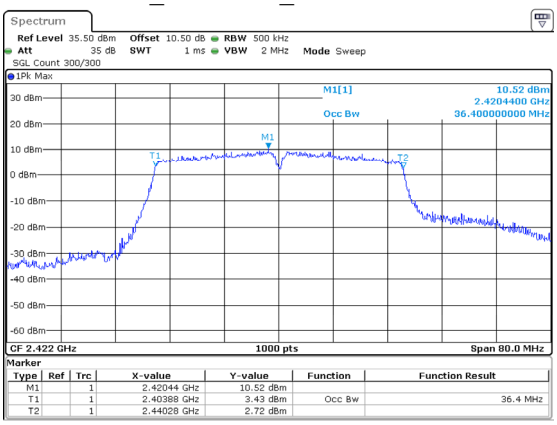
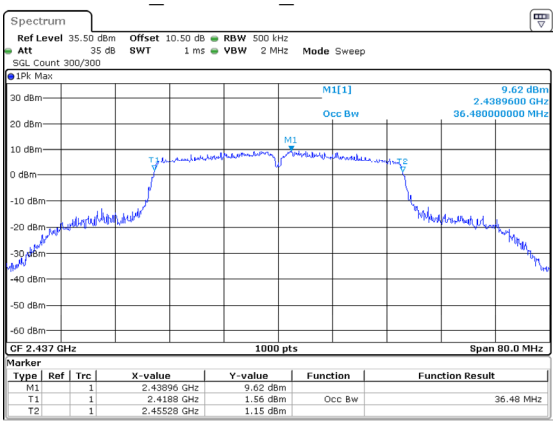
802.11n40_2422MHz_Chain 0 36.400MHz



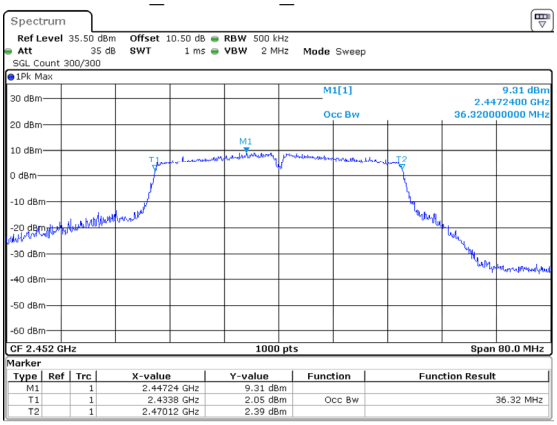
ProjectNo.:2401Y27848E-RF Tester:Allen Bai
Date: 28.NOV.2024 22:56:40

802.11n40_2437MHz_Chain 0 36.480MHz



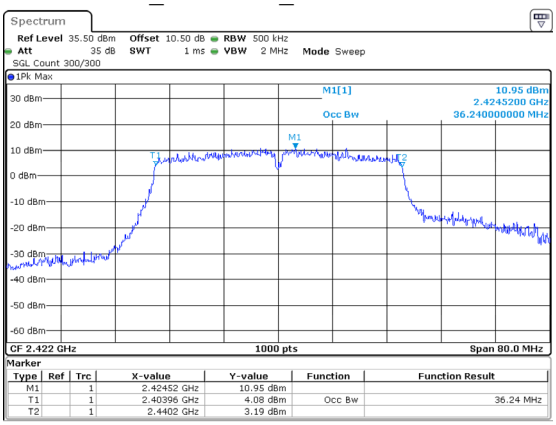
ProjectNo.:2401Y27848E-RF Tester:Allen Bai
Date: 28.NOV.2024 22:58:21

802.11n40_2452MHz_Chain 0 36.320MHz



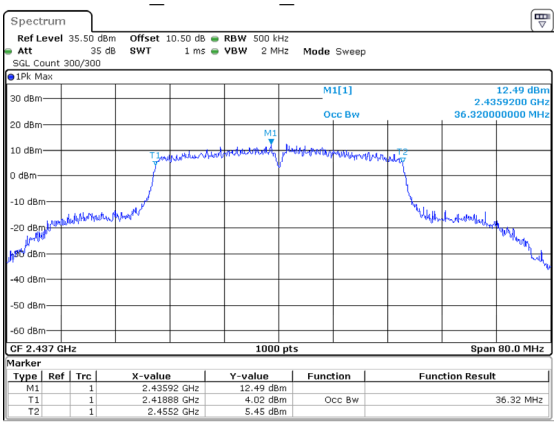
ProjectNo.:2401Y27848E-RF Tester:Allen Bai
Date: 28.NOV.2024 22:59:57

802.11n40_2422MHz_Chain 1 36.240MHz



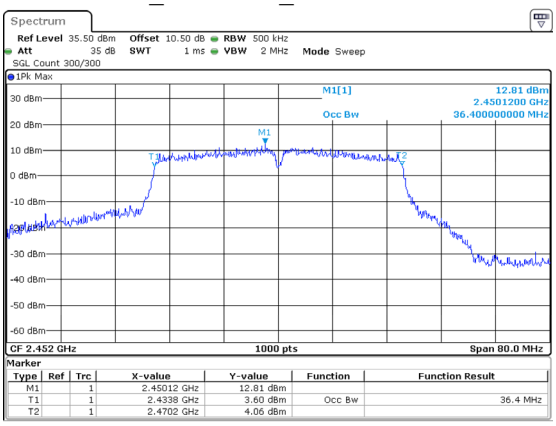
ProjectNo.:2401Y27848E-RF Tester:Allen Bai
Date: 28.NOV.2024 22:51:21

802.11n40_2437MHz_Chain 1 36.320MHz



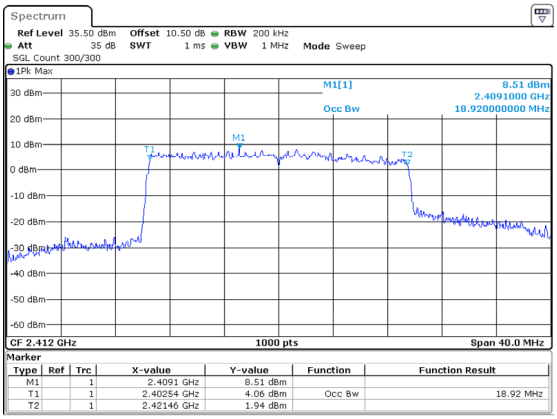
ProjectNo.:2401Y27848E-RF Tester:Allen Bai
Date: 28.NOV.2024 22:53:15

802.11n40_2452MHz_Chain 1 36.400MHz

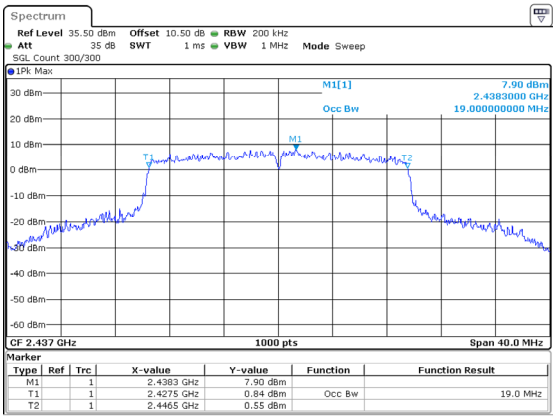


ProjectNo.:2401Y27848E-RF Tester:Allen Bai
Date: 28.NOV.2024 22:54:46

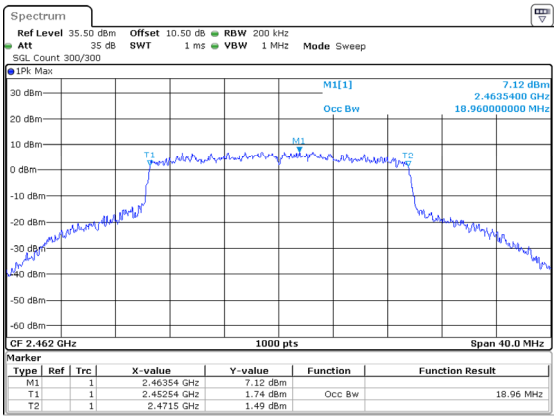
802.11ax20_2412MHz_RU_Full_Chain 0 18.920MHz



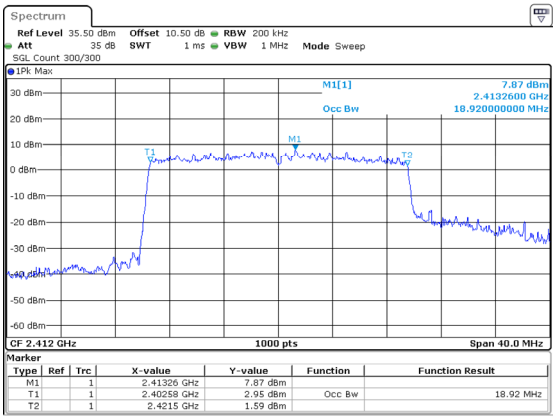
802.11ax20_2437MHz_RU_Full_Chain 0 19MHz



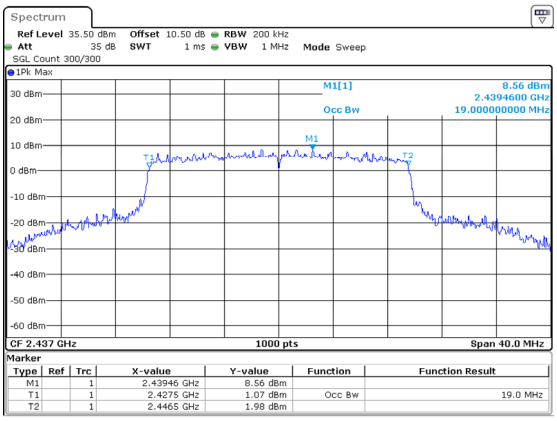
802.11ax20_2462MHz_RU_Full_Chain 0 18.960MHz



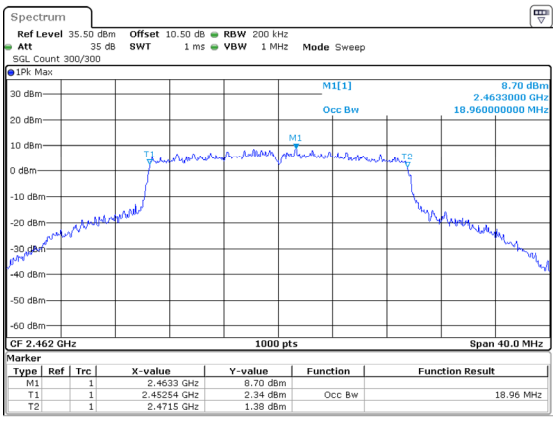
802.11ax20_2412MHz_RU_Full_Chain 1 18.920MHz



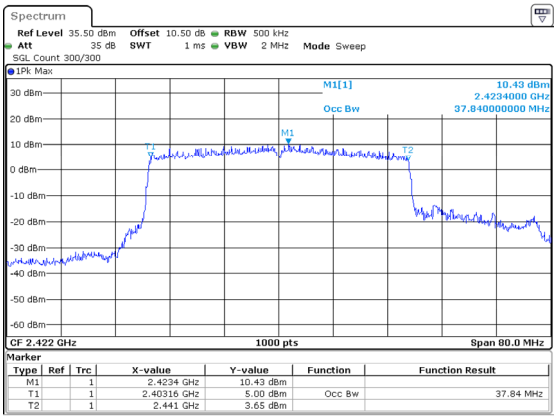
802.11ax20_2437MHz_RU_Full_Chain 1 19MHz



802.11ax20_2462MHz_RU_Full_Chain 1 18.960MHz

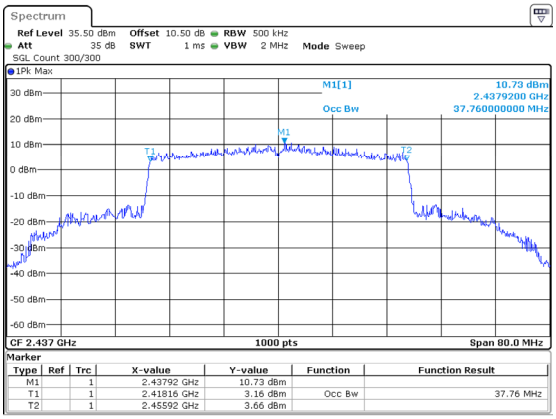


802.11ax40_2422MHz_RU_Full_Chain 0
37.840MHz



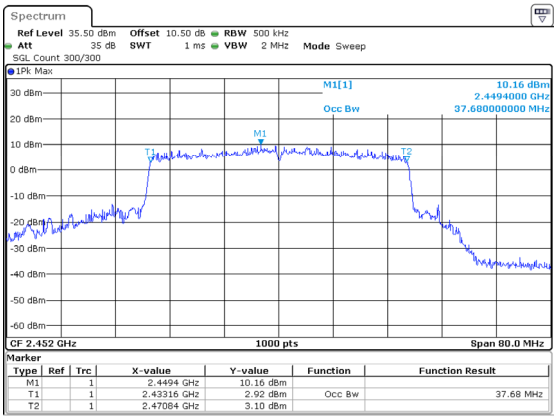
ProjectNo.:2401Y27848E-RF Tester:Allen Bai
Date: 3.DEC.2024 00:30:36

802.11ax40_2437MHz_RU_Full_Chain 0
37.760MHz



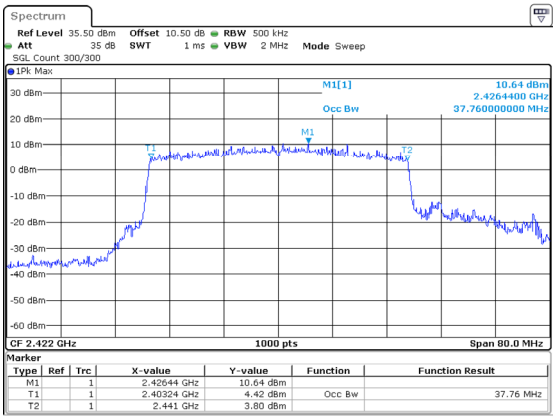
ProjectNo.:2401Y27848E-RF Tester:Allen Bai
Date: 3.DEC.2024 00:32:13

802.11ax40_2452MHz_RU_Full_Chain 0
37.680MHz



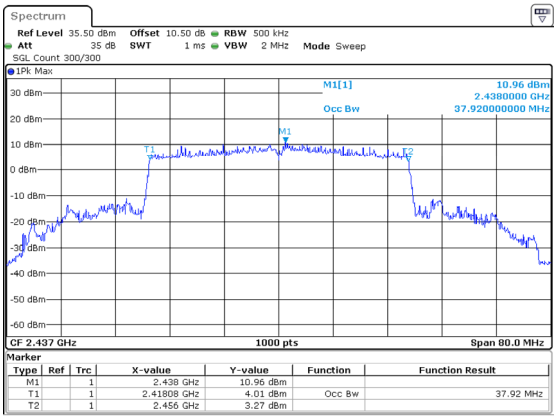
ProjectNo.:2401Y27848E-RF Tester:Allen Bai
Date: 3.DEC.2024 00:11:27

802.11ax40_2422MHz_RU_Full_Chain 1
37.760MHz



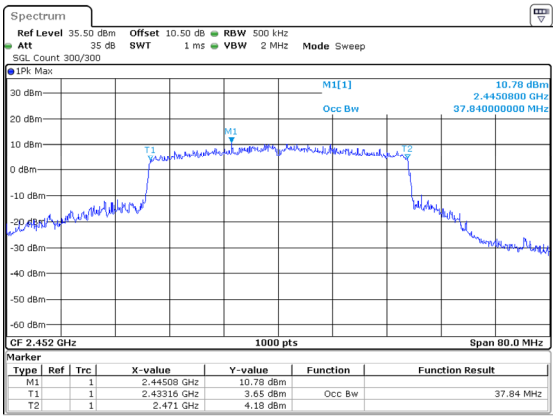
ProjectNo.:2401Y27848E-RF Tester:Allen Bai
Date: 3.DEC.2024 00:25:48

802.11ax40_2437MHz_RU_Full_Chain 1
37.920MHz



ProjectNo.:2401Y27848E-RF Tester:Allen Bai
Date: 3.DEC.2024 00:27:54

802.11ax40_2452MHz_RU_Full_Chain 1
37.840MHz



ProjectNo.:2401Y27848E-RF Tester:Allen Bai
Date: 3.DEC.2024 00:13:27

Maximum Conducted Output Power

Test Information:

Sample No.:	2TPH-12	**Test Date:**	2024/11/28~2024/12/04
Test Site:	RF	**Test Mode:**	Transmitting
Tester:	Allen Bai	**Test Result:**	Pass

Environmental Conditions:

Temperature: (°C):	23-27	**Relative Humidity: (%)**	41-48	**ATM Pressure: (kPa)**	101

Test Data:

Mode	Antenna	Test Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)	EIRP (dBm)	Limit (dBm)	Verdict
802.11b	Chain 0	2412	26.23	30	30.88	36	Pass
		2437	26.24	30	30.89	36	Pass
		2462	26.14	30	30.79	36	Pass
	Chain 1	2412	26.51	30	31.12	36	Pass
		2437	26.68	30	31.29	36	Pass
		2462	26.54	30	31.15	36	Pass
802.11g	Chain 0	2412	26.72	30	31.37	36	Pass
		2437	26.40	30	31.05	36	Pass
		2462	26.06	30	30.71	36	Pass
	Chain 1	2412	26.13	30	30.74	36	Pass
		2437	26.83	30	31.44	36	Pass
		2462	26.94	30	31.55	36	Pass
802.11n20	Chain 0	2412	25.56	30	30.21	36	Pass
		2437	25.35	30	30.00	36	Pass
		2462	25.42	30	30.07	36	Pass
	Chain 1	2412	25.08	30	29.69	36	Pass
		2437	25.29	30	29.90	36	Pass
		2462	25.18	30	29.79	36	Pass
	Chain 0+Chain 1	2412	**28.34**	28.36	35.98	36	Pass
		2437	28.33	28.36	35.97	36	Pass
		2462	28.31	28.36	35.95	36	Pass
802.11n40	Chain 0	2422	24.98	30	29.63	36	Pass
		2437	25.14	30	29.79	36	Pass
		2452	25.29	30	29.94	36	Pass
	Chain 1	2422	25.12	30	29.73	36	Pass
		2437	24.79	30	29.40	36	Pass
		2452	24.83	30	29.44	36	Pass
	Chain 0+Chain 1	2422	28.06	28.36	35.70	36	Pass
		2437	27.98	28.36	35.62	36	Pass
		2452	28.08	28.36	35.72	36	Pass

Mode	Antenna	Test Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)	EIRP (dBm)	Limit (dBm)	Verdict
802.11ax20	Chain 0	2412	24.95	30	29.60	36	Pass
		2437	24.63	30	29.28	36	Pass
		2462	24.27	30	28.92	36	Pass
	Chain 1	2412	24.85	30	29.46	36	Pass
		2437	25.45	30	30.06	36	Pass
		2462	25.64	30	30.25	36	Pass
	Chain 0+Chain 1	2412	27.91	28.36	35.55	36	Pass
		2437	28.07	28.36	35.71	36	Pass
		2462	28.02	28.36	35.66	36	Pass
802.11ax40	Chain 0	2422	24.84	30	29.49	36	Pass
		2437	24.68	30	29.33	36	Pass
		2452	24.49	30	29.14	36	Pass
	Chain 1	2422	24.85	30	29.46	36	Pass
		2437	25.48	30	30.09	36	Pass
		2452	25.48	30	30.09	36	Pass
	Chain 0+Chain 1	2422	27.86	28.36	35.50	36	Pass
		2437	28.11	28.36	35.75	36	Pass
		2452	28.02	28.36	35.66	36	Pass

Note: For 802.11n/ax modes, the device support beam-forming function, per KDB 662911 D01 Multiple Transmitter Output v02r01:

- $$DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$$

where
Each antenna is driven by no more than one spatial stream;
N_{SS} = the number of independent spatial streams of data;
N_{ANT} = the total number of antennas
$g_{j,k} = 10^{G_k/20}$ if the k_{th} antenna is being fed by spatial stream j, or zero if it is not;
G_k is the gain in dBi of the k_{th} antenna.

Chain 0	Antenna Gain	4.65	dBi	Directional Gain:	7.64	dBi
Chain 1	Antenna Gain	4.61	dBi			

Power Spectral Density

Test Information:

Sample No.:	2TPH-12	**Test Date:**	2024/11/28~2024/12/03
Test Site:	RF	**Test Mode:**	Transmitting
Tester:	Allen Bai	**Test Result:**	Pass

Environmental Conditions:

Temperature: (°C):	23-27	**Relative Humidity: (%)**	41-48	**ATM Pressure: (kPa)**	101

Test Data:

Mode	Antenna	Test Frequency (MHz)	Result (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
802.11b	Chain 0	2412	1.87	8	Pass
		2437	1.40	8	Pass
		2462	1.40	8	Pass
	Chain 1	2412	**2.65**	8	Pass
		2437	1.76	8	Pass
		2462	1.64	8	Pass
802.11g	Chain 0	2412	-5.24	8	Pass
		2437	-5.07	8	Pass
		2462	-5.26	8	Pass
	Chain 1	2412	-3.97	8	Pass
		2437	-3.73	8	Pass
		2462	-4.22	8	Pass
802.11n20	Chain 0	2412	-5.40	8	Pass
		2437	-5.26	8	Pass
		2462	-5.66	8	Pass
	Chain 1	2412	-5.53	8	Pass
		2437	-5.47	8	Pass
		2462	-3.90	8	Pass
	Chain 0+Chain 1	2412	-2.45	6.36	Pass
		2437	-2.35	6.36	Pass
		2462	-1.68	6.36	Pass
802.11n40	Chain 0	2422	-7.44	8	Pass
		2437	-8.02	8	Pass
		2452	-8.22	8	Pass
	Chain 1	2422	-8.14	8	Pass
		2437	-7.57	8	Pass
		2452	-8.14	8	Pass
	Chain 0+Chain 1	2422	-4.77	6.36	Pass
		2437	-4.78	6.36	Pass
		2452	-5.17	6.36	Pass

Mode	Antenna	Test Frequency (MHz)	Result (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
802.11ax20_RU_Full	Chain 0	2412	-8.26	8	Pass
		2437	-8.03	8	Pass
		2462	-8.01	8	Pass
	Chain 1	2412	-6.96	8	Pass
		2437	-7.21	8	Pass
		2462	-7.35	8	Pass
	Chain 0+Chain 1	2412	-4.55	6.36	Pass
		2437	-4.59	6.36	Pass
		2462	-4.66	6.36	Pass
802.11ax40_RU_Full	Chain 0	2422	-10.04	8	Pass
		2437	-10.87	8	Pass
		2452	-11.19	8	Pass
	Chain 1	2422	-10.81	8	Pass
		2437	-10.21	8	Pass
		2452	-10.37	8	Pass
	Chain 0+Chain 1	2422	-7.40	6.36	Pass
		2437	-7.52	6.36	Pass
		2452	-7.75	6.36	Pass

Note: For 802.11n/ax modes, the device support beam-forming function, per KDB 662911 D01 Multiple Transmitter Output v02r01:

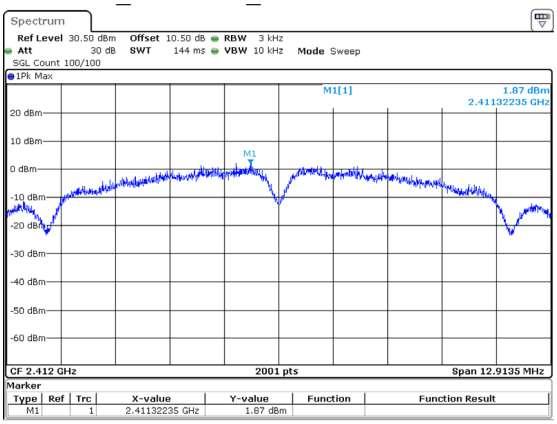
- $$DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$$

where
Each antenna is driven by no more than one spatial stream;
N_{SS} = the number of independent spatial streams of data;
N_{ANT} = the total number of antennas
$g_{j,k} = 10^{G_k/20}$ if the k_{th} antenna is being fed by spatial stream j, or zero if it is not;
G_k is the gain in dBi of the k_{th} antenna.

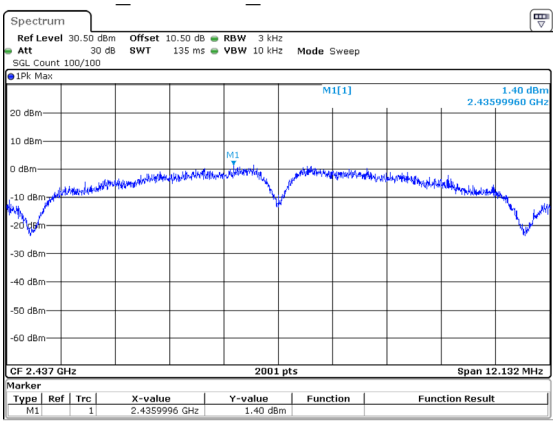
Chain 0	Antenna Gain	4.65	dBi	Directional Gain:	7.64	dBi
Chain 1	Antenna Gain	4.61	dBi			

2.4G

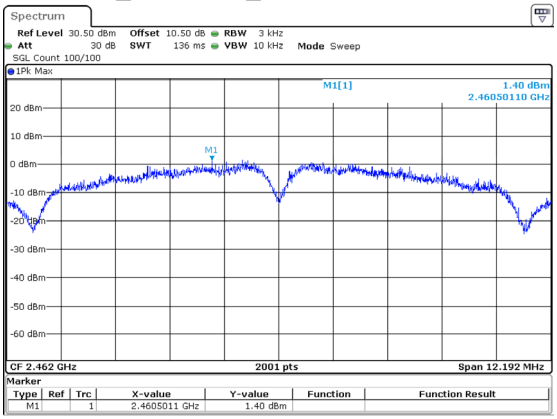
802.11b_2412MHz_Chain 0 1.87dBm/3kHz



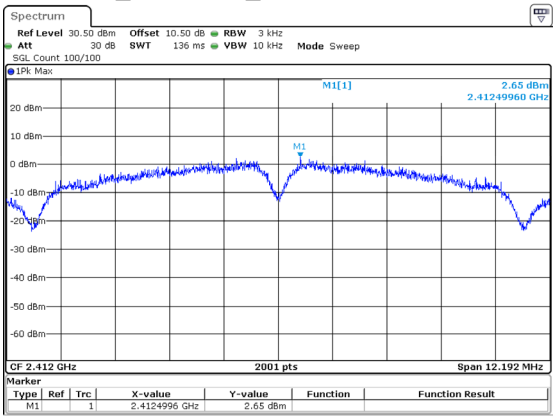
802.11b_2437MHz_Chain 0 1.40dBm/3kHz



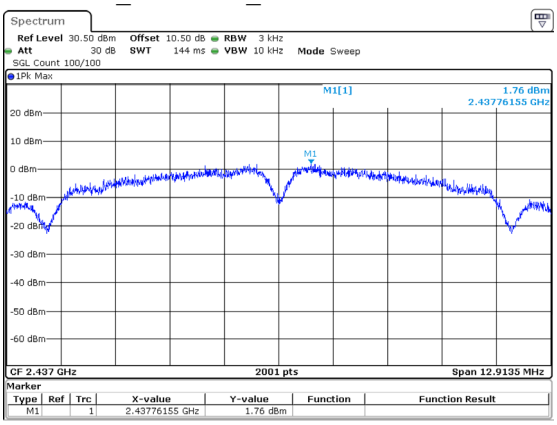
802.11b_2462MHz_Chain 0 1.40dBm/3kHz



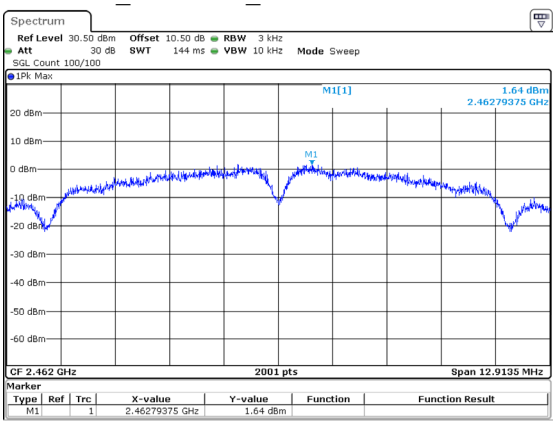
802.11b_2412MHz_Chain 1 2.65dBm/3kHz



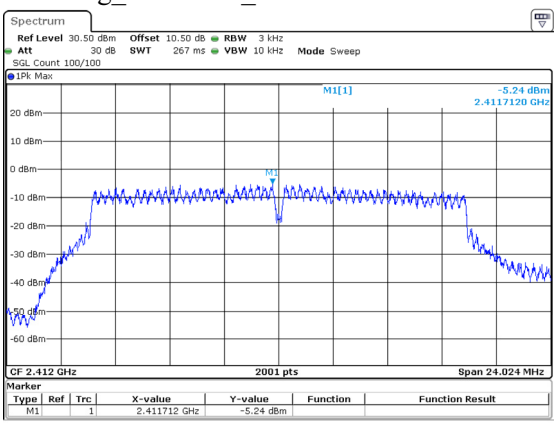
802.11b_2437MHz_Chain 1 1.76dBm/3kHz



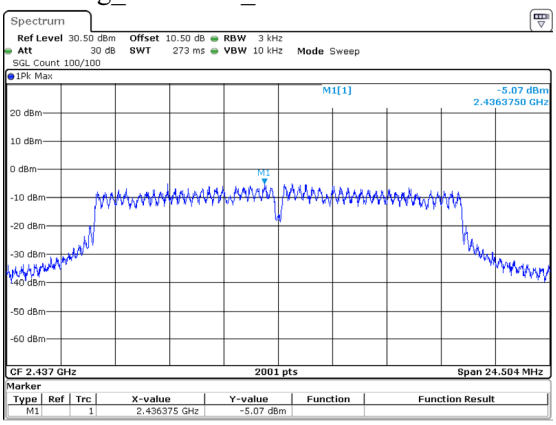
802.11b_2462MHz_Chain 1 1.64dBm/3kHz



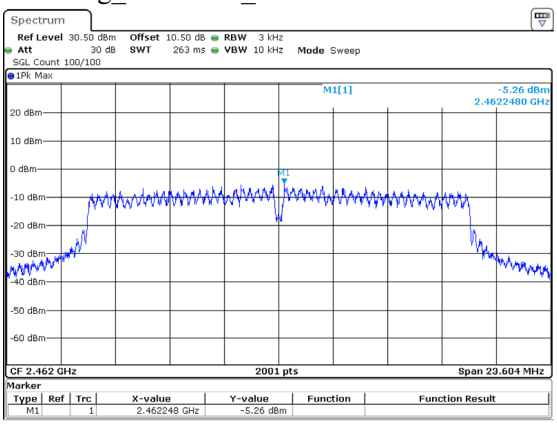
802.11g_2412MHz_Chain 0 -5.24dBm/3kHz



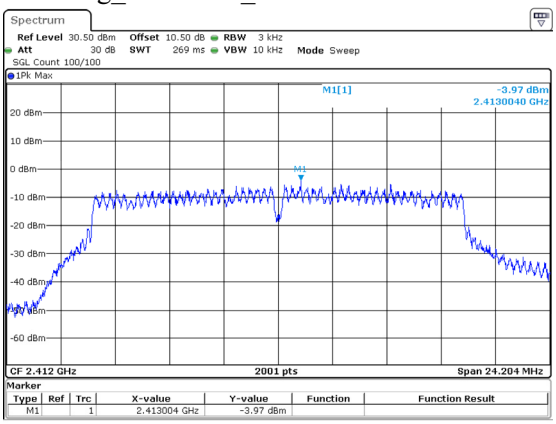
802.11g_2437MHz_Chain 0 -5.07dBm/3kHz



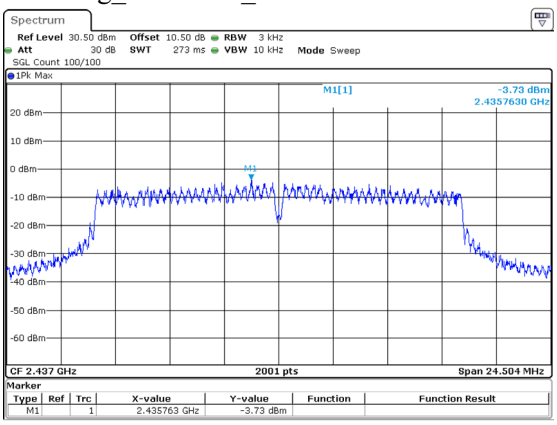
802.11g_2462MHz_Chain 0 -5.26dBm/3kHz



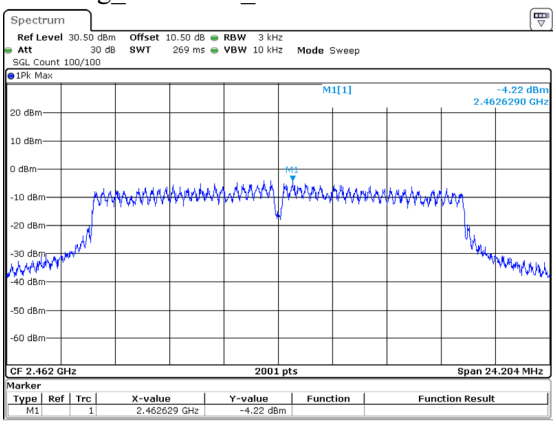
802.11g_2412MHz_Chain 1 -3.97dBm/3kHz



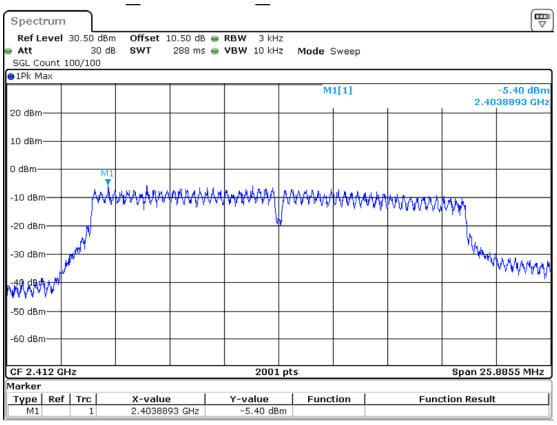
802.11g_2437MHz_Chain 1 -3.73dBm/3kHz



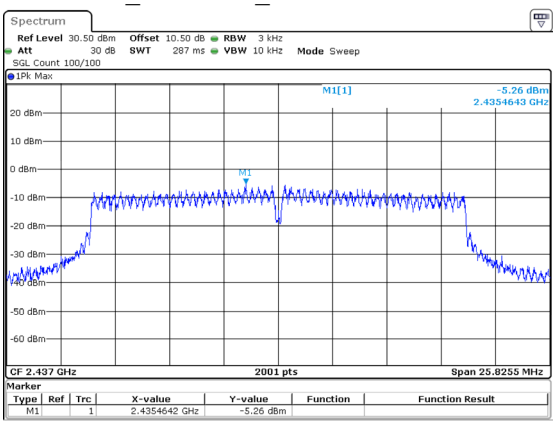
802.11g_2462MHz_Chain 1 -4.22dBm/3kHz



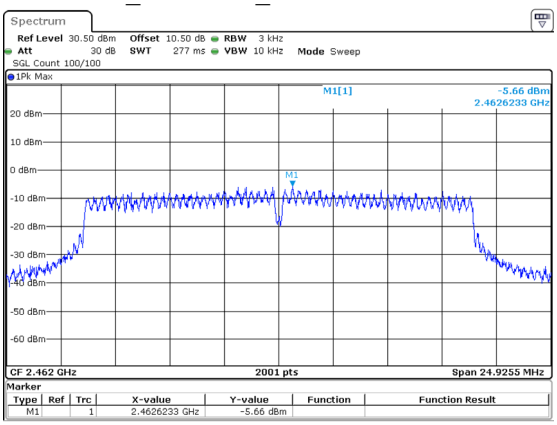
802.11n20_2412MHz_Chain 0 -5.40dBm/3kHz



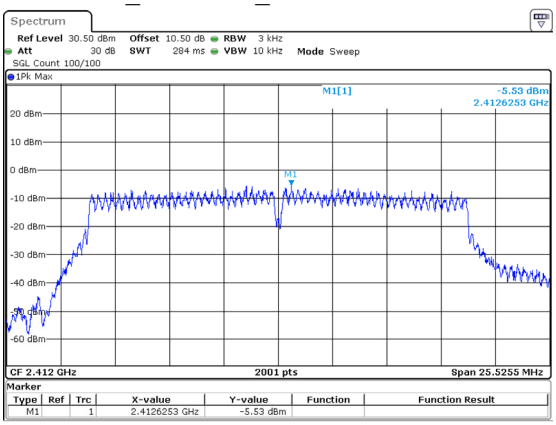
802.11n20_2437MHz_Chain 0 -5.26dBm/3kHz



802.11n20_2462MHz_Chain 0 -5.66dBm/3kHz



802.11n20_2412MHz_Chain 1 -5.53dBm/3kHz



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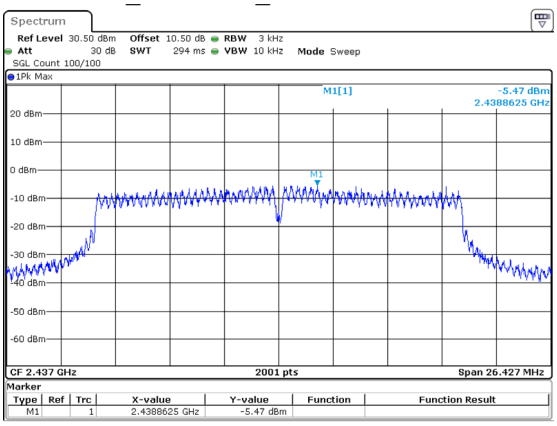
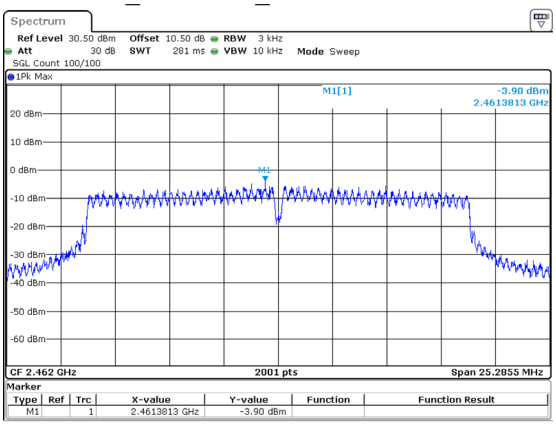
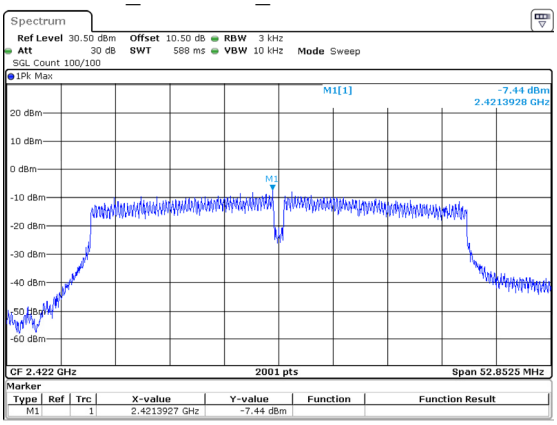


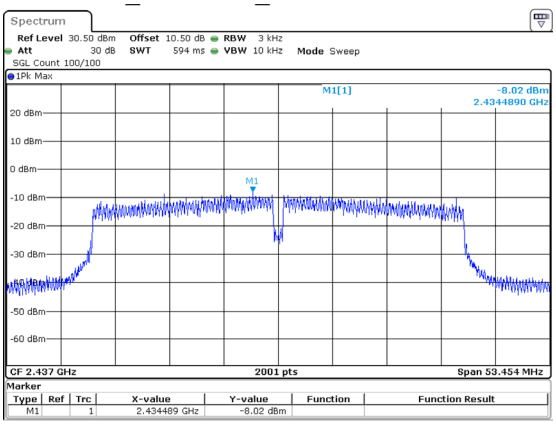
802.11n20_2462MHz_Chain 1 -3.90dBm/3kHz



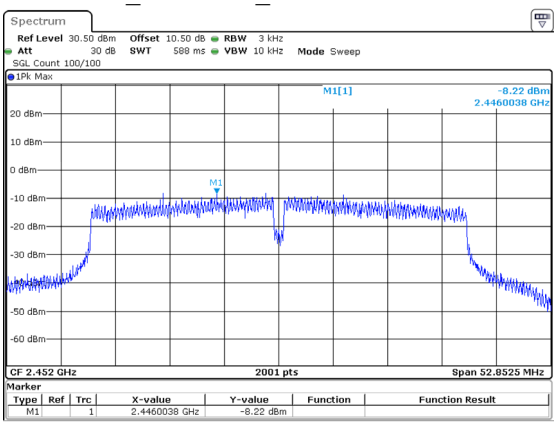
802.11n40_2422MHz_Chain 0 -7.44dBm/3kHz



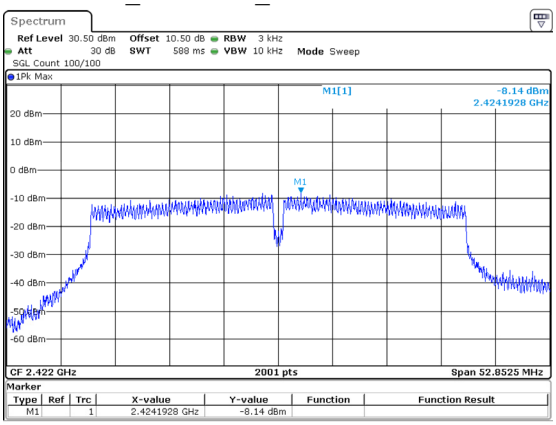
802.11n40_2437MHz_Chain 0 -8.02dBm/3kHz



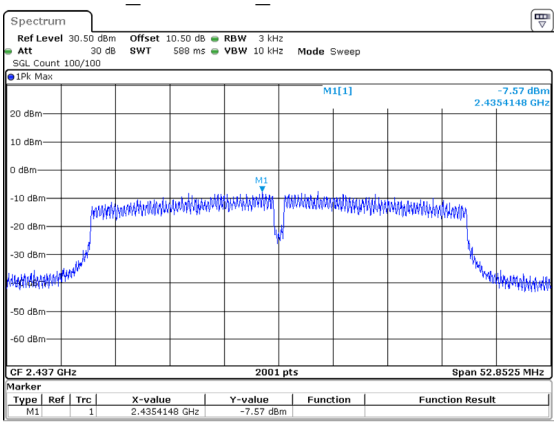
802.11n40_2452MHz_Chain 0 -8.22dBm/3kHz



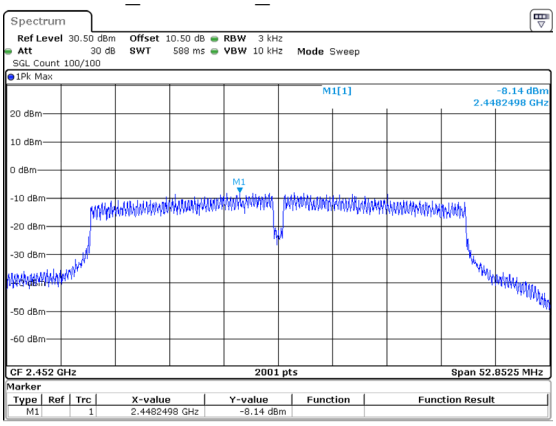
802.11n40_2422MHz_Chain 1 -8.14dBm/3kHz



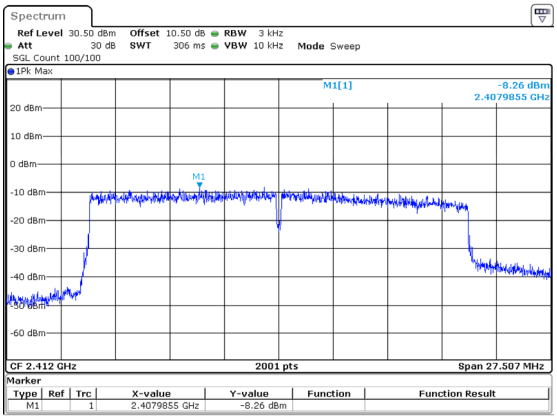
802.11n40_2437MHz_Chain 1 -7.57dBm/3kHz



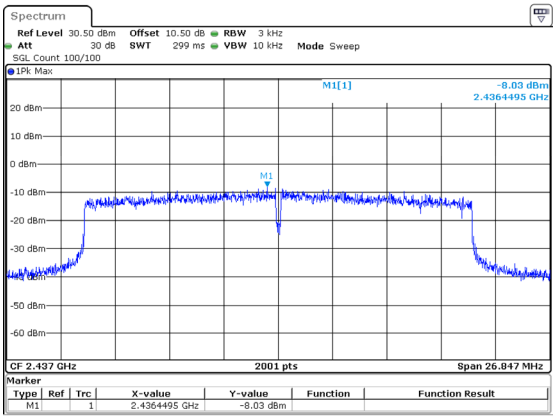
802.11n40_2452MHz_Chain 1 -8.14dBm/3kHz



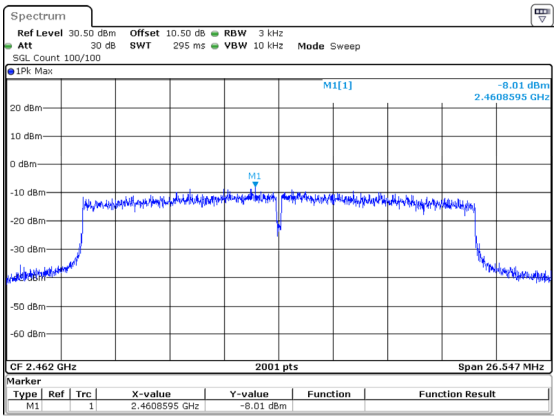
802.11ax20_2412MHz_RU_Full_Chain 0 - 8.26dBm/3kHz



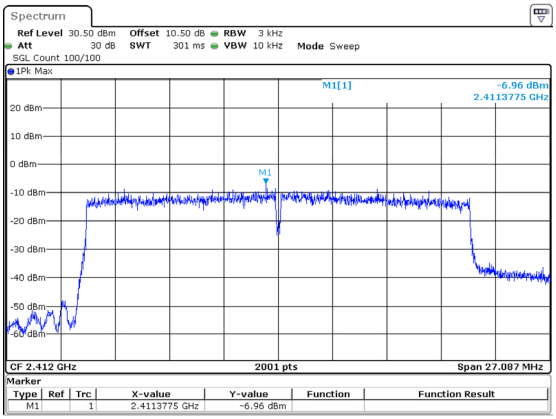
802.11ax20_2437MHz_RU_Full_Chain 0 - 8.03dBm/3kHz



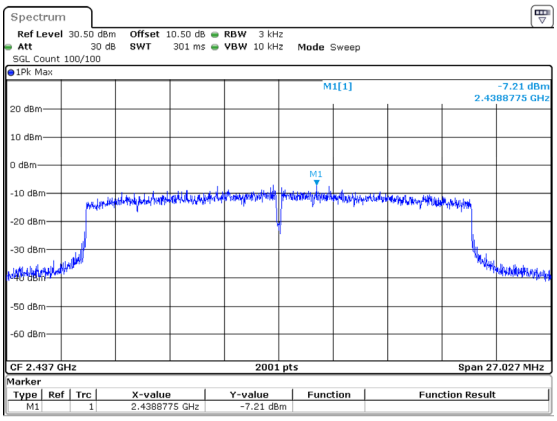
802.11ax20_2462MHz_RU_Full_Chain 0 - 8.01dBm/3kHz



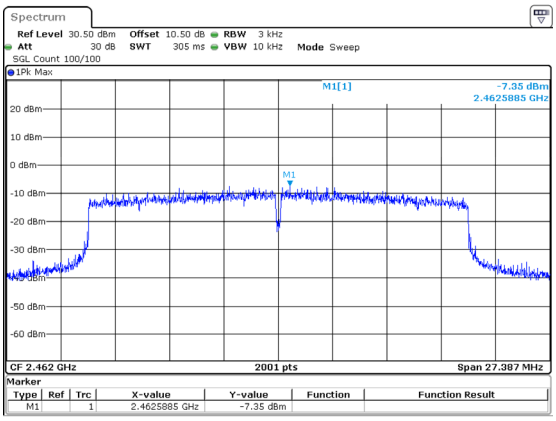
802.11ax20_2412MHz_RU_Full_Chain 1 - 6.96dBm/3kHz



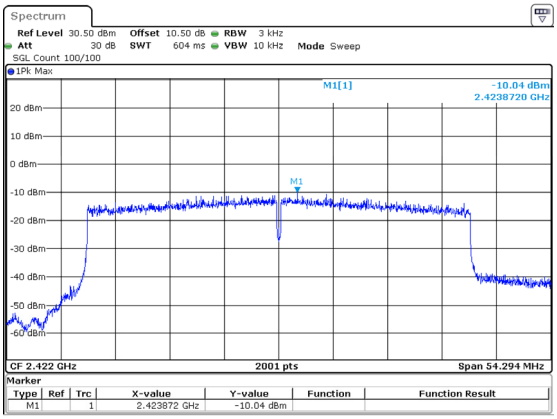
802.11ax20_2437MHz_RU_Full_Chain 1 - 7.21dBm/3kHz



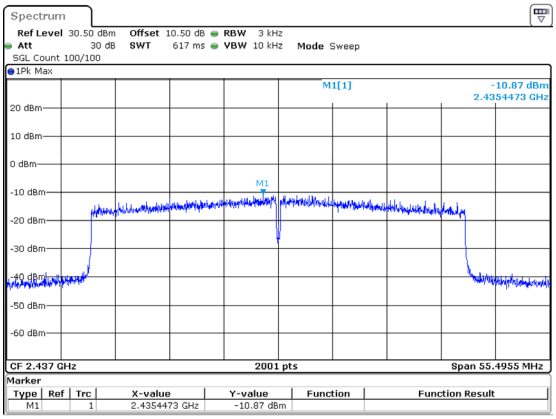
802.11ax20_2462MHz_RU_Full_Chain 1 - 7.35dBm/3kHz



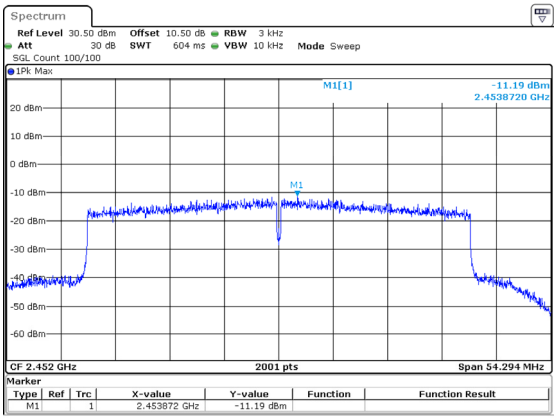
802.11ax40_2422MHz_RU_Full_Chain 0 - 10.04dBm/3kHz



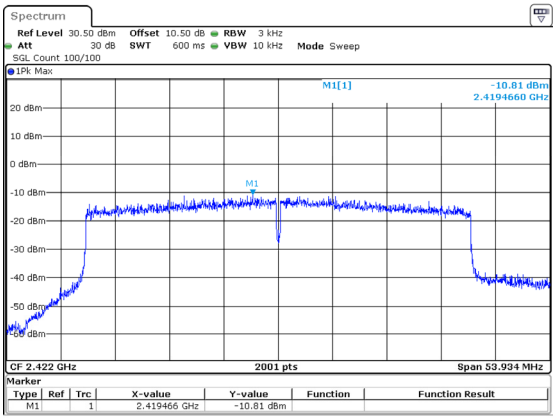
802.11ax40_2437MHz_RU_Full_Chain 0 - 10.87dBm/3kHz



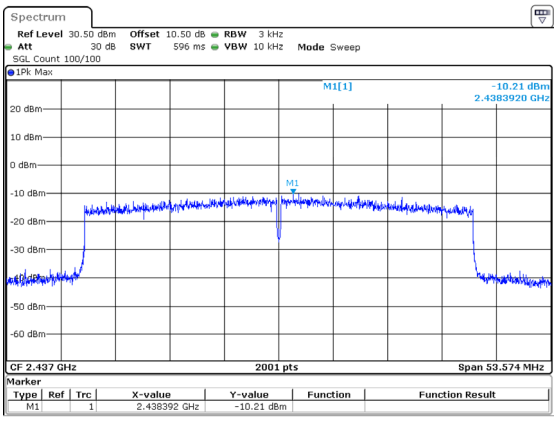
802.11ax40_2452MHz_RU_Full_Chain 0 - 11.19dBm/3kHz



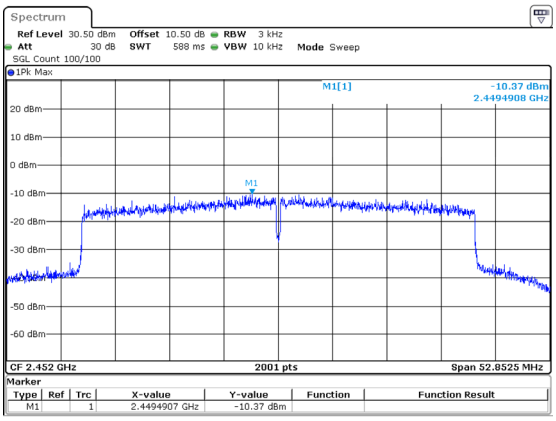
802.11ax40_2422MHz_RU_Full_Chain 1 - 10.81dBm/3kHz



802.11ax40_2437MHz_RU_Full_Chain 1 - 10.21dBm/3kHz



802.11ax40_2452MHz_RU_Full_Chain 1 - 10.37dBm/3kHz



100 kHz Bandwidth of Frequency Band Edge

Test Information:

Sample No.:	2TPH-12	**Test Date:**	2024/11/28~2024/12/03
Test Site:	RF	**Test Mode:**	Transmitting
Tester:	Allen Bai	**Test Result:**	Pass

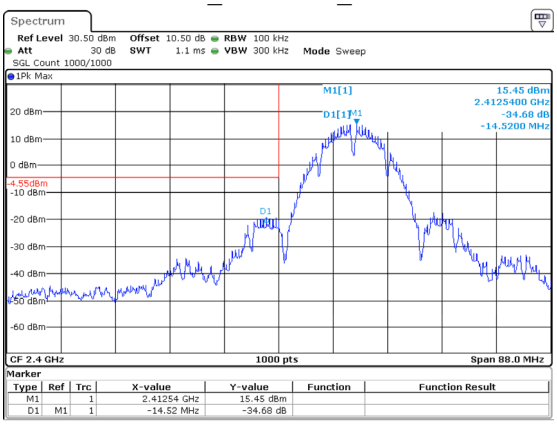
Environmental Conditions:

Temperature: (°C):	23-27	**Relative Humidity: (%)**	41-48	**ATM Pressure: (kPa)**	101

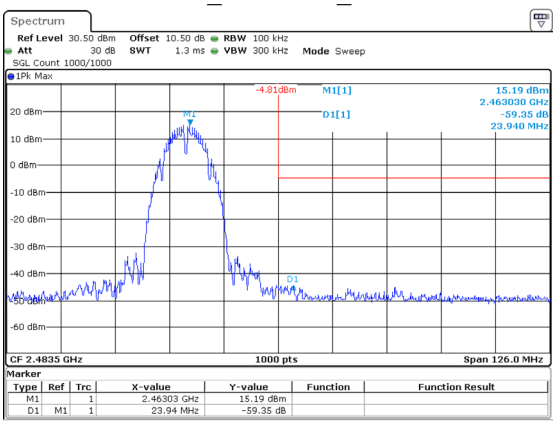
Test Data:

2.4G

802.11b_2412MHz_Chain 0



802.11b_2462MHz_Chain 0



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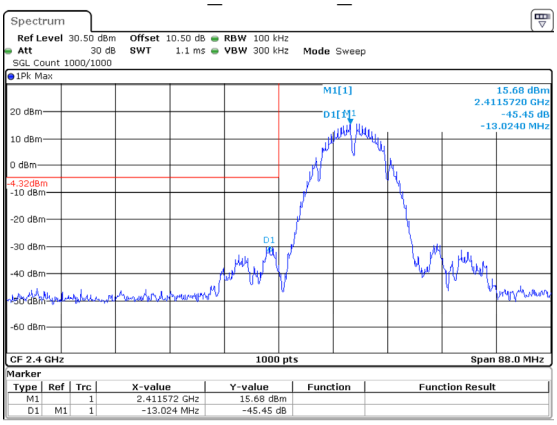

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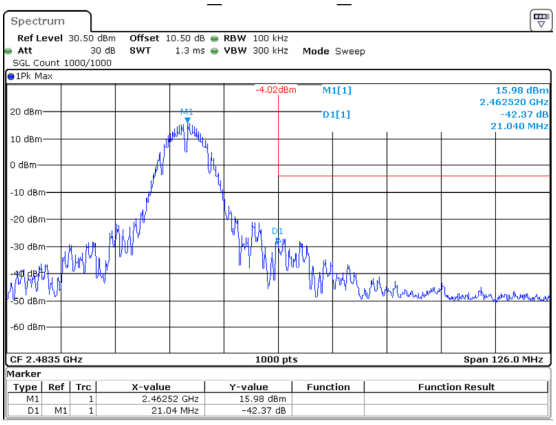

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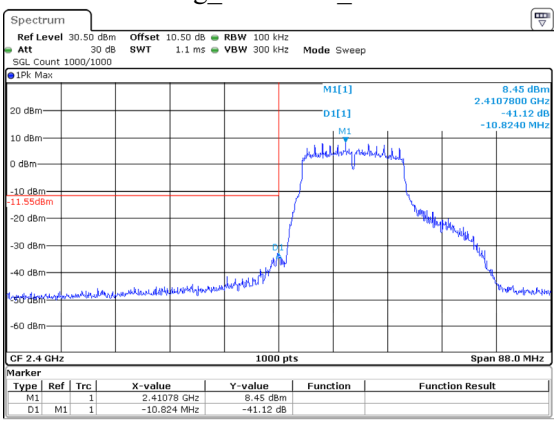
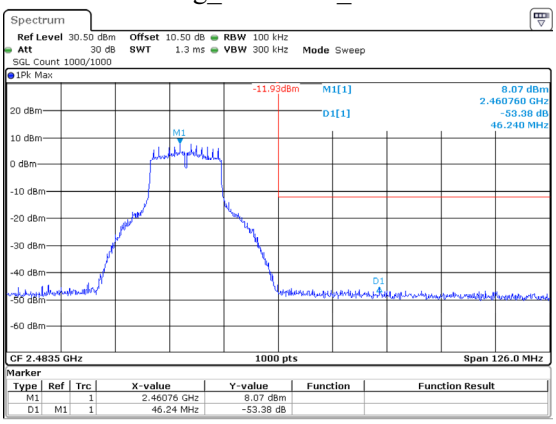
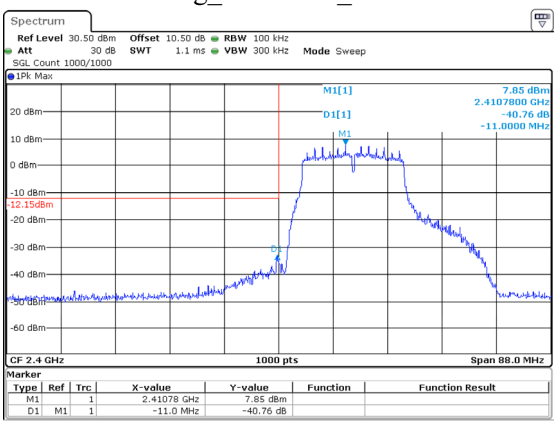


802.11g_2462MHz_Chain 0

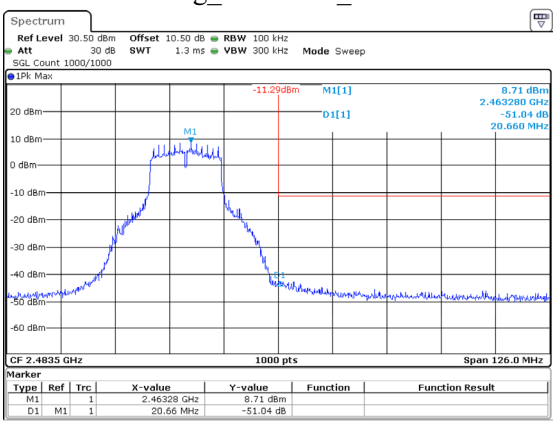


802.11g_2412MHz_Chain 1



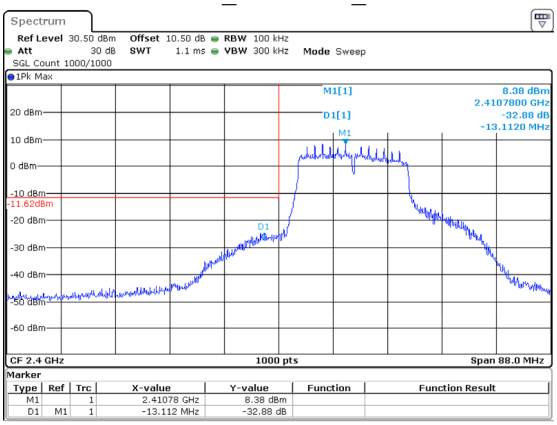
ProjectNo.:2401Y27848E-RF Tester:Allen Bai
Date: 28.NOV.2024 02:18:32

802.11g_2462MHz_Chain 1



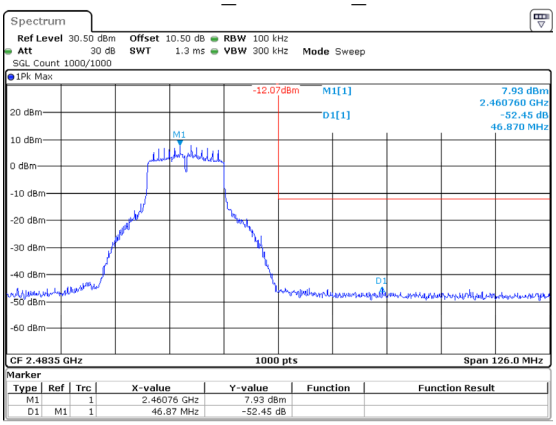
ProjectNo.:2401Y27848E-RF Tester:Allen Bai
Date: 28.NOV.2024 02:21:23

802.11n20_2412MHz_Chain 0



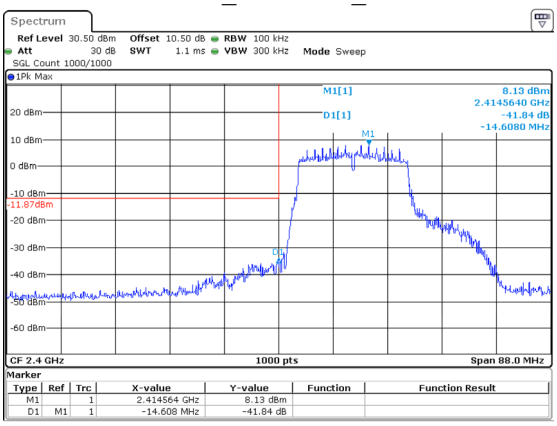
ProjectNo.:2401Y27848E-RF Tester:Allen Bai
Date: 28.NOV.2024 23:11:31

802.11n20_2462MHz_Chain 0



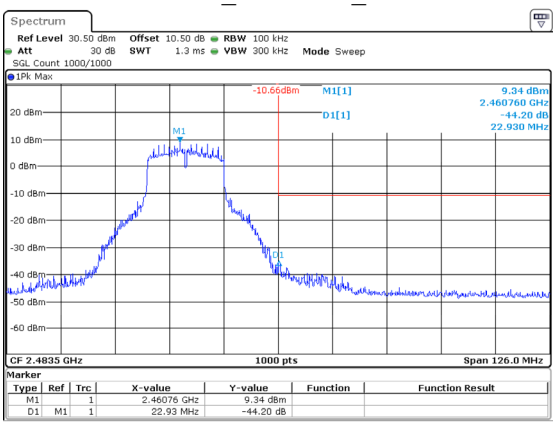
ProjectNo.:2401Y27848E-RF Tester:Allen Bai
Date: 28.NOV.2024 23:13:42

802.11n20_2412MHz_Chain 1



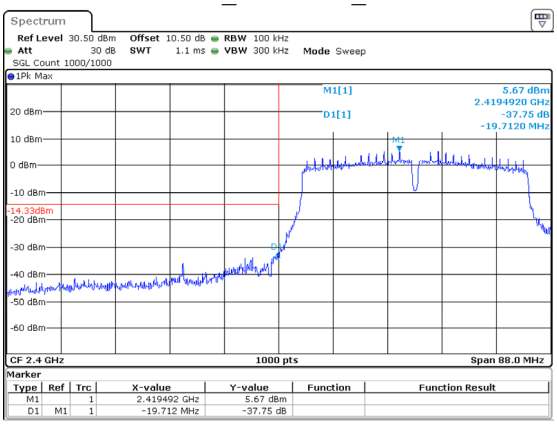
ProjectNo.:2401Y27848E-RF Tester:Allen Bai
Date: 28.NOV.2024 23:08:50

802.11n20_2462MHz_Chain 1

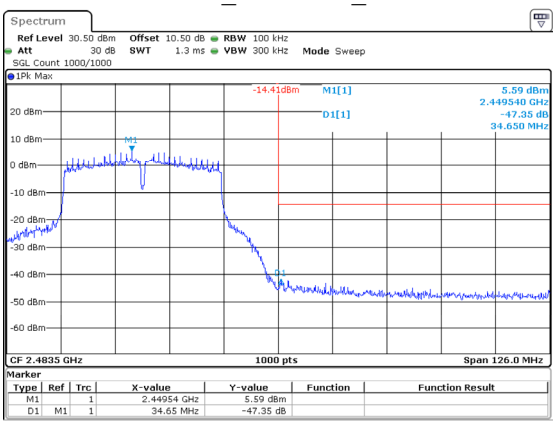


ProjectNo.:2401Y27848E-RF Tester:Allen Bai
Date: 28.NOV.2024 23:07:25

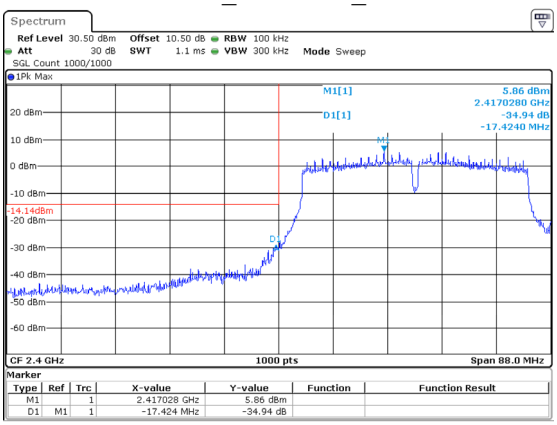
802.11n40_2422MHz_Chain 0



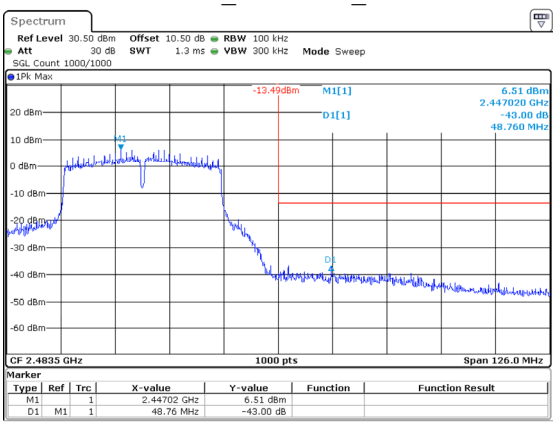
802.11n40_2452MHz_Chain 0



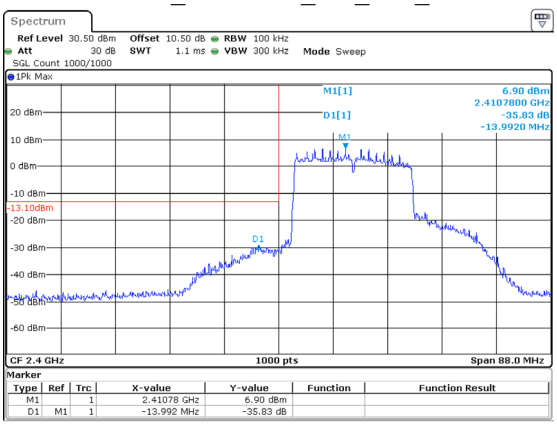
802.11n40_2422MHz_Chain 1



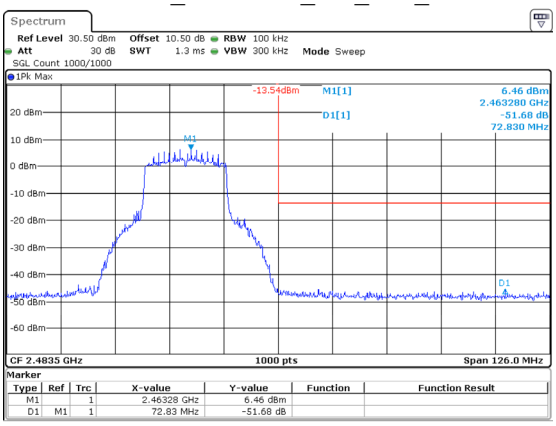
802.11n40_2452MHz_Chain 1



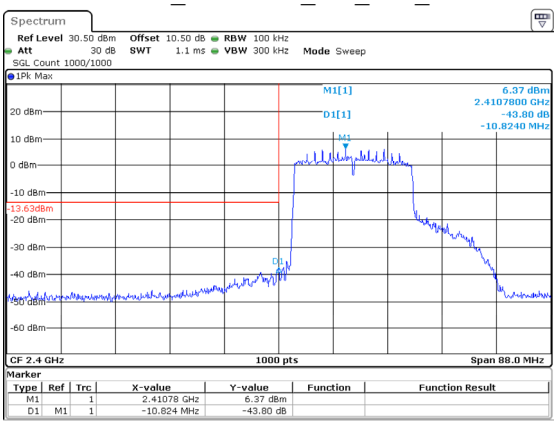
802.11ax20_2412MHz_RU_Full_Chain 0



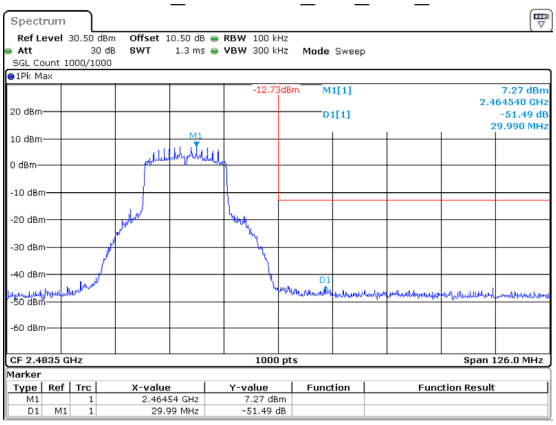
802.11ax20_2462MHz_RU_Full_Chain 0



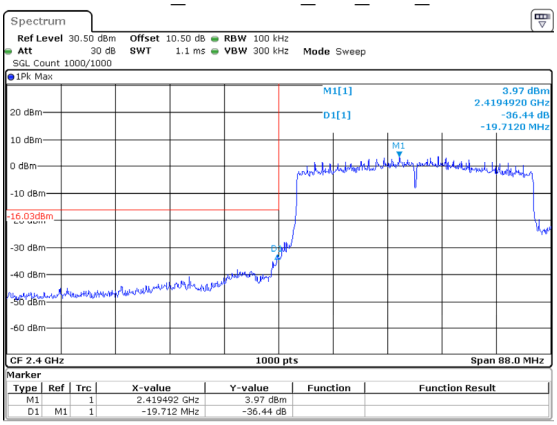
802.11ax20_2412MHz_RU_Full_Chain 1



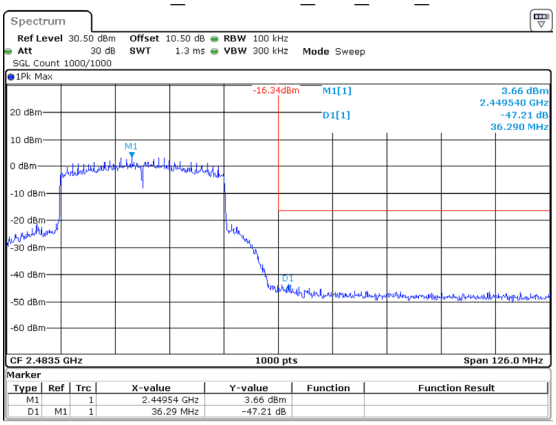
802.11ax20_2462MHz_RU_Full_Chain 1



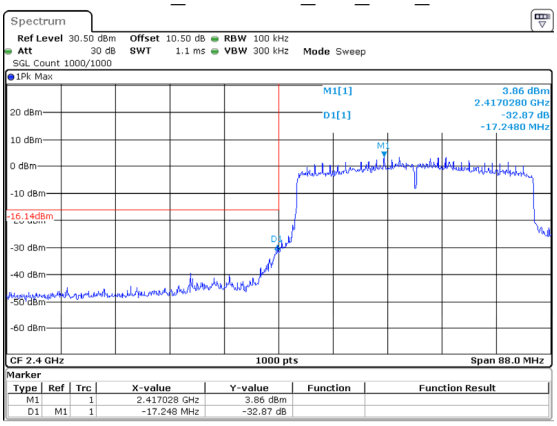
802.11ax40_2422MHz_RU_Full_Chain 0



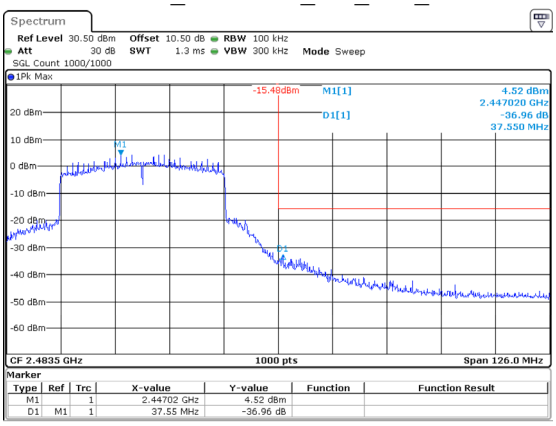
802.11ax40_2452MHz_RU_Full_Chain 0



802.11ax40_2422MHz_RU_Full_Chain 1



802.11ax40_2452MHz_RU_Full_Chain 1



Duty Cycle

Test Information:

Sample No.:	2TPH-12	**Test Date:**	2024/11/27~2024/12/03
Test Site:	RF	**Test Mode:**	Transmitting
Tester:	Allen Bai	**Test Result:**	N/A

Environmental Conditions:

Temperature: (°C):	23-27	**Relative Humidity: (%)**	41-48	**ATM Pressure: (kPa)**	101

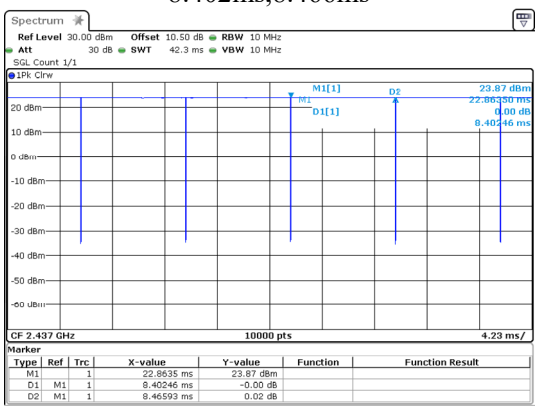
Test Data:

Mode	Antenna	Test Frequency (MHz)	Ton (ms)	Ton+Toff (ms)	Duty Cycle (%)	Duty Cycle Factor(dB)	1/Ton (Hz)	VBW Setting (kHz)
802.11b	Chain 0	2437	8.402	8.466	99.24	/	/	0.010
	Chain 1	2437	**8.407**	8.466	99.30	/	/	0.010
802.11g	Chain 0	2437	1.388	1.444	96.12	0.17	720	1
	Chain 1	2437	1.393	1.450	96.07	0.17	718	1
802.11n20	Chain 0	2437	1.309	1.366	95.83	0.18	764	1
	Chain 1	2437	1.307	1.364	95.82	0.19	765	1
802.11n40	Chain 0	2437	0.648	0.705	91.91	0.37	1543	2
	Chain 1	2437	0.648	0.705	91.91	0.37	1543	2
802.11ax20_RU_Full	Chain 0	2437	0.312	0.369	84.55	0.73	3205	5
	Chain 1	2437	0.312	0.369	84.55	0.73	3205	5
802.11ax40_RU_Full	Chain 0	2437	0.312	0.369	84.55	0.73	3205	5
	Chain 1	2437	0.312	0.369	84.55	0.73	3205	5

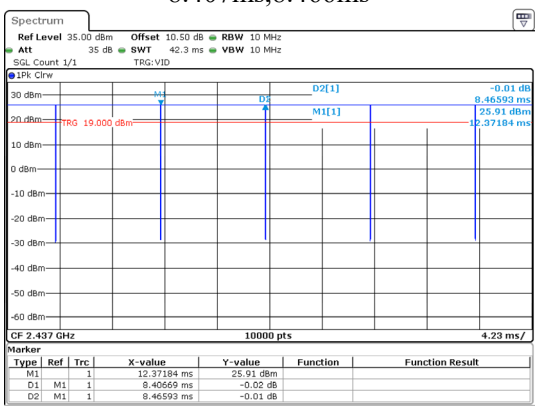
Duty Cycle = Ton/(Ton+Toff)*100%

2.4G

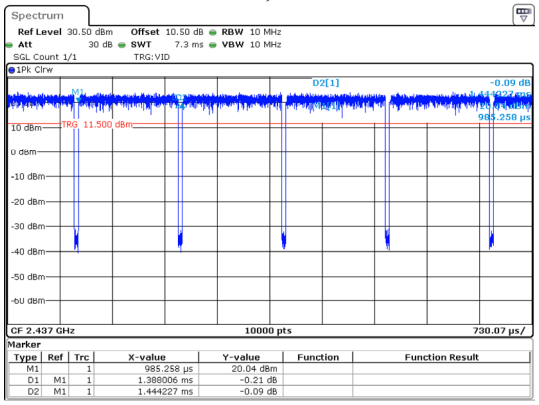
802.11b_2437MHz_Chain 0
8.402ms,8.466ms



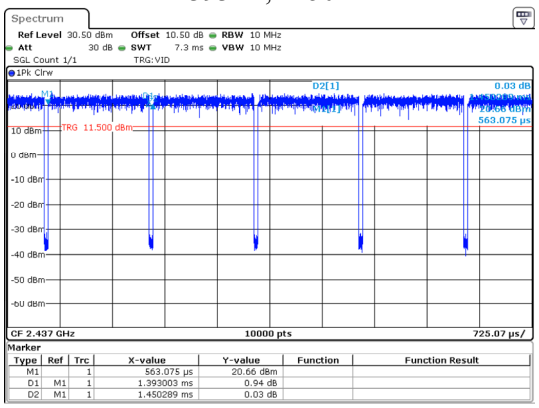
802.11b_2437MHz_Chain 1
8.407ms,8.466ms



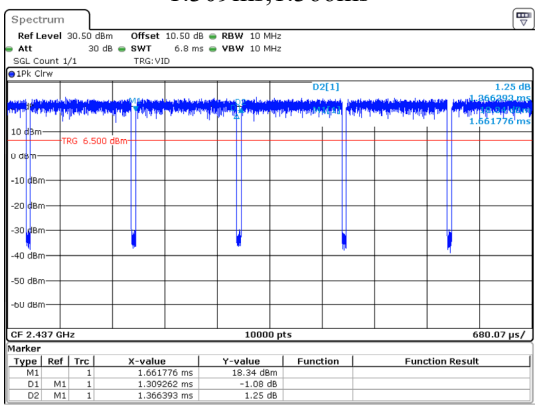
802.11g_2437MHz_Chain 0
1.388ms,1.444ms



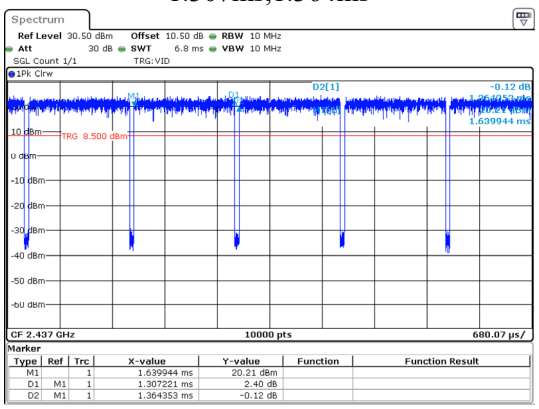
802.11g_2437MHz_Chain 1
1.393ms,1.450ms



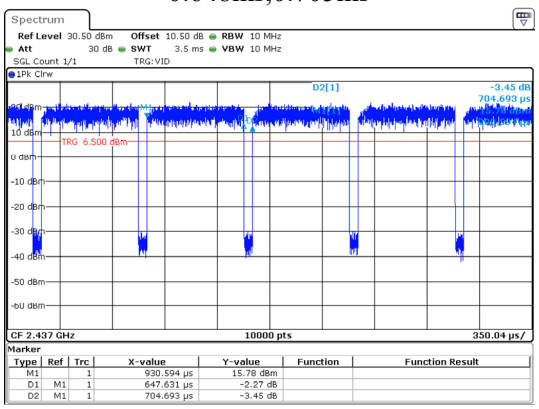
802.11n20_2437MHz_Chain 0
1.309ms,1.366ms



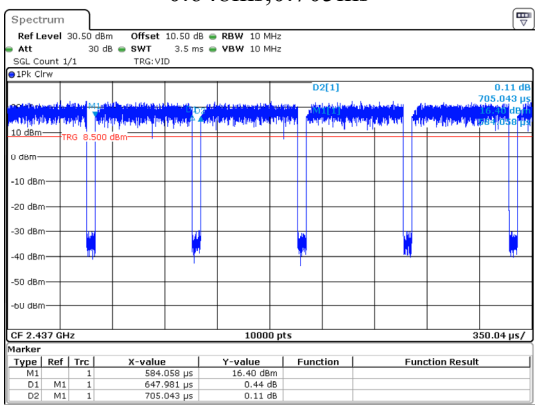
802.11n20_2437MHz_Chain 1
1.307ms,1.364ms



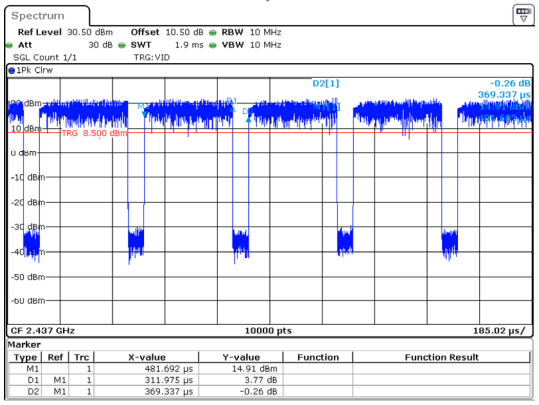
802.11n40_2437MHz_Chain 0
0.648ms,0.705ms



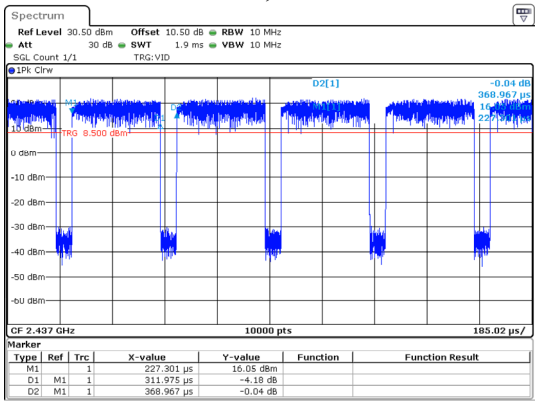
802.11n40_2437MHz_Chain 1
0.648ms,0.705ms



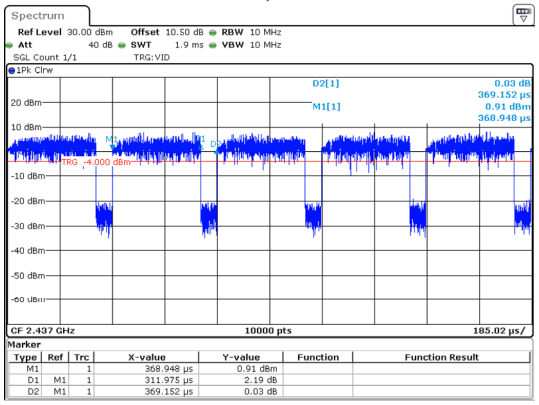
802.11ax20_2437MHz_RU_Full_Chain 0
0.312ms,0.369ms



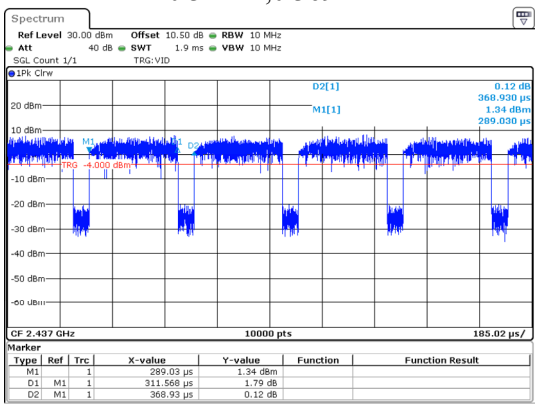
802.11ax20_2437MHz_RU_Full_Chain 1
0.312ms,0.369ms



802.11ax40_2437MHz_RU_Full_Chain 0
0.312ms,0.369ms



802.11ax40_2437MHz_RU_Full_Chain 1
0.312ms,0.369ms



RF EXPOSURE EVALUATION

MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247(i)and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm^2)**	**Averaging Time (minutes)**
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30
30–300	27.5	0.073	0.2	30
300–1500	/	/	f/1500	30
1500–100,000	/	/	1.0	30

f = frequency in MHz; * = Plane-wave equivalent power density;

According to §1.1310 and §2.1091 RF exposure is calculated.

Result

Calculation formula:

Prediction of power density at the distance of the applicable MPE limit
$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm^2);
P = power input to the antenna (in appropriate units, e.g., mW);
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

Calculated Data:

For worst case:

Mode	Frequency (MHz)	Antenna Gain#		Max Tune-up Power#		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
2.4G Wi-Fi	2412-2462	7.64	5.81	29.0	794.33	31	0.3822	1.0
5G Wi-Fi	5150-5250	8.67	7.36	25.0	316.23	31	0.1927	1.0
	5250-5350	8.67	7.36	21.5	141.25	31	0.0861	1.0
	5470-5725	8.67	7.36	21.0	125.89	31	0.0767	1.0
	5725-5850	8.67	7.36	26.5	446.68	31	0.2722	1.0
	5850-5895	8.67	7.36	26.0	398.11	31	0.2426	1.0

Note:
1) The tune up conducted power and antenna gain was declared by the applicant.
2) The antenna gain should be the directional gain.
3) The 2.4G Wi-Fi and 5G Wi-Fi can Simultaneous transmitting.

Simultaneous transmitting consideration (worst case):

The ratio=$MPE_{2.4G\ Wi\text{-}Fi}$/limit+$MPE_{5G\ Wi\text{-}Fi}$/limit = 0.3822/1.0+0.2722/1.0 =0.654<1.0,
so simultaneous exposure is compliant.

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 31cm from nearby persons.

Result: Compliant.

EXPOSURE LIMITS

Applicable Standard

According to RSS-102 Issue 6 §5.3.2:

Table 7: RF field strength and power density limits for devices used by the general public (uncontrolled environment)

Frequency range (MHz)	Electric field (V_{RMS}/m)	Magnetic field (A_{RMS}/m)	Power density (W/m^2)	Reference period (minutes)
10-20	27.46	0.0728	2	6
20-48	58.07 / $f^{0.25}$	0.1540 / $f^{0.25}$	8.944 / $f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 $f^{0.3417}$	0.008335 $f^{0.3417}$	0.02619 $f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ $f^{1.2}$
150000-300000	0.158 $f^{0.5}$	4.21×10^{-4} $f^{0.5}$	6.67×10^{-5} f	616000/ $f^{1.2}$

Note: f is frequency in MHz.

Calculated Formulary:
Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm^2)

P = power input to the antenna (in appropriate units, e.g., mW).

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \le 1$$

Mode	Frequency (MHz)	Antenna Gain#		Tune up output power#		Evaluation Distance	Power Density	MPE Limit
		(dBi)	(numeric)	(dBm)	(mW)	(cm)	(W/m^2)	(W/m^2)
2.4G Wi-Fi	2412-2462	7.64	5.81	29.0	794.33	31	3.822	5.37
5G Wi-Fi	5150-5250	8.67	7.36	16.5	44.67	31	0.272	9.01
	5250-5350	8.67	7.36	18.5	70.79	31	0.431	9.13
	5470-5725	8.67	7.36	21.0	125.89	31	0.767	9.39
	5725-5850	8.67	7.36	26.5	446.68	31	2.722	9.69
	5850-5895	8.67	7.36	26.0	398.11	31	2.426	9.83

Note:
1) The tune up conducted power and antenna gain was declared by the applicant.
2) The antenna gain should be the directional gain.
3) The 2.4G Wi-Fi and 5G Wi-Fi can simultaneous transmitting.

Simultaneous transmitting consideration (worst case):

The ratio=$MPE_{2.4G\ Wi\text{-}Fi}$/limit+$MPE_{5G\ Wi\text{-}Fi}$/limit = 3.822/5.37+2.722/9.69 =0.993<1.0,
so simultaneous exposure is compliant.

Result: Compliant

Note: To maintain compliance with the RF exposure guidelines, place the equipment at least 31cm from nearby persons.

EUT PHOTOGRAPHS

Please refer to the attachment 2401Y27848E-RF External photo and 2401Y27848E-RF Internal photo.

TEST SETUP PHOTOGRAPHS

Please refer to the attachment 2401Y27848E-RFA Test Setup photo.

******* END OF REPORT *******