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FCC/ISED Test Report

Prepared for: Garmin International, Inc.

Address: 1200 E. 151st Street
Olathe, Kansas, 66062, USA

Product: AA4724

Test Report No: R20240506-00-E7 **Rev: B**

Approved by:

Fox Lane,
EMC Test Engineer

DATE: April 25, 2025

Total Pages: 82

ACCREDITED
TESTING LABORATORY
CERTIFICATE NO. 1953.01

REVISION PAGE

Rev. No.	Date	Description
0	14 April 2025	Issued by FLane Prepared by Flane, ESchmidt
A	23 April 2025	Added FVIN – FL
B	25 April 2025	Corrected Plot labeling Updated equipment list – FL

CONTENTS

1.0 SUMMARY OF TEST RESULTS

The worst-case measurements were reported in this report. Summary of test results presented in this report correspond to the following section(s):

(1) US Code of Federal Regulations, Title 47, Part 15
(2) ISED RSS-Gen, Issue 5
(3) ISED RSS-247, Issue 3

APPLIED STANDARDS AND REGULATIONS		
Standard Section	**Test Type**	**Result**
FCC Part 15.35 RSS Gen, Issue 5, Section 6.10	Duty Cycle	Pass
FCC Part 15.247(b)(3) RSS-247 Issue 3 Section 5.4(d)	Peak output power	Pass
FCC Part 15.247(a)(2) RSS-247 Issue 3 Section 5.2 (a)	Bandwidth	Pass
FCC Part 15.209 RSS-Gen Issue 5, Section 7.3	Receiver Radiated Emissions	Pass
FCC Part 15.209 (restricted bands), 15.247 (unrestricted) RSS-247 Issue 3 Section 5.5, RSS-Gen Issue 5, Section 8.9	Transmitter Radiated Emissions	Pass
FCC Part 15.247(e) RSS-247 Issue 3 Section 5.2 (b)	Power Spectral Density	Pass
FCC Part 15.209, 15.247(d) RSS-247 Issue 3 Section 5.5	Band Edge Measurement	Pass
FCC Part 15.207 RSS-Gen Issue 5, Section 8.8	Conducted Emissions	Pass

2.0 EUT DESCRIPTION

2.1 EQUIPMENT UNDER TEST

Summary and Operating Condition:

EUT	AA4724
FCC ID	IPH-A4724
IC ID	1792A-A4724
FVIN	13.17
EUT Received	30 August 2024
EUT Tested	6 March 2025- 26 March 2025
Serial No.	3495066773 (Radiated Measurements) 3495066743 (Conducted Measurements)
Operating Band	2400 – 2483.5 MHz
Device Type	☐ GMSK ☐ GFSK ☐ BT BR ☐ BT EDR 2MB ☐ BT EDR 3MB ☒ 802.11x
Power Supply / Voltage	Internal Battery / 5VDC Charger: Garmin (Phi Hong) Model: PSAI05R-050Q GPN: 362-00072-00 (Representative Power Supply)

NOTE: For more detailed features description, please refer to the manufacturer's specifications or user's manual.

2.2 DESCRIPTION OF TEST MODES

The operating range of the EUT is dependent on the device type found in section 2.1:
Region was set to 00:

Data Rates:

Modulation	Low/High Data rate
802.11b	1MB/11MB
802.11g	6MB/54MB
802.11n	MCS0/MCS7

For 802.11x Transmissions:

Channel	Frequency
Low	2412 MHz
Mid	2437 MHz
High	2472 MHz

These are the only representative channels tested in the frequency range according to FCC Part 15.31 and RSS-Gen Table A1. See the operational description for a list of all channel frequencies and designations.

2.3 DESCRIPTION OF SUPPORT UNITS

None

3.0 LABORATORY AND GENERAL TEST DESCRIPTION

3.1 LABORATORY DESCRIPTION

All testing was performed at the following Facility:

The Nebraska Center for Excellence in Electronics (NCEE Labs)
4740 Discovery Drive
Lincoln, NE 68521

A2LA Certificate Number:	1953.01
FCC Accredited Test Site Designation No:	US1060
Industry Canada Test Site Registration No:	4294A
NCC CAB Identification No:	US0177

Environmental conditions varied slightly throughout the tests:

Relative humidity of 35 ± 4%
Temperature of 22 ± 3° Celsius

3.2 TEST PERSONNEL

No.	PERSONNEL	TITLE	ROLE
1	Fox Lane	Test Engineer	Testing and Report
2	Blake Winter	Test Engineer	Testing
3	Ethan Schmidt	Test Engineer	Testing and Report

Notes: All personnel are permanent staff members of NCEE Labs. No testing or review was sub-contracted or performed by sub-contracted personnel.

3.3 TEST EQUIPMENT

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Keysight MXE Signal Analyzer (44GHz)	N9038A	MY59050109	July 17, 2024	July 18, 2026
Keysight MXE Signal Analyzer (26.5GHz)	N9038A	MY56400083	July 17, 2024	July 18, 2026
Keysight EXA Signal Analyzer	N9010A	MY56070862	July 18, 2023	July 17, 2025
SunAR RF Motion	JB1	A082918-1	July 17, 2024	July 17, 2025
EMCO Horn Antenna	3117	29616	June 12, 2024	June 12, 2025
EMCO Horn Antenna	3116	2576	July 31, 2023	July 30, 2025
Com-Power LISN, Single Phase	LI-220C	20070017	July 17, 2023	July 17, 2025
Agilent Preamp*	87405A	3207A01475	May 2, 2024	May 2, 2026
ETS Red Preamplifier (Orange)*	3115-PA	00218576	January 22, 2024	January 22, 2026
Trilithic High Pass Filter*	6HC330	23042	June 5, 2023	June 5, 2025
Tektronix Average Power Meter	PSM3110	118674	July 17, 2024	July 18, 2026
ETS – Lindgren- VSWR on 10m Chamber	10m Semi-anechoic chamber-VSWR	4740 Discovery Drive	May 15, 2024	May 15, 2027
NCEE Labs-NSA on 10m Chamber*	10m Semi-anechoic chamber-NSA	NCEE-001	May 22, 2024	May 22, 2026
RF Cables (3m Ant. to Control room Bulkhead)	MFR-57500	1E3874	June 5, 2023	June 5, 2025
RF Cable (antenna to 10m chamber bulkhead)*	FSCM 64639	01E3872	June 5, 2023	June 5, 2025
RF Cable (10m chamber bulkhead to control room bulkhead)*	FSCM 64639	01E3874	June 5, 2023	June 5, 2025
RF Cable (control room bulkhead to test receiver)*	FSCM 64639	01F1206	June 5, 2023	June 5, 2025
N connector bulkhead (10m chamber)*	PE9128	NCEEBH1	June 5, 2023	June 5, 2025
N connector bulkhead (control room)*	PE9128	NCEEBH2	June 5, 2023	June 5, 2025
TDK Emissions Lab Software	V11.25	700307	NA	NA

*Internal Characterization

Notes:

All equipment is owned by NCEE Labs and stored permanently at NCEE Labs facilities.

3.4 GENERAL TEST PROCEDURE AND SETUP FOR RADIO MEASUREMNTS

Measurement type presented in this report (Please see the checked box below):

Conducted ☐

The conducted measurements were performed by connecting the output of the transmitter directly into a spectrum analyzer using an impedance matched cable and connector soldered to the EUT in place of the antenna. The information regarding resolution bandwidth, video bandwidth, span and the detector used can be found in the graphs provided in Appendix C. All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

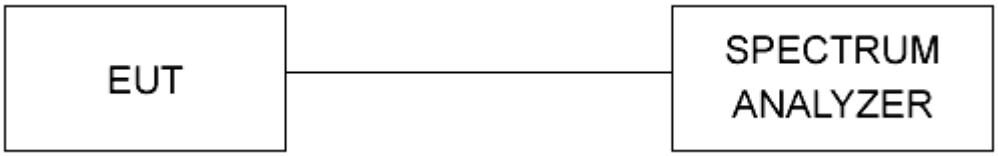


Figure 1 - Bandwidth Measurements Test Setup

Radiated ☒

All the radiated measurements were taken at a distance of 3m from the EUT. The information regarding resolution bandwidth, video bandwidth, span and the detector used can be found in the graphs provided in Appendix C. All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

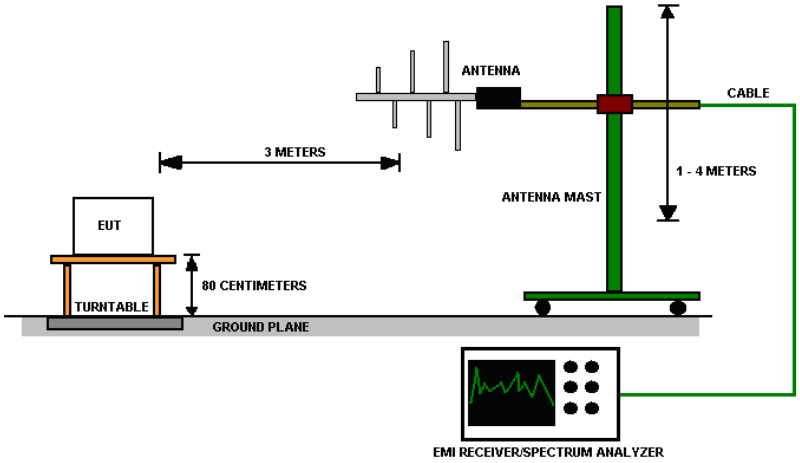


Figure 2 - Radiated Emissions Test Setup

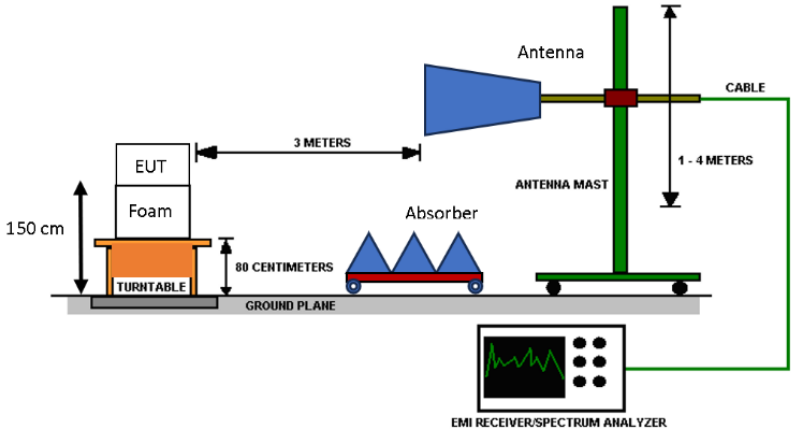


Figure 3 - Radiated Emissions Test Setup, >1GHz

4.0 RESULTS

DTS Radio Measurements, Low Data Rate							
CHANNEL	**Mode**	**Occupied BW (kHz)**	**6 dB BW (kHz)**	**PSD (dBm)**	**AVG OUTPUT POWER (dBm)**	**AVG OUTPUT POWER (mW)**	**RESULT**
Low	Wifi B 1MB	13922.00	11590.00	-17.637	14.393	**27.498**	PASS
Mid	Wifi B 1MB	14320.00	11570.00	-17.671	18.629	**72.929**	PASS
High	Wifi B 1MB	13905.00	12550.00	-18.433	13.001	**19.957**	PASS
Low	Wifi G 6MB	16493.00	16520.00	-15.963	11.096	**12.871**	PASS
Mid	Wifi G 6MB	16547.00	16530.00	-14.349	17.009	**50.223**	PASS
High	Wifi G 6MB	16491.00	16530.00	-17.047	10.103	**10.240**	PASS
Low	Wifi N MCS0	17670.00	17770.00	-16.842	10.823	**12.086**	PASS
Mid	Wifi N MCS0	17718.00	17770.00	-10.087	16.744	**47.250**	PASS
High	Wifi N MCS0	17680.00	17770.00	-17.564	10.431	**11.043**	PASS
Occupied Bandwidth = N/A; 6dB Bandwidth Limit = N/A				Peak Output Power Limit = 30dBm; PSD Limit = 8dBm			

Unrestricted Band-Edge, Low Data Rate							
CHANNEL	**Mode**	**Band edge /Measurement Frequency (MHz)**	**Relative Highest out of band level (dBm)**	**Relative Fundamental (dBm)**	**Delta (dB)**	**Min Delta (dB)**	**Result**
Low	Wifi B 1MB	2400.00	-35.72	0.82	**36.53**	30.00	PASS
Low	Wifi G 6MB	2400.00	-42.07	-5.63	**36.45**	30.00	PASS
Low	Wifi N MCS0	2400.00	-41.75	-5.28	**36.47**	30.00	PASS
High	Wifi B 1MB	2483.50	-53.35	-2.01	**51.35**	30.00	PASS
High	Wifi G 6MB	2483.50	-44.38	-7.00	**37.38**	30.00	PASS
High	Wifi N MCS0	2483.50	-46.90	-5.49	**41.41**	30.00	PASS

Peak Restricted Band-Edge, Low Data Rate							
CHANNEL	**Mode**	**Band edge /Measurement Frequency (MHz)**	**Highest out of band level (dBuV/m @ 3m)**	**Detector**	**Limit (dBuV/m @ 3m)**	**Margin**	**Result**
Low	Wifi B 1MB	2390.00	55.15	Peak	73.98	**18.83**	PASS
Low	Wifi G 6MB	2390.00	55.66	Peak	73.98	**18.32**	PASS
Low	Wifi N MCS0	2390.00	55.22	Peak	73.98	**18.76**	PASS
High	Wifi B 1MB	2483.50	57.41	Peak	73.98	**16.57**	PASS
High	Wifi G 6MB	2483.50	60.29	Peak	73.98	**13.69**	PASS
High	Wifi N MCS0	2483.50	62.80	Peak	73.98	**11.18**	PASS
*Limit shown is the peak limit taken from FCC Part 15.209							
Average Restricted Band-Edge, Low Data Rate							
CHANNEL	**Mode**	**Band edge /Measurement Frequency (MHz)**	**Highest out of band level (dBuV/m @ 3m)**	**Detector**	**Limit (dBuV/m @ 3m)**	**Margin**	**Result**
Low	Wifi B 1MB	2390.00	43.31	Average	53.98	**10.67**	PASS
Low	Wifi G 6MB	2390.00	43.61	Average	53.98	**10.37**	PASS
Low	Wifi N MCS0	2390.00	43.82	Average	53.98	**10.16**	PASS
High	Wifi B 1MB	2483.50	48.15	Average	53.98	**5.83**	PASS
High	Wifi G 6MB	2483.50	44.12	Average	53.98	**9.86**	PASS
High	Wifi N MCS0	2483.50	44.30	Average	53.98	**9.68**	PASS
*Limit shown is the average limit taken from FCC Part 15.209							

DTS Radio Measurements, High Data Rate							
CHANNEL	**Mode**	**Occupied BW (kHz)**	**6 dB BW (kHz)**	**PSD (dBm)**	**AVG OUTPUT POWER (dBm)**	**AVG OUTPUT POWER (mW)**	**RESULT**
Low	Wifi B 11MB	13754.00	11820.00	-18.181	13.888	**24.479**	PASS
Mid	Wifi B 11MB	13889.00	11630.00	-8.095	18.670	**73.621**	PASS
High	Wifi B 11MB	13748.00	11770.00	-14.528	13.068	**20.267**	PASS
Low	Wifi G 54MB	16483.00	16530.00	-16.057	11.249	**13.332**	PASS
Mid	Wifi G 54MB	16554.00	16530.00	-9.187	17.041	**50.594**	PASS
High	Wifi G 54MB	16489.00	16530.00	-17.18	9.965	**9.920**	PASS
Low	Wifi N MCS7	17665.00	17770.00	-17.659	11.283	**13.437**	PASS
Mid	Wifi N MCS7	17716.00	17780.00	-10.384	16.737	**47.174**	PASS
High	Wifi N MCS7	17679.00	17770.00	-17.772	9.981	**9.956**	PASS
Occupied Bandwidth = N/A; 6dB Bandwidth Limit = N/A				Peak Output Power Limit = 30dBm; PSD Limit = 8dBm			

Unrestricted Band-Edge, High Data Rate							
CHANNEL	**Mode**	**Band edge /Measurement Frequency (MHz)**	**Relative Highest out of band level (dBm)**	**Relative Fundamental (dBm)**	**Delta (dB)**	**Min Delta (dB)**	**Result**
Low	Wifi B 11MB	2400.00	-45.23	-4.43	**40.81**	30.00	PASS
Low	Wifi G 54MB	2400.00	-42.69	-4.12	**38.57**	30.00	PASS
Low	Wifi N MCS7	2400.00	-41.63	-4.89	**36.74**	30.00	PASS
High	Wifi B 11MB	2483.50	-50.61	-1.37	**49.24**	30.00	PASS
High	Wifi G 54MB	2483.50	-48.34	-4.51	**43.83**	30.00	PASS
High	Wifi N MCS7	2483.50	-47.81	-6.15	**41.66**	30.00	PASS

Peak Restricted Band-Edge, High Data Rate							
CHANNEL	**Mode**	**Band edge /Measurement Frequency (MHz)**	**Highest out of band level (dBuV/m @ 3m)**	**Detector**	**Limit (dBuV/m @ 3m)**	**Margin**	**Result**
Low	Wifi B 11MB	2390.00	54.43	Peak	73.98	**19.55**	PASS
Low	Wifi G 54MB	2390.00	55.14	Peak	73.98	**18.84**	PASS
Low	Wifi N MCS7	2390.00	55.19	Peak	73.98	**18.79**	PASS
High	Wifi B 11MB	2483.50	57.91	Peak	73.98	**16.07**	PASS
High	Wifi G 54MB	2483.50	60.29	Peak	73.98	**13.69**	PASS
High	Wifi N MCS7	2483.50	63.39	Peak	73.98	**10.59**	PASS
*Limit shown is the peak limit taken from FCC Part 15.209							

Average Restricted Band-Edge, High Data Rate							
CHANNEL	**Mode**	**Band edge /Measurement Frequency (MHz)**	**Highest out of band level (dBuV/m @ 3m)**	**Detector**	**Limit (dBuV/m @ 3m)**	**Margin**	**Result**
Low	Wifi B 11MB	2390.00	43.28	Average	53.98	**10.70**	PASS
Low	Wifi G 54MB	2390.00	43.68	Average	53.98	**10.30**	PASS
Low	Wifi N MCS7	2390.00	43.70	Average	53.98	**10.28**	PASS
High	Wifi B 11MB	2483.50	47.46	Average	53.98	**6.52**	PASS
High	Wifi G 54MB	2483.50	44.23	Average	53.98	**9.75**	PASS
High	Wifi N MCS7	2483.50	44.29	Average	53.98	**9.69**	PASS
*Limit shown is the average limit taken from FCC Part 15.209							

4.1 OUTPUT POWER

Test Method:
Power measurements were performed using ANSI C63.10, Section 11.9.2.3.1.

Limits of power measurements:
For FCC Part 15.247 Device:
The maximum allowed output power is 30 dBm.

Test procedures:
Details can be found in section 3.4 of this report.

Deviations from test standard:
No deviation.

Test setup:
Details can be found in section 3.4 of this report.

EUT operating conditions:
Details can be found in section 2.1 of this report.

Test results:

Pass

Comments:

1. All the measurements were found to be compliant.
2. Tabulated data is listed in section 4.0.

4.2 BANDWIDTH

Test Method:
All the radio measurements were performed using ANSI C63.10 Sec. 11.8.1 for 6dB BW.

Limits of bandwidth measurements:
For FCC Part 15.247 Device:
The 99% occupied bandwidth is for informational/documentation purposes only. The 6dB bandwidth of the signal must be greater than 500 kHz.

Test procedures:
Details can be found in section 3.4 of this report.

Deviations from test standard:
No deviation.

Test setup:
Test setup details can be found in section 3.4 of this report.

EUT operating conditions:
Details can be found in section 2.1 of this report.

Test results:

Pass

Comments:

1. All the bandwidth plots can be found in Appendix C.
2. All the measurements were found to be compliant.
3. Tabulated data is listed in section 4.0.

4.3 DUTY CYCLE

Modulations in this report have a duty cycle of >98%. No DCCF used.

4.4 RADIATED EMISSIONS

Test Method:
ANSI C63.10-2020, Section 6.5, 6.6

Limits for radiated emissions measurements:
Emissions radiated outside of the specified bands shall be applied to the limits in 15.209 as followed:

FREQUENCIES (MHz)	FIELD STRENGTH (μV/m)	MEASUREMENT DISTANCE (m)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	3
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

NOTE:
1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 * log * Emission level (μV/m).
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits by more than 20dB under any condition of modulation.

Test procedures:

a. The EUT was placed on the top of a rotating table above the ground plane in a 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. The table was 0.8m high for measurements from 30MHz-1Ghz and 1.5m for measurements from 1GHz and higher.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The antenna was a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are used to make the measurement.

d. For each suspected emission, the EUT was arranged to maximize its emissions and then the antenna height was varied from 1 meter to 4 meters and the rotating table was turned from 0 degrees to 360 degrees to find the maximum emission reading.

e. The test-receiver system was set to use a peak detector with a specified resolution bandwidth. For spectrum analyzer measurements, the composite maximum of several analyzer sweeps was used for final measurements.

f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

g. The EUT was maximized in all 3 orthogonal positions. The results are presented for the axis that had the highest emissions.

Test setup:

NOTE:
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequencies below 1GHz.

2. The resolution bandwidth 1 MHz for all measurements and at frequencies above 1GHz, A peak detector was used for all measurements above 1GHz. Measurements were made with an EMI Receiver.

Deviations from test standard:
No deviation.

EUT operating conditions
Details can be found in section 2.1 of this report.

Test results:

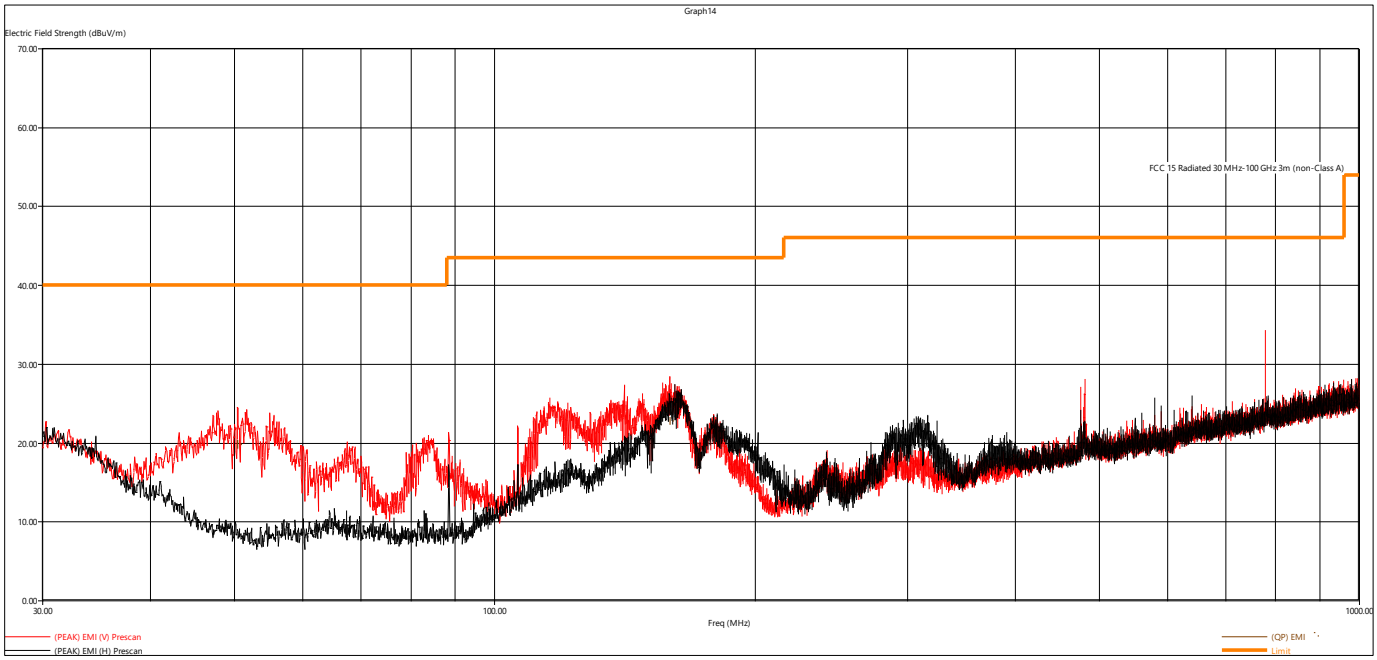


Figure 4 - Radiated Emissions Plot, Receive

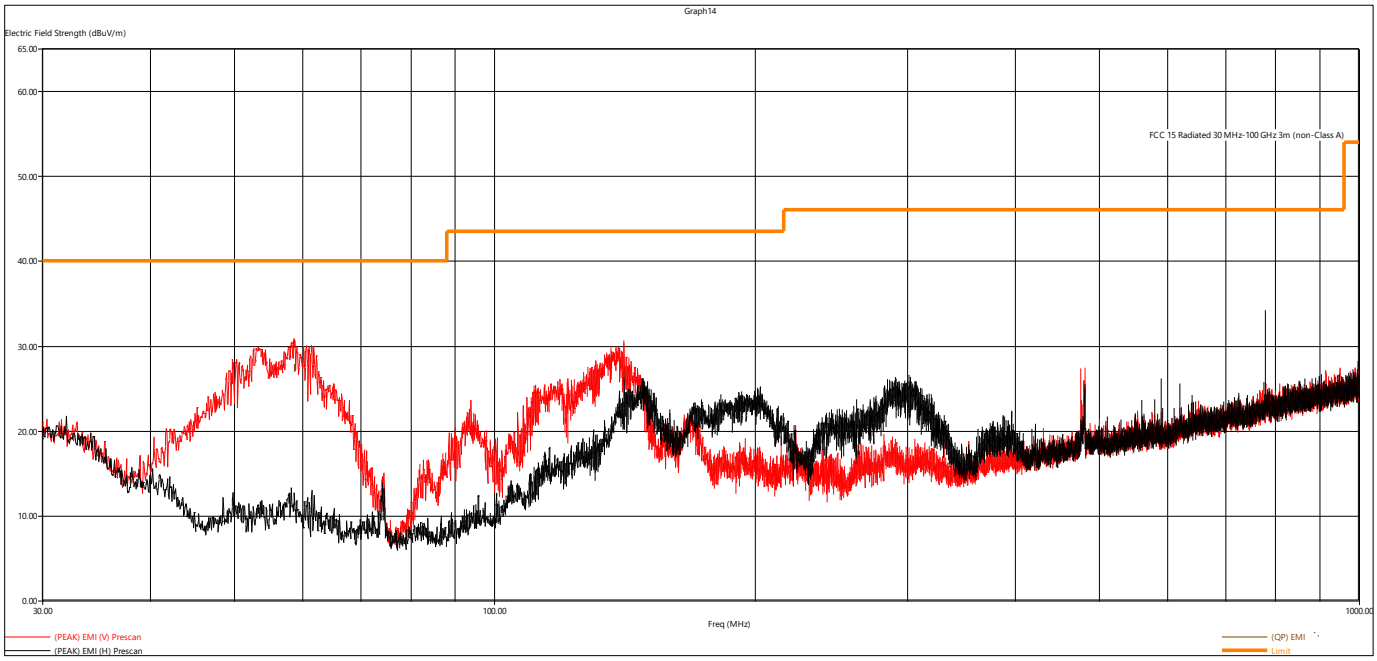


Figure 5 - Radiated Emissions Plot, 802.11b 1MB

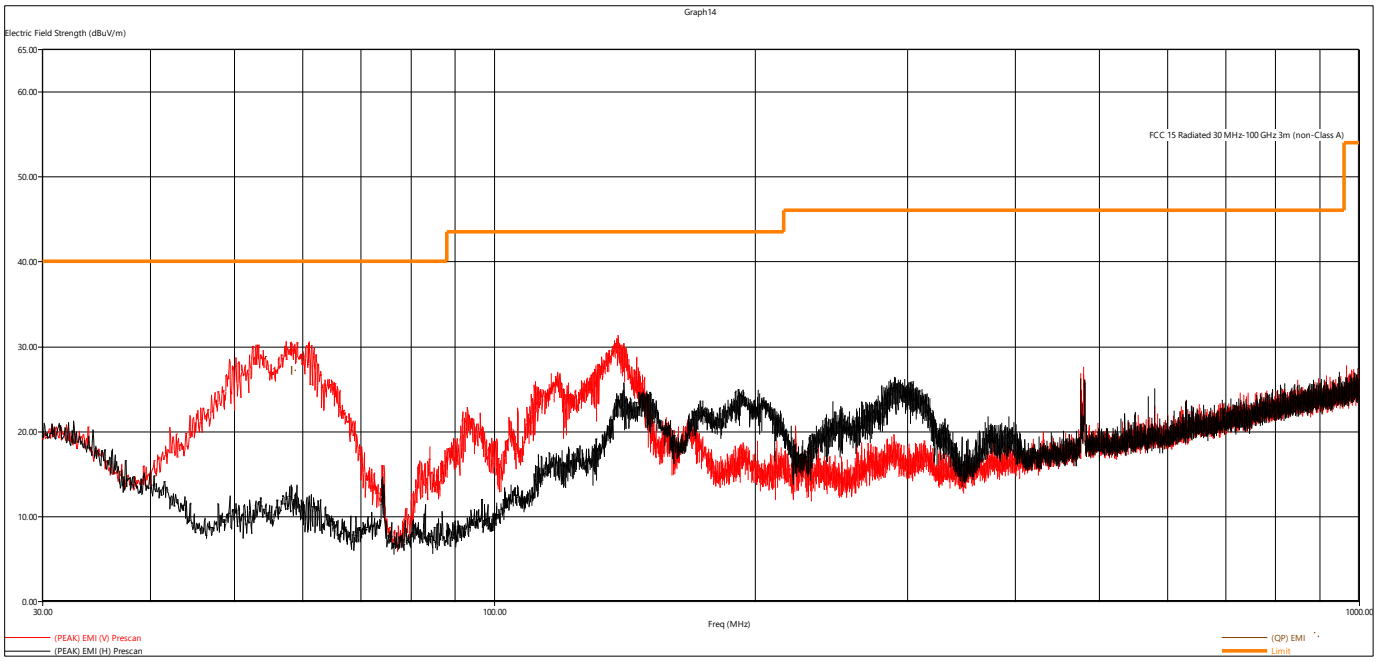


Figure 6 - Radiated Emissions Plot, 802.11b 11MB

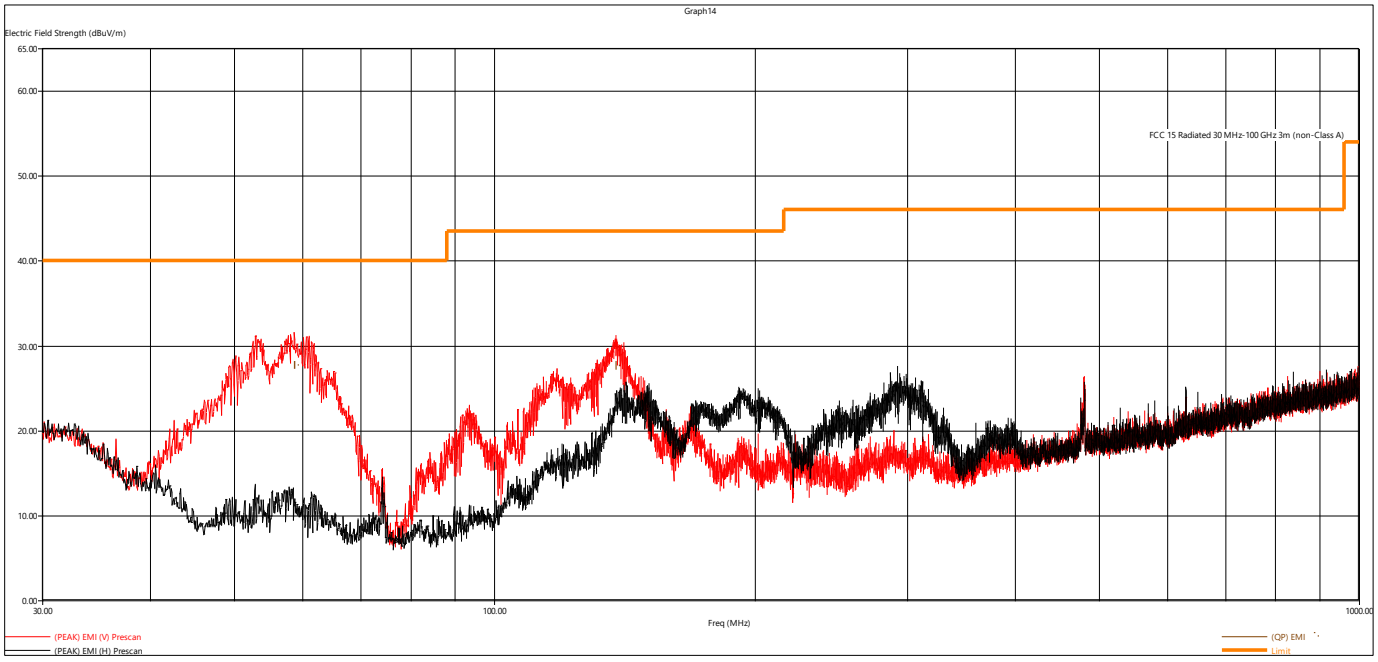


Figure 7 - Radiated Emissions Plot, 802.11g 6MB

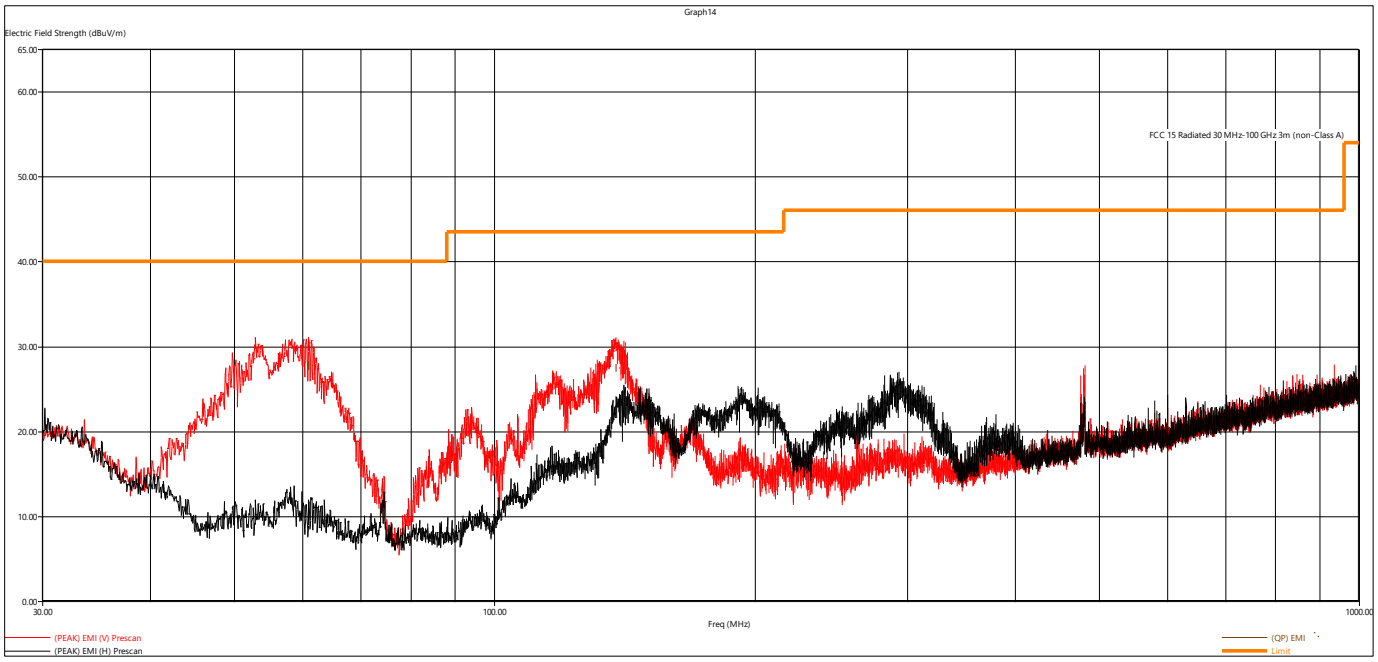


Figure 8 - Radiated Emissions Plot, 802.11g 54MB

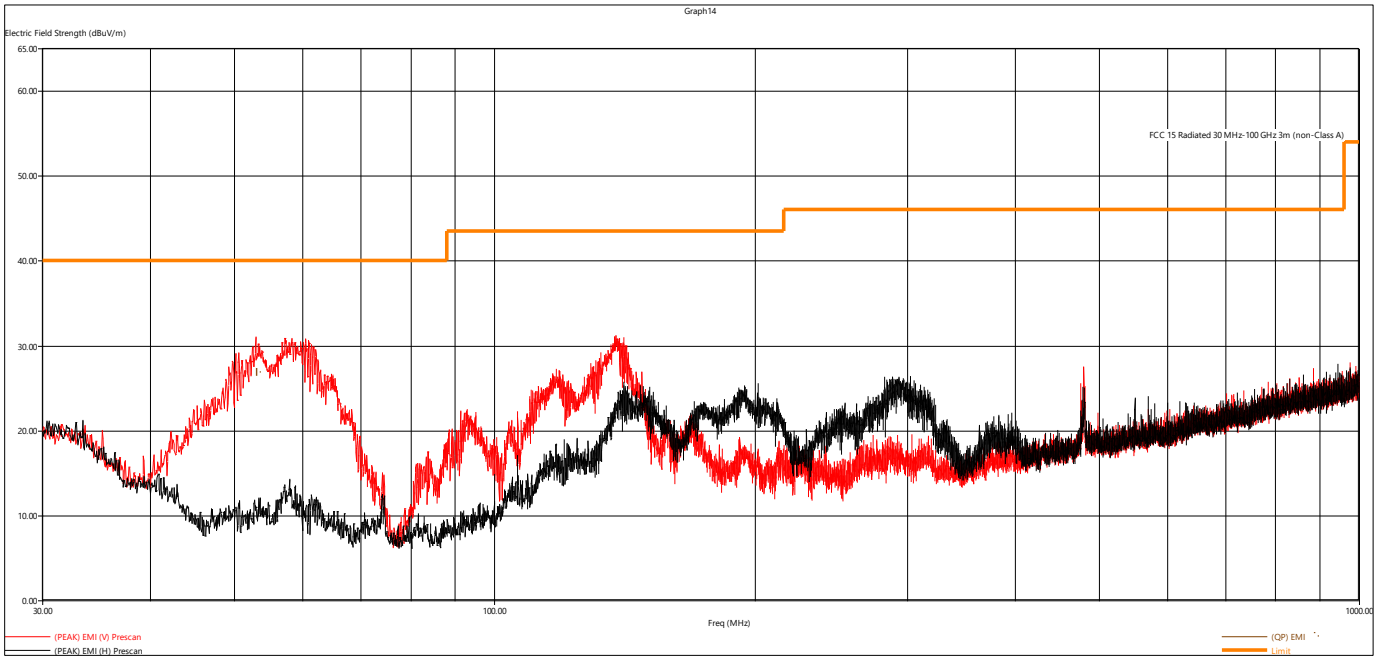


Figure 9 - Radiated Emissions Plot, 802.11n MCS0

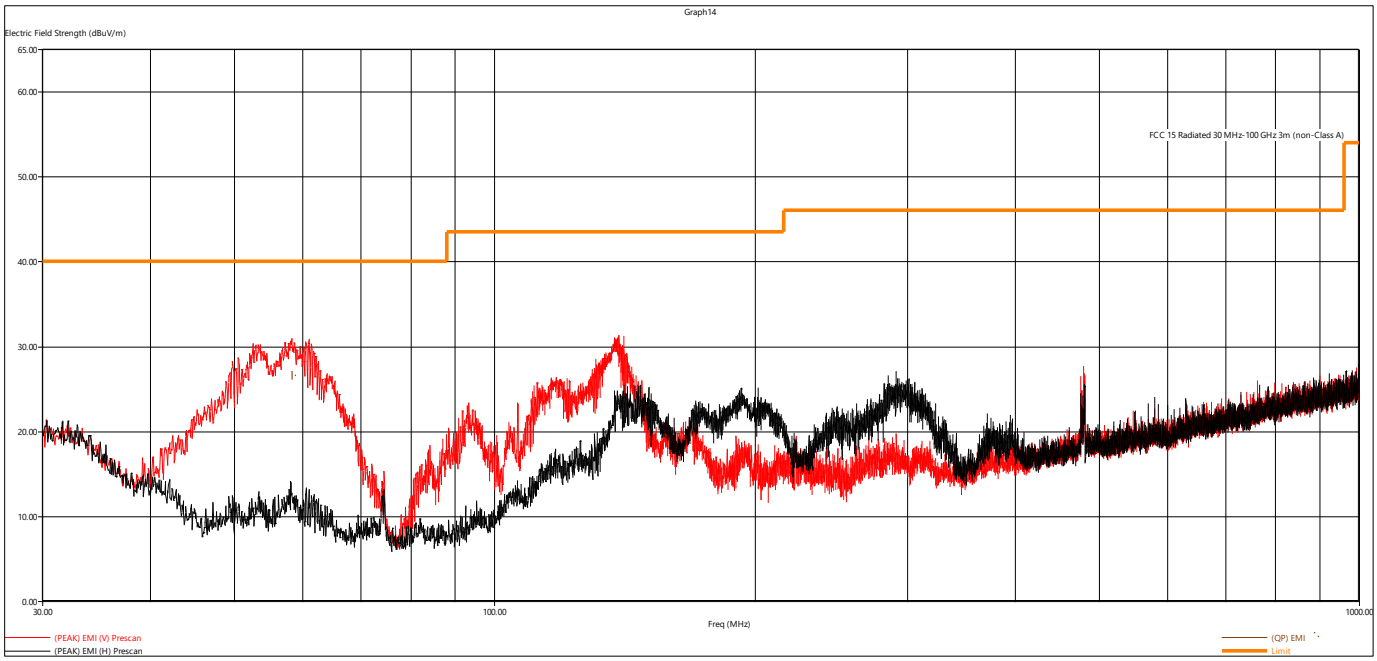


Figure 10 - Radiated Emissions Plot, 802.11n MCS7

REMARKS:
1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Limit value - Emission level

Frequency	Level	Limit	Margin	Height	Angle	Pol	Modulation
MHz	dBµV/m	dBµV/m	dB	cm.	deg.		
58.562160	27.38	40.00	12.62	106.32	59.25	V	802.11b 1MB
141.127440	26.44	43.52	17.08	103.58	228.00	V	802.11b 1MB
58.172400	27.09	40.00	12.91	106.44	167.50	V	802.11b 11MB
58.612560	27.65	40.00	12.35	104.00	148.00	V	802.11g 6MB
138.064560	27.59	43.52	15.93	104.59	286.00	V	802.11g 6MB
60.938160	27.64	40.00	12.36	118.74	209.75	V	802.11g 54MB
138.105840	27.40	43.52	16.12	112.89	299.25	V	802.11g 54MB
52.810560	26.86	40.00	13.14	108.11	306.00	V	802.11n MCS0
58.147200	26.52	40.00	13.48	103.64	197.00	V	802.11n MCS7
50.433600	19.71	40.00	20.29	109.01	207.50	V	RX
159.132480	22.73	43.52	20.79	121.85	277.50	V	RX

The EUT was maximized in all 3 orthogonal axes. The worst-case is shown in the plot and table above.

Peak Radiated Emissions								
Freq (Max)	(PEAK) EMI	Limit	(PEAK) Margin	Twr Ht	Ttbl Ang	Pol	Channel	Modulation
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	(cm)	(deg)			
7306.410000	49.39	73.98	24.59	199.94	193.75	V	6	Wifi B 1MB
7303.864000	49.67	73.98	24.31	186.32	173.75	V	6	Wifi G 6MB
7308.076000	48.48	73.98	25.50	129.91	193.25	V	6	Wifi G 54MB

All other measurements up to 25GHz were investigated and found to be at least 10dB below the applicable limit line

Average Radiated Emissions								
Freq (Max)	(CISPR AVG) EMI	Limit	(CISPR AVG) Margin	Twr Ht	Ttbl Ang	Pol	Channel	Modulation
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	(cm)	(deg)			
7306.410000	38.92	53.98	15.06	199.94	193.75	V	6	Wifi B 1MB
7303.864000	35.07	53.98	18.91	186.32	173.75	V	6	Wifi G 6MB
7308.076000	34.42	53.98	19.56	129.91	193.25	V	6	Wifi G 54MB

All other measurements up to 25GHz were investigated and found to be at least 10dB below the applicable limit line

4.5 CONDUCTED SPURIOUS EMISSIONS

Test Method: ANSI C63.10-2020, Section 6.7

Limits of spurious emissions:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

Test procedures:
The highest emissions level was measured and recorded. All spurious measurements were evaluated to 30dB below the fundamental. More details can be found in section 3.4 of this report.

Deviations from test standard:
None.

Test setup:
Test setup details can be found in section 3.4 of this report.

EUT operating conditions:
Details can be found in section 2.1 of this report.

Test results:
Note that the limit shown on the plots does not apply. It is a line for reference.

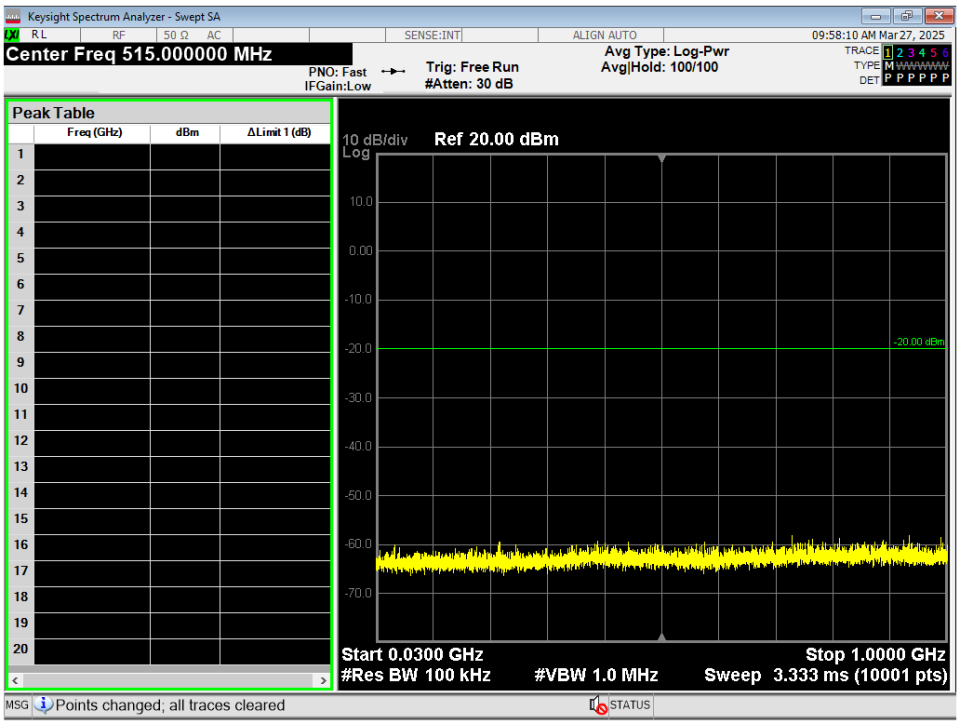


Figure 11 - Conducted Emissions Plot, WIFI 802.11b, 30M – 1G, Mid

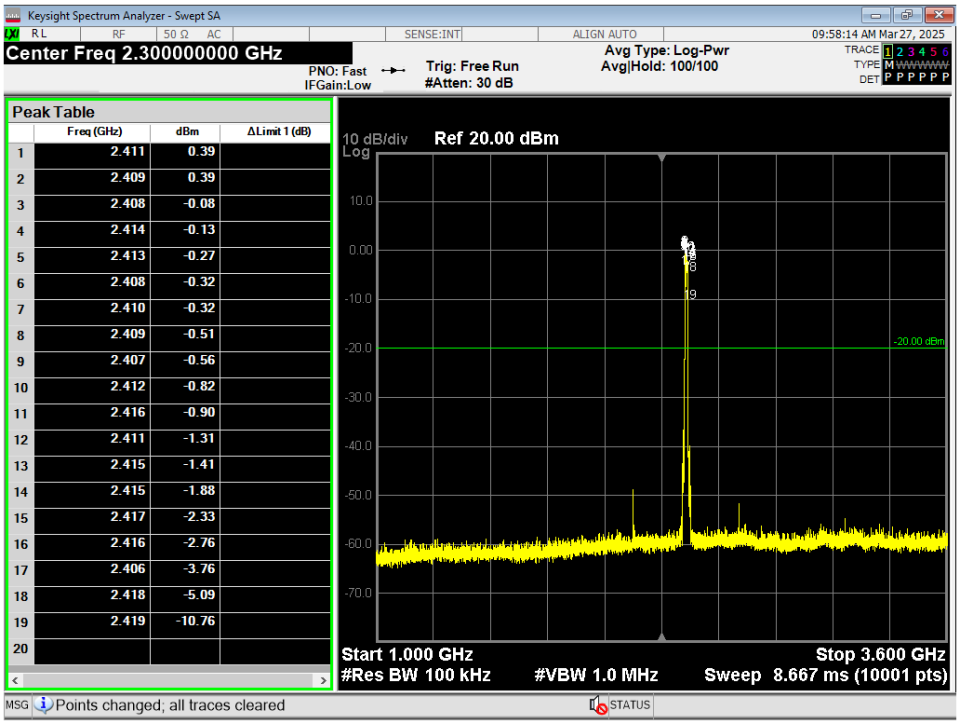


Figure 12 - Conducted Emissions Plot, WIFI 802.11b, 1G – 3.6G, Mid

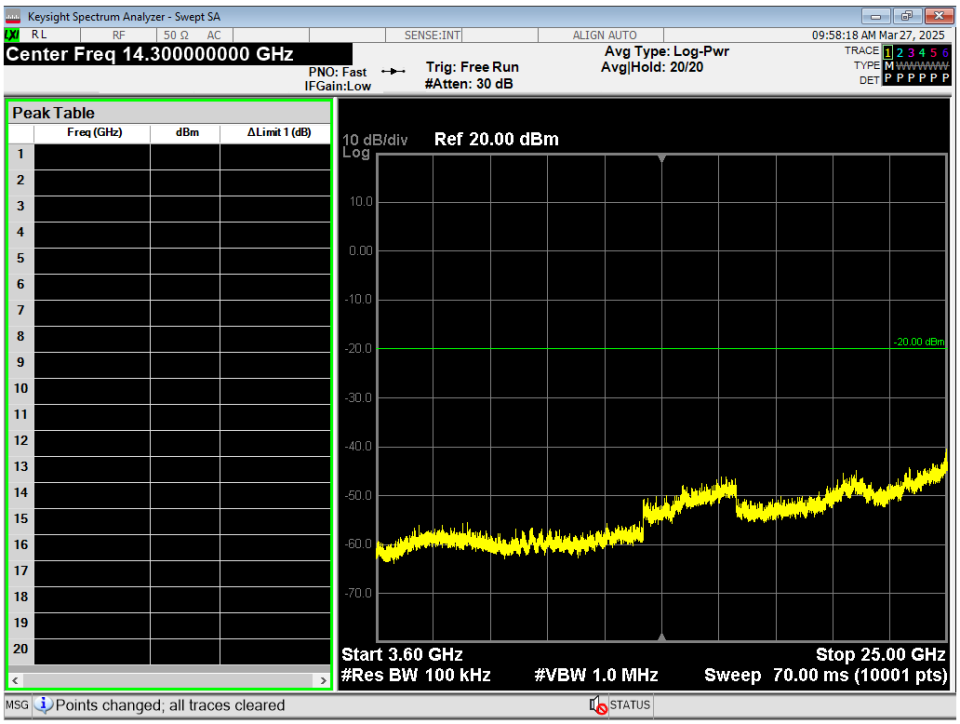


Figure 13 - Conducted Emissions Plot, WIFI 802.11b, 3.6G – 25G, Mid

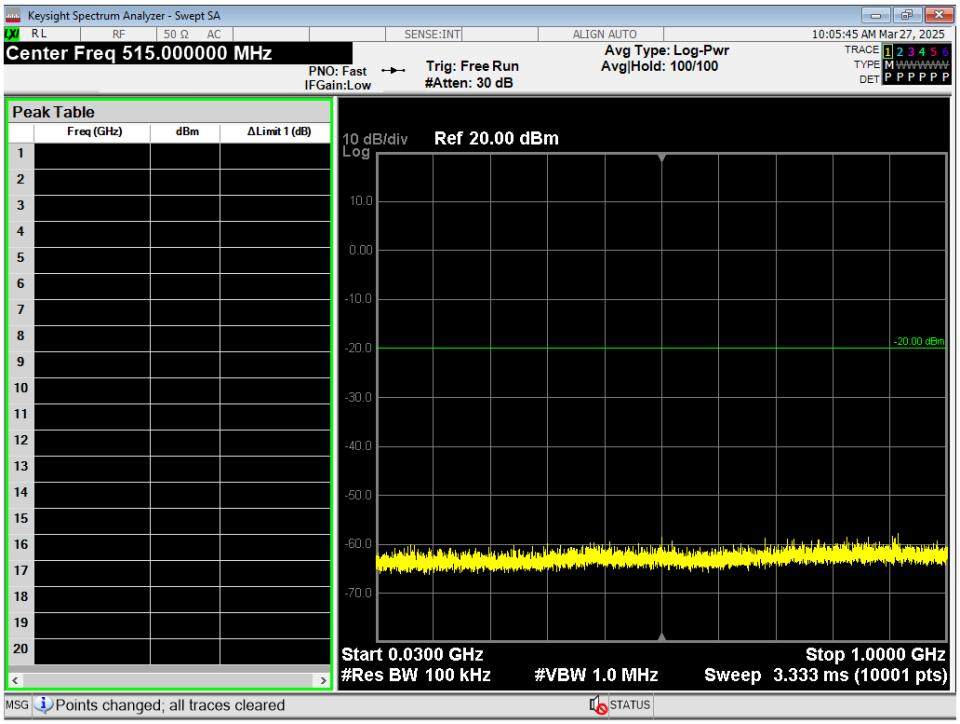


Figure 14 - Conducted Emissions Plot, WIFI 802.11g, 30M – 1G, Mid

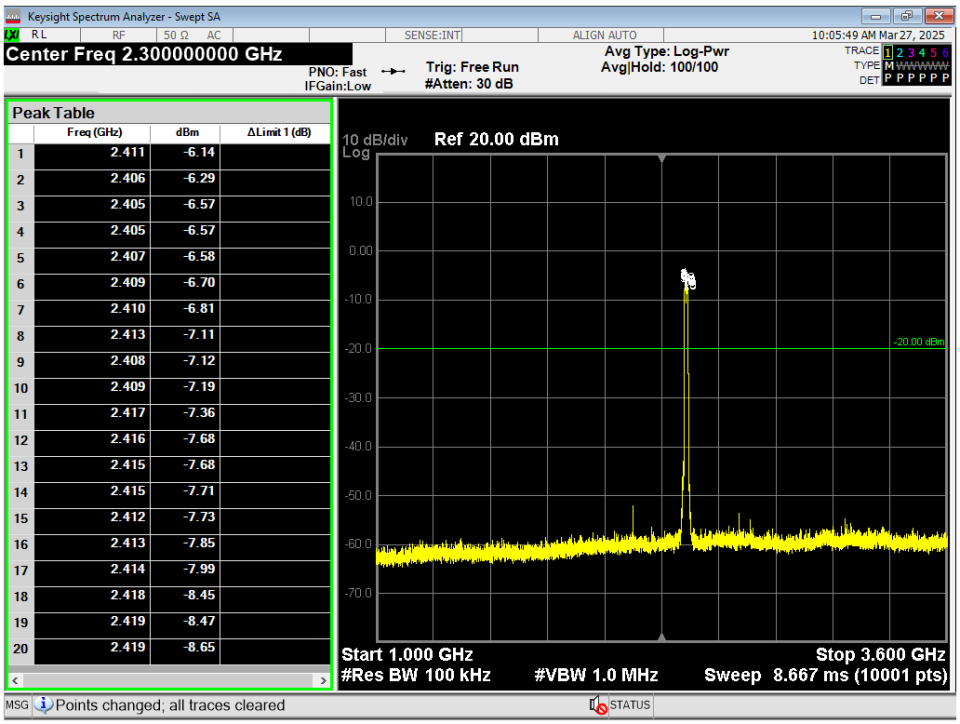


Figure 15 - Conducted Emissions Plot, WIFI 802.11g, 1G – 3.6G, Mid

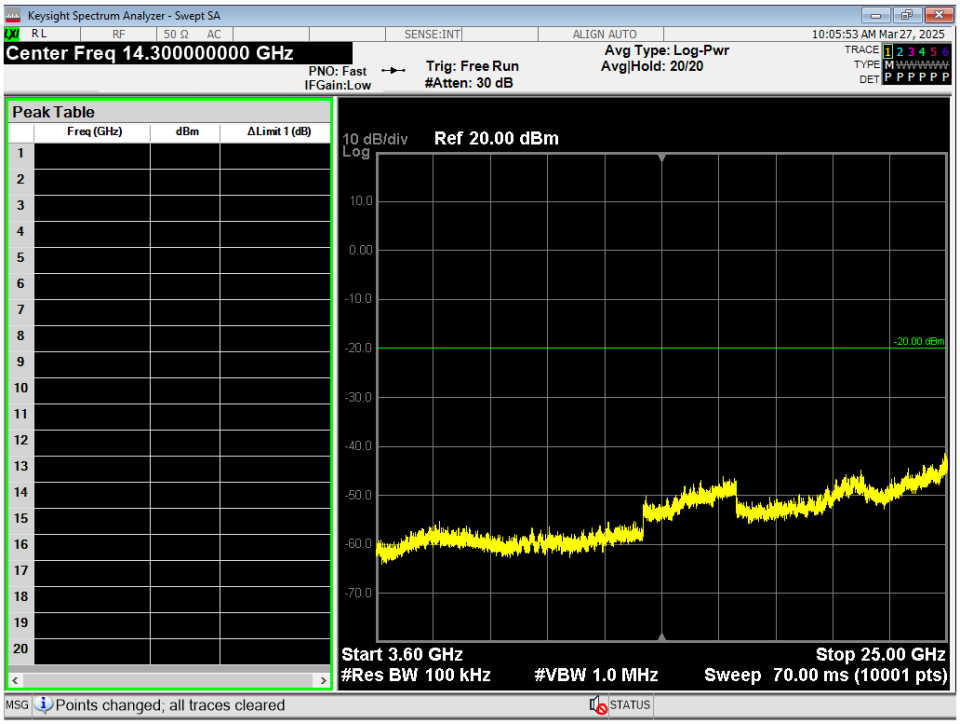


Figure 16 - Conducted Emissions Plot, WIFI 802.11g, 3.6G – 25G, Mid

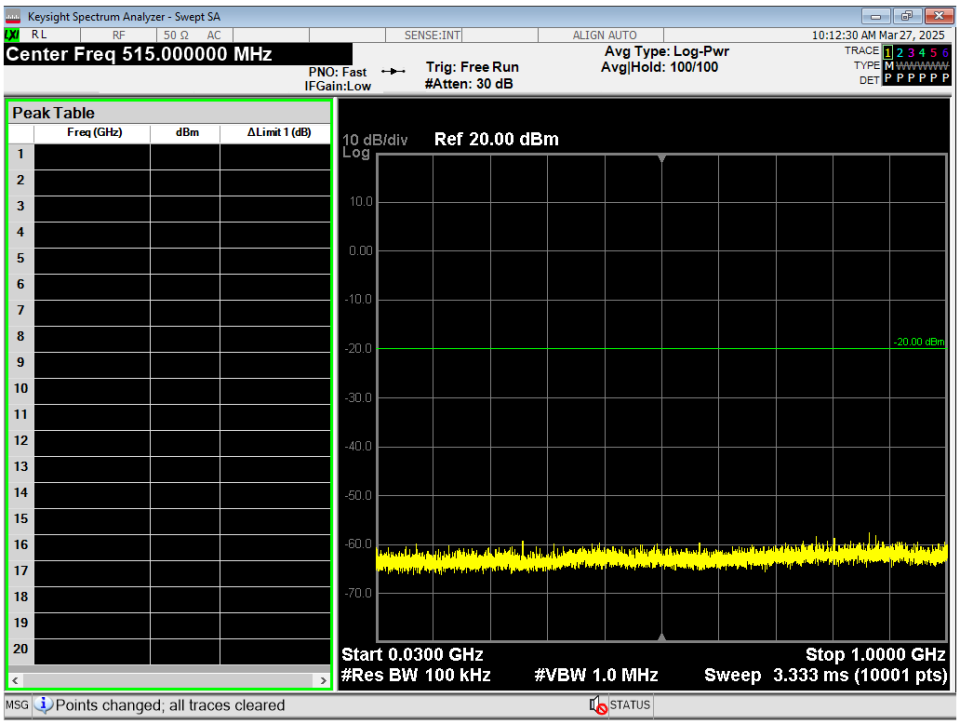


Figure 17 - Conducted Emissions Plot, WIFI 802.11n, 30M – 1G, Mid

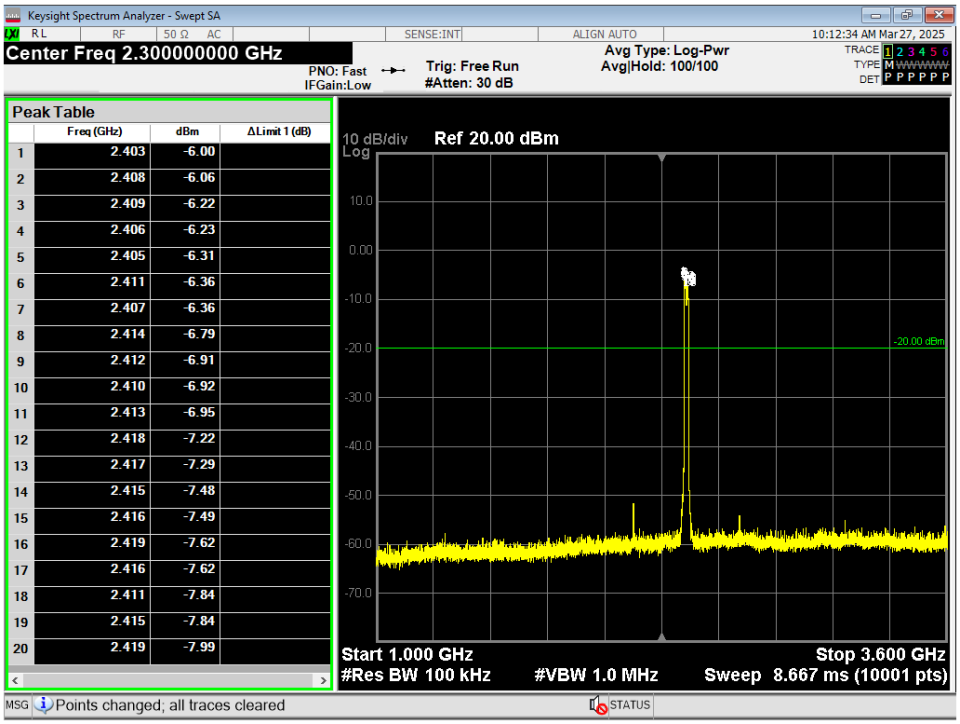


Figure 18 - Conducted Emissions Plot, WIFI 802.11n, 1G – 3.6G, Mid

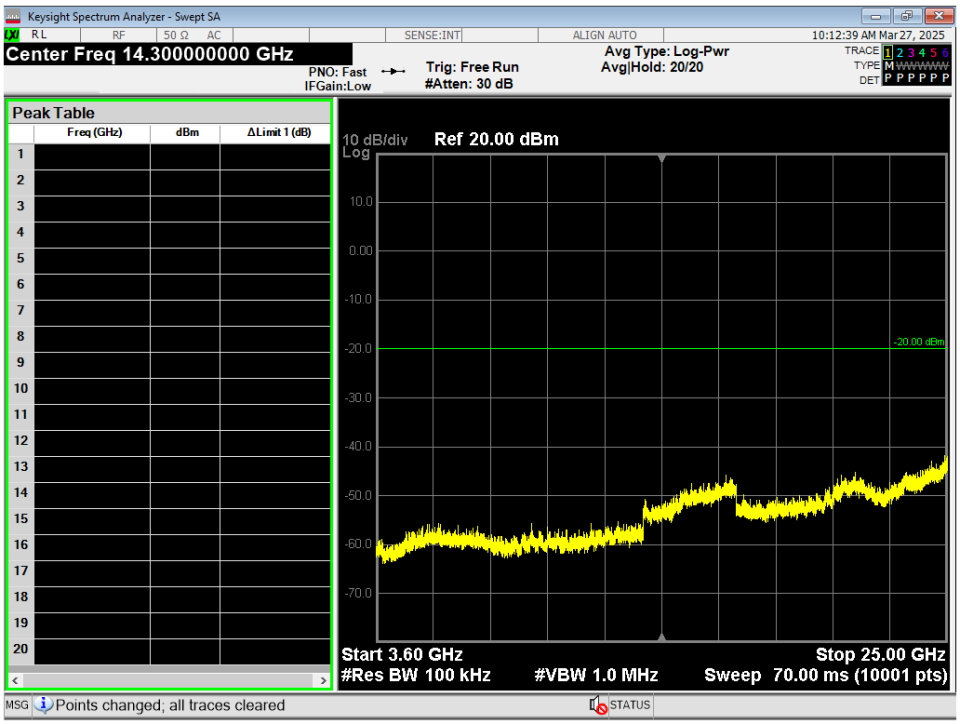


Figure 19 - Conducted Emissions Plot, WIFI 802.11n, 3.6G – 25G, Mid

4.6 BAND EDGES

Test Method: All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

Limits of band-edge measurements:
For FCC Part 15.247 Device:
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c))

Test procedures:
The highest emissions level beyond the band-edge was measured and recorded. All band edge measurements were evaluated to the general limits in Part 15.209. More details can be found in section 3.4 of this report.

Deviations from test standard:
No deviation.

Test setup:
Test setup details can be found in section 3.4 of this report.

EUT operating conditions:
Details can be found in section 2.1 of this report.

Test results:

Pass

Comments:

1. All the band edge plots can be found in Appendix C.
2. If the device falls under FCC Part 15.247 (Details can be found in summary of test results), compliance is shown in the unrestricted band edges by showing minimum delta of 20 dB between peak and the band edge.
3. The restricted band edge compliance is shown by comparing it to the general limit defined in Part 15.209.
4. Tabulated data is listed in section 4.0.

4.7 POWER SPECTRAL DENSITY

Test Method: All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

Limits of power measurements:

For FCC Part 15.247 Device:
The maximum PSD allowed is 8 dBm.

Test procedures:
Details can be found in section 3.4 of this report.

Deviations from test standard:
No deviation.

Test setup:
Details can be found in section 3.4 of this report.

EUT operating conditions:
Details can be found in section 2.1 of this report.

Test results:

Pass

Comments:

1. All the Power Spectral Density (PSD) plots can be found in Appendix C.
2. All the measurements were found to be compliant.
3. Tabulated data is listed in section 4.0.

4.8 CONDUCTED AC MAINS EMISSIONS

Test Method: ANSI C63.10-2020, Section(s) 6.2

Limits for conducted emissions measurements:

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

Notes:

1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz
3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

Test Procedures:

a. The EUT was placed 0.8m above a ground reference plane and 0.4 meters from the conducting wall of a shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). The LISN provides 50 ohm/ 50uH of coupling impedance for the measuring instrument.
b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference as well as the ground.
c. The frequency range from 150 kHz to 30 MHz was searched. Emission levels over 10dB under the prescribed limits are not reported.
d. Results were compared to the 15.207 limits.

Deviation from the test standard:

No deviation

EUT operating conditions:

Details can be found in section 2.1 of this report.

Test Results:

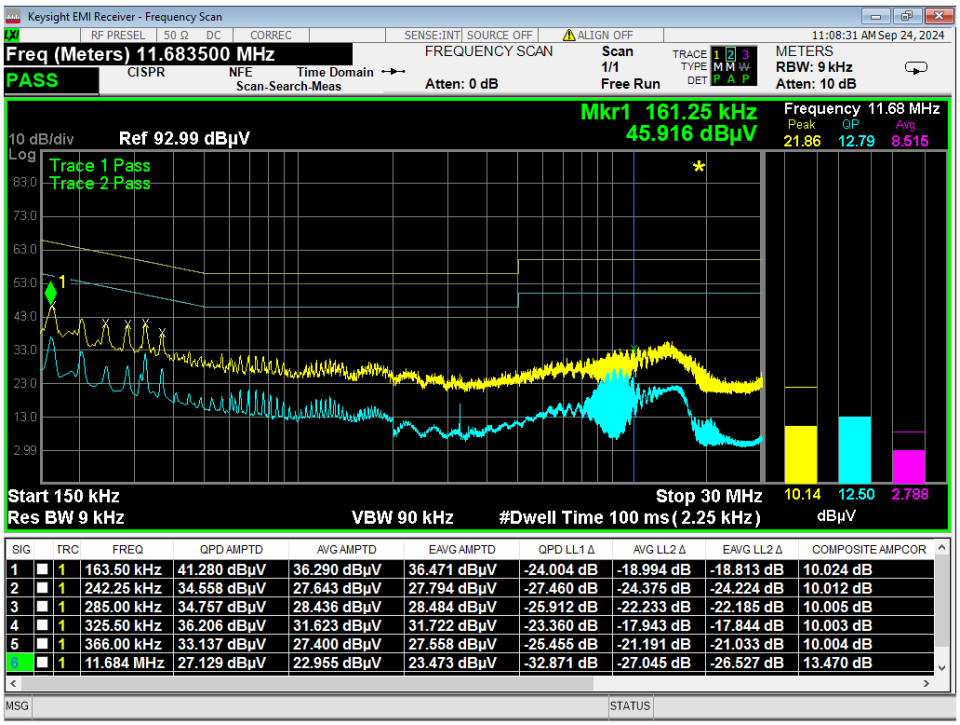


Figure 20 - Conducted Emissions Plot, Line, TX

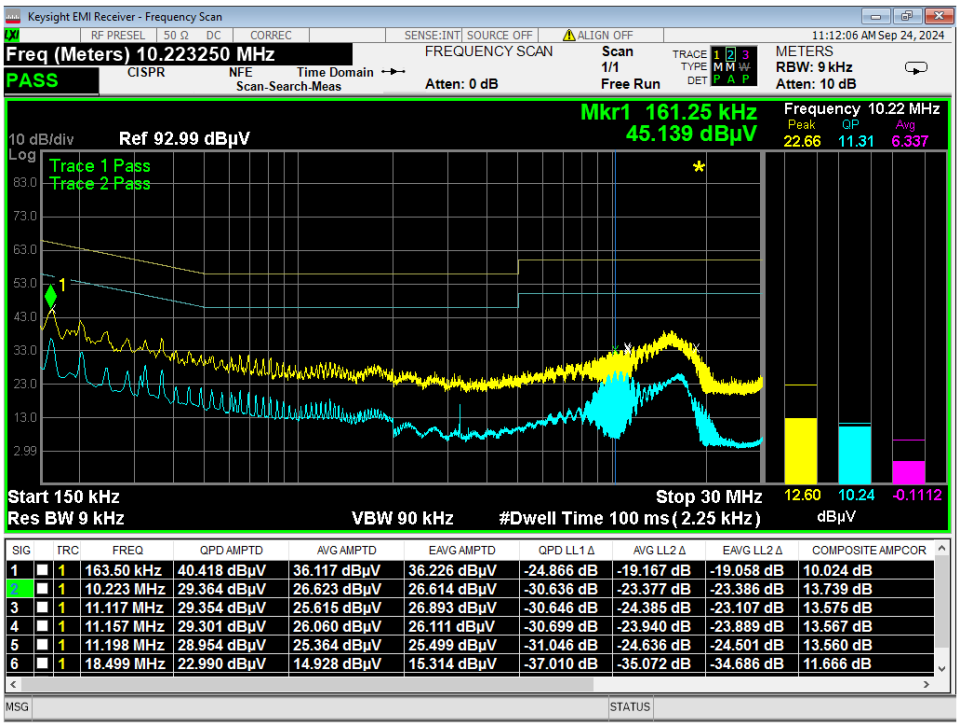


Figure 21 - Conducted Emissions Plot, Neutral, TX

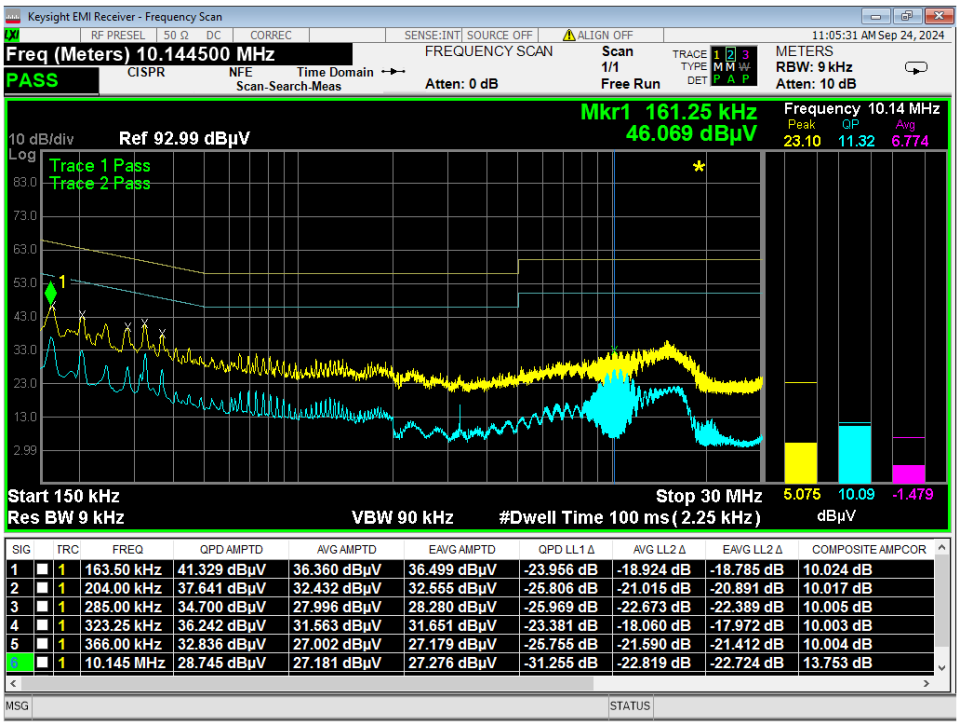


Figure 22 - Conducted Emissions Plot, Line, IDLE

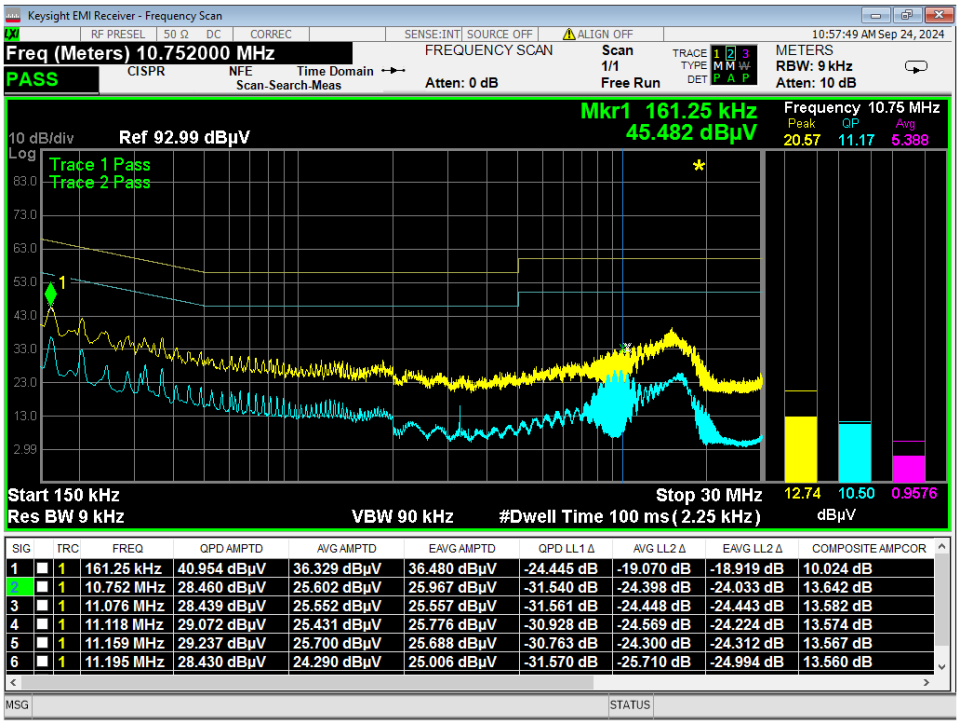


Figure 23 - Conducted Emissions Plot, Neutral, IDLE

APPENDIX A: SAMPLE CALCULATION

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor, Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF – (-CF + AG) + AV

where FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier Gain
AV = Averaging Factor (if applicable)

Assume a receiver reading of 55 dBμV is obtained. The Antenna Factor of 12 and a Cable Factor of 1.1 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.1 dBμV/m.

FS = 55 + 12 – (-1.1 + 20) + 0 = 48.1 dBμV/m

The 48.1 dBμV/m value can be mathematically converted to its corresponding level in μV/m.

Level in μV/m = Common Antilogarithm [(48.1 dBμV/m)/20]= 254.1 μV/m

AV is calculated by taking the 20*log(T_{on}/100) where T_{on} is the maximum transmission time in any 100ms window.

EIRP Calculations

In cases where direct antenna port measurement is not possible or would be inaccurate, output power is measured in EIRP. The maximum field strength is measured at a specified distance and the EIRP is calculated using the following equation;

EIRP (Watts) = [Field Strength (V/m) x antenna distance (m)]^2 / 30
Power (watts) = 10^[Power (dBm)/10] / 1000
Voltage (dBμV) = Power (dBm) + 107 (for 50Ω measurement systems)
Field Strength (V/m) = 10^[Field Strength (dBμV/m) / 20] / 10^6
Gain = 1 (numeric gain for isotropic radiator)
Conversion from 3m field strength to EIRP (d=3):
EIRP = [FS(V/m) x d^2]/30 = FS [0.3] for d = 3
EIRP(dBm) = FS(dBμV/m) – 10(log 10^9)+ 10log[0.3] = FS(dBμV/m) - 95.23
10log(10^9) is the conversion from micro to milli

APPENDIX B – MEASUREMENT UNCERTAINTY

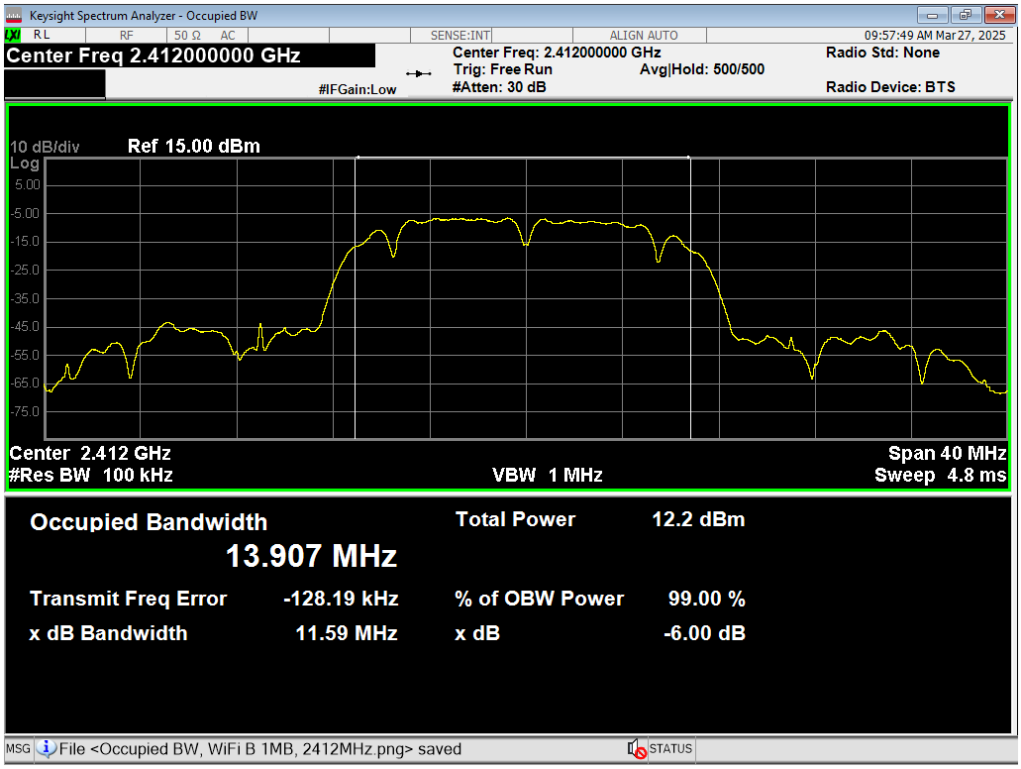
NCEE Labs does not add uncertainty levels to measurement levels

Where relevant, the following measurement uncertainty levels have been for tests performed in this test report:

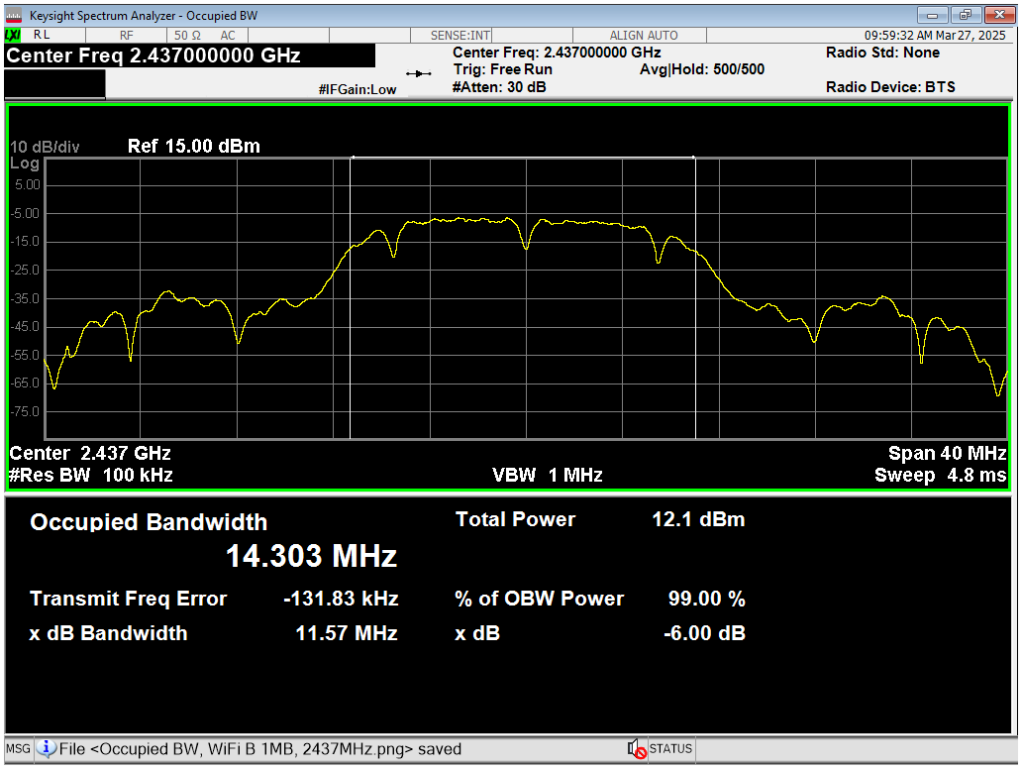
Test	Frequency Range	Uncertainty Value (dB)
Radiated Emissions, 3m	30MHz – 1GHz	±4.31
Radiated Emissions, 3m	1GHz – 18GHz	±5.08
Emissions limits, conducted	30MHz – 18GHz	±3.03

Expanded uncertainty values are calculated to a confidence level of 95%.

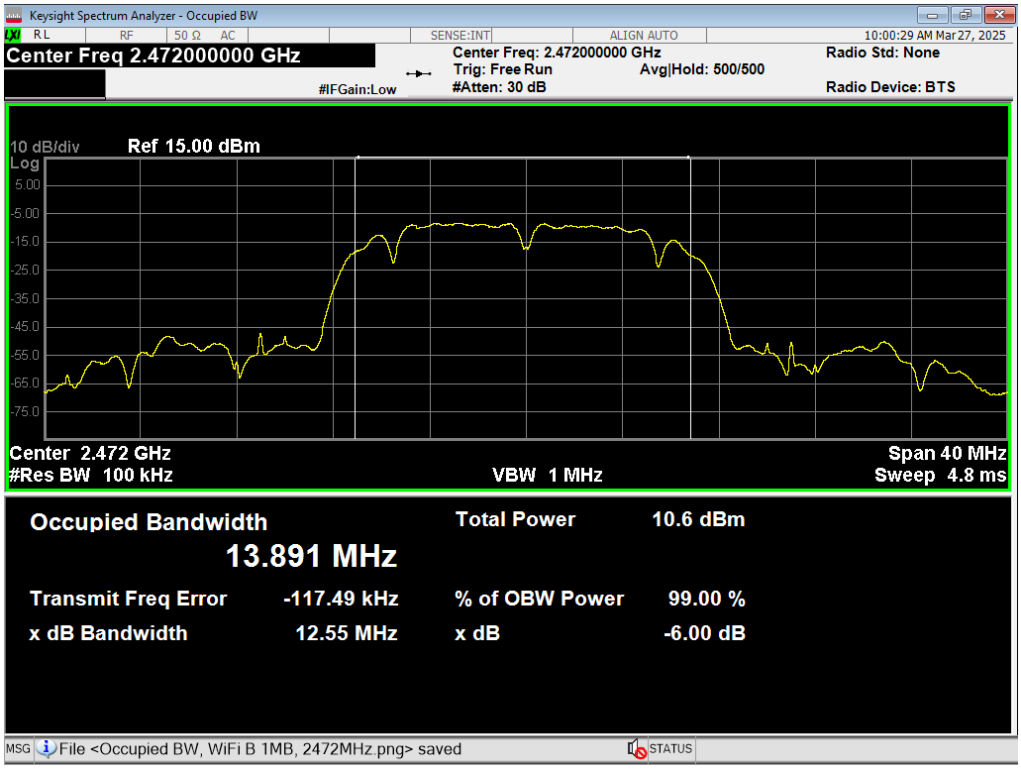
APPENDIX C – GRAPHS AND TABLES



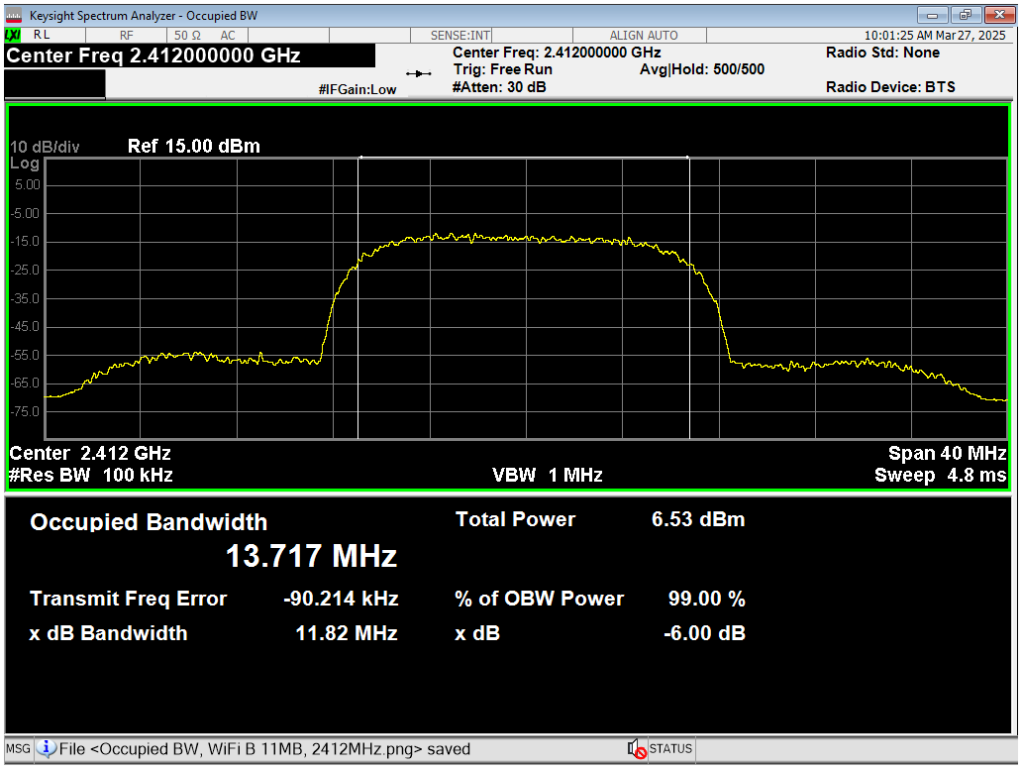
01 6dB BW, WiFi B 1MB, 2412MHz



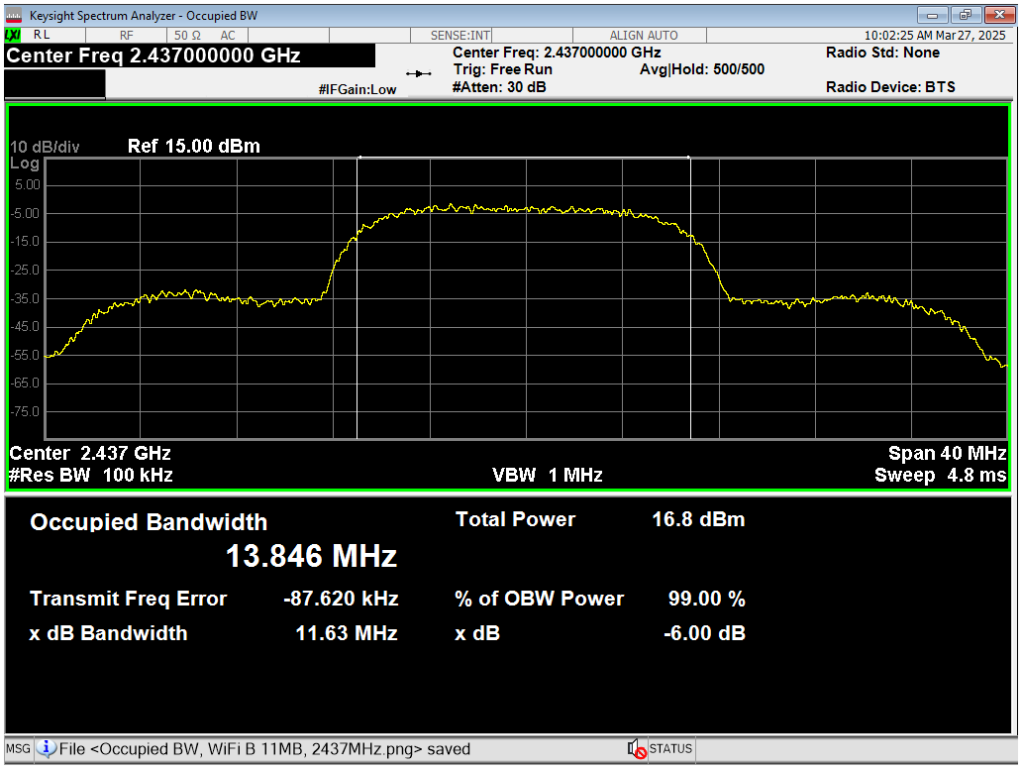
02 6dB BW, WiFi B 1MB, 2437MHz



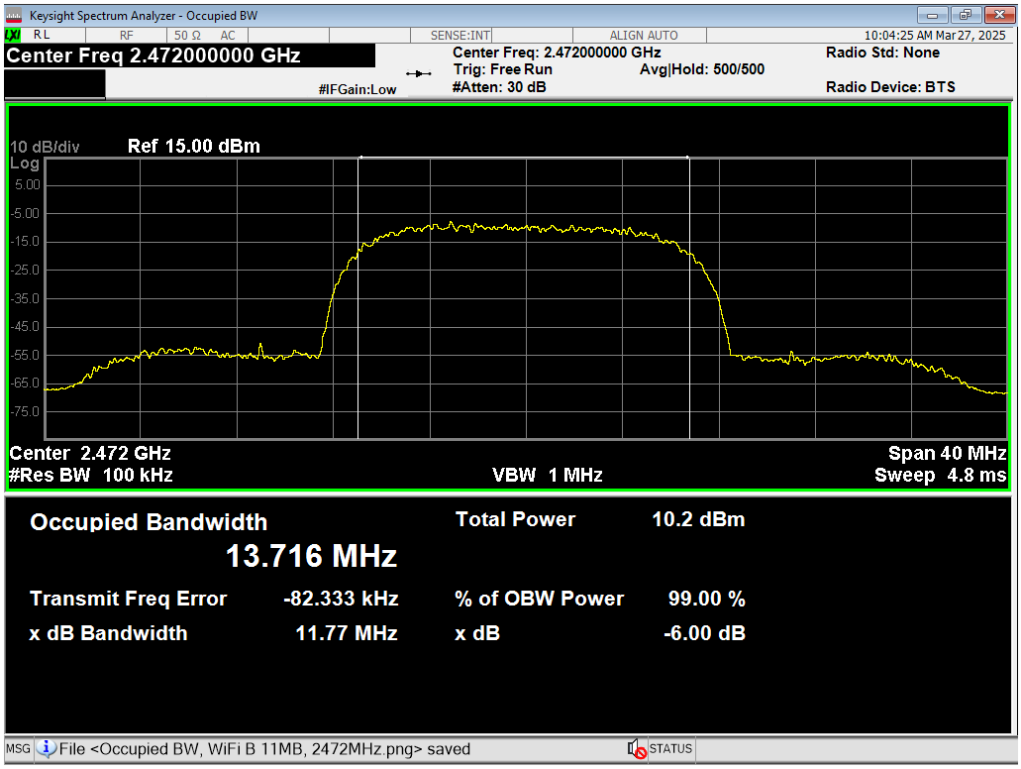
03 6dB BW, WiFi B 1MB, 2472MHz



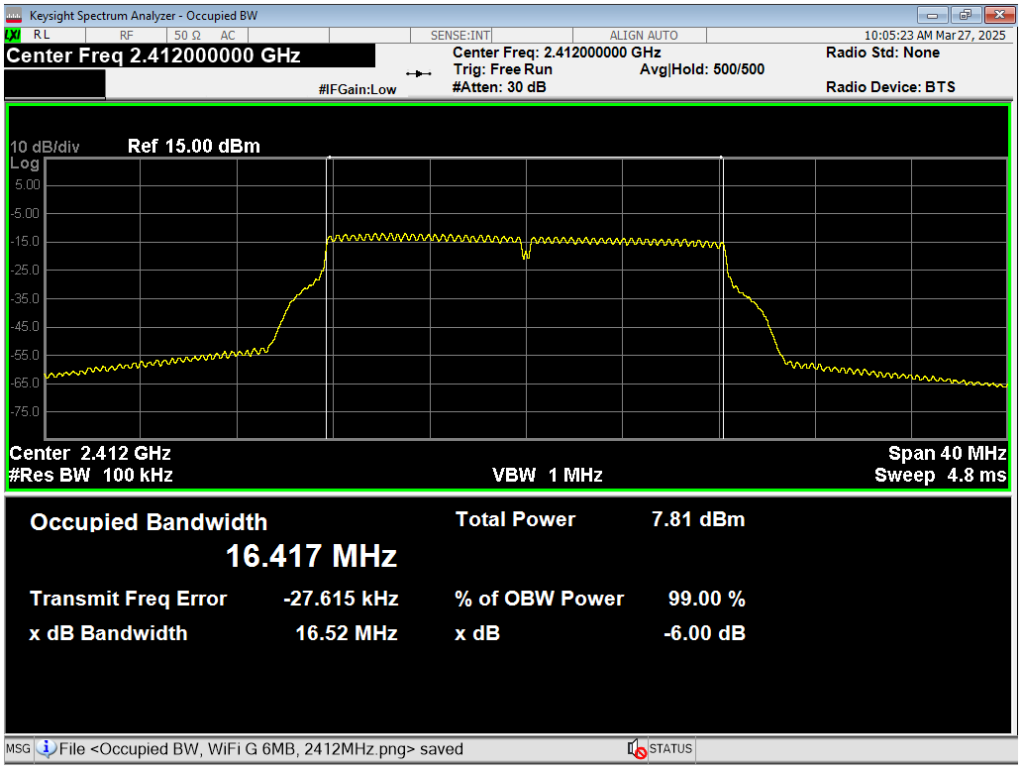
04 6dB BW, WiFi B 11MB, 2412MHz



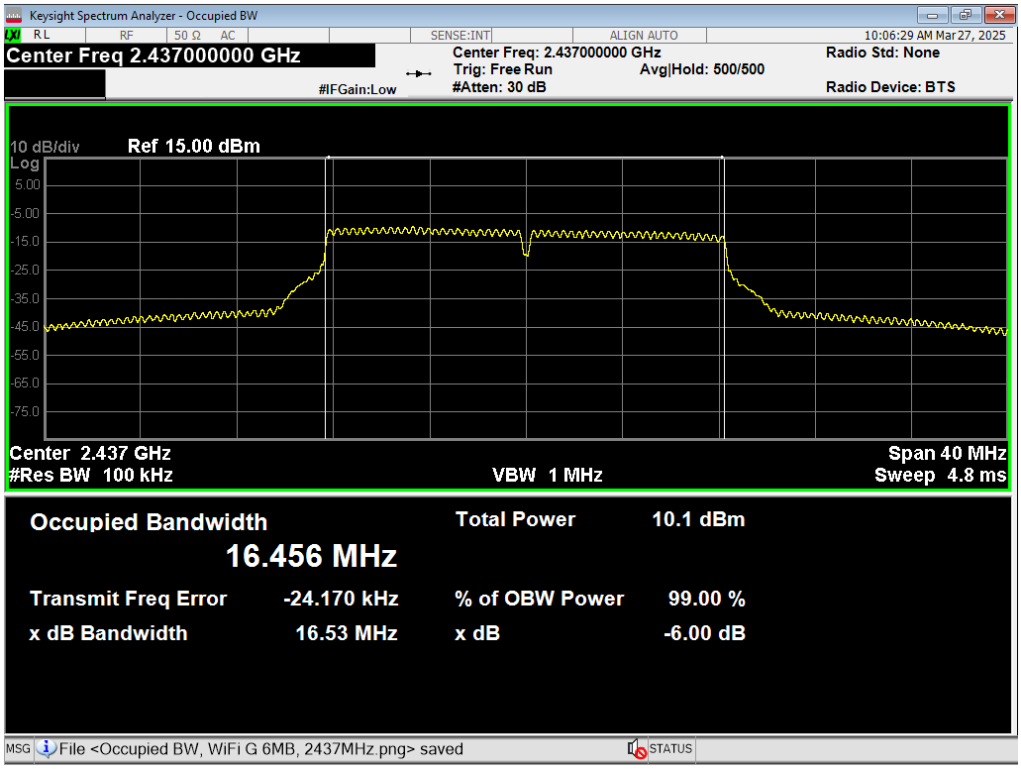
05 6dB BW, WiFi B 11MB, 2437MHz



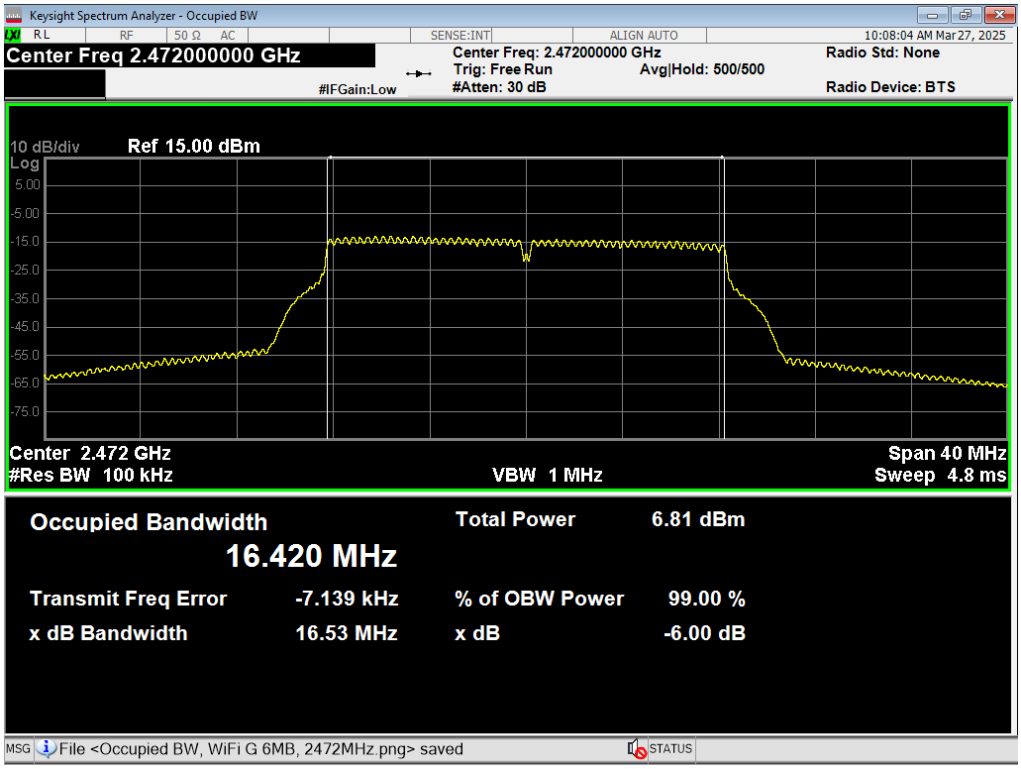
06 6dB BW, WiFi B 11MB, 2472MHz



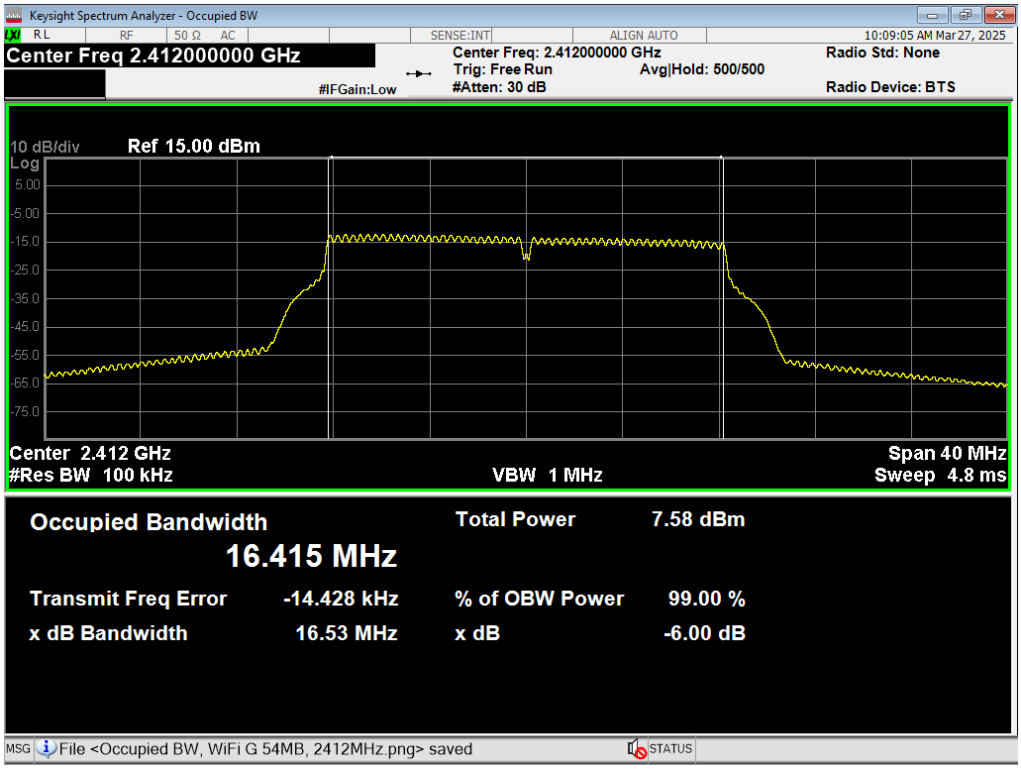
07 6dB BW, WiFi G 6MB, 2412MHz



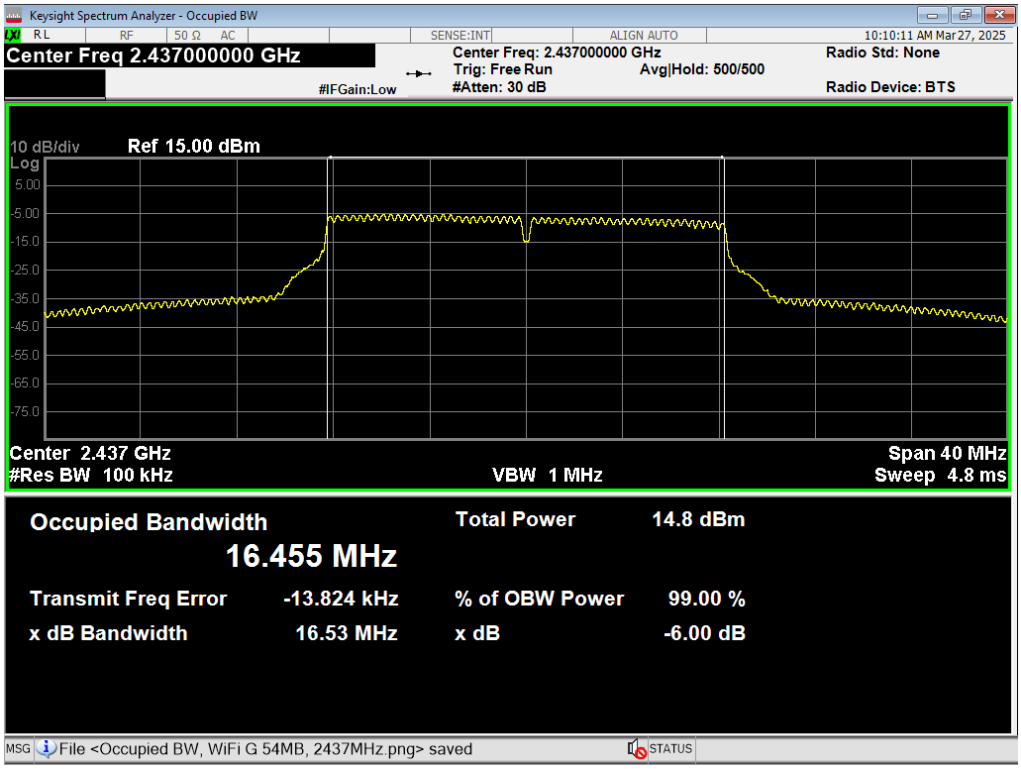
08 6dB BW, WiFi G 6MB, 2437MHz



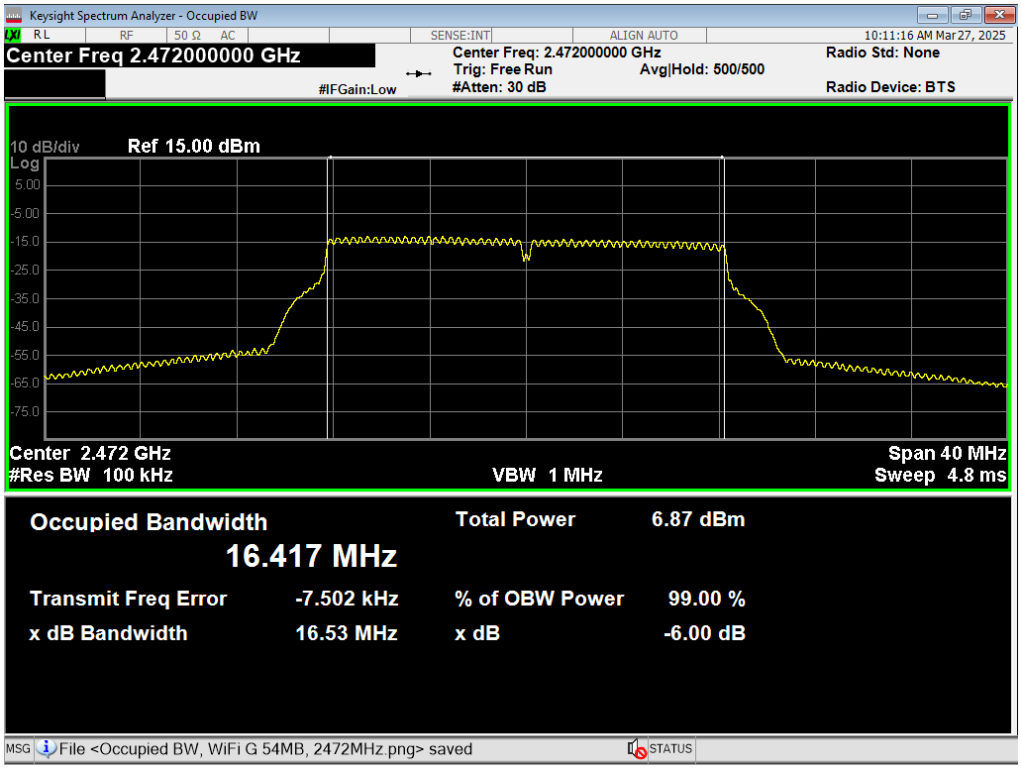
09 6dB BW, WiFi G 6MB, 2472MHz



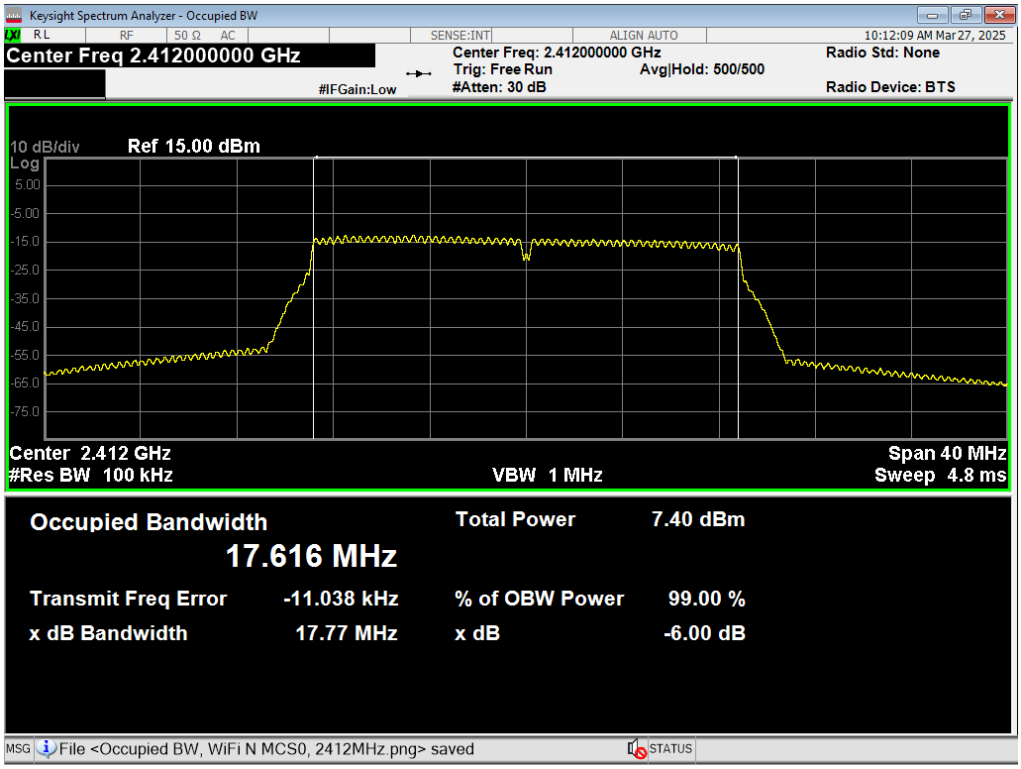
10 6dB BW, WiFi G 54MB, 2412MHz



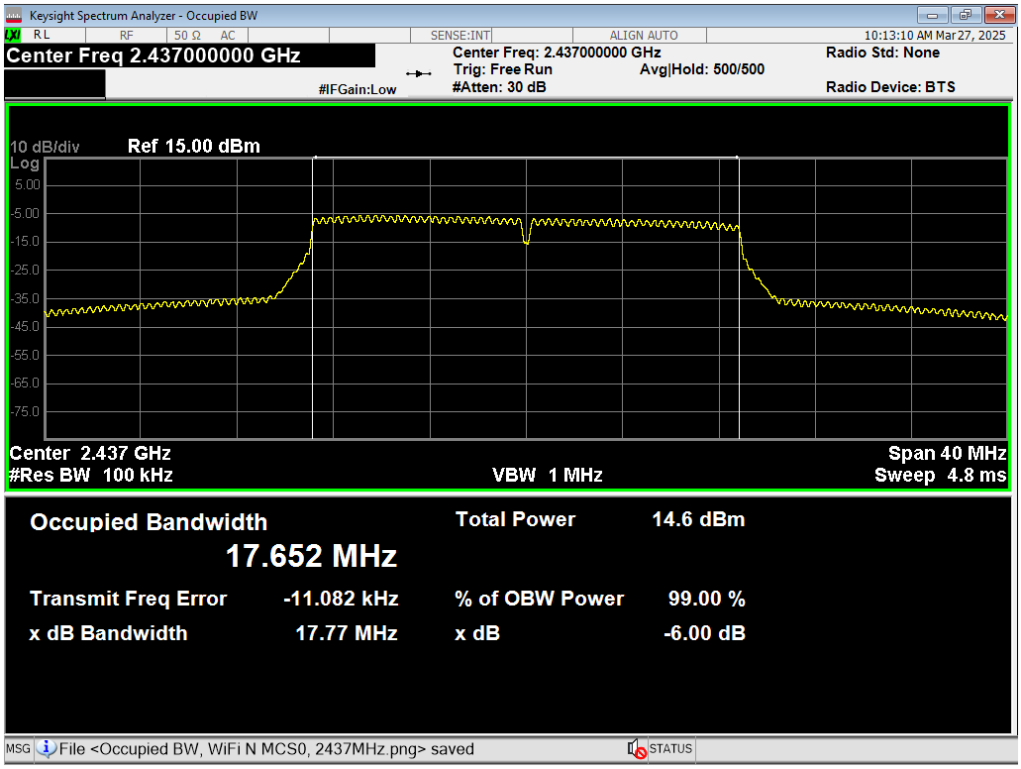
11 6dB BW, WiFi G 54MB, 2437MHz



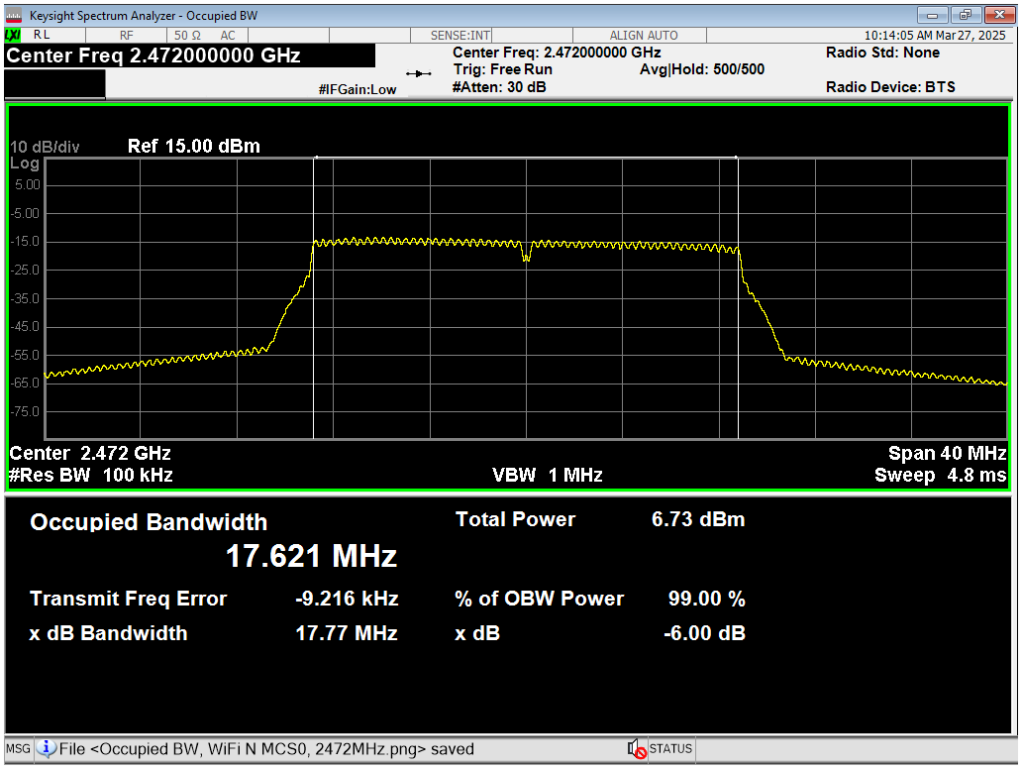
12 6dB BW, WiFi G 54MB, 2472MHz



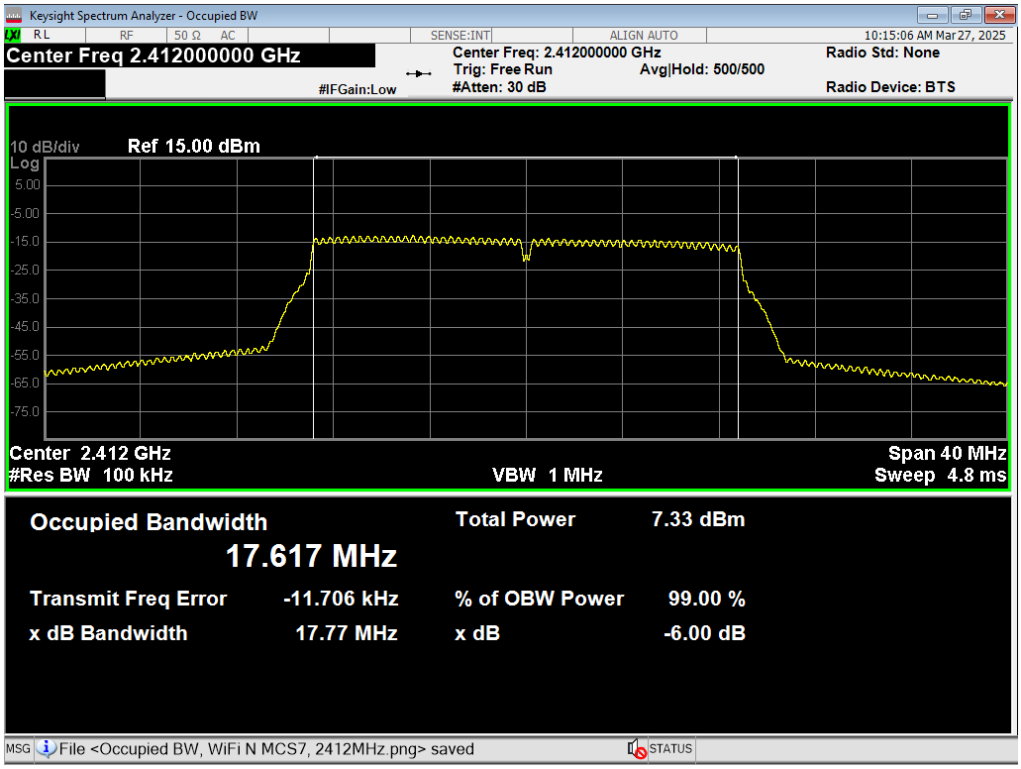
13 6dB BW, WiFi N MCS0, 2412MHz



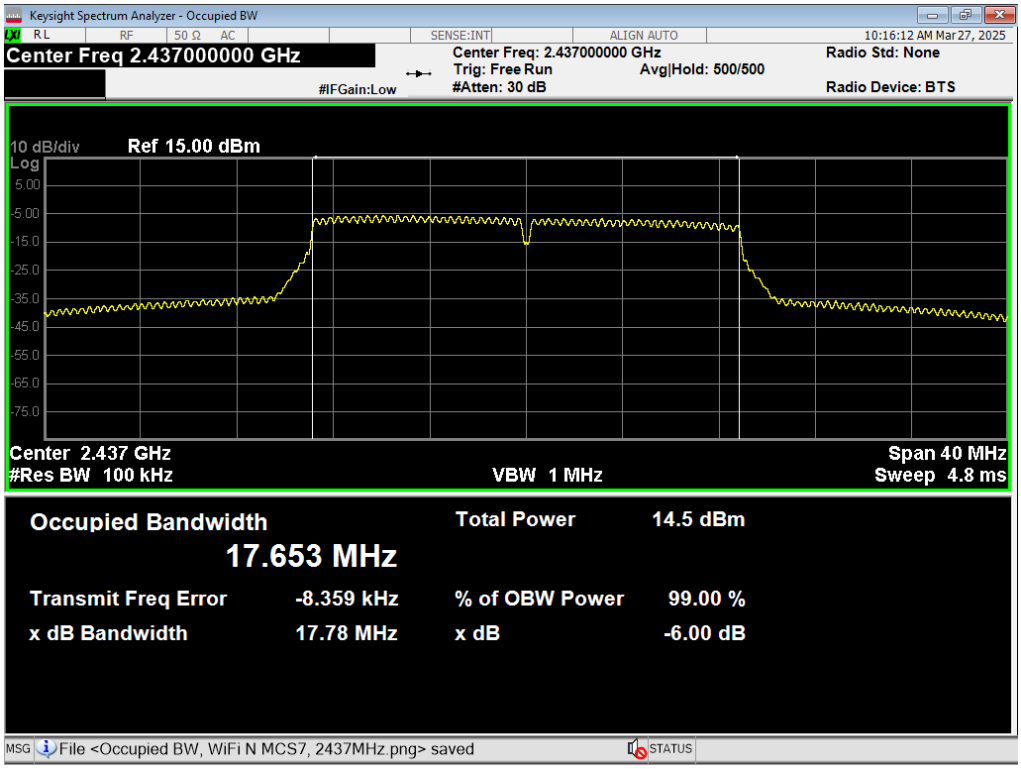
14 6dB BW, WiFi N MCS0, 2437MHz



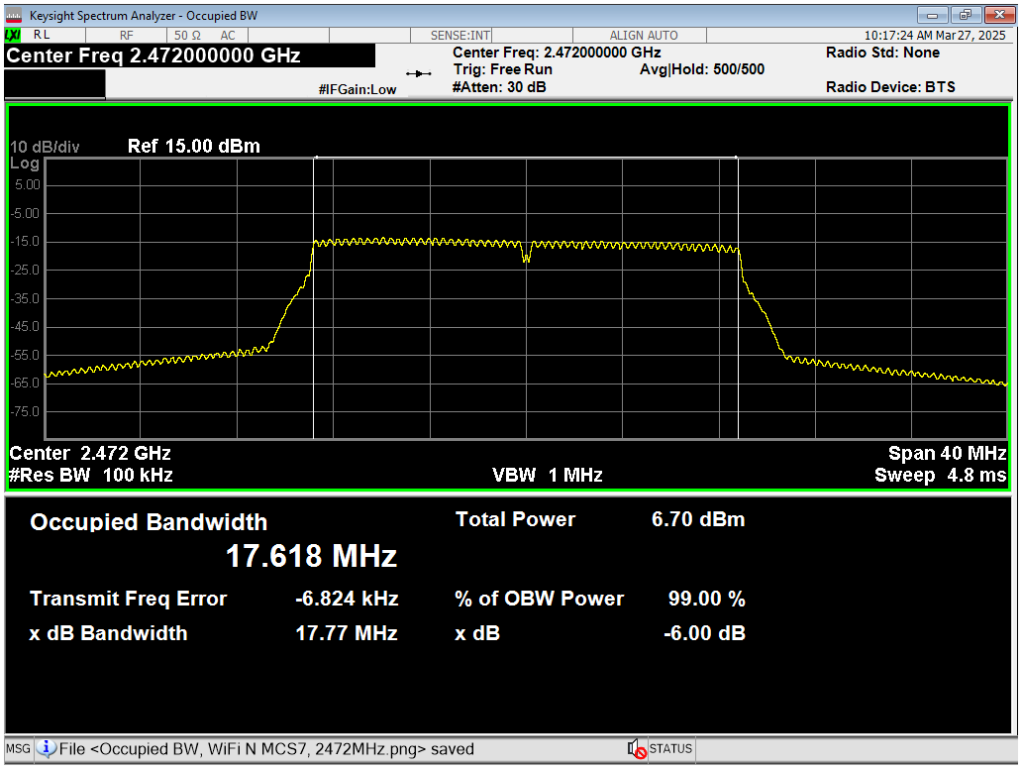
15 6dB BW, WiFi N MCS0, 2472MHz



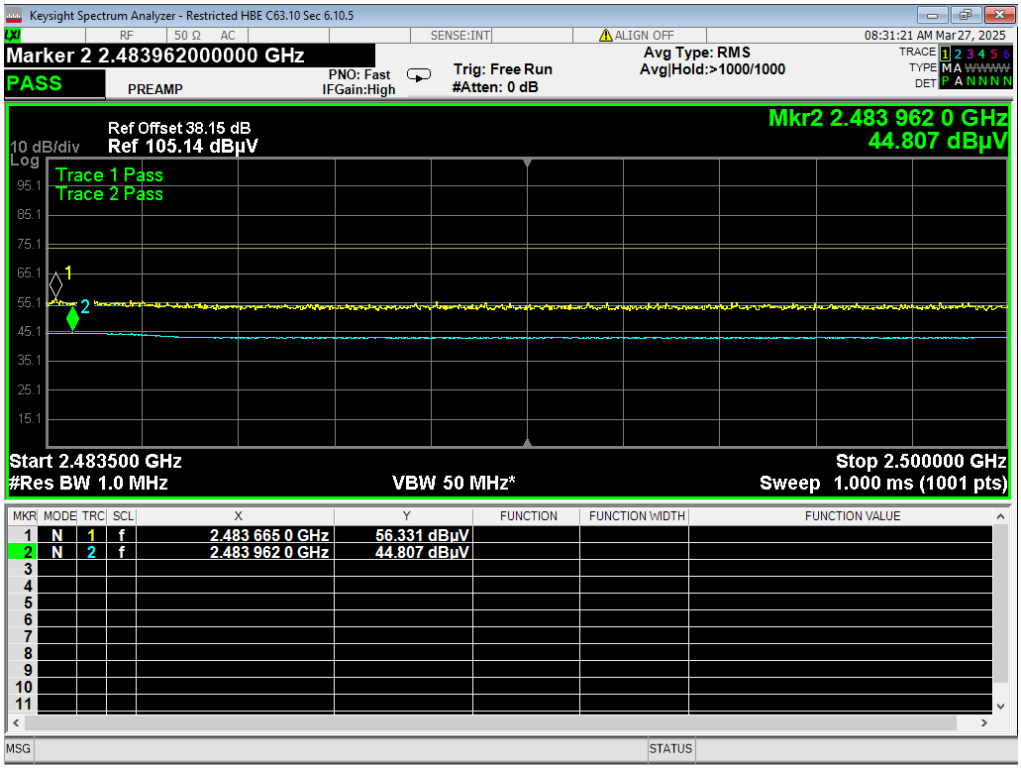
16 6dB BW, WiFi N MCS7, 2412MHz



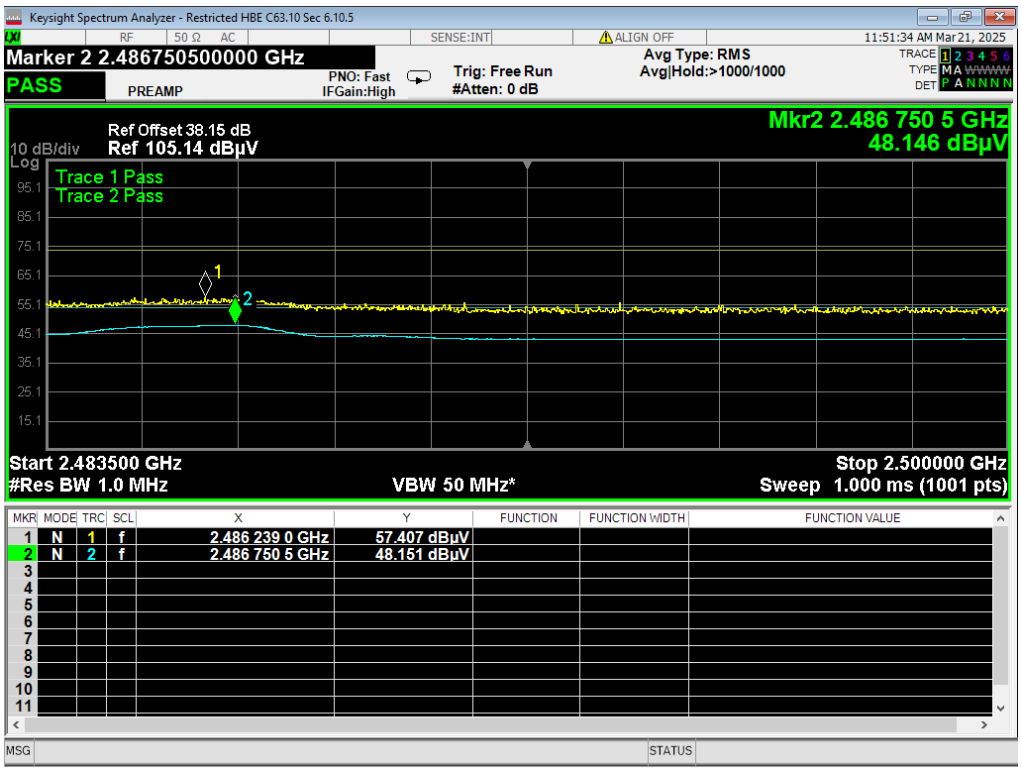
17 6dB BW, WiFi N MCS7, 2437MHz



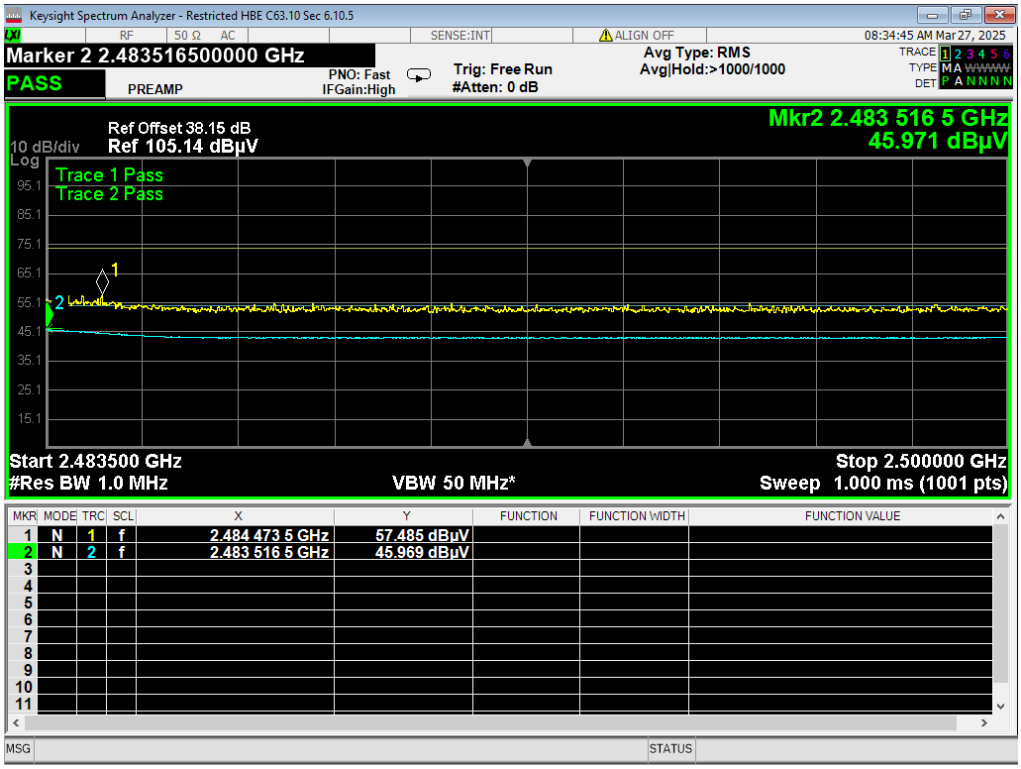
18 6dB BW, WiFi N MCS7, 2472MHz



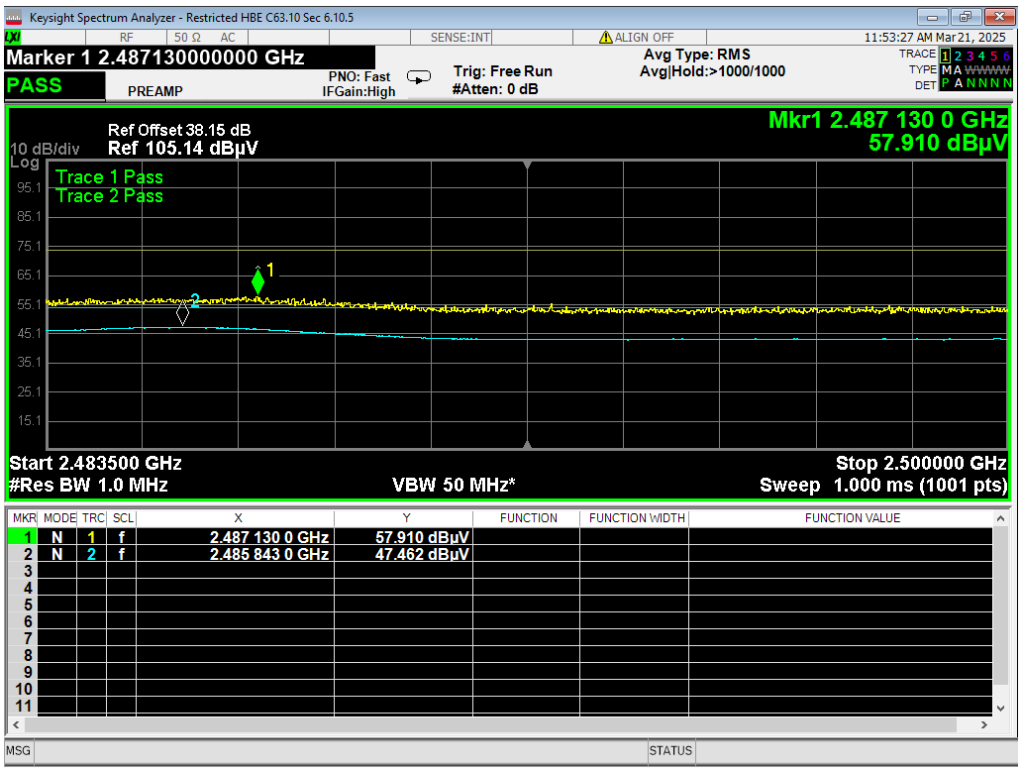
19 HBE Restricted, Wifi B 1MB, ch12, new power settings



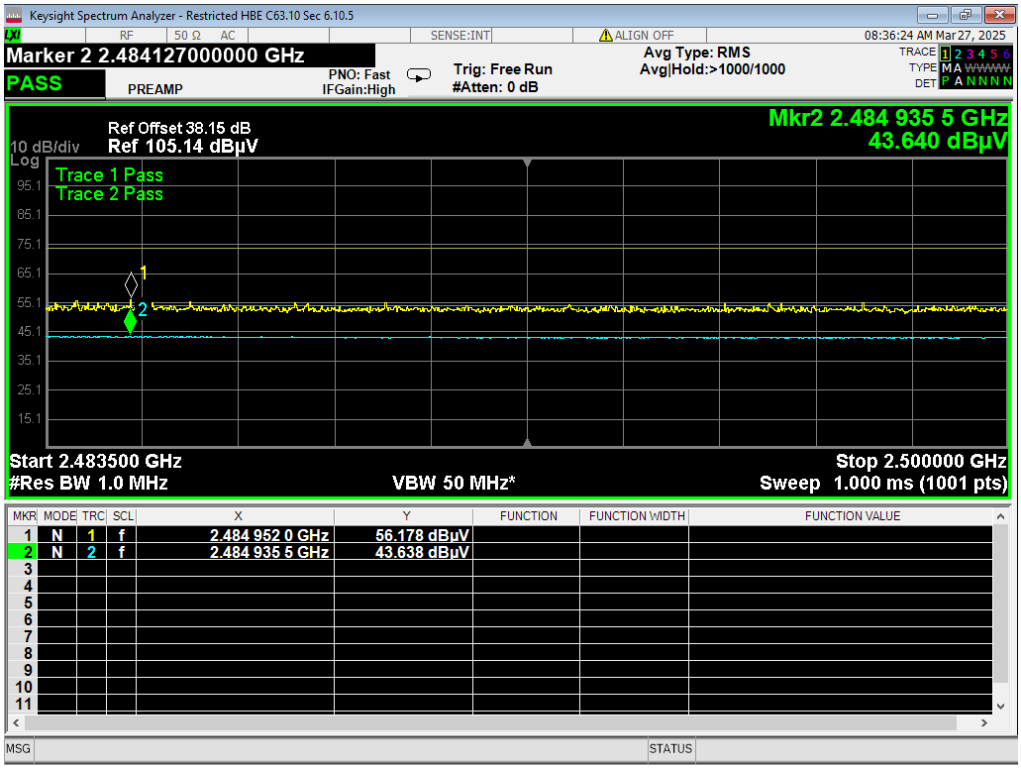
20 HBE Restricted, Wifi B 1MB, ch13, new power settings



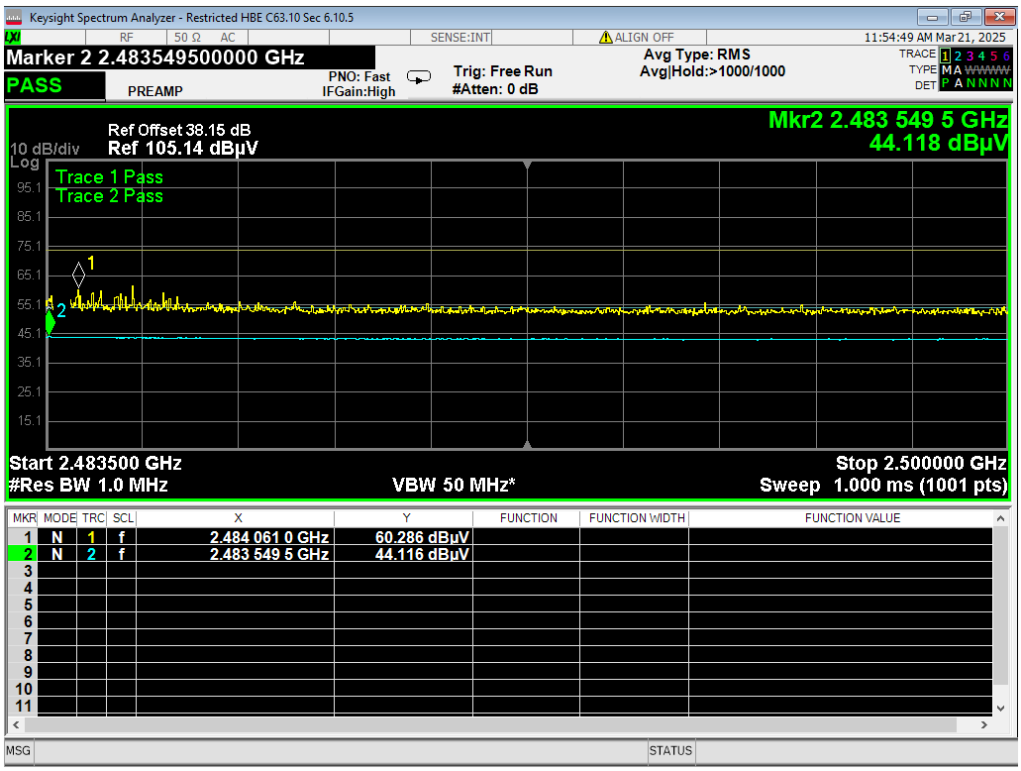
21 HBE Restricted, Wifi B 11MB, ch12, new power settings



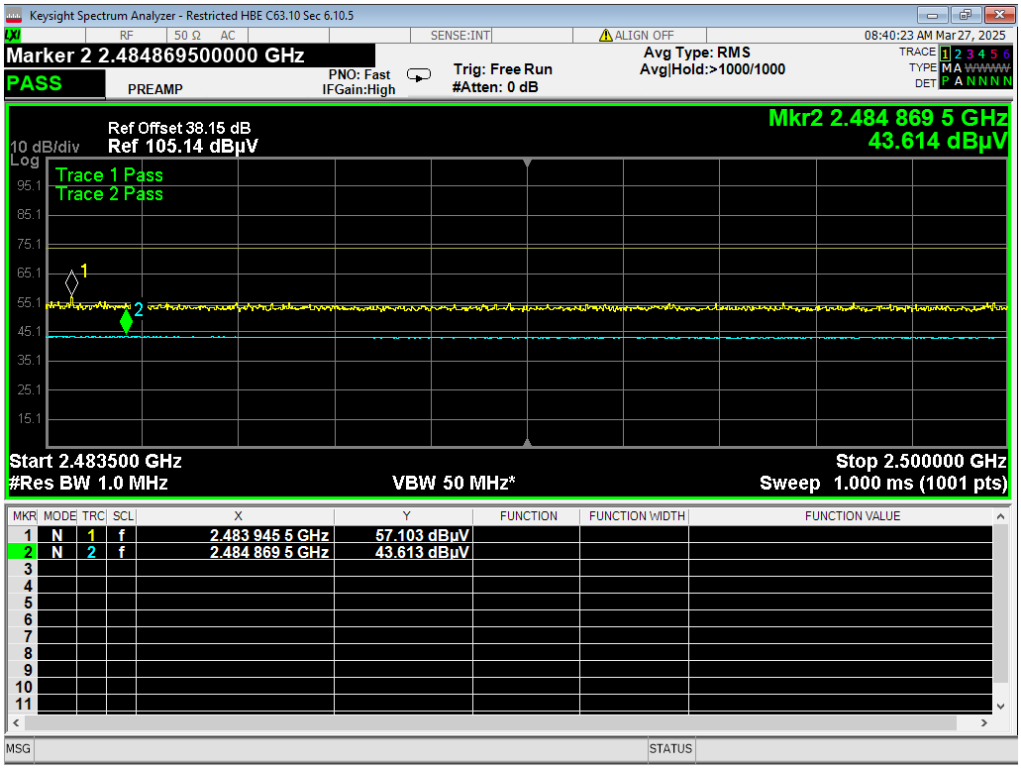
22 HBE Restricted, Wifi B 11MB, ch13, new power settings



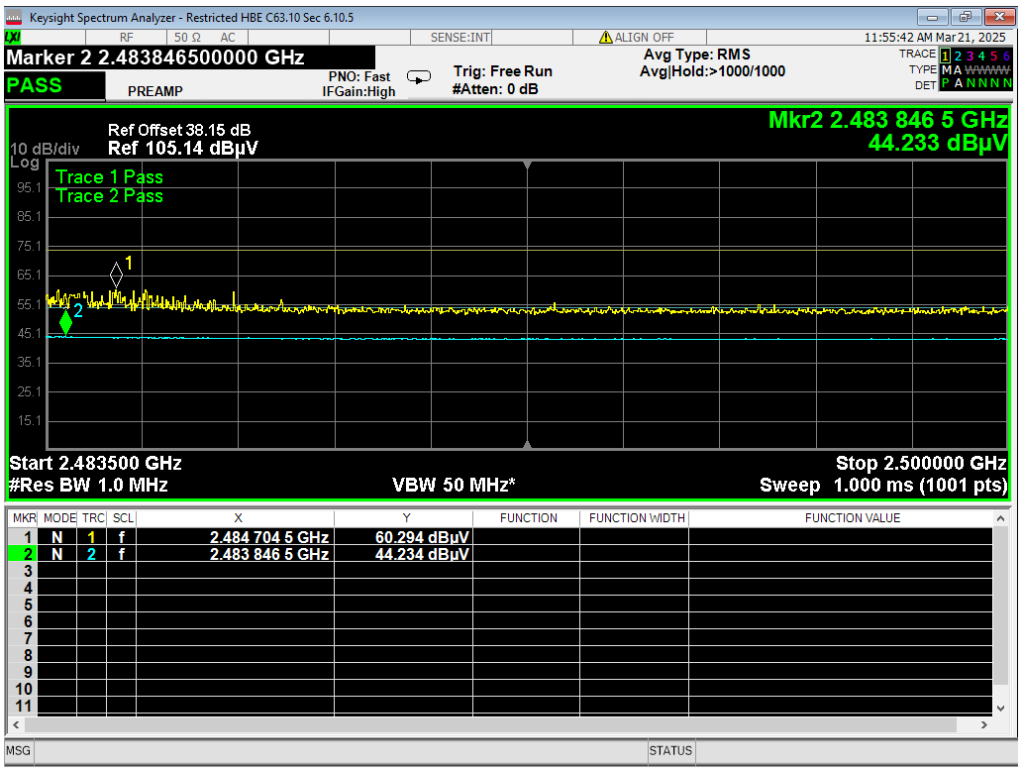
23 HBE Restricted, Wifi G 6MB, ch12, new power settings



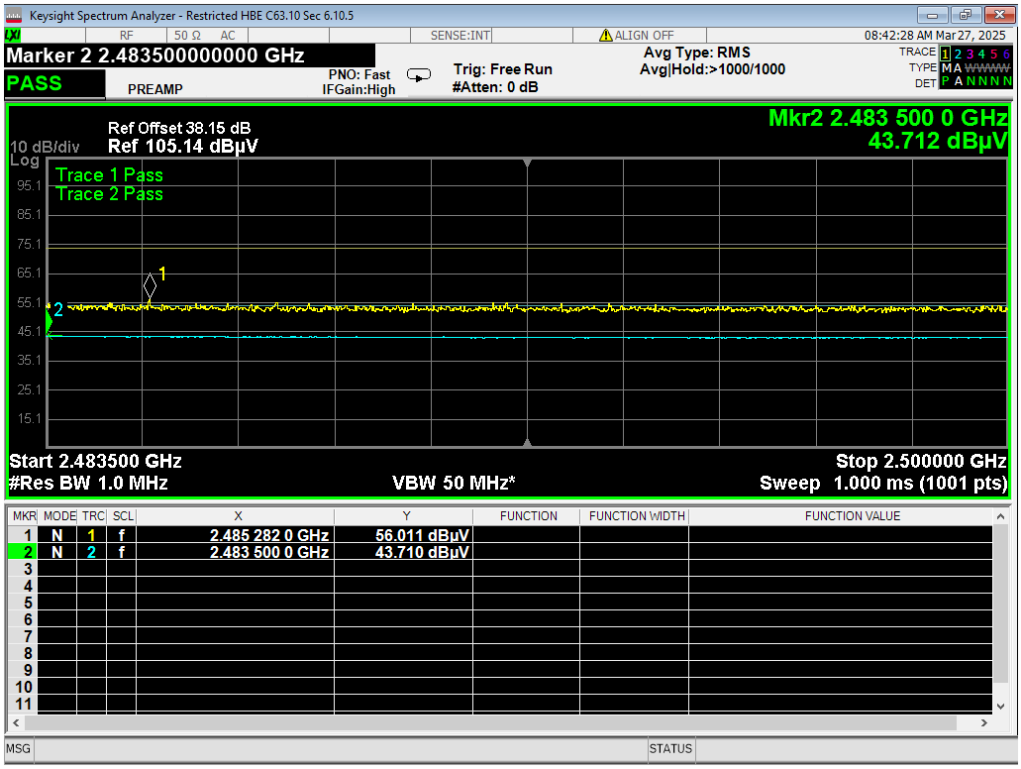
24 HBE Restricted, Wifi G 6MB, ch13, new power settings



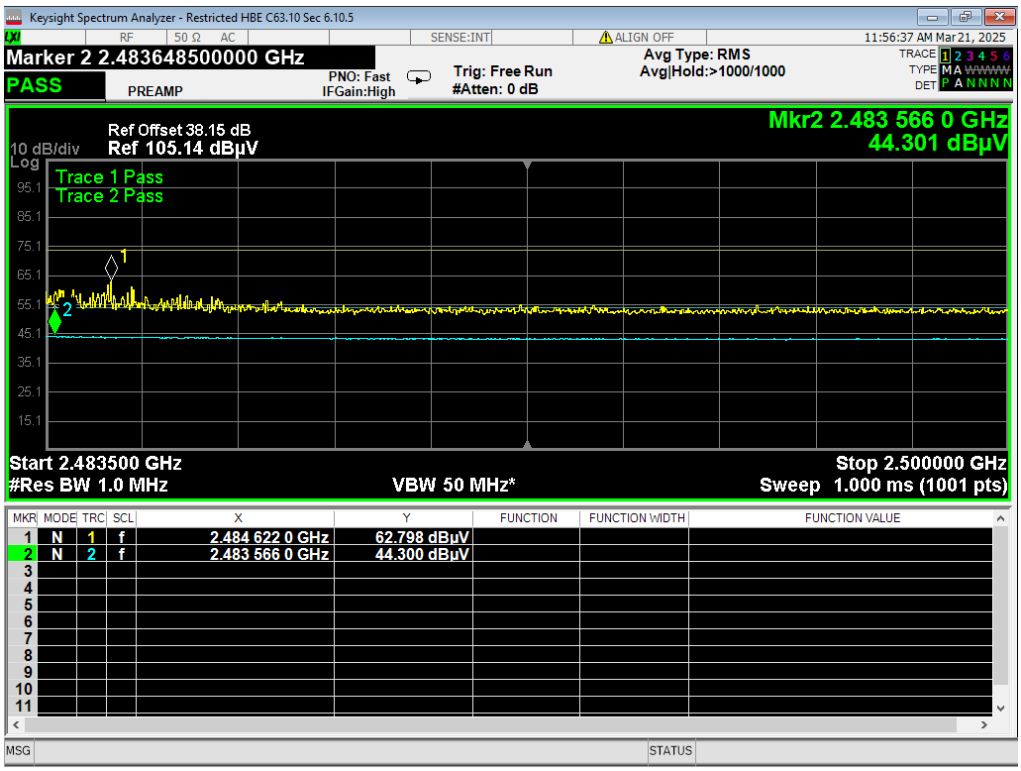
25 HBE Restricted, Wifi G 54MB, ch12, new power settings



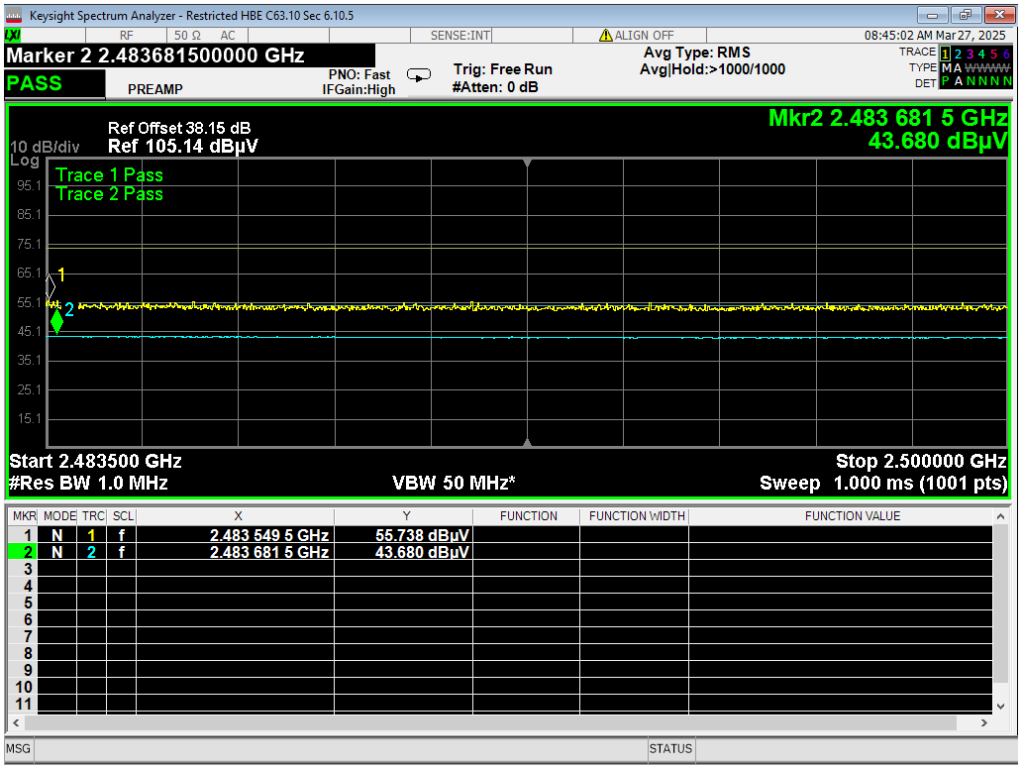
26 HBE Restricted, Wifi G 54MB, ch13, new power settings



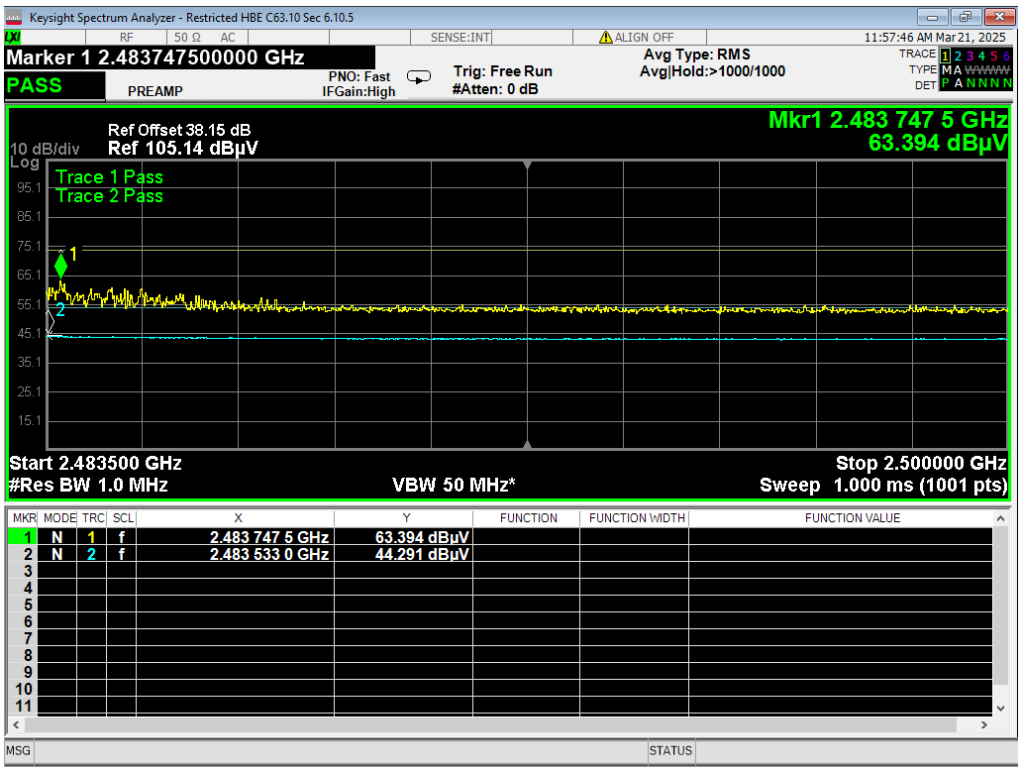
27 HBE Restricted, Wifi N MCS0, ch12, new power settings



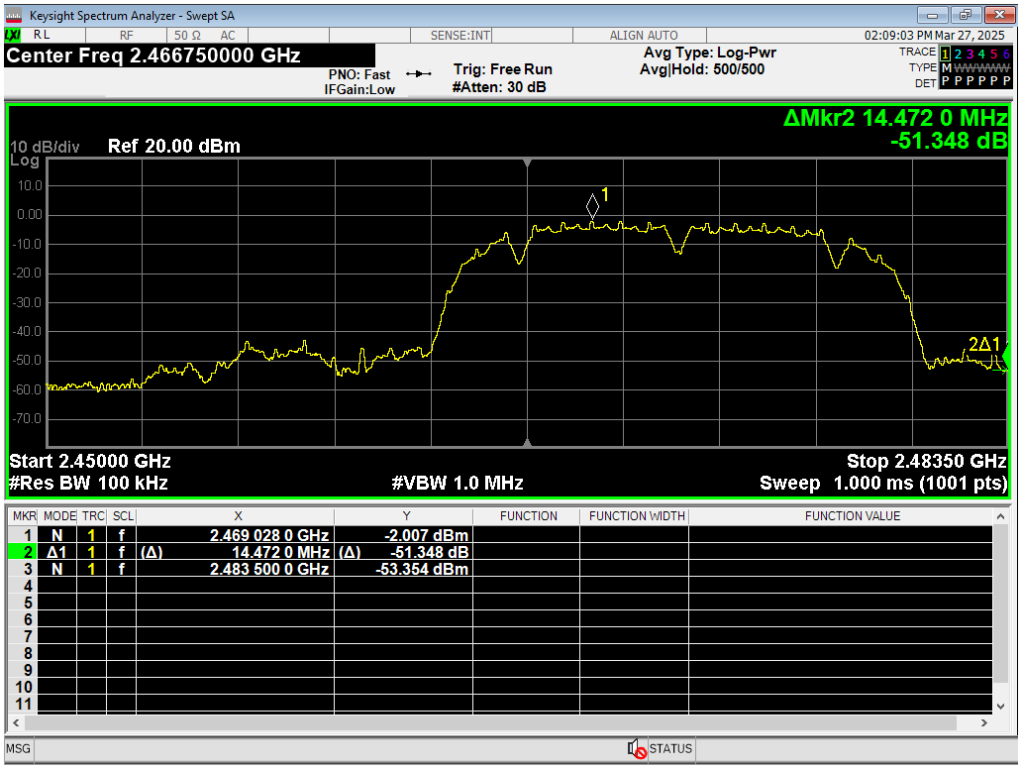
28 HBE Restricted, Wifi N MCS0, ch13, new power settings



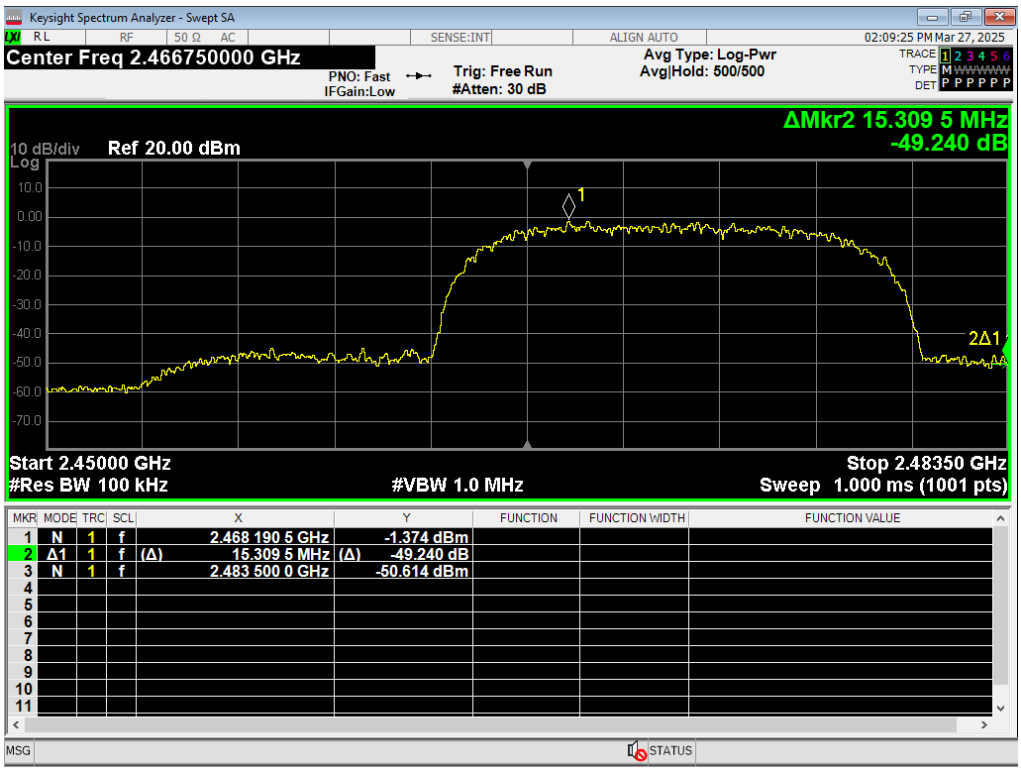
29 HBE Restricted, Wifi N MCS7, ch12, new power settings



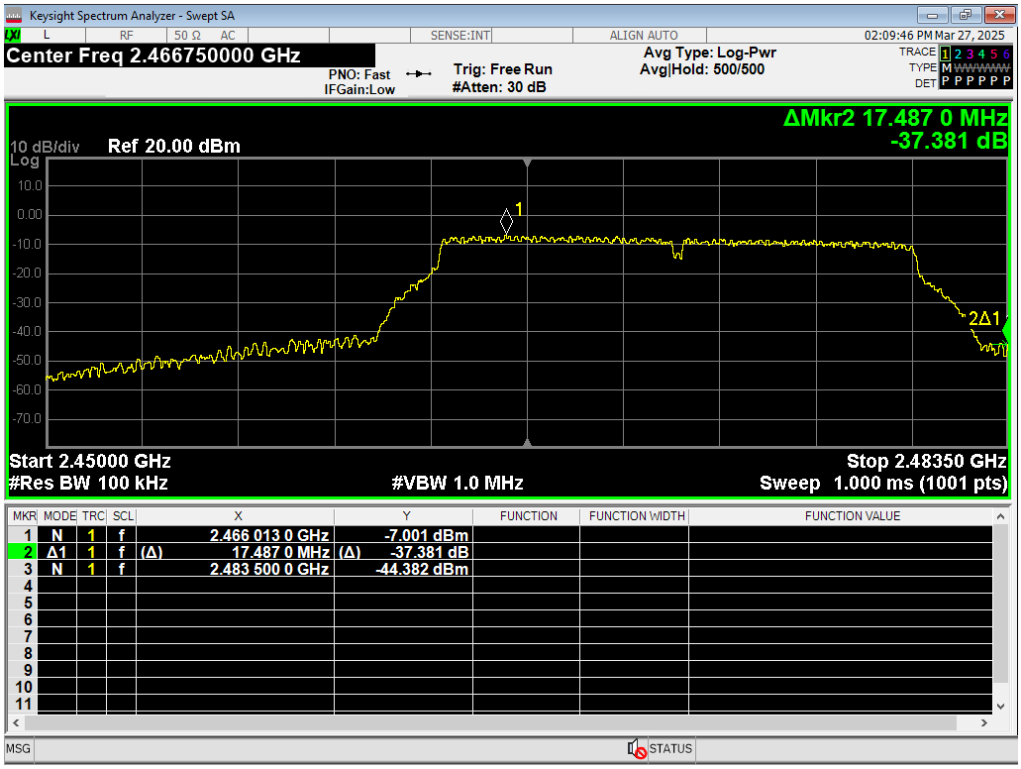
30 HBE Restricted, Wifi N MCS7, ch13, new power settings



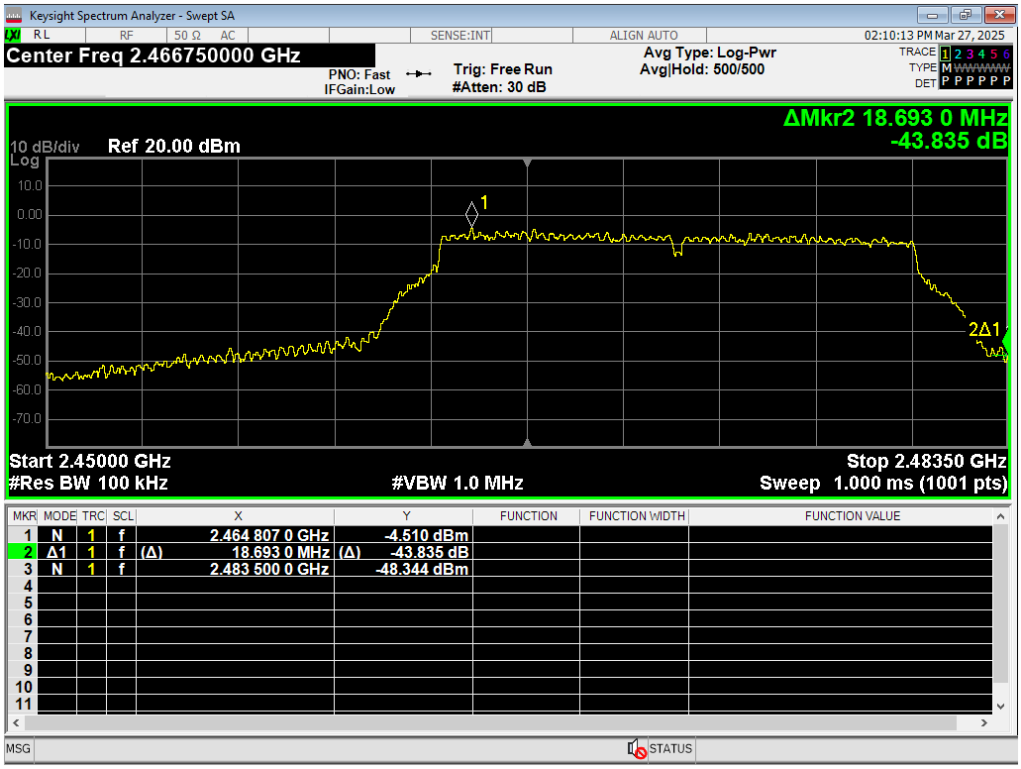
31 HBE Unrestricted, WiFi B 1MB



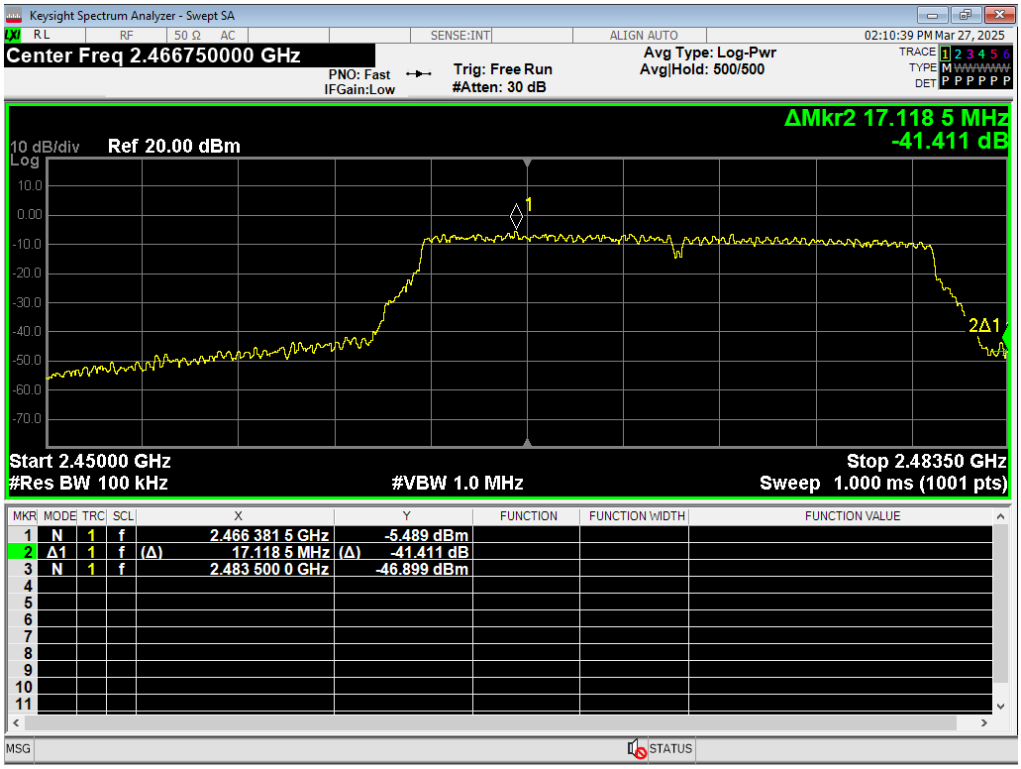
32 HBE Unrestricted, WiFi B 11MB



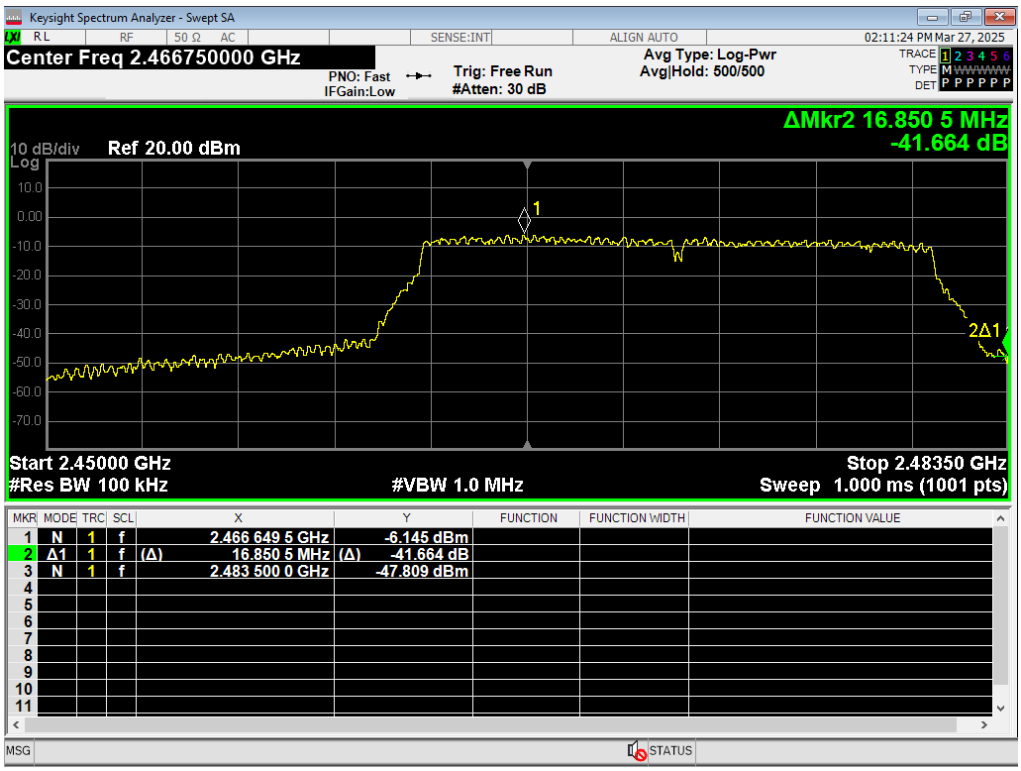
33 HBE Unrestricted, WiFi G 6MB



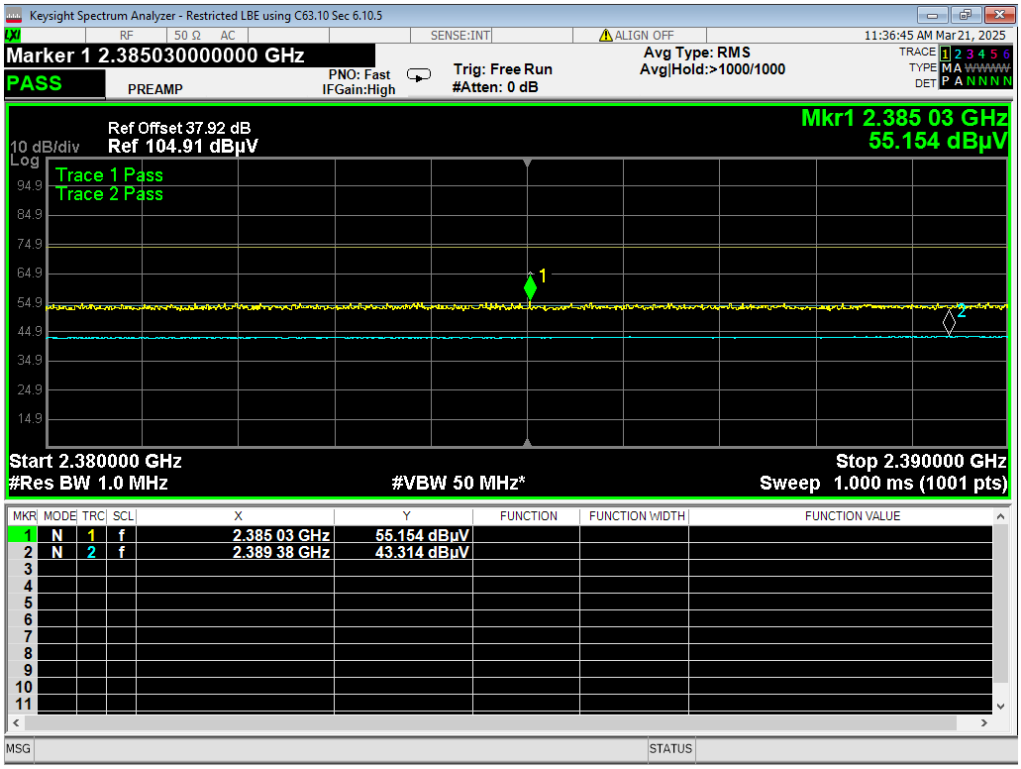
34 HBE Unrestricted, WiFi G 54MB



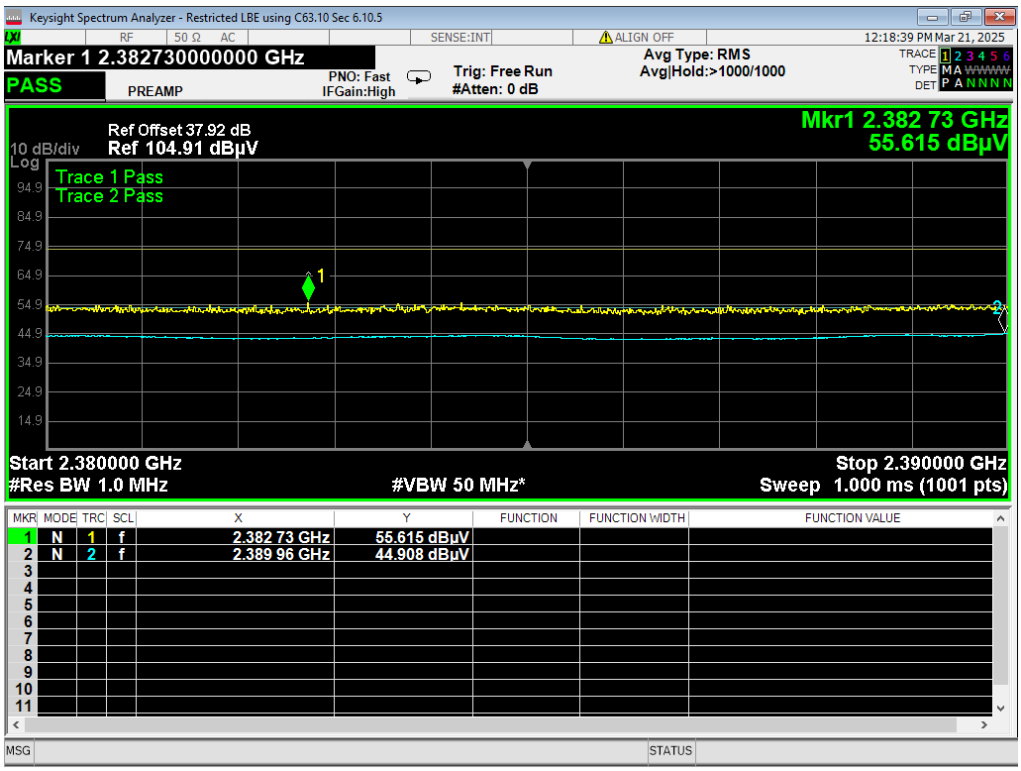
35 HBE Unrestricted, WiFi N MCS0



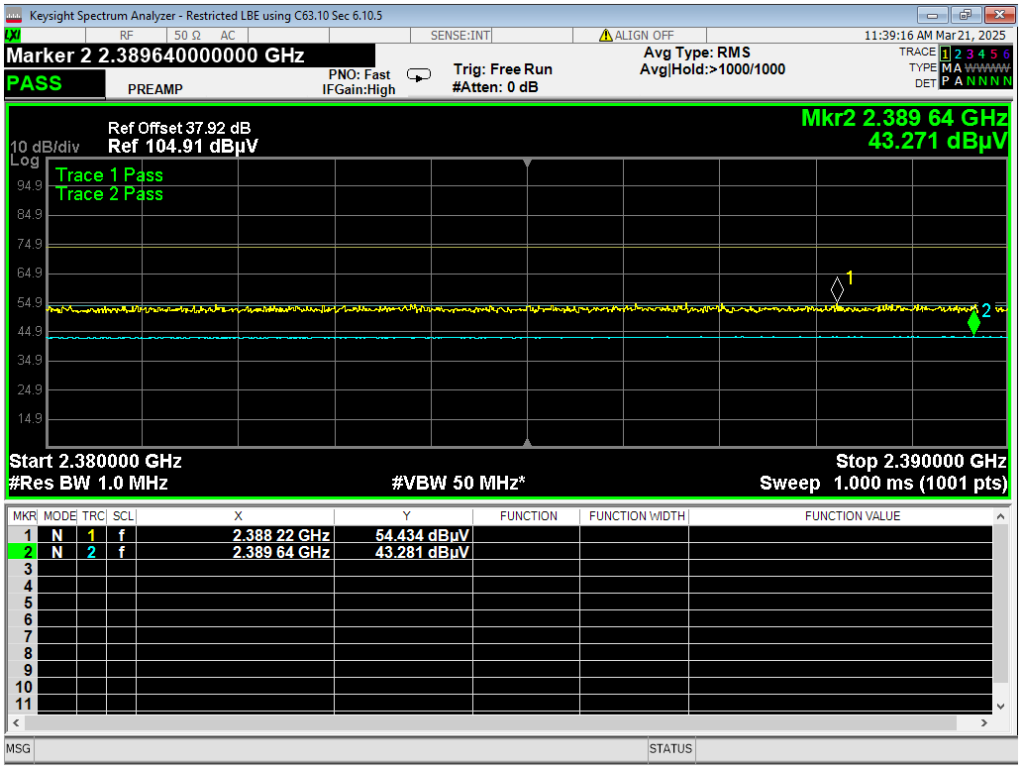
36 HBE Unrestricted, WiFi N MCS7



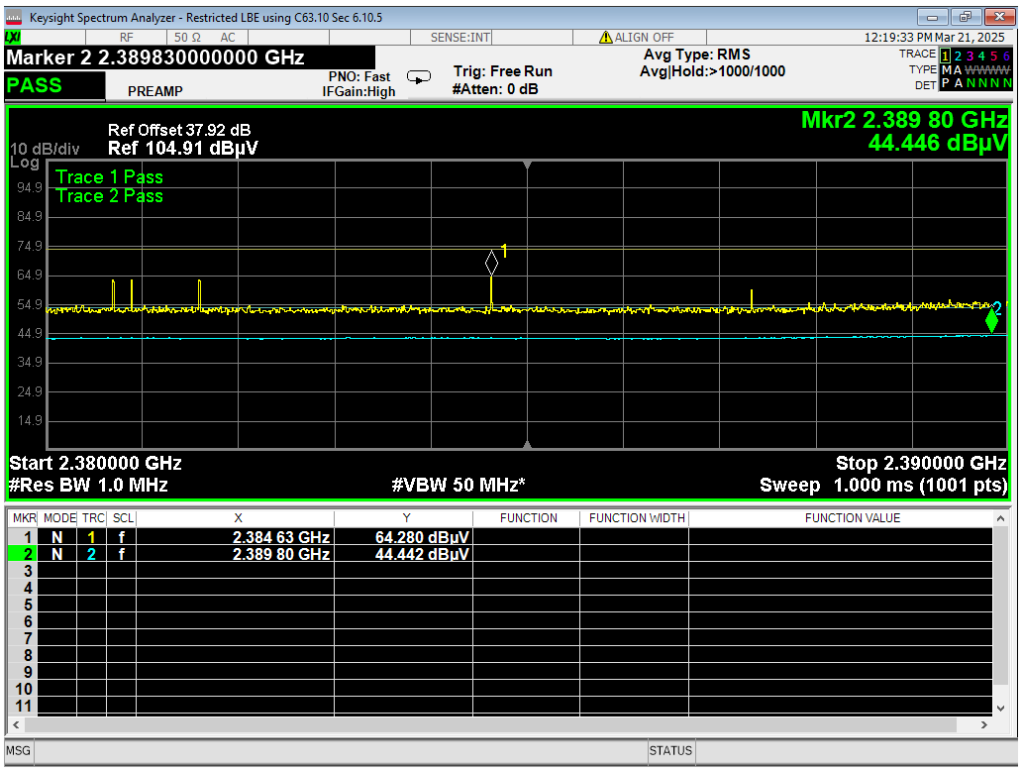
37 LBE Restricted, Wifi B 1MB, ch1, new power settings



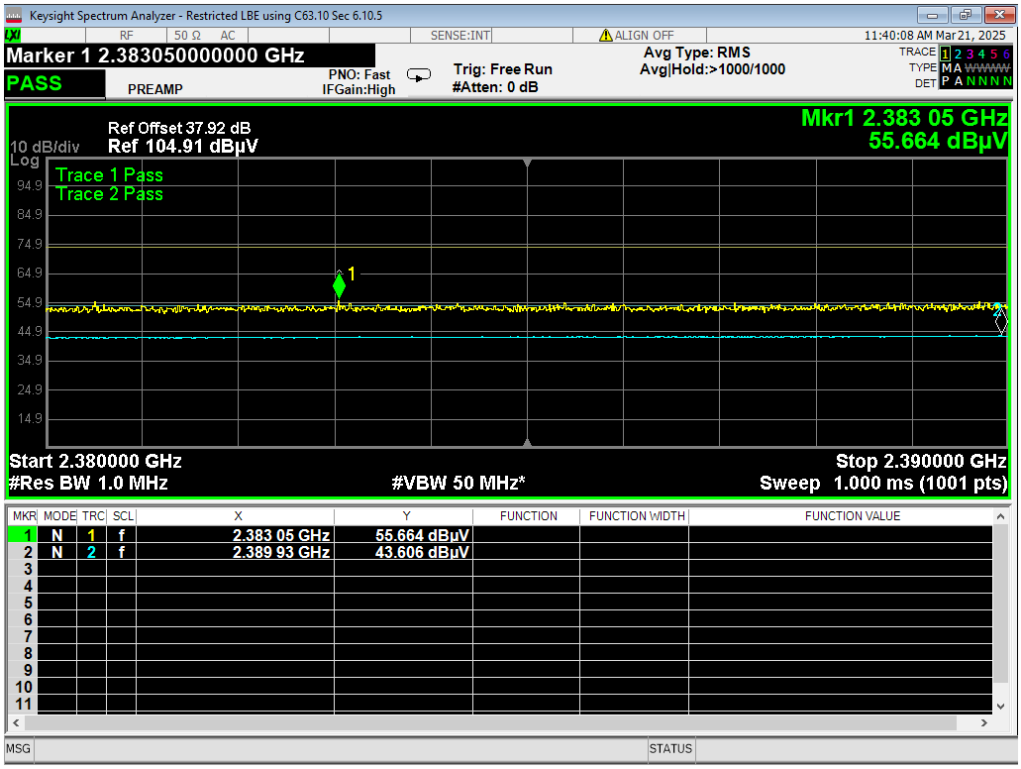
38 LBE Restricted, Wifi B 1MB, ch2, new power settings



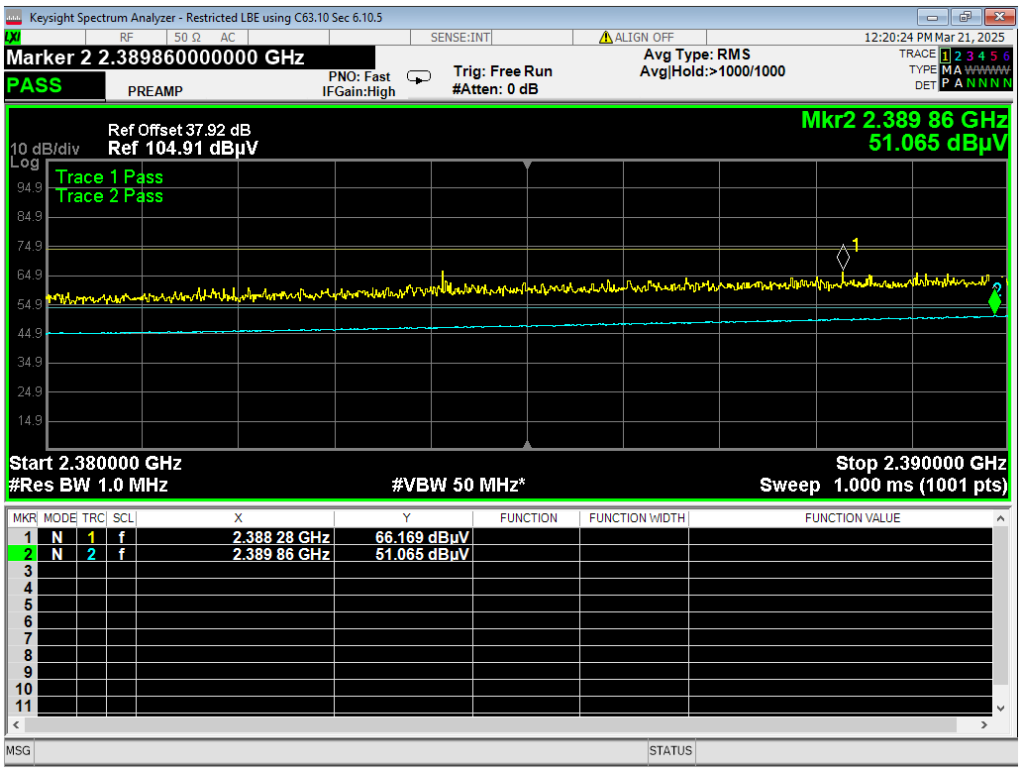
39 LBE Restricted, Wifi B 11MB, ch1, new power settings



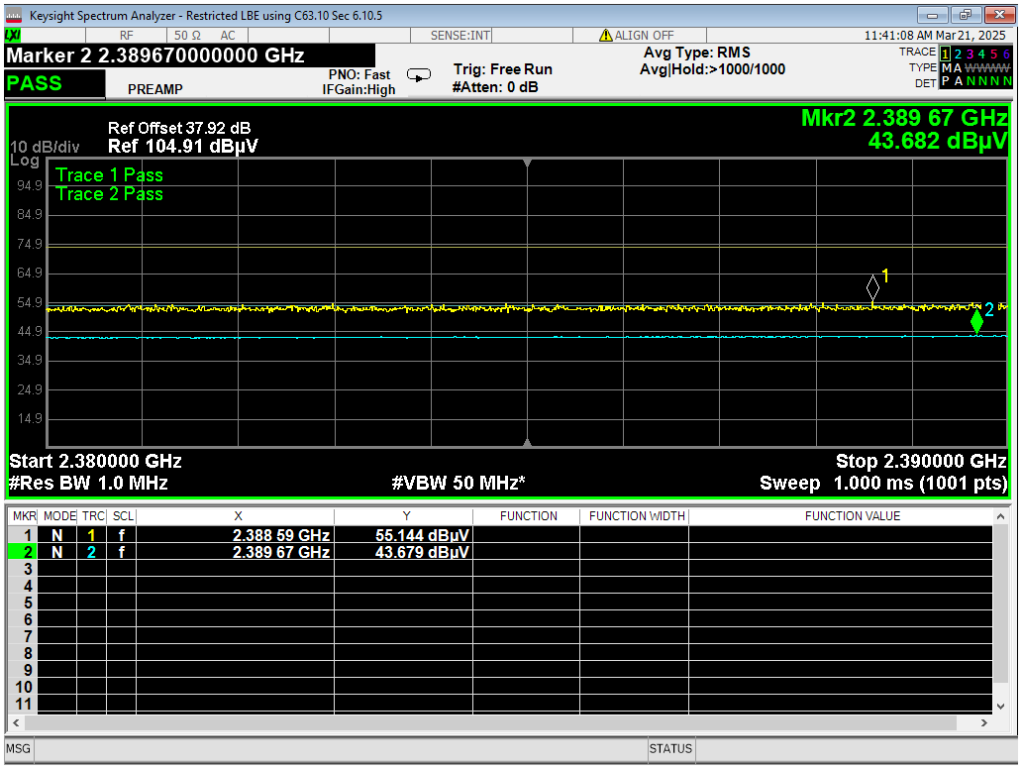
40 LBE Restricted, Wifi B 11MB, ch2, new power settings



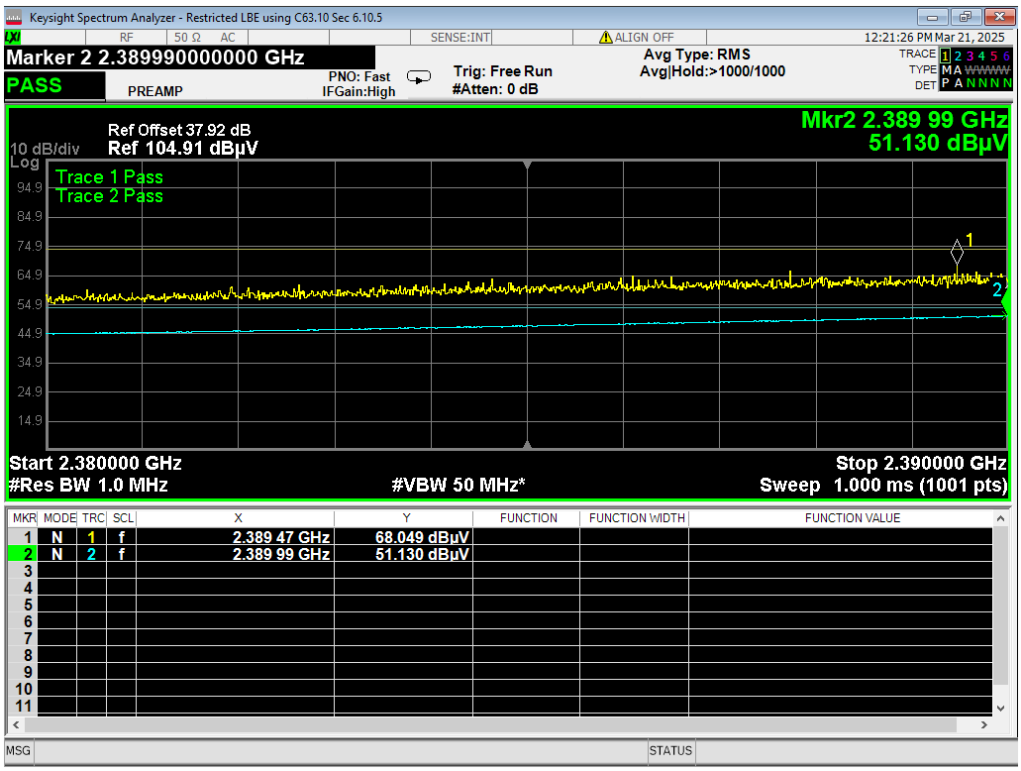
41 LBE Restricted, Wifi G 6MB, ch1, new power settings



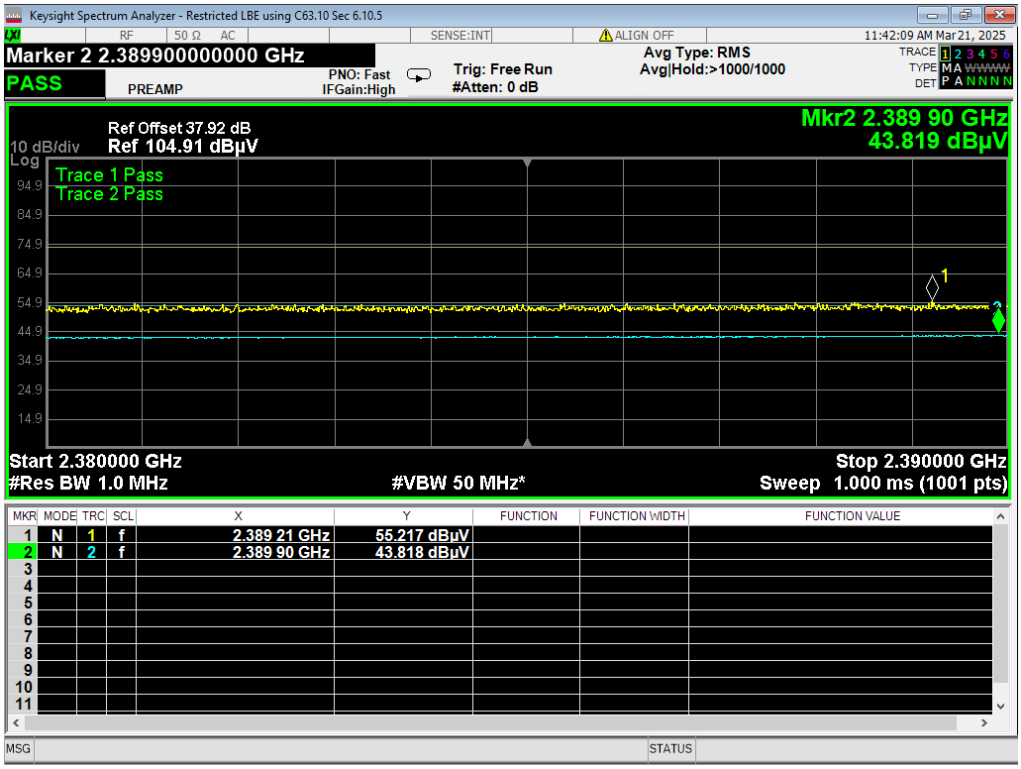
42 LBE Restricted, Wifi G 6MB, ch2, new power settings



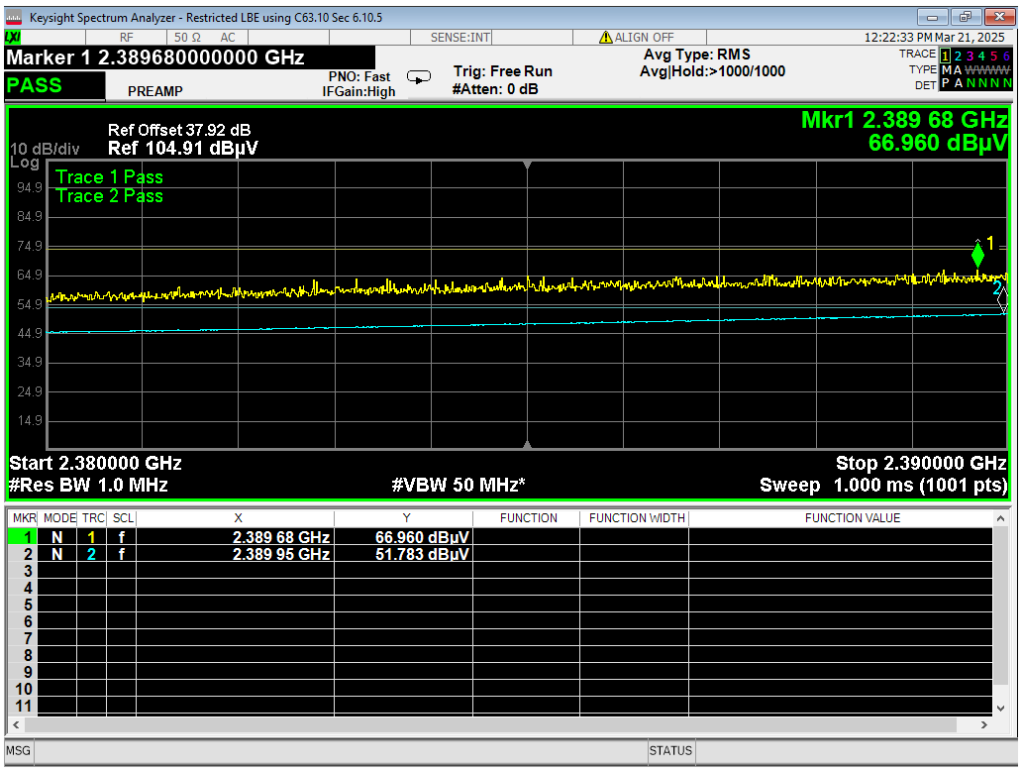
43 LBE Restricted, Wifi G 54MB, ch1, new power settings



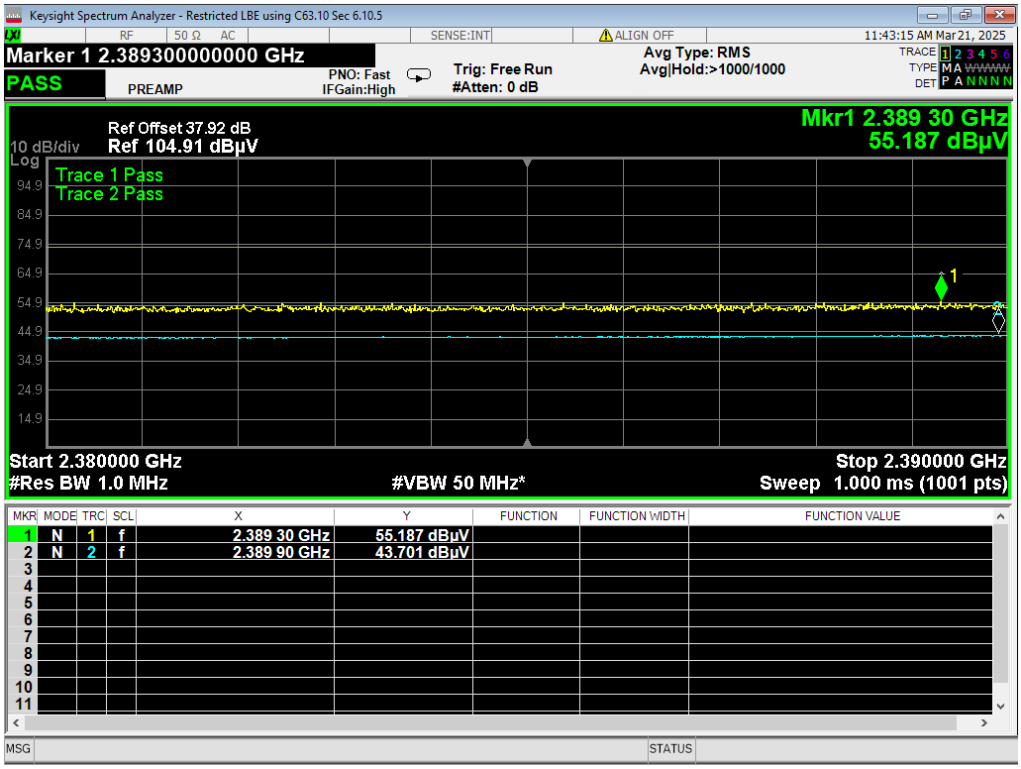
44 LBE Restricted, Wifi G 54MB, ch2, new power settings



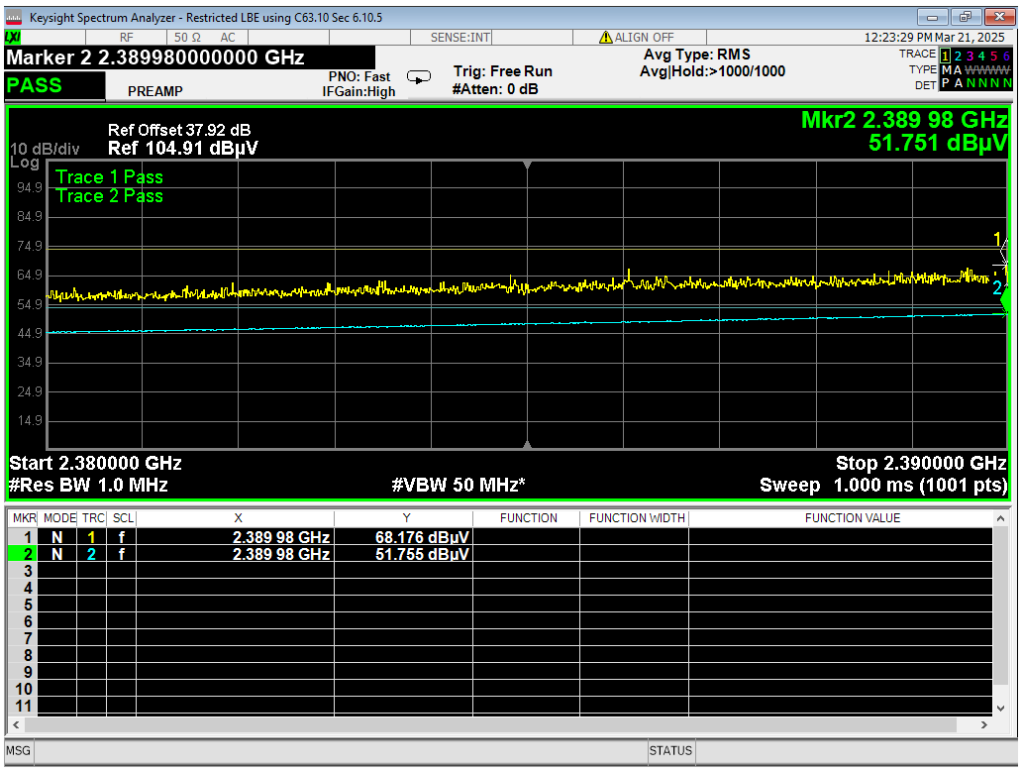
45 LBE Restricted, Wifi N MCS0, ch1, new power settings



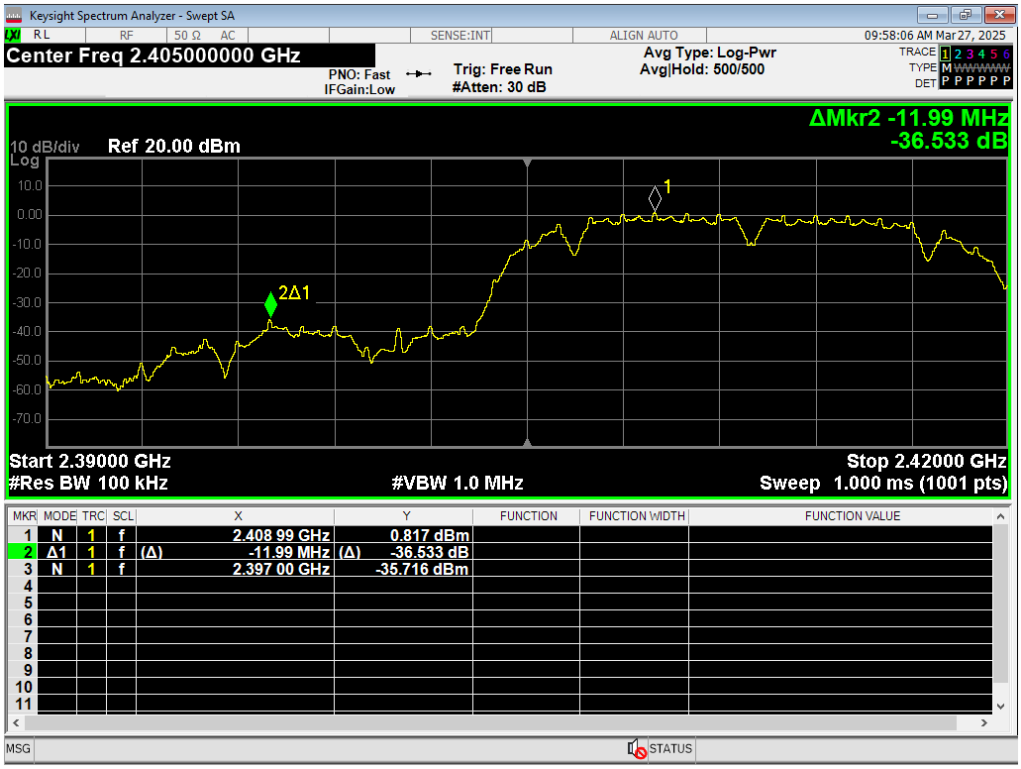
46 LBE Restricted, Wifi N MCS0, ch2, new power settings



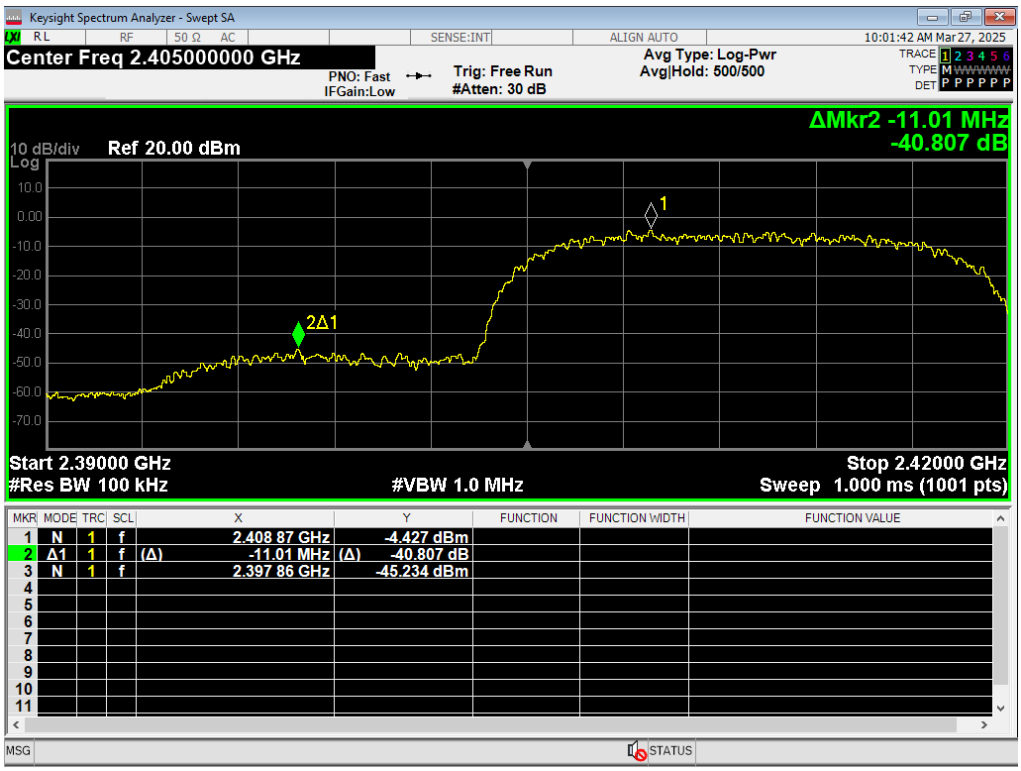
47 LBE Restricted, Wifi N MCS7, ch1, new power settings



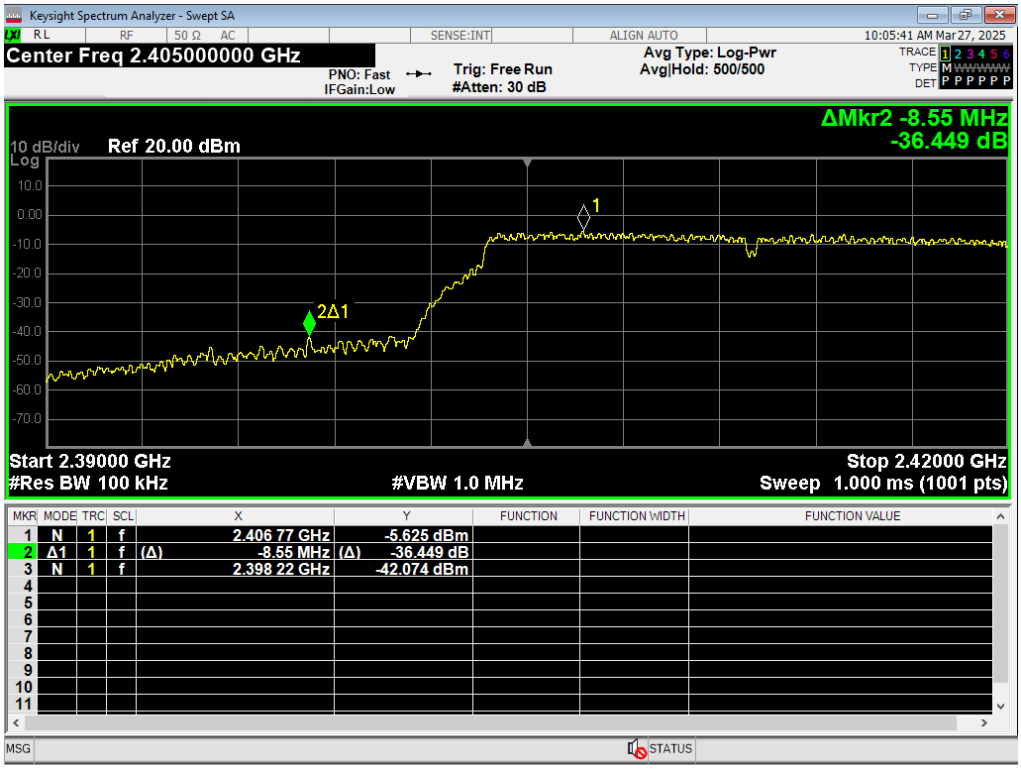
48 LBE Restricted, Wifi N MCS7, ch2, new power settings



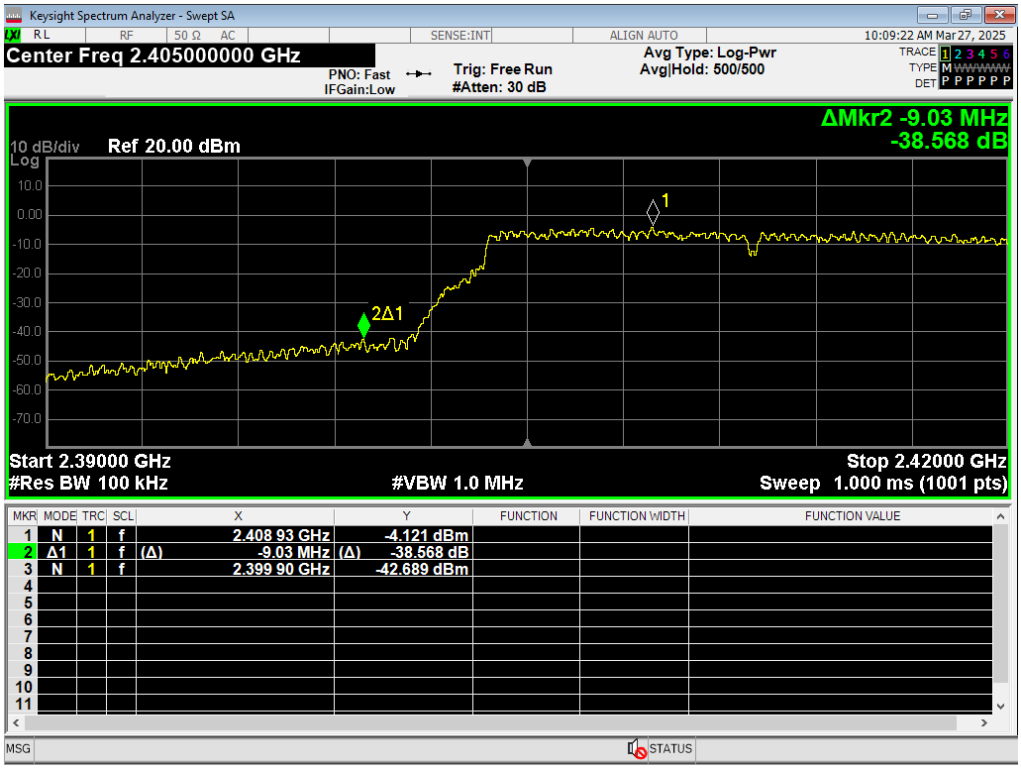
49 LBE Unrestricted, WiFi B 1MB



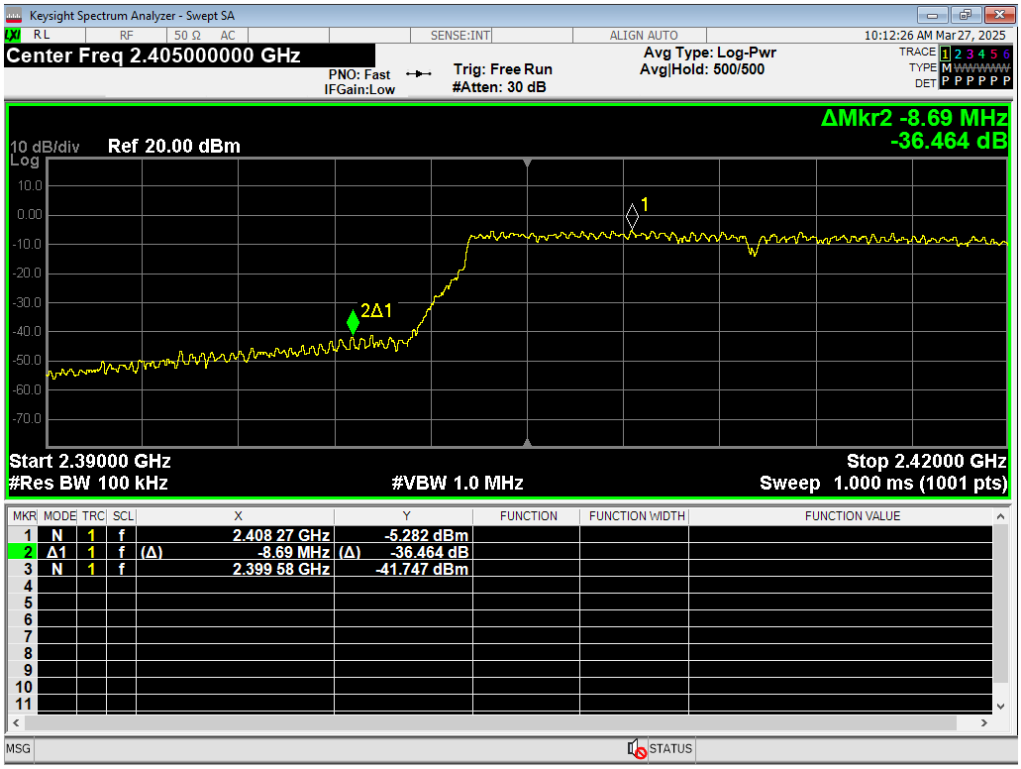
50 LBE Unrestricted, WiFi B 11MB



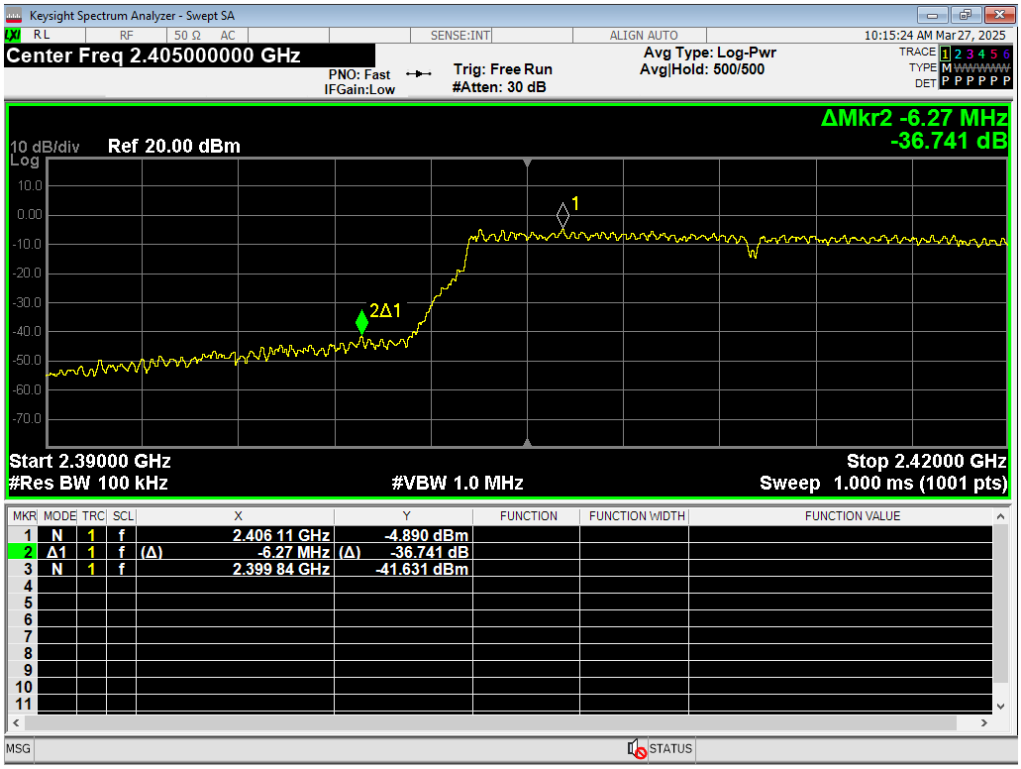
51 LBE Unrestricted, WiFi G 6MB



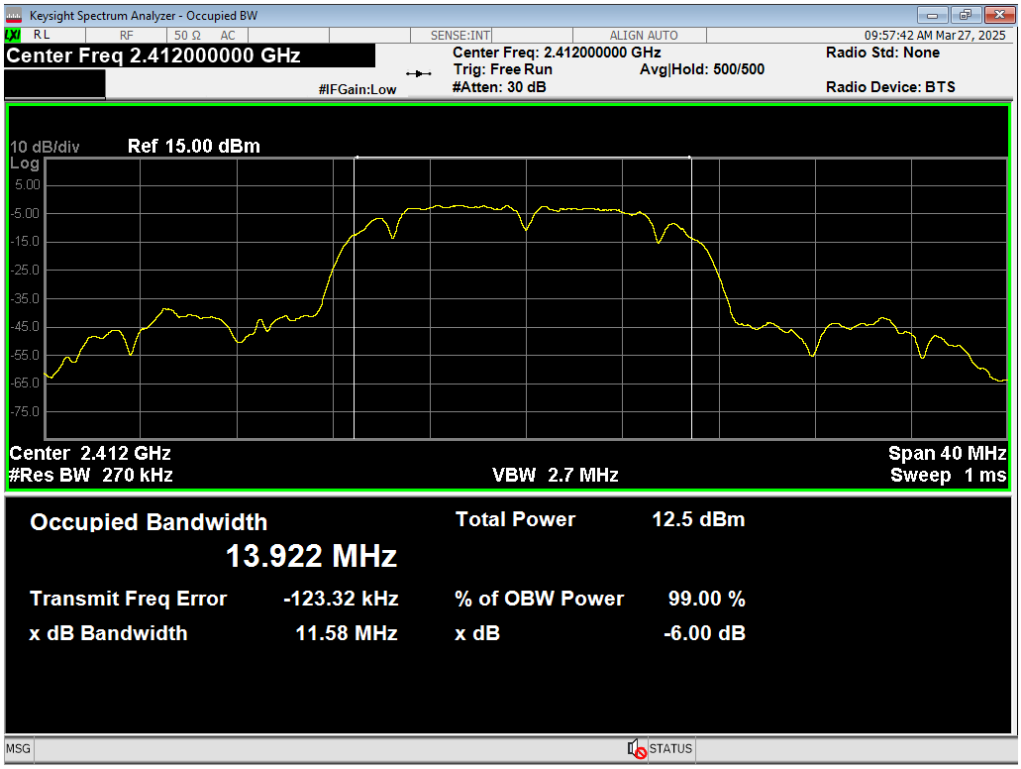
52 LBE Unrestricted, WiFi G 54MB



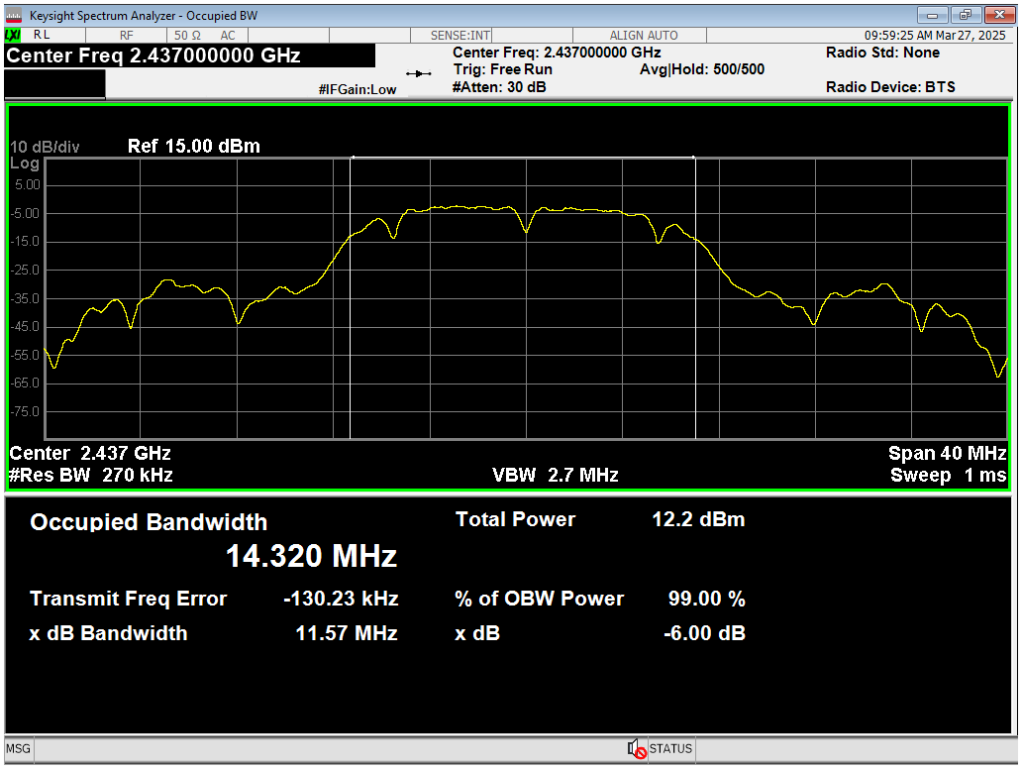
53 LBE Unrestricted, WiFi N MCS0



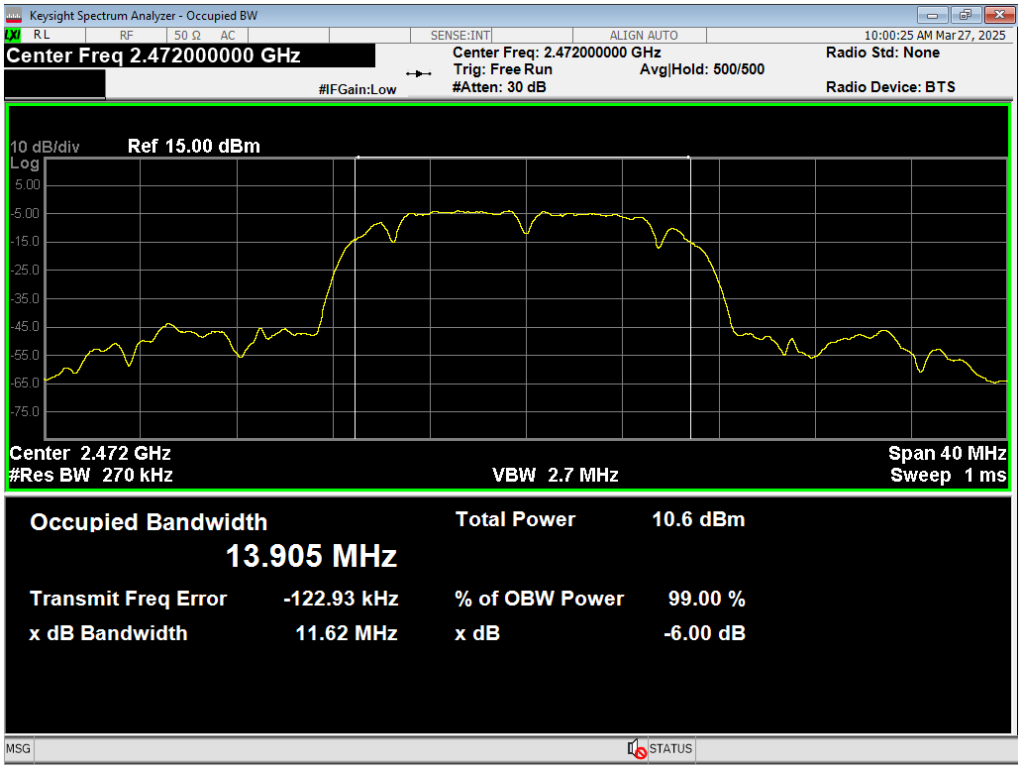
54 LBE Unrestricted, WiFi N MCS7



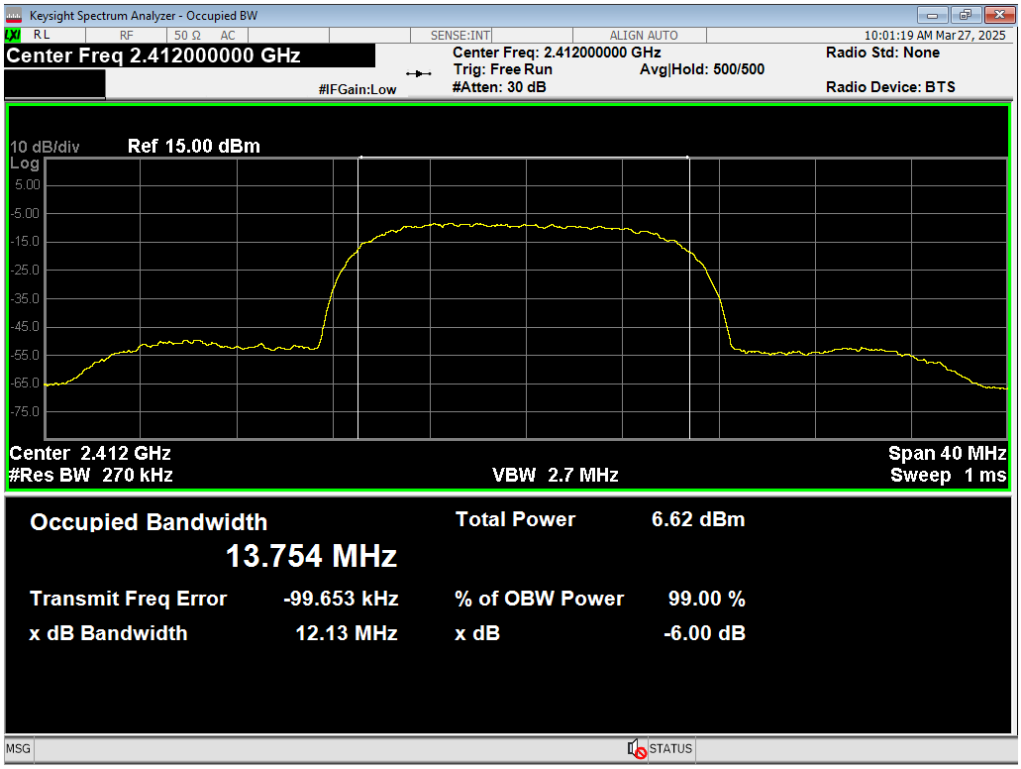
55 Occupied BW, WiFi B 1MB, 2412MHz



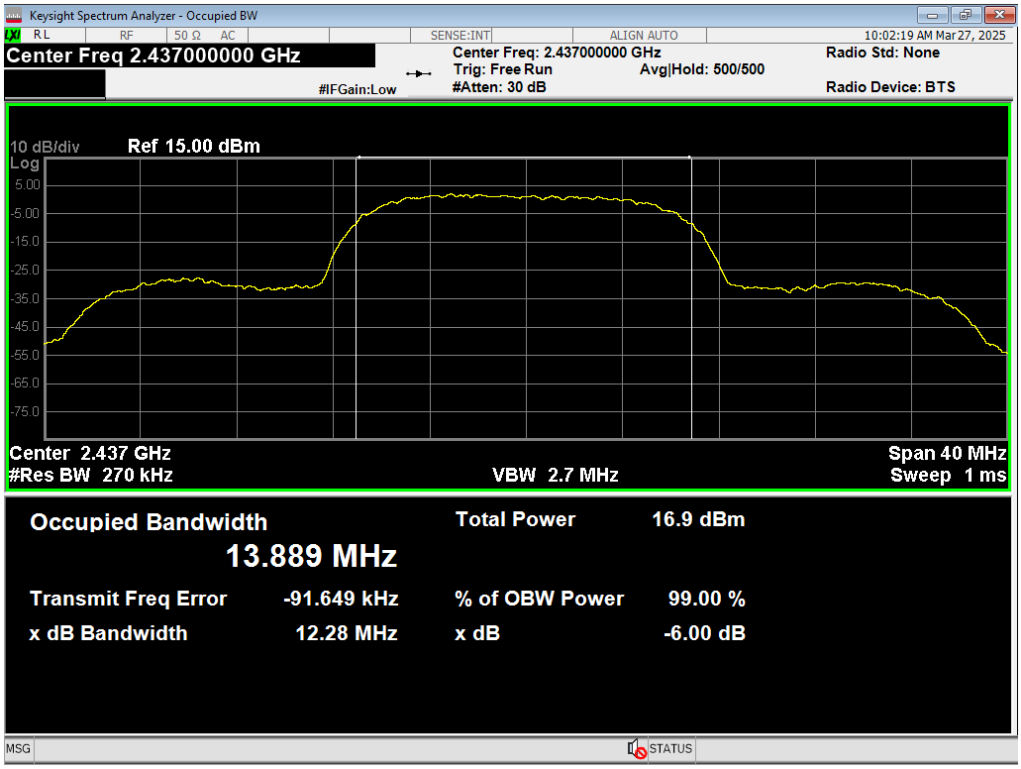
56 Occupied BW, WiFi B 1MB, 2437MHz



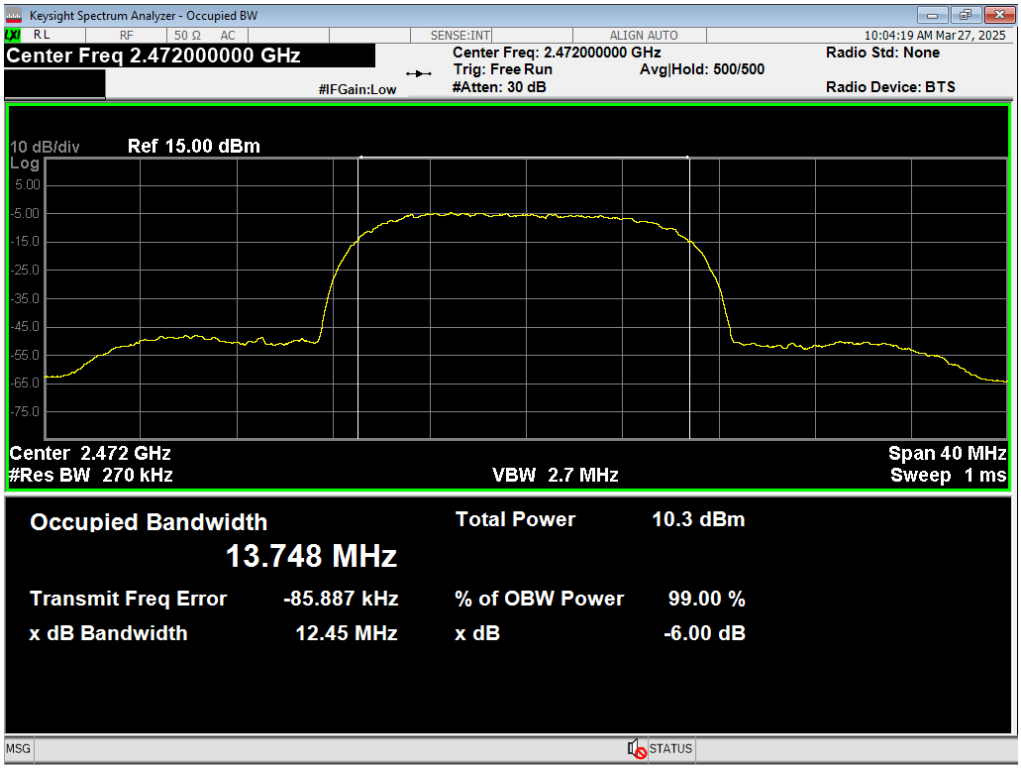
57 Occupied BW, WiFi B 1MB, 2472MHz



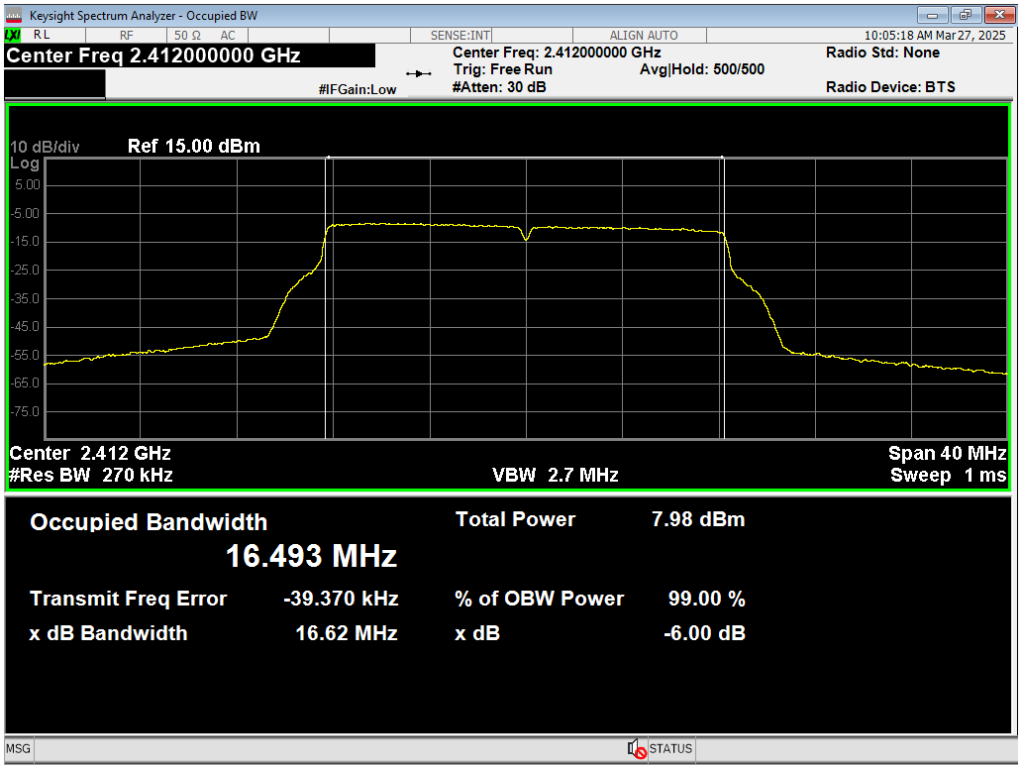
58 Occupied BW, WiFi B 11MB, 2412MHz



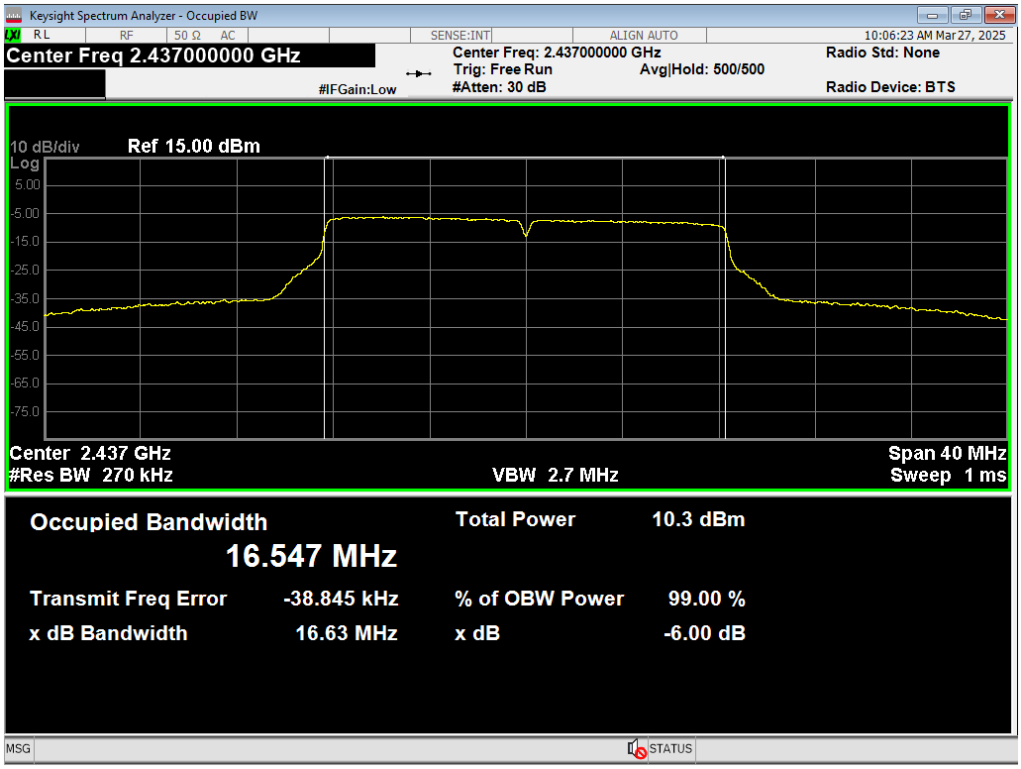
59 Occupied BW, WiFi B 11MB, 2437MHz



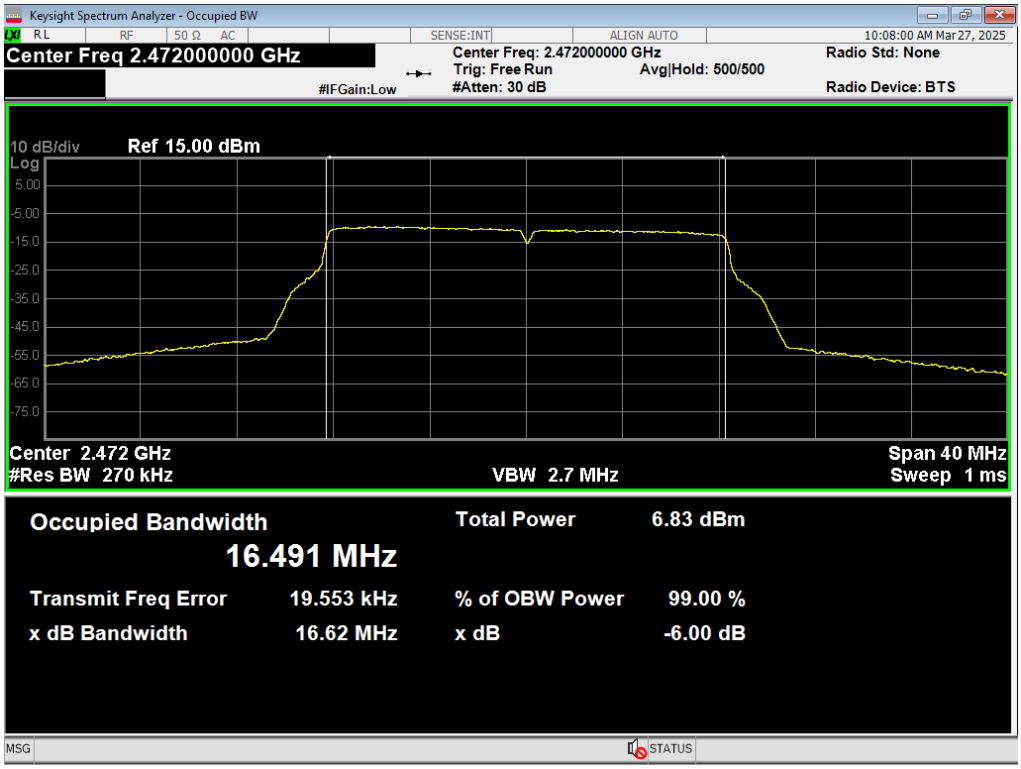
60 Occupied BW, WiFi B 11MB, 2472MHz



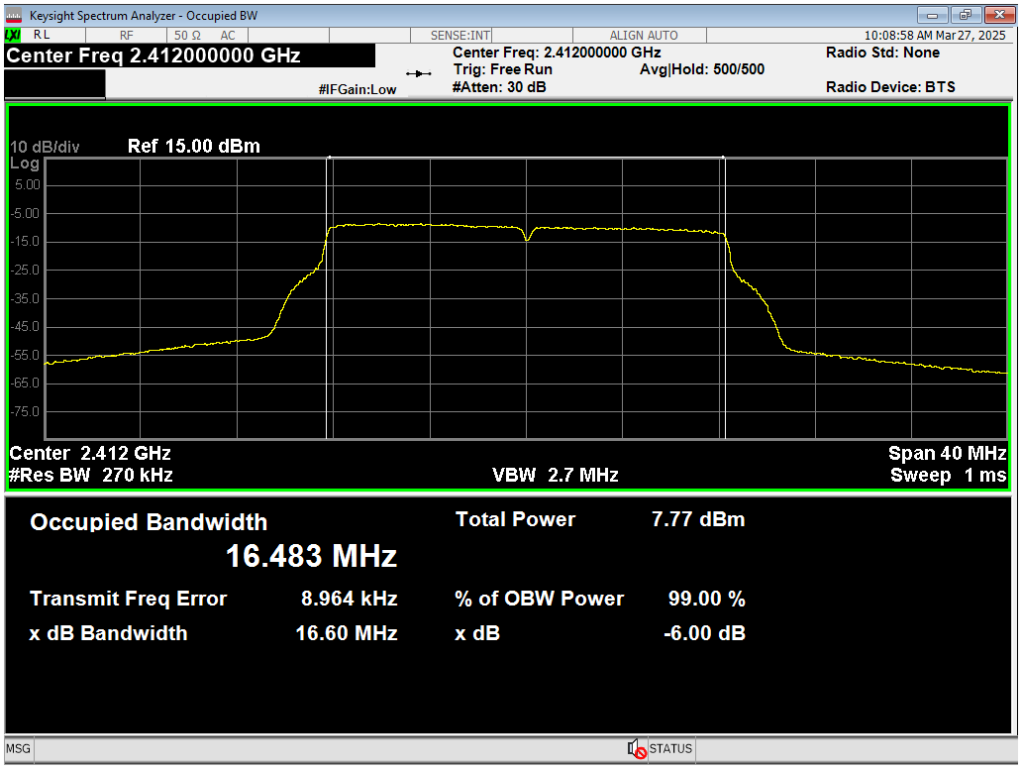
61 Occupied BW, WiFi G 6MB, 2412MHz



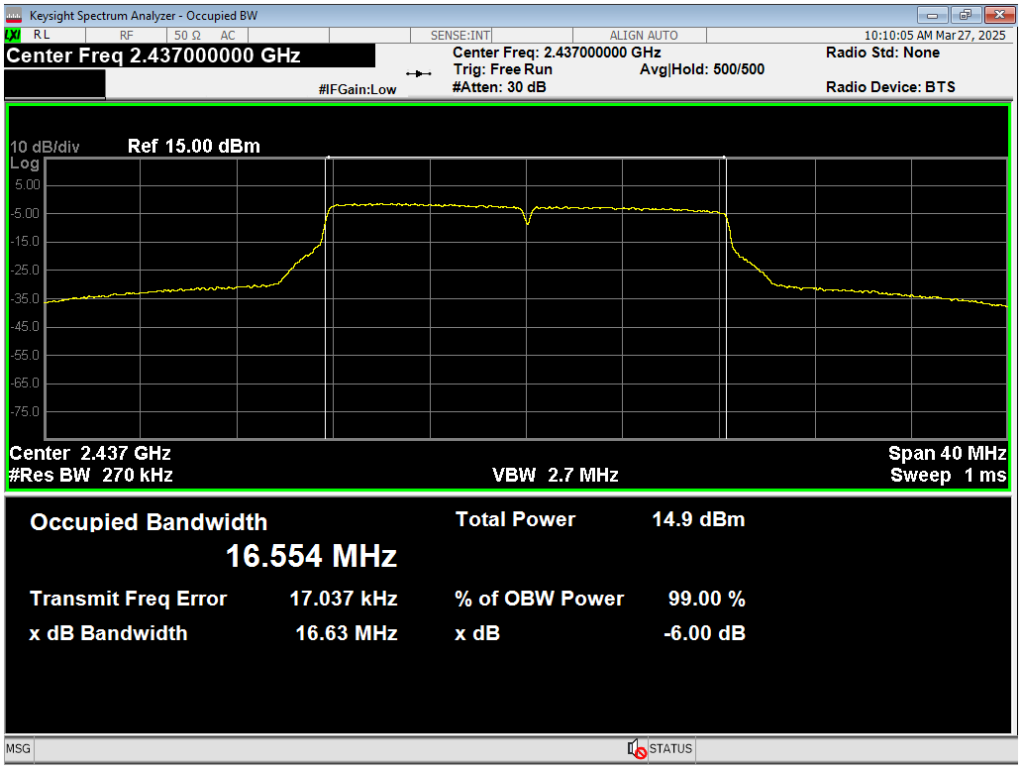
62 Occupied BW, WiFi G 6MB, 2437MHz



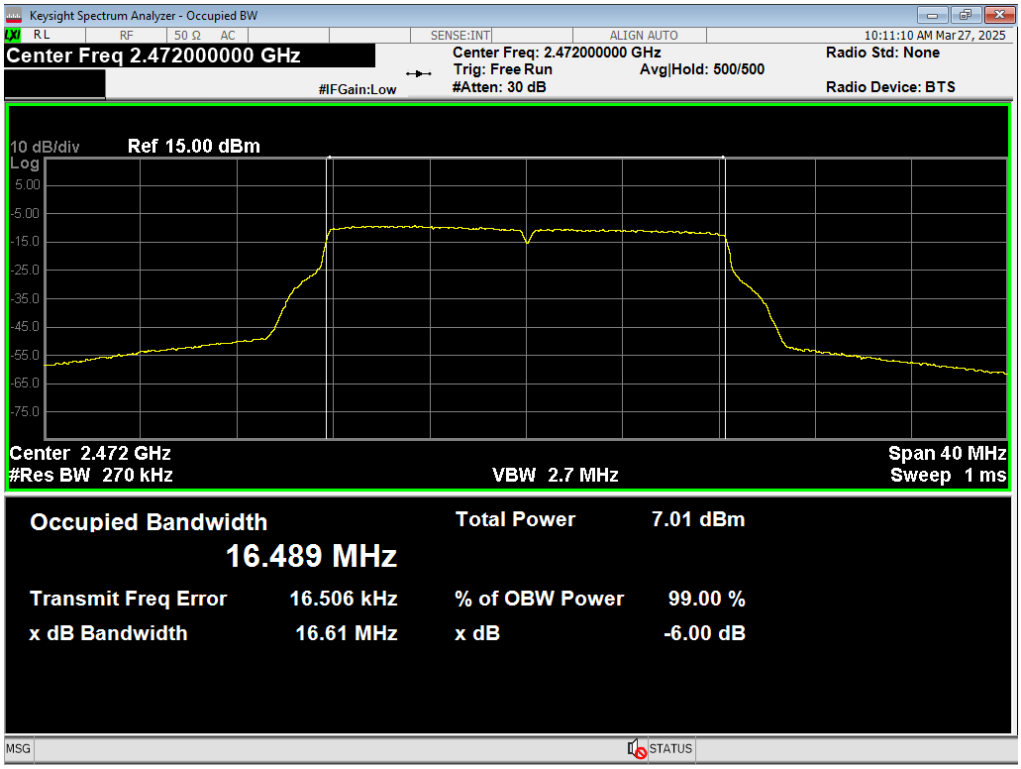
63 Occupied BW, WiFi G 6MB, 2472MHz



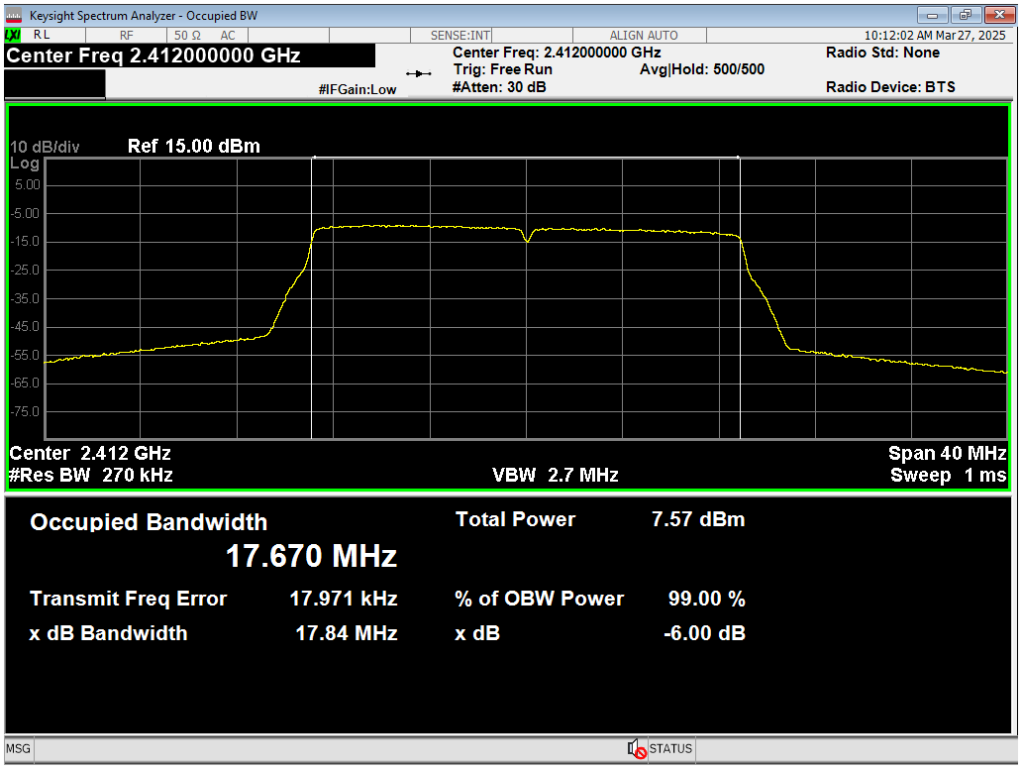
64 Occupied BW, WiFi G 54MB, 2412MHz



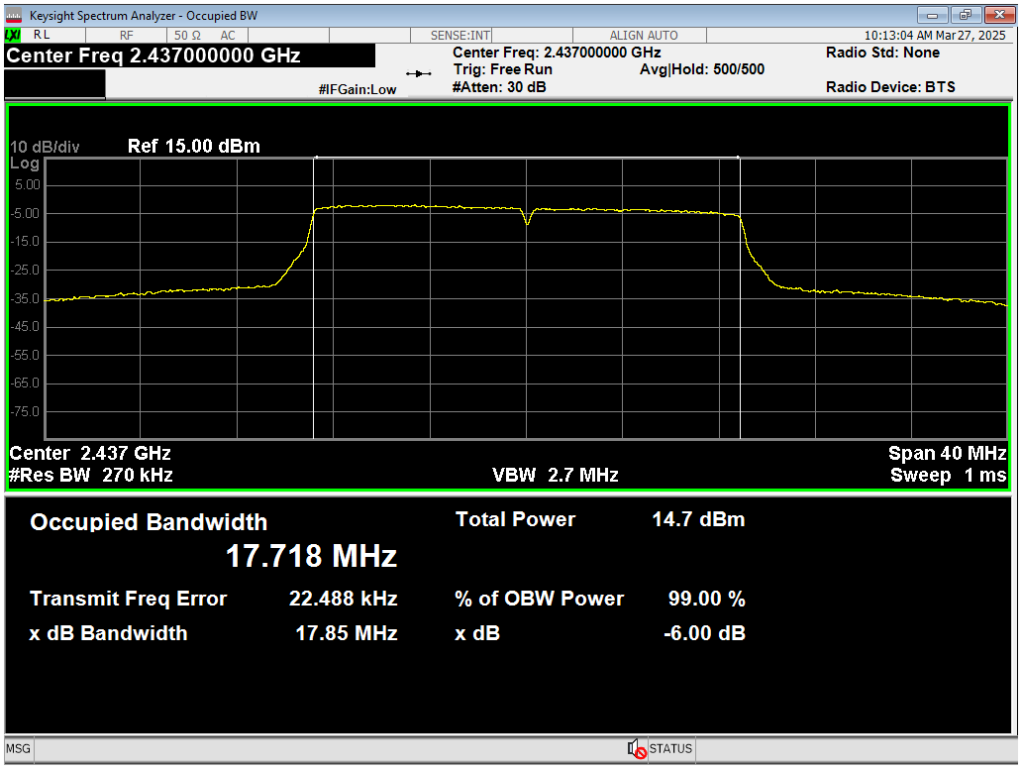
65 Occupied BW, WiFi G 54MB, 2437MHz



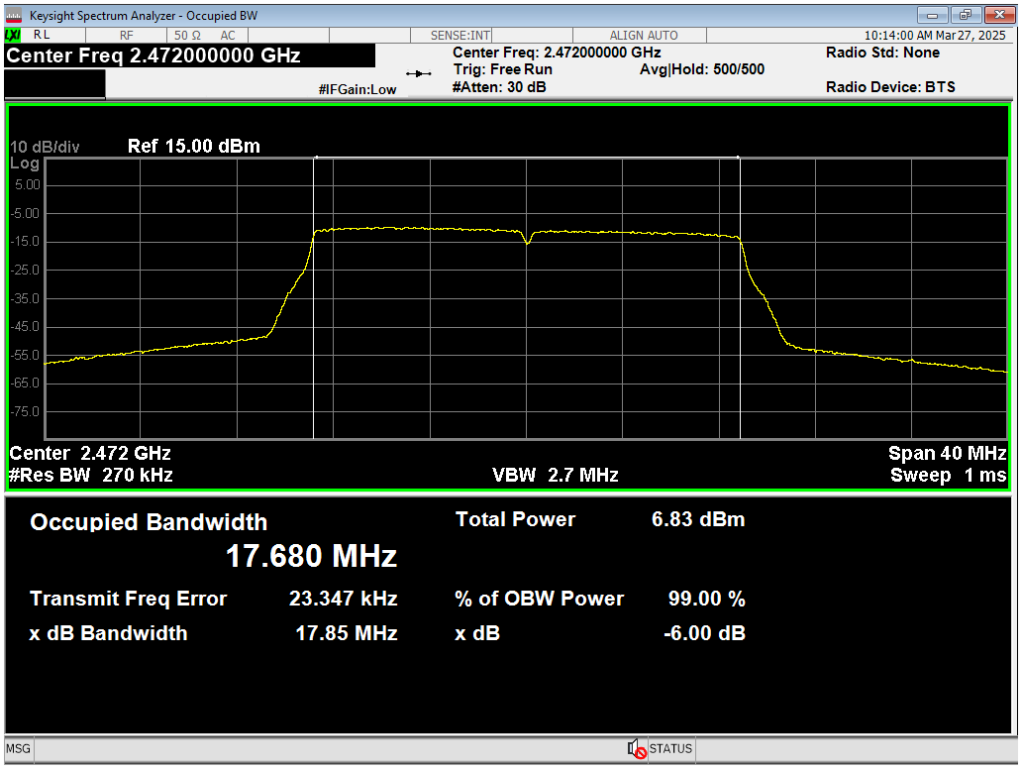
66 Occupied BW, WiFi G 54MB, 2472MHz



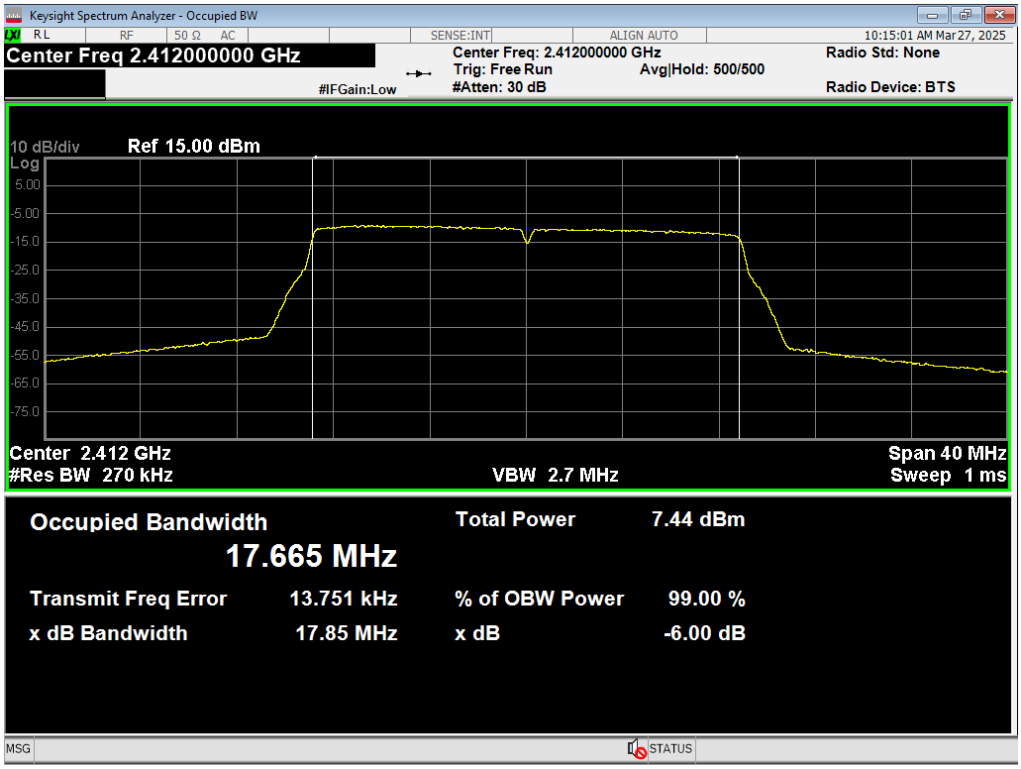
67 Occupied BW, WiFi N MCS0, 2412MHz



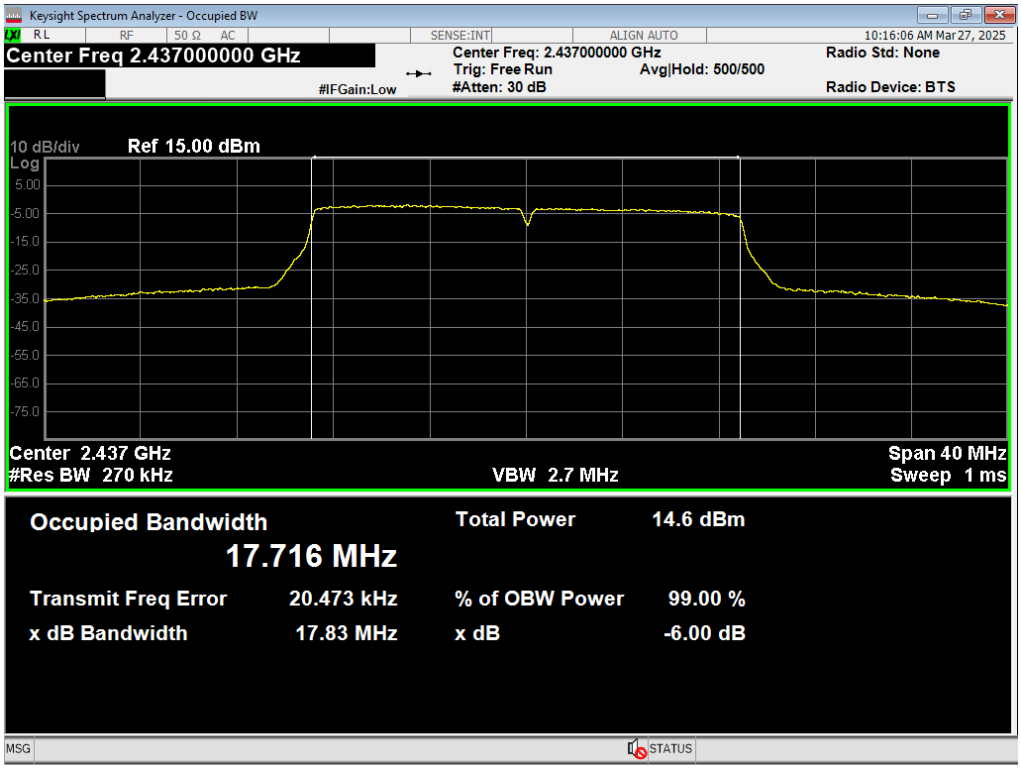
68 Occupied BW, WiFi N MCS0, 2437MHz



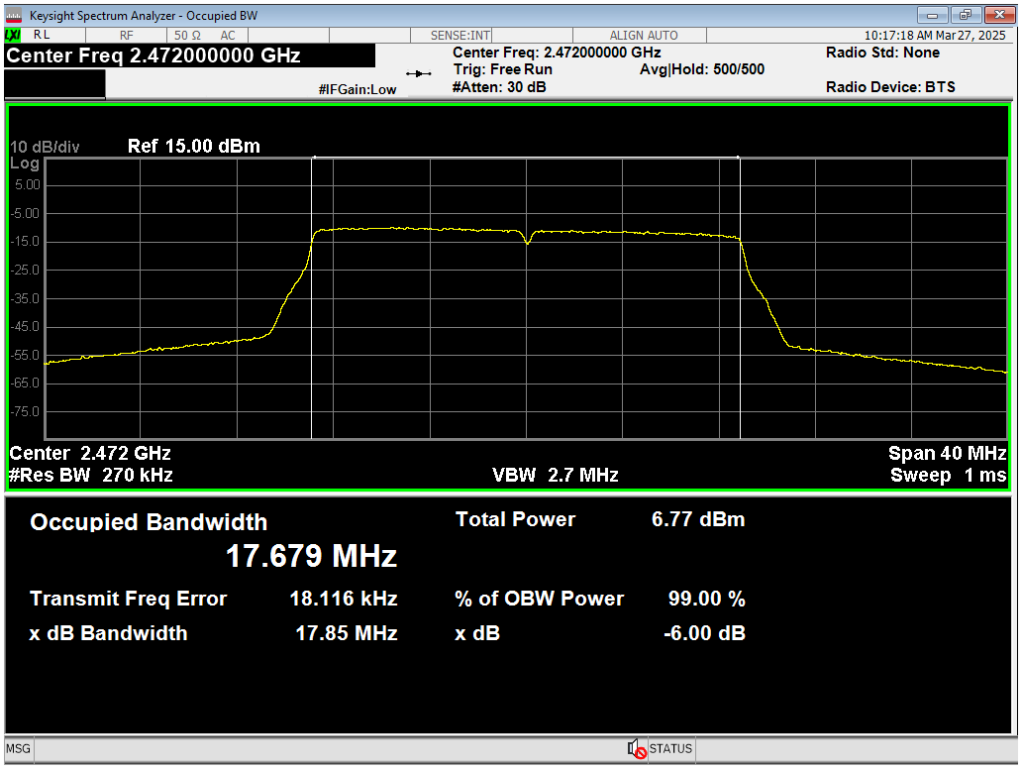
69 Occupied BW, WiFi N MCS0, 2472MHz



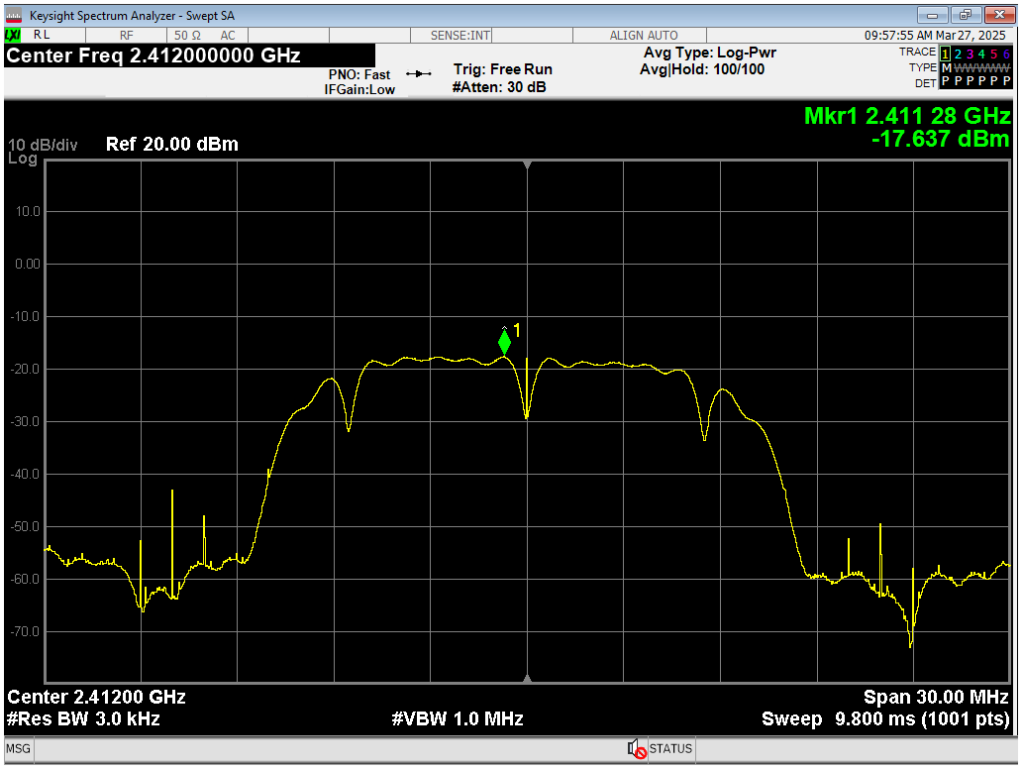
70 Occupied BW, WiFi N MCS7, 2412MHz



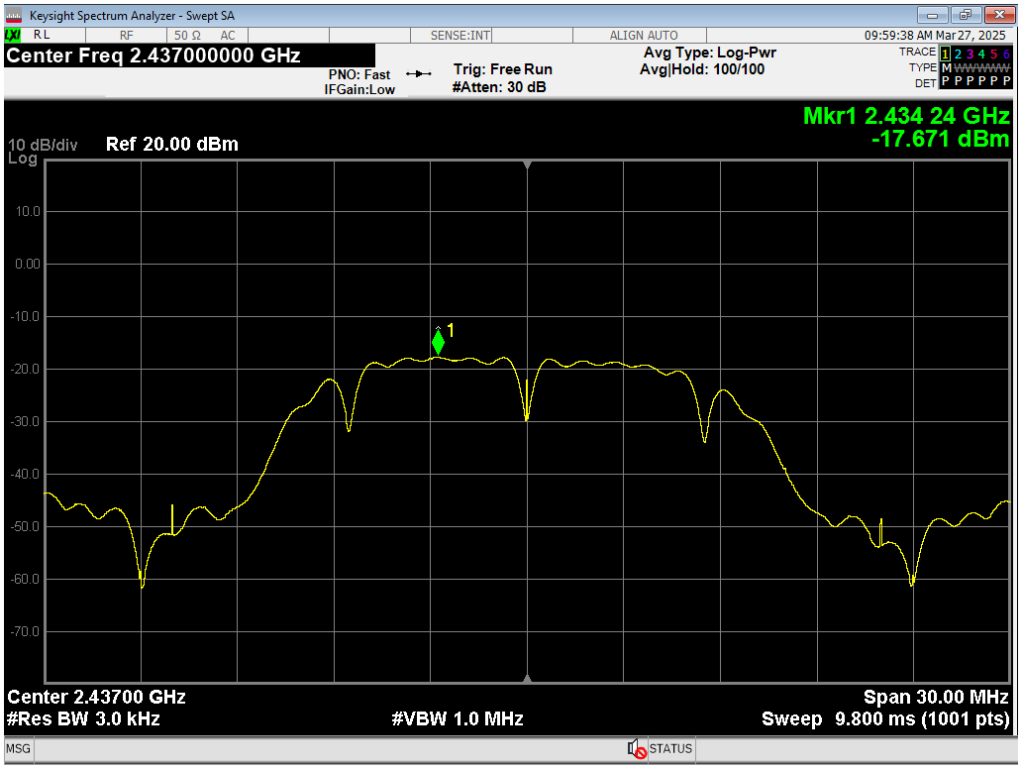
71 Occupied BW, WiFi N MCS7, 2437MHz



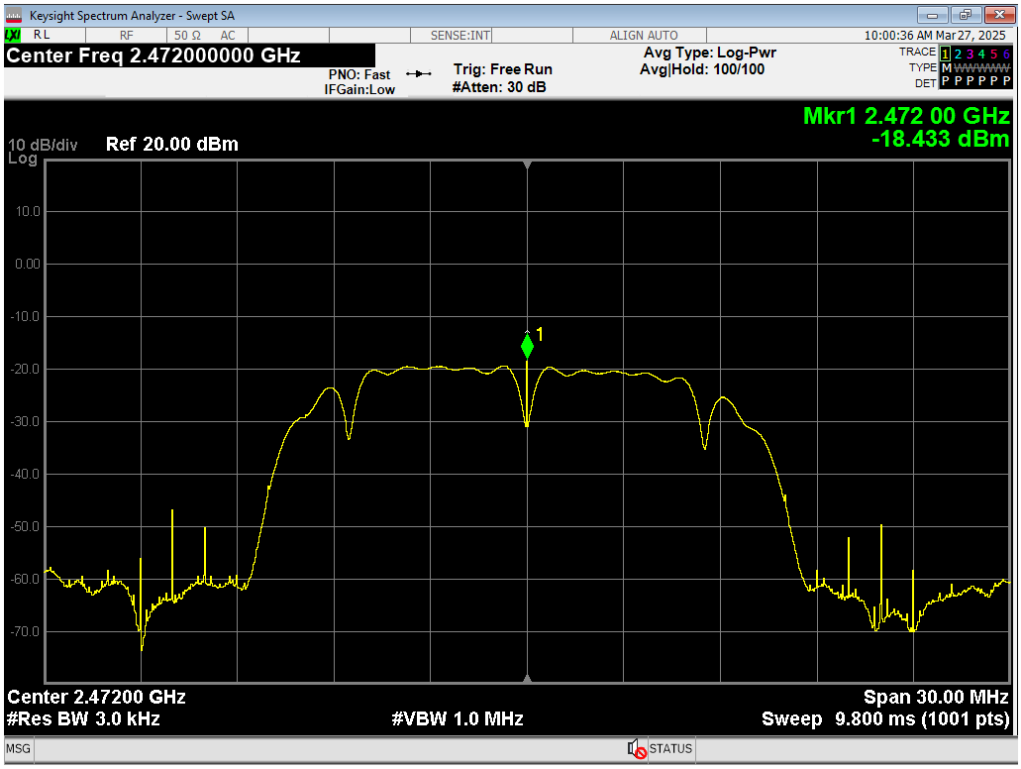
72 Occupied BW, WiFi N MCS7, 2472MHz



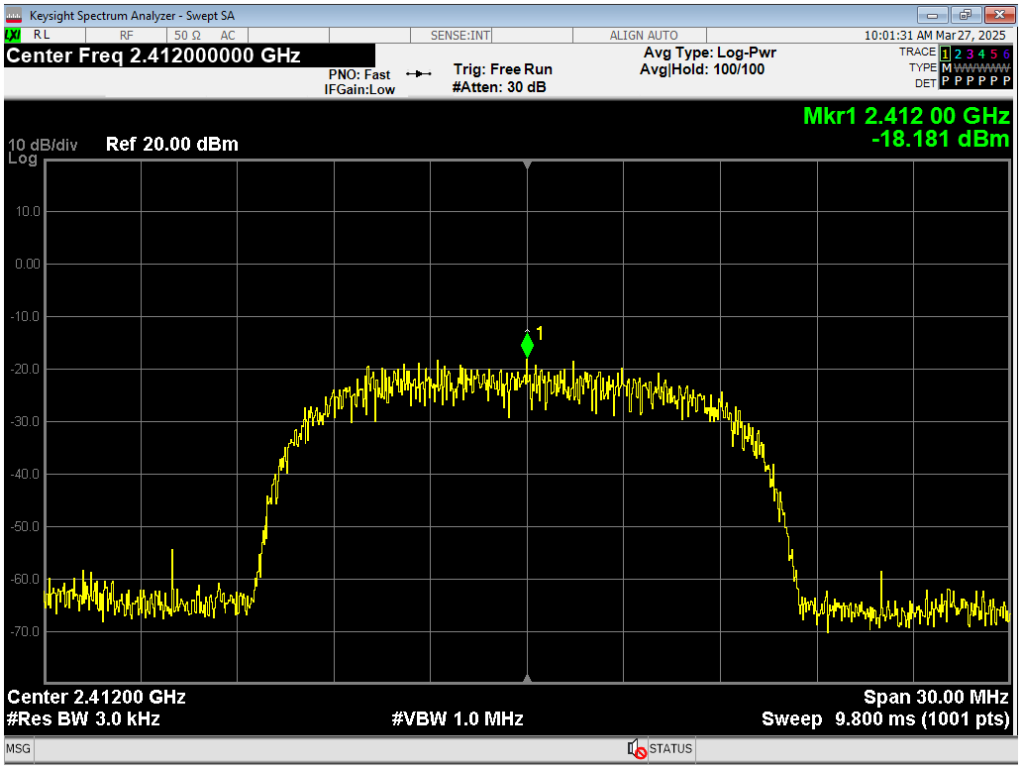
73 PSD, WiFi B 1MB, 2412MHz



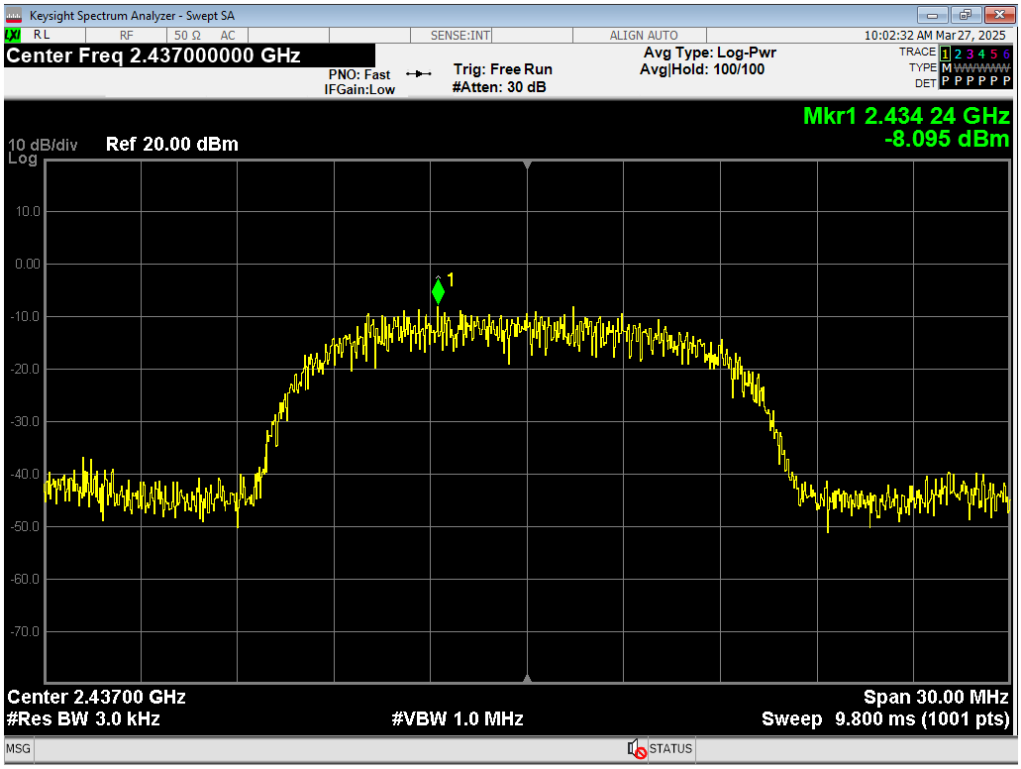
74 PSD, WiFi B 1MB, 2437MHz



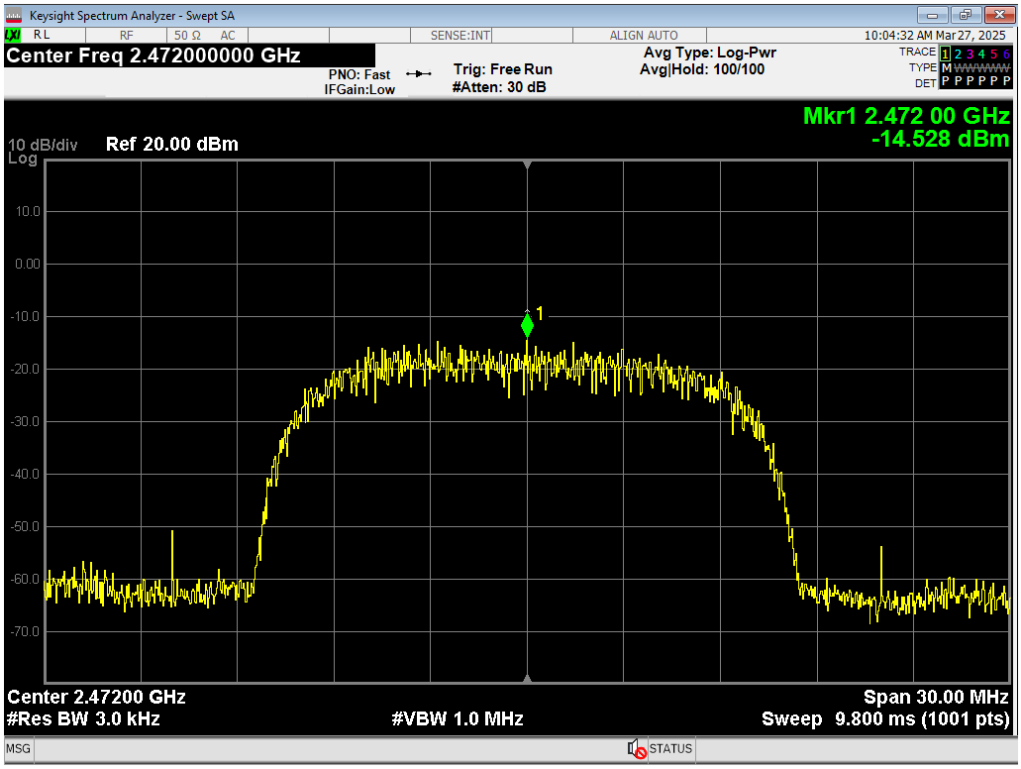
75 PSD, WiFi B 1MB, 2472MHz



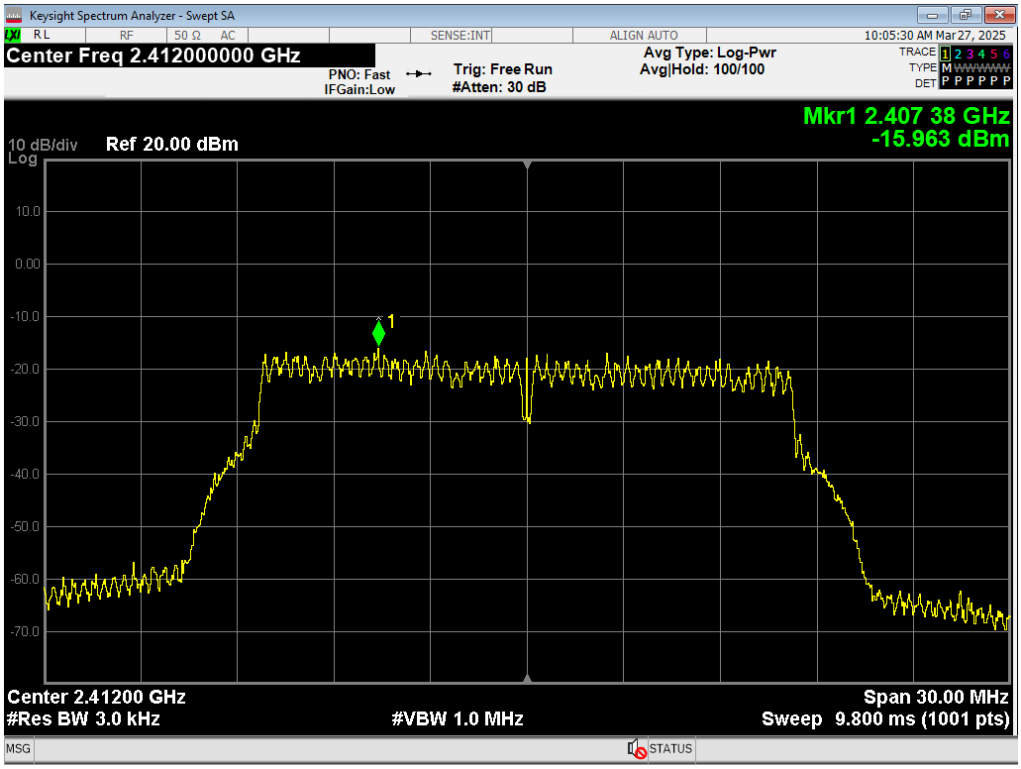
76 PSD, WiFi B 11MB, 2412MHz



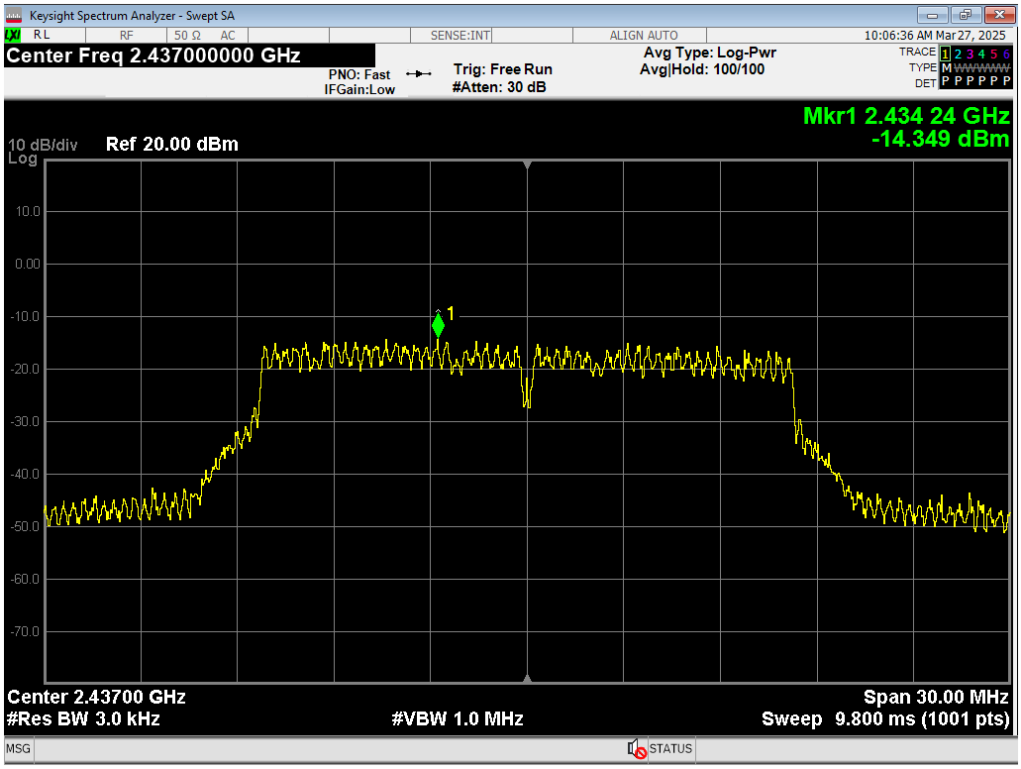
77 PSD, WiFi B 11MB, 2437MHz



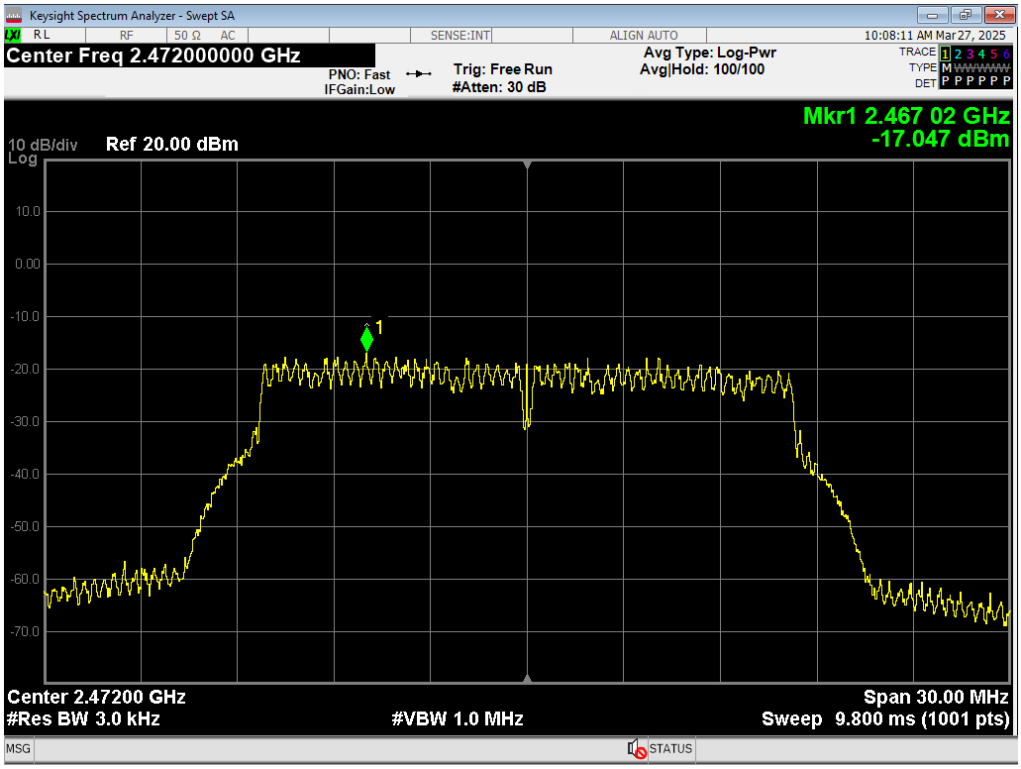
78 PSD, WiFi B 11MB, 2472MHz



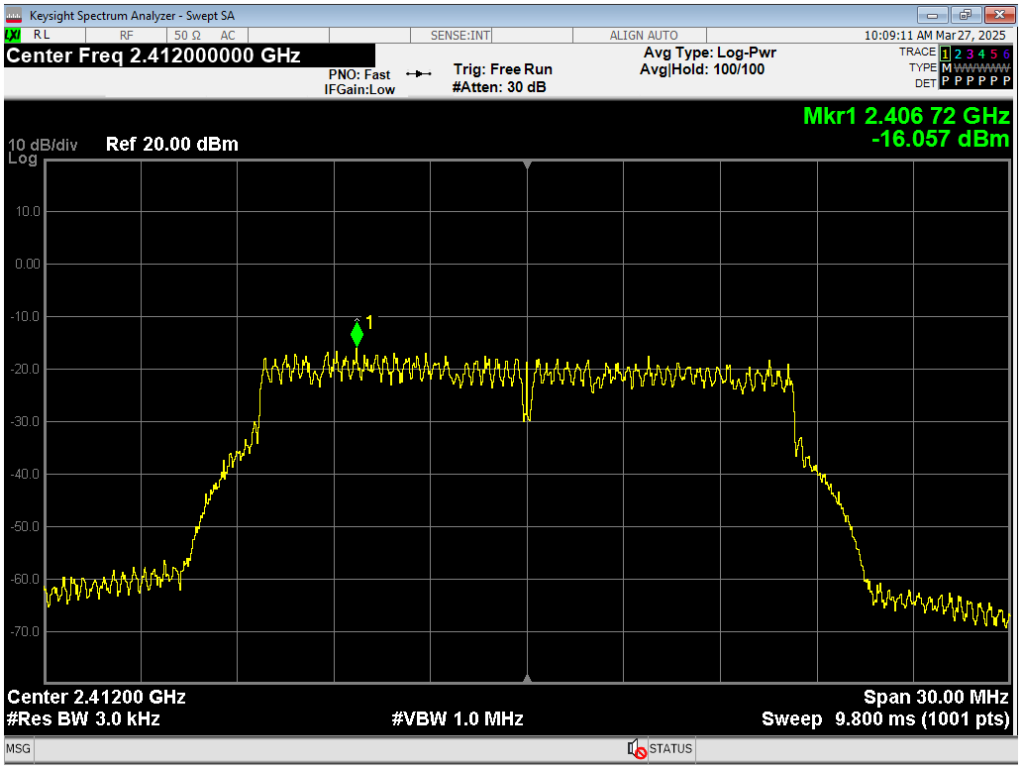
79 PSD, WiFi G 6MB, 2412MHz



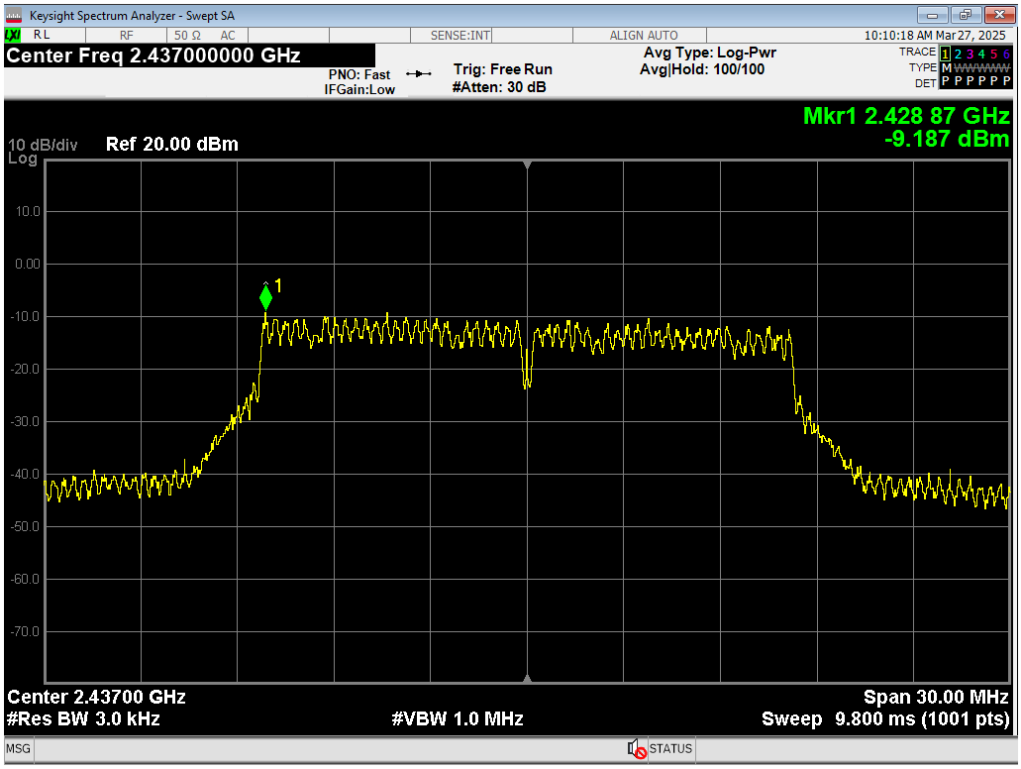
80 PSD, WiFi G 6MB, 2437MHz



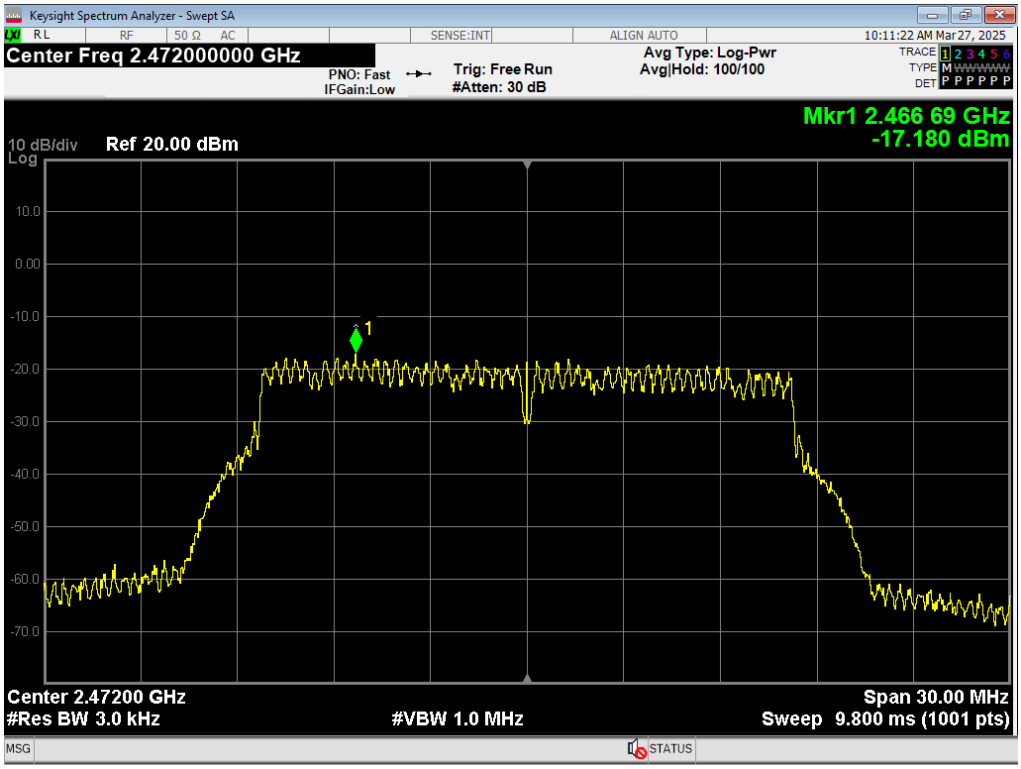
81 PSD, WiFi G 6MB, 2472MHz



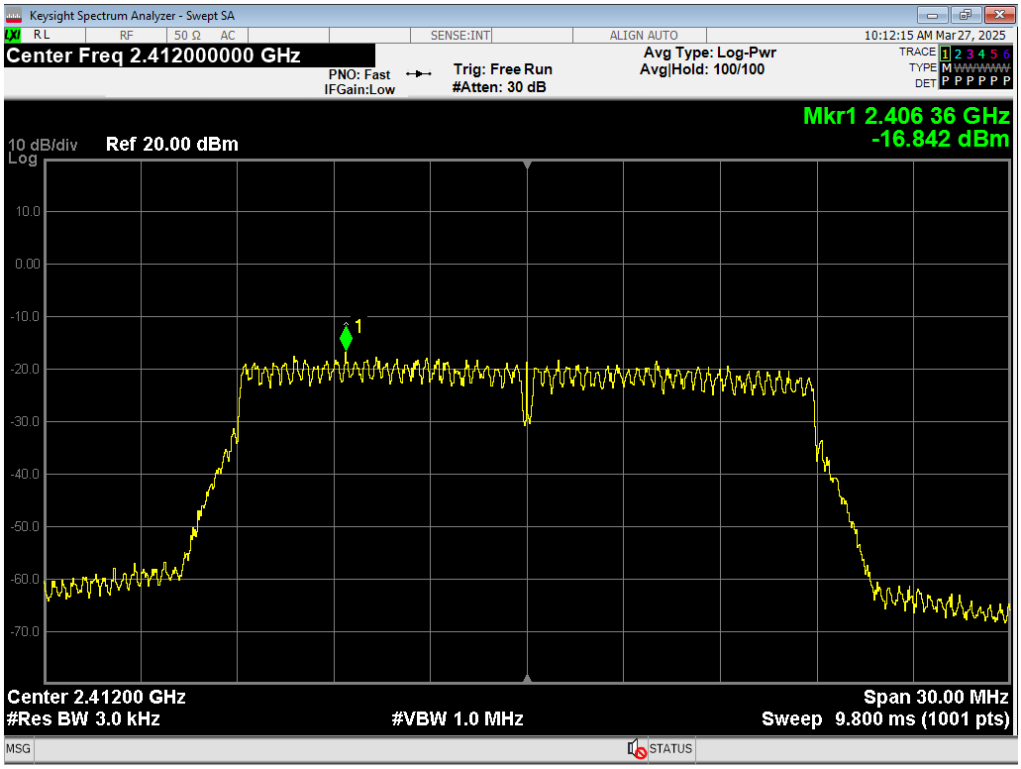
82 PSD, WiFi G 54MB, 2412MHz



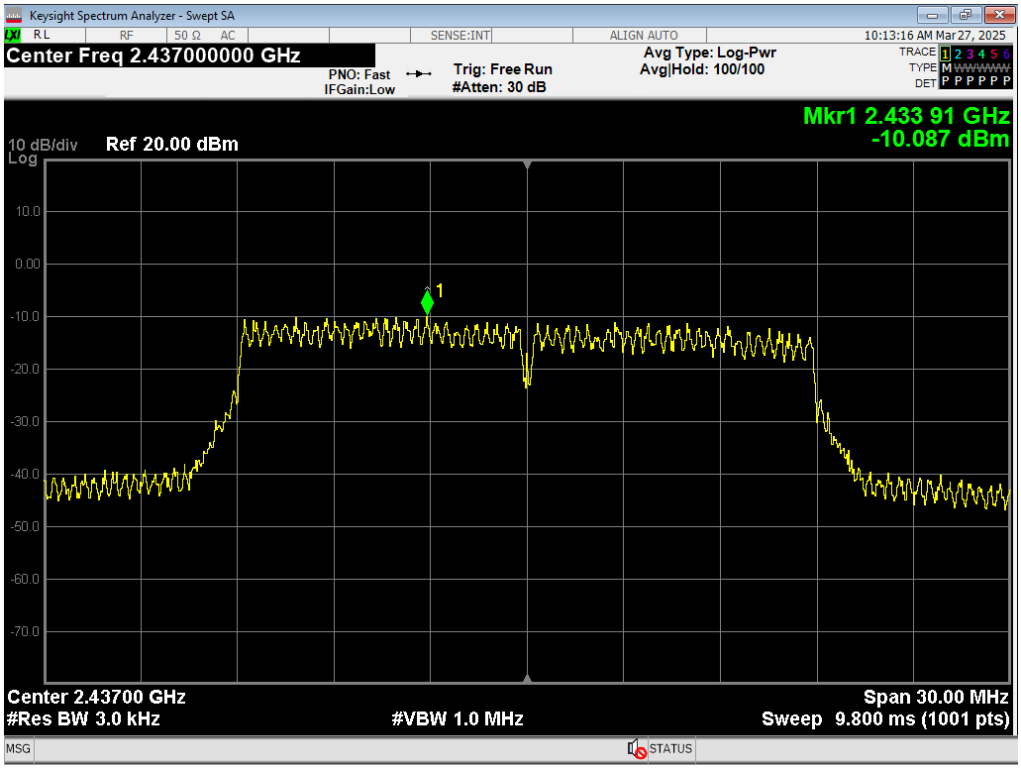
83 PSD, WiFi G 54MB, 2437MHz



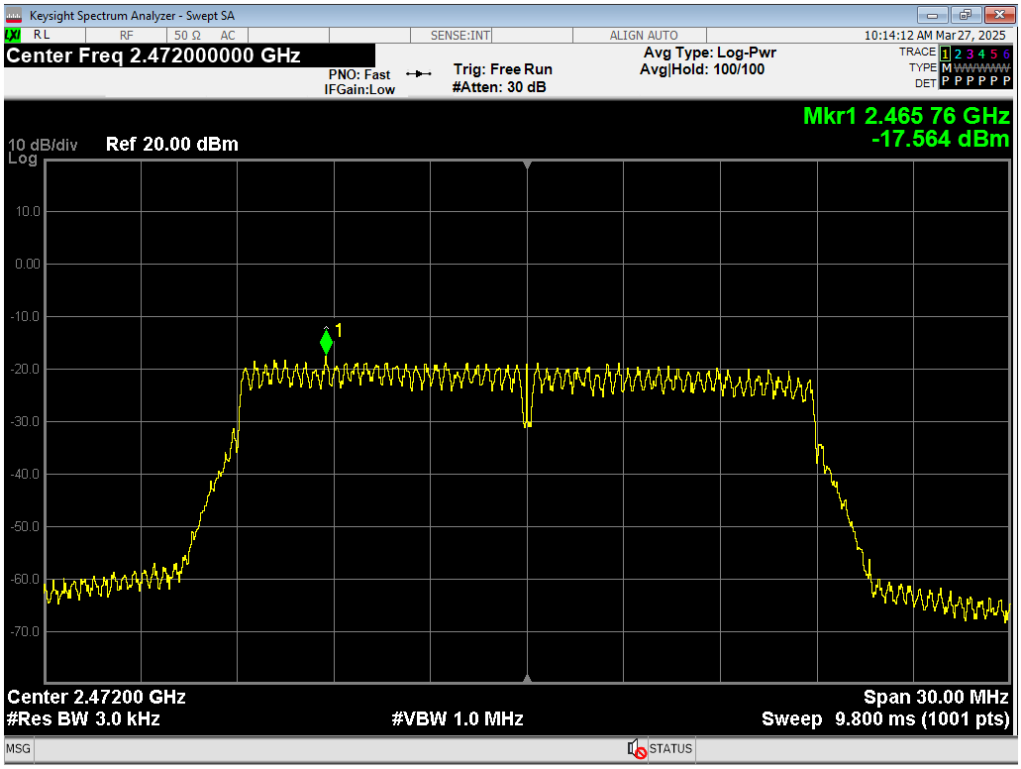
84 PSD, WiFi G 54MB, 2472MHz



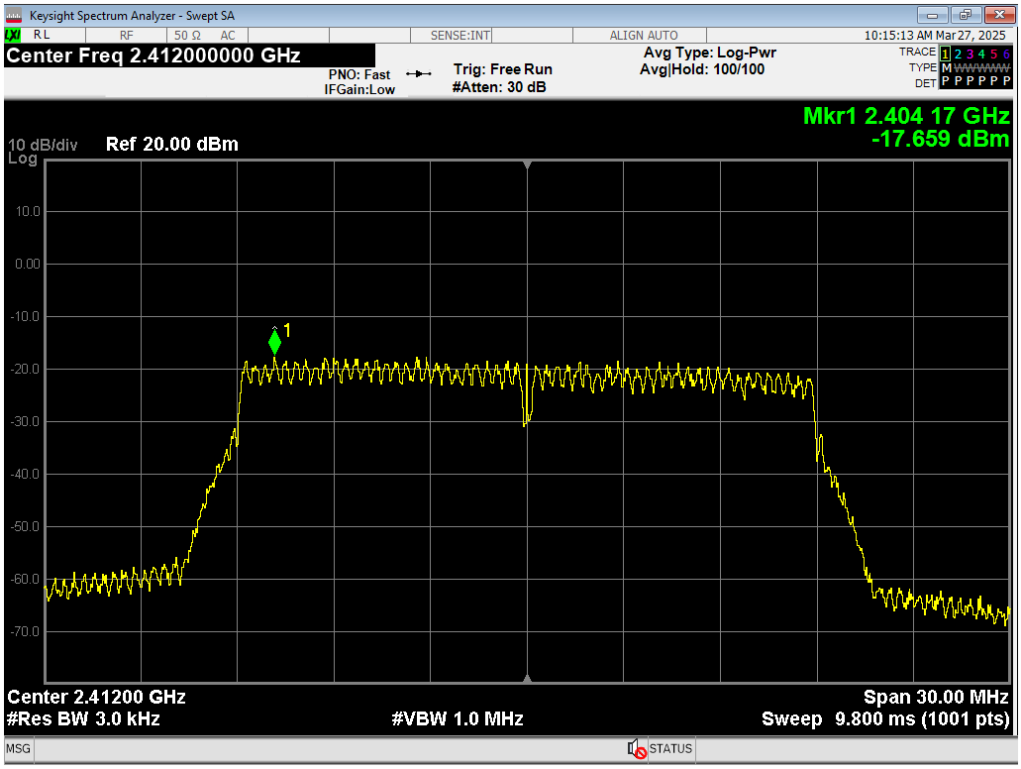
85 PSD, WiFi N MCS0, 2412MHz



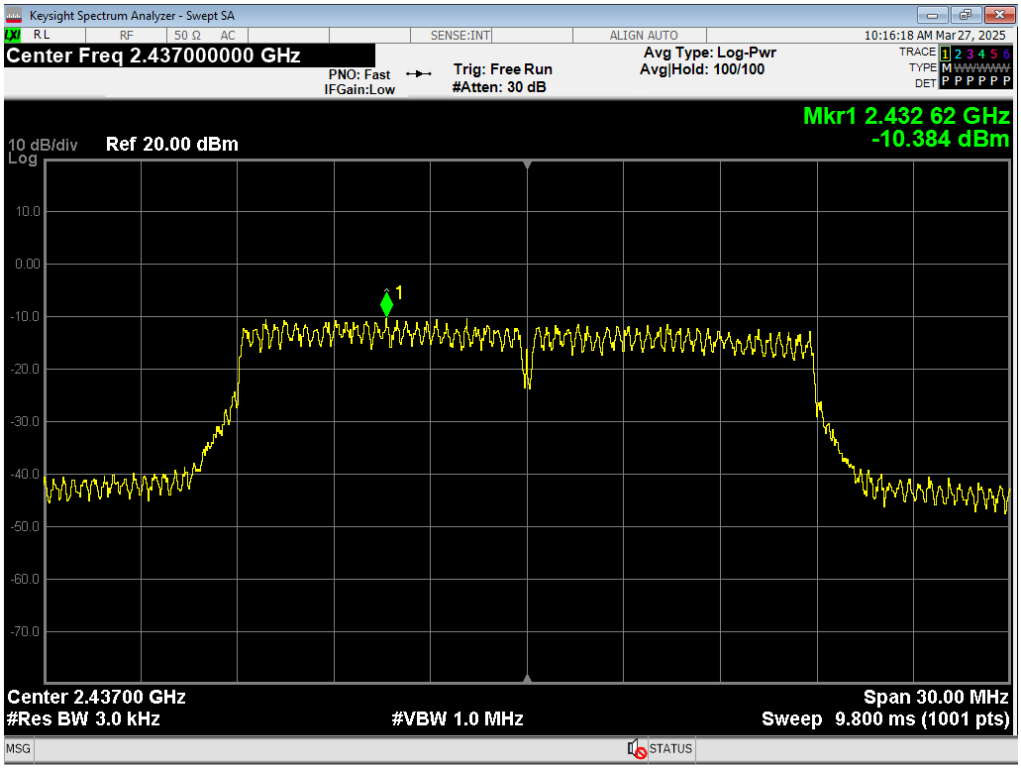
86 PSD, WiFi N MCS0, 2437MHz



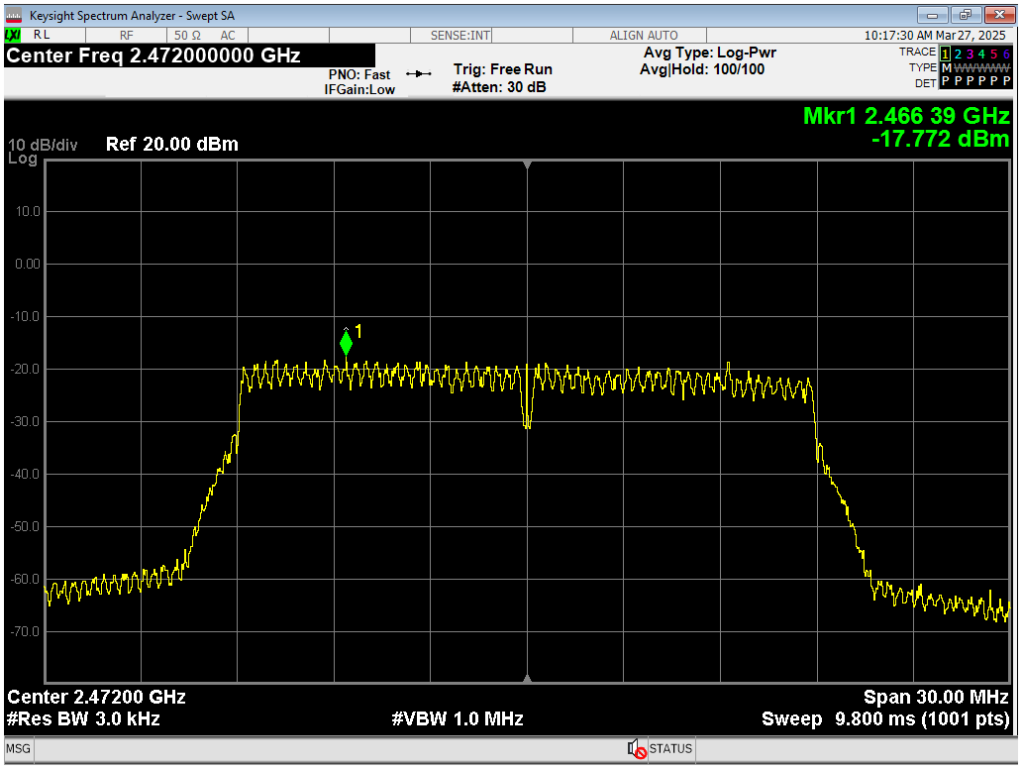
87 PSD, WiFi N MCS0, 2472MHz



88 PSD, WiFi N MCS7, 2412MHz



89 PSD, WiFi N MCS7, 2437MHz



90 PSD, WiFi N MCS7, 2472MHz

REPORT END