FCC RF Test Report

APPLICANT	:	Amazon.com Services LLC
EQUIPMENT	:	Digital Media Receiver
MODEL NAME	:	CP38RE
FCC ID	:	2A4DH-3877
STANDARD	:	FCC Part 15 Subpart C §15.247
CLASSIFICATION	:	(DTS) Digital Transmission System
TEST DATE(S)	:	Sep. 29, 2023 ~ Oct. 31, 2023

We, Sporton International Inc. (Shenzhen), would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. (Shenzhen), the test report shall not be reproduced except in full.

Jason Jia

Approved by: Jason Jia

ACCREDITED
Cert #5145.01

Sporton International Inc. (ShenZhen)
1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan, Shenzhen, 518055
People's Republic of China

TABLE OF CONTENTS

REVISION HISTORY **3**

SUMMARY OF TEST RESULT **4**

1 GENERAL DESCRIPTION **5**

1.1 Applicant 5
1.2 Product Feature of Equipment Under Test 5
1.3 Product Specification of Equipment Under Test 5
1.4 Modification of EUT 5
1.5 Testing Location 6
1.6 Test Software 6
1.7 Applicable Standards 6

2 TEST CONFIGURATION OF EQUIPMENT UNDER TEST **7**

2.1 Carrier Frequency and Channel 7
2.2 Test Mode 8
2.3 Connection Diagram of Test System 8
2.4 Support Unit used in test configuration and system 9
2.5 EUT Operation Test Setup 9
2.6 Measurement Results Explanation Example 10

3 TEST RESULT **11**

3.1 6dB and 99% Bandwidth Measurement 11
3.2 Output Power Measurement 13
3.3 Power Spectral Density Measurement 14
3.4 Conducted Band Edges and Spurious Emission Measurement 16
3.5 Radiated Band Edges and Spurious Emission Measurement 57
3.6 AC Conducted Emission Measurement 61
3.7 Antenna Requirements 63

4 LIST OF MEASURING EQUIPMENT **64**

5 UNCERTAINTY OF EVALUATION **65**

APPENDIX A. CONDUCTED TEST RESULTS

APPENDIX B. AC CONDUCTED EMISSION TEST RESULT

APPENDIX C. RADIATED SPURIOUS EMISSION

APPENDIX D. DUTY CYCLE PLOTS

REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR353104-01D	Rev. 01	Initial issue of report	Dec. 22, 2023
FR353104-01D	Rev. 02	Update the information of WLAN AP in Section 2.4	Feb. 21, 2024
FR353104-01D	Rev. 03	Corrected average power of 11b CH1 & CH6	Apr. 11, 2024

SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.247(a)(2)	6dB Bandwidth	≥ 0.5MHz	Pass	-
3.1	-	99% Bandwidth	-	Report Only	-
3.2	15.247(b)	Output Power Measurement	≤ 30dBm	Pass	-
3.3	15.247(e)	Power Spectral Density	≤ 8dBm/3kHz	Pass	-
3.4	15.247(d)	Conducted Band Edges	≤ 20dBc	Pass	-
		Conducted Spurious Emission		Pass	-
3.5	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 3.09 dB at 2483.580 MHz
3.6	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 20.30 dB at 0.156 MHz
3.7	15.203 & 15.247(b)	Antenna Requirement	15.203 & 15.247(b)	Pass	-

Conformity Assessment Condition:

1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
2. The measurement uncertainty please refer to each test result in the section “Measurement Uncertainty”

Disclaimer:

The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.

1 General Description

1.1 Applicant

Amazon.com Services LLC
410 Terry Avenue N Seattle, WA 98109-5210 United States

1.2 Product Feature of Equipment Under Test

Product Feature	
Equipment	Digital Media Receiver
Model Name	CP38RE
FCC ID	2A4DH-3877
SN	Conducted: P0B3FD01336406W3 Conduction: G0B3230233840056 Radiation: G0B323023384003Q

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.3 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Channel Frequency Range	2412 MHz ~ 2472 MHz
Maximum (Peak) Output Power to antenna	**<MIMO Ant. 0+1>:** 802.11b : 23.64 dBm (0.2312 W) 802.11g : 27.73 dBm (0.5929 W) 802.11n HT20 : 26.67 dBm (0.4645 W) 802.11ax HE20 : 27.09 dBm (0.5117 W)
99% Occupied Bandwidth	802.11b : 12.59MHz 802.11g : 17.43MHz 802.11n HT20 : 18.53MHz 802.11ax HE20 : 19.08MHz
Antenna Type / Gain	**<Ant.0>:** PCB dipole with gain 7.2 dBi **<Ant.1>:** PCB dipole with gain 4.0 dBi
Type of Modulation	802.11b : DSSS (DBPSK / DQPSK / CCK) 802.11g/n : OFDM (BPSK / QPSK / 16QAM / 64QAM) 802.11ax : OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM / 1024QAM)

Remark:

1. For WLAN SISO & CDD MIMO mode, the whole testing has assessed only MIMO mode by referring to the higher normal conducted power.
2. 802.11ax support OFDMA full RU tone and partial RU tone, both full RU and partial RU-left (for low CH) and partial RU-right (for high CH) test output power, the full RU Power > partial RU, therefore the full RU perform full test to cover partial RU except for PSD.

1.4 Modification of EUT

No modifications are made to the EUT during all test items.

1.5 Testing Location

Sporton International Inc. (Shenzhen) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.01.

Test Firm	Sporton International Inc. (Shenzhen)		
Test Site Location	1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan, Shenzhen, 518055 People's Republic of China TEL: +86-755-86379589 FAX: +86-755-86379595		
Test Site No.	**Sporton Site No.**	**FCC Designation No.**	**FCC Test Firm Registration No.**
	CO02-SZ TH01-SZ	CN1256	421272

Test Firm	Sporton International Inc. (Shenzhen)		
Test Site Location	101, 1st Floor, Block B, Building 1, No. 2, Tengfeng 4th Road, Fenghuang Community, Fuyong Street, Baoan District, Shenzhen City Guangdong Province China 518103 TEL: +86-755-33202398		
Test Site No.	**Sporton Site No.**	**FCC Designation No.**	**FCC Test Firm Registration No.**
	03CH03-SZ	CN1256	421272

1.6 Test Software

Item	Site	Manufacturer	Name	Version
1.	03CH03-SZ	AUDIX	E3	6.2009-8-24
2.	CO02-SZ	AUDIX	E3	6.2009-8-24al

1.7 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR Part 15 Subpart C §15.247
- FCC KDB 558074 D01 15.247 Meas Guidance v05r02
- FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ANSI C63.10-2013

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

2 Test Configuration of Equipment Under Test

a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (Z plane) were recorded in this report.

b. AC power line Conducted Emission was tested under maximum output power.

2.1 Carrier Frequency and Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	1	2412	8	2447
	2	2417	9	2452
	3	2422	10	2457
	4	2427	11	2462
	5	2432	12	2467
	6	2437	13	2472
	7	2442		

2.2 Test Mode

Final test modes are considering the modulation and worse data rates as Appendix C.

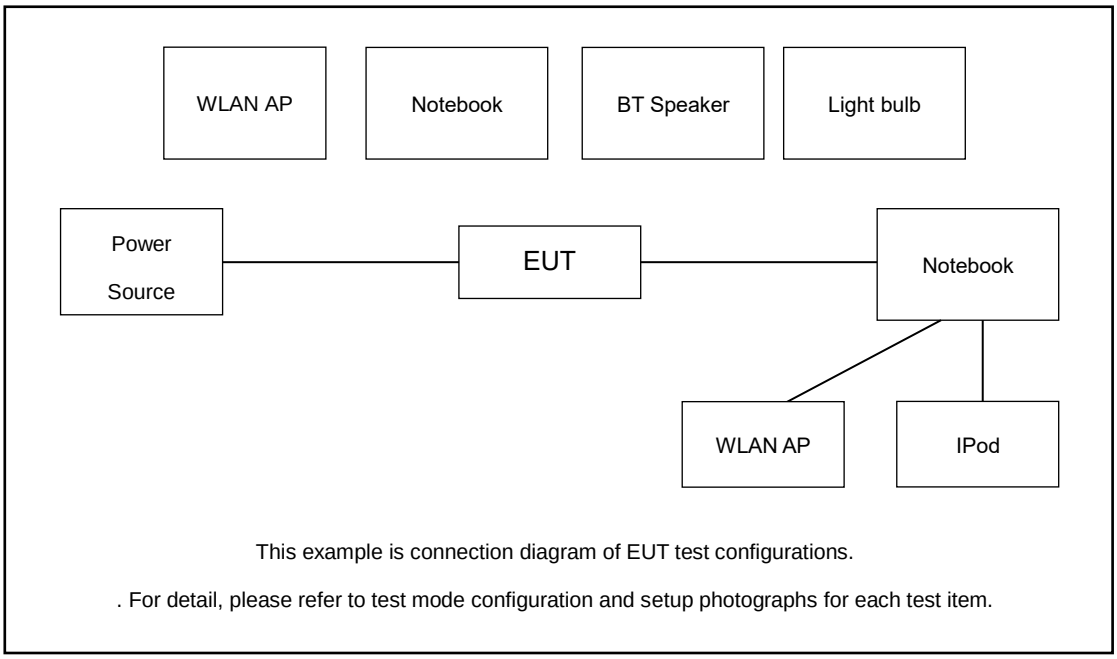
MIMO Antenna

Modulation	Data Rate
802.11b	1 Mbps
802.11g	6 Mbps
802.11n HT20	MCS0
802.11ax HE20	MCS0

Test Cases	
AC Conducted Emission	Mode 1 :LORA TX + Zigbee Link + Bluetooth Link + WLAN Link(2.4G)
Remark: For Radiated Test Cases, The tests were performance with Adapter	

2.3 Connection Diagram of Test System

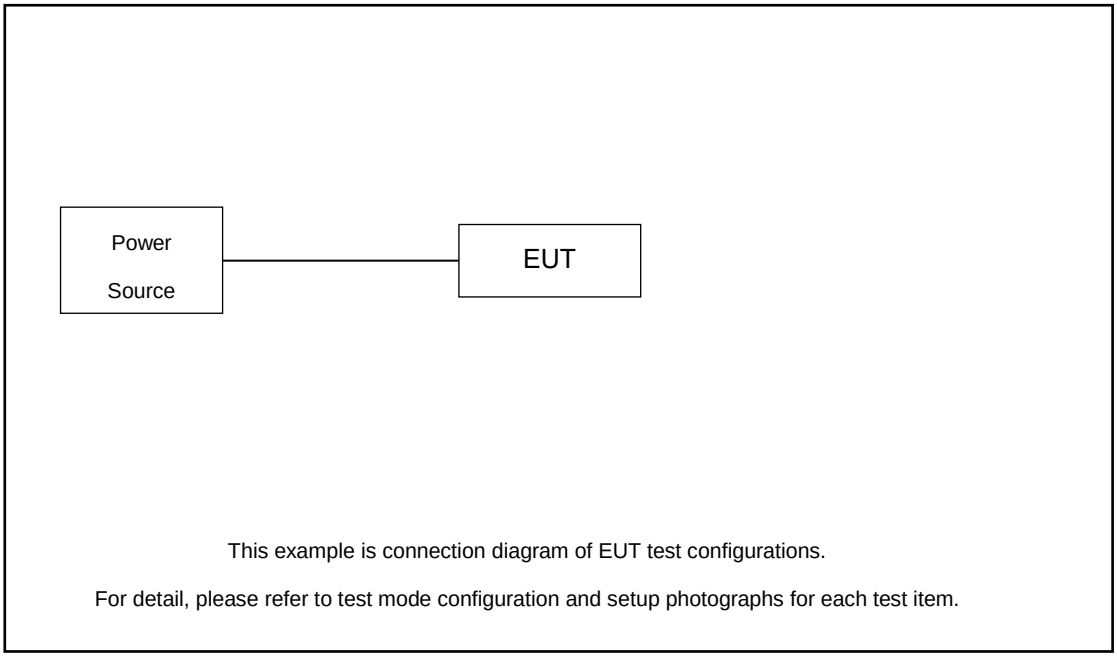
AC Conducted Emission:



This example is connection diagram of EUT test configurations.

. For detail, please refer to test mode configuration and setup photographs for each test item.

Radiated Emission:



2.4 Support Unit used in test configuration and system

Item	Equipment	Model Name	FCC ID	Data Cable	Power Cord
1.	WLAN AP	RT-AC66U	MSQ-RTAC66U	N/A	Unshielded, 2.7m with Core
2.	WLAN AP	RT-AX88U	MSQ-RTAXHP00	N/A	Unshielded,1.8m with Core
3.	Notebook	Inspiron 15-7570	Fcc DoC	N/A	AC I/P: Unshielded, 1.8 m DC O/P: Shielded, 1.8 m
4.	BT Speaker	N/A	N/A	N/A	N/A
5.	Light bulb	N/A	N/A	N/A	N/A
6.	IPod	MC525 ZP/A	Fcc DoC	Shielded, 1.0m	N/A

2.5 EUT Operation Test Setup

For WLAN RF test items, an engineering test program was provided and enabled to make EUT continuous transmit.

2.6 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example:
The spectrum analyzer offset is derived from RF cable loss and attenuator factor.
Offset = RF cable loss + attenuator factor.
Following shows an offset computation example with cable loss 1.5 dB and 10dB attenuator.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).
= 1.5 + 10 = 11.5 (dB)

3 Test Result

3.1 6dB and 99% Bandwidth Measurement

3.1.1 Limit of 6dB and 99% Bandwidth

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

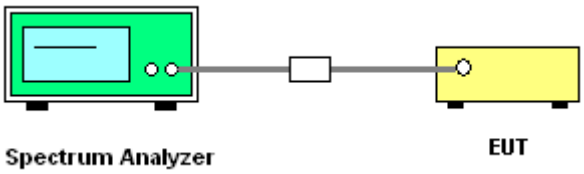
3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.1.3 Test Procedures

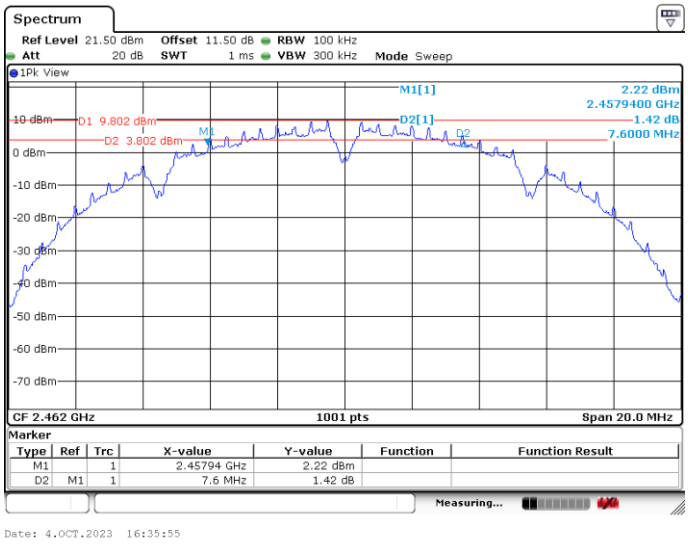
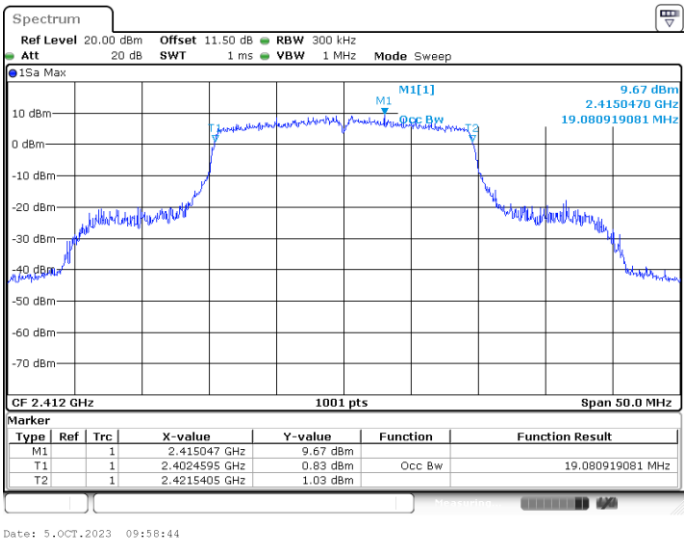
1. The testing follows ANSI C63.10-2013 clause 11.8
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) = 1%~5% of OBW and set the Video bandwidth (VBW) ≥ 3* RBW.
6. Measure and record the results in the test report.

3.1.4 Test Setup



3.1.5 Test Result of 6dB and 99% Occupied Bandwidth

Please refer to Appendix A.

Minimum 6dB Bandwidth	Maximum 99% Occupied Bandwidth
	

Note : The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

3.2 Output Power Measurement

3.2.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for output power is 30dBm. If transmitting antenna with directional gain greater than 6dBi is used, the output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

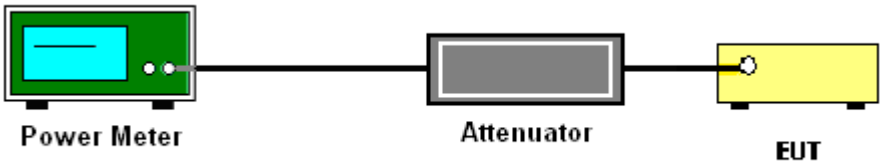
3.2.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.2.3 Test Procedures

1. The testing follows the Measurement Procedure of ANSI C63.10-2013 clause 11.9.1.3 PKPM1 Peak power meter or ANSI C63.10-2013 clause 11.9.2.3.1 Method AVGPM method.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power and record the results in the test report.
5. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

3.2.4 Test Setup



3.2.5 Test Result of Peak Output Power

Please refer to Appendix A.

3.2.6 Test Result of Average Output Power (Reporting Only)

Please refer to Appendix A.

3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

3.3.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.3.3 Test Procedures

1. The testing follows Measurement Procedure of ANSI C63.10-2013 clause 11.10.2 Method PKPSD.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
5. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.
6. Measure and record the results in the test report.
7. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

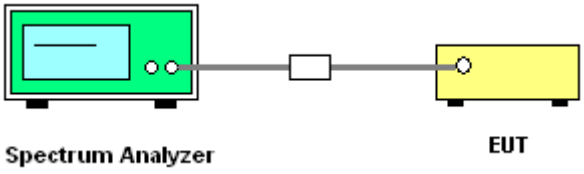
   If measurements performed using method (2) plus 10 log (N) exceeds the emission limit, the test should choose method (1) before declaring that the device fails the emission limit.

   Method (1): Measure and sum the spectra across the outputs.

   The total final Power Spectral Density is from a device with 2 transmitter outputs. The spectrum measurements of the individual outputs are all performed with the same span and number of points, the spectrum value in the first spectral bin of output 1 is summed with that in the first spectral bin of output 2 to obtain the value for the first frequency bin of the summed spectrum.

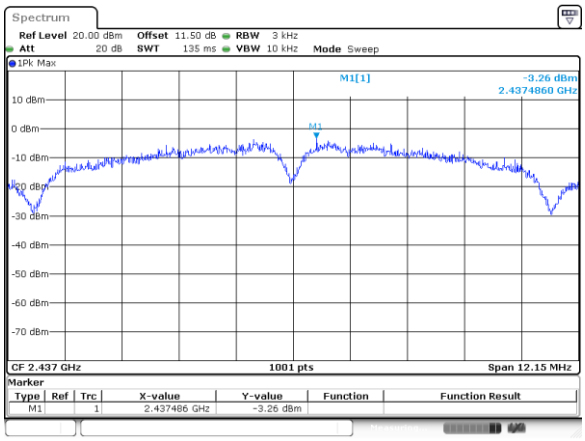
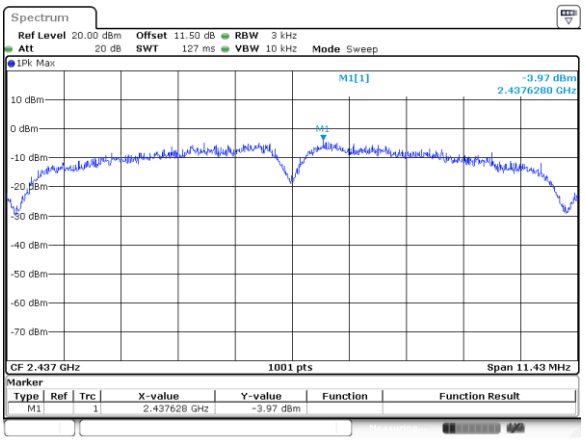
   Method (2): Measure and add 10 log (N) dB, where N is the number of outputs. (N=2)

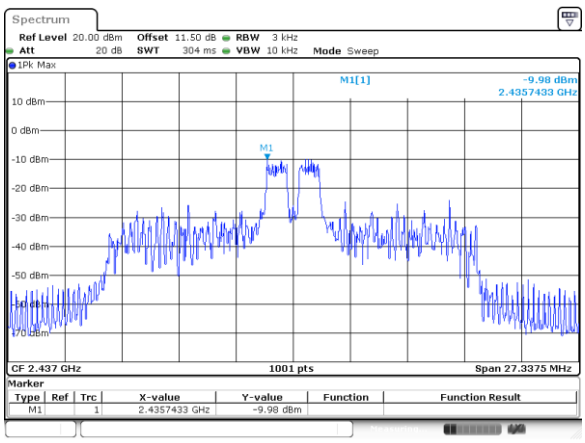
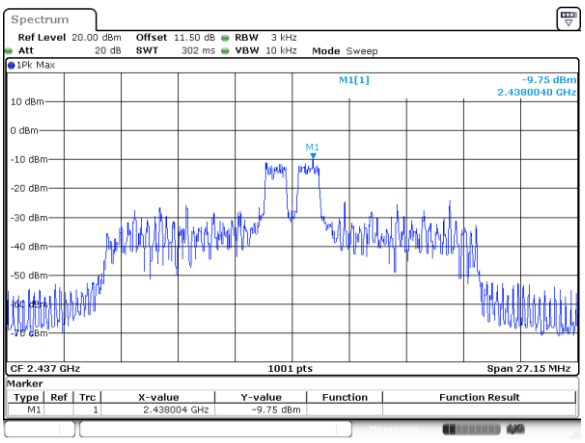
3.3.4 Test Setup



3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.

Worst Case Power Density (dBm/3kHz)	
11b CH06 2437MHz for MIMO Ant. 0	**11b CH06 2437MHz for MIMO Ant. 1**
	

Partial RU	
CH06 2437MHz 26RU4 for MIMO Ant. 0	**CH06 2437MHz 26RU4 for MIMO Ant. 1**
	

3.4 Conducted Band Edges and Spurious Emission Measurement

3.4.1 Limit of Conducted Band Edges and Spurious Emission Measurement

In any 100 kHz bandwidth outside of the authorized frequency band, the emissions which fall in the non-restricted bands shall be attenuated at least 20 dB / 30dB relative to the maximum PSD level in 100 kHz by RF conducted measurement.

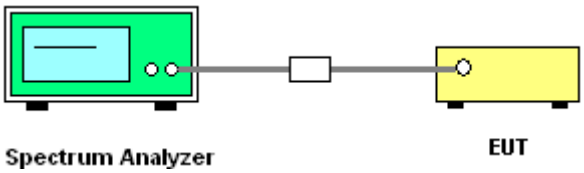
3.4.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.4.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 11.11
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB per 15.247(d).
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

3.4.4 Test Setup



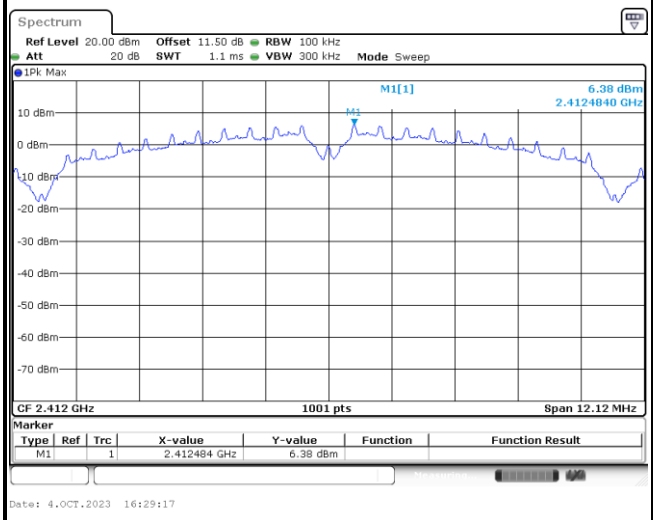
3.4.5 Test Result of Conducted Band Edges and Spurious Emission

Test Engineer :	Liu Qiu Qiu	Temperature :	24~26℃
		Relative Humidity :	50~53%

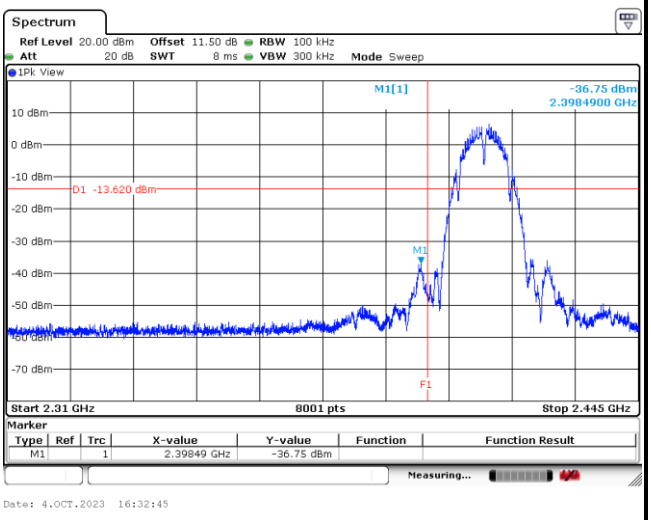
Number of TX = 2, Ant. 0 (Measured)

Test Mode :	802.11b	Test Channel :	01

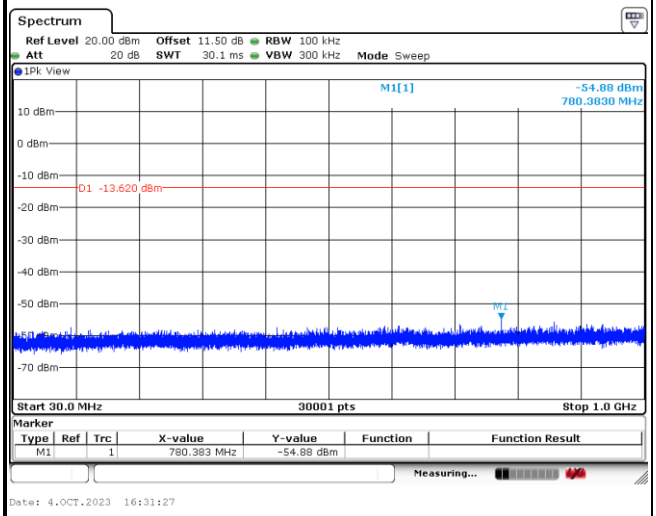
100kHz PSD reference Level



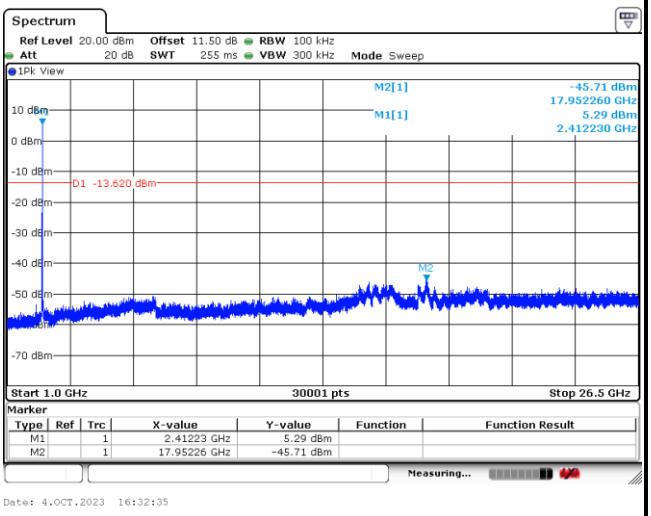
Channel Plot



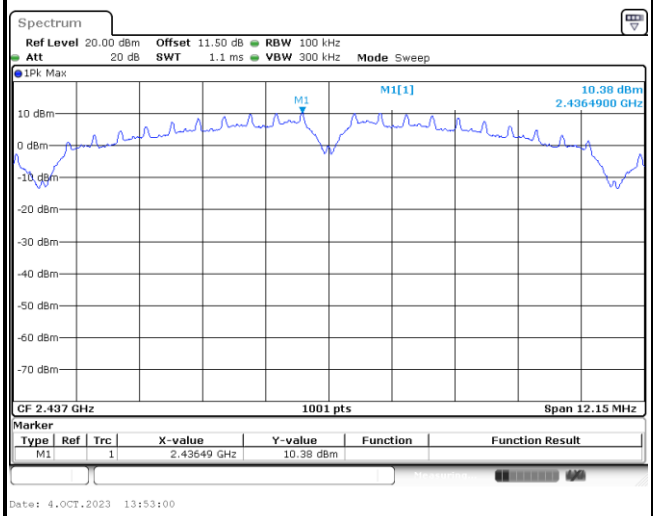
Spurious Emission 30MHz~1GHz

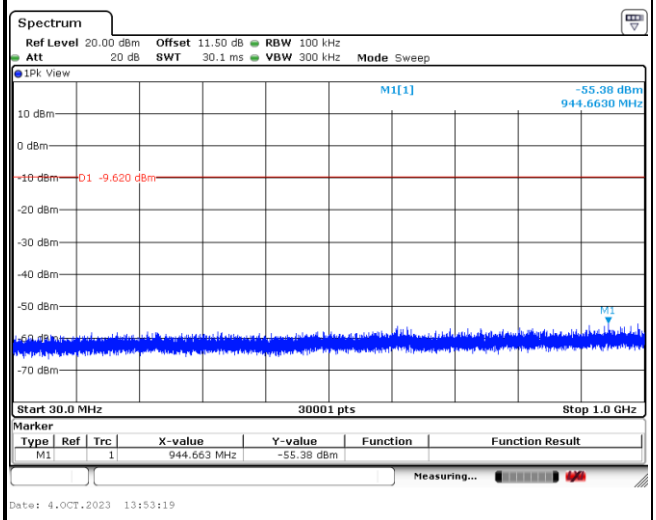
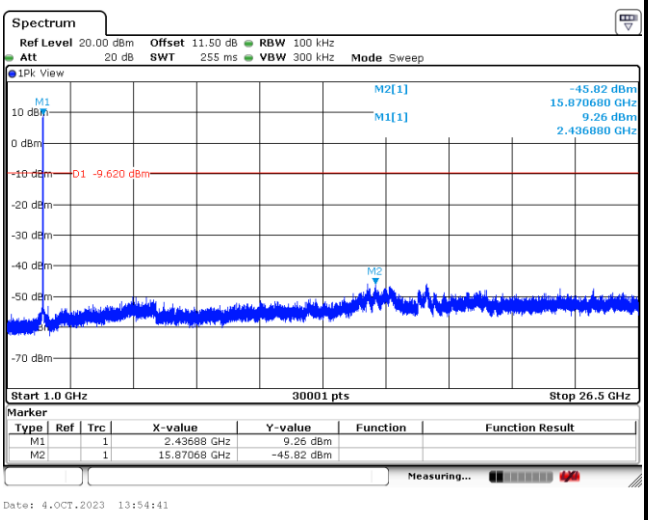


Spurious Emission 1GHz~26.5GHz



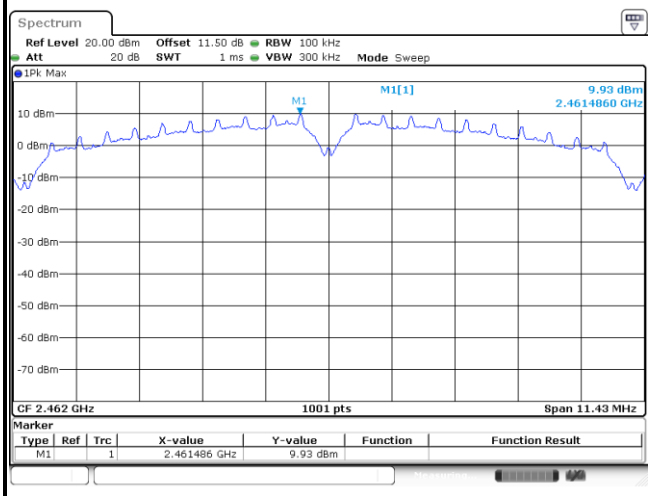
Test Mode :	802.11b	Test Channel :	06

100kHz PSD reference Level	Channel Plot
	-

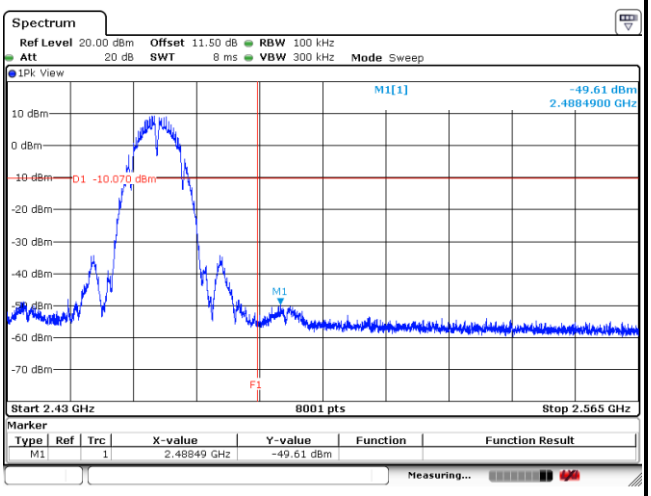
Spurious Emission 30MHz~1GHz	Spurious Emission 1GHz~26.5GHz
	

Test Mode :	802.11b	Test Channel :	11

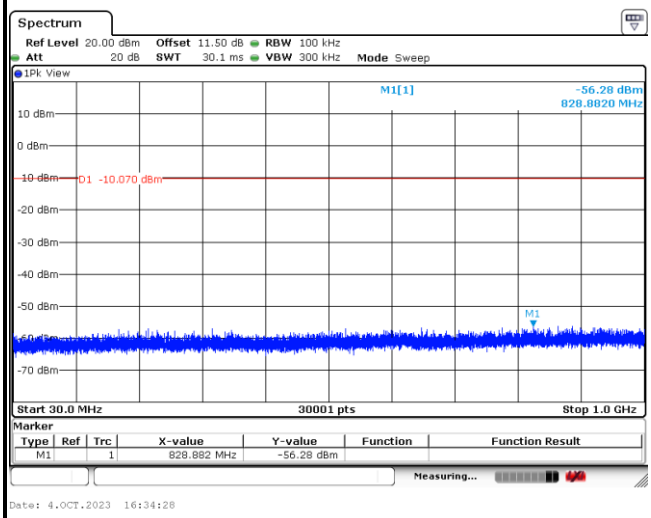
100kHz PSD reference Level



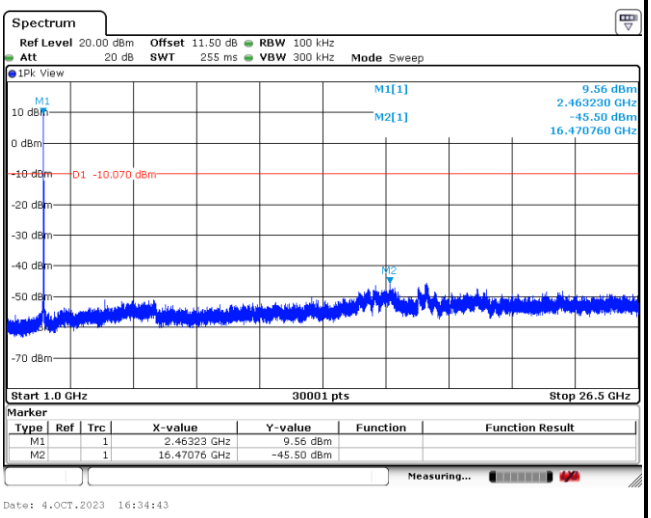
Channel Plot



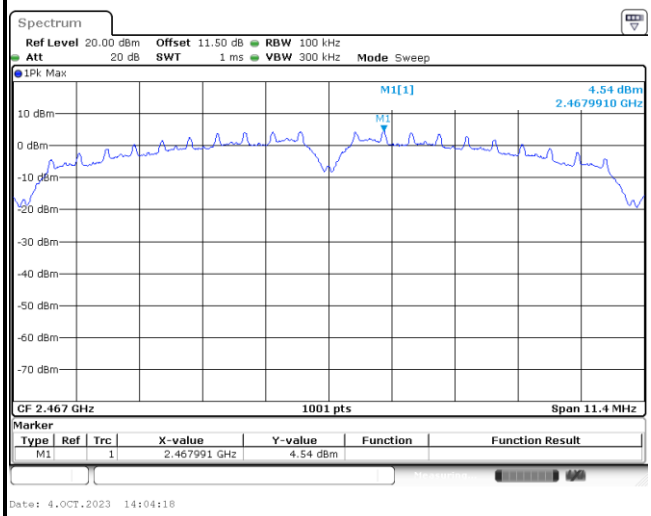
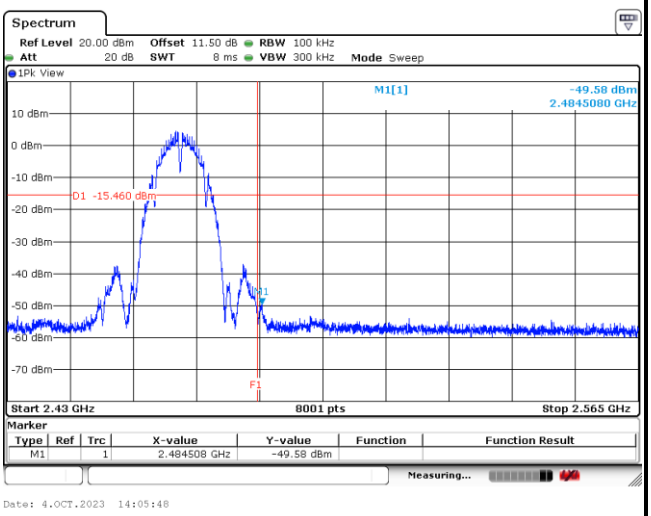
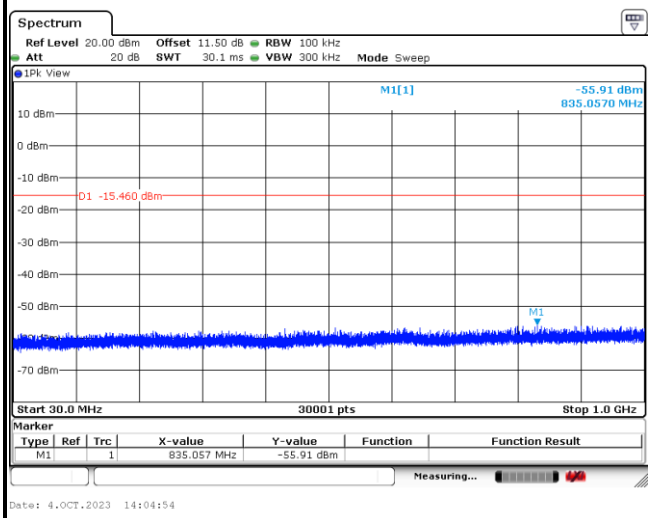
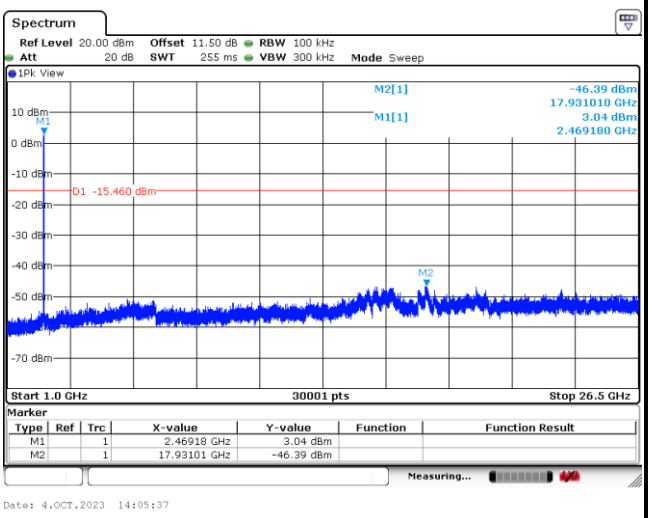
Spurious Emission 30MHz~1GHz



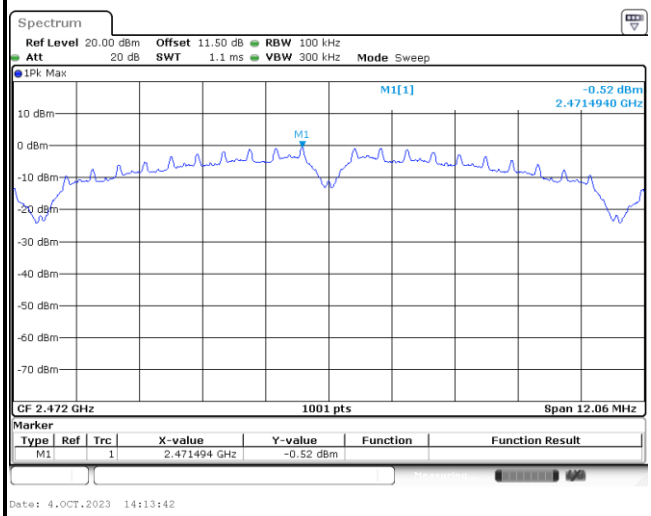
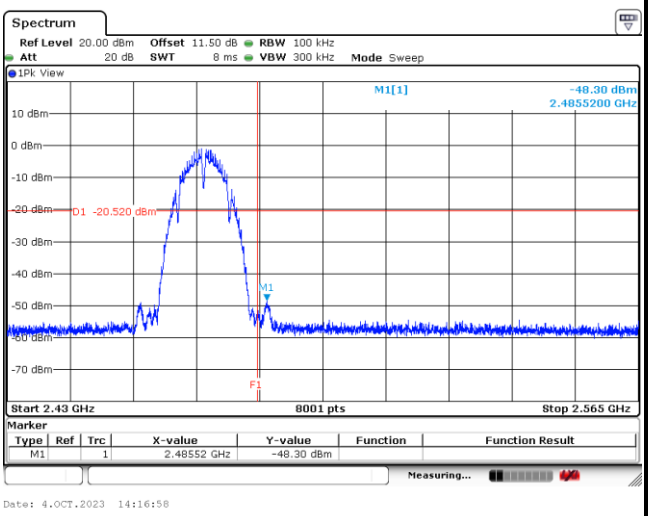
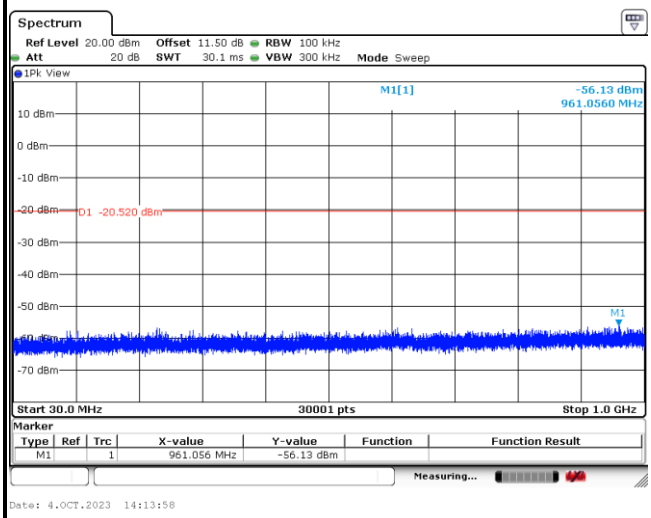
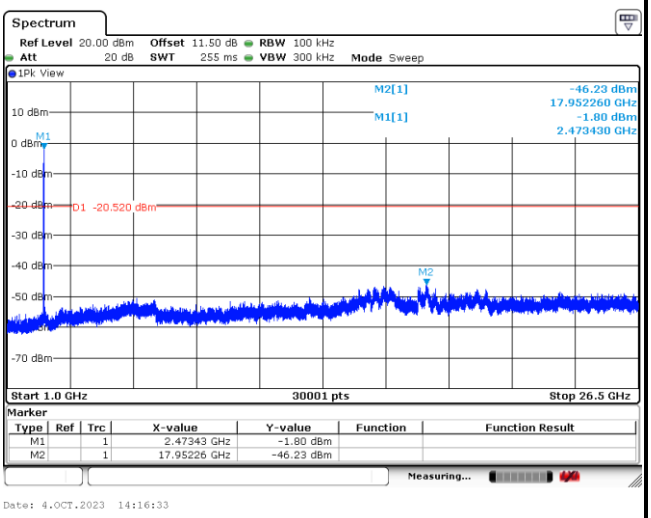
Spurious Emission 1GHz~26.5GHz



Test Mode :	802.11b	Test Channel :	12

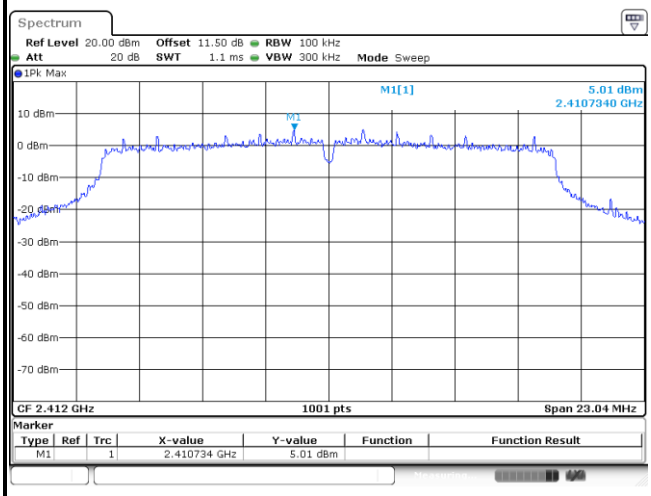
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~1GHz	**Spurious Emission 1GHz~26.5GHz**
	

Test Mode :	802.11b	Test Channel :	13

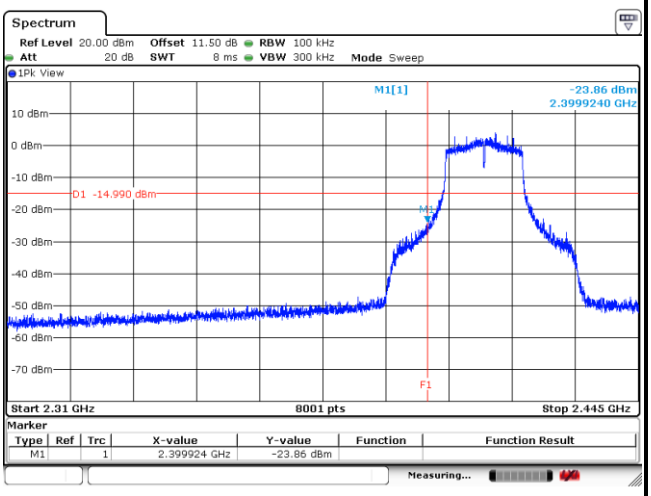
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~1GHz	**Spurious Emission 1GHz~26.5GHz**
	

Test Mode :	802.11g	Test Channel :	01

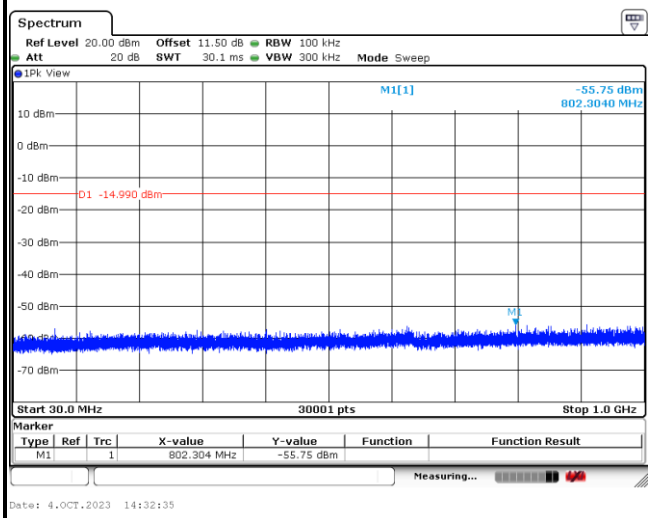
100kHz PSD reference Level



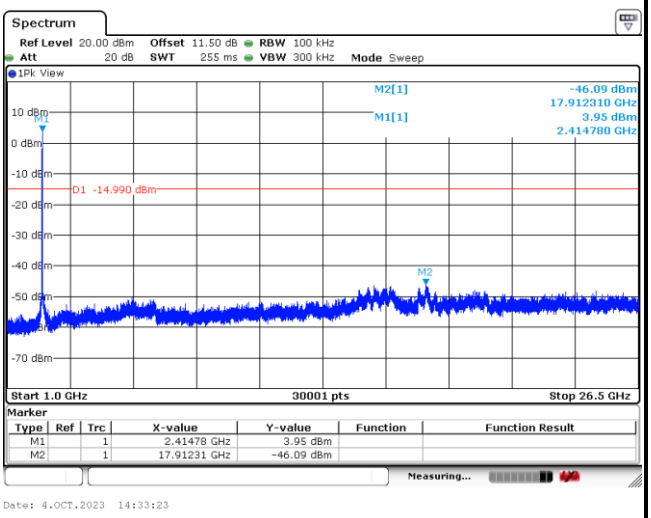
Channel Plot



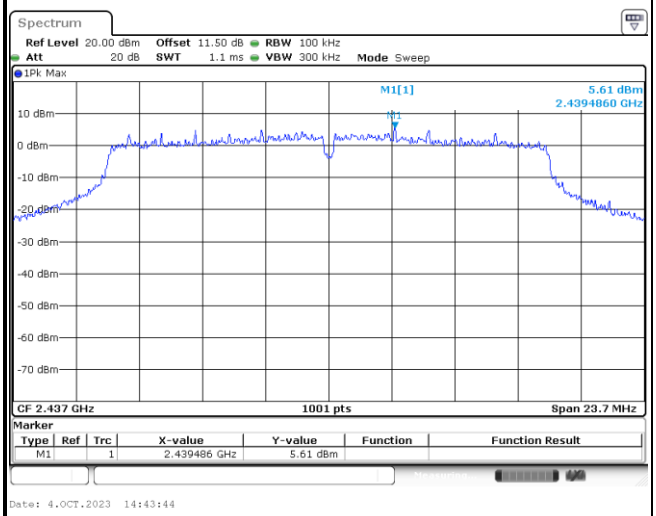
Spurious Emission 30MHz~1GHz

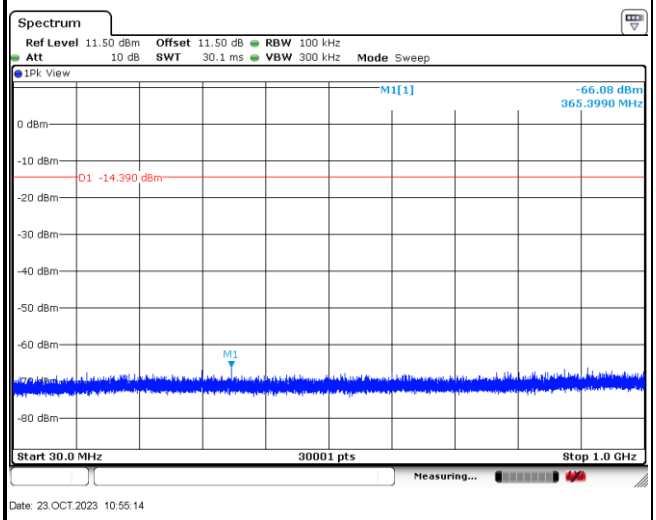
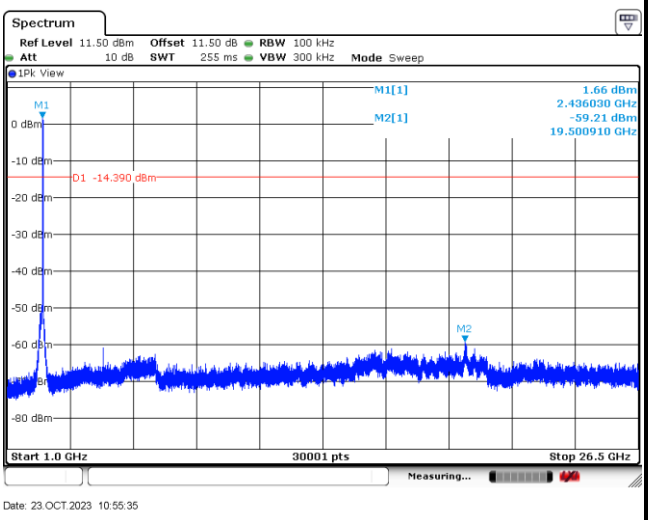


Spurious Emission 1GHz~26.5GHz



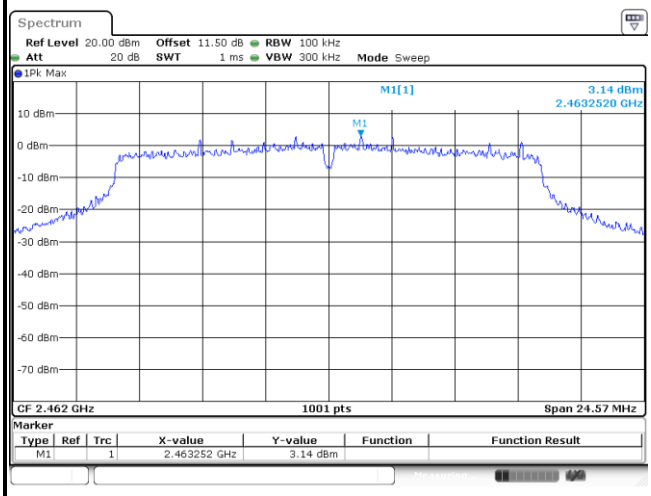
Test Mode :	802.11g	Test Channel :	06

100kHz PSD reference Level	Channel Plot
	-

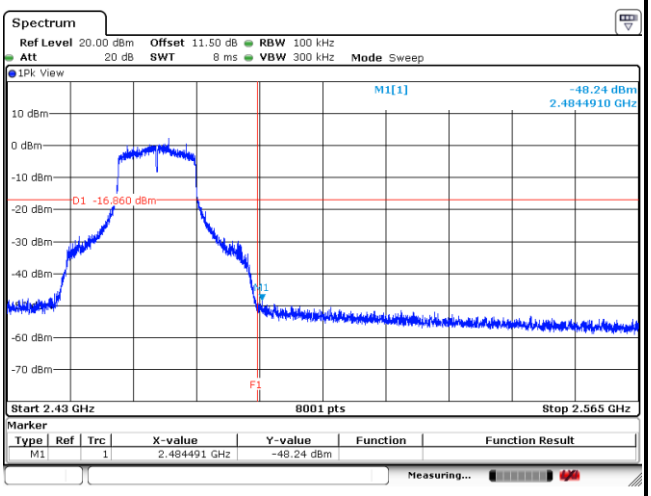
Spurious Emission 30MHz~1GHz	Spurious Emission 1GHz~26.5GHz
	

Test Mode :	802.11g	Test Channel :	11

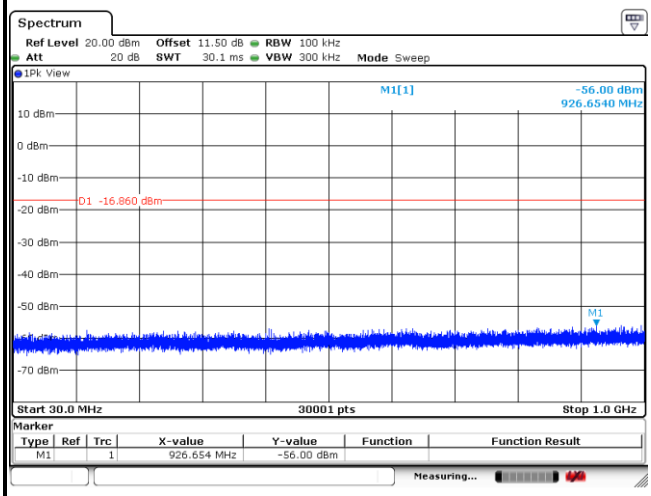
100kHz PSD reference Level



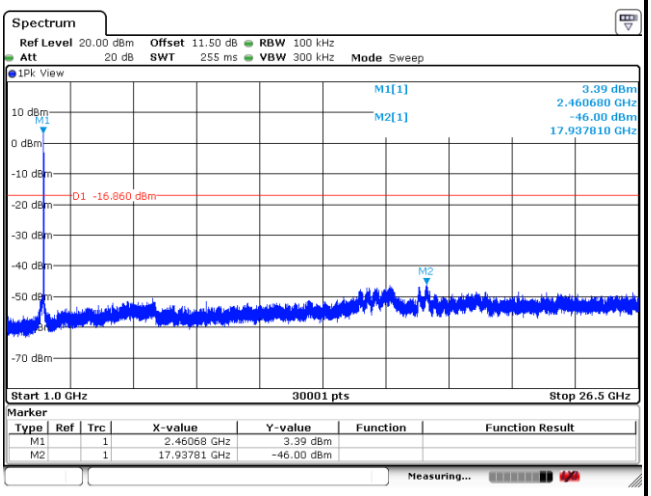
Channel Plot



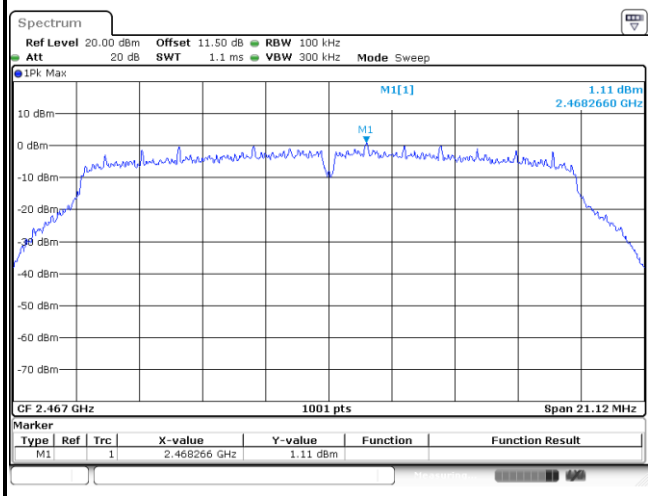
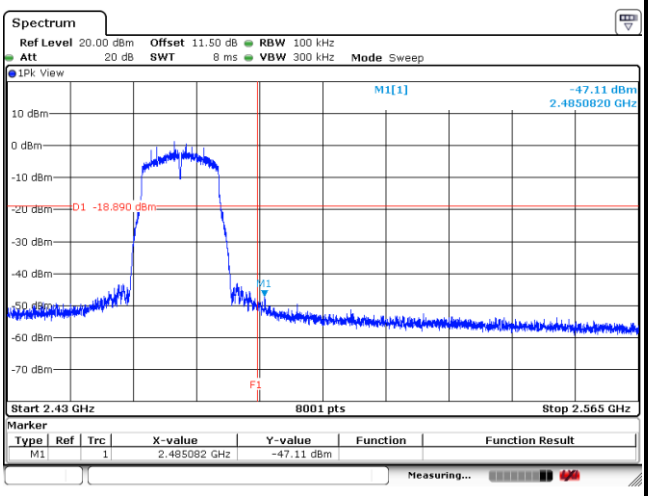
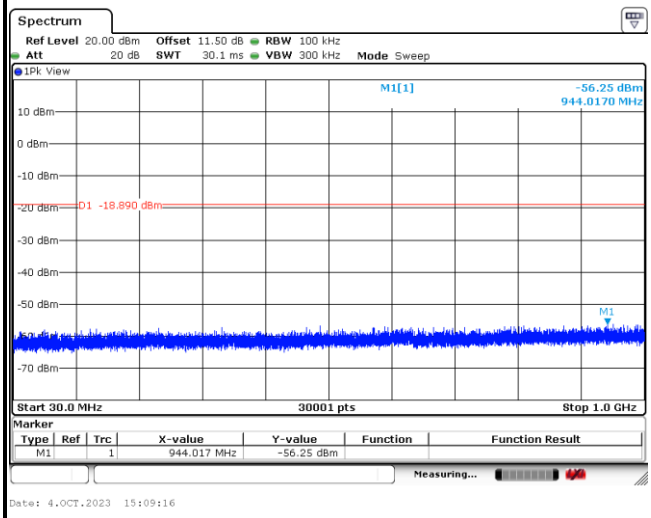
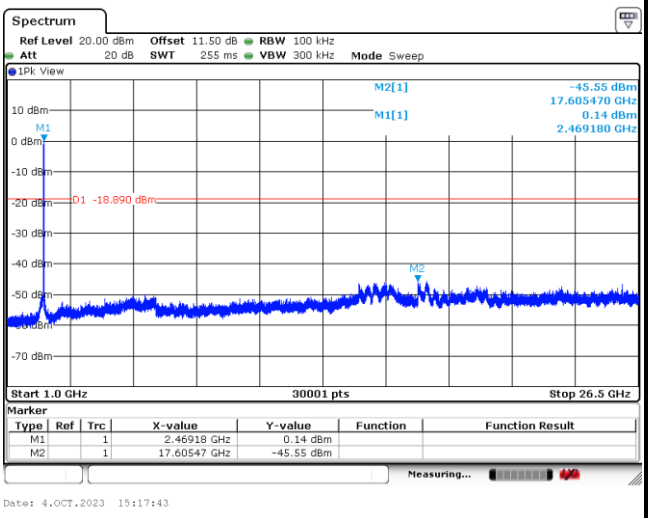
Spurious Emission 30MHz~1GHz



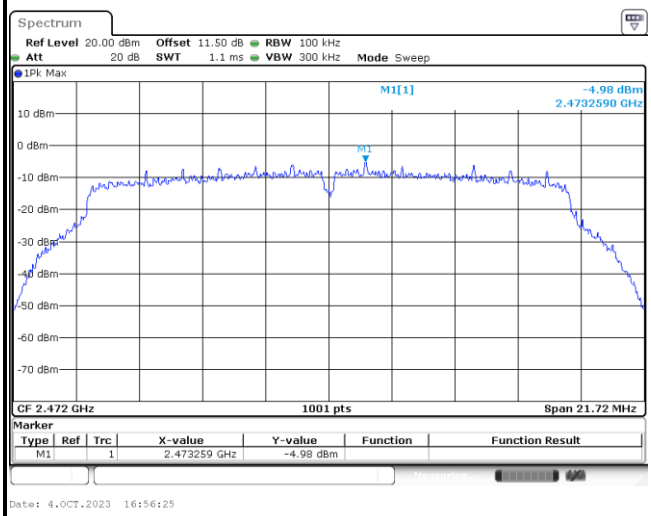
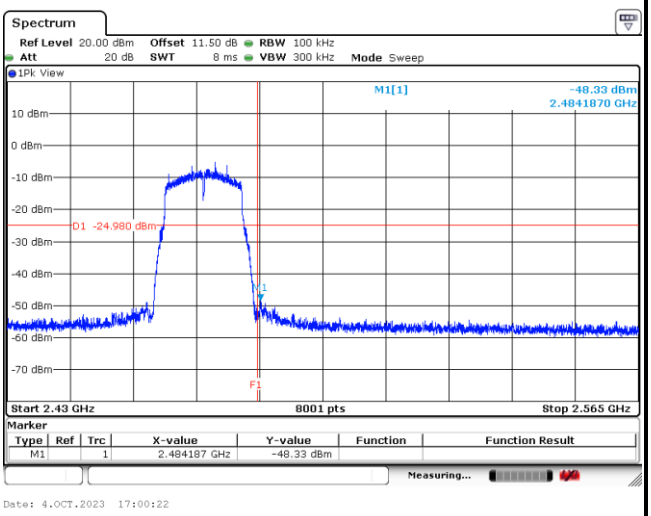
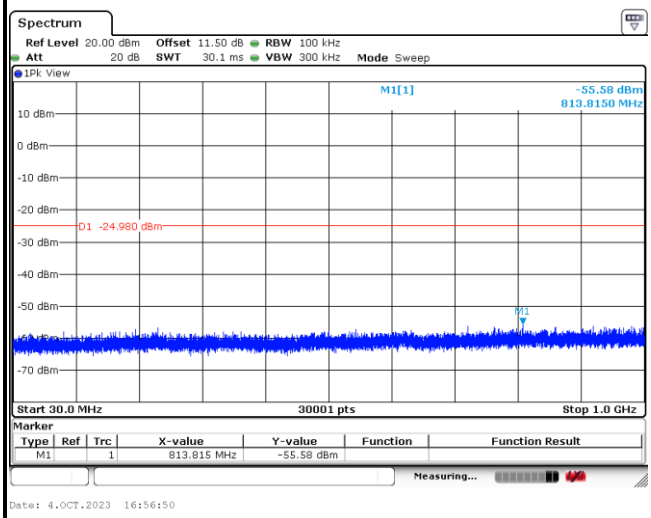
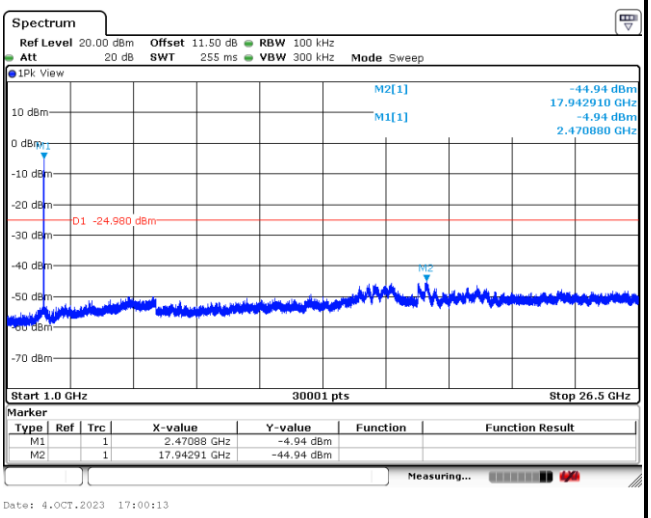
Spurious Emission 1GHz~26.5GHz



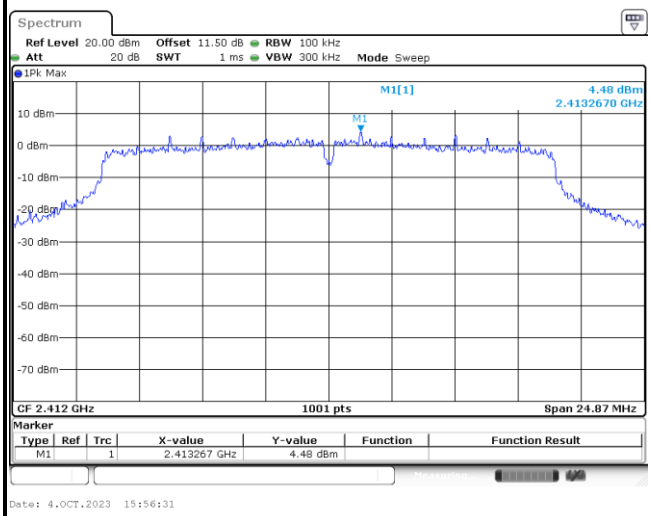
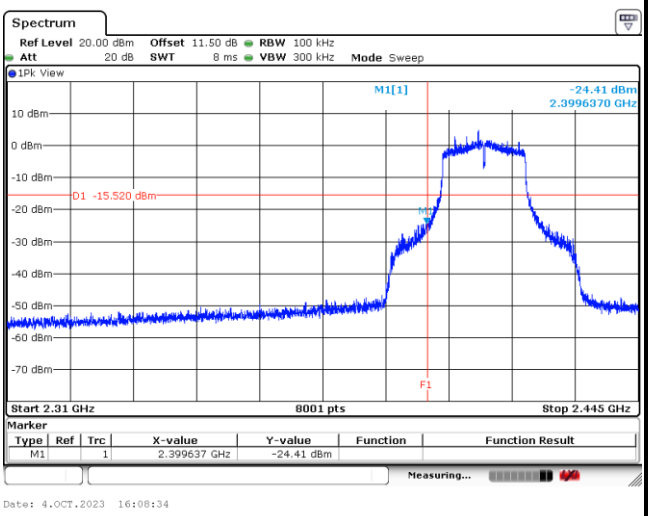
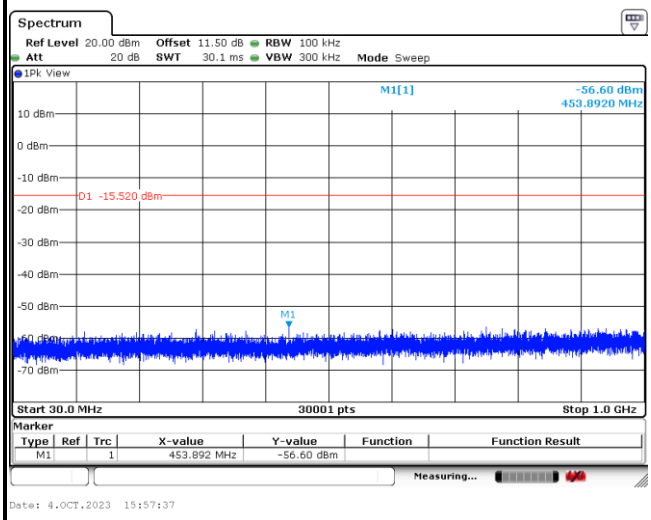
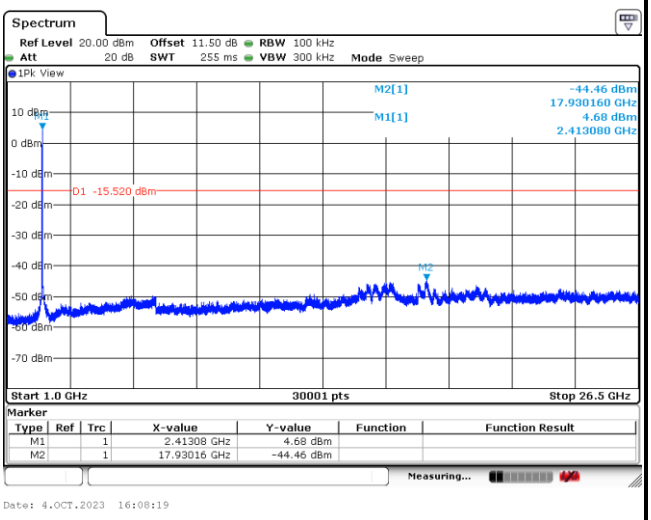
Test Mode :	802.11g	Test Channel :	12

100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~1GHz	**Spurious Emission 1GHz~26.5GHz**
	

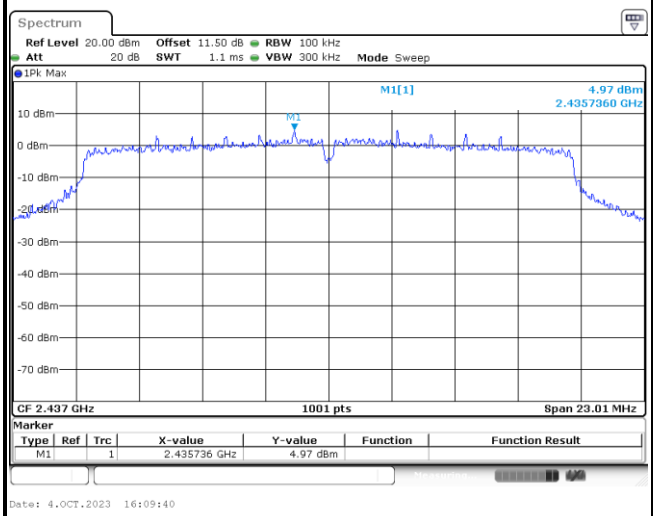
Test Mode :	802.11g	Test Channel :	13

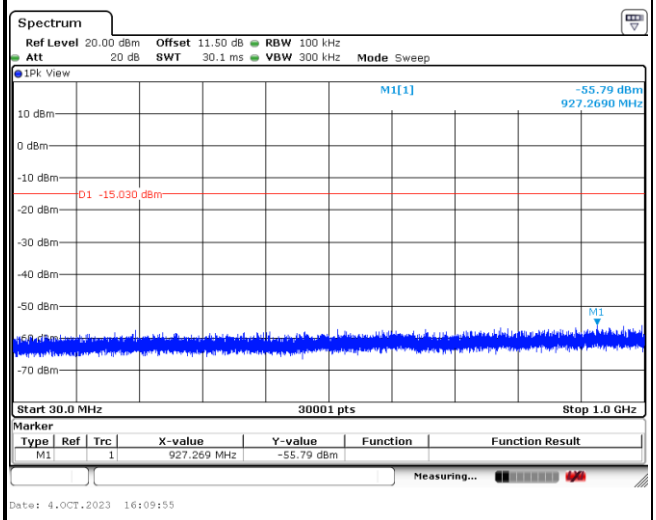
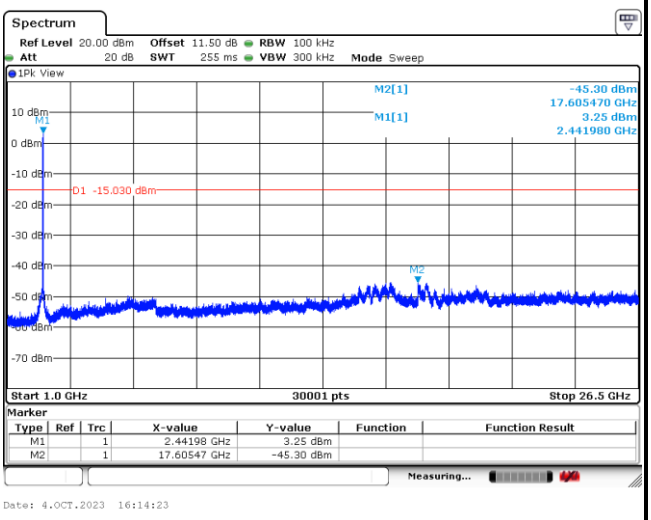
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~1GHz	**Spurious Emission 1GHz~26.5GHz**
	

Test Mode :	802.11n HT20	Test Channel :	01

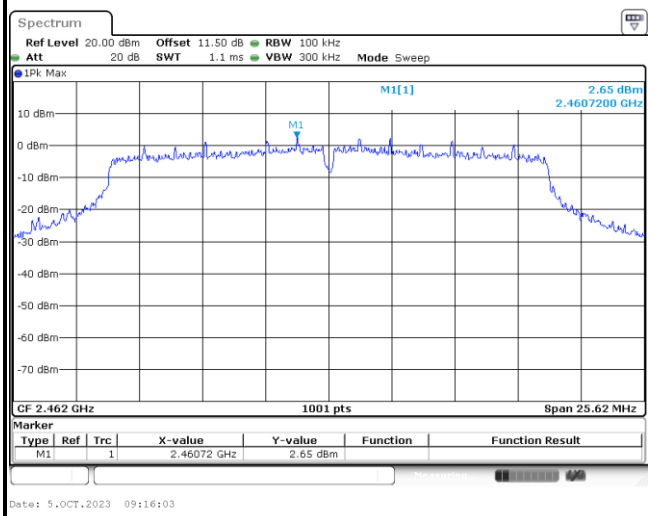
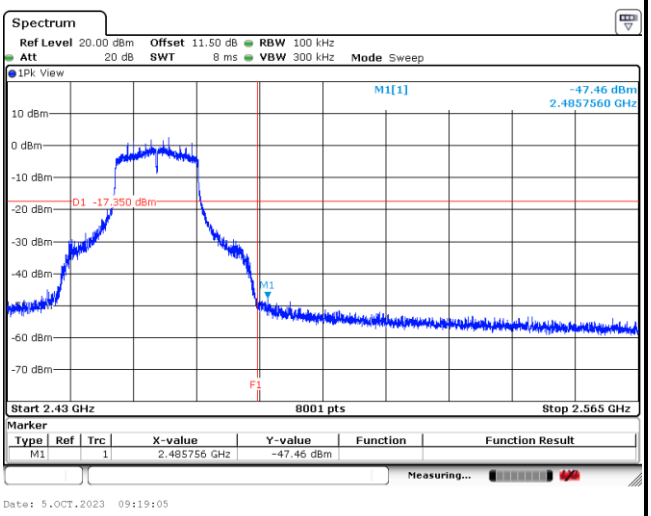
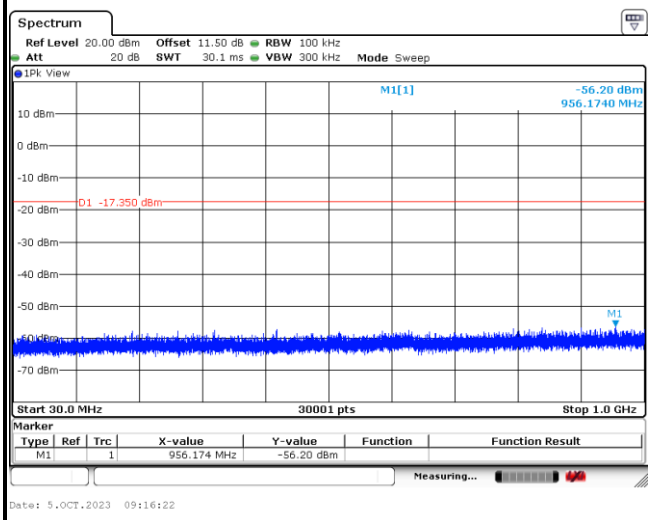
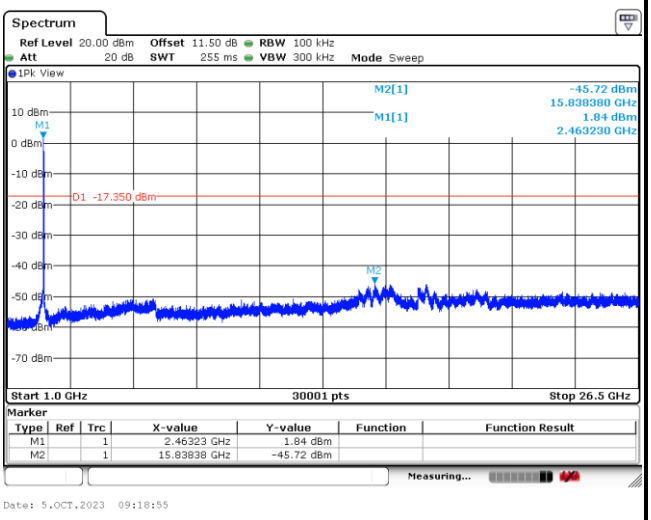
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~1GHz	**Spurious Emission 1GHz~26.5GHz**
	

Test Mode :	802.11n HT20	Test Channel :	06

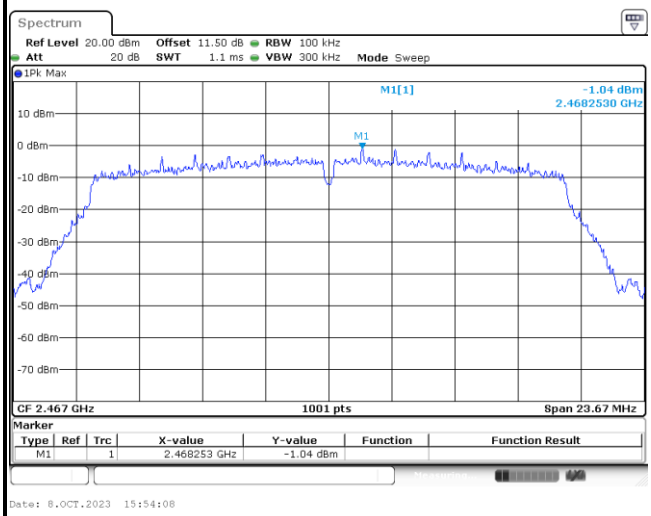
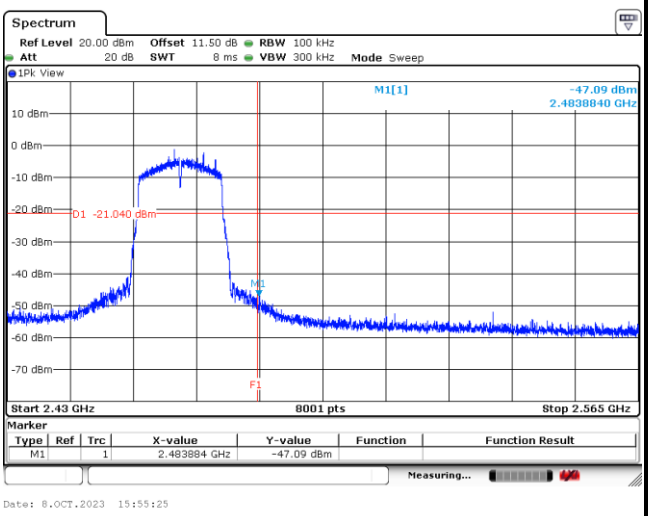
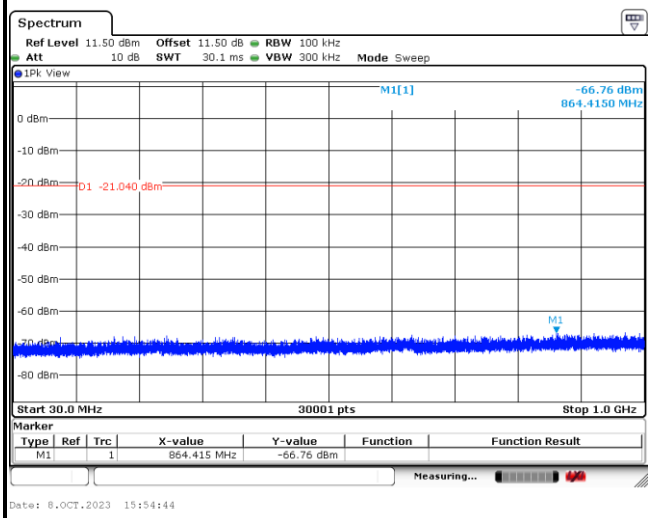
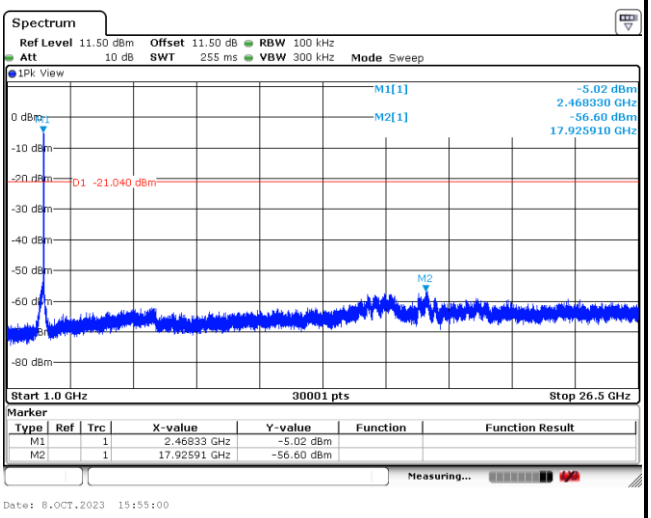
100kHz PSD reference Level	Channel Plot
	-

Spurious Emission 30MHz~1GHz	Spurious Emission 1GHz~26.5GHz
	

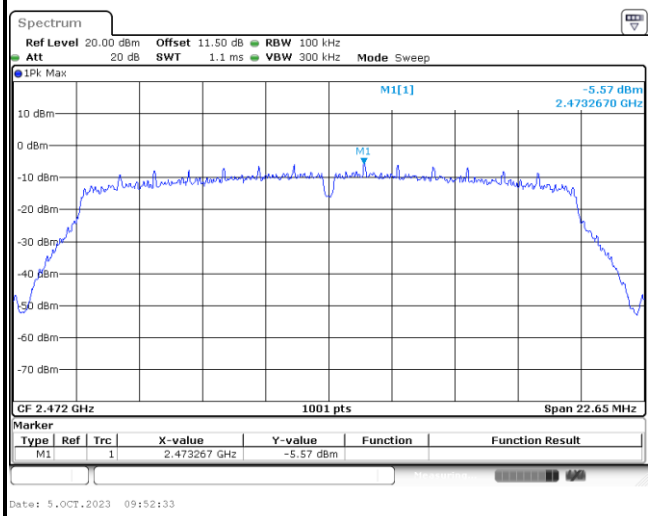
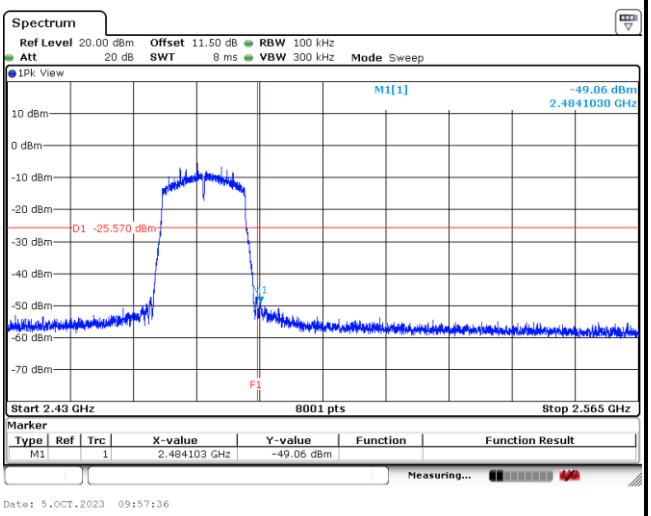
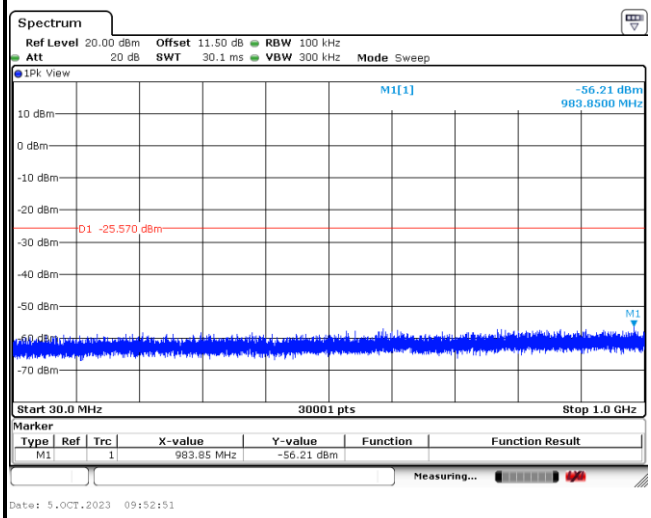
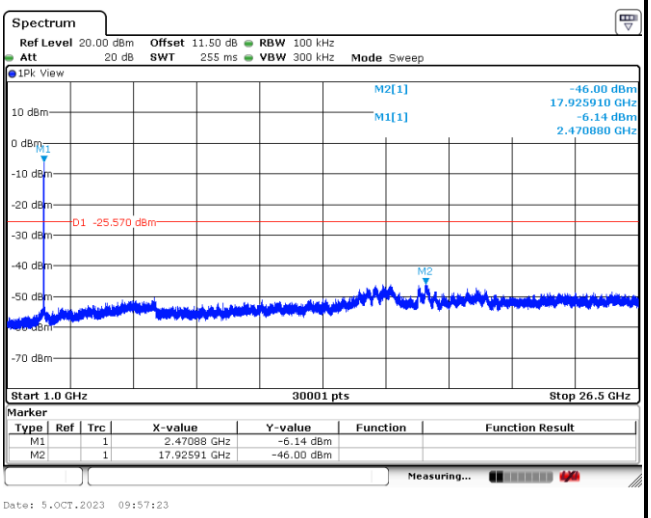
Test Mode :	802.11n HT20	Test Channel :	11

100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~1GHz	**Spurious Emission 1GHz~26.5GHz**
	

Test Mode :	802.11n HT20	Test Channel :	12

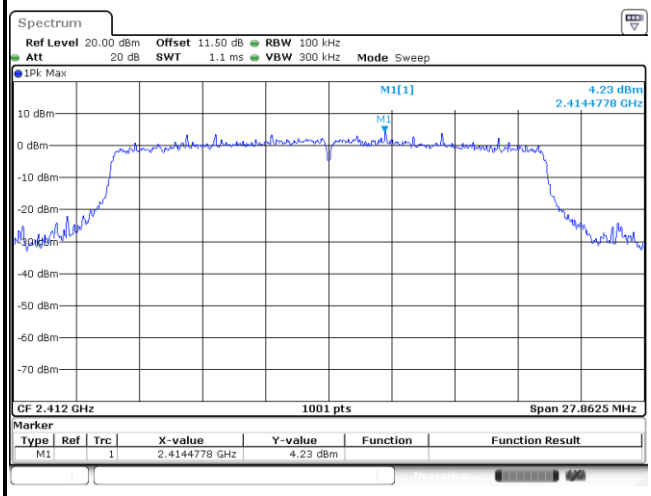
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~1GHz	**Spurious Emission 1GHz~26.5GHz**
	

Test Mode :	802.11n HT20	Test Channel :	13

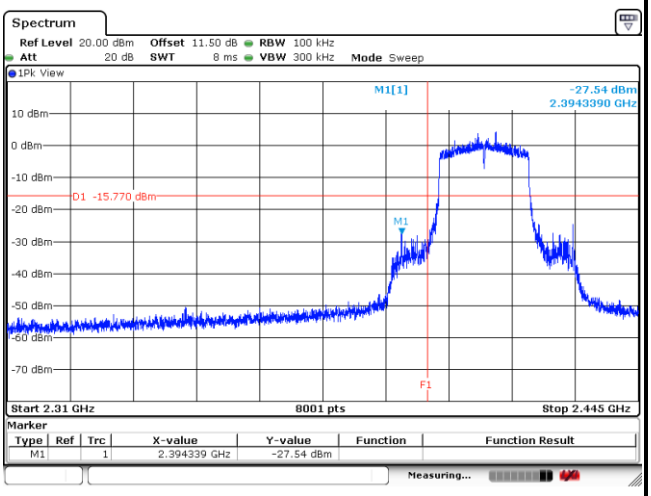
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~1GHz	**Spurious Emission 1GHz~26.5GHz**
	

Test Mode :	802.11ax HE20	Test Channel :	01

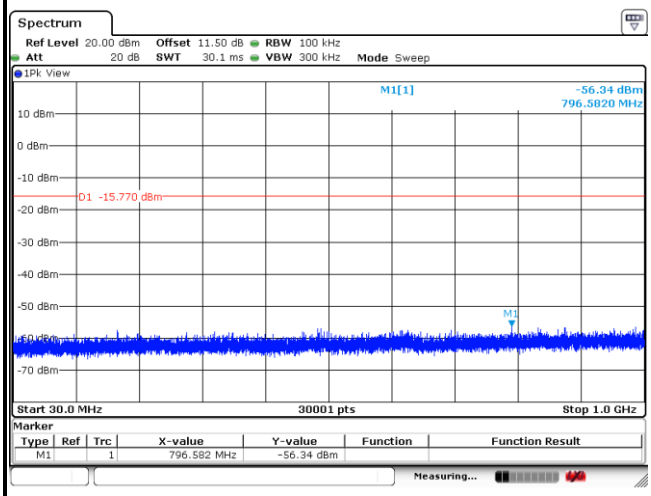
100kHz PSD reference Level



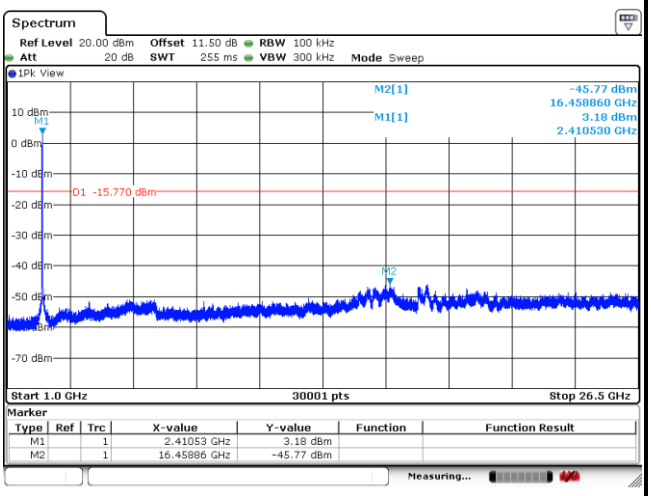
Channel Plot



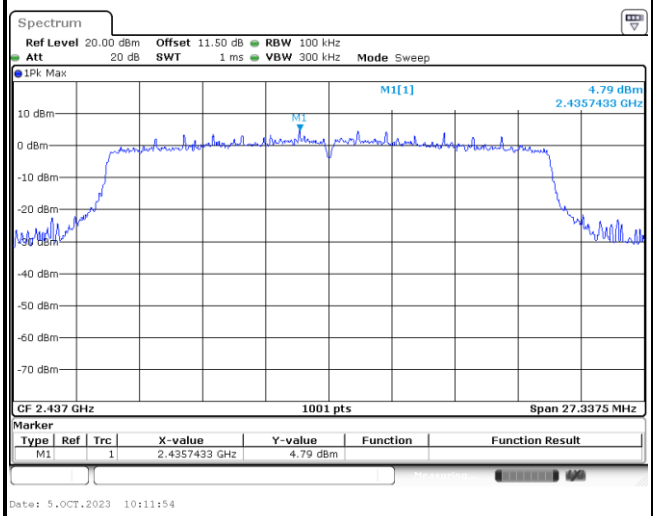
Spurious Emission 30MHz~1GHz

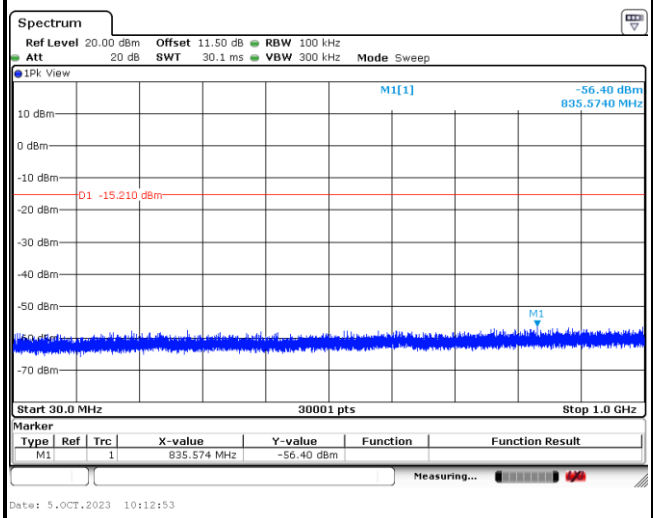
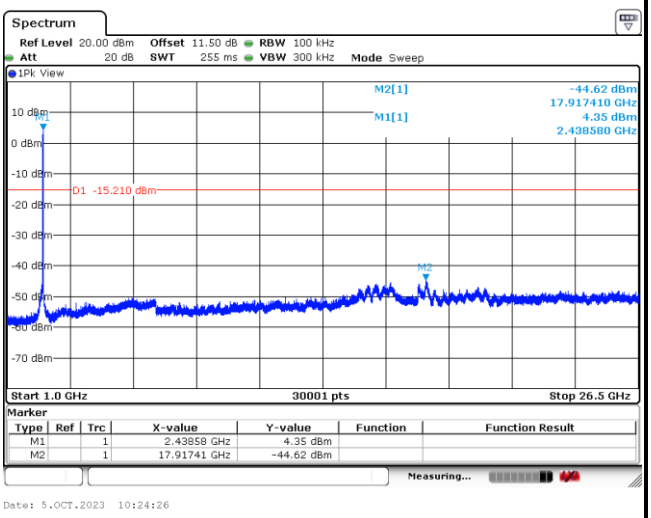


Spurious Emission 1GHz~26.5GHz

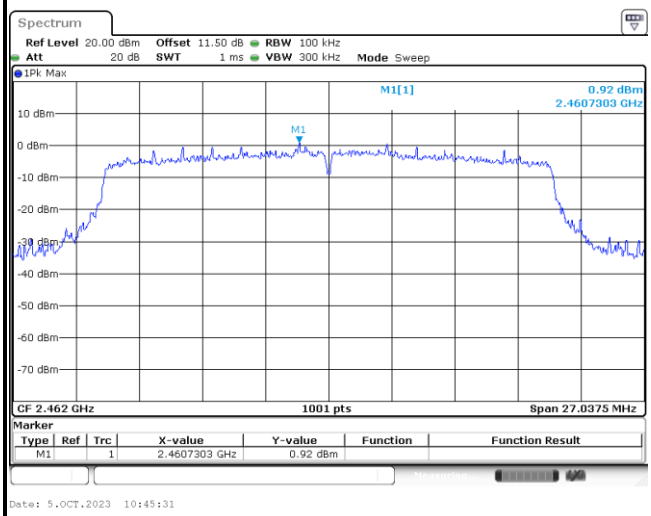
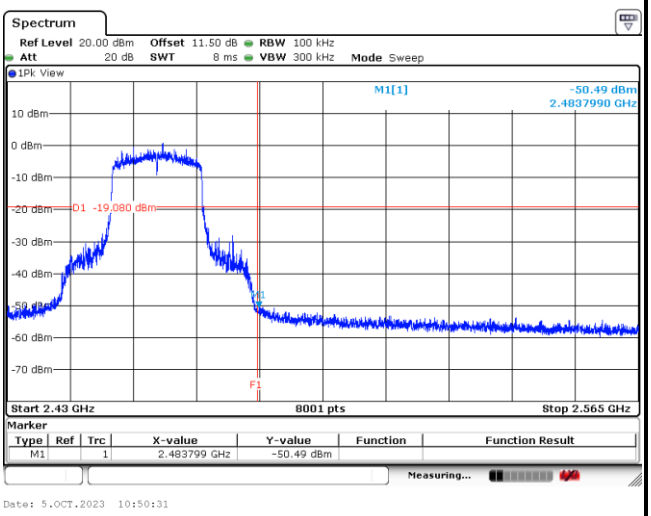
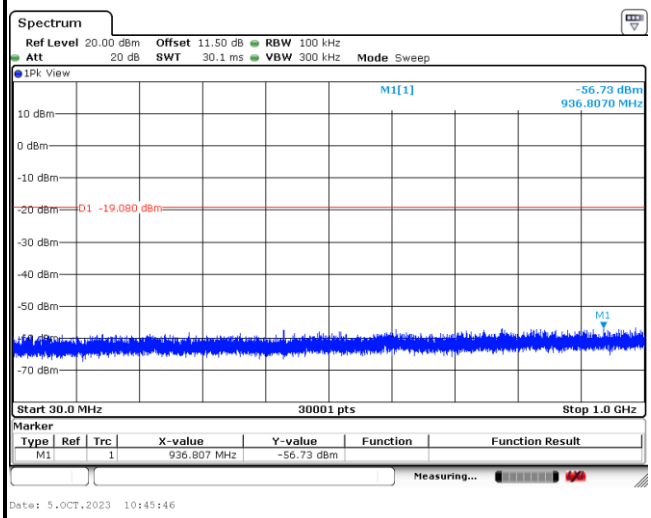
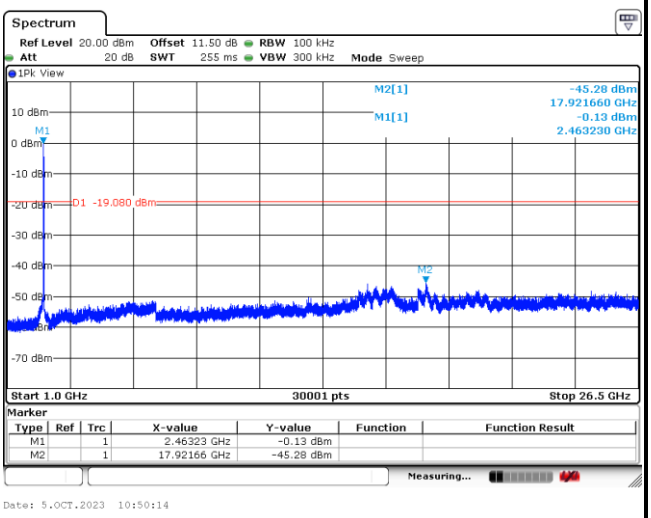


Test Mode :	802.11ax HE20	Test Channel :	06

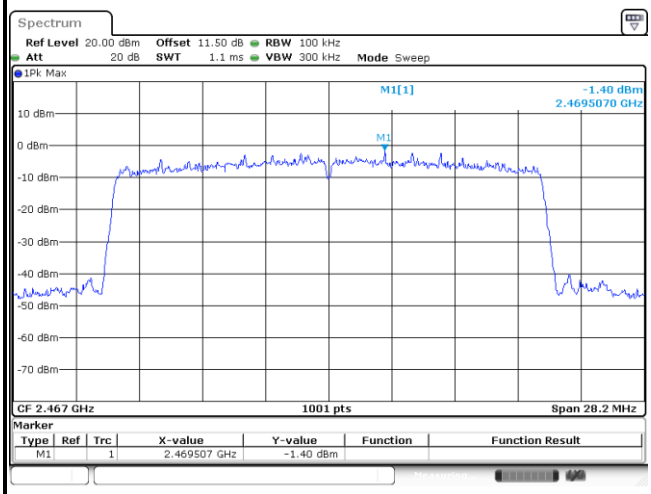
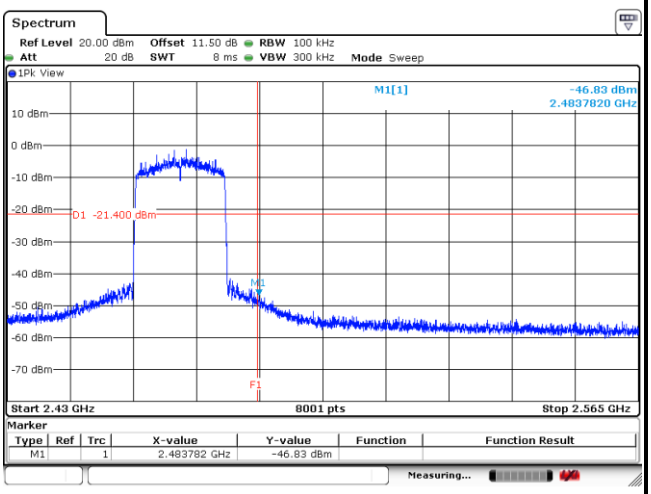
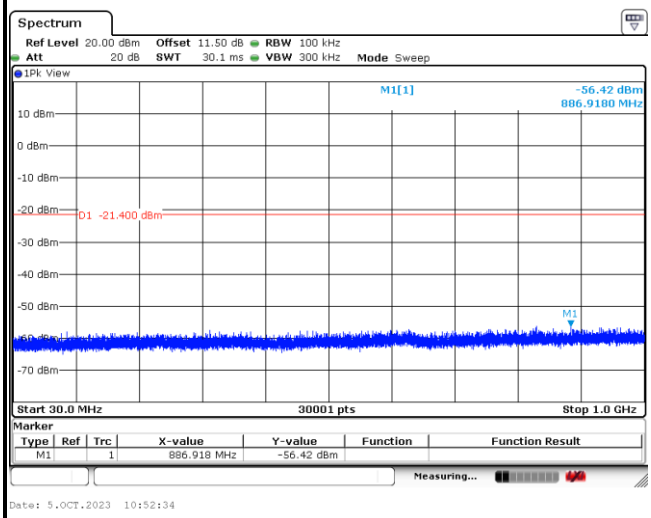
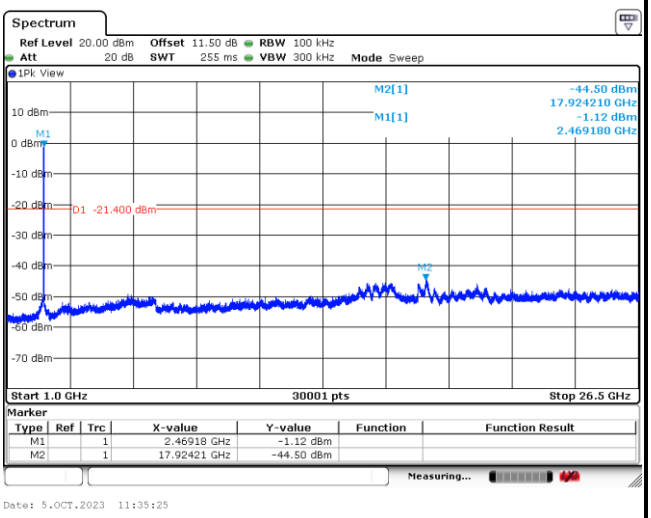
100kHz PSD reference Level	Channel Plot
	-

Spurious Emission 30MHz~1GHz	Spurious Emission 1GHz~26.5GHz
	

Test Mode :	802.11ax HE20	Test Channel :	11

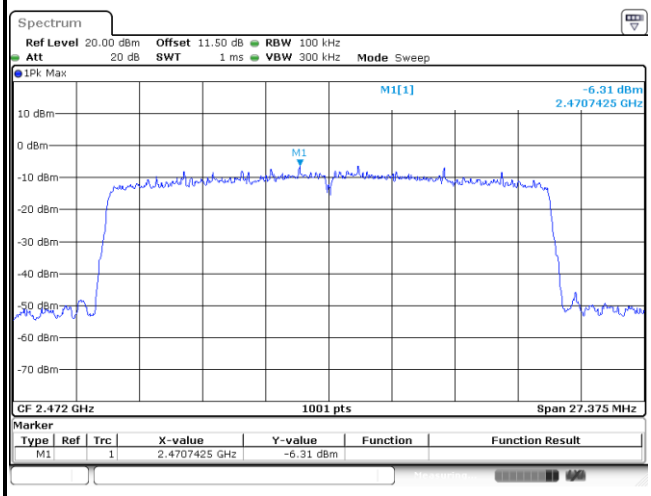
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~1GHz	**Spurious Emission 1GHz~26.5GHz**
	

Test Mode :	802.11ax HE20	Test Channel :	12

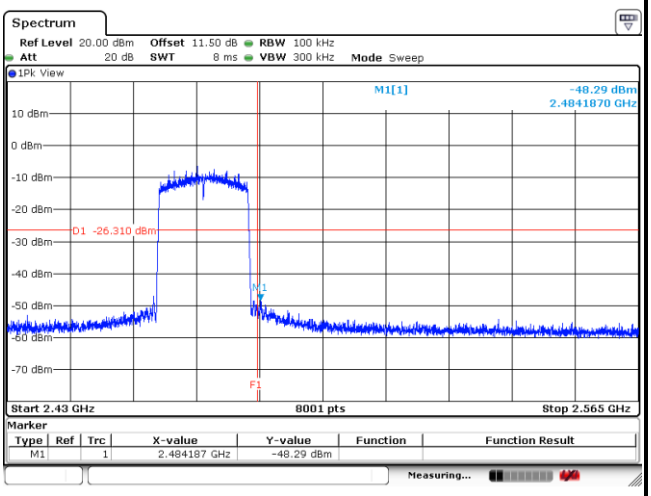
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~1GHz	**Spurious Emission 1GHz~26.5GHz**
	

Test Mode :	802.11ax HE20	Test Channel :	13

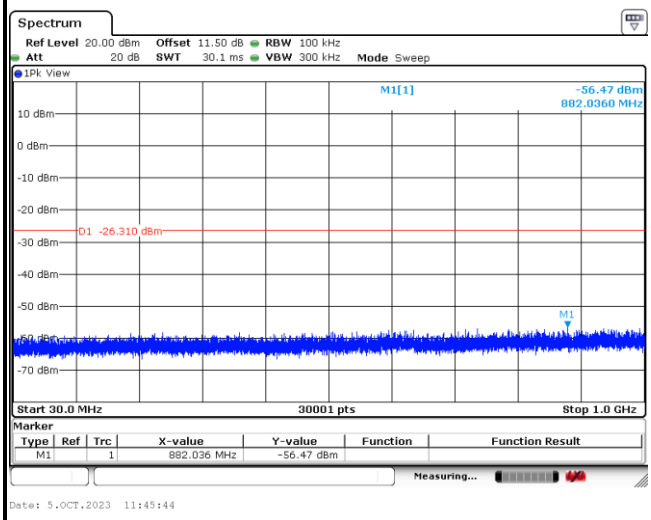
100kHz PSD reference Level



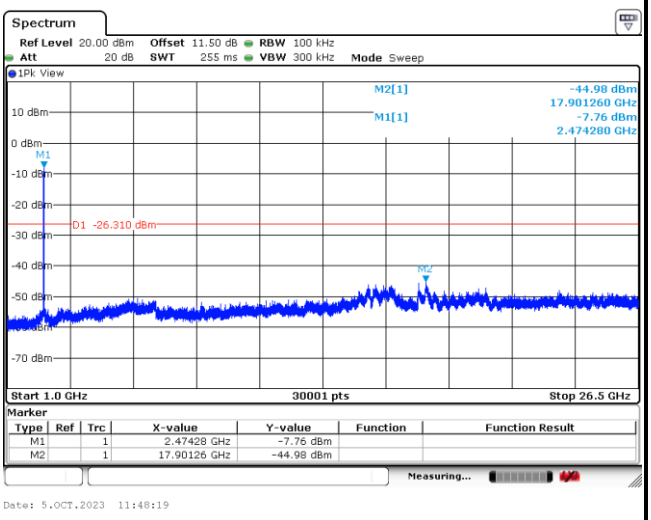
Channel Plot



Spurious Emission 30MHz~1GHz

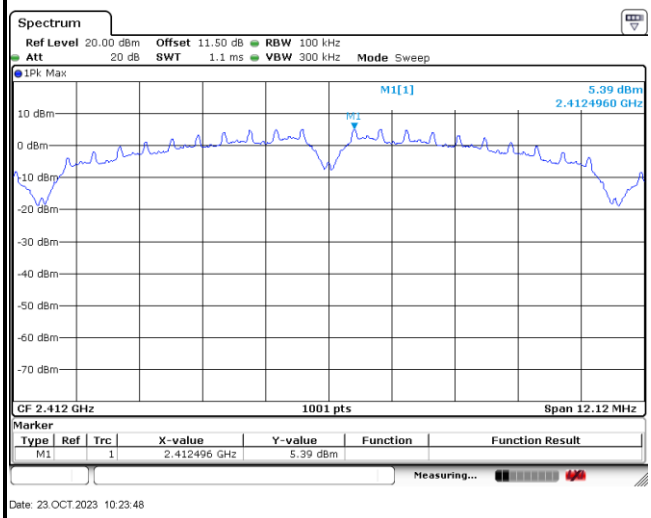
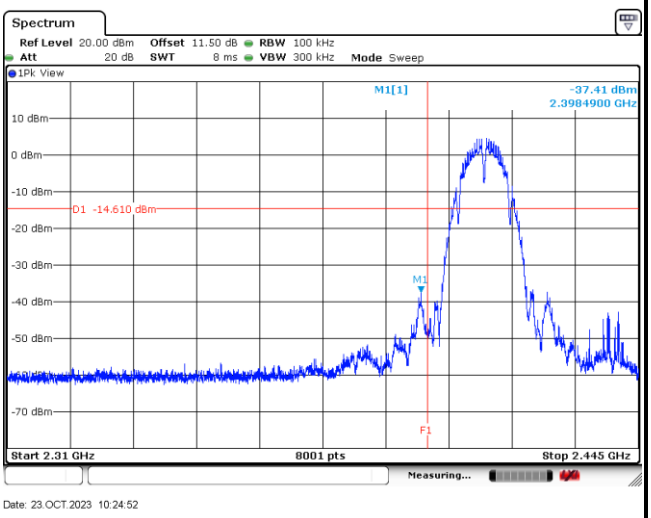
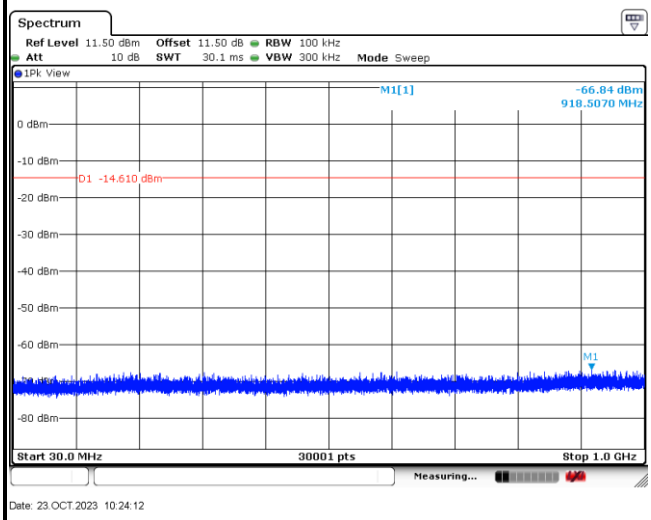
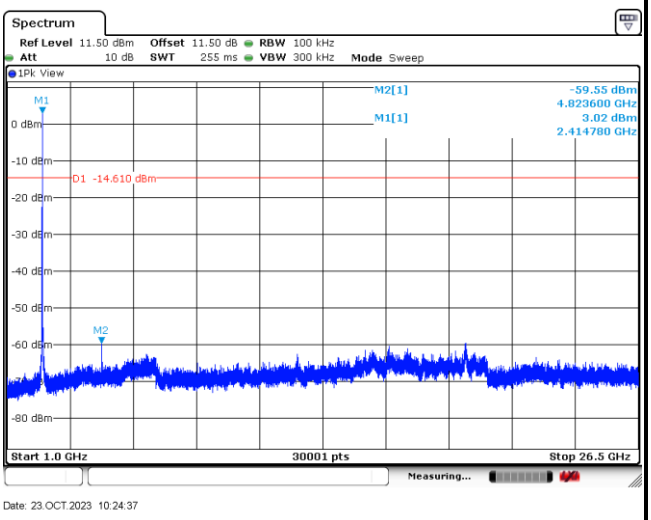


Spurious Emission 1GHz~26.5GHz

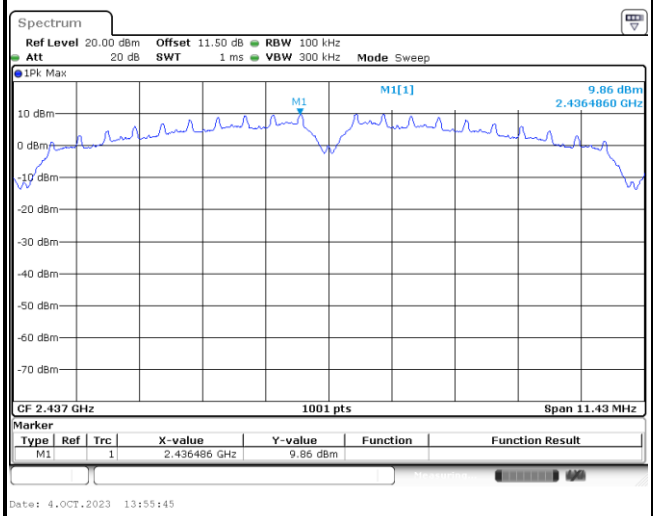


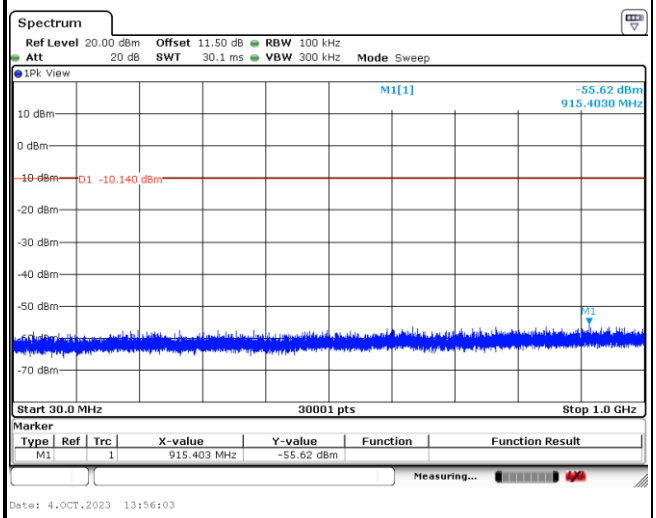
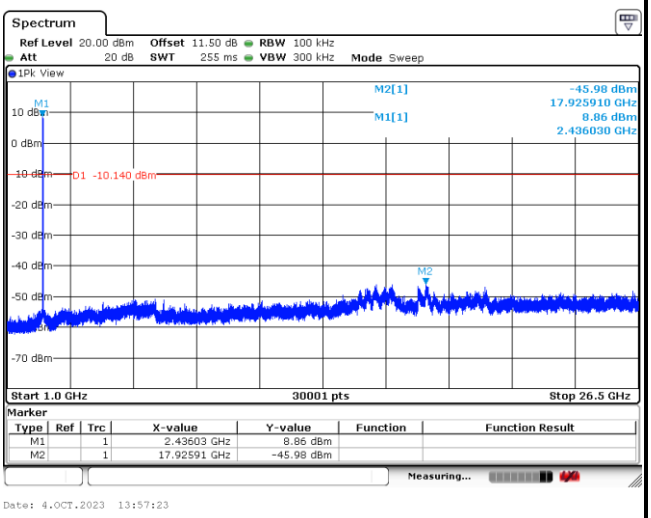
Number of TX = 2, Ant. 1 (Measured)

Test Mode :	802.11b	Test Channel :	01

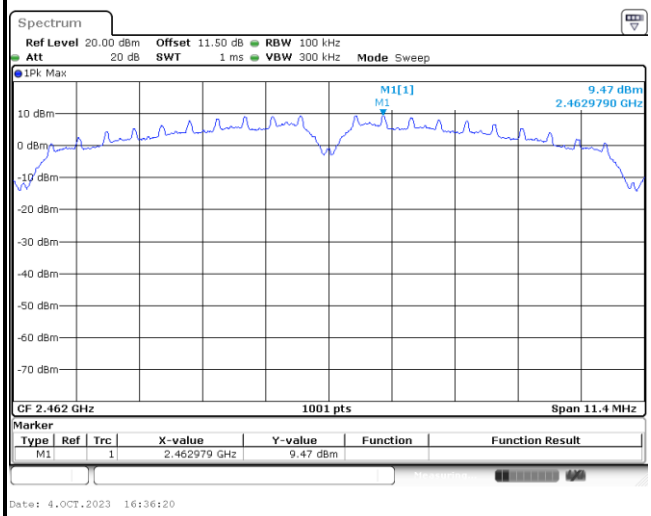
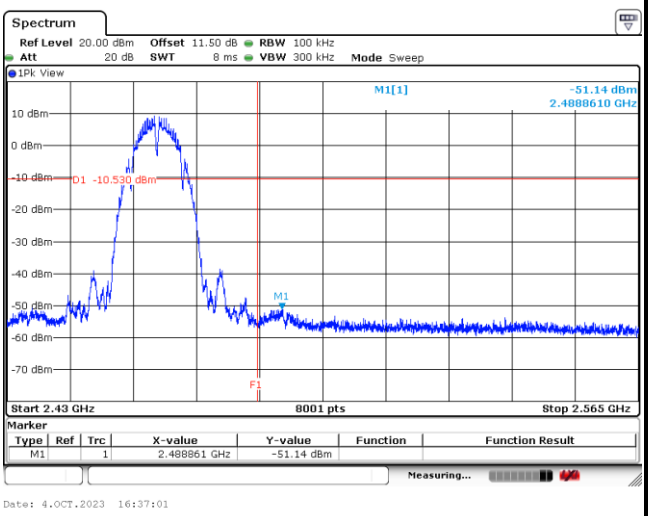
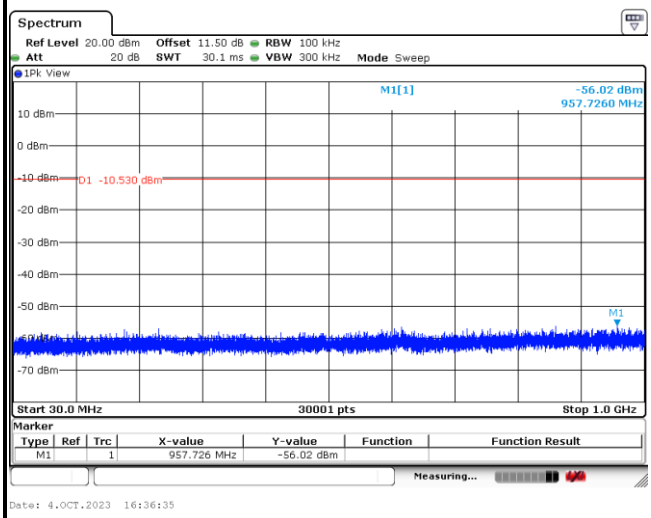
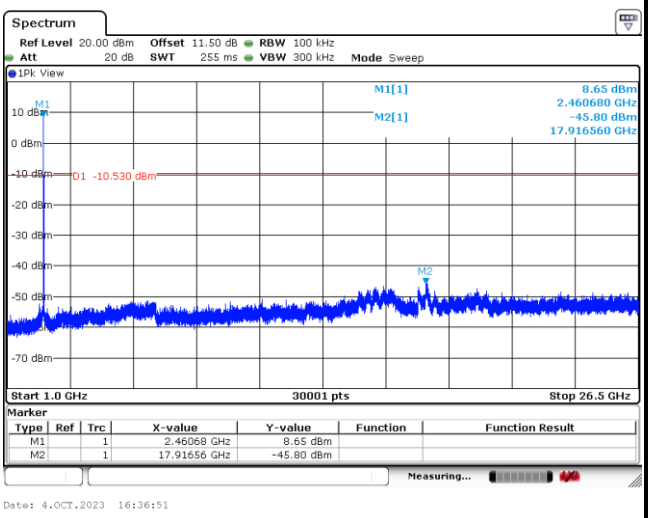
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~1GHz	**Spurious Emission 1GHz~26.5GHz**
	

Test Mode :	802.11b	Test Channel :	06

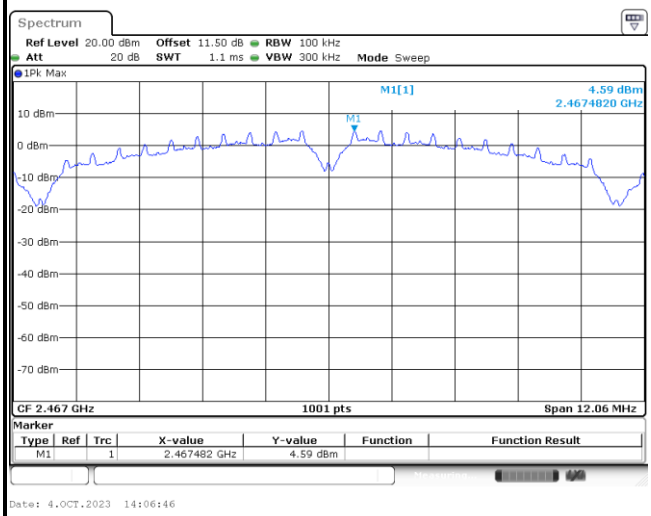
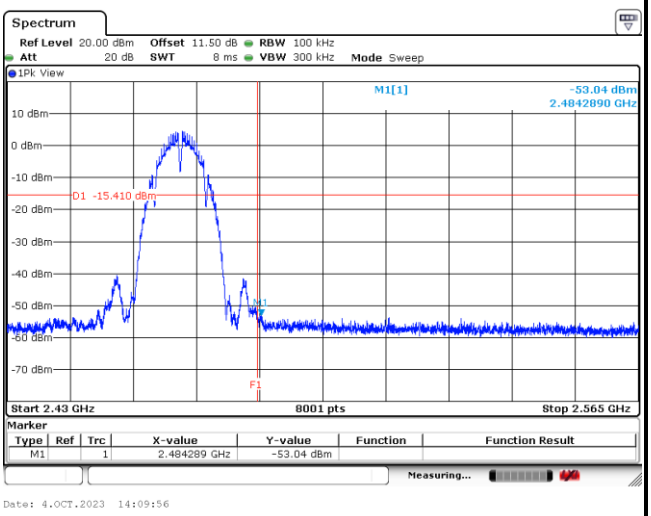
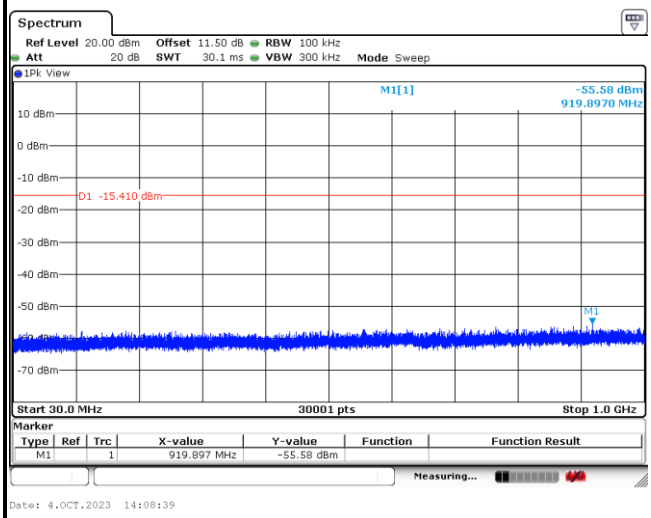
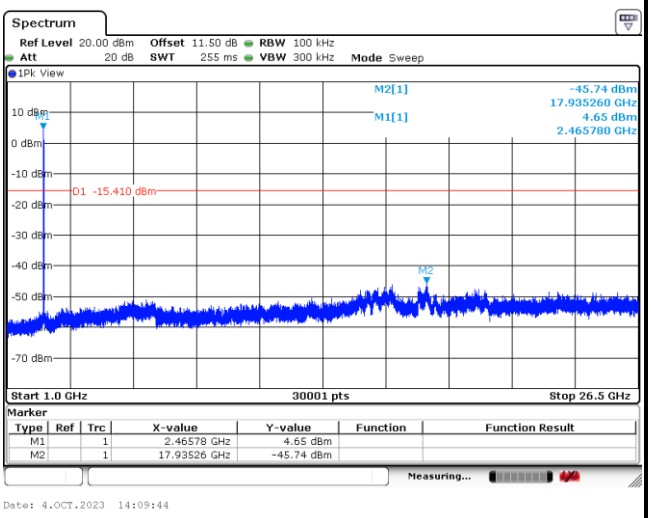
100kHz PSD reference Level	Channel Plot
	-

Spurious Emission 30MHz~1GHz	Spurious Emission 1GHz~26.5GHz
	

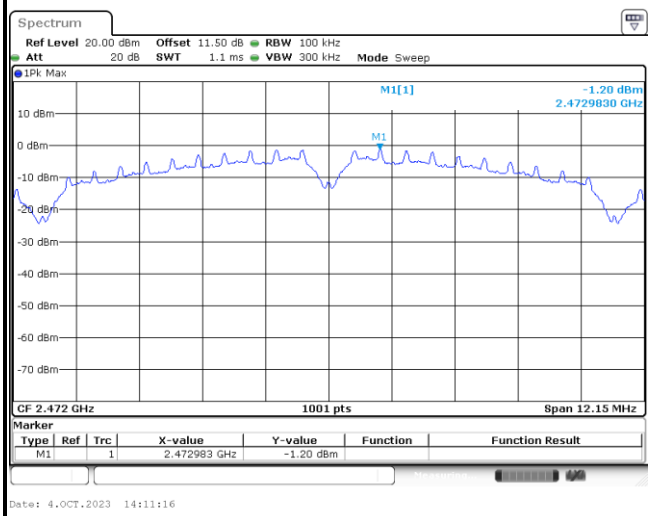
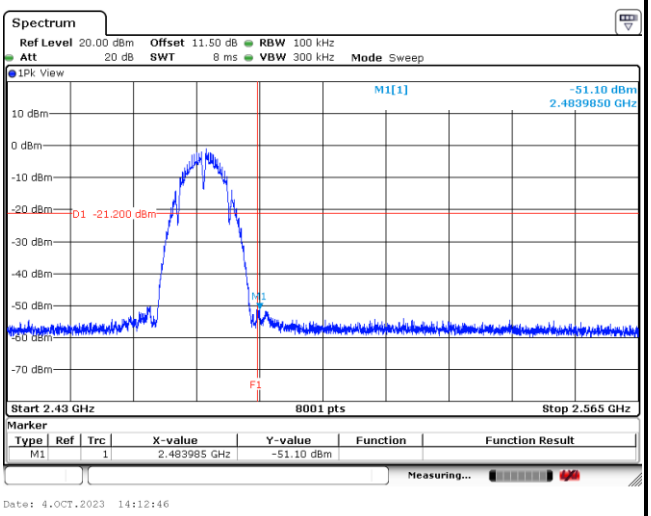
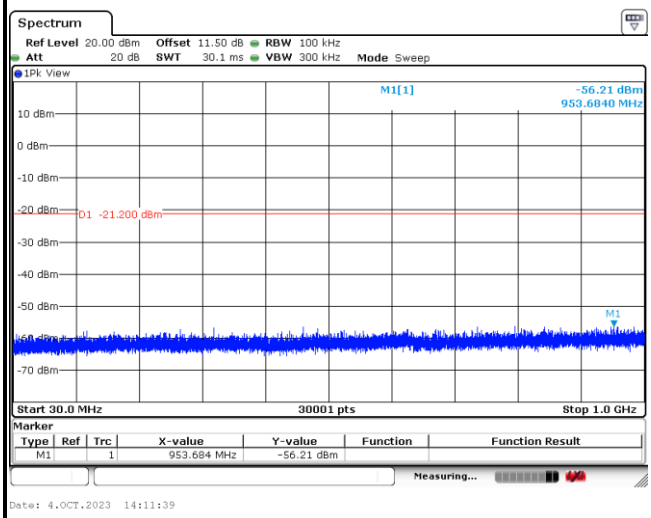
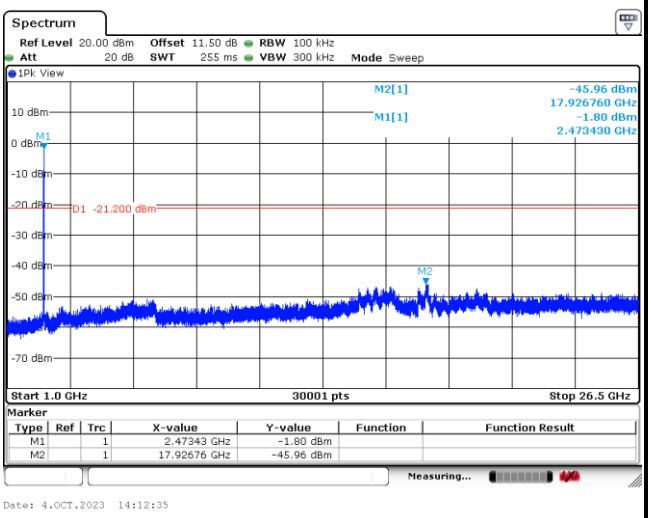
Test Mode :	802.11b	Test Channel :	11

100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~1GHz	**Spurious Emission 1GHz~26.5GHz**
	

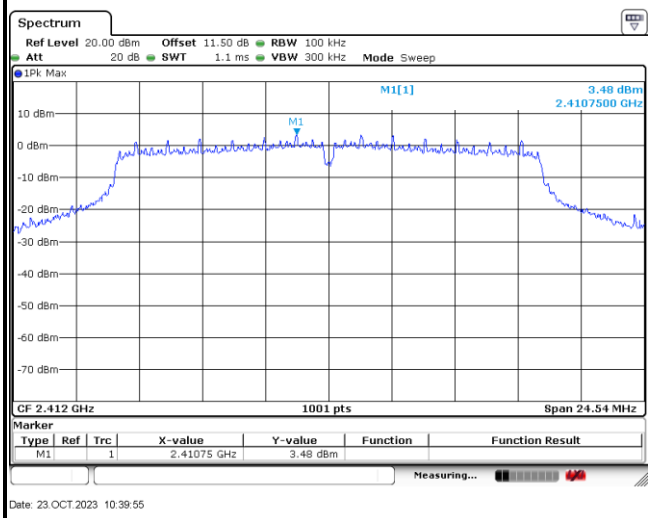
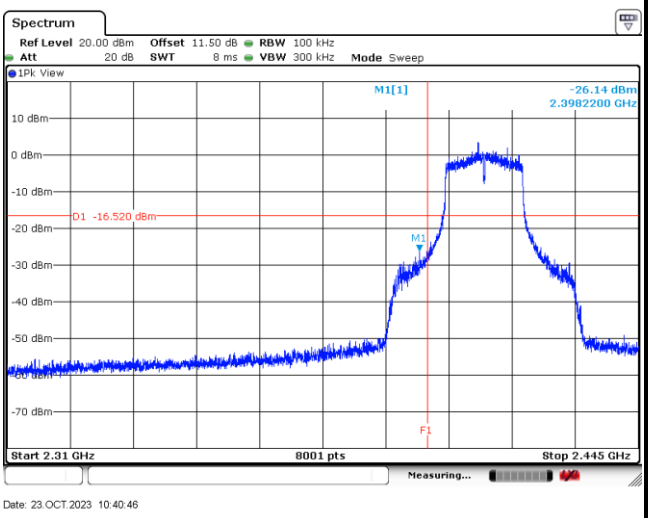
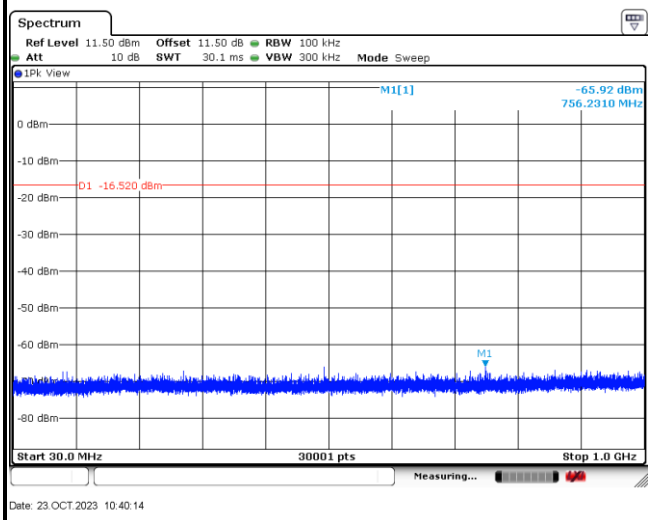
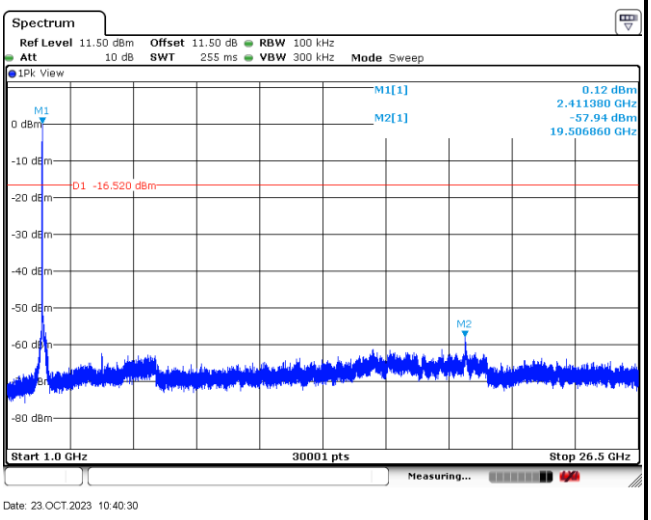
Test Mode :	802.11b	Test Channel :	12

100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~1GHz	**Spurious Emission 1GHz~26.5GHz**
	

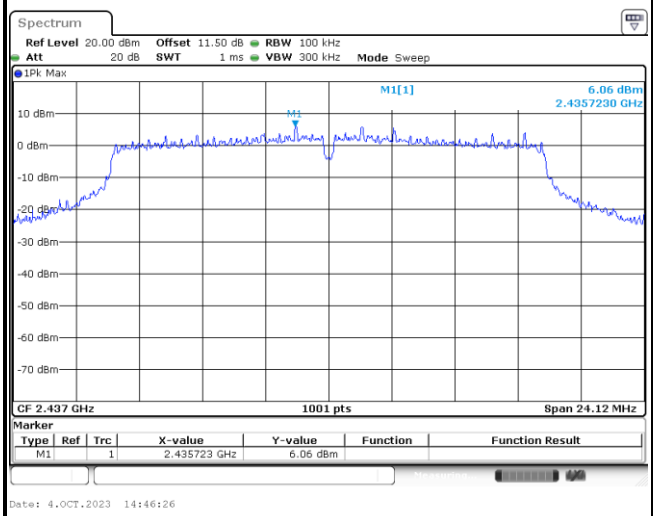
Test Mode :	802.11b	Test Channel :	13

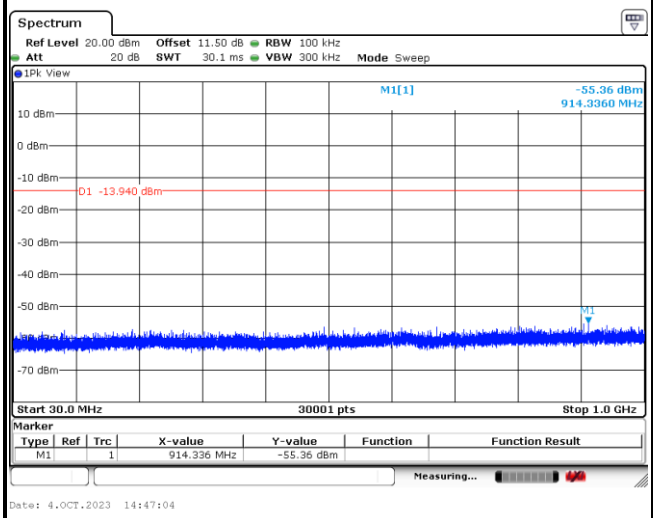
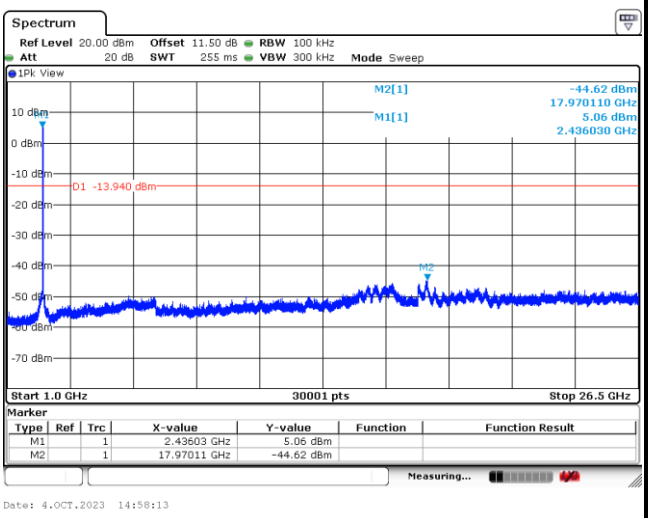
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~1GHz	**Spurious Emission 1GHz~26.5GHz**
	

Test Mode :	802.11g	Test Channel :	01

100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~1GHz	**Spurious Emission 1GHz~26.5GHz**
	

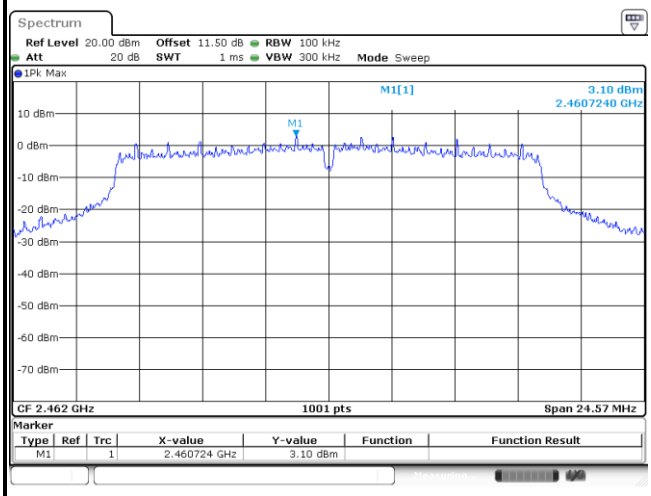
Test Mode :	802.11g	Test Channel :	06

100kHz PSD reference Level	Channel Plot
	-

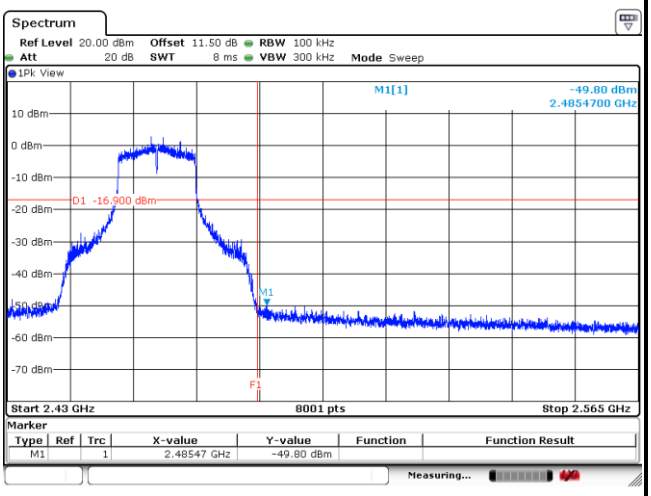
Spurious Emission 30MHz~1GHz	Spurious Emission 1GHz~26.5GHz
	

Test Mode :	802.11g	Test Channel :	11

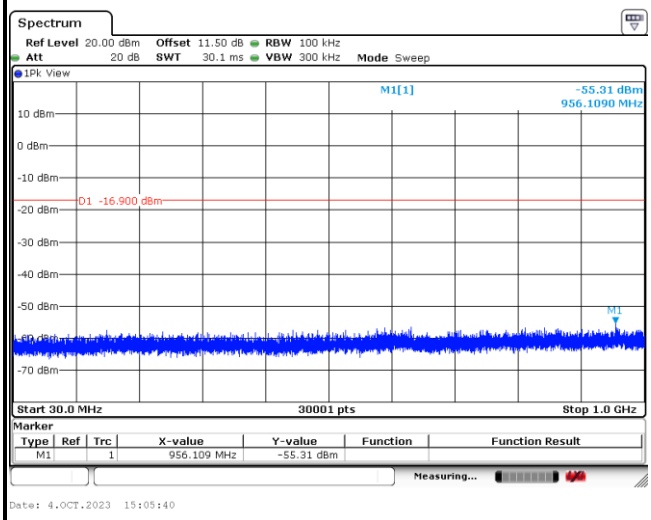
100kHz PSD reference Level



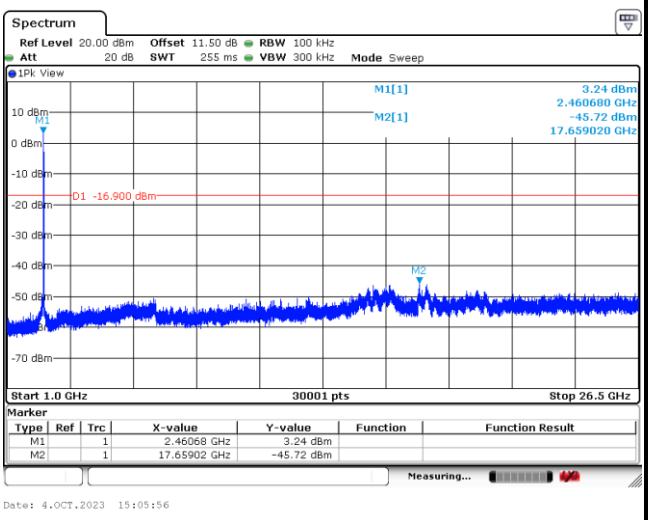
Channel Plot



Spurious Emission 30MHz~1GHz

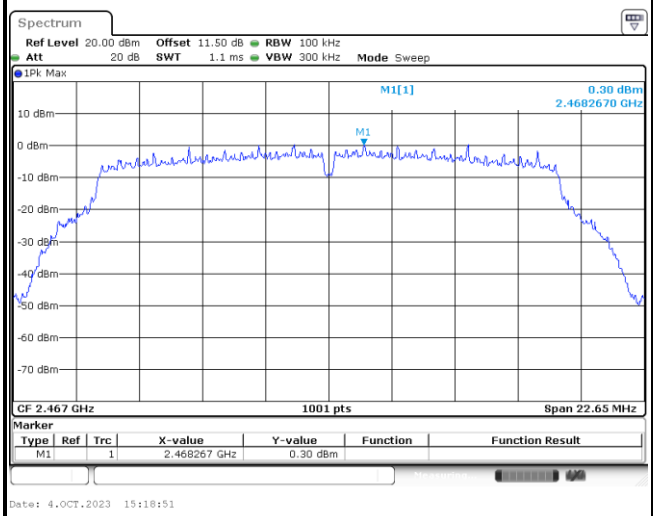


Spurious Emission 1GHz~26.5GHz

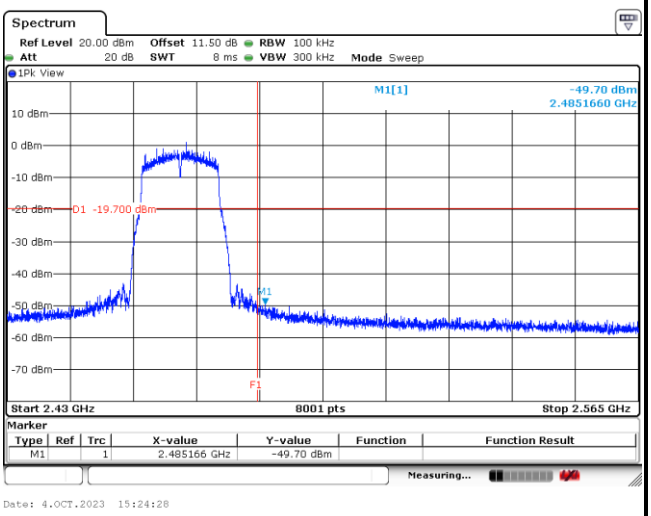


Test Mode :	802.11g	Test Channel :	12

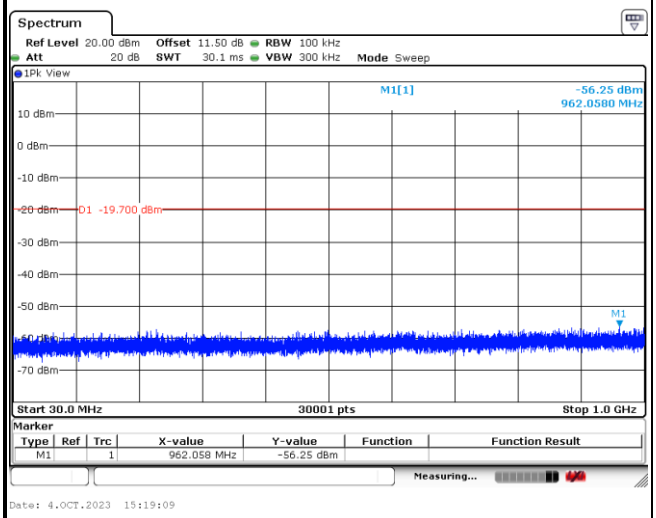
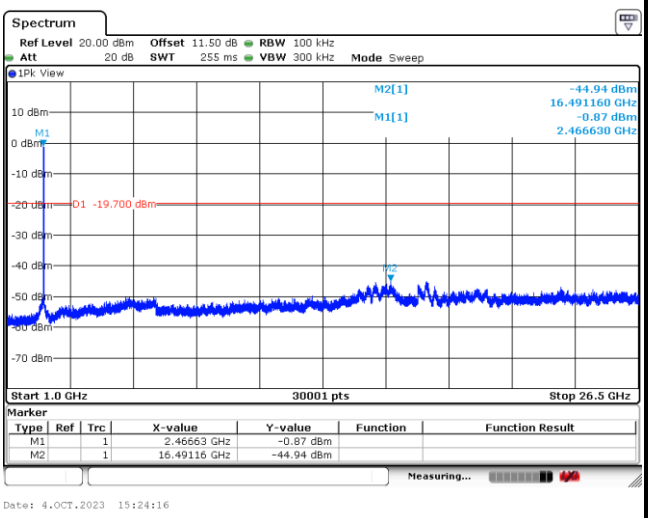
100kHz PSD reference Level



Channel Plot



Spurious Emission 30MHz~1GHz



Spurious Emission 1GHz~26.5GHz