



FCC RF Test Report

APPLICANT : Espressif Systems (Shanghai) Co.,Ltd.
EQUIPMENT : 2.4GHz Wi-Fi & BT IoT Module
BRAND NAME : ESPRESSIF
MODEL NAME : ESP8684-WROOM-06C
FCC ID : 2AC7Z-ESP868406C
STANDARD : FCC Part 15 Subpart C §15.247
CLASSIFICATION : (DTS) Digital Transmission System
TEST DATE(S) : Mar. 01, 2024 ~ Sep. 28, 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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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 1.31 dB at 2389.95 MHz
3.6	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 10.97 dB at 0.169 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/manufacturer 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

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 Wi-Fi & BT IoT Module
Brand Name	ESPRESSIF
Model Name	ESP8684-WROOM-06C
FCC ID	2AC7Z-ESP868406C
HW Version	v1.1
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 : 21.85 dBm (0.1531 W) 802.11g : 27.42 dBm (0.5521 W) 802.11n HT20 : 26.90 dBm (0.4898 W)
99% Occupied Bandwidth	802.11b : 12.907MHz 802.11g : 16.703MHz 802.11n HT20 : 17.343MHz
Antenna Type / Gain	PCB antenna with gain 2.7 dBi
Type of Modulation	802.11b : DSSS (DBPSK / DQPSK / CCK) 802.11g/n : OFDM (BPSK / QPSK / 16QAM / 64QAM)

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 03CH06-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.	03CH06-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: All test items were verified and recorded according to the standards and without any deviation during the test.



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

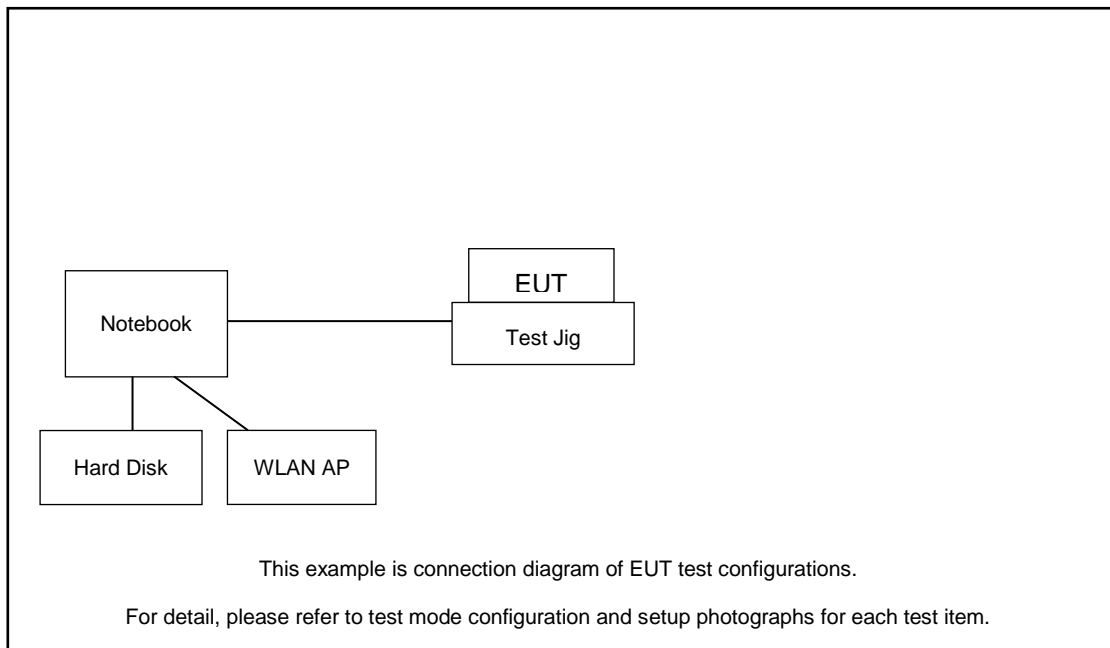
Final test modes are considering the modulation and worse data rates as below table.

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

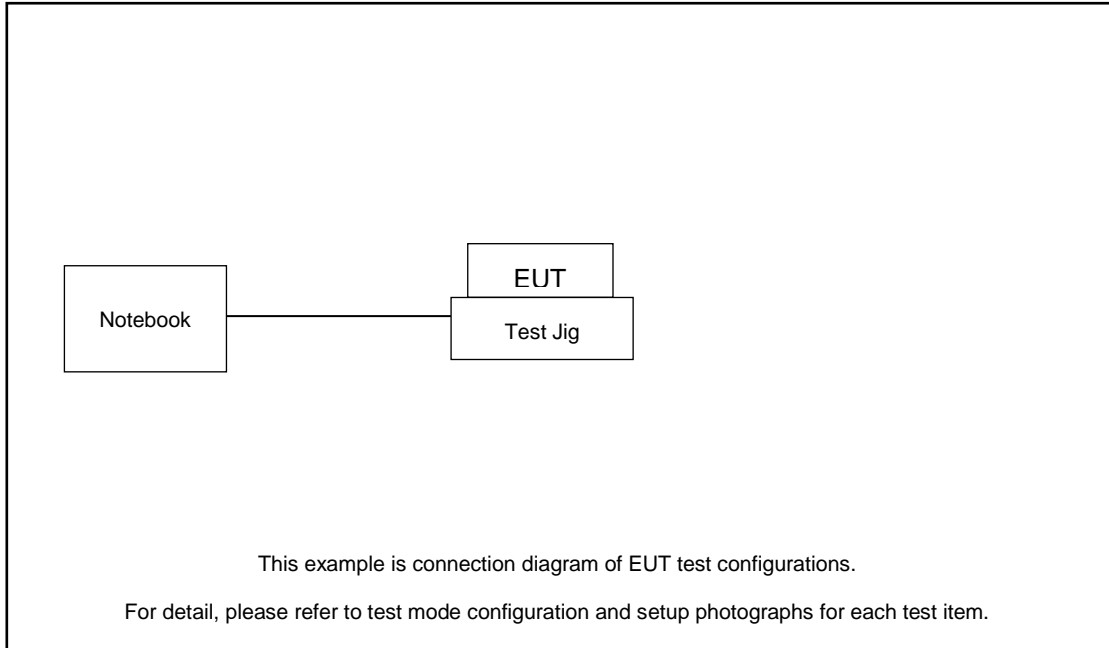
Test Cases	
AC Conducted Emission	Mode 1 :WLAN TX(2.4G) + Powered by Notebook
Remark: For Radiated Test Cases, The tests were performed with Notebook.	

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.	Hard Disk	WD	C6B	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 notebook 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 10dB attenuator.

$$\begin{aligned} \text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)}. \\ &= 1.91 + 10 = 11.91 \text{ (dB)} \end{aligned}$$

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) = 2MHz.
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.

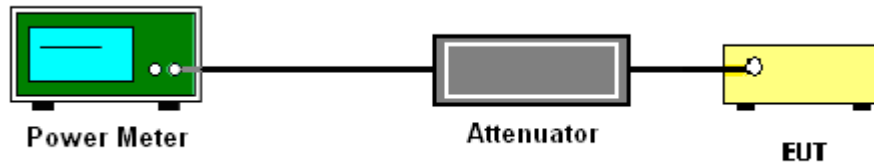
3.2.2 Measuring Instruments

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	21.85	30.00	2.70	24.55	36.00	Pass
11b	1Mbps	1	6	2437	21.83	30.00	2.70	24.53	36.00	Pass
11b	1Mbps	1	11	2462	21.20	30.00	2.70	23.90	36.00	Pass
11g	6Mbps	1	1	2412	25.83	30.00	2.70	28.53	36.00	Pass
11g	6Mbps	1	2	2417	26.59	30.00	2.70	29.29	36.00	Pass
11g	6Mbps	1	6	2437	27.42	30.00	2.70	30.12	36.00	Pass
11g	6Mbps	1	9	2452	26.71	30.00	2.70	29.41	36.00	Pass
11g	6Mbps	1	10	2457	25.99	30.00	2.70	28.69	36.00	Pass
11g	6Mbps	1	11	2462	25.48	30.00	2.70	28.18	36.00	Pass
HT20	MCS0	1	1	2412	25.45	30.00	2.70	28.15	36.00	Pass
HT20	MCS0	1	2	2417	26.28	30.00	2.70	28.98	36.00	Pass
HT20	MCS0	1	6	2437	26.90	30.00	2.70	29.60	36.00	Pass
HT20	MCS0	1	10	2457	25.94	30.00	2.70	28.64	36.00	Pass
HT20	MCS0	1	11	2462	25.12	30.00	2.70	27.82	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	Power setting
11b	1Mbps	1	1	2412	0.00	18.48	30.00	2.70	21.18	36.00	Pass	6.00
11b	1Mbps	1	6	2437	0.00	18.65	30.00	2.70	21.35	36.00	Pass	6.00
11b	1Mbps	1	11	2462	0.00	17.94	30.00	2.70	20.64	36.00	Pass	10.00
11g	6Mbps	1	1	2412	0.00	15.45	30.00	2.70	18.15	36.00	Pass	20.00
11g	6Mbps	1	2	2417	0.00	17.90	30.00	2.70	20.60	36.00	Pass	10.00
11g	6Mbps	1	6	2437	0.00	20.19	30.00	2.70	22.89	36.00	Pass	0.00
11g	6Mbps	1	9	2452	0.00	17.38	30.00	2.70	20.08	36.00	Pass	10.00
11g	6Mbps	1	10	2457	0.00	16.37	30.00	2.70	19.07	36.00	Pass	16.00
11g	6Mbps	1	11	2462	0.00	14.92	30.00	2.70	17.62	36.00	Pass	22.00
HT20	MCS0	1	1	2412	0.03	14.87	30.00	2.70	17.57	36.00	Pass	12.00
HT20	MCS0	1	2	2417	0.03	17.15	30.00	2.70	19.85	36.00	Pass	4.00
HT20	MCS0	1	6	2437	0.03	17.86	30.00	2.70	20.56	36.00	Pass	0.00
HT20	MCS0	1	10	2457	0.03	16.16	30.00	2.70	18.86	36.00	Pass	8.00
HT20	MCS0	1	11	2462	0.03	14.76	30.00	2.70	17.46	36.00	Pass	14.00

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.

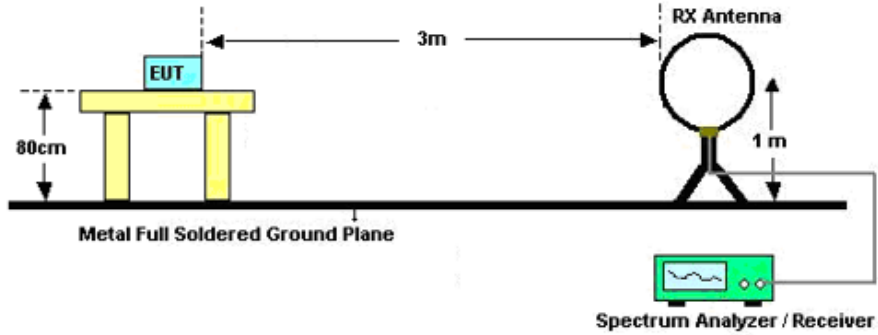


3.5.3 Test Procedures

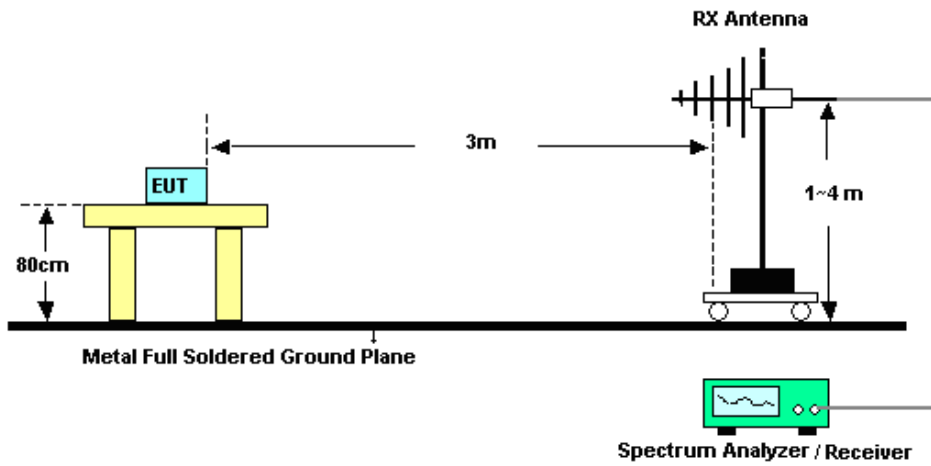
1. The testing follows ANSI C63.10-2013 clause 11.11 & 11.12
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better 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 \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

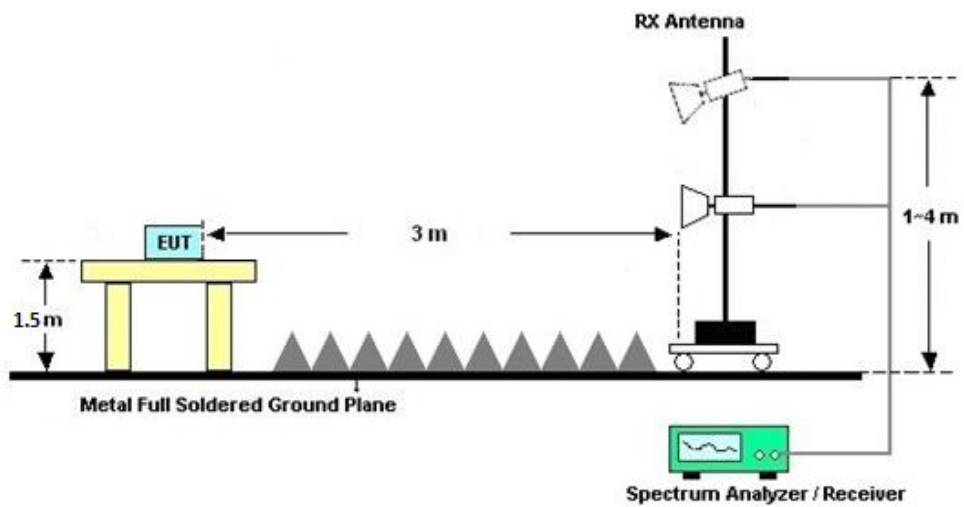
For radiated emissions below 30MHz



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 (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.

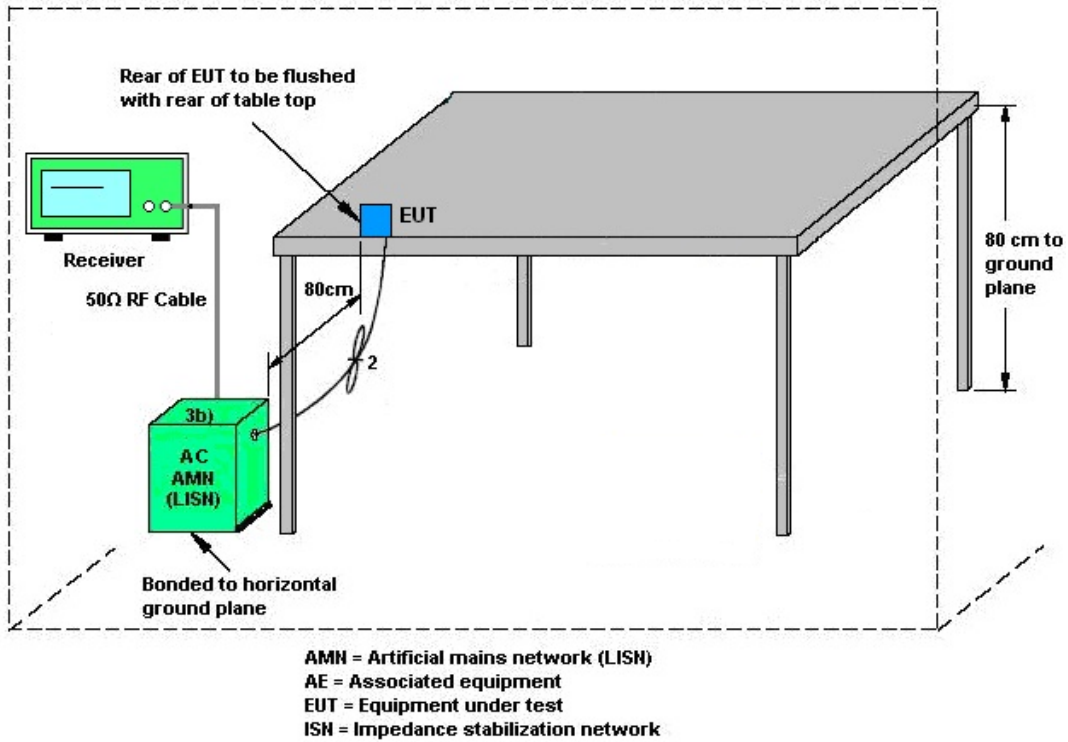
3.6.2 Measuring Instruments

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 Test Receiver	Keysight	N9038A	MY56400004	3Hz~8.5GHz;Max 30dBm	Oct. 10, 2023	Mar. 14, 2024~Sep. 28, 2024	Oct. 09, 2024	Radiation (03CH06-KS)
EXA Spectrum Analyzer	Keysight	N9010B	MY60242126	10Hz~44GHz	Oct. 10, 2023	Mar. 14, 2024~Sep. 28, 2024	Oct. 09, 2024	Radiation (03CH06-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 10, 2023	Mar. 14, 2024~Sep. 28, 2024	Oct. 09, 2024	Radiation (03CH06-KS)
Bilog Antenna	TeseQ	CBL6111D	59913	30MHz~1GHz	Aug. 19, 2023	Mar. 14, 2024~Sep. 28, 2024	Aug. 18, 2024	Radiation (03CH06-KS)
Bilog Antenna	TeseQ	CBL6111D	59913	30MHz~1GHz	Aug. 18, 2024		Aug. 17, 2025	Radiation (03CH06-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	00240132	1GHz~18GHz	Jul. 12, 2023	Mar. 14, 2024~Sep. 28, 2024	Jul. 11, 2024	Radiation (03CH06-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	00240132	1GHz~18GHz	Jul. 11, 2024		Jul. 10, 2025	Radiation (03CH06-KS)
SHF-EHF Horn	Com-power	AH-840	101093	18GHz~40GHz	Jan. 05, 2024	Mar. 14, 2024~Sep. 28, 2024	Jan. 04, 2025	Radiation (03CH06-KS)
Amplifier	SONOMA	310N	380827	9KHz ~1GHZ	Jul. 06, 2023	Mar. 14, 2024~Sep. 28, 2024	Jul. 05, 2024	Radiation (03CH06-KS)
Amplifier	MITEQ	EM18G40GGA	060728	18~40GHz	Jan. 04, 2024	Mar. 14, 2024~Sep. 28, 2024	Jan. 03, 2025	Radiation (03CH06-KS)
high gain Amplifier	MITEQ	AMF-7D-00101800-30-10P	2082395	1Ghz-18Ghz	Jan. 04, 2024	Mar. 14, 2024~Sep. 28, 2024	Jan. 03, 2025	Radiation (03CH06-KS)
Amplifier	Keysight	83017A	MY53270319	500MHz~26.5GHz	Oct. 10, 2023	Mar. 14, 2024~Sep. 28, 2024	Oct. 09, 2024	Radiation (03CH06-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Mar. 14, 2024~Sep. 28, 2024	NCR	Radiation (03CH06-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Mar. 14, 2024~Sep. 28, 2024	NCR	Radiation (03CH06-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Mar. 14, 2024~Sep. 28, 2024	NCR	Radiation (03CH06-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	May 16, 2023	Mar. 01, 2024	May 15, 2024	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060103	9kHz~30MHz	Oct. 11, 2023	Mar. 01, 2024	Oct. 10, 2024	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060105	9kHz~30MHz	May 16, 2023	Mar. 01, 2024	May 15, 2024	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP00000811	AC 0V~300V, 45Hz~1000Hz	Oct. 11, 2023	Mar. 01, 2024	Oct. 10, 2024	Conduction (CO01-KS)
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Oct. 11, 2023	Mar. 13, 2024~Sep. 28, 2024	Oct. 10, 2024	Conducted (TH01-KS)
Pulse Power Sensor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 02, 2024	Mar. 13, 2024~Sep. 28, 2024	Jan. 01, 2025	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 02, 2024	Mar. 13, 2024~Sep. 28, 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 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
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Uncertainty of Radiated Emission Measurement (9 KHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	3.32 dB
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Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	6.26 dB
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Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.02 dB
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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: <u>25</u> °C, <u>45</u> %RH	
Test Date: <u>2024/3/13~2024/9/28</u>	Test Engineer: <u>Jacob Zhang</u>

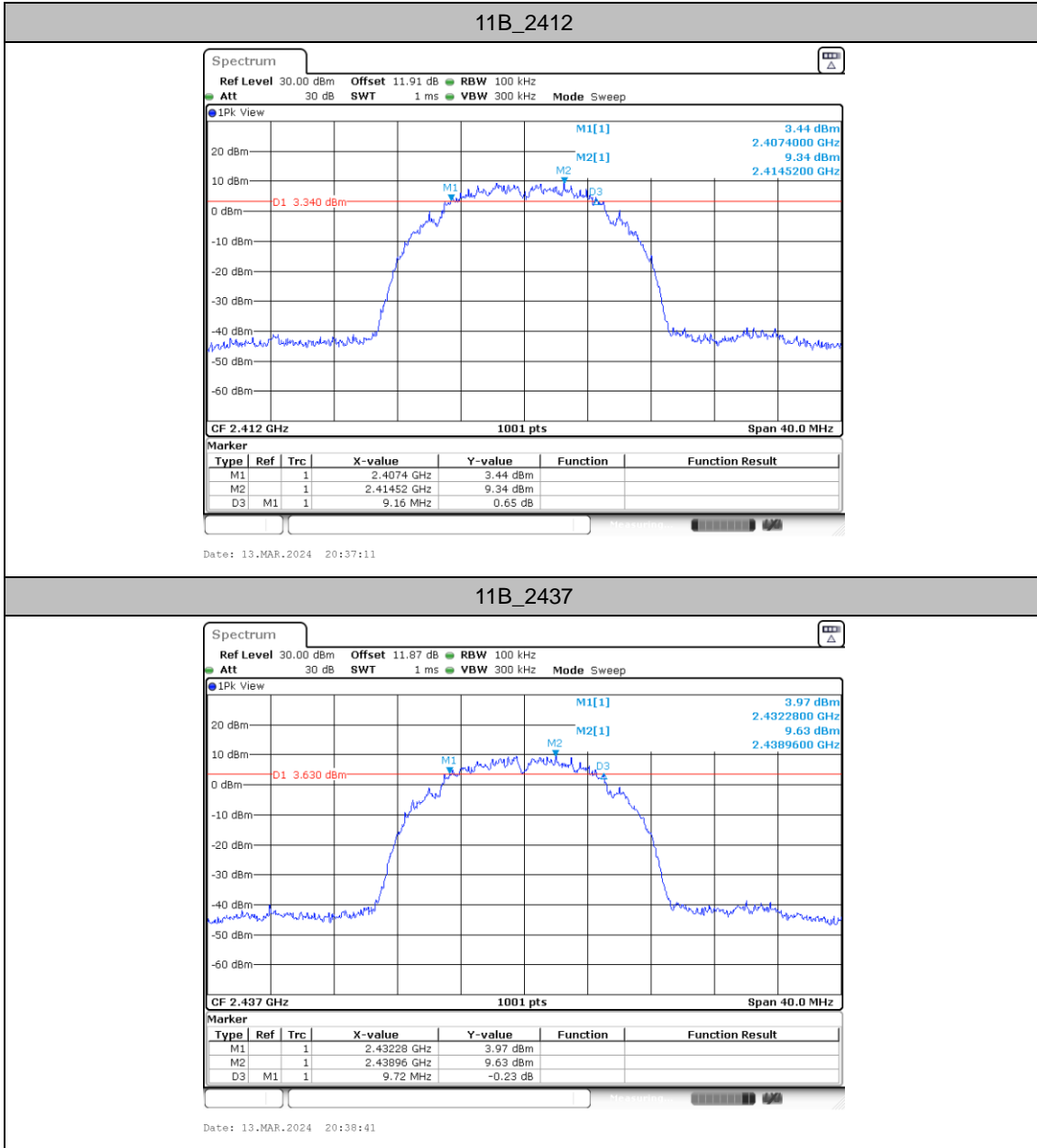
DTS Bandwidth

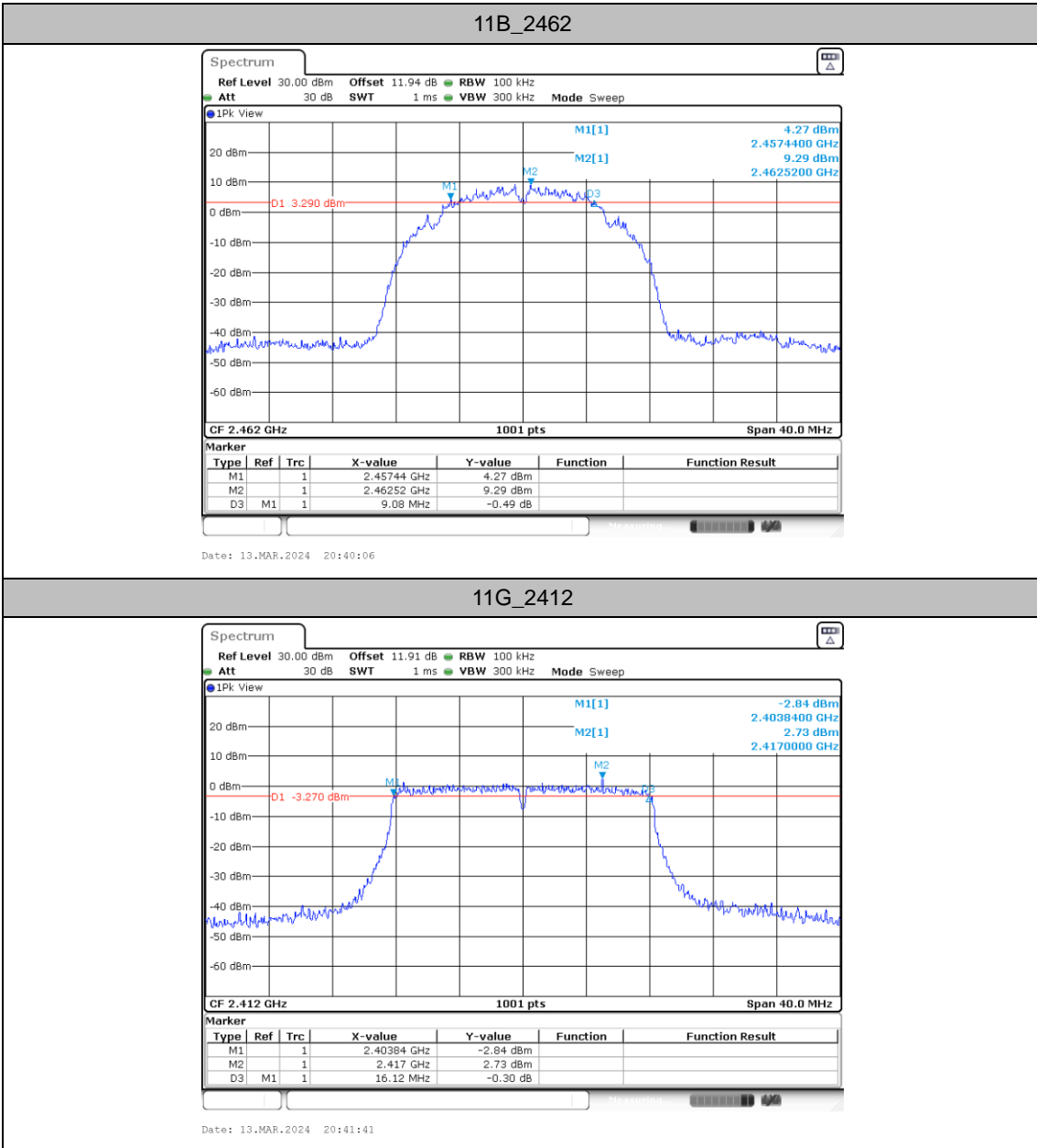
Test Result

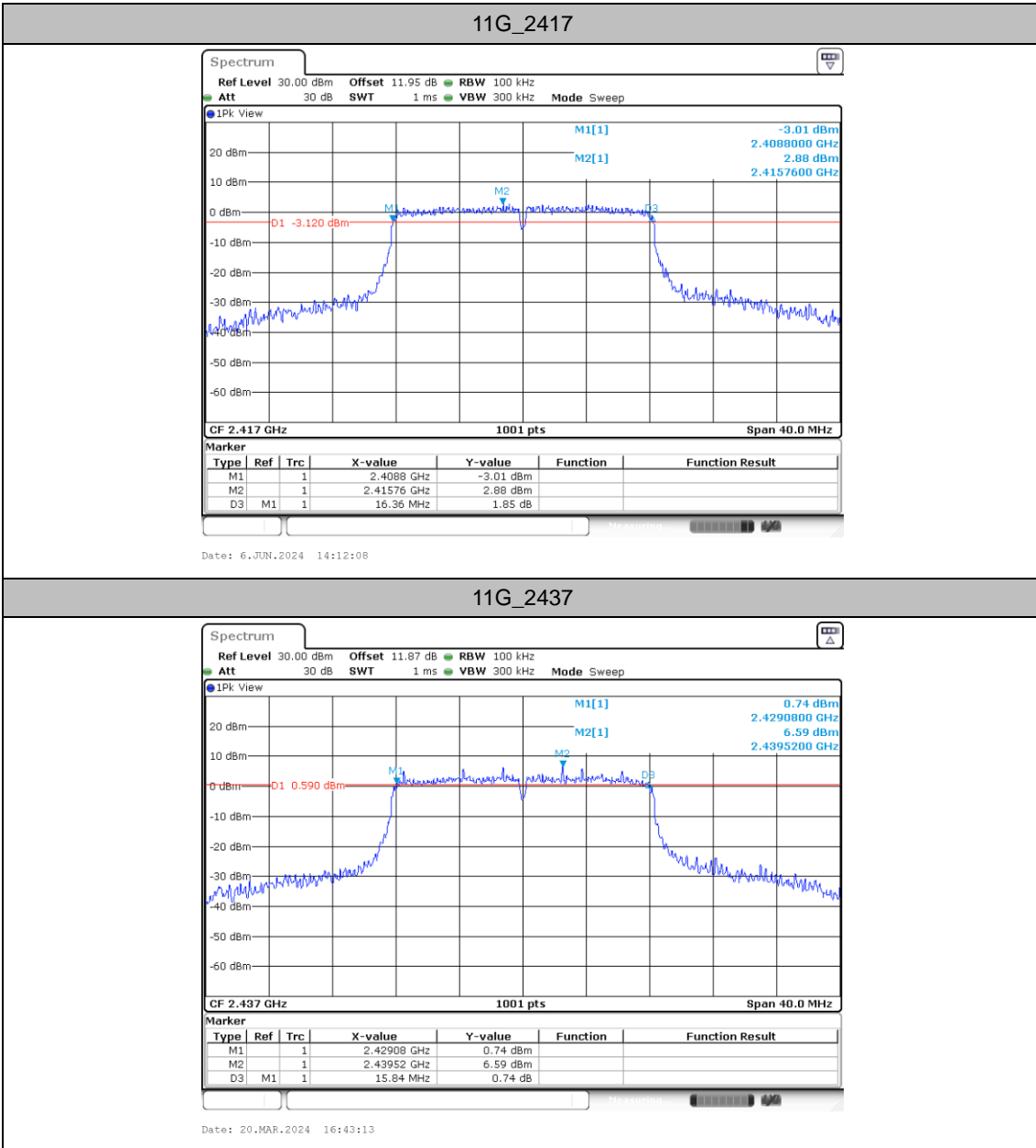
TestMode	Freq(MHz)	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11B	2412	9.16	2407.40	2416.56	0.5	PASS
	2437	9.72	2432.28	2442.00	0.5	PASS
	2462	9.08	2457.44	2466.52	0.5	PASS
11G	2412	16.12	2403.84	2419.96	0.5	PASS
	2417	16.36	2408.80	2425.16	0.5	PASS
	2437	15.84	2429.08	2444.92	0.5	PASS
	2452	16.32	2443.84	2460.16	0.5	PASS
	2457	16.04	2448.84	2464.88	0.5	PASS
	2462	15.80	2454.08	2469.88	0.5	PASS
11N20SISO	2412	16.08	2403.84	2419.92	0.5	PASS
	2417	16.12	2408.84	2424.96	0.5	PASS
	2437	15.80	2429.08	2444.88	0.5	PASS
	2457	15.80	2449.08	2464.88	0.5	PASS
	2462	15.84	2454.04	2469.88	0.5	PASS

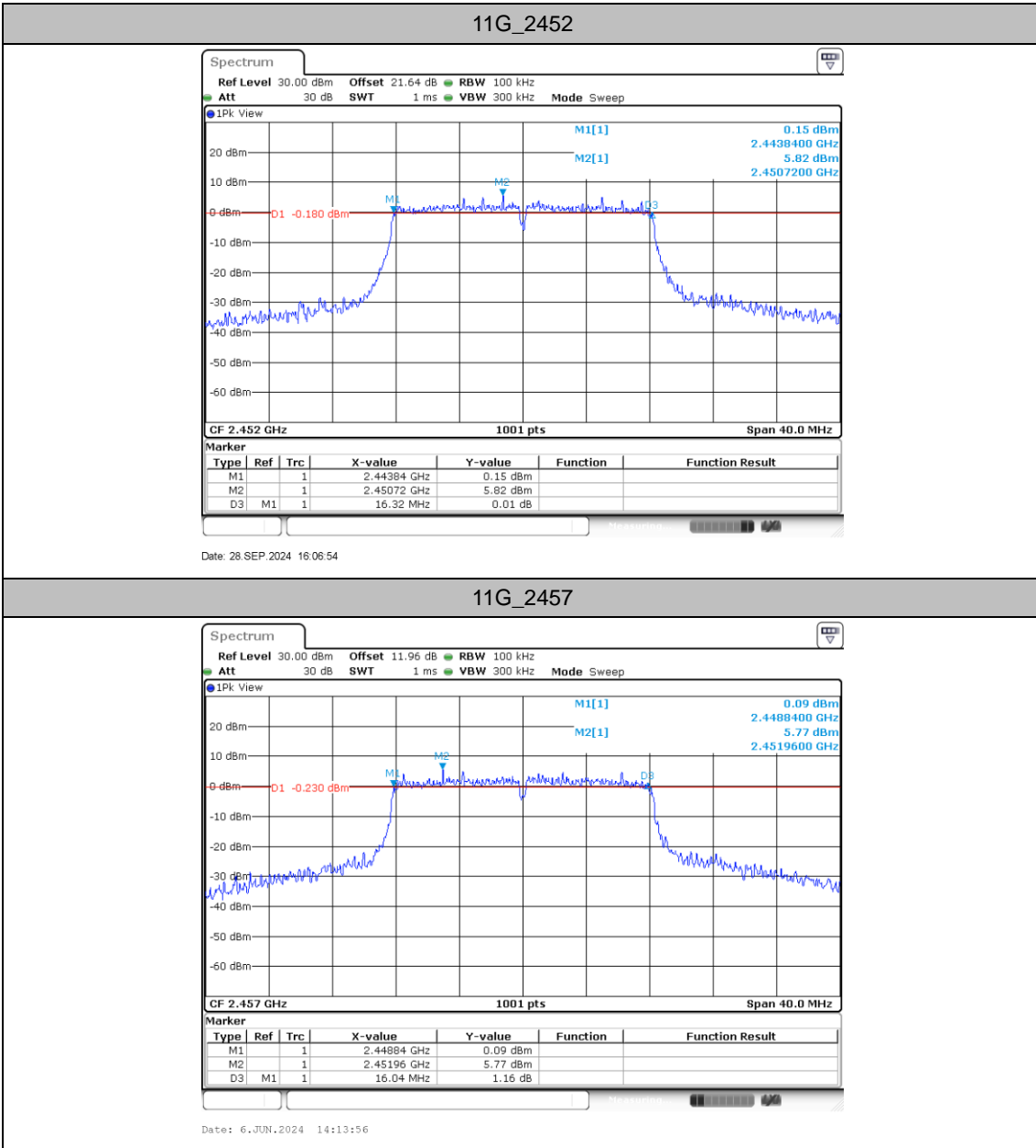


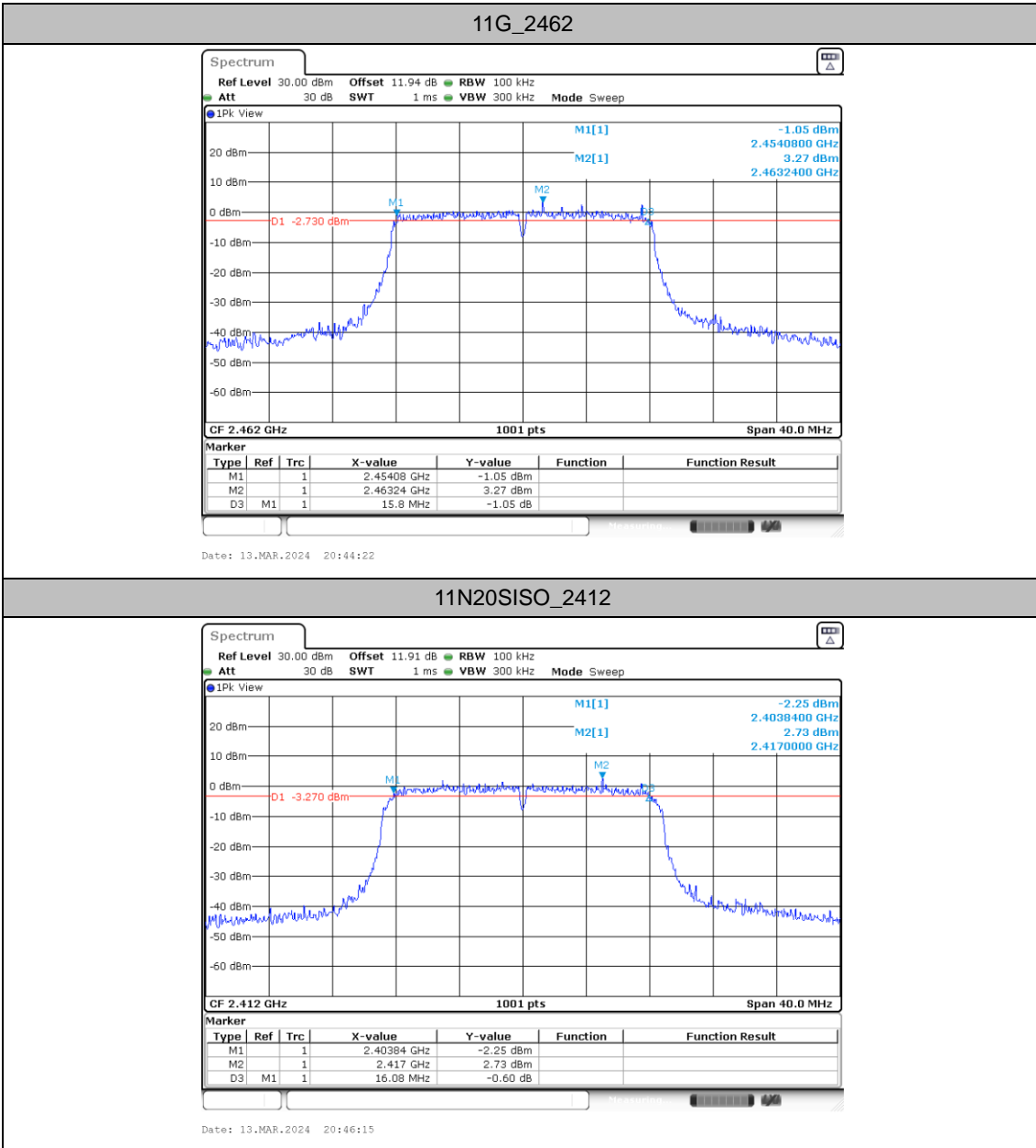
Test Graphs

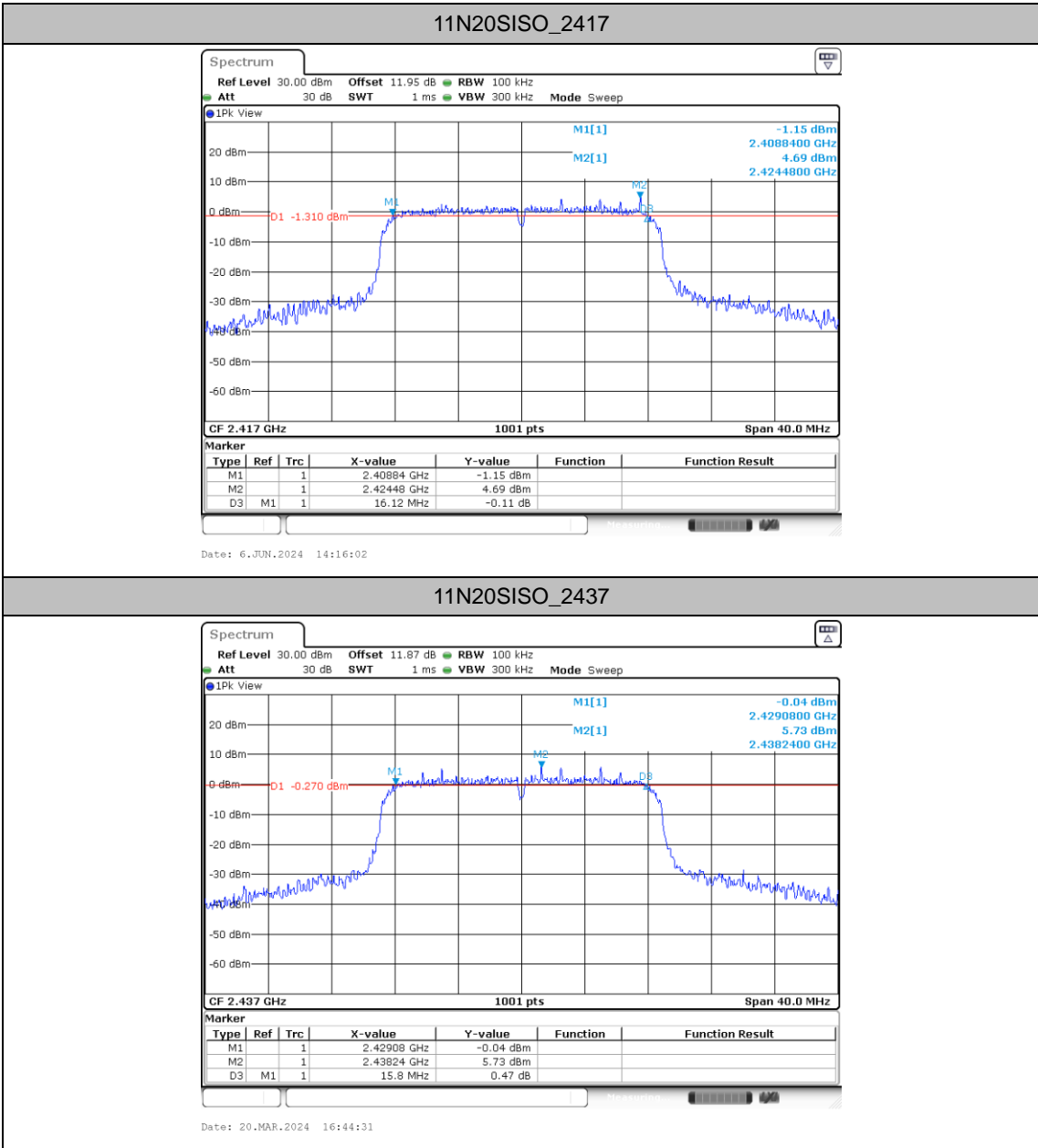


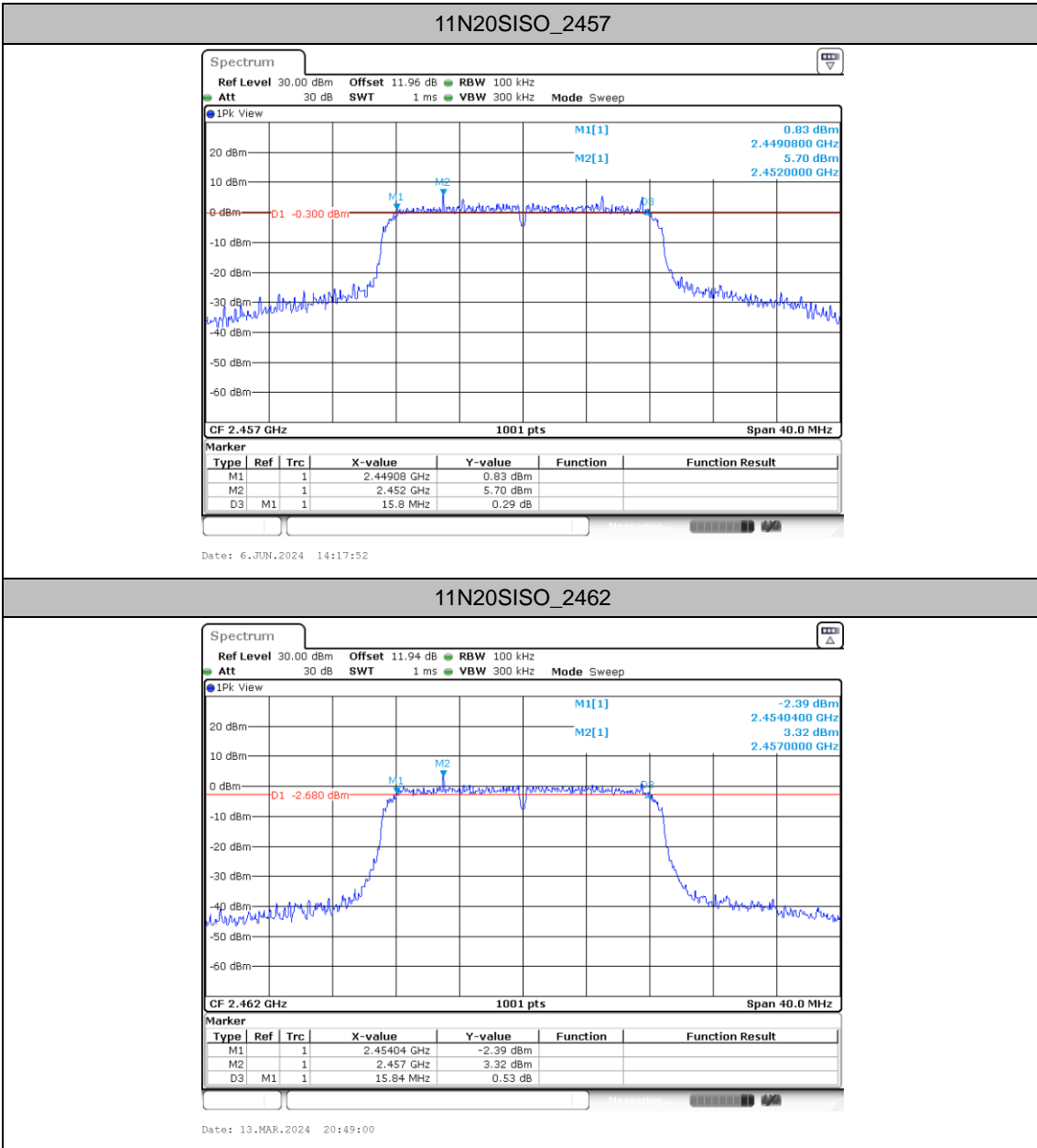














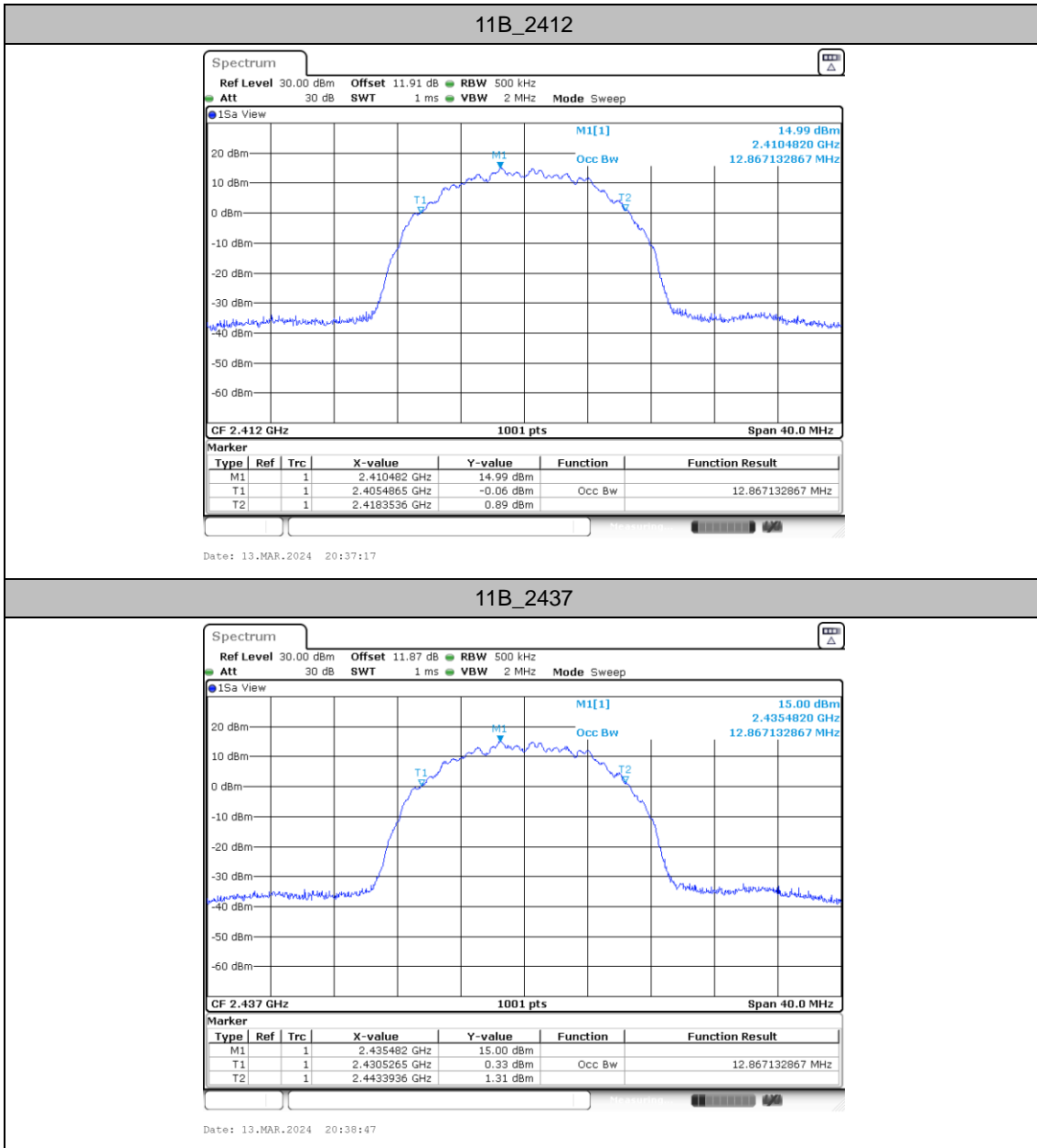
Occupied Channel Bandwidth

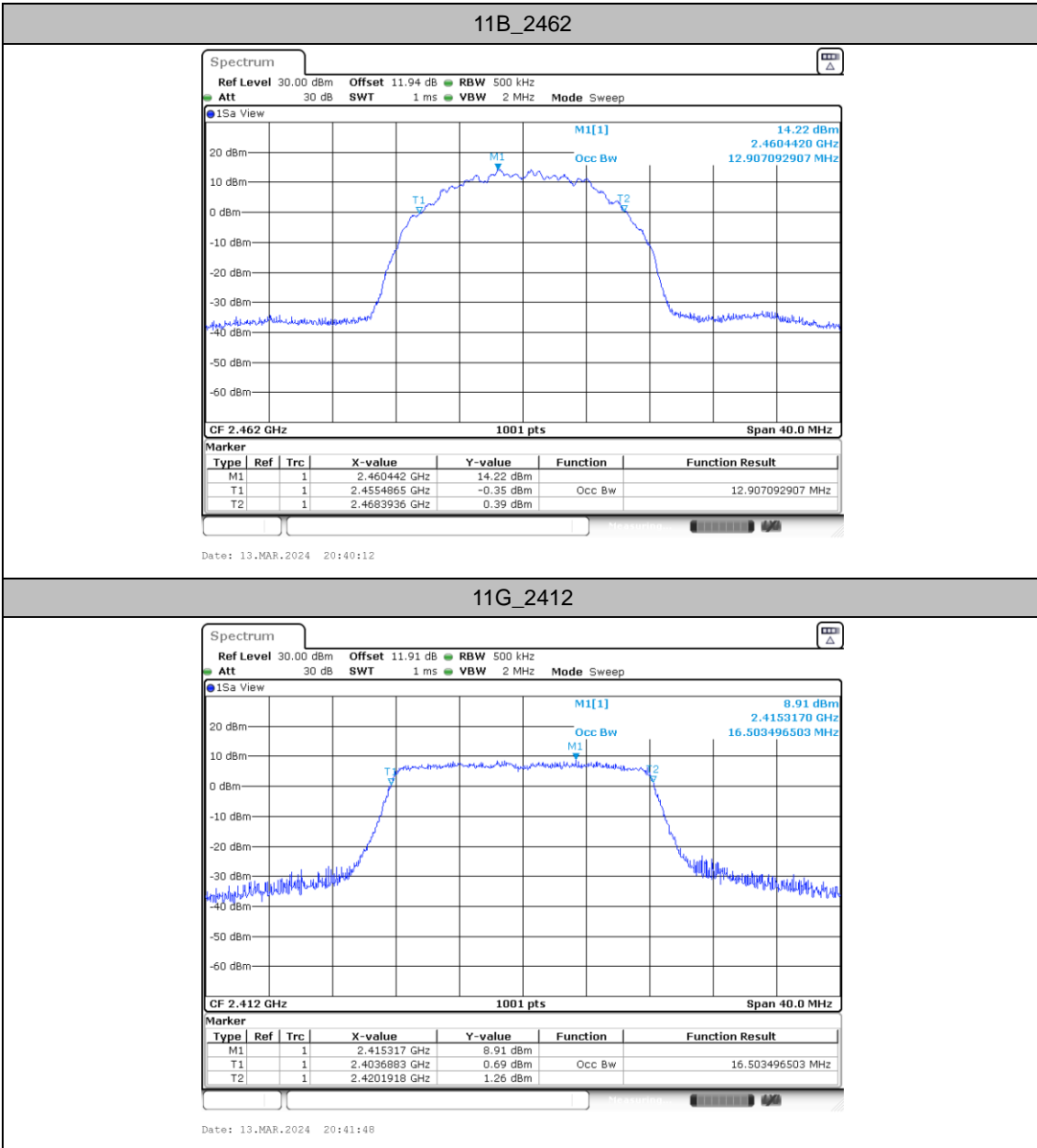
Test Result

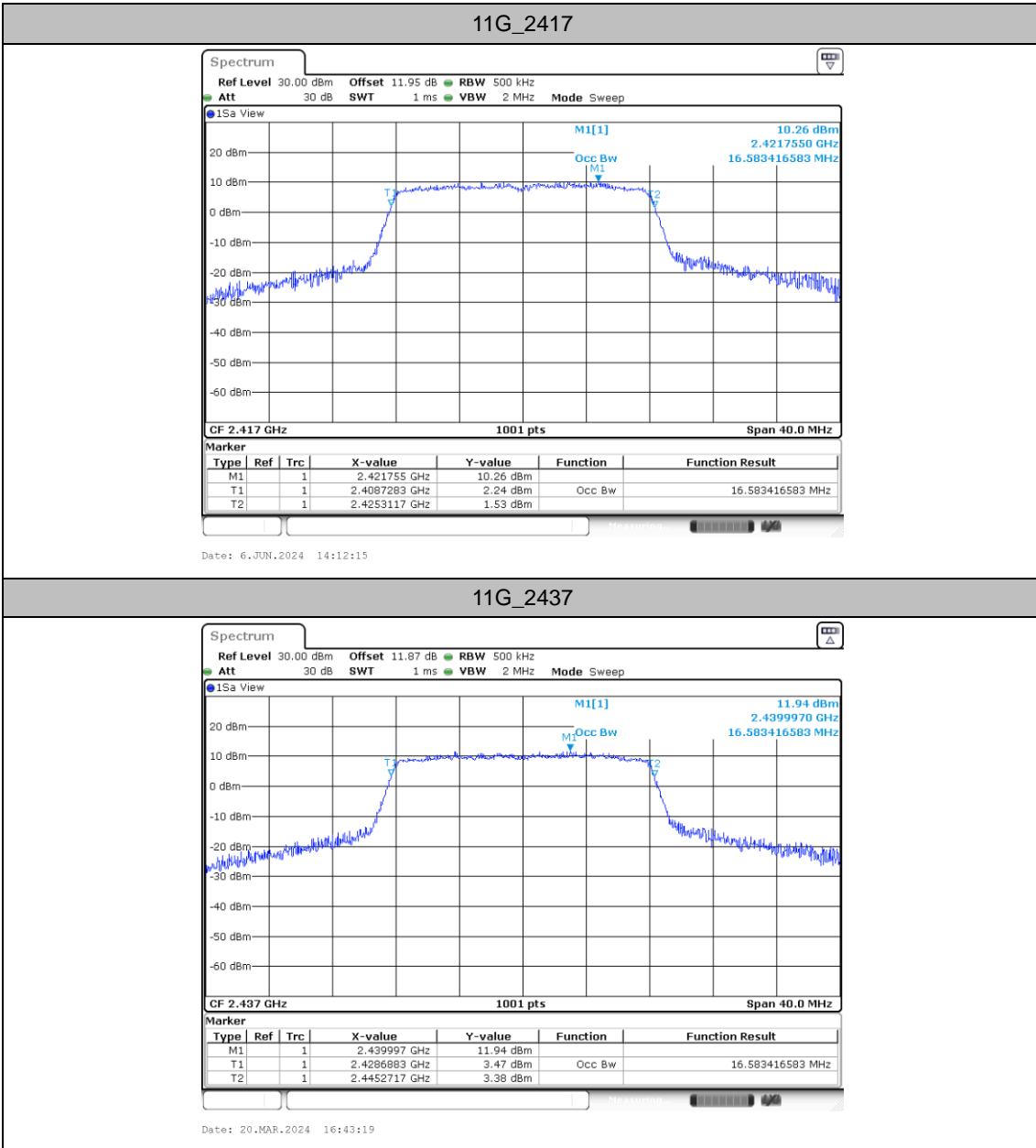
TestMode	Freq(MHz)	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11B	2412	12.867	2405.4865	2418.3536	---	---
	2437	12.867	2430.5265	2443.3936	---	---
	2462	12.907	2455.4865	2468.3936	---	---
11G	2412	16.503	2403.6883	2420.1918	---	---
	2417	16.583	2408.7283	2425.3117	---	---
	2437	16.583	2428.6883	2445.2717	---	---
	2452	16.703	2443.6084	2460.3117	---	---
	2457	16.663	2448.6484	2465.3117	---	---
	2462	16.503	2453.7283	2470.2318	---	---
11N20SISO	2412	17.223	2403.3686	2420.5914	---	---
	2417	17.263	2408.3686	2425.6314	---	---
	2437	17.223	2428.3686	2445.5914	---	---
	2457	17.343	2448.3287	2465.6713	---	---
	2462	17.183	2453.4086	2470.5914	---	---

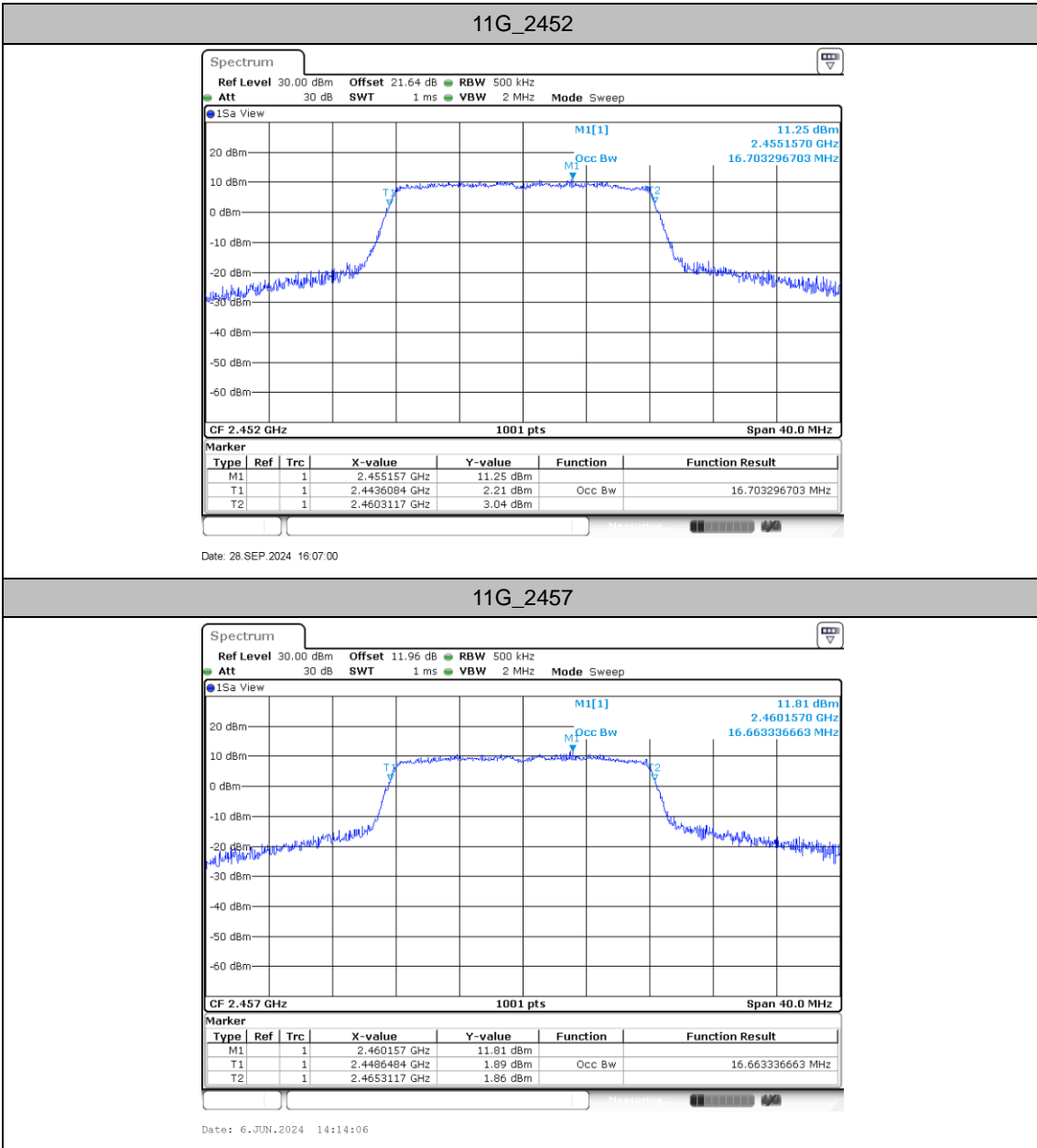


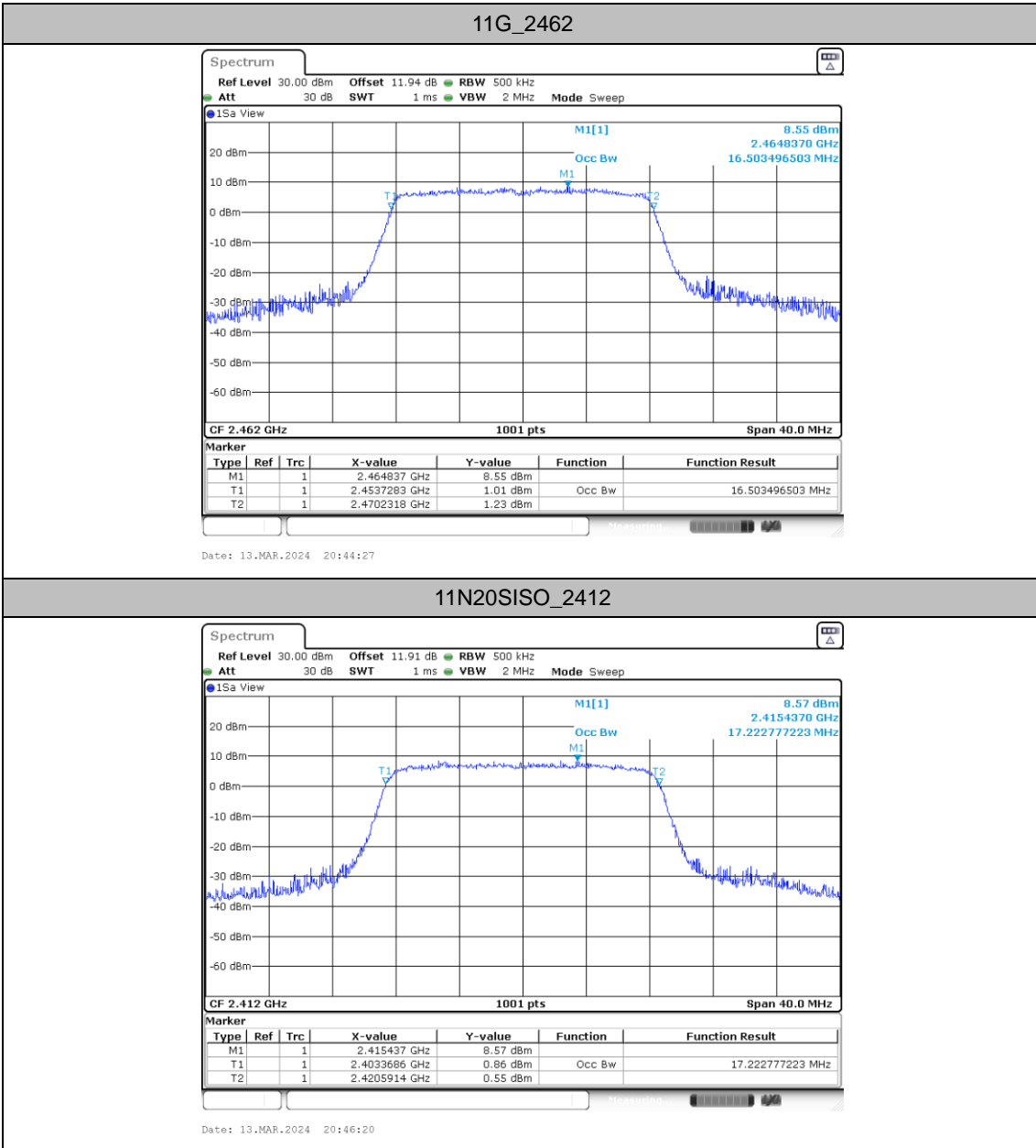
Test Graphs

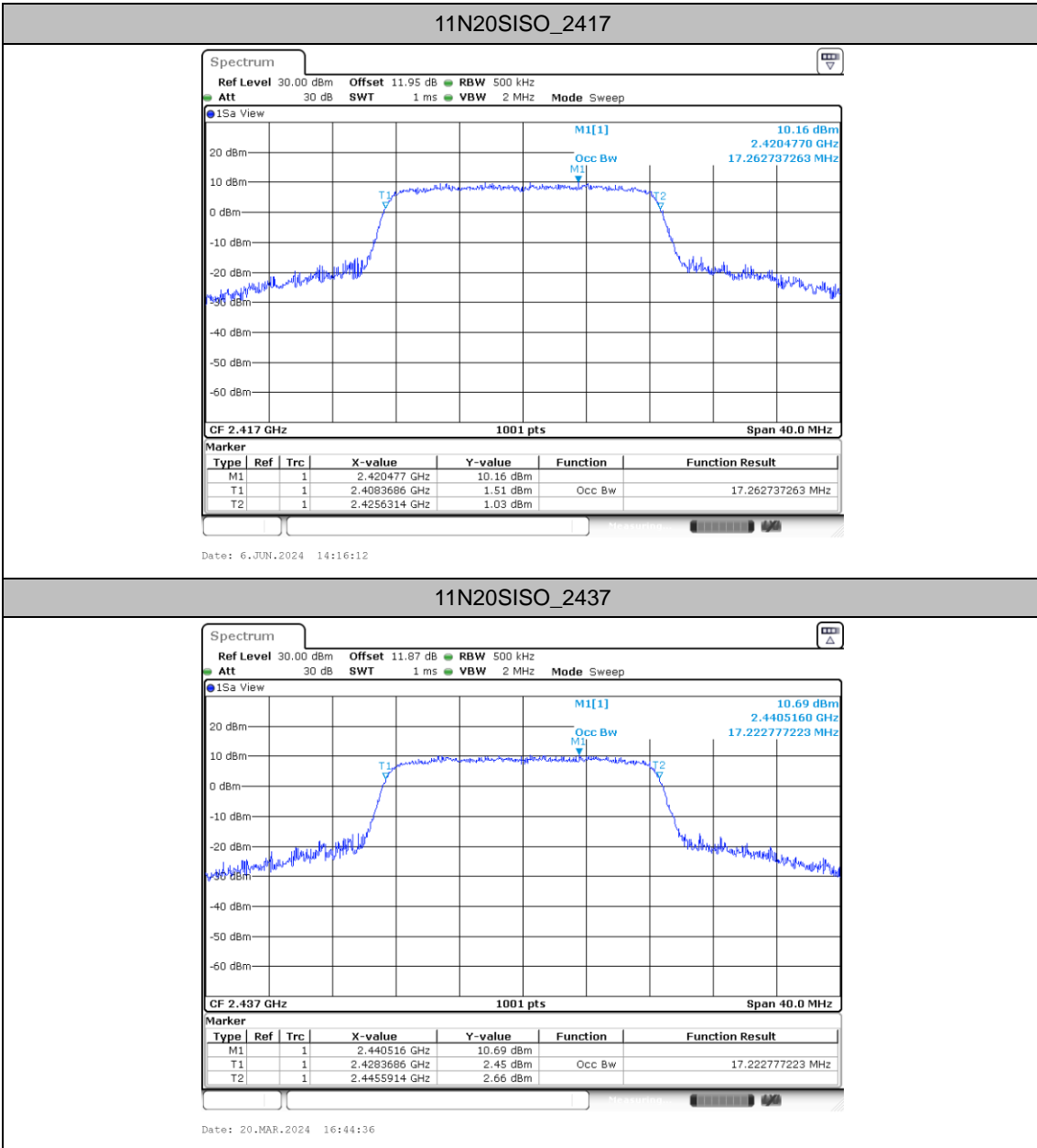


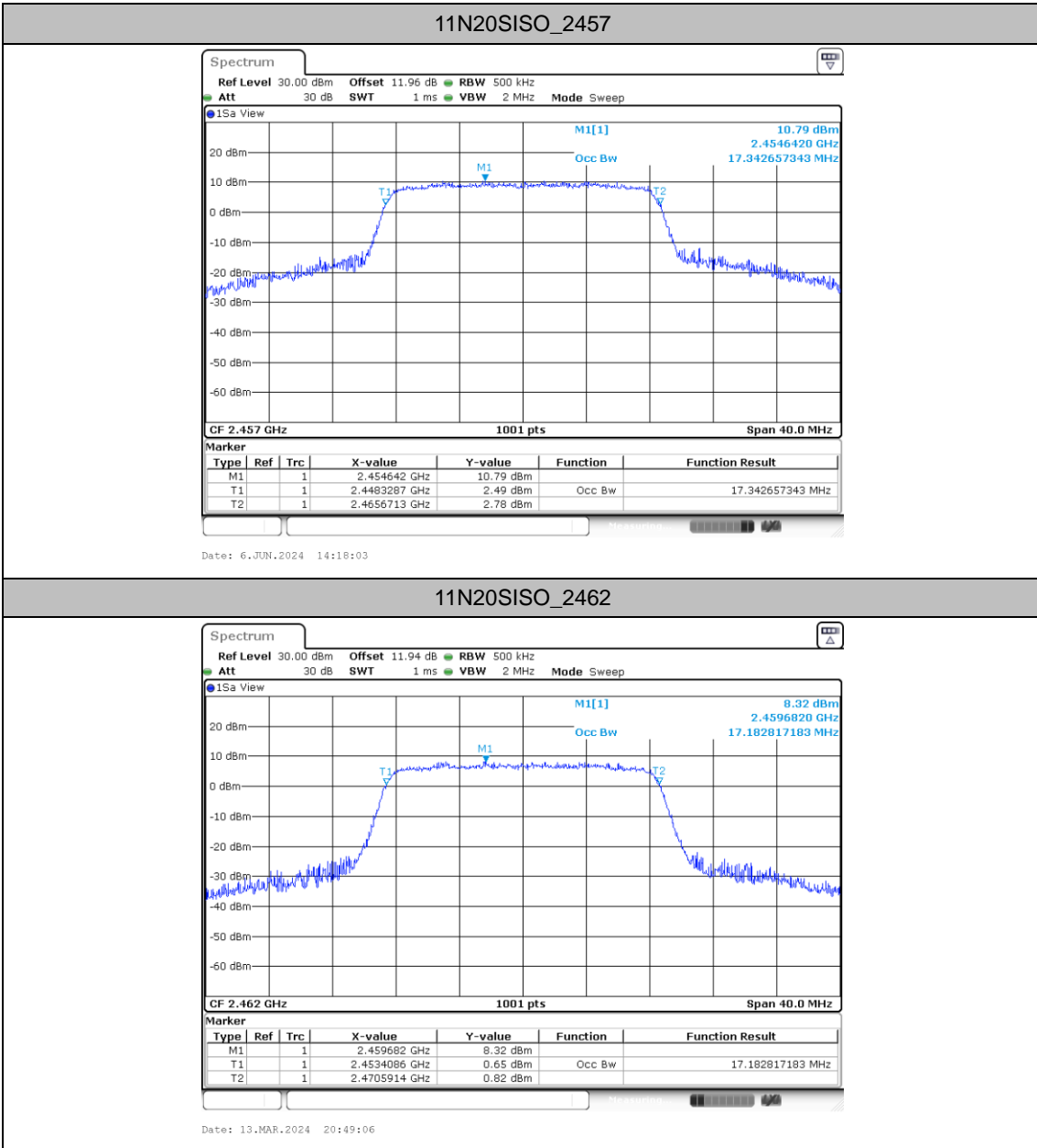














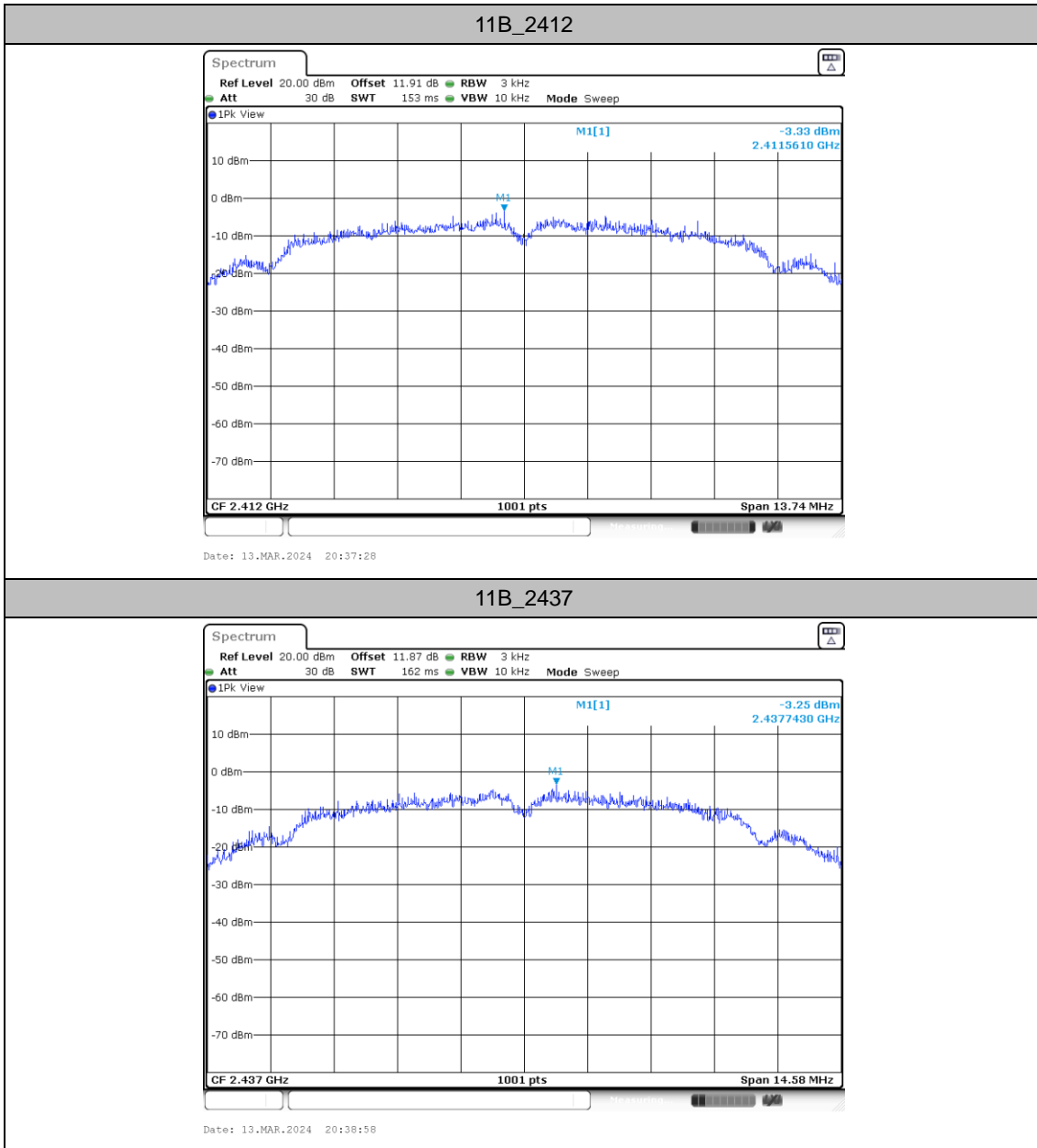
Maximum power spectral density

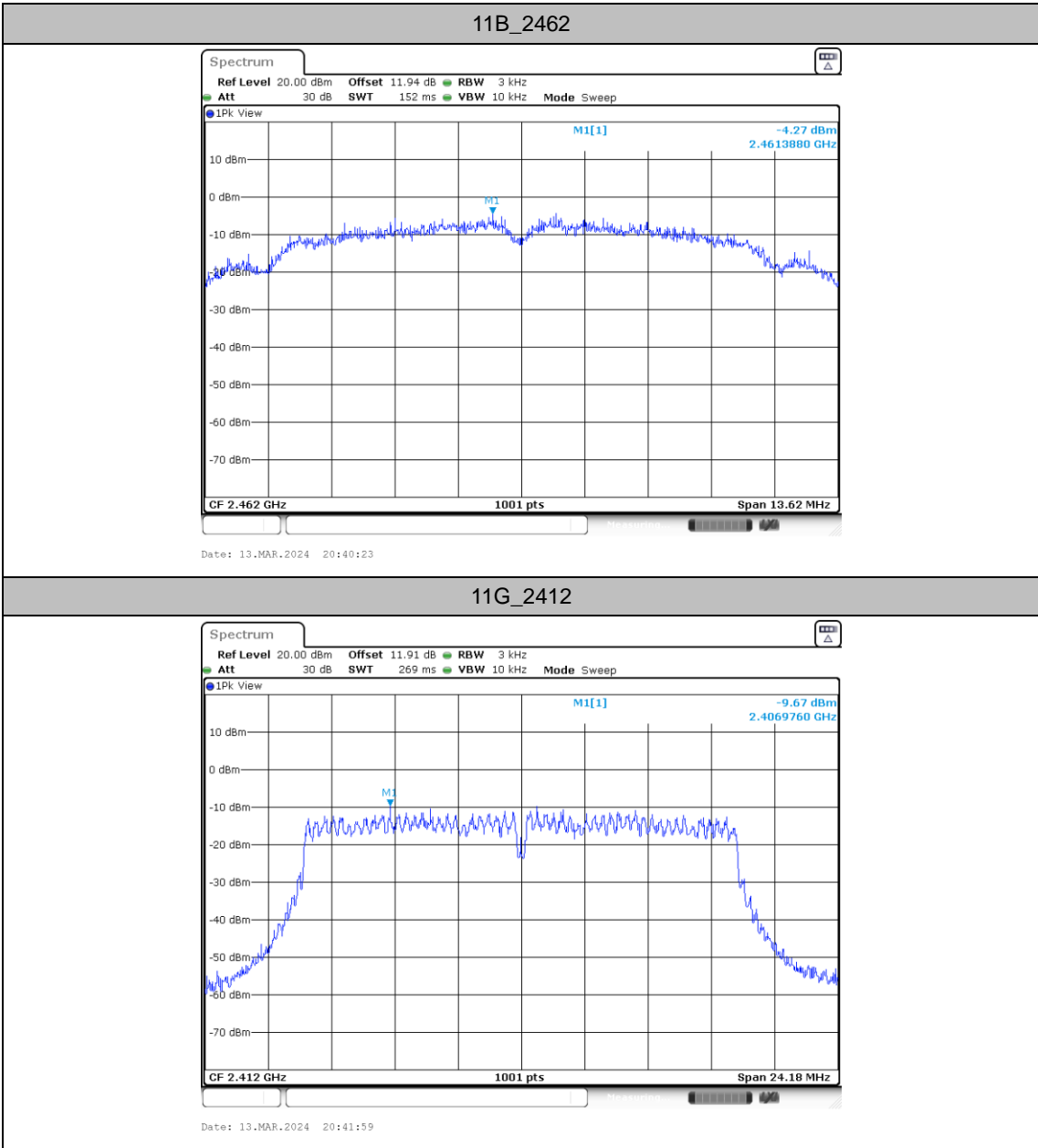
Test Result

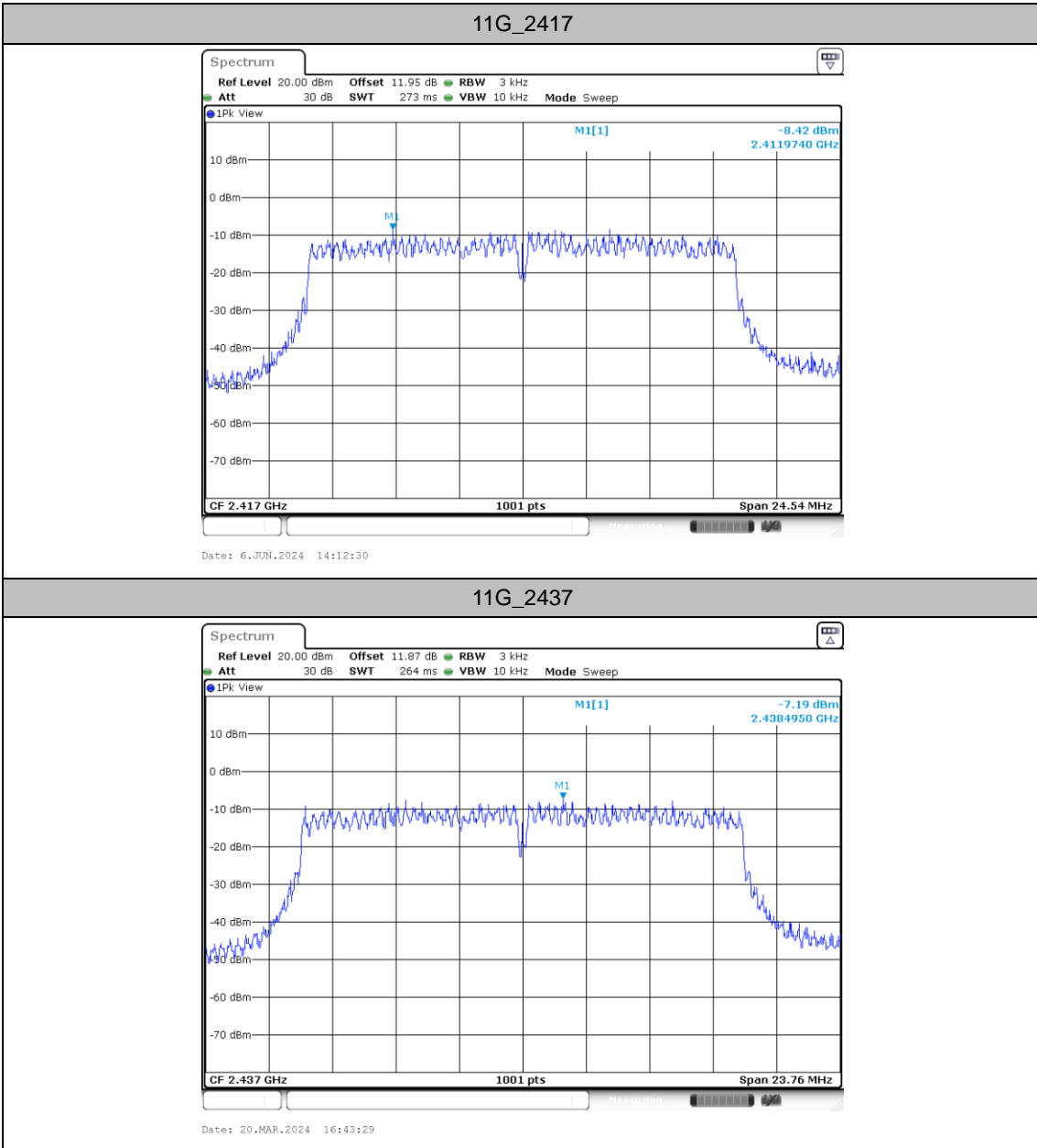
TestMode	Freq(MHz)	Result [dBm/3kHz]	Limit [dBm/3kHz]	Verdict
11B	2412	-3.33	≤8.00	PASS
	2437	-3.25	≤8.00	PASS
	2462	-4.27	≤8.00	PASS
11G	2412	-9.67	≤8.00	PASS
	2417	-8.42	≤8.00	PASS
	2437	-7.19	≤8.00	PASS
	2452	-7.46	≤8.00	PASS
	2457	-9.11	≤8.00	PASS
	2462	-10.24	≤8.00	PASS
11N20SISO	2412	-9.73	≤8.00	PASS
	2417	-9.32	≤8.00	PASS
	2437	-7.99	≤8.00	PASS
	2457	-9.32	≤8.00	PASS
	2462	-10.15	≤8.00	PASS

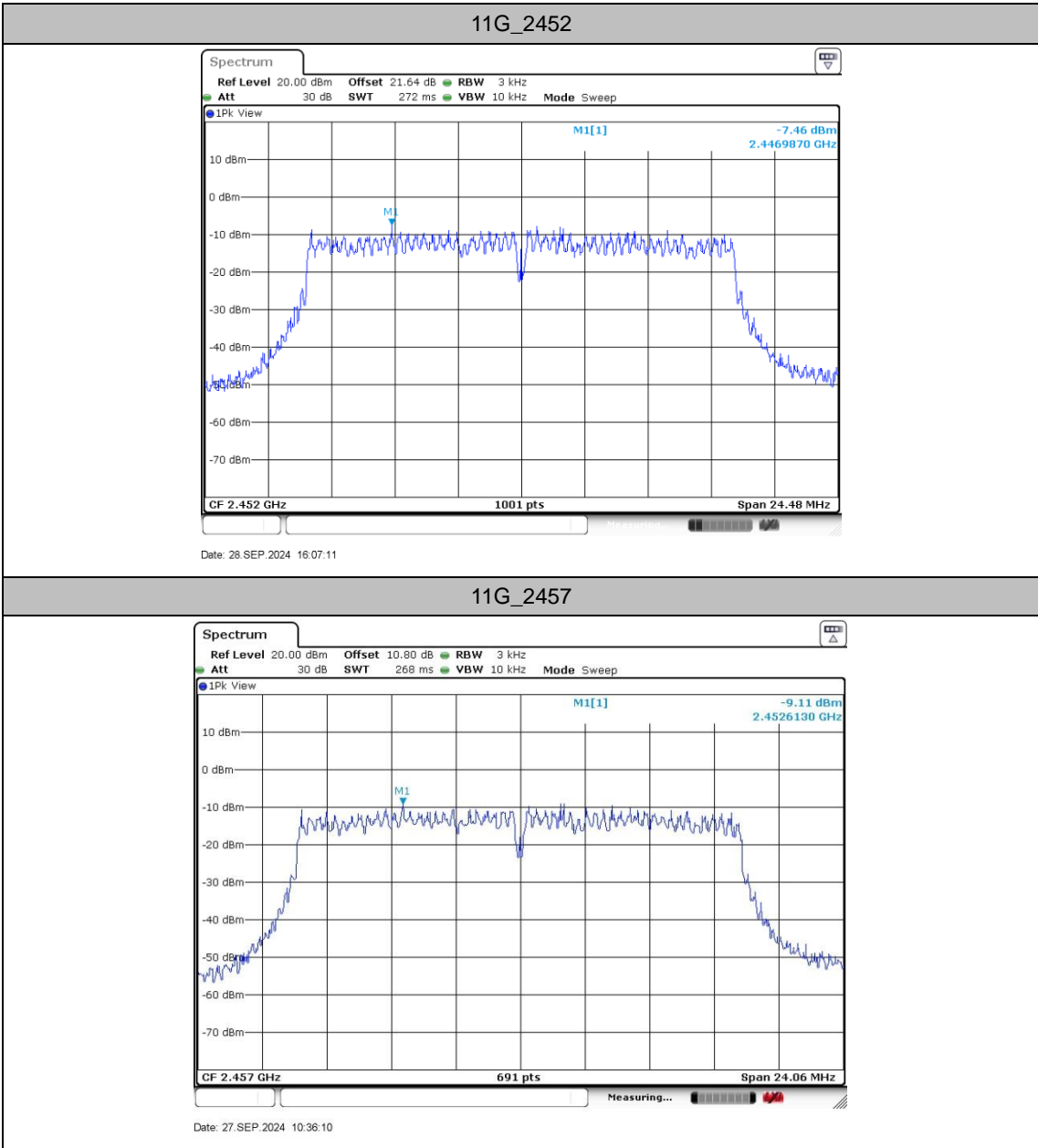


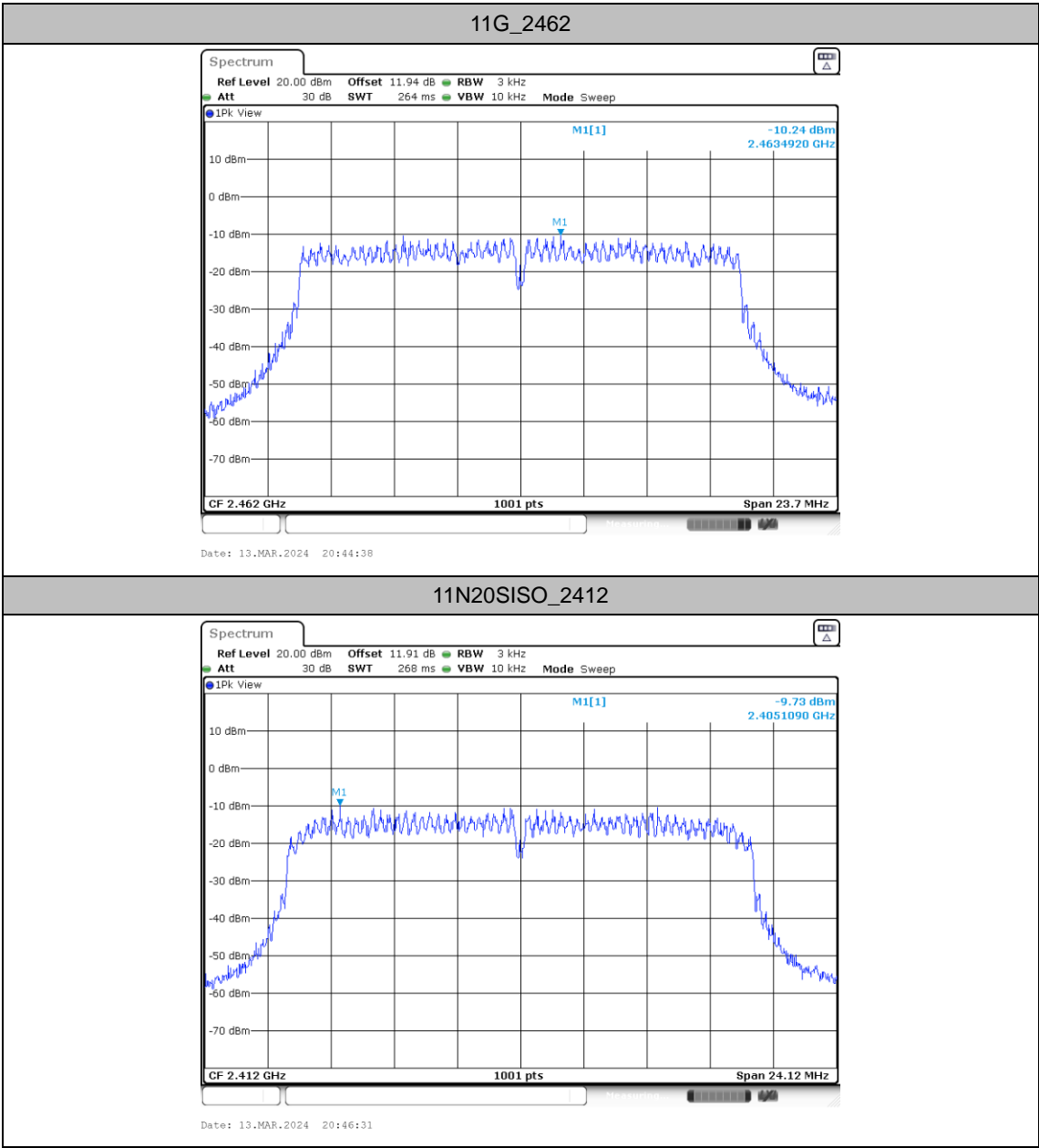
Test Graphs

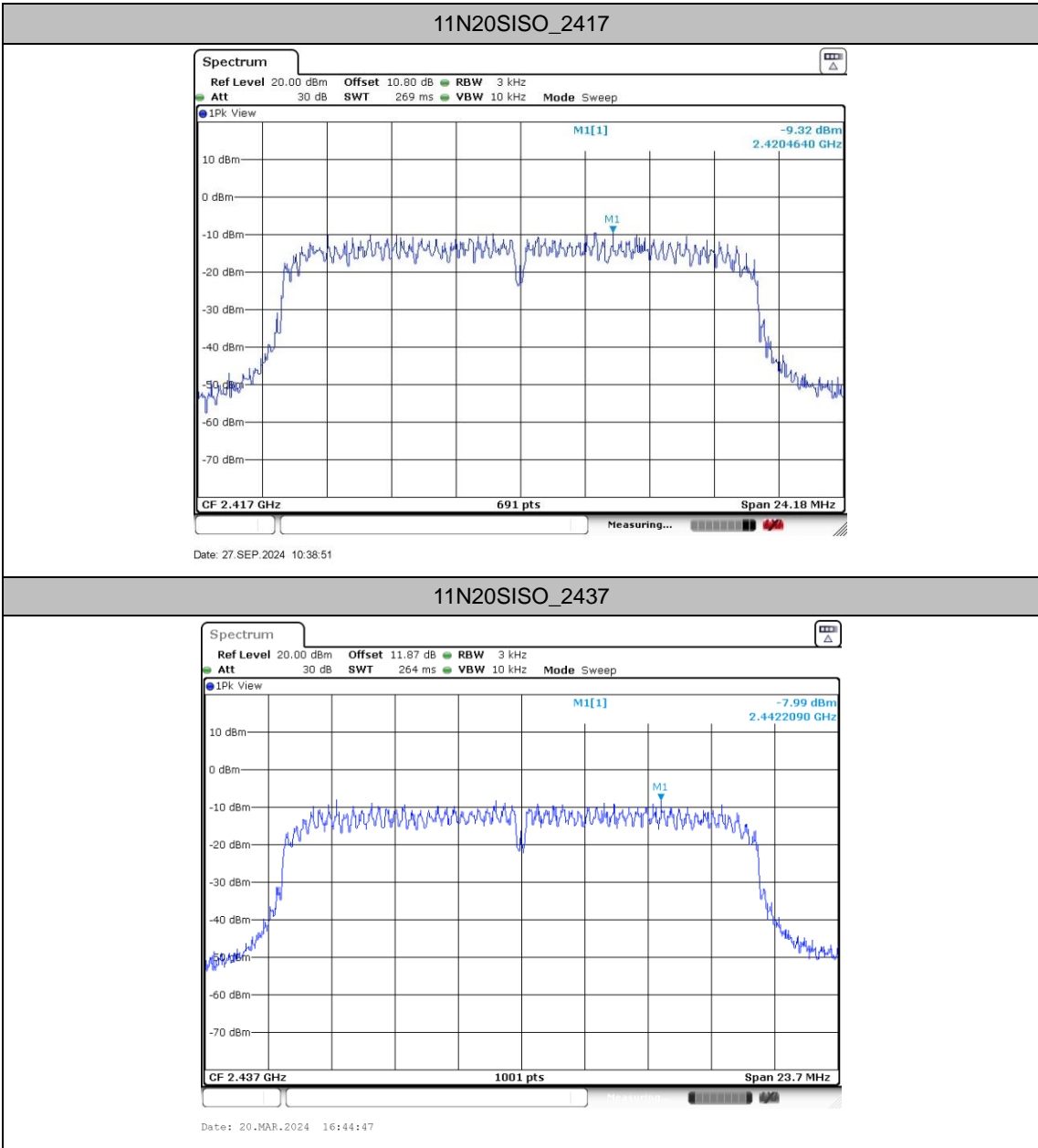






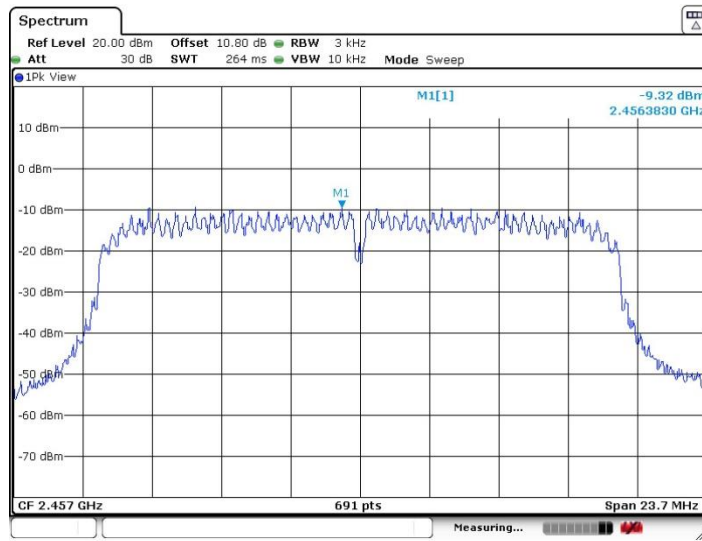




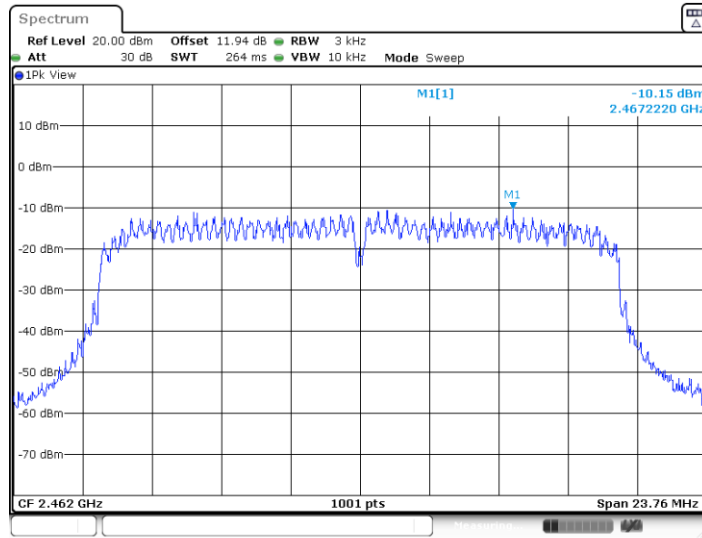




11N20SISO_2457



11N20SISO_2462





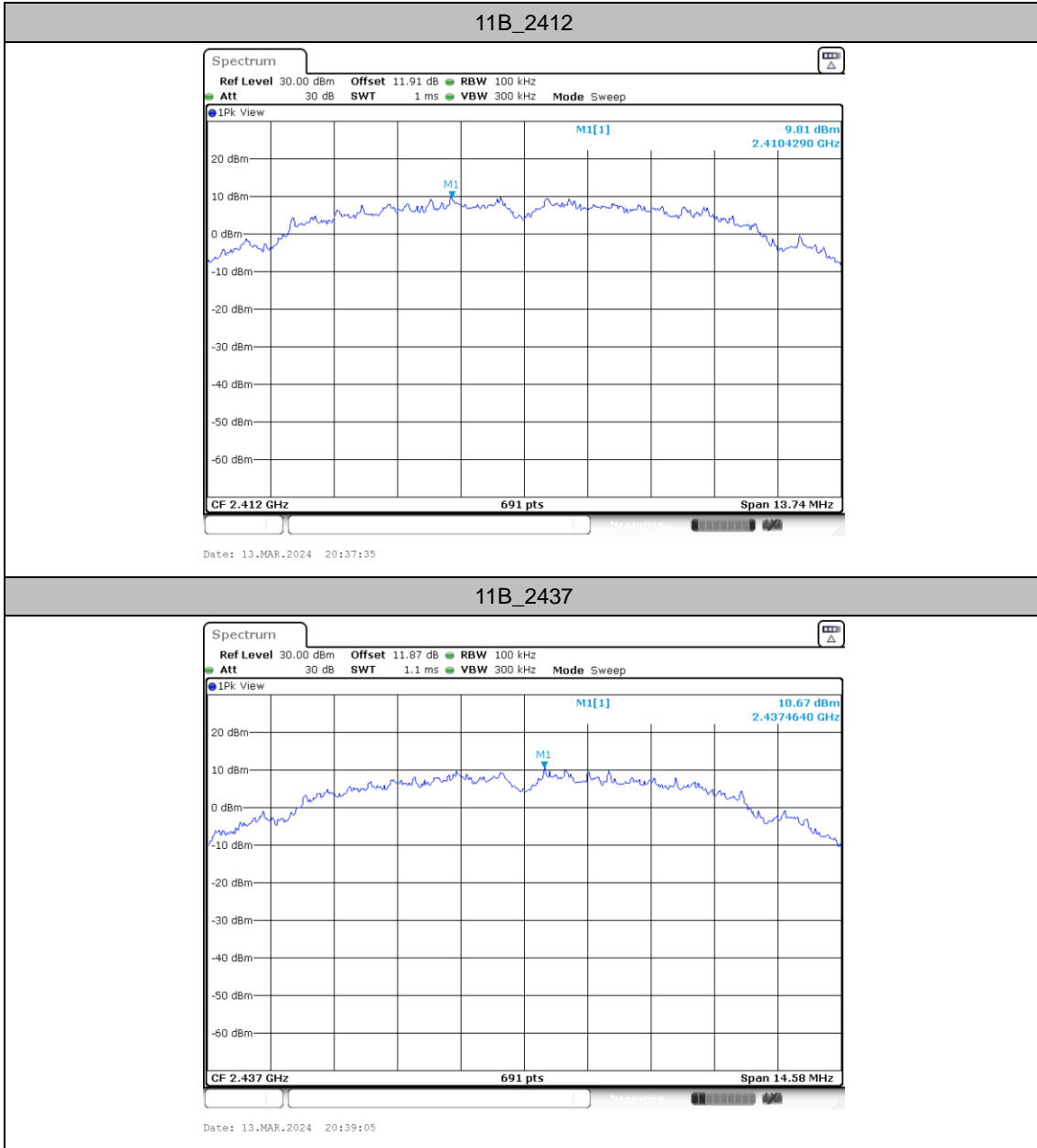
Reference level measurement

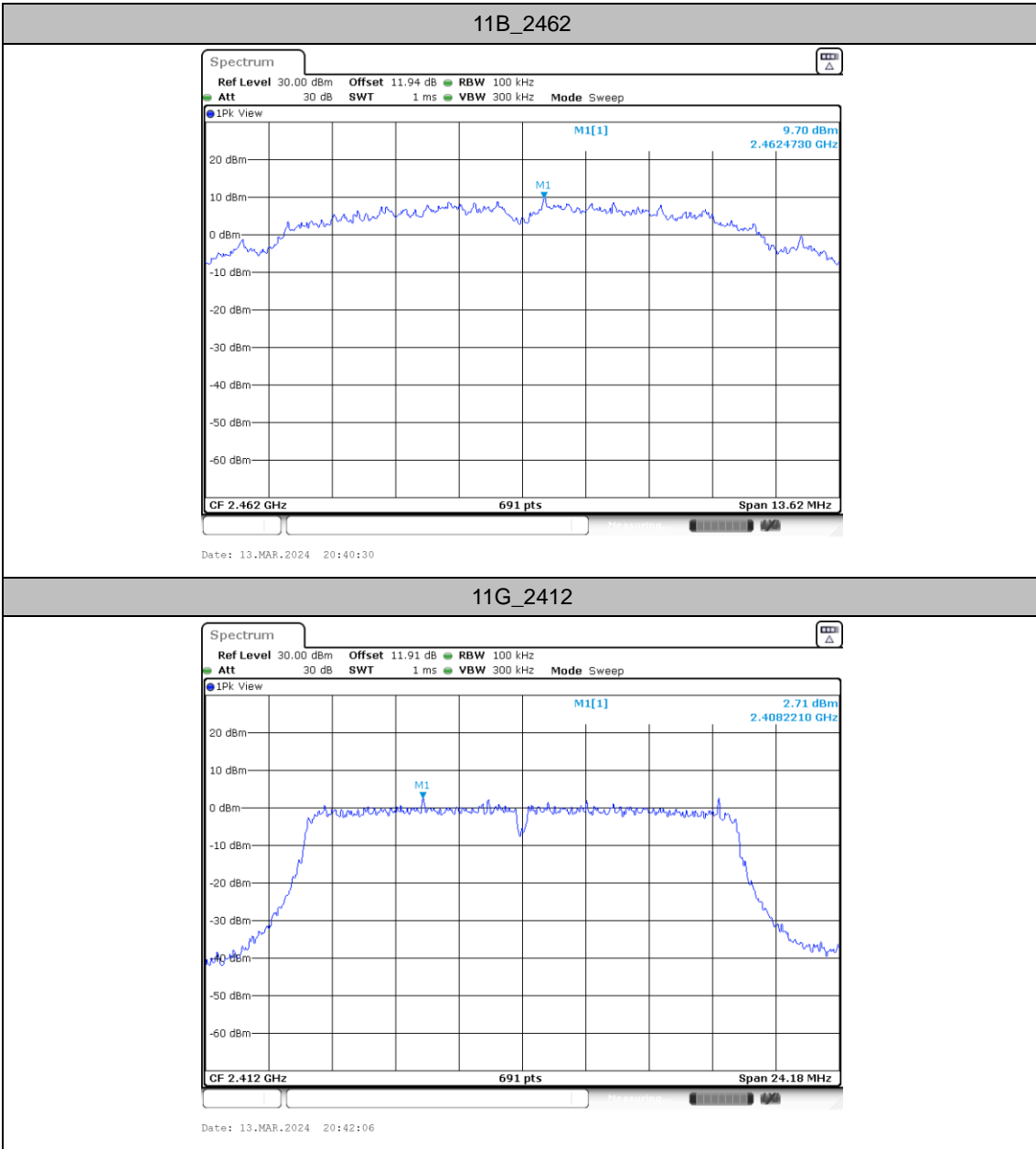
Test Result

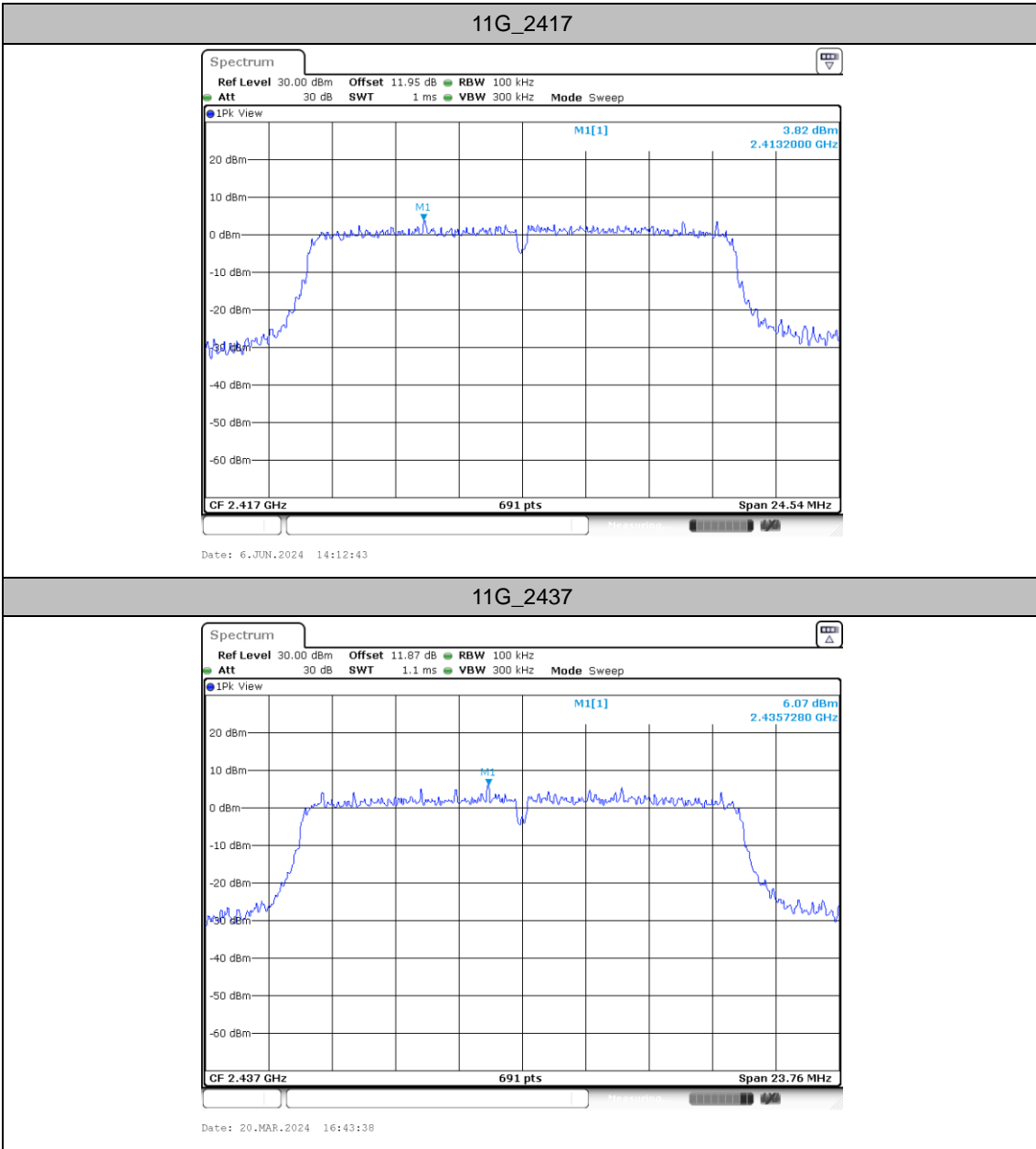
TestMode	Freq(MHz)	Max.Point[MHz]	Result[dBm/100KHz]
11B	2412	2410.43	9.81
	2437	2437.46	10.67
	2462	2462.47	9.70
11G	2412	2408.22	2.71
	2417	2413.20	3.82
	2437	2435.73	6.07
	2452	2454.48	5.34
	2457	2461.98	5.99
	2462	2466.97	2.84
11N20SISO	2412	2410.74	3.50
	2417	2419.48	4.39
	2437	2435.73	5.34
	2457	2459.47	5.84
	2462	2464.48	3.27

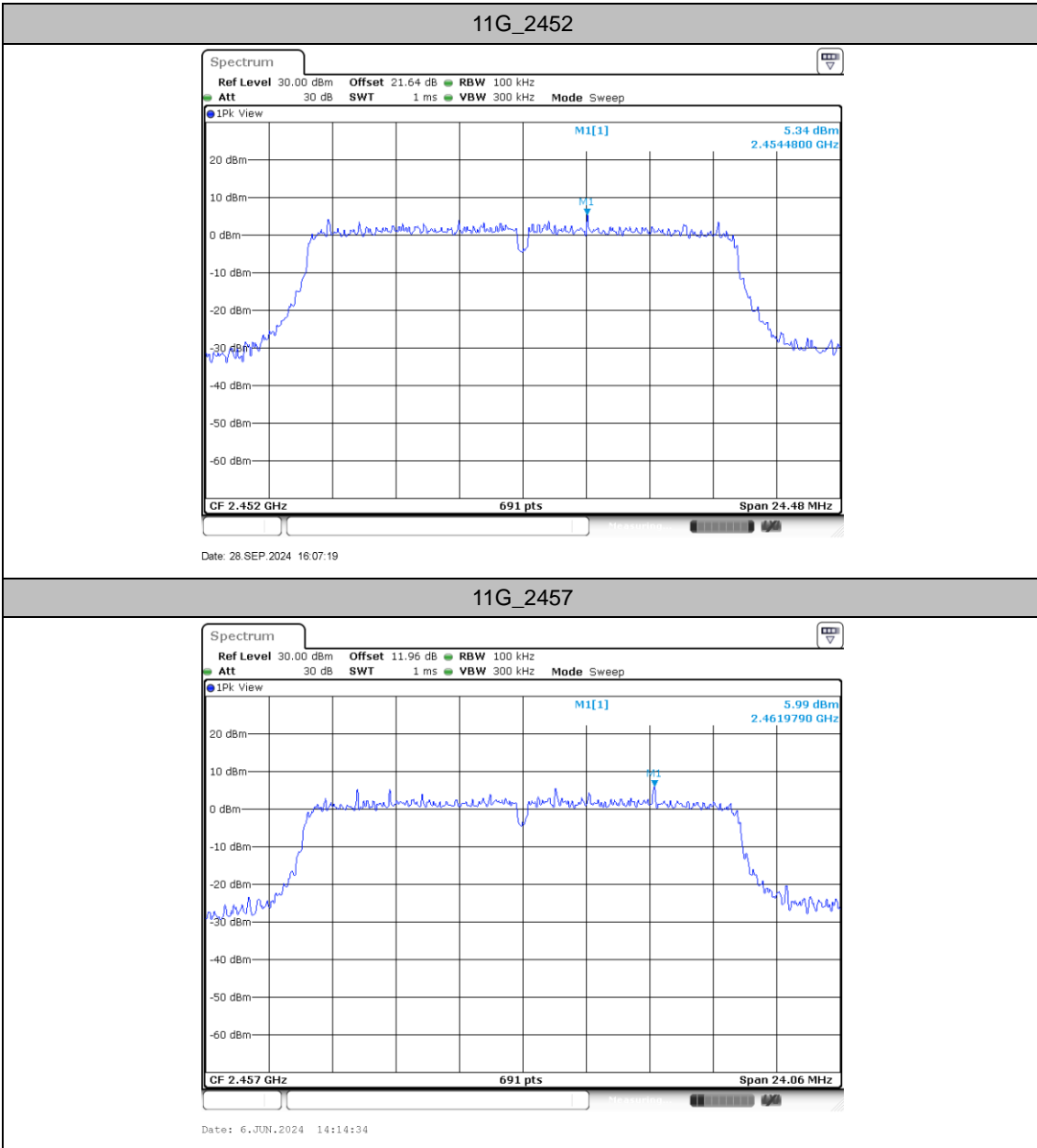


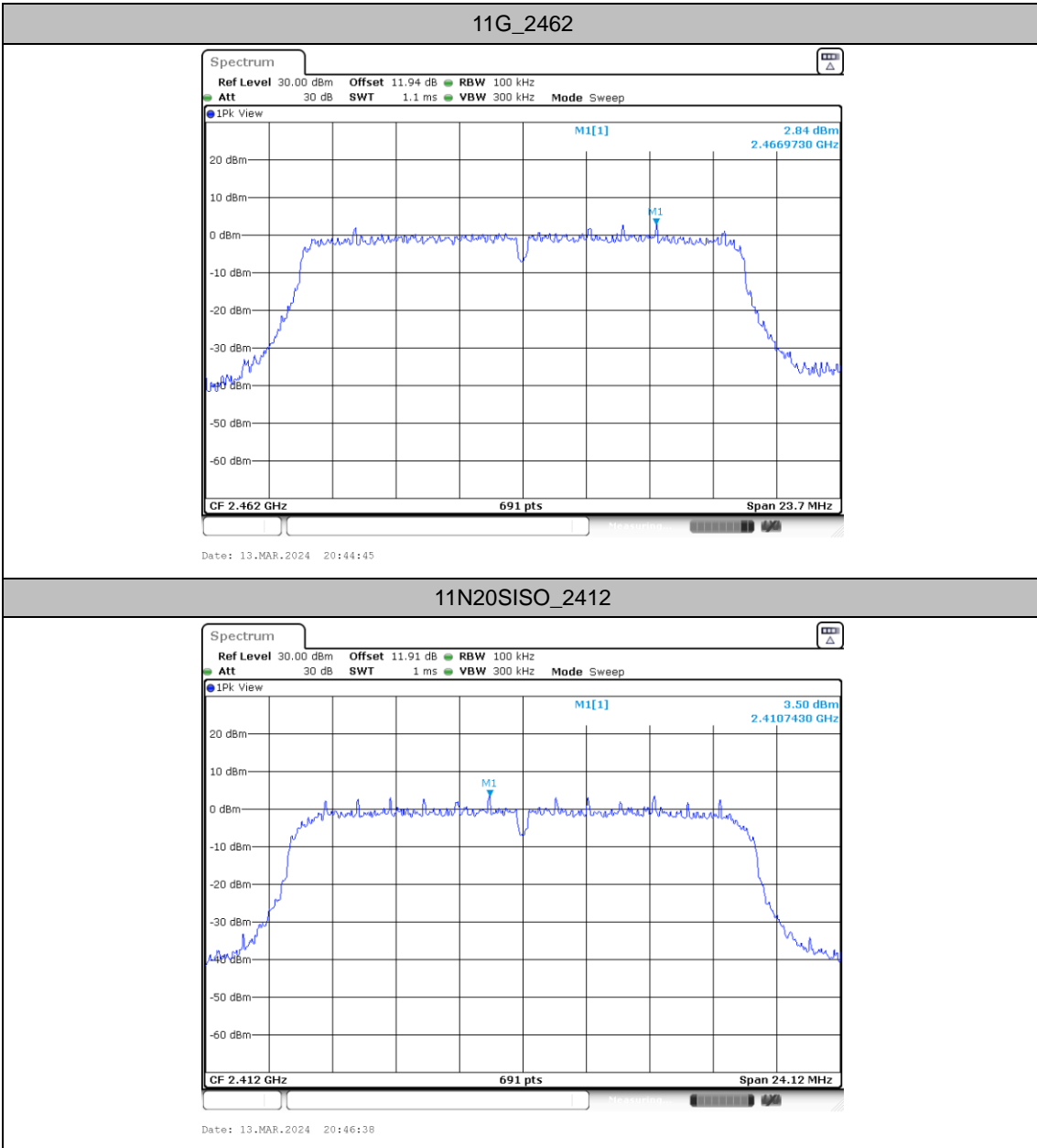
Test Graphs

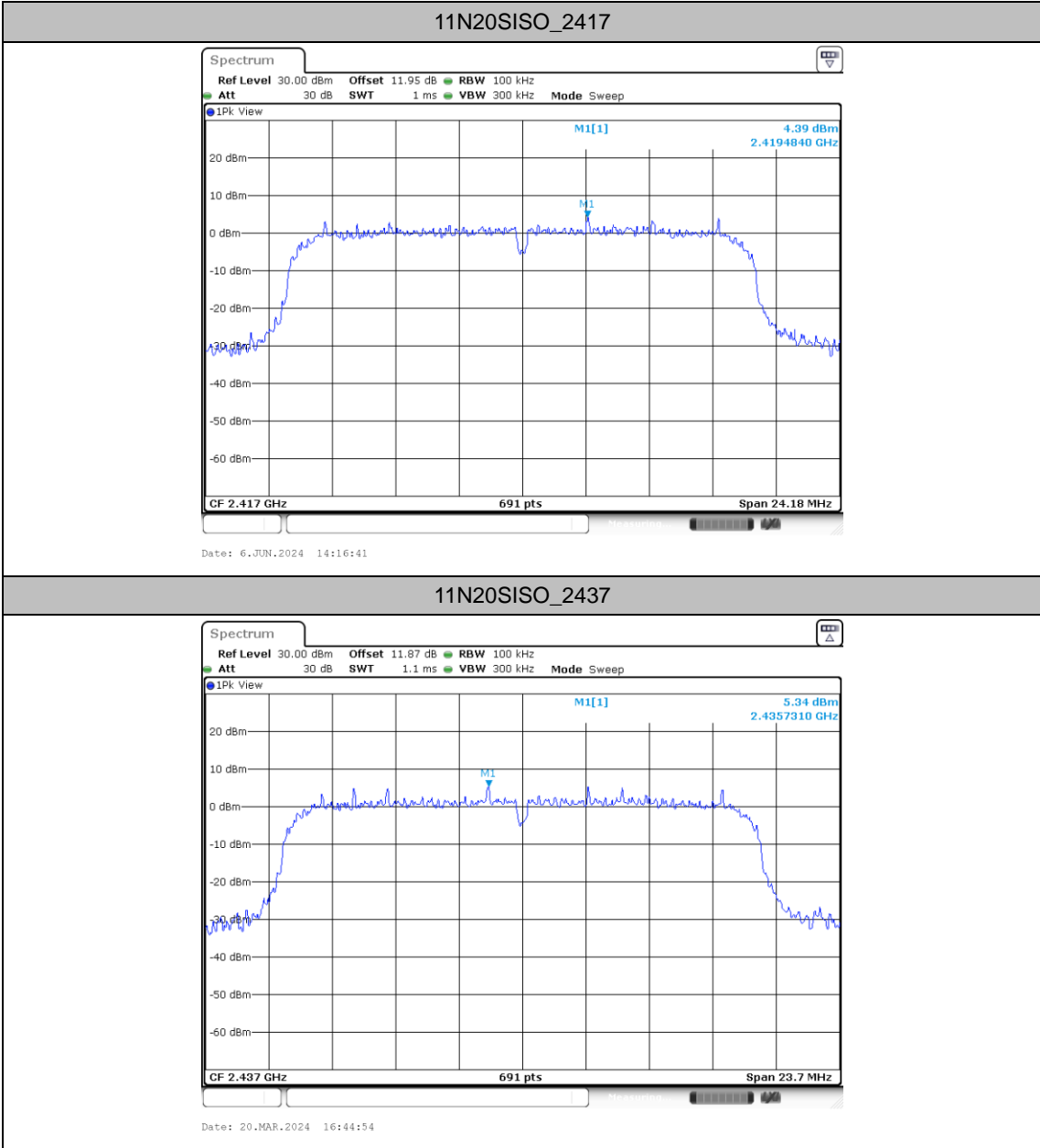


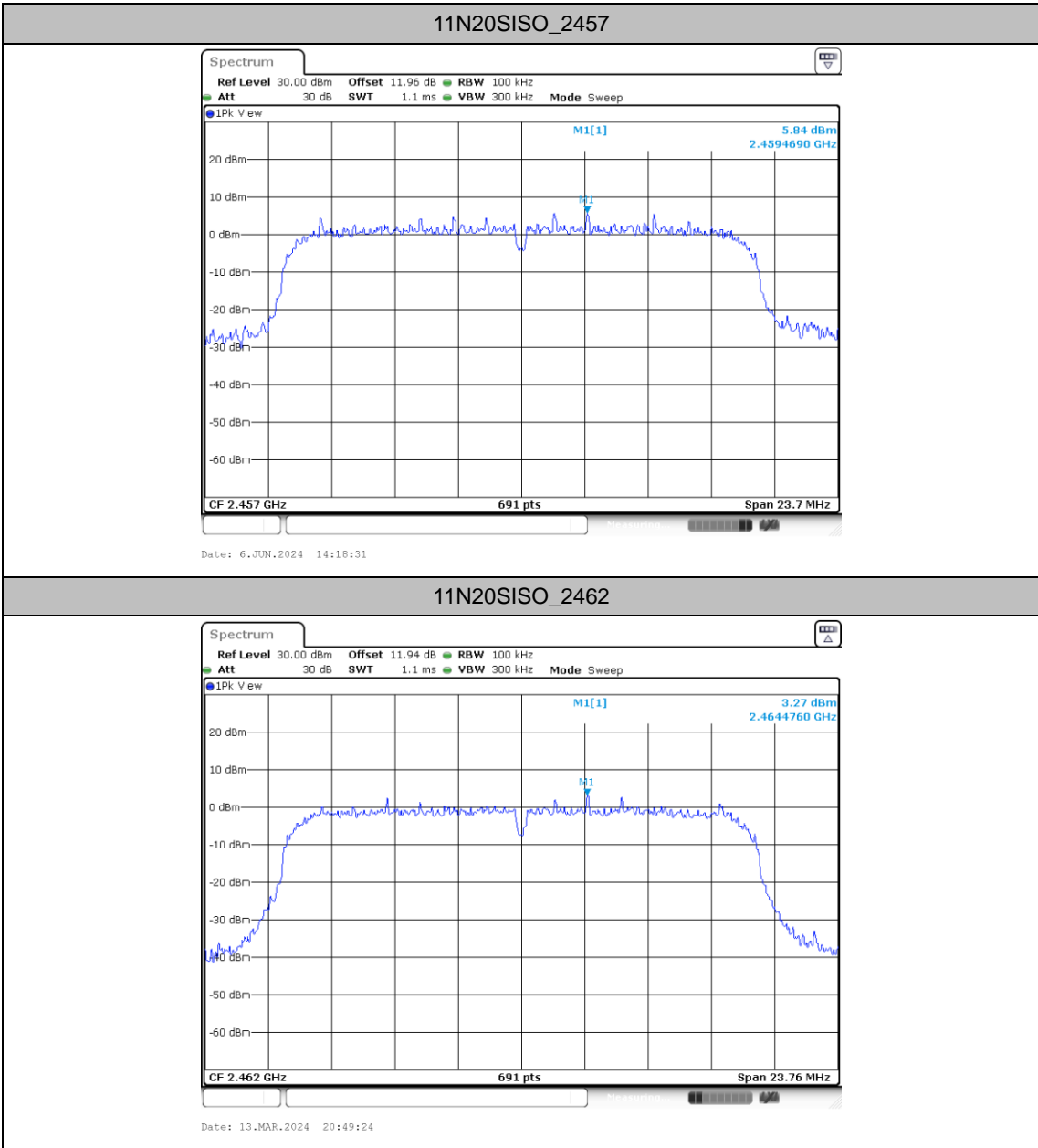














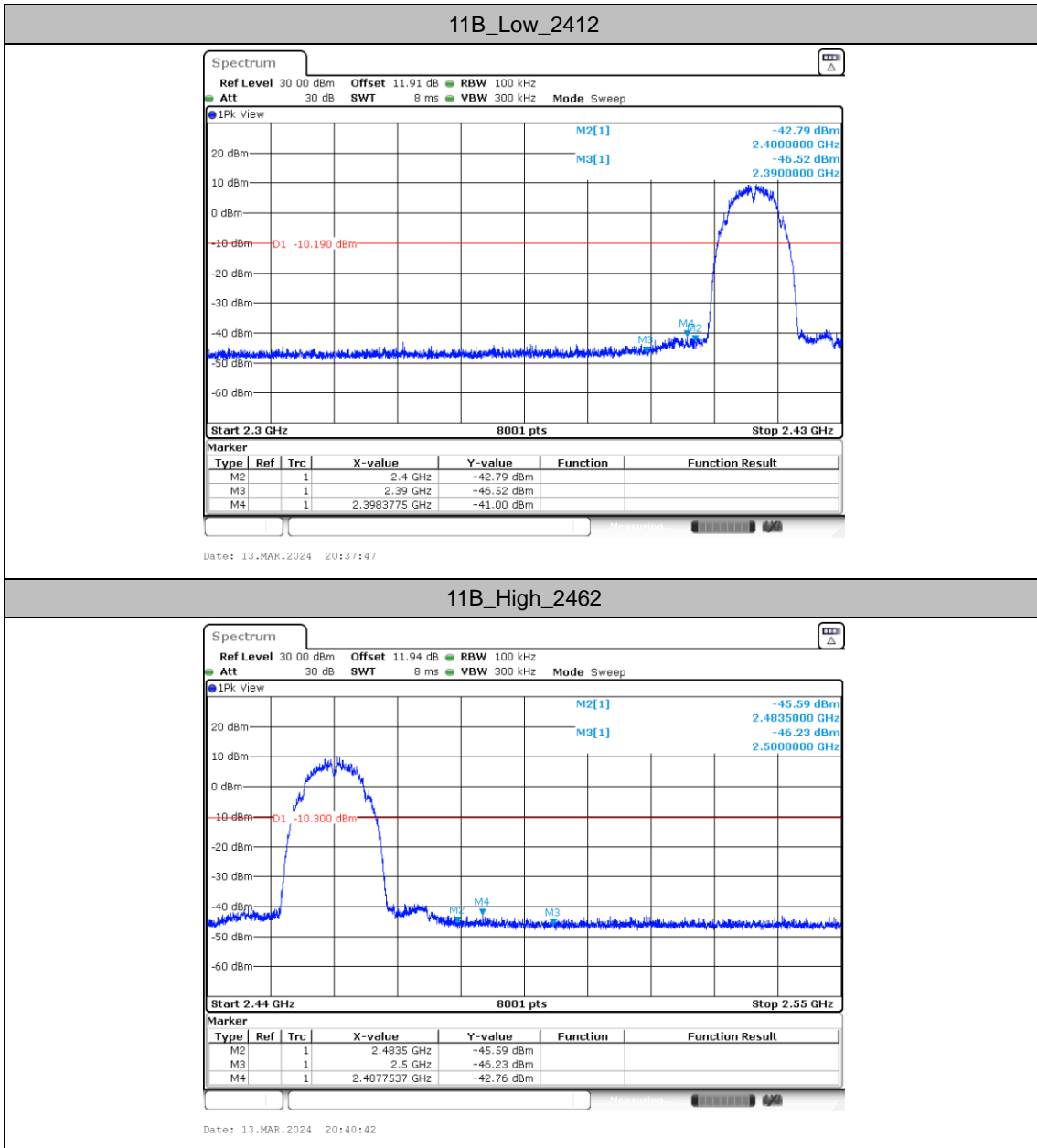
Band edge measurements

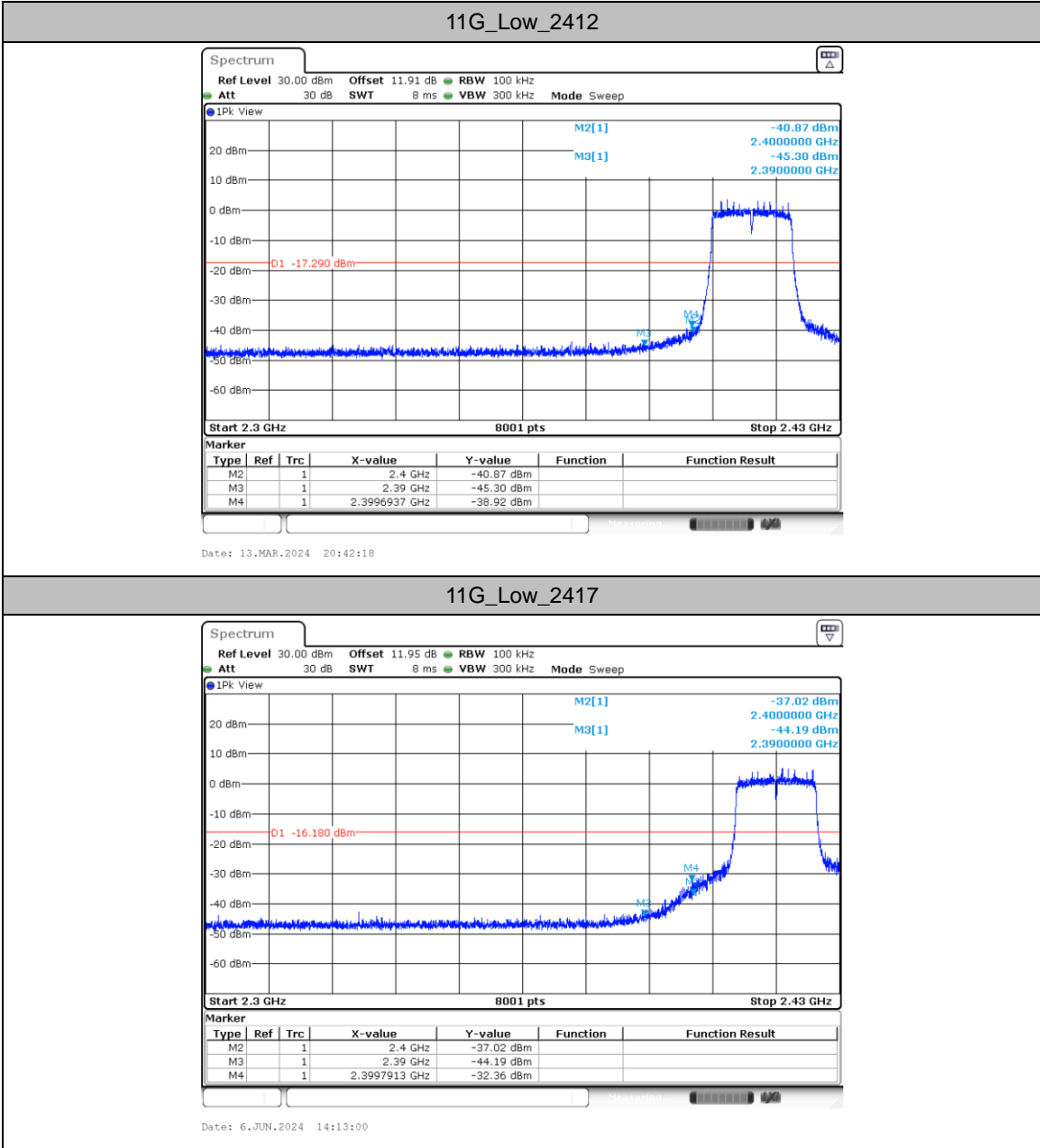
Test Result

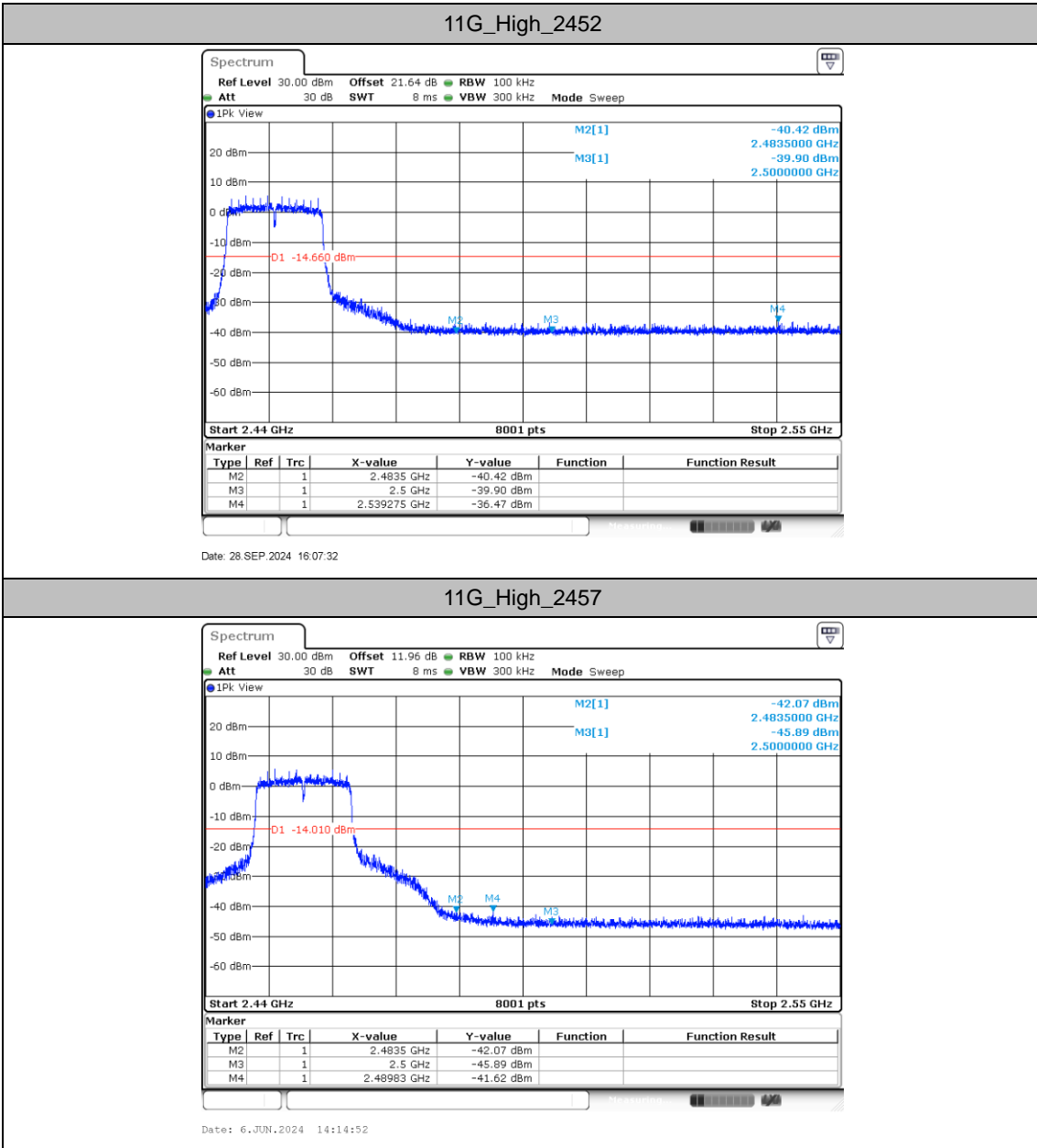
TestMode	ChName	Freq(MHz)	RefLevel[dBm /100KHz]	Result[dBm /100KHz]	Limit[dBm /100KHz]	Verdict
11B	Low	2412	9.81	-41	≤-10.19	PASS
	High	2462	9.70	-42.76	≤-10.3	PASS
11G	Low	2412	2.71	-38.92	≤-17.29	PASS
		2417	3.82	-32.36	≤-16.18	PASS
	High	2452	5.34	-36.47	≤-14.66	PASS
		2457	5.99	-41.62	≤-14.01	PASS
		2462	2.84	-42.8	≤-17.16	PASS
11N20SISO	Low	2412	3.50	-38.97	≤-16.5	PASS
		2417	4.39	-33.76	≤-15.61	PASS
	High	2457	5.84	-41.25	≤-14.16	PASS
		2462	3.27	-43.09	≤-16.73	PASS

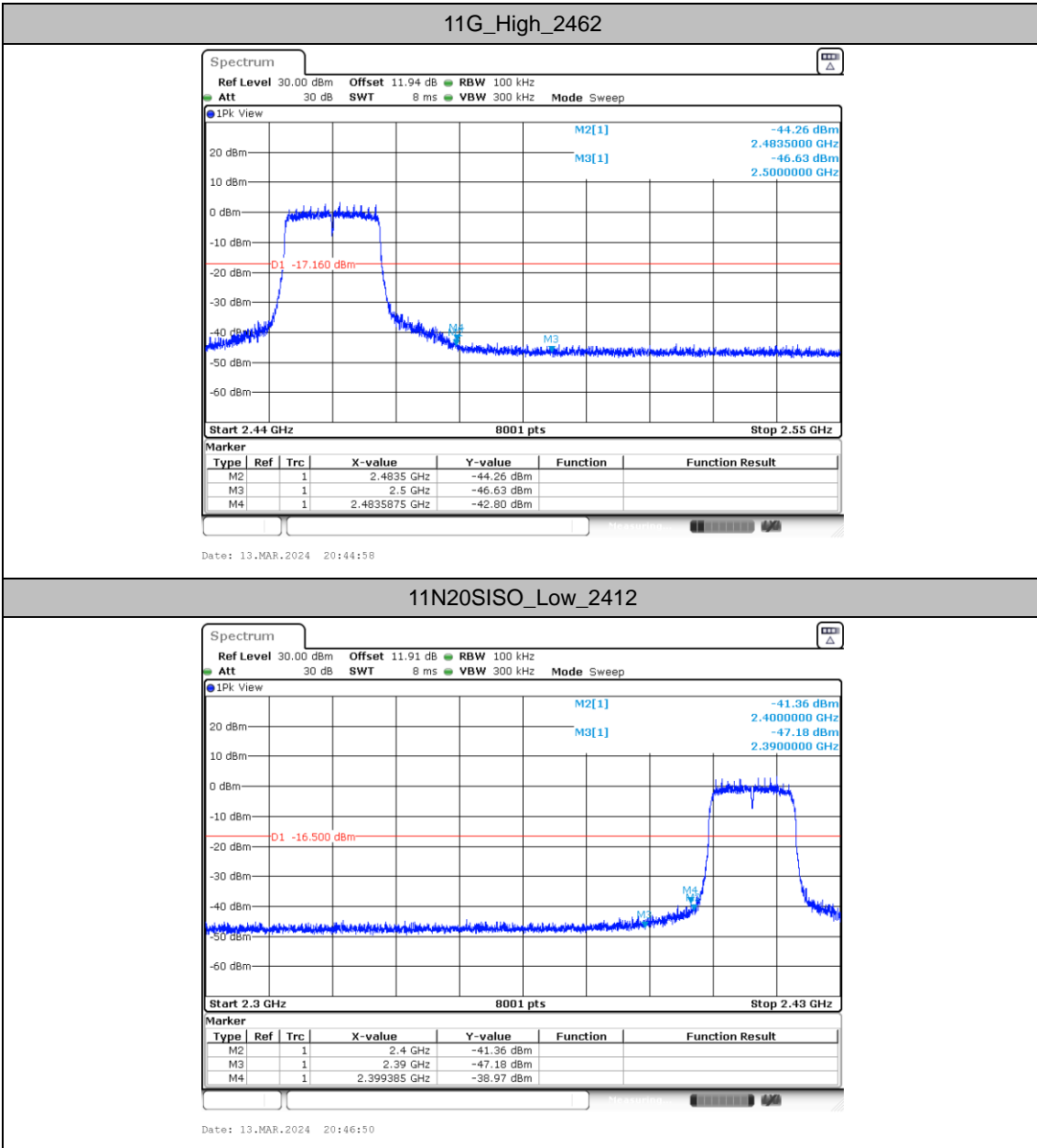


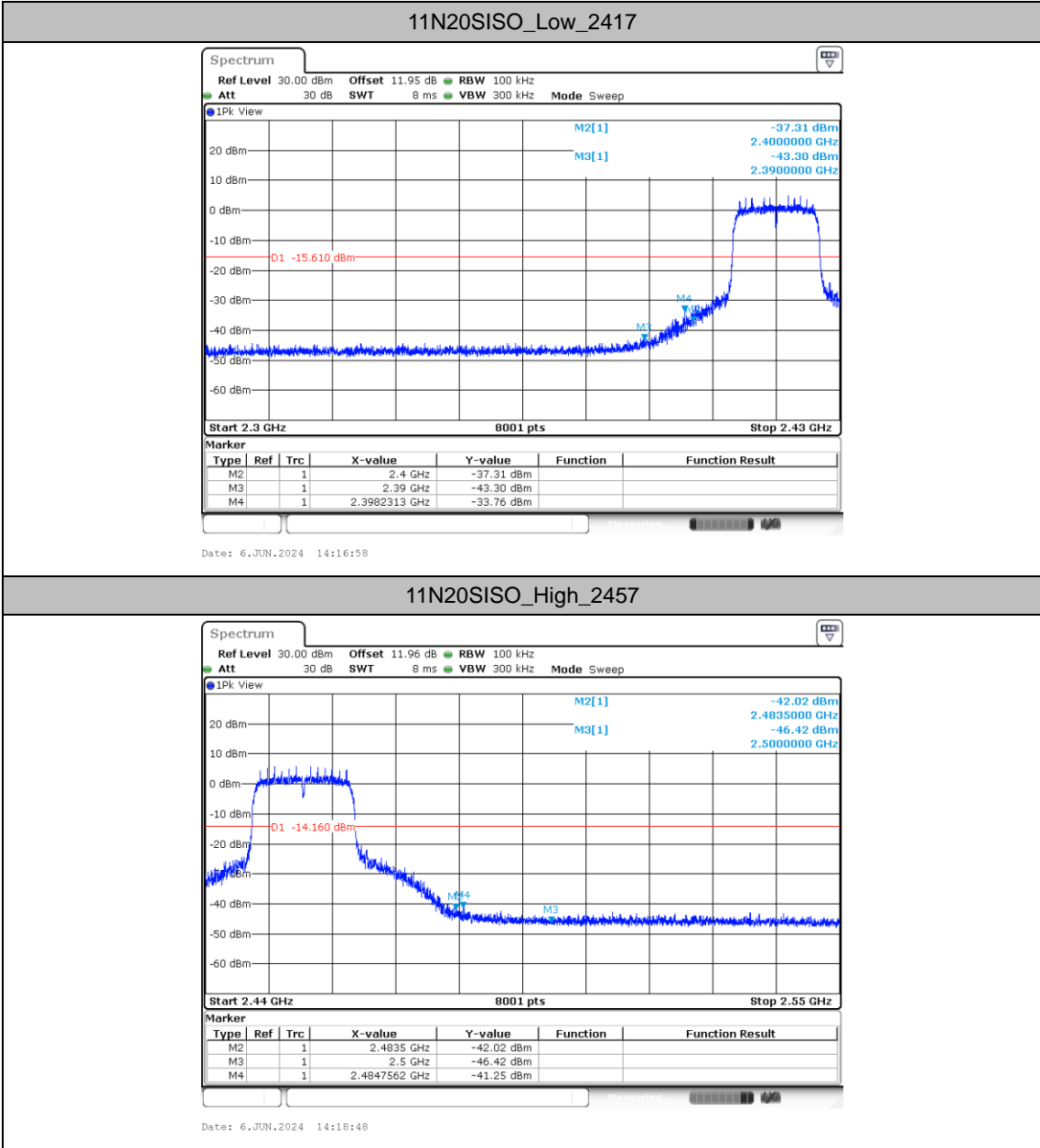
Test Graphs

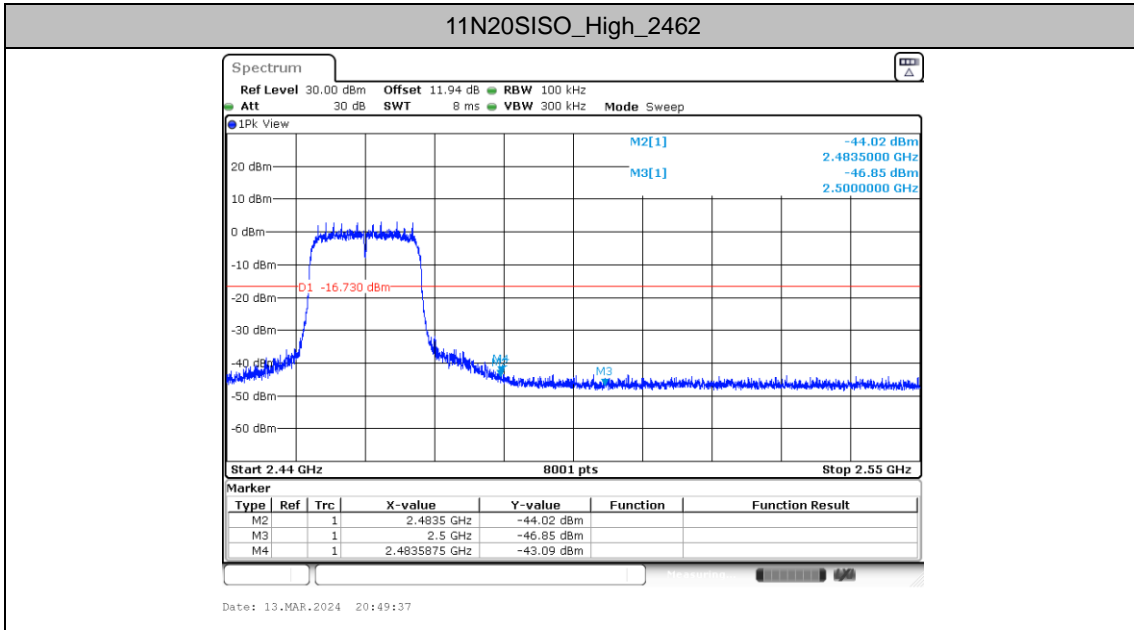














Conducted Spurious Emission

Test Result

TestMode	Freq(MHz)	FreqRange [Mhz]	RefLevel [dBm/100KHz]	Result [dBm/100KHz]	Limit [dBm/100KHz]	Verdict	
11B	2412	30~1000	9.81	-55.9	≤-10.19	PASS	
		1000~26500	9.81	-44.61	≤-10.19	PASS	
	2437	30~1000	10.67	-55.17	≤-9.33	PASS	
		1000~26500	10.67	-44.82	≤-9.33	PASS	
	2462	30~1000	9.70	-55.69	≤-10.3	PASS	
		1000~26500	9.70	-45.02	≤-10.3	PASS	
11G	2412	30~1000	2.71	-56.26	≤-17.29	PASS	
		1000~26500	2.71	-46.03	≤-17.29	PASS	
	2417	30~1000	3.82	-44.64	≤-16.18	PASS	
		1000~26500	3.82	-36.91	≤-16.18	PASS	
	2437	30~1000	6.07	-55.8	≤-13.93	PASS	
		1000~26500	6.07	-45.68	≤-13.93	PASS	
	2452	30~1000	5.34	-55.48	≤-14.66	PASS	
		1000~26500	5.34	-44.46	≤-14.66	PASS	
	2457	30~1000	5.99	-44.7	≤-14.01	PASS	
		1000~26500	5.99	-36.55	≤-14.01	PASS	
	2462	30~1000	2.84	-55.05	≤-17.16	PASS	
		1000~26500	2.84	-46.86	≤-17.16	PASS	
	11N20SISO	2412	30~1000	3.50	-55.5	≤-16.5	PASS
			1000~26500	3.50	-46.91	≤-16.5	PASS
2417		30~1000	4.39	-45.7	≤-15.61	PASS	
		1000~26500	4.39	-35.97	≤-15.61	PASS	
2437		30~1000	5.34	-55.27	≤-14.66	PASS	
		1000~26500	5.34	-45.18	≤-14.66	PASS	
2457		30~1000	5.84	-45.42	≤-14.16	PASS	
		1000~26500	5.84	-36.01	≤-14.16	PASS	
2462		30~1000	3.27	-56.1	≤-16.73	PASS	
		1000~26500	3.27	-47.11	≤-16.73	PASS	



Test Graphs

