


# FCC PART 15.247 TEST REPORT

For

## CALTTA TECHNOLOGIES CO., LTD.

Floor12, Building G2, international E-City Nanshan District, Shenzhen, China

**FCC ID: 2AQV7PH6X0VHF**

<b>Report Type:</b> Original Report	<b>Product Type:</b> Digital Portable Radio
<b>Report Number:</b> <u>RSZ210401011-00B</u>	
<b>Report Date:</b> <u>2021-06-22</u>	
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## GENERAL INFORMATION

### Product Description for Equipment under Test (EUT)

Product	Digital Portable Radio
Tested Model	PH690 VHF
Multiple Model	PH660 VHF,PH600 VHF
Model Differences	Refer to the DoS letter
Frequency Range	Bluetooth: 2402-2480MHz
Maximum conducted Peak output power	Bluetooth: 1.17dBm
Modulation Technique	Bluetooth: GFSK, $\pi/4$ -DQPSK, 8DPSK
Antenna Specification*	-4.0dBi(It is provided by the applicant)
Voltage Range	DC7.4V from battert and DC12.0V from Adapter
Date of Test	2021-04-13 to 2021-06-22
Sample serial number	RSZ210401011-RF -S1 (for PH690 VHF) RSZ210401011-RF -S2 (for PH660 VHF) RSZ210401011-RF -S2 (for PH600 VHF) (Assigned by BACL, Shenzhen)
Received date	2021-04-01
Sample/EUT Status	Good condition
Adapter information	Model:ES086H-X120100XYF Input:100-240~50/60Hz,0.5A Output:12.0V,1.0A

### 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.

For Radiated Emissions testing, please refer to DA 00-705 Released March 30, 2000, Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

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		$\pm 5\%$
RF Output Power with Power meter		$\pm 0.73\text{dB}$
RF conducted test with spectrum		$\pm 1.6\text{dB}$
AC Power Lines Conducted Emissions		$\pm 1.95\text{dB}$
Emissions, Radiated	Below 1GHz	$\pm 4.75\text{dB}$
	Above 1GHz	$\pm 4.88\text{dB}$
Temperature		$\pm 1\text{ }^{\circ}\text{C}$
Humidity		$\pm 6\%$
Supply voltages		$\pm 0.4\%$

*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 Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 5F(B-West) , 6F, 7F, the 3rd Phase of Wan Li Industrial Building D, Shihua Rd, FuTian Free Trade Zone, Shenzhen, 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.: 342867, the FCC Designation No.: CN1221.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

## SYSTEM TEST CONFIGURATION

### Description of Test Configuration

The system was configured for testing in an engineering mode.

### EUT Exercise Software

"BlueSuite2\_4\_8 " Exercise Software was used and 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

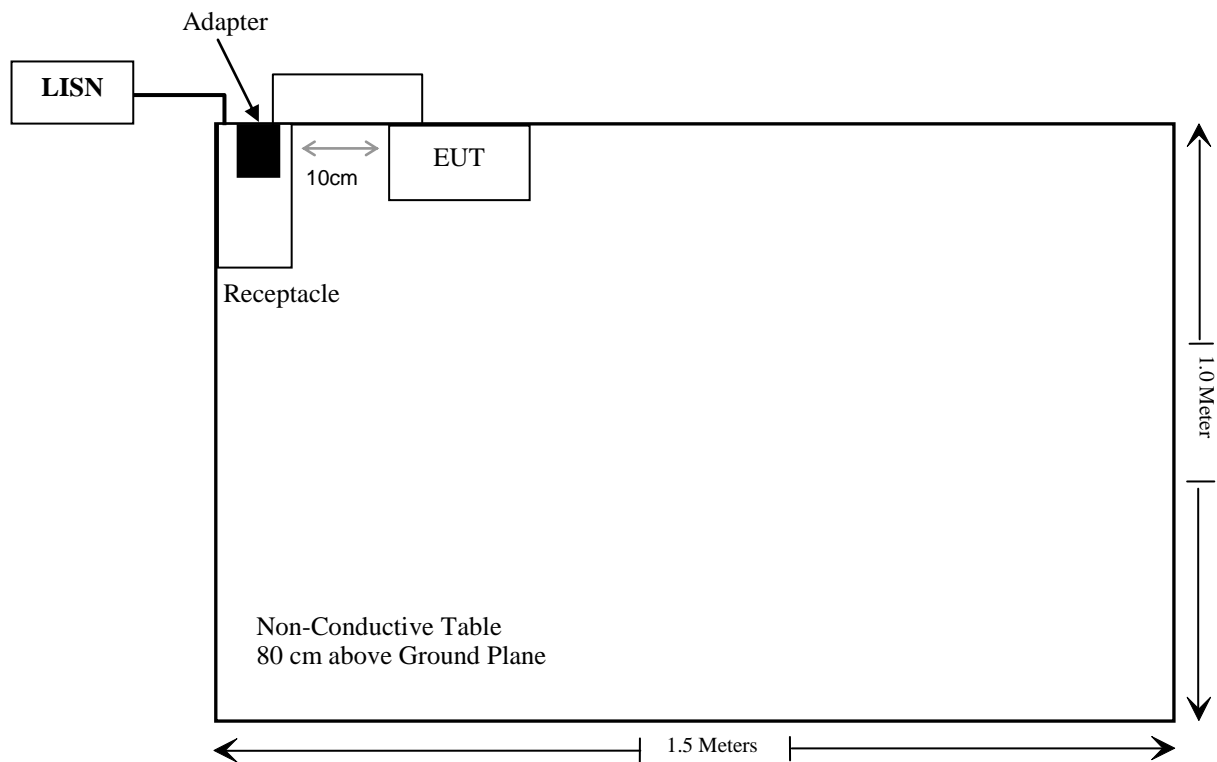
Manufacturer	Description	Model	Serial Number
/	/	/	/

### External I/O Cable

Cable Description	Length (m)	From Port	To
Un-shield Detachable DC Cable	1.2	Adapter	EUT

## Block Diagram of Test Setup

For conducted emission:



## SUMMARY OF TEST RESULTS

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



## TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
<b>Conducted Emissions Test</b>					
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2020/08/04	2021/08/03
Rohde & Schwarz	LISN	ENV216	101613	2020/08/04	2021/08/03
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
<b>Radiated Emission Test</b>					
R&S	EMI Test Receiver	ESR3	102455	2020/08/04	2021/08/03
Sonoma instrument	Pre-amplifier	310 N	186238	2020/08/04	2021/08/03
Sunol Sciences	Broadband Antenna	JB1	A040904-2	2020/12/22	2023/12/21
Unknown	Cable 2	RF Cable 2	F-03-EM197	2020/11/29	2021/11/28
Unknown	Cable	Chamber Cable 1	F-03-EM236	2020/11/29	2021/11/28
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR
Rohde & Schwarz	Spectrum Analyzer	FSV40-N	102259	2020/08/04	2021/08/03
COM-POWER	Pre-amplifier	PA-122	181919	2020/11/29	2021/11/28
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2020/11/28	2021/11/27
Sunol Sciences	Horn Antenna	3115	9107-3694	2021/01/15	2024/01/14
Insulted Wire Inc.	RF Cable	SPS-2503-3150	02222010	2020/11/29	2021/11/28
Unknown	RF Cable	W1101-EQ1 OUT	F-19-EM005	2020/11/29	2021/11/28
SNSD	Band Reject filter	BSF2402-2480MN-0898-001	2.4G filter	2021/04/20	2022/04/20
Ducommun Technologies	Horn antenna	ARH-4223-02	1007726-021304	2020/12/06	2023/12/05
<b>RF Conducted Test</b>					
Tonscend Corporation	RF control Unit	JS0806-2	19D8060154	2020/08/04	2021/08/03
Rohde & Schwarz	Signal and Spectrum Analyzer	FSV40	101473	2020/08/04	2021/08/03
Unknown	RF Cable	Unknown	Unknown	2020/11/29	2021/11/28

**\* Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

## FCC §15.247 (i), §1.1307 (b) (1) & §2.1093 – RF EXPOSURE

### Applicable Standard

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

According to KDB 447498 D01 General RF Exposure Guidance

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances  $\leq 50$  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  $\leq 7.5$  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.

**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	1.5	1.41	5	0.4	3.0	Yes

**Result: No Standalone SAR test is required**

## **FCC §15.203 – ANTENNA REQUIREMENT**

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### **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 external antenna, the antenna was professionally installed by user and the antenna gain is -4.0dBi, fulfill the requirement of this section. Please refer to the EUT photos.

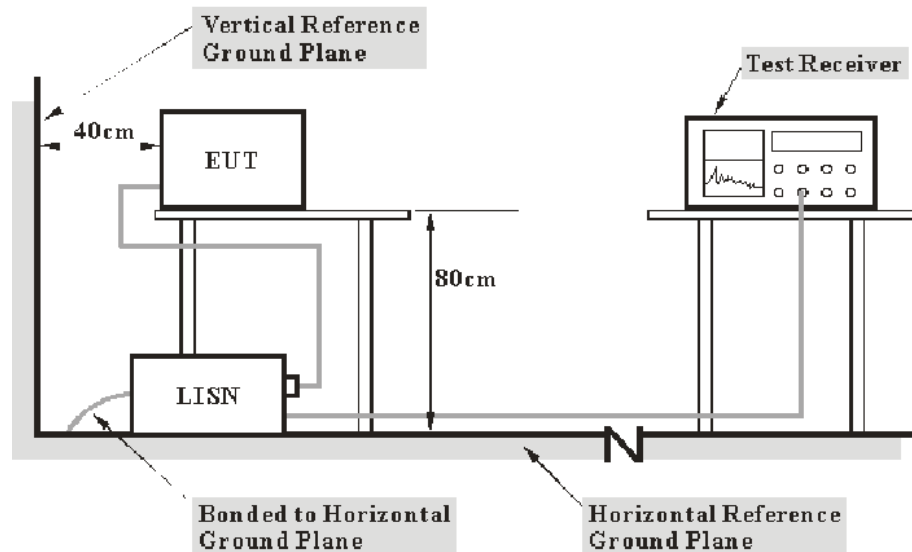
**Result:** Compliance.

## 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 device was connected to the outlet of the LISN.

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

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

## Corrected Factor & Margin Calculation

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

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

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:

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

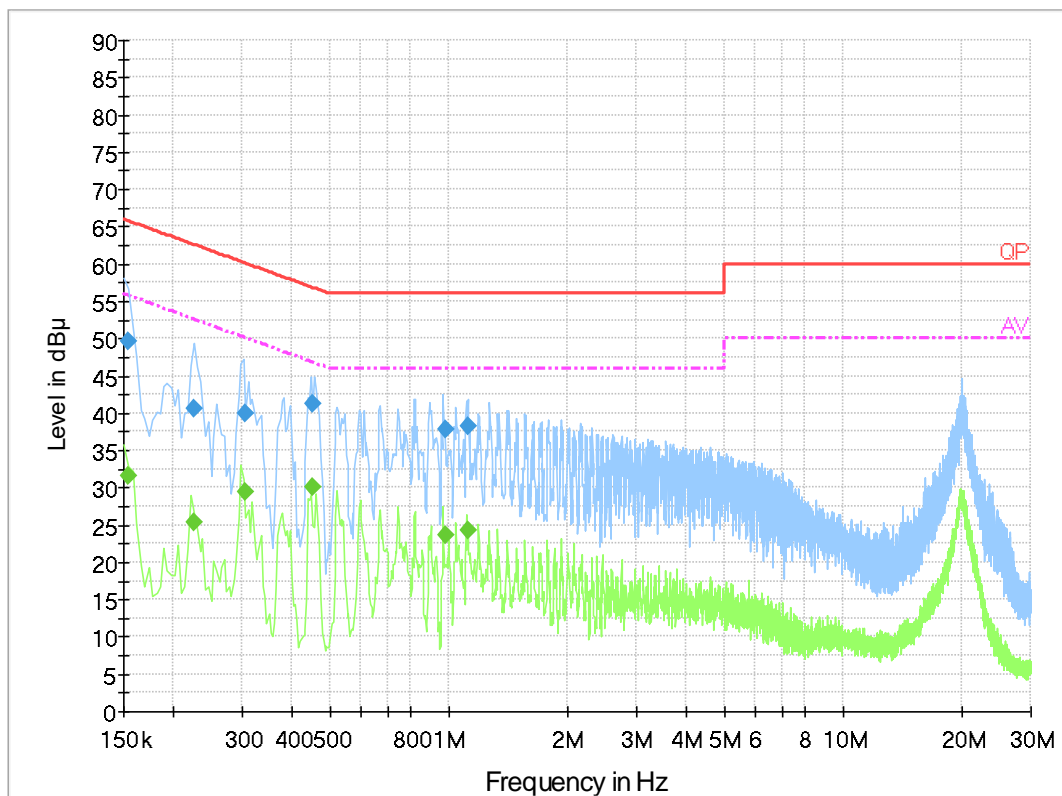
## Test Data

### Environmental Conditions

<b>Temperature:</b>	25 °C
<b>Relative Humidity:</b>	65 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Haiguo Li on 2021-04-13.*

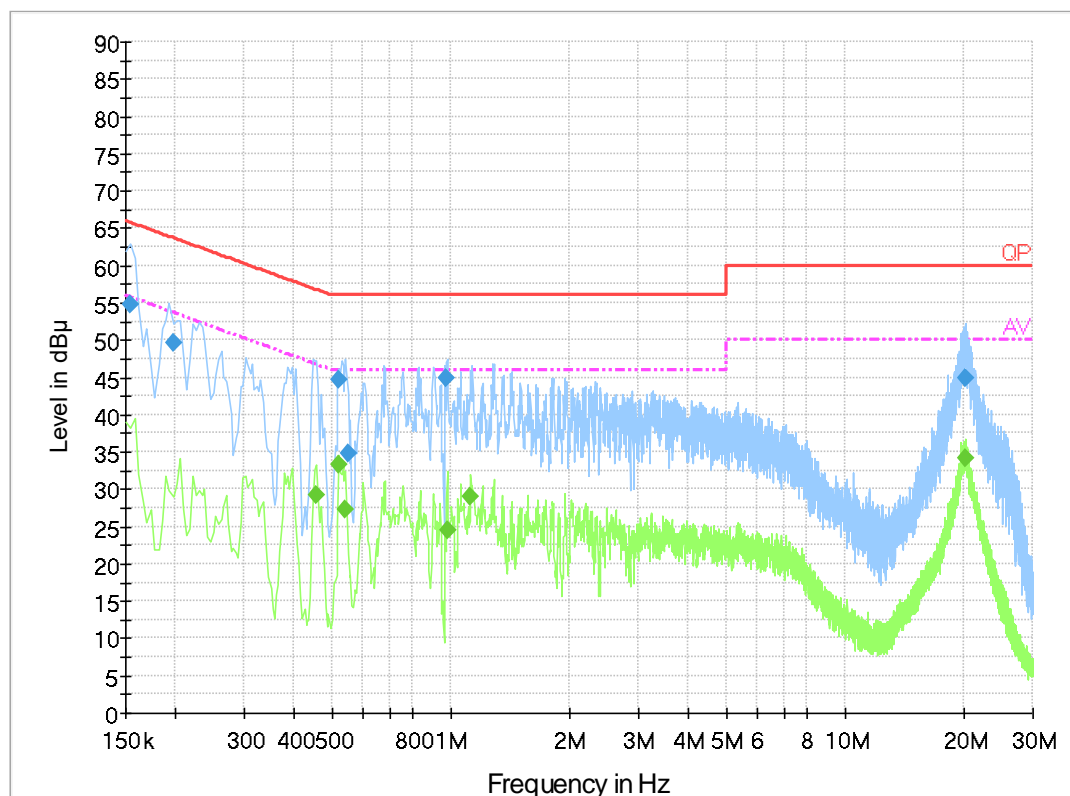
*EUT operation mode: Charging&Transmitting*

**AC 120V/60 Hz, Line****Final Result 1**

Frequency (MHz)	QuasiPeak (dBμ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμ V)
0.154000	49.6	9.000	L1	19.8	16.2	65.8
0.225500	40.7	9.000	L1	19.8	21.9	62.6
0.305470	40.0	9.000	L1	19.7	20.1	60.1
0.451130	41.2	9.000	L1	19.8	15.7	56.9
0.980490	37.8	9.000	L1	19.9	18.2	56.0
1.121230	38.3	9.000	L1	19.8	17.7	56.0

**Final Result 2**

Frequency (MHz)	Average (dBμ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμ V)
0.154000	31.7	9.000	L1	19.8	24.1	55.8
0.225500	25.3	9.000	L1	19.8	27.3	52.6
0.305470	29.5	9.000	L1	19.7	20.6	50.1
0.451130	30.0	9.000	L1	19.8	16.9	46.9
0.980490	23.6	9.000	L1	19.9	22.4	46.0
1.121230	24.3	9.000	L1	19.8	21.7	46.0

**AC 120V/60 Hz, Neutral****Final Result 1**

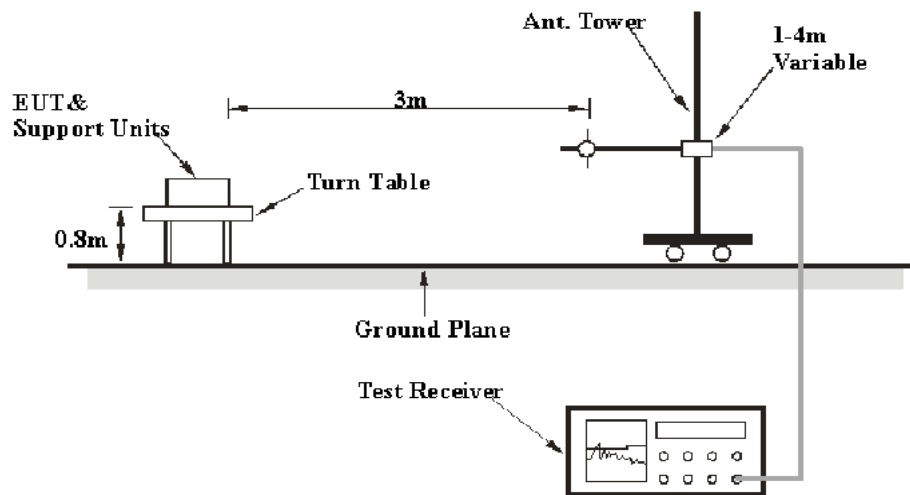
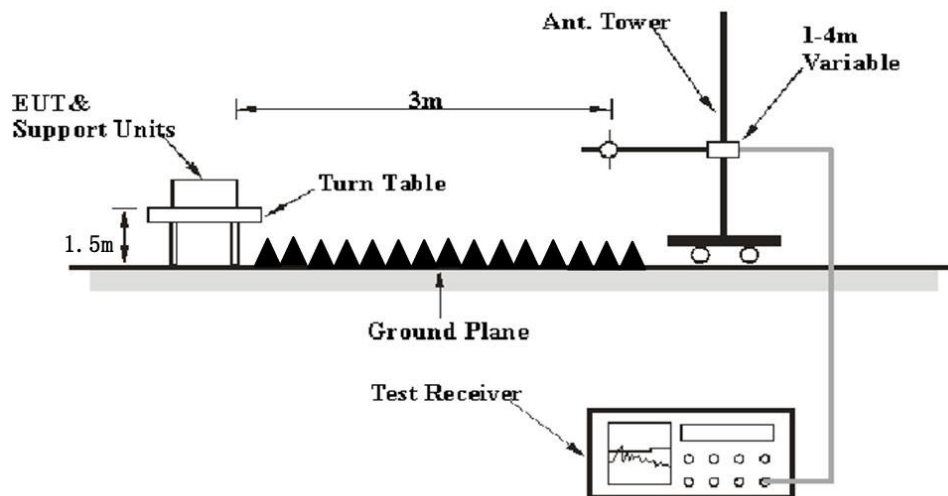
Frequency (MHz)	QuasiPeak (dBμ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμ V)
0.154000	54.8	9.000	N	19.8	11.0	65.8
0.198500	49.6	9.000	N	19.8	14.1	63.7
0.522050	44.6	9.000	N	19.8	11.4	56.0
0.549870	34.9	9.000	N	19.8	21.1	56.0
0.971270	44.9	9.000	N	19.8	11.1	56.0
20.270610	44.8	9.000	N	20.4	15.2	60.0

**Final Result 2**

Frequency (MHz)	Average (dBμ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμ V)
0.458000	29.1	9.000	N	19.8	17.6	46.7
0.522000	33.2	9.000	N	19.8	12.8	46.0
0.542000	27.3	9.000	N	19.8	18.7	46.0
0.982000	24.5	9.000	N	19.8	21.5	46.0
1.126000	29.1	9.000	N	19.8	16.9	46.0
20.190000	34.2	9.000	N	20.4	15.8	50.0

**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, according to the DA 00-705 Released March 30, 2000, 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

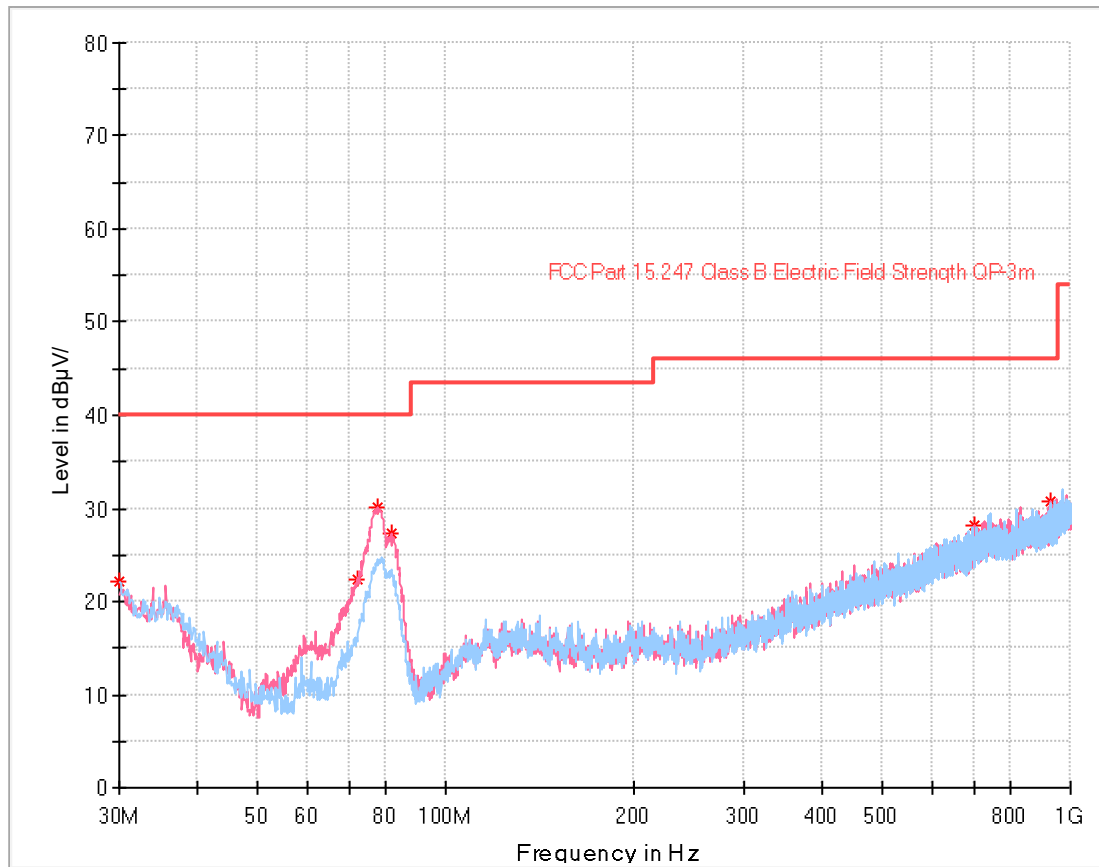
<b>Temperature:</b>	26~27.8℃
<b>Relative Humidity:</b>	51~57%
<b>ATM Pressure:</b>	101.0~101.2kPa

*The testing was performed by Zero Yan on 2021-04-15 and 2021-06-22 for below 1GHz and Alan He on 2021-05-12 and 2021-06-22 for above 1GHz.*

*EUT operation mode: Transmitting*

**30 MHz~1 GHz: (BT link)**

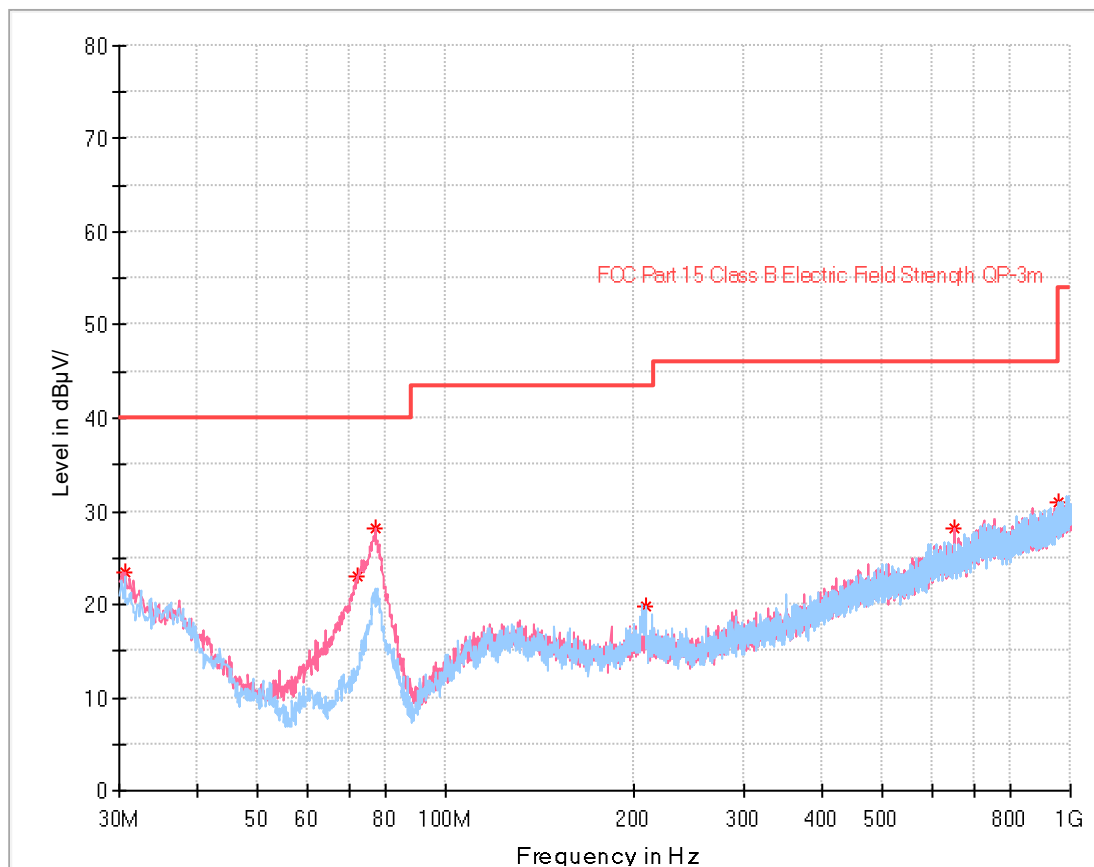
*For model: PH690 VHF*



### Critical\_Freqs

Frequency (MHz)	MaxPeak (dBμ V/m)	Limit (dBμ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.000000	22.14	40.00	17.86	200.0	H	176.0	-3.5
72.073750	22.27	40.00	17.73	200.0	V	209.0	-16.3
77.651250	30.03	40.00	9.97	200.0	V	306.0	-16.6
81.652500	27.29	40.00	12.71	200.0	V	209.0	-16.7
703.665000	28.12	46.00	17.88	200.0	V	230.0	-1.4
930.402500	30.68	46.00	15.32	300.0	V	29.0	1.4

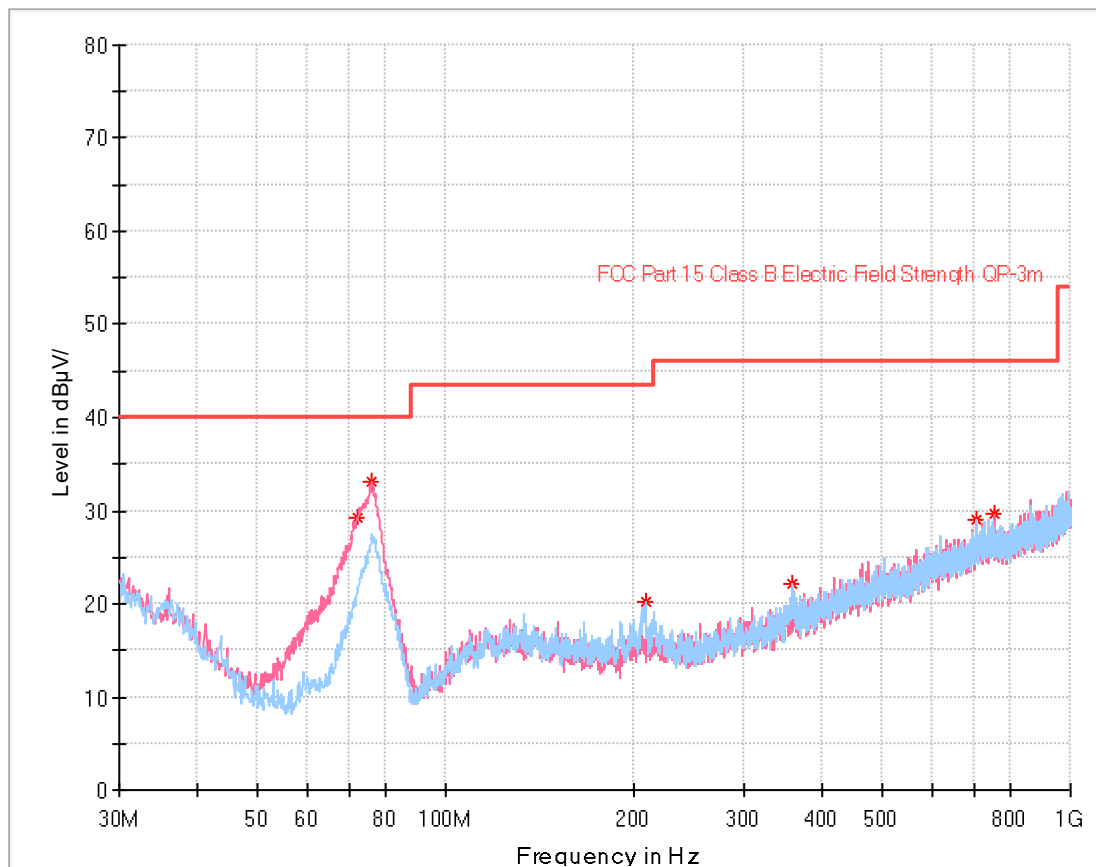
For model: PH600 VHF



### Critical\_Freqs

Frequency (MHz)	MaxPeak (dBμ V/m)	Limit (dBμ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.606250	23.43	40.00	16.57	400.0	V	236.0	-4.0
72.073750	23.11	40.00	16.89	300.0	V	243.0	-16.3
77.287500	28.23	40.00	11.77	300.0	V	212.0	-16.6
208.843750	19.80	43.50	23.70	300.0	H	288.0	-11.2
652.982500	28.15	46.00	17.85	100.0	V	93.0	-2.4
959.017500	31.05	46.00	14.95	400.0	H	105.0	2.0

For model:PH660 VHF



### Critical\_Freqs

Frequency (MHz)	MaxPeak (dBμ V/m)	Limit (dBμ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
71.952500	29.20	40.00	10.80	300.0	V	252.0	-16.3
76.317500	33.21	40.00	6.79	300.0	V	231.0	-16.5
208.358750	20.15	43.50	23.35	200.0	H	233.0	-11.2
359.436250	22.09	46.00	23.91	300.0	H	279.0	-8.6
706.938750	29.00	46.00	17.00	100.0	H	0.0	-1.4
753.862500	29.66	46.00	16.34	300.0	V	0.0	-0.5

**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)									
2380.62	30.34	PK	1	1.7	H	31.87	62.21	74	11.79
2380.62	14.01	Ave.	1	1.7	H	31.87	45.88	54	8.12
2489.08	30.55	PK	337	2.2	H	32.13	62.68	74	11.32
2489.08	14.22	Ave.	337	2.2	H	32.13	46.35	54	7.65
4804.00	55.12	PK	13	2.1	H	6.28	61.40	74	12.60
4804.00	36.43	Ave.	13	2.1	H	6.28	42.71	54	11.29
Middle Channel (2441 MHz)									
4882.00	54.72	PK	288	1.2	H	6.76	61.48	74	12.52
4882.00	36.26	Ave.	288	1.2	H	6.76	43.02	54	10.98
High Channel (2480 MHz)									
2380.37	30.12	PK	217	2.2	H	31.87	61.99	74	12.01
2380.37	14.04	Ave.	217	2.2	H	31.87	45.91	54	8.09
2484.14	30.29	PK	158	1.0	H	32.13	62.42	74	11.58
2484.14	14.24	Ave.	158	1.0	H	32.13	46.37	54	7.63
4960.00	54.94	PK	62	2.2	H	6.80	61.74	74	12.26
4960.00	36.51	Ave.	166	1.7	H	6.80	43.31	54	10.69

**Co-location radiation:** (BT mode 2402MHz+ DMR 173.15MHz)

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)
	Reading (dB $\mu$ V)	PK/QP/Ave.		Height (m)	Polar (H/V)				
77.65	47.25	QP	305	2.0	V	-16.6	30.65	40	9.35
346.30	36.81	QP	241	1.5	V	-10.84	25.97	46	20.03
1385.20	43.26	PK	68	1.2	H	-2.43	40.83	74	33.17
1385.20	42.16	Ave.	68	1.2	H	-2.43	39.73	54	14.27
1558.35	43.87	PK	312	1.2	H	-2.05	41.82	74	32.18
1558.35	42.24	Ave.	312	1.2	H	-2.05	40.19	54	13.81
1731.50	43.41	PK	253	1.7	H	-1.86	41.55	74	32.45
1731.50	41.86	Ave.	253	1.7	H	-1.86	40.00	54	14.00
4804.00	48.08	PK	90	1.1	H	6.28	54.36	74	19.64
4804.00	41.33	Ave.	147	1.8	H	6.28	47.61	54	6.39

Note:

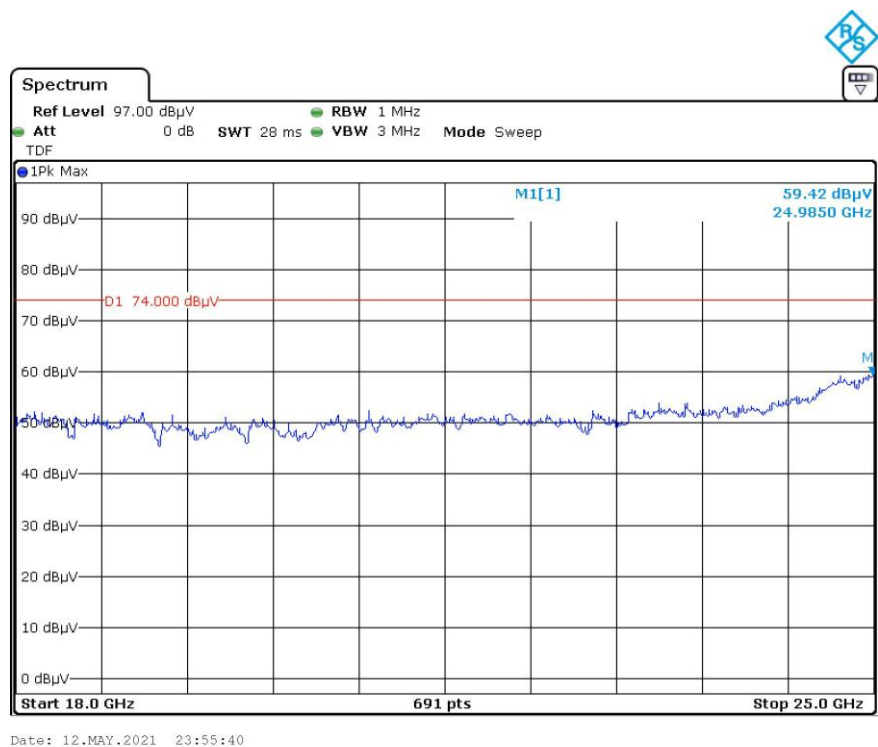
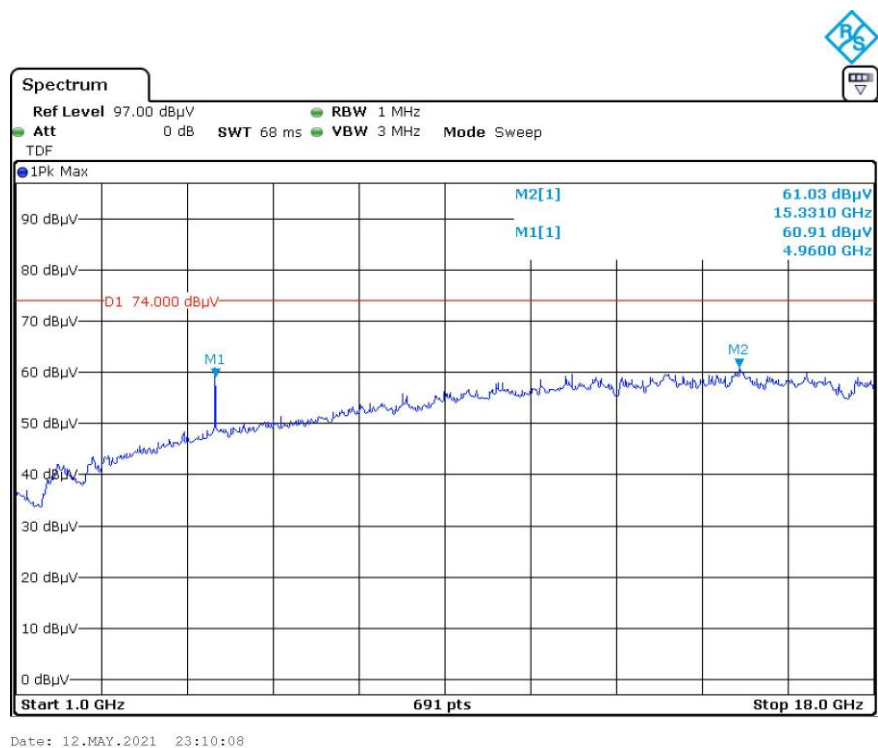
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Corrected Amplitude = Corrected Factor + Reading

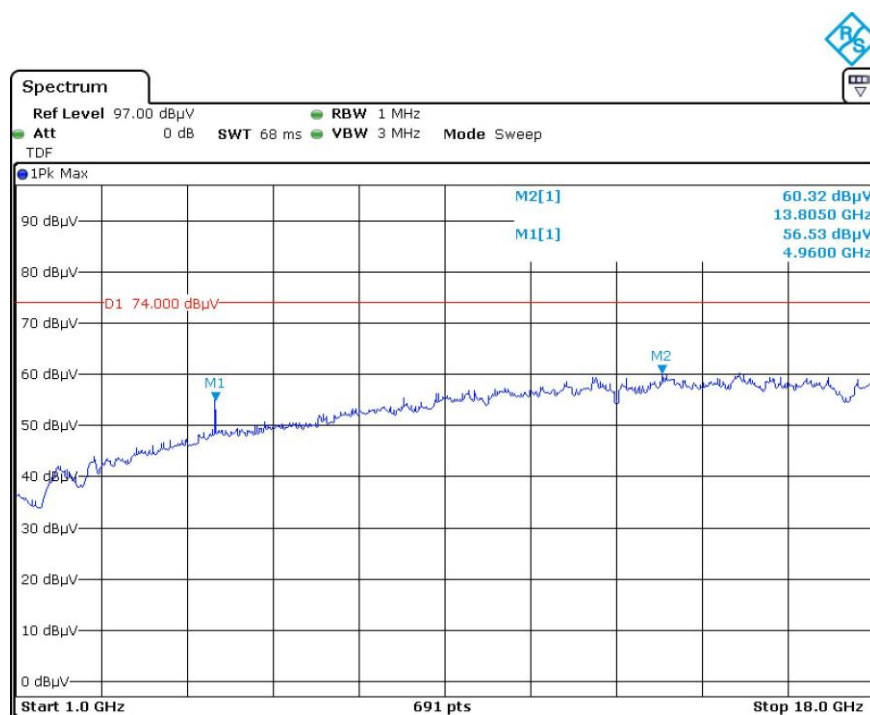
Margin = Limit - Corrected. Amplitude

The other spurious emission which is 20dB to the limit was not recorded.

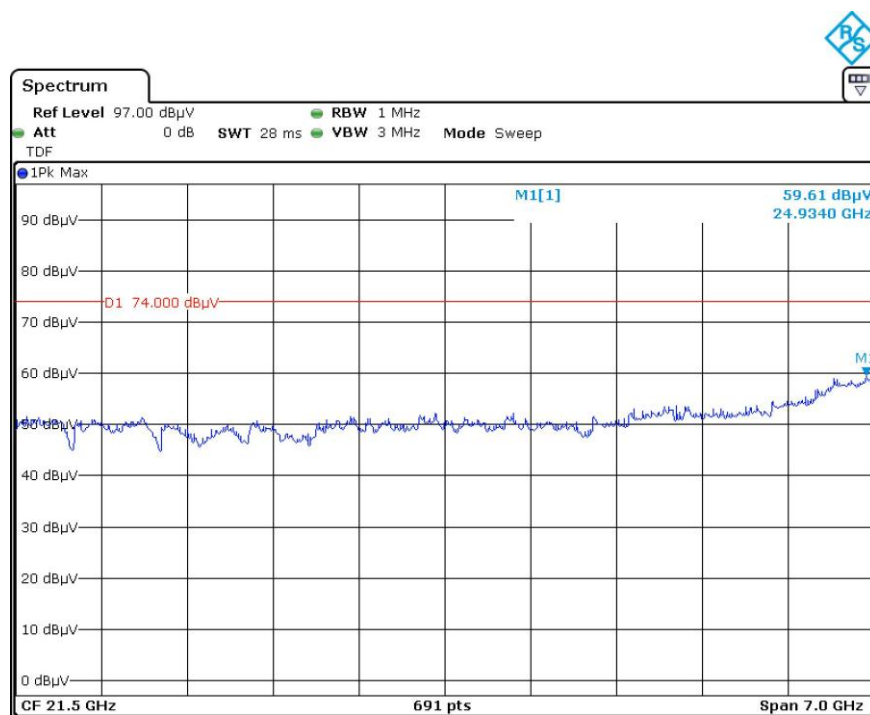
### Pre-scan with high channel Peak Horizontal



## Vertical

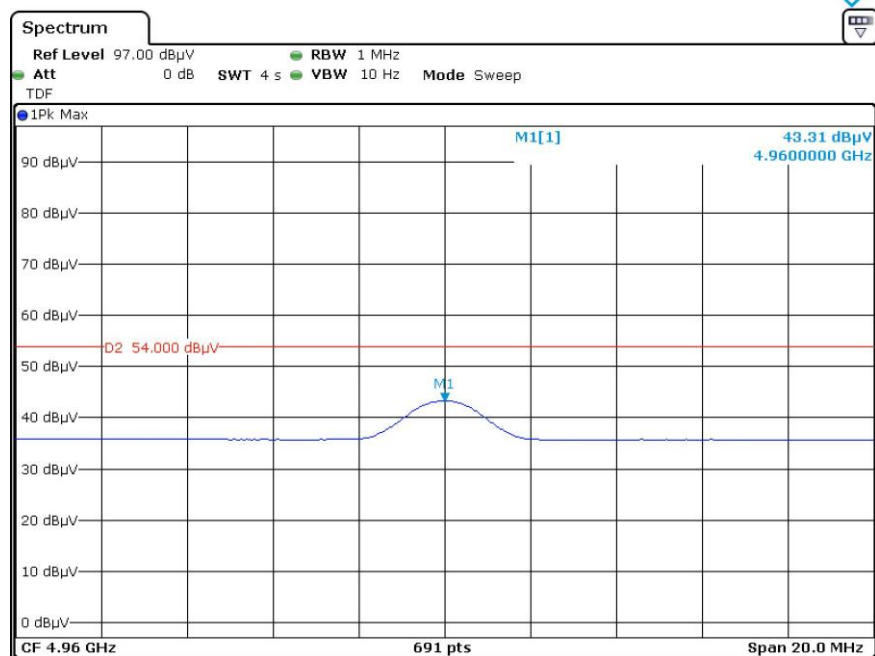


Date: 12.MAY.2021 23:20:32

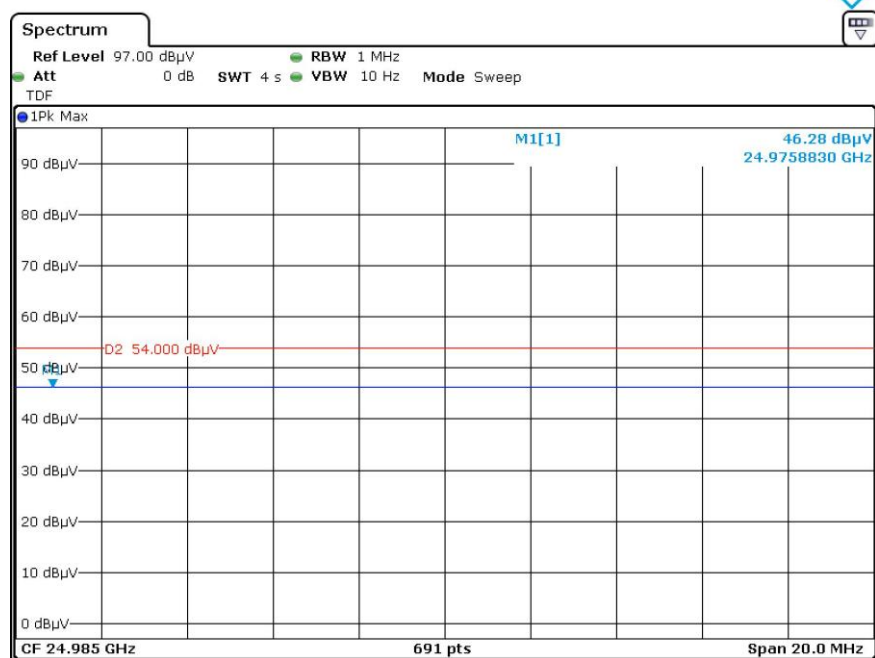


Date: 13.MAY.2021 00:06:01

# Average Horizontal



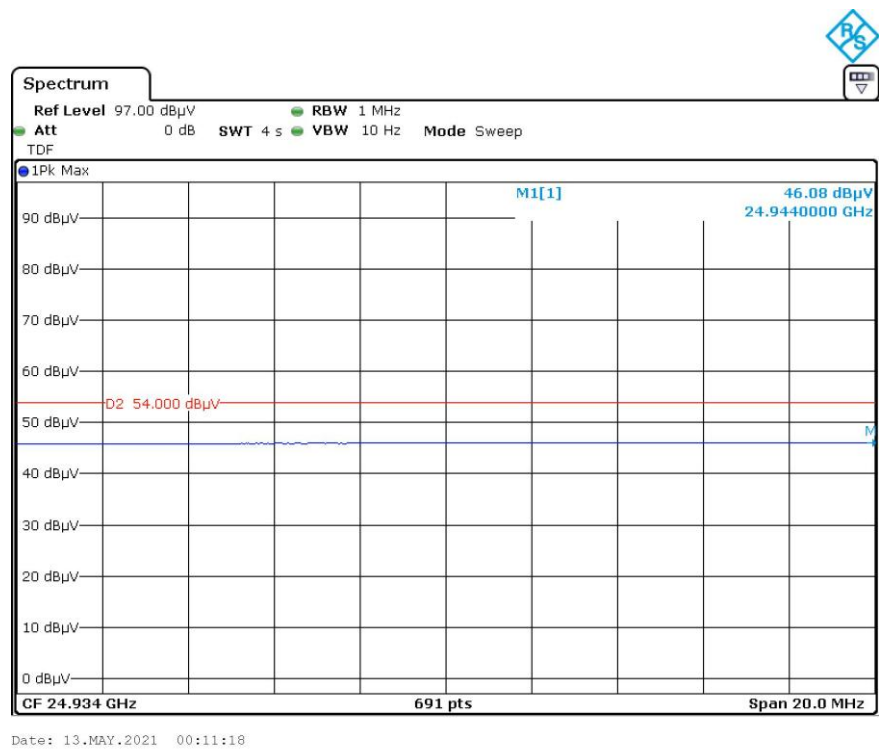
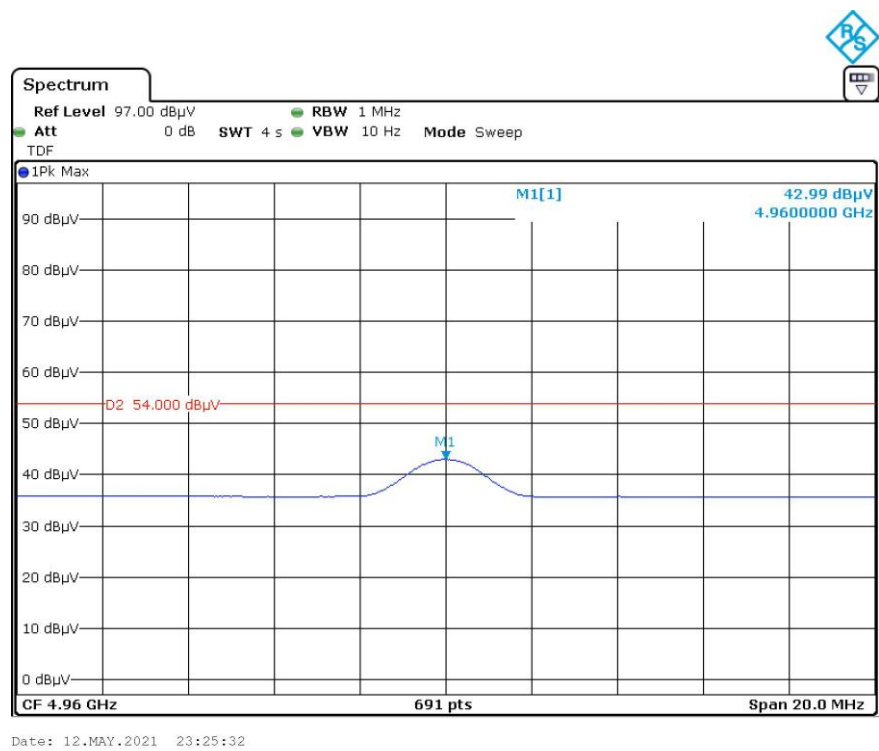
Date: 12.MAY.2021 23:15:35



Date: 13.MAY.2021 00:00:45



## 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:	28.6 °C
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

*The testing was performed by Blaker Zhang on 2021-05-14.*

*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**

<b>Temperature:</b>	28.6 °C
<b>Relative Humidity:</b>	53 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Blaker Zhang on 2021-05-14.*

*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**

<b>Temperature:</b>	28.6 °C
<b>Relative Humidity:</b>	53 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Blaker Zhang on 2021-05-14.*

*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**

<b>Temperature:</b>	28.6 °C
<b>Relative Humidity:</b>	53 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Blaker Zhang on 2021-05-14.*

*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

<b>Temperature:</b>	28.6 °C
<b>Relative Humidity:</b>	53 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Blaker Zhang on 2021-05-14 and 2021-05-28.*

*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

<b>Temperature:</b>	28.6 °C
<b>Relative Humidity:</b>	53 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Blaker Zhang on 2021-05-14.*

*EUT operation mode: Transmitting*

Test Result: Compliant. Please refer to the Appendix.

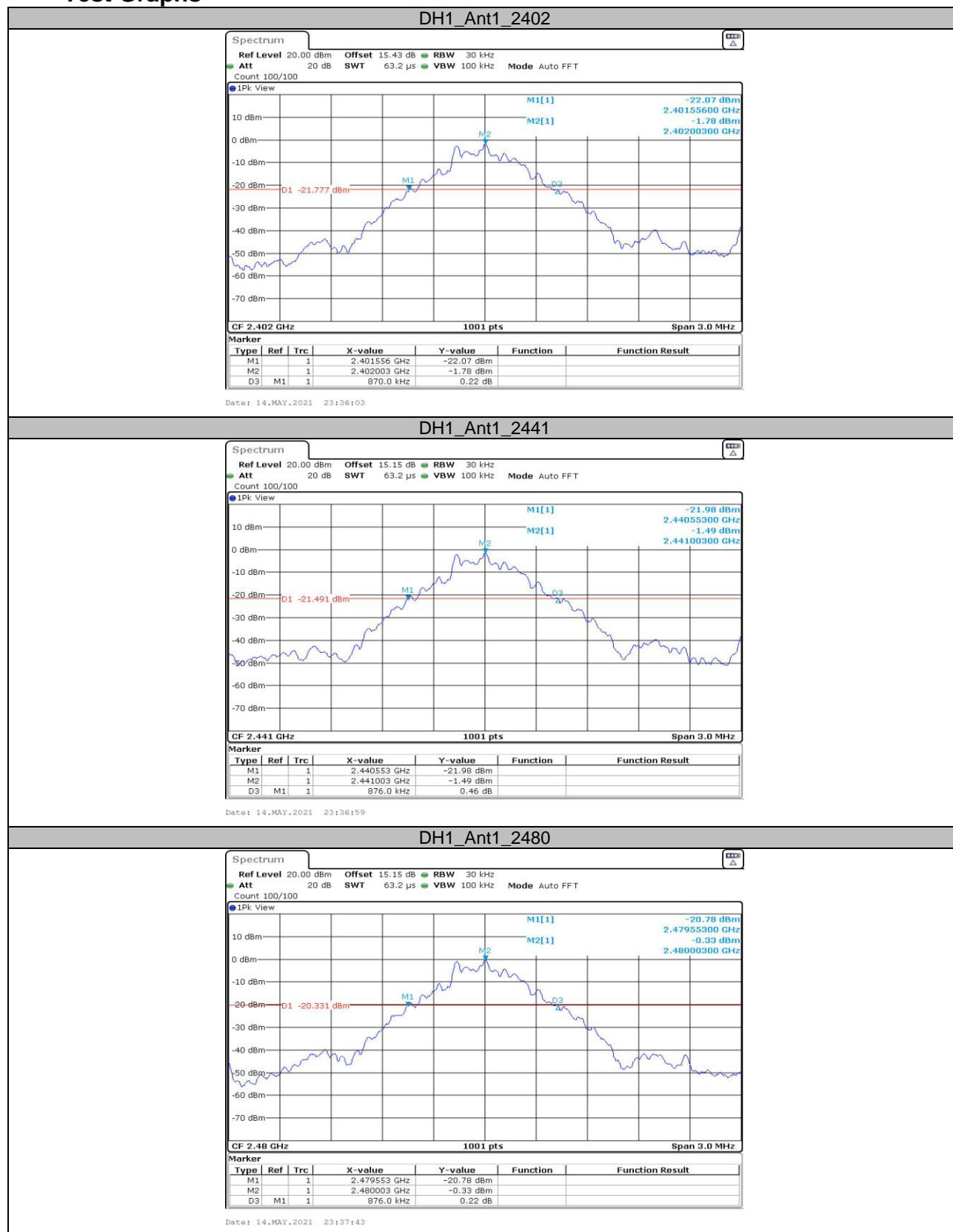
## APPENDIX

### AppendixA: 20dB Emission Bandwidth Test Result

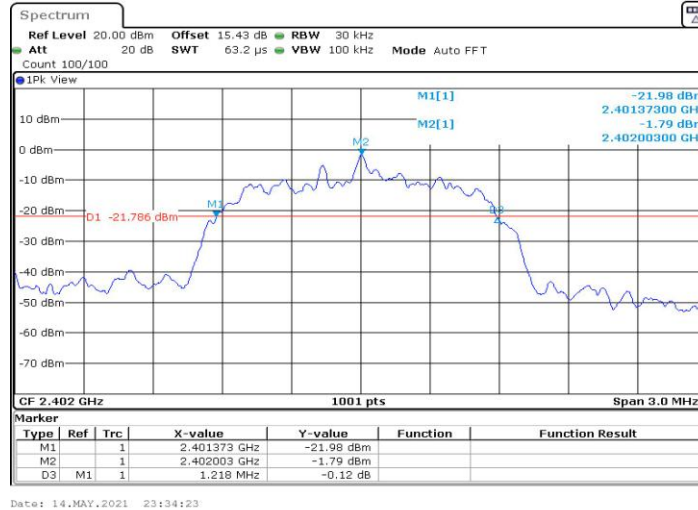
TestMode	Antenna	Channel	20db EBW[MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	0.870	---	PASS
		2441	0.876	---	PASS
		2480	0.876	---	PASS
2DH1	Ant1	2402	1.218	---	PASS
		2441	1.221	---	PASS
		2480	1.221	---	PASS
3DH1	Ant1	2402	1.209	---	PASS
		2441	1.212	---	PASS
		2480	1.212	---	PASS



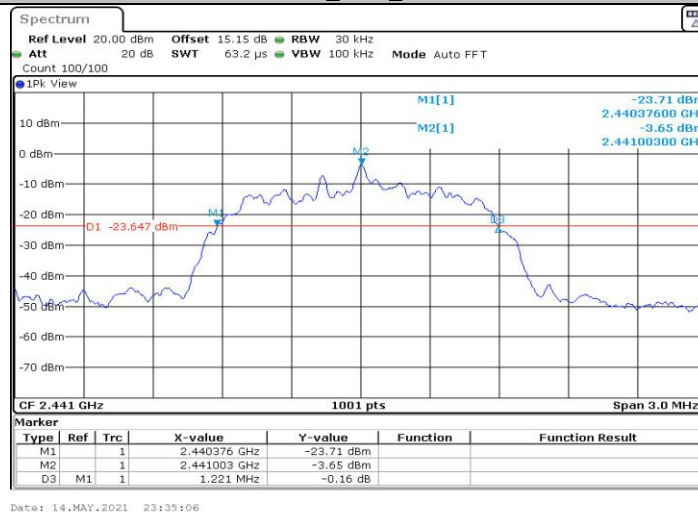
## Test Graphs



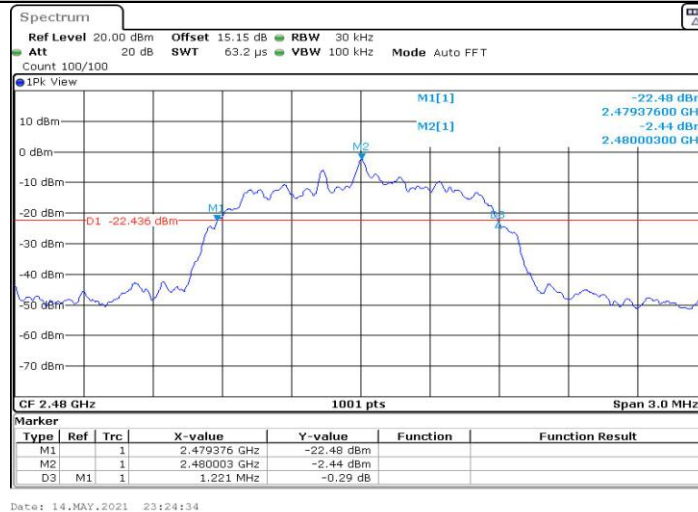
## 2DH1\_Ant1\_2402



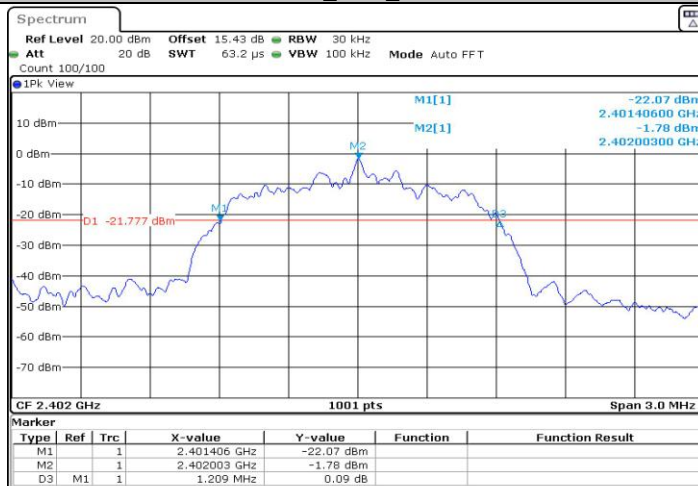
## 2DH1\_Ant1\_2441



## 2DH1\_Ant1\_2480

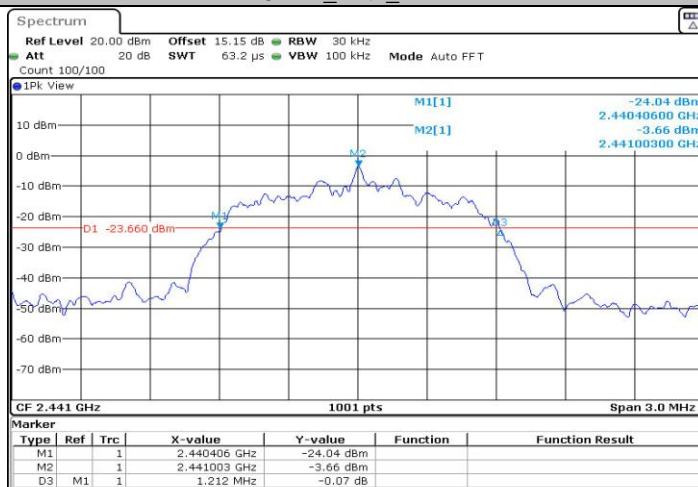


## 3DH1\_Ant1\_2402



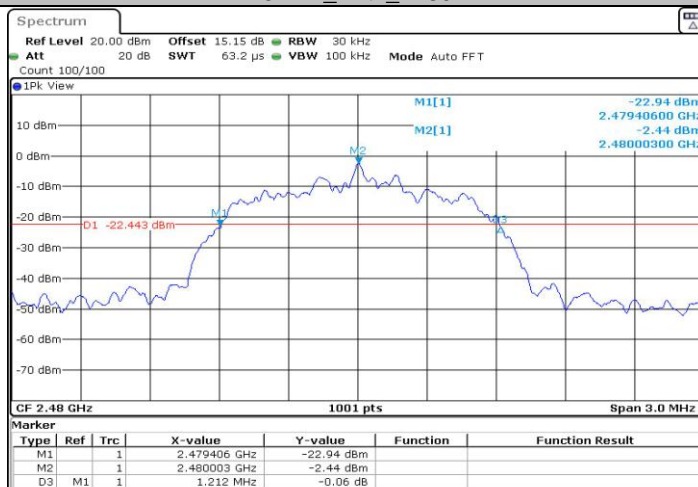
Date: 14.MAY.2021 23:38:35

## 3DH1\_Ant1\_2441



Date: 14.MAY.2021 23:45:35

## 3DH1\_Ant1\_2480

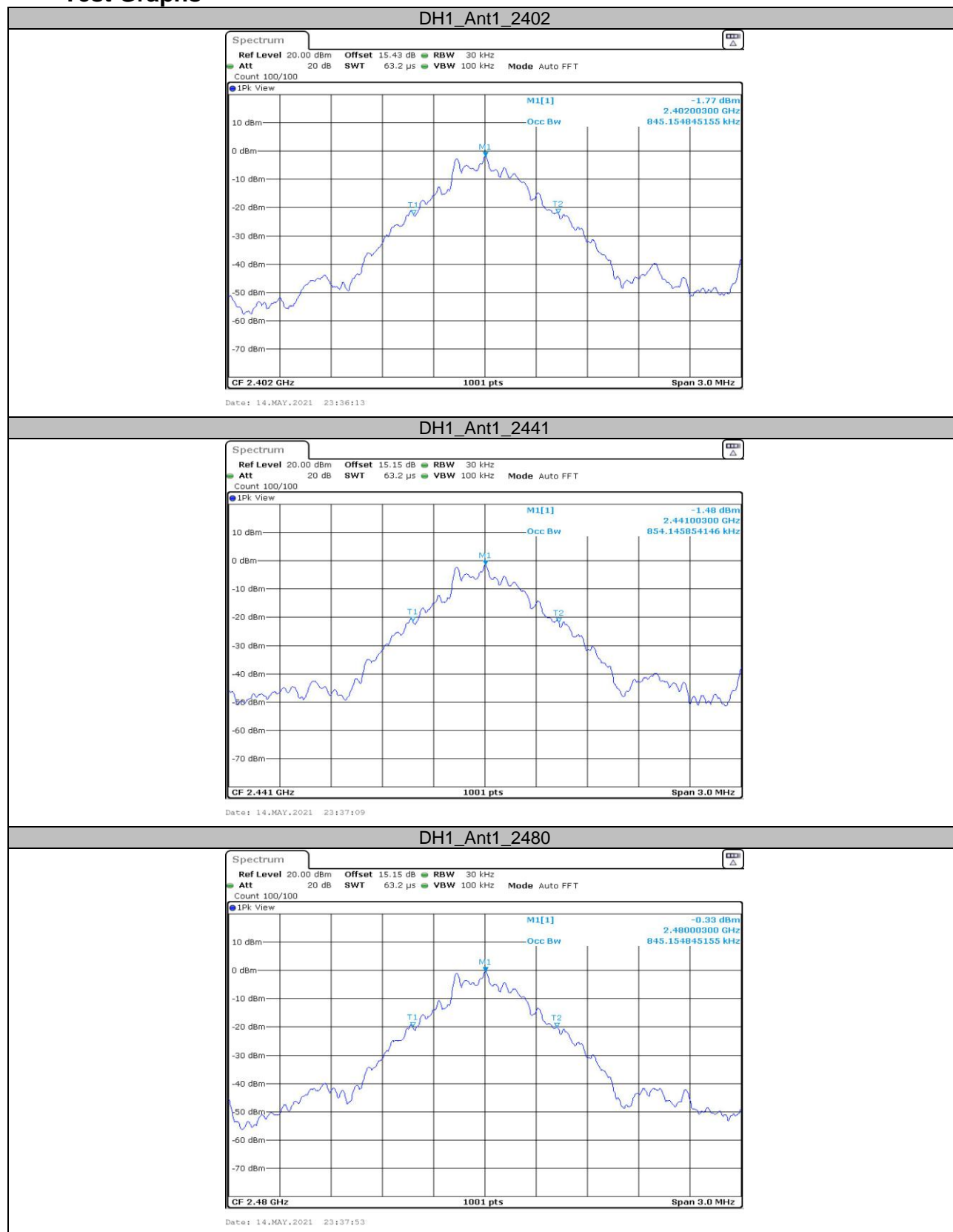


Date: 14.MAY.2021 23:46:18

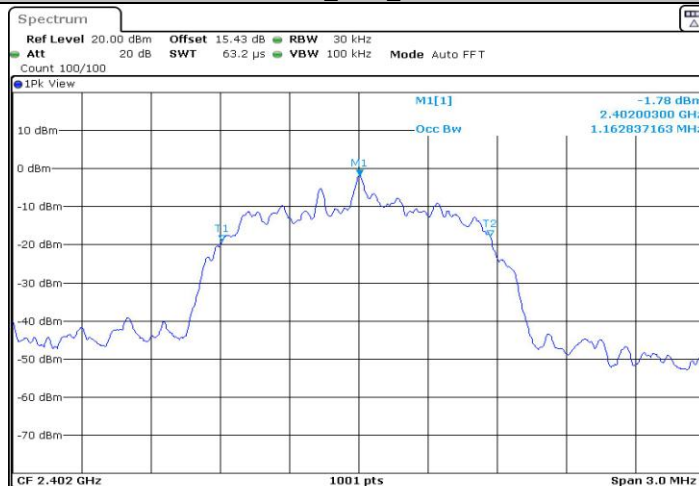
**AppendixB: Occupied Channel Bandwidth  
Test Result**

TestMode	Antenna	Channel	OCB [MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	0.845	---	PASS
		2441	0.854	---	PASS
		2480	0.845	---	PASS
2DH1	Ant1	2402	1.163	---	PASS
		2441	1.160	---	PASS
		2480	1.160	---	PASS
3DH1	Ant1	2402	1.142	---	PASS
		2441	1.145	---	PASS
		2480	1.148	---	PASS

## Test Graphs

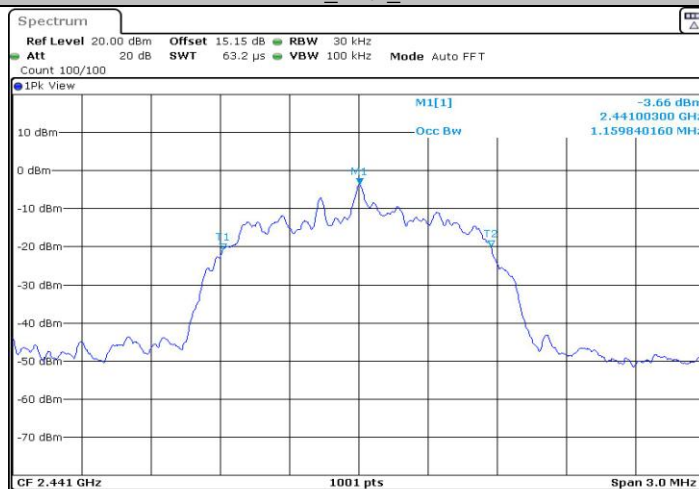


## 2DH1\_Ant1\_2402



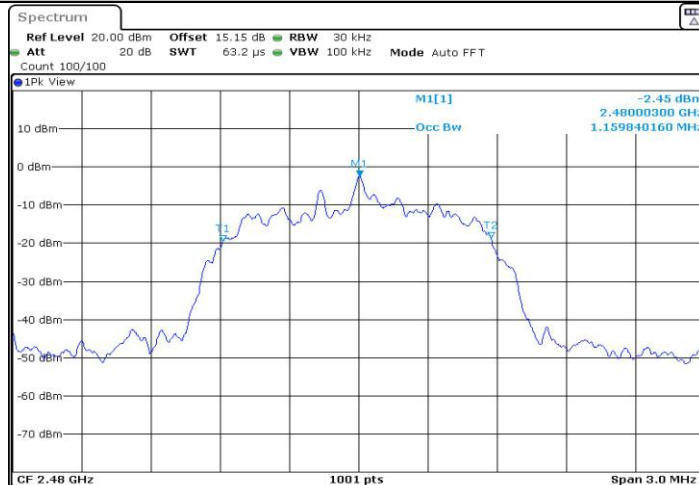
Date: 14.MAY.2021 23:34:33

## 2DH1\_Ant1\_2441



Date: 14.MAY.2021 23:35:16

## 2DH1\_Ant1\_2480



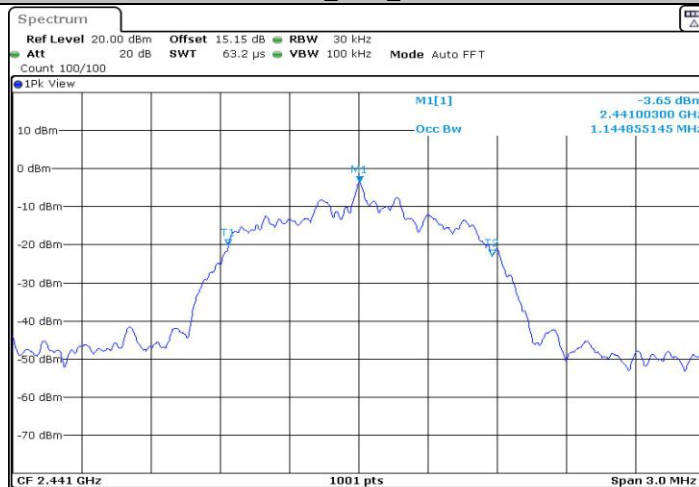
Date: 14.MAY.2021 23:24:44

## 3DH1\_Ant1\_2402



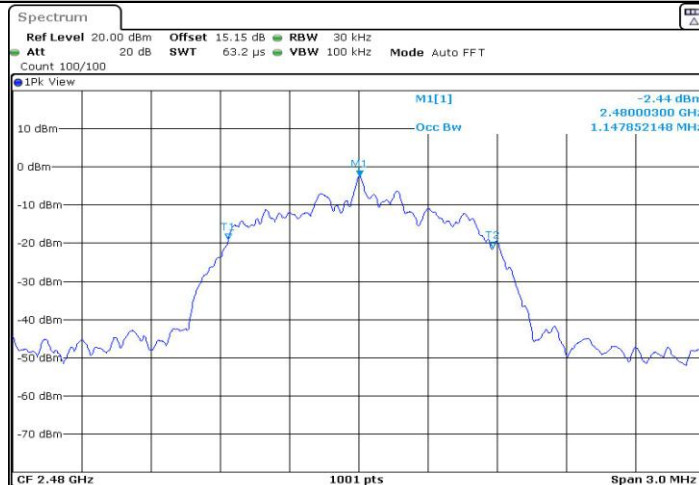
Date: 14.MAY.2021 23:38:45

## 3DH1\_Ant1\_2441



Date: 14.MAY.2021 23:45:45

## 3DH1\_Ant1\_2480



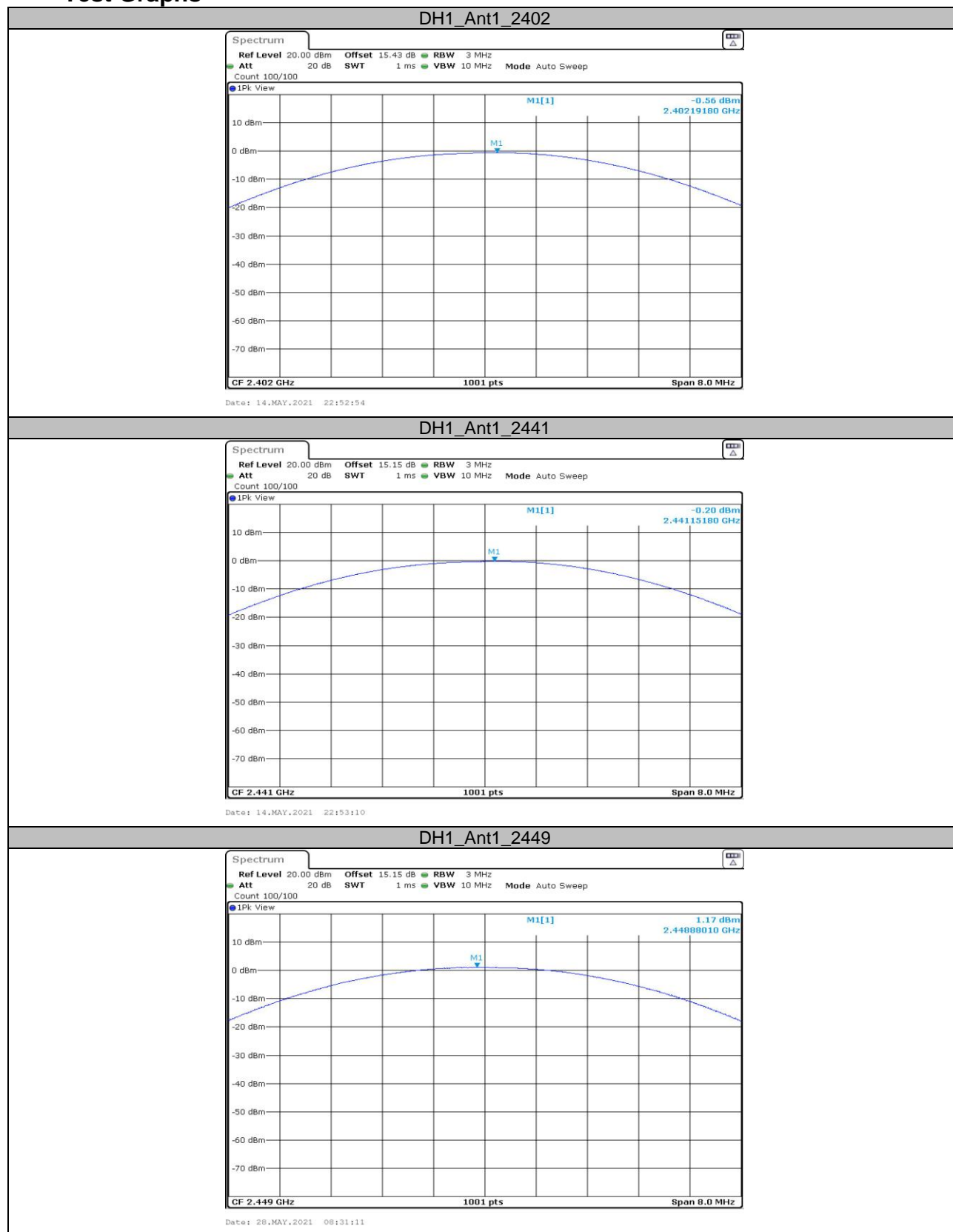
Date: 14.MAY.2021 23:46:28

**AppendixC: Maximum conducted Peak output power  
Test Result**

TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
DH1	Ant1	2402	-0.56	<=20.97	PASS
		2441	-0.2	<=20.97	PASS
		2449	1.17	<=20.97	PASS
		2480	0.89	<=20.97	PASS
2DH1	Ant1	2402	0.52	<=20.97	PASS
		2441	-1.48	<=20.97	PASS
		2449	1.07	<=20.97	PASS
		2480	-0.37	<=20.97	PASS
3DH1	Ant1	2402	0.84	<=20.97	PASS
		2441	-1.21	<=20.97	PASS
		2449	1.15	<=20.97	PASS
		2480	-0.07	<=20.97	PASS



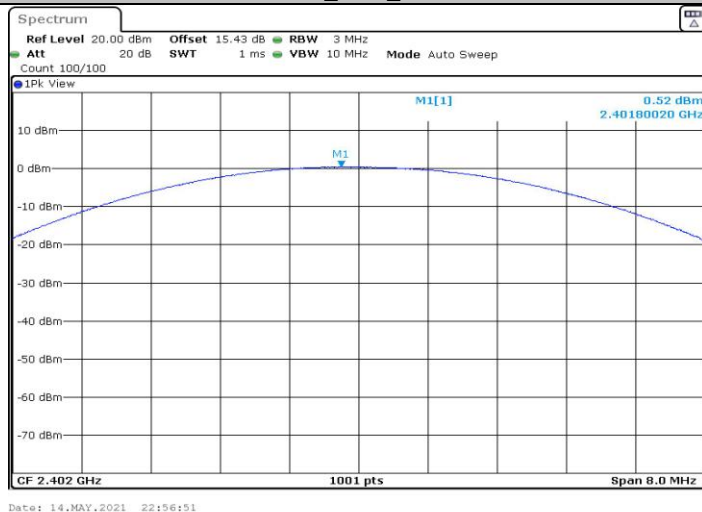
## Test Graphs



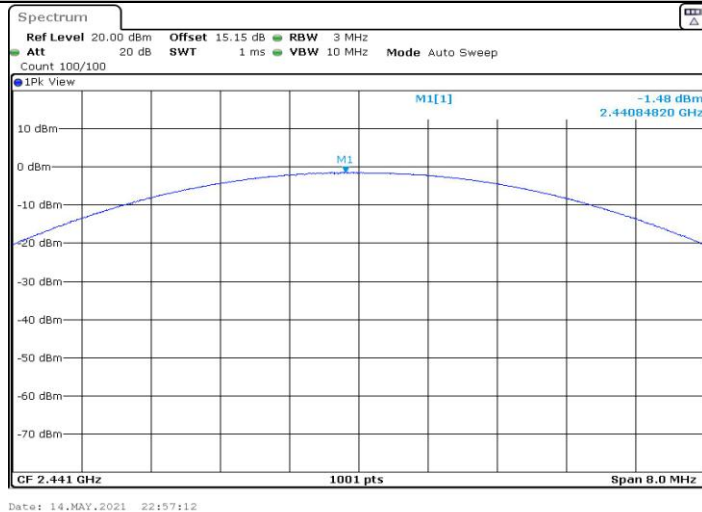
## DH1\_Ant1\_2480



## 2DH1\_Ant1\_2402



## 2DH1\_Ant1\_2441

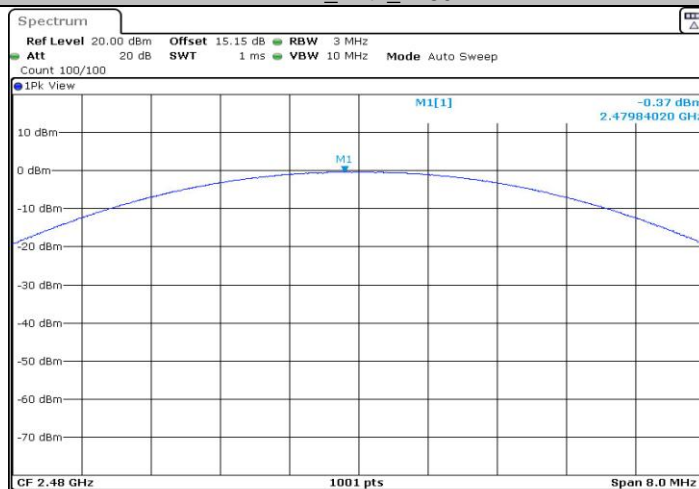


## 2DH1\_Ant1\_2449



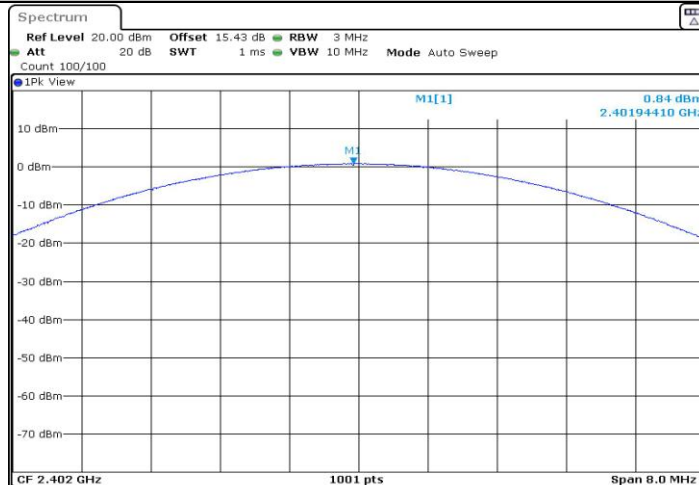
Date: 28.MAY.2021 08:28:52

## 2DH1\_Ant1\_2480



Date: 14.MAY.2021 22:57:37

## 3DH1\_Ant1\_2402



Date: 14.MAY.2021 22:55:09

## 3DH1\_Ant1\_2441



Date: 14.MAY.2021 22:55:32

## 3DH1\_Ant1\_2449



Date: 28.MAY.2021 08:28:20

## 3DH1\_Ant1\_2480

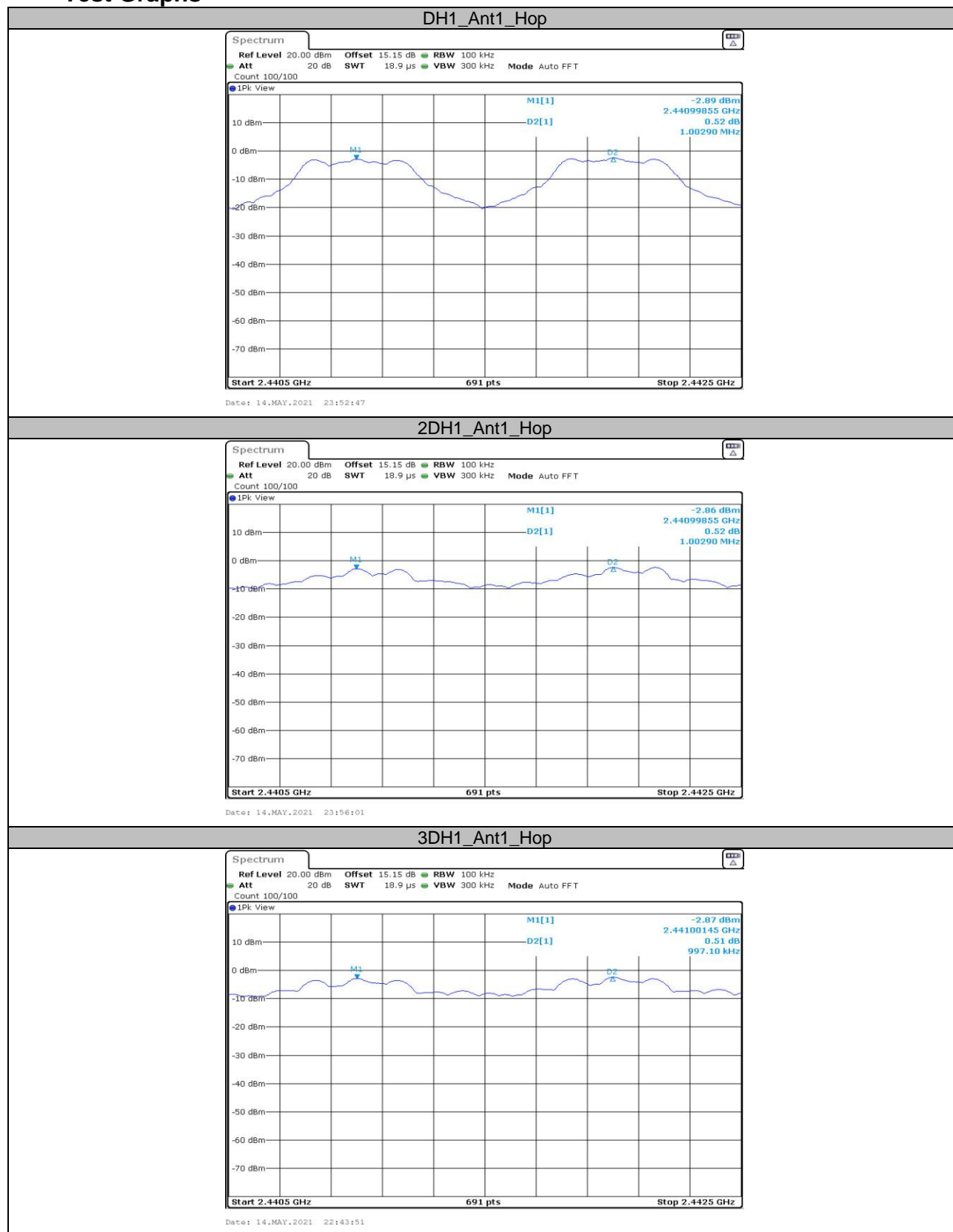


Date: 14.MAY.2021 22:56:07

**AppendixD: Carrier frequency separation  
Test Result**

TestMode	Antenna	Channel	Result[MHz]	Limit[MHz]	Verdict
DH1	Ant1	Hop	1.003	$\geq 0.584$	PASS
2DH1	Ant1	Hop	1.003	$\geq 0.814$	PASS
3DH1	Ant1	Hop	0.997	$\geq 0.808$	PASS

## Test Graphs



**AppendixE: Time of occupancy  
Test Result**

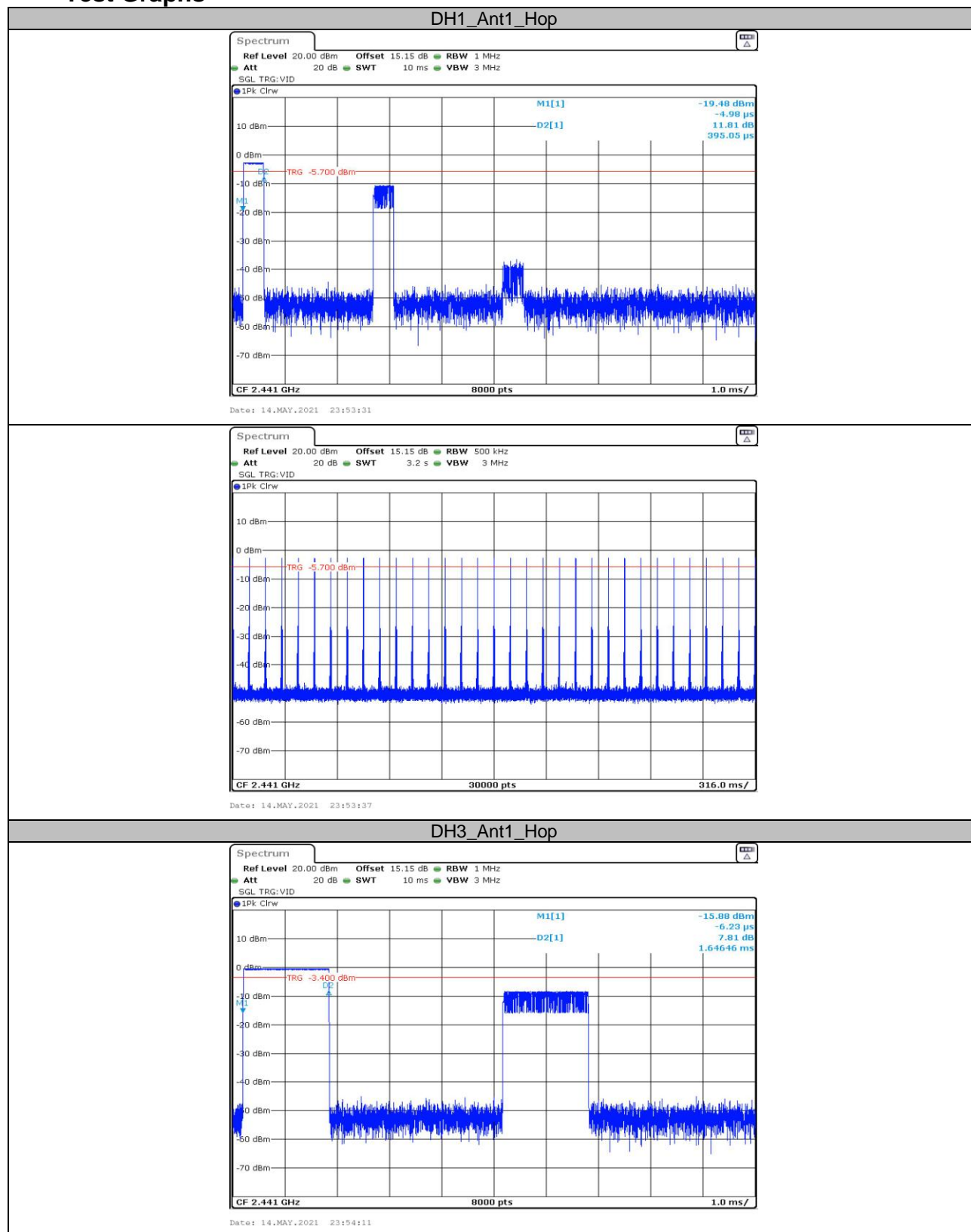
TestMode	Antenna	Channel	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH1	Ant1	Hop	0.40	320	0.126	$\leq 0.4$	PASS
DH3	Ant1	Hop	1.65	160	0.263	$\leq 0.4$	PASS
DH5	Ant1	Hop	2.89	110	0.318	$\leq 0.4$	PASS
2DH1	Ant1	Hop	0.41	320	0.131	$\leq 0.4$	PASS
2DH3	Ant1	Hop	1.66	160	0.265	$\leq 0.4$	PASS
2DH5	Ant1	Hop	2.90	110	0.318	$\leq 0.4$	PASS
3DH1	Ant1	Hop	0.41	320	0.131	$\leq 0.4$	PASS
3DH3	Ant1	Hop	1.65	160	0.264	$\leq 0.4$	PASS
3DH5	Ant1	Hop	2.90	110	0.318	$\leq 0.4$	PASS

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

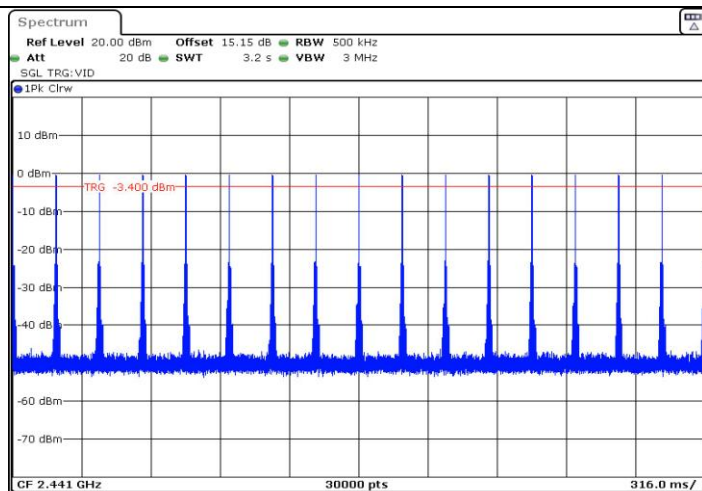
Note 2: Totalhops=Hopping Number in  $3.16s \times 10$

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

## Test Graphs

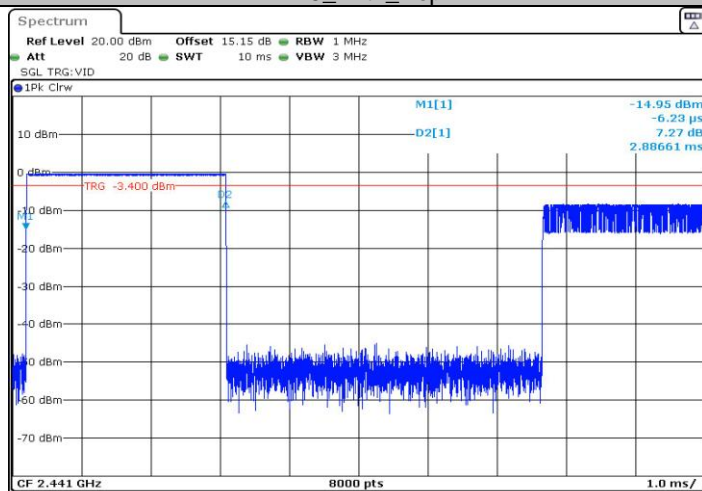




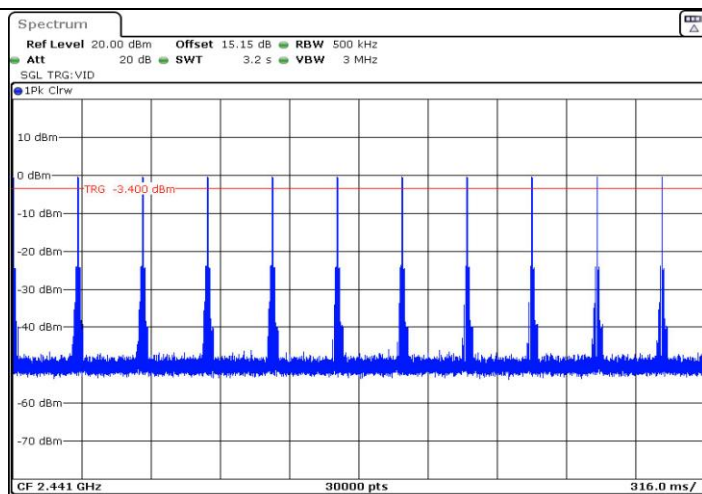


Date: 14.MAY.2021 23:54:17

## DH5\_Ant1\_Hop

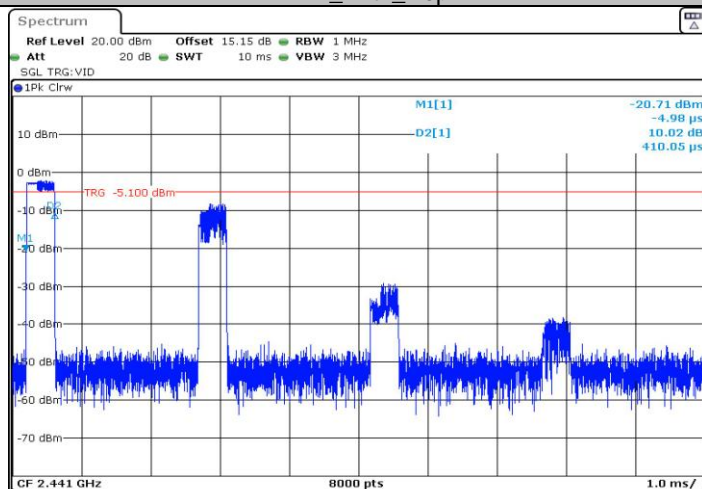


Date: 14.MAY.2021 22:36:06



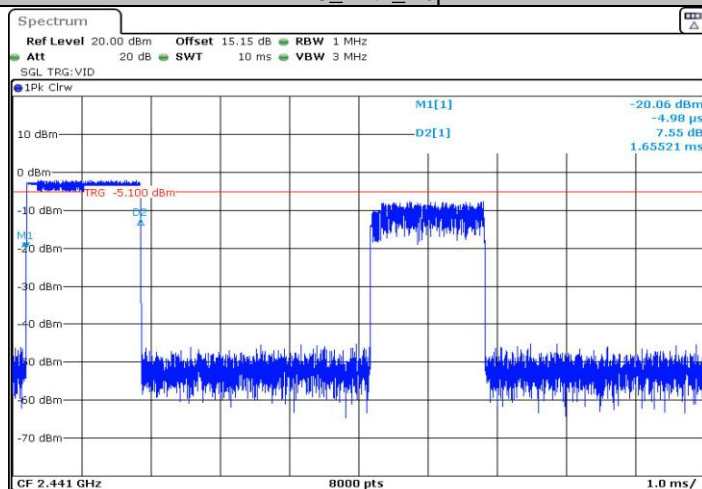
Date: 14.MAY.2021 22:36:12

## 2DH1\_Ant1\_Hop

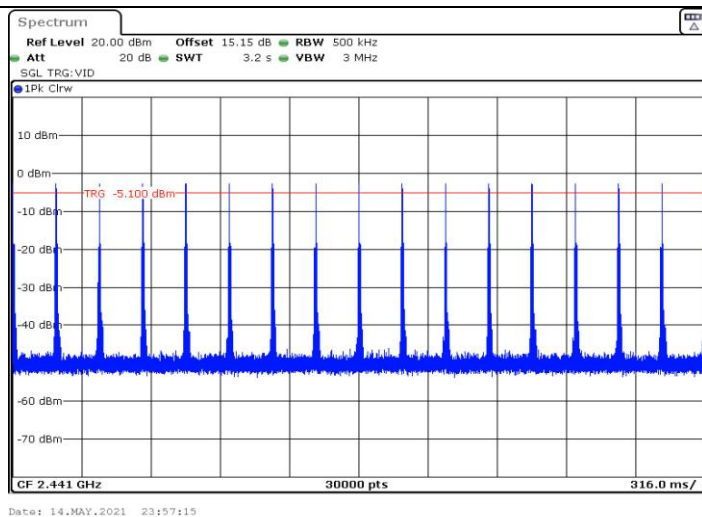


Date: 14.MAY.2021 23:56:38

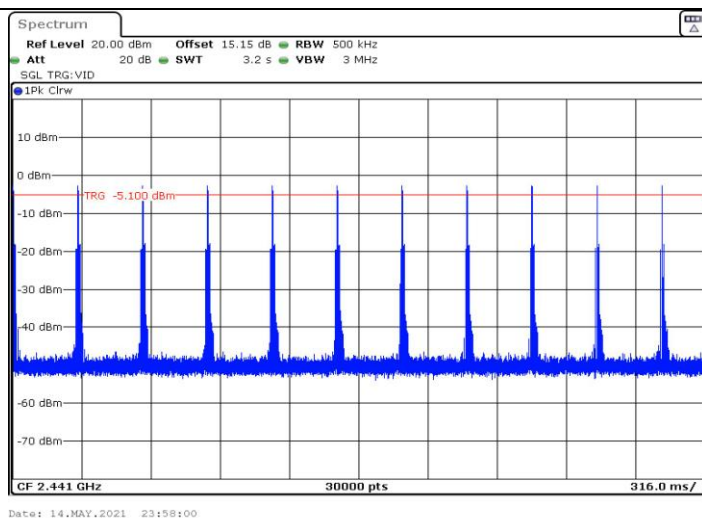
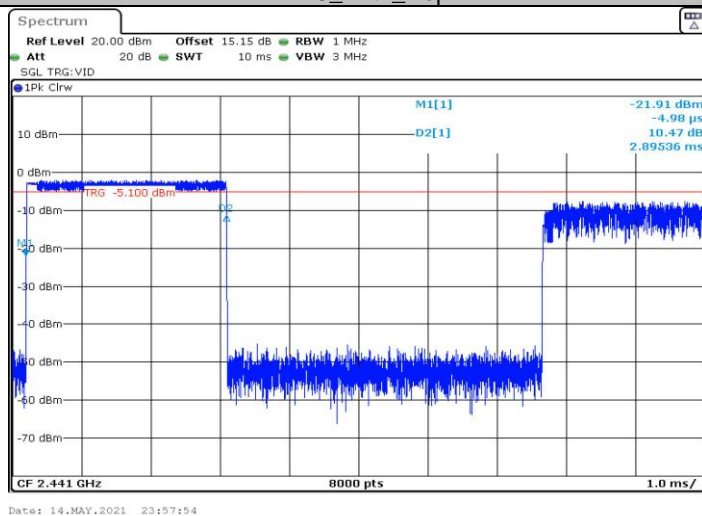
## 2DH3\_Ant1\_Hop



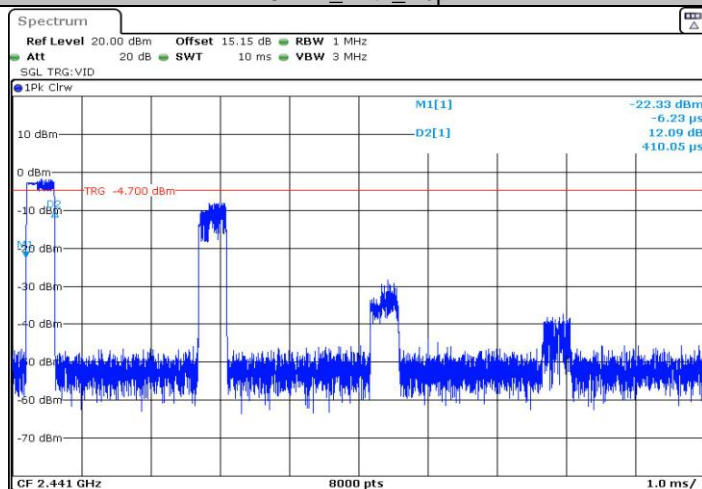
Date: 14.MAY.2021 23:57:09



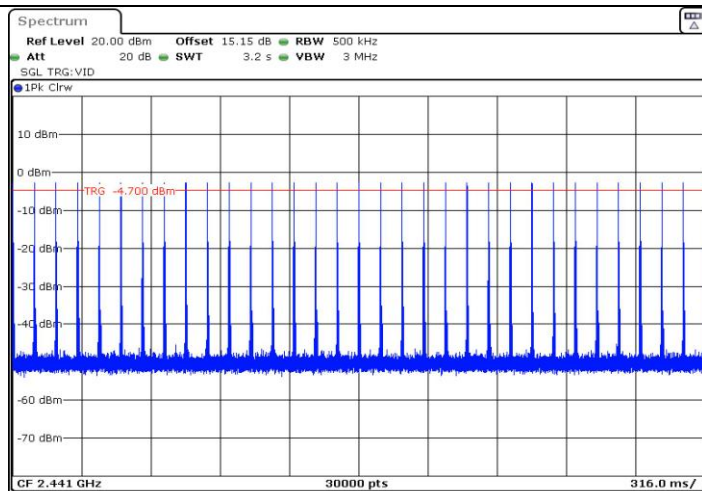
## 2DH5\_Ant1\_Hop



## 3DH1\_Ant1\_Hop

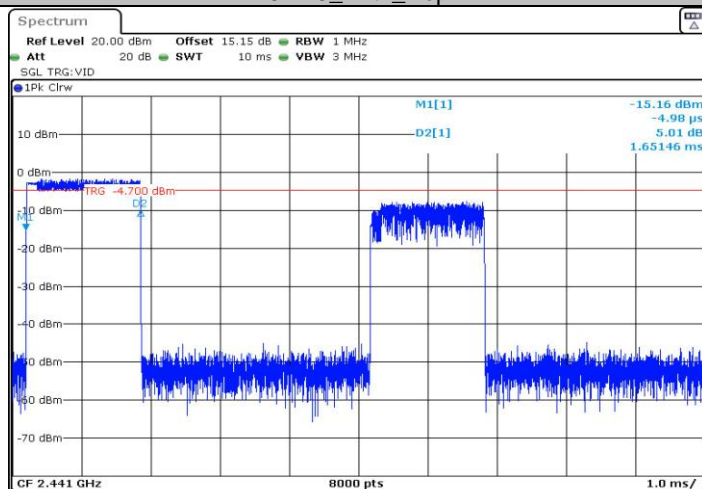


Date: 14.MAY.2021 22:45:10

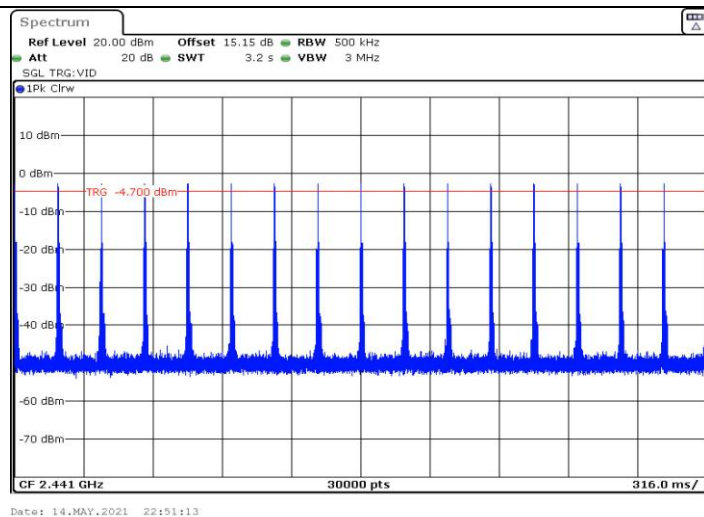


Date: 14.MAY.2021 22:45:16

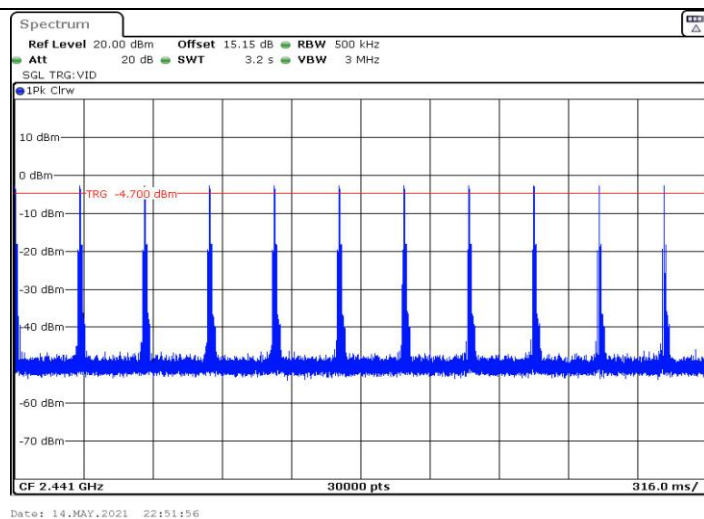
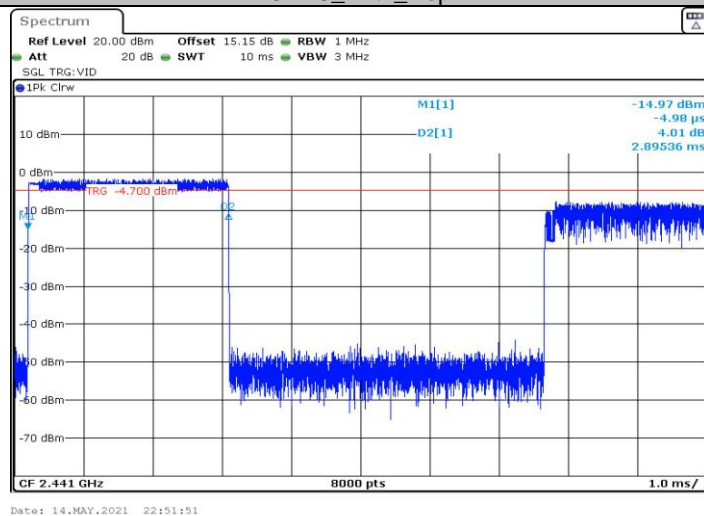
## 3DH3\_Ant1\_Hop



Date: 14.MAY.2021 22:51:07



## 3DH5\_Ant1\_Hop

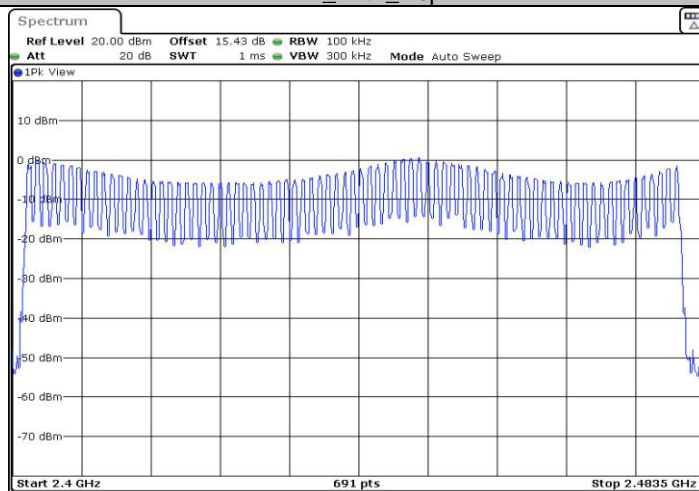


**AppendixF: Number of hopping channels  
Test Result**

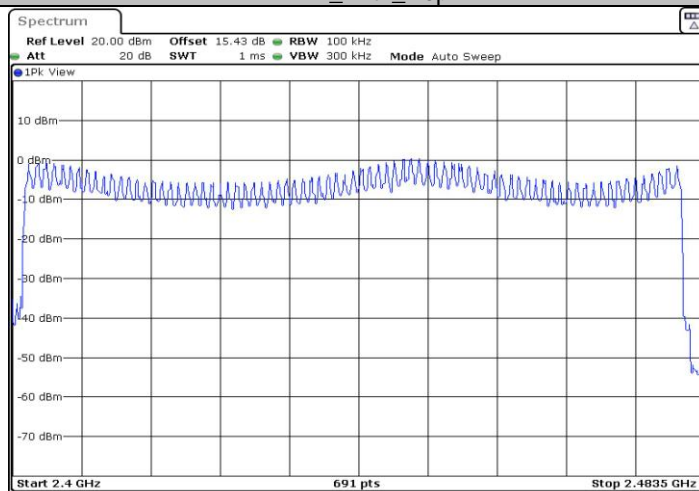
TestMode	Antenna	Channel	Result[Num]	Limit[Num]	Verdict
DH1	Ant1	Hop	79	>=15	PASS
2DH1	Ant1	Hop	79	>=15	PASS
3DH1	Ant1	Hop	79	>=15	PASS

## Test Graphs

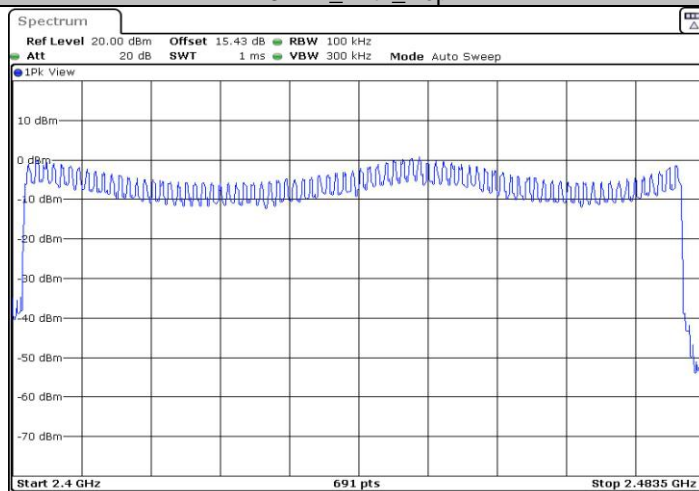
DH1\_Ant1\_Hop



2DH1\_Ant1\_Hop



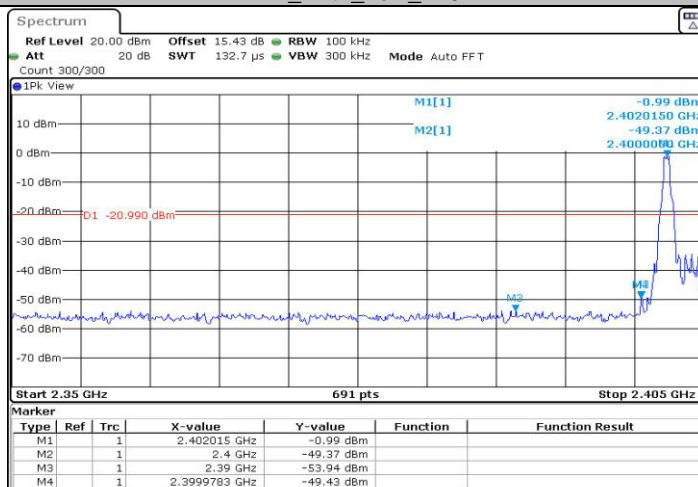
3DH1\_Ant1\_Hop



## Appendix G: Band edge measurements

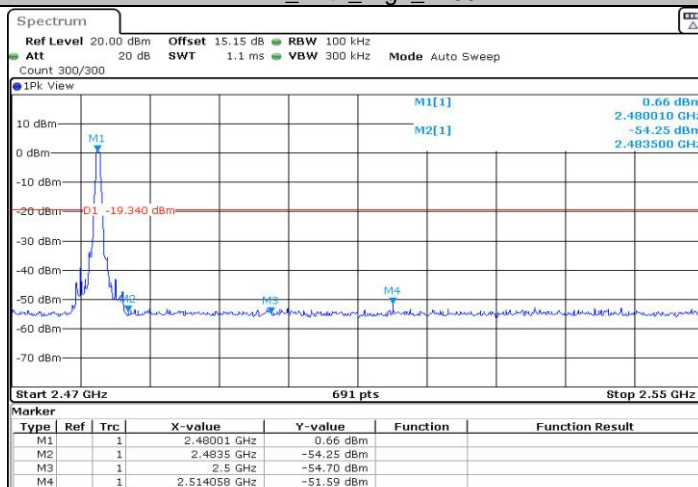
### Test Graphs

DH1\_Ant1\_Low\_2402



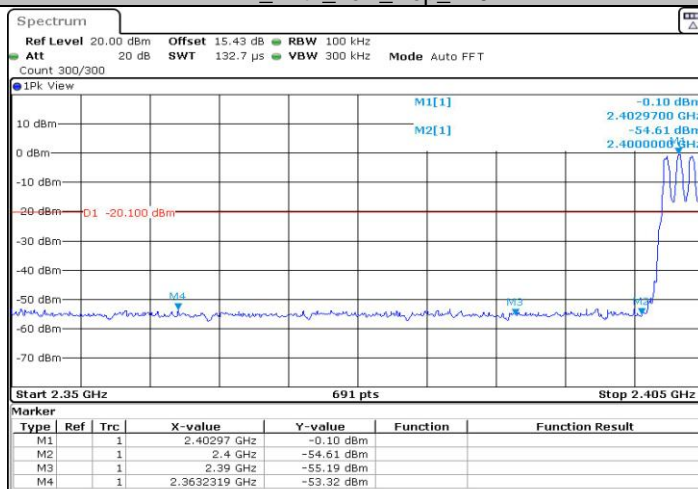
Date: 14.MAY.2021 23:16:22

DH1\_Ant1\_High\_2480



Date: 14.MAY.2021 23:18:01

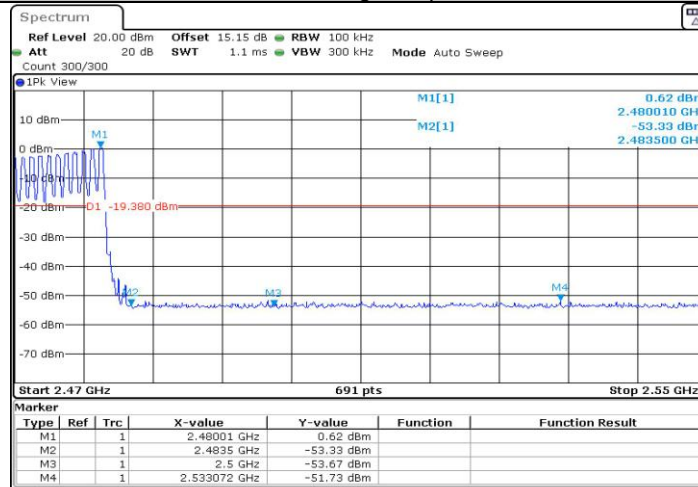
DH1\_Ant1\_Low\_Hop\_2402



Date: 14.MAY.2021 22:15:28

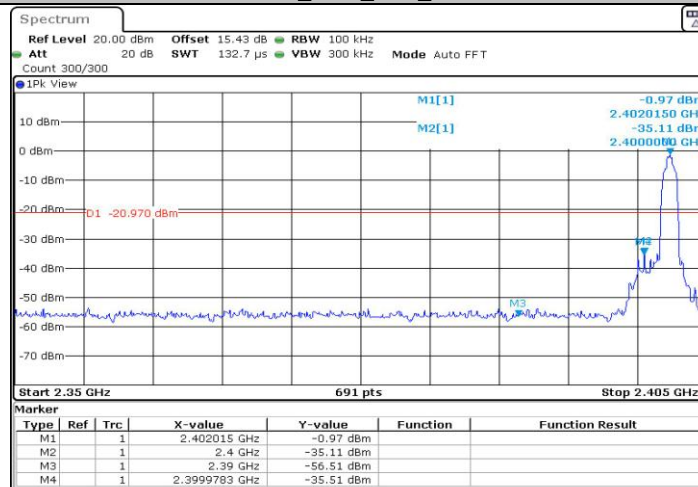


## DH1\_Ant1\_High\_Hop\_2480



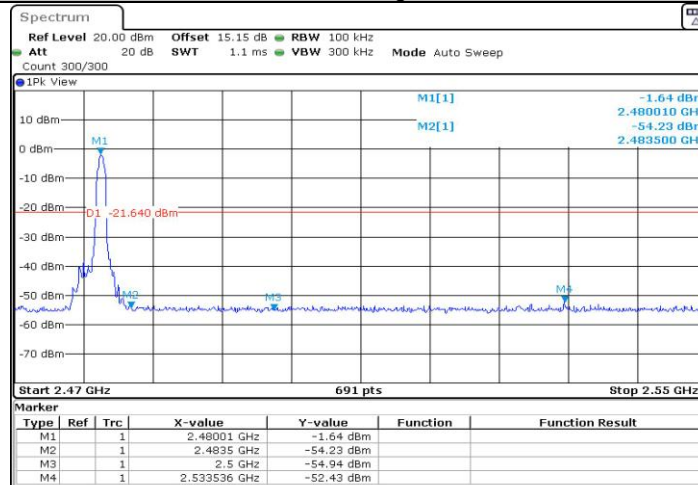
Date: 14.MAY.2021 22:38:33

## 2DH1\_Ant1\_Low\_2402



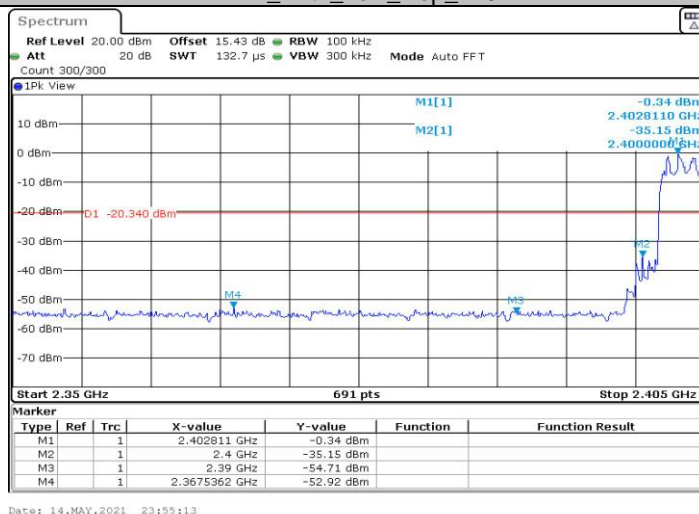
Date: 14.MAY.2021 23:34:41

## 2DH1\_Ant1\_High\_2480

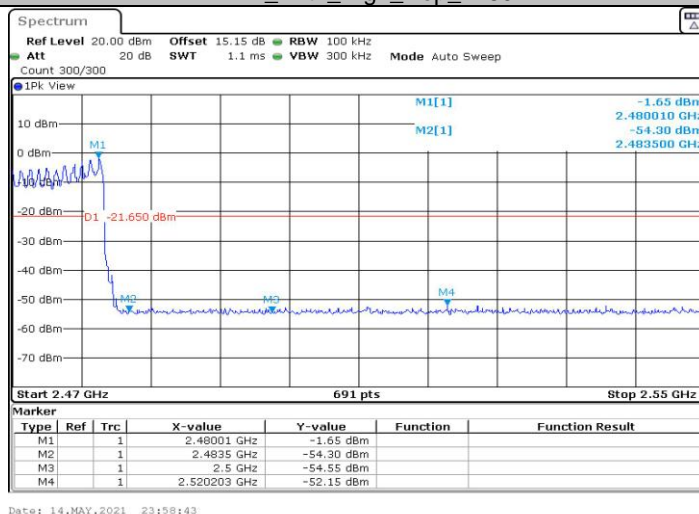


Date: 14.MAY.2021 23:24:52

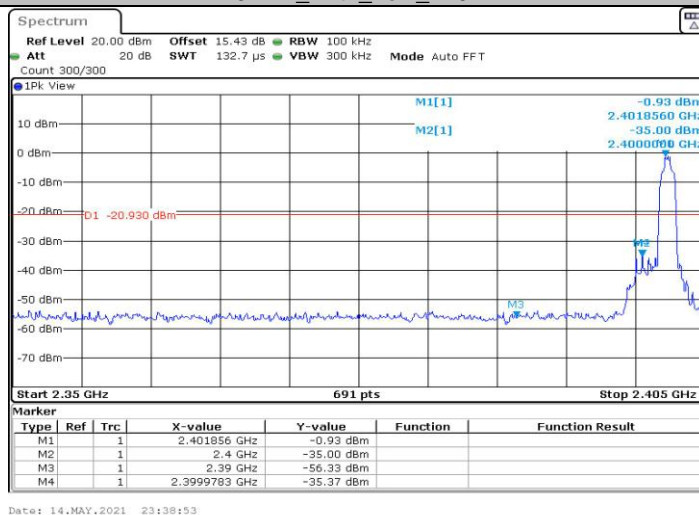
## 2DH1\_Ant1\_Low\_Hop\_2402



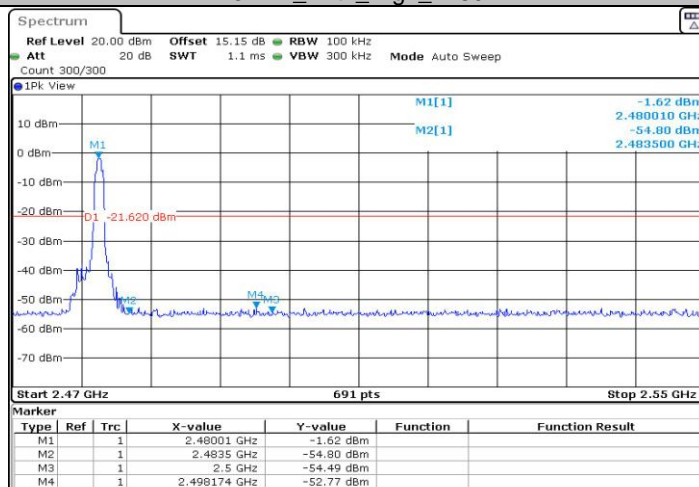
## 2DH1\_Ant1\_High\_Hop\_2480



## 3DH1\_Ant1\_Low\_2402

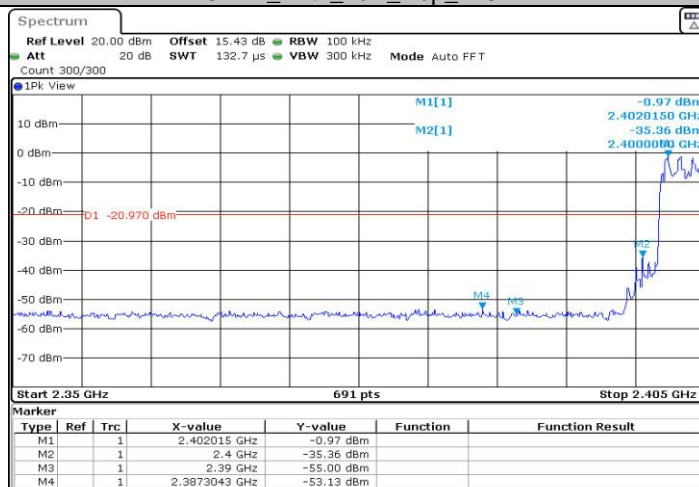


## 3DH1\_Ant1\_High\_2480



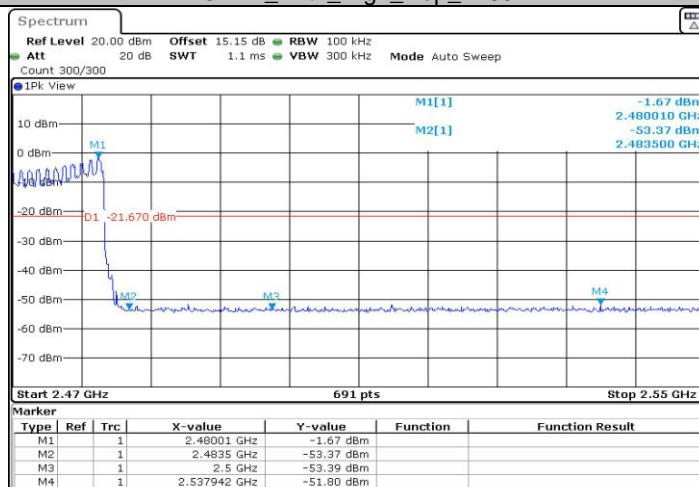
Date: 14.MAY.2021 23:46:36

## 3DH1\_Ant1\_Low\_Hop\_2402



Date: 14.MAY.2021 22:41:01

## 3DH1\_Ant1\_High\_Hop\_2480



Date: 14.MAY.2021 22:50:14

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