



FCC RF Test Report

APPLICANT : Quectel Wireless Solutions Co., Ltd.
EQUIPMENT : Wi-Fi & Bluetooth Module
BRAND NAME : QUECTEL
MODEL NAME : FCS851U
FCC ID : XMR2023FCS851U
STANDARD : FCC Part 15 Subpart C §15.247
CLASSIFICATION : (DTS) Digital Transmission System
TEST DATE(S) : Aug. 10, 2023 ~ Apr. 10, 2024

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



Sporton International Inc. (Kunshan)

No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300
People's Republic of China



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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR371207C	Rev. 01	Initial issue of report	May 23, 2024

SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.247(a)(2)	6dB Bandwidth	$\geq 0.5\text{MHz}$	Pass	-
3.1	-	99% Bandwidth	-	Report Only	-
3.2	15.247(b)	Power Output Measurement	$\leq 30\text{dBm}$	Pass	-
3.3	15.247(e)	Power Spectral Density	$\leq 8\text{dBm}/3\text{kHz}$	Pass	-
3.4	15.247(d)	Conducted Band Edges	$\leq 20\text{dBc}$	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 3.11 dB at 4924.00 MHz
3.6	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 6.28 dB at 0.558 MHz
3.7	15.203 & 15.247(b)	Antenna Requirement	15.203 & 15.247(b)	Pass	-

Conformity Assessment Condition:

- 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/manufacture who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
- 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

Quectel Wireless Solutions Co., Ltd.

Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai 200233, China

1.2 Manufacturer

Quectel Wireless Solutions Co., Ltd.

Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai 200233, China

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	Wi-Fi & Bluetooth Module
Brand Name	QUECTEL
Model Name	FCS851U
FCC ID	XMR2023FCS851U
SN Code	Conducted: MPY23E033000030 Conduction: E1N23FH06000133 Radiation: E1N23FH06000076
HW Version	R1.0
SW Version	N/A
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	<SISO Ant 0> 802.11b : 19.63 dBm (0.0918 W) 802.11g : 25.33 dBm (0.3412 W) <MIMO Ant 0+1> 802.11n HT20 : 27.61 dBm (0.5768 W) 802.11n HT40 : 24.40 dBm (0.2754 W)
99% Occupied Bandwidth	<SISO Ant 0> 802.11b : 12.108MHz 802.11g : 17.502MHz <MIMO Ant 0+1> 802.11n HT20 : 18.222MHz 802.11n HT40 : 36.364MHz
Antenna Type / Gain	Ant 0 : Dipole Antenna type with gain 0.73 dBi Ant 1 : Dipole Antenna type with gain 0.73 dBi
Type of Modulation	802.11b : DSSS (DBPSK / DQPSK / CCK) 802.11g/n : OFDM (BPSK / QPSK / 16QAM / 64QAM)

Note:

1. 802.11b/g mode supports SISO mode only of Ant.0.
2. For 802.11n WLAN SISO & MIMO mode, the whole testing has assessed only MIMO mode by referring to the higher normal output power.

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 03CH05-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.	03CH05-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
- ♦ 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 (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.

SISO Antenna

Modulation	Data Rate
802.11b	1 Mbps
802.11g	6 Mbps

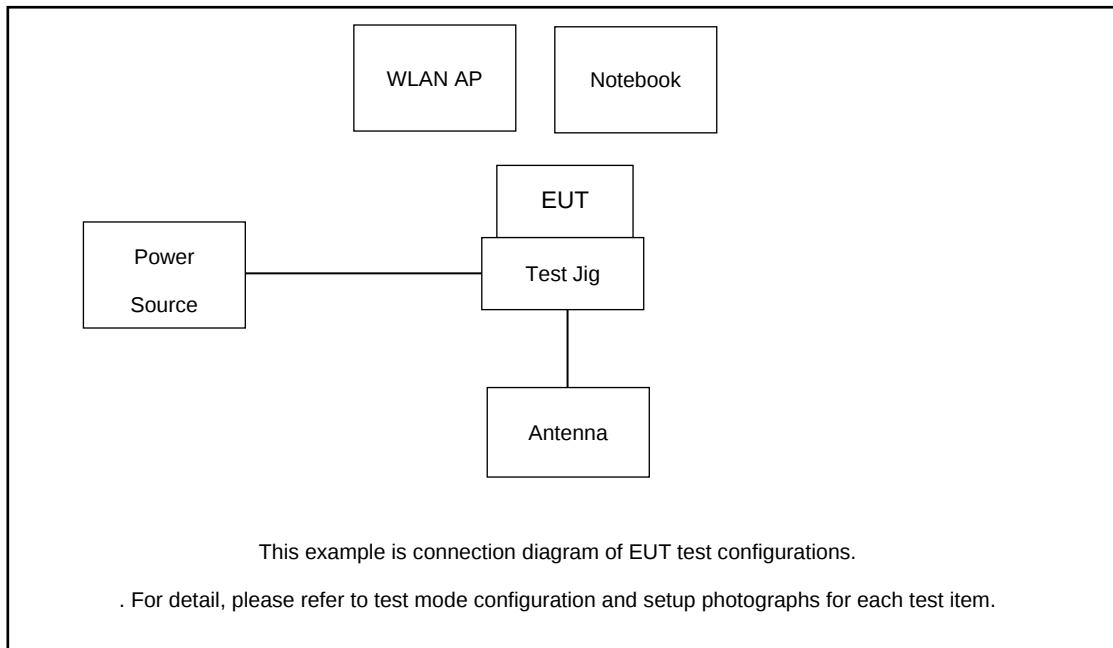
MIMO Antenna

Modulation	Data Rate
802.11n HT20	MCS0
802.11n HT40	MCS0

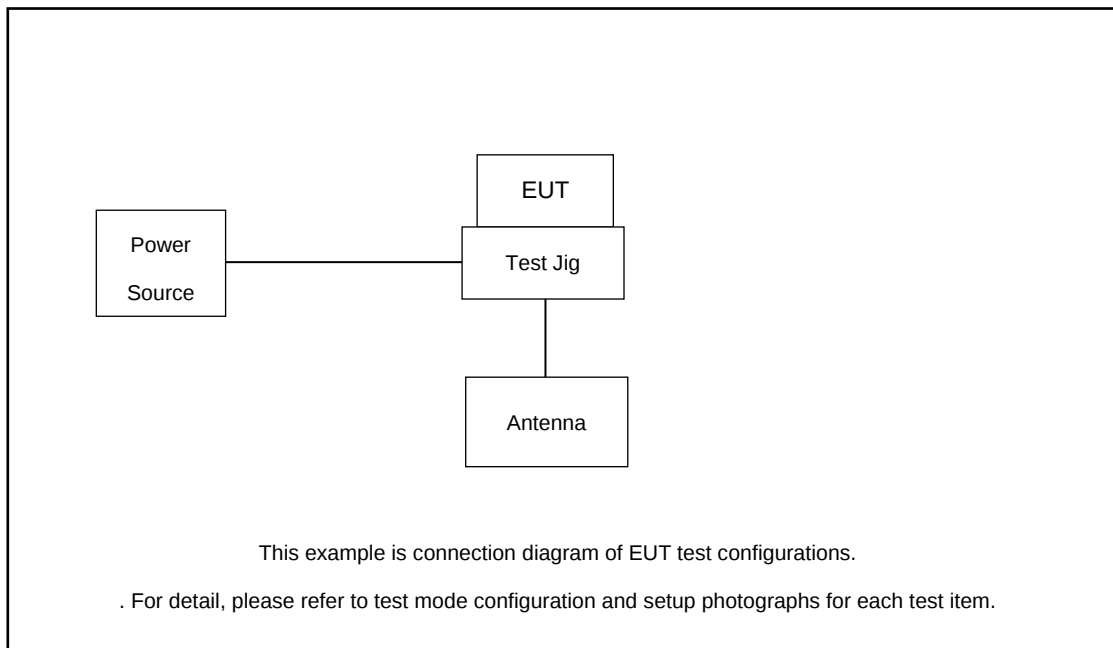
Test Cases	
AC Conducted Emission	Mode 1 :WLAN Link(2.4G) + Charging From Test Jig
Remark: For Radiated Test Cases, The tests were performed with Adapter.	

2.3 Connection Diagram of Test System

AC Conducted Emission:



Radiated Emission:



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.	Antenna	N/A	N/A	N/A	N/A	N/A
4.	Test Jig	N/A	N/A	N/A	N/A	N/A
5.	Adapter	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 1.71 dB and 10dB attenuator.

$$\begin{aligned}\text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)} \\ &= 1.71 + 10 = 11.71 \text{ (dB)}\end{aligned}$$

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.

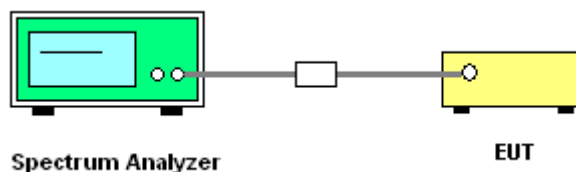
3.1.2 Measuring Instruments

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 times of 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.

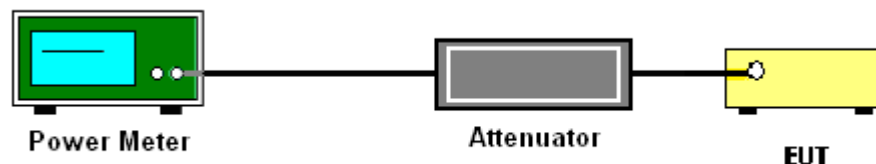
3.2.2 Measuring Instruments

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.
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

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
					Ant0	-	Ant0	-	Ant0	-	Ant0	-	Ant0	-	
11b	1Mbps	1	1	2412	19.63	-	30.00	-	0.73	-	20.36	-	36.00	-	Pass
11b	1Mbps	1	6	2437	17.23	-	30.00	-	0.73	-	17.96	-	36.00	-	Pass
11b	1Mbps	1	11	2462	18.23	-	30.00	-	0.73	-	18.96	-	36.00	-	Pass
11g	6Mbps	1	1	2412	22.86	-	30.00	-	0.73	-	23.59	-	36.00	-	Pass
11g	6Mbps	1	2	2417	24.94	-	30.00	-	0.73	-	25.67	-	36.00	-	Pass
11g	6Mbps	1	6	2437	25.33	-	30.00	-	0.73	-	26.06	-	36.00	-	Pass
11g	6Mbps	1	8	2447	24.81	-	30.00	-	0.73	-	25.54	-	36.00	-	Pass
11g	6Mbps	1	9	2452	24.12	-	30.00	-	0.73	-	24.85	-	36.00	-	Pass
11g	6Mbps	1	10	2457	23.31	-	30.00	-	0.73	-	24.04	-	36.00	-	Pass
11g	6Mbps	1	11	2462	20.47	-	30.00	-	0.73	-	21.20	-	36.00	-	Pass

2.4GHz Band MIMO																
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
					Ant0	Ant1	SUM	Ant0	Ant1	Ant0	Ant1	Ant0	Ant1	Ant0	Ant1	
HT20	MCS0	2	1	2412	16.82	16.95	19.90	30.00		0.73		20.63		36.00		Pass
HT20	MCS0	2	2	2417	20.93	20.16	23.57	30.00		0.73		24.30		36.00		Pass
HT20	MCS0	2	3	2422	23.56	25.43	27.61	30.00		0.73		28.34		36.00		Pass
HT20	MCS0	2	6	2437	23.87	23.18	26.55	30.00		0.73		27.28		36.00		Pass
HT20	MCS0	2	7	2442	23.34	23.49	26.43	30.00		0.73		27.16		36.00		Pass
HT20	MCS0	2	8	2447	23.31	23.53	26.43	30.00		0.73		27.16		36.00		Pass
HT20	MCS0	2	9	2452	21.92	21.76	24.85	30.00		0.73		25.58		36.00		Pass
HT20	MCS0	2	10	2457	17.42	19.49	21.59	30.00		0.73		22.32		36.00		Pass
HT20	MCS0	2	11	2462	15.66	16.21	18.95	30.00		0.73		19.68		36.00		Pass
HT40	MCS0	2	3	2422	16.14	16.12	19.14	30.00		0.73		19.87		36.00		Pass
HT40	MCS0	2	4	2427	17.33	17.38	20.37	30.00		0.73		21.10		36.00		Pass
HT40	MCS0	2	5	2432	21.12	21.38	24.26	30.00		0.73		24.99		36.00		Pass
HT40	MCS0	2	6	2437	21.48	21.29	24.40	30.00		0.73		25.13		36.00		Pass
HT40	MCS0	2	7	2442	17.99	17.92	20.97	30.00		0.73		21.70		36.00		Pass
HT40	MCS0	2	8	2447	16.83	17.31	20.09	30.00		0.73		20.82		36.00		Pass
HT40	MCS0	2	9	2452	15.92	16.56	19.26	30.00		0.73		19.99		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	
					Ant 0	-	Ant 0	-	Ant 0	-	Ant 0	-	Ant 0	-	Ant 0	-		Ant 0	-
11b	1Mbps	1	1	2412	0.05	-	15.89	-	30.00	-	0.73	-	16.62	-	36.00	-	Pass	28.00	-
11b	1Mbps	1	6	2437	0.05	-	13.41	-	30.00	-	0.73	-	14.14	-	36.00	-	Pass	46.00	-
11b	1Mbps	1	11	2462	0.05	-	14.61	-	30.00	-	0.73	-	15.34	-	36.00	-	Pass	34.00	-
11g	6Mbps	1	1	2412	0.31	-	15.63	-	30.00	-	0.73	-	16.36	-	36.00	-	Pass	34.00	-
11g	6Mbps	1	2	2417	0.31	-	18.82	-	30.00	-	0.73	-	19.55	-	36.00	-	Pass	6.00	-
11g	6Mbps	1	6	2437	0.31	-	19.08	-	30.00	-	0.73	-	19.81	-	36.00	-	Pass	6.00	-
11g	6Mbps	1	8	2447	0.31	-	18.65	-	30.00	-	0.73	-	19.38	-	36.00	-	Pass	8.00	-
11g	6Mbps	1	9	2452	0.31	-	17.32	-	30.00	-	0.73	-	18.05	-	36.00	-	Pass	20.00	-
11g	6Mbps	1	10	2457	0.31	-	16.22	-	30.00	-	0.73	-	16.95	-	36.00	-	Pass	30.00	-
11g	6Mbps	1	11	2462	0.31	-	13.29	-	30.00	-	0.73	-	14.02	-	36.00	-	Pass	52.00	-

2.4GHz Band MIMO																				
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	
					Ant 0	Ant 1	Ant 0	Ant 1	SUM	Ant 0	Ant 1	Ant 0	Ant 1	Ant 0	Ant 1	Ant 0	Ant 1		Ant 0	Ant 1
HT20	MCS0	2	1	2412	0.31	0.33	9.38	9.56	12.48	30.00		0.73		13.21		36.00		Pass	85.00	
HT20	MCS0	2	2	2417	0.31	0.33	12.11	12.87	15.52	30.00		0.73		16.25		36.00		Pass	60.00	
HT20	MCS0	2	3	2422	0.31	0.33	15.97	17.09	19.58	30.00		0.73		20.31		36.00		Pass	32.00	
HT20	MCS0	2	6	2437	0.31	0.33	15.50	16.00	18.77	30.00		0.73		19.50		36.00		Pass	33.00	
HT20	MCS0	2	7	2442	0.31	0.33	16.19	16.74	19.48	30.00		0.73		20.21		36.00		Pass	28.00	
HT20	MCS0	2	8	2447	0.31	0.33	16.13	16.86	19.52	30.00		0.73		20.25		36.00		Pass	29.00	
HT20	MCS0	2	9	2452	0.31	0.33	13.97	14.04	17.02	30.00		0.73		17.75		36.00		Pass	47.00	
HT20	MCS0	2	10	2457	0.31	0.33	10.07	10.47	13.28	30.00		0.73		14.01		36.00		Pass	78.00	
HT20	MCS0	2	11	2462	0.31	0.33	8.50	9.00	11.77	30.00		0.73		12.50		36.00		Pass	93.00	
HT40	MCS0	2	3	2422	0.67	0.64	8.62	9.31	11.99	30.00		0.73		12.72		36.00		Pass	90.00	
HT40	MCS0	2	4	2427	0.67	0.64	10.32	10.26	13.30	30.00		0.73		14.03		36.00		Pass	80.00	
HT40	MCS0	2	5	2432	0.67	0.64	14.29	14.63	17.47	30.00		0.73		18.20		36.00		Pass	44.00	
HT40	MCS0	2	6	2437	0.67	0.64	13.82	14.20	17.02	30.00		0.73		17.75		36.00		Pass	48.00	
HT40	MCS0	2	7	2442	0.67	0.64	10.78	11.21	14.01	30.00		0.73		14.74		36.00		Pass	74.00	
HT40	MCS0	2	8	2447	0.67	0.64	9.74	10.38	13.08	30.00		0.73		13.81		36.00		Pass	80.00	
HT40	MCS0	2	9	2452	0.67	0.64	8.91	9.21	12.07	30.00		0.73		12.80		36.00		Pass	88.00	

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.

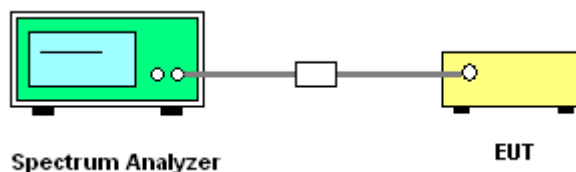
3.3.3 Test Procedures

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.
7. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01:

Method (b): Measure and sum spectral maxima across the outputs.

The measurement on each individual output were performed with the same span and number on each individual output. The maximum value (peak) of each spectrum is determined. These maximum values are then summed mathematically in linear power units across the outputs.

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 / 30dB relative to the maximum PSD level in 100 kHz by RF conducted measurement.

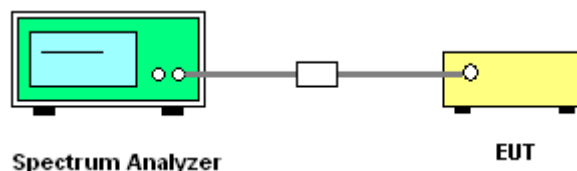
3.4.2 Measuring Instruments

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

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

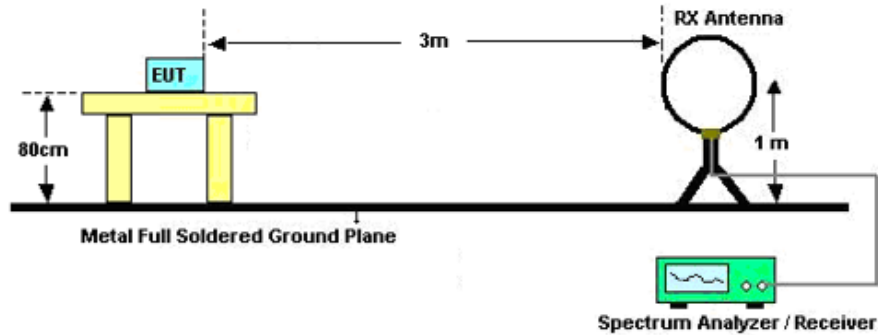
The measuring equipment is listed in the section 4 of this test report.

3.5.3 Test Procedures

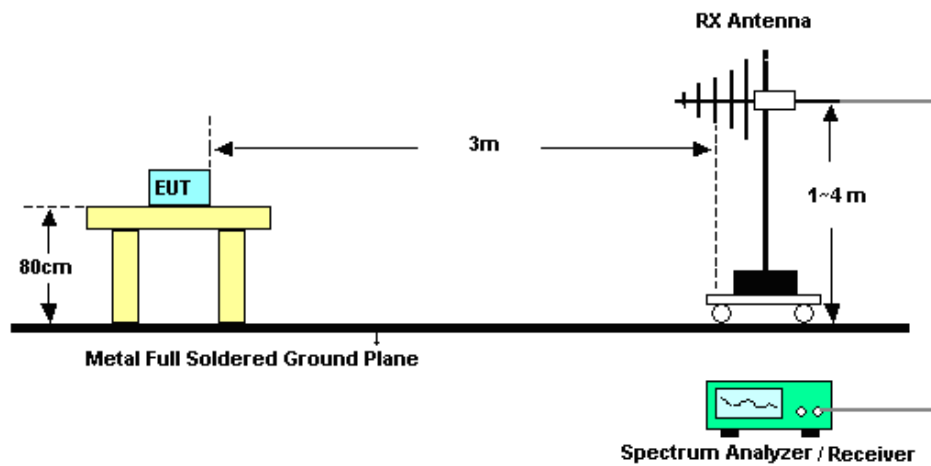
1. The testing follows ANSI C63.10-2013 clause 11.11 & 11.12
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better 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 $\geq$ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
 - (3) Set RBW = 1 MHz, VBW= 3MHz for $f \geq 1$ GHz for peak measurement.
For average measurement:
 - VBW = 10 Hz, when duty cycle is no less than 98 percent.
 - VBW $\geq 1/T$, 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

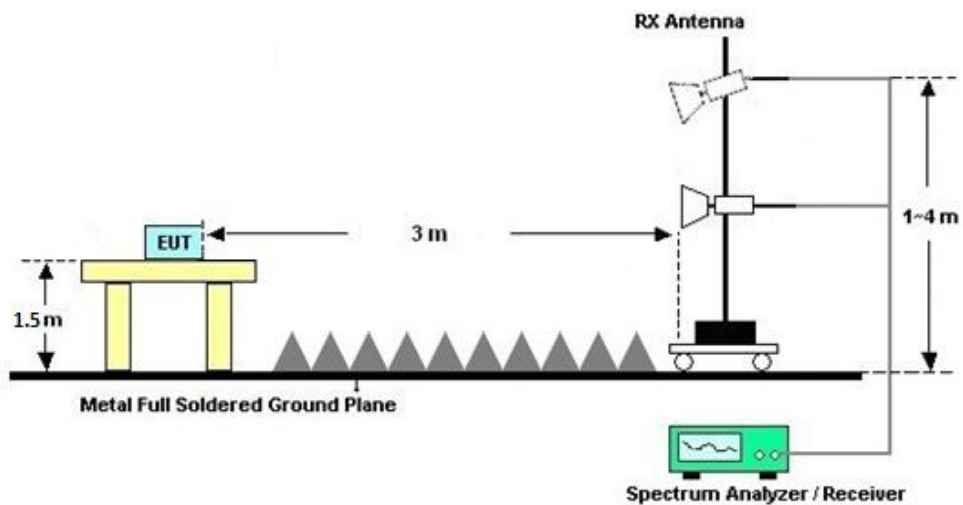
For radiated emissions below 30MHz



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 (dB μ V)	
	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.

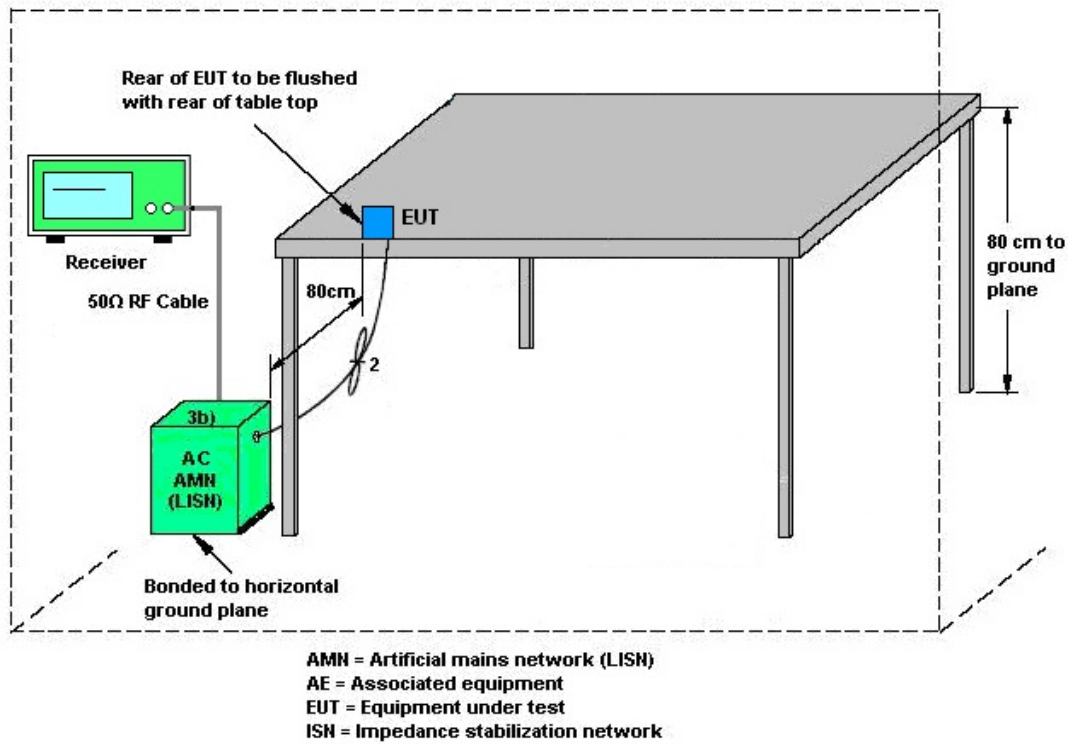
3.6.2 Measuring Instruments

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

Non-standard antenna connector is used.

3.7.3 Antenna Gain

<CDD Modes >

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

For CDD transmissions, directional gain is calculated as

Directional gain = G_{ANT} + Array Gain, where Array Gain is as follows.

For power spectral density (PSD) measurements on all devices,

Array Gain = $10 \log(N_{ANT}/N_{SS}=1)$ dB.

For power measurements on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$.

Directional gain may be calculated by using the formulas applicable to equal gain antennas with

G_{ANT} set equal to the gain of the antenna having the highest gain;

The EUT supports CDD mode.

For power, the directional gain G_{ANT} is set equal to the antenna having the highest gain, i.e., F)2)f)i).

For PSD, the directional gain calculation is following F)2)f)ii) of KDB 662911 D01 v02r01.

The power and PSD limit should be modified if the directional gain of EUT is over 6 dBi,

The directional gain "DG" is calculated as following table.

<CDD Modes>						
			DG for Power (dBi)	DG for PSD (dBi)	Power Limit Reduction (dB)	PSD Limit Reduction (dB)
	Ant. 0 (dBi)	Ant. 1 (dBi)				
2.4 GHz	0.73	0.73	0.73	3.74	0.00	0.00

Power Limit Reduction = $DG(Power) - 6dBi$, (min = 0)

PSD Limit Reduction = $DG(PSD) - 6dBi$, (min = 0)



4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
EMI Test Receiver	Keysight	N9038A	MY56400004	3Hz~8.5GHz;Max 30dBm	Oct. 10, 2023	Apr. 05, 2024	Oct. 09, 2024	Radiation (03CH05-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY55150244	10Hz~44G,MAX 30dB	Mar. 23, 2024	Apr. 05, 2024	Mar. 22, 2025	Radiation (03CH05-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 10, 2023	Apr. 05, 2024	Oct. 09, 2024	Radiation (03CH05-KS)
Bilog Antenna	TeseQ	CBL6111D	49922	30MHz~1GHz	Apr. 09, 2023	Apr. 05, 2024	Apr. 08, 2024	Radiation (03CH05-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	00218642	1GHz~18GHz	Apr. 06, 2023	Apr. 05, 2024	Apr. 05, 2024	Radiation (03CH05-KS)
SHF-EHF Horn	Com-power	AH-840	101093	18GHz~40GHz	Jan. 05, 2024	Apr. 05, 2024	Jan. 04, 2025	Radiation (03CH05-KS)
Amplifier	SONOMA	310N	380826	9KHz~1GHz	Jul. 06, 2023	Apr. 05, 2024	Jul. 05, 2024	Radiation (03CH05-KS)
Amplifier	EM	EM18G40GA	060852	18~40GHz	Jan. 05, 2024	Apr. 05, 2024	Jan. 04, 2025	Radiation (03CH05-KS)
high gain Amplifier	EM	EM01G18GA	060839	1Ghz~18Ghz	Oct. 10, 2023	Apr. 05, 2024	Oct. 09, 2024	Radiation (03CH05-KS)
Amplifier	EM	EM01G18GA	060833	1Ghz~18Ghz	Jan. 03, 2024	Apr. 05, 2024	Jan. 02, 2025	Radiation (03CH05-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Apr. 05, 2024	NCR	Radiation (03CH05-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Apr. 05, 2024	NCR	Radiation (03CH05-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Apr. 05, 2024	NCR	Radiation (03CH05-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	May 16, 2023	Aug. 10, 2023	May 15, 2024	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060103	9kHz~30MHz	Oct. 13, 2022	Aug. 10, 2023	Oct. 12, 2023	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060105	9kHz~30MHz	May 16, 2023	Aug. 10, 2023	May 15, 2024	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP000000811	AC 0V~300V, 45Hz~1000Hz	Oct. 12, 2022	Aug. 10, 2023	Oct. 11, 2023	Conduction (CO01-KS)
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Oct. 11, 2023	Apr. 10, 2024	Oct. 10, 2024	Conducted (TH01-KS)
Pulse Power Sensor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 02, 2024	Apr. 10, 2024	Jan. 01, 2025	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 02, 2024	Apr. 10, 2024	Jan. 01, 2025	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	±2.26 dB
Occupied Channel Bandwidth	±0.1%
Conducted Power	±0.46 dB
Conducted Power Spectral Density	±0.88 dB
Frequency	±0.4 ppm

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))	6.28 dB
---	---------

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	4.88 dB
---	---------

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

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



Appendix A. Conducted Test Results



Ambient Condition: 25 °C, 45 %RH

According Standard: ■Part15C

Test Date: 2024.4.10

Test Engineer: Gene Wang

DTS Bandwidth

Test Result

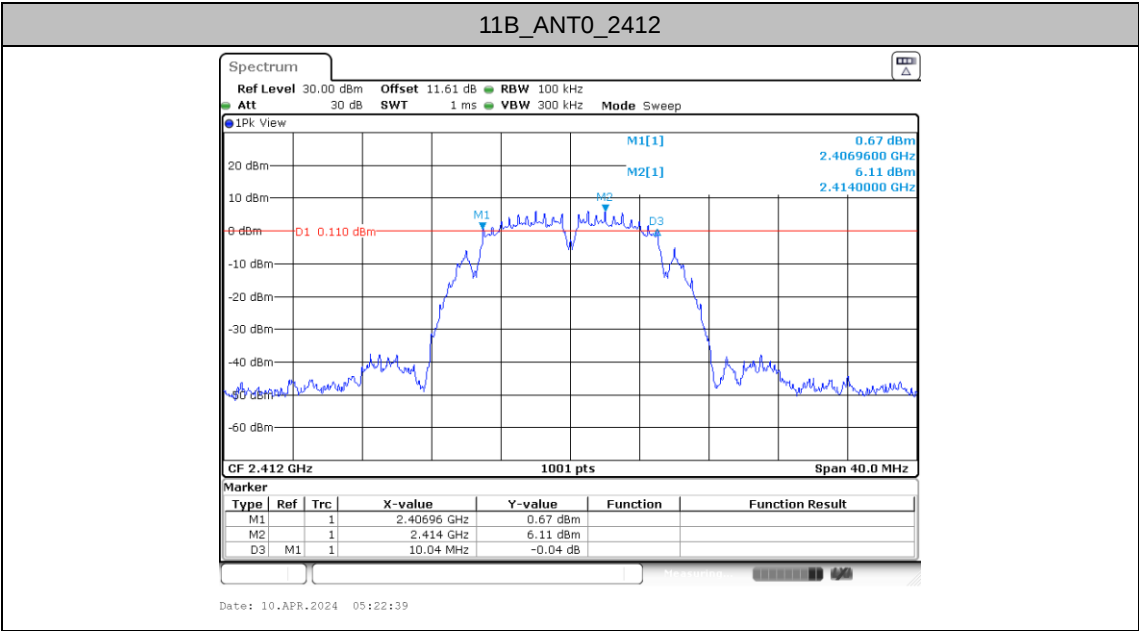
TestMode	Antenna	Freq(MHz)	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11B	ANT0	2412	10.04	2406.96	2417.00	0.5	PASS
	ANT0	2437	10.04	2431.96	2442.00	0.5	PASS
	ANT0	2462	10.04	2457.00	2467.04	0.5	PASS
11G	ANT0	2412	16.32	2403.84	2420.16	0.5	PASS
	ANT0	2417	16.36	2408.84	2425.20	0.5	PASS
	ANT0	2437	16.32	2428.84	2445.16	0.5	PASS
	ANT0	2447	16.28	2438.88	2455.16	0.5	PASS
	ANT0	2452	16.32	2443.84	2460.16	0.5	PASS
	ANT0	2457	16.32	2448.84	2465.16	0.5	PASS
	ANT0	2462	16.36	2453.84	2470.20	0.5	PASS
11N20MIMO	ANT0	2412	17.16	2403.60	2420.76	0.5	PASS
	ANT1	2412	17.60	2403.20	2420.80	0.5	PASS
	ANT0	2417	17.08	2408.48	2425.56	0.5	PASS
	ANT1	2417	17.52	2408.24	2425.76	0.5	PASS
	ANT0	2422	17.16	2413.40	2430.56	0.5	PASS
	ANT1	2422	17.60	2413.20	2430.80	0.5	PASS
	ANT0	2437	16.92	2428.60	2445.52	0.5	PASS
	ANT1	2437	17.28	2428.48	2445.76	0.5	PASS
	ANT0	2442	16.92	2433.60	2450.52	0.5	PASS
	ANT1	2442	17.16	2433.60	2450.76	0.5	PASS
	ANT0	2447	16.56	2438.84	2455.40	0.5	PASS
	ANT1	2447	16.92	2438.60	2455.52	0.5	PASS
	ANT0	2452	17.56	2443.20	2460.76	0.5	PASS
	ANT1	2452	17.56	2443.20	2460.76	0.5	PASS
	ANT0	2457	17.28	2448.24	2465.52	0.5	PASS
	ANT1	2457	17.52	2448.24	2465.76	0.5	PASS
	ANT0	2462	16.92	2453.60	2470.52	0.5	PASS
	ANT1	2462	17.28	2453.48	2470.76	0.5	PASS
11N40MIMO	ANT0	2422	35.12	2404.48	2439.60	0.5	PASS

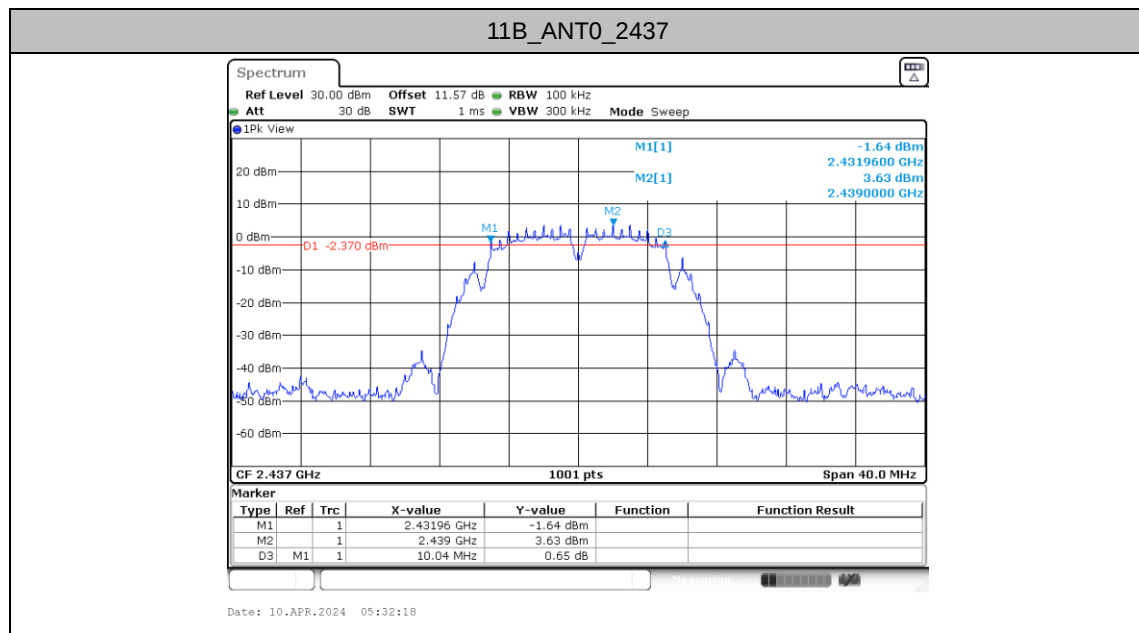


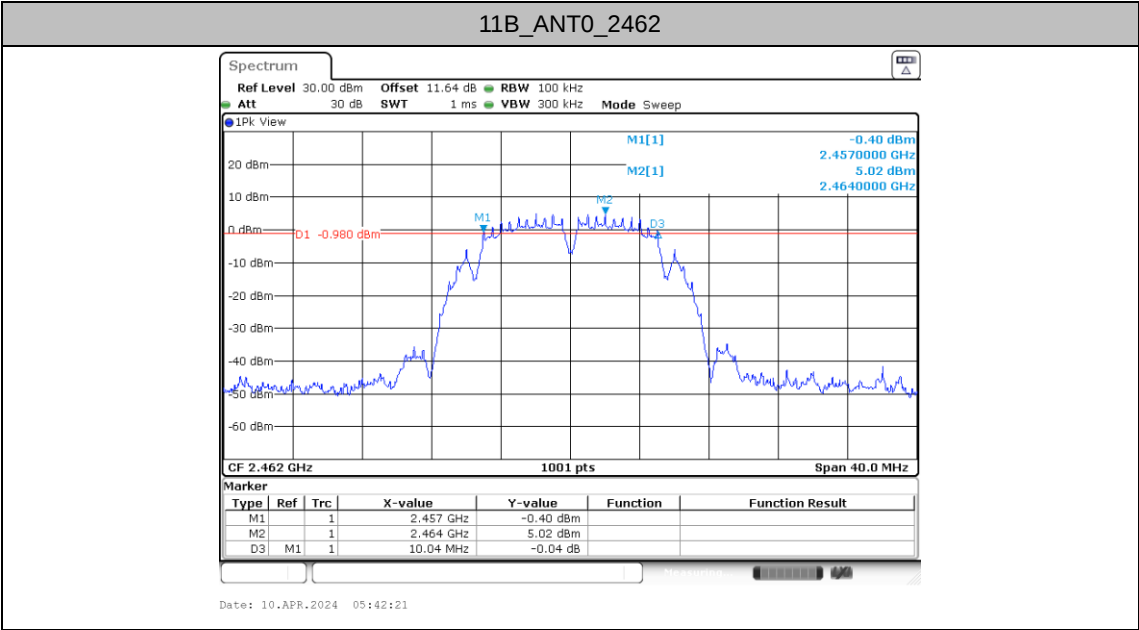
	ANT1	2422	35.12	2404.48	2439.60	0.5	PASS
	ANT0	2427	35.12	2409.48	2444.60	0.5	PASS
	ANT1	2427	35.12	2409.48	2444.60	0.5	PASS
	ANT0	2432	35.52	2414.40	2449.92	0.5	PASS
	ANT1	2432	35.52	2414.40	2449.92	0.5	PASS
	ANT0	2437	35.52	2419.40	2454.92	0.5	PASS
	ANT1	2437	35.44	2419.48	2454.92	0.5	PASS
	ANT0	2442	35.52	2424.24	2459.76	0.5	PASS
	ANT1	2442	35.28	2424.48	2459.76	0.5	PASS
	ANT0	2447	35.12	2429.48	2464.60	0.5	PASS
	ANT1	2447	35.12	2429.48	2464.60	0.5	PASS
	ANT0	2452	35.12	2434.48	2469.60	0.5	PASS
	ANT1	2452	35.12	2434.48	2469.60	0.5	PASS

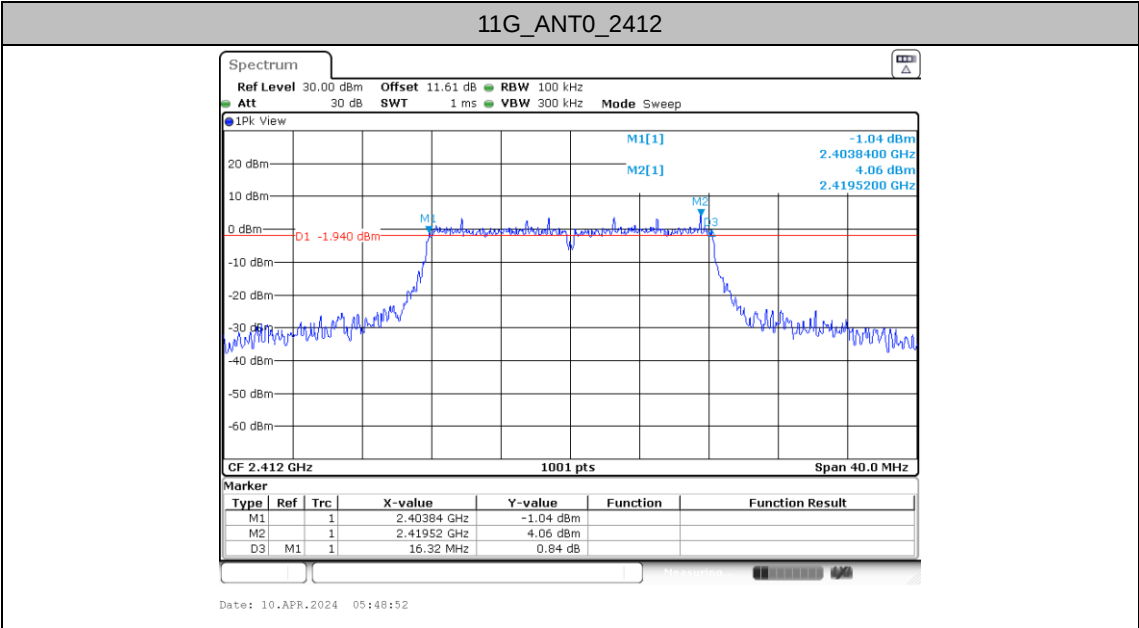


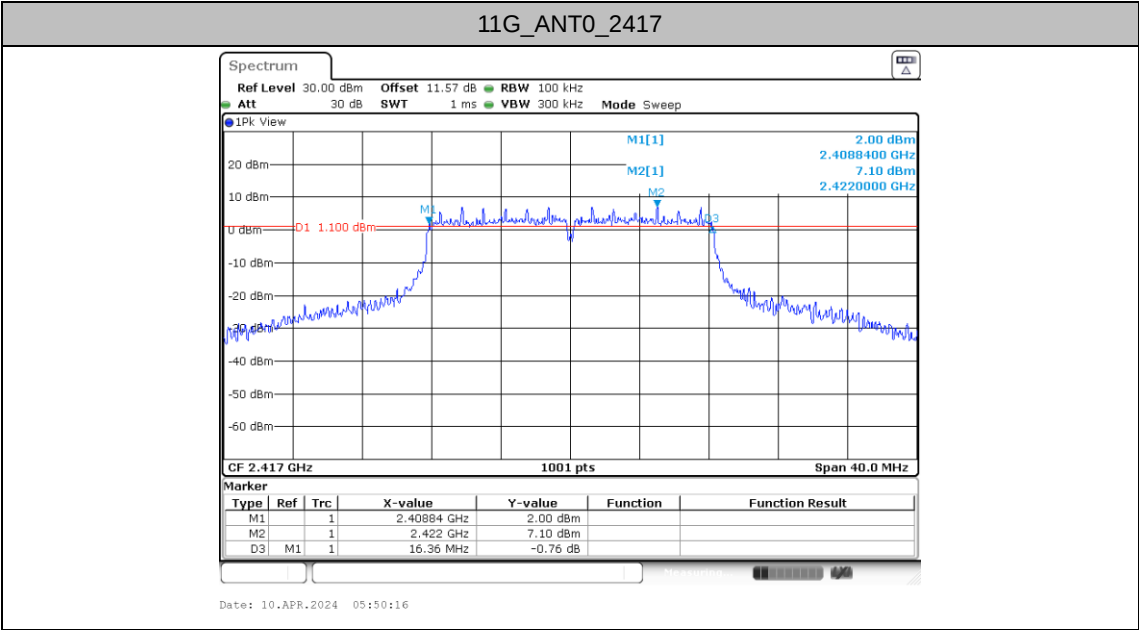
Test Graphs

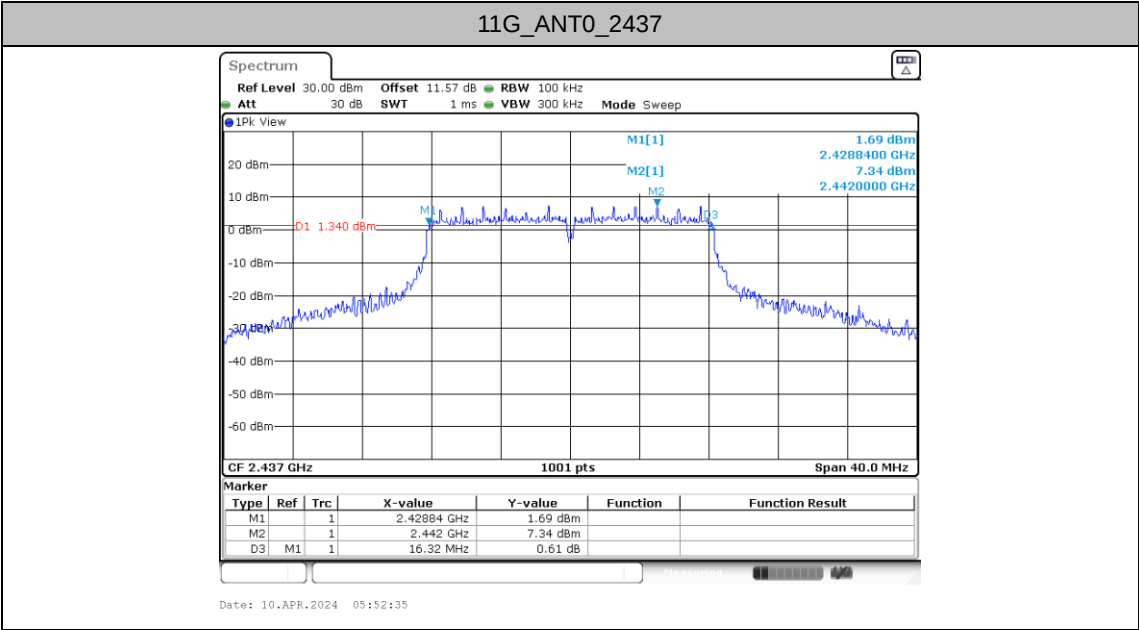


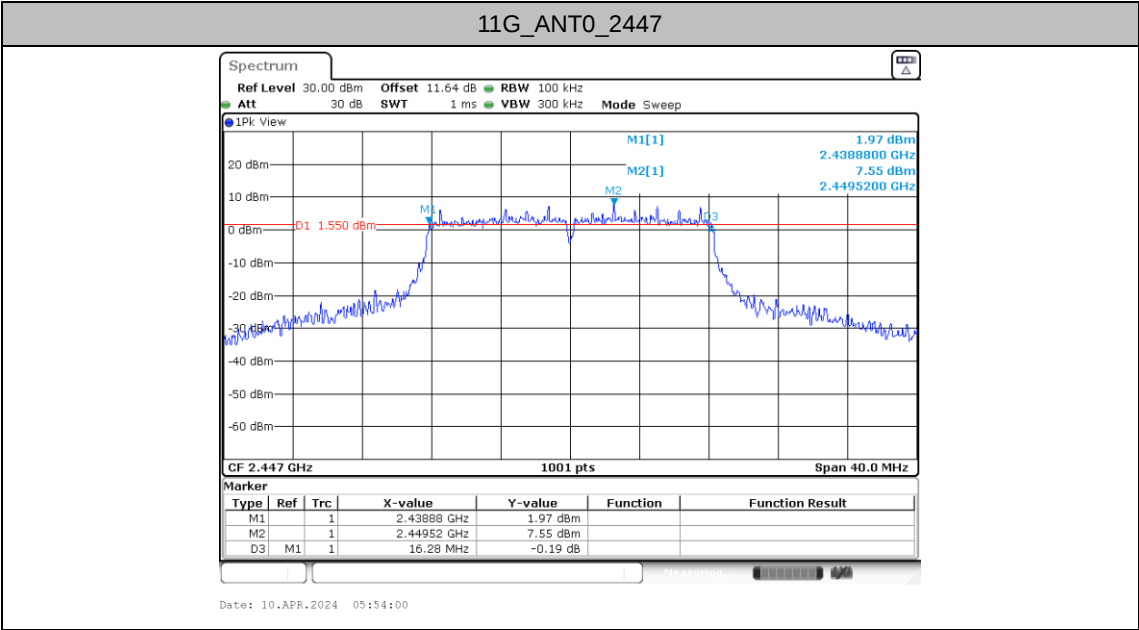


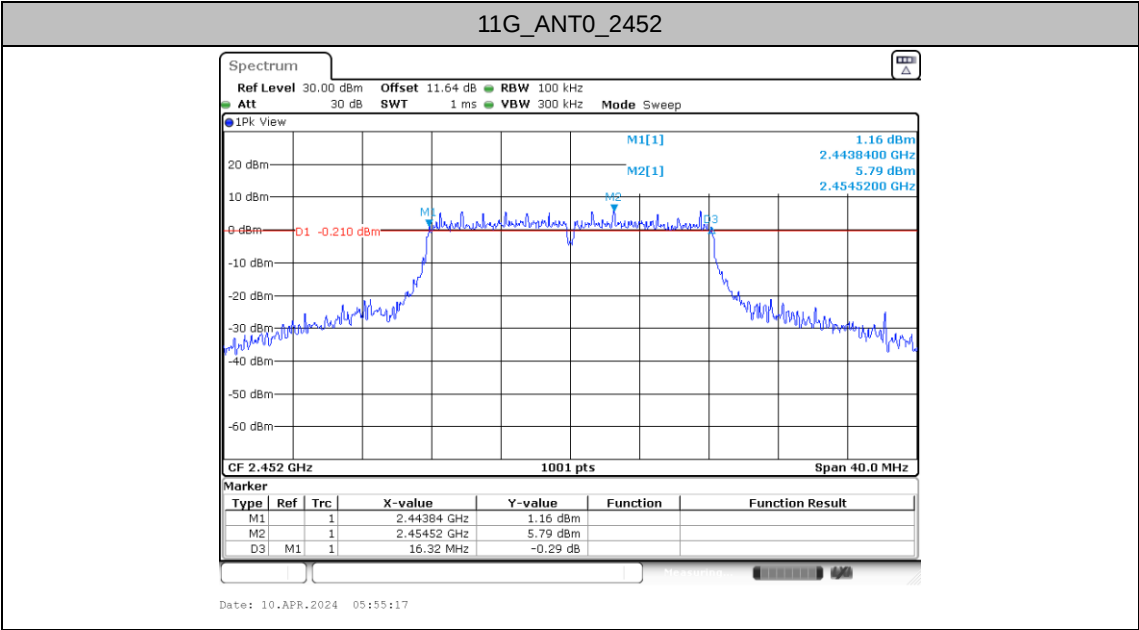


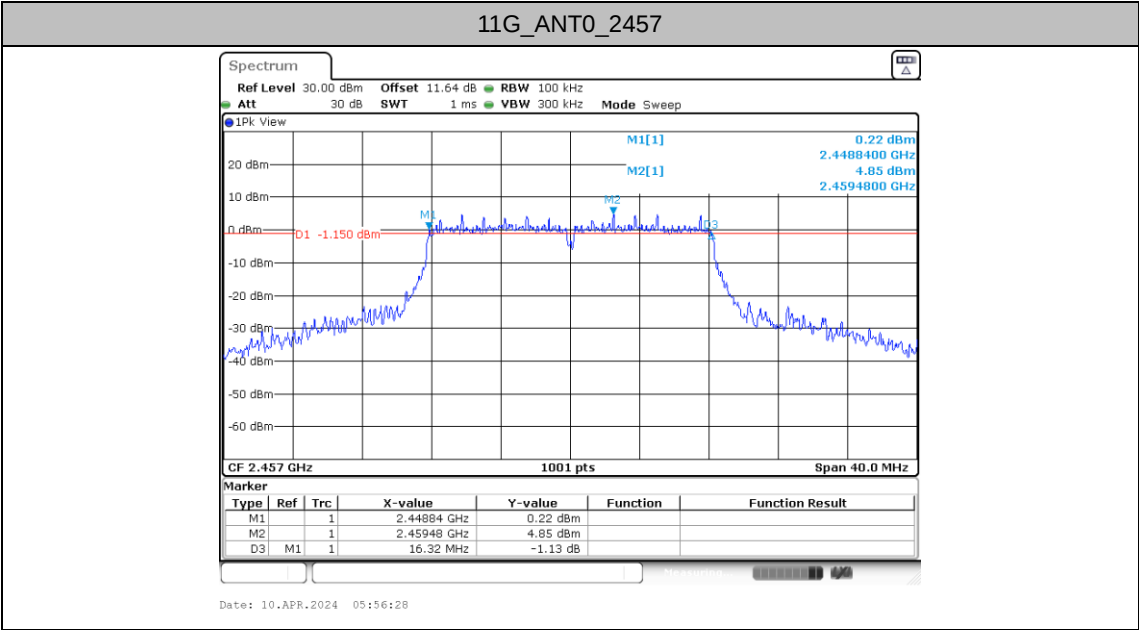


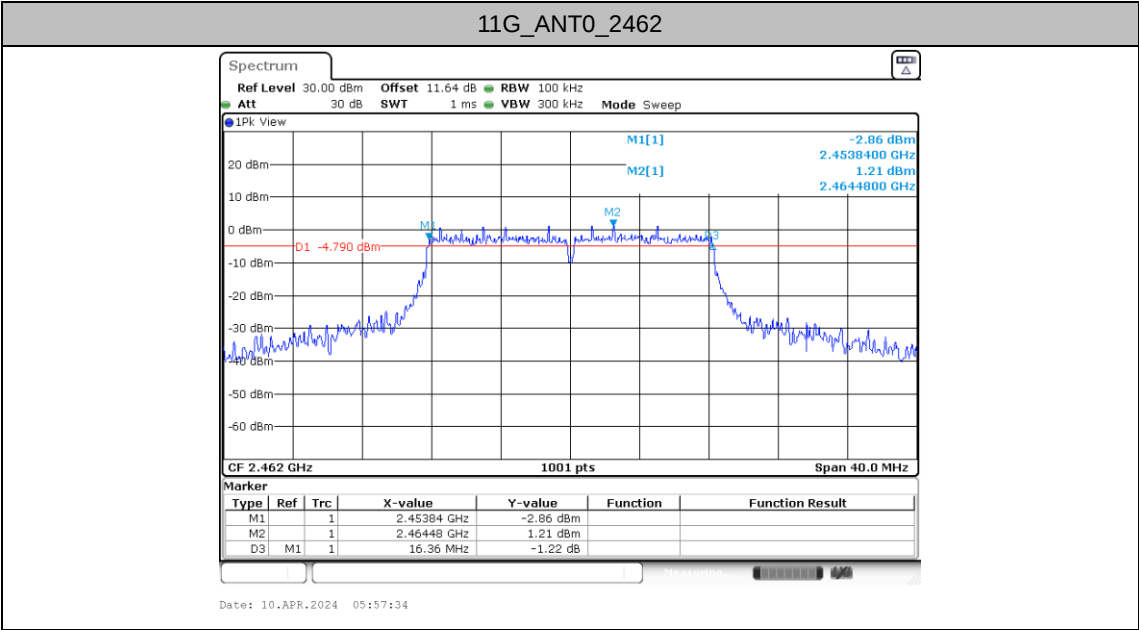


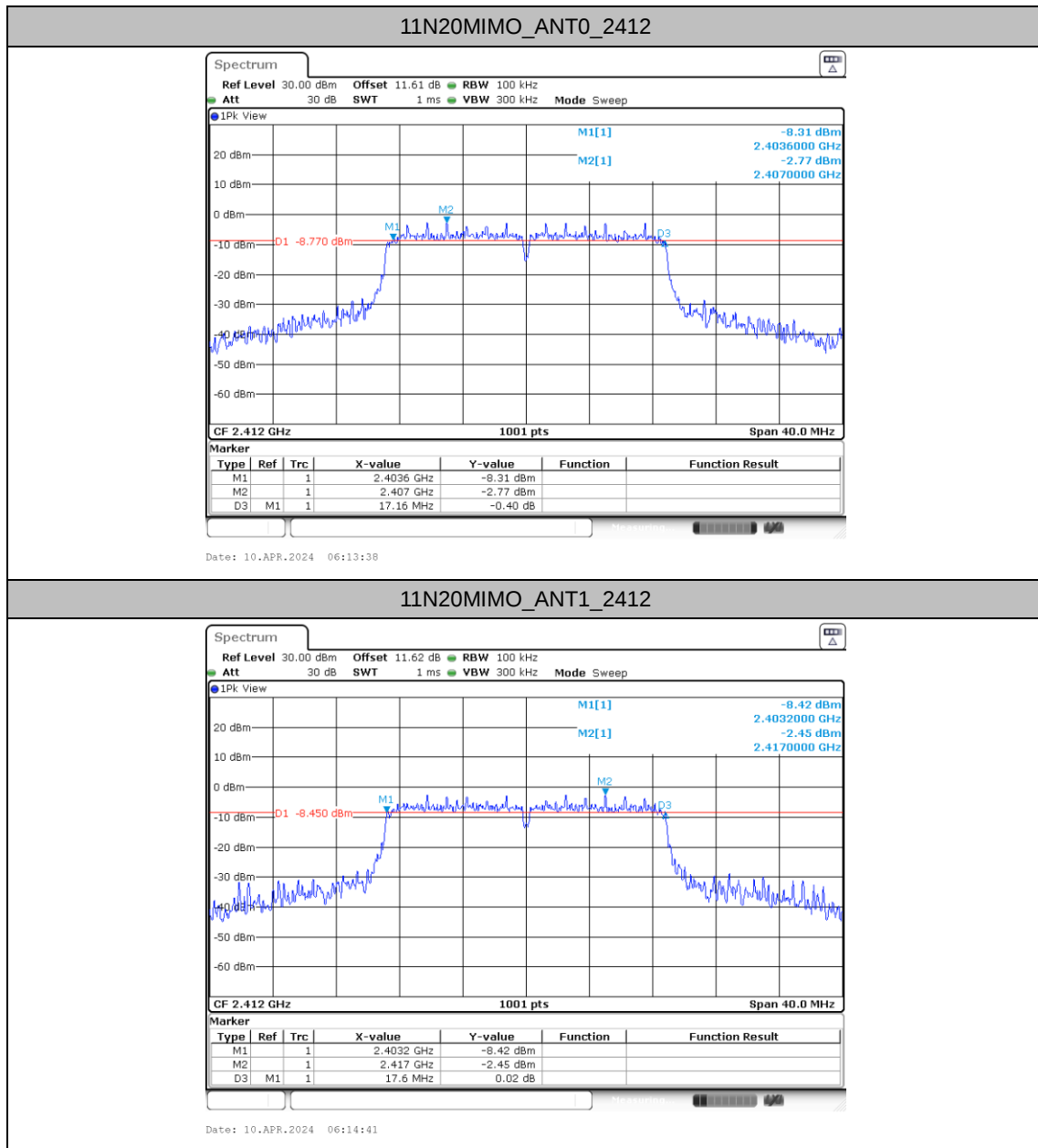


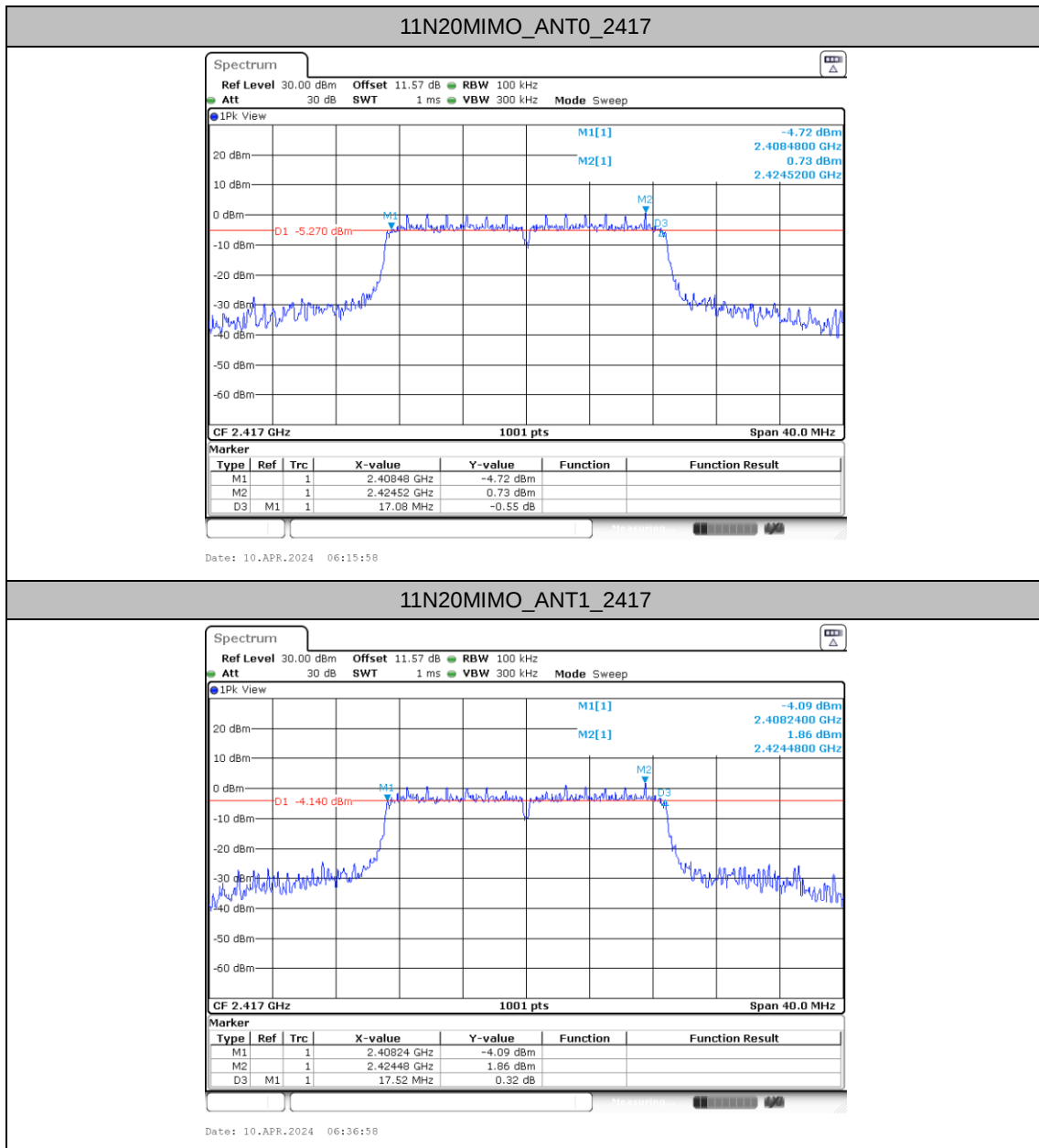


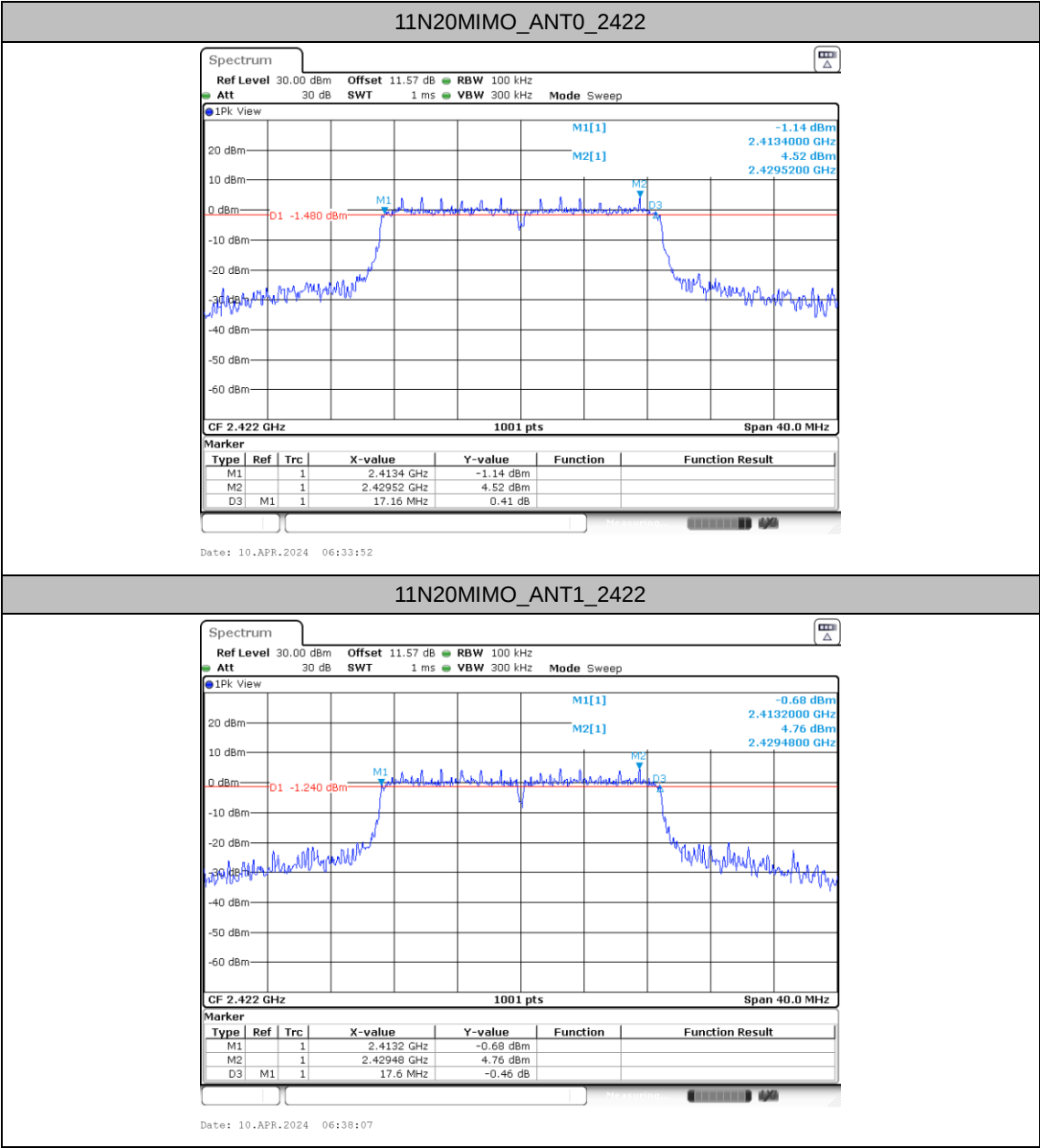


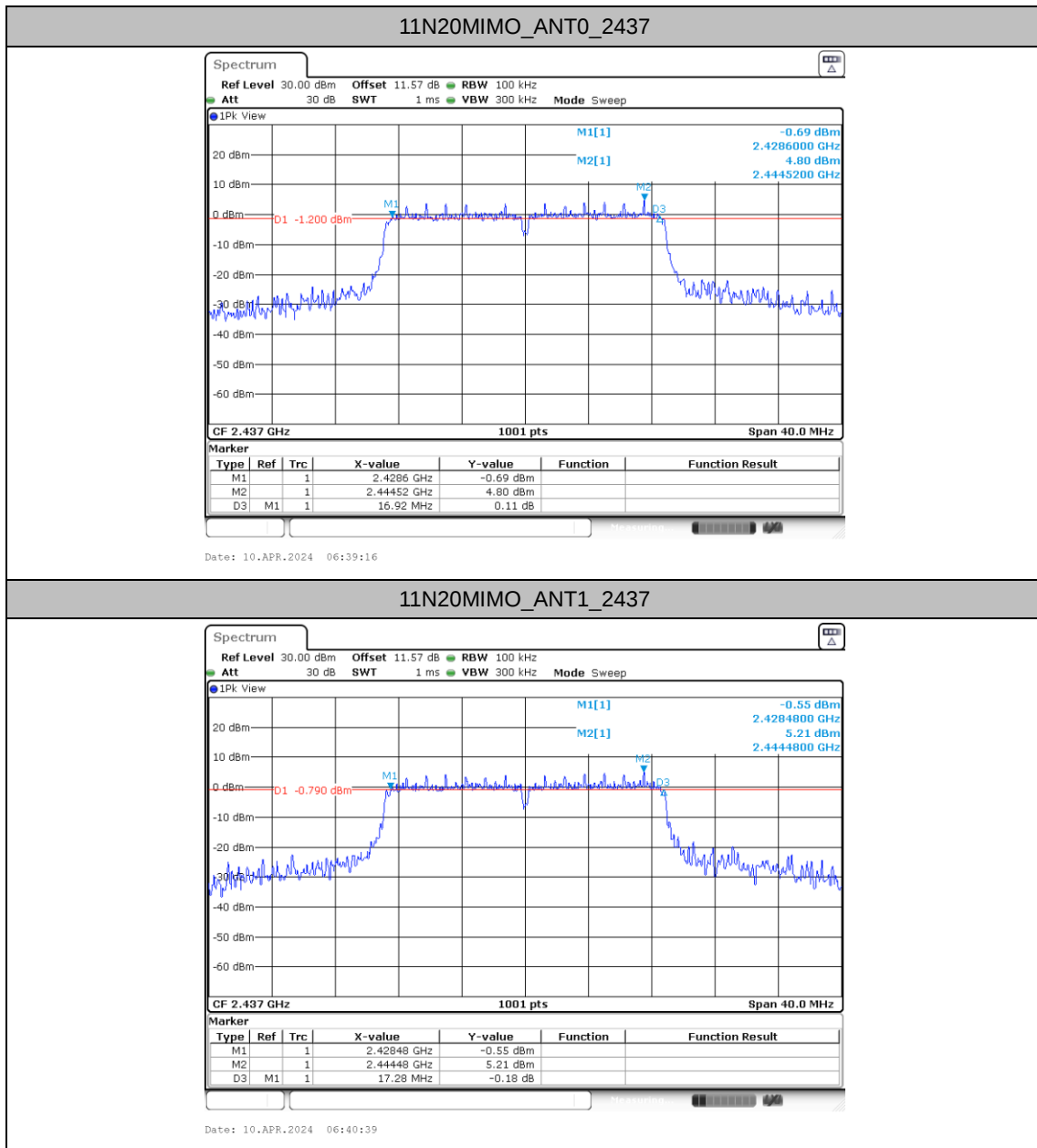


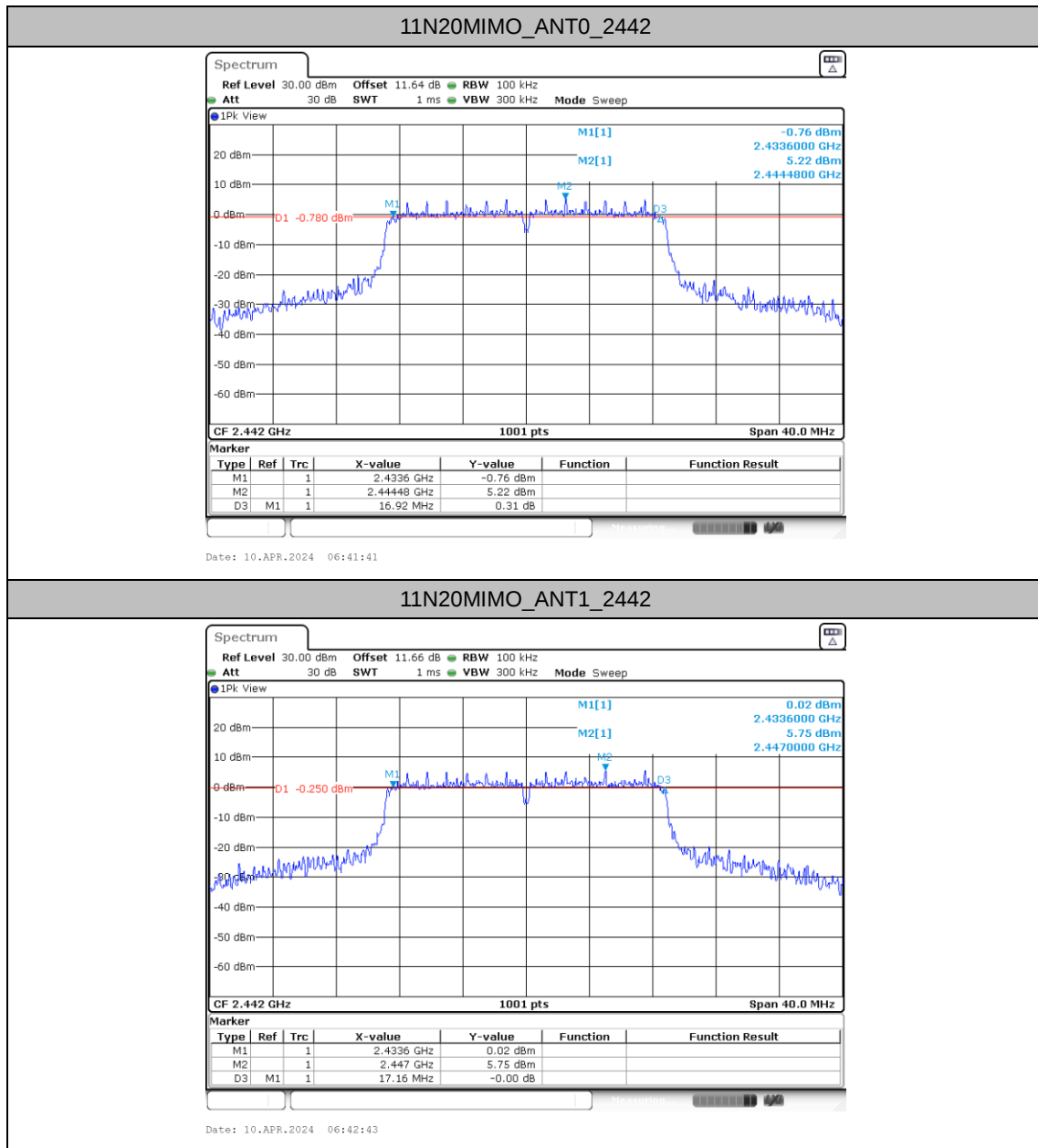


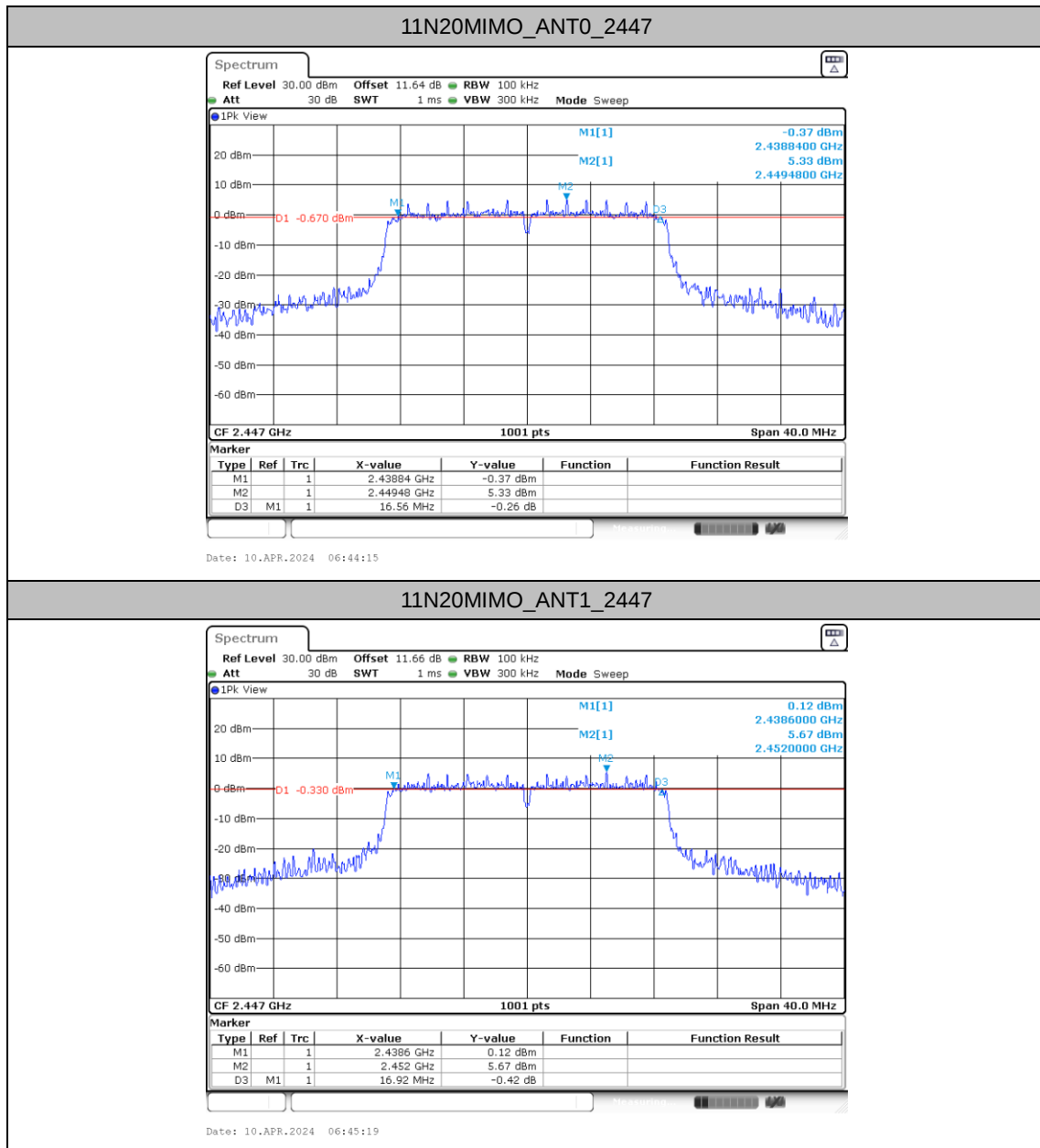


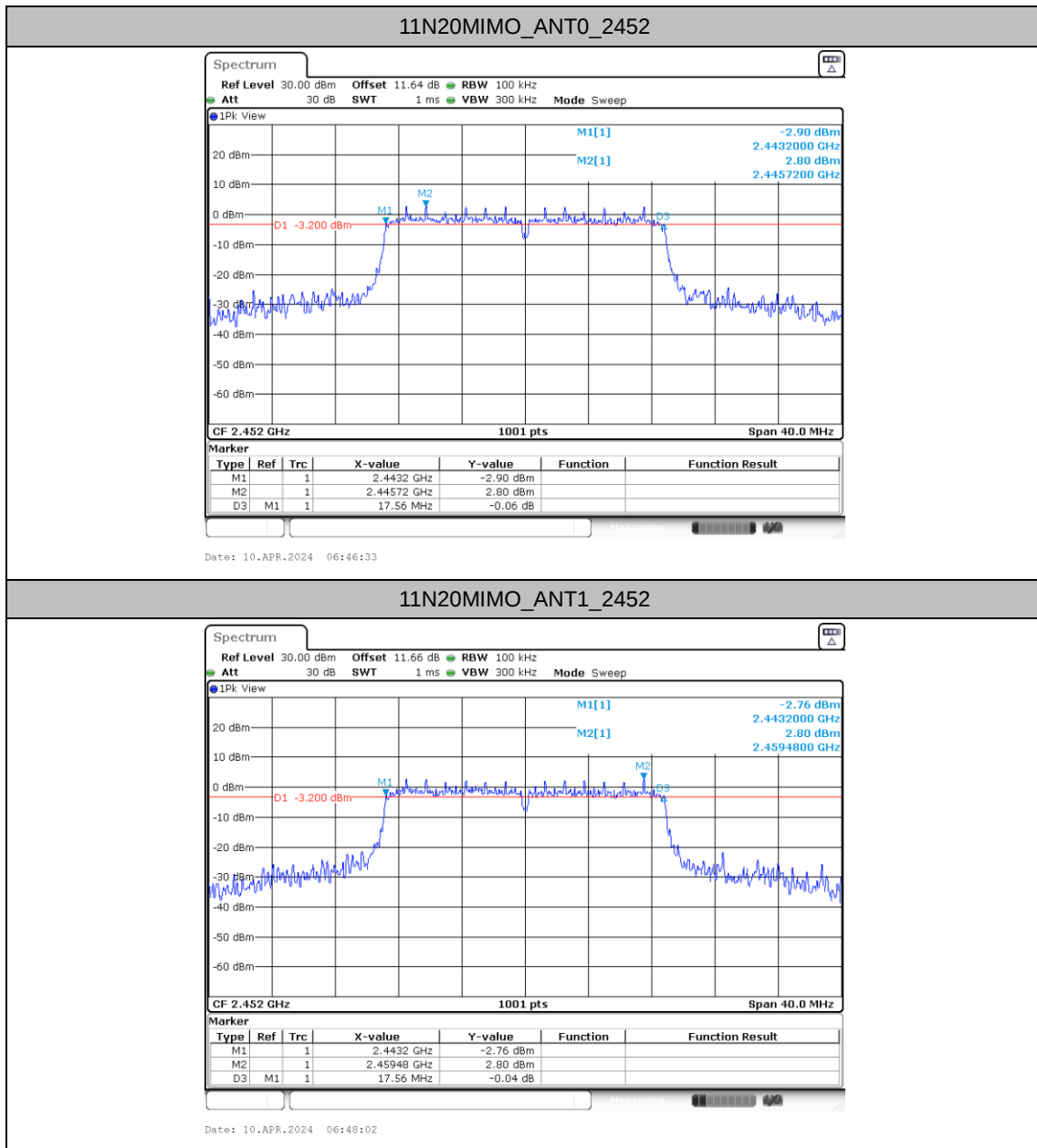


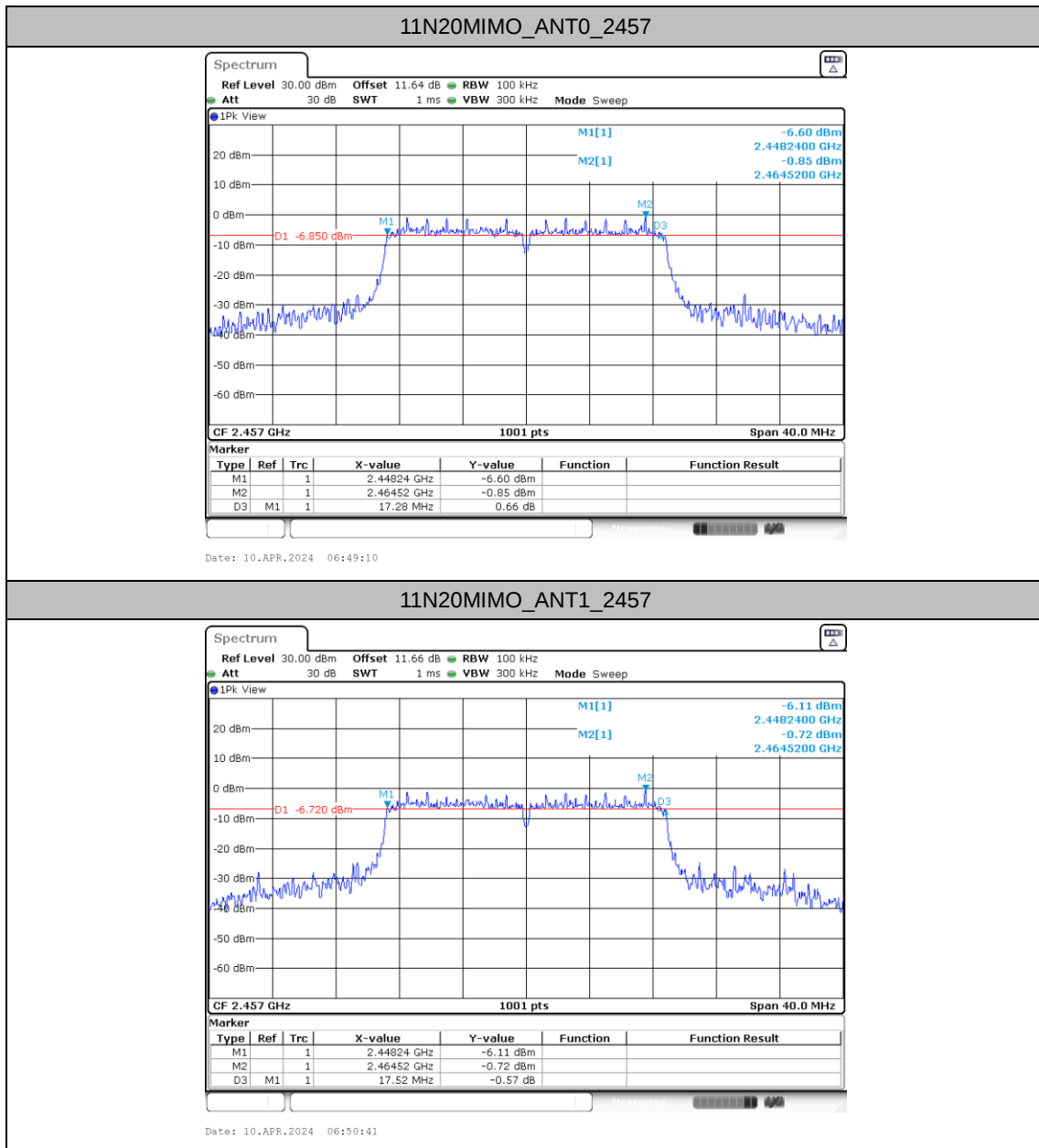


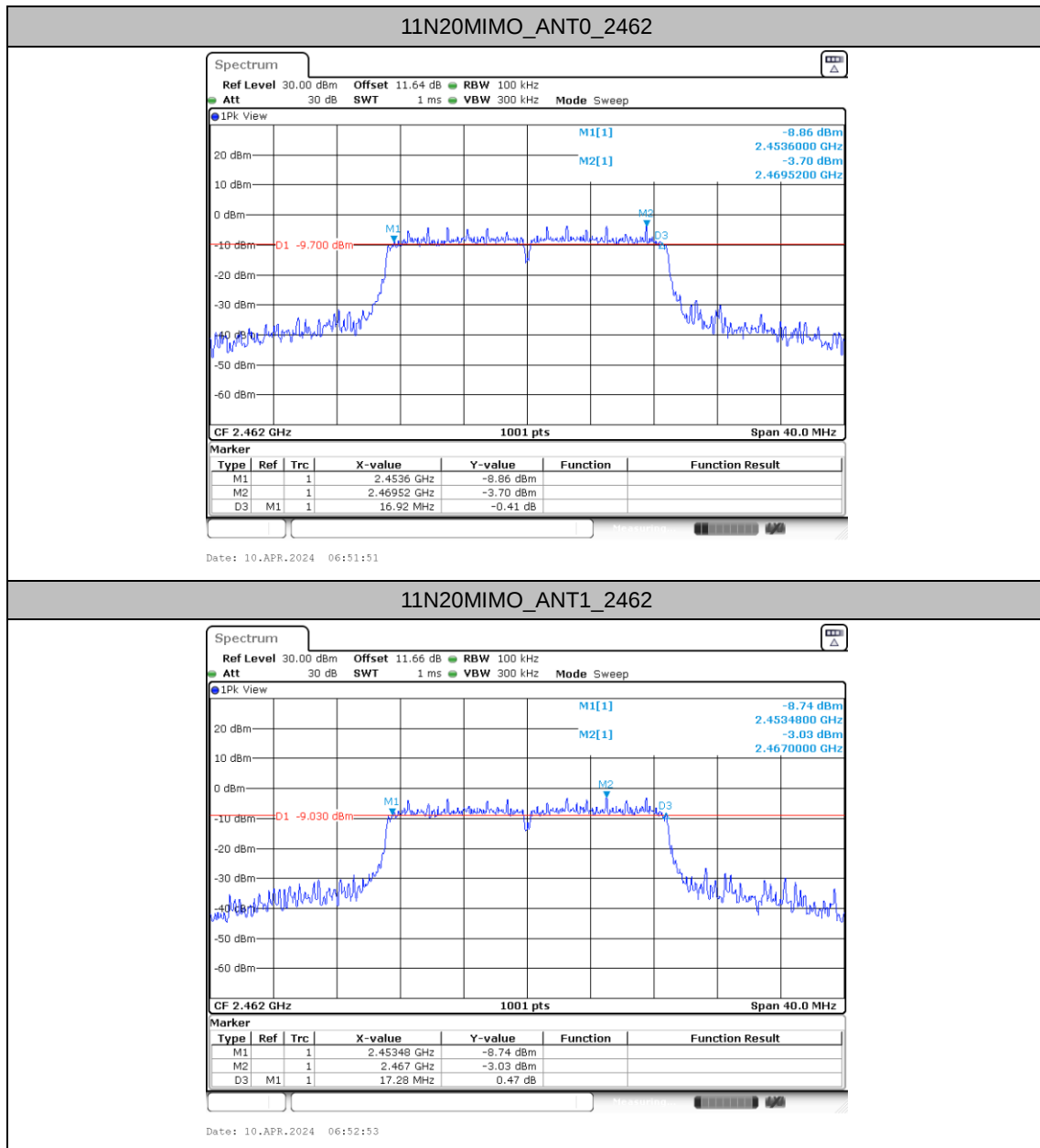


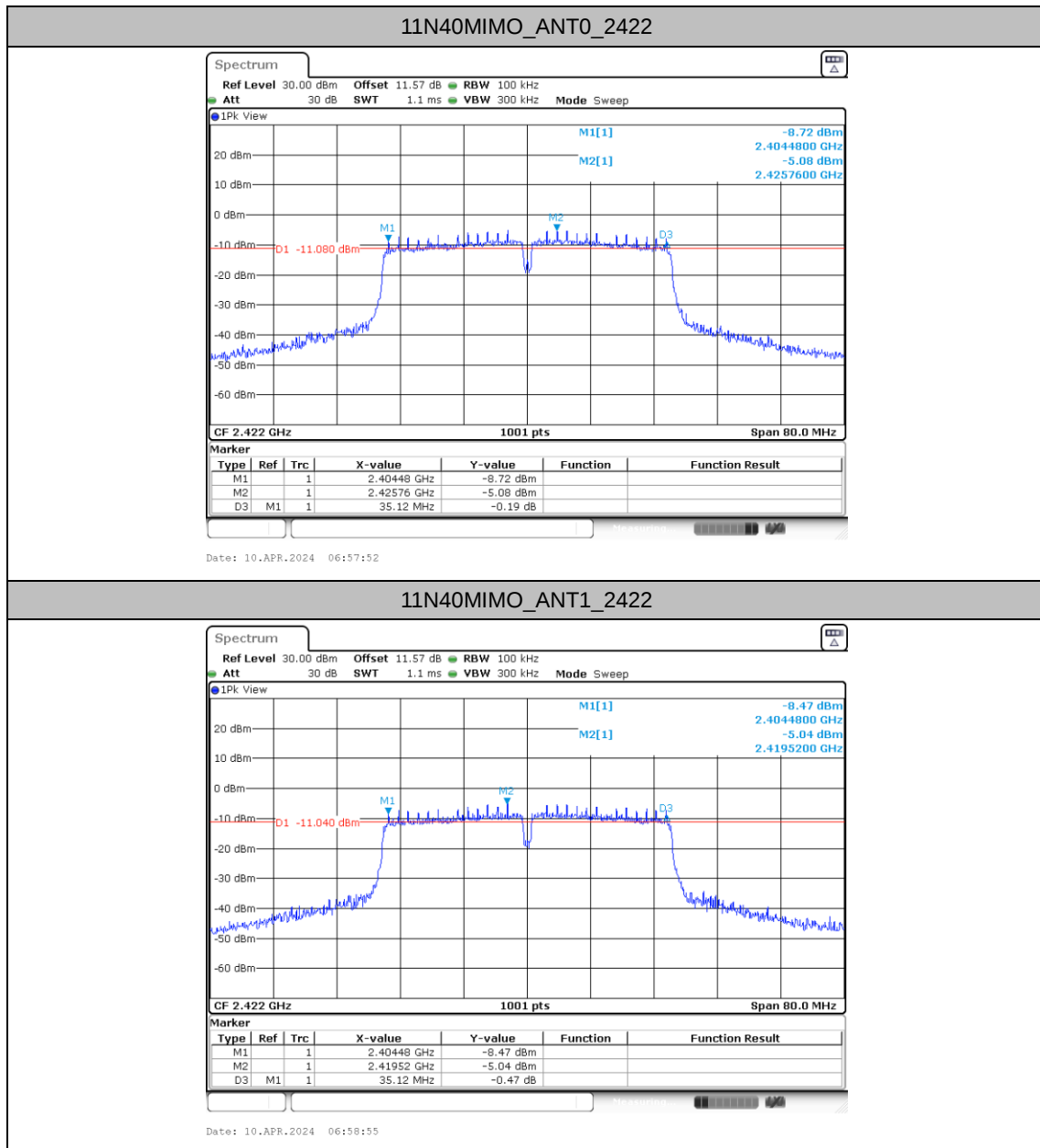


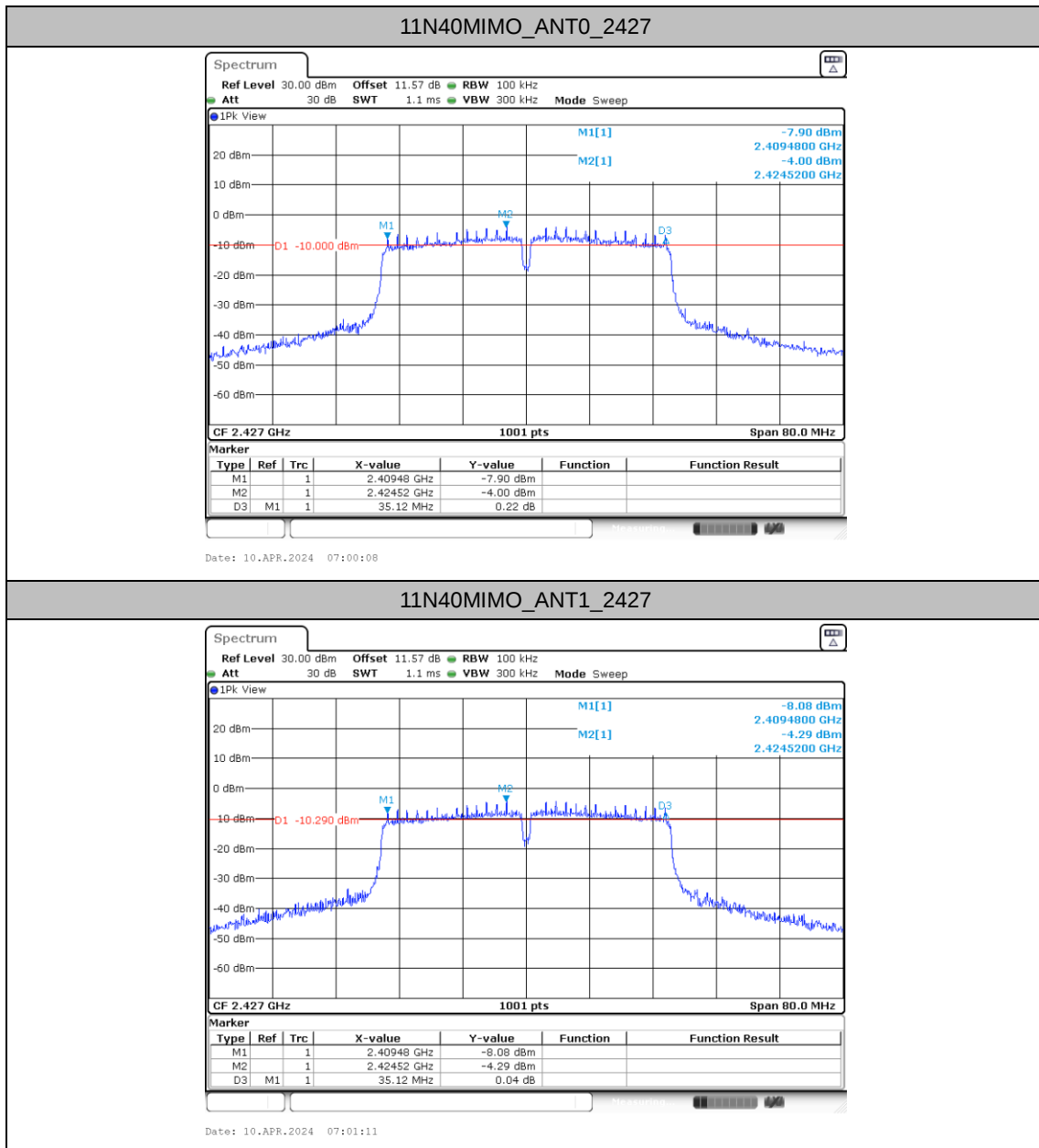


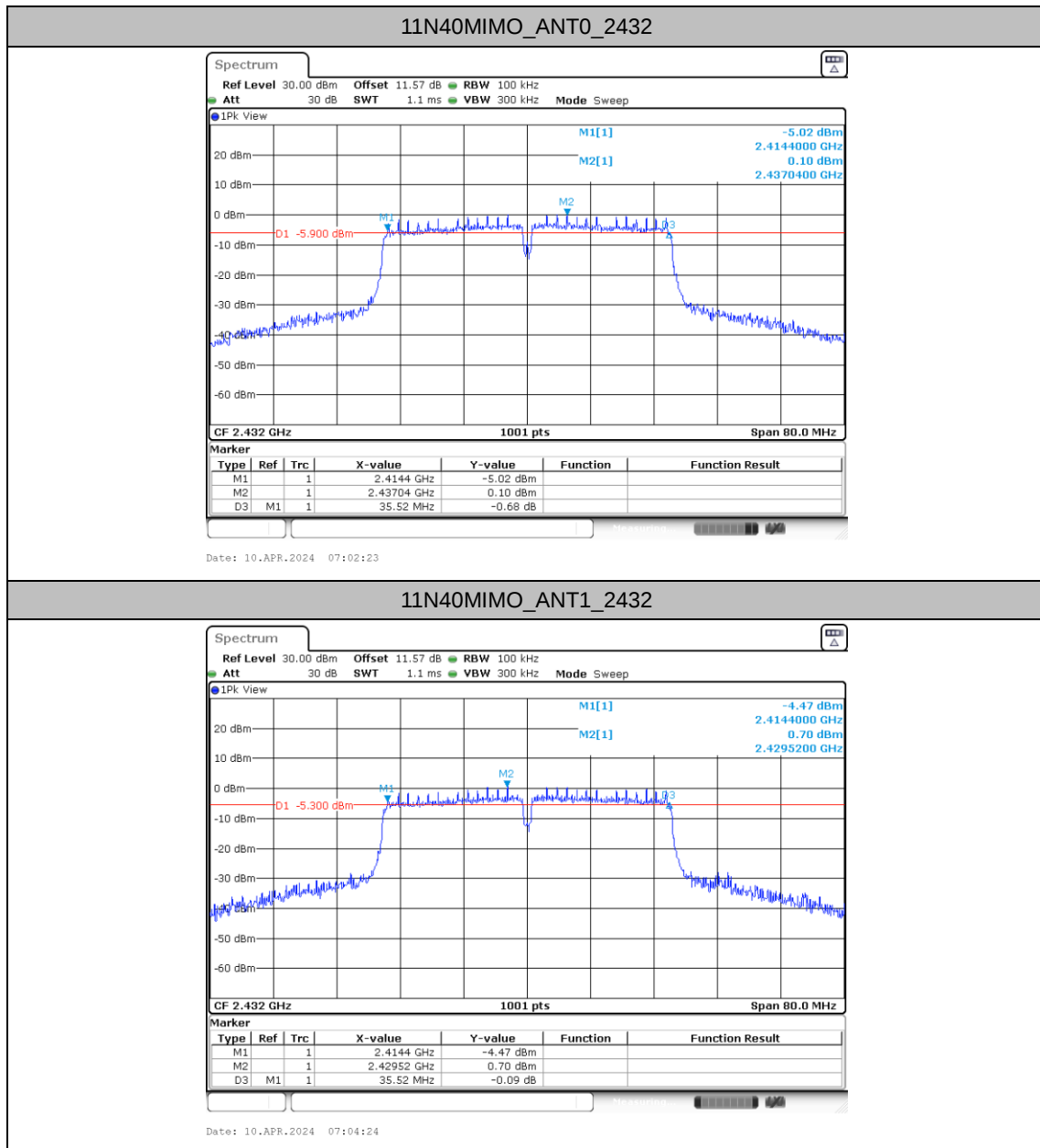


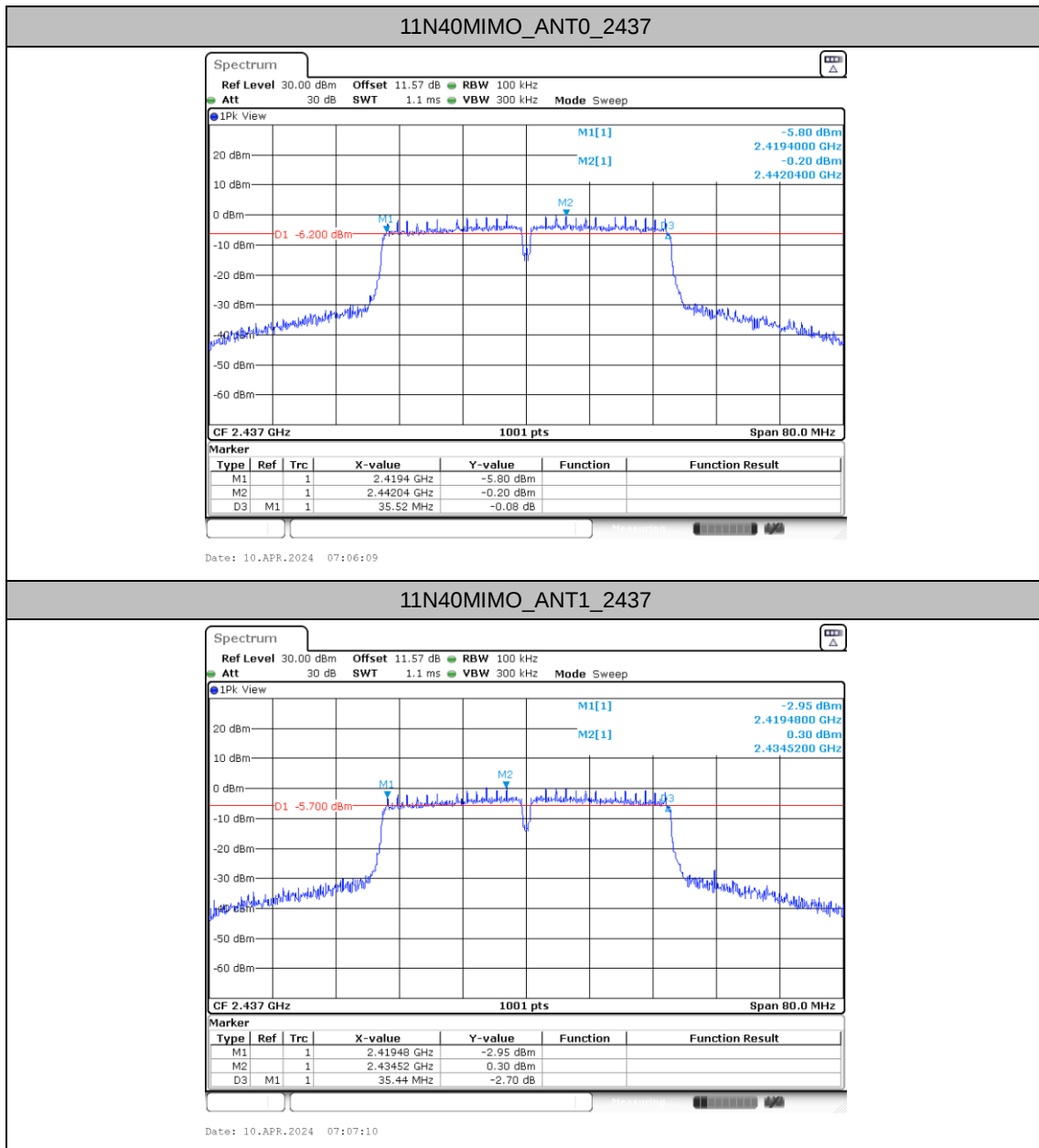


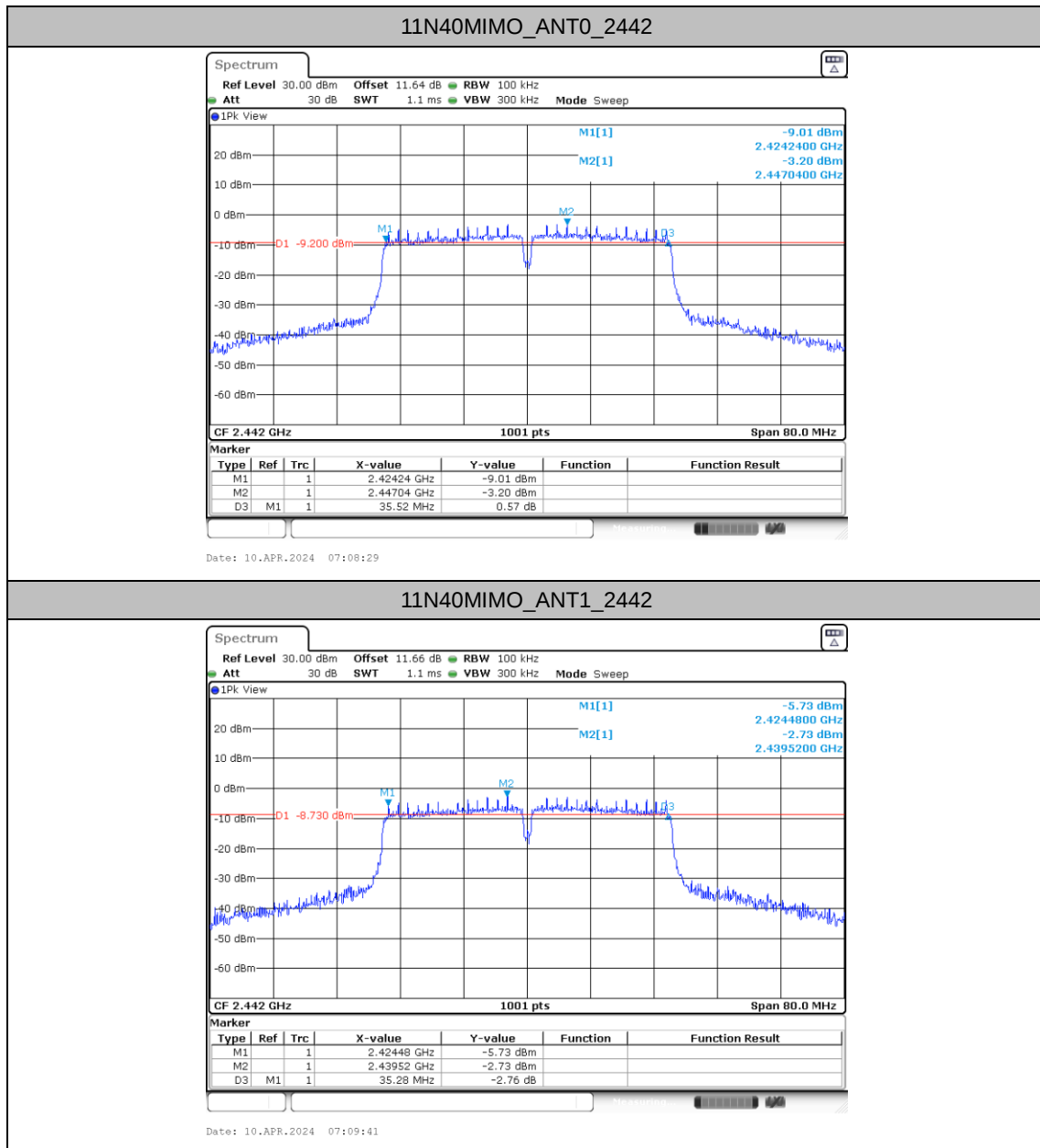


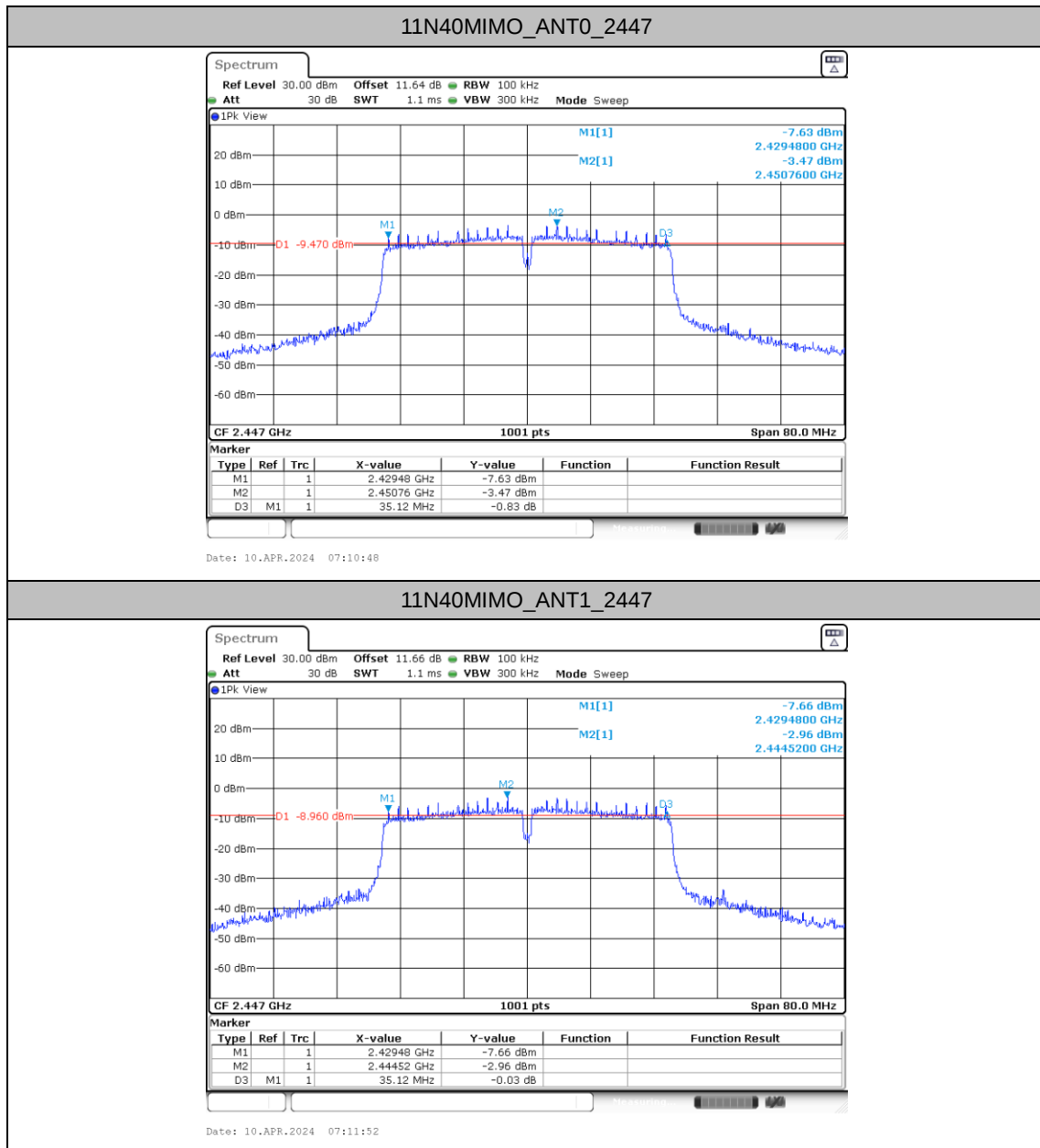


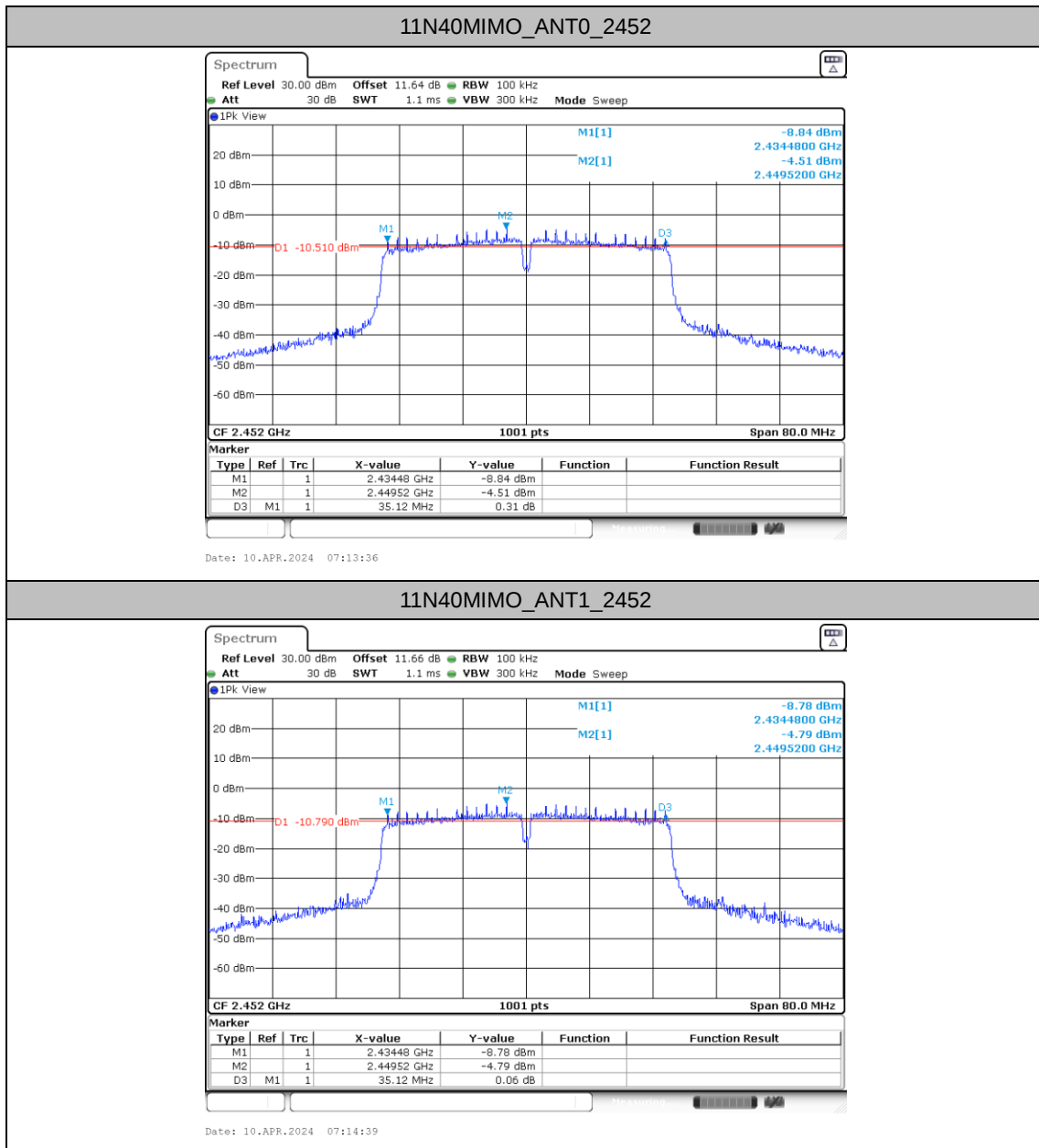














Occupied Channel Bandwidth

Test Result

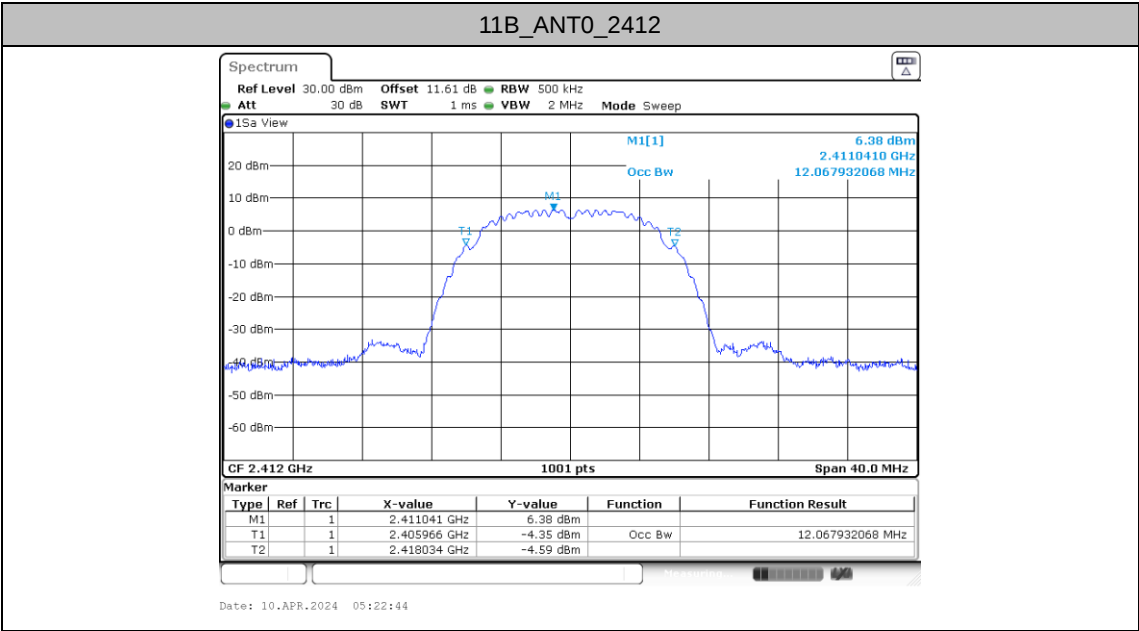
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11B	ANT0	2412	12.068	2405.9660	2418.0340	---	---
	ANT0	2437	12.108	2430.9660	2443.0739	---	---
	ANT0	2462	12.108	2455.9660	2468.0739	---	---
11G	ANT0	2412	17.502	2403.2488	2420.7512	---	---
	ANT0	2417	17.343	2408.3287	2425.6713	---	---
	ANT0	2437	17.303	2428.3686	2445.6713	---	---
	ANT0	2447	17.223	2438.4086	2455.6314	---	---
	ANT0	2452	17.223	2443.4086	2460.6314	---	---
	ANT0	2457	17.223	2448.4086	2465.6314	---	---
	ANT0	2462	17.383	2453.3287	2470.7113	---	---
11N20MIMO	ANT0	2412	18.022	2402.9690	2420.9910	---	---
	ANT1	2412	17.982	2403.0090	2420.9910	---	---
	ANT0	2417	18.142	2407.9291	2426.0709	---	---
	ANT1	2417	18.062	2407.9690	2426.0310	---	---
	ANT0	2422	18.182	2412.9291	2431.1109	---	---
	ANT1	2422	18.062	2412.9690	2431.0310	---	---
	ANT0	2437	18.182	2427.9690	2446.1508	---	---
	ANT1	2437	18.022	2428.0490	2446.0709	---	---
	ANT0	2442	17.982	2433.0490	2451.0310	---	---
	ANT1	2442	17.982	2433.0090	2450.9910	---	---
	ANT0	2447	17.982	2438.0090	2455.9910	---	---
	ANT1	2447	17.982	2438.0090	2455.9910	---	---
	ANT0	2452	18.142	2442.9291	2461.0709	---	---
	ANT1	2452	18.062	2442.9291	2460.9910	---	---
	ANT0	2457	18.222	2447.8891	2466.1109	---	---
	ANT1	2457	18.062	2447.9690	2466.0310	---	---
	ANT0	2462	17.942	2453.0490	2470.9910	---	---
	ANT1	2462	17.942	2453.0490	2470.9910	---	---
11N40MIMO	ANT0	2422	36.204	2403.9381	2440.1419	---	---
	ANT1	2422	36.284	2403.8581	2440.1419	---	---
	ANT0	2427	36.124	2409.0180	2445.1419	---	---
	ANT1	2427	36.284	2408.8581	2445.1419	---	---
	ANT0	2432	36.364	2413.9381	2450.3017	---	---

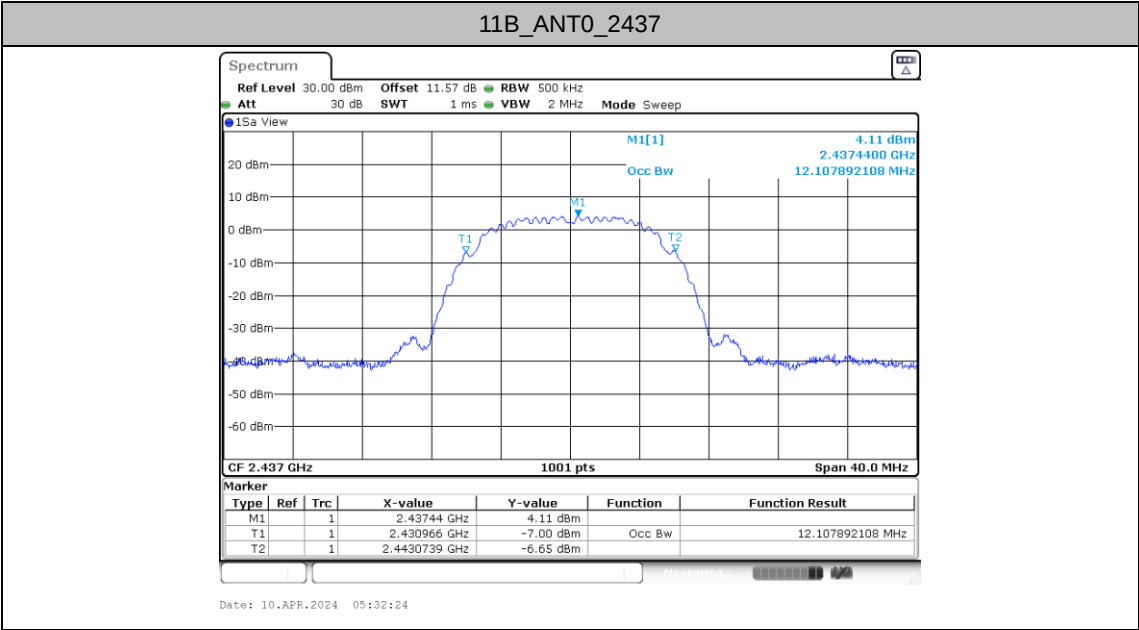


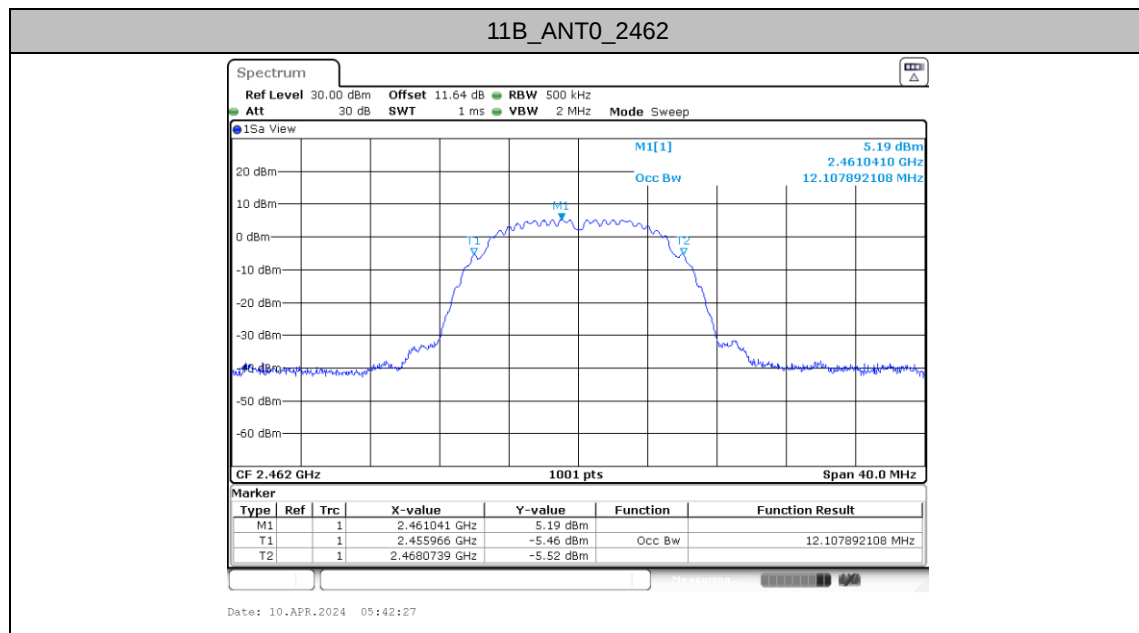
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	ANT0	2437	36.364	2418.8581	2455.2218	---	---
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	ANT0	2442	36.364	2423.8581	2460.2218	---	---
	ANT1	2442	36.364	2423.8581	2460.2218	---	---
	ANT0	2447	36.124	2429.0180	2465.1419	---	---
	ANT1	2447	36.044	2429.0180	2465.0619	---	---
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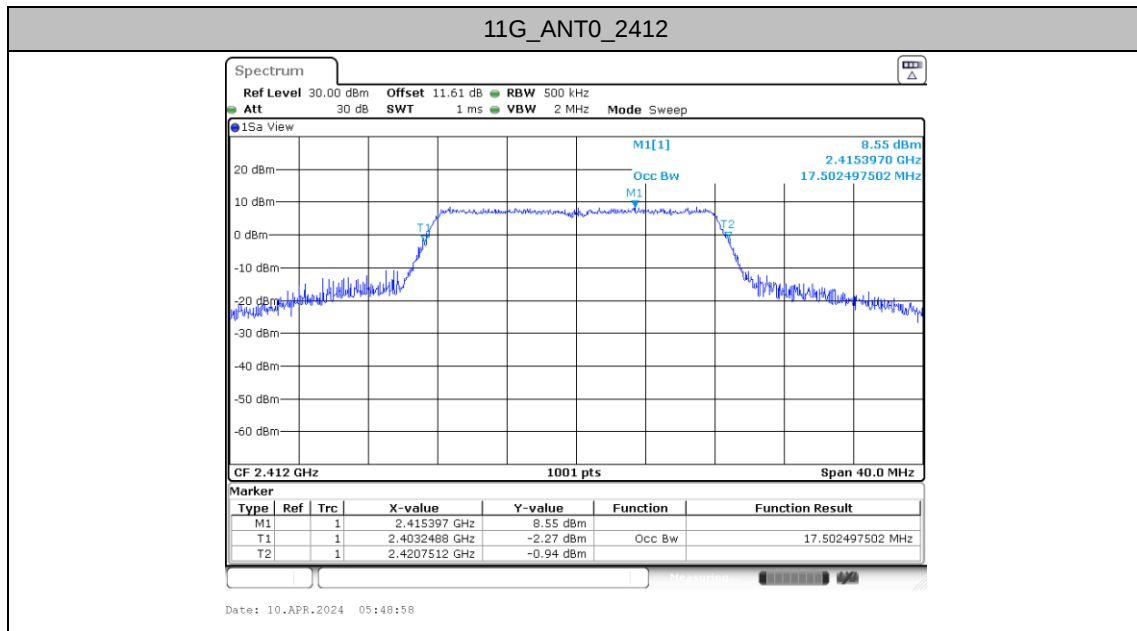


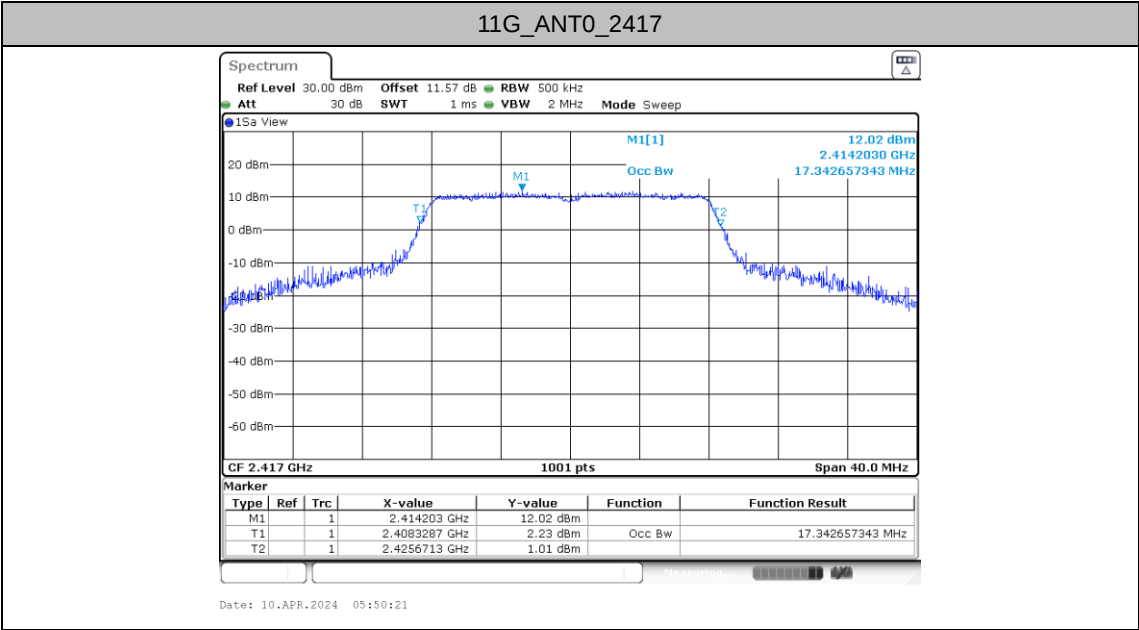
Test Graphs

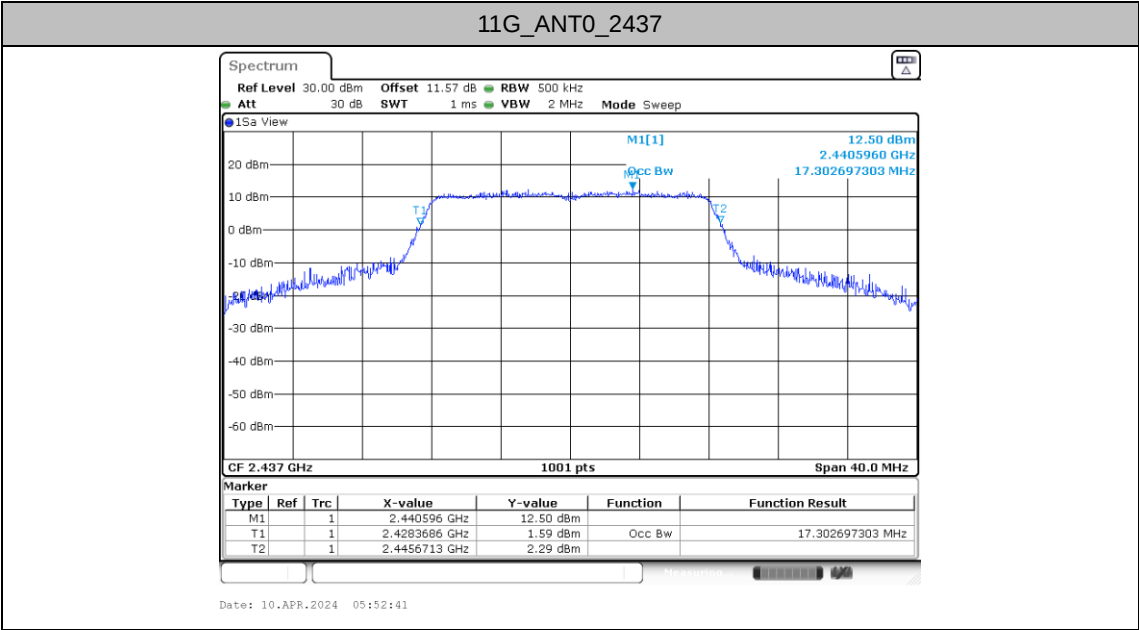


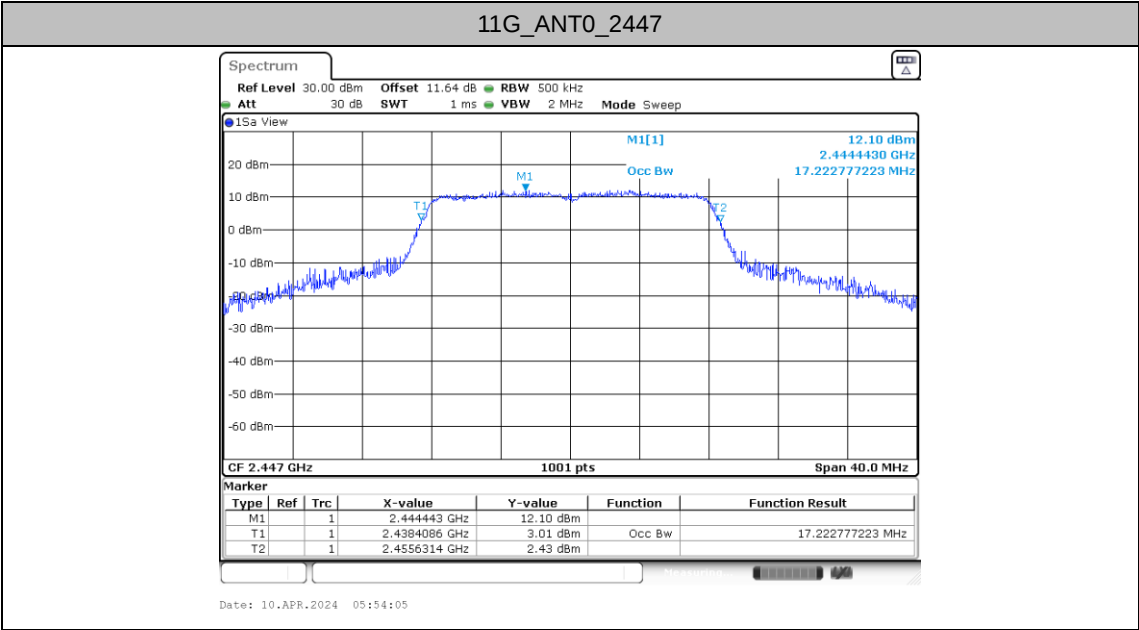


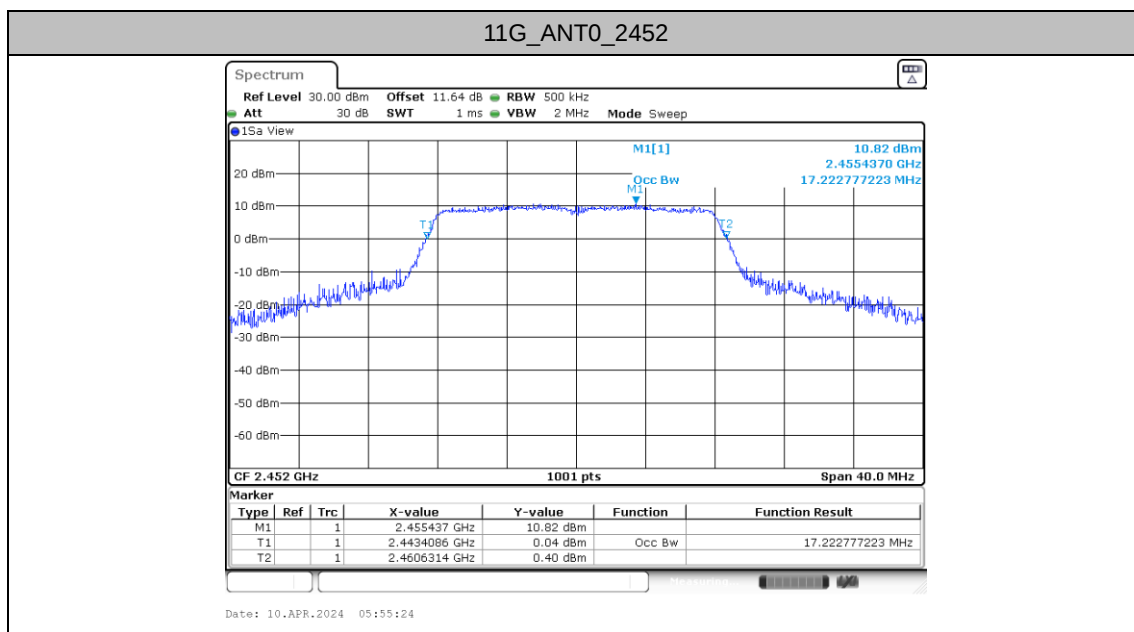


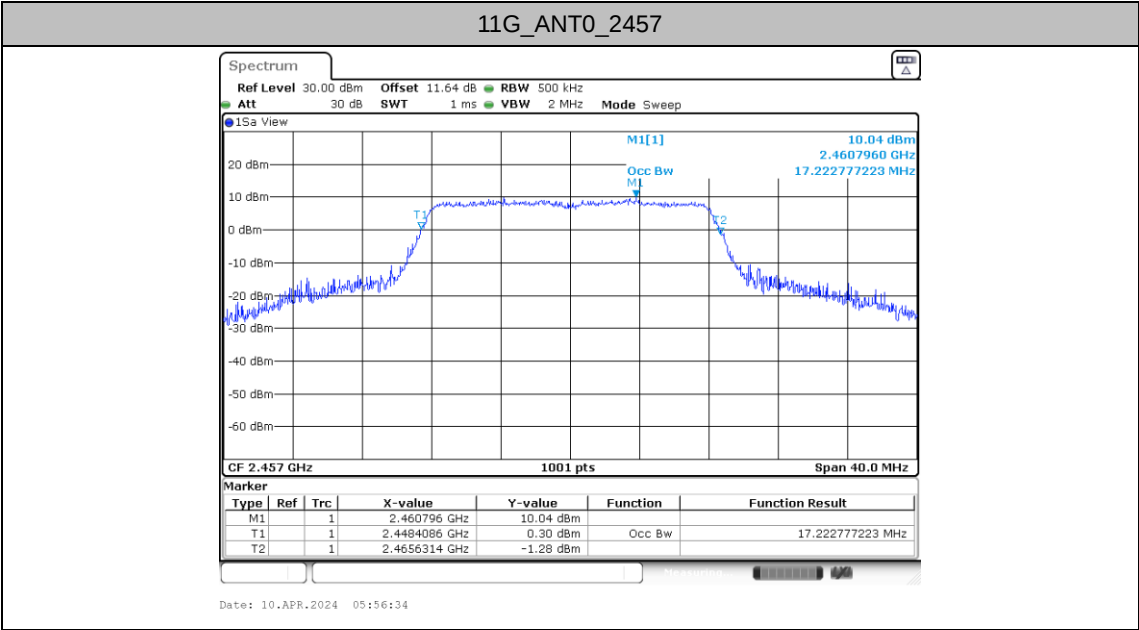


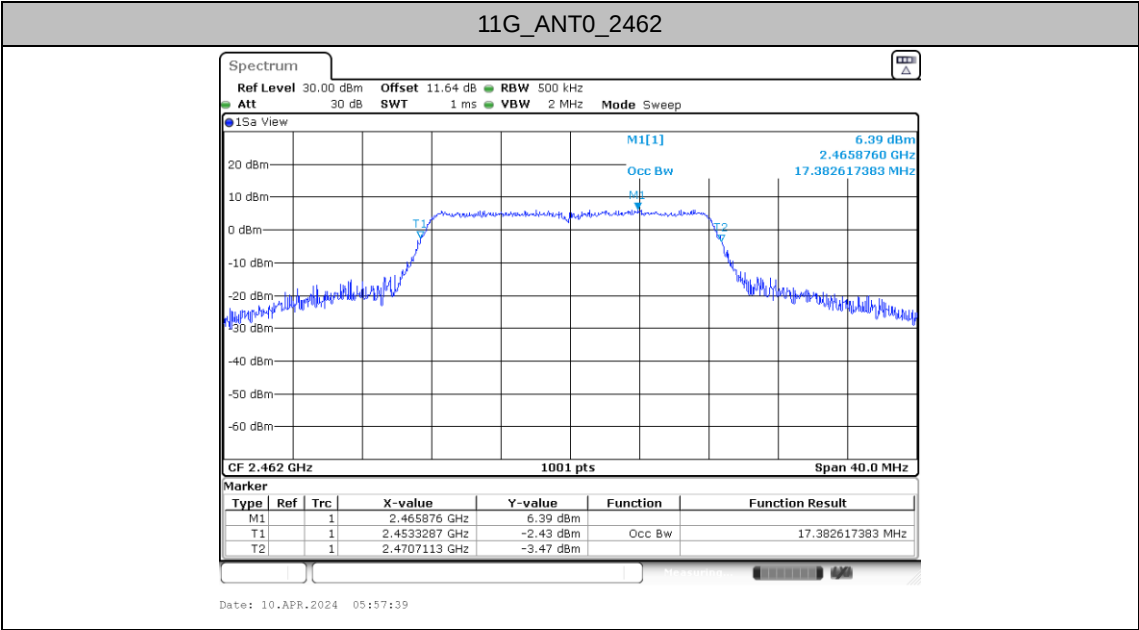


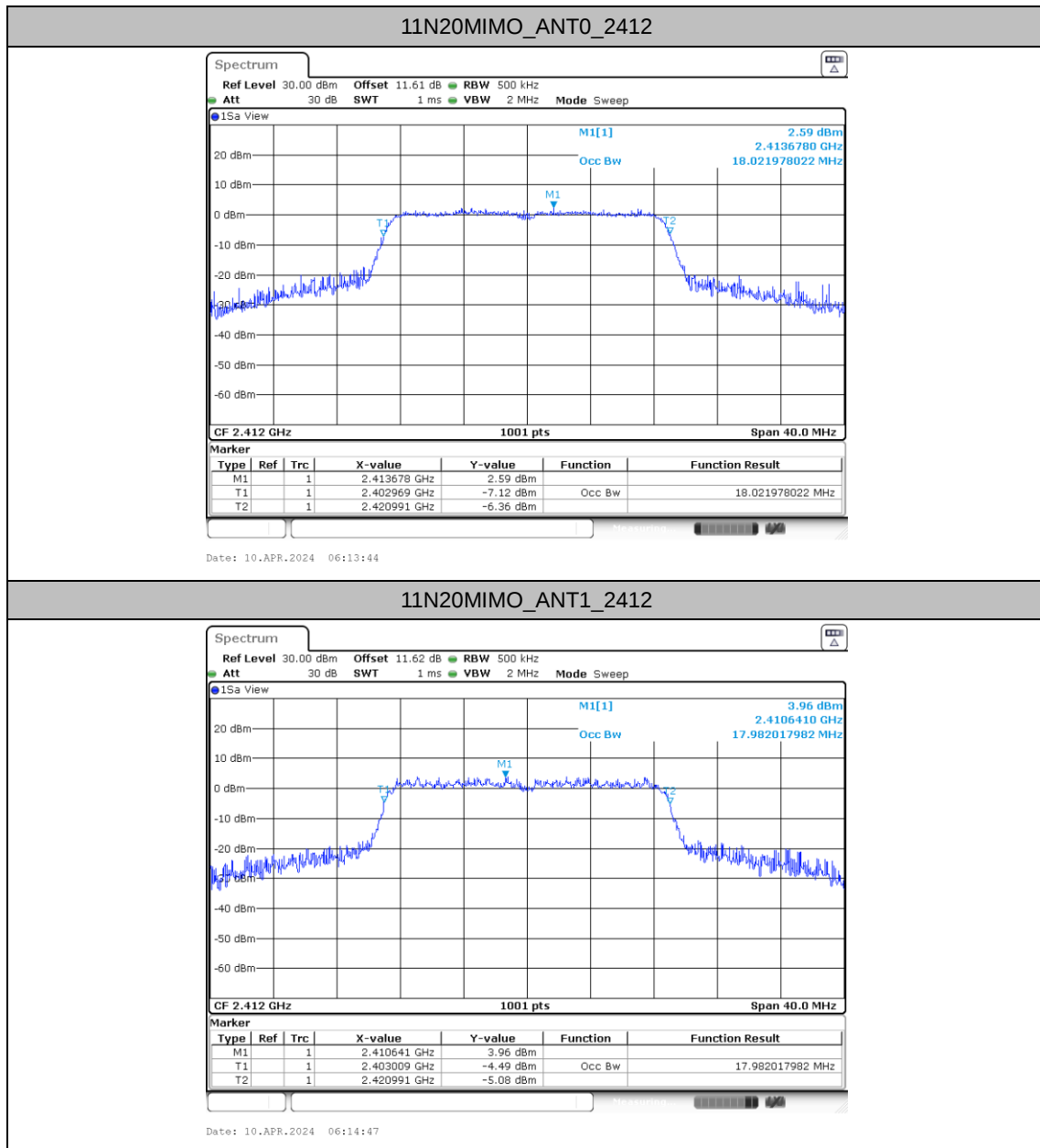


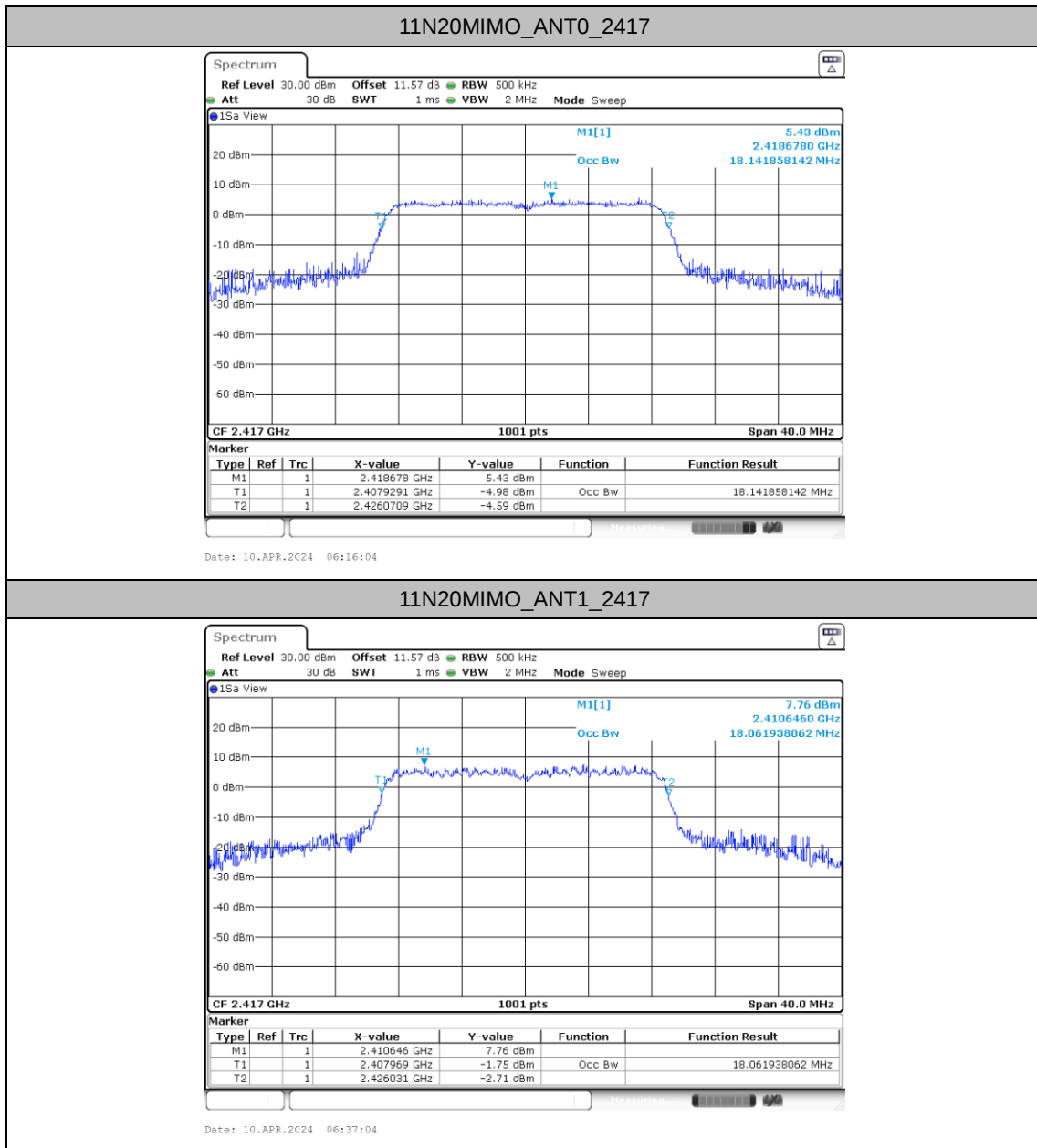


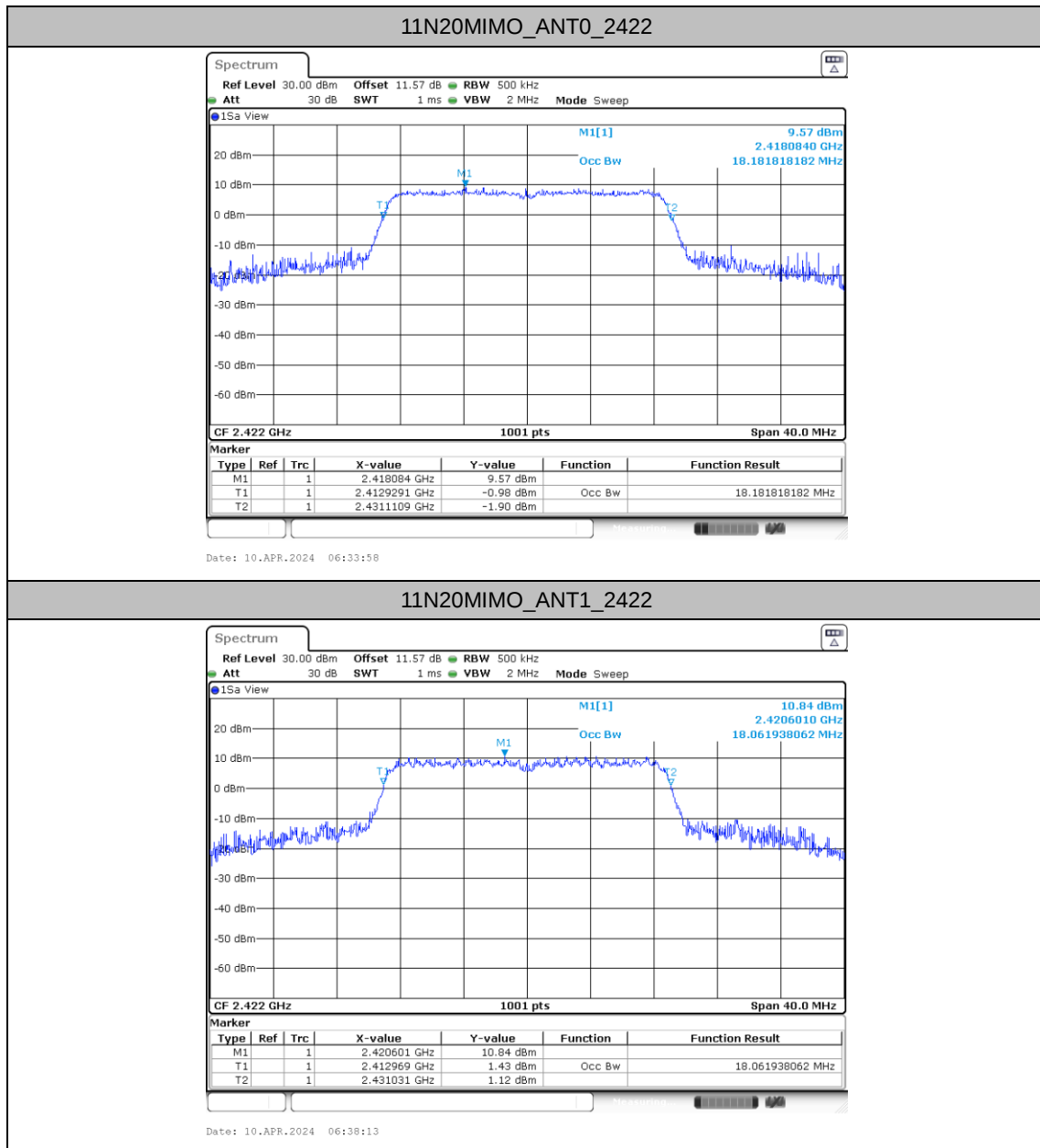


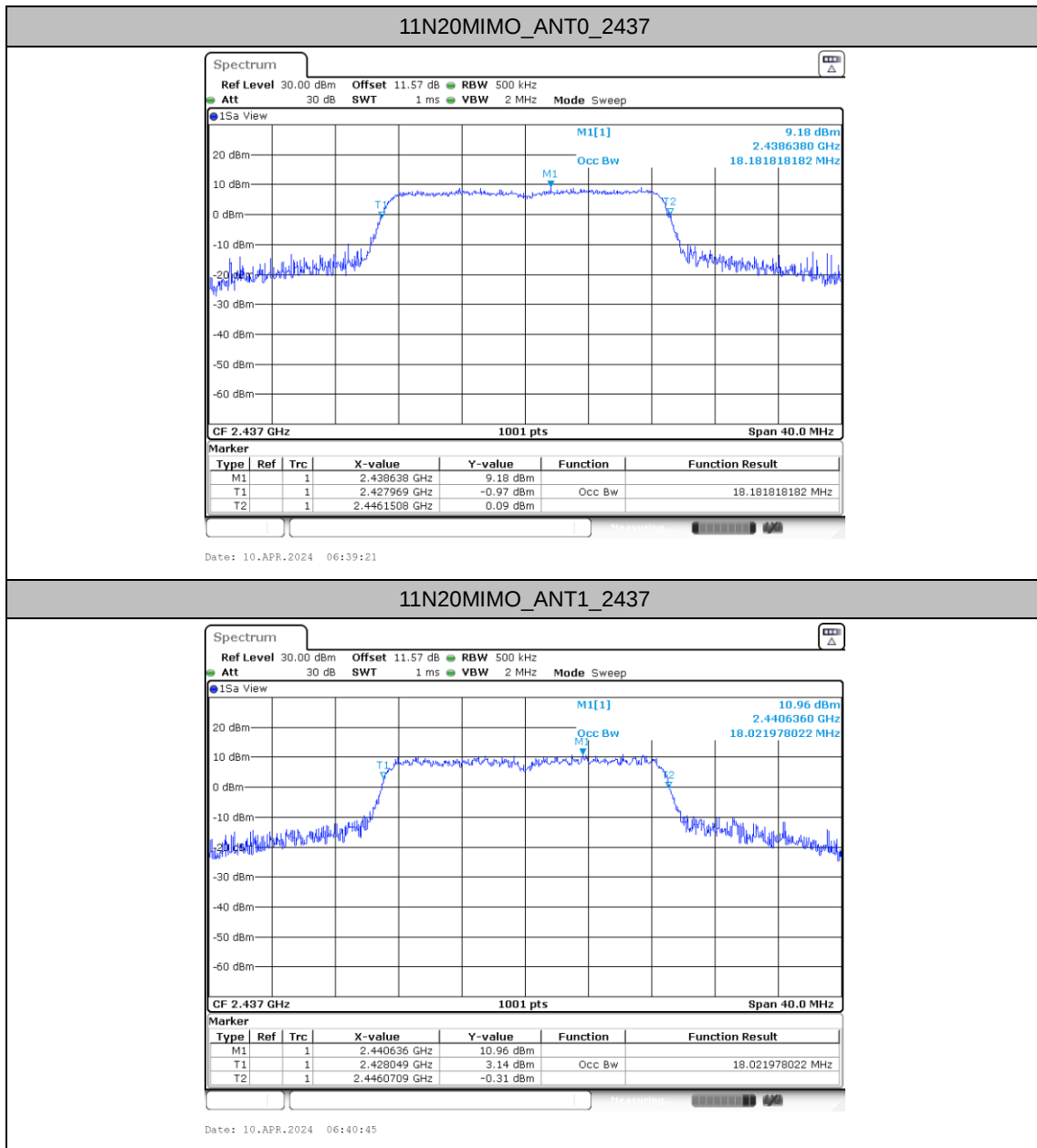


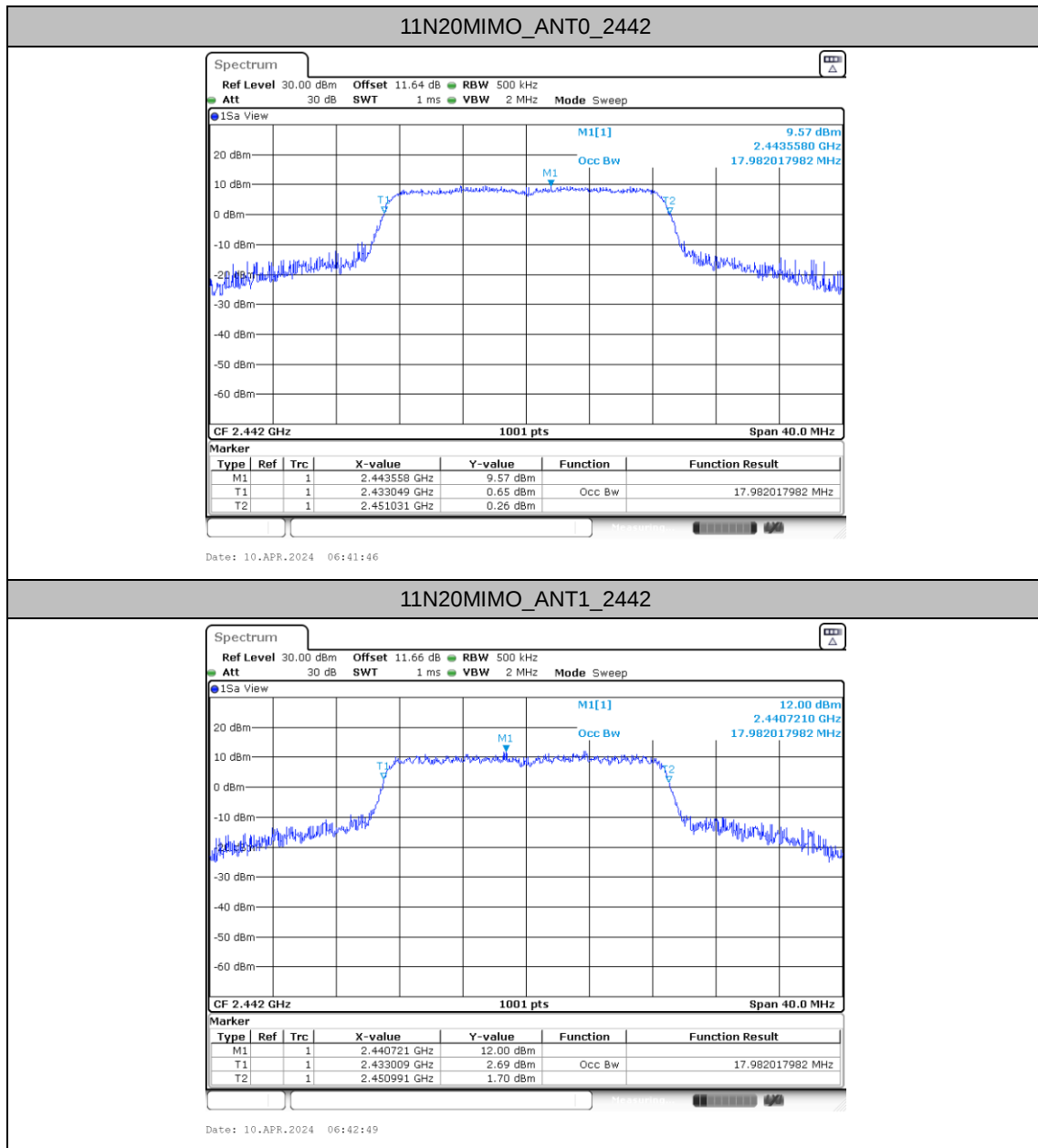


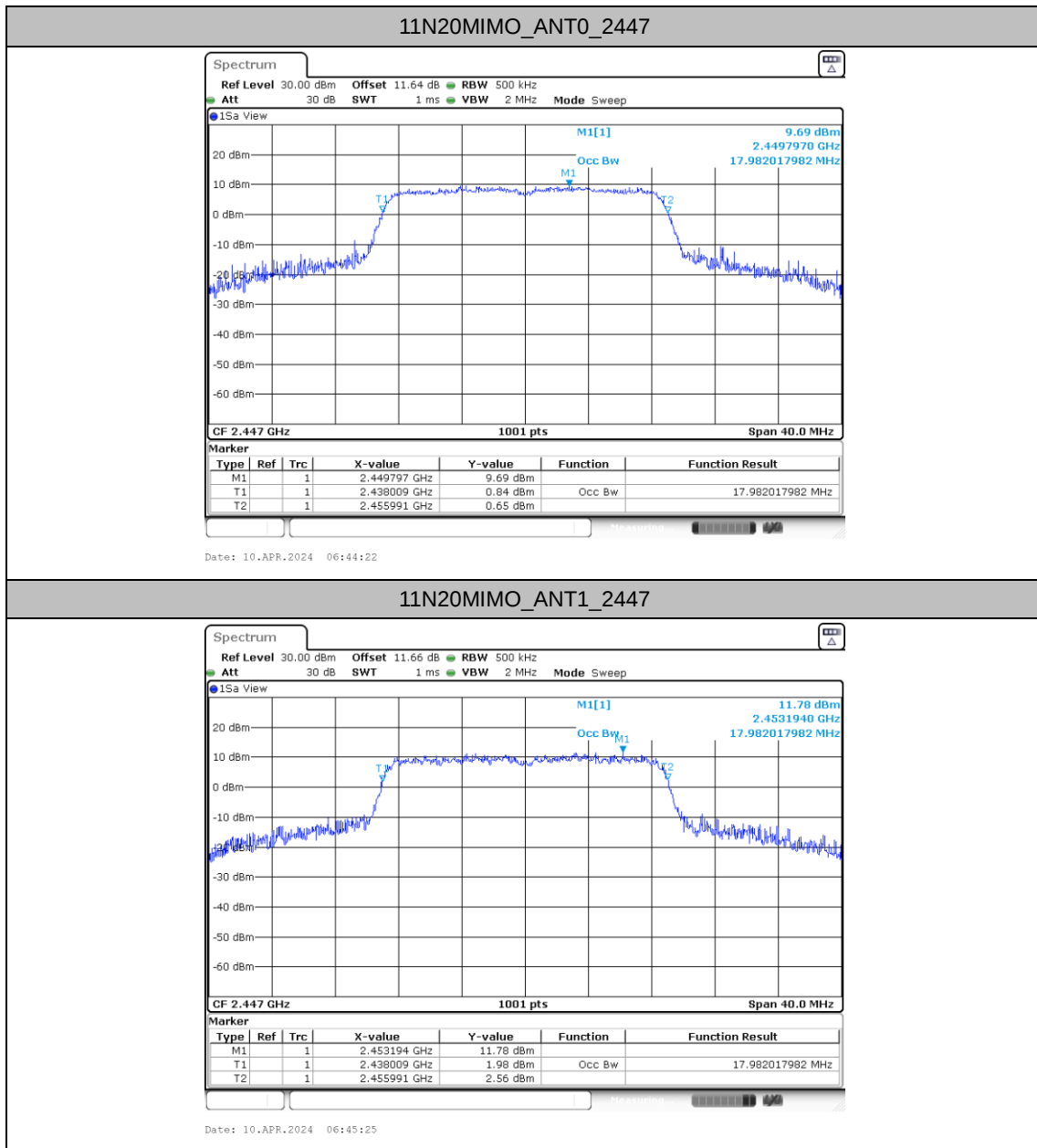


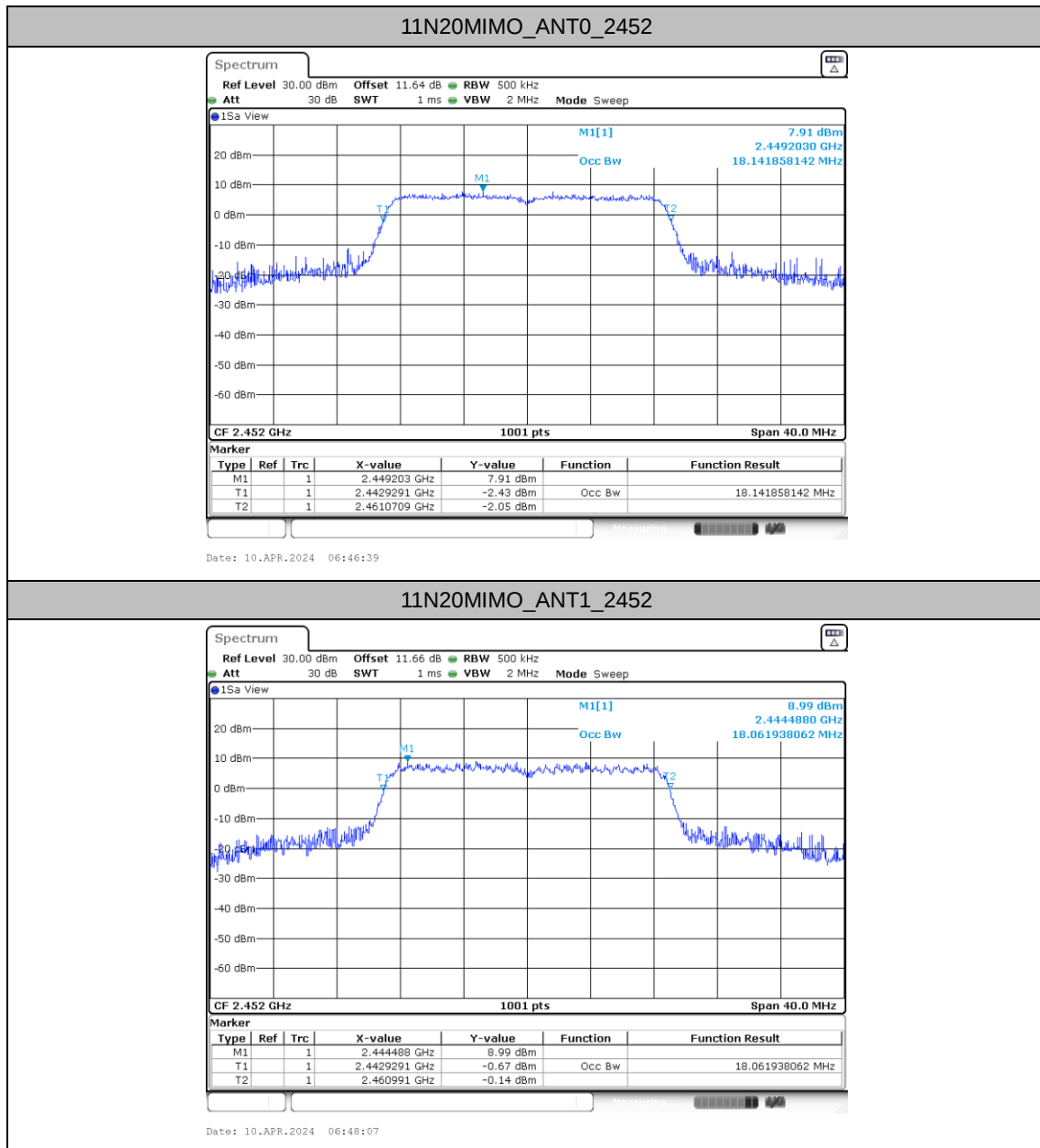






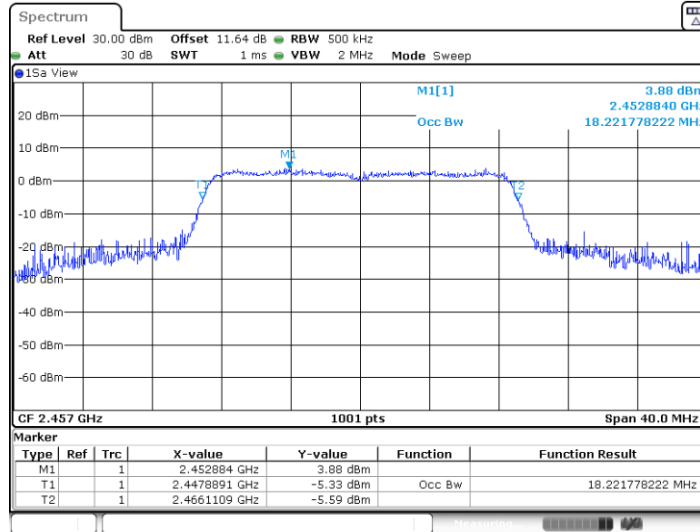






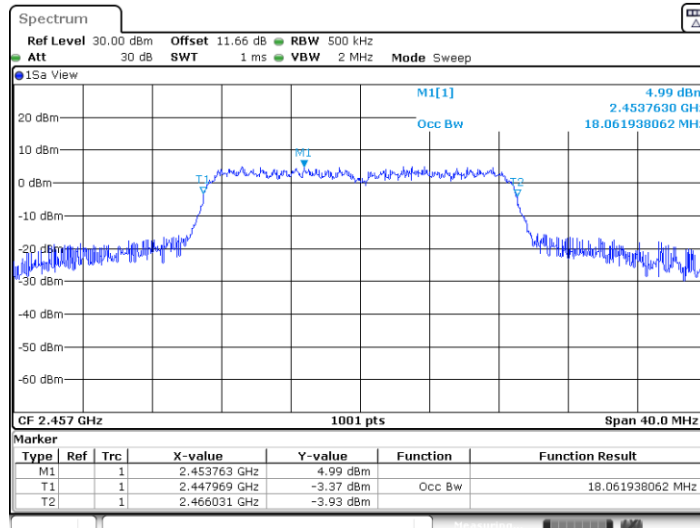


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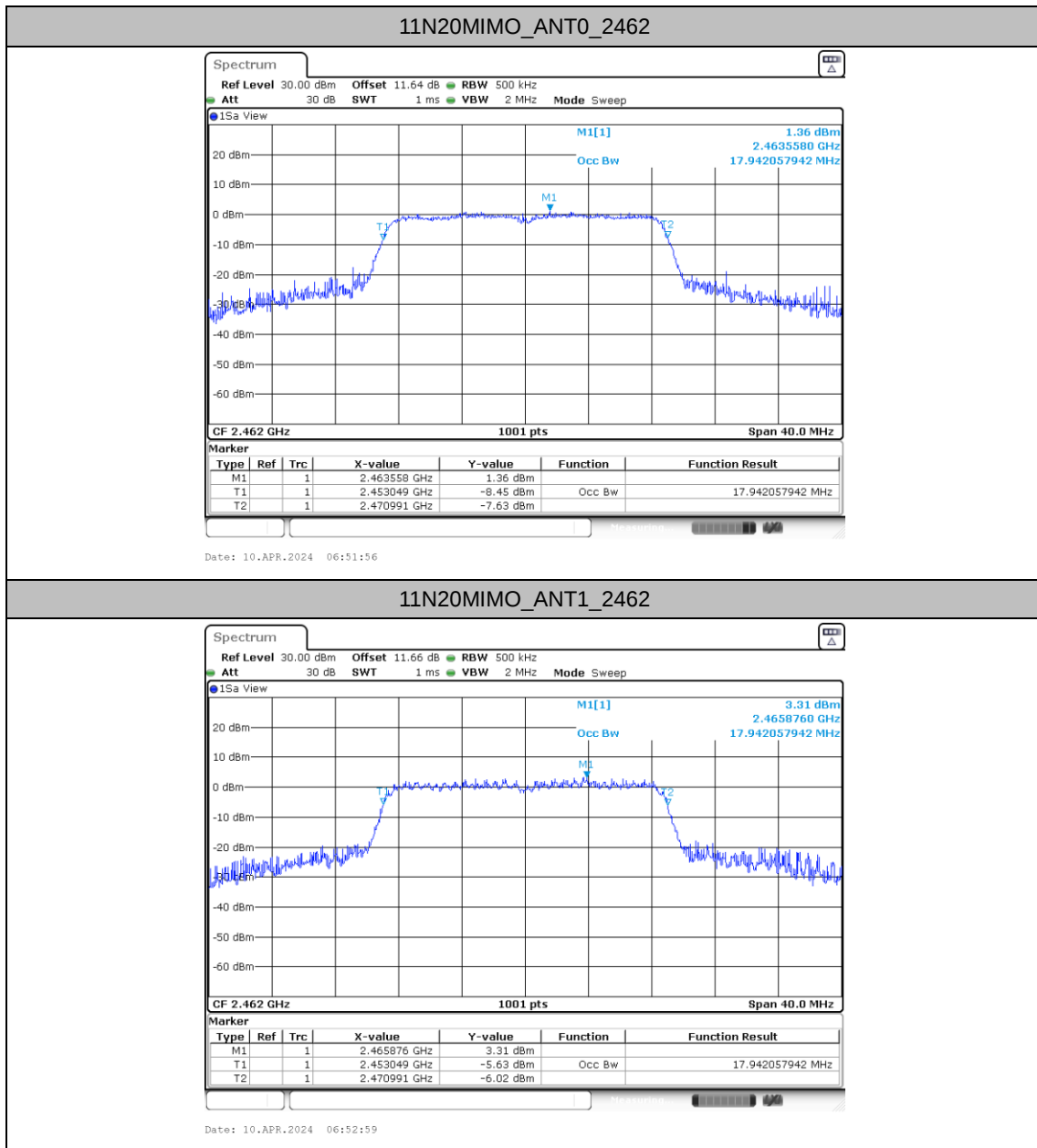


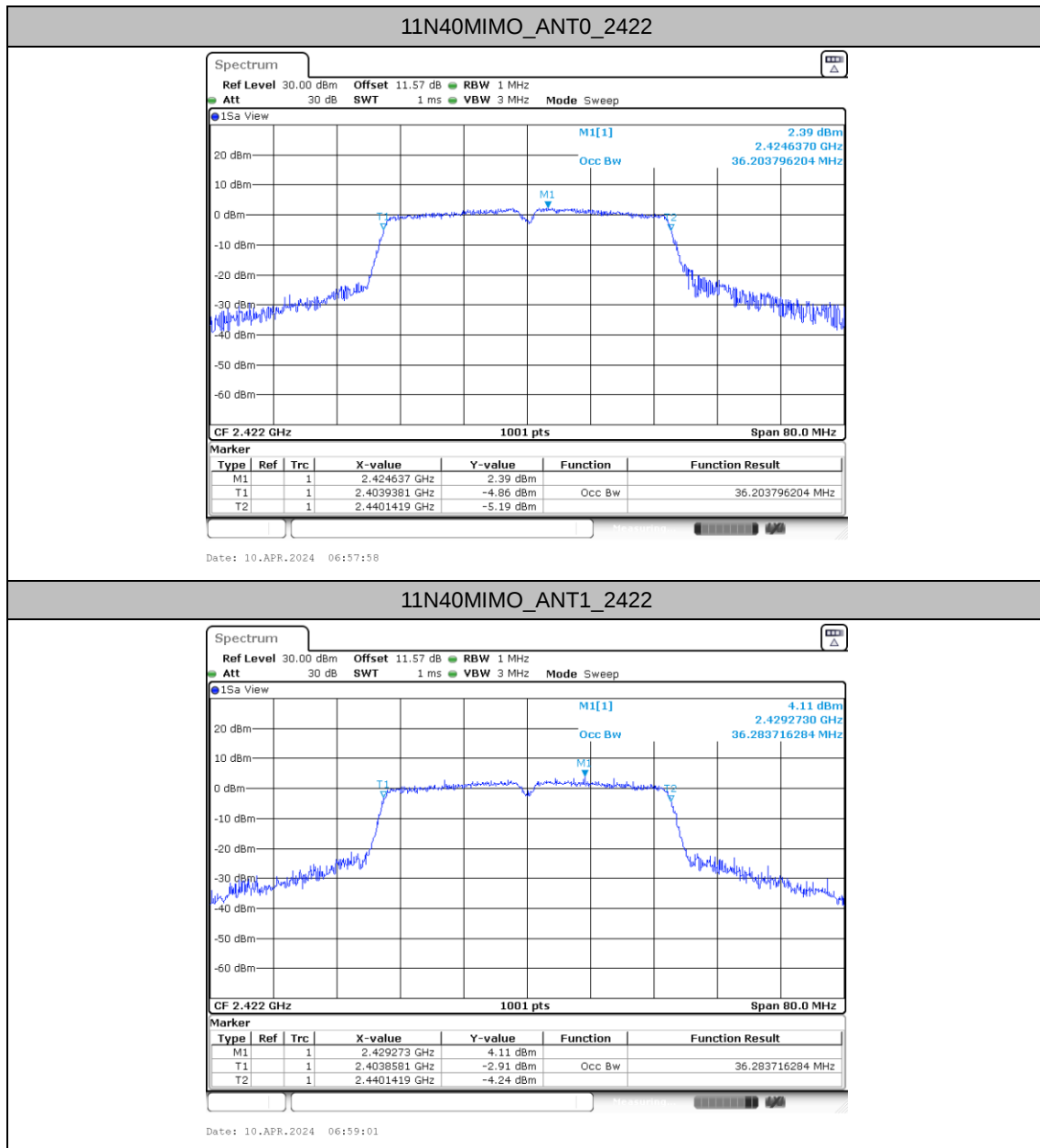
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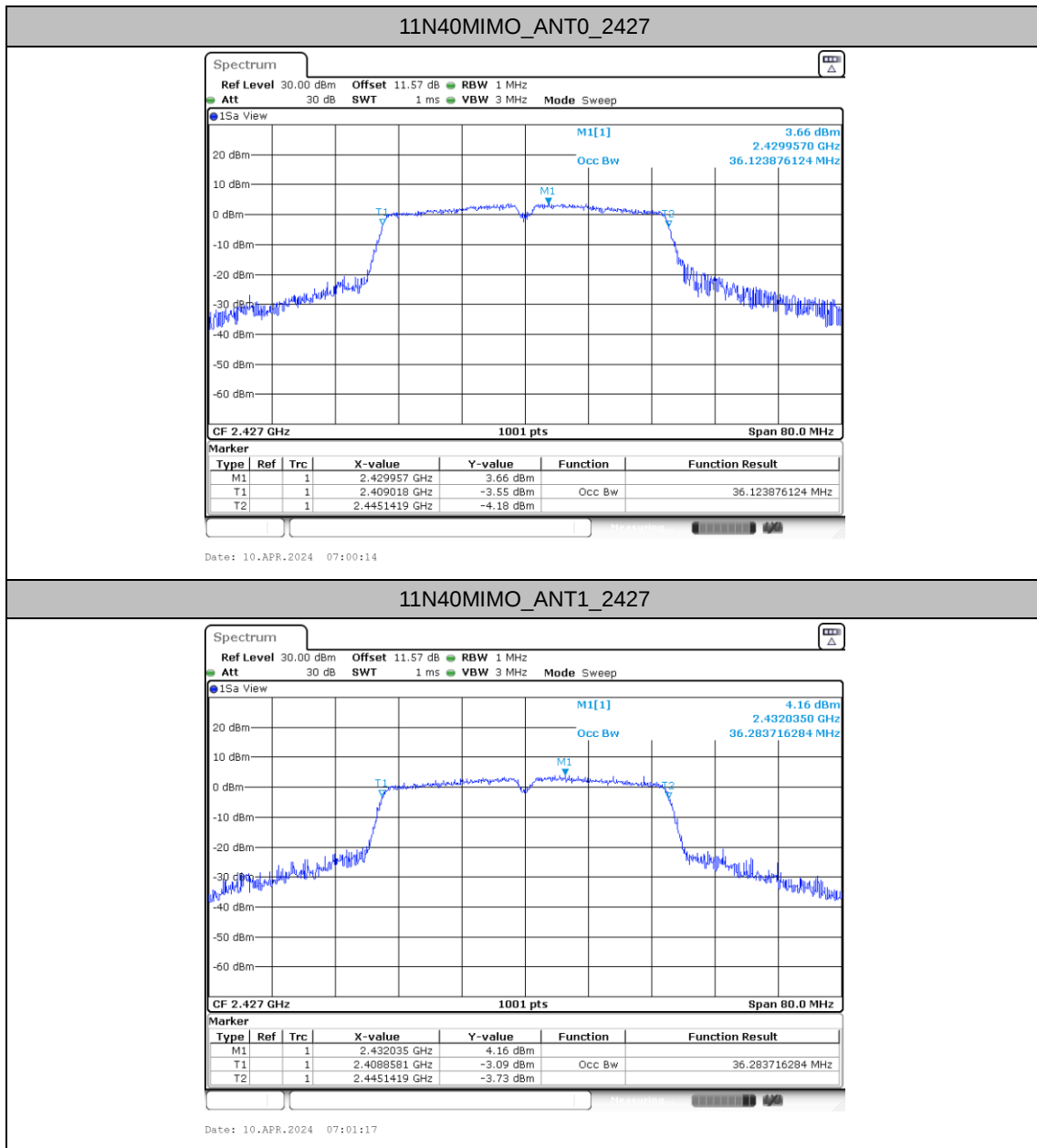
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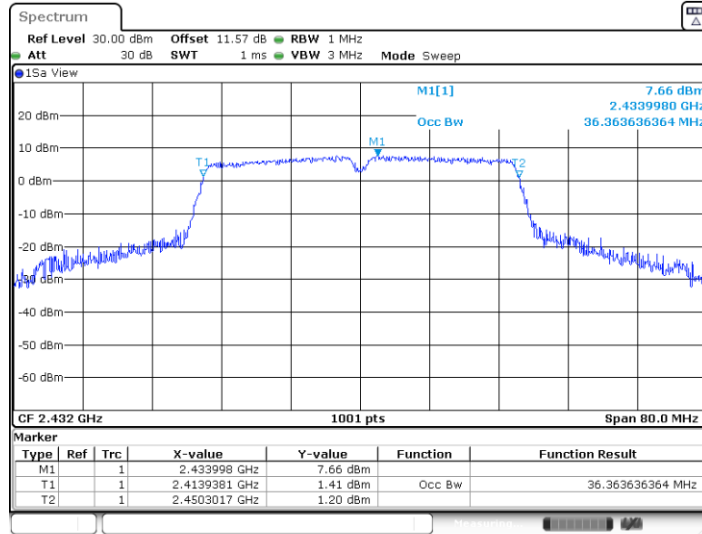






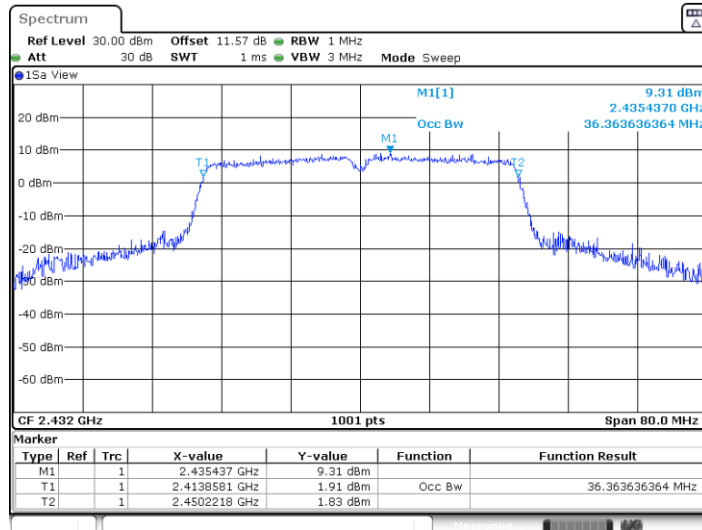


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11N40MIMO_ANT1_2432



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