RADIO REPORT

FCC 47 CFR Part 15E

Unlicensed National Information Infrastructure Devices in the 5 GHz Bands

Report Reference No	G0M-2405-2583-TFC407WF-V02
Testing Laboratory	Eurofins Product Service GmbH
Address	Storkower Str. 38c 15526 Reichenwalde Germany
Accreditation	DAkkS - Registration number : D-PL-12092-01-04 (FCC) FCC Filed Test Laboratory, Reg.-No.: 96970
Applicant	u-blox AG
Address	Zürcherstrasse 68 8800 Thalwil Switzerland
Test Specification	47 CFR Part 15E
Non-Standard Test Method	None
Equipment under Test (EUT):	
Product Description	M.2 card for the MAYA-W2 Wi-Fi 6, Bluetooth 5.3 and IEEE 802.15.4 module
Model(s)	M2-MAYA-W271-00C
Brand Name(s)	None
Additional Models	None
Hardware Version(s)	05
Software Version(s)	01
FCC ID	XPYMAYAW2A
Test Result	**PASSED**

Possible test case verdicts:		
Required by standard but not tested	N/T	
Not required by standard	N/R	
Not applicable to EUT	N/A	
Test object does meet the requirement	P(PASS)	
Test object does not meet the requirement	F(FAIL)	
Testing:		
Test Lab Temperature	20 °C - 30 °C	
Test Lab Humidity	25 % - 55 %	
Date of receipt of test item	2024-06-24	
Report:		
Compiled by	Azamat Ibraimov	
Tested and tests supervised by (+ signature) (Responsible for Test)	Azamat Ibraimov	
Approved by (+ signature) (Senior Radio Expert)	Radwan Jaafar	 .....
Date of Issue	2024-09-10	
Total number of pages	25	
General Remarks:		
The test results presented in this report relate only to the object tested. **The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report.** This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.		
Additional Comments:		
None		

VERSION HISTORY

Version History			
Version	Issue Date	Remarks	Revised By
01	2024-08-02	Initial Release	--
02	2024-09-10	Replaced document: G0M-2405-2583-TFC407WF-V01 Replaced by: G0M-2405-2583-TFC407WF-V02 Changes: • Update and correction of Support Equipment table	St. Liebich

ABBREVIATIONS AND ACRONYMS

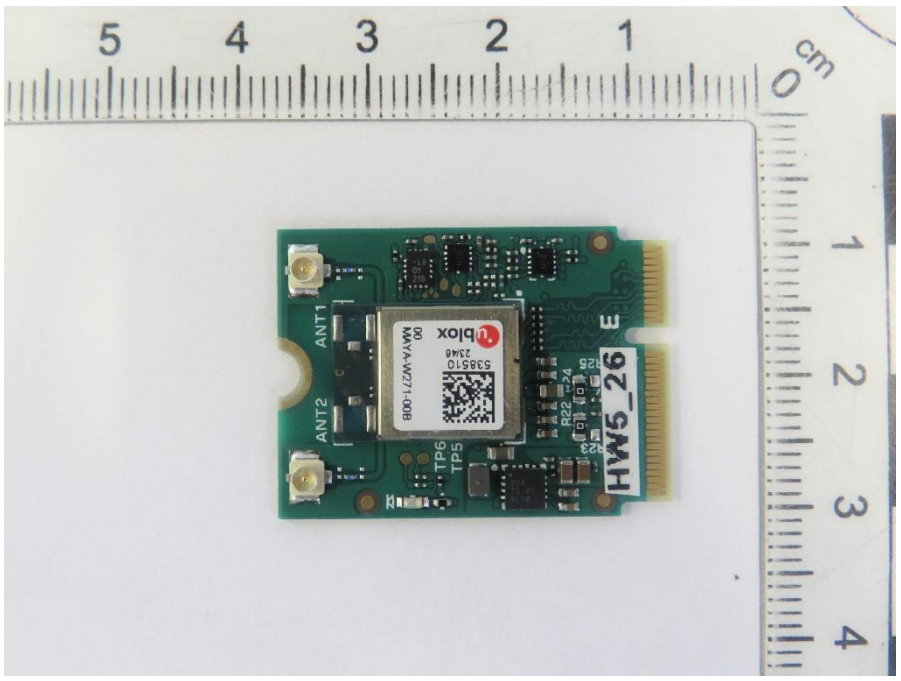
Acronyms	
Acronym	Description
BPSK	Binary Phase Shift Keying
DSSS	Direct Sequence Spread Spectrum
EUT	Equipment Under Test
FCC	Federal Communications Commission
HT	High Throughput
IEEE 802.11	MAC and PHY Layer for WiFi
ISED	Innovation, Science and Economic Development Canada
OFDM	Orthogonal Frequency Division Multiplexing
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RBW	Resolution bandwidth
RMS	Root mean square
VBW	Video bandwidth
V_{NOM}	Nominal supply voltage

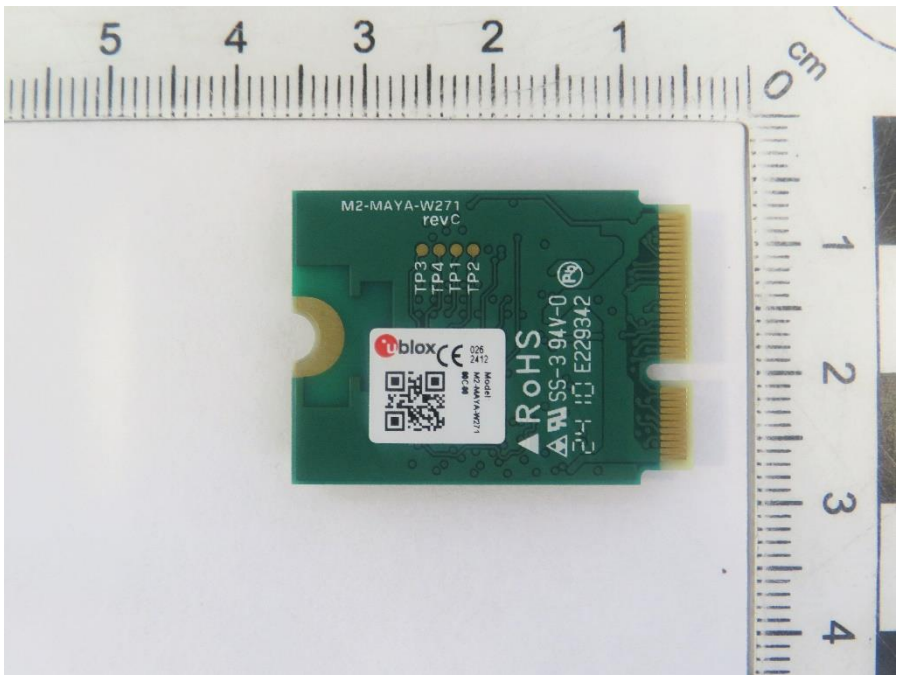
REPORT INDEX

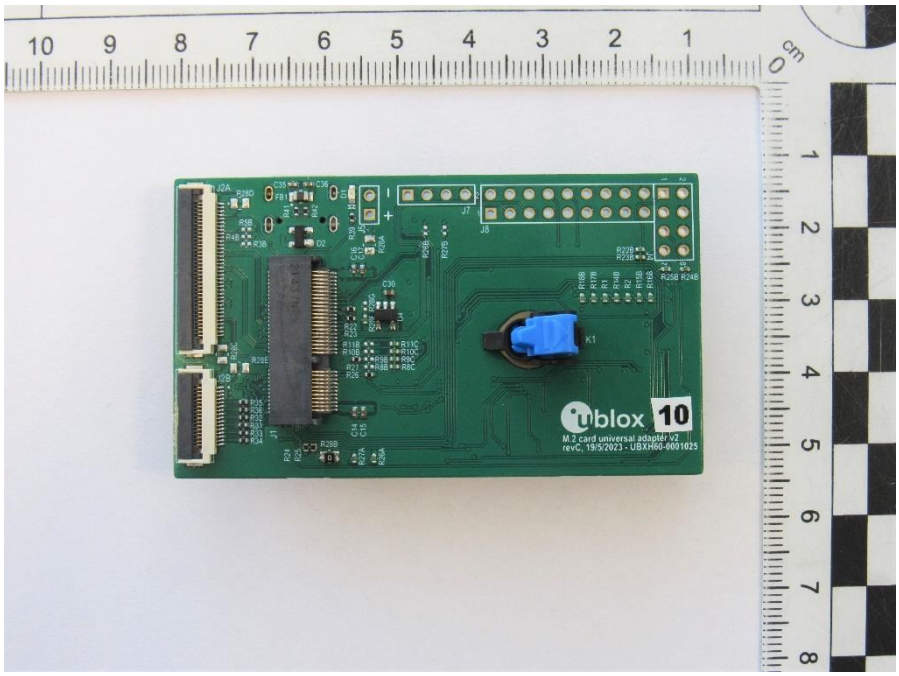
1 Equipment (Test Item) Under Test

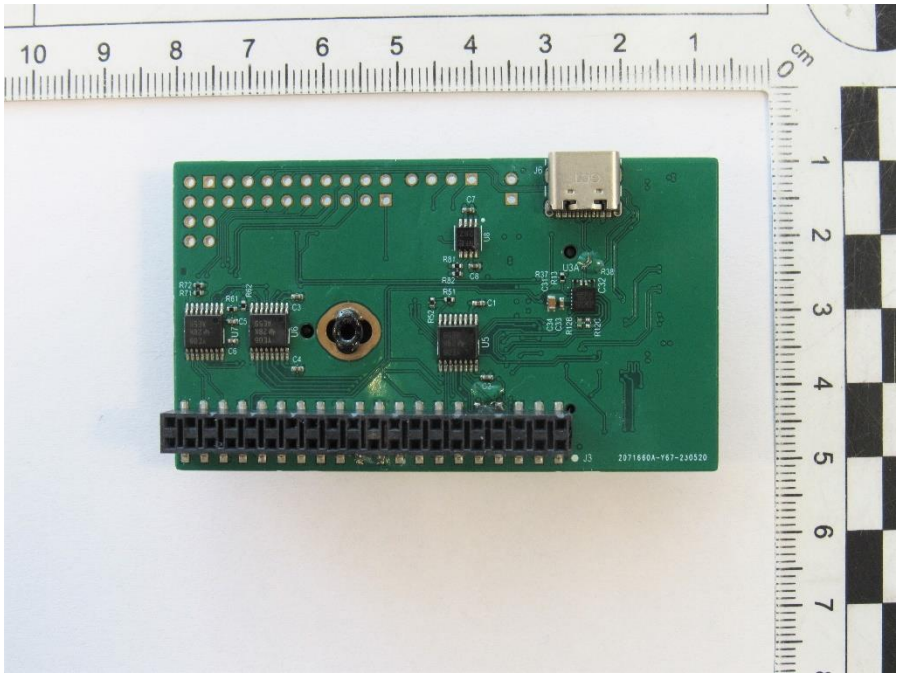
Description	M.2 card for the MAYA-W2 Wi-Fi 6, Bluetooth 5.3 and IEEE 802.15.4 module			
Model(s)	M2-MAYA-W271-00C			
Additional Model(s)	None			
Brand Name(s)	None			
Sample Identification	EUT #	Sample-ID	Serial Number	Date of receipt
	EUT 1	49021	HW5_26	2024-06-24
Hardware Version(s)	05			
Software Version(s)	01			
FCC ID	XPYMAYAW2A			
Equipment type	Radio Module			
Radio type	Transceiver			
Assigned frequency bands	5150 - 5250 MHz 5250 - 5350 MHz 5470 - 5725 MHz 5725 - 5850 MHz			
Radio technology	IEEE 802.11a IEEE 802.11n (HT20, HT40) IEEE 802.11ac (VHT20, VHT40, VHT80) IEEE 802.11ax (HE20, HE40, HE80)			
Modulation	BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM, 1024-QAM			
Number of antenna ports	2 (only one port is active for WLAN)			
Radio Module	Type	WLAN 2.4/5 GHz / Bluetooth / ZigBee module		
	Model	M2-MAYA-W271-00C		
	Manufacturer	u-blox AG		
	HW Version	05		
	SW Version	01		
Antenna	Type	External antenna		
	Model	ANT-DB1-RAF-SMA		
	Manufacturer	TE/Linx Technologies		
	Gain	+ 5.1 dBi		
Supply Voltage	V_{NOM}	3.3 VDC		
Operating Temperature	T_{NOM}	20 °C		
AC/DC-Adaptor	None			
Manufacturer	u-blox AG Zürcherstrasse 68 8800 Thalwil Switzerland			

1.1 Photos

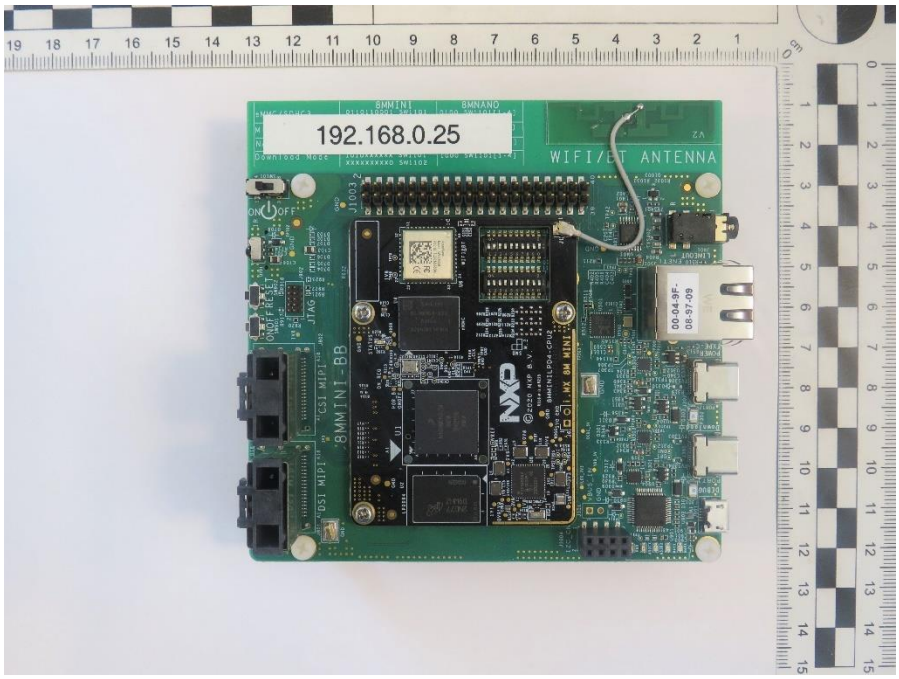
EUT with M2 card top


M2 card bottom


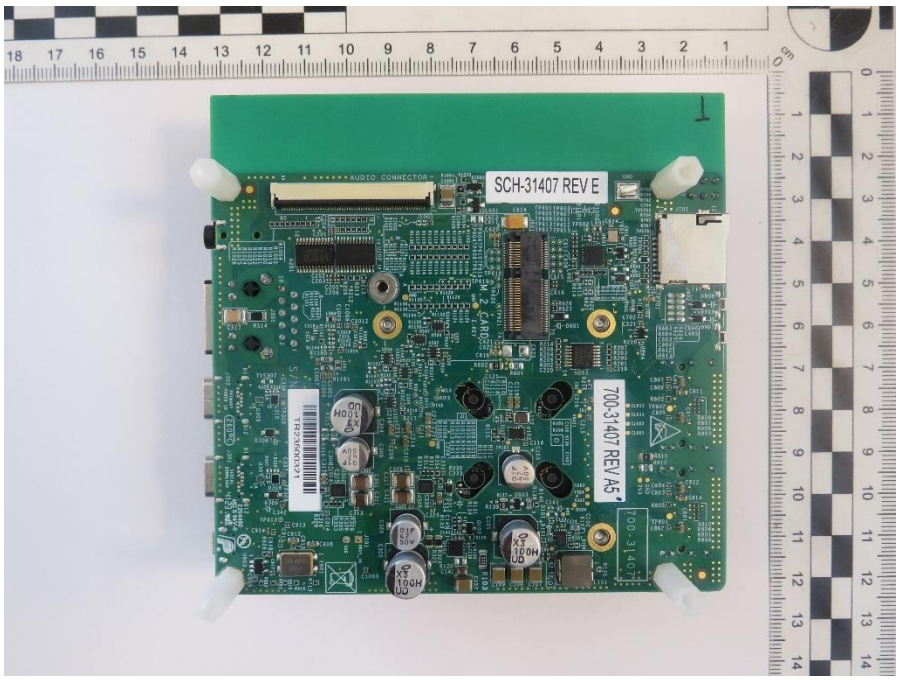
M2 card adapter top


M2 card adapter bottom


Evaluation board top

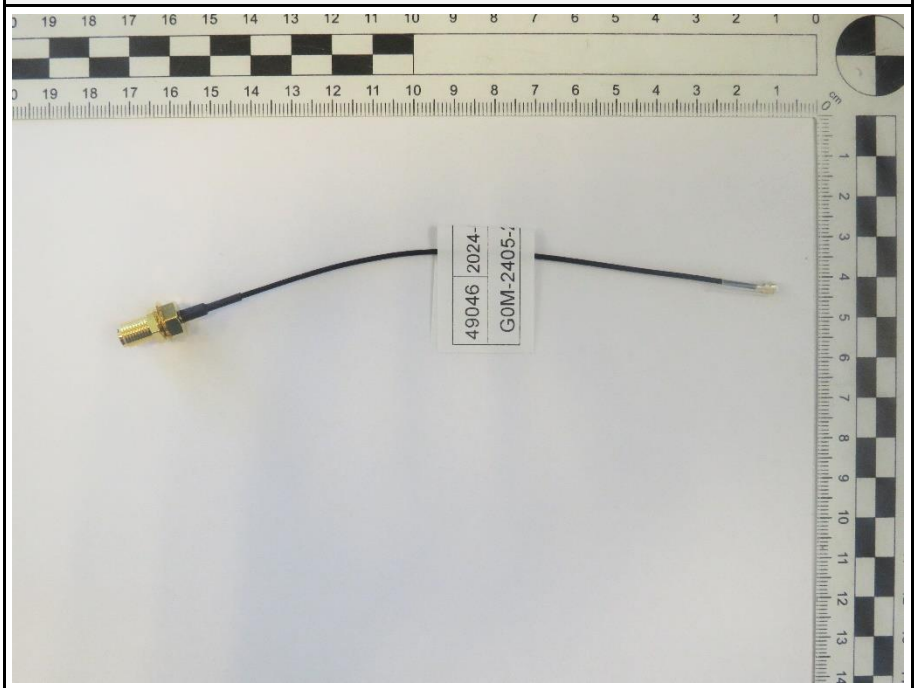


Evaluation board bottom

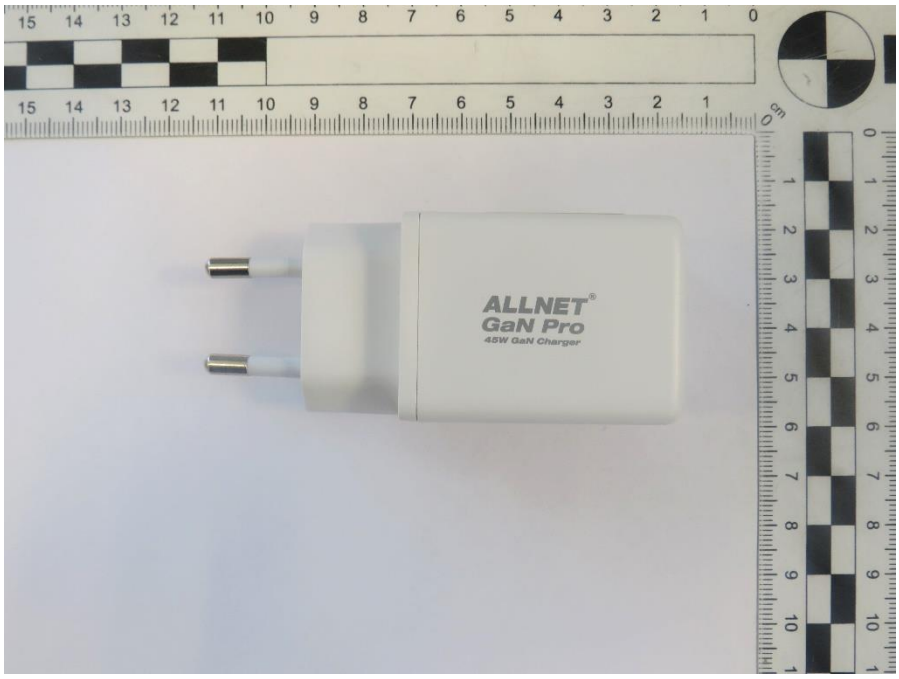


Antenna

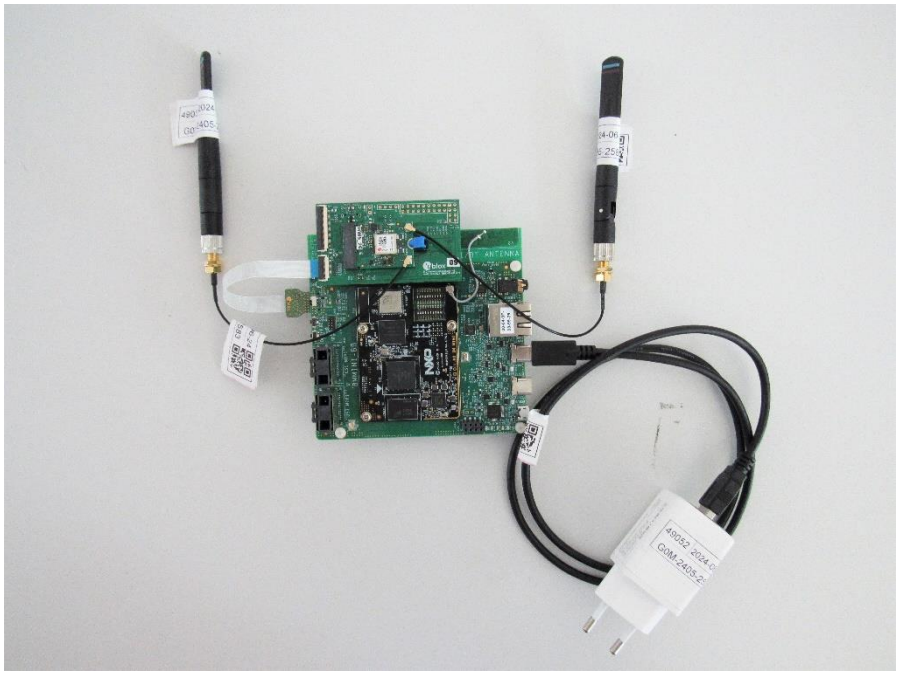
Antenna cable



AC/DC adapter



EUT Set up



1.2 Support Equipment

Product Type	Device	Manufacturer	Model	Comment
AE	Laptop	Lenovo	--	For configuring test mode
AE	Evaluation Kit for the i.MX 8M Mini Applications Processor	NXP	8MMINILPD4-EVK	Host computer board
AE	M2 card adapter	u-blox	v2 revC	--
AE	AC/DC adapter	Allnet	212154	For evaluation board
CBL	Data cable	Molex	15266-0171	From M2 card adapter to Evaluation Kit for the i.MX 8M Mini Applications Processor, length is 153 mm
CBL	USB-C	--	--	--
SFT	Terminal	--	--	Test mode activation
Description:				
AE	Auxiliary Equipment			
SIM	Simulator			
CBL	Connecting Cable			
SFT	Software			
Comment: --				

1.3 Test Modes

Mode	Description
HE20 (IEEE 802.11ax)	Mode = Transmit Bandwidth = 20 MHz Duty Cycle = 99% Power setting = 19 (software setting) Data rate = MCS 0
Comment: The above settings are found as worst case during evaluation of the original modular test report No.: G0M-2302-1881-TFC407WF-W271-V03, issued on 2024-01-11 by Eurofins Product Service GmbH and No.: USRC239070001, issued on 2023-11-27 by Eurofins E&E Taiwan Co., Ltd.	

1.4 Test Frequencies

Designator	Mode	Channel	Frequency [MHz]
F1	Tx	48	5240

1.5 Sample emission level calculation

The following is a description of terms and a sample calculation, as appears in the radiated emissions data table. The numbers used in the calculation are for example only. There is no direct correlation to the specific data taken for the product described in this document:

Reading:

This is the reading obtained on the spectrum analyzer in dBµV. Any external preamplifiers used are taken into account through internal analyzer settings.

A.F.:

This is the antenna factor for the receiving antenna. It is a conversion factor, which converts electric fields strengths to voltages, which can be measured directly on the spectrum analyzer. It is treated as a loss in dB. Cable losses have been included with the A.F. to simplify the calculations. The antenna factor is used in calculations as follows:

Reading on Analyzer (dBµV) + A.F. (dB/m) = Net field strength (dBµV/m)

Net:

This is the net field strength measurement (as shown above).

Margin:

This is the margin of compliance below the FCC limit. The units are given in dB. A negative margin indicates the emission was below the limit. A positive margin indicates that the emission exceeds the limit.

Field strength limit:

This is the FCC Class B radiated emission limit (in units of dBµV/m). The FCC limits are given in units of µV/m. The following formula is used to convert the units of µV/m to dBµV/m:

Field strength limit (dBµV/m) = 20 · log (µV/m)

Example only for radiated field strength:

Reading + AF	= Net Reading	:	Net reading	- Field strength limit	= Margin
+21.5 dBµV	+ 26 dB/m	:	47.5 dBµV/m	- 57.0 dBµV/m	= -9.5

2 Result Summary

FCC 47 CFR Part 15E				
Product Standard Reference	**Requirement**	**Reference Method**	**Result**	**Remarks**
FCC 15.407(e)	6 dB bandwidth	KDB 789033 C.2 ANSI C63.10 12.4	N/T	Note 1
FCC 15.407(a)(2), (a)(5), (h)(2)	26 dB bandwidth	KDB 789033 C.1 ANSI C63.10 12.4	N/T	Note 1
FCC 15.407(a)	Maximum output power	KDB 789033 E ANSI C63.10 12.3	N/T	Note 1
FCC 15.407(h)	Transmit power control	KDB 789033 E ANSI C63.10 12.3	N/T	Note 1
FCC 15.407(a)	Power spectral density	KDB 789033 F ANSI C63.10 12.5	N/T	Note 1
FCC 15.407(g)	Frequency stability	ANSI C63.10 6.8	N/T	Note 1
FCC 15.207	AC power line conducted emissions	ANSI C63.10 6.2	N/R	Note 1
FCC 15.407(b)	Transmitter radiated emissions	KDB 789033 G ANSI C63.10 12.7	PASS	--
FCC 15.407(a)	Radiation pattern	KDB 789033 H	N/R	5250-5350 MHz band only with EIRP > 23 dBm
FCC 15.407(h)	DFS requirements	KDB 905462 D02	N/T	Note 1 & 2
Note 1: Permissive change of a certified module. Note 2: For DFS results refer to the original modular test report No.:G0M-2302-1881-TFC407DF-W271-V03, issued on 2024-01-11 by Eurofins Product Service GmbH; and report No.: USRC239070002 issued on 2024-11-27 by Eurofins E&E Wireless Taiwan Co., Ltd.				
Comment: The Decision Rule is applied on the basis of ETSI TR 102 273 and ETSI TR 100 028. These standards provide guidance on how to calculate and apply measurement uncertainty whilst providing maximum uncertainties allowance. In all cases due consideration will be given to ILAC-G8:09/2019. Where a result is considered conditional in respect of its proximity to the limit line, the customer would be made aware of situation so that they can make an informed decision on how to proceed.				

Possible Test Case Verdicts	
PASS	Test object does meet the requirements
FAIL	Test object does not meet the requirements
N/T	Required by standard but not tested
N/R	Not required by standard for the test object

3 Test Conditions and Results

3.1 Test Conditions and Results - Transmitter radiated emissions

3.1.1 Information

Test Information	
Reference	FCC 15.407(b);
Measurement Method	KDB 789033 G ANSI C63.10 6.3-6.6 6.3; ANSI C63.10 12.7
Operator	Azamat Ibraimov
Date	2024-07-18 - 2024-07-23
Measurement Uncertainty	± 5.95 dB

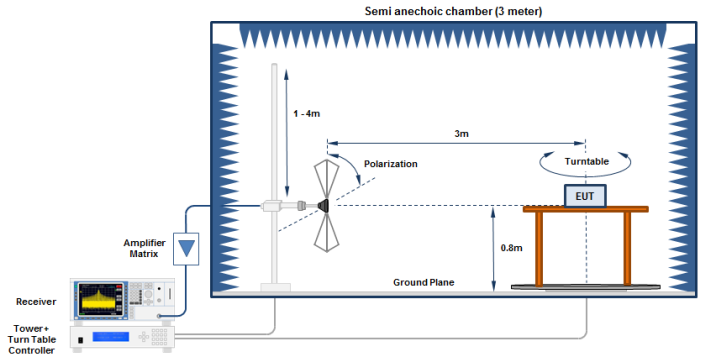
3.1.2 Limits

Limits - Restricted frequency bands and below 1 GHz			
Frequency [MHz]	Detector	Field strength [µV/m]	Measurement distance [m]
30 - 88	Quasi-Peak	100	3
88 - 216	Quasi-Peak	150	3
216 - 960	Quasi-Peak	200	3
960 - 1000	Quasi-Peak	500	3
>1000	Average	500	3

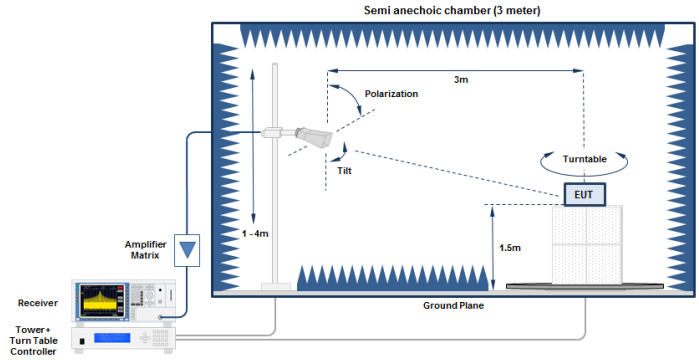
Limits - Outside restricted frequency bands above 1 GHz			
Frequency band [MHz]	Power limit [dBm EIRP]	Field strength limit [dBµV/m]	Measurement distance [m]
5150 - 5250	-27 dBm/MHz	68.2	3
5250 - 5350	-27 dBm/MHz	68.2	3
5470 - 5725	-27 dBm/MHz	68.2	3
5725 - 5850	-27 dBm/MHz @ ±75 MHz from band edge	68.2	3
5725 - 5850	10 to -27 dBm/MHz @ ±25 to ±75 MHz from band edge	105.2 to 68.2	3
5725 - 5850	15.6 to 10 dBm/MHz @ ±5 to ±25 MHz from band edge	110.8 to 105.2	3
5725 - 5850	27 to 15.6 dBm/MHz @ ±0 to ±5 MHz from band edge	122.2 to 110.8	3

3.1.3 Setup

Test Setup 30 MHz - 1000 MHz



Test Setup > 1 GHz



3.1.4 Equipment

Test Software			
Description	Manufacturer	Name	Version
EMC Software	DARE Instruments	RadiMation	2023.2.6

Test Equipment 30 MHz - 1000 MHz					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic Chamber	Frankonia	AC1	EF00062	2022-11	2025-11
Test Receiver	Rohde & Schwarz	ESW44	EF01856	2024-04	2025-04
Antenna	Schwarzbeck	VULB 9168	EF01824	2022-10	2025-10

Test Equipment > 1 GHz					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic Chamber	Frankonia	AC2	EF01616	2023-12	2024-12
Spectrum analyzer	Rohde & Schwarz	FSW43	EF00896	2023-08	2024-08
Horn antenna	Schwarzbeck	BBHA 9120B (1-10GHz)	EF01678	2024-05	2027-05
Double Ridged Waveguide Horn Antenna	Schwarzbeck	HWRD 650 (6,5-18GHz)	EF01679	2024-05	2027-05
Antenna	Amplifier Research	AT4560	EF00302	2023-09	2025-09

3.1.5 Procedure

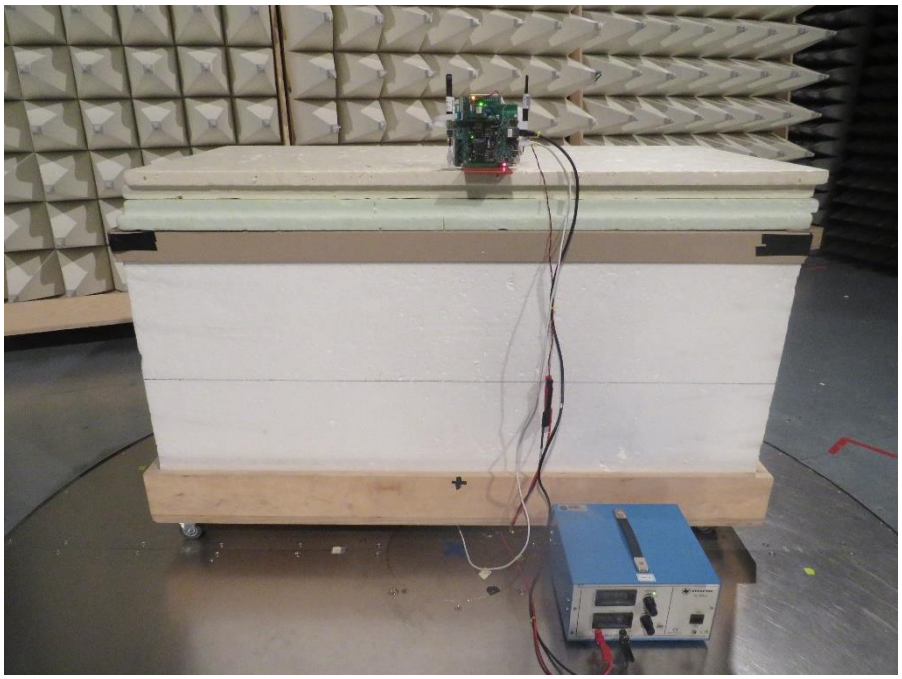
Test Procedure 30 MHz - 1000 MHz
1. EUT is placed on a non conducting support at the center of a turn table 0.8 m above the ground
2. EUT set to test mode
3. The receiver is set to peak detection with max hold
4. The EUT is rotated through 360° and the height of the antenna is varied from 1 m to 4 m
5. All significant emissions are measured again using the corresponding final detector

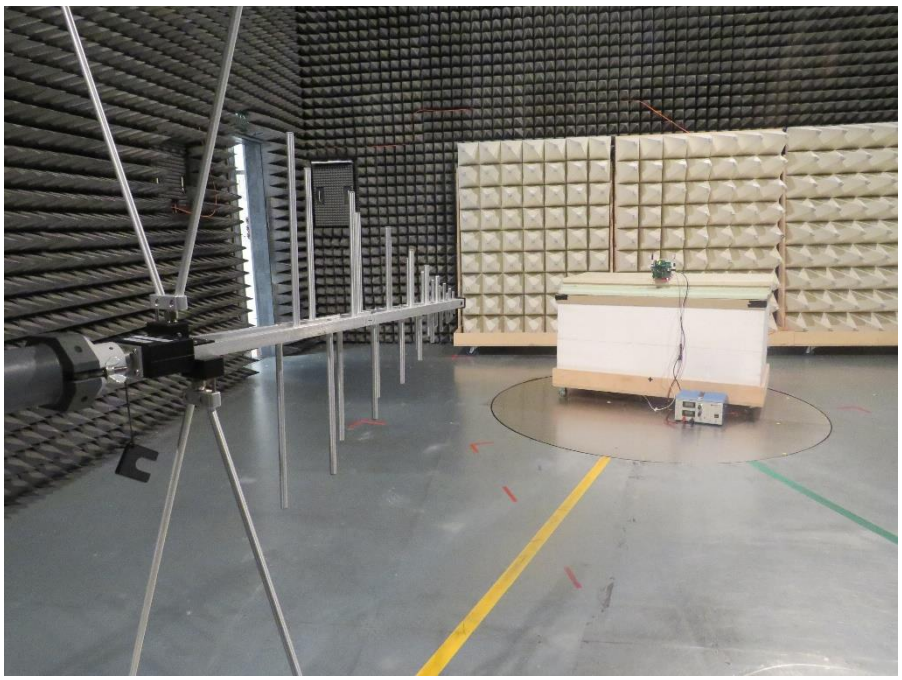
Test Procedure > 1 GHz
1. EUT is placed on a non conducting support at the center of a turn table 1.5 m above the ground
2. EUT set to test mode
3. The receiver is set to peak detection with max hold
4. The EUT is rotated through 360° and the height of the antenna is varied from 1 m to 4 m
5. All significant emissions are measured again using the corresponding final detector

3.1.6 Results

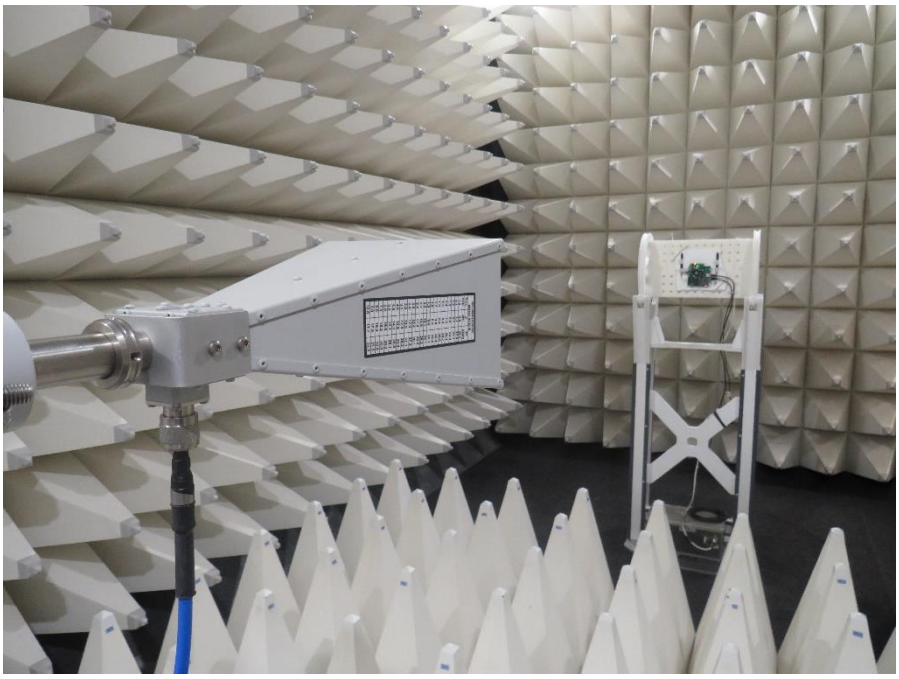
Test Results						
Channel [MHz]	Emission [MHz]	Level [dBµV/m]	Det.	Pol.	Limit [dBµV/m]	Margin [dB]
5240	73.3267	29.1	pk	ver	40	-10.93
5240	166.4467	29.3	pk	ver	43.5	-14.19
5240	1113.9	41.57	pk	ver	74	-32.43
5240	5145.438	44.17	RMS	ver	54	-9.83
5240	5366.342	45.72	pk	ver	74	-28.28
5240	10479.667	40.25	pk	ver	68.2	-27.95
5240	15723.315	45.56	RMS	hor	54	-8.44

3.1.7 Setup Photos

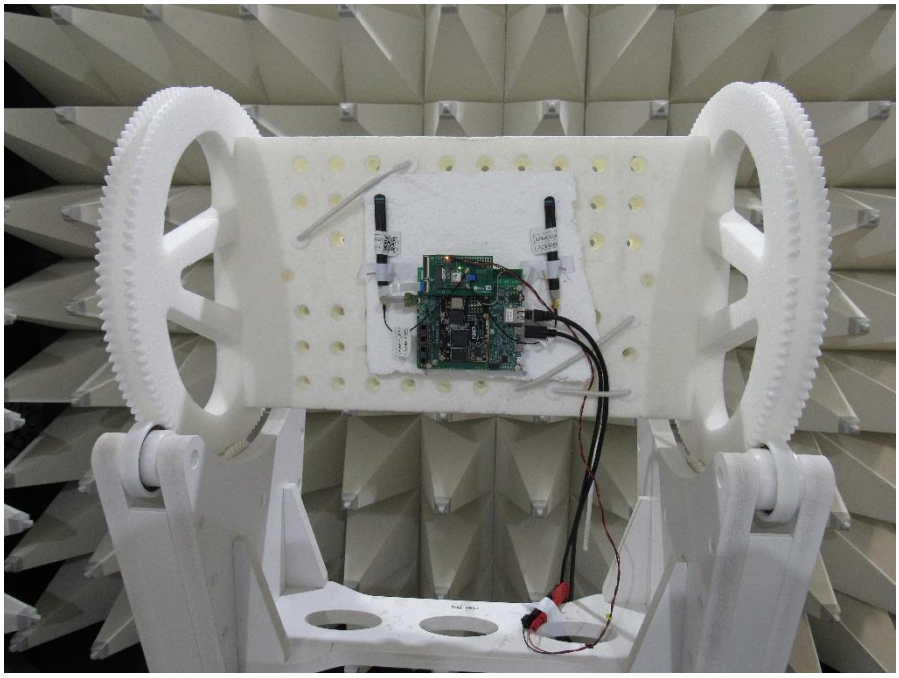
EUT setup below 1 GHz


Test setup below 1 GHz


Test setup above 1 GHz



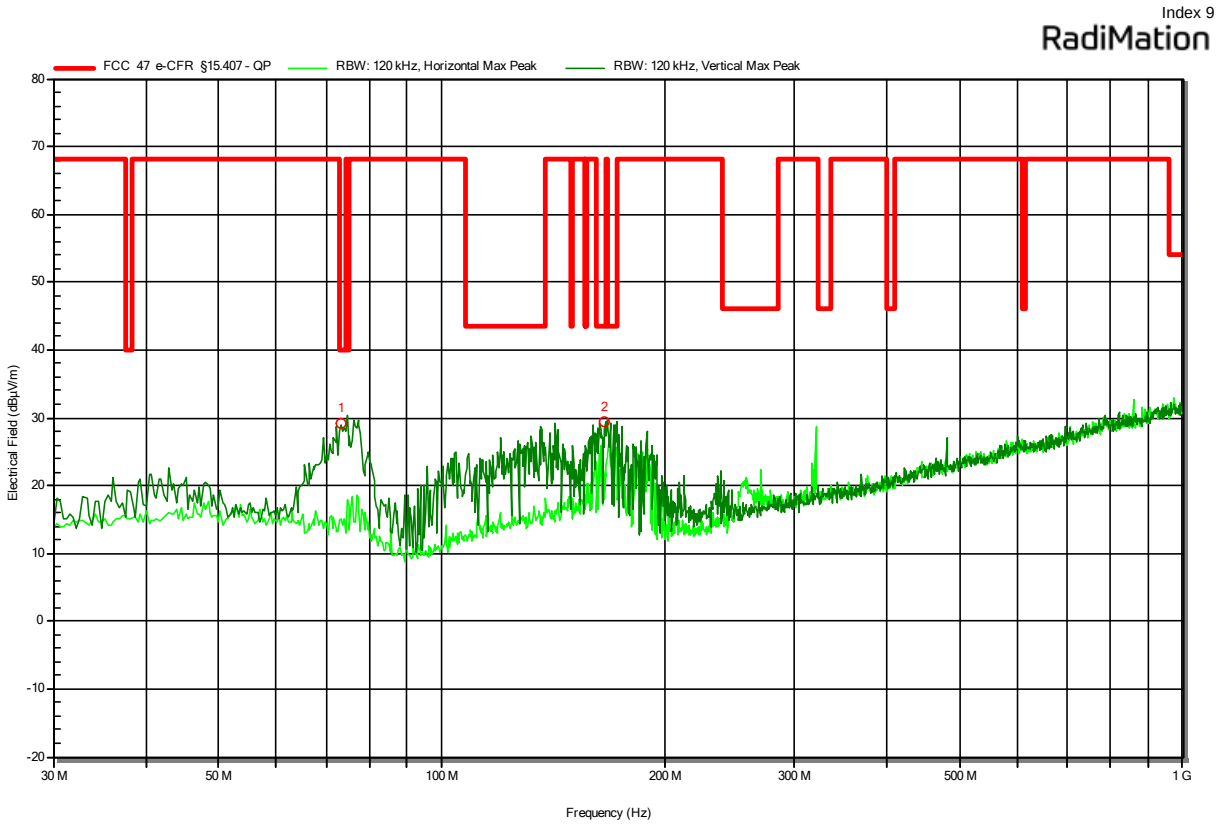
EUT setup above 1 GHz



ANNEX A Transmitter spurious emissions

Radiated Spurious Emissions according to FCC 15.407

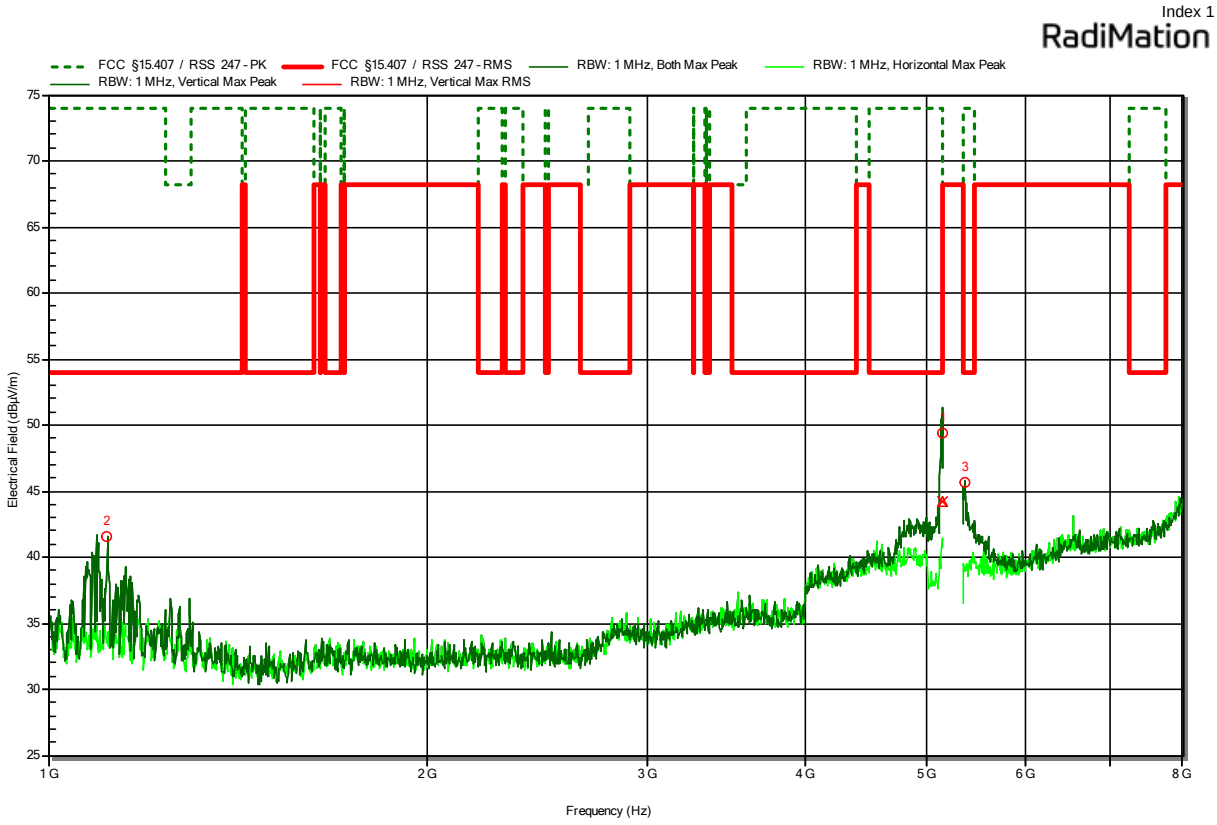
Project Number:	G0M-2405-2583
Applicant:	u-blox AG
Model Description:	M.2 card for the MAYA-W2 Wi-Fi 6, Bluetooth 5.3 and IEEE 802.15.4 module
Model:	M2-MAYA-W271-00C
Test Sample ID:	49021
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Ibraimov
Measurement software:	RadiMation, version 2023.2.6
Test Conditions:	Tnom: 24 °Celsius, Vnom: 3.3 VDC
Antenna:	Schwarzbeck VULB 9168
Measurement distance:	3 m
Mode:	Tx; 802.11ax_HE20_5240 MHz_Tx
Test Date:	2024-07-23



Peak Number	Frequency (MHz)	Peak (dBµV/m)	Peak Limit (dBµV/m)	Peak Difference (dB)	Peak Status	Polarization
1	73.3267	29.1	40	-10.93	Pass	Vertical
2	166.4467	29.3	43.5	-14.19	Pass	Vertical

Radiated Spurious Emissions according to FCC 15.407

Project Number:	G0M-2405-2583
Applicant:	u-blox AG
Model Description:	M.2 card for the MAYA-W2 Wi-Fi 6, Bluetooth 5.3 and IEEE 802.15.4 module
Model:	M2-MAYA-W271-00C
Test Sample ID:	49021
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Siddique
Measurement software:	RadiMation, version 2020.1.8
Test Conditions:	Tnom: 24 °Celsius, Vnom: 3.3 VDC
Antenna:	Schwarzbeck BBHA 9120B
Measurement distance:	3 m
Mode:	Tx; 802.11ax_HE20_5240 MHz_Tx
Test Date:	2024-07-18

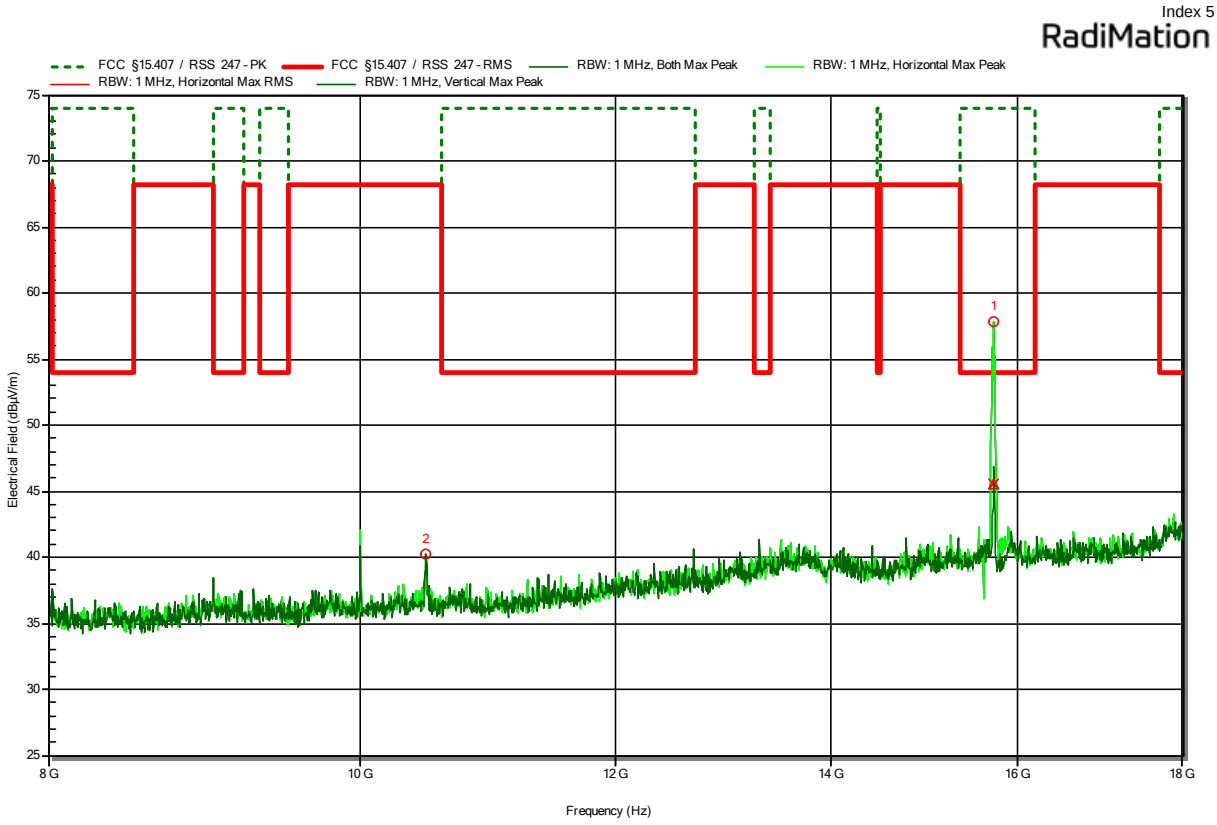


Peak Number	Frequency (MHz)	Peak (dBµV/m)	Peak Limit (dBµV/m)	Peak Difference (dB)	Peak Status	Polarization
2	1113.9	41.57	74	-32.43	Pass	Vertical
3	5366.342	45.72	74	-28.28	Pass	Vertical

Peak Number	Frequency (MHz)	RMS (dBµV/m)	RMS Limit (dBµV/m)	RMS Difference (dB)	RMS Status	Polarization
1	5145.438	44.17	54	-9.83	Pass	Vertical

Radiated Spurious Emissions according to FCC 15.407

Project Number:	G0M-2405-2583
Applicant:	u-blox AG
Model Description:	M.2 card for the MAYA-W2 Wi-Fi 6, Bluetooth 5.3 and IEEE 802.15.4 module
Model:	M2-MAYA-W271-00C
Test Sample ID:	49021
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Ibraimov
Measurement software:	RadiMation, version 2020.1.8
Test Conditions:	Tnom: 24 °Celsius, Vnom: 3.3 VDC
Antenna:	Schwarzbeck HWRD 650
Measurement distance:	3 m
Mode:	Tx; 802.11ax_HE20_5240 MHz_Tx
Test Date:	2024-07-19

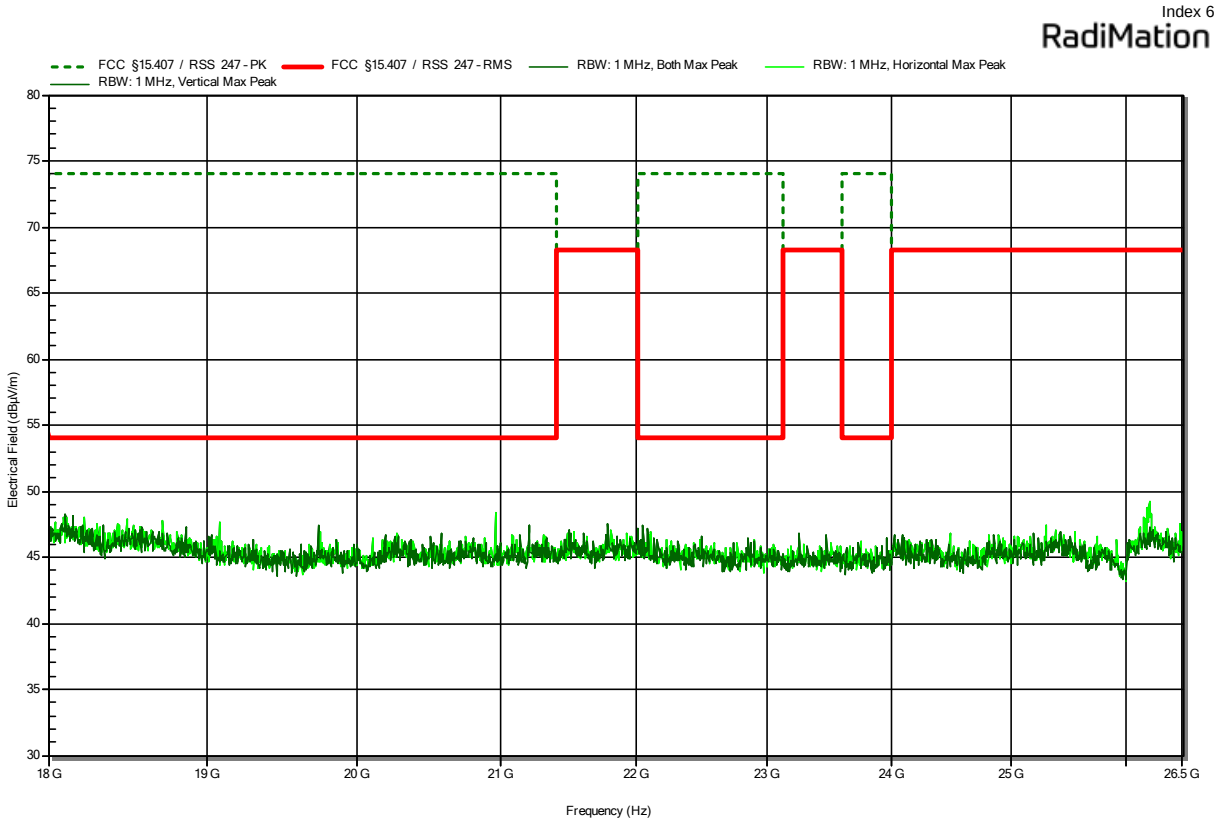


Peak Number	Frequency (MHz)	Peak (dBµV/m)	Peak Limit (dBµV/m)	Peak Difference (dB)	Peak Status	Polarization
2	10479.667	40.25	68.2	-27.95	Pass	Vertical

Peak Number	Frequency (MHz)	RMS (dBµV/m)	RMS Limit (dBµV/m)	RMS Difference (dB)	RMS Status	Polarization
1	15723.315	45.56	54	-8.44	Pass	Horizontal

Radiated Spurious Emissions according to FCC 15.407

Project Number:	G0M-2405-2583
Applicant:	u-blox AG
Model Description:	M.2 card for the MAYA-W2 Wi-Fi 6, Bluetooth 5.3 and IEEE 802.15.4 module
Model:	M2-MAYA-W271-00C
Test Sample ID:	49021
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Ibraimov
Measurement software:	RadiMation, version 2020.1.8
Test Conditions:	Tnom: 24 °Celsius, Vnom: 3.3 VDC
Antenna:	Amplifier Research AT4560
Measurement distance:	3 m
Mode:	Tx; 802.11ax_HE20_5240 MHz_Tx
Test Date:	2024-07-19



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