

FCC Test Report

Report No.: AGC01284210504FE03

FCC ID : T4KD878UVII

APPLICATION PURPOSE : Original Equipment

PRODUCT DESIGNATION: Digital DMR and Analog UHF/VHF Two Way Radio

BRAND NAME : AnyTone

MODEL NAME

AT-D878UVII PLUS, AT-D878UVII, AT-D878UV V2,

AT-D878UV PLUS V3, AT-D899UV

APPLICANT: Qixiang Electron Science & Technology Co., Ltd.

DATE OF ISSUE : Jul. 06, 2021

STANDARD(S) : FCC Part 15.247

REPORT VERSION : V1.0

Attestation of Global Confine (Shenzhen) Co., Ltd



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REPORT REVISE RECORD

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	® /	Jul. 06, 2021	Valid	Initial Release

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1. VERIFICATION OF CONFORMITY

Qixiang Electron Science & Technology Co., Ltd.
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Digital DMR and Analog UHF/VHF Two Way Radio
AnyTone
AT-D878UVII PLUS
AT-D878UVII, AT-D878UV V2, AT-D878UV PLUS V3, AT-D899UV
All the same except for the model name
May 24, 2021~Jul. 06, 2021
No any deviation from the test method
Normal
Pass
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

Donjon Huang
(Project Engineer)

Reviewed By

Calvin Liu
(Reviewer)

Jul. 06, 2021

Approved By

Forrest Lei
Authorized Officer

Jul. 06, 2021

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2. GENERAL INFORMATION

2.1. PRODUCT DESCRIPTION

The EUT is designed as "Digital DMR and Analog UHF/VHF Two Way Radio". 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

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Operation Frequency	2.402 GHz to 2.480 GHz		
RF Output Power	3.200dBm (Max)		
Bluetooth Version	V4.2		
Modulation	BR ⊠GFSK, EDR ⊠π /4-DQPSK, ⊠8DPSK BLE □GFSK 1Mbps □GFSK 2Mbps		
Number of channels	79		
Hardware Version	V2.00		
Software Version	V1.0		
Antenna Designation	PIFA Antenna (Comply with requirements of the FCC part 15.203)		
Antenna Gain	1.5dBi		
Power Supply	DC 7.4V,3100mAh by battery		

2.2. TABLE OF CARRIER FREQUENCYS

Frequency Band	Channel Number	Frequency
8	0	2402 MHz
	9 1	2403 MHz
	38	2440 MHz
2402~2480MHz	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 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.

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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: T4KD878UVII** 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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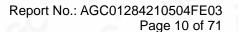
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3. MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement y ±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 = ±2 %	
Uncertainty of Occupied Channel Bandwidth	U _c = ±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 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.
- 4. The test software is bluetool_1.9.3.4_setup, EUT can be set to a separate test mode.

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5. SYSTEM TEST CONFIGURATION

5.1. CONFIGURATION OF EUT SYSTEM

Radiated Emission Configure:



Conducted Emission Configure:

EUT	AE
-----	----

5.2. EQUIPMENT USED IN TESTED SYSTEM

Item	Equipment	Model No.	ID or Specification	Remark
1	Digital DMR and Analog UHF/VHF Two Way Radio	AT-D878UVII PLUS	T4KD878UVII	EUT
2	Adapter	SAW12-120-1000UD	Input: AC 100-240V,50/60HZ, 0.3A Output: DC 12V,1A	AE
3	Charger	QBC-45L	Input: DC 12V 1A Output: 8.4V,01A	AE
_4	Battery	QB-44HL	DC 7.4V 3100mAh	AE
5	Back clip	N/A	N/A	AE
6	Antenna	QA-11UV	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)	Frequency Separation	Compliant
15.207	Conducted Emission	Compliant

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6. TEST FACILITY

Test Site	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			

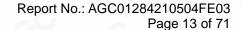
TEST EQUIPMENT OF CONDUCTED EMISSION TEST

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Due
TEST RECEIVER	R&S	ESPI	101206	May 11, 2021	May 10, 2022
LISN	R&S	ESH2-Z5	100086	Jul. 03,2020	Jul. 02, 2021
LISN	R&S	ESH2-Z5	100086	Jul. 01, 2021	Jun. 30, 2022
Test software	R&S	ES-K1(Ver.V1.71)	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	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	BBHA 9170	#768	Sep. 21, 2019	Sep. 20, 2021
Active loop antenna (9K-30MHz)	ZHINAN	ZN30900C	18051	May 22, 2020	May 21, 2022
Double-Ridged Waveguide Horn	ETS LINDGREN	3117	00034609	Apr. 23, 2021	Apr. 22, 2023
Broadband Preamplifier	ETS LINDGREN	3117PA	00225134	Sep. 03, 2020	Sep. 02, 2022
ANTENNA	SCHWARZBECK	VULB9168	494	Jan. 08, 2021	Jan. 07, 2023
Test software	Tonscend	JS32-RE (Ver.2.5)	N/A	N/A	N/A

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7. PEAK OUTPUT POWER

7.1. MEASUREMENT PROCEDURE

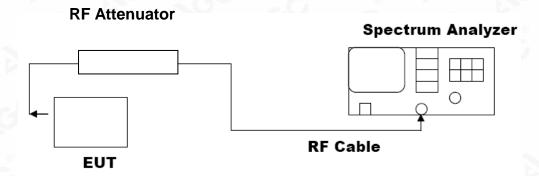
For peak power test:

- 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 ≥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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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	
-C	2402	1.520	≤21	Pass	
GFSK	2441	2.571	≤21	Pass	
	2480	3.200	≤21	Pass	
π /4-DQPSK	2402	1.016	≤21	Pass	
	2441	2.046	≤21	Pass	
	2480	2.551	≤21	Pass	
8DPSK	2402	1.102	≤21	Pass	
	2441	2.225	≤21	Pass	
	2480	2.769	≤21	Pass	

Test Graphs of Conducted Output Power



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Test_Graph_BR_ANT1_2441_1Mbps_Peak Power



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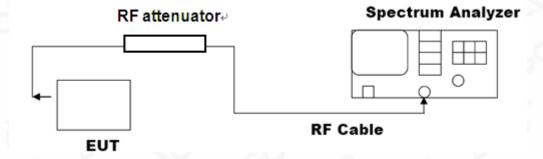


8. 20DB BANDWIDTH

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 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)



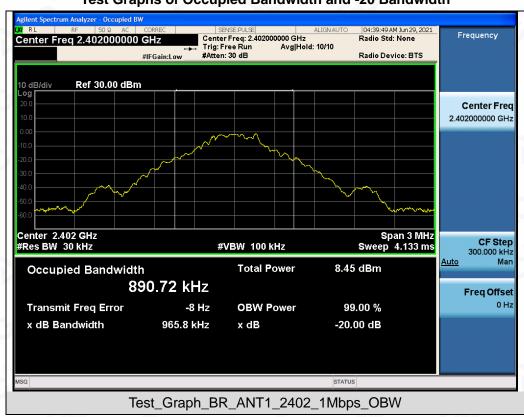
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8.3. LIMITS AND MEASUREMENT RESULTS

Test Data of Occupied Bandwidth and -20dB Bandwidth					
Test Mode	Test Channel (MHz)	99% Occupied Bandwidth (MHz)	-20dB Bandwidth (MHz)	Limits	Pass or Fail
-G	2402	0.891	0.966	N/A	Pass
GFSK	2441	0.894	1.028	N/A	Pass
	2480	0.897	0.965	N/A	Pass
π /4-DQPSK	2402	1.199	1.311	N/A	Pass
	2441	1.188	1.311	N/A	Pass
	2480	1.178	1.286	N/A	Pass
8DPSK	2402	1.212	1.294	N/A	Pass
	2441	1.202	1.294	N/A	Pass
	2480	1.189	1.292	N/A	Pass

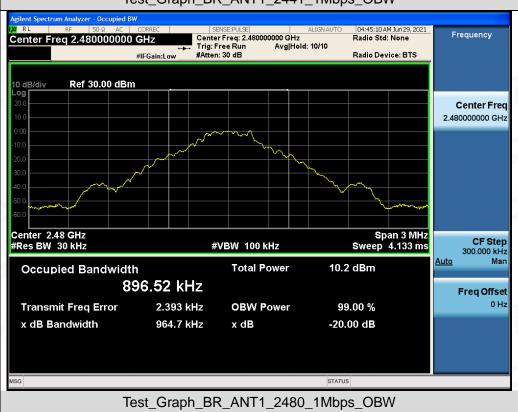
Test Graphs of Occupied Bandwidth and -20 Bandwidth



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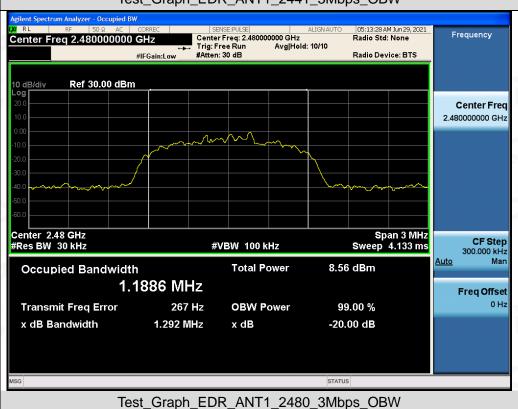




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Report No.: AGC01284210504FE03

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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					
Amuliachia 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			

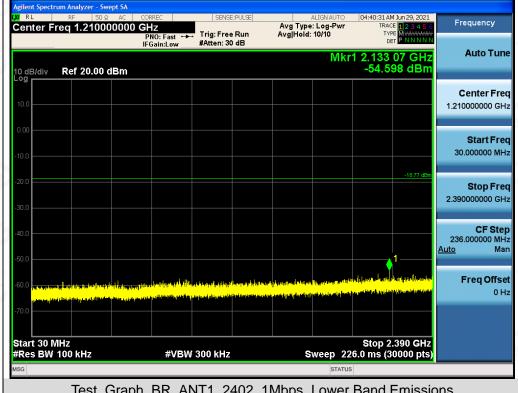
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Test Graphs of Spurious Emissions in Non-Restricted Frequency Bands



Test_Graph_BR_ANT1_2402_1Mbps_Reference Level



Test_Graph_BR_ANT1_2402_1Mbps_Lower Band Emissions

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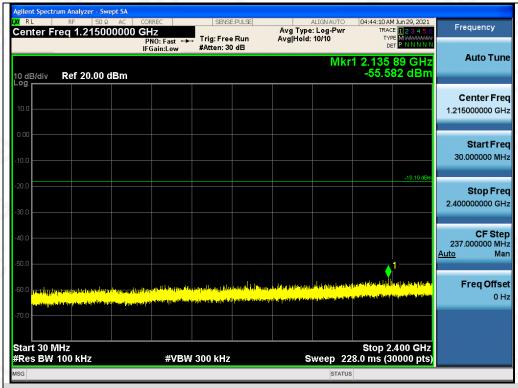


Test_Graph_BR_ANT1_2402_1Mbps_Higher Band Emissions

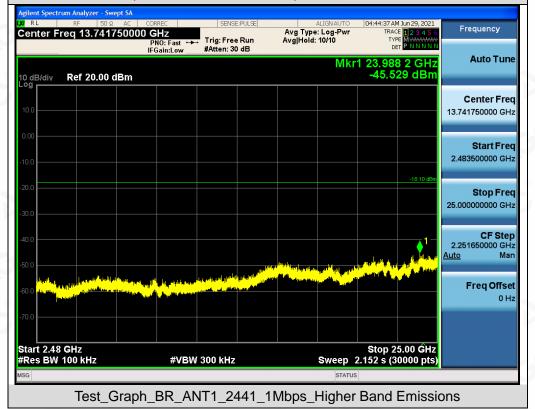


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Test_Graph_BR_ANT1_2441_1Mbps_Lower Band Emissions

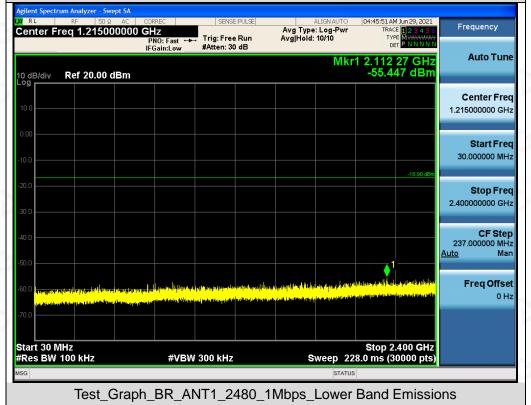


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Test_Graph_BR_ANT1_2480_1Mbps_Reference Level



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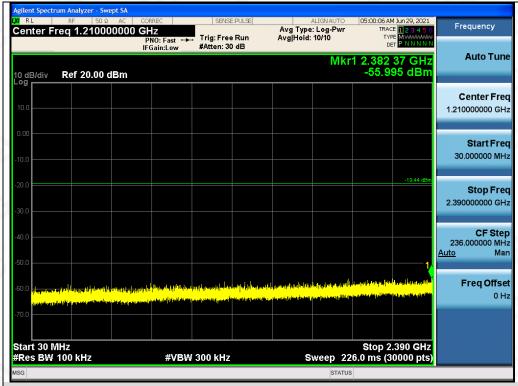


Test_Graph_BR_ANT1_2480_1Mbps_Higher Band Emissions

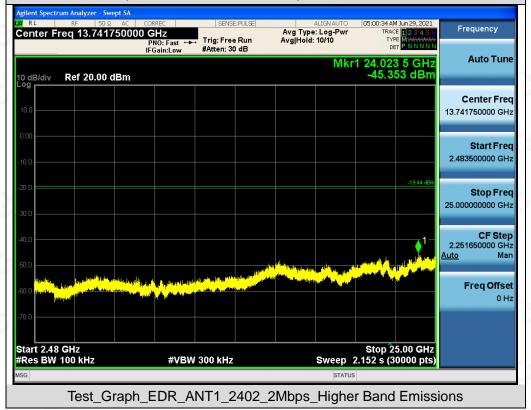


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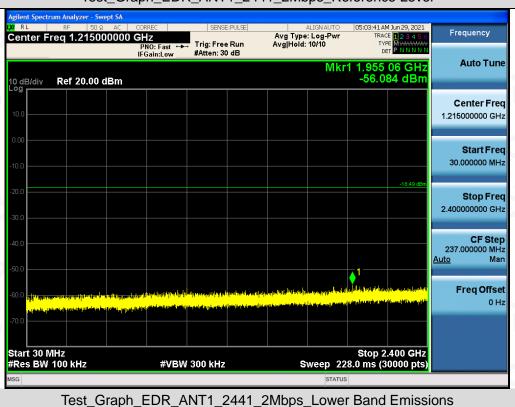
Test_Graph_EDR_ANT1_2402_2Mbps_Lower Band Emissions



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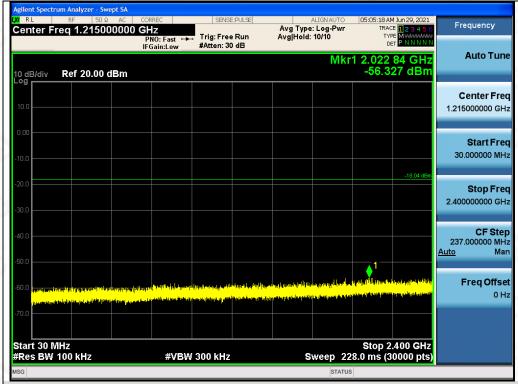


Test_Graph_EDR_ANT1_2441_2Mbps_Higher Band Emissions

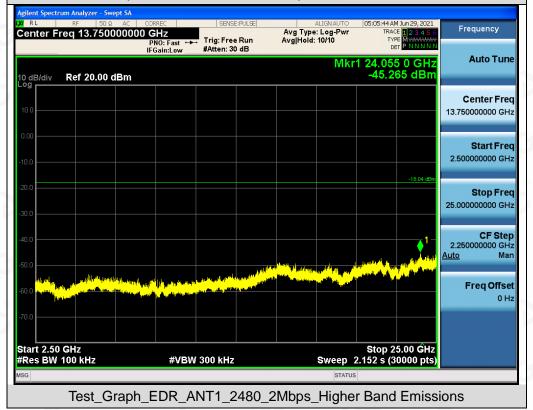


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Test_Graph_EDR_ANT1_2480_2Mbps_Lower Band Emissions

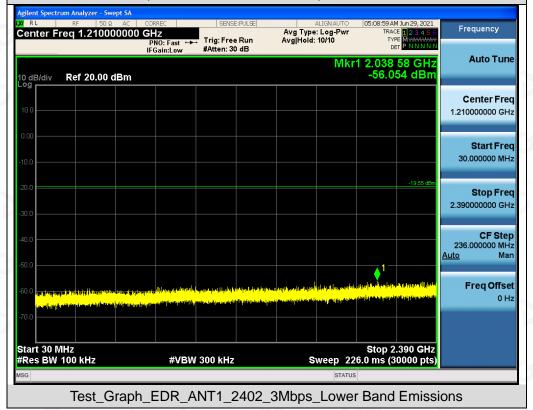


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Test_Graph_EDR_ANT1_2402_3Mbps_Reference Level



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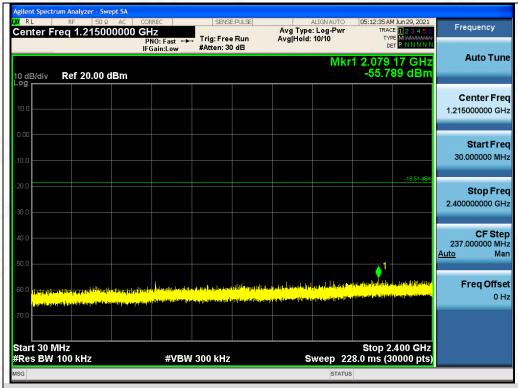


Test_Graph_EDR_ANT1_2402_3Mbps_Higher Band Emissions



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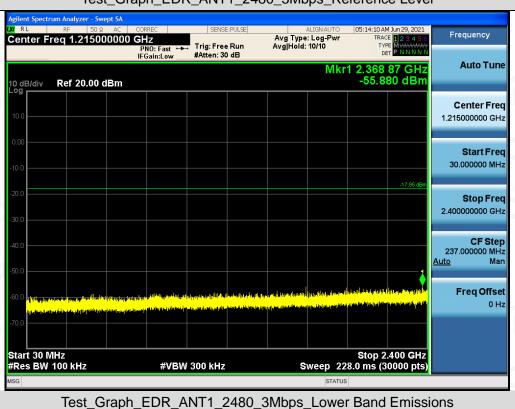
Test_Graph_EDR_ANT1_2441_3Mbps_Lower Band Emissions



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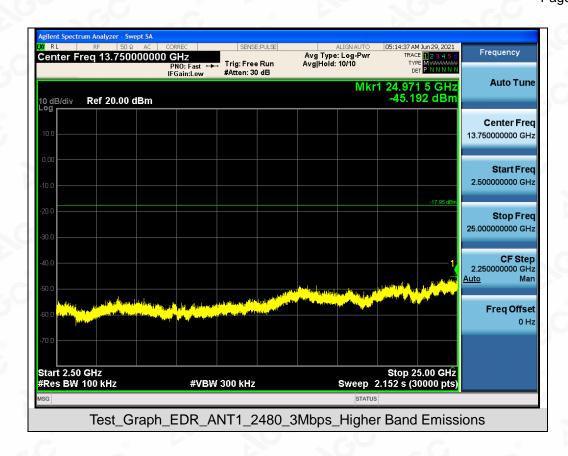




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g/Inspection
The test results
the test report.

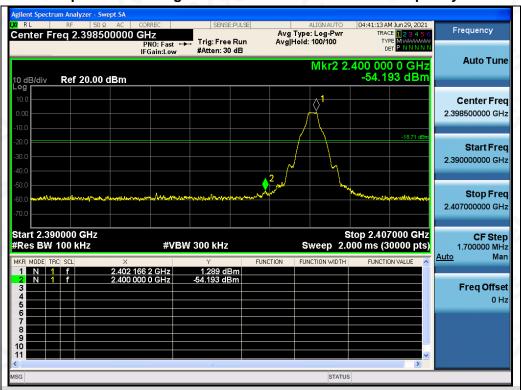




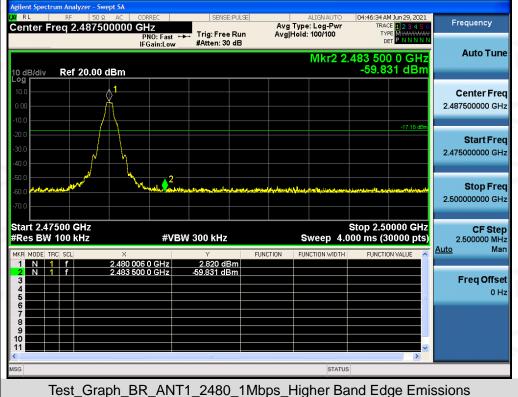
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Test Graphs of Band Edge Emissions in Non-Restricted Frequency Bands



Test_Graph_BR_ANT1_2402_1Mbps_Lower Band Edge Emissions

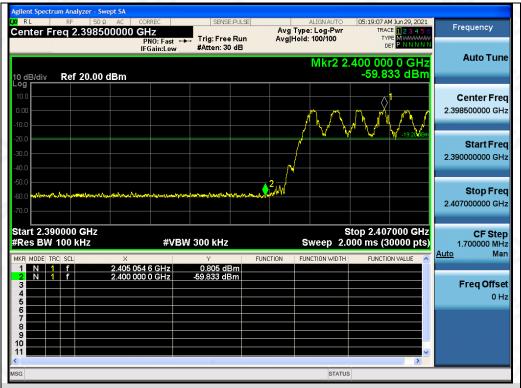


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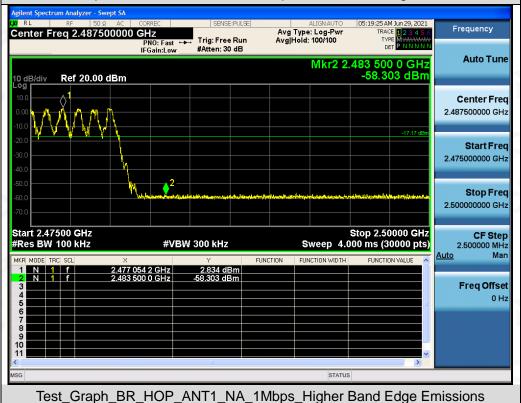
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The test results





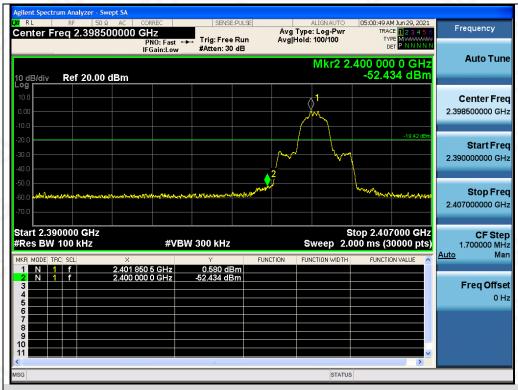
Test_Graph_BR_HOP_ANT1_NA_1Mbps_Lower Band Edge Emissions



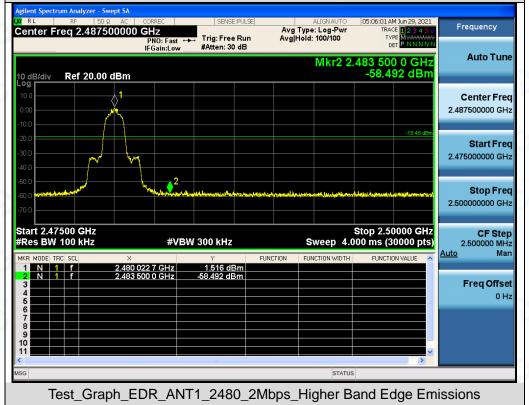
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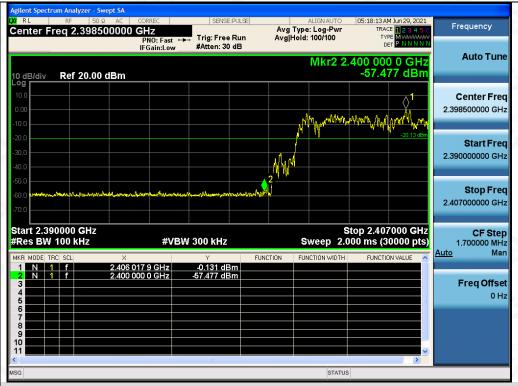
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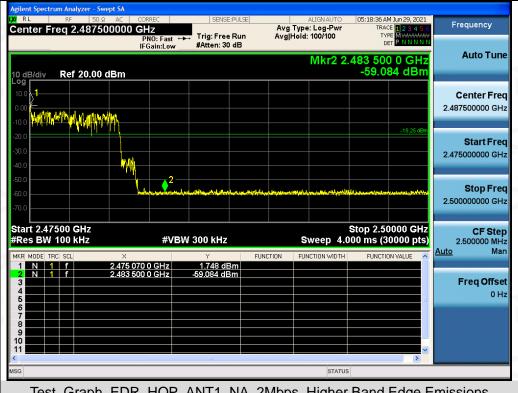
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The test results





Test_Graph_EDR_HOP_ANT1_NA_2Mbps_Lower Band Edge Emissions



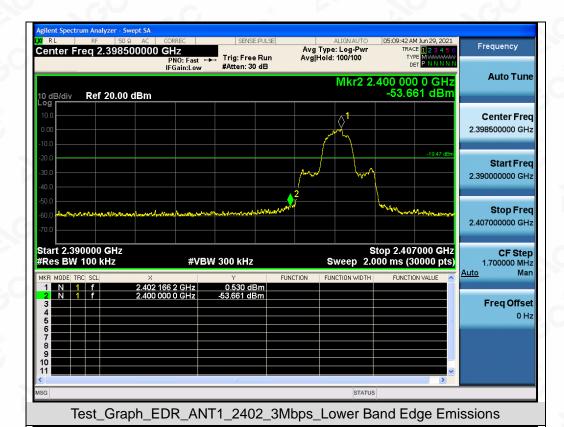
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Frequency Avg Type: Log-Pw Avg|Hold: 100/100 Center Freq 2.487500000 GHz Trig: Free Run #Atten: 30 dB **Auto Tune** Mkr2 2.483 500 0 GH: -58.687 dBm Ref 20.00 dBm Center Frea 2.487500000 GHz 2.475000000 GHz Stop Freq 2.500000000 GHz Start 2.47500 GHz #Res BW 100 kHz Stop 2.50000 GHz Sweep 4.000 ms (30000 pts) **CF Step** 2.500000 MHz **#VBW** 300 kHz Auto FUNCTION FUNCTION WIDTH Freq Offset

Test_Graph_EDR_ANT1_2480_3Mbps_Higher Band Edge Emissions

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