
FCC Test Report

Report No.: AGC05877240702FR01

FCC ID : 2APA9-CMSXJ115A
APPLICATION PURPOSE : Original Equipment
PRODUCT DESIGNATION : IMILAB EC6 Panorama
BRAND NAME : imilab, imilab
MODEL NAME : CMSXJ115A
APPLICANT : Shanghai Imilab Technology Co., Ltd.
DATE OF ISSUE : Aug. 26, 2024
STANDARD(S) : FCC Part 15 Subpart C §15.247
REPORT VERSION : V1.0

Attestation of Global Compliance (Shenzhen) Co., Ltd



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Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Aug. 26, 2024	Valid	Initial Release

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Table of Contents

1. General Information	5
2. Product Information	6
2.1 Product Technical Description	6
2.2 Table of Carrier Frequency	7
2.3 IEEE 802.11n Modulation Scheme	8
2.4 Related Submittal(S) / Grant (S)	9
2.5 Test Methodology	9
2.6 Special Accessories	9
2.7 Equipment Modifications	9
2.8 Antenna Requirement.....	9
2.9 Description of Test Software	10
3. Test Environment	11
3.1 Address of The Test Laboratory	11
3.2 Test Facility	11
3.3 Environmental Conditions	12
3.4 Measurement Uncertainty	12
3.5 List of Equipment Used	13
4. System Test Configuration.....	15
4.1 EUT Configuration	15
4.2 EUT Exercise.....	15
4.3 Configuration of Tested System	15
4.4 Equipment Used in Tested System	15
4.5 Summary of Test Results	16
5. Description of Test Modes	17
6. Duty Cycle Measurement	18
7. RF Output Power Measurement	20
7.1 Provisions Applicable	20
7.2 Measurement Procedure.....	20
7.3 Measurement Setup (Block Diagram of Configuration)	20
7.4 Measurement Result	21
8. 6dB Bandwidth Measurement.....	22
8.1 Provisions Applicable	22
8.2 Measurement Procedure.....	22
8.3 Measurement Setup (Block Diagram of Configuration)	22
8.4 Measurement Result	23
9. Power Spectral Density Measurement.....	36

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9.1 Provisions Applicable	36
9.2 Measurement Procedure.....	36
9.3 Measurement Setup (Block Diagram of Configuration)	37
9.4 Measurement Result	37
10. Conducted Band Edge and Out-of-Band Emissions.....	44
10.1 Provisions Applicable	44
10.2 Measurement Procedure.....	44
10.3 Measurement Setup (Block Diagram of Configuration)	44
10.4 Measurement Result	45
11. Radiated Spurious Emission	59
11.1 Measurement Limits	59
11.2 Measurement Procedure	59
11.3 Measurement Setup (Block Diagram of Configuration)	62
11.4 Measurement Result	63
12. AC Power Line Conducted Emission.....	84
12.1 Measurement Limits.....	84
12.2 Block Diagram of Line Conducted Emission Test.....	84
12.3 Preliminary Procedure of Line Conducted Emission Test	85
12.4 Final Procedure of Line Conducted Emission Test	85
12.5 Test Result of Line Conducted Emission Test.....	85
Appendix I: Photographs of Test Setup.....	88
Appendix II: Photographs of Test EUT	88

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1. General Information

Applicant	Shanghai Imilab Technology Co., Ltd.
Address	Room 001A, Floor 11, Block 1, No. 588 Zixing Road, Minhang District, Shanghai, China
Manufacturer	Shanghai Imilab Technology Co., Ltd.
Address	Room 001A, Floor 11, Block 1, No. 588 Zixing Road, Minhang District, Shanghai, China
Factory	N/A
Address	N/A
Product Designation	IMILAB EC6 Panorama
Brand Name	imilab, iMiLAb
Test Model	CMSXJ115A
Series Model(s)	N/A
Difference Description	N/A
Date of receipt of test item	Jul. 23, 2024
Date of Test	Jul. 23, 2024 - Aug. 26, 2024
Deviation from Standard	No any deviation from the test method
Condition of Test Sample	Normal
Test Result	Pass
Test Report Form No	AGCER-FCC-2.4GWLAN-V1

Note: The test results of this report relate only to the tested sample identified in this report.

Prepared By



Cici Li
(Project Engineer)

Aug. 26, 2024

Reviewed By



Calvin Liu
(Reviewer)

Aug. 26, 2024

Approved By



Max Zhang
(Authorized Officer)

Aug. 26, 2024

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2. Product Information

2.1 Product Technical Description

Equipment Type	WLAN 2.4G
Frequency Band	2400MHz ~ 2483.5MHz
Operation Frequency	2412MHz ~ 2462MHz
Output Power (Average)	IEEE 802.11b: 15.87dBm; IEEE 802.11g: 10.63dBm; IEEE 802.11n(HT20): 10.66dBm;IEEE 802.11ax (HE20): 10.38dBm
Output Power (Peak)	IEEE 802.11b: 18.44dBm; IEEE 802.11g: 17.89dBm; IEEE 802.11n(HT20): 18.43dBm; IEEE 802.11ax (HE20): 19.04dBm;
Modulation	802.11b:(DQPSK, DBPSK, CCK) DSSS 802.11g/n:(64-QAM,16-QAM, QPSK, BPSK) OFDM 802.11ax:(1024-QAM,256-QAM,64-QAM,16-QAM,QPSK,BPSK)OFDMA
Data Rate	802.11b:1/2/5.5/11Mbps 802.11g: 6/9/12/18/24/36/48/54Mbps 802.11n: up to 72.2Mbps 802.11ax: up to 143Mbps
Number of channels	11
Hardware Version	LSAM113C1-1
Software Version	5.3.1_0501
Antenna Designation	PCB Antenna
Antenna Gain	1.5dBi
Power Supply	DC 12V by adapter

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2.2 Table of Carrier Frequency

For 2412-2462MHz:

11 channels are provided for 802.11b/g/n(HT20)/ax(HE20):

Channel	Frequency	Channel	Frequency	Channel	Frequency
01	2412 MHz	02	2417 MHz	03	2422 MHz
04	2427 MHz	05	2432 MHz	06	2437 MHz
07	2442 MHz	08	2447 MHz	09	2452 MHz
10	2457 MHz	11	2462 MHz		

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2.3 IEEE 802.11n Modulation Scheme

MCS Index	Nss	Modulation	R	N _{BPSC}	N _{CBPS}	N _{DBPS}	Data Rate(Mbps)
							800nsGI
					20MHz	20MHz	20MHz
0	1	BPSK	1/2	1	52	26	6.5
1	1	QPSK	1/2	2	104	52	13.0
2	1	QPSK	3/4	2	104	78	19.5
3	1	16-QAM	1/2	4	208	104	26.0
4	1	16-QAM	3/4	4	208	156	39.0
5	1	64-QAM	2/3	6	312	208	52.0
6	1	64-QAM	3/4	6	312	234	58.5
7	1	64-QAM	5/6	6	312	260	65.0

Symbol	Explanation
NSS	Number of spatial streams
R	Code rate
NBPSC	Number of coded bits per single carrier
NCBPS	Number of coded bits per symbol
NDBPS	Number of data bits per symbol
GI	Guard interval

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2.4 Related Submittal(S) / Grant (S)

This submittal(s) (test report) is intended for FCC ID: **2APA9-CMSXJ115A**, filing to comply with Part 2, Part 15 of the Federal Communication Commission rules.

2.5 Test Methodology

The tests were performed according to following standards:

No.	Identity	Document Title
1	FCC 47 CFR Part 2	Frequency allocations and radio treaty matters; general rules and regulations
2	FCC 47 CFR Part 15	Radio Frequency Devices
3	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
4	KDB 662911	KDB 662911 D01 Multiple Transmitter Output v02r01 Emissions Testing of Transmitters with Multiple Outputs in the Same Band (e.g., MIMO, Smart Antenna, etc)

2.6 Special Accessories

Refer to section 4.4.

2.7 Equipment Modifications

Not available for this EUT intended for grant.

2.8 Antenna Requirement

Standard Requirement
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 EUT Antenna: The non-detachable antenna inside the device cannot be replaced by the user at will. The gain of the antenna is 1.5dBi.

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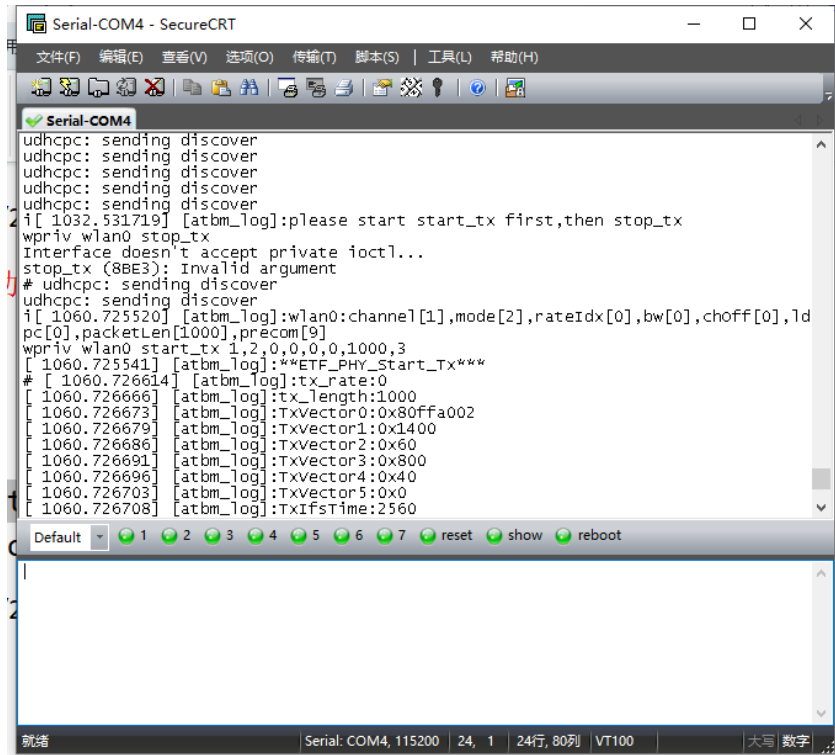
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2.9 Description of Test Software

For IEEE 802.11 mode:

The test utility software used during testing was “SecureCRT”.

Software Setting Diagram



```

Serial-COM4 - SecureCRT
文件(F) 编辑(E) 查看(V) 选项(O) 传输(T) 脚本(S) | 工具(L) 帮助(H)

Serial-COM4
udhcpc: sending discover
udhcpc: sending discover
udhcpc: sending discover
udhcpc: sending discover
udhcpc: sending discover
21[ 1032.531719] [atbm_log]:please start start_tx first,then stop_tx
wpriv wlan0 stop_tx
Interface doesn't accept private ioctl...
stop_tx (8BE3): Invalid argument
# udhcpc: sending discover
udhcpc: sending discover
1[ 1060.725520] [atbm_log]:wlan0:channel[1],mode[2],rateIdx[0],bw[0],choff[0],ld
pc[0],packetLen[1000],precom[9]
wpriv wlan0 start_tx 1,2,0,0,0,0,1000,3
[ 1060.725541] [atbm_log]**ETF_PHY_Start_Tx***
# [ 1060.726614] [atbm_log]:tx_rate:0
[ 1060.726666] [atbm_log]:tx_length:1000
1060.726673 [atbm_log]:TxVector0:0x80ffa002
1060.726679 [atbm_log]:TxVector1:0x1400
1060.726686 [atbm_log]:TxVector2:0x60
1060.726691 [atbm_log]:TxVector3:0x800
1060.726696 [atbm_log]:TxVector4:0x40
1060.726703 [atbm_log]:TxVector5:0x0
[ 1060.726708] [atbm_log]:TxIfstime:2560

Default 1 2 3 4 5 6 7 reset show reboot
就绪 Serial: COM4, 115200 24, 1 24行, 80列 VT100 大写 数字
  
```

Test Mode	Channel	Power Index
802.11b	L/M/H	-4
802.11g	L/M/H	default
802.11n-HT20	L/M/H	default
802.11ax-HE20	L/M/H	default

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3. Test Environment

3.1 Address of The Test Laboratory

Laboratory: Attestation of Global Compliance (Shenzhen) Co., Ltd.

Address: 1-2/F, Building 19, Junfeng Industrial Park, Chongqing Road, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China

3.2 Test Facility

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

CNAS-Lab Code: L5488

Attestation of Global Compliance (Shenzhen) Co., Ltd. has been assessed and proved to follow CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories).

A2LA-Lab Cert. No.: 5054.02

Attestation of Global Compliance (Shenzhen) Co., Ltd. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to follow ISO/IEC 17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

FCC-Registration No.: 975832

Attestation of Global Compliance (Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files with Registration 975832.

IC-Registration No.: 24842 (CAB identifier: CN0063)

Attestation of Global Compliance (Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the Certification and Engineering Bureau of Industry Canada. The acceptance letter from the IC is maintained in our files with Registration 24842.

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3.3 Environmental Conditions

	Normal Conditions
Temperature range (°C)	15 - 35
Relative humidity range	20 % - 75 %
Pressure range (kPa)	86 - 106

3.4 Measurement Uncertainty

The reported uncertainty of measurement $y \pm U$, where expanded uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95%.

Item	Measurement Uncertainty
Uncertainty of Conducted Emission for AC Port	$U_c = \pm 2.9 \text{ dB}$
Uncertainty of Radiated Emission below 1GHz	$U_c = \pm 3.9 \text{ dB}$
Uncertainty of Radiated Emission above 1GHz	$U_c = \pm 4.9 \text{ dB}$
Uncertainty of total RF power, conducted	$U_c = \pm 0.8 \text{ dB}$
Uncertainty of RF power density, conducted	$U_c = \pm 2.6 \text{ dB}$
Uncertainty of spurious emissions, conducted	$U_c = \pm 2 \%$
Uncertainty of Occupied Channel Bandwidth	$U_c = \pm 2 \%$

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3.5 List of Equipment Used

● RF Conducted Test System							
Used	Equipment No.	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
☒	AGC-ER-E036	Spectrum Analyzer	Agilent	N9020A	MY49100060	2024-05-24	2025-05-23
☒	AGC-ER-E062	Power Sensor	Agilent	U2021XA	MY54110007	2024-02-01	2025-01-31
☒	AGC-ER-E063	Power Sensor	Agilent	U2021XA	MY54110009	2024-02-01	2025-01-31
☒	AGC-ER-A001	6dB Attenuator	Eeatsheep	LM-XX-6-5W	N/A	2023-09-21	2025-09-20
☒	AGC-ER-E083	Signal Generator	Agilent	E4421B	US39340815	2024-05-23	2025-05-22
☒	N/A	RF Connection Cable	N/A	1#	N/A	Each time	N/A
☒	N/A	RF Connection Cable	N/A	2#	N/A	Each time	N/A

● Radiated Spurious Emission							
Used	Equipment No.	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
☐	AGC-EM-E046	EMI Test Receiver	R&S	ESCI	10096	2024-02-01	2025-01-31
☒	AGC-EM-E116	EMI Test Receiver	R&S	ESCI	100034	2024-05-24	2025-05-23
☒	AGC-EM-E061	Spectrum Analyzer	Agilent	N9010A	MY53470504	2024-05-28	2025-05-27
☒	AGC-EM-E086	Loop Antenna	ZHINAN	ZN30900C	18051	2024-03-05	2026-03-04
☒	AGC-EM-E001	Wideband Antenna	SCHWARZBECK	VULB9168	D69250	2023-05-11	2025-05-10
☒	AGC-EM-E029	Broadband Ridged Horn Antenna	ETS	3117	00034609	2024-03-31	2025-03-30
☒	AGC-EM-E082	Horn Antenna	SCHWARZBECK	BBHA 9170	#768	2023-09-24	2025-09-23
☒	AGC-EM-E146	Pre-amplifier	ETS	3117-PA	00246148	2022-08-04	2024-08-03
☒	AGC-EM-E146	Pre-amplifier	ETS	3117-PA	00246148	2024-07-24	2026-07-23
☒	AGC-EM-A119	2.4G Filter	SongYi	N/A	N/A	2024-05-23	2025-05-22
☐	AGC-EM-A138	6dB Attenuator	Eeatsheep	LM-XX-6-5W	N/A	2023-06-09	2025-06-08
☒	AGC-EM-A139	6dB Attenuator	Eeatsheep	LM-XX-6-5W	N/A	2023-06-09	2025-06-08

● AC Power Line Conducted Emission							
Used	Equipment No.	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
☒	AGC-EM-E045	EMI Test Receiver	R&S	ESPI	101206	2024-05-28	2025-05-27
☒	AGC-EM-A130	6dB Attenuator	Eeatsheep	LM-XX-6-5W	DC-6GZ	2023-06-09	2025-06-08
☒	AGC-EM-E023	AMN	R&S	100086	ESH2-Z5	2024-05-28	2025-05-27

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● Test Software					
Used	Equipment No.	Test Equipment	Manufacturer	Model No.	Version Information
☒	AGC-EM-S001	CE Test System	R&S	ES-K1	V1.71
☐	AGC-EM-S003	RE Test System	FARA	EZ-EMC	VRA-03A
☒	AGC-EM-S004	RE Test System	Tonscend	TS ⁺ Ver2.1(JS32-RE)	4.0.0.0
☒	AGC-ER-S012	BT/WIFI Test System	Tonscend	JS1120-2	2.6
☒	AGC-EM-S011	RSE Test System	Tonscend	TS+-Ver2.1(JS36-RSE)	4.0.0.0

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4. System Test Configuration

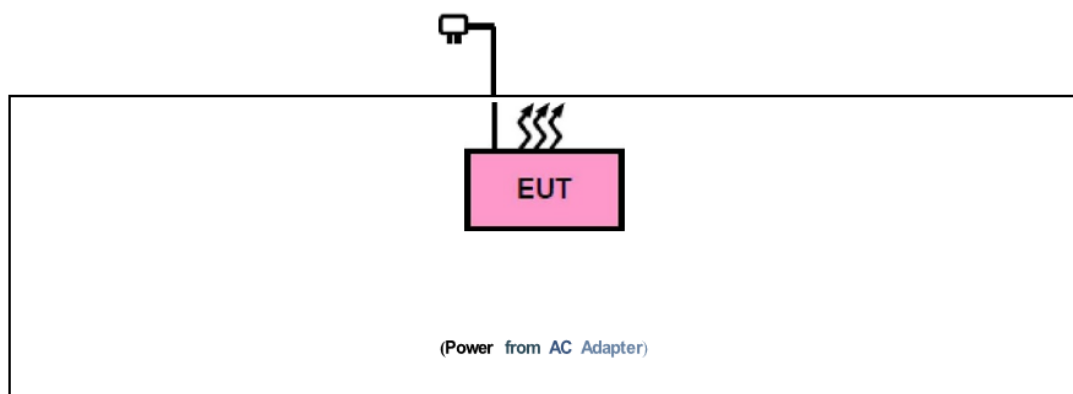
4.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commission's requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

4.2 EUT Exercise

The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

4.3 Configuration of Tested System



4.4 Equipment Used in Tested System

The following peripheral devices and interface cables were connected during the measurement:

☒ Test Accessories Come From The Laboratory

No.	Equipment	Manufacturer	Model No.	Specification Information	Cable
1	Control Box	--	USB-TTL	--	--
2	TF Card	Sandi	SDSQUNC-032G-ZN6MA	--	--
3	Xiaomi Phone	Xiaomi	MI 10	--	--

☒ Test Accessories Come From The Manufacturer

No.	Equipment	Manufacturer	Model No.	Specification Information	Cable
1	Adapter	Shenzhen AMC Technology Co., Ltd.	AD-0121200100U S-5	INPUT:100-240V~50/60Hz 0.5A OUTPUT:12V=1A	--

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4.5 Summary of Test Results

Item	FCC Rules	Description of Test	Result
1	§15.203&15.247(b)(4)	Antenna Equipment	Pass
2	§15.247 (b)(1)	RF Output Power	Pass
3	§15.247 (a)(1)	6 dB Bandwidth	Pass
4	§15.247 (e)	Power Spectral Density	Pass
5	§15.247 (d)	Conducted Band Edge and Out-of-Band Emissions	Pass
6	§15.247 (d)&15.209	Radiated Spurious Emission	Pass
7	§15.207	AC Power Line Conducted Emission	Pass

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5. Description of Test Modes

Summary table of Test Cases	
Test Item	Data Rate / Modulation
	2.4G WLAN – 802.11b/g/n/ax (DSSS/OFDM/OFDMA)
Radiated & Conducted Test Cases	Mode 1: 802.11b_TX CH01_2412 MHz_1 Mbps Mode 2: 802.11b_TX CH06_2437 MHz_1 Mbps Mode 3: 802.11b_TX CH11_2462 MHz_1 Mbps Mode 4: 802.11g_TX CH01_2412 MHz_6 Mbps Mode 5: 802.11g_TX CH06_2437 MHz_6 Mbps Mode 6: 802.11g_TX CH11_2462 MHz_6 Mbps Mode 7: 802.11n-HT20_TX CH01_2412 MHz_MCS0 Mbps Mode 8: 802.11n-HT20_TX CH06_2437 MHz_MCS0 Mbps Mode 9: 802.11n-HT20_TX CH11_2462 MHz_MCS0 Mbps Mode 10: 802.11ax-HE20_TX CH01_2412 MHz_MCS0 Mbps Mode 11: 802.11ax-HE20_TX CH06_2437 MHz_MCS0 Mbps Mode 12: 802.11ax-HE20_TX CH11_2462 MHz_MCS0 Mbps
AC Conducted Emission	Mode 1: 2.4G WLAN Link + DC Adapter
Note: 1. The 802.11ax mode is only tested and evaluated at Full RU bandwidth. 2. For Radiated Emission, 3axis were chosen for testing for each applicable mode. 3. For Conducted Test method, a temporary antenna connector is provided by the manufacture.	

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6. Duty Cycle Measurement

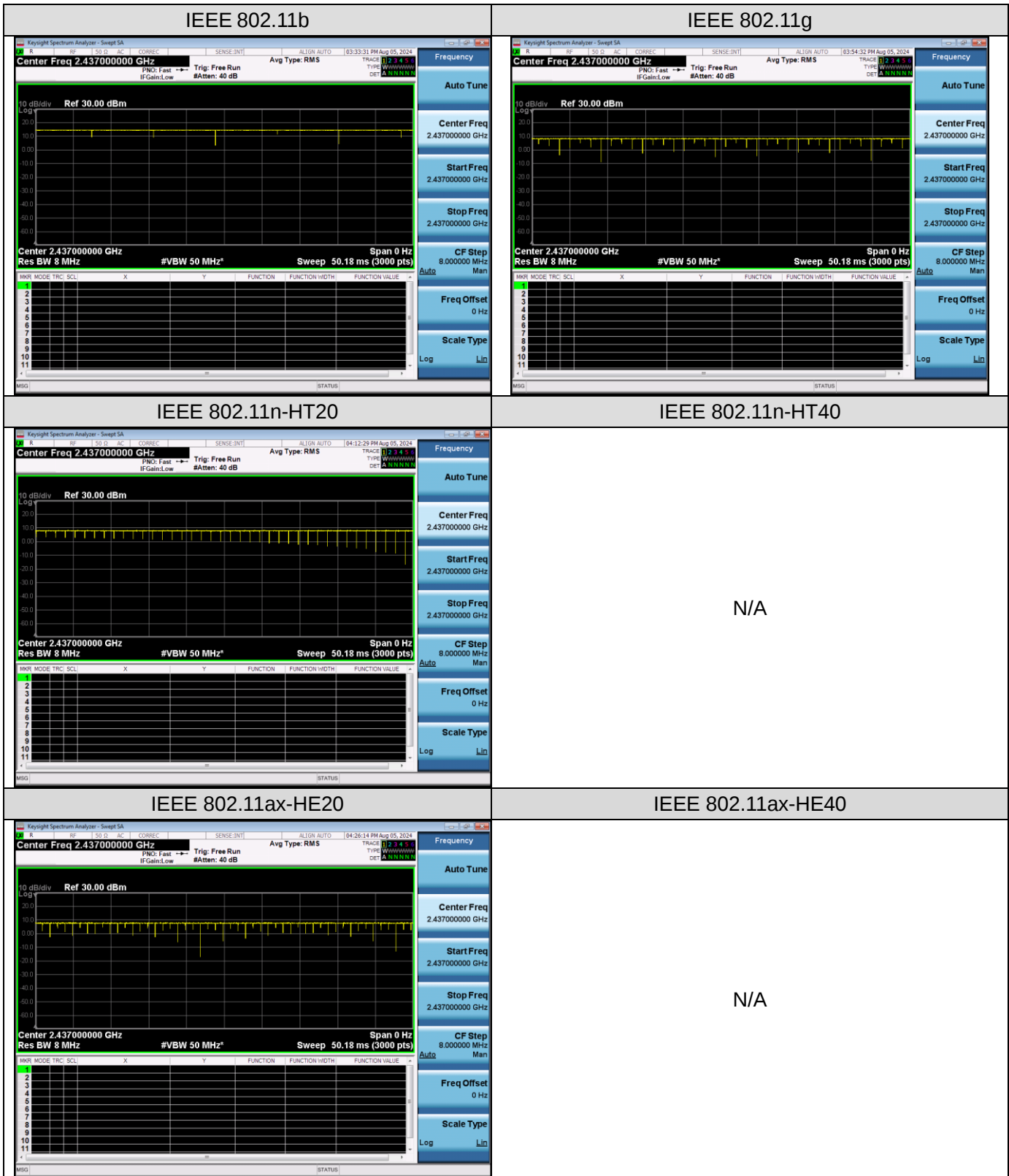
2.4GHz WLAN (DTS) operation is possible in 20MHz, and 40MHz channel bandwidths. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz, and detector = Average. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

Operating mode	Data rates (Mbps)	Duty Cycle (%)	Duty Cycle Factor (dB)
IEEE 802.11b	1	100	/
IEEE 802.11g	6	100	/
IEEE 802.11n-HT20	MCS0	100	/
IEEE 802.11ax-HE20	MCS0	100	/

Remark:

1. Duty Cycle factor = $10 * \log (1/ \text{Duty cycle})$
2. The duty cycle of each frequency band mode reflects the determination requirements of the Middle channel measurement value.

The test plots as follows:



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7. RF Output Power Measurement

7.1 Provisions Applicable

For DTSSs employing digital modulation techniques operating in the bands 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W.

7.2 Measurement Procedure

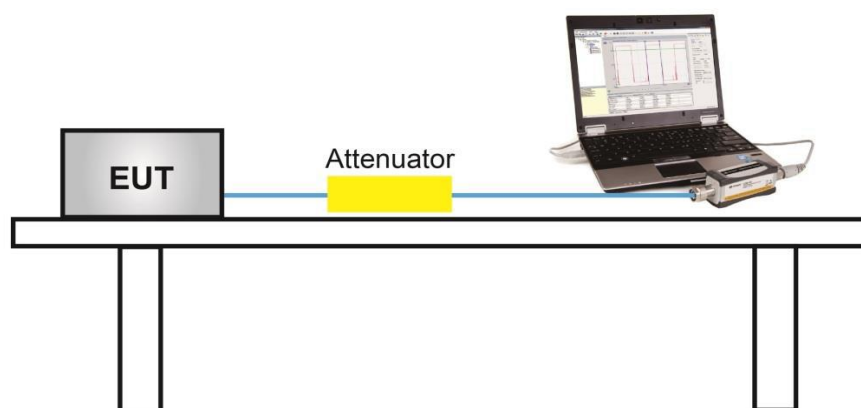
☒ Method PM is Measurement using an RF Peak power meter. The procedure for this method is as follows:

1. The testing follows the ANSI C63.10 Section 11.9.1.3
2. 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 use a fast-responding diode detector.

☒ Method PM is Measurement using an RF average power meter. The procedure for this method is as follows:

1. The testing follows the ANSI C63.10 Section 11.9.2.3
2. Measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the following conditions are satisfied:
3. The EUT is configured to transmit continuously, or to transmit with a constant duty cycle.
4. At all times when the EUT is transmitting, it shall be transmitting at its maximum power control level.
5. The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.
6. Determine according to the duty cycle of the equipment: when it is less than 98%, follow the steps below.
7. Measure the average power of the transmitter. This measurement is an average over both the ON and OFF periods of the transmitter.
8. Adjust the measurement in dBm by adding $[10 \log (1 / D)]$, where D is the duty cycle {e.g., $[10 \log (1 / 0.25)]$, if the duty cycle is 25%}.
9. Record the test results in the report.

7.3 Measurement Setup (Block Diagram of Configuration)



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7.4 Measurement Result

Test Data of Conducted Output Power					
Test Mode	Test Frequency (MHz)	Average Power (dBm)	Peak Power (dBm)	Limits (dBm)	Pass or Fail
802.11b	2412	15.87	18.44	≤ 30	Pass
	2437	15.58	18.13	≤ 30	Pass
	2462	15.28	17.86	≤ 30	Pass
802.11g	2412	10.63	17.89	≤ 30	Pass
	2437	10.19	17.84	≤ 30	Pass
	2462	9.85	17.48	≤ 30	Pass
802.11n20	2412	10.66	18.43	≤ 30	Pass
	2437	10.10	17.81	≤ 30	Pass
	2462	9.75	17.33	≤ 30	Pass
802.11ax20	2412	10.38	19.04	≤ 30	Pass
	2437	9.84	18.76	≤ 30	Pass
	2462	9.34	18.14	≤ 30	Pass

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8. 6dB Bandwidth Measurement

8.1 Provisions Applicable

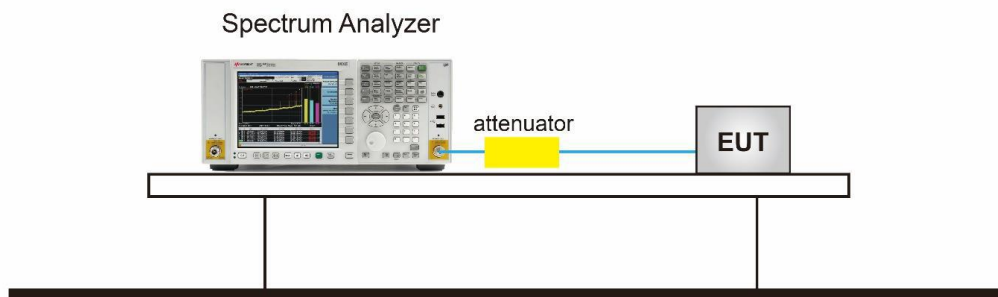
The minimum 6dB bandwidth shall be 500 kHz.

8.2 Measurement Procedure

The testing follows the ANSI C63.10 Section 6.9.3 (OBW) and 11.8.1 (6dB BW).

1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. For 6dB Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement.
4. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 1-5% of the OBW and set the Video bandwidth (VBW) $\geq 3 * RBW$.
5. Detector = peak
6. Trace mode = max hold.
7. Sweep = auto couple.
8. Allow the trace to stabilize.
9. Measure and record the results in the test report.

8.3 Measurement Setup (Block Diagram of Configuration)



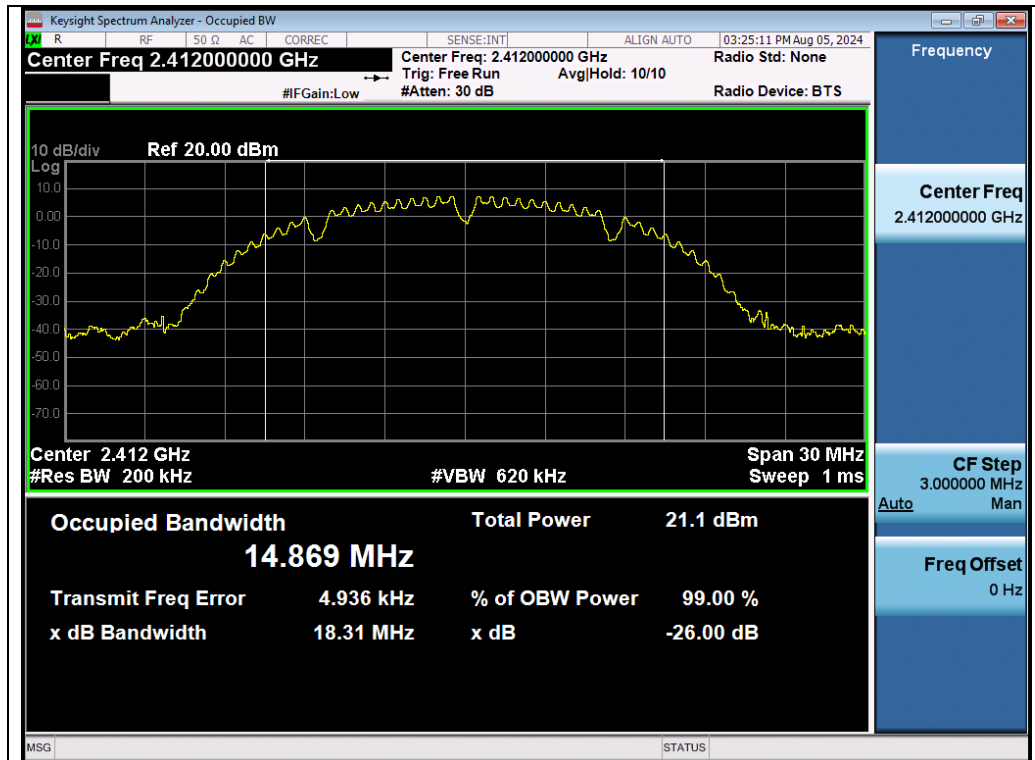
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8.4 Measurement Result

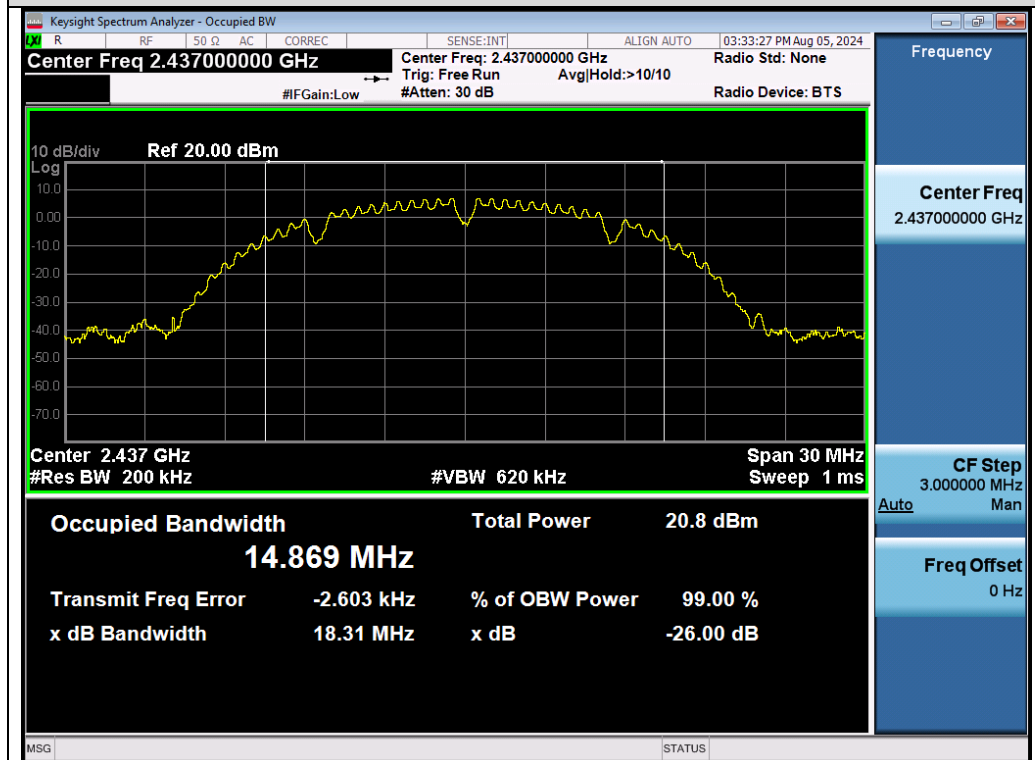
Test Data of Occupied Bandwidth and DTS Bandwidth					
Test Mode	Test Frequency (MHz)	99% Occupied Bandwidth (MHz)	DTS Bandwidth (MHz)	DTS Bandwidth Limits (MHz)	Pass or Fail
802.11b	2412	14.869	9.947	≥ 0.5	Pass
	2437	14.869	9.953	≥ 0.5	Pass
	2462	14.883	9.937	≥ 0.5	Pass
802.11g	2412	16.008	12.552	≥ 0.5	Pass
	2437	15.998	15.091	≥ 0.5	Pass
	2462	15.993	15.086	≥ 0.5	Pass
802.11n20	2412	17.083	15.065	≥ 0.5	Pass
	2437	17.058	15.059	≥ 0.5	Pass
	2462	17.051	13.777	≥ 0.5	Pass
802.11ax20	2412	18.206	13.834	≥ 0.5	Pass
	2437	18.284	15.023	≥ 0.5	Pass
	2462	18.236	14.461	≥ 0.5	Pass

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Test Graphs of Occupied Bandwidth

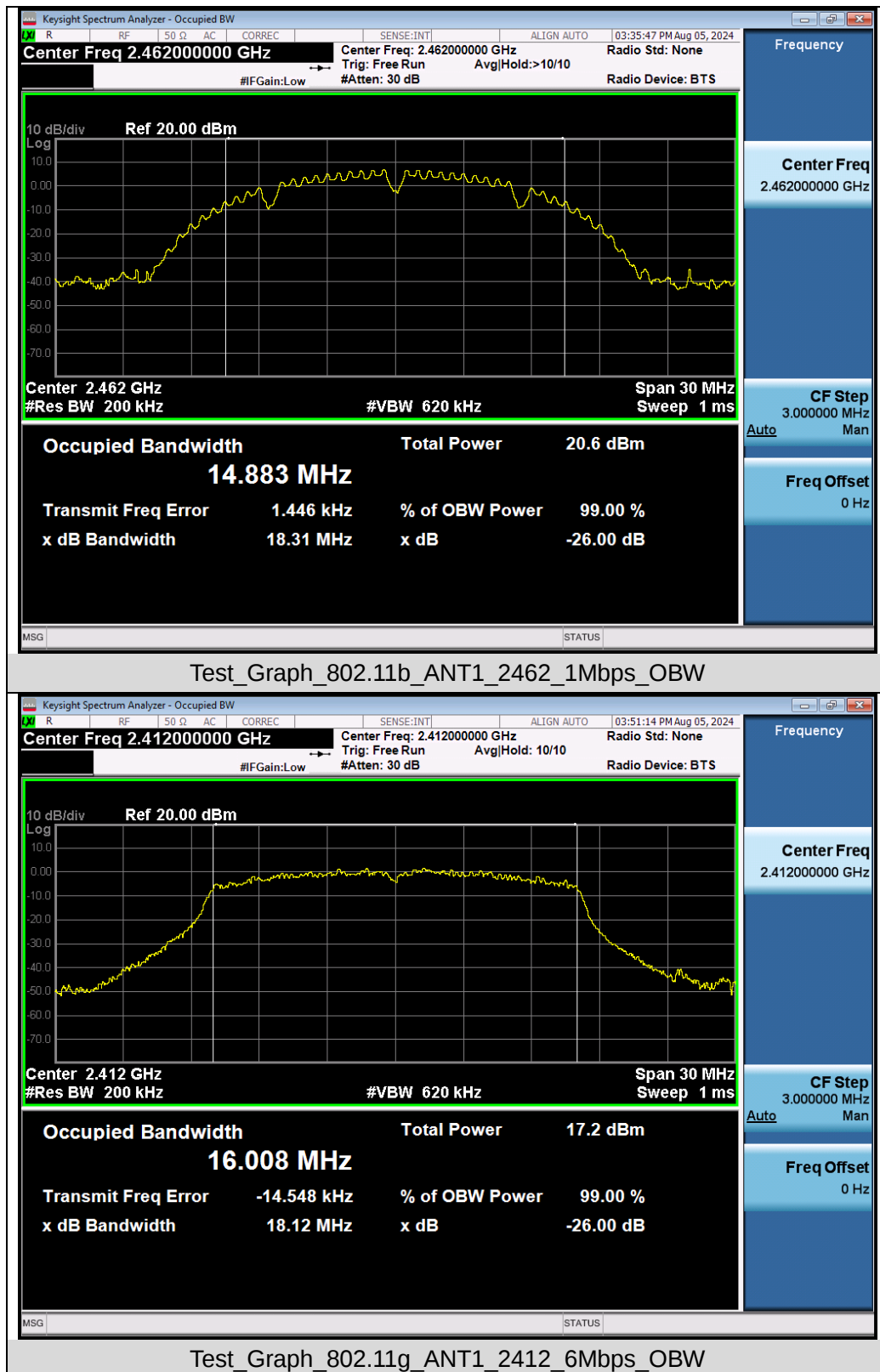


Test_Graph_802.11b_ANT1_2412_1Mbps_OBW



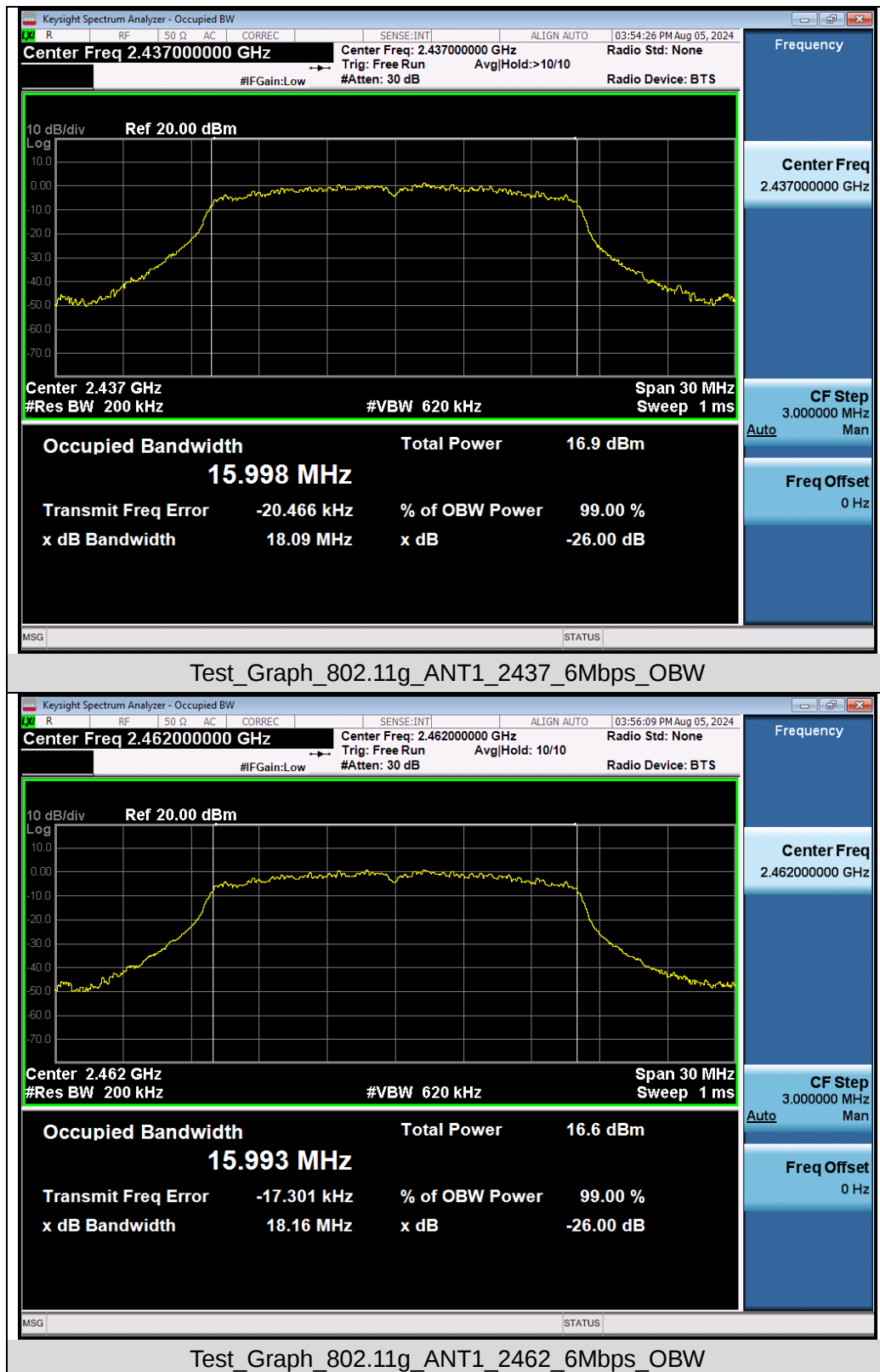
Test_Graph_802.11b_ANT1_2437_1Mbps_OBW

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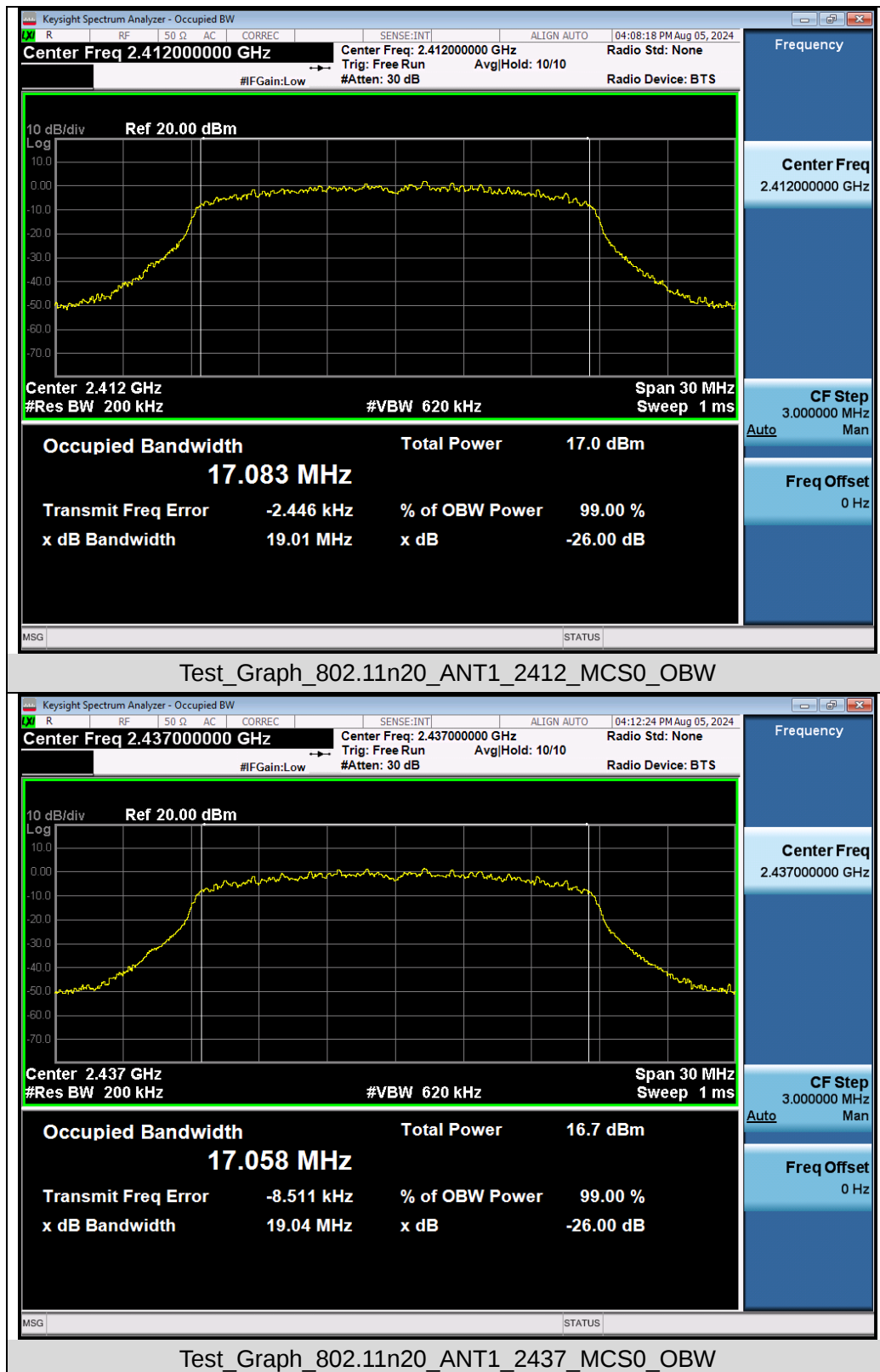


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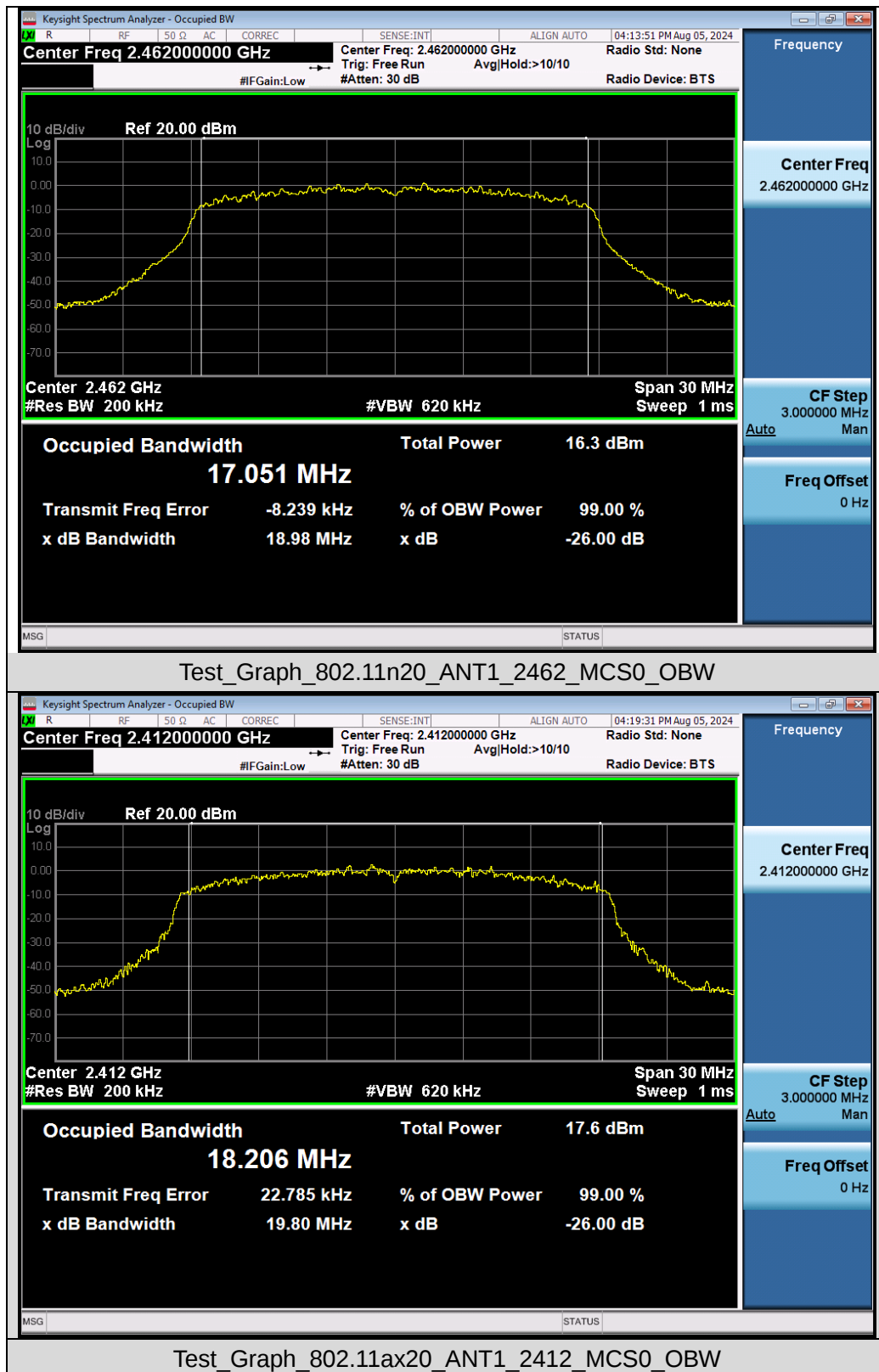
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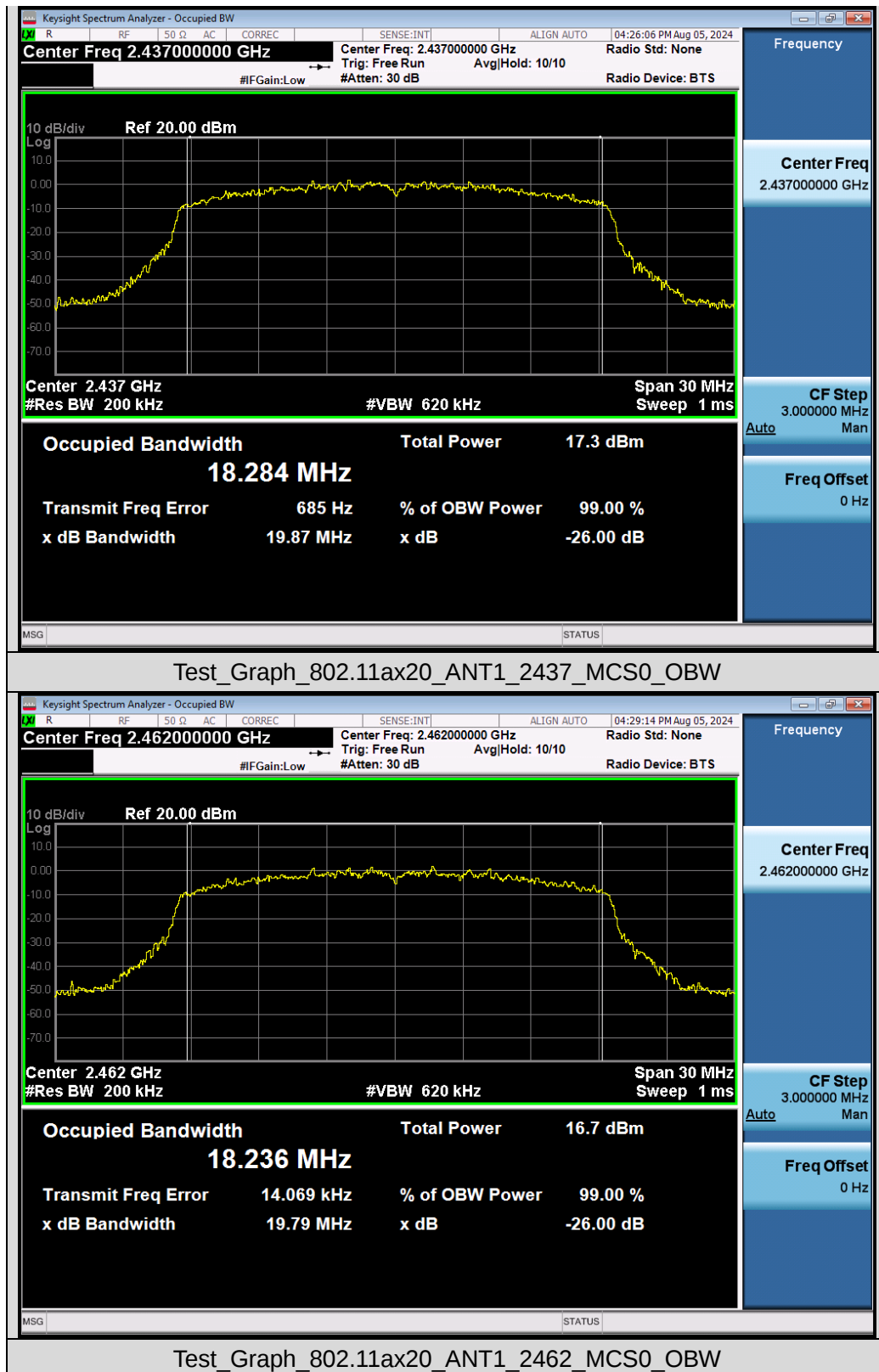
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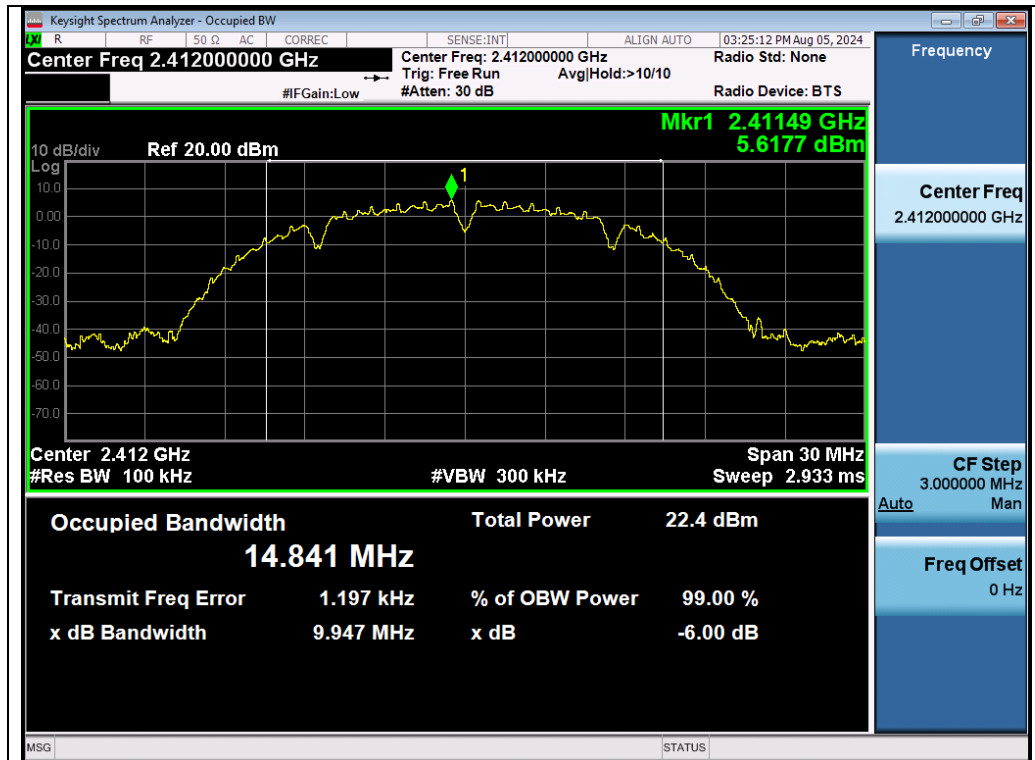


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Test Graphs of DTS Bandwidth

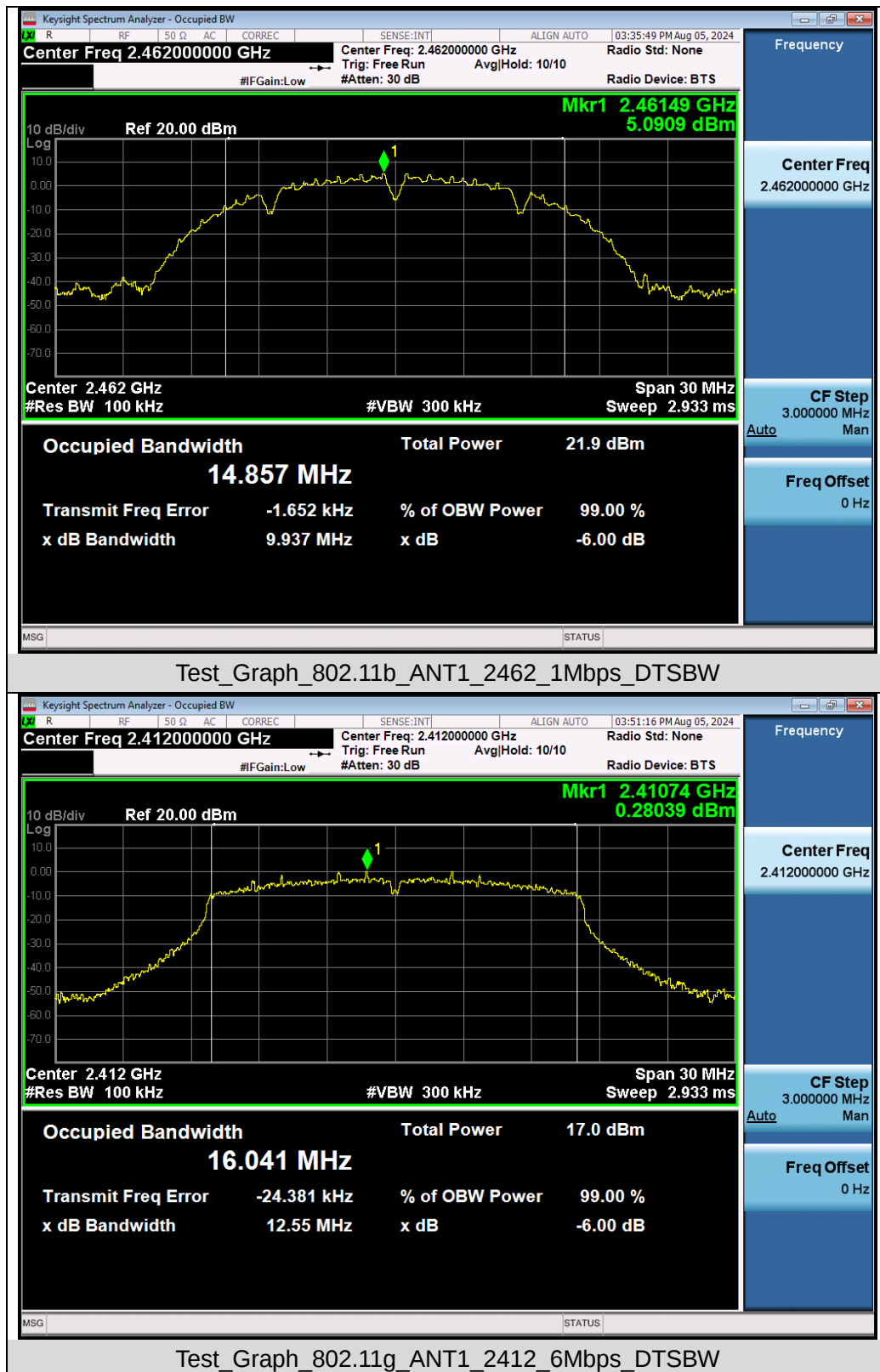


Test_Graph_802.11b_ANT1_2412_1Mbps_DTSBW

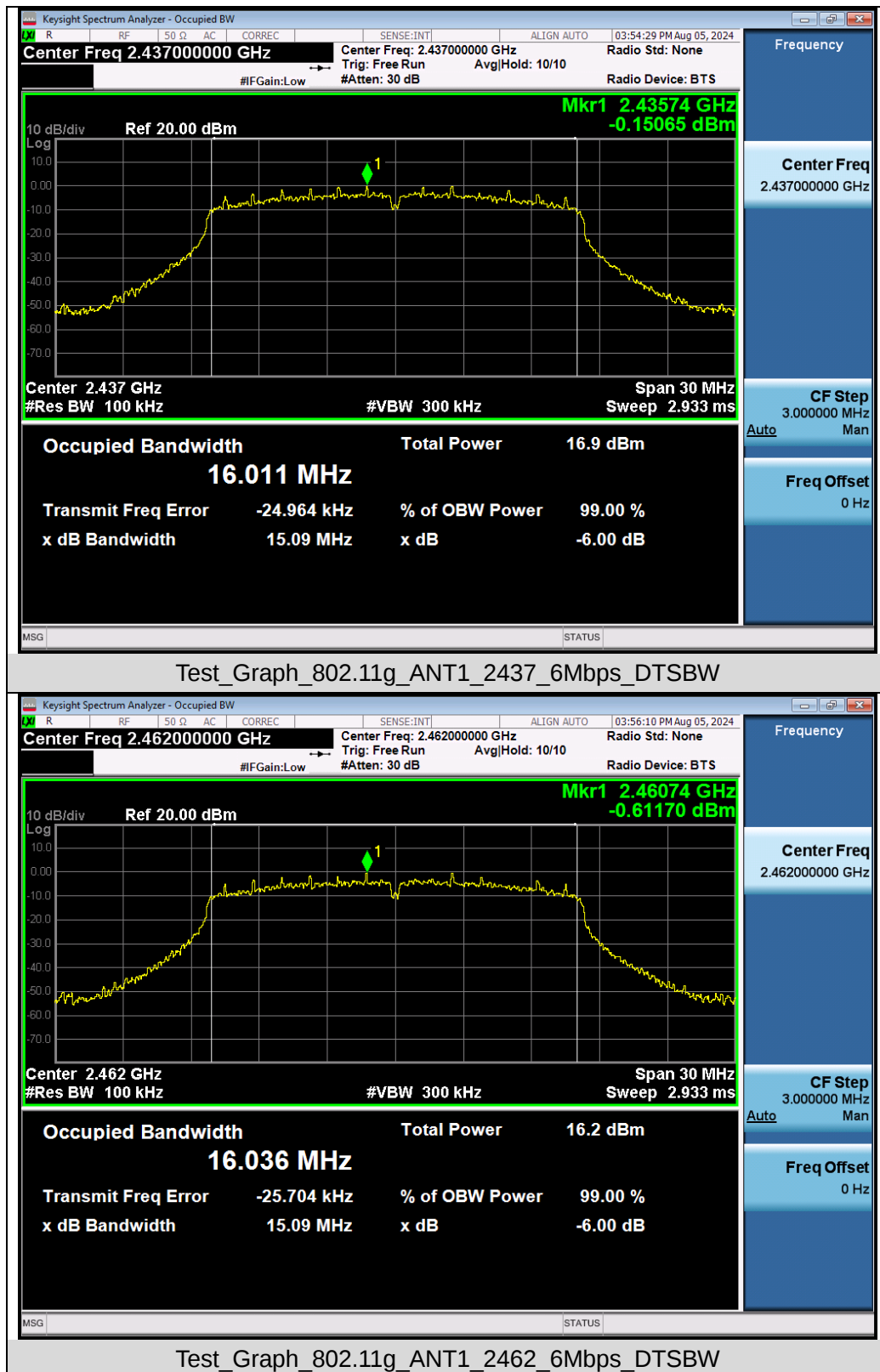


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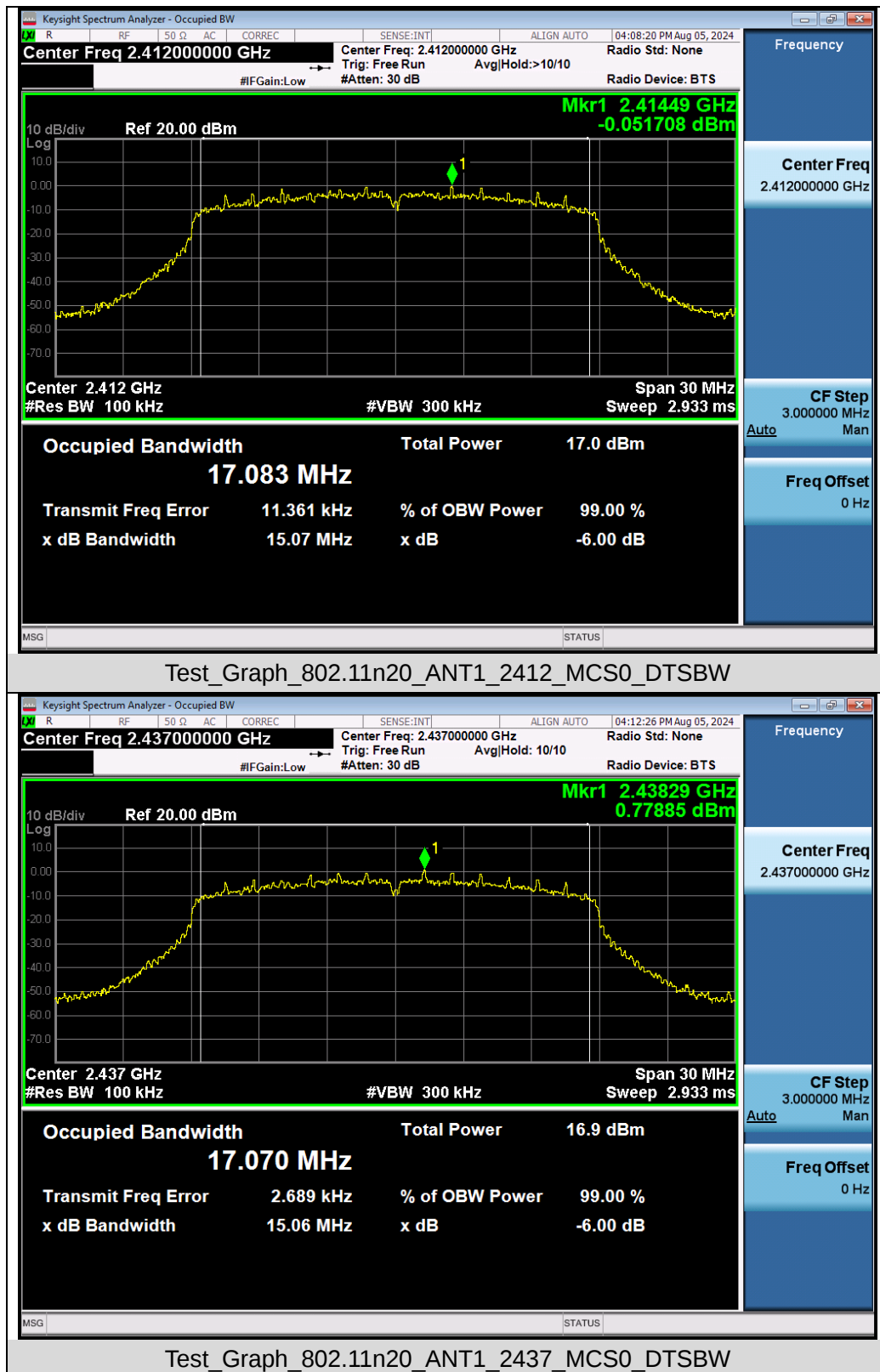
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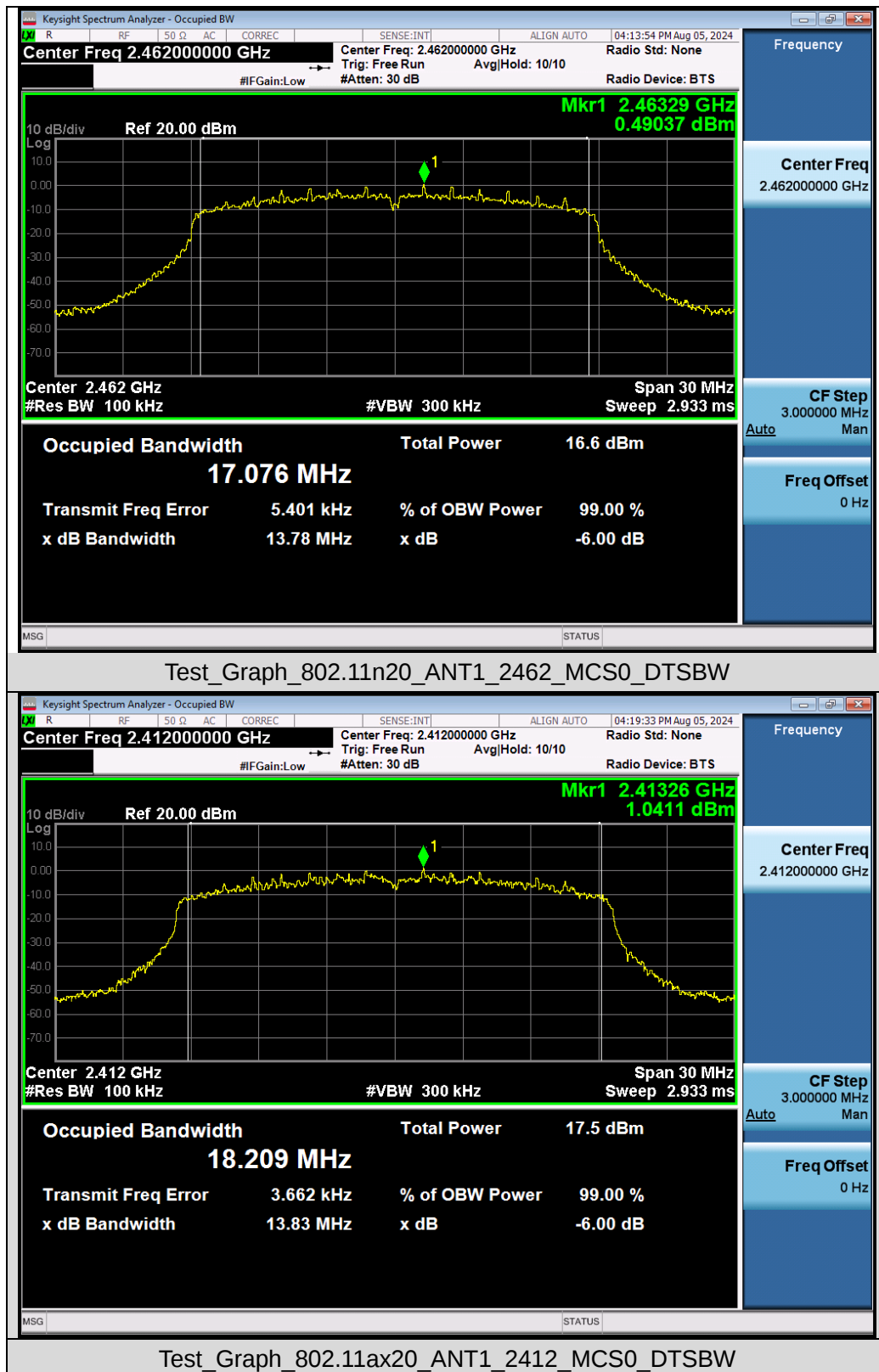
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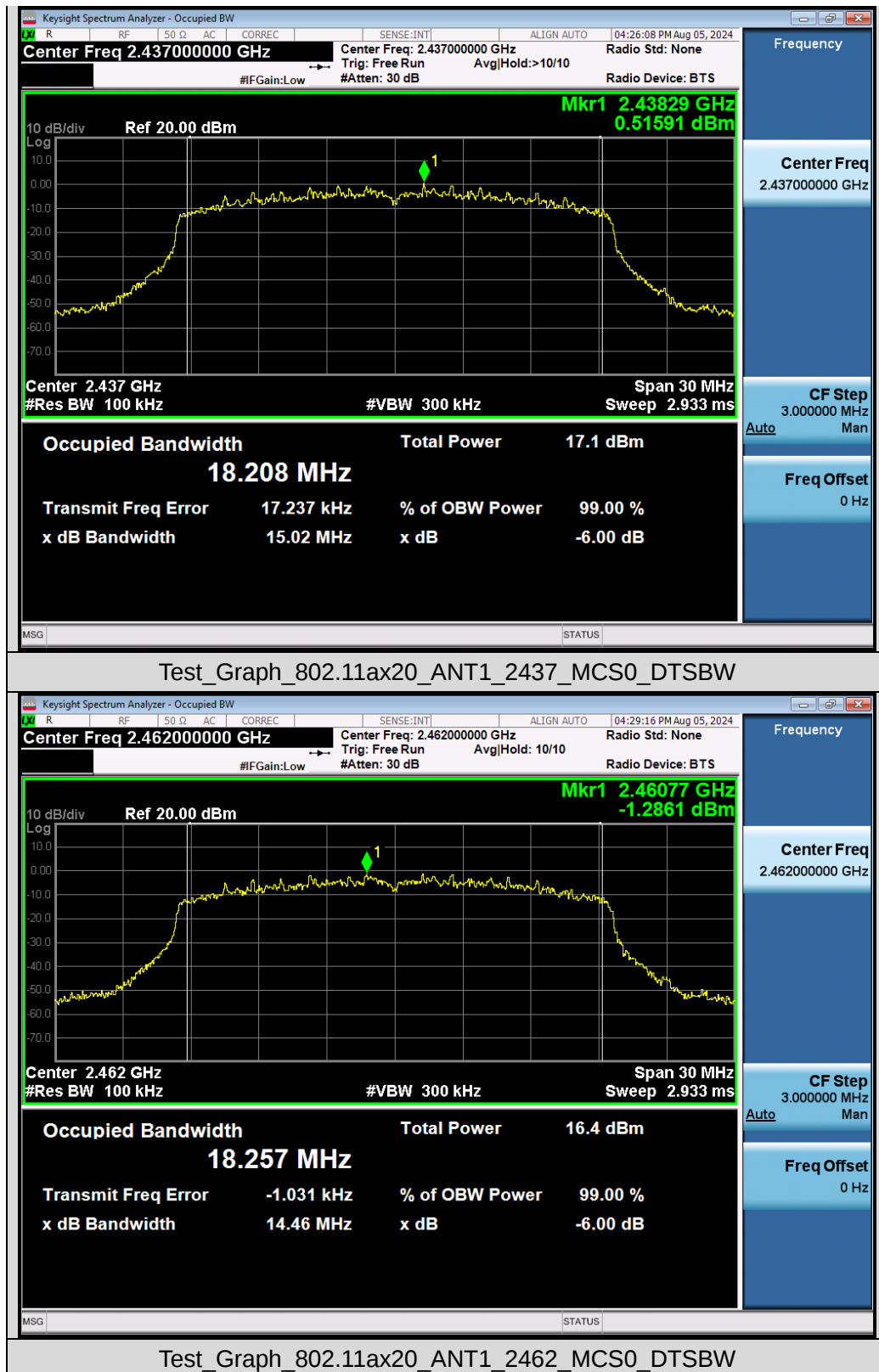
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9. Power Spectral Density Measurement

9.1 Provisions Applicable

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

9.2 Measurement Procedure

☒ For Peak power spectral density test:

1. The testing follows the ANSI C63.10 Section 11.10.2 Method PKPSD.
2. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
3. Set the RBW = 20 kHz.
4. Set the VBW $\geq [3 \times \text{RBW}]$.
5. Set the Span $\geq [1.5 \times \text{DTS bandwidth}]$.
6. Sweep time=Auto couple.
7. Detector function=Peak.
8. Trace Mode=Max hold.
9. When the measurement bandwidth of Maximum PSD is specified in 3 kHz, add a constant factor $10 \times \log(3\text{kHz}/20\text{kHz}) = -8.23 \text{ dB}$ to the measured result.
10. Allow trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission.
11. The indicated level is the peak output power, after any corrections for external attenuators and cables.

☐ For Average power spectral density test:

1. The testing follows the ANSI C63.10 Section 11.10.5 Method AVPSD.
2. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator.
3. Set Span to at least 1.5 times the OBW.
4. Set RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
5. Set $\text{VBW} \geq [3 \times \text{RBW}]$.
6. Sweep Time=Auto couple.
7. Detector function=RMS (i.e., power averaging).
8. Trace average at least 100 traces in power averaging (rms) mode.
9. When the measurement bandwidth of Maximum PSD is specified in 3 kHz, add a constant factor $10 \times \log(3\text{kHz}/20\text{kHz}) = -8.23 \text{ dB}$ to the measured result.
10. Determine according to the duty cycle of the equipment: when it is less than 98%, follow the steps below.
11. Add $[10 \log (1 / D)]$, where D is the duty cycle, to the measured power to compute the average power during the actual transmission times (because the measurement represents an average over both the ON and OFF times of the transmission). For example, add $[10 \log (1/0.25)] = 6 \text{ dB}$ if the duty cycle is 25%.
12. Record the test results in the report.

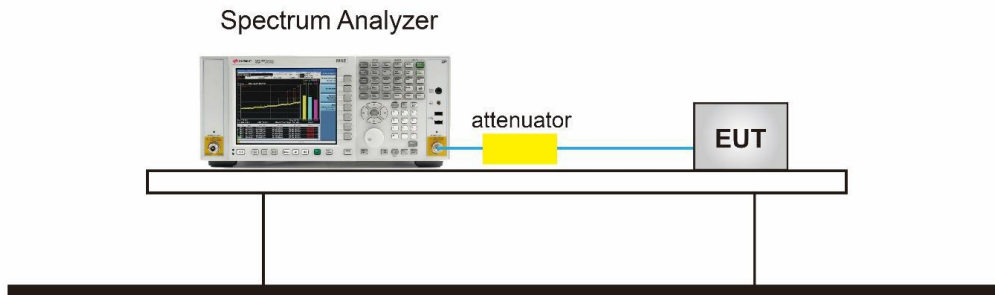
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9.3 Measurement Setup (Block Diagram of Configuration)



9.4 Measurement Result

Test Data of Conducted Output Power Spectral Density					
Test Mode	Test Frequency (MHz)	Power Spectral density (dBm/20kHz)	Power Spectral density (dBm/3kHz)	Limit (dBm/3kHz)	Pass or Fail
802.11b	2412	-1.894	-10.133	≤ 8	Pass
	2437	-2.034	-10.273	≤ 8	Pass
	2462	-2.465	-10.704	≤ 8	Pass
802.11g	2412	-6.655	-14.894	≤ 8	Pass
	2437	-7.352	-15.591	≤ 8	Pass
	2462	-7.189	-15.428	≤ 8	Pass
802.11n20	2412	-6.509	-14.748	≤ 8	Pass
	2437	-7.095	-15.334	≤ 8	Pass
	2462	-7.391	-15.63	≤ 8	Pass
802.11ax20	2412	-5.783	-14.022	≤ 8	Pass
	2437	-6.291	-14.53	≤ 8	Pass
	2462	-6.700	-14.939	≤ 8	Pass

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Test Graphs of Conducted Output Power Spectral Density

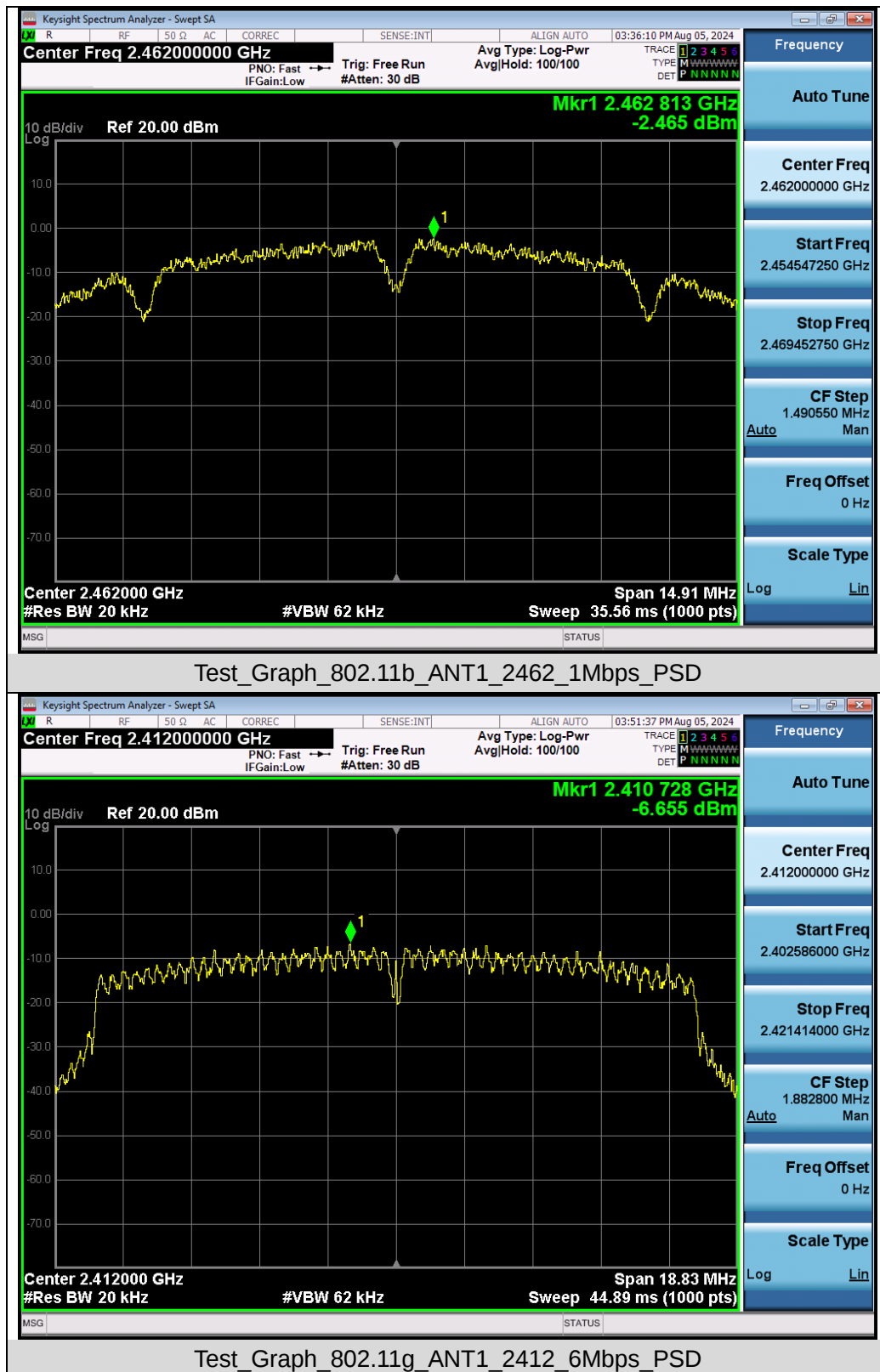


Test_Graph_802.11b_ANT1_2412_1Mbps_PSD

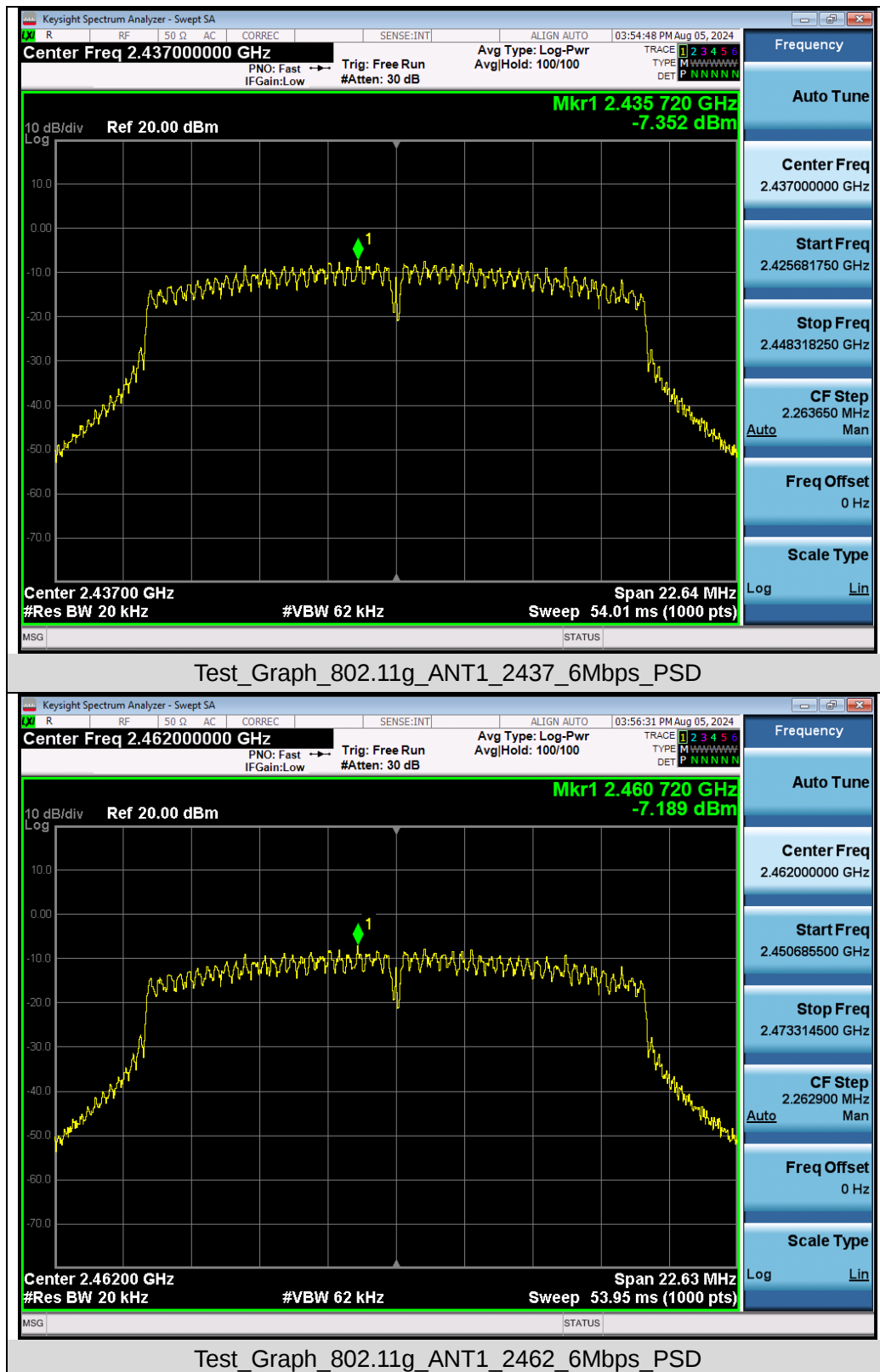


Test_Graph_802.11b_ANT1_2437_1Mbps_PSD

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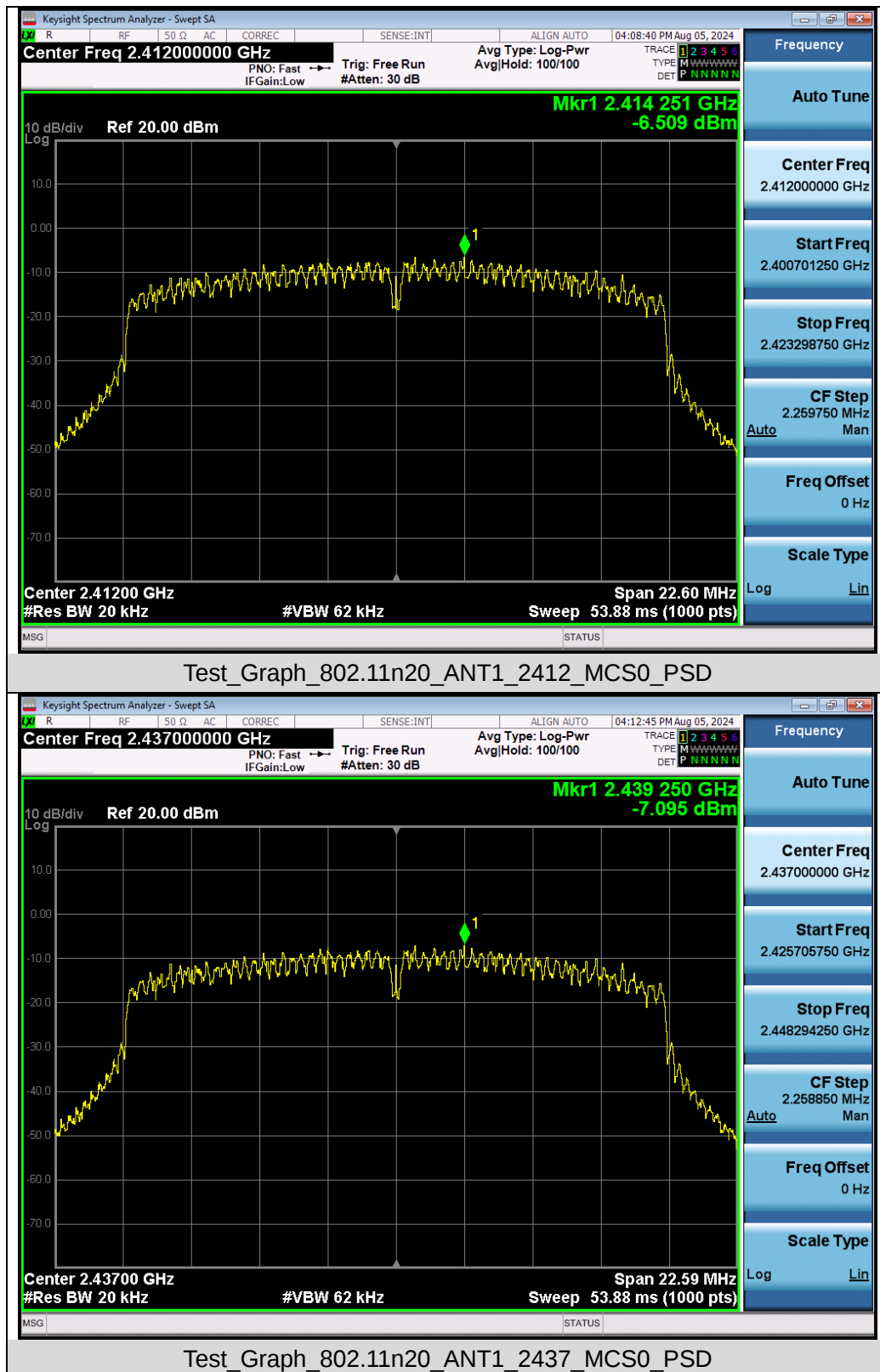


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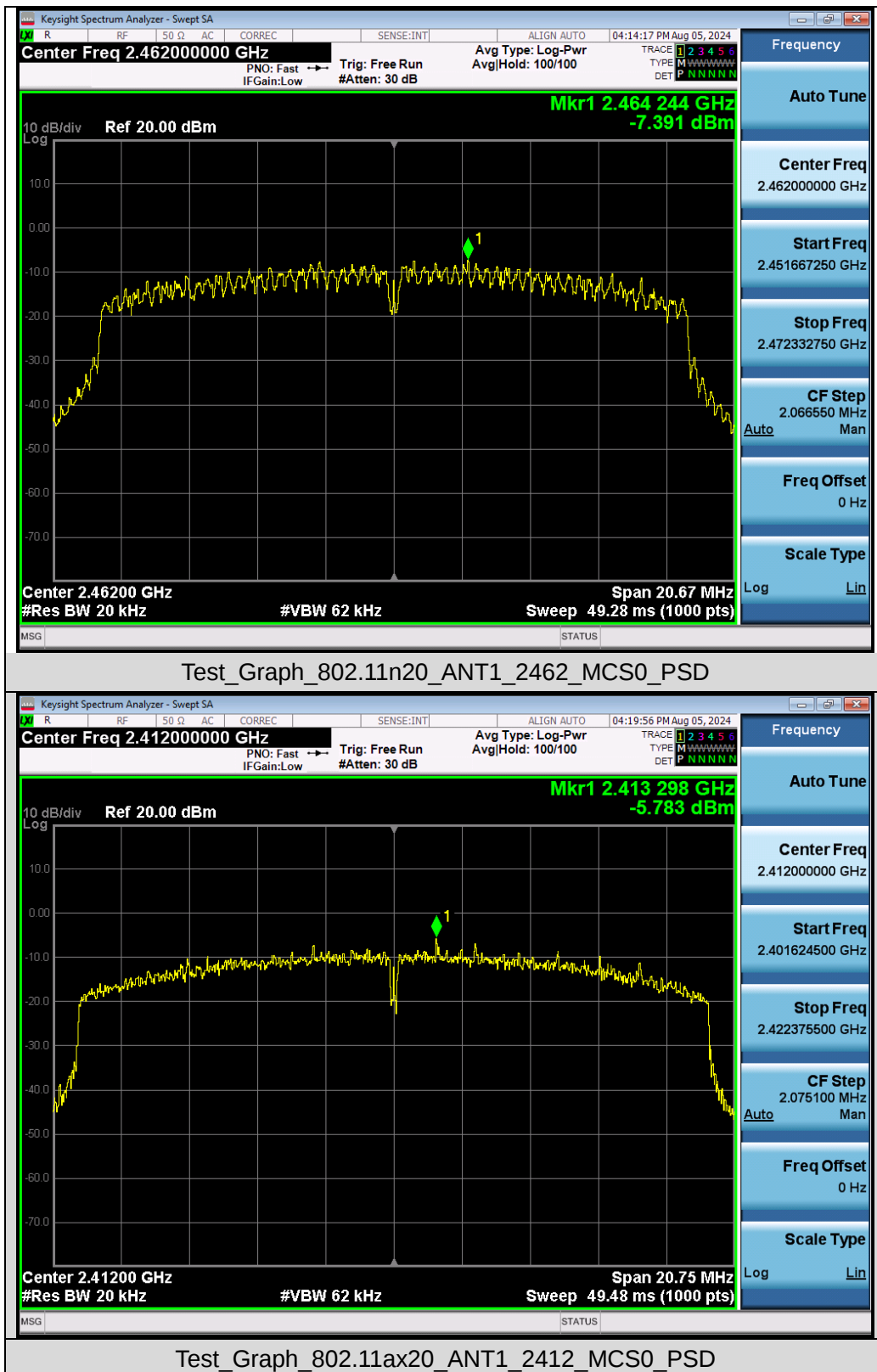
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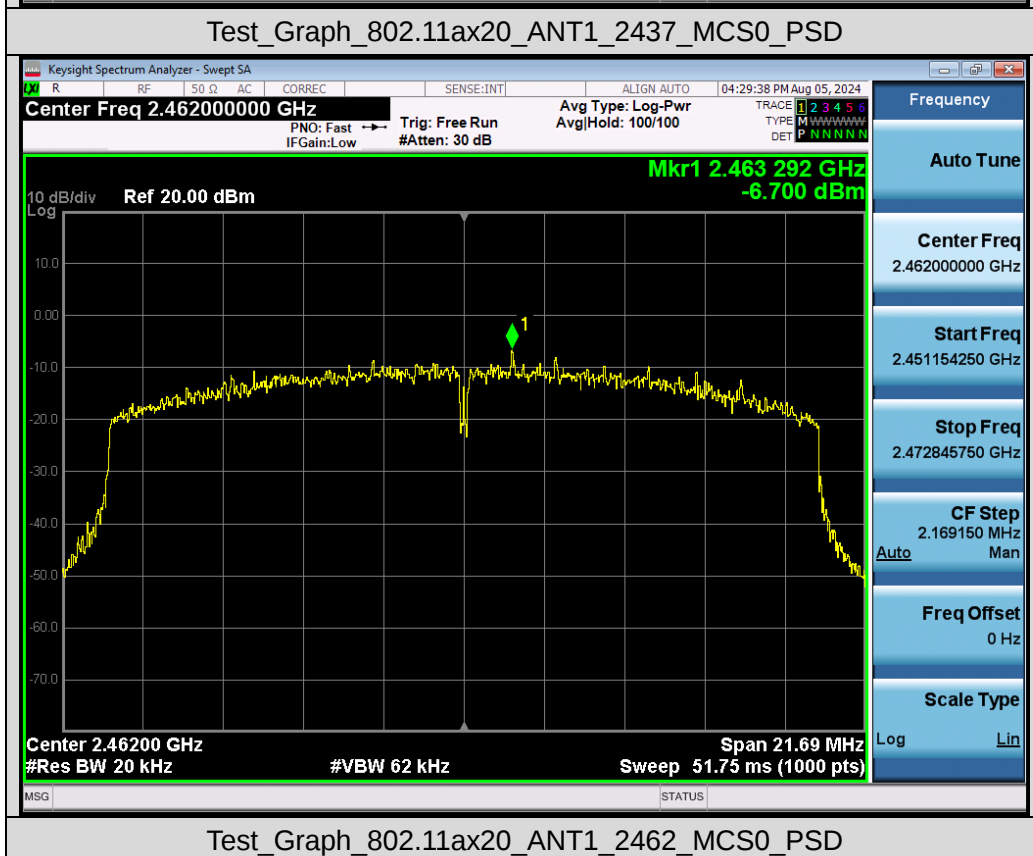
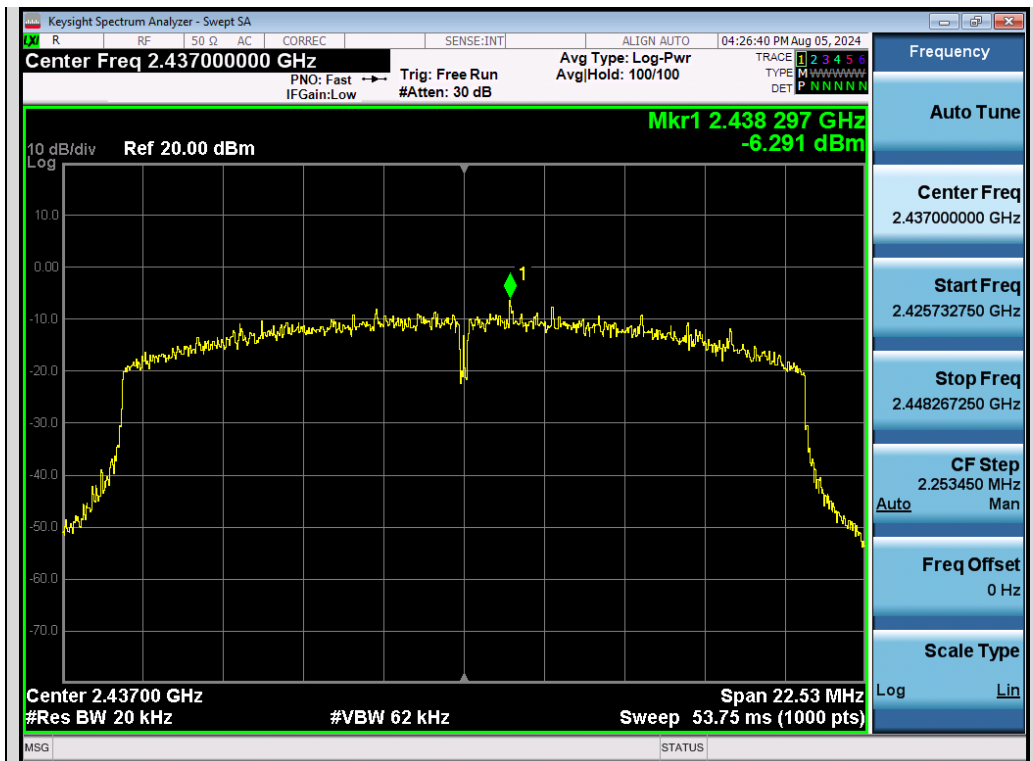


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10. Conducted Band Edge and Out-of-Band Emissions

10.1 Provisions Applicable

In any 100kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power.

10.2 Measurement Procedure

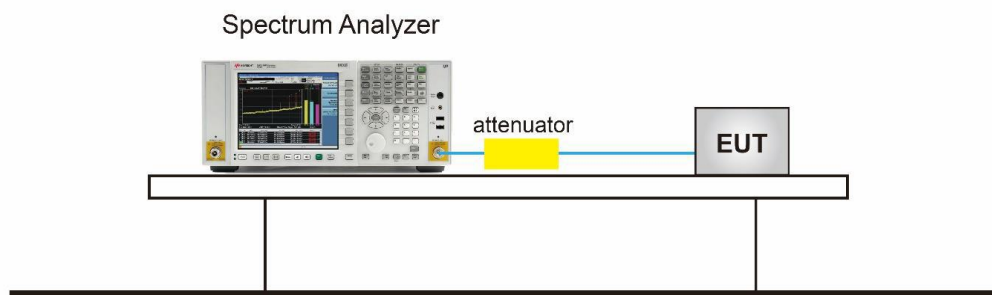
Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

Use the following spectrum analyzer settings:

- Step 1: Measurement Procedure In-Band Reference Level
 1. Set instrument center frequency to DTS channel center frequency.
 2. Set the span to ≥ 1.5 times the DTS bandwidth.
 3. Set the RBW = 100 kHz.
 4. Set the VBW $\geq 3 \times$ RBW.
 5. Detector = peak.
 6. Sweep time = auto couple.
 7. Trace mode = max hold.
 8. Allow trace to fully stabilize.
 9. Use the peak marker function to determine the maximum PSD level.
 10. Note that the channel found to contain the maximum PSD level can be used to establish the reference level.
 11. For reference level values, please refer to DTS bandwidth test.
- Step 2: Measurement Procedure Out of Band Emission
 1. Set RBW = 100 kHz.
 2. Set VBW ≥ 300 kHz.
 3. Detector = peak.
 4. Sweep = auto couple.
 5. Trace Mode = max hold.
 6. Allow trace to fully stabilize.
 7. Use the peak marker function to determine the maximum amplitude level.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

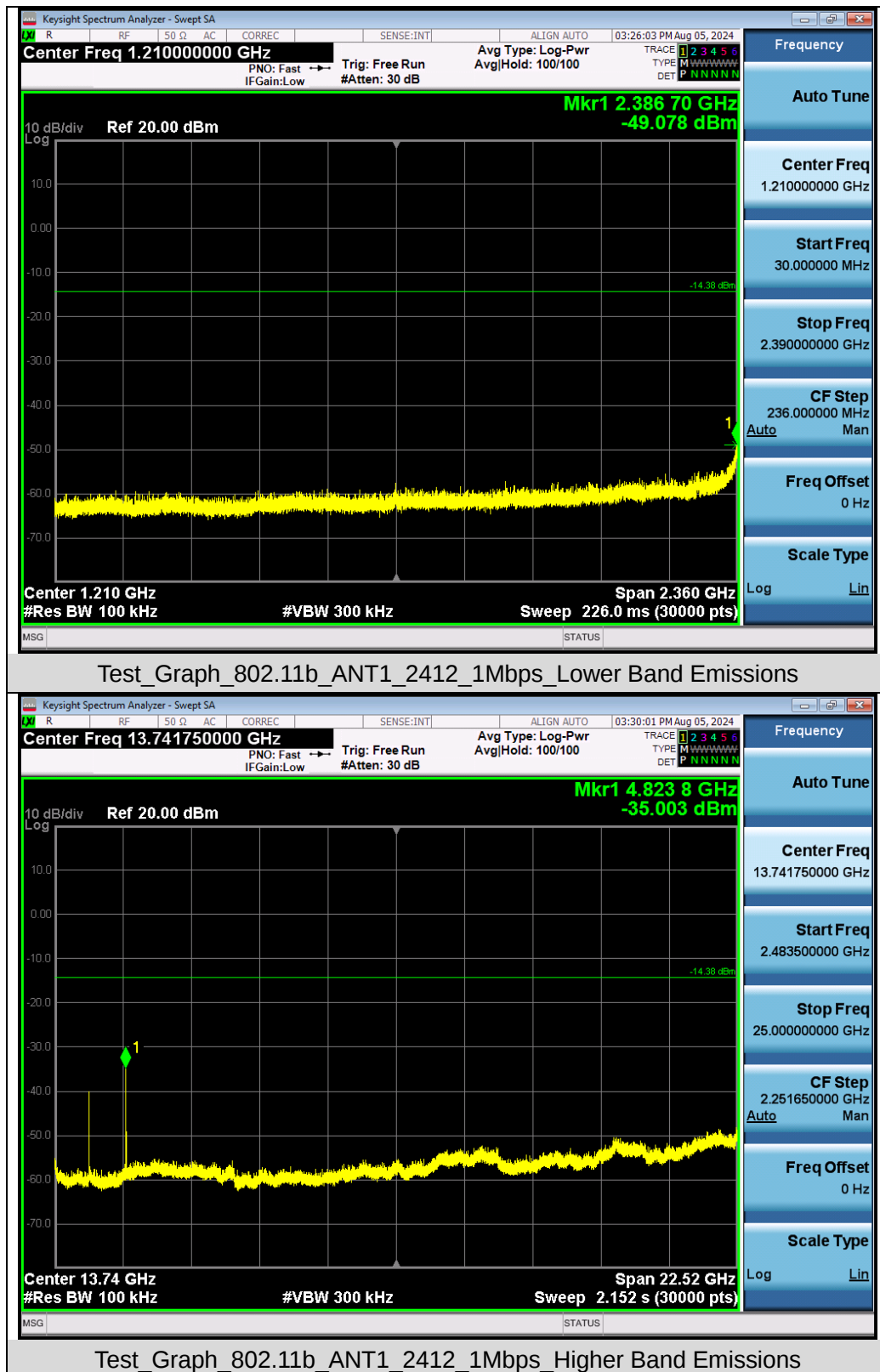
10.3 Measurement Setup (Block Diagram of Configuration)



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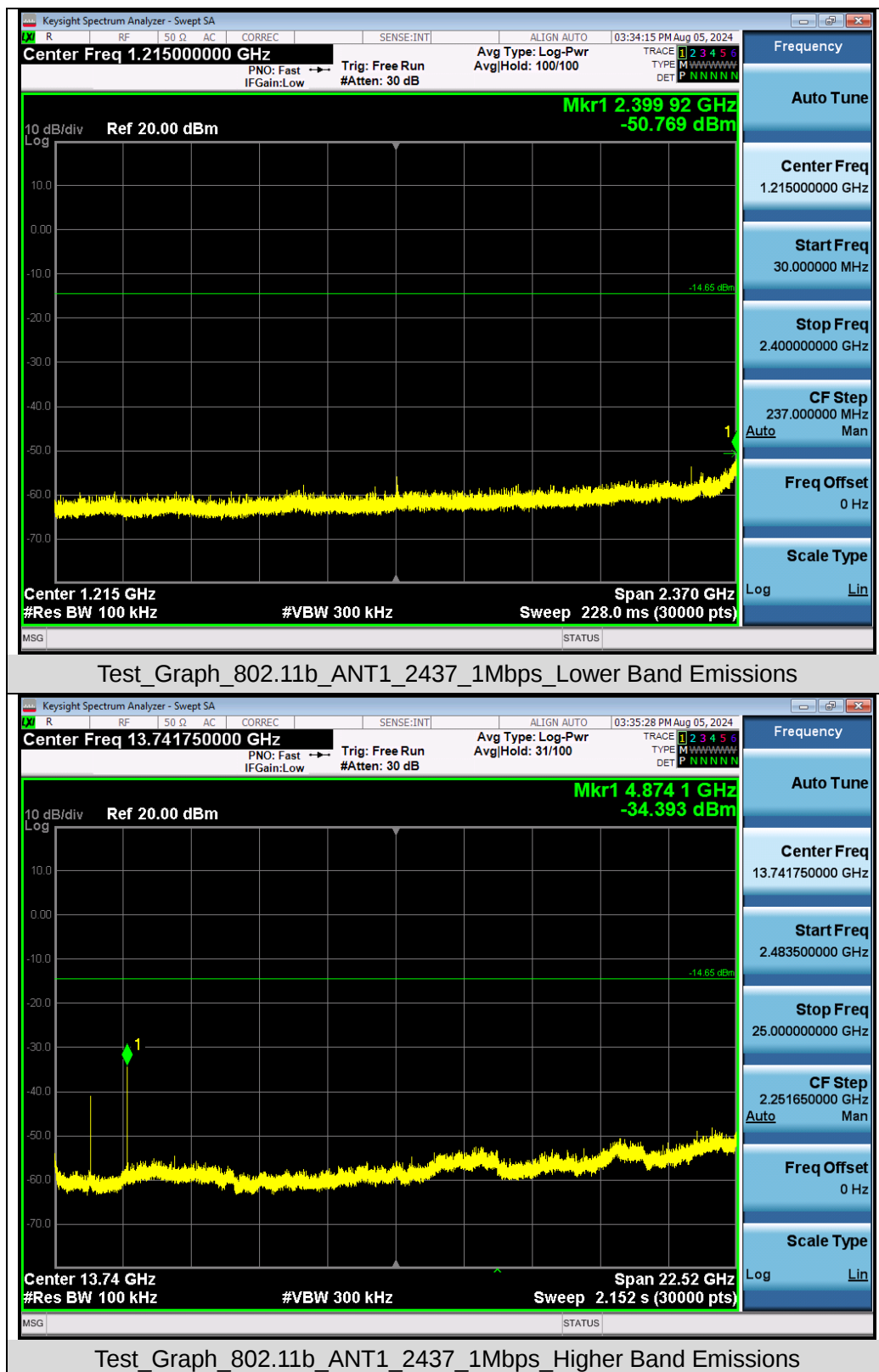
10.4 Measurement Result

Test Graphs of Spurious Emissions in Non-Restricted Frequency Bands



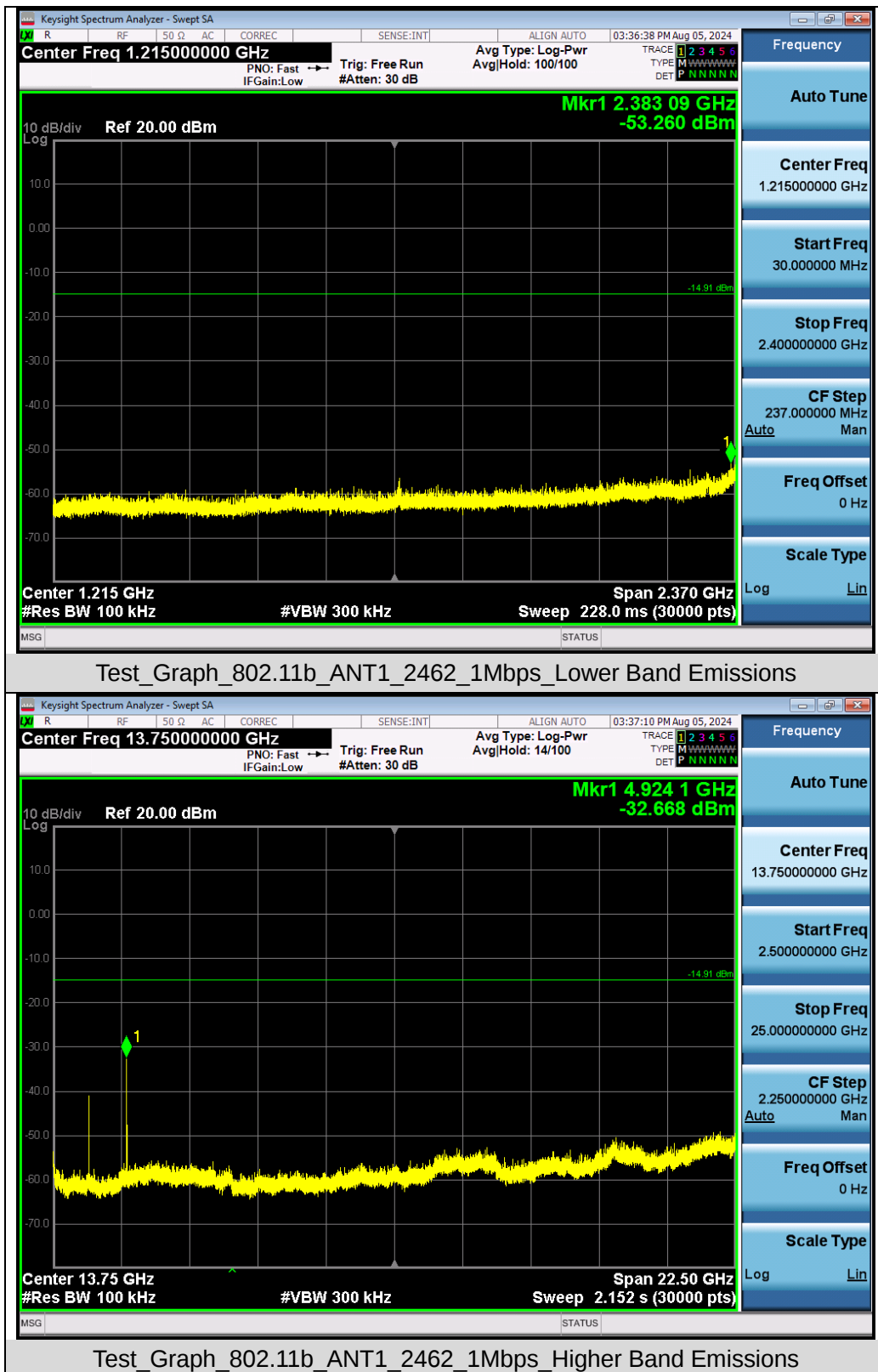
Test_Graph_802.11b_ANT1_2412_1Mbps_Higher Band Emissions

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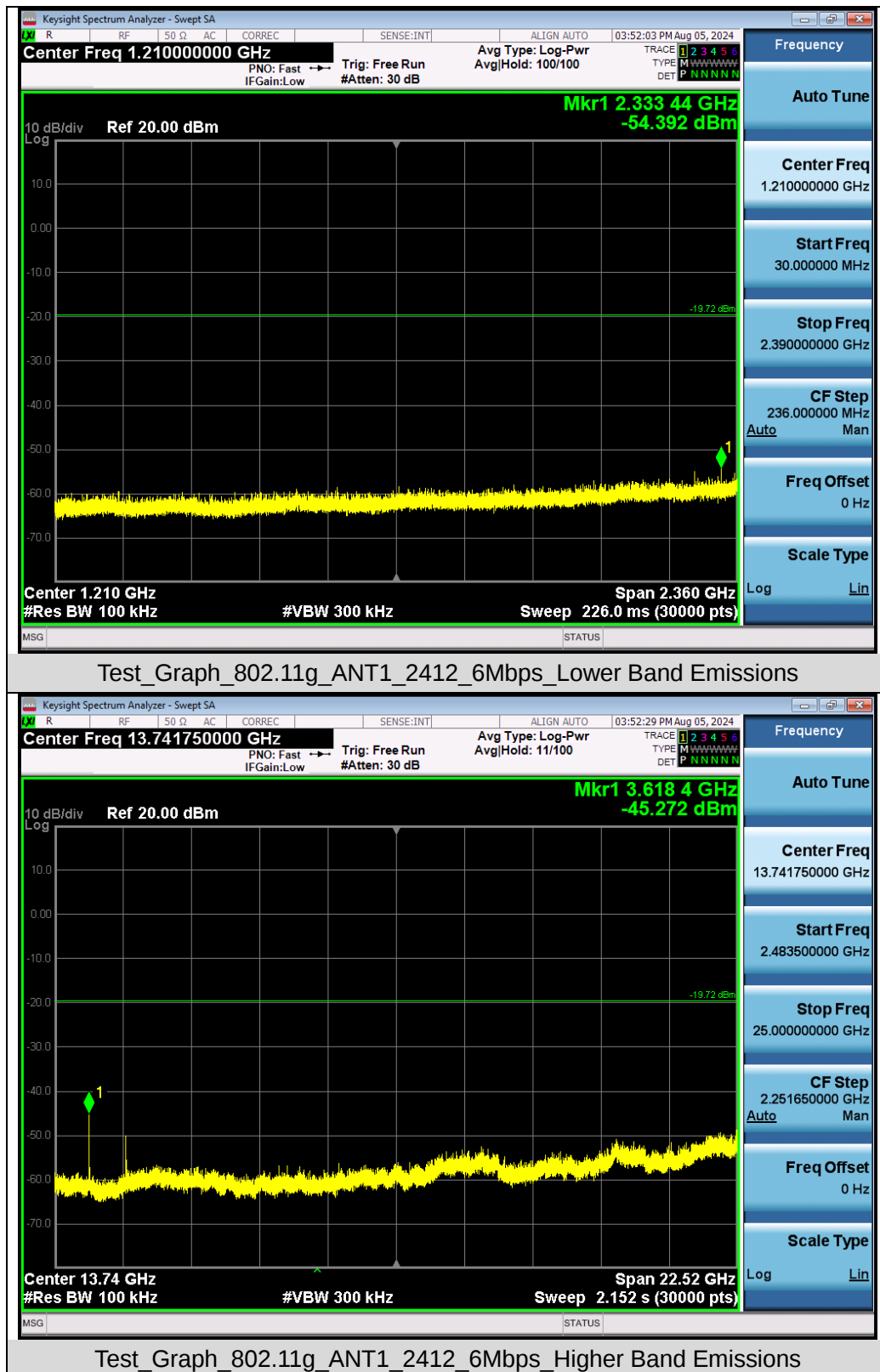


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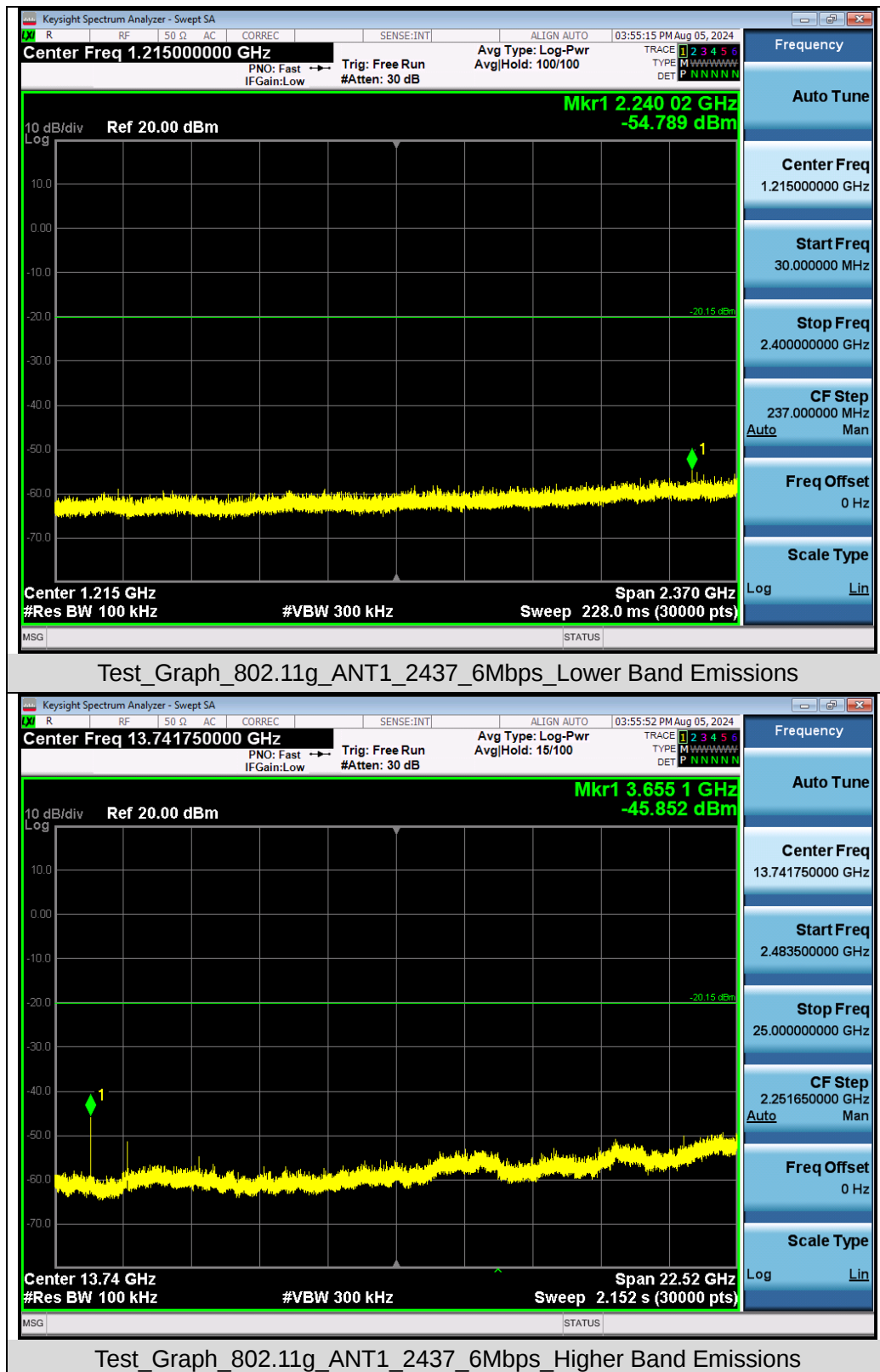
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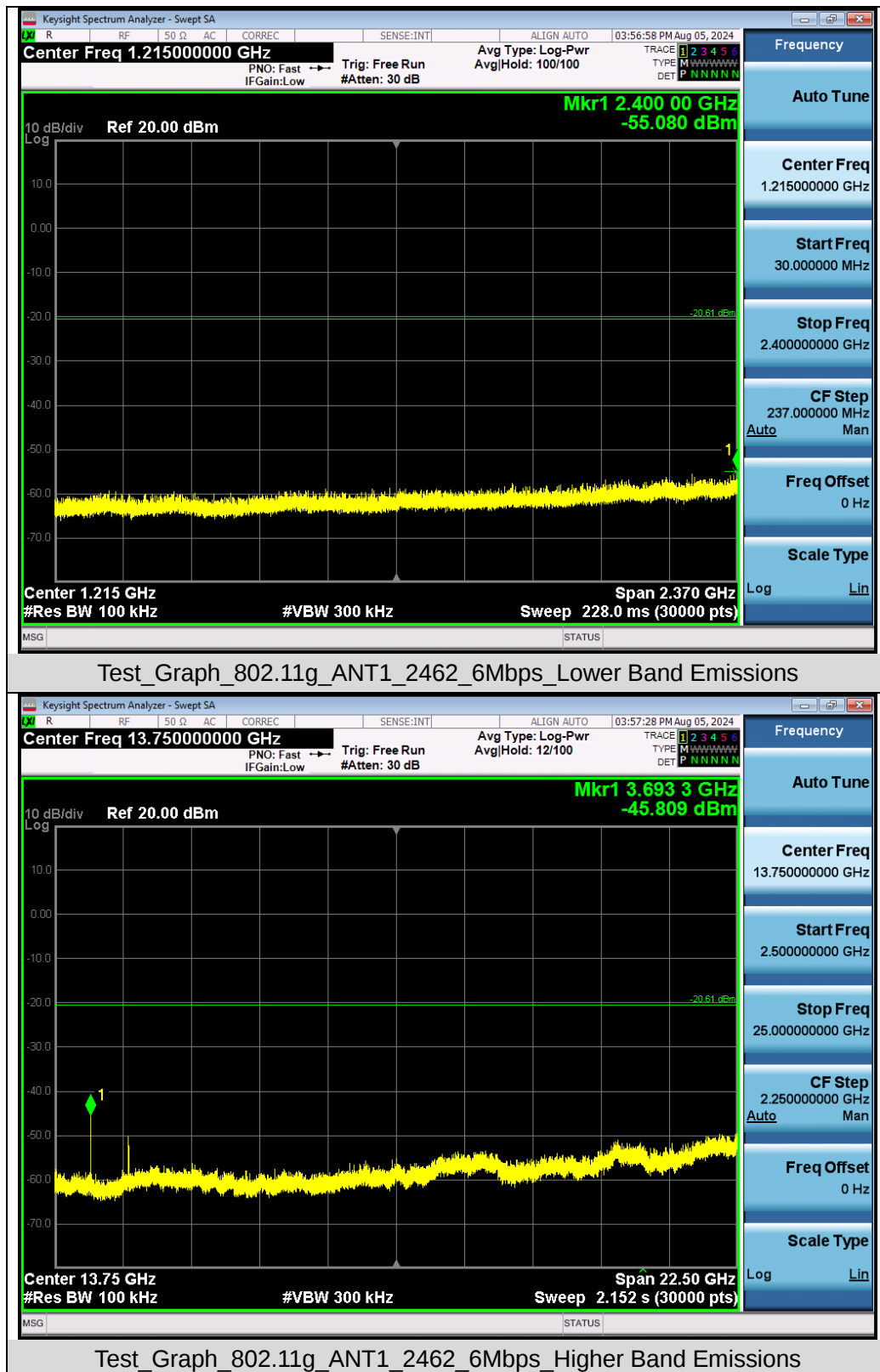
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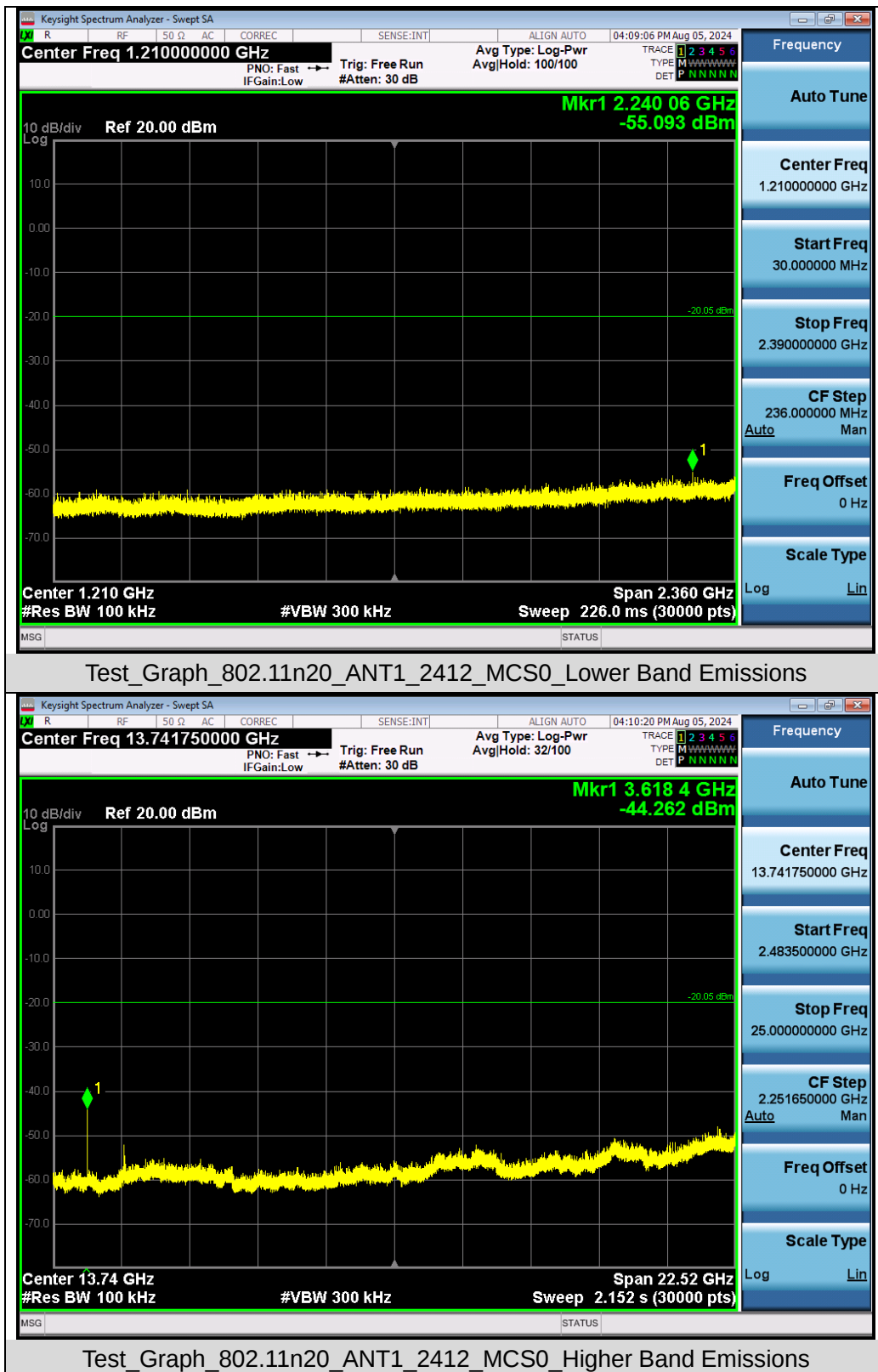
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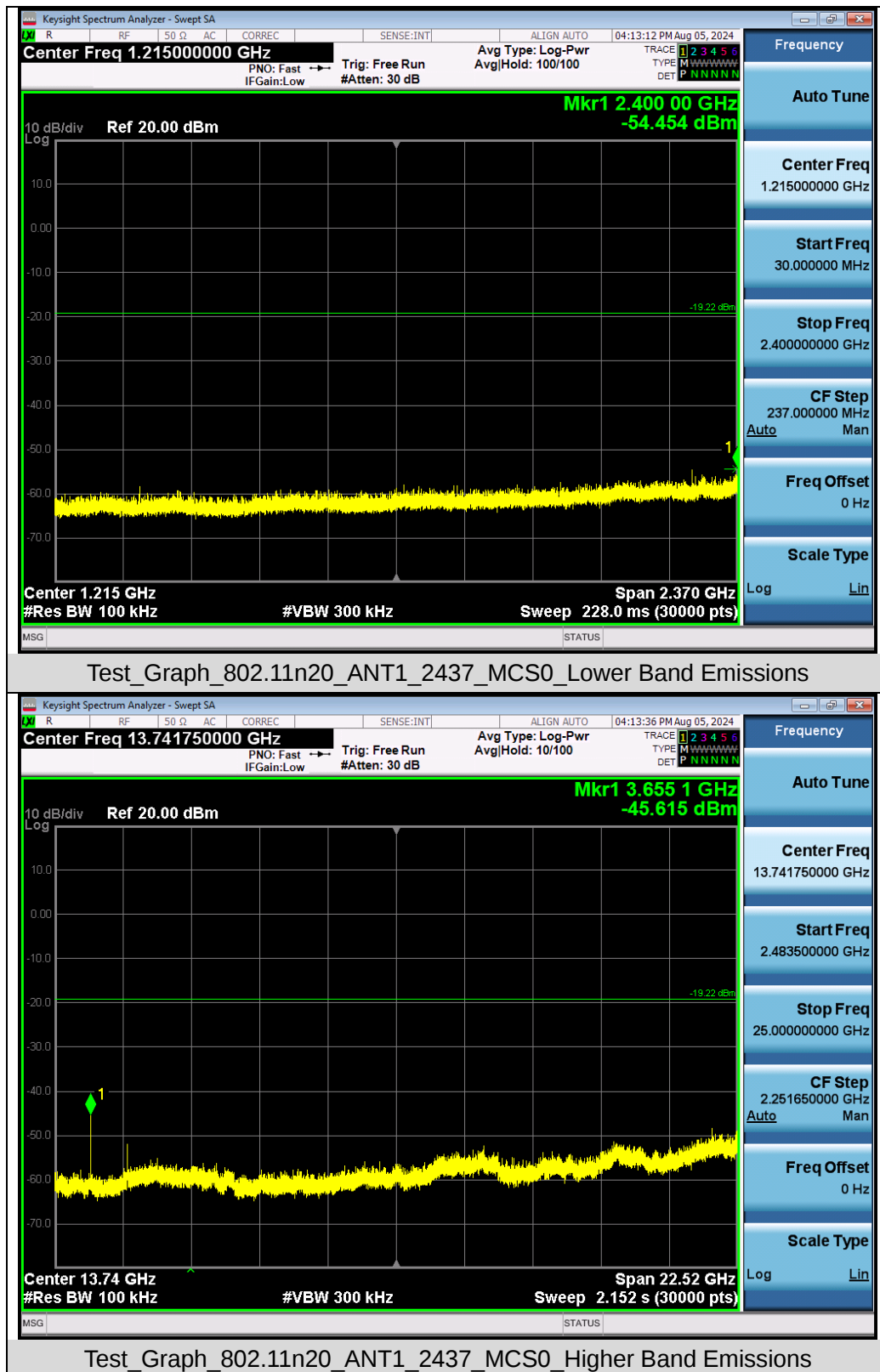
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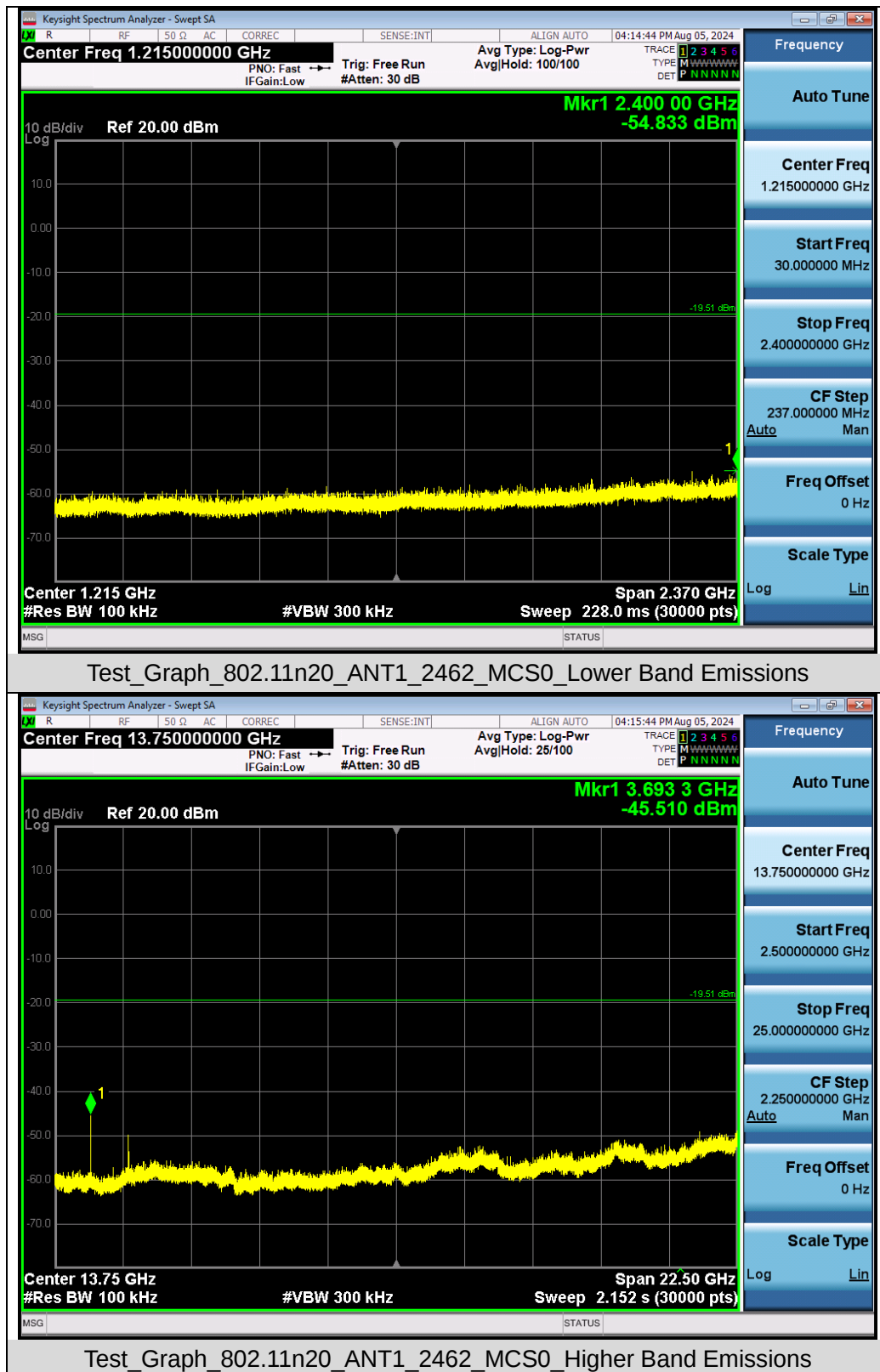
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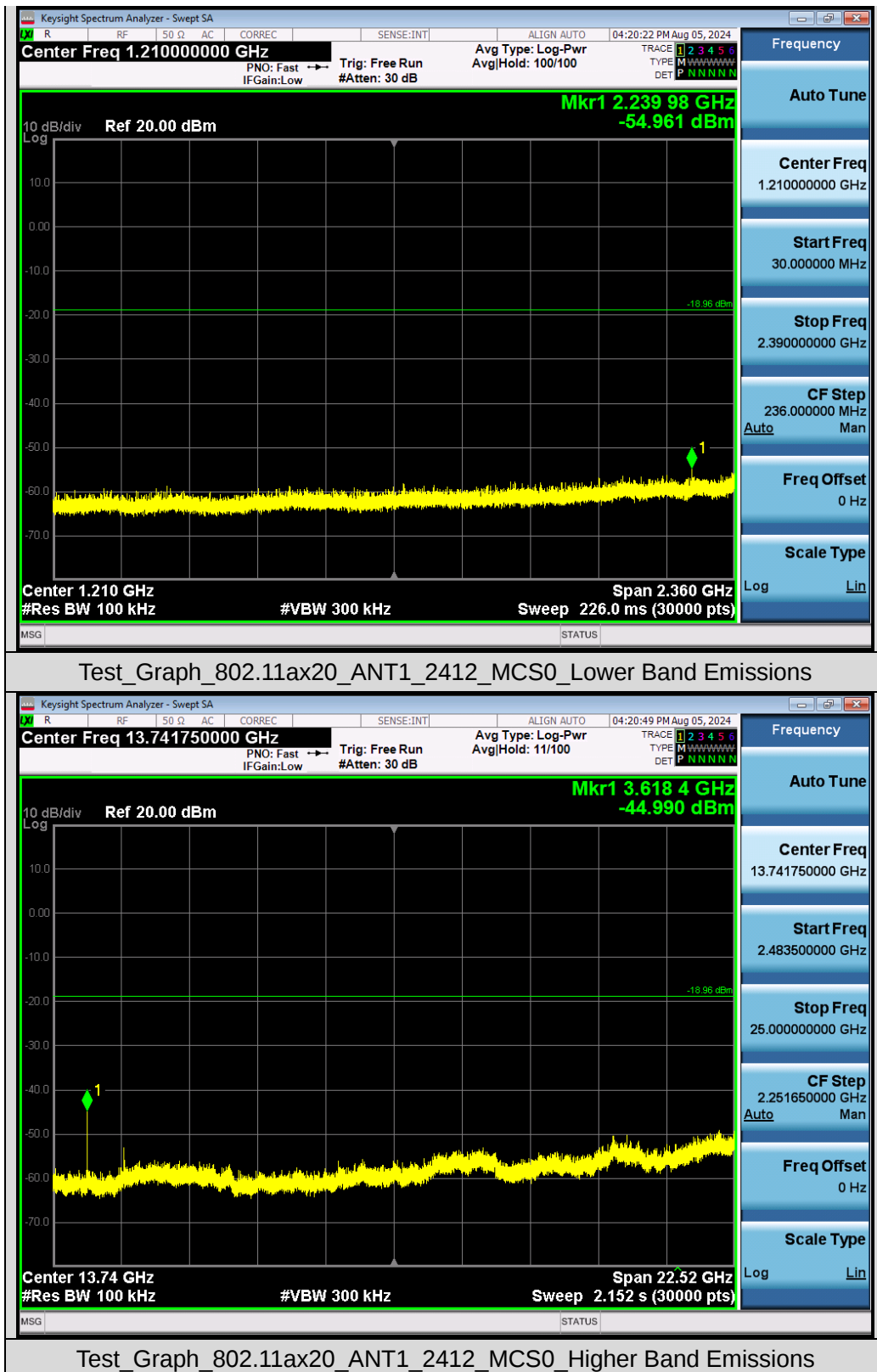
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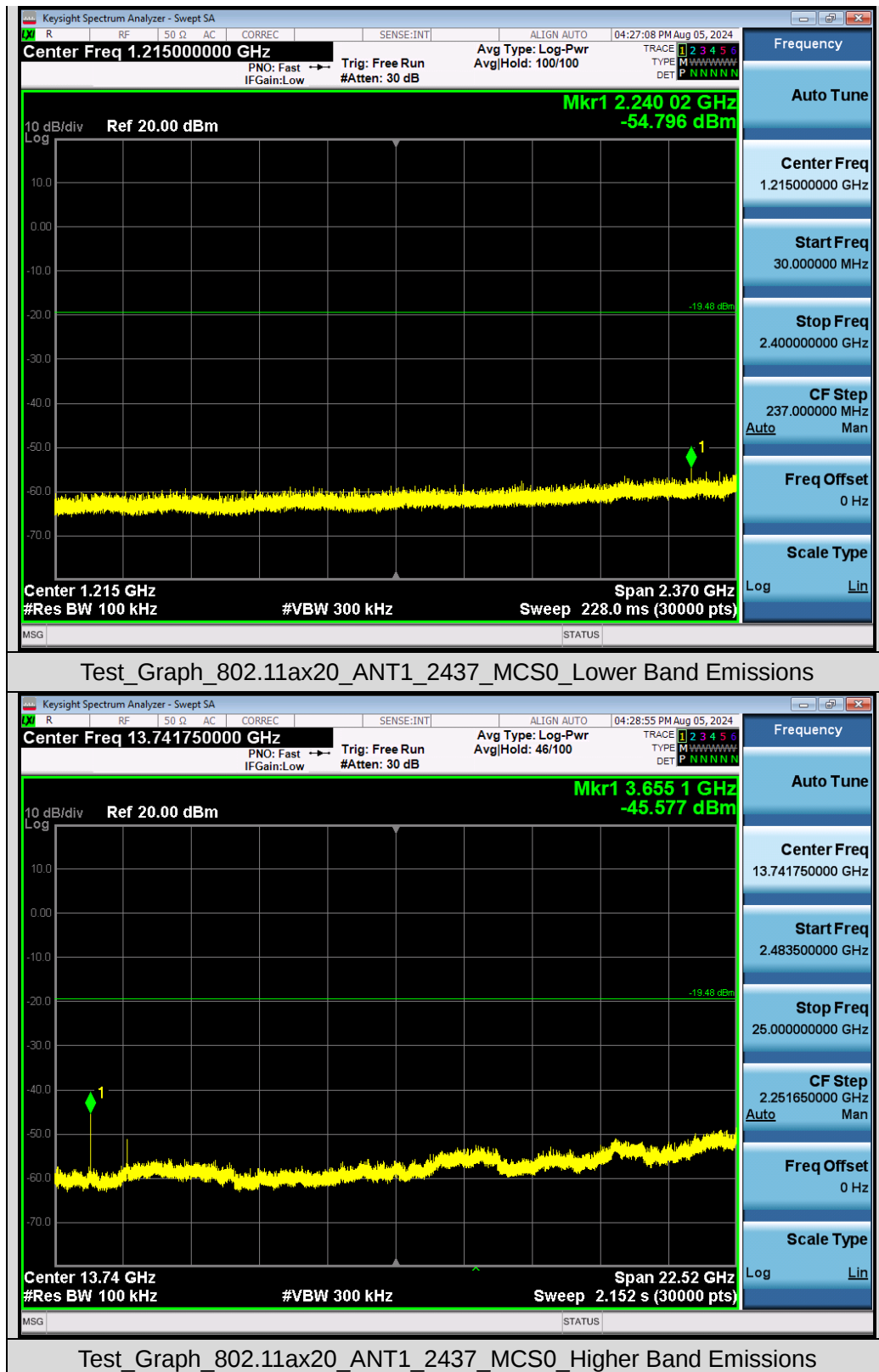
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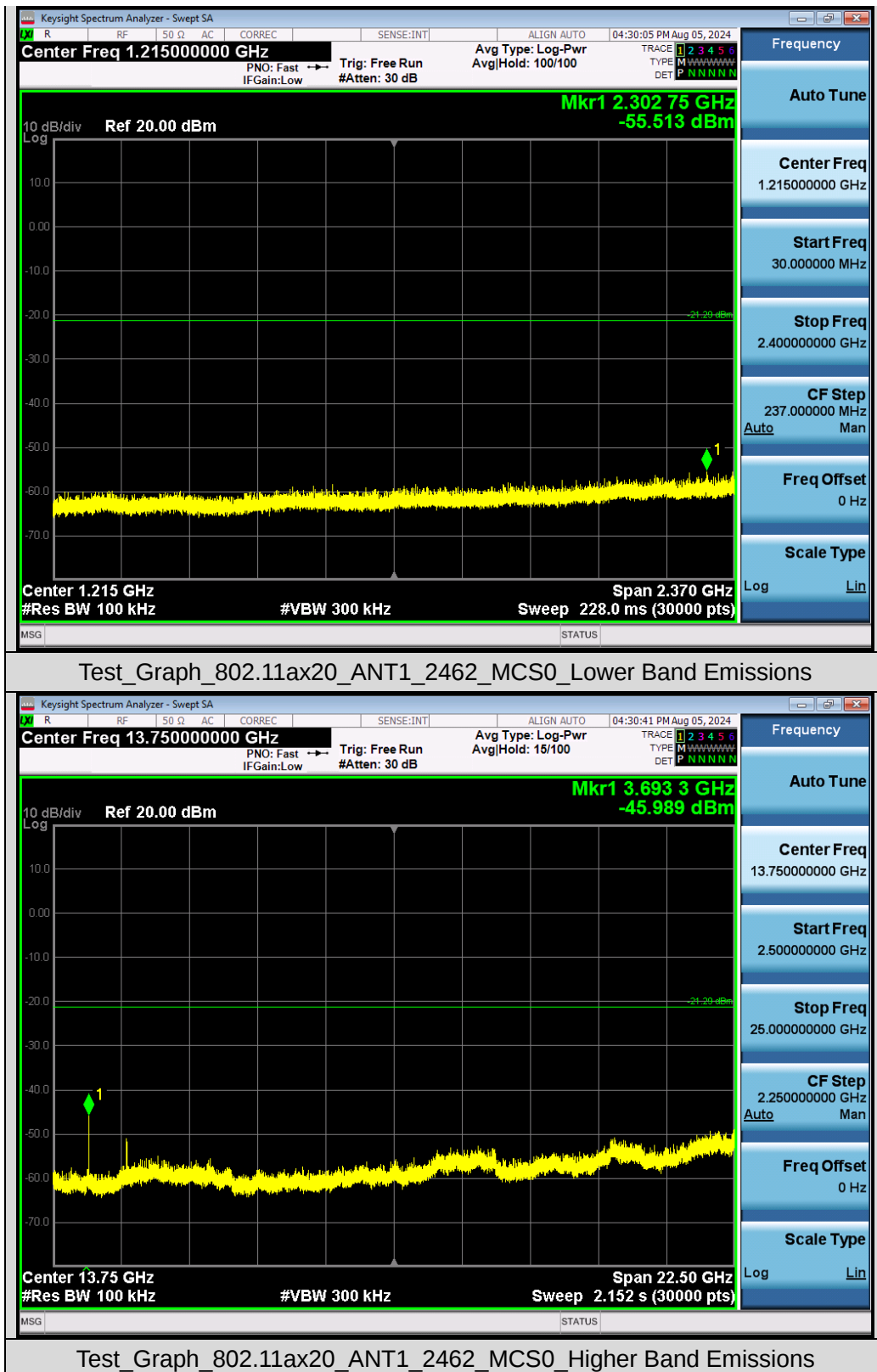
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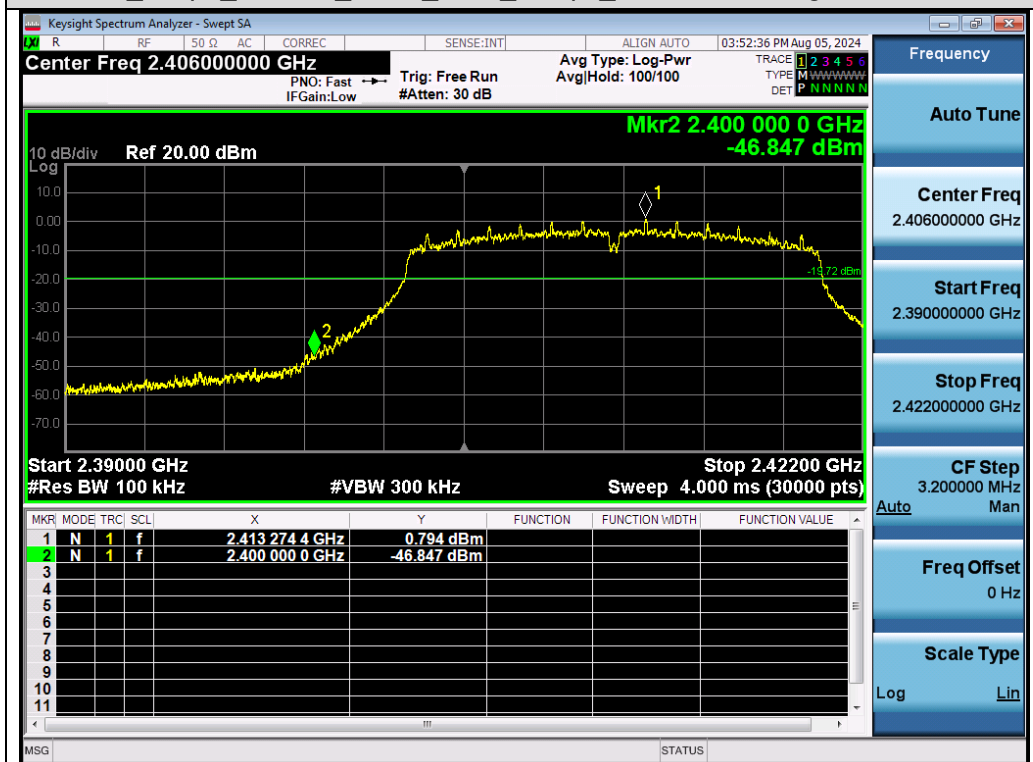


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Test Graphs of Band Edge Emissions in Non-Restricted Frequency Bands

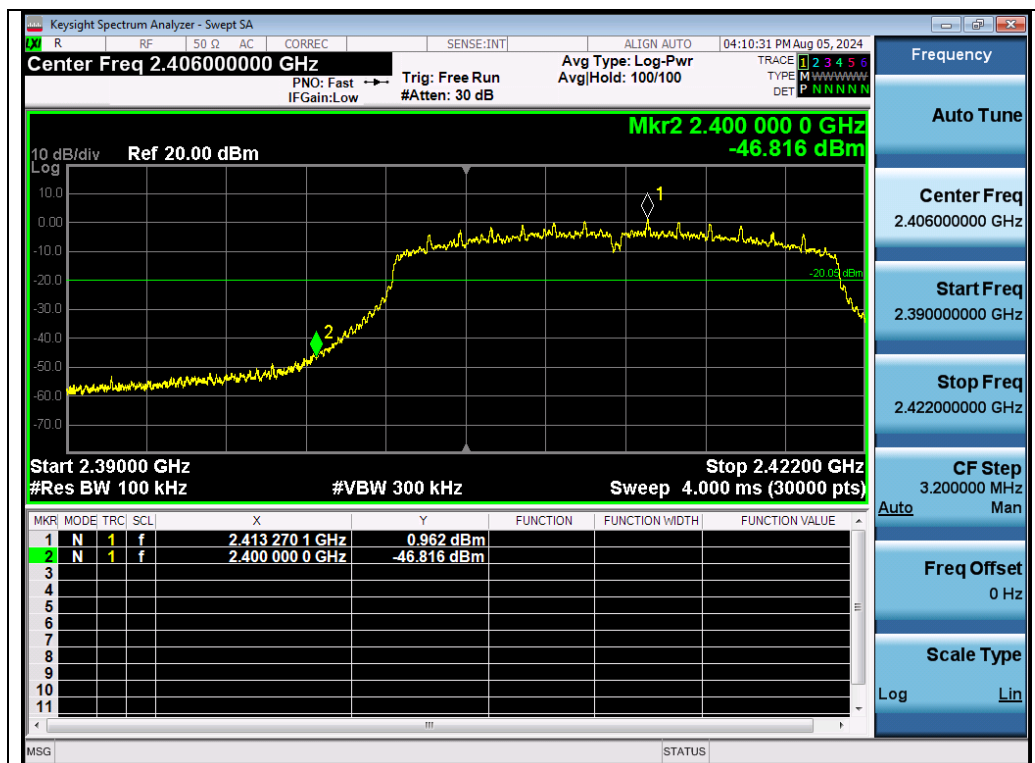


Test_Graph_802.11b_ANT1_2412_1Mbps_Lower Band Edge Emissions

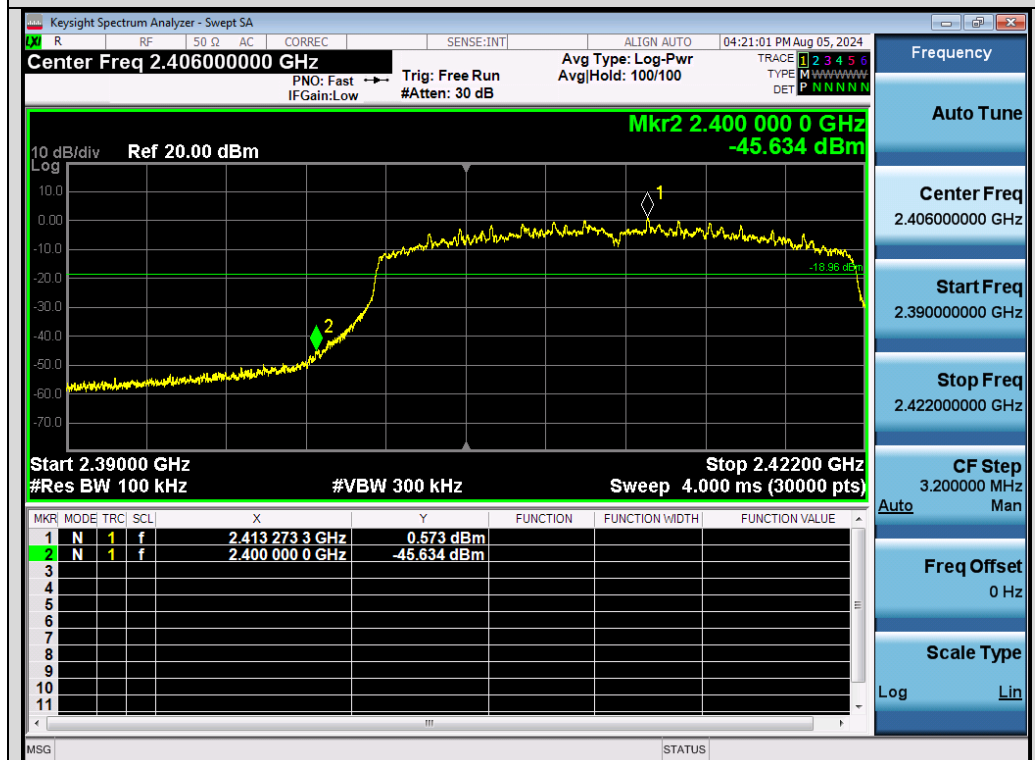


Test_Graph_802.11g_ANT1_2412_6Mbps_Lower Band Edge Emissions

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Test Graph 802.11n20 ANT1 2412 MCS0 Lower Band Edge Emissions



Test Graph 802.11ax20 ANT1 2412 MCS0 Lower Band Edge Emissions

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11. Radiated Spurious Emission

11.1 Measurement Limits

15.209(a) Limit in the below table has to be followed

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(kHz)	300
0.490~1.705	24000/F(kHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

Note: All modes were tested for restricted band radiated emission, the test records reported below are the worst result compared to other modes.

11.2 Measurement Procedure

1. The EUT was placed on the top of the turntable 0.8 or 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emission, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz RBW and 3MHz VBW for peak reading. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds.

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As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum values.

8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High - Low scan is not required in this case.

◆ The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Start ~Stop Frequency	9kHz~150KHz/RB 200Hz for QP
Start ~Stop Frequency	150kHz~30MHz/RB 9kHz for QP
Start ~Stop Frequency	30MHz~1000MHz/RB 120kHz for QP
Start ~Stop Frequency	1GHz~26.5GHz 1MHz/3MHz for Peak, 1MHz/3MHz for Average

Receiver Parameter	Setting
Start ~Stop Frequency	9kHz~150KHz/RB 200Hz for QP
Start ~Stop Frequency	150kHz~30MHz/RB 9kHz for QP
Start ~Stop Frequency	30MHz~1000MHz/RB 120kHz for QP

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- **Quasi-Peak Measurements below 1GHz**

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. Span was set greater than 1MHz
3. RBW = as shown in the table above
4. Detector = CISPR quasi-peak
5. Sweep time = auto couple
6. Trace was allowed to stabilize

- **Peak Measurements above 1GHz**

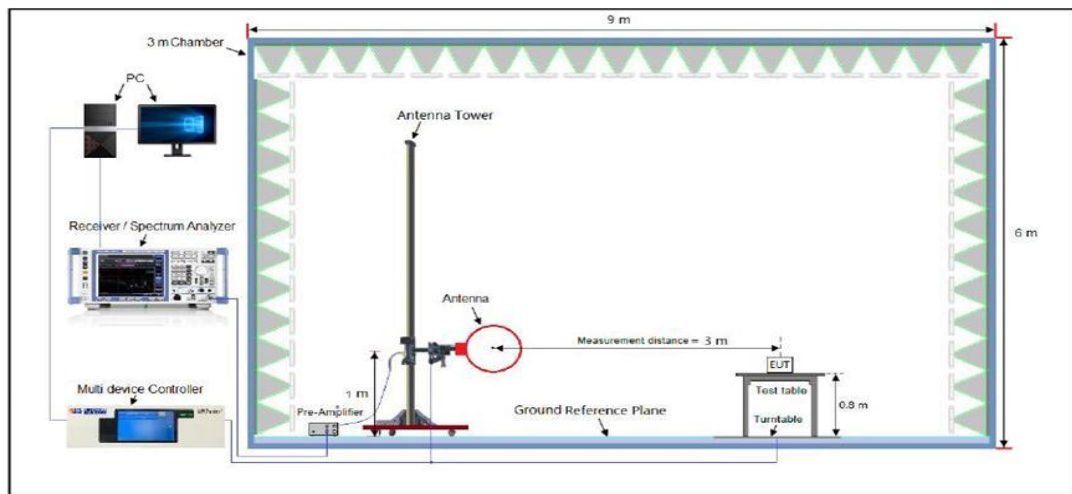
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

- **Average Measurements above 1GHz**

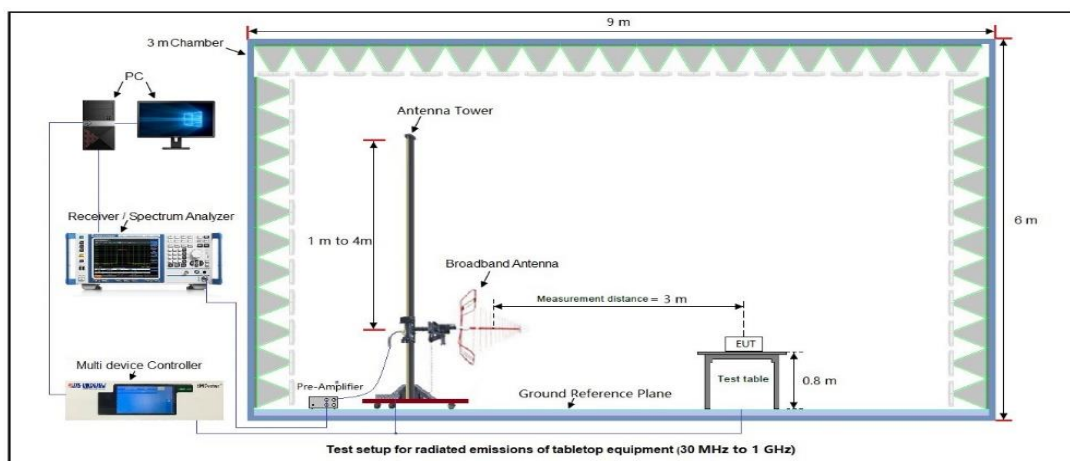
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW $\geq [3 \times \text{RBW}]$
4. Detector = Power averaging (rms)
5. Averaging type = power (i.e., rms)
6. Sweep time = auto
7. Perform a trace average of at least 100 traces.
8. The applicable correction factor is $[10 \cdot \log(1 / D)]$, where D is the duty cycle. The factor had been edited in the "Input Correction" of the Spectrum Analyzer.

11.3 Measurement Setup (Block Diagram of Configuration)

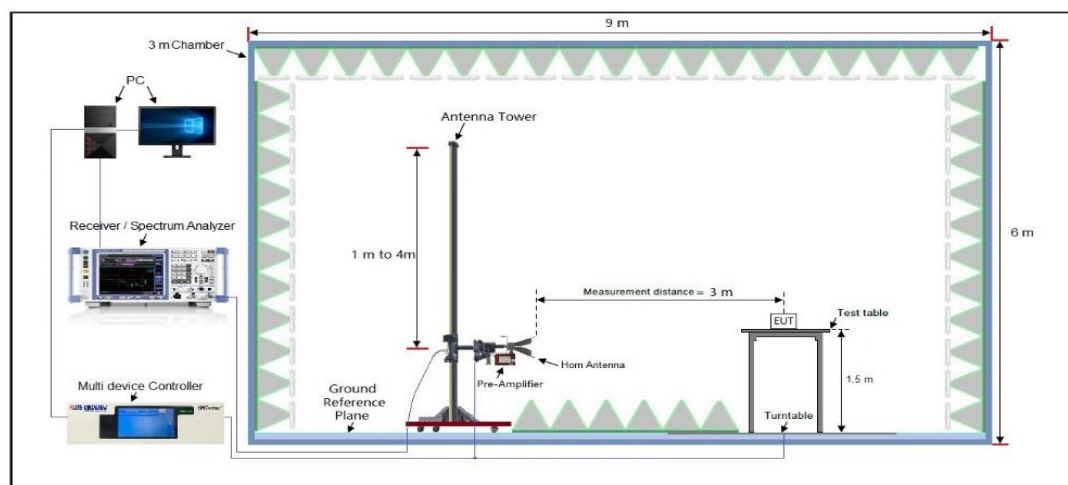
Radiated Emission Test Setup 9kHz-30MHz



Radiated Emission Test Setup 30MHz-1000MHz



Radiated Emission Test Setup Above 1000MHz



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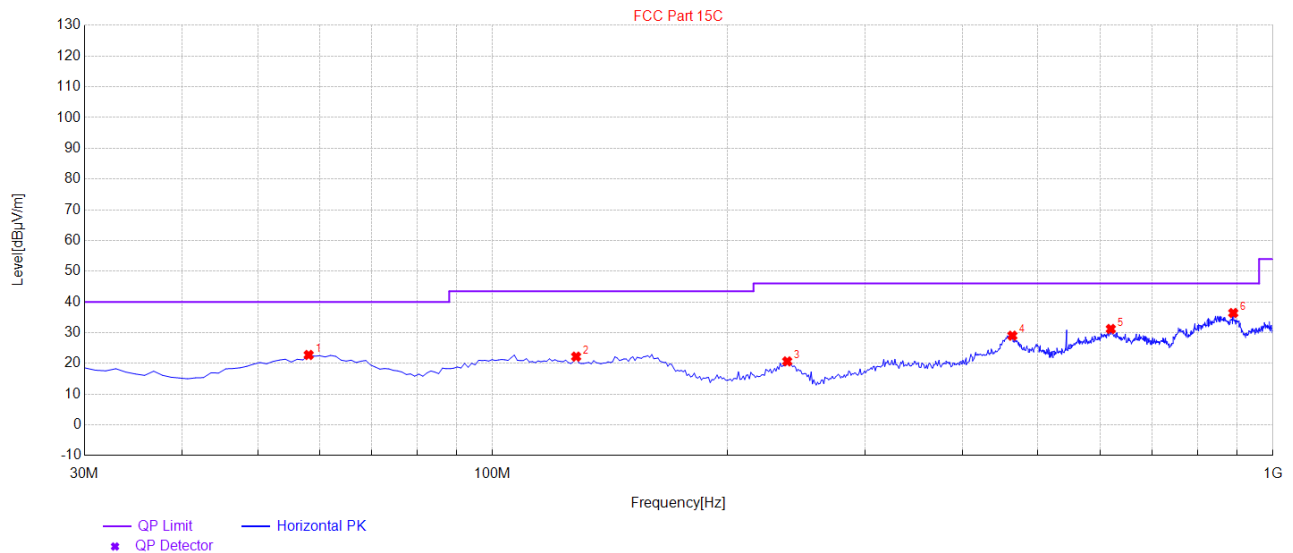
11.4 Measurement Result

Radiated Emission at 9kHz-30MHz

The amplitude of spurious emissions from 9kHz to 30MHz which are attenuated more than 20 dB below the permissible value need not be reported.

Radiated Emission Test Results at 30MHz-1GHz

EUT Name	IMILAB EC6 Panorama	Model Name	CMSXJ115A
Temperature	22.7℃	Relative Humidity	59.1 %
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 1	Antenna Polarity	Horizontal



Final Data List

NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	58.13	22.76	17.38	40.00	17.24	100	76	Horizontal
2	127.97	22.21	15.65	43.50	21.29	100	4	Horizontal
3	238.55	20.67	15.81	46.00	25.33	100	358	Horizontal
4	463.59	29.03	23.86	46.00	16.97	100	252	Horizontal
5	619.76	31.22	25.90	46.00	14.78	100	263	Horizontal
6	889.42	36.41	29.79	46.00	9.59	100	274	Horizontal

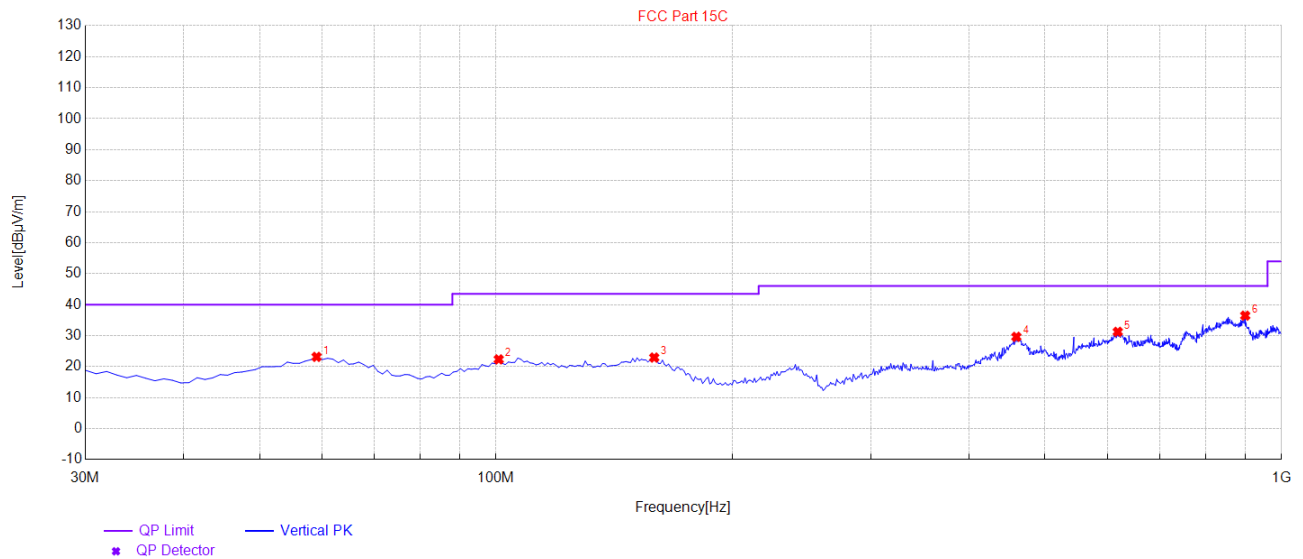
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Radiated Emission Test Results at 30MHz-1GHz			
EUT Name	IMILAB EC6 Panorama	Model Name	CMSXJ115A
Temperature	22.7℃	Relative Humidity	59.1 %
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 1	Antenna Polarity	Vertical



Final Data List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	59.1	23.16	17.64	40.00	16.84	100	63	Vertical
2	100.81	22.35	17.03	43.50	21.15	100	343	Vertical
3	159.01	22.93	17.75	43.50	20.57	100	52	Vertical
4	459.71	29.63	24.69	46.00	16.37	100	328	Vertical
5	618.79	31.24	25.79	46.00	14.76	100	113	Vertical
6	899.12	36.46	30.26	46.00	9.54	100	360	Vertical

RESULT: Pass

Note: 1. Factor=Antenna Factor + Cable loss, Margin=Measurement-Limit.

2. All test modes had been pre-tested. The mode 1 is the worst case and recorded in the report.

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Radiated Emissions Test Results above 1 GHz

EUT Name	IMILAB EC6 Panorama	Model Name	CMSXJ115A
Temperature	22.7°C	Relative Humidity	59.1 %
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 1	Antenna Polarity	Horizontal

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
4824.000	46.43	0.08	46.51	74	-27.49	peak
4824.000	37.01	0.08	37.09	54	-16.91	AVG
7236.000	41.96	2.21	44.17	74	-29.83	peak
7236.000	32.77	2.21	34.98	54	-19.02	AVG

Remark:

Factor = Antenna Factor + Cable Loss – Pre-amplifier.

EUT Name	IMILAB EC6 Panorama	Model Name	CMSXJ115A
Temperature	22.7°C	Relative Humidity	59.1 %
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 1	Antenna Polarity	Vertical

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
4824.000	46.35	0.08	46.43	74	-27.57	peak
4824.000	37.70	0.08	37.78	54	-16.22	AVG
7236.000	41.56	2.21	43.77	74	-30.23	peak
7236.000	32.36	2.21	34.57	54	-19.43	AVG

Remark:

Factor = Antenna Factor + Cable Loss – Pre-amplifier.

RESULT: Pass

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Radiated Emissions Test Results above 1GHz

EUT Name	IMILAB EC6 Panorama	Model Name	CMSXJ115A
Temperature	22.7℃	Relative Humidity	59.1 %
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 2	Antenna Polarity	Horizontal

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
4874.000	46.68	0.08	46.76	74	-27.24	peak
4874.000	37.02	0.08	37.10	54	-16.90	AVG
7311.000	41.11	2.21	43.32	74	-30.68	peak
7311.000	32.15	2.21	34.36	54	-19.64	AVG

Remark:

Factor = Antenna Factor + Cable Loss – Pre-amplifier.

EUT Name	IMILAB EC6 Panorama	Model Name	CMSXJ115A
Temperature	22.7℃	Relative Humidity	59.1 %
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 2	Antenna Polarity	Vertical

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
4874.000	46.61	0.08	46.69	74	-27.31	peak
4874.000	37.41	0.08	37.49	54	-16.51	AVG
7311.000	41.51	2.21	43.72	74	-30.28	peak
7311.000	32.76	2.21	34.97	54	-19.03	AVG

Remark:

Factor = Antenna Factor + Cable Loss – Pre-amplifier.

RESULT: Pass

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Radiated Emissions Test Results above 1GHz

EUT Name	IMILAB EC6 Panorama	Model Name	CMSXJ115A
Temperature	22.7°C	Relative Humidity	59.1 %
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 3	Antenna Polarity	Horizontal

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
4924.000	46.59	0.08	46.67	74	-27.33	peak
4924.000	37.29	0.08	37.37	54	-16.63	AVG
7386.000	41.27	2.21	43.48	74	-30.52	peak
7386.000	32.41	2.21	34.62	54	-19.38	AVG

Remark:

Factor = Antenna Factor + Cable Loss – Pre-amplifier.

EUT Name	IMILAB EC6 Panorama	Model Name	CMSXJ115A
Temperature	22.7°C	Relative Humidity	59.1 %
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 3	Antenna Polarity	Vertical

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
4924.000	46.97	0.08	47.05	74	-26.95	peak
4924.000	37.94	0.08	38.02	54	-15.98	AVG
7386.000	41.26	2.21	43.47	74	-30.53	peak
7386.000	32.48	2.21	34.69	54	-19.31	AVG

Remark:

Factor = Antenna Factor + Cable Loss – Pre-amplifier.

RESULT: Pass

Note:

- The amplitude of other spurious emissions from 1G to 25 GHz which are attenuated more than 20 dB below the permissible value need not be reported.
- Factor = Antenna Factor + Cable loss – Pre-amplifier gain, Margin =Emission Level-Limit.

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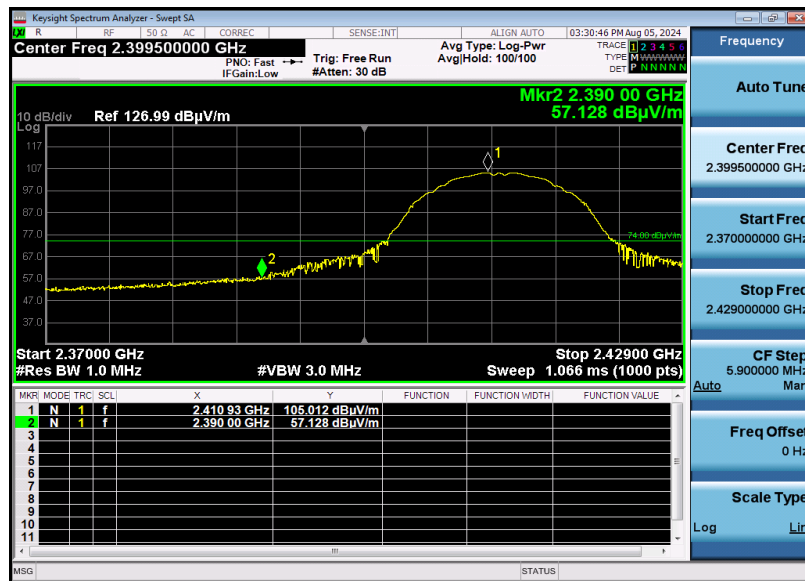
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3. The “Factor” value can be calculated automatically by software of measurement system.
4. All test modes had been tested. The 802.11b modulation is the worst case and recorded in the report.

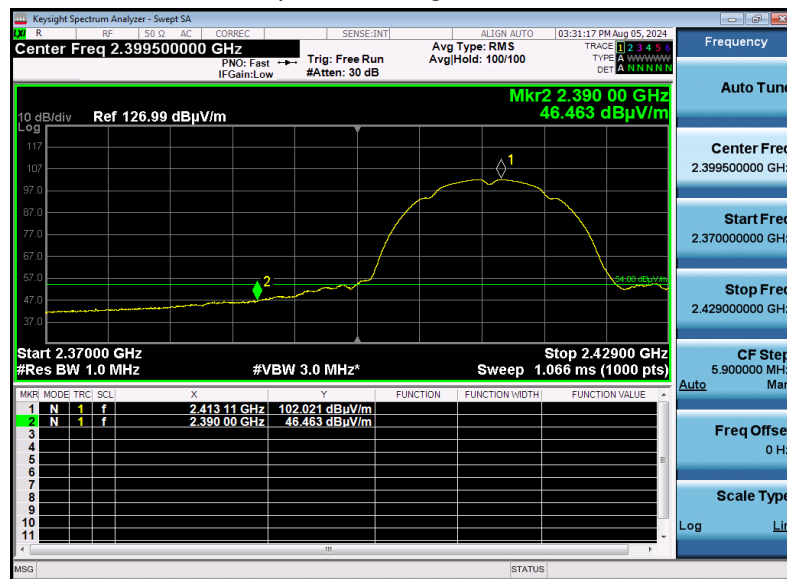
Band Edge Emission Test Results for Restricted Bands

EUT Name	IMILAB EC6 Panorama	Model Name	CMSXJ115A
Temperature	24.7°C	Relative Humidity	58 %
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 1	Antenna Polarity	Horizontal

Test Graph for Peak Measurement



Test Graph for Average Measurement



RESULT: Pass

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