

FCC Test Report

Report No.: AGC00213211102FE03

Attestation of Global Constance (Shenzhen) Co., Ltd

omplianc



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 Attestation of Global Compliance(Shenzhen)Std & Tech Co., Ltd

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REPORT REVISE RECORD

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	1	Nov. 12, 2021	Invalid	Initial Release
V1.1	1 st	Dec. 01, 2021	Valid	Revise report

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1. VERIFICATION OF CONFORMITY

Applicant	HMD Global Oy
Address	Bertel Jungin aukio 9, Espoo 02600 Finland
Manufacturer HMD Global Oy	
Address	Bertel Jungin aukio 9, Espoo 02600 Finland
Factory	Sky Wing Technology Co., Ltd.
Address	Building 2, No. 11, Renmin Road, Huaide Zone, Humen Town, Dongguan, Guangdong Province, China
Product Designation Nokia Clarity Earbuds+	
Brand Name Nokia	
Test Model	TWS-731
Date of test Nov. 09, 2021 to Nov. 12, 2021	
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

John Zeng

John Zeng (Project Engineer)

Dec. 01, 2021

Reviewed By

sin

Calvin Liu (Reviewer)

Dec. 01, 2021

Approved By

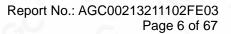
Max Zhang

Max Zhang (Authorized Officer)

Dec. 01, 2021

Any report having not been signed by authorized approver, or having been altered without authorization, or having not been stamped by the "Dedicated Participation" is deemed to be invalid. Copying or excerpting portion of, or altering the content of the report is not permitted without the written authorization of AGE The test results presented in the report apply only to the tested sample. Any objections to report issued by AGC should be submitted to AGC within 15day after the issues of the test report. Further enquiry of validity or verification of the test report should be addressed to AGC by agc@agc~cert.com.

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2. GENERAL INFORMATION

2.1. PRODUCT DESCRIPTION

The EUT is designed as "Nokia Clarity Earbuds+". 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	3.783dBm (Max)
Bluetooth Version	V5.2
Modulation	BR⊠GFSK, EDR⊠π /4-DQPSK, ⊠8DPSK BLE⊡GFSK 1Mbps □GFSK 2Mbps
Number of channels	79 Channels
Hardware Version	T18F_AB1562F_V1.0_20210416
Software Version	V1.5.1
Antenna Designation	FPC Antenna (Comply with requirements of the FCC part 15.203)
Antenna Gain	-2.58dBi
Power Supply	DC 3.7V by battery
Note: The EUT comprises le tested and recorded in this r	eft and right channel headsets, both are the same, the right headset had been

2.2. TABLE OF CARRIER FREQUENCYS

Frequency Band	Channel Number	Frequency
	0	2402 MHz
		2403 MHz
.C		
	38	2440 MHz
2402~2480MHz	39	2441 MHz
	40	2442 MHz
	0	
	77	2479 MHz
• C •	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 of 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: 2AJOT-TWS-731** 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.

3. MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement y \pm U, where expended 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	$U_c = \pm 3.1 \text{ dB}$	
Uncertainty of Radiated Emission below 1GHz	$U_c = \pm 4.0 \text{ dB}$	
Uncertainty of Radiated Emission above 1GHz	$U_c = \pm 4.8 \text{ dB}$	
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	$U_c = \pm 2 \%$	



4. DESCRIPTION OF TEST MODES

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

1562 Lab Test Tool-1.3.10		
		Password:
ма – 👩 👸	2	
	<u></u>	
	RF Freq.(MHz) 2480 💌 🛛 Enable Hopping	
sh	Packet Type DH5 From Channel 0 to 78	
Single Tone	Payload Length 339	
Burst LE BTx	Pattern Type PRBS-9 •	
	GC (0~63) = GC 50 (Default GC = 61)	
Packet LE BRx		
vstal	BD Address: 0x 00006BC6967E	
Crystal Trim		
uch Touch Setting		
	Report GC	
	Stop Execute	
÷	4	
	lu	
.30.335) Ari-01_013_pag :33.709] Tx Burst stopp		
33.709] API-BT_BT3_pac 38.246] Tx Burst succe	cket_tx_stop	
:38.246] API-BT_BT3_pac :01.264] Tx Burst stopp	cket_tx_start	
.01.204] IX burst scopp	cket_tx_stop	
:01.264] API-BT_BT3_pac :05.221] Tx Burst succe		

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Attestation of Global Compliance(Shenzhen)Co., Ltd Attestation of Global Compliance(Shenzhen)Std & Tech Co., Ltd Tel: +86-755 2523 4088 E-mail: agc@agc-cert.com Web: http://cn.agc-cert.com/



5. SYSTEM TEST CONFIGURATION

5.1. CONFIGURATION OF EUT SYSTEM

Radiated Emission Configure:

EUT

Conducted Emission Configure:

	0	
EUT		AE

5.2. EQUIPMENT USED IN TESTED SYSTEM

ltem	Equipment	Model No.	ID or Specification	Remark
16	Nokia Clarity Earbuds+	TWS-731	2AJOT-TWS-731	EUT
2	Control Box	USB-TTL	N/A	AE

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)	5.247 (a)(1) Frequency Separation	
15.207	Conducted Emission	Not applicable

Note: The BT function cannot transmit when charging.



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 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	Aglient	N9010A	MY53470504	Dec. 07, 2020	Dec. 06, 2021
2.4GHz Filter	EM Electronics	2400-2500MHz	N/A	Mar. 23, 2020	Mar. 22, 2022
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
Double-Ridged Waveguide Horn	ETS	3117	00034609	Apr. 23, 2021	Apr. 22, 2023
Preamplifier Assembly	ETS LINDGREN	3117PA	00225134	Sep. 03, 2020	Sep. 02, 2022
WIDEBAND REQUENCY ANTENNA	SCHWARZBECK	VULB9168	VULB9168-49 4	Jan. 08, 2021	Jan. 07, 2023
Test Software	Tonscend	JS32-RE(Ver.2.5)	N/A	N/A	N/A



7. PEAK OUTPUT POWER

7.1. MEASUREMENT PROCEDURE

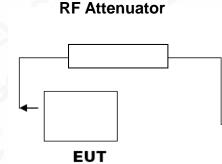
For peak power test:

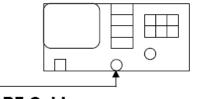
- 1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
- 2. Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
- 3. RBW > 20 dB bandwidth of the emission being measured.
- 4. VBW ≥RBW.
- 5. Sweep: Auto.
- 6. Detector function: Peak.
- 7. Trace: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





Spectrum Analyzer

RF Cable

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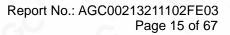
7.3. LIMITS AND MEASUREMENT RESULT

Test Data of Conducted Output Power				
Test Mode	Test Channel (MHz)	Peak Power (dBm)	Limits (dBm)	Pass or Fail
- 6	2402	2.761	≪21	Pass
GFSK	2441	3.319	\$21	Pass
	2480	3.694	\$21	Pass
0	2402	2.742	\$21	Pass
π /4-DQPSK	2441	3.346	\$21	Pass
	2480	3.720	≪21	Pass
8	2402	2.785	≪21	Pass
8DPSK	2441	3.394	\$21	Pass
	2480	3.783	\$21	Pass

Test Graphs of Conducted Output Power

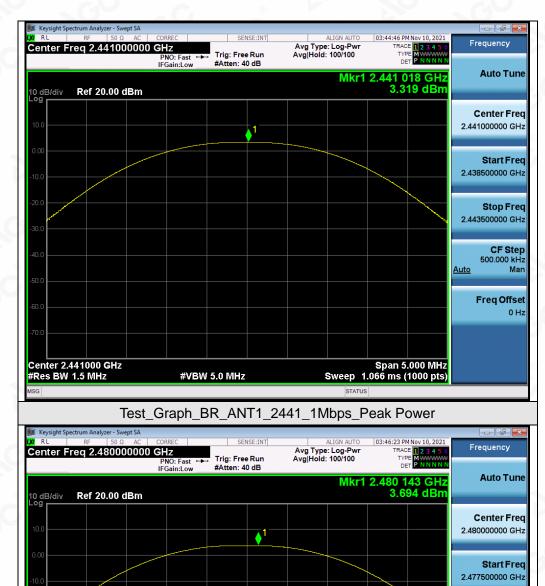


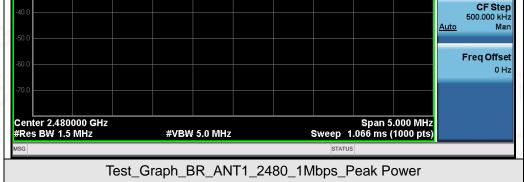
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Stop Freq 2.482500000 GHz

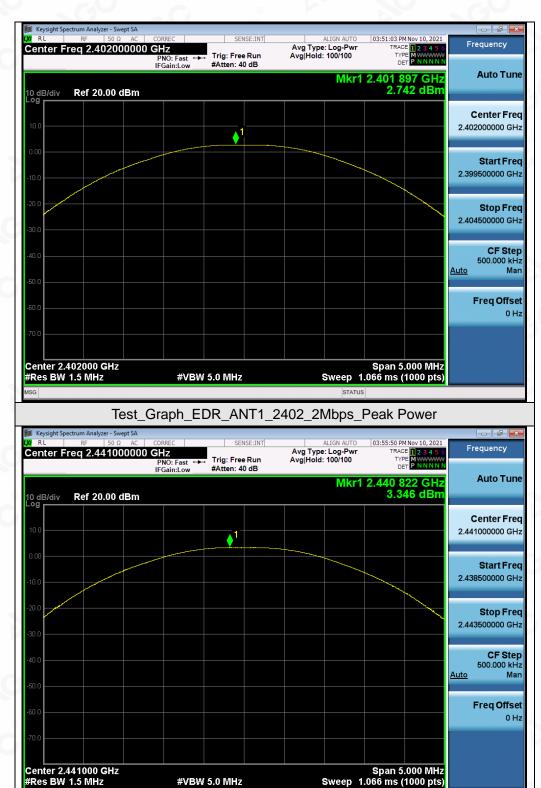




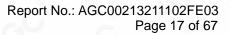


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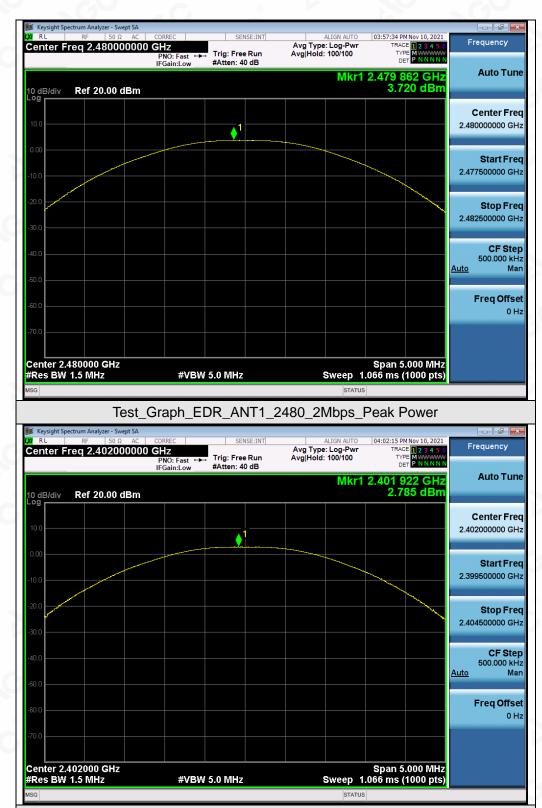




Test_Graph_EDR_ANT1_2441_2Mbps_Peak Power



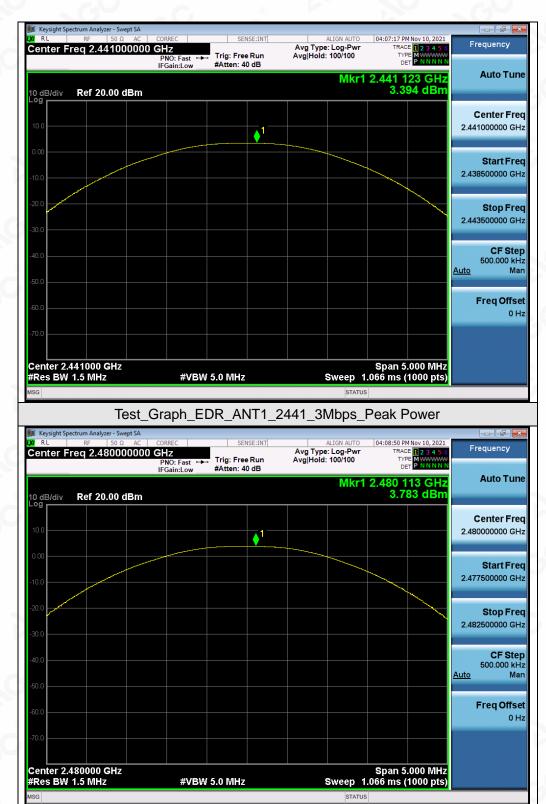




Test_Graph_EDR_ANT1_2402_3Mbps_Peak Power

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Test_Graph_EDR_ANT1_2480_3Mbps_Peak Power

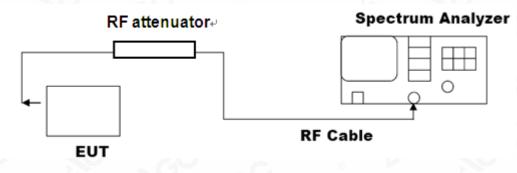


8. 20DB BANDWIDTH

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 hoping 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)



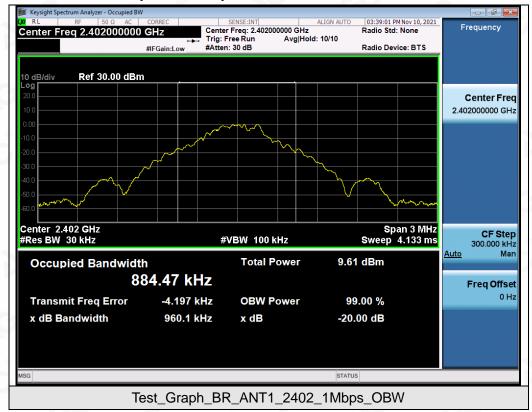
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8.3. LIMITS AND MEASUREMENT RESULTS	
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	Test Data of	Occupied Bandwidt	h and -20dB Bandwi	dth	
Test Mode	Test Channel (MHz)	99% Occupied Bandwidth (MHz)	-20dB Bandwidth (MHz)	Limits	Pass or Fail
GFSK	2402	0.884	0.960	N/A	Pass
	2441	0.885	0.961	N/A	Pass
	2480	0.884	0.959	N/A	Pass
π /4-DQPSK	2402	1.149	1.229	N/A	Pass
	2441	1.149	1.229	N/A	Pass
	2480	1.149	1.229	N/A	Pass
8DPSK	2402	1.153	1.267	N/A	Pass
	2441	1.152	1.268	N/A	Pass
	2480	1.153	1.267	N/A	Pass

Test Graphs of Occupied Bandwidth and -20 Bandwidth





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Test_Graph_BR_ANT1_2441_1Mbps_OBW



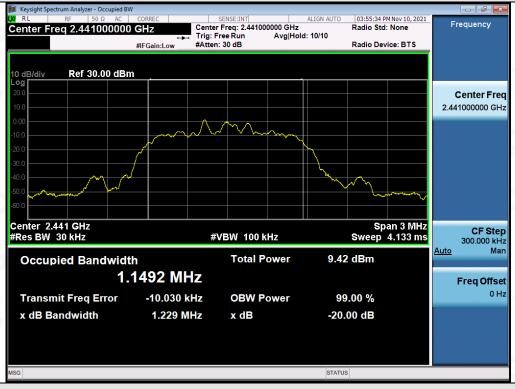
Test_Graph_BR_ANT1_2480_1Mbps_OBW



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Test_Graph_EDR_ANT1_2402_2Mbps_OBW



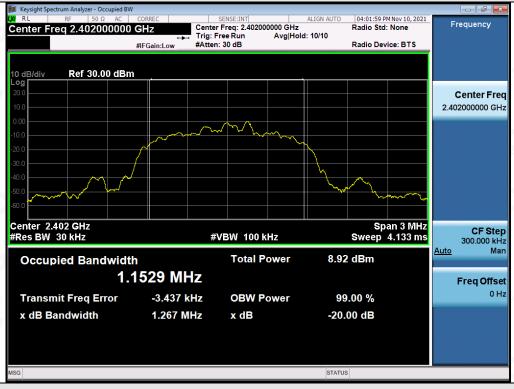
Test_Graph_EDR_ANT1_2441_2Mbps_OBW



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Test_Graph_EDR_ANT1_2480_2Mbps_OBW



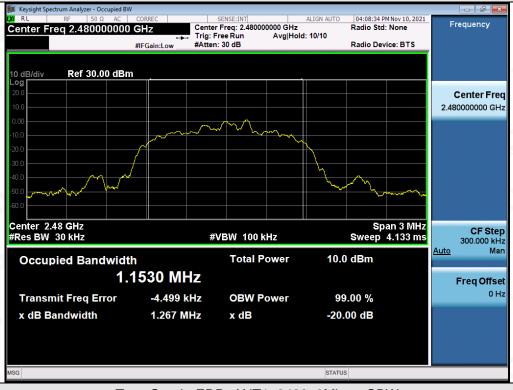
Test_Graph_EDR_ANT1_2402_3Mbps_OBW



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Test_Graph_EDR_ANT1_2441_3Mbps_OBW



Test_Graph_EDR_ANT1_2480_3Mbps_OBW



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.
- 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				
Annlinghia Limita	Measurement Result			
Applicable Limits	Test Data	Criteria		
In any 100 kHz Bandwidth Outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency	At least -20dBc than the limit Specified on the BOTTOM Channel	PASS		
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 TOP Channel	PASS		



Test Graphs of Spurious Emissions in Non-Restricted Frequency Bands

AGC

 Center Freq 1.210000000 GHz Province
 Trig: Free Run Hatten: 30 dB
 Arg Type: Log-Pwr ArgType: Log-Pwr ArgType: Log-Pwr Trace
 Trace
 2.34 Str Tree Run Det Status

 10 dB/dv
 Ref 20.00 dBm
 Status
 Mkr1 2.225 19 GHz Status
 Auto Tune

 10 dB/dv
 Ref 20.00 dBm
 Status
 Status
 Status
 Status

 10 dB/dv
 Ref 20.00 dBm
 Status
 Status
 Status
 Status
 Status

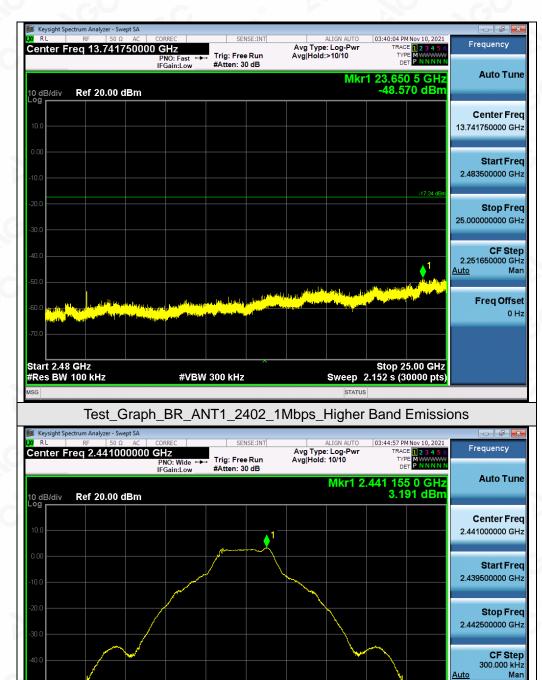
 10 dB/dv
 Ref 20.00 dBm
 Status
 <t

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Freq Offset 0 Hz

Span 3.000 MHz Sweep 2.000 ms (30000 pts)





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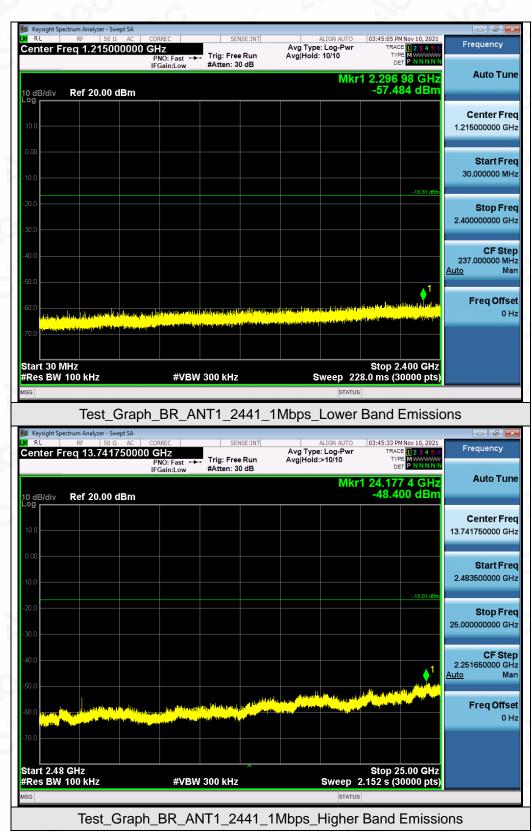
Test_Graph_BR_ANT1_2441_1Mbps_Reference Level

#VBW 300 kHz

Center 2.441000 GHz #Res BW 100 kHz

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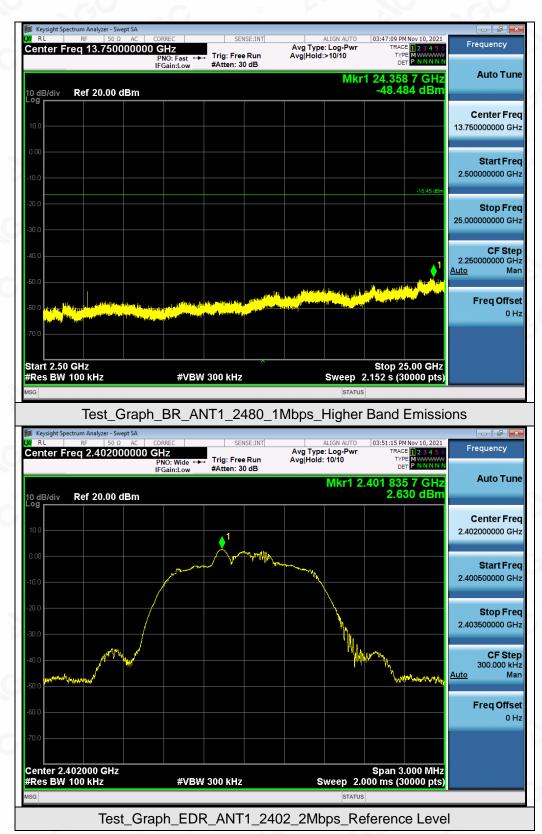






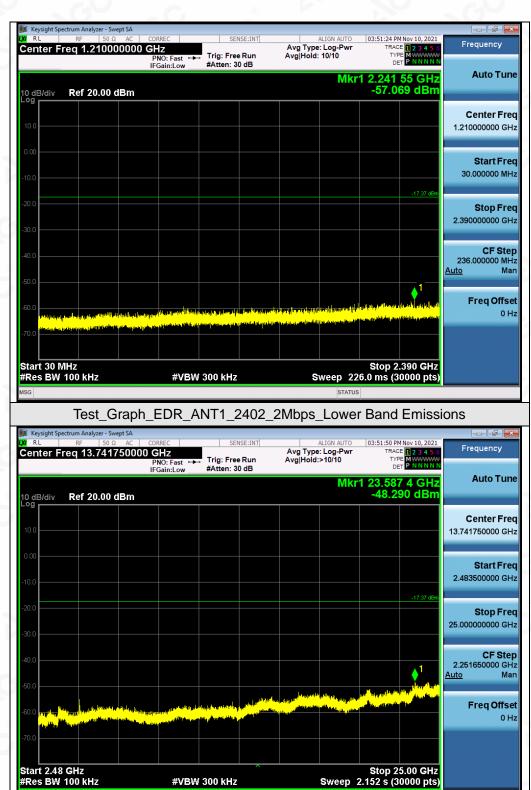
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Test_Graph_EDR_ANT1_2402_2Mbps_Higher Band Emissions





Test_Graph_EDR_ANT1_2441_2Mbps_Lower Band Emissions

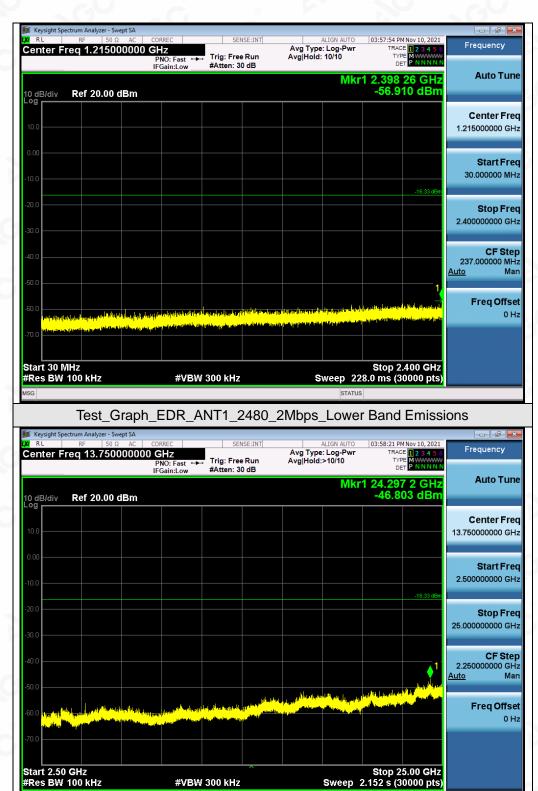
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Test_Graph_EDR_ANT1_2480_2Mbps_Higher Band Emissions

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