

## FCC PART 15.247 TEST REPORT

For

### Winner Wave Limited

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<b>Report Type:</b> Original Report	<b>Product Type:</b> Wireless Presentation System
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## GENERAL INFORMATION

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

Product	Wireless Presentation System
Tested Model	TY-WPR1
Frequency Range	Bluetooth: 2402~2480MHz
Peak Conducted Output Power	Bluetooth:6.07dBm
Modulation Technique	Bluetooth: GFSK, $\pi/4$ -DQPSK, 8DPSK
Antenna Specification	Internal antenna: 3.05dBi
Voltage Range	DC 5.0V from adapter
Date of Test	2020-07-31 to 2020-08-29
Sample serial number	RSZ200717003-RF-S1 ( Assigned by BACL, Shenzhen)
Received date	2020-07-17
Sample/EUT Status	Good condition
Adapter information	Model: ICP12-050-2000B Input: AC 100-240V, 50/60Hz, 0.3A Output: DC 5.0V, 2.0A, 10.0W

### 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.

**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 °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 Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, 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

“Bluetooth MP Tool” exercise software was made to the EUT tested, and the power level is 28.

### Special Accessories

No special accessory.

### Equipment Modifications

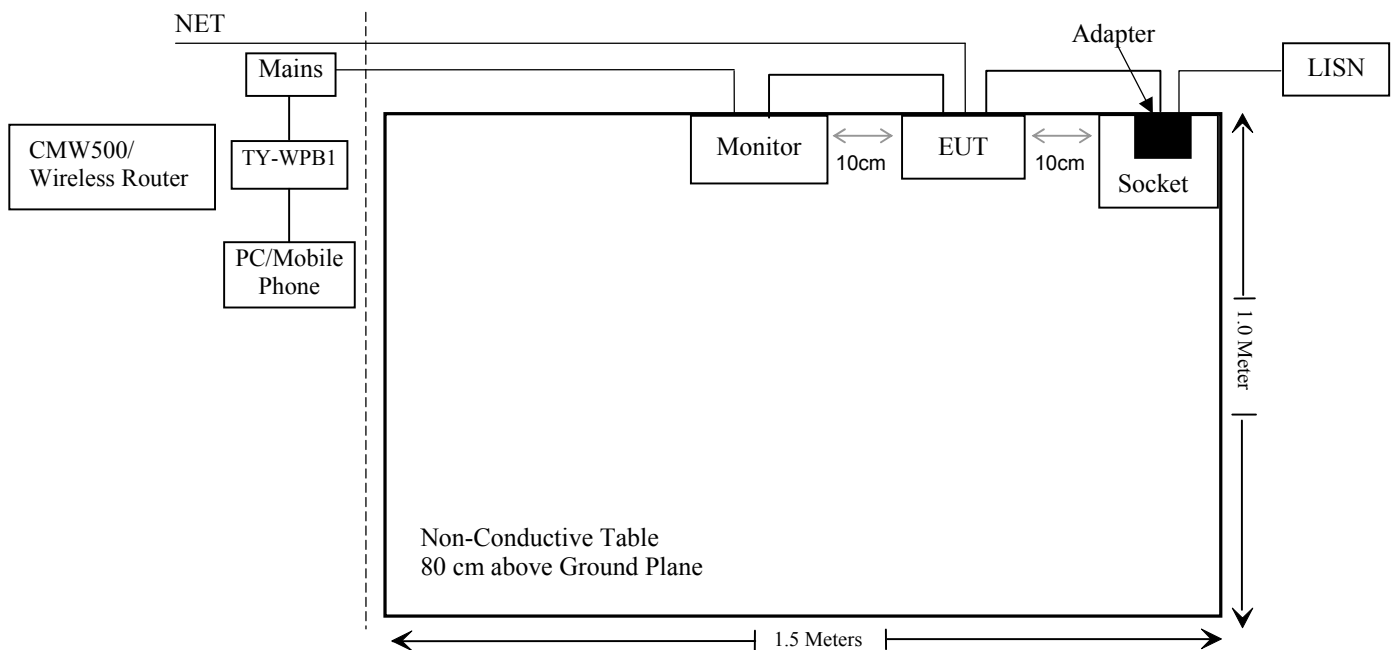
No modification was made to the EUT tested.

### Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
BULL	Socket	GN-212	A37209315081183
DELL	Monitor	ST2420Lb	CN-0X0K27-74261-2AF-090U
SAMSUNG	Monitor	22505	22505
DELL	PC	Latitude E5430	JG3NLV1
Apple	Mobile Phone	ML6N2CH/A	ML6N2CH/A
Panasonic Corporation	Wireless Presentation System	TY-WPB1	TY-WPB1
SAGEM	Wireless Router	SAGEM F@ST <sup>TM</sup> 2604 White	2604
Rohde & Schwarz	Wideband Radio Communication Tester	CMW500	1201.002K50-146520-wh

**External I/O Cable**

Cable Description	Length (m)	From Port	To
Unshielded Un-detachable AC Cable	1.0	Socket	LISN
Unshielded Detachable DC Cable	1.0	Adapter	EUT
Unshielded Detachable AC Cable	1.0	Monitor	Mains
Unshielded Detachable HDMI Cable	1.0	Monitor	EUT
Unshielded detachable RJ45 cable	10.0	EUT	NET

**Block Diagram of Test Setup**

**SUMMARY OF TEST RESULTS**

FCC Rules	Description of Test	Result
§15.247 (i), §2.1091	Maximum Permissible Exposure(MPE)	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	2020/7/9	2021/7/8
Rohde & Schwarz	LISN	ENV216	101613	2020/1/22	2021/1/21
Rohde & Schwarz	Transient Limiter	ESH3Z2	DE25985	2019/11/29	2020/11/28
Unknown	CE Cable	CE Cable	UF A210B-1-0720-504504	2019/11/29	2020/11/28
Rohde & Schwarz	CE Test software	EMC 32	V8.53.0	NCR	NCR
<b>Radiated Emission Test (below 1G)</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	A040904-1	2017/12/22	2020/12/21
Unknown	Cable 2	RF Cable 2	F-03-EM197	2019/11/29	2020/11/28
Unknown	Cable	Chamber Cable 1	F-03-EM236	2019/11/29	2020/11/28
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR
<b>Radiated Emission Test (above 1G)</b>					
Rohde & Schwarz	Spectrum Analyzer	FSV40-N	102259	2020/7/22	2021/7/21
COM-POWER	Pre-amplifier	PA-122	181919	2019/11/29	2020/11/28
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2019/11/29	2020/11/28
Sunol Sciences	Horn Antenna	DRH-118	A052604	2017/12/22	2020/12/21
Insulted Wire Inc.	RF Cable	SPS-2503-3150	02222010	2019/11/29	2020/11/28
Unknown	RF Cable	W1101-EQ1 OUT	F-19-EM005	2019/11/29	2020/11/28
SNSD	Band Reject filter	BSF2402-2480MN-0898-001	2.4G filter	2020/04/20	2021/04/20
Ducommun Technologies	Horn antenna	ARH-4223-02	1007726-02 1304	2017/12/06	2020/12/05
<b>RF Conducted Test</b>					
Tonscend Corporation	RF control Unit	JS0806-2	19D8060154	2020/7/10	2021/7/9
Rohde & Schwarz	Signal and Spectrum Analyzer	FSV40	101473	2020/7/22	2021/7/21
Unknown	RF Cable	Unknown	2301 276	2019/11/29	2020/11/28

**\* 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) & §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 <sup>2</sup> )	Averaging Time (Minutes)
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f <sup>2</sup> )	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/cm<sup>2</sup>)

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)

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

Frequency (MHz)	Antenna Gain		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )
	(dBi)	(numeric)	(dBm)	(mW)			
2402-2480	3.05	2.02	6.5	4.47	20	0.002	1
5150-5250	4.42	2.77	12.0	15.85	20	0.009	1
5725-5850	4.42	2.77	12.5	17.78	20	0.010	1

Note:

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

2) Bluetooth and 5GHz Wi-Fi can transmit simultaneously for this device.

3) Simultaneous transmitting consideration:

The ratio= $MPE_{DSS}/limit + MPE_{NII}/limit = 0.002 + 0.010 = 0.012 < 1.0$ , so simultaneous exposure is not required.

**Result: Pass**

**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 one internal antenna arrangement, which was permanently attached and the antenna gain is 3.05 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

**Result: Pass**

## 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:

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

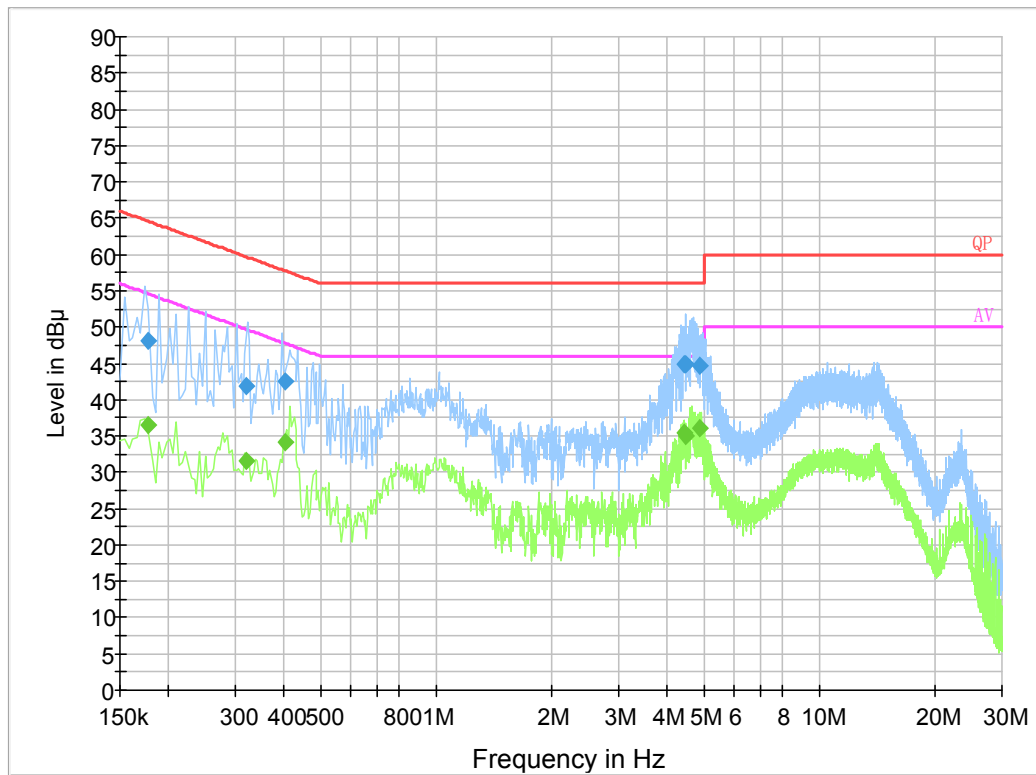
## Test Data

### Environmental Conditions

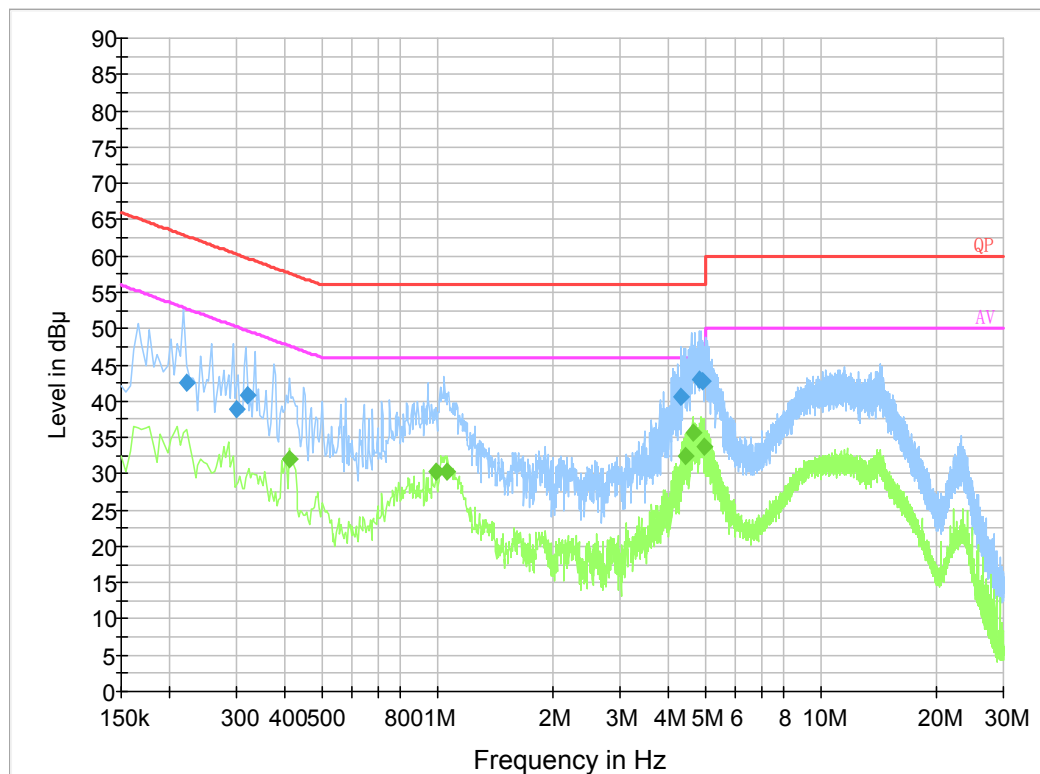
<b>Temperature:</b>	25 °C
<b>Relative Humidity:</b>	65 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Haiguo Li on 2020-08-03.*

*EUT operation mode: Transmitting (the worst case is 8DPSK mode, High channel)*

**AC 120V/60 Hz, Line**

Frequency (MHz)	Corrected Amplitude (dBμV)	Correction Factor (dB)	Limit (dBμV)	Margin (dB)	Detector (PK/Ave./QP)
0.177500	48.1	19.9	64.6	16.5	QP
0.321170	41.9	19.8	59.7	17.8	QP
0.403970	42.6	19.9	57.8	15.2	QP
4.424450	44.9	19.9	56.0	11.1	QP
4.466890	44.8	19.9	56.0	11.2	QP
4.899390	44.7	19.9	56.0	11.3	QP
0.177500	36.6	19.9	54.6	18.0	Ave.
0.321170	31.6	19.8	49.7	18.1	Ave.
0.403970	34.1	19.9	47.8	13.7	Ave.
4.424450	35.5	19.9	46.0	10.5	Ave.
4.466890	35.0	19.9	46.0	11.0	Ave.
4.899390	36.2	19.9	46.0	9.8	Ave.

**AC 120V/60 Hz, Neutral**

Frequency (MHz)	Corrected Amplitude (dBμV)	Correction Factor (dB)	Limit (dBμV)	Margin (dB)	Detector (PK/Ave./QP)
0.221500	42.5	19.8	62.8	20.3	QP
0.298500	38.8	19.7	60.3	21.5	QP
0.321230	40.8	19.8	59.7	18.9	QP
4.340990	40.6	19.9	56.0	15.4	QP
4.829670	43.0	19.9	56.0	13.0	QP
4.931210	42.9	19.9	56.0	13.1	QP
0.414000	32.0	19.8	47.6	15.6	Ave.
0.998000	30.4	19.8	46.0	15.6	Ave.
1.066000	30.3	19.8	46.0	15.7	Ave.
4.446000	32.4	19.9	46.0	13.6	Ave.
4.670000	35.6	19.9	46.0	10.4	Ave.
4.974000	33.8	19.9	46.0	12.2	Ave.

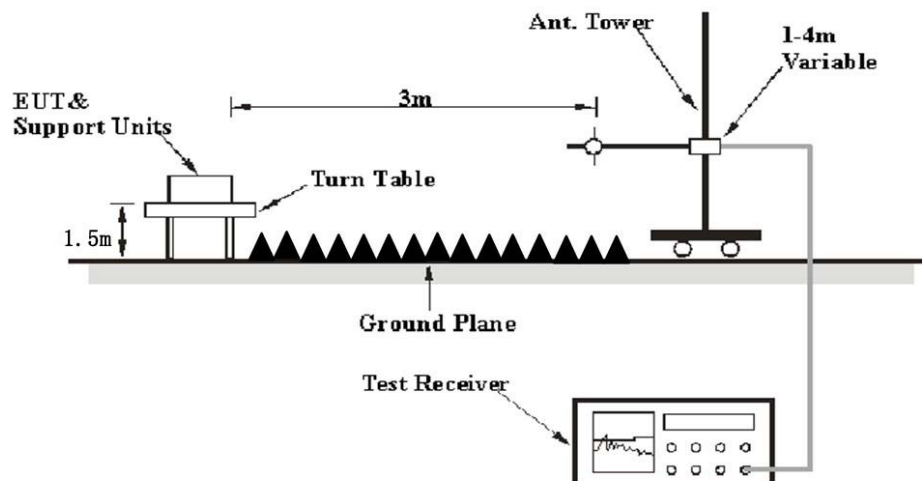
**Note:**

- 1) Correction Factor = LISN VDF (Voltage Division Factor) + Cable Loss + Transient Limiter Attenuation
- 2) Corrected Amplitude = Reading + Correction Factor
- 3) Margin = Limit – Corrected Amplitude



**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 system was investigated from 30 MHz to 25 GHz.

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

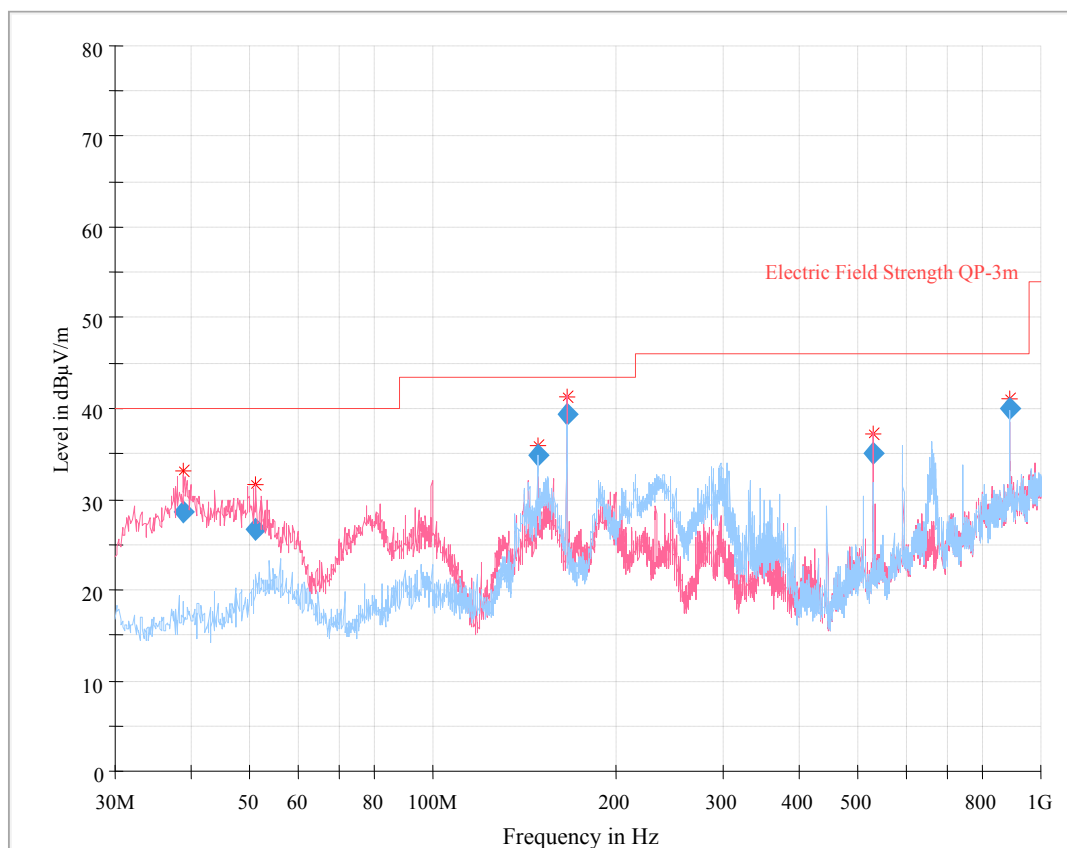
### Environmental Conditions

<b>Temperature:</b>	25~28 °C
<b>Relative Humidity:</b>	56 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Harris He on 2020-08-29 for below 1GHz and by Leven Gan on 2020-07-31 for above 1GHz.*

*EUT operation mode: Transmitting*

**30 MHz~1 GHz:** (the worst case is 8DPSK mode, High channel)



Frequency (MHz)	Corrected Amplitude (dBμV/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
38.900125	28.70	108.0	V	33.0	-13.1	40.00	11.30
50.926625	26.77	123.0	V	33.0	-19.7	40.00	13.23
148.511000	34.92	180.0	H	260.0	-14.2	43.50	8.58
166.279250	39.28	109.0	V	343.0	-14.7	43.50	4.22
530.400125	35.16	109.0	V	13.0	-4.5	46.00	10.84
890.989125	40.04	165.0	H	312.0	4.0	46.00	5.96

**1 GHz - 25 GHz:** (Scan with GFSK,  $\pi/4$ -DQPSK, 8DPSK mode, the worst case is in 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)									
2388.47	28.12	PK	184	2.1	H	31.87	59.99	74	14.01
2388.47	13.76	Ave.	184	2.1	H	31.87	45.63	54	8.37
2484.55	27.84	PK	271	1.8	H	32.13	59.97	74	14.03
2484.55	13.72	Ave.	271	1.8	H	32.13	45.85	54	8.15
4804.00	43.85	PK	242	1.3	H	6.28	50.13	74	23.87
4804.00	33.02	Ave.	242	1.3	H	6.28	39.30	54	14.70
Middle Channel (2441 MHz)									
4882.00	43.58	PK	34	2.5	H	6.76	50.34	74	23.66
4882.00	31.41	Ave.	34	2.5	H	6.76	38.17	54	15.83
High Channel (2480 MHz)									
2389.44	27.86	PK	184	1.9	H	31.87	59.73	74	14.27
2389.44	13.70	Ave.	184	1.9	H	31.87	45.57	54	8.43
2483.75	28.10	PK	177	2.3	H	32.13	60.23	74	13.77
2483.75	13.73	Ave.	177	2.3	H	32.13	45.86	54	8.14
4960.00	43.83	PK	31	2.0	H	6.80	50.63	74	23.37
4960.00	31.56	Ave.	31	2.0	H	6.80	38.36	54	15.64

**Note:**

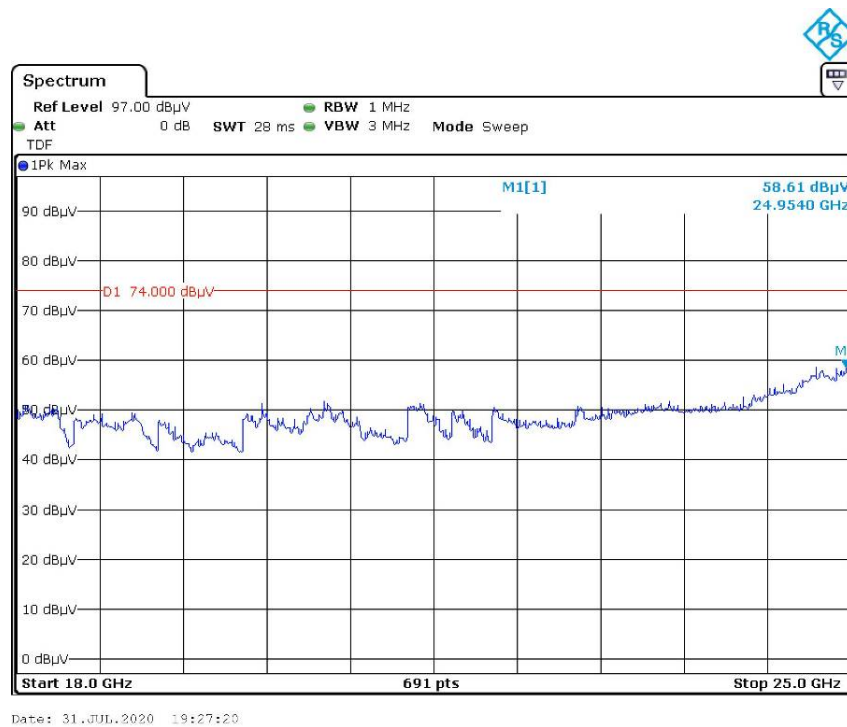
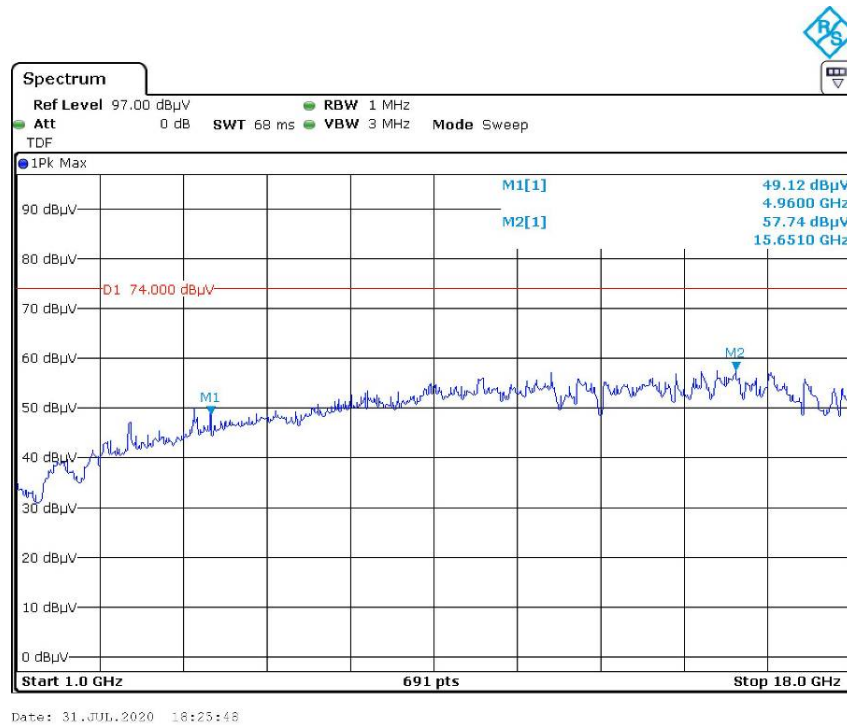
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Corrected Amplitude = Corrected Factor + Reading

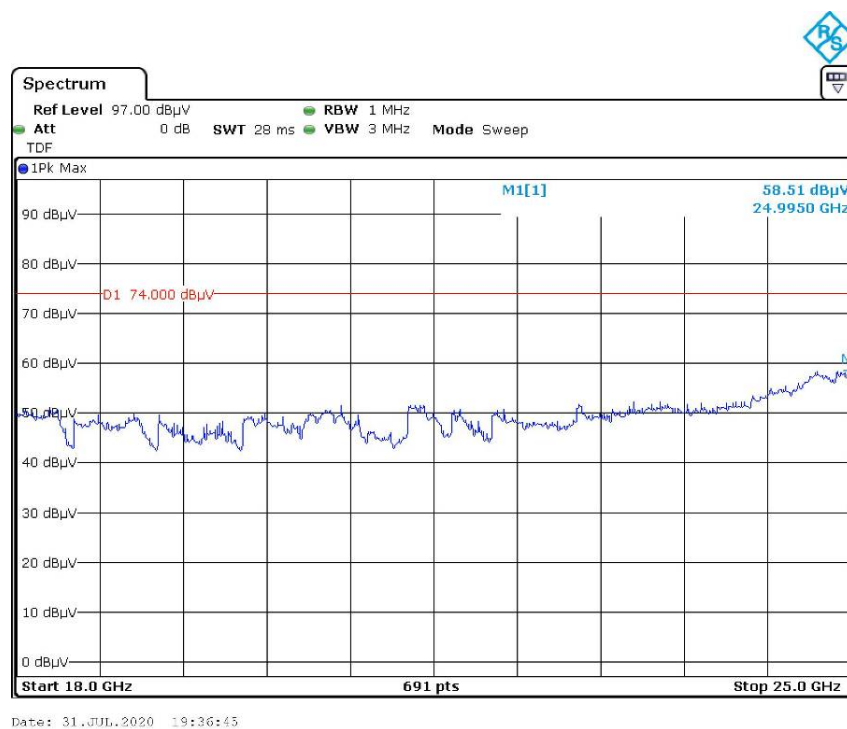
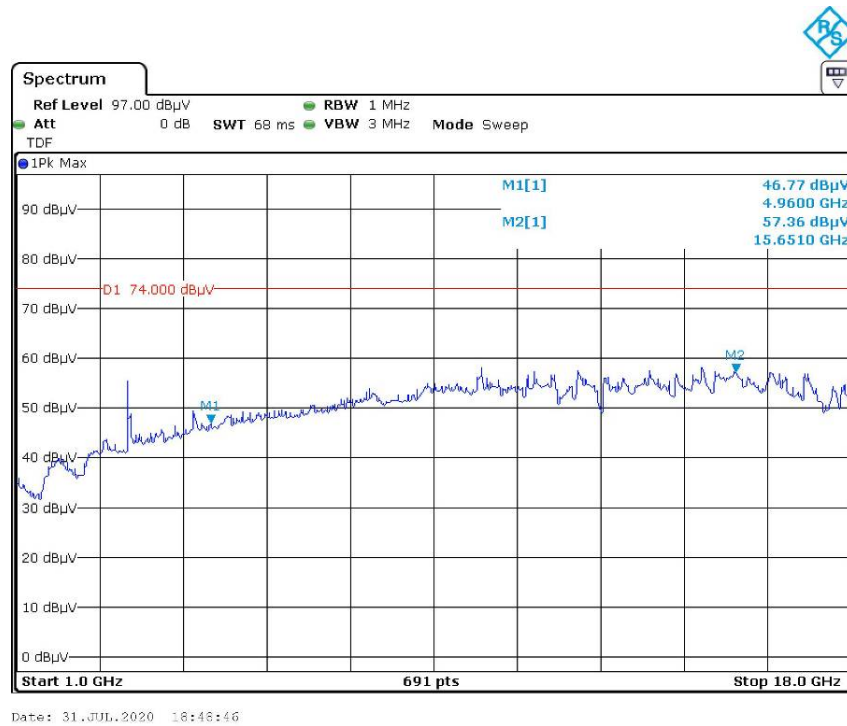
Margin = Limit - Corrected. Amplitude

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

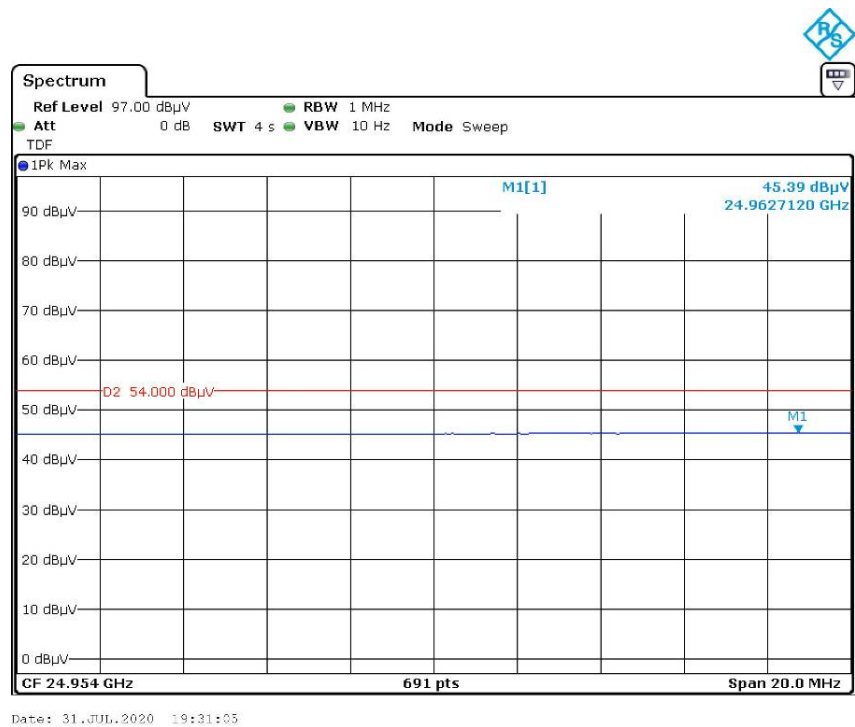
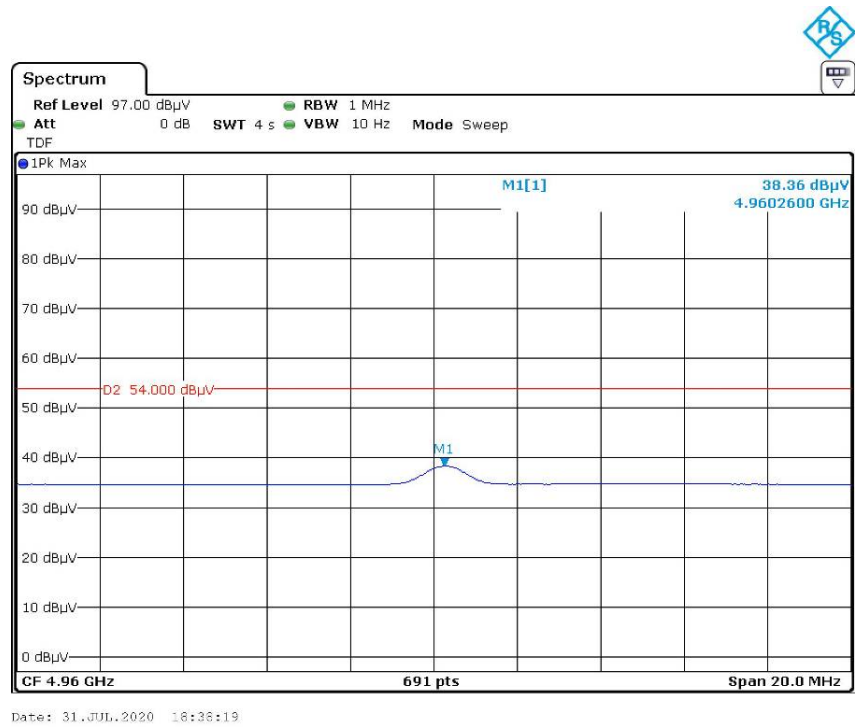
### Pre-scan with High channel Peak Horizontal



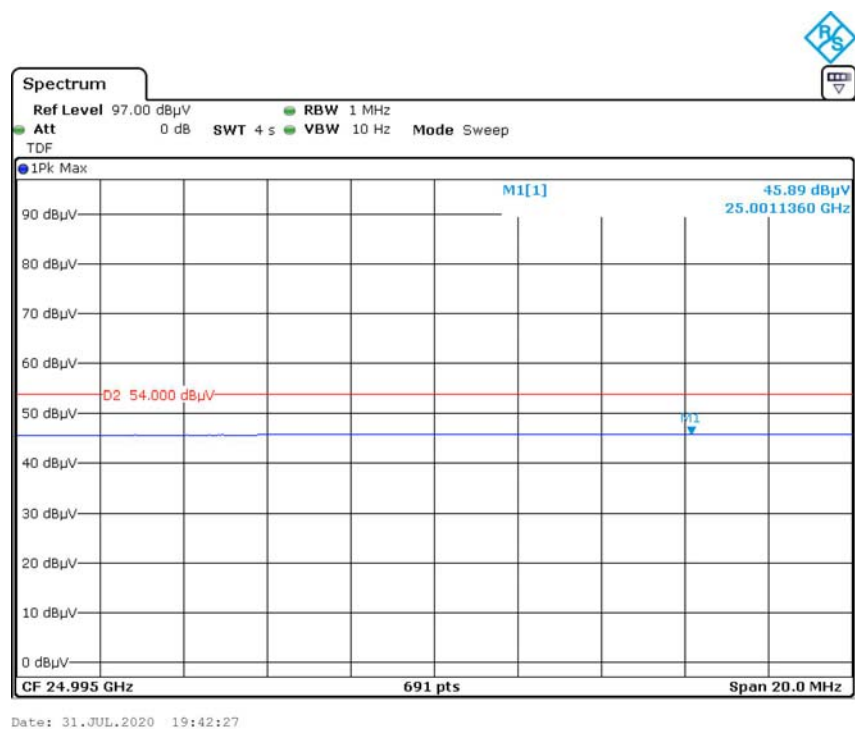
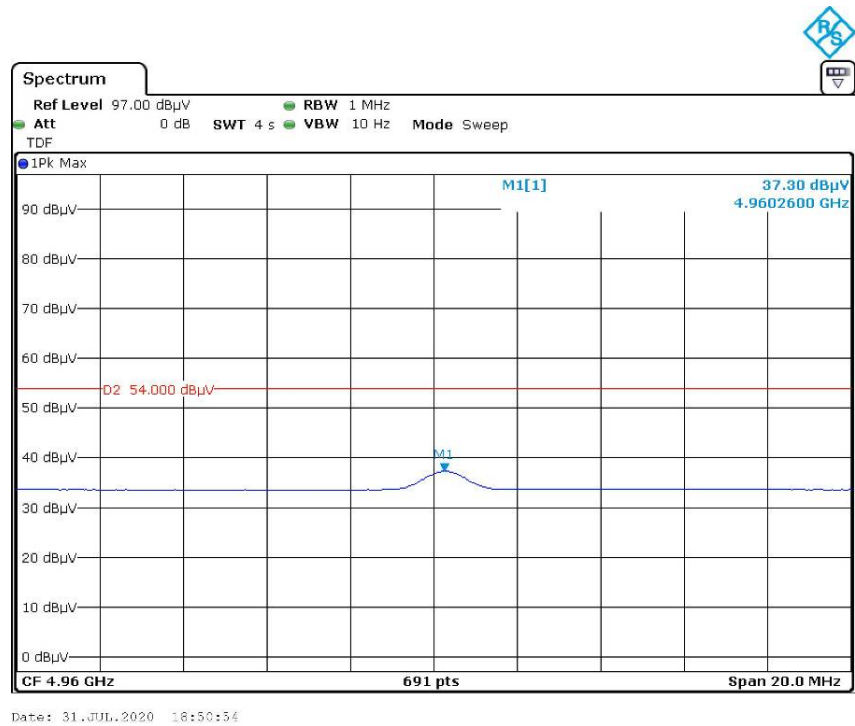
## Vertical



### Average 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**

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

*The testing was performed by James Fu on 2020-08-03.*

*EUT operation mode: Transmitting*

**Test Result: Pass**

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

*The testing was performed by James Fu on 2020-08-03.*

*EUT operation mode: Transmitting*

**Test Result: Pass**

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

*The testing was performed by James Fu on 2020-08-03.*

*EUT operation mode: Transmitting*

**Test Result: Pass**

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

*The testing was performed by James Fu on 2020-08-03.*

*EUT operation mode: Transmitting*

**Test Result: Pass**

*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:	25 °C
Relative Humidity:	65 %
ATM Pressure:	101.0 kPa

*The testing was performed by James Fu on 2020-08-03.*

*EUT operation mode: Transmitting*

#### Test Result: Pass

*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:	25 °C
Relative Humidity:	65 %
ATM Pressure:	101.0 kPa

*The testing was performed by James Fu on 2020-08-03.*

*EUT operation mode: Transmitting*

#### Test Result: Pass

*Please refer to the Appendix.*

## APPENDIX

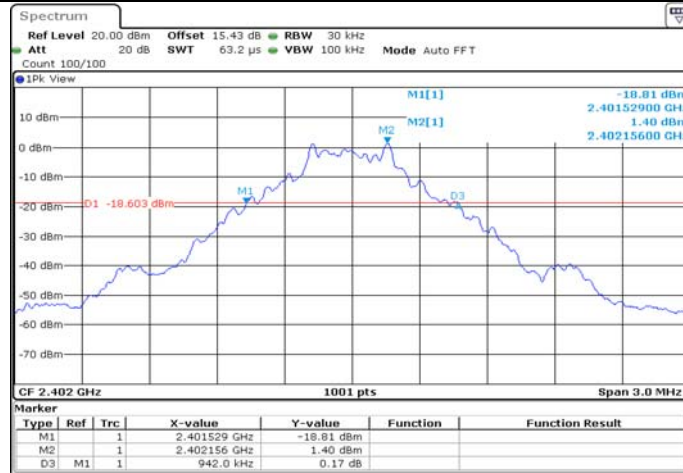
### Appendix A: 20dB Emission Bandwidth

#### Test Result

TestMode	Antenna	Channel	20db EBW[MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	0.942	---	PASS
		2441	0.942	---	PASS
		2480	0.945	---	PASS
2DH1	Ant1	2402	1.284	---	PASS
		2441	1.284	---	PASS
		2480	1.287	---	PASS
3DH1	Ant1	2402	1.224	---	PASS
		2441	1.224	---	PASS
		2480	1.227	---	PASS

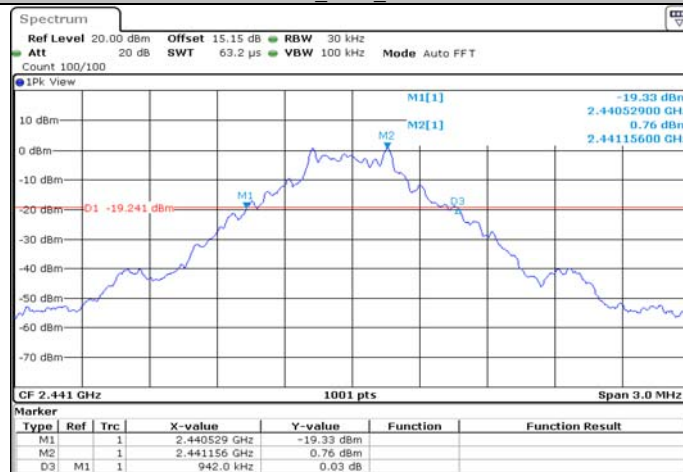
## Test Graphs

DH1\_Ant1\_2402



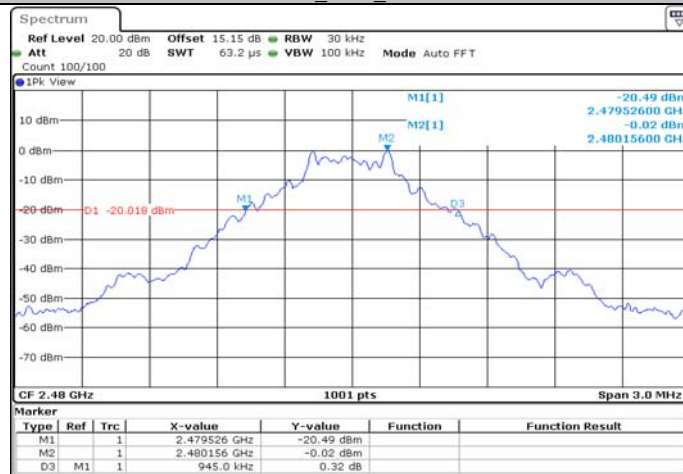
Date: 3.AUG.2020 12:26:45

DH1\_Ant1\_2441



Date: 3.AUG.2020 12:28:16

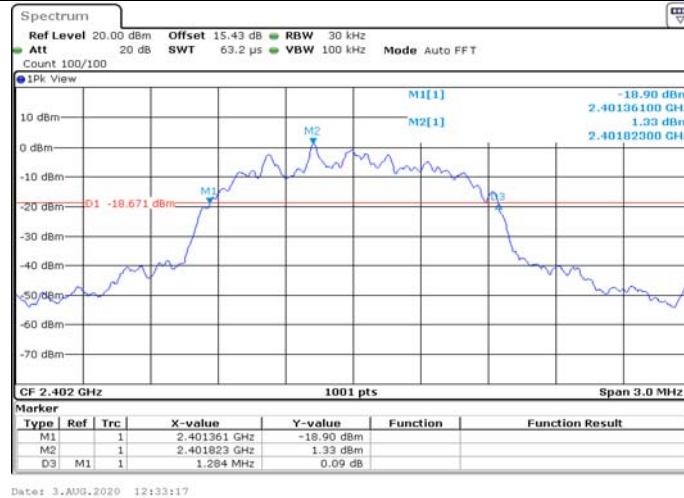
DH1\_Ant1\_2480



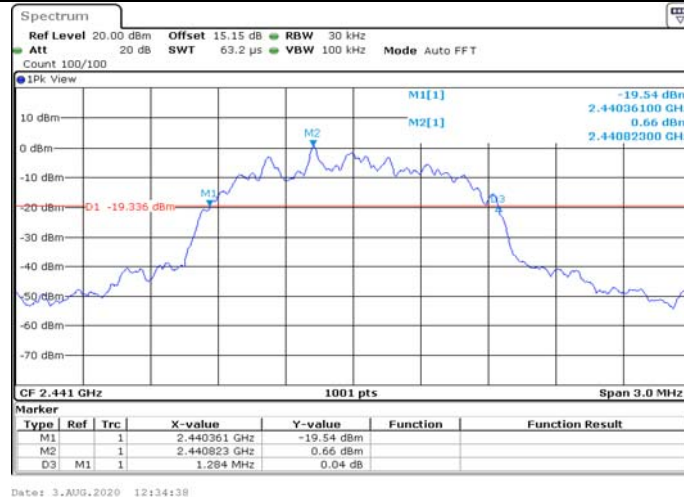
Date: 3.AUG.2020 12:29:39



2DH1\_Ant1\_2402



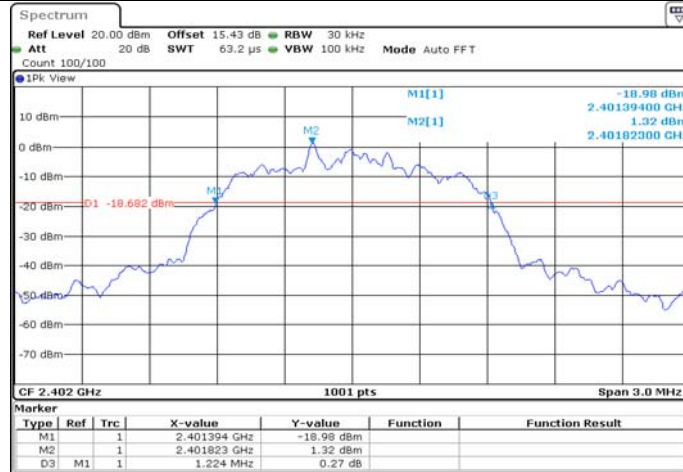
2DH1\_Ant1\_2441



2DH1\_Ant1\_2480

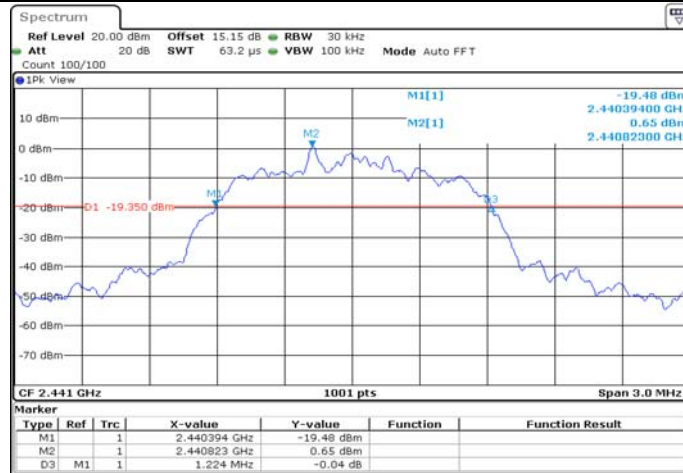


## 3DH1 Ant1 2402



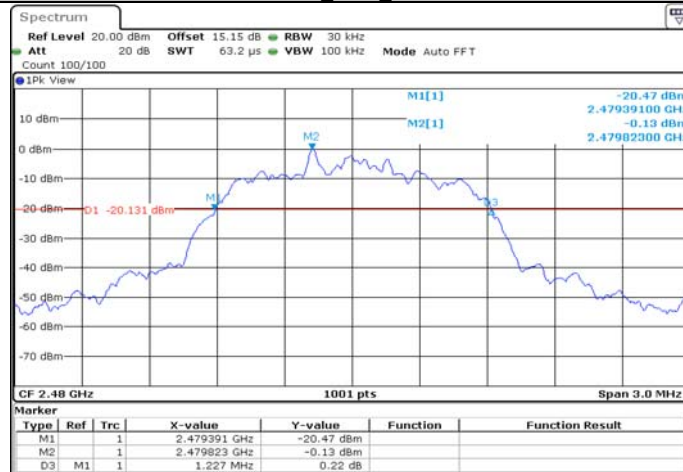
Date: 3.AUG.2020 12:37:27

## 3DH1 Ant1 2441



Date: 3.AUG.2020 12:41:12

## 3DH1 Ant1 2480



Date: 3.AUG.2020 12:42:24

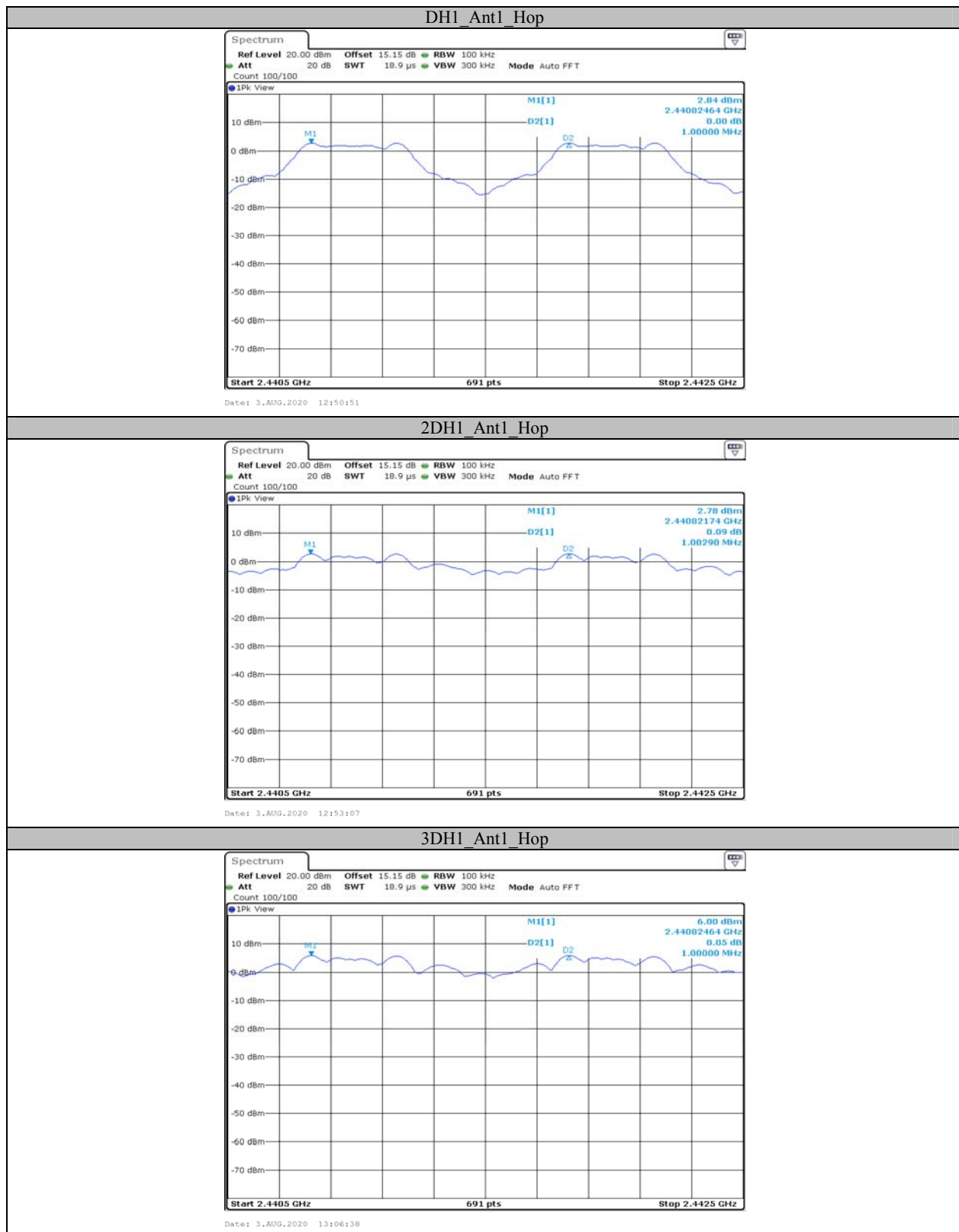
**Appendix B: Maximum conducted Peak output power****Test Result**

TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
DH1	Ant1	2402	3.27	<=20.97	PASS
		2441	2.86	<=20.97	PASS
		2480	2.25	<=20.97	PASS
2DH1	Ant1	2402	4.53	<=20.97	PASS
		2441	3.87	<=20.97	PASS
		2480	3.23	<=20.97	PASS
3DH1	Ant1	2402	6.07	<=20.97	PASS
		2441	6.04	<=20.97	PASS
		2480	5.48	<=20.97	PASS

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

TestMode	Antenna	Channel	Result[MHz]	Limit[MHz]	Verdict
DH1	Ant1	Hop	1	$\geq 0.628$	PASS
2DH1	Ant1	Hop	1.003	$\geq 0.856$	PASS
3DH1	Ant1	Hop	1	$\geq 0.816$	PASS

## Test Graphs



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

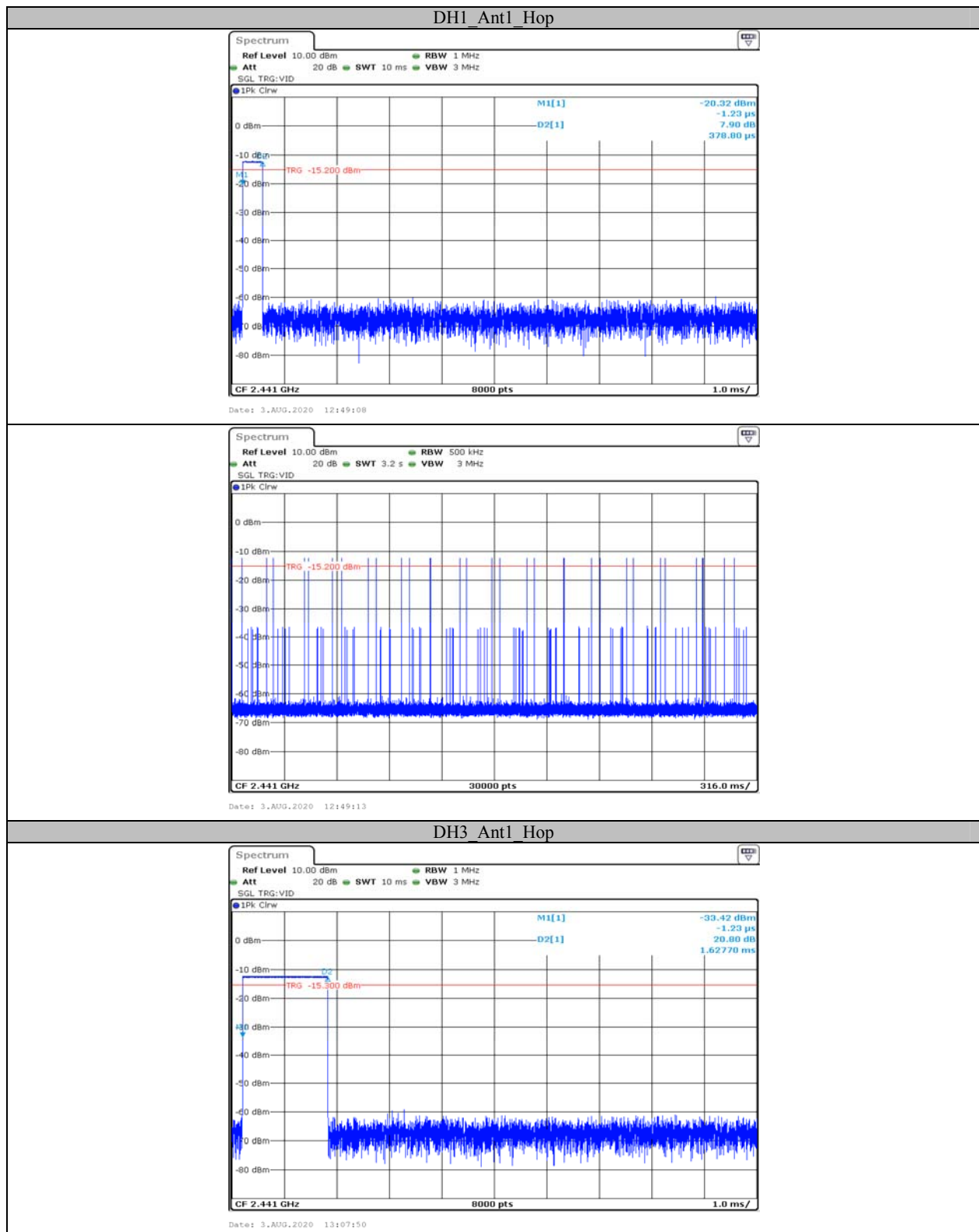
TestMode	Antenna	Channel	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH1	Ant1	Hop	0.38	320	0.121	<=0.4	PASS
DH3	Ant1	Hop	1.63	170	0.277	<=0.4	PASS
DH5	Ant1	Hop	2.87	120	0.344	<=0.4	PASS
2DH1	Ant1	Hop	0.39	320	0.124	<=0.4	PASS
2DH3	Ant1	Hop	1.63	150	0.245	<=0.4	PASS
2DH5	Ant1	Hop	2.87	110	0.316	<=0.4	PASS
3DH1	Ant1	Hop	0.39	330	0.128	<=0.4	PASS
3DH3	Ant1	Hop	1.63	180	0.294	<=0.4	PASS
3DH5	Ant1	Hop	2.87	130	0.374	<=0.4	PASS

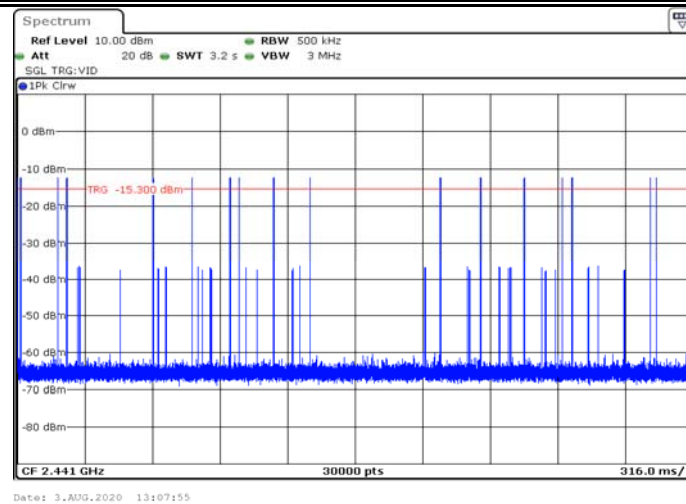
Note 1: A period time= $0.4 \times 79 = 31.6(S)$ , Result=BurstWidth\*Totalhops

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

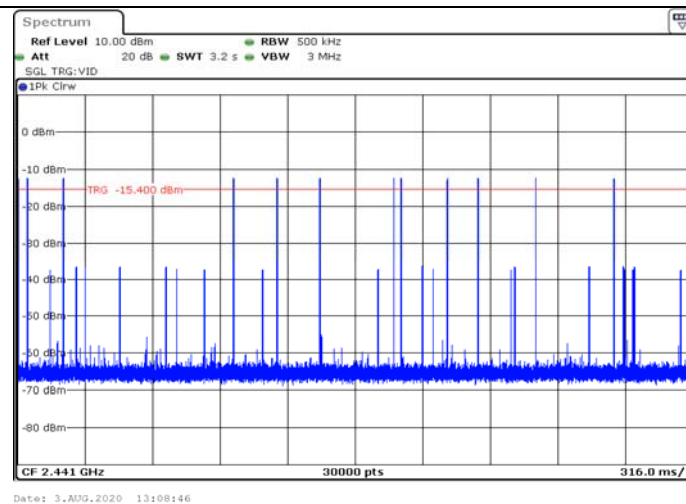
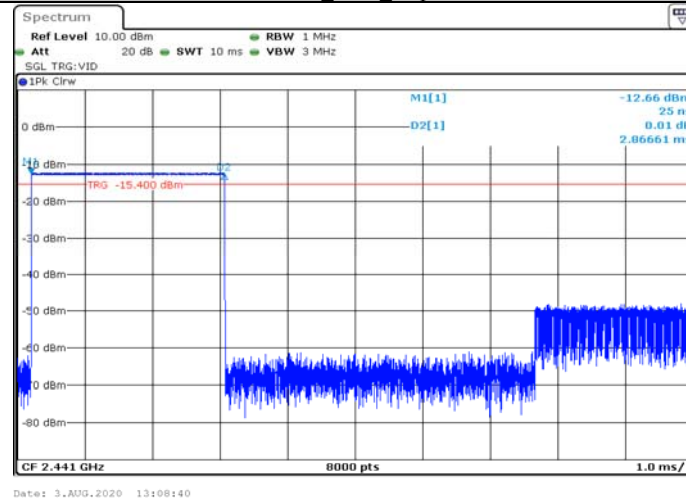
Note 3: Hopping Number in 3.16s=Total of highest signals in 3.16s (Second high signals were other channel)

## Test Graphs

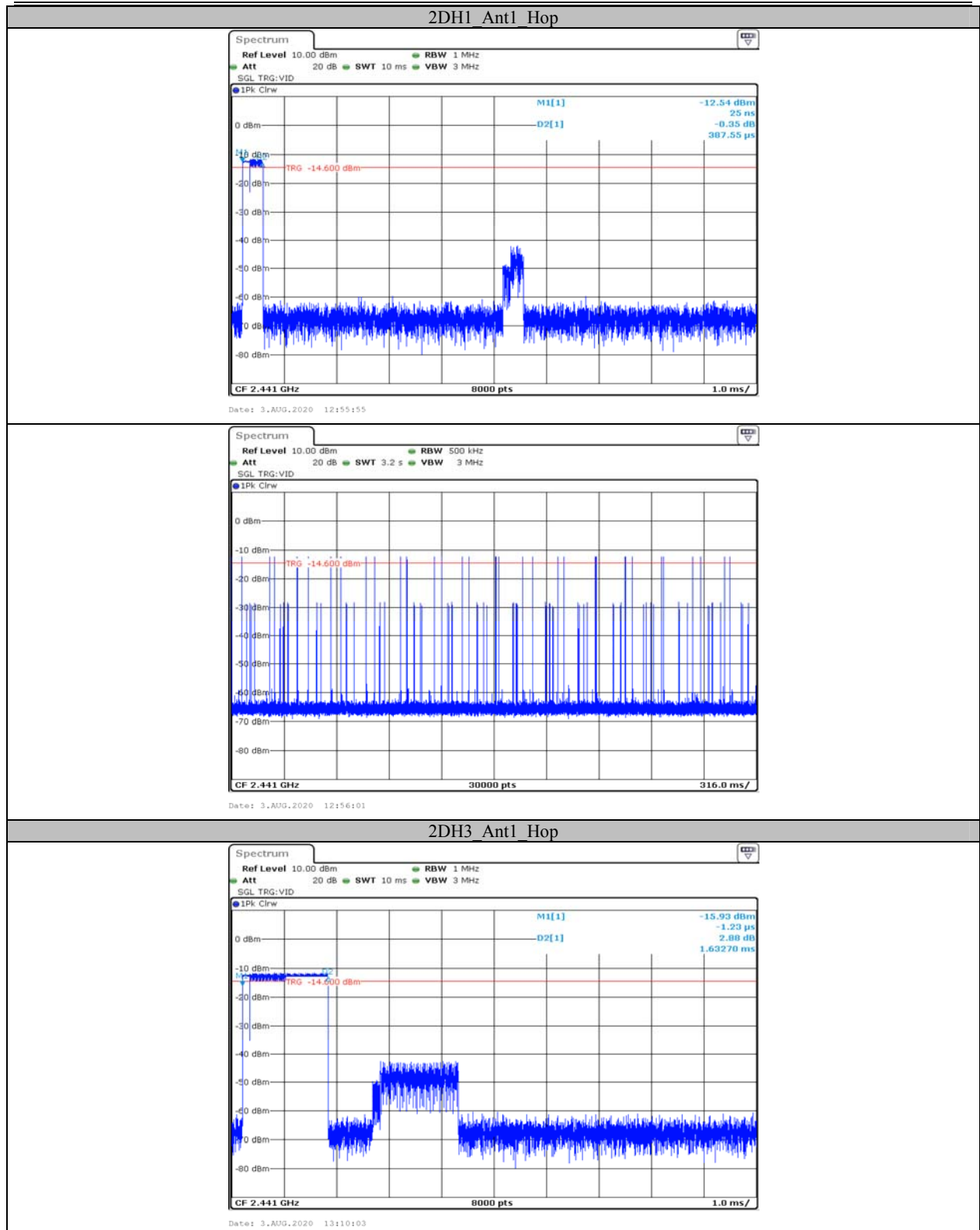


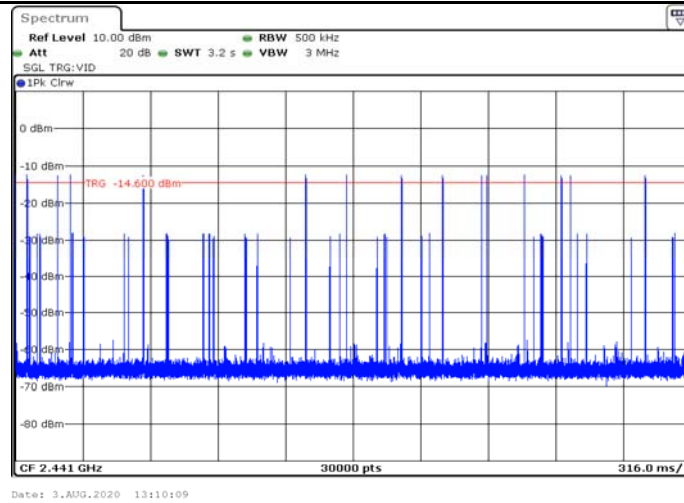


### DH5 Ant1 Hop

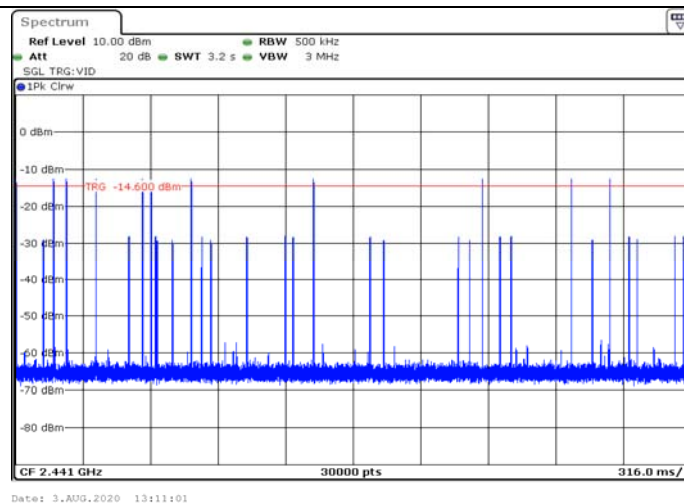
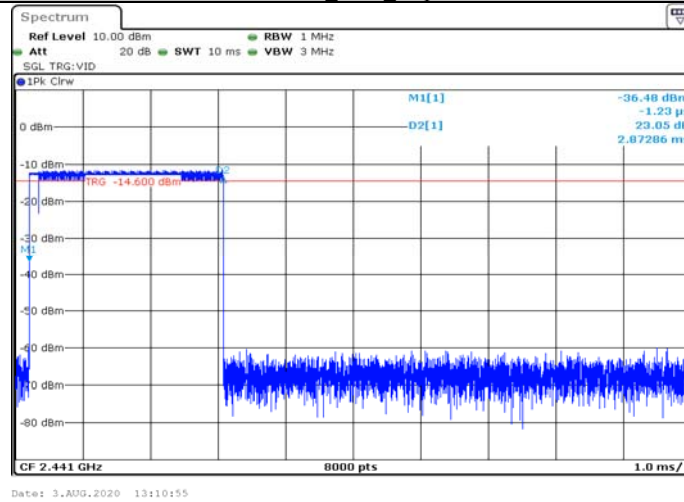




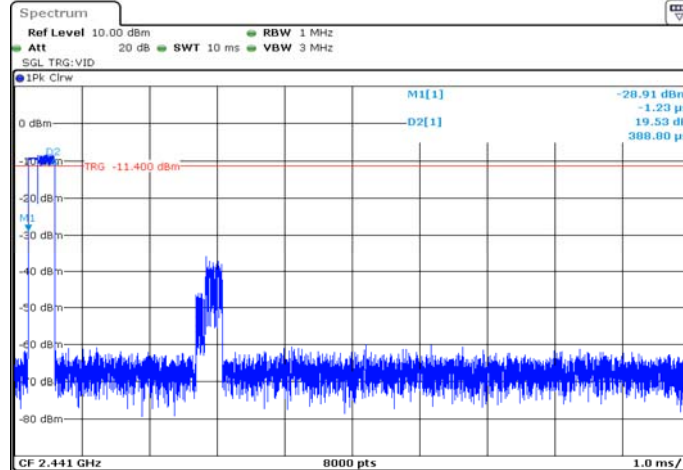




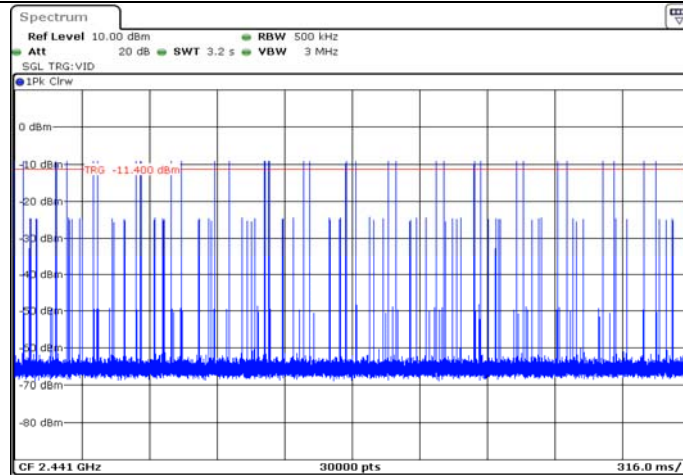
2DH5 Ant1 Hop



3DH1 Ant1 Hop

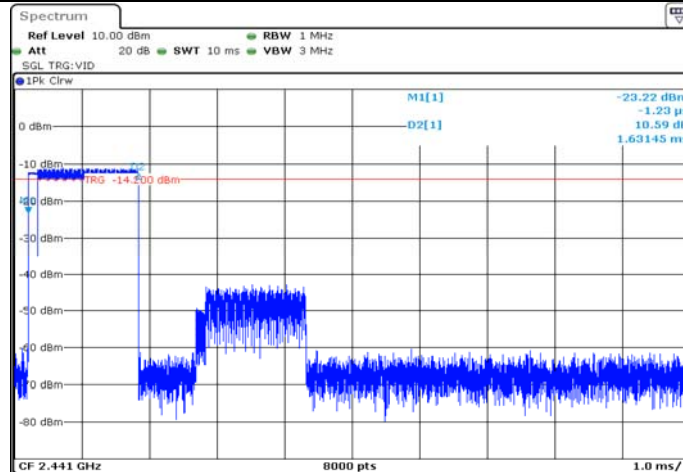


Date: 3.AUG.2020 13:01:53

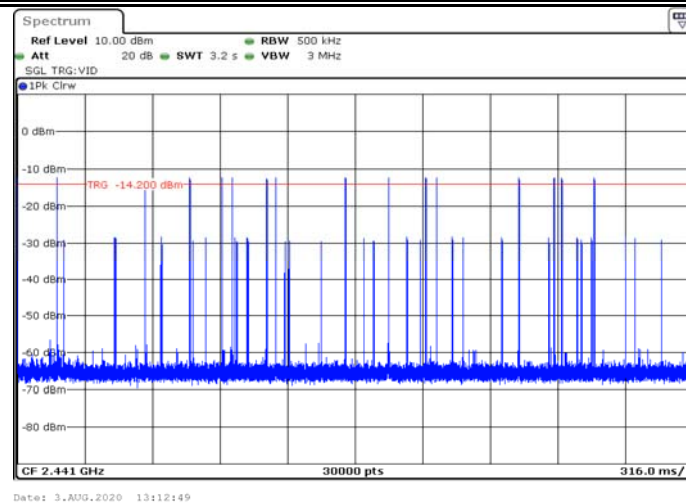


Date: 3.AUG.2020 13:01:59

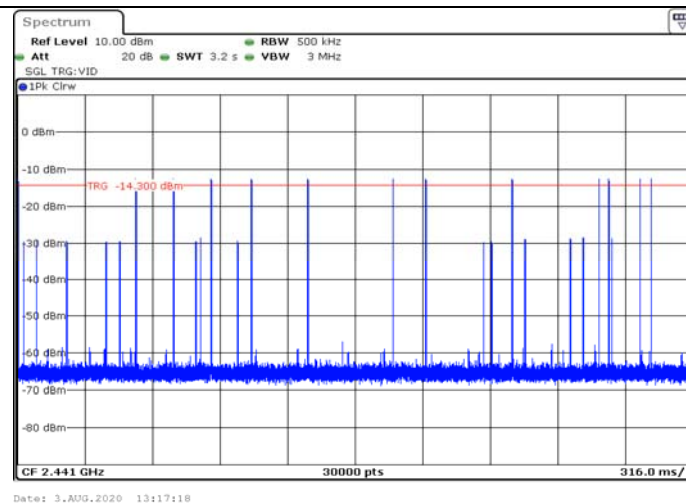
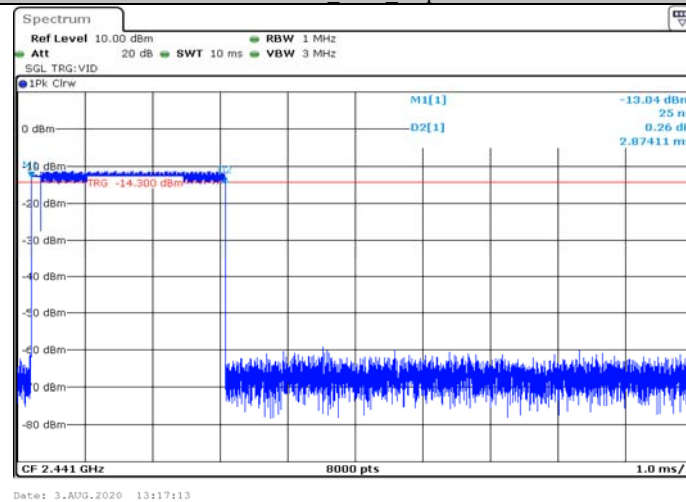
3DH3 Ant1 Hop



Date: 3.AUG.2020 13:12:43



## 3DH5 Ant1 Hop

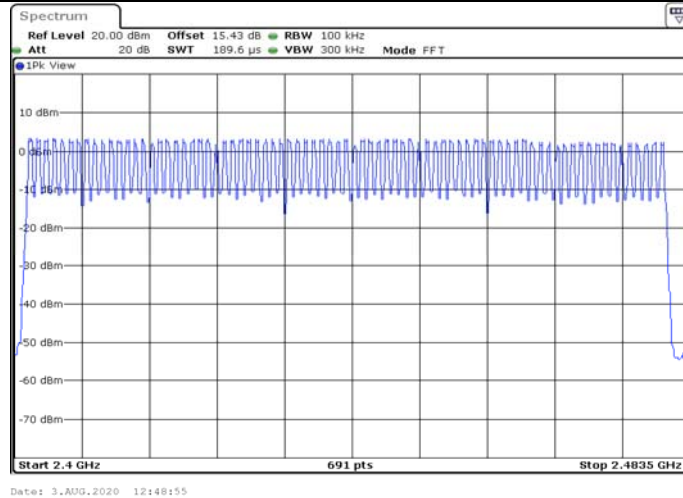


**Appendix E: Number of hopping channels****Test Result**

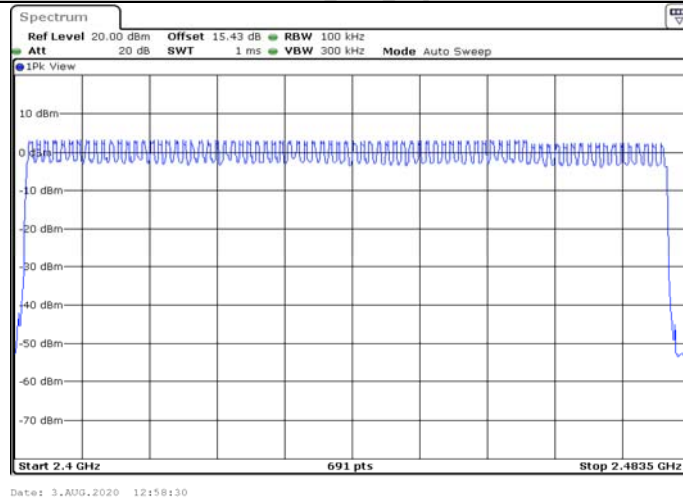
TestMode	Antenna	Channel	Result[Num]	Limit[Num]	Verdict
DH1	Ant1	Hop	79	$\geq 15$	PASS
2DH1	Ant1	Hop	79	$\geq 15$	PASS
3DH1	Ant1	Hop	79	$\geq 15$	PASS

## Test Graphs

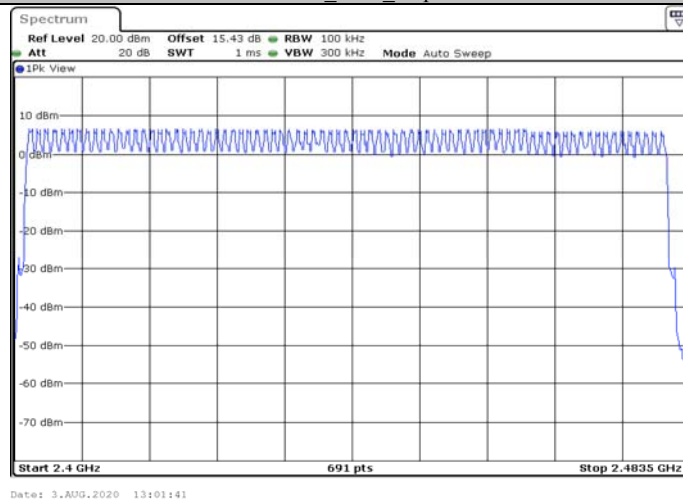
DH1\_Ant1\_Hop

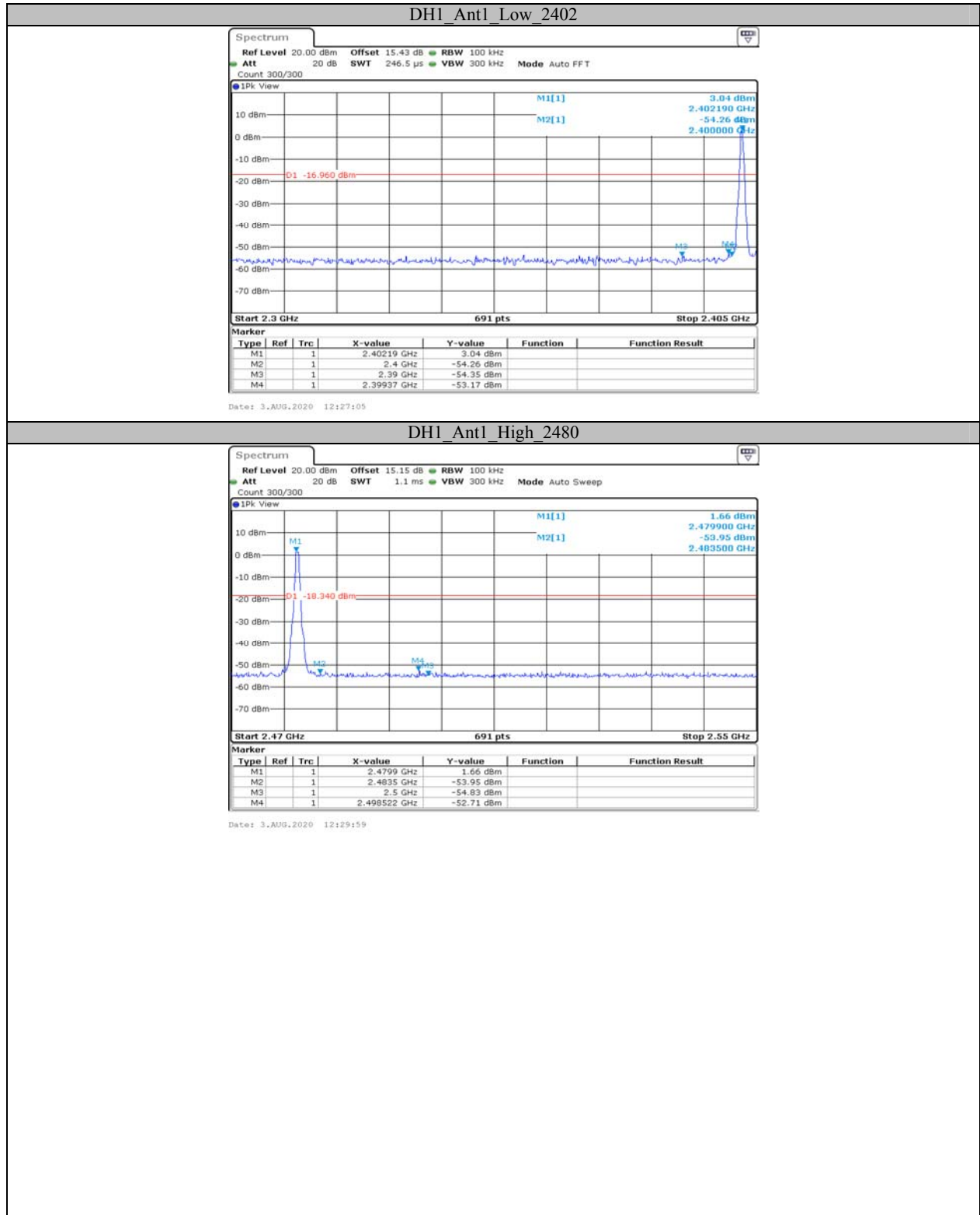


2DH1\_Ant1\_Hop

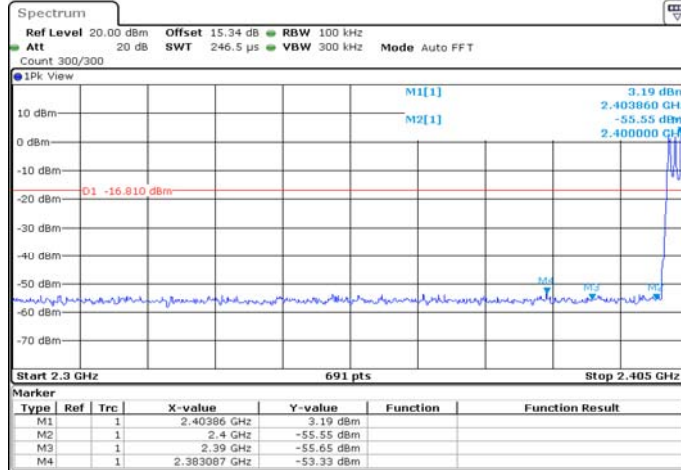


3DH1\_Ant1\_Hop



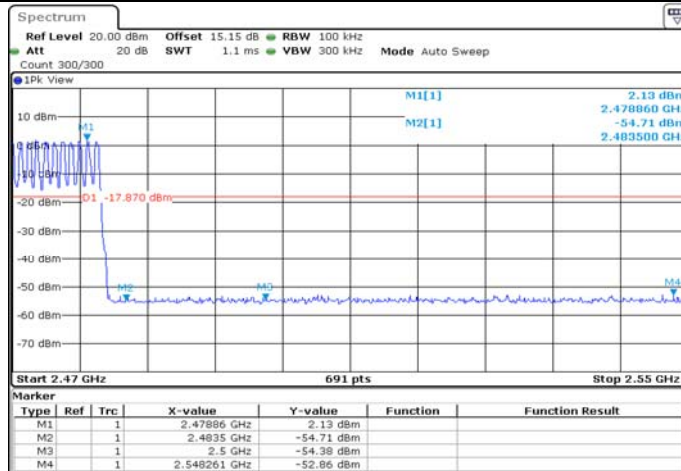
**Appendix F: Band edge measurements****Test Graphs**

DH1 Ant1 Low Hop 2402



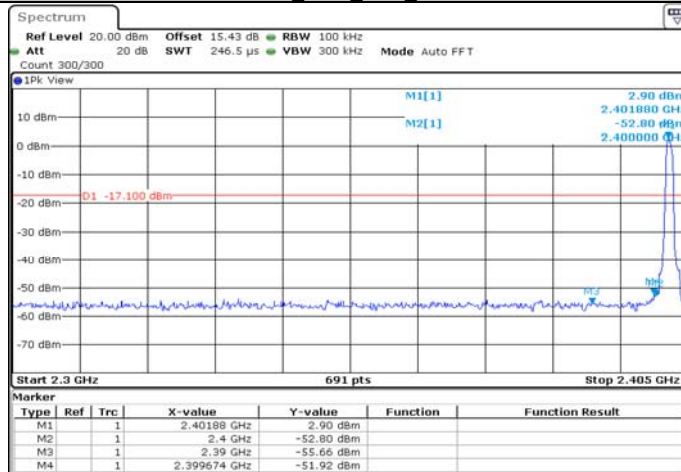
Date: 3.AUG.2020 12:50:20

DH1 Ant1 High Hop 2480



Date: 3.AUG.2020 12:49:44

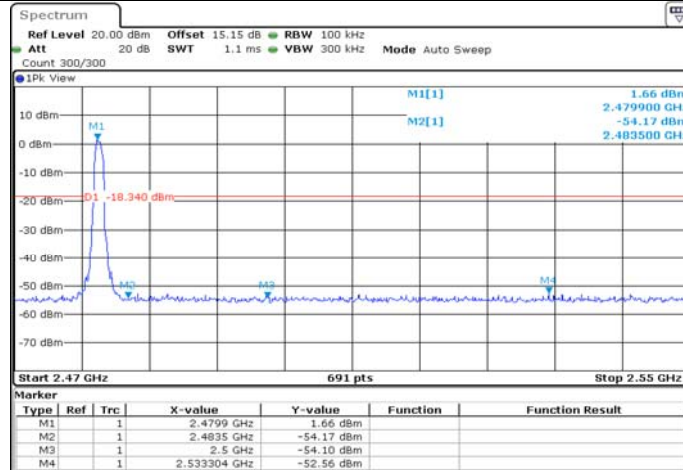
2DH1 Ant1 Low 2402



Date: 3.AUG.2020 12:33:37

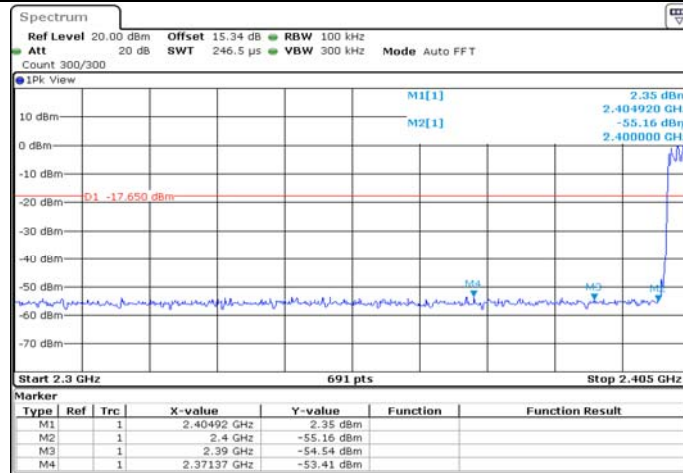


## 2DH1 Ant1 High 2480



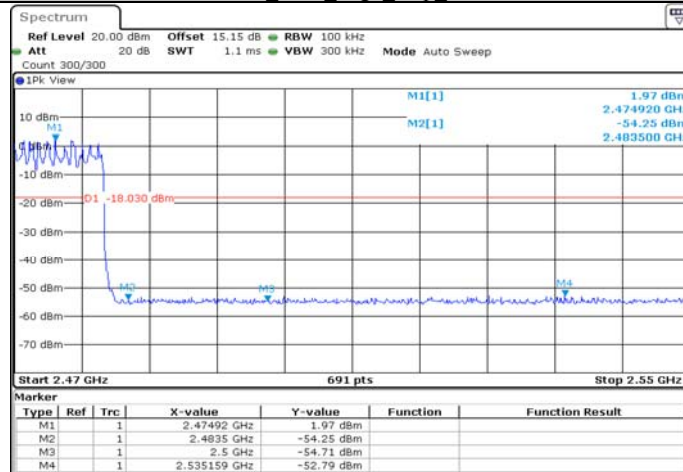
Date: 3.AUG.2020 12:16:22

## 2DH1 Ant1 Low Hop 2402



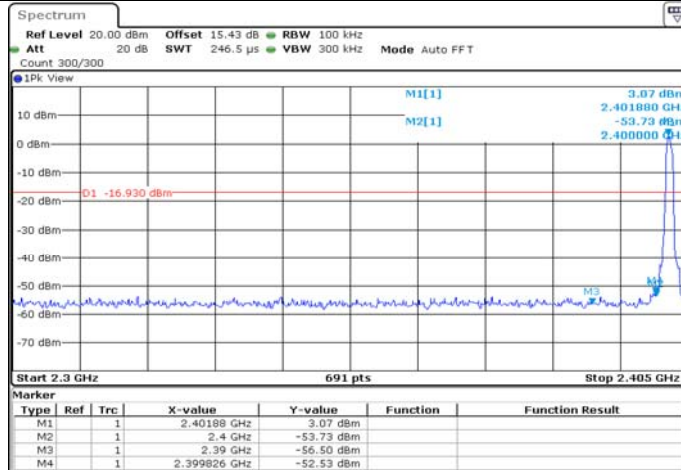
Date: 3.AUG.2020 12:52:26

## 2DH1 Ant1 High Hop 2480



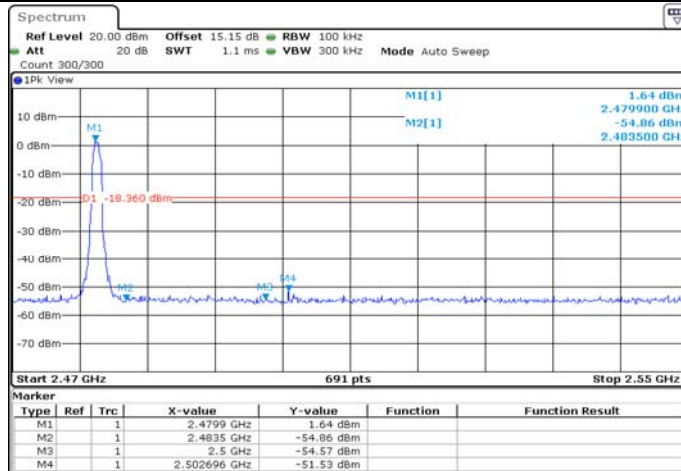
Date: 3.AUG.2020 12:56:13

## 3DH1 Ant1 Low 2402



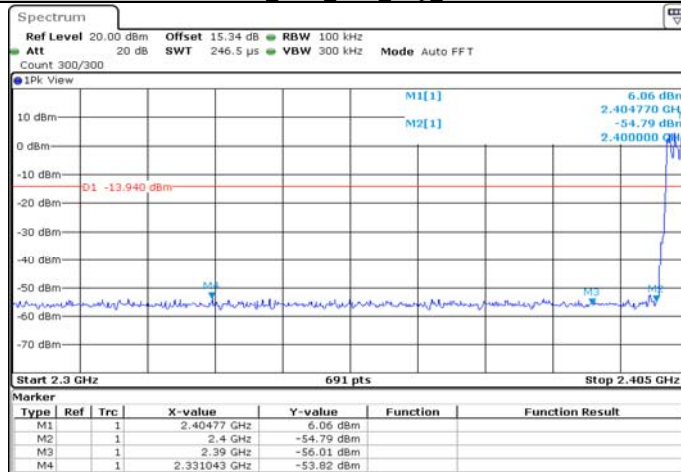
Date: 3.AUG.2020 12:37:47

## 3DH1 Ant1 High 2480

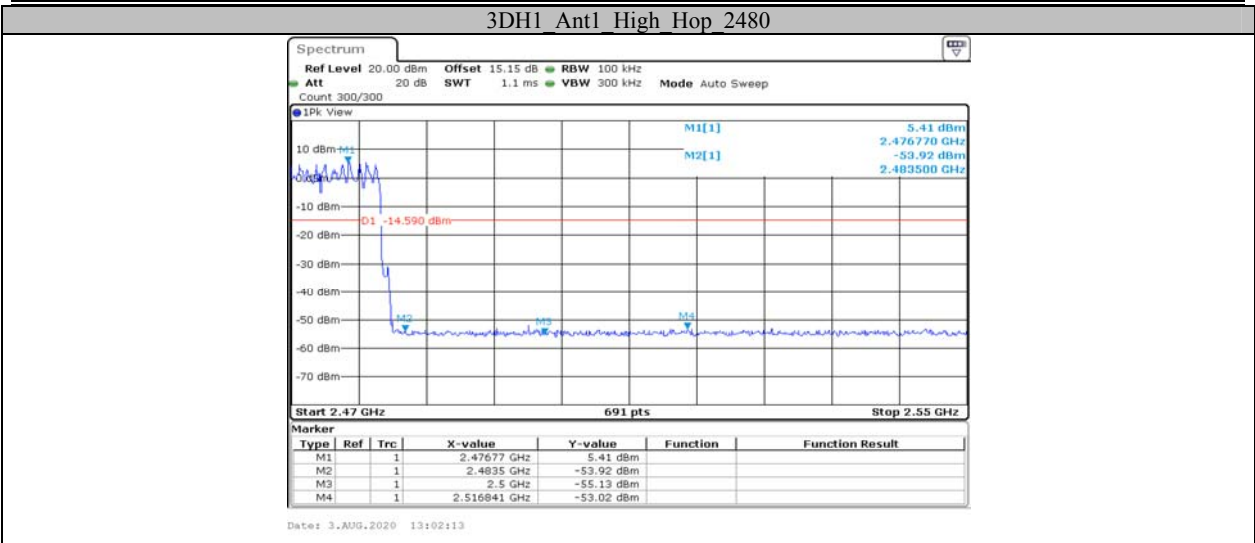


Date: 3.AUG.2020 12:42:44

## 3DH1 Ant1 Low Hop 2402



Date: 3.AUG.2020 12:59:25



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