

ATC

TEST REPORT

Applicant Name : AudioCodes Ltd.
Address : 1 Hayarden Street, Airport City, Lod. Israel
Report Number : SZ6210924-49813E-RF-00A
FCC ID: XAK455HDB

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type: IP Phone 455HD
Model No.: C455HD
Multiple Model(s) No.: N/A
Trade Mark: Audiocodes
Date Received: 2021/09/24
Date of Test: 2021/10/27~2021/11/26
Report Date: 2021/12/01

Test Result:	Pass*
--------------	-------

* In the configuration tested, the EUT complied with the standards above.

Prepared and Checked By:

Ting Lv
EMC Engineer

Approved By:

Candy Li
EMC Engineer

Note: This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk “*”.

Shenzhen Accurate Technology Co., Ltd. is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with an asterisk “**”. Customer model name, addresses, names, trademarks etc. are not considered data.

This report cannot be reproduced except in full, without prior written approval of the Company. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested. This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

Shenzhen Accurate Technology Co., Ltd.

1/F., Building A, Changyuan New Material Port, Science & Industry Park, Nanshan District, Shenzhen, Guangdong, P.R. China
Tel: +86 755-26503290 Fax: +86 755-26503396 Web: www.atc-lab.com

TABLE OF CONTENTS

GENERAL INFORMATION.....	4
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT).....	4
OBJECTIVE	4
TEST METHODOLOGY	4
MEASUREMENT UNCERTAINTY.....	5
TEST FACILITY.....	5
SYSTEM TEST CONFIGURATION.....	6
DESCRIPTION OF TEST CONFIGURATION	6
EUT EXERCISE SOFTWARE	6
SPECIAL ACCESSORIES.....	6
EQUIPMENT MODIFICATIONS	6
SUMMARY OF TEST RESULTS	10
TEST EQUIPMENT LIST	11
FCC §15.247 (I) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE).....	13
APPLICABLE STANDARD	13
RESULT	13
FCC §15.203 – ANTENNA REQUIREMENT.....	15
APPLICABLE STANDARD	15
ANTENNA CONNECTOR CONSTRUCTION	15
FCC §15.207 (A) – AC LINE CONDUCTED EMISSIONS	16
APPLICABLE STANDARD	16
EUT SETUP	16
EMI TEST RECEIVER SETUP.....	16
TEST PROCEDURE	16
TRANSD FACTOR & MARGIN CALCULATION.....	17
TEST DATA	17
FCC §15.205, §15.209 & §15.247(D) – RADIATED EMISSIONS	22
APPLICABLE STANDARD	22
EUT SETUP	22
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP	23
TEST PROCEDURE	23
CORRECTED FACTOR & MARGIN CALCULATION	23
TEST DATA	23
FCC §15.247(A) (1)-CHANNEL SEPARATION TEST	29
APPLICABLE STANDARD	29
TEST PROCEDURE	29
TEST DATA	29
FCC §15.247(A) (1) – 20 DB EMISSION BANDWIDTH	30
APPLICABLE STANDARD	30
TEST PROCEDURE	30
TEST DATA	31

FCC §15.247(A) (1) (III)-QUANTITY OF HOPPING CHANNEL TEST.....	32
APPLICABLE STANDARD	32
TEST PROCEDURE	32
TEST DATA	32
FCC §15.247(A) (1) (III) - TIME OF OCCUPANCY (DWELL TIME).....	33
APPLICABLE STANDARD	33
TEST PROCEDURE	33
TEST DATA	33
FCC §15.247(B) (1) - PEAK OUTPUT POWER MEASUREMENT	34
APPLICABLE STANDARD	34
TEST PROCEDURE	34
TEST DATA	34
FCC §15.247(D) - BAND EDGES TESTING.....	35
APPLICABLE STANDARD	35
TEST PROCEDURE	35
TEST DATA	35
APPENDIX	36
APPENDIX A: 20dB EMISSION BANDWIDTH.....	36
APPENDIX B: OCCUPIED CHANNEL BANDWIDTH	40
APPENDIX C: MAXIMUM CONDUCTED PEAK OUTPUT POWER.....	44
APPENDIX D: CARRIER FREQUENCY SEPARATION	48
APPENDIX E: TIME OF OCCUPANCY	50
APPENDIX F: NUMBER OF HOPPING CHANNELS	57
APPENDIX G: BAND EDGE MEASUREMENTS	59

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Frequency Range	Bluetooth: 2402~2480MHz
Maximum conducted Peak output power	Bluetooth: 8.28dBm
Modulation Technique	Bluetooth: GFSK, $\pi/4$ -DQPSK, 8DPSK
Antenna Specification*	2.5dBi (provided by the applicant)
Voltage Range	DC 12V from Adapter or DC48V from POE
Sample serial number	SZ6210924-49813E-RF-S1 (Assigned by ATC)
Sample/EUT Status	Good condition
Adapter information	Model: RD1202000-C55-29MG Input: AC 100-240V, 50/60Hz, 0.6A Output: DC12.0V, 2.0A

Objective

This test report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

All emissions measurement was performed at Shenzhen Accurate Technology Co., Ltd. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Parameter	Uncertainty	
Occupied Channel Bandwidth	5%	
RF Frequency	$0.082*10^{-7}$	
RF output power, conducted	0.73dB	
Unwanted Emission, conducted	1.6dB	
AC Power Lines Conducted Emissions	2.72dB	
Emissions, Radiated	9kHz - 30MHz	2.66dB
	30MHz - 1GHz	4.28dB
	1GHz - 18GHz	4.98dB
	18GHz - 26.5GHz	5.06dB
	26.5GHz - 40GHz	4.72dB
Temperature	1°C	
Humidity	6%	
Supply voltages	0.4%	

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The test site used by Shenzhen Accurate Technology Co., Ltd. to collect test data is located on the 1/F., Building A, Changyuan New Material Port, Science & Industry Park, Nanshan District, Shenzhen, Guangdong, P.R. China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 708358, the FCC Designation No.: CN1189. Accredited by American Association for Laboratory Accreditation (A2LA) The Certificate Number is 429 7.01.

Listed by Innovation, Science and Economic Development Canada (ISED), the Registration Number is 5077A.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in an engineering mode.

EUT Exercise Software

“secucrcrt.exe *” software was used to test, which provided by manufacturer.

The device was tested with the Power level is 27*.

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

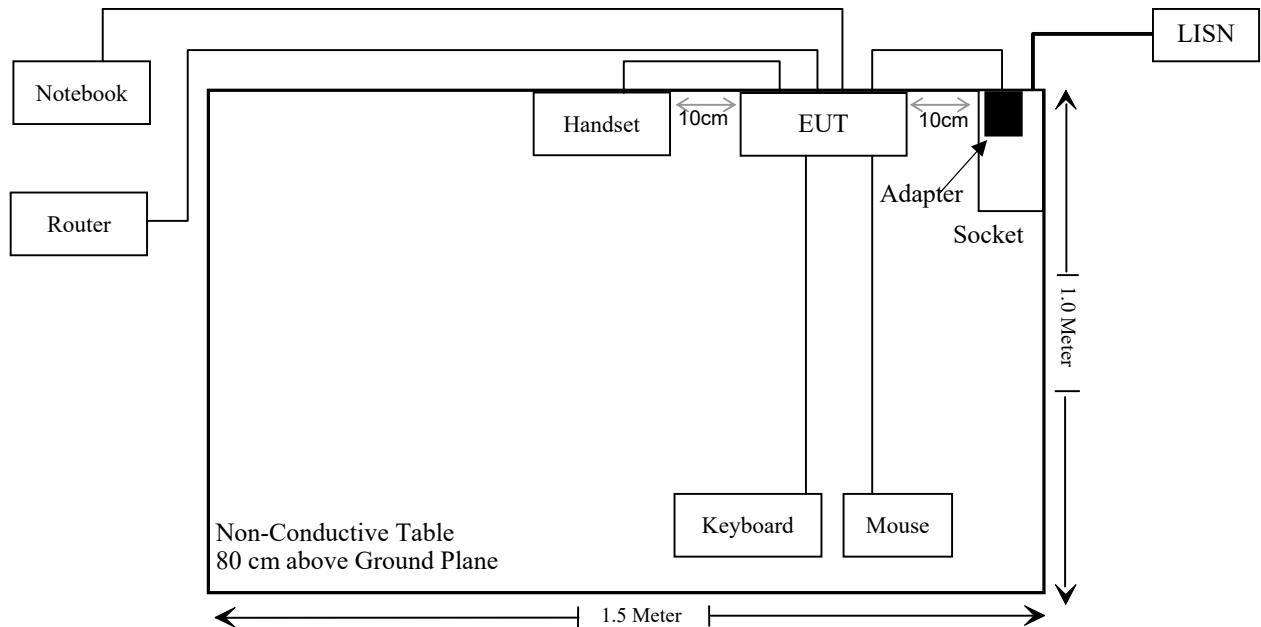
Manufacturer	Description	Model	Serial Number
DELL	NoteBook	Latitude E4710	PC201911252059
HUAWEI	Router	WS5100	A4933FEF1D01
LUOJI	mouse	MS111-L	CN-09RRC7-48729-38F-0H8S
DELL	Keyboard	KB212-B	0K6KPN
GOSPELL	POE	G0720-480-050	212701319

External I/O Cable

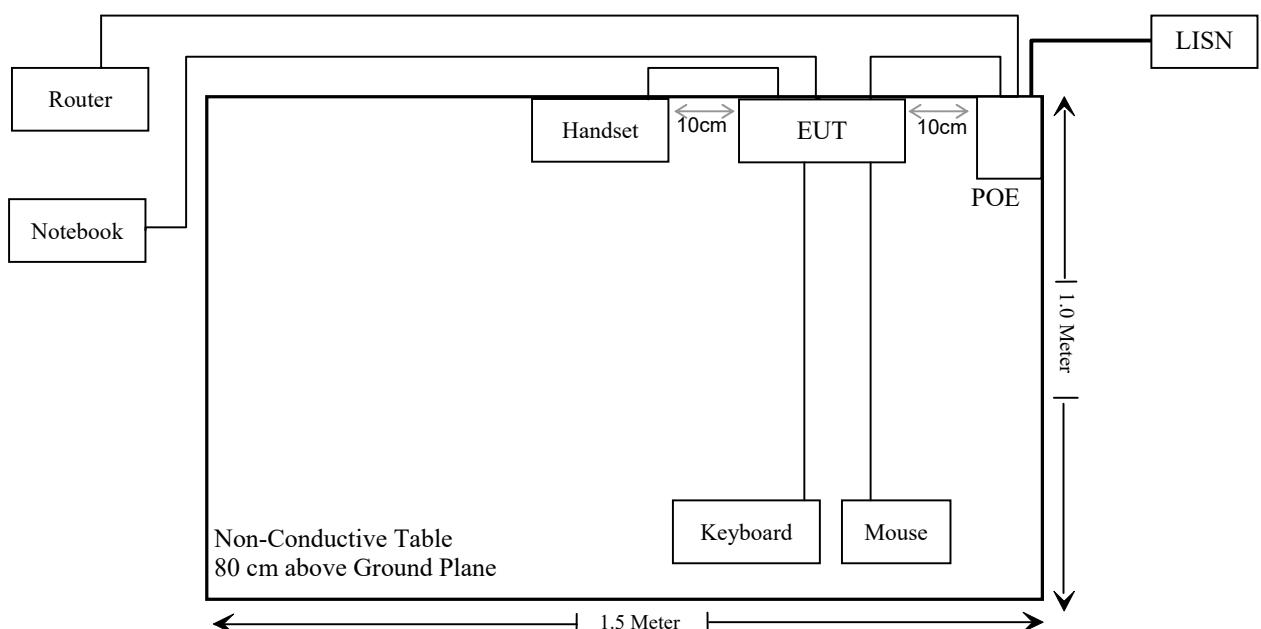
Cable Description	Length (m)	From/Port	To
Un-shielding Detachable DC Cable	1.2	EUT	Adapter
Un-shielded detachable RJ45 Cable	8.0	EUT	NoteBook
Un-shielded detachable RJ45 Cable	8.0	EUT	Router
Un-shielded detachable RJ45 Cable	8.0	Router	POE
Un-shielded detachable RJ45 Cable	0.8	EUT	POE
Un-shielded detachable USB Cable	1.5	EUT	Keyboard
Un-shielded detachable USB Cable	1.5	EUT	Mouse

Block Diagram of Test Setup

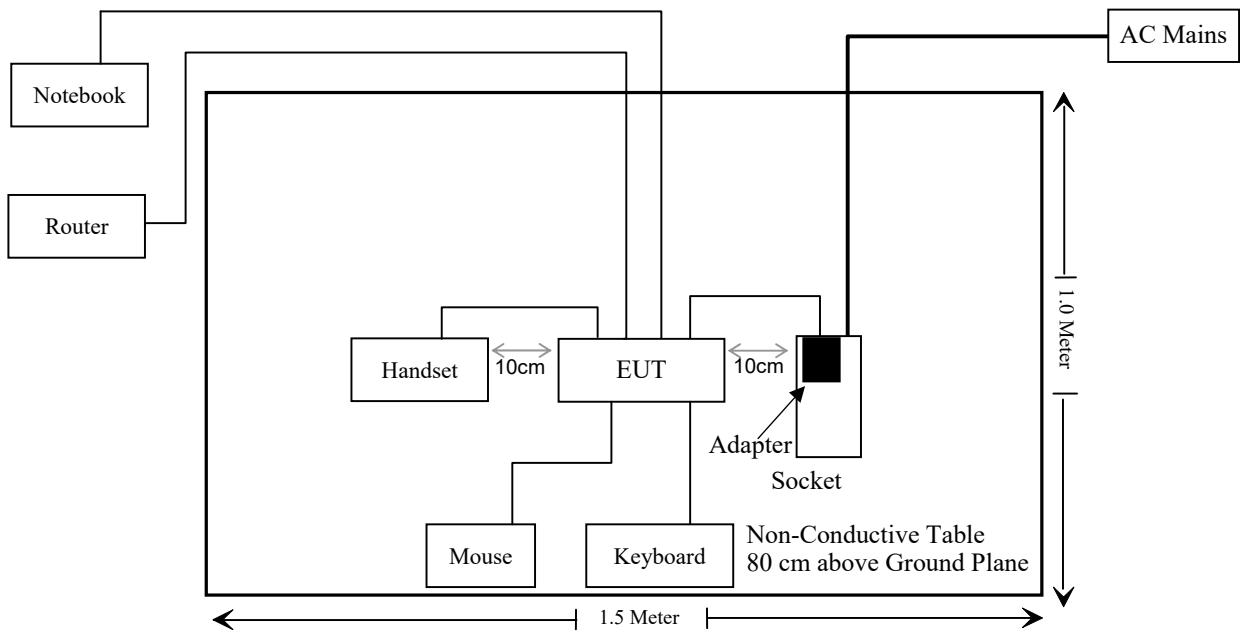
For conducted emission: (Adapter)



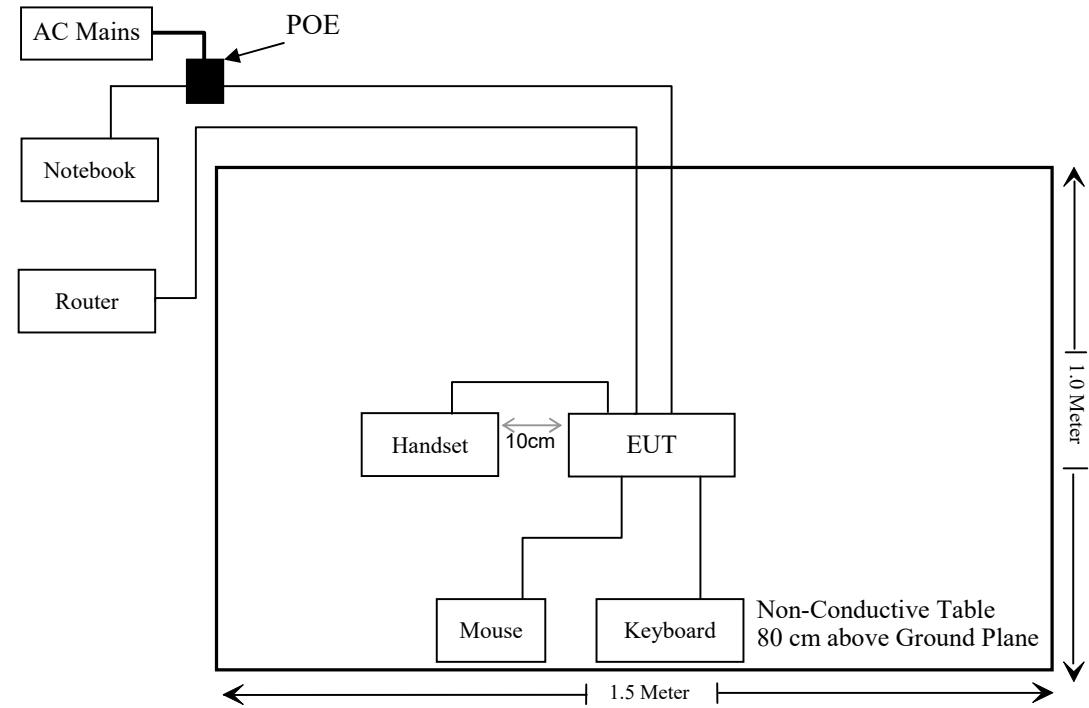
For conducted emission: (POE)



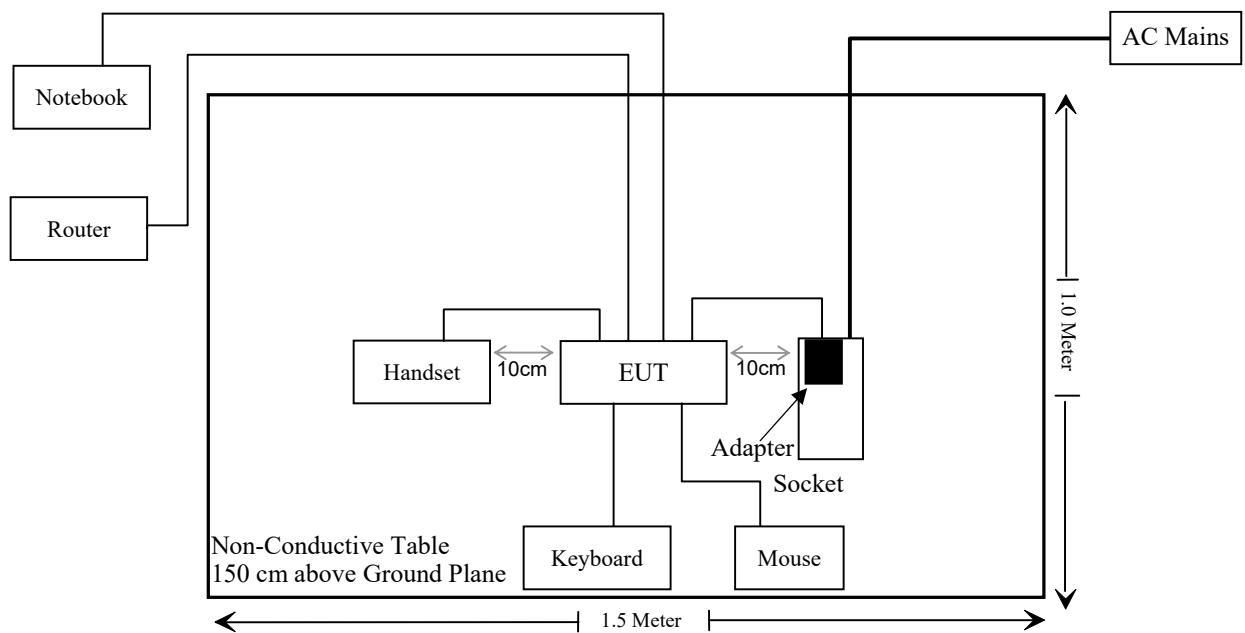
For radiated emission: (below 1GHz-Adapter)



For radiated emission: (below 1GHz-POE)



For radiated emission: (above 1GHz)



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
FCC §15.247 (i) & §2.1091	Maximum Permissible Exposure (MPE)	Compliant
§15.203	Antenna Requirement	Compliance
§15.207(a)	AC Line Conducted Emissions	Compliance
§15.205, §15.209 & §15.247(d)	Radiated Emissions	Compliance
§15.247(a)(1)	20 dB Emission Bandwidth	Compliance
§15.247(a)(1)	Channel Separation Test	Compliance
§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Compliance
§15.247(a)(1)(iii)	Quantity of hopping channel Test	Compliance
§15.247(b)(1)	Peak Output Power Measurement	Compliance
§15.247(d)	Band edges	Compliance

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde& Schwarz	Test Receiver	ESPI3	100396	2020/12/24	2021/12/23
R & S	L.I.S.N.	ENV216	101314	2020/12/25	2021/12/24
Anritsu Corp	50ΩCoaxial Switch	MP59B	6200506474	2020/12/25	2021/12/24
Unknown	RF Coaxial Cable	N-2m	No.2	2020/12/25	2021/12/24
Conducted Emission Test Software: e3 19821b (V9)					
Radiated Emissions Test					
Rohde& Schwarz	Test Receiver	ESR	101817	2020/12/24	2021/12/23
Rohde&Schwarz	Spectrum Analyzer	FSV40	101495	2020/12/24	2021/12/23
SONOMA INSTRUMENT	Amplifier	310 N	186131	2020/12/25	2021/12/24
A.H. Systems, inc.	Preamplifier	PAM-0118P	531	2021/07/08	2022/07/07
Anritsu Corp	50 Coaxial Switch	MP59B	6100237248	2020/12/25	2021/12/24
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2020/11/28	2021/11/27
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2020/01/05	2023/01/04
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	2020/01/05	2023/01/04
Schwarzbeck	HORN ANTENNA	BBHA9170	9170-359	2020/01/05	2023/01/04
Unknown	RF Coaxial Cable	N-5m	No.3	2020/12/25	2021/12/24
Unknown	RF Coaxial Cable	N-5m	No.4	2020/12/25	2021/12/24
Unknown	RF Coaxial Cable	N-1m	No.5	2020/12/25	2021/12/24
Unknown	RF Coaxial Cable	N-1m	No.6	2020/12/25	2021/12/24
Wainwright	High Pass Filter	WHKX3.6/18 G-10SS	5	2020/12/25	2021/12/24
Radiated Emission Test Software: e3 19821b (V9)					

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Rohde & Schwarz	Spectrum Analyzer	FSV-40	101495	2020/12/24	2021/12/23
Tonscend	RF Control Unit	JS0806-2	19G8060182	2021/07/06	2022/07/05

*** Statement of Traceability:** Shenzhen Accurate Technology Co., Ltd. attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC §15.247 (i) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (Minutes)
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f ²)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

Result

Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm²)

P = power input to the antenna (in appropriate units, e.g., mW).

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

Mode	Frequency (MHz)	Antenna Gain		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
BT	2402-2480	2.5	1.78	8.5	7.08	20	0.0025	1
BLE	2402-2480	2.5	1.78	1.0	1.26	20	0.0004	1
2.4GHz Wi-Fi	2412-2462	2.5	1.78	19.5	89.13	20	0.0316	1
5GHz Wi-Fi	5150-5250	3.52	2.25	13.5	22.39	20	0.0100	1
	5250-5350	3.03	2.01	14.0	25.12	20	0.0101	1
	5470-5725	2.59	1.82	14.0	25.12	20	0.0091	1
	5725-5850	1.97	1.57	13.0	19.95	20	0.0062	1

Note: The 2.4G Wi-Fi/BT/BLE can't transmit with the 5G Wi-Fi at the same time, but 2.4G Wi-Fi can transmit with BT/BLE simultaneously.

Simultaneous transmitting consideration (worst case):

The ratio=MPE_{2.4G Wi-Fi}/limit+MPE_{BT}/limit=0.0316/1+0.0025/1=0.0341<1.0

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: Compliance

FCC §15.203 – ANTENNA REQUIREMENT

Applicable Standard

According to FCC § 15.203, 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 shall be considered sufficient to comply with the provisions of this Section. 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.

Antenna Connector Construction

The EUT has one internal Antenna arrangement, which was permanently attached and the antenna gain is 2.5dBi, fulfill the requirement of this section. Please refer to the EUT photos.

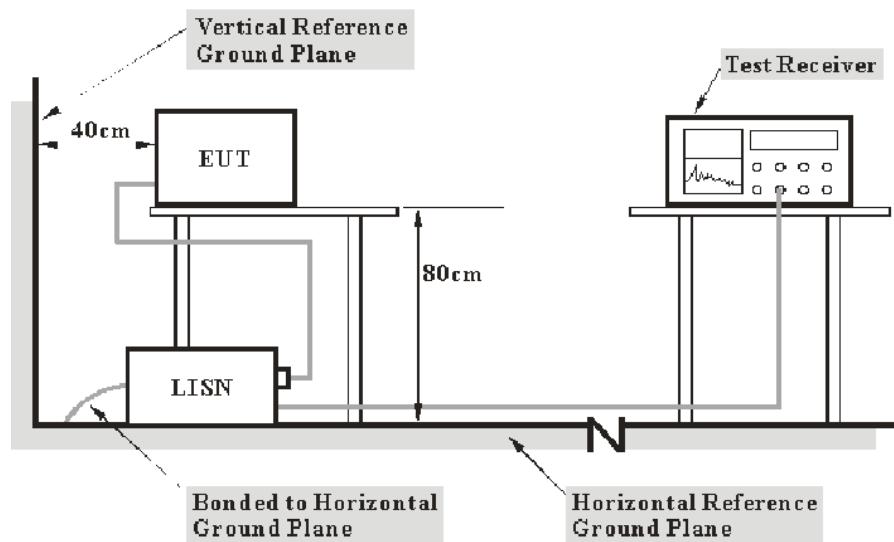
Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207(a)

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The measurement procedure of EUT setup is according with ANSI C63.10-2013. The related limit was specified in FCC Part 15.207.

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

Transd Factor & Margin Calculation

The Transd factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss. The basic equation is as follows:

$$\text{Transd Factor} = \text{LISN VDF} + \text{Cable Loss}$$

The “Over Limit” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a over limit of -7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

$$\text{Over Limit} = \text{Result} - \text{Limit}$$

$$\text{Result} = \text{reading level} + \text{Transd Factor}$$

Test Data

Environmental Conditions

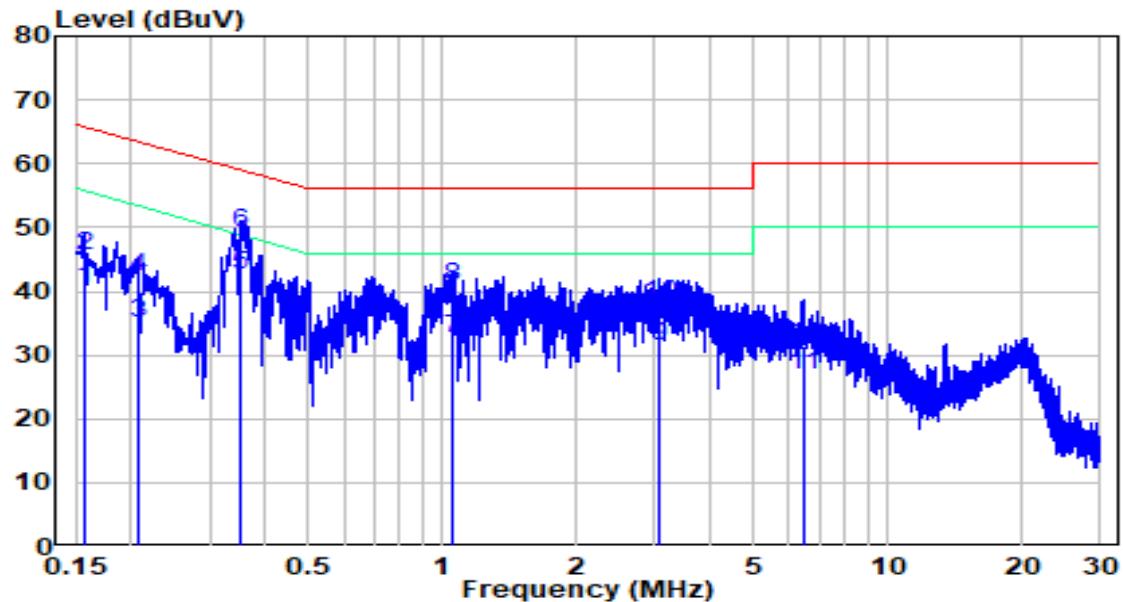
Temperature:	25°C
Relative Humidity:	48 %
ATM Pressure:	101.0 kPa

The testing was performed by Bin Deng on 2021-10-27.

EUT operation mode: Transmitting (the worst case is 8DPSK Mode, Low channel)

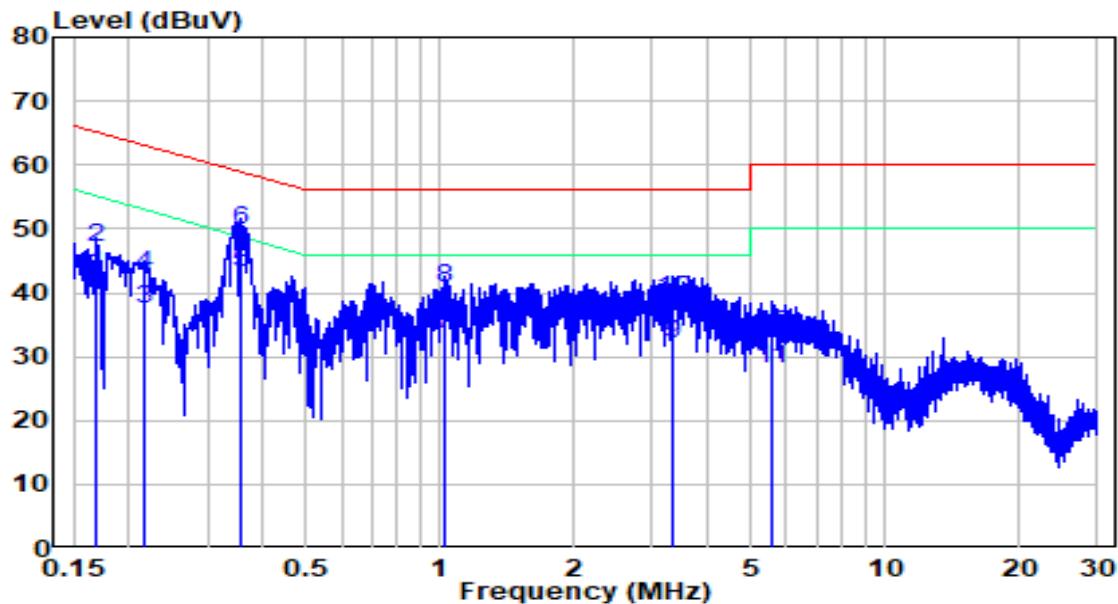
Powered by Adapter:

AC 120V/60 Hz, Line



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Over Limit (dB)	Remark	Phase
1	0.156	30.50	9.89	40.39	55.66	-15.27	Average	Line
2	0.156	35.74	9.89	45.63	65.66	-20.03	QP	Line
3	0.206	25.23	9.80	35.03	53.35	-18.32	Average	Line
4	0.206	32.60	9.80	42.40	63.35	-20.95	QP	Line
5	0.352	32.72	9.80	42.52	48.91	-6.39	Average	Line
6	0.352	39.42	9.80	49.23	58.91	-9.68	QP	Line
7	1.052	22.73	9.82	32.55	46.00	-13.45	Average	Line
8	1.052	30.91	9.82	40.72	56.00	-15.28	QP	Line
9	3.082	21.43	9.93	31.36	46.00	-14.64	Average	Line
10	3.082	28.21	9.93	38.14	56.00	-17.86	QP	Line
11	6.475	16.73	10.05	26.78	50.00	-23.22	Average	Line
12	6.475	21.40	10.05	31.45	60.00	-28.55	QP	Line

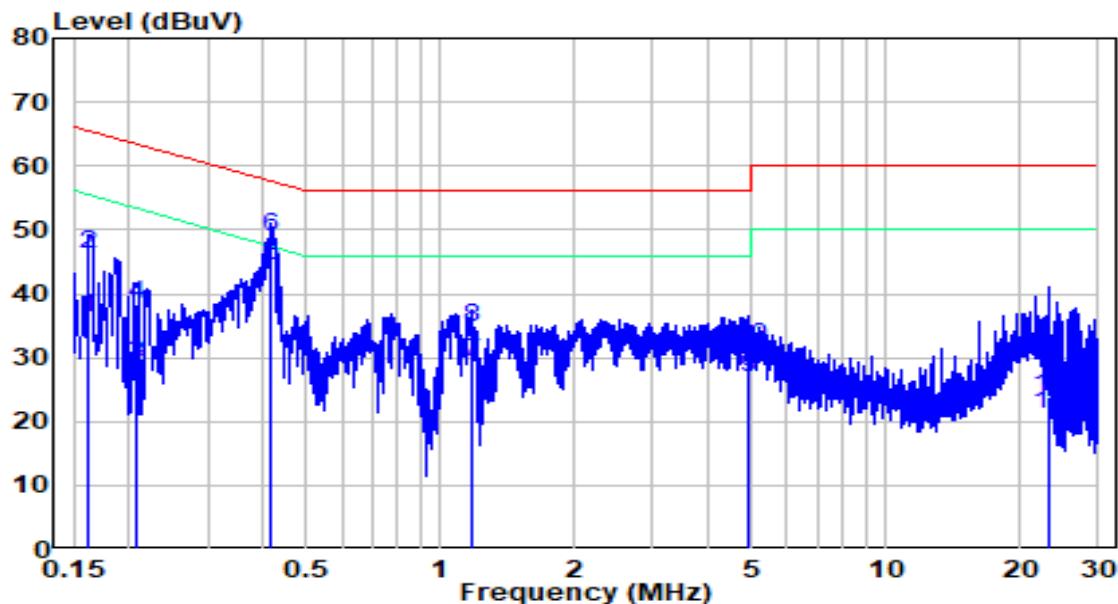
AC 120V/60 Hz, Neutral



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Over Limit (dB)	Remark	Phase
1	0.169	32.89	9.94	42.84	54.99	-12.15	Average	Neutral
2	0.169	37.26	9.94	47.21	64.99	-17.78	QP	Neutral
3	0.217	27.33	9.99	37.33	52.95	-15.62	Average	Neutral
4	0.217	32.85	9.99	42.85	62.95	-20.10	QP	Neutral
5	0.357	33.13	9.94	43.07	48.79	-5.72	Average	Neutral
6	0.357	39.80	9.94	49.74	58.79	-9.05	QP	Neutral
7	1.027	23.71	9.91	33.62	46.00	-12.38	Average	Neutral
8	1.027	30.80	9.91	40.71	56.00	-15.29	QP	Neutral
9	3.313	22.14	10.01	32.14	46.00	-13.86	Average	Neutral
10	3.313	28.88	10.01	38.88	56.00	-17.12	QP	Neutral
11	5.568	18.12	10.06	28.18	50.00	-21.82	Average	Neutral
12	5.568	23.35	10.06	33.41	60.00	-26.59	QP	Neutral

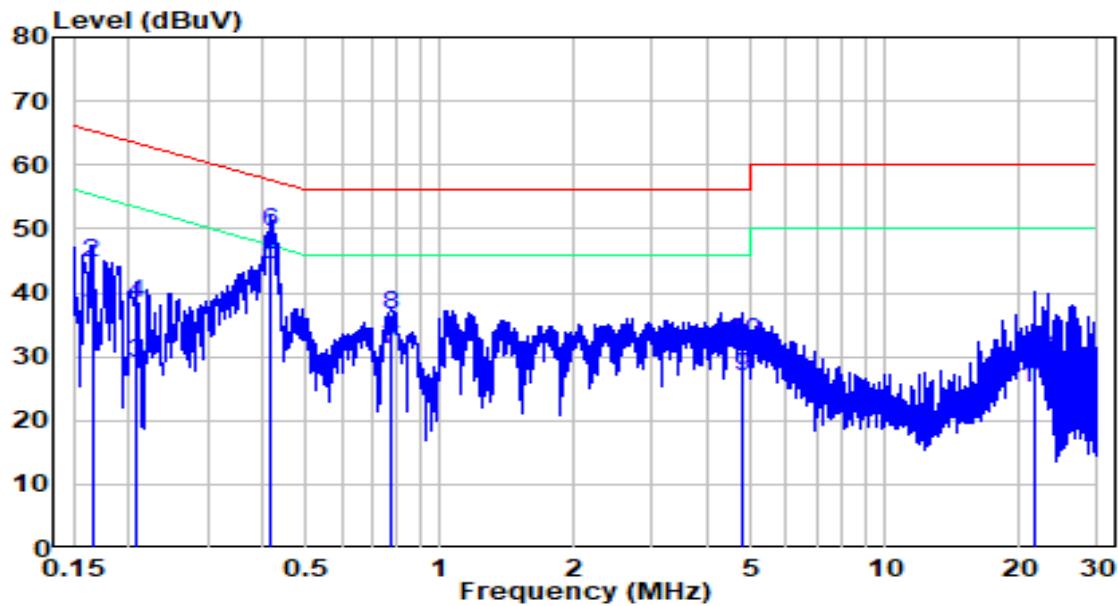
Powered by POE:

AC 120V/60 Hz, Line



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Over Limit (dB)	Remark	Phase
1	0.163	26.29	9.87	36.16	55.33	-19.17	Average	Line
2	0.163	36.28	9.87	46.15	65.33	-19.18	QP	Line
3	0.208	19.06	9.80	28.86	53.30	-24.44	Average	Line
4	0.208	28.53	9.80	38.33	63.30	-24.97	QP	Line
5	0.416	34.43	9.80	44.23	47.52	-3.29	Average	Line
6	0.416	39.17	9.80	48.98	57.52	-8.54	QP	Line
7	1.180	19.53	9.84	29.36	46.00	-16.64	Average	Line
8	1.180	24.79	9.84	34.62	56.00	-21.38	QP	Line
9	4.913	16.75	9.99	26.74	46.00	-19.26	Average	Line
10	4.913	21.66	9.99	31.65	56.00	-24.35	QP	Line
11	23.140	10.84	10.30	21.15	50.00	-28.85	Average	Line
12	23.140	13.42	10.30	23.72	60.00	-36.28	QP	Line

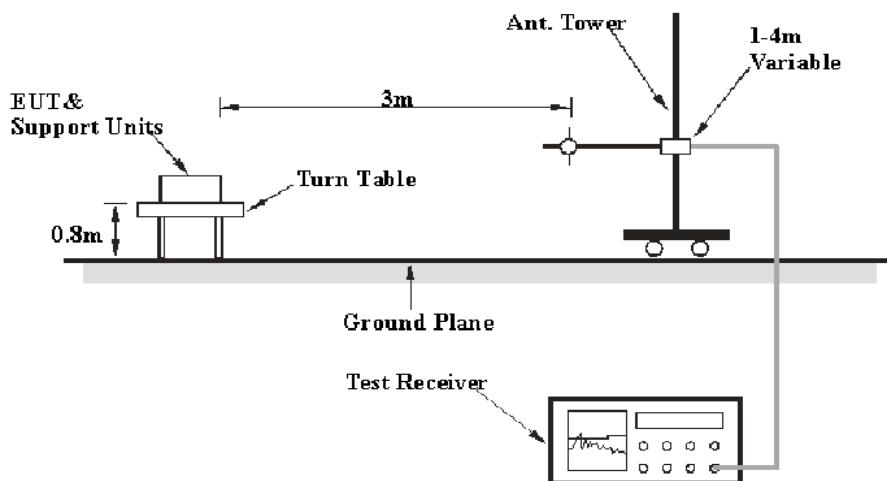
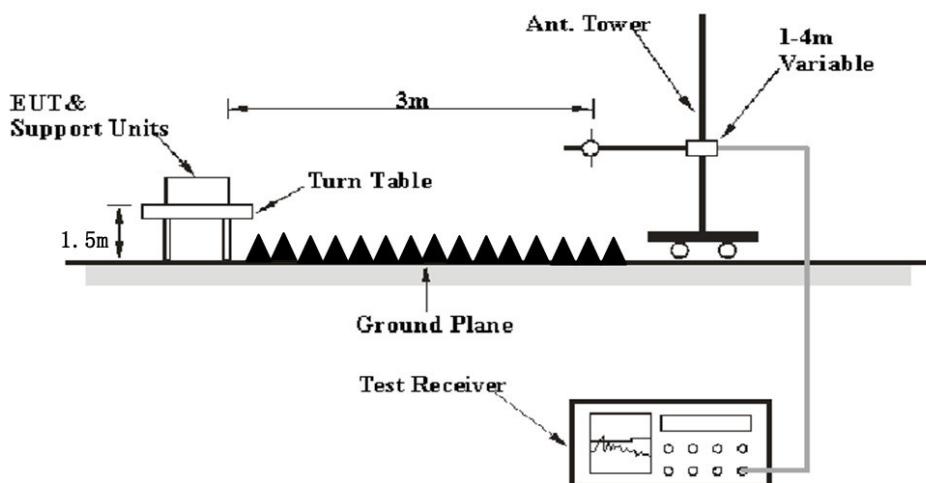
AC 120V/60 Hz, Neutral



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Over Limit (dB)	Remark	Phase
1	0.165	26.46	9.93	36.40	55.21	-18.81	Average	Neutral
2	0.165	34.89	9.93	44.83	65.21	-20.38	QP	Neutral
3	0.208	19.01	10.00	29.01	53.30	-24.29	Average	Neutral
4	0.208	28.42	10.00	38.42	63.30	-24.88	QP	Neutral
5	0.416	34.58	9.92	44.50	47.52	-3.02	Average	Neutral
6	0.416	39.66	9.92	49.59	57.52	-7.93	QP	Neutral
7	0.774	21.09	9.91	31.00	46.00	-15.00	Average	Neutral
8	0.774	26.66	9.91	36.56	56.00	-19.44	QP	Neutral
9	4.775	16.68	10.05	26.73	46.00	-19.27	Average	Neutral
10	4.775	22.38	10.05	32.43	56.00	-23.57	QP	Neutral
11	21.672	14.81	10.24	25.05	50.00	-24.95	Average	Neutral
12	21.672	19.24	10.24	29.47	60.00	-30.53	QP	Neutral

FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS**Applicable Standard**

FCC §15.205; §15.209; §15.247(d)

EUT Setup**Below 1 GHz:****Above 1GHz:**

The radiated emission tests were performed in the 3 meters, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209 and FCC 15.247 limits.

EMI Test Receiver & Spectrum Analyzer Setup

The EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1 MHz	3 MHz	/	PK
	1 MHz	10 Hz	/	Average

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

All final data was recorded in Quasi-peak detection mode for frequency range of 30 MHz -1 GHz and peak and Average detection modes for frequencies above 1 GHz.

Corrected Factor & Margin Calculation

The Corrected Factor is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain. The basic equation is as follows:

$$\text{Corrected Factor} = \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Over limit or Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a over limit or margin of -7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Over limit/Margin} = \text{Result}/\text{Corrected Amplitude-Limit}$$

$$\text{Result}/\text{Corrected Amplitude} = \text{Reading} + \text{Corrected Factor}$$

Test Data

Environmental Conditions

Temperature:	25~28.6°C
Relative Humidity:	54 %
ATM Pressure:	100.9~101.0 kPa

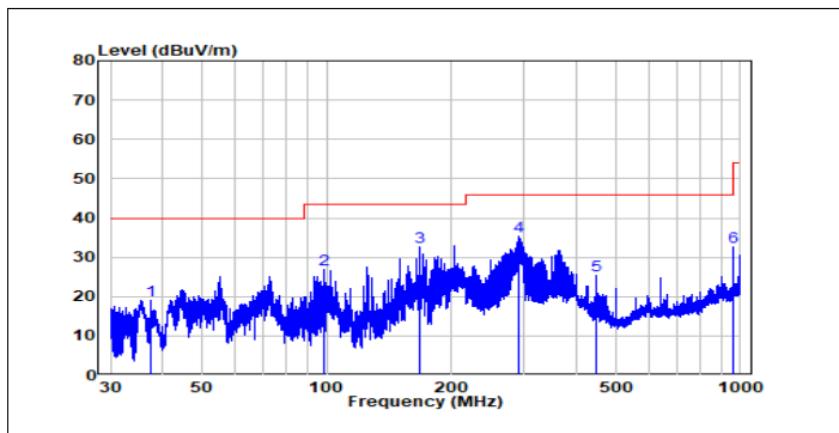
The testing was performed by Chao Mo on 2021-10-27 for below 1GHz and Caro Hu on 2021-11-20 for above 1GHz.

EUT operation mode: Transmitting

30MHz-1GHz: (the worst case is 8DPSK Mode, Low channel)

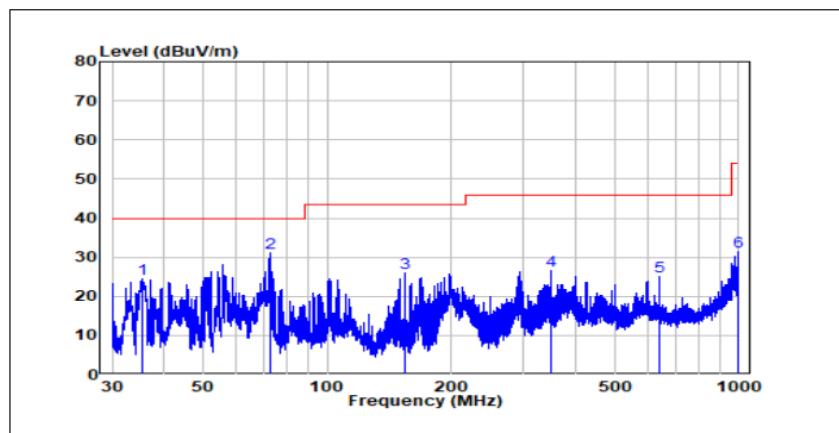
Powered by adapter:

Horizontal:



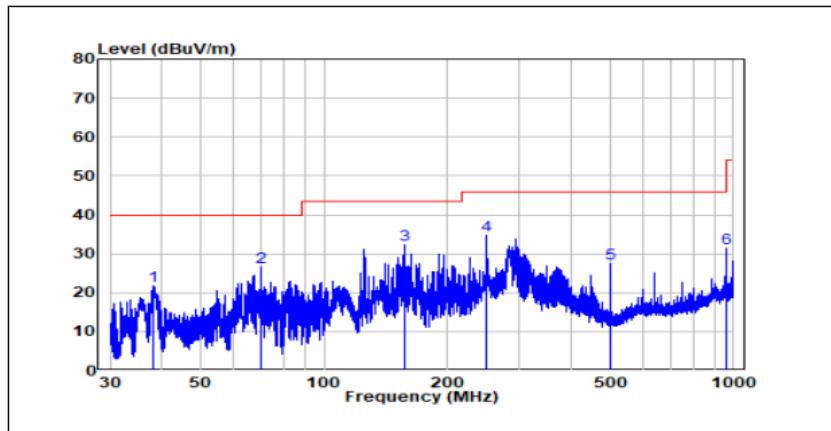
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Remark	Phase
1	37.597	38.00	-19.03	18.97	40.00	-21.03	Peak	HORIZONTAL
2	98.789	46.15	-19.42	26.73	43.50	-16.77	Peak	HORIZONTAL
3	167.677	53.71	-21.16	32.55	43.50	-10.95	Peak	HORIZONTAL
4	291.419	52.50	-17.09	35.41	46.00	-10.59	Peak	HORIZONTAL
5	450.147	39.65	-14.28	25.36	46.00	-20.64	Peak	HORIZONTAL
6	960.056	40.63	-7.99	32.64	54.00	-21.36	Peak	HORIZONTAL

Vertical

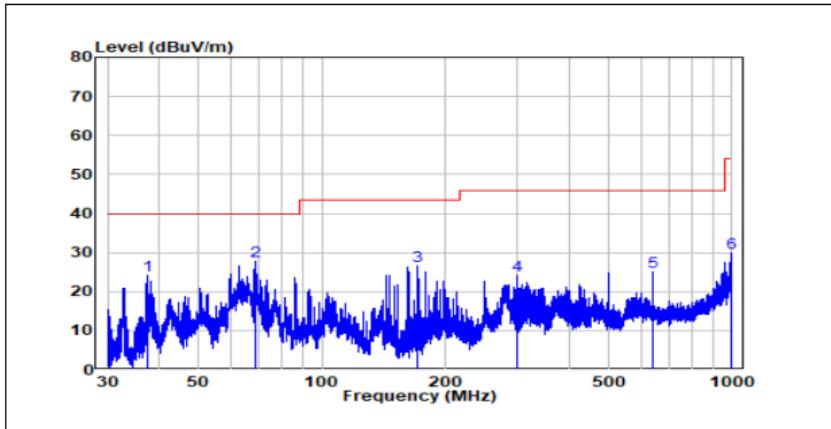


No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Remark	Phase
1	35.562	43.93	-19.36	24.57	40.00	-15.43	Peak	VERTICAL
2	72.623	52.87	-21.81	31.06	40.00	-8.94	Peak	VERTICAL
3	154.279	47.69	-21.66	26.03	43.50	-17.47	Peak	VERTICAL
4	350.016	42.62	-16.08	26.54	46.00	-19.46	Peak	VERTICAL
5	639.209	36.14	-11.23	24.91	46.00	-21.09	Peak	VERTICAL
6	995.626	38.86	-7.44	31.42	54.00	-22.58	Peak	VERTICAL

Powered by POE:

Horizontal:

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Remark	Phase
1	38.262	40.59	-18.92	21.66	40.00	-18.34	Peak	HORIZONTAL
2	69.968	47.78	-21.29	26.49	40.00	-13.51	Peak	HORIZONTAL
3	157.283	54.10	-21.72	32.38	43.50	-11.12	Peak	HORIZONTAL
4	250.082	53.20	-18.53	34.68	46.00	-11.32	Peak	HORIZONTAL
5	500.082	41.69	-14.18	27.51	46.00	-18.49	Peak	HORIZONTAL
6	960.056	39.39	-7.99	31.40	54.00	-22.60	Peak	HORIZONTAL

Vertical

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Remark	Phase
1	37.466	43.18	-19.05	24.13	40.00	-15.87	Peak	VERTICAL
2	68.691	48.93	-21.06	27.87	40.00	-12.13	Peak	VERTICAL
3	171.092	47.67	-21.02	26.66	43.50	-16.84	Peak	VERTICAL
4	299.973	40.87	-16.59	24.28	46.00	-21.72	Peak	VERTICAL
5	639.209	36.19	-11.23	24.96	46.00	-21.04	Peak	VERTICAL
6	996.937	37.35	-7.41	29.95	54.00	-24.05	Peak	VERTICAL

Above 1GHz: (the worst case is 8DPSK Mode, powered by adapter)

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
	Reading (dB μ V)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2402 MHz)									
2310	67.38	PK	225	1.9	V	-7.24	60.14	74	-13.86
2310	53.76	Ave.	225	1.9	V	-7.24	46.52	54	-7.48
2310	67.13	PK	161	1.7	H	-7.24	59.89	74	-14.11
2310	51.48	Ave.	161	1.7	H	-7.24	44.24	54	-9.76
2390	70.71	PK	269	2.0	V	-7.22	63.49	74	-10.51
2390	55.40	Ave.	269	2.0	V	-7.22	48.18	54	-5.82
2390	67.62	PK	72	1.6	H	-7.22	60.40	74	-13.60
2390	52.65	Ave.	72	1.6	H	-7.22	45.43	54	-8.57
4804	56.47	PK	266	2.0	V	-3.51	52.96	74	-21.04
4804	50.87	PK	43	1.8	H	-3.51	47.36	74	-26.64
Middle Channel (2441 MHz)									
4882	55.84	PK	19	1.6	H	-3.37	52.47	74	-21.53
4882	50.32	PK	336	1.6	V	-3.37	46.95	74	-27.05
High Channel (2480 MHz)									
2483.5	70.07	PK	2	2.0	V	-7.20	62.87	74	-11.13
2483.5	55.29	Ave.	2	2.0	V	-7.20	48.09	54	-5.91
2483.5	67.34	PK	219	2.0	H	-7.20	60.14	74	-13.86
2483.5	52.52	Ave.	219	2.0	H	-7.20	45.32	54	-8.68
2500	69.43	PK	290	2.0	V	-7.18	62.25	74	-11.75
2500	54.82	Ave.	290	2.0	V	-7.18	47.64	54	-6.36
2500	63.52	PK	75	1.6	H	-7.18	56.34	74	-17.66
2500	50.34	Ave.	75	1.6	H	-7.18	43.16	54	-10.84
4960	56.27	PK	113	1.9	V	-3.01	53.26	74	-20.74
4960	51.70	PK	80	1.9	H	-3.01	48.69	74	-25.31

Note:

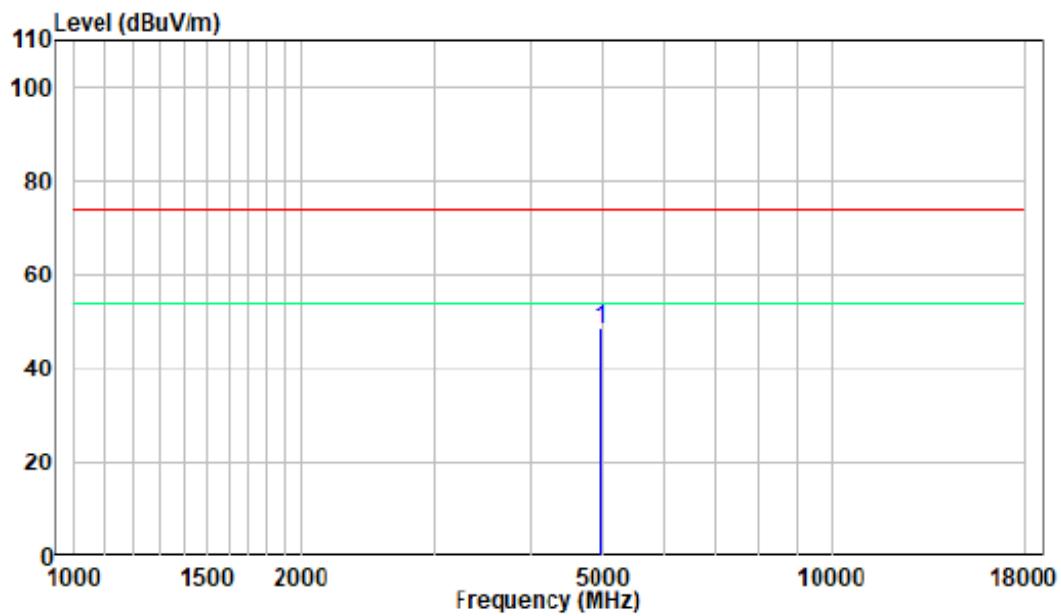
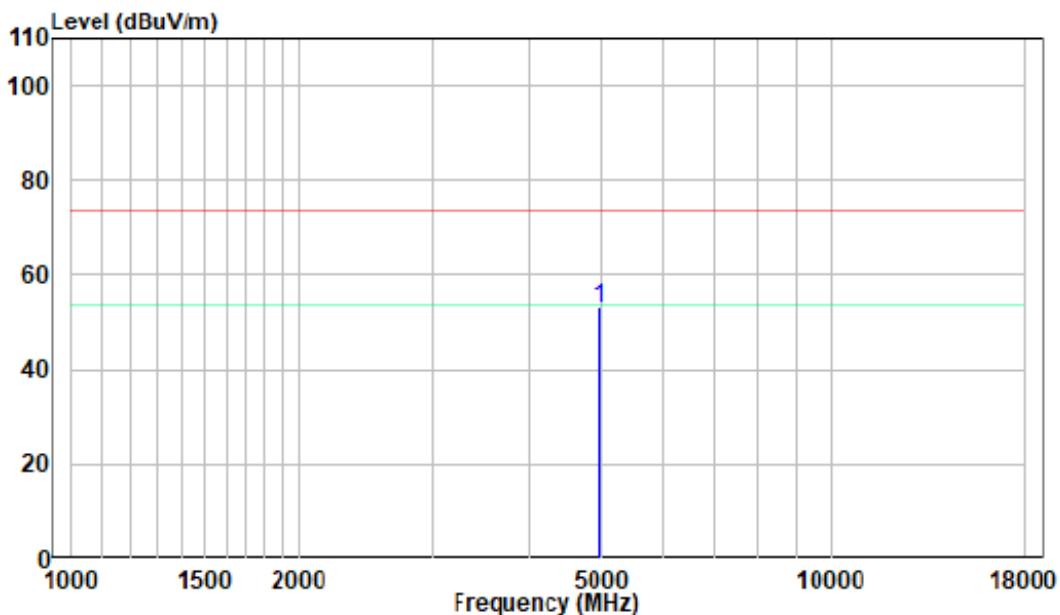
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Corrected Amplitude = Corrected Factor + Reading

Margin = Corrected. Amplitude - Limit

The other spurious emission which is in the noise floor level was not recorded.

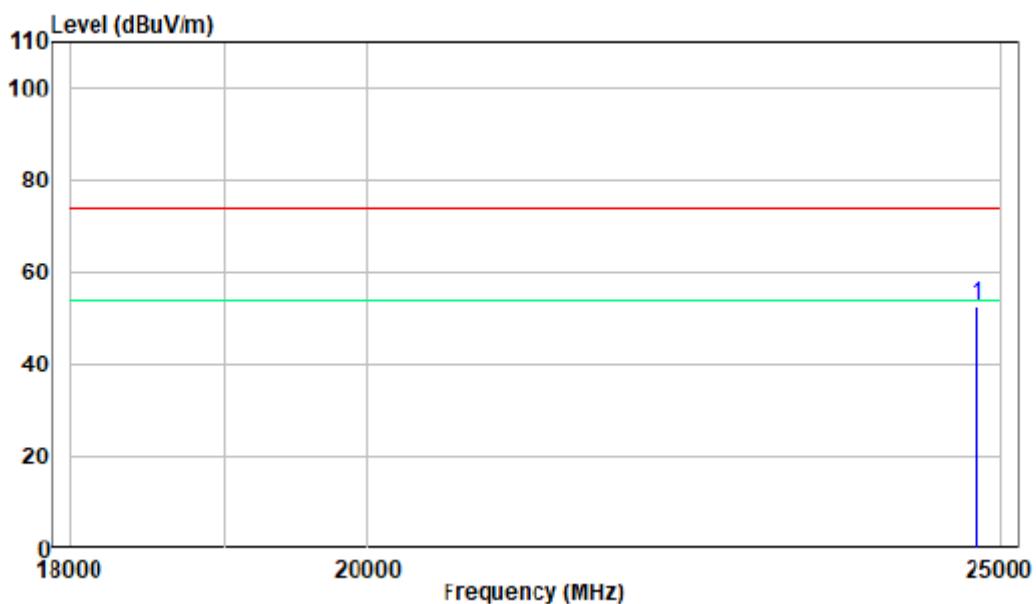
The test result of peak was less than the limit of average, so just peak value were recorded.

1-18GHz**Pre-scan for Peak****High Channel****Horizontal:****Vertical:**

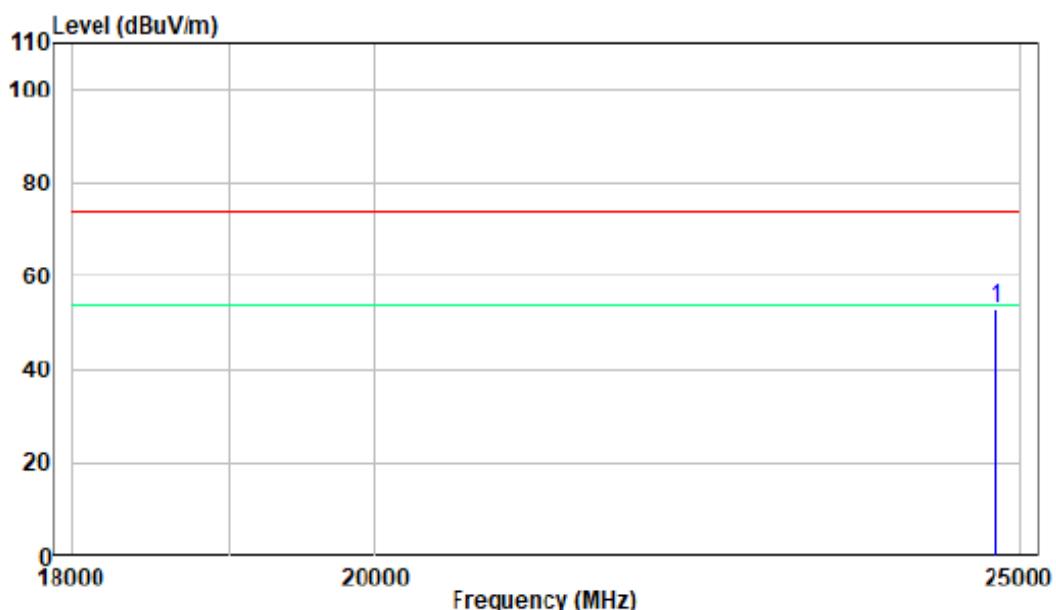
18-25GHz
Pre-scan for Peak

High Channel

Horizontal:



Vertical:



FCC §15.247(a) (1)-CHANNEL SEPARATION TEST

Applicable Standard

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Test Procedure

1. Set the EUT in transmitting mode, maxhold the channel.
2. Set the adjacent channel of the EUT and maxhold another trace.
3. Measure the channel separation.

Test Data

Environmental Conditions

Temperature:	24 °C
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Fan Yang on 2021-11-26.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

FCC §15.247(a) (1) – 20 dB EMISSION BANDWIDTH

Applicable Standard

Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

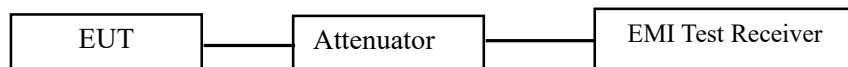
Test Procedure

The following conditions shall be observed for measuring the occupied bandwidth and 20 dB bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / 20 dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / 20 dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).



Test Data

Environmental Conditions

Temperature:	24 °C
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Fan Yang on 2021-11-26.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

FCC §15.247(a) (1) (iii)-QUANTITY OF HOPPING CHANNEL TEST

Applicable Standard

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Set the EUT in hopping mode from first channel to last.
3. By using the max-hold function record the quantity of the channel.

Test Data

Environmental Conditions

Temperature:	24 °C
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Fan Yang on 2021-11-26.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME)**Applicable Standard**

Frequency hopping systems in the 2400-2483.5 MHz shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Procedure

1. The EUT was worked in channel hopping.
2. Set the RBW to: 1MHz.
3. Set the VBW $\geq 3 \times$ RBW.
4. Set the span to 0Hz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Recorded the time of single pulses

Test Data**Environmental Conditions**

Temperature:	24 °C
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Fan Yang on 2021-11-26.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT

Applicable Standard

According to §15.247(b) (1), for frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. And for all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

Test Procedure

1. Place the EUT on a bench and set in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.

Test Data

Environmental Conditions

Temperature:	24 °C
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Fan Yang on 2021-11-26.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

FCC §15.247(d) - BAND EDGES TESTING

Applicable Standard

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated 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) (see §15.205(c)).

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

Test Data

Environmental Conditions

Temperature:	24°C
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Fan Yang on 2021-11-26.

EUT operation mode: Transmitting

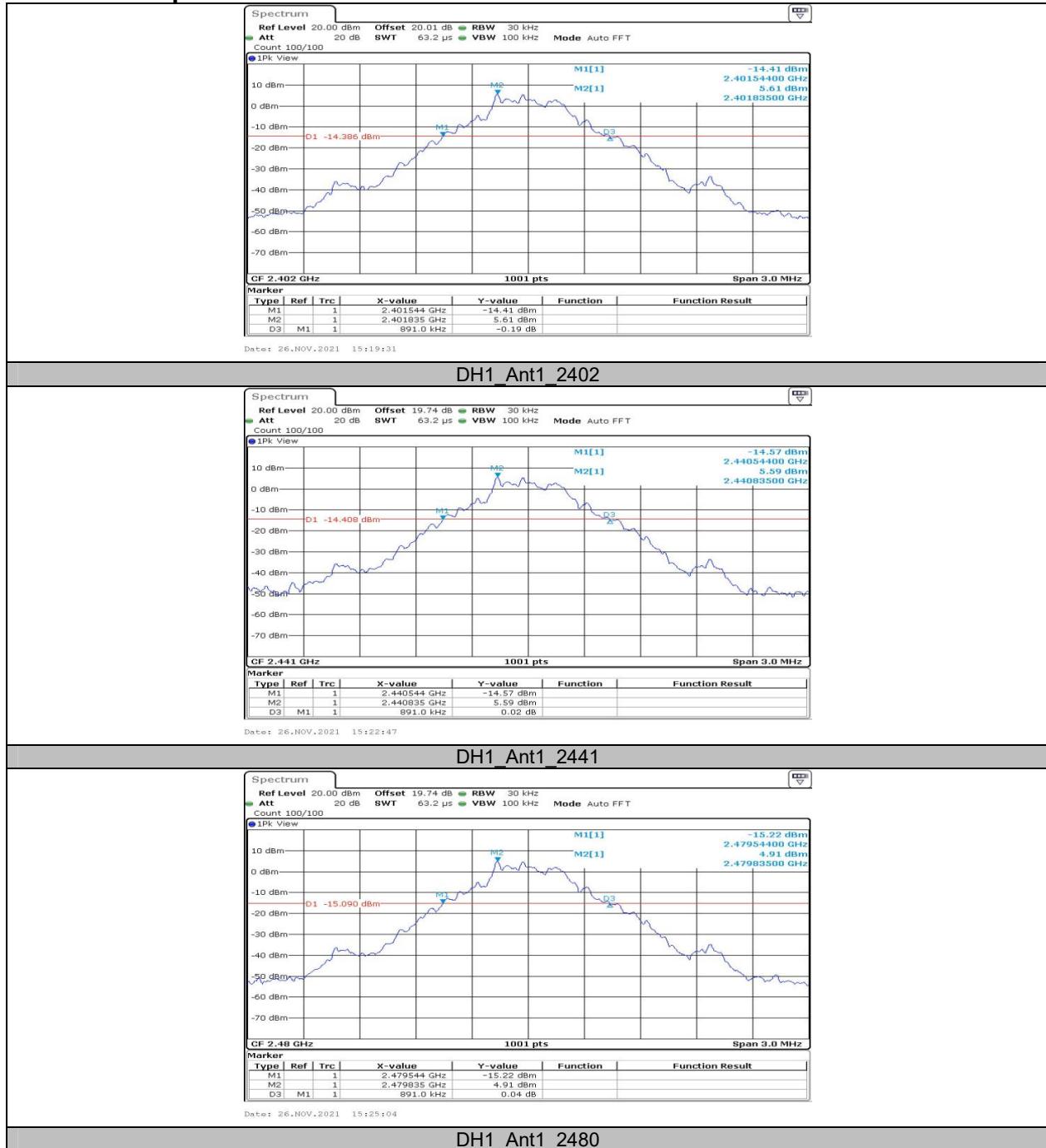
Test Result: Compliant. Please refer to the Appendix.

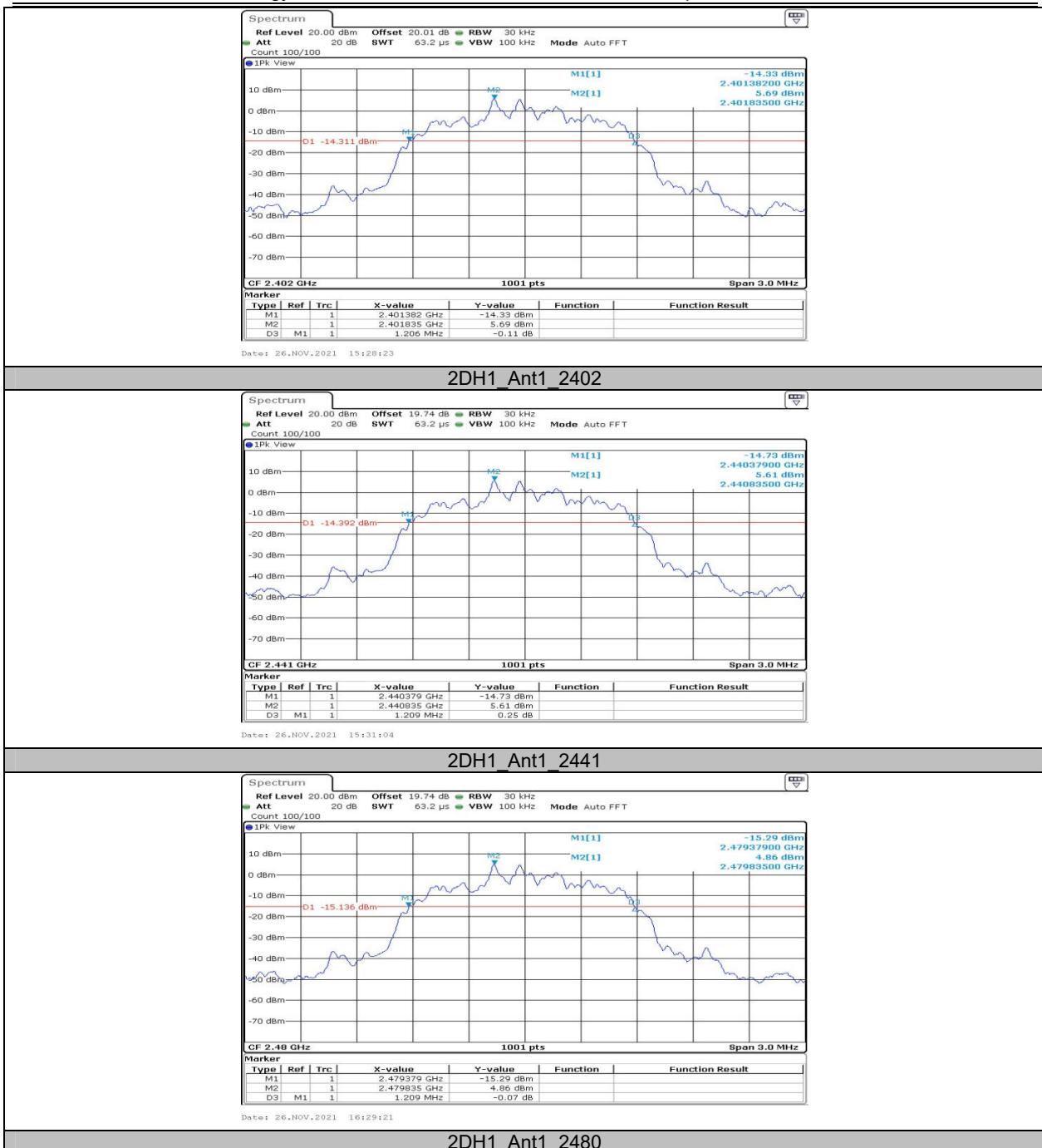
APPENDIX

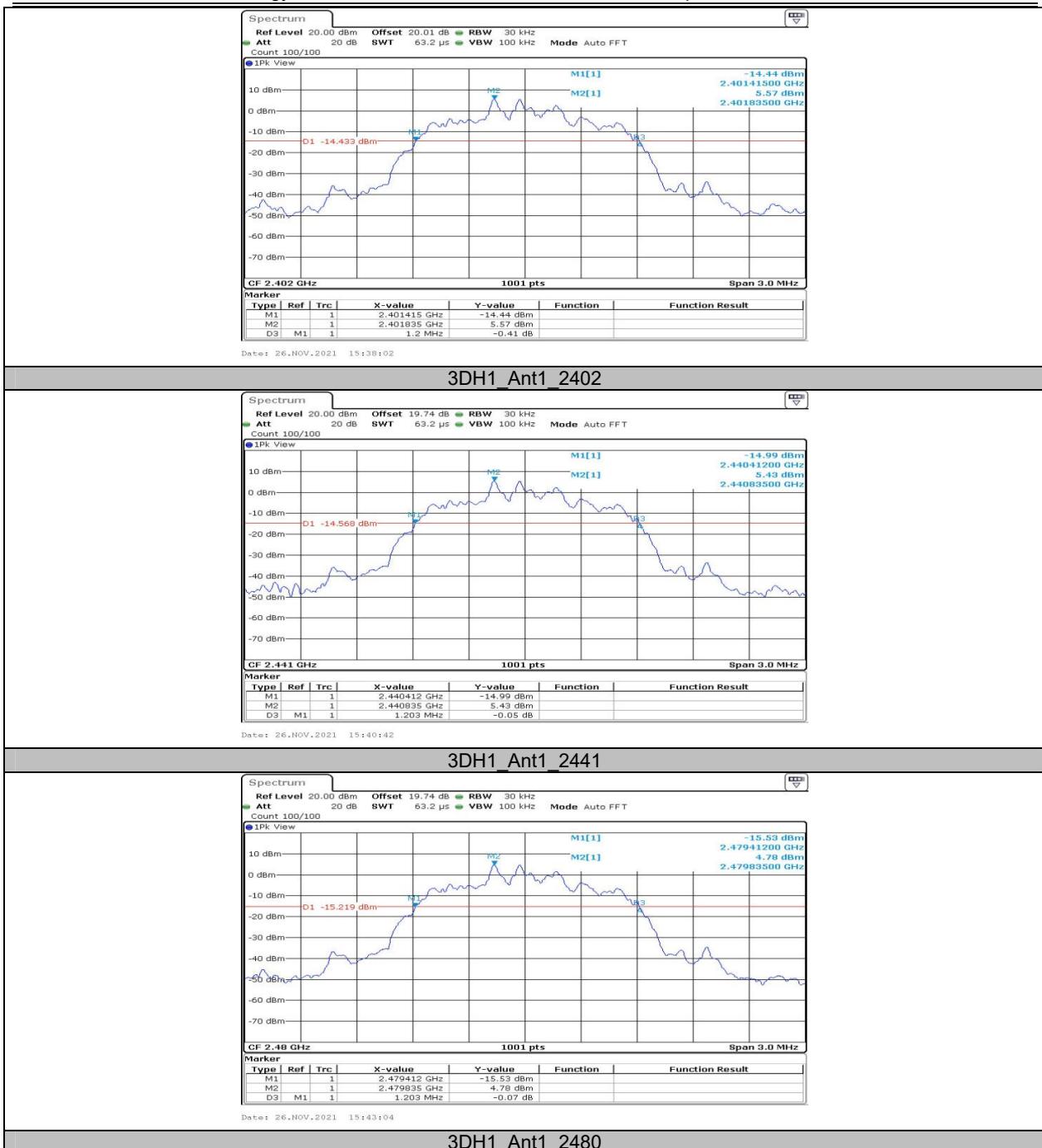
Appendix A: 20dB Emission Bandwidth Test Result

Test Mode	Antenna	Channel	20db EBW[MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	0.891	---	PASS
		2441	0.891	---	PASS
		2480	0.891	---	PASS
2DH1	Ant1	2402	1.206	---	PASS
		2441	1.209	---	PASS
		2480	1.209	---	PASS
3DH1	Ant1	2402	1.200	---	PASS
		2441	1.203	---	PASS
		2480	1.203	---	PASS

Test Graphs



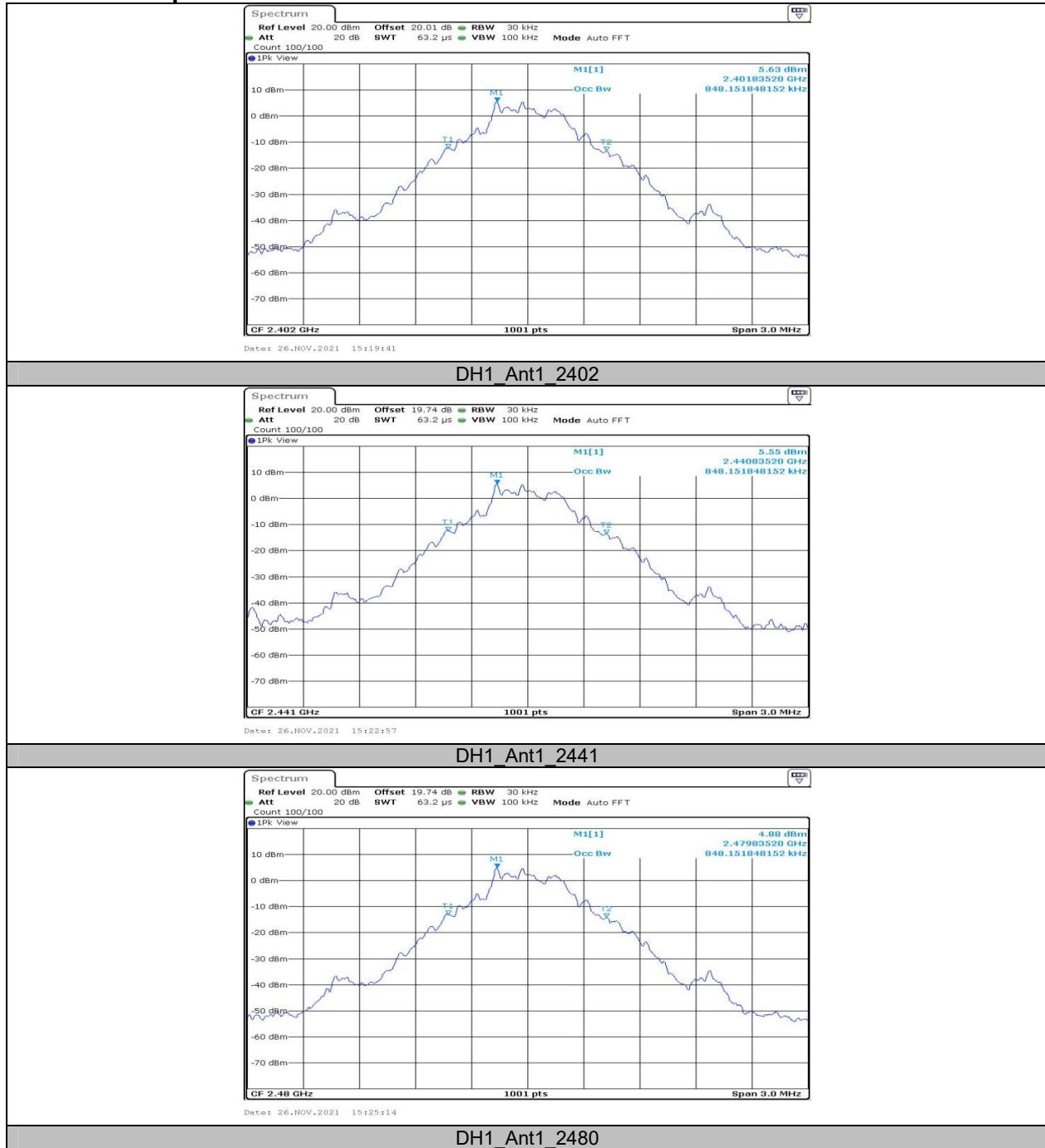




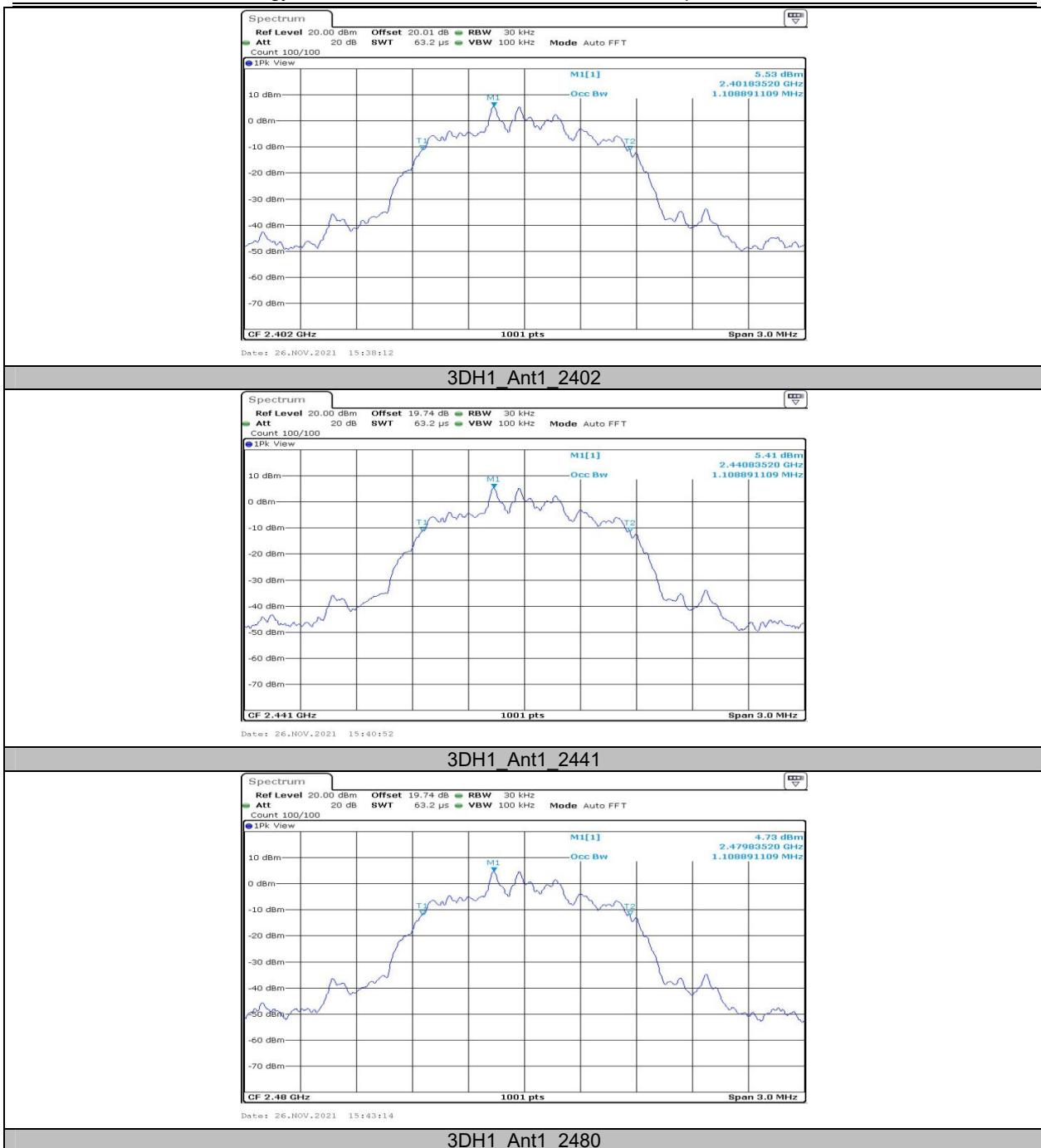
**Appendix B: Occupied Channel Bandwidth
Test Result**

Test Mode	Antenna	Channel	OCB [MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	0.848	---	PASS
		2441	0.848	---	PASS
		2480	0.848	---	PASS
2DH1	Ant1	2402	1.130	---	PASS
		2441	1.133	---	PASS
		2480	1.133	---	PASS
3DH1	Ant1	2402	1.109	---	PASS
		2441	1.109	---	PASS
		2480	1.109	---	PASS

Test Graphs





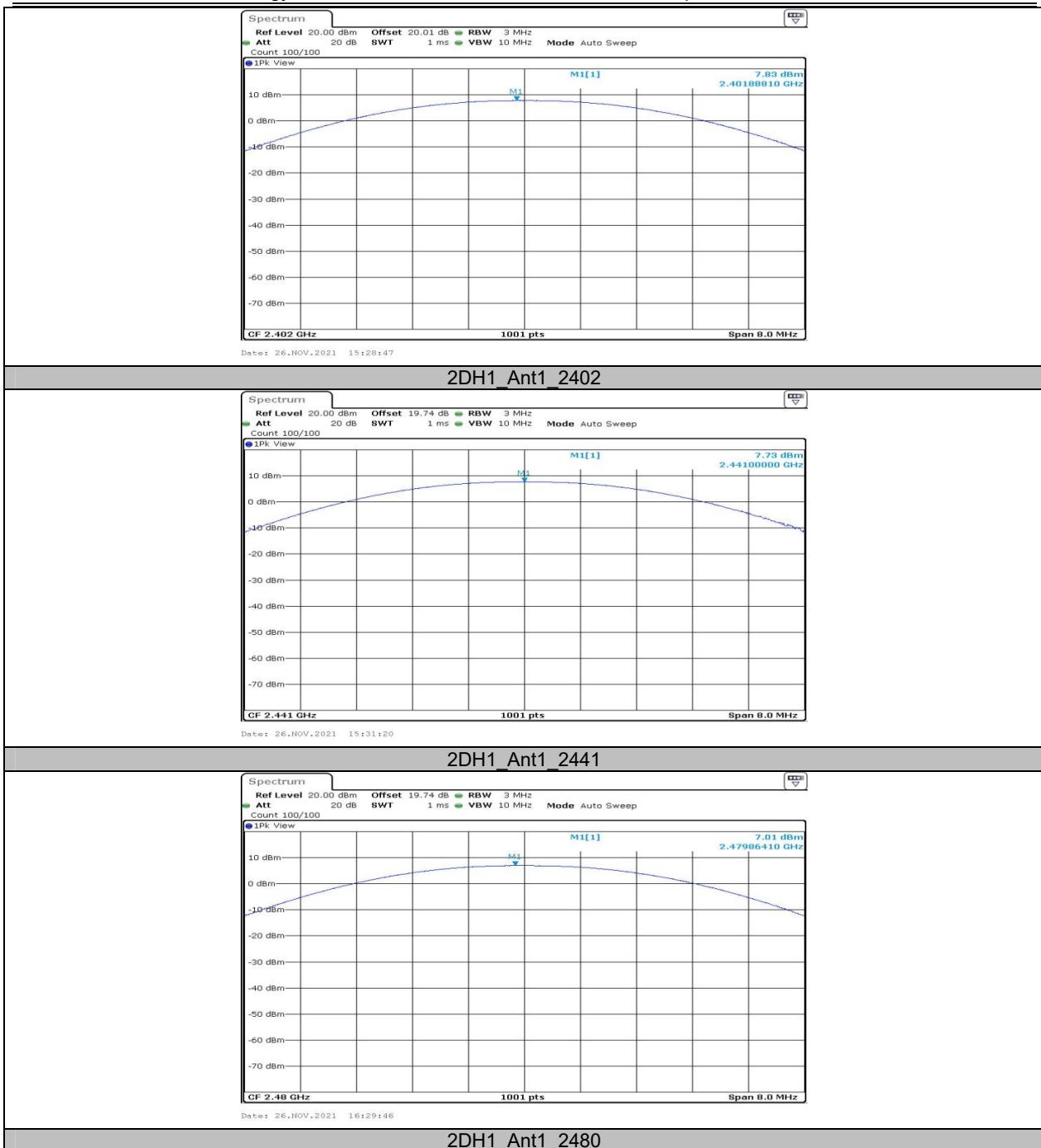


**Appendix C: Maximum conducted Peak output power
Test Result**

Test Mode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
DH1	Ant1	2402	7.83	≤20.97	PASS
		2441	7.75	≤20.97	PASS
		2480	7.03	≤20.97	PASS
2DH1	Ant1	2402	7.83	≤20.97	PASS
		2441	7.73	≤20.97	PASS
		2480	7.01	≤20.97	PASS
3DH1	Ant1	2402	8.28	≤20.97	PASS
		2441	8.18	≤20.97	PASS
		2480	7.51	≤20.97	PASS

Test Graphs







**Appendix D: Carrier frequency separation
Test Result**

Test Mode	Antenna	Channel	Result[MHz]	Limit[MHz]	Verdict
DH1	Ant1	Hop	1.003	≥ 0.594	PASS
2DH1	Ant1	Hop	1.003	≥ 0.806	PASS
3DH1	Ant1	Hop	1.003	≥ 0.802	PASS

Test Graphs



**Appendix E: Time of occupancy
Test Result**

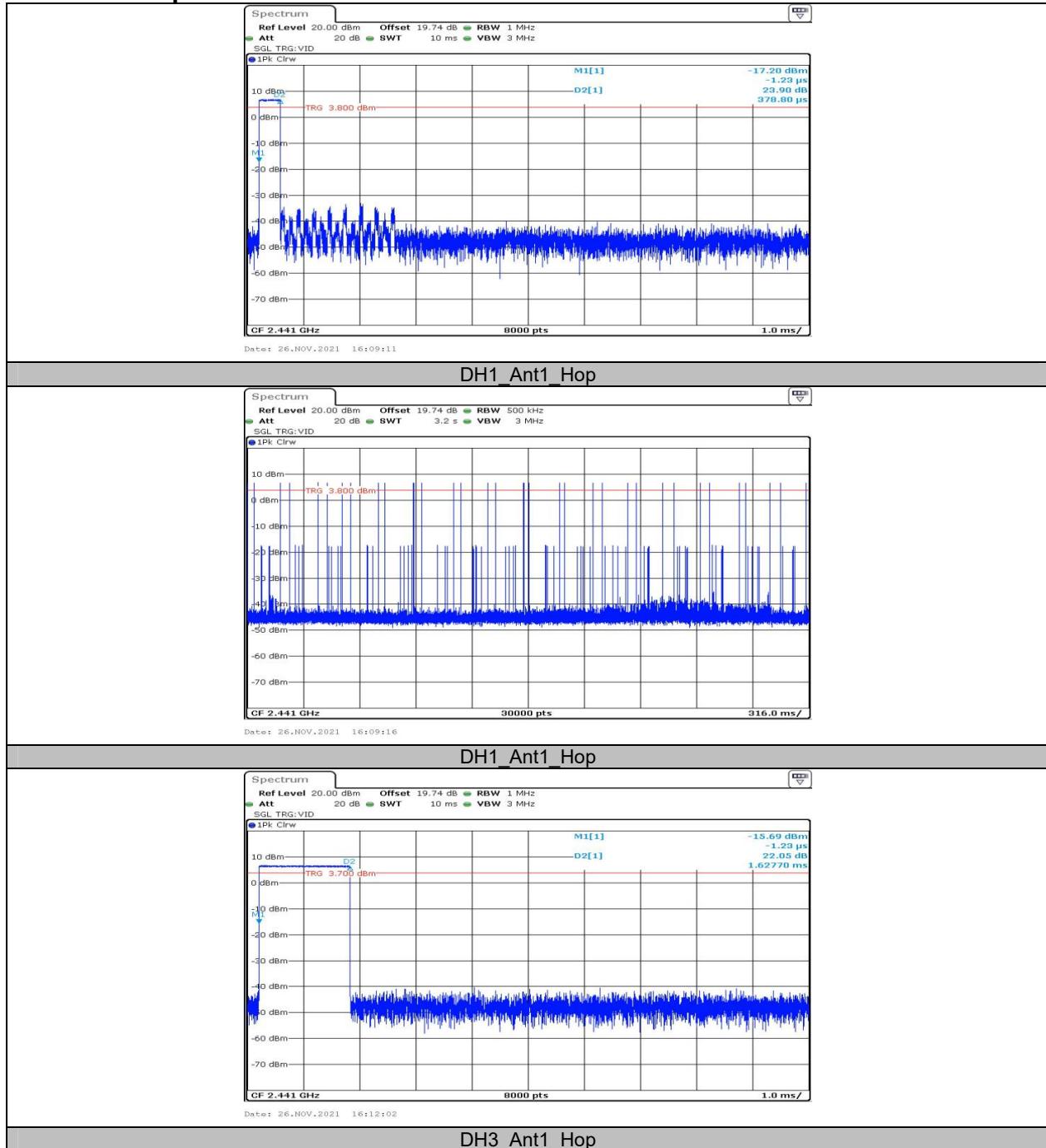
Test Mode	Antenna	Channel	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH1	Ant1	Hop	0.38	330	0.125	≤ 0.4	PASS
DH3	Ant1	Hop	1.63	160	0.261	≤ 0.4	PASS
DH5	Ant1	Hop	2.87	110	0.316	≤ 0.4	PASS
2DH1	Ant1	Hop	0.39	320	0.125	≤ 0.4	PASS
2DH3	Ant1	Hop	1.63	170	0.277	≤ 0.4	PASS
2DH5	Ant1	Hop	2.87	110	0.316	≤ 0.4	PASS
3DH1	Ant1	Hop	0.39	330	0.129	≤ 0.4	PASS
3DH3	Ant1	Hop	1.63	170	0.277	≤ 0.4	PASS
3DH5	Ant1	Hop	2.87	120	0.344	≤ 0.4	PASS

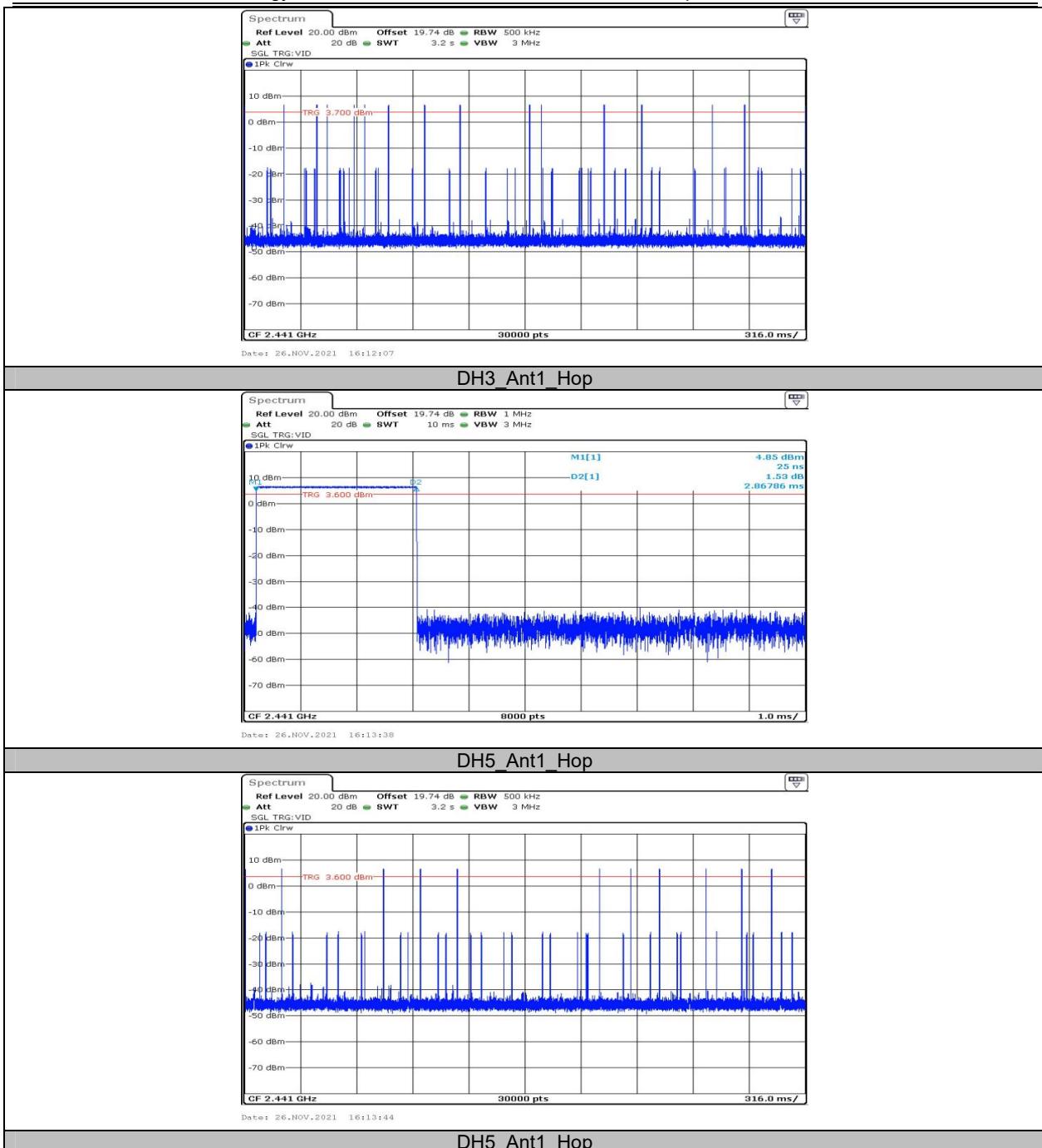
Note 1: A period time=0.4*79=31.6(S), Result=BurstWidth*Totalhops

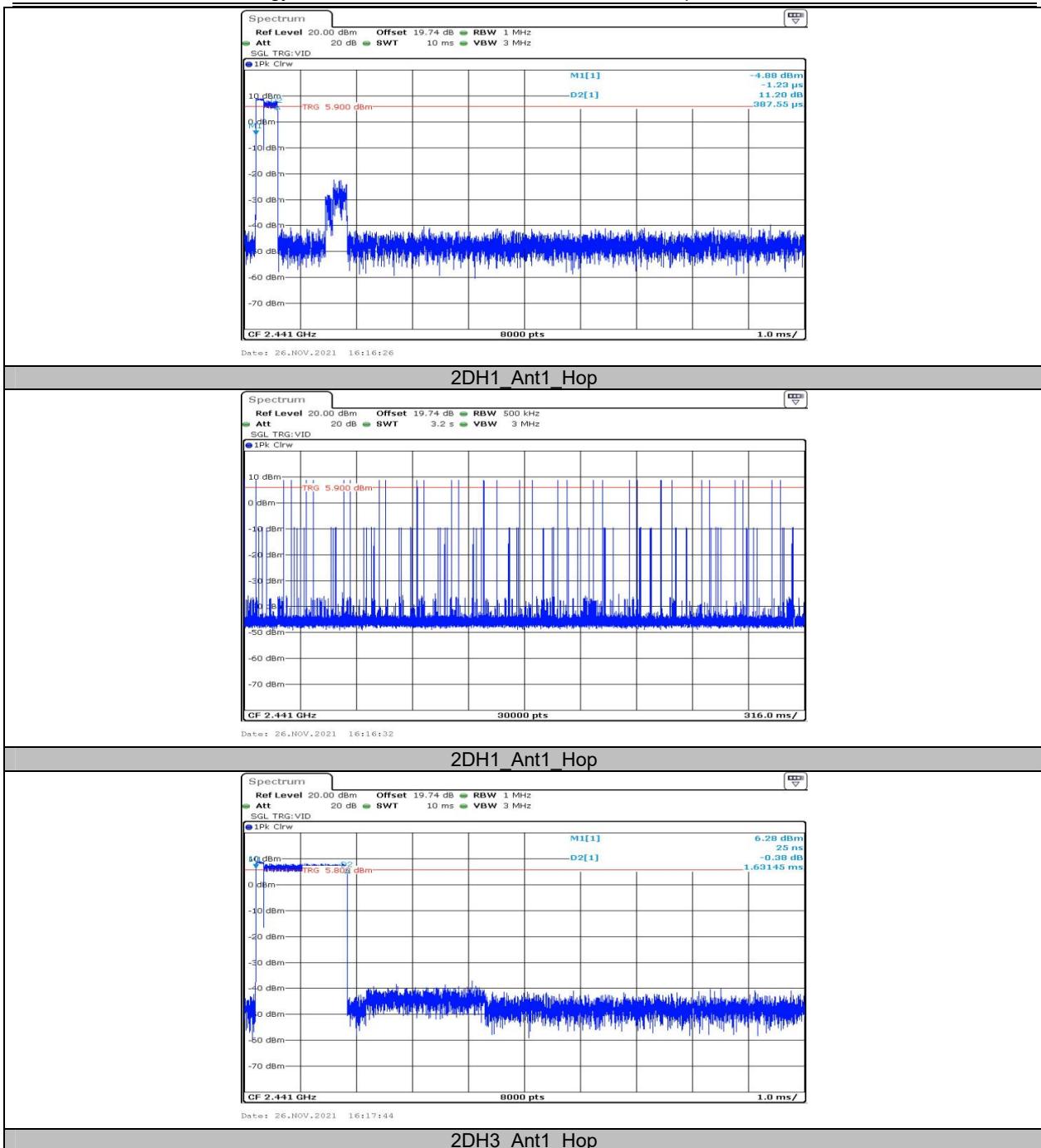
Note 2: Totalhops=Hopping Number in 3.16s*10

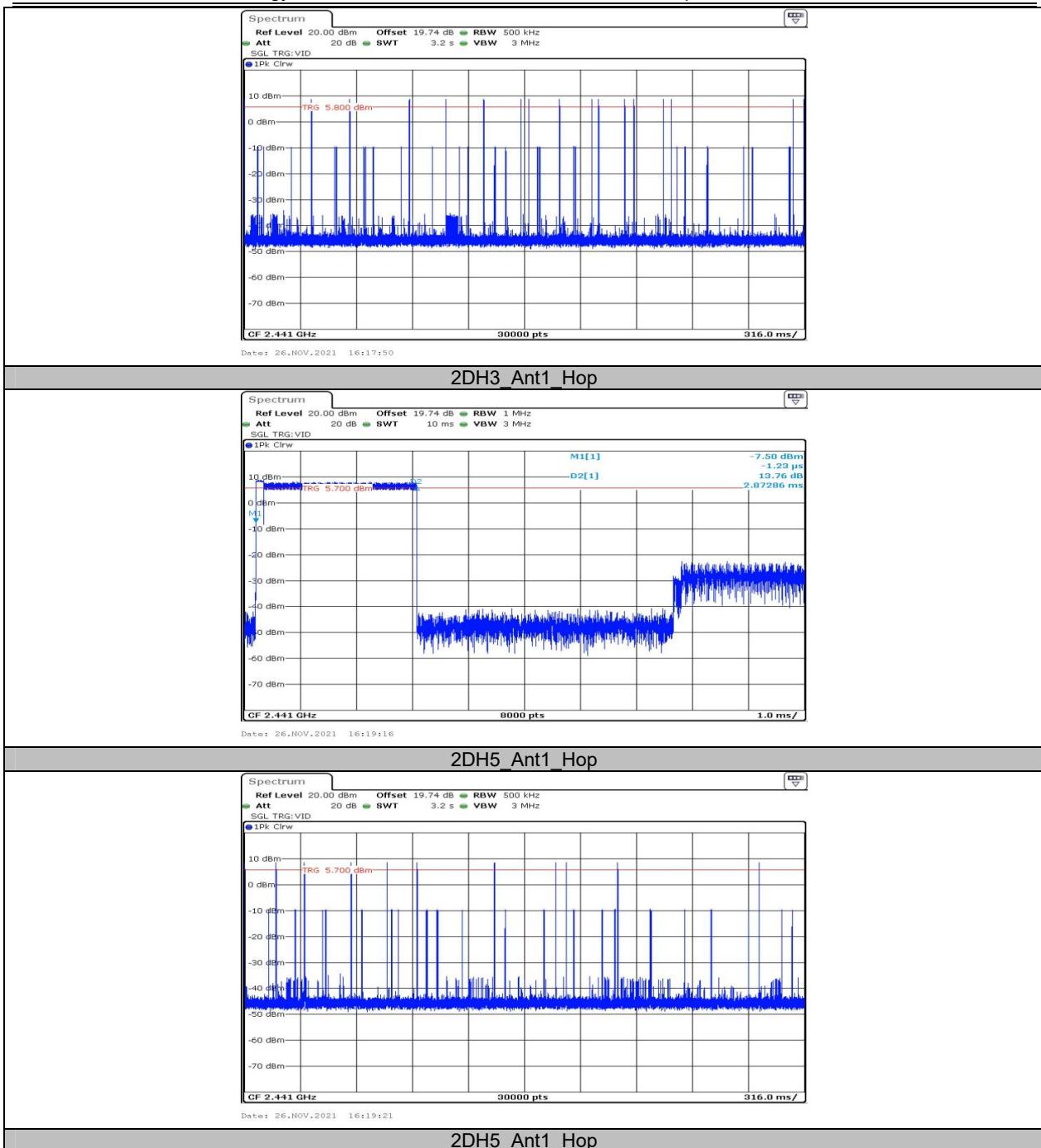
Note 3: Hopping Number in 3.16s=Total of highest signals in 3.16s(Second high signals were other channel)

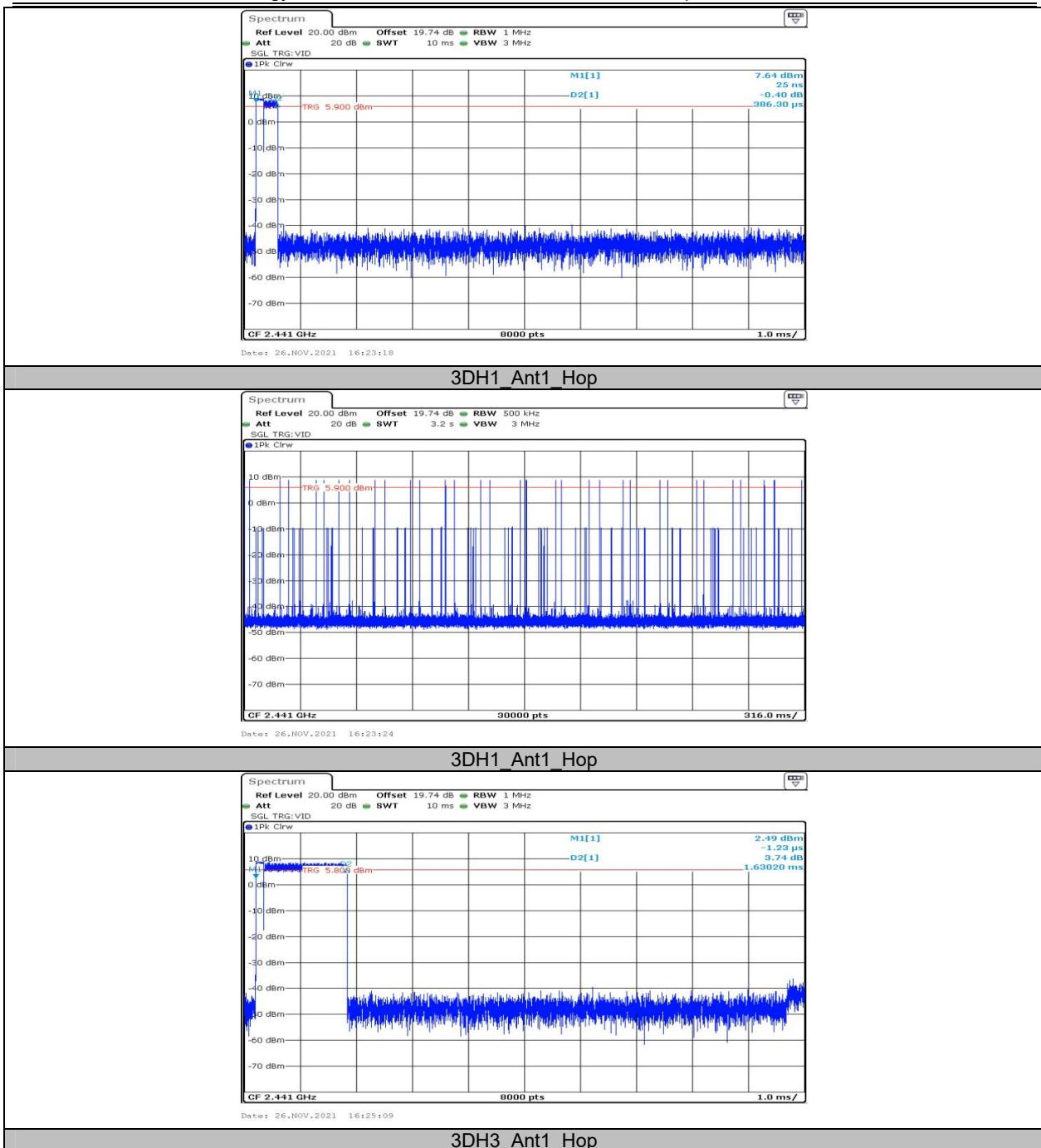
Test Graphs

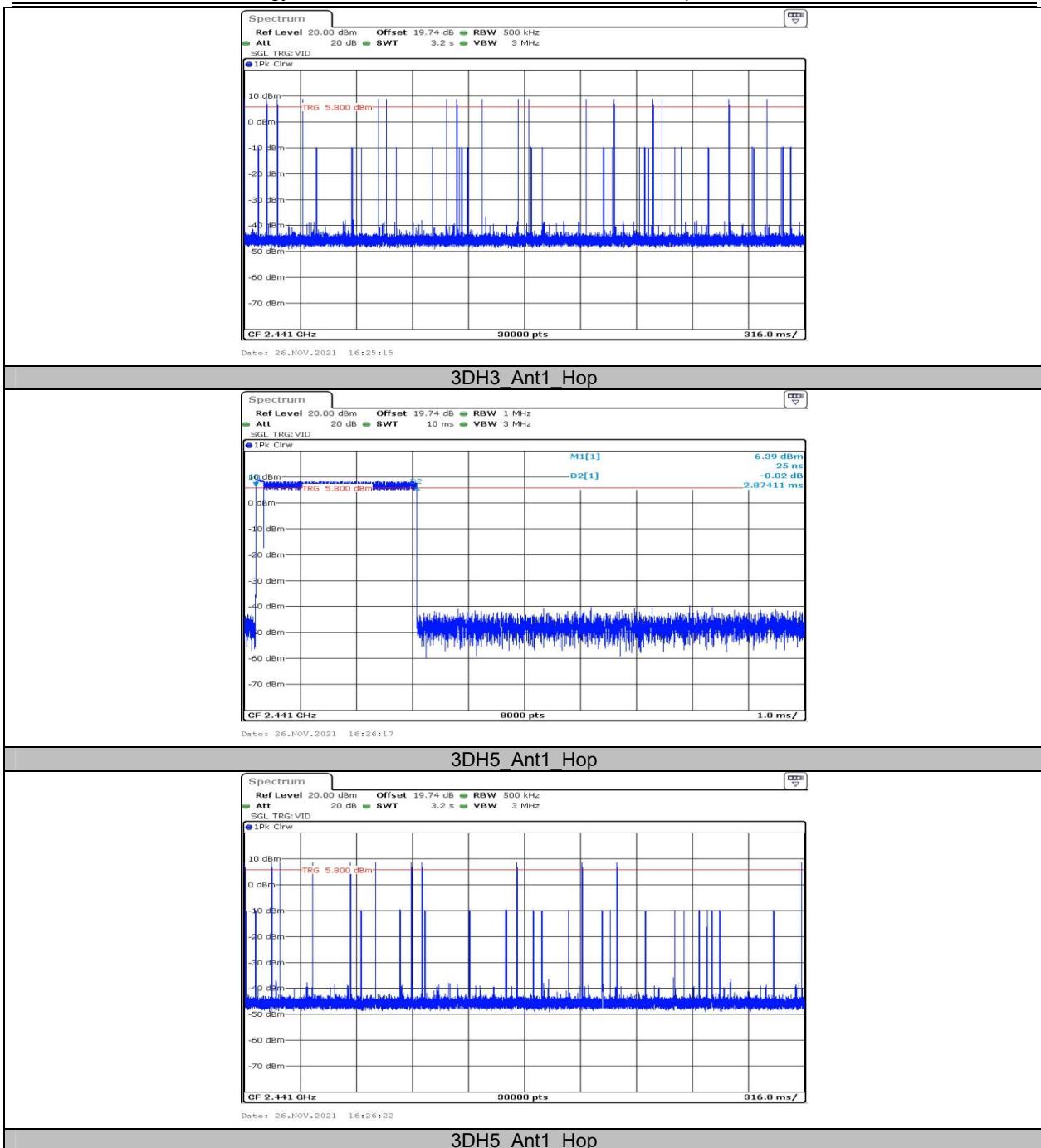








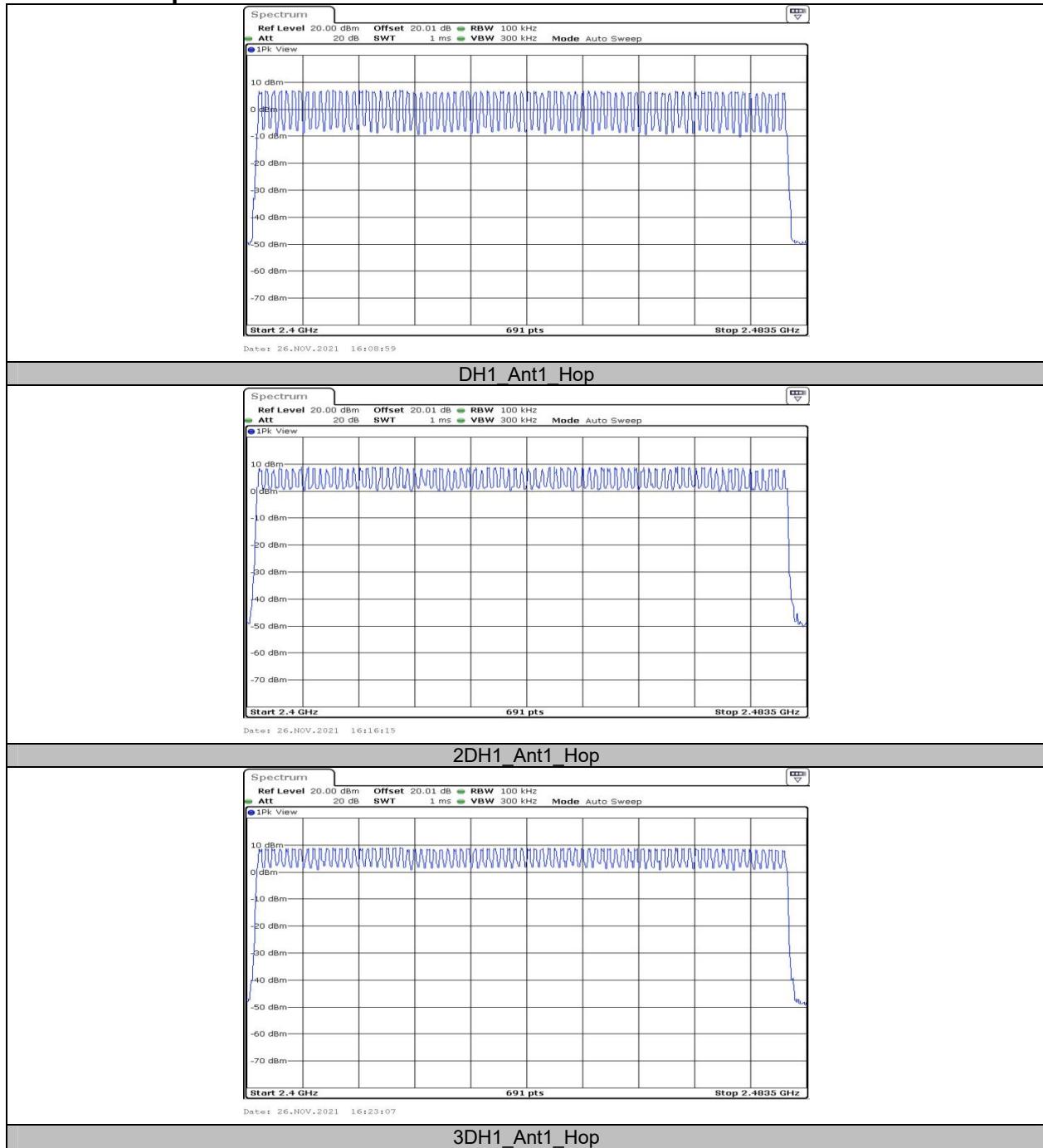




Appendix F: Number of hopping channels**Test Result**

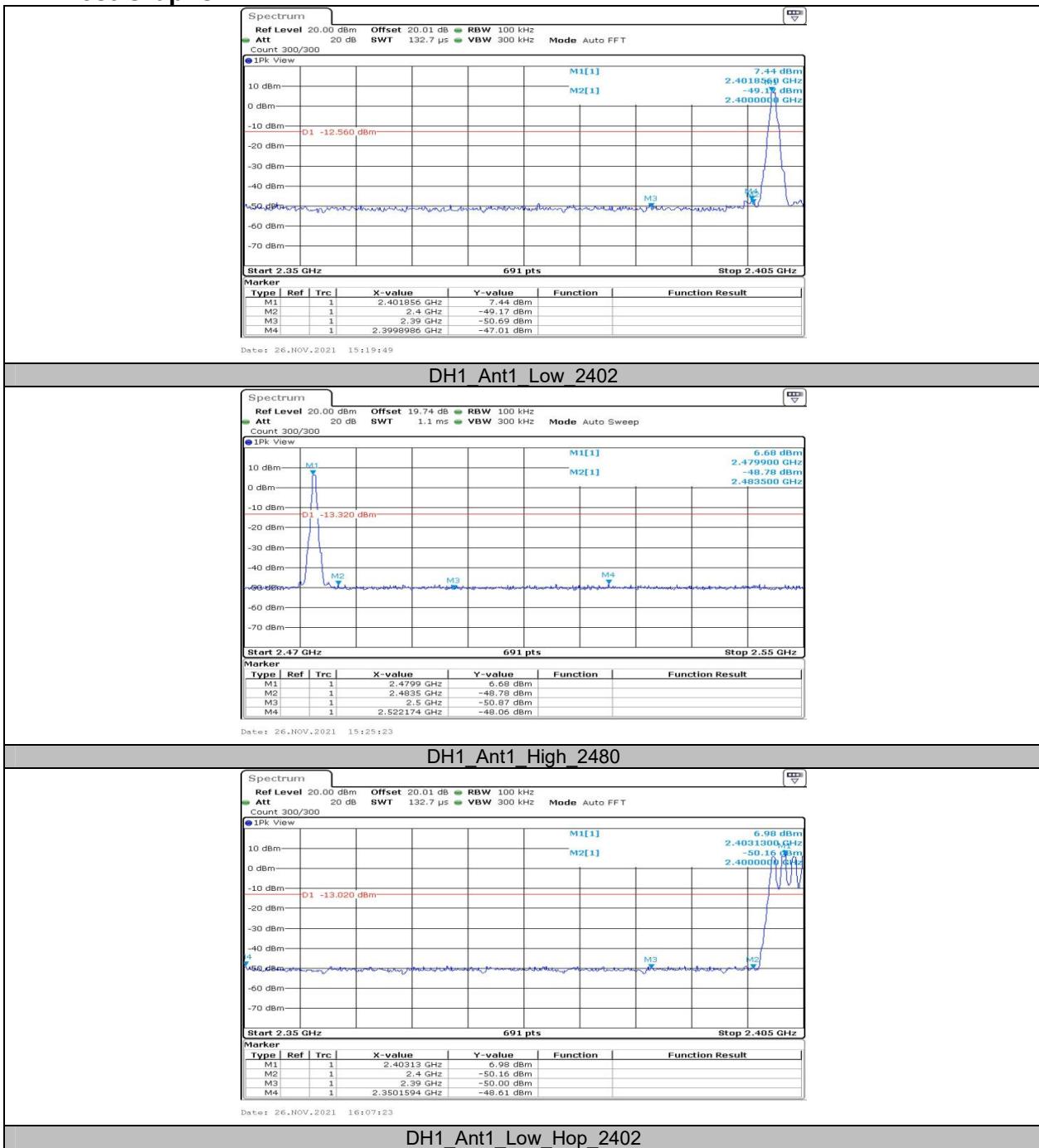
Test Mode	Antenna	Channel	Result[Num]	Limit[Num]	Verdict
DH1	Ant1	Hop	79	≥15	PASS
2DH1	Ant1	Hop	79	≥15	PASS
3DH1	Ant1	Hop	79	≥15	PASS

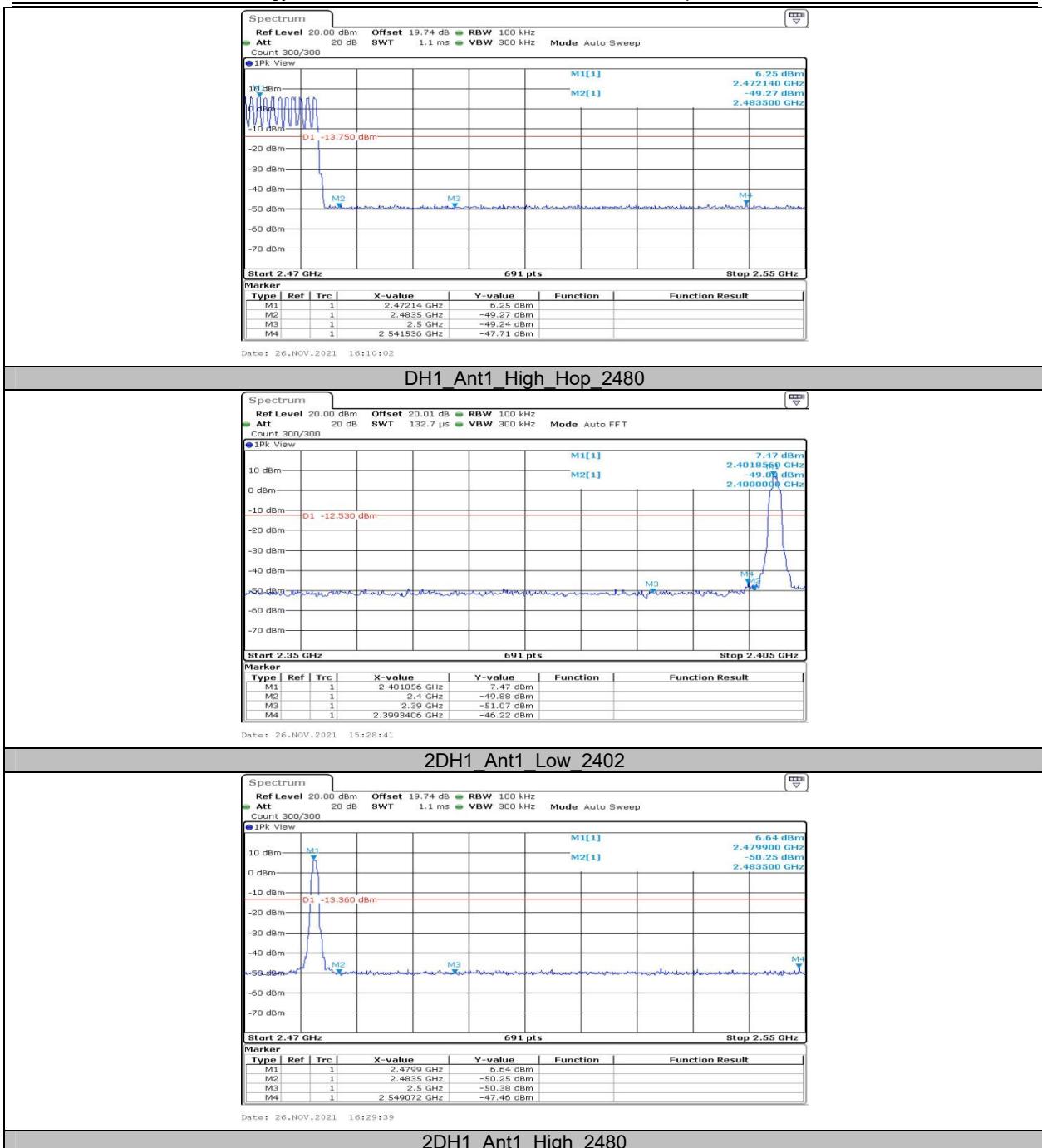
Test Graphs

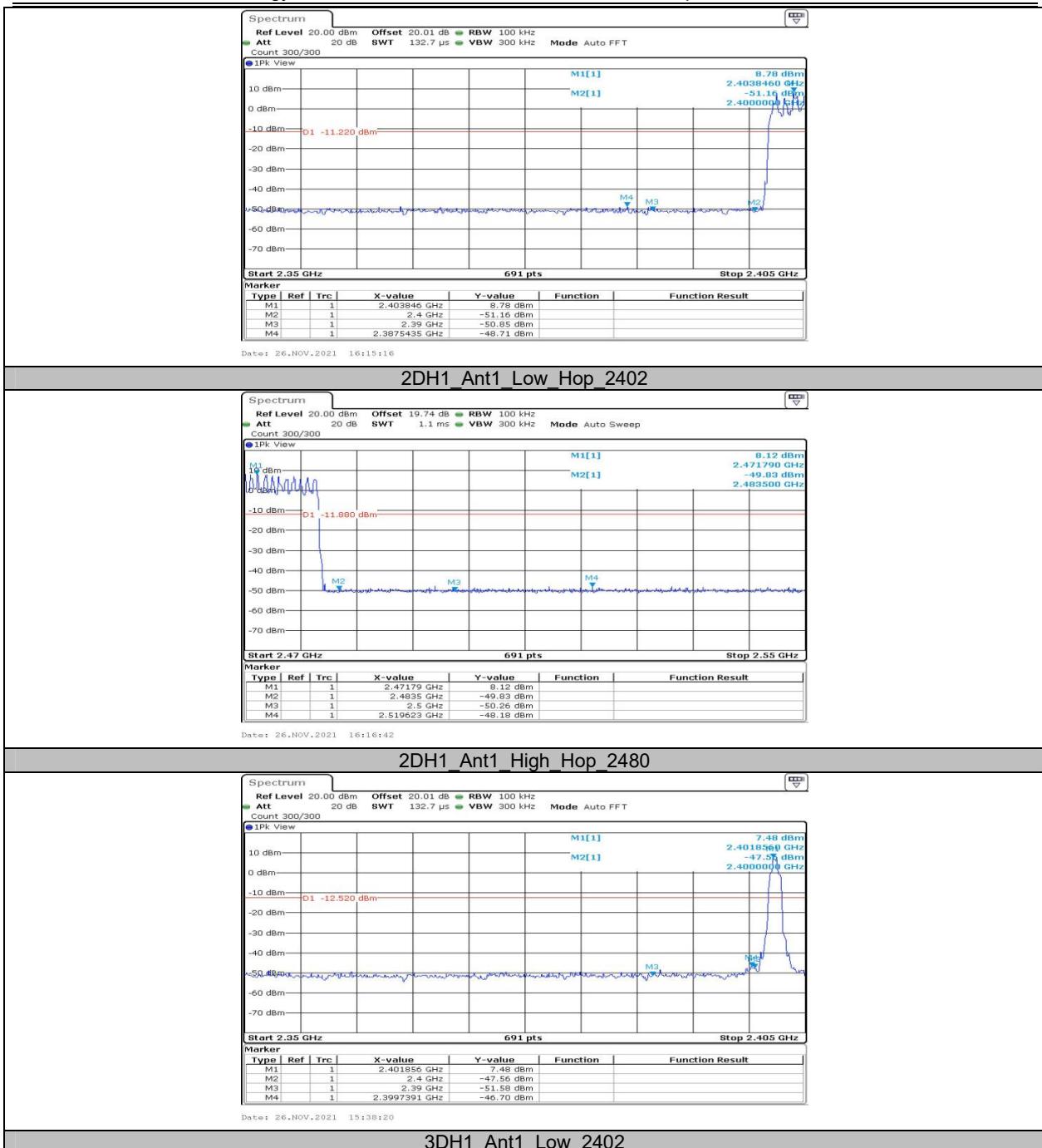


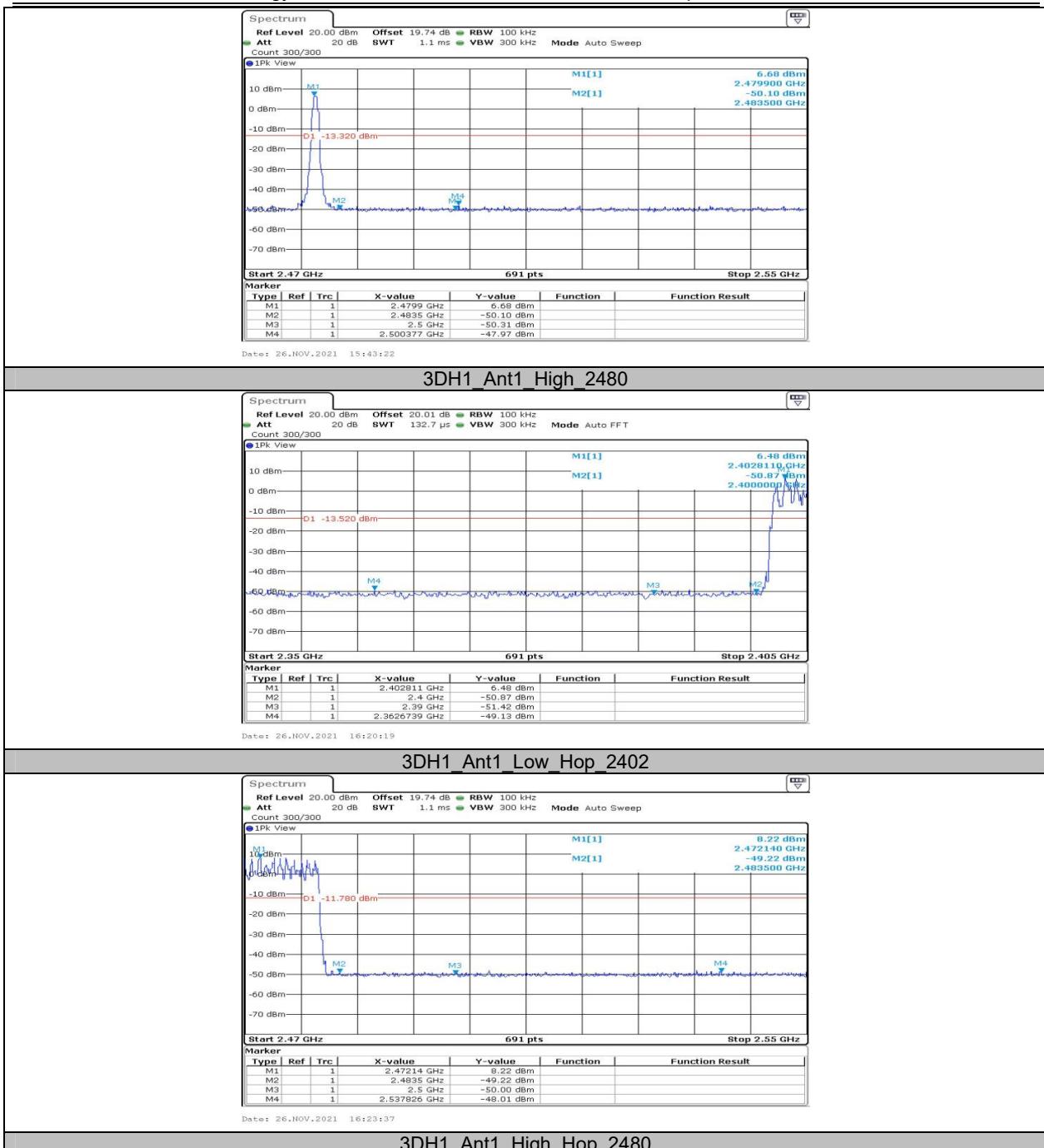
Appendix G: Band edge measurements

Test Graphs









***** END OF REPORT *****