TEST REPORT

Applicant Name :	Zeeva International Limited
Address :	Suite 1007B, 10th Floor, Exchange Tower, 33 Wang Chiu Road, Kowloon Bay, Hong Kong
Report Number :	SZNS211103-56459E-RF-00
FCC ID:	2ADM5-GA-131-L

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type:	NS CONTROLLER 2PK
Model No.:	GA-131
Multiple Model(s) No.:	N/A
Trade Mark:	N/A
Date Received:	2021/11/03
Date of Test:	2021/11/16~2021/11/22
Report Date:	2021/11/24

Test Result:	Pass*

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

Prepared and Checked By:

Black Ding
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.
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Frequency Range	Bluetooth: 2402~2480MHz
SKU number	4665017
UPC number	1922342100028
Maximum conducted Peak output power	Bluetooth: 2.10dBm
Modulation Technique	Bluetooth: GFSK, π/4-DQPSK, 8DPSK
Antenna Specification*	-0.58dBi (provided by the applicant)
Voltage Range	DC 3.7V from battery or DC 5.0V from USB port
Sample serial number	SZNS211103-56459E-RF-S1 for CE&RE SZNS211103-56459E-RF-S2 for RF conducted (Assigned by ATC)
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 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 output power, conducted		0.73dB
Unwanted Emission, conducted		1.6dB
AC Power Lines Conducted Emissions		2.72dB
Emissions, Radiated	30MHz - 1GHz	4.28dB
	1GHz - 18GHz	4.98dB
	18GHz - 26.5GHz	5.06dB
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

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 (ISEDC), the Registration Number is 5077A.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in an engineering mode.

Modulation	Data Rate (Mbps)
GFSK	1
π/4-DQPSK	2
8DPSK	3

EUT Exercise Software

"bt_tool_v1.1.0"* software was used to test, which provided by manufacturer.

The device was tested with the Power level is 7*.

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

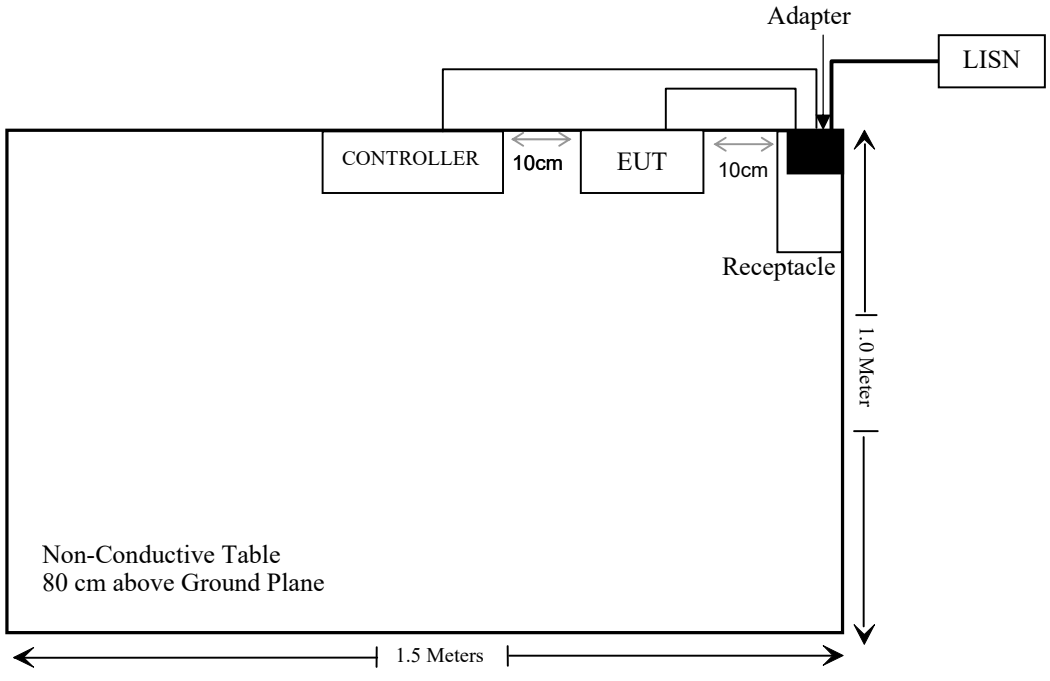
Manufacturer	Description	Model	Serial Number
BLU	Adapter（black）	US-BB-1000	E362552
EPK	Adapter（white）	YMK-6W050100	Unknown
Zeeva	CONTROLLER	GA-131	Unknown

External I/O Cable

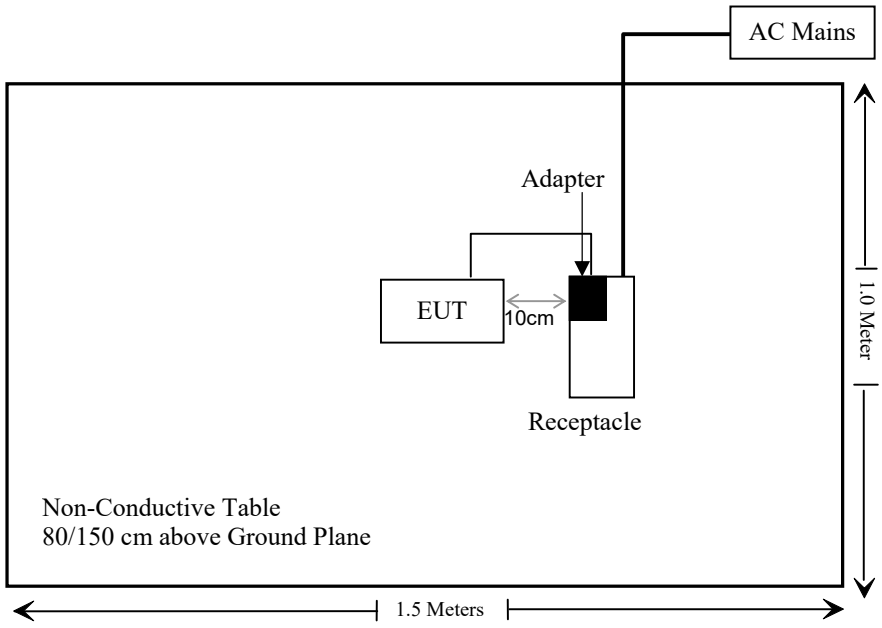
Cable Description	Length (m)	From Port	To
Un-shielding Un-Detachable AC Cable	1.2	LISN	Receptacle
Un-shielding Detachable USB Cable	0.5	Adapter	EUT
Un-shielding Detachable USB Cable	0.5	Adapter	CONTROLLER

Block Diagram of Test Setup

For conducted emission



For Radiated Emissions: Below & Above 1GHz



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 & 99% Occupied 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	100784	2021/02/03	2022/02/02
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	2021/11/09	2022/11/08
Anritsu Corp	50 Coaxial Switch	MP59B	6100237248	2020/12/25	2021/12/24
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
Wainwright	High Pass Filter	WHKX3.6/18 G-10SS	5	2020/12/25	2021/12/24
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2020/11/28	2021/11/27
Radiated Emission Test Software: e3 19821b (V9)					
Unknown	RF Coaxial Cable	N-5m	No.3	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-10m	No.7	2021/11/09	2022/11/08
Unknown	RF Coaxial Cable	N-2m	No.8	2021/11/09	2022/11/08

RF Conducted Test					
Rohde & Schwarz	Spectrum Analyzer	FSV-40	101495	2020/12/24	2021/12/23
Rohde & Schwarz	Open Switch and Control Unit	OSP120 + OSP-B157	101244 + 100866	2020/12/24	2021/12/23
HP	6dB Attenuator	8493B 6dB Attenuator	2708A 04769	2020/12/25	2021/12/24

*** 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), §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	2.5	1.78	5	0.6	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 -0.58dBi, fulfill the requirement of this section. Please refer to the EUT photos.

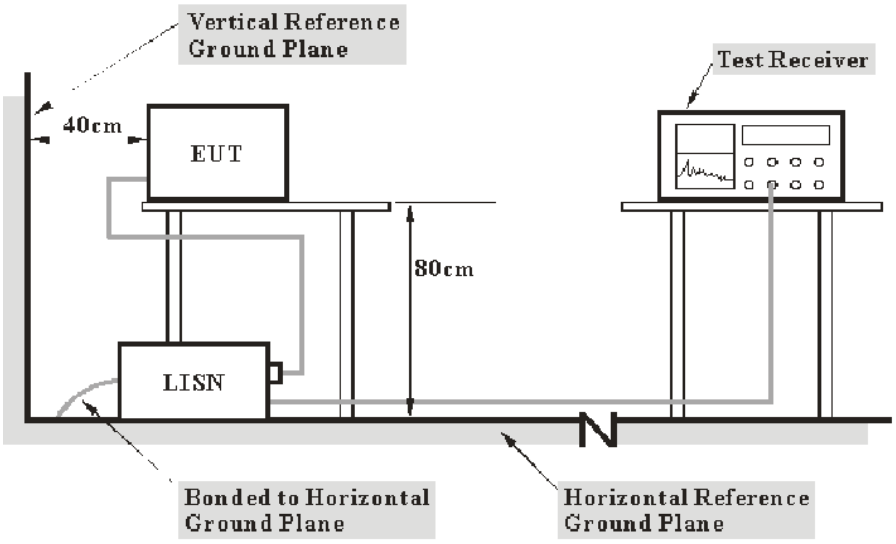
Result: Compliance.

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) and Cable Loss. The basic equation is as follows:

Transd Factor = LISN VDF + 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 over limit calculation is as follows:

Over limit = Level - Limit
Level= Reading level+ Transd Factor

Test Data

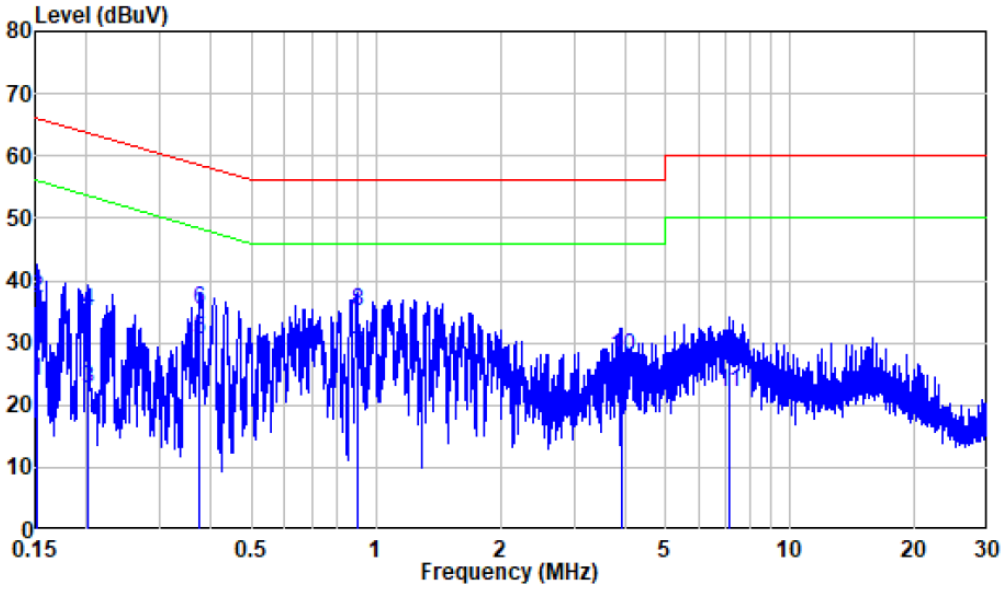
Environmental Conditions

Temperature:	25℃
Relative Humidity:	64 %
ATM Pressure:	101.0 kPa

The testing was performed by Bin Deng on 2021-11-16.

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

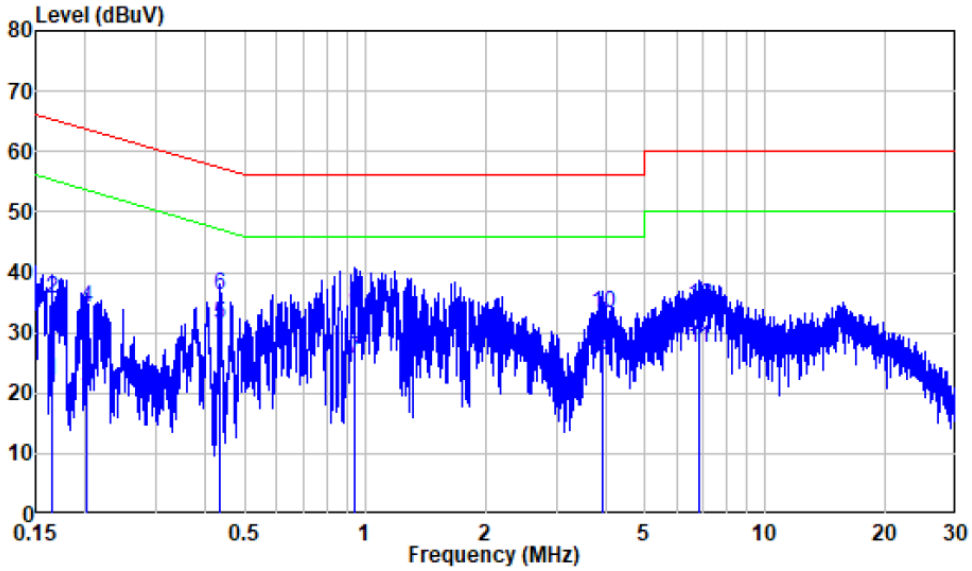
AC 120V/60 Hz, Line



Site : Shielding Room
Condition: Line
Mode : BT
Model : GA-131

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.152	9.89	13.87	23.76	55.88	-32.12	Average
2	0.152	9.89	27.18	37.07	65.88	-28.81	QP
3	0.202	9.80	12.79	22.59	53.54	-30.95	Average
4	0.202	9.80	25.22	35.02	63.54	-28.52	QP
5	0.375	9.80	20.68	30.48	48.38	-17.90	Average
6	0.375	9.80	25.48	35.28	58.38	-23.10	QP
7	0.898	9.81	18.41	28.22	46.00	-17.78	Average
8	0.898	9.81	25.23	35.04	56.00	-20.96	QP
9	3.922	9.94	10.15	20.09	46.00	-25.91	Average
10	3.922	9.94	17.71	27.65	56.00	-28.35	QP
11	7.090	10.07	11.89	21.96	50.00	-28.04	Average
12	7.090	10.07	16.98	27.05	60.00	-32.95	QP

AC 120V/60 Hz, Neutral



Site : Shielding Room
Condition: Neutral
Mode : BT
Model : GA-131

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.165	9.93	12.11	22.04	55.22	-33.18	Average
2	0.165	9.93	25.70	35.63	65.22	-29.59	QP
3	0.201	10.00	10.89	20.89	53.57	-32.68	Average
4	0.201	10.00	23.97	33.97	63.57	-29.60	QP
5	0.433	9.92	21.56	31.48	47.19	-15.71	Average
6	0.433	9.92	26.21	36.13	57.19	-21.06	QP
7	0.945	9.91	15.83	25.74	46.00	-20.26	Average
8	0.945	9.91	24.63	34.54	56.00	-21.46	QP
9	3.922	10.04	16.07	26.11	46.00	-19.89	Average
10	3.922	10.04	23.06	33.10	56.00	-22.90	QP
11	6.814	10.07	17.35	27.42	50.00	-22.58	Average
12	6.814	10.07	24.30	34.37	60.00	-25.63	QP

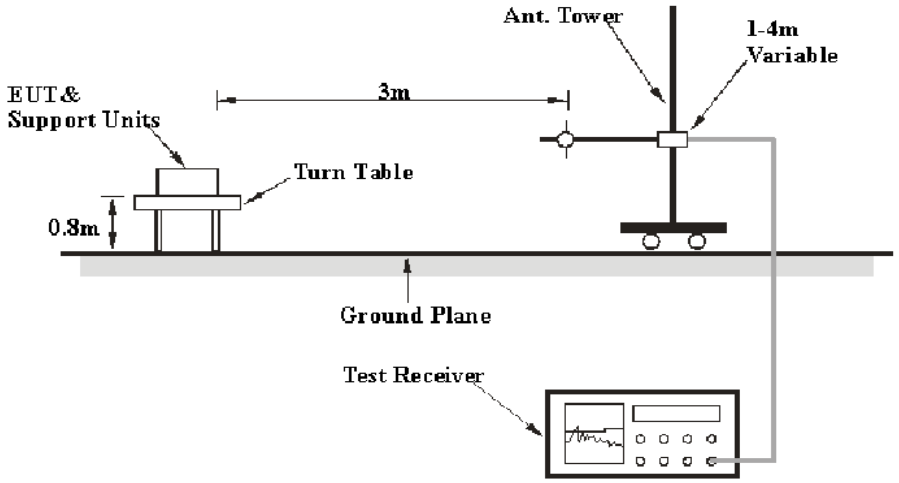
FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS

Applicable Standard

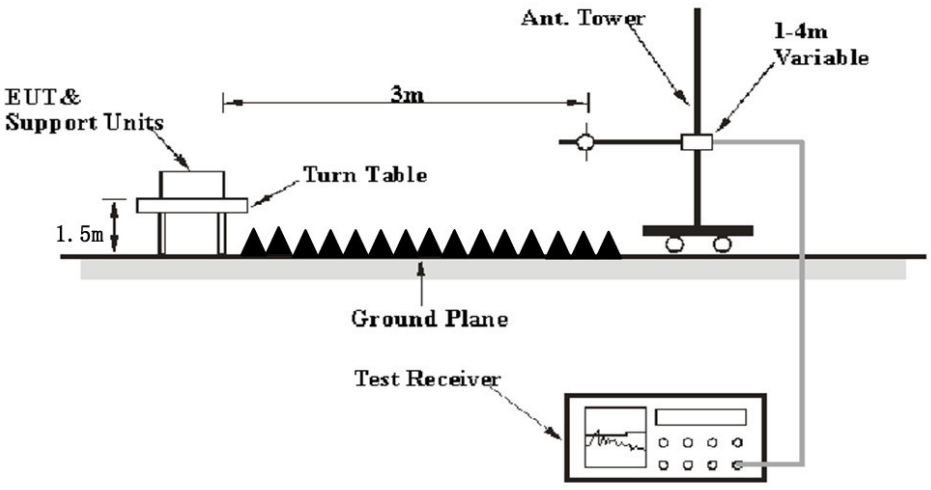
FCC §15.205; §15.209; §15.247(d)

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.

Factor & Margin Calculation

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

Factor = Antenna Factor + Cable Loss - Amplifier Gain

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

Over Limit/Margin = Level / Corrected Amplitude – Limit
Level / Corrected Amplitude = Read Level + Factor

Test Data

Environmental Conditions

Temperature:	25~26.3℃
Relative Humidity:	51~64 %
ATM Pressure:	101.0~101.2 kPa

The testing was performed by Bin Deng on 2021-11-16 for below 1GHz and 2021-11-19 for above 1GHz.

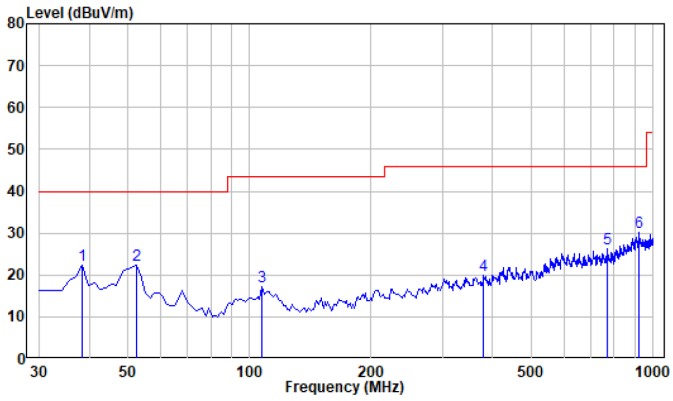
(Pre-scan in the X,Y and Z axes of orientation, the worst case X-axis of orientation was recorded)

EUT operation mode: Transmitting

(Scan with GFSK, π/4-DQPSK, 8DPSK mode, the worst case is 8DPSK Mode)

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

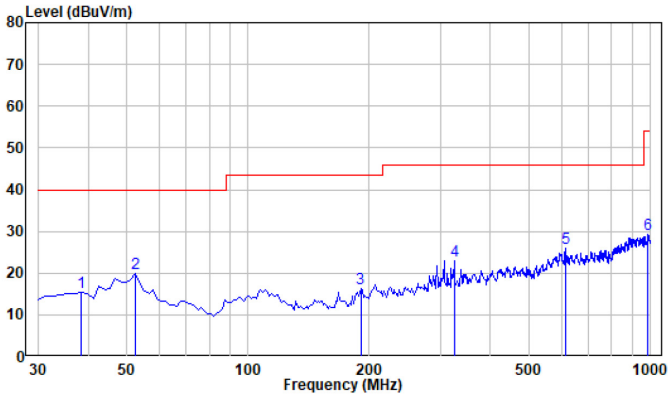
Horizontal:



Site : chamber
Condition: 3m VERTICAL
Job NO. : SZNS211103-56459-RF
Mode : TX

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	38.43	-18.90	41.31	22.41	40.00	-17.59	Peak
2	52.49	-17.81	40.26	22.45	40.00	-17.55	Peak
3	107.32	-19.18	36.37	17.19	43.50	-26.31	Peak
4	380.04	-15.72	35.76	20.04	46.00	-25.96	Peak
5	768.04	-11.15	37.31	26.16	46.00	-19.84	Peak
6	922.68	-7.86	38.11	30.25	46.00	-15.75	Peak

Vertical



Site : chamber
Condition: 3m HORIZONTAL
Job NO. : SZNS211103-56459-RF
Mode : TX

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	38.43	-18.90	34.30	15.40	40.00	-24.60	Peak
2	52.49	-17.81	37.67	19.86	40.00	-20.14	Peak
3	190.26	-20.13	36.41	16.28	43.50	-27.22	Peak
4	325.22	-16.78	39.76	22.98	46.00	-23.02	Peak
5	613.41	-11.16	37.04	25.88	46.00	-20.12	Peak
6	981.72	-7.75	37.00	29.25	54.00	-24.75	Peak

Above 1GHz:

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)									
2310.00	47.70	PK	219	1.9	H	-6.84	40.86	74.00	-33.14
2310.00	49.04	PK	23	1.6	V	-6.84	42.20	74.00	-31.80
2390.00	48.52	PK	18	1.4	H	-6.44	42.08	74.00	-31.92
2390.00	51.51	PK	42	2	V	-6.44	45.07	74.00	-28.93
4804.00	54.88	PK	269	1.8	H	2.81	57.69	74.00	-16.31
4804.00	42.54	Ave	269	1.8	H	2.81	45.35	54.00	-8.65
4804.00	55.45	PK	9	2	V	2.81	58.26	74.00	-15.74
4804.00	43.65	Ave	9	2	V	2.81	46.46	54.00	-7.54
Middle Channel (2441 MHz)									
4882.00	49.42	PK	219	2	H	3.04	52.46	74.00	-21.54
4882.00	50.27	PK	190	1.3	V	3.04	53.31	74.00	-20.69
High Channel (2480 MHz)									
2483.50	47.76	PK	21	1.9	H	-5.96	41.80	74.00	-32.20
2483.50	51.06	PK	24	1.6	V	-5.96	45.10	74.00	-28.90
2500.00	49.28	PK	182	2	H	-5.88	43.40	74.00	-30.60
2500.00	51.49	PK	84	2.1	V	-5.88	45.61	74.00	-28.39
4960.00	47.49	PK	90	1.9	H	3.29	50.78	74.00	-23.22
4960.00	50.20	PK	293	1.2	V	3.29	53.49	74.00	-20.51

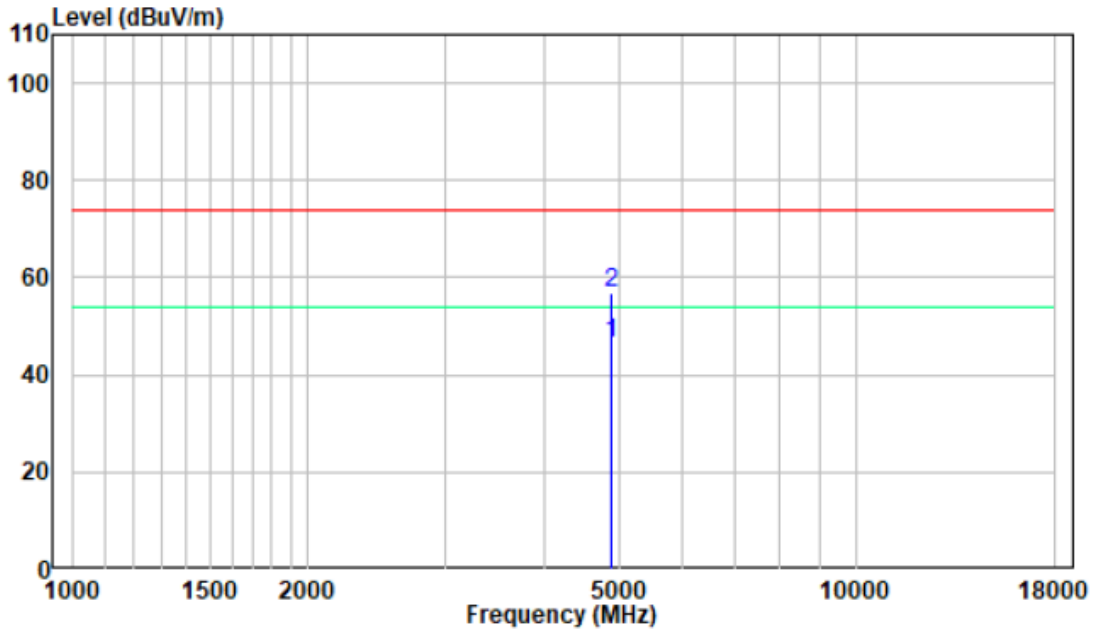
Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Corrected. Amplitude - Limit
The other spurious emission is in the noise floor level was not recorded.
The test result of peak was less than the limit of average, so just peak value were recorded.

1-18GHz

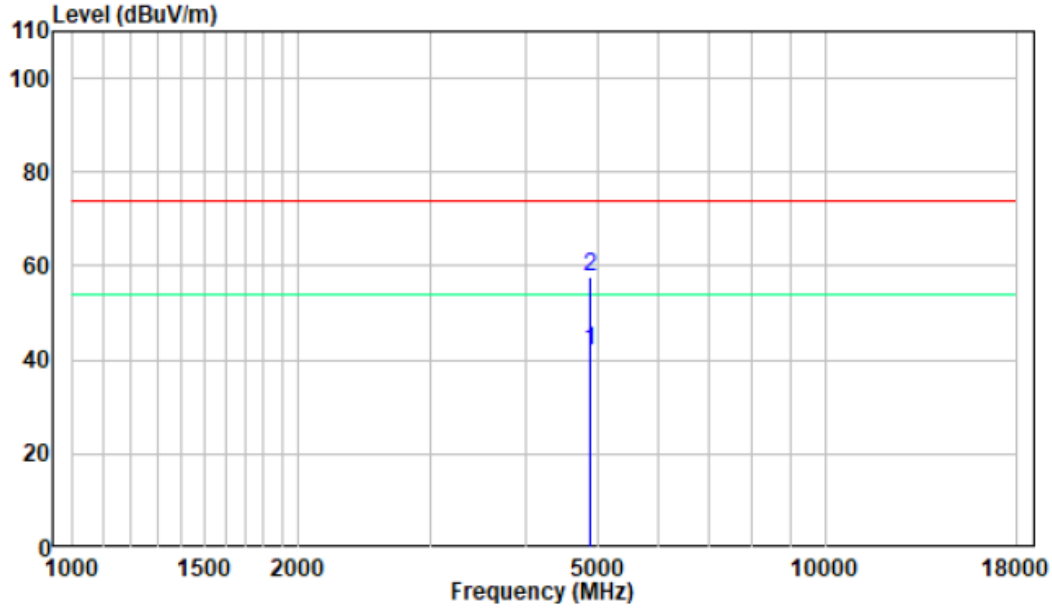
Pre-scan plots(Peak and AV)

Low Channel

Horizontal:



Vertical:

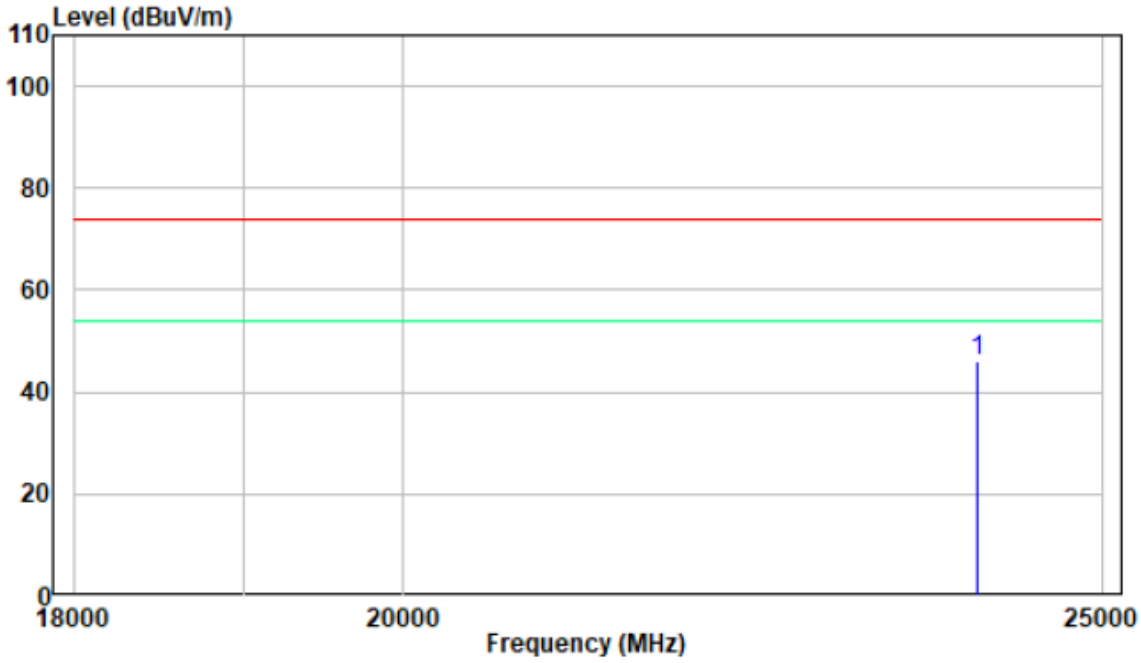


18-25GHz

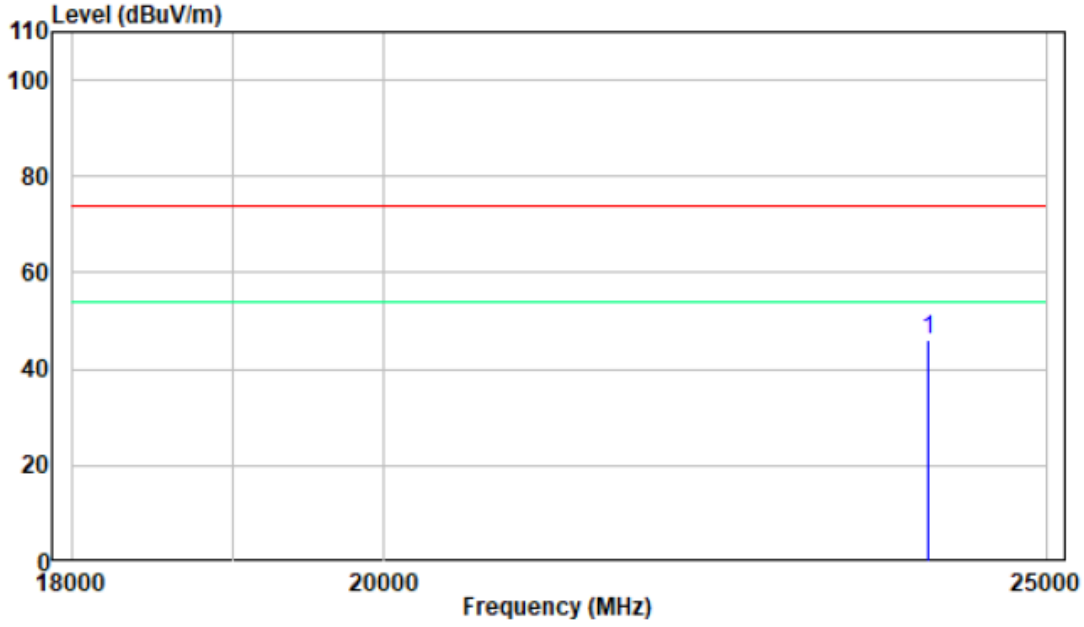
Pre-scan for Peak

Low Channel

Horizontal:



Vertical:



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:	26 ℃
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

The testing was performed by Paul liu on 2021-11-19.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

FCC §15.247(a) (1) – 20 dB EMISSION BANDWIDTH & 99% OCCUPIED 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

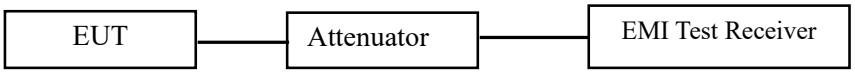
The following conditions shall be observed for measuring the occupied bandwidth and 20 dB bandwidth:
• The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

• 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:	26 ℃
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

The testing was performed by Paul liu on 2021-11-19.

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:	26 ℃
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

The testing was performed by Paul liu on 2021-11-19.

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:	26 ℃
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

The testing was performed by Paul liu on 2021-11-19.

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:	26 ℃
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

The testing was performed by Paul liu on 2021-11-22.

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:	26 ℃
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

The testing was performed by Paul liu on 2021-11-19.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

APPENDIX

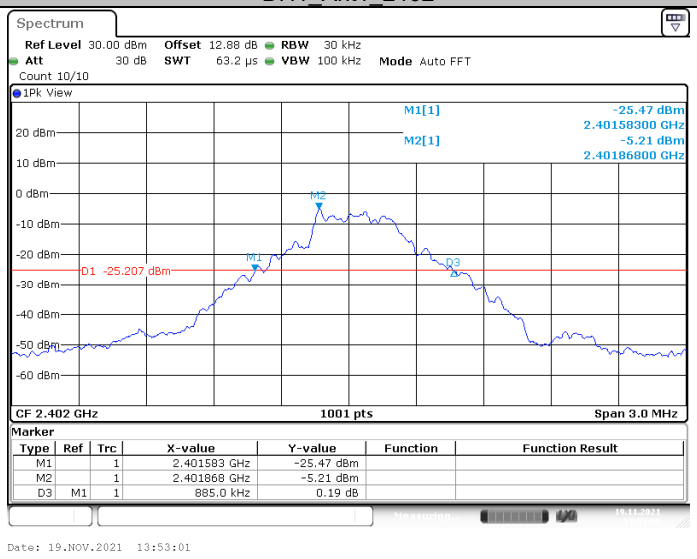
Appendix A: 20dB Emission Bandwidth

Test Result

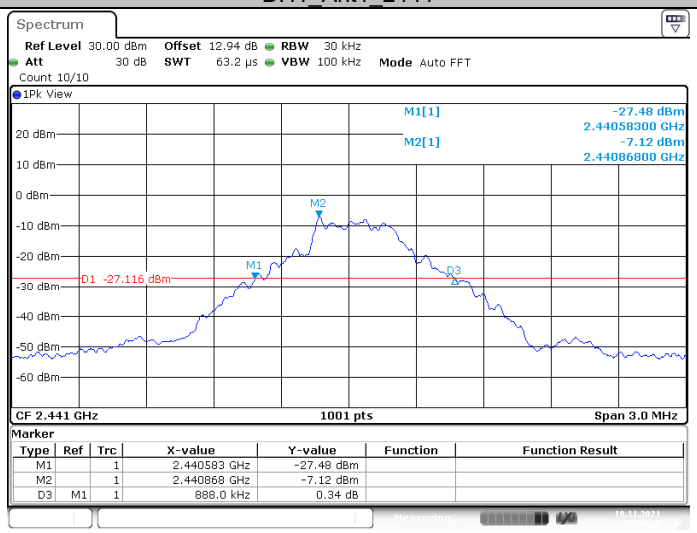
Test Mode	Antenna	Channel	20db EBW[MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	0.885	2401.583	2402.468	---	PASS
		2441	0.888	2440.583	2441.471	---	PASS
		2480	0.888	2479.583	2480.471	---	PASS
2DH1	Ant1	2402	1.260	2401.397	2402.657	---	PASS
		2441	1.263	2440.397	2441.660	---	PASS
		2480	1.263	2479.397	2480.660	---	PASS
3DH1	Ant1	2402	1.263	2401.400	2402.663	---	PASS
		2441	1.266	2440.397	2441.663	---	PASS
		2480	1.266	2479.397	2480.663	---	PASS

Test Graphs

DH1_Ant1_2402



DH1_Ant1_2441



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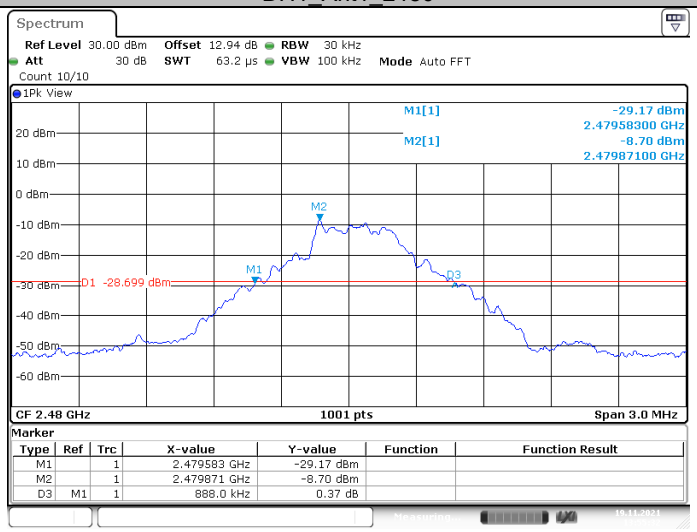
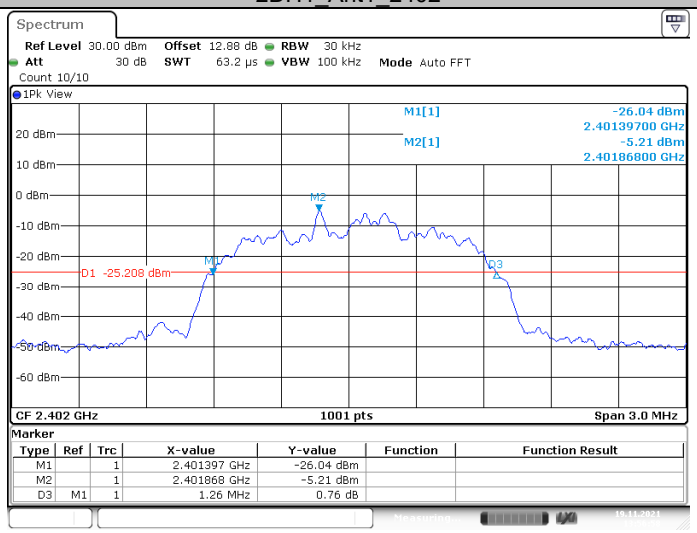
DH1_Ant1_2480



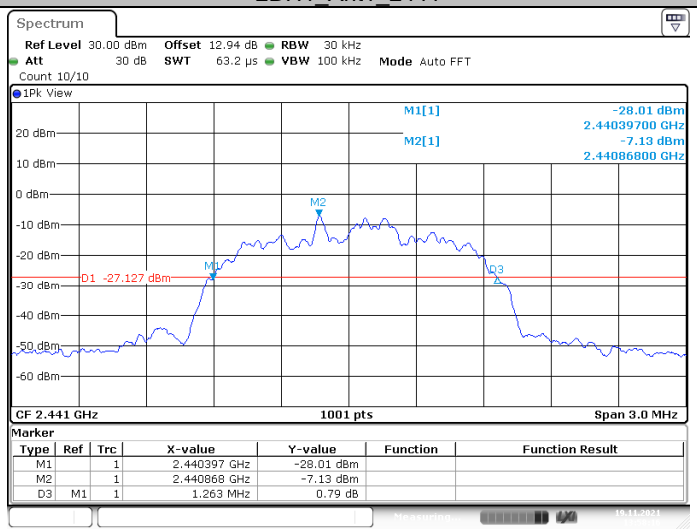
Date: 19.NOV.2021 13:55:33

2DH1_Ant1_2402



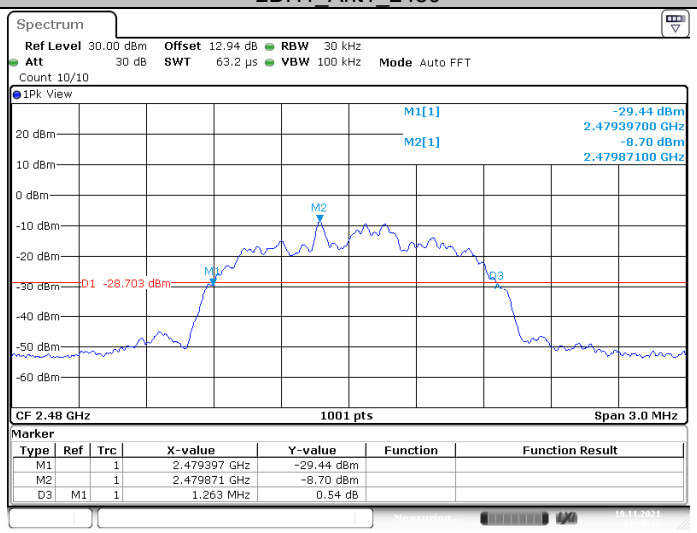
Date: 19.NOV.2021 13:56:59

2DH1_Ant1_2441



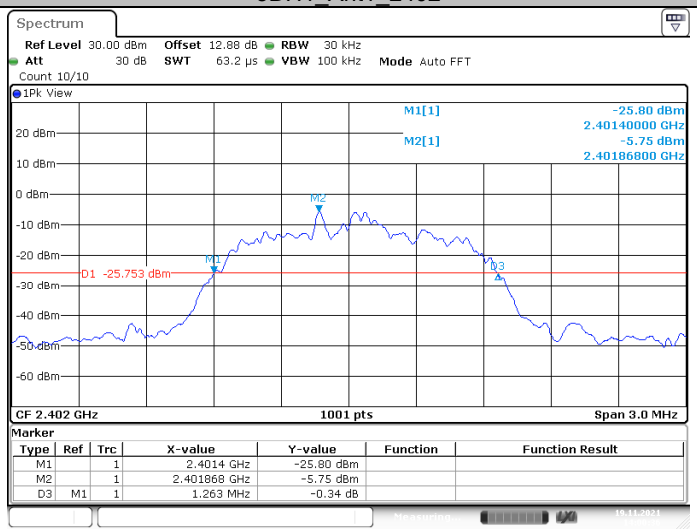
Date: 19.NOV.2021 13:58:17

2DH1_Ant1_2480



Date: 19.NOV.2021 13:59:17

3DH1_Ant1_2402



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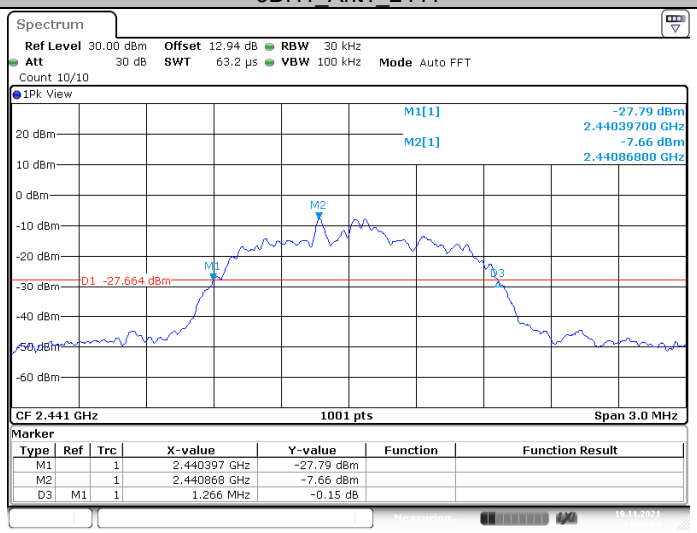

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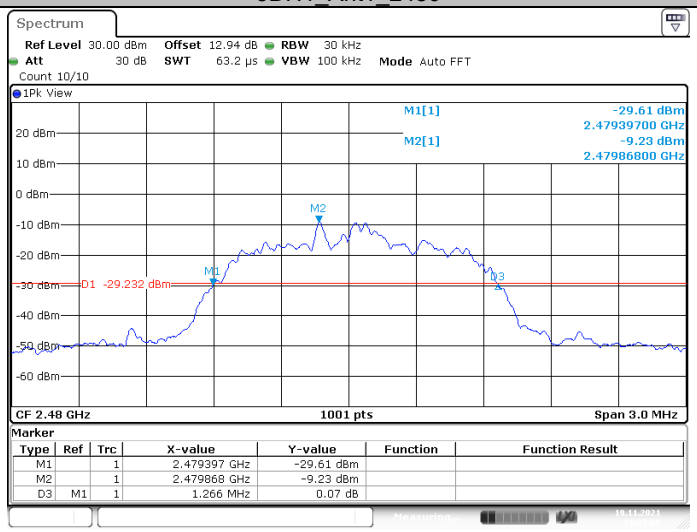


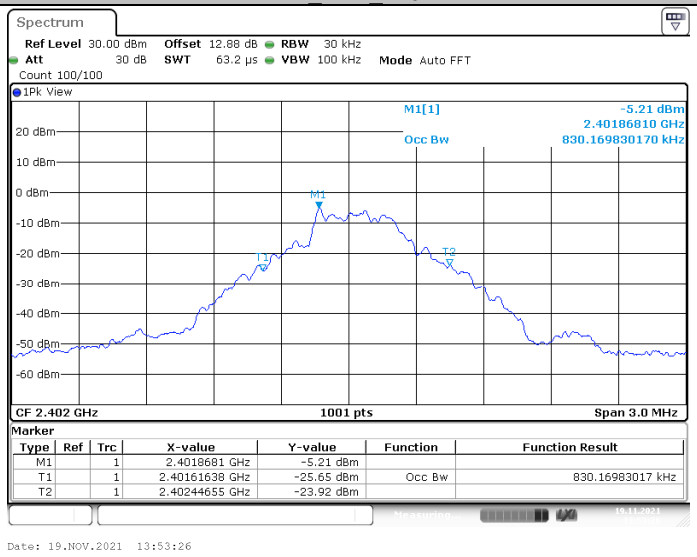
Appendix B: Occupied Channel Bandwidth

Test Result

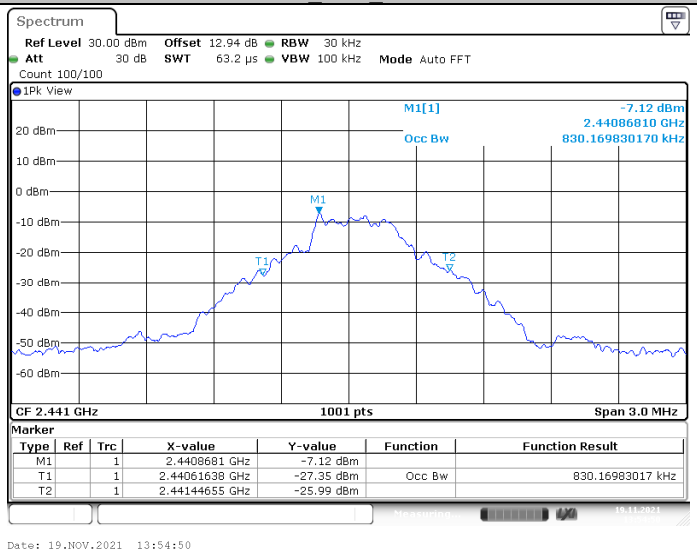
Test Mode	Antenna	Channel	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	0.83	2401.616	2402.447	---	PASS
		2441	0.83	2440.616	2441.447	---	PASS
		2480	0.836	2479.613	2480.450	---	PASS
2DH1	Ant1	2402	1.157	2401.446	2402.602	---	PASS
		2441	1.157	2440.446	2441.602	---	PASS
		2480	1.16	2479.446	2480.605	---	PASS
3DH1	Ant1	2402	1.157	2401.461	2402.617	---	PASS
		2441	1.154	2440.464	2441.617	---	PASS
		2480	1.16	2479.461	2480.620	---	PASS

Test Graphs

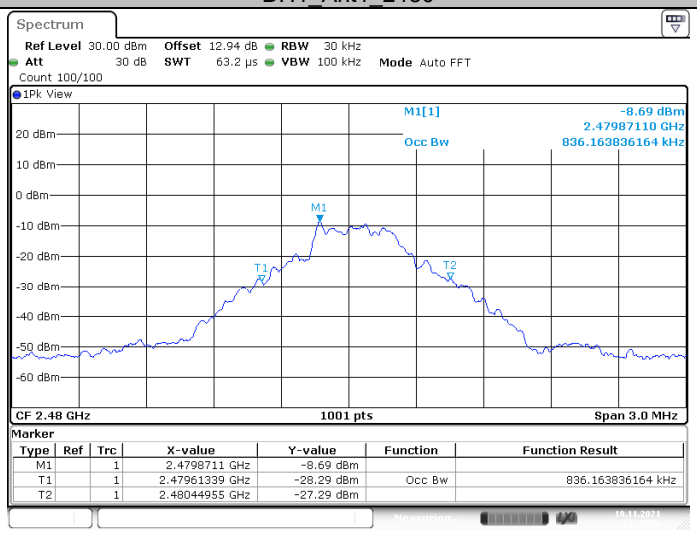
DH1_Ant1_2402



DH1_Ant1_2441

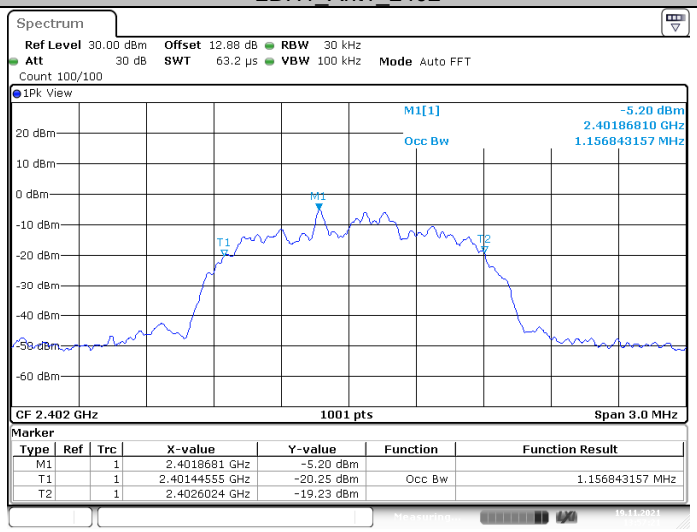


DH1_Ant1_2480



Date: 19.NOV.2021 13:56:00

2DH1_Ant1_2402



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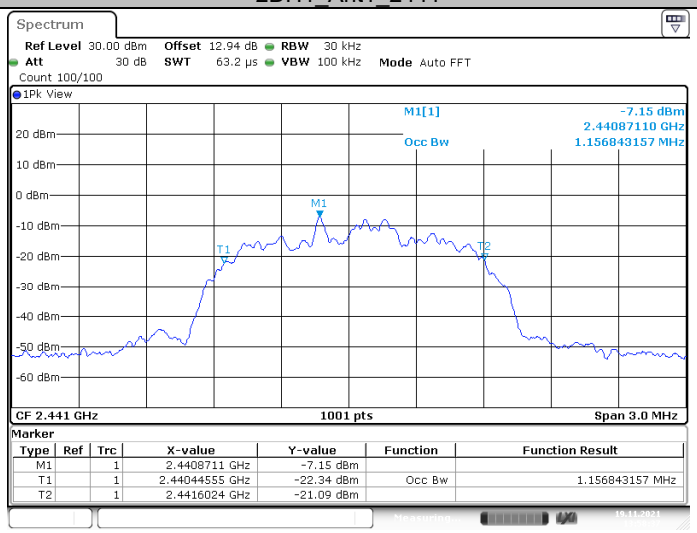
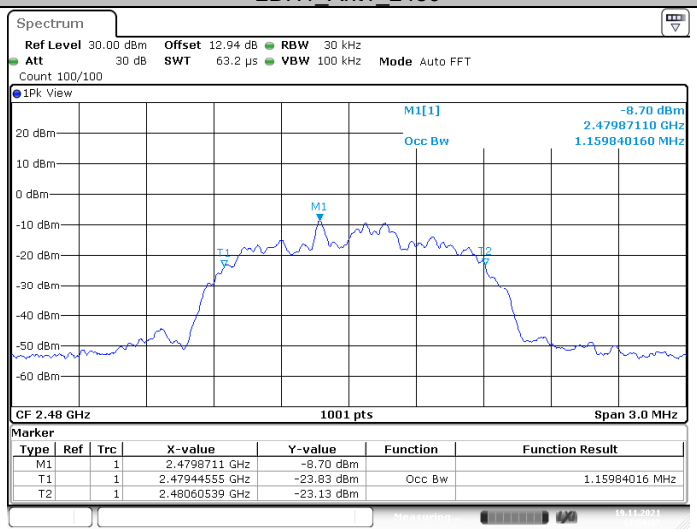
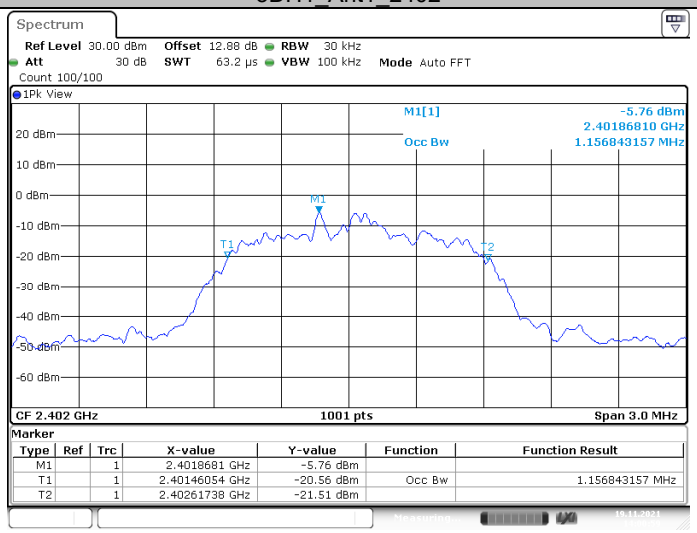
2DH1_Ant1_2441



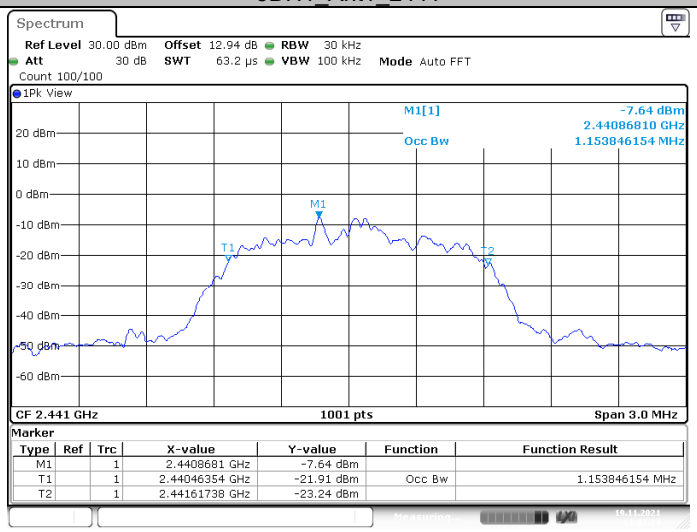
2DH1_Ant1_2480



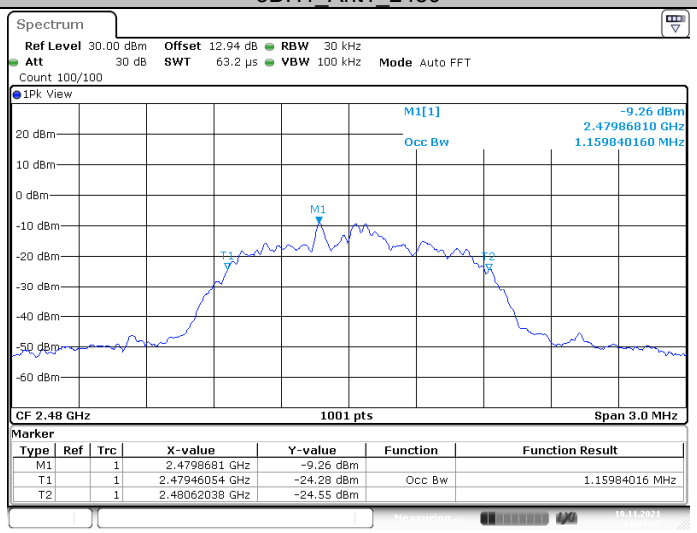
3DH1_Ant1_2402



3DH1_Ant1_2441



3DH1_Ant1_2480



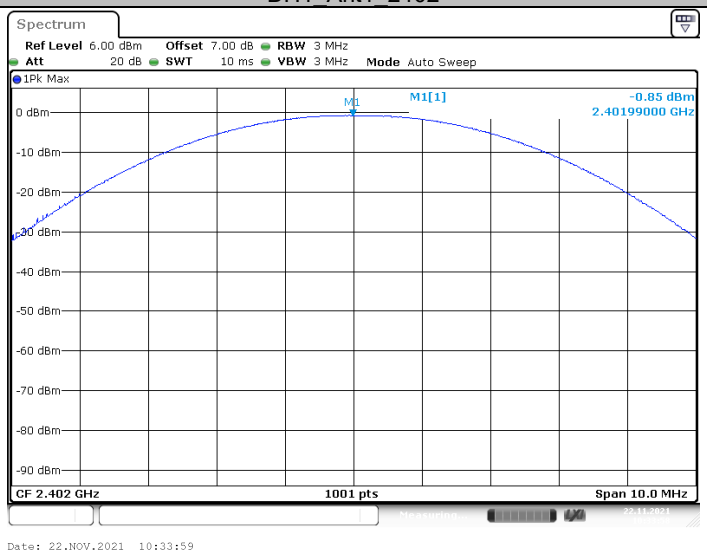
Appendix C: Maximum conducted output power

Test Result

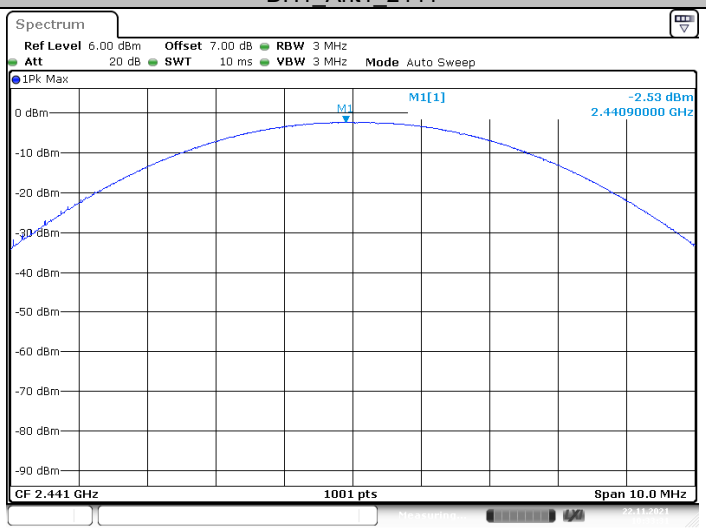
Test Mode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
DH1	Ant1	2402	-0.85	<=20.97	PASS
		2441	-2.53	<=20.97	PASS
		2480	-3.96	<=20.97	PASS
2DH1	Ant1	2402	1.18	<=20.97	PASS
		2441	-0.52	<=20.97	PASS
		2480	-1.97	<=20.97	PASS
3DH1	Ant1	2402	2.10	<=20.97	PASS
		2441	0.41	<=20.97	PASS
		2480	-0.93	<=20.97	PASS

Test Graphs

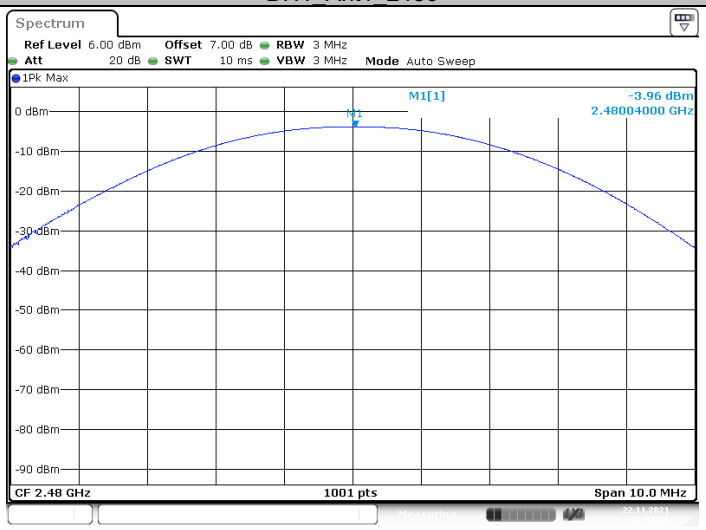
DH1_Ant1_2402



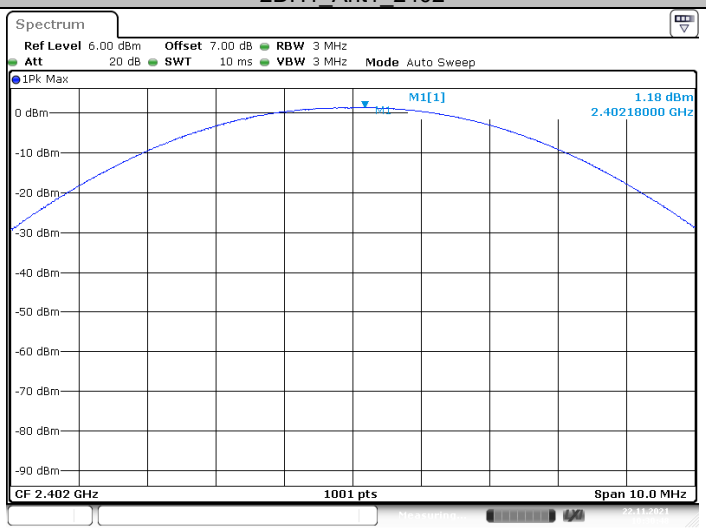
DH1_Ant1_2441



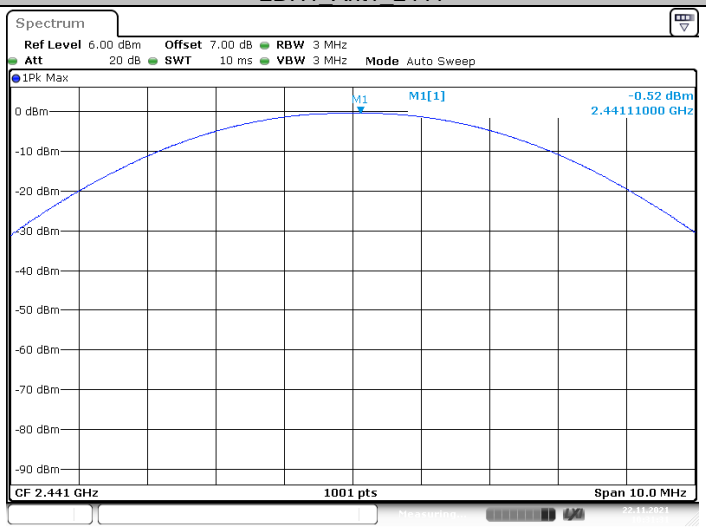
DH1_Ant1_2480



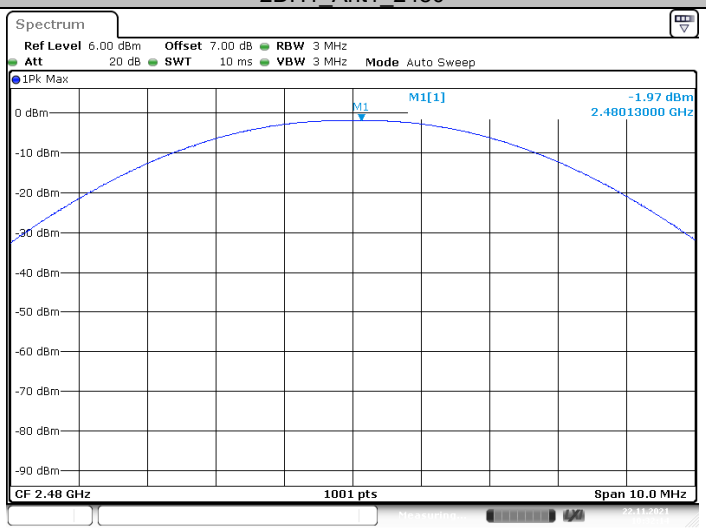
2DH1_Ant1_2402



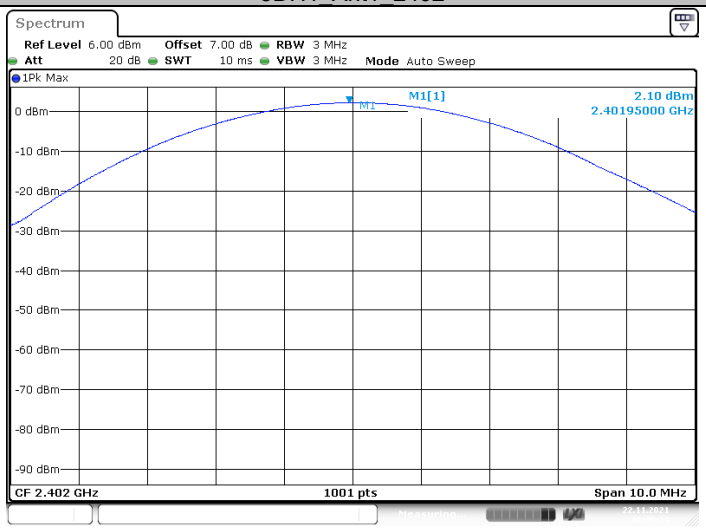
2DH1_Ant1_2441



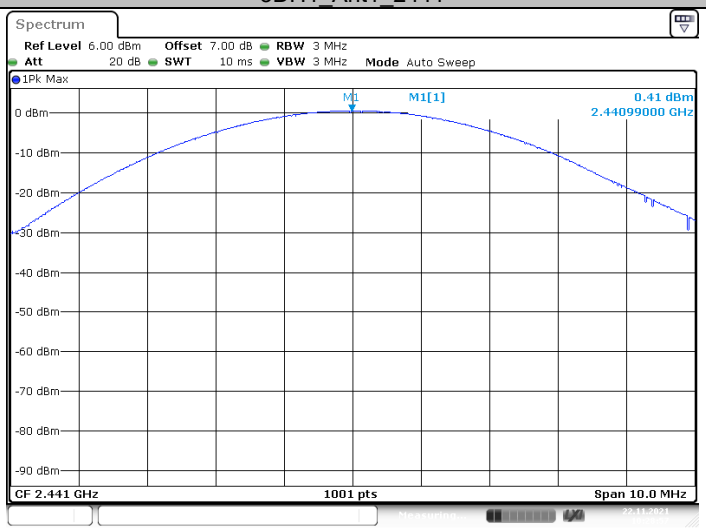
2DH1_Ant1_2480



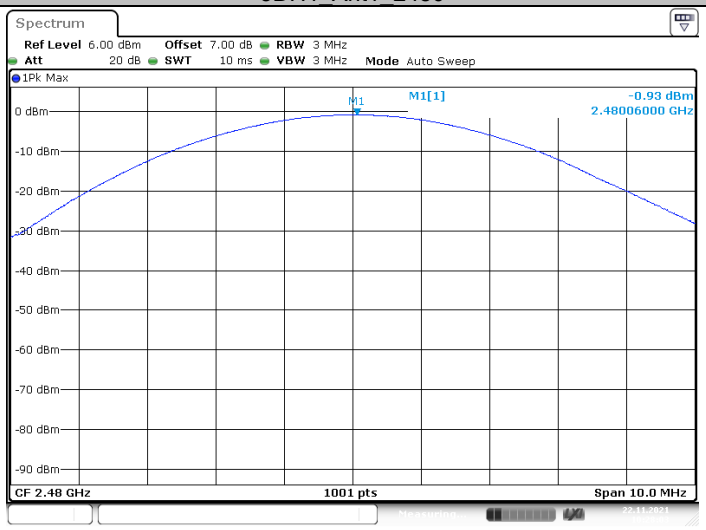
3DH1_Ant1_2402



3DH1_Ant1_2441



3DH1_Ant1_2480



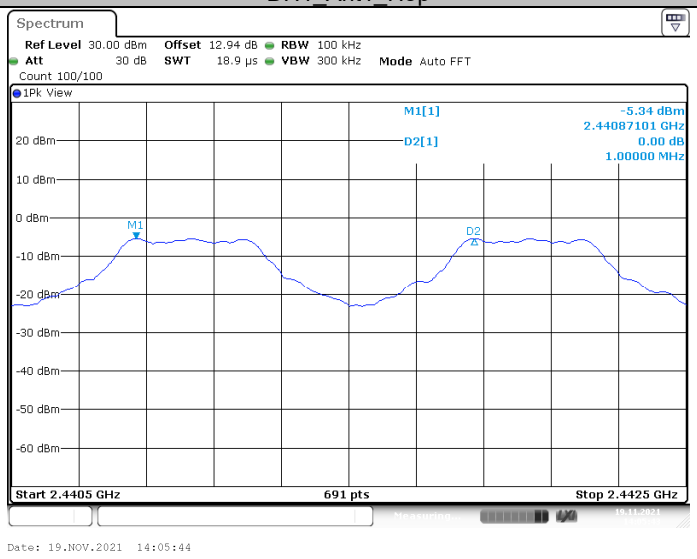
Appendix D: Carrier frequency separation

Test Result

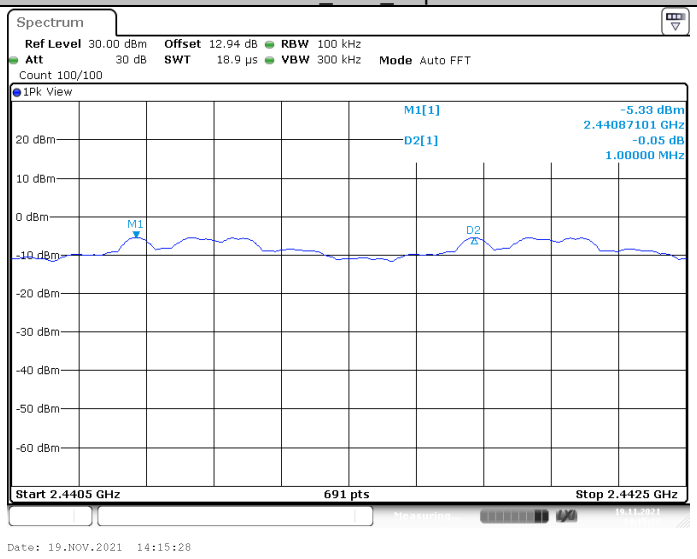
Test Mode	Antenna	Channel	Result[MHz]	Limit[MHz]	Verdict
DH1	Ant1	Hop	1	>=0.592	PASS
2DH1	Ant1	Hop	1	>=0.842	PASS
3DH1	Ant1	Hop	1	>=0.844	PASS

Test Graphs

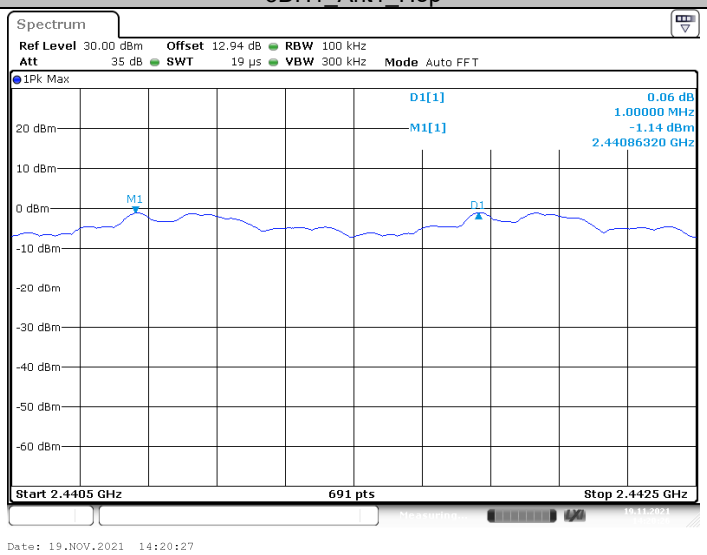
DH1_Ant1_Hop



2DH1_Ant1_Hop



3DH1_Ant1_Hop



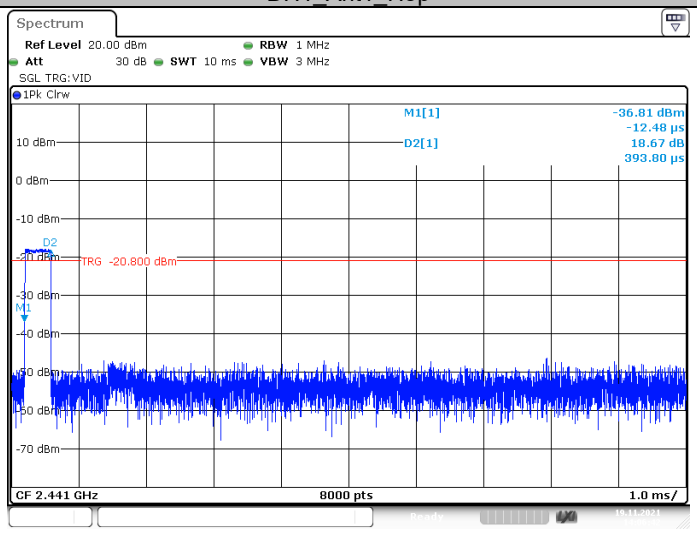
Appendix E: Time of occupancy

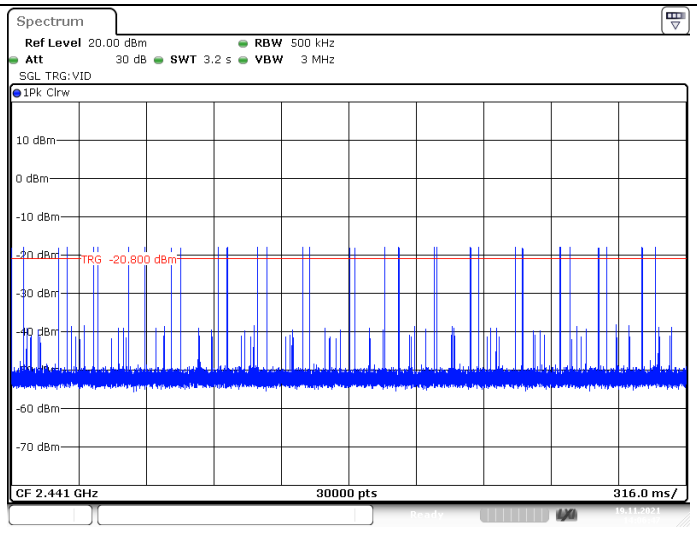
Test Result

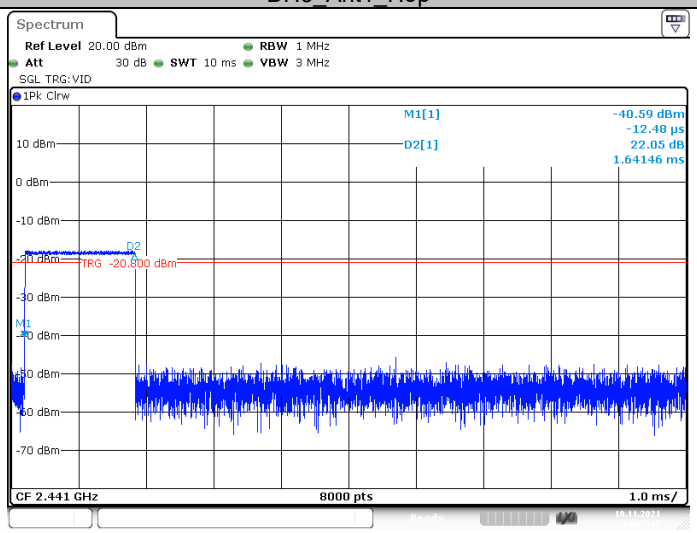
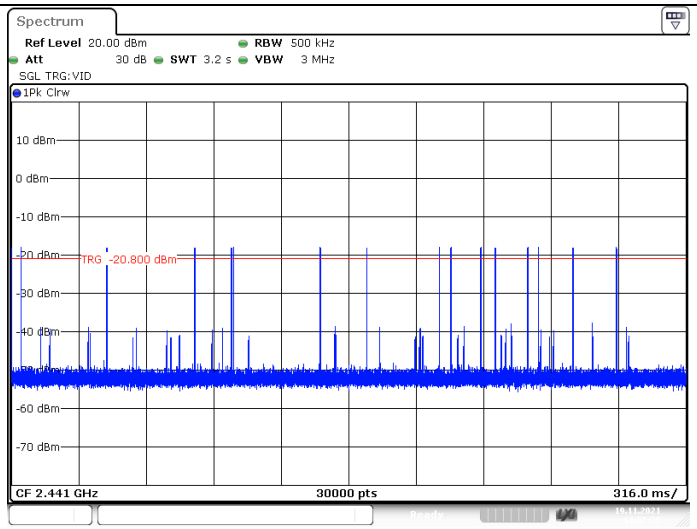
Test Mode	Antenna	Channel	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH1	Ant1	Hop	0.39	320	0.126	<=0.4	PASS
DH3	Ant1	Hop	1.64	160	0.263	<=0.4	PASS
DH5	Ant1	Hop	2.88	130	0.374	<=0.4	PASS
2DH1	Ant1	Hop	0.40	330	0.133	<=0.4	PASS
2DH3	Ant1	Hop	1.65	190	0.313	<=0.4	PASS
2DH5	Ant1	Hop	2.89	110	0.318	<=0.4	PASS
3DH1	Ant1	Hop	0.40	320	0.129	<=0.4	PASS
3DH3	Ant1	Hop	1.65	160	0.263	<=0.4	PASS
3DH5	Ant1	Hop	2.89	130	0.376	<=0.4	PASS

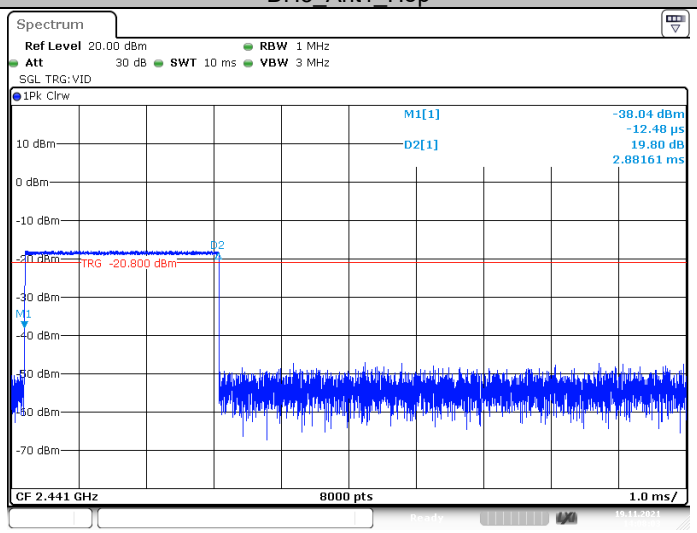
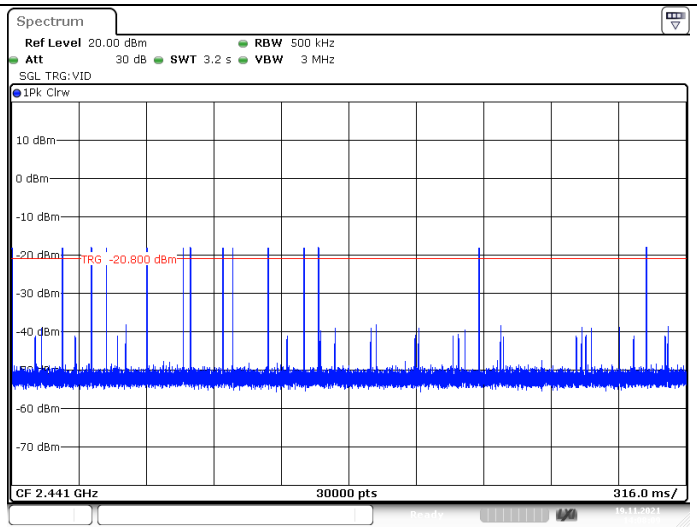
Test Graphs

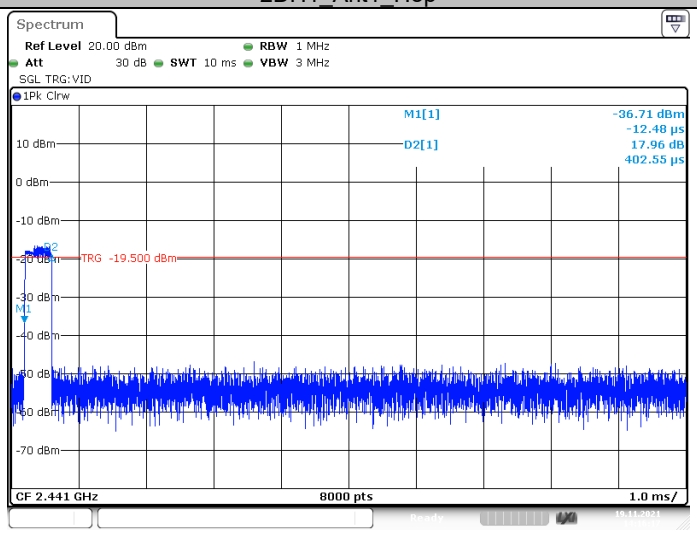
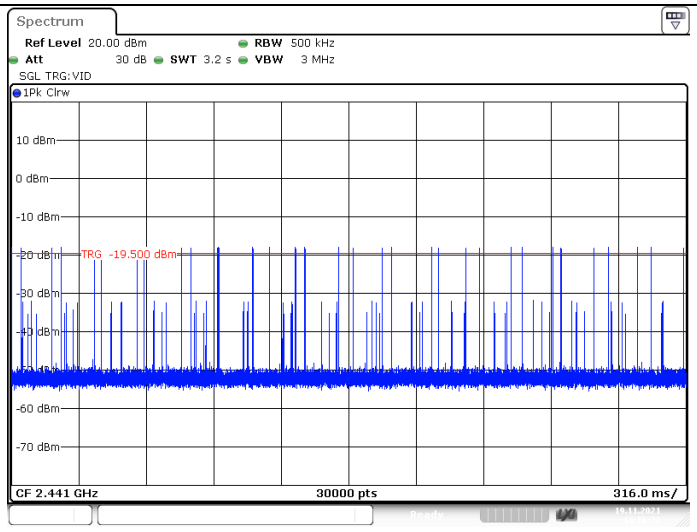
DH1_Ant1_Hop



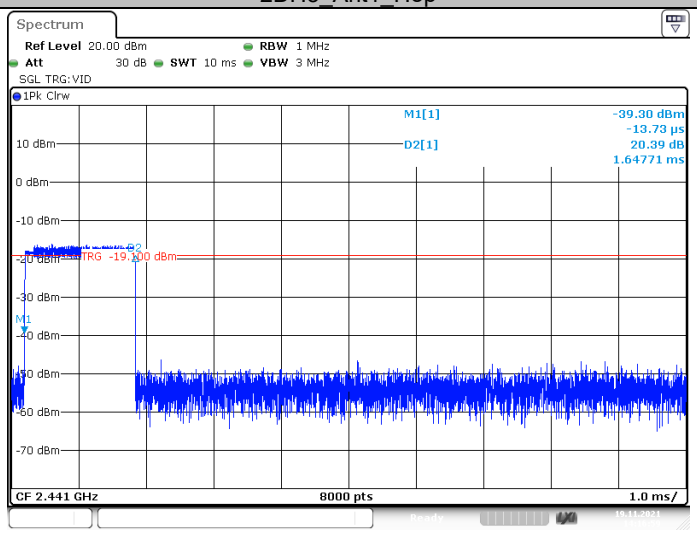


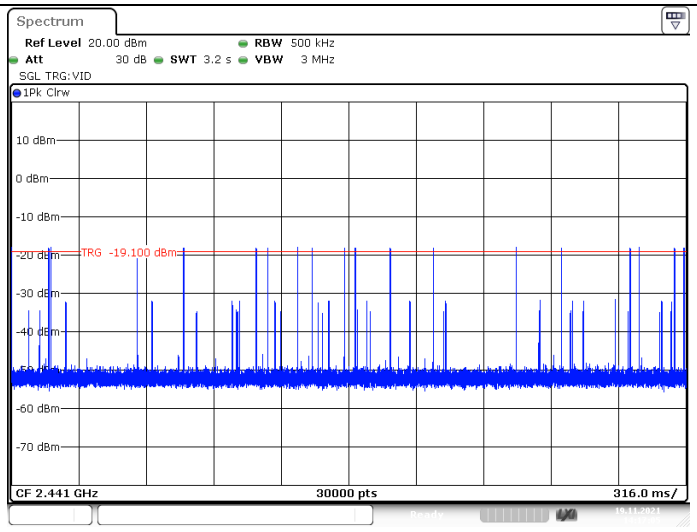
DH3_Ant1_Hop
 Spectrum Ref Level 20.00 dBm RBW 1 MHz Att 30 dB SWT 10 ms VBW 3 MHz SGL TRG:VID 1Pk Clrw M1[1] -40.59 dBm -12.48 µs D2[1] 22.05 dB 1.64146 ms 10 dBm 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm -50 dBm -60 dBm -70 dBm D2 TRG -20.800 dBm M1 CF 2.441 GHz 8000 pts 1.0 ms/ Date: 19.NOV.2021 14:07:20
 Spectrum Ref Level 20.00 dBm RBW 500 kHz Att 30 dB SWT 3.2 s VBW 3 MHz SGL TRG:VID 1Pk Clrw 10 dBm 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm -60 dBm -70 dBm TRG -20.800 dBm CF 2.441 GHz 30000 pts 316.0 ms/ Date: 19.NOV.2021 14:07:26

DH5_Ant1_Hop
   

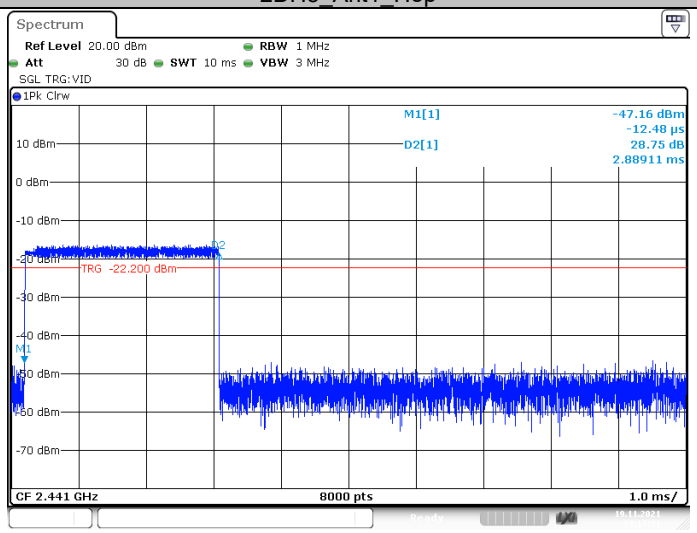
2DH1_Ant1_Hop
   

2DH3_Ant1_Hop





2DH5_Ant1_Hop



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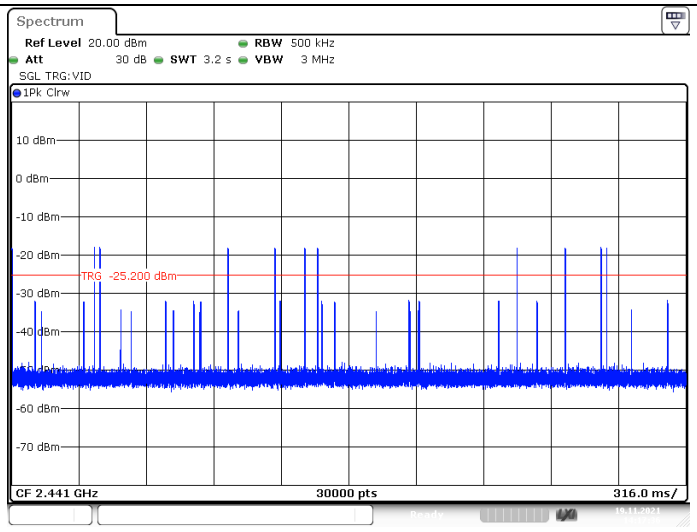

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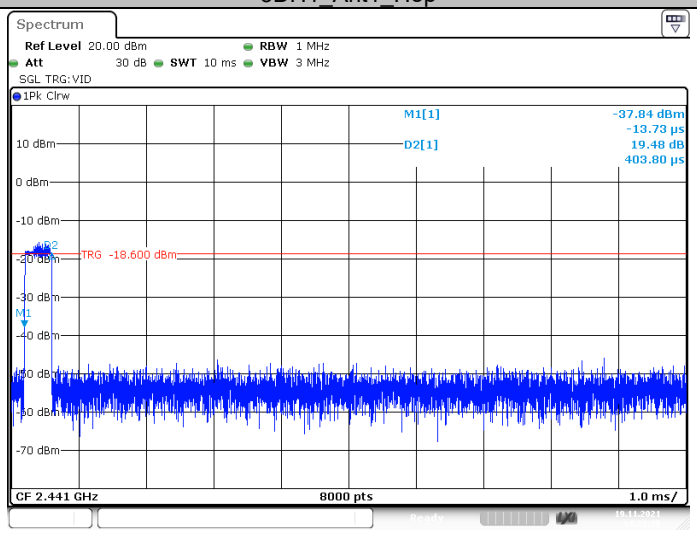
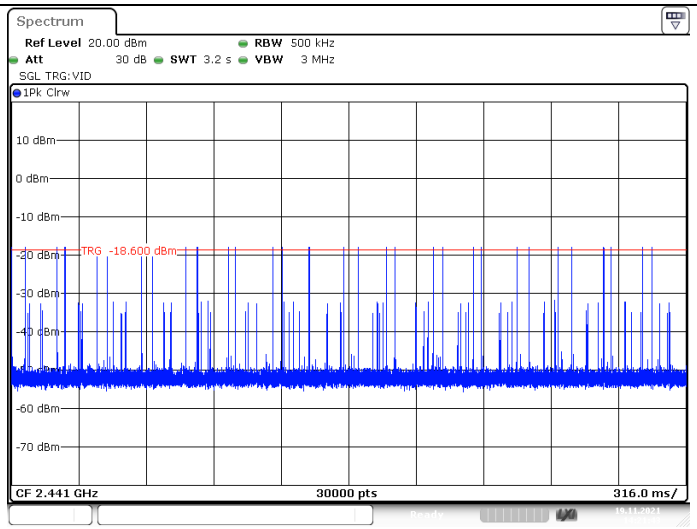
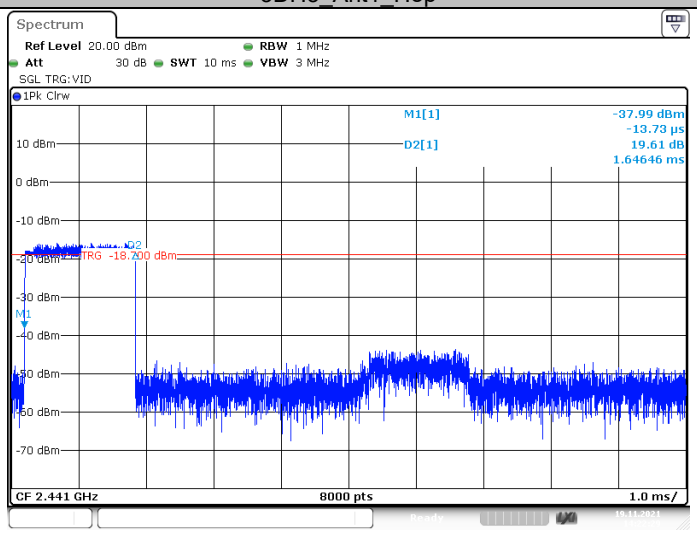
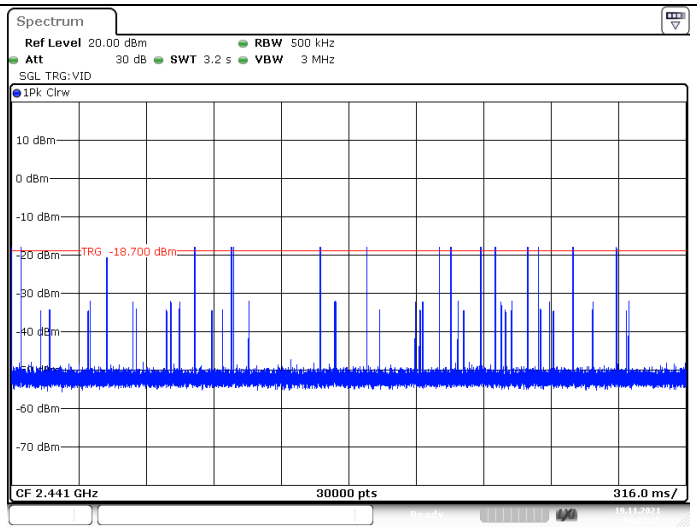
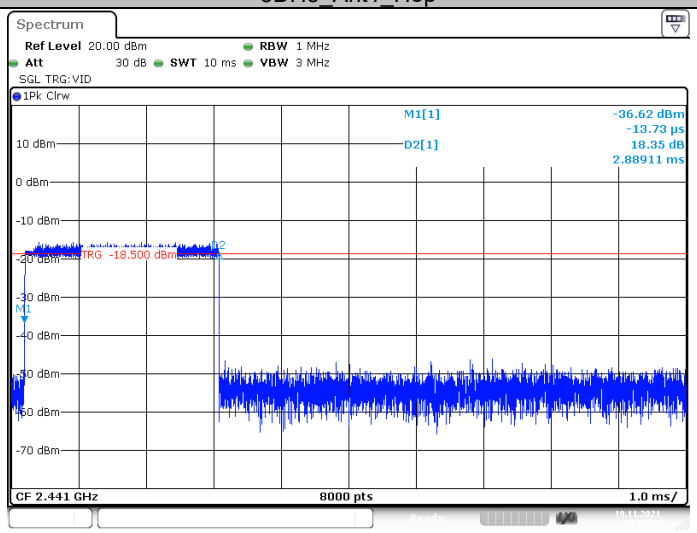
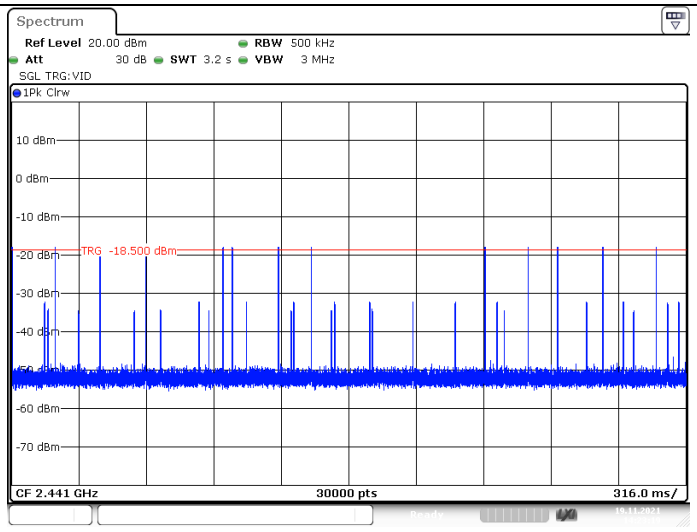
3DH1_Ant1_Hop
   

3DH3_Ant1_Hop
   

3DH5_Ant1_Hop



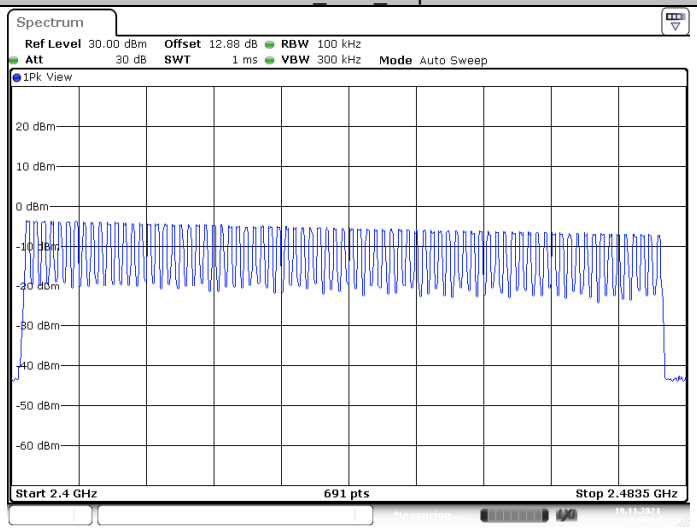
Appendix F: Number of hopping channels

Test Result

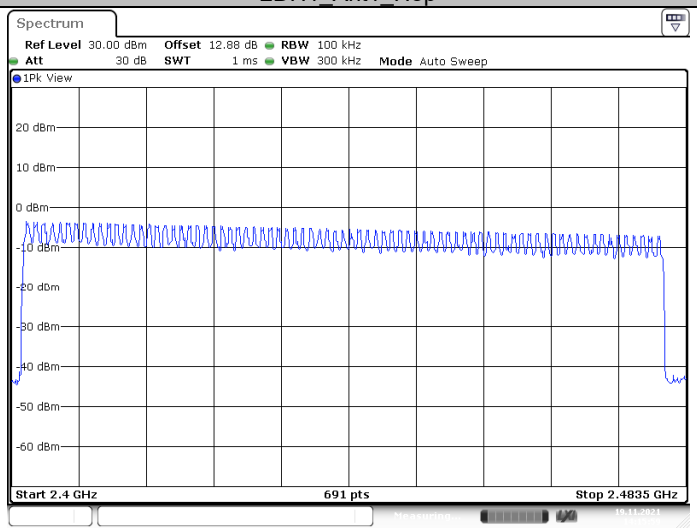
Test Mode	Antenna	Channel	Result[Num]	Limit[Num]	Verdict
DH1	Ant1	Hop	79	>=15	PASS
2DH1	Ant1	Hop	79	>=15	PASS
3DH1	Ant1	Hop	79	>=15	PASS

Test Graphs

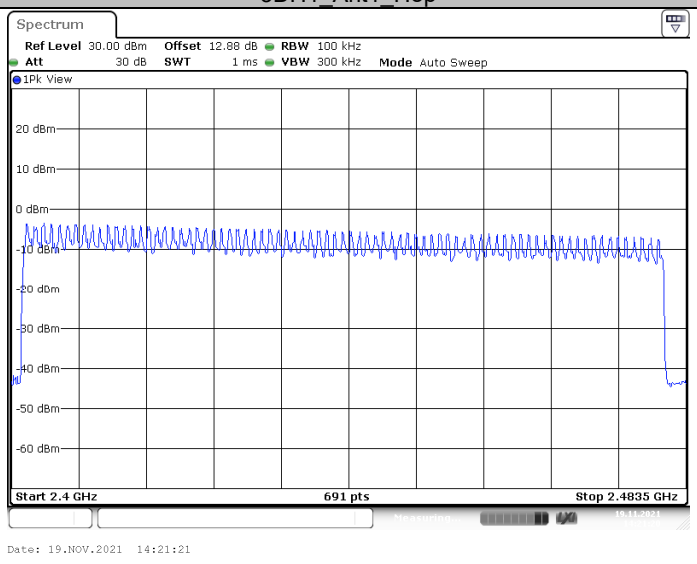
DH1_Ant1_Hop



2DH1_Ant1_Hop



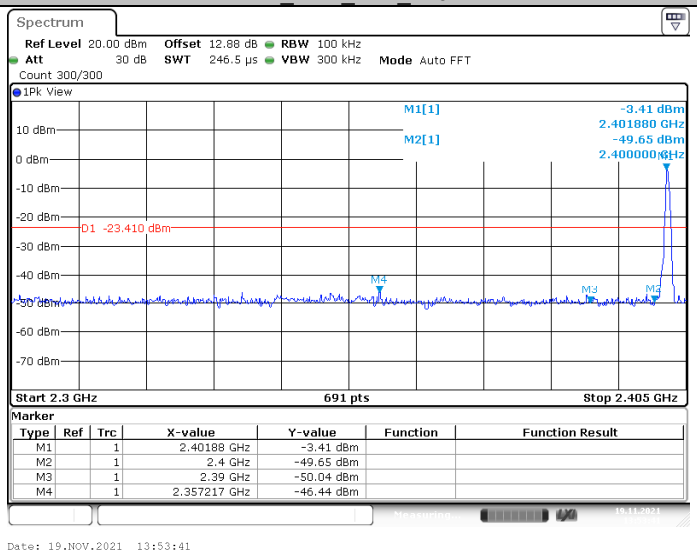
3DH1_Ant1_Hop



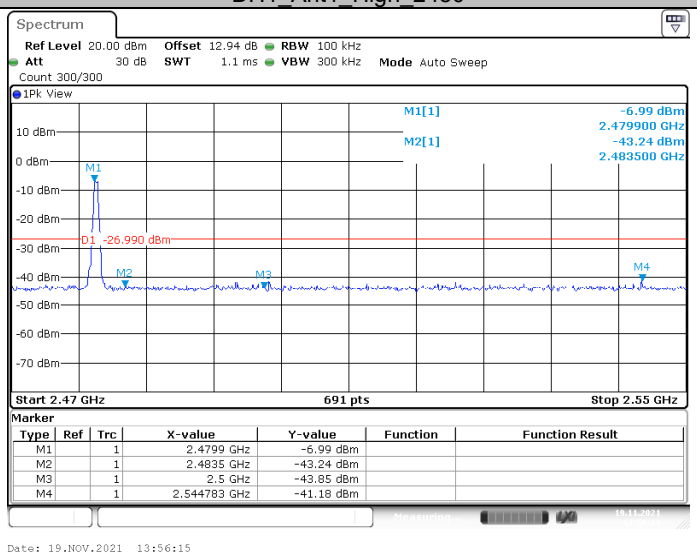
Appendix G: Band edge measurements

Test Graphs

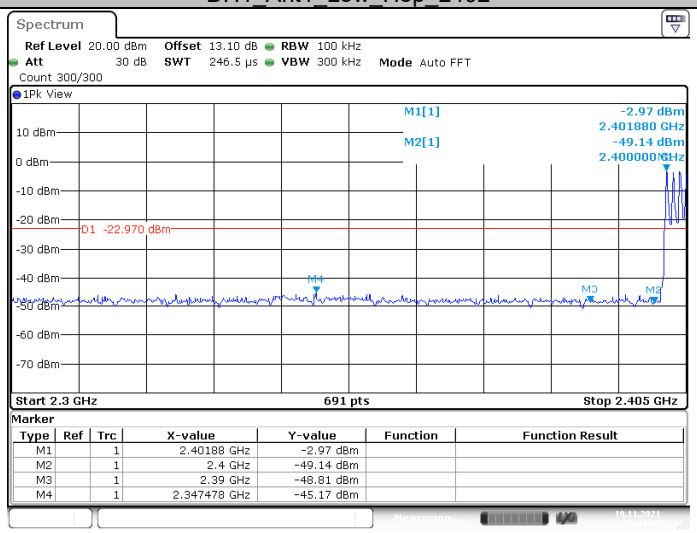
DH1_Ant1_Low_2402



DH1_Ant1_High_2480



DH1_Ant1_Low_Hop_2402



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40188 GHz	-2.97 dBm		
M2		1	2.4 GHz	-49.14 dBm		
M3		1	2.39 GHz	-48.81 dBm		
M4		1	2.347478 GHz	-45.17 dBm		

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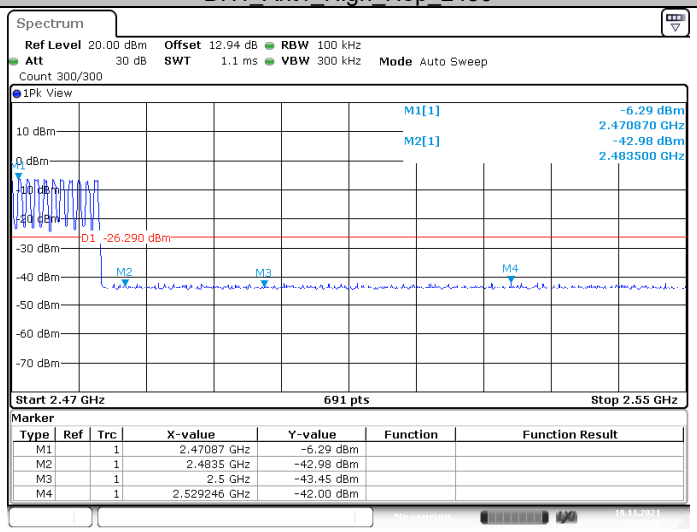
DH1_Ant1_High_Hop_2480



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.47087 GHz	-6.29 dBm		
M2		1	2.4835 GHz	-42.98 dBm		
M3		1	2.5 GHz	-43.45 dBm		
M4		1	2.529246 GHz	-42.00 dBm		

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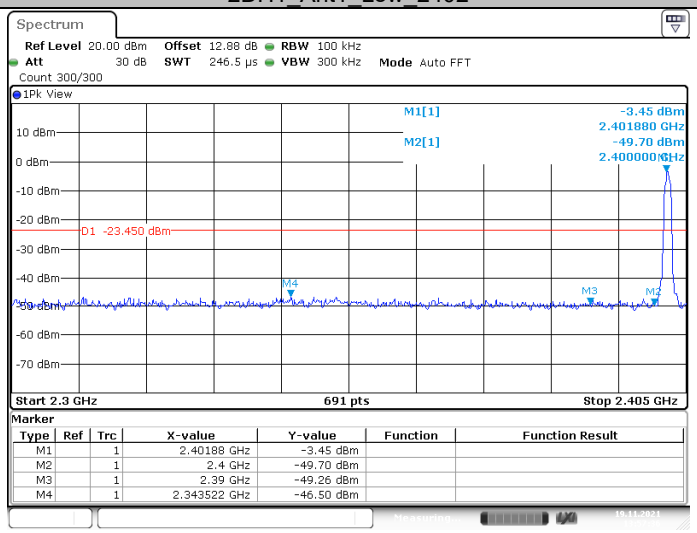
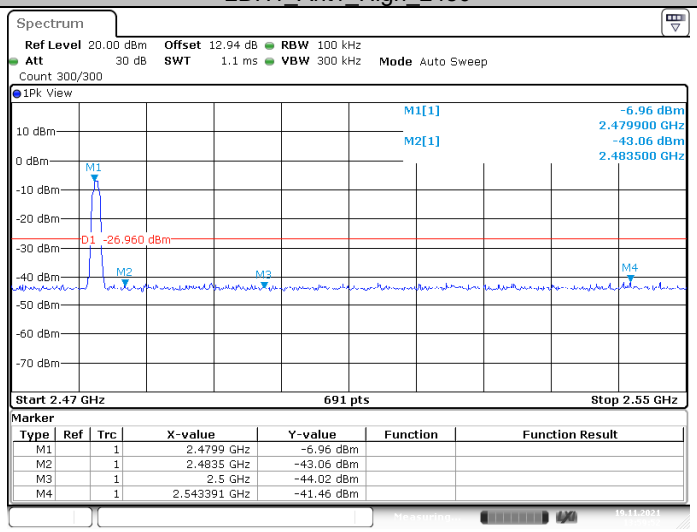
2DH1_Ant1_Low_2402



Date: 19.NOV.2021 13:57:37

2DH1_Ant1_High_2480



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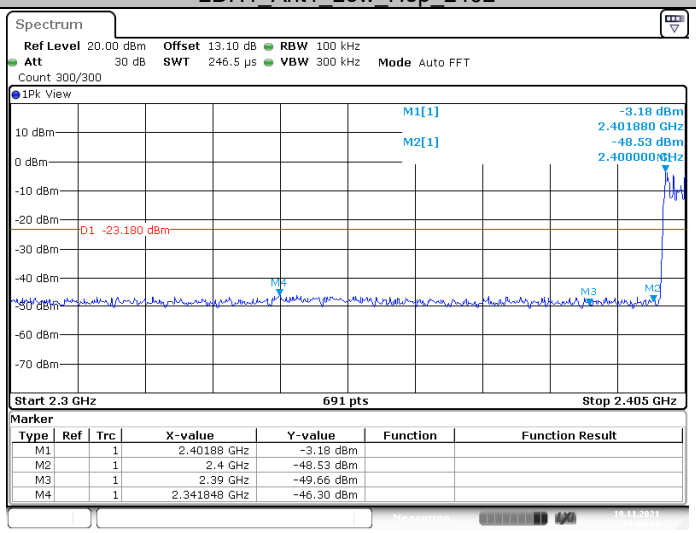
2DH1_Ant1_Low_Hop_2402



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40188 GHz	-3.18 dBm		
M2		1	2.4 GHz	-48.53 dBm		
M3		1	2.39 GHz	-49.66 dBm		
M4		1	2.341848 GHz	-46.30 dBm		

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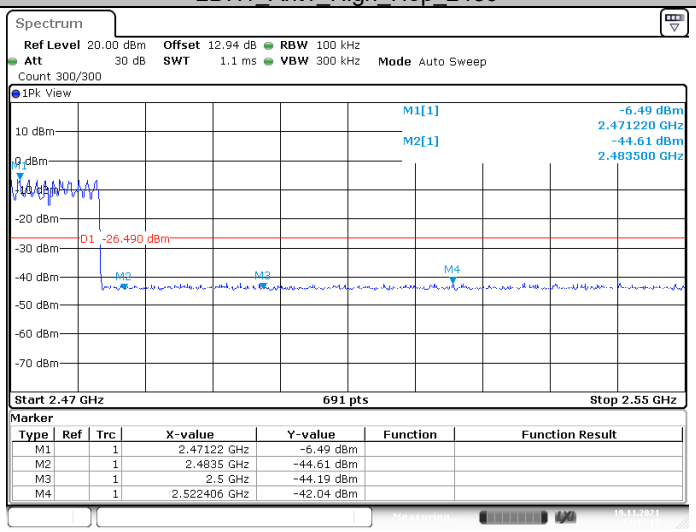
2DH1_Ant1_High_Hop_2480



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.47122 GHz	-6.49 dBm		
M2		1	2.4835 GHz	-44.61 dBm		
M3		1	2.5 GHz	-44.19 dBm		
M4		1	2.522406 GHz	-42.04 dBm		

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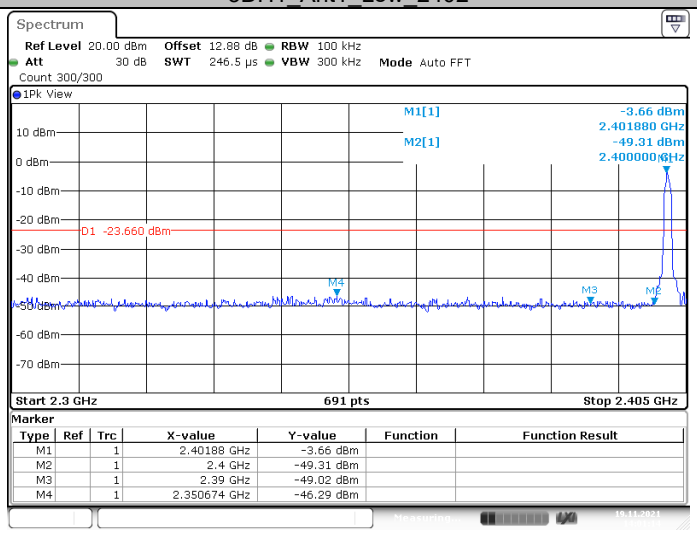
3DH1_Ant1_Low_2402



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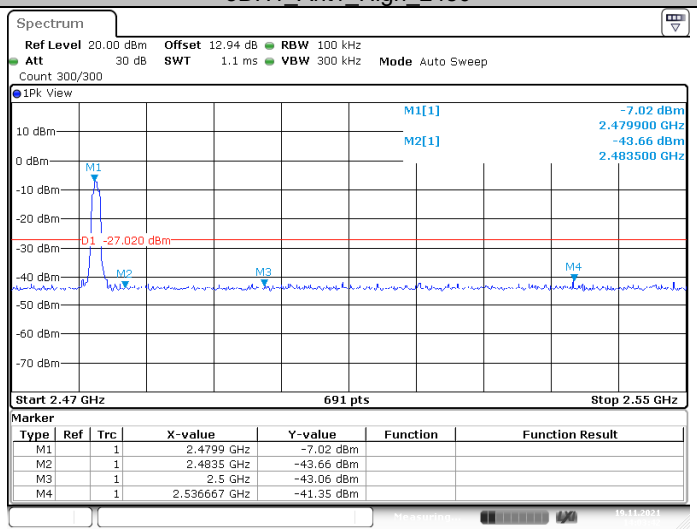
3DH1_Ant1_High_2480



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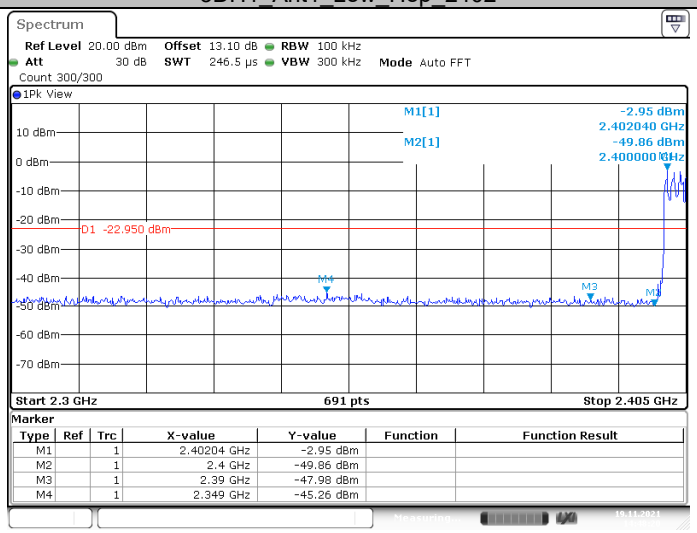
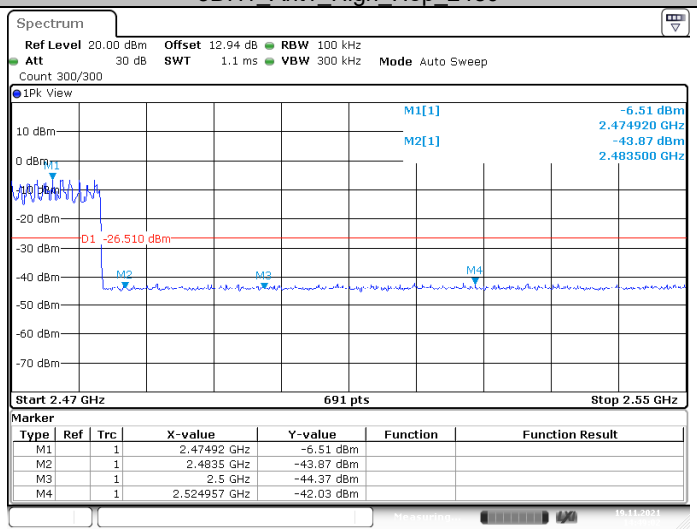
3DH1_Ant1_Low_Hop_2402



Date: 19.NOV.2021 14:48:21

3DH1_Ant1_High_Hop_2480



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