FCC RF Test Report

APPLICANT	:	Espressif Systems (Shanghai) Co.,Ltd.
EQUIPMENT	:	2.4GHz &5GHz Wifi&BLE&Zigbee module
BRAND NAME	:	ESPRESSIF
MODEL NAME	:	ESP32-C5-WROOM-1U
FCC ID	:	2AC7Z-ESPC5WROOMU
STANDARD	:	FCC Part 15 Subpart C §15.247
CLASSIFICATION	:	(DTS) Digital Transmission System
TEST DATE(S)	:	Dec. 11, 2024 ~ Jan. 02, 2025

We, Sporton International Inc. (Kunshan), 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. (Kunshan), the test report shall not be reproduced except in full.

Jason Jia

Approved by: Jason Jia

ACCREDITED
Cert #5145.02

Sporton International Inc. (Kunshan)
No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 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 Manufacturer 5
1.3 Product Feature of Equipment Under Test 5
1.4 Product Specification of Equipment Under Test 5
1.5 Modification of EUT 6
1.6 Testing Location 6
1.7 Test Software 6
1.8 Applicable Standards 7
2 TEST CONFIGURATION OF EQUIPMENT UNDER TEST **8**
2.1 Carrier Frequency and Channel 8
2.2 Test Mode 8
2.3 Connection Diagram of Test System 9
2.4 Support Unit used in test configuration and system 10
2.5 EUT Operation Test Setup 10
2.6 Measurement Results Explanation Example 10
3 TEST RESULT **11**
3.1 6dB and 99% Bandwidth Measurement 11
3.2 Output Power Measurement 12
3.3 Power Spectral Density Measurement 15
3.4 Conducted Band Edges and Spurious Emission Measurement 16
3.5 Radiated Band Edges and Spurious Emission Measurement 17
3.6 AC Conducted Emission Measurement 21
3.7 Antenna Requirements 23
4 LIST OF MEASURING EQUIPMENT **24**
5 MEASUREMENT UNCERTAINTY **25**
APPENDIX A. CONDUCTED TEST RESULTS
APPENDIX B. AC CONDUCTED EMISSION TEST RESULT
APPENDIX C. RADIATED SPURIOUS EMISSION
APPENDIX D. DUTY CYCLE PLOTS
APPENDIX E. SETUP PHOTOGRAPHS

REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR4N0707B	Rev. 01	Initial issue of report	Mar. 04, 2025

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)	Power Output 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 0.49 dB at 2389.30 MHz
3.6	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 6.85 dB at 0.486 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

Espressif Systems (Shanghai) Co.,Ltd.
Suite 204, Block 2, 690 Bibo Road, Zhang Jiang Hi-Tech Park, Shanghai, China

1.2 Manufacturer

Espressif Systems (Shanghai) Co.,Ltd.
Suite 204, Block 2, 690 Bibo Road, Zhang Jiang Hi-Tech Park, Shanghai, China

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	2.4GHz &5GHz Wifi&BLE&Zigbee module
Brand Name	ESPRESSIF
Model Name	ESP32-C5-WROOM-1U
FCC ID	2AC7Z-ESPC5WROOMU
SN Code	Conducted: 6055F9FAA8E0 Conduction: 6055F9FAA88C Radiation: 6055F9FAA8C4
HW Version	V1
SW Version	v1.1.3.4
EUT Stage	Identical Prototype

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

1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Channel Frequency Range	2412 MHz ~ 2462 MHz
Maximum (Peak) Output Power to antenna	802.11b : 19.81 dBm (0.0957 W) 802.11g : 25.55 dBm (0.3589 W) 802.11n HT20 : 25.64 dBm (0.3664 W) 802.11n HT40 : 23.42 dBm (0.2198 W) 802.11ax HE20 : 25.41 dBm (0.3475 W)
99% Occupied Bandwidth	802.11b : 13.107MHz 802.11g : 17.183MHz 802.11n HT20 : 18.142MHz 802.11n HT40 : 36.284MHz 802.11ax HE20 : 18.941MHz
Antenna Type / Gain	External PCB antenna with gain 3.86 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)

Note: The device only support full RU for 11ax.

1.5 Modification of EUT

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

1.6 Testing Location

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Test Firm	Sporton International Inc. (Kunshan)		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158		
Test Site No.	**Sporton Site No.**	**FCC Designation No.**	**FCC Test Firm Registration No.**
	CO01-KS 03CH08-KS TH01-KS	CN1257	314309

1.7 Test Software

Item	Site	Manufacturer	Name	Version
1.	TH01-KS	Tonscend	JS1120-3 test system China_210602	3.3.10
2.	03CH08-KS	AUDIX	E3	210616
3.	CO01-KS	AUDIX	E3	6.2009-8-24

1.8 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
- 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 (X 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	7	2442
	2	2417	8	2447
	3	2422	9	2452
	4	2427	10	2457
	5	2432	11	2462
	6	2437	-	-

2.2 Test Mode

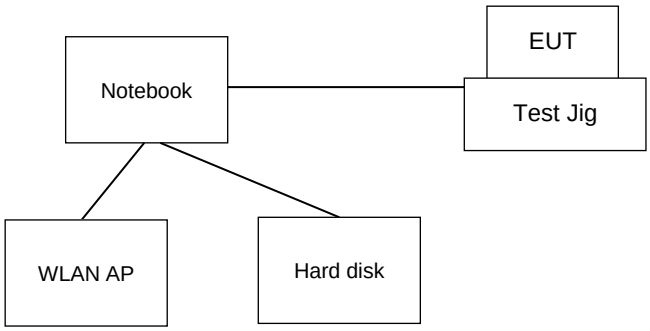
Final test modes are considering the modulation and worse data rates as below table.

Modulation	Data Rate
802.11b	**1 Mbps**
802.11g	**6 Mbps**
802.11n HT20	**MCS0**
802.11n HT40	**MCS0**
802.11ax HE20	**MCS0**

Test Cases	
AC Conducted Emission	Mode 1 :WLAN TX + Charging from Notebook

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:

This example is connection diagram of EUT test configurations.

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

2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Notebook	Lenovo	G480	QDS-BRCM1050I	N/A	Shielded cable DC O/P 1.8m, Unshielded AC I/P cable 1.8m
2.	WLAN AP	D-link	DIR-655	KA21R655B1	N/A	Unshielded,1.8m
3.	Hard disk	N/A	N/A	N/A	N/A	N/A
4.	Test Jig	N/A	N/A	N/A	N/A	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.

For AC power line conducted emissions, the EUT was set to connect with the WLAN AP under large package sizes transmission.

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 1.91 dB and 20dB attenuator.

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

= 1.91 + 20 = 21.91 (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.

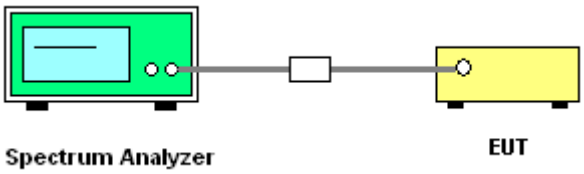
3.1.2 Measuring Instruments

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) ≥ 3*RBW. 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) approximately three times the 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.

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 peak output power is 30dBm. If transmitting antenna with directional gain greater than 6dBi is used, the peak 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.

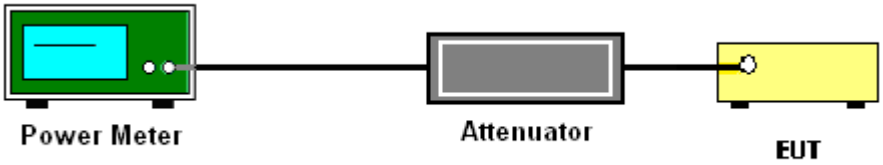
3.2.2 Measuring Instruments

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.

3.2.4 Test Setup



3.2.5 Test Result of Peak Output Power

2.4GHz Band Single Antenna										
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
11b	1Mbps	1	1	2412	19.52	30.00	3.86	23.38	36.00	Pass
11b	1Mbps	1	6	2437	19.59	30.00	3.86	23.45	36.00	Pass
11b	1Mbps	1	11	2462	19.81	30.00	3.86	23.67	36.00	Pass
11g	6Mbps	1	1	2412	24.32	30.00	3.86	28.18	36.00	Pass
11g	6Mbps	1	6	2437	25.55	30.00	3.86	29.41	36.00	Pass
11g	6Mbps	1	10	2457	24.65	30.00	3.86	28.51	36.00	Pass
11g	6Mbps	1	11	2462	21.43	30.00	3.86	25.29	36.00	Pass
HT20	MCS0	1	1	2412	23.73	30.00	3.86	27.59	36.00	Pass
HT20	MCS0	1	2	2417	25.49	30.00	3.86	29.35	36.00	Pass
HT20	MCS0	1	6	2437	25.64	30.00	3.86	29.50	36.00	Pass
HT20	MCS0	1	10	2457	24.57	30.00	3.86	28.43	36.00	Pass
HT20	MCS0	1	11	2462	21.52	30.00	3.86	25.38	36.00	Pass
HT40	MCS0	1	3	2422	23.42	30.00	3.86	27.28	36.00	Pass
HT40	MCS0	1	6	2437	23.18	30.00	3.86	27.04	36.00	Pass
HT40	MCS0	1	7	2442	20.67	30.00	3.86	24.53	36.00	Pass
HT40	MCS0	1	8	2447	18.94	30.00	3.86	22.80	36.00	Pass
HT40	MCS0	1	9	2452	18.98	30.00	3.86	22.84	36.00	Pass

2.4GHz Band Single Antenna											
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	RU Config.	Peak Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
HE20	MCS0	1	1	2412	Full	24.02	30.00	3.86	27.88	36.00	Pass
HE20	MCS0	1	6	2437	Full	25.41	30.00	3.86	29.27	36.00	Pass
HE20	MCS0	1	10	2457	Full	23.82	30.00	3.86	27.68	36.00	Pass
HE20	MCS0	1	11	2462	Full	20.98	30.00	3.86	24.84	36.00	Pass

3.2.6 Test Result of Average Output Power (Reporting Only)

2.4GHz Band Single Antenna												
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power with duty factor (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail	Setting
11b	1Mbps	1	1	2412	0.00	16.93	30.00	3.86	20.79	36.00	Pass	0.00
11b	1Mbps	1	6	2437	0.00	17.22	30.00	3.86	21.08	36.00	Pass	0.00
11b	1Mbps	1	11	2462	0.00	17.09	30.00	3.86	20.95	36.00	Pass	4.00
11g	6Mbps	1	1	2412	0.00	13.87	30.00	3.86	17.73	36.00	Pass	12.00
11g	6Mbps	1	6	2437	0.00	16.58	30.00	3.86	20.44	36.00	Pass	0.00
11g	6Mbps	1	10	2457	0.00	15.72	30.00	3.86	19.58	36.00	Pass	8.00
11g	6Mbps	1	11	2462	0.00	11.31	30.00	3.86	15.17	36.00	Pass	25.00
HT20	MCS0	1	1	2412	0.00	13.62	30.00	3.86	17.48	36.00	Pass	14.00
HT20	MCS0	1	2	2417	0.00	16.12	30.00	3.86	19.98	36.00	Pass	2.00
HT20	MCS0	1	6	2437	0.00	16.43	30.00	3.86	20.29	36.00	Pass	0.00
HT20	MCS0	1	10	2457	0.00	15.47	30.00	3.86	19.33	36.00	Pass	8.00
HT20	MCS0	1	11	2462	0.00	11.18	30.00	3.86	15.04	36.00	Pass	25.00
HT40	MCS0	1	3	2422	0.05	13.06	30.00	3.86	16.92	36.00	Pass	14.00
HT40	MCS0	1	6	2437	0.05	12.69	30.00	3.86	16.55	36.00	Pass	15.00
HT40	MCS0	1	7	2442	0.05	10.46	30.00	3.86	14.32	36.00	Pass	24.00
HT40	MCS0	1	8	2447	0.05	8.77	30.00	3.86	12.63	36.00	Pass	32.00
HT40	MCS0	1	9	2452	0.05	8.71	30.00	3.86	12.57	36.00	Pass	33.00

2.4GHz Band Single Antenna													
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	RU Config.	Duty Factor (dB)	Average Conducted Power with duty factor (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail	Setting
HE20	MCS0	1	1	2412	Full	0.03	13.81	30.00	3.86	17.67	36.00	Pass	12.00
HE20	MCS0	1	6	2437	Full	0.03	16.36	30.00	3.86	20.22	36.00	Pass	0.00
HE20	MCS0	1	10	2457	Full	0.03	14.15	30.00	3.86	18.01	36.00	Pass	12.00
HE20	MCS0	1	11	2462	Full	0.03	10.62	30.00	3.86	14.48	36.00	Pass	28.00

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.

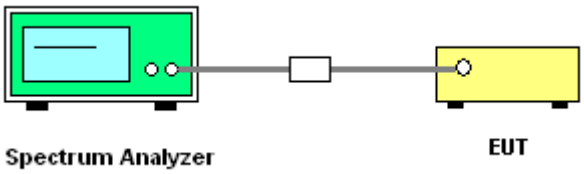
3.3.2 Measuring Instruments

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.

3.3.4 Test Setup



3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.

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 relative to the maximum PSD level in 100 kHz by RF conducted measurement.

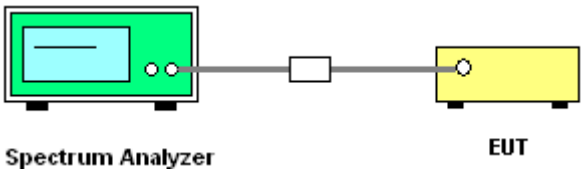
3.4.2 Measuring Instruments

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

Please refer to Appendix A.

3.5 Radiated Band Edges and Spurious Emission Measurement

3.5.1 Limit of Radiated band edge and Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

3.5.2 Measuring Instruments

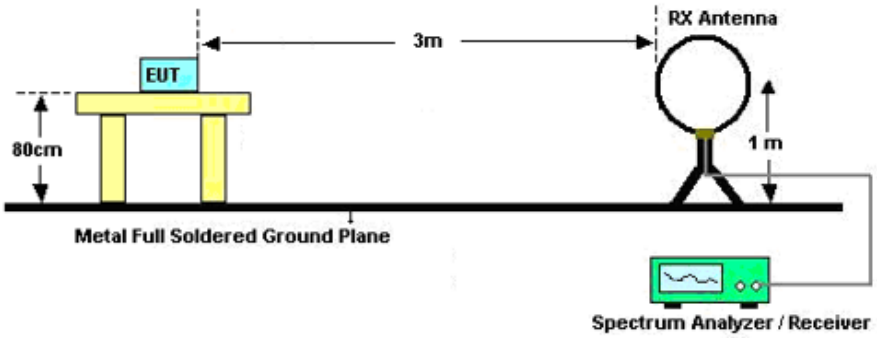
The measuring equipment is listed in the section 4 of this test report.

3.5.3 Test Procedures

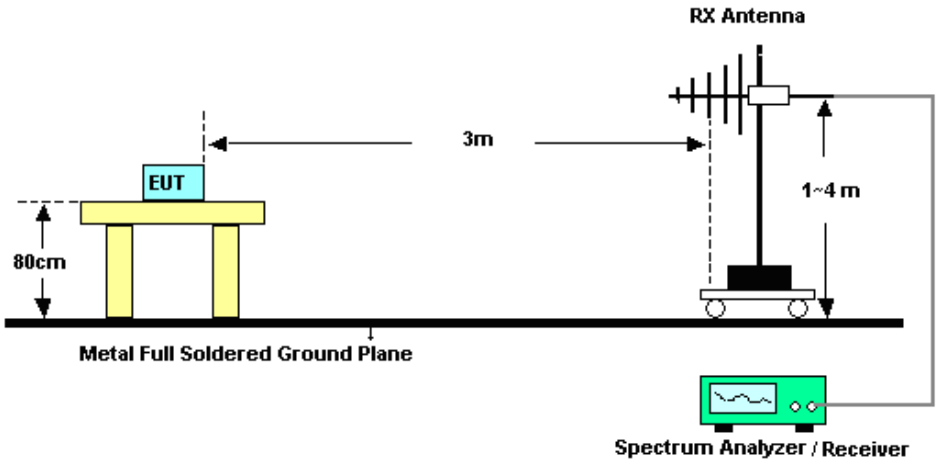
1. The testing follows ANSI C63.10-2013 clause 11.11 & 11.12
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than peak limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
8. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz for f < 1 GHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
   (3) Set RBW = 1 MHz, VBW= 3MHz for f ≥ 1 GHz for peak measurement.
   For average measurement:
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.5.4 Test Setup

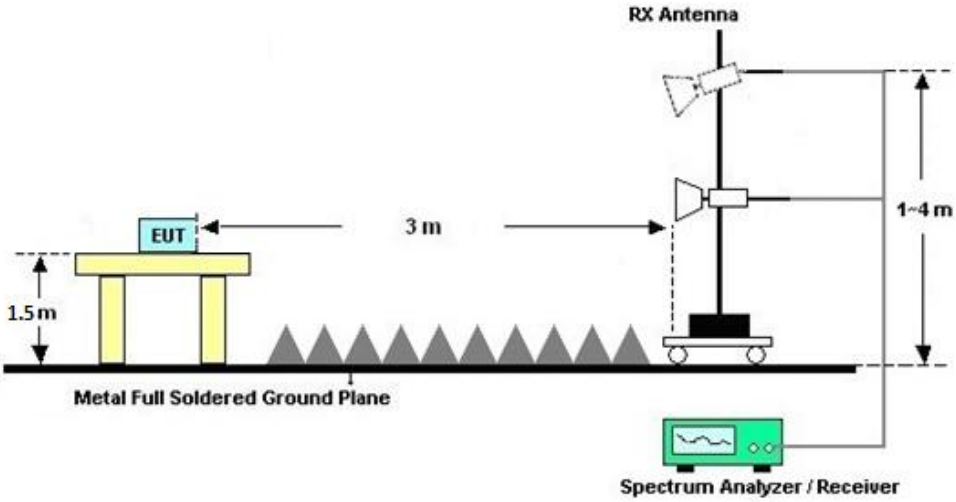
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.5.5 Test Results of Radiated Spurious Emissions (9kHz ~ 30MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C.

3.5.7 Duty Cycle

Please refer to Appendix D.

3.5.8 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic or 40GHz, whichever is lower)

Please refer to Appendix C.

3.6 AC Conducted Emission Measurement

3.6.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

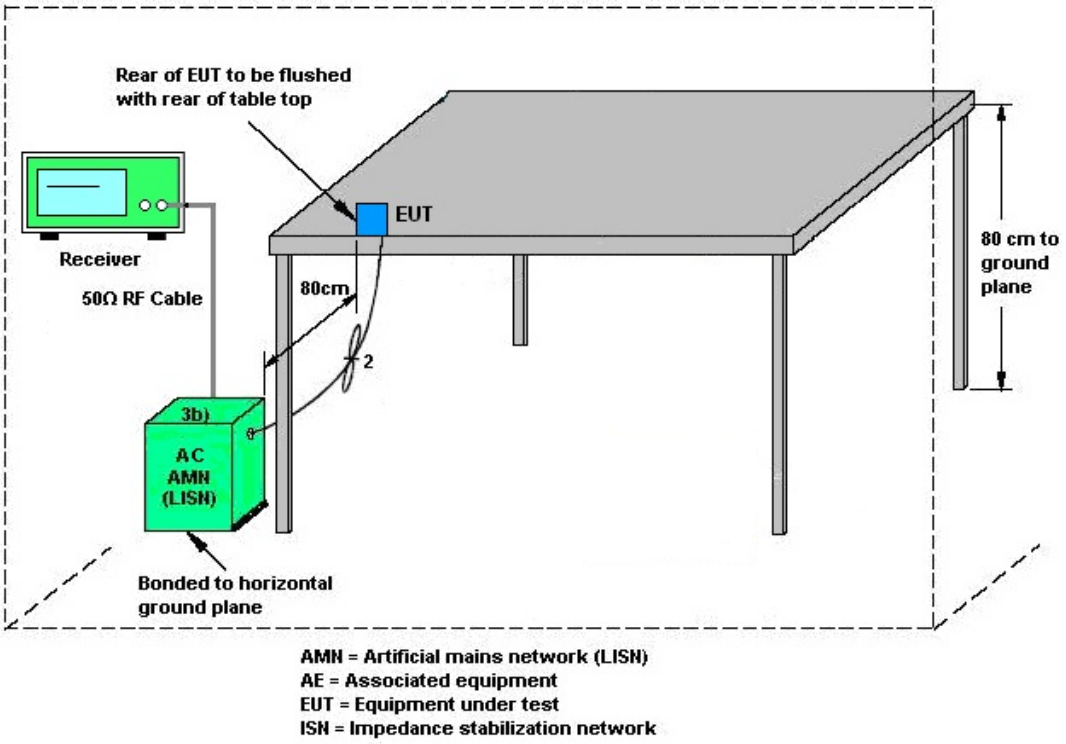
3.6.2 Measuring Instruments

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

3.6.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room, and it was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF bandwidth = 9kHz) with Maximum Hold Mode.

3.6.4 Test Setup



3.6.5 Test Result of AC Conducted Emission

Please refer to Appendix B.

3.7 Antenna Requirements

3.7.1 Standard Applicable

If directional gain of transmitting Antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. 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 rule.

3.7.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.7.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	Apr. 18, 2024	Dec. 15, 2024	Apr. 17, 2025	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060103	9kHz~30MHz	Aug. 20, 2024	Dec. 15, 2024	Aug. 19, 2025	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060105	9kHz~30MHz	Apr. 18, 2024	Dec. 15, 2024	Apr. 17, 2025	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP000000811	AC 0V~300V, 45Hz~1000Hz	Oct. 09, 2024	Dec. 15, 2024	Oct. 08, 2025	Conduction (CO01-KS)
EMI Test Receiver	Keysight	N9038A	MY57290151	3Hz~8.5GHz;Max 30dBm	Jul. 04, 2024	Dec. 11, 2024	Jul. 03, 2025	Radiation (03CH08-KS)
EXA Spectrum Analyzer	Keysight	N9010B	MY57441079	10Hz-44GHz	Oct. 09, 2024	Dec. 11, 2024	Oct. 08, 2025	Radiation (03CH08-KS)
Loop Antenna	R&S	HFH2-Z2E	101125	9kHz~30MHz	Sep. 08, 2024	Dec. 11, 2024	Sep. 07, 2025	Radiation (03CH08-KS)
Bilog Antenna	TESEQ	CBL 6111D	59915	30MHz-1GHz	Aug. 18, 2024	Dec. 11, 2024	Aug.17, 2025	Radiation (03CH08-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	00240138	1GHz~18GHz	Jul. 06, 2024	Dec. 11, 2024	Jul. 05, 2025	Radiation (03CH08-KS)
high gain Amplifier	EM	EM01G18GA	060890	1Ghz-18Ghz	Jul. 23, 2024	Dec. 11, 2024	Jul. 22, 2025	Radiation (03CH08-KS)
SHF-EHF Horn	Com-power	AH-840	101116	18GHz~40GHz	Oct. 22, 2024	Dec. 11, 2024	Oct. 21, 2025	Radiation (03CH08-KS)
Amplifier	SONOMA	310N	380826	9KHz-1GHz	Jul. 03, 2024	Dec. 11, 2024	Jul. 02, 2025	Radiation (03CH08-KS)
Amplifier	Keysight	83017A	MY53270417	500MHz~26.5GHz	Oct. 09, 2024	Dec. 11, 2024	Oct. 08, 2025	Radiation (03CH08-KS)
Amplifier	EM	EM18G40GGA	060737	18~40GHz	Jan. 03, 2024	Dec. 11, 2024	Jan. 02, 2025	Radiation (03CH08-KS)
AC Power Source	Chroma	61601	616010002473	N/A	NCR	Dec. 11, 2024	NCR	Radiation (03CH08-KS)
Turn Table	EM	EM 1000-T	N/A	0~360 degree	NCR	Dec. 11, 2024	NCR	Radiation (03CH08-KS)
Antenna Mast	EM	EM 1000-A	N/A	1 m~4 m	NCR	Dec. 11, 2024	NCR	Radiation (03CH08-KS)
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Oct. 10, 2024	Dec. 23, 2024~ Jan. 02, 2025	Oct. 09, 2025	Conducted (TH01-KS)
Pulse Power Senor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 02, 2024	Dec. 23, 2024~ Jan. 02, 2025	Jan. 01, 2025	Conducted (TH01-KS)
Pulse Power Senor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 02, 2025		Jan. 01, 2026	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 02, 2024	Dec. 23, 2024~ Jan. 02, 2025	Jan. 01, 2025	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 02, 2025		Jan. 01, 2026	Conducted (TH01-KS)

NCR: No Calibration Required

5 Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10-2013. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

Uncertainty of Conducted Measurement

Conducted Spurious Emission & Bandedge	**±2.22 dB**
Occupied Channel Bandwidth	**±0.1%**
Conducted Power	**±0.50 dB**
Conducted Power Spectral Density	**±0.90 dB**
Frequency	**±0.04 Hz**

Uncertainty of AC Conducted Emission Measurement (0.15 MHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**2.84 dB**

Uncertainty of Radiated Emission Measurement (9 KHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**3.30 dB**

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**6.04 dB**

Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.26 dB**

Uncertainty of Radiated Emission Measurement (18 GHz ~ 40 GHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.40 dB**

---------- THE END ----------

Appendix A. Conducted Test Results

Ambient Condition: 25 ℃, 45 %RH	
Test Date: 2024.12.23~2025.1.2	**Test Engineer:** Zhang Zhizheng

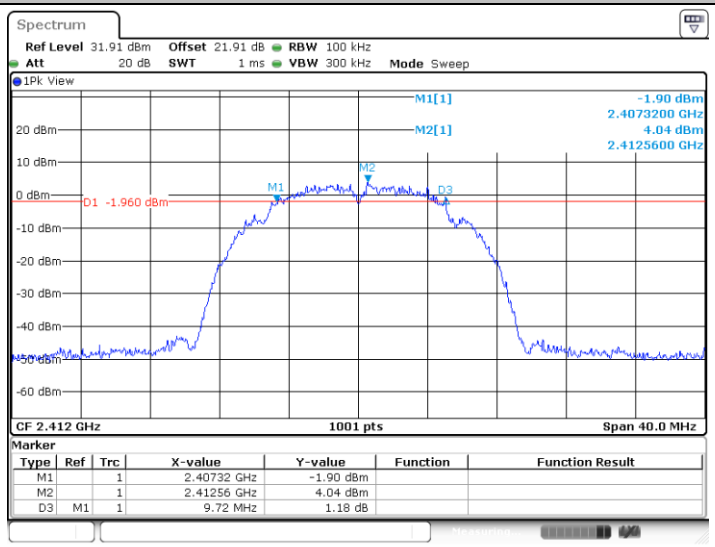
DTS Bandwidth

Test Result

TestMode	Antenna	Freq(MHz)	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11B	Ant1	2412	9.72	2407.32	2417.04	0.5	PASS
		2437	9.00	2432.52	2441.52	0.5	PASS
		2462	9.12	2457.40	2466.52	0.5	PASS
11G	Ant1	2412	16.32	2403.84	2420.16	0.5	PASS
		2437	16.28	2428.88	2445.16	0.5	PASS
		2457	16.32	2448.84	2465.16	0.5	PASS
		2462	16.32	2453.84	2470.16	0.5	PASS
11N20SISO	Ant1	2412	17.52	2403.24	2420.76	0.5	PASS
		2417	17.32	2408.48	2425.80	0.5	PASS
		2437	16.32	2429.08	2445.40	0.5	PASS
		2457	16.92	2448.60	2465.52	0.5	PASS
		2462	16.80	2453.60	2470.40	0.5	PASS
11N40SISO	Ant1	2422	35.12	2404.48	2439.60	0.5	PASS
		2437	35.12	2419.48	2454.60	0.5	PASS
		2442	35.12	2424.48	2459.60	0.5	PASS
		2447	35.12	2429.48	2464.60	0.5	PASS
		2452	35.12	2434.48	2469.60	0.5	PASS
11AX20SISO	Ant1	2412	17.04	2403.44	2420.48	0.5	PASS
		2437	17.24	2428.76	2446.00	0.5	PASS
		2457	17.84	2448.44	2466.28	0.5	PASS
		2462	17.28	2453.24	2470.52	0.5	PASS

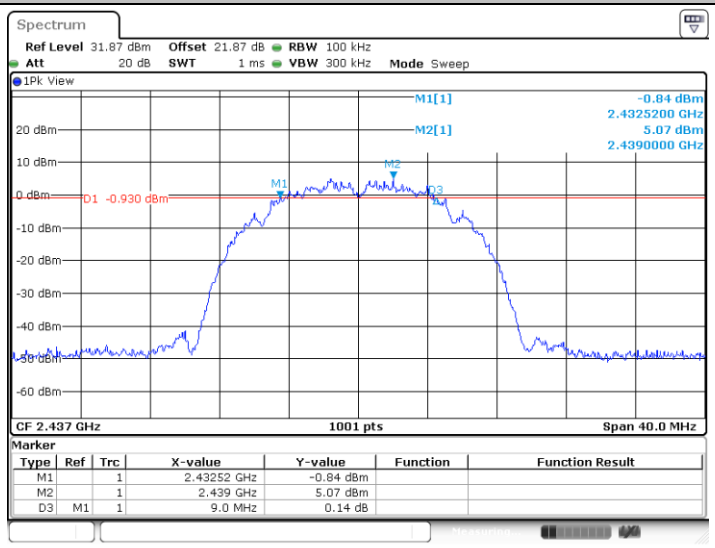
Test Graphs

11B_Ant1_2412



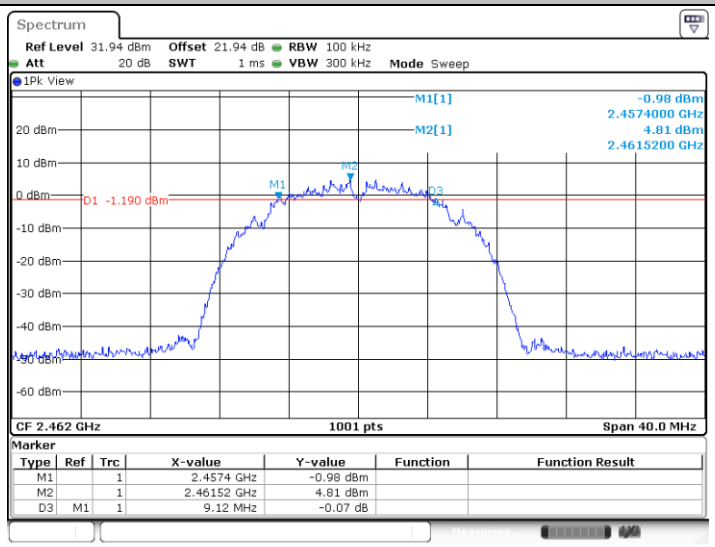
Date: 23.DEC.2024 08:13:57

11B_Ant1_2437



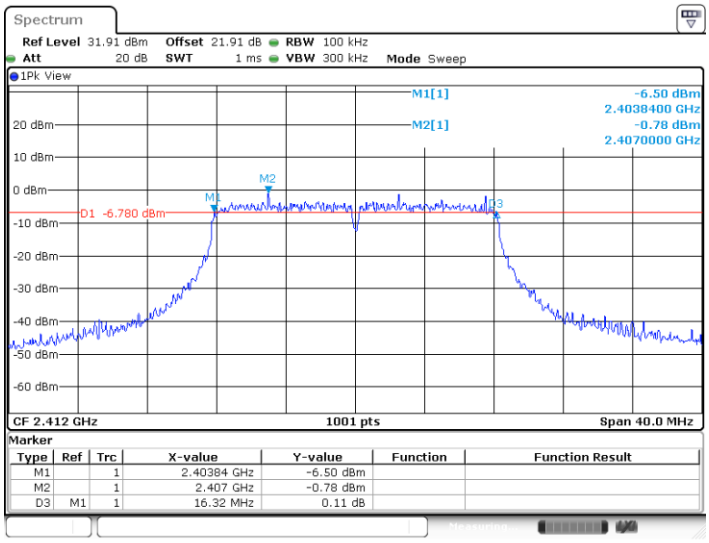
Date: 23.DEC.2024 08:15:16

11B_Ant1_2462



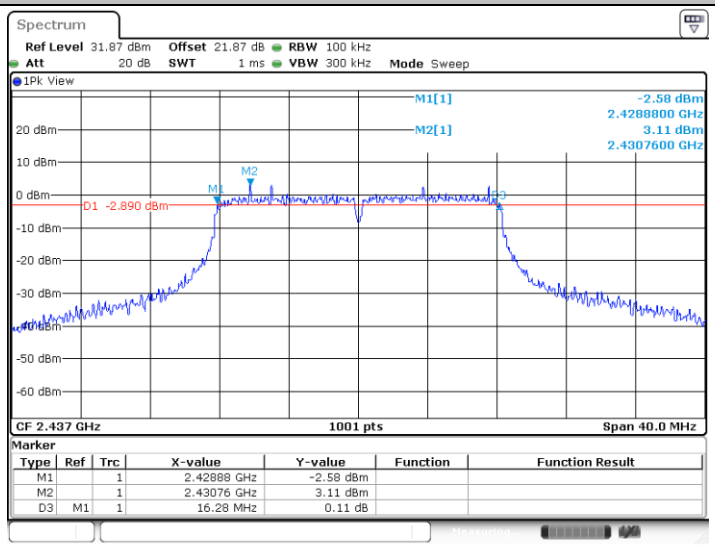
Date: 23.DEC.2024 08:18:12

11G_Ant1_2412



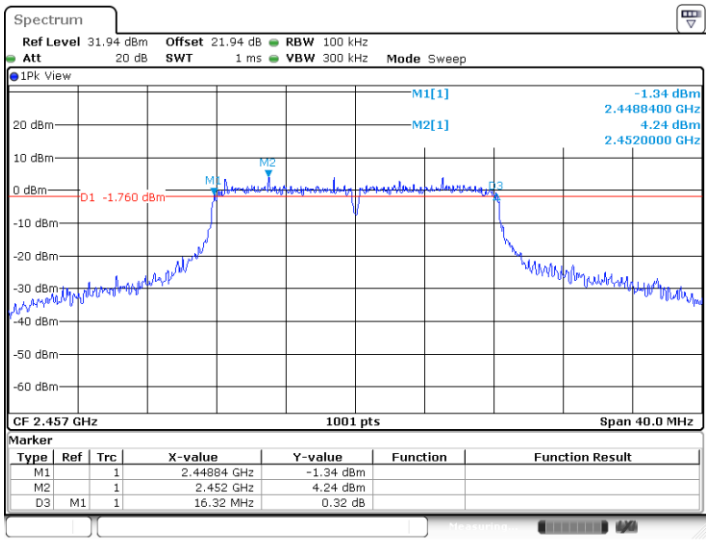
Date: 23.DEC.2024 08:19:36

11G_Ant1_2437



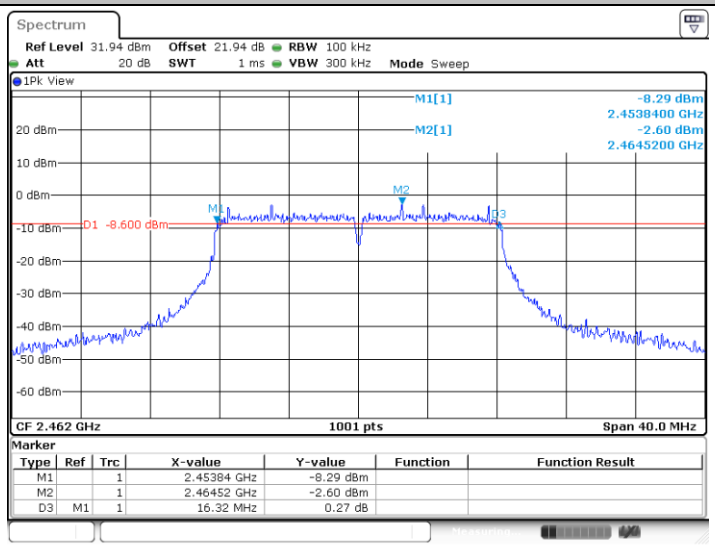
Date: 23.DEC.2024 08:20:54

11G_Ant1_2457



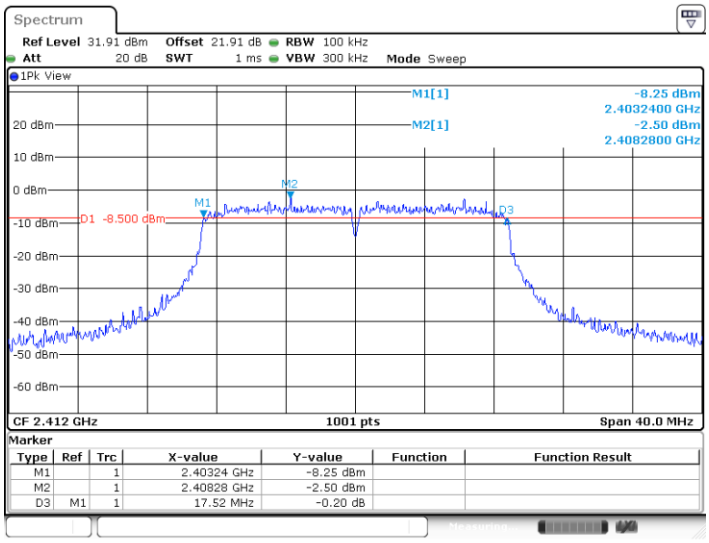
Date: 2.JAN.2025 19:23:07

11G_Ant1_2462



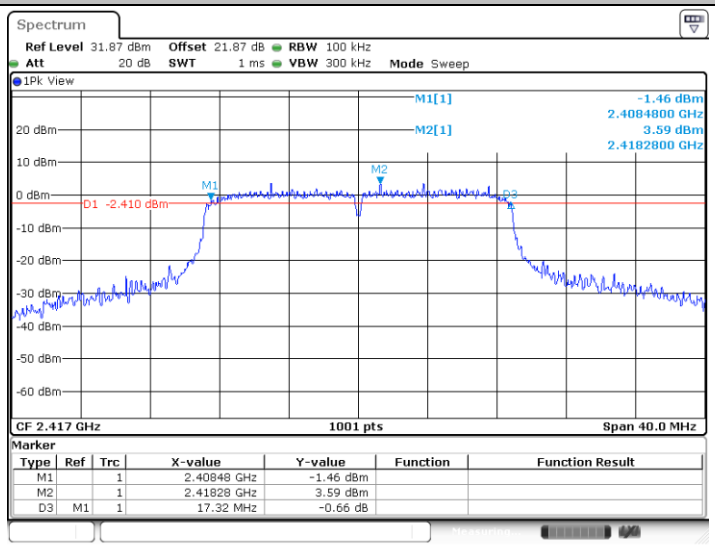
Date: 23.DEC.2024 08:22:06

11N20SISO_Ant1_2412

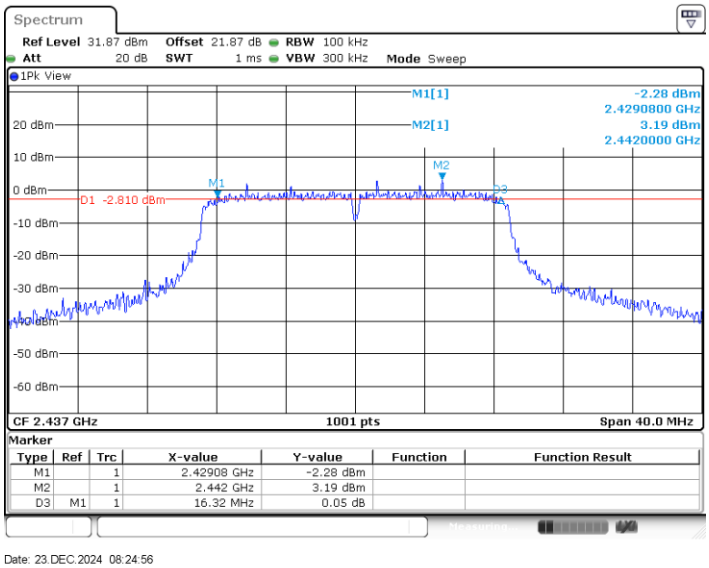


Date: 23.DEC.2024 08:23:35

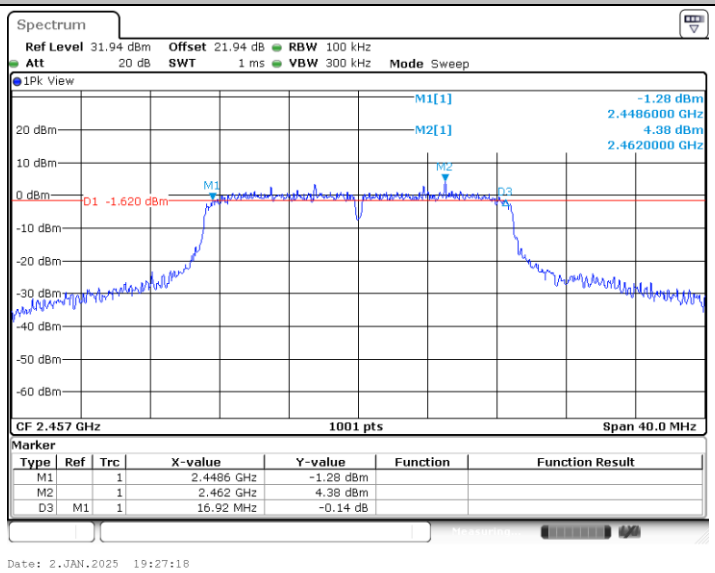
11N20SISO_Ant1_2417



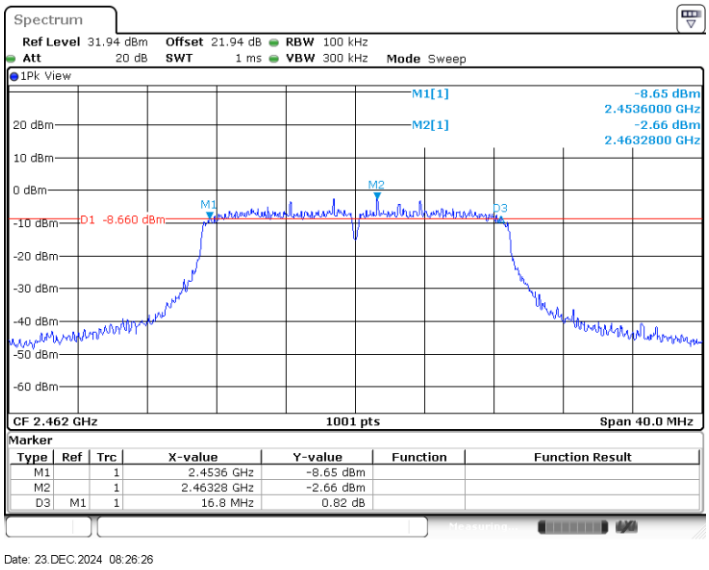
11N20SISO_Ant1_2437



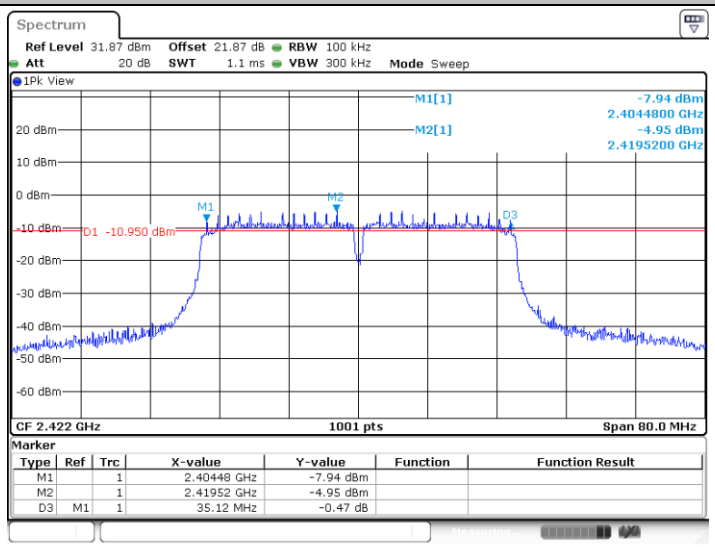
11N20SISO_Ant1_2457



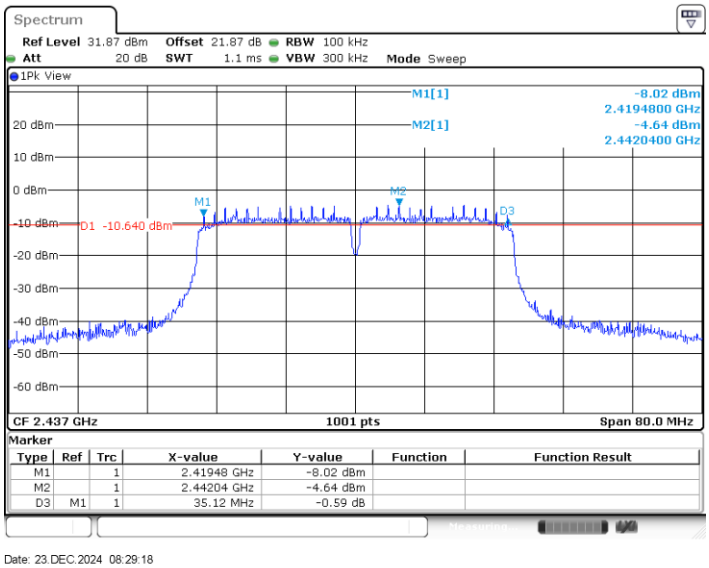
11N20SISO_Ant1_2462



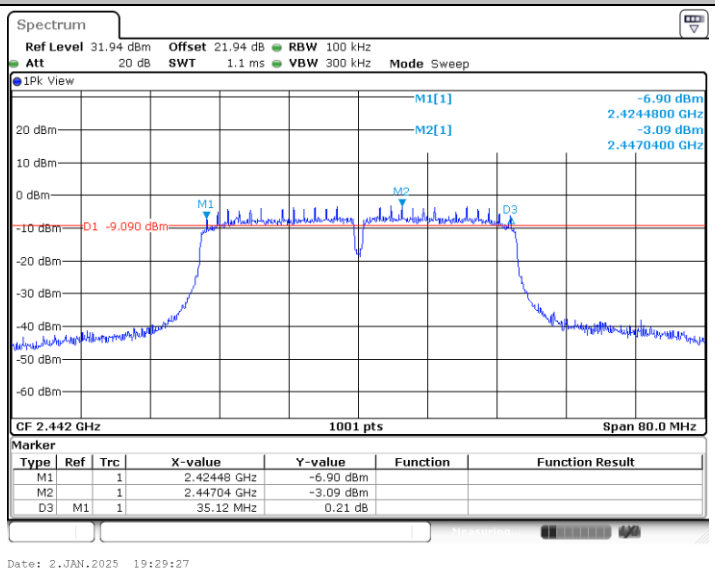
11N40SISO_Ant1_2422



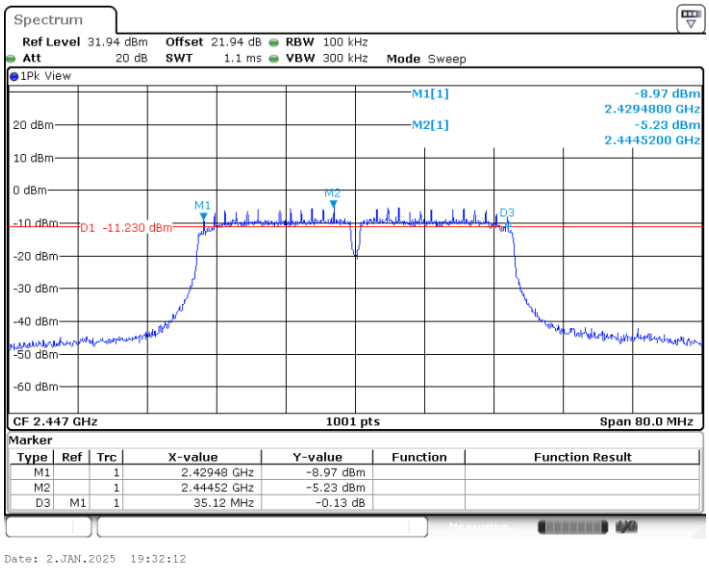
11N40SISO_Ant1_2437



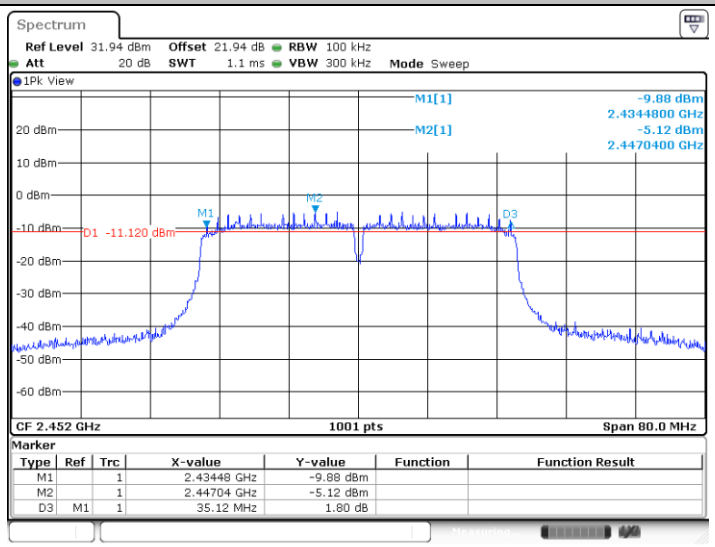
11N40SISO_Ant1_2442



11N40SISO_Ant1_2447

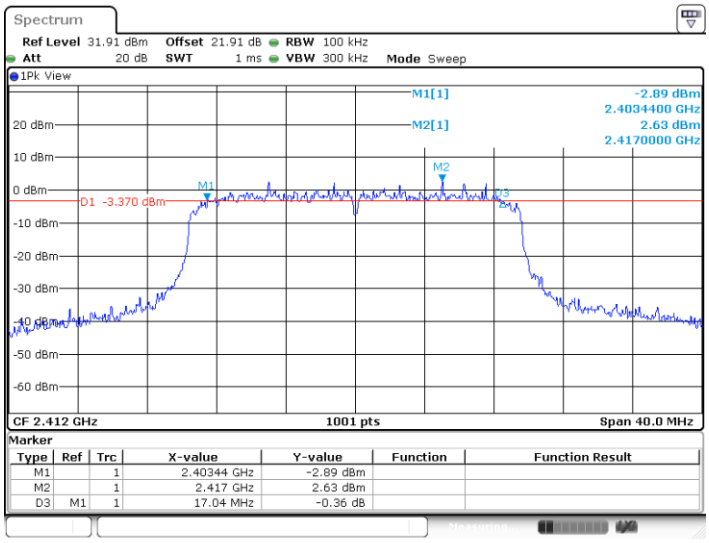


11N40SISO_Ant1_2452



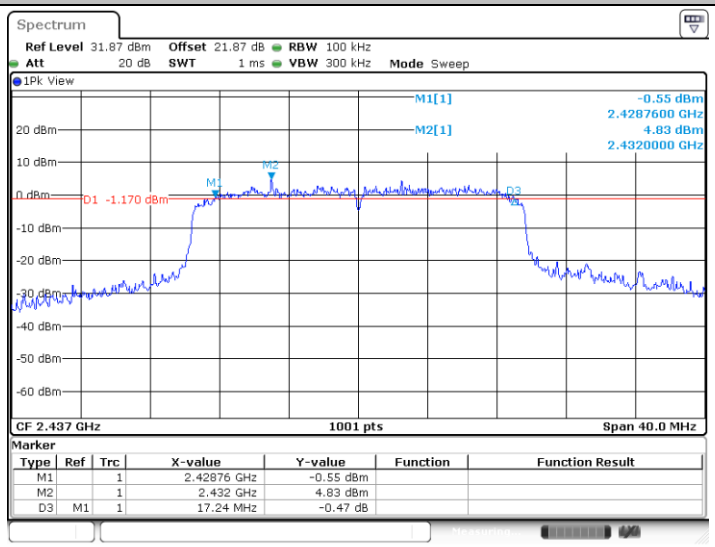
Date: 23.DEC.2024 08:56:24

11AX20SISO_Ant1_2412

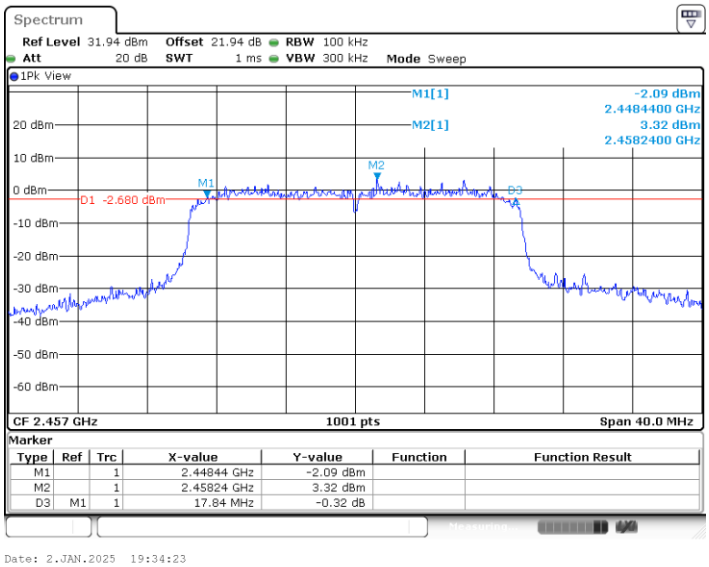


Date: 23.DEC.2024 08:58:15

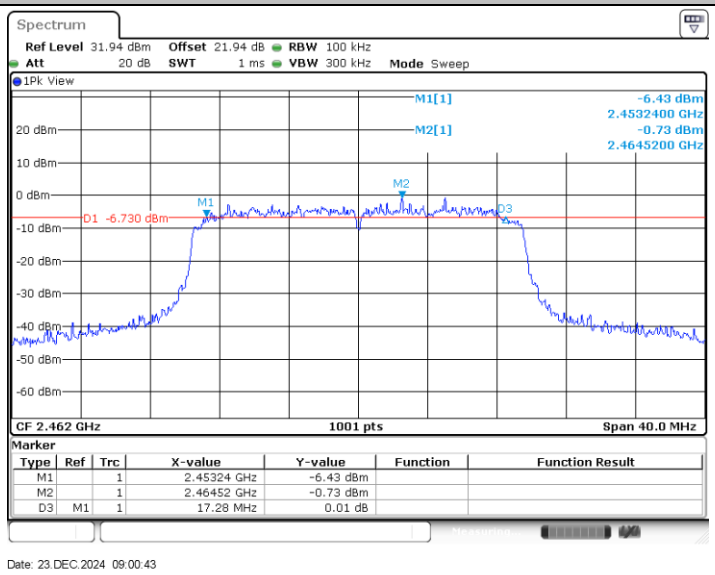
11AX20SISO_Ant1_2437



11AX20SISO_Ant1_2457



11AX20SISO_Ant1_2462



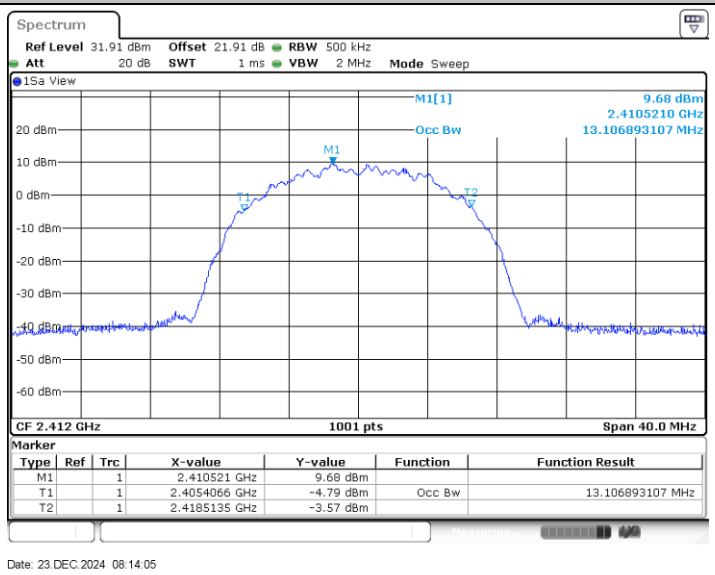
Occupied Channel Bandwidth

Test Result

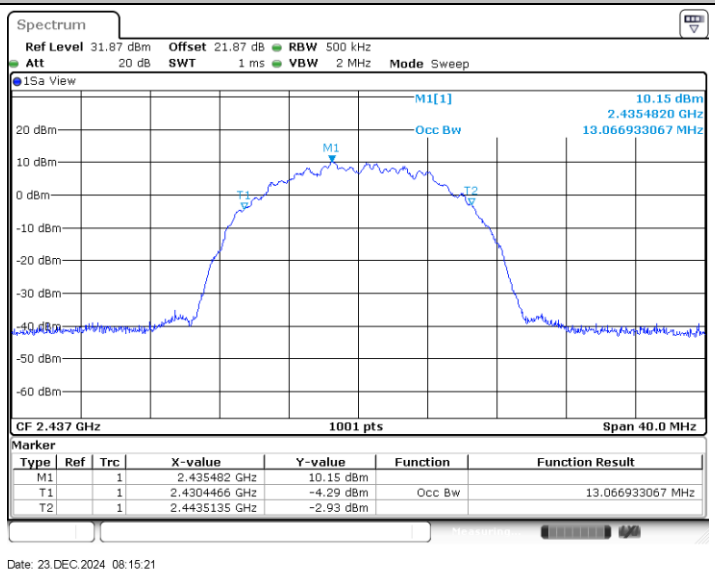
TestMode	Antenna	Freq(MHz)	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11B	Ant1	2412	13.107	2405.4066	2418.5135	---	---
		2437	13.067	2430.4466	2443.5135	---	---
		2462	13.067	2455.4466	2468.5135	---	---
11G	Ant1	2412	16.983	2403.5285	2420.5115	---	---
		2437	16.983	2428.5684	2445.5514	---	---
		2457	17.183	2448.4885	2465.6713	---	---
		2462	16.983	2453.5285	2470.5115	---	---
11N20SISO	Ant1	2412	17.862	2403.0889	2420.9510	---	---
		2417	18.062	2408.0490	2426.1109	---	---
		2437	17.942	2428.0889	2446.0310	---	---
		2457	18.142	2448.0090	2466.1508	---	---
		2462	17.862	2453.0889	2470.9510	---	---
11N40SISO	Ant1	2422	36.284	2403.8581	2440.1419	---	---
		2437	36.124	2418.9381	2455.0619	---	---
		2442	36.204	2423.9381	2460.1419	---	---
		2447	36.204	2428.9381	2465.1419	---	---
		2452	36.284	2433.8581	2470.1419	---	---
11AX20SISO	Ant1	2412	18.861	2402.6094	2421.4705	---	---
		2437	18.941	2427.6094	2446.5504	---	---
		2457	18.861	2447.6094	2466.4705	---	---
		2462	18.821	2452.6094	2471.4306	---	---

Test Graphs

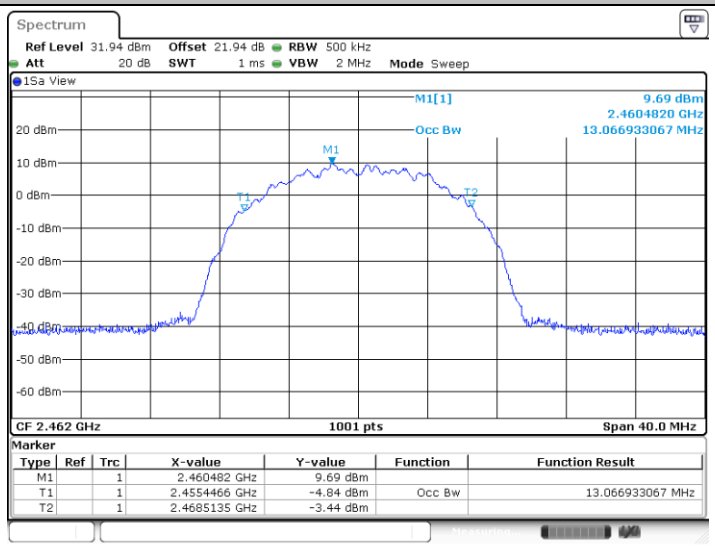
11B_Ant1_2412



11B_Ant1_2437

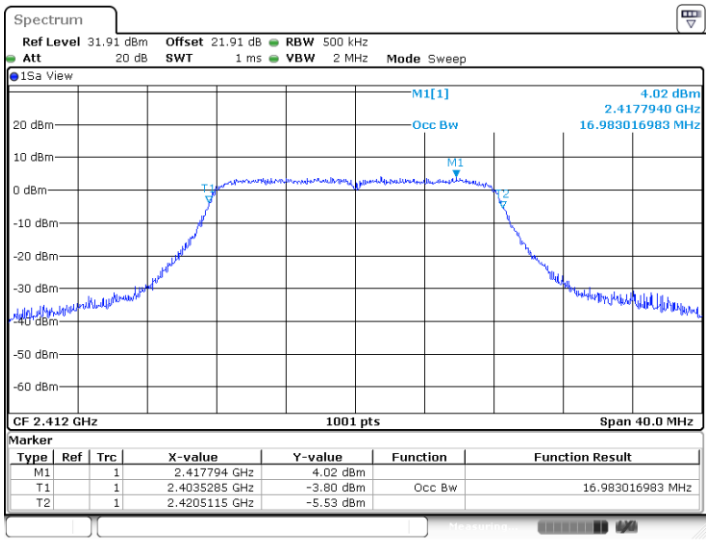


11B_Ant1_2462



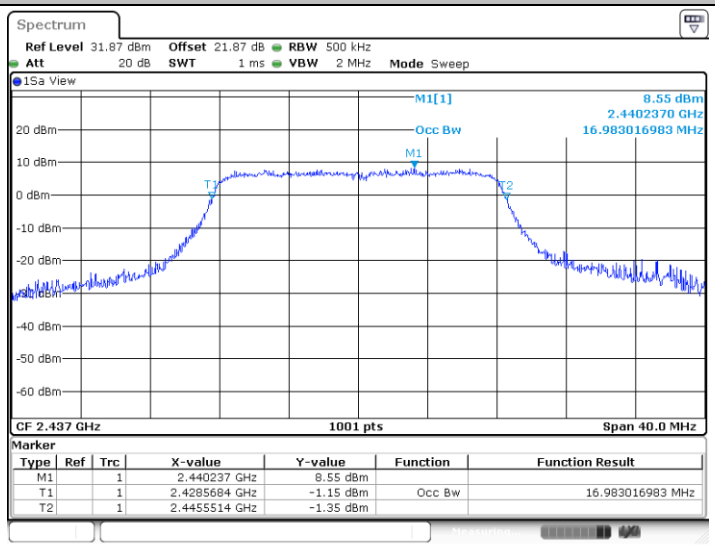
Date: 23.DEC.2024 08:18:17

11G_Ant1_2412



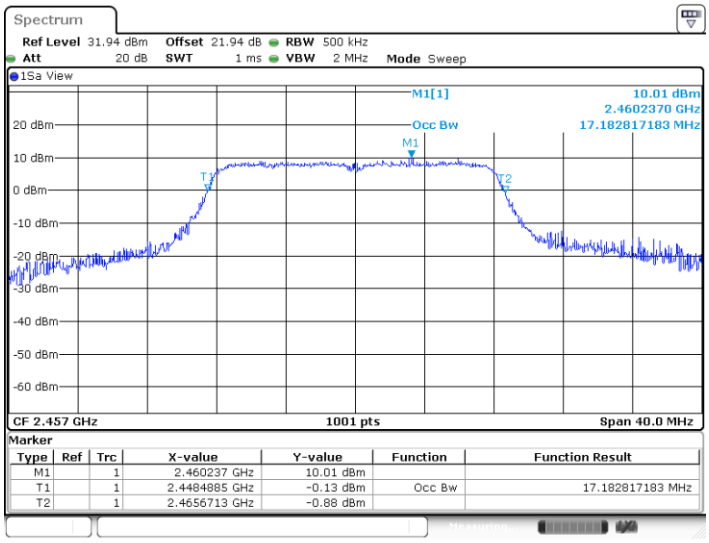
Date: 23.DEC.2024 08:19:42

11G_Ant1_2437



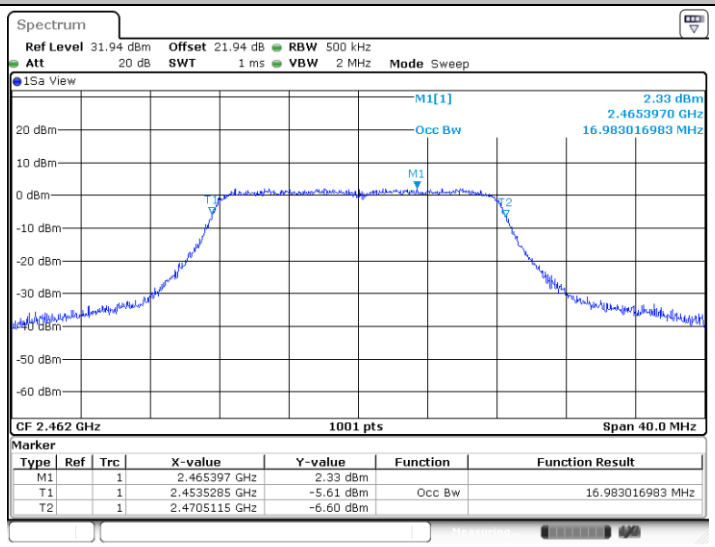
Date: 23.DEC.2024 08:21:00

11G_Ant1_2457



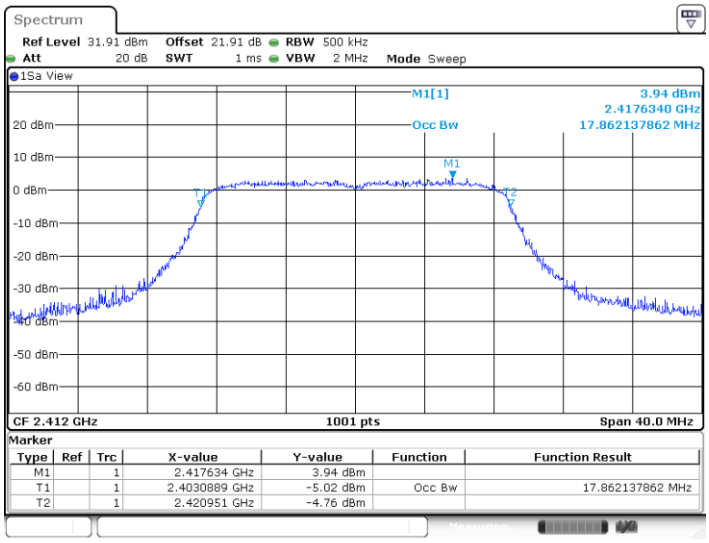
Date: 2.JAN.2025 19:23:13

11G_Ant1_2462



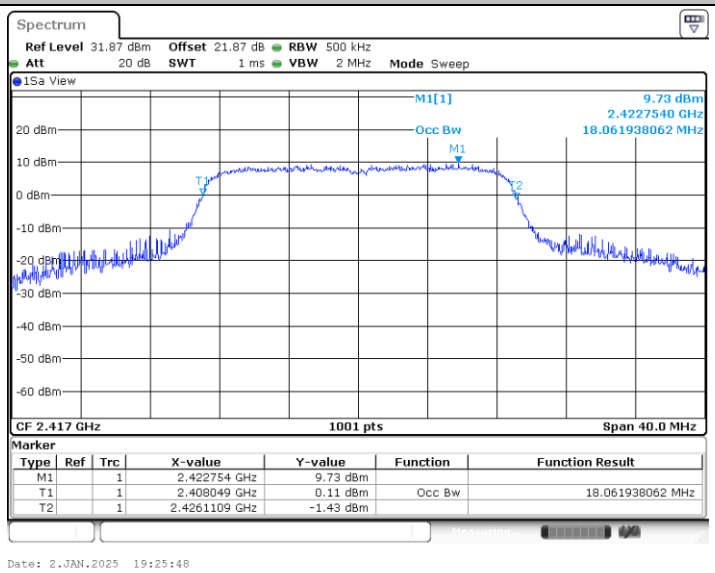
Date: 23.DEC.2024 08:22:12

11N20SISO_Ant1_2412

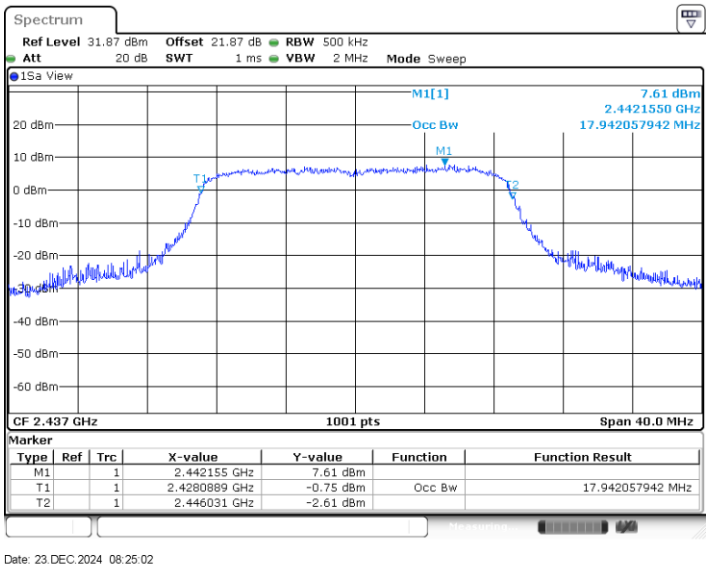


Date: 23.DEC.2024 08:23:40

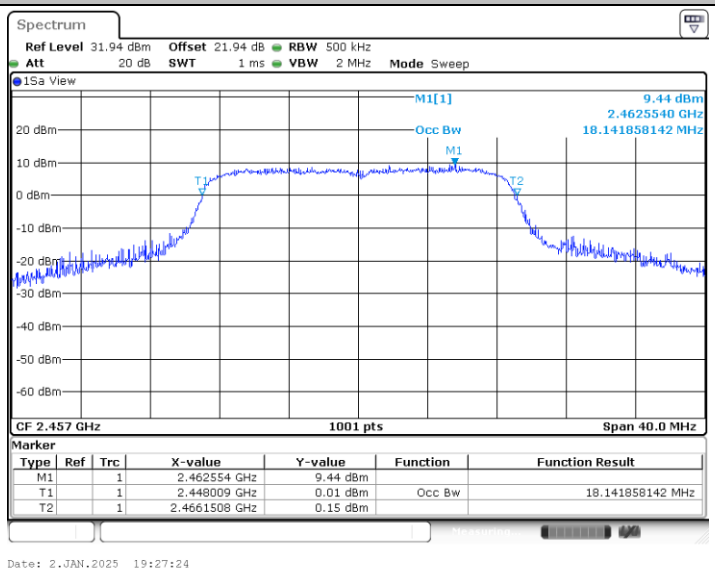
11N20SISO_Ant1_2417



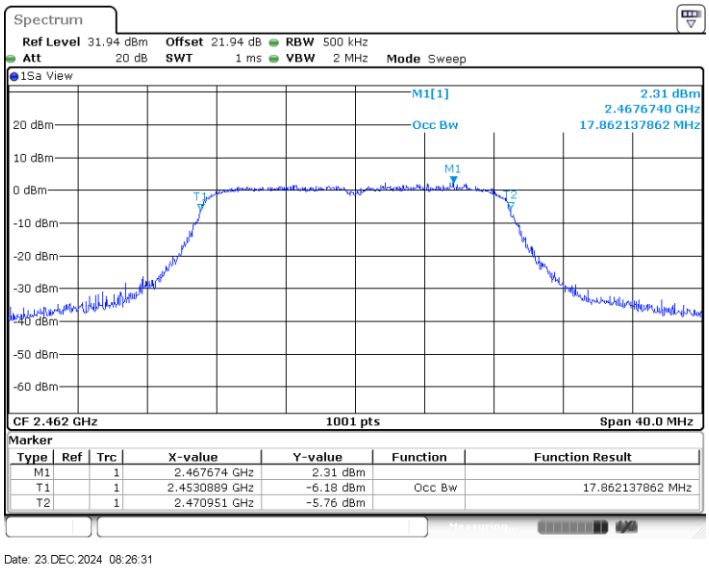
11N20SISO_Ant1_2437



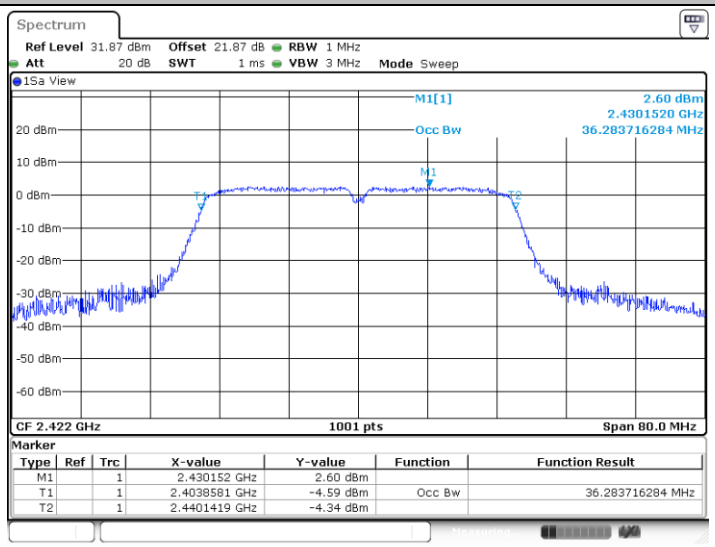
11N20SISO_Ant1_2457



11N20SISO_Ant1_2462

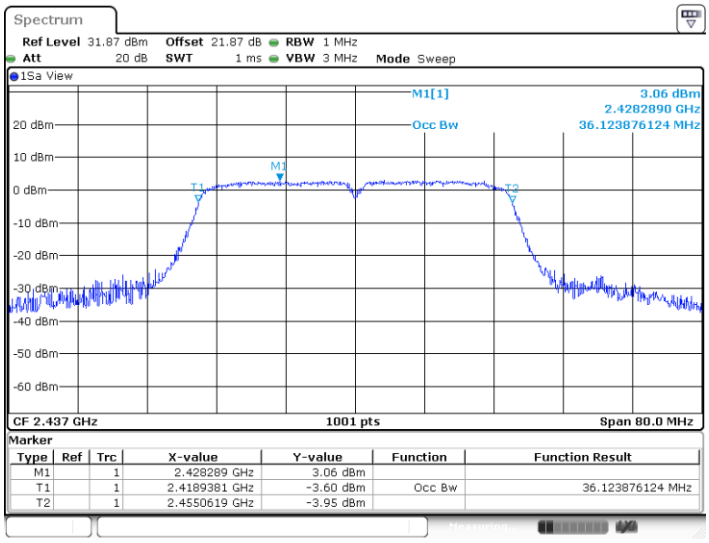


11N40SISO_Ant1_2422



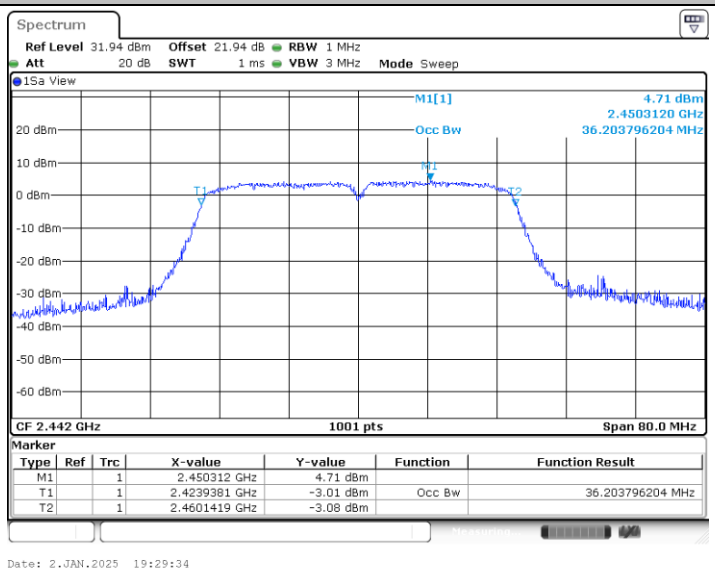
Date: 23.DEC.2024 08:28:03

11N40SISO_Ant1_2437

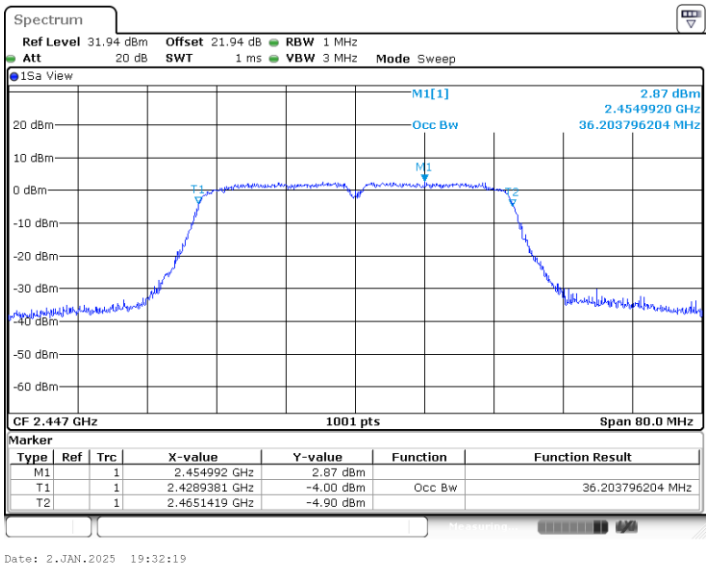


Date: 23.DEC.2024 08:29:23

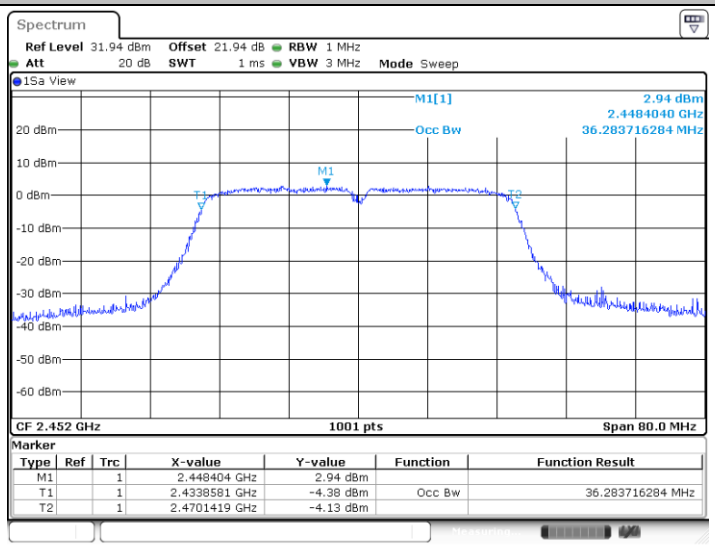
11N40SISO_Ant1_2442



11N40SISO_Ant1_2447

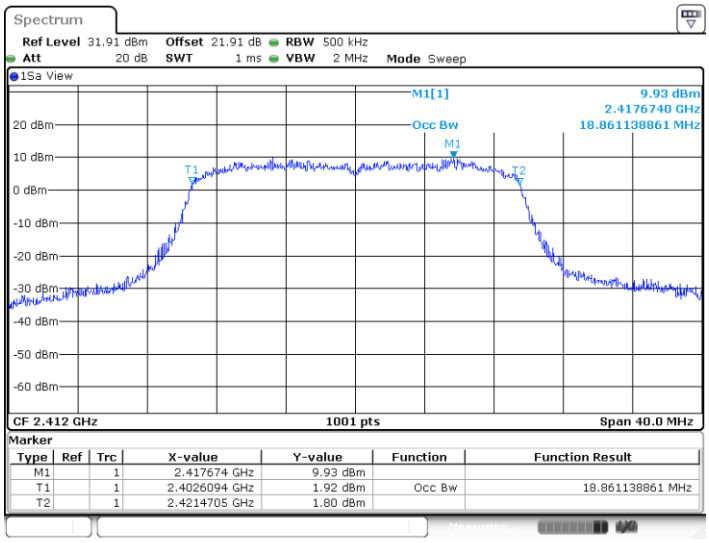


11N40SISO_Ant1_2452



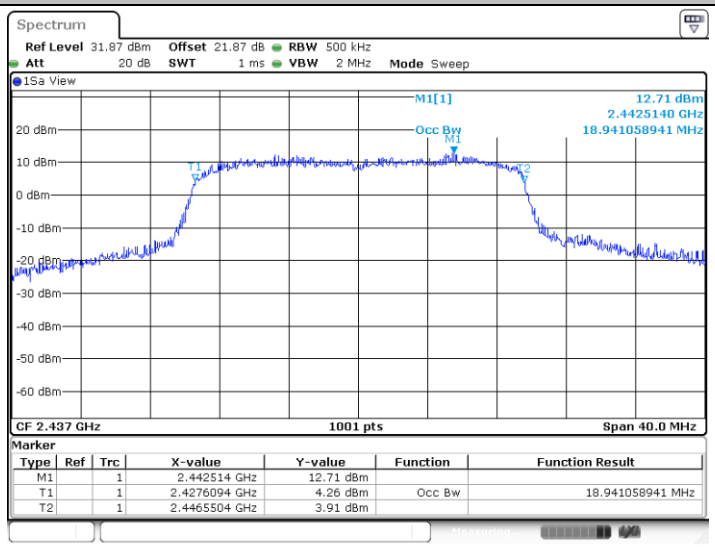
Date: 23.DEC.2024 08:56:30

11AX20SISO_Ant1_2412

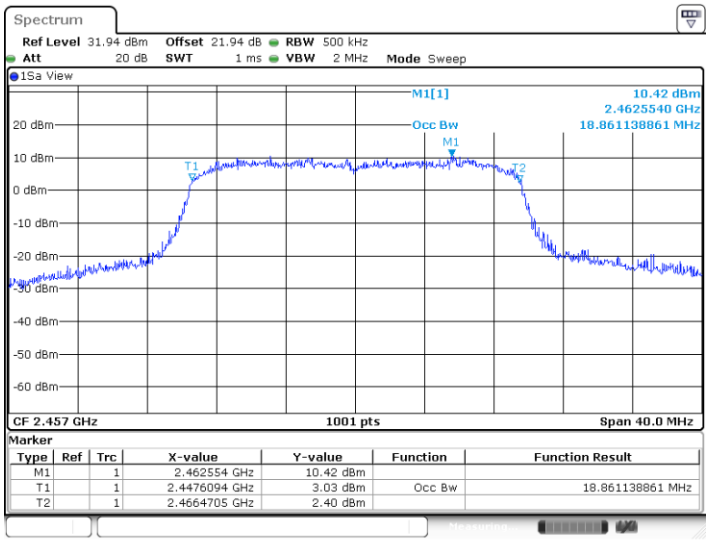


Date: 23.DEC.2024 08:58:20

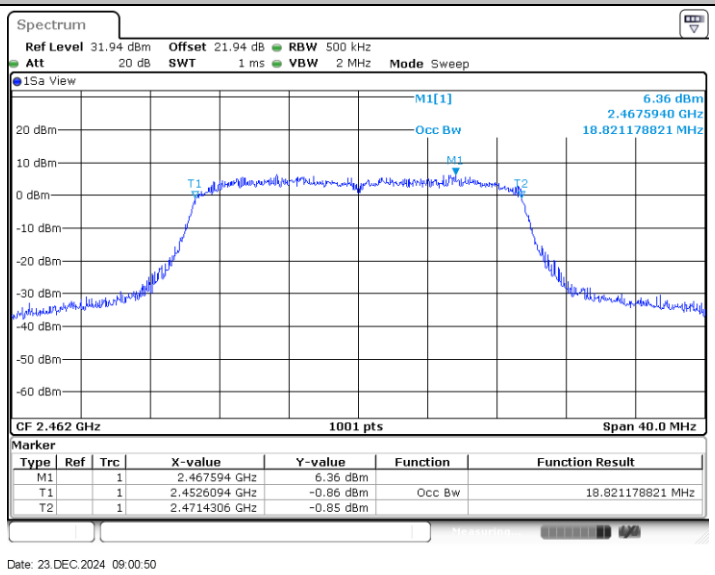
11AX20SISO_Ant1_2437



11AX20SISO_Ant1_2457



11AX20SISO_Ant1_2462



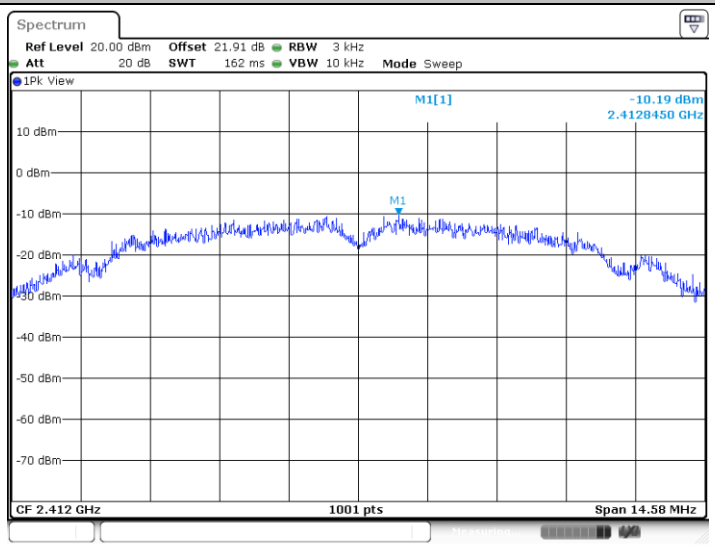
Maximum power spectral density

Test Result

TestMode	Antenna	Freq(MHz)	Result [dBm/3kHz]	Limit [dBm/3kHz]	Verdict
11B	Ant1	2412	-10.19	≤8.00	PASS
		2437	-8.2	≤8.00	PASS
		2462	-9.89	≤8.00	PASS
11G	Ant1	2412	-14.68	≤8.00	PASS
		2437	-11.37	≤8.00	PASS
		2457	-9.9	≤8.00	PASS
		2462	-16.63	≤8.00	PASS
11N20SISO	Ant1	2412	-14.59	≤8.00	PASS
		2417	-8.82	≤8.00	PASS
		2437	-11.48	≤8.00	PASS
		2457	-9.86	≤8.00	PASS
		2462	-17.05	≤8.00	PASS
11N40SISO	Ant1	2422	-18.45	≤8.00	PASS
		2437	-18.69	≤8.00	PASS
		2442	-16.92	≤8.00	PASS
		2447	-19.13	≤8.00	PASS
		2452	-19.01	≤8.00	PASS
11AX20SISO	Ant1	2412	-11.4	≤8.00	PASS
		2437	-8.97	≤8.00	PASS
		2457	-11.16	≤8.00	PASS
		2462	-14.84	≤8.00	PASS

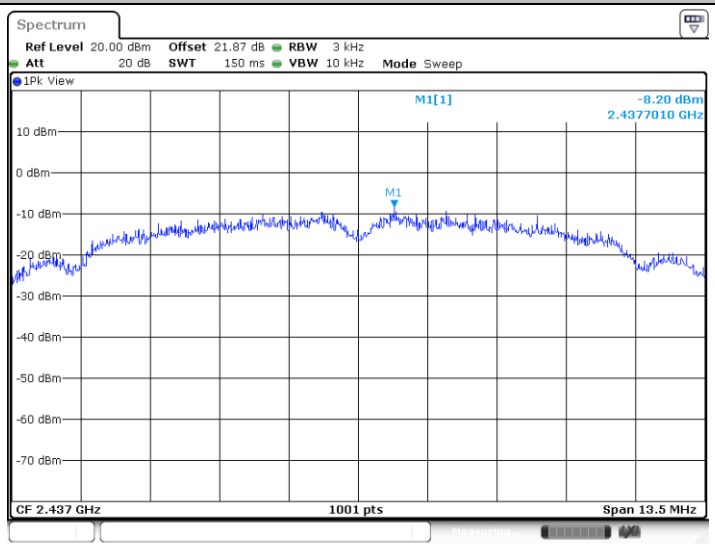
Test Graphs

11B_Ant1_2412



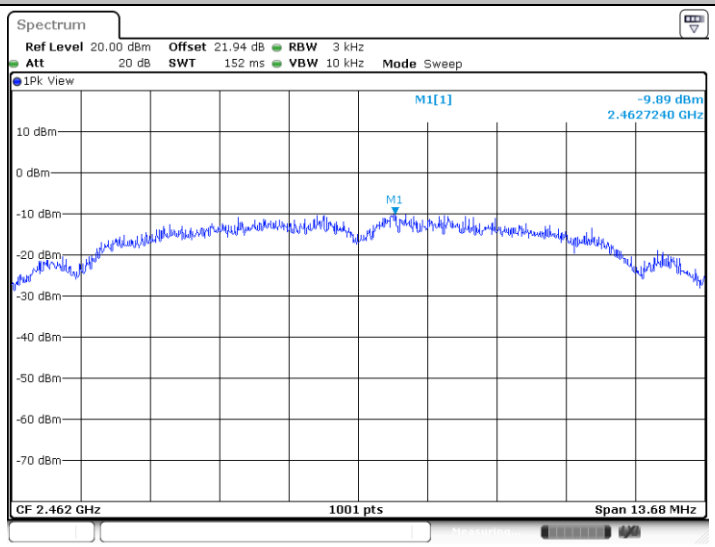
Date: 23.DEC.2024 08:14:16

11B_Ant1_2437



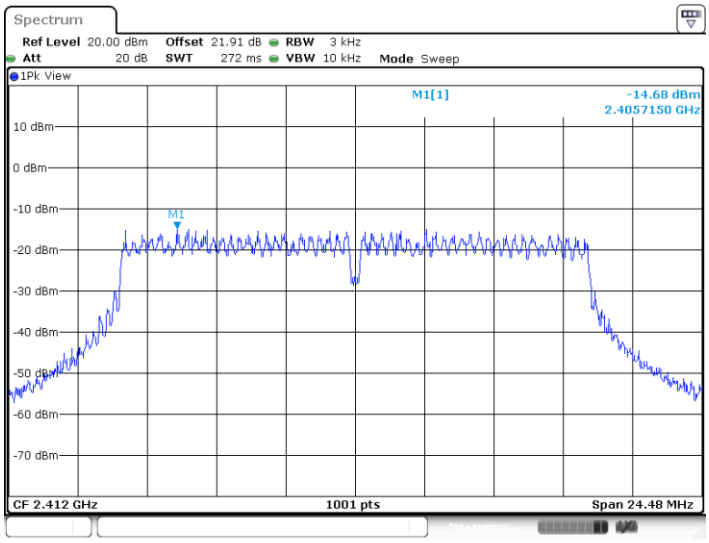
Date: 23.DEC.2024 08:15:32

11B_Ant1_2462



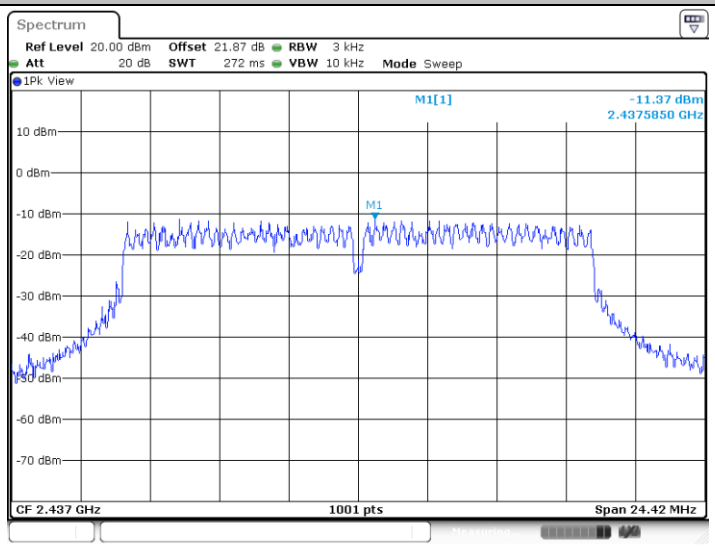
Date: 23.DEC.2024 08:18:28

11G_Ant1_2412



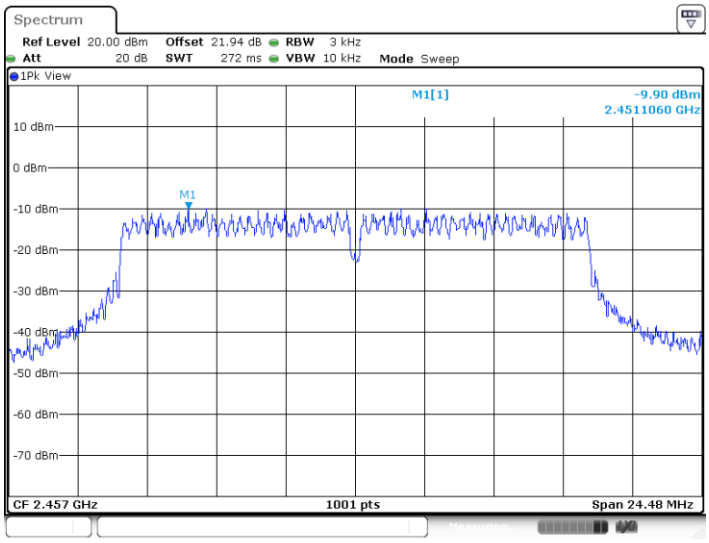
Date: 23.DEC.2024 08:19:53

11G_Ant1_2437



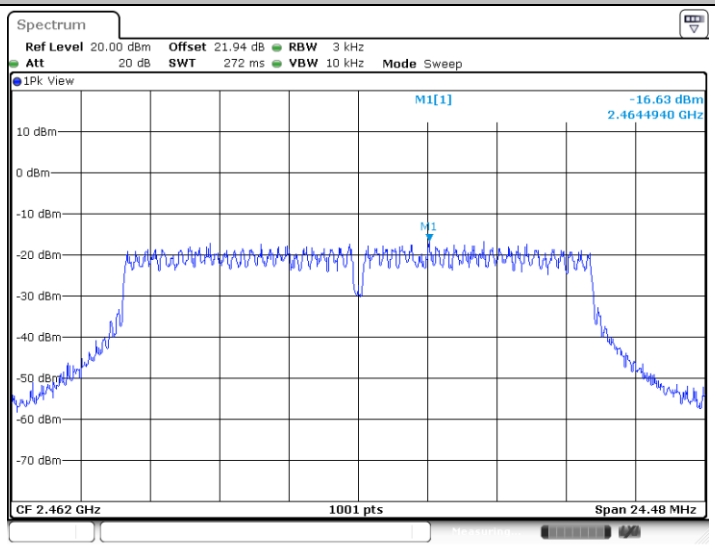
Date: 23.DEC.2024 08:21:10

11G_Ant1_2457



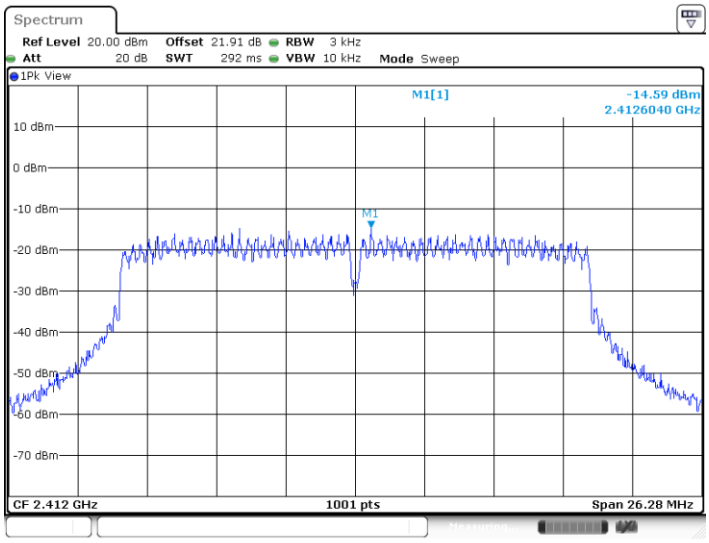
Date: 2.JAN.2025 19:23:24

11G_Ant1_2462



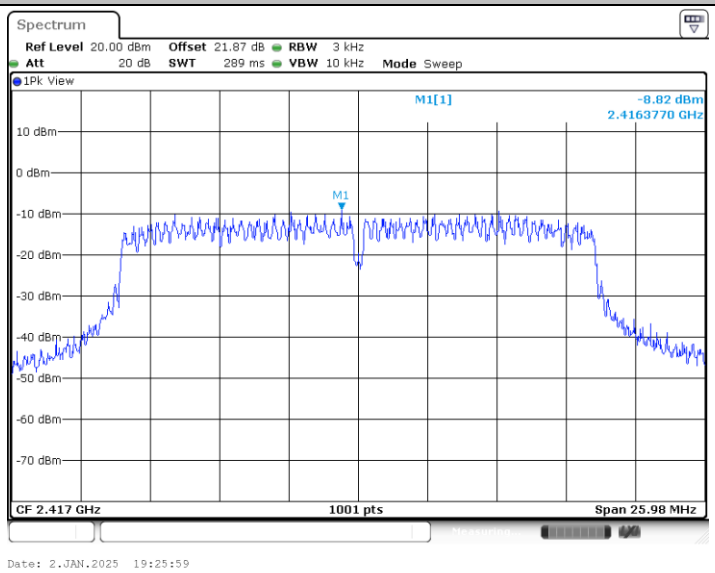
Date: 23.DEC.2024 08:22:22

11N20SISO_Ant1_2412

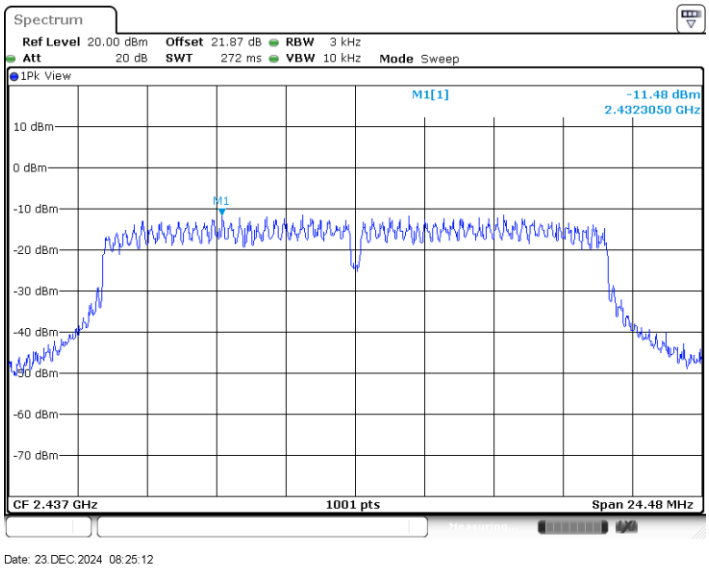


Date: 23.DEC.2024 08:23:51

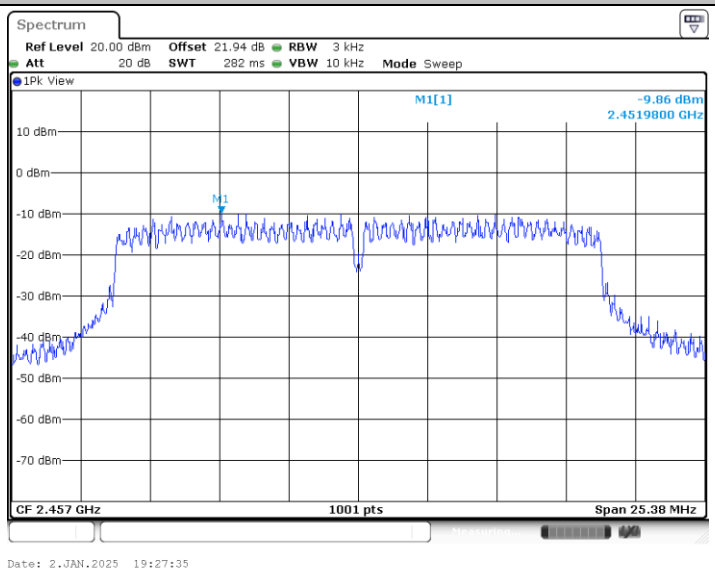
11N20SISO_Ant1_2417



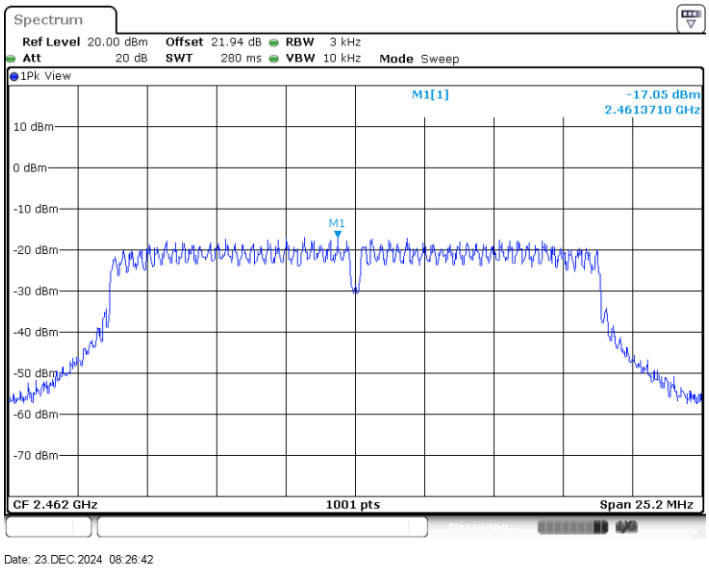
11N20SISO_Ant1_2437



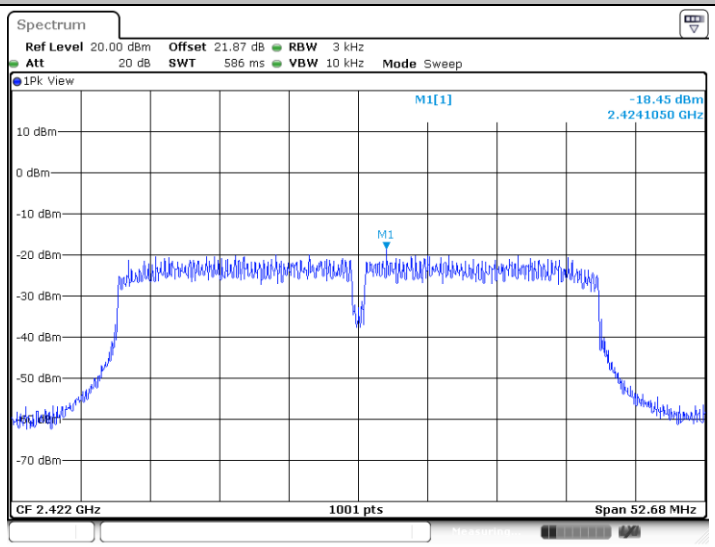
11N20SISO_Ant1_2457



11N20SISO_Ant1_2462

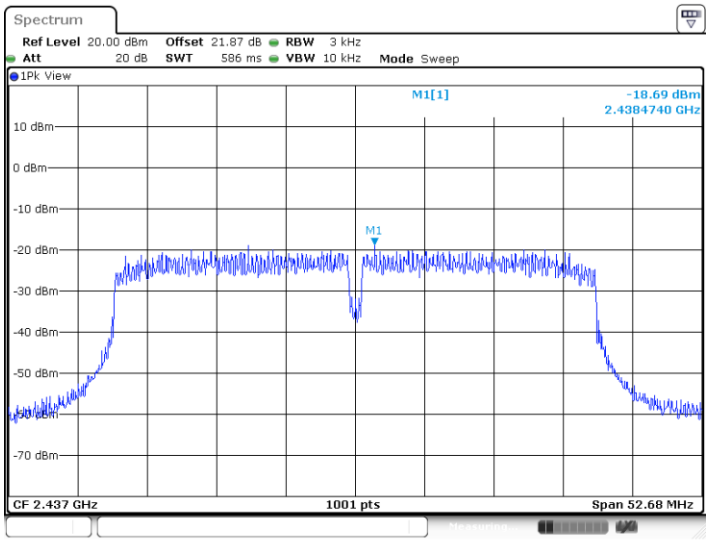


11N40SISO_Ant1_2422



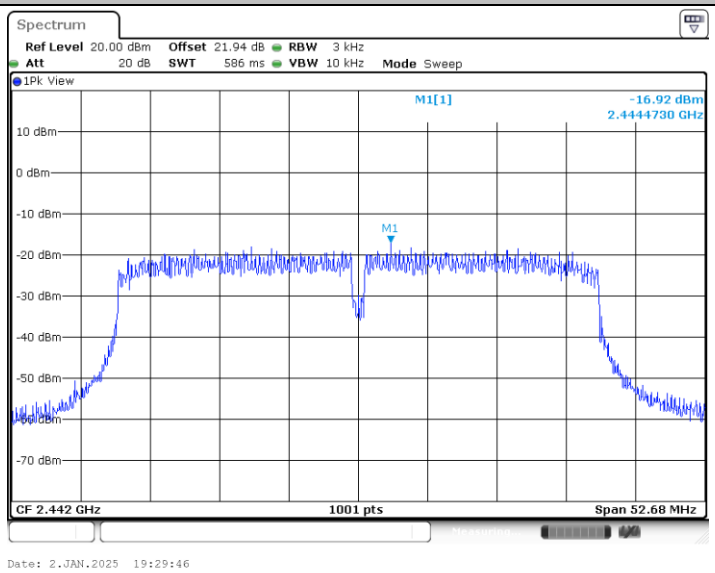
Date: 23.DEC.2024 08:28:13

11N40SISO_Ant1_2437

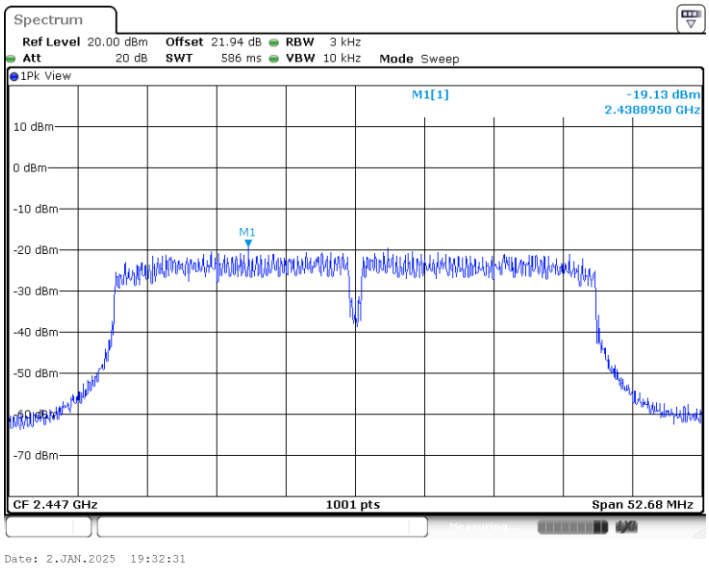


Date: 23.DEC.2024 08:29:34

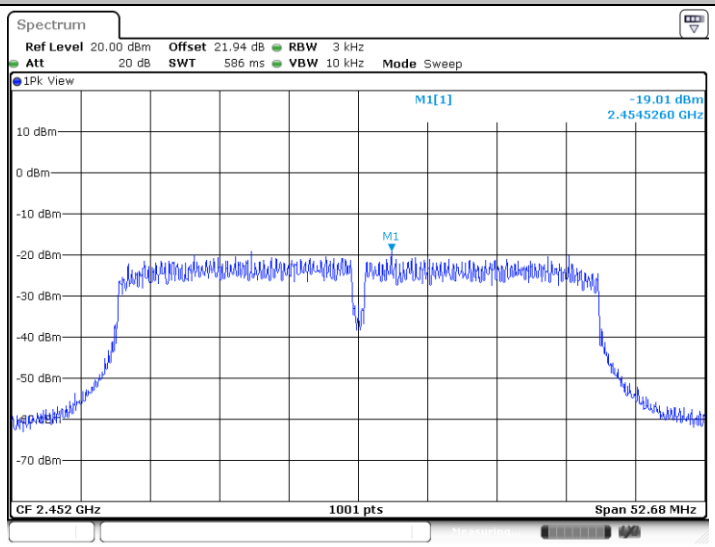
11N40SISO_Ant1_2442



11N40SISO_Ant1_2447

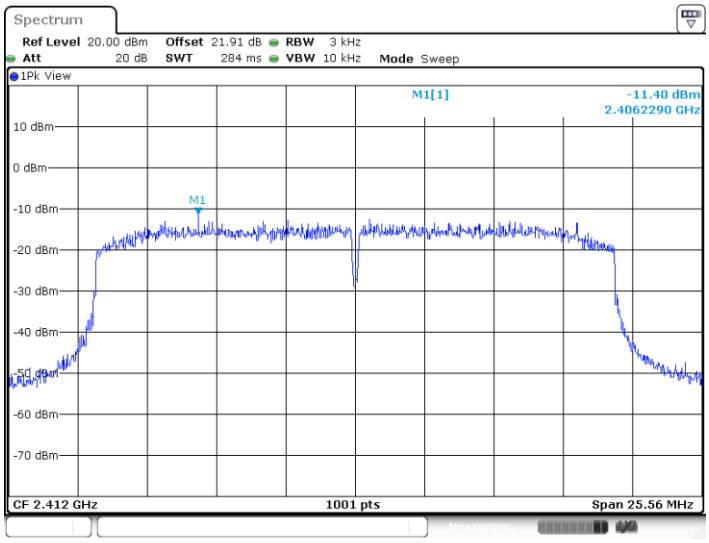


11N40SISO_Ant1_2452



Date: 23.DEC.2024 08:56:41

11AX20SISO_Ant1_2412



Date: 23.DEC.2024 08:58:31