FCC RF Test Report

APPLICANT	:	CASTLES TECHNOLOGY CO., LTD.
EQUIPMENT	:	POS Terminal
BRAND NAME	:	CASTLES TECHNOLOGY
MODEL NAME	:	S1F4
FCC ID	:	WIYS1F4001
STANDARD	:	FCC Part 15 Subpart E §15.407
CLASSIFICATION	:	(NII) Unlicensed National Information Infrastructure
TEST DATE(S)	:	Mar. 29, 2025 ~ Apr. 09, 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

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR520601E	Rev. 01	Initial issue of report	Jun. 03, 2025

SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit for U-NII-1/2A/2C	Limit for U-NII-3	Result	Remark
3.1	2.1049 & 15.403(i)	6dB, 26dB & 99% Bandwidth	-	6dB Bandwidth > 500kHz	Pass	-
3.2	15.407(a)	Maximum Conducted Output Power	≤ 24 dBm	≤ 30 dBm	Pass	-
3.3	15.407(a)	Power Spectral Density	≤ 11 dBm/MHz	≤ 30 dBm/500kHz	Pass	-
3.4	15.407(b)	Unwanted Emissions	15.407(b) & 15.209(a)	15.407(b)(4)(i) &15.209(a)	Pass	Under limit 3.24 dB at 5725.84 MHz
3.5	15.207	AC Conducted Emission	15.207(a)	15.207(a)	Pass	Under limit 19.53 dB at 0.150 MHz
3.6	15.203 & 15.407(a)	Antenna Requirement	15.203 & 15.407(a)	15.203 & 15.407(a)	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

CASTLES TECHNOLOGY CO., LTD.
6F, NO. 207-5, SEC. 3, BEIXIN RD., XINDIAN DISTRICT, NEW TAIPEI CITY 231030, TAIWAN (R.O.C.)

1.2 Manufacturer

CASTLES TECHNOLOGY CO., LTD.
6F, NO. 207-5, SEC. 3, BEIXIN RD., XINDIAN DISTRICT, NEW TAIPEI CITY 231030, TAIWAN (R.O.C.)

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	POS Terminal
Brand Name	CASTLES TECHNOLOGY
Model Name	S1F4
FCC ID	WIYS1F4001
IMEI / SN Code	Conducted: 188245006243 Conduction: 350512260009048/350512260009055 Radiation: 188245006203
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 Frequency Range	5180 MHz ~ 5240 MHz 5260 MHz ~ 5320 MHz 5500 MHz ~ 5700 MHz 5745 MHz ~ 5825 MHz
Maximum Output Power to Antenna	**<5180 MHz ~ 5240 MHz>** 802.11a : 16.51 dBm / 0.0448 W 802.11n HT20 : 15.46 dBm / 0.0352 W 802.11n HT40 : 15.40 dBm / 0.0347 W 802.11ac VHT20: 14.40 dBm / 0.0275 W 802.11ac VHT40: 14.43 dBm / 0.0277 W 802.11ac VHT80: 12.53 dBm / 0.0179 W **<5260 MHz ~ 5320 MHz>** 802.11a : 16.31 dBm / 0.0428 W 802.11n HT20 : 15.10 dBm / 0.0324 W 802.11n HT40 : 15.50 dBm / 0.0355 W 802.11ac VHT20: 14.17 dBm / 0.0261 W 802.11ac VHT40: 14.54 dBm / 0.0284 W 802.11ac VHT80: 13.32 dBm / 0.0215 W **<5500 MHz ~ 5700 MHz >** 802.11a : 16.27 dBm / 0.0424 W 802.11n HT20 : 15.10 dBm / 0.0324 W 802.11n HT40 : 15.49 dBm / 0.0354 W 802.11ac VHT20: 14.05 dBm / 0.0254 W 802.11ac VHT40: 14.49 dBm / 0.0281 W 802.11ac VHT80: 13.60 dBm / 0.0229 W **<5745 MHz ~ 5825 MHz>** 802.11a : 16.18 dBm / 0.0415 W 802.11n HT20 : 15.31 dBm / 0.0340 W 802.11n HT40 : 15.46 dBm / 0.0352 W 802.11ac VHT20: 14.41 dBm / 0.0276 W 802.11ac VHT40: 14.34 dBm / 0.0272 W 802.11ac VHT80: 14.22 dBm / 0.0264 W

99% Occupied Bandwidth	**<5180 MHz ~ 5240 MHz>** 802.11a : 17.333 MHz 802.11n HT20 : 18.19 MHz 802.11n HT40 : 36.533 MHz 802.11ac VHT80 : 75.581 MHz **<5260 MHz ~ 5320 MHz>** 802.11a : 17.219 MHz 802.11n HT20 : 18.095 MHz 802.11n HT40 : 36.61 MHz 802.11ac VHT80 : 75.581 MHz **<5500 MHz ~ 5700 MHz>** 802.11a : 17.181 MHz 802.11n HT20 : 18.076 MHz 802.11n HT40 : 36.457 MHz 802.11ac VHT80 : 75.733 MHz **<5745 MHz ~ 5825 MHz>** 802.11a : 17.181 MHz 802.11n HT20 : 18.133 MHz 802.11n HT40 : 36.343 MHz 802.11ac VHT80 : 75.505 MHz
Antenna Type / Gain	**<5180 MHz ~ 5240 MHz>** IFA Antenna with gain -2.28 dBi **<5260 MHz ~ 5320 MHz>** IFA Antenna with gain -2.25 dBi **<5500 MHz ~ 5700 MHz>** IFA Antenna with gain -2.24 dBi **<5745 MHz ~ 5825 MHz>** IFA Antenna with gain -3.20 dBi
Type of Modulation	802.11a/n : OFDM (BPSK / QPSK / 16QAM / 64QAM) 802.11ac : OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM)

Note:

1. WLAN operation in 5600 MHz ~ 5650 MHz is notched.
2. For 802.11n HT20 / 11n HT40 and 802.11 ac VHT20 / 11ac VHT40 mode, the whole testing has assessed only 802.11n HT20 / 11n HT40 by referring to their higher conducted 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 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 E
- FCC KDB 789033 D02 General UNII Test Procedures New Rules 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)
5180-5240 MHz U-NII-1	36	5180	44	5220
	38*	5190	46*	5230
	40	5200	48	5240
	42#	5210	-	-

Frequency Band	Channel	Freq.(MHz)	Channel	Freq. (MHz)
5260-5320 MHz U-NII-2A	52	5260	60	5300
	54*	5270	62*	5310
	56	5280	64	5320
	58#	5290	-	-

Frequency Band	Channel	Freq.(MHz)	Channel	Freq. (MHz)
5500-5700MHz U-NII-2C	100	5500	112	5560
	102*	5510	116	5580
	104	5520	132	5660
	106#	5530	134*	5670
	108	5540	136	5680
	110*	5550	140	5700

Frequency Band	Channel	Freq.(MHz)	Channel	Freq. (MHz)
5745-5825 MHz U-NII-3	149	5745	157	5785
	151*	5755	159*	5795
	153	5765	161	5805
	155#	5775	165	5825

Note:

1. The above Frequency and Channel in "*" are 40MHz bandwidth.
2. The above Frequency and Channel in "#" are 80MHz bandwidth.

2.2 Test Mode

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

SISO Mode

Modulation	Data Rate
802.11a	6 Mbps
802.11n HT20	MCS0
802.11n HT40	MCS0
802.11ac VHT80	MCS0

AC Conducted Emission	Mode 1 : WCDMA Band V + Bluetooth Link + WLAN Link (5G) + Power from Adapter1 + Earphone
Remark: For Radiated Test Cases, The tests were performance with Adapter1.	

RSE Co-location mode
802.11n HT40 CH62 5310MHz Tx + LTE Band 41- BW 20M Link

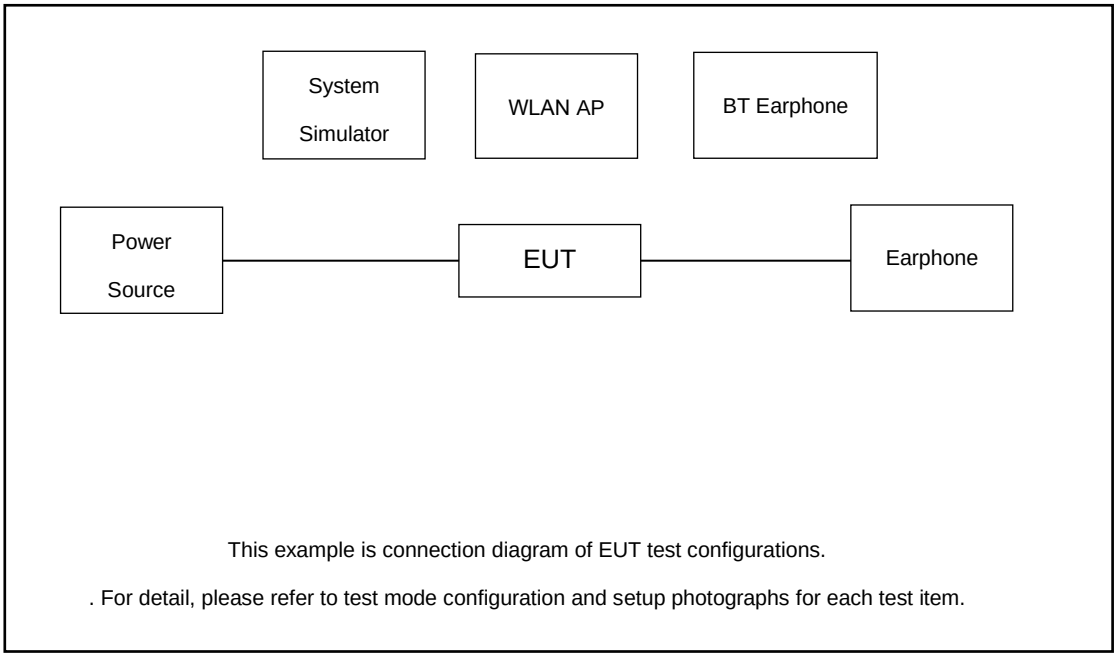
Ch. #		U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
		20M BW	20M BW	20M BW	20M BW
L	Low	36	52	100	149
M	Middle	44	60	116	157
H	High	48	64	140	165

Ch. #		U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
		40M BW	40M BW	40M BW	40M BW
L	Low	38	54	102	151
M	Middle	-	-	110	-
H	High	46	62	134	159

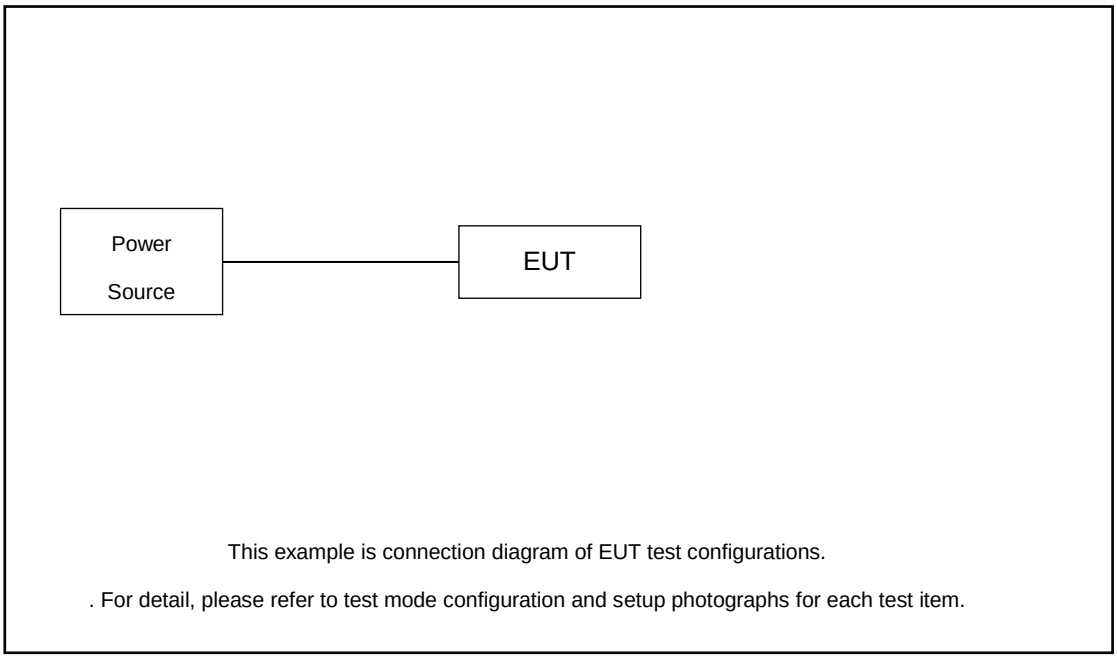
Ch. #		U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
		80M BW	80M BW	80M BW	80M BW
L	Low	-	-	-	-
M	Middle	42	58	106	155
H	High	-	-	-	-

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.	Base Station	Anritus	MT8821C	N/A	N/A	Unshielded,1.8m
2.	Bluetooth Earphone	Lenovo	thinkplus-BH3	N/A	N/A	N/A
3.	WLAN AP	D-link	DIR-655	KA21R655B1	N/A	Unshielded,1.8m
4.	SD Card	Kingston	8GB	N/A	N/A	N/A
5.	Adapter 1	N/A	N/A	N/A	N/A	N/A
6.	Earphone	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 continuously 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 6.05 dB and 20dB attenuator.

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

= 6.05 + 20 = 26.05 (dB)

3 Test Result

3.1 6dB and 26dB and 99% Occupied Bandwidth Measurement

3.1.1 Description of 6dB and 26dB and 99% Occupied Bandwidth

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

26dB and 99% Occupied bandwidth are reporting only.

3.1.2 Measuring Instruments

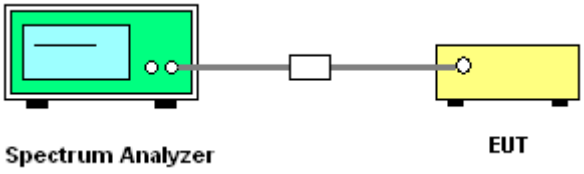
The measuring equipment is listed in the section 4 of this test report.

3.1.3 Test Procedures

1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.

☒	Section C) Bandwidth Measurement 1. Emission Bandwidth (EBW) and 99% OBW
	1. Set RBW = approximately 1% of the emission bandwidth. **2.** Set the VBW > RBW. **3.** Detector = Peak. **4.** Trace mode = max hold **5.** Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%. **6.** For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set to 1%~5% of the OBW and set the Video bandwidth (VBW) ≥ 3 * RBW. **7.** Measure and record the results in the test report.
☒	Section C) Bandwidth Measurement 2. Minimum Emission Bandwidth for the band 5.725 - 5.85 GHz
	1. Set RBW = 100kHz. **2.** Set the VBW ≥ 3 x RBW. **3.** Detector = Peak. **4.** Trace mode = max hold **5.** Measure the maximum width of the emission that is 6 dB down from the peak of the emission. **6.** Measure and record the results in the test report.

3.1.4 Test Setup



3.1.5 Test Result of 6dB and 26dB and 99% Occupied Bandwidth

Please refer to Appendix A.

3.2 Maximum Conducted Output Power Measurement

3.2.1 Limit of Maximum Conducted Output Power

<FCC 14-30 CFR 15.407>

For mobile and portable client devices in the 5.15–5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW.

For the 5.25–5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm +10 $\log_{10}$ B, where B is the 26 dB emission bandwidth in megahertz.

For the band 5.725–5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Note that U-NII-2 band, devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

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3.2.2 Measuring Instruments

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

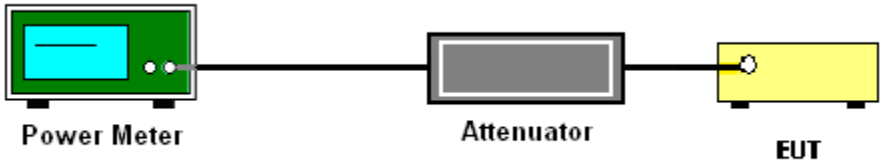
3.2.3 Test Procedures

The testing follows Method PM of FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.

Method PM (Measurement using an RF average power meter):

1. Measurement is performed using a wideband RF power meter.
2. The EUT is configured to transmit continuously with a consistent duty cycle at its maximum power control level.
3. Measure the average power of the transmitter, and the average power is corrected with duty factor, 10 log(1/x), where x is the duty cycle.

3.2.4 Test Setup



3.2.5 Test Result of Maximum Conducted Output Power

FCC U-NII-1 single antenna										
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power with duty factor (dBm)	FCC Conducted Power Limit (dBm)	DG (dBi)	Pass/Fail	Power Setting
11a	6Mbps	1	36	5180	0.10	16.32	24.00	-2.28	Pass	18
11a	6Mbps	1	44	5220	0.10	16.51	24.00	-2.28	Pass	18
11a	6Mbps	1	48	5240	0.10	16.45	24.00	-2.28	Pass	18
HT20	MCS0	1	36	5180	0.14	15.29	24.00	-2.28	Pass	17
HT20	MCS0	1	44	5220	0.14	15.46	24.00	-2.28	Pass	17
HT20	MCS0	1	48	5240	0.14	15.40	24.00	-2.28	Pass	17
HT40	MCS0	1	38	5190	0.29	13.75	24.00	-2.28	Pass	15.5
HT40	MCS0	1	46	5230	0.29	15.40	24.00	-2.28	Pass	17
VHT20	MCS0	1	36	5180	0.14	14.40	24.00	-2.28	Pass	16
VHT20	MCS0	1	44	5220	0.14	14.37	24.00	-2.28	Pass	16
VHT20	MCS0	1	48	5240	0.14	14.12	24.00	-2.28	Pass	16
VHT40	MCS0	1	38	5190	0.28	13.71	24.00	-2.28	Pass	15.5
VHT40	MCS0	1	46	5230	0.28	14.43	24.00	-2.28	Pass	16
VHT80	MCS0	1	42	5210	0.54	12.53	24.00	-2.28	Pass	14.5

FCC U-NII-2A single antenna											
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power with duty factor (dBm)	FCC Conducted Power Limit (dBm)	DG (dBi)	EIRP Power Limit (dBm)	Pass/Fail	Power Setting
11a	6Mbps	1	52	5260	0.10	16.11	23.95	-2.25	26.99	Pass	17.5
11a	6Mbps	1	60	5300	0.10	16.13	23.96	-2.25	26.99	Pass	17.5
11a	6Mbps	1	64	5320	0.10	16.31	23.97	-2.25	26.99	Pass	17.5
HT20	MCS0	1	52	5260	0.14	15.08	23.98	-2.25	26.99	Pass	16.5
HT20	MCS0	1	60	5300	0.14	15.02	23.98	-2.25	26.99	Pass	16.5
HT20	MCS0	1	64	5320	0.14	15.10	23.98	-2.25	26.99	Pass	16.5
HT40	MCS0	1	54	5270	0.29	15.50	23.98	-2.25	26.99	Pass	17
HT40	MCS0	1	62	5310	0.29	14.70	23.98	-2.25	26.99	Pass	16
VHT20	MCS0	1	52	5260	0.14	14.02	23.98	-2.25	26.99	Pass	16
VHT20	MCS0	1	60	5300	0.14	14.17	23.98	-2.25	26.99	Pass	16
VHT20	MCS0	1	64	5320	0.14	14.05	23.98	-2.25	26.99	Pass	16
VHT40	MCS0	1	54	5270	0.28	14.46	23.98	-2.25	26.99	Pass	16
VHT40	MCS0	1	62	5310	0.28	14.54	23.98	-2.25	26.99	Pass	16
VHT80	MCS0	1	58	5290	0.54	13.32	23.98	-2.25	26.99	Pass	15

FCC U-NII-2C single antenna											
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power with duty factor (dBm)	FCC Conducted Power Limit (dBm)	DG (dBi)	EIRP Power Limit (dBm)	Pass/Fail	Power Setting
11a	6Mbps	1	100	5500	0.10	16.27	23.98	-2.24	26.99	Pass	17.5
11a	6Mbps	1	116	5580	0.10	16.05	23.98	-2.24	26.99	Pass	17.5
11a	6Mbps	1	140	5700	0.10	16.15	23.98	-2.24	26.99	Pass	17.5
HT20	MCS0	1	100	5500	0.14	15.10	23.98	-2.24	26.99	Pass	16.5
HT20	MCS0	1	116	5580	0.14	14.95	23.98	-2.24	26.99	Pass	16.5
HT20	MCS0	1	140	5700	0.14	13.74	23.98	-2.24	26.99	Pass	15.5
HT40	MCS0	1	102	5510	0.29	15.38	23.98	-2.24	26.99	Pass	17
HT40	MCS0	1	110	5550	0.29	15.49	23.98	-2.24	26.99	Pass	17
HT40	MCS0	1	134	5670	0.29	15.40	23.98	-2.24	26.99	Pass	17
VHT20	MCS0	1	100	5500	0.14	13.98	23.98	-2.24	26.99	Pass	16
VHT20	MCS0	1	116	5580	0.14	14.05	23.98	-2.24	26.99	Pass	16
VHT20	MCS0	1	140	5700	0.14	13.71	23.98	-2.24	26.99	Pass	15.5
VHT40	MCS0	1	102	5510	0.28	14.49	23.98	-2.24	26.99	Pass	16
VHT40	MCS0	1	110	5550	0.28	14.45	23.98	-2.24	26.99	Pass	16
VHT40	MCS0	1	134	5670	0.28	14.37	23.98	-2.24	26.99	Pass	16
VHT80	MCS0	1	106	5530	0.54	13.60	23.98	-2.24	26.99	Pass	15.5

U-NII-3 single antenna										
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power with duty factor (dBm)	FCC Conducted Power Limit (dBm)	DG (dBi)	Pass/Fail	Power Setting
11a	6Mbps	1	149	5745	0.10	16.18	30.00	-3.20	Pass	17.5
11a	6Mbps	1	157	5785	0.10	15.99	30.00	-3.20	Pass	17.5
11a	6Mbps	1	165	5825	0.10	15.95	30.00	-3.20	Pass	17.5
HT20	MCS0	1	149	5745	0.14	15.26	30.00	-3.20	Pass	17
HT20	MCS0	1	157	5785	0.14	15.31	30.00	-3.20	Pass	17
HT20	MCS0	1	165	5825	0.14	15.22	30.00	-3.20	Pass	17
HT40	MCS0	1	151	5755	0.29	15.46	30.00	-3.20	Pass	17
HT40	MCS0	1	159	5795	0.29	15.28	30.00	-3.20	Pass	17
VHT20	MCS0	1	149	5745	0.14	14.41	30.00	-3.20	Pass	16
VHT20	MCS0	1	157	5785	0.14	14.33	30.00	-3.20	Pass	16
VHT20	MCS0	1	165	5825	0.14	14.30	30.00	-3.20	Pass	16
VHT40	MCS0	1	151	5755	0.28	14.34	30.00	-3.20	Pass	16
VHT40	MCS0	1	159	5795	0.28	14.32	30.00	-3.20	Pass	16
VHT80	MCS0	1	155	5775	0.54	14.22	30.00	-3.20	Pass	16

3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

<FCC 14-30 CFR 15.407>

For mobile and portable client devices in the 5.15–5.25 GHz band, the maximum power spectral density shall not exceed 11dBm in any 1 megahertz band.

For the 5.25–5.725 GHz bands, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

For the band 5.725–5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band.

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3.3.2 Measuring Instruments

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

3.3.3 Test Procedures

The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v01r04.
Section F) Maximum power spectral density.

For devices operating in the bands UNII-1/2A/2C

 # Method SA-2 #

(trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction).

- Measure the duty cycle.
- Set span to encompass the entire emission bandwidth (EBW) of the signal.
- Set RBW = 1 MHz.
- Set VBW ≥ 3 MHz.
- Number of points in sweep ≥ 2 Span / RBW.
- Sweep time = auto.
- Detector = RMS
- Trace average at least 100 traces in power averaging mode.
- Add 10 log(1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times. For example, add 10 log(1/0.25) = 6 dB if the duty cycle is 25 percent.

For devices operating in the band UNII-3

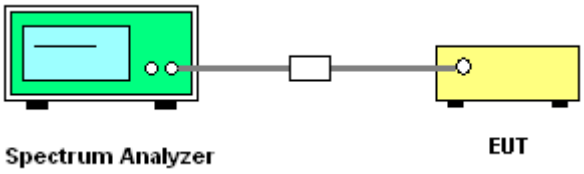
 # Method SA-2 #

(trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction).

- Measure the duty cycle.
- Set span to encompass the entire emission bandwidth (EBW) of the signal.
- Set RBW = 500KHz (or 300 kHz if the SA can't set RBW=500KHz).
- Set VBW ≥ 1 MHz.
- Number of points in sweep ≥ 2 Span / RBW.
- Sweep time = auto.
- Detector = RMS
- Trace average at least 100 traces in power averaging mode.
- If the SA can't set RBW=500KHz, then add 10 log(500kHz/RBW) to the test result.
- Add 10 log(1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times. For example, add 10 log(1/0.25) = 6 dB if the duty cycle is 25 percent.

1. The RF output of EUT was connected to the spectrum analyzer by a low loss cable.
2. Each plot has already offset with cable loss, and attenuator loss. Measure the PPSD and record it.

3.3.4 Test Setup



3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.

3.4 Unwanted Emissions Measurement

This section as specified in FCC Part 15.407(b) is to measure unwanted emissions through radiated measurement for band edge spurious emissions and out of band emissions measurement. The unwanted emissions shall comply with 15.407(b)(1) to (6), and restricted bands per FCC Part15.205.

3.4.1 Limit of Unwanted Emissions

(1) For transmitters operating in the 5150-5250 MHz band: all emissions outside of the 5150-5350 MHz band shall not exceed an EIRP of –27dBm/MHz.

For transmitters operating in the 5250-5350 MHz band: all emissions outside of the 5150-5350 MHz band shall not exceed an EIRP of -27 dBm/MHz. Devices operating in the 5250-5350 MHz band that generate emissions in the 5150-5250 MHz band must meet all applicable technical requirements for operation in the 5150-5250 MHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of -27 dBm/MHz in the 5150-5250 MHz band.

For transmitters operating in the 5470-5600 MHz and 5650-5725MHz band: all emissions outside of the 5470-5600 MHz and 5650-5725MHz band shall not exceed an EIRP of -27 dBm/MHz.

(2) Unwanted spurious emissions fallen in restricted bands shall comply with the general field strength limits as below table,

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) EIRP (dBm)	Field Strength at 3m (dBμV/m)
- 27	68.2

Note: The following formula is used to convert the EIRP to field strength.

$$EIRP = E_{Meas} + 20\log(d_{Meas}) - 104.7$$

where

EIRP is the equivalent isotropically radiated power, in dBm

E_{Meas} is the field strength of the emission at the measurement distance, in dBμV/m

d_{Meas} is the measurement distance, in m

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 FCC KDB 789033 D02 General UNII Test Procedures New Rules v01r04. Section G) Unwanted emissions measurement.

   (1) Procedure for Unwanted Emissions Measurements Below 1000MHz

   - RBW = 120 kHz
   - VBW = 300 kHz
   - Detector = Peak
   - Trace mode = max hold

   (2) Procedure for Peak Unwanted Emissions Measurements Above 1000 MHz

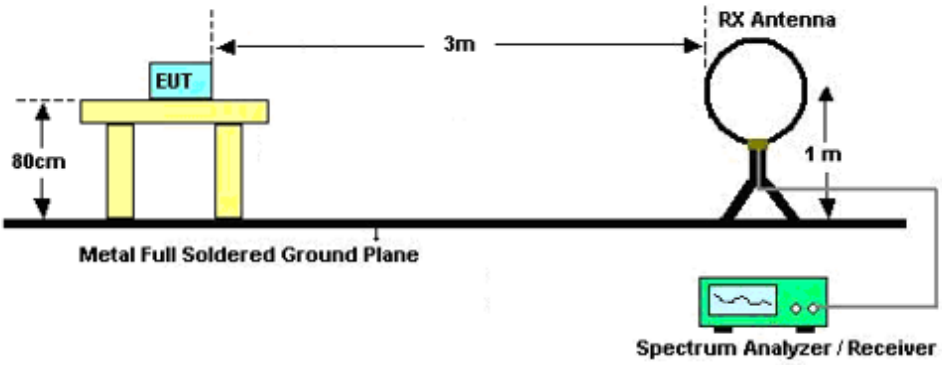
   - RBW = 1 MHz
   - VBW ≥ 3 MHz
   - Detector = Peak
   - Sweep time = auto
   - Trace mode = max hold

   (3) Procedures for Average Unwanted Emissions Measurements Above 1000MHz

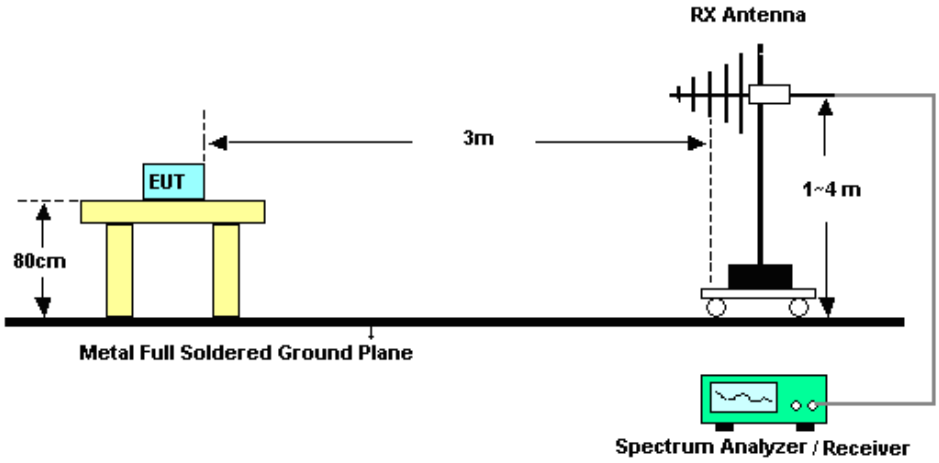
   - RBW = 1 MHz
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on.
2. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
3. The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
4. The antenna is a broadband antenna and its height is adjusted between one meter and four meters above ground to find the maximum value of the field strength for both horizontal polarization and vertical polarization of the antenna.
5. For each suspected emission, the EUT was arranged to its worst case and then adjust the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading.
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 average 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.

3.4.4 Test Setup

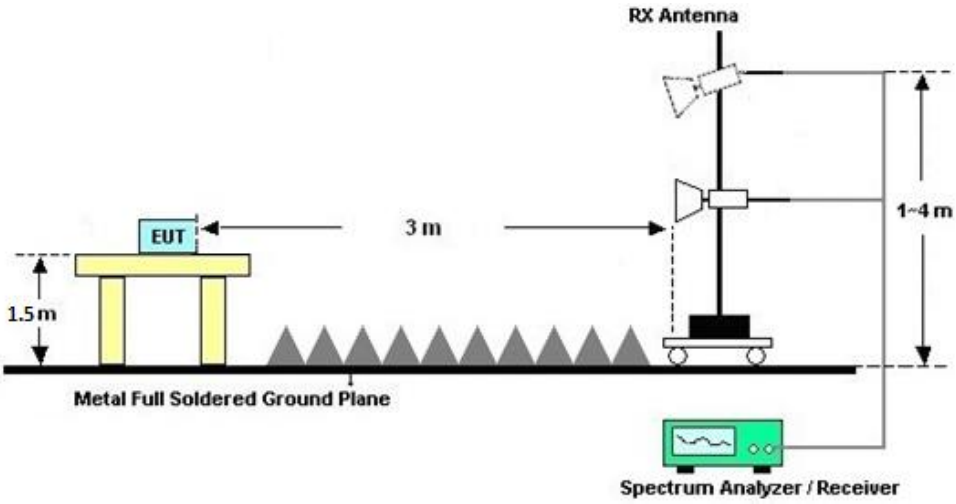
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



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

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.

3.4.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C.

3.4.7 Duty Cycle

Please refer to Appendix D.

3.4.8 Test Result of Radiated Spurious Emissions (30MHz ~ 10th Harmonic)

Please refer to Appendix C.

3.5 AC Conducted Emission Measurement

3.5.1 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.

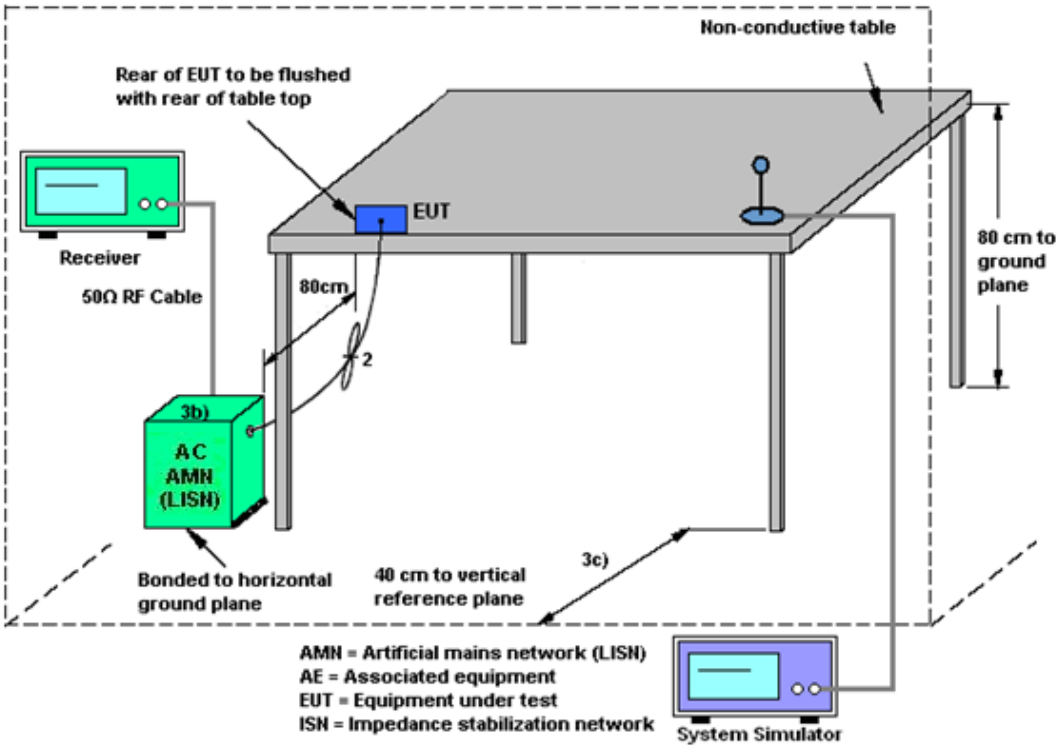
3.5.2 Measuring Instruments

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

3.5.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room 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 with Maximum Hold Mode.

3.5.4 Test Setup



3.5.5 Test Result of AC Conducted Emission

Please refer to Appendix B.

3.6 Antenna Requirements

3.6.1 Standard Applicable

According to FCC 47 CFR Section 15.407(a)(1)(2) ,if transmitting antenna directional gain is greater than 6 dBi, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3.6.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.6.3 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	Apr. 01, 2025	Apr. 17, 2025	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060103	9kHz~30MHz	Aug. 20, 2024	Apr. 01, 2025	Aug. 19, 2025	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060105	9kHz~30MHz	Apr. 18, 2024	Apr. 01, 2025	Apr. 17, 2025	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP000000811	AC 0V~300V, 45Hz~1000Hz	Oct. 09, 2024	Apr. 01, 2025	Oct. 08, 2025	Conduction (CO01-KS)
EMI Test Receiver	Keysight	N9038A	MY57290151	3Hz~8.5GHz;Max 30dBm	Jul. 04, 2024	Mar. 29, 2025	Jul. 03, 2025	Radiation (03CH08-KS)
EXA Spectrum Analyzer	Keysight	N9010B	MY57441079	10Hz-44GHz	Oct. 09, 2024	Mar. 29, 2025	Oct. 08, 2025	Radiation (03CH08-KS)
Loop Antenna	R&S	HFH2-Z2E	101125	9kHz~30MHz	Sep. 08, 2024	Mar. 29, 2025	Sep. 07, 2025	Radiation (03CH08-KS)
Bilog Antenna	TESEQ	CBL 6111D	59915	30MHz-1GHz	Aug. 18, 2024	Mar. 29, 2025	Aug.17, 2025	Radiation (03CH08-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	00240138	1GHz~18GHz	Jul. 06, 2024	Mar. 29, 2025	Jul. 05, 2025	Radiation (03CH08-KS)
high gain Amplifier	EM	EM01G18GA	060890	1Ghz-18Ghz	Jul. 23, 2024	Mar. 29, 2025	Jul. 22, 2025	Radiation (03CH08-KS)
SHF-EHF Horn	Com-power	AH-840	101116	18GHz~40GHz	Oct. 22, 2024	Mar. 29, 2025	Oct. 21, 2025	Radiation (03CH08-KS)
Amplifier	SONOMA	310N	380826	9KHz-1GHz	Jul. 03, 2024	Mar. 29, 2025	Jul. 02, 2025	Radiation (03CH08-KS)
Amplifier	Keysight	83017A	MY53270417	500MHz~26.5GHz	Oct. 09, 2024	Mar. 29, 2025	Oct. 08, 2025	Radiation (03CH08-KS)
Amplifier	EM	EM18G40GGA	060737	18~40GHz	Jan. 03, 2025	Mar. 29, 2025	Jan. 02, 2026	Radiation (03CH08-KS)
AC Power Source	Chroma	61601	616010002473	N/A	NCR	Mar. 29, 2025	NCR	Radiation (03CH08-KS)
Turn Table	EM	EM 1000-T	N/A	0~360 degree	NCR	Mar. 29, 2025	NCR	Radiation (03CH08-KS)
Antenna Mast	EM	EM 1000-A	N/A	1 m~4 m	NCR	Mar. 29, 2025	NCR	Radiation (03CH08-KS)
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Oct. 10, 2024	Apr. 09, 2025	Oct. 09, 2025	Conducted (TH01-KS)
Pulse Power Senor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 02, 2025	Apr. 09, 2025	Jan. 01, 2026	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 02, 2025	Apr. 09, 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	**±0.4 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**

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: 2025.4.9	**Test Engineer:** Jiang Jun

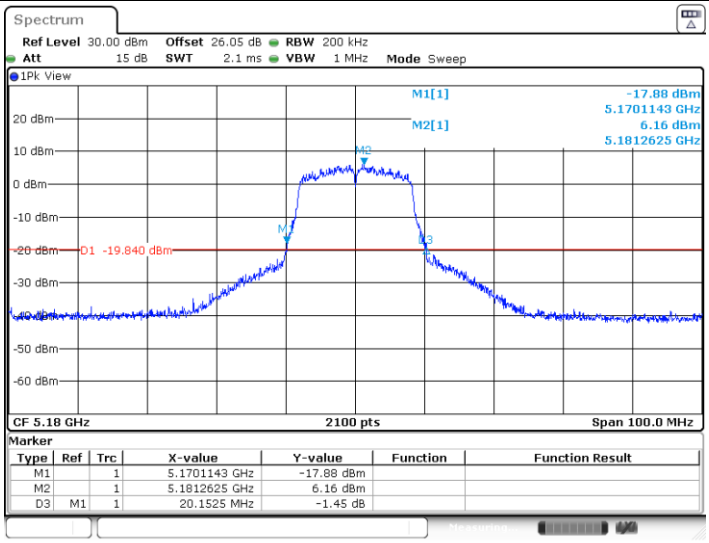
Emission Bandwidth

Test Result

TestMode	Antenna	Freq(MHz)	26dB EBW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11A	Ant1	5180	20.15	5170.11	5190.27	---	---
		5220	20.25	5209.78	5230.03	---	---
		5240	19.96	5230.07	5250.03	---	---
		5260	19.72	5250.11	5269.84	---	---
		5300	19.77	5290.16	5309.93	---	---
		5320	19.82	5310.11	5329.93	---	---
		5500	19.96	5489.97	5509.93	---	---
		5580	19.96	5570.07	5590.03	---	---
		5700	19.91	5690.07	5709.98	---	---
		5745	19.91	5735.02	5754.93	---	---
		5785	20.11	5775.02	5795.12	---	---
		5825	20.58	5815.07	5835.65	---	---
11N20SISO	Ant1	5180	20.25	5169.92	5190.17	---	---
		5220	20.20	5209.92	5230.12	---	---
		5240	20.11	5230.02	5250.12	---	---
		5260	20.20	5249.88	5270.08	---	---
		5300	20.15	5289.92	5310.08	---	---
		5320	20.11	5309.97	5330.08	---	---
		5500	20.20	5489.88	5510.08	---	---
		5580	20.15	5569.92	5590.08	---	---
		5700	20.15	5689.97	5710.12	---	---
		5745	20.20	5734.92	5755.12	---	---
		5785	20.34	5774.78	5795.12	---	---
		5825	20.15	5815.02	5835.17	---	---
11N40SISO	Ant1	5190	40.69	5169.66	5210.34	---	---
		5230	41.26	5209.66	5250.92	---	---
		5270	43.35	5247.08	5290.44	---	---
		5310	40.59	5289.75	5330.34	---	---
		5510	40.69	5489.66	5530.34	---	---
		5550	40.40	5529.85	5570.25	---	---
		5670	40.59	5649.75	5690.34	---	---
		5755	40.78	5734.66	5775.44	---	---
		5795	40.40	5774.75	5815.15	---	---
11AC80SISO	Ant1	5210	80.80	5169.70	5250.50	---	---
		5290	80.99	5249.51	5330.50	---	---
		5530	81.37	5489.31	5570.69	---	---
		5775	80.80	5734.70	5815.50	---	---

Test Graphs

11A_5180



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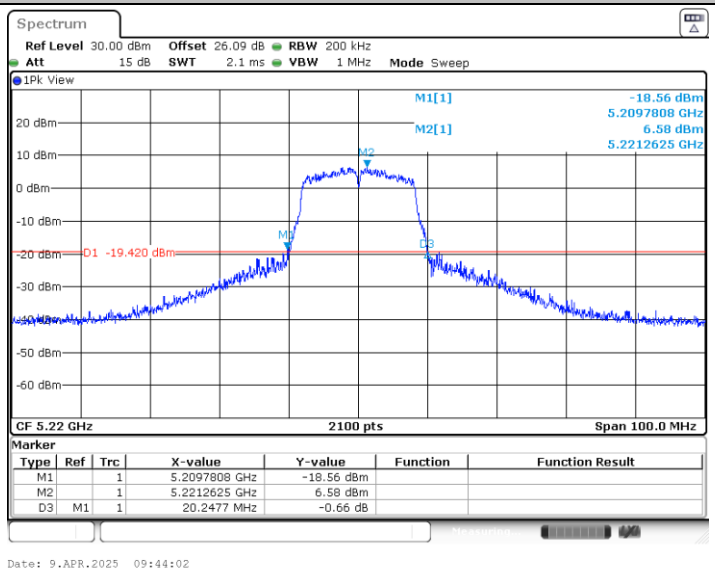

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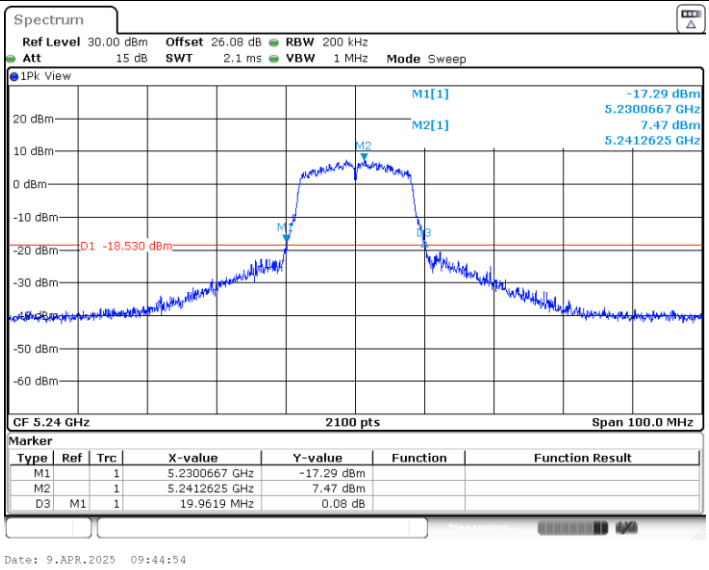

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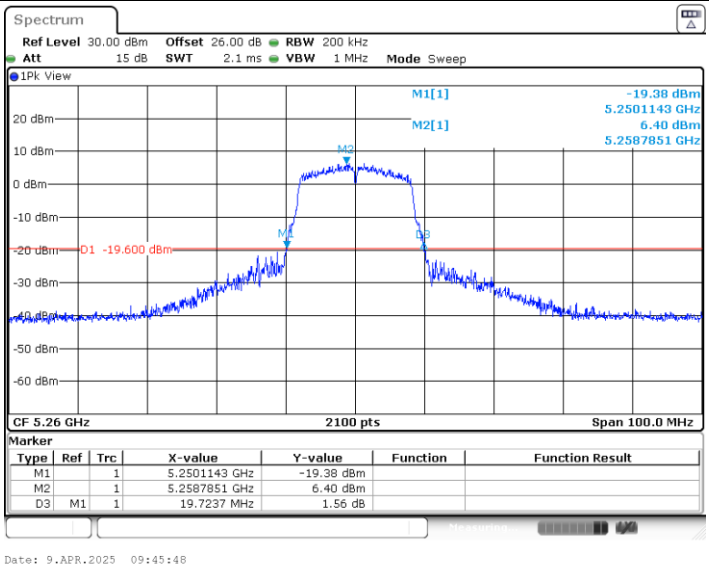

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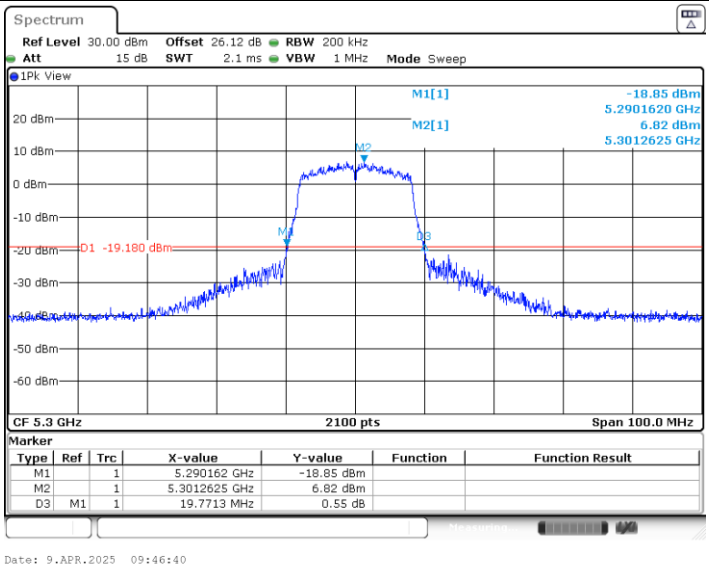

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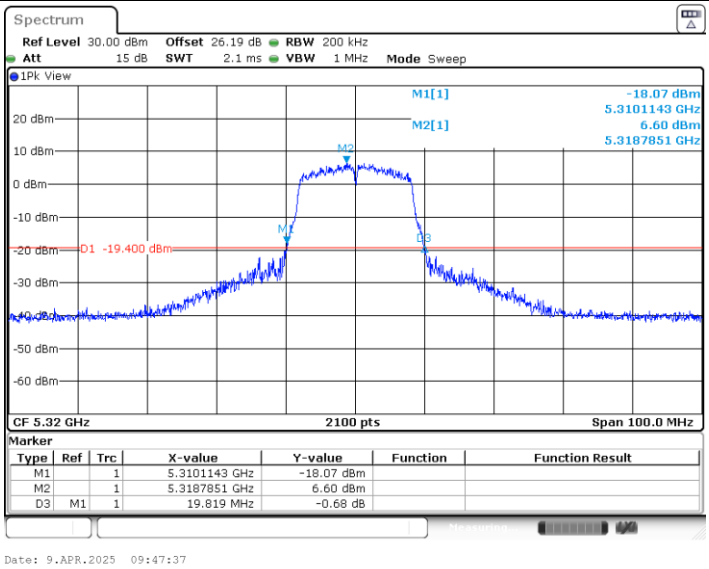

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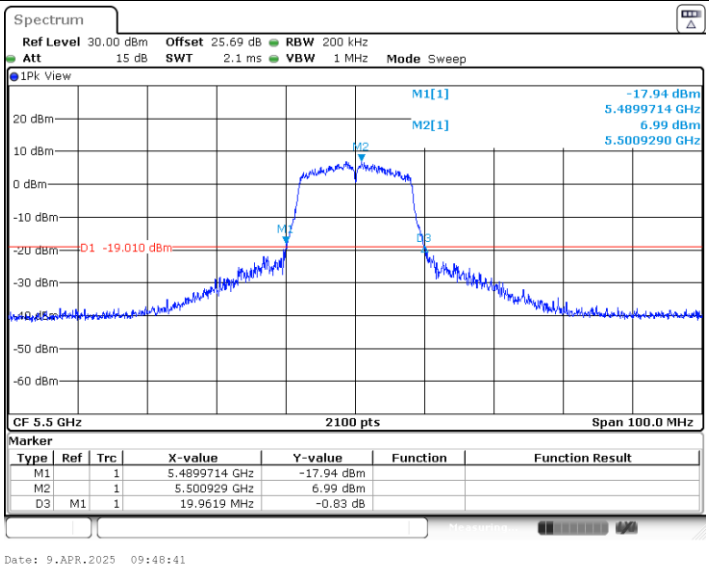

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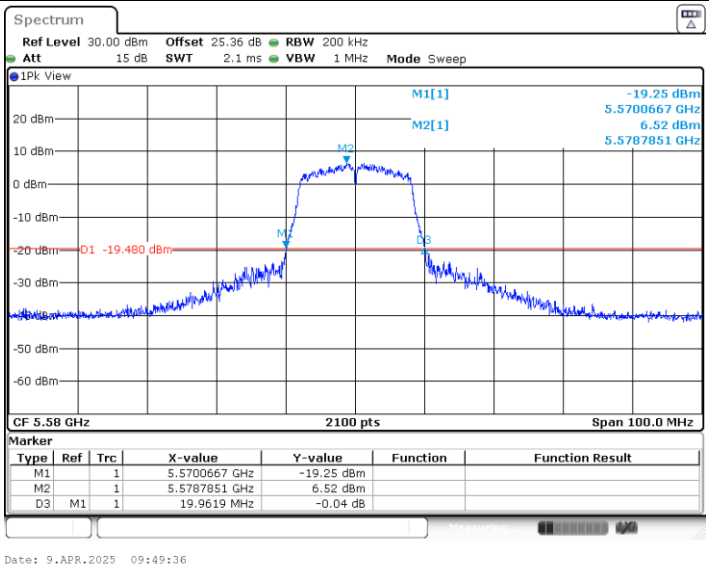

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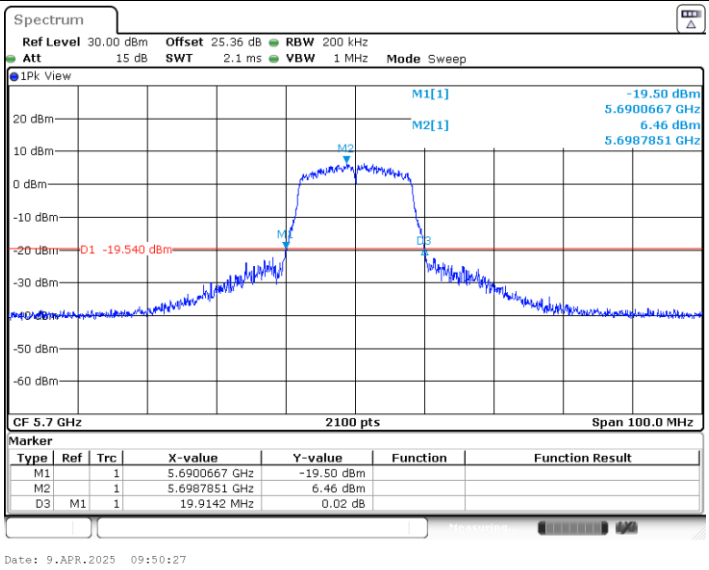

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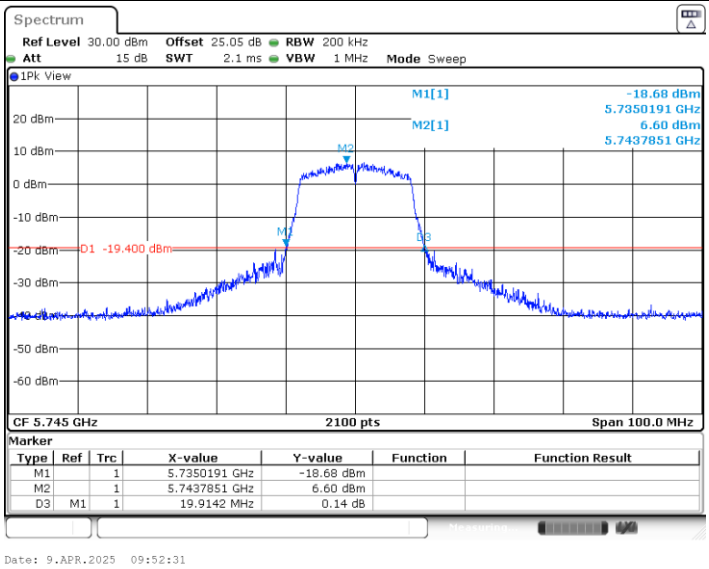

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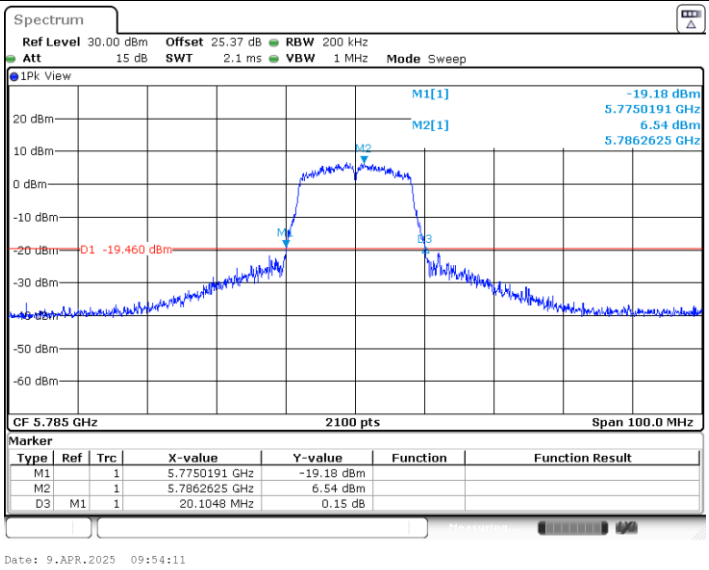

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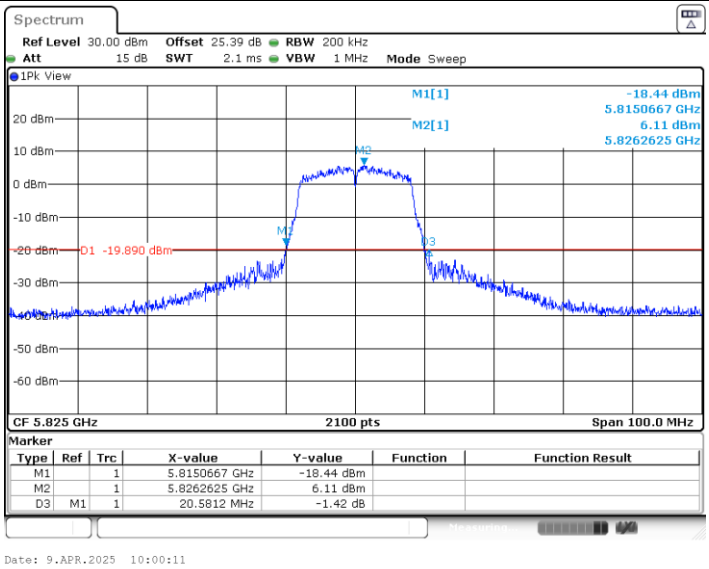
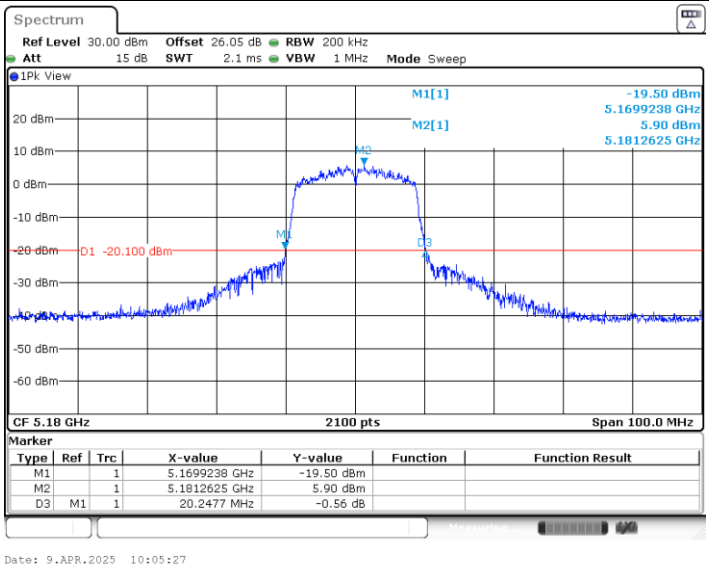


11N20SISO_5180



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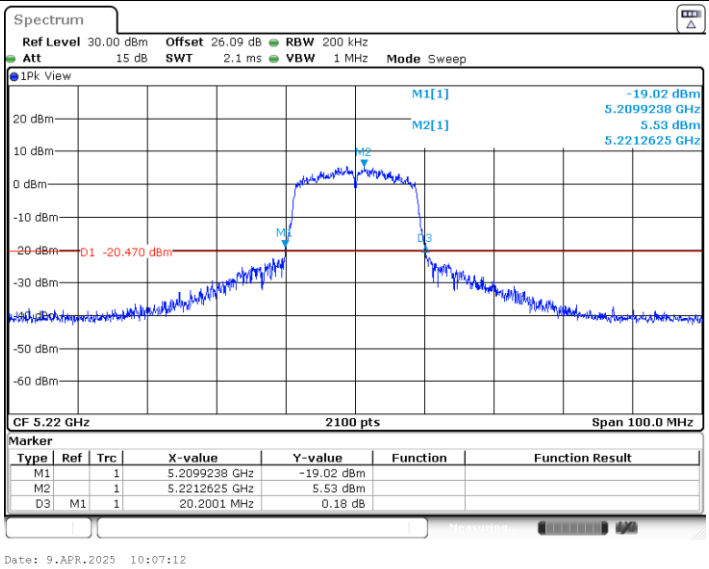

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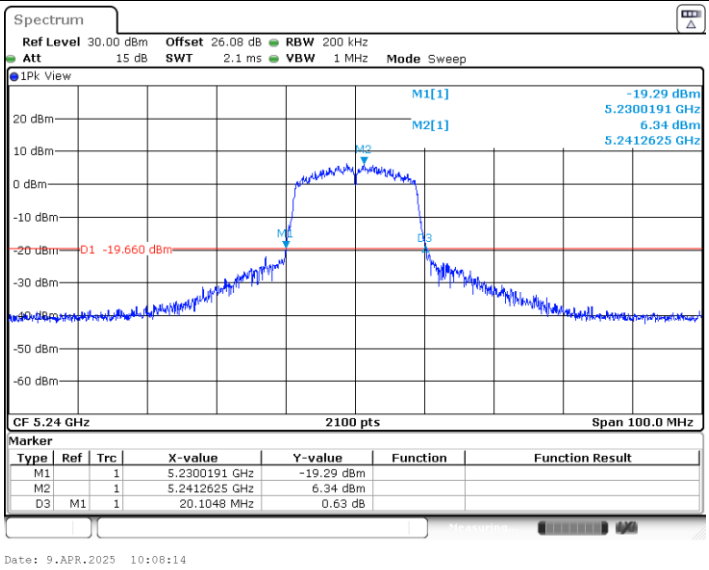

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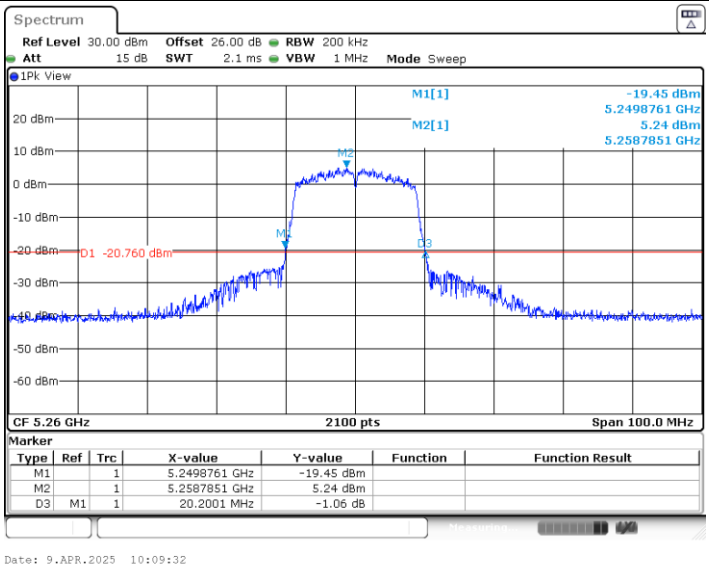

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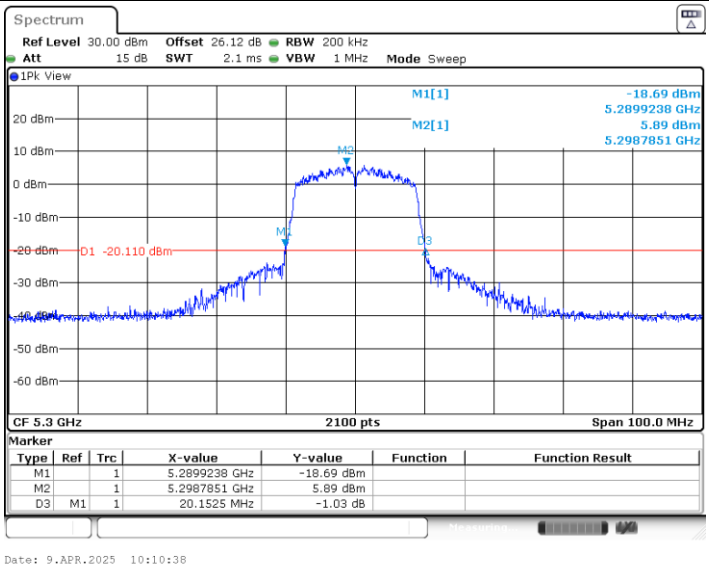

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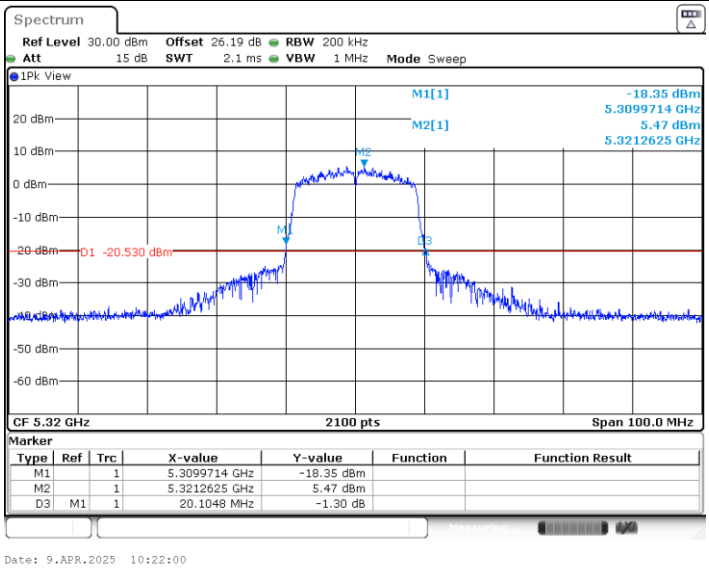

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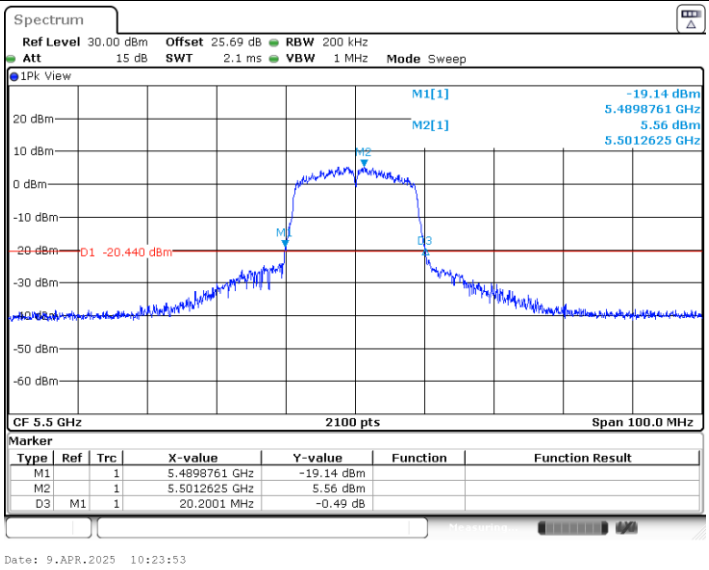

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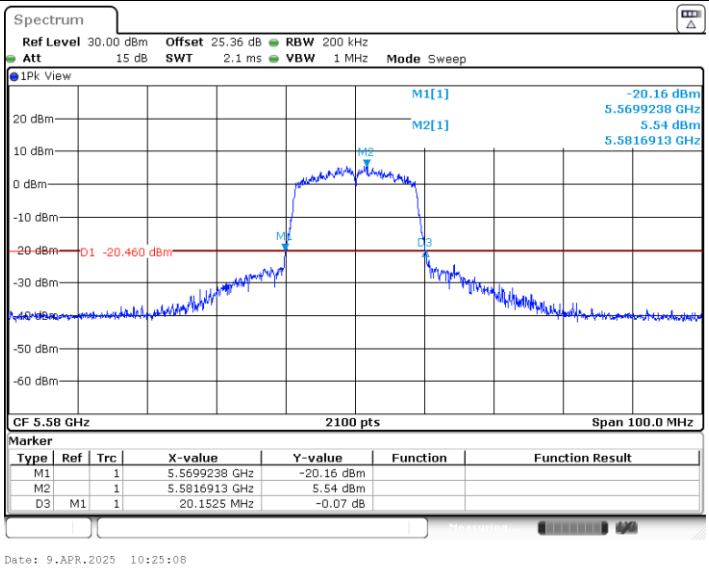

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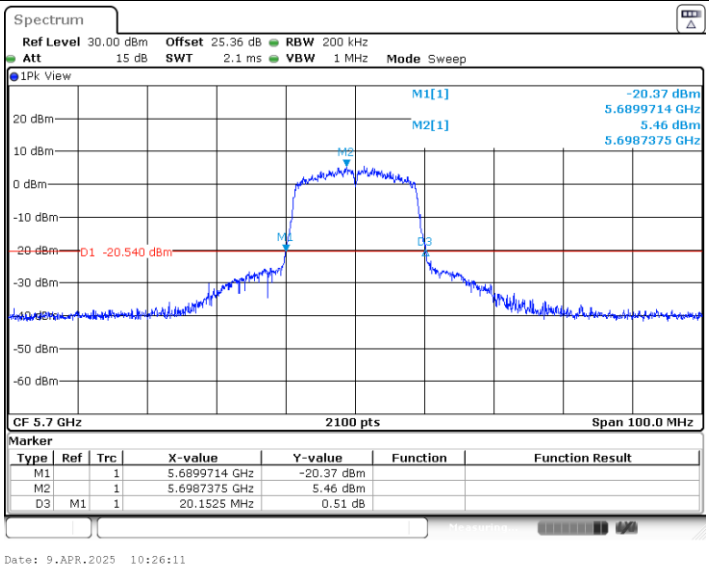

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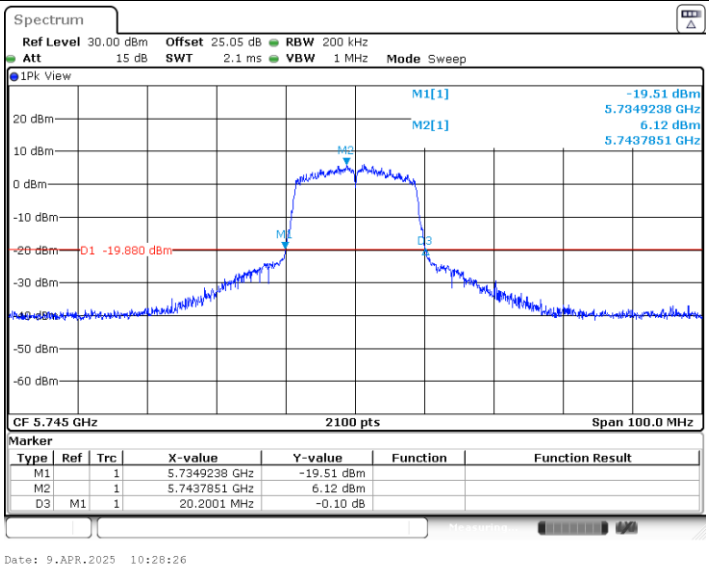

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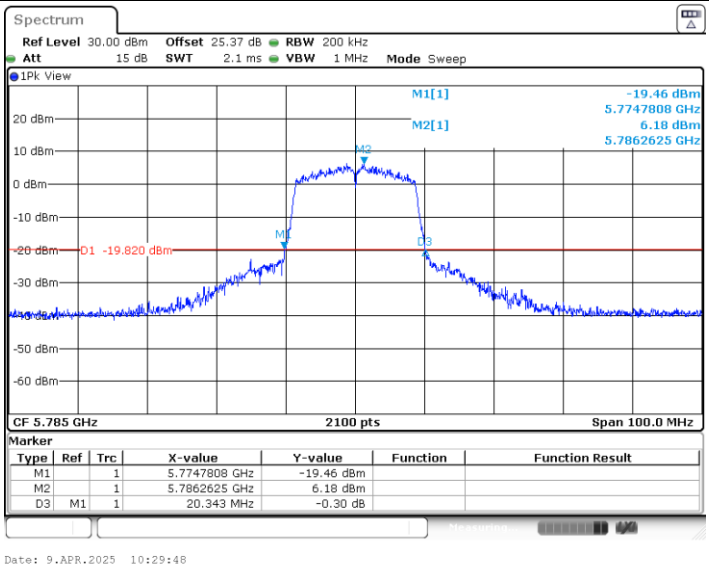

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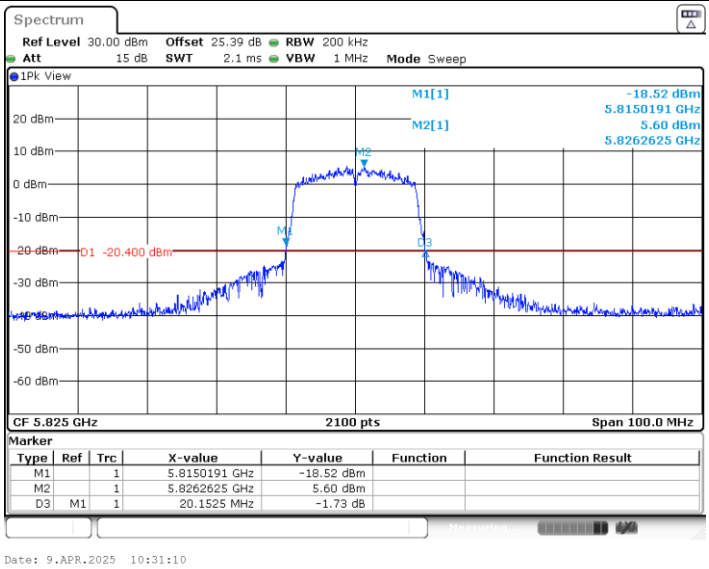

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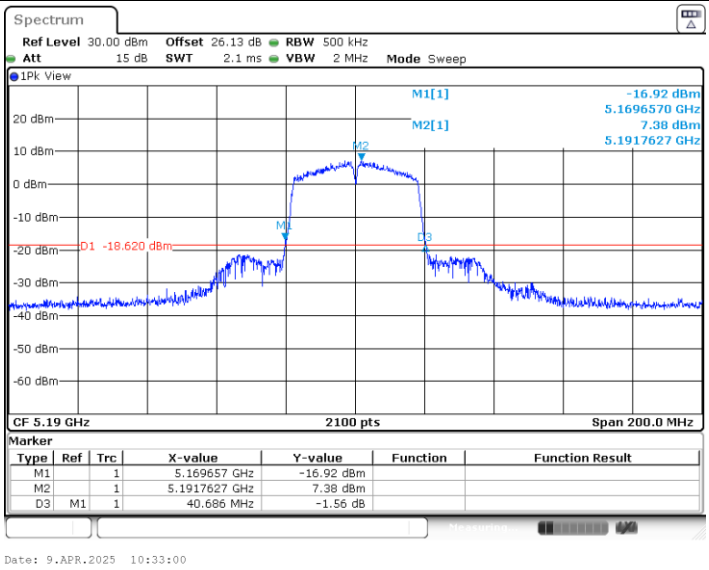

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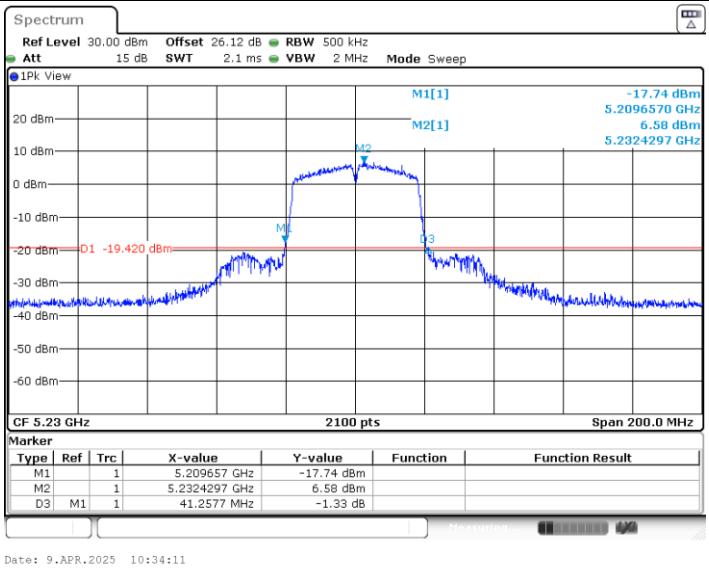

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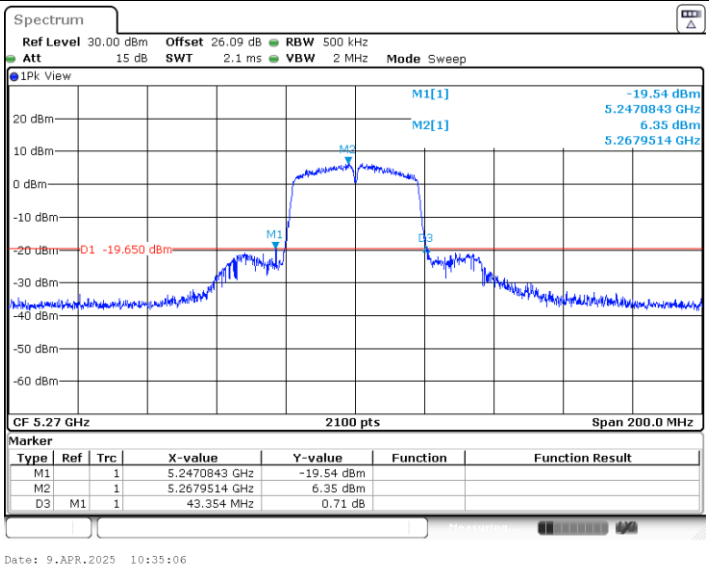

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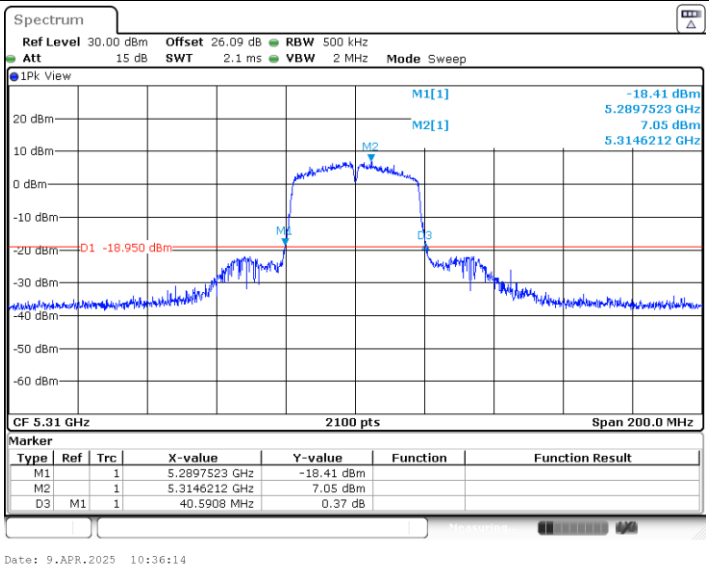

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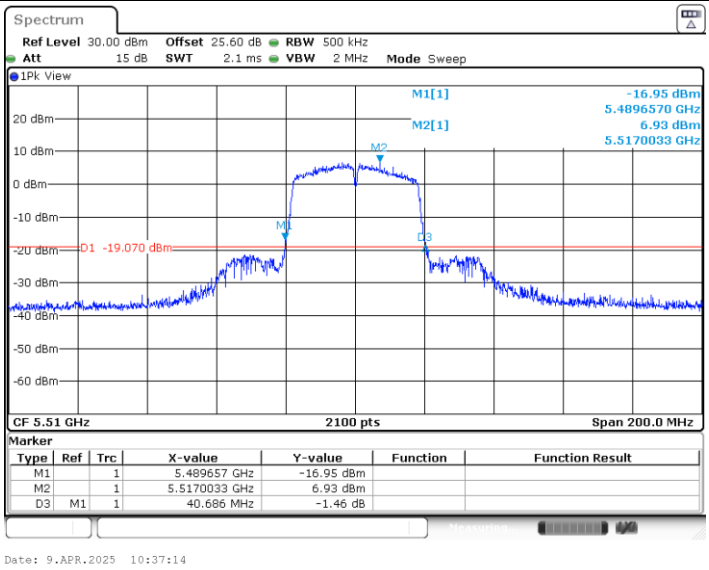

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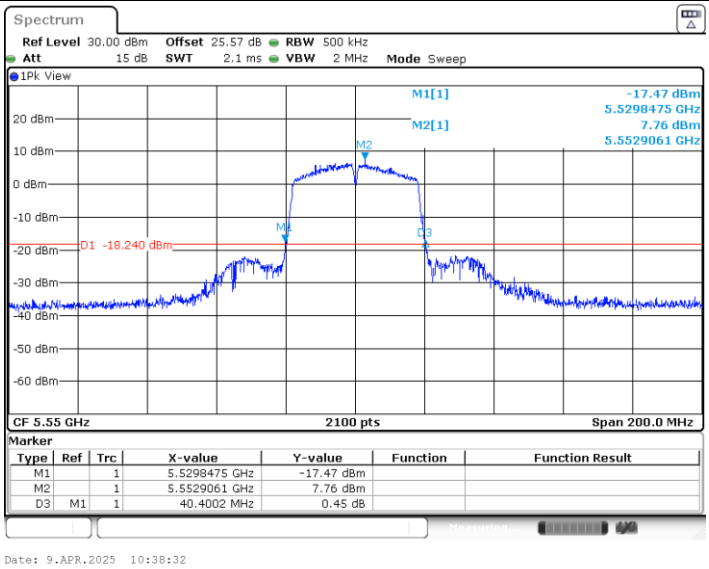

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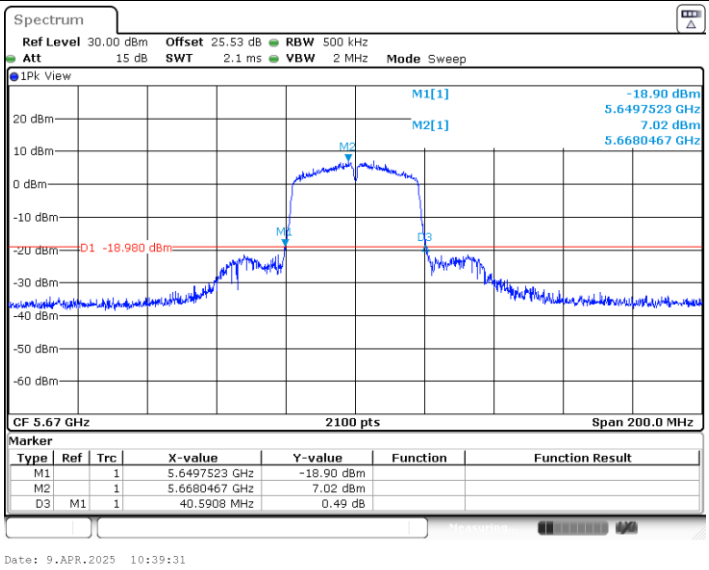

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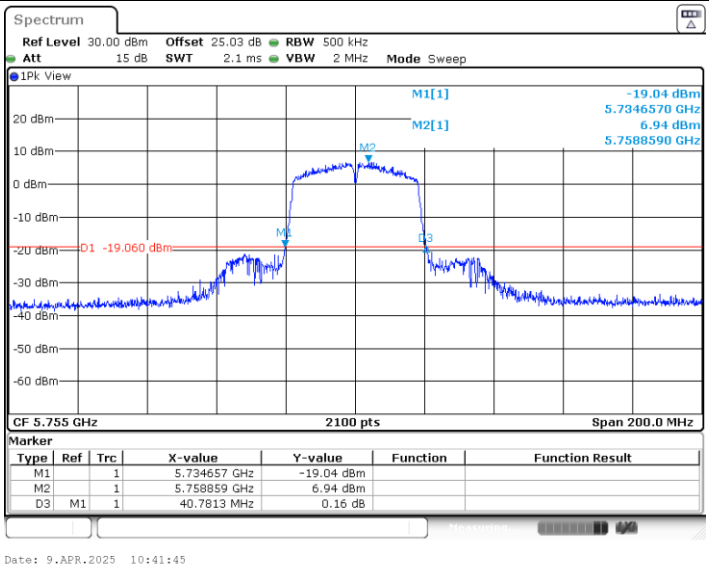

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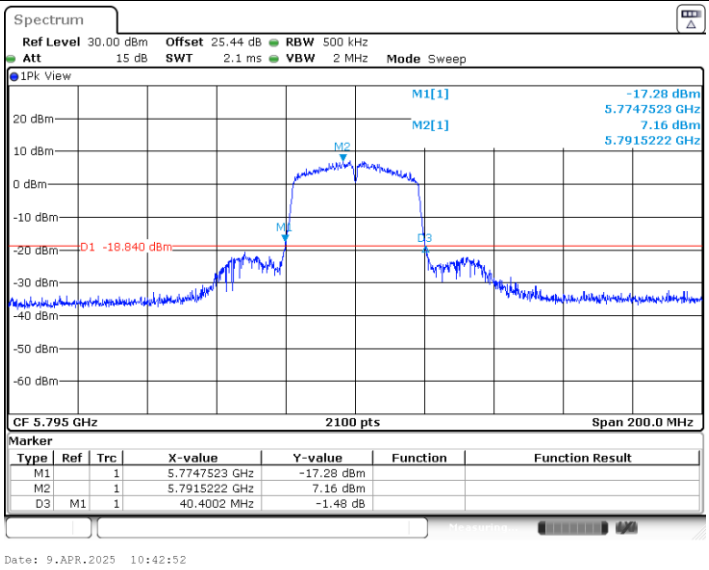

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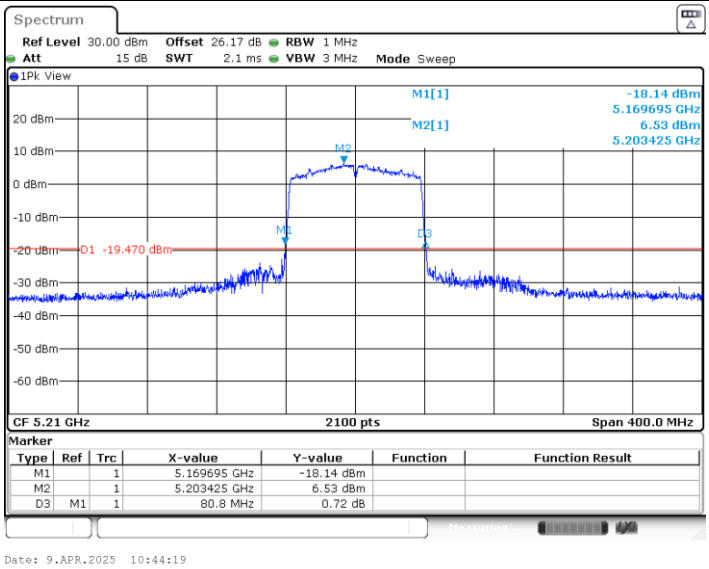

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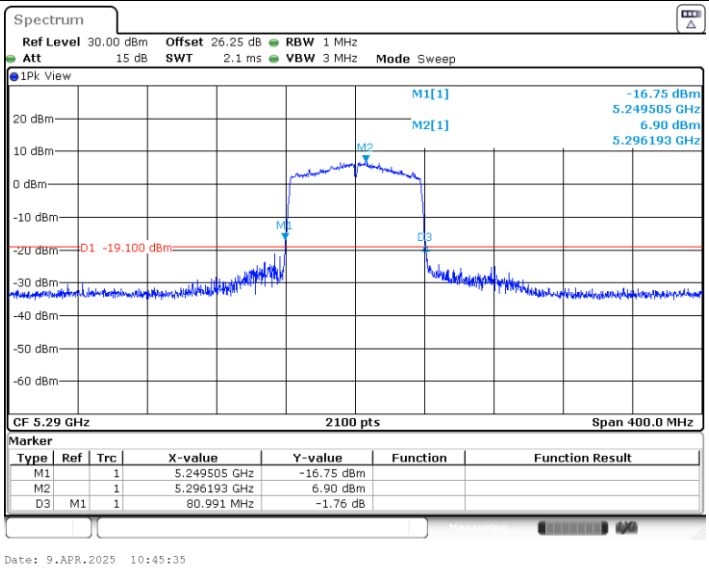

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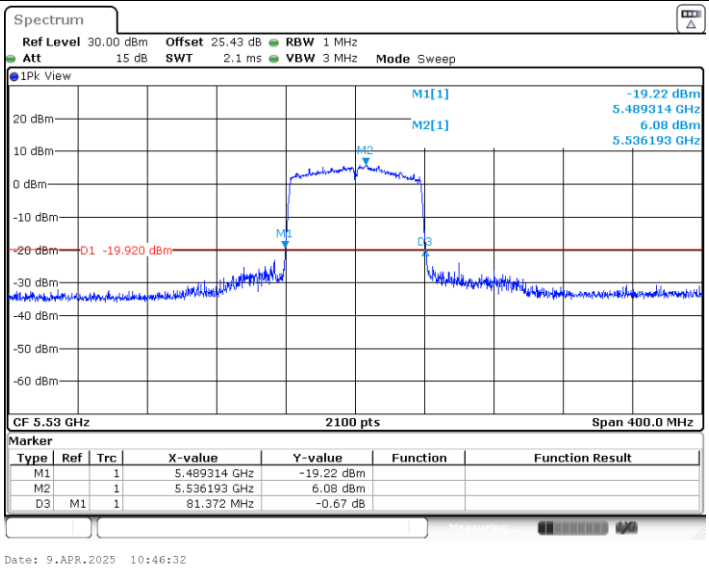

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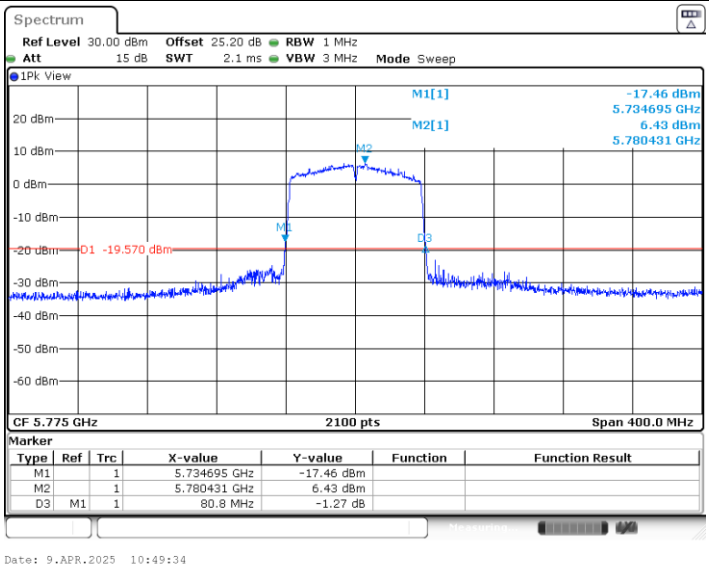


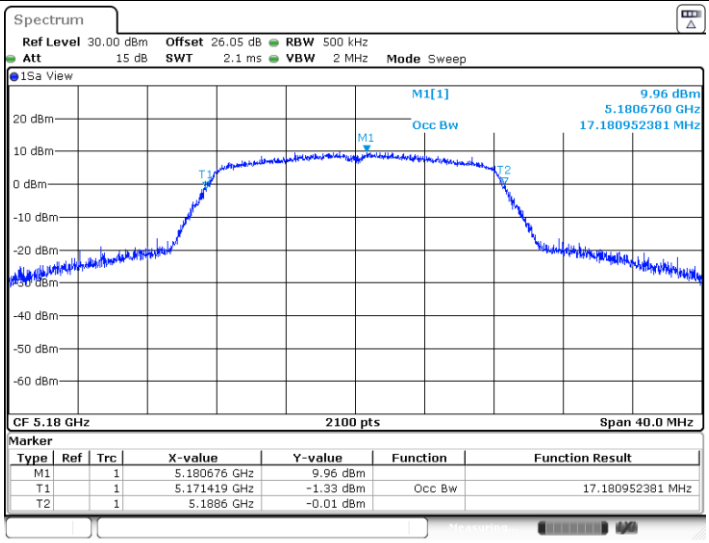
Occupied channel bandwidth

Test Result

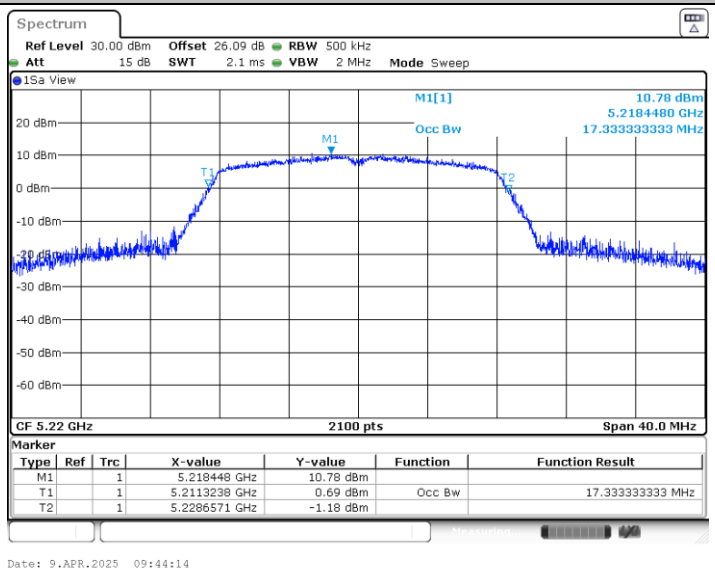
TestMode	Antenna	Freq(MHz)	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11A	Ant1	5180	17.181	5171.4190	5188.6000	---	---
		5220	17.333	5211.3238	5228.6571	---	---
		5240	17.181	5231.4190	5248.6000	---	---
		5260	17.162	5251.3810	5268.5429	---	---
		5300	17.162	5291.3810	5308.5429	---	---
		5320	17.219	5311.3619	5328.5810	---	---
		5500	17.143	5491.3810	5508.5238	---	---
		5580	17.162	5571.4190	5588.5810	---	---
		5700	17.181	5691.4190	5708.6000	---	---
		5745	17.162	5736.4000	5753.5619	---	---
		5785	17.162	5776.4000	5793.5619	---	---
		5825	17.181	5816.4190	5833.6000	---	---
11N20SISO	Ant1	5180	18.095	5170.9619	5189.0571	---	---
		5220	18.19	5210.8857	5229.0762	---	---
		5240	18.114	5230.9619	5249.0762	---	---
		5260	18.076	5250.9238	5269.0000	---	---
		5300	18.038	5290.9619	5309.0000	---	---
		5320	18.095	5310.9238	5329.0190	---	---
		5500	18.057	5490.9238	5508.9810	---	---
		5580	18.076	5570.9619	5589.0381	---	---
		5700	18.076	5690.9619	5709.0381	---	---
		5745	18.133	5735.9048	5754.0381	---	---
		5785	18.095	5775.9429	5794.0381	---	---
		5825	18.114	5815.9619	5834.0762	---	---
11N40SISO	Ant1	5190	36.343	5171.8095	5208.1524	---	---
		5230	36.533	5211.7333	5248.2667	---	---
		5270	36.61	5251.6952	5288.3048	---	---
		5310	36.419	5291.7714	5328.1905	---	---
		5510	36.457	5491.6952	5528.1524	---	---
		5550	36.343	5531.8476	5568.1905	---	---
		5670	36.381	5651.8095	5688.1905	---	---
		5755	36.343	5736.7714	5773.1143	---	---
		5795	36.305	5776.8095	5813.1143	---	---
11AC80SISO	Ant1	5210	75.581	5172.2476	5247.8286	---	---
		5290	75.581	5252.1714	5327.7524	---	---
		5530	75.733	5492.0190	5567.7524	---	---
		5775	75.505	5737.0952	5812.6000	---	---

Test Graphs

11A_5180



11A_5220



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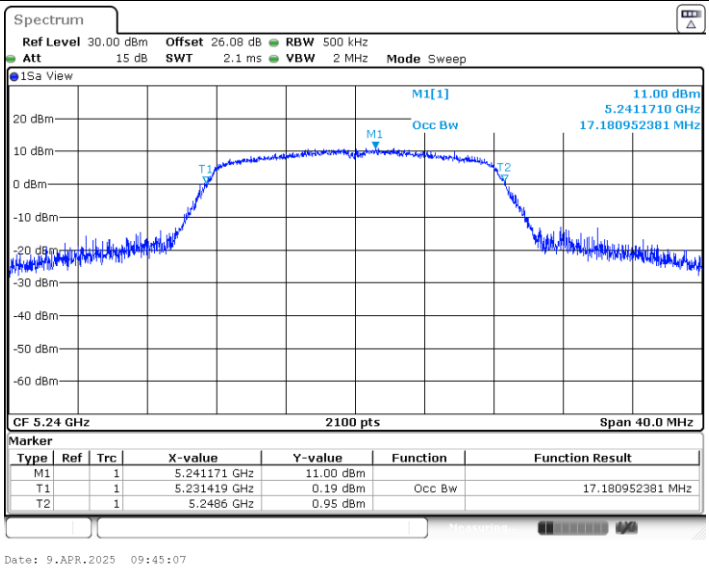

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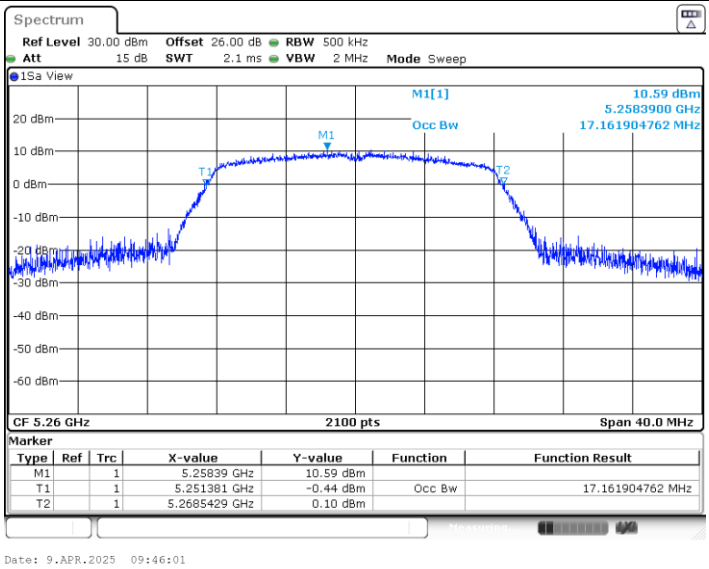

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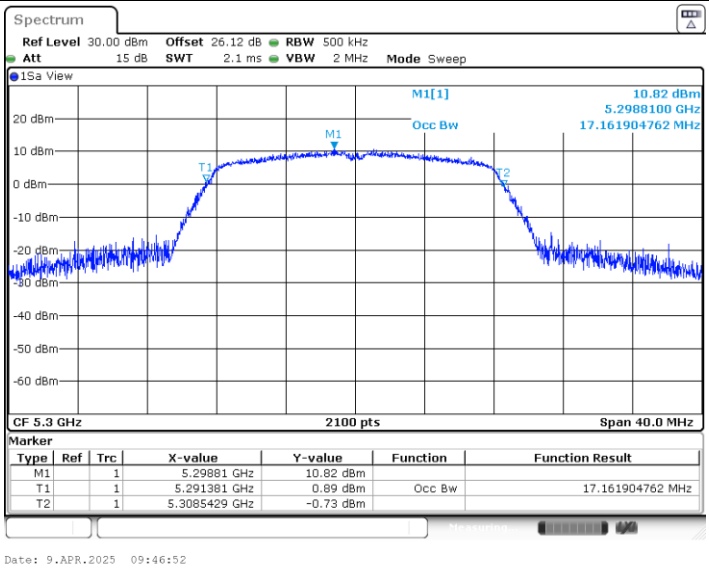

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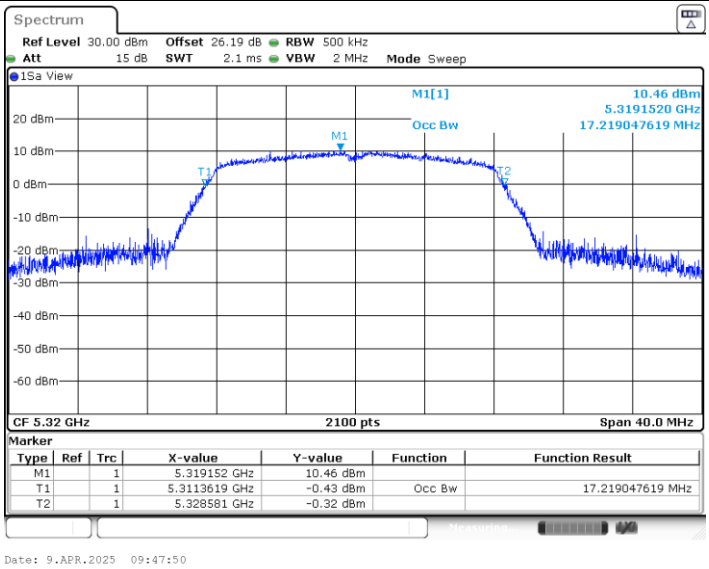
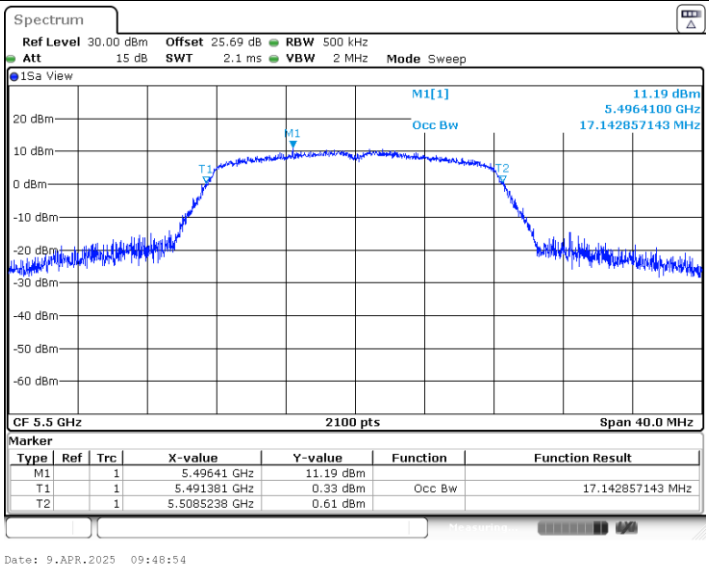


11A_5500



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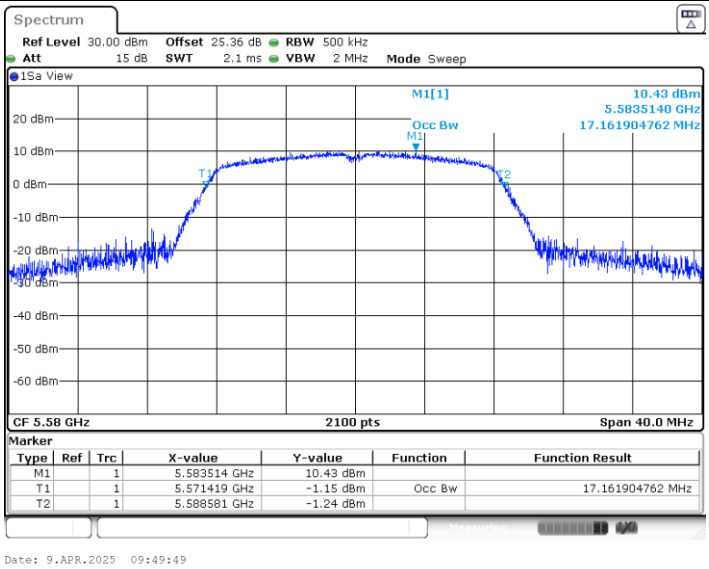

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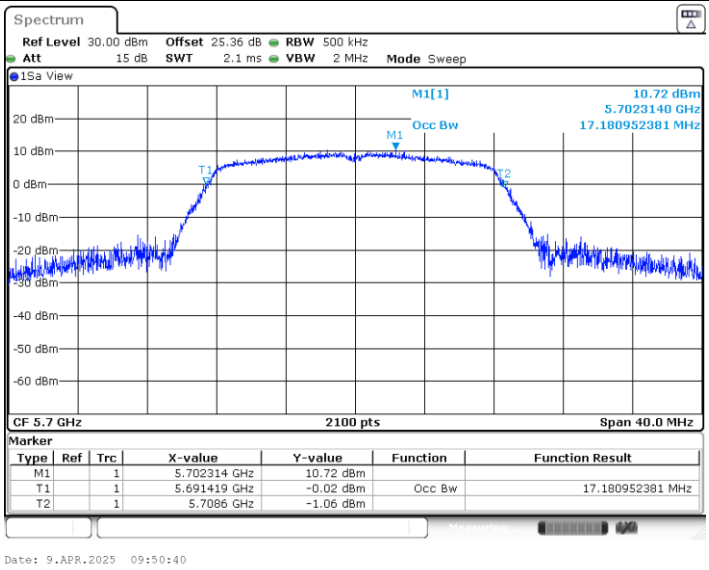

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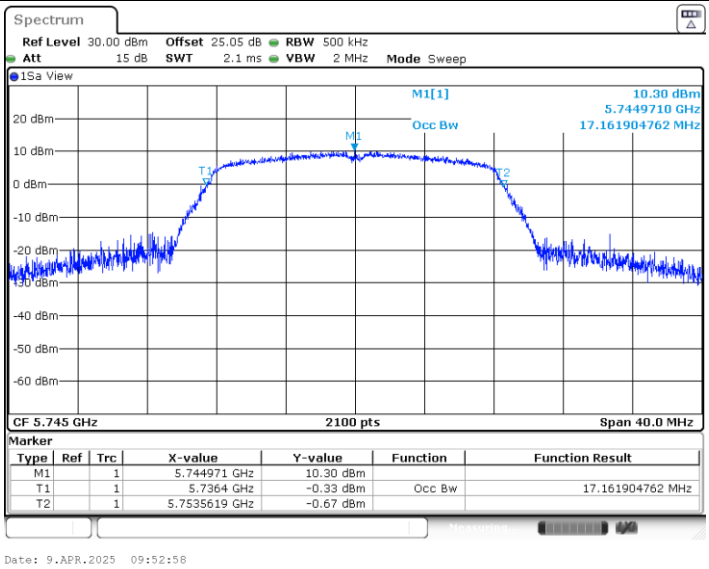

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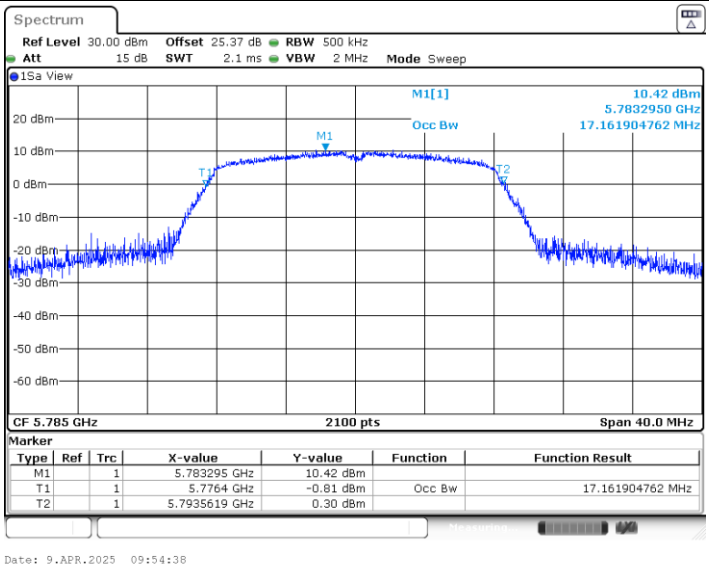
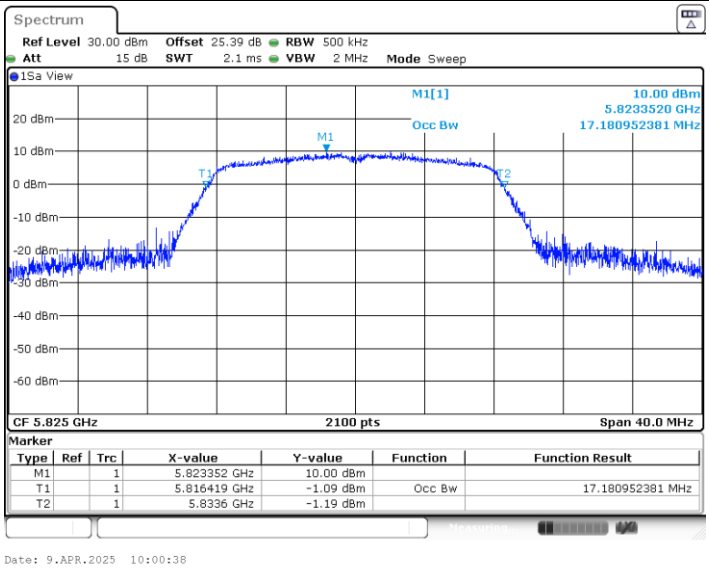
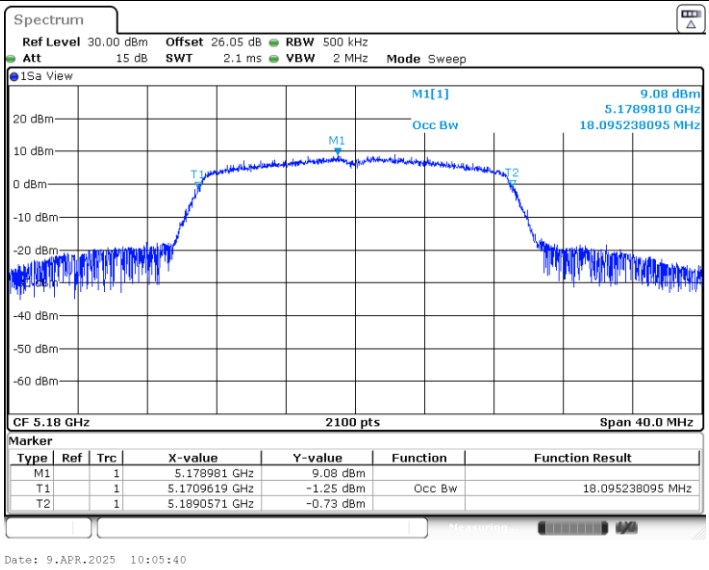


11A_5825



11N20SISO_5180



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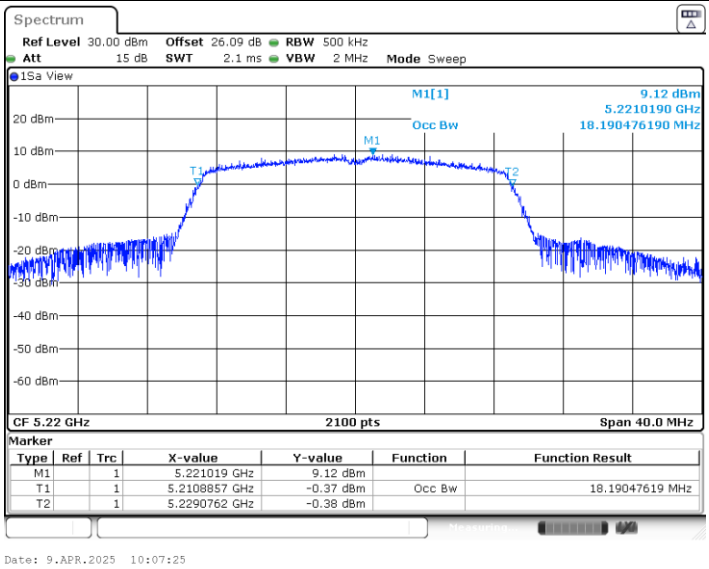
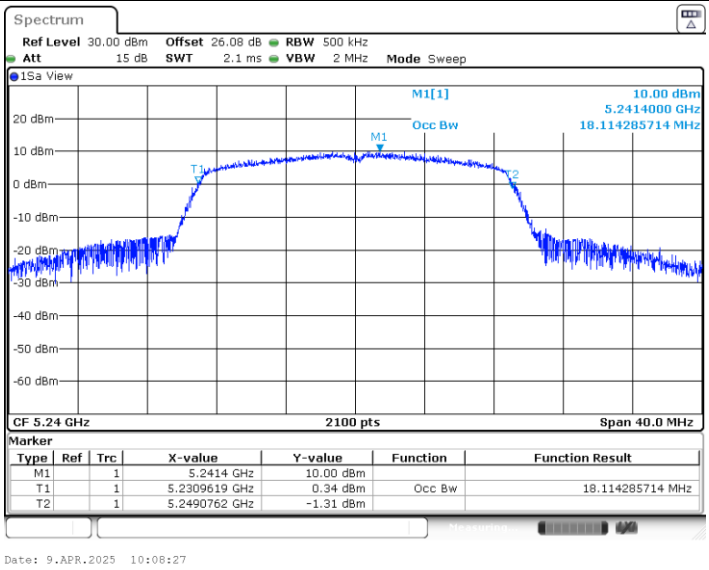


11N20SISO_5240



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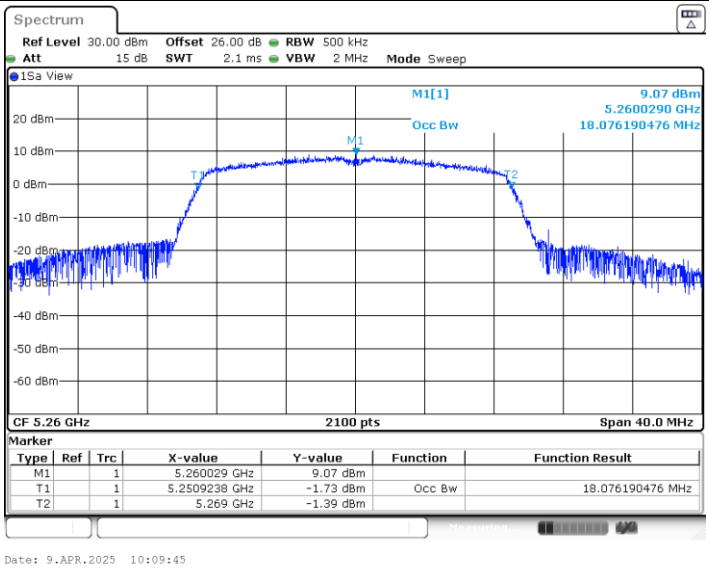

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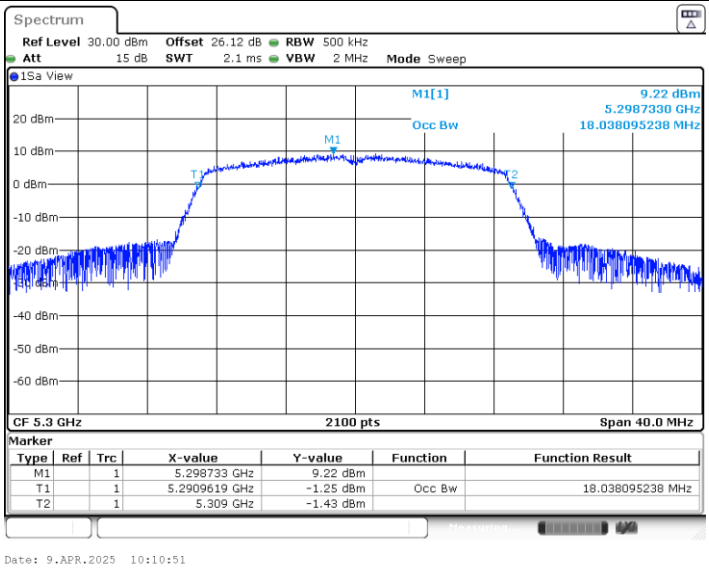

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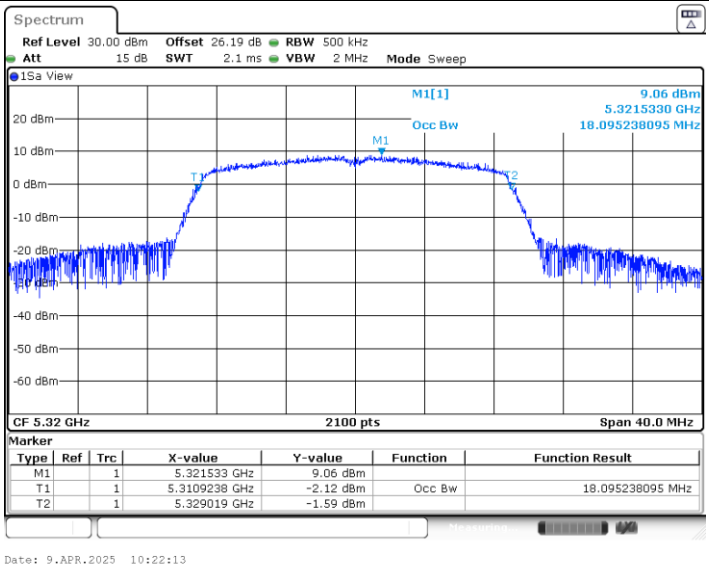

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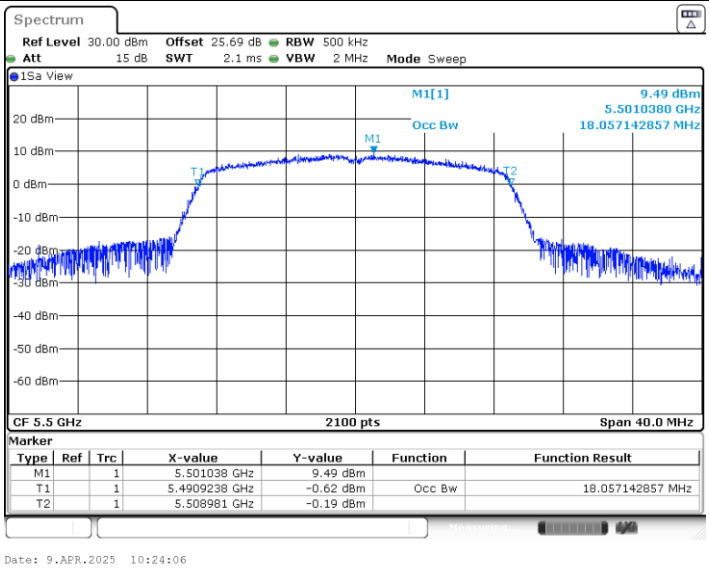

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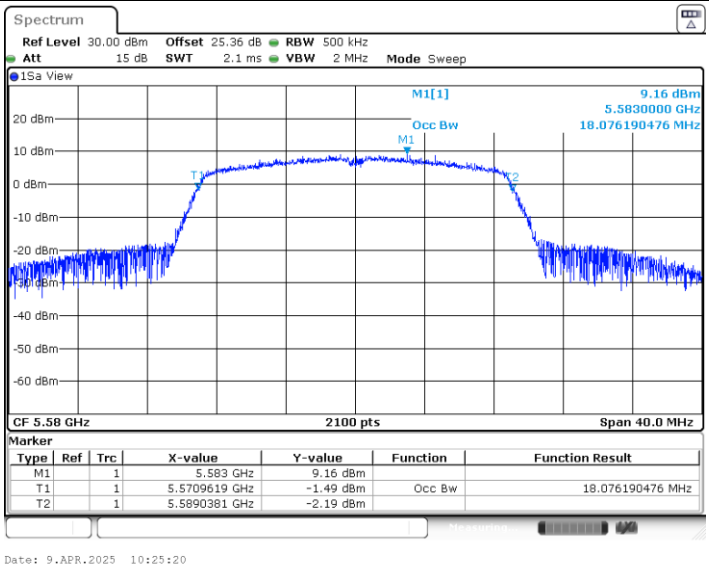

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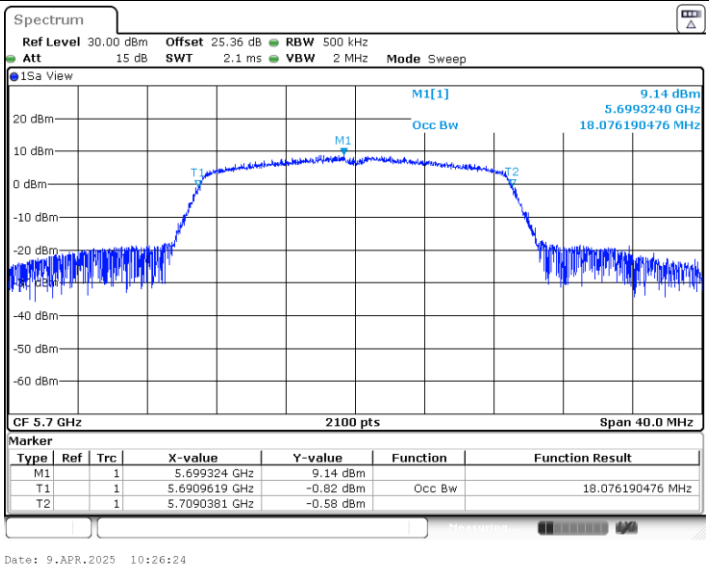
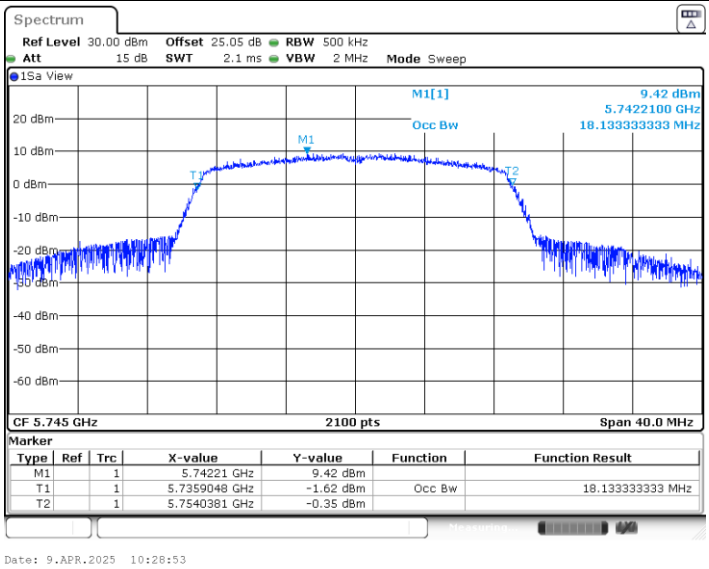


11N20SISO_5745



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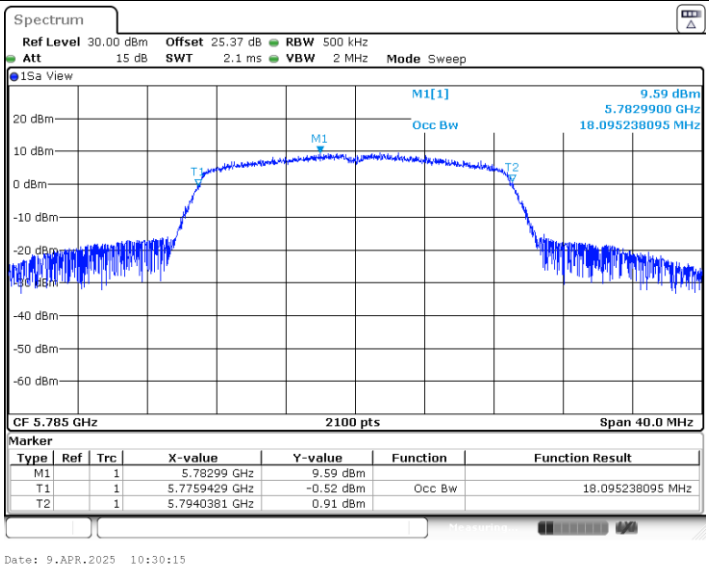
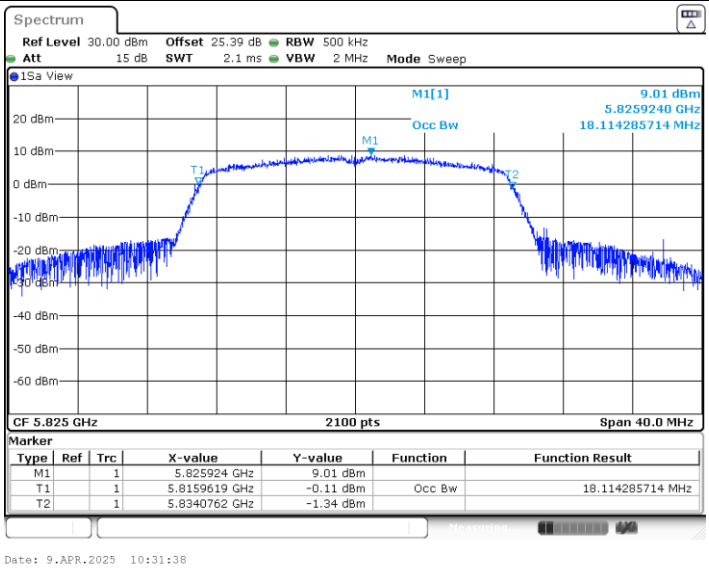


11N20SISO_5825



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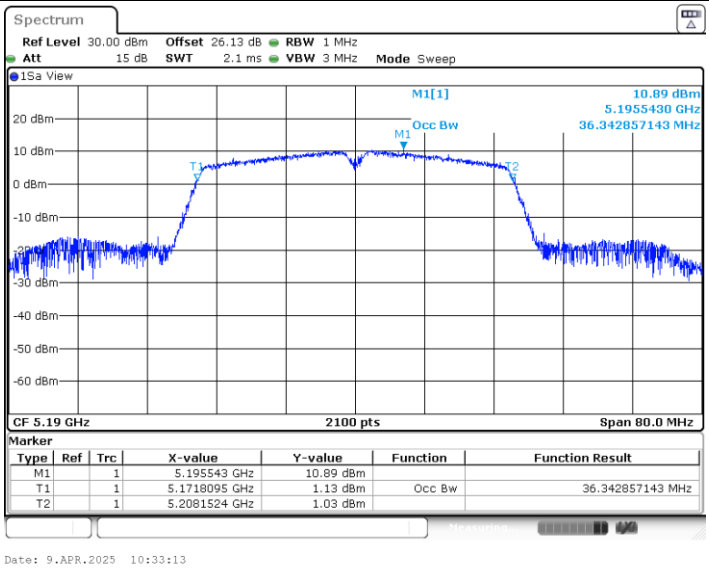

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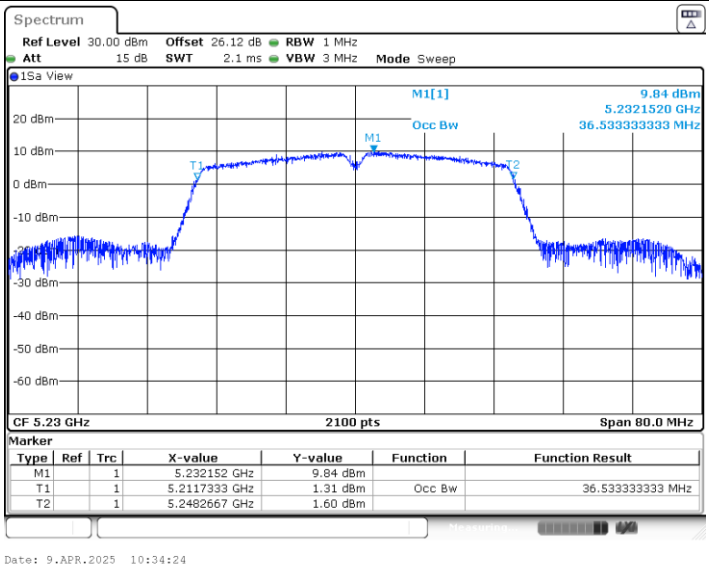

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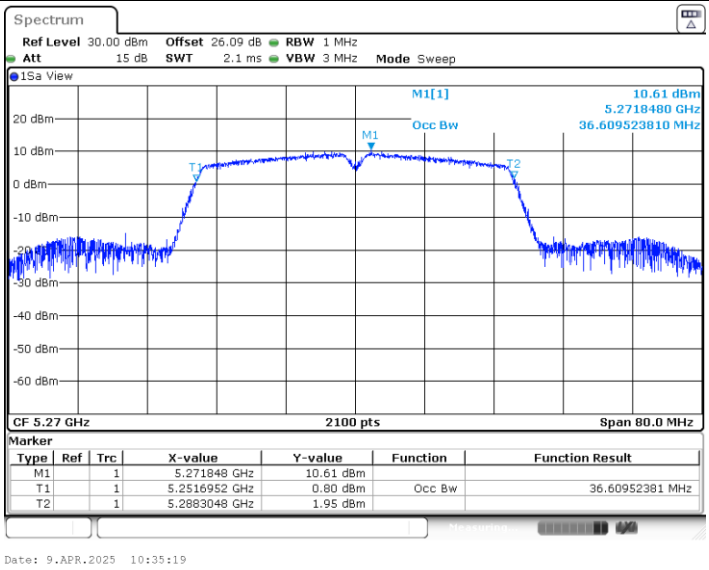

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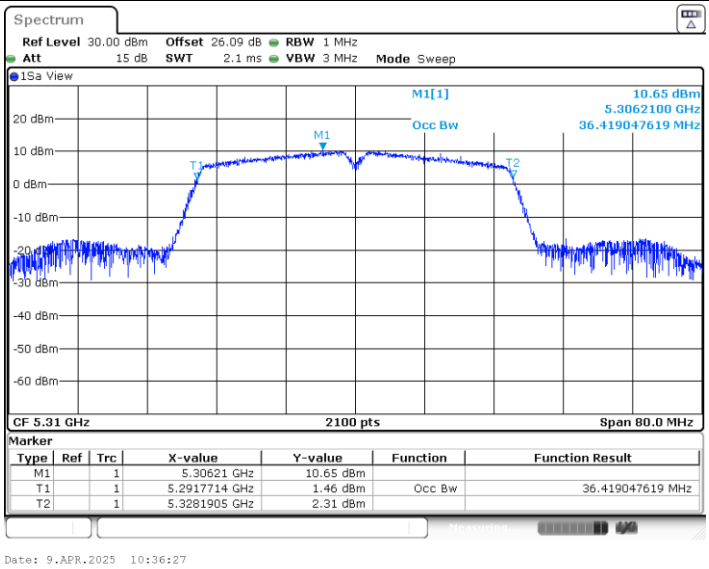

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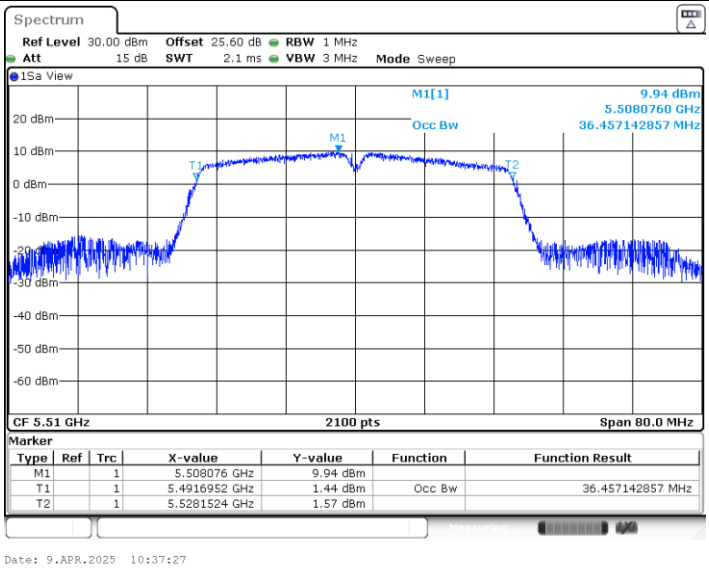

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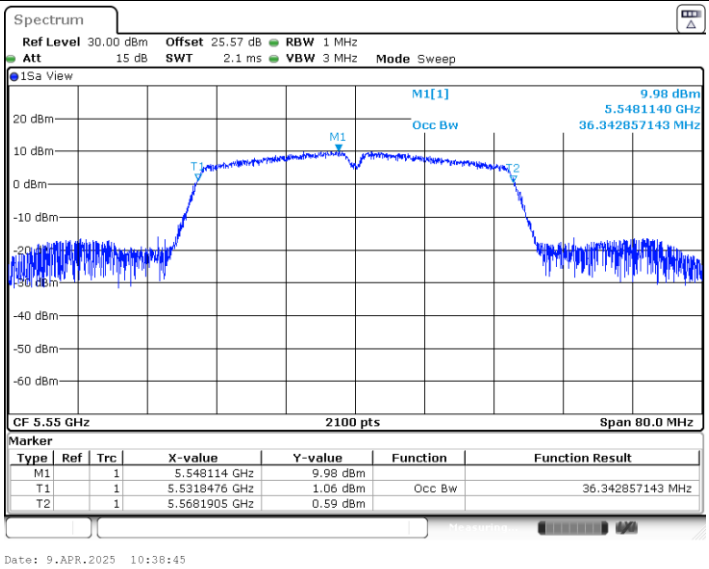

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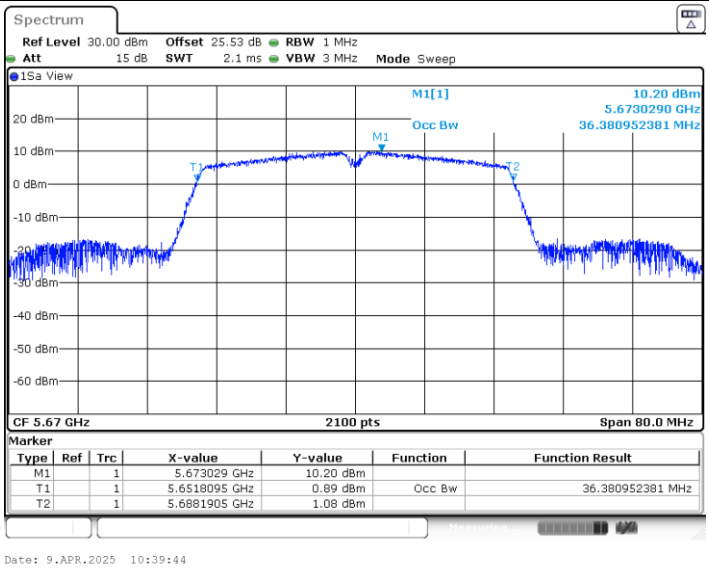

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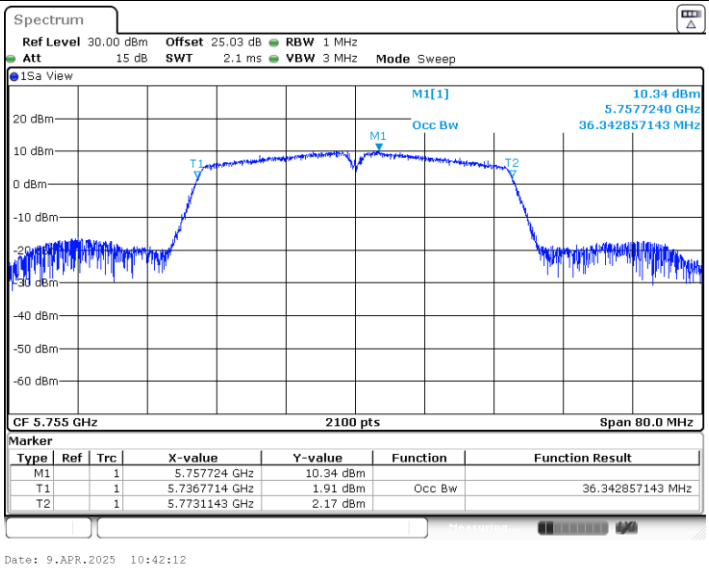

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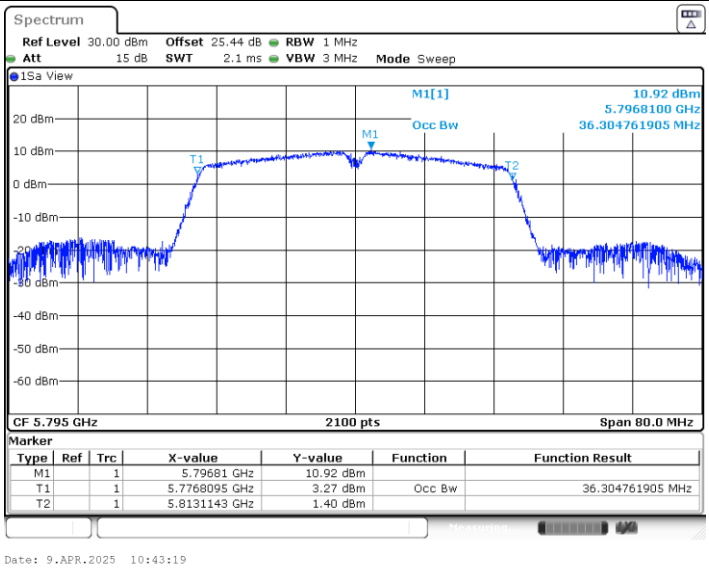
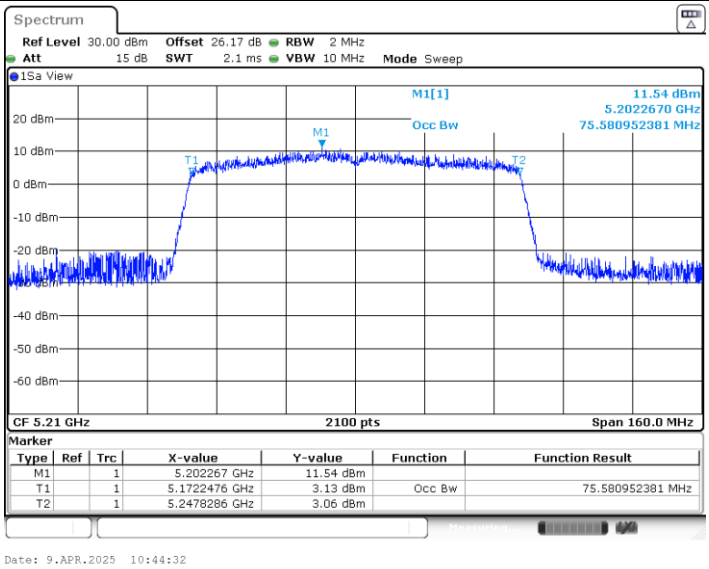


11AC80SISO_5210



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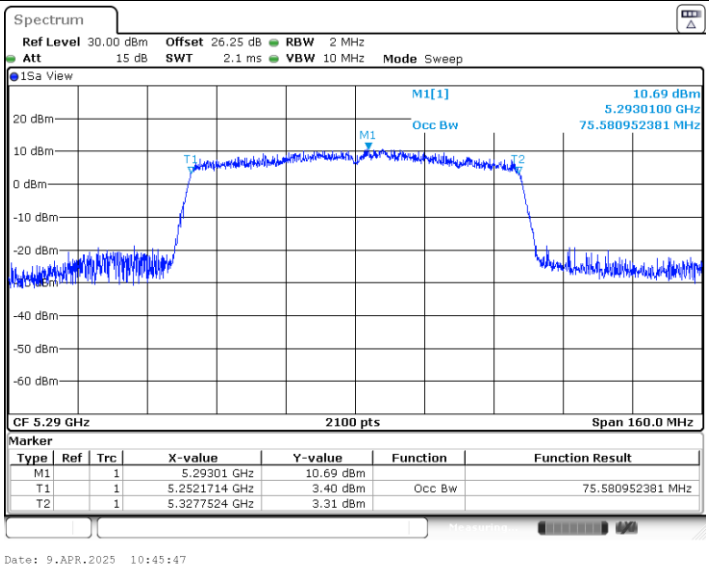
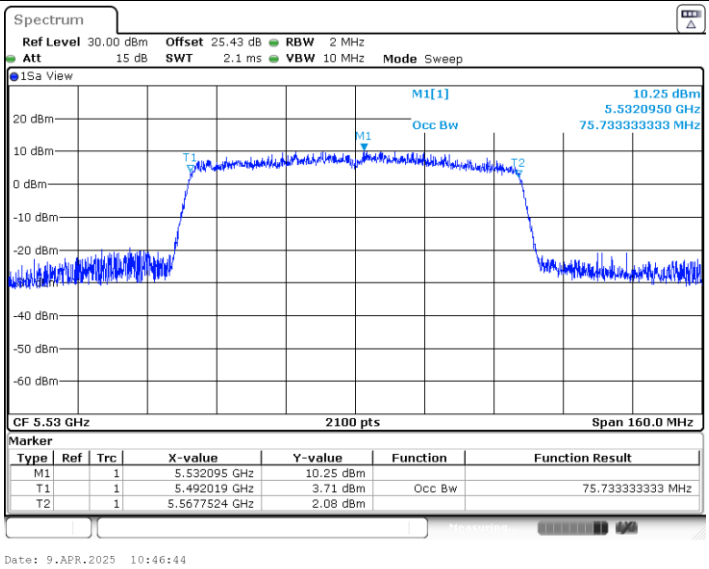


11AC80SISO_5530



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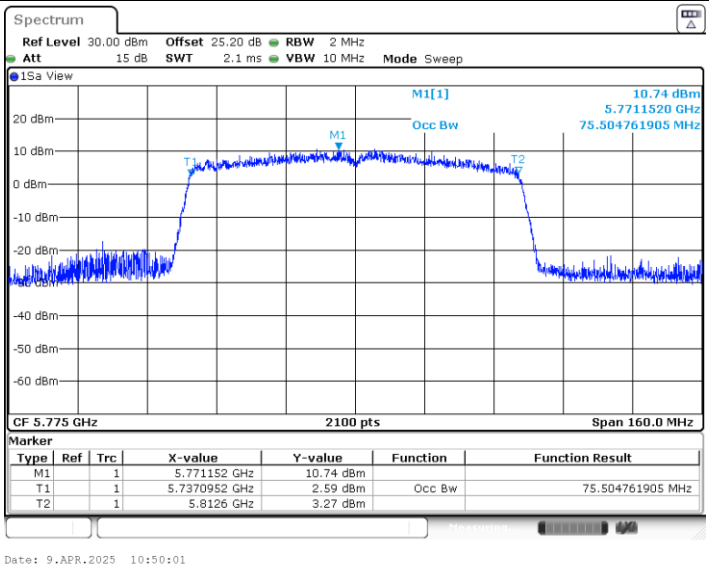


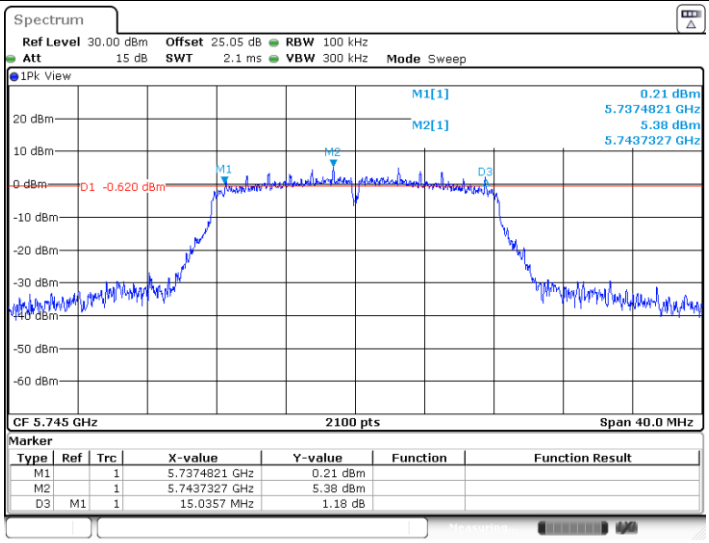
Min emission bandwidth

Test Result

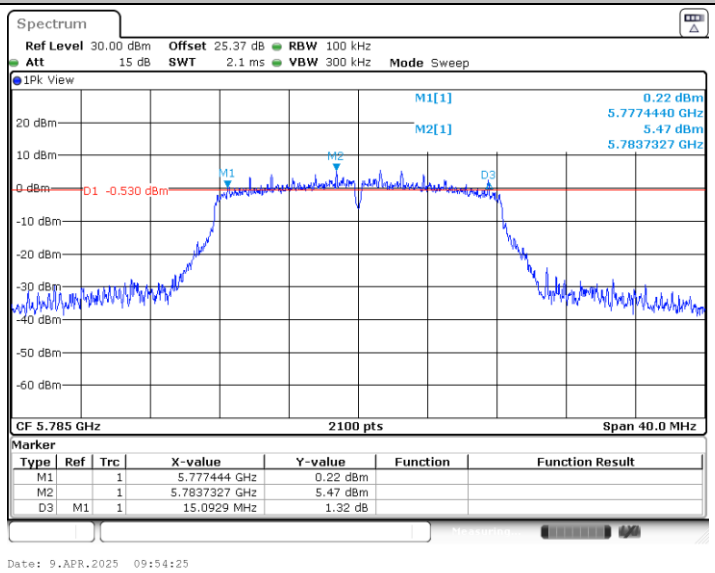
TestMode	Antenna	Freq(MHz)	6dB EBW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11A	Ant1	5745	15.04	5737.48	5752.52	0.5	PASS
		5785	15.09	5777.44	5792.54	0.5	PASS
		5825	15.11	5817.44	5832.56	0.5	PASS
11N20SISO	Ant1	5745	13.78	5737.44	5751.22	0.5	PASS
		5785	15.06	5777.50	5792.56	0.5	PASS
		5825	15.11	5817.44	5832.56	0.5	PASS
11N40SISO	Ant1	5755	35.10	5737.45	5772.55	0.5	PASS
		5795	35.10	5777.45	5812.55	0.5	PASS
11AC80SISO	Ant1	5775	75.08	5737.46	5812.54	0.5	PASS

Test Graphs

11A_5745



11A_5785



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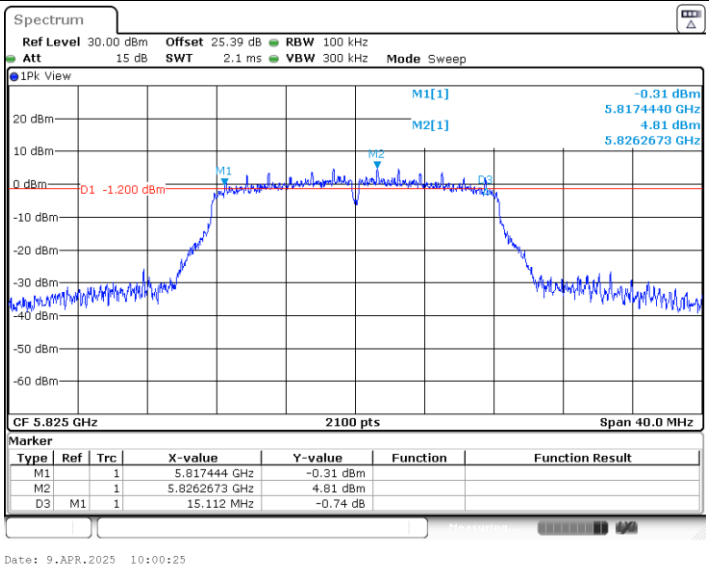
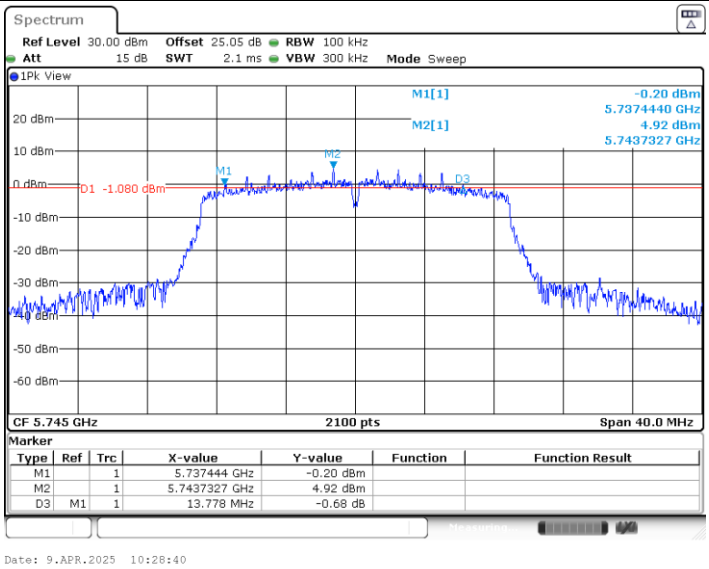
11N20SISO_5745