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HEADQUARTERS: 914 WEST PATAPSCO AVENUE • BALTIMORE, MARYLAND 21230 • PHONE (410) 354-3300 • FAX (410) 354-3313

April 30, 2024

Lutron Electronics
Andrew Vaughn
7200 Suter Rd
Coopersburg, PA 18036

Dear Andrew Vaughn,

Enclosed is the EMC Wireless 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 Zigbee Rev. 2)

A2LA ACCREDITED TESTING CERT #0591.01

Eurofins Electrical and Electronic Testing NA, Inc. is part of the Eurofins Electrical & Electronics (E&E) global compliance network.

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

the IC Certification Rules
contained in
RSS-247, Issue 3, August 2023 for Intentional Radiators

Report: EMC131030-FCC_RSS 247 Zigbee 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 customer address; Updated Table 2; Updated Table 4.
2	April 30, 2024	CAB Identifier Added. Power Settings Added.

Table of Contents

List of Tables

List of Figures

List of Terms and Abbreviations

AC	**A**lternating **C**urrent
ACF	**A**ntenna **C**orrection **F**actor
Cal	**Cal**ibration
d	**M**easurement **D**istance
dB	**D**eci**b**els
dBµA	**D**eci**b**els above one **micro**amp
dBµV	**D**eci**b**els above one **micro**volt
dBµA/m	**D**eci**b**els above one **micro**amp **per m**eter
dBµV/m	**D**eci**b**els above one **micro**volt **per m**eter
DC	**D**irect **C**urrent
E	**E**lectric Field
DSL	**D**igital **S**ubscriber **L**ine
ESD	**E**lectro**s**tatic **D**ischarge
EUT	**E**quipment **U**nder **T**est
f	**F**requency
FCC	**F**ederal **C**ommunications **C**ommission
GRP	**G**round **R**eference **P**lane
H	Magnetic Field
HCP	**H**orizontal **C**oupling **P**lane
Hz	**H**er**z**
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**k**ilo**h**er**z**
kPa	**k**ilo**pa**scal
kV	**k**ilo**v**olt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**h**ertz
µH	**micro**henry
µ	**micro**farad
µs	**micro**seconds
NEBS	**N**etwork **E**quipment-**B**uilding **S**ystem
PRF	**P**ulse **R**epetition **F**requency
RF	**R**adio **F**requency
RMS	**R**oot-**M**ean-**S**quare
TWT	**T**raveling **W**ave **T**ube
V/m	**V**olts **per m**eter
VCP	**V**ertical **C**oupling **P**lane

I. 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, in accordance with Lutron Electronics, purchase order number AR1062669. All tests were conducted using measurement procedure ANSI C63.10-2013.

FCC Reference 47 CFR Part 15.247:2005	IC Reference RSS-247 Issue 1: 2015; RSS-GEN Issue 4: 2014	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); §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(d)	RSS-247(5.5)	Spurious Emissions in Non-restricted Bands	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)	-	Maximum Permissible Exposure (MPE)	Compliant
-	RSS-102(3.2)	RF Exposure Evaluation of Devices	Compliant

Table 1. Executive Summary of EMC Part 15.247 ComplianceTesting

II. 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 AR1062669.

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	
EUT Specifications:	Primary Power: 120 VAC	
	FCC ID: JPZ0154 IC ID: 2851A-JPZ0154	
	Type of Modulations:	ZigBee
	Equipment Code:	DTS
	Peak RF Output Power:	19.98 dBm; 99.54 mW
	EUT Frequency Ranges:	2402-2480 MHz
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35° 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 Zigbee Power Setting:	Default (per support software GUI)
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:	-
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.

III. Electromagnetic Compatibility Criteria for Intentional Radiators

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(s): Donald Salguero

Test Date(s): 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 Σ 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- 0.45	66 - 56	56 - 46
0.45 - 0.5	56	46
0.5 - 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 C63.10-2013*. 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) 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 8, 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 8 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*	56 to 46*
0.5-5	56	46
5-30	60	50

Table 9. AC Power Line Conducted Emissions Limits

* - 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.

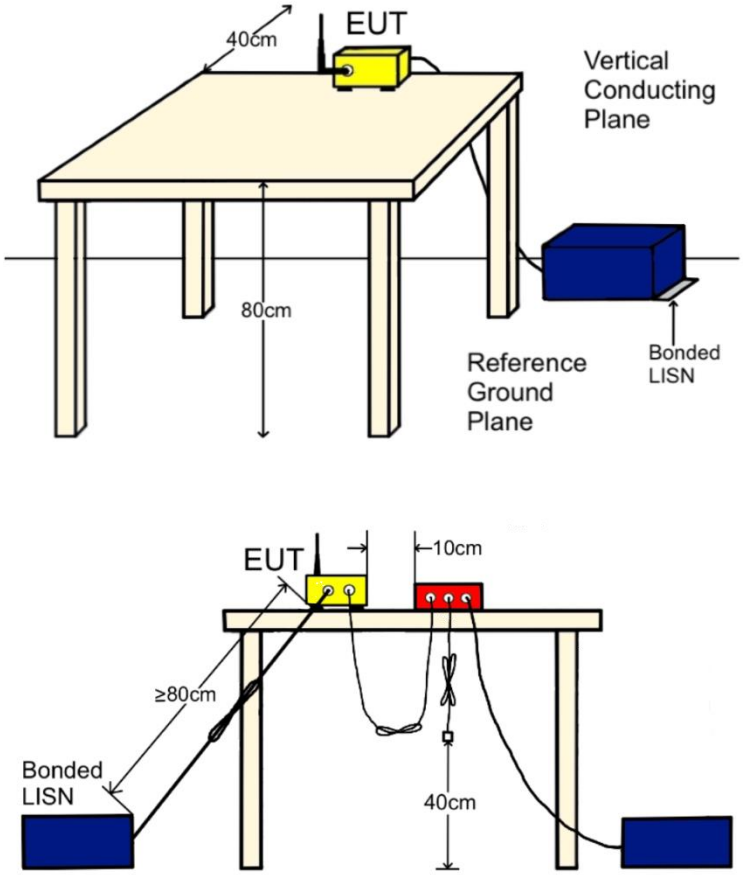


Figure 1. CEV Test Setup

Test Results: The EUT was compliant with this requirement.

Test Engineer(s): Donald Salguero

Test Date(s): 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	43.62	10.54	54.15	66	-11.85	PASS
0.196	36.85	10.32	47.17	64.69	-17.52	PASS
1.99	31.76	10.04	41.8	56	-14.2	PASS
5.97	33.8	10.09	43.89	60	-16.11	PASS
9.954	35.62	10.16	45.78	60	-14.22	PASS
13.934	28.87	10.25	39.12	60	-20.88	PASS
Frequency	**Average Measurement**	**Correction Factor**	**Corrected Measurement**	**Average Limit**	**Margin**	**Result**
MHz	dBµV	dB	dBµV	dBµV	dB	Pass/Fail
0.15	26.57	10.54	37.11	56	-18.893	PASS
8.54	21.75	10.14	31.88	50	-18.116	PASS
9.003	21.74	10.15	31.88	50	-18.119	PASS
9.024	21.71	10.15	31.85	50	-18.146	PASS
9.954	22.03	10.16	32.19	50	-17.81	PASS
12.799	22.13	10.23	32.35	50	-17.648	PASS

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

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	44.78	10.53	55.3	66	-10.696	PASS
0.196	38.93	10.32	49.25	64.69	-15.443	PASS
0.263	30.54	10.2	40.74	62.78	-22.044	PASS
1.99	31.58	10.07	41.66	56	-14.343	PASS
5.97	32.99	10.12	43.11	60	-16.888	PASS
9.954	34.41	10.19	44.6	60	-15.398	PASS
Frequency	**Average Measurement**	**Correction Factor**	**Corrected Measurement**	**Average Limit**	**Margin**	**Result**
MHz	dBµV	dB	dBµV	dBµV	dB	Pass/Fail
0.15	29.39	10.53	39.92	56	-16.084	PASS
0.2	24.16	10.3	34.46	54.57	-20.109	PASS
0.534	22.76	10.08	32.83	46	-13.169	PASS
0.596	23.24	10.08	33.32	46	-12.682	PASS
0.68	22.31	10.06	32.37	46	-13.632	PASS
12.799	22.09	10.25	32.34	50	-17.662	PASS

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

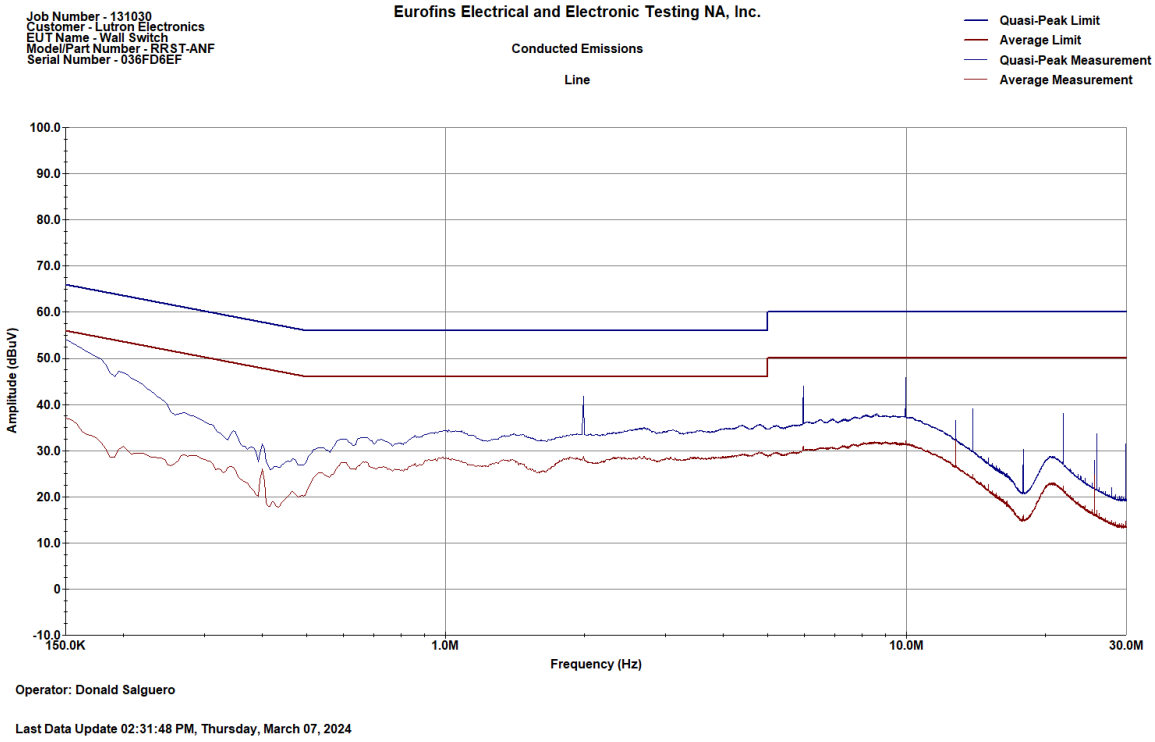


Figure 2. CE Prescan [120V60Hz, Line, Zigbee]

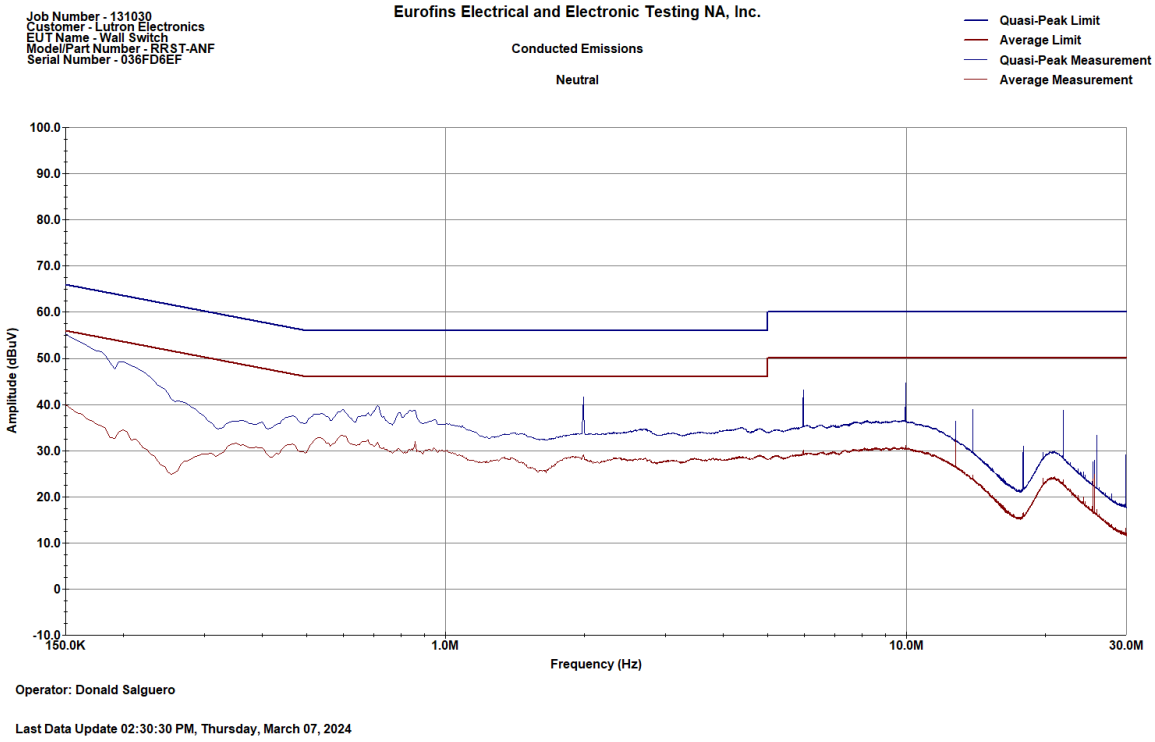
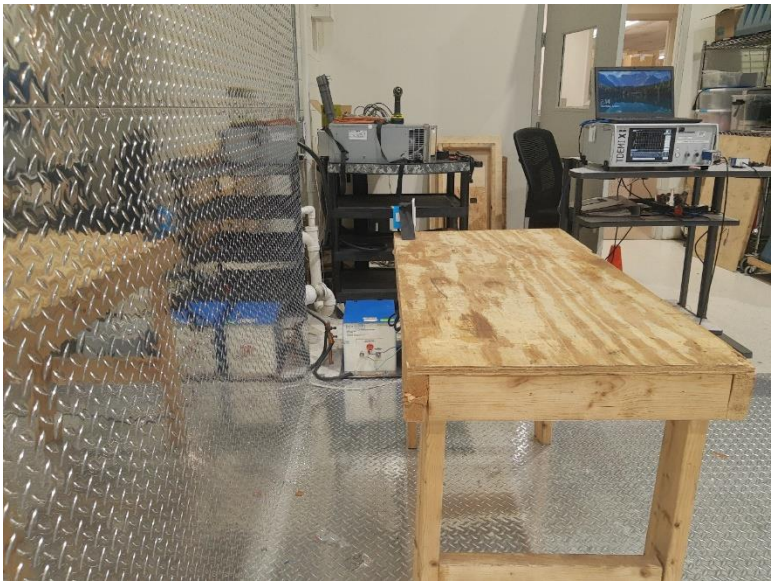
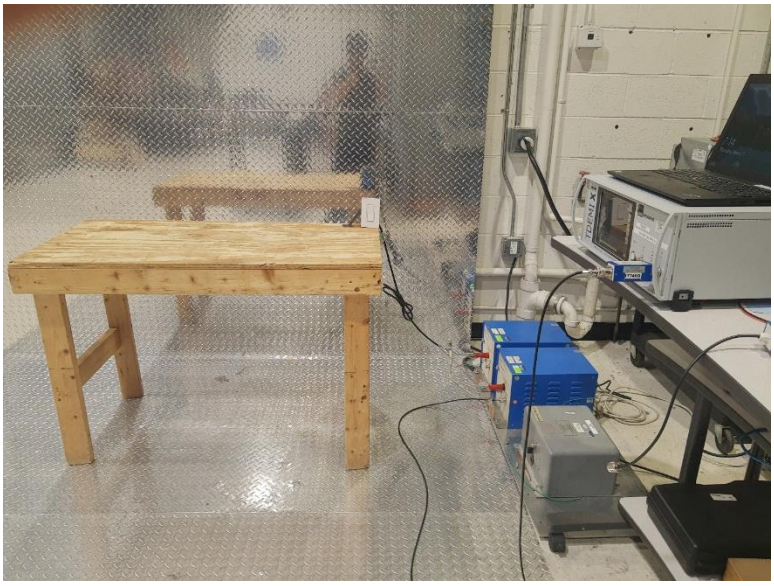


Figure 3. CE Prescan [120V60Hz, Neutral, Zigbee]

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.

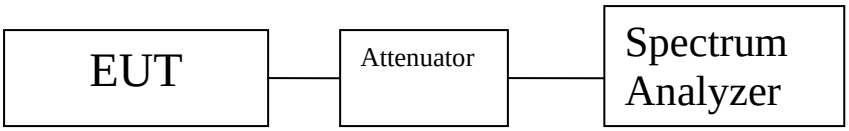


Figure 4. Block Diagram, Occupied Bandwidth Test Setup

RSS-GEN (6.6) & RSS-247 (5.2) 99% and -6dB Occupied Bandwidth

Test Requirements:

RSS-GEN (6.6): The emission bandwidth (×dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated × dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3× the resolution bandwidth.

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3×RBW.

Note: Video averaging is not permitted.

A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.

The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.

The difference between the two recorded frequencies is the 99% occupied bandwidth.

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

Test Procedure:

For the 99% Bandwidth, 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.

For the -6dB Bandwidth, 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.

Test Results: The EUT was compliant with this requirement.

Test Engineer(s): Donald Salguero

Test Date(s): March 7, 2024

Test Data

Frequency (MHz)	99% Bandwidth (MHz)	-6dB Bandwidth (MHz)	-6dB Bandwidth Limit (MHz)
2405	2.2397	1.652	> 0.5
2440	2.2473	1.650	> 0.5
2480	2.2461	1.675	> 0.5

Table 12. OBW, Zigbee Test Results

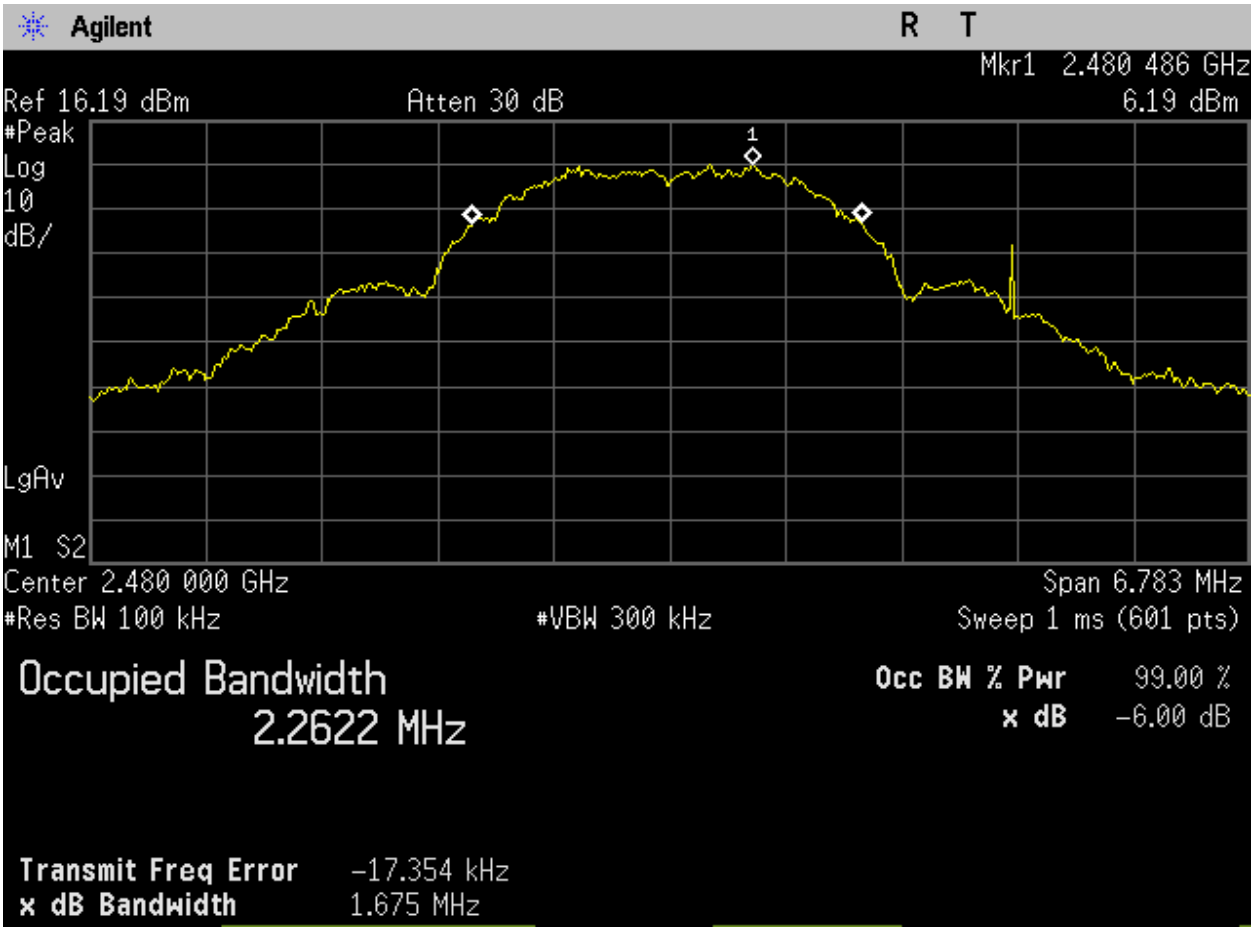


Figure 5. Zigbee_High Ch_2480MHz_2MBit_Occupied Bandwidth_-6dB_Port 1.

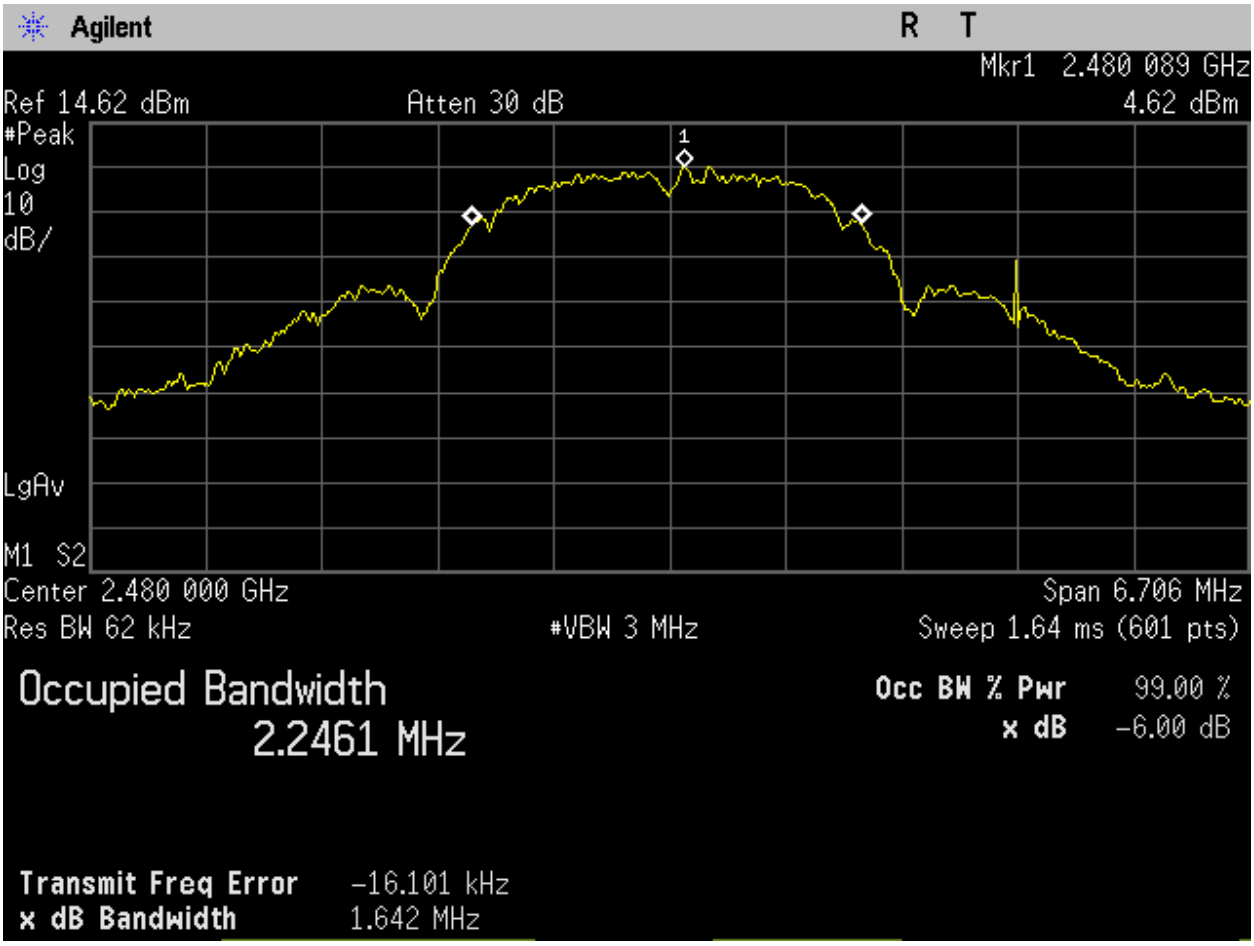


Figure 6. Zigbee_High Ch_2480MHz_2MBit_Occupied Bandwidth_99 percent_Port 1.

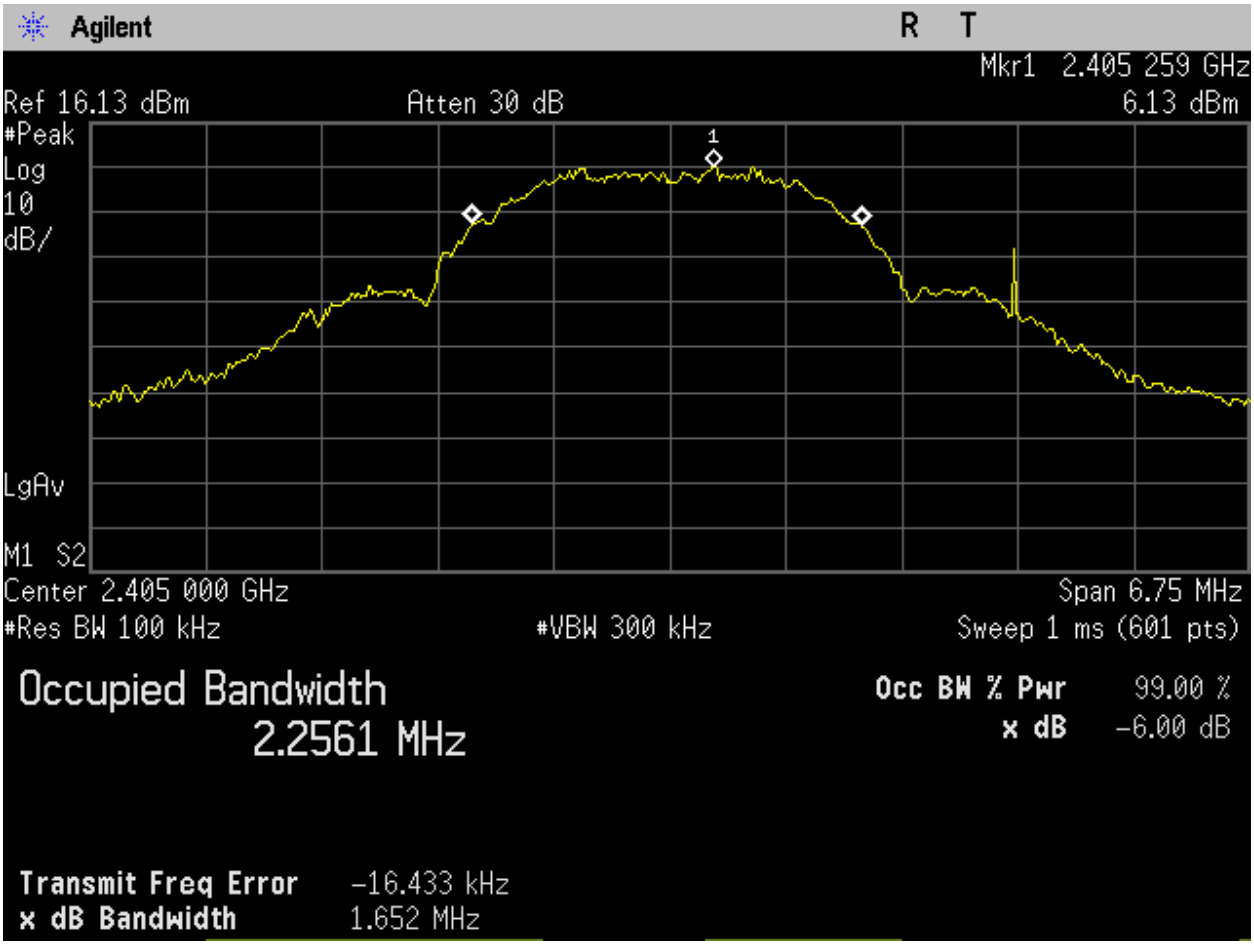


Figure 7. Zigbee_Low Ch_2405MHz_2MBit_Occupied Bandwidth_-6dB_Port 1.

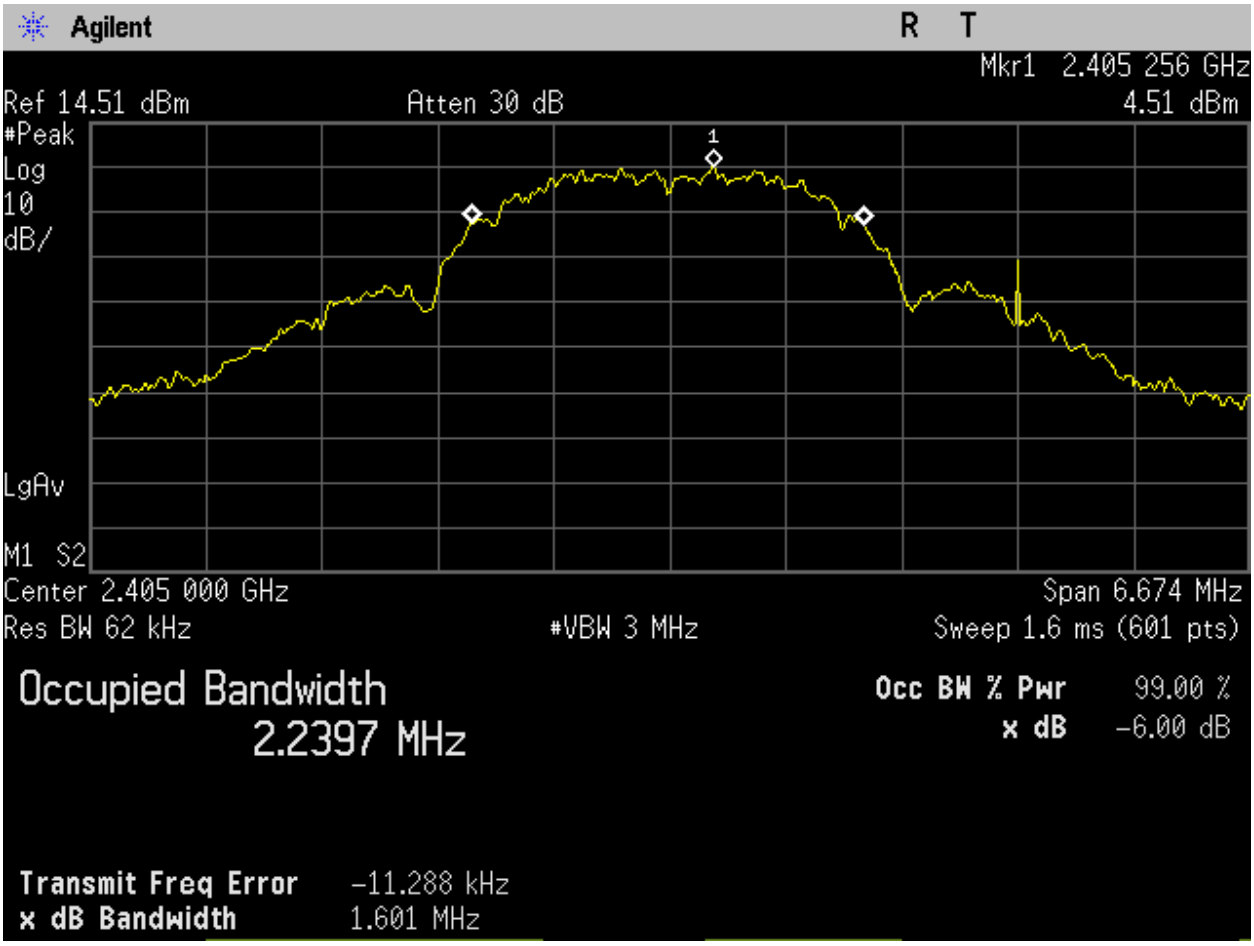


Figure 8. Zigbee_Low Ch_2405MHz_2MBit_Occupied Bandwidth_99 percent_Port 1.

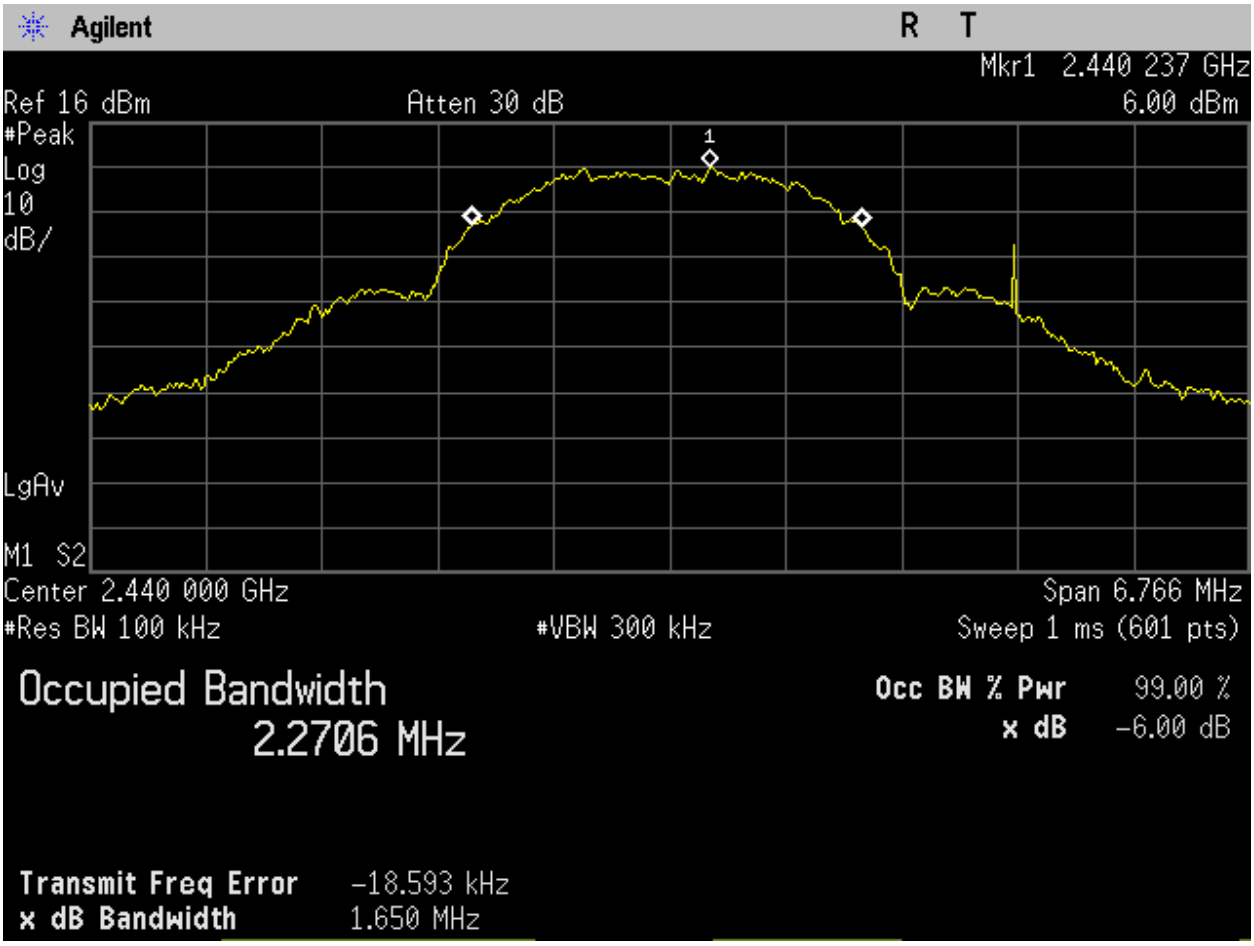


Figure 9. Zigbee_Mid Ch_2440MHz_2MBit_Occupied Bandwidth_-6dB_Port 1.

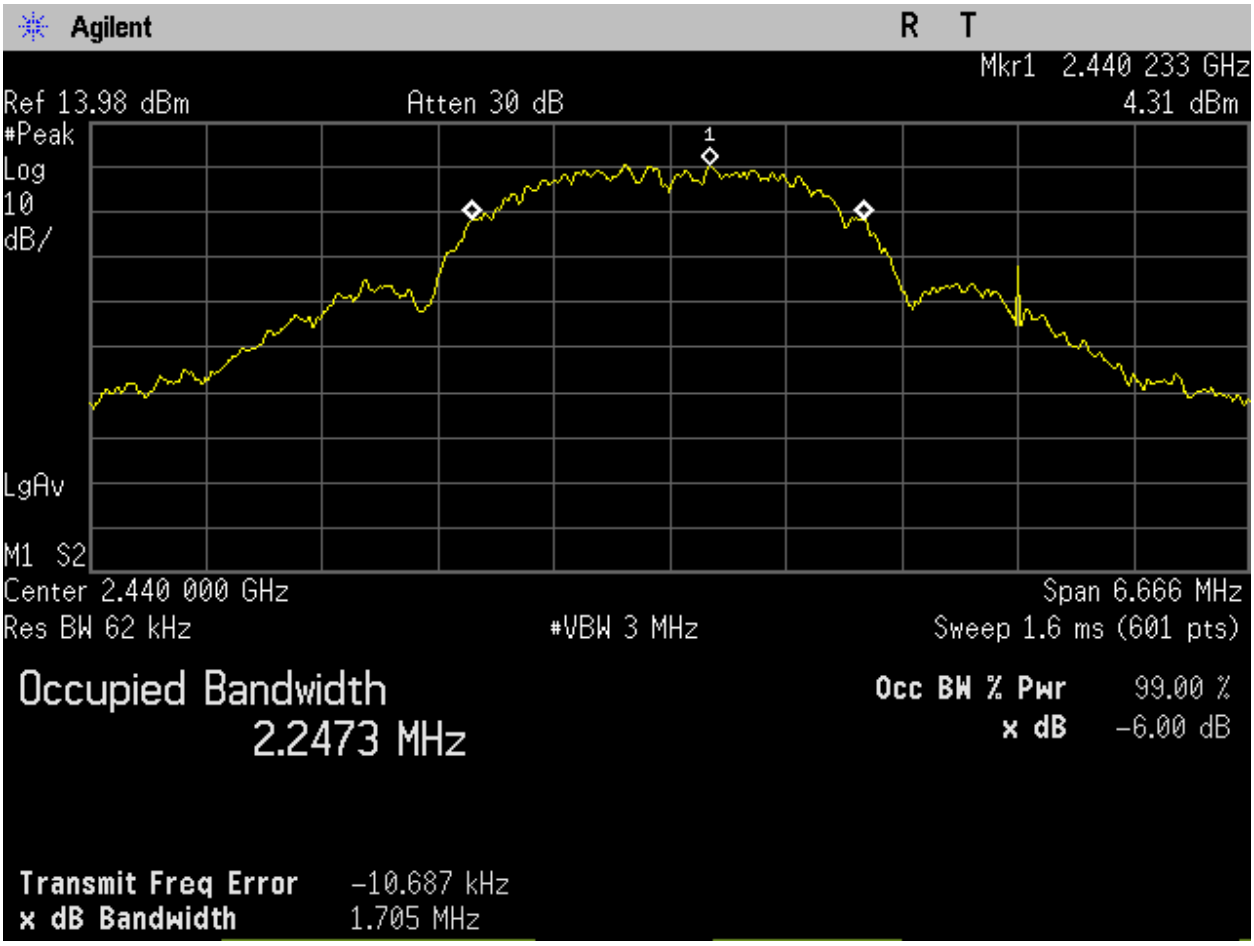


Figure 10. Zigbee_Mid Ch_2440MHz_2MBit_Occupied Bandwidth_99 percent_Port 1.

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)
902-928	1.000
2400–2483.5	1.000
5725– 5850	1.000

Table 13. 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 Table 13, 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.

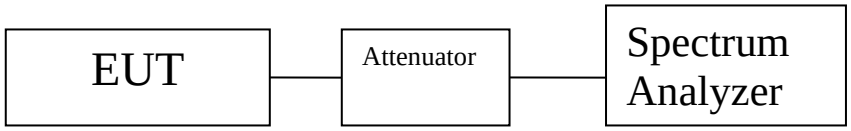


Figure 11. Peak Power Output Test Setup

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.

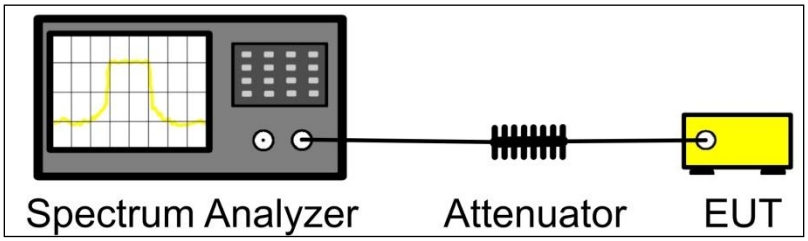


Figure 12. Power Output Test Setup

Test Results: The EUT was compliant with this requirement.

Test Engineer(s): Donald Salguero

Test Date(s): March 7, 2024

Test Data

Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
2405	19.94	30	-10.06	2.5	22.44	36	-13.56
2440	19.85	30	-10.15	2.5	22.35	36	-13.65
2480	19.98	30	-10.02	2.5	22.48	36	-13.52

Table 14. Output Power, Zigbee Test Results

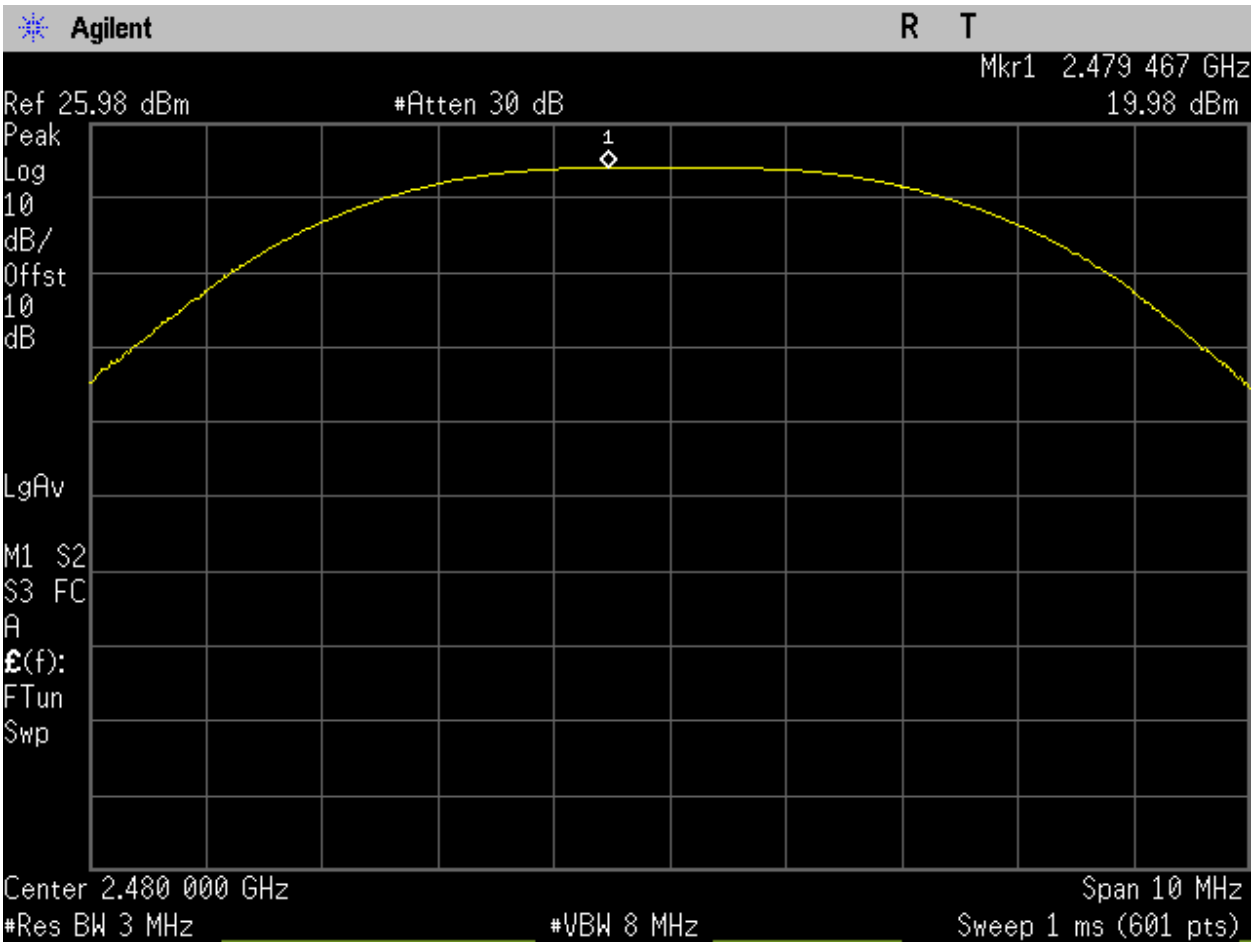


Figure 13. Zigbee_High Ch_2480MHz_2MBit_Output Power_Port 1.

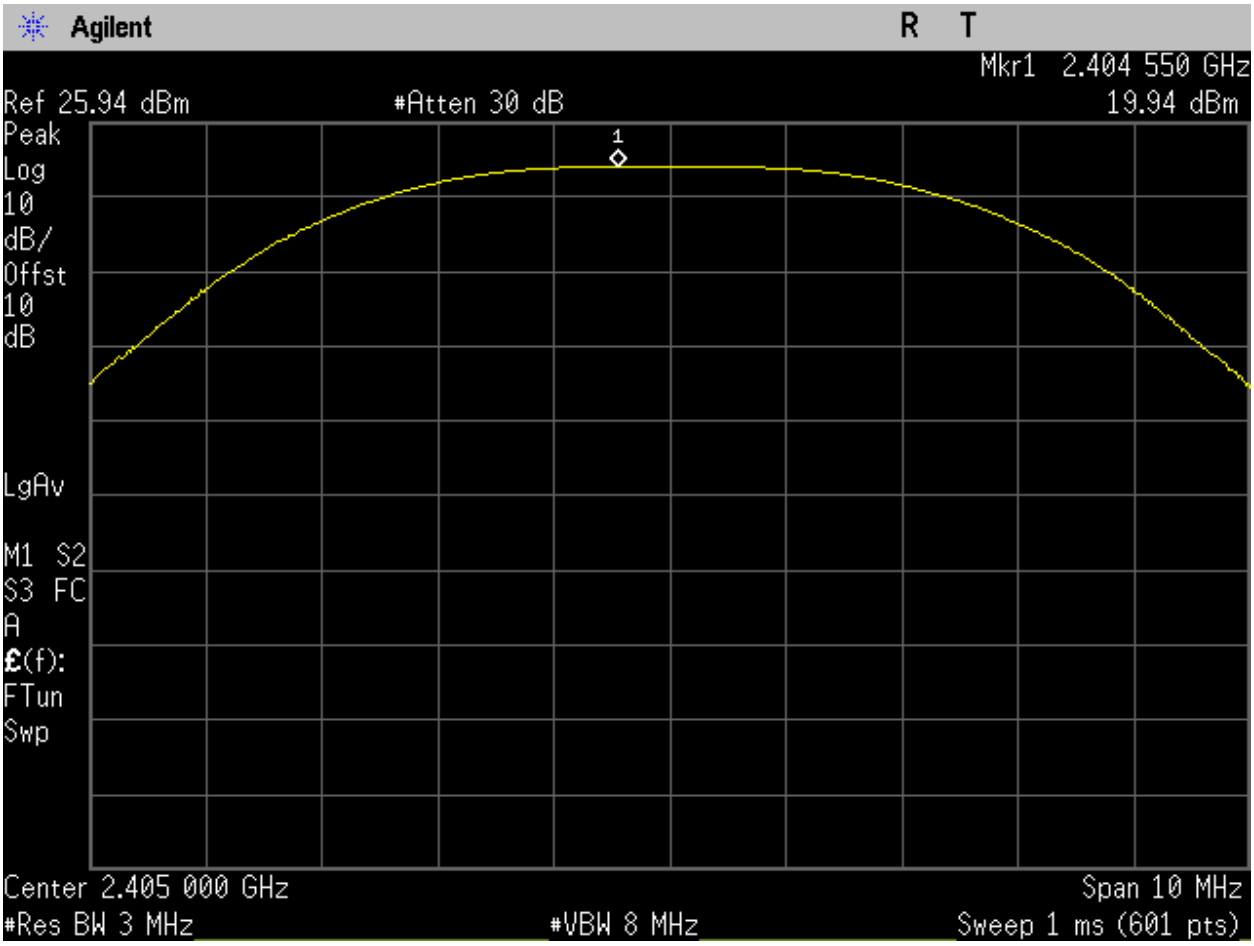


Figure 14. Zigbee_Low Ch_2405MHz_2MBit_Output Power_Port 1.

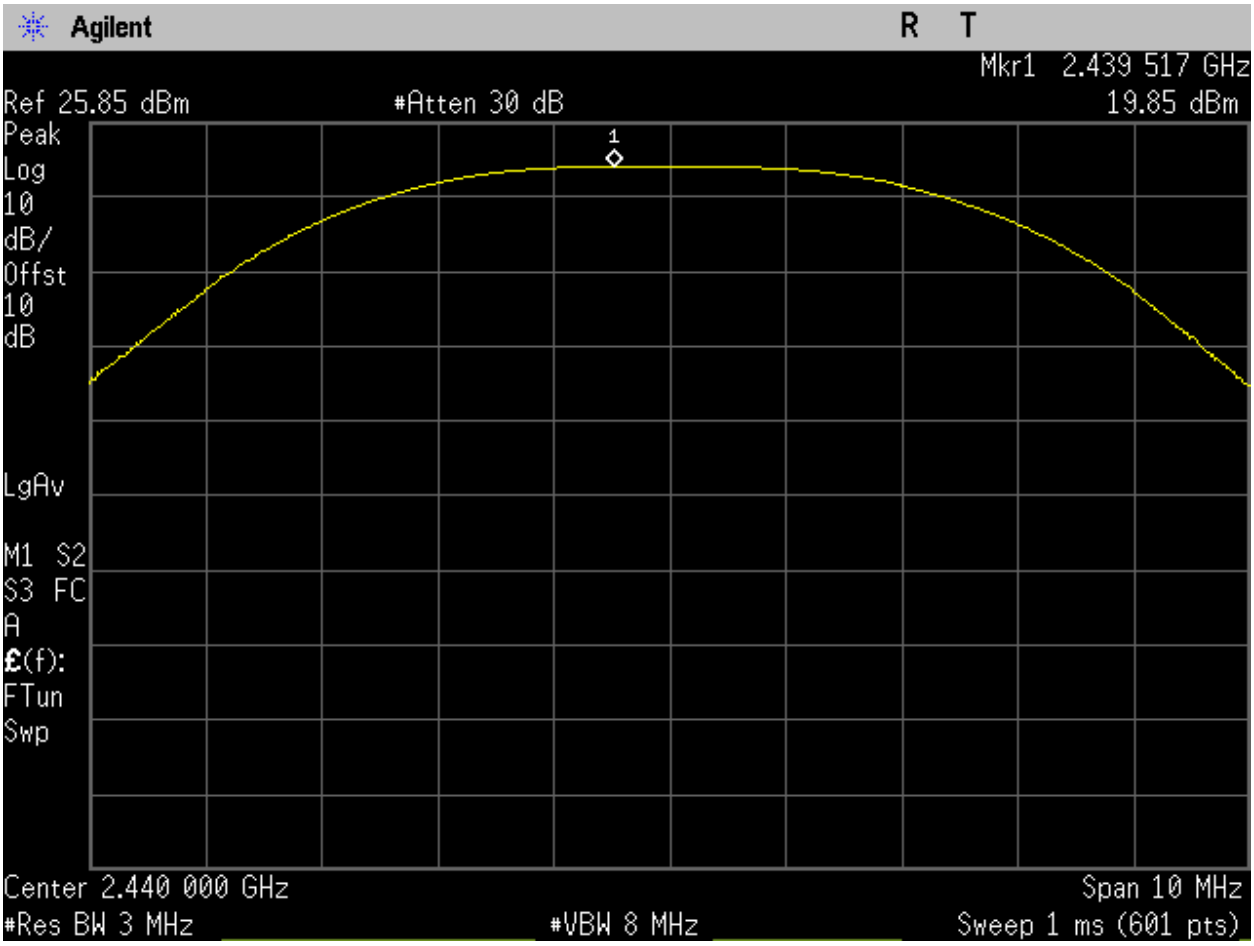


Figure 15. Zigbee_Mid Ch_2440MHz_2MBit_Output Power_Port 1.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) 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 15. 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 16.

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 16. 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.

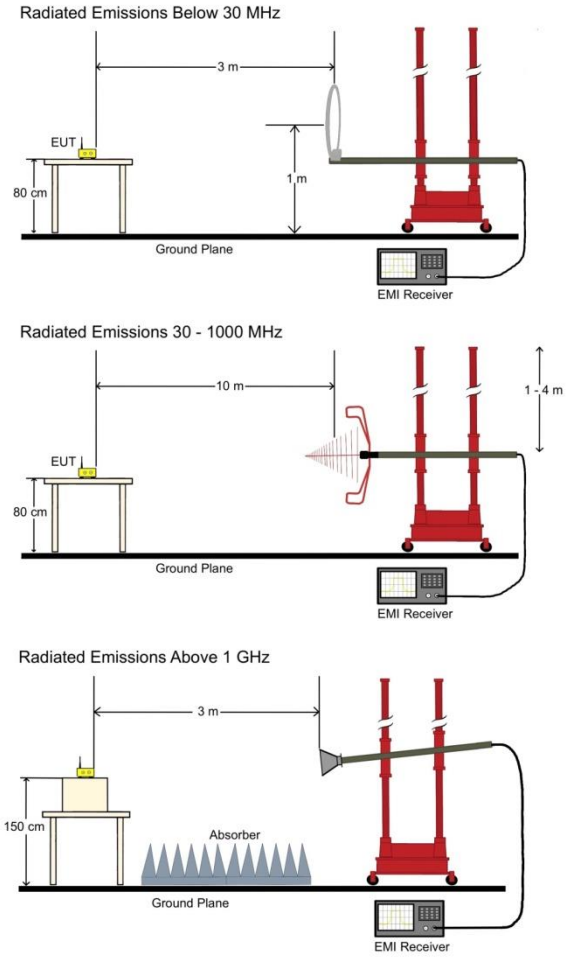


Figure 16. Radiated Emissions Test Setup

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

Test Requirements:

RSS-GEN (6.13): The measurement method shall be described in the test report. When the applicable unwanted emissions limits are defined in relative terms, the same parameter, peak power or average power, used for the transmitter's output power measurement shall also be used for the unwanted emission measurements.

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.

(b) If the equipment operates at or above 10 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

Particular attention should be paid to harmonics and sub-harmonics of the carrier frequency, as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.

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. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line.

Test Results: The EUT was compliant with this requirement.

Test Engineer(s): Donald Salguero

Test Date(s): March 5 – March 7, 2024

Test Data

Frequency	Polarity	Antenna Height	Turtable Position	Measured	Correction Factor	Duty Cycle Factor	Corrected Reading	Limit	Margin
GHz	Horizontal/ Vertical	cm	Degrees	dBµV	dB	dB	dBµV/m	dBµV/m	dB
2.39	H	174	339.1	14.17	38.428	-9.897	42.701	54	-11.299
2.39	V	102	306.5	14.01	38.384	-9.897	42.497	54	-11.503
2.4835	H	175	273.6	22.97	38.834	-9.897	51.907	54	-2.093
2.4835	V	101	298.8	19.29	38.784	-9.897	48.177	54	-5.823

Table 17. Zigbee - 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	174	339.1	25.04	38.428	63.468	74	-10.532
2.39	V	102	306.5	25.72	38.384	64.104	74	-9.896
2.4835	H	175	273.6	34.66	38.834	73.494	74	-0.506
2.4835	V	101	298.8	29.4	38.784	68.184	74	-5.816

Table 18. Zigbee - Radiated Band Edge, Peak Test Results

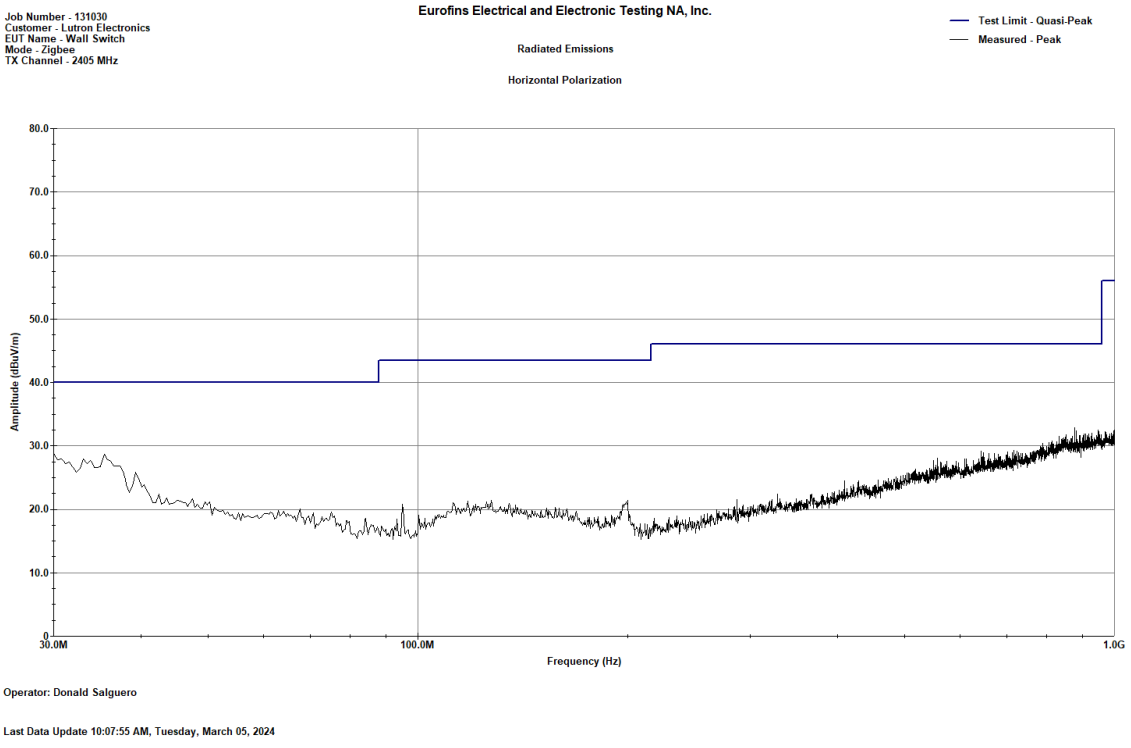


Figure 17. Zigbee_2405MHz_Radiated Emissions, 30 MHz to 1 GHz-_H

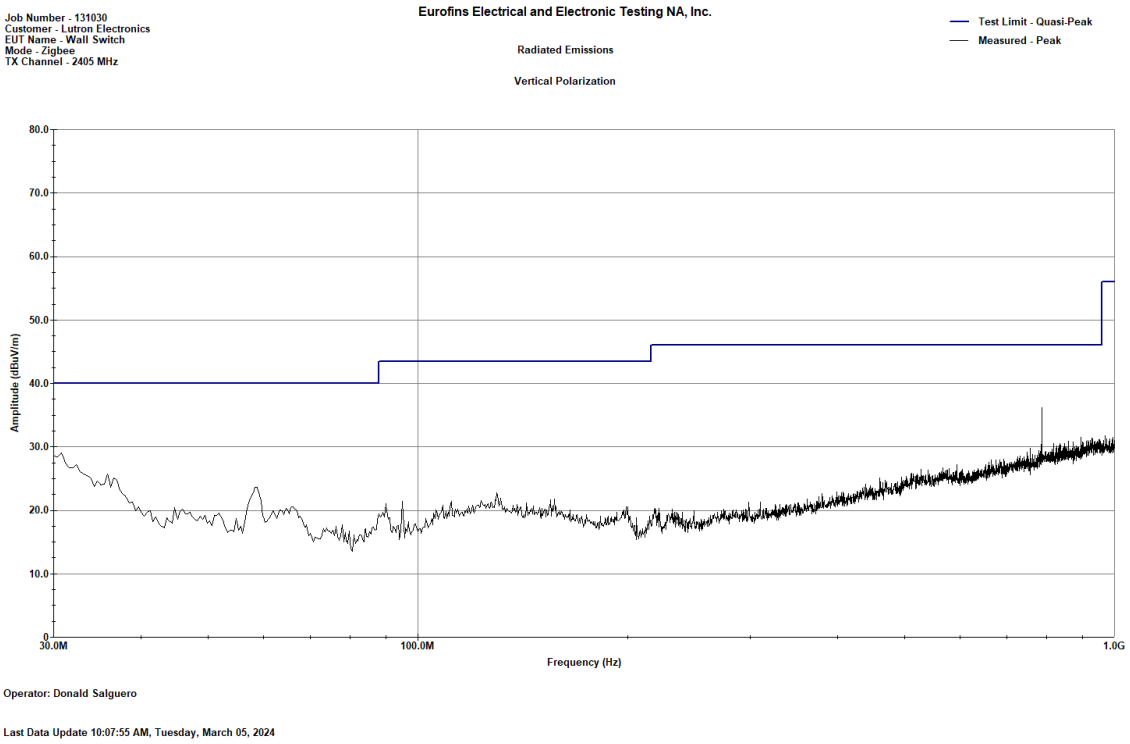


Figure 18. Zigbee_2405MHz_Radiated Emissions, 30 MHz to 1 GHz-_V

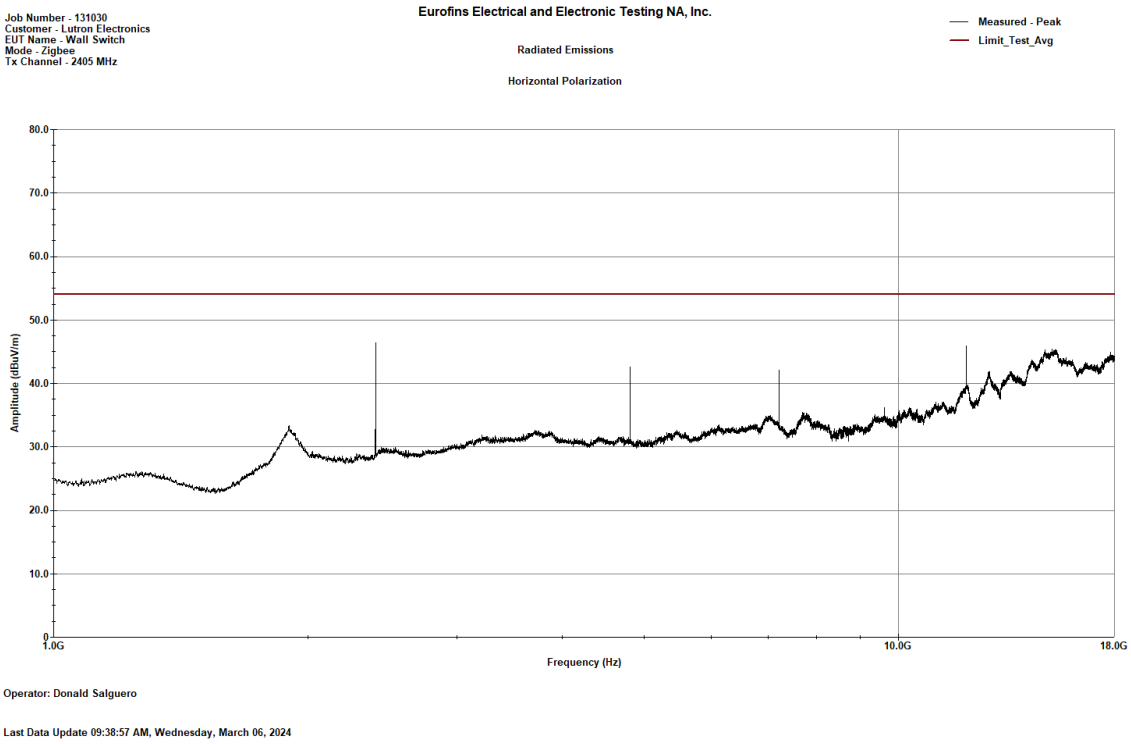


Figure 19. Zigbee_2405MHz_Radiated Emissions, Average, 1 - 18 GHz-_H

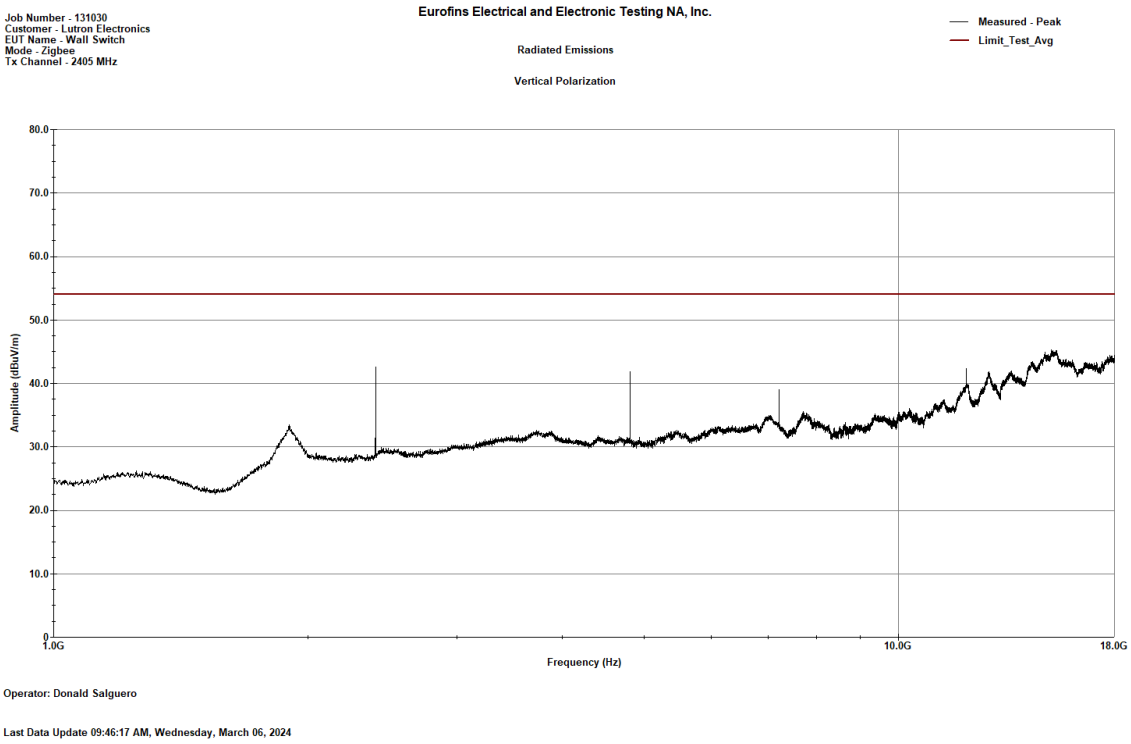


Figure 20. Zigbee_2405MHz_Radiated Emissions, Average, 1 - 18 GHz-_V

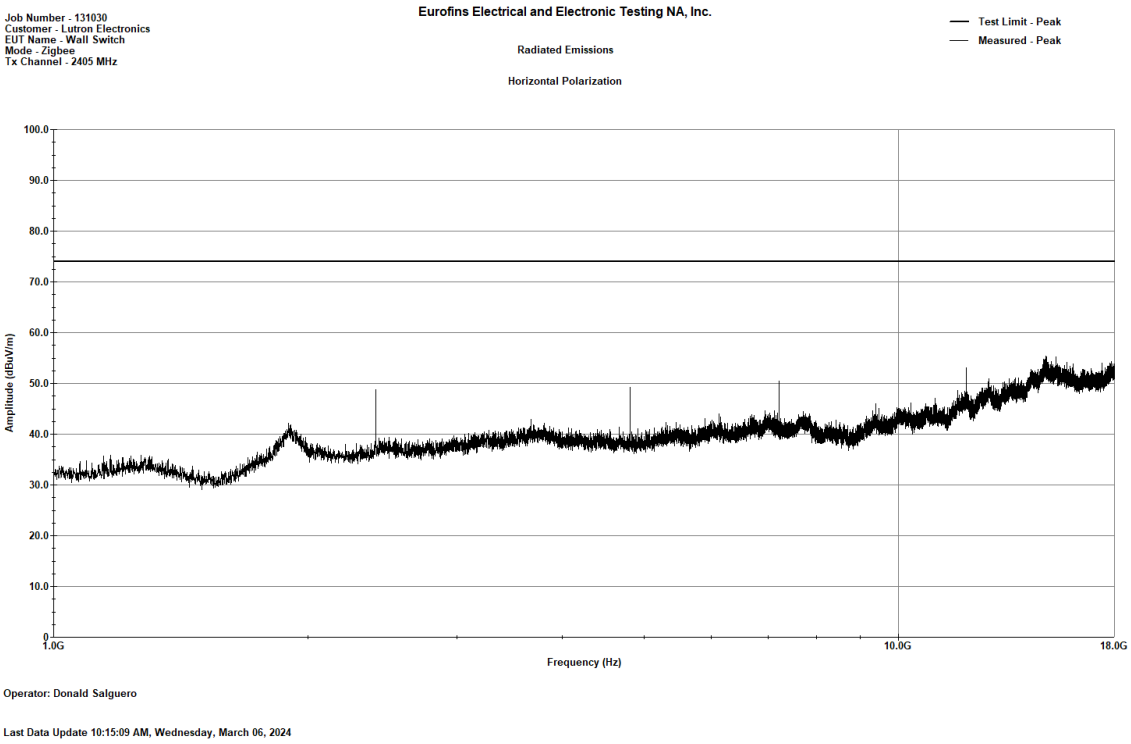


Figure 21. Zigbee_2405MHz_Radiated Emissions, Peak, 1 - 18 GHz-_H

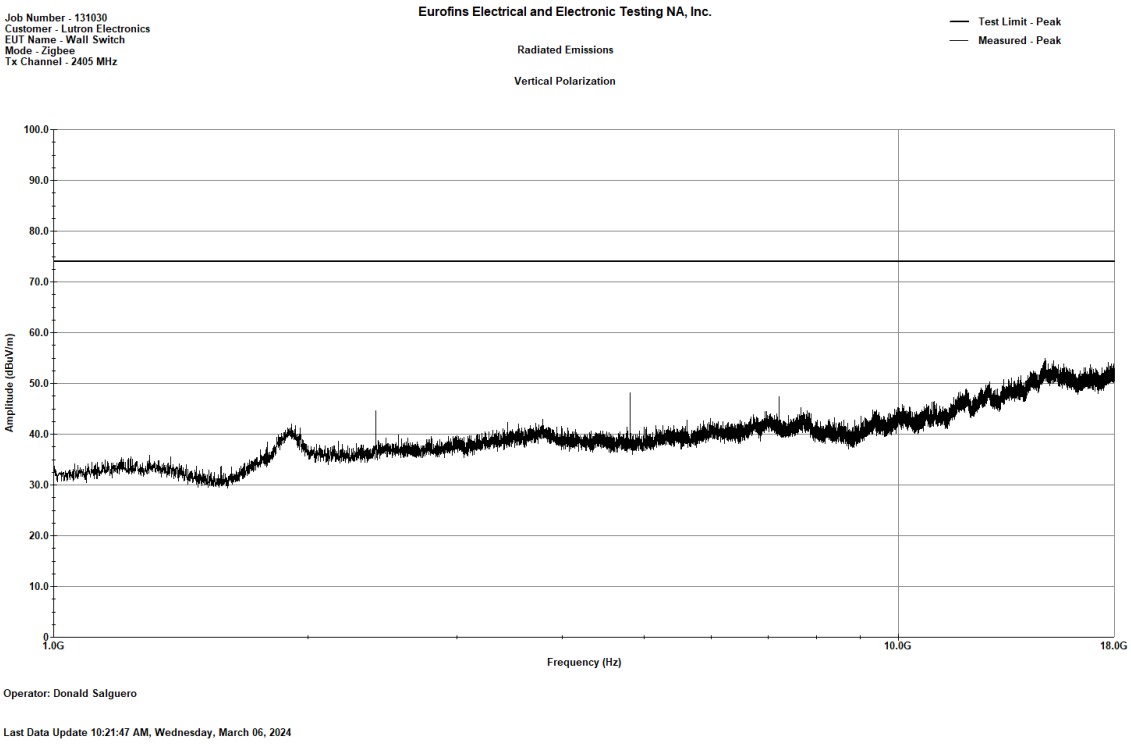


Figure 22. Zigbee_2405MHz_Radiated Emissions, Peak, 1 - 18 GHz-_V

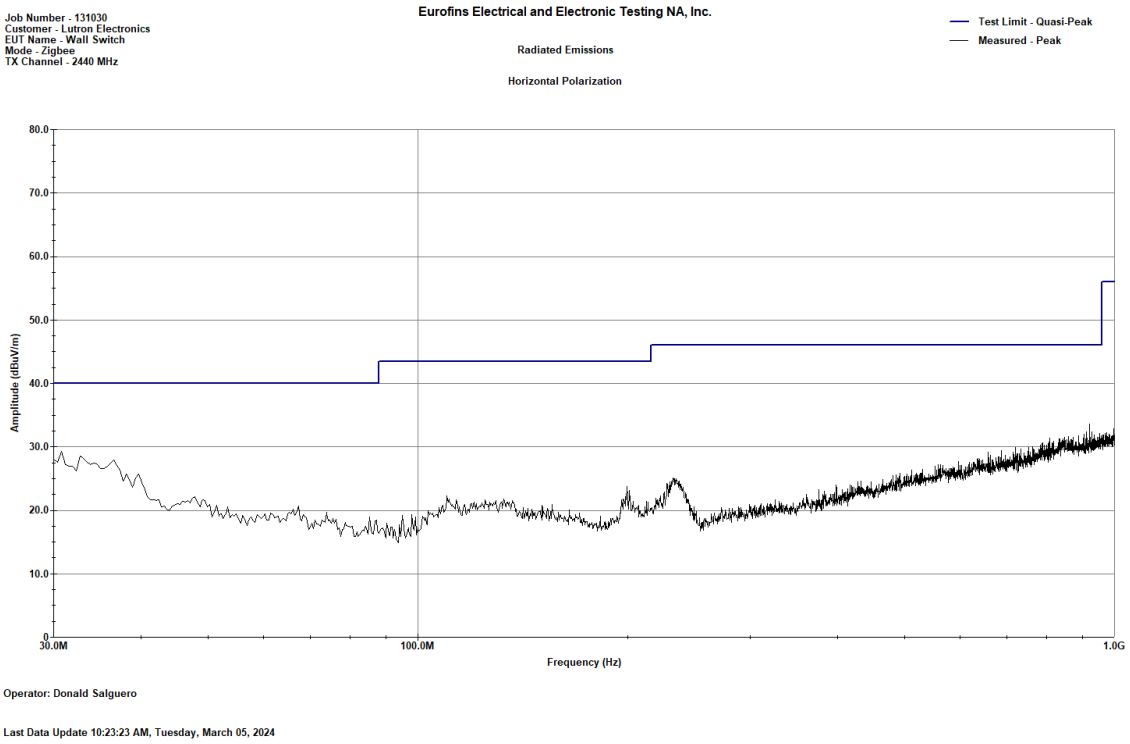


Figure 23. Zigbee_2440MHz_Radiated Emissions, 30 MHz to 1 GHz-_H

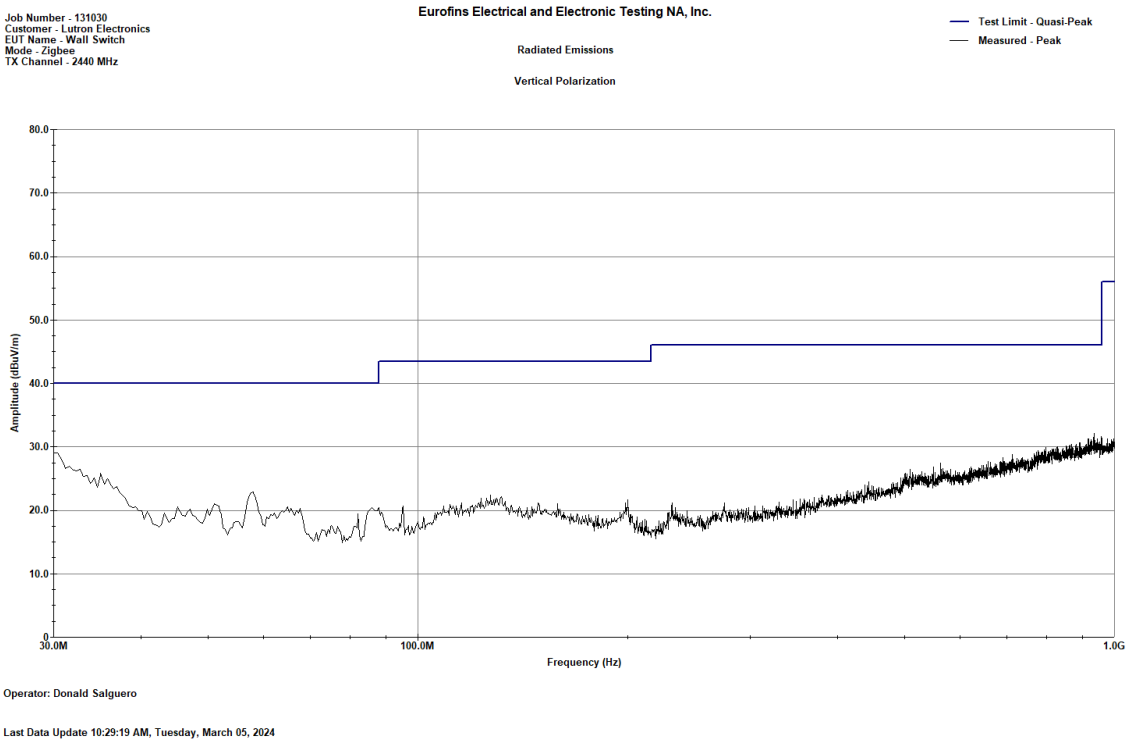


Figure 24. Zigbee_2440MHz_Radiated Emissions, 30 MHz to 1 GHz-_V

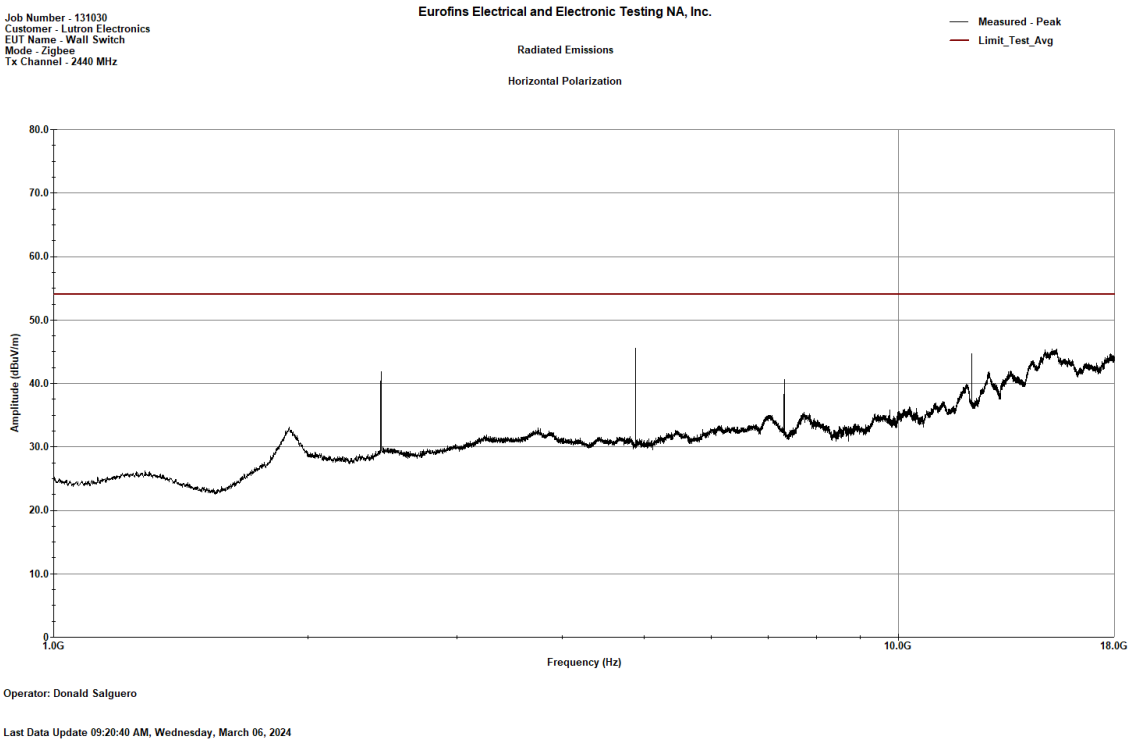


Figure 25. Zigbee_2440MHz_Radiated Emissions, Average, 1 - 18 GHz-_H

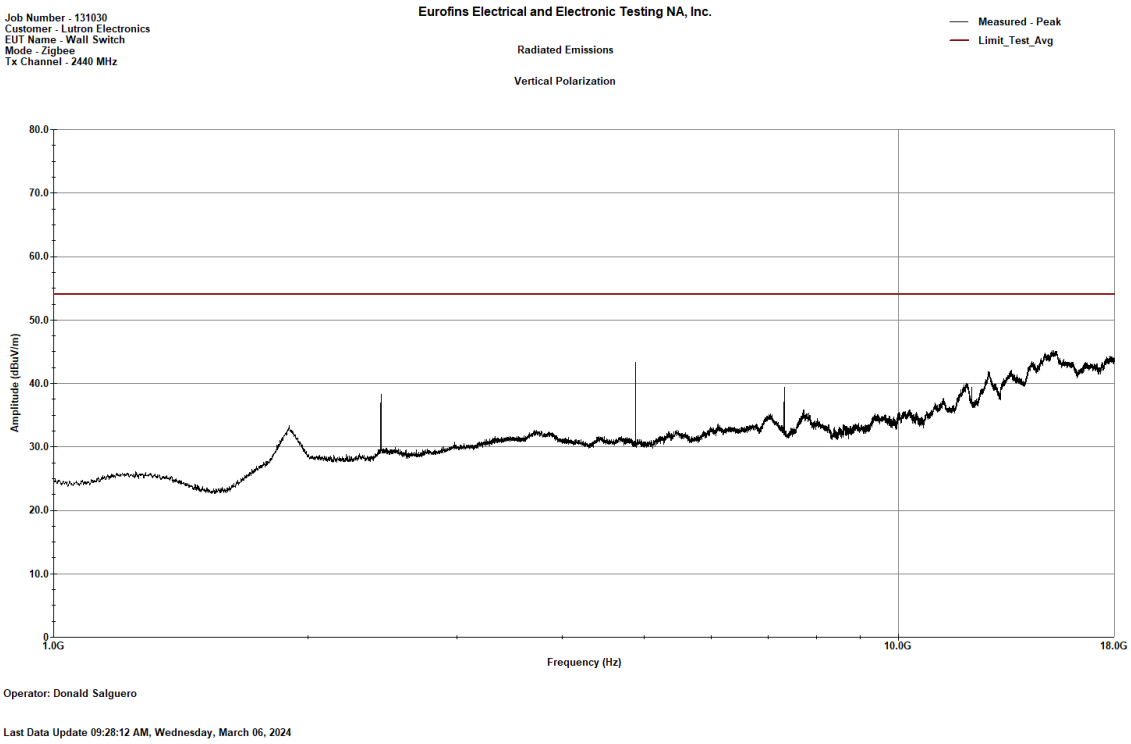


Figure 26. Zigbee_2440MHz_Radiated Emissions, Average, 1 - 18 GHz-_V

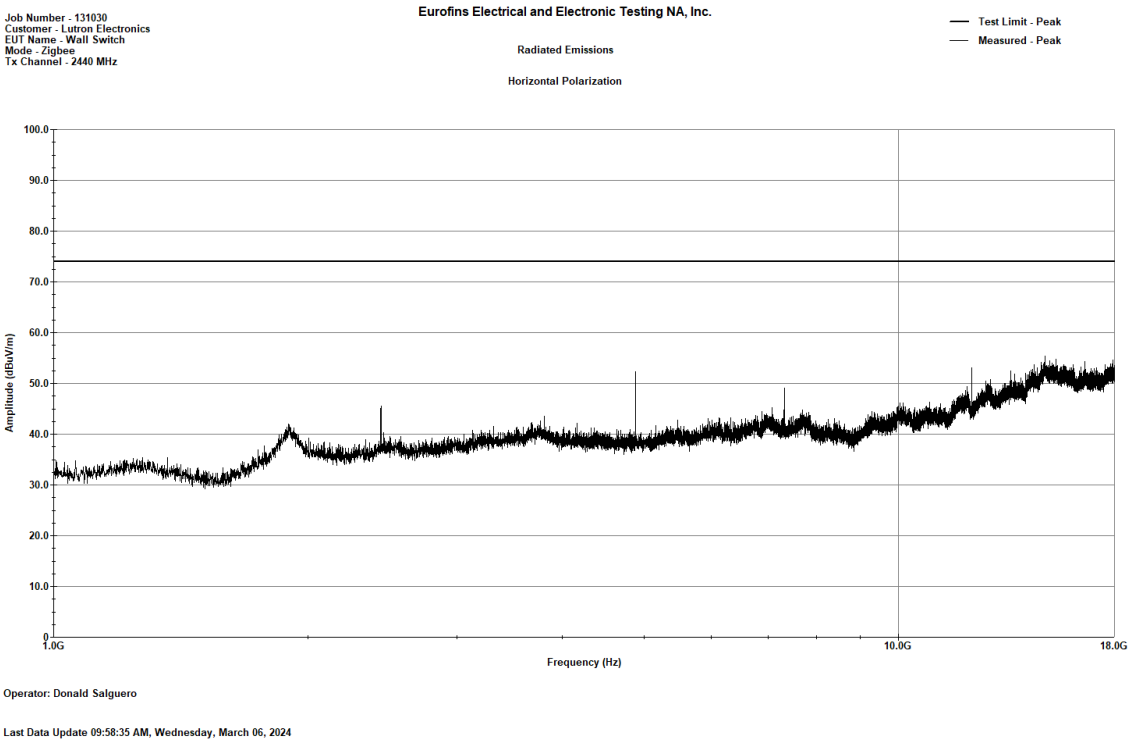


Figure 27. Zigbee_2440MHz_Radiated Emissions, Peak, 1 - 18 GHz-_H

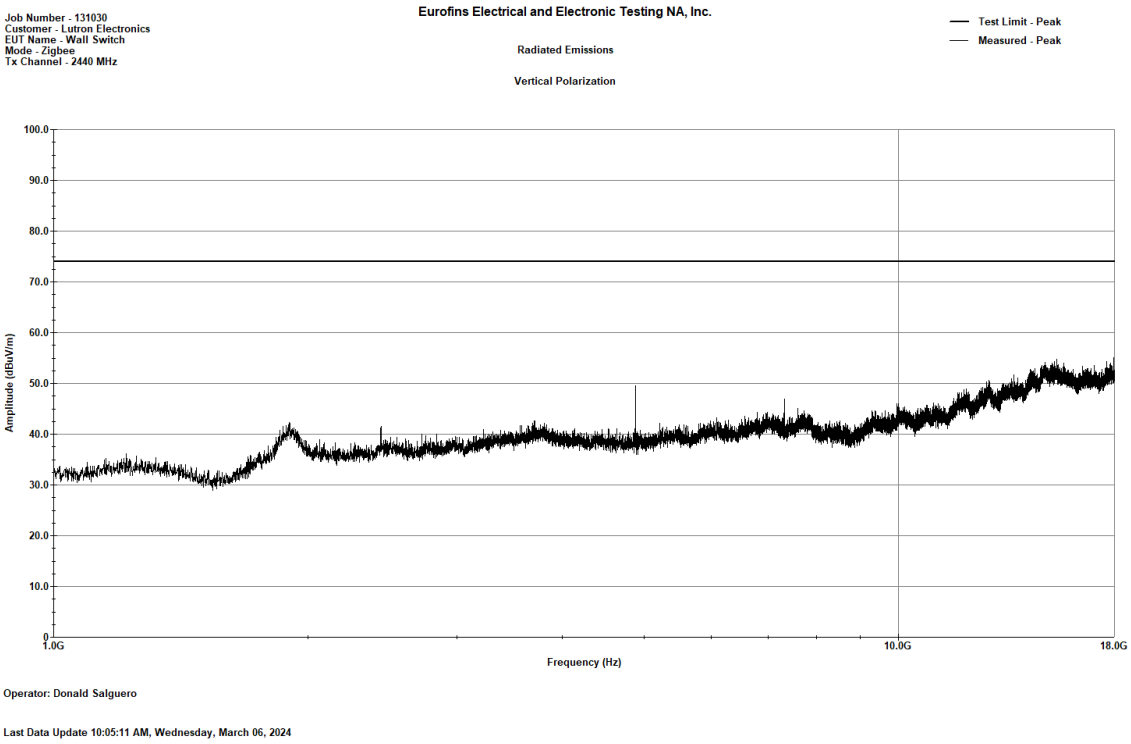


Figure 28. Zigbee_2440MHz_Radiated Emissions, Peak, 1 - 18 GHz-_V

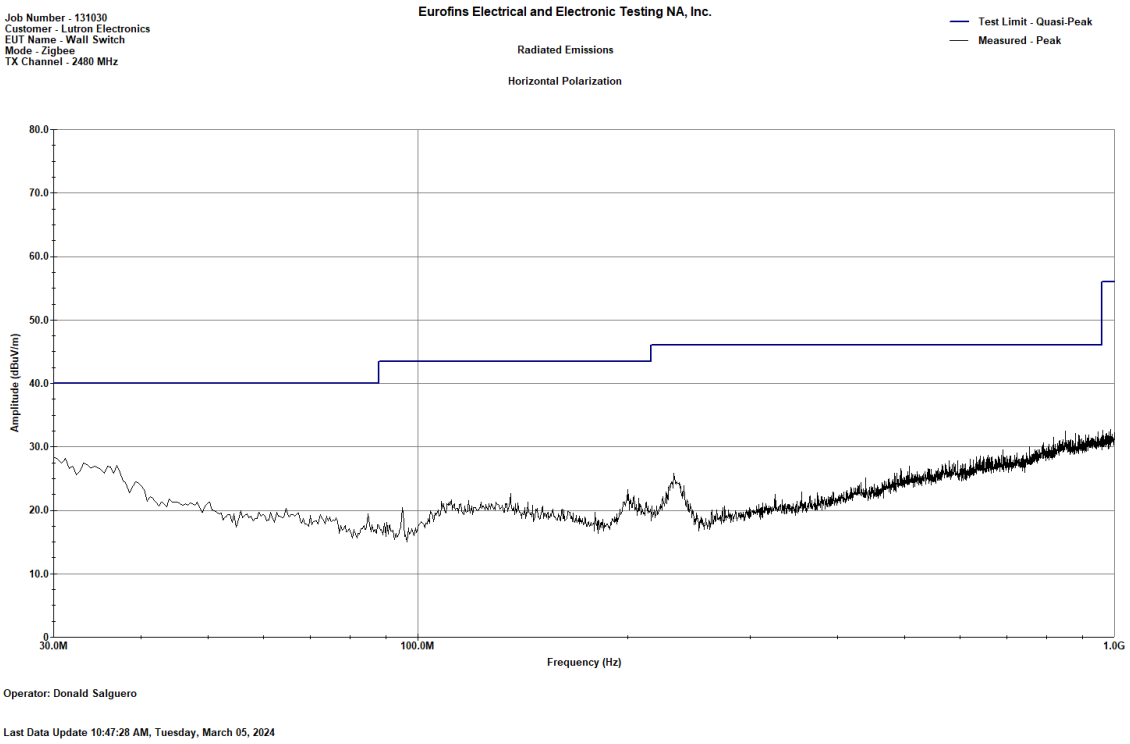


Figure 29. Zigbee_2480MHz_Radiated Emissions, 30 MHz to 1 GHz-_H

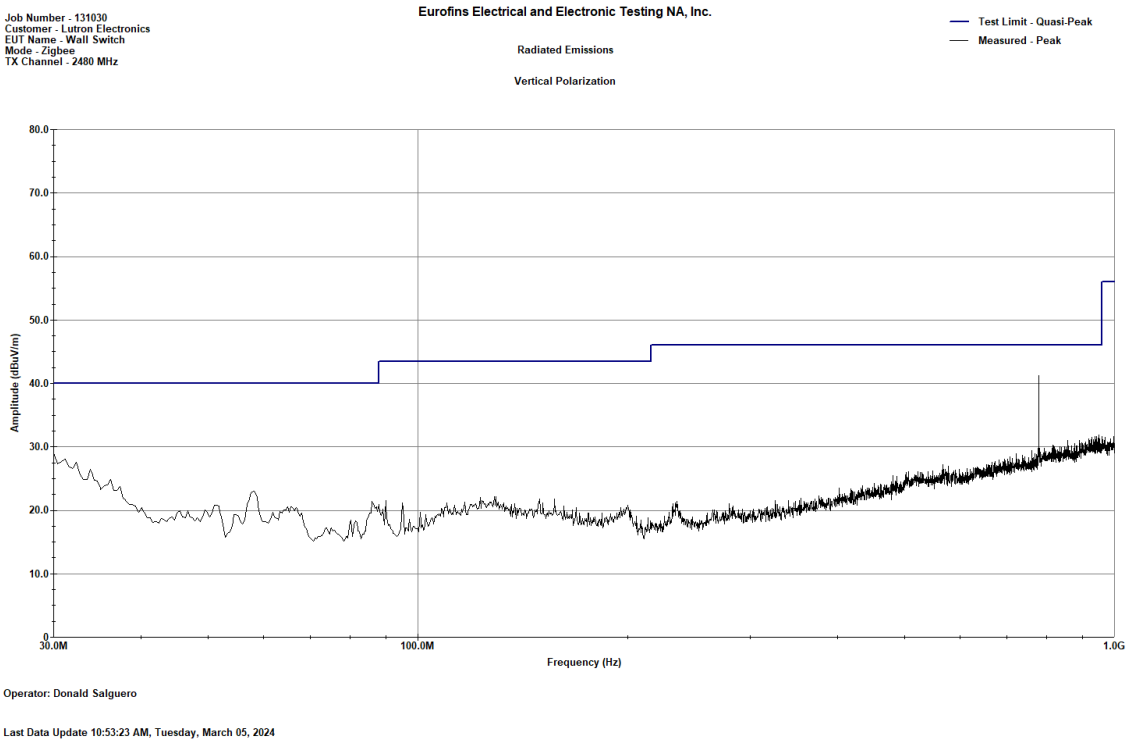


Figure 30. Zigbee_2480MHz_Radiated Emissions, 30 MHz to 1 GHz-_V

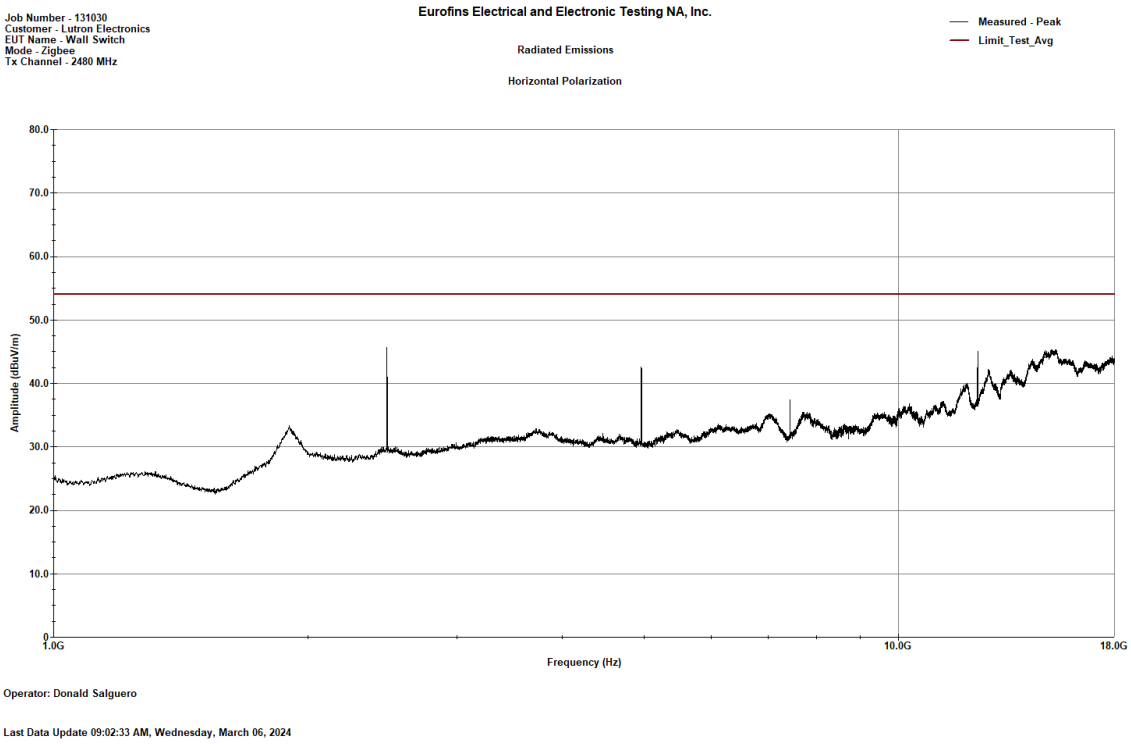


Figure 31. Zigbee_2480MHz_Radiated Emissions, Average, 1 - 18 GHz-_H

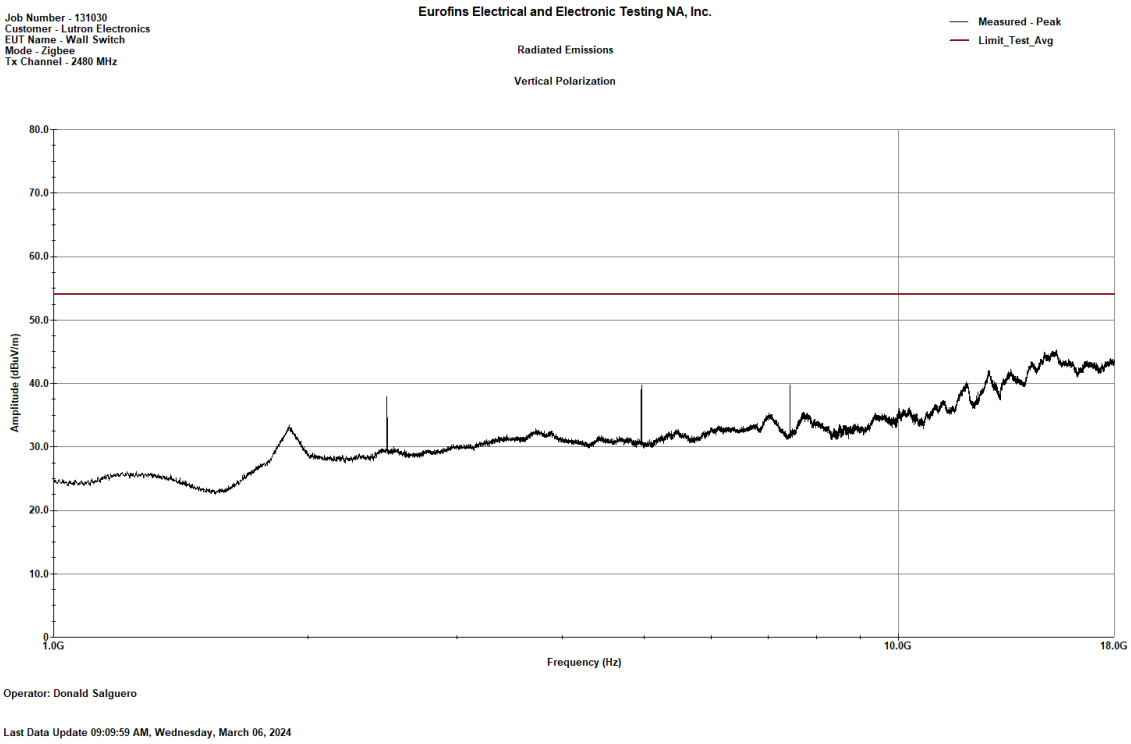


Figure 32. Zigbee_2480MHz_Radiated Emissions, Average, 1 - 18 GHz-_V

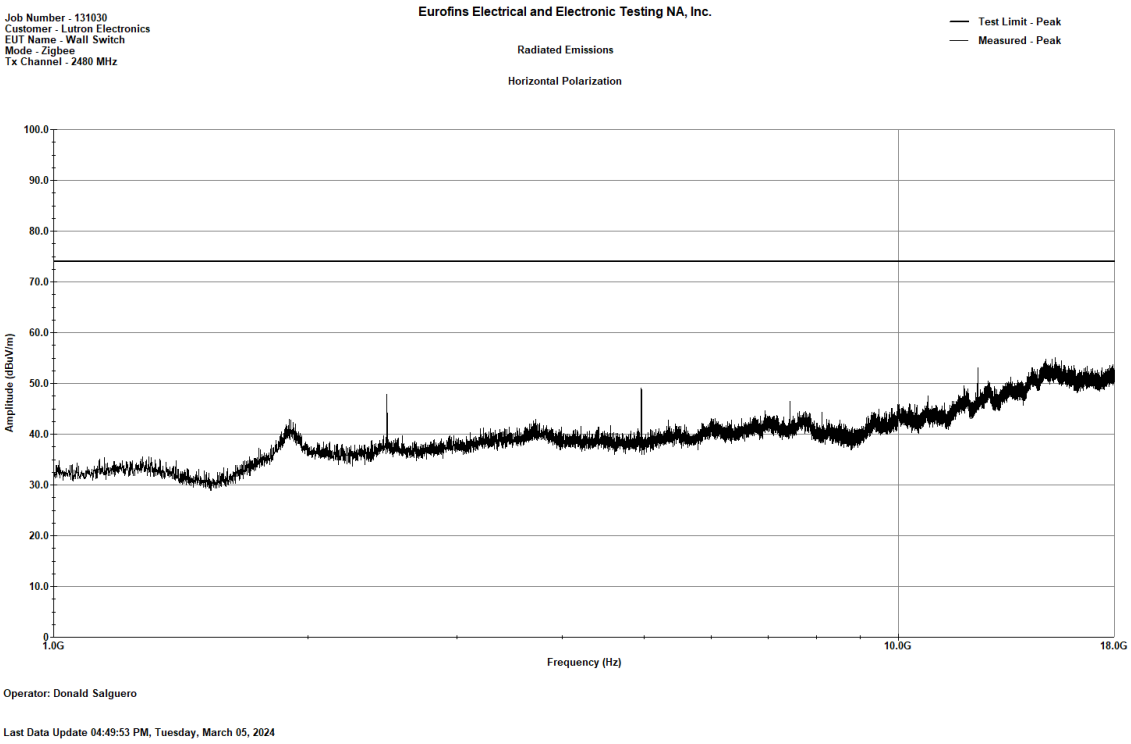


Figure 33. Zigbee_2480MHz_Radiated Emissions, Peak, 1 - 18 GHz-_H

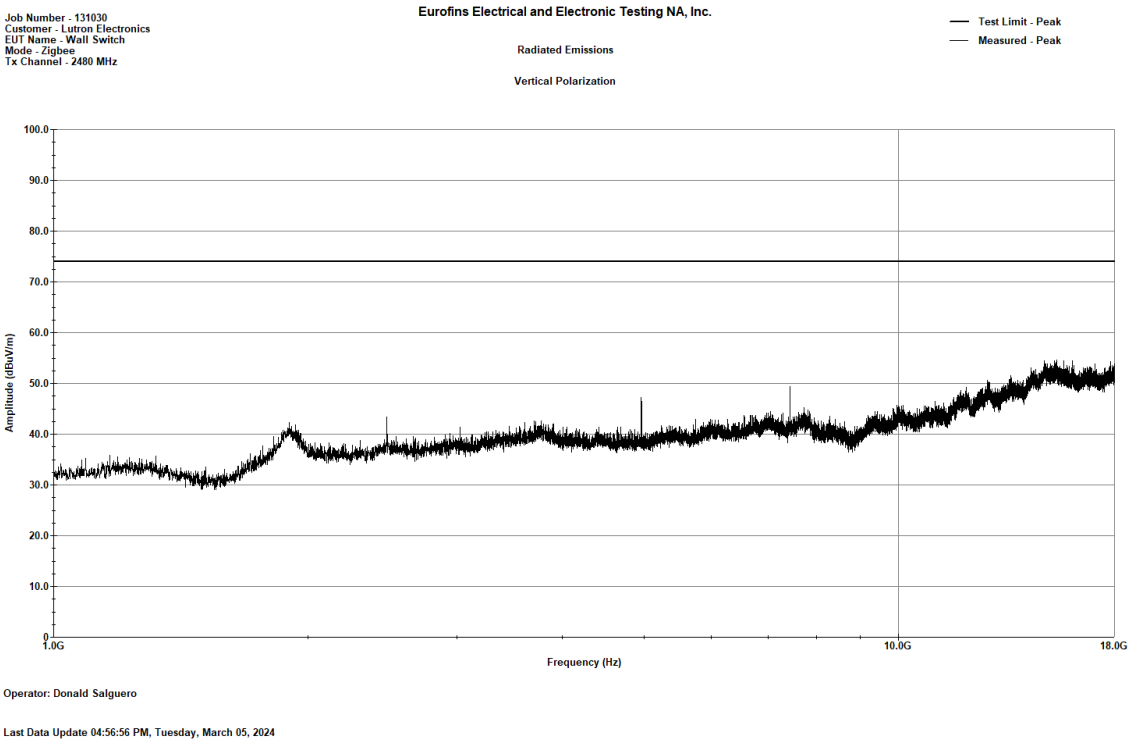


Figure 34. Zigbee_2480MHz_Radiated Emissions, Peak, 1 - 18 GHz-_V

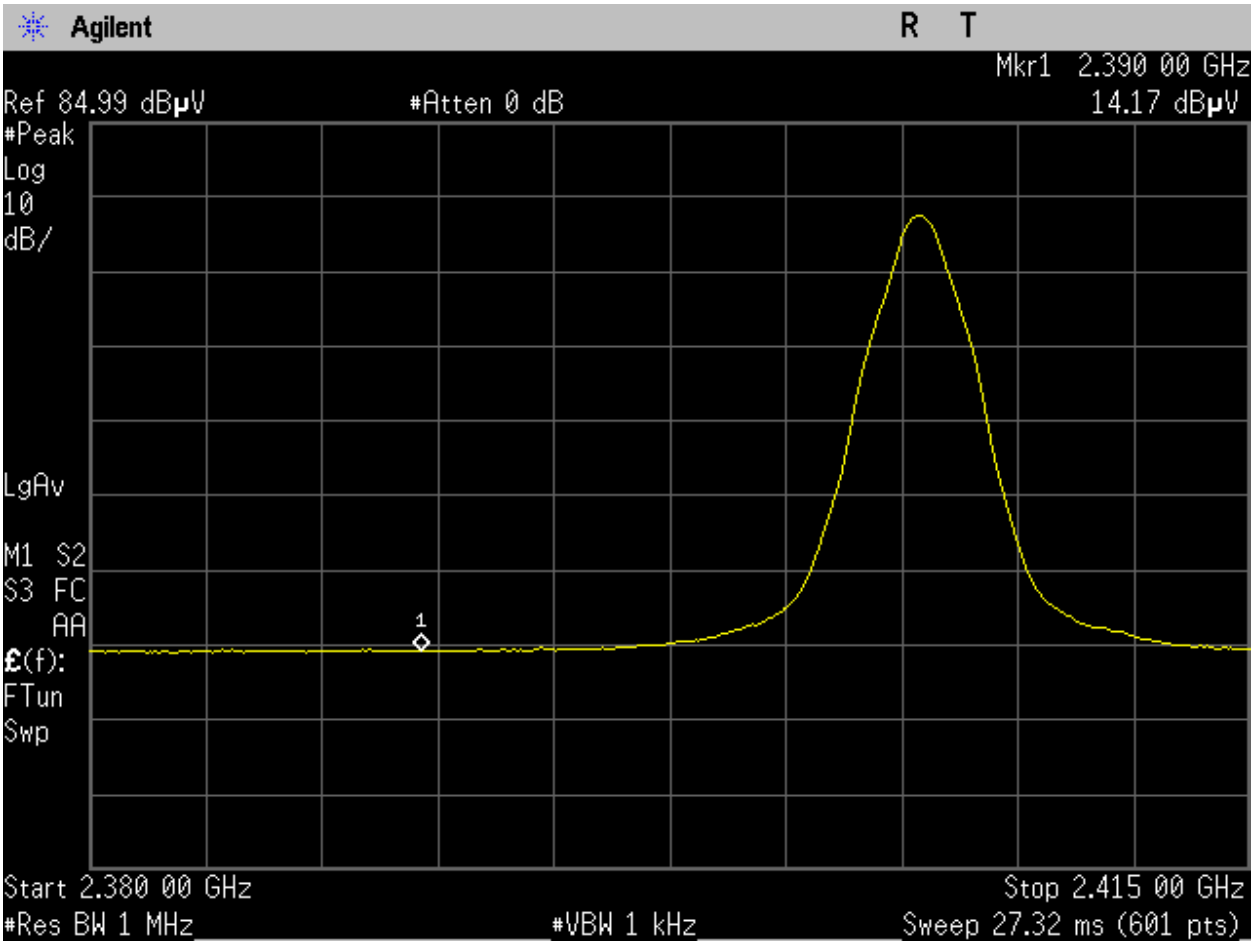


Figure 35. zigbbee_2390MHz band edge_H_AVG.

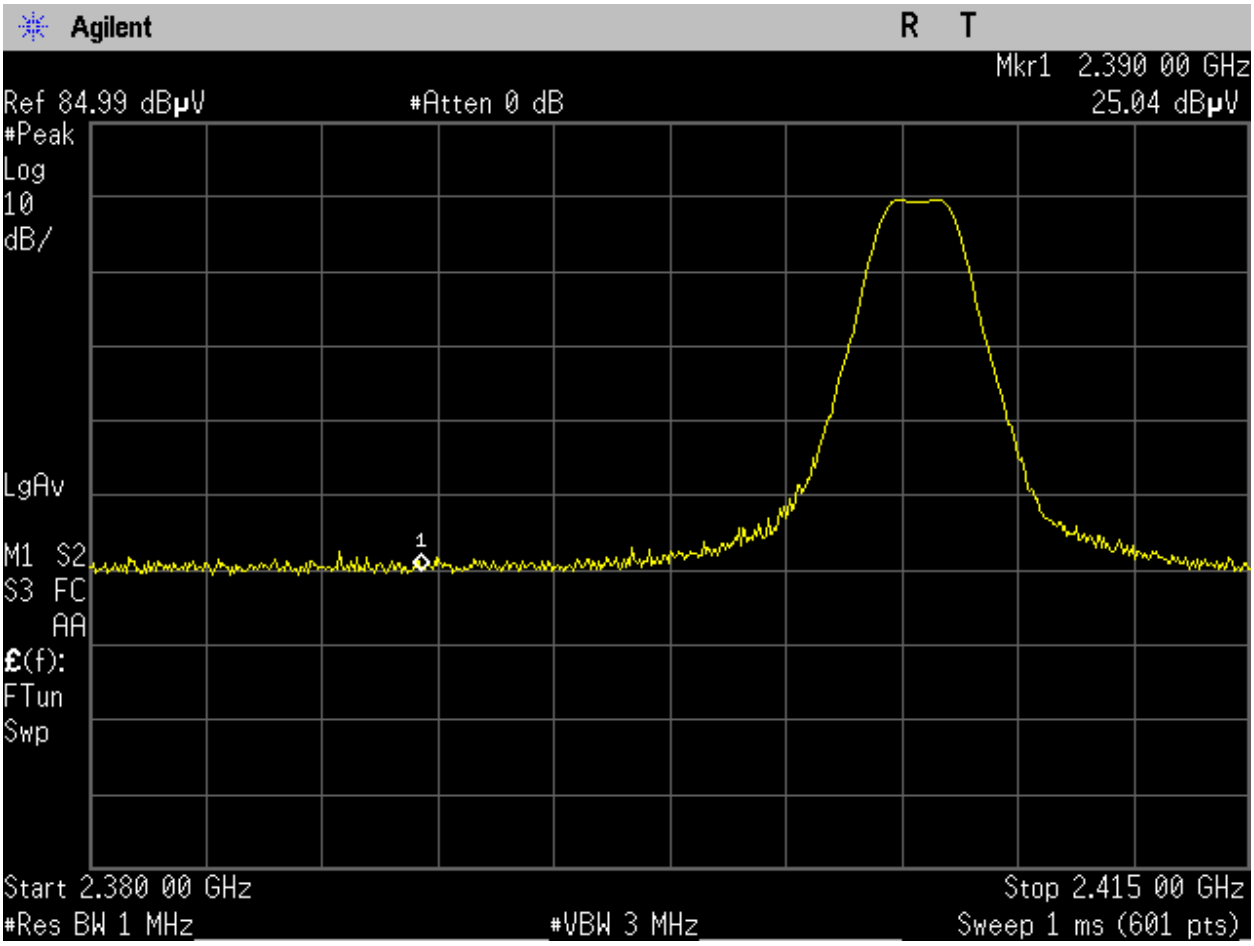


Figure 36. zigbbee_2390MHz band edge_H_PK.

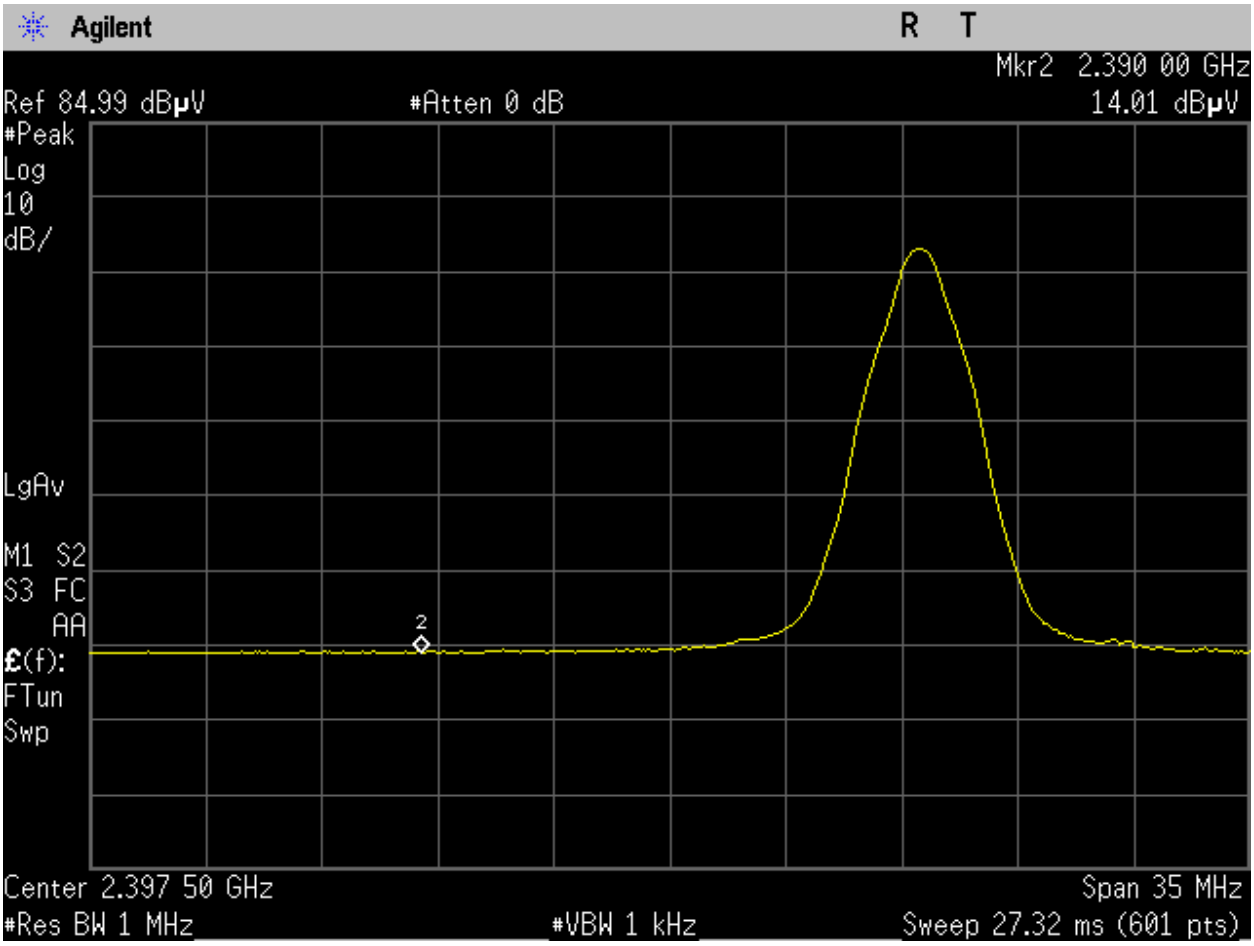


Figure 37. zigbbee_2390MHz band edge_V_AVG.

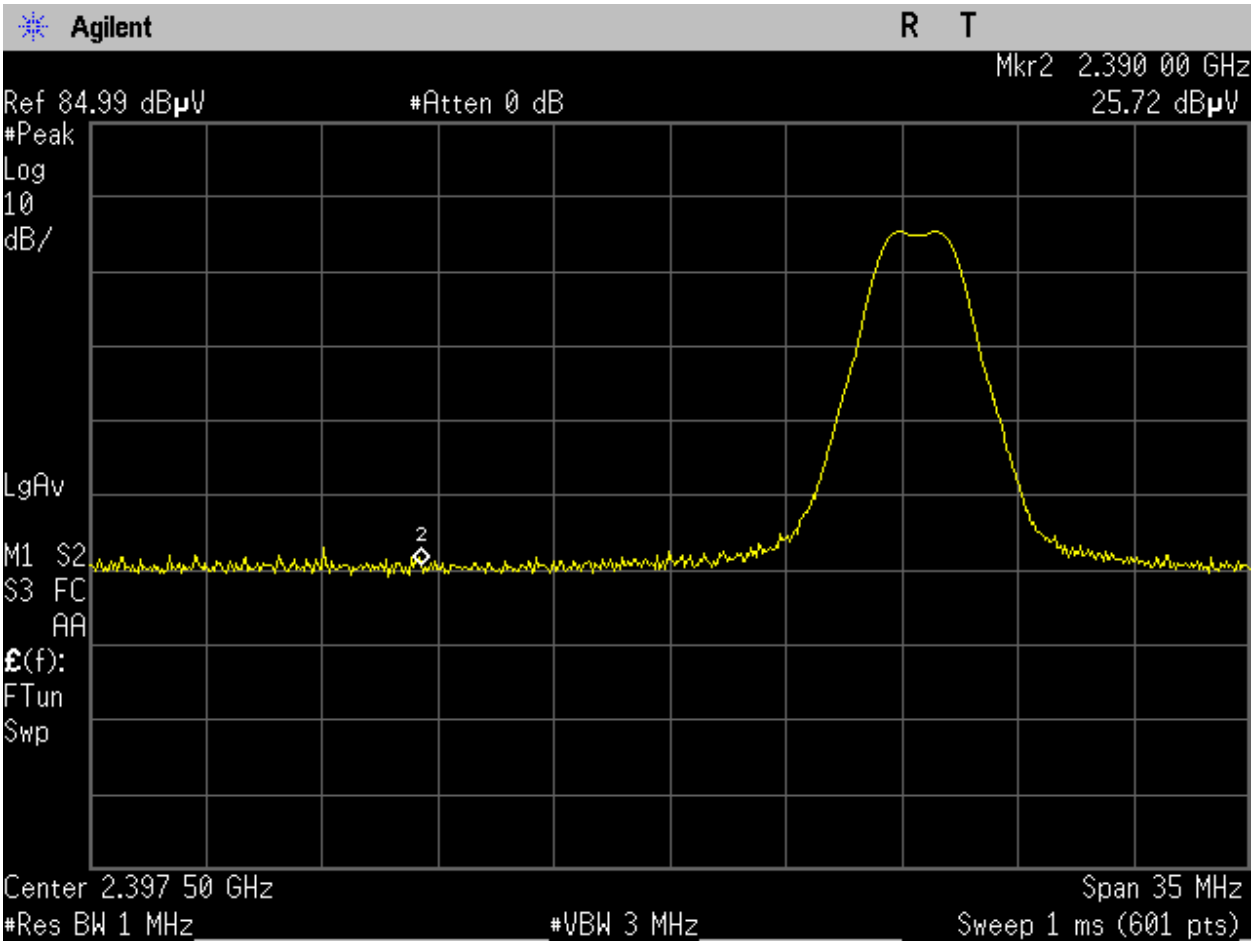


Figure 38. zigbbee_2390MHz band edge_V_PK.

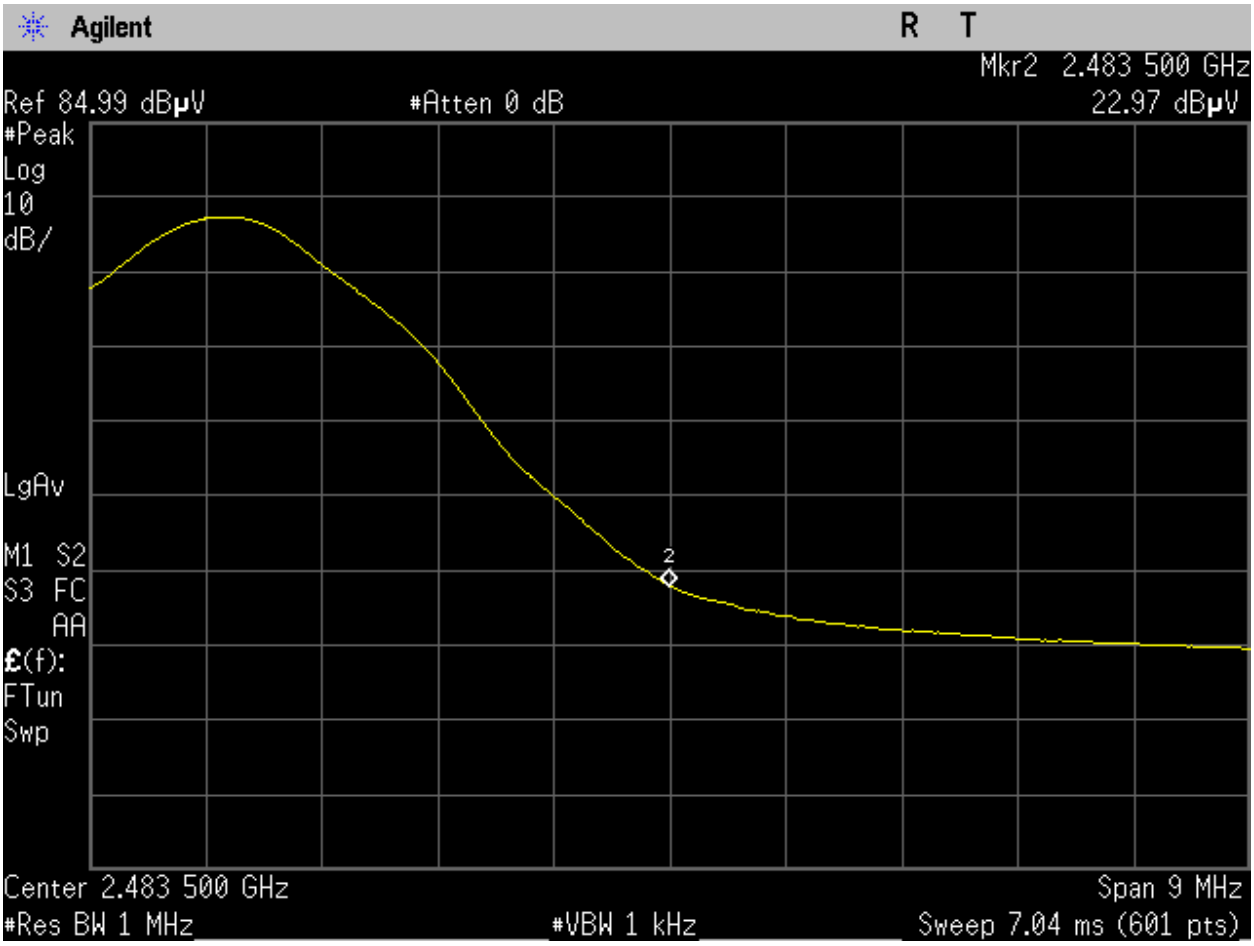


Figure 39. zigbbee_2483.5MHz band edge_H_AVG.

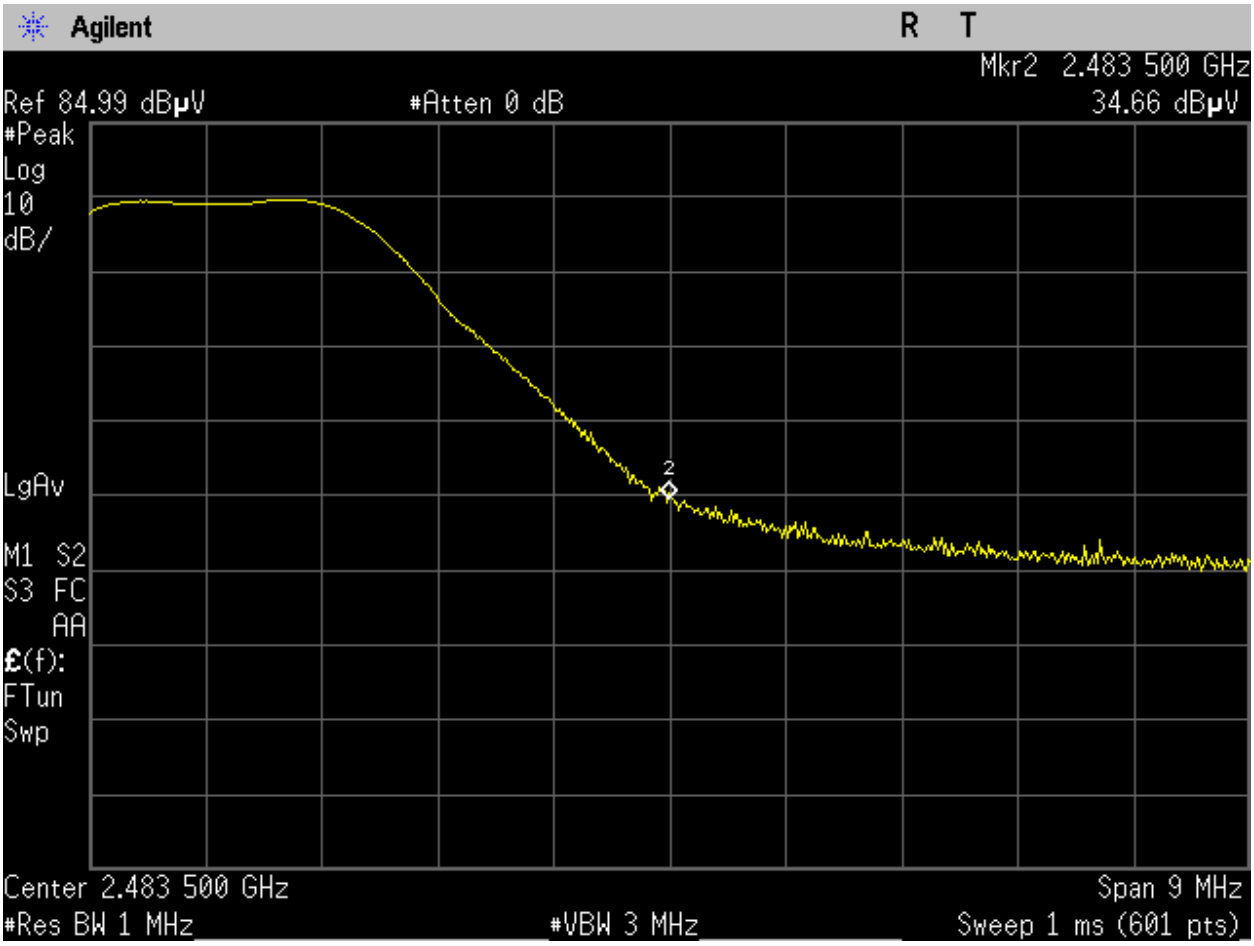


Figure 40. zigbbee_2483.5MHz band edge_H_PK.

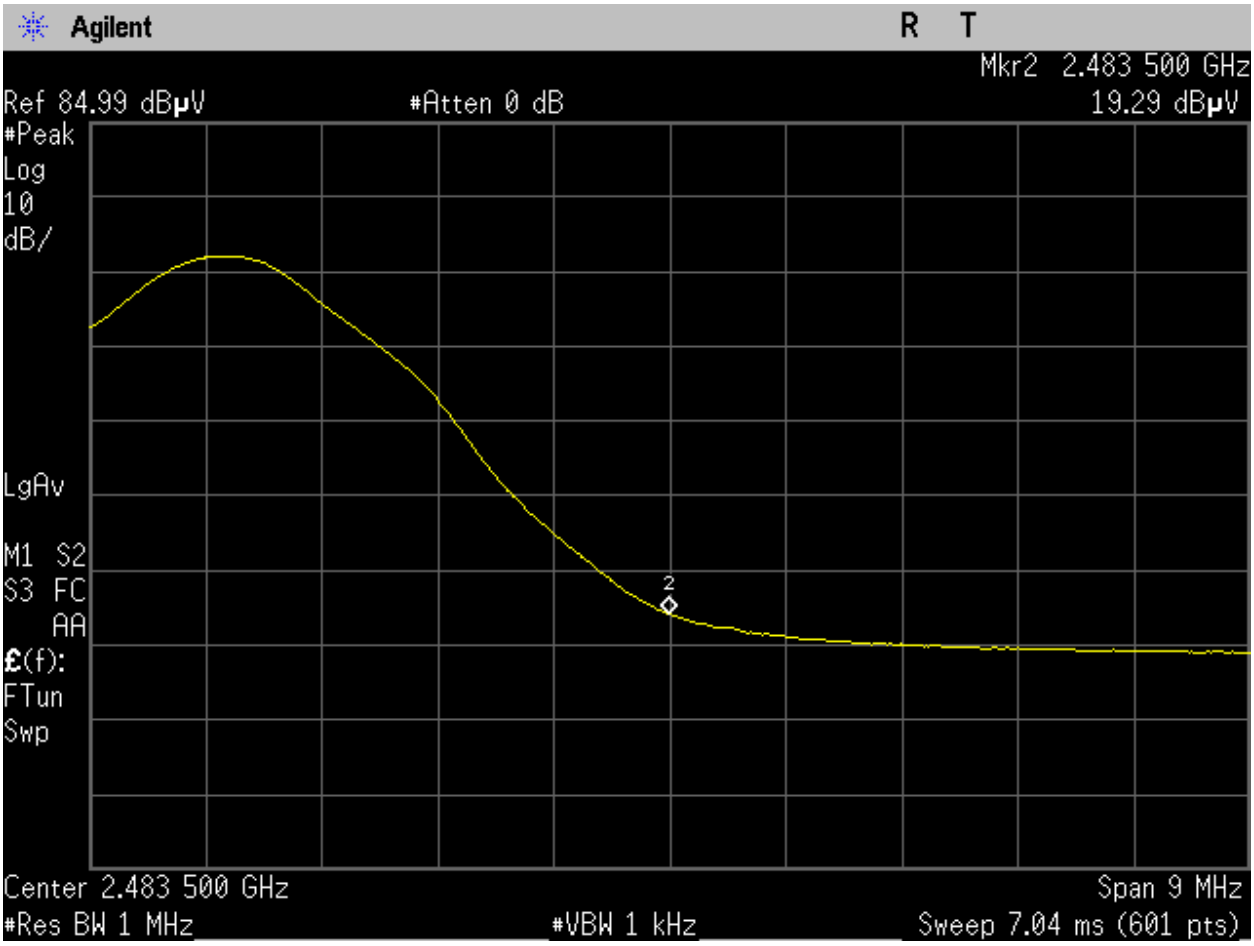


Figure 41. zigbbee_2483.5MHz band edge_V_AVG.

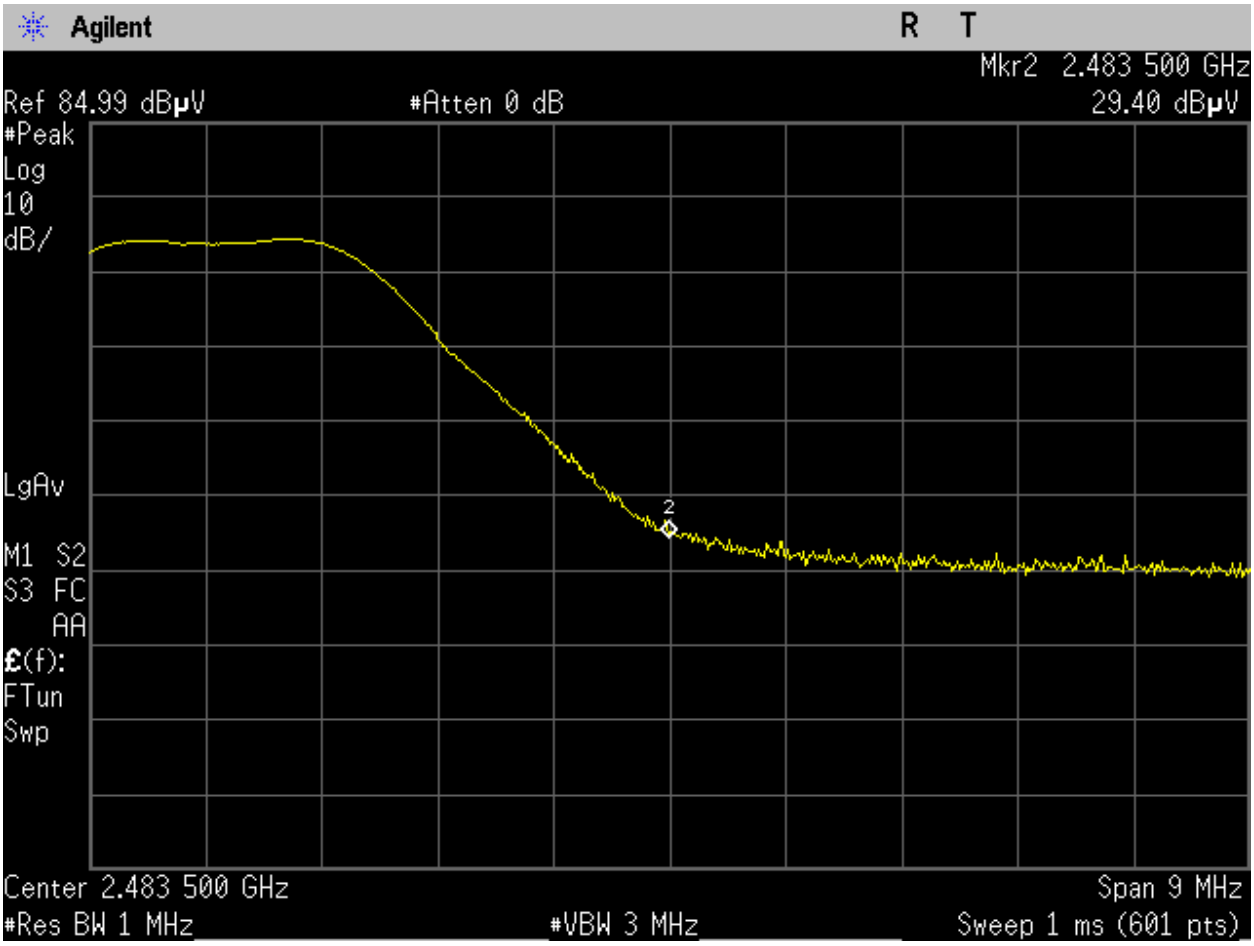


Figure 42. zigbbee_2483.5MHz band edge_V_PK.

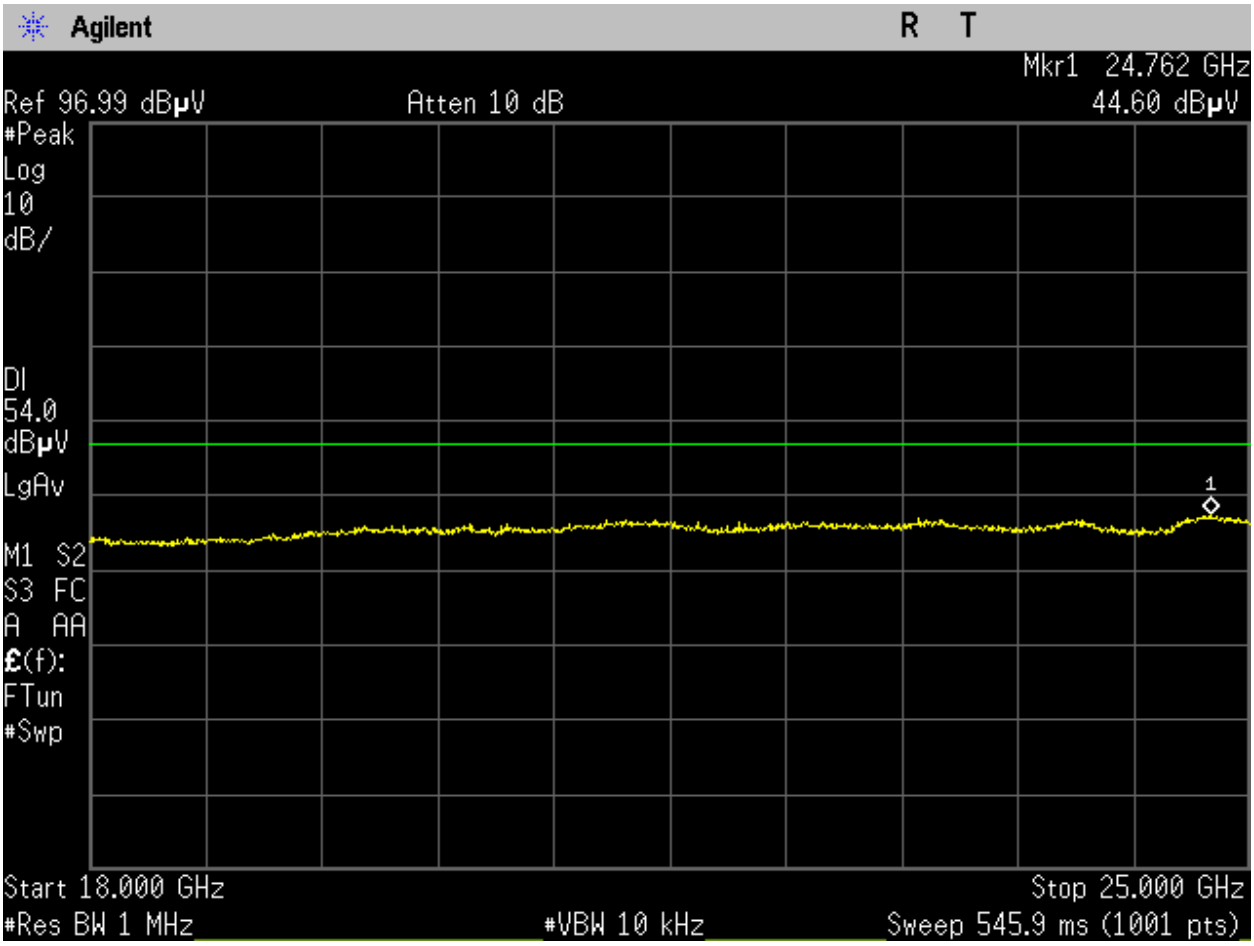


Figure 43. Zigbee_Radiated Spurious Emissions, Average_H_18-25GHz.

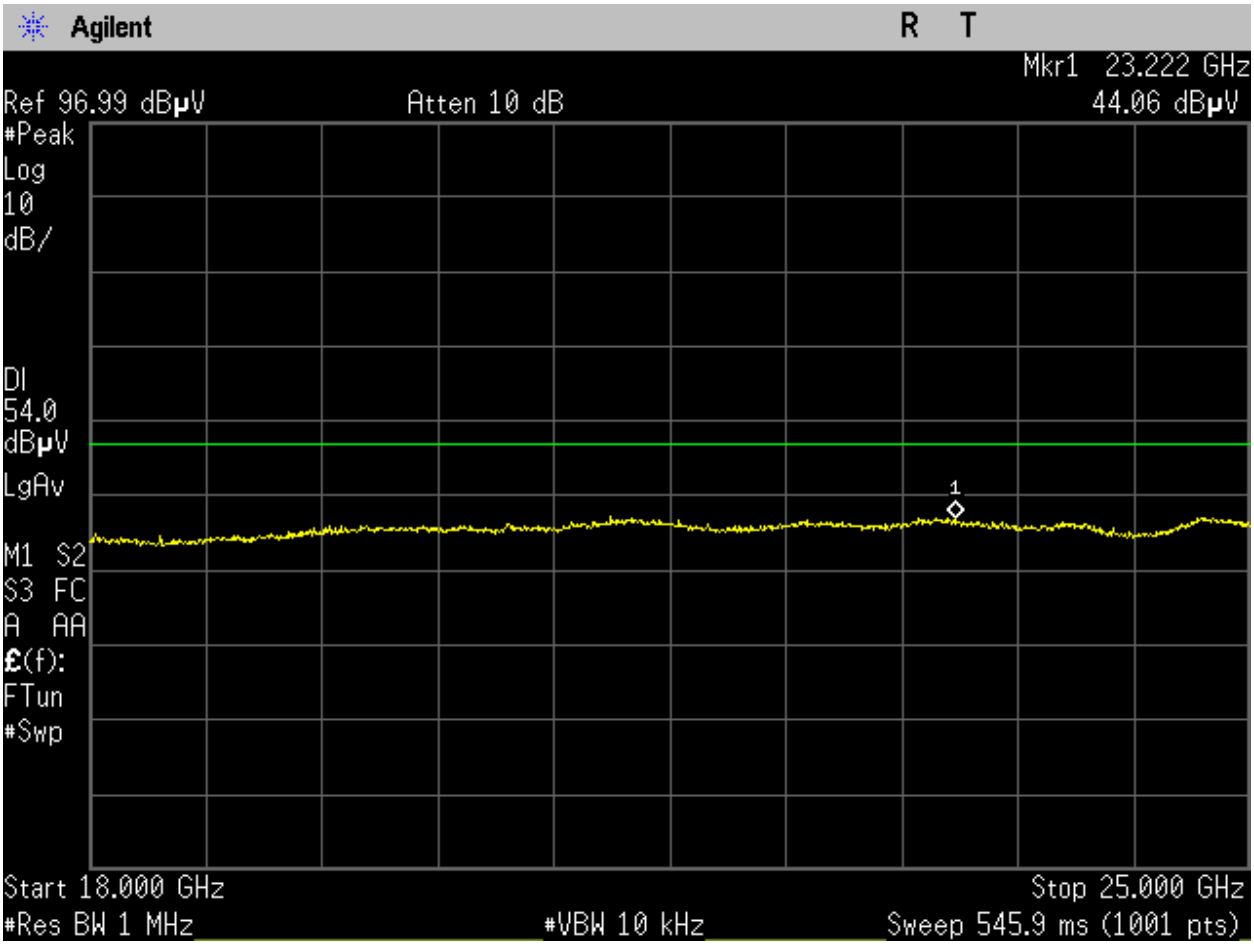


Figure 44. Zigbee_Radiated Spurious Emissions, Average_V_18-25GHz.

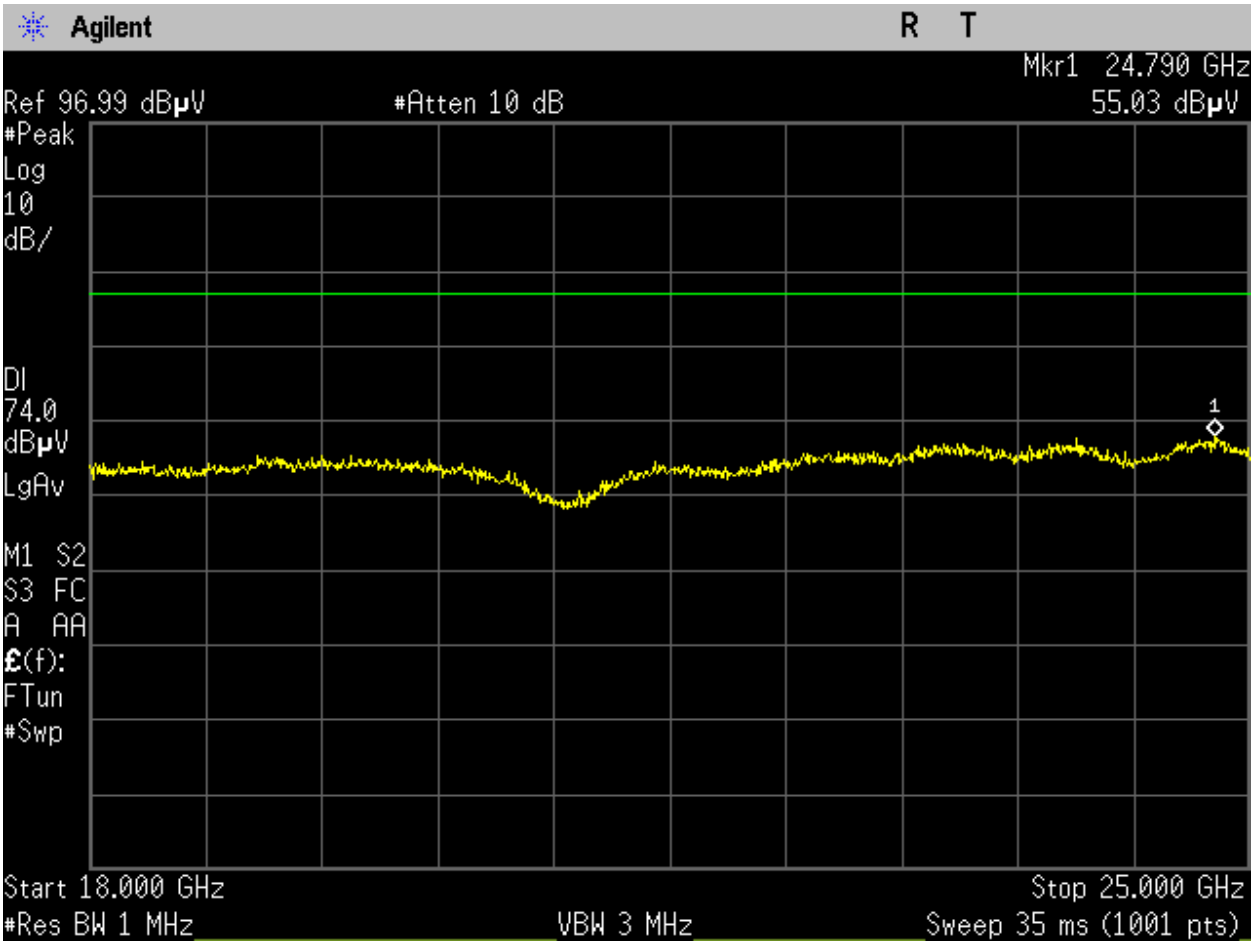


Figure 45. Zigbee_Radiated Spurious Emissions, Peak_H_18-25GHz.

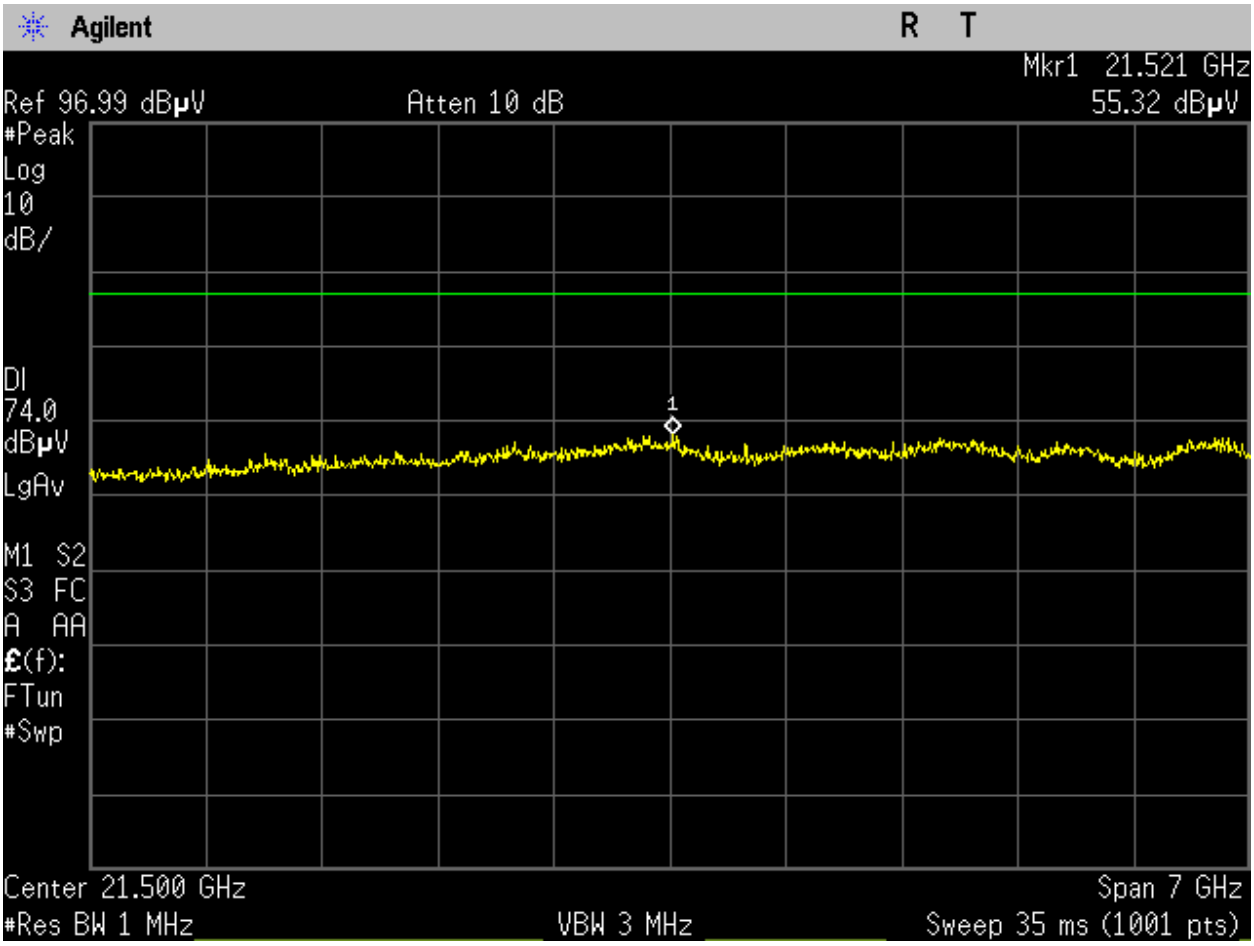
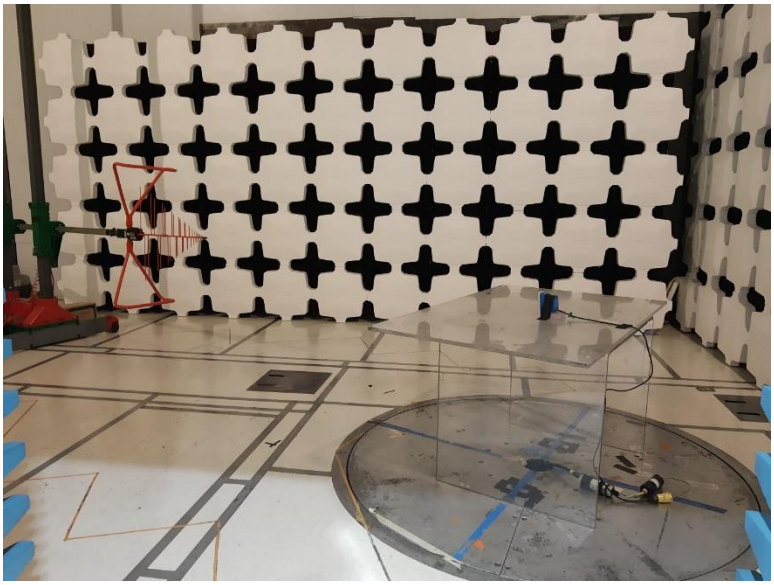
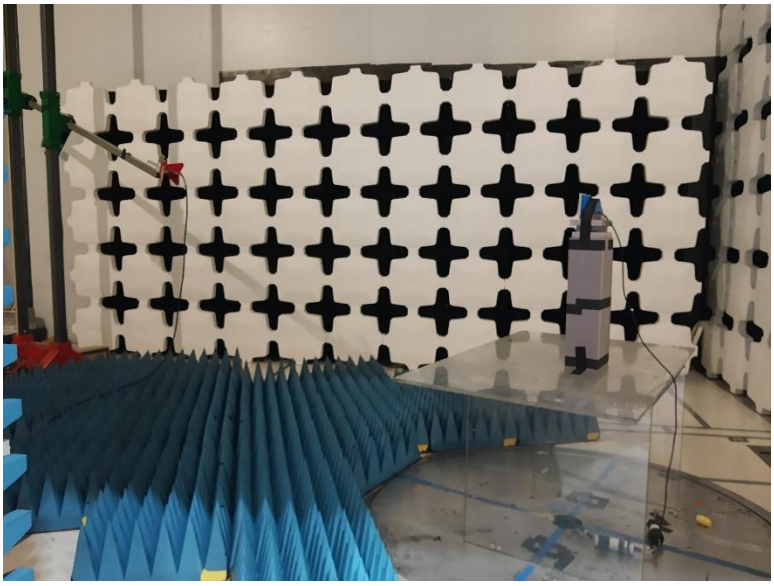


Figure 46. Zigbee_Radiated Spurious Emissions, Peak_V_18-25GHz.

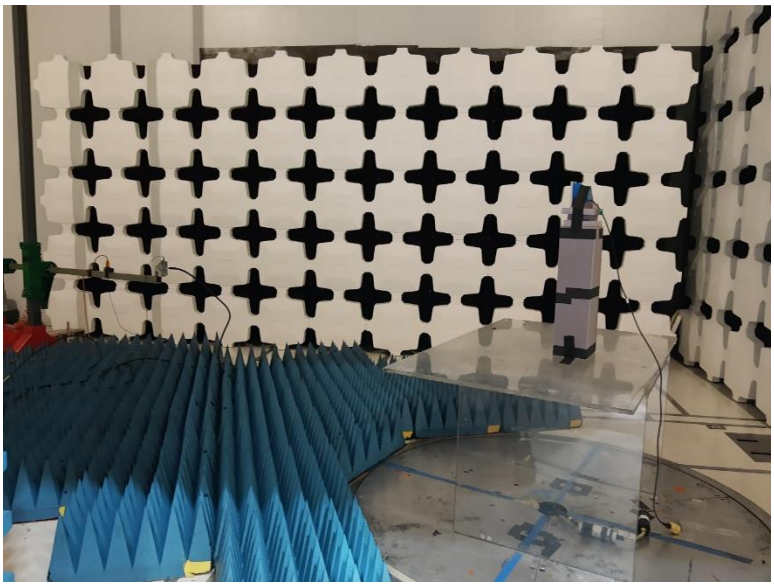
Test Photographs



Photograph 3. RE Setup [30MHz-1GHz]



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



Photograph 5. RE Setup [18GHz-25GHz]

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) RF Conducted Spurious Emissions Requirements and Band Edge

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.

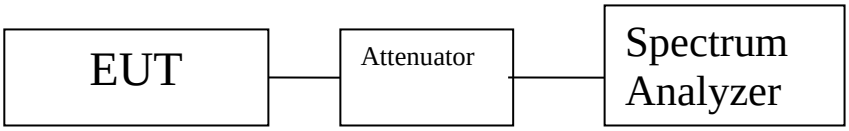


Figure 47. Block Diagram, Conducted Spurious Emissions Test Setup

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 §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.

Test Results: The EUT was compliant with this requirement.

Test Engineer(s): Donald Salguero

Test Date(s): March 7, 2024

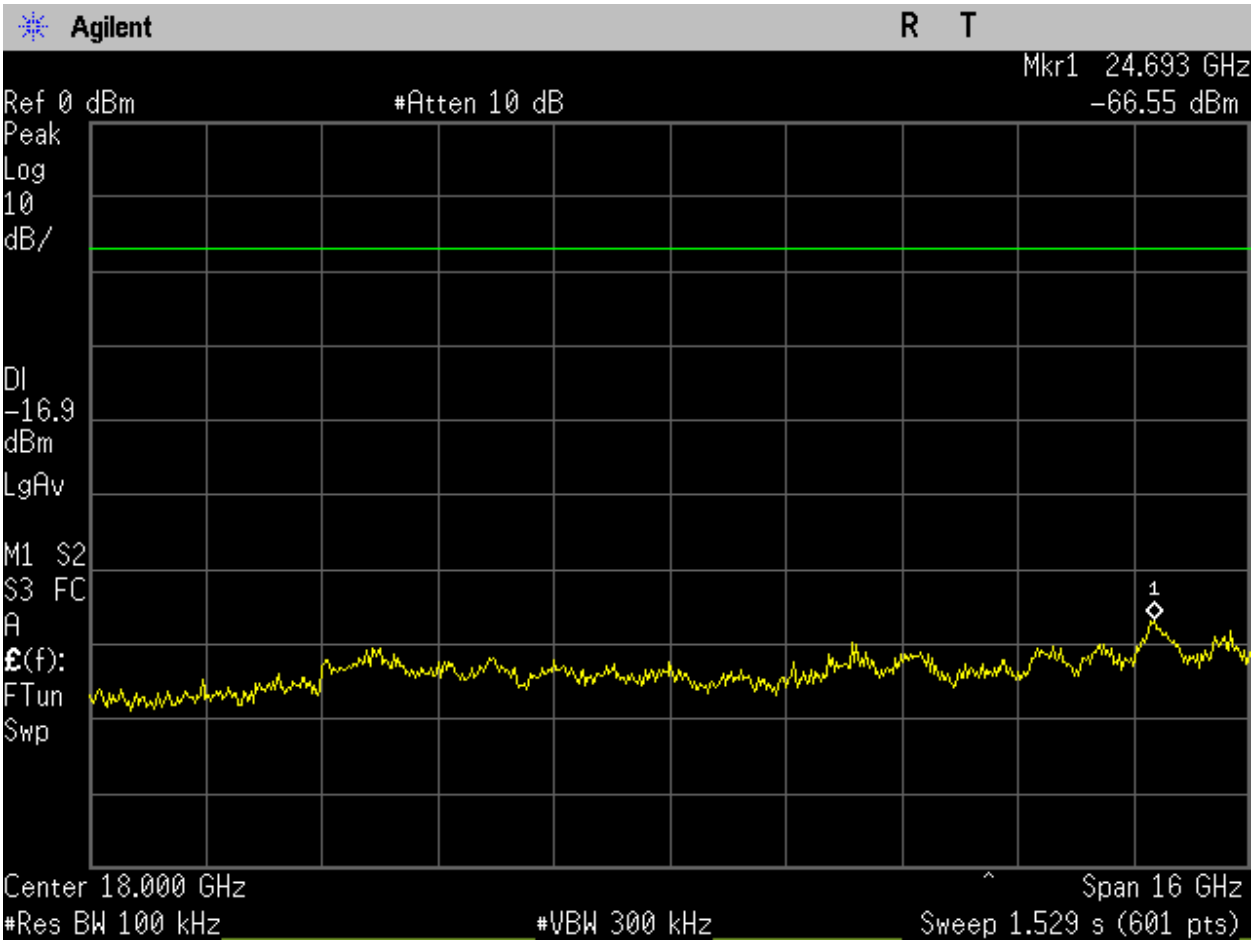


Figure 48. Zigbee_High Ch_2480MHz_2MBit_-20dBc_10-26GHz_Port 1.

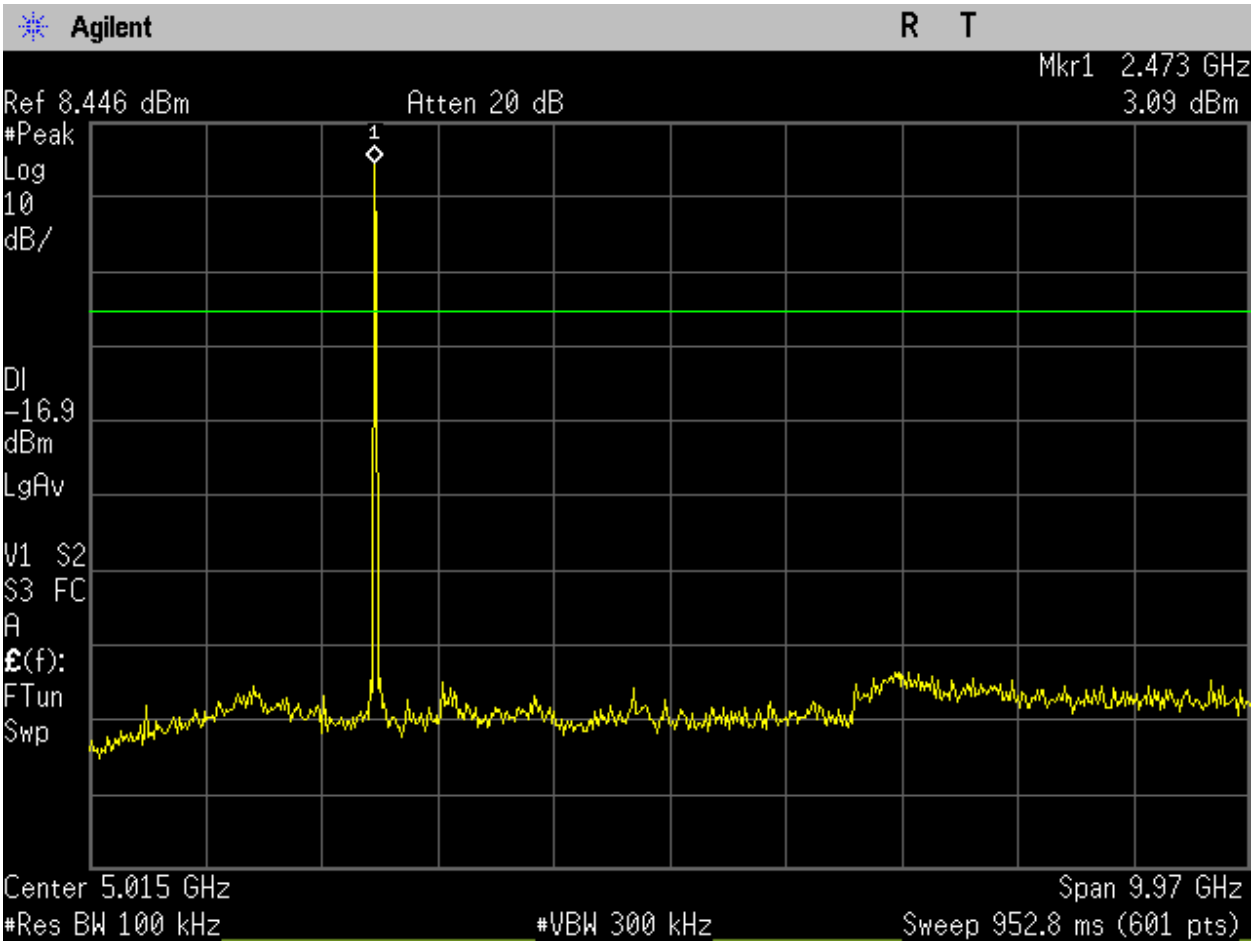


Figure 49. Zigbee_High Ch_2480MHz_2MBit_-20dBc_30MHz-10GHz_Port 1.

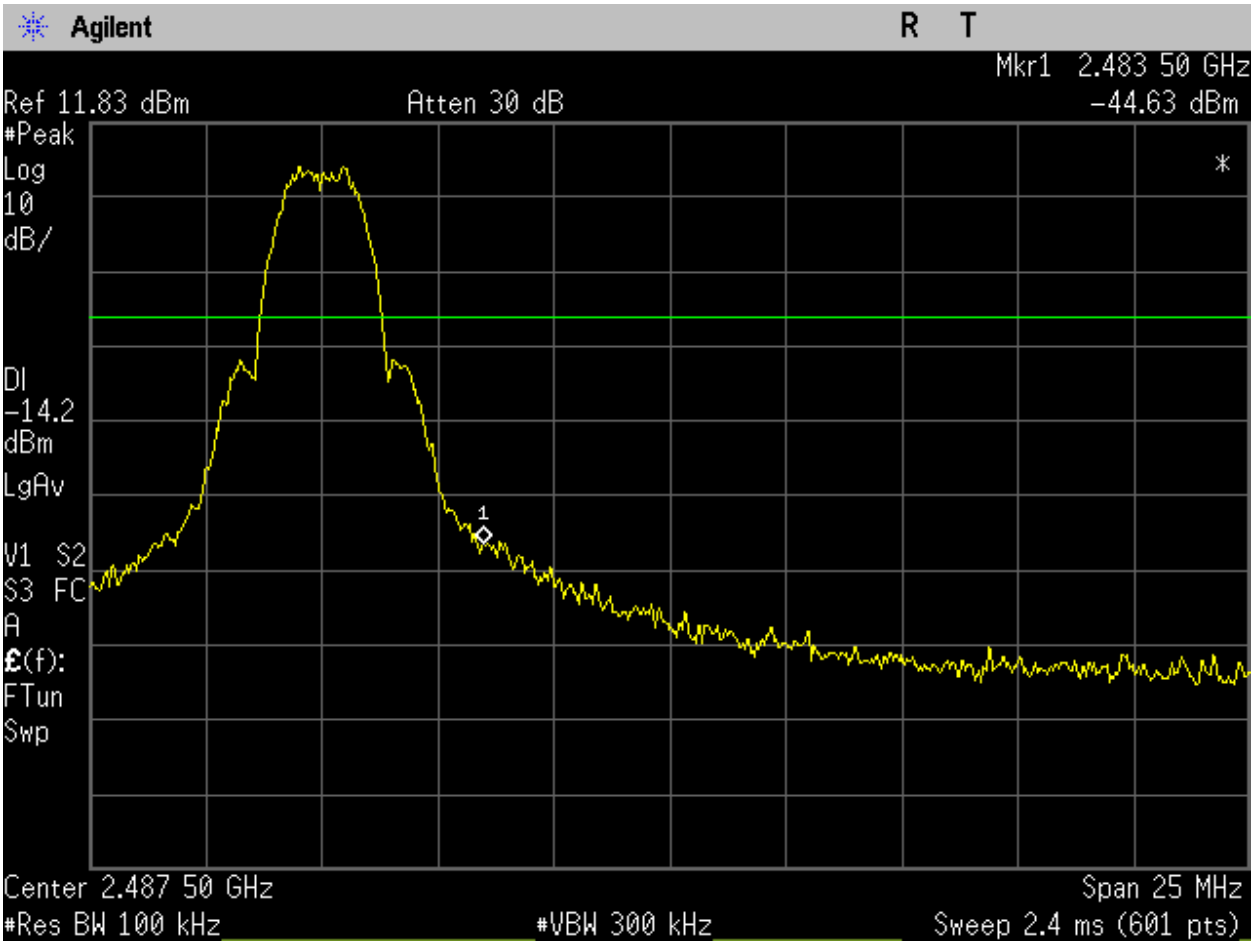


Figure 50. Zigbee_High Ch_2480MHz_2MBit_-20dBc_Upper Band Edge_Port 1.

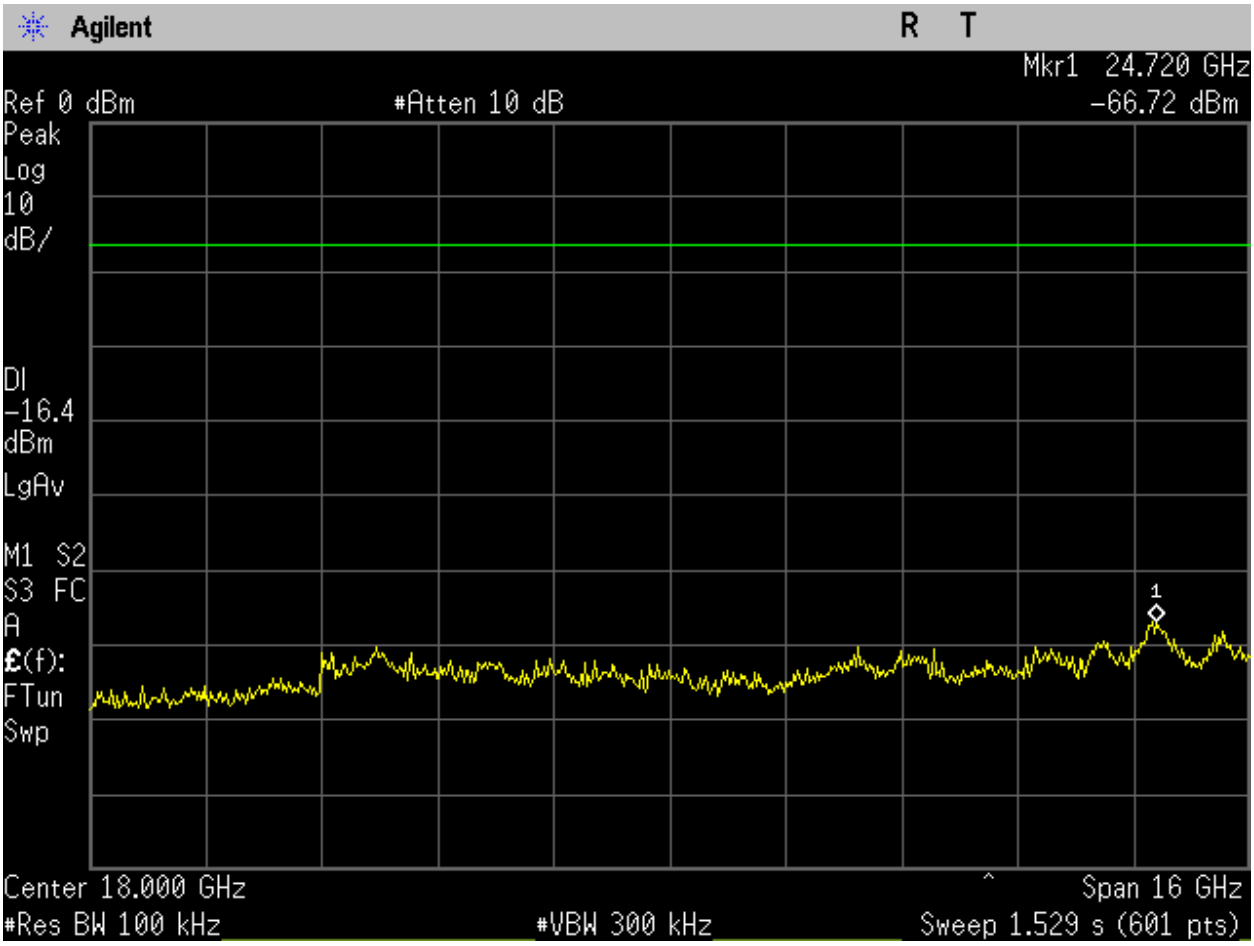


Figure 51. Zigbee_Low Ch_2405MHz_2MBit_-20dBc_10-26GHz_Port 1.

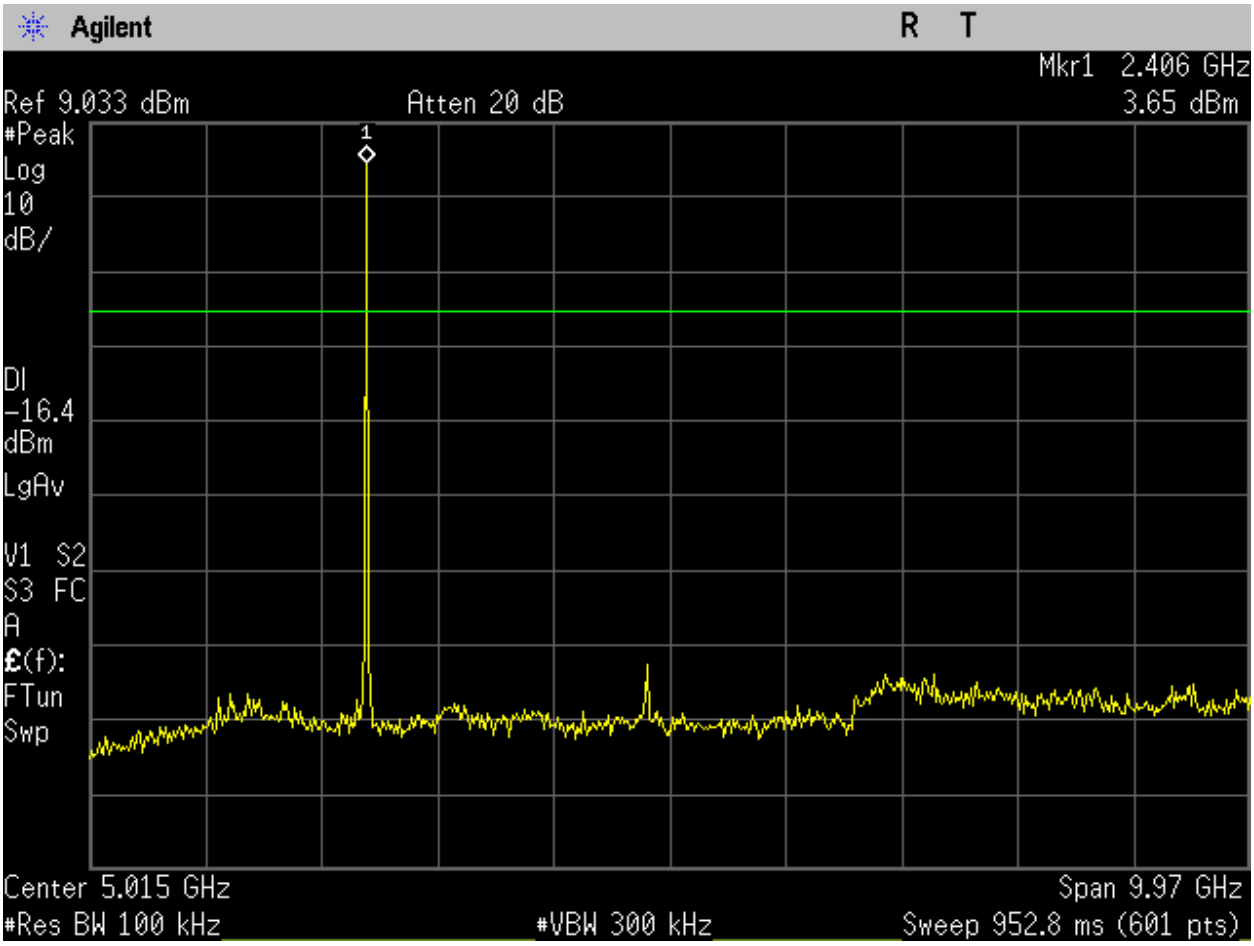


Figure 52. Zigbee_Low Ch_2405MHz_2MBit_-20dBc_30MHz-10GHz_Port 1.

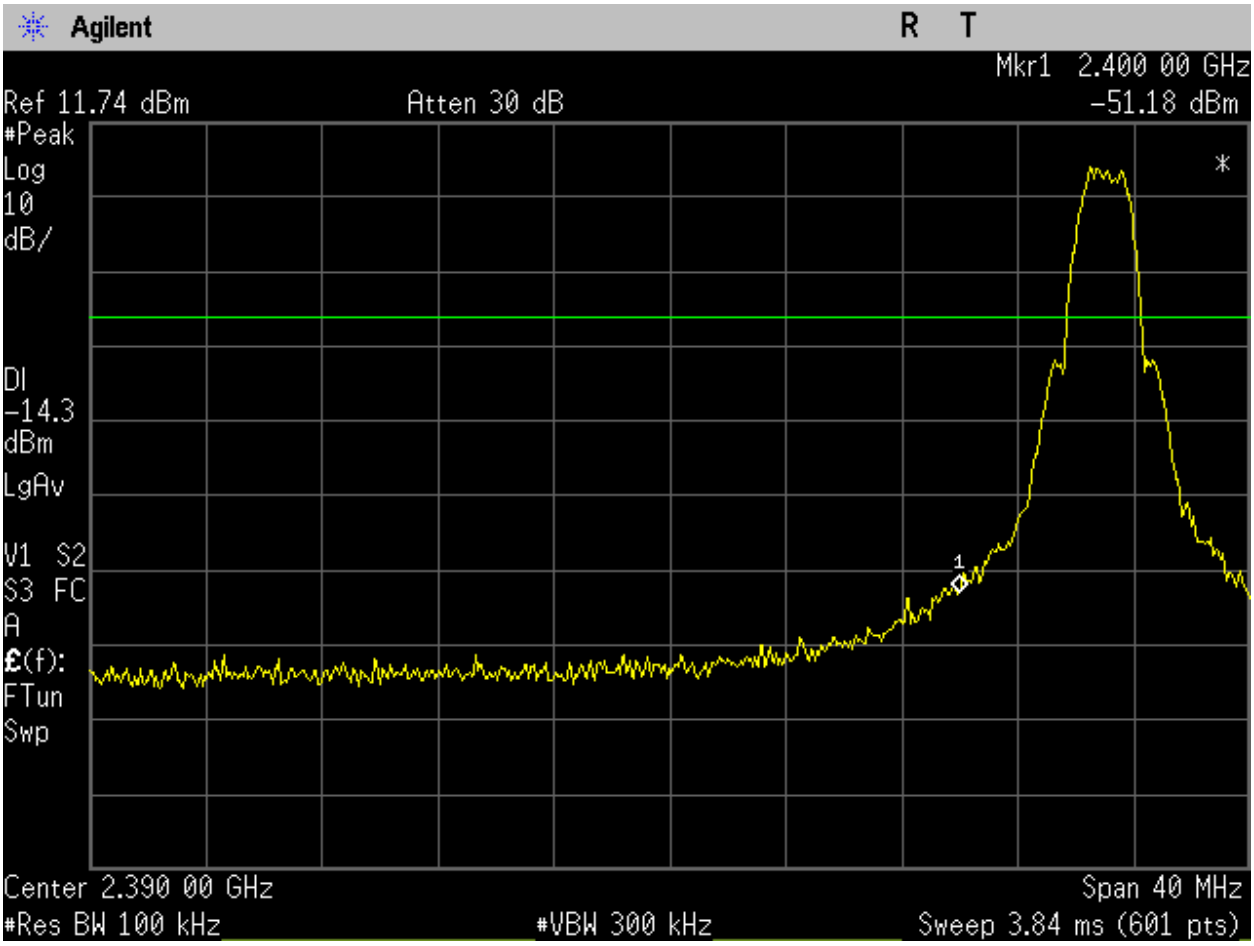


Figure 53. Zigbee_Low Ch_2405MHz_2MBit_-20dBc_Lower Band Edge_Port 1.

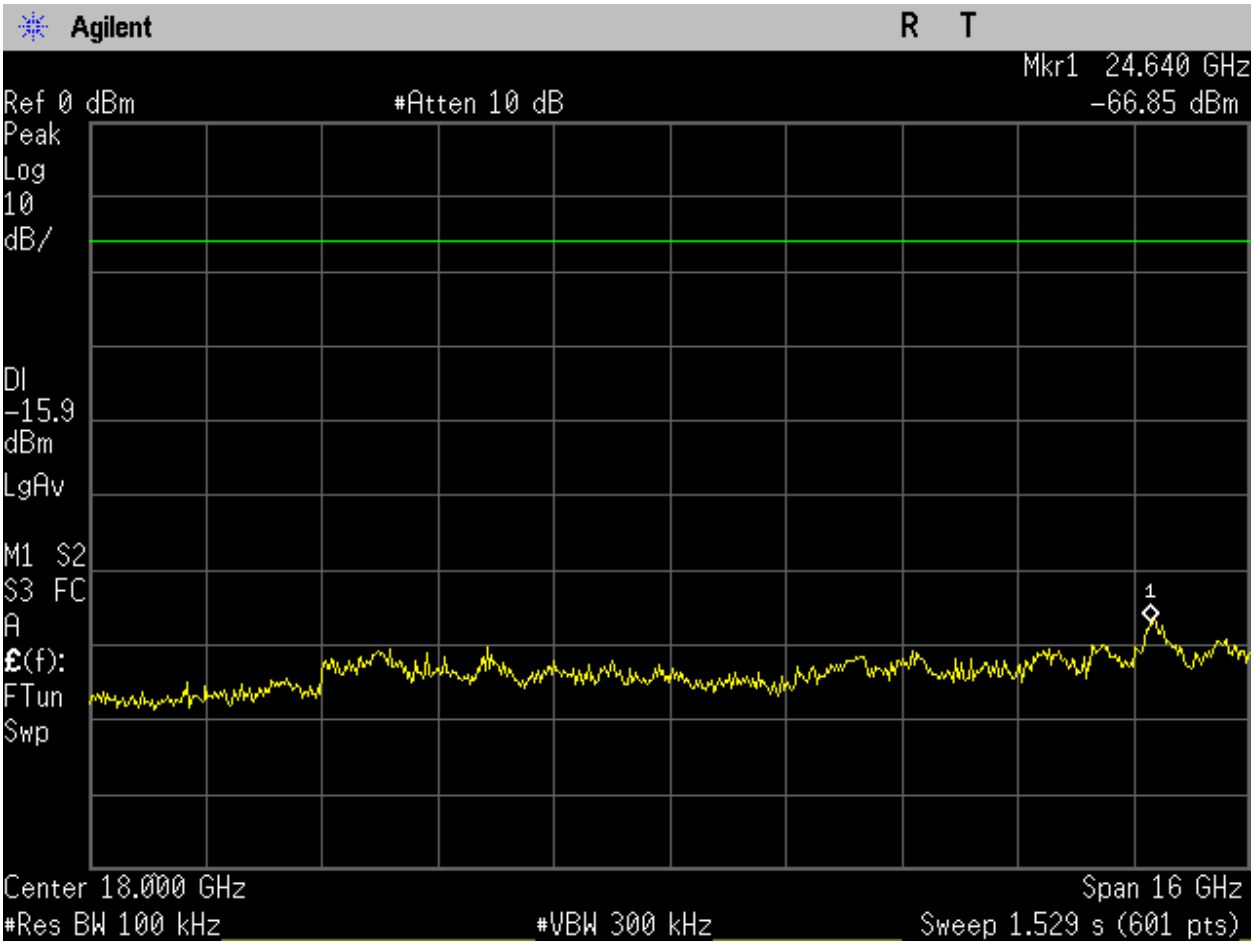


Figure 54. Zigbee_Mid Ch_2440MHz_2MBit_-20dBc_10-26GHz_Port 1.

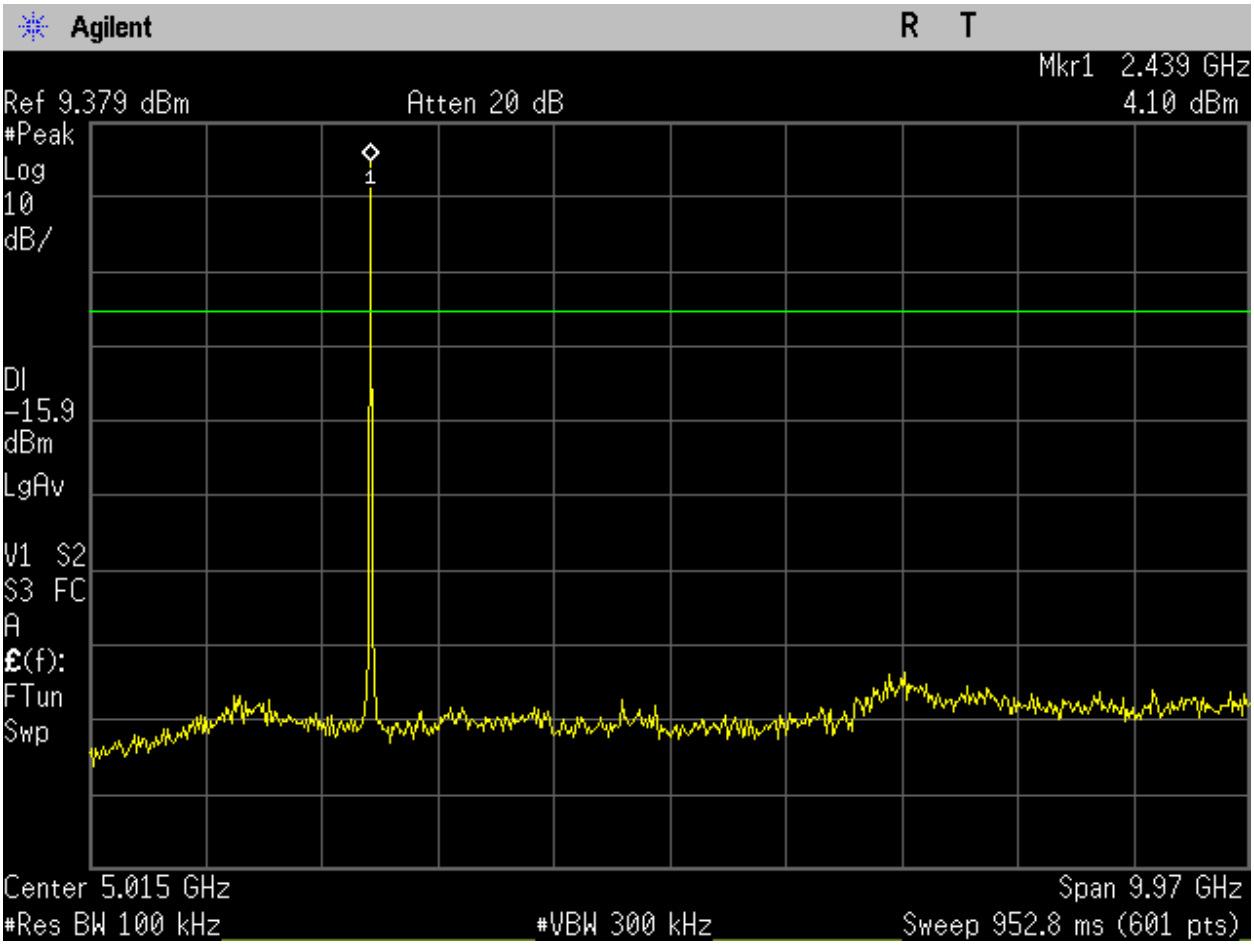


Figure 55. Zigbee_Mid Ch_2440MHz_2MBit_-20dBc_30MHz-10GHz_Port 1.

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.

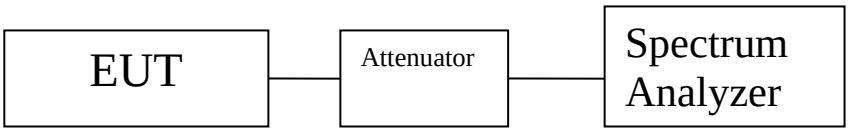


Figure 56. Block Diagram, Peak Power Spectral Density Test Setup

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 (4), (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(s): March 7, 2024

Test Data

Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)
2405	4.5	8	-3.5
2440	4.87	8	-3.13
2480	4.97	8	-3.03

Table 19. PSD, Zigbee Test Results

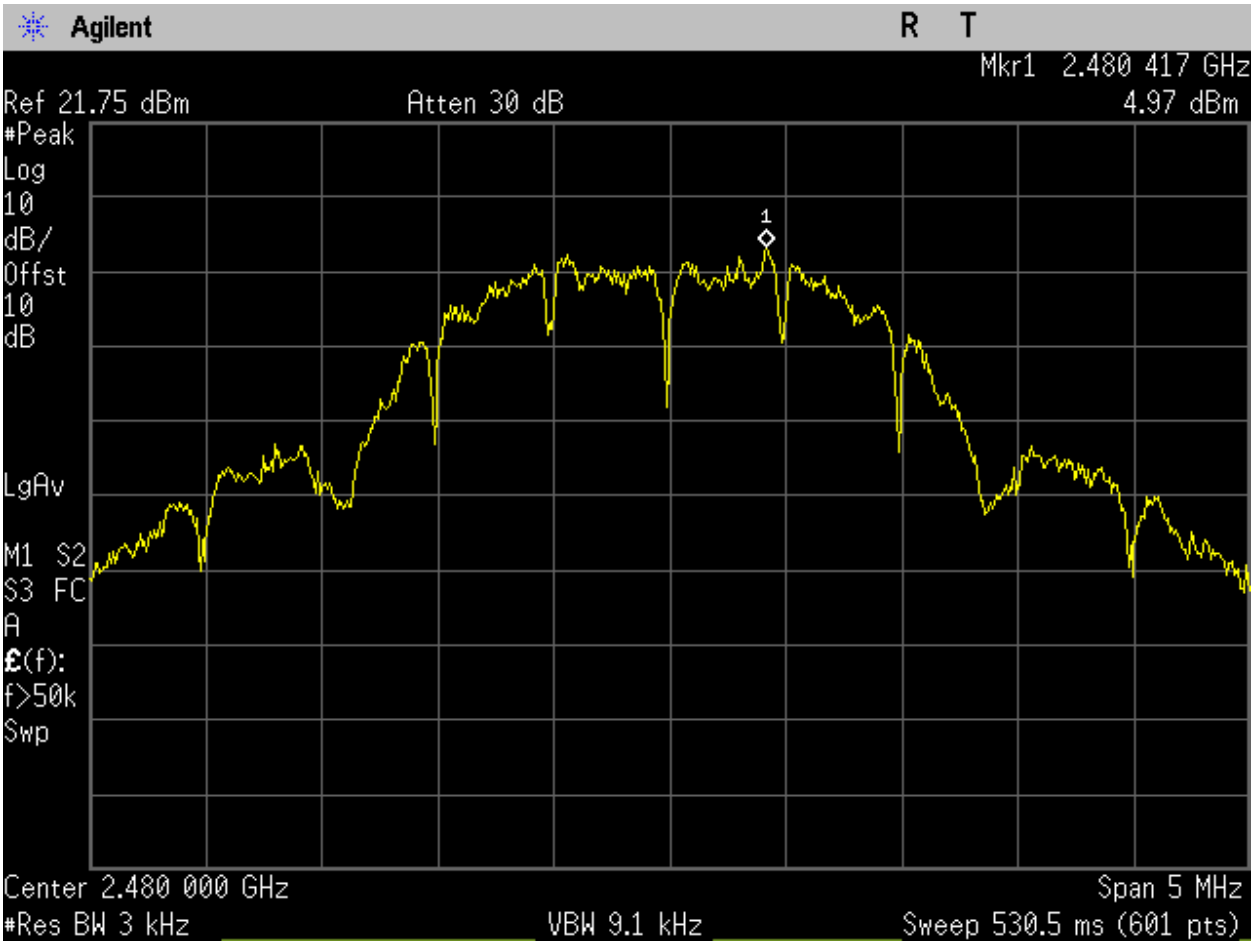


Figure 57. Zigbee_High Ch_2480MHz_2MBit_Spectral Density.

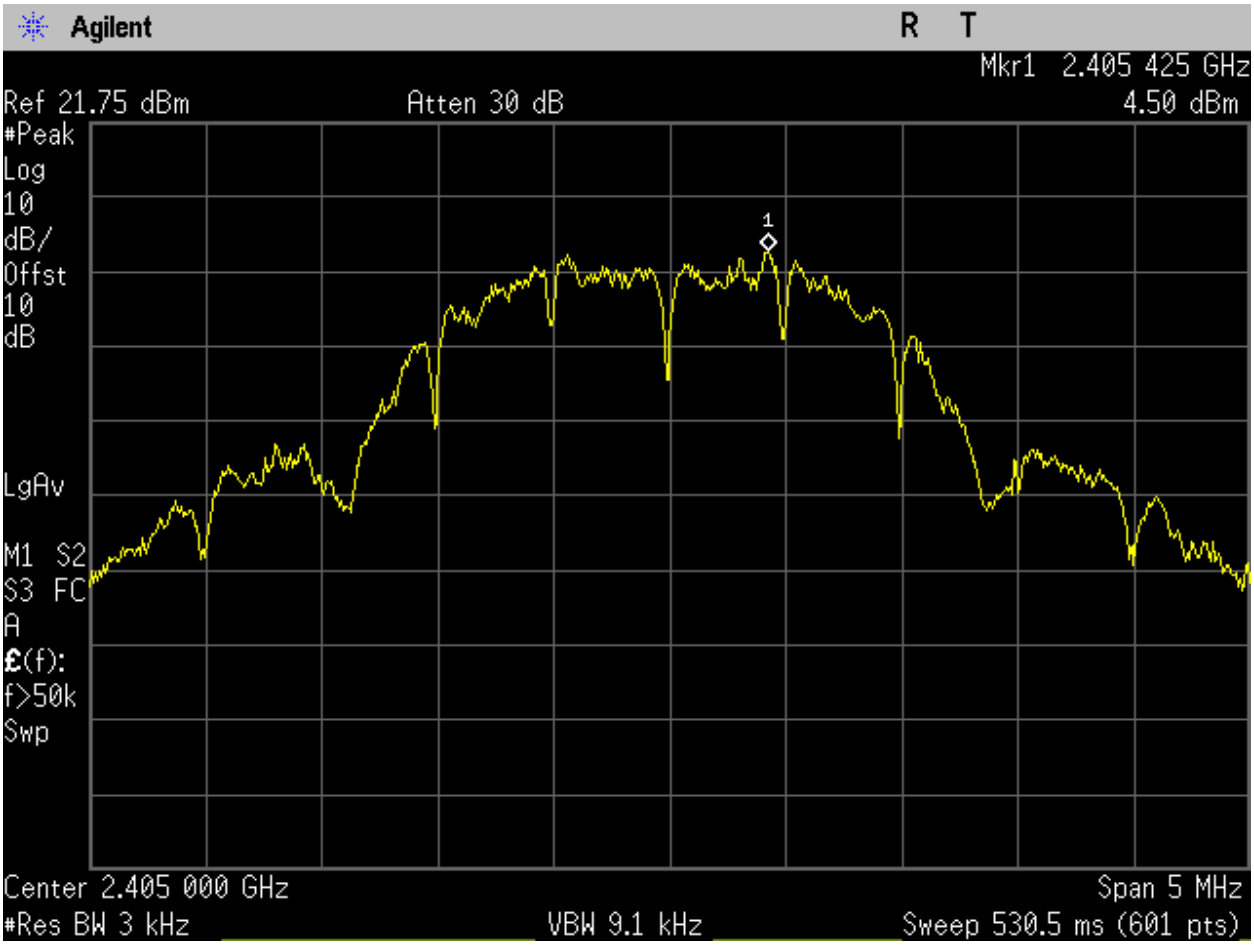


Figure 58. Zigbee_Low Ch_2405MHz_2MBit_Spectral Density.

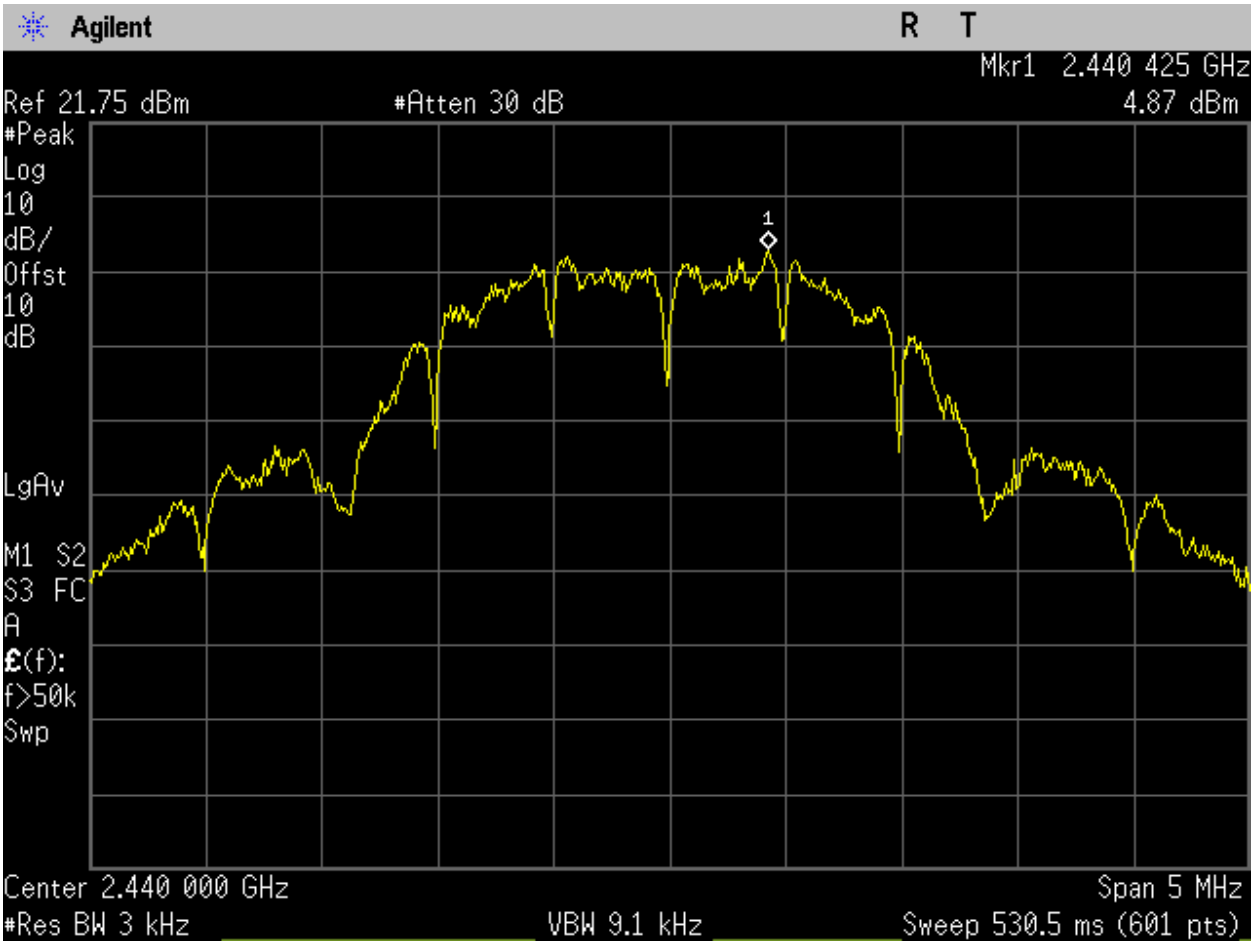


Figure 59. Zigbee_Mid Ch_2440MHz_2MBit_Spectral Density.

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(s): March 7, 2024

Test Data

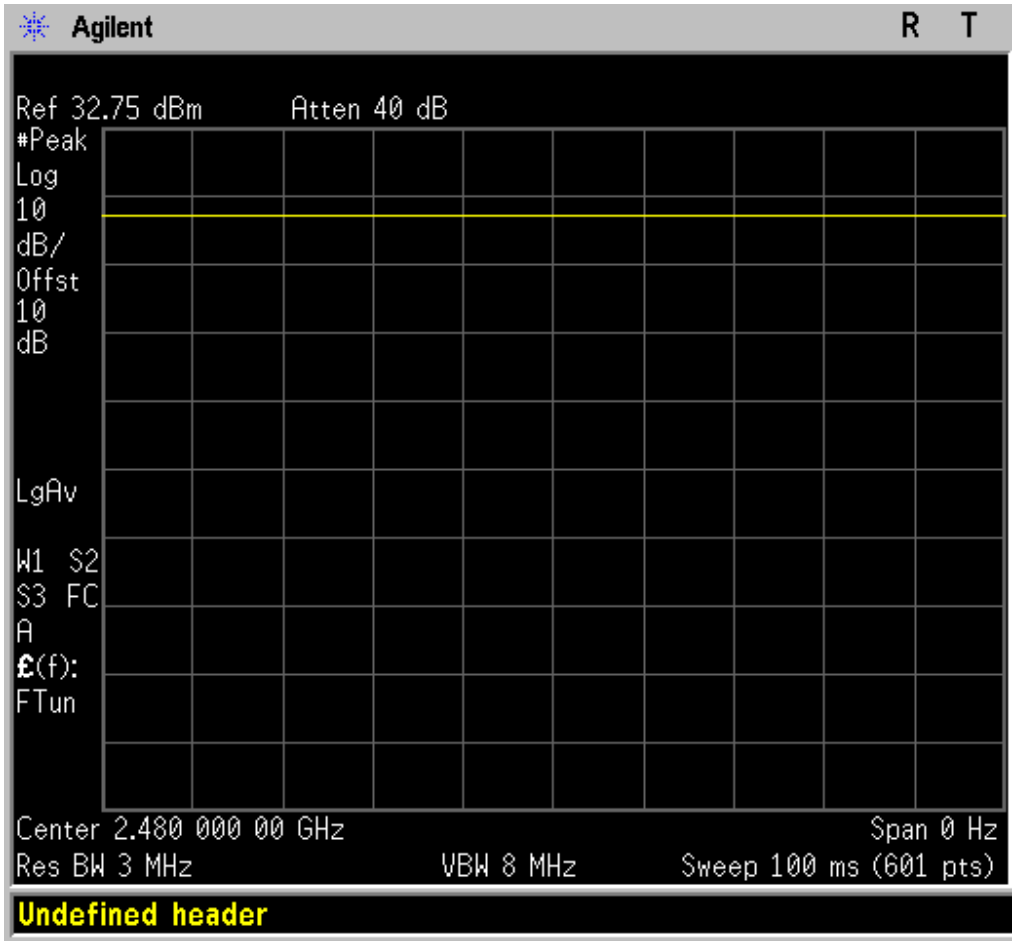


Figure 60. zigbee test mode duty cycle.

III. 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 20. 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 21. CE Equipment List

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

IV. Certification & User's Manual Information

Certification & User's Manual Information

A. Certification Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart I — Marketing of Radio frequency devices:

§ 2.801 Radio-frequency device defined.

As used in this part, a radio-frequency device is any device which in its operation is capable of Emitting radio-frequency energy by radiation, conduction, or other means. Radio- frequency devices include, but are not limited to:

(a) The various types of radio communication transmitting devices described throughout this chapter.

(b) The incidental, unintentional and intentional radiators defined in Part 15 of this chapter.

(c) The industrial, scientific, and medical equipment described in Part 18 of this chapter.

(d) Any part or component thereof which in use emits radio-frequency energy by radiation, conduction, or other means.

§ 2.803 Marketing of radio frequency devices prior to equipment authorization.

(a) Except as provided elsewhere in this chapter, no person shall sell or lease, or offer for sale or lease (including advertising for sale or lease), or import, ship or distribute for the purpose of selling or leasing or offering for sale or lease, any radio frequency device unless:

(1) In the case of a device subject to certification, such device has been authorized by the Commission in accordance with the rules in this chapter and is properly identified and labeled as required by §2.925 and other relevant sections in this chapter; or

(2) In the case of a device that is not required to have a grant of equipment authorization issued by the Commission, but which must comply with the specified technical standards prior to use, such device also complies with all applicable administrative (including verification of the equipment or authorization under a Declaration of Conformity, where required), technical, labeling and identification requirements specified in this chapter.

(d) Notwithstanding the provisions of paragraph (a) of this section, the offer for sale solely to business, commercial, industrial, scientific or medical users (but not an offer for sale to other parties or to end users located in a residential environment) of a radio frequency device that is in the conceptual, developmental, design or pre-production stage is permitted prior to equipment authorization or, for devices not subject to the equipment authorization requirements, prior to a determination of compliance with the applicable technical requirements *provided* that the prospective buyer is advised in writing at the time of the offer for sale that the equipment is subject to the FCC rules and that the equipment will comply with the appropriate rules before delivery to the buyer or to centers of distribution.

(e)(1) Notwithstanding the provisions of paragraph (a) of this section, prior to equipment authorization or determination of compliance with the applicable technical requirements any radio frequency device may be operated, but not marketed, for the following purposes and under the following conditions:

(i) Compliance testing;

(ii) Demonstrations at a trade show provided the notice contained in paragraph (c) of this section is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iii) Demonstrations at an exhibition conducted at a business, commercial, industrial, scientific or medical location, but excluding locations in a residential environment, provided the notice contained in paragraphs (c) or (d) of this section, as appropriate, is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iv) Evaluation of product performance and determination of customer acceptability, provided such operation takes place at the manufacturer's facilities during developmental, design or pre-production states; or

(v) Evaluation of product performance and determination of customer acceptability where customer acceptability of a radio frequency device cannot be determined at the manufacturer's facilities because of size or unique capability of the device, provided the device is operated at a business, commercial, industrial, scientific or medical user's site, but not at a residential site, during the development, design or pre-production stages.

(e)(2) For the purpose of paragraphs (e)(1)(iv) and (e)(1)(v) of this section, the term *manufacturer's facilities* includes the facilities of the party responsible for compliance with the regulations and the manufacturer's premises, as well as the facilities of other entities working under the authorization of the responsible party in connection with the development and manufacture, but not the marketing, of the equipment.

(f) For radio frequency devices subject to verification and sold solely to business, commercial, industrial, scientific and medical users (excluding products sold to other parties or for operation in a residential environment), parties responsible for verification of the devices shall have the option of ensuring compliance with the applicable technical specifications of this chapter at each end user's location after installation, provided that the purchase or lease agreement includes a proviso that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.

Certification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart J — Equipment Authorization Procedures:

§ 2.901 Basis and Purpose

(a) In order to carry out its responsibilities under the Communications Act and the various treaties and international regulations, and in order to promote efficient use of the radio spectrum, the Commission has developed technical standards for radio frequency equipment and parts or components thereof. The technical standards applicable to individual types of equipment are found in that part of the rules governing the service wherein the equipment is to be operated.[2] *In addition to the technical standards provided, the rules governing the service may require that such equipment be verified by the manufacturer or importer*, be authorized under a Declaration of Conformity, or receive an equipment authorization from the Commission by one of the following procedures: certification or registration.

(b) The following sections describe the verification procedure, the procedure for a Declaration of Conformity, and the procedures to be followed in obtaining certification from the Commission and the conditions attendant to such a grant.

§ 2.907 Certification.

(a) Certification is an equipment authorization issued by the Commission, based on representation and test data submitted by the applicant.

(b) Certification attaches to all units subsequently marketed by the grantee which are identical (see Section 2.908) to the sample tested except for permissive changes or other variations authorized by the Commission pursuant to Section 2.1043.

[2] In this case, the equipment is subject to the rules of Part 15. More specifically, the equipment falls under Subpart B (of Part 15), which deals with unintentional radiators.

Certification & User's Manual Information

§ 2.948 Description of measurement facilities.

(a) Each party making measurements of equipment that is subject to an equipment authorization under Part 15 or Part 18 of this chapter, regardless of whether the measurements are filed with the Commission or kept on file by the party responsible for compliance of equipment marketed within the U.S. or its possessions, shall compile a description of the measurement facilities employed.

(1) If the measured equipment is subject to the verification procedure, the description of the measurement facilities shall be retained by the party responsible for verification of the equipment.

(i) If the equipment is verified through measurements performed by an independent laboratory, it is acceptable for the party responsible for verification of the equipment to rely upon the description of the measurement facilities retained by or placed on file with the Commission by that laboratory. In this situation, the party responsible for the verification of the equipment is not required to retain a duplicate copy of the description of the measurement facilities.

(ii) If the equipment is verified based on measurements performed at the installation site of the equipment, no specific site calibration data is required. It is acceptable to retain the description of the measurement facilities at the site at which the measurements were performed.

(2) If the equipment is to be authorized by the Commission under the certification procedure, the description of the measurement facilities shall be filed with the Commission's Laboratory in Columbia, Maryland. The data describing the measurement facilities need only be filed once but must be updated as changes are made to the measurement facilities or as otherwise described in this section. At least every three years, the organization responsible for filing the data with the Commission shall certify that the data on file is current.

Certification & User's Manual Information

1. Label and User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart A — General:

§ 15.19 Labeling requirements.

(a) In addition to the requirements in Part 2 of this chapter, a device subject to certification or verification shall be labeled as follows:

(1) Receivers associated with the operation of a licensed radio service, e.g., FM broadcast under Part 73 of this chapter, land mobile operation under Part 90, etc., shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

(2) A stand-alone cable input selector switch, shall bear the following statement in a conspicuous location on the device:

This device is verified to comply with Part 15 of the FCC Rules for use with cable television service.

(3) All other devices shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

(4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified under paragraph (a) of this section is required to be affixed only to the main control unit.

(5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

§ 15.21 Information to user.

The user's manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Verification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart B — Unintentional Radiators:

§ 15.105 Information to the user.

(a) For a Class A digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at own expense.

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

– Reorient or relocate the receiving antenna.

– Increase the separation between the equipment and receiver.

– Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

– Consult the dealer or an experienced radio/TV technician for help.

Certification & User's Manual Information

ICES-003 Procedural & Labeling Requirements

The manufacturer, importer or supplier shall meet the labelling requirements set out in this section for every ITE unit:

- (i) Prior to marketing in Canada, for ITE manufactured in Canada, and;
- (ii) Prior to importation into Canada, for imported ITE.

The presence of the label on the ITE represents the manufacturer's or importer's Self-Declaration of Compliance (SDoC) to Industry Canada ICES-003. Each unit of an ITE model shall bear a label indicating the model's compliance with ICES-003.

The label shall be permanently affixed to the ITE or displayed electronically and its text must be clearly legible. When the dimension of the device is too small or it is otherwise not practical to place the label on the ITE, the label shall be placed in a prominent location in the user manual supplied with the ITE. The user manual may be in an electronic format and must be readily available.

Labeling Requirements:

Industry Canada ICES-003 Compliance Label:

CAN ICES-3 (B)/NMB-3(B)

END OF REPORT