

Test Report No. <i>Prüfbericht-Nr.:</i>	US245QTK.001 Rev.01	Order No. <i>Auftrags-Nr.:</i>	P01233817 234208189-20	Page 1 of 104 <i>Seite 1 von 104</i>
Client Reference No.: <i>Kunden-Referenz-Nr.:</i>	2218280	Order date: <i>Auftragsdatum:</i>	2023-09-29	
Client: <i>Auftraggeber:</i>	Hunter Douglas Window Fashions, Inc. 1 Duette Way Broomfield CO 80020			
Identification/ Type No.: <i>Bezeichnung / Typ-Nr</i>	Silent Curtain Motor/HD60G-PV			
Order content: <i>Auftrags-Inhalt:</i>	Compliance Test Report FCC ID: UXUMOTG3K & IC: 7316A-MOTG3K			
Test specification: <i>Prüfgrundlage</i>	CFR 15.247 RSS-247 Issue 3			
Date of sample receipt: <i>Wareneingangsdatum:</i>	6/21/2024			
Test sample No: <i>Prüfmuster-Nr.:</i>	SN: 010001/010027			
Testing period: <i>Prüfzeitraum</i>	6/24/2024 - 6/26/2024			
Place of testing: <i>Ort der Prüfung:</i>	TUV Rheinland of North America Inc. 5015 Brandin Ct Fremont CA 94538 USA			
Testing laboratory: <i>Prüflaboratorium</i>	TUV Rheinland of North America, Inc.			
Test result*: <i>Prüfergebnis*:</i>	Pass			
Tested by: <i>geprüft von:</i>	Isaac Aguilar	Authorized by: <i>genehmigt von:</i>	Osvaldo Casorla	
Date: 10/2/2024 <i>Datum:</i>		Issue Date: 10/2/2024 <i>Ausstellungsdatum:</i>		
Position / Stellung:	Test Engineer	Position / Stellung:	Expert	
Others / <i>Sonstiges:</i>				
Condition of the test item at delivery: <i>Zustand des Prüfgegenstandes bei Anlieferung:</i>				
* Legend:	P(ass) = passed a.m. test specification(s)	F(ail) = failed a.m. test specification(s)	N/A = not applicable	N/T = not tested
* Legende:	P(ass) = entspricht o.g. Prüfgrundlage(n)	F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark. <i>Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.</i>				

TÜV Rheinland of North America, Inc., 5015 Brandin Ct., Fremont, CA 94538, USA

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Remarks
Anmerkungen

1	The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system. Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request. <i>Alle eingesetzten Prüfmittel waren zum angegebenen Prüfzeitraum gemäß eines festgelegten Kalibrierungsprogramms unseres Prüfhauses kalibriert. Sie entsprechen den in den Prüfprogrammen hinterlegten Anforderungen. Die Rückverfolgbarkeit der eingesetzten Prüfmittel ist durch die Einhaltung der Regelungen unseres Managementsystems gegeben.</i> <i>Detaillierte Informationen bezüglich Prüfkonditionen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden.</i>
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3	Test clauses with remark of * are subcontracted to qualified subcontractors and described under the respective test clause in the report. Deviations of testing specification(s) or customer requirements are listed in specific test clause in the report. <i>Prüfklausel mit der Note * wurden an qualifizierte Unterauftragnehmer vergeben und sind unter der jeweiligen Prüfklausel des Berichts beschrieben.</i> <i>Abweichungen von Prüfspezifikation(en) oder Kundenanforderungen sind in der jeweiligen Prüfklausel im Bericht aufgeführt.</i>
4	Electromagnetic Compatibility Test Report. The above product was found to be Compliant to the above test standard(s).

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Product description
Produktbeschreibung

1	Product details: <i>Produktdetails:</i>	Bluetooth Low Energy wireless connected motor drive for windows shades
2	Dimensions / Weight: <i>Maße / Gewicht:</i>	10.16 x 6.35 x 30.48 cm ³
3	Operating elements: <i>Bedienelemente:</i>	100 – 240 VAC/50 – 60 Hz; 1.6A
4	Equipment / Accessories: <i>Ausstattung / Zubehör:</i>	--
5	Used materials: <i>Verwendete Materialien:</i>	--
6	Other: <i>Sonstiges:</i>	Test sample(s), as well sample information, description, product details and intended usage was provided by customer.
7	Test sample obtaining: <i>Prüfmusterbereitstellung:</i>	☐ Sending by customer ☐ Sampling by TÜV Rheinland Group ☐ others:

Revisions

[illegible]

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1 Executive Summary

1.1 Scope

This report is intended to document the status of conformance with the requirements of CFR 15.247 & RSS-247 Issue 3, based on the results of testing performed on 6/24/2024 to 6/26/2024 on HD60G-PV manufactured by Hunter Douglas Window Fashions, Inc.. This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report. The 2400 MHz to 2483.5 MHz frequency band is covered in this document.

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1.3 Summary of Test Results

Table 1: Summary of Test Results

Test	Test Method ANSI C63.10: 2013	Worst Case (Measured)	Result
Spurious Emission in Transmitted Mode	CFR47 15.209, CFR47 15.247 (d) RSS-Gen section 8.9 RSS-247 Section 5.5	46.99 dBμV/m @ 7206.74 MHz	Complied
Restricted Bands of Operation	CFR47 15.205 RSS-Gen Section 8.10	46.99 dBμV/m @ 7206.74 MHz	Complied
AC Power Conducted Emission	CFR47 15.207 RSS-Gen Section 8.8	28.85 dBμV @ 544.7 kHz	N/A
Occupied Bandwidth	CFR47 15.247 (a) RSS-247 Section 5.2 a)	0.707MHz @ 2402 MHz	Complied
Emissions Bandwidth	RSS-Gen Section 6.7	2.09 MHz @ 2402 MHz	Complied
Maximum Output Power	CFR47 15.247 (b) RSS-247 Section 5.4 d)	4.48 dBm/2.81mW @ 2480 MHz	Complied
Peak Power Spectral Density	CFR47 15.247 (e), RSS-247 Section 5.2 (b)	-11.42 dBm/3kHz @ 2402MHz	Complied
Out of Band Emission	CFR47 15.247 (d) RSS-247 Section 5.5	-53.02 dBm @ 25184 MHz	Complied
RF Exposure	CFR47 15.247 (i), 2.1093 RSS-102 Issue 6	Note 2, 3	Note 2, 3
Note: 1. This test report covers 2400 MHz to 2483.5 MHz band. 2. FCC RF Exposure evaluation is covered in a separate report (US24PCQR 001). 3. ISED RF Exposure evaluation is covered in a separate report (US243GEF.001).			

1.4 Special Accessories

None

1.5 Equipment Modifications

None

2 Laboratory Information

2.1.1 US Federal Communications Commission, US1131



TUV Rheinland of North America EMC test facilities located at 1279 Quarry Lane, Ste. A, Pleasanton, CA, 94566, and 5015 Brandin Ct, Fremont Ca., 94538, are recognized by the Commission for performing testing services for the general public on a fee basis. These laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (Pleasanton Registration No. US1131, Fremont Registration No. US1131). The laboratory Scopes of Accreditation include Title 47 CFR Parts 15, 18 and 90. The accreditations are updated every three years.

2.1.2 NIST / A2LA, Testing Cert #3331.02



TUV Rheinland of North America EMC test facilities are accredited by the American Association for Laboratory Accreditation (A2LA). The laboratories have been assessed and accredited by A2LA in accordance with ISO Standard 17025:2017 (Testing Certificate #3331.02). The Scope of Laboratory Accreditation includes emission and immunity testing. The accreditations are updated annually.

2.1.3 Canada – Innovation, Science and Economic Development (ISED), 2932D



Innovation, Science and
Economic Development Canada

Innovation, Sciences et
Développement économique Canada

The Fremont 10-meter Semi-Anechoic Chamber, Registration No. 2932D, has been accepted by ISED to perform testing to 3 and 10 meters based on the test procedures described in ANSI C63.4-2014.

2.1.4 Japan – VCCI



The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. TUV Rheinland of North America EMC test facilities located at 1279 Quarry Lane, Ste. A, Pleasanton, CA, 94566, and 5015 Brandin Ct. Fremont Ca., 94538, have been assessed and approved in accordance with the Regulations for Voluntary Control Measures.

VCCI Registration No. for Fremont: A-409

2.1.5 Acceptance by Mutual Recognition Arrangement



The United States has an established agreement with specific countries under the Asia Pacific Laboratory Accreditation Corporation (APLAC) Mutual Recognition Arrangement. Under this agreement, all TÜV Rheinland at 1279 Quarry Ln, Pleasanton, CA 94566 test results and test reports within the scope of the laboratory NIST / A2LA accreditation will be accepted by each member country.

2.1.6 BSMI

Registration No.: SL2-IN-E-1150R. The BSMI accreditation was obtained by NIST MRA with the BSMI

2.1.7 Korea

(Designation No.: US0185). Recognized by National Radio Research Agency (RRA) as an accredited Conformity Assessment Body (CAB) under the terms for Korea Phase I of the APEC TEL.

2.2 Test Facilities

Test facilities are located at 5015 Brandin Ct, Fremont, California, 94538, USA and 1279 Quarry Lane, Pleasanton, California 94566, USA (Fremont is the Pleasanton Annex).

2.2.1 Emission Test Facility

The Semi-Anechoic Chambers and AC Line Conducted measurement facilities used to collect radiated and conducted emissions data have been constructed in accordance with ANSI C63.7:1992. The Fremont 10-meter semi-anechoic chamber has been measured in accordance with and verified to comply with the theoretical volumetric normalized site attenuation of ANSI C63.4:2014 and SVSWR requirements of CISPR 16-1-4 Consol. Ed. 3.0 (2010-04), at test distances of 3 and 10 meters. This site has been described in reports dated November 1st, 2006, submitted to the FCC, and accepted by letter dated November 28, 2006. The site is listed with the FCC and accredited by A2LA (Testing Certificate #3331.02). The Pleasanton 5-meter semi-anechoic chamber has been verified to comply with the theoretical volumetric normalized site attenuation of ANSI C63.4:2009 and SVSWR requirements of CISPR 16-1-4 Consol. Ed. 3.0 (2010-04) at a test distance of 3 meters. This site has been described in reports dated November 1st, 2006, submitted to the FCC, and accepted by letter dated November 28, 2006. The site is listed with the FCC and accredited by A2LA (Testing Certificate #3331.02).

2.3 Measurement Uncertainty

Two types of measurement uncertainty are expressed in this report, per *ISO Guide To The Expression Of Uncertainty In Measurement*, 1st Edition, 1995.

The Combined Standard Uncertainty is the standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities; it is equal to the positive square root of the sum of the variances or co-variances of these other quantities, weighted according to how the measurement result varies with changes in these quantities. The term *standard uncertainty* is the result of a measurement expressed as a standard deviation.

The Expanded Uncertainty defines an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurement and the fraction may be viewed as the coverage probability or level of confidence of the interval.

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2.3.1 Sample Calculation – radiated & conducted emissions

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

$$\text{Field Strength (dB}\mu\text{V/m)} = \text{RAW} - \text{AMP} + \text{CBL} + \text{ACF}$$

Where: RAW = Measured level before correction (dBμV)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu\text{V/m} = 10^{\frac{\text{dB}\mu\text{V/m}}{20}}$$

Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dBμV/m)

$$25 \text{ dBuV/m} + 17.5 \text{ dB} - 20 \text{ dB} + 1.0 \text{ dB} = 23.5 \text{ dBuV/m}$$

2.3.2 Measurement Uncertainty

Per CISPR 16-4-2	U _{lab}	U _{usp}
Radiated Disturbance @ 10 meters		
30 – 1,000 MHz	2.25 dB	4.51 dB
Radiated Disturbance @ 5 meters		
30 – 1,000 MHz	2.26 dB	4.52 dB
1 – 6 GHz	2.12 dB	4.25 dB
6 – 18 GHz	2.47 dB	4.93 dB
Conducted Disturbance @ Mains Terminals		
150 kHz – 30 MHz	1.09 dB	2.18 dB
Disturbance Power		
30 MHz – 300 MHz	3.92 dB	4.3 dB

Voltech PM6000A

The estimated combined standard uncertainty for harmonic current and flicker measurements is ± 5.0%.

Per CISPR 16-4-2
Methods

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2.3.3 Measurement Uncertainty Immunity

The estimated combined standard uncertainty for ESD immunity measurements is $\pm 8.2\%$.	Per IEC 61000-4-2
The estimated combined standard uncertainty for radiated immunity measurements is ± 4.10 dB.	Per IEC 61000-4-3
The estimated combined standard uncertainty for conducted immunity measurements with CDN is ± 3.66 dB	Per IEC 61000-4-6
The estimated combined standard uncertainty for power frequency magnetic field immunity is $\pm 2.9\%$.	Per IEC 61000-4-8

Thermo KeyTek EMC Pro

The estimated combined standard uncertainty for EFT fast transient immunity measurements is $\pm 2.6\%$.
The estimated combined standard uncertainty for surge immunity measurements is $\pm 2.6\%$.
The estimated combined standard uncertainty for voltage variation and interruption measurements is $\pm 1.74\%$.

The expanded uncertainty at a level of 95% confidence is obtained by multiplying the combined standard uncertainty by a coverage factor of 2. Compliance criteria are not based on measurement uncertainty.

2.4 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2017. Equipment calibration records are kept on file at the test facility.

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3 EMC Test Plan

3.1 Introduction

This section provides a description of the Equipment Under Test (EUT), configurations, operating conditions, and performance acceptance criteria. It is an overview of information provided by the manufacturer so that the test laboratory may perform the requested testing.

3.2 Customer Information

Table 2: Customer Information

Client	Hunter Douglas Window Fashions, Inc.
Address 1	1 Duette Way Broomfield CO 80020
Contact Person	Mike Rockwood
Telephone	+1 (720) 778-0205
Fax	--

Table 3: Technical Contact Information

Contact Person	Mike Rockwood
Telephone	+1 (720) 778-0205
E-Mail	mike.rockwood@hunterdouglas.com

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3.3 Equipment Under Test (EUT)

Table 4: EUT Specifications

EUT Specifications	
Dimensions	10.16 x 6.35 x 30.48 cm ³
Power Input	24 VDC
Operating Temperature Range:	-25 to 65°C
Multiple Feeds:	☐ Yes, ☒ No
Hardware Version/Model	HD60G-PV
Firmware Version	1
RF Software Version	1
Product Marketing Name	Silent Curtain Motor
Operating Mode	Bluetooth Low Energy
Transmitter Frequency Band	BLE: 2402 – 2480 MHz
Antenna Manufacturer	YAGEO Group
Antenna Model	ANTX1000P011B24003
Antenna Type	Linear Passive PCB Antenna
Antenna Gain	+1.5 dBi
Modulation Type	GFSK
Data Rate	1, 2 Mbps
Supported Bandwidths	1 MHz
TX/RX Chain (s)	1 Spatial Stream
Directional Gain Type	N/A
Type of Equipment	☐ Table Top ☐ Wall-mount ☐ Floor standing cabinet ☒ Other: Indoor/Residential
Note: 1. All EUT specifications are provided by the manufacturer or the TUV direct customer. Information supplied by the customer and can affect the validity of results.	

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Table 5: EUT Test Samples

Equipment	Manufacturer	Model	Serial	Used for
1	Hunter Douglas Window Fashions, Inc	HD60G-PV	010001	Conducted testing
2	Hunter Douglas Window Fashions, Inc	HD60G-PV	010027	Radiated emissions
Note: None.				

Table 6: Power Setting/Specification

Freq. (MHz)	BLE 1Mbps	BLE 2Mbps	--	--	--	--	--	--
2400-2480	+ 6 dBm	+6 dBm	--	--	--	--	--	--
Note: None								

Table 7: General Product Information

Dimensions	Height:	10.16 cm	Width:	6.35 cm	Length:	30.48 cm
Weight	1.36 kg		Fork-lift Needed:		No	
Note: None						

Table 8: Electrical Power Type

Name	Type	Voltage		Frequency (Hz)	Current (A)
		Min	Max		
AD0481-2401600UB	Class 2 Power Supply	100	240	50 – 60	1.6
Note: None					

Table 9: EUT Interface/Port Specifications

EUT Port	Connect To	Location	Length	Shielded/ Unshielded
--	--	--	--	--

4 Product Information

4.1 Product Description

The EUT is a Bluetooth Low Energy wireless connected motor drive for windows shades.

4.2 Equipment Configuration

A description of the equipment configuration is given in the Equipment Under Test section. The EUT was tested as called for in the test standard and was configured and operated in a manner consistent with its intended use. The placement of the EUT system components was guided by the test standard and selected to represent typical installation conditions.

In the case of an EUT that can operate in more than one configuration, preliminary testing was performed to determine the configuration that produced maximum radiation.

The final configuration was selected to produce the worst-case radiation for emissions testing.

4.3 Operating Mode

A description of the operation mode is given in the Test Plan Section. In the case of an EUT that can operate in more than one state, preliminary testing was performed to determine the operating mode that produced maximum radiation.

The final operating mode was selected to produce the worst-case radiation for emissions testing.

4.4 Unique Antenna Connector

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. This requirement does not apply to carrier current devices or to devices operated under the provisions of CFR47 Parts 15.211, 15.213, 15.217, 15.219, 15.221.

4.4.1 Results

The EUT is professionally installed, and the end-user has no access to the antenna in the product.

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4.4.2 Duty Cycle

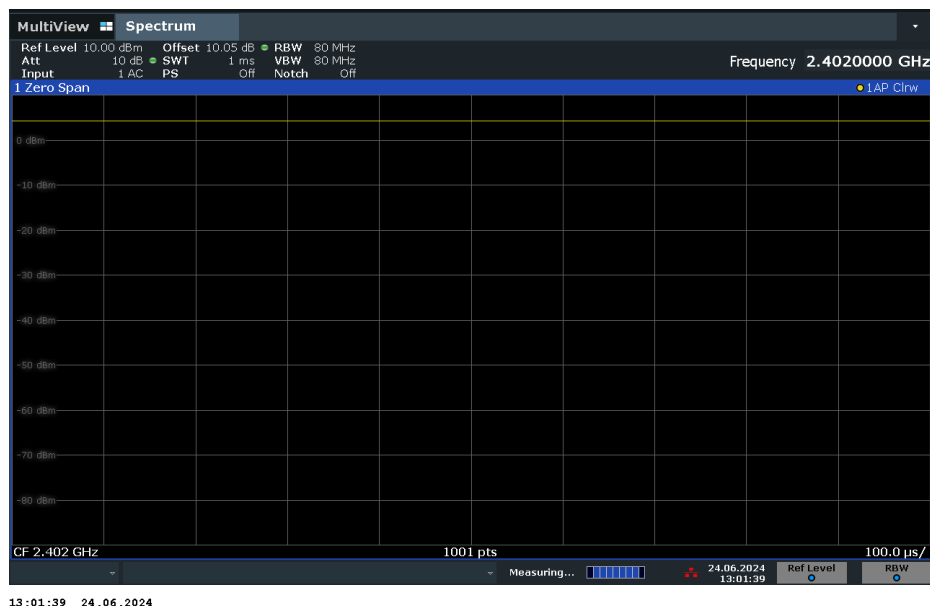
The duty cycle of the device was determined before testing was performed in order to choose the appropriate test methodology. Duty cycle was measured with a spectrum analyzer in zero span and calculated as the percentage between the transmitters on time over the signal period.

$$\text{Duty cycle \%} = (\text{Transmitter on time} / \text{Signal Period}) * 100$$

4.4.3 Results

Table 10: Test Results – Duty Cycle

Test Condition:	Conducted, Normal Temperature	Date:	6/24/2024
Antenna Type:	Linear Passive PCB Antenna	Power Level:	See Table 6
Ambient Temperature:	24.7 °C	Relative Humidity:	38 %
Max. Antenna Gain:	+1.5 dBi	Test Engineer	Isaac Aguilar
Signal State: Modulated			
1Mbps			
Frequency (MHz)	On-Time (ms)	Signal Period (ms)	Duty Cycle (%)
2402	1	1	100
2442	1	1	100
2480	1	1	100
2Mbps			
2402	1	1	100
2442	1	1	100
2480	1	1	100
Note: None			



5 Emissions

Testing was performed in accordance with CFR 47 Part 15.247/RSS-247 Issue 3. These test methods are listed under the laboratory's A2LA Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices. Procedures described in section 8 of the standard were used.

5.1 Output Power Requirements

The maximum output power requirement is the maximum equivalent isotropic radiated power delivering at the transmitting antenna under specified conditions of measurements in the presence of modulation.

The maximum output power and harmonics shall not exceed CFR47 Part 15.247 (b), RSS 247 Sect. 5.4 d.

The maximum transmitted powers are:

Band 2400-2483.5 MHz: the maximum peak conducted output power shall not exceed 1 W and the E.R.I.P shall not exceed 4 W.

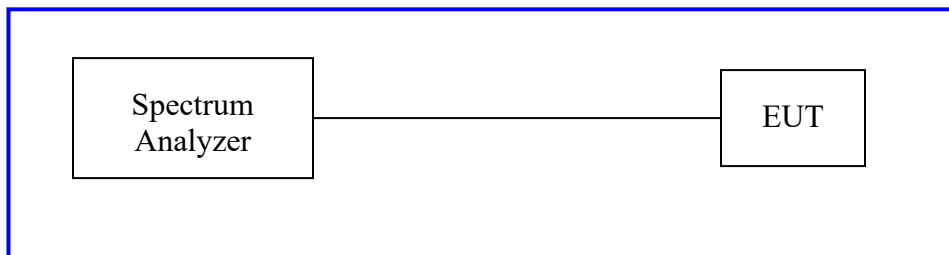
5.1.1 Test Method

The ANSI C63.10 section 11.9.1.1 conducted method was used to measure the channel power output. The measurements were conducted on 3 channels in each operating range per CFR47 Part 15.247(b): 2017. The device was connected to the spectrum analyzer with the following setting:

1. Span ≥ 1.5 times the OBW
2. Sweep Trigger = Free Run
3. RBW = RBW > DTS Bandwidth
4. VBW $\geq 3 \times$ RBW
5. Detector = Peak
6. Trace Mode = Max Hold
7. Sweep Time = auto couple

The trace was allowed to maximize, and the peak search function was used to determine the maximum power. All measurement system losses have been accounted for and inputted into the analyzer.

Test Setup:



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5.1.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 11: Test Results – RF Output Power at the Antenna Port

Test Condition:	Conducted, Normal Temperature	Date:	6/24/2024
Antenna Type:	Linear Passive PCB Antenna	Power Level:	See Table 6
Ambient Temperature:	24.7 °C	Relative Humidity:	37.8 %
Max. Antenna Gain:	+1.5 dBi	Test Engineer	Isaac Aguilar
Signal State: Modulated			
1Mbps			
Frequency (MHz)	Maximum Power (dBm)	Limit (dBm)	Margin (dB)
2402	4.24	30	25.76
2442	4.25	30	25.75
2480	4.48	30	25.52
2Mbps			
2402	4.24	30	25.76
2442	4.24	30	25.76
2480	4.47	30	25.53
Note:			
1. All insertion loss and corrections are accounted for in the measurement plots.			

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5.1.3 Analyzer Data

5.1.3.1 Output Power



RF Output Power 2402 MHz, 1Mbps



RF Output Power 2442 MHz, 1Mbps

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RF Output Power 2480 MHz, 1Mbps

5.1.3.1.1 Modulation: 2 Mbps



RF Output Power 2402 MHz, 2Mbps

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RF Output Power 2442 MHz, 2Mbps



RF Output Power 2480 MHz, 2Mbps

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5.2 Occupied Bandwidth (Emission Bandwidth) and DTS Bandwidth (X dB bandwidth)

The occupied bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency.

The 99% bandwidth is the bandwidth in which 99% of the transmitted power occupied.

The minimum 6 dB bandwidth shall be at least 500 kHz.

5.2.1 Test Method

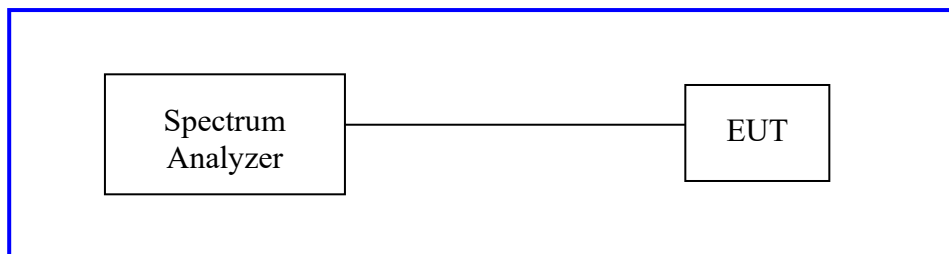
The conducted method was used to measure the occupied bandwidth according to ANSI C63.10 section 11.8 The measurement was performed with modulation per CFR47 15.247(a) (2) and RSS-247 section 5.2 on three channels operating between frequency range; 2400 MHz to 2483.5 MHz.

The device was connected to the spectrum analyzer with the following setting:

1. RBW = 100 kHz
2. VBW = 3 x RBW
3. Detector = Peak
4. Sweep = auto couple

The trace was allowed to maximize, and the peak emission was determined. For 99% occupied bandwidth, the spectrum analyzer's internal occupied bandwidth measurement function was used. For 6 dB bandwidth, the bandwidth was measured from the two outermost amplitude points that were attenuated by 6 dB. Emission bandwidth used the analyzer bandwidth function to calculate the bandwidth. All measurement system losses have been accounted for and inputted into the analyzer.

Test Setup:



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5.2.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 12: Test Results – Occupied Bandwidth

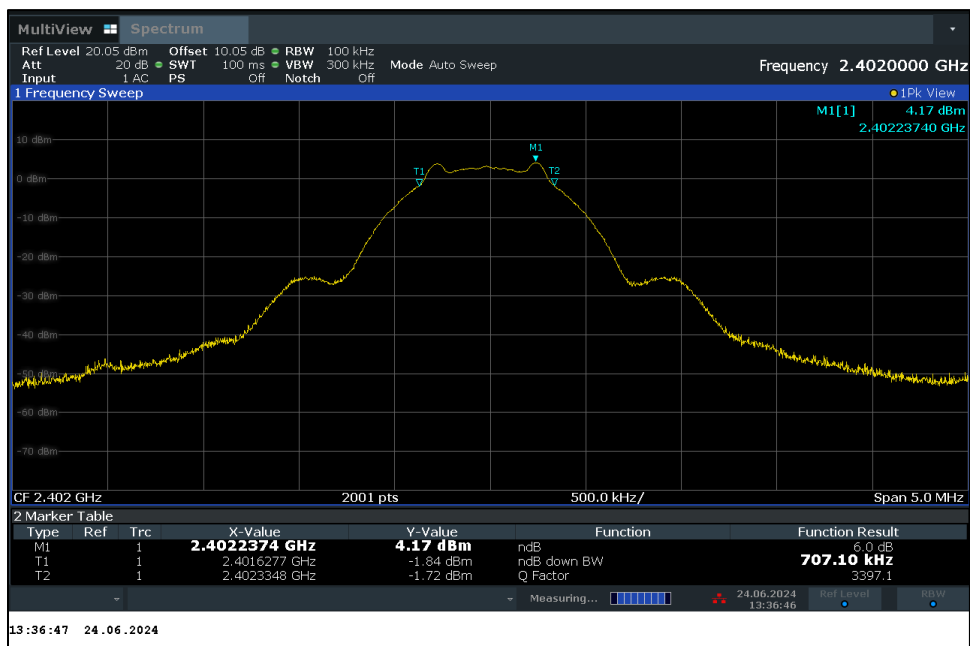
Test Condition:	Conducted, Normal Temperature		Date:	6/24/2024
Antenna Type:	Linear Passive PCB Antenna		Power Level:	See Table 6
Ambient Temperature:	24.7 °C		Relative Humidity:	37.8 %
Max. Antenna Gain:	+1.5 dBi		Test Engineer	Isaac Aguilar
Signal State: Modulated				
1Mbps				
Frequency (MHz)	6 dB Bandwidth (kHz)	99% Bandwidth (MHz)	6 dB BW Limit (kHz)	Pass/Fail
2402	0.707	1.06	500	Pass
2442	0.752	1.07	500	Pass
2480	0.720	1.07	500	Pass
2Mbps				
Frequency (MHz)	6 dB Bandwidth (kHz)	99% Bandwidth (MHz)	6 dB BW Limit (kHz)	Pass/Fail
2402	1.29	2.09	500	Pass
2442	1.27	2.09	500	Pass
2480	1.27	2.07	500	Pass
Note:				
1. All insertion loss and corrections are accounted for in the measurement plots.				

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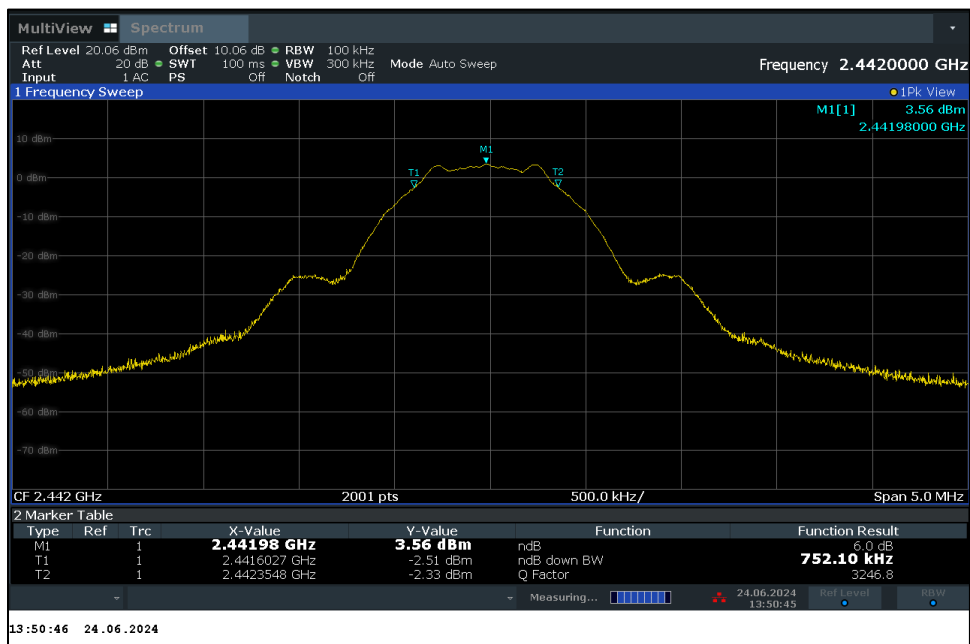
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5.2.3 Analyzer Data

5.2.3.1 6 dB Occupied Bandwidth: 1 Mbps



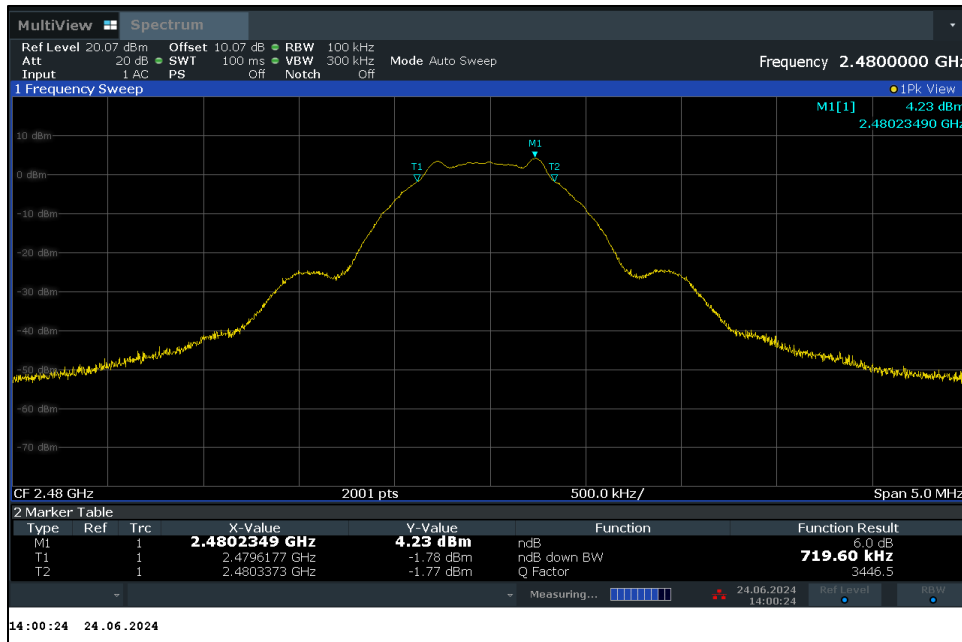
6 dB Bandwidth 2402 MHz, 1Mbps



6 dB Bandwidth 2442 MHz, 1Mbps

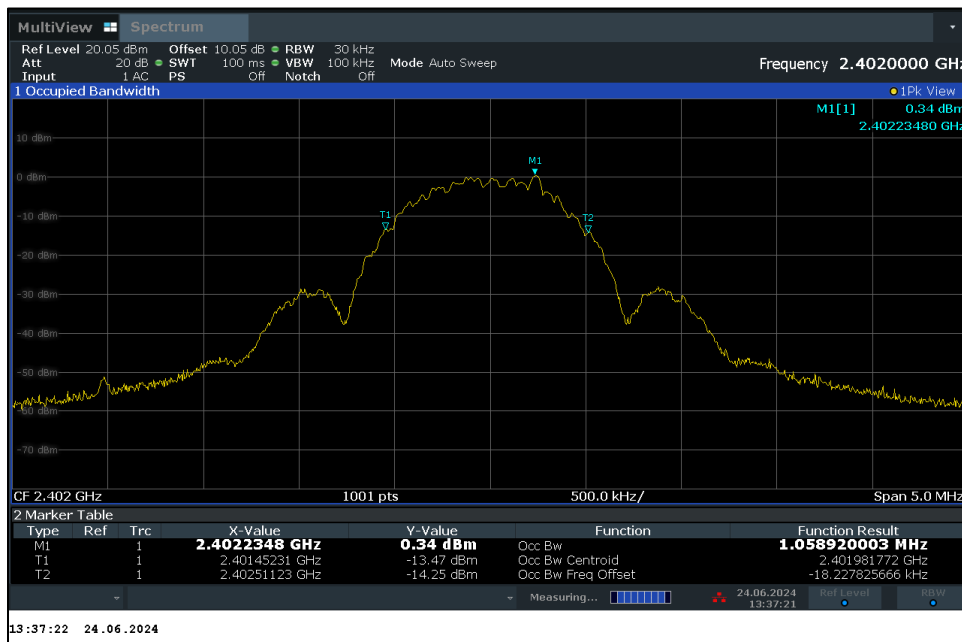
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6 dB Bandwidth 2480 MHz, 1 Mbps

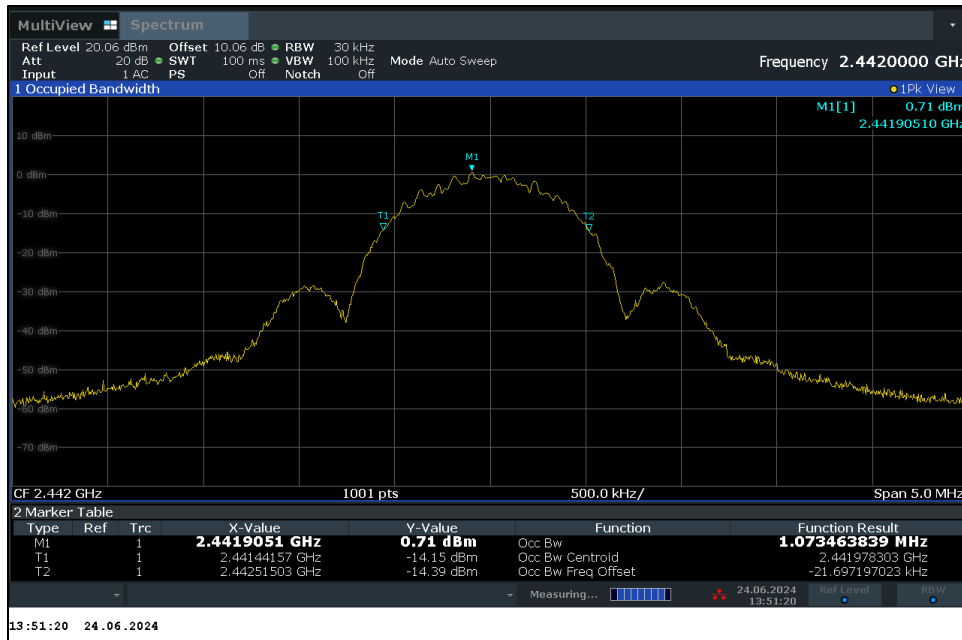
5.2.3.2 99% Occupied Bandwidth: 1 Mbps



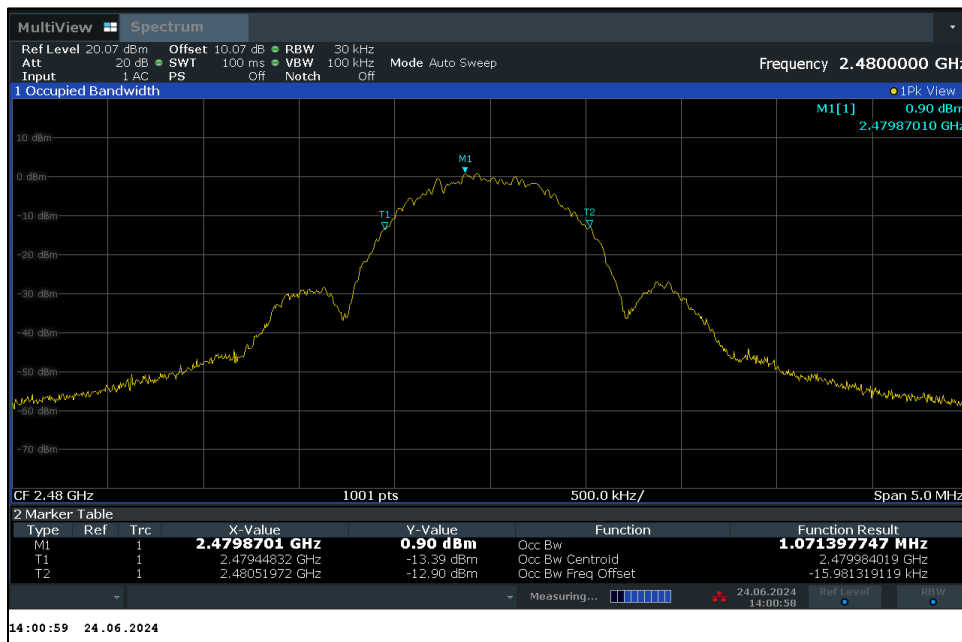
99% Occupied Bandwidth 2402 MHz, 1 Mbps

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99% Occupied Bandwidth 2442 MHz, 1 Mbps

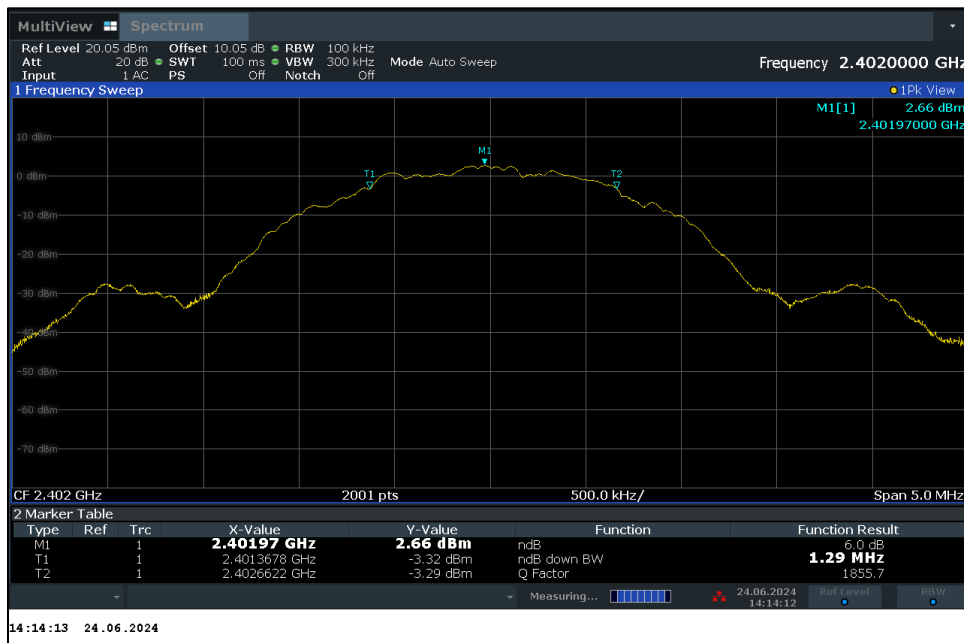


99% Occupied Bandwidth 2480 MHz, 1 Mbps

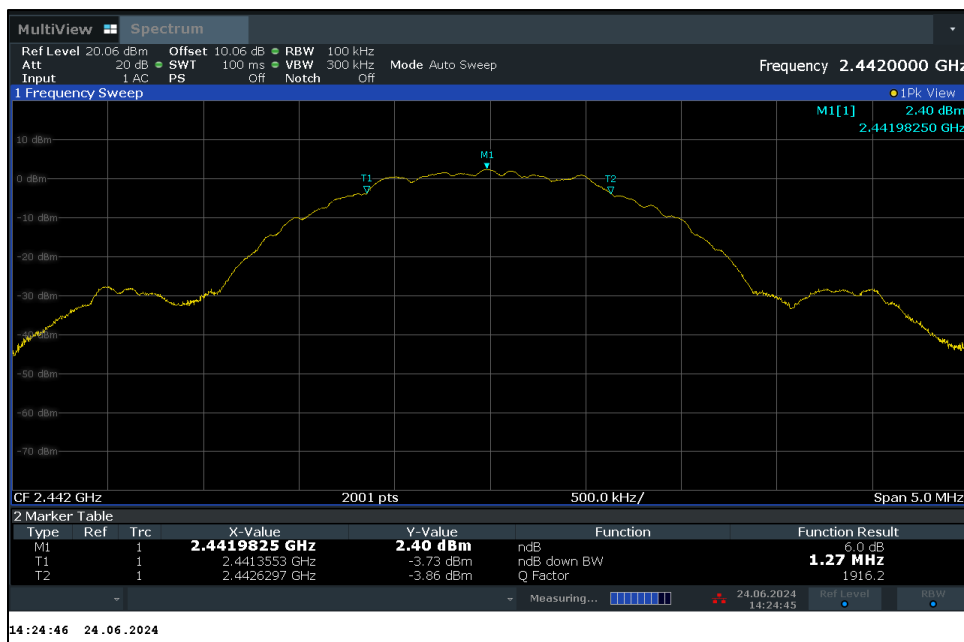
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5.2.3.3 6 dB Occupied Bandwidth: 2 Mbps



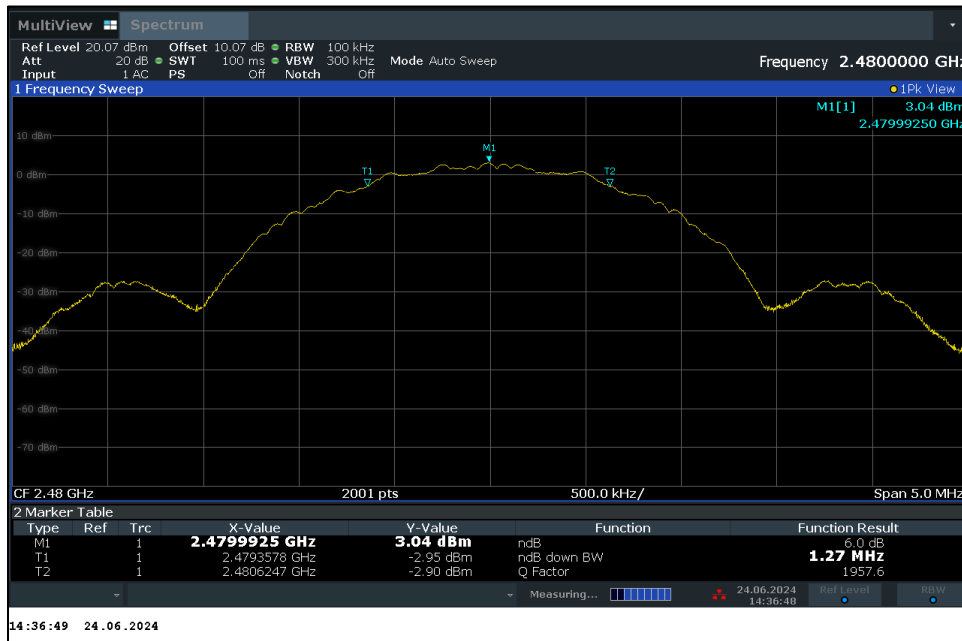
6 dB Bandwidth 2402 MHz, 2 Mbps



6 dB Bandwidth 2442 MHz, 2 Mbps

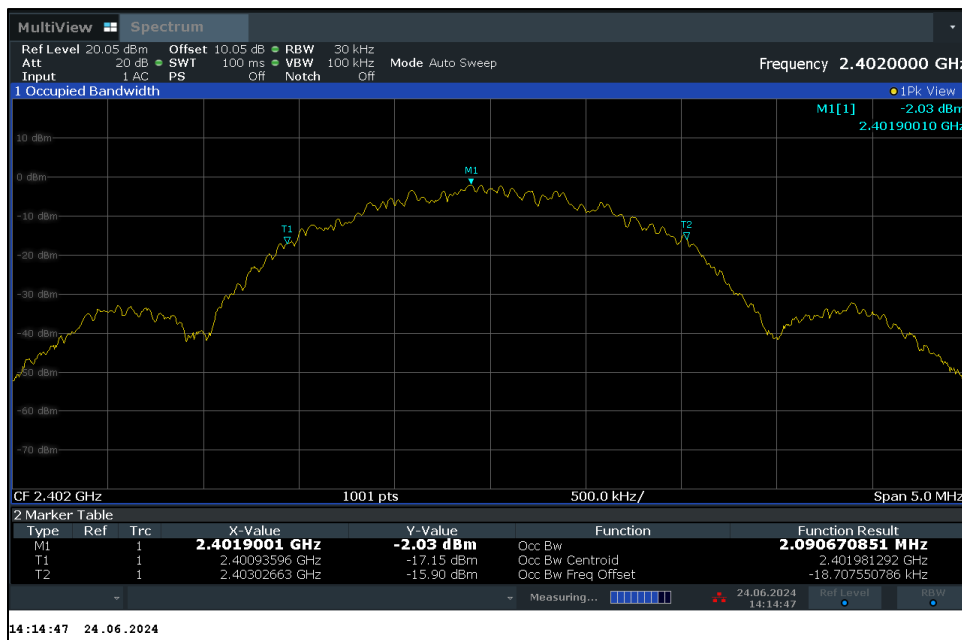
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6 dB Bandwidth 2480 MHz, 2 Mbps

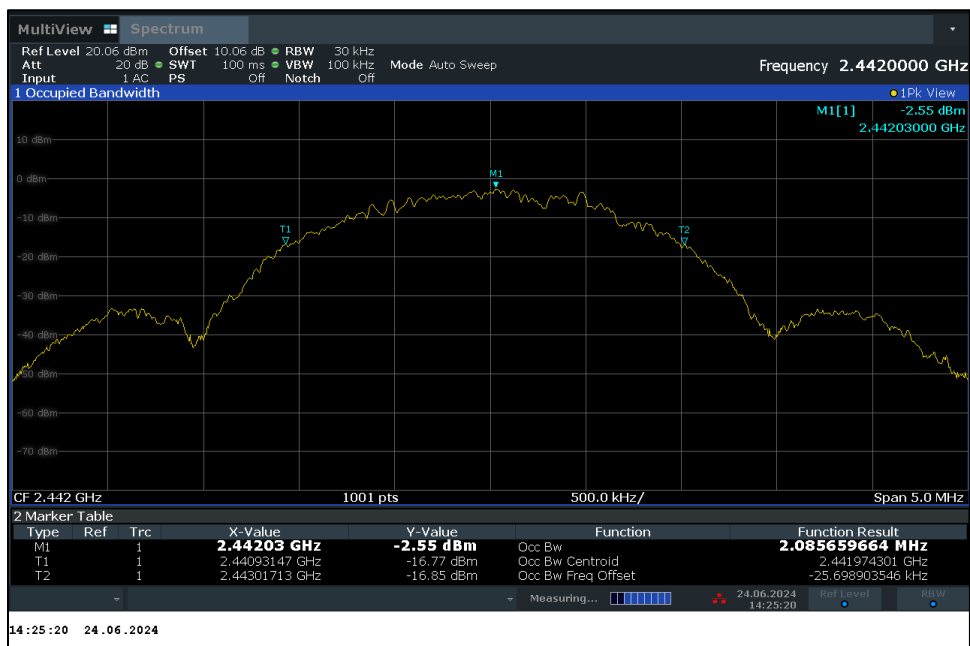
5.2.3.4 99% Occupied Bandwidth: 2 Mbps



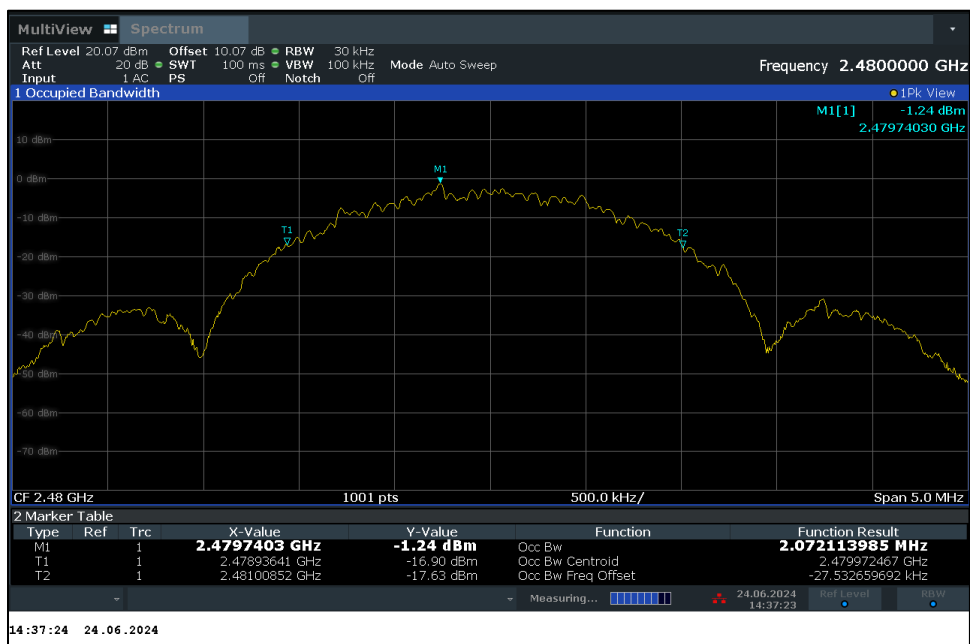
99% Occupied Bandwidth 2402 MHz, 2 Mbps

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99% Occupied Bandwidth 2442 MHz, 2 Mbps



99% Occupied Bandwidth 2480 MHz, 2 Mbps

5.3 Peak Power Spectral Density

According to the CFR47 Part 15.247 (e) and RSS-247 section 5.2 b) Issue 3, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

5.3.1 Test Method

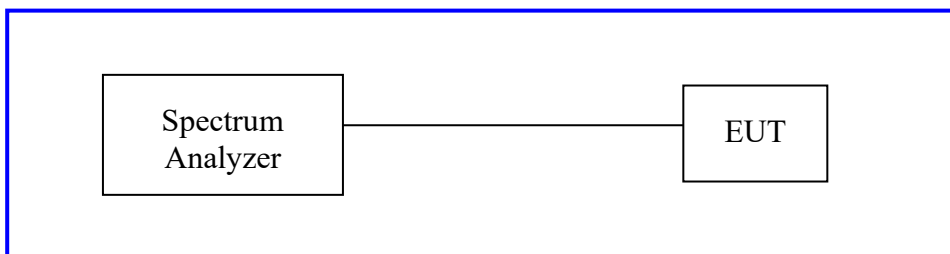
The conducted method was used to measure the channel power output per ANSI C63.10-2013 Section 11.10.2. The measurement was performed with modulation per CFR47 Part 15.247(e), RSS-247 section 5. The device was connected to the spectrum analyzer with the following setting:

1. Span = 1.5 x DTS Bandwidth
2. RBW = 3 kHz
3. VBW $\geq$ 3 x RBW
4. Detector = Peak
5. Sweep time = auto couple
6. Trace Mode = Max Hold

The trace is allowed to maximize, and the peak marker function is used to find the peak power spectral density.

All measurement system losses have been accounted for and inputted into the analyzer.

Test Setup:



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5.3.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 13: Test Results – Peak Power Spectral Density

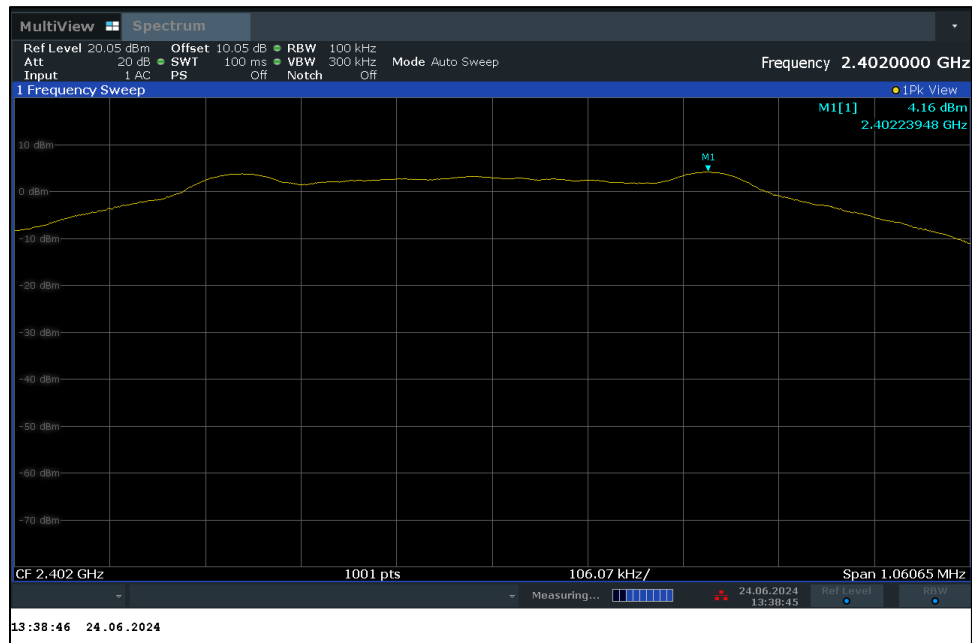
Test Condition:		Conducted, Normal Temperature	Date:	6/24/2024	
Antenna Type:		Linear Passive PCB Antenna	Power Level:	See Table 6	
Ambient Temperature:		24.7 °C	Relative Humidity:	37.8 %	
Max. Antenna Gain:		+1.5 dBi	Test Engineer	Isaac Aguilar	
Signal State: Modulated					
1Mbps					
Frequency (MHz)	Power Spectral Density (dBm/100kHz)	Correction (dB)	Power Spectral Density (dBm/3kHz)	Limit (dBm/3KHz)	Margin (dB)
2402	4.16	-15.23	-11.42	8	19.42
2442	3.56	-15.23	-12.02	8	20.02
2480	4.22	-15.23	-11.36	8	19.36
2Mbps					
2402	2.68	-15.23	-12.9	8	20.9
2442	2.40	-15.23	-13.18	8	21.18
2480	3.04	-15.23	-12.54	8	20.54
Note:					
1. All insertion loss and corrections are accounted for in the measurement plots.					

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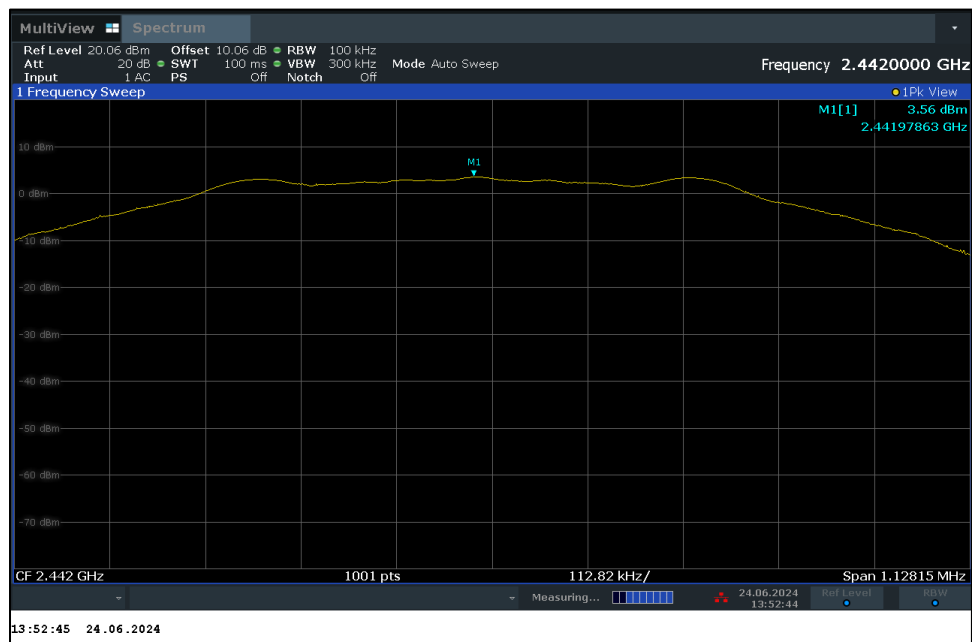
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5.3.3 Analyzer Data

5.3.3.1 Power Spectral Density: 1 Mbps



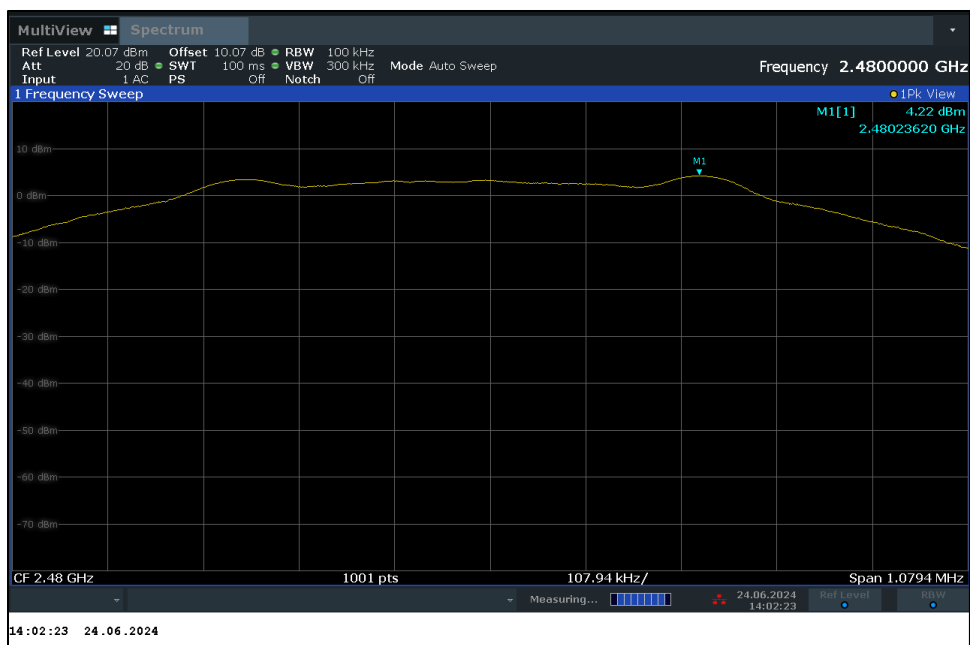
Power Spectral Density 2402 MHz, 1Mbps



Power Spectral Density 2442 MHz, 1Mbps

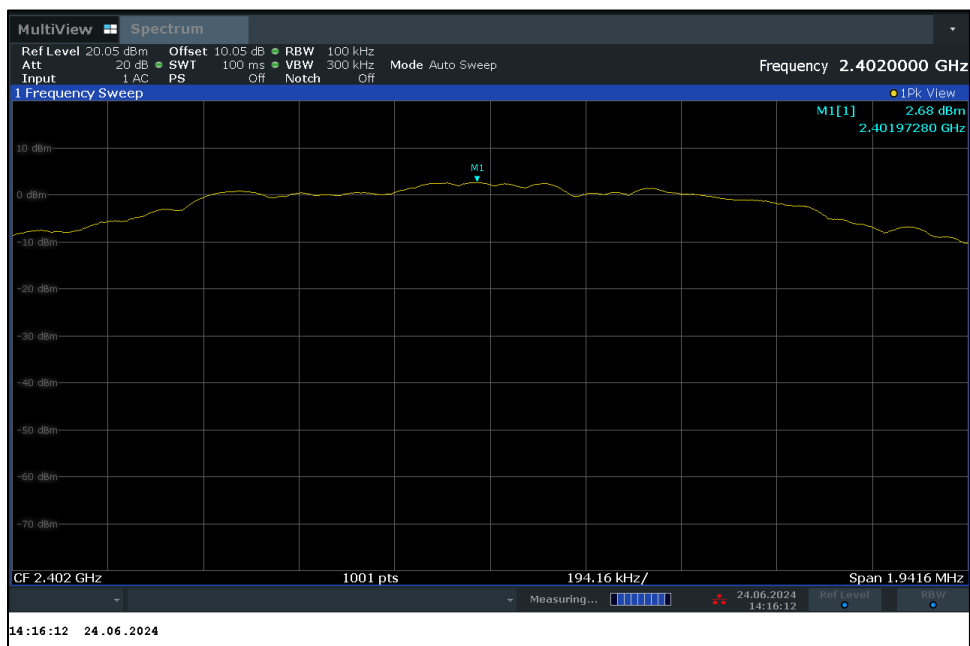
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Power Spectral Density 2480 MHz, 1Mbps

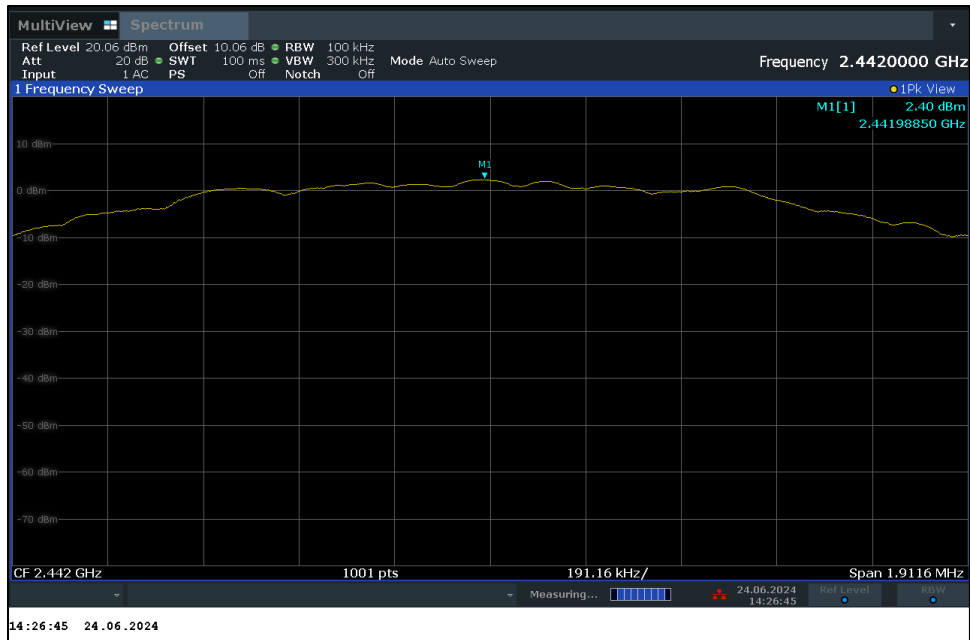
5.3.3.2 Power Spectral Density: 2 Mbps



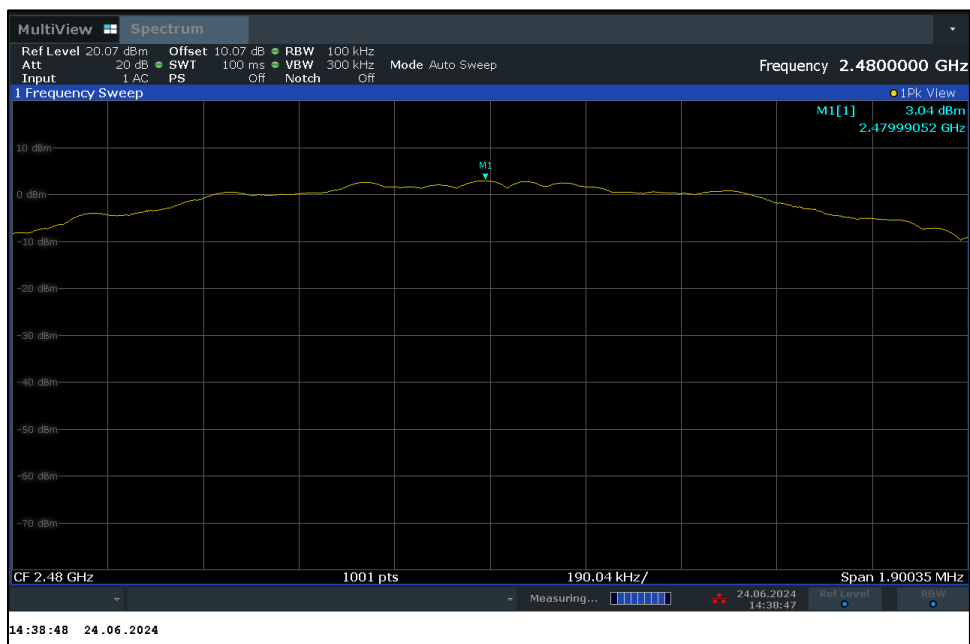
Power Spectral Density 2402 MHz, 2Mbps

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Power Spectral Density 2442 MHz, 2Mbps



Power Spectral Density 2480 MHz, 2Mbps

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5.4 Out of Band Emissions: Non-Restricted Band

Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmitting mode; per requirement of CFR47 2.1051, 15.247(d), RSS-247 section 5.5.

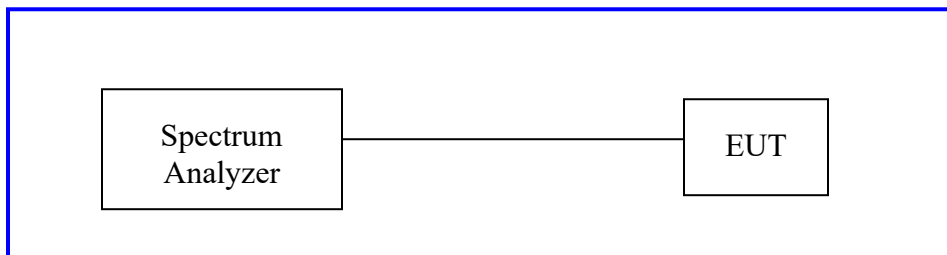
5.4.1 Test Method

ANSI C63.10 section 11.11 was used. The level (20 dBc or 30 dBc) was determined from the maximum PSD reference level procedure of section 11.11.2 of ANSI C63.10. The device was directly connected to a spectrum analyzer with the following settings:

1. Span set to encompass 30 MHz to the 10th harmonic of the fundamental
2. RBW = 100 kHz
3. VBW = 300 kHz
4. Detector: Peak
5. Sweep Time = auto couple
6. Trace Mode = max hold

The trace was allowed to maximize, and maximum emissions reported. All measurement system losses have been accounted for and inputted into the analyzer.

Test Setup:



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5.4.2 Results

As originally tested, the EUT was found to compliant to the requirements of the test standard(s).

Table 14: Test Results – Emissions at Antenna Port

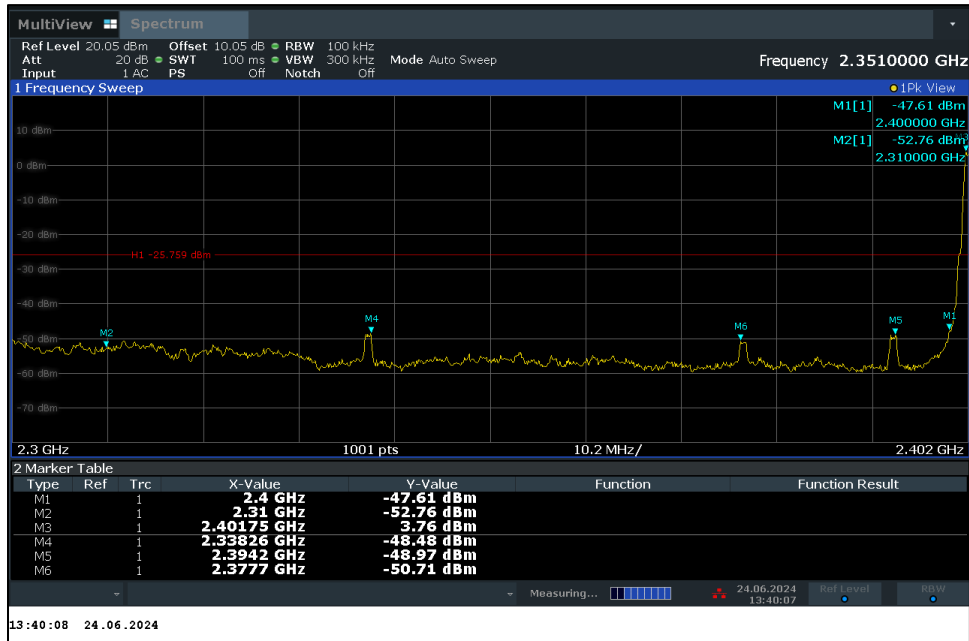
Test Condition:		Conducted, Normal Temperature		Date:	6/24/2024
Antenna Type:		Linear Passive PCB Antenna		Power Level:	See Table 6
Ambient Temperature:		24.7 °C		Relative Humidity:	37.8 %
Max. Antenna Gain:		+1.5 dBi		Test Engineer	Isaac Aguilar
Signal State: Modulated					
1Mbps					
Test Frequency: 2402 MHz					
Emission (MHz)	Power (dBm)	Duty Cycle Correction (dB)	Corrected Power (dBm)	Limit (dB)	Margin (dB)
7440	-58.01	N/A ⁴	-58.01	-25.78	32.04
25184	-53.02		-53.02	-25.78	27.24
26392	-48.43		-48.43	-25.78	22.65
2Mbps					
Test Frequency: 2480 MHz					
11257	-57.82	N/A ⁴	-57.82	-25.78	32.04
21411	-54.30		-54.30	-25.78	28.52
26395	-48.34		-48.34	-25.78	22.56
Note:					
1. All insertion loss and corrections are accounted for in the measurement plots.					
2. Limit reflects -30 dBc from highest power spectral density measured in Table 12.					
3. Worst case test frequency for each modulation and its three worst emissions reported in table. All data provided in the section 4.4.2.1.					
4. Duty cycle measured was greater than 98% so no correction required.					

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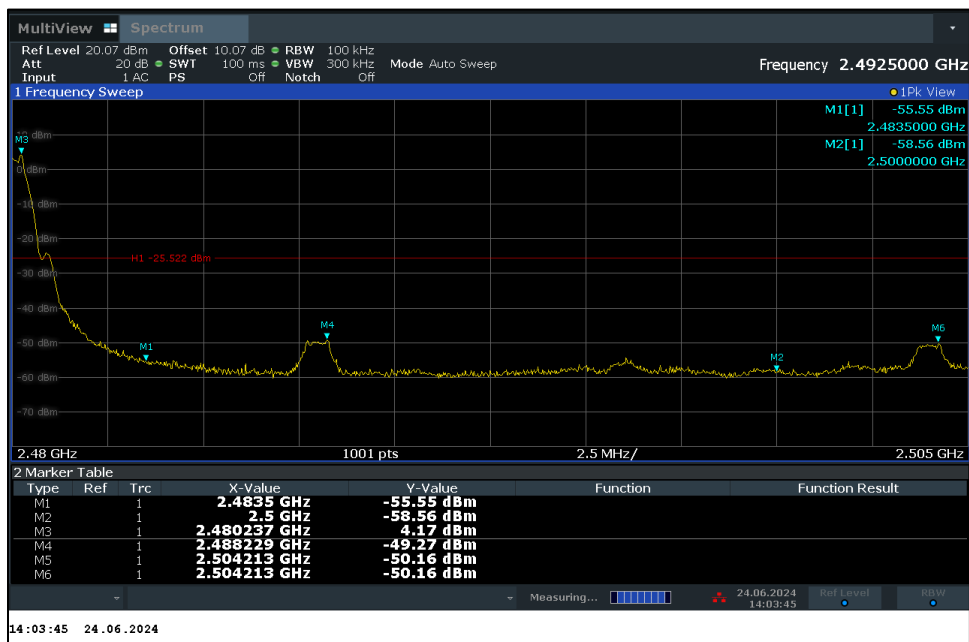
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5.4.3 Analyzer Data

5.4.3.1 Conducted Bandedge: 1 Mbps



2310 to 2390 MHz Bandedge

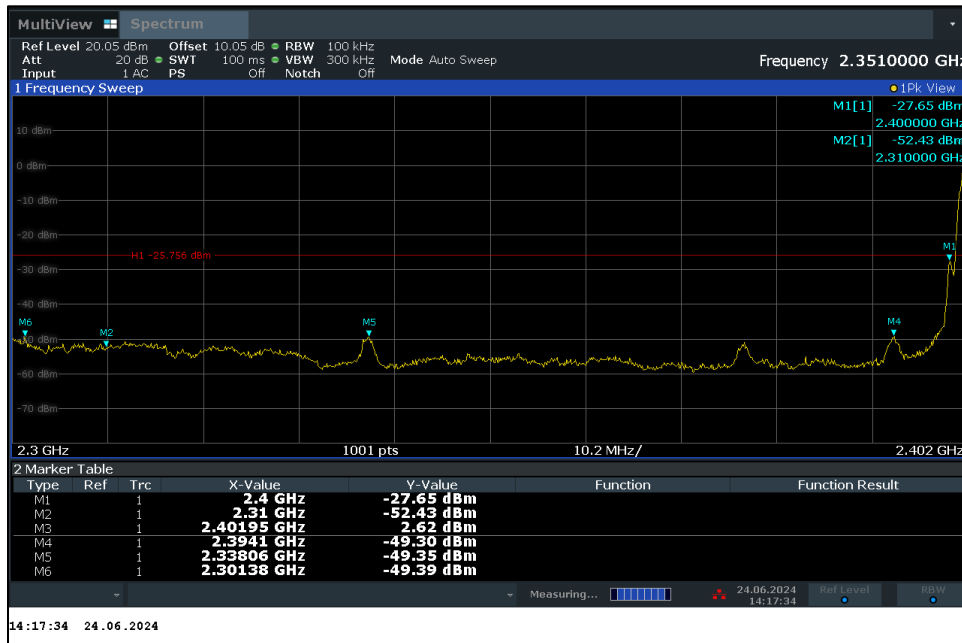


2483.5 to 2500 MHz Bandedge

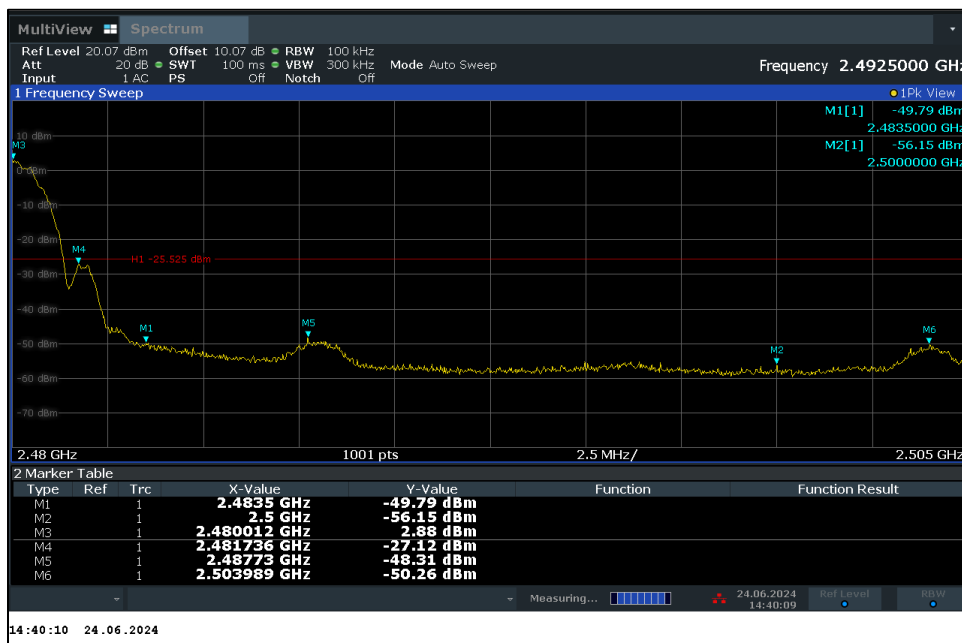
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5.4.3.2 Conducted Bandedge: 2 Mbps



2310 to 2390 MHz Bandedge

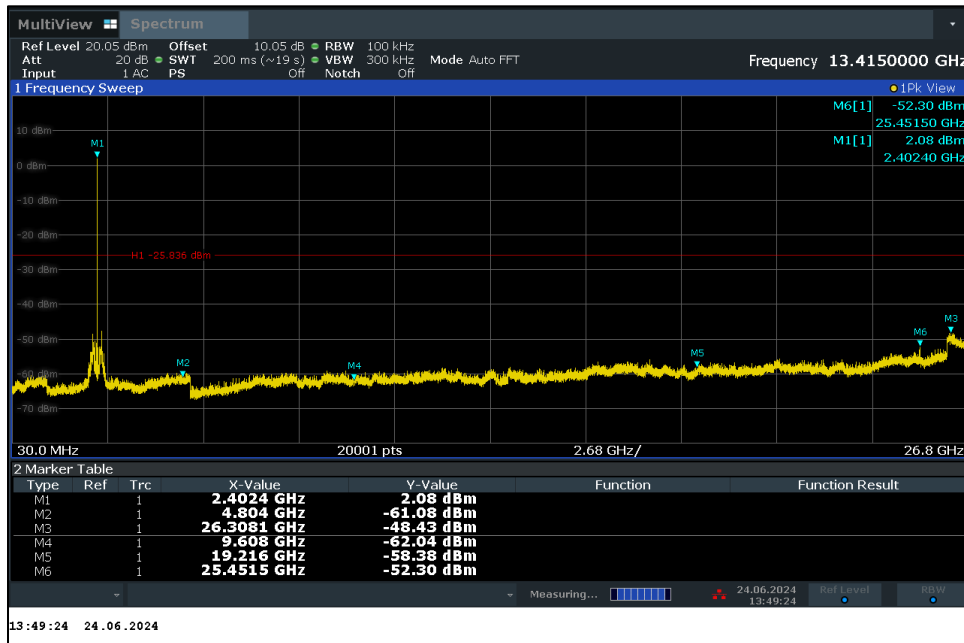


2483.5 to 2500 MHz Bandedge

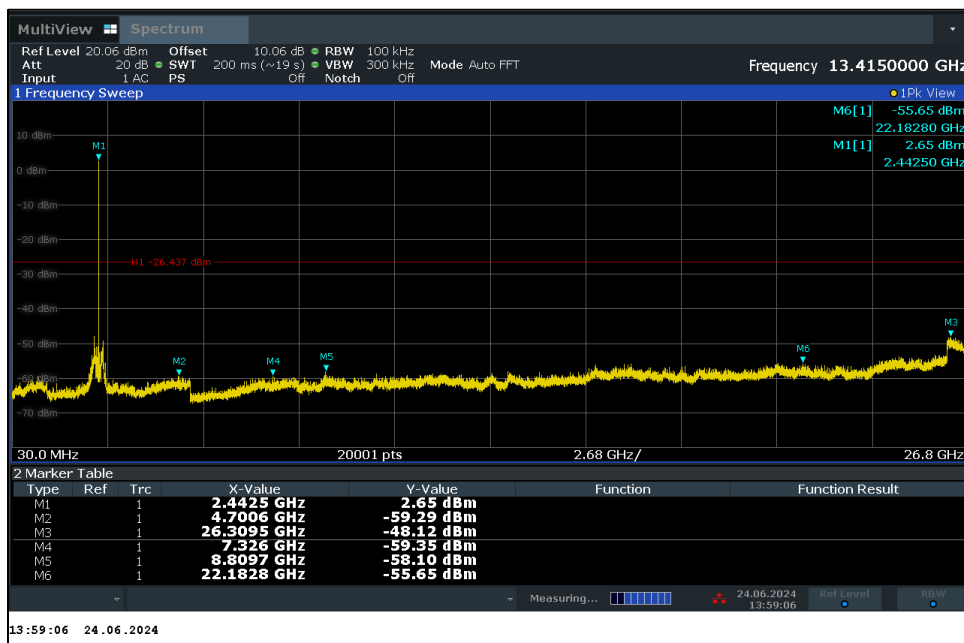
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5.4.3.3 Conducted Spurious Emission: 1 Mbps



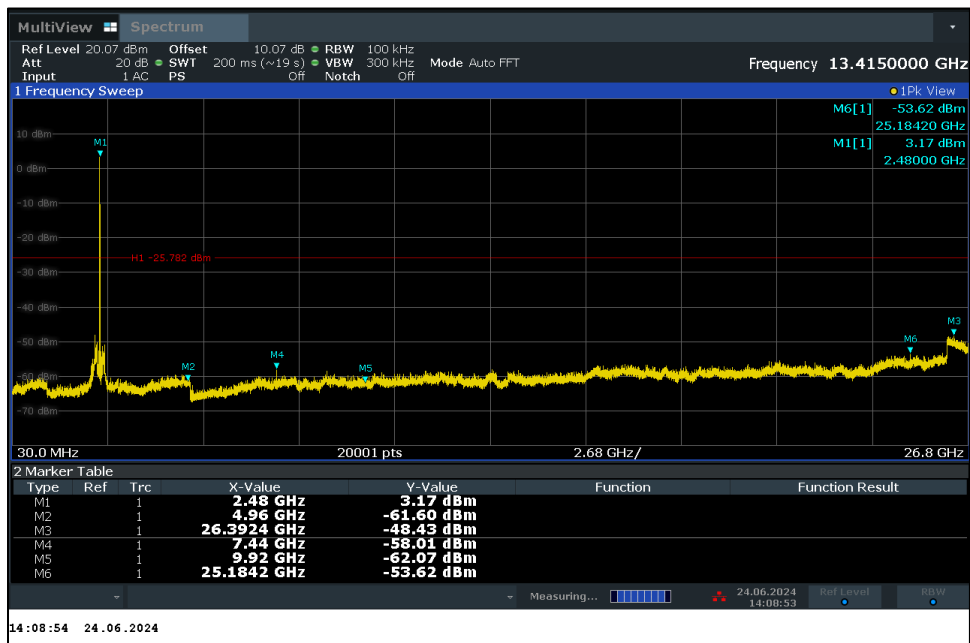
Conducted Emission: Non-Restricted Band 2402 MHz, 1Mbps



Conducted Emission: Non-Restricted Band 2442 MHz, 1Mbps.

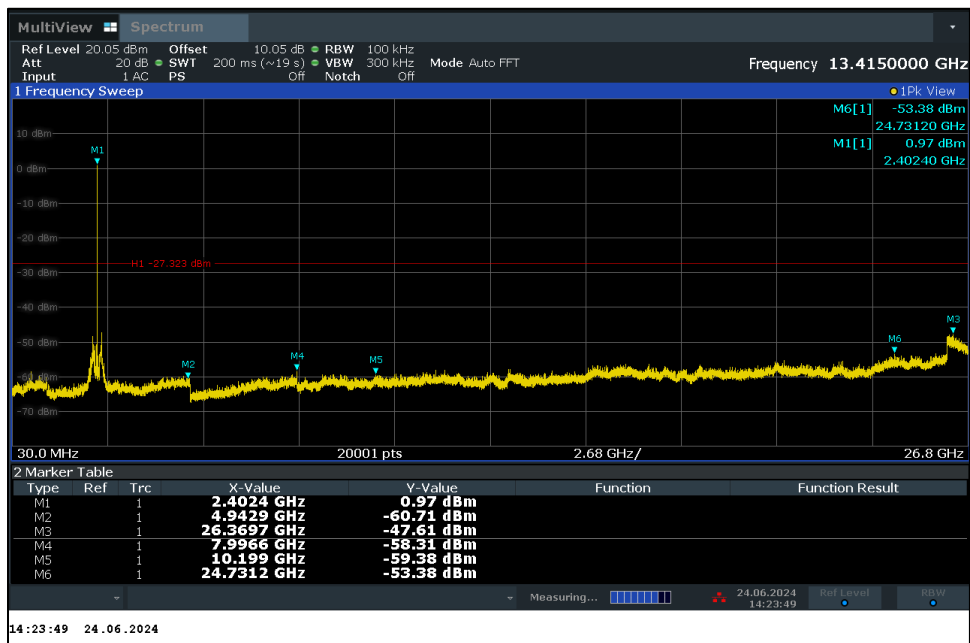
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Conducted Emission: Non-Restricted Band 2480 MHz, 1Mbps.

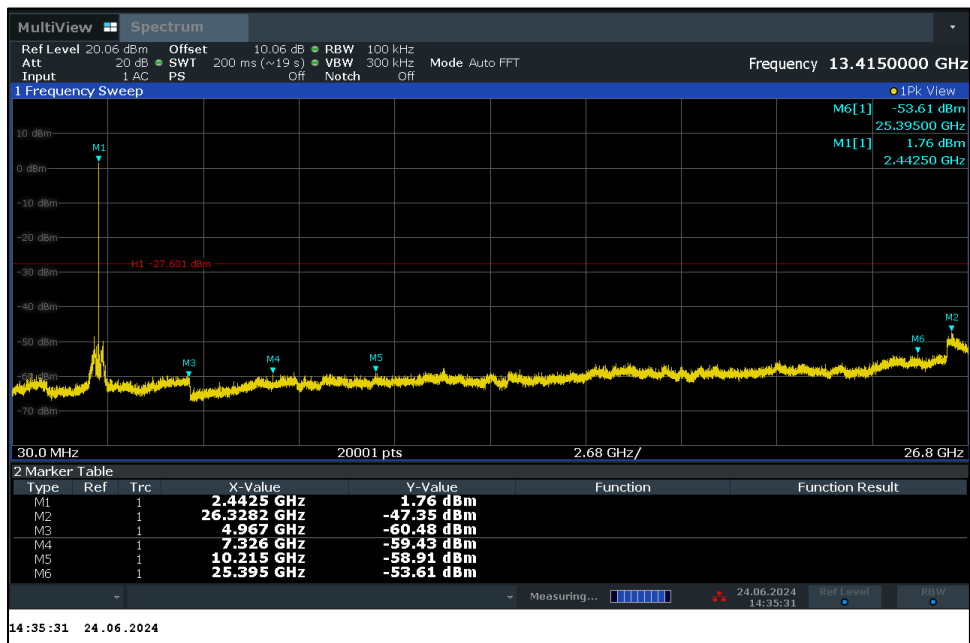
5.4.3.4 Conducted Spurious Emission: 2 Mbps



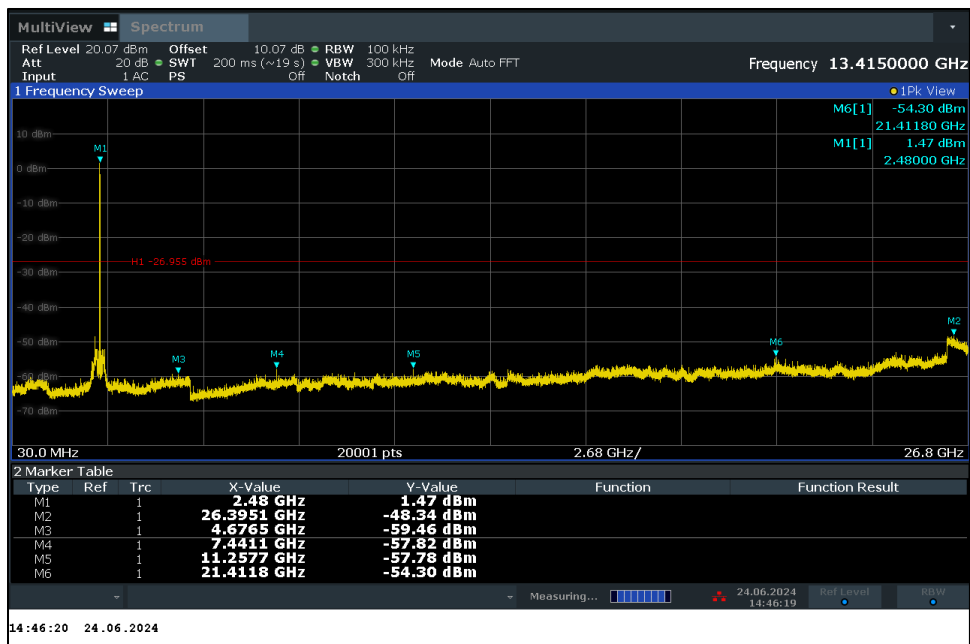
Conducted Emission: Non-Restricted Band 2402 MHz, 2Mbps.

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Conducted Emission: Non-Restricted Band 2442 MHz, 2Mbps.



Conducted Emission: Non-Restricted Band 2480 MHz, 2Mbps.