

FCC PART 15.247 TEST REPORT

For

Zeeva International Limited

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Hong Kong, China

FCC ID: 2ADM5-SP-0041

Report Type: Original Report	Product Type: LED BT TOWER SPEAKER2
Report Number: SZ3210811-33904E-RF-00	
Report Date: 2021-09-08	
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	LED BT TOWER SPEAKER2
Tested Model	SP-0041
SKU Number	4570160
UPC Number	1922341100159
Frequency Range	Bluetooth: 2402-2480MHz
Maximum conducted Peak output power	Bluetooth: -1.87dBm
Modulation Technique	Bluetooth: GFSK, $\pi/4$ -DQPSK, 8DPSK
Antenna Specification*	-0.68dBi(It is provided by the applicant)
Voltage Range	DC 3.7V from battery or DC 5V from Micro USB Port
Date of Test	2021-08-16 to 2021-09-02
Sample number	SZ3210811-33904E-RF-S1 (Assigned by BACL, Shenzhen)
Received date	2021-08-11
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.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters. Each test item follows test standards and with no deviation.

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	±4.88dB
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

“FCC_assist_1.0.2.2”* software was used to the EUT tested and power level is 10. 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

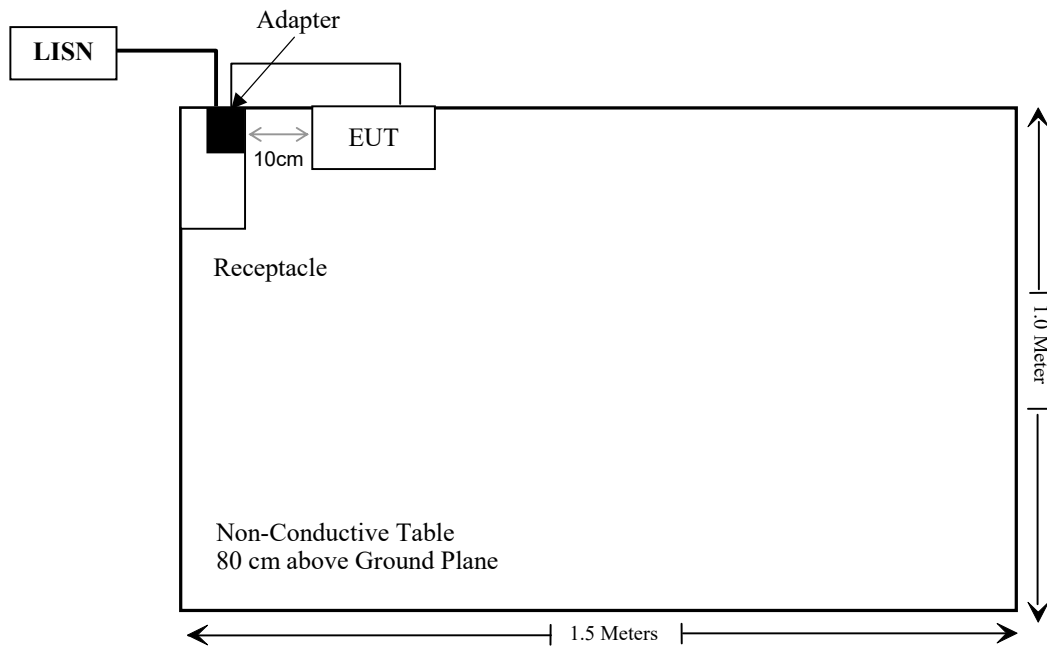
Manufacturer	Description	Model	Serial Number
Dongguan Aohai Power Technology Co.,Ltd.	Adapter	A8-501000	A1906034835
BULL	Receptacle	GN-415K	5503290068073

External I/O Cable

Cable Description	Length (m)	From Port	To
Un-shielded detachable DC cable	0.4	EUT	Adapter

Block Diagram of Test Setup

For conducted emission:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §2.1091	Maximum Permissible Exposure(MPE)	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	2021/07/07	2022/07/06
Rohde & Schwarz	LISN	ENV216	101613	2021/07/07	2022/07/06
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 Below 1G Test					
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 4	EC-007	2021/08/03	2022/08/02
Rohde & Schwarz	Auto test software	EMC 32	V9.10.00	NCR	NCR
CHIGO	Temperature & Humidity Meter	HTC-1S	T-03-EM451	2021/04/07	2022/04/06
Radiated Emission Above 1G Test					
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 Technologies	Horn antenna	ARH-4223-02	1007726-021304	2020/12/06	2023/12/05
wainwrigh	Band Reject filter	WRCG2400	2.4G filter	2021/04/20	2022/04/20
CHIGO	Temperature & Humidity Meter	HTC-1S	T-03-EM458	2021/04/12	2022/04/11

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
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	CE Cable	CE Cable	UF A210B-1-0720-504504	2020/11/29	2021/11/28
Yijia	Temperature & Humidity Meter	10316377	T-03-EM397	2021/03/01	2022/02/28

* **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) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

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

Limits for General Population/Uncontrolled Exposure

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

f = frequency in MHz

* = Plane-wave equivalent power density

Result

Calculated Formulary:

Predication of MPE limit at a given distance

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

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

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

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

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

Frequency (MHz)	Antenna Gain		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
	(dBi)	(numeric)	(dBm)	(mW)			
2402-2480	-0.68	0.86	-1	0.8	20	0.0001	1

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

Result: Compliance

FCC §15.203 – ANTENNA REQUIREMENT

Applicable Standard

According to FCC § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

Antenna Connector Construction

The EUT has an internal antenna arrangement, which was permanently attached and the antenna gain is -0.68dBi, 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

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:

$$\text{Correction Factor} = \text{LISN VDF} + \text{Cable Loss} + \text{Transient Limiter Attenuation}$$

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:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

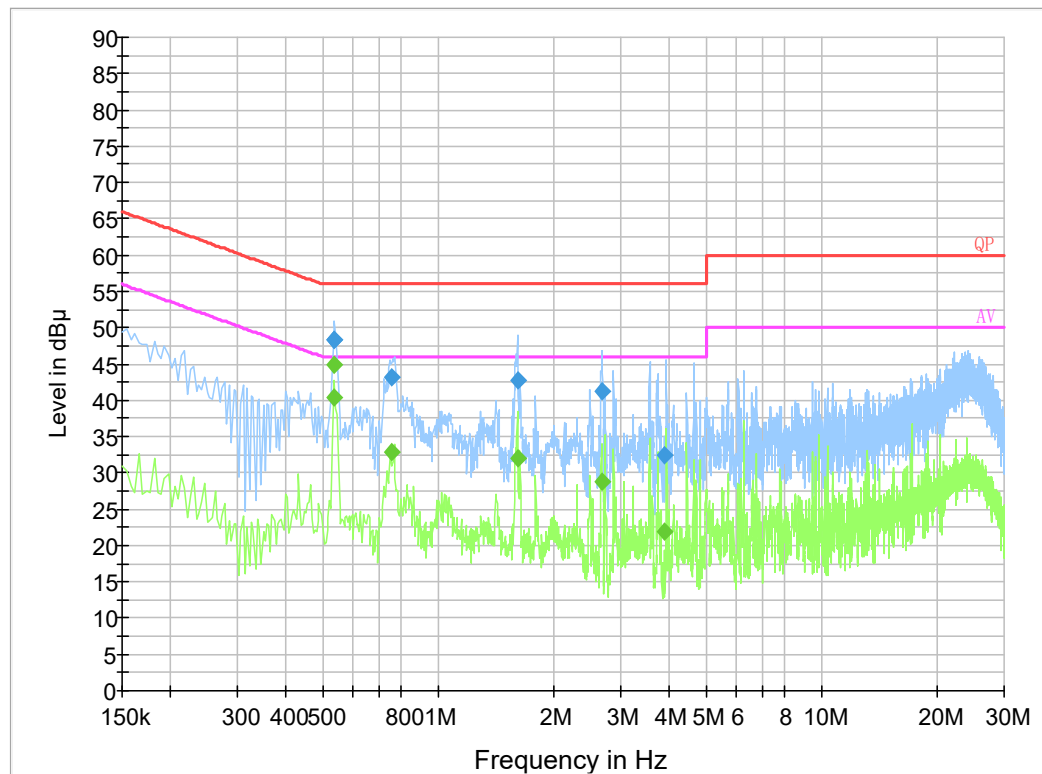
Test Data

Environmental Conditions

Temperature:	25 °C
Relative Humidity:	68 %
ATM Pressure:	101.0 kPa

The testing was performed by Haiguo Li on 2021-08-16.

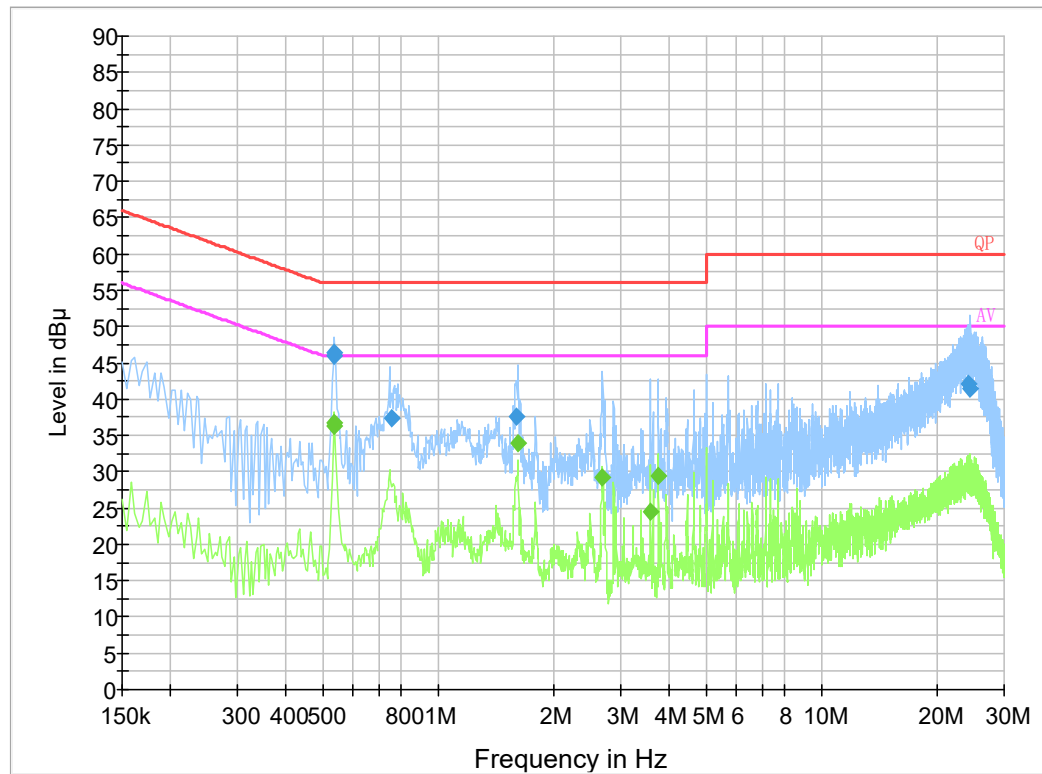
EUT operation mode: Transmitting

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)
0.537930	48.4	9.000	L1	19.8	7.6	56.0
0.537990	48.3	9.000	L1	19.8	7.7	56.0
0.758450	43.1	9.000	L1	19.8	12.9	56.0
1.613850	42.6	9.000	L1	19.9	13.4	56.0
2.689710	41.3	9.000	L1	19.9	14.7	56.0
3.906810	32.5	9.000	L1	19.9	23.5	56.0

Final Result 2

Frequency (MHz)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.537930	44.9	9.000	L1	19.8	1.1	46.0
0.537990	40.3	9.000	L1	19.8	5.7	46.0
0.758450	32.9	9.000	L1	19.8	13.1	46.0
1.613850	32.0	9.000	L1	19.9	14.0	46.0
2.689710	28.8	9.000	L1	19.9	17.2	46.0
3.906810	21.9	9.000	L1	19.9	24.1	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)
0.537930	46.0	9.000	N	19.8	10.0	56.0
0.537990	46.5	9.000	N	19.8	9.5	56.0
0.754750	37.3	9.000	N	19.8	18.7	56.0
1.605790	37.5	9.000	N	19.8	18.5	56.0
24.199390	42.2	9.000	N	20.3	17.8	60.0
24.450050	41.5	9.000	N	20.3	18.5	60.0

Final Result 2

Frequency (MHz)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.534000	36.8	9.000	N	19.8	9.2	46.0
0.538000	36.2	9.000	N	19.8	9.8	46.0
1.614000	33.9	9.000	N	19.8	12.1	46.0
2.690000	29.3	9.000	N	19.8	16.7	46.0
3.578000	24.4	9.000	N	19.9	21.6	46.0
3.762000	29.4	9.000	N	19.9	16.6	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

During the radiated emission test, 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:

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

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:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

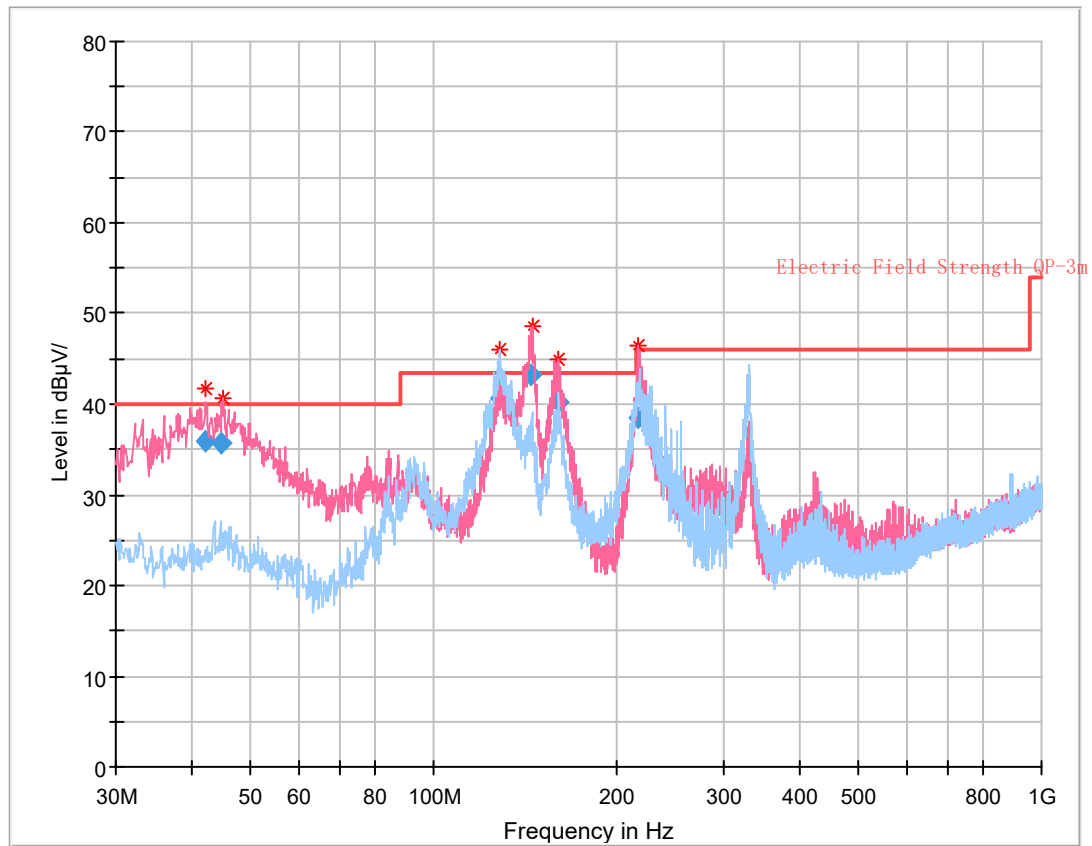
Test Data

Environmental Conditions

Temperature:	26~27 °C
Relative Humidity:	55~56 %
ATM Pressure:	101 kPa

The testing was performed by Cloud Qiu on 2021-08-21 for below 1GHz and Andy Yu on 2021-08-27 for above 1GHz.

EUT operation mode: Transmitting

30 MHz~1 GHz (BT Playing):**Final Result**

Frequency (MHz)	QuasiPeak (dB µ V/m)	Limit (dB µ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
42.249375	35.96	40.00	4.04	111.0	V	131.0	-12.0
44.661000	35.60	40.00	4.40	103.0	V	172.0	-13.5
128.565625	40.62	43.50	2.88	303.0	H	52.0	-10.3
144.981750	43.25	43.50	0.25	111.0	V	13.0	-11.0
160.694000	40.21	43.50	3.29	103.0	V	61.0	-11.9
216.741625	38.60	46.00	7.40	173.0	V	260.0	-11.3

1 GHz - 25 GHz: (Scan with GFSK, $\pi/4$ -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)									
2377.86	28.77	PK	91	1.8	H	30.91	59.68	74.0	14.32
2377.86	15.79	Ave.	91	1.8	H	30.91	46.70	54.0	7.30
2488.04	29.52	PK	152	1.3	H	30.72	60.24	74.0	13.76
2488.04	15.55	Ave.	152	1.3	H	30.72	46.27	54.0	7.73
4804.00	53.21	PK	186	2.1	H	-3.52	49.69	74.0	24.31
4804.00	44.03	Ave.	186	2.1	H	-3.52	40.51	54.0	13.49
Middle Channel (2441 MHz)									
4882.00	50.83	PK	298	1.7	H	-2.94	47.89	74.0	26.11
4882.00	41.69	Ave.	298	1.7	H	-2.94	38.75	54.0	15.25
High Channel (2480 MHz)									
2329.69	28.74	PK	304	2.5	H	30.83	59.57	74.0	14.43
2329.69	15.56	Ave.	304	2.5	H	30.83	46.39	54.0	7.61
2490.92	29.34	PK	243	1.7	H	30.72	60.06	74.0	13.94
2490.92	15.00	Ave.	243	1.7	H	30.72	45.72	54.0	8.28
4960.00	49.66	PK	17	1.1	H	-2.73	46.93	74.0	27.07
4960.00	42.36	Ave.	17	1.1	H	-2.73	39.63	54.0	14.37

Note:

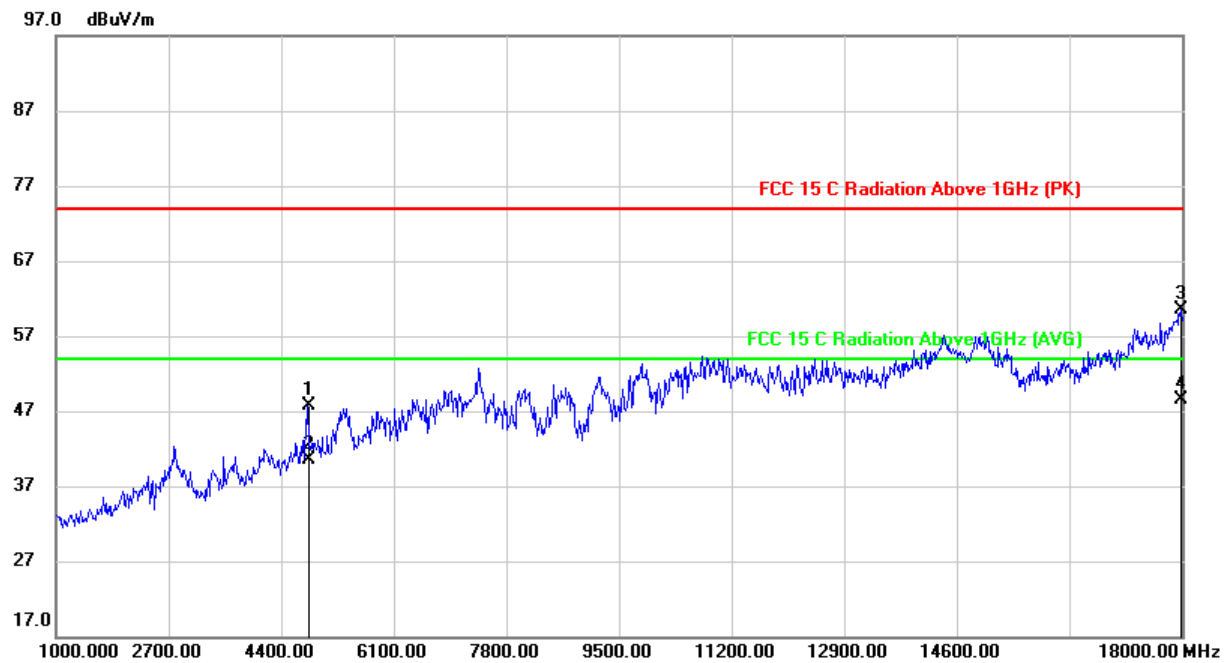
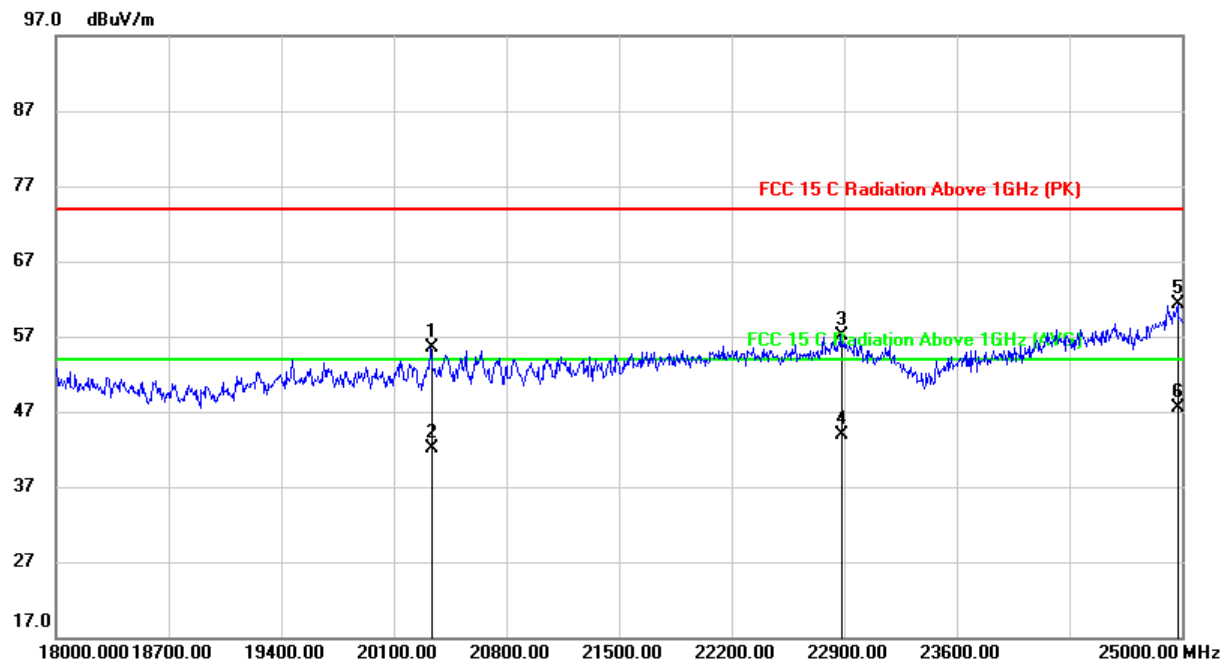
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Corrected Amplitude = Corrected Factor + Reading

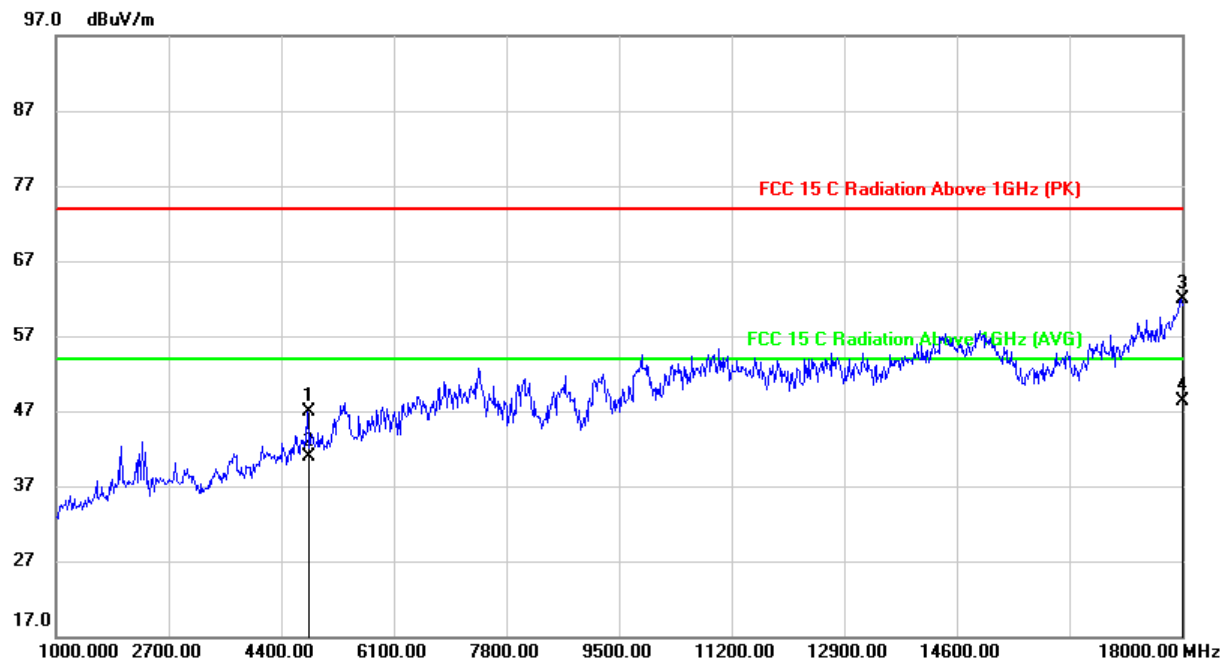
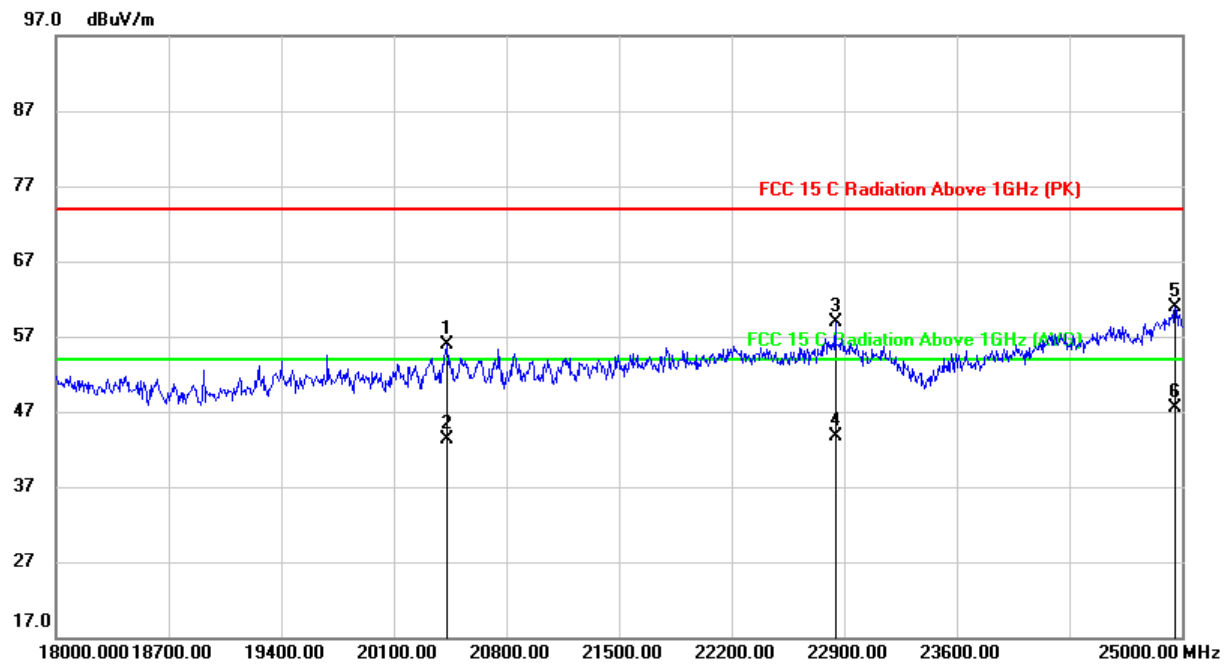
Margin = Limit - Corrected. Amplitude

The other spurious emission which is 20dB below the limit or on the noise floor was not recorded.

**Pre-scan with 8DPSK Mode Low 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:	28.3 °C
Relative Humidity:	63 %
ATM Pressure:	101.0 kPa

The testing was performed by Restar Li on 2021-09-02.

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:	28.3 °C
Relative Humidity:	63 %
ATM Pressure:	101.0 kPa

The testing was performed by Restar Li on 2021-09-02

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:	28.3 °C
Relative Humidity:	63 %
ATM Pressure:	101.0 kPa

The testing was performed by Restar Li on 2021-09-02

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:	28.3 °C
Relative Humidity:	63 %
ATM Pressure:	101.0 kPa

The testing was performed by Restar Li on 2021-09-02

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:	28.3 °C
Relative Humidity:	63 %
ATM Pressure:	101.0 kPa

The testing was performed by Restar Li on 2021-09-02

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:	28.3 °C
Relative Humidity:	63 %
ATM Pressure:	101.0 kPa

The testing was performed by Restar Li on 2021-09-02

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

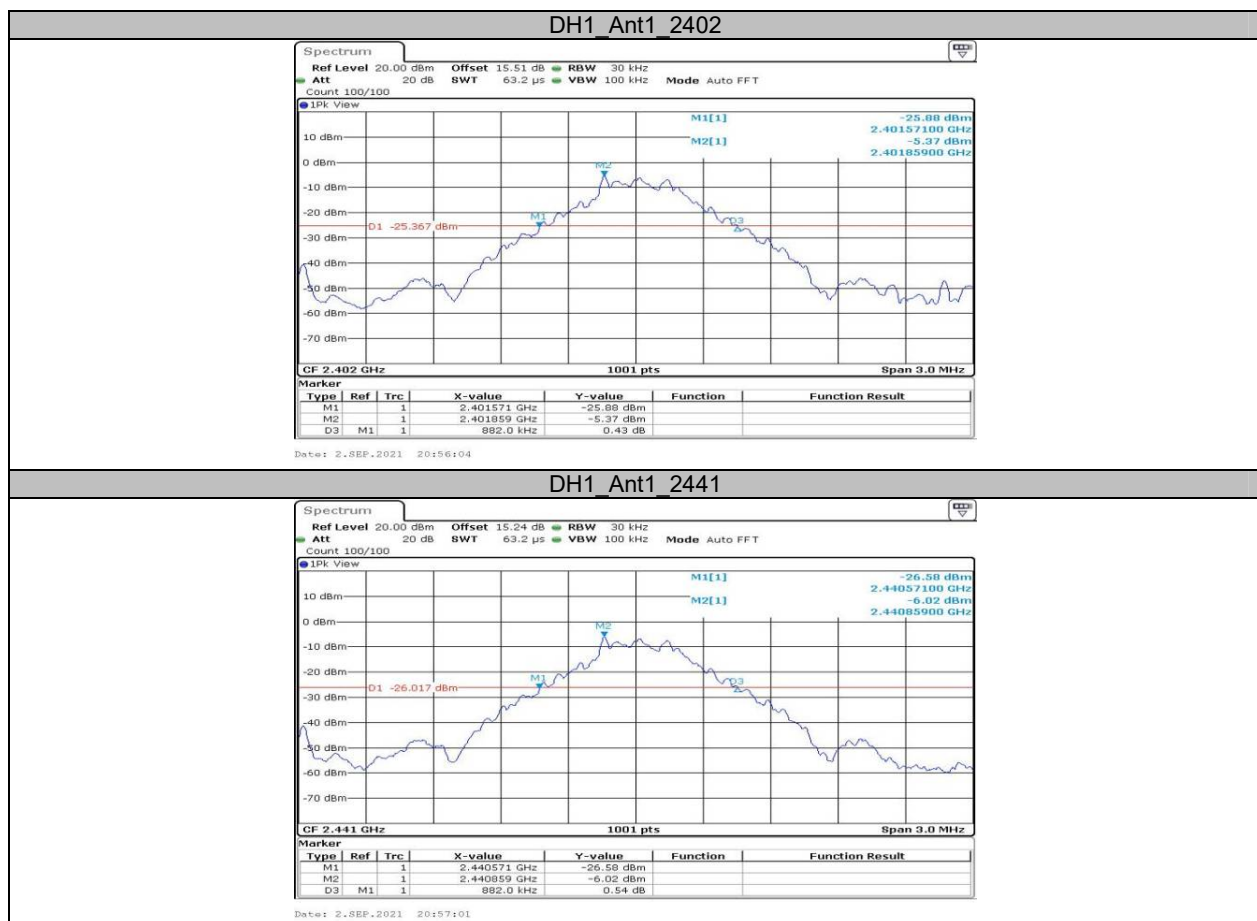
APPENDIX

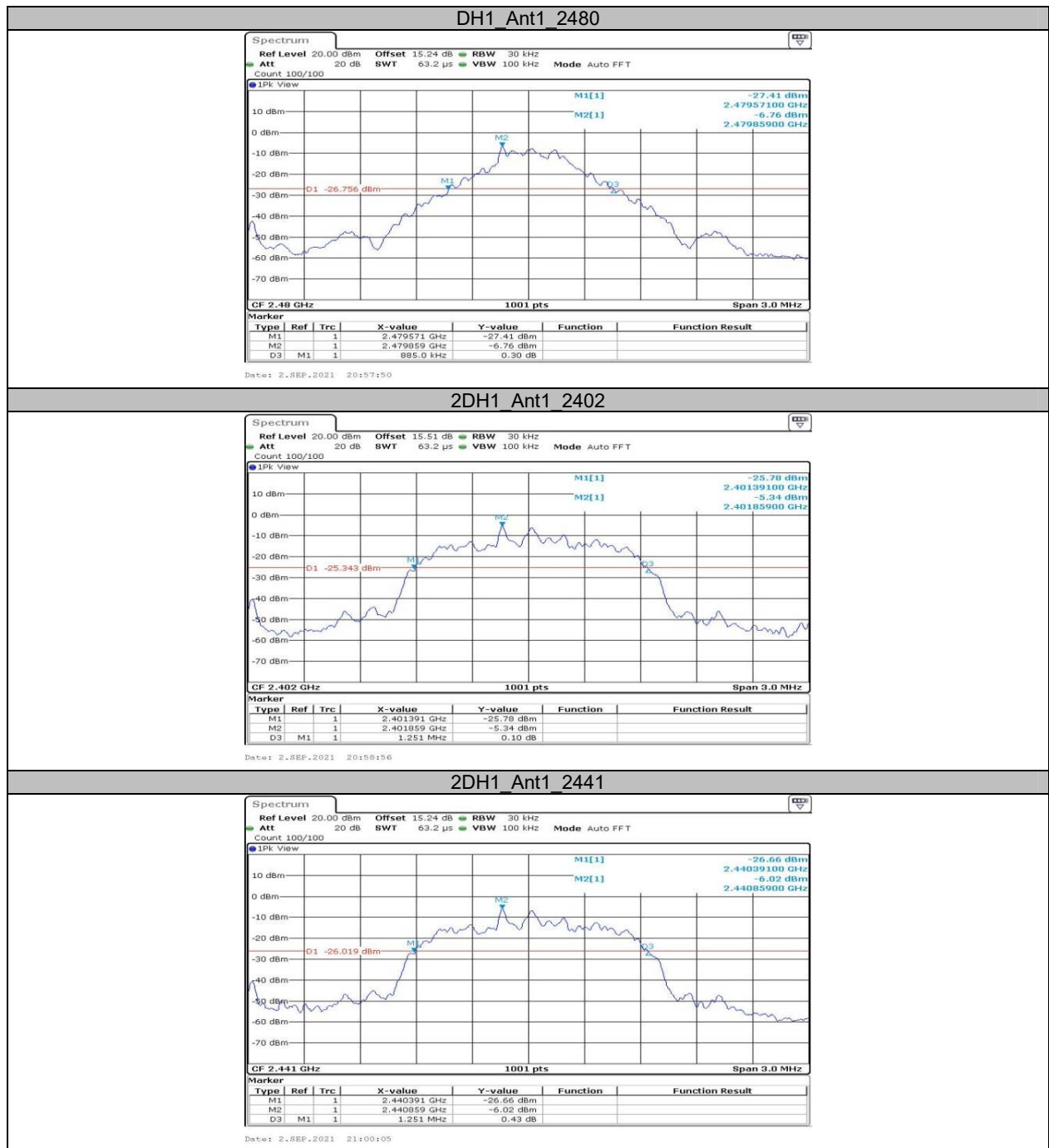
Appendix A: 20dB Emission Bandwidth

Test Result

Test Mode	Antenna	Channel	20db EBW[MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	0.882	---	PASS
		2441	0.882	---	PASS
		2480	0.885	---	PASS
2DH1	Ant1	2402	1.251	---	PASS
		2441	1.251	---	PASS
		2480	1.251	---	PASS
3DH1	Ant1	2402	1.218	---	PASS
		2441	1.218	---	PASS
		2480	1.218	---	PASS

Test Graphs





2DH1_Ant1_2480

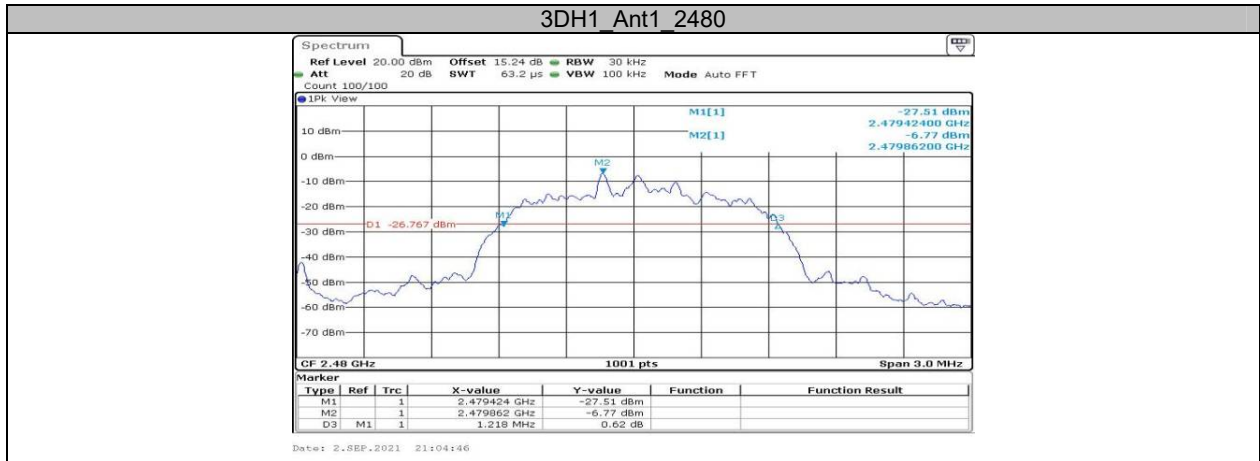


3DH1_Ant1_2402



3DH1_Ant1_2441





Appendix B: Maximum conducted Peak output power Test Result

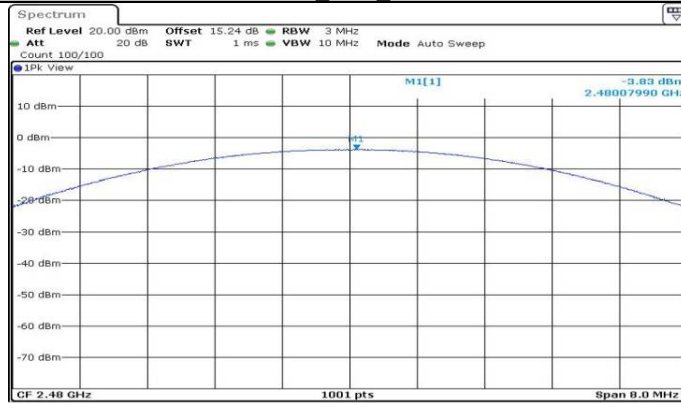
Test Mode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
DH1	Ant1	2402	-3.27	≤20.97	PASS
		2441	-3.93	≤20.97	PASS
		2480	-4.64	≤20.97	PASS
2DH1	Ant1	2402	-2.46	≤20.97	PASS
		2441	-3.09	≤20.97	PASS
		2480	-3.83	≤20.97	PASS
3DH1	Ant1	2402	-1.87	≤20.97	PASS
		2441	-2.46	≤20.97	PASS
		2480	-3.21	≤20.97	PASS

Test Graphs





2DH1_Ant1_2480



Date: 2.SEP.2021 21:01:20

3DH1_Ant1_2402

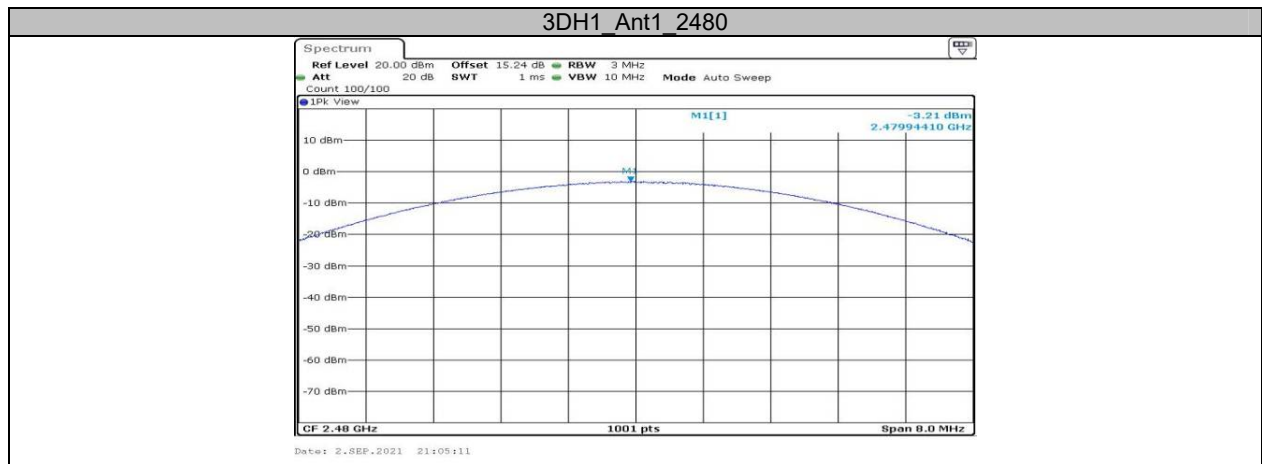


Date: 2.SEP.2021 21:02:43

3DH1_Ant1_2441



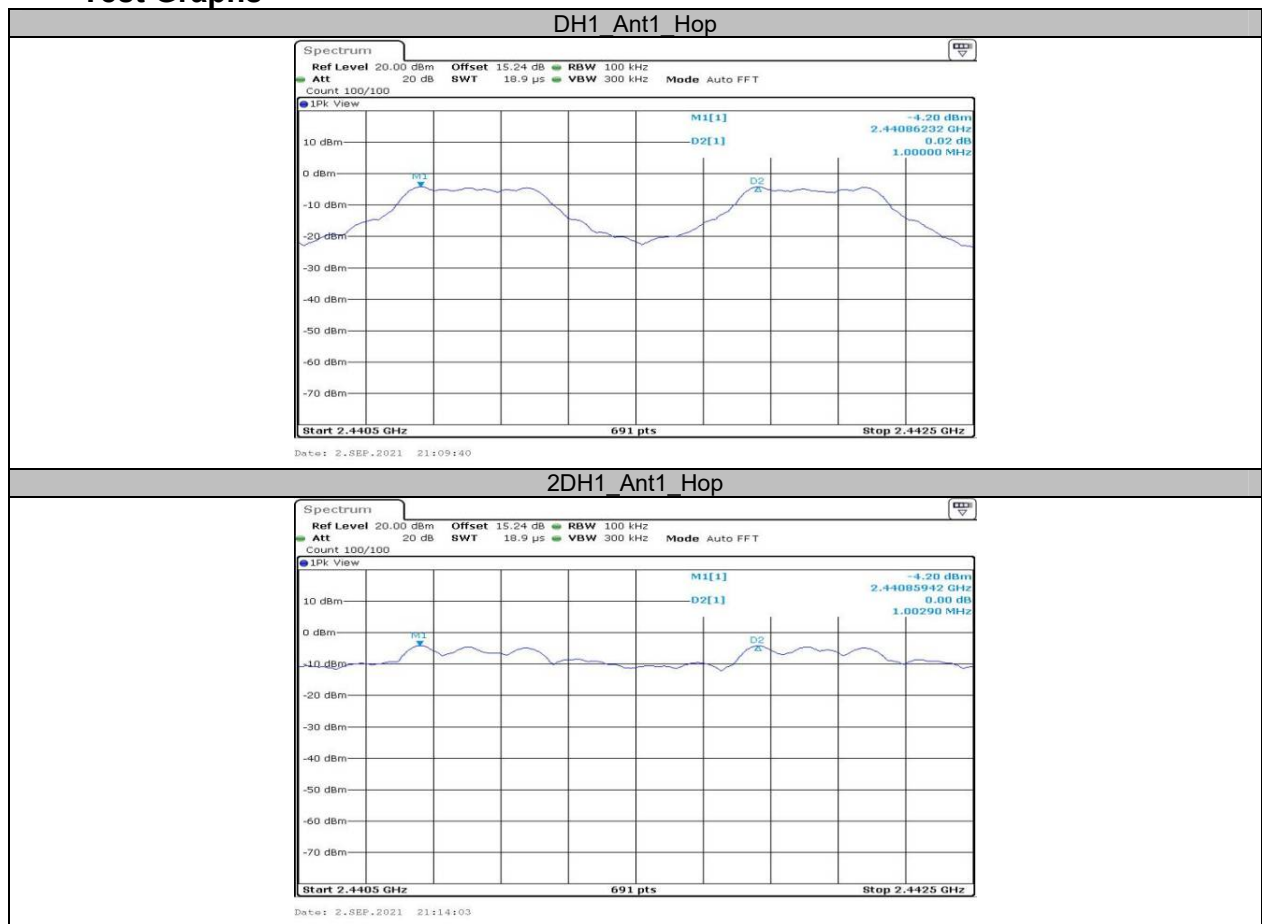
Date: 2.SEP.2021 21:04:06

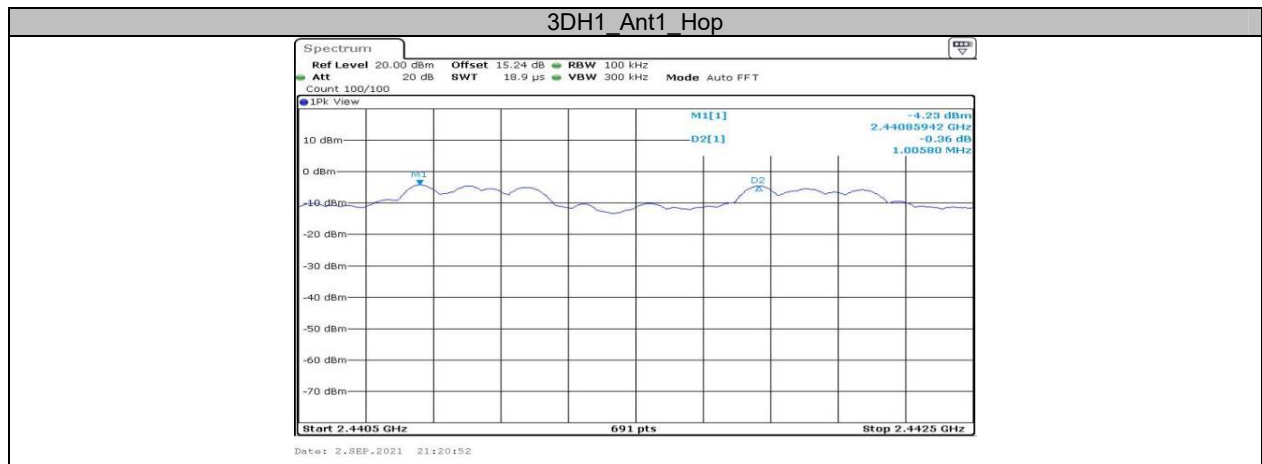


Appendix C: Carrier frequency separation Test Result

Test Mode	Antenna	Channel	Result[MHz]	Limit[MHz]	Verdict
DH1	Ant1	Hop	1.000	0.590	PASS
2DH1	Ant1	Hop	1.003	0.834	PASS
3DH1	Ant1	Hop	1.006	0.812	PASS

Test Graphs





Appendix D: Time of occupancy

Test Result

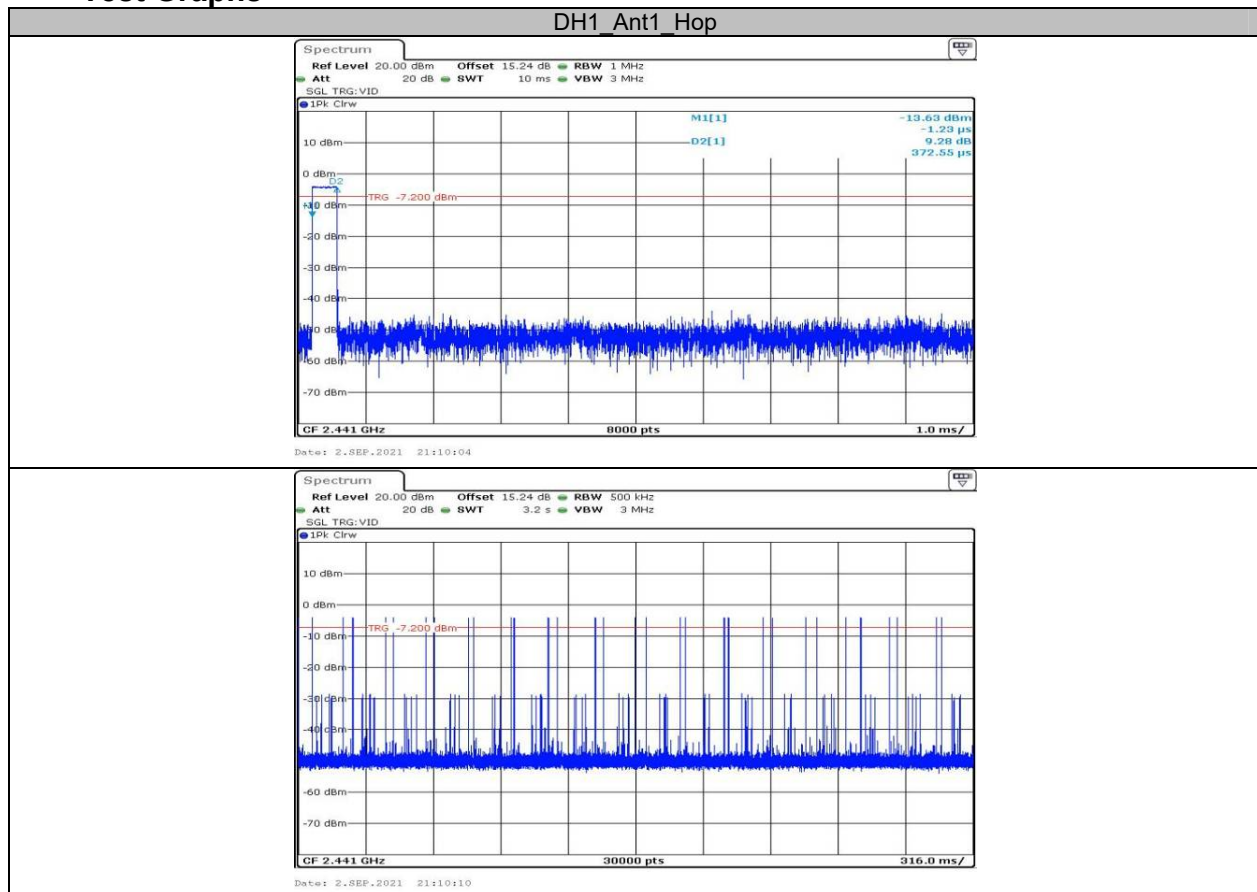
Test Mode	Antenna	Channel	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH1	Ant1	Hop	0.37	320	0.119	≤0.4	PASS
DH3	Ant1	Hop	1.62	140	0.227	≤0.4	PASS
DH5	Ant1	Hop	2.86	120	0.343	≤0.4	PASS
2DH1	Ant1	Hop	0.38	320	0.122	≤0.4	PASS
2DH3	Ant1	Hop	1.63	180	0.293	≤0.4	PASS
2DH5	Ant1	Hop	2.87	130	0.373	≤0.4	PASS
3DH1	Ant1	Hop	0.38	320	0.123	≤0.4	PASS
3DH3	Ant1	Hop	1.63	150	0.244	≤0.4	PASS
3DH5	Ant1	Hop	2.87	130	0.373	≤0.4	PASS

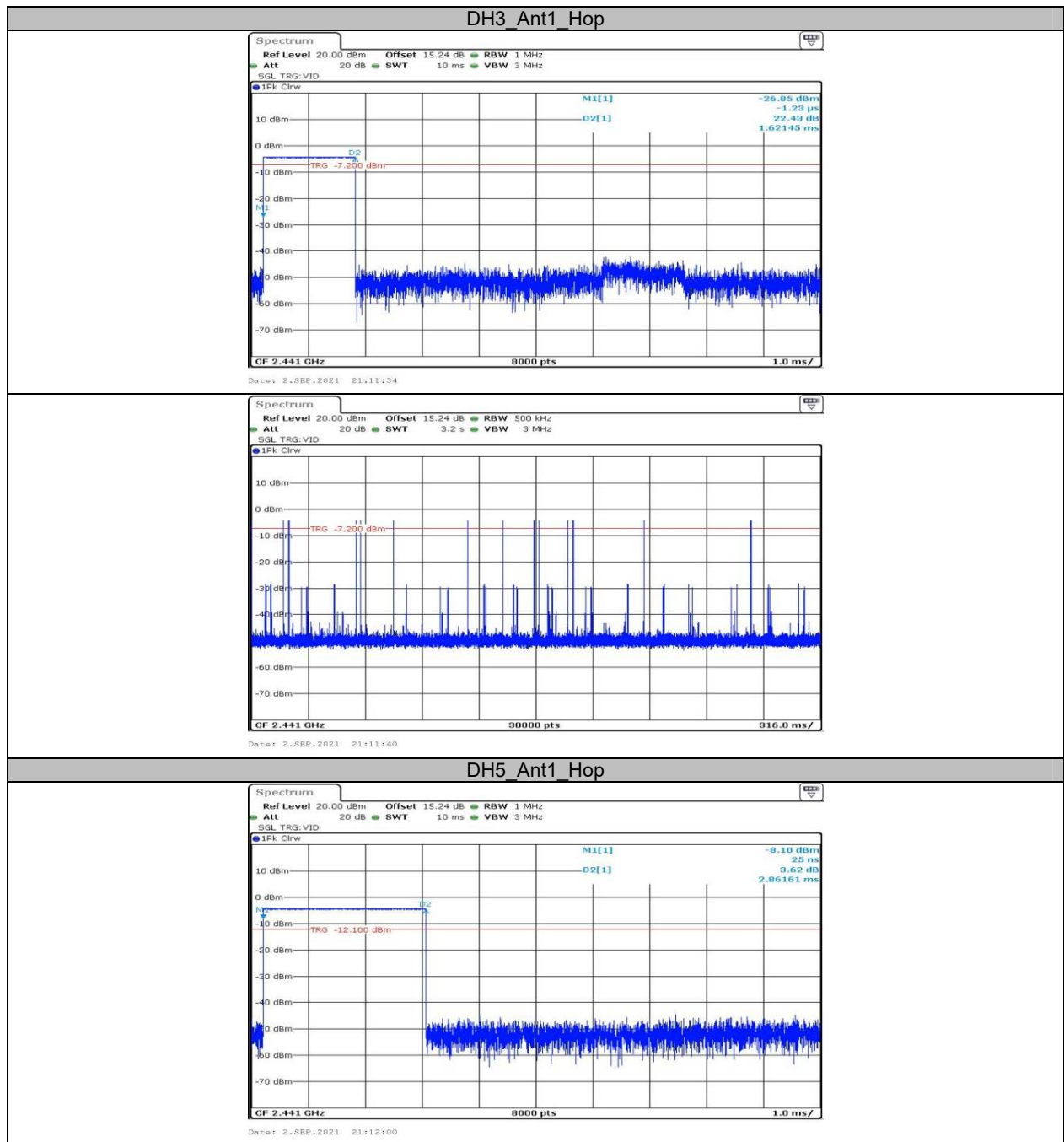
Note 1: A period time= $0.4 \times 79 = 31.6(S)$, Result=BurstWidth*Totalhops

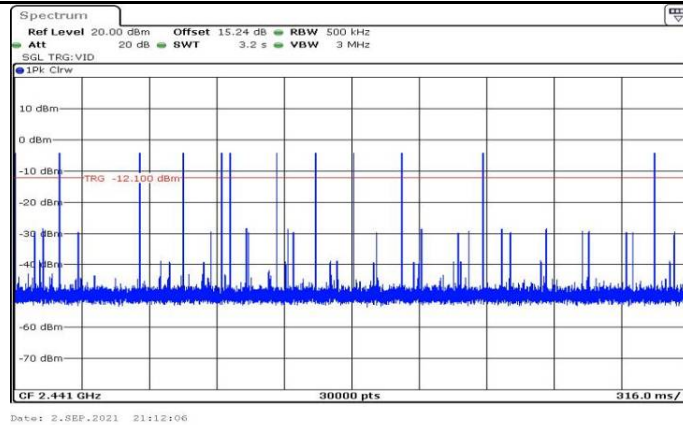
Note 2: Totalhops=Hopping Number in $3.16s \times 10$

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

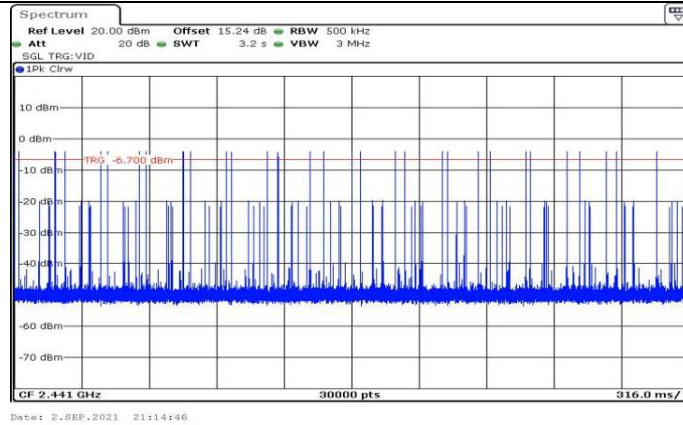
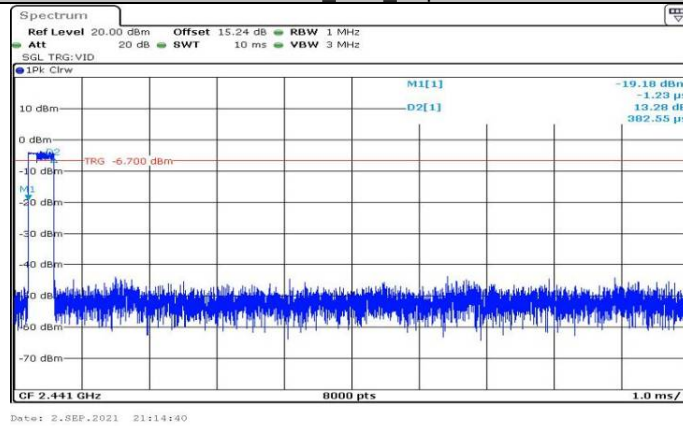
Test Graphs

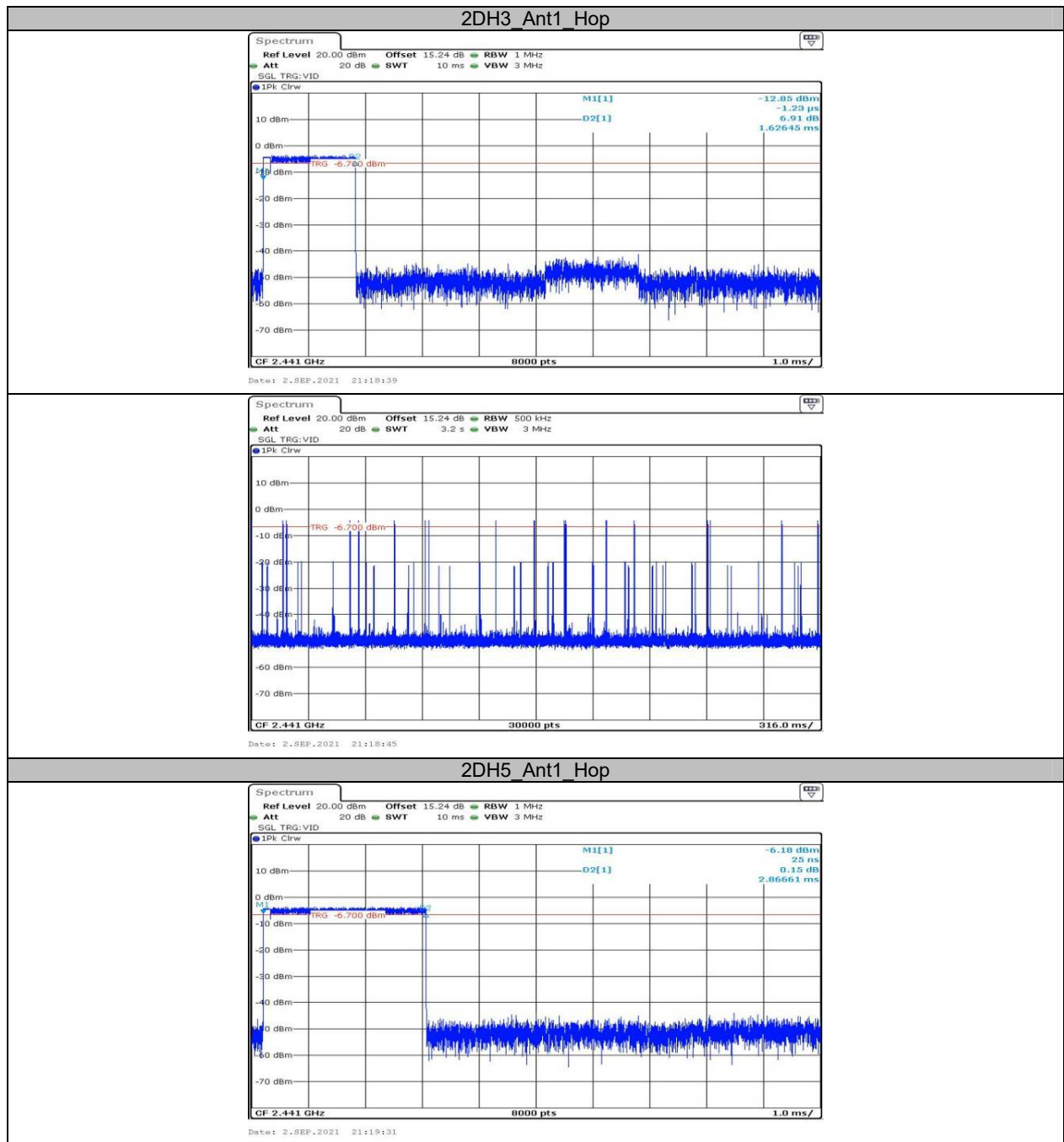


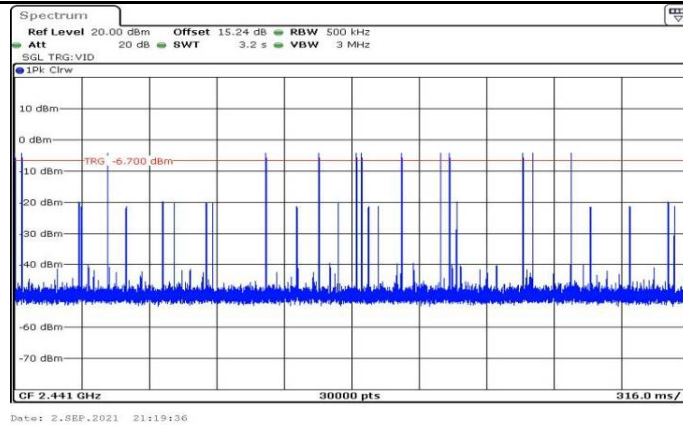




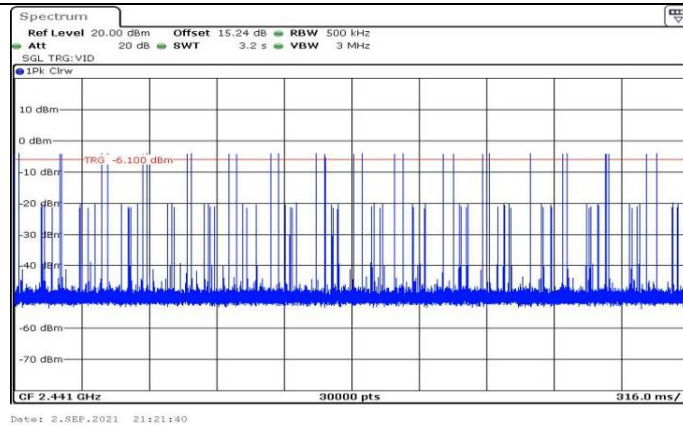
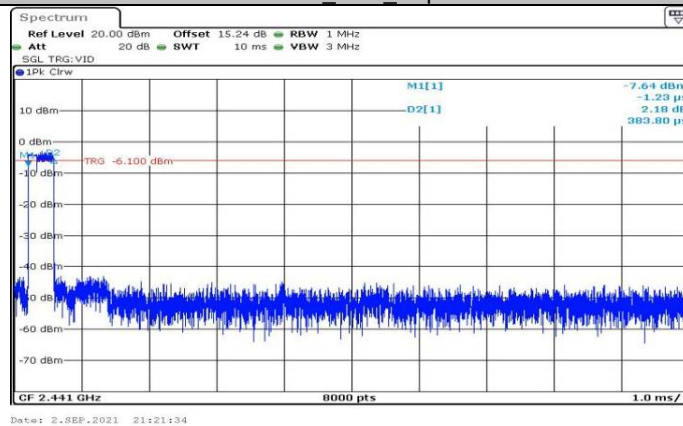
2DH1_Ant1_Hop

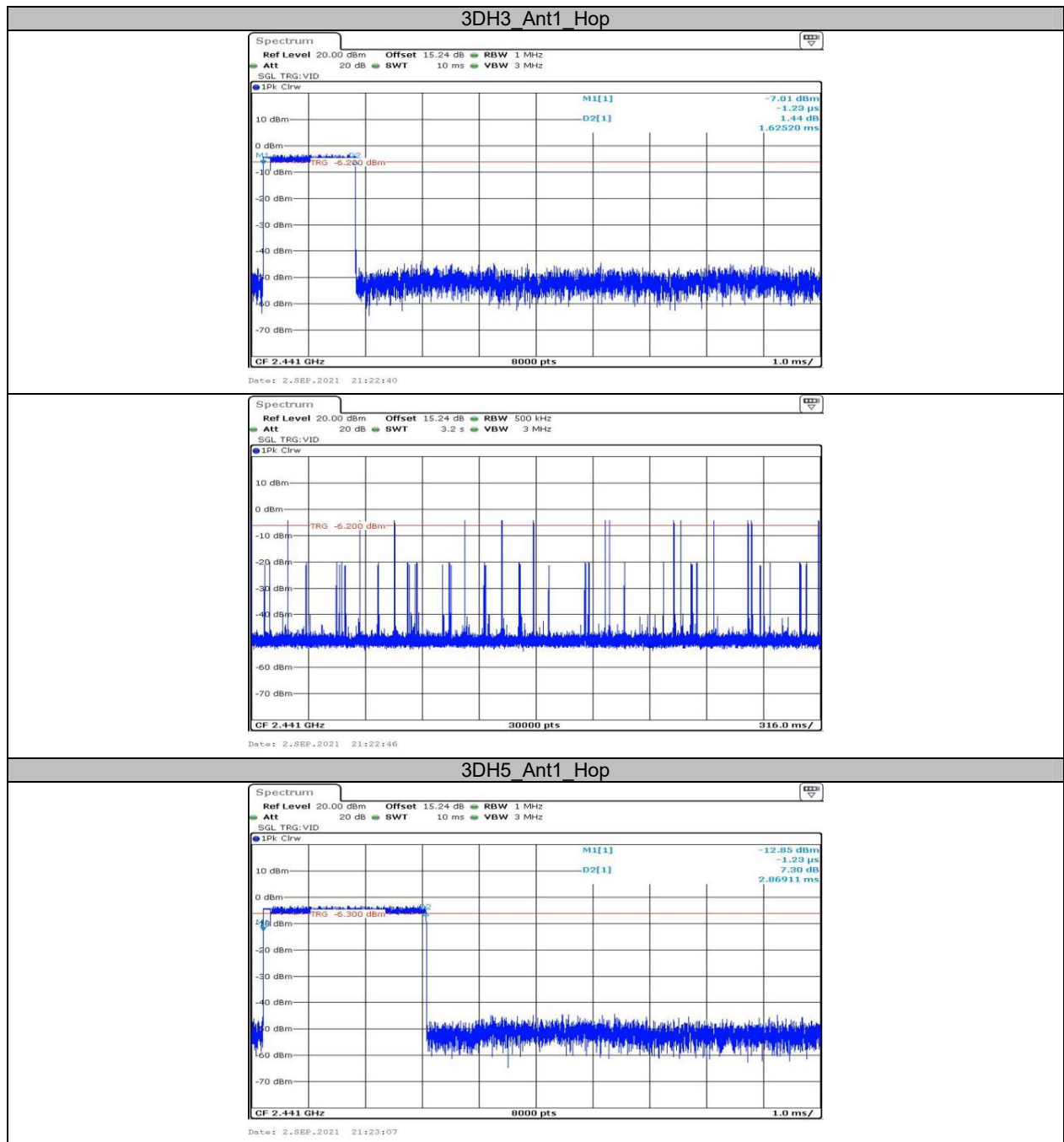


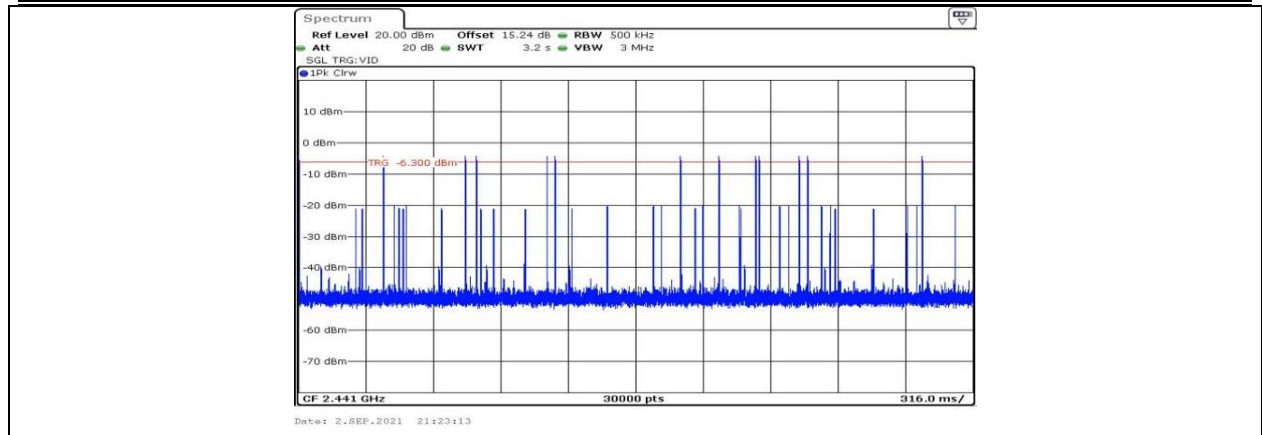




3DH1_Ant1_Hop





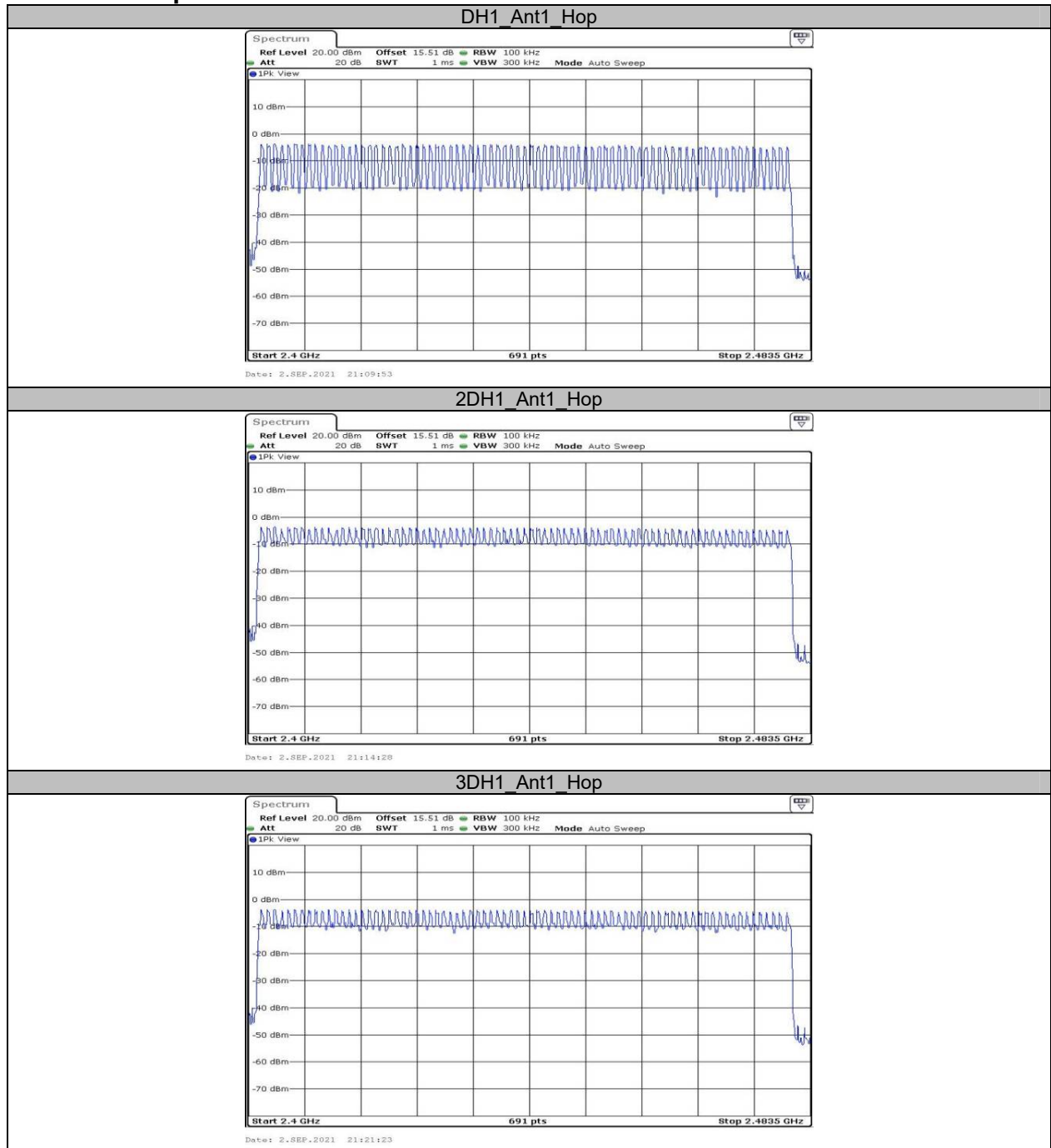


Appendix E: Number of hopping channels

Test Result

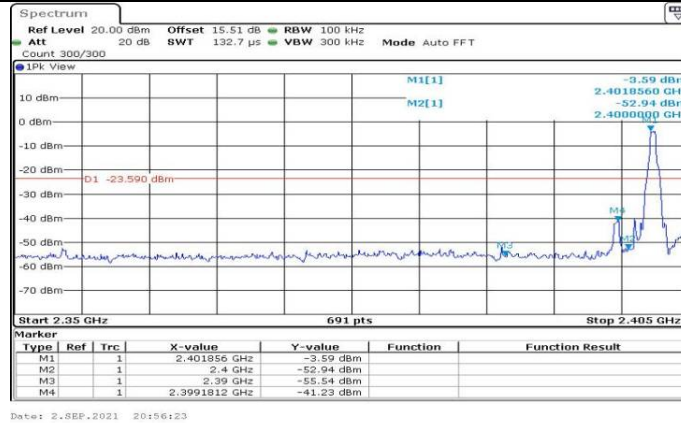
Test Mode	Antenna	Channel	Result[Num]	Limit[Num]	Verdict
DH1	Ant1	Hop	79	≥15	PASS
2DH1	Ant1	Hop	79	≥15	PASS
3DH1	Ant1	Hop	79	≥15	PASS

Test Graphs

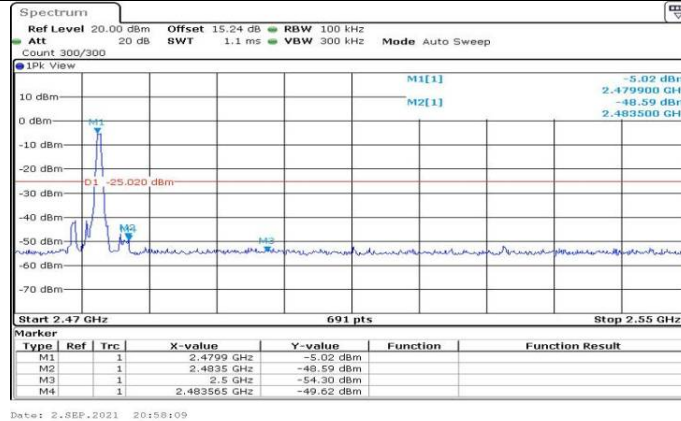


Appendix F: Band edge measurements Test Graphs

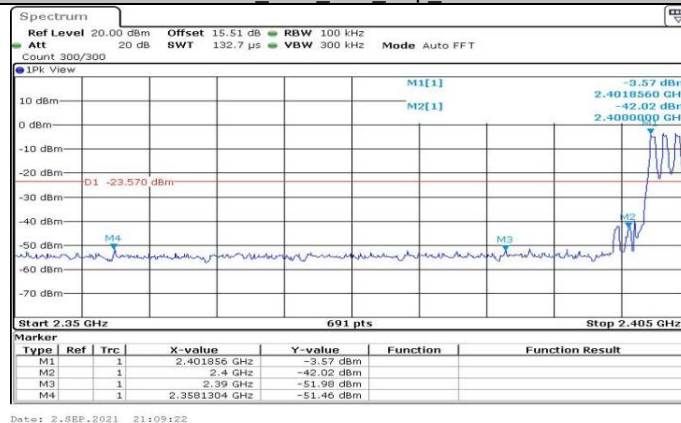
DH1_Ant1_Low_2402



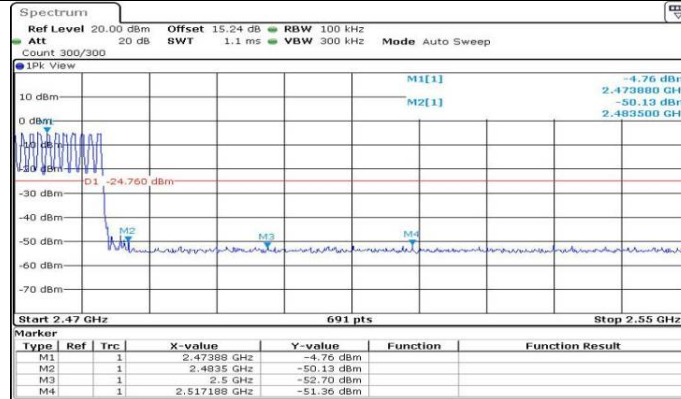
DH1_Ant1_High_2480



DH1_Ant1_Low_Hop_2402

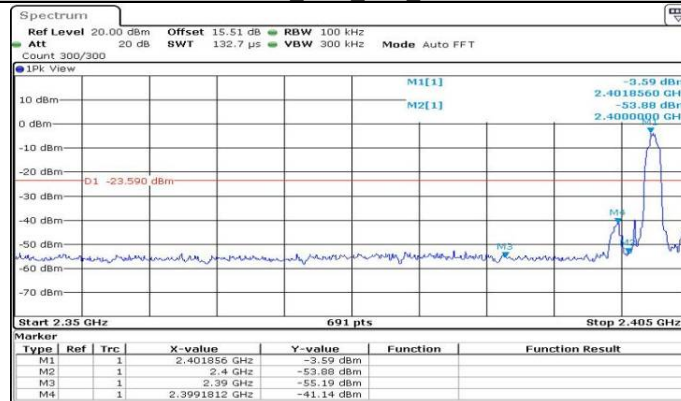


DH1 Ant1 High Hop 2480



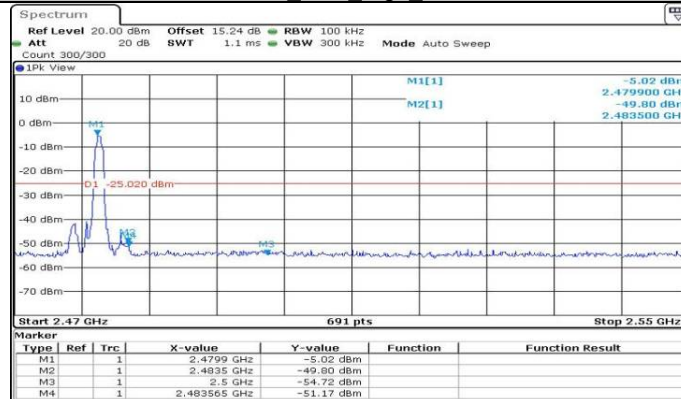
Date: 2.SEP.2021 21:11:06

2DH1 Ant1 Low 2402



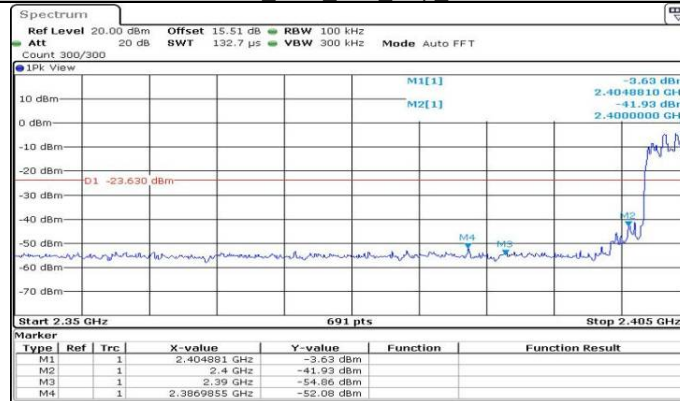
Date: 2.SEP.2021 20:59:15

2DH1 Ant1 High 2480



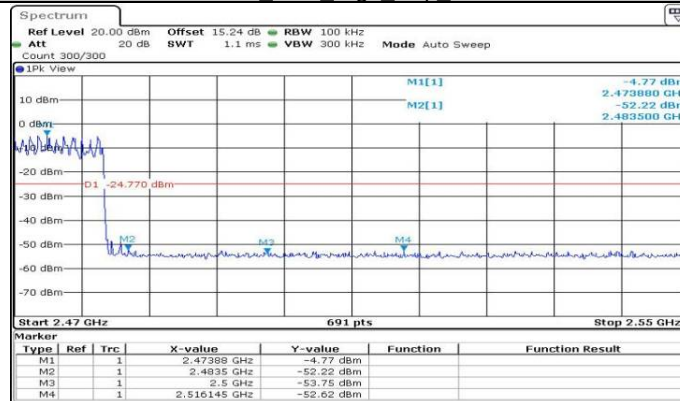
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2DH1 Ant1 Low Hop 2402



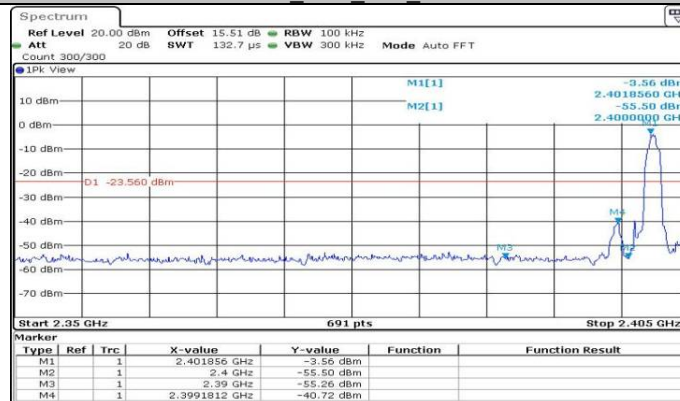
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2DH1 Ant1 High Hop 2480



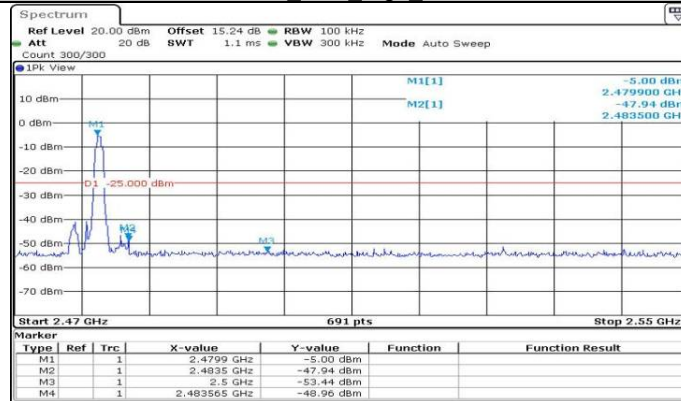
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3DH1 Ant1 Low 2402



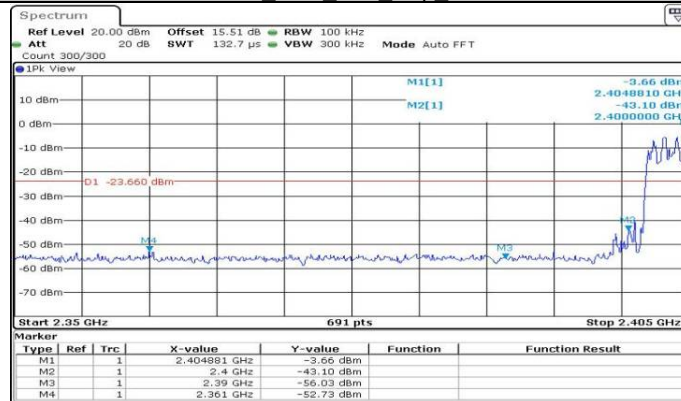
Date: 2.SEP.2021 21:02:36

3DH1_Ant1_High_2480



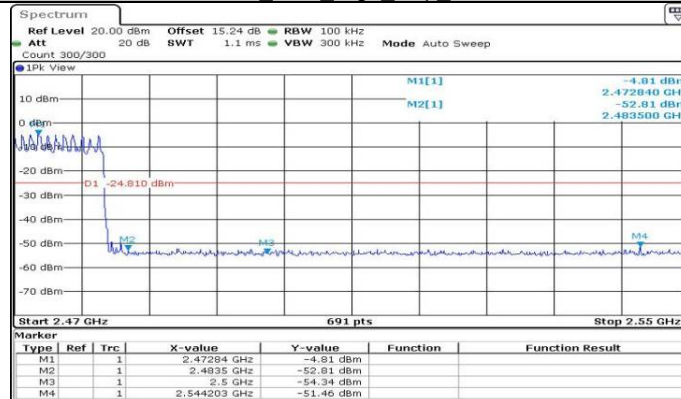
Date: 2.SEP.2021 21:05:05

3DH1_Ant1_Low_Hop_2402



Date: 2.SEP.2021 21:20:30

3DH1_Ant1_High_Hop_2480



Date: 2.SEP.2021 21:22:15

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