

SGS-CSTC Standards Technical Services (Suzhou) Co., Ltd.

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Rev.: Amendment 02
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TEST REPORT

Application No.: SUCR2501000021IT
Applicant: Shanghai Sunmi Technology Co.,Ltd.
Address of Applicant: Room 505,No.388,Song Hu Road,Yang Pu District,Shanghai,China
Manufacturer: Shanghai Sunmi Technology Co.,Ltd.
Address of Manufacturer: Room 505,No.388,Song Hu Road,Yang Pu District,Shanghai,China
EUT Description: Wireless Data Terminal
Model No.: TF31B
Trade Mark: SUNMI
FCC ID: 2AH25M3L
Standards: FCC 47 CFR Part 2, Subpart J
FCC 47 CFR Part 15, Subpart C
Date of Receipt: January 9, 2025
Date of Test: January 20, 2025 to March 14, 2025
Date of Issue: May 21, 2025, Amendment 02: June 9, 2025

Test Result :	PASS *
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* In the configuration tested, the EUT detailed in this report complied with the standards specified above.

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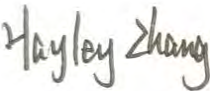


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Version

Revision Record			
Version	Description	Date	Remark
01	Original	May 21, 2025	/
02	Updated	June 9, 2025	PAG Comment
This report supersedes our previous report SUCR250100002104, issued on 2025/05/21, which is hereby deemed null and void.			

Authorized for issue by:				
Tested By				
		Hayley Zhang / Project Manager		
Approved By				
		Cloud Peng/Technical Manager		



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1 Test Summary

Test Item	FCC Rule No.	Test Method	Test Result	Result
Antenna Requirement	15.203/15.247(b)	--	Clause 3.1	PASS
AC Power Line Conducted Emission	15.207	ANSI C63.10 2013 Section 6.2	Clause 3.2	PASS
Duty Cycle	--	ANSI C63.10 2013 Section 11.6	Clause 3.3	For Report Purpose
Conducted Output Power	15.247 (b)(3)	ANSI C63.10 2013 Section 11.9.1.3	Clause 3.4	PASS
DTS (6 dB) Bandwidth & 99% Occupied Bandwidth	15.247 (a)(2)	ANSI C63.10 2013 Section 11.8 Option 2 / 6.9.3	Clause 3.5	PASS
Power Spectral Density	15.247 (e)	ANSI C63.10 2013 Section 11.10.2	Clause 3.6	PASS
Band-edge for RF Conducted Emissions	15.247(d)	ANSI C63.10 2013 Section 11.11	Clause 3.7	PASS
RF Conducted Spurious Emissions	15.247(d)	ANSI C63.10 2013 Section 11.11	Clause 3.8	PASS
Radiated Spurious Emissions	15.247(d);15.205/15.209	ANSI C63.10 2013 Section 11.12	Clause 3.9	PASS
Restricted bands around fundamental frequency (Radiated Emission)	15.247(d);15.205/15.209	ANSI C63.10 2013 Section 11.12	Clause 3.10	PASS



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2 General Information

2.1 Details of Client

Applicant:	Shanghai Sunmi Technology Co.,Ltd.
Address of Applicant:	Room 505,No.388,Song Hu Road,Yang Pu District,Shanghai,China
Manufacturer:	Shanghai Sunmi Technology Co.,Ltd.
Address of Manufacturer:	Room 505,No.388,Song Hu Road,Yang Pu District,Shanghai,China

2.2 Test Location

Company:	SGS-CSTC Standards Technical Services (Suzhou) Co., Ltd.
Address:	South of No. 6 Plant, No. 1, Runsheng Road, Suzhou Industrial Park, Suzhou Area, China (Jiangsu) Pilot Free Trade Zone
Post code:	215000
Test engineer:	Ives Cheng, King-p Li

2.3 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **A2LA (Certificate No. 6336.01)**

SGS-CSTC STANDARDS TECHNICAL SERVICES (SUZHOU) CO., LTD. is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 6336.01.

- **Innovation, Science and Economic Development Canada**

SGS-CSTC STANDARDS TECHNICAL SERVICES (SUZHOU) CO., LTD. has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0120.

IC#: 27594.

- **FCC –Designation Number: CN1312**

SGS-CSTC STANDARDS TECHNICAL SERVICES (SUZHOU) CO., LTD. has been recognized as an accredited testing laboratory.

Designation Number: CN1312.

Test Firm Registration Number: 717327



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2.4 General Description of EUT

EUT Description:	Wireless Data Terminal		
Model No.:	TF31B		
Trade Mark:	SUNMI		
Hardware Version:	V1.2		
Software Version:	T602AA_EVT_14.0_SUNMI_202503131820.00-00		
Power Supply:	3.87V from battery		
Operation Frequency:	802.11b/g/n(HT20)/ax(HE20):		2412MHz to 2462MHz
Modulation Type:	802.11b:	DSSS (DBPSK, DQPSK, CCK)	
	802.11g/n:	OFDM (BPSK, QPSK, 16QAM, 64QAM)	
	802.11ax:	OFDM/OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)	
Number of Channels:	802.11b/g/n(HT20)/ax(HE20): 11		
Channel Spacing:	5MHz		
Smart System:	☒ SISO	802.11b/g	
	☒ MIMO	802.11n/ax: 2Tx & 2Rx	
Antenna Type:	FPC Antenna		
Antenna Gain:	3.1dBi(Ant3); -1.74dBi(Ant2)		
	Note: The antenna gain are derived from the gain information report provided by the manufacturer.		
RF Cable:	1dB		
Remark: 1.As above information is provided and confirmed by the applicant. SGS is not liable to the accuracy, suitability, reliability or/and integrity of the information. 2.The device does not support 802.11ax OFDMA Partial RU tones (26T, 52T, 106T, etc.)			



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Operation Frequency of each channel (802.11b/g/n HT20 /ax HE20)							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2412MHz	4	2427MHz	7	2442MHz	10	2457MHz
2	2417MHz	5	2432MHz	8	2447MHz	11	2462MHz
3	2422MHz	6	2437MHz	9	2452MHz		
Remark: In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:							
Channel		Frequency for 802.11 b/g/n (HT20) /ax (HE20)					
The Lowest channel		2412MHz					
The Middle channel		2437MHz					
The Highest channel		2462MHz					



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2.5 Test Environment and Mode

Environment Parameter	101 kPa Selected Values During Tests	
Relative Humidity	44-46 % RH Ambient	
Value	Temperature(°C)	Voltage(V)
NTNV	22~23	3.87
Remark: NV: Normal Voltage NT: Normal Temperature		

2.6 Description of Support Units

The EUT has been tested as an independent unit.

2.7 Worst-case configuration and mode

Low data rate was used to test on antenna port conducted tests and radiated spurious emissions since it has the highest maximum power. Following are the worst-case data rates set for test:

Modulation Type	SISO - Data Rate	CDD/MIMO - Data Rate
802.11b	1 Mbps	/
802.11g	6 Mbps	/
802.11n (HT 20)	/	MCS0 (13 Mbps)
802.11ax (HE 20)	/	MCS0 (16 Mbps)



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3 Equipment List

RF Test Equipment					
Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. date (yyyy/mm/dd)	Cal.Due date (yyyy/mm/dd)
Shielding Room	Brilliant-emc	N/A	SUWI-04-08-01	2022/11/09	2025/11/08
Temperature and humidity meter	MingGao	TH101B	SUWI-01-01-07	2024/02/18	2025/02/17
				2025/02/13	2026/02/12
Measurement Software	Tonscend	TST272 V2.0	SUWI-03-55-03	NCR	NCR
Signal Analyzer	ROHDE&SCHWARZ	FSW43	SUWI-01-02-04	2024/05/08	2025/05/07
Temperature Chamber	ESPEC	SU-242	SUWI-01-13-02	2024/05/09	2025/05/08
Wideband Radio Communication Tester	ROHDE&SCHWARZ	CMW500	SUWI-01-16-05	2024/02/04	2025/02/03
				2025/01/21	2026/01/20
DC Power Supply	HYELEC	HY3005B	SUWI-01-18-01	2024/02/04	2025/02/03
				2025/01/15	2026/01/14
Power meter	Anritsu	ML2495A	SUWI-01-31-01	2024/11/19	2025/11/18
Pulse power sensor	Anritsu	MA2411B	SUWI-01-32-01	2024/11/19	2025/11/18
MXG Vector signal genitor	KEYSIGHT	N5182B	SUWI-01-38-01	2024/02/04	2025/02/03
				2025/01/15	2026/01/14
Router	ASUS	GT-AXE11000(FCC ID MSQ-RTAXJF00)	SUWI-03-14-02	NCR	NCR
Signal Analyzer	KEYSIGHT	N9020A	SUWI-01-02-07	2024/11/19	2025/11/18

CE Test System					
Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. date (yyyy/mm/dd)	Cal.Due date (yyyy/mm/dd)
Test receiver	ROHDE&SCHWARZ	ESR7	SUWI-01-10-01	2025/01/15	2026/01/14
Temperature and humidity meter*	MingGao	TH101B	SUWI-01-01-06	2025/02/13	2026/02/12
Artificial network	ROHDE&SCHWARZ	ENV216	SUWI-01-19-03	2024/05/06	2025/05/05
Artificial network	ROHDE&SCHWARZ	ENV216	SUWI-01-19-04	2024/05/06	2025/05/05
Measurement Software	Tonscend	JS32-CE 4.0.0.2	SUWI-02-09-05	NCR	NCR

*Note:The CE was tested from 2025/02/20 to 2025/02/26.



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9*6*6 Test Equipment					
Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. date (yyyy/mm/dd)	Cal.Due date (yyyy/mm/dd)
Semi-Anechoic Chamber	Brilliant-emc	N/A	SUWI-04-02-01	2023/06/03	2026/06/02
Temperature and humidity meter*	MingGao	TH101B	SUWI-01-01-05	2025/02/13	2026/02/12
Signal Analyzer	ROHDE &SCHWARZ	FSW43	SUWI-01-02-04	2024/05/08	2025/05/07
Signal Analyzer	KEYSIGHT	N9020A	SUWI-01-02-07	2024/11/21	2025/11/20
Test receiver*	ROHDE &SCHWARZ	ESR7	SUWI-01-10-01	2025/01/15	2026/01/14
Receiving antenna	SCHWRZBECK MESS-ELEKTRONIK	VULB 9168	SUWI-01-11-04	2023/11/25	2025/11/24
Receiving antenna	SCHWRZBECK MESS-ELEKTRONIK	BBHA 9120D	SUWI-01-11-02	2023/05/13	2025/05/12
Receiving antenna	SCHWRZBECK MESS-ELEKTRONIK	BBHA 9170	SUWI-01-11-03	2023/05/12	2025/05/11
Active Loop Antenna	SCHWRZBECK MESS-ELEKTRONIK	FMZB 1519B	SUWI-01-21-01	2023/05/13	2025/05/12
Amplifier*	Tonscend	TAP9K3G40	SUWI-01-14-01	2025/01/16	2026/01/15
Amplifier*	Tonscend	TAP01018050	SUWI-01-14-02	2025/01/16	2026/01/15
Amplifier*	Tonscend	TAP18040048	SUWI-01-14-03	2025/01/20	2026/01/19
Measurement Software	Tonscend	JS32-RE V4.0.0.0	SUWI-02-09-04	NCR	NCR

*Note:The RSE was tested from 2025/02/20 to 2025/02/26.

Remark: NCR=No Calibration Requirement.



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4 Measurement Uncertainty (95% confidence levels, k=2)

No.	Item	Measurement Uncertainty
1	Total RF power, conducted	±0.54dB
2	RF power density, conducted	±1.03dB
3	Spurious emissions, conducted	±0.54dB
4	Radio Frequency	1%
5	Duty Cycle	±0.37%
6	Occupied Bandwidth	1%
7	Conduction Emission	± 2.90dB (150kHz to 30MHz)
8	Radiated Emission	± 3.13dB (9k -30MHz)
		± 4.8dB (30M -1GHz)
		± 4.8dB (1GHz to 18GHz)
		± 4.80dB (Above 18GHz)
Remark: The U _{lab} (lab Uncertainty) is less than U _{cispr/ETSI} (CISPR/ETSI Uncertainty), so the test results – compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit; – non-compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit.		



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5 Test results and Measurement Data

5.1 Antenna Requirement

Standard requirement:	47 CFR Part 15C Section 15.203 /247(b)
15.203 requirement: 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, 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. 15.247(b) (4) requirement: 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.	
The antenna is FPC Antenna and no consideration of replacement. The best case gain of the antenna is 3.1dBi(Ant3); -1.74dBi(Ant2).	
<i>Note:</i> <i>The antenna gain are derived from the gain information report provided by the manufacturer.</i> <i>Remark:</i> <i>As above information is provided and confirmed by the applicant. SGS is not liable to the accuracy, suitability, reliability or/and integrity of the information.</i>	



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Cyclic Delay Diversity (CDD) System:

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

If all antennas have the same gain, G_{ANT} , Directional gain = G_{ANT} + Array Gain, where Array Gain is as follows.

- For power spectral density (PSD) measurements on all devices,
 $Array\ Gain = 10 \log(N_{ANT}/N_{SS} = 1) \text{ dB}$.
- For power measurements on IEEE 802.11 devices:
 $Array\ Gain = 0 \text{ dB}$ (i.e., no array gain) for $N_{ANT} \leq 4$;

For power, the directional gain may be calculated by using the formulas applicable to equal gain antennas with G_{ANT} set equal to the gain of the antenna having the highest gain.

For PSD, the directional gain calculation is following F2)f)ii) of KDB 662911 D01 v02r01.

The Power and PSD limit should be modified if the directional gain of eut is over 6dbi.

The EUT supports CDD System.

All antennas have the Unequal antenna gain:

ANT Gain0 (dBi)	ANT Gain1 (dBi)	Power DG (dBi)	PSD DG (dBi)	Power Limit Reduction(dB)	PSD Limit Reduction(dB)
3.1	-1.74	3.1	4.02	0	0

Power Limit Reduction = Directional gain – 6dBi, (Directional gain < 6dBi) =0

PSD Limit Reduction = Directional gain – 6dBi, (Directional gain < 6dBi) =0



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5.2 AC Power Line Conducted Emissions

Test Requirement:	47 CFR Part 15C Section 15.207		
Test Method:	ANSI C63.10: 2013 Section 6.2		
Test Frequency Range:	150kHz to 30MHz		
Receiver Setup:	RBW = 9kHz, VBW = 30kHz		
Limit:	Frequency range (MHz)	Limit (dBuV)	
		Quasi-peak	Average
	0.15-0.5	66 to 56*	56 to 46*
	0.5-5	56	46
	5-30	60	50
* Decreases with the logarithm of the frequency.			
Test Procedure:	1) The mains terminal disturbance voltage test was conducted in a shielded room. 2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a $50\Omega/50\mu\text{H} + 5\Omega$ linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded. 3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane, 4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10: 2013 on conducted measurement.		

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Test Setup:	
Test Mode:	BT Link + WIFI 2.4G Link + WIFI 5G/6E Link
Instruments Used:	Refer to section 6 for details.
Test Results:	Pass



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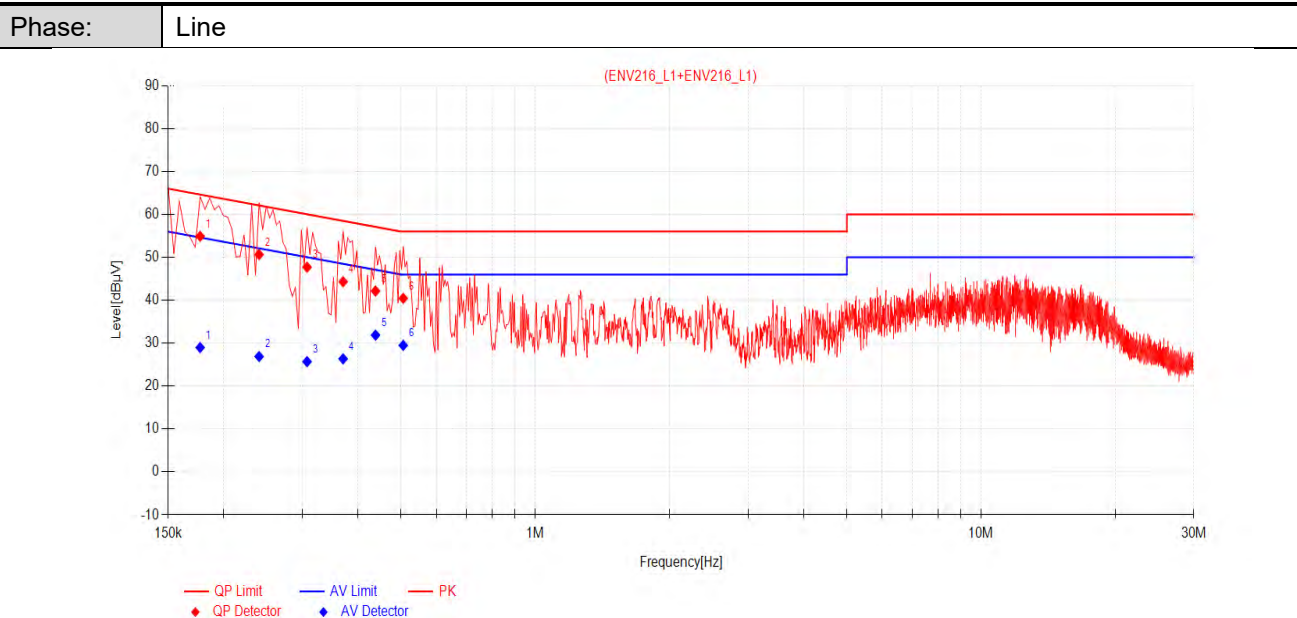
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Measurement Data

An initial pre-scan was performed on the live and neutral lines with peak detector.

Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

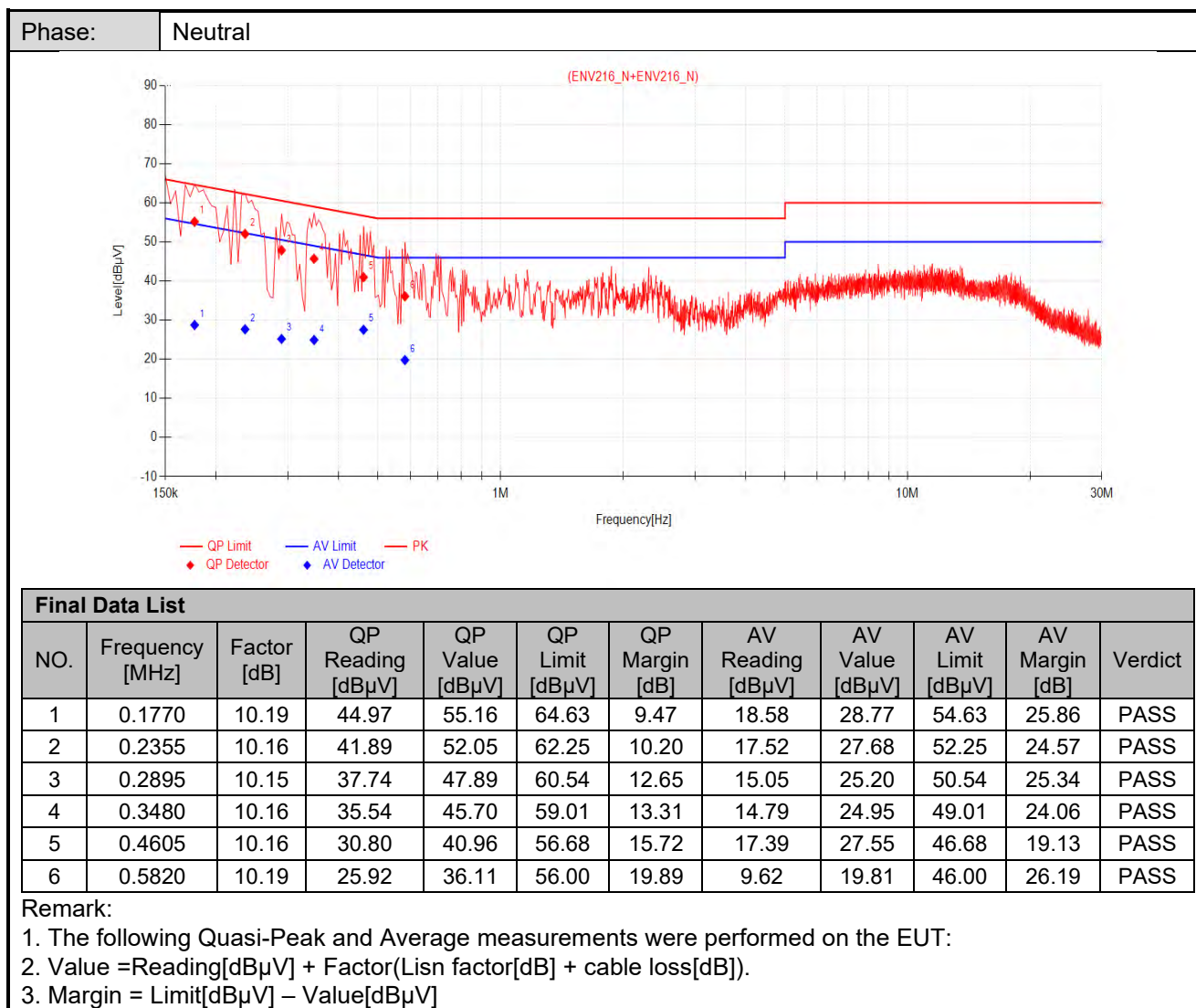


Final Data List

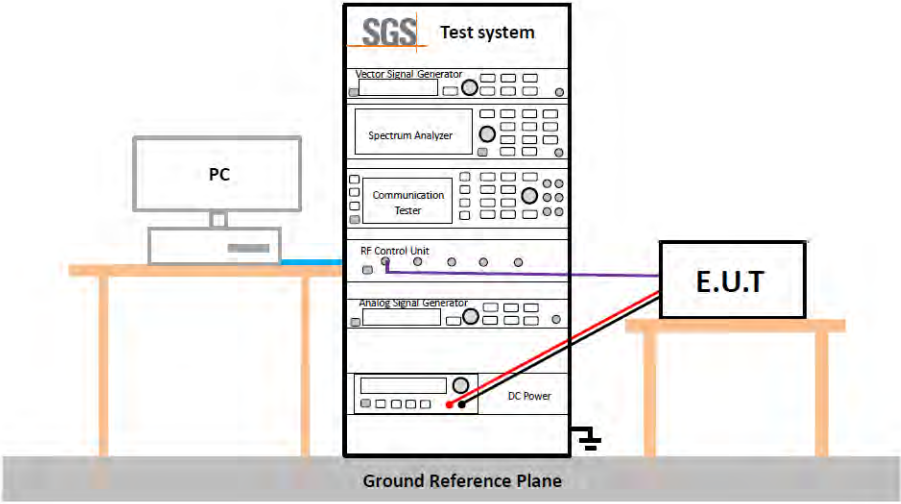
NO.	Frequency [MHz]	Factor [dB]	QP Reading [dBμV]	QP Value [dBμV]	QP Limit [dBμV]	QP Margin [dB]	AV Reading [dBμV]	AV Value [dBμV]	AV Limit [dBμV]	AV Margin [dB]	Verdict
1	0.1770	10.19	44.72	54.91	64.63	9.72	18.79	28.98	54.63	25.65	PASS
2	0.2400	10.16	40.48	50.64	62.10	11.46	16.73	26.89	52.10	25.21	PASS
3	0.3075	10.16	37.54	47.70	60.04	12.34	15.54	25.70	50.04	24.34	PASS
4	0.3705	10.16	34.16	44.32	58.49	14.17	16.19	26.35	48.49	22.14	PASS
5	0.4380	10.17	31.98	42.15	57.10	14.95	21.71	31.88	47.10	15.22	PASS
6	0.5055	10.18	30.28	40.46	56.00	15.54	19.31	29.49	46.00	16.51	PASS

Remark:

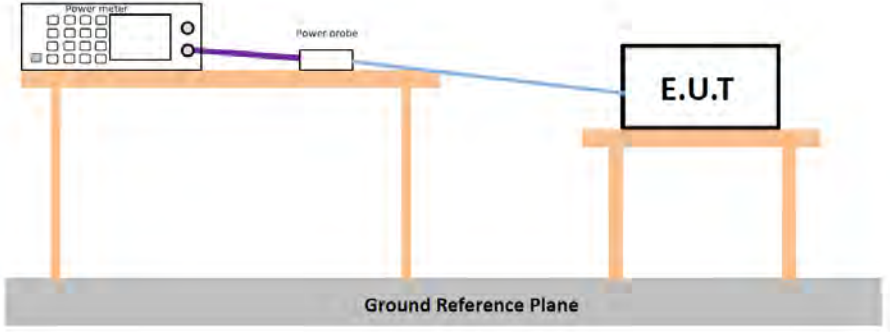
1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Value = Reading [dBμV] + Factor (Lisn factor [dB] + cable loss [dB]).
3. Margin = Limit [dBμV] – Value [dBμV]



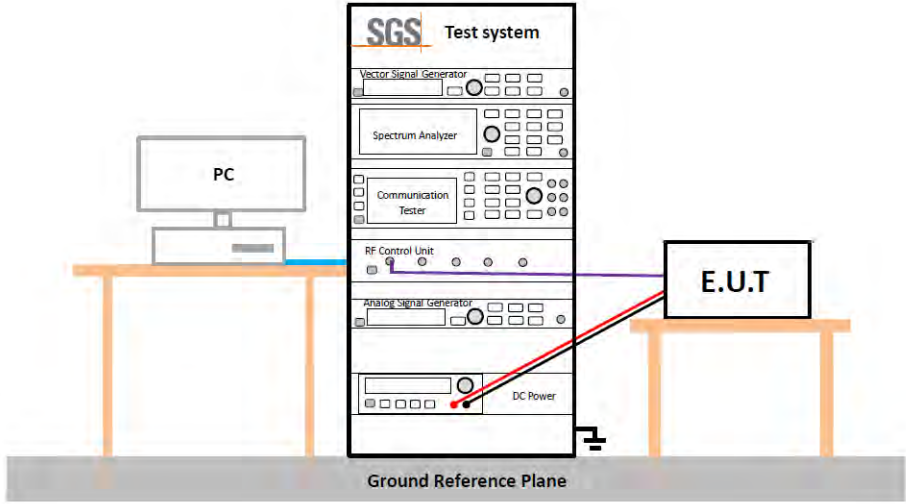
5.3 Duty Cycle

Test Requirement:	ANSI C63.10 :2013 Section 11.6
Test Method:	ANSI C63.10 :2013 Section 11.6
Test Setup:	
Instruments Used:	Refer to section 6 for details
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates
Final Test Mode:	Refer to section 3.7 for details.
Limit:	No restriction limits
Test Results:	For Report Purpose
The detailed test data see: Appendix	

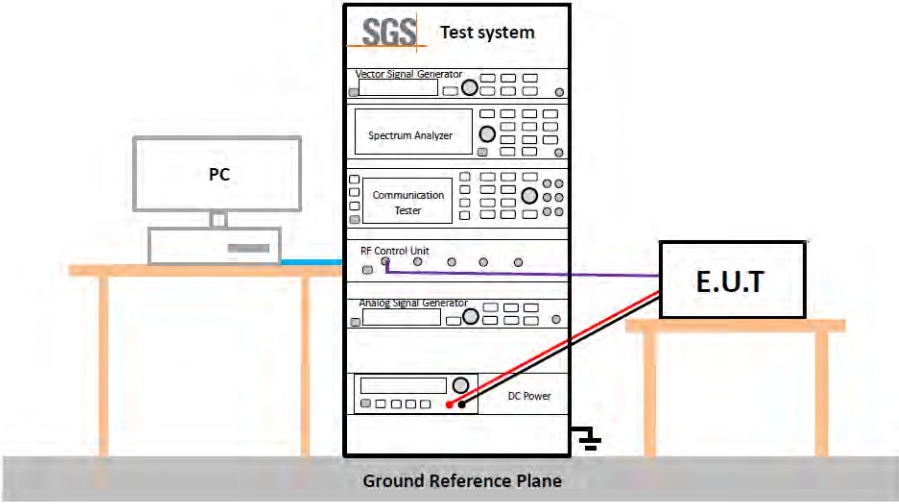
5.4 Conducted Output Power

Test Requirement:	47 CFR Part 15C Section 15.247 (b)(3)
Test Method:	ANSI C63.10 :2013 Section 11.9.1.3
Test Setup:	 * Test with power meter (Detector function: Peak)
Test Instruments:	Refer to section 6 for details.
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates
Final Test Mode:	Refer to section 3.7 for details.
Limit:	30dBm
Test Results:	Pass
The detailed test data see: Appendix	

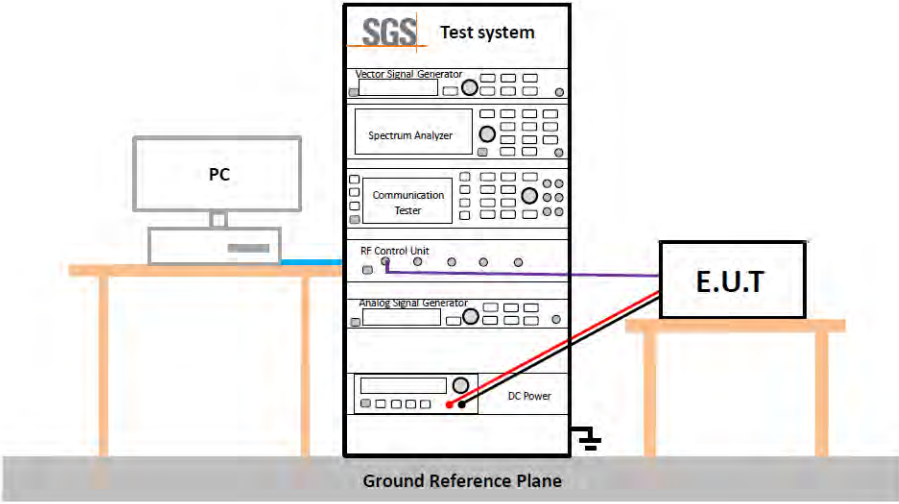
5.5 DTS (6 dB) Bandwidth & 99% Occupied Bandwidth

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(2)
Test Method:	ANSI C63.10: 2013 Section 11.8 Option 2 / 6.9.3
Test Setup:	
Instruments Used:	Refer to section 6 for details.
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates
Final Test Mode:	Refer to section 3.7 for details.
Limit:	≥ 500 kHz for DTS Bandwidth
Test Results:	Pass
The detailed test data see: Appendix	

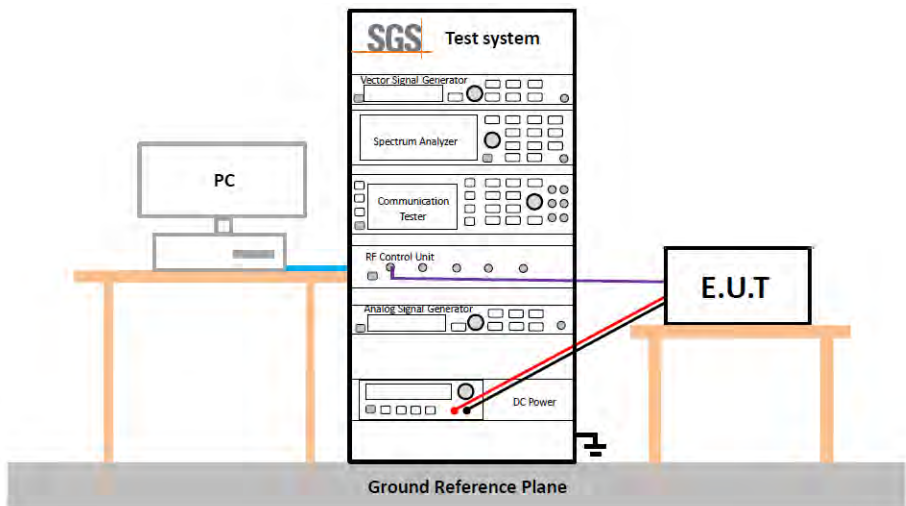
5.6 Power Spectral Density

Test Requirement:	47 CFR Part 15C Section 15.247 (e)
Test Method:	ANSI C63.10 :2013 Section 11.10.2
Test Setup:	
Test Instruments:	Refer to section 6 for details.
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates
Final Test Mode:	Refer to section 3.7 for details.
Limit:	$\leq 8.00\text{dBm}/3\text{kHz}$
Test Results:	Pass
The detailed test data see: Appendix	

5.7 Band-edge for RF Conducted Emissions

Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10: 2013 Section 11.11
Test Setup:	
Instruments Used:	Refer to section 6 for details.
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates
Final Test Mode:	Refer to section 3.7 for details.
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.
Test Results:	Pass
The detailed test data see: Appendix	

5.8 RF Conducted Spurious Emissions

Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10: 2013 Section 11.11
Test Setup:	
Instruments Used:	Refer to section 6 for details.
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates
Final Test Mode:	Refer to section 3.7 for details.
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.
Test Results:	Pass
The detailed test data see: Appendix	



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5.9 Radiated Spurious Emissions

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205				
Test Method:	ANSI C63.10 :2013 Section 11.12				
Test Site:	Measurement Distance: 3m (Semi-Anechoic Chamber)				
Test Frequency:	9kHz ~ 25GHz				
Receiver Setup:	Frequency	Detector	RBW	VBW	Remark
	0.009MHz-0.090MHz	Peak	10kHz	30kHz	Peak
	0.009MHz-0.090MHz	Average	10kHz	30kHz	Average
	0.090MHz-0.110MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
	0.110MHz-0.490MHz	Peak	10kHz	30kHz	Peak
	0.110MHz-0.490MHz	Average	10kHz	30kHz	Average
	0.490MHz -30MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
	30MHz-1GHz	Quasi-peak	120kHz	300kHz	Quasi-peak
	Above 1GHz	Peak	1MHz	3MHz	Peak
		Peak	1MHz	3MHz	Peak
Limit:	Frequency	Field strength (microvolt/meter)	Limit (dBuV/m)	Remark	Measurement distance (m)
	0.009MHz-0.490MHz	2400/F(kHz)	-	-	300
	0.490MHz-1.705MHz	24000/F(kHz)	-	-	30
	1.705MHz-30MHz	30	-	-	30
	30MHz-88MHz	100	40.0	Quasi-peak	3
	88MHz-216MHz	150	43.5	Quasi-peak	3
	216MHz-960MHz	200	46.0	Quasi-peak	3
	960MHz-1GHz	500	54.0	Quasi-peak	3
	Above 1GHz	500	54.0	Average	3
	Remark: 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.				

Test Setup:

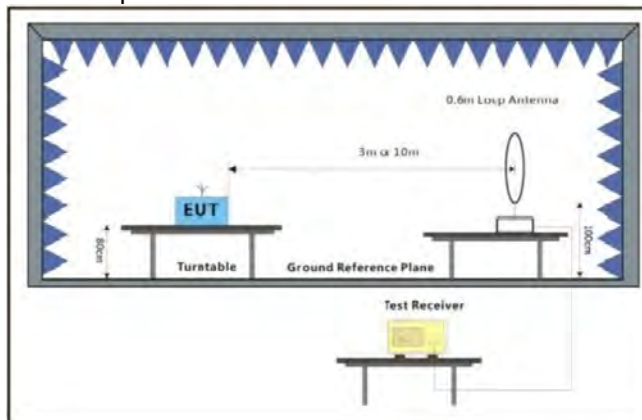


Figure 1. Below 30MHz

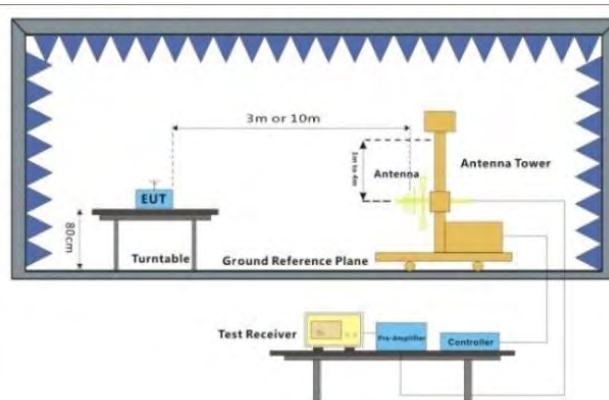


Figure 2. 30MHz to 1GHz

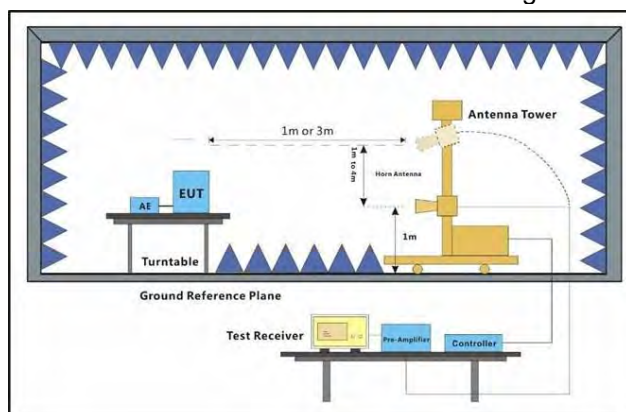


Figure 3. Above 1 GHz

Test Procedure:

- For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation (Distance from antenna to EUT is 1m for measurements >18GHz).
- The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- Test the EUT in the lowest channel, the middle channel, the Highest



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	channel. h. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, And found the X axis positioning which it is worse case. i. Repeat above procedures until all frequencies measured was complete. j. The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported k. The disturbance above 18GHz was very low, and the harmonics were the highest point could be found when testing, so only the harmonics had been displayed. l. At a measurement distance of 1 meter the limit line was increased by $20 \times \text{LOG}(3/1) = 9.54 \text{ dB}$.
Test Configuration:	Measurements below 30MHz • RBW = 10 kHz • VBW = 30 kHz • Detector = Peak & Average & Quasi-peak • Trace mode = max hold Measurements Below 1000MHz • RBW = 120 kHz • VBW = 300 kHz • Detector = Quasi-peak • Trace mode = max hold Peak Measurements Above 1000 MHz • RBW = 1 MHz • VBW $\geq 3 \text{ MHz}$ • Detector = Peak • Sweep time = auto • Trace mode = max hold Average Measurements Above 1000MHz • RBW = 1 MHz • VBW = 10 Hz, when duty cycle is no less than 98 percent. • VBW $\geq 1/T$, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates. Charge + Transmitting mode.
Final Test Mode:	Refer to section 3.7 for details. For below 1GHz part, through pre-scan all channels, but only the worst case is recorded in the report.
Instruments Used:	Refer to section 6 for details.
Test Results:	Pass
The detailed test data see: Appendix	

5.10 Restricted bands around fundamental frequency

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205		
Test Method:	ANSI C63.10: 2013 Section 11.12		
Test Site:	Measurement Distance: 3m (Semi-Anechoic Chamber)		
Limit:	Frequency	Limit (dBuV/m)	Remark
	30MHz-88MHz	40.0	Quasi-peak
	88MHz-216MHz	43.5	Quasi-peak
	216MHz-960MHz	46.0	Quasi-peak
	960MHz-1GHz	54.0	Quasi-peak
	Above 1GHz	54.0	Average Value
		74.0	Peak Value

Test Setup:

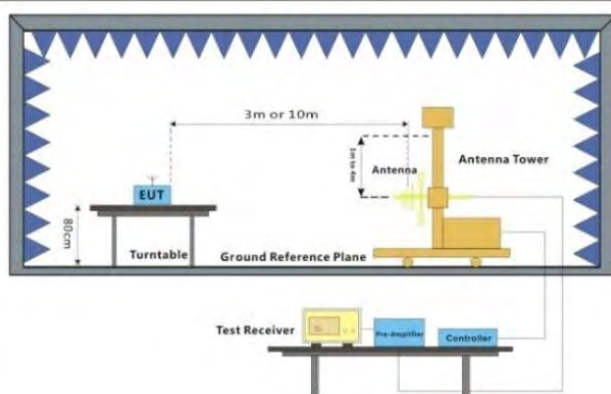


Figure 1. 30MHz to 1GHz

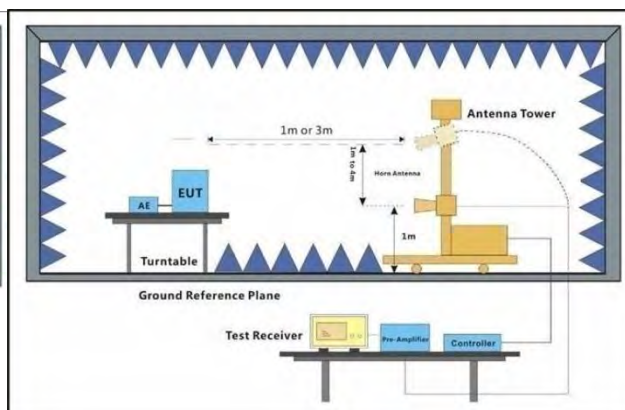


Figure 2. Above 1 GHz

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Test Procedure:	- For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. - For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. - The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. - The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. - For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. - The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. - Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands. Save the spectrum analyzer plot. Repeat for each power and modulation for lowest and highest channel - Test the EUT in the lowest channel , the Highest channel - The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, And found the X axis positioning which it is worse case. - Repeat above procedures until all frequencies measured was complete.
Test Configuration:	Measurements Below 1000MHz • RBW = 120 kHz • VBW = 300 kHz • Detector = Quasi-peak • Trace mode = max hold Peak Measurements Above 1000 MHz • RBW = 1 MHz • VBW ≥ 3 MHz • Detector = Peak • Sweep time = auto • Trace mode = max hold Average Measurements Above 1000MHz • RBW = 1 MHz • VBW = 10 Hz, when duty cycle is no less than 98 percent. • VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates. Charge + Transmitting mode.
Final Test Mode:	Refer to section 3.7 for details.
Instruments Used:	Refer to section 6 for details.
Test Results:	Pass
The detailed test data see: Appendix	



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6 Photographs - Setup Photos

Refer to Appendix A.2 WLAN Setup Photos.



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7 Appendix

1. Duty Cycle

1.1 Test Result

1.1.1 Ant3

Ant2									
Mode	TX Type	Frequency (MHz)	RU	RU Pos	T_on (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	Max. DC Variation (%)
802.11b	SISO	2412	/	/	8.610	8.750	98.40	0.07	0.00
802.11g	SISO	2412	/	/	1.427	1.576	90.55	0.43	0.03
802.11n (HT20)	MIMO	2412	/	/	0.692	0.840	82.38	0.84	0.03
802.11ax (HEW20)	MIMO	2412	SU	/	1.034	1.183	87.40	0.58	0.10

1.1.2 Ant2

Ant3									
Mode	TX Type	Frequency (MHz)	RU	RU Pos	T_on (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	Max. DC Variation (%)
802.11b	SISO	2412	/	/	8.606	8.750	98.35	0.07	0.04
802.11g	SISO	2412	/	/	1.428	1.577	90.55	0.43	0.03
802.11n (HT20)	MIMO	2412	/	/	0.692	0.840	82.38	0.84	0.03
802.11ax (HEW20)	MIMO	2412	SU	/	1.045	1.194	87.52	0.58	0.03



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2. Bandwidth

2.1 Test Result

2.1.1 OBW

Mode	TX Type	Frequency (MHz)	RU	RU Pos	ANT	99% Occupied Bandwidth (MHz)		Verdict
						Result	Limit	
802.11b	SISO	2412	/	/	2	11.302	/	Pass
		2437	/	/	2	10.982	/	Pass
		2462	/	/	2	11.217	/	Pass
802.11g	SISO	2412	/	/	2	18.394	/	Pass
		2437	/	/	2	19.018	/	Pass
		2462	/	/	2	18.521	/	Pass
802.11n (HT20)	MIMO	2412	/	/	2	19.303	/	Pass
		2437	/	/	2	19.739	/	Pass
		2462	/	/	2	19.355	/	Pass
802.11ax (HEW20)	MIMO	2412	SU	/	2	19.509	/	Pass
		2437	SU	/	2	19.522	/	Pass
		2462	SU	/	2	19.572	/	Pass

2.1.2 6dB BW

Mode	TX Type	Frequency (MHz)	RU	RU Pos	ANT	6dB Bandwidth (MHz)		Verdict
						Result	Limit	
802.11b	SISO	2412	/	/	2	7.812	≥ 0.5	Pass
		2437	/	/	2	7.773	≥ 0.5	Pass
		2462	/	/	2	8.124	≥ 0.5	Pass
802.11g	SISO	2412	/	/	2	16.608	≥ 0.5	Pass
		2437	/	/	2	16.597	≥ 0.5	Pass
		2462	/	/	2	16.593	≥ 0.5	Pass
802.11n (HT20)	MIMO	2412	/	/	2	18.052	≥ 0.5	Pass
		2437	/	/	2	17.781	≥ 0.5	Pass
		2462	/	/	2	18.084	≥ 0.5	Pass
802.11ax (HEW20)	MIMO	2412	SU	/	2	19.122	≥ 0.5	Pass
		2437	SU	/	2	19.050	≥ 0.5	Pass
		2462	SU	/	2	19.125	≥ 0.5	Pass

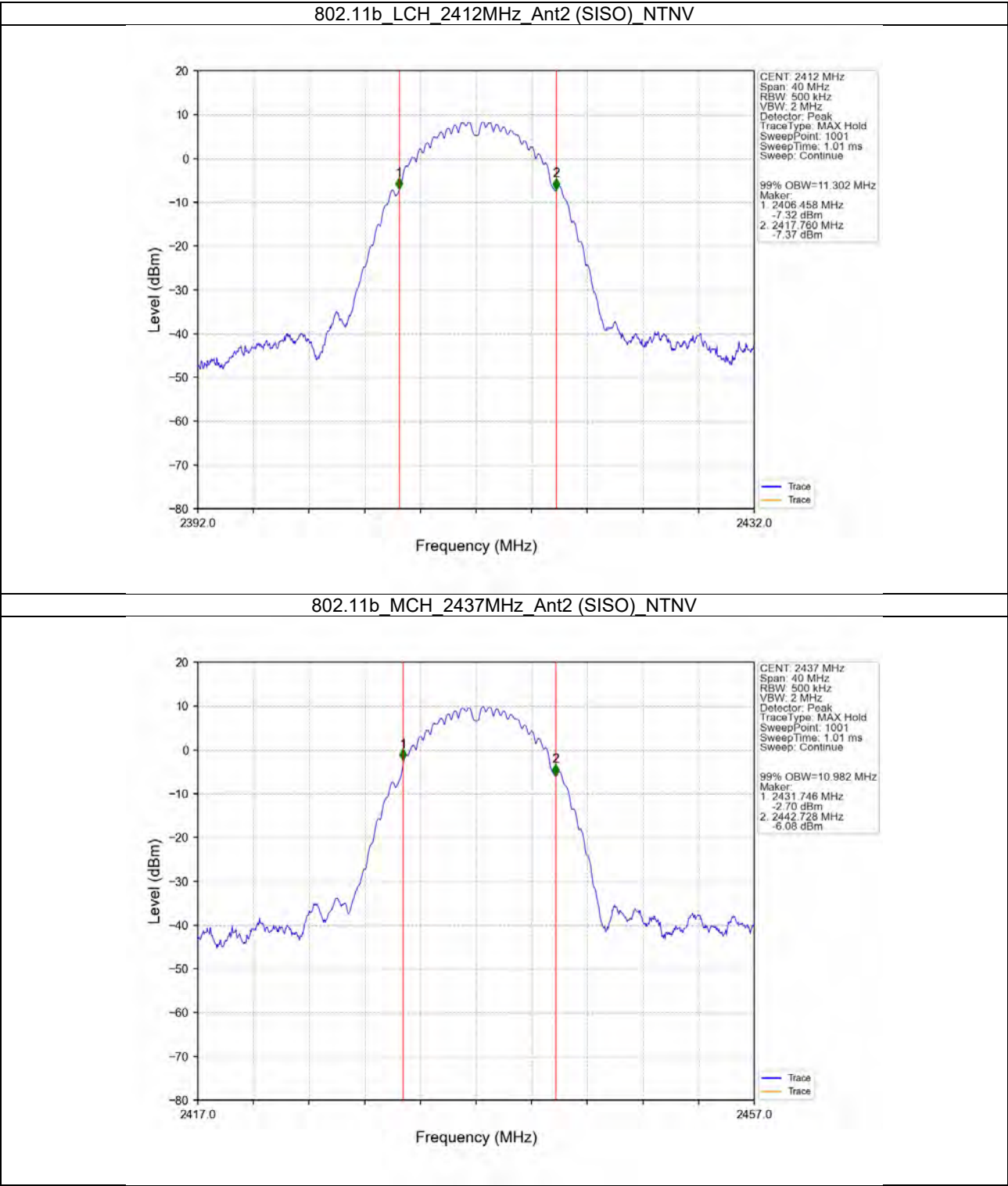


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2.2 Test Graph

2.2.1 OBW

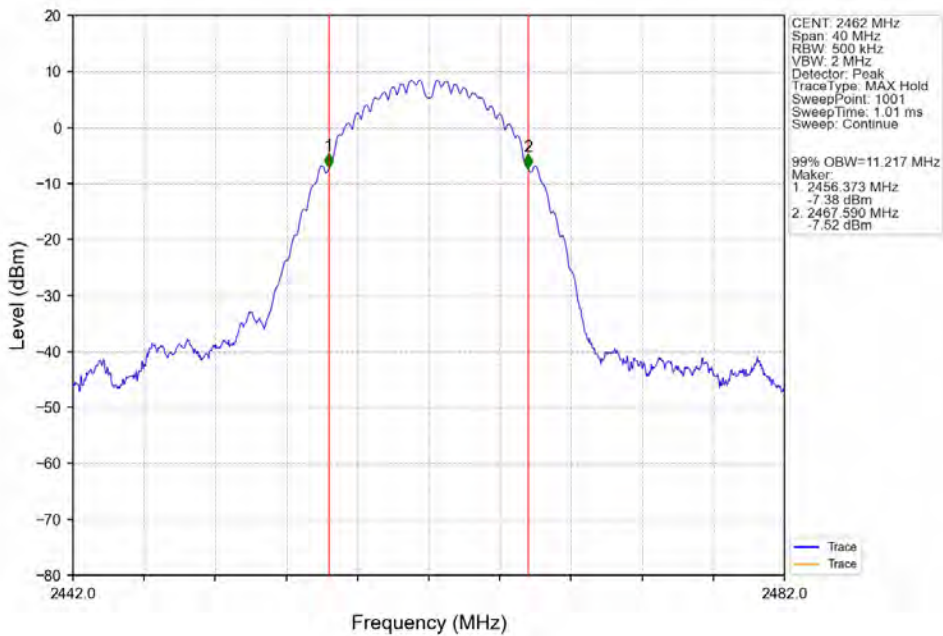




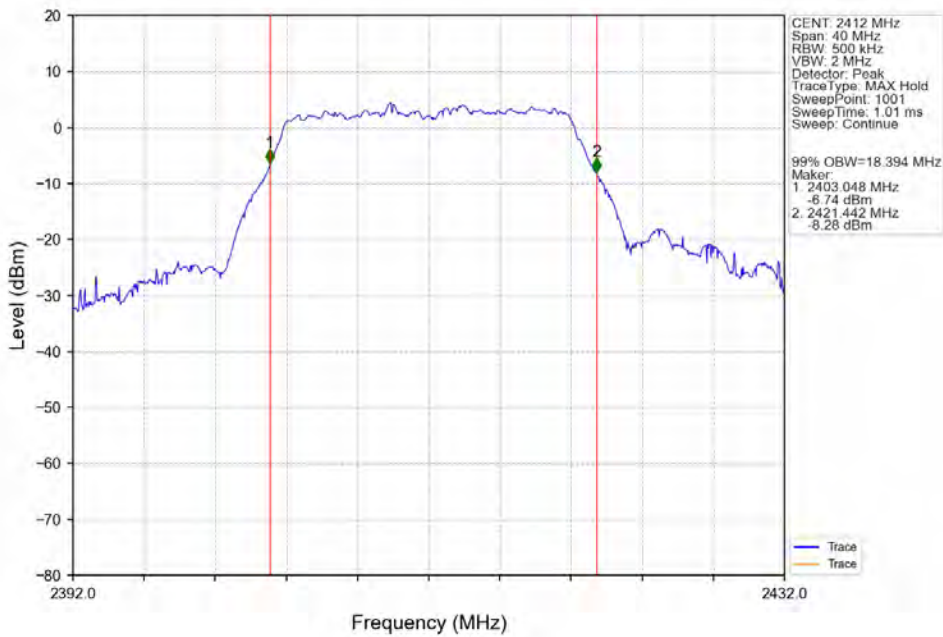
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802.11b_HCH_2462MHz_Ant2 (SISO)_NTNV



802.11g_LCH_2412MHz_Ant2 (SISO)_NTNV

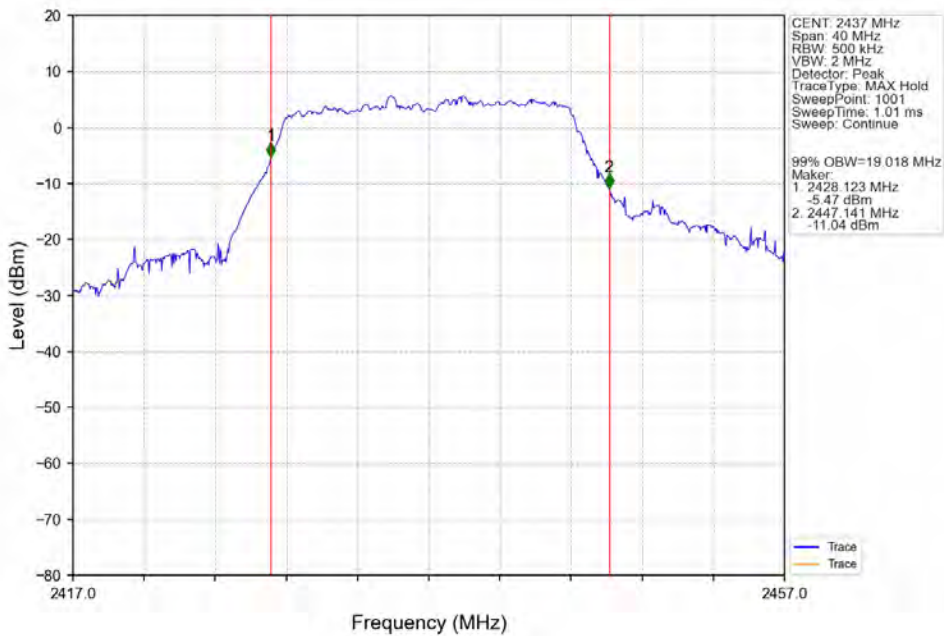




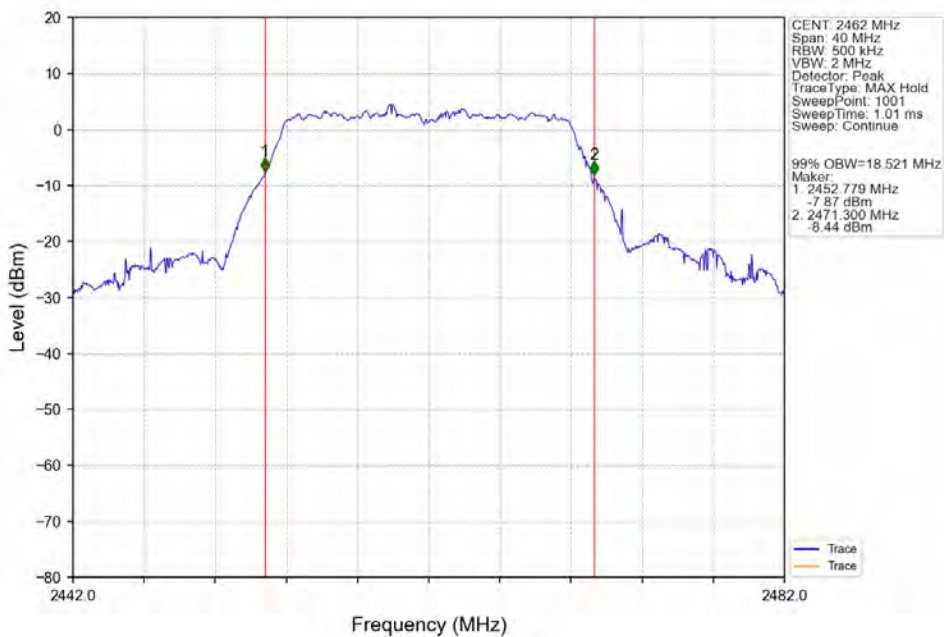
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802.11g_MCH_2437MHz_Ant2 (SISO)_NTNV



802.11g_HCH_2462MHz_Ant2 (SISO)_NTNV

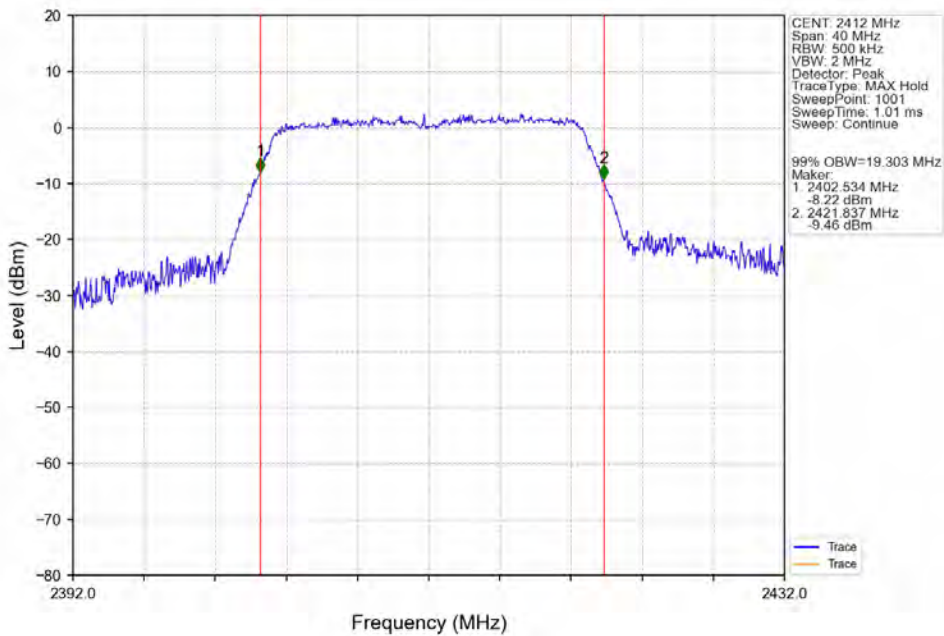




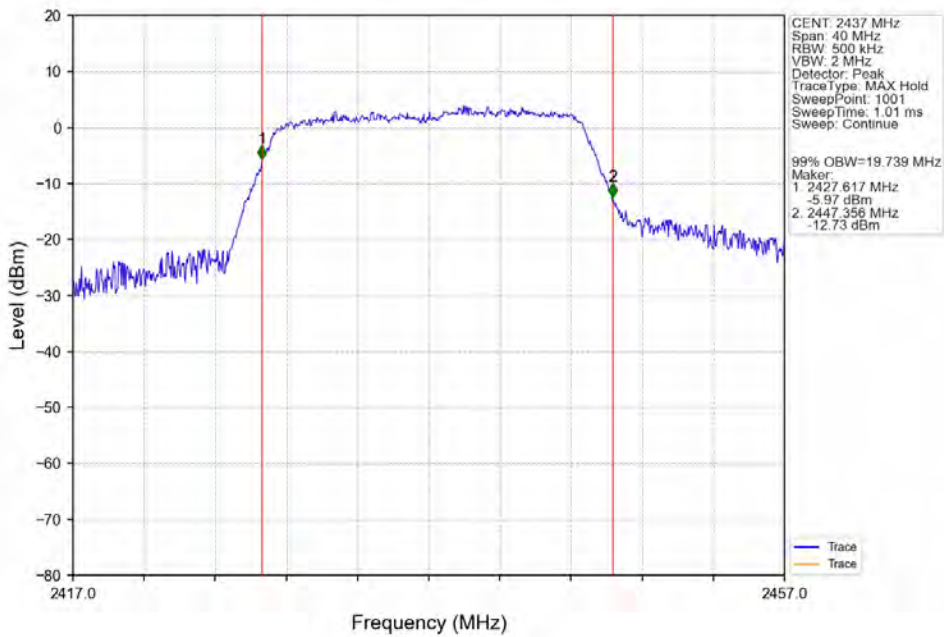
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802.11n(HT20)_LCH_2412MHz_Ant2 (MIMO)_NTNV



802.11n(HT20)_MCH_2437MHz_Ant2 (MIMO)_NTNV

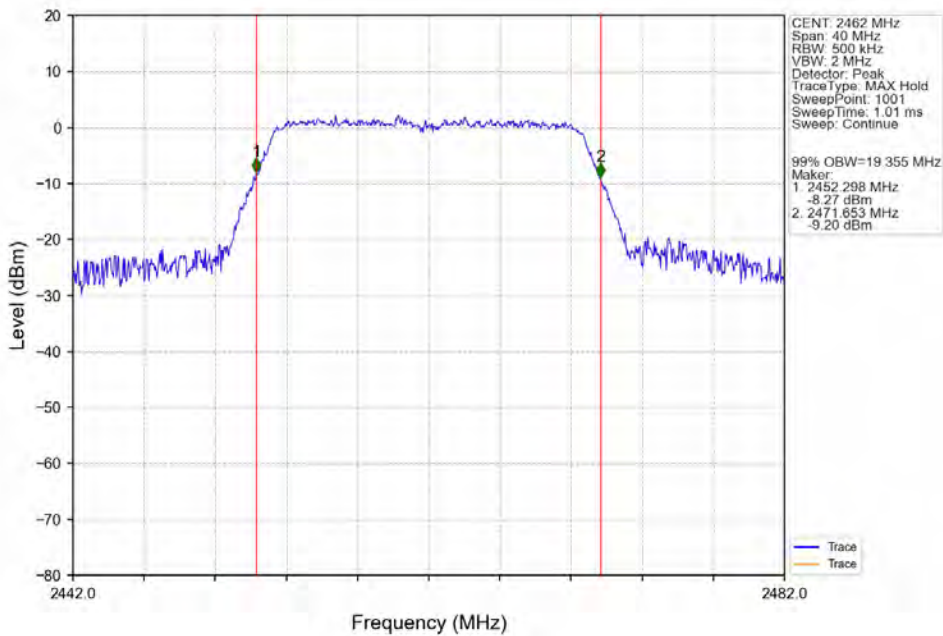




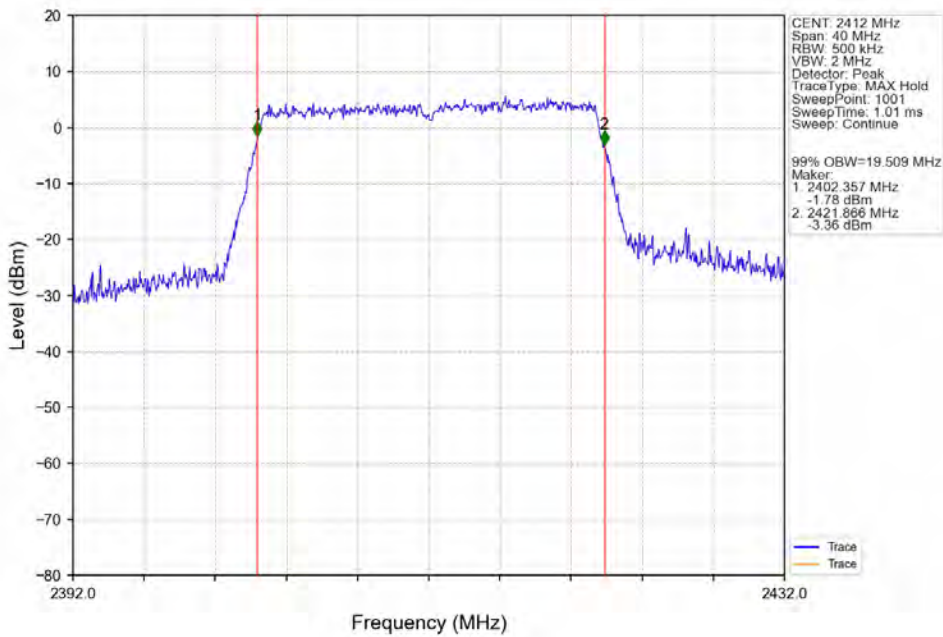
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802.11n(HT20)_HCH_2462MHz_Ant2 (MIMO)_NTNV



802.11ax(HEW20)_LCH_2412MHz_SU / Ant2 (MIMO)_NTNV

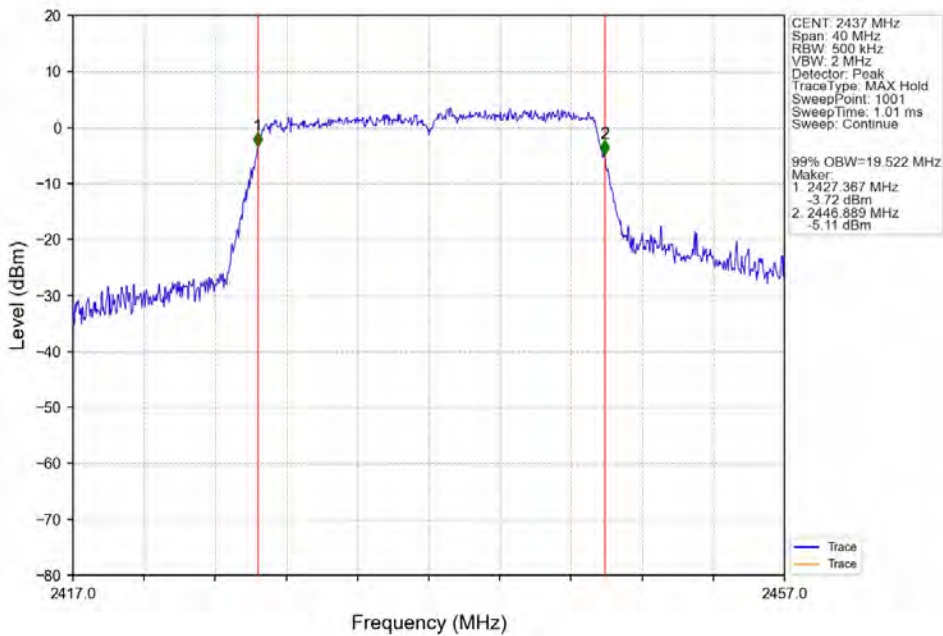




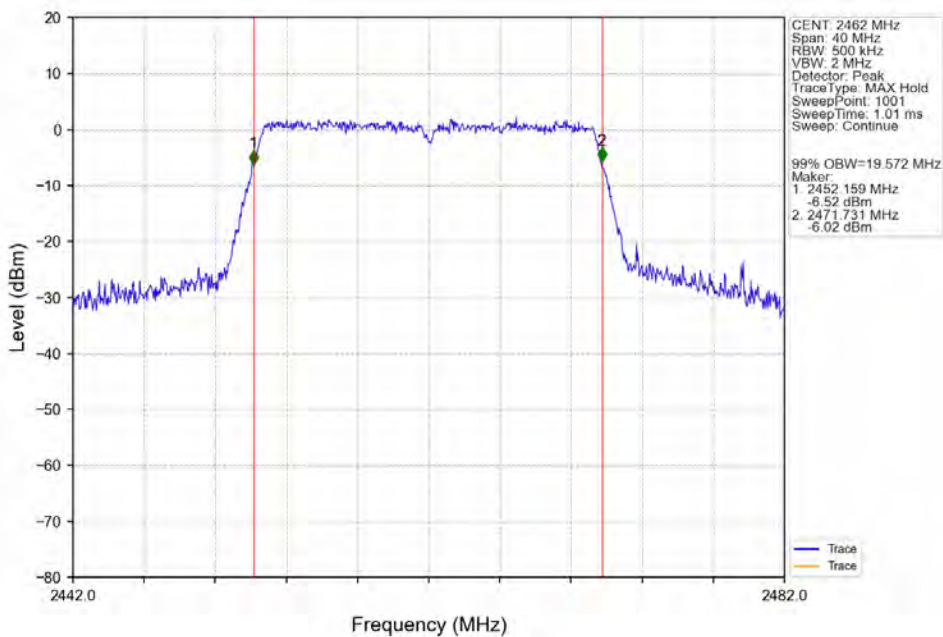
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802.11ax(HEW20) MCH 2437MHz SU / Ant2 (MIMO) NTNv



802.11ax(HEW20) HCH 2462MHz SU / Ant2 (MIMO) NTNv

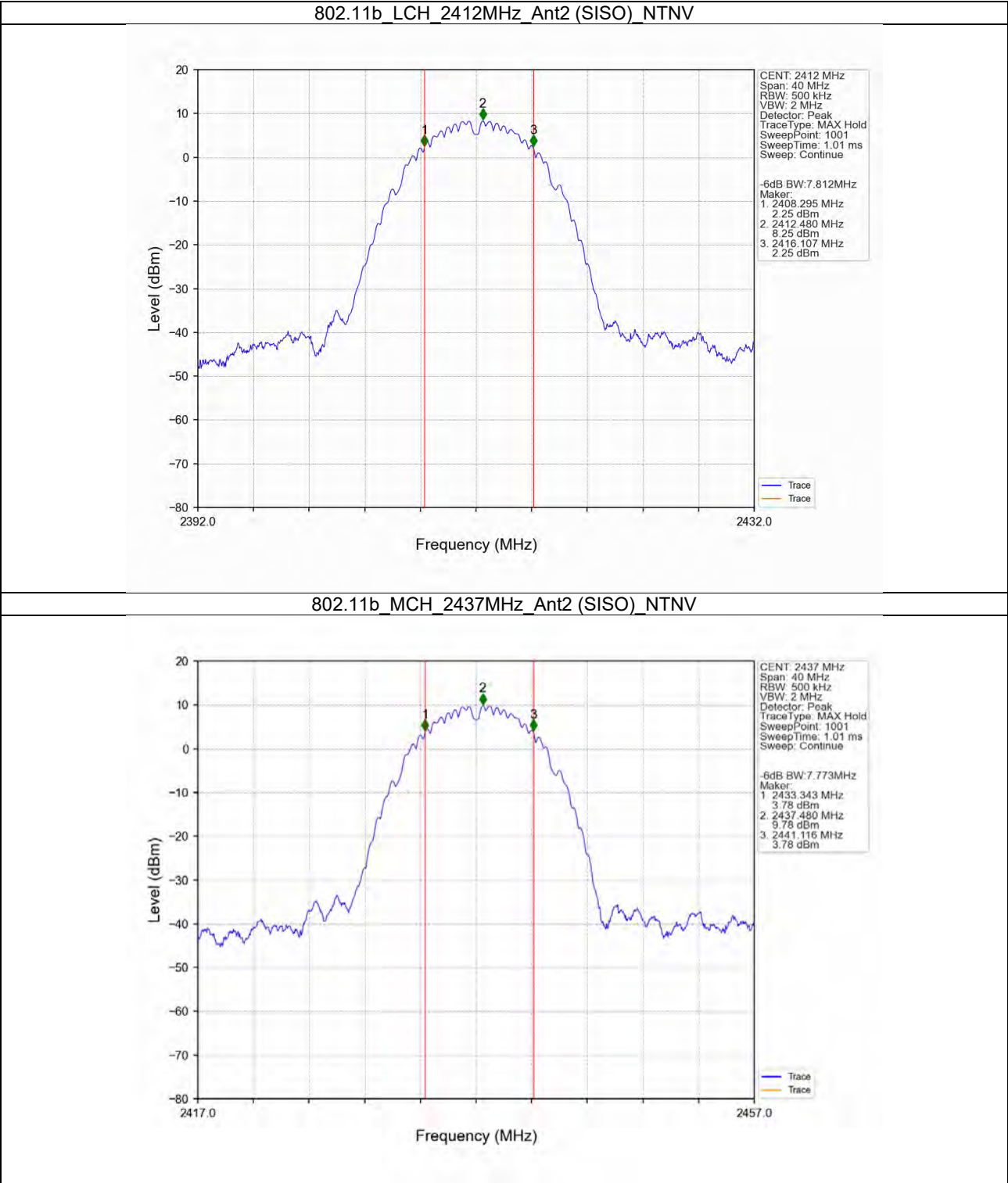




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2.2.2 6dB BW

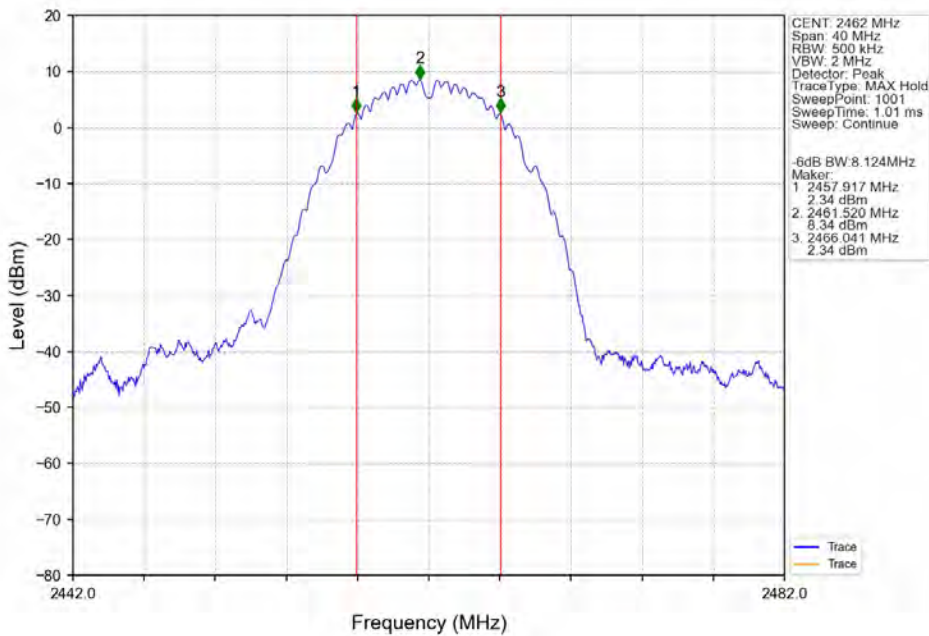




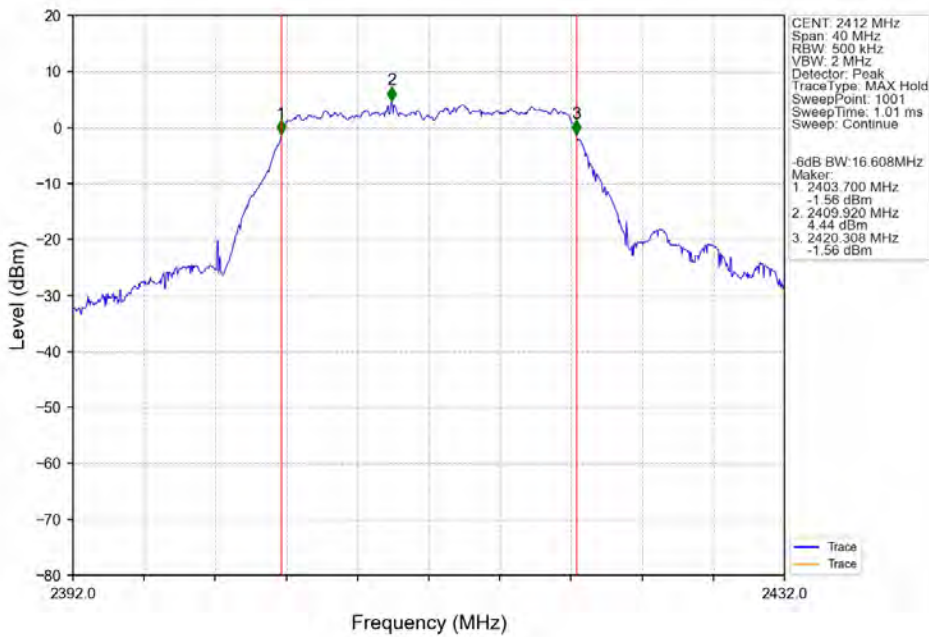
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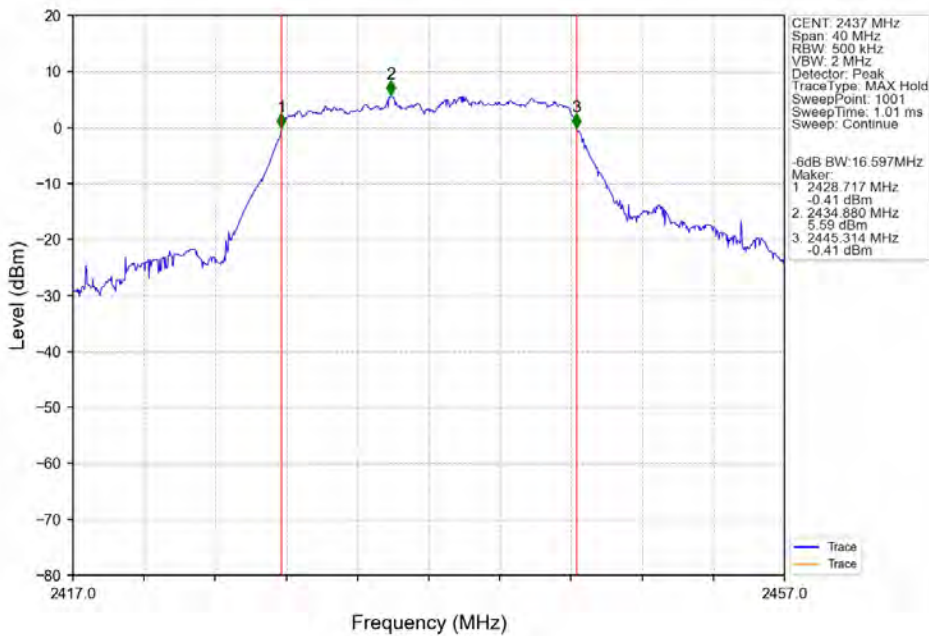
802.11b_HCH_2462MHz_Ant2 (SISO)_NTNV



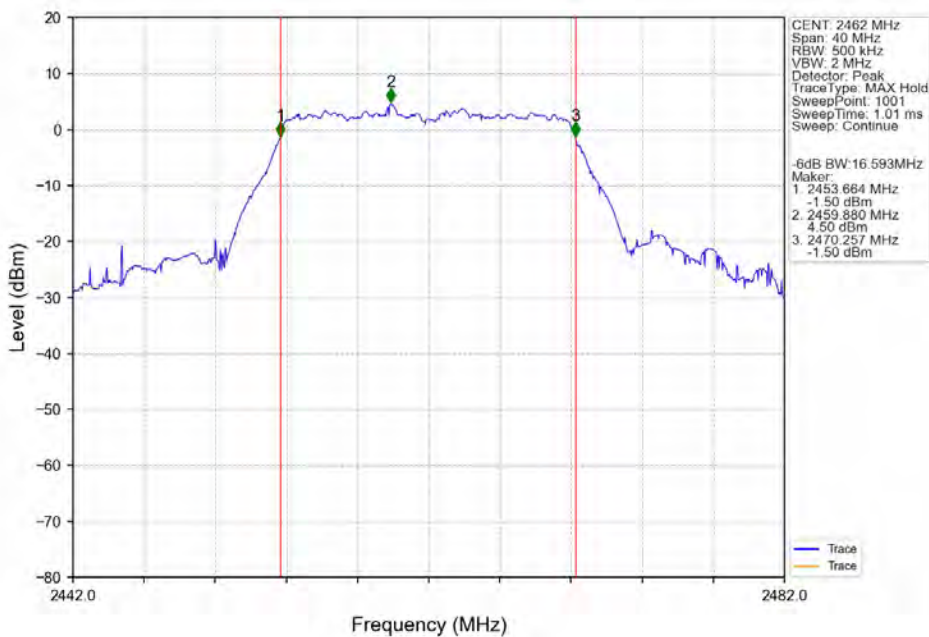
802.11g_LCH_2412MHz_Ant2 (SISO)_NTNV



802.11g_MCH_2437MHz_Ant2 (SISO)_NTNV



802.11g_HCH_2462MHz_Ant2 (SISO)_NTNV

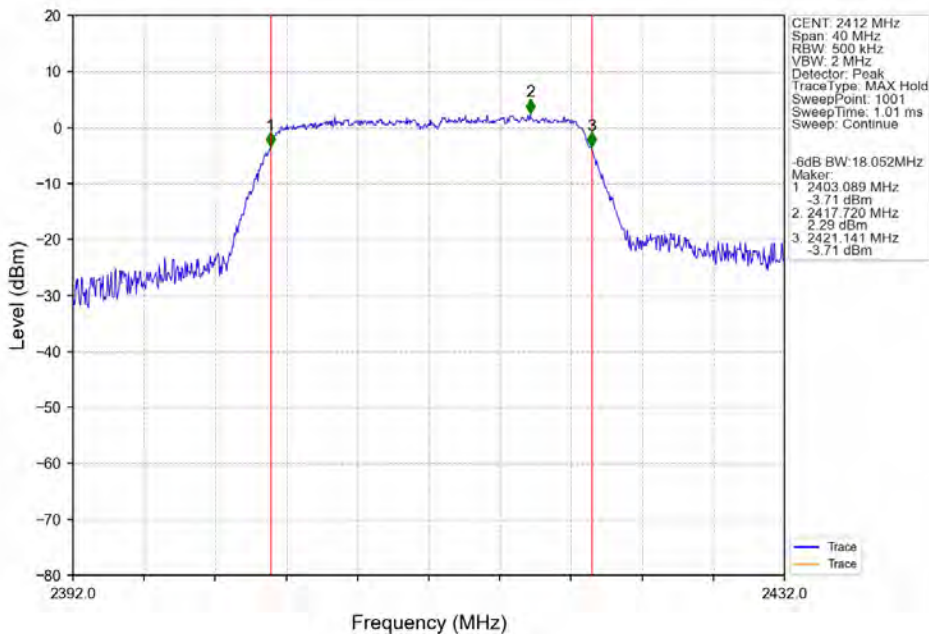




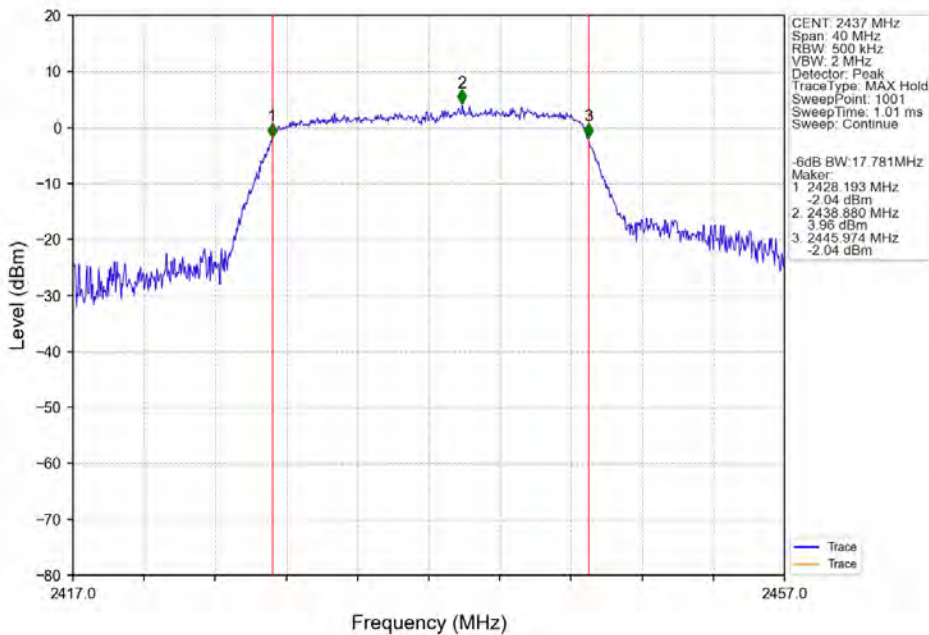
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802.11n(HT20)_LCH_2412MHz_Ant2 (MIMO)_NTNV



802.11n(HT20)_MCH_2437MHz_Ant2 (MIMO)_NTNV

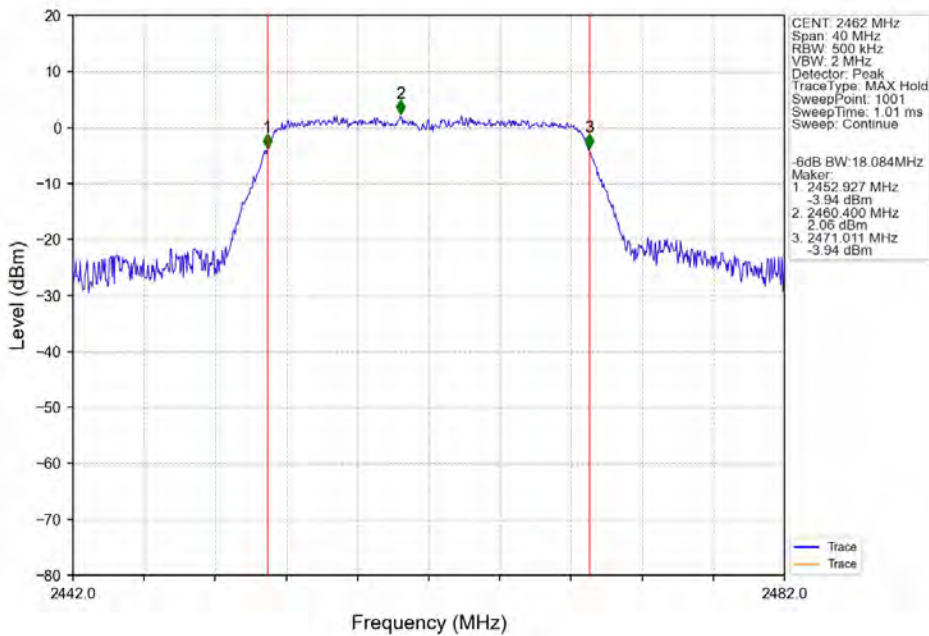




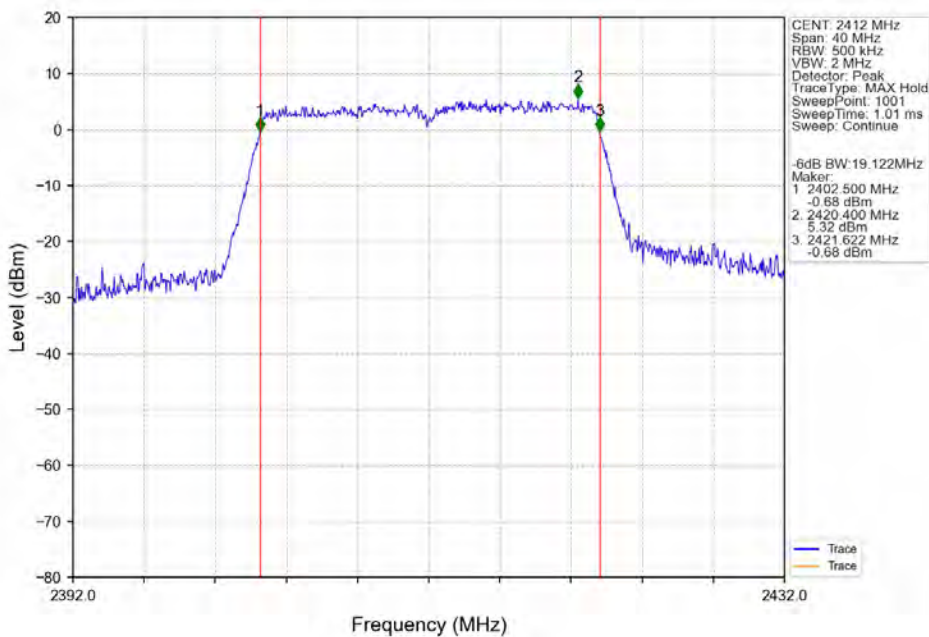
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802.11n(HT20) HCH_2462MHz_Ant2 (MIMO)_NTNV



802.11ax(HEW20) LCH_2412MHz_SU / Ant2 (MIMO)_NTNV

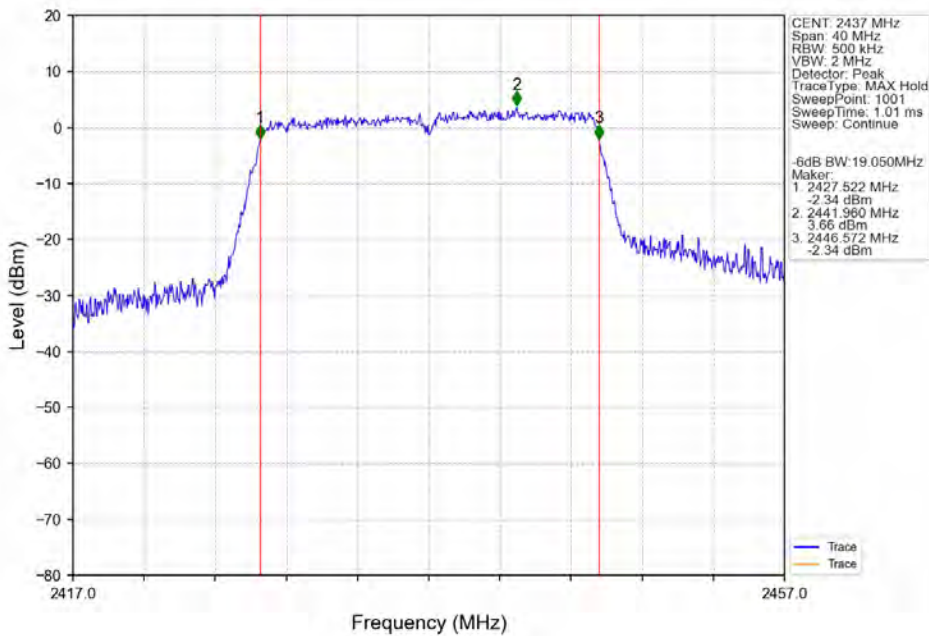




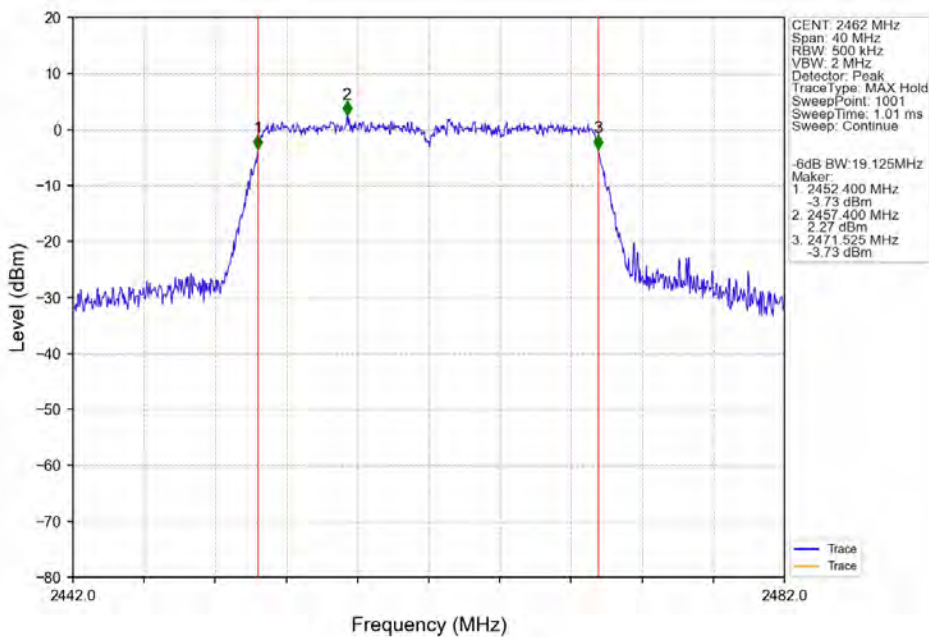
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802.11ax(HEW20) MCH_2437MHz_SU / Ant2 (MIMO) NTVN



802.11ax(HEW20) HCH_2462MHz_SU / Ant2 (MIMO) NTVN



Mode	TX Type	Frequency (MHz)	RU	RU Pos	Maximum Peak Conducted Output Power (dBm)				Verdict
					ANT2	ANT3	MIMO	Limit	
802.11b	SISO	2412	/	/	12.35	11.42	/	<=30	Pass
		2437	/	/	12.69	11.22	/	<=30	Pass
		2462	/	/	12.50	11.09	/	<=30	Pass
802.11g	SISO	2412	/	/	12.26	12.58	/	<=30	Pass
		2437	/	/	12.01	12.22	/	<=30	Pass
		2462	/	/	12.51	12.35	/	<=30	Pass
802.11n (HT20)	MIMO	2412	/	/	11.52	11.81	14.68	<=30	Pass
		2437	/	/	11.63	11.15	14.41	<=30	Pass
		2462	/	/	11.72	11.47	14.61	<=30	Pass
802.11ax (HEW20)	MIMO	2412	SU	/	9.92	10.62	13.29	<=30	Pass
		2437	SU	/	10.05	10.33	13.20	<=30	Pass
		2462	SU	/	10.15	10.43	13.30	<=30	Pass
Note1: Antenna Gain: Ant3: 3.10dBi; Ant2: -1.74dBi; Note2: Directional Gain: 3.10dBi									



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4. Maximum Power Spectral Density

4.1 Test Result

4.1.1 PSD

Mode	TX Type	Frequency (MHz)	RU	RU Pos	Maximum PSD (dBm/3kHz)				Verdict
					ANT2	ANT3	MIMO	Limit	
802.11b	SISO	2412	/	/	-11.33	/	/	<=8	Pass
		2437	/	/	-9.51	/	/	<=8	Pass
		2462	/	/	-12.96	/	/	<=8	Pass
802.11g	SISO	2412	/	/	-12.34	/	/	<=8	Pass
		2437	/	/	-8.02	/	/	<=8	Pass
		2462	/	/	-13.99	/	/	<=8	Pass
802.11n (HT20)	MIMO	2412	/	/	-14.78	-22.70	-14.62	<=7.89	Pass
		2437	/	/	-9.47	-18.45	-9.39	<=7.89	Pass
		2462	/	/	-14.60	-23.07	-14.35	<=7.89	Pass
802.11ax (HEW20)	MIMO	2412	SU	/	-14.32	-16.33	-12.86	<=7.89	Pass
		2437	SU	/	-11.04	-10.70	-9.05	<=7.89	Pass
		2462	SU	/	-15.63	-16.59	-14.31	<=7.89	Pass

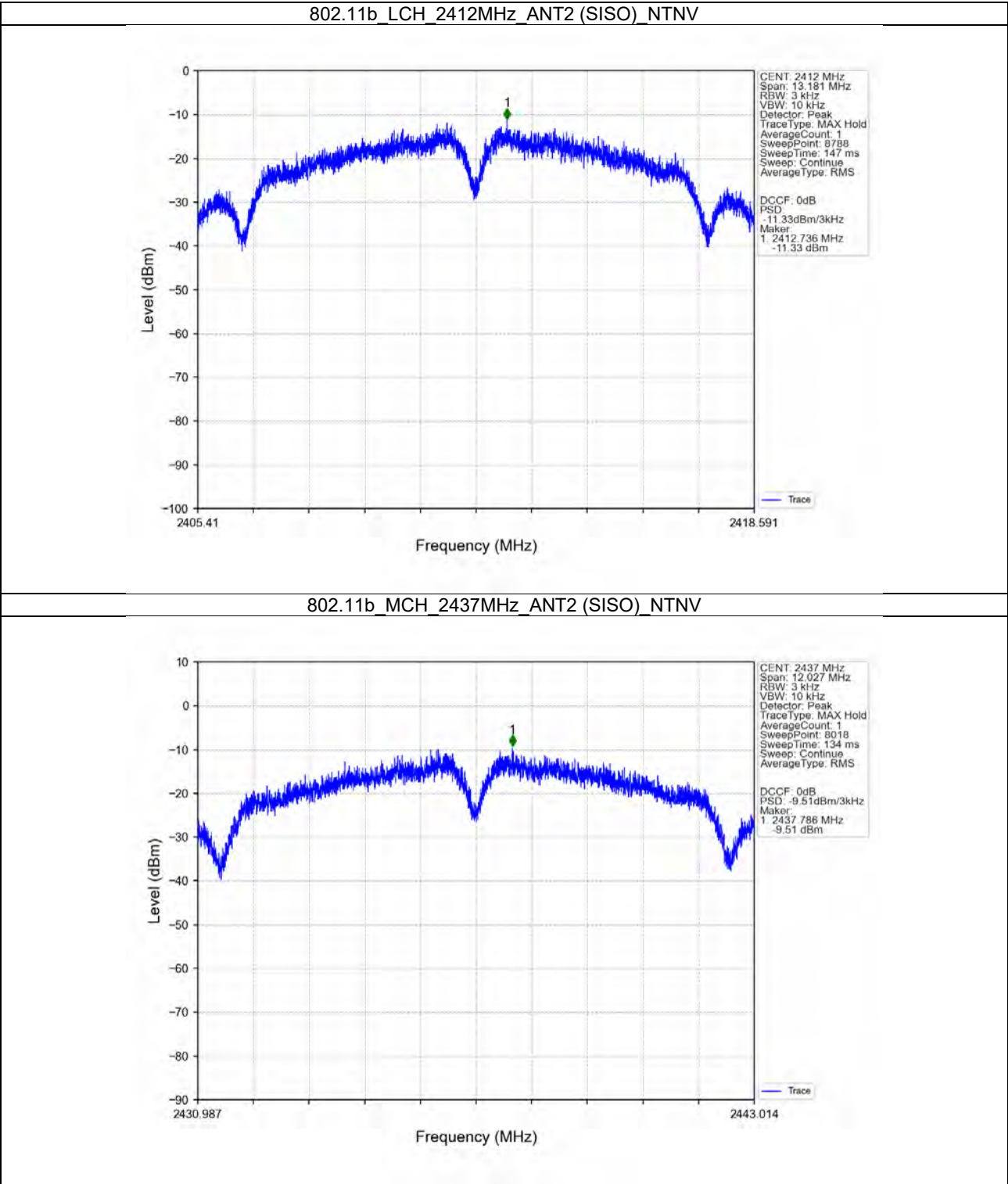


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4.2 Test Graph

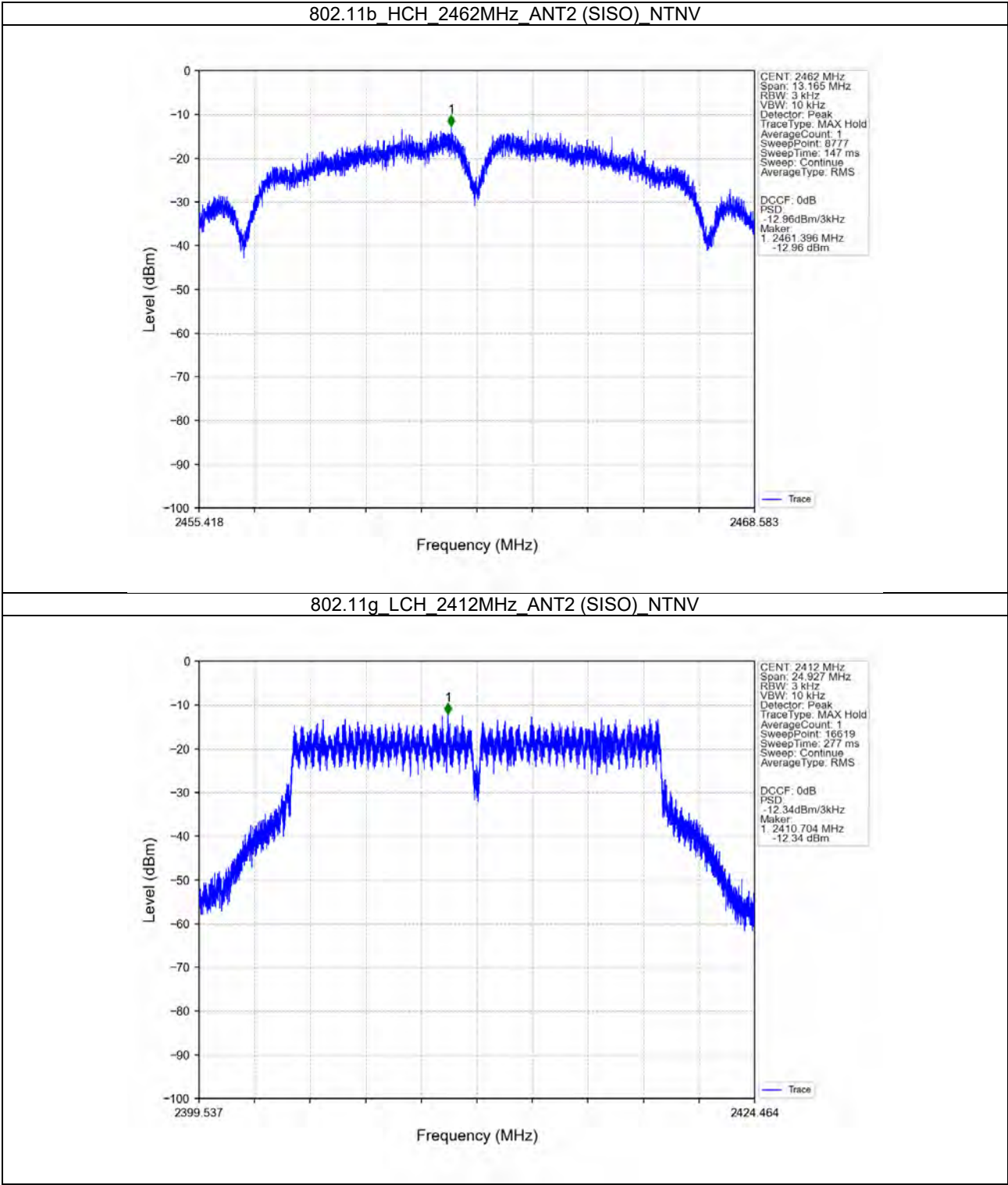
4.2.1 PSD





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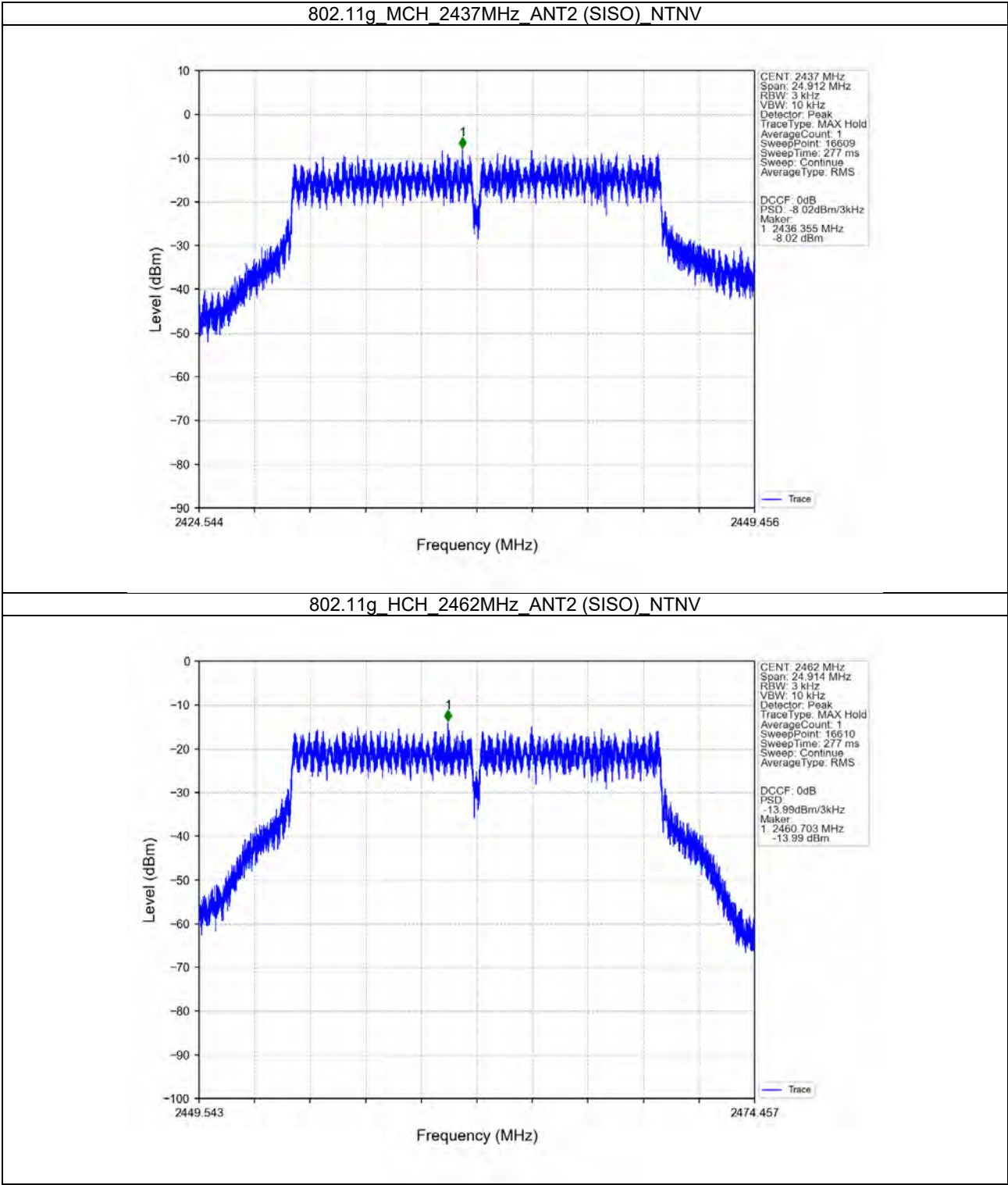
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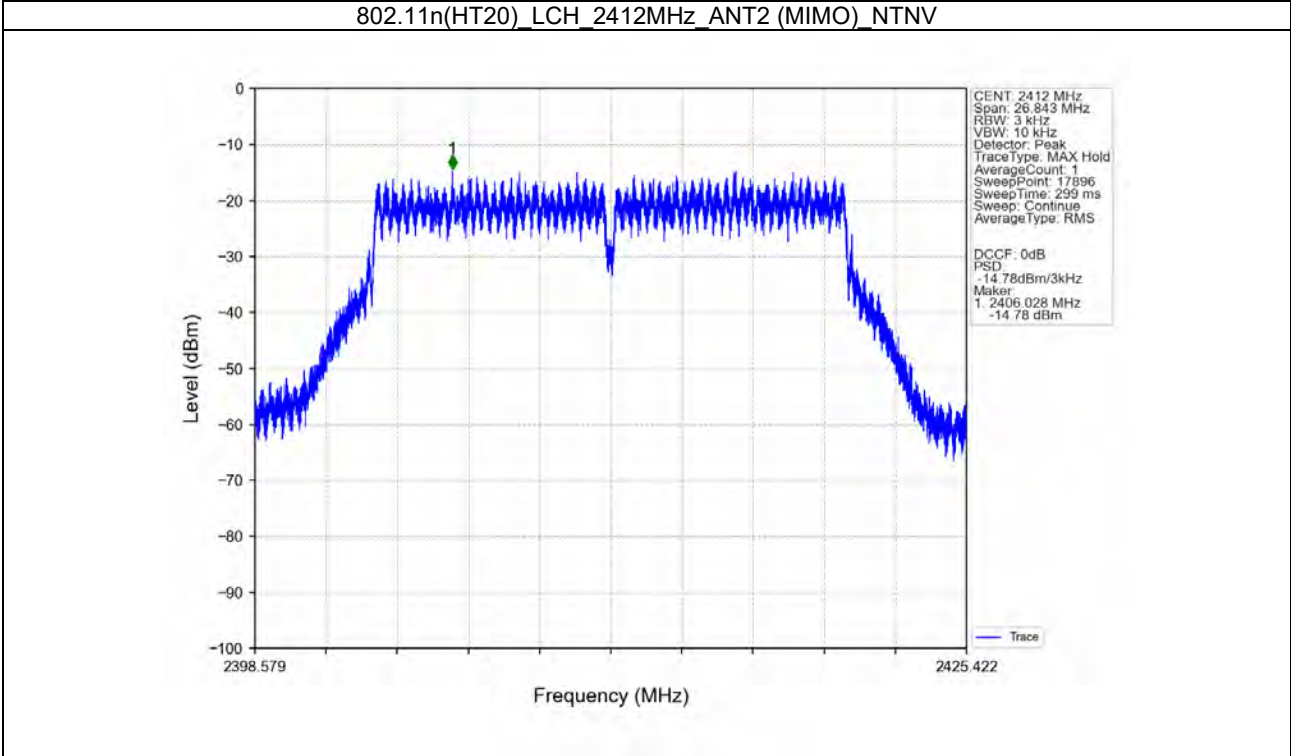




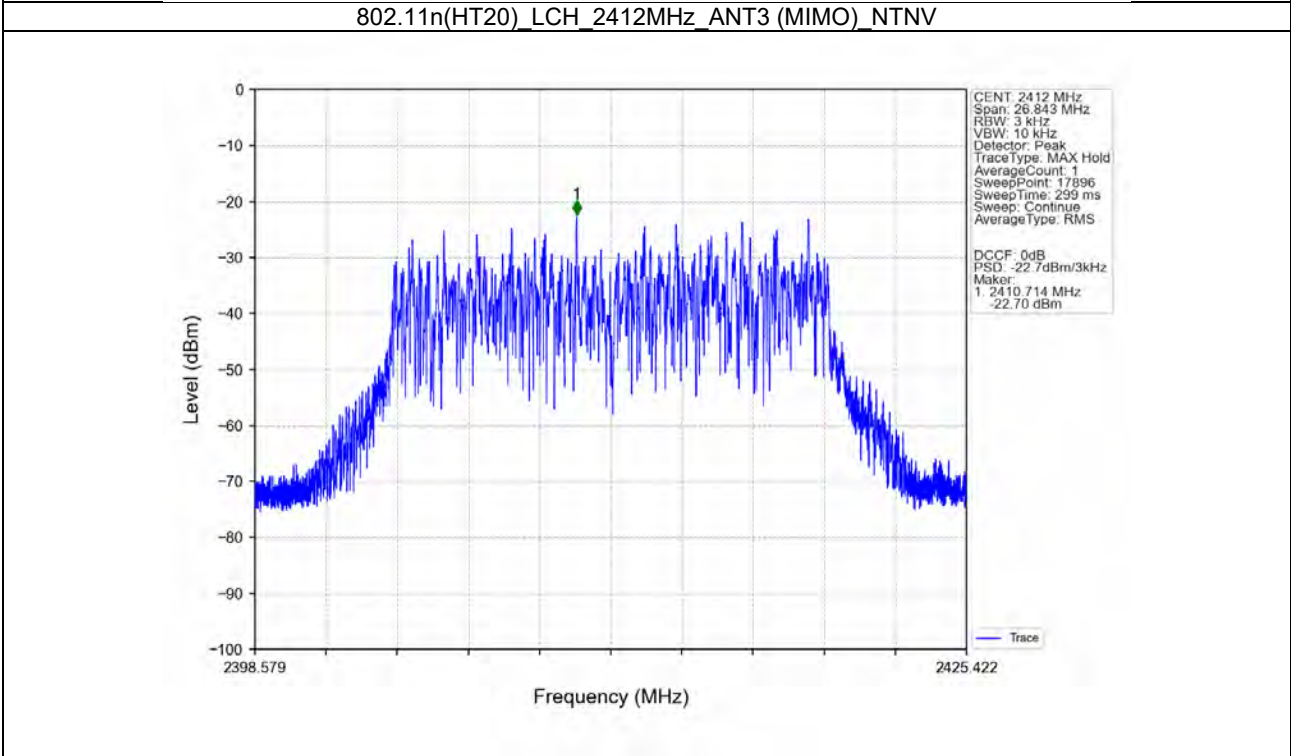
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802.11n(HT20)_LCH_2412MHz_ANT2 (MIMO)_NTNV



802.11n(HT20)_LCH_2412MHz_ANT3 (MIMO)_NTNV

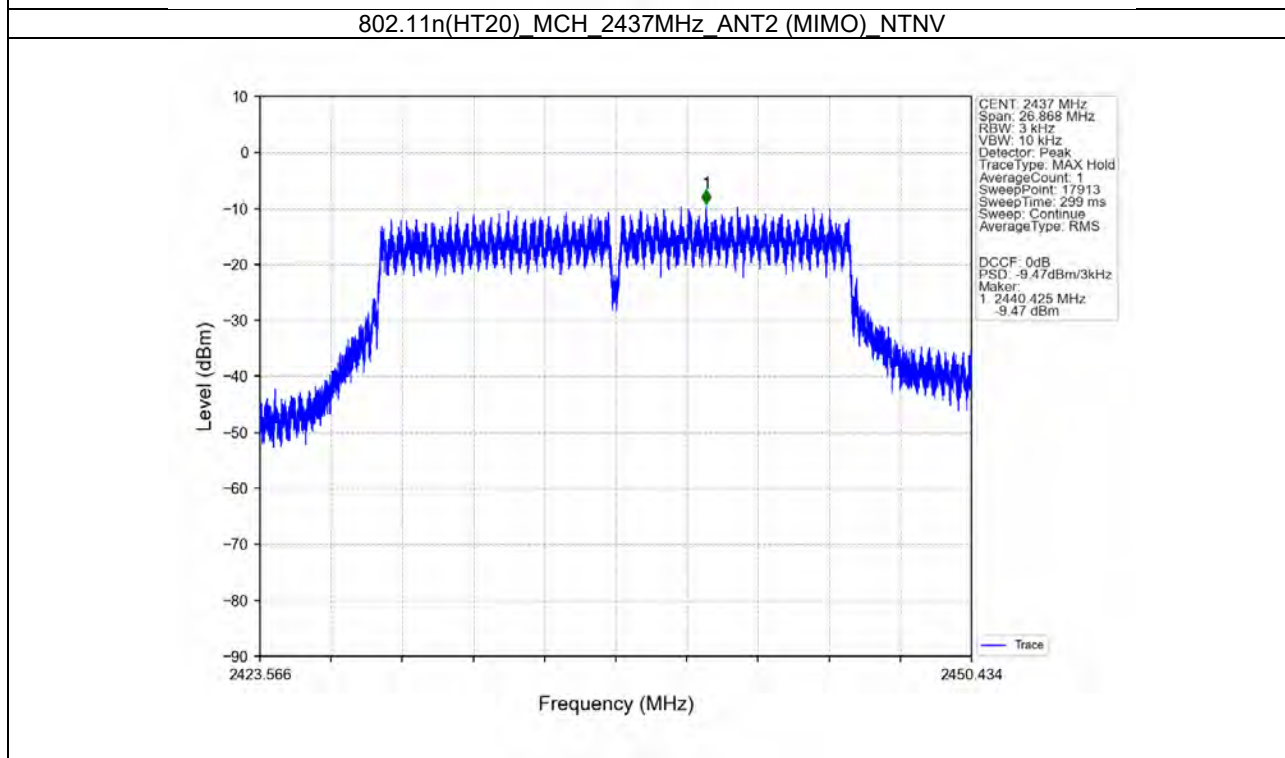
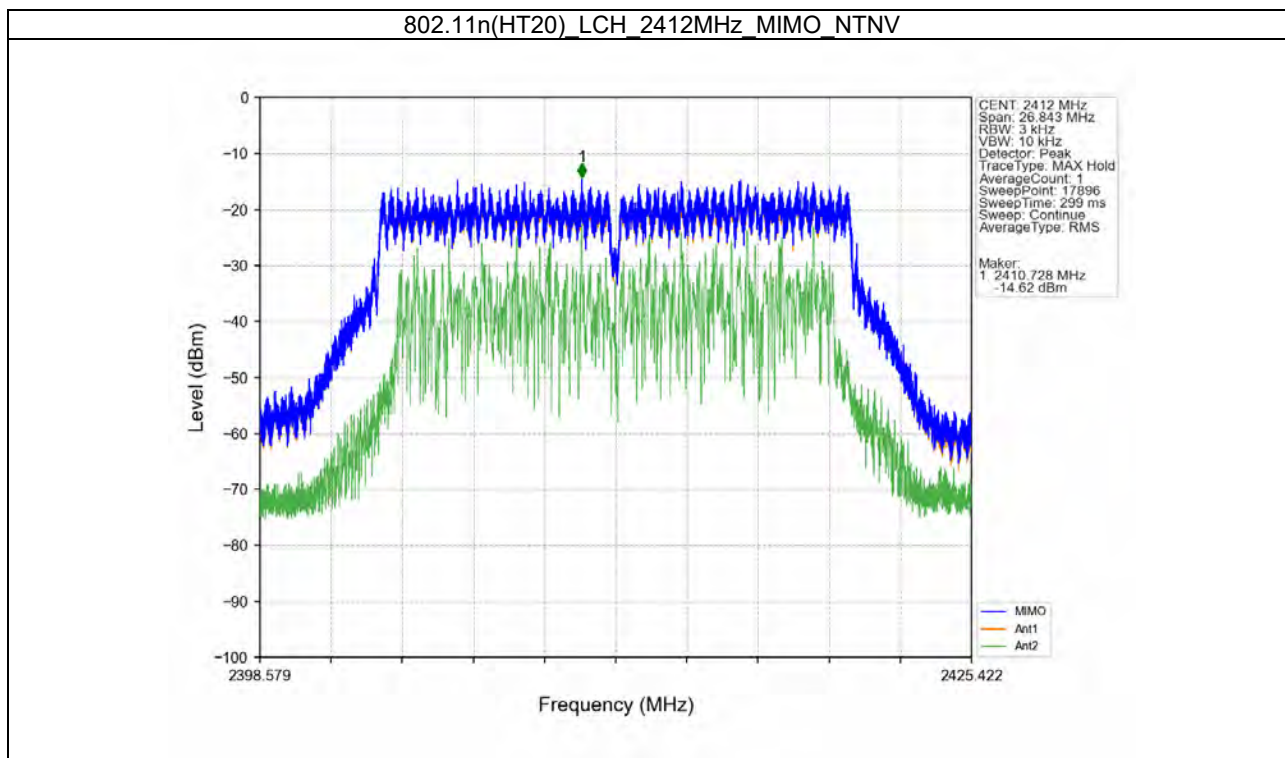


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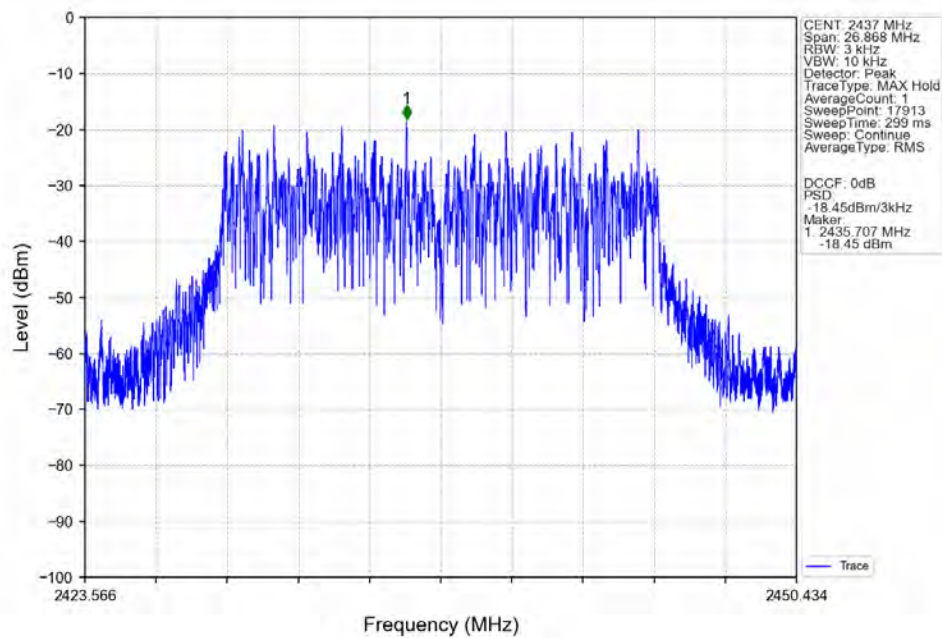




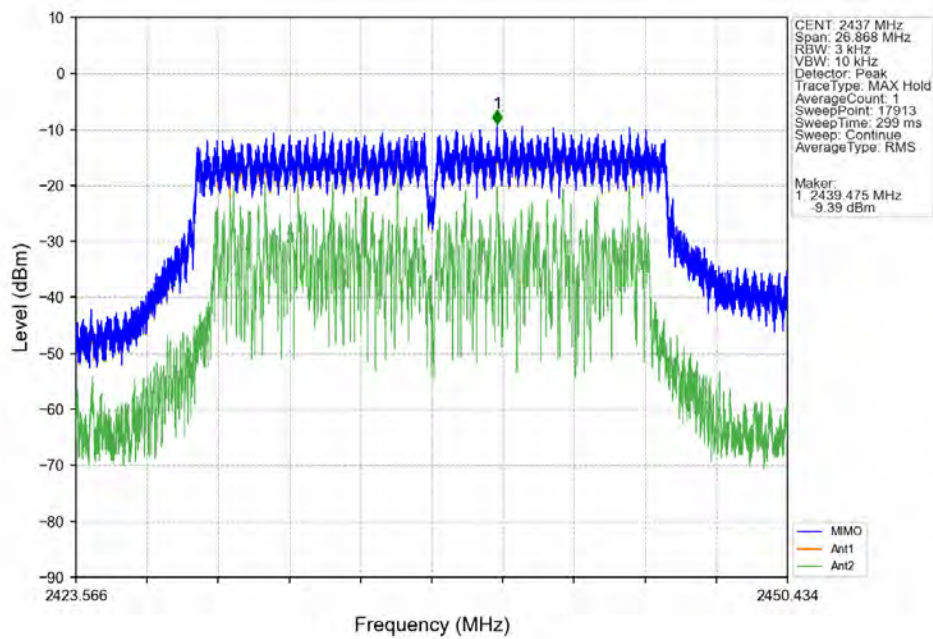
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802.11n(HT20)_MCH_2437MHz_ANT3 (MIMO)_NTNV



802.11n(HT20)_MCH_2437MHz_MIMO_NTNV

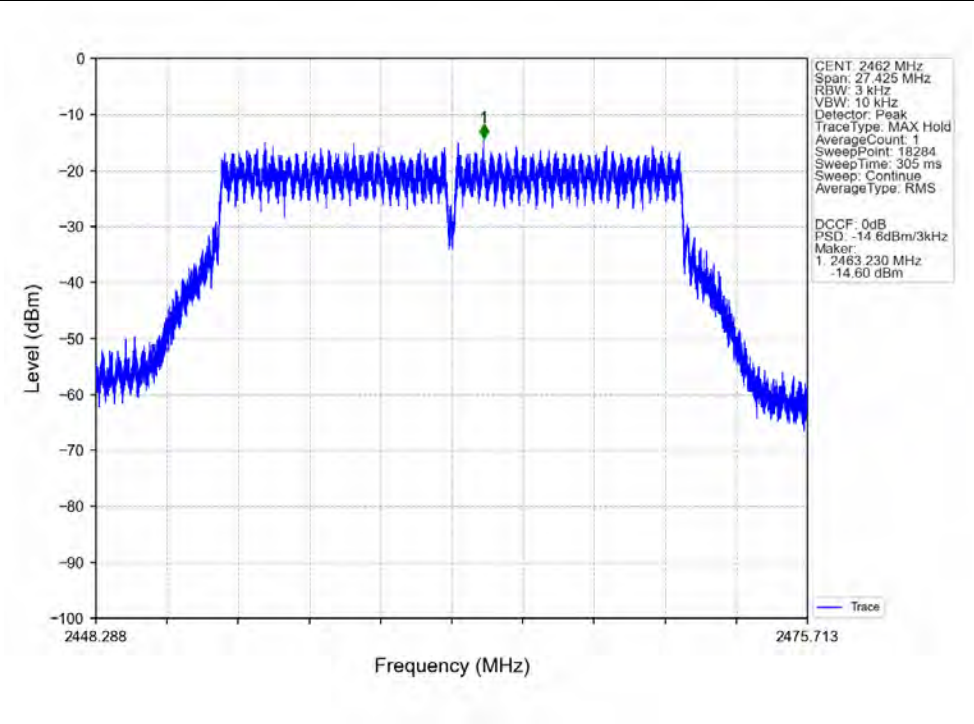




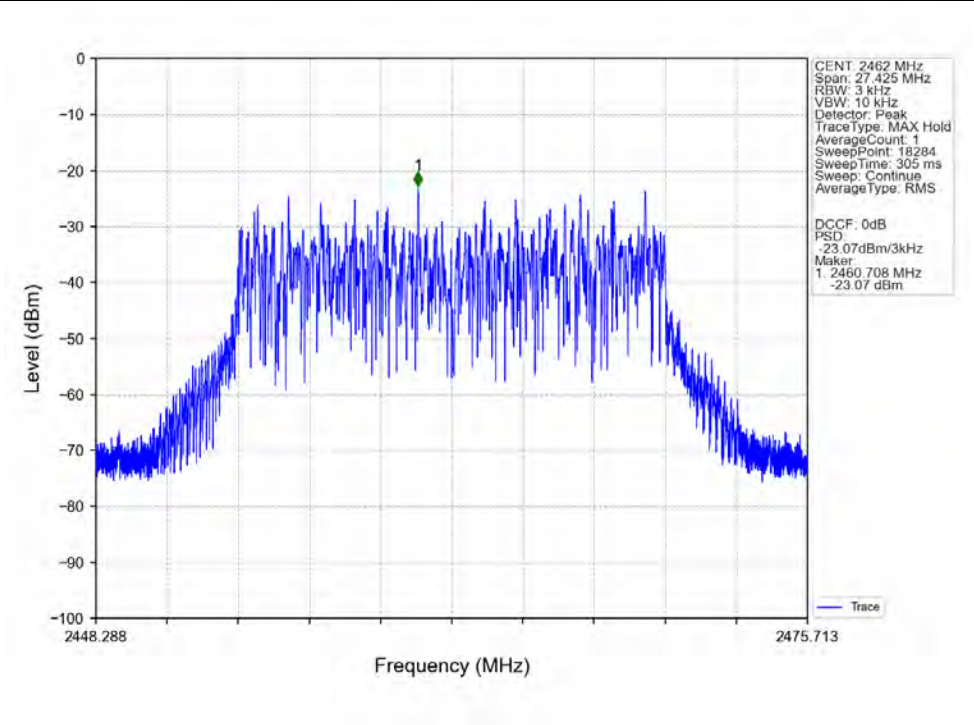
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802.11n(HT20)_HCH_2462MHz_ANT2 (MIMO)_NTNV



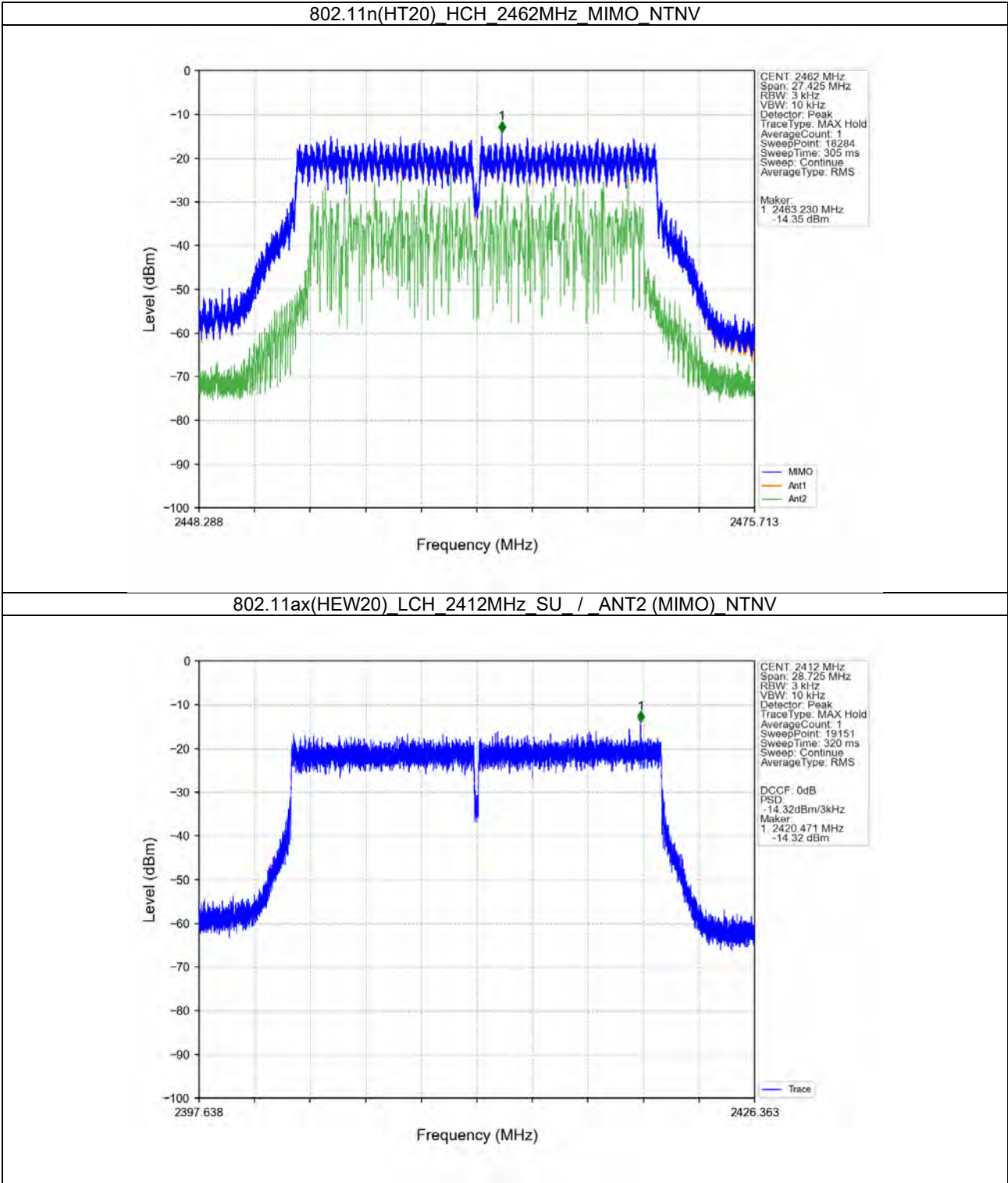
802.11n(HT20)_HCH_2462MHz_ANT3 (MIMO)_NTNV





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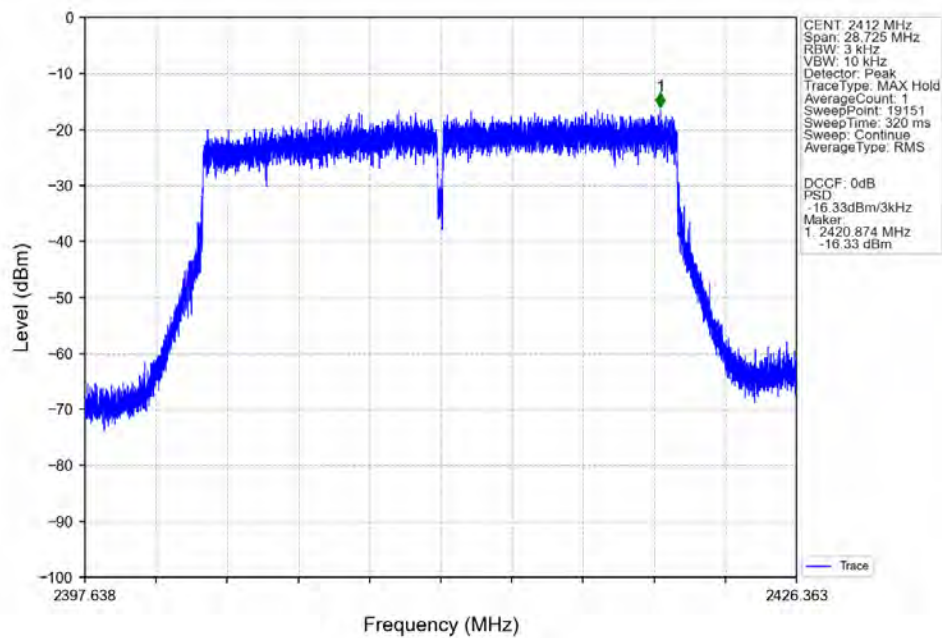




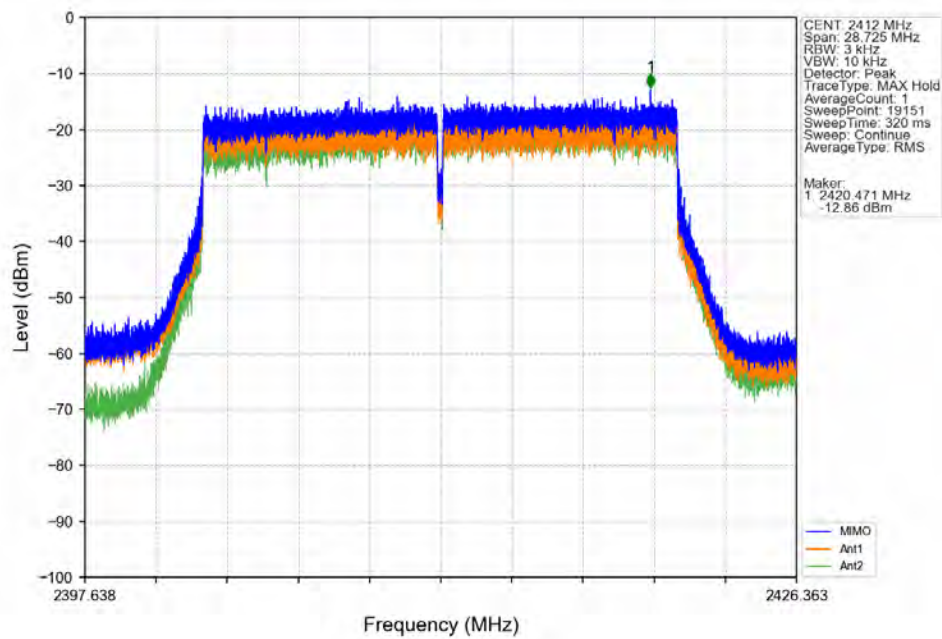
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802.11ax(HEW20) LCH 2412MHz_SU / ANT3 (MIMO) NTN



802.11ax(HEW20) LCH 2412MHz_SU / MIMO NTN

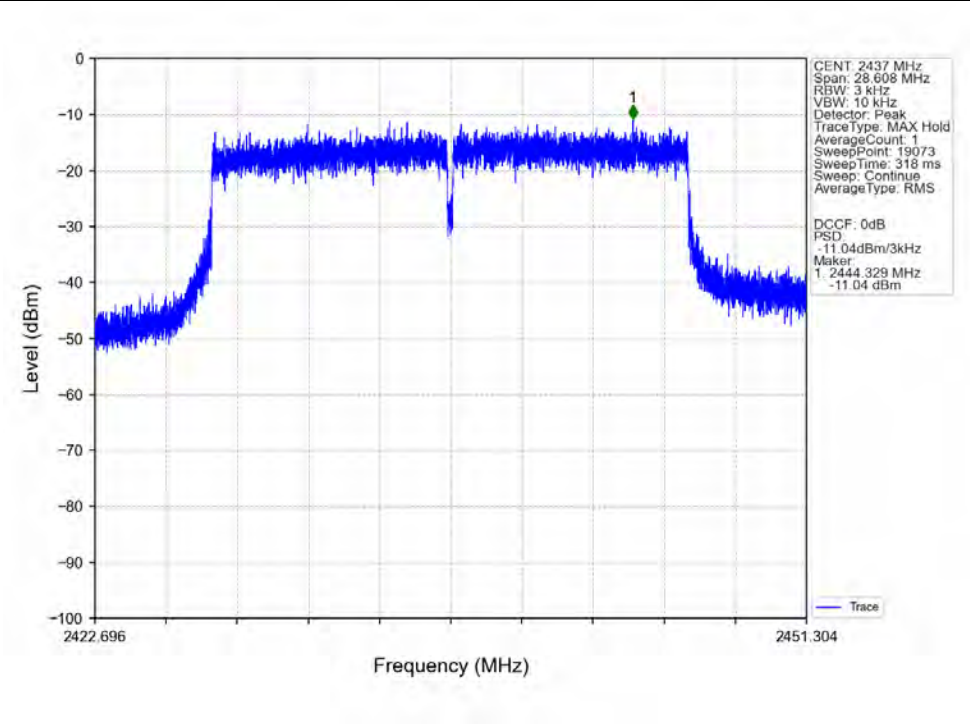




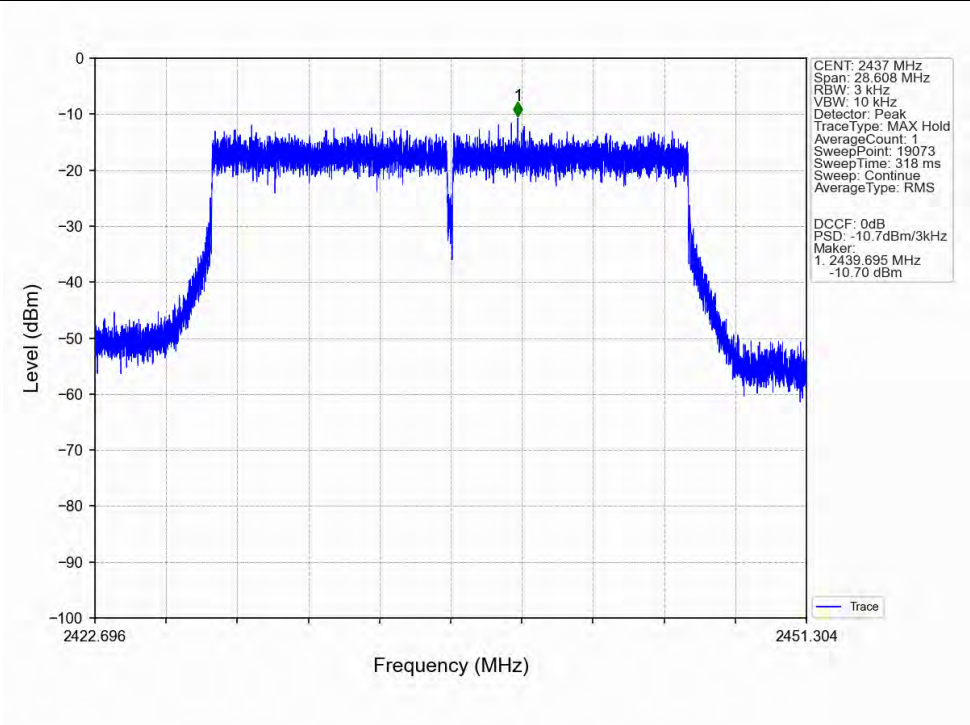
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802.11ax(HEW20) MCH_2437MHz_SU / ANT2 (MIMO) NTNv



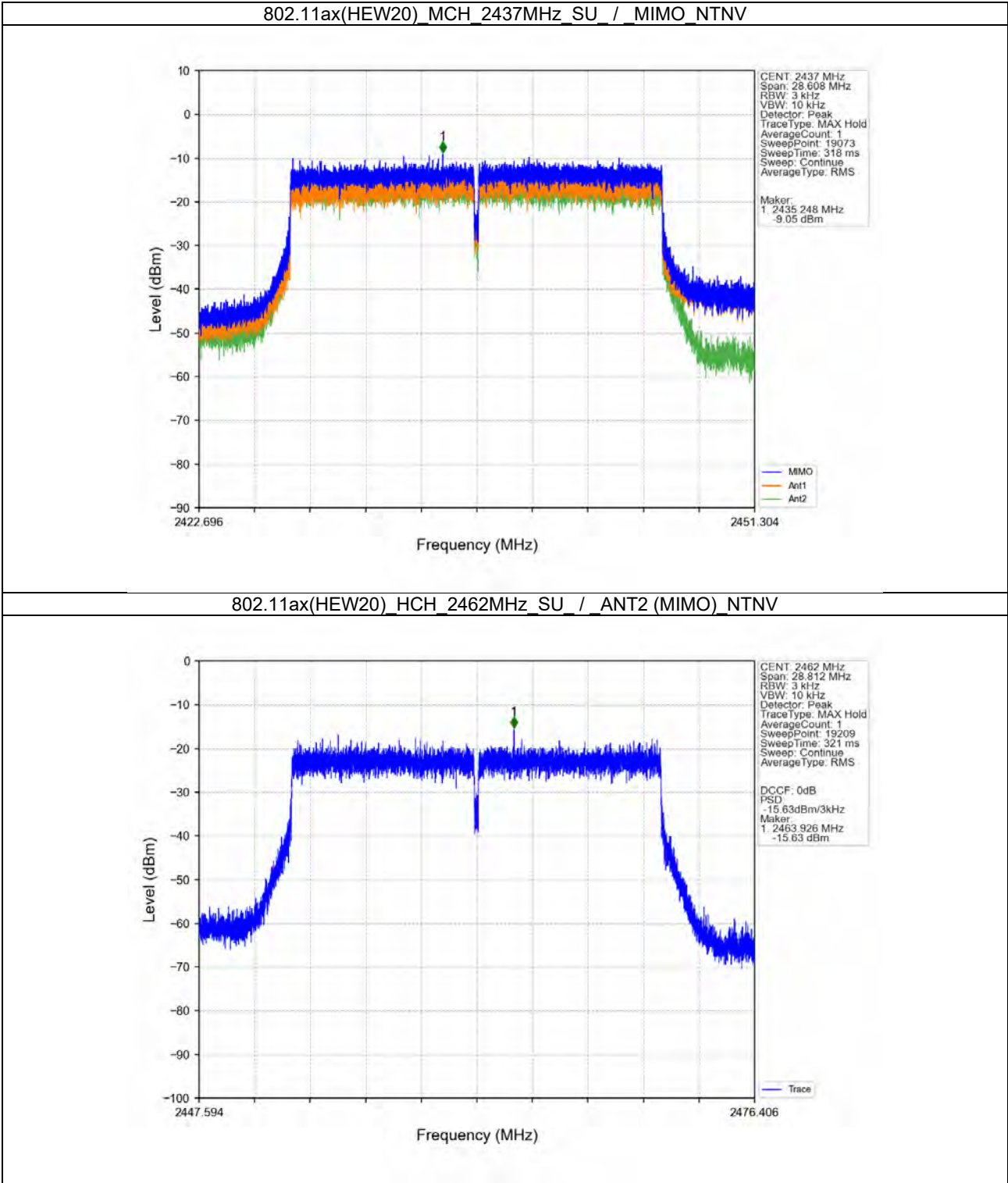
802.11ax(HEW20) MCH_2437MHz_SU / ANT3 (MIMO) NTNv





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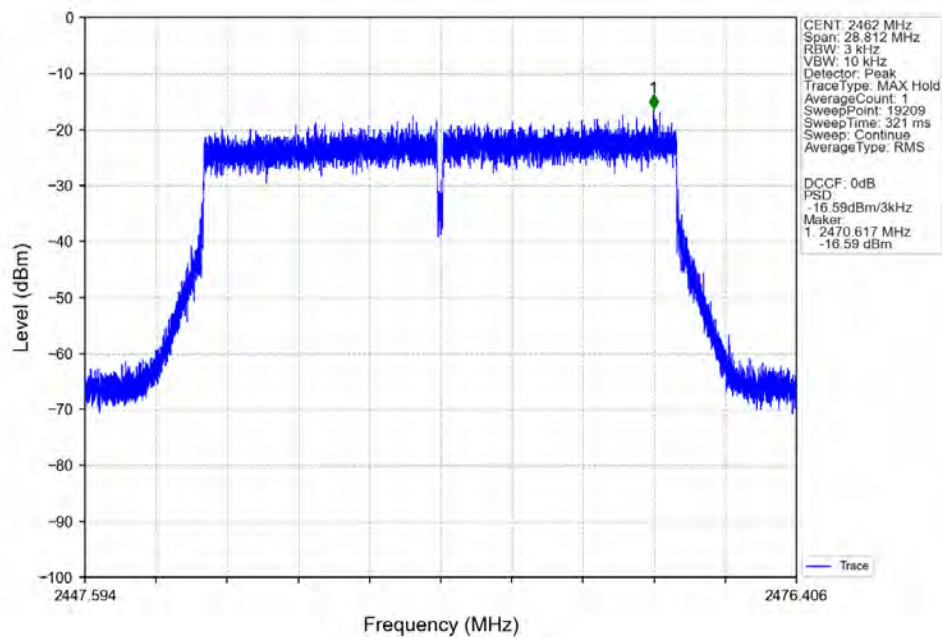




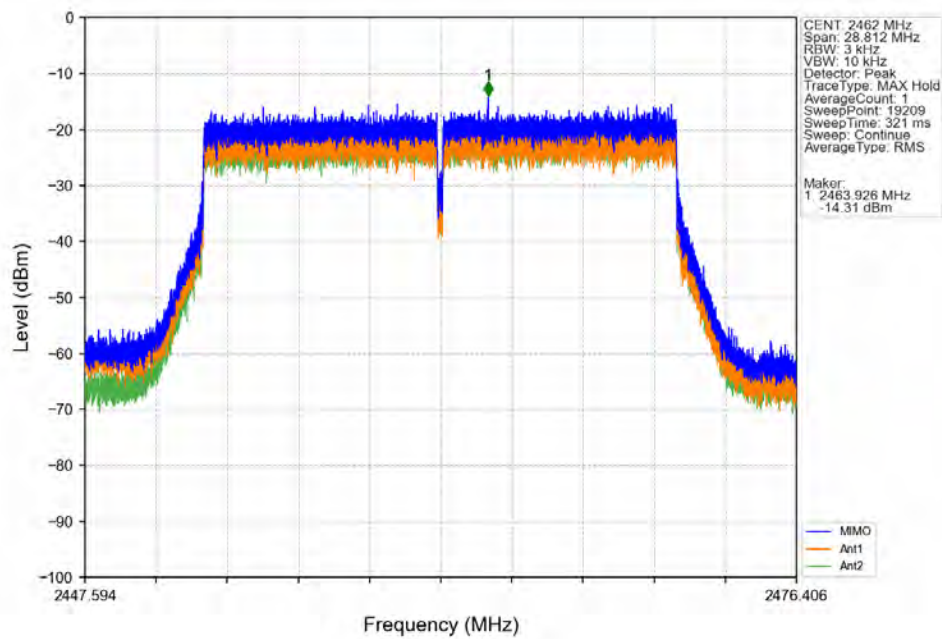
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802.11ax(HEW20) HCH 2462MHz SU / ANT3 (MIMO) NTN



802.11ax(HEW20) HCH 2462MHz SU / MIMO NTN





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5. Unwanted Emissions In Non-restricted Frequency Bands

5.1 Test Result

5.1.1 Ref

Mode	TX Type	Frequency (MHz)	RU	RU Pos	ANT	Level of Reference (dBm)
802.11b	SISO	2412	/	/	2	2.26
					3	6.17
		2437	/	/	2	4.32
					3	6.73
		2462	/	/	2	1.15
					3	5.51
802.11g	SISO	2412	/	/	2	1.21
					3	2.01
		2437	/	/	2	5.69
					3	4.15
		2462	/	/	2	-0.97
					3	-1.28
802.11n (HT20)	MIMO	2412	/	/	2	-0.55
					3	-0.02
		2437	/	/	2	4.34
					3	3.26
		2462	/	/	2	-0.78
					3	-0.49
802.11ax (HEW20)	MIMO	2412	SU	/	2	-1.26
					3	-1.13
		2437	SU	/	2	3.68
					3	2.51
		2462	SU	/	2	-2.90
					3	-2.50

Note1: Refer to FCC Part 15.247 (d) and ANSI C63.10-2020, the channel contains the maximum PSD level was used to establish the reference level.

5.1.2 CSE

Mode	TX Type	Frequency (MHz)	RU	RU Pos	ANT	Level of Reference (dBm)	Limit (dBm)	Verdict
802.11b	SISO	2412	/	/	2	4.32	-15.68	Pass
					3	6.73	-13.27	Pass
		2437	/	/	2	4.32	-15.68	Pass
					3	6.73	-13.27	Pass
		2462	/	/	2	4.32	-15.68	Pass
					3	6.73	-13.27	Pass
802.11g	SISO	2412	/	/	2	5.69	-14.31	Pass
					3	4.15	-15.85	Pass
		2437	/	/	2	5.69	-14.31	Pass
					3	4.15	-15.85	Pass
		2462	/	/	2	5.69	-14.31	Pass
					3	4.15	-15.85	Pass
802.11n (HT20)	MIMO	2412	/	/	2	4.34	-15.66	Pass
					3	3.26	-16.74	Pass
		2437	/	/	2	4.34	-15.66	Pass
					3	3.26	-16.74	Pass
		2462	/	/	2	4.34	-15.66	Pass
					2	4.34	-15.66	Pass

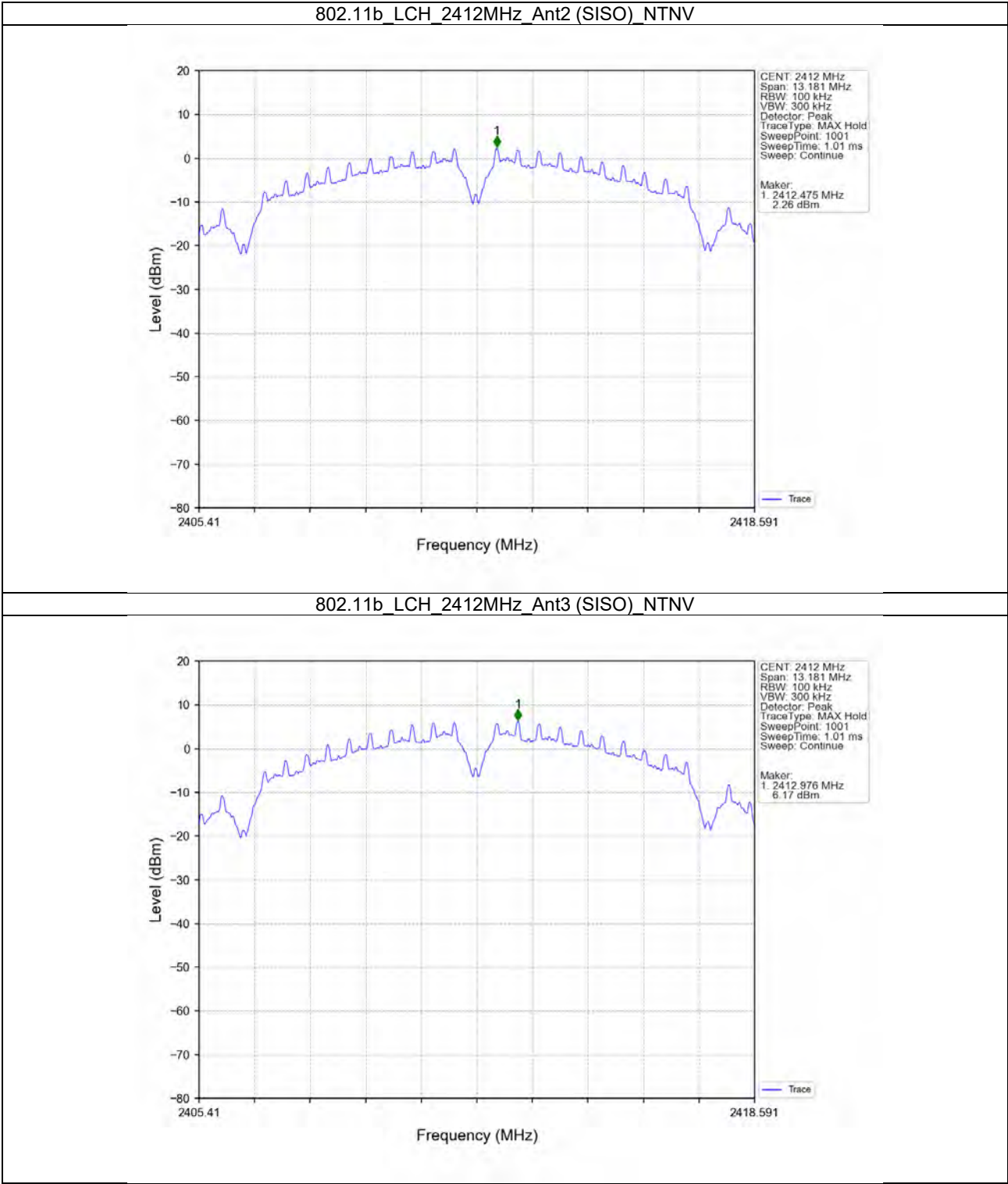


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5.2 Test Graph

5.2.1 Ref

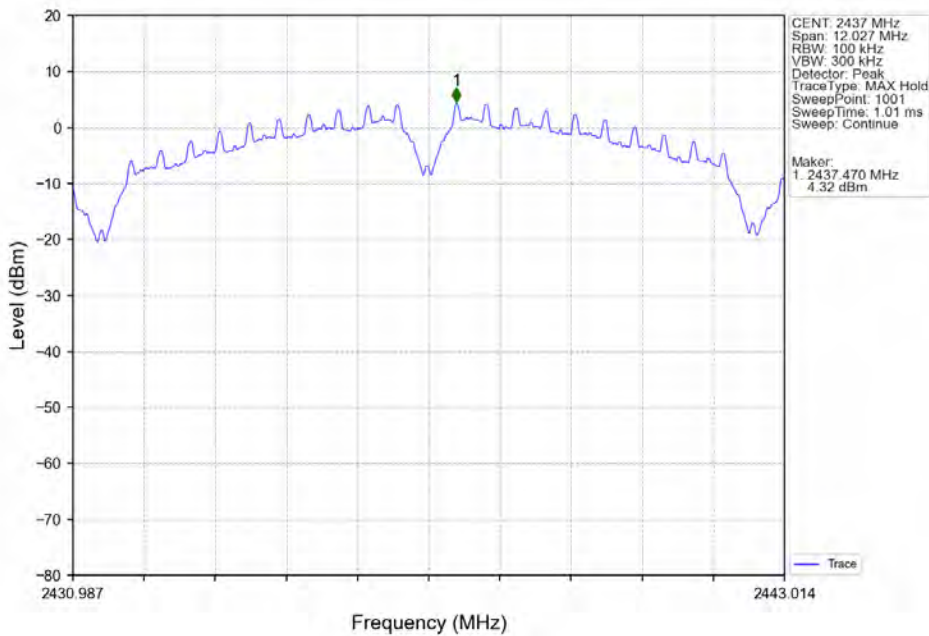




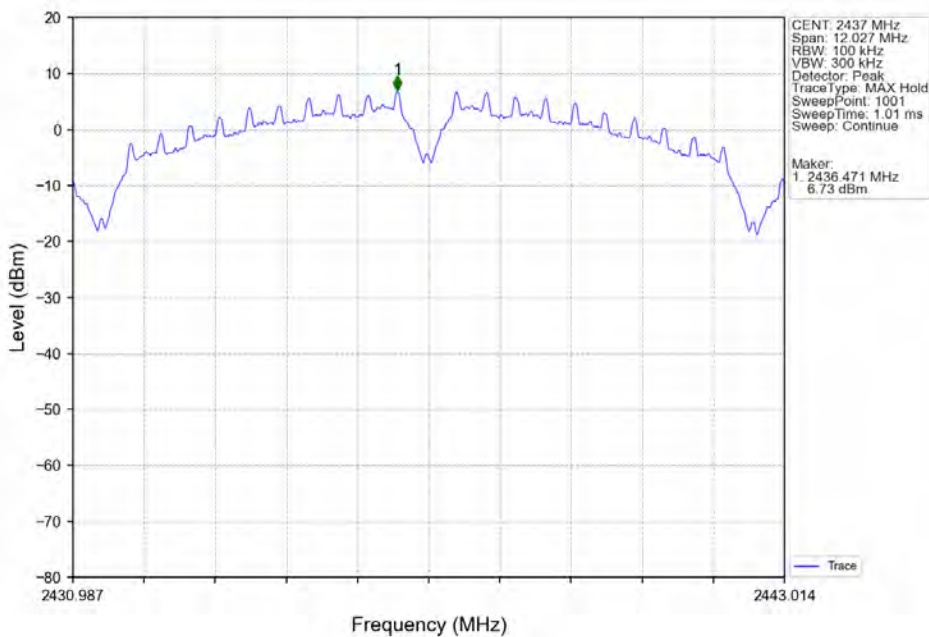
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802.11b_MCH_2437MHz_Ant2 (SISO)_NTNV



802.11b_MCH_2437MHz_Ant3 (SISO)_NTNV

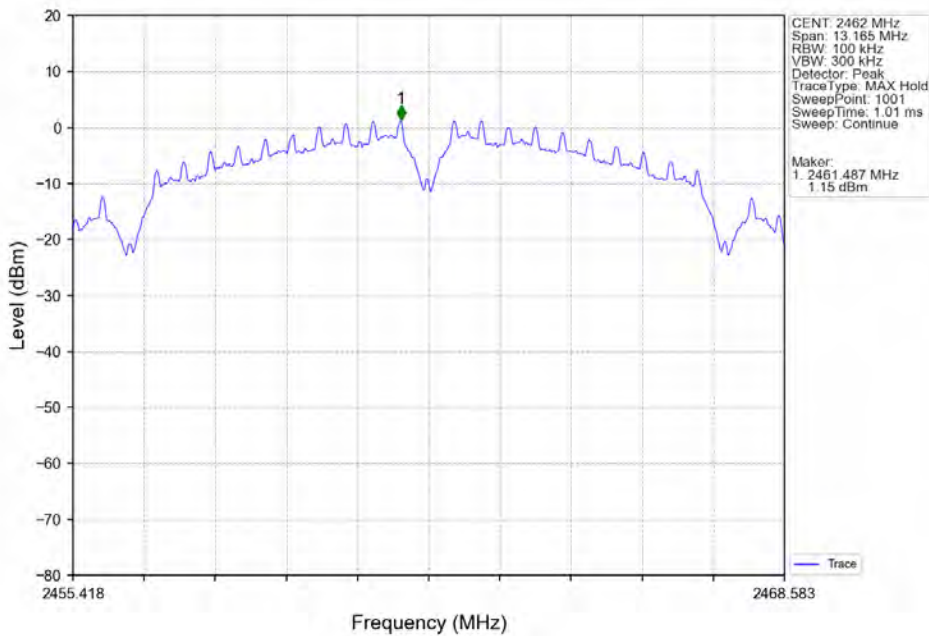




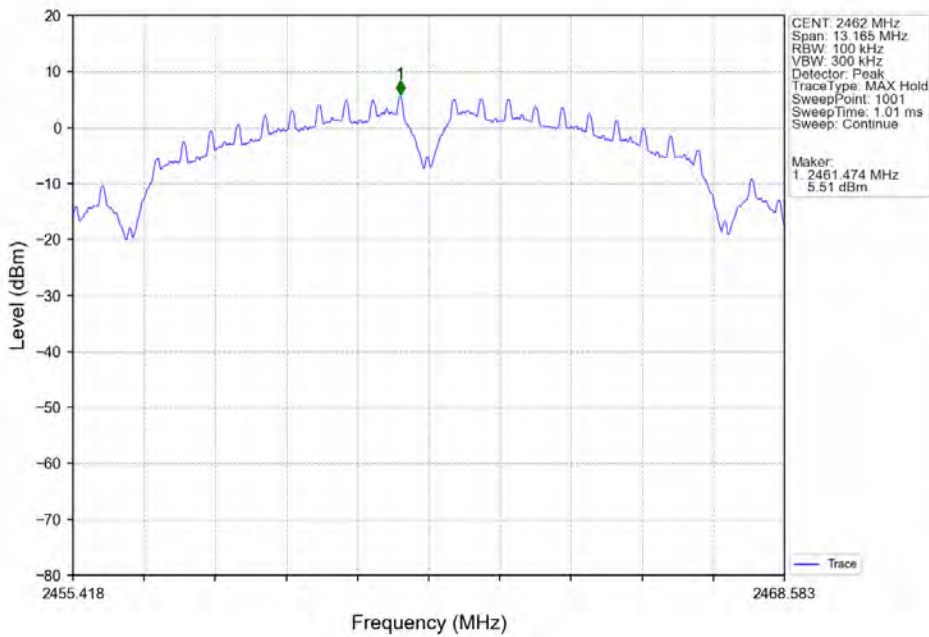
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802.11b HCH 2462MHz_Ant2 (SISO) NTN



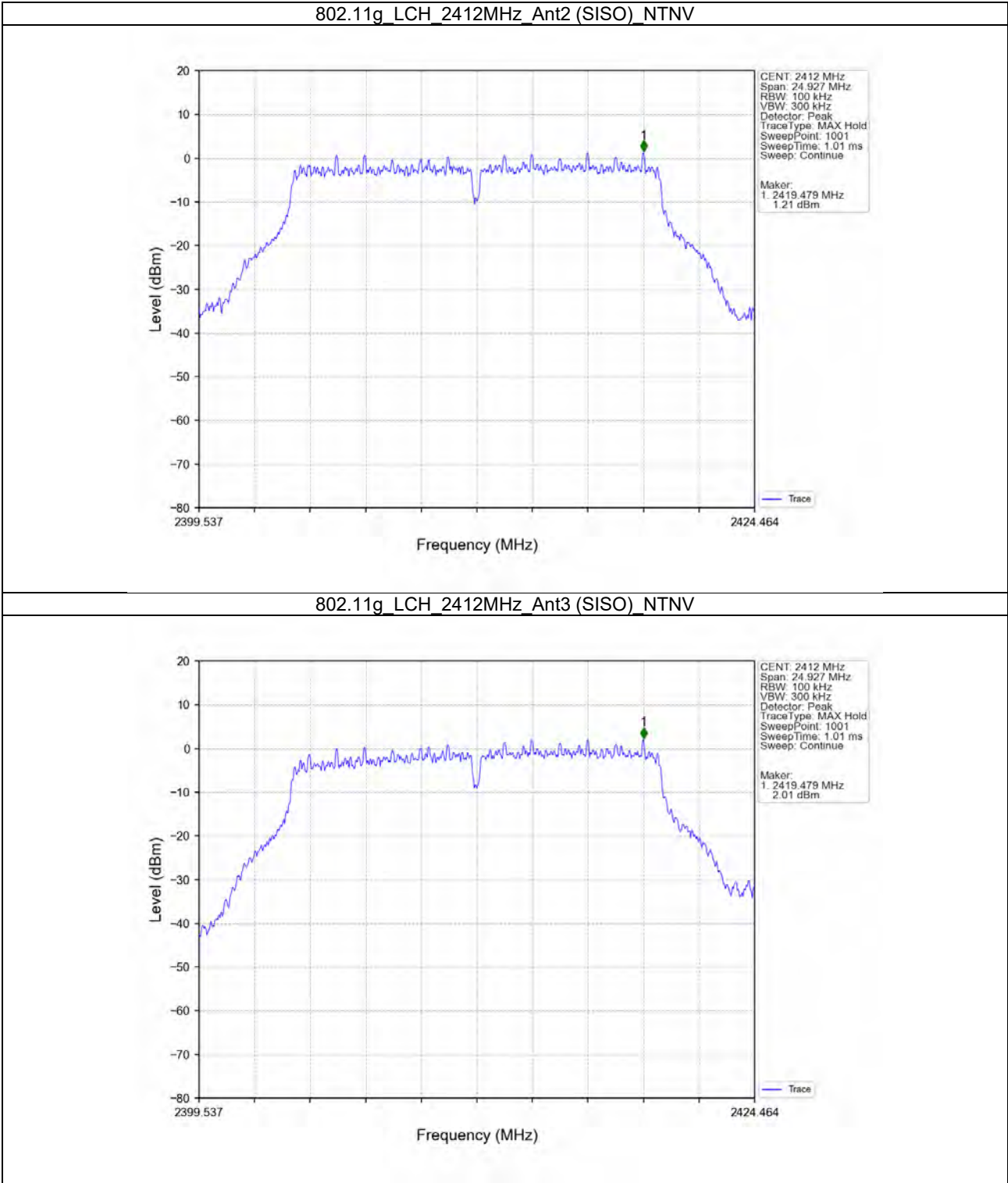
802.11b HCH 2462MHz_Ant3 (SISO) NTN





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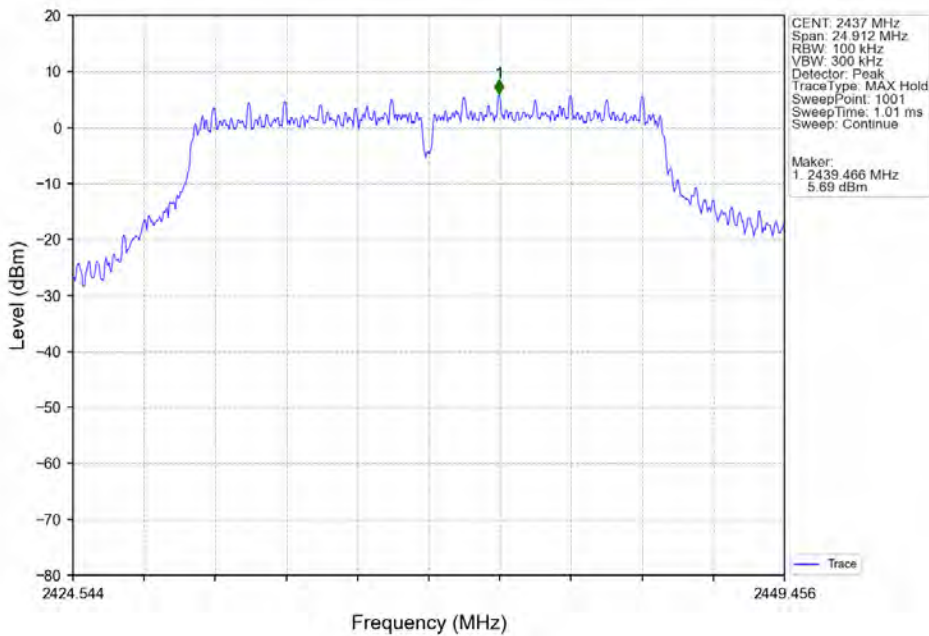




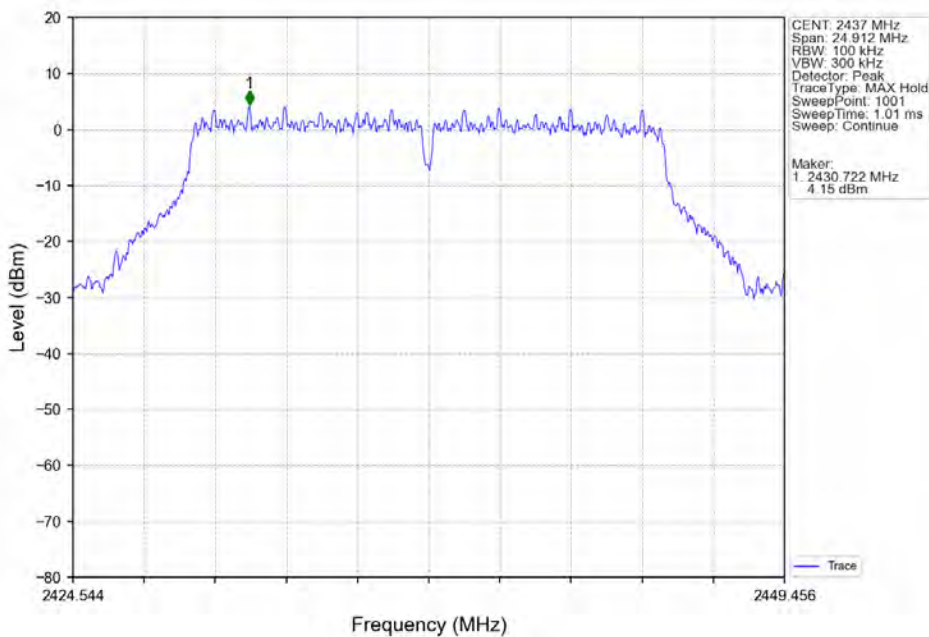
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802.11g_MCH_2437MHz_Ant2 (SISO) NTN



802.11g_MCH_2437MHz_Ant3 (SISO) NTN

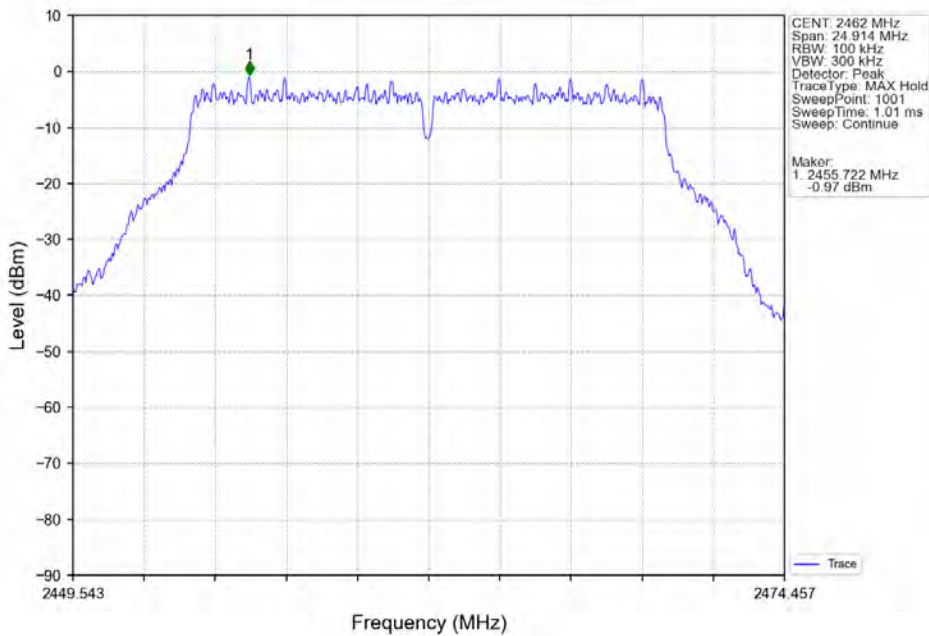




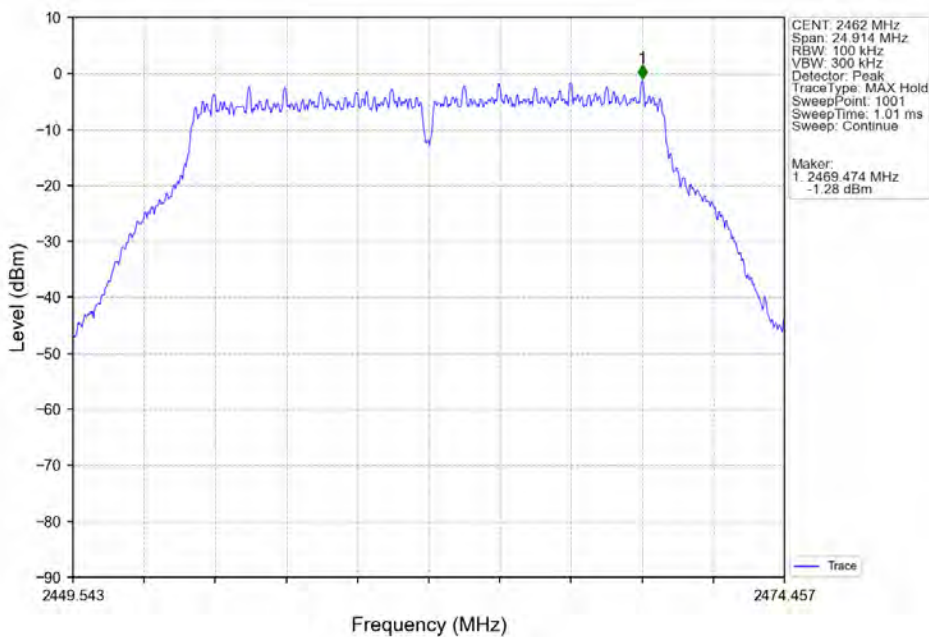
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802.11g_HCH_2462MHz_Ant2 (SISO)_NTNV



802.11g_HCH_2462MHz_Ant3 (SISO)_NTNV

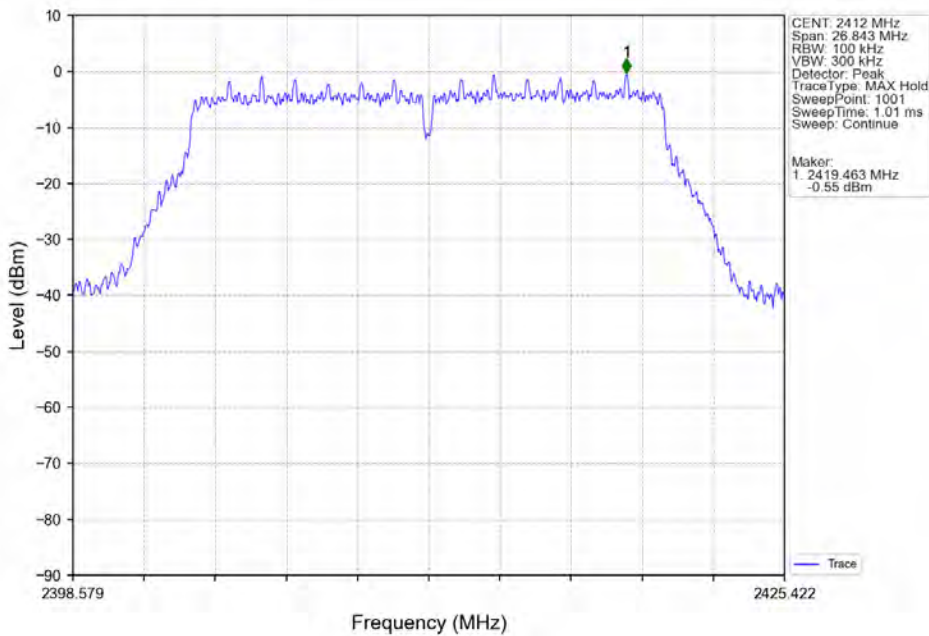




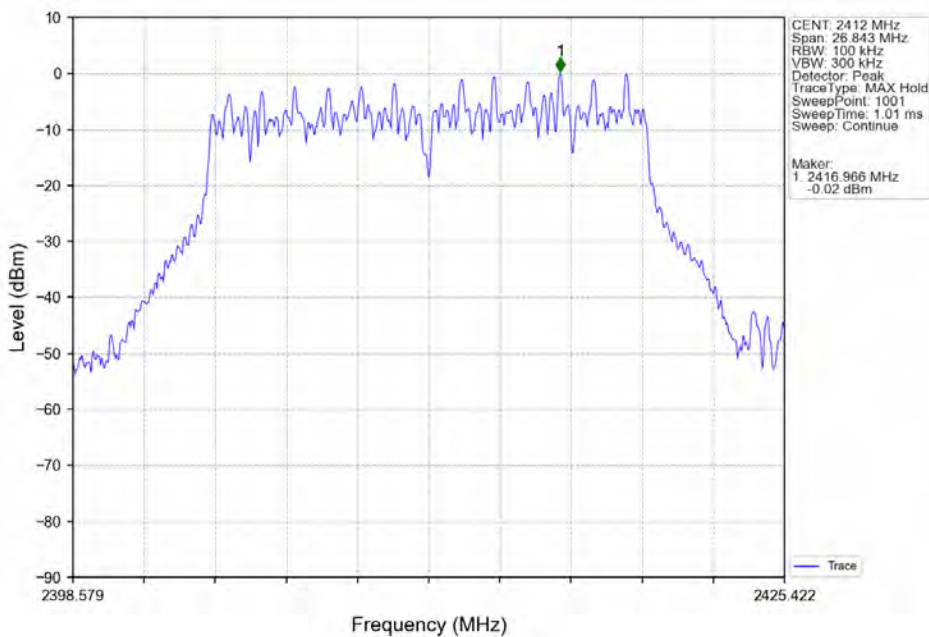
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802.11n(HT20)_LCH_2412MHz_Ant2 (MIMO)_NTNV



802.11n(HT20)_LCH_2412MHz_Ant3 (MIMO)_NTNV

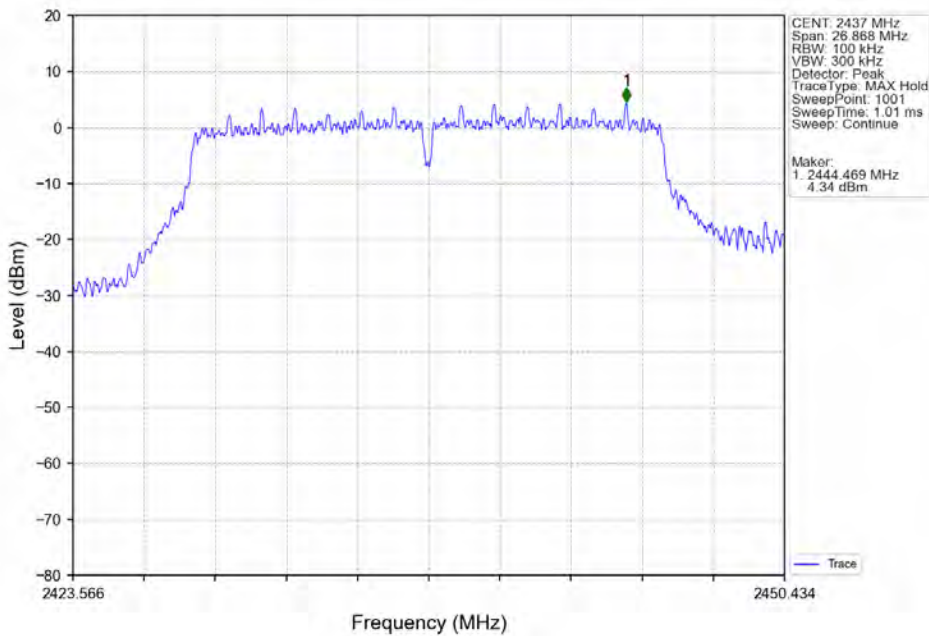




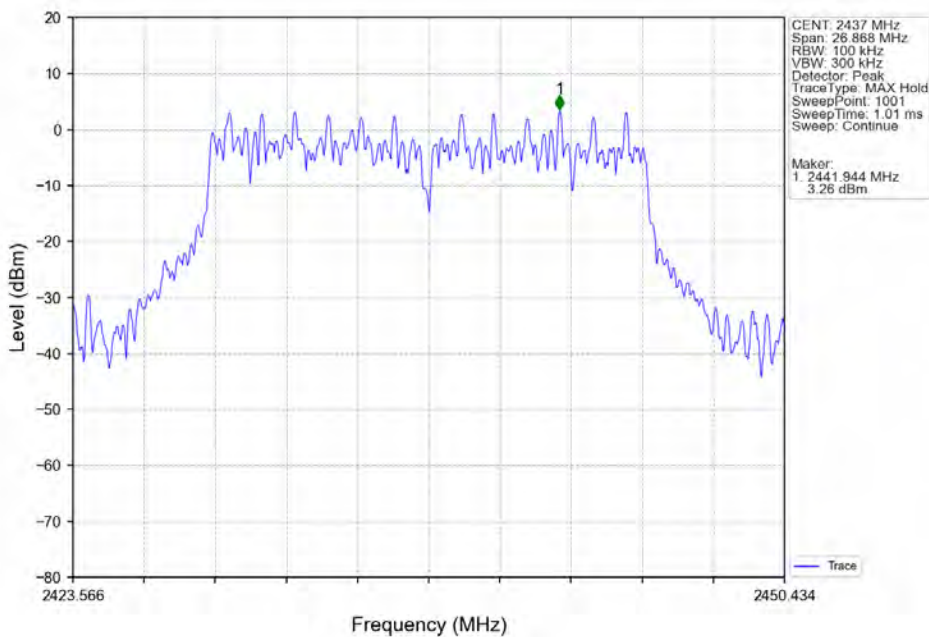
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802.11n(HT20)_MCH_2437MHz_Ant2 (MIMO)_NTNV



802.11n(HT20)_MCH_2437MHz_Ant3 (MIMO)_NTNV

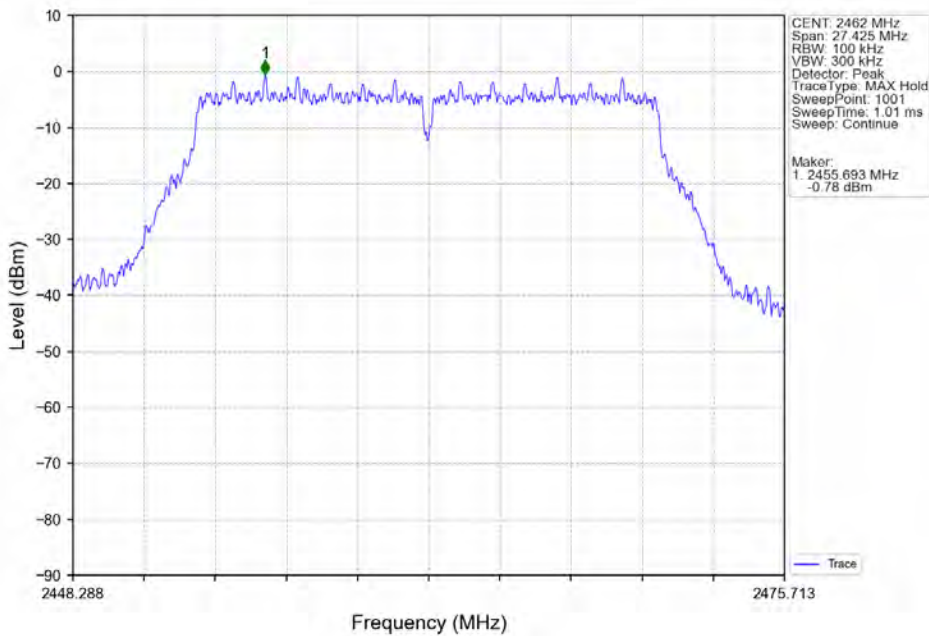




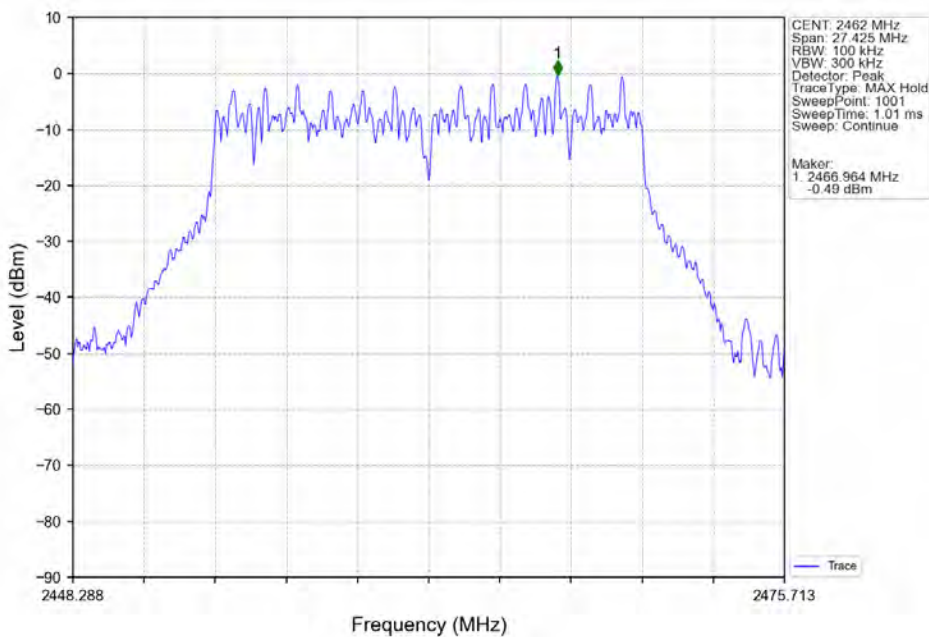
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802.11n(HT20) HCH_2462MHz_Ant2 (MIMO)_NTNV



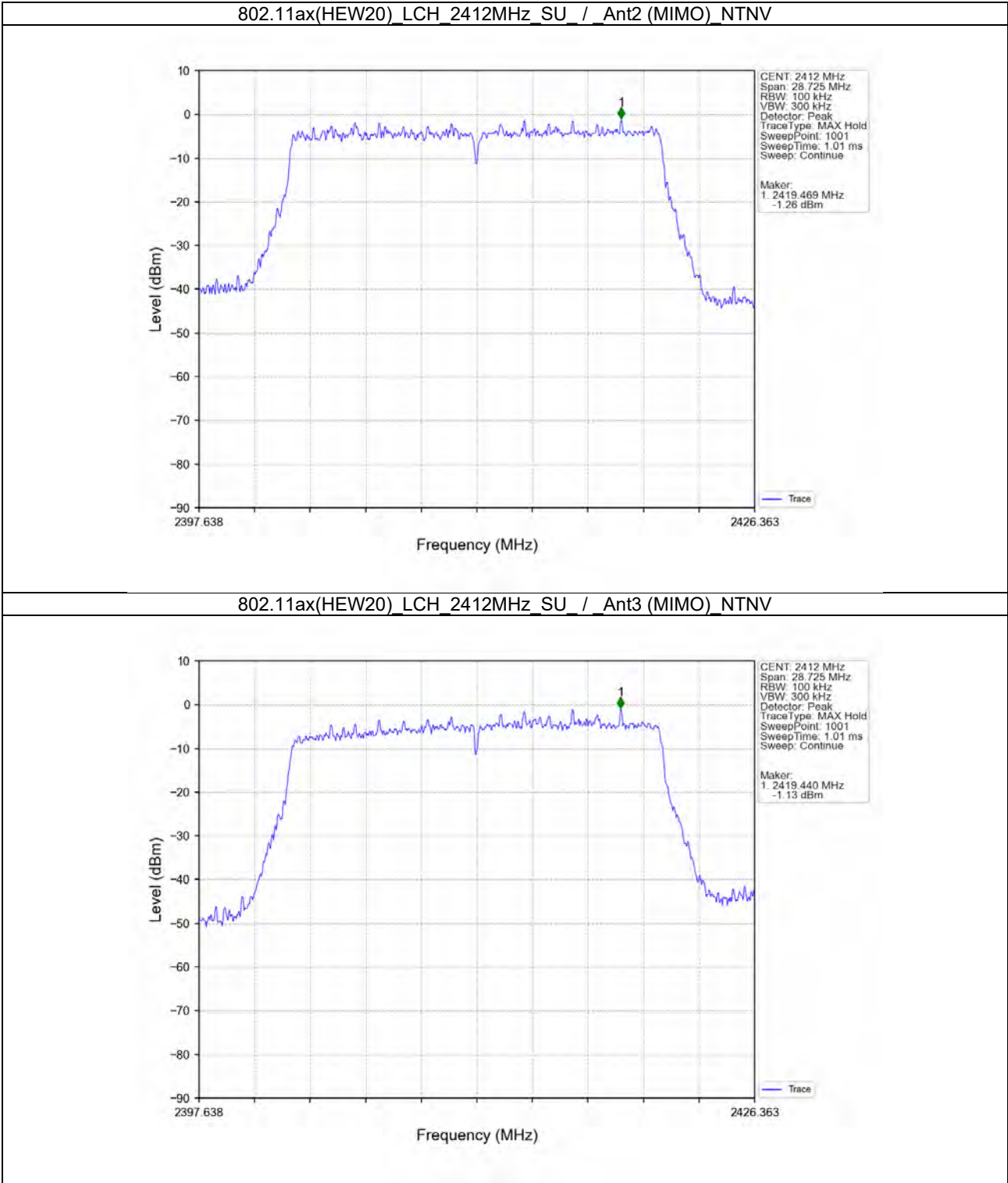
802.11n(HT20) HCH_2462MHz_Ant3 (MIMO)_NTNV





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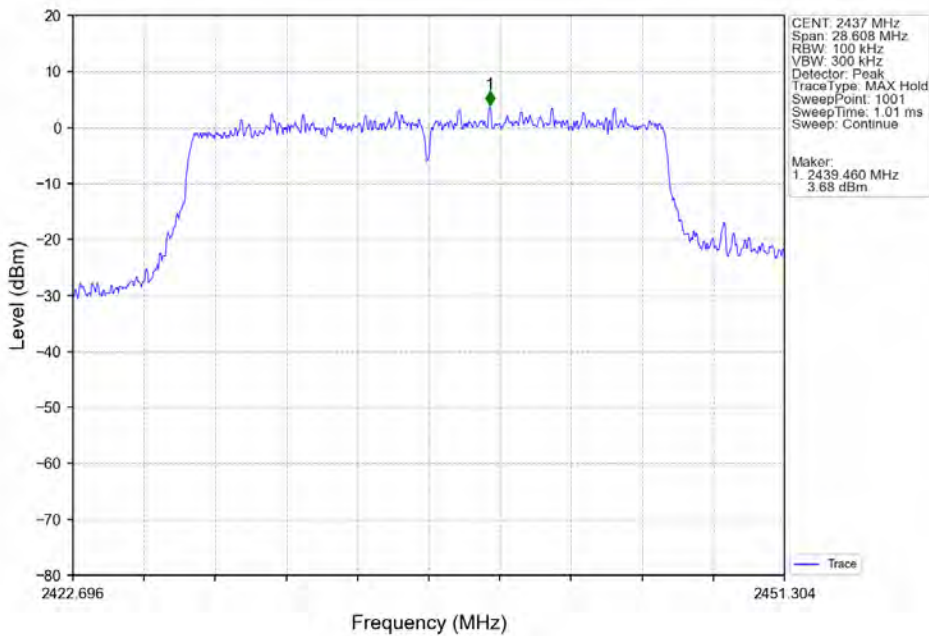




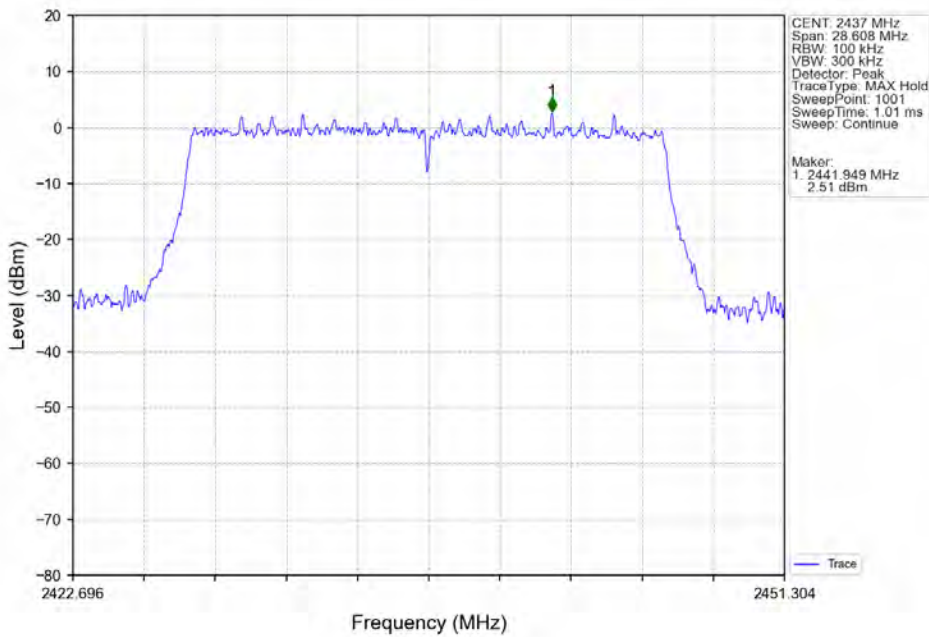
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802.11ax(HEW20)_MCH_2437MHz_SU / _Ant2 (MIMO)_NTNV



802.11ax(HEW20)_MCH_2437MHz_SU / _Ant3 (MIMO)_NTNV

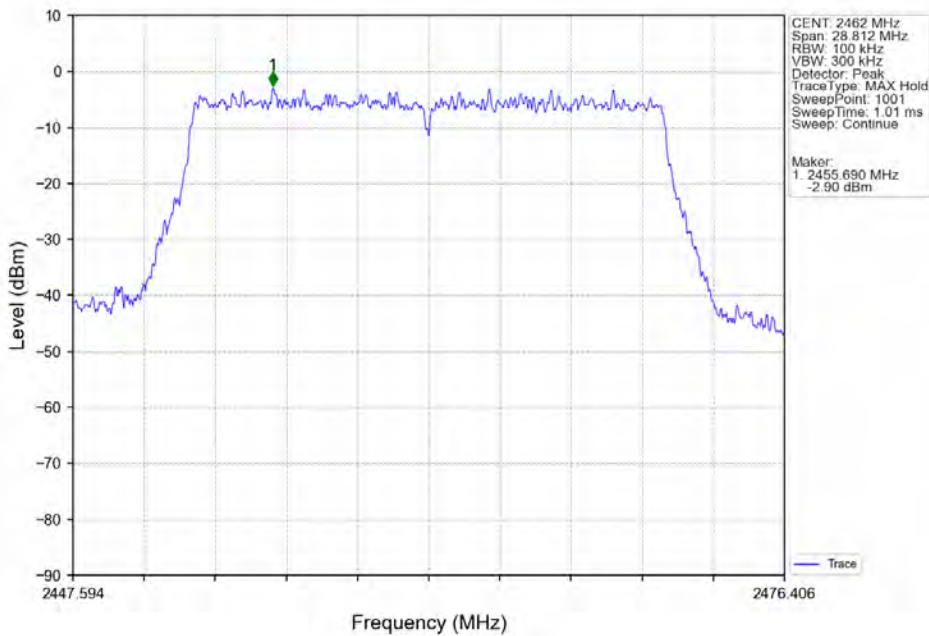




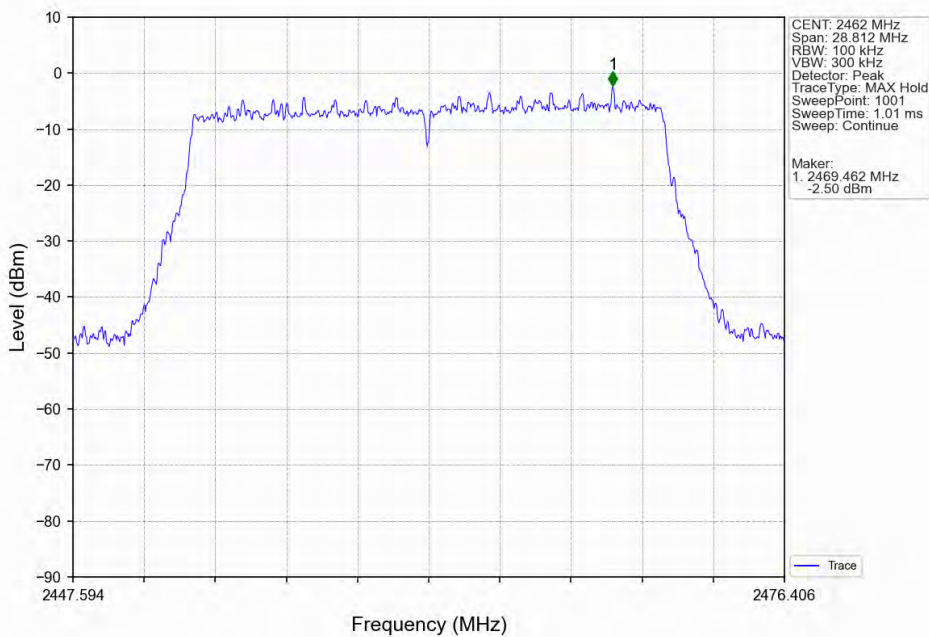
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802.11ax(HEW20) HCH 2462MHz SU / Ant2 (MIMO) NTN



802.11ax(HEW20) HCH 2462MHz SU / Ant3 (MIMO) NTN

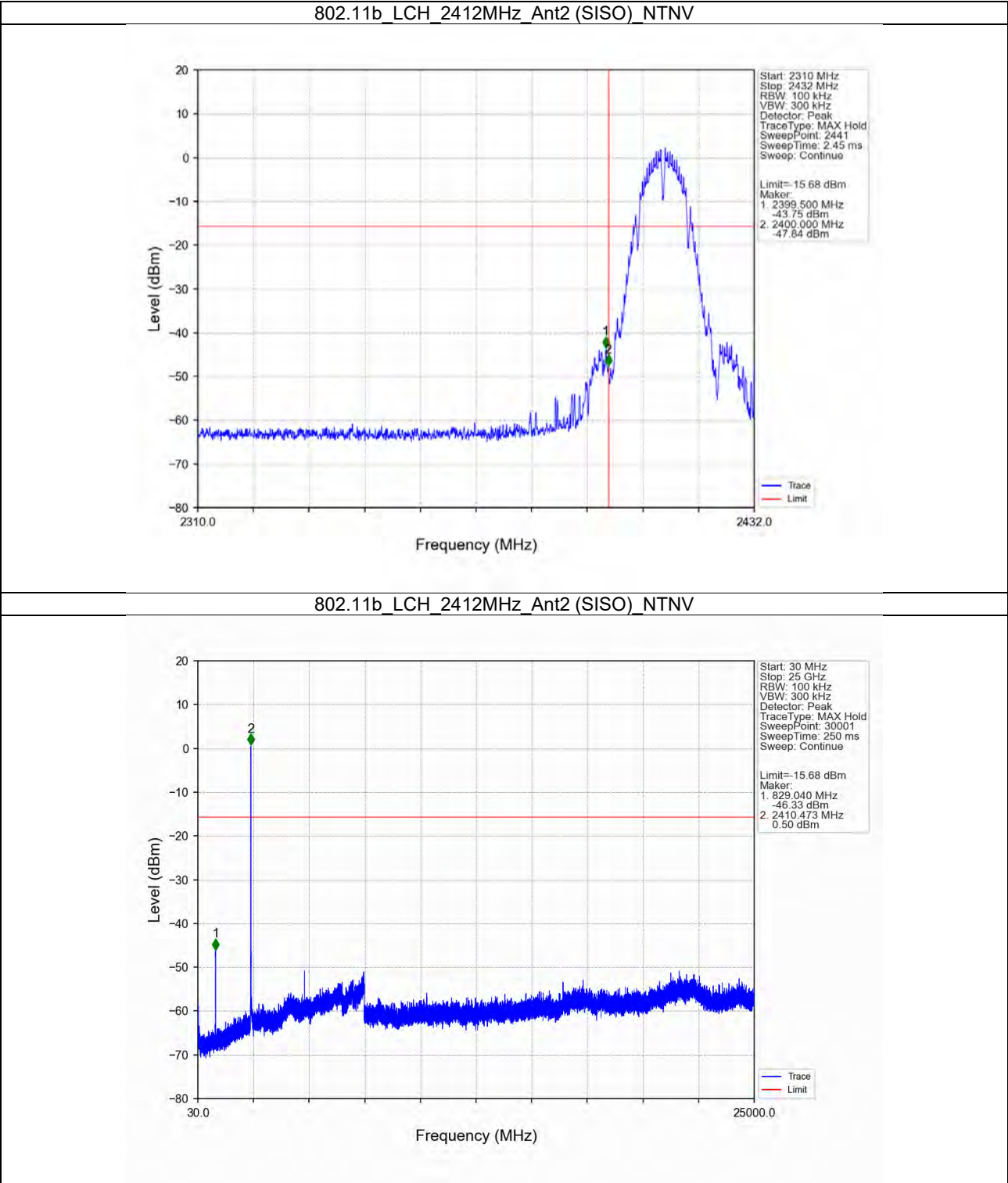




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5.2.2 CSE

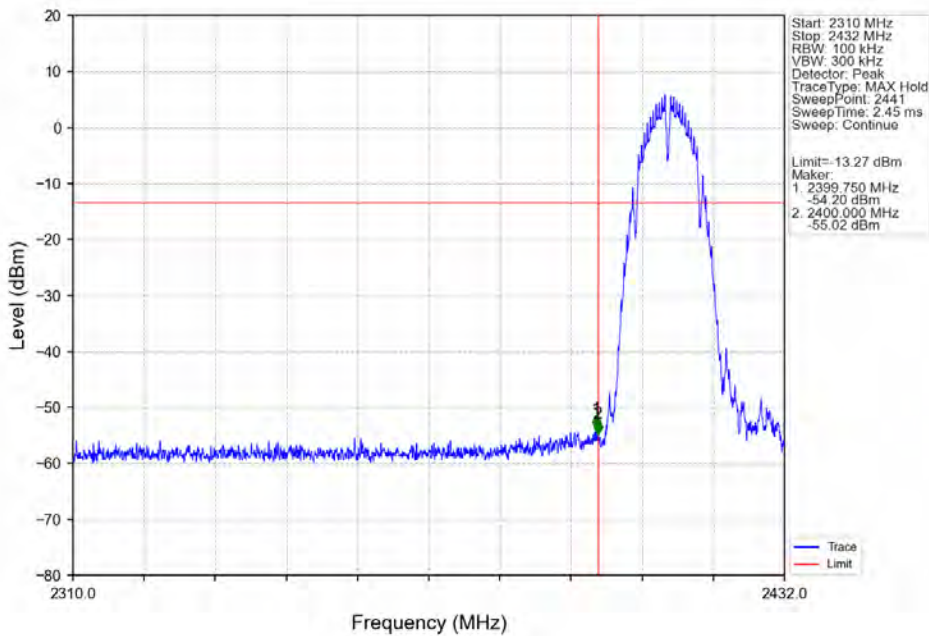




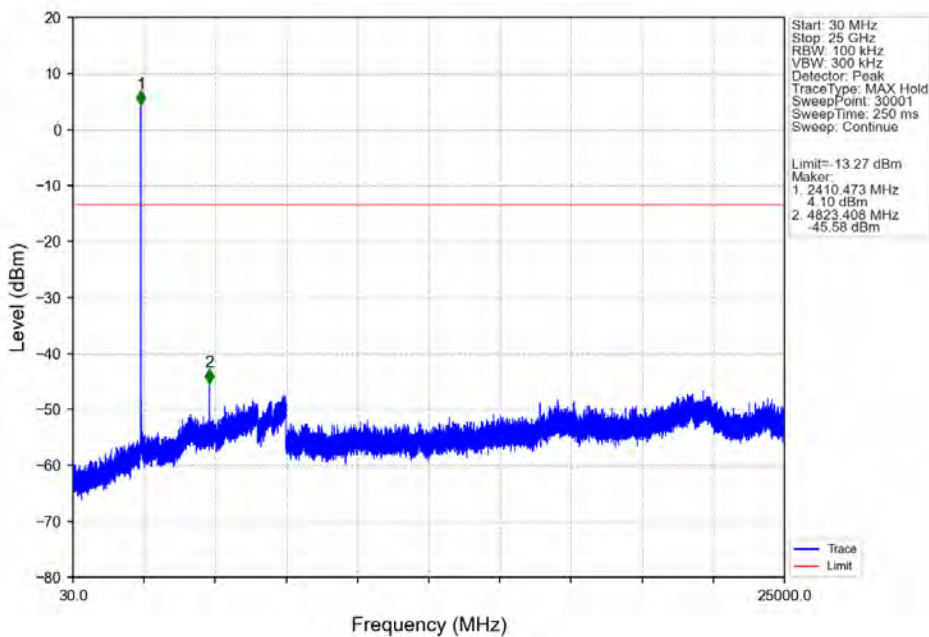
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802.11b LCH 2412MHz_Ant3 (SISO) _NTNV



802.11b LCH 2412MHz_Ant3 (SISO) _NTNV

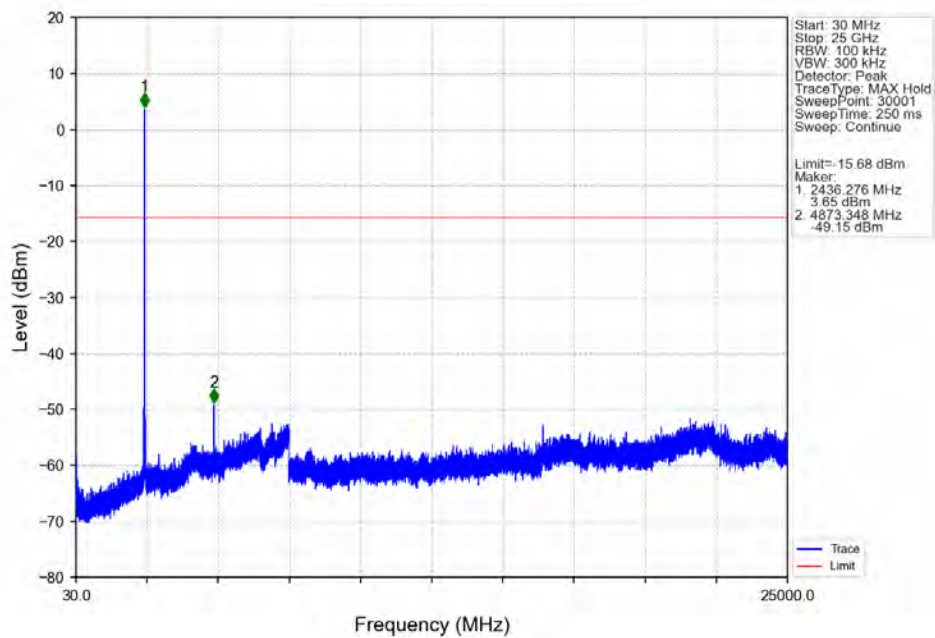




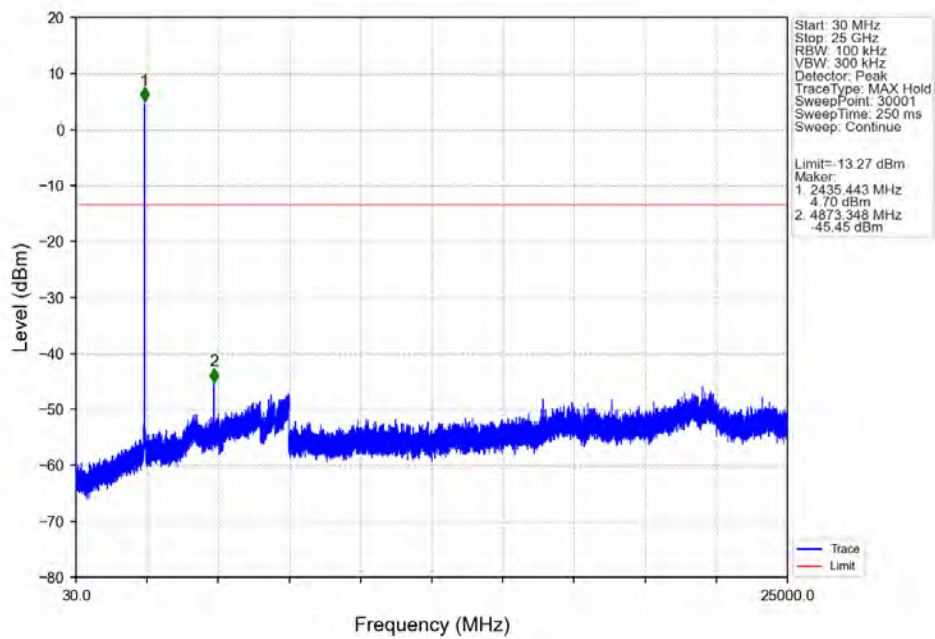
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802.11b_MCH_2437MHz_Ant2 (SISO)_NTNV



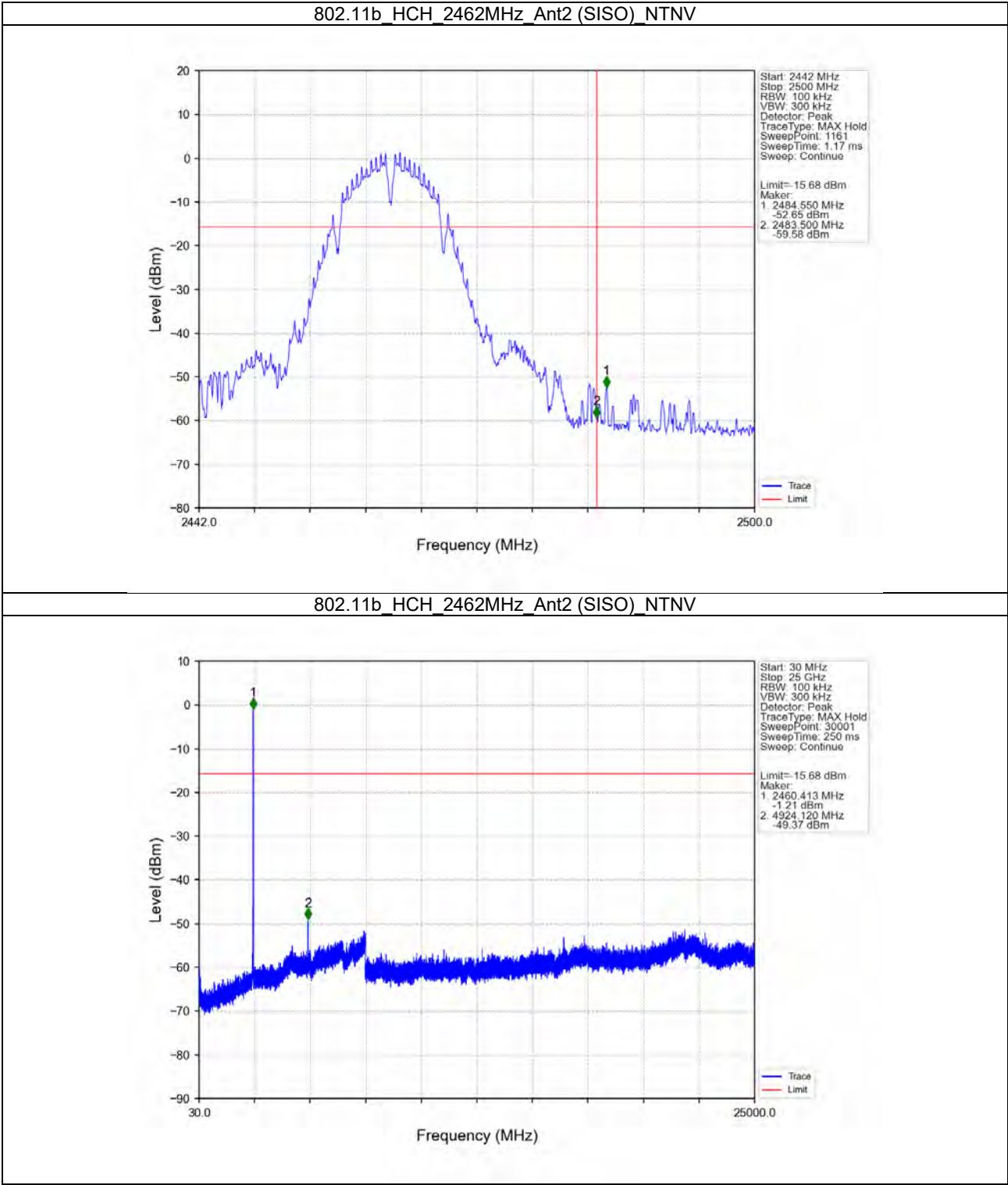
802.11b_MCH_2437MHz_Ant3 (SISO)_NTNV





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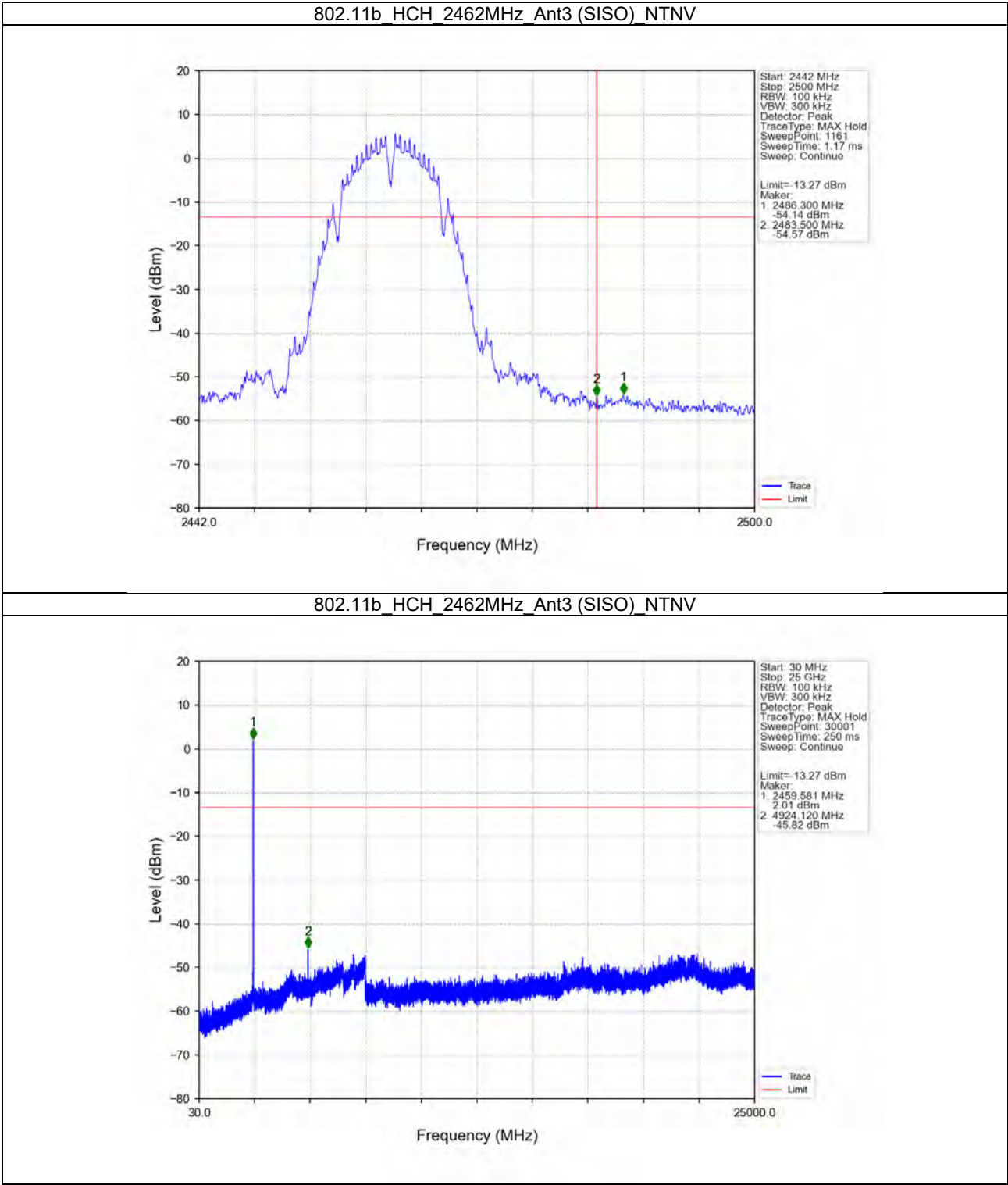
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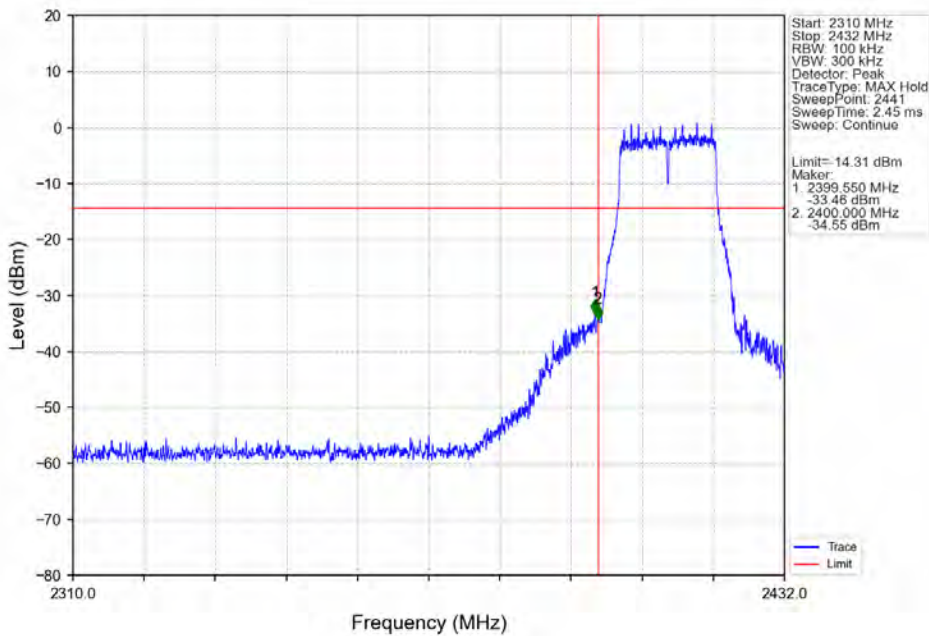




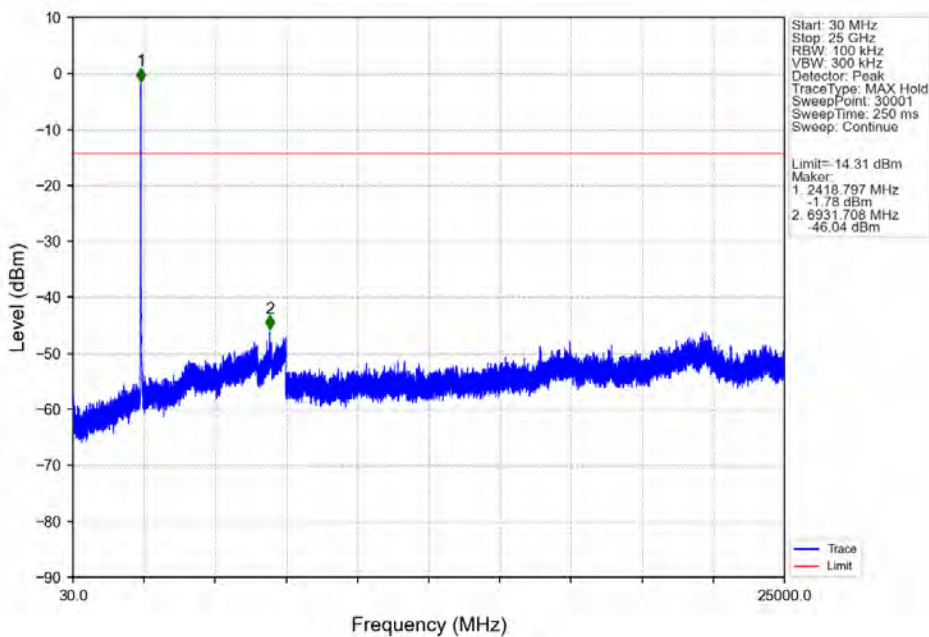
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802.11g_LCH_2412MHz_Ant2 (SISO)_NTNV



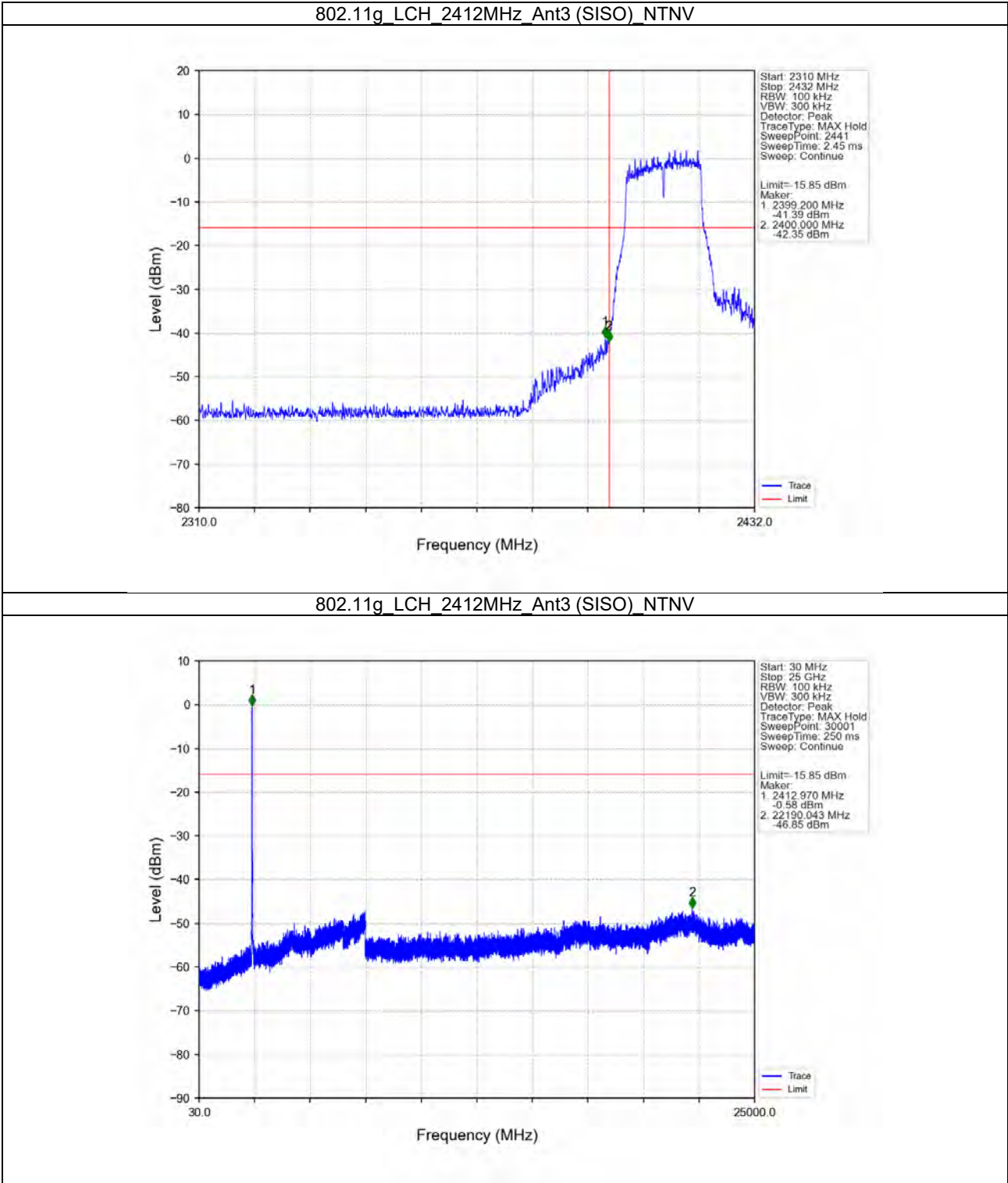
802.11g_LCH_2412MHz_Ant2 (SISO)_NTNV





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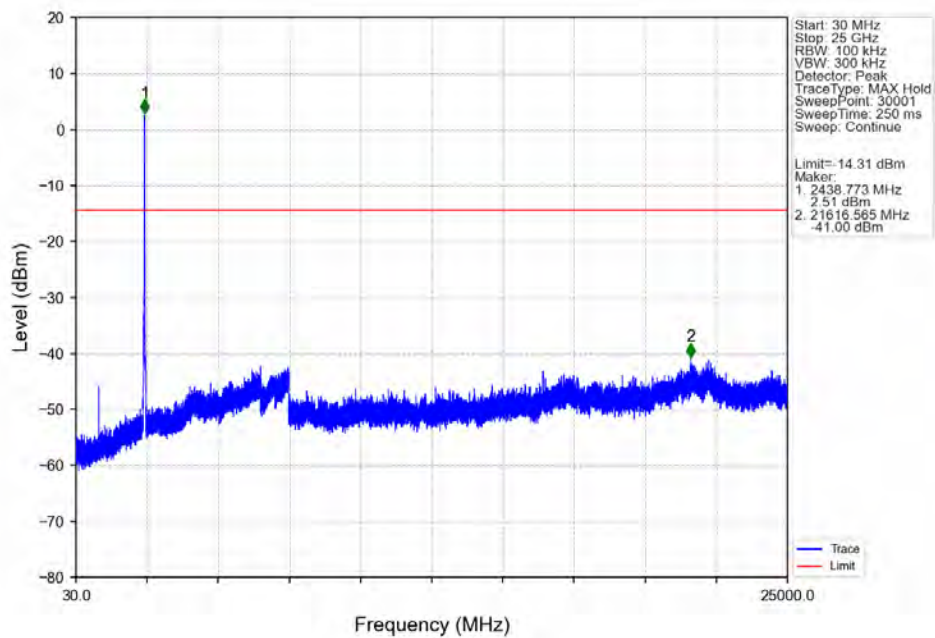




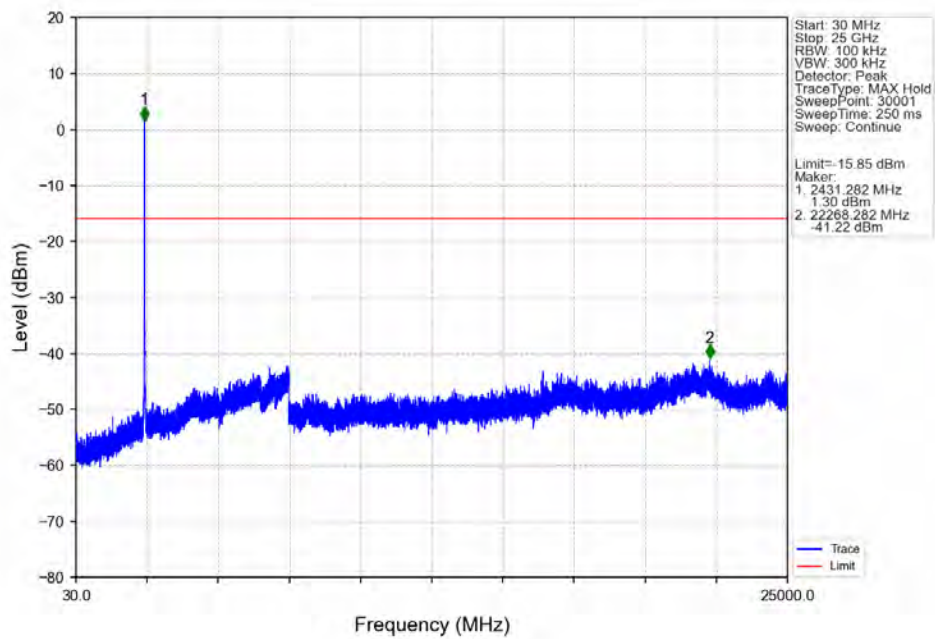
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802.11g_MCH_2437MHz_Ant2 (SISO)_NTNV



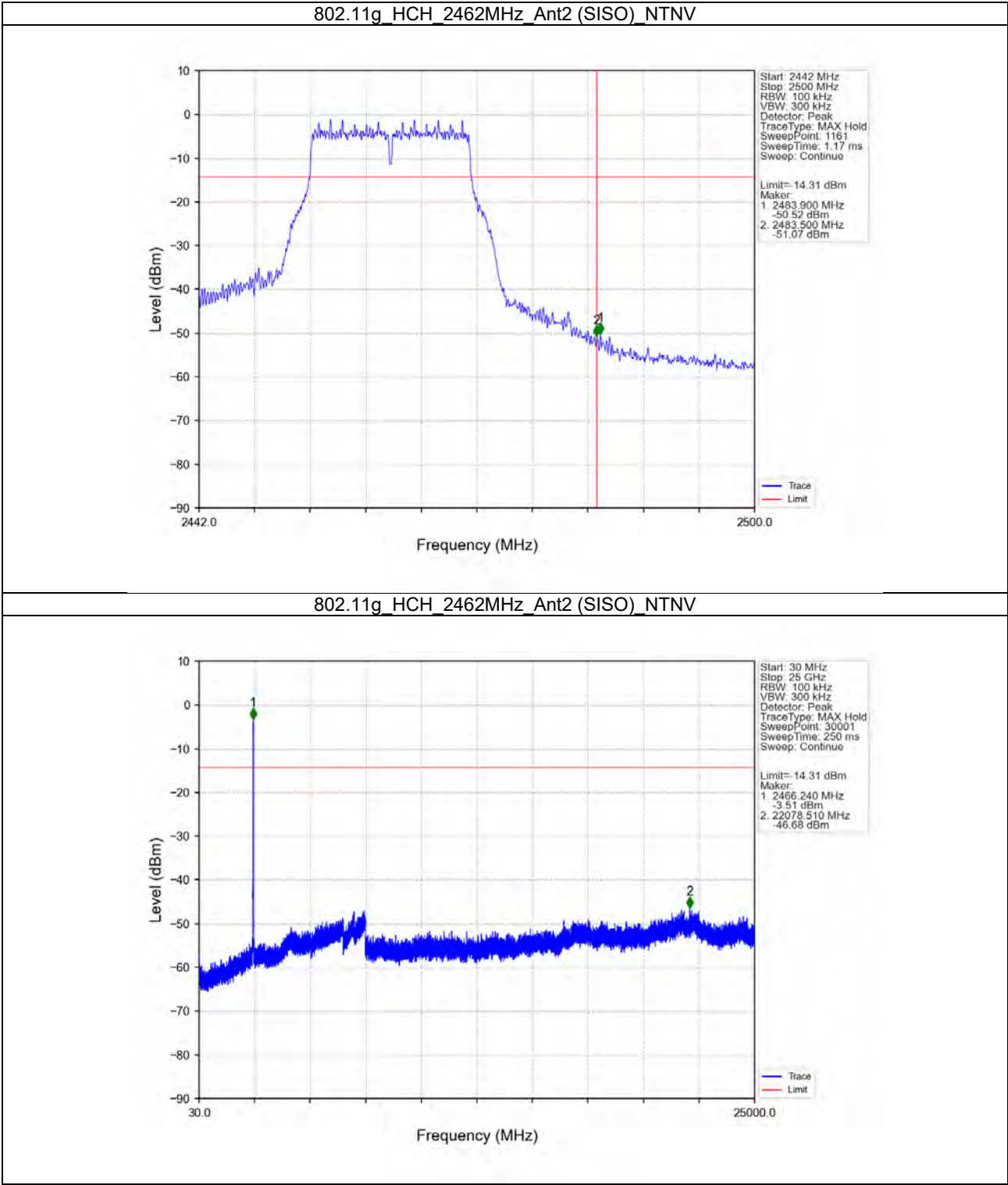
802.11g_MCH_2437MHz_Ant3 (SISO)_NTNV





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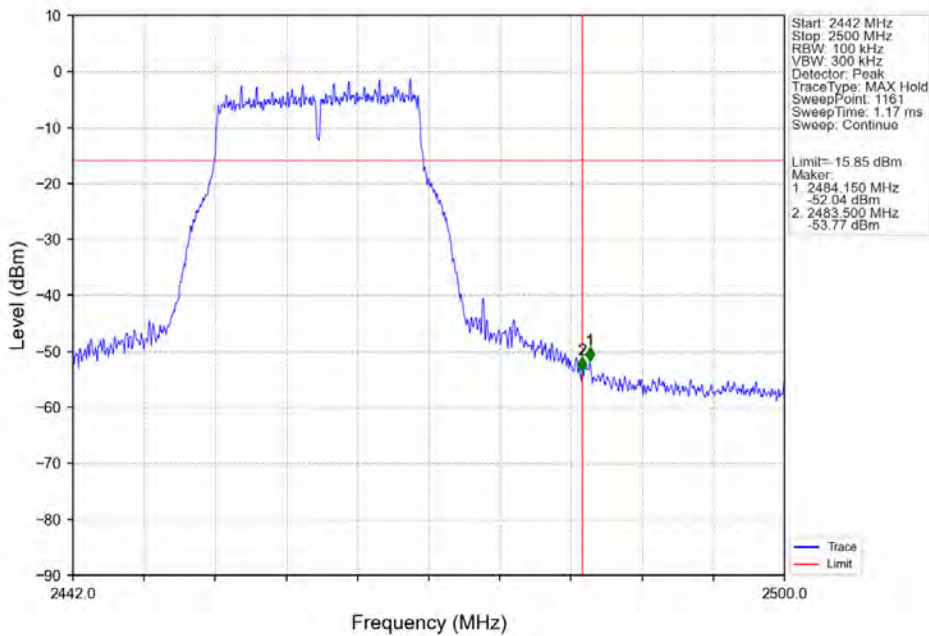




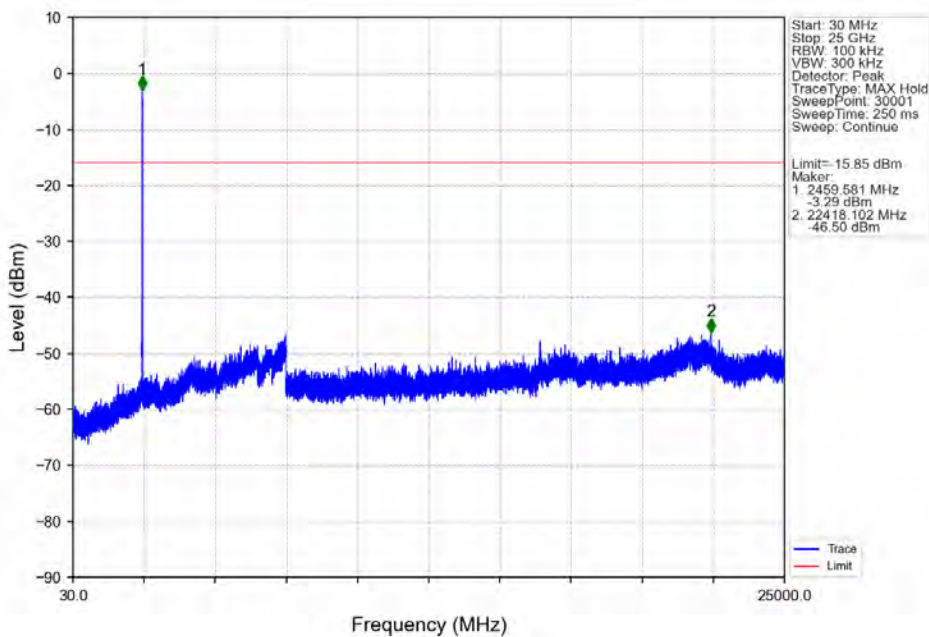
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802.11g_HCH_2462MHz_Ant3 (SISO)_NTNV



802.11g_HCH_2462MHz_Ant3 (SISO)_NTNV

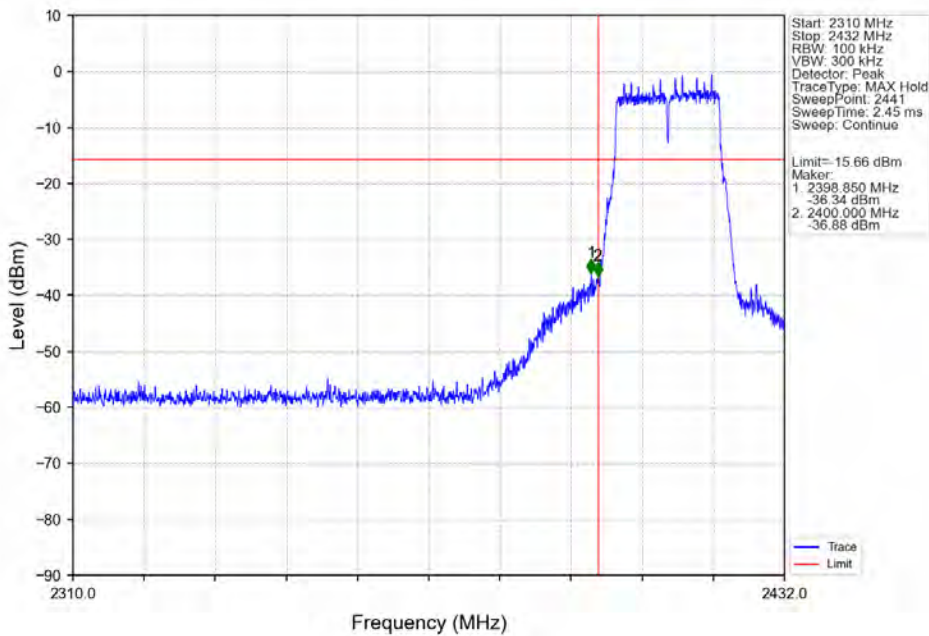




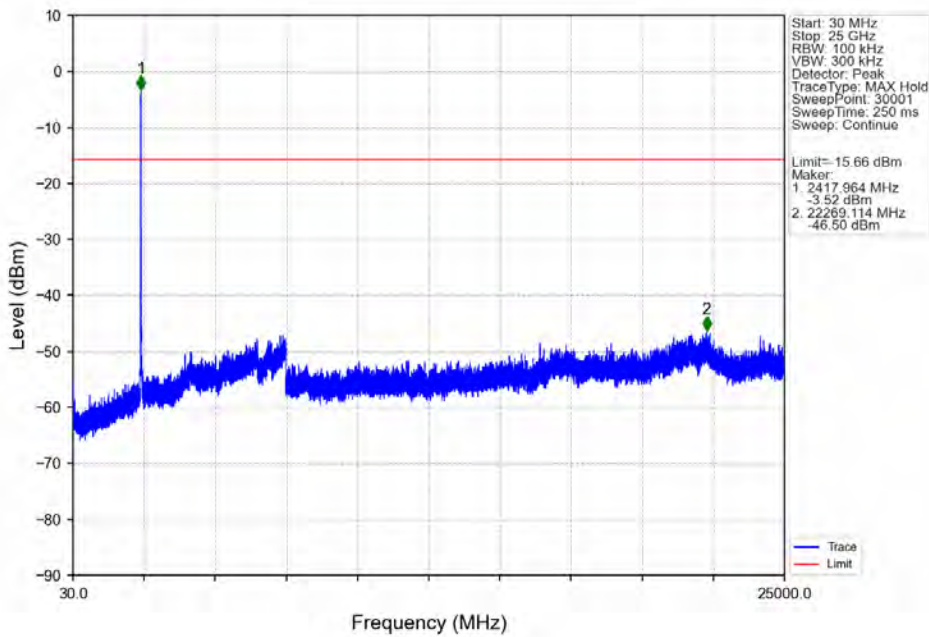
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802.11n(HT20)_LCH_2412MHz_Ant2 (MIMO)_NTNV



802.11n(HT20)_LCH_2412MHz_Ant2 (MIMO)_NTNV

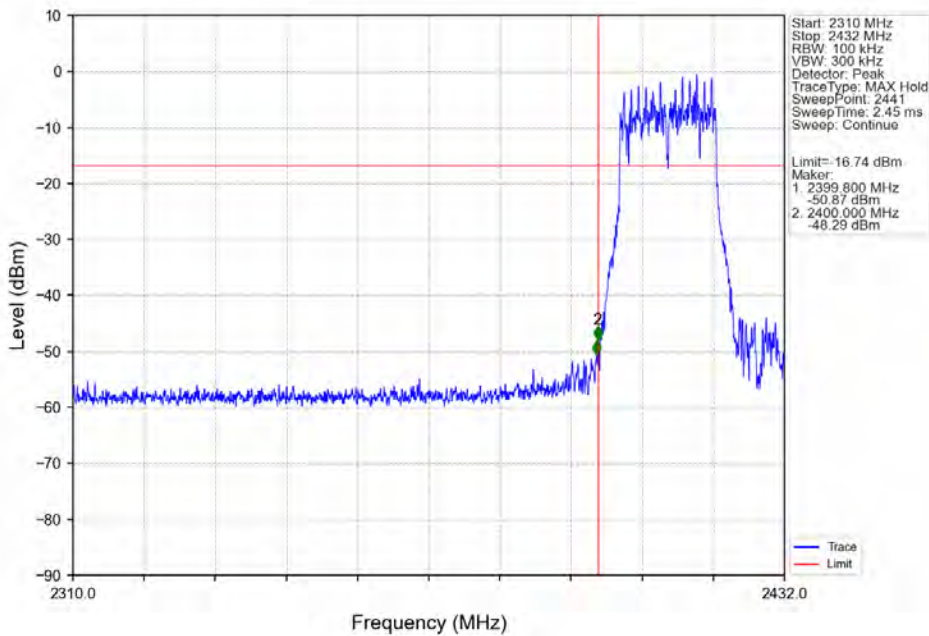




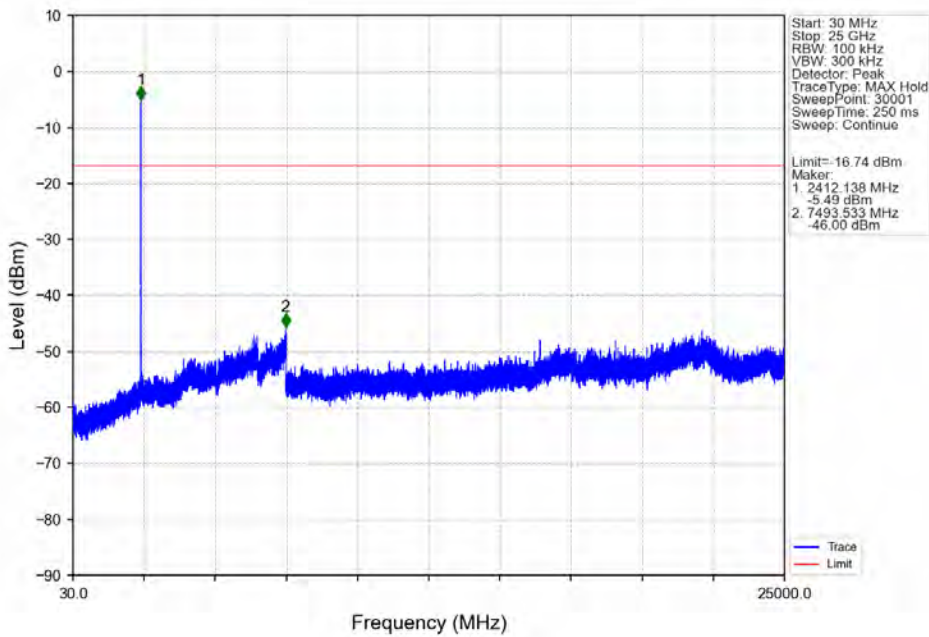
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802.11n(HT20)_LCH_2412MHz_Ant3 (MIMO)_NTNV



802.11n(HT20)_LCH_2412MHz_Ant3 (MIMO)_NTNV

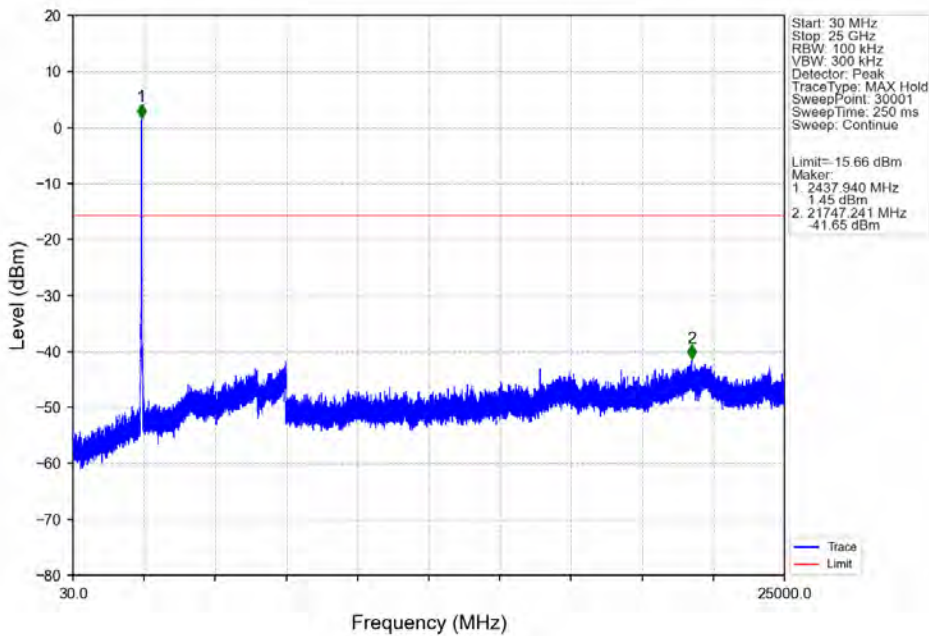




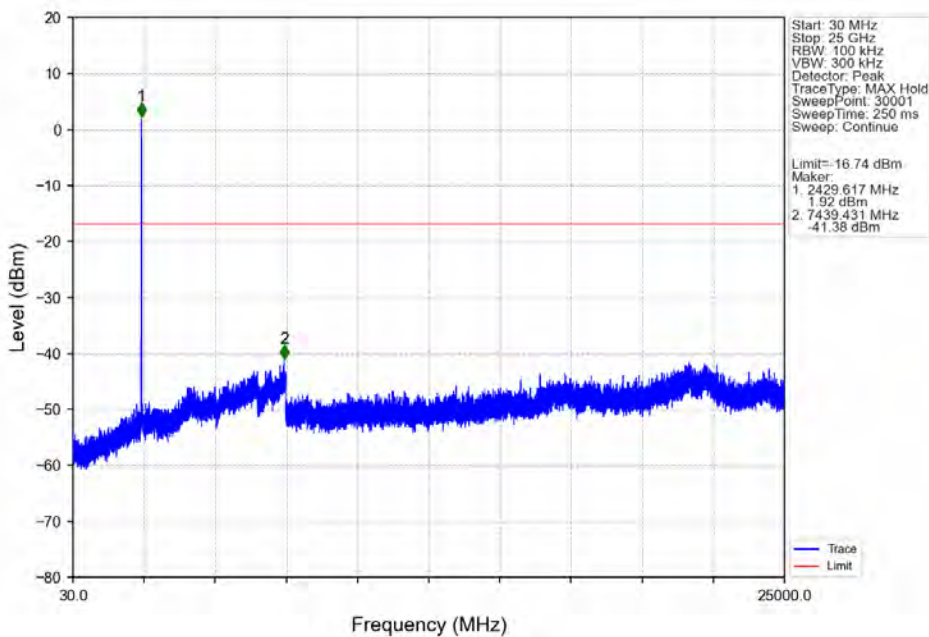
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802.11n(HT20)_MCH_2437MHz_Ant2 (MIMO)_NTNV



802.11n(HT20)_MCH_2437MHz_Ant3 (MIMO)_NTNV

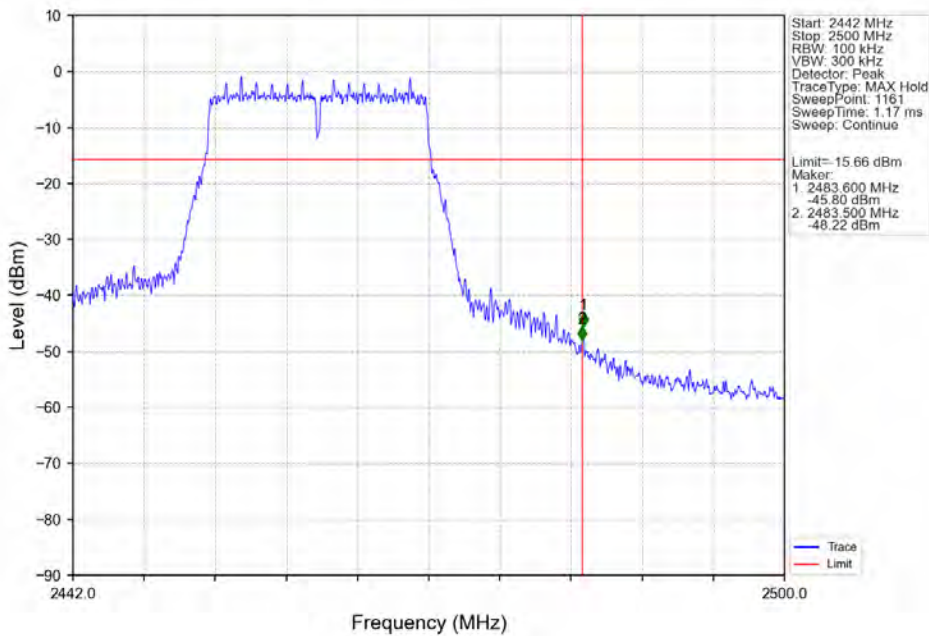




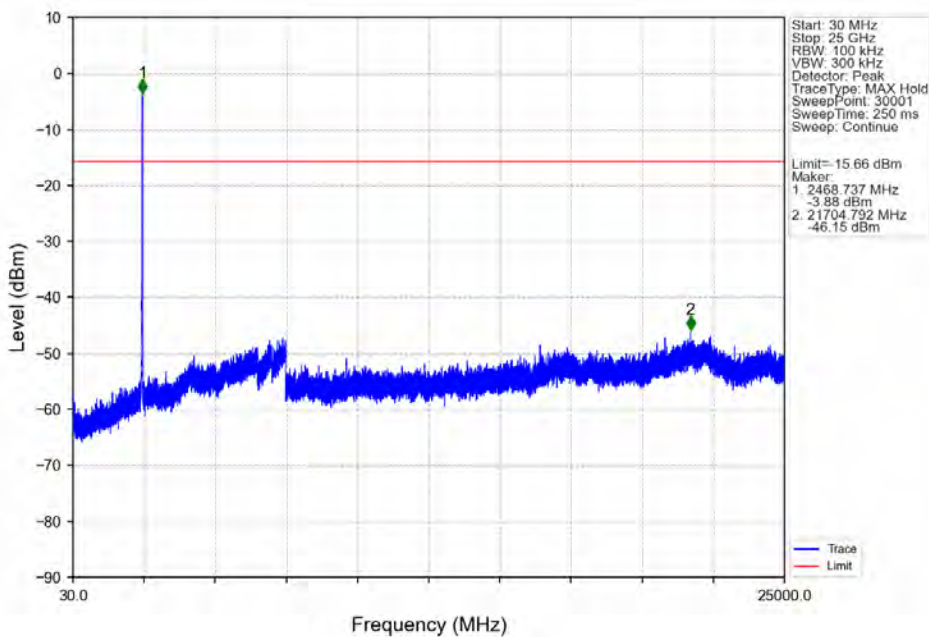
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802.11n(HT20) HCH_2462MHz_Ant2 (MIMO)_NTNV



802.11n(HT20) HCH_2462MHz_Ant2 (MIMO)_NTNV

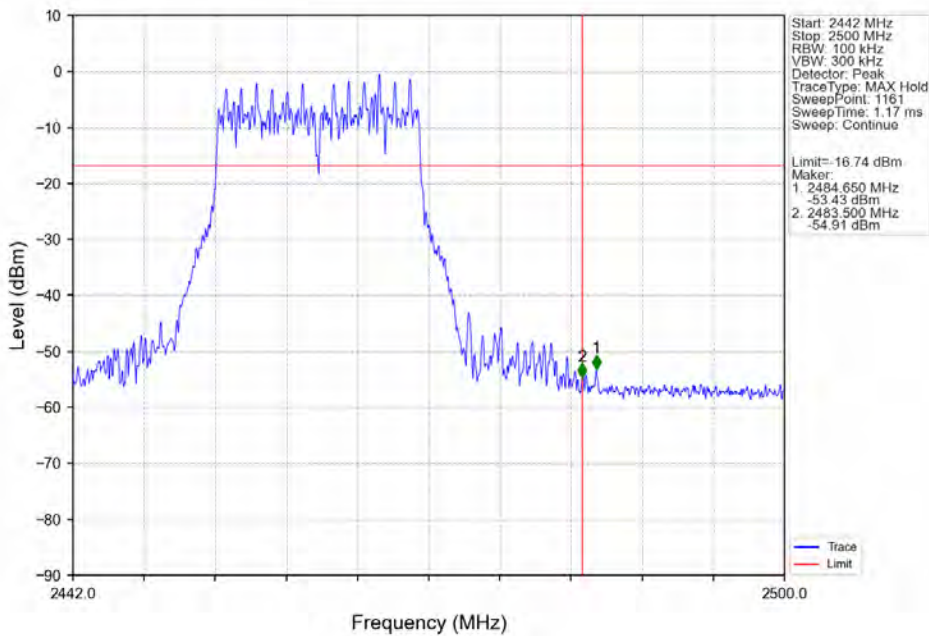




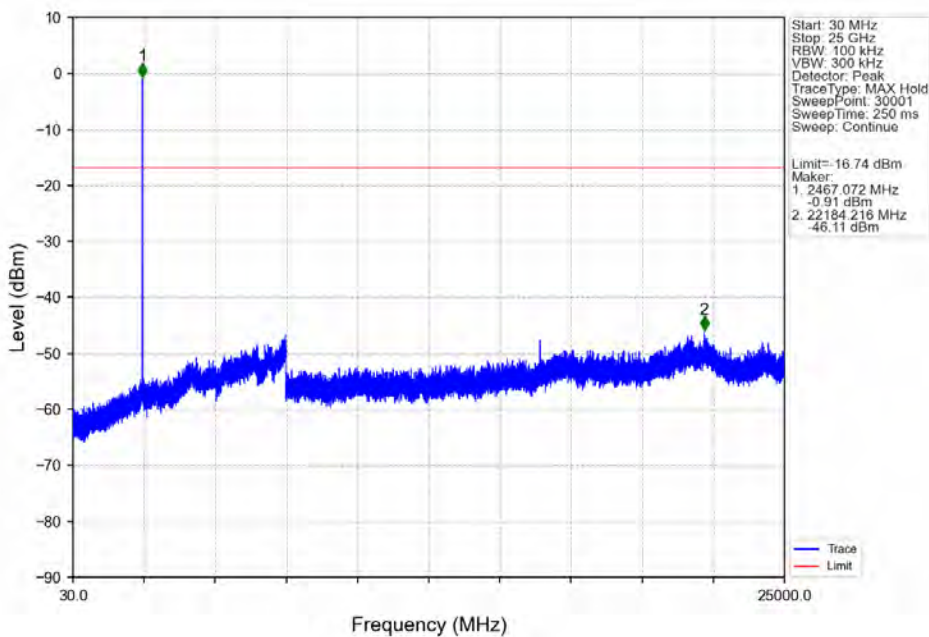
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802.11n(HT20) HCH_2462MHz_Ant3 (MIMO)_NTNV



802.11n(HT20) HCH_2462MHz_Ant3 (MIMO)_NTNV

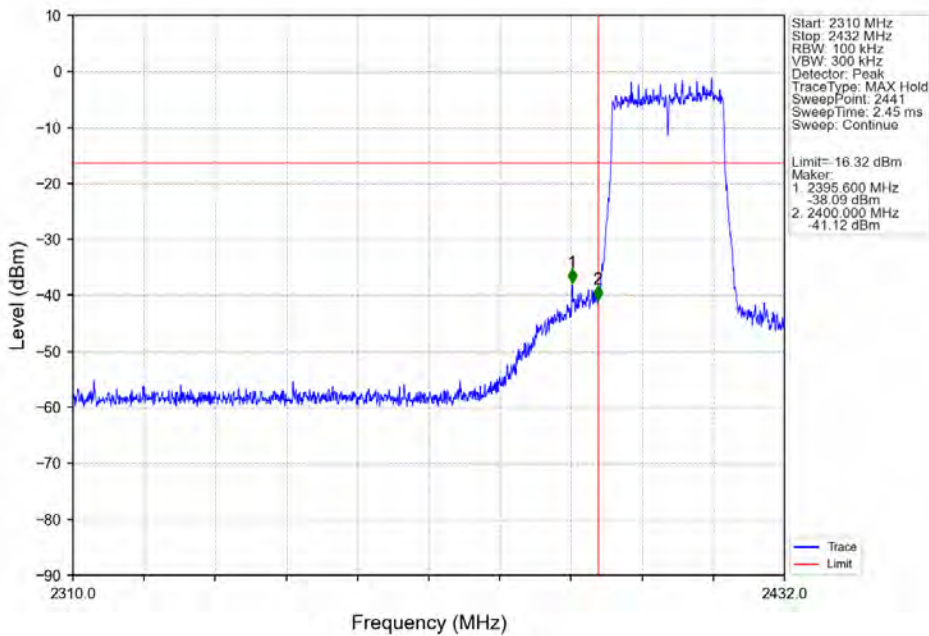




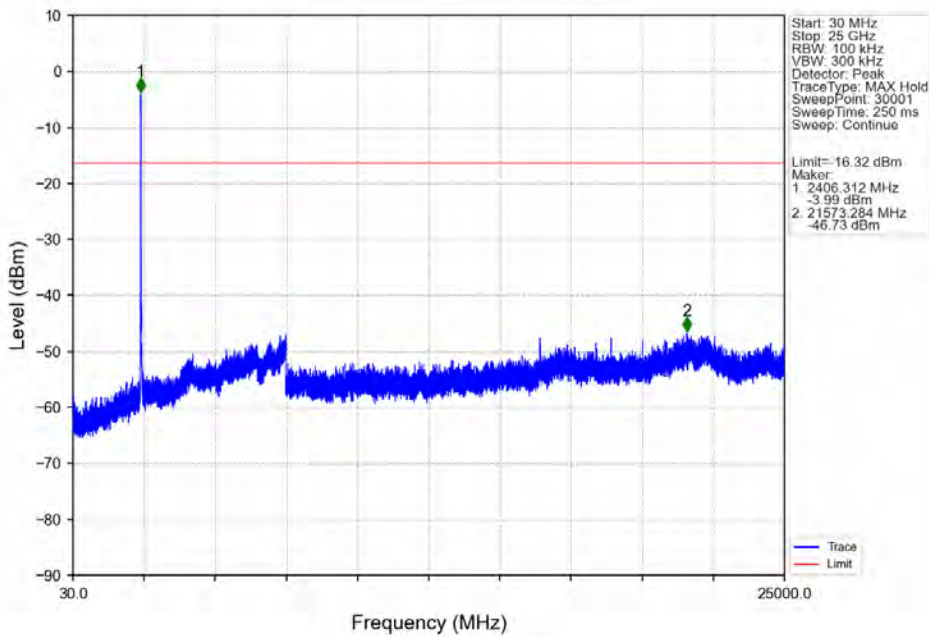
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802.11ax(HEW20) LCH_2412MHz_SU / Ant2 (MIMO) NTN



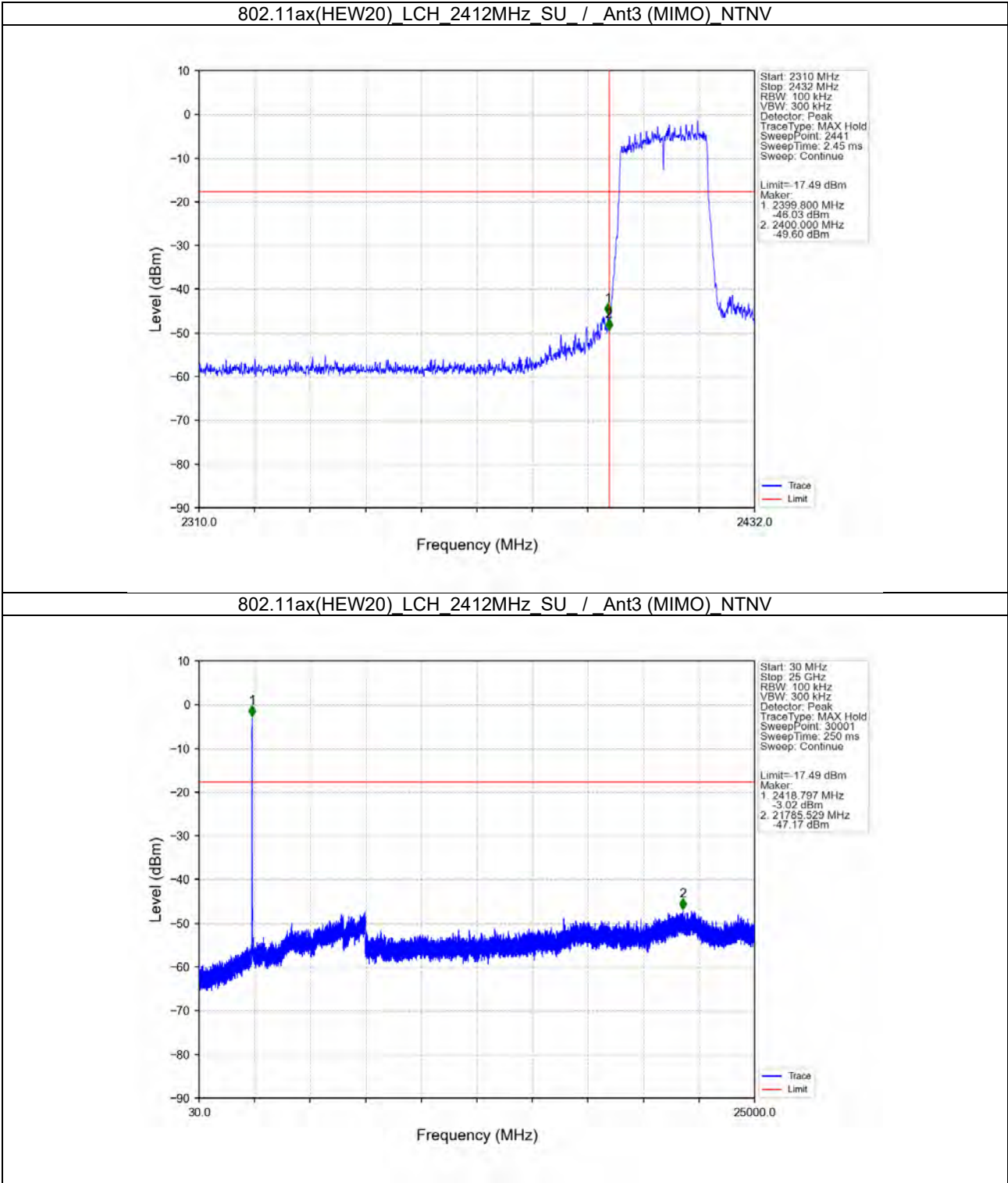
802.11ax(HEW20) LCH_2412MHz_SU / Ant2 (MIMO) NTN





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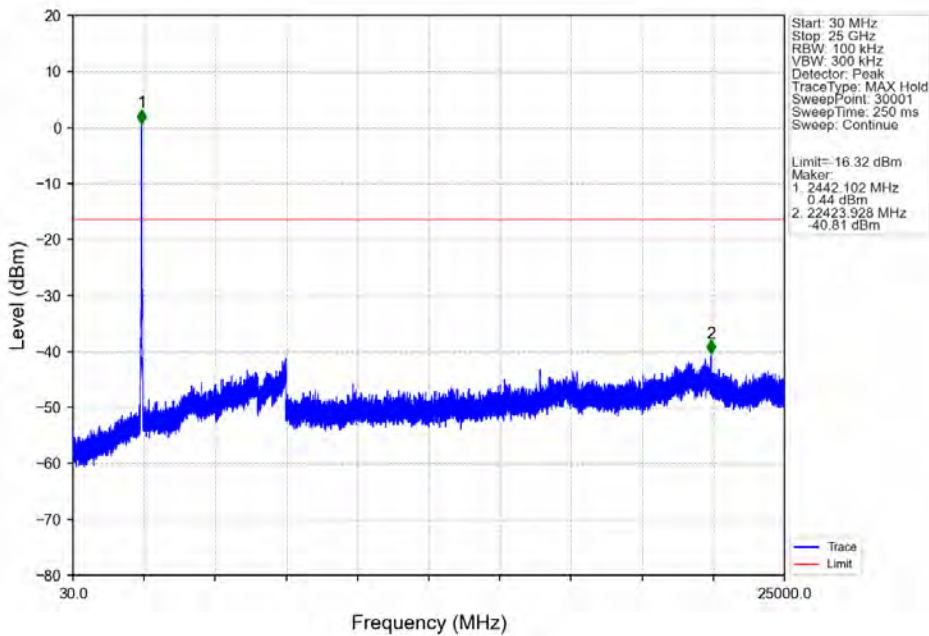




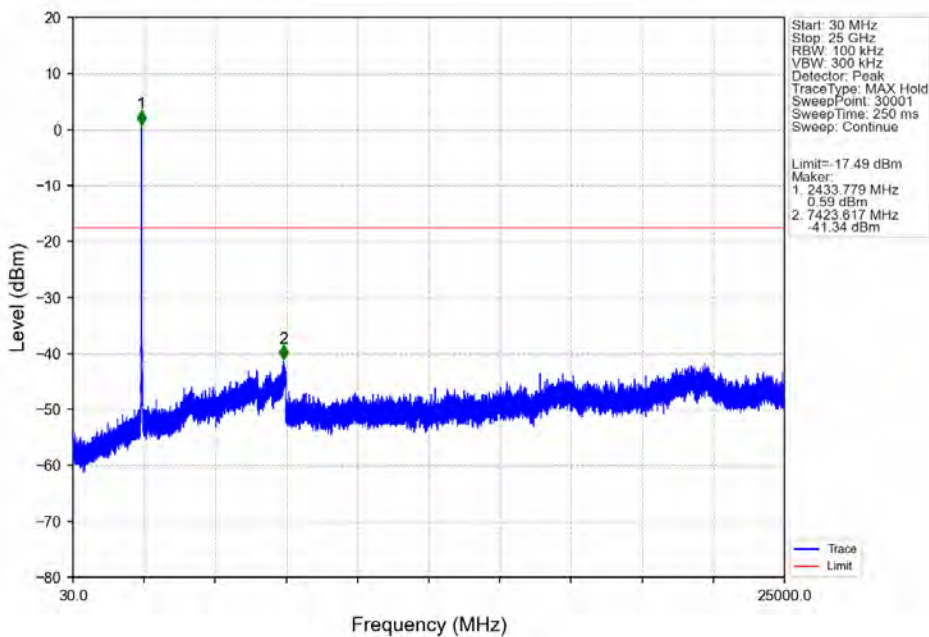
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802.11ax(HEW20)_MCH_2437MHz_SU / _Ant2 (MIMO)_NTNV



802.11ax(HEW20)_MCH_2437MHz_SU / _Ant3 (MIMO)_NTNV

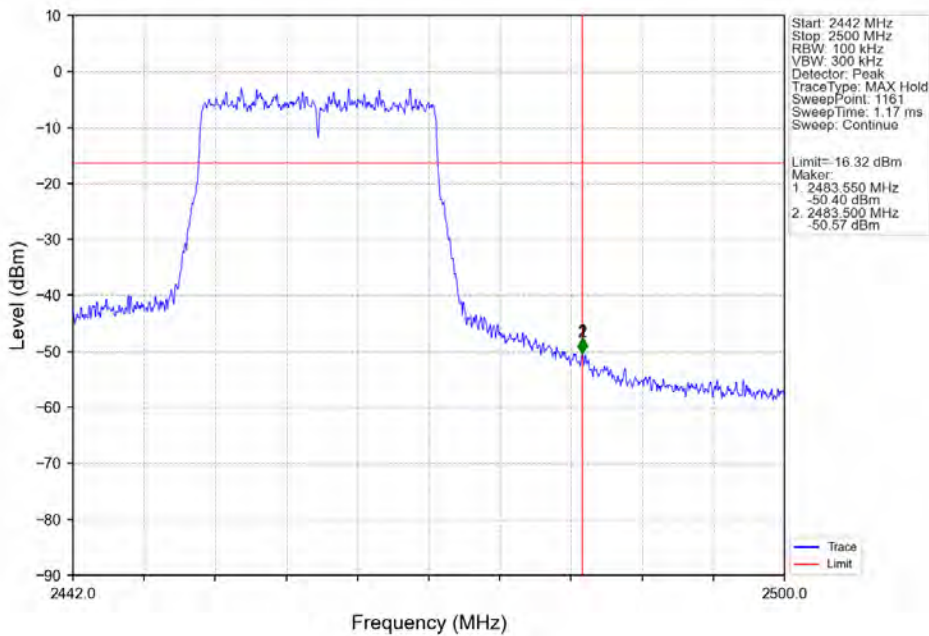




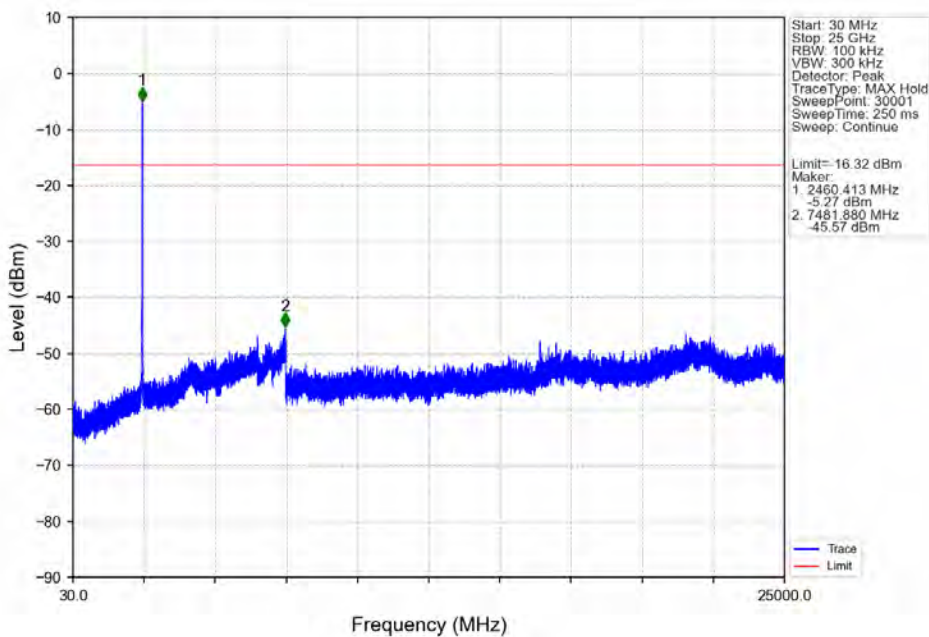
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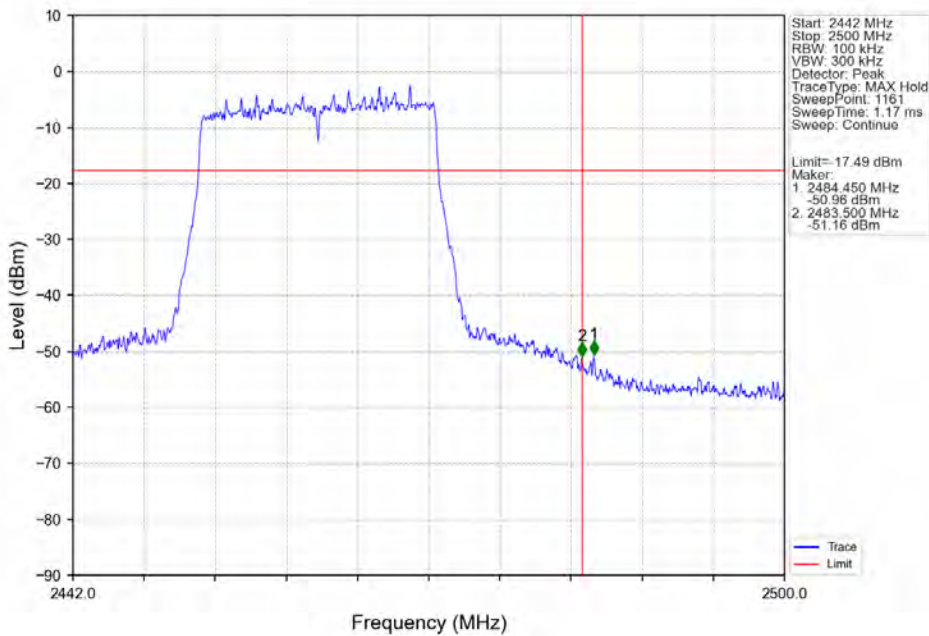
802.11ax(HEW20) HCH_2462MHz_SU / Ant2 (MIMO) NTN



802.11ax(HEW20) HCH_2462MHz_SU / Ant2 (MIMO) NTN



802.11ax(HEW20) HCH_2462MHz_SU / Ant3 (MIMO) NTVN



802.11ax(HEW20) HCH_2462MHz_SU / Ant3 (MIMO) NTVN

