

FCC Test Report

Report No.: AGC10516220202FE03

FCC ID : 2AWM4KLIMBOOMBOX
APPLICATION PURPOSE : Original Equipment
PRODUCT DESIGNATION : KLIM Boombox
BRAND NAME : KLIM
MODEL NAME : See page 5
APPLICANT : Marcus Excelsior Limited
DATE OF ISSUE : Mar. 24, 2022
STANDARD(S) : FCC Part 15.247
REPORT VERSION : V1.0

Attestation of Global Compliance (Shenzhen) Co., Ltd



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Tel: +86-755 2523 4088 E-mail: agc@agc-cert.com Web: <http://cn.agc-cert.com/>



REPORT REVISE RECORD

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Mar. 24, 2022	Valid	Initial Release

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1. VERIFICATION OF CONFORMITY

Applicant	Marcus Excelsior Limited
Address	2512, Langham Place Office Tower, 8 Argyle Street, Mongkok, Kowloon, HONG KONG
Manufacturer	Shenzhen WINOMOKO KLIM technology Co., Ltd
Address	B207, Jianan Road, Luther Industry zone, Tangwei community, Fuhai street, Bao'an District, Shenzhen, Guangdong province, China 518101
Factory	Shenzhen WINOMOKO KLIM technology Co., Ltd
Address	B207, Jianan Road, Luther Industry zone, Tangwei community, Fuhai street, Bao'an District, Shenzhen, Guangdong province, China 518101
Product Designation	KLIM Boombox
Brand Name	KLIM
Test Model	KLIM Boombox B4
Series Model	KLIM Boombox, KLIM Boombox B3, KLIM Boombox B5, KLIM Candy, KLIM Tunes, KLIM Boombox B6, KLIM Boombox B7, KLIM Boombox B8, KLIM Boombox B9, KLIM Boombox B10, KLIM Boombox B11, KLIM Boombox B12, KLIM Boombox B13, KLIM Boombox B14, KLIM Boombox B15, KLIM Boombox B16, KLIM Boombox B17, KLIM Boombox B18, KLIM Boombox B19, KLIM Boombox B20
Declaration of Difference	All the same except for the model name and appearance material
Date of test	Feb. 24, 2022 to Mar. 23, 2022
Deviation	No any deviation from the test method
Condition of Test Sample	Normal
Test Result	Pass
Report Template	AGCRT-US-BR/RF

We hereby certify that:

The above equipment was tested by Attestation of Global Compliance (Shenzhen) Co., Ltd. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 (2013) and the energy emitted by the sample EUT tested as described in this report is in compliance with radiated emission limits of FCC PART 15.247.

Prepared By

Cool Cheng

Cool Cheng
(Project Engineer)

Mar. 24, 2022

Reviewed By

Calvin Liu

Calvin Liu
(Reviewer)

Mar. 24, 2022

Approved By

Max Zhang

Max Zhang
(Authorized Officer)

Mar. 24, 2022

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2. GENERAL INFORMATION

2.1. PRODUCT DESCRIPTION

The EUT is designed as “KLIM Boombox”. It is designed by way of utilizing the GFSK, Pi/4 DQPSK and 8DPSK technology to achieve the system operation.

A major technical description of EUT is described as following

Operation Frequency	2.402GHz to 2.480GHz
RF Output Power	-0.693dBm (Max)
Bluetooth Version	V5.0
Modulation	BR <input checked="" type="checkbox"/> GFSK, EDR <input checked="" type="checkbox"/> $\pi/4$ -DQPSK, <input checked="" type="checkbox"/> 8DPSK BLE <input type="checkbox"/> GFSK 1Mbps <input type="checkbox"/> GFSK 2Mbps
Number of channels	79 Channels
Hardware Version	V004
Software Version	V004
Antenna Designation	PCB Antenna (Comply with requirements of the FCC part 15.203)
Antenna Gain	0dBi
Power Supply	AC 100-120V, 50/60Hz

2.2. TABLE OF CARRIER FREQUENCIES

Frequency Band	Channel Number	Frequency
2402~2480MHz	0	2402 MHz
	1	2403 MHz
	:	:
	38	2440 MHz
	39	2441 MHz
	40	2442 MHz
	:	:
	77	2479 MHz
	78	2480 MHz

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2.3. RECEIVER INPUT BANDWIDTH

The input bandwidth of the receiver is 1.3MHz, in every connection one Bluetooth device is the master and the other one is slave. The master determines the hopping sequence. The slave follows this sequence. Both devices shift between RX and TX time slot according to the clock of the master. Additionally, the type of connection (e.g. single or multi slot packet) is set up at the beginning of the connection. The master adapts its hopping frequency and its TX/RX timing according to the packet type of the connection. Also, the slave of the connection will use these settings. Repeating of a packet has no influence on the hopping sequence. The hopping sequence generated by the master of the connection will be followed in any case. That means, a repeated packet will not be send on the same frequency, it is send on the next frequency of the hopping sequence.

2.4. EXAMPLE OF A HOPPING SEQUENCY IN DATA MODE

Example of a hopping sequence in data mode:

40, 21, 44, 23, 04, 15, 66, 56, 19, 78, 07, 28, 69, 55,
36, 45, 05, 13, 43, 74, 57, 35, 67, 76, 02, 34, 54, 63,
42, 11, 30, 06, 64, 25, 75, 48, 17, 33, 58, 01, 29, 14,
51, 72, 03, 31, 50, 61, 77, 18, 10, 47, 12, 68, 08, 49,
20, 00, 73, 09, 16, 60, 71, 41, 24, 53, 38, 26, 46, 37,
65, 32, 70, 52, 27, 59, 22, 62, 39

2.5. EQUALLY AVERAGE USE OF FREQUENCIES AND BEHAVIOUR

The generation of the hopping sequence in connection mode depends essentially on two input values:

1. LAP/UAP of the master of the connection.
2. Internal master clock.

The LAP (lower address part) are the 24 LSB's of the 48 BD_ADDRESS. The BD_ADDRESS is an unambiguous number of every Bluetooth unit. The UAP (upper address part) are the 24MSB's of the 48BD_ADDRESS

The internal clock of a Bluetooth unit is derived from a free running clock which is never adjusted and is never turned off. For behavior action with other units only offset is used. It has no relation to the time of the day. Its resolution is at least half the RX/TX slot length of 312.5us. The clock has a cycle of about one day(23h30). In most case it is implemented as 28 bits counter. For the deriving of the hopping sequence the entire. LAP (24 bits),4LSB's(4bits) (Input 1) and the 27MSB's of the clock (Input 2) are used. With this input values different mathematical procedures (permutations, additions, XOR-operations) are performed to generate the Sequence. This will be done at the beginning of every new transmission.

Regarding short transmissions the Bluetooth system has the following behavior:

The first connection between the two devices is established, a hopping sequence was generated. For Transmitting the wanted data the complete hopping sequence was not used. The connection ended.



The second connection will be established. A new hopping sequence is generated. Due to the fact the Bluetooth clock has a different value, because the period between the two transmission is longer (and it Cannot be shorter) than the minimum resolution of the clock(312.5us). The hopping sequence will always differ from the first one.

2.6. RELATED SUBMITTAL(S) / GRANT (S)

This submittal(s) (test report) is intended for **FCC ID: 2AWM4KLIMBOOMBOX** filing to comply with the FCC PART 15.247 requirements.

2.7. TEST METHODOLOGY

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10 (2013). Radiated testing was performed at an antenna to EUT distance 3 meters.

2.8. SPECIAL ACCESSORIES

Refer to section 5.2.

2.9. EQUIPMENT MODIFICATIONS

Not available for this EUT intended for grant.

2.10. ANTENNA REQUIREMENT

This intentional radiator is designed with a permanently attached antenna of an antenna to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

For more information of the antenna, please refer to the APPENDIX B: PHOTOGRAPHS OF EUT.

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3. 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	$U_c = \pm 3.8 \text{ dB}$
Uncertainty of Radiated Emission above 1GHz	$U_c = \pm 4.4 \text{ dB}$
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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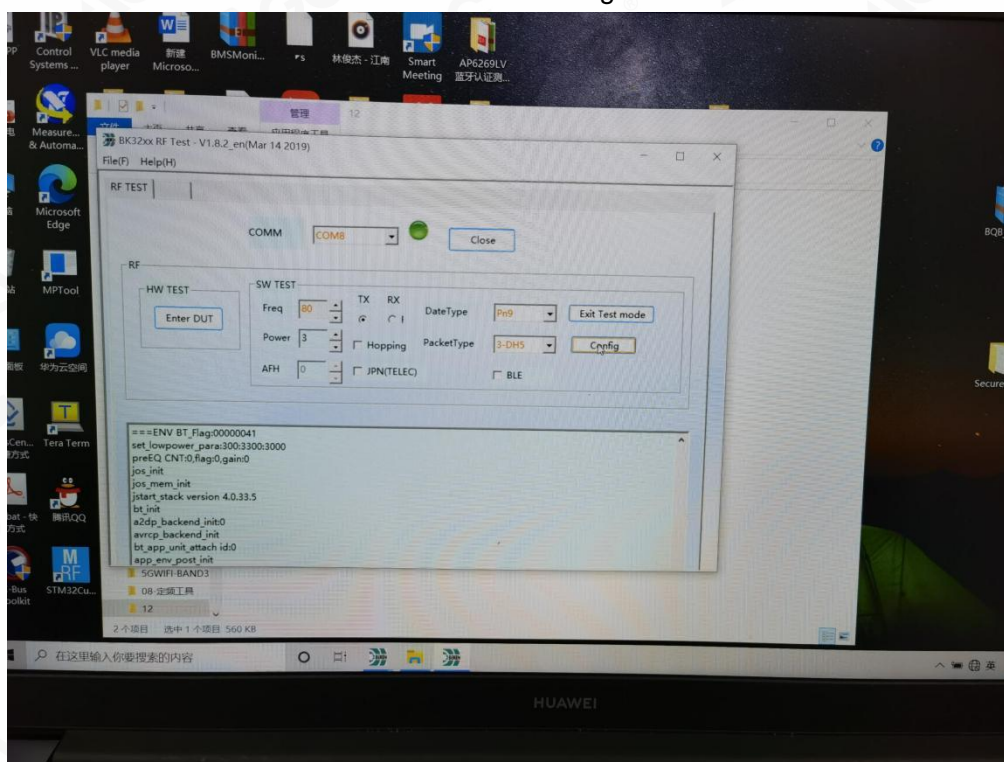


4. DESCRIPTION OF TEST MODES

NO.	TEST MODE DESCRIPTION
1	Low channel GFSK
2	Middle channel GFSK
3	High channel GFSK
4	Low channel $\pi/4$ -DQPSK
5	Middle channel $\pi/4$ -DQPSK
6	High channel $\pi/4$ -DQPSK
7	Low channel 8DPSK
8	Middle channel 8DPSK
9	High channel 8DPSK
10	Hopping mode GFSK
11	Hopping mode $\pi/4$ -DQPSK
12	Hopping mode 8DPSK

- Note: 1. Only the result of the worst case was recorded in the report, if no other cases.
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.

Software Setting



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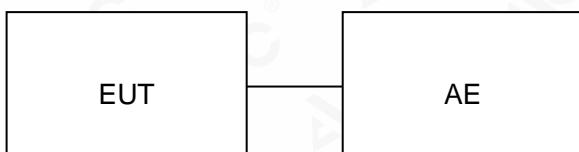
5. SYSTEM TEST CONFIGURATION

5.1. CONFIGURATION OF EUT SYSTEM

Radiated Emission Configure:



Conducted Emission Configure:



5.2. EQUIPMENT USED IN TESTED SYSTEM

Item	Equipment	Model No.	ID or Specification	Remark
1	KLIM Boombox	KLIM Boombox B4	2AWM4KLIMBOOMBOX	EUT
2	Control Box	USB-TTL	N/A	AE
3	AC IN line	N/A	1.5m unshielded	Accessory

5.3. SUMMARY OF TEST RESULTS

FCC RULES	DESCRIPTION OF TEST	RESULT
15.247 (b)(1)	Peak Output Power	Compliant
15.247 (a)(1)	20 dB Bandwidth	Compliant
15.247 (d)	Conducted Spurious Emission	Compliant
15.209	Radiated Emission	Compliant
15.247 (a)(1)(iii)	Number of Hopping Frequency	Compliant
15.247 (a)(1)(iii)	Time of Occupancy	Compliant
15.247 (a)(1)	Frequency Separation	Compliant
15.207	Conducted Emission	Compliant

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6. TEST FACILITY

Test Site	Attestation of Global Compliance (Shenzhen) Co., Ltd
Location	1-2/F, Building 19, Junfeng Industrial Park, Chongqing Road, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China
Designation Number	CN1259
FCC Test Firm Registration Number	975832
A2LA Cert. No.	5054.02
Description	Attestation of Global Compliance (Shenzhen) Co., Ltd is accredited by A2LA

TEST EQUIPMENT OF CONDUCTED EMISSION TEST

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Due
TEST RECEIVER	R&S	ESPI	101206	May 11, 2021	May 10, 2022
AMN	R&S	ESH2-Z5	100086	Jun. 09, 2021	Jun. 08, 2022
Test Software	FARA	EZ-EMC(Ver. AGC-CON03A1)	N/A	N/A	N/A

TEST EQUIPMENT OF RADIATED EMISSION TEST

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Due
Test Receiver	R&S	ESCI	10096	Apr. 14, 2021	Apr. 13, 2022
EXA Signal Analyzer	Agilent	N9010A	MY53470504	Nov. 17, 2021	Nov. 16, 2022
2.4GHz Filter	EM Electronics	N/A	N/A	Mar. 23, 2020	Mar. 22, 2022
2.4GHz Filter	EM Electronics	N/A	N/A	Mar. 18, 2022	Mar. 19, 2024
Attenuator	ZHINAN	E-002	N/A	Sep. 03, 2020	Sep. 02, 2022
Horn Antenna	SCHWARZBECK	BBHA9170	768	Oct. 31, 2021	Oct. 30, 2023
Active loop antenna (9K-30MHz)	ZHINAN	ZN30900C	18051	May 22, 2020	May 21, 2022
preamplifier	ChengYi	EMC184045SE	980508	Oct. 29, 2021	Oct. 28, 2023
Double-Ridged Waveguide Horn	ETS	3117	00034609	Apr. 23, 2021	Apr. 22, 2023
Preamplifier Assembly	ETS	3117PA	00225134	Sep. 03, 2020	Sep. 02, 2022
Wideband Antenna	SCHWARZBECK	VULB9168	VULB9168-494	Jan. 08, 2021	Jan. 07, 2023
Test Software	FARA	EZ-EMC(Ver.RA-03A)	N/A	N/A	N/A

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7. PEAK OUTPUT POWER

7.1. MEASUREMENT PROCEDURE

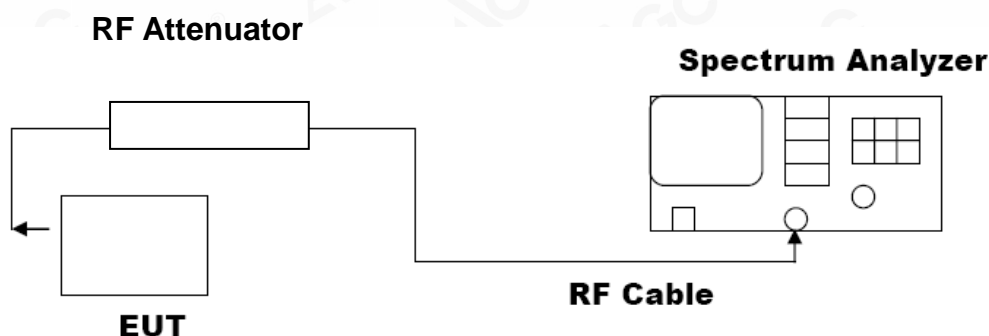
For peak power test:

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
3. RBW > 20 dB bandwidth of the emission being measured.
4. VBW \geq RBW.
5. Sweep: Auto.
6. Detector function: Peak.
7. Trace: Max hold.

Allow trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power, after any corrections for external attenuators and cables.

7.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

PEAK POWER TEST SETUP



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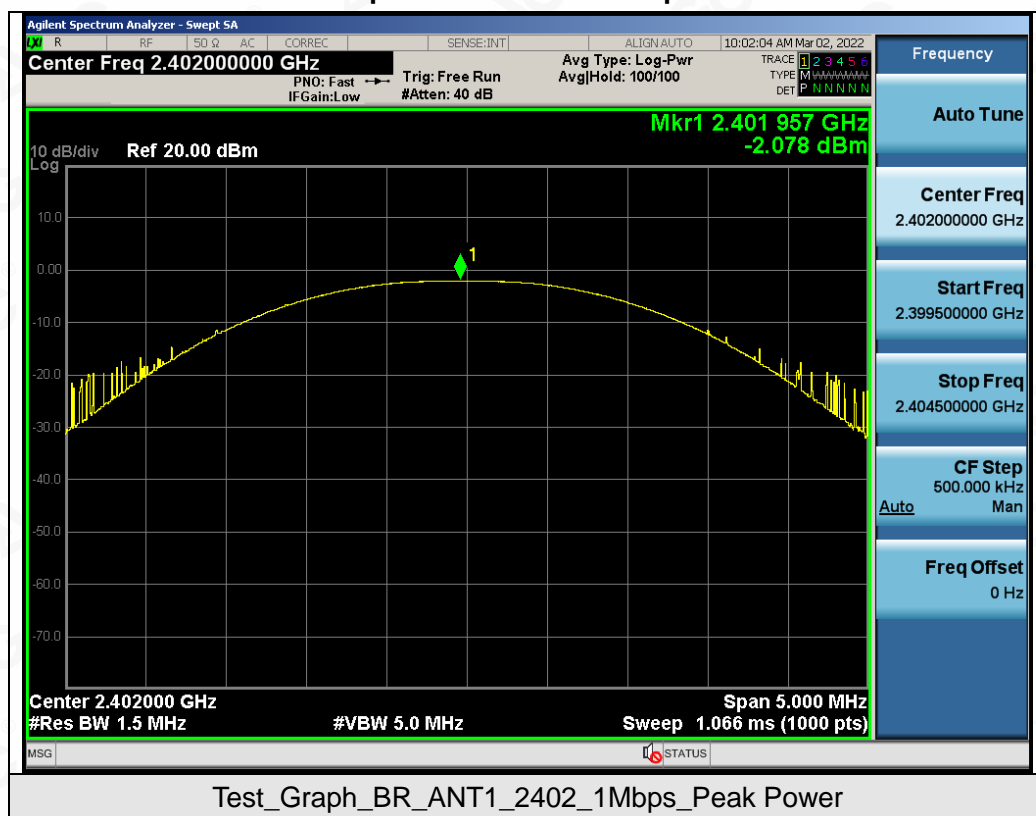
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7.3. LIMITS AND MEASUREMENT RESULT

Test Data of Conducted Output Power				
Test Mode	Test Channel (MHz)	Peak Power (dBm)	Limits (dBm)	Pass or Fail
GFSK	2402	-2.078	≤1	Pass
	2441	-2.793	≤1	Pass
	2480	-3.948	≤1	Pass
π/4-DQPSK	2402	-1.108	≤1	Pass
	2441	-1.501	≤1	Pass
	2480	-2.652	≤1	Pass
8DPSK	2402	-0.693	≤1	Pass
	2441	-1.174	≤1	Pass
	2480	-2.367	≤1	Pass

Test Graphs of Conducted Output Power



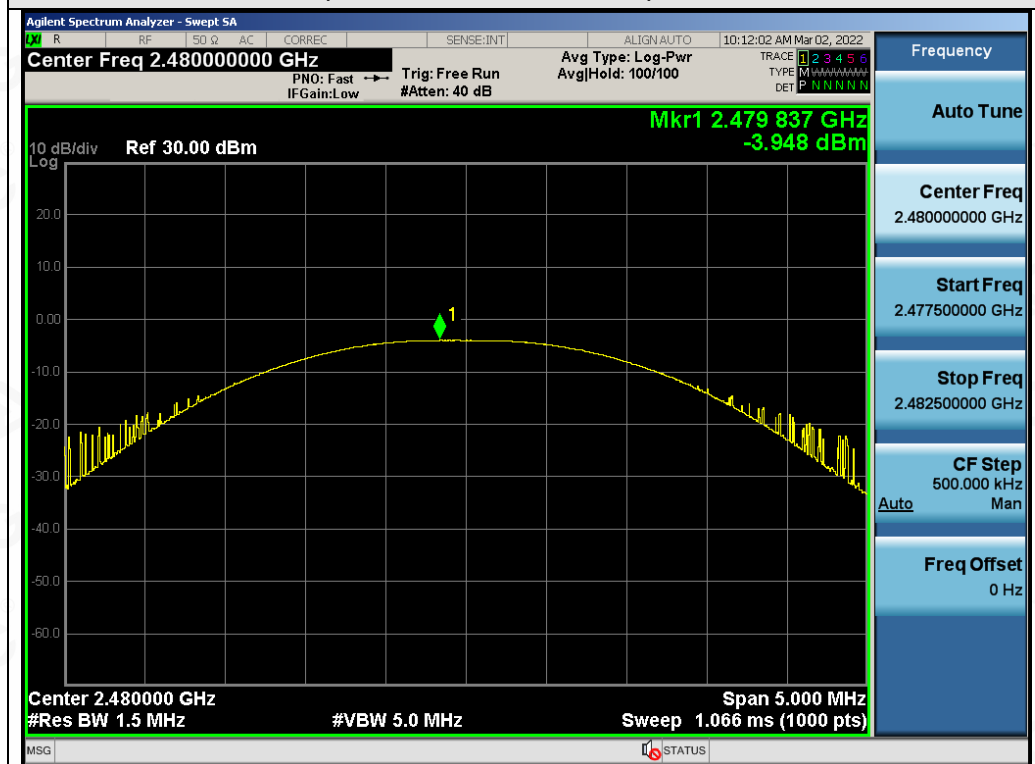
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Test_Graph_BR_ANT1_2441_1Mbps_Peak Power

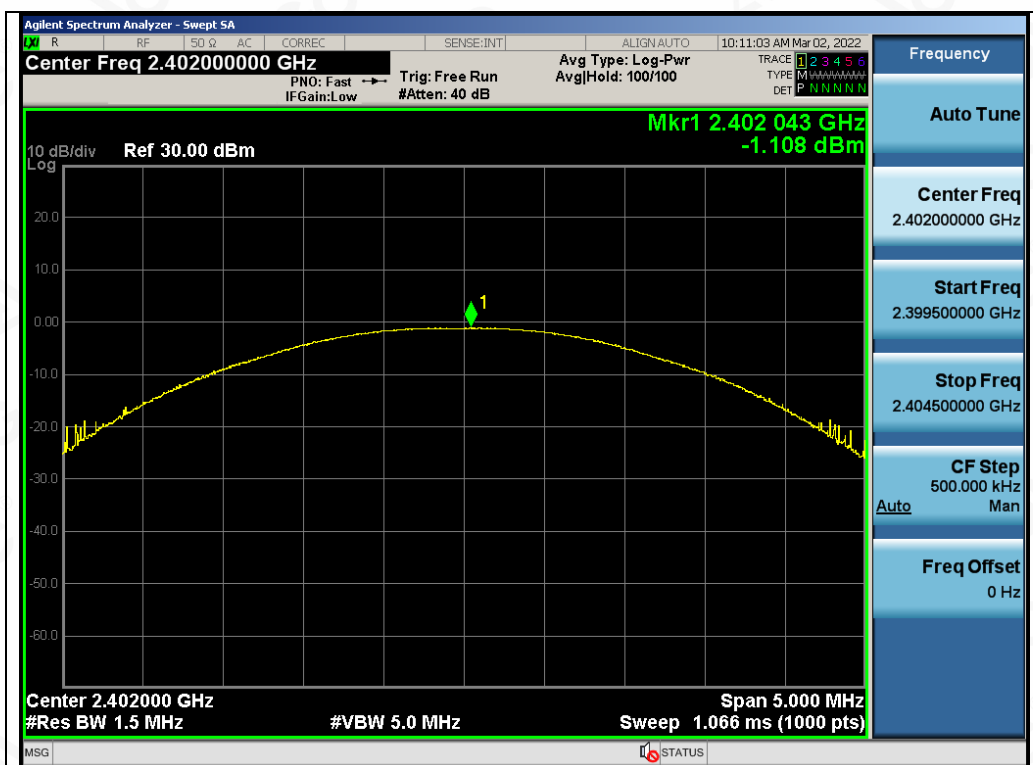


Test_Graph_BR_ANT1_2480_1Mbps_Peak Power

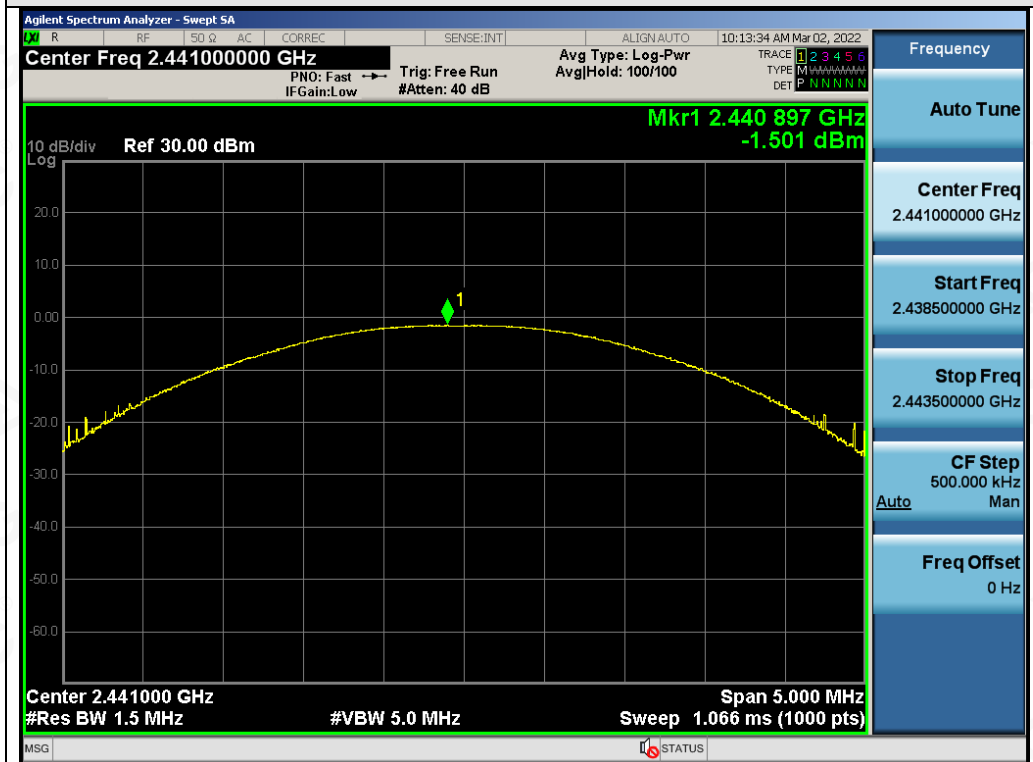
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Test_Graph_EDR_ANT1_2402_2Mbps_Peak Power

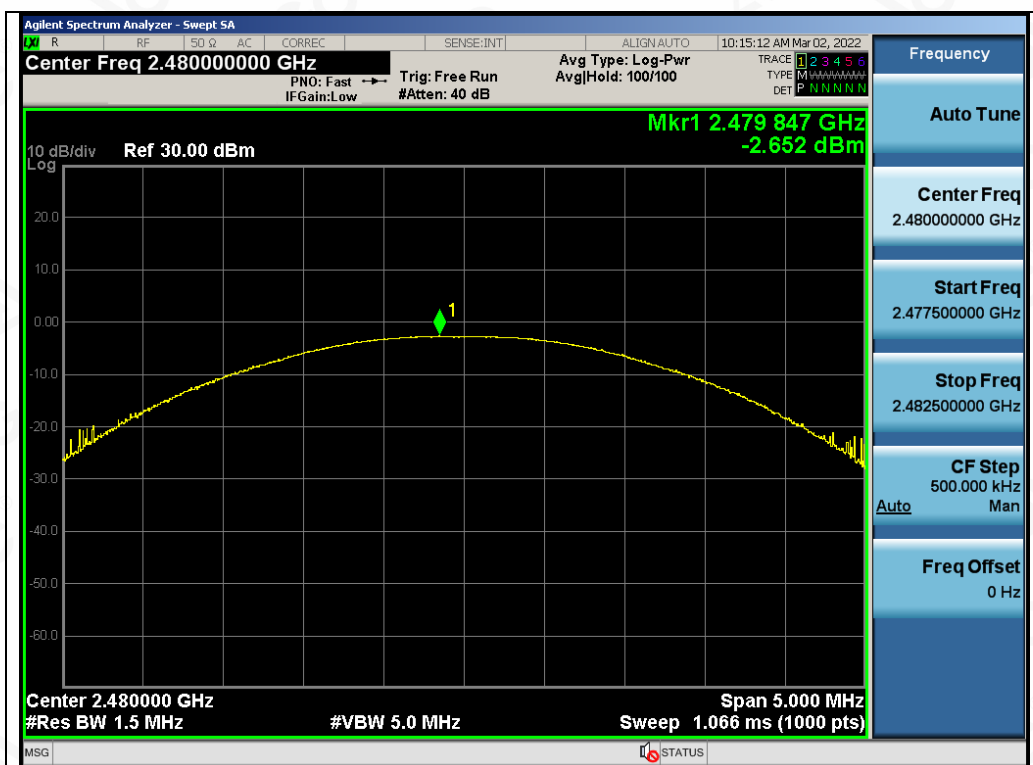


Test_Graph_EDR_ANT1_2441_2Mbps_Peak Power

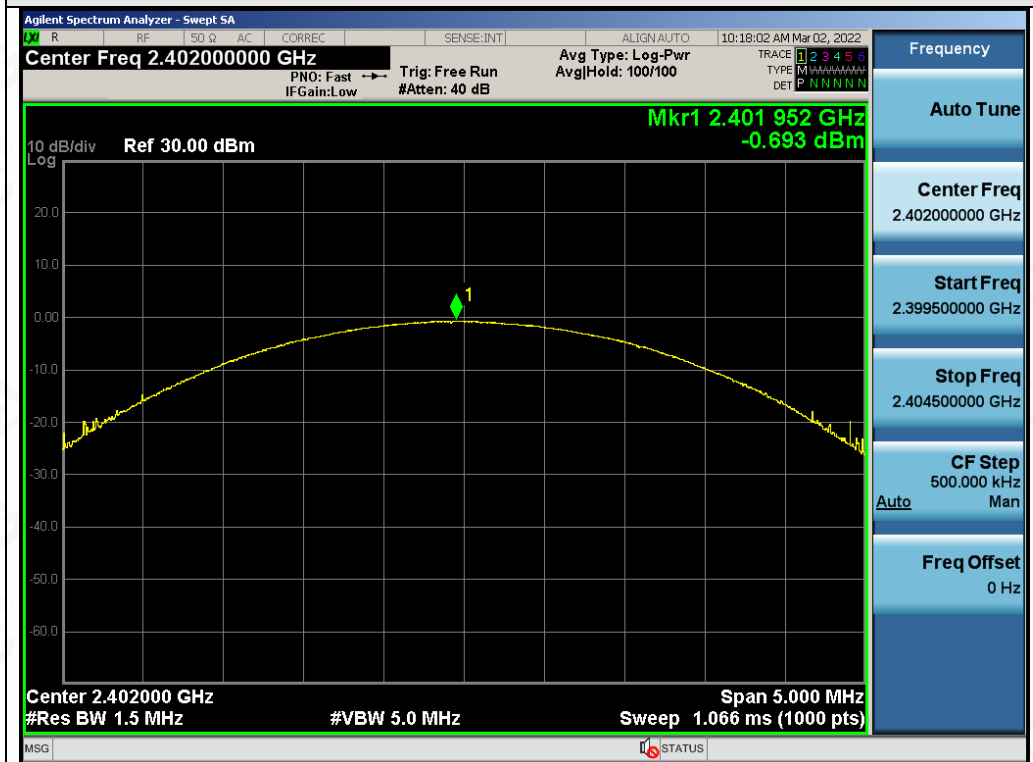
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Test_Graph_EDR_ANT1_2480_2Mbps_Peak Power

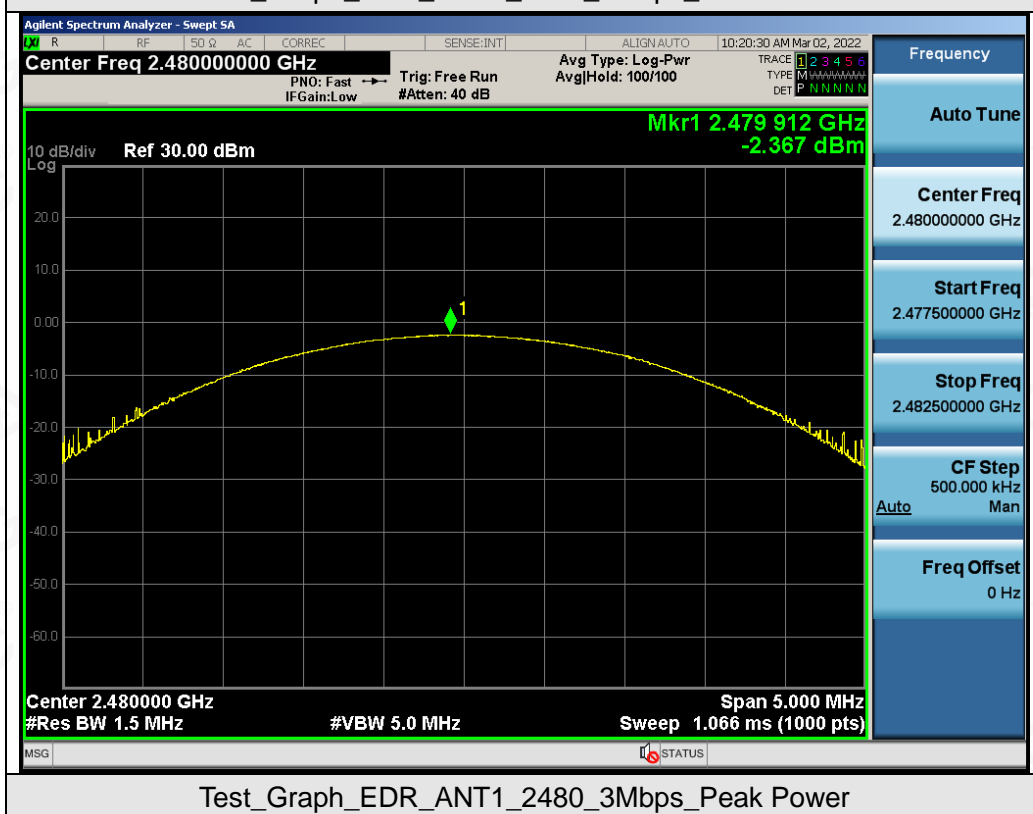
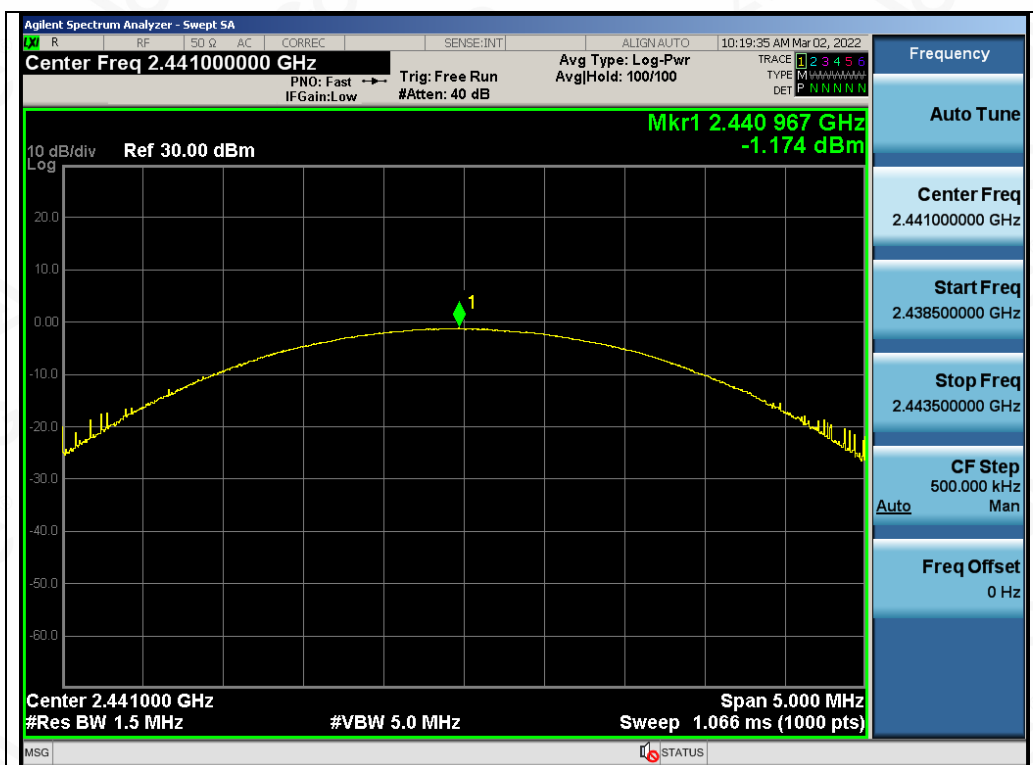


Test_Graph_EDR_ANT1_2402_3Mbps_Peak Power

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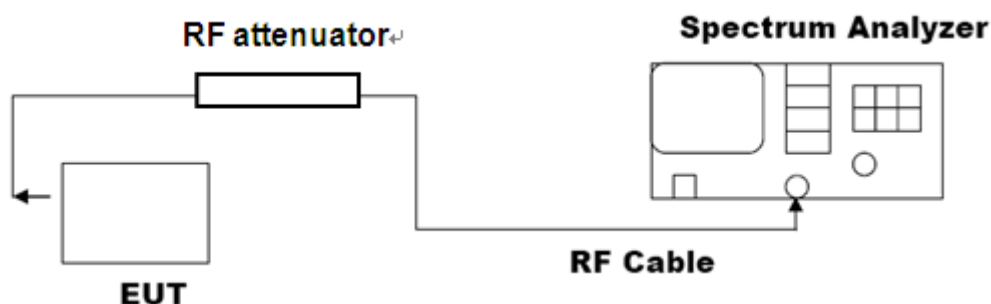


8. 20DB BANDWIDTH

8.1. MEASUREMENT PROCEDURE

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Set the EUT Work on the top, the middle and the bottom operation frequency individually.
3. Set Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel
The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW; Sweep = auto; Detector function = peak
4. Set SPA Trace 1 Max hold, then View.

8.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)



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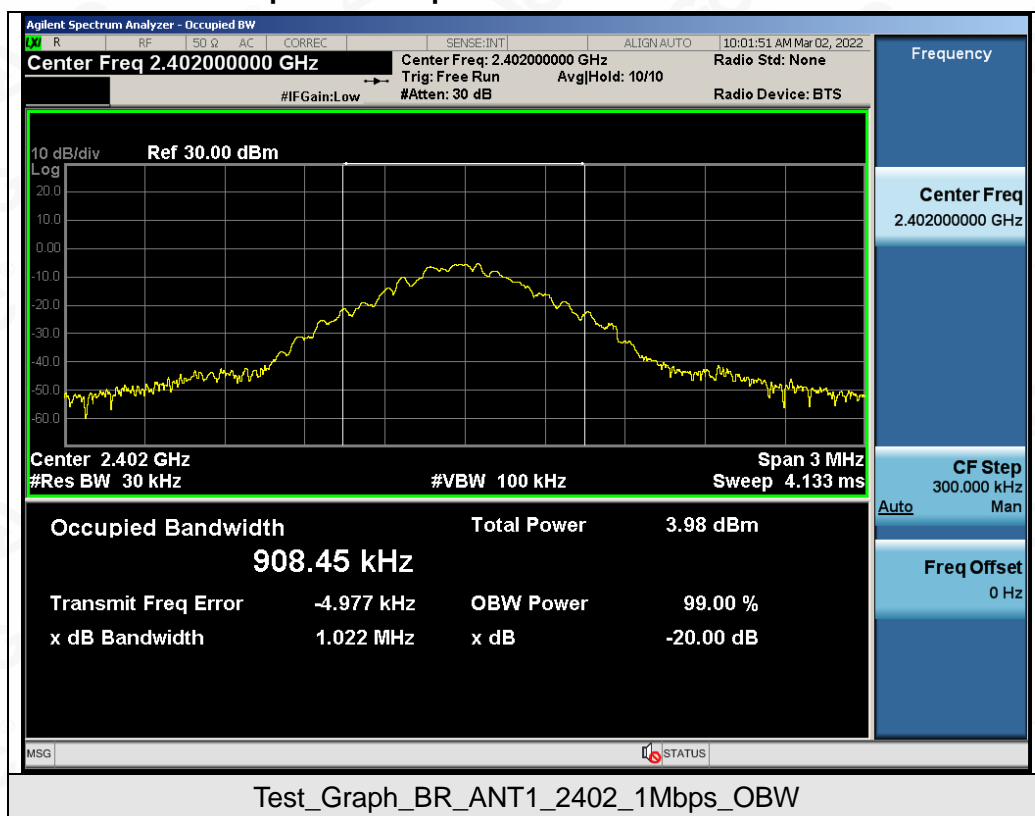
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8.3. LIMITS AND MEASUREMENT RESULTS

Test Data of Occupied Bandwidth and -20dB Bandwidth					
Test Mode	Test Channel (MHz)	99% Occupied Bandwidth (MHz)	-20dB Bandwidth (MHz)	Limits	Pass or Fail
GFSK	2402	0.908	1.022	N/A	Pass
	2441	0.908	1.015	N/A	Pass
	2480	0.910	1.021	N/A	Pass
π /4-DQPSK	2402	1.217	1.372	N/A	Pass
	2441	1.217	1.369	N/A	Pass
	2480	1.218	1.370	N/A	Pass
8DPSK	2402	1.225	1.354	N/A	Pass
	2441	1.226	1.358	N/A	Pass
	2480	1.225	1.357	N/A	Pass

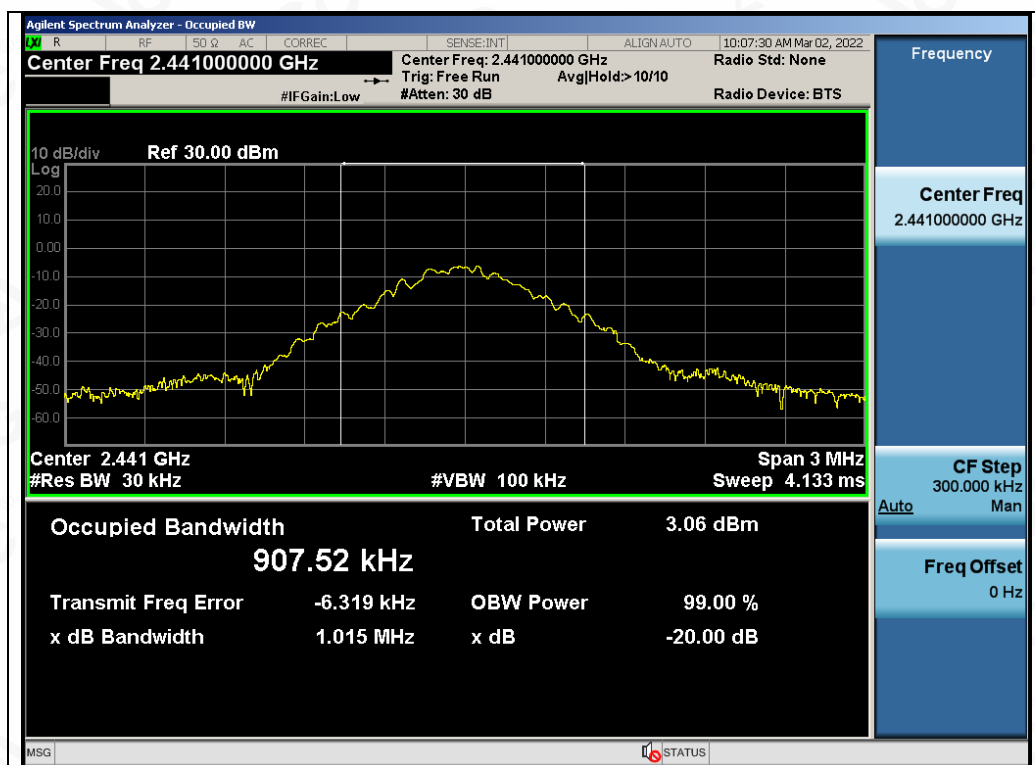
Test Graphs of Occupied Bandwidth and -20 Bandwidth



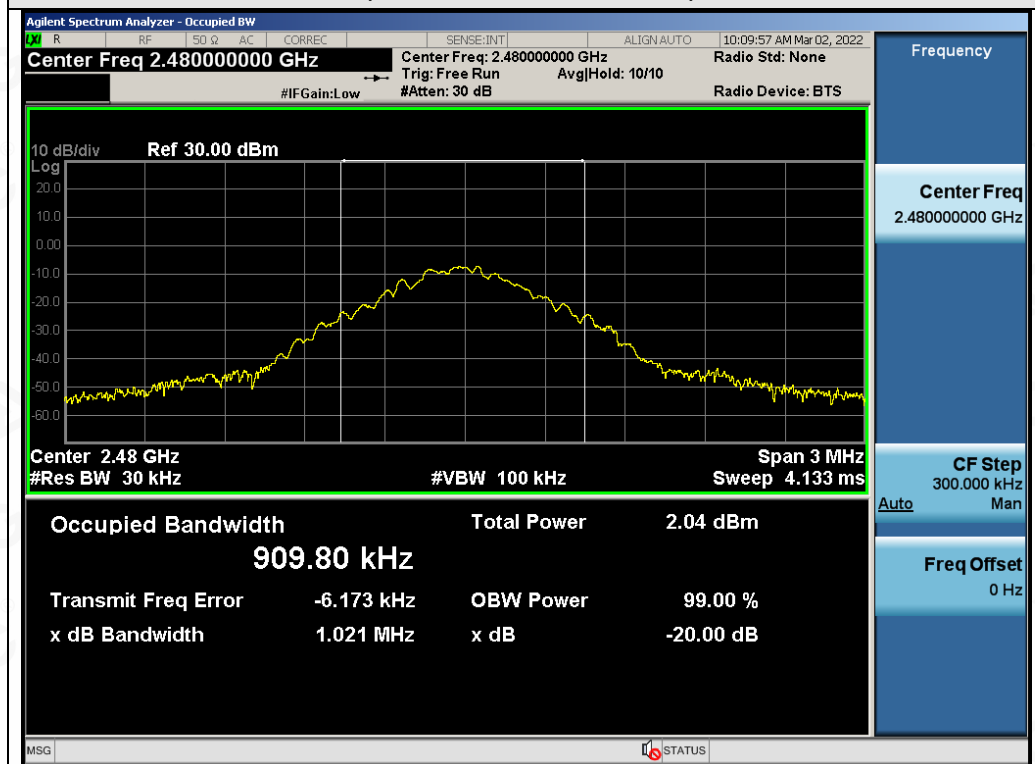
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Test_Graph_BR_ANT1_2441_1Mbps_OBW

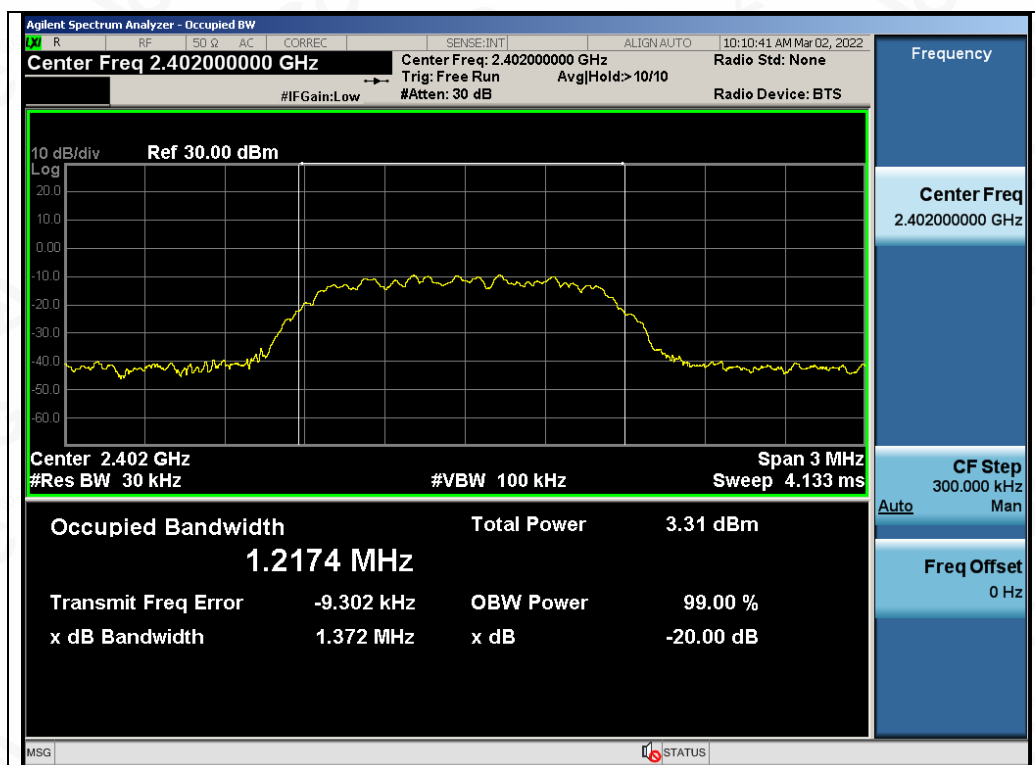


Test_Graph_BR_ANT1_2480_1Mbps_OBW

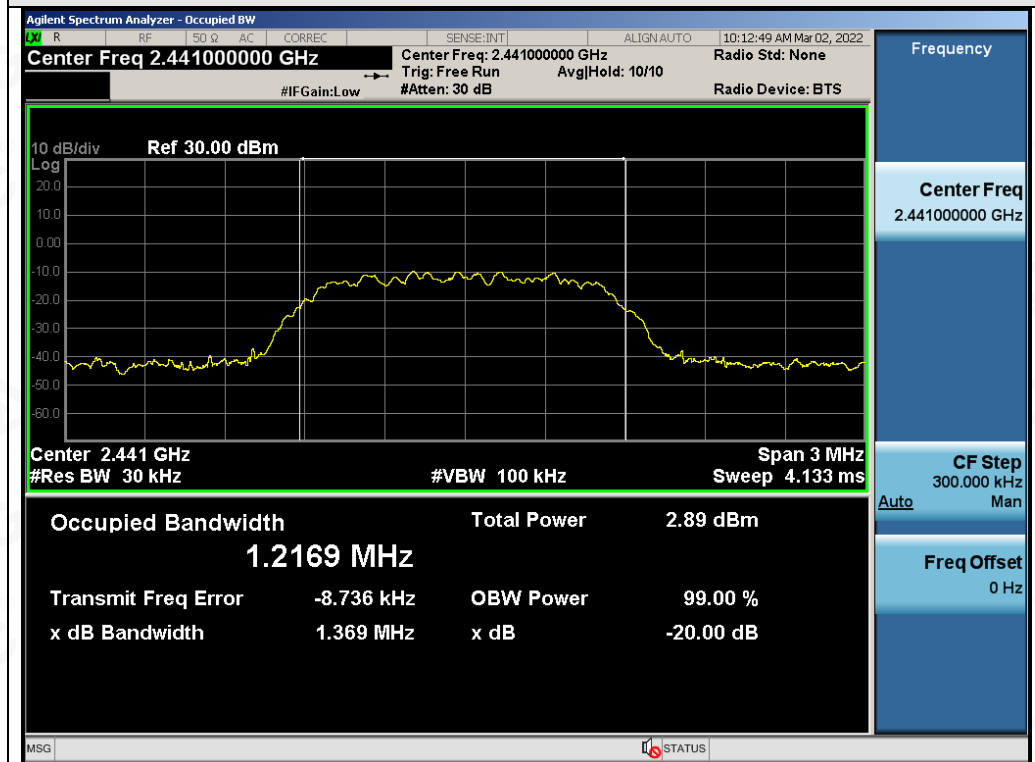
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Test_Graph_EDR_ANT1_2402_2Mbps_OBW

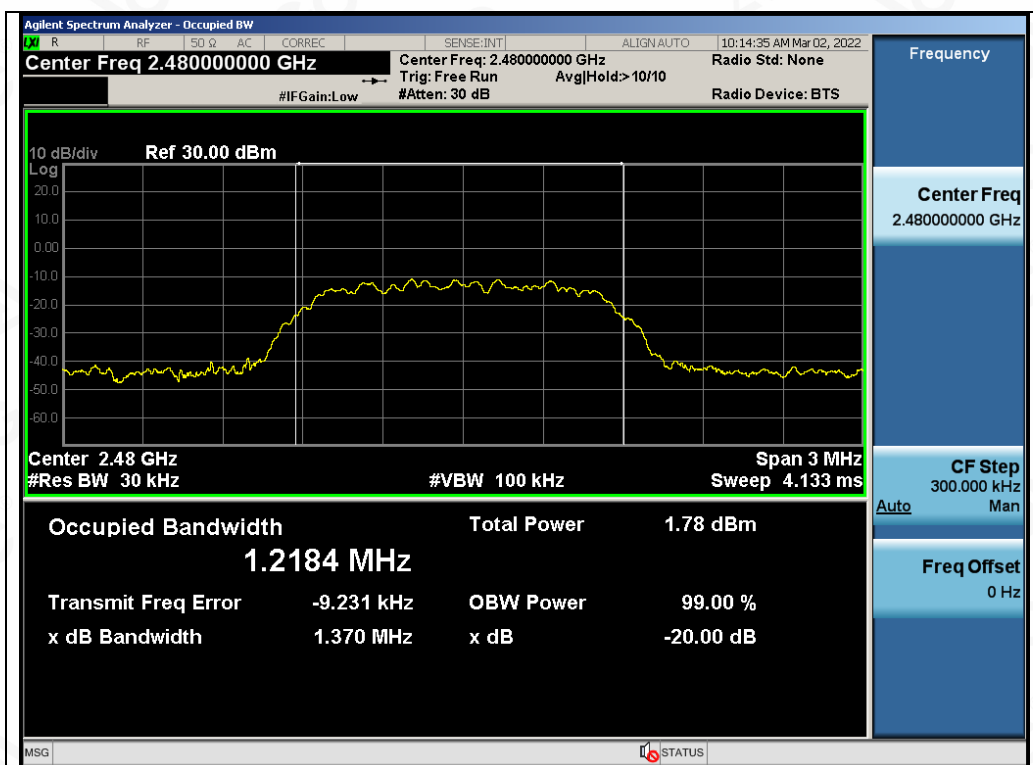


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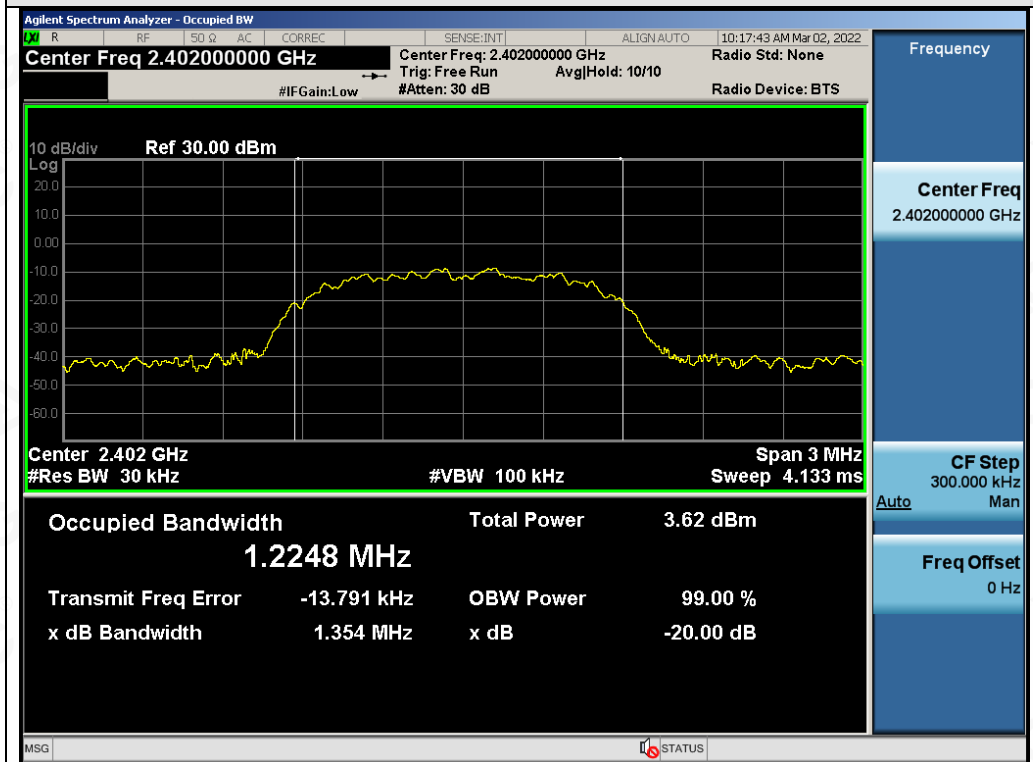
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Test_Graph_EDR_ANT1_2480_2Mbps_OBW

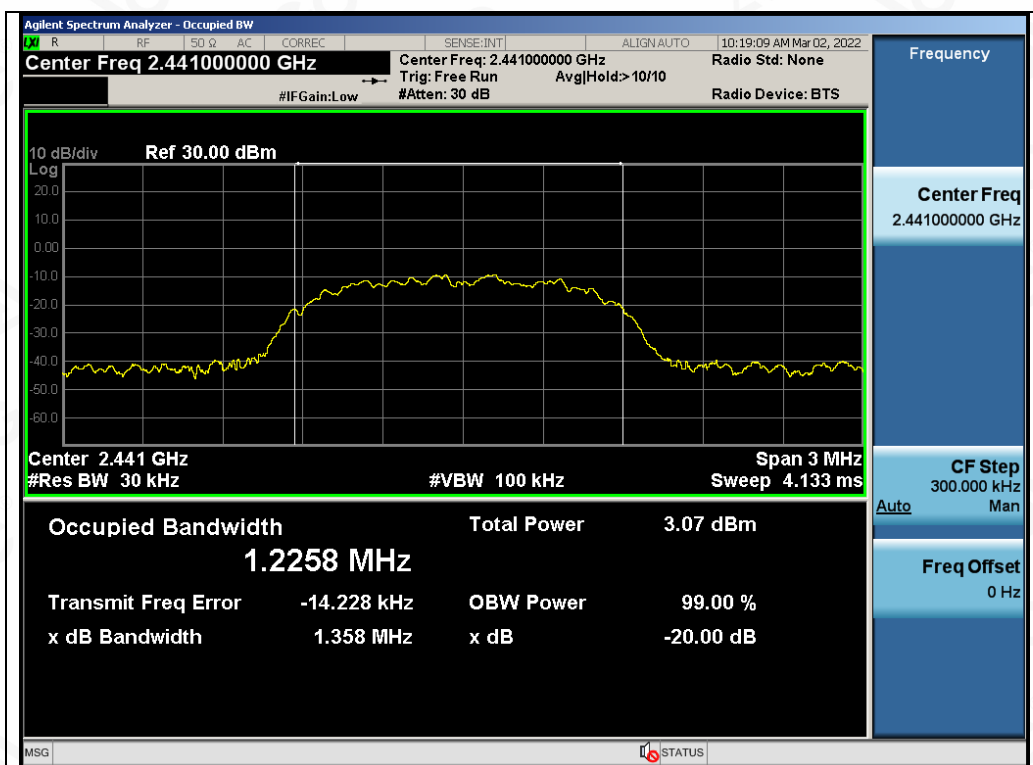


Test_Graph_EDR_ANT1_2402_3Mbps_OBW

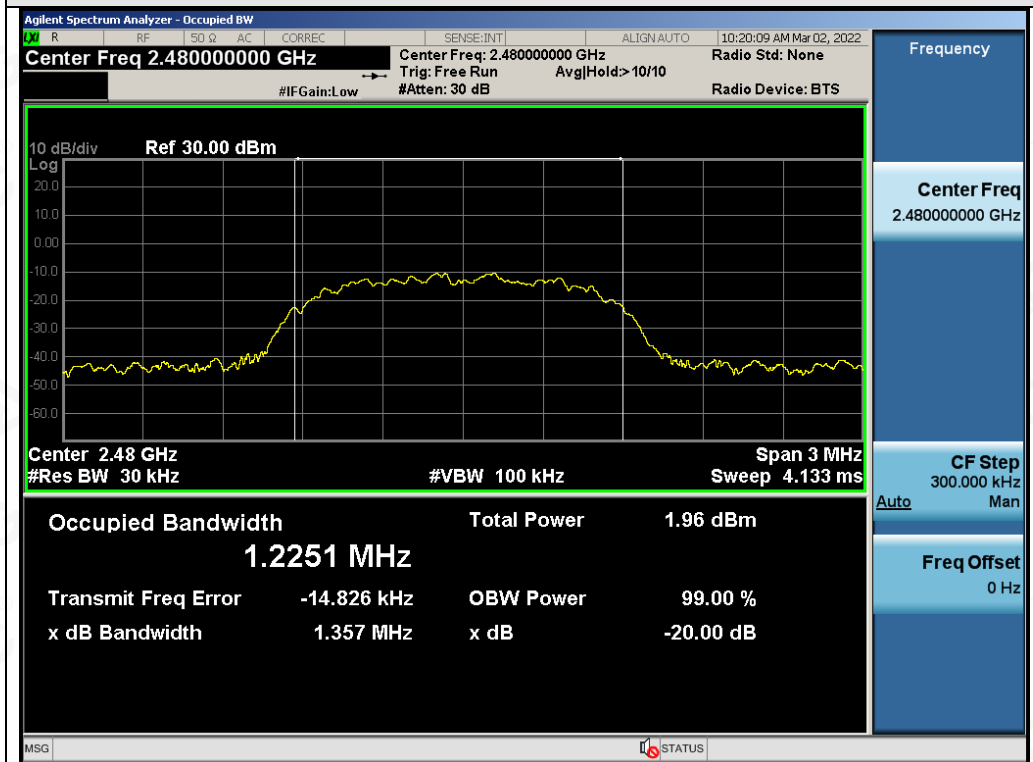
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Test_Graph_EDR_ANT1_2441_3Mbps_OBW



Test_Graph_EDR_ANT1_2480_3Mbps_OBW

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9. CONDUCTED SPURIOUS EMISSION

9.1. MEASUREMENT PROCEDURE

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Set the EUT Work on the top, the Middle and the bottom operation frequency individually.
3. Set the Span = wide enough to capture the peak level of the in-band emission and all spurious emissions from the lowest frequency generated in the EUT up through the 10th harmonic.
RBW = 100 kHz; VBW= 300 kHz; Sweep = auto; Detector function = peak.
4. Set SPA Trace 1 Max hold, then View.

9.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

The same as described in section 8.2

9.3. MEASUREMENT EQUIPMENT USED

The same as described in section 6

9.4. LIMITS AND MEASUREMENT RESULT

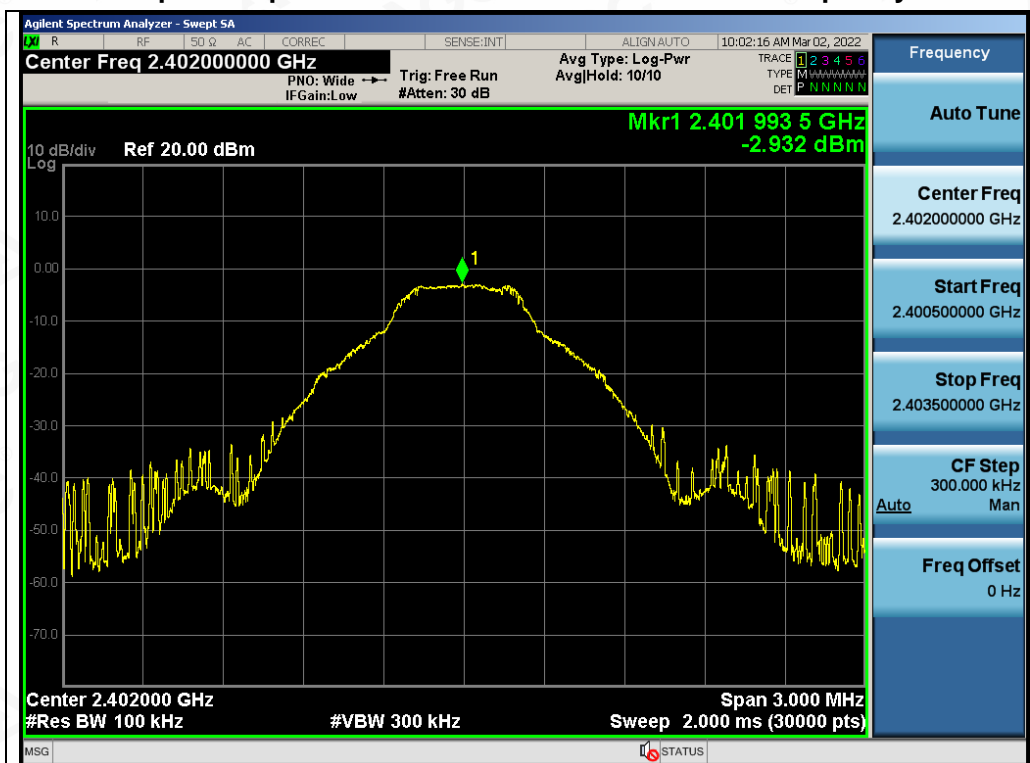
LIMITS AND MEASUREMENT RESULT		
Applicable Limits	Measurement Result	
	Test Data	Criteria
In any 100 kHz Bandwidth Outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produce by the intentional radiator shall be at least 20 dB below that in 100KHz bandwidth within the band that contains the highest level of the desired power. In addition, radiation emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in§15.209(a))	At least -20dBc than the limit Specified on the BOTTOM Channel	PASS
	At least -20dBc than the limit Specified on the TOP Channel	PASS

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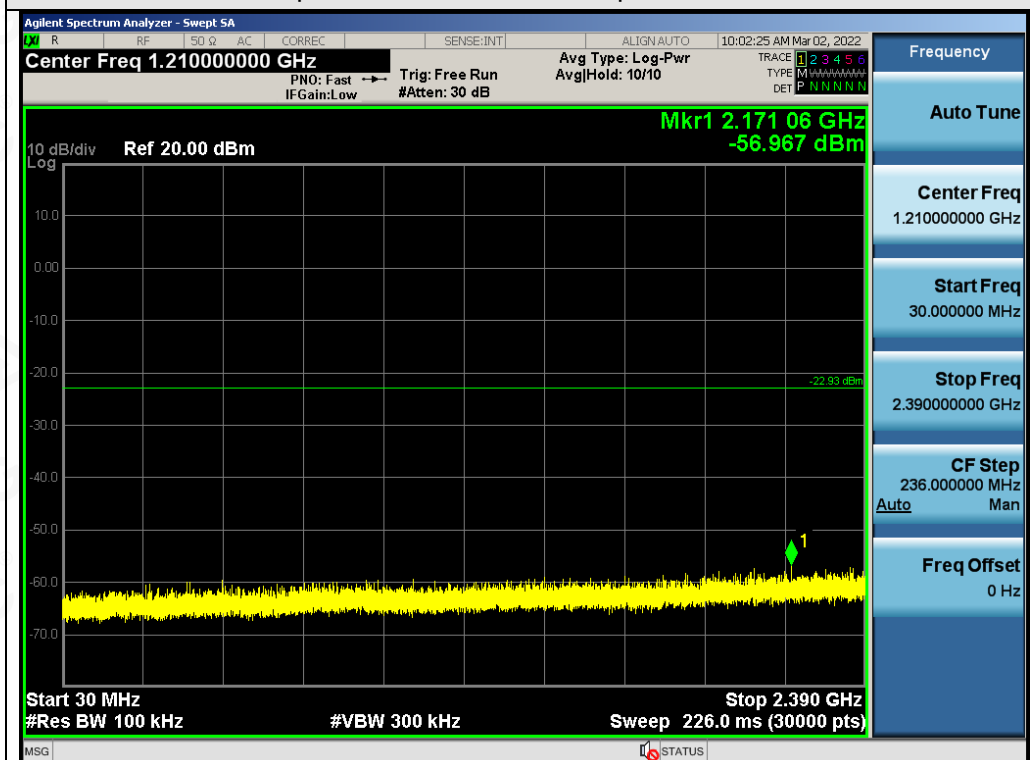
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Test Graphs of Spurious Emissions in Non-Restricted Frequency Bands



Test_Graph_BR_ANT1_2402_1Mbps_Reference Level

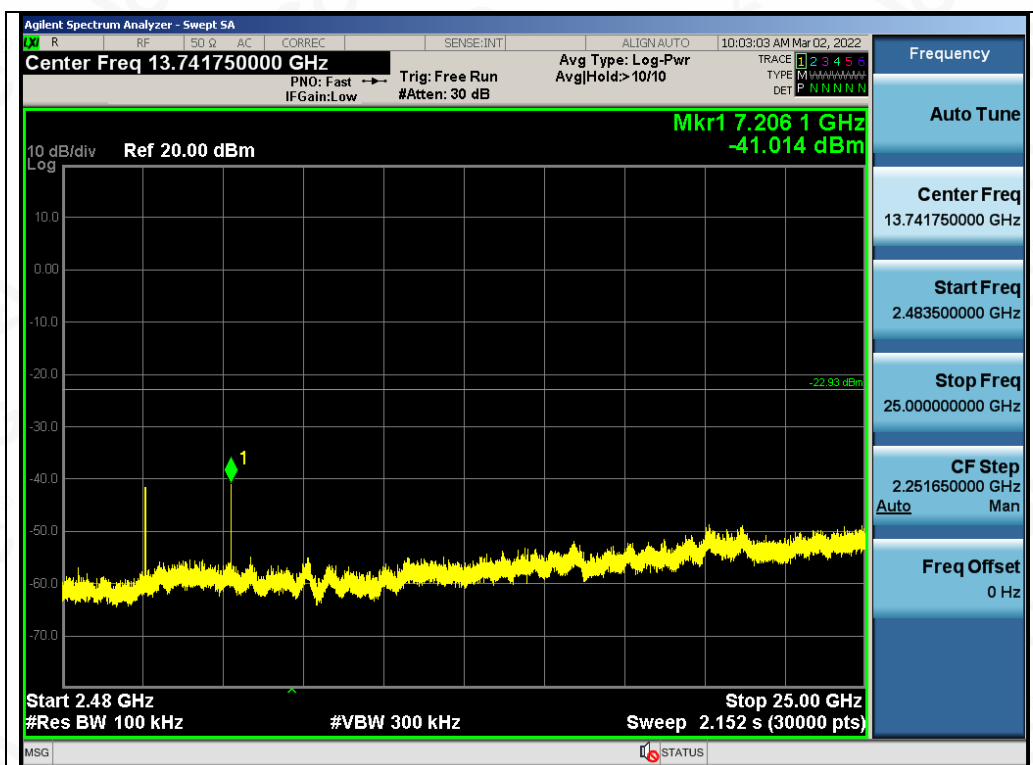


Test_Graph_BR_ANT1_2402_1Mbps_Lower Band Emissions

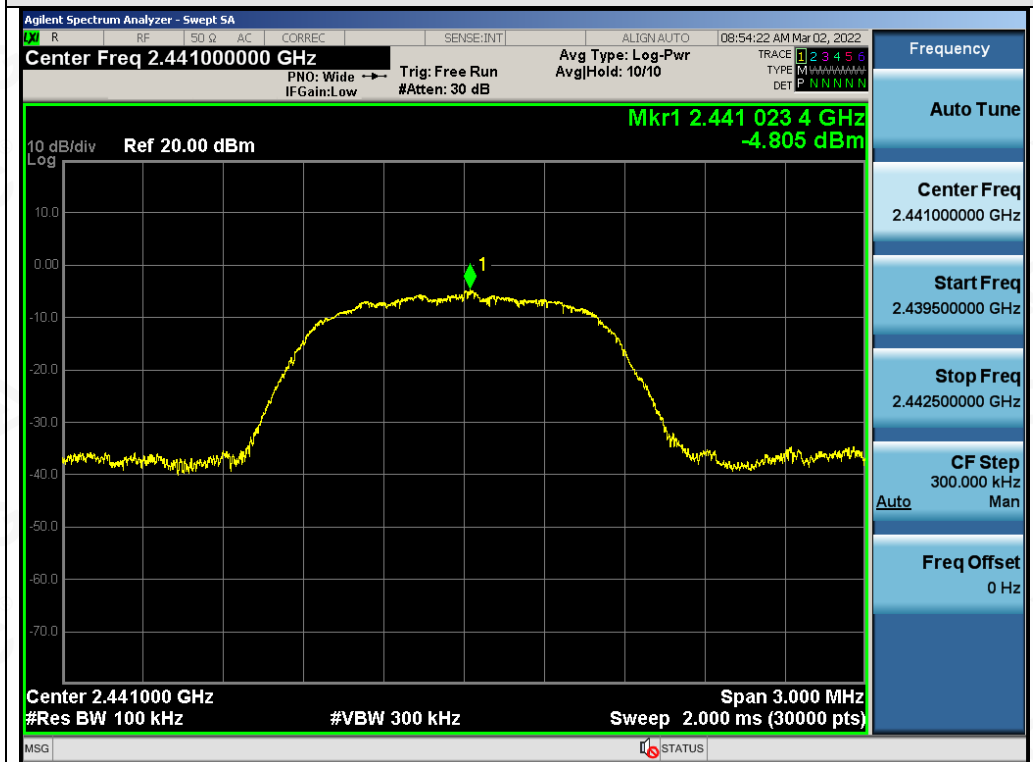
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Test_Graph_BR_ANT1_2402_1Mbps_Higher Band Emissions

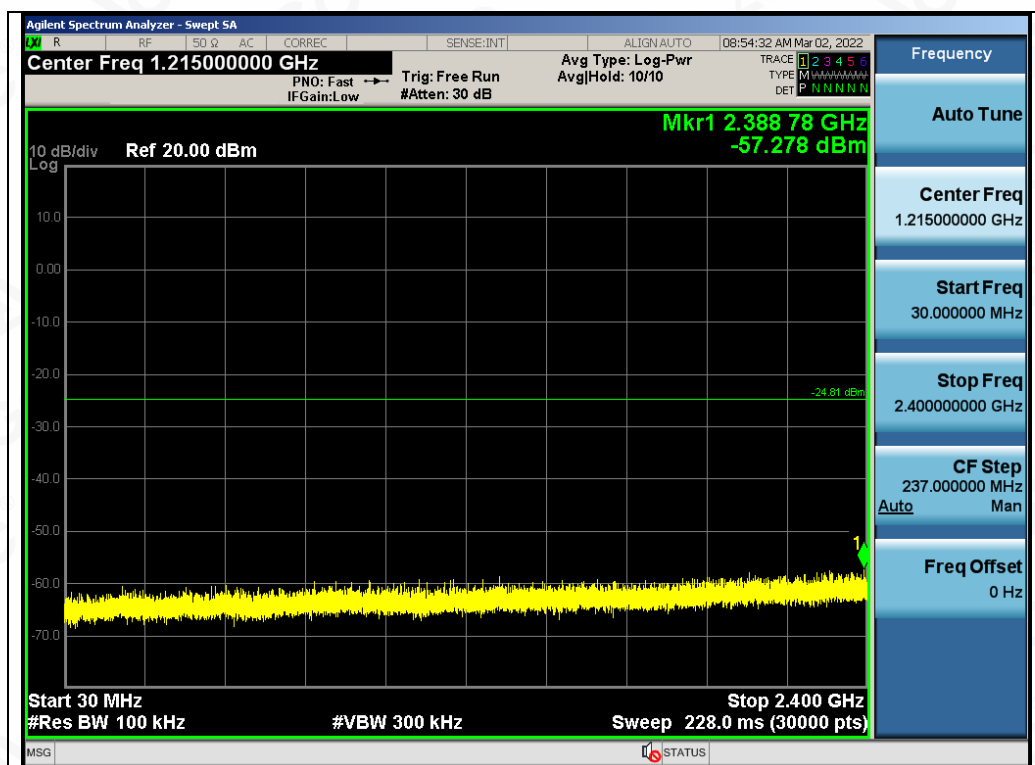


Test_Graph_BR_ANT1_2441_1Mbps_Reference Level

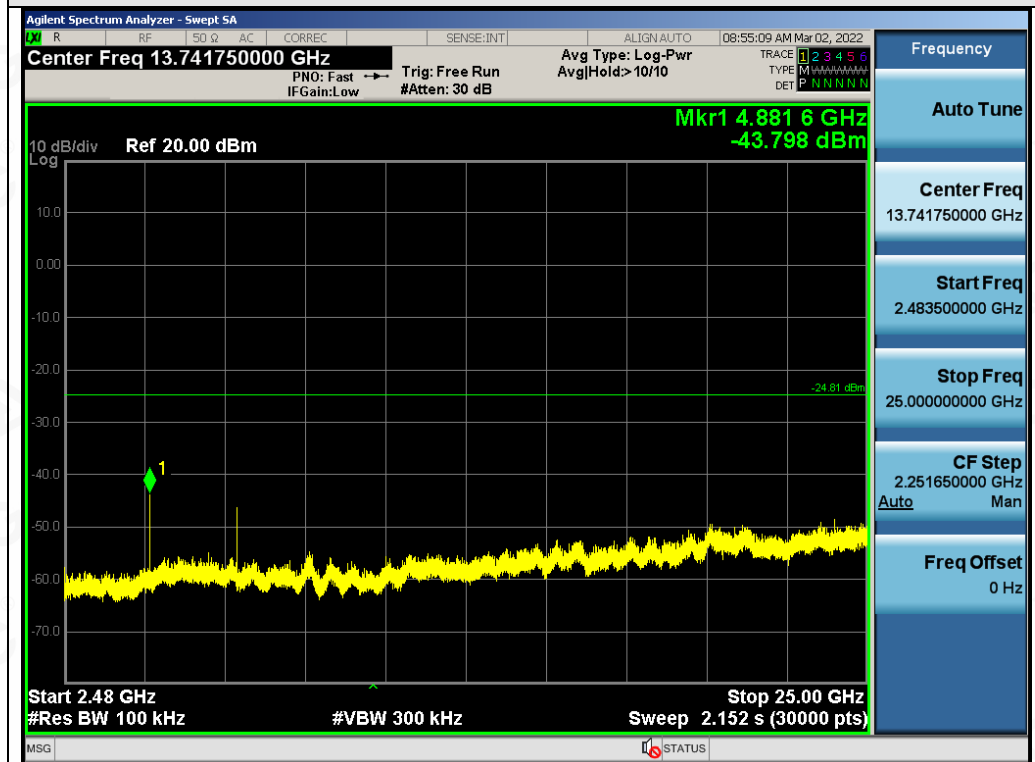
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Test_Graph_BR_ANT1_2441_1Mbps_Lower Band Emissions

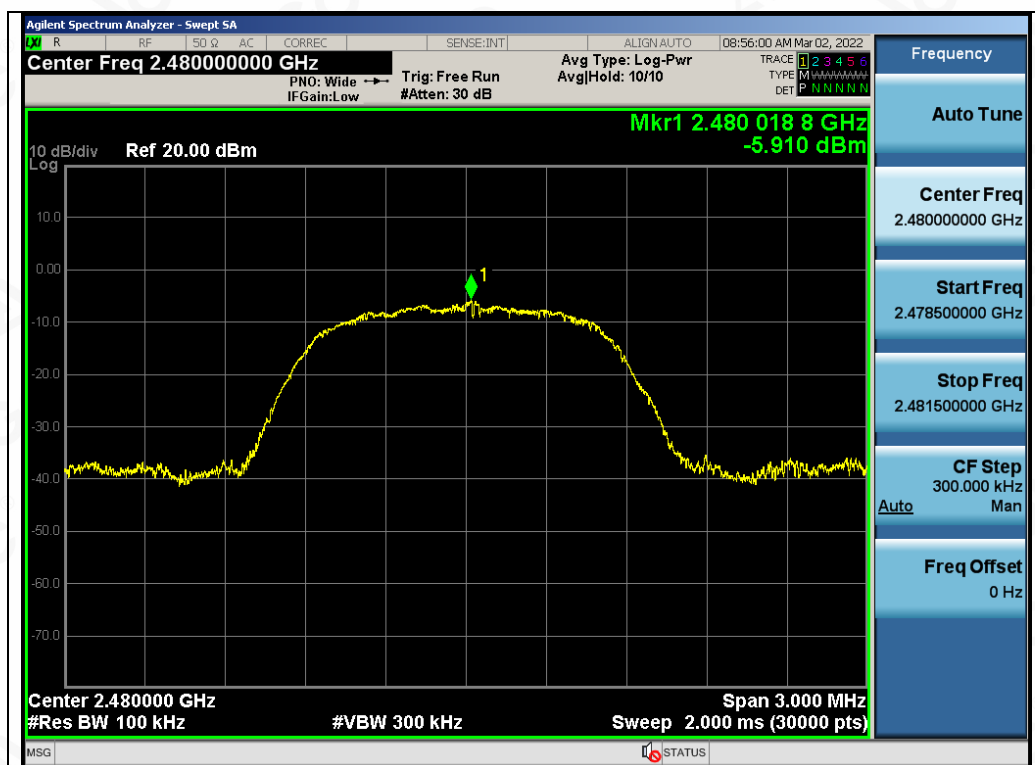


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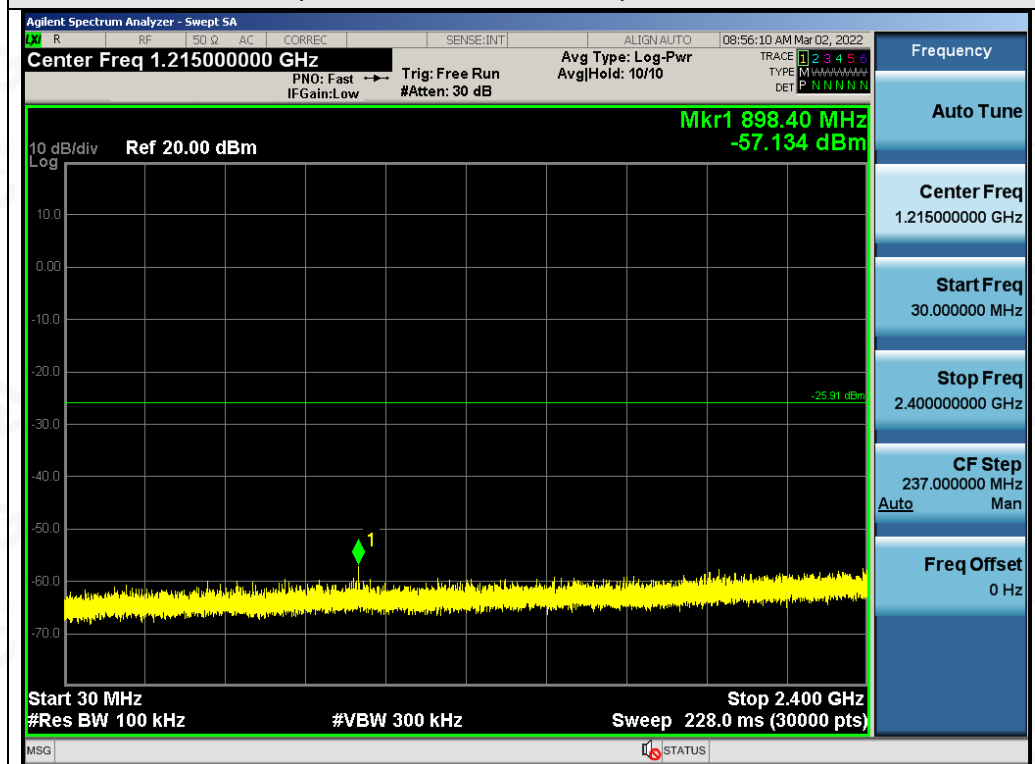
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Test_Graph_BR_ANT1_2480_1Mbps_Reference Level

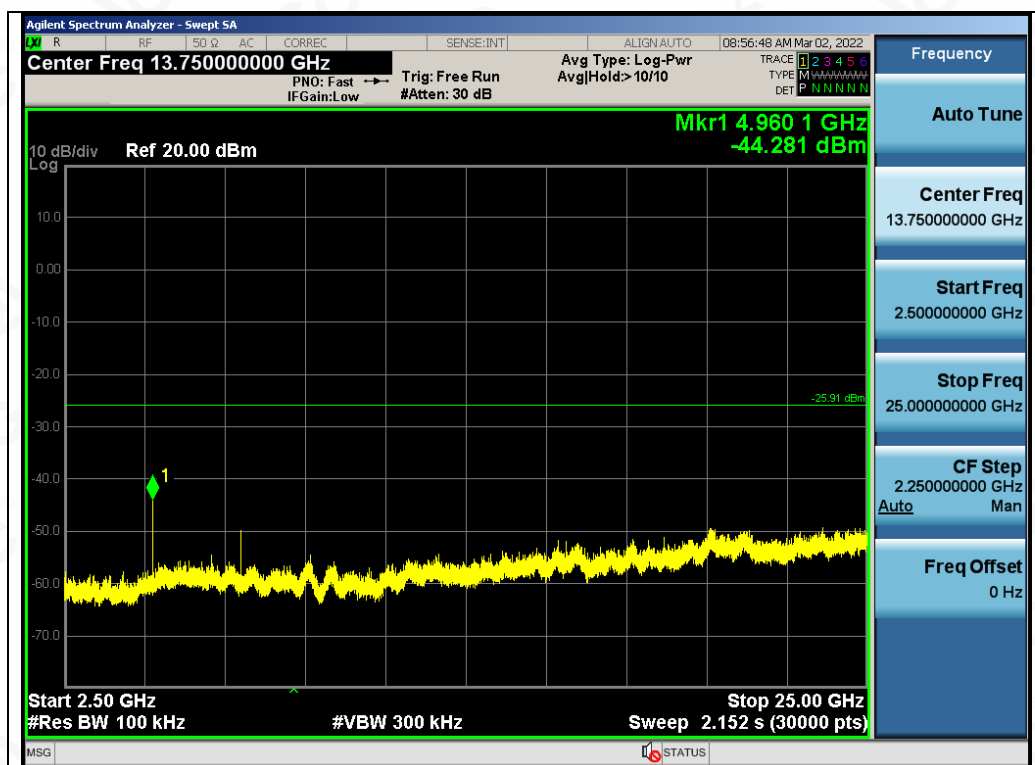


Test_Graph_BR_ANT1_2480_1Mbps_Lower Band Emissions

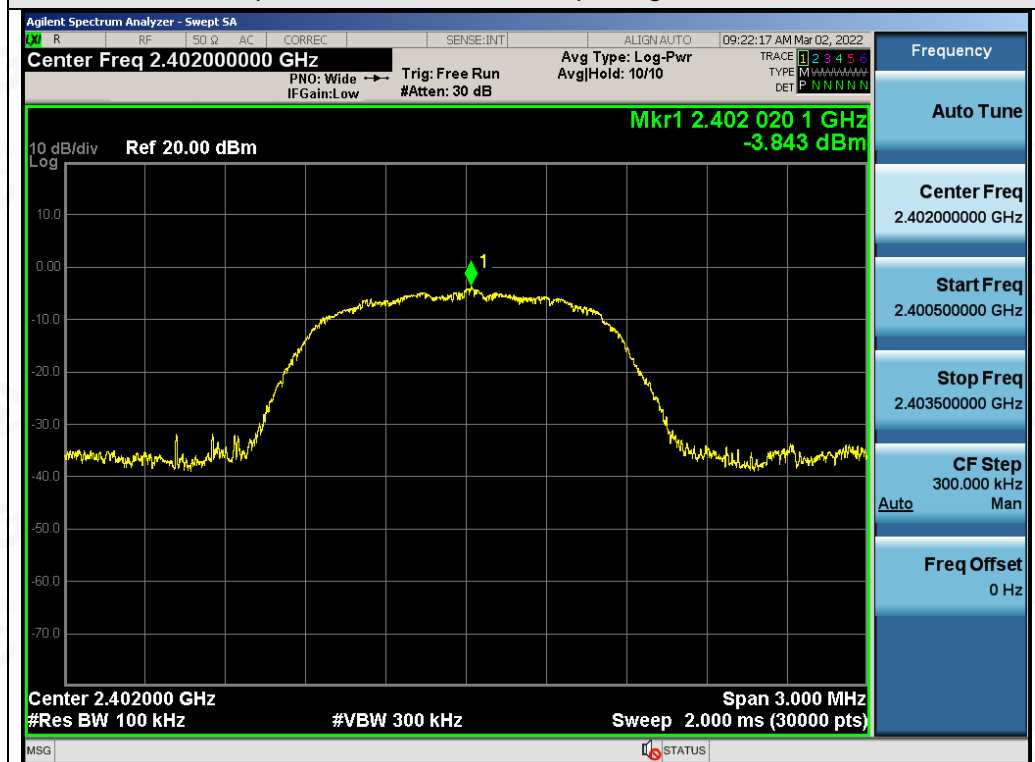
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Test_Graph_BR_ANT1_2480_1Mbps_Higher Band Emissions

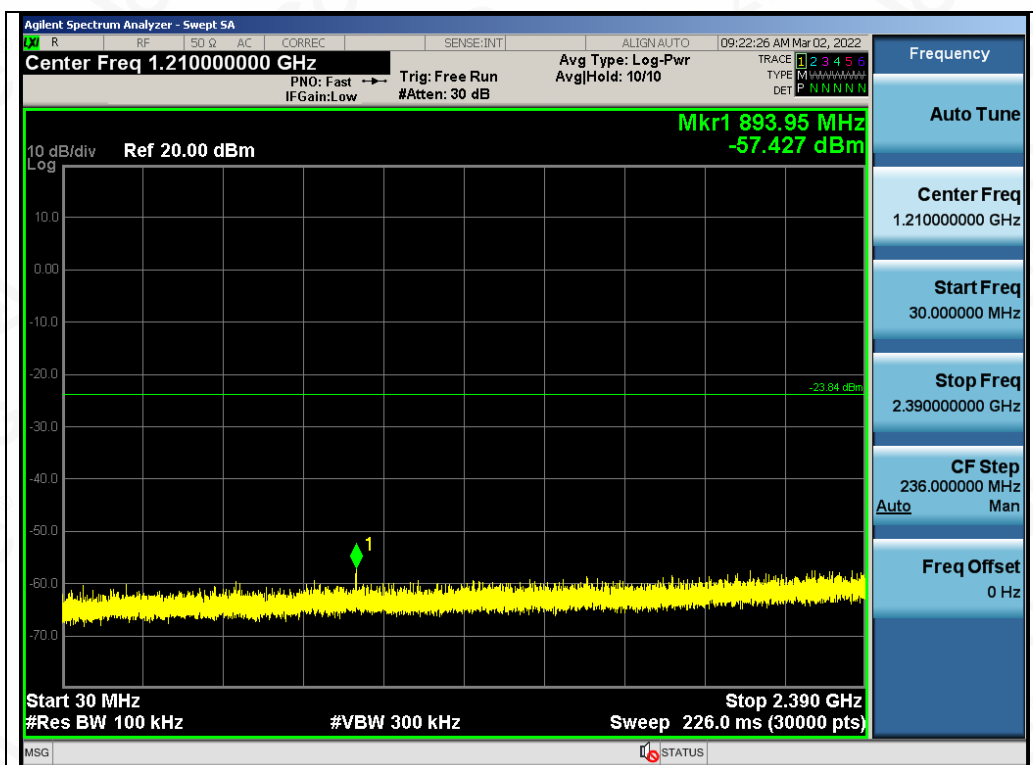


Test_Graph_EDR_ANT1_2402_2Mbps_Reference Level

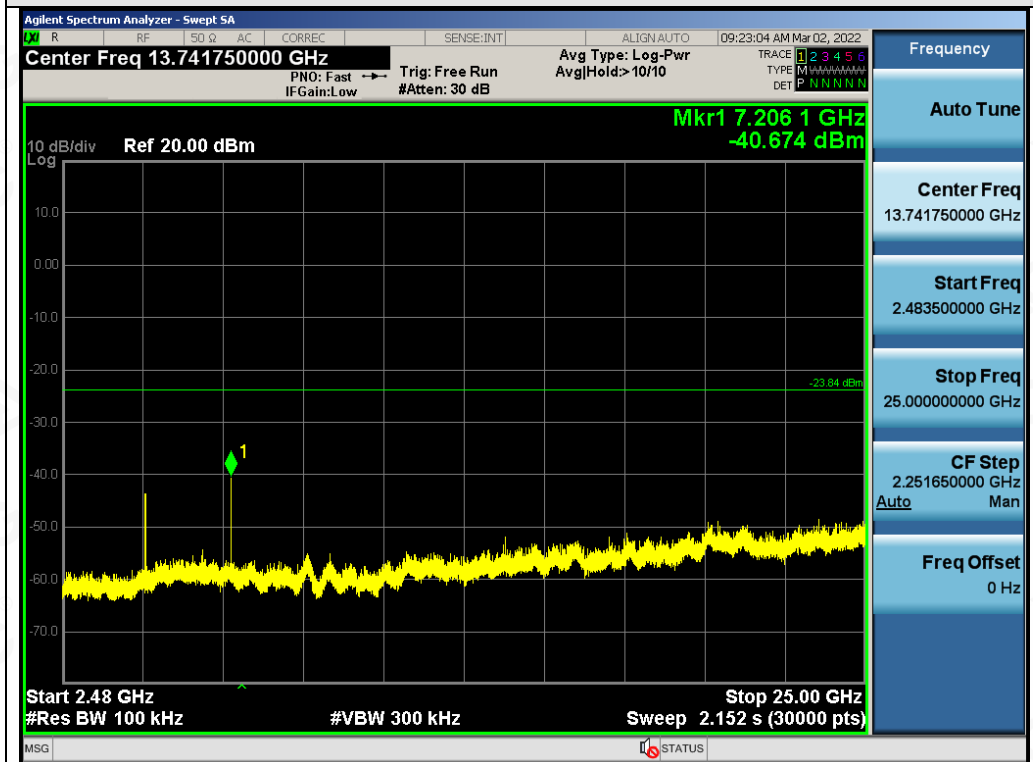
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Test_Graph_EDR_ANT1_2402_2Mbps_Lower Band Emissions

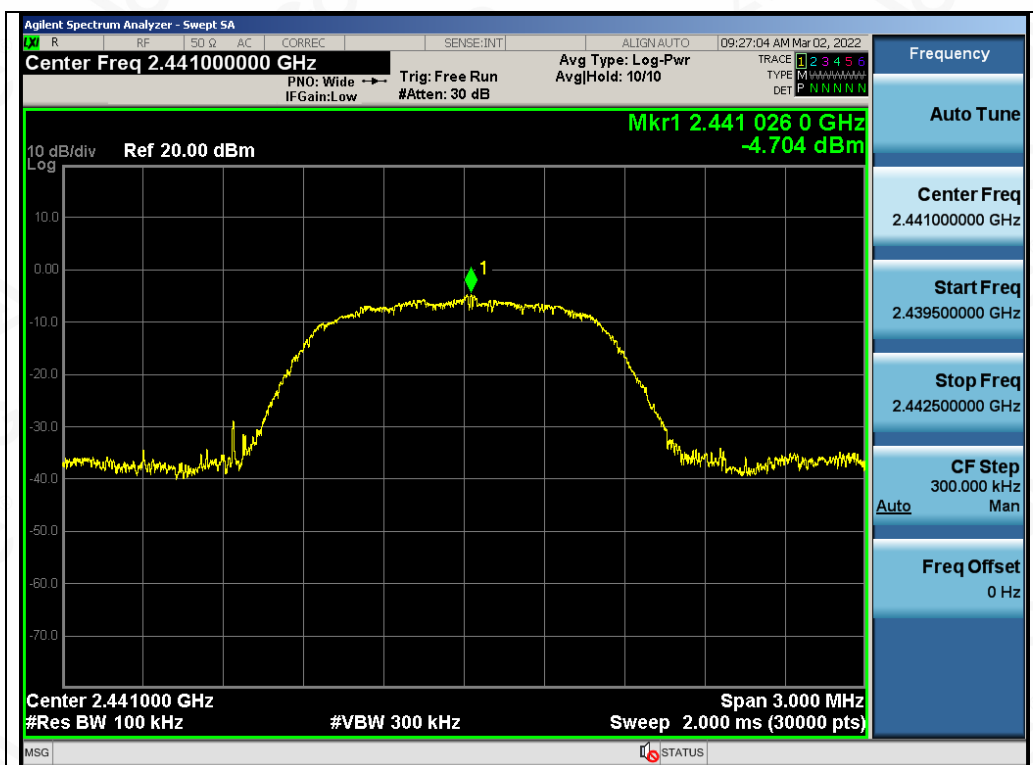


Test_Graph_EDR_ANT1_2402_2Mbps_Higher Band Emissions

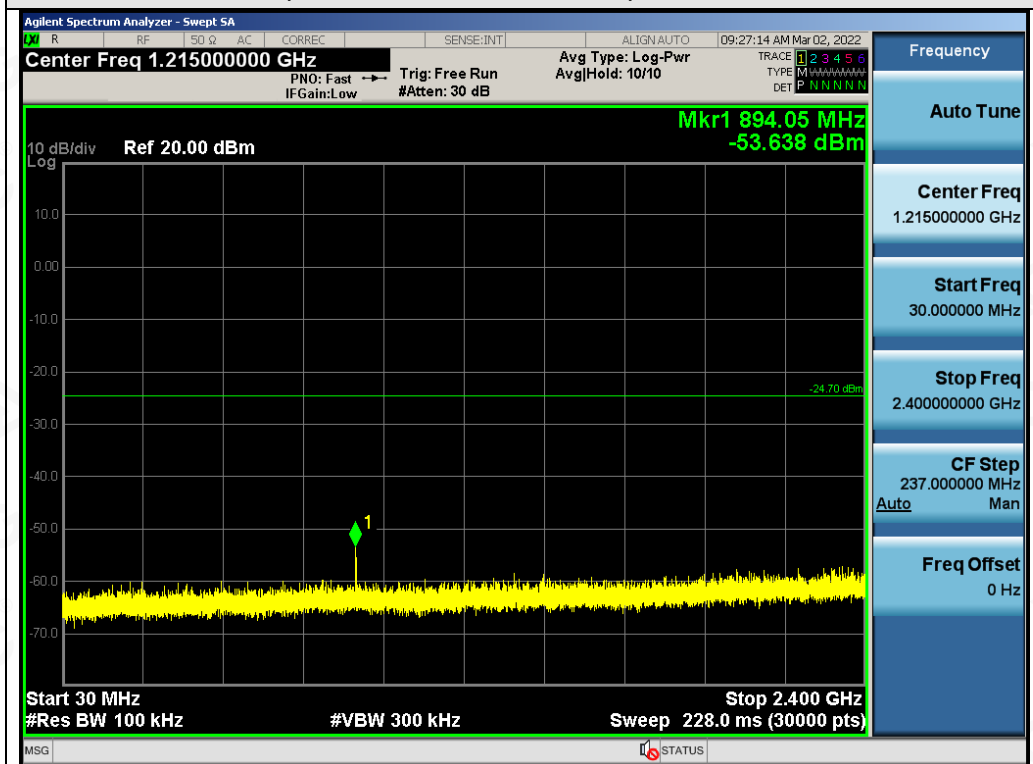
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Test_Graph_EDR_ANT1_2441_2Mbps_Reference Level



Test_Graph_EDR_ANT1_2441_2Mbps_Lower Band Emissions

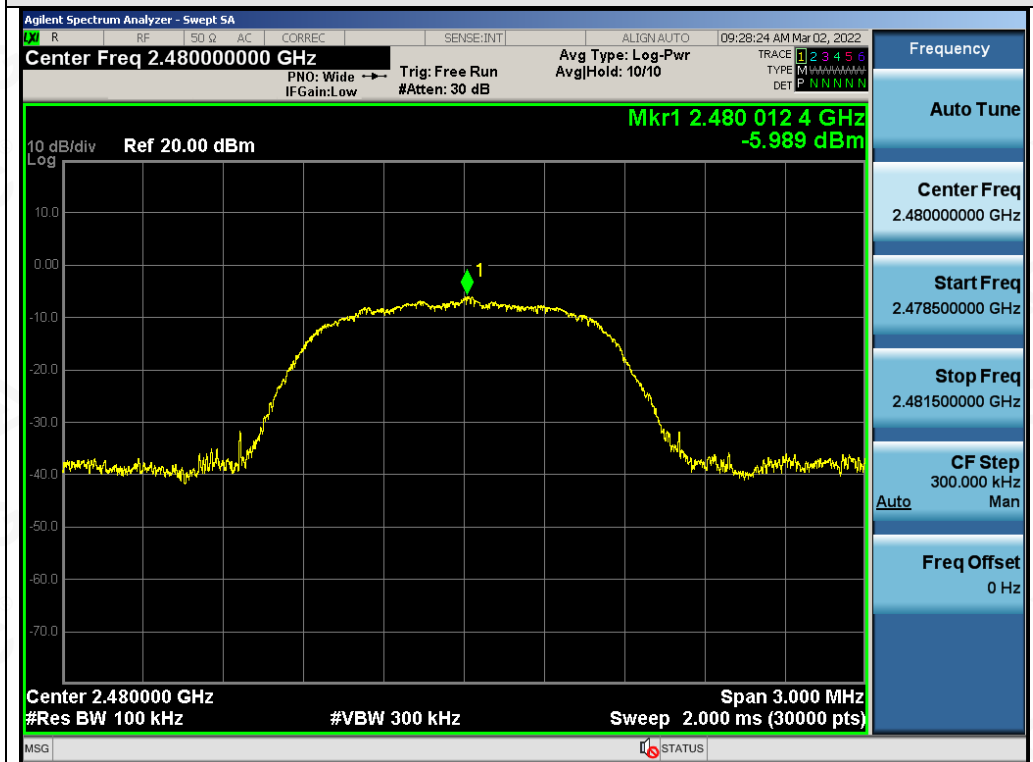
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Test_Graph_EDR_ANT1_2441_2Mbps_Higher Band Emissions

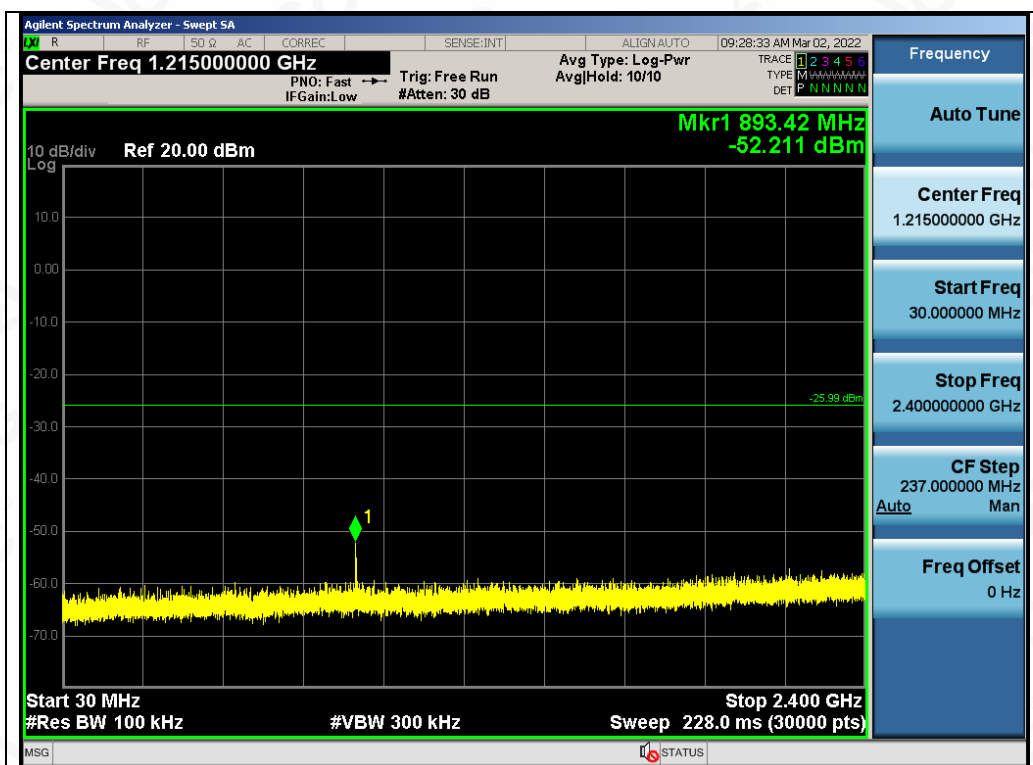


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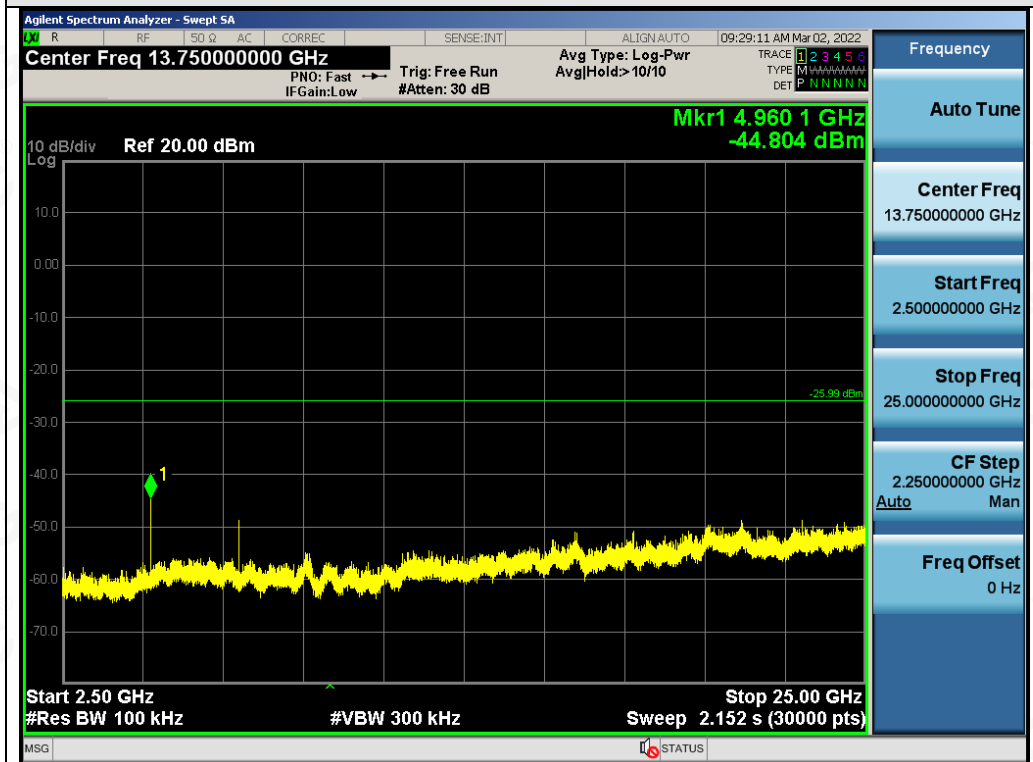
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Test_Graph_EDR_ANT1_2480_2Mbps_Lower Band Emissions

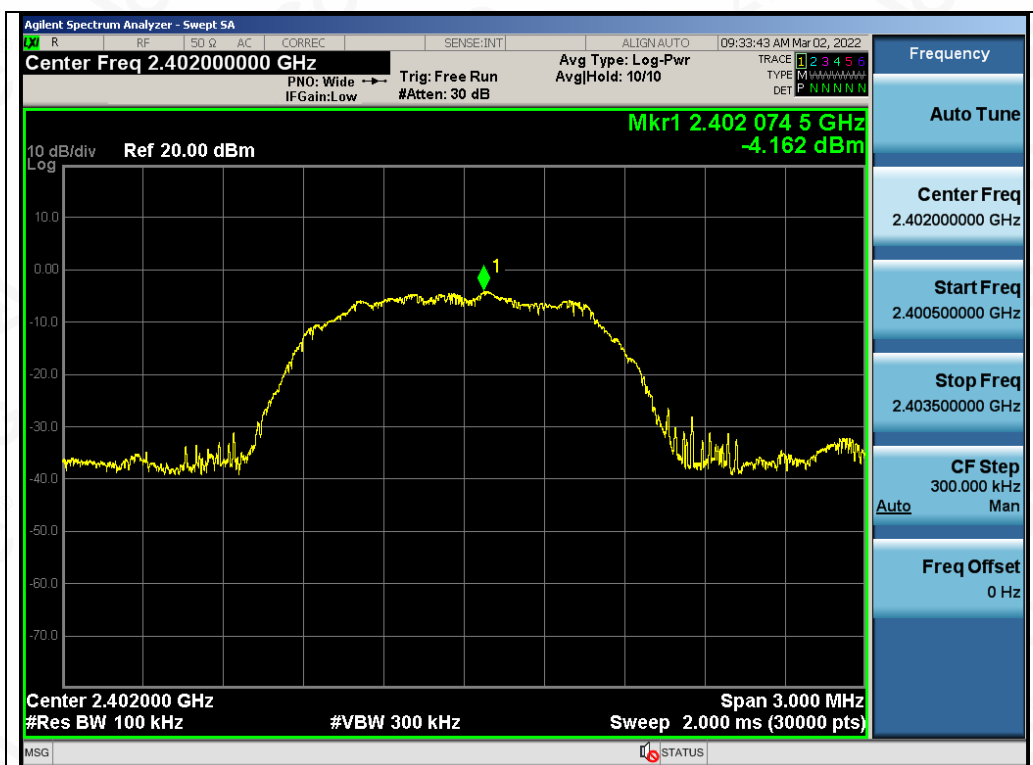


Test_Graph_EDR_ANT1_2480_2Mbps_Higher Band Emissions

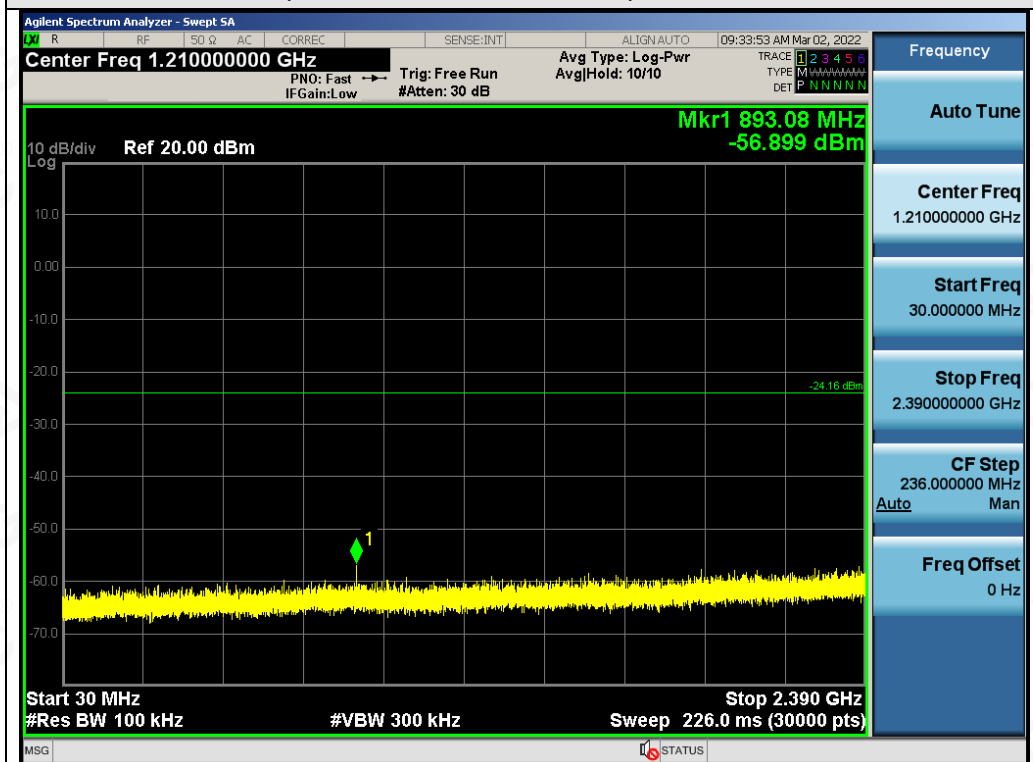
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Test_Graph_EDR_ANT1_2402_3Mbps_Reference Level

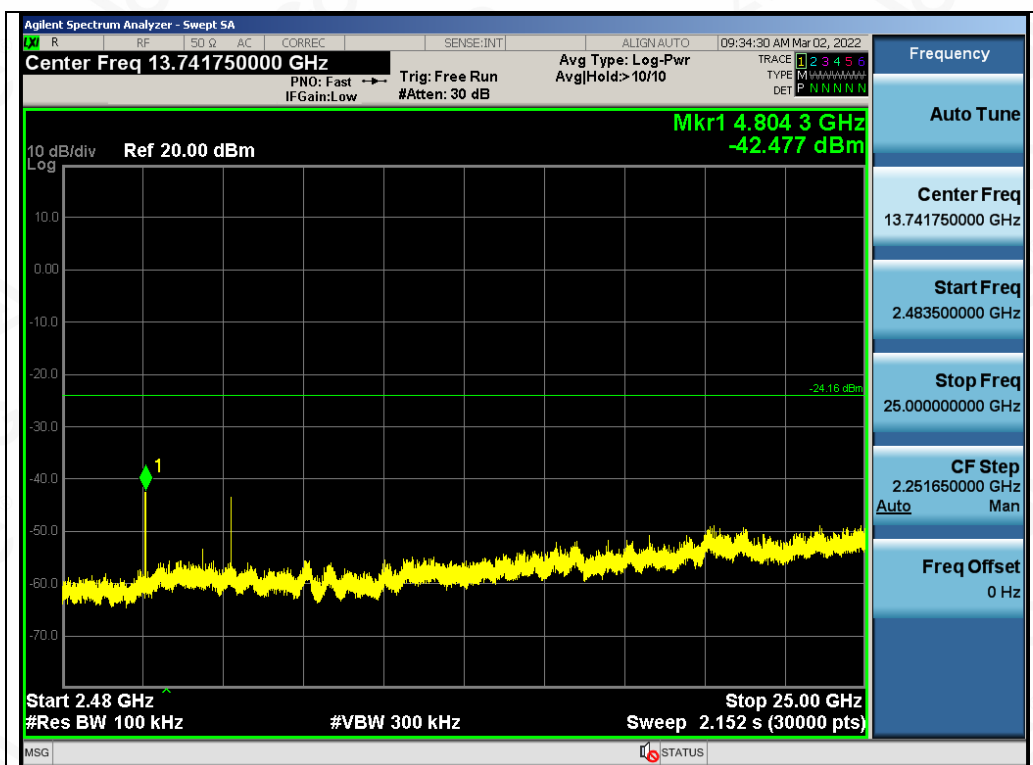


Test_Graph_EDR_ANT1_2402_3Mbps_Lower Band Emissions

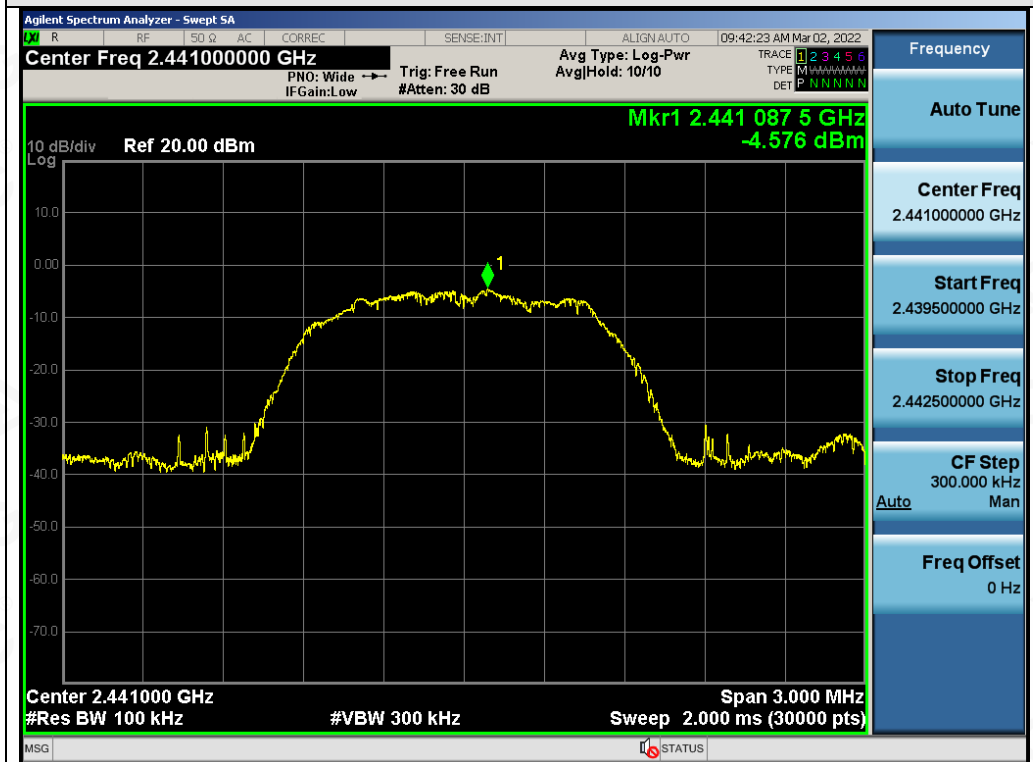
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Test_Graph_EDR_ANT1_2402_3Mbps_Higher Band Emissions

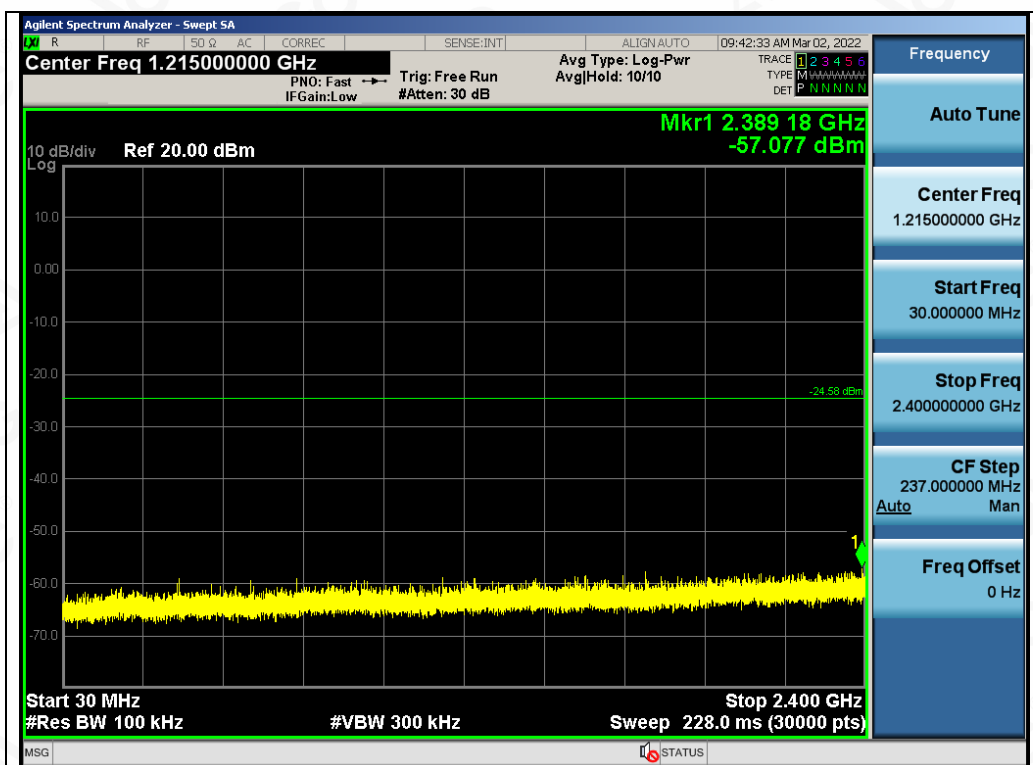


Test_Graph_EDR_ANT1_2441_3Mbps_Reference Level

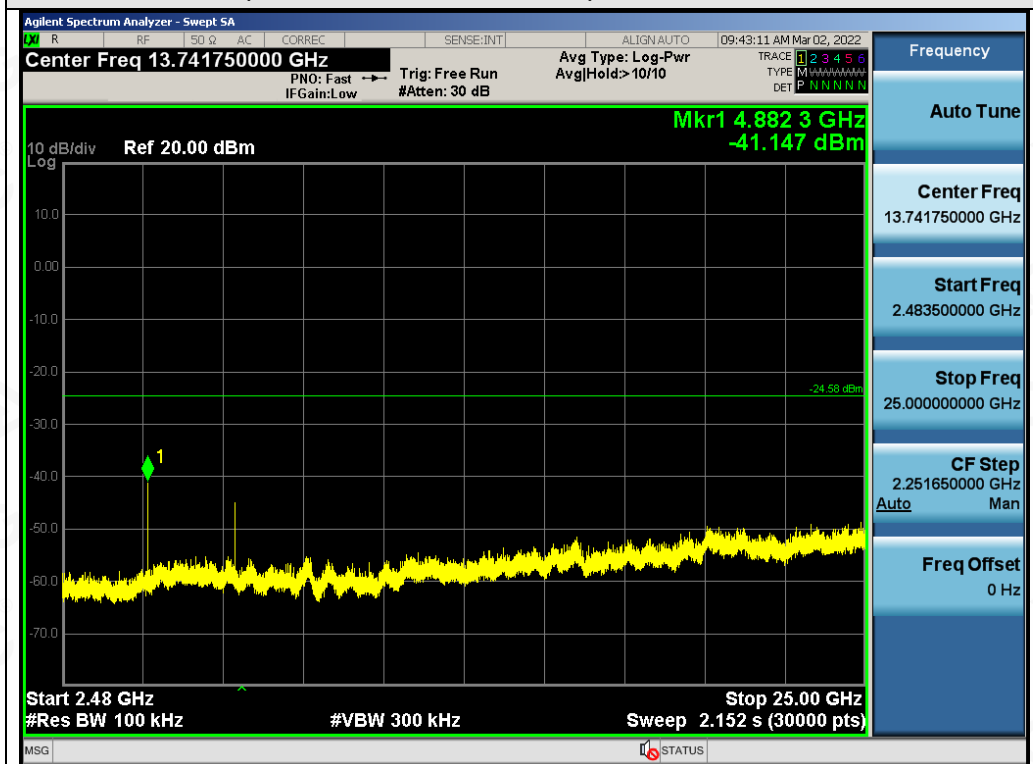
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Test_Graph_EDR_ANT1_2441_3Mbps_Lower Band Emissions

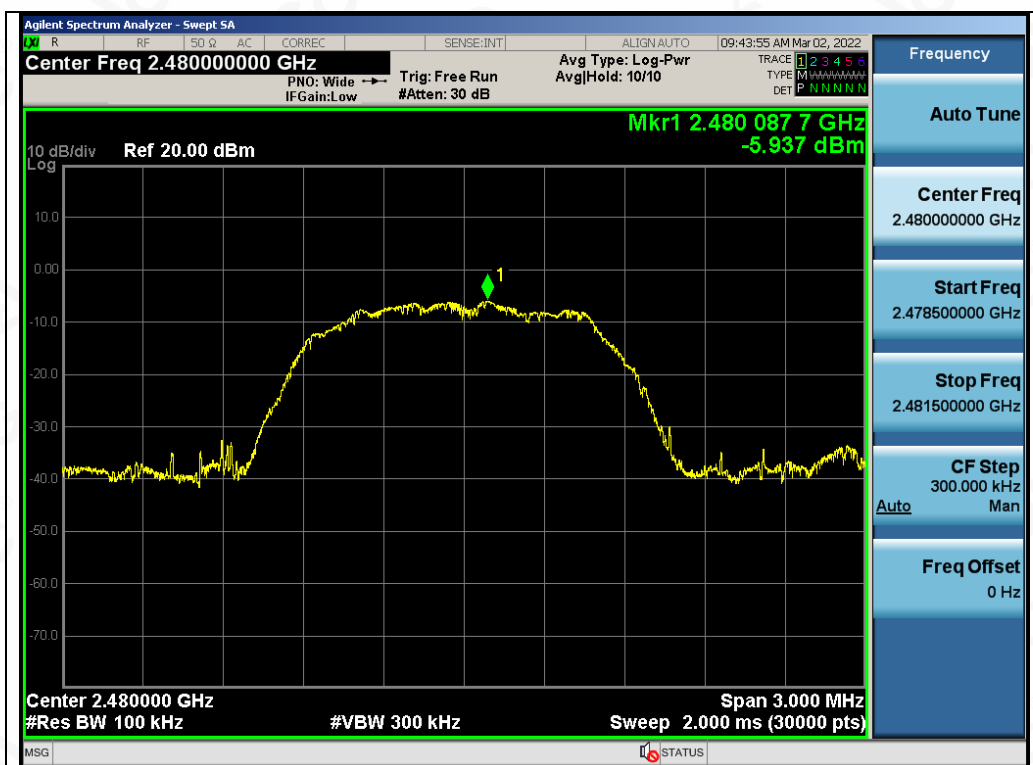


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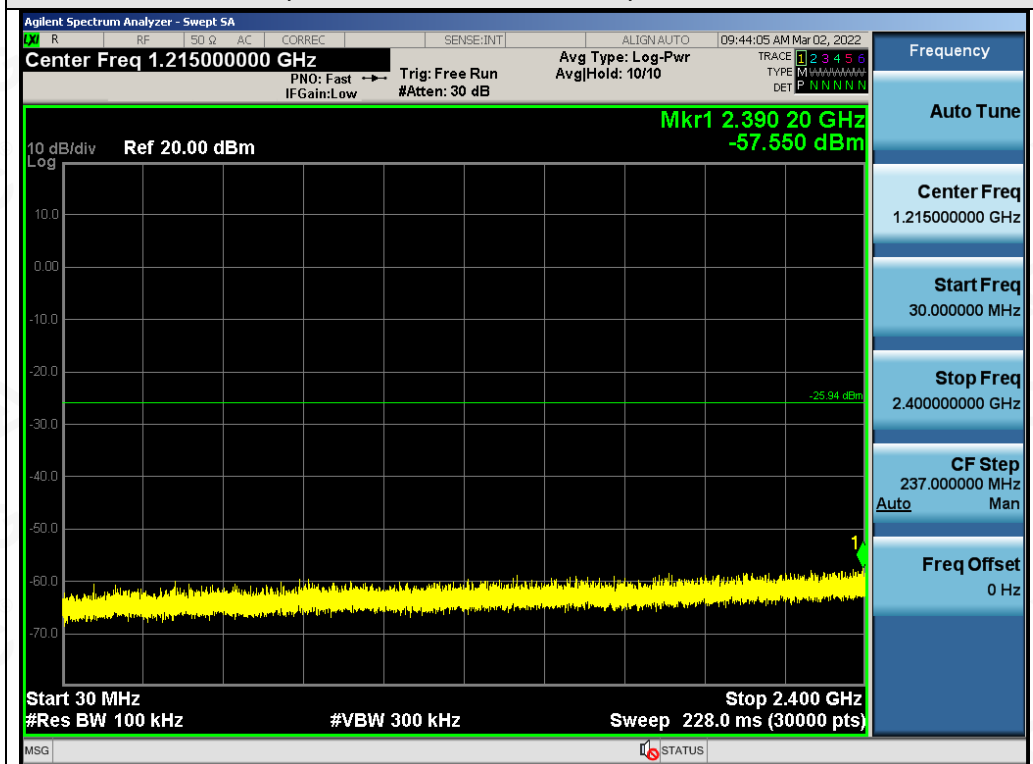
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Test_Graph_EDR_ANT1_2480_3Mbps_Reference Level

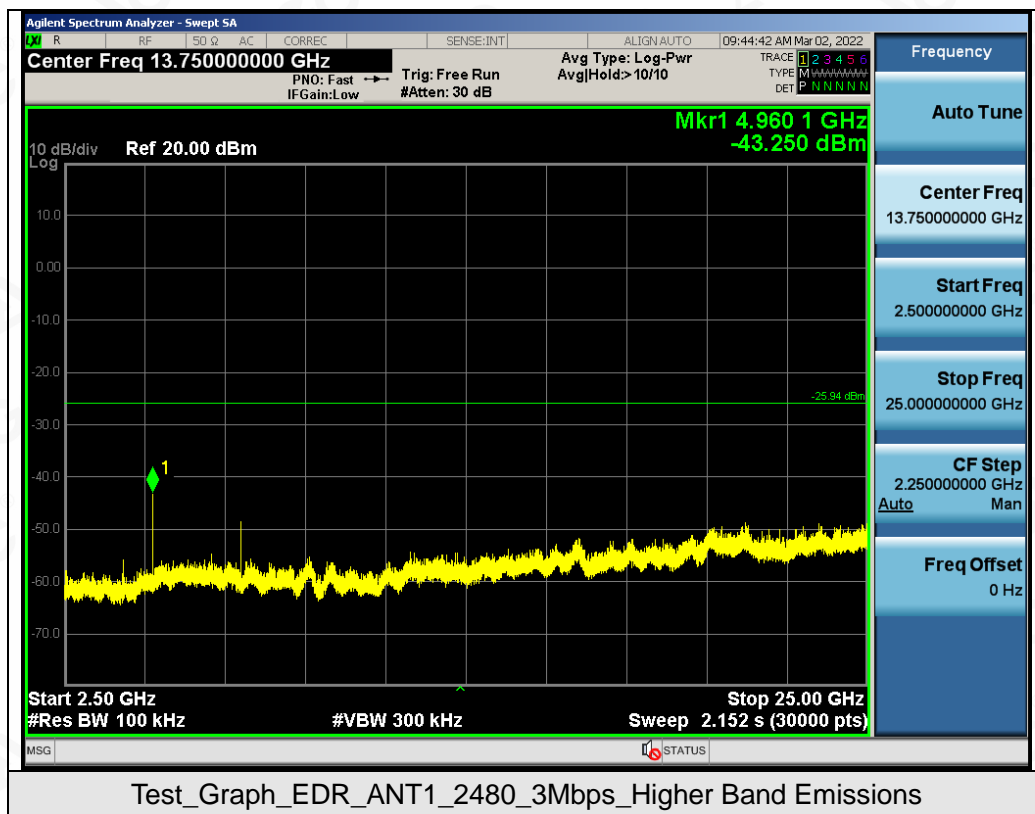


Test_Graph_EDR_ANT1_2480_3Mbps_Lower Band Emissions

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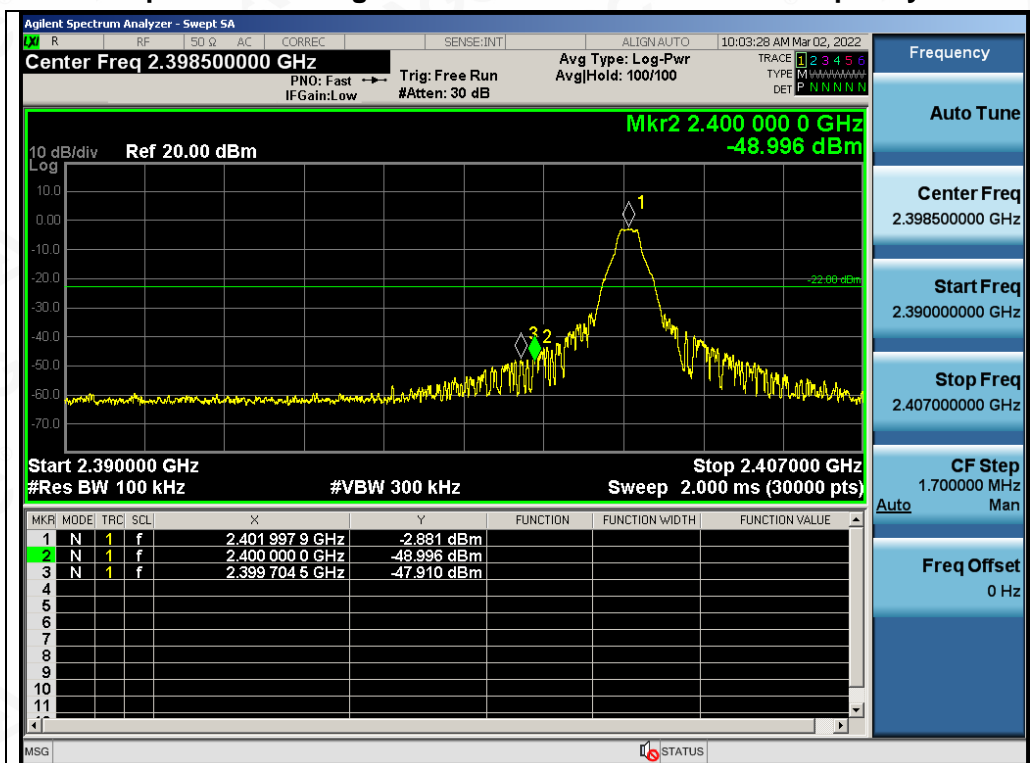


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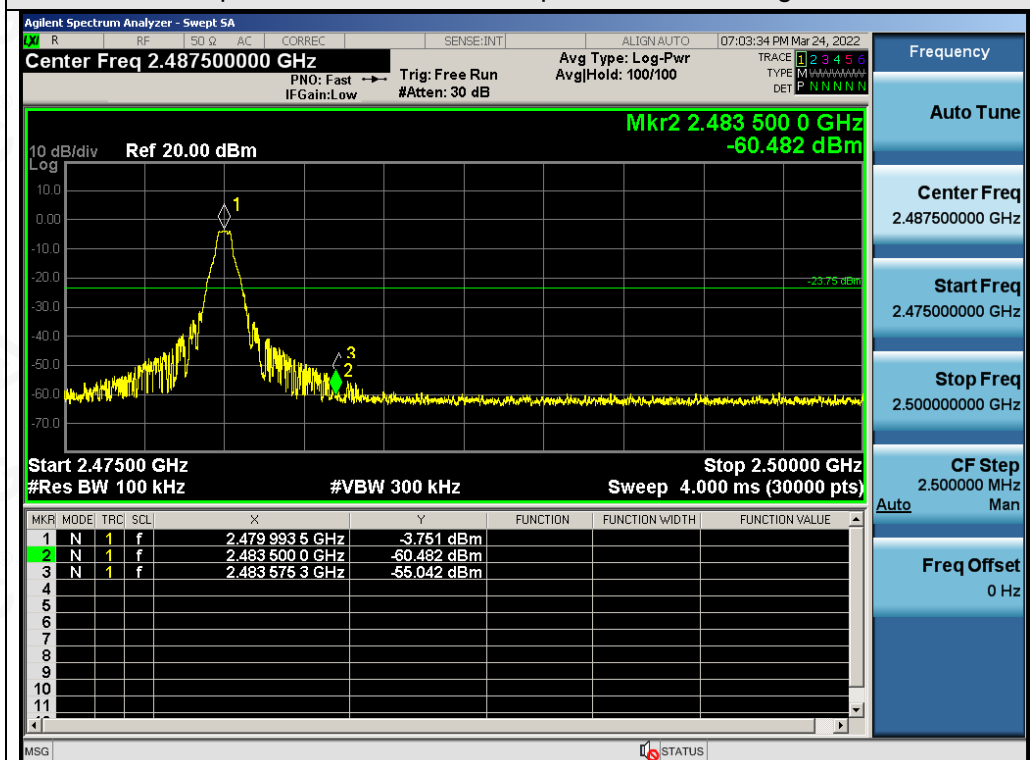
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Test Graphs of Band Edge Emissions in Non-Restricted Frequency Bands



Test_Graph_BR_ANT1_2402_1Mbps_Lower Band Edge Emissions

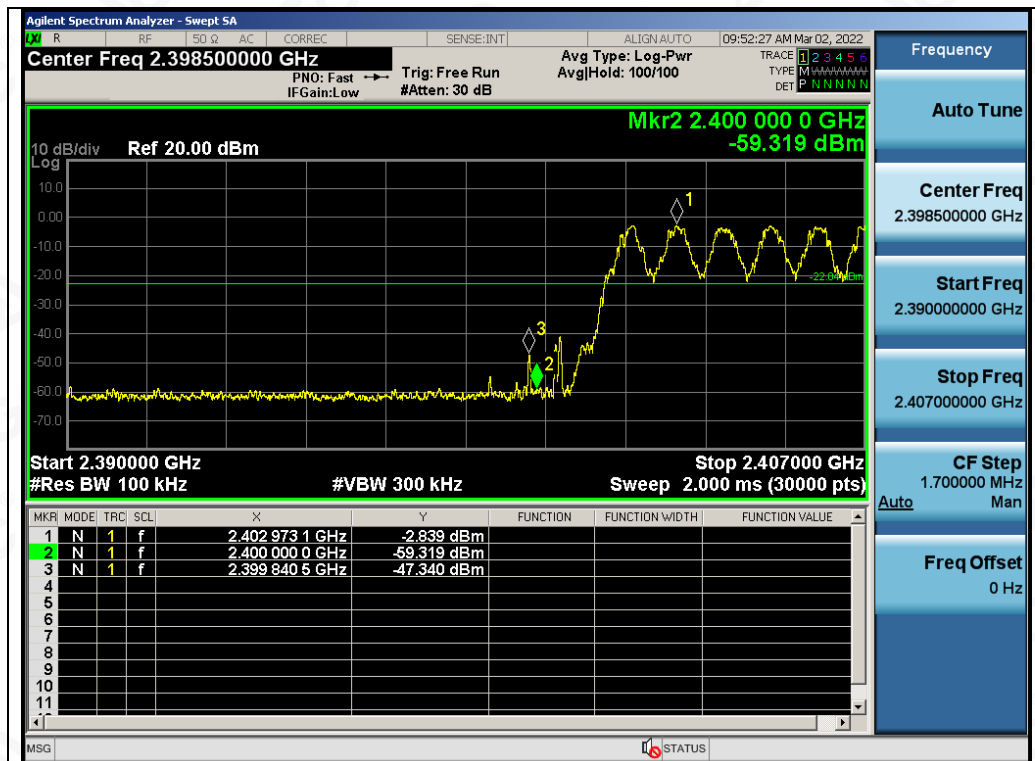


Test_Graph_BR_ANT1_2480_1Mbps_Higher Band Edge Emissions

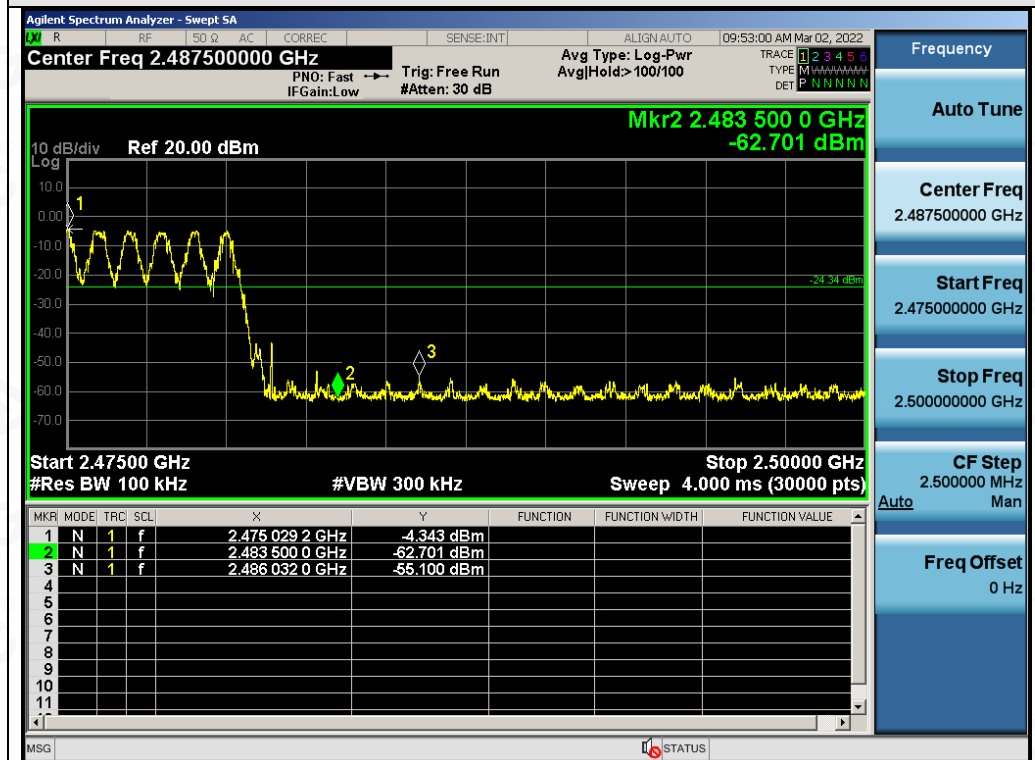
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Test_Graph_BR_HOP_ANT1_NA_1Mbps_Lower Band Edge Emissions

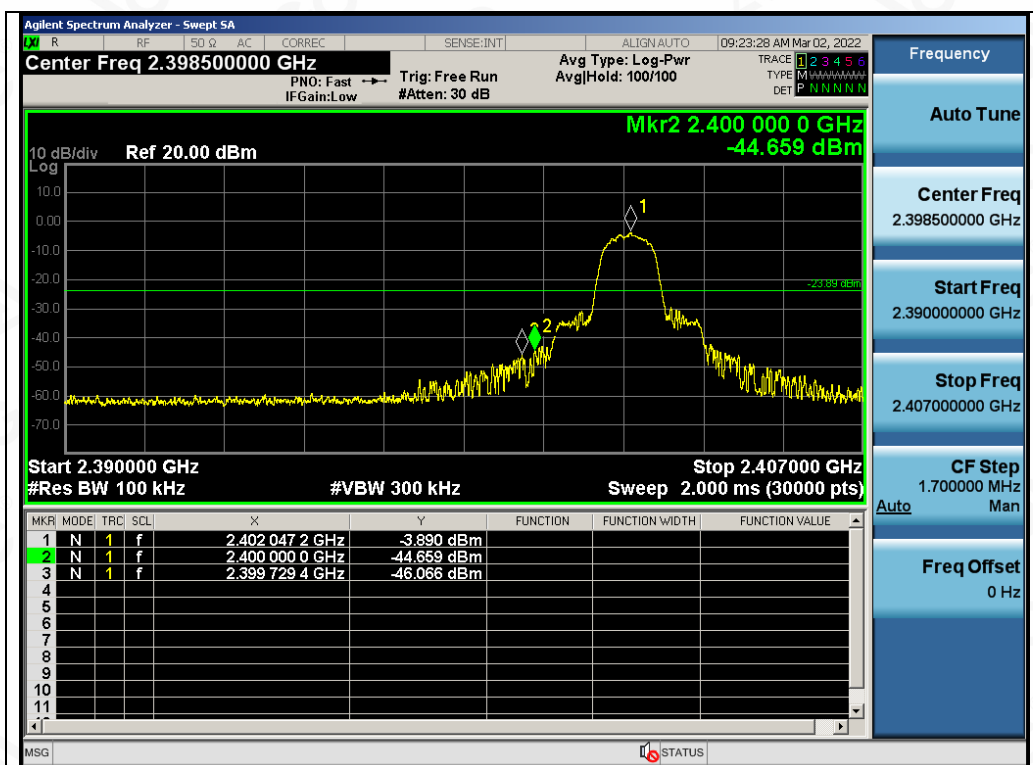


Test_Graph_BR_HOP_ANT1_NA_1Mbps_Higher Band Edge Emissions

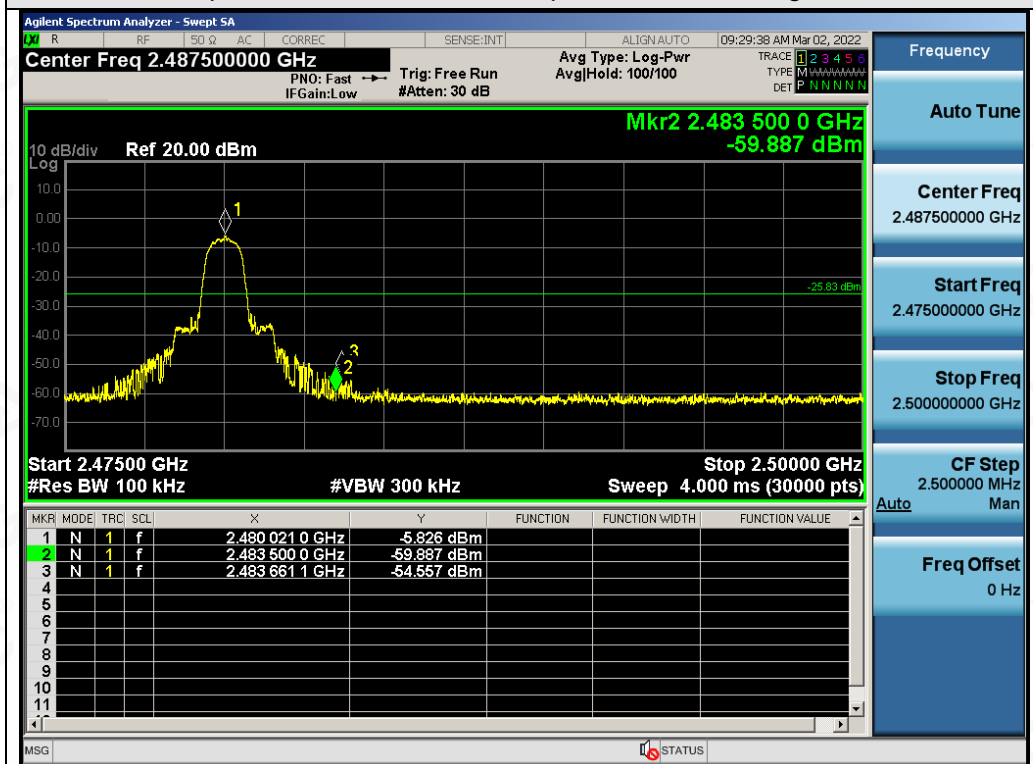
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Test_Graph_EDR_ANT1_2402_2Mbps_Lower Band Edge Emissions

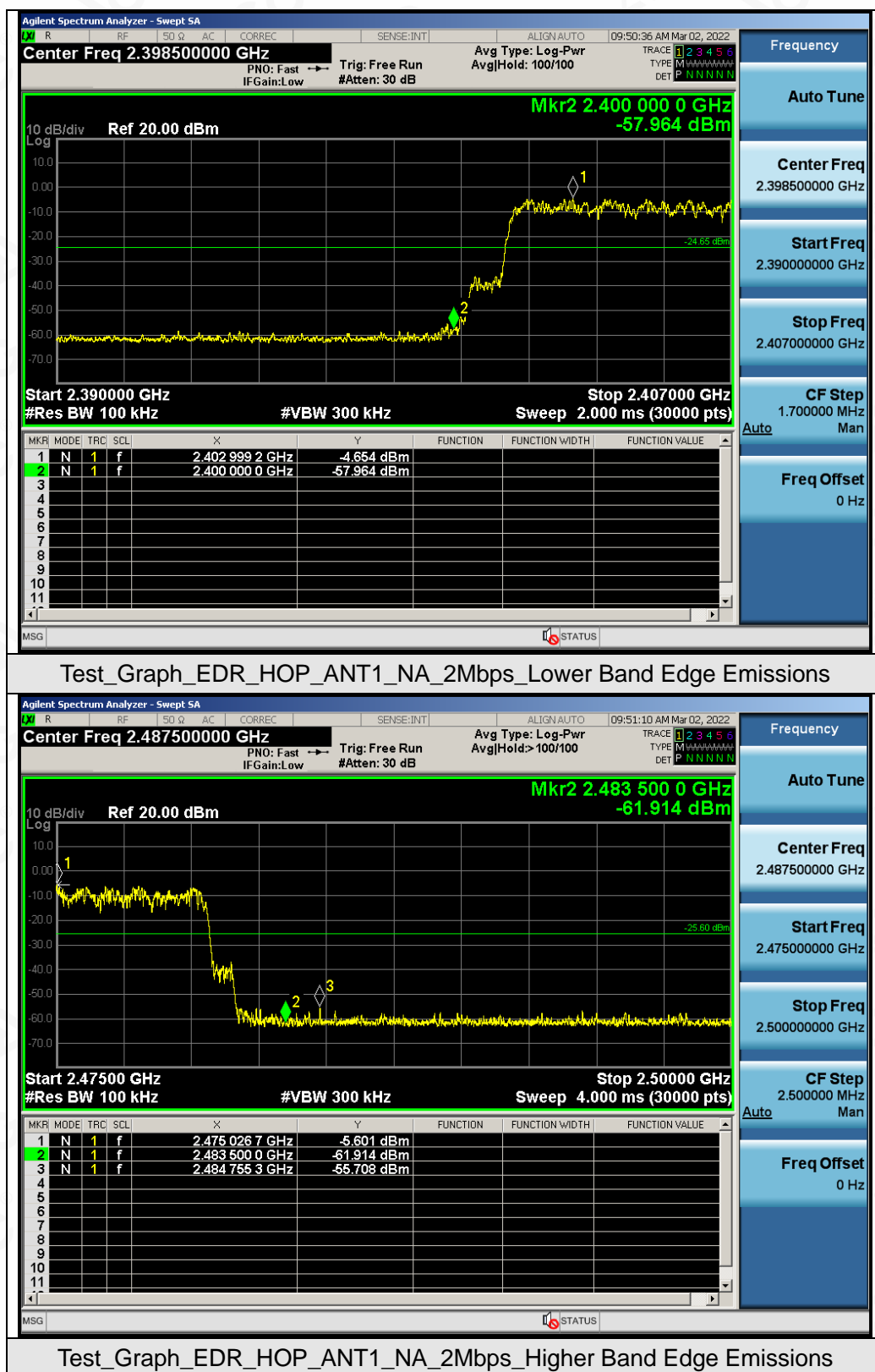


Test_Graph_EDR_ANT1_2480_2Mbps_Higher Band Edge Emissions

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