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TEST REPORT

Report Number	180200017SEL-TEL3(R2)
Applicant Name / Address	Hanwha Techwin Co., Ltd. 1204, Changwon-daero, Seongsan-gu Changwon-si, Gyeongsangnam-do, Korea
Test Sample Description	
- Product name	4 Channel Wireless NVR
- Model and/or Brand name	SNR-73201W
- FCC ID and/or IC ID	NLMSNR73201W and/or 21482-SNR73201W
- Manufacturer Name	Zhuhai RaySharp Technology Co., Ltd.
- Manufacturer Address	NO.100 OF TECHNOLOGY ROAD 6, NATIONAL HI-TECH ZONE, ZHUHAI, GUANGDONG, P.R.CHINA
- Variant model Name	N/A
Date of receipt of sample(s)	06 Feb. 2018
Date of Test	08 Feb. 2018 - 07 Mar. 2018
Test standard(s)	CFR 47 Part 15 Subpart C, RSS-247 Issue 2
Test Results & uncertainty	See Summary
Issue date	14 Mar. 2018

Note 1. The results shown in this test report refer only to the sample(s) tested.

Note 2: This report shall not be reproduced except in full, without the written approval of Intertek.

Tested by

Name : David.Jang
RF Engineer

Approved by

Name : Kangmin.Rhee
RF Technical Manager

Intertek ETL SEMKO Korea Ltd.

SECTION 1 CONTENTS

SECTION 2 GENERAL DESCRIPTION

1. Laboratory Information

Name	Intertek ETL SEMKO Korea Ltd.
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2. Applicant Information

Name	Hanwha Techwin Co., Ltd.
Address	1204, Changwon-daero, Seongsan-gu Changwon-si, Gyeongsangnam-do, Korea
Contact Person	Jei Soon, Kang
Phone No.	+82 10 2667 4196

3. Factory Information

Name	Zhuhai RaySharp Technology Co., Ltd.
Address	NO.100 OF TECHNOLOGY ROAD 6, NATIONAL HI-TECH ZONE, ZHUHAI, GUANGDONG, P.R.CHINA
Country	China

4. Description of EUT

Product name	4 channel Wireless NVR
Model name	SNR-73201W
Serial No.	N/A
Manufacturer	Zhuhai RaySharp Technology Co., Ltd.
Country of Manufacture	China
Rated Voltage	DC 12 V (input 100 V ~ 240 V Adapter)
Frequency Range	2 412 MHz ~ 2 462 MHz: 802.11b/g/n(HT20) 2 422 MHz ~ 2 452 MHz: 802.11n(HT40)
Modulation Technique	DSSS: 802.11b, OFDM: 802.11g/n(HT20)/n(HT40)
Number of Channel	11 channels: 802.11b/g/n(HT20) 9 channels: 802.11n(HT40)
Antenna Type	Helical Antenna (2x2 MIMO)
Antenna Gain	Ant 1: 5 dBi, Ant 2: 5 dBi
Transmit Power	17.52 dBm(Peak)
H/W Version	SNR-73201W
S/W Version	Rev 1
RF Power Setting Parameter	802.11b: 12(Ant1)/ 10(Ant2), 802.11g: 0A(Ant1)/ 0A(Ant2), 802.11n(HT20): 6(Ant1)/ 6 (Ant2), 802.11n(HT40): 6(Ant1)/ 6(Ant2)

5. Test Instrument

Control No.	Equipment	Manufacturer	Model	Serial No.	Cal. Due.
ES1006	SIGNAL & SPECTRUM ANAYZER	Rohde & Schwarz	FSW43	103893	18, Sep. 2018
ES949	EMI Test Receiver	Rohde & Schwarz	ESU40	100478	24, Jan. 2019
ES950	EMI Test Receiver	Rohde & Schwarz	ESU26	100590	23, Jan. 2019
ES951	Open Switch and Control Platform	Rohde & Schwarz	OSP130	101467	N/A
ES957	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100465	20, Jan. 2019
ES972	Biconilog (Type7)	ETS-Lindgren	3142E	00203547	23, Jan. 2019
ES975	DRG Horn (Medium)	ETS-Lindgren	3117	00201915	20, Jan. 2019
ES977	Standard Gain Horn	ETS-Lindgren	3160-09	LM9738	3, May 2018
ES1027	AMP	Rohde & Schwarz	SCU-08	100737	24, Jan. 2019
ES1029	AMP	Rohde & Schwarz	SCU-18D	1952128	20, Jul. 2018
ES1031	AMP	Rohde & Schwarz	SCU-26D	1879069	18, Jul. 2018
ES1004	VECTOR SIGNAL GENERATOR	Rohde & Schwarz	SMBV100A	261569	19, Sep. 2018
ES1005	SIGNAL GENERATOR	Rohde & Schwarz	SMB100A	178493	24, Jan. 2019
ES1038	ATTENUATOR	WEINSCHEL	10dB	TEMPNO.4824	20, Sep. 2018
ES1036	ATTENUATOR	WEINSCHEL	54A-10	69679	19, Sep. 2018
ES1074	Notch RF filter	Micro-Tronics	BRM50702-02	G043	18, Jul. 2018
ES1154	RF Meter	ANRITSU	MA2411B	1648099	2, Feb. 2019
ES1155	RF Sensor	ANRITSU	ML2495A	1531208	18, Sep. 2018
ES1152	System DC Power Supply	KEYSIGHT	N5747A	US16D4132P	18, Sep. 2018
ES955	Two-Line V-Network	Rohde & Schwarz	ENV216	101982	09, Nov. 2018
ES952	EMI Test Receiver	Rohde & Schwarz	ESR7	101560	22, Jan. 2019
ES1109	Digital multi meter	FLUKE	381	34980197WS	22, Jan. 2019
41	Software	Rohde & Schwarz	EMC32	Ver9.21.00	-

6. External accessories

Equipment Name	Model name	Manufacturer	S/N	Remarks
EUT's Adaptor	FJ-SW1202000U	Shenzhen Fujia Electric	N/A	
Monitor1	P2314Ht	DELL	CN-0JH6ND-74445-57S-BWAS	
Monitor2	U2804 UHD 4K2K	Alpha Scan	15182804010110	
Note PC	NT500I5Q	Samsung Electronics	0HV991BH500767H	
Note PC Adaptor	A13-040N2A	Samsung Electronics	AD-4019C	
Mouse	STW-JXOP589B	N/A	N/A	
USB	SDCZ36-004G	SANDISK	BH130524583B	
D-Sub Cable	N/A	N/A	N/A	Unsheild (2 m)
HDMI Cable	E168141	N/A	20276	Unsheild (2 m)

7. Channel List

Channel No.	Frequency(MHz)	Channel No.	Frequency(MHz)
802.11b/g/n(HT20)		802.11n(HT40)	
1	2 412	3	2 422
2	2 417	4	2 427
3	2 422	5	2 432
4	2 427	6	2 437
5	2 432	7	2 442
6	2 437	8	2 447
7	2 442	9	2 452
8	2 447		
9	2 452		
10	2 457		
11	2 462		

8. Test Condition

Mode	Test Frequency(MHz)		
	Lowest	Middle	Highest
802.11b – 1 Mbps	2 412	2 437	2 462
802.11g – 6 Mbps	2 412	2 437	2 462
802.11n(HT20) – MCS0	2 412	2 437	2 462
802.11n(HT40) – MCS0	2 422	2 437	2 452
802.11n(HT20) –MIMO – MCS8	2 412	2 437	2 462
802.11n(HT40) – MIMO – MCS8	2 422	2 437	2 452

Note)

The EUT is tested by worst case data rate transmission based on highest output power.

SECTION 3 SUMMARY

1. Summary of test results

Requirements	FCC Rule	IC Rule	Compliance
Antenna Requirement	15.203 15.247(b)(4)	-	Complied
Maximum Output Power	15.247(b)(4)	RSS-247 5.4(d)	Complied
Power Spectral Density	15.247(e)	RSS-247 5.2(b)	Complied
6 dB Channel Bandwidth	15.247(a)(2)	RSS-247 5.2(a)	Complied
Occupied Bandwidth	-	RSS-GEN 6.6	Complied
Radiated Spurious Emissions & Restricted Band, Conducted Spurious Emissions & Band Edge	15.247(d) 15.205(a) 15.209(a)	RSS-247 5.5, RSS-GEN 8.9, 8.10	Complied
Conducted Emissions	15.207(a)	RSS-GEN, 8.8	Complied
Test method: According to ANSI C63.10-2013, KDB 558074 D01 DTS Meas. Guidance v04			

2. Measurement Uncertainty

Parameters	Uncertainty (k = 2)	
Maximum Peak Conducted Output Power	1.66 dB	
Power Spectral Density	1.32 dB	
Channel Bandwidth	4.69 kHz	
Spurious Emissions (Conducted)	1.32 dB	
Spurious Emissions (Radiated)	9 kHz to 30 MHz	4.2 dB
	30 MHz to 1 GHz	3.9 dB
	1 GHz to 6 GHz	5.9 dB
	6 GHz to 18 GHz	5.1 dB
	18 GHz to 26 GHz	4.5 dB

SECTION 4 TEST RESULT

1. Antenna Requirement

1.1 Rule

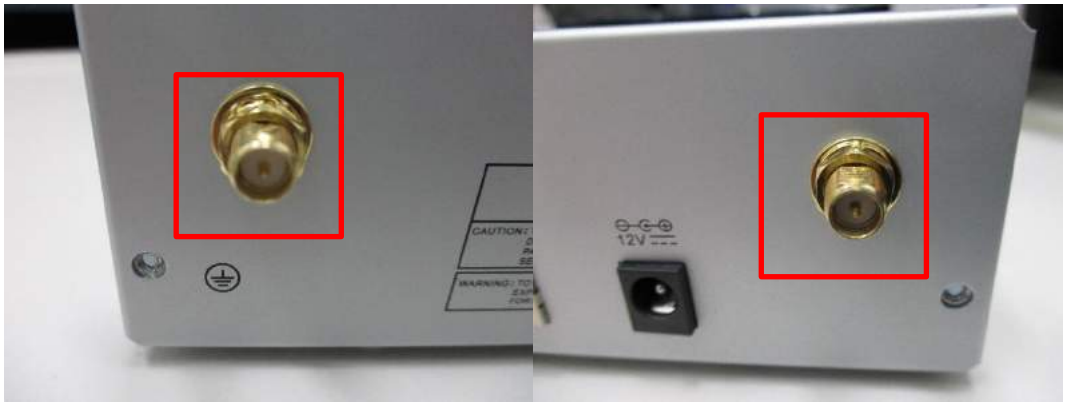
According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to §15.407(a)(1)(2)(3), If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

1.2 Test Results - Complied

The Transmitter has a connector of antenna that uses a unique coupling.
Directional peak gain of the antenna is 5 dBi.

Antenna Connector picture



2. Maximum Peak Output Power

2.1 Rule

According to §15.247(b)(3), For systems using digital modulation in the 902-928 MHz, 2 400-2 483.5 MHz, and 5 725-5 850 MHz bands: 1 Watt.
As an alternative to a peak power measurement, compliance with the 1 Watt limit can be based on a measurement of the maximum conducted output power.
Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signalling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

According to §15.247(b)(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

2.2 Measurement Procedure

According to ANSI C63.10-2013 & KDB 558074 D01 DTS Meas. Guidance v04, 9.1.3 PKPM1 Peak power meter method.

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

2.3 Test Results - Complied

Test Condition: Temperature (23 ± 2) °C; Humidity (42 ± 2) %

Test Mode	Test Frequency	Peak Output Power (dBm)	Limit (dBm)
802.11b_Ant1	2 412 MHz	P = 12.83 dBm	30
	2 437 MHz	P = 12.89 dBm	
	2 462 MHz	P = 12.84 dBm	

Test Mode	Test Frequency	Peak Output Power (dBm)	Limit (dBm)
802.11b_Ant2	2 412 MHz	P = 12.88 dBm	30
	2 437 MHz	P = 12.83 dBm	
	2 462 MHz	P = 12.93 dBm	

Test Mode	Test Frequency	Peak Output Power (dBm)	Limit (dBm)
802.11g_Ant1	2 412 MHz	P = 16.65 dBm	30
	2 437 MHz	P = 17.08 dBm	
	2 462 MHz	P = 16.61 dBm	

Test Mode	Test Frequency	Peak Output Power (dBm)	Limit (dBm)
802.11g_Ant2	2 412 MHz	P = 16.55 dBm	30
	2 437 MHz	P = 17.15 dBm	
	2 462 MHz	P = 17.11 dBm	

Note)

1. Peak Output Power = Reading (dBm) + Cable loss (dB) + Attenuator (dB)
2. Peak Output Power is tested by Power meter & sensor (VBW = 50 MHz)

Test Mode	Test Frequency	Peak Output Power (dBm)	Limit (dBm)
802.11n(HT20)_Ant1	2 412 MHz	P = 15.50 dBm	30
	2 437 MHz	P = 15.34 dBm	
	2 462 MHz	P = 15.12 dBm	

Test Mode	Test Frequency	Peak Output Power (dBm)	Limit (dBm)
802.11n(HT20)_Ant2	2 412 MHz	P = 15.50 dBm	30
	2 437 MHz	P = 15.70 dBm	
	2 462 MHz	P = 15.82 dBm	

Test Mode	Test Frequency	Peak Output Power (dBm)						Limit (dBm)
		Ant1(dBm)	Ant1(mW)	Ant2(dBm)	Ant2(mW)	Ant 1+2 (mW)	Ant 1+2 (dBm)	
802.11n(HT20)_MIMO	2 412 MHz	14.51	28.25	14.35	27.23	55.48	17.44	30
	2 437 MHz	14.13	25.88	14.47	27.99	53.87	17.31	
	2 462 MHz	14.20	26.30	14.53	28.38	54.68	17.38	

Note)

1. Peak Output Power = Reading (dBm) + Cable loss (dB) + Attenuator (dB)
2. Peak Output Power is tested by Power meter & sensor (VBW = 50 MHz)

Test Mode	Test Frequency	Peak Output Power (dBm)	Limit (dBm)
802.11n(HT40)_Ant1	2 422 MHz	P = 14.74 dBm	30
	2 437 MHz	P = 14.54 dBm	
	2 452 MHz	P = 14.25 dBm	

Test Mode	Test Frequency	Peak Output Power (dBm)	Limit (dBm)
802.11n(HT40)_Ant2	2 422 MHz	P = 14.26 dBm	30
	2 437 MHz	P = 14.49 dBm	
	2 452 MHz	P = 14.72 dBm	

Test Mode	Test Frequency	Peak Output Power (dBm)						Limit (dBm)
		Ant1(dBm)	Ant1(mW)	Ant2(dBm)	Ant2(mW)	Ant 1+2 (mW)	Ant 1+2 (dBm)	
802.11n(HT40)_MIMO	2 422 MHz	14.61	28.91	14.41	27.61	56.51	17.52	30
	2 437 MHz	14.39	27.48	14.20	26.30	53.78	17.31	
	2 452 MHz	14.05	25.41	14.39	27.48	52.89	17.23	

Note)

1. Peak Output Power = Reading (dBm) + Cable loss (dB) + Attenuator (dB)
2. Peak Output Power is tested by Power meter & sensor (VBW = 50 MHz)

3. Power Spectral Density

3.1 Rule

According to §15.247(e), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

3.2 Measurement Procedure

According to ANSI C63.10-2013 & KDB 558074 D01 DTS Meas. Guidance v04, 10.2 Method PKPSD.

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance, and is optional if the maximum conducted (average) output power was used to demonstrate compliance.

a) Set Spectrum Analyzer centre frequency to DTS channel centre frequency.
b) Set the span to 1.5 x DTS bandwidth.
c) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ≥ 3 x RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.
j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

3.3 Test Results – Complied

Test Condition: Temperature (23 ± 2) °C; Humidity (42 ± 2) %

Test Mode	Test Frequency	Power Spectral Density (dBm/MHz)				Limit (dBm/MHz)
802.11b_Ant1	2 412 MHz	P.S.D.	=	-0.66	dBm/MHz	8
	2 437 MHz	P.S.D.	=	-1.67	dBm/MHz	
	2 462 MHz	P.S.D.	=	-0.48	dBm/MHz	

Test Mode	Test Frequency	Power Spectral Density (dBm/MHz)				Limit (dBm/MHz)
802.11b_Ant2	2 412 MHz	P.S.D.	=	0.18	dBm/MHz	8
	2 437 MHz	P.S.D.	=	0.06	dBm/MHz	
	2 462 MHz	P.S.D.	=	0.08	dBm/MHz	

Test Mode	Test Frequency	Power Spectral Density (dBm/MHz)				Limit (dBm/MHz)
802.11g_Ant1	2 412 MHz	P.S.D.	=	-19.99	dBm/MHz	8
	2 437 MHz	P.S.D.	=	-19.04	dBm/MHz	
	2 462 MHz	P.S.D.	=	-19.88	dBm/MHz	

Test Mode	Test Frequency	Power Spectral Density (dBm/MHz)				Limit (dBm/MHz)
802.11g_Ant2	2 412 MHz	P.S.D.	=	-19.36	dBm/MHz	8
	2 437 MHz	P.S.D.	=	-19.57	dBm/MHz	
	2 462 MHz	P.S.D.	=	-19.50	dBm/MHz	

Note)

1. Power Spectral Density(dBm/MHz)= Reading (dBm/MHz) + Cable loss (dB) + Attenuator (dB)

Test Mode	Test Frequency	Power Spectral Density (dBm/MHz)			Limit (dBm/MHz)
802.11n(HT20)_Ant1	2 412 MHz	P.S.D. =	-19.99	dBm/MHz	8
	2 437 MHz	P.S.D. =	-20.36	dBm/MHz	
	2 462 MHz	P.S.D. =	-19.89	dBm/MHz	

Test Mode	Test Frequency	Power Spectral Density (dBm/MHz)			Limit (dBm/MHz)
802.11n(HT20)_Ant2	2 412 MHz	P.S.D. =	-19.77	dBm/MHz	8
	2 437 MHz	P.S.D. =	-20.87	dBm/MHz	
	2 462 MHz	P.S.D. =	-19.74	dBm/MHz	

Test Mode	Test Frequency	Power Spectral Density (dBm/MHz)						Limit (dBm/MHz)
		Ant1 (dBm/MHz)	Ant1 (mW/MHz)	Ant2 (dBm/MHz)	Ant2 (mW/MHz)	Ant1+2 (mW/MHz)	Ant1+2 (dBm/MHz)	
802.11n(HT20)_MIMO	2 412 MHz	-20.72	0.008	-19.57	0.011	0.020	-17.10	8
	2 437 MHz	-19.86	0.010	-19.20	0.012	0.022	-16.51	
	2 462 MHz	-20.99	0.008	-19.33	0.012	0.020	-17.07	

Note)

1. Power Spectral Density(dBm/MHz)= Reading (dBm) + Cable loss (dB) + Attenuator (dB)

Test Mode	Test Frequency	Power Spectral Density (dBm/MHz)			Limit (dBm/MHz)
802.11n(HT40)_Ant1	2 422 MHz	P.S.D.	=	-24.06 dBm/MHz	8
	2 437 MHz	P.S.D.	=	-24.14 dBm/MHz	
	2 452 MHz	P.S.D.	=	-24.28 dBm/MHz	

Test Mode	Test Frequency	Power Spectral Density (dBm/MHz)			Limit (dBm/MHz)
802.11n(HT40)_Ant2	2 422 MHz	P.S.D.	=	-23.65 dBm/MHz	8
	2 437 MHz	P.S.D.	=	-24.16 dBm/MHz	
	2 452 MHz	P.S.D.	=	-23.89 dBm/MHz	

Test Mode	Test Frequency	Power Spectral Density (dBm/MHz)						Limit (dBm/MHz)
		Ant1 (dBm/MHz)	Ant1 (mW/MHz)	Ant2 (dBm/MHz)	Ant2 (mW/MHz)	Ant1+2 (mW/MHz)	Ant1+2 (dBm/MHz)	
802.11n(HT40)_MIMO	2 422 MHz	-23.89	0.004	-22.89	0.005	0.009	-20.35	8
	2 437 MHz	-24.13	0.004	-22.58	0.006	0.009	-20.28	
	2 452 MHz	-24.45	0.004	-22.66	0.005	0.009	-20.45	

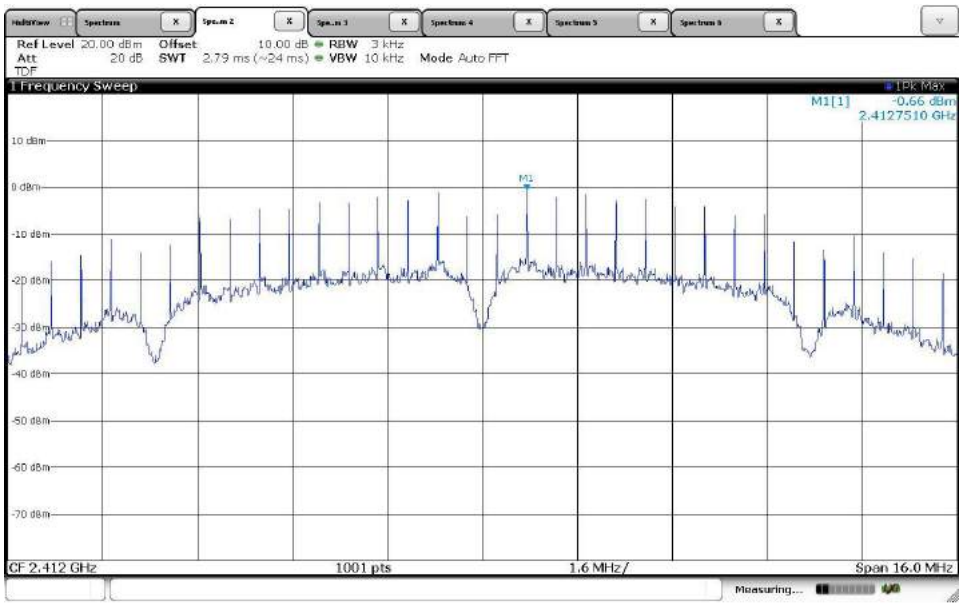
Note)

1. Power Spectral Density(dBm/MHz)= Reading (dBm/MHz) + Cable loss (dB) + Attenuator (dB)

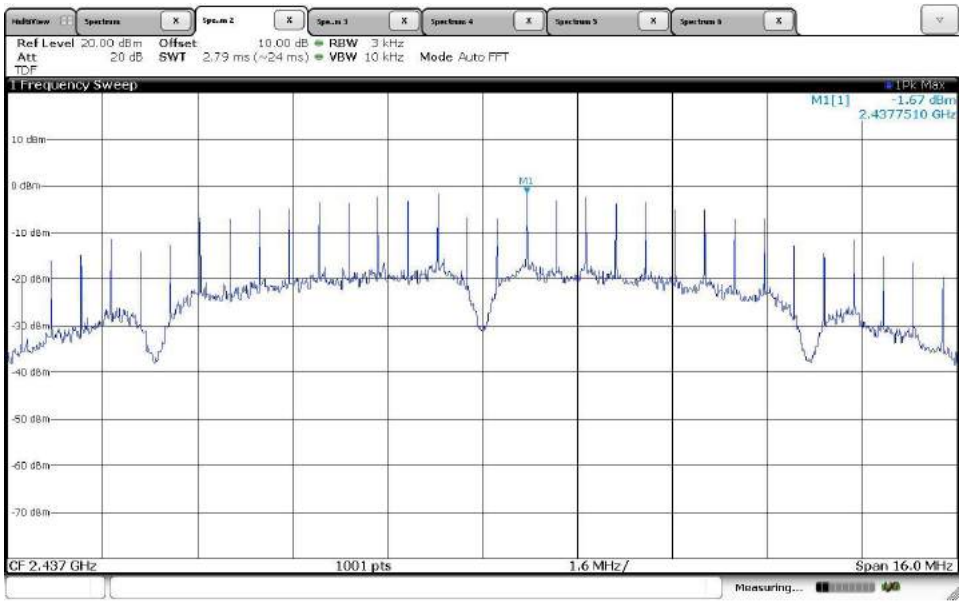
Photographs of Test Results

Test Mode – 802.11b_Ant1

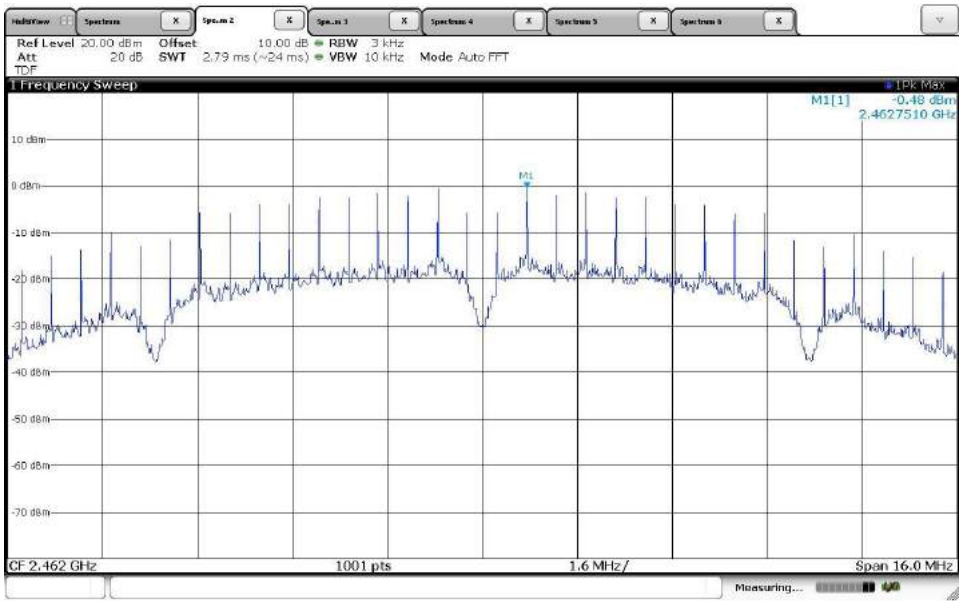
Lowest – 2 412 MHz



Middle – 2 437 MHz

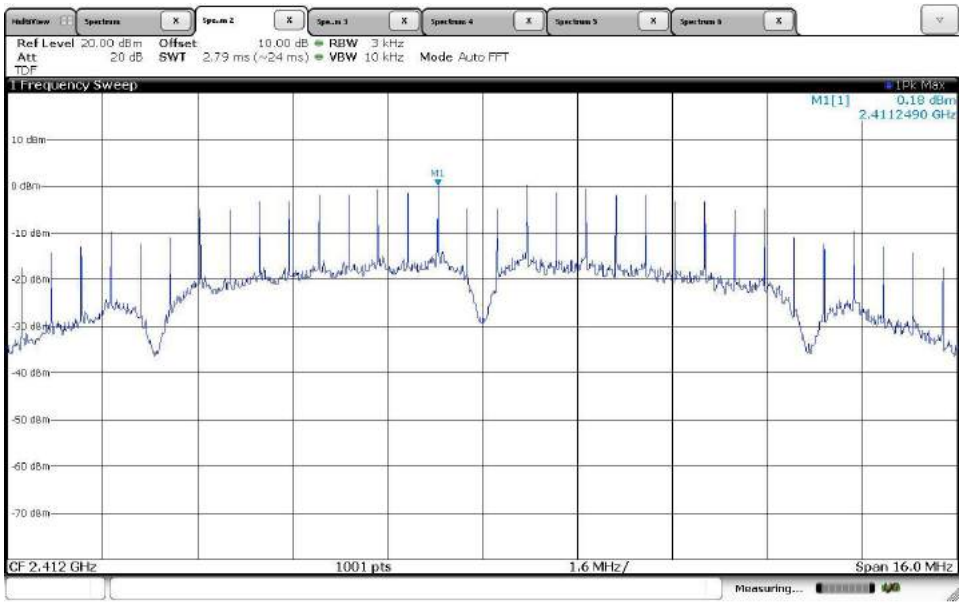


Highest – 2 462 MHz

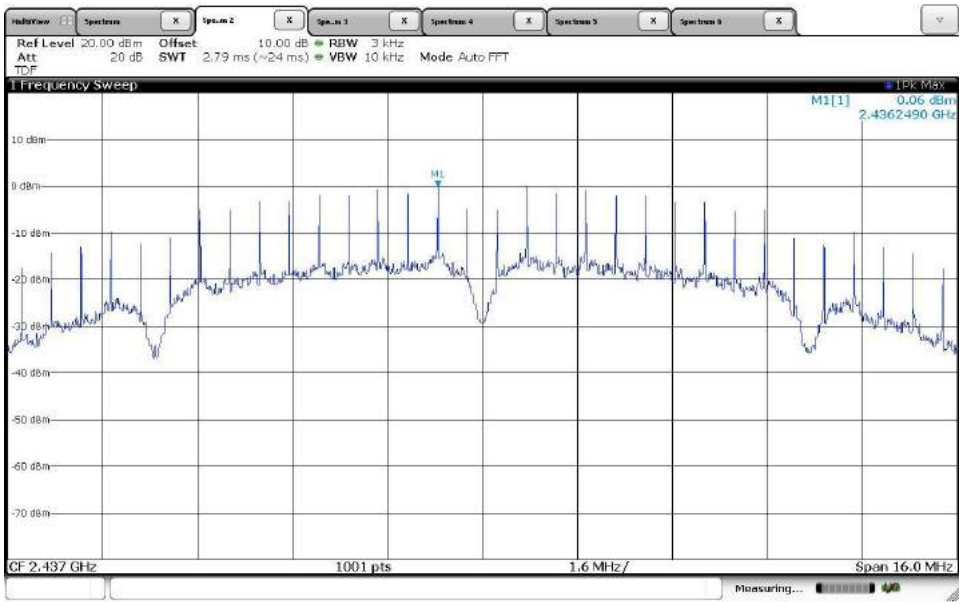


Test Mode – 802.11b_Ant2

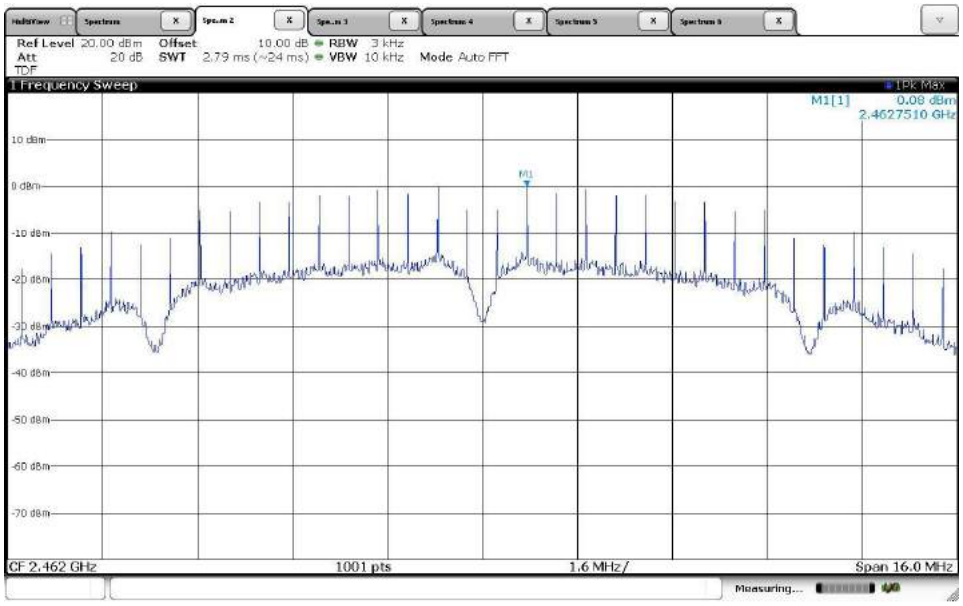
Lowest – 2 412 MHz



Middle – 2 437 MHz

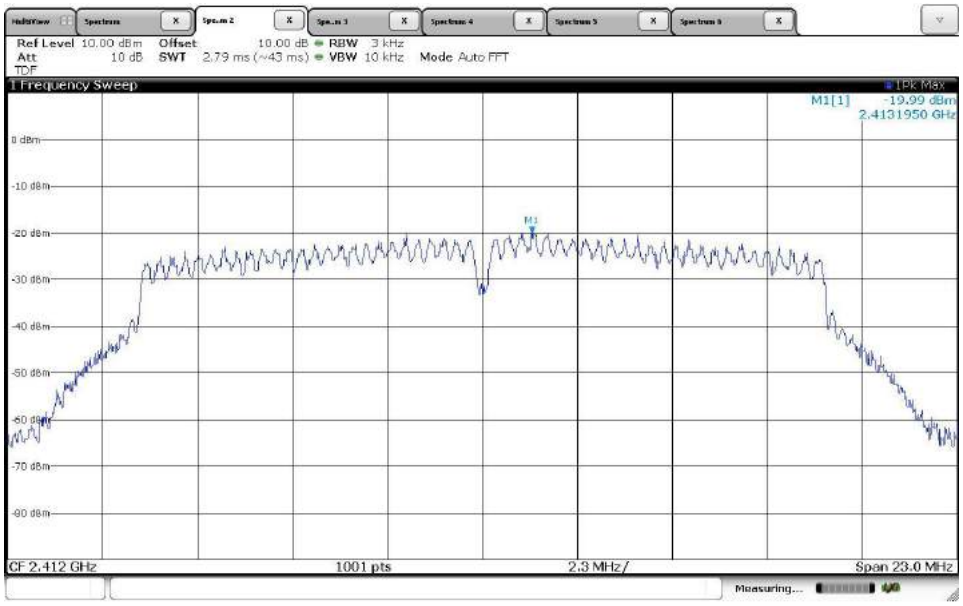


Highest – 2 462 MHz

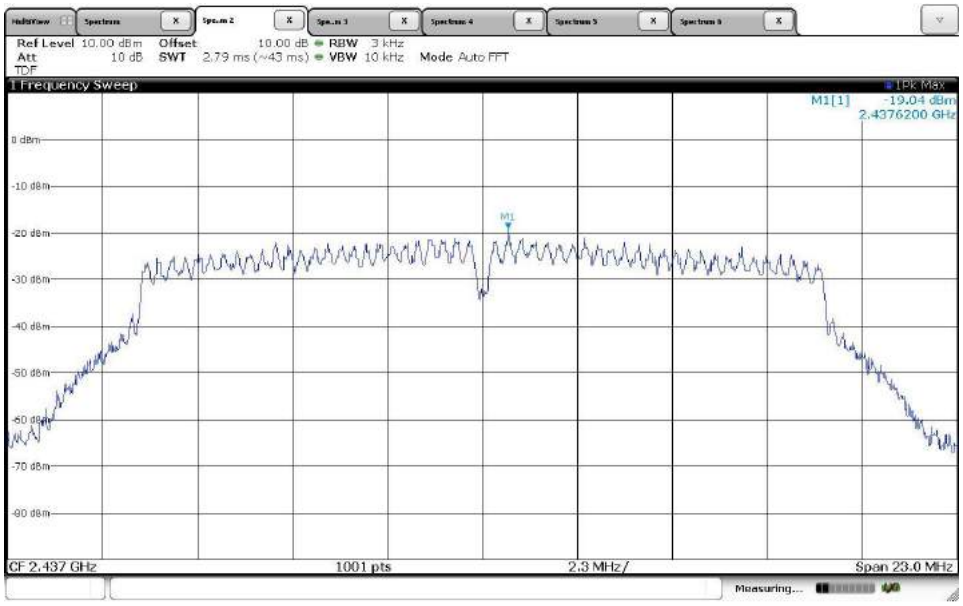


Test Mode – 802.11g_Ant1

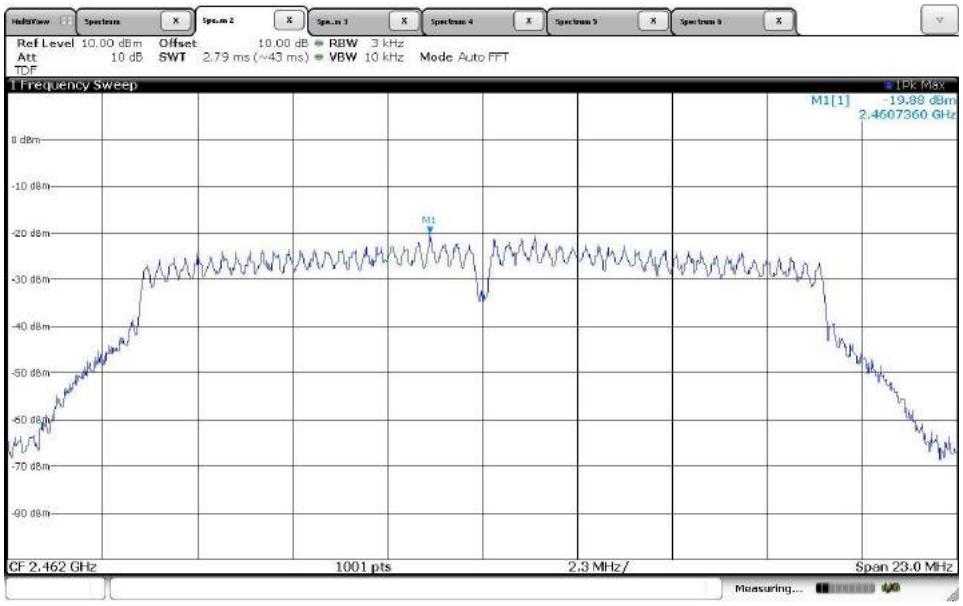
Lowest – 2 412 MHz



Middle – 2 437 MHz

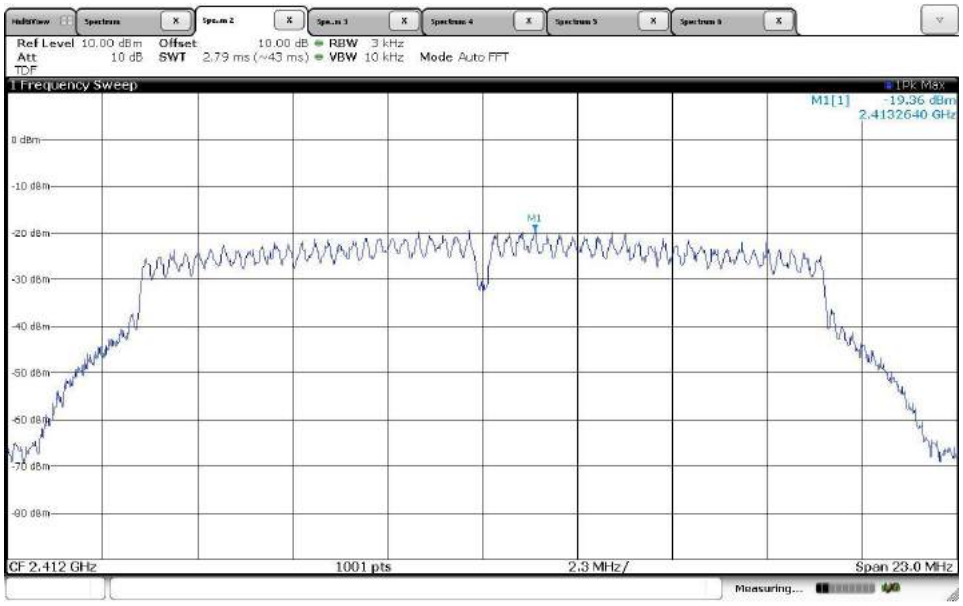


Highest – 2 462 MHz

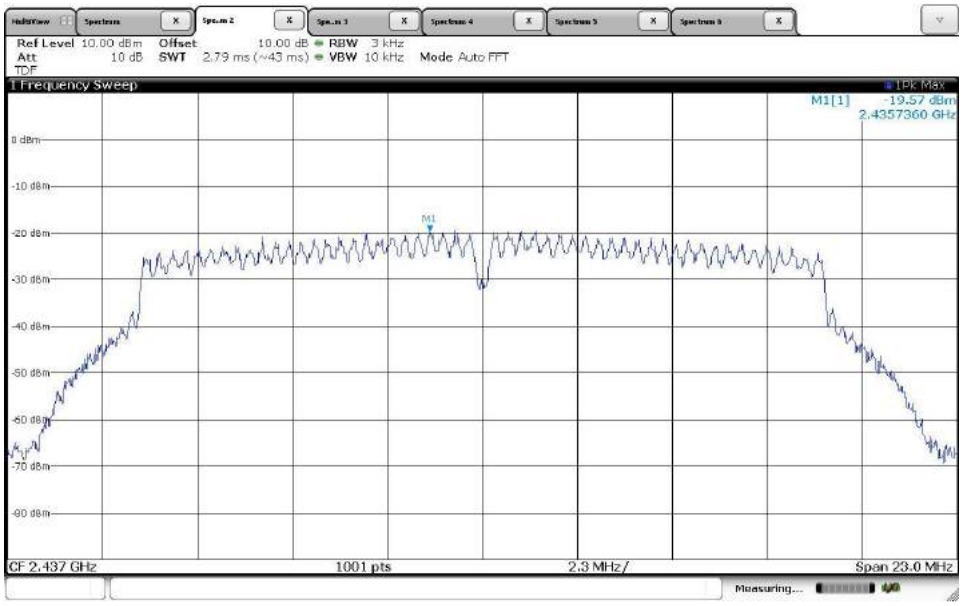


Test Mode – 802.11g_Ant2

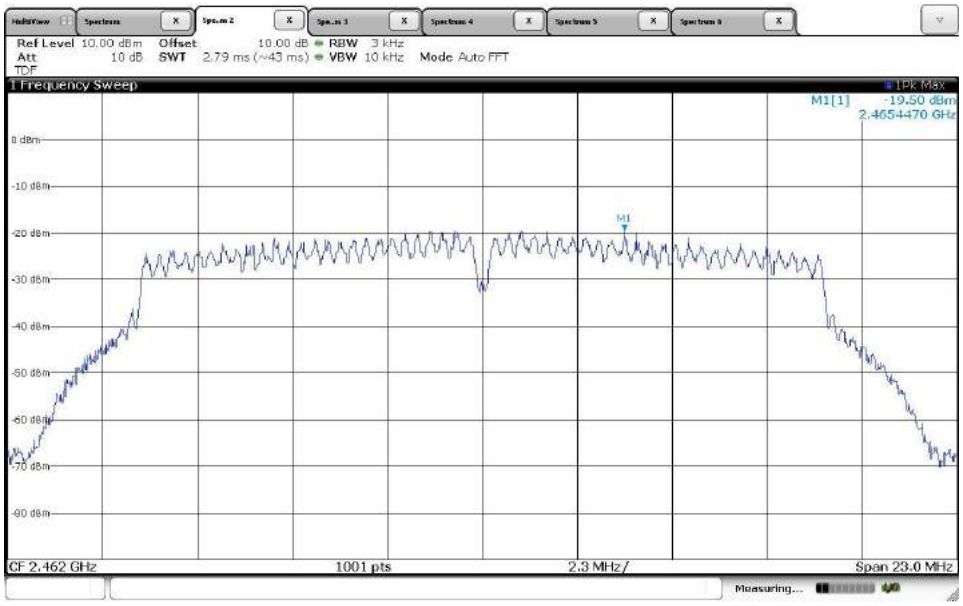
Lowest – 2 412 MHz



Middle – 2 437 MHz

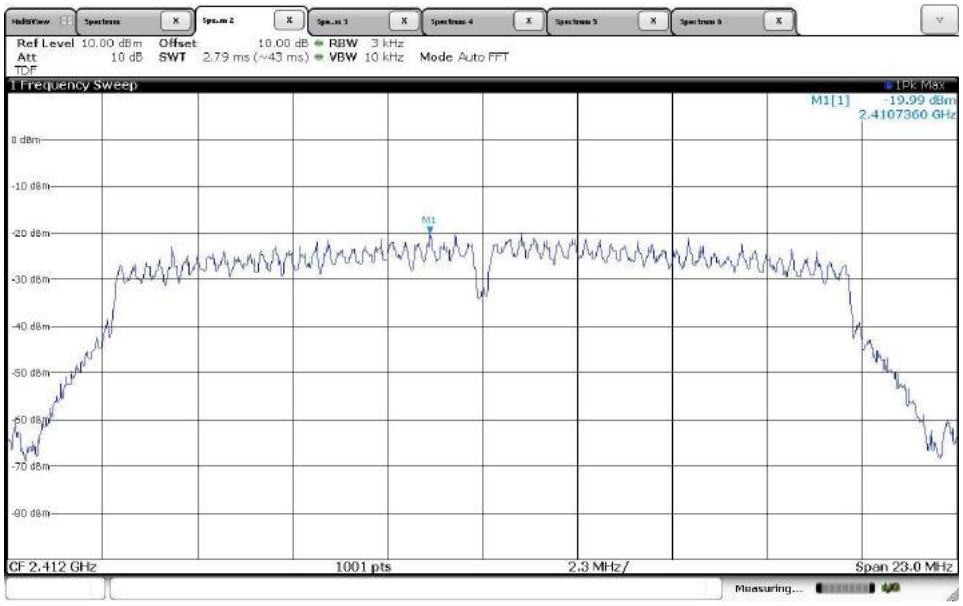


Highest – 2 462 MHz

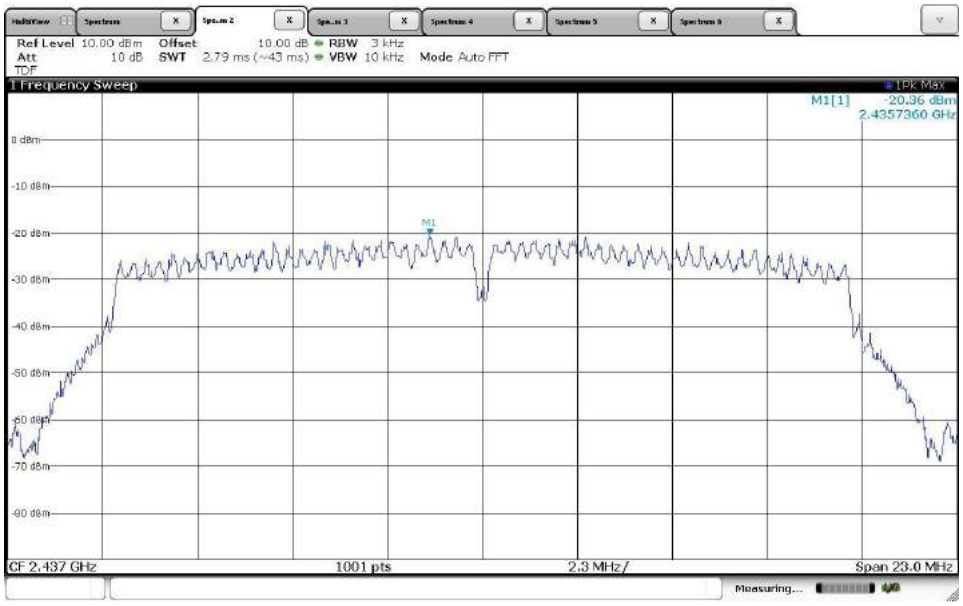


Test Mode – 802.11n(HT20)_Ant1

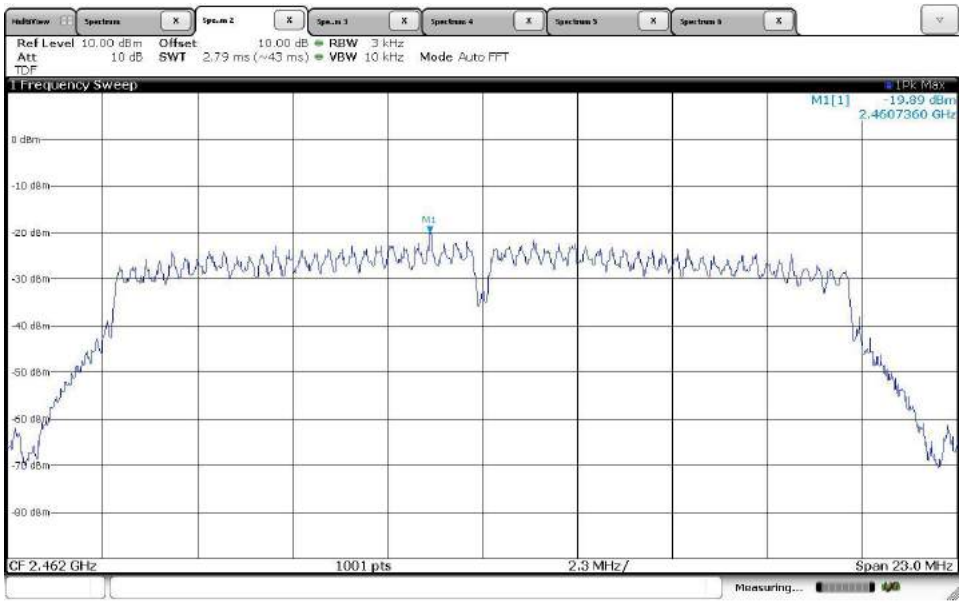
Lowest – 2 412 MHz



Middle – 2 437 MHz

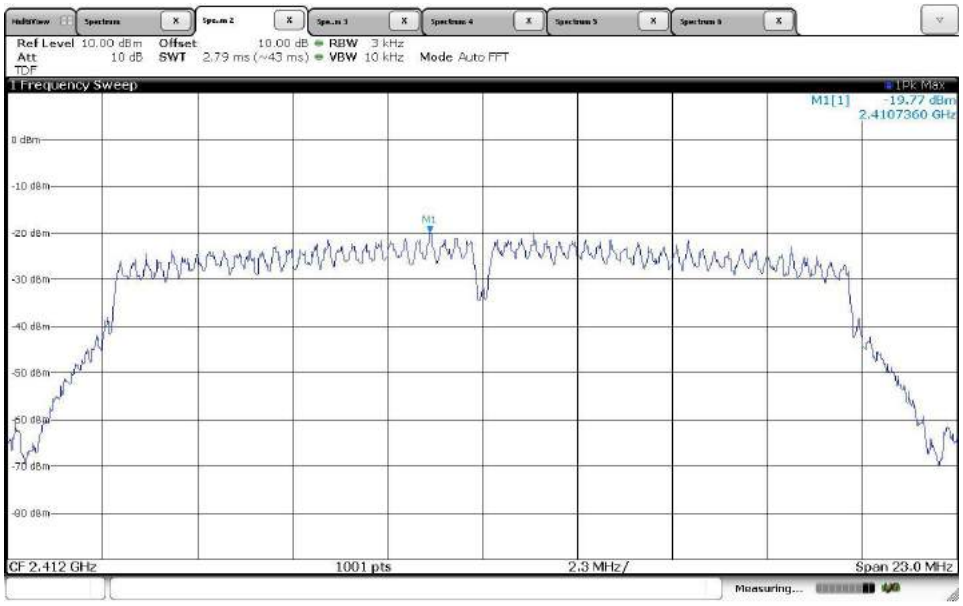


Highest – 2 462 MHz

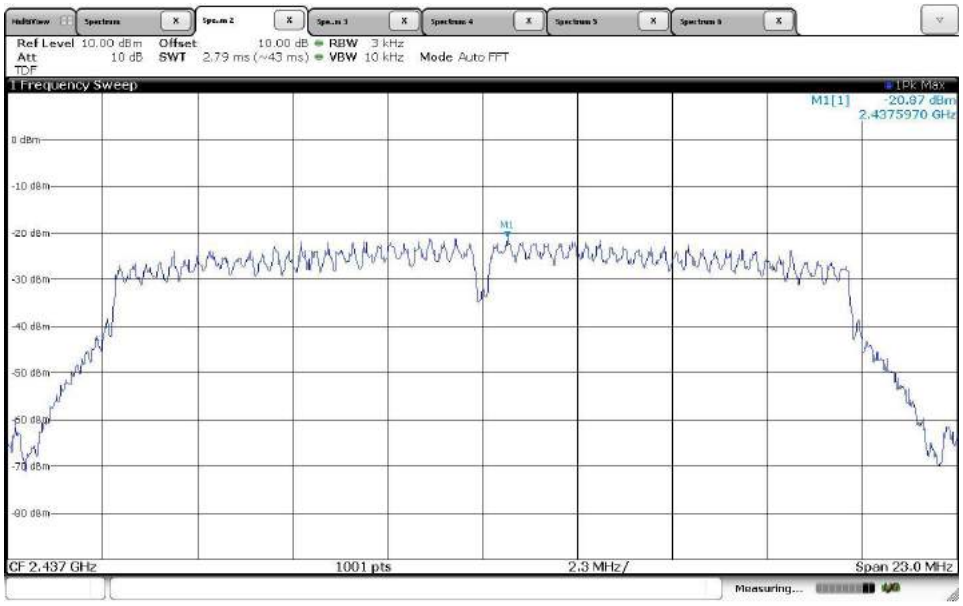


Test Mode – 802.11n(HT20)_Ant2

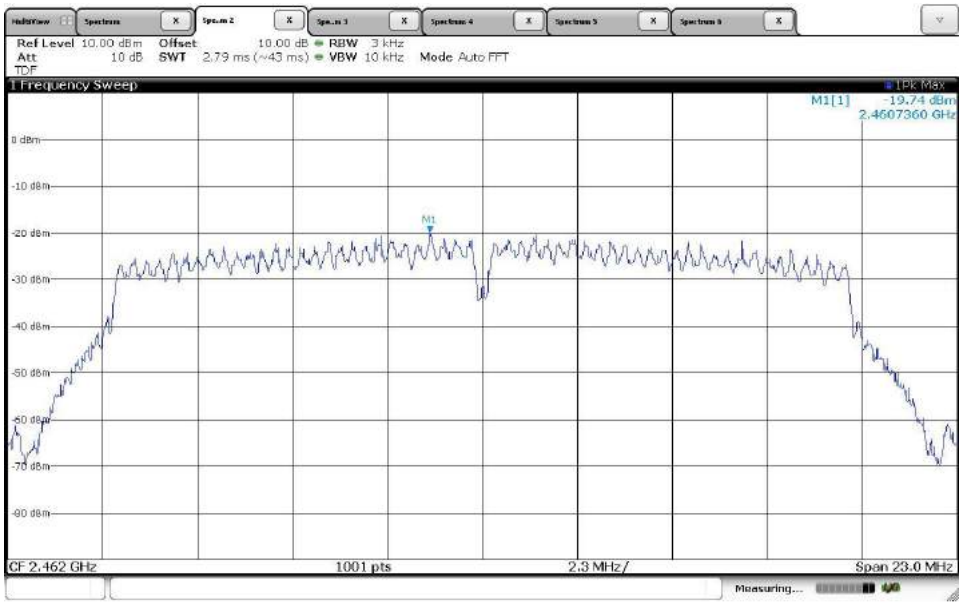
Lowest – 2 412 MHz



Middle – 2 437 MHz

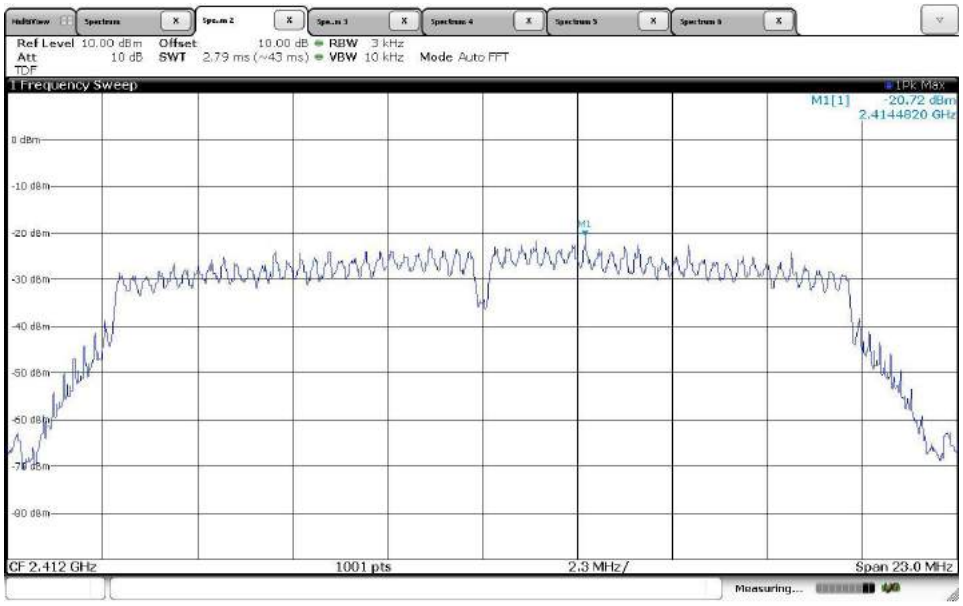


Highest – 2 462 MHz

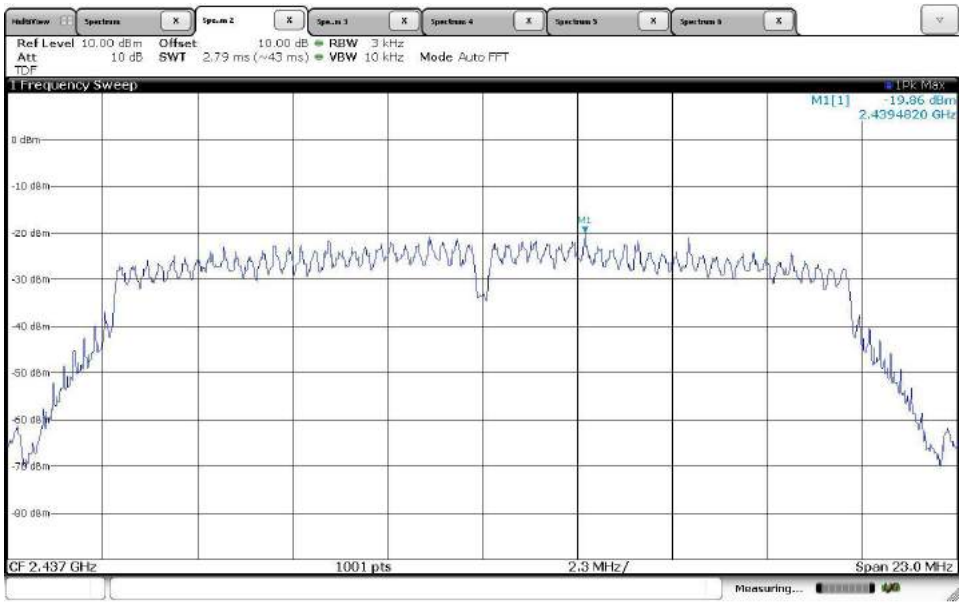


Test Mode – 802.11n(HT20)_MIMO_Ant1

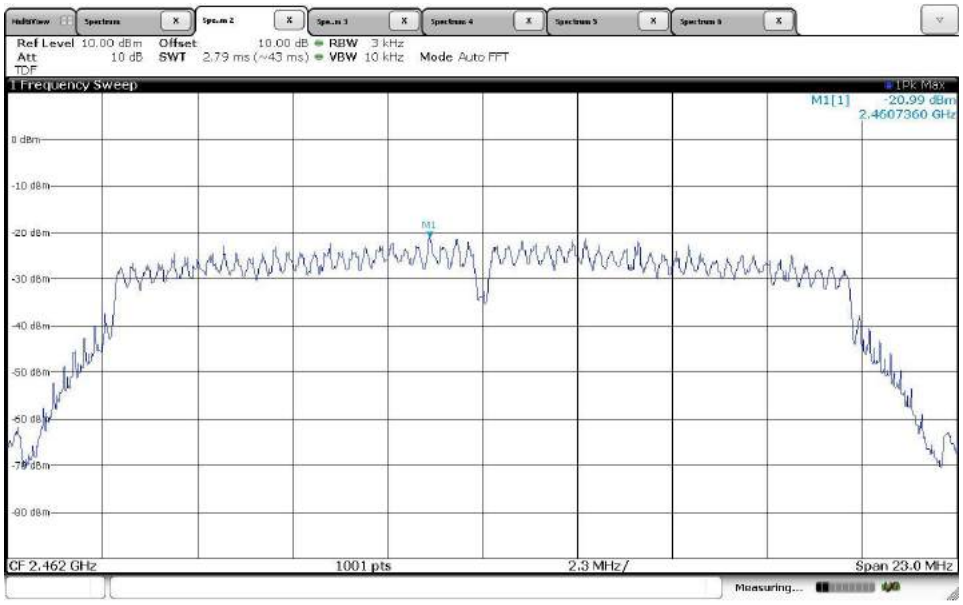
Lowest – 2 412 MHz



Middle – 2 437 MHz

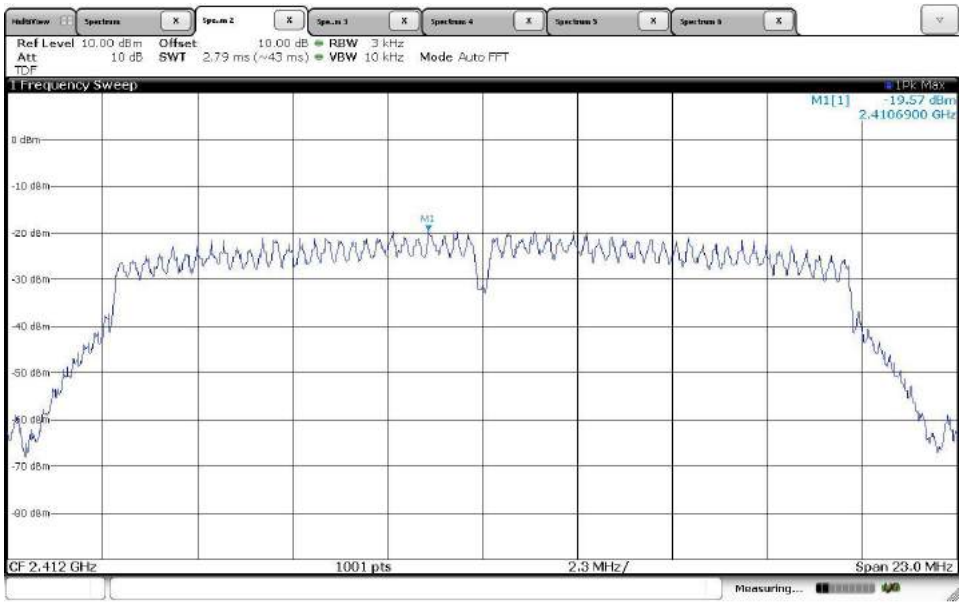


Highest – 2 462 MHz

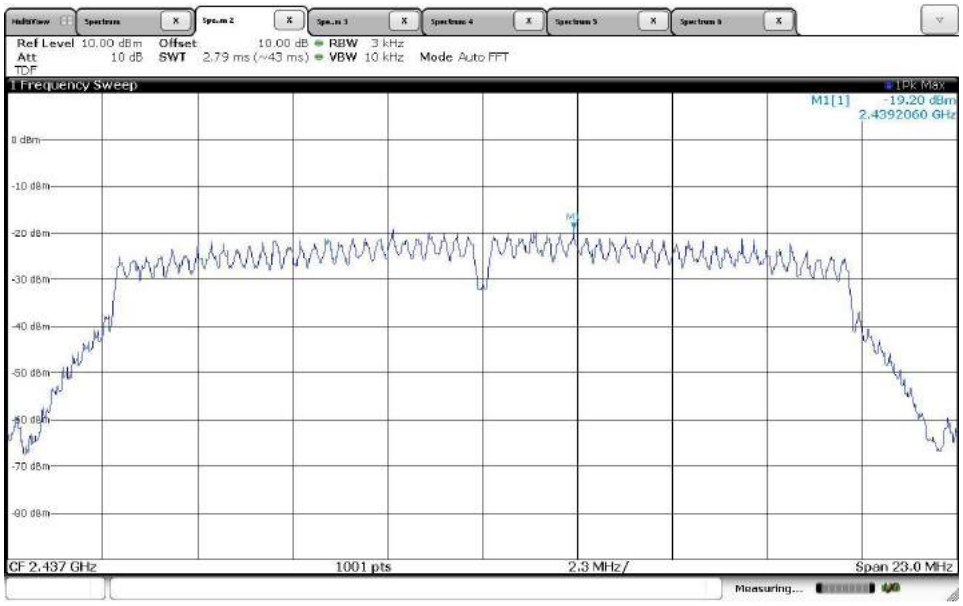


Test Mode – 802.11n(HT20)_MIMO_Ant2

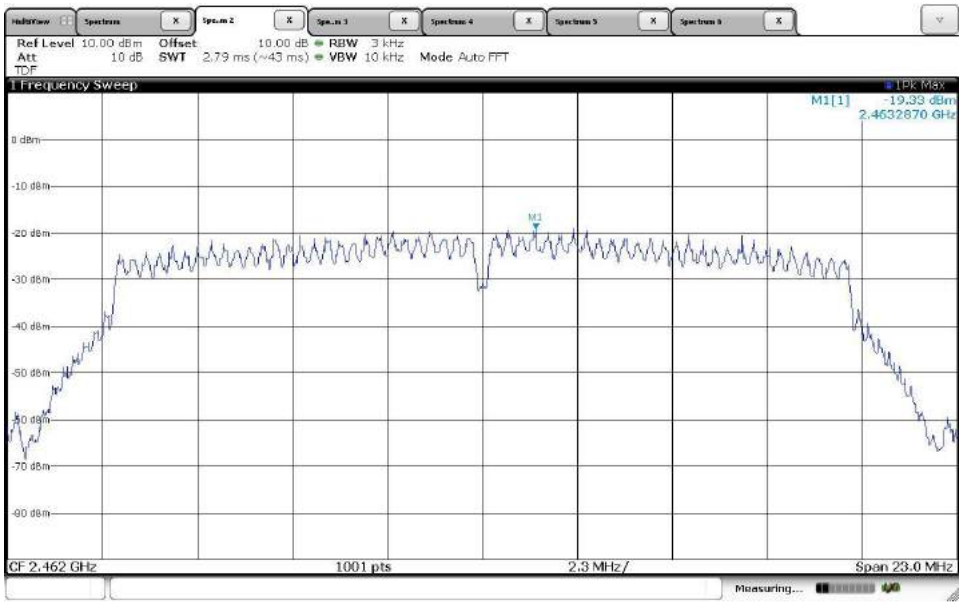
Lowest – 2 412 MHz



Middle – 2 437 MHz

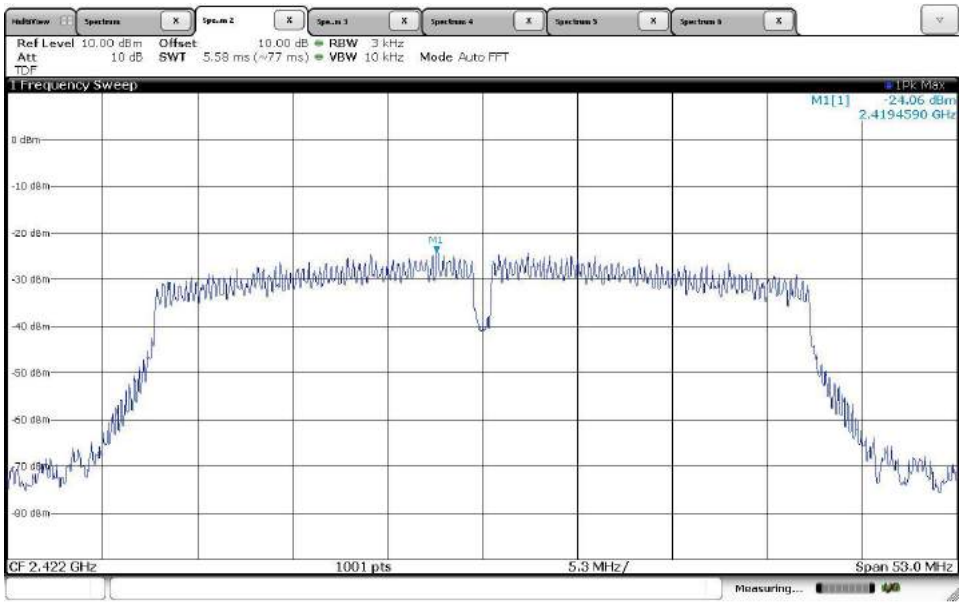


Highest – 2 462 MHz

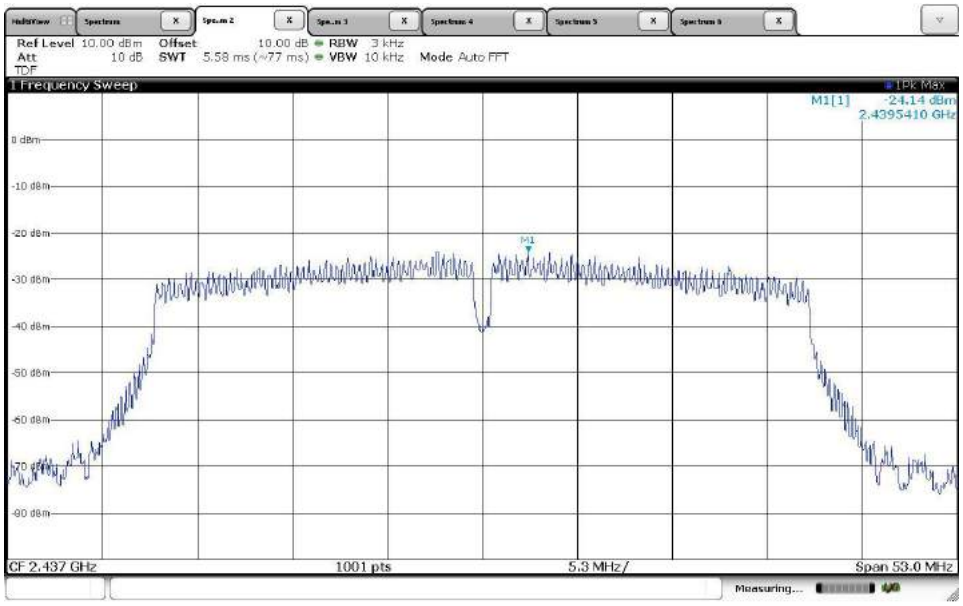


Test Mode – 802.11n(HT40)_Ant1

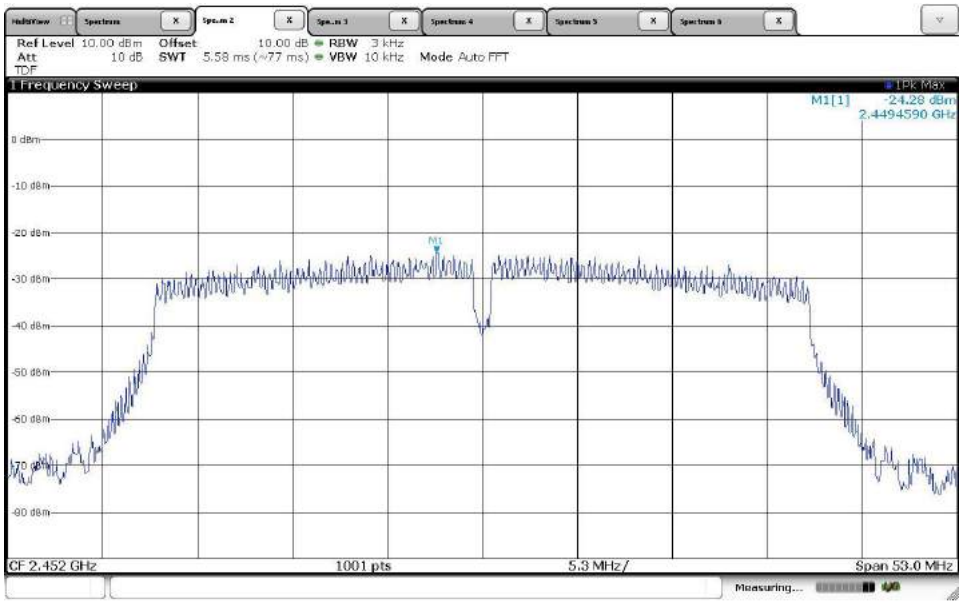
Lowest – 2 422 MHz



Middle – 2 437 MHz

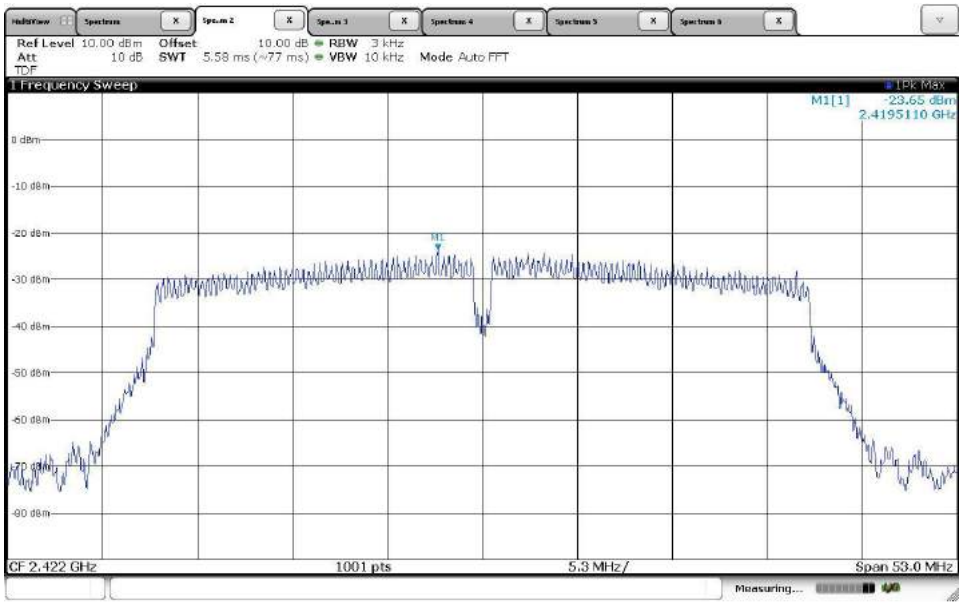


Highest – 2 452 MHz

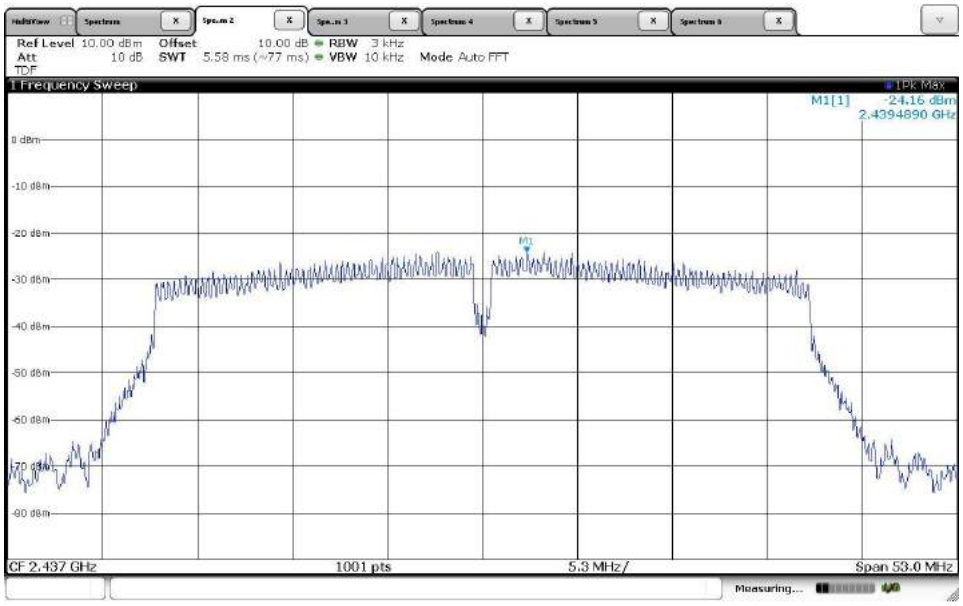


Test Mode – 802.11n(HT40)_Ant2

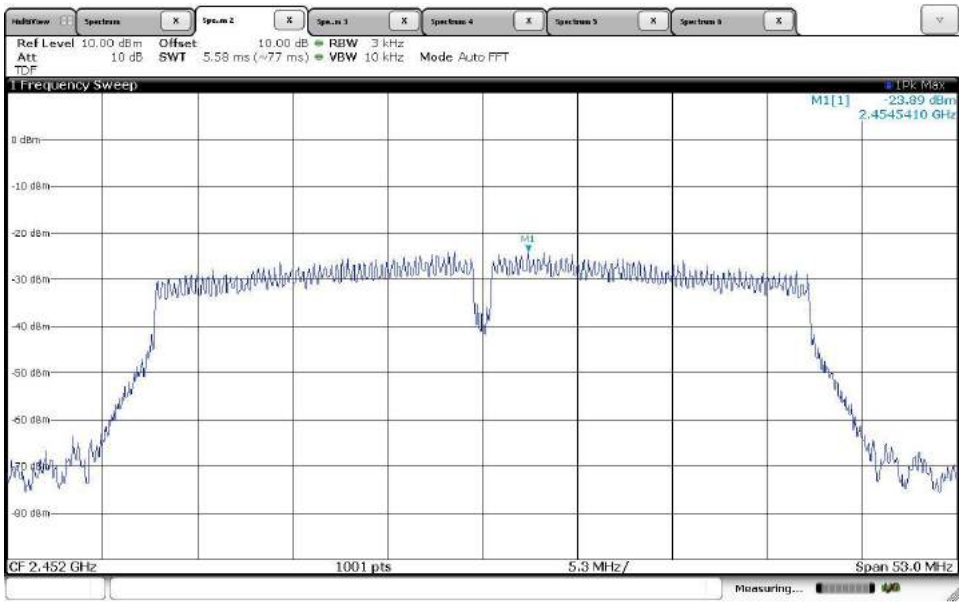
Lowest – 2 422 MHz



Middle – 2 437 MHz

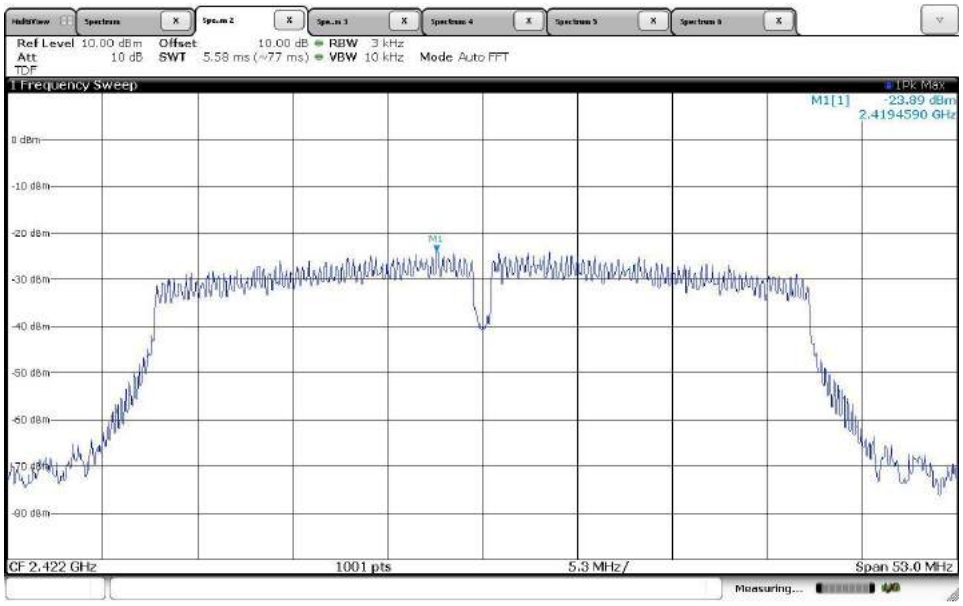


Highest – 2 452 MHz

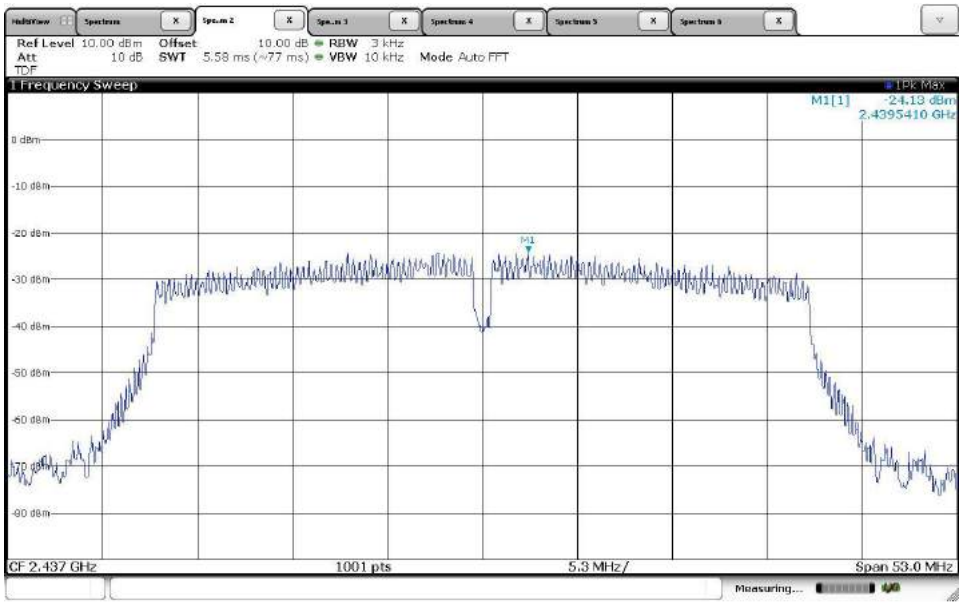


Test Mode – 802.11n(HT40)_MIMO_Ant1

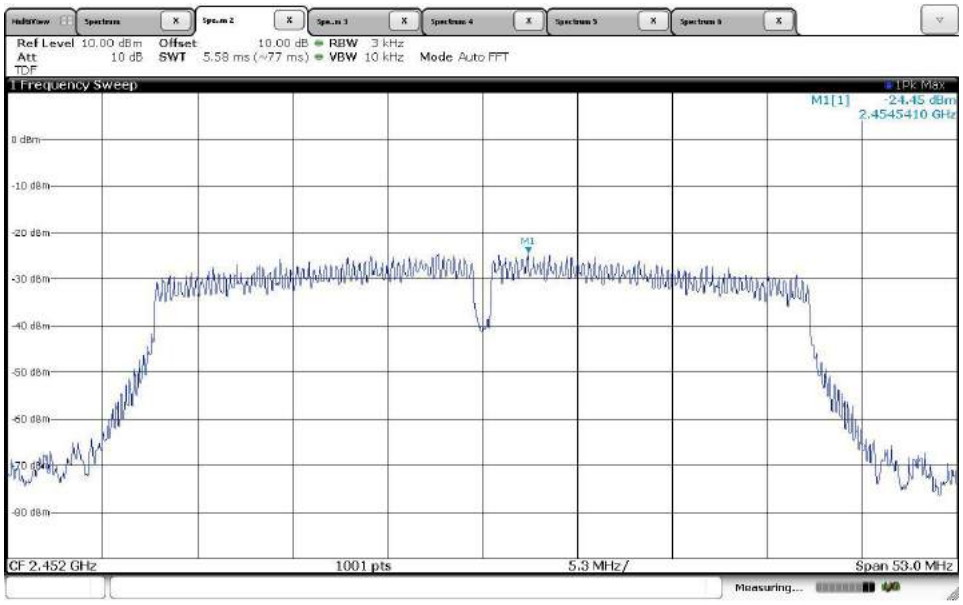
Lowest – 2 422 MHz



Middle – 2 437 MHz

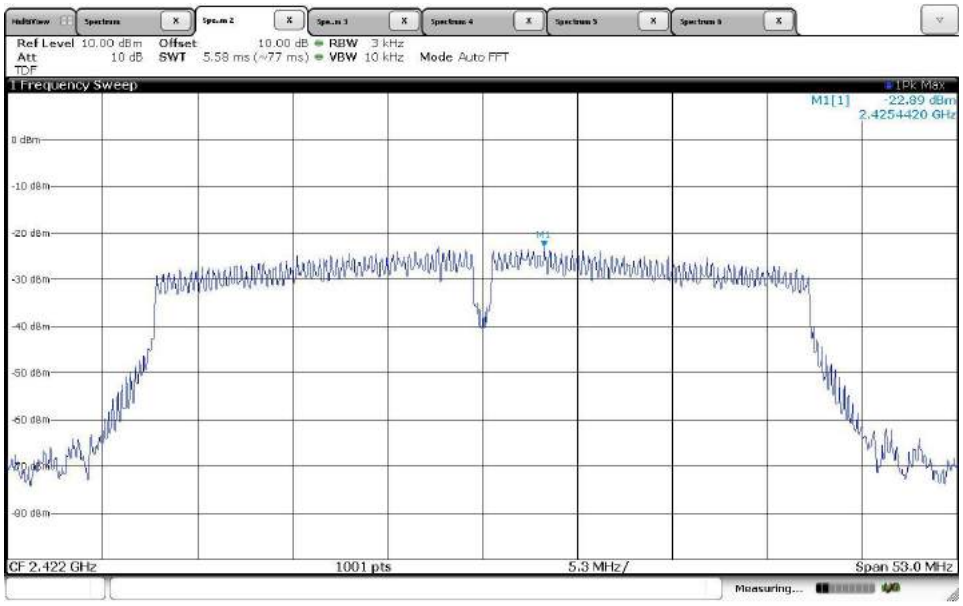


Highest – 2 452 MHz

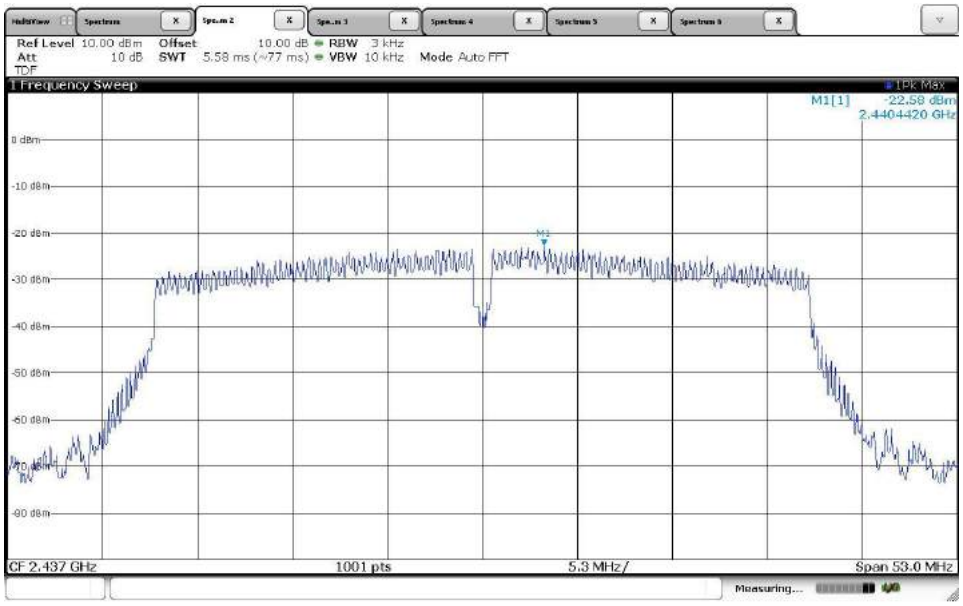


Test Mode – 802.11n(HT40)_MIMO_Ant2

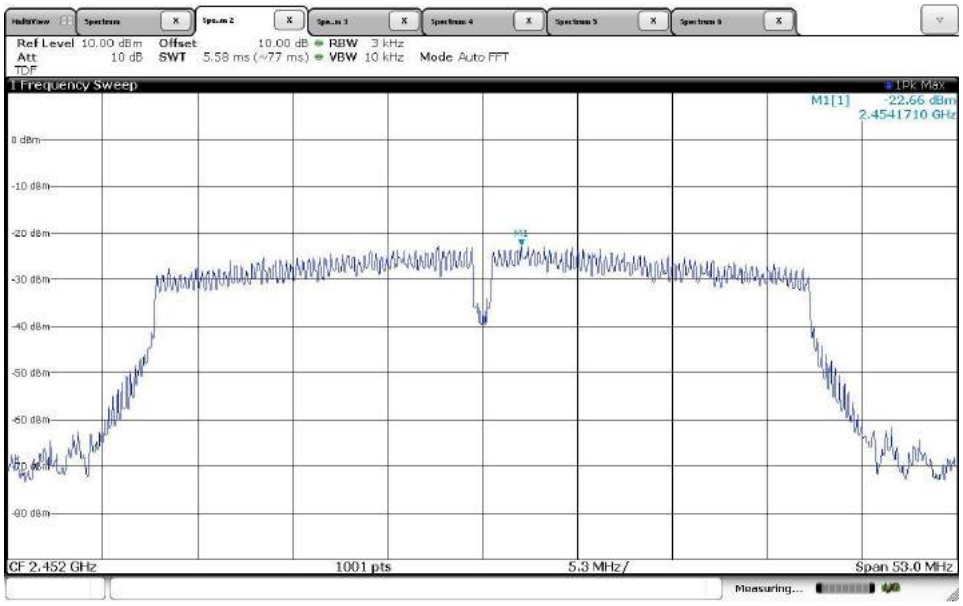
Lowest – 2 422 MHz



Middle – 2 437 MHz



Highest – 2 452 MHz



4 6 dB Bandwidth (DTS Channel Bandwidth) & Occupied Bandwidth

4.1 Rule

-6 dB Bandwidth
According to §15.247(a)(2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2 400–2 483.5 MHz, and 5 725–5 850 MHz bands.
The minimum 6 dB bandwidth shall be at least 500 kHz.

-Occupied Bandwidth
N/A

4.2 Measurement Procedure

-6 dB Bandwidth
According to ANSI C63.10-2013 & KDB 558074 D01 DTS Meas. Guidance v04, 8.2 Option 2.

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW ≥ 3 x RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.

-Occupied Bandwidth
According to ANSI C63.10-2013, 6.9 Occupied Bandwidth tests

The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
The resolution bandwidth (RBW) shall be in the range of 1 % to 5 % of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW. Detector = sampling, Trace mode = max hold.
The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 % of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency).
This frequency is then recorded.

4.3 Test Results - Complied

Test Condition: Temperature (23 ± 2) °C; Humidity (42 ± 2) %

Test Mode	Frequency (MHz)	6 dB Bandwidth (MHz)	Occupied Bandwidth (MHz)	Limit (kHz)
802.11b_Ant1	2 412	10.04	14.39	500
	2 437	10.04	14.43	
	2 462	10.04	14.43	

Test Mode	Frequency (MHz)	6 dB Bandwidth (MHz)	Occupied Bandwidth (MHz)	Limit (kHz)
802.11b_Ant2	2 412	10.04	14.55	500
	2 437	10.04	14.55	
	2 462	10.04	14.47	

Test Mode	Frequency (MHz)	6 dB Bandwidth (MHz)	Occupied Bandwidth (MHz)	Limit (kHz)
802.11g_Ant1	2 412	15.19	16.63	500
	2 437	15.19	16.68	
	2 462	15.19	16.63	

Test Mode	Frequency (MHz)	6 dB Bandwidth (MHz)	Occupied Bandwidth (MHz)	Limit (kHz)
802.11g_Ant2	2 412	15.19	16.63	500
	2 437	15.19	16.63	
	2 462	15.19	16.63	

Test Mode	Frequency (MHz)	6 dB Bandwidth (MHz)	Occupied Bandwidth (MHz)	Limit (kHz)
802.11n(HT20)_Ant1	2 412	15.19	17.58	500
	2 437	15.19	17.53	
	2 462	15.14	17.58	

Test Mode	Frequency (MHz)	6 dB Bandwidth (MHz)	Occupied Bandwidth (MHz)	Limit (kHz)
802.11n(HT20)_Ant2	2 412	15.19	17.58	500
	2 437	15.19	17.58	
	2 462	15.19	17.53	

Test Mode	Frequency (MHz)	6 dB Bandwidth (MHz)	Occupied Bandwidth (MHz)	Limit (kHz)
802.11n(HT20)_MIMO	2 412	15.19	17.53	500
	2 437	15.19	17.53	
	2 462	15.14	17.53	

Note)

The MIMO mode is tested by Ant2 port of the EUT based on highest output power.

Test Mode	Frequency (MHz)	6 dB Bandwidth (MHz)	Occupied Bandwidth (MHz)	Limit (kHz)
802.11n(HT40)_Ant1	2 422	35.26	36.06	500
	2 437	35.26	36.06	
	2 452	35.25	36.06	

Test Mode	Frequency (MHz)	6 dB Bandwidth (MHz)	Occupied Bandwidth (MHz)	Limit (kHz)
802.11n(HT40)_Ant2	2 422	35.26	36.06	500
	2 437	35.26	36.06	
	2 452	35.26	36.16	

Test Mode	Frequency (MHz)	6 dB Bandwidth (MHz)	Occupied Bandwidth (MHz)	Limit (kHz)
802.11n(HT40)_MIMO	2 422	35.26	36.26	500
	2 437	35.26	36.16	
	2 452	35.26	36.16	

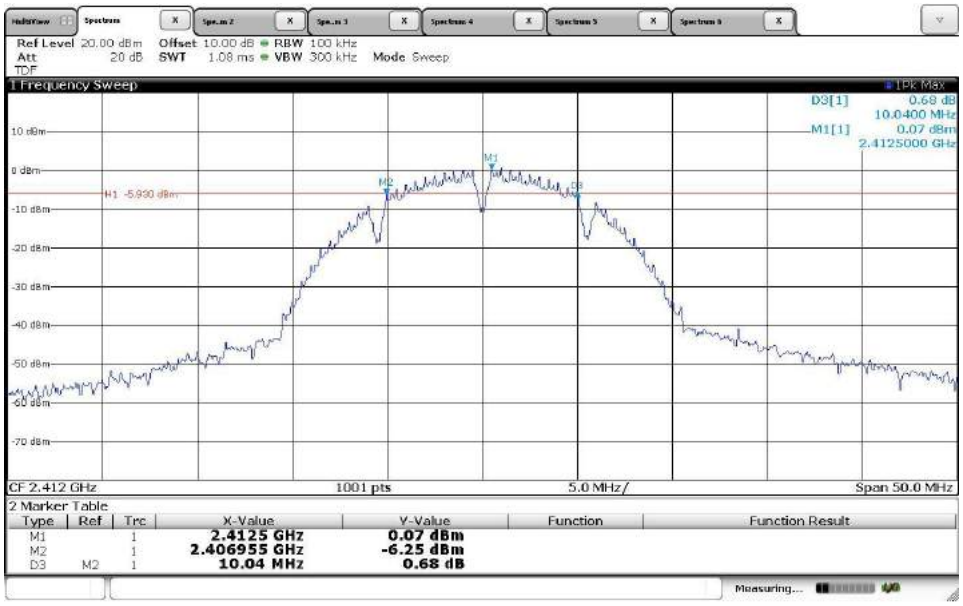
Note)

The MIMO mode is tested by Ant1 port of the EUT based on highest output power.

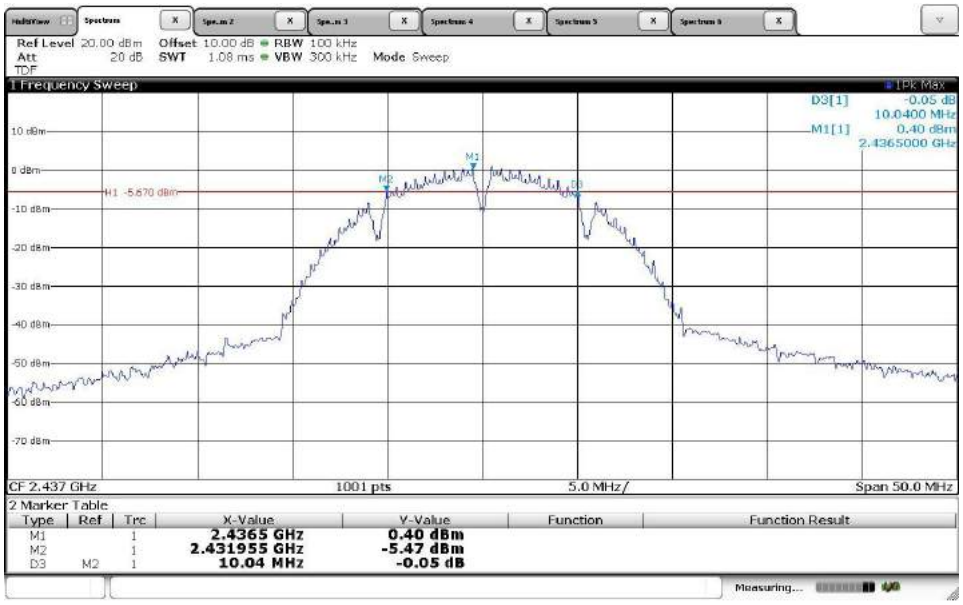
Photographs of Test Results (6dB Bandwidth)

Test Mode – 802.11b_Ant1

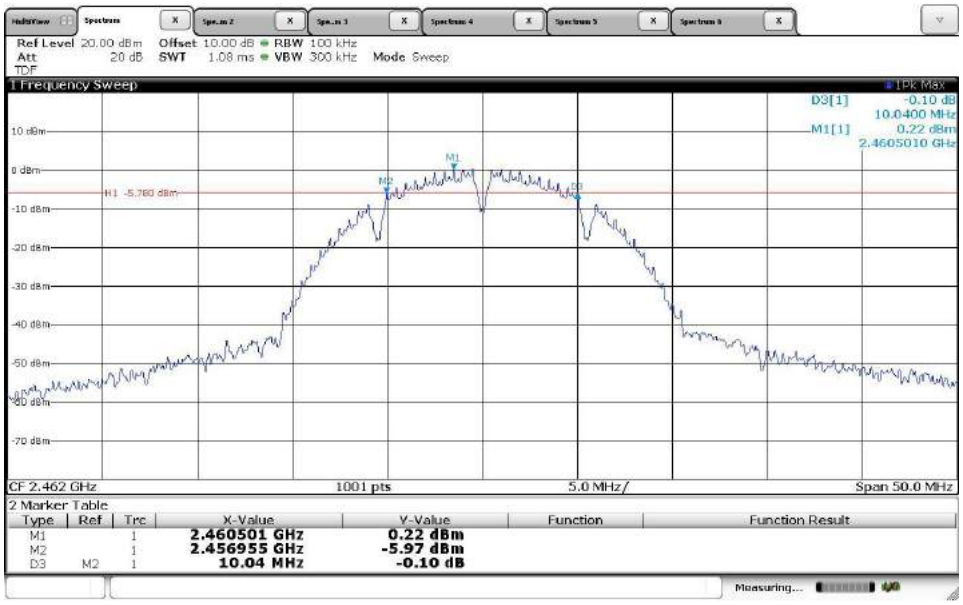
Lowest – 2 412 MHz



Middle – 2 437 MHz

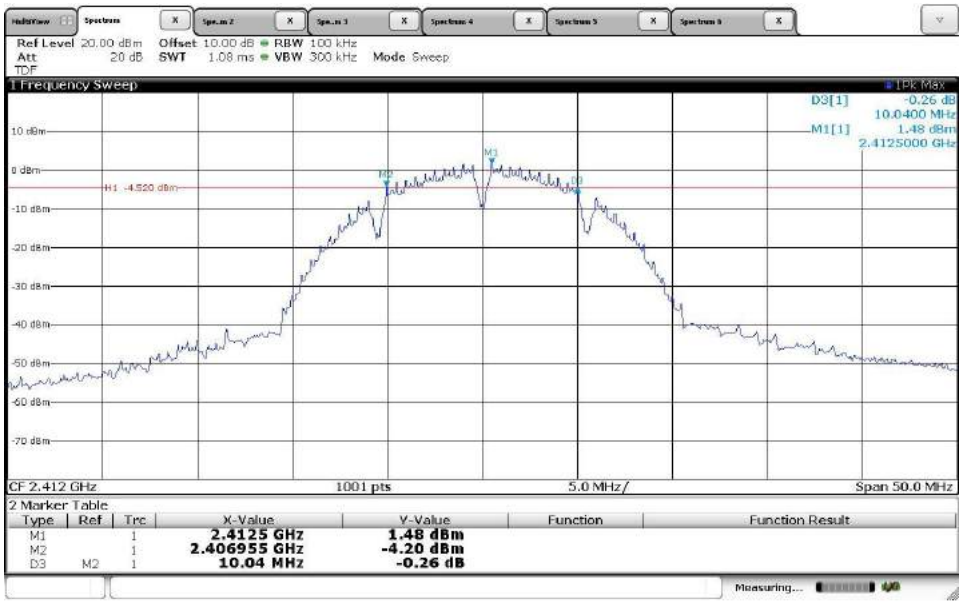


Highest – 2 462 MHz

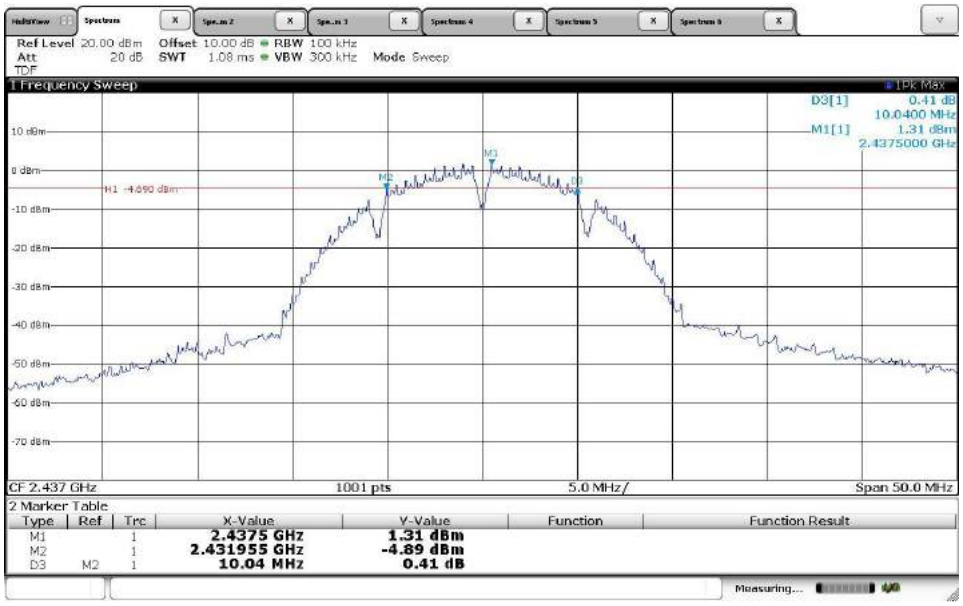


Test Mode – 802.11b_Ant2

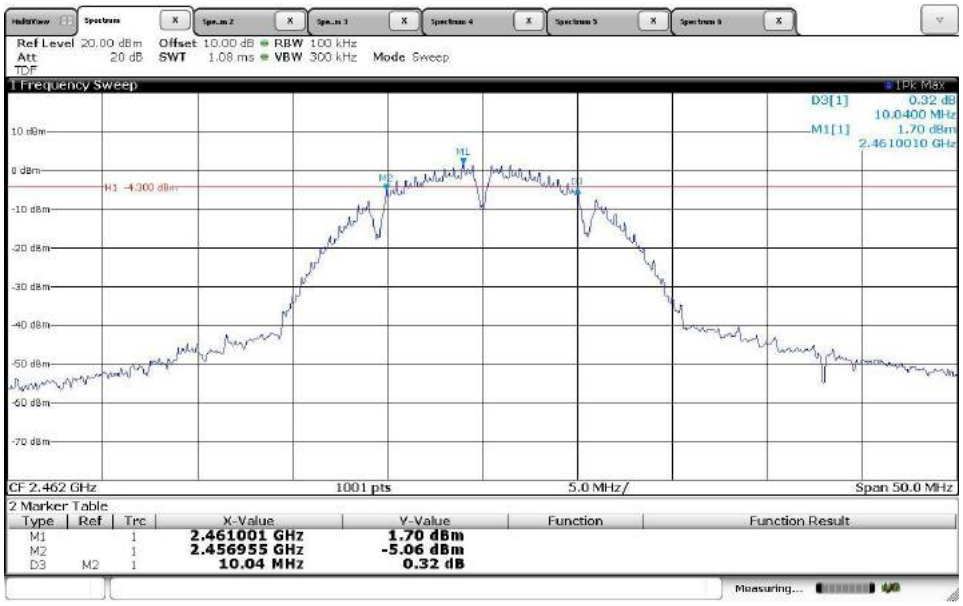
Lowest – 2 412 MHz



Middle – 2 437 MHz

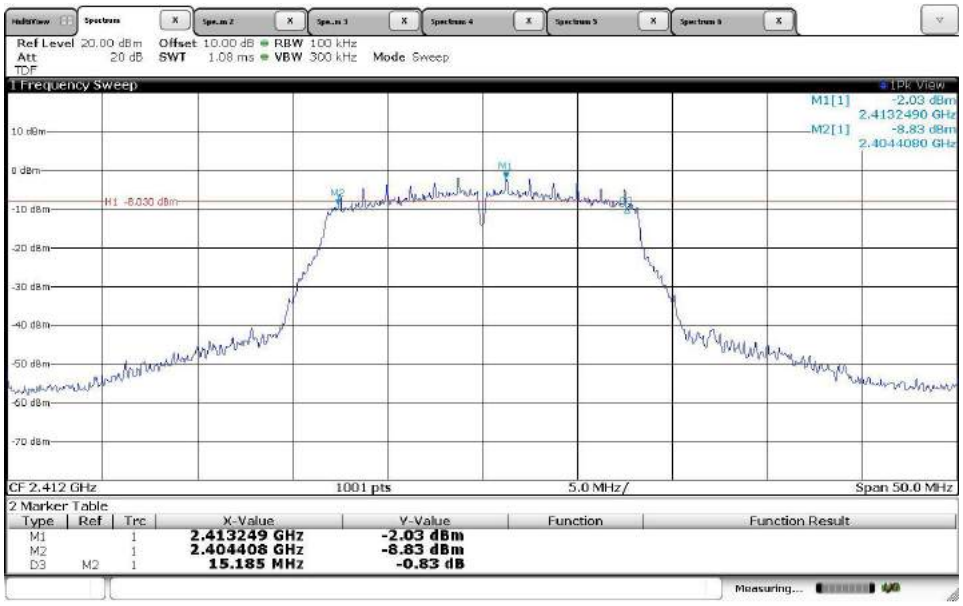


Highest – 2 462 MHz

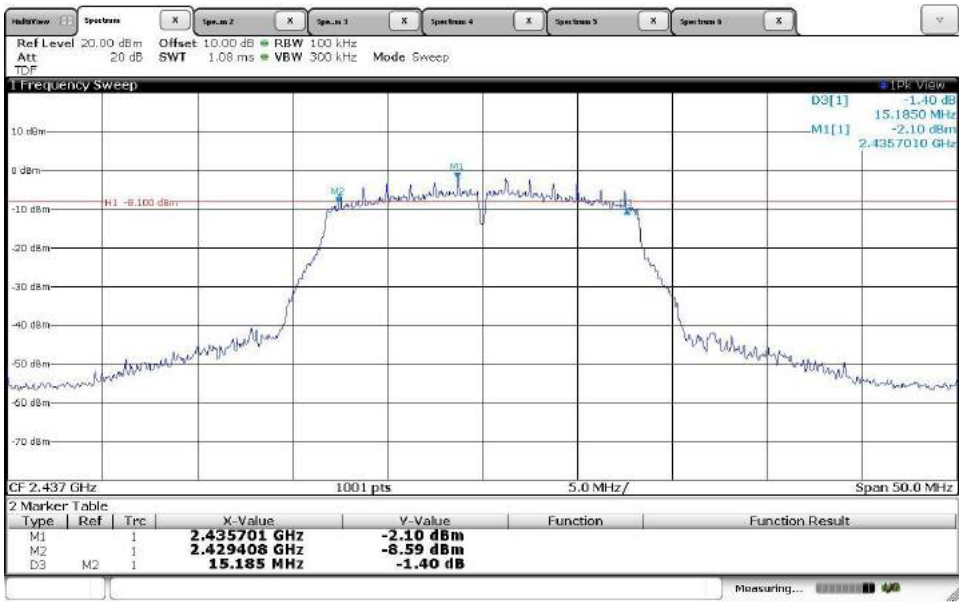


Test Mode – 802.11g_Ant1

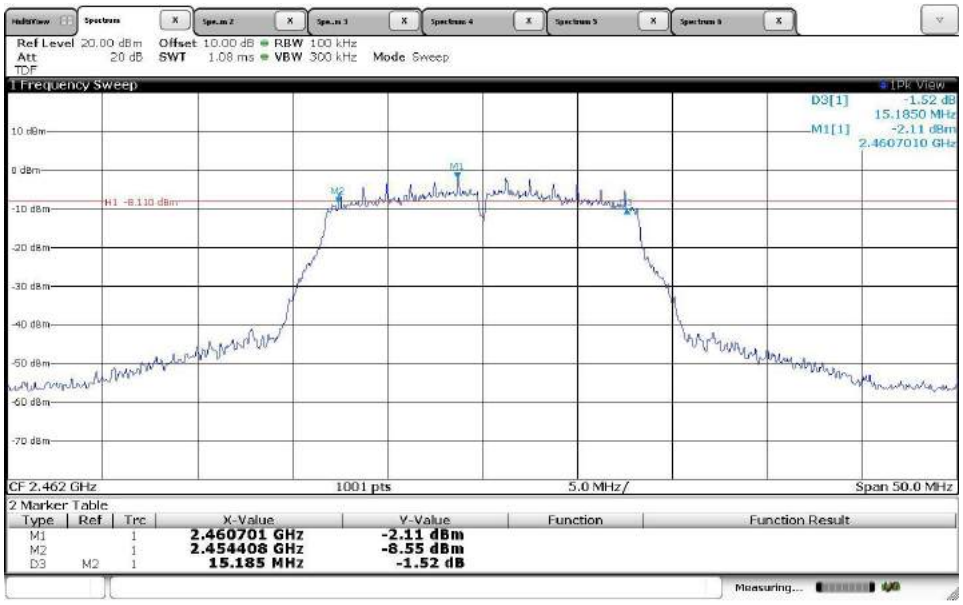
Lowest – 2 412 MHz



Middle – 2 437 MHz

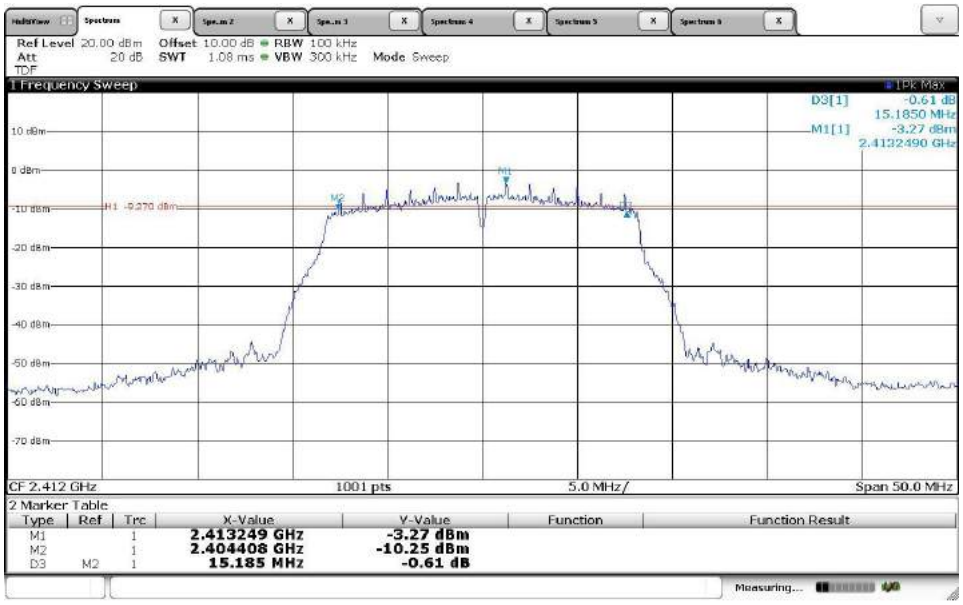


Highest – 2 462 MHz

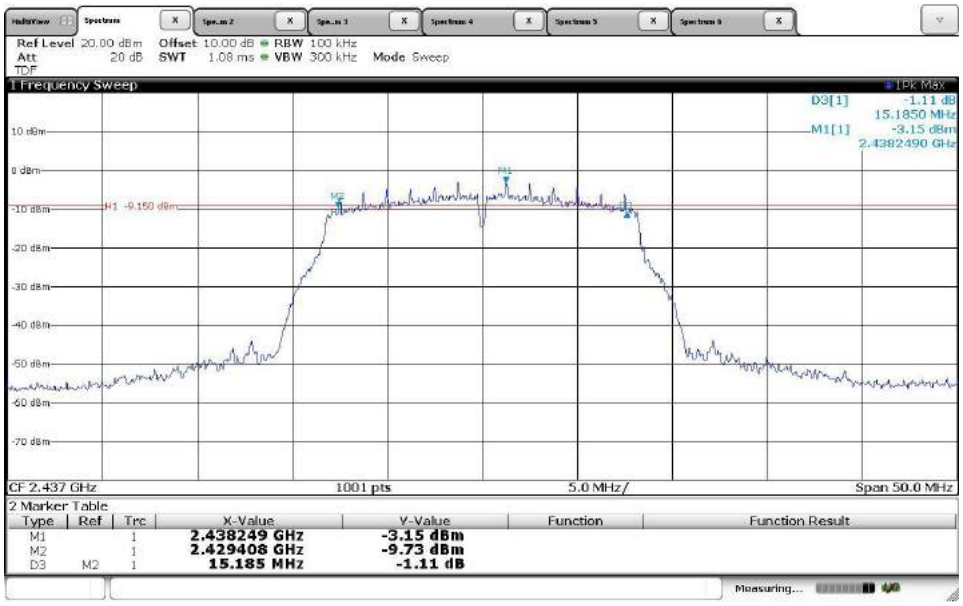


Test Mode – 802.11g_Ant2

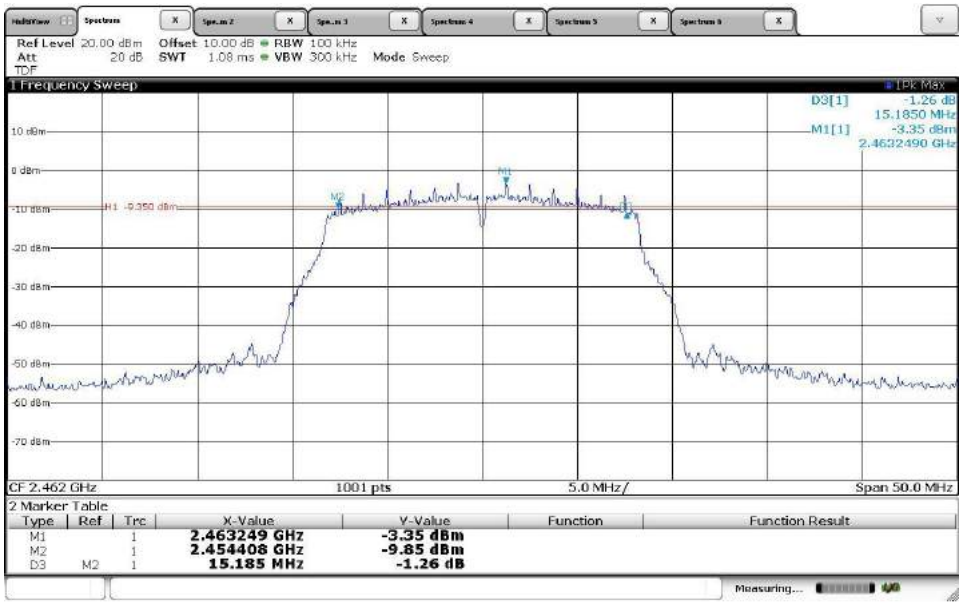
Lowest – 2 412 MHz



Middle – 2 437 MHz

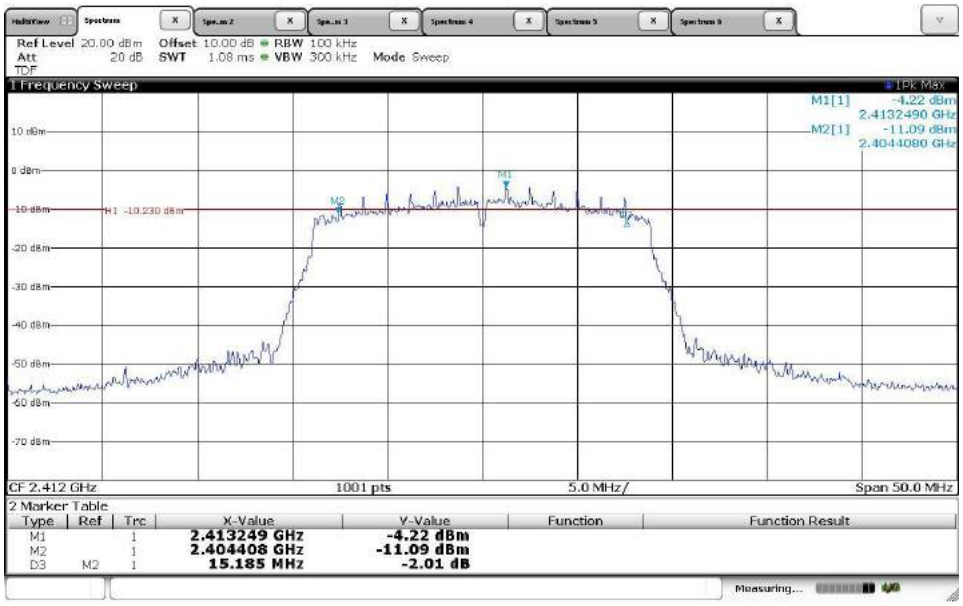


Highest – 2 462 MHz

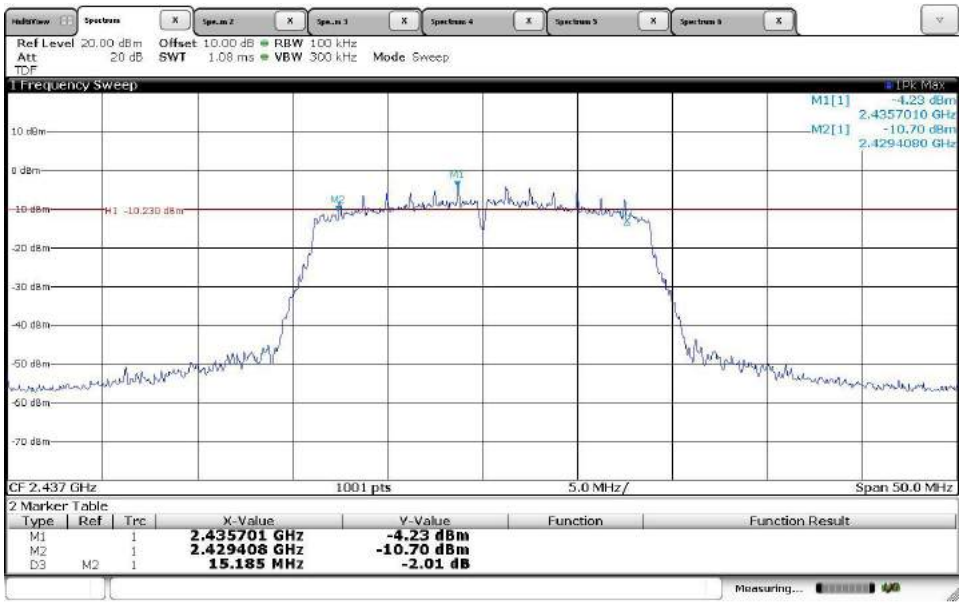


Test Mode – 802.11n(HT20)_Ant1

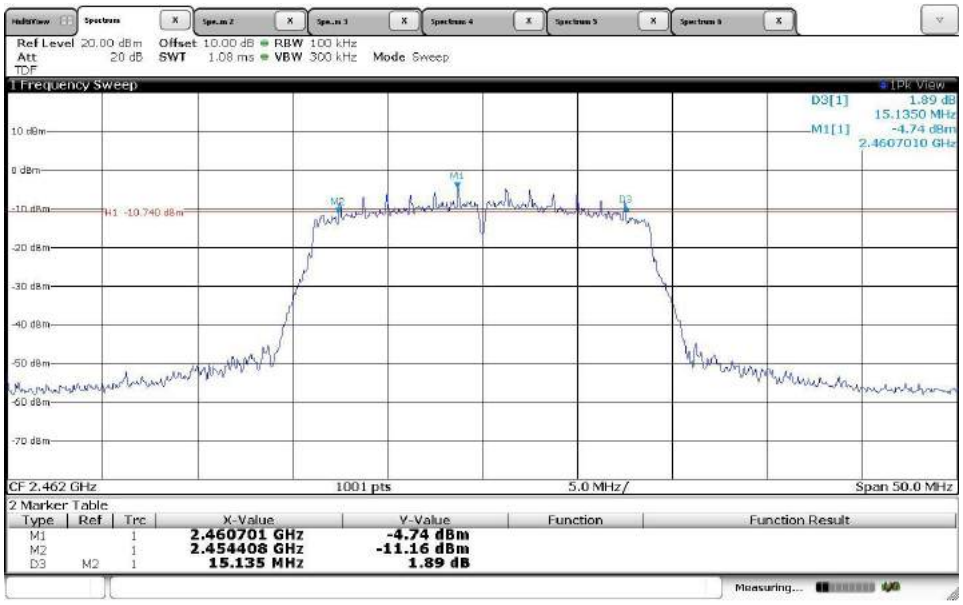
Lowest – 2 412 MHz



Middle – 2 437 MHz

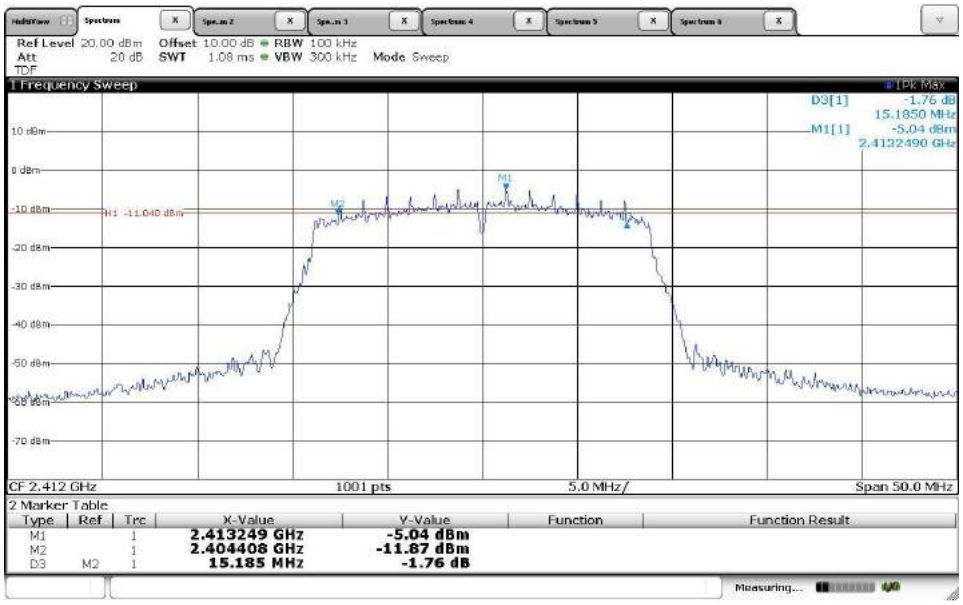


Highest – 2 462 MHz

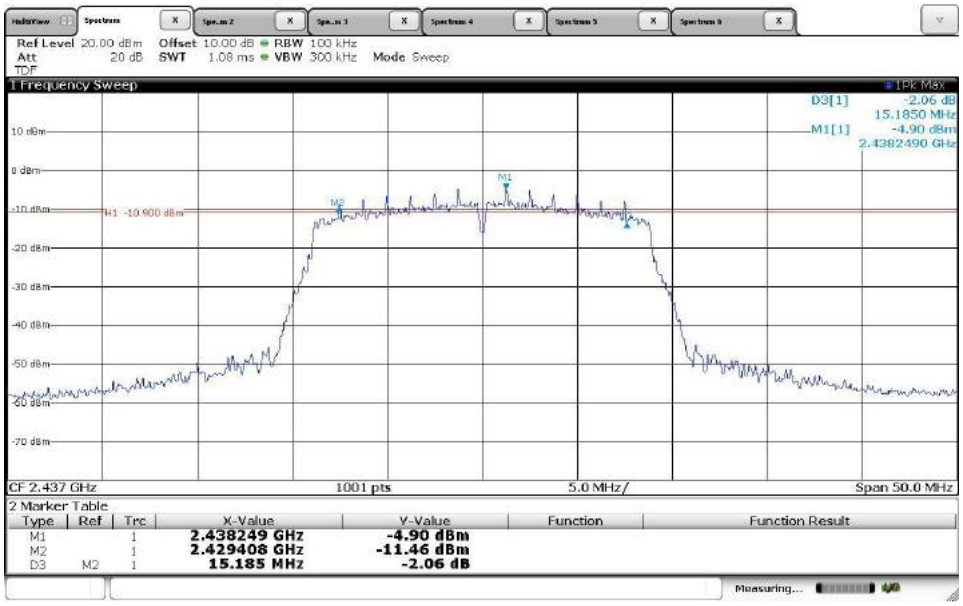


Test Mode – 802.11n(HT20)_Ant2

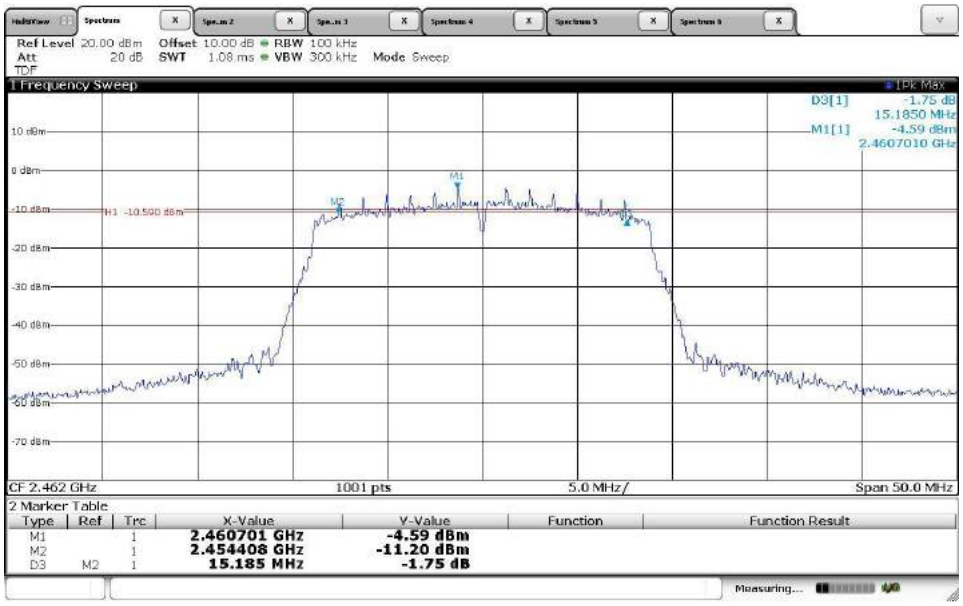
Lowest – 2 412 MHz



Middle – 2 437 MHz

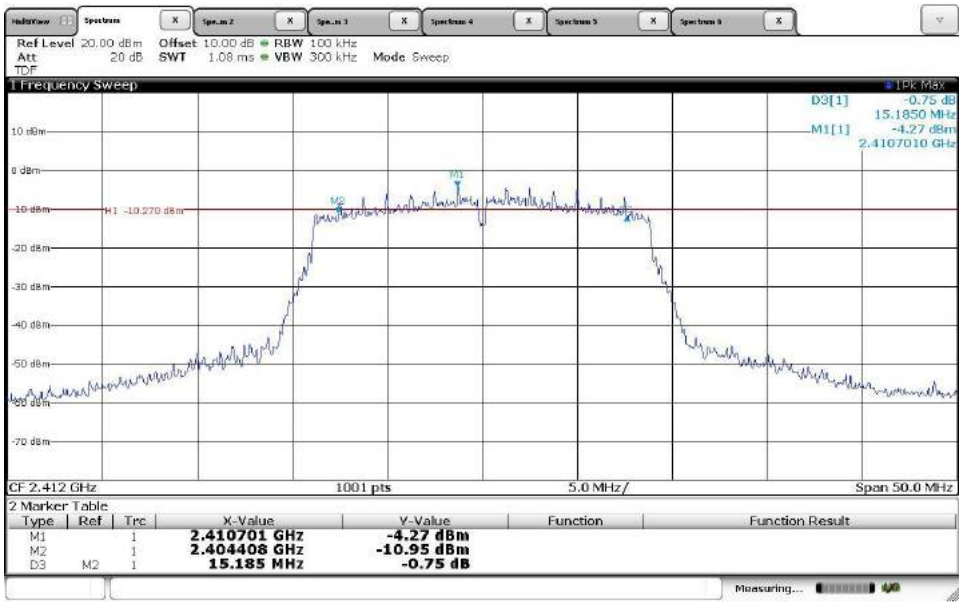


Highest – 2 462 MHz

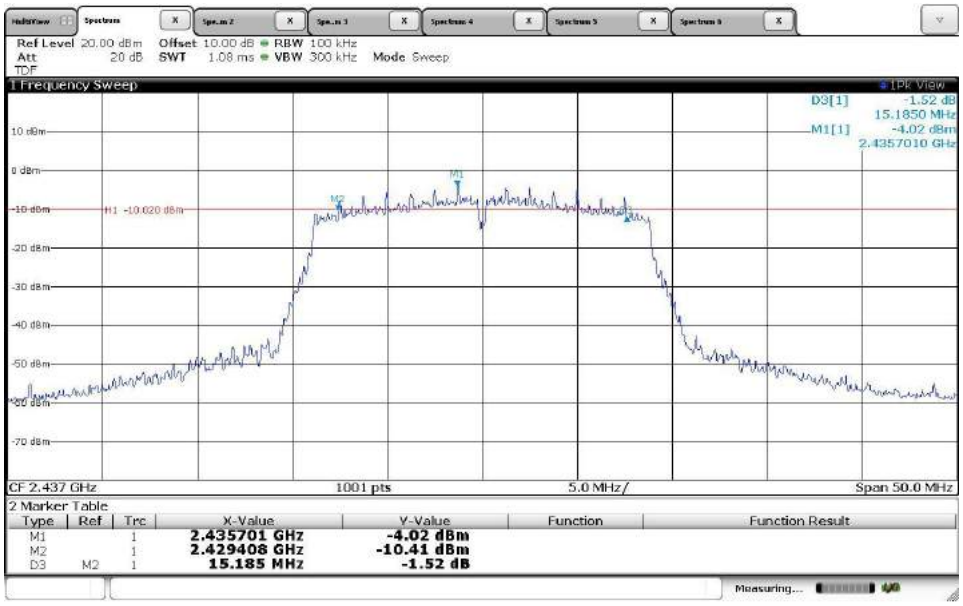


Test Mode – 802.11n(HT20)_MIMO

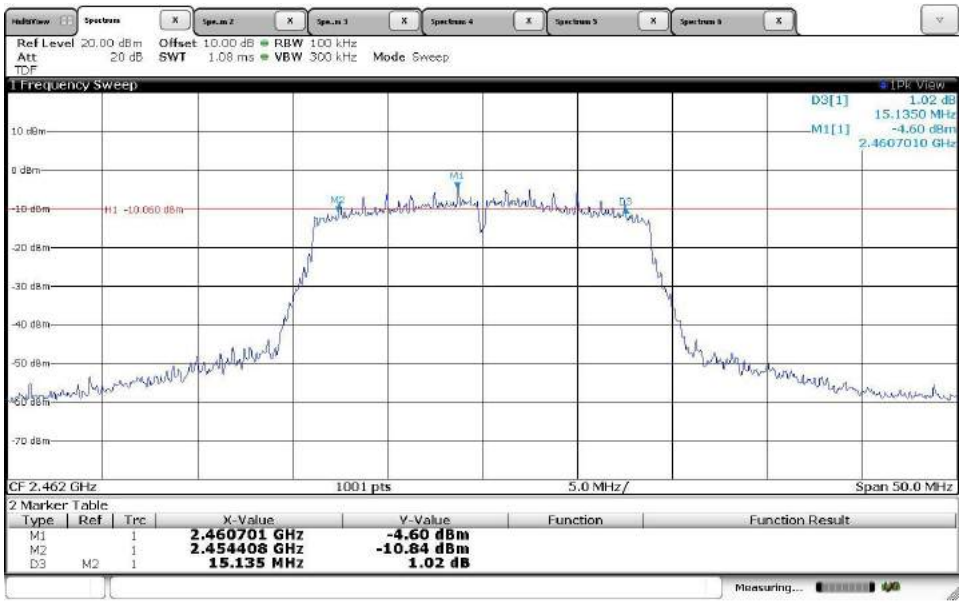
Lowest – 2 412 MHz



Middle – 2 437 MHz

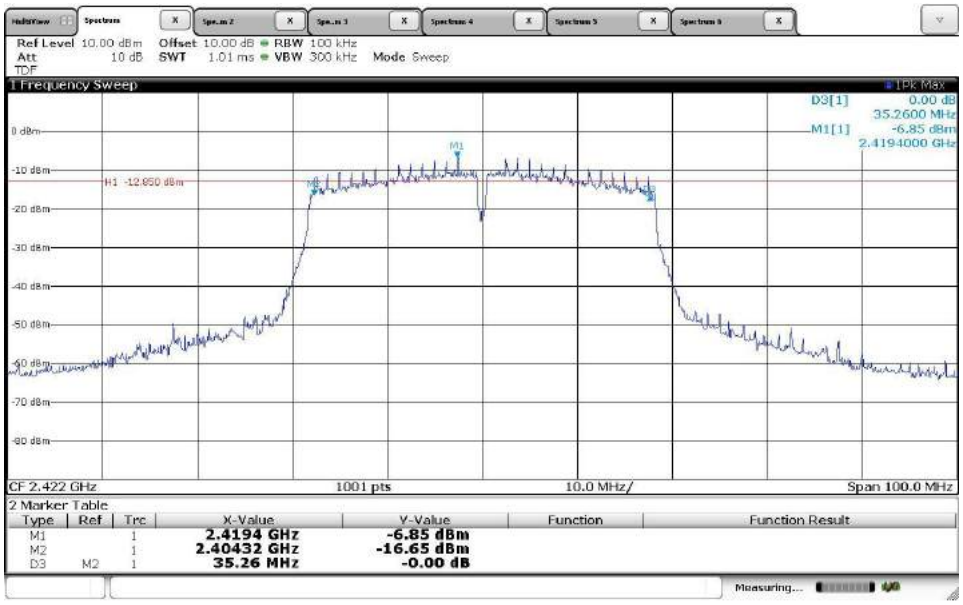


Highest – 2 462 MHz

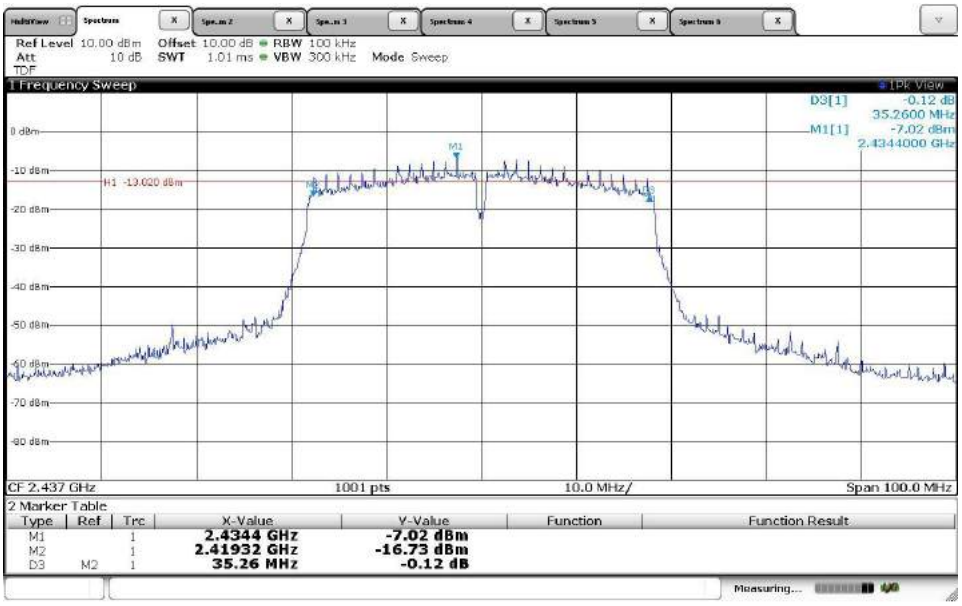


Test Mode – 802.11n(HT40)_Ant1

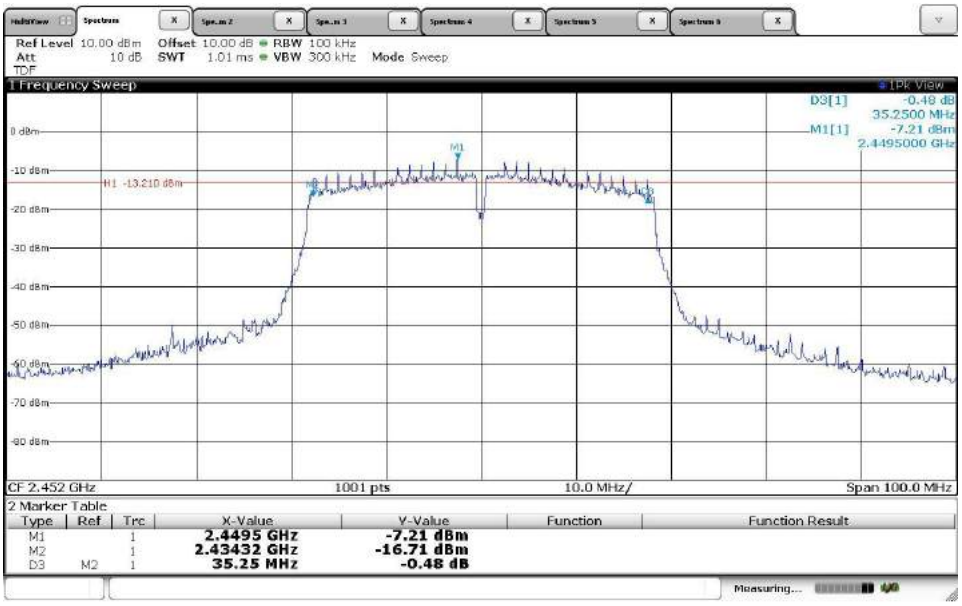
Lowest – 2 422 MHz



Middle – 2 437 MHz

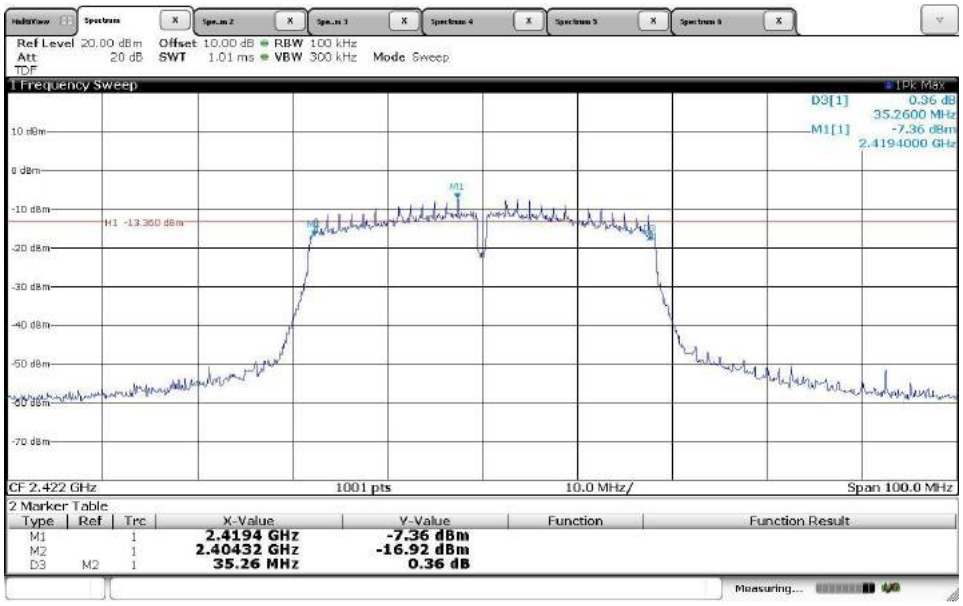


Highest – 2 452 MHz

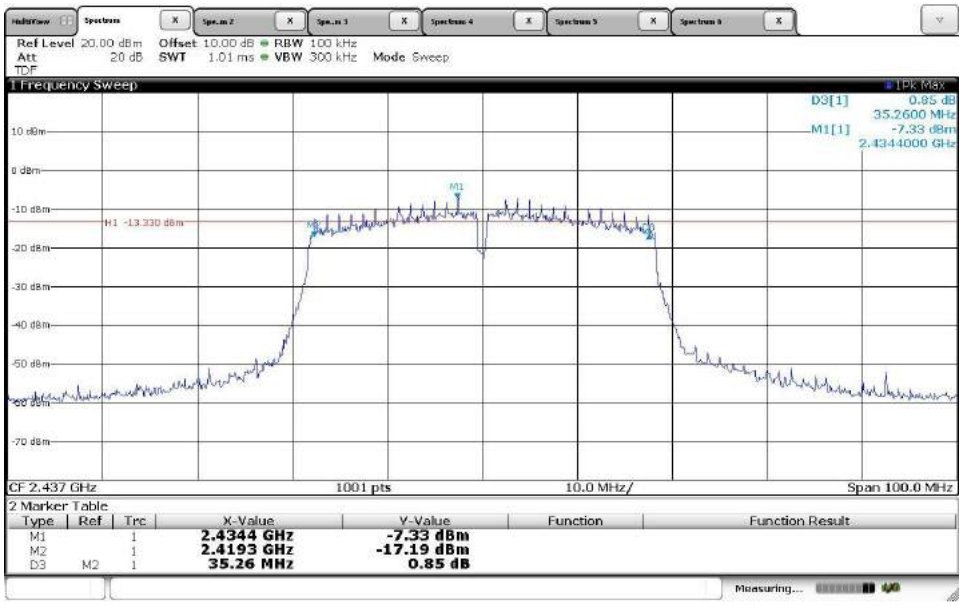


Test Mode – 802.11n(HT40)_Ant2

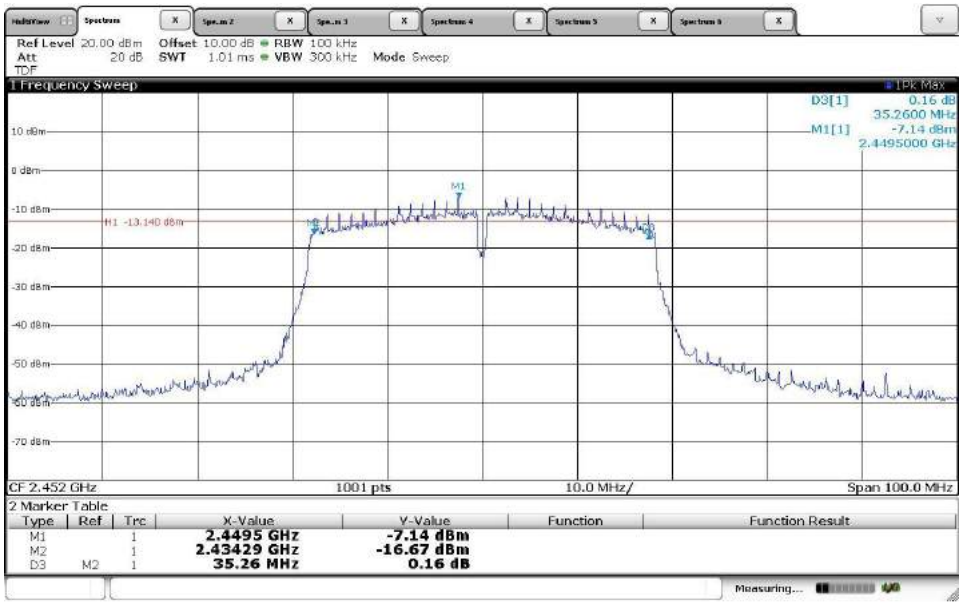
Lowest – 2 422 MHz



Middle – 2 437 MHz

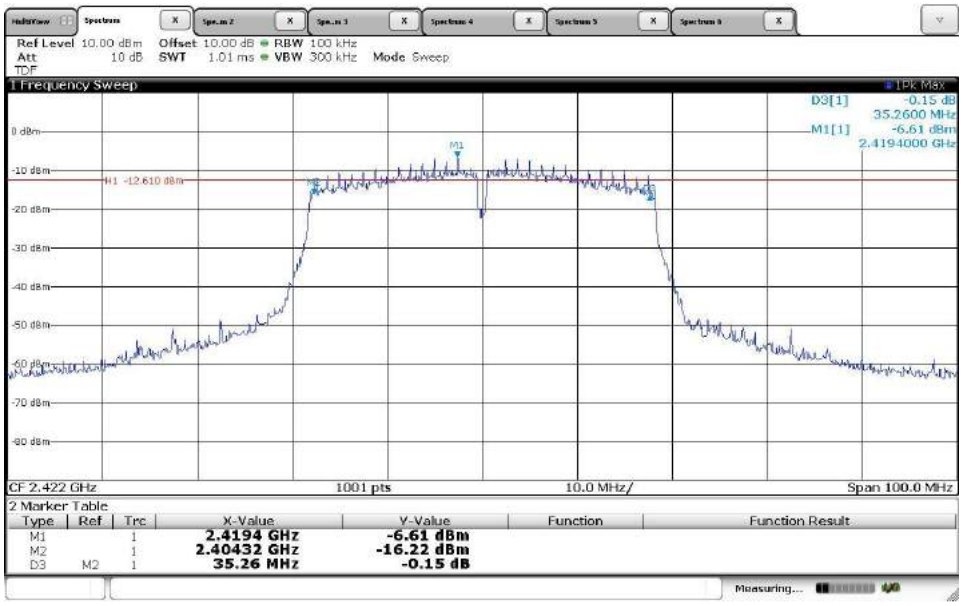


Highest – 2 452 MHz

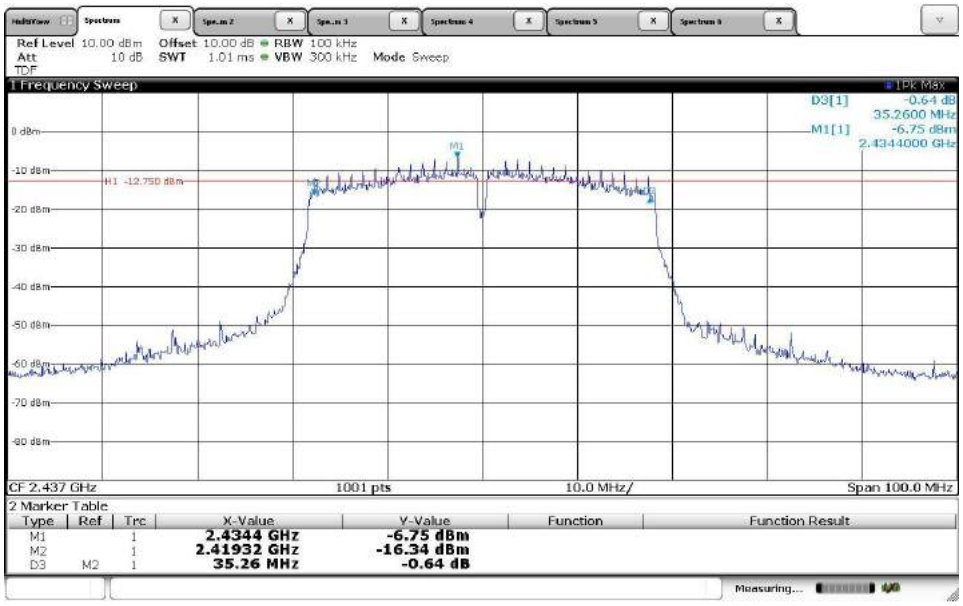


Test Mode – 802.11n(HT40)_MIMO

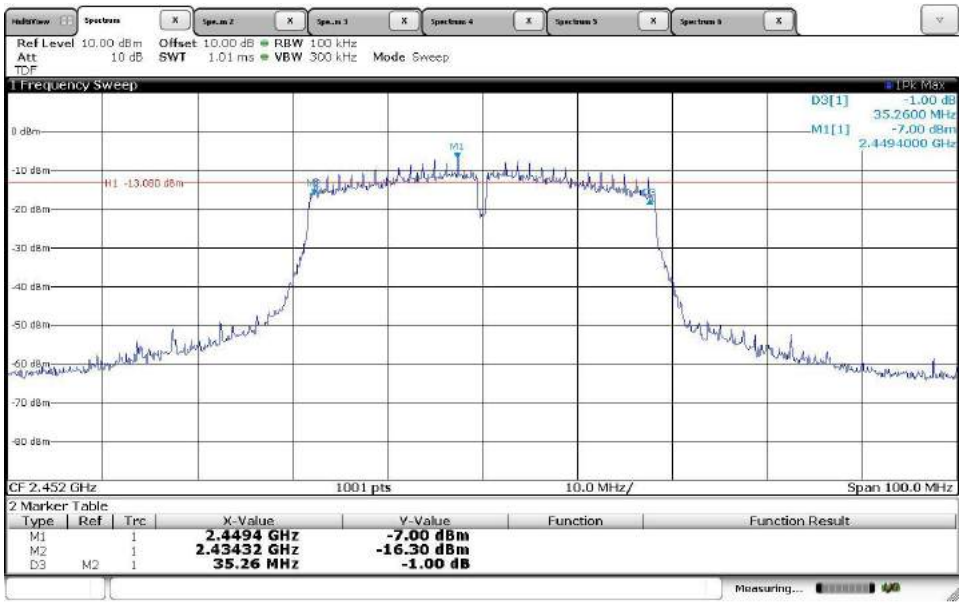
Lowest – 2 422 MHz



Middle – 2 437 MHz



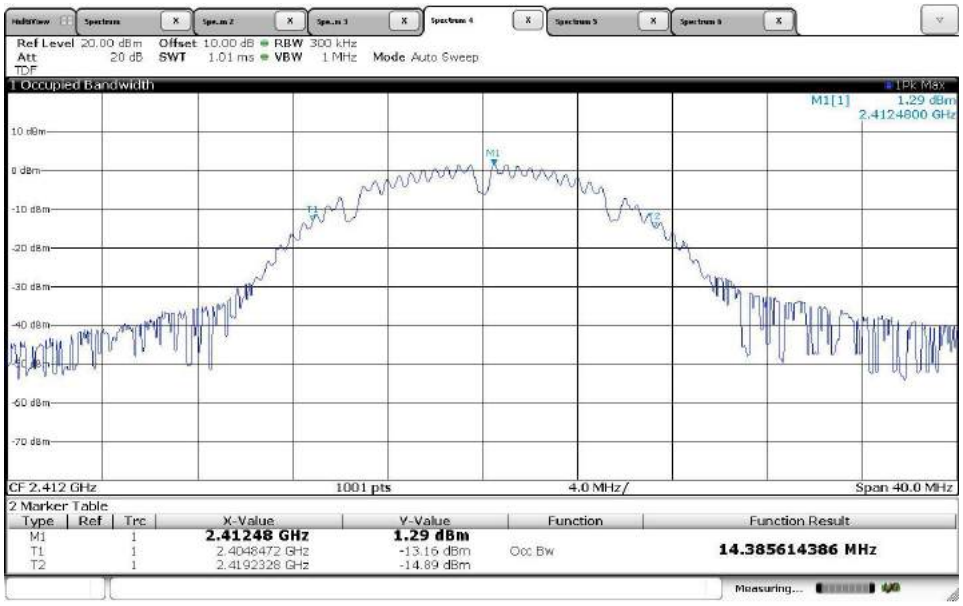
Highest – 2 452 MHz



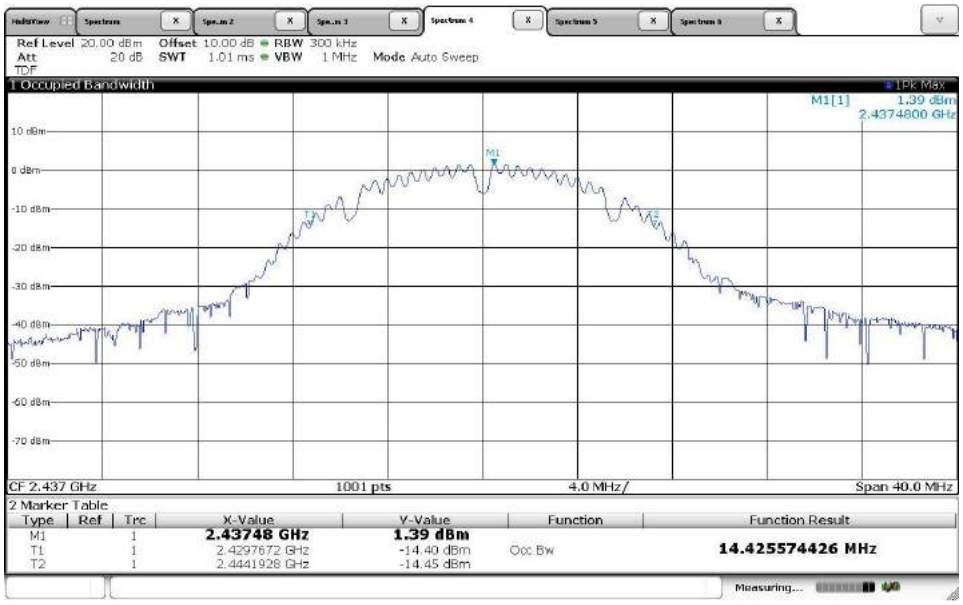
Photographs of Test Results (Occupied Bandwidth)

Test Mode – 802.11b_Ant1

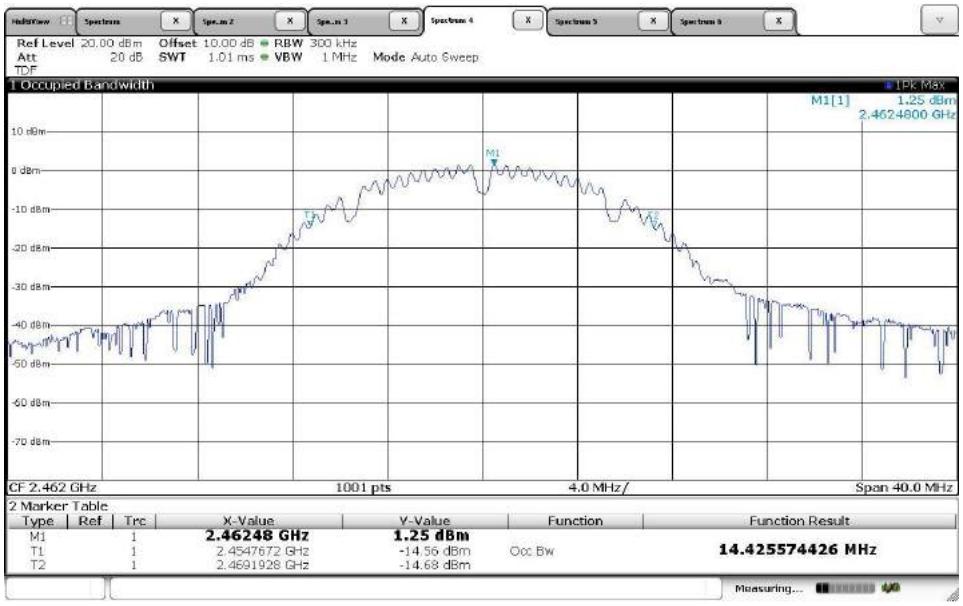
Lowest – 2 412 MHz



Middle – 2 437 MHz

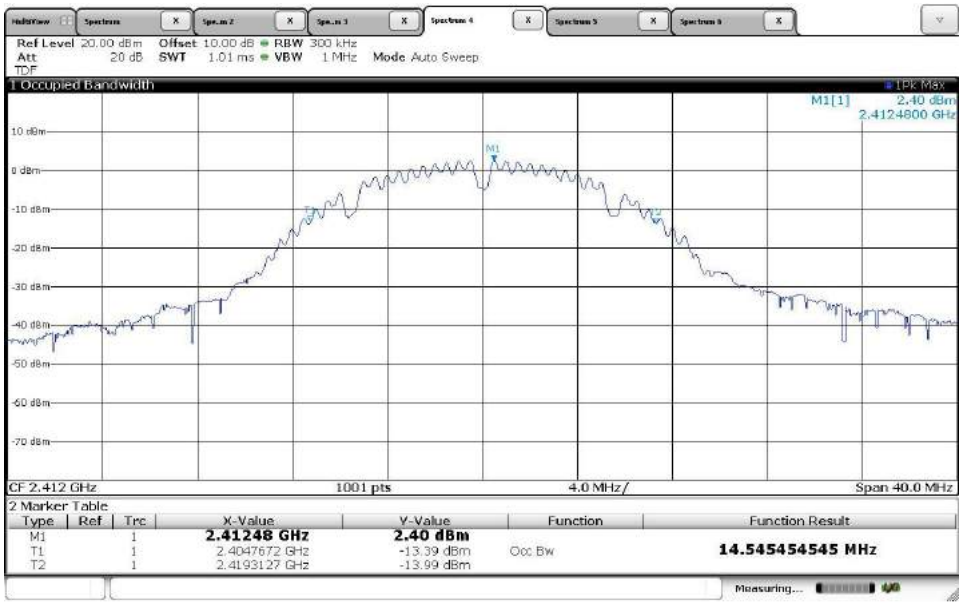


Highest – 2 462 MHz

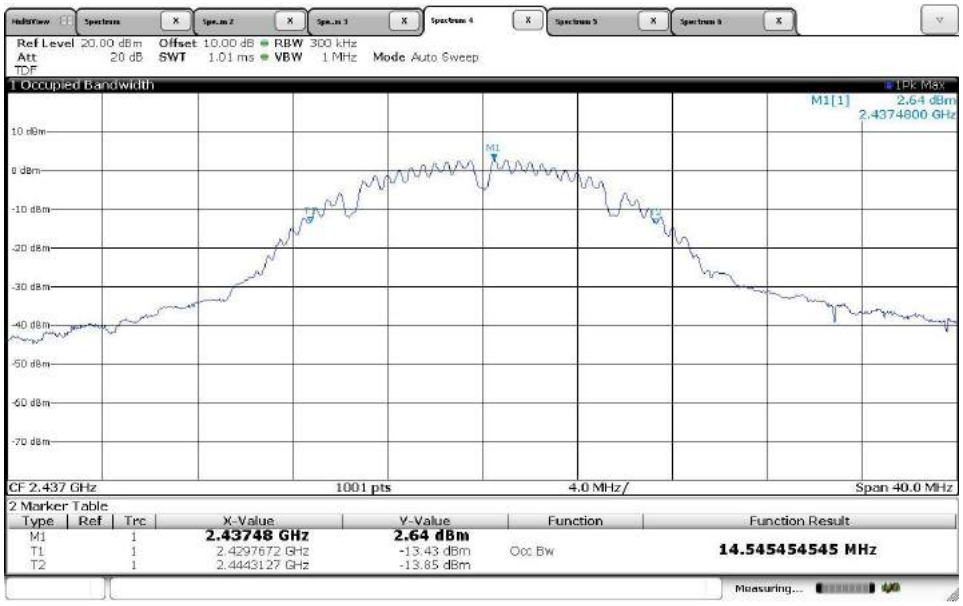


Test Mode – 802.11b_Ant2

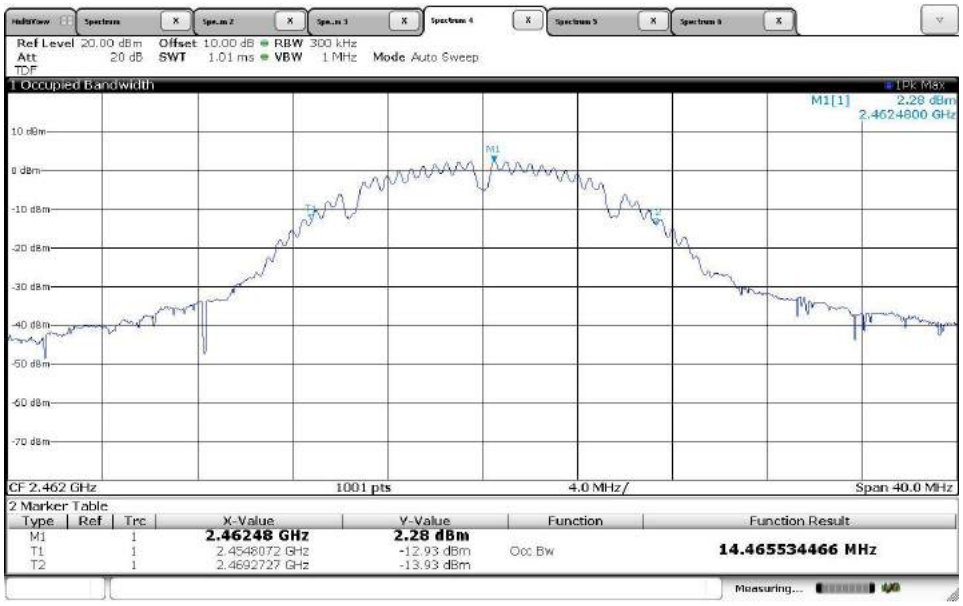
Lowest – 2 412 MHz



Middle – 2 437 MHz



Highest – 2 462 MHz



Test Mode – 802.11g_Ant1

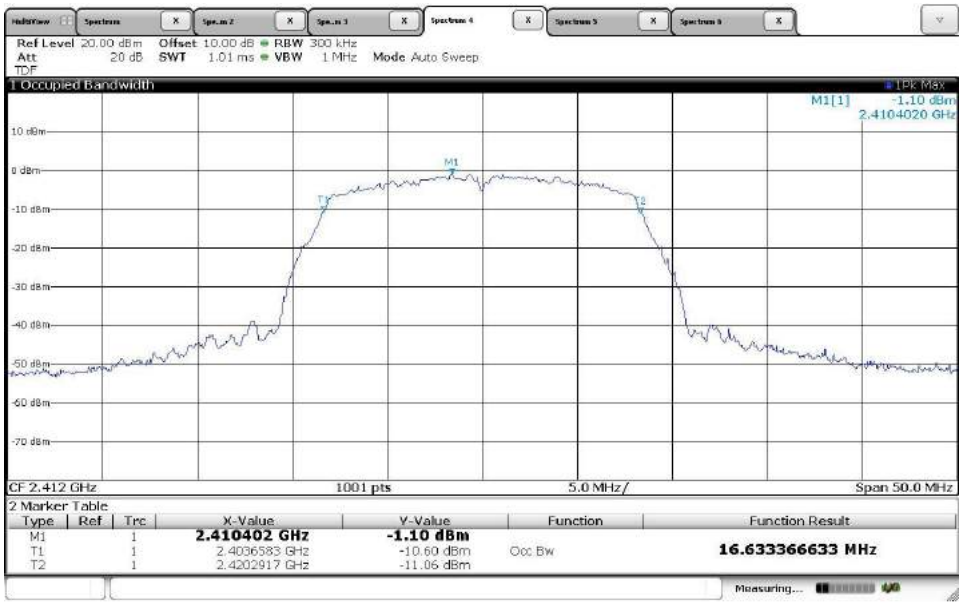
Lowest – 2 412 MHz

Middle – 2 437 MHz

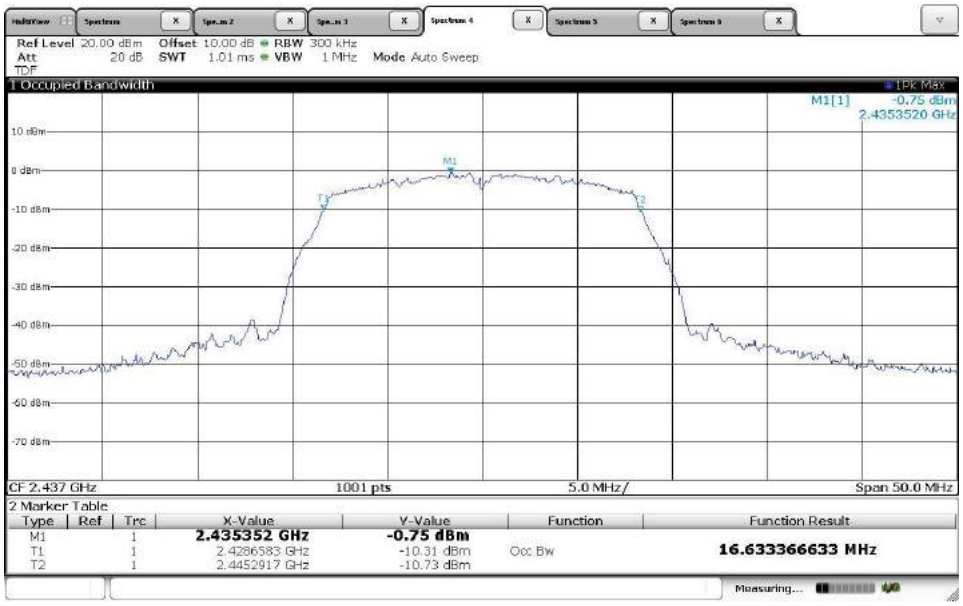
Highest – 2 462 MHz

Test Mode – 802.11g_Ant2

Lowest – 2 412 MHz



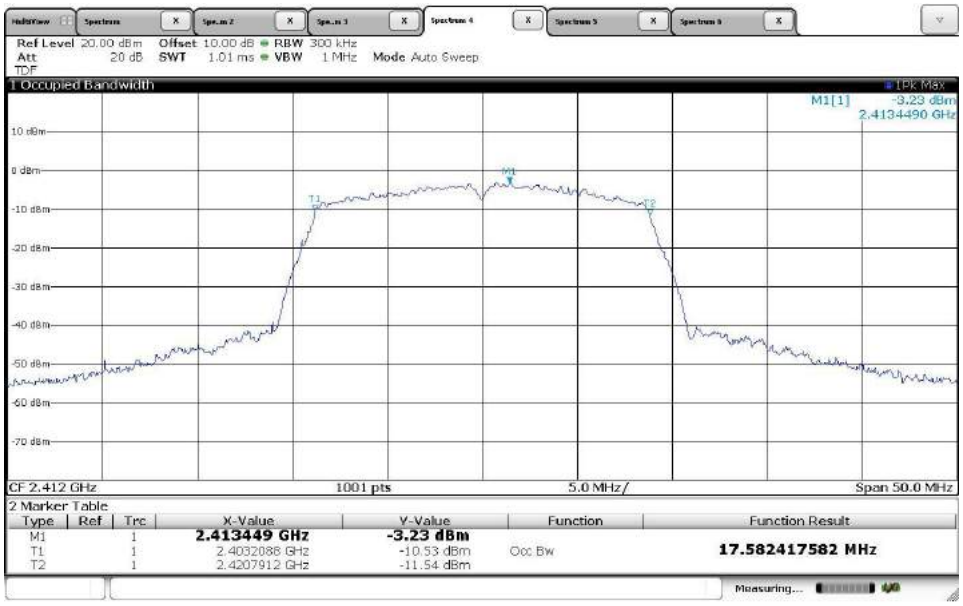
Middle – 2 437 MHz



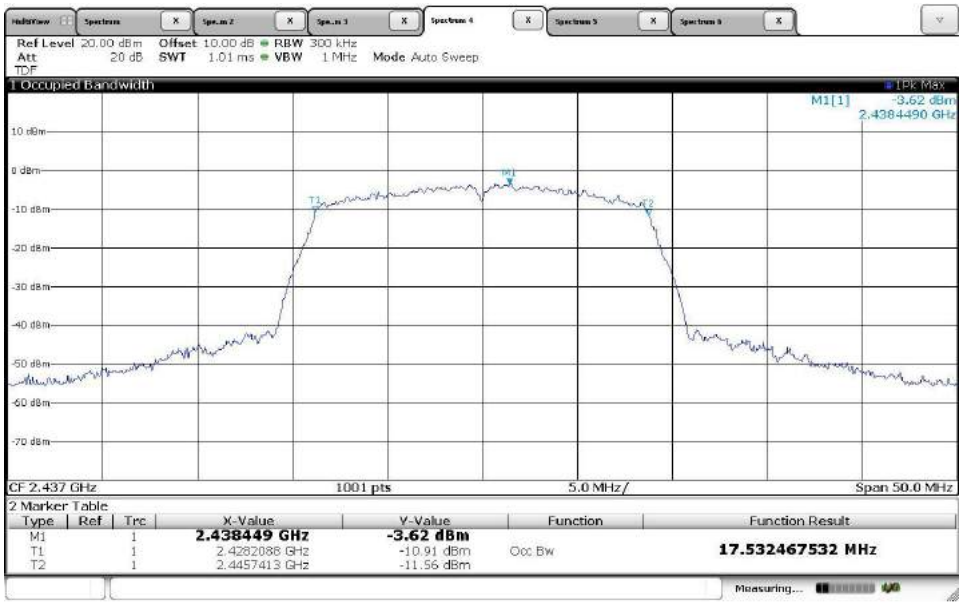
Highest – 2 462 MHz

Test Mode – 802.11n(HT20)_Ant1

Lowest – 2 412 MHz



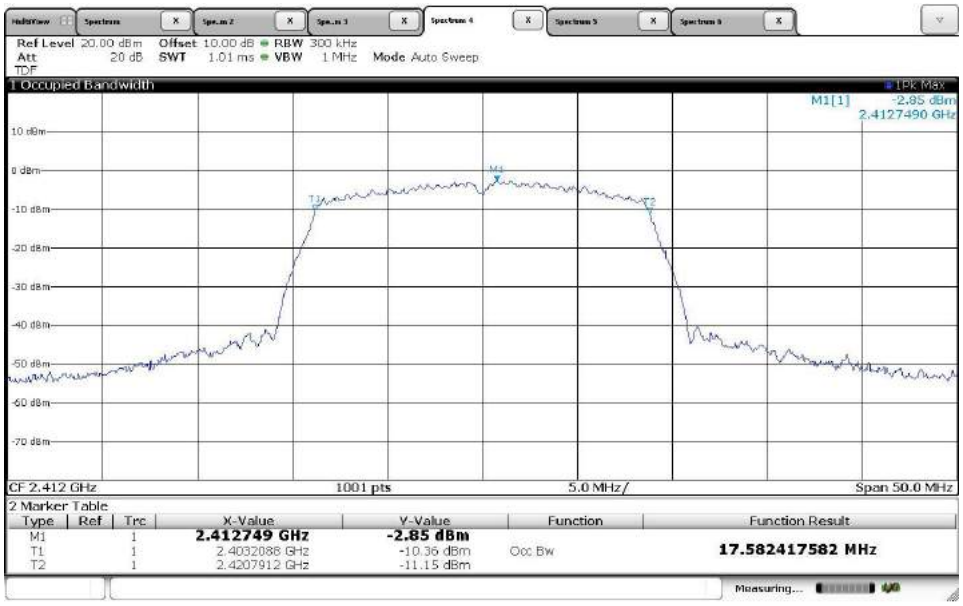
Middle – 2 437 MHz



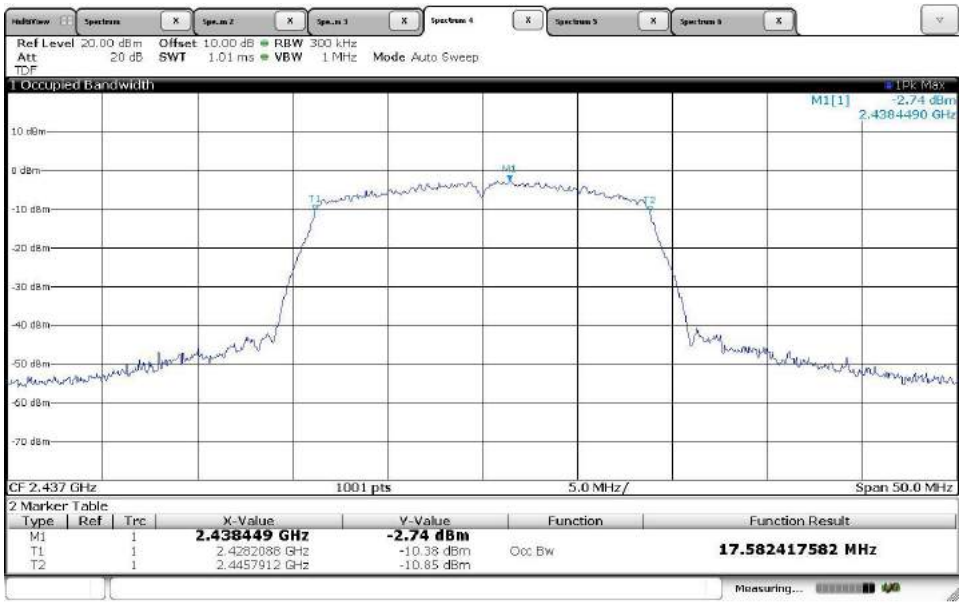
Highest – 2 462 MHz

Test Mode – 802.11n(HT20)_Ant2

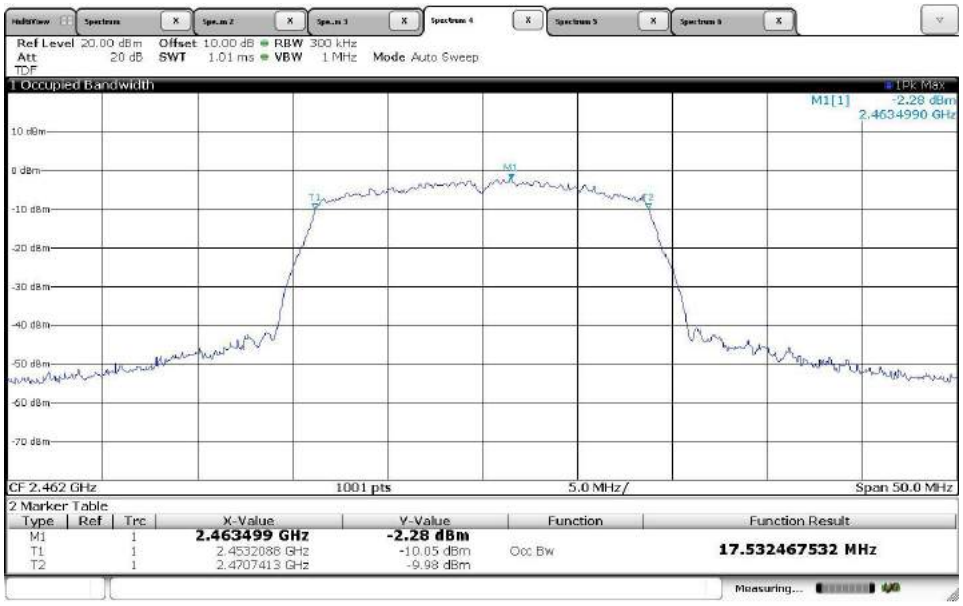
Lowest – 2 412 MHz



Middle – 2 437 MHz

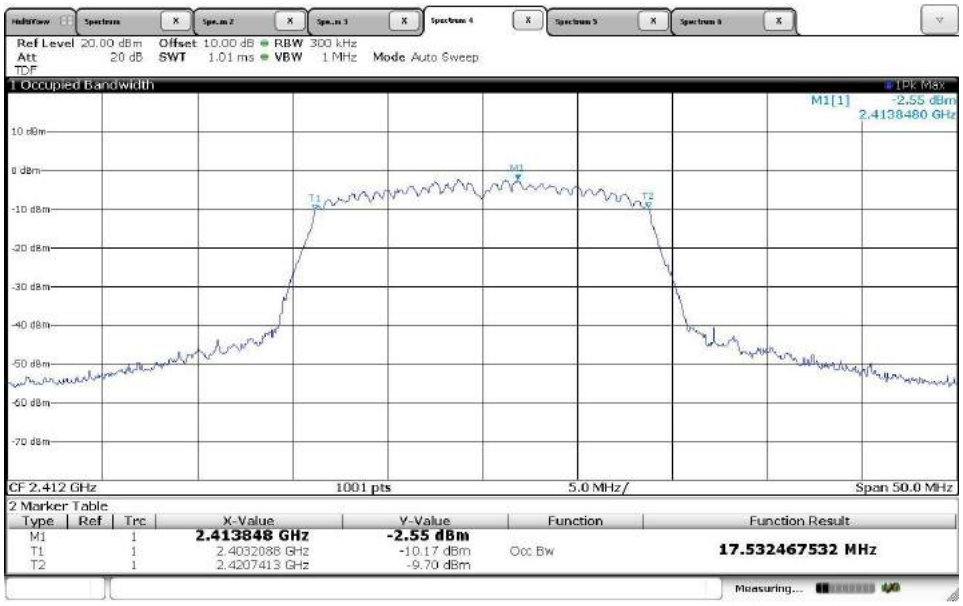


Highest – 2 462 MHz

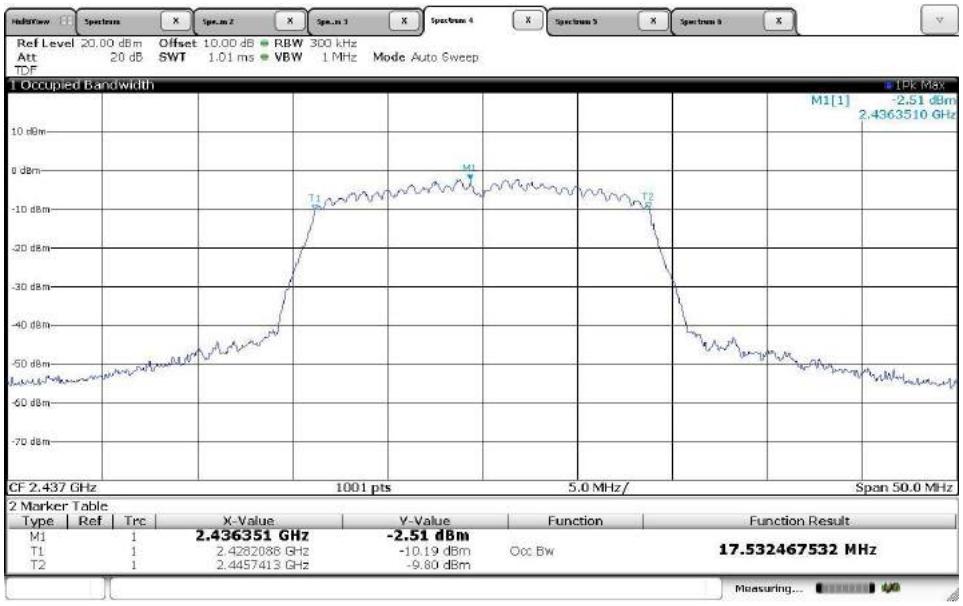


Test Mode – 802.11n(HT20)_MIMO

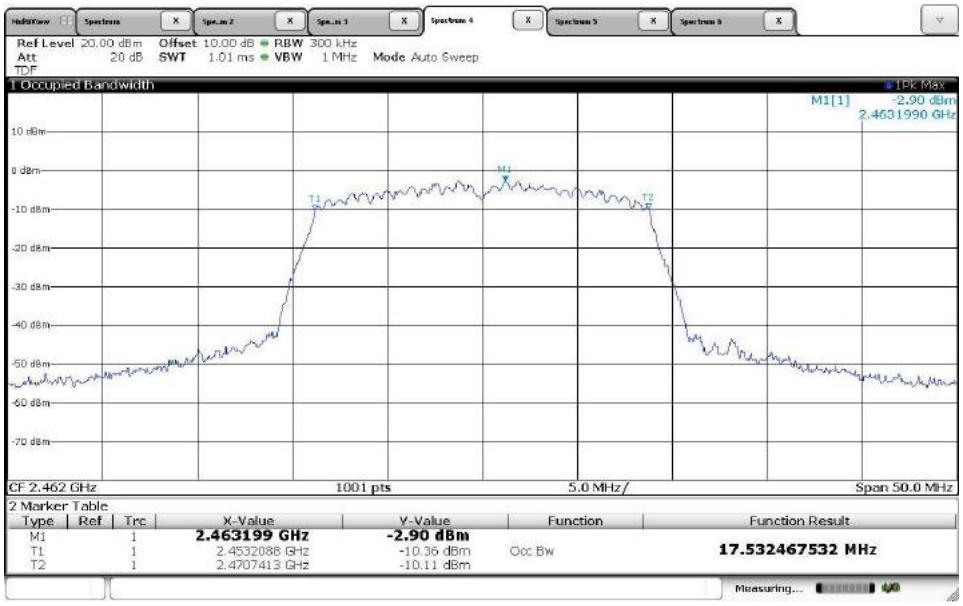
Lowest – 2 412 MHz



Middle – 2 437 MHz



Highest – 2 462 MHz



Test Mode – 802.11n(HT40)_Ant1

Lowest – 2 422 MHz

Middle – 2 437 MHz

Highest – 2 452 MHz

Test Mode – 802.11n(HT40)_Ant2

Lowest – 2 422 MHz

Middle – 2 437 MHz

Highest – 2 452 MHz

Test Mode – 802.11n(HT40)_MIMO

Lowest – 2 422 MHz

Middle – 2 437 MHz

Highest – 2 452 MHz

5. Radiated Spurious Emissions & Restricted Band, Conducted Spurious Emissions & Band Edge

5.1 Rule

According to §15.247(d), 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 Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

According to §15.209(a), Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009 - 0.490	2 400/F(kHz)	20log (2 400/F(kHz))	300
0.490 - 1.705	24 000/F(kHz)	20log (24 000/F(kHz))	30
1.705 - 30	30	30	30
30 - 88	100**	100**	3
88 - 216	150**	150**	3
216 - 960	200**	200**	3
Above 960	500	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54–72 MHz, 76–88 MHz, 174–216 MHz or 470–806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §15.231 and 15.241.

According to § 15.205(a) and (b), only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.009 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.495 - 0.505	16.694 75 - 16.695 25	608 - 614	5.35 - 5.46
2.173 5 - 2.190 5	16.804 25 - 16.804 75	960 – 1 240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1 300 – 1 427	8.025 - 8.5
4.177 25 - 4.177 75	37.5 - 38.25	1 435 – 1 626.5	9.0 - 9.2
4.207 25 - 4.207 75	73 - 74.6	1 645.5 – 1 646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1 660 – 1 710	10.6 - 12.7
6.267 75 - 6.268 25	108 - 121.94	1 718.8 – 1 722.2	13.25 - 13.4
6.311 75 - 6.312 25	123 - 138	2 200 – 2 300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2 310 – 2 390	15.35 - 16.2
8.362 - 8.366	156.524 75 - 156.525 25	2 483.5 – 2 500	17.7 - 21.4
8.376 25 - 8.386 75	156.7 - 156.9	2 690 – 2 900	22.01 - 23.12
8.414 25 - 8.414 75	162.012 5 - 167.17	3 260 – 3 267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3 332 – 3 339	31.2 - 31.8
12.519 75 - 12.520 25	240 - 285	3 345.8 – 3 358	36.43 - 36.5
12.576 75 - 12.577 25	322 - 335.4	3 600 – 4 400	Above 38.6
13.36 - 13.41			

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1 000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1 000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements

5.2 Measurement Procedure

According to ANSI C63.10-2013 & KDB 558074 D01 DTS Meas. Guidance v04, 11.0 Emissions in non-restricted frequency band, and 12.0 Emissions in restricted frequency bands

5.2.1. Test Procedures for emission below 30 MHz

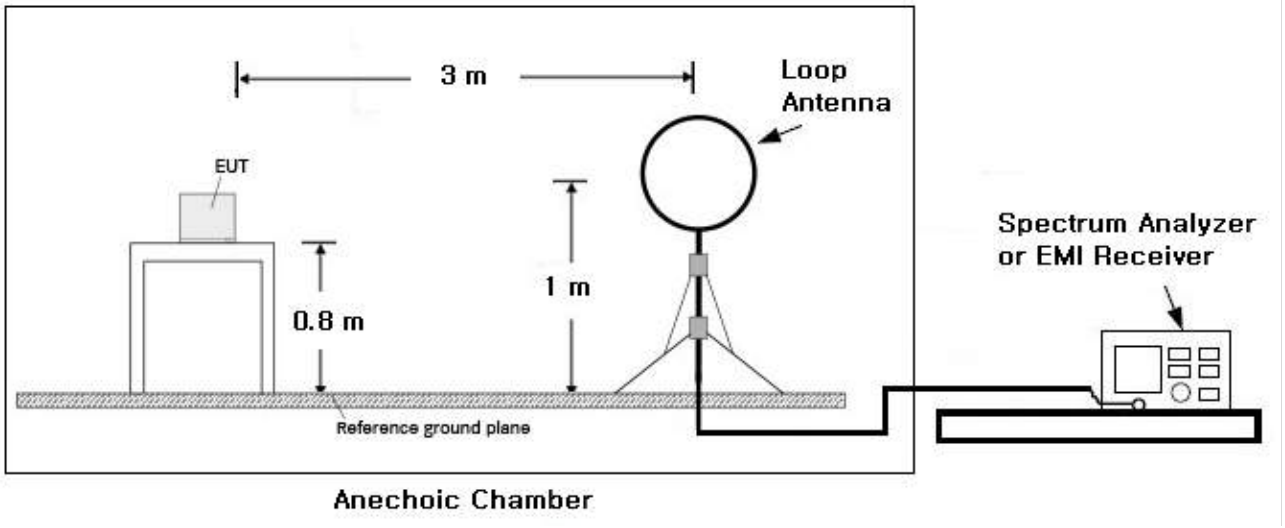
1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
3. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test-receiver system was set to quasi peak detect function and Specified Bandwidth with Maximum Hold Mode.

5.2.2. Test Procedures for emission below 1 000 MHz & above 1 000 MHz

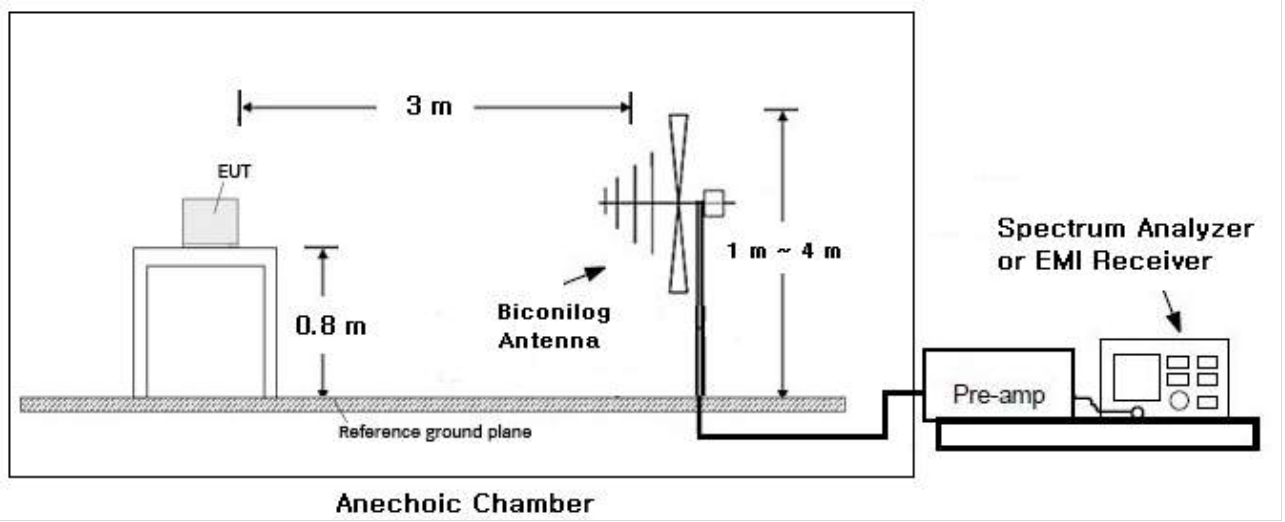
1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at anechoic chamber test site (below 1 GHz) and 1.5 meters above the ground at anechoic chamber test site (above 1 GHz). The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
3. The antenna is a bi-log antenna, a horn antenna and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength (Keeping antenna aimed at EUT). Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. The test-receiver system was set to quasi peak detect function (below 1 GHz), peak detect function and average detect function (above 1 GHz).

5.2.3. Test Setup

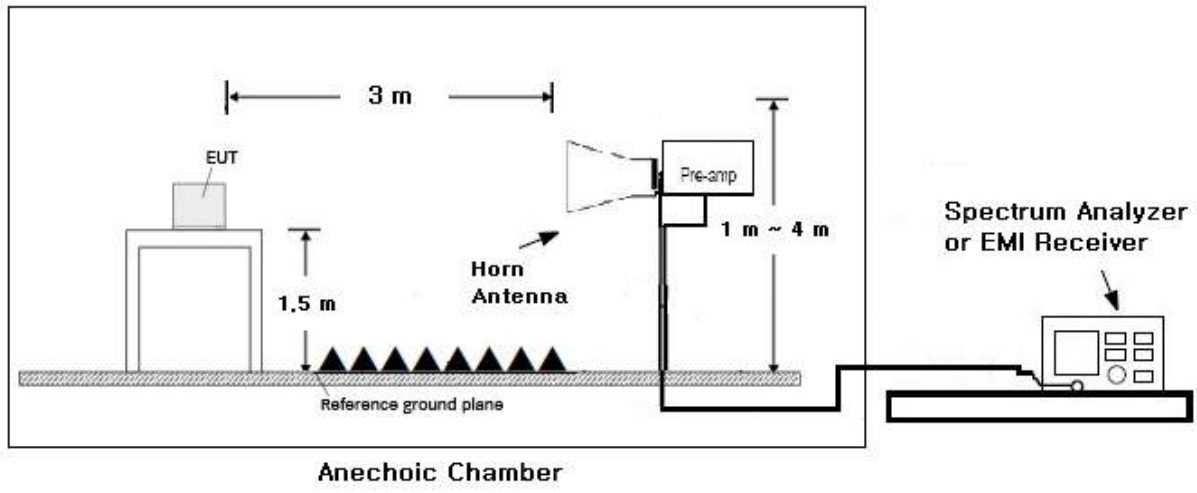
1. 9 kHz to 30 MHz Emissions



2. 30 MHz to 1 000 MHz Emissions



3. Above 1 000 MHz Emissions



NOTE;

All data rates and modes were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

1. Unwanted Emissions into Non-Restricted Frequency Bands

- The Reference Level Measurement refer to section 11.2
Set Analyzer centre frequency to DTS channel centre frequency, SPAN ≥ 1.5 times the DTS bandwidth, the RBW = 100 kHz and VBW ≥ 3 × RBW, Detector = Peak, Sweep time = Auto couple, Trace = Max hold.

- Unwanted Emissions Level Measurement refer to section 11.3
Set the centre frequency and span to encompass frequency range to be measured, the RBW = 100 kHz and VBW ≥ 3 × RBW, Detector = Peak, Sweep time = Auto couple, Trace = Max hold.

2. Unwanted Emissions into Restricted Frequency Bands

- Peak Power measurement procedure refer to section 12.2.4
Set RBW = as specified in Table 1, VBW ≥ 3 x RBW, Detector = Peak, Sweep time = auto, Trace = Max hold.

Table 1- RBW as a function of frequency

Frequency	RBW
9 – 150 kHz	200 – 300 Hz
0.15 – 30 MHz	9 – 10 kHz
30 – 1 000 MHz	100 – 120 kHz
> 1 000 MHz	1 MHz

-Average Power measurements procedure refer to section 12.2.5.2
The EUT shall be configured to operate at the maximum achievable duty cycle.
Measure the duty cycle, x, of the transmitter output signal as described in section 6.0.
Set RBW = 1 MHz, VBW ≥ 3 x RBW, Detector = RMS, if span / (# of points in sweep) ≤ (RBW/2).
Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied then the detector mode shall be set to peak.

Averaging type = power (i.e., RMS).
As an alternative the detector and averaging type may be set for linear voltage averaging.
Some instruments require linear display mode in order to use linear voltage averaging. Log or dB averaging shall not be used. Sweep time = auto, Perform a trace average of at least 100 traces.

A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:

1) If power averaging (RMS) mode was used in step f), then the applicable correction factor is 10 log (1/x), where x is the duty cycle.
3) If a specific emission is demonstrated to be continuous (≥ 98 percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.

the EUT is manipulated through three orthogonal planes (X, Y, Z). Worst orthogonal plan of EUT is **X – axis** during radiation test.

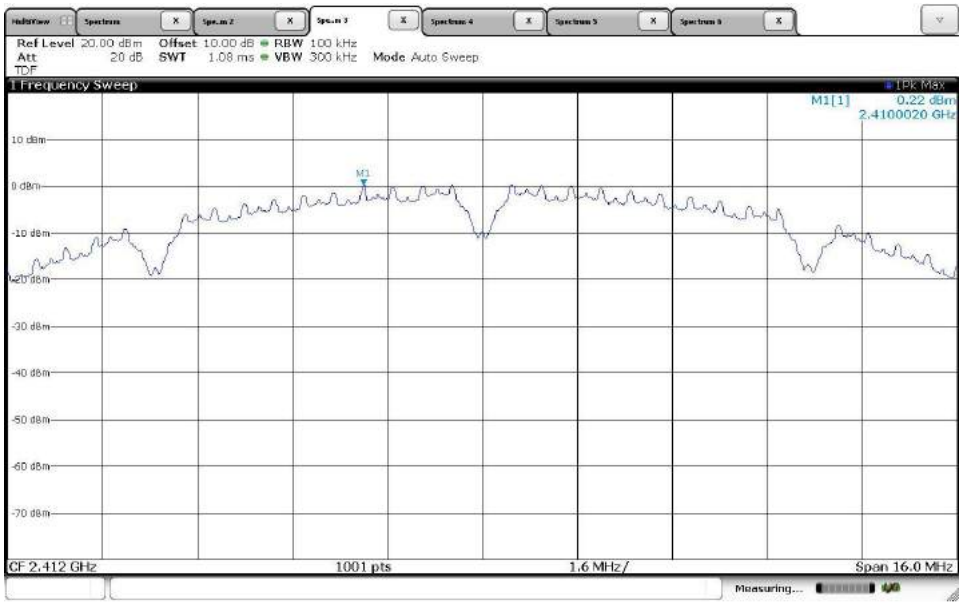
5.3 Test results – Complied

Test Condition: Temperature (23 ± 2) °C; Humidity (42 ± 2) %

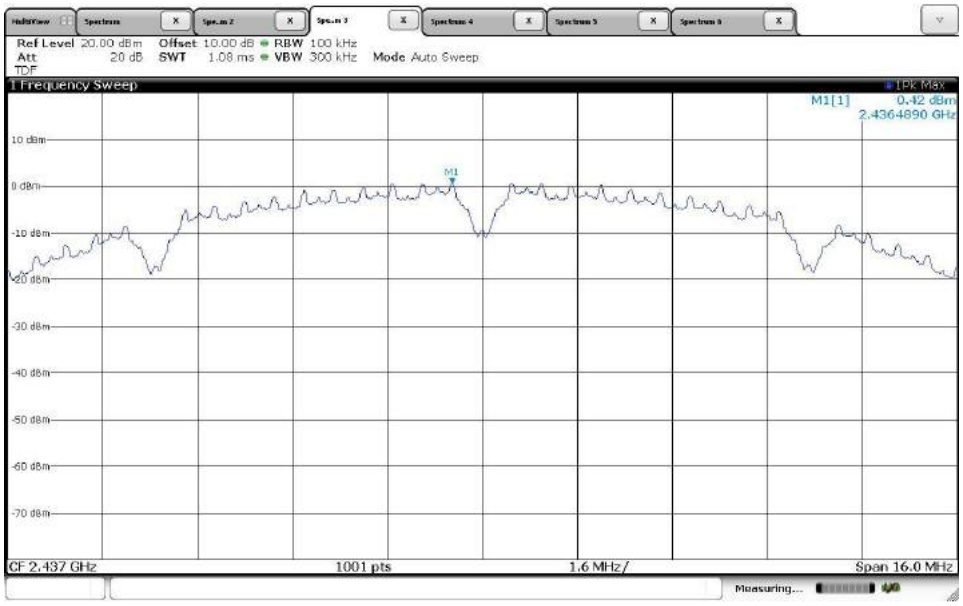
Photographs of Test Result (Conducted Measurements)

Test Mode – 802.11b_Ant1

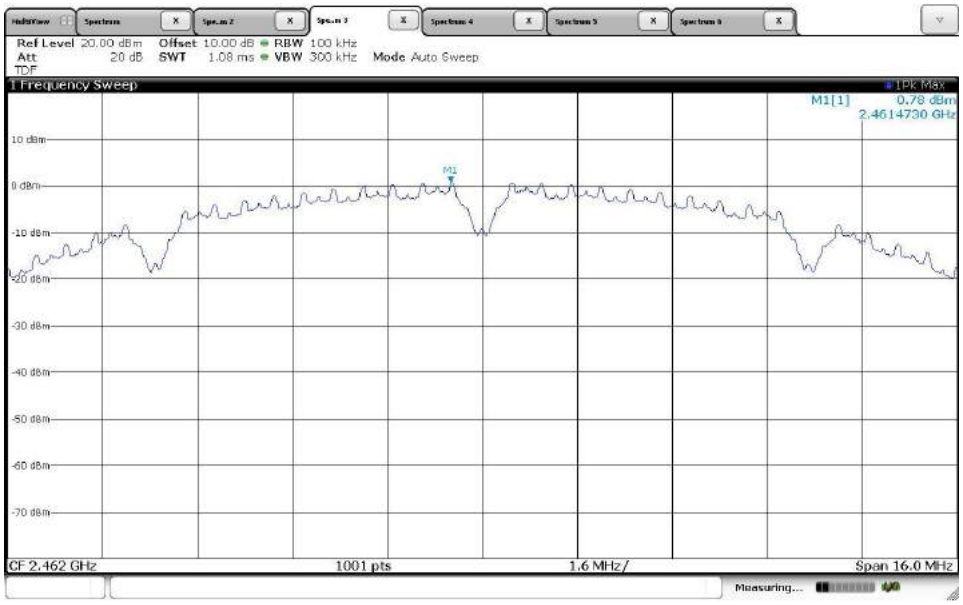
Reference Level– 2 412 MHz



Reference Level– 2 437 MHz

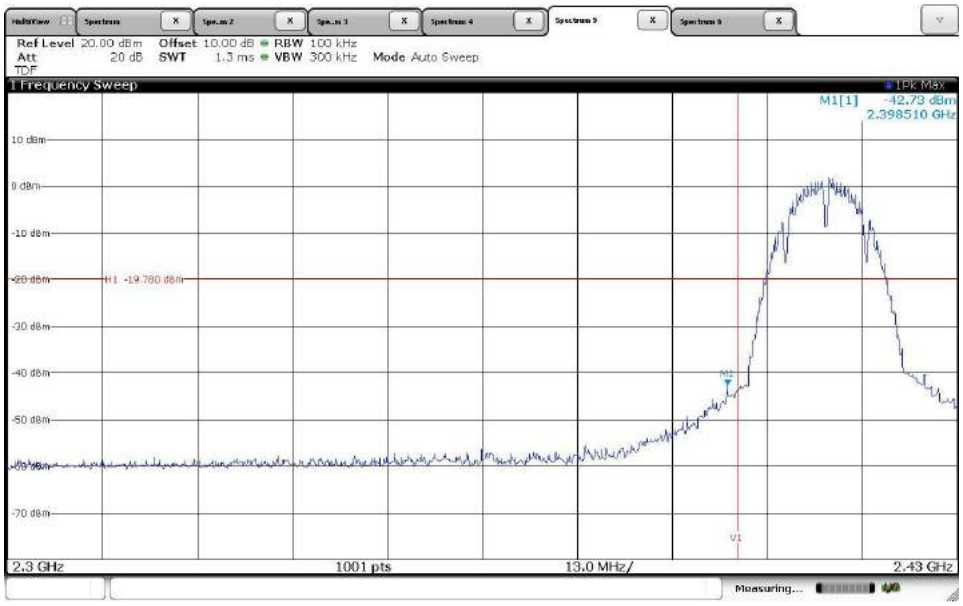


Reference Level– 2 462 MHz

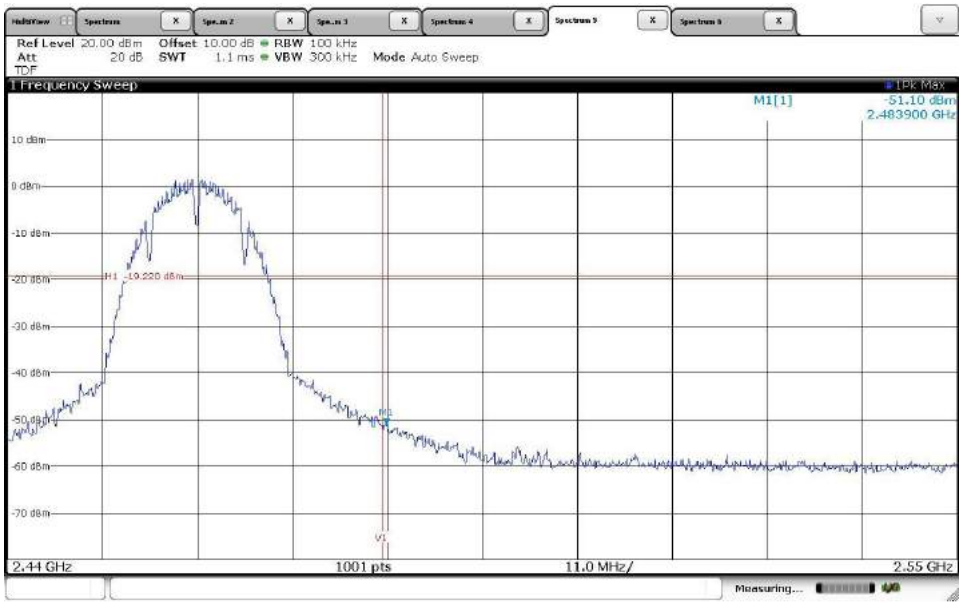


Band Edge

Lowest – 2 412 MHz

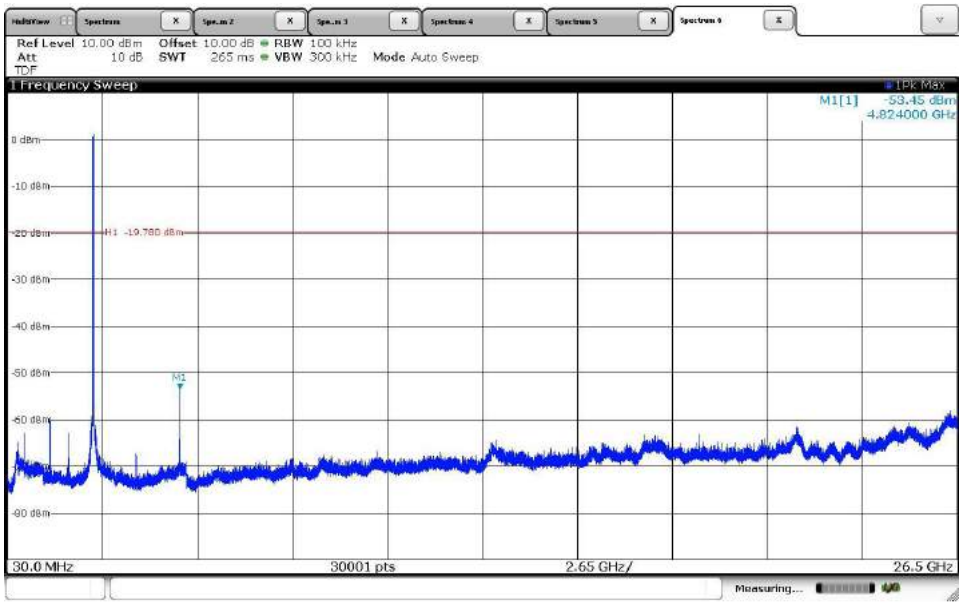


Highest – 2 462 MHz

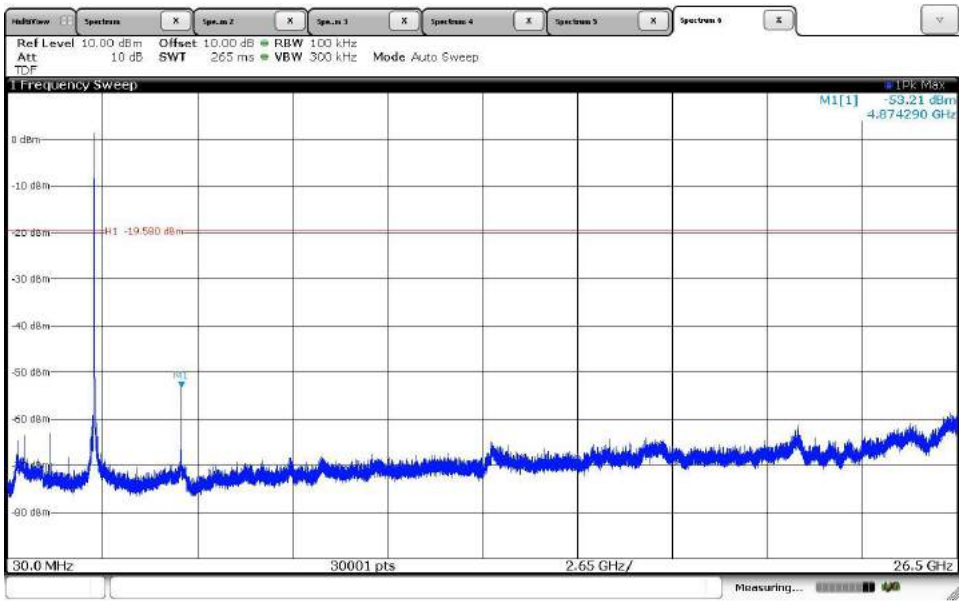


Spurious

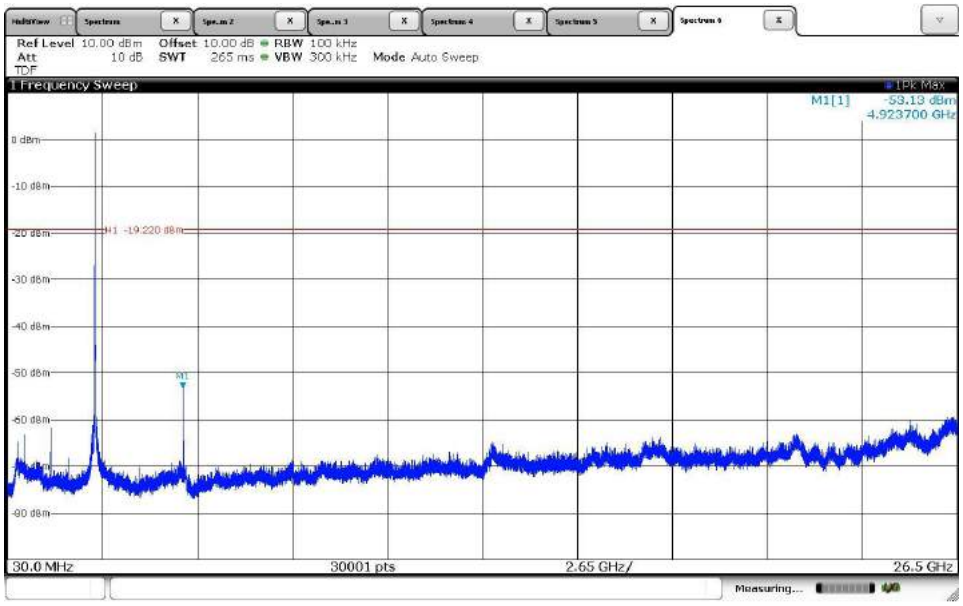
Lowest – 2 412 MHz



Middle – 2 437 MHz

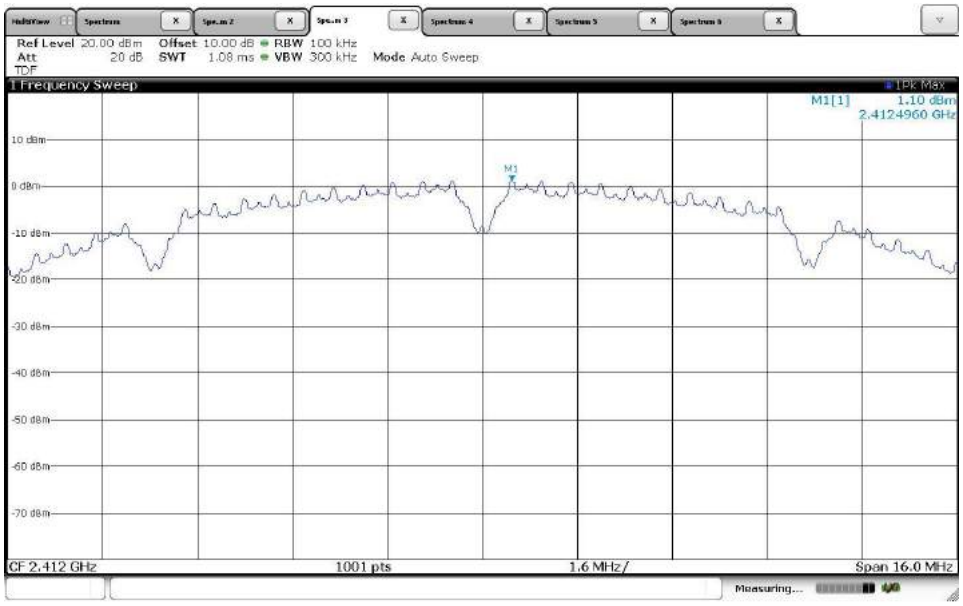


Highest – 2 462 MHz

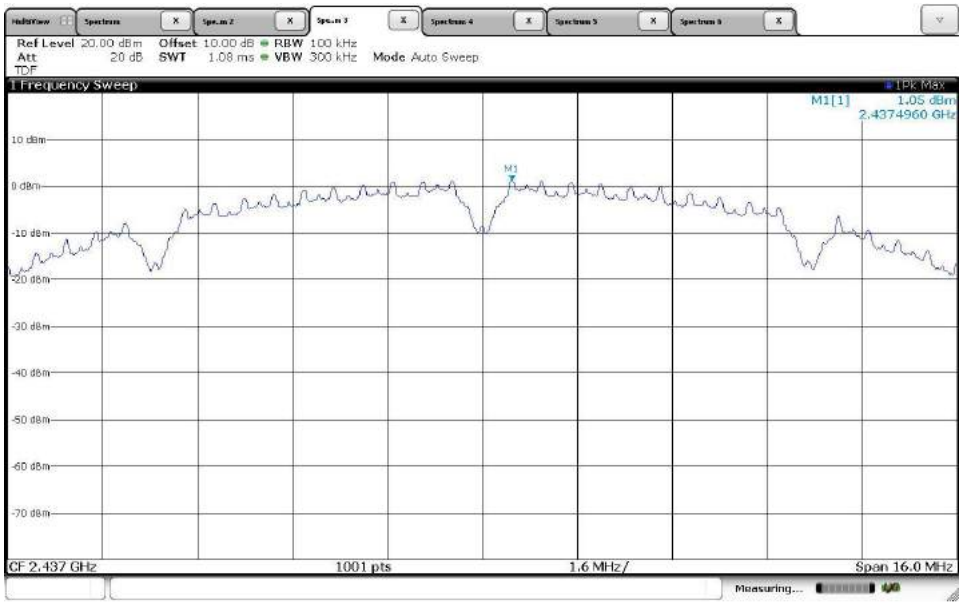


Test Mode – 802.11b_Ant2

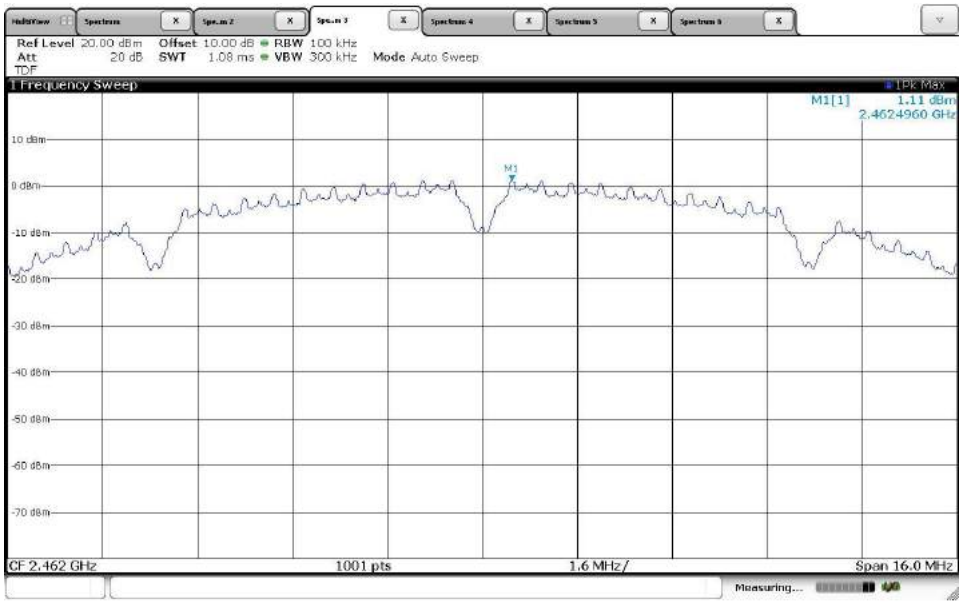
Reference Level– 2 412 MHz



Reference Level– 2 437 MHz

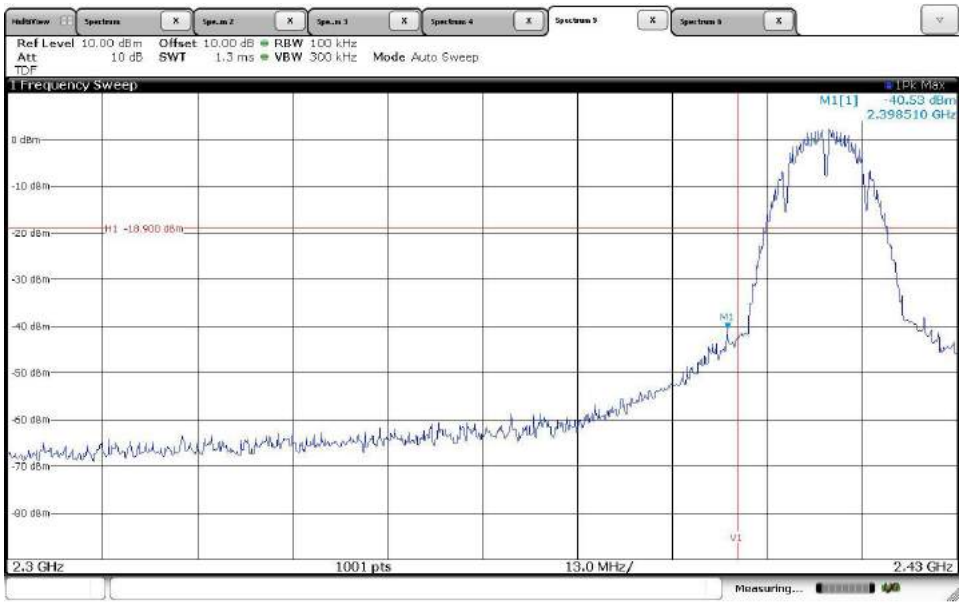


Reference Level– 2 462 MHz

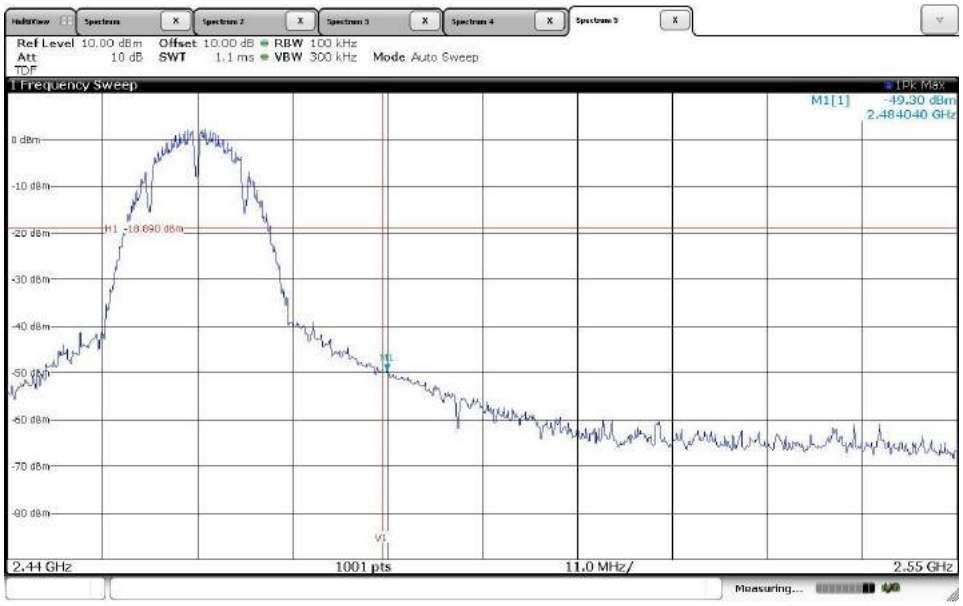


Band Edge

Lowest – 2 412 MHz

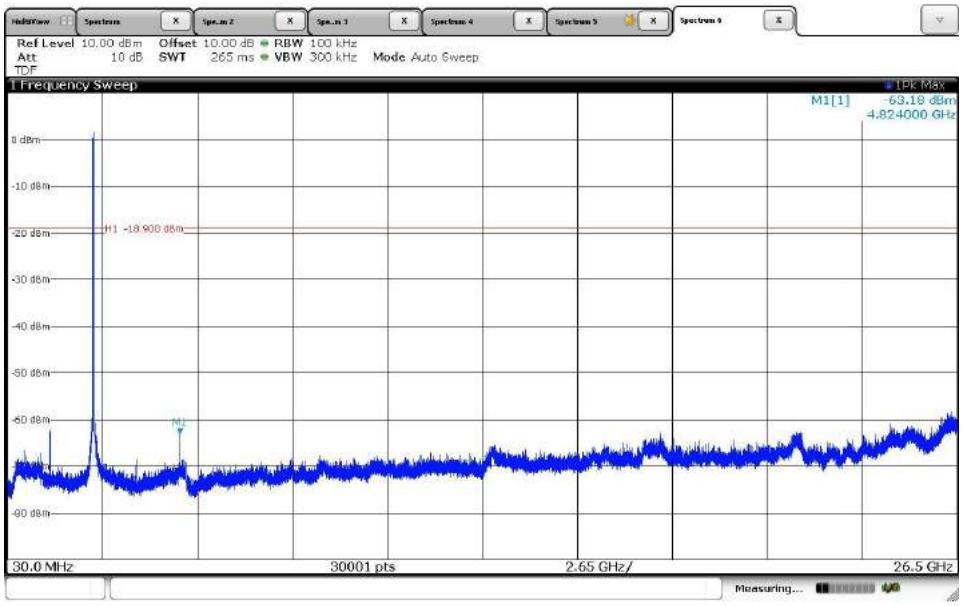


Highest – 2 462 MHz

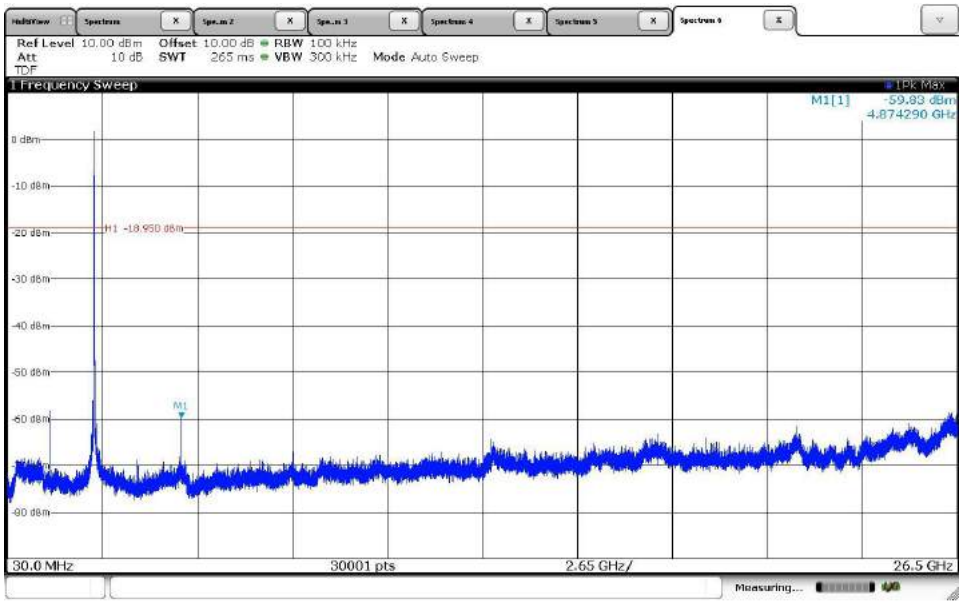


Spurious

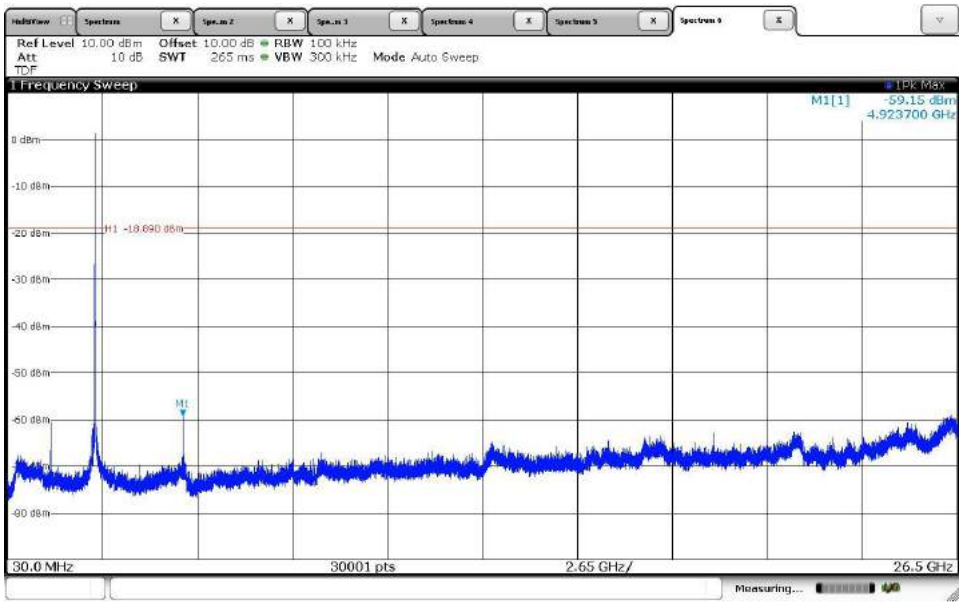
Lowest – 2 412 MHz



Middle – 2 437 MHz

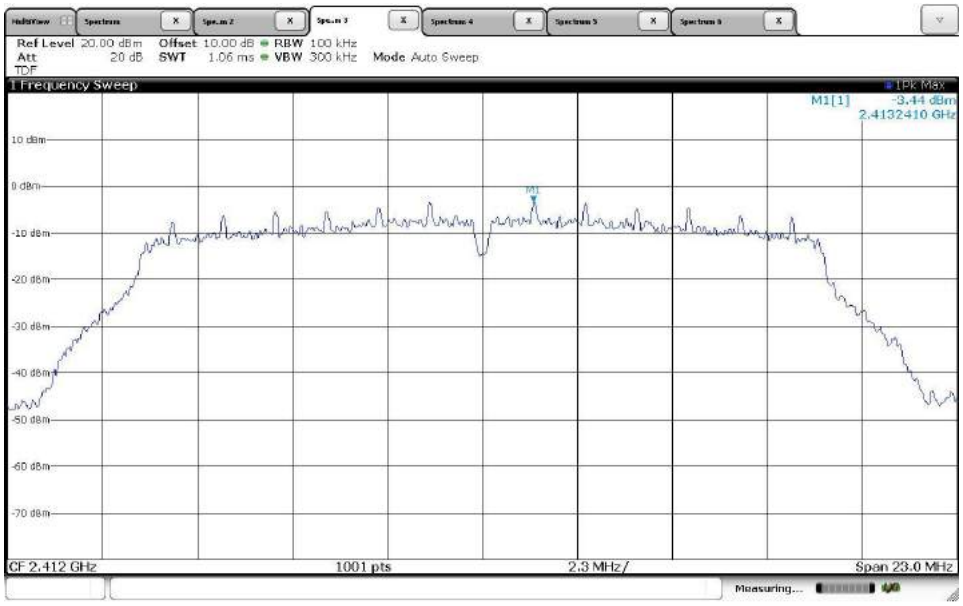


Highest – 2 462 MHz

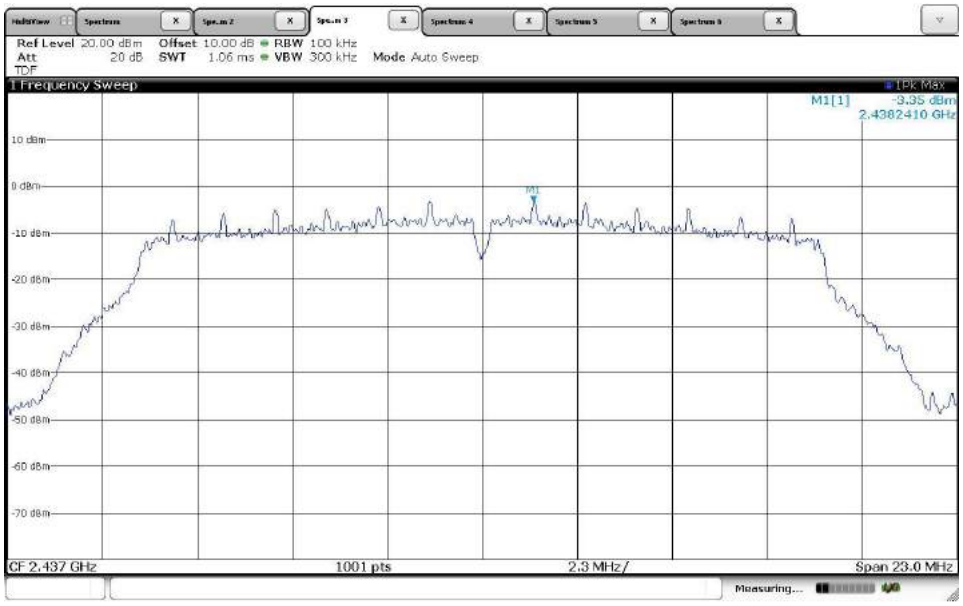


Test Mode – 802.11g_Ant1

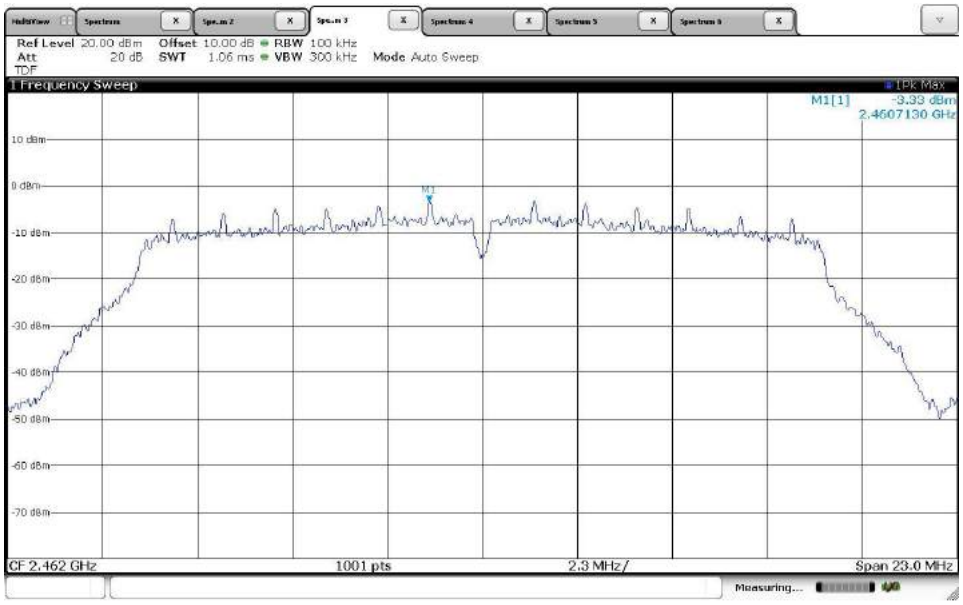
Reference Level– 2 412 MHz



Reference Level– 2 437 MHz

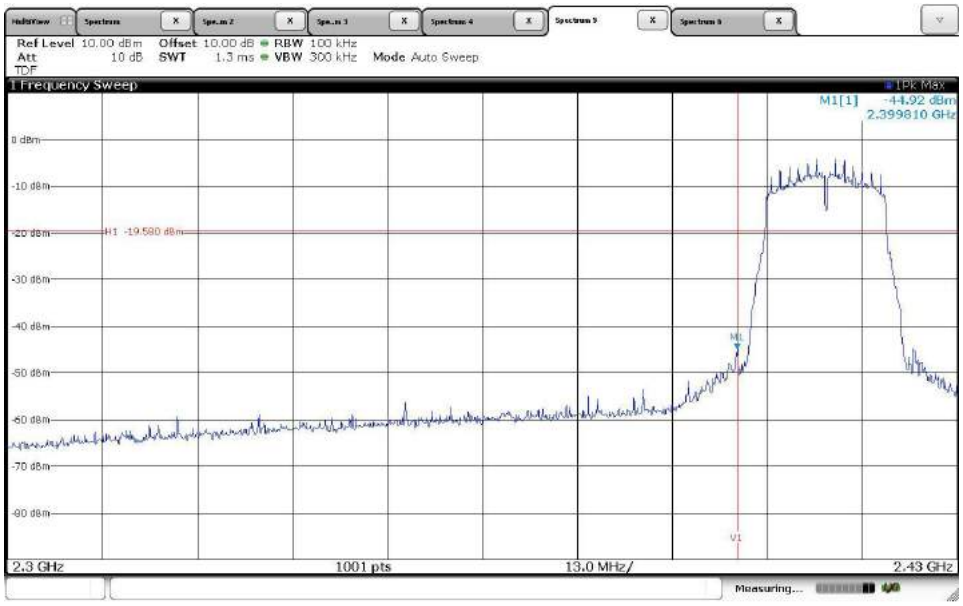


Reference Level– 2 462 MHz

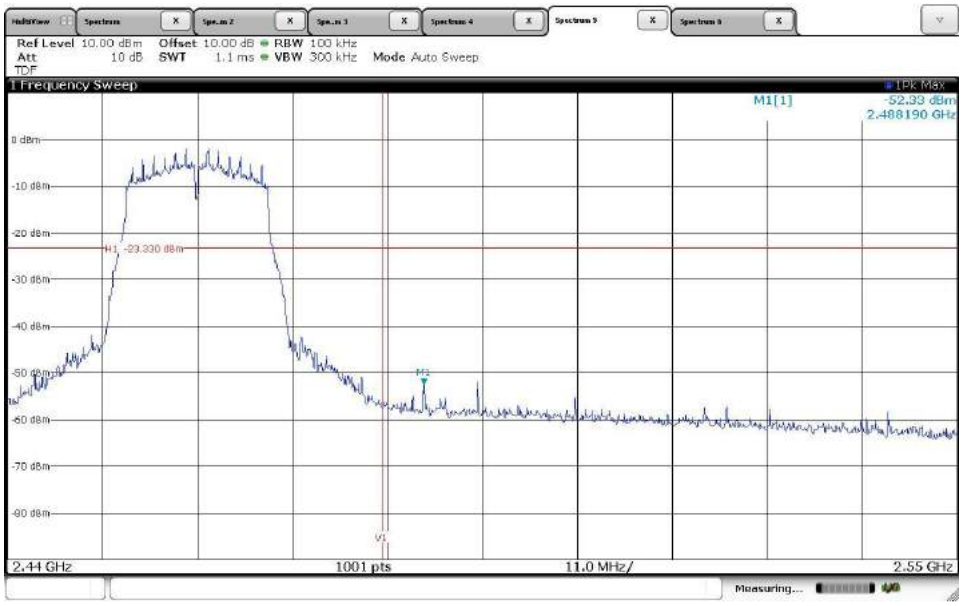


Band Edge

Lowest – 2 412 MHz

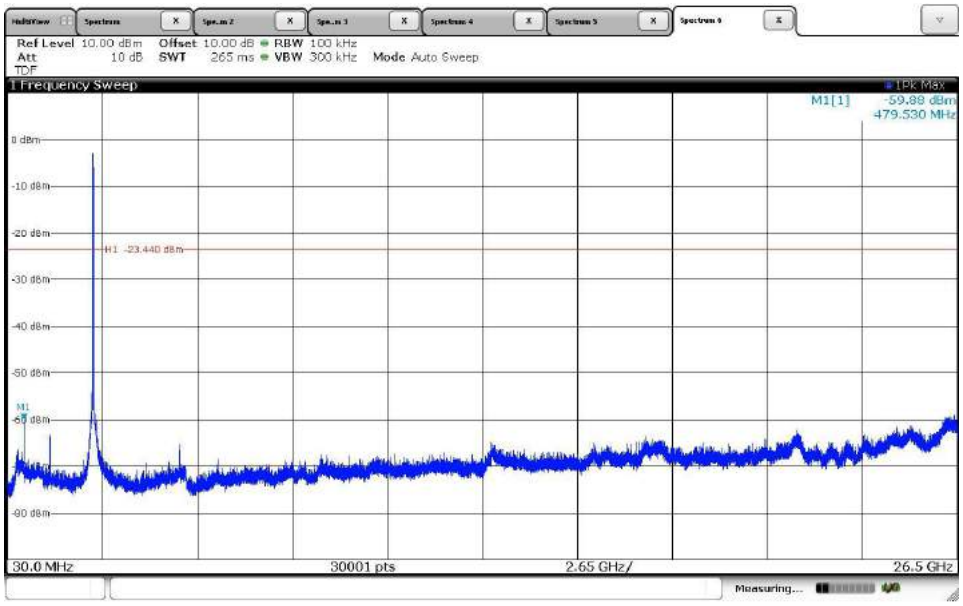


Highest – 2 462 MHz

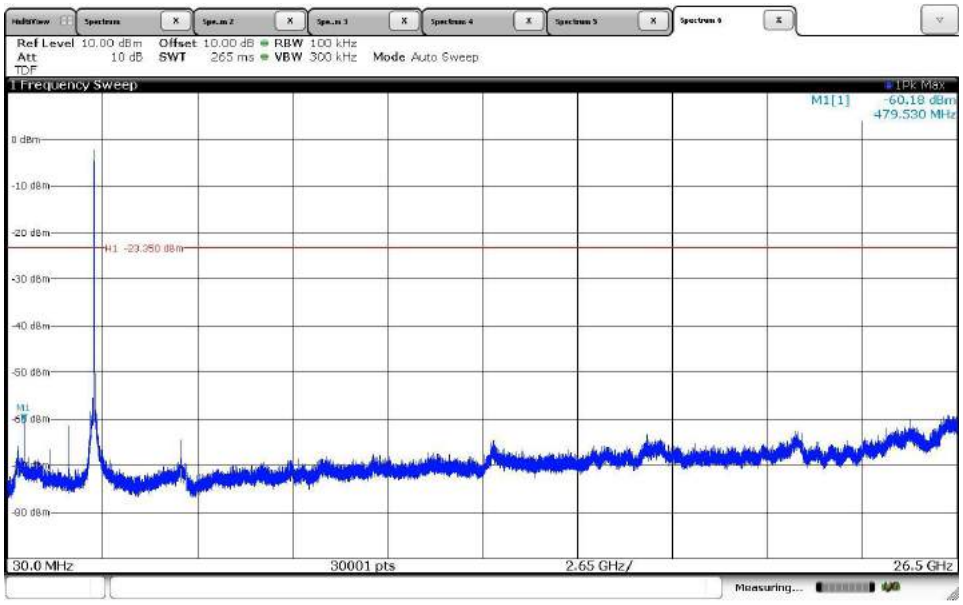


Spurious

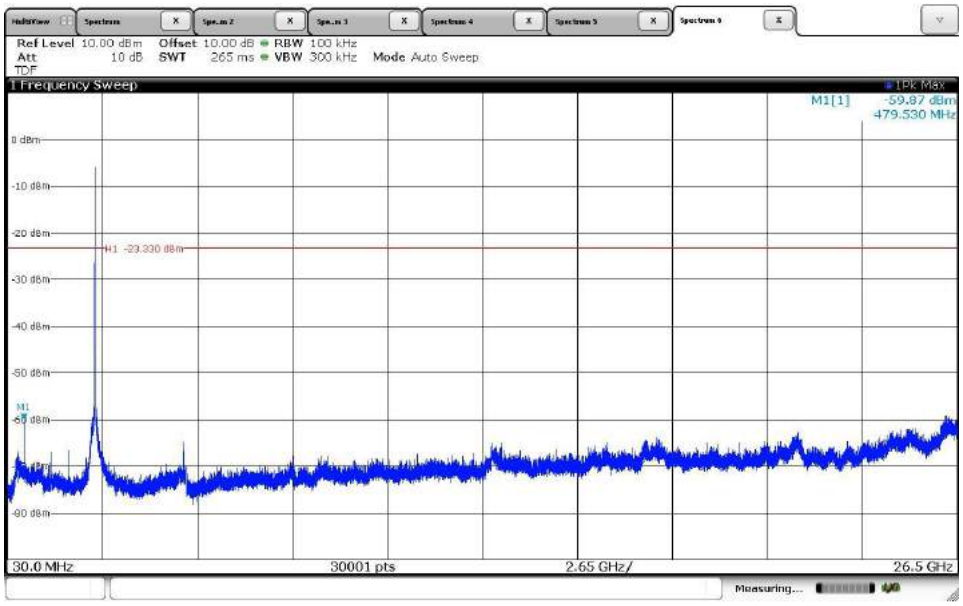
Lowest – 2 412 MHz



Middle – 2 437 MHz

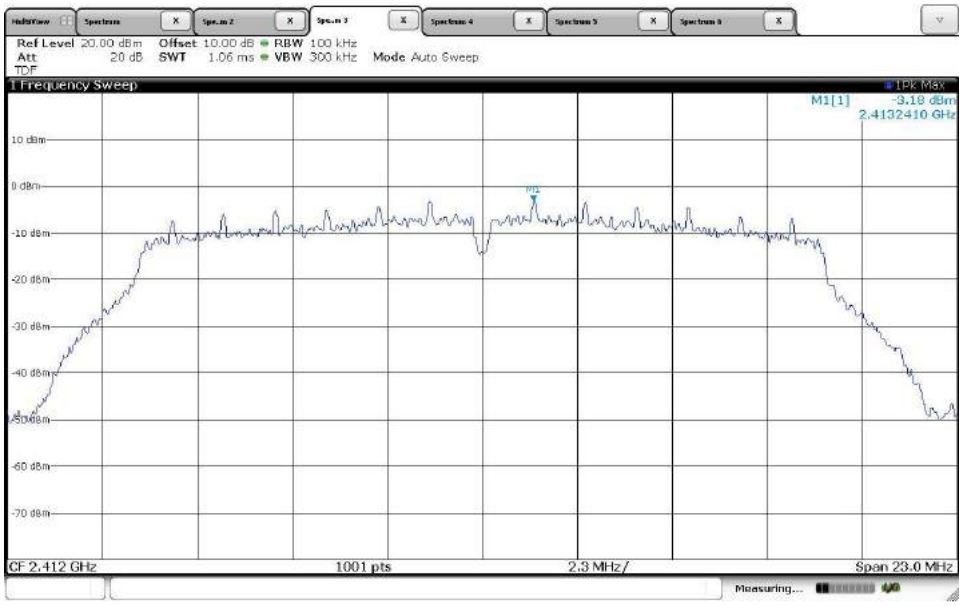


Highest – 2 462 MHz

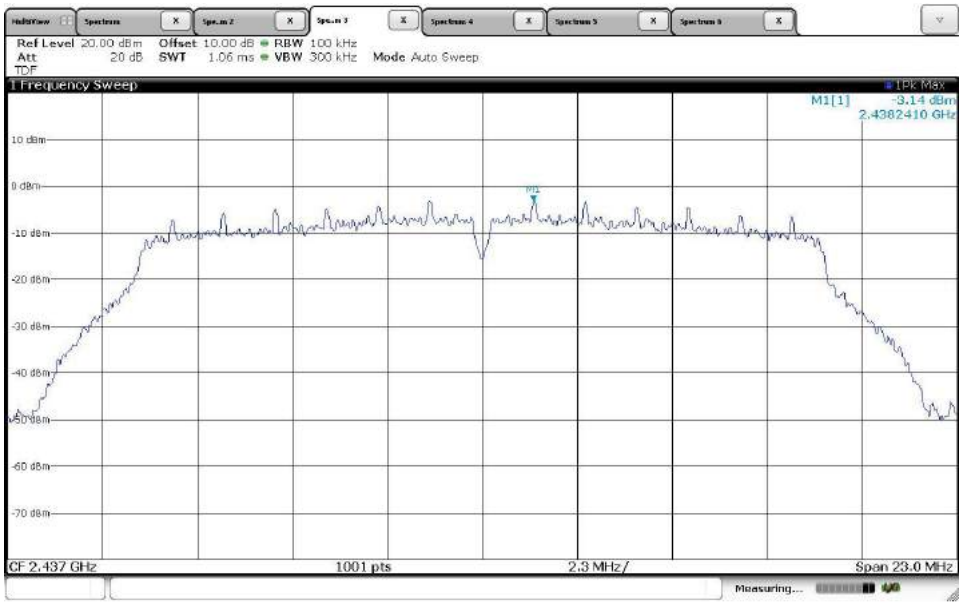


Test Mode – 802.11g_Ant2

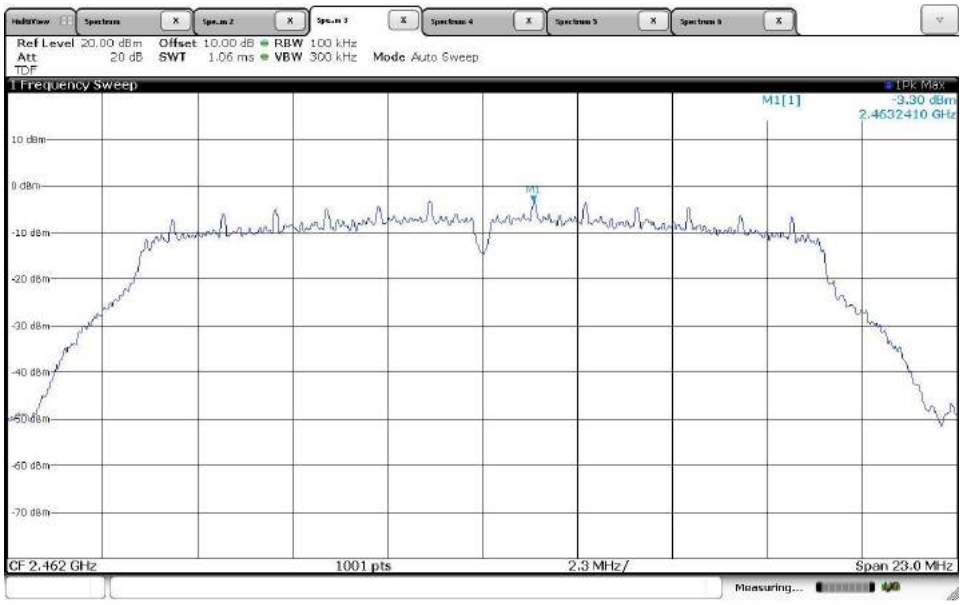
Reference Level– 2 412 MHz



Reference Level– 2 437 MHz

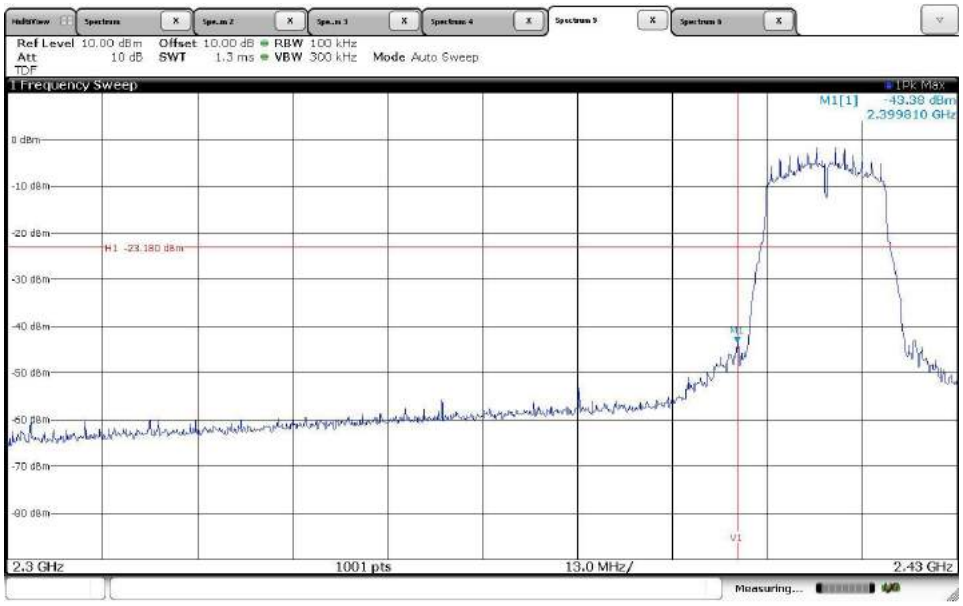


Reference Level– 2 462 MHz

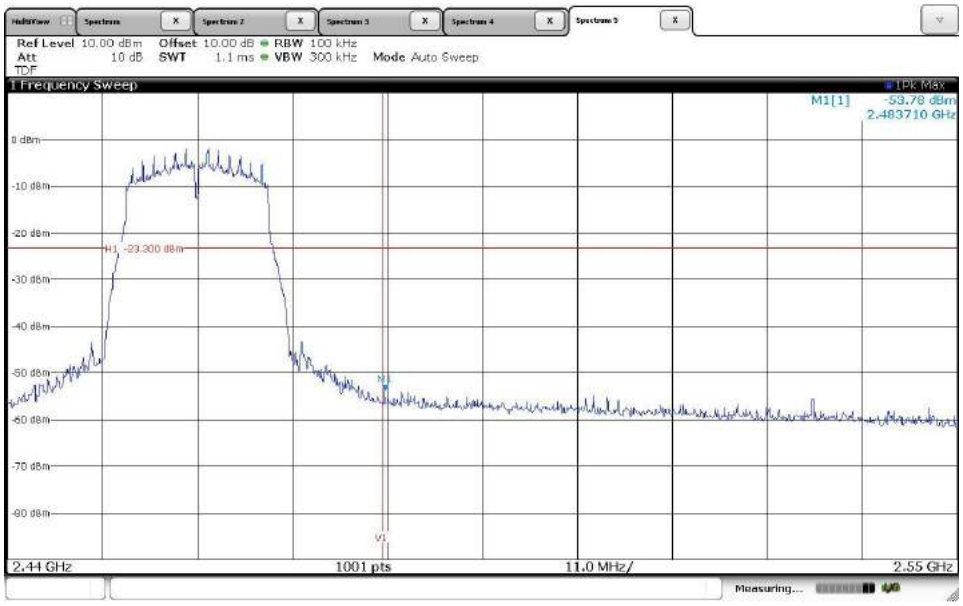


Band Edge

Lowest – 2 412 MHz

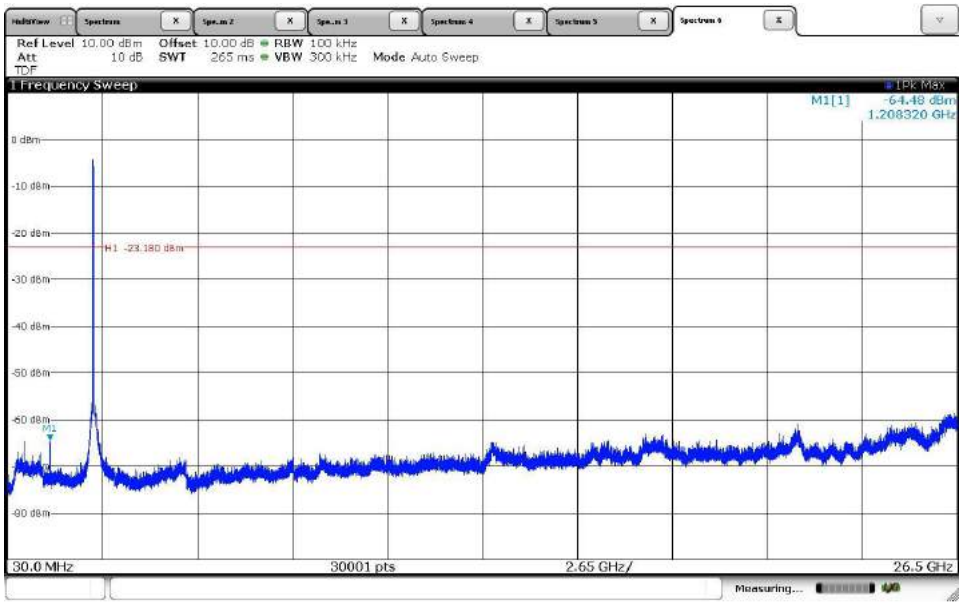


Highest – 2 462 MHz

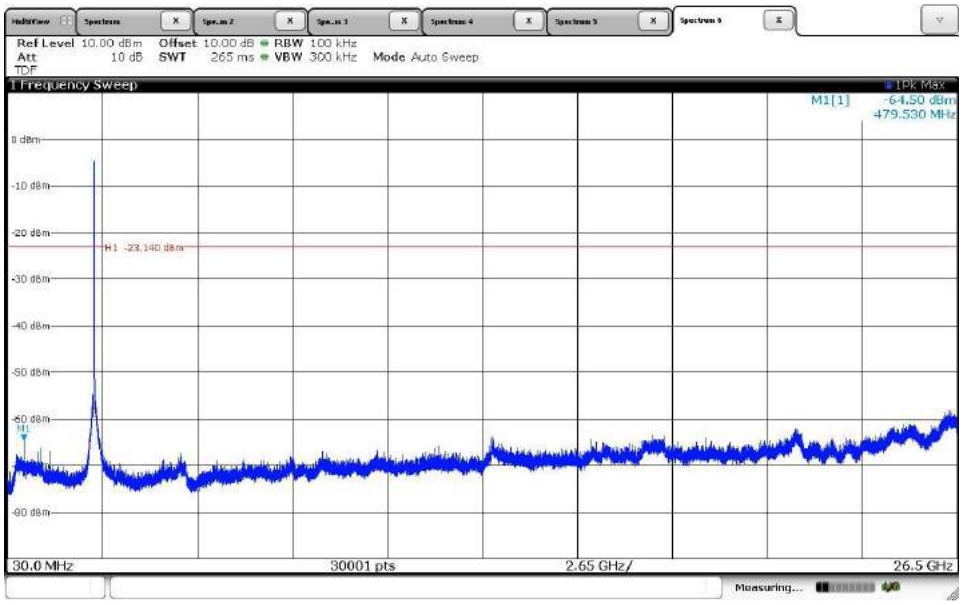


Spurious

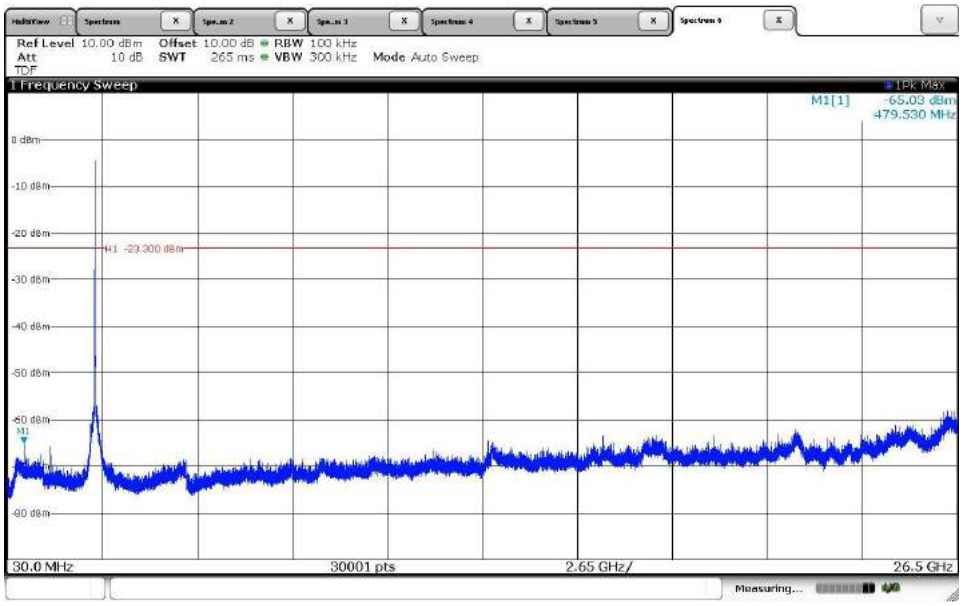
Lowest – 2 412 MHz



Middle – 2 437 MHz

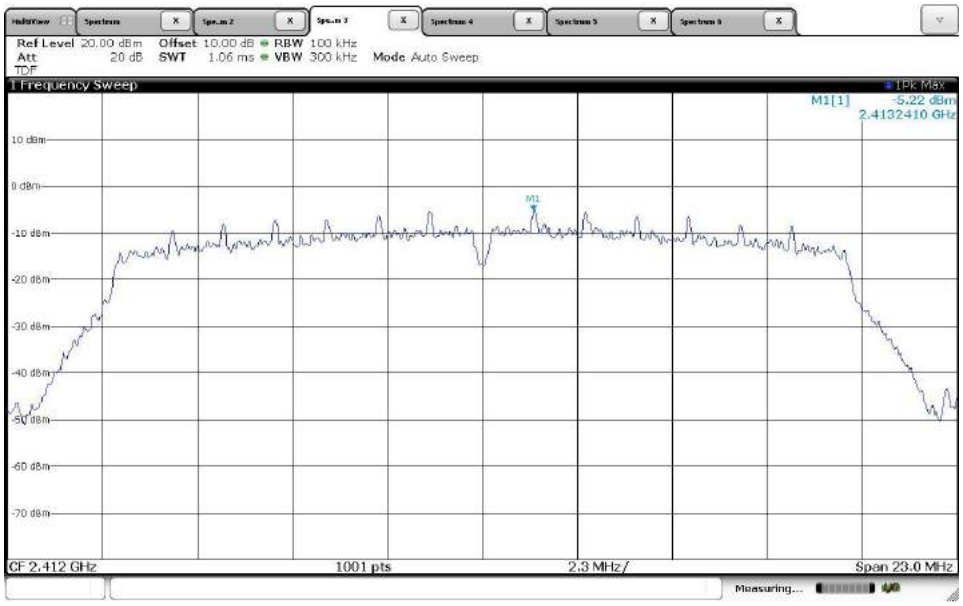


Highest – 2 462 MHz

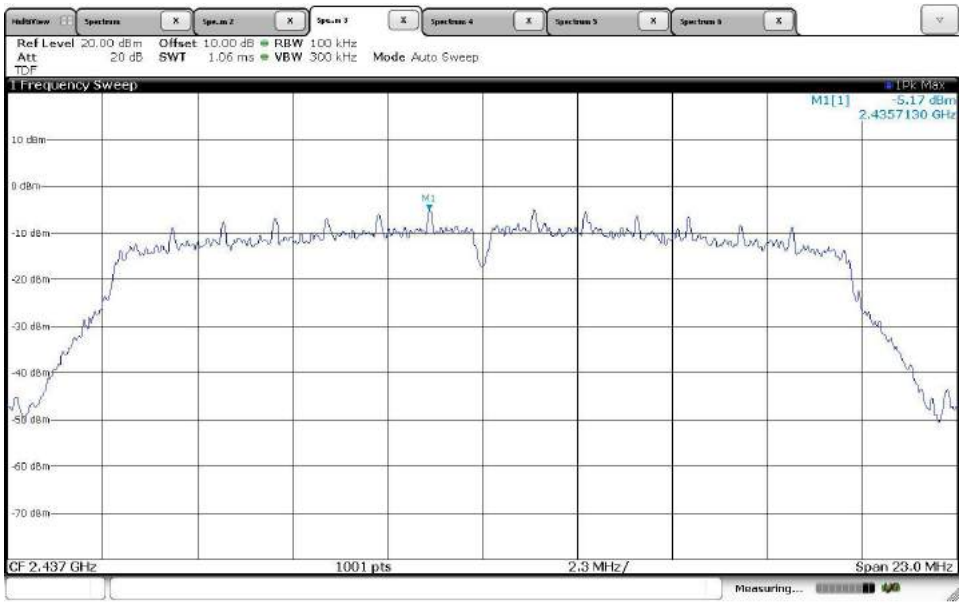


Test Mode – 802.11n(HT20)_Ant1

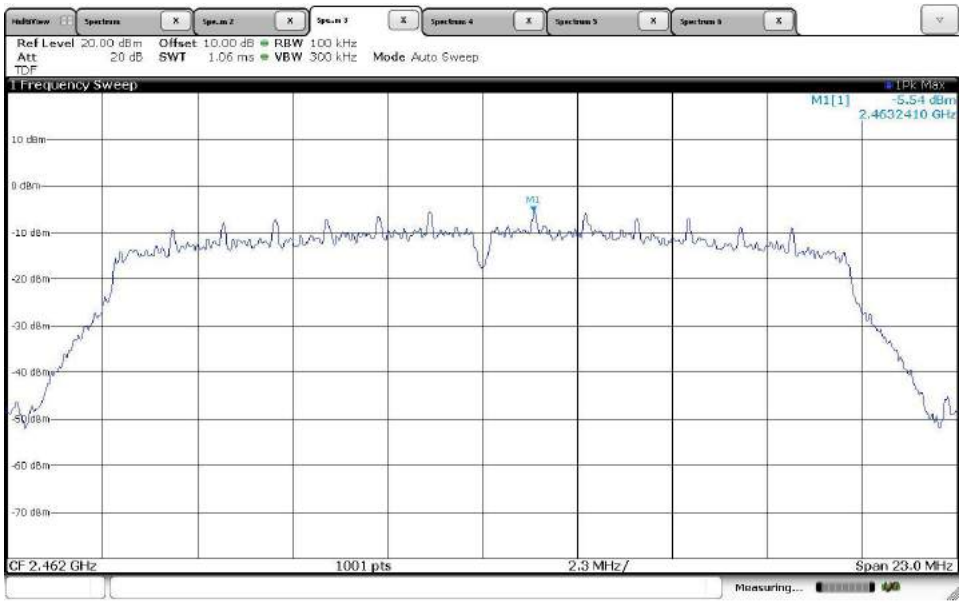
Reference Level– 2 412 MHz



Reference Level– 2 437 MHz

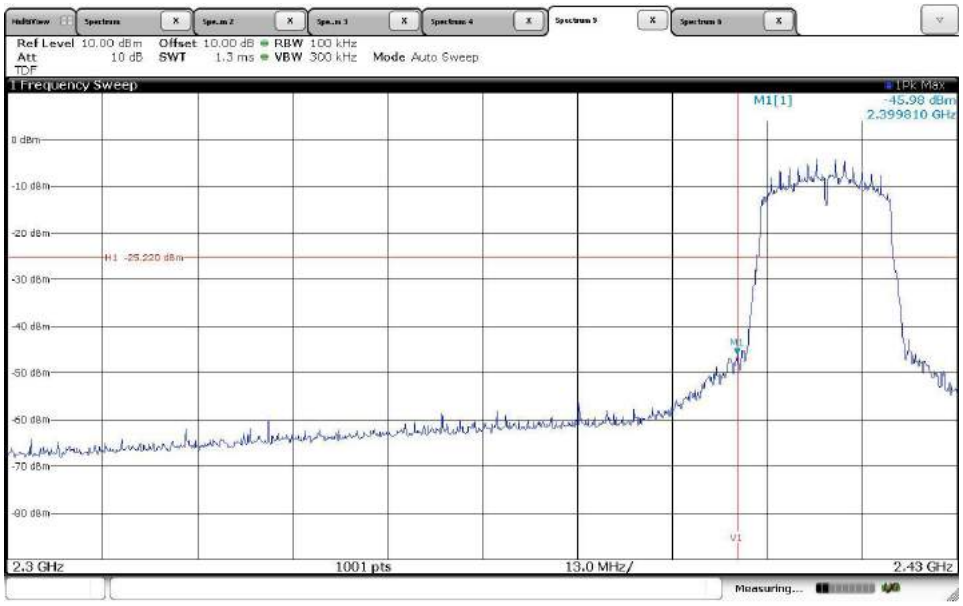


Reference Level– 2 462 MHz

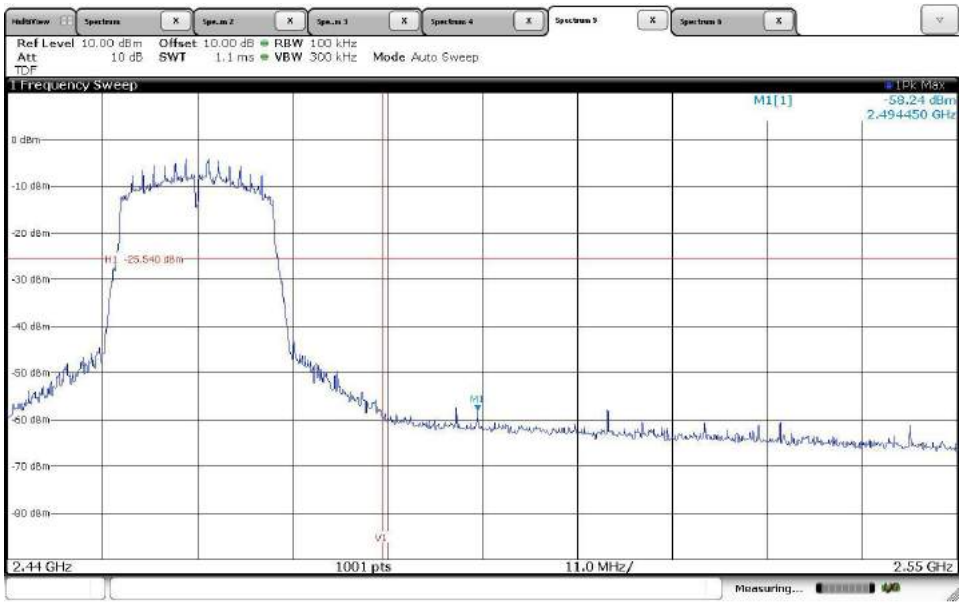


Band Edge

Lowest – 2 412 MHz

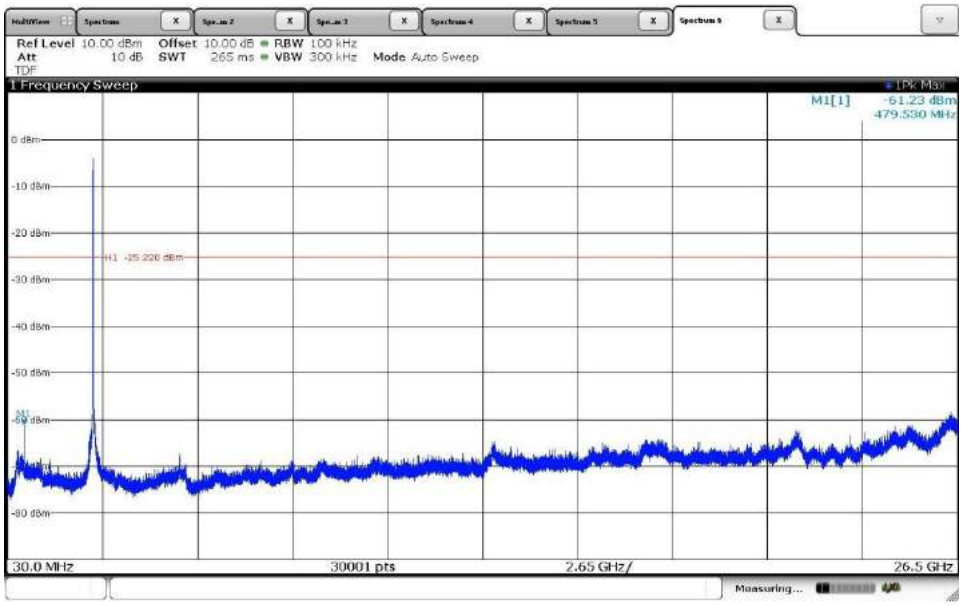


Highest – 2 462 MHz

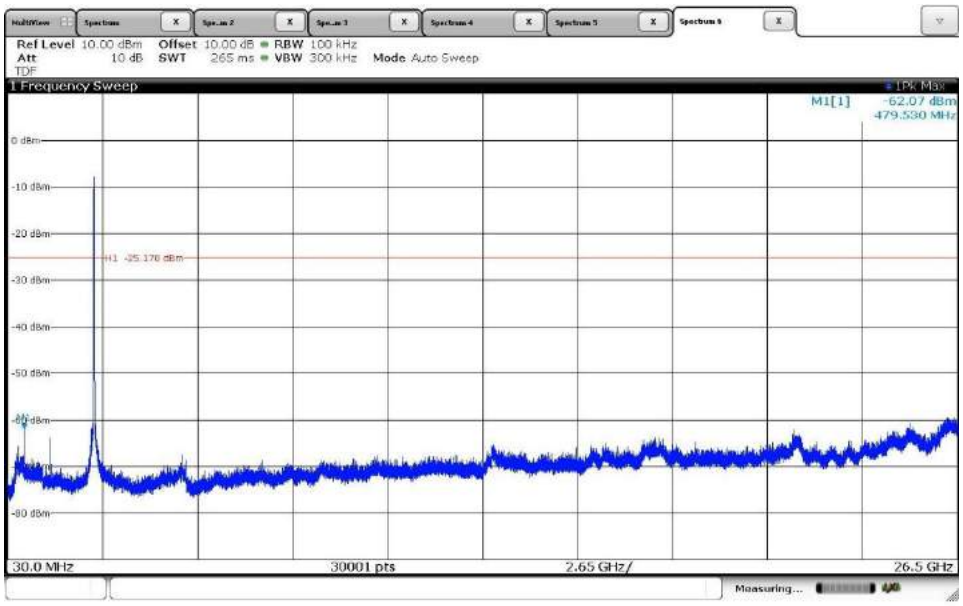


Spurious

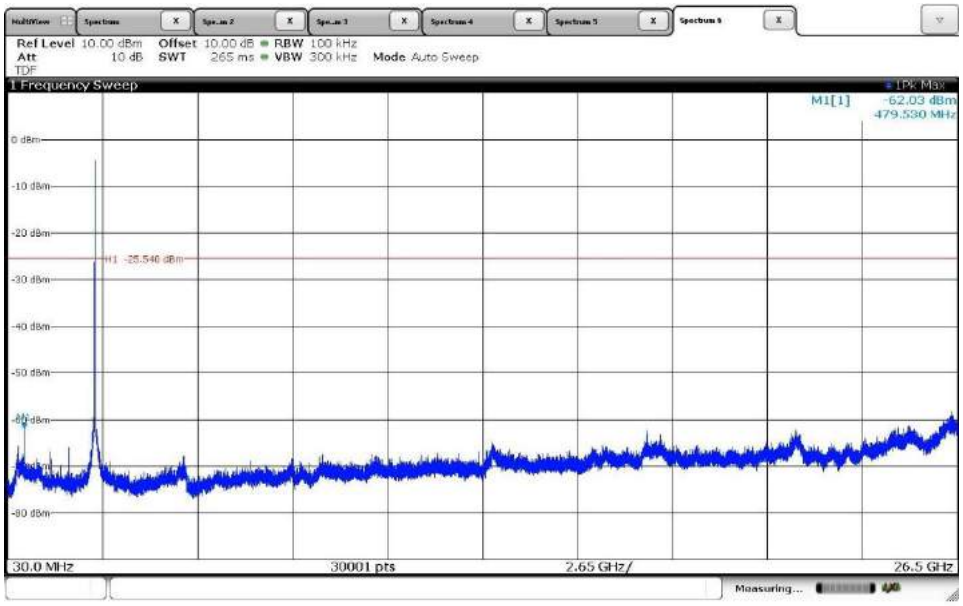
Lowest – 2 412 MHz



Middle – 2 437 MHz

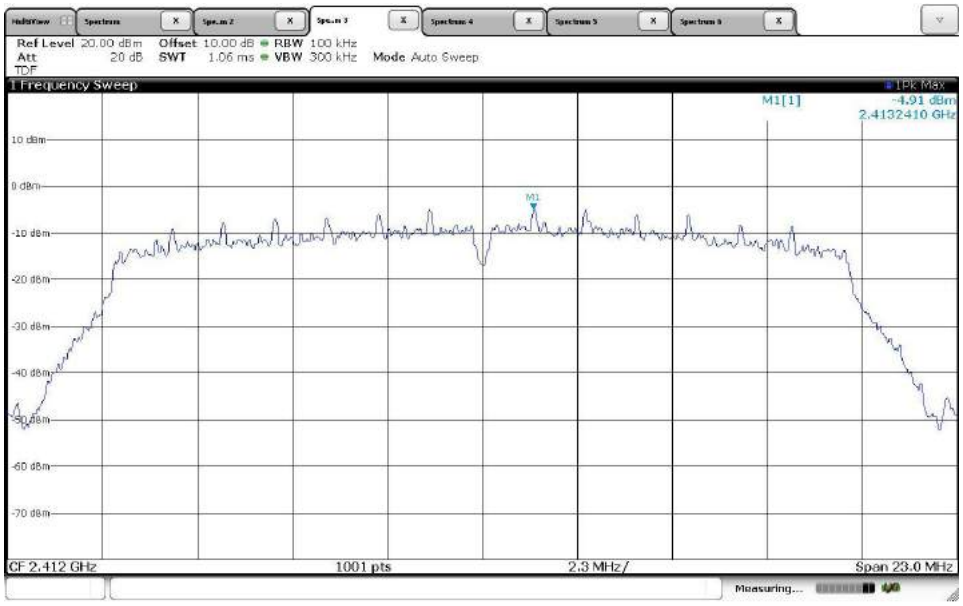


Highest – 2 462 MHz

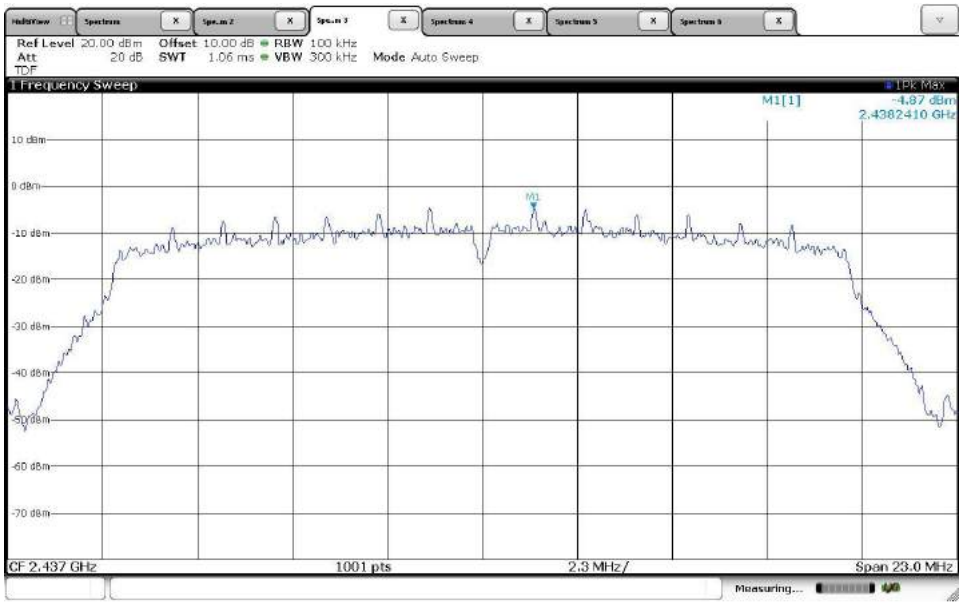


Test Mode – 802.11n(HT20)_Ant2

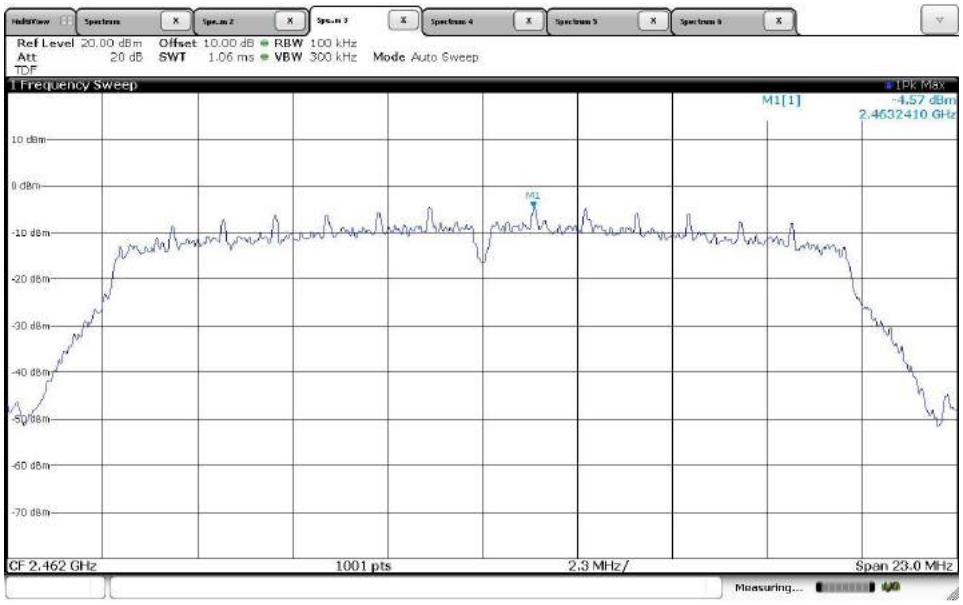
Reference Level– 2 412 MHz



Reference Level– 2 437 MHz

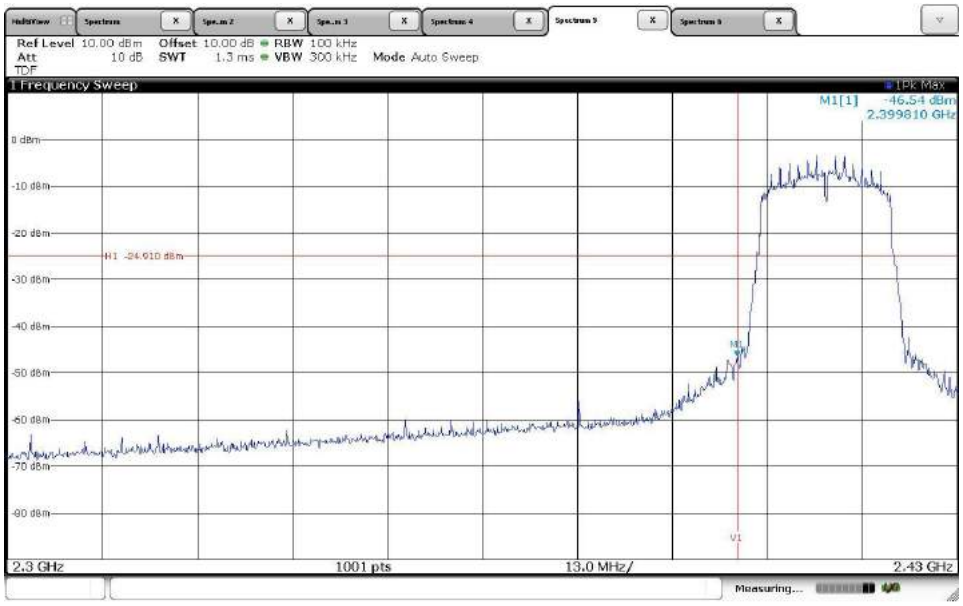


Reference Level– 2 462 MHz

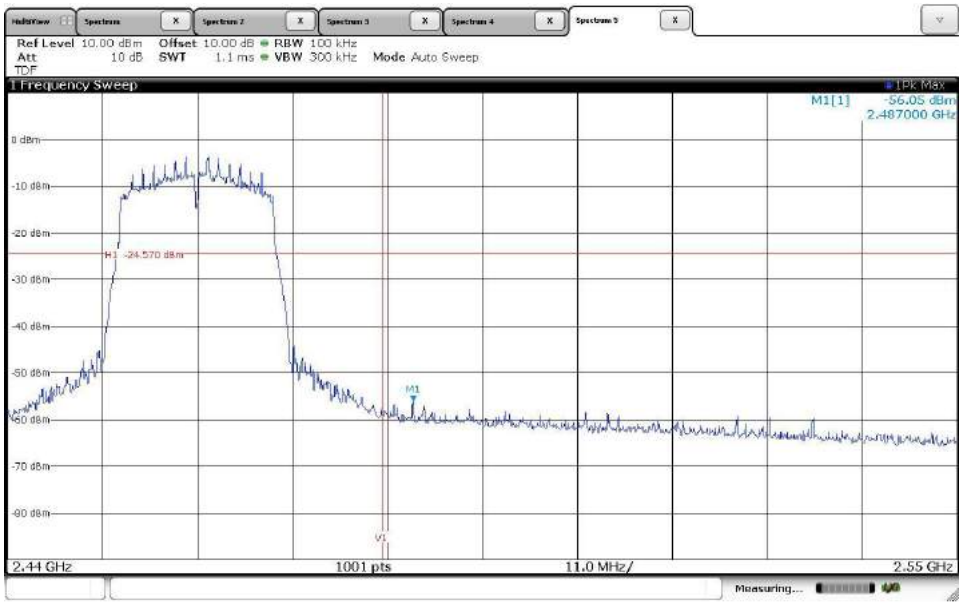


Band Edge

Lowest – 2 412 MHz

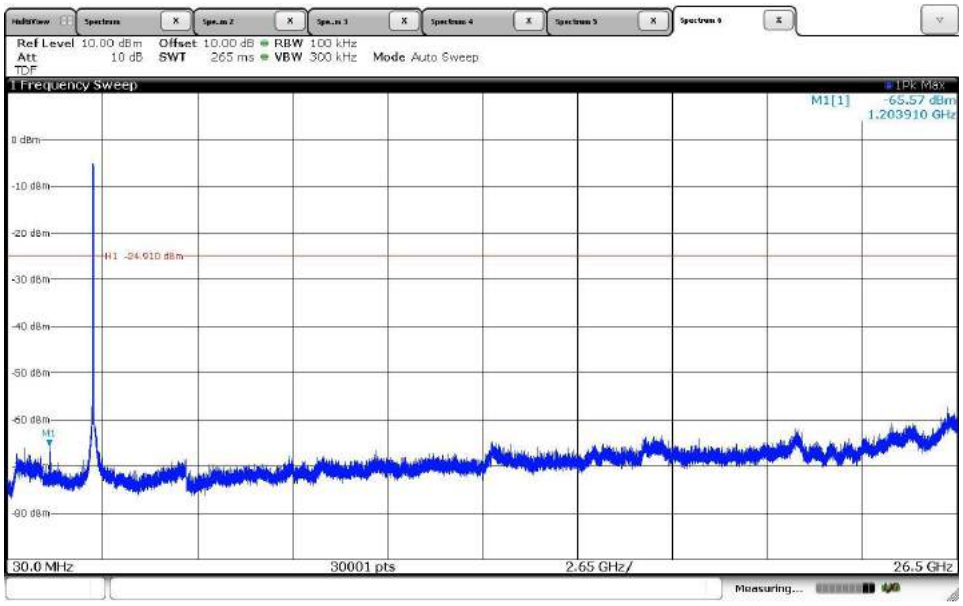


Highest – 2 462 MHz

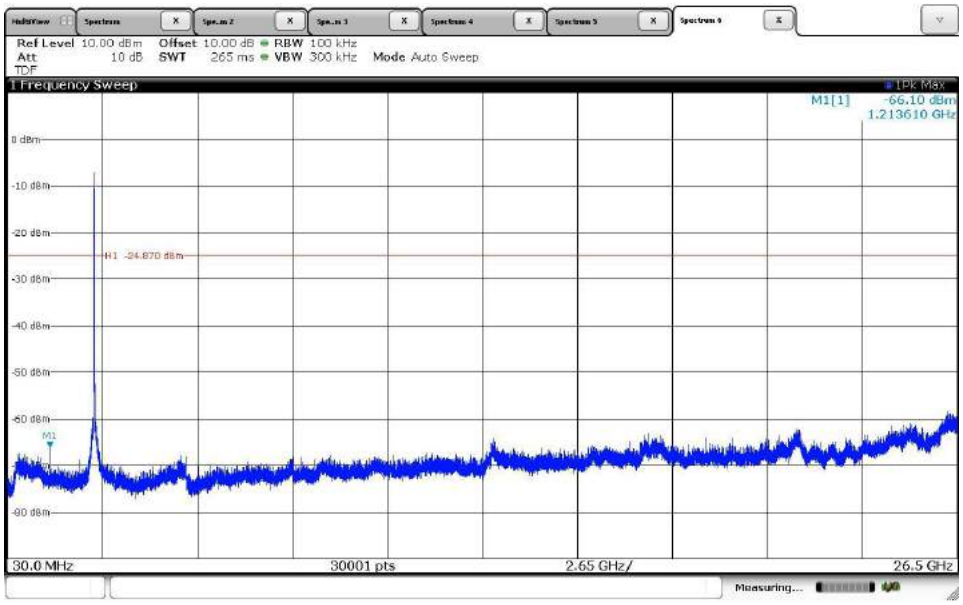


Spurious

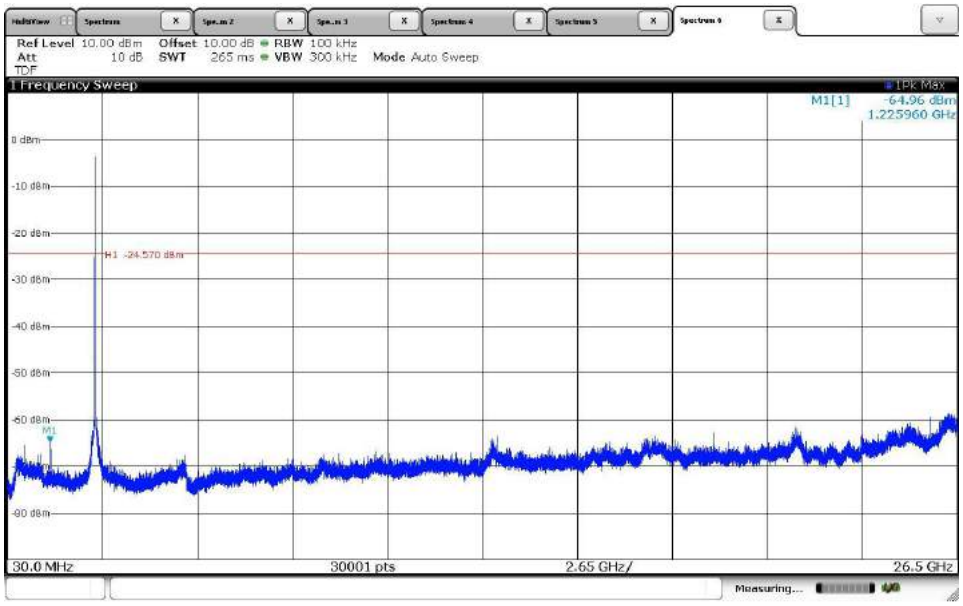
Lowest – 2 412 MHz



Middle – 2 437 MHz

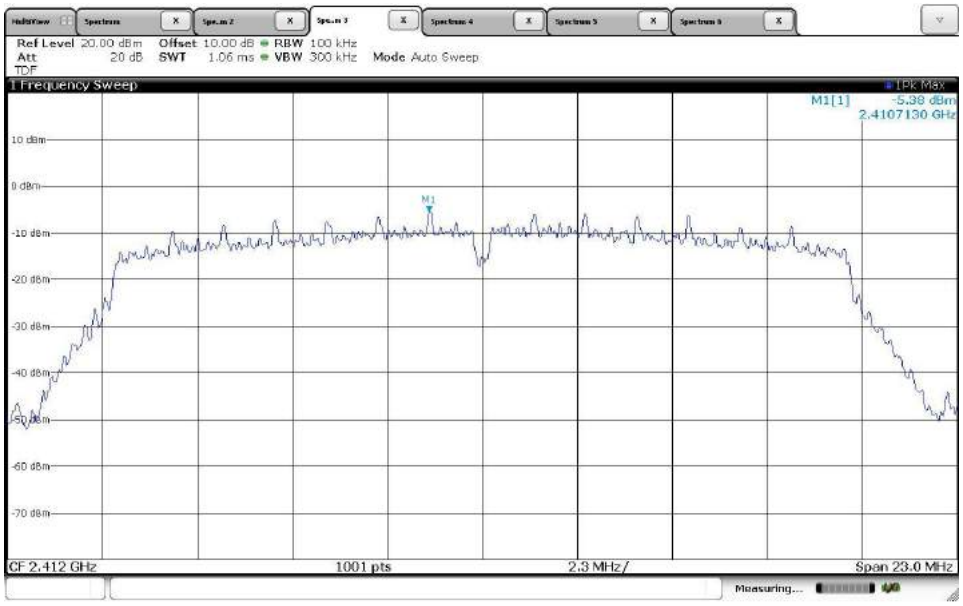


Highest – 2 462 MHz

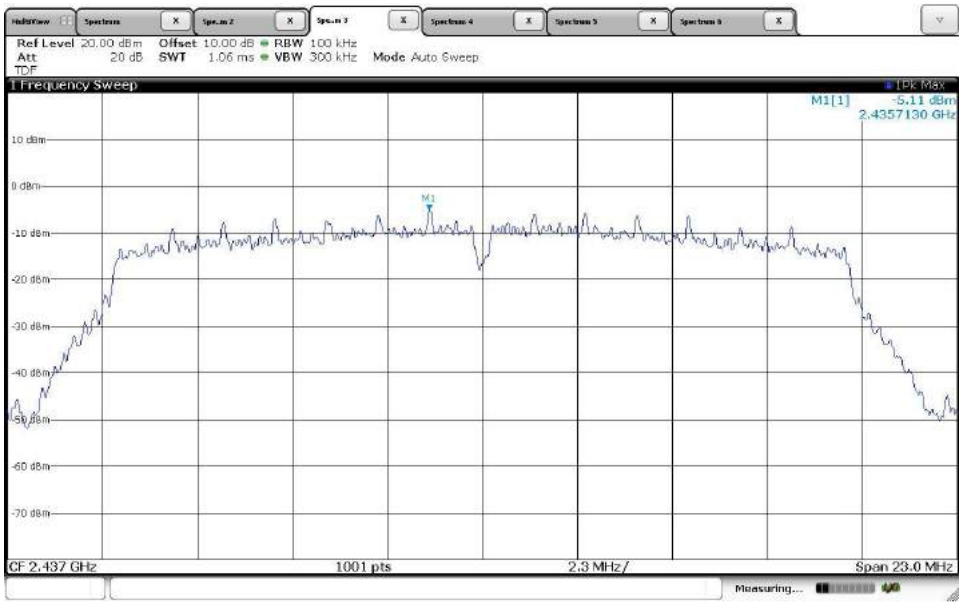


Test Mode – 802.11n(HT20)_MIMO

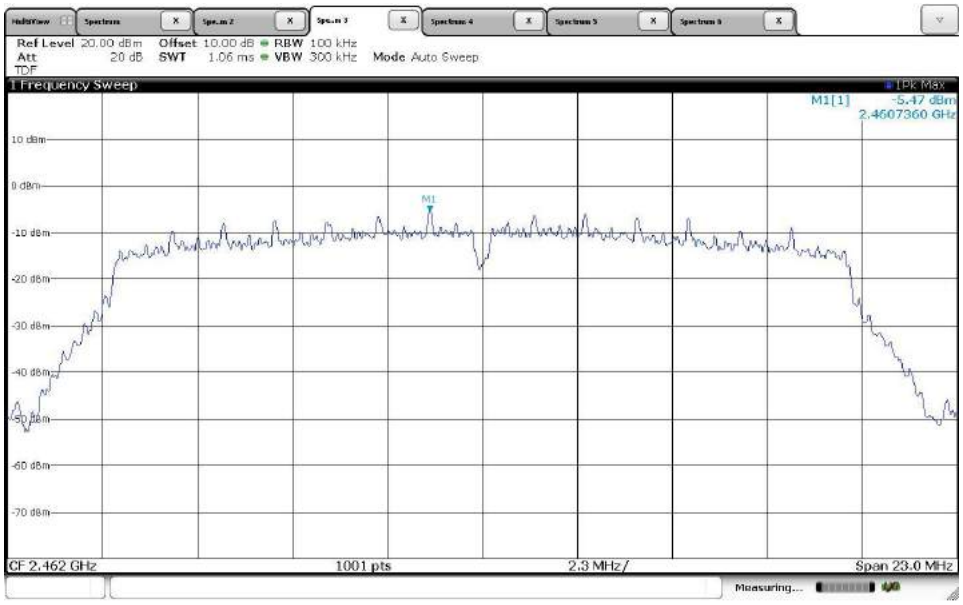
Reference Level– 2 412 MHz



Reference Level– 2 437 MHz

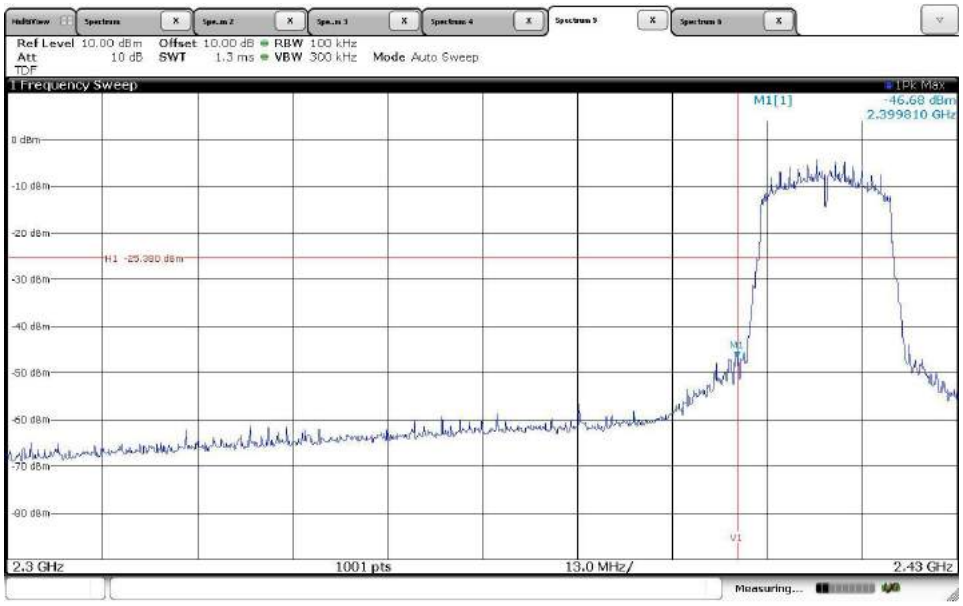


Reference Level– 2 462 MHz

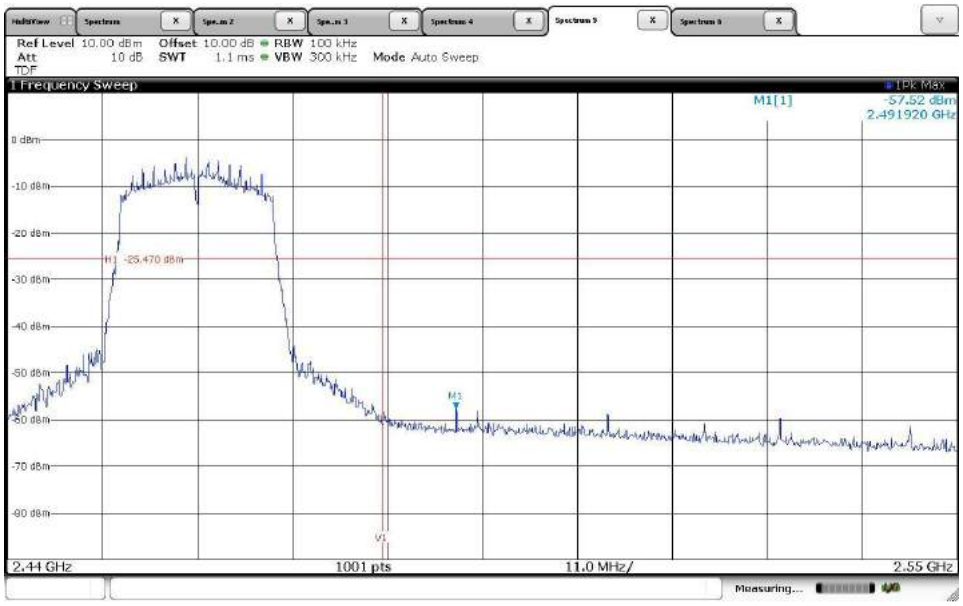


Band Edge

Lowest – 2 412 MHz

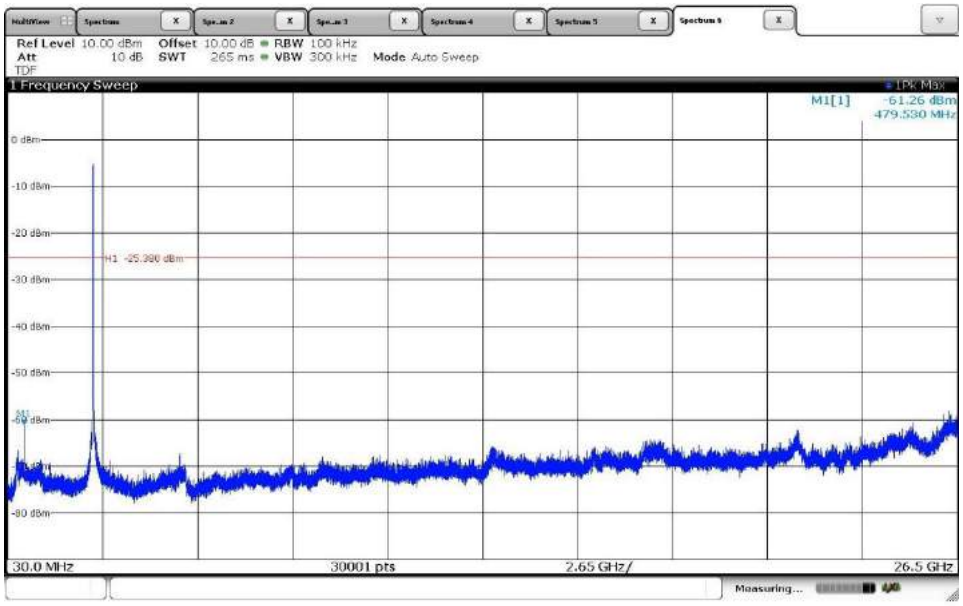


Highest – 2 462 MHz

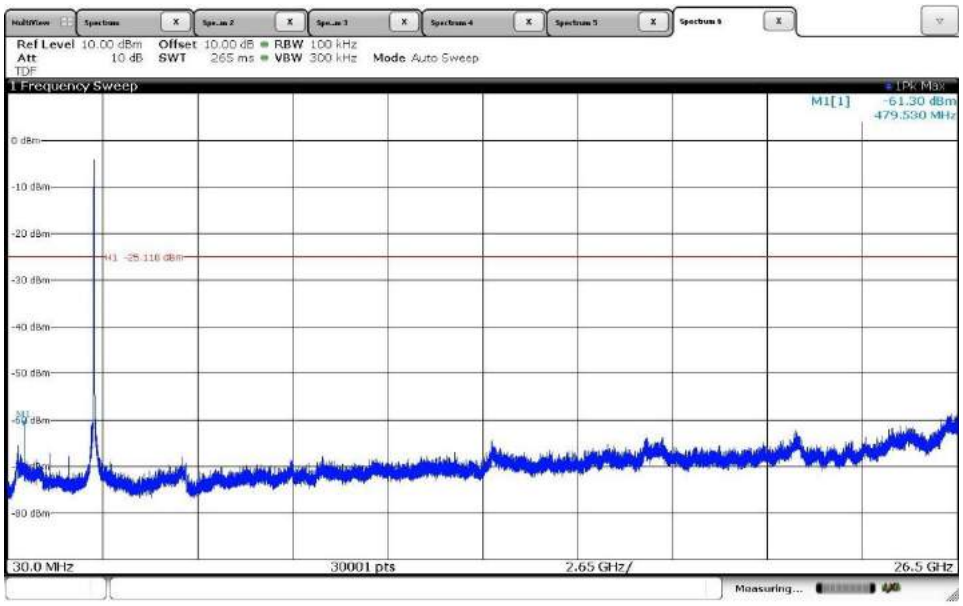


Spurious

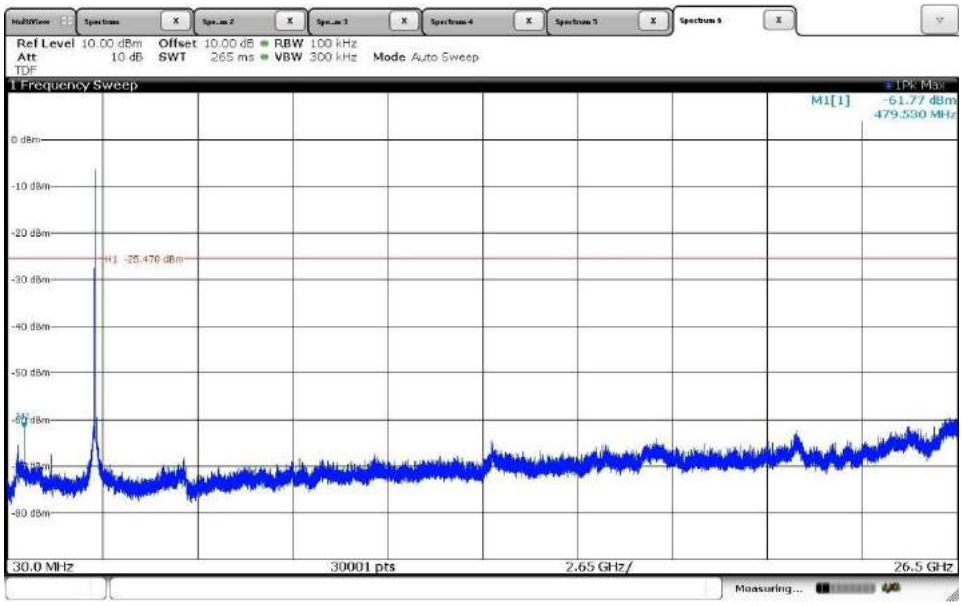
Lowest – 2 412 MHz



Middle – 2 437 MHz

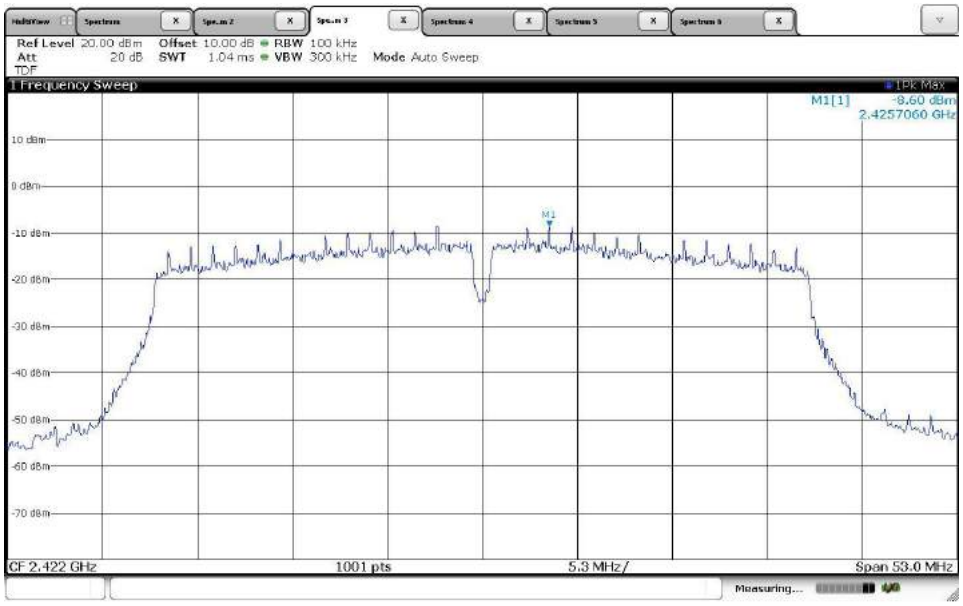


Highest – 2 462 MHz

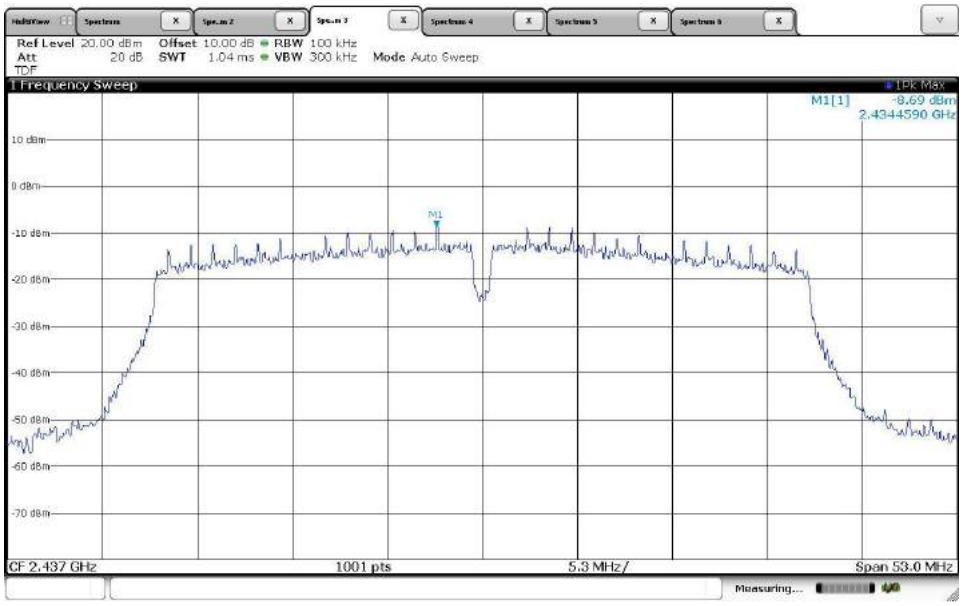


Test Mode – 802.11n(HT40)_Ant1

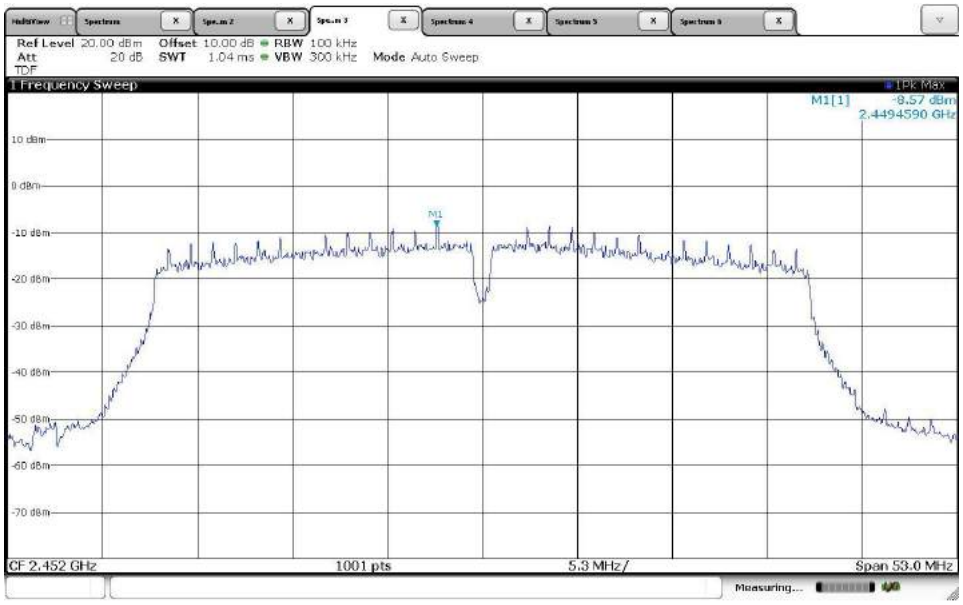
Reference Level– 2 422 MHz



Reference Level– 2 437 MHz

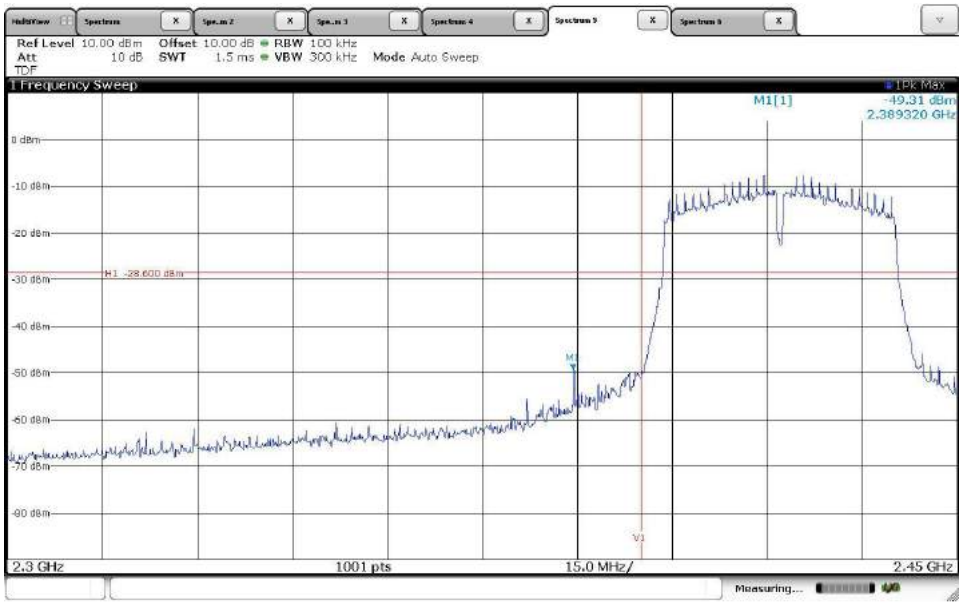


Reference Level– 2 452 MHz

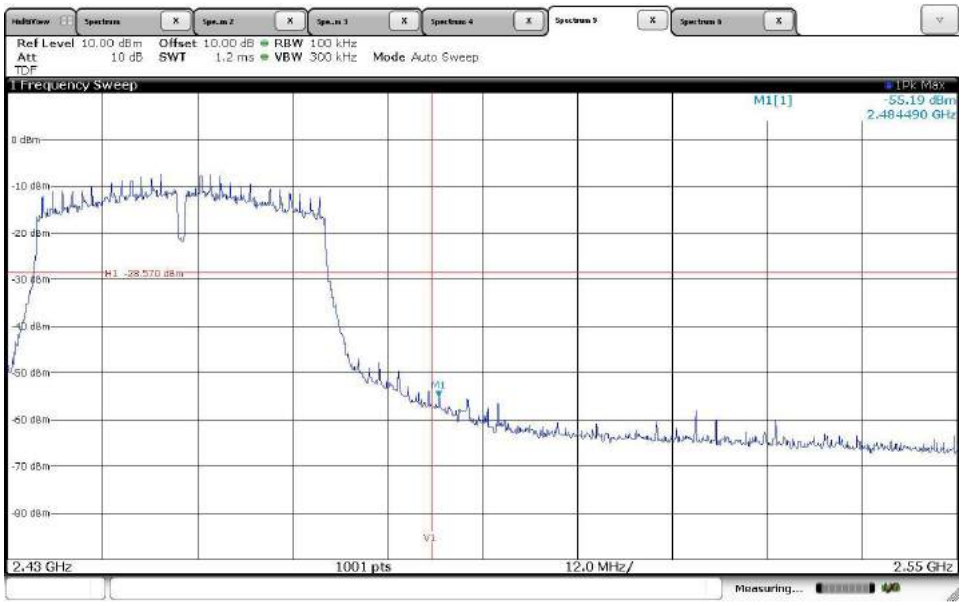


Band Edge

Lowest – 2 422 MHz

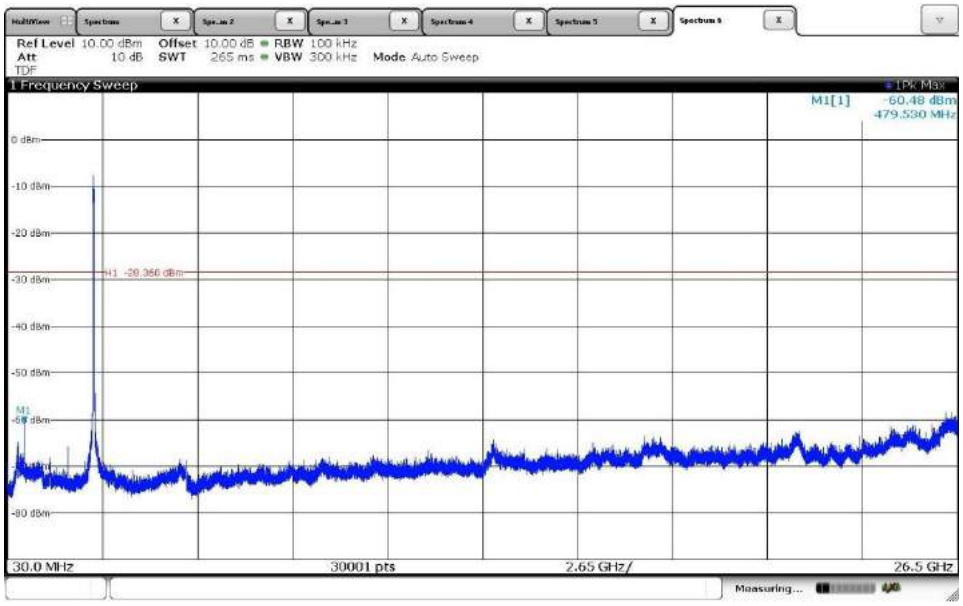


Highest – 2 452 MHz

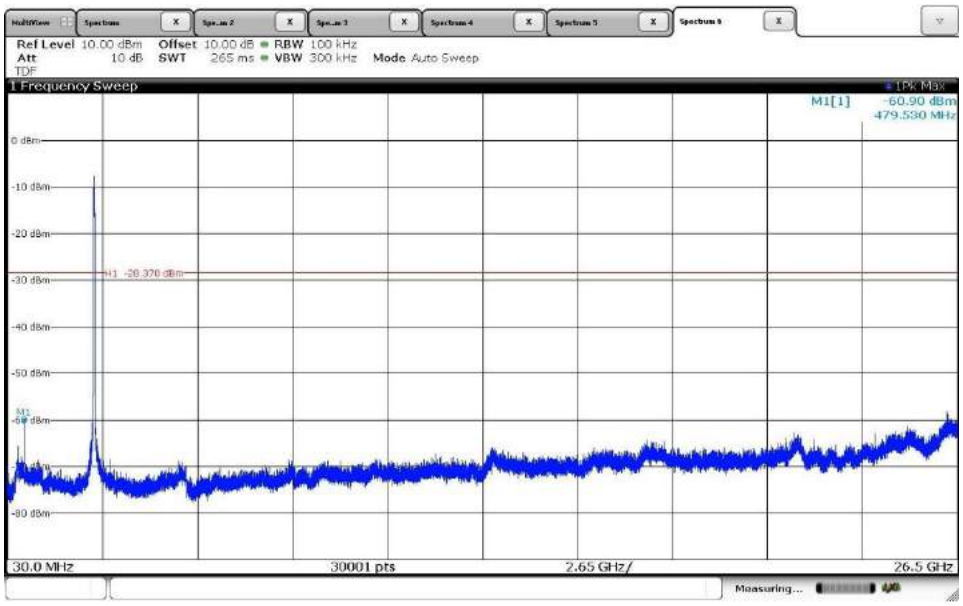


Spurious

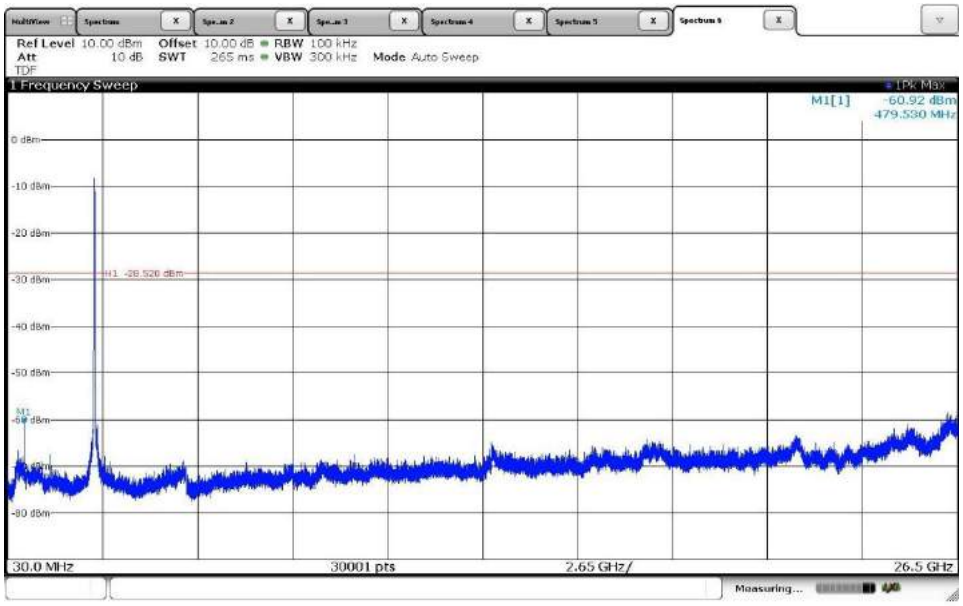
Lowest – 2 422 MHz



Middle – 2 437 MHz

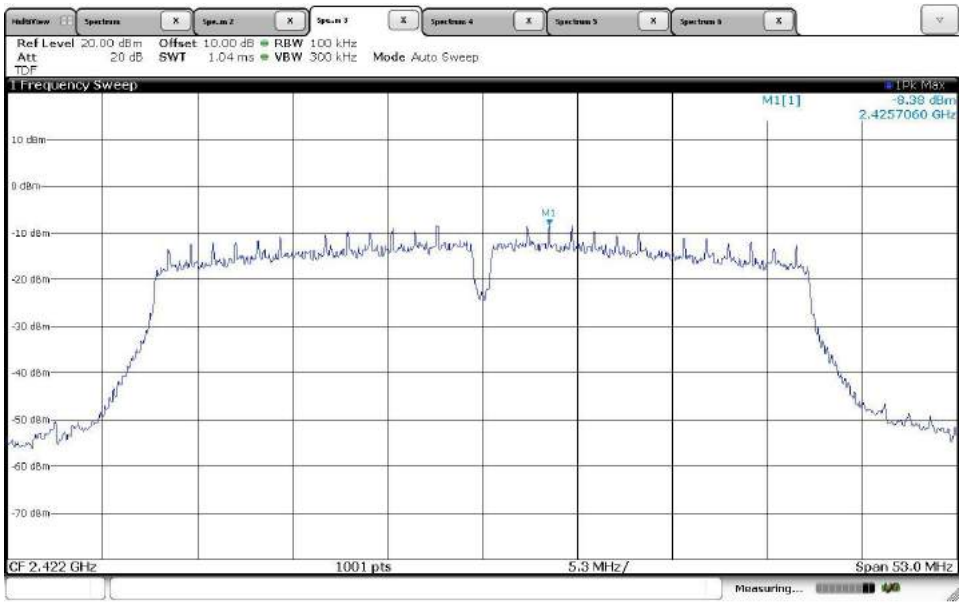


Highest – 2 452 MHz

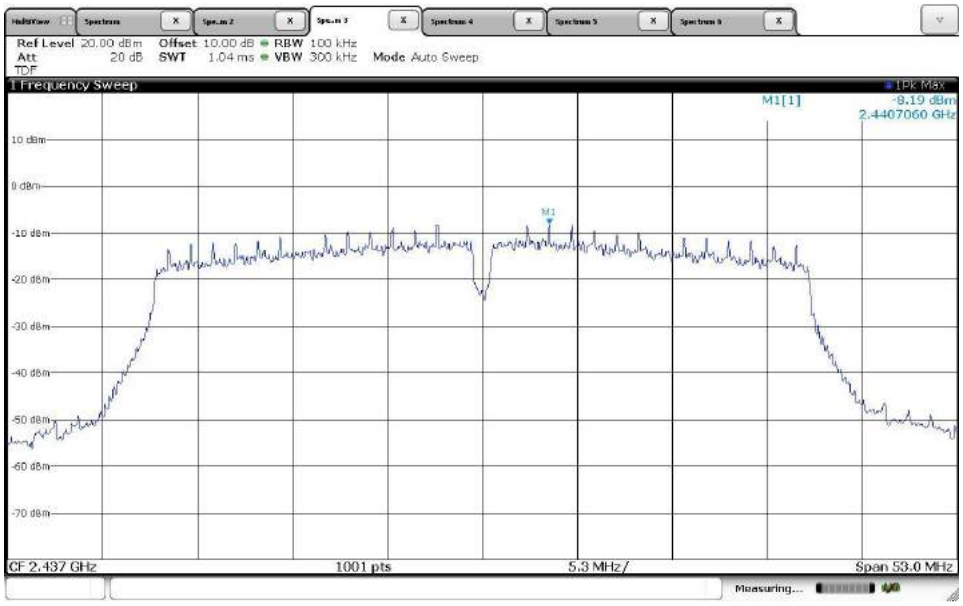


Test Mode – 802.11n(HT40)_Ant2

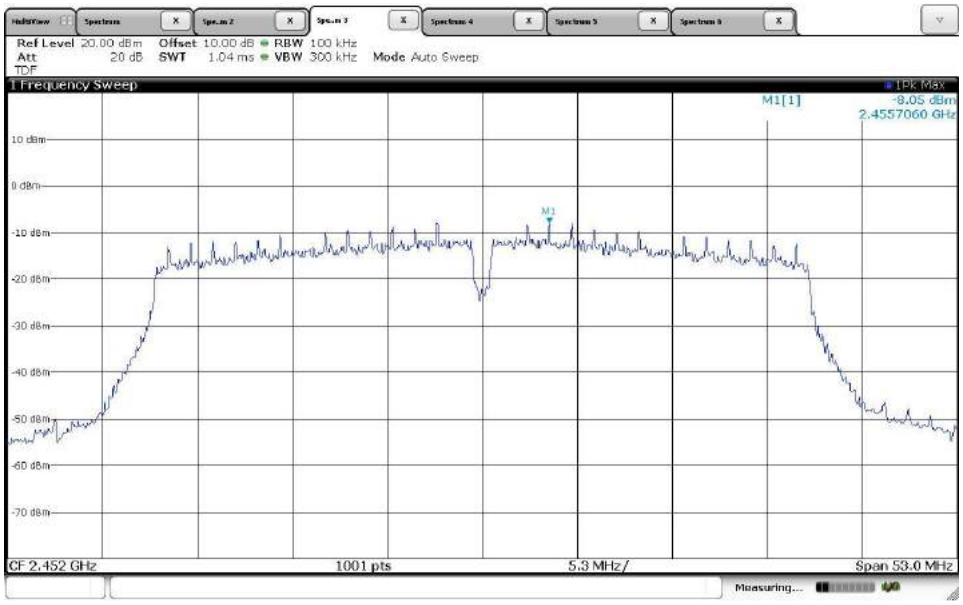
Reference Level– 2 422 MHz



Reference Level– 2 437 MHz

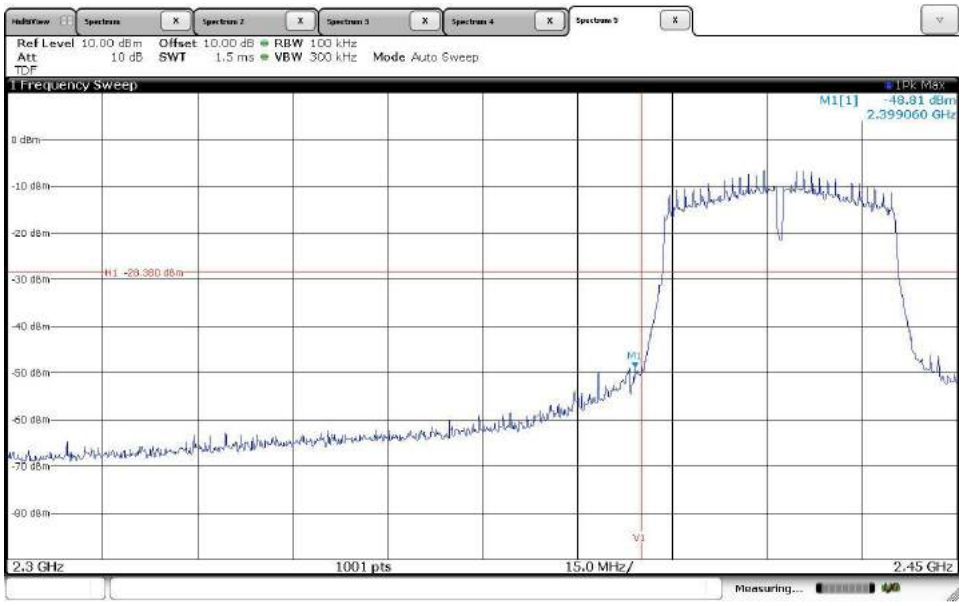


Reference Level– 2 452 MHz

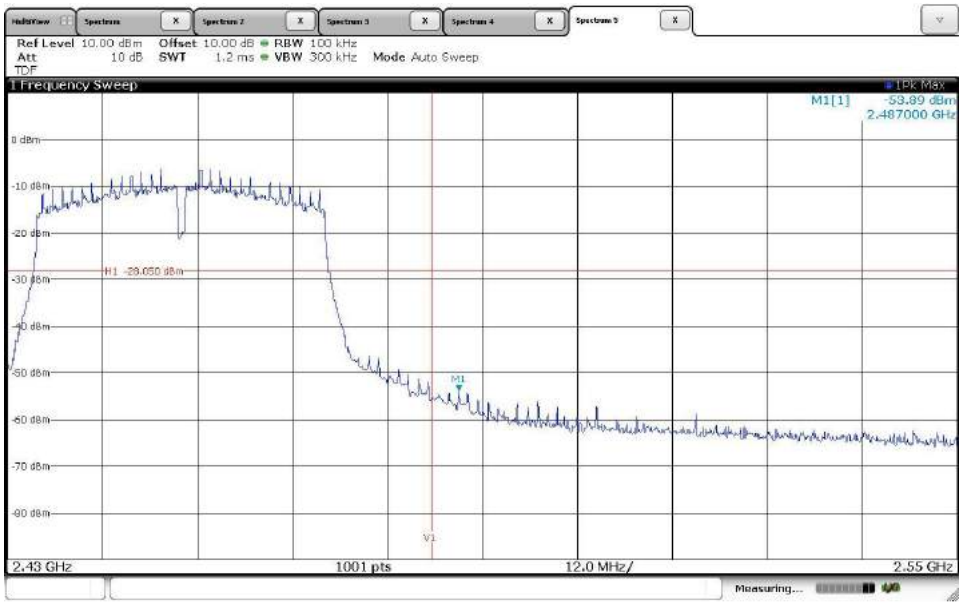


Band Edge

Lowest – 2 422 MHz

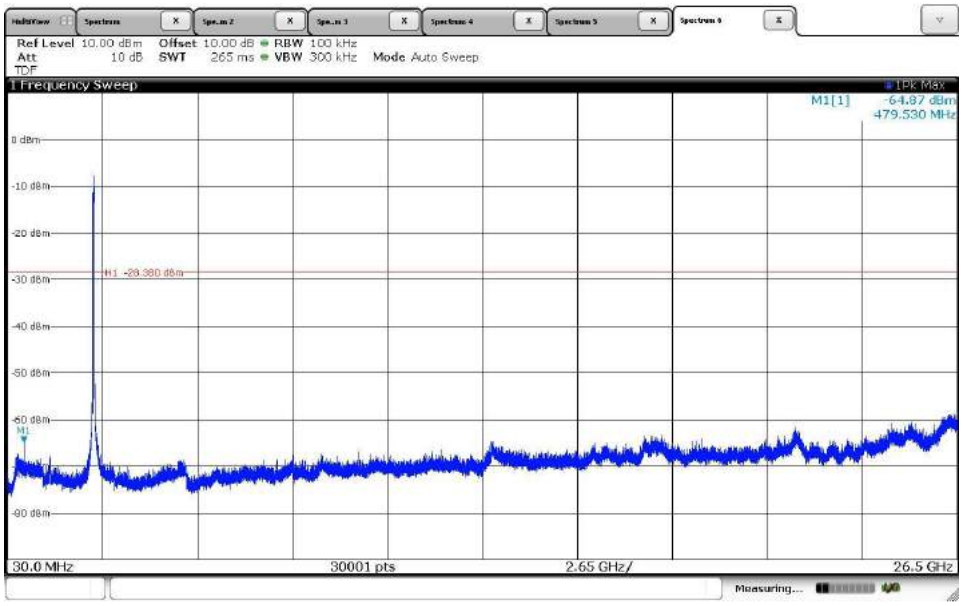


Highest – 2 452 MHz

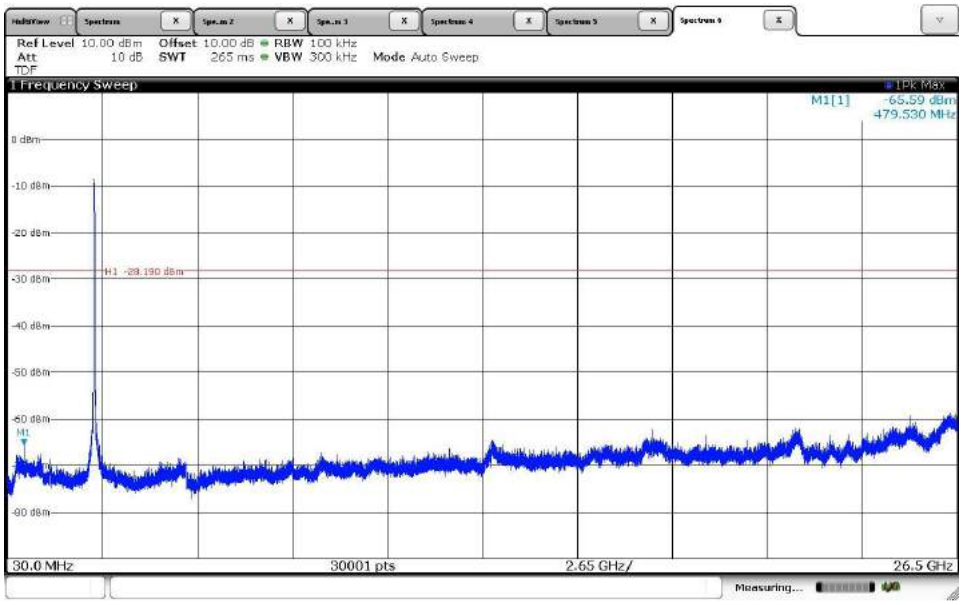


Spurious

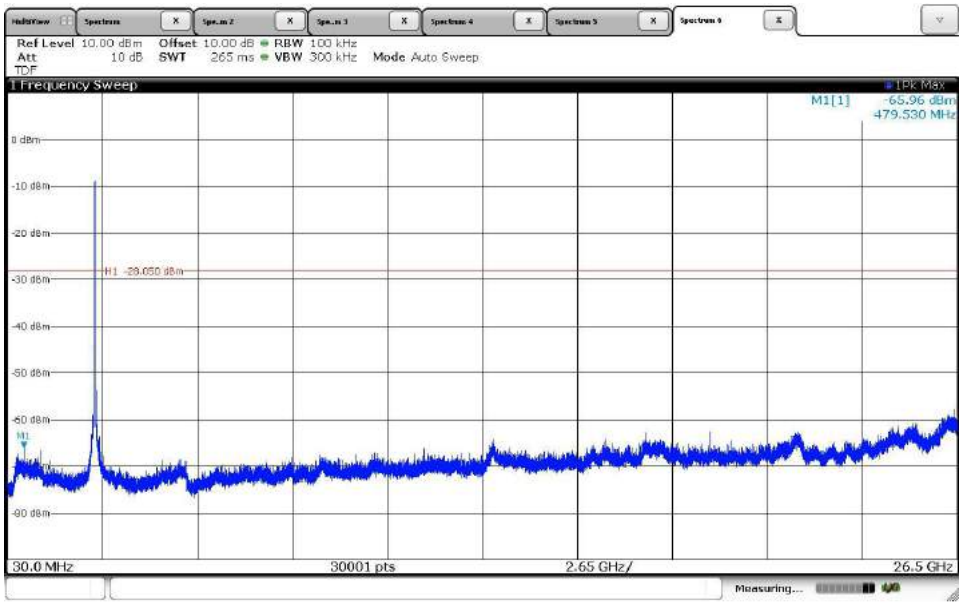
Lowest – 2 422 MHz



Middle – 2 437 MHz

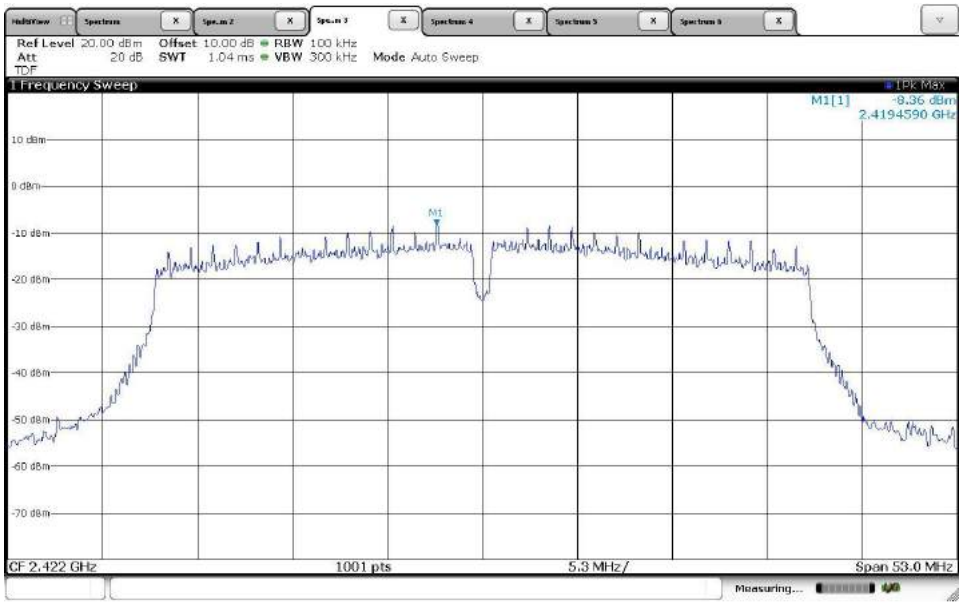


Highest – 2 452 MHz

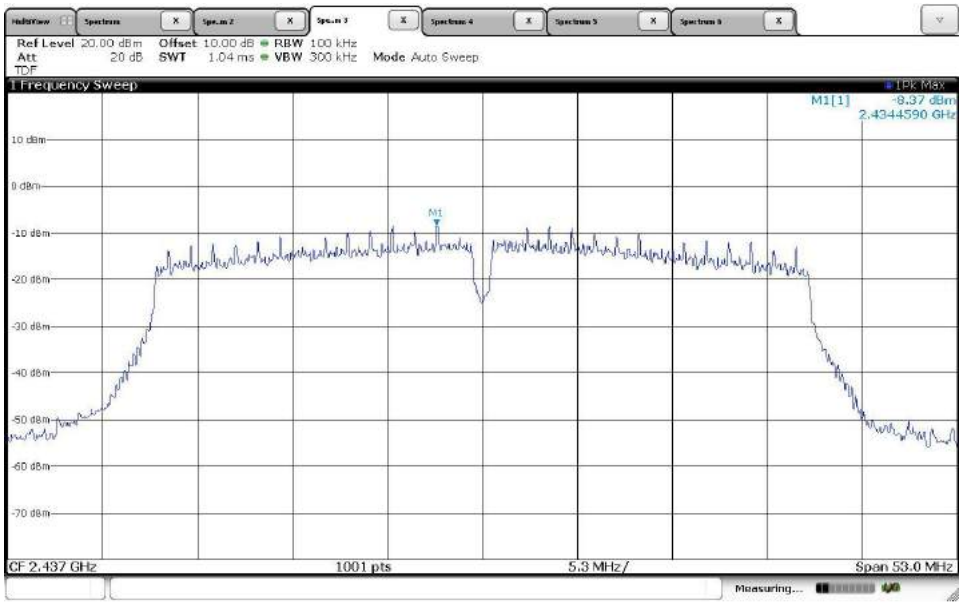


Test Mode – 802.11n(HT40)_MIMO

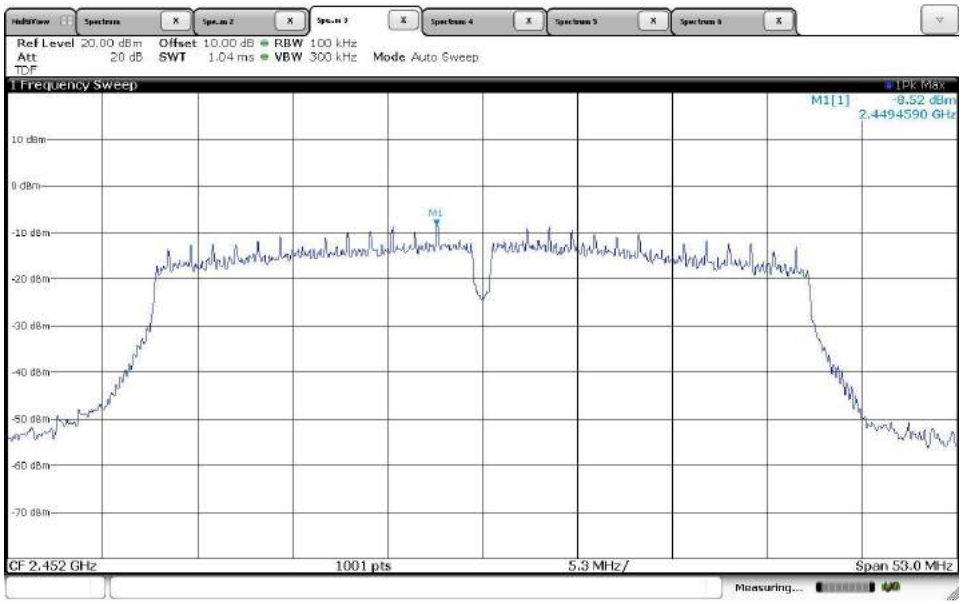
Reference Level– 2 422 MHz



Reference Level– 2 437 MHz

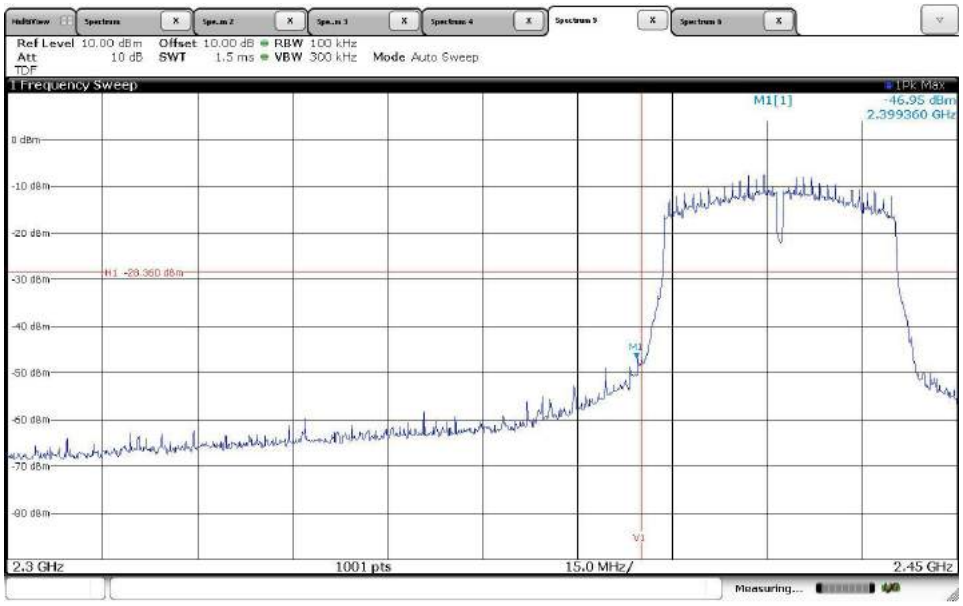


Reference Level– 2 452 MHz

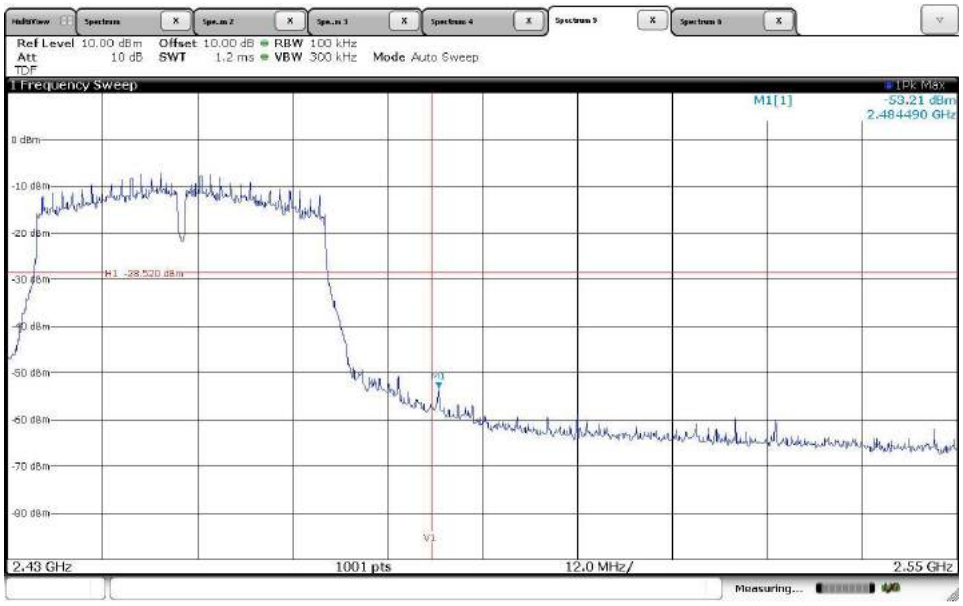


Band Edge

Lowest – 2 422 MHz

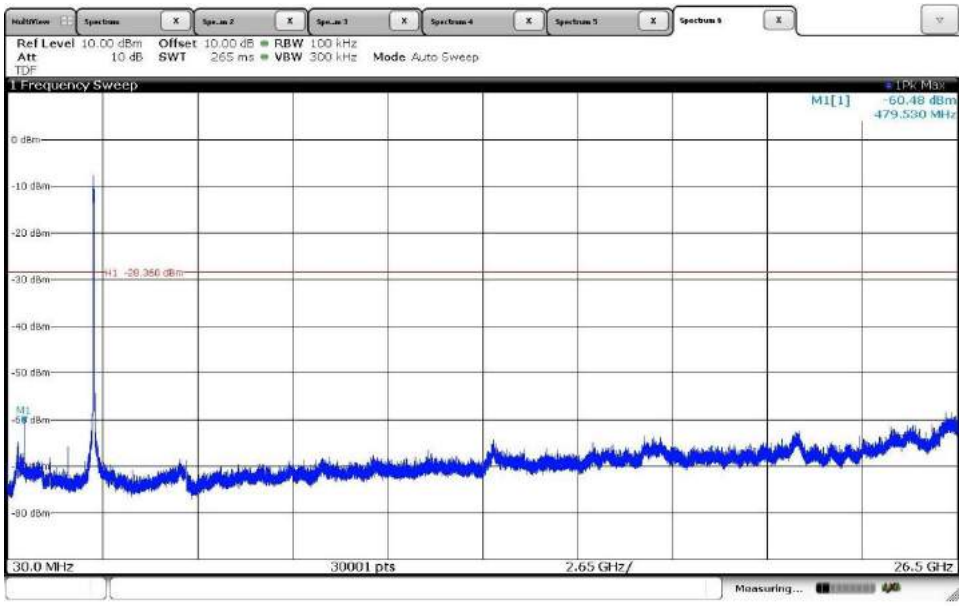


Highest – 2 452 MHz

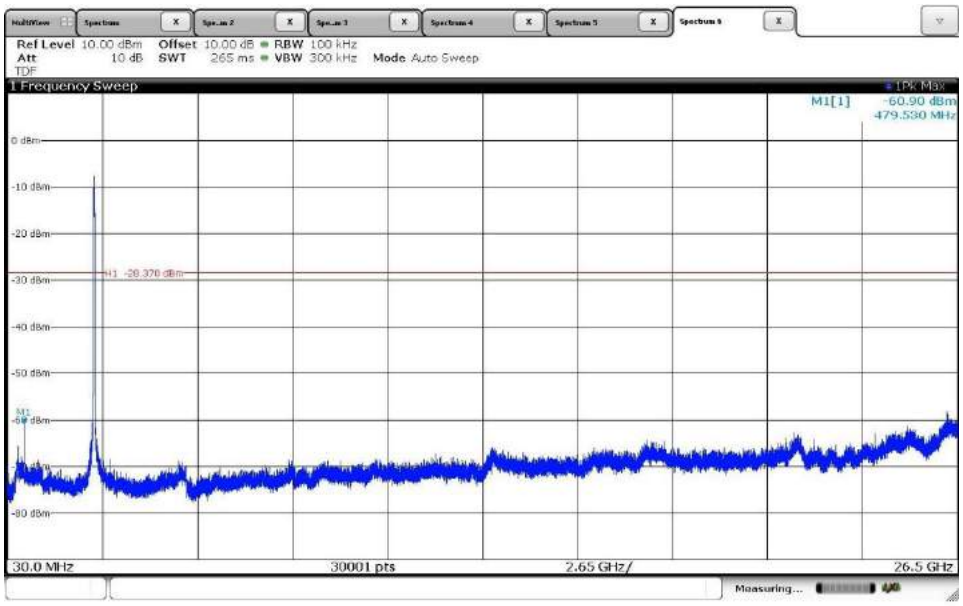


Spurious

Lowest – 2 422 MHz



Middle – 2 437 MHz



Highest – 2 452 MHz