TESTING LABORATORY
CERTIFICATE # 4821.01

FCC PART 15.247
TEST REPORT

For

Gener8 LLC

1901 W. 16th Street,Indianapolis, IN 46202 USA

FCC ID: 2AW5H-GS20901

Report Type:	**Product Type:**
Original Report	Headphones

Report Number: SZ3210720-30081E-RF-00

Report Date: 2021-08-25

Reviewed By: Alvin Huang
Lab Manager

Prepared By: Bay Area Compliance Laboratories Corp. (Shenzhen)
5F(B-West) , 6F, 7F, the 3rd Phase of Wan Li Industrial Building D, Shihua Rd, FuTian Free Trade Zone, Shenzhen, China
Tel: +86-755-33320018
Fax: +86-755-33320008
www.baclcorp.com.cn

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

BACL 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.

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
SUPPORT EQUIPMENT LIST AND DETAILS 6
EXTERNAL I/O CABLE 6
BLOCK DIAGRAM OF TEST SETUP 7
SUMMARY OF TEST RESULTS **8**
TEST EQUIPMENT LIST **9**
FCC§15.247 (i), §1.1307 (b) (1) &§2.1093 – RF EXPOSURE **10**
APPLICABLE STANDARD 10
FCC §15.203 – ANTENNA REQUIREMENT **11**
APPLICABLE STANDARD 11
ANTENNA CONNECTOR CONSTRUCTION 11
FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS **12**
APPLICABLE STANDARD 12
EUT SETUP 12
EMI TEST RECEIVER SETUP 12
TEST PROCEDURE 12
CORRECTED FACTOR & MARGIN CALCULATION 13
TEST DATA 13
FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS **16**
APPLICABLE STANDARD 16
EUT SETUP 16
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP 17
TEST PROCEDURE 17
CORRECTED AMPLITUDE & MARGIN CALCULATION 17
TEST DATA 17
FCC §15.247(a) (1)-CHANNEL SEPARATION TEST **22**
APPLICABLE STANDARD 22
TEST PROCEDURE 22
TEST DATA 22
FCC §15.247(a) (1) – 20 dB EMISSION BANDWIDTH **23**
APPLICABLE STANDARD 23
TEST PROCEDURE 23
TEST DATA 23

FCC §15.247(a) (1) (iii)-QUANTITY OF HOPPING CHANNEL TEST 24
APPLICABLE STANDARD 24
TEST PROCEDURE 24
TEST DATA 24
FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME) 25
APPLICABLE STANDARD 25
TEST PROCEDURE 25
TEST DATA 25
FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT 26
APPLICABLE STANDARD 26
TEST PROCEDURE 26
TEST DATA 26
FCC §15.247(d) - BAND EDGES TESTING 27
APPLICABLE STANDARD 27
TEST PROCEDURE 27
TEST DATA 27
APPENDIX 28
APPENDIX A: 20DB EMISSION BANDWIDTH 28
APPENDIX B: OCCUPIED CHANNEL BANDWIDTH 32
APPENDIX C: MAXIMUM CONDUCTED PEAK OUTPUT POWER 36
APPENDIX D: CARRIER FREQUENCY SEPARATION 40
APPENDIX E: TIME OF OCCUPANCY 42
APPENDIX F: NUMBER OF HOPPING CHANNELS 49
APPENDIX G: BAND EDGE MEASUREMENTS 51

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Headphones
Tested Model	GS20901
Multiple Model	HK-P47
Model Differences	Refer to the DoS letter
Frequency Range	Bluetooth: 2402-2480MHz
Maximum conducted Peak output power	Bluetooth: 1.77dBm
Modulation Technique	Bluetooth: GFSK, π/4-DQPSK, 8DPSK
Antenna Specification*	1.3dBi(It is provided by the applicant)
Voltage Range	DC3.7V from battery
Date of Test	2021-08-10 to 2021-08-19
Sample number	SZ3210720-30081E-RF -S1(Assigned by BACL, Shenzhen)
Received date	2021-07-20
Sample/EUT Status	Good condition

Objective

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

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		±5%
RF Output Power with Power meter		±0.73dB
RF conducted test with spectrum		±1.6dB
AC Power Lines Conducted Emissions		±1.95dB
Emissions, Radiated	Below 1GHz	±4.75dB
	Above 1GHz	±4.60dB
Temperature		±1℃
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

Test Location 1:
1st Floor, East (3) Block, Laobing Building, Xingye Road, Baoan District, Shenzhen, Guangdong, P.R.C
(ISED Registration Number 27372)

Test Items: Radiated emission above 1GHz test

Test Location 2:
5F(B-West) , 6F, 7F, the 3rd Phase of Wan Li Industrial Building D, Shihua Rd, FuTian Free Trade Zone, Shenzhen, China.
(ISED Registration Number 3062B)

Test Items: All other test item

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.: 342867, the FCC Designation No.: CN1221.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in an engineering mode.

EUT Exercise Software

"BT_tool.exe"* software was used to the EUT tested and power level is 7*. The software and power level was provided by the applicant.

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

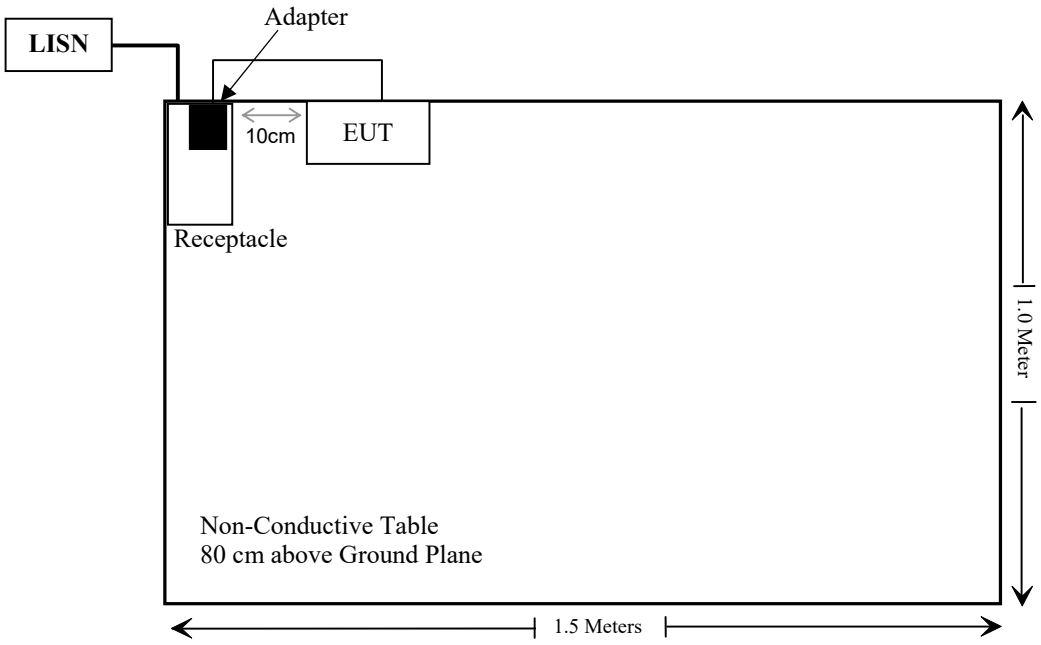
Manufacturer	Description	Model	Serial Number
BLU	Adapter	FX2U-050200U	202182463

External I/O Cable

Cable Description	Length (m)	From Port	To
/	/	/r	/

Block Diagram of Test Setup

For conducted emission:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §1.1307 (b) (1)& §2.1093	RF Exposure	Compliant
§15.203	Antenna Requirement	Compliant
§15.207(a)	AC Line Conducted Emissions	Compliant
§15.205, §15.209 & §15.247(d)	Radiated Emissions	Compliant
§15.247(a)(1)	20 dB Emission Bandwidth	Compliant
§15.247(a)(1)	Channel Separation Test	Compliant
§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Compliant
§15.247(a)(1)(iii)	Quantity of hopping channel Test	Compliant
§15.247(b)(1)	Peak Output Power Measurement	Compliant
§15.247(d)	Band edges	Compliant

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2021/07/06	2022/07/05
Rohde & Schwarz	LISN	ENV216	101613	2021/07/06	2022/07/05
Rohde & Schwarz	Transient Limitor	ESH3Z2	DE25985	2020/11/29	2021/11/28
Unknown	CE Cable	CE Cable	UF A210B-1-0720-504504	2020/11/29	2021/11/28
Rohde & Schwarz	CE Test software	EMC 32	V8.53.0	NCR	NCR
Radiated Emission Test below 1GHz					
R&S	EMI Test Receiver	ESR3	102455	2021/07/06	2022/07/05
Sonoma instrument	Pre-amplifier	310 N	186238	2021/08/03	2022/08/02
Sunol Sciences	Broadband Antenna	JB1	A040904-2	2020/12/22	2023/12/21
Unknown	Cable 2	RF Cable 2	F-03-EM197	2020/11/29	2021/11/28
Unknown	Cable	Chamber Cable 1	F-03-EM236	2020/11/29	2021/11/28
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR
Radiated Emission Test above 1GHz					
Rohde & Schwarz	Spectrum Analyzer	FSV40	101590	2020/12/14	2021/12/13
Preamplifer	Pre-amplifier	PAM-0118	226	2020/11/29	2021/11/28
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2021/06/29	2022/06/29
Agilent	Horn Antenna	AHA-118S	3017	2021-02-25	2022-2-24
Unknown	Cable	Chamber Cable 1	UFB311A-0-0788-50V50VTV	2021/02/03	2022/02/03
Unknown	Cable	Chamber Cable 2	UFB311A-0-0789-50V50VTV	2021/02/03	2022/02/03
Unknown	Cable 2	RF Cable 2	UFB311A-0-0787-50V50VTV	2021/02/03	2022/02/03
Ducommun Technolagies	Horn antenna	ARH-4223-02	1007726-02 1304	2020/12/06	2023/12/05
wainwrigh	Band Reject filter	WRCG2400	2.4G filter	2021/04/20	2022/04/20
Rohde & Schwarz	Auto test software	EZ_EMC.db	1.1.4.2	NCR	NCR
RF Conducted Test					
Tonscend Corporation	RF control Unit	JS0806-2	19D8060154	2021/07/06	2022/07/05
Rohde & Schwarz	Signal and Spectrum Analyzer	FSV40	101473	2021/07/06	2022/07/05
Unknown	RF Cable	Unknown	2301 276	2020/11/29	2021/11/28

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) 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), §1.1307 (b) (1) &§2.1093 – RF EXPOSURE

Applicable Standard

According to FCC §2.1093 and §1.1307(b) (1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

According to KDB 447498 D01 General RF Exposure Guidance

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:
[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where
1. f(GHz) is the RF channel transmit frequency in GHz.
2. Power and distance are rounded to the nearest mW and mm before calculation.
3. The result is rounded to one decimal place for comparison.
4. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test Exclusion.

For worst case:

Frequency (MHz)	Maximum Tune-up power		Calculated Distance (mm)	Calculated Value	Threshold (1-g SAR)	SAR Test Exclusion
	(dBm)	(mW)				
2402-2480	2.0	1.58	5	0.5	3.0	**Yes**

Result: No Standalone SAR test is required

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 1.3dBi, fulfill the requirement of this section. Please refer to the EUT photos.

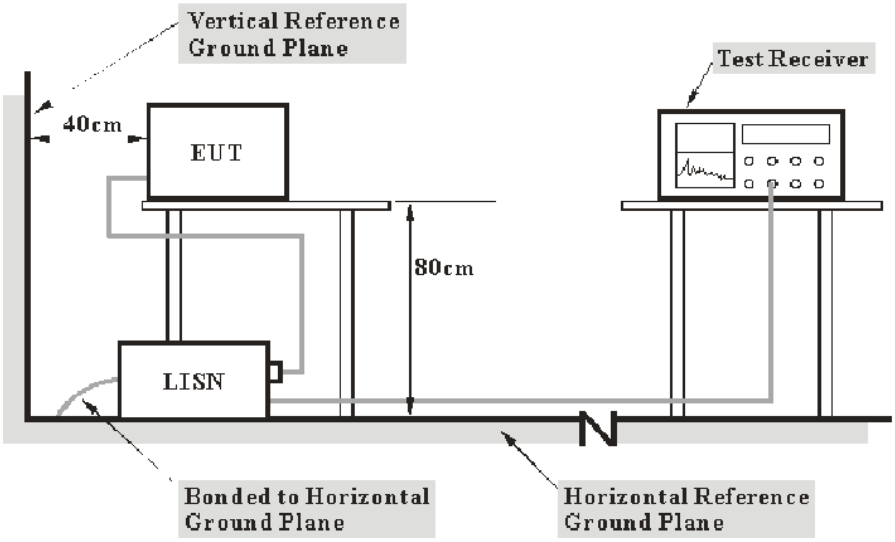
Result: Compliant.

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.

Corrected Factor & Margin Calculation

The Corrected factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

Correction Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

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

Margin = Limit – Corrected Amplitude

Test Data

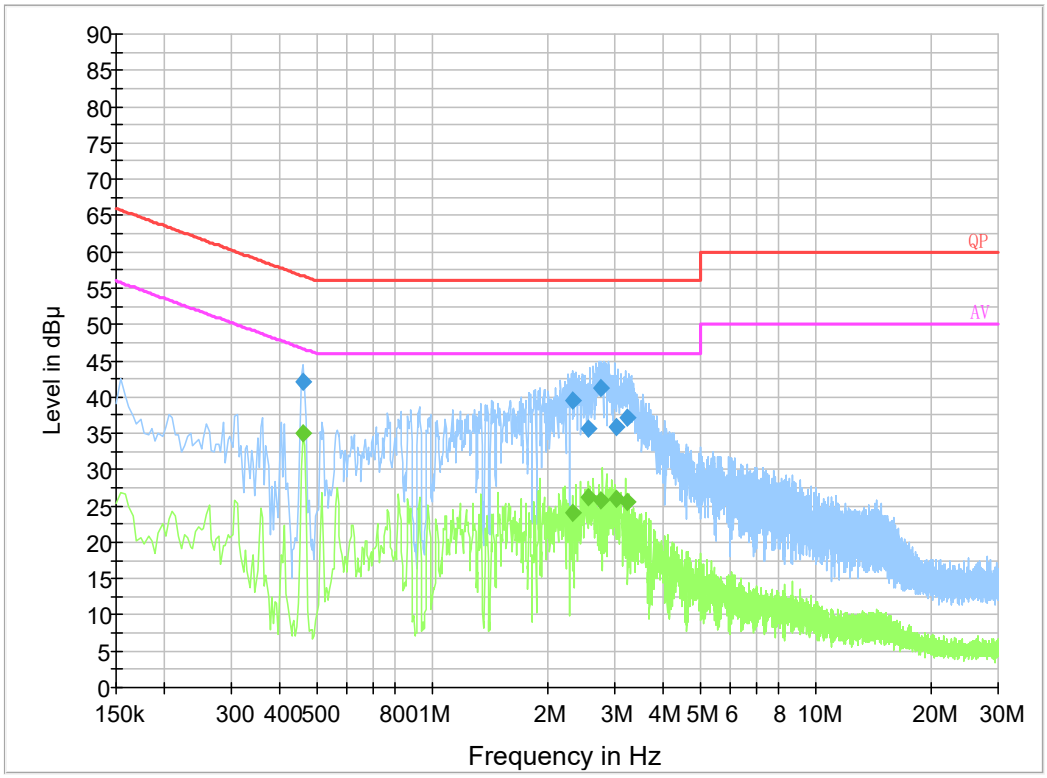
Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	65 %
ATM Pressure:	101.0 kPa

The testing was performed by Haiguo Li on 2021-08-10.

EUT operation mode: Charging

AC 120V/60 Hz, Line



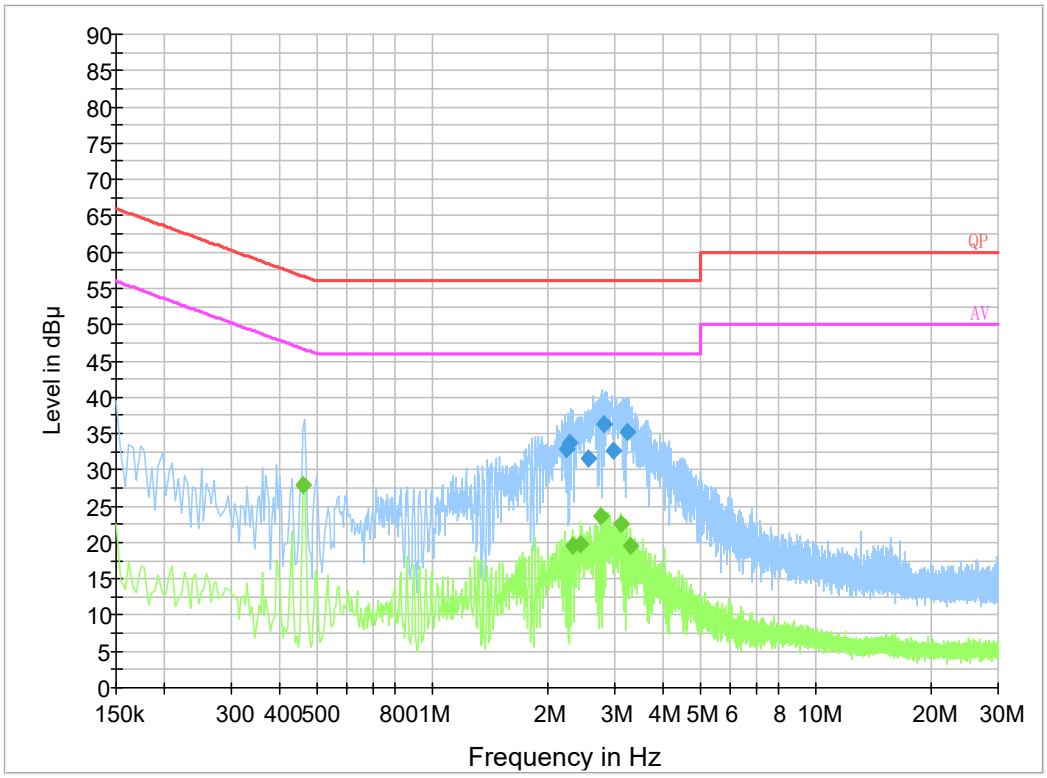
Final Result 1

Frequency (MHz)	QuasiPeak (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.463070	42.1	9.000	L1	19.8	14.5	56.6
2.323050	39.5	9.000	L1	19.9	16.5	56.0
2.563150	35.7	9.000	L1	19.8	20.3	56.0
2.748810	41.2	9.000	L1	19.9	14.8	56.0
3.016970	35.9	9.000	L1	19.9	20.1	56.0
3.225010	37.1	9.000	L1	19.9	18.9	56.0

Final Result 2

Frequency (MHz)	Average (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.463070	35.0	9.000	L1	19.8	11.6	46.6
2.323050	24.0	9.000	L1	19.9	22.0	46.0
2.563150	26.3	9.000	L1	19.8	19.7	46.0
2.748810	25.8	9.000	L1	19.9	20.2	46.0
3.016970	26.0	9.000	L1	19.9	20.0	46.0
3.225010	25.6	9.000	L1	19.9	20.4	46.0

AC 120V/60 Hz, Neutral



Final Result 1

Frequency (MHz)	QuasiPeak (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
2.248070	33.0	9.000	N	19.8	23.0	56.0
2.287530	33.6	9.000	N	19.8	22.4	56.0
2.563030	31.6	9.000	N	19.8	24.4	56.0
2.820270	36.2	9.000	N	19.9	19.8	56.0
2.973750	32.7	9.000	N	19.9	23.3	56.0
3.241010	35.1	9.000	N	19.9	20.9	56.0

Final Result 2

Frequency (MHz)	Average (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.462000	27.9	9.000	N	19.8	18.8	46.7
2.322000	19.5	9.000	N	19.8	26.5	46.0
2.434000	19.7	9.000	N	19.8	26.3	46.0
2.766000	23.5	9.000	N	19.9	22.5	46.0
3.126000	22.6	9.000	N	19.9	23.4	46.0
3.290000	19.5	9.000	N	19.9	26.5	46.0

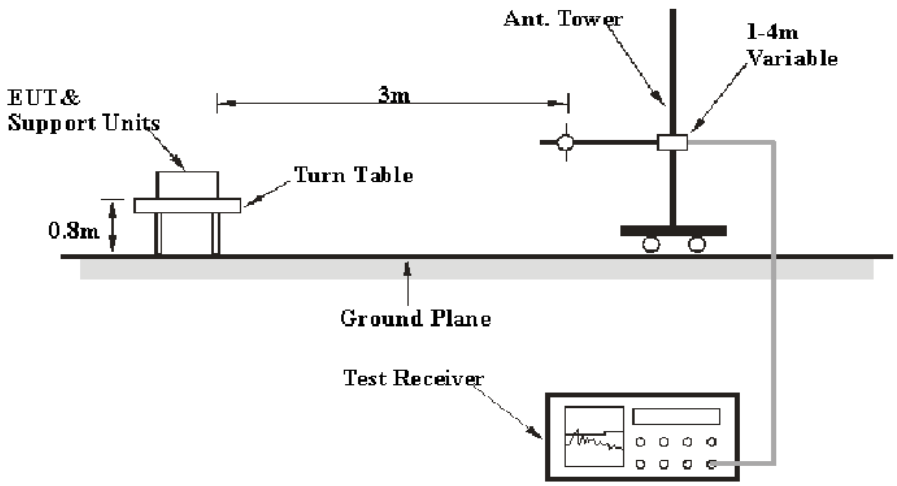
FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS

Applicable Standard

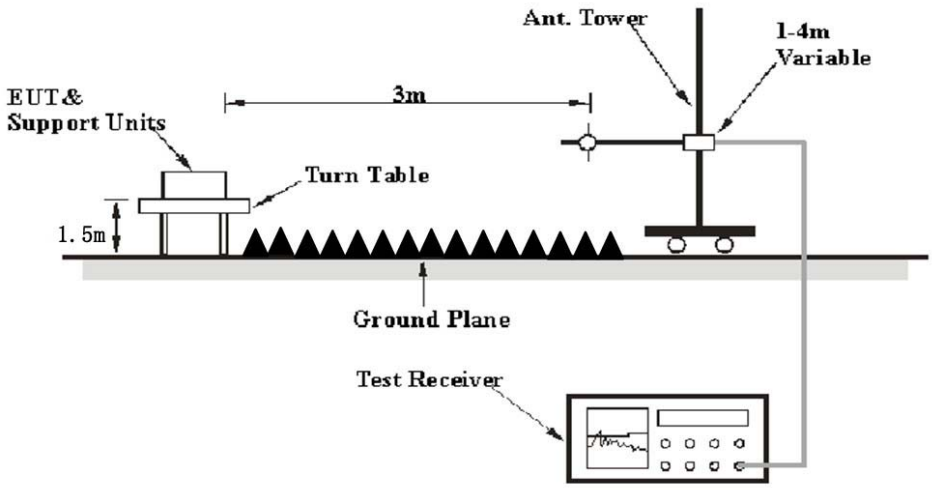
FCC §15.205; §15.209; §15.247(d)

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 Amplitude & Margin Calculation

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

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - Amplifier Gain

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

Margin = Limit – Corrected Amplitude

Test Data

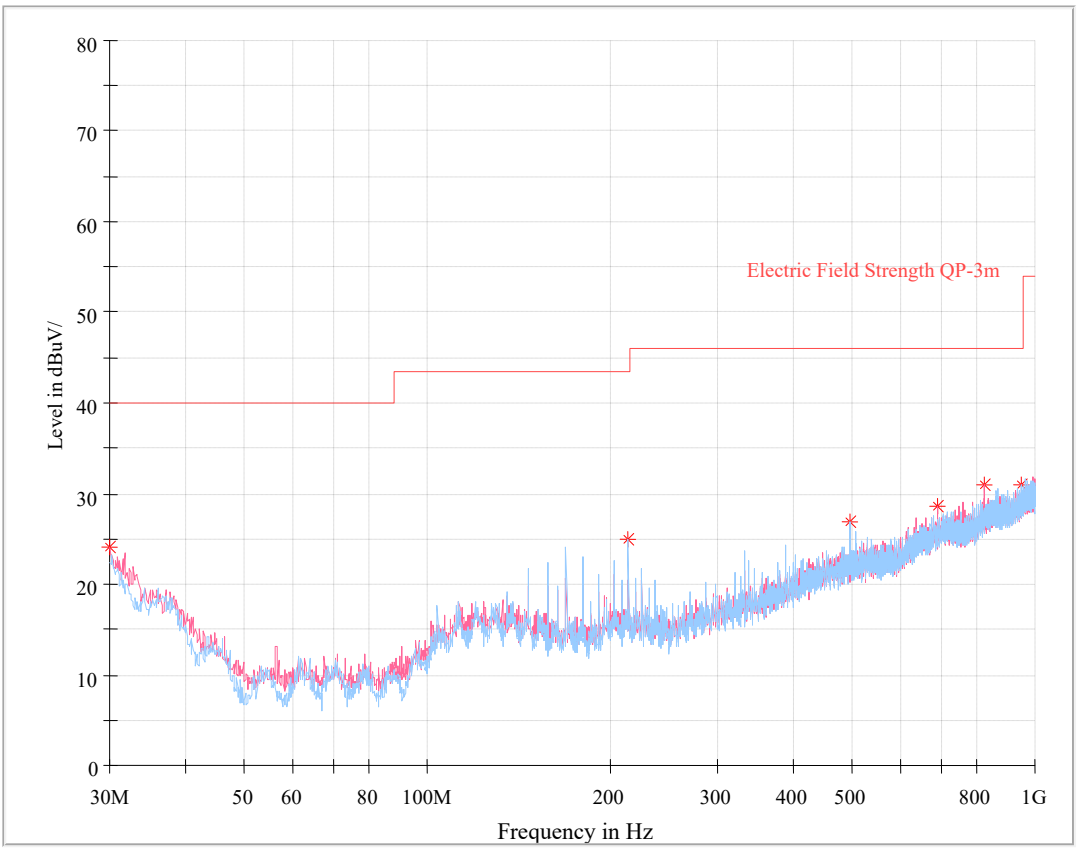
Environmental Conditions

Temperature:	26 ℃
Relative Humidity:	55~56 %
ATM Pressure:	101 kPa

The testing was performed by Cloud Qiu on 2021-08-12 for below 1GHz and Andy Yu on 2021-08-19 for above 1GHz.

EUT operation mode: Transmitting

30 MHz~1 GHz:



Critical_Freqs

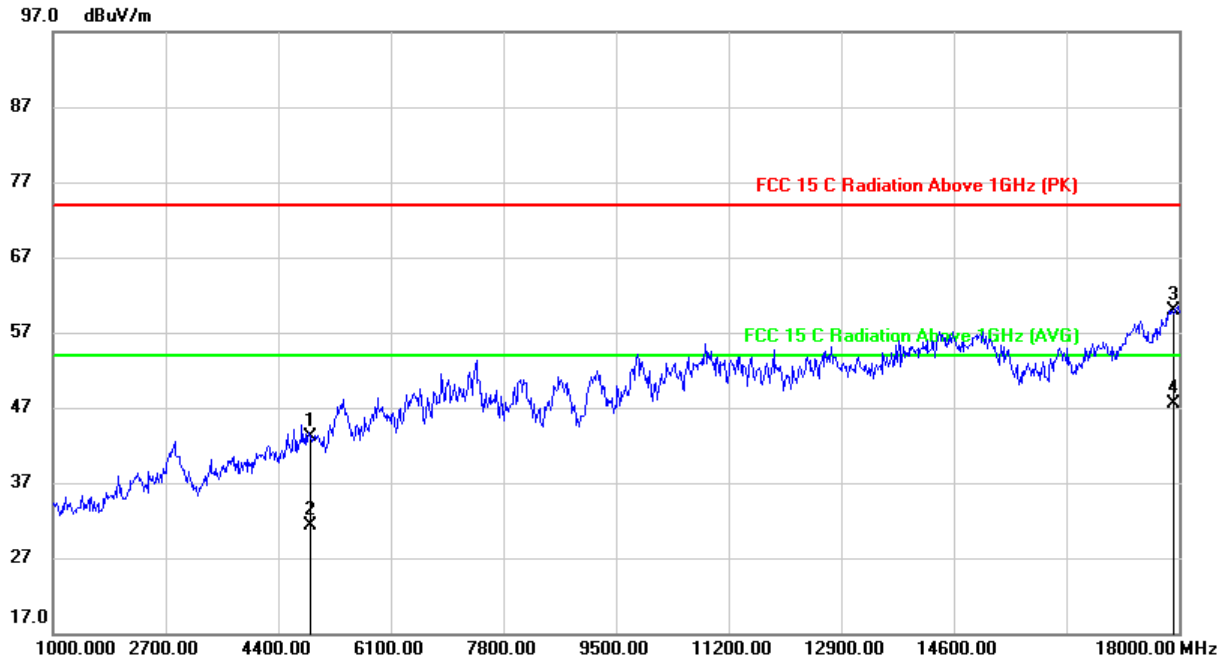
Frequency (MHz)	MaxPeak (dB µ V/m)	Limit (dB µ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.000000	24.18	40.00	15.82	200.0	V	311.0	-3.5
214.421250	25.00	43.50	18.50	200.0	H	181.0	-11.3
496.691250	26.96	46.00	19.04	200.0	H	276.0	-5.1
691.661250	28.50	46.00	17.50	300.0	V	81.0	-1.7
824.793750	30.94	46.00	15.06	100.0	V	174.0	-0.2
950.408750	30.98	46.00	15.02	200.0	H	0.0	1.6

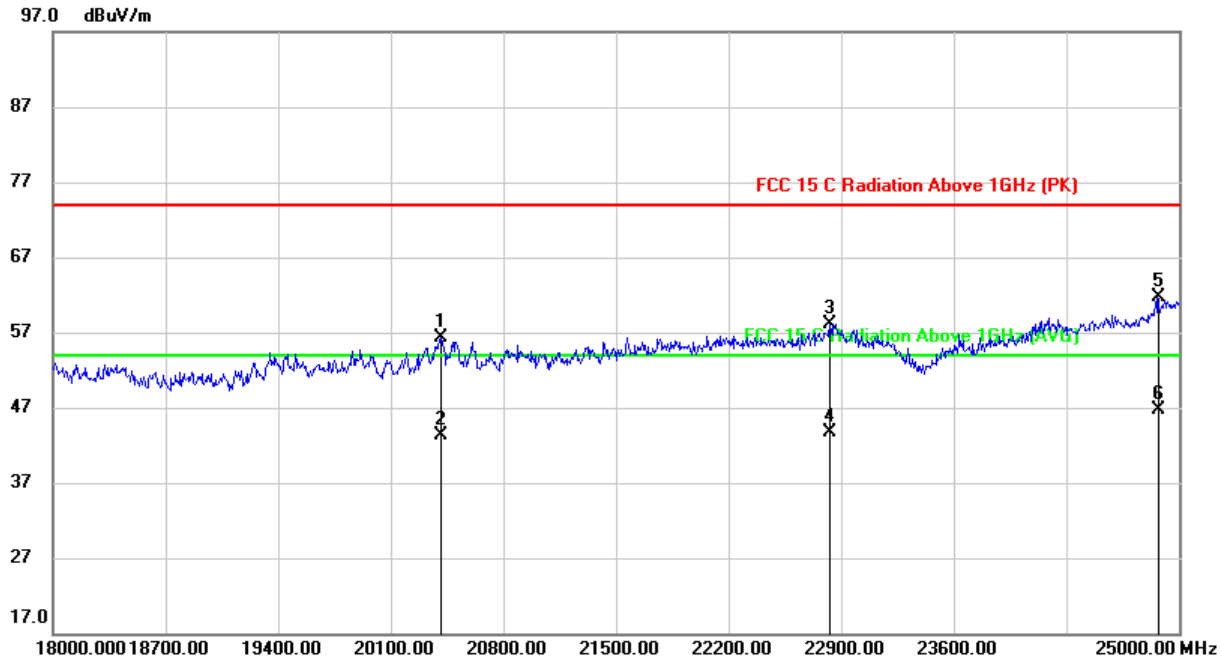
1 GHz - 25 GHz: (*Scan with GFSK, π/4-DQPSK, 8DPSK mode, the worst case is 8DPSK Mode*)

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2402 MHz)									
2385.05	59.2	PK	47	1.4	V	30.91	28.29	74	45.71
2385.05	44.99	Ave.	47	1.4	V	30.91	14.08	54	39.92
2488.22	58.76	PK	347	1.8	V	30.75	28.01	74	45.99
2488.22	45.08	Ave.	347	1.8	V	30.75	14.33	54	39.67
4804.00	47.09	PK	76	1.7	V	-3.49	43.6	74	30.40
4804.00	35.96	Ave.	76	1.7	V	-3.49	32.47	54	21.53
Middle Channel (2441 MHz)									
4882.00	46.23	PK	201	1.6	V	-3.05	43.18	74	30.82
4882.00	36.9	Ave.	201	1.6	V	-3.05	33.85	54	20.15
High Channel (2480 MHz)									
2388.00	58.57	PK	57	1.4	V	30.91	27.66	74	46.34
2388.00	44.99	Ave.	57	1.4	V	30.91	14.08	54	39.92
2491.26	58.72	PK	30	1.8	V	30.74	27.98	74	46.02
2491.26	45.06	Ave.	30	1.8	V	30.74	14.32	54	39.68
4960.00	47.72	PK	274	1.6	V	-2.75	44.97	74	29.03
4960.00	35.13	Ave.	274	1.6	V	-2.75	32.38	54	21.62

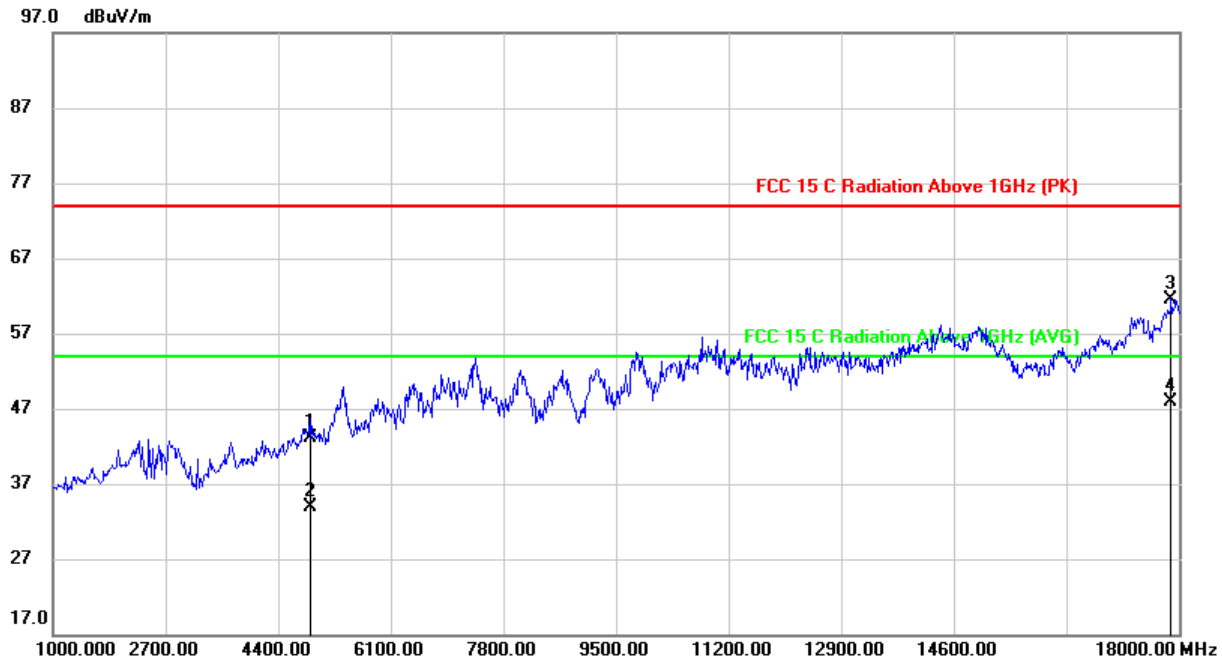
Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude
The other spurious emission which is 20dB to the limit was not recorded.

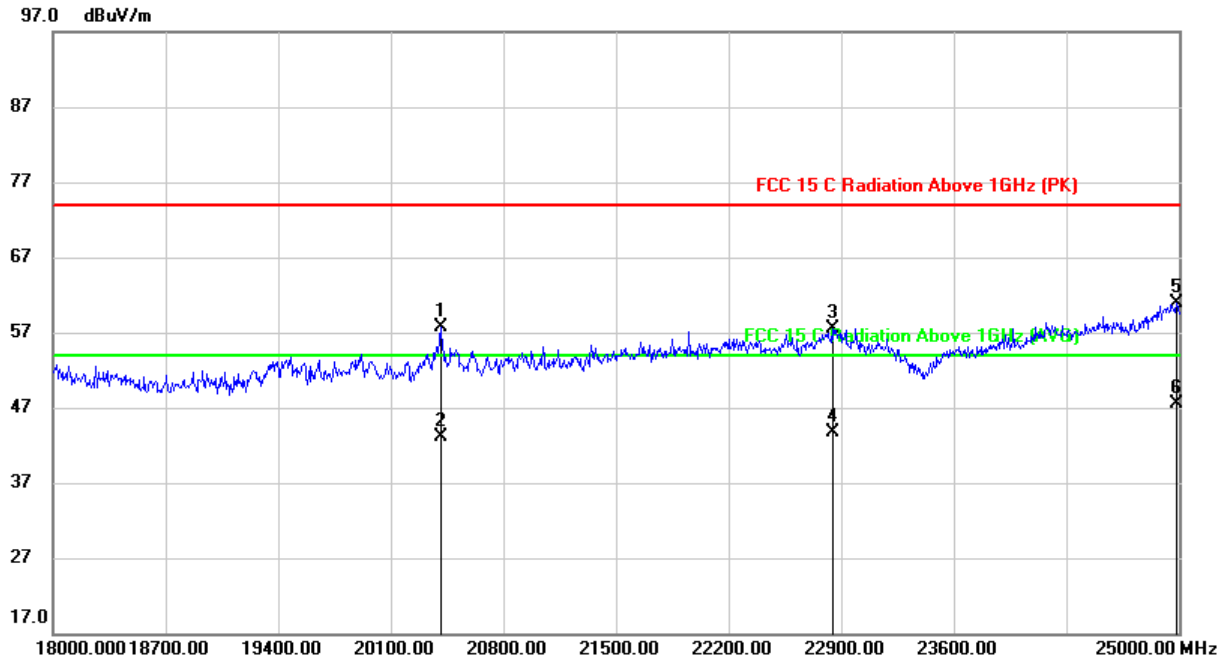
Pre-scan with Middle channel Peak
Horizontal





Vertical


97.0 dBuV/m
87
77
67
57
47
37
27
17.0
FCC 15 C Radiation Above 1GHz (PK)
FCC 15 C Radiation Above 1GHz (AVG)
1000.000 2700.00 4400.00 6100.00 7800.00 9500.00 11200.00 12900.00 14600.00 18000.00 MHz


97.0 dBuV/m
87
77
67
57
47
37
27
17.0
FCC 15 C Radiation Above 1GHz (PK)
FCC 15 C Radiation Above 1GHz (AVG)
18000.000 18700.00 19400.00 20100.00 20800.00 21500.00 22200.00 22900.00 23600.00 25000.00 MHz

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

Applicable Standard

Frequency hopping systems shall have hoping 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 ℃
Relative Humidity:	24 %
ATM Pressure:	101.0 kPa

The testing was performed by Carl Yang on 2021-08-12.

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

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

Test Data

Environmental Conditions

Temperature:	24 ℃
Relative Humidity:	24 %
ATM Pressure:	101.0 kPa

The testing was performed by Carl Yang on 2021-08-12.

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 ℃
Relative Humidity:	24 %
ATM Pressure:	101.0 kPa

The testing was performed by Carl Yang on 2021-08-12.

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 ≥ 3×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 ℃
Relative Humidity:	24 %
ATM Pressure:	101.0 kPa

The testing was performed by Carl Yang on 2021-08-12.

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 ℃
Relative Humidity:	24 %
ATM Pressure:	101.0 kPa

The testing was performed by Carl Yang on 2021-08-12.

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 ℃
Relative Humidity:	24 %
ATM Pressure:	101.0 kPa

The testing was performed by Carl Yang on 2021-08-12.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

APPENDIX

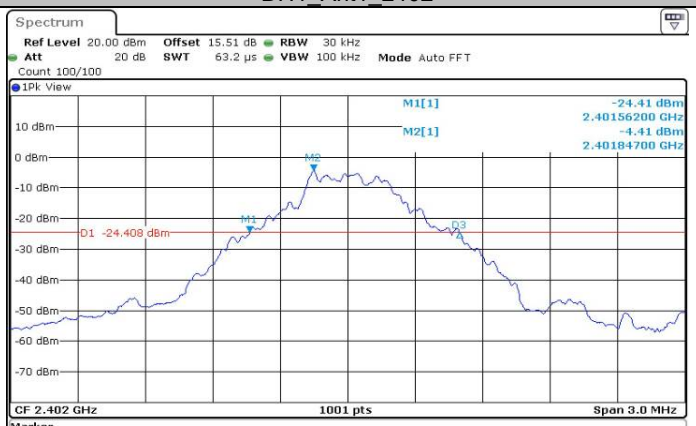
Appendix A: 20dB Emission Bandwidth

Test Result

TestMode	Antenna	Channel	20db EBW[MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	0.936	---	PASS
		2441	0.939	---	PASS
		2480	0.942	---	PASS
2DH1	Ant1	2402	1.269	---	PASS
		2441	1.269	---	PASS
		2480	1.269	---	PASS
3DH1	Ant1	2402	1.257	---	PASS
		2441	1.260	---	PASS
		2480	1.260	---	PASS

Test Graphs

DH1_Ant1_2402

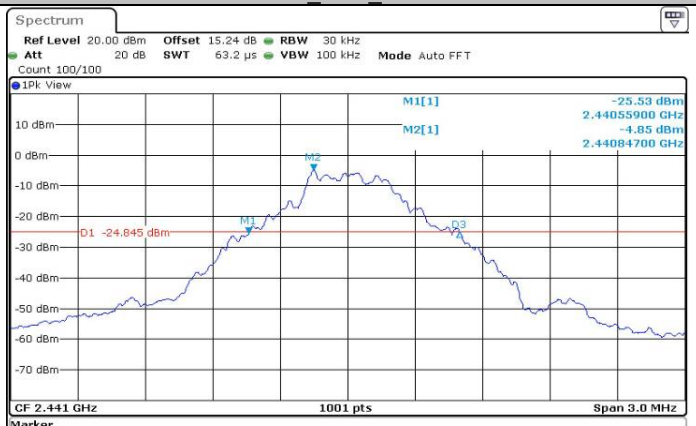


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.401562 GHz	-24.41 dBm		
M2		1	2.401847 GHz	-4.41 dBm		
D3	M1	1	936.0 kHz	-0.02 dB		

Date: 12.AUG.2021 16:55:45

DH1_Ant1_2441

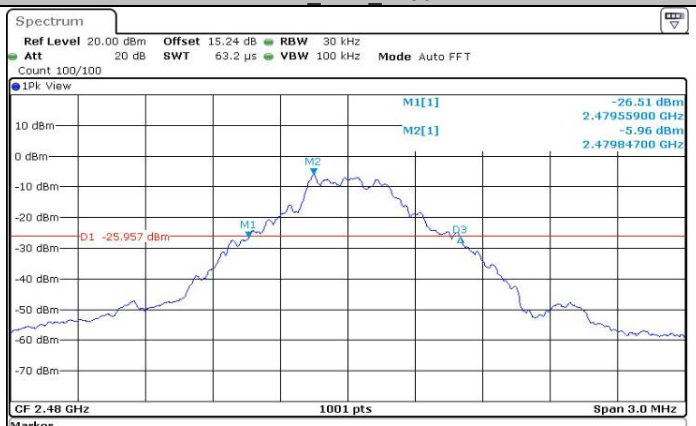


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.440559 GHz	-25.53 dBm		
M2		1	2.440847 GHz	-4.85 dBm		
D3	M1	1	939.0 kHz	0.67 dB		

Date: 12.AUG.2021 16:58:32

DH1_Ant1_2480

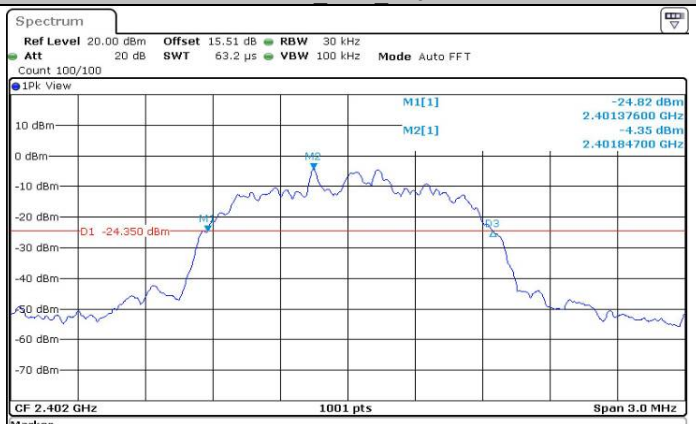


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.479559 GHz	-26.51 dBm		
M2		1	2.479847 GHz	-5.96 dBm		
D3	M1	1	942.0 kHz	0.12 dB		

Date: 12.AUG.2021 16:59:43

2DH1_Ant1_2402

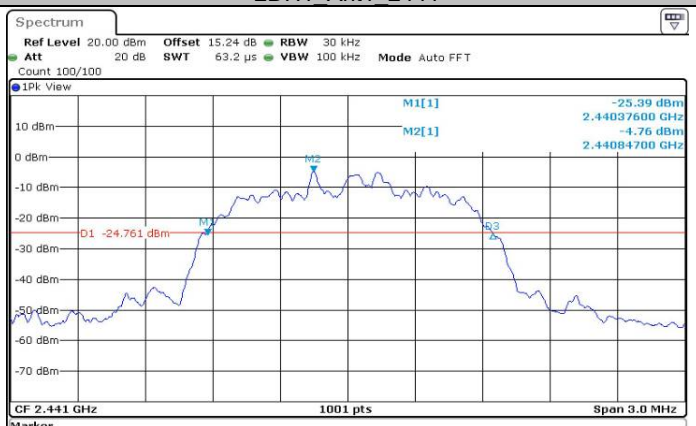


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.401376 GHz	-24.82 dBm		
M2		1	2.401847 GHz	-4.35 dBm		
D3	M1	1	1.269 MHz	0.32 dB		

Date: 12.AUG.2021 17:00:47

2DH1_Ant1_2441

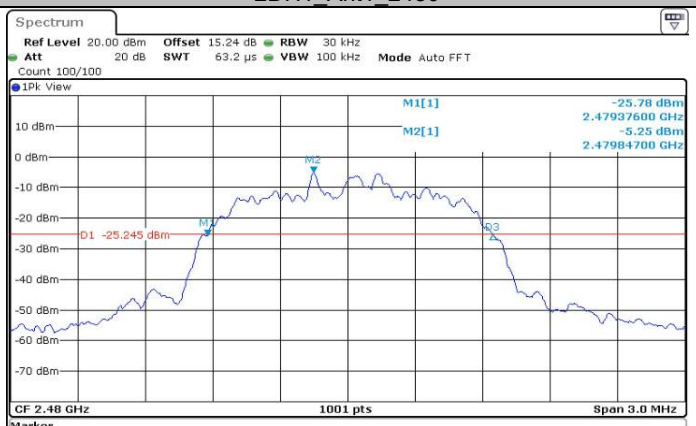


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.440376 GHz	-25.39 dBm		
M2		1	2.440847 GHz	-4.76 dBm		
D3	M1	1	1.269 MHz	0.50 dB		

Date: 12.AUG.2021 17:03:02

2DH1_Ant1_2480

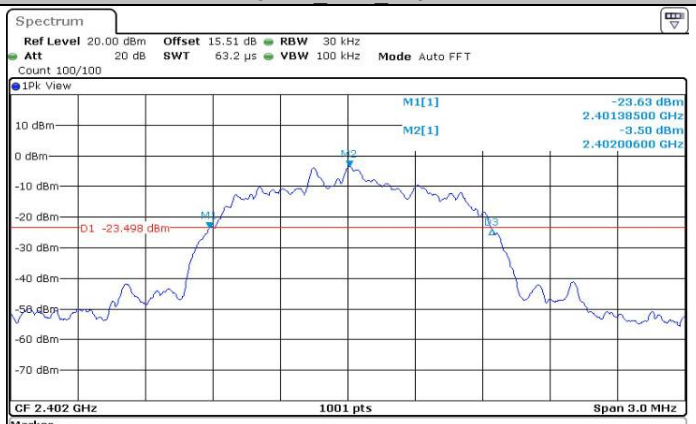


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.479376 GHz	-25.78 dBm		
M2		1	2.479847 GHz	-5.25 dBm		
D3	M1	1	1.269 MHz	0.45 dB		

Date: 12.AUG.2021 17:04:00

3DH1_Ant1_2402



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.401385 GHz	-23.63 dBm		
M2		1	2.402006 GHz	-3.50 dBm		
D3	M1	1	1.257 MHz	-0.20 dB		

Date: 12.AUG.2021 17:04:45

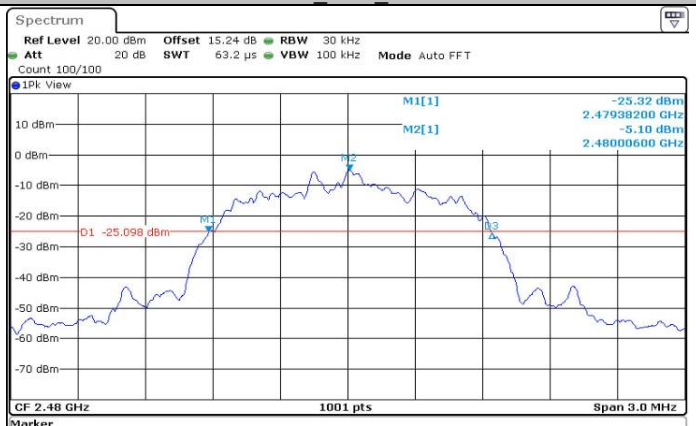
3DH1_Ant1_2441

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.440382 GHz	-24.75 dBm		
M2		1	2.441006 GHz	-4.52 dBm		
D3	M1	1	1.26 MHz	0.08 dB		

Date: 12.AUG.2021 17:05:35

3DH1_Ant1_2480



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.479382 GHz	-25.32 dBm		
M2		1	2.480006 GHz	-5.10 dBm		
D3	M1	1	1.26 MHz	-0.07 dB		

Date: 12.AUG.2021 17:06:22

Appendix B: Occupied Channel Bandwidth

Test Result

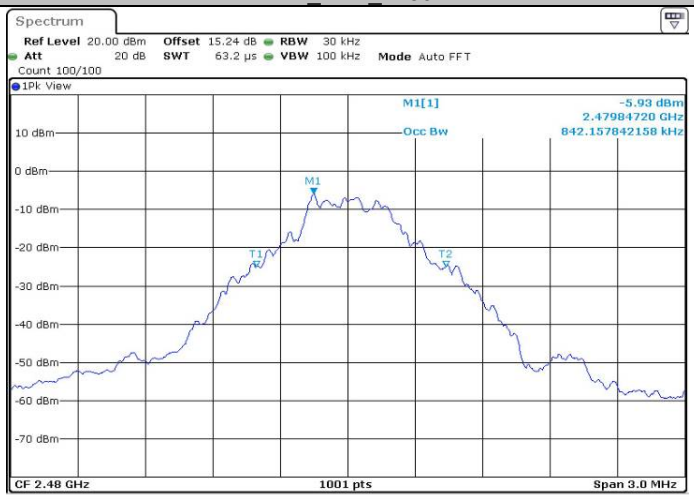
TestMode	Antenna	Channel	OCB [MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	0.839	---	PASS
		2441	0.836	---	PASS
		2480	0.842	---	PASS
2DH1	Ant1	2402	1.157	---	PASS
		2441	1.157	---	PASS
		2480	1.157	---	PASS
3DH1	Ant1	2402	1.151	---	PASS
		2441	1.151	---	PASS
		2480	1.151	---	PASS

Test Graphs

DH1_Ant1_2402

DH1_Ant1_2441

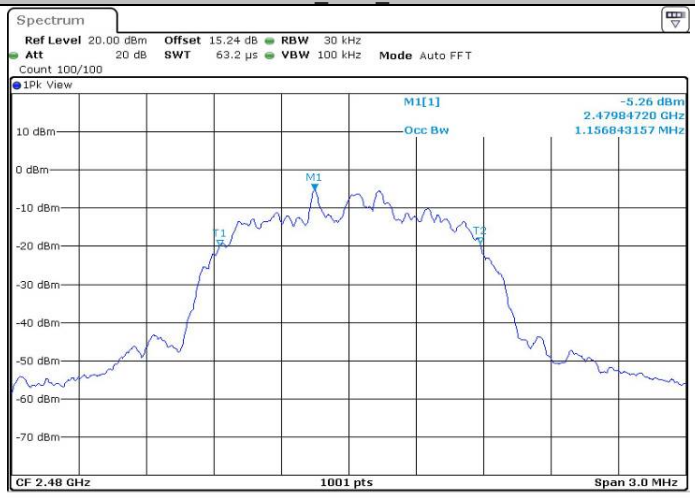
DH1_Ant1_2480



2DH1_Ant1_2402

2DH1_Ant1_2441

2DH1_Ant1_2480



3DH1_Ant1_2402

3DH1_Ant1_2441

3DH1_Ant1_2480

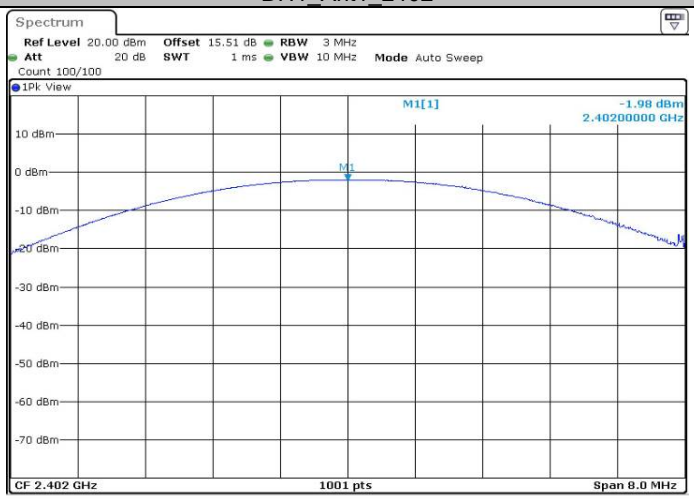
Appendix C: Maximum conducted Peak output power

Test Result

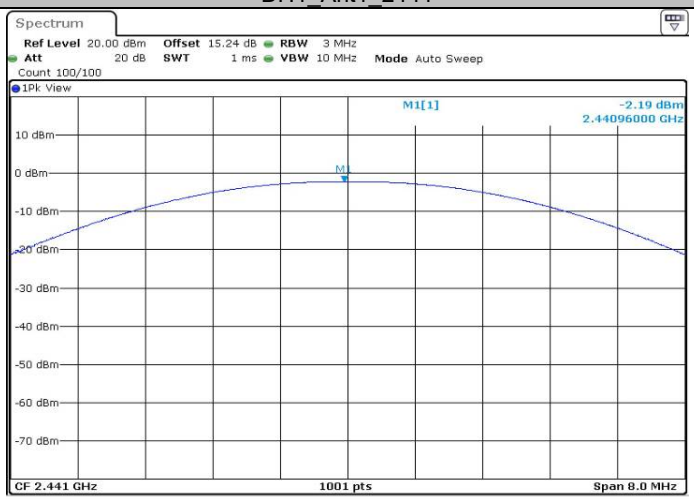
TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
DH1	Ant1	2402	-1.98	≤30	PASS
		2441	-2.19	≤30	PASS
		2480	-3.49	≤30	PASS
2DH1	Ant1	2402	0.28	≤30	PASS
		2441	0	≤30	PASS
		2480	-0.45	≤30	PASS
3DH1	Ant1	2402	1.77	≤30	PASS
		2441	0.77	≤30	PASS
		2480	0.23	≤30	PASS

Test Graphs

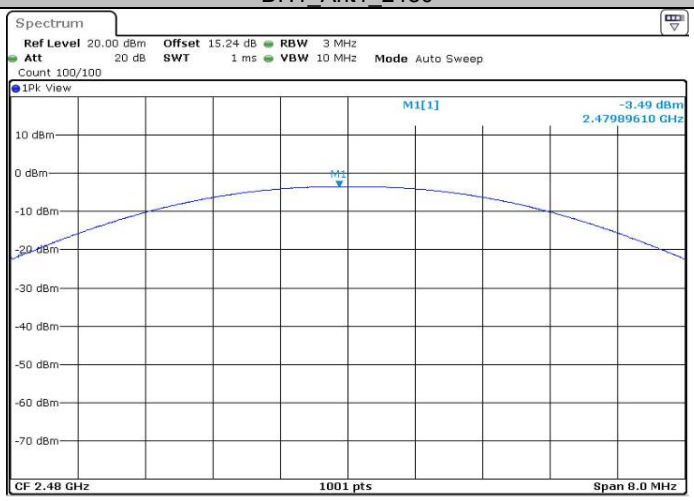
DH1_Ant1_2402



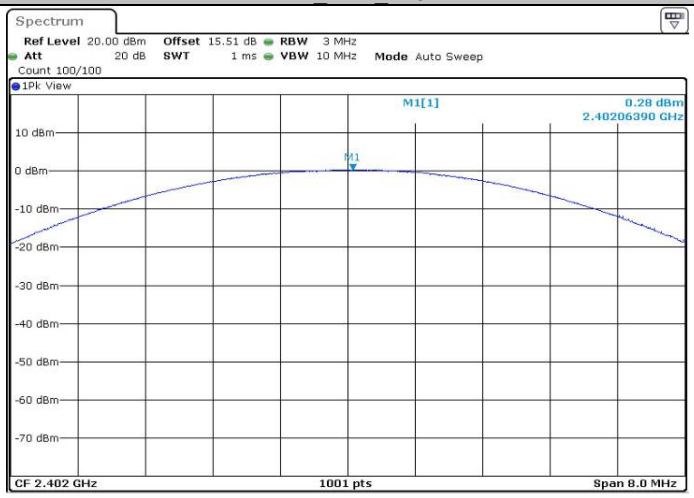
DH1_Ant1_2441



DH1_Ant1_2480

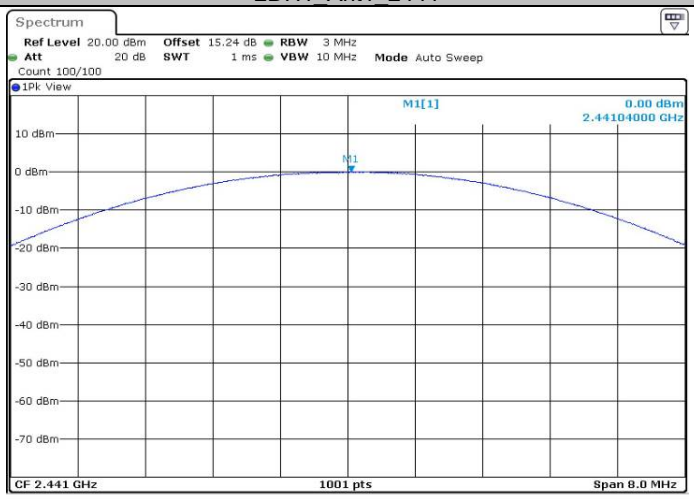


2DH1_Ant1_2402



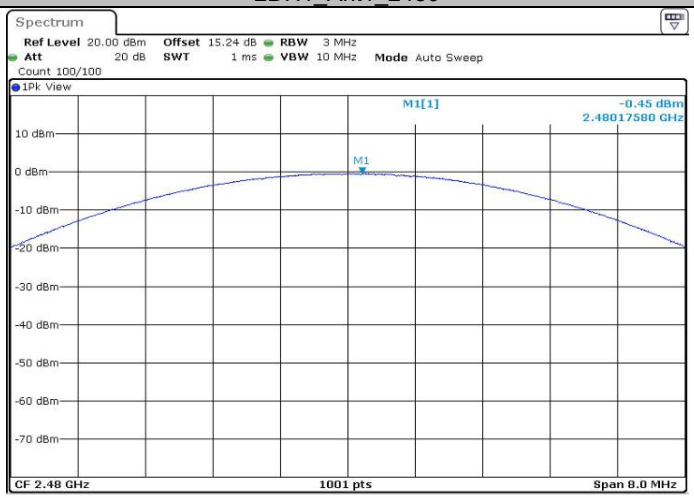
Date: 12.AUG.2021 17:00:22

2DH1_Ant1_2441



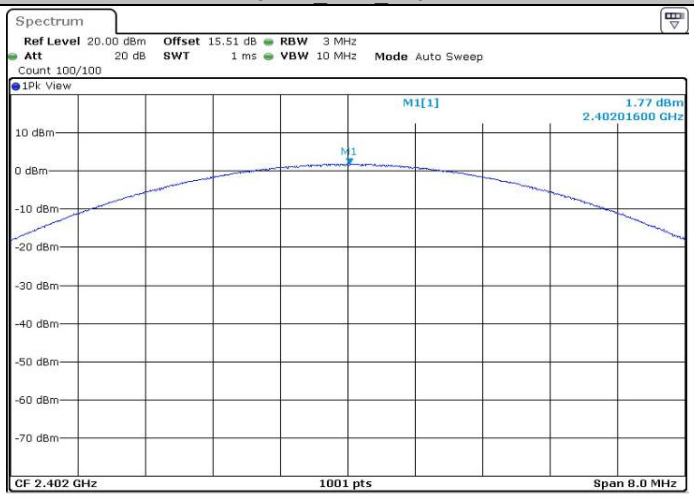
Date: 12.AUG.2021 17:02:36

2DH1_Ant1_2480



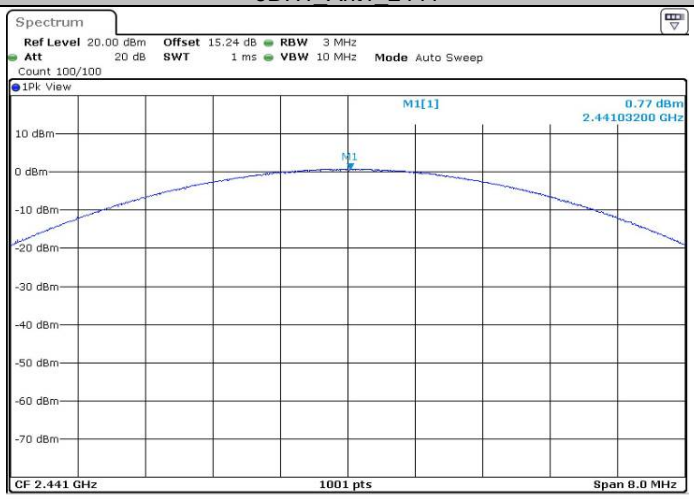
Date: 12.AUG.2021 17:03:33

3DH1_Ant1_2402



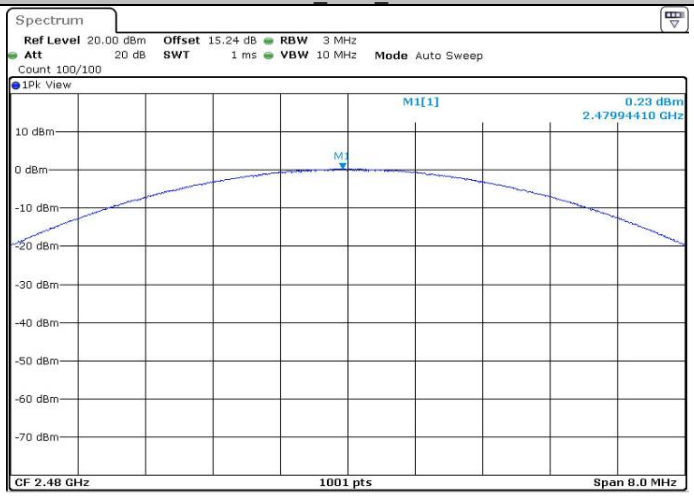
Date: 12.AUG.2021 17:05:10

3DH1_Ant1_2441



Date: 12.AUG.2021 17:05:51

3DH1_Ant1_2480



Date: 12.AUG.2021 17:06:46

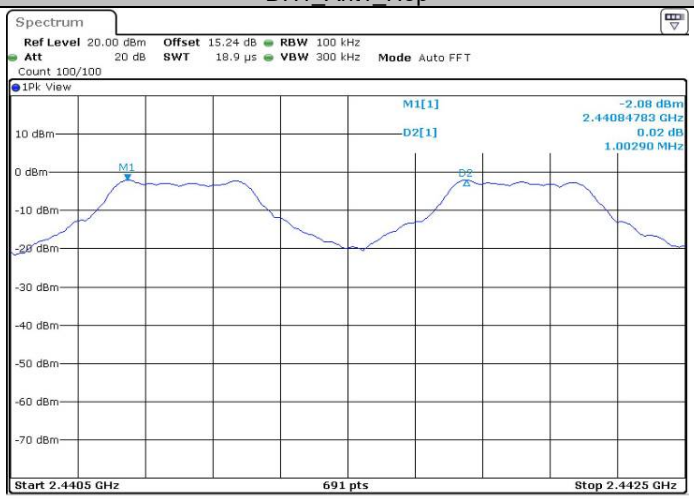
Appendix D: Carrier frequency separation

Test Result

TestMode	Antenna	Channel	Result[MHz]	Limit[MHz]	Verdict
DH1	Ant1	Hop	1.003	≥0.626	PASS
2DH1	Ant1	Hop	1.003	≥0.846	PASS
3DH1	Ant1	Hop	1.003	≥0.840	PASS

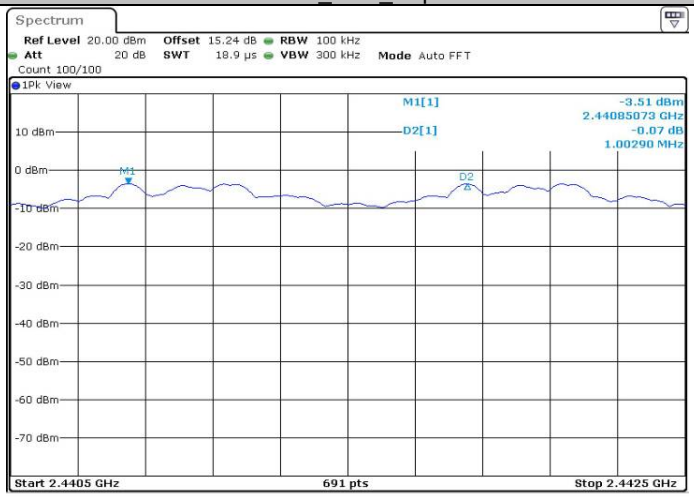
Test Graphs

DH1_Ant1_Hop



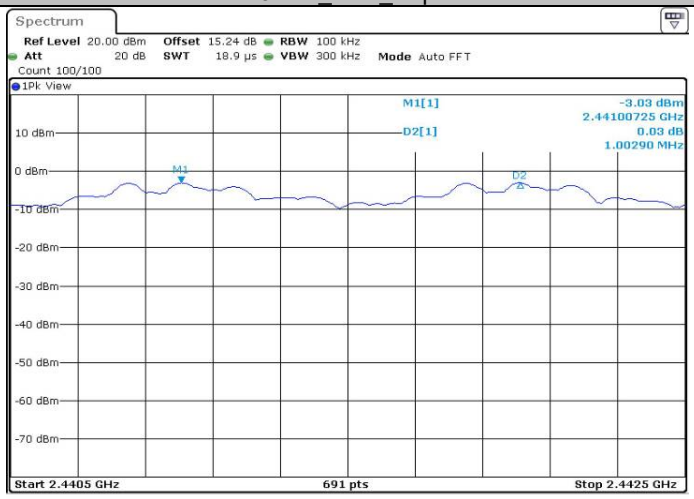
Date: 12.AUG.2021 17:09:23

2DH1_Ant1_Hop



Date: 12.AUG.2021 17:28:56

3DH1_Ant1_Hop



Date: 12.AUG.2021 17:30:04

Appendix E: Time of occupancy

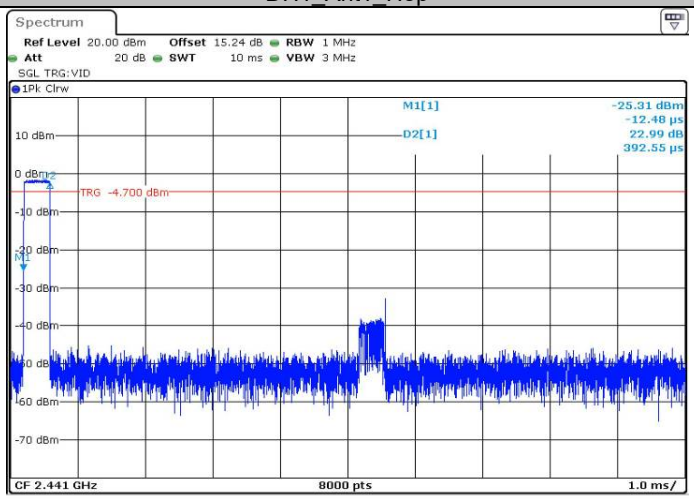
Test Result

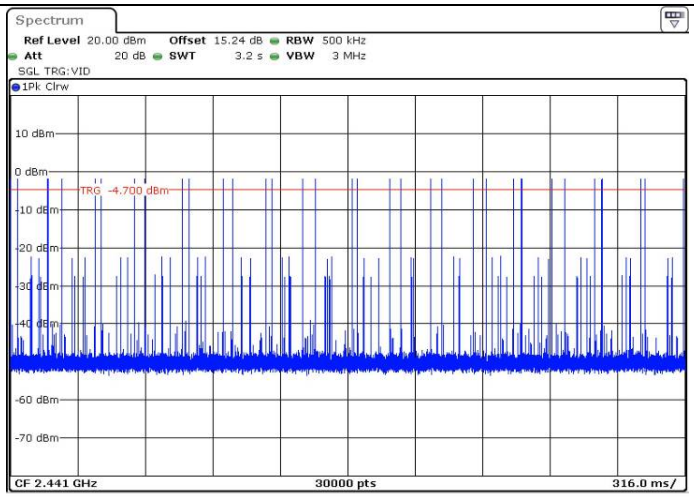
TestMode	Antenna	Channel	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH1	Ant1	Hop	0.39	330	0.13	≤0.4	PASS
DH3	Ant1	Hop	1.64	140	0.23	≤0.4	PASS
DH5	Ant1	Hop	2.88	100	0.288	≤0.4	PASS
2DH1	Ant1	Hop	0.40	320	0.129	≤0.4	PASS
2DH3	Ant1	Hop	1.65	170	0.281	≤0.4	PASS
2DH5	Ant1	Hop	2.89	100	0.289	≤0.4	PASS
3DH1	Ant1	Hop	0.40	320	0.129	≤0.4	PASS
3DH3	Ant1	Hop	1.65	150	0.247	≤0.4	PASS
3DH5	Ant1	Hop	2.89	130	0.376	≤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)

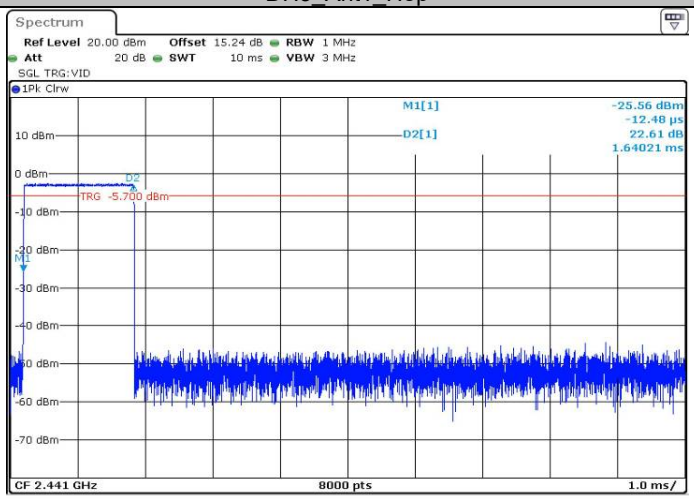
Test Graphs

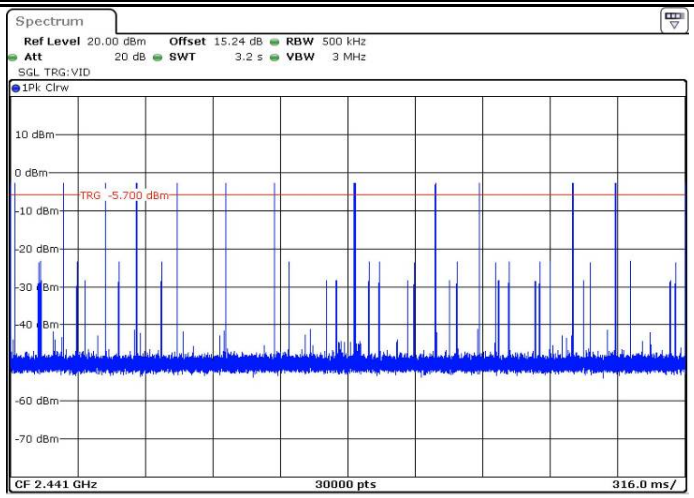
DH1_Ant1_Hop





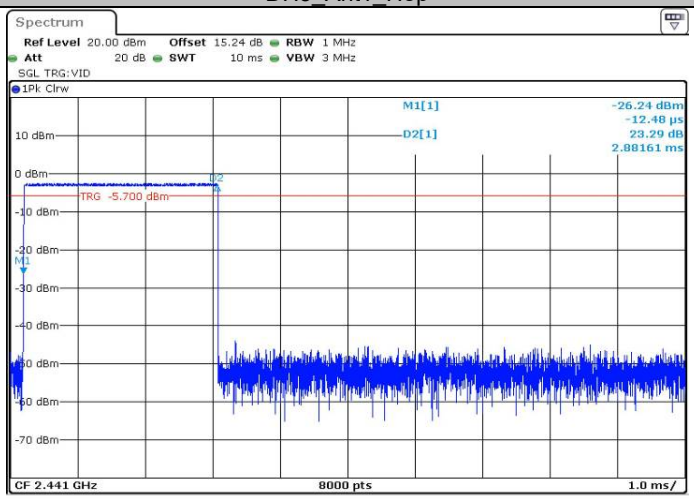
DH3_Ant1_Hop



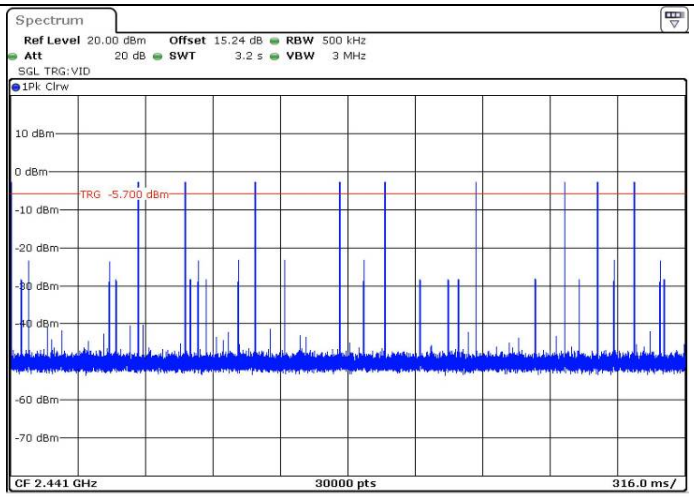


Date: 12.AUG.2021 17:31:41

DH5_Ant1_Hop

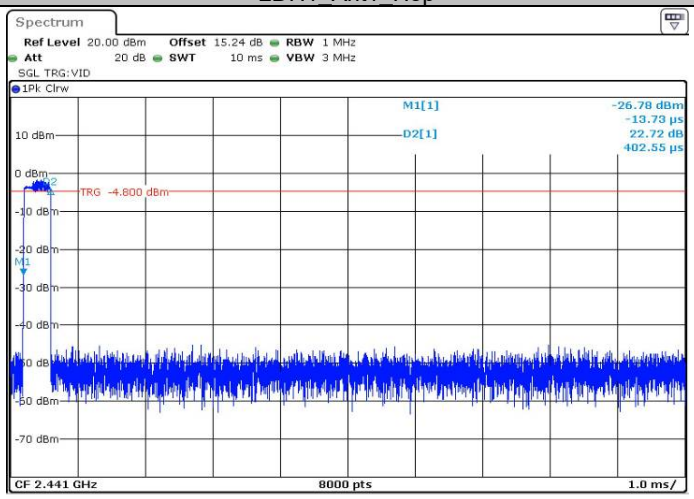


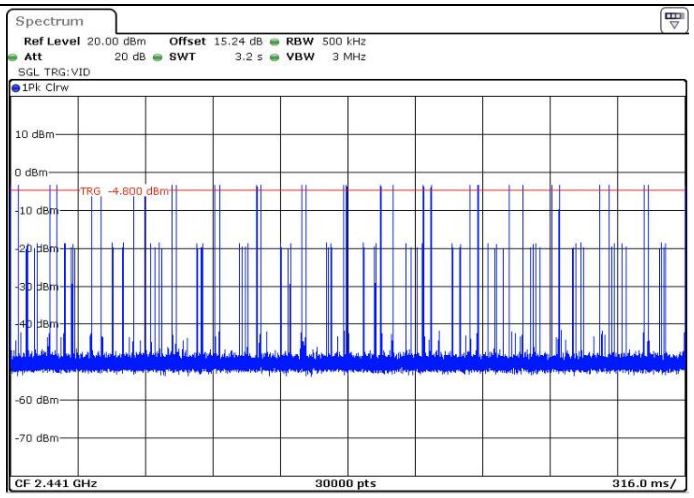
Date: 12.AUG.2021 17:32:31



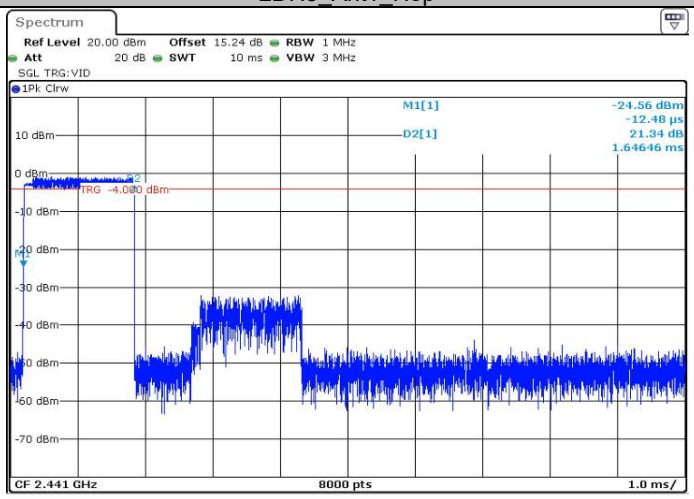
Date: 12.AUG.2021 17:32:37

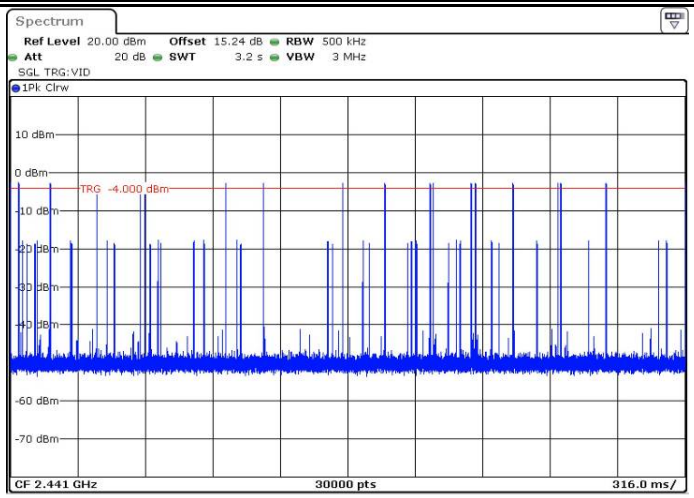
2DH1_Ant1_Hop



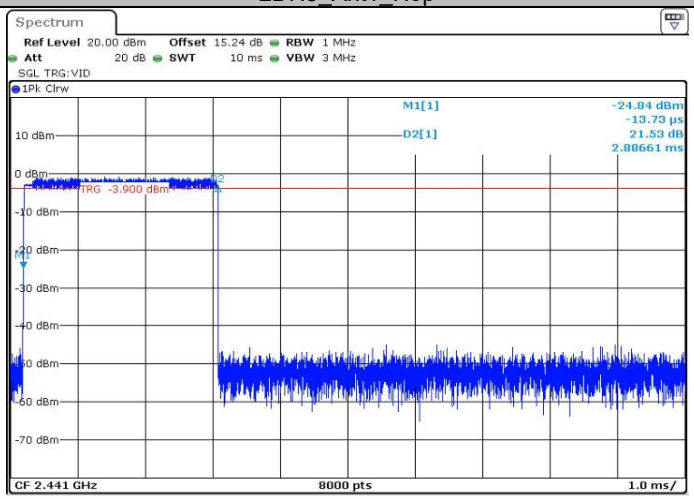


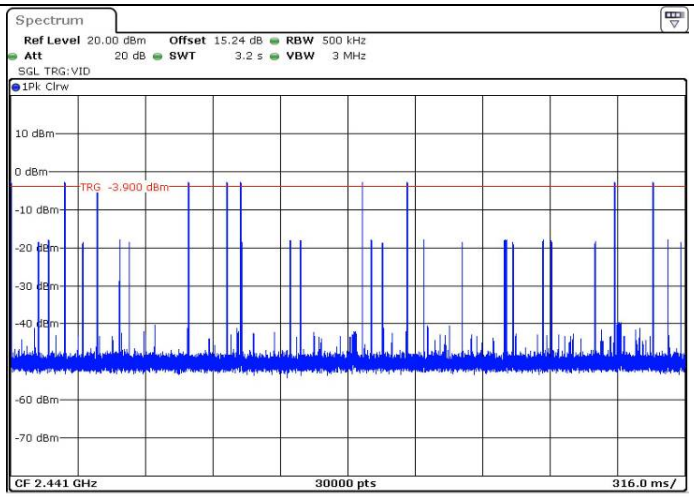
2DH3_Ant1_Hop



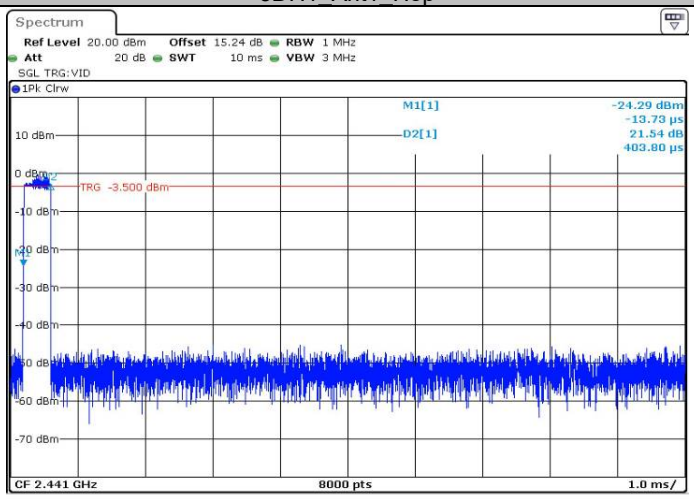


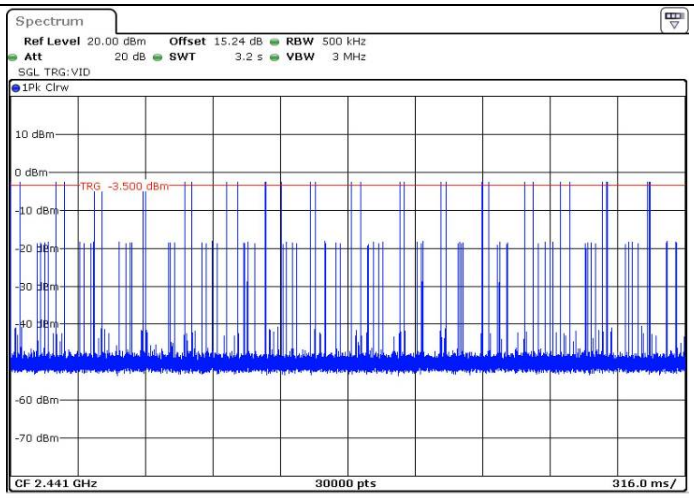
2DH5_Ant1_Hop



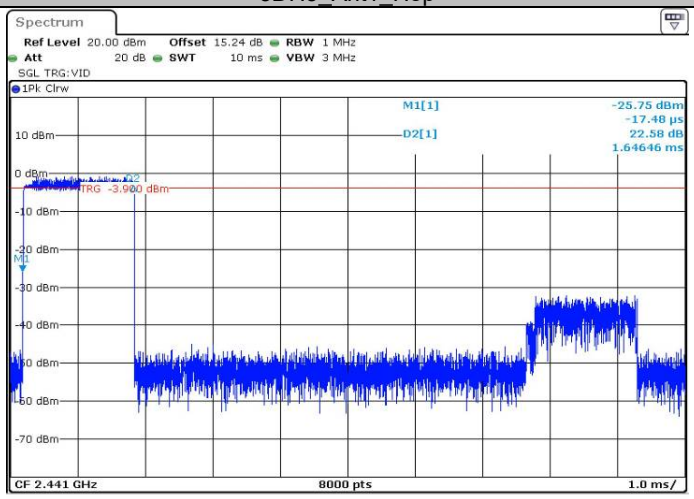


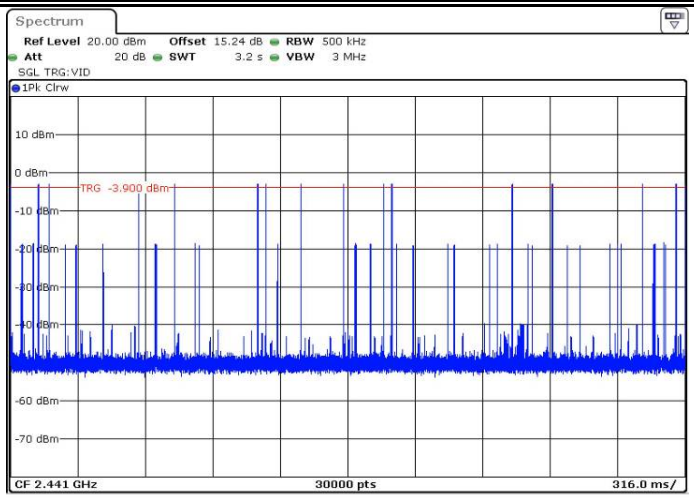
3DH1_Ant1_Hop





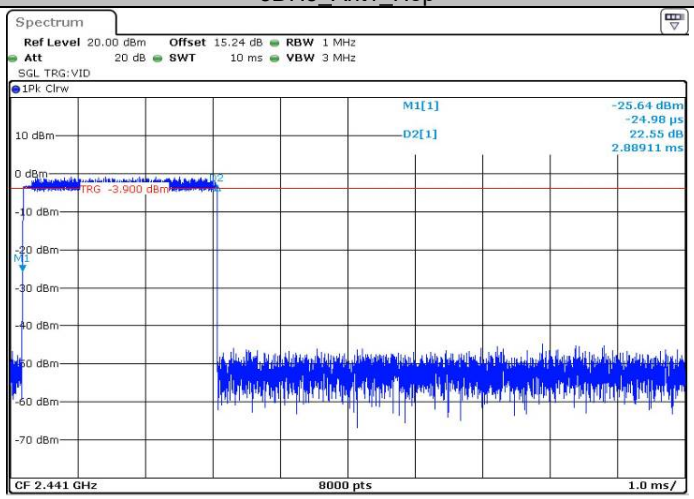
3DH3_Ant1_Hop



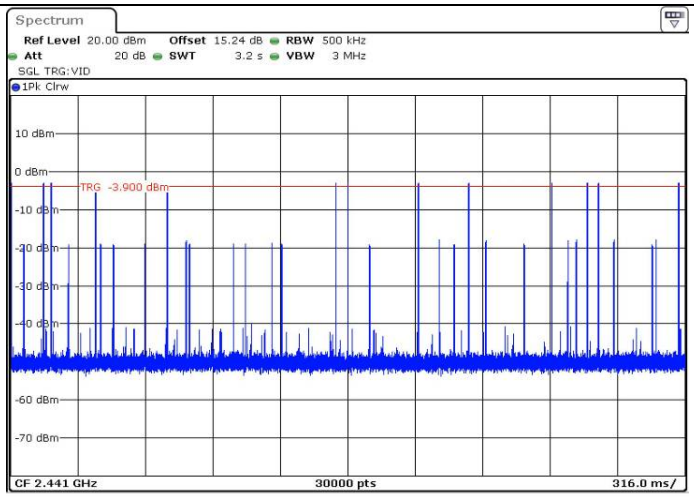


Date: 12.AUG.2021 17:35:08

3DH5_Ant1_Hop



Date: 12.AUG.2021 17:36:01



Date: 12.AUG.2021 17:36:06

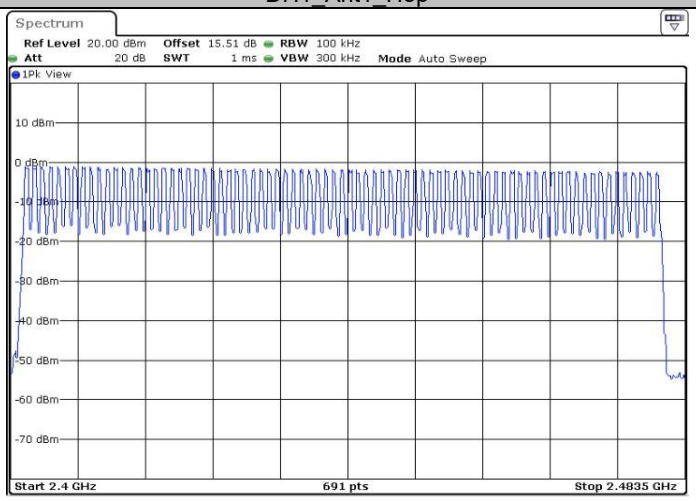
Appendix F: Number of hopping channels

Test Result

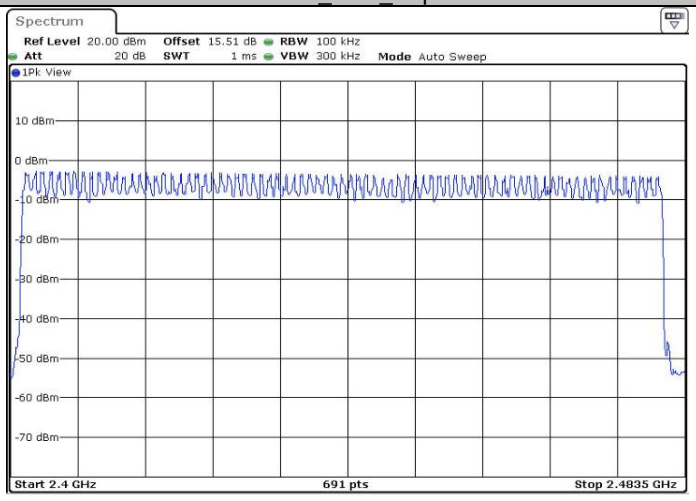
TestMode	Antenna	Channel	Result[Num]	Limit[Num]	Verdict
DH1	Ant1	Hop	79	≥15	PASS
2DH1	Ant1	Hop	79	≥15	PASS
3DH1	Ant1	Hop	79	≥15	PASS

Test Graphs

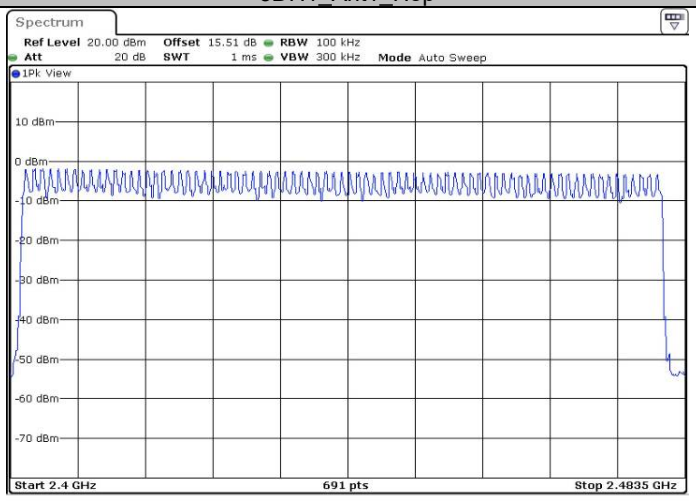
DH1_Ant1_Hop



2DH1_Ant1_Hop



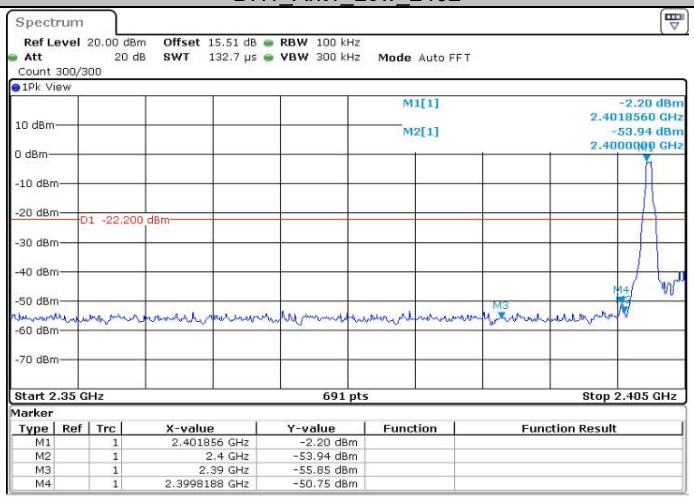
3DH1_Ant1_Hop



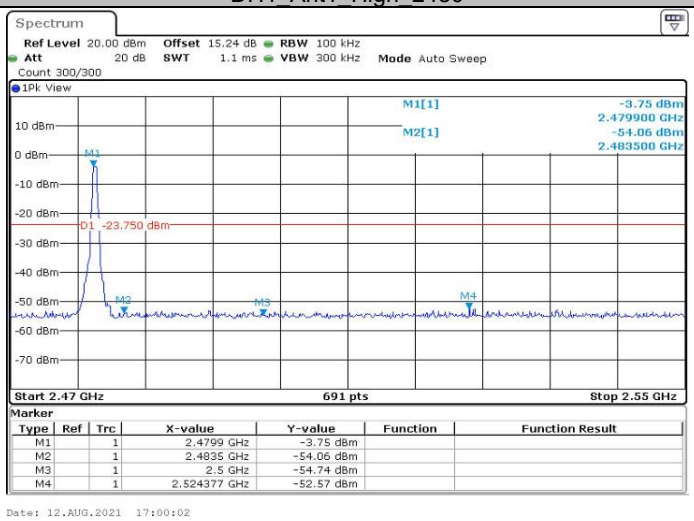
Appendix G: Band edge measurements

Test Graphs

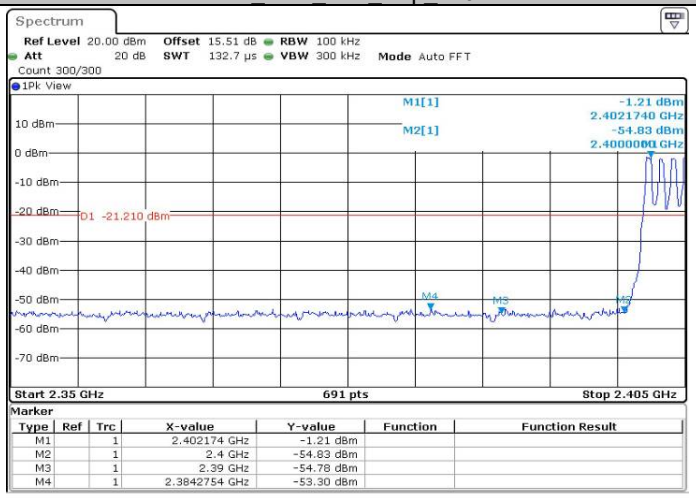
DH1_Ant1_Low_2402



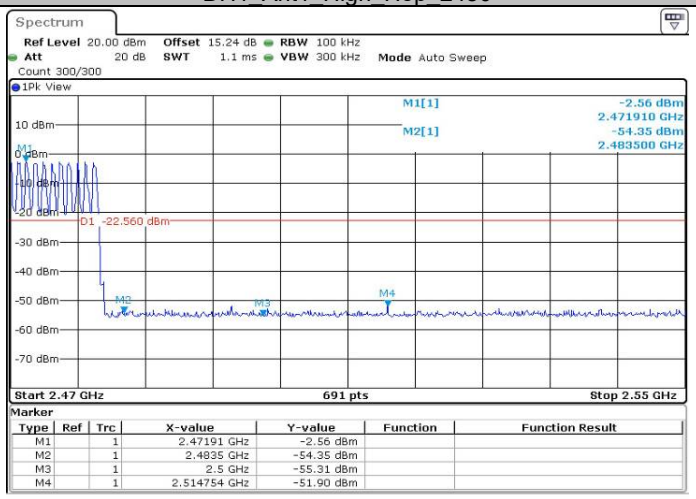
DH1_Ant1_High_2480



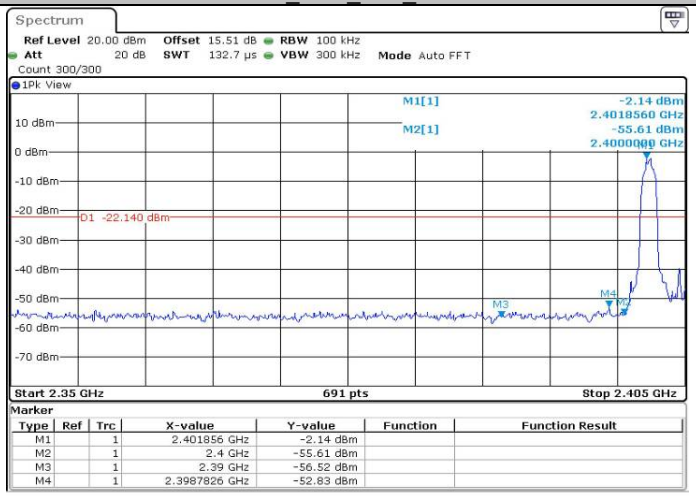
DH1_Ant1_Low_Hop_2402



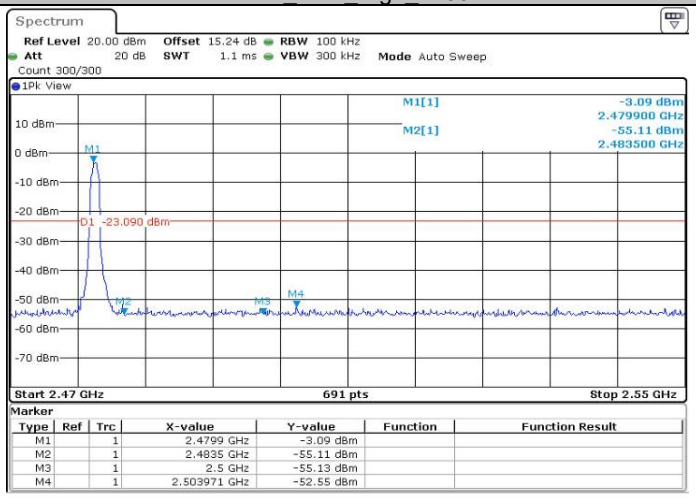
DH1_Ant1_High_Hop_2480



2DH1_Ant1_Low_2402



2DH1_Ant1_High_2480

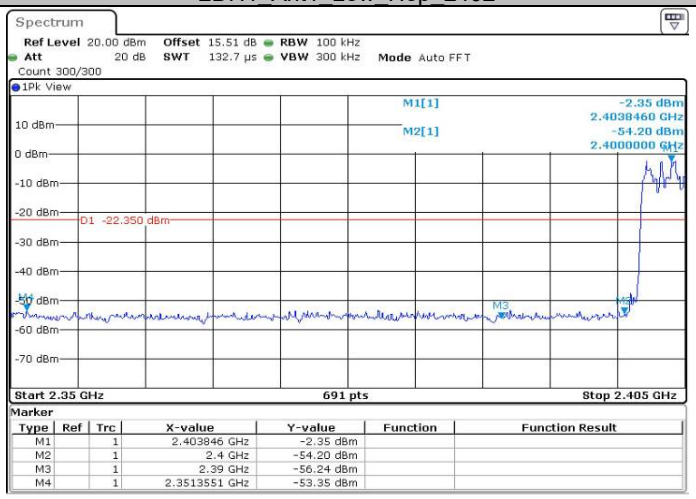


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4799 GHz	-3.09 dBm		
M2		1	2.4835 GHz	-55.11 dBm		
M3		1	2.5 GHz	-55.13 dBm		
M4		1	2.503971 GHz	-52.55 dBm		

Date: 12.AUG.2021 17:04:18

2DH1_Ant1_Low_Hop_2402

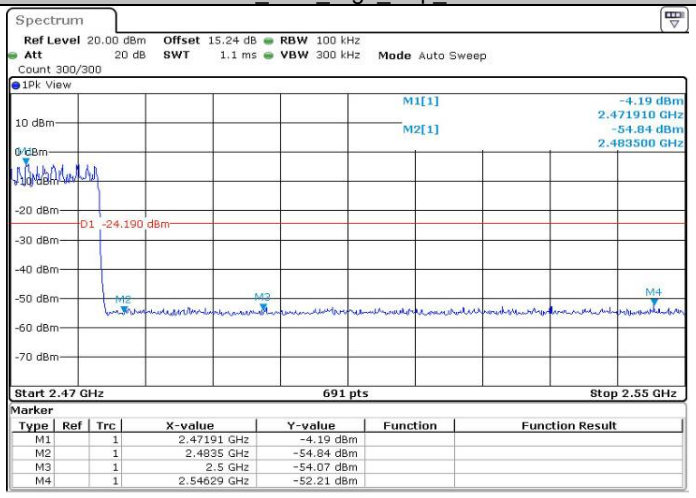


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.403846 GHz	-2.35 dBm		
M2		1	2.4 GHz	-54.20 dBm		
M3		1	2.39 GHz	-56.24 dBm		
M4		1	2.3513551 GHz	-53.35 dBm		

Date: 12.AUG.2021 17:27:10

2DH1_Ant1_High_Hop_2480

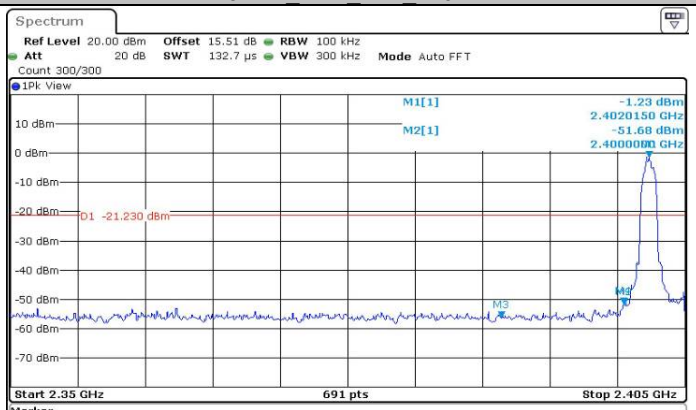


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.47191 GHz	-4.19 dBm		
M2		1	2.4835 GHz	-54.84 dBm		
M3		1	2.5 GHz	-54.07 dBm		
M4		1	2.54629 GHz	-52.21 dBm		

Date: 12.AUG.2021 17:28:10

3DH1_Ant1_Low_2402

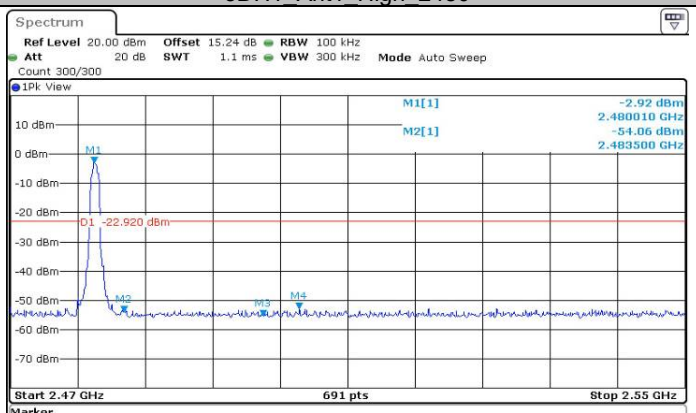


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.402015 GHz	-1.23 dBm		
M2		1	2.4 GHz	-51.68 dBm		
M3		1	2.39 GHz	-56.33 dBm		
M4		1	2.3999783 GHz	-51.47 dBm		

Date: 12.AUG.2021 17:05:04

3DH1_Ant1_High_2480

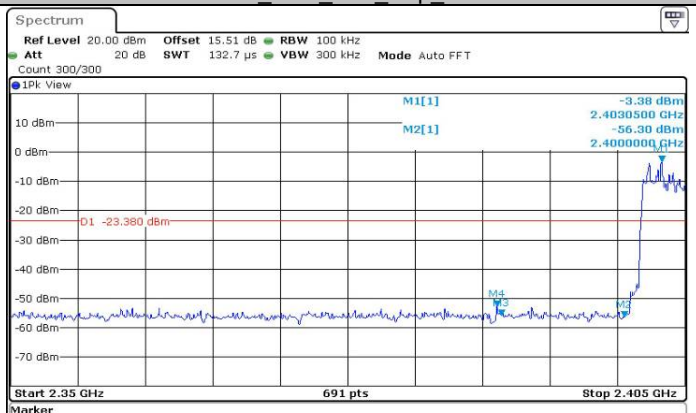


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.48001 GHz	-2.92 dBm		
M2		1	2.4835 GHz	-54.06 dBm		
M3		1	2.5 GHz	-55.31 dBm		
M4		1	2.504203 GHz	-52.74 dBm		

Date: 12.AUG.2021 17:06:40

3DH1_Ant1_Low_Hop_2402

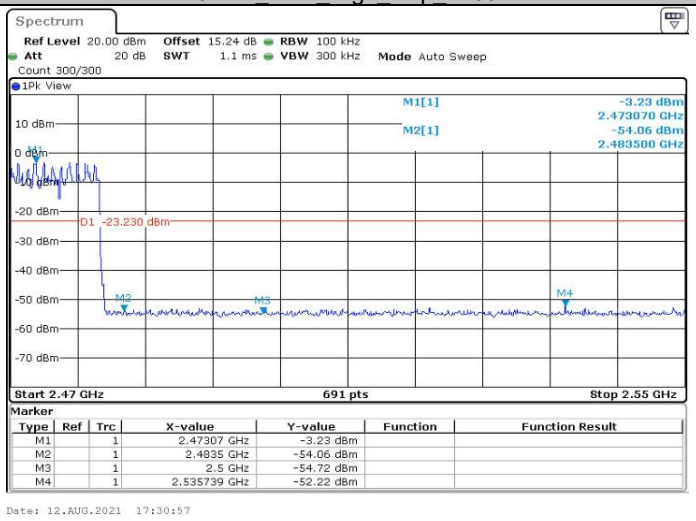


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40305 GHz	-3.38 dBm		
M2		1	2.4 GHz	-56.30 dBm		
M3		1	2.39 GHz	-55.98 dBm		
M4		1	2.3896957 GHz	-52.77 dBm		

Date: 12.AUG.2021 17:29:21

3DH1_Ant1_High_Hop_2480



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