

TEST REPORT

Applicant Name : Inrico Technologies Co.,Ltd
Address : 3/F, Building NO.118, High Tech Industrial Park, 72 Guowei Road, Luohu District, Shenzhen, China
Report Number : SZ1210930-51080E-RF-00A
FCC ID: 2AIV6-T368

Test Standard (s)

FCC PART 15.247

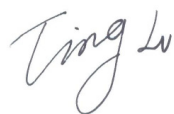
Sample Description

Product Type: Intelligent Two Way Radio
Model No.: T368
Multiple Model(s) No.: N/A
Trade Mark: Inrico
Date Received: 2021/09/30
Date of Test: 2021/10/18~2021/11/17
Report Date: 2022/01/18

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

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

Prepared and Checked By:



Ting Lü
EMC Engineer

Approved By:



Robert Li
EMC Engineer

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

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

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

Shenzhen Accurate Technology Co., Ltd.

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

TABLE OF CONTENTS

GENERAL INFORMATION.....	4
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	4
OBJECTIVE	4
TEST METHODOLOGY	4
MEASUREMENT UNCERTAINTY	5
TEST FACILITY	5
SYSTEM TEST CONFIGURATION	6
DESCRIPTION OF TEST CONFIGURATION	6
EUT EXERCISE SOFTWARE	6
SPECIAL ACCESSORIES	6
EQUIPMENT MODIFICATIONS	6
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	11
APPLICABLE STANDARD	11
FCC §15.203 – ANTENNA REQUIREMENT	12
APPLICABLE STANDARD	12
ANTENNA CONNECTOR CONSTRUCTION	12
FCC §15.207 (A) – AC LINE CONDUCTED EMISSIONS	13
APPLICABLE STANDARD	13
EUT SETUP	13
EMI TEST RECEIVER SETUP	13
TEST PROCEDURE	13
TRANSD FACTOR & MARGIN CALCULATION	14
TEST DATA	14
FCC §15.205, §15.209 & §15.247(D) – RADIATED EMISSIONS	17
APPLICABLE STANDARD	17
EUT SETUP	17
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP	18
TEST PROCEDURE	18
FACTOR & MARGIN CALCULATION	18
FACTOR & MARGIN CALCULATION	18
TEST DATA	18
FCC §15.247(A) (1)-CHANNEL SEPARATION TEST	24
APPLICABLE STANDARD	24
TEST PROCEDURE	24
TEST DATA	24

FCC §15.247(A) (1) – 20 DB EMISSION BANDWIDTH & 99% OCCUPIED BANDWIDTH	25
APPLICABLE STANDARD	25
TEST PROCEDURE	25
TEST DATA	26
FCC §15.247(A) (1) (III)-QUANTITY OF HOPPING CHANNEL TEST	27
APPLICABLE STANDARD	27
TEST PROCEDURE	27
TEST DATA	27
FCC §15.247(A) (1) (III) - TIME OF OCCUPANCY (DWELL TIME).....	28
APPLICABLE STANDARD	28
TEST PROCEDURE	28
TEST DATA	28
FCC §15.247(B) (1) - PEAK OUTPUT POWER MEASUREMENT	29
APPLICABLE STANDARD	29
TEST PROCEDURE	29
TEST DATA	29
FCC §15.247(D) - BAND EDGES TESTING.....	30
APPLICABLE STANDARD	30
TEST PROCEDURE	30
TEST DATA	30
APPENDIX	31
APPENDIX A: 20dB EMISSION BANDWIDTH.....	31
APPENDIX B: OCCUPIED CHANNEL BANDWIDTH	35
APPENDIX C: MAXIMUM CONDUCTED PEAK OUTPUT POWER.....	39
APPENDIX D: CARRIER FREQUENCY SEPARATION	44
APPENDIX E: TIME OF OCCUPANCY	46
APPENDIX F: NUMBER OF HOPPING CHANNELS	53
APPENDIX G: BAND EDGE MEASUREMENTS	55

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Frequency Range	Bluetooth: 2402~2480MHz
Maximum conducted Peak output power	Bluetooth: 4.45dBm
Modulation Technique	Bluetooth: GFSK, $\pi/4$ -DQPSK, 8DPSK
Antenna Specification*	1.4dBi (provided by the applicant)
Voltage Range	DC 3.8V from battery or DC 5V from adapter
Sample serial number	SZ1210930-51080E-RF-S1 (Assigned by ATC)
Sample/EUT Status	Good condition
Adapter information	Model: HJ-0502000W2-US Input: AC 100-240V, 50/60Hz, 0.3A Output: DC 5V, 2000mA

Objective

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

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

Test Methodology

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

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

Measurement Uncertainty

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

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

Test Facility

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

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

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

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in an engineering mode.

EUT Exercise Software

EUT was test in the engineering mode.

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

The 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

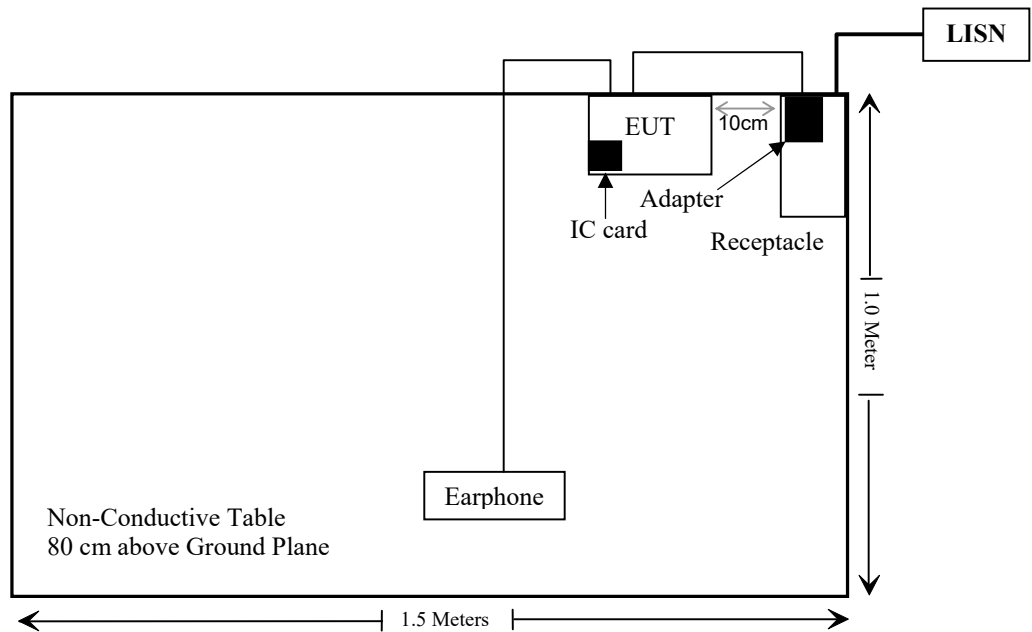
Manufacturer	Description	Model	Serial Number
Unknown	IC card	Unknown	Unknown

External I/O Cable

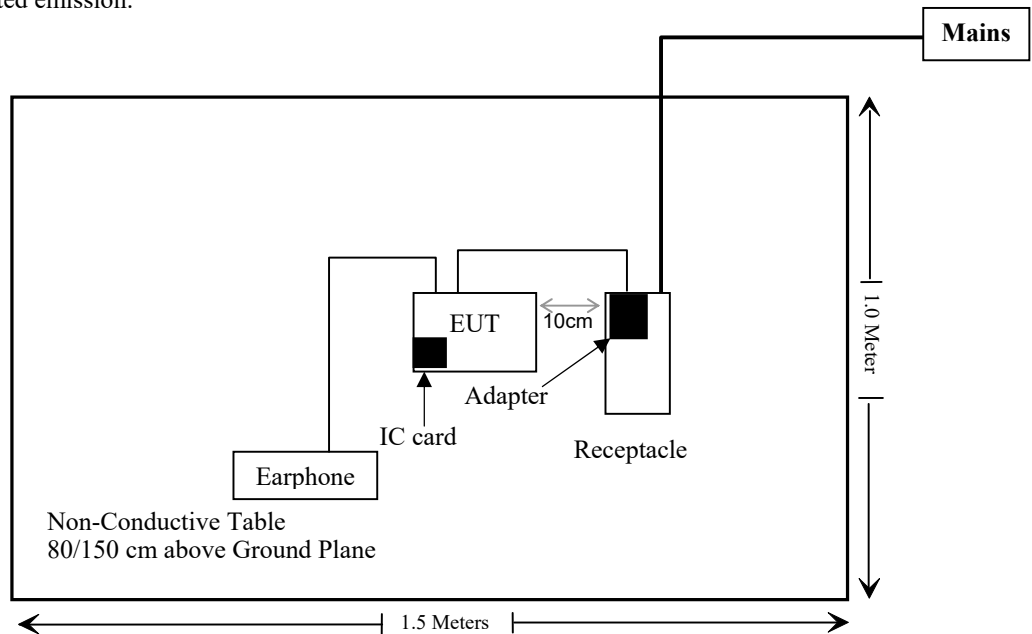
Cable Description	Length (m)	From Port	To
Un-shield Detachable USB Cable	1.0	Adapter	EUT

Block Diagram of Test Setup

For conducted emission:



For radiated 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 & 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	Test Receiver	ESPI3	100396	2020/12/24	2021/12/23
R & S	L.I.S.N.	ENV216	101314	2020/12/25	2021/12/24
Anritsu Corp	50ΩCoaxial Switch	MP59B	6200506474	2020/12/25	2021/12/24
Unknown	RF Coaxial Cable	N-2m	No.2	2020/12/25	2021/12/24
Conducted Emission Test Software: e3 19821b (V9)					
Radiated Emissions Test					
Rohde& Schwarz	Test Receiver	ESR	101817	2020/12/24	2021/12/23
Rohde&Schwarz	Spectrum Analyzer	FSV40	101495	2020/12/24	2021/12/23
SONOMA INSTRUMENT	Amplifier	310 N	186131	2020/12/25	2021/12/24
A.H. Systems, inc.	Preamplifier	PAM-0118P	531	2021/07/08	2022/07/07
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2020/11/28	2021/11/27
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
Conducted 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-5m	No.4	2020/12/25	2021/12/24
Unknown	RF Coaxial Cable	N-1m	No.5	2020/12/25	2021/12/24
Unknown	RF Coaxial Cable	N-1m	No.6	2020/12/25	2021/12/24
Wainwright	High Pass Filter	WHKX3.6/18 G-10SS	5	2020/12/25	2021/12/24

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Rohde & Schwarz	Spectrum Analyzer	FSV-40	101495	2020/12/24	2021/12/23
Tonscend	RF Control Unit	JS0806-2	19G8060182	2021/07/06	2022/07/05
Unknown	RF Cable	Unknown	Unknown	Each time	/
Unknown	RF Coaxial Cable	No.31	RF-01	Each time	/

* **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:

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

1. $f(\text{GHz})$ 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.

Measurement Result

For worst case:

Frequency (MHz)	Tune-up power (dBm)	Tune-up power (mW)	Distance (mm)	Calculated value	Threshold (1-g SAR)	SAR Test Exclusion
2480	4.7	2.95	5.0	0.9	3.0	Yes

Result: No 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 1.4dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207(a)

EUT Setup



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

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

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

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

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

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

Test Procedure

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

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

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

Transd Factor & Margin Calculation

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

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

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

$$\begin{aligned} \text{Over Limit} &= \text{Result} - \text{Limit} \\ \text{Result} &= \text{reading level} + \text{Transd Factor} \end{aligned}$$

Test Data

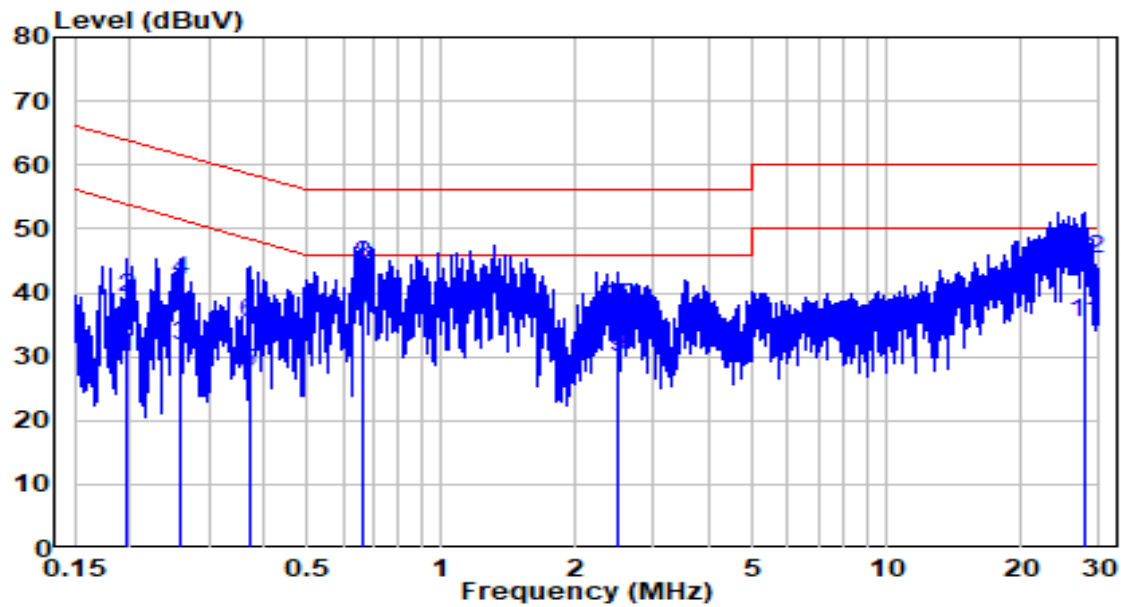
Environmental Conditions

Temperature:	23 °C
Relative Humidity:	48 %
ATM Pressure:	101.0 kPa

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

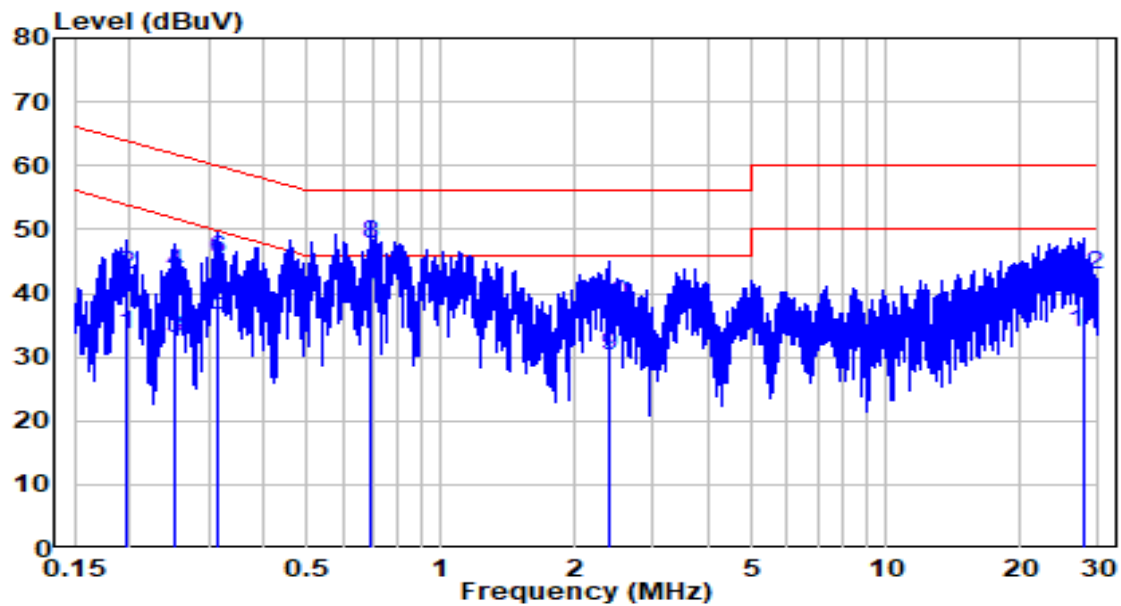
EUT operation mode: Transmitting (the worst case for 8DPSK Mode, Low channel)

AC 120V/60 Hz, Line



No.	Frequency	Reading	Correct	Result	Limit	Over Limit	Remark	Phase
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)		
1	0.197	20.02	9.81	29.83	53.74	-23.91	Average	Line
2	0.197	29.57	9.81	39.38	63.74	-24.36	QP	Line
3	0.261	21.75	9.80	31.55	51.41	-19.86	Average	Line
4	0.261	32.21	9.80	42.01	61.41	-19.40	QP	Line
5	0.369	17.59	9.80	27.40	48.52	-21.12	Average	Line
6	0.369	25.59	9.80	35.39	58.52	-23.13	QP	Line
7	0.664	26.20	9.81	36.00	46.00	-10.00	Average	Line
8	0.664	34.55	9.81	44.35	56.00	-11.65	QP	Line
9	2.480	20.10	9.92	30.02	46.00	-15.98	Average	Line
10	2.480	27.73	9.92	37.65	56.00	-18.35	QP	Line
11	27.837	24.78	10.44	35.23	50.00	-14.77	Average	Line
12	27.837	34.78	10.44	45.22	60.00	-14.78	QP	Line

AC 120V/60 Hz, Neutral



No.	Frequency	Reading	Correct	Result	Limit	Over Limit	Remark	Phase
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)		
1	0.196	23.60	9.99	33.59	53.79	-20.20	Average	Neutral
2	0.196	32.96	9.99	42.95	63.79	-20.84	QP	Neutral
3	0.252	22.89	9.98	32.87	51.70	-18.83	Average	Neutral
4	0.252	33.26	9.98	43.23	61.70	-18.47	QP	Neutral
5	0.315	26.59	9.95	36.55	49.84	-13.29	Average	Neutral
6	0.315	35.39	9.95	45.34	59.84	-14.50	QP	Neutral
7	0.695	29.89	9.91	39.80	46.00	-6.20	Average	Neutral
8	0.695	37.83	9.91	47.74	56.00	-8.26	QP	Neutral
9	2.398	20.24	9.95	30.19	46.00	-15.81	Average	Neutral
10	2.398	28.41	9.95	38.36	56.00	-17.64	QP	Neutral
11	27.708	23.33	10.36	33.69	50.00	-16.31	Average	Neutral
12	27.708	32.47	10.36	42.83	60.00	-17.17	QP	Neutral

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

FCC §15.205; §15.209; §15.247(d)

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

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

EMI Test Receiver & Spectrum Analyzer Setup

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

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

Test Procedure

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

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

Factor & Margin Calculation

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:

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

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

$$\begin{aligned} \text{Over limit/Margin} &= \text{Result/Corrected Amplitude} - \text{Limit} \\ \text{Result/Corrected Amplitude} &= \text{Reading} + \text{Factor} \end{aligned}$$

Test Data

Environmental Conditions

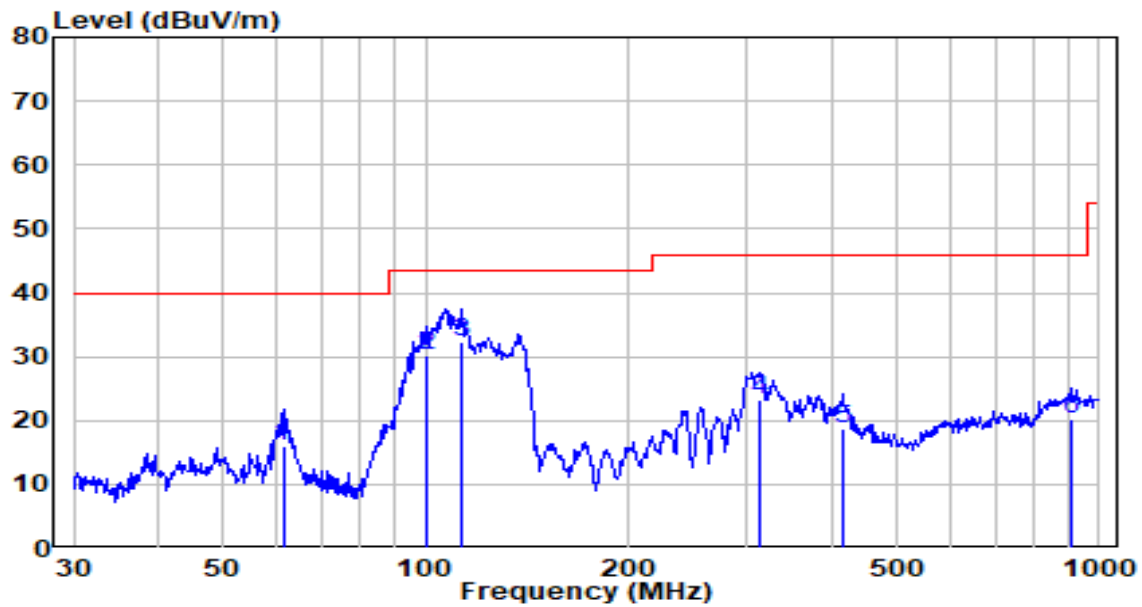
Temperature:	23~26.5℃
Relative Humidity:	52~64 %
ATM Pressure:	101.0 kPa

The testing was performed by Bin Deng on 2021-10-28 for below 1GHz, Bin Deng and Caro Hu on 2021-10-19 and 2021-11-17 for above 1GHz.

EUT operation mode: Transmitting (Pre-scan in the X,Y and Z axes of orientation, the worst case of orientation was recorded)

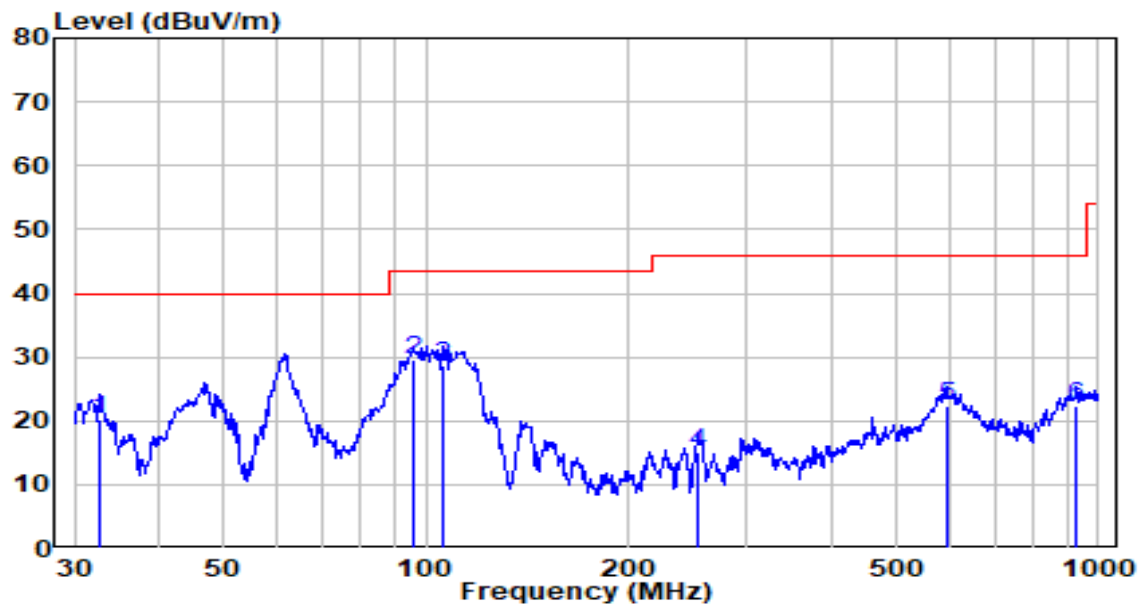
30MHz-1GHz: (the worst case for 8DPSK Mode, Low channel)

Horizontal:



No.	Frequency	Reading	Correct	Result	Limit	Over Limit	Remark	Phase
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)		
1	61.346	35.72	-19.76	15.96	40.00	-24.04	QP	HORIZONTAL
2	99.878	49.45	-19.19	30.26	43.50	-13.24	QP	HORIZONTAL
3	113.316	51.76	-19.59	32.17	43.50	-11.33	QP	HORIZONTAL
4	314.377	39.96	-16.70	23.26	46.00	-22.74	QP	HORIZONTAL
5	416.179	33.60	-14.90	18.70	46.00	-27.30	QP	HORIZONTAL
6	909.667	28.38	-8.00	20.37	46.00	-25.63	QP	HORIZONTAL

Vertical



No.	Frequency	Reading	Correct	Result	Limit	Over Limit	Remark	Phase
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)		
1	32.634	40.06	-19.97	20.09	40.00	-19.91	QP	VERTICAL
2	95.762	49.53	-20.05	29.48	43.50	-14.02	QP	VERTICAL
3	106.013	47.79	-19.18	28.62	43.50	-14.88	QP	VERTICAL
4	254.728	33.51	-18.44	15.07	46.00	-30.93	QP	VERTICAL
5	595.133	33.33	-10.88	22.45	46.00	-23.55	QP	VERTICAL
6	929.008	30.31	-7.87	22.44	46.00	-23.56	QP	VERTICAL

Above 1GHz: *(the worst case for 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/AV		Height (m)	Polar (H/V)				
Low Channel (2402 MHz)									
2310	59.3	PK	113	2.2	H	-6.84	52.46	74	-21.54
2310	54.68	PK	156	2.3	V	-6.84	47.84	74	-26.16
2390	67.17	PK	259	1.3	H	-6.44	60.73	74	-13.27
2390	53.04	AV	259	1.3	H	-6.44	46.6	54	-7.4
2390	60.55	PK	49	1.3	V	-6.44	54.11	74	-19.89
2390	48.05	AV	49	1.3	V	-6.44	41.61	54	-12.39
4804	48.95	PK	31	1.3	H	2.81	51.76	74	-22.24
4804	42.5	PK	231	1.5	V	2.81	45.31	74	-28.69
Middle Channel (2441 MHz)									
4882	49.97	PK	34	2.4	H	3.04	53.01	74	-20.99
4882	45.27	PK	243	2.1	V	3.04	48.31	74	-25.69
High Channel (2480 MHz)									
2483.5	68.87	PK	137	2.1	H	-5.96	62.91	74	-11.09
2483.5	53.61	AV	137	2.1	H	-5.96	47.65	54	-6.35
2483.5	61.35	PK	207	2.5	V	-5.96	55.39	74	-18.61
2483.5	47.42	AV	207	2.5	V	-5.96	41.46	54	-12.54
2500	58.19	PK	178	2.5	H	-5.88	52.31	74	-21.69
2500	33.07	PK	123	2.2	V	-5.88	27.19	54	-26.81
4960	48.93	PK	59	2.2	H	3.29	52.22	74	-21.78
4960	42.24	PK	241	2.3	V	3.29	45.53	74	-28.47

Note:

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

Corrected Amplitude = Corrected Factor + Reading

Margin = Corrected. Amplitude - Limit

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

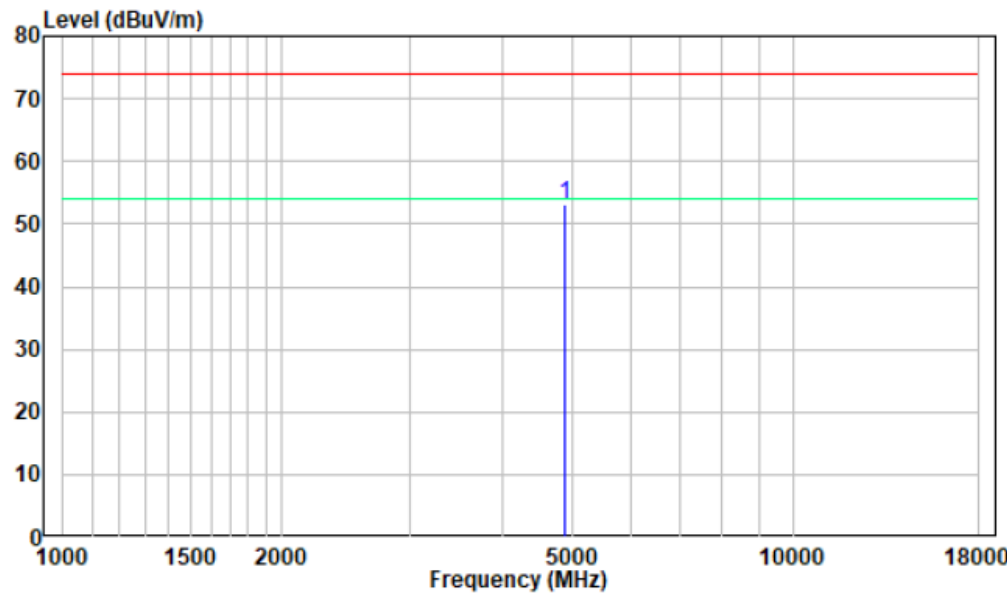
The test result of peak was less than the limit of average, so just peak value were recorded.

1-18GHz

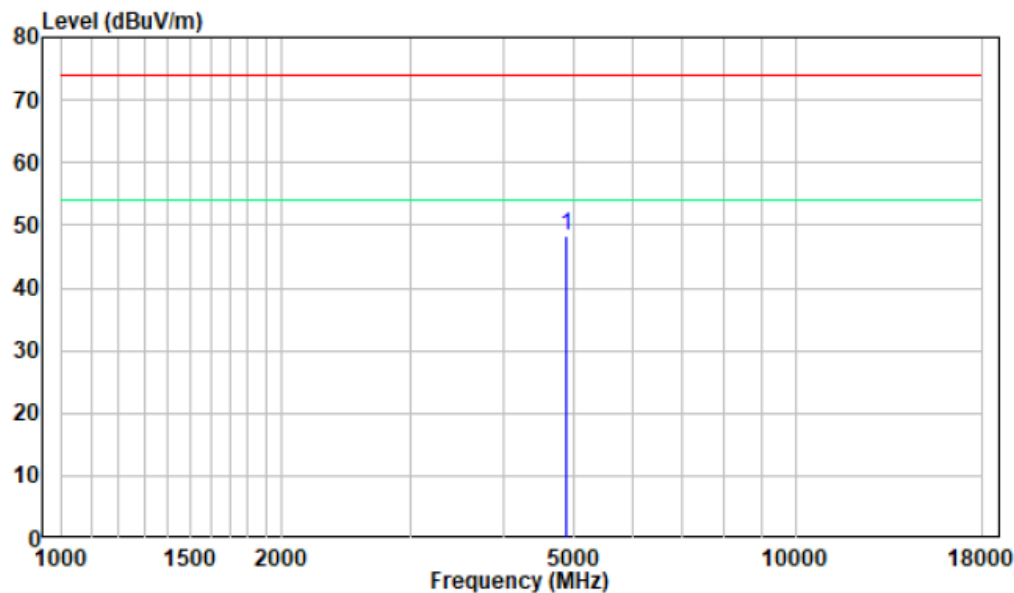
Pre-scan for Peak

Middle Channel

Horizontal:



Vertical:

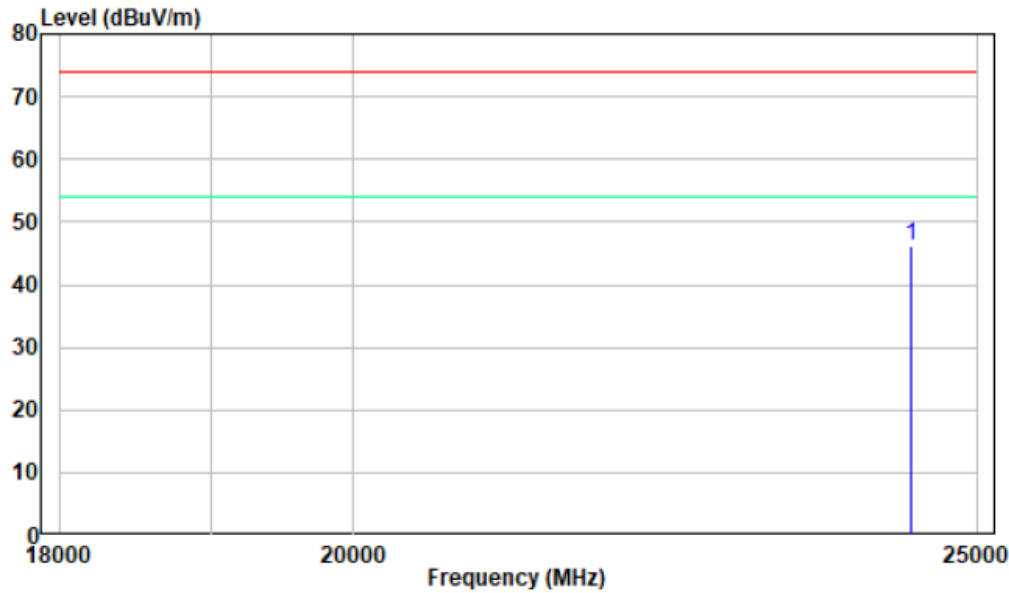


18-25GHz

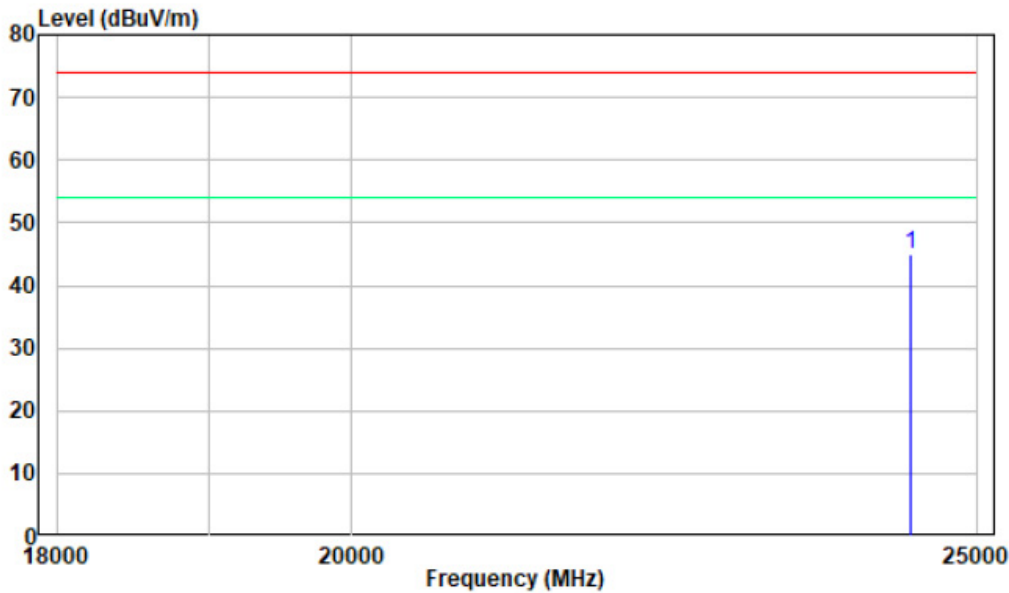
Pre-scan for Peak

Middle Channel

Horizontal:



Vertical:



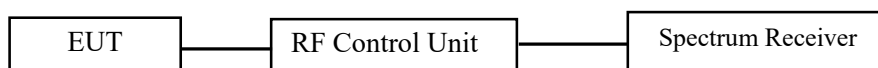
FCC §15.247(a) (1)-CHANNEL SEPARATION TEST

Applicable Standard

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

Test Procedure

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



Test Data

Environmental Conditions

Temperature:	23 °C
Relative Humidity:	62 %
ATM Pressure:	101.0 kPa

The testing was performed by Paul Liu on 2021-10-18.

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.

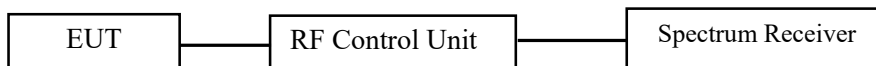
Test Procedure

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:	23 °C
Relative Humidity:	62 %
ATM Pressure:	101.0 kPa

The testing was performed by Paul Liu on 2021-10-18.

EUT operation mode: Transmitting

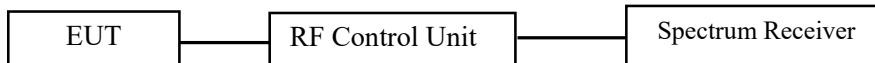
Test Result: Compliant. Please refer to the Appendix.

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:	23 °C
Relative Humidity:	62 %
ATM Pressure:	101.0 kPa

The testing was performed by Paul Liu on 2021-10-18.

EUT operation mode: Transmitting

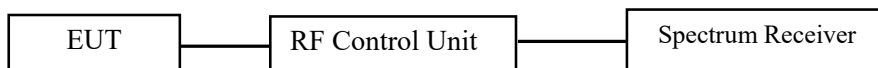
Test Result: Compliant. Please refer to the Appendix.

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

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

Test Procedure

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

**Test Data****Environmental Conditions**

Temperature:	23 °C
Relative Humidity:	62 %
ATM Pressure:	101.0 kPa

The testing was performed by Paul Liu on 2021-10-18.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

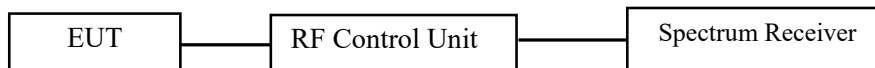
FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT

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:	23 °C
Relative Humidity:	62 %
ATM Pressure:	101.0 kPa

The testing was performed by Paul Liu on 2021-10-18.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

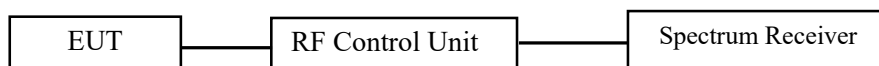
FCC §15.247(d) - BAND EDGES TESTING

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:	23 °C
Relative Humidity:	62 %
ATM Pressure:	101.0 kPa

The testing was performed by Paul Liu on 2021-10-18.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

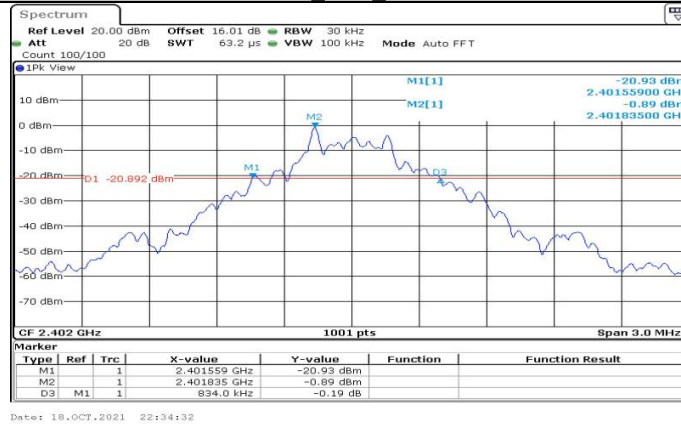
APPENDIX

Appendix A: 20dB Emission Bandwidth Test Result

Test Mode	Antenna	Channel	20db EBW[MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	0.834	---	PASS
		2441	0.924	---	PASS
		2480	0.885	---	PASS
2DH1	Ant1	2402	1.251	---	PASS
		2441	1.251	---	PASS
		2480	1.248	---	PASS
3DH1	Ant1	2402	1.266	---	PASS
		2441	1.266	---	PASS
		2480	1.263	---	PASS

Test Graphs

DH1_Ant1_2402



DH1_Ant1_2441



DH1_Ant1_2480



2DH1_Ant1_2402



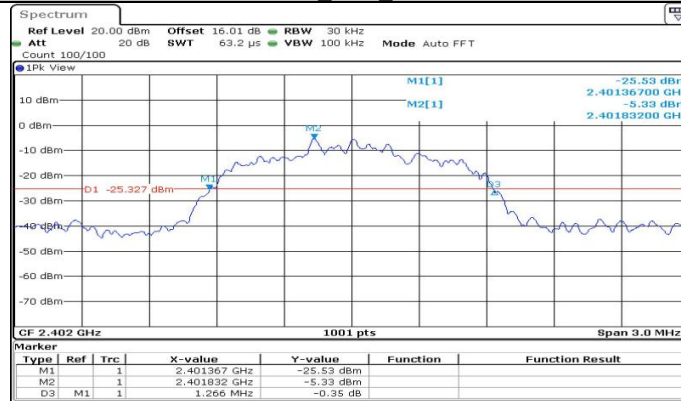
2DH1_Ant1_2441



2DH1_Ant1_2480

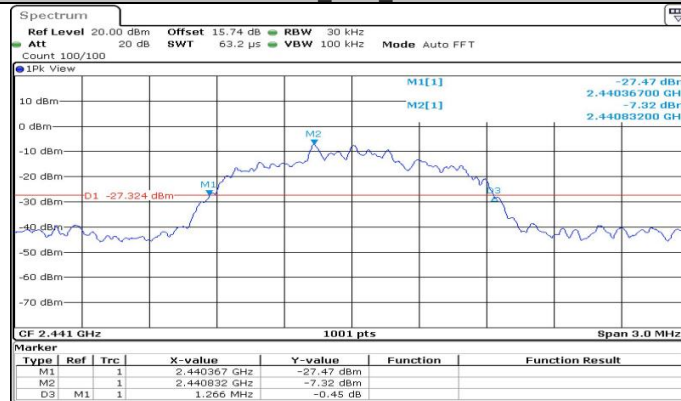


3DH1_Ant1_2402



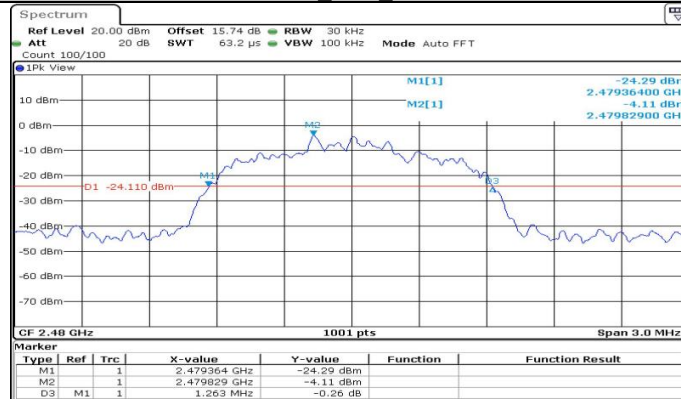
Date: 18.OCT.2021 22:41:09

3DH1_Ant1_2441



Date: 18.OCT.2021 22:42:03

3DH1_Ant1_2480

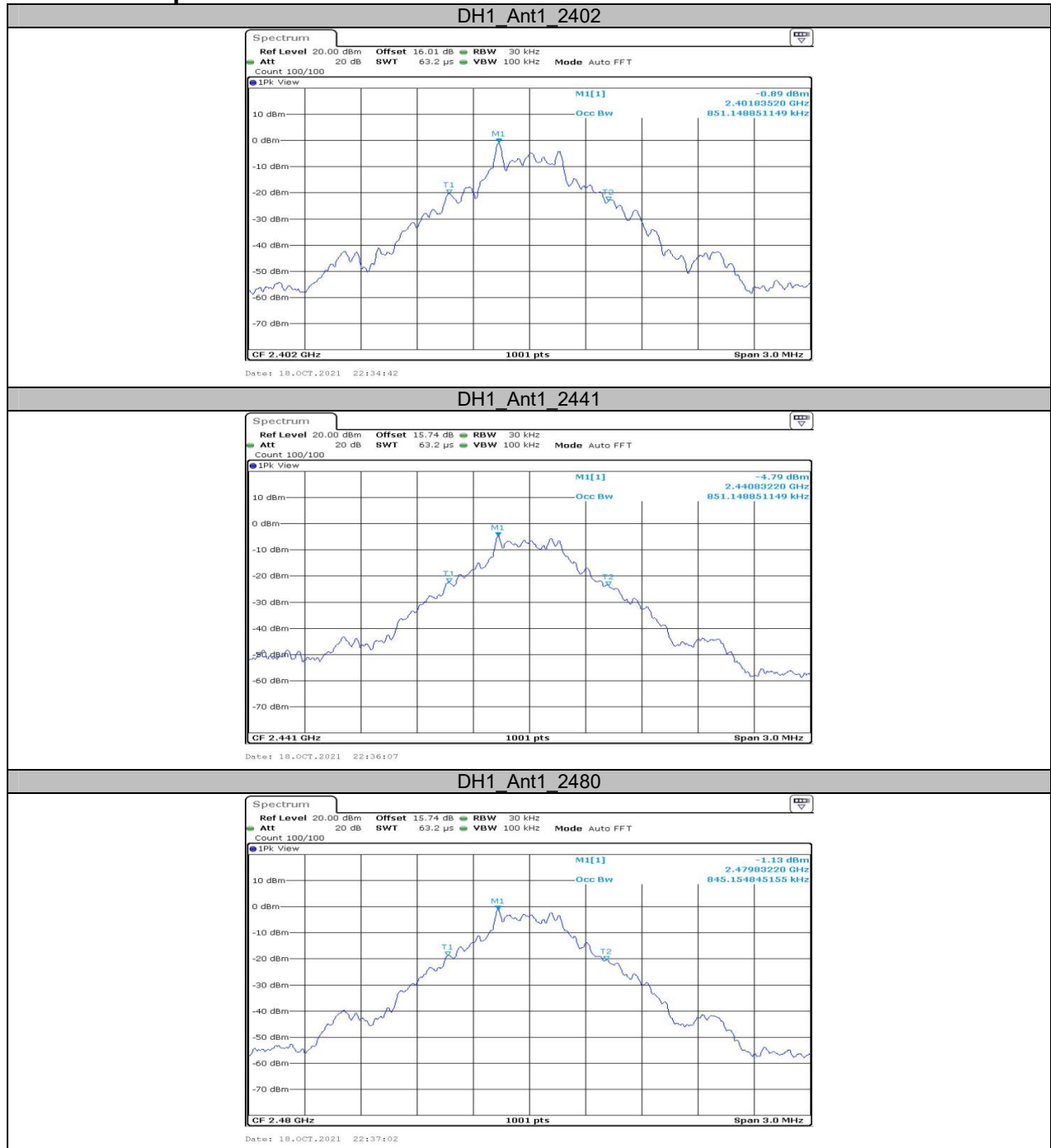


Date: 18.OCT.2021 22:42:59

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

Test Mode	Antenna	Channel	OCB [MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	0.851	---	PASS
		2441	0.851	---	PASS
		2480	0.845	---	PASS
2DH1	Ant1	2402	1.175	---	PASS
		2441	1.175	---	PASS
		2480	1.163	---	PASS
3DH1	Ant1	2402	1.172	---	PASS
		2441	1.175	---	PASS
		2480	1.160	---	PASS

Test Graphs



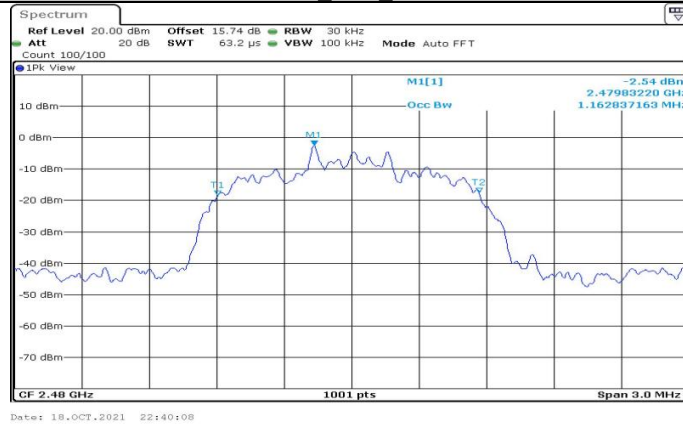
2DH1_Ant1_2402



2DH1_Ant1_2441



2DH1_Ant1_2480



3DH1_Ant1_2402



3DH1_Ant1_2441



3DH1_Ant1_2480



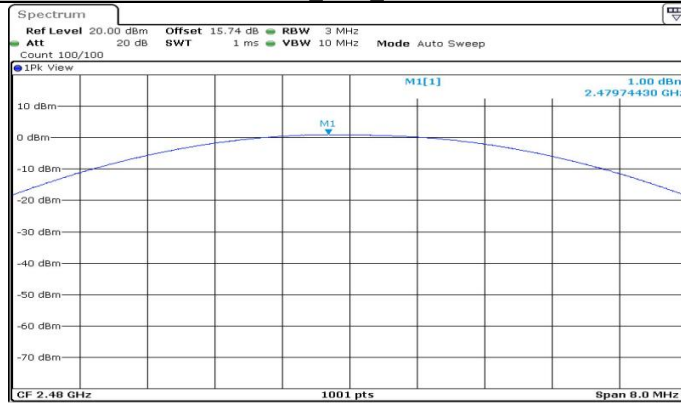
**Appendix C: Maximum conducted Peak output power
Test Result**

Test Mode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
DH1	Ant1	2402	-0.54	≤20.97	PASS
		2441	-2.55	≤20.97	PASS
		2452	4.45	≤20.97	PASS
		2480	1	≤20.97	PASS
2DH1	Ant1	2402	-1.15	≤20.97	PASS
		2441	-3.16	≤20.97	PASS
		2453	2.94	≤20.97	PASS
		2480	0.1	≤20.97	PASS
3DH1	Ant1	2402	-0.98	≤20.97	PASS
		2441	-3.02	≤20.97	PASS
		2451	3.41	≤20.97	PASS
		2480	0.33	≤20.97	PASS

Test Graphs

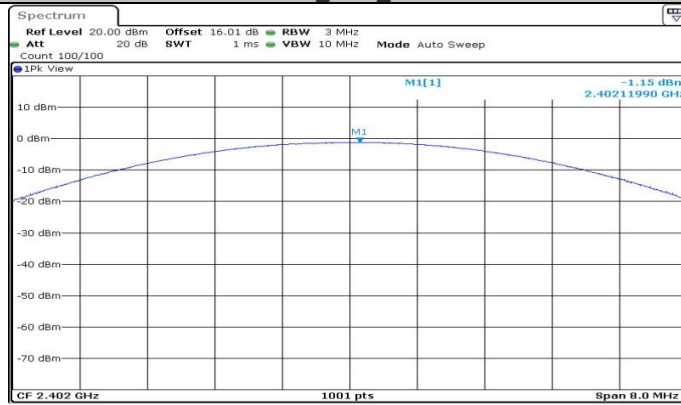


DH1 Ant1 2480



Date: 18.OCT.2021 22:37:16

2DH1 Ant1 2402



Date: 18.OCT.2021 22:38:29

2DH1 Ant1 2441



Date: 18.OCT.2021 22:39:17

2DH1_Ant1_2453



2DH1_Ant1_2480



3DH1_Ant1_2402



3DH1_Ant1_2441



3DH1_Ant1_2451



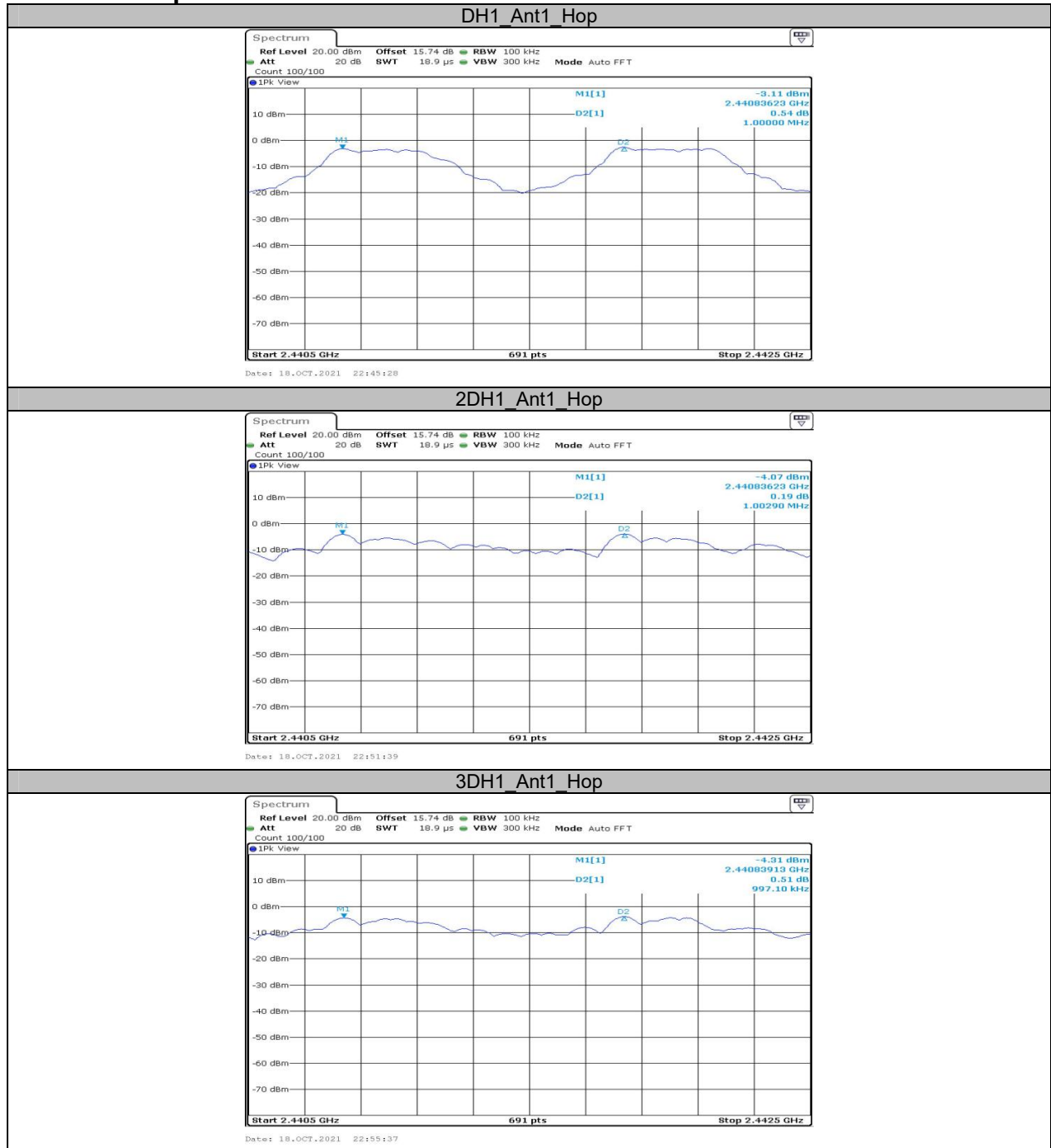
3DH1_Ant1_2480



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

TestMode	Antenna	Channel	Result[MHz]	Limit[MHz]	Verdict
DH1	Ant1	Hop	1.000	0.616	PASS
2DH1	Ant1	Hop	1.003	0.834	PASS
3DH1	Ant1	Hop	0.997	0.844	PASS

Test Graphs



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

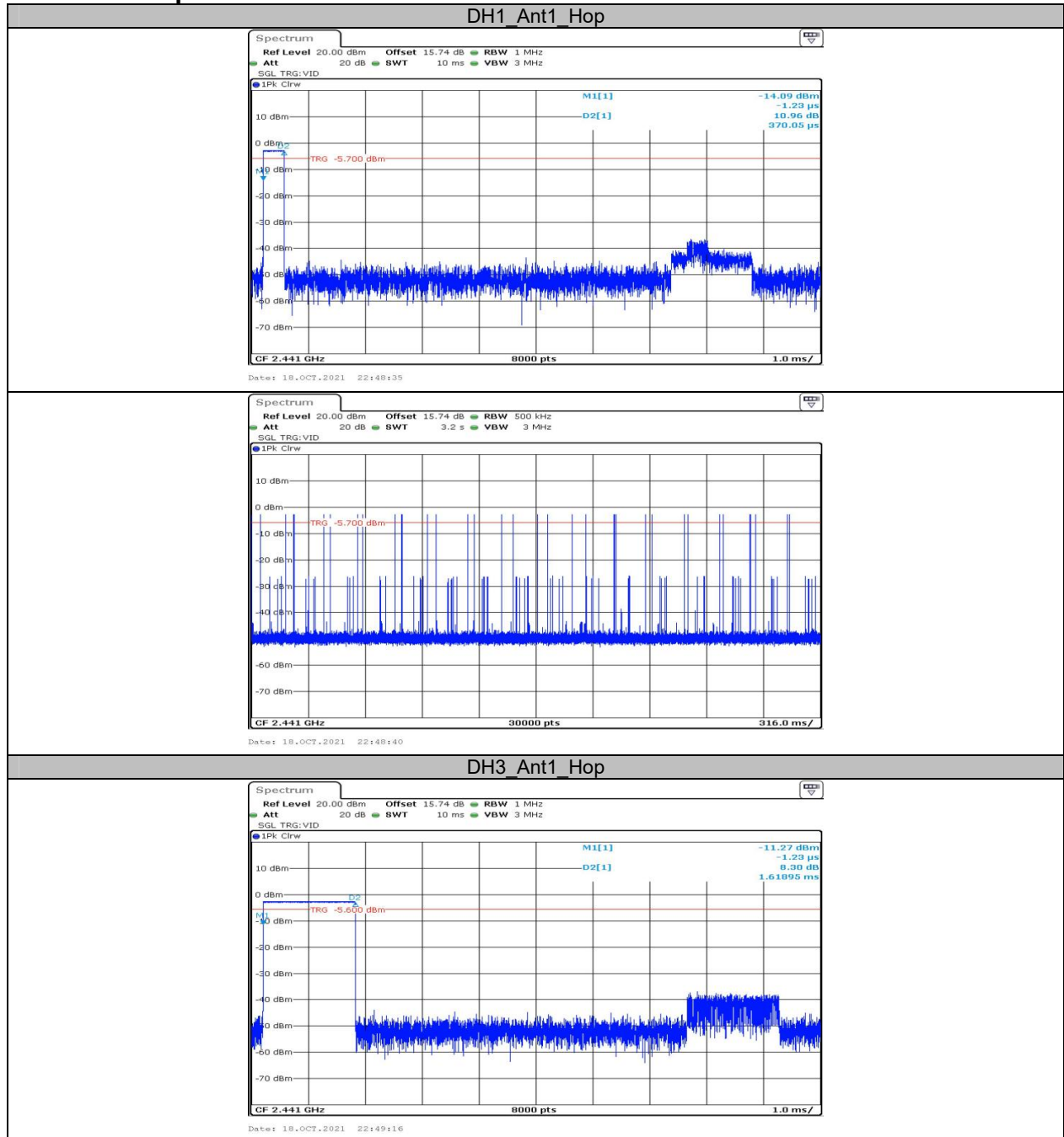
TestMode	Antenna	Channel	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH1	Ant1	Hop	0.37	320	0.118	≤0.4	PASS
DH3	Ant1	Hop	1.62	170	0.275	≤0.4	PASS
DH5	Ant1	Hop	2.86	110	0.315	≤0.4	PASS
2DH1	Ant1	Hop	0.38	320	0.121	≤0.4	PASS
2DH3	Ant1	Hop	1.62	170	0.276	≤0.4	PASS
2DH5	Ant1	Hop	2.86	100	0.286	≤0.4	PASS
3DH1	Ant1	Hop	0.38	320	0.121	≤0.4	PASS
3DH3	Ant1	Hop	1.62	150	0.243	≤0.4	PASS
3DH5	Ant1	Hop	2.87	90	0.258	≤0.4	PASS

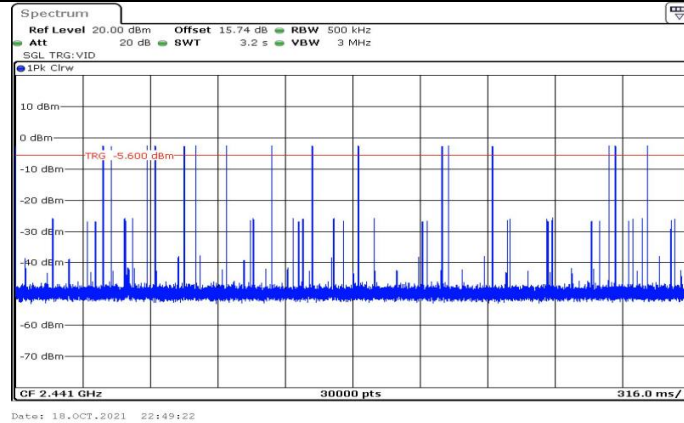
Note 1: A period time=0.4*79=31.6(S), Result=BurstWidth*Totalhops

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

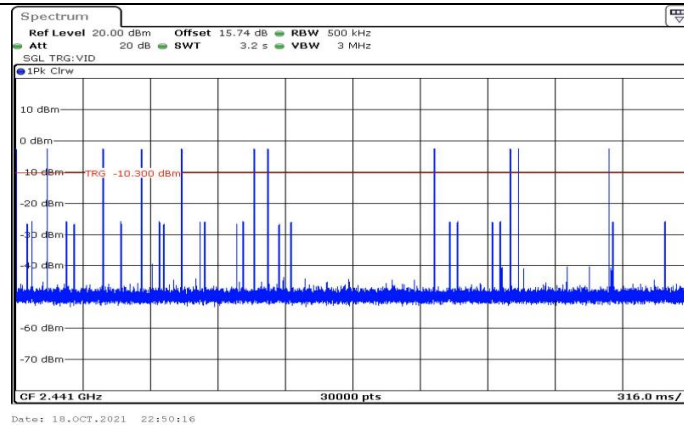
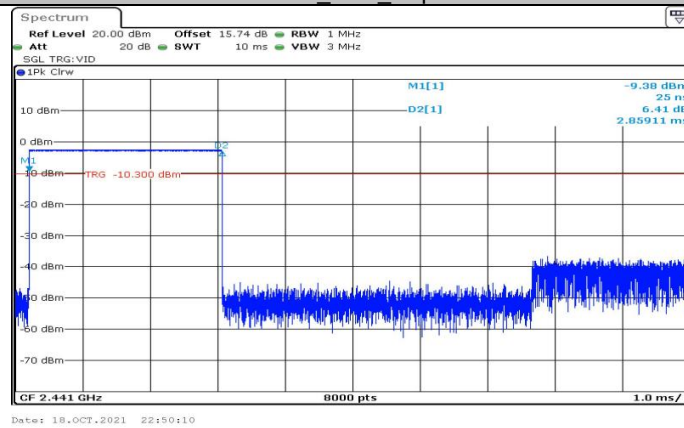
Note 3: Hopping Number in 3.16s=Total of highest signals in 3.16s(Second high signals were other channel)

Test Graphs

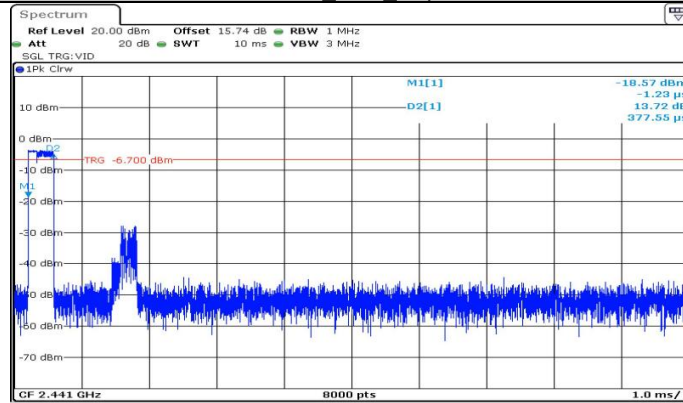




DH5_Ant1_Hop

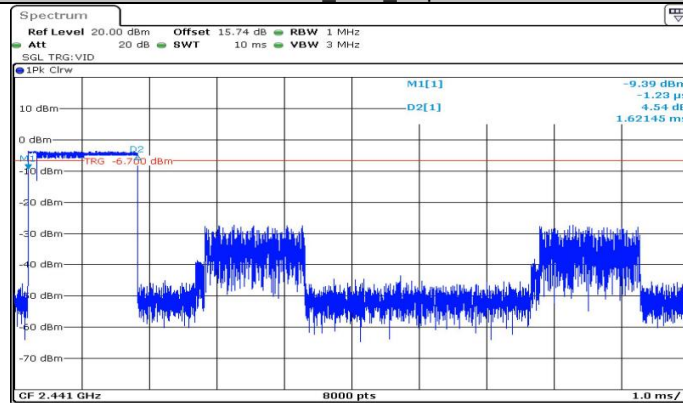


2DH1_Ant1_Hop

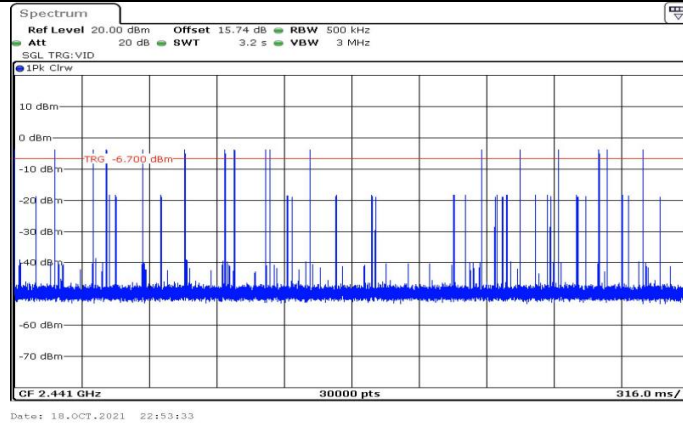


Date: 18.OCT.2021 22:52:34

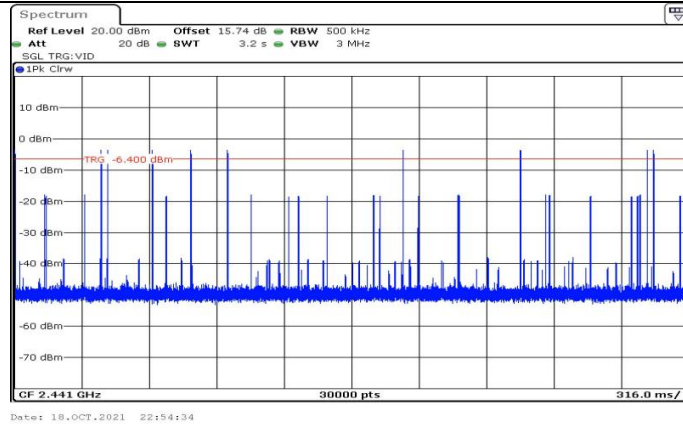
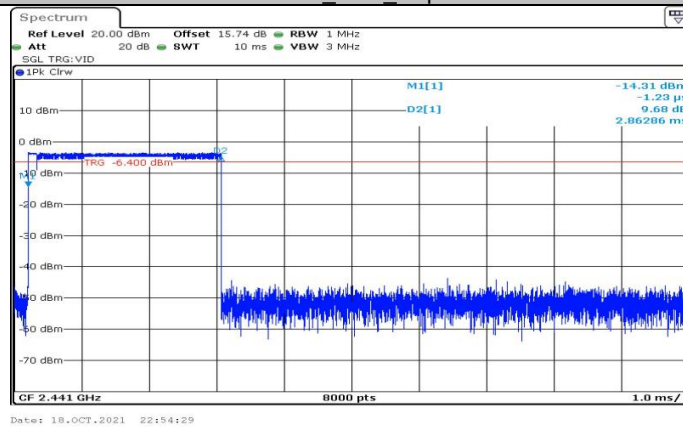
2DH3_Ant1_Hop



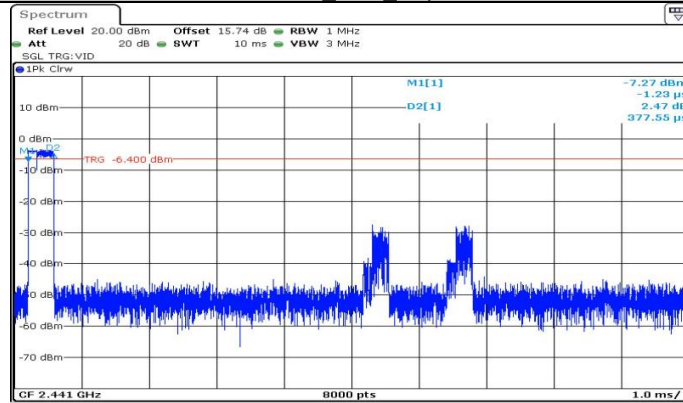
Date: 18.OCT.2021 22:53:28



2DH5_Ant1_Hop

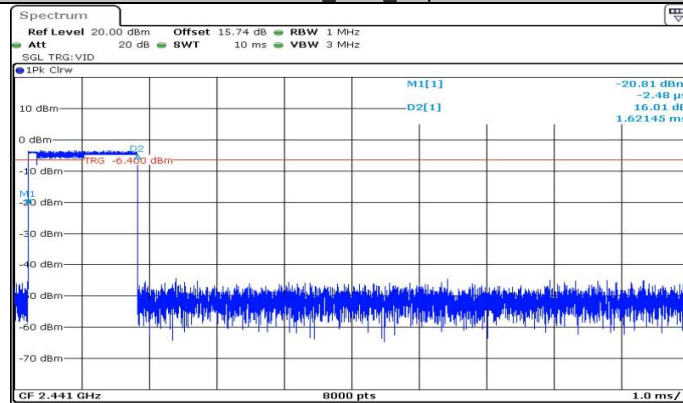


3DH1_Ant1_Hop

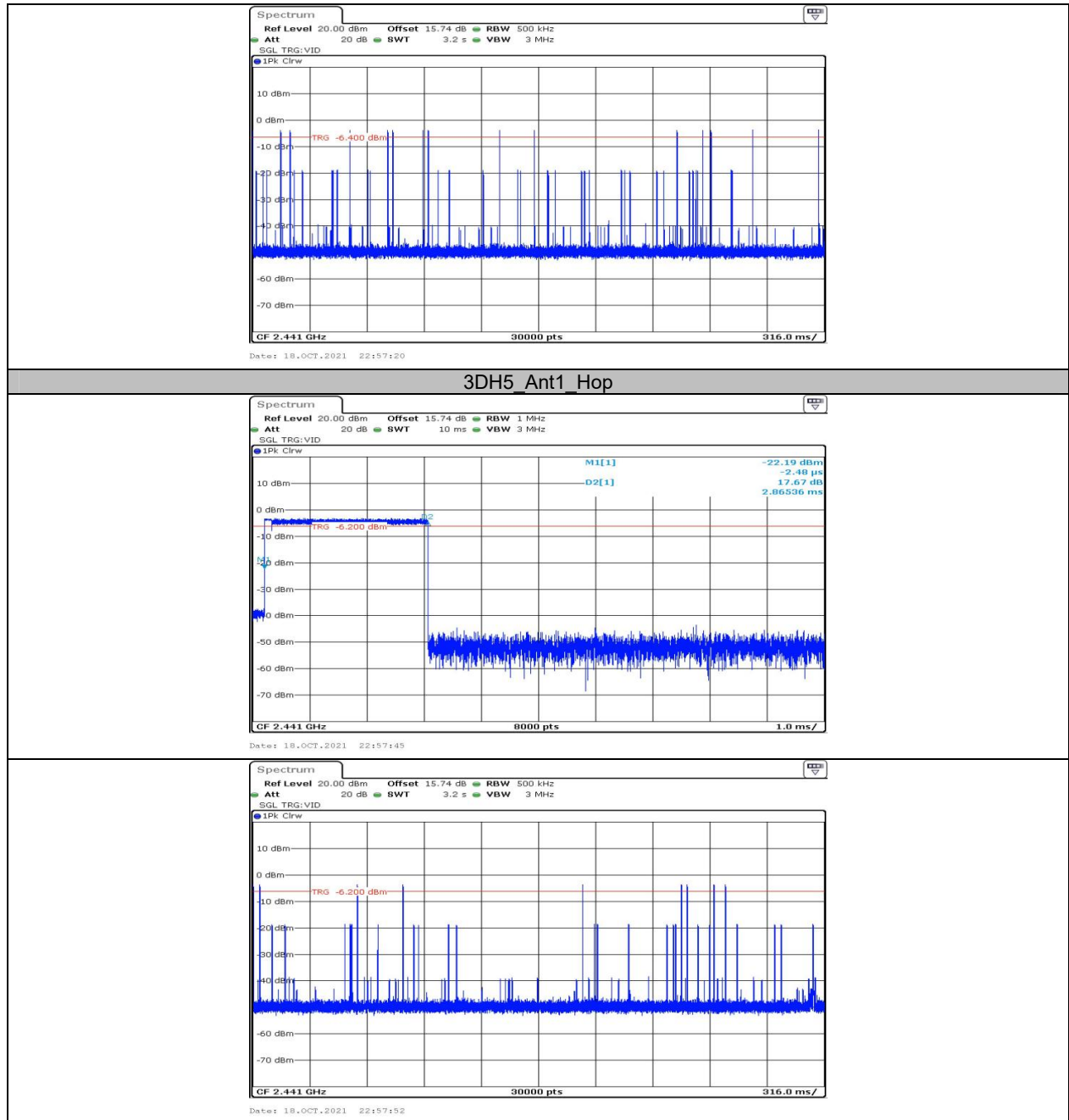


Date: 18.OCT.2021 22:56:18

3DH3_Ant1_Hop

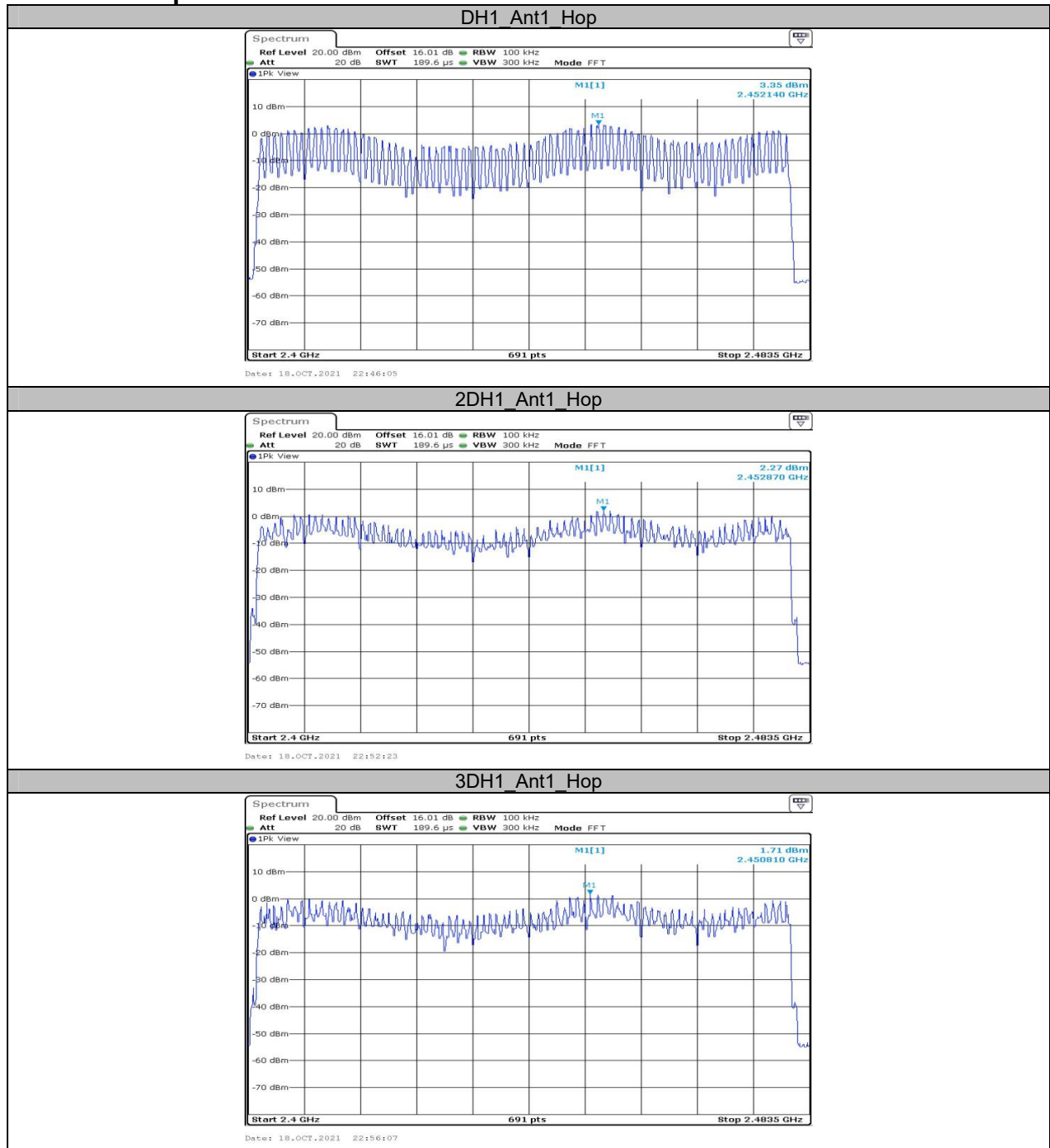


Date: 18.OCT.2021 22:57:15



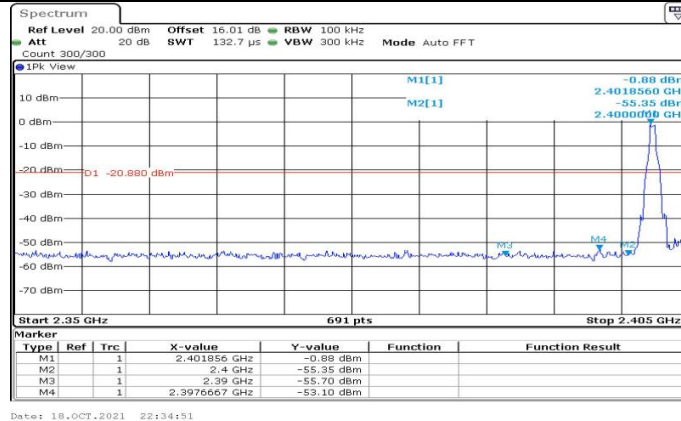
**Appendix F: Number of hopping channels
Test Result**

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

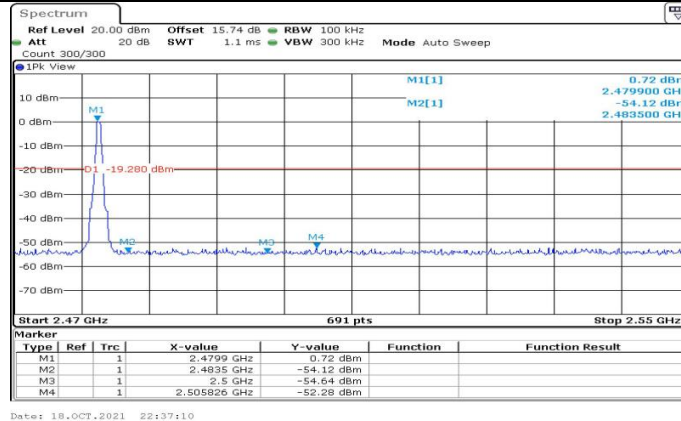
Test Graphs

Appendix G: Band edge measurements Test Graphs

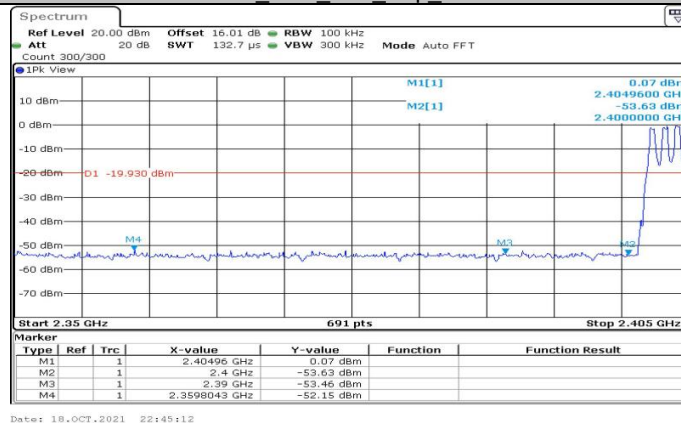
DH1_Ant1_Low_2402



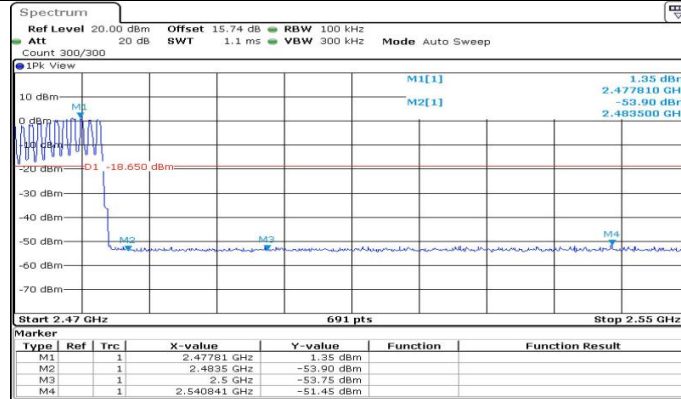
DH1_Ant1_High_2480



DH1_Ant1_Low_Hop_2402

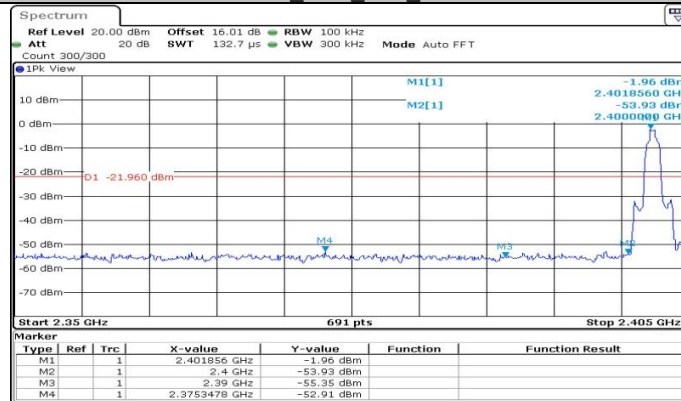


DH1_Ant1_High_Hop_2480



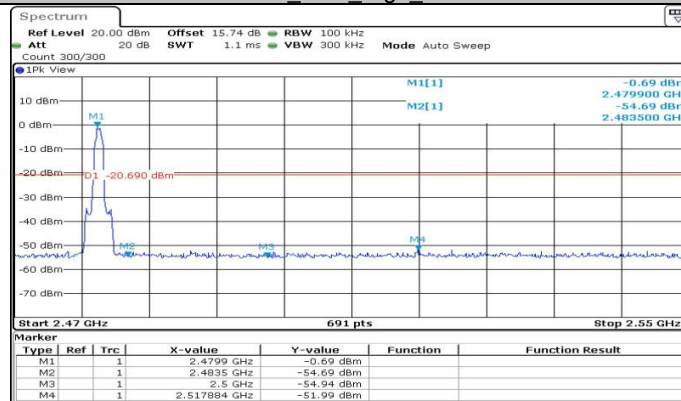
Date: 18.OCT.2021 22:48:12

2DH1_Ant1_Low_2402



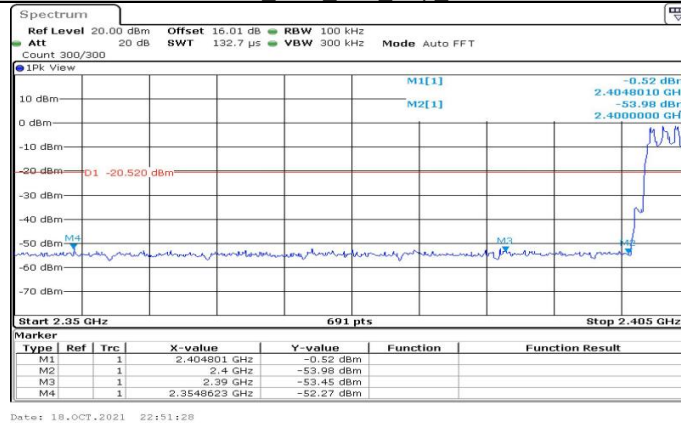
Date: 18.OCT.2021 22:38:23

2DH1_Ant1_High_2480

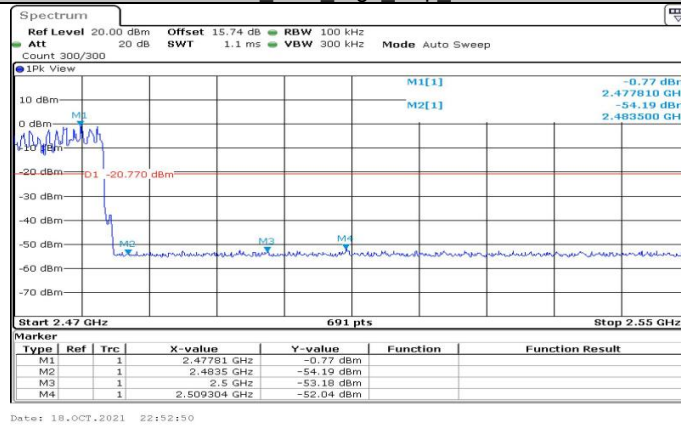


Date: 18.OCT.2021 22:40:17

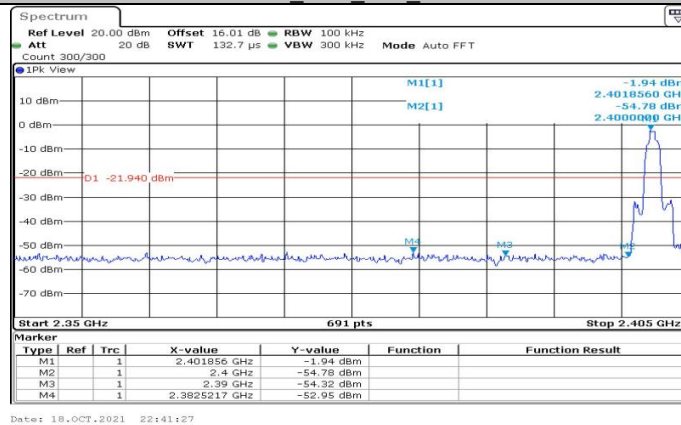
2DH1 Ant1 Low Hop 2402

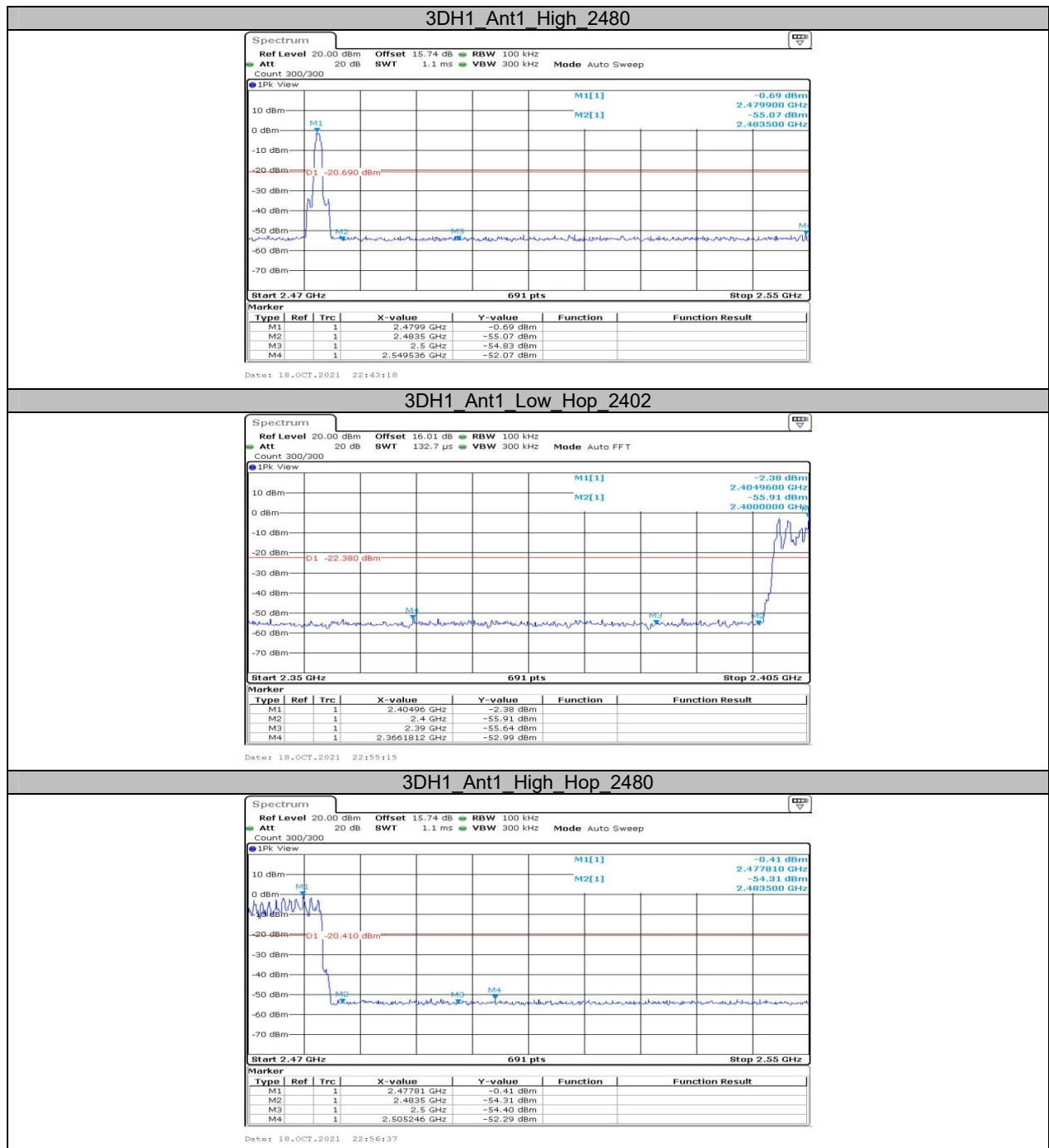


2DH1 Ant1 High Hop 2480



3DH1 Ant1 Low 2402





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