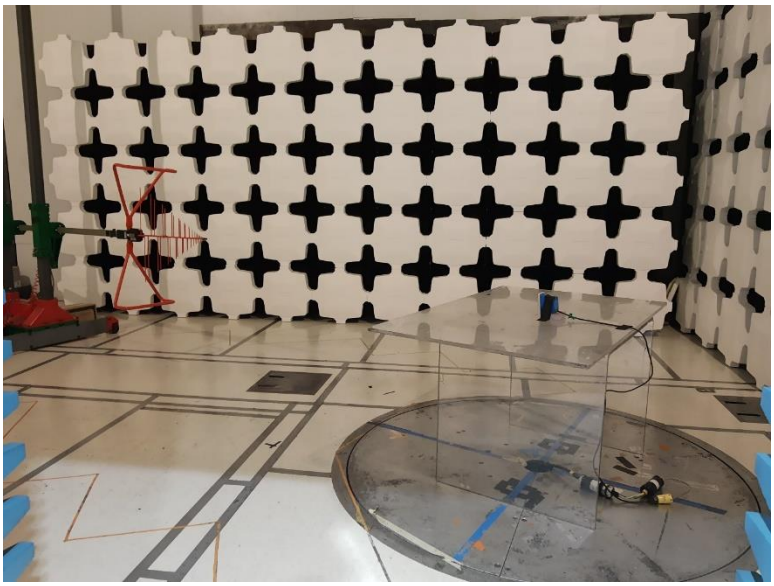
Test Photographs



Photograph 3. RE Setup [18GHz-25GHz]



Photograph 4. RE Setup [1GHz-18GHz]



Photograph 5. RE Setup [30MHz-1GHz]

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Spurious Emissions in Non-restricted Bands

Test Requirement: **15.247(d)** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Test Procedure: For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per §15.33(a)(1) and §15.33(a)(4); i.e., the lowest RF signal generated or used in the device up to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

Conducted measurements were performed. The plots were corrected for cable loss.

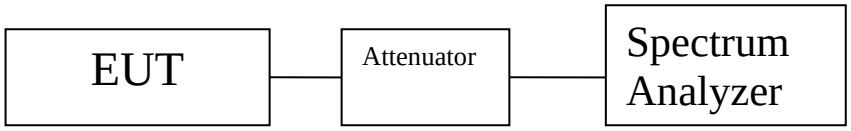


Figure 87. Block Diagram, Conducted Spurious Emissions Test Setup

RSS-247 (5.5) RF Conducted Spurious Emissions

Test Requirements: **RSS-247 (5.5):** Out-of-Band Emissions

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Test Procedure: For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per section 5.5 of ANSI C63.10-2013; i.e., the lowest RF signal generated or used in the device up to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

The EUT was connected to a spectrum analyzer through a cable and an attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels for all its bandwidths at maximum power. Conducted spurious emissions were measured according to sections 11.11.2 and 11.11.3 of ANSI C63.10-2013.

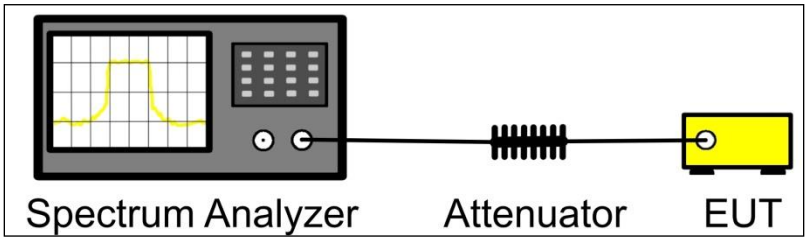


Figure 88. Block Diagram, Conducted Spurious Emissions Test Setup

Test Results: The EUT was **compliant** with this requirement.

Test Engineer: Donald Salguero

Test Date: March 7, 2024

Test Data

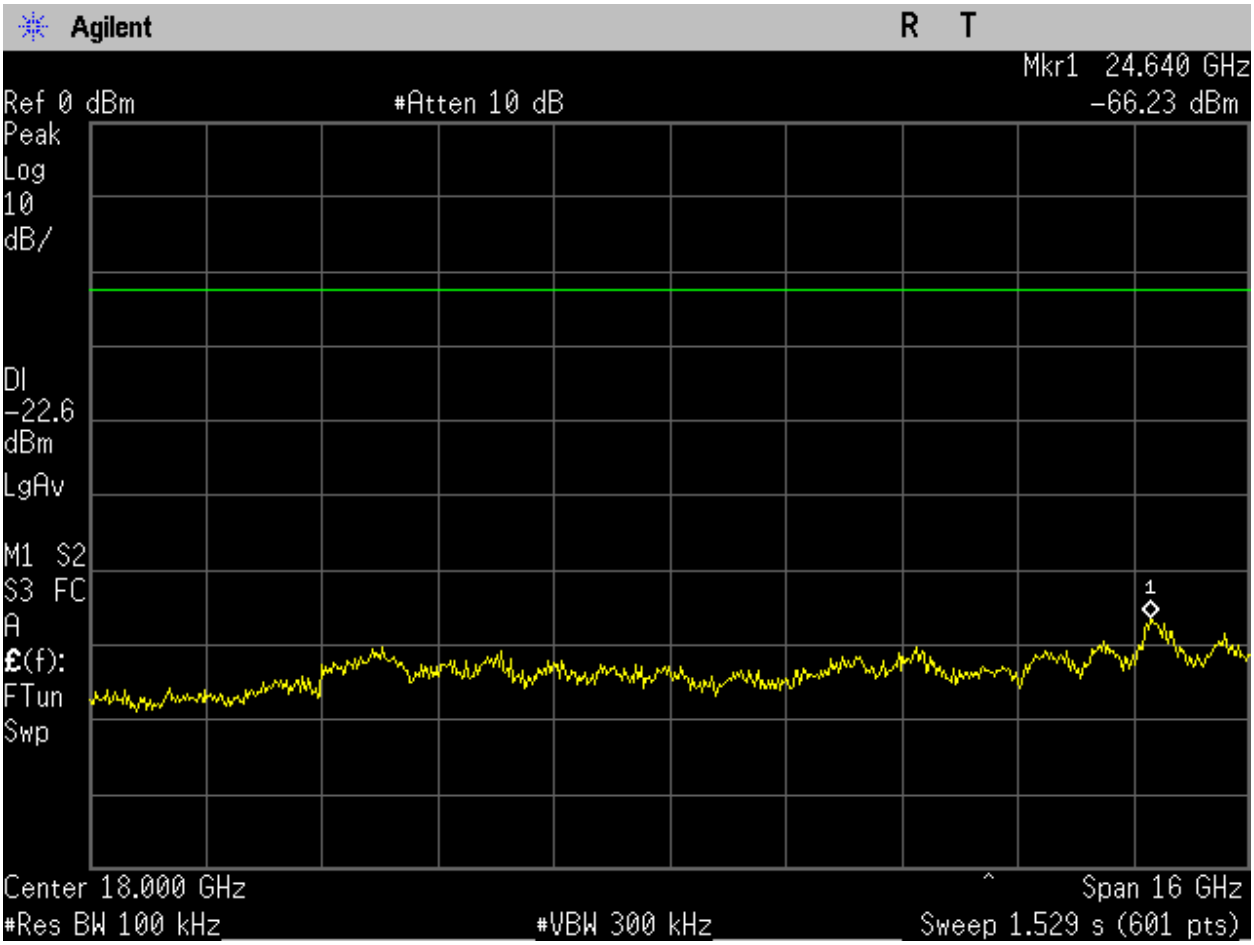


Figure 89. BLE_High Ch_2480MHz_1MBit_-20dBc_10-26GHz_Port 1.

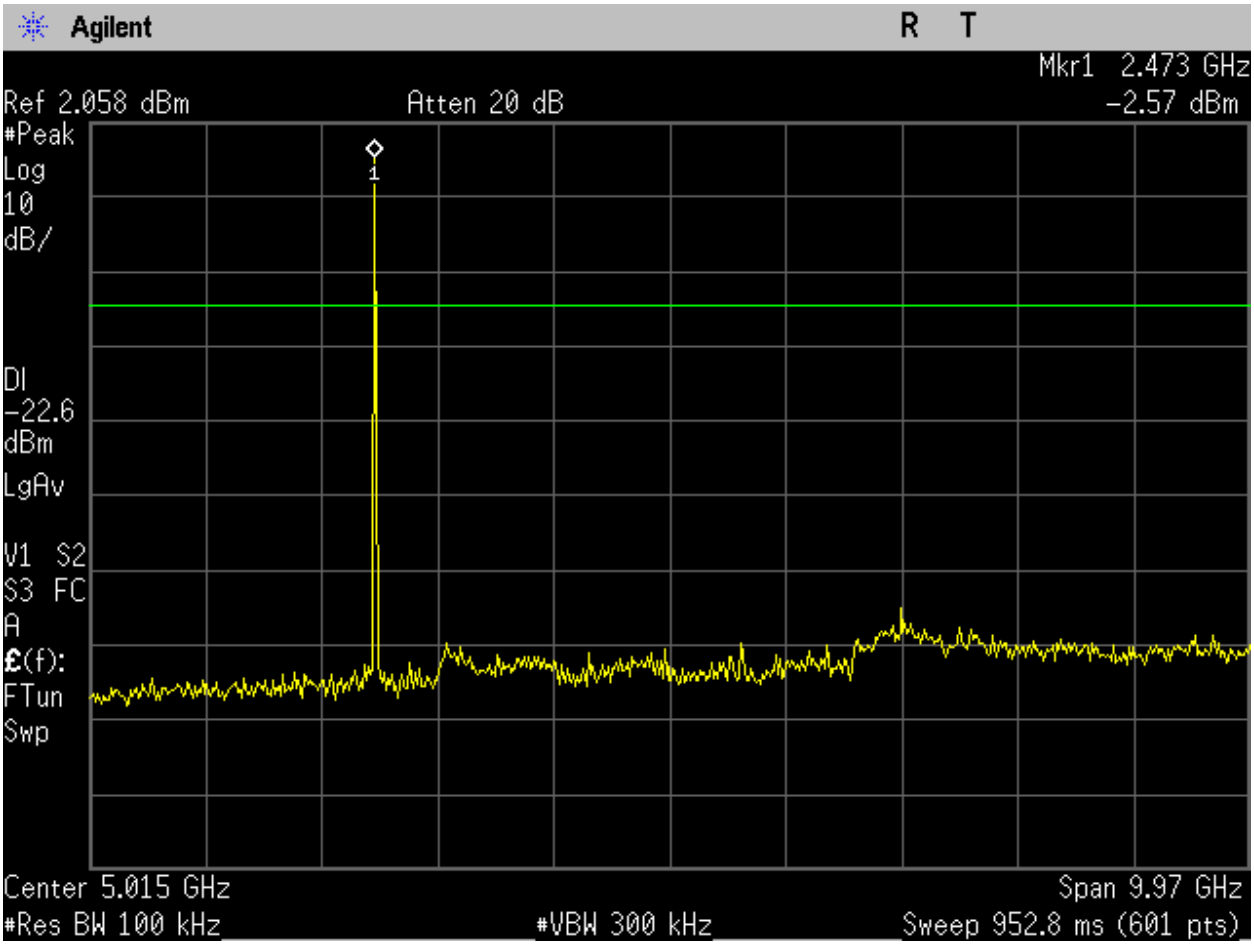


Figure 90. BLE_High Ch_2480MHz_1MBit_-20dBc_30MHz-10GHz_Port 1.

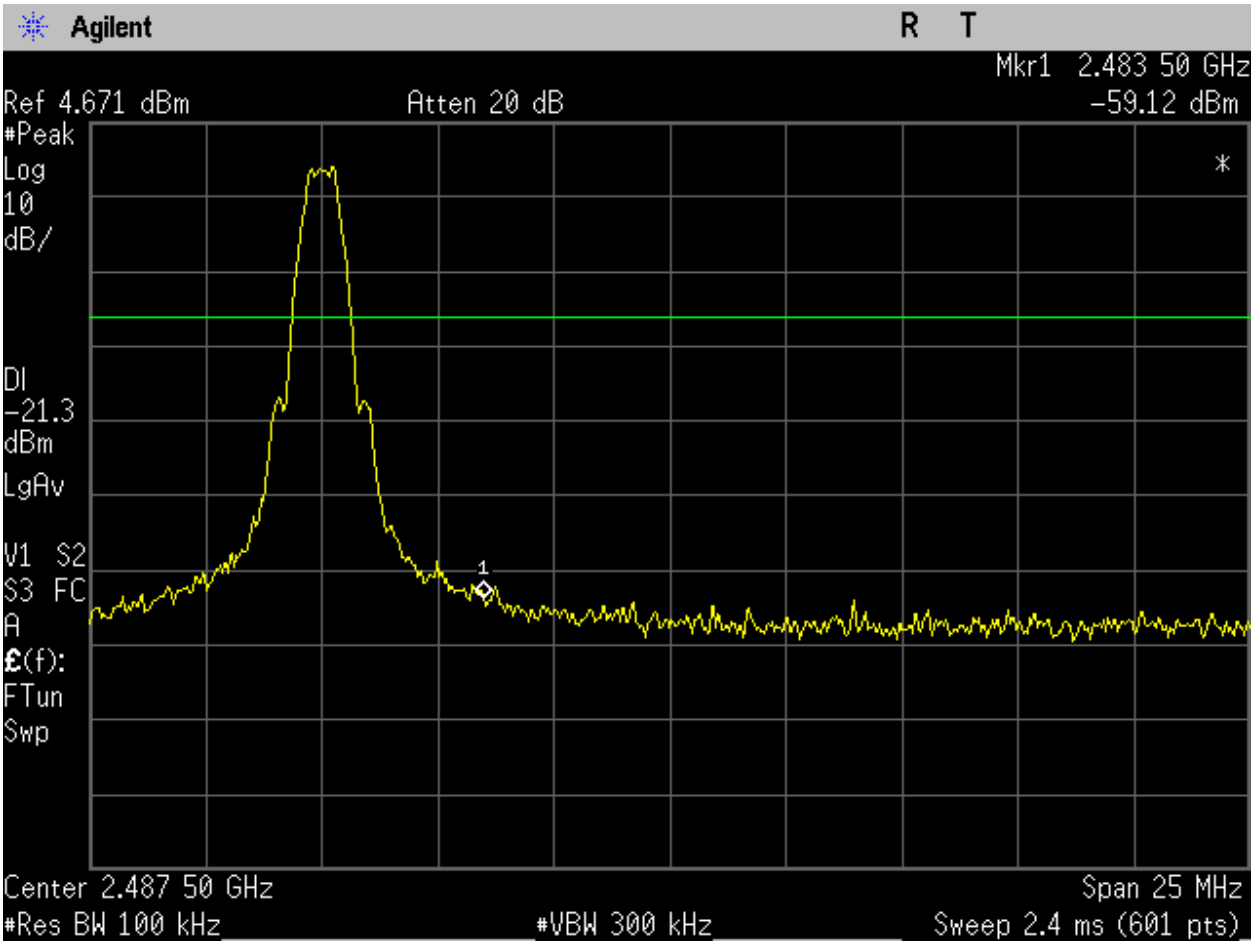


Figure 91. BLE_High Ch_2480MHz_1MBit_-20dBc_Upper Band Edge_Port 1.

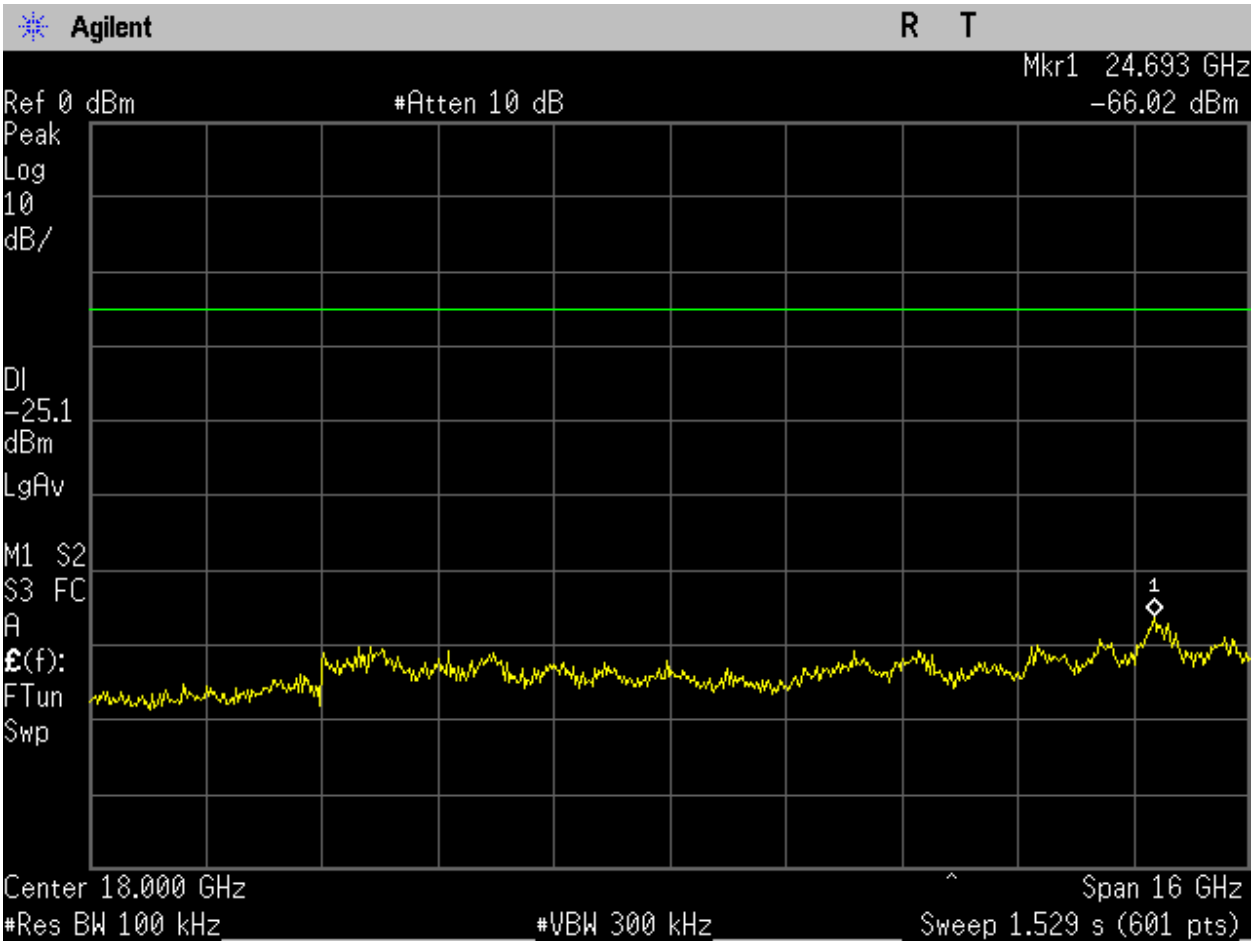


Figure 92. BLE_High Ch_2480MHz_2MBit_-20dBc_10-26GHz_Port 1.

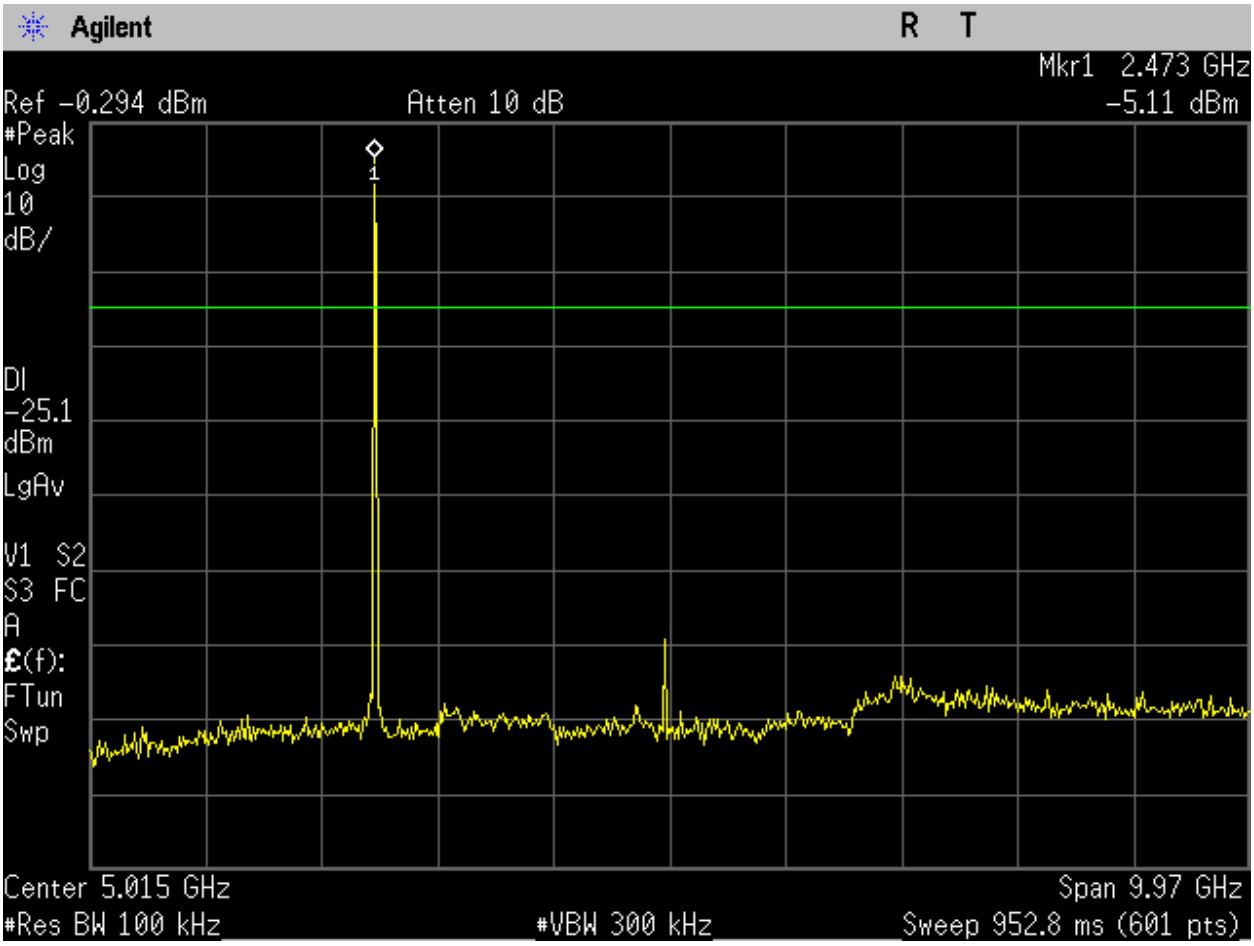


Figure 93. BLE_High Ch_2480MHz_2MBit_-20dBc_30MHz-10GHz_Port 1.

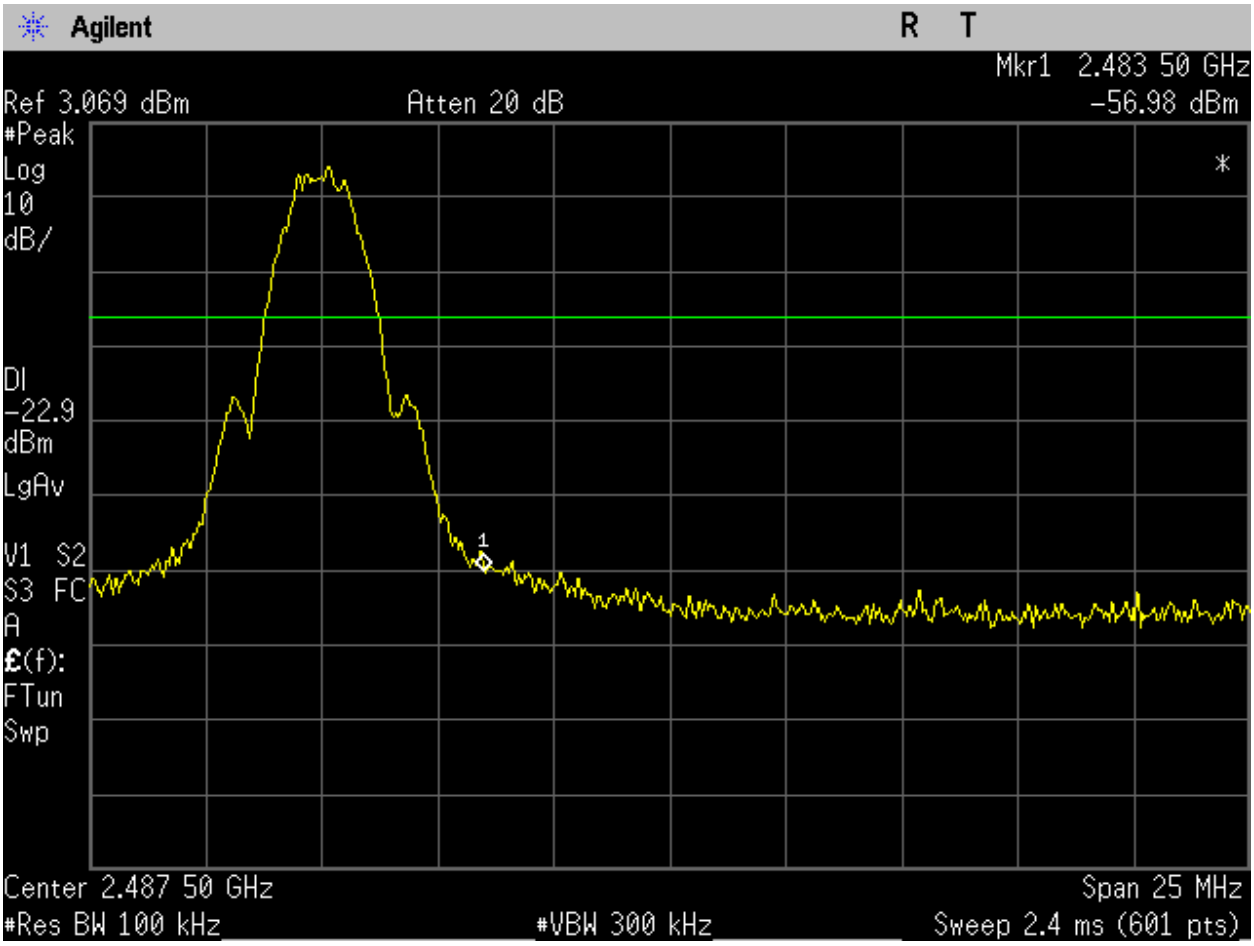


Figure 94. BLE_High Ch_2480MHz_2MBit_-20dBc_Upper Band Edge_Port 1.

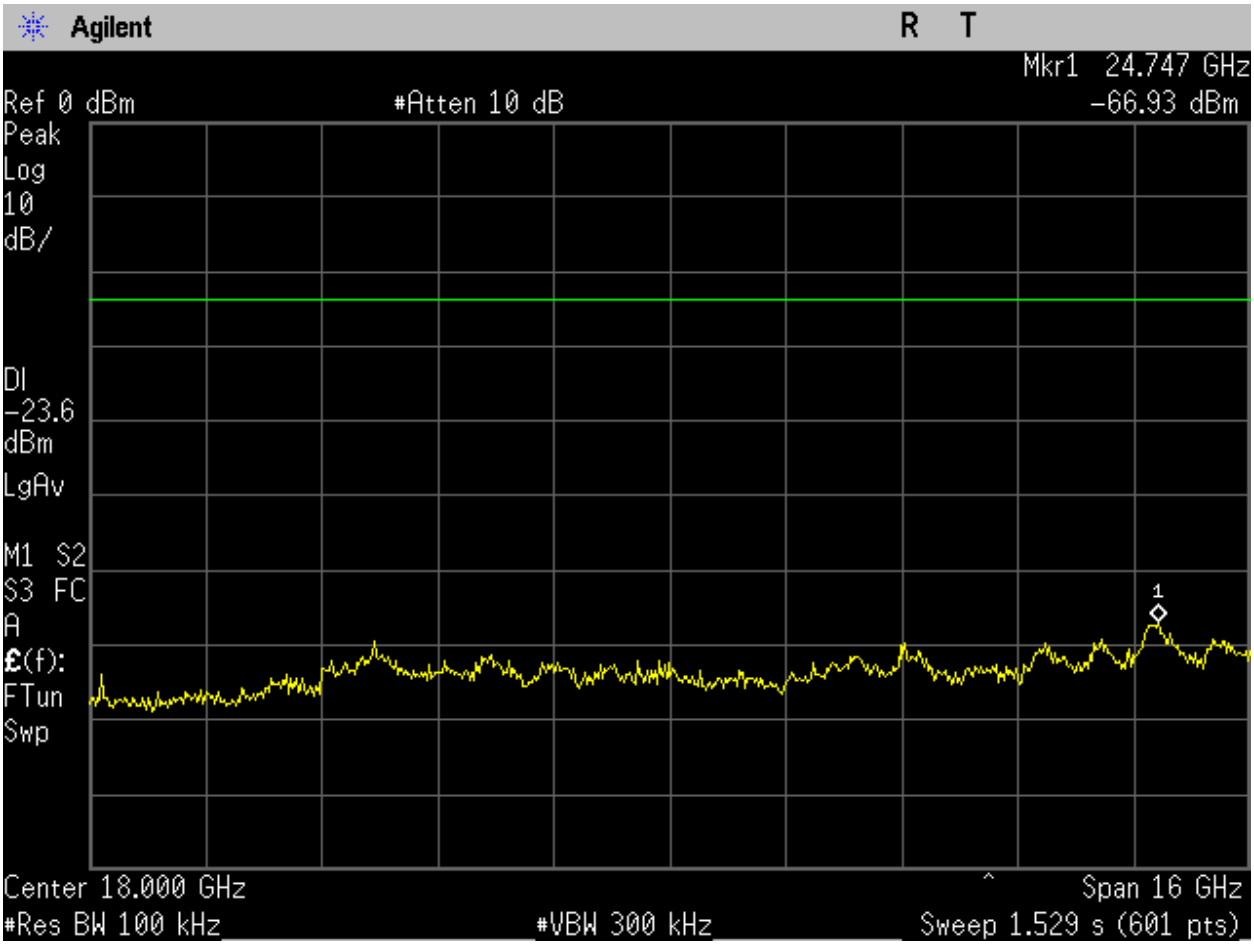


Figure 95. BLE_Low Ch_2402MHz_1MBit_-20dBc_10-26GHz_Port 1.

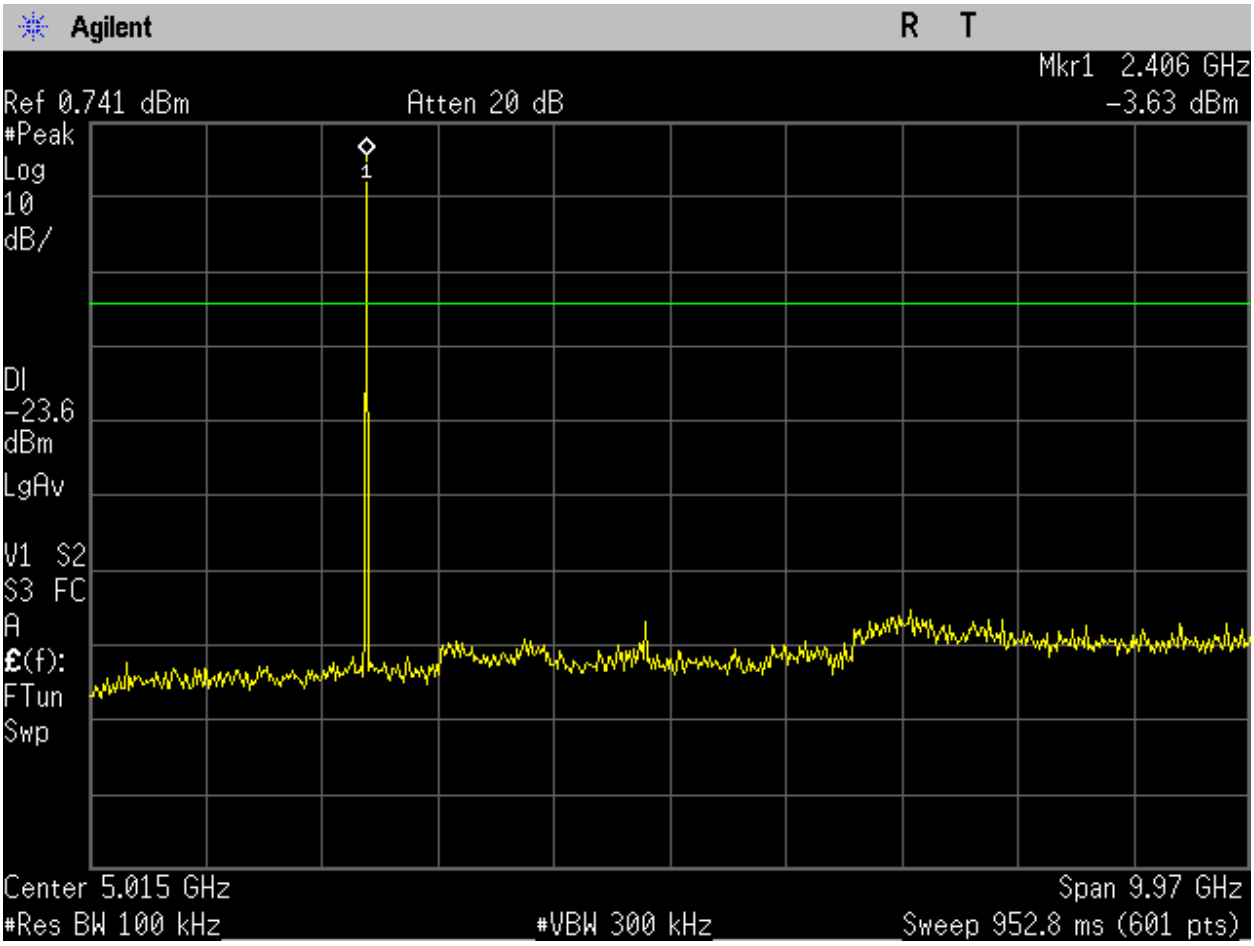


Figure 96. BLE_Low Ch_2402MHz_1MBit_-20dBc_30MHz-10GHz_Port 1.

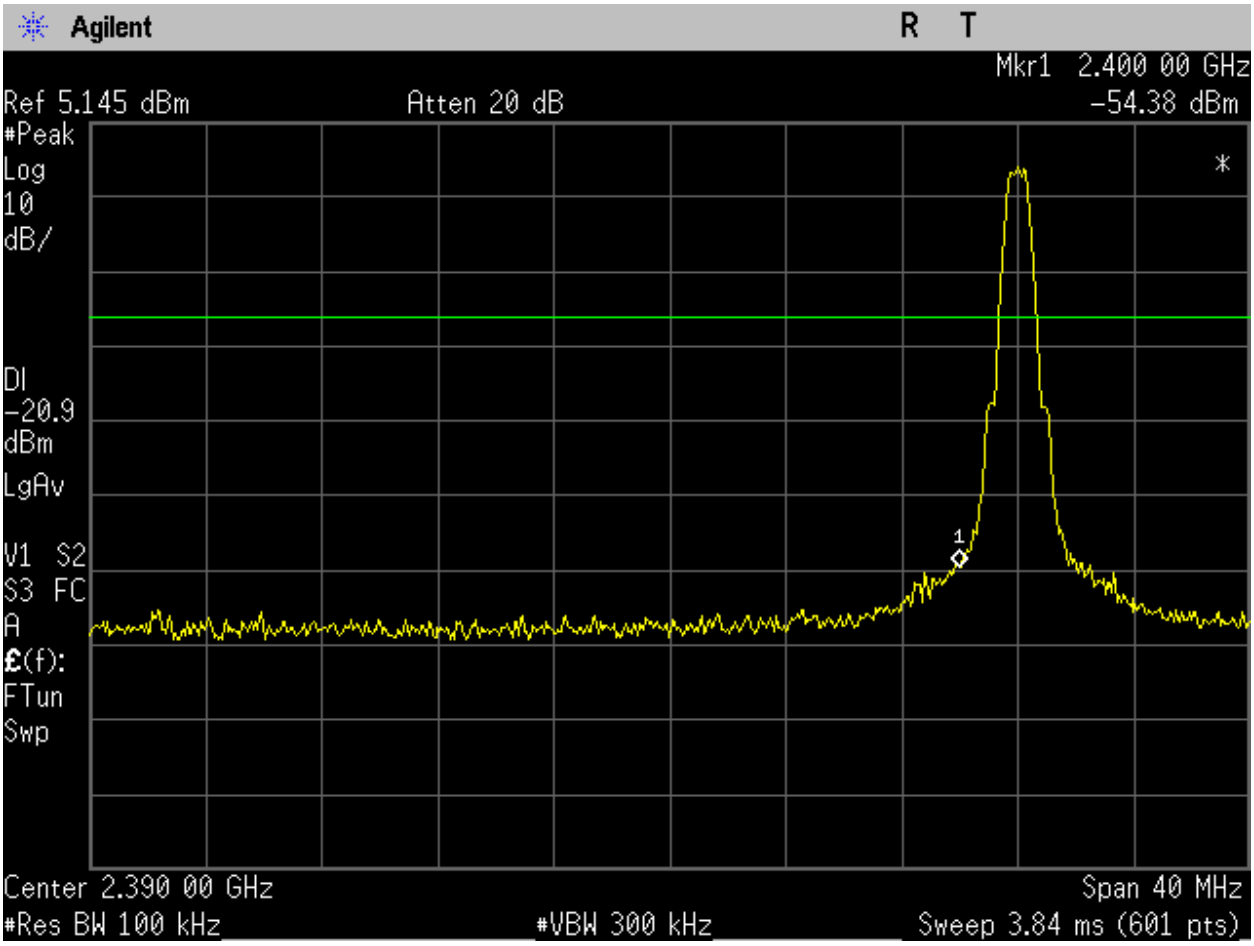


Figure 97. BLE_Low Ch_2402MHz_1MBit_-20dBc_Lower Band Edge_Port 1.

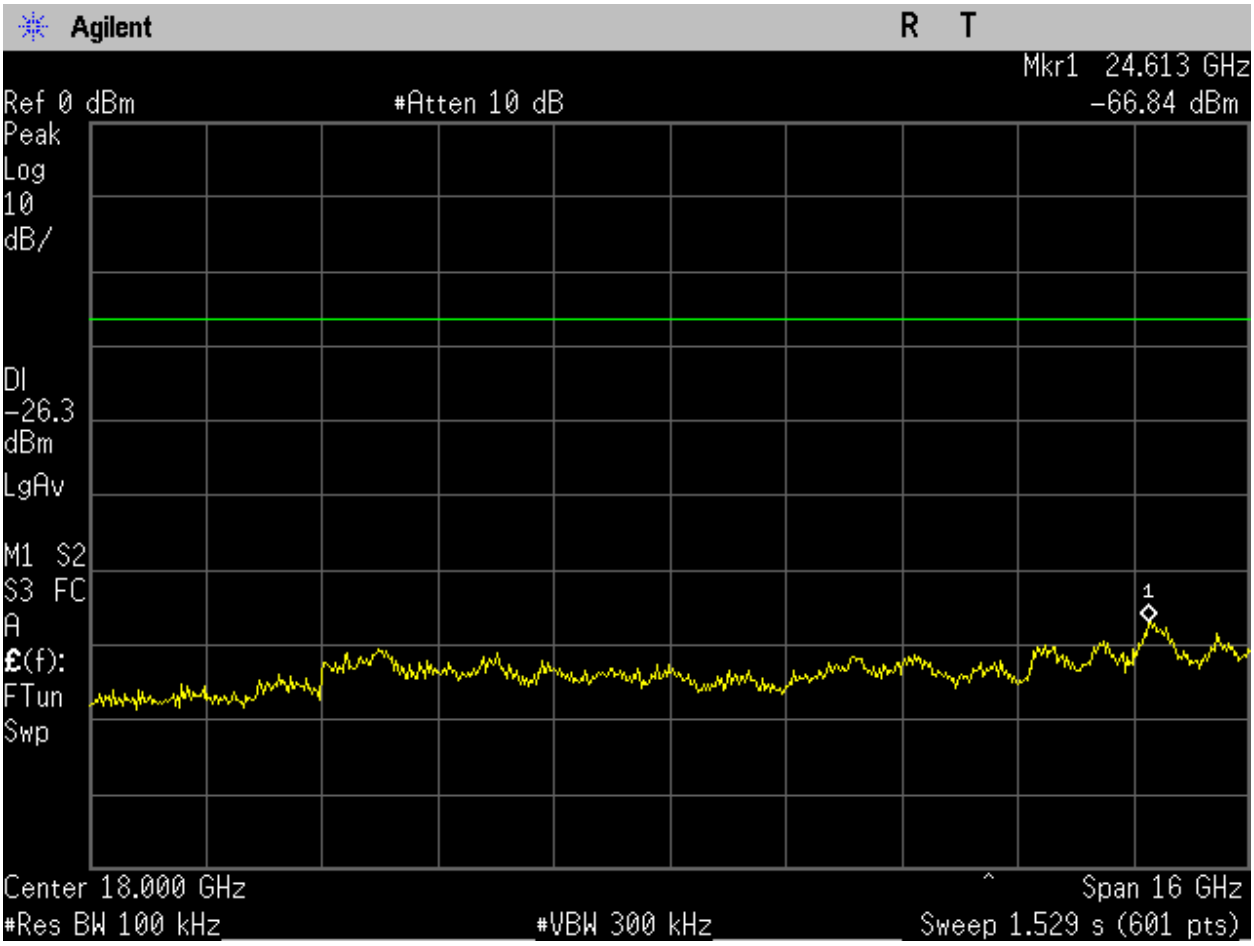


Figure 98. BLE_Low Ch_2402MHz_2MBit_-20dBc_10-26GHz_Port 1.

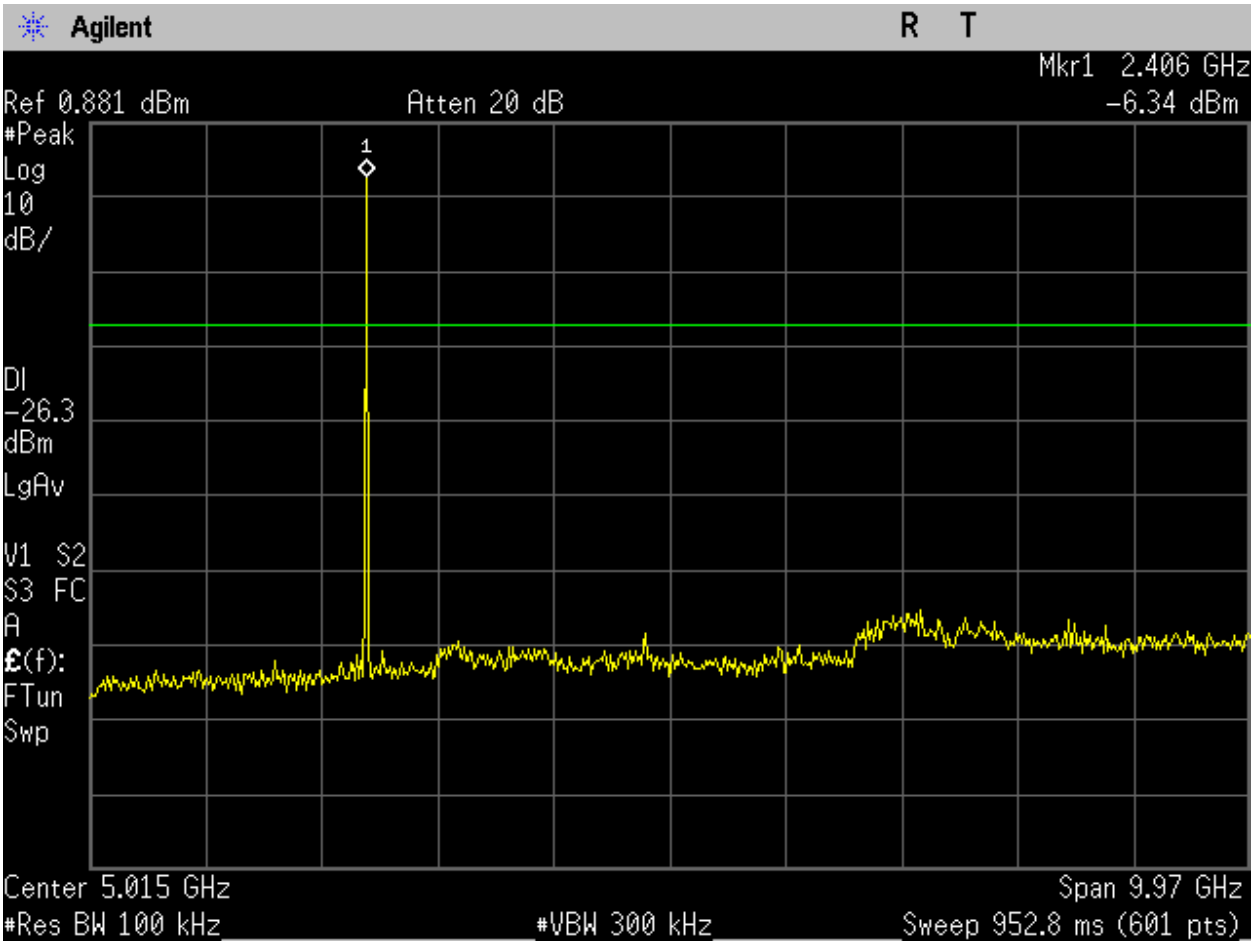


Figure 99. BLE_Low Ch_2402MHz_2MBit_-20dBc_30MHz-10GHz_Port 1.

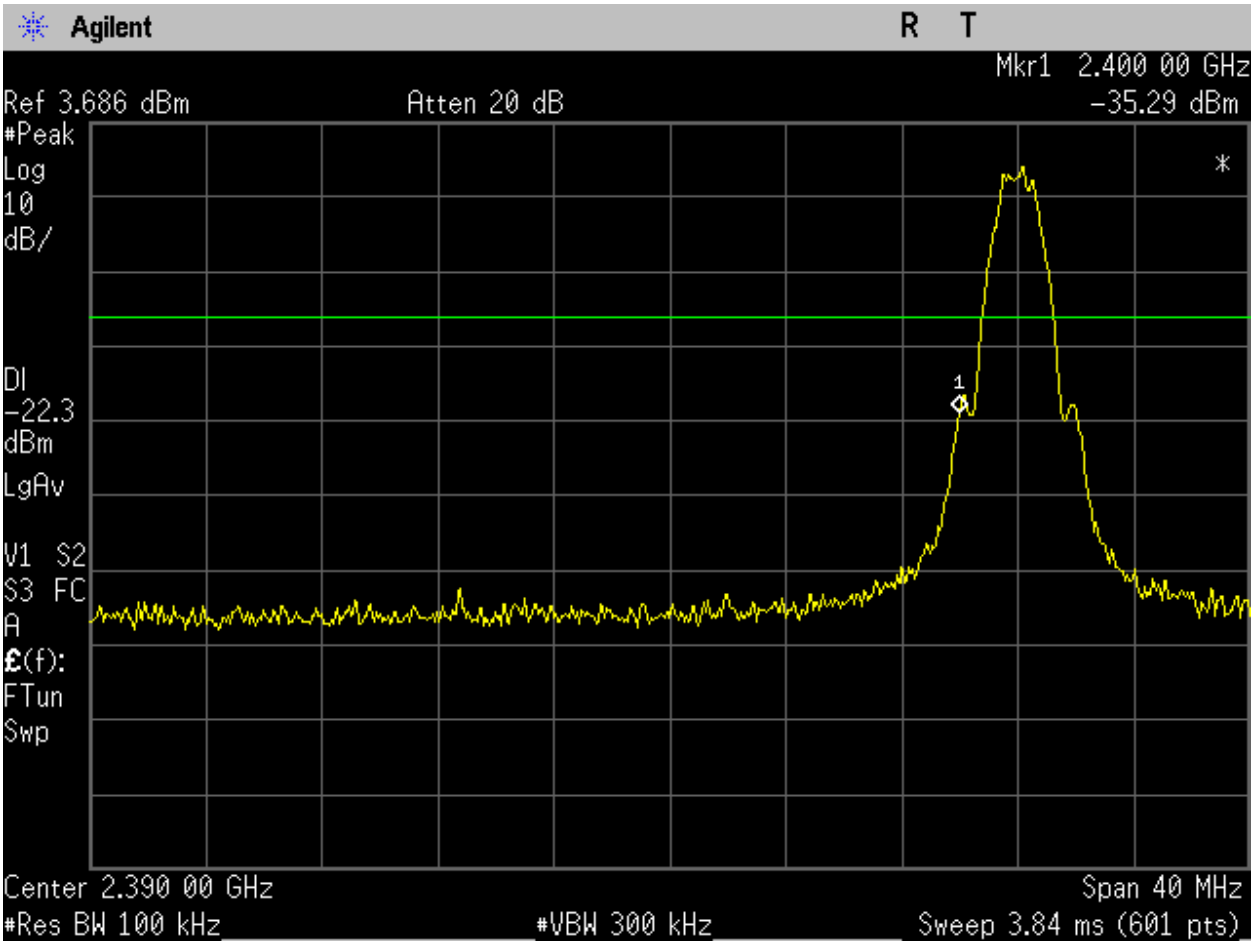


Figure 100. BLE_Low Ch_2402MHz_2MBit_-20dBc_Lower Band Edge_Port 1.

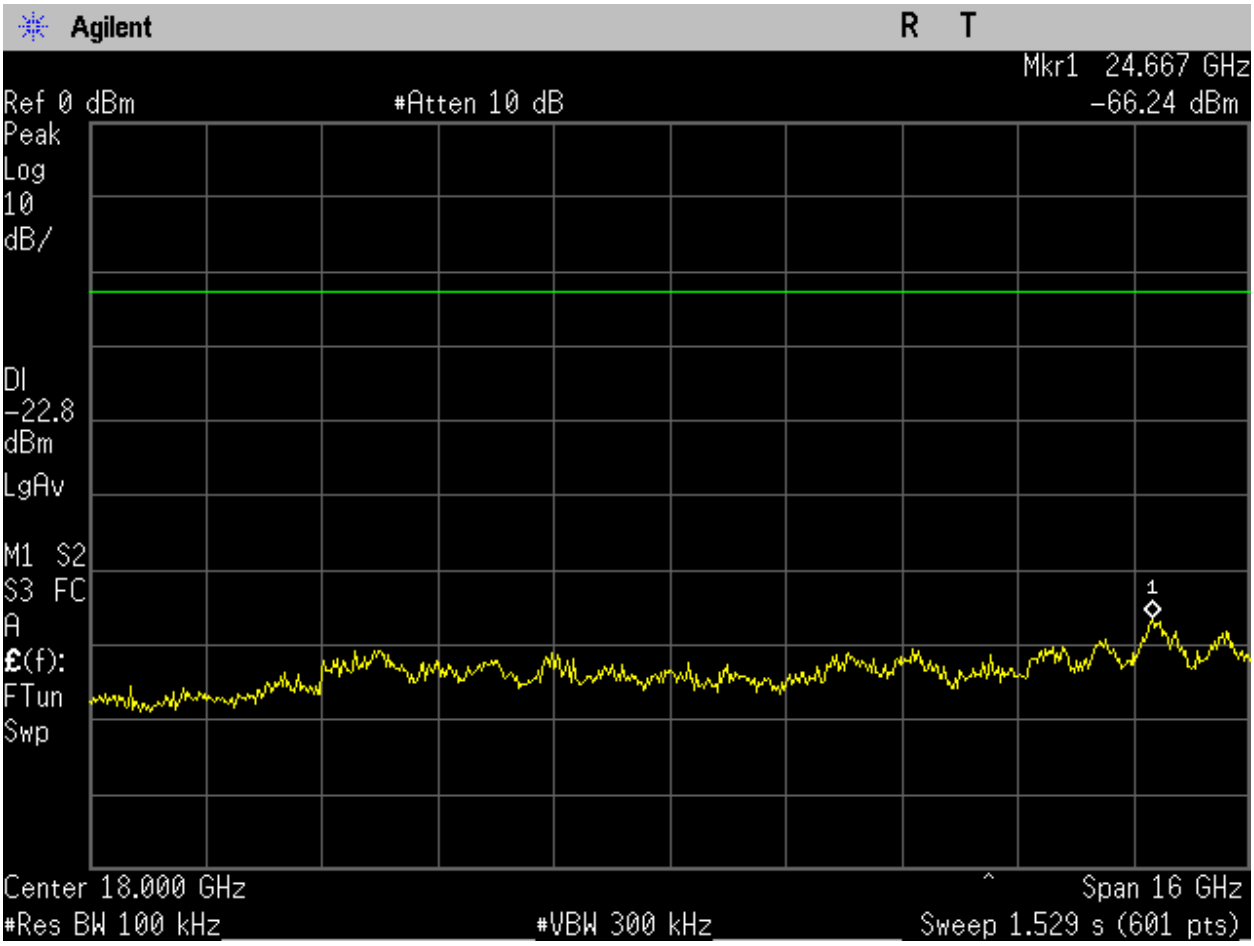


Figure 101. BLE_Mid Ch_2440MHz_1MBit_-20dBc_10-26GHz_Port 1.

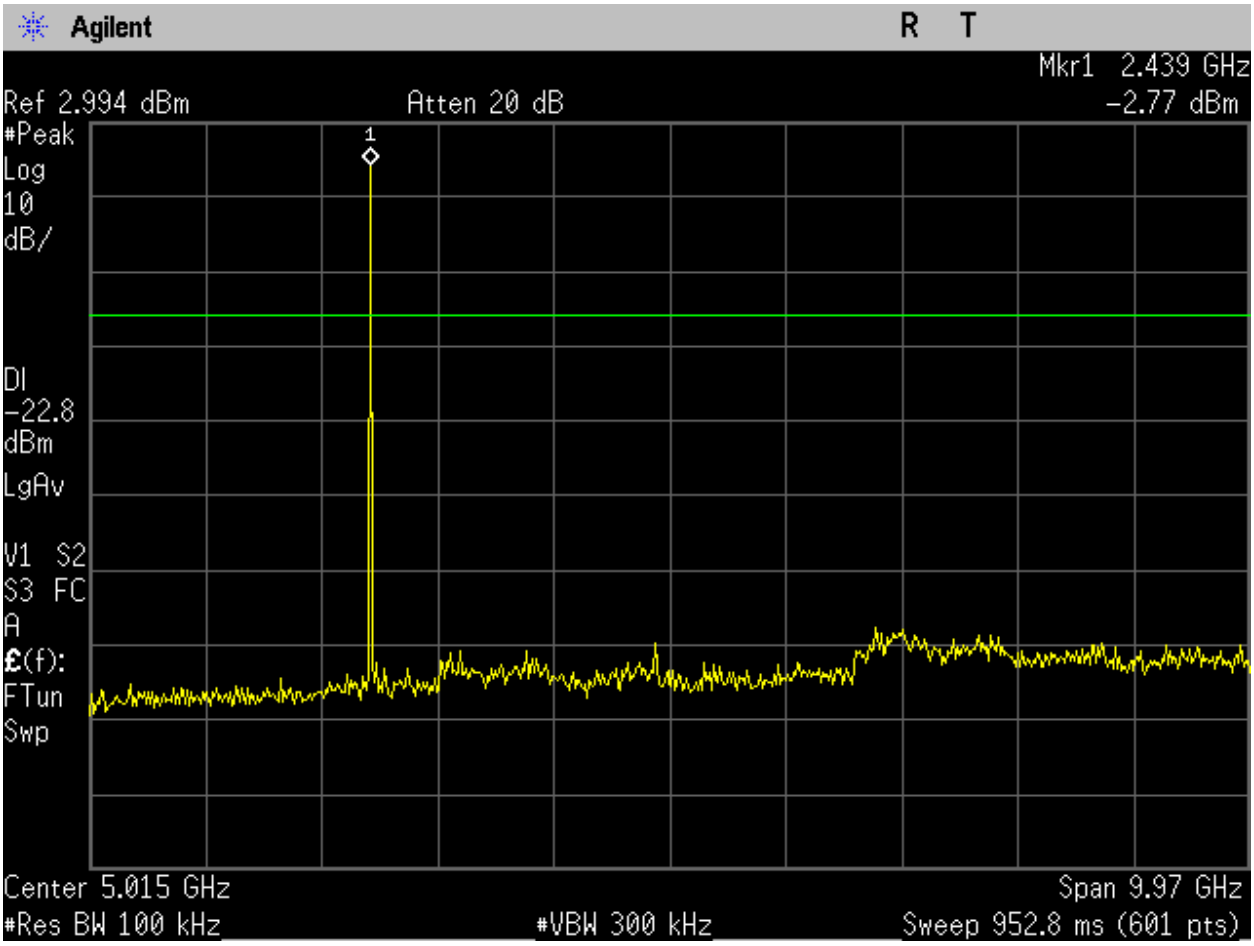


Figure 102. BLE_Mid Ch_2440MHz_1MBit_-20dBc_30MHz-10GHz_Port 1.

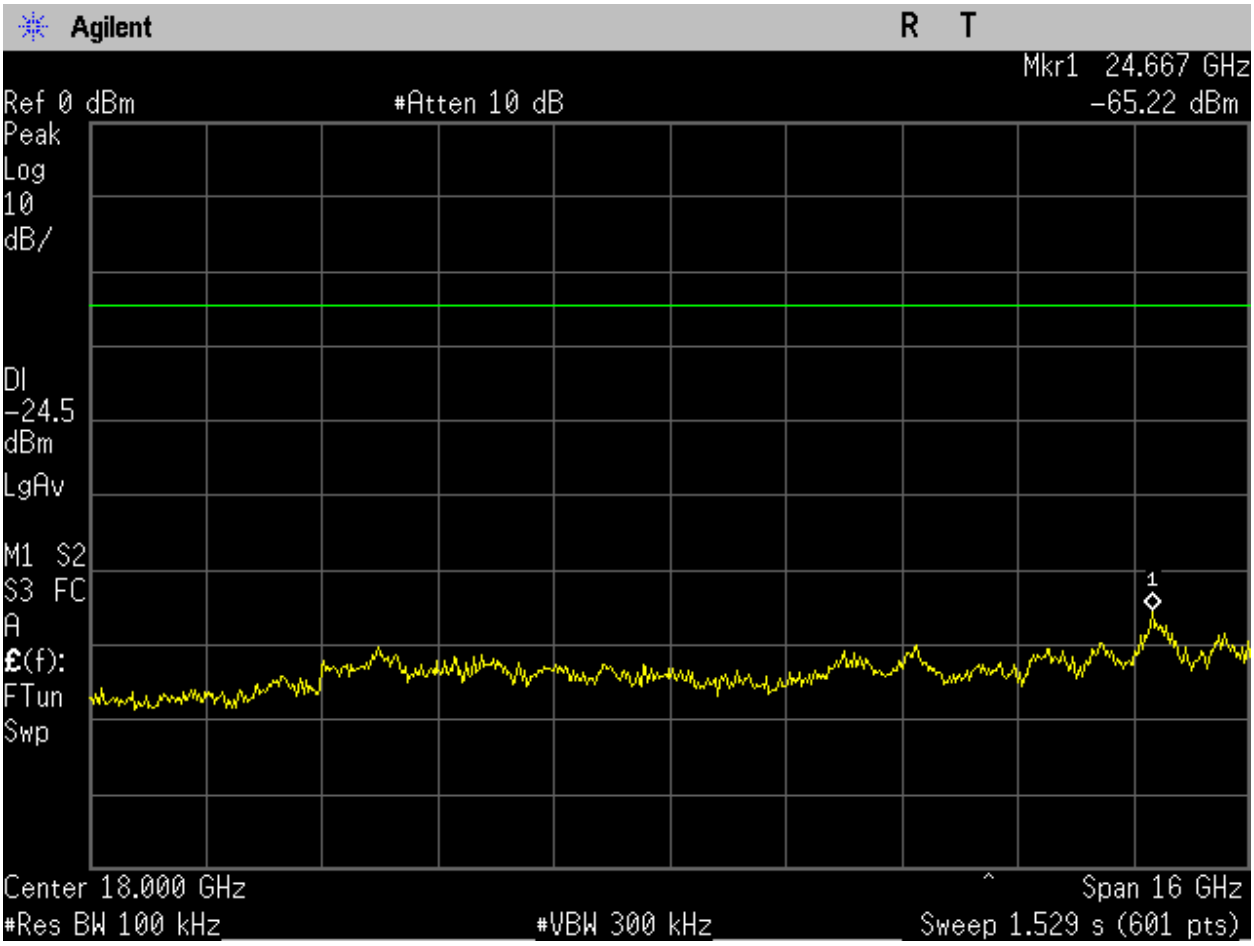


Figure 103. BLE_Mid Ch_2440MHz_2MBit_-20dBc_10-26GHz_Port 1.

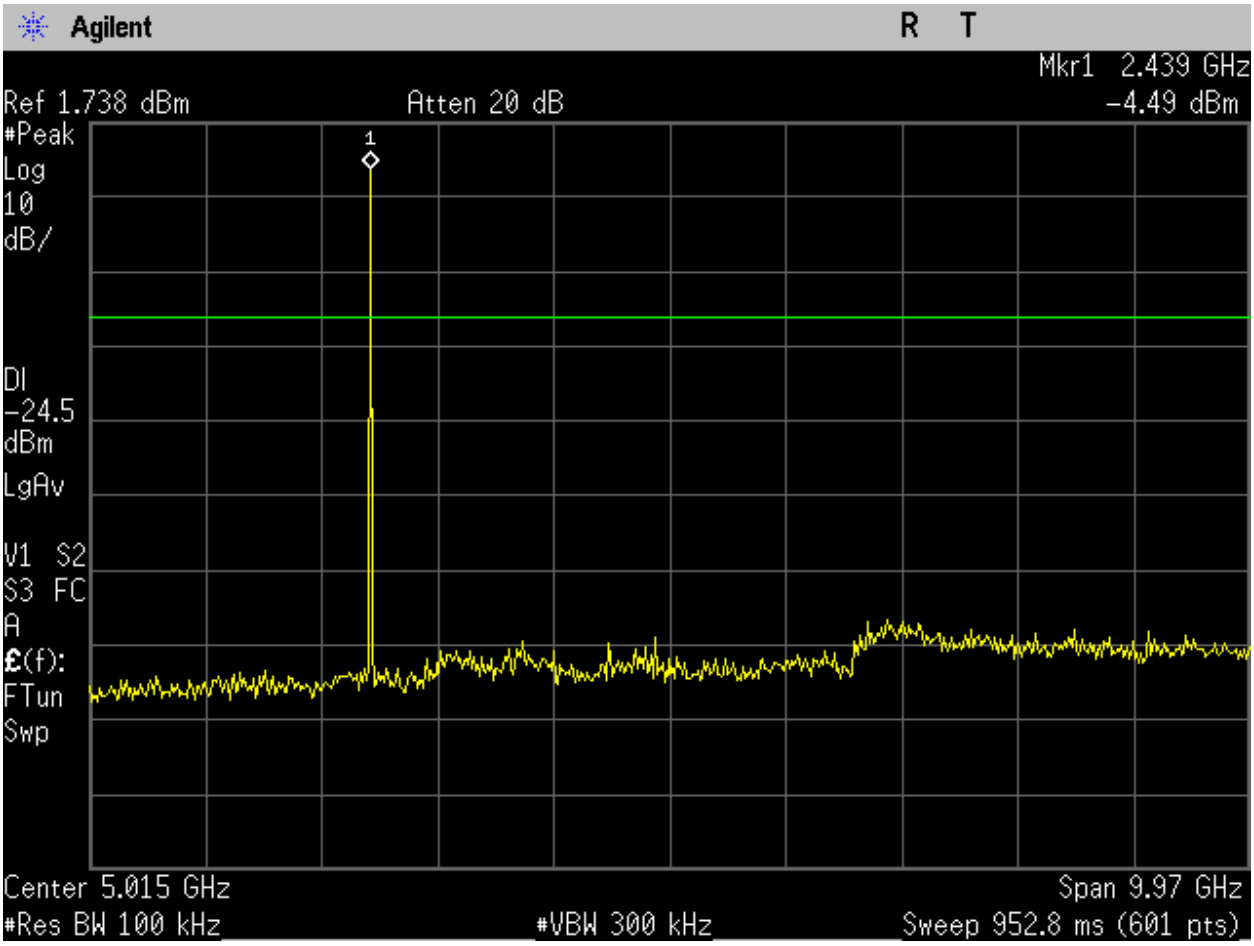


Figure 104. BLE_Mid Ch_2440MHz_2MBit_-20dBc_30MHz-10GHz_Port 1.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(e) Peak Power Spectral Density

Test Requirements: **§15.247(e):** For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

Test Procedure: The EUT was connected to a spectrum analyzer through a cable and an attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels for all its bandwidths at maximum power. Power spectral density was measured according to measurement method PKPSD, as described in ANSI C63.10-2013, section 11.10.2. Attenuator and cable loss factors were programmed into the spectrum analyzer.

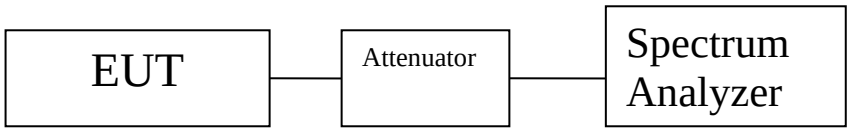


Figure 105. Block Diagram, Power Spectral Density Test Setup

RSS-247 (5.2) Power Spectral Density

Test Requirements: **RSS-247 (5.2):** The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of Section 5.4 (d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

Test Procedure: The EUT was connected to a spectrum analyzer through a cable and an attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels for all its bandwidths at maximum power. Power spectral density was measured according to measurement method PKPSD, as described in ANSI C63.10-2013, section 11.10.2. Attenuator and cable loss factors were programmed into the spectrum analyzer.

Test Results: The EUT was **compliant** with this requirement.

Test Engineer: Donald Salguero

Test Date: March 7, 2024

Test Data

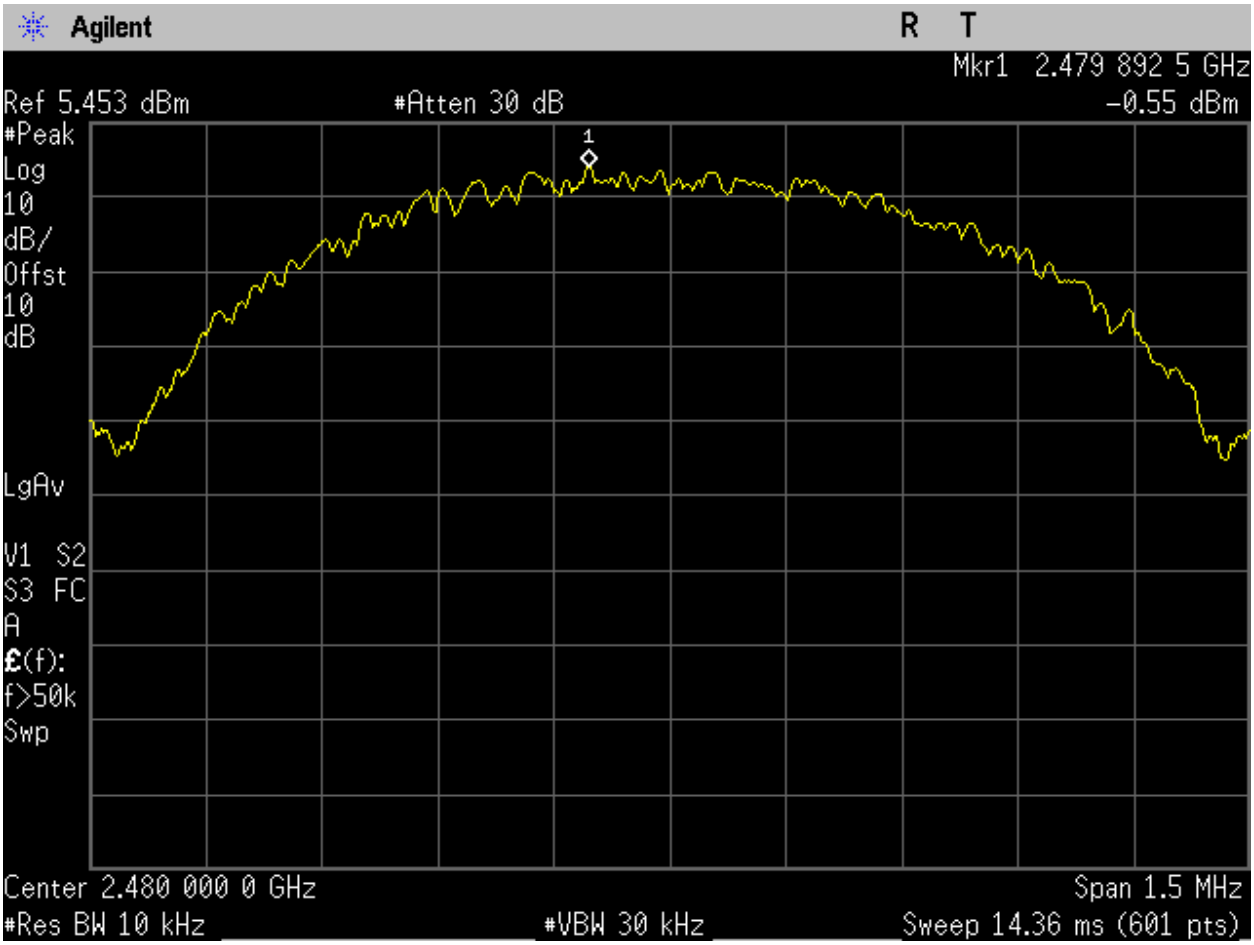


Figure 106. BLE_High Ch_2480MHz_1MBit_Spectral Density_Port 1.

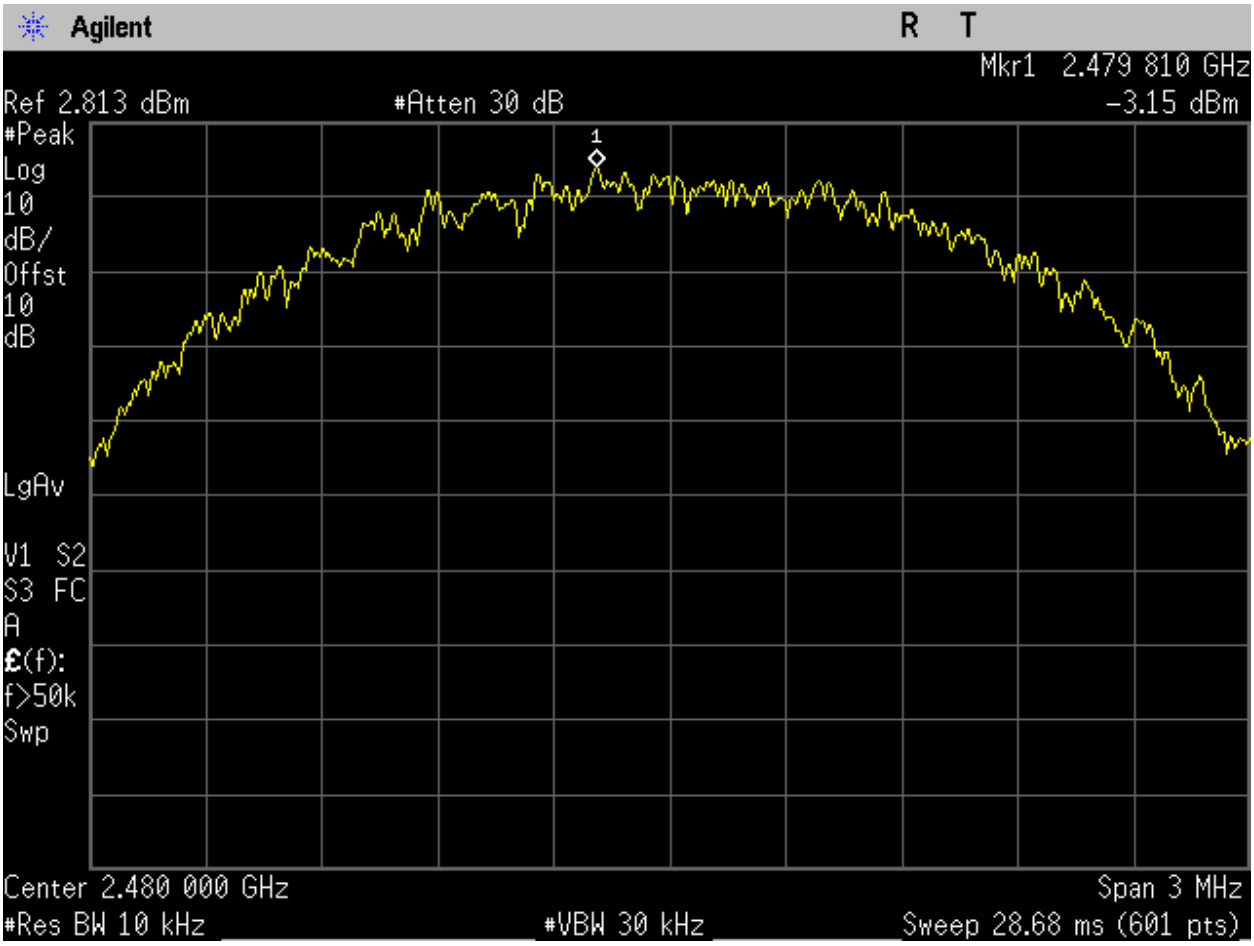


Figure 107. BLE_High Ch_2480MHz_2MBit_Spectral Density_Port 1.

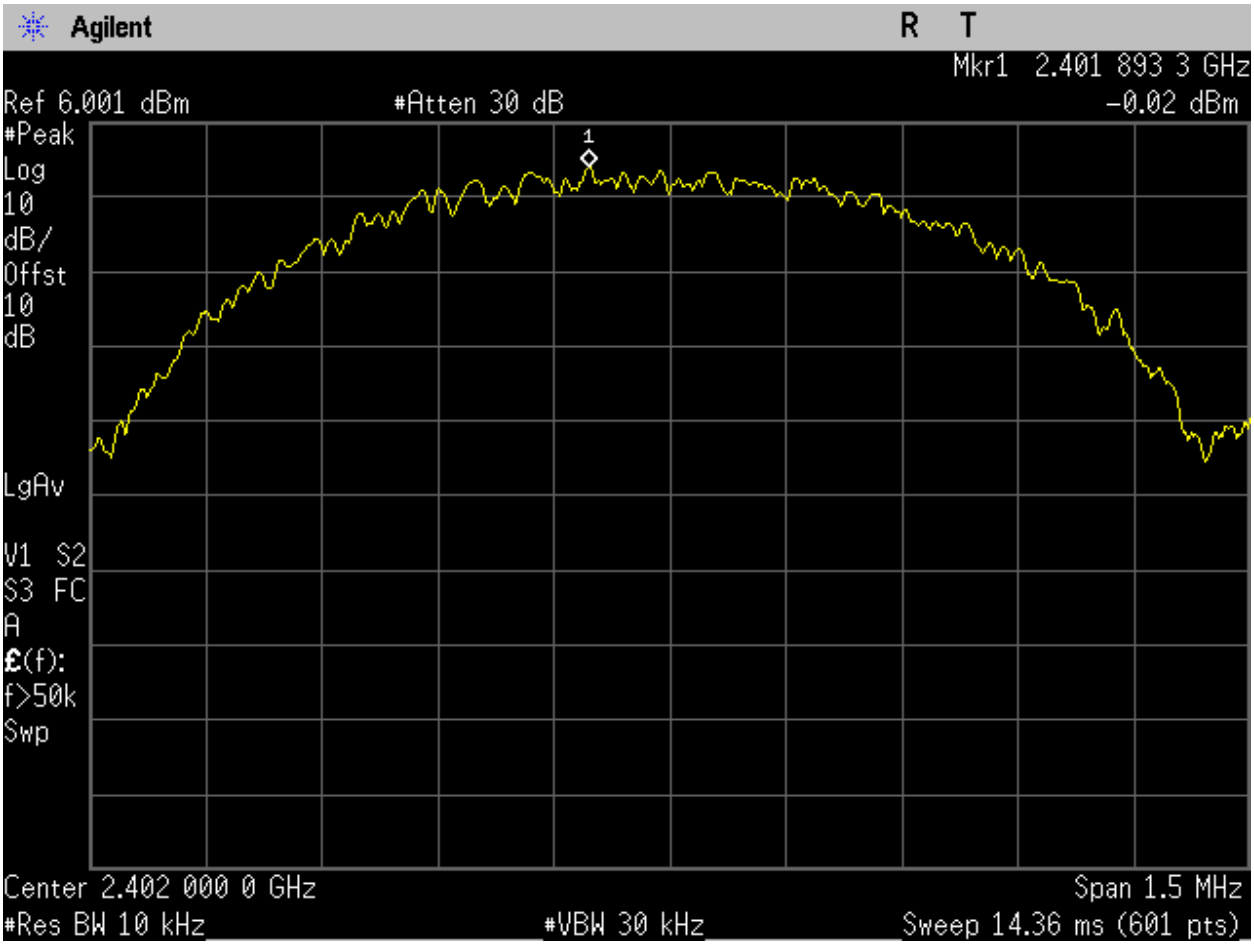


Figure 108. BLE_Low Ch_2402MHz_1MBit_Spectral Density_Port 1.

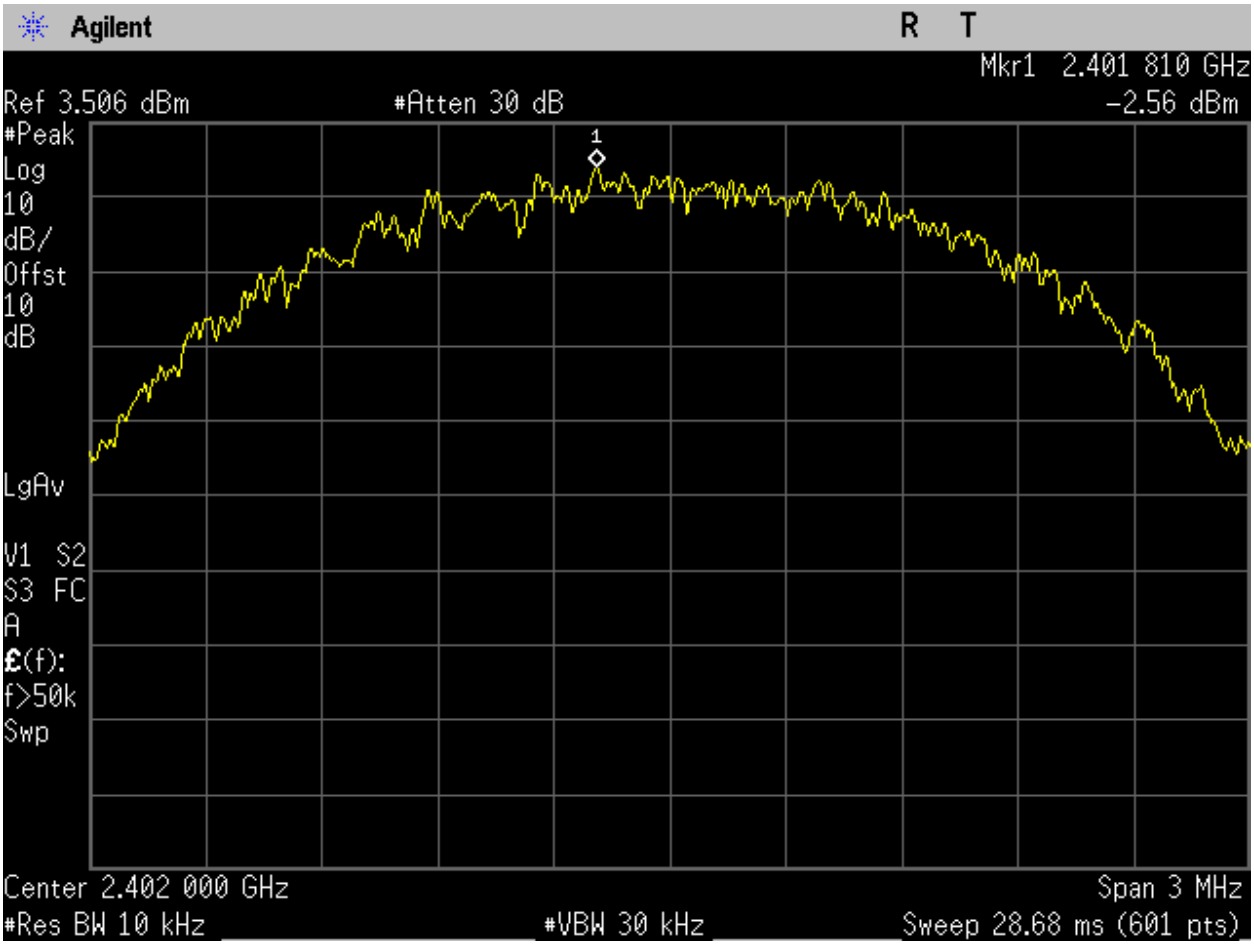


Figure 109. BLE_Low Ch_2402MHz_2MBit_Spectral Density_Port 1.

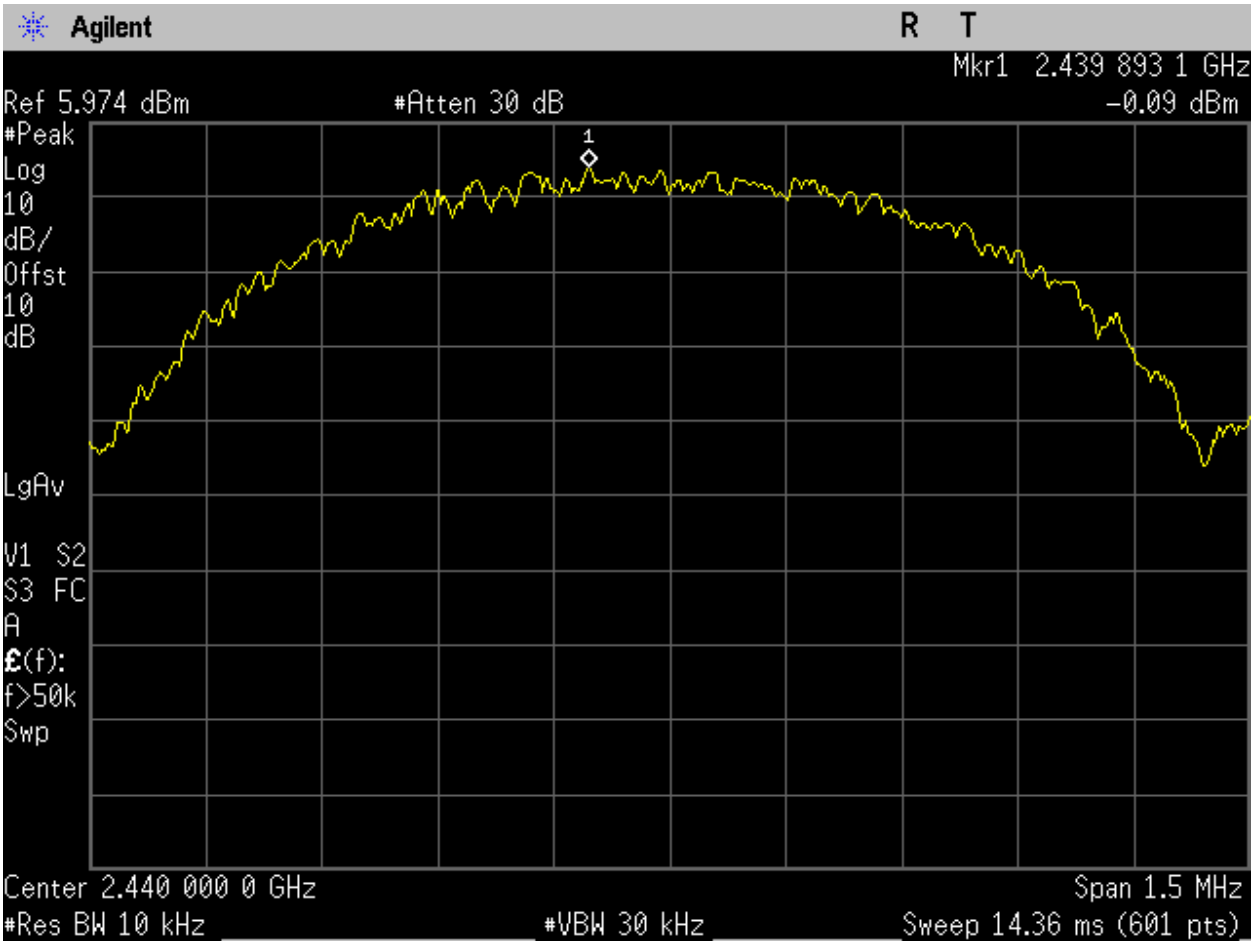


Figure 110. BLE_Mid Ch_2440MHz_1MBit_Spectral Density_Port 1.

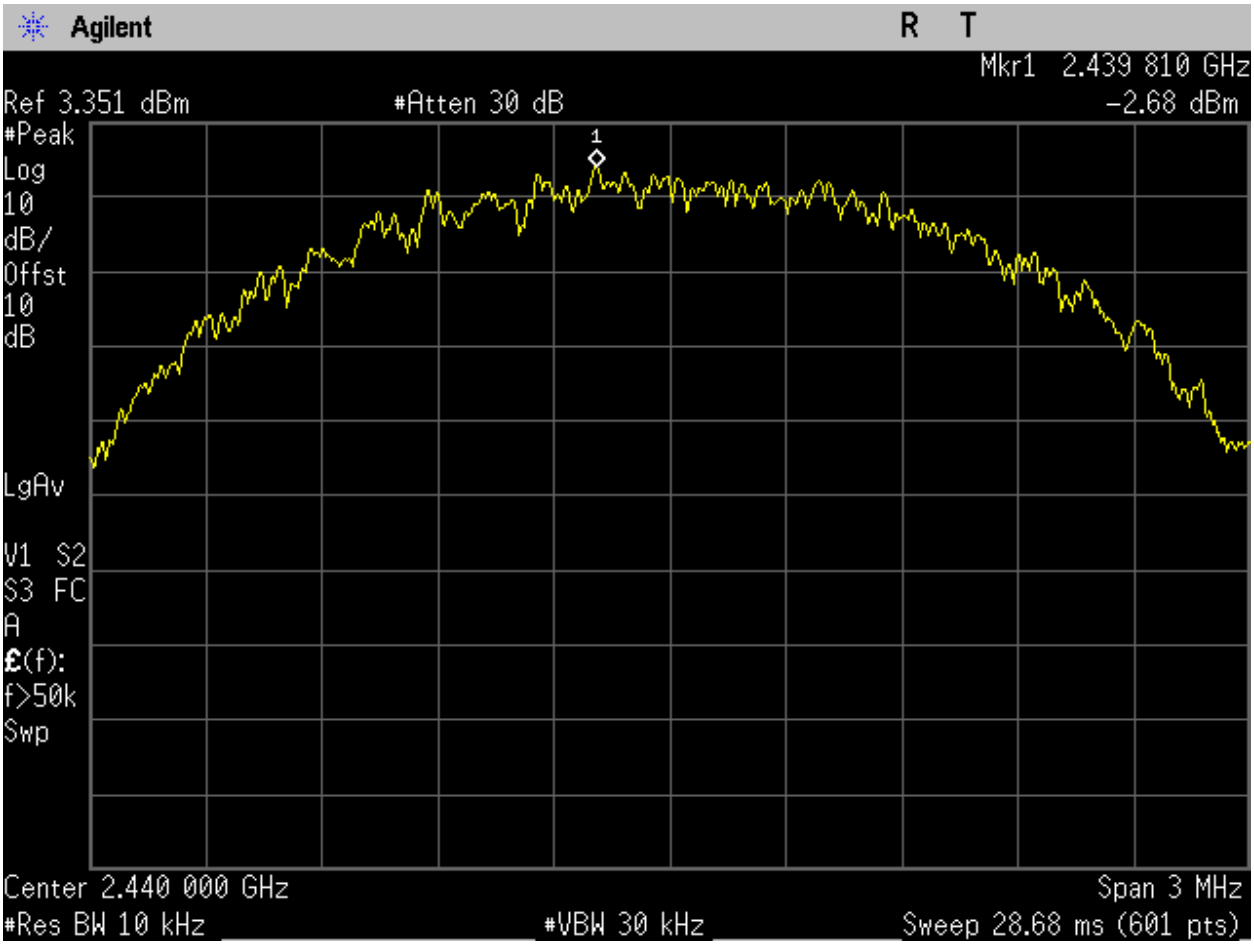


Figure 111. BLE_Mid Ch_2440MHz_2MBit_Spectral Density_Port 1.

Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)
2402	-0.02	8	-8.02
2440	-0.09	8	-8.09
2480	-0.55	8	-8.55

Table 23. PSD, BLE (1 Mbps) Test Results

Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)
2402	-2.56	8	-10.56
2440	-2.68	8	-10.68
2480	-3.15	8	-11.15

Table 24. PSD, BLE (2 Mbps) Test Results

Electromagnetic Compatibility Criteria for Intentional Radiators

Duty Cycle

Test Procedure: The EUT was connected to a spectrum analyzer and was ran at the maximum achievable duty cycle for all modes. The duty cycle was measured in accordance with section 11.6 of ANSI C63.10-2013.

Test Results: The EUT was **compliant** with this requirement. EUT's test mode has a 100% duty cycle.

Test Engineer: Donald Salguero

Test Date: March 7, 2024

Test Data

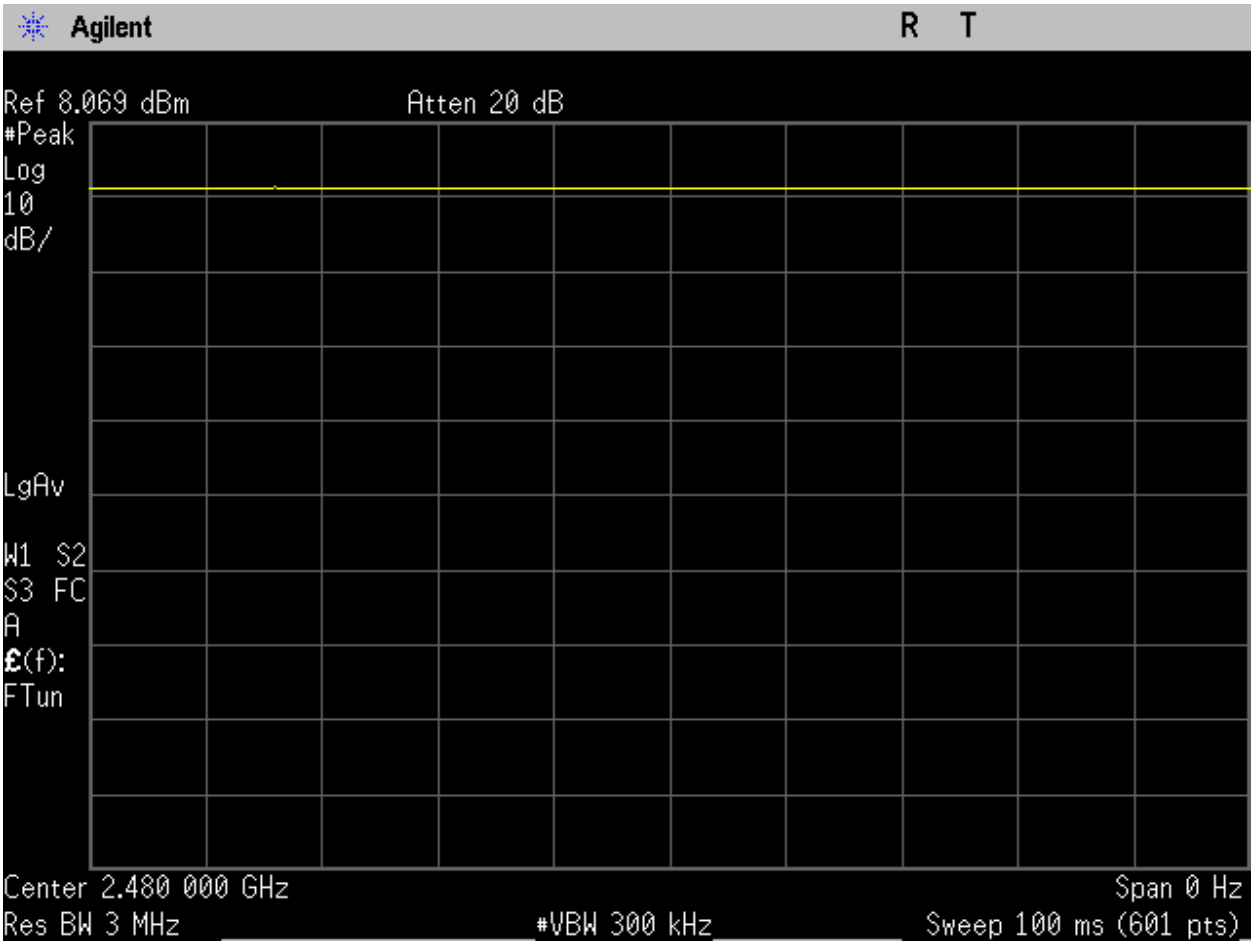


Figure 112. BLE (1 Mbps) test mode duty cycle.

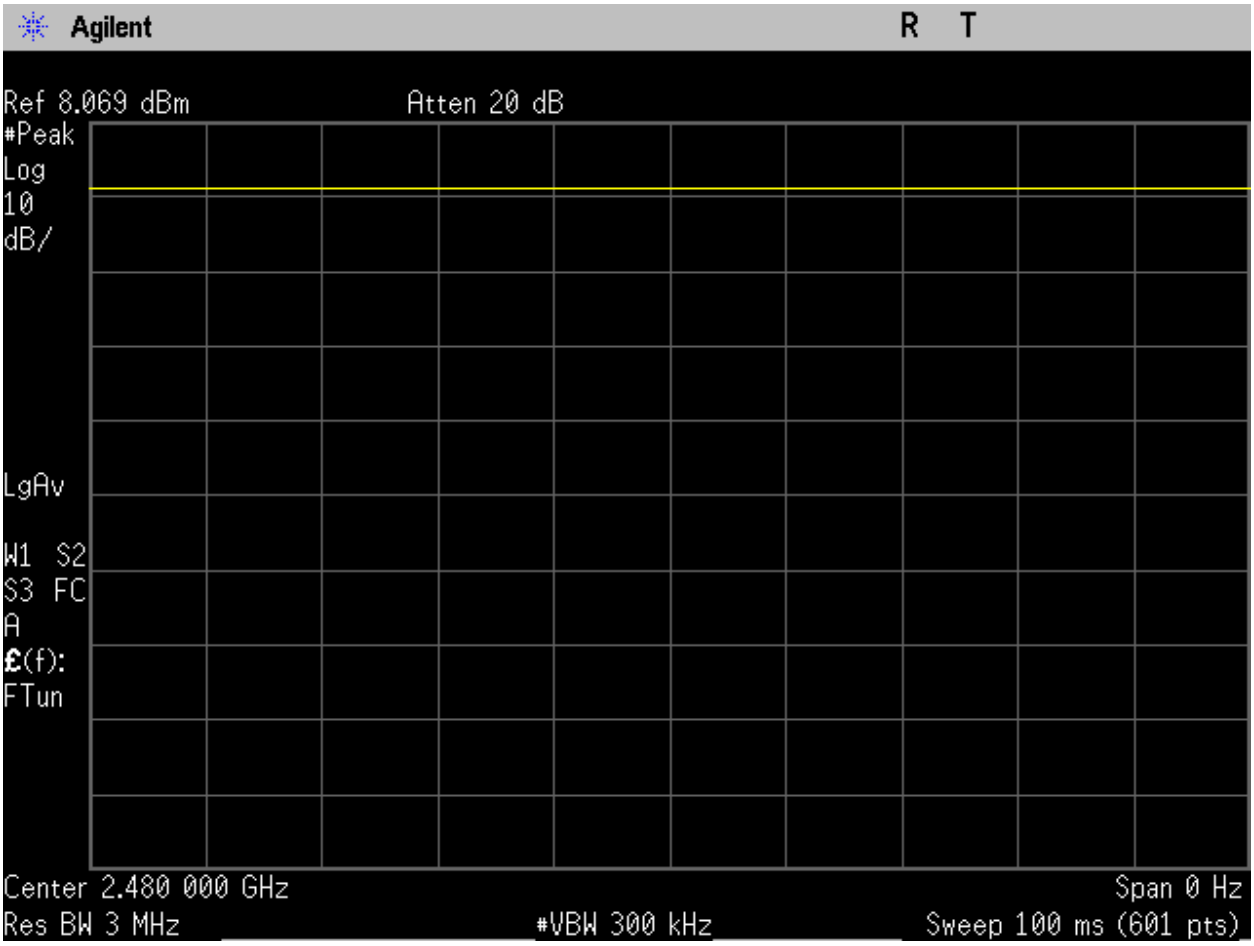


Figure 113. BLE (2 Mbps) test mode duty cycle.

Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2017.

Asset Number	Description	Manufacturer	Model Number	Serial Number	Calibration Date	Calibration Due Date
1T4300	SEMI-ANECHOIC CHAMBER (NSA)	EMC TEST SYSTEMS	NONE	NONE	8/31/2023	8/31/2025
1T4300B	Semi-Anechoic 3m Chamber sVSWR	EMC TEST SYSTEMS	NONE	NONE	2/12/2024	2/12/2026
1T4753	Antenna - Bilog	Sunol Sciences	JB6	A110310	12/5/2023	6/30/2025
1T4757	Antenna; Horn	ETS-Lindgren	3117	123516	7/24/2023	1/31/2025
1T4744	Antenna, Horn	ETS-Lindgren	3116	126519	12/16/2022	6/16/2024
1T8743	Preamplifier	A.H. Systems, Inc.	PAM-0118P	419	Func Verify	Func Verify
1T4752	Pre-Amplifier	Miteq	JS44-18004000-35-8P	1594792	Func Verify	Func Verify
1T4409	EMI Receiver	Rohde & Schwarz	ESIB7	100207	11/2/2023	11/30/2024
1T4771	PSA Spectrum Analyzer	Agilent Technologies	E4446A	MY51100015	11/2/2023	5/31/2025
1T9999	Thermometer/Hygrometer	VWR International	36934-164	230368599	5/31/2023	5/31/2025

Table 25. Equipment List

Conducted Emissions Equipment List						
Asset Number	**Description**	**Manufacturer**	**Model Number**	**Serial Number**	**Calibration Date**	**Calibration Due Date**
1T4795	LISN	Com-Power	LI-150A	201065	10/17/2022	4/30/2024
1T4796	LISN	Com-Power	LI-150A	201072	10/17/2022	4/30/2024
1T9572	EMI Receiver	Gauss Instruments	TDEMI X40	1902001	11/2/2023	11/30/2025
1T7450	Transient Limiter	Com-Power	LIT-153A	22010020	Func Verify	Func Verify
1T8374	Power Supply	Ametek Programmable Power	CSW5550-160-208-704	1708A01789	Func Verify	Func Verify
1T9999	Thermometer/Hygrometer	VWR International	36934-164	230368599	5/31/2023	5/31/2025

Table 26. CE Equipment List

Note: Functionally verified test equipment is verified using calibrated instrumentation at time of testing.

END OF REPORT