

FCC PART 15.247

RSS-GEN ISSUE 5, MARCH 2019 AMENDMENT 1 RSS-247, ISSUE 2, FEBRUARY 2017 TEST REPORT

For

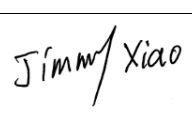
FCC: VTech Telecommunications Ltd

FCC: 23/F Tai Ping Ind Center Block 1 57 Ting Kok Rd Tai Po NT, Hong Kong

ISED: VTECH TELECOMMUNICATIONS LIMITED

ISED: BL.1 23/F Tai Ping Industr Ctr. 57 Ting Kok Road Tai Po, NT Hongkong

FCC ID: EW780-2261-00
IC: 1135B-80226100

Report Type: Original Report	Product Type: DECT6.0 cordless phone
Report Number: RSZ201207006B	
Report Date: 2021-01-19	
Reviewed By: RF Engineer	Jimmy Xiao 
Prepared By: Bay Area Compliance Laboratories Corp. (Shenzhen) 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China Tel: +86-755-33320018 Fax: +86-755-33320008 www.baclcorp.com.cn	

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	DECT6.0 cordless phone
Tested Model	IS8251
Multiple Models (FCC)	IS8251-2, IS8251-3, IS8251-4, IS8251-5, IS8252-5, IS825Z-XY (Z= any alphanumeric character is presenting different package type (material); X= any alphanumeric character or blank is presenting number of Handset and extra Charger; Y= any alphanumeric character or blank is presenting different color of enclosure.)
Multiple Models (ISED)	IS8251-2, IS8251-3, IS8251-4, IS8251-5
Model Differences	Refer to the DoS letter
HVIN	35-201430BS
Frequency Range	Bluetooth: 2402~2480MHz
Maximum conducted Peak output power	Bluetooth: 4.97dBm
Modulation Technique	Bluetooth: GFSK, $\pi/4$ -DQPSK, 8DPSK
Antenna Specification*	0dBi(It is provided by the applicant)
Voltage Range	DC 5.9V or 6.0V from adapter
Date of Test	2020-12-21 to 2021-01-19
Sample number	RSZ201207006-RF-S1(Assigned by BACL, Shenzhen)
Received date	2020-12-07
Sample/EUT Status	Good condition
Adapter 1 information	Model: A318-059060W-US1 Input: 100-240V, 50/60Hz, 0.15A Output: DC 5.9V, 0.6A
Adapter 2 information	Model: VT05EUS06060 Input: 100-240V, 50/60Hz, 0.15A Output: DC 6.0V, 0.6A 3.6W

Objective

This test report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commissions rules and RSS-GEN Issue 5, March 2019 Amendment 1 and RSS-247, Issue 2, February 2017 of the Innovation, Science and Economic Development Canada 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 tests and measurements indicated in this document were performed in accordance with the ANSI C63.10-2013, RSS-GEN Issue 5, March 2019 Amendment 1 and RSS-247, Issue 2, February 2017.

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.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0023.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in an engineering mode.

EUT Exercise Software

“unitool & realtek Bluetooth MP tool” software was used to test the EUT and power level is 7*. The software and power level were provided by the applicant.

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

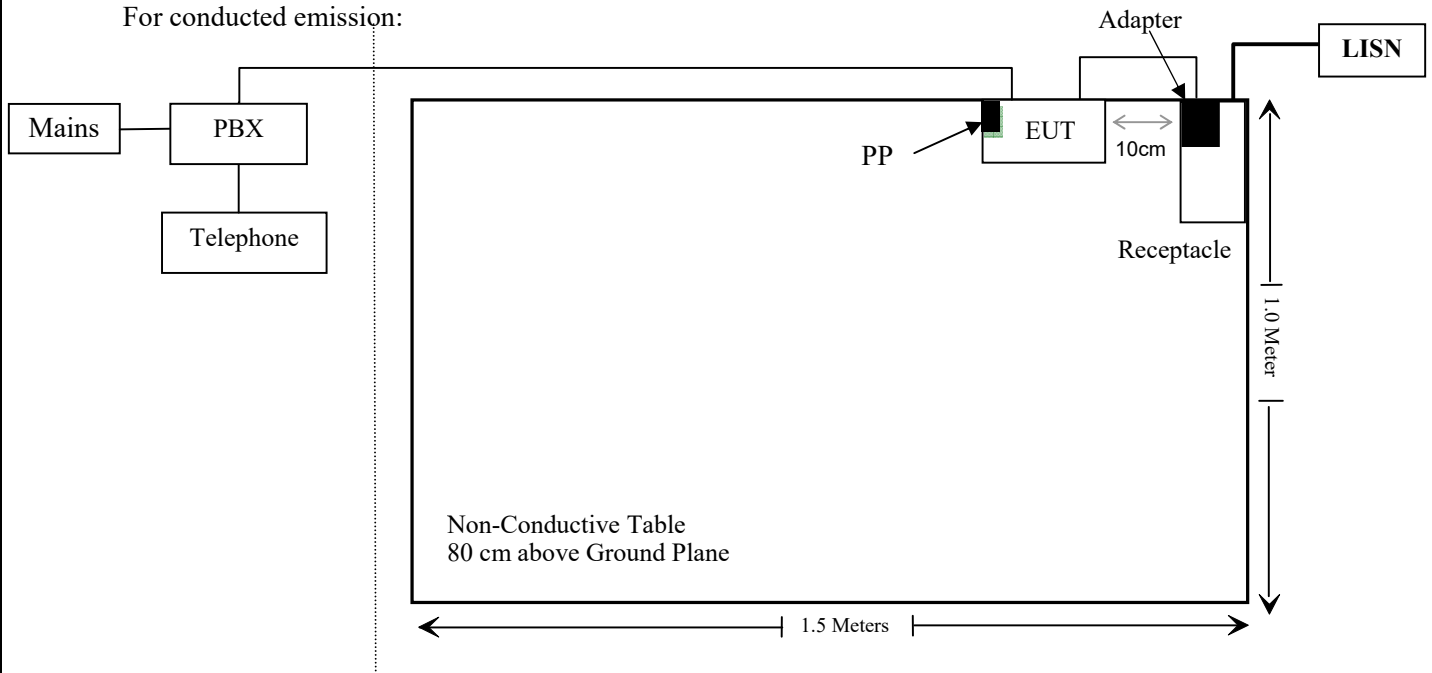
Manufacturer	Description	Model	Serial Number
YIKE	PBX	TC-208H	TC-208H
Kinhao	Telephone	KT86AS	KT86AS
Vtech	PP	DLP73540	DLP73540

External I/O Cable

Cable Description	Length (m)	From Port	To
Un-shielding Detachable RJ11 Cable	10	PBX	Base
Un-shielding Detachable RJ11 Cable	1.5	PBX	Telephone
Un-shielding Un-detachable DC Cable	1.5	Adapter	EUT

Block Diagram of Test Setup

For conducted emission:



SUMMARY OF TEST RESULTS

FCC Rules	IC Rules	Description of Test	Result
§15.247 (i), §2.1091	RSS-102 § 4	Maximum Permissible Exposure(MPE) & EXPOSURE LIMITS	Compliance
§15.203	RSS-Gen §6.8	Antenna Requirement	Compliance
§15.207(a)	RSS-Gen §8.8	AC Line Conducted Emissions	Compliance
§15.205, §15.209 & §15.247(d)	RSS-247 § 5.5	Radiated Emissions	Compliance
§15.247(a)(1)	RSS- Gen§6.7, RSS-247 § 5.1 (a)	99% Occupied Bandwidth & 20 dB Emission Bandwidth	Compliance
§15.247(a)(1)	RSS-247 § 5.1 (b)	Channel Separation Test	Compliance
§15.247(a)(1)(iii)	RSS-247 § 5.1 (d)	Time of Occupancy (Dwell Time)	Compliance
§15.247(a)(1)(iii)	RSS-247 § 5.1 (d)	Quantity of hopping channel Test	Compliance
§15.247(b)(1)	RSS-247 § 5.1(b) & § 5.4(b)	Peak Output Power Measurement	Compliance
§15.247(d)	RSS-247 § 5.5	Band edges	Compliance

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
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
Radiated Emission Test					
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	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	2020/11/29	2021/11/28
Sunol Sciences	Horn Antenna	DRH-118	A052604	2020/12/22	2023/12/21
Insulated 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	2020/04/20	2021/04/20
Ducommun Technologies	Horn antenna	ARH-4223-02	1007726-021304	2020/12/06	2023/12/05
RF Conducted Test					
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	2301 276	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) & §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)

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 ²)	MPE Limit (mW/cm ²)
	(dBi)	(numeric)	(dBm)	(mW)			
2402-2480	0	1	5	3.16	20	0.0006	1.0
1921.536 - 1928.448	0	1	20.5	112.2	20	0.022	1.0

Note: 1. the tune up conducted power was declared by the applicant
 2. the Bluetooth can transmit at the same time with the DECT function.

Simultaneous transmitting consideration:

$$\text{The ratio} = \text{MPE}_{\text{Bluetooth}}/\text{limit} + \text{MPE}_{\text{DECT}}/\text{limit} = 0.0006 + 0.022 = 0.0226 < 1.0$$

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

Result: Compliance

RSS-102 § 4 –EXPOSURE LIMITS

Applicable Standard

According to RSS-102 § 4:

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-10 ⁴¹	83	90	-	Instantaneous [*]
0.1-10	-	0.73/ <i>f</i>	-	6 ^{**}
1.1-10	87/ <i>f</i> ^{0.5}	-	-	6 ^{**}
10-20	27.46	0.0728	-2	6
20-48	58.07/ <i>f</i> ^{0.25}	0.1540/ <i>f</i> ^{0.25}	8.944/ <i>f</i> ^{0.5}	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 <i>f</i> ^{0.3417}	0.008335 <i>f</i> ^{0.3417}	0.02619 <i>f</i> ^{0.6834}	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ <i>f</i> ^{1.2}
150000-300000	0.158 <i>f</i> ^{0.5}	4.21 x 10 ⁻⁴ <i>f</i> ^{0.5}	6.67 x 10 ⁻⁵ <i>f</i>	616000/ <i>f</i>

Note: *f* is frequency in MHz.

^{*} Based on nerve stimulation (NS).

^{**} Based on specific absorption rate (SAR).

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. W/m²)

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

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 (m)	Power Density (W/m ²)	MPE Limit (W/m ²)
	(dBi)	(numeric)	(dBm)	(W)			
2402-2480	0	1	5	0.003	0.2	0.006	5.35
1921.536 - 1928.448	0	1	20.5	0.112	0.2	0.223	4.59

Note: 1. the tune up conducted power was declared by the applicant
 2. the Bluetooth can transmit at the same time with the DECT function.

Simultaneous transmitting consideration:

The ratio= $MPE_{\text{Bluetooth}}/\text{limit} + MPE_{\text{DECT}}/\text{limit} = 0.006/5.35 + 0.223/4.59 = 0.05 < 1.0$

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

Result: Compliance

FCC §15.203 & RSS-GEN §6.8– 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.

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

For licence-exempt equipment with detachable antennas, the user manual shall also contain the following notice in a conspicuous location:

This radio transmitter [enter the device's ISED certification number] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device. Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

Antenna Connector Construction

The EUT has one internal antenna arrangement, which was permanently attached and the antenna gain is 0 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Type	Antenna Gain	Impedance
Helix	0dBi	50 Ω

Result: Compliance.

FCC §15.207 (a) & RSS-GEN §8.8– AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207(a)

Unless stated otherwise in the applicable RSS, for radio apparatus that are designed to be connected to the public utility AC power network, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 kHz to 30 MHz shall not exceed the limits in table 4, as measured using a 50 μ H / 50 Ω line impedance stabilization network. This requirement applies for the radio frequency voltage measured between each power line and the ground terminal of each AC power-line mains cable of the EUT.

For an EUT that connects to the AC power lines indirectly, through another device, the requirement for compliance with the limits in table 4 shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the EUT. The lower limit applies at the boundary between the frequency ranges. The device used to power the EUT shall be representative of typical applications.

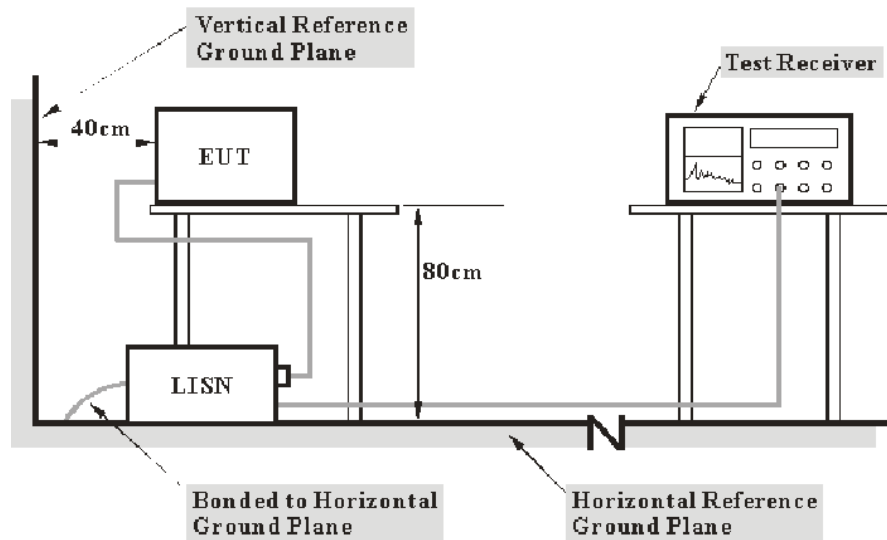
Table 4 - AC Power Lines Conducted Emission Limits		
Frequency range (MHz)	Conducted limit (dBμV)	
	Quasi-Peak	Average
0.15 – 0.5	66 to 56 ¹	56 to 46 ¹
0.5 – 5	56	46
5 – 30	60	50

Note 1: The level decreases linearly with the logarithm of the frequency.

For an EUT with a permanent or detachable antenna operating between 150 kHz and 30 MHz, the AC power-line conducted emissions must be measured using the following configurations:

- (a) Perform the AC power-line conducted emissions test with the antenna connected to determine compliance with the limits of table 4 outside the transmitter's fundamental emission band.
- (b) Retest with a dummy load instead of the antenna to determine compliance with the limits of table 4 within the transmitter's fundamental emission band. For a detachable antenna, remove the antenna and connect a suitable dummy load to the antenna connector. For a permanent antenna, remove the antenna and terminate the RF output with a dummy load or network that simulates the antenna in the fundamental frequency band.

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 and RSS-Gen limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

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:

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

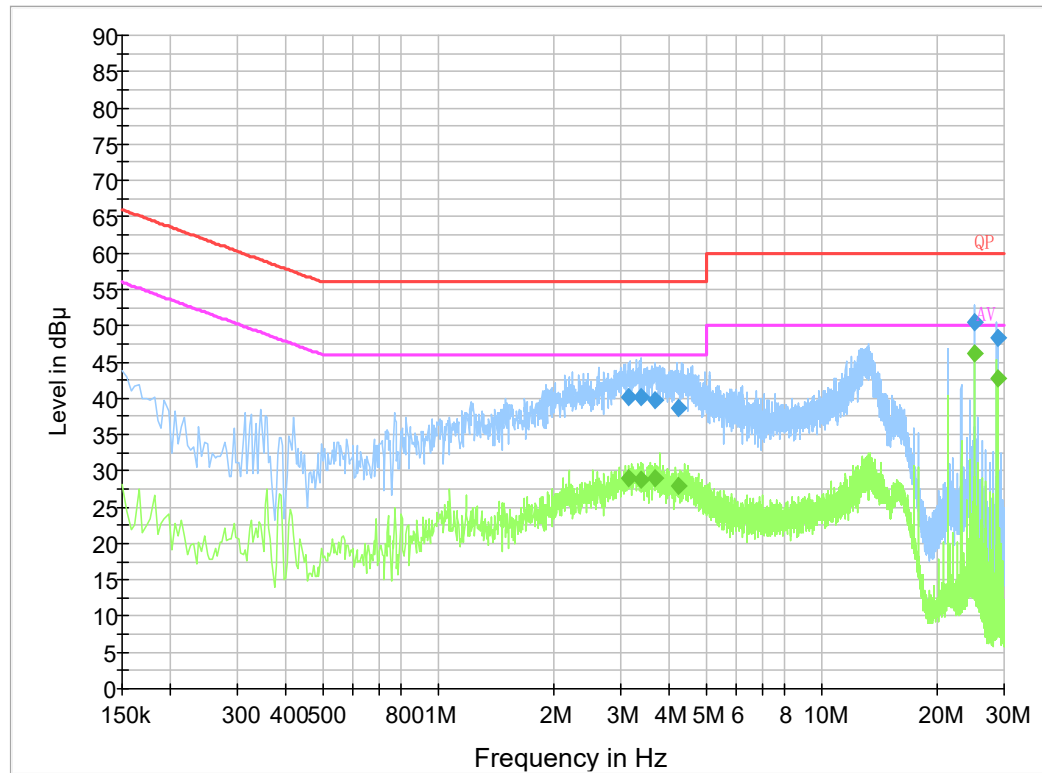
Test Data

Environmental Conditions

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

The testing was performed by Haiguo Li on 2020-12-21.

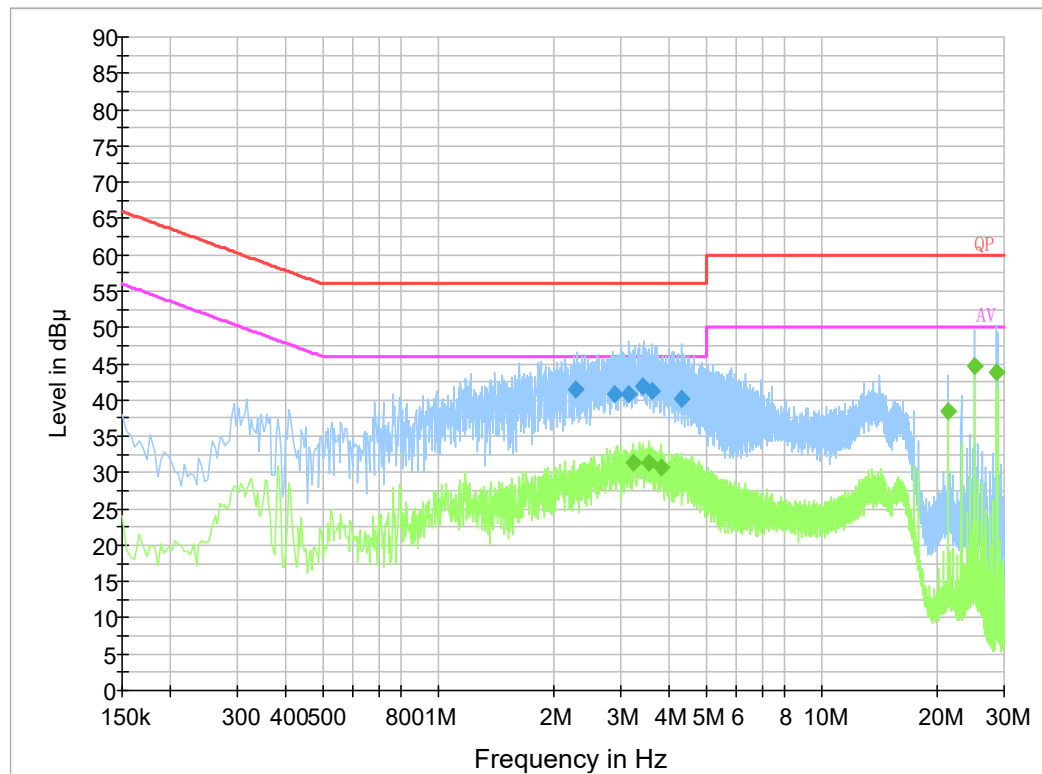
EUT operation mode: Transmitting & charging

Adapter 1 (A318-059060W-US1)**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)
3.150330	40.1	9.000	L1	19.9	15.9	56.0
3.403030	40.1	9.000	L1	19.9	15.9	56.0
3.686950	39.7	9.000	L1	19.9	16.3	56.0
4.253230	38.7	9.000	L1	19.9	17.3	56.0
25.069950	50.6	9.000	L1	20.3	9.4	60.0
29.000250	48.3	9.000	L1	20.2	11.7	60.0

Final Result 2

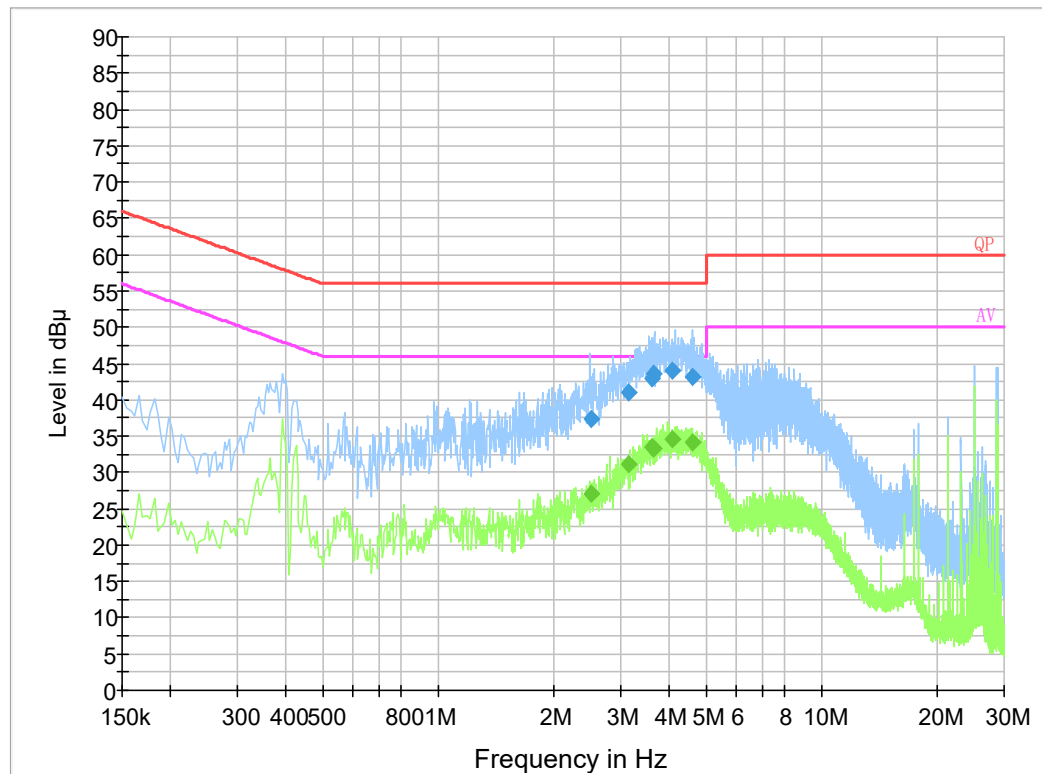
Frequency (MHz)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
3.150330	29.0	9.000	L1	19.9	17.0	46.0
3.403030	28.8	9.000	L1	19.9	17.2	46.0
3.686950	29.1	9.000	L1	19.9	16.9	46.0
4.253230	27.9	9.000	L1	19.9	18.1	46.0
25.069950	46.1	9.000	L1	20.3	3.9	50.0
29.000250	42.7	9.000	L1	20.2	7.3	50.0

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

Frequency (MHz)	QuasiPeak (dB μV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μV)
2.291530	41.4	9.000	N	19.8	14.6	56.0
2.891070	40.8	9.000	N	19.9	15.2	56.0
3.134690	40.8	9.000	N	19.9	15.2	56.0
3.406310	41.9	9.000	N	19.9	14.1	56.0
3.603910	41.3	9.000	N	19.9	14.7	56.0
4.321410	40.2	9.000	N	19.9	15.8	56.0

Final Result 2

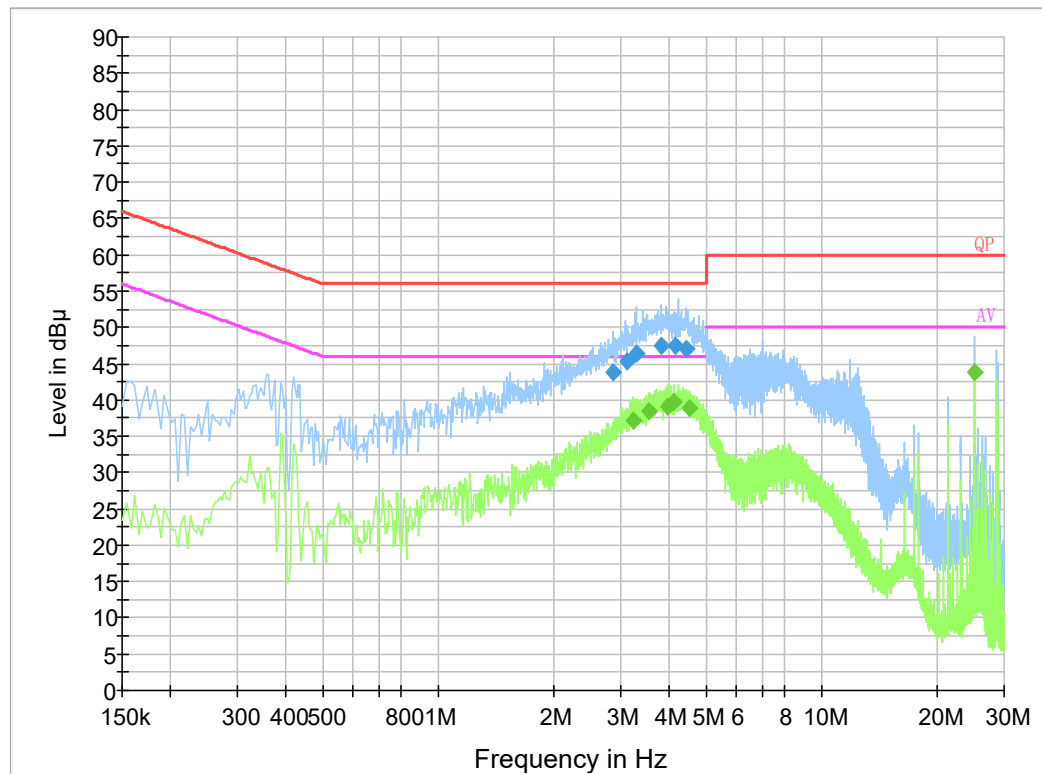
Frequency (MHz)	Average (dB μV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μV)
3.234000	31.5	9.000	N	19.9	14.5	46.0
3.534000	31.4	9.000	N	19.9	14.6	46.0
3.830000	30.6	9.000	N	19.9	15.4	46.0
21.486000	38.4	9.000	N	20.4	11.6	50.0
25.070000	44.7	9.000	N	20.3	5.3	50.0
28.650000	43.9	9.000	N	20.2	6.1	50.0

Adapter 2 (VT05EUS06060)**AC 120V/60 Hz, Line****Final Result 1**

Frequency (MHz)	QuasiPeak (dB μV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μV)
2.504710	37.4	9.000	L1	19.8	18.6	56.0
3.146210	41.1	9.000	L1	19.9	14.9	56.0
3.604690	43.0	9.000	L1	19.9	13.0	56.0
3.638950	43.6	9.000	L1	19.9	12.4	56.0
4.099750	44.0	9.000	L1	19.9	12.0	56.0
4.592970	43.1	9.000	L1	19.9	12.9	56.0

Final Result 2

Frequency (MHz)	Average (dB μV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μV)
2.504710	27.2	9.000	L1	19.8	18.8	46.0
3.146210	31.1	9.000	L1	19.9	14.9	46.0
3.604690	33.4	9.000	L1	19.9	12.6	46.0
3.638950	33.4	9.000	L1	19.9	12.6	46.0
4.099750	34.7	9.000	L1	19.9	11.3	46.0
4.592970	34.1	9.000	L1	19.9	11.9	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)
2.855070	43.8	9.000	N	19.9	12.2	56.0
3.123830	45.4	9.000	N	19.9	10.6	56.0
3.304530	46.3	9.000	N	19.9	9.7	56.0
3.832790	47.5	9.000	N	19.9	8.5	56.0
4.178370	47.4	9.000	N	19.9	8.6	56.0
4.447070	47.1	9.000	N	19.9	8.9	56.0

Final Result 2

Frequency (MHz)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
3.234000	37.3	9.000	N	19.9	8.7	46.0
3.554000	38.4	9.000	N	19.9	7.6	46.0
3.974000	39.2	9.000	N	19.9	6.8	46.0
4.126000	39.7	9.000	N	19.9	6.3	46.0
4.542000	38.9	9.000	N	19.9	7.1	46.0
25.070000	43.8	9.000	N	20.3	6.2	50.0

FCC §15.205, §15.209 & §15.247(d) & RSS-247§ 5.5 – RADIATED EMISSIONS

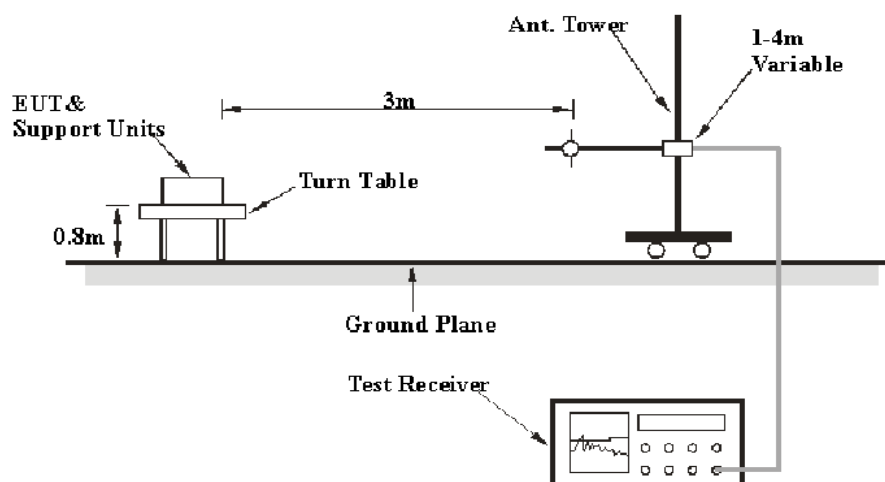
Applicable Standard

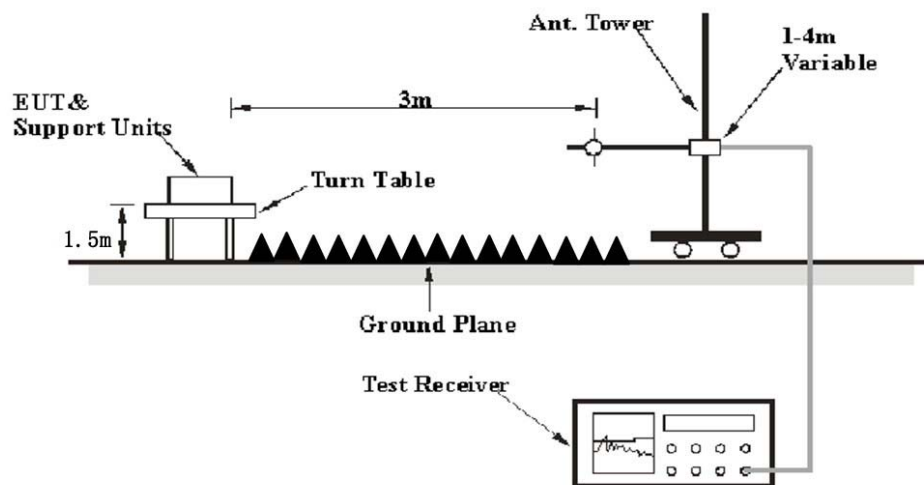
FCC §15.205; §15.209; §15.247(d) and RSS-247 §5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

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, FCC 15.247 limits and RSS-247/RSS-Gen 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**

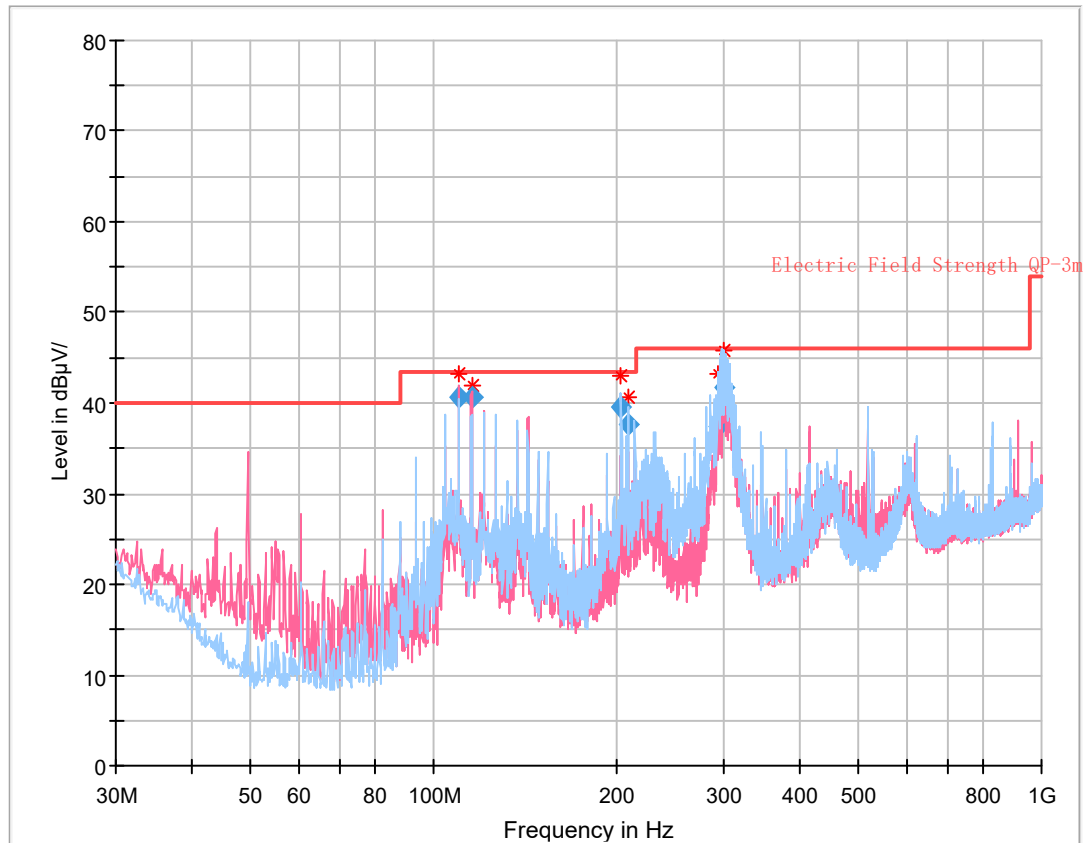
Temperature:	20~30.4 °C
Relative Humidity:	52~60 %
ATM Pressure:	101.0~101.1 kPa

The testing was performed by Harris He on 2020-12-21 for below 1GHz and Alan He on 2020-12-22 for above 1GHz.

EUT operation mode: Transmitting

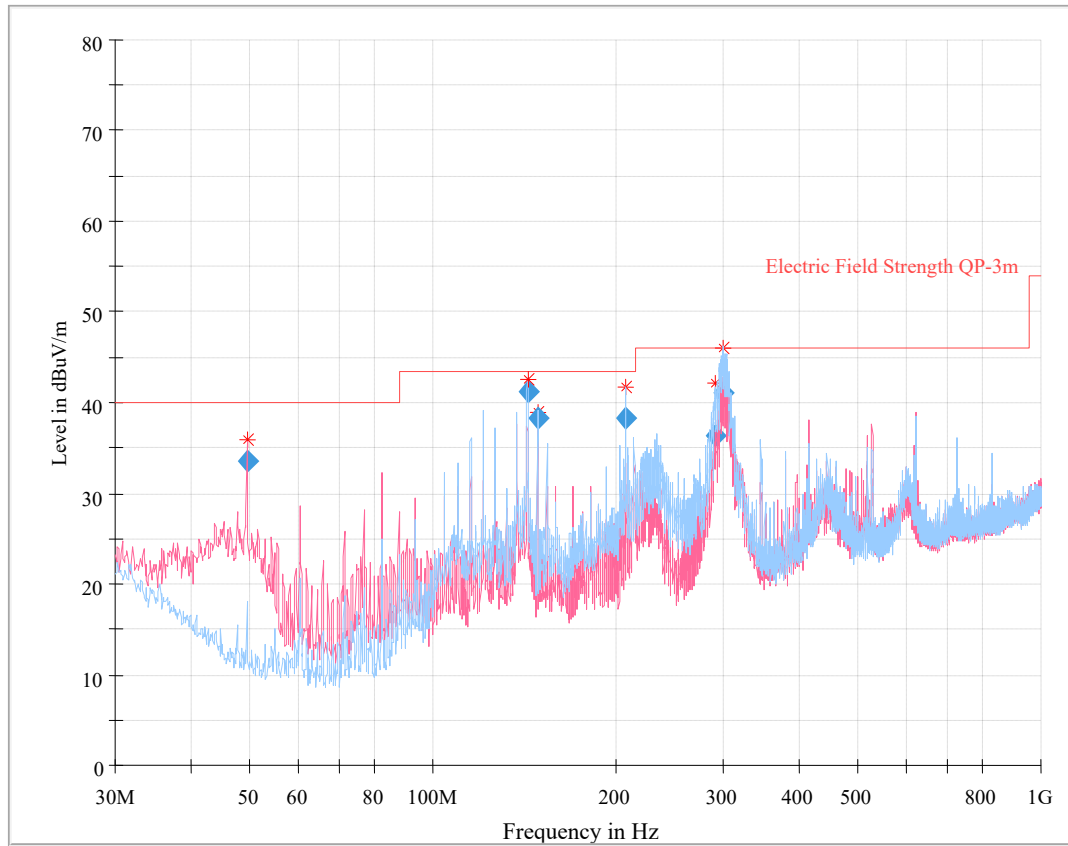
30 MHz~1 GHz: (the worst case is 8DPSK Mode, Low channel)

Adapter 1 (A318-059060W-US1)



Final Result

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
110.000500	40.56	43.50	2.94	102.0	V	287.0	-12.0
115.468625	40.66	43.50	2.84	101.0	V	290.0	-11.4
203.502625	39.60	43.50	3.90	176.0	H	317.0	-10.6
209.016625	37.57	43.50	5.93	102.0	H	132.0	-10.7
292.659125	37.39	46.00	8.61	111.0	H	37.0	-9.4
300.326250	41.67	46.00	4.33	111.0	H	38.0	-9.2

Adapter 2 (VT05EUS06060)**Final Result**

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
49.402388	33.46	40.00	6.54	102.0	V	316.0	-16.3
143.013875	42.46	43.50	1.04	204.0	H	270.0	-11.1
148.480000	38.19	43.50	5.31	199.0	H	272.0	-11.0
207.383250	38.38	43.50	5.12	168.0	H	353.0	-10.7
291.315125	36.36	46.00	9.64	110.0	H	154.0	-9.4
300.307125	41.18	46.00	4.82	108.0	H	151.0	-9.2

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)									
2327.19	29.73	PK	28	1.8	H	31.64	61.37	74	12.63
2327.19	15.04	Ave.	28	1.8	H	31.64	46.68	54	7.32
2488.91	29.64	PK	97	1.8	H	32.13	61.77	74	12.23
2488.91	14.59	Ave.	97	1.8	H	32.13	46.72	54	7.28
4804.00	46.23	PK	77	1.2	H	6.28	52.51	74	21.49
4804.00	33.79	Ave.	77	1.2	H	6.28	40.07	54	13.93
Middle Channel (2441 MHz)									
4882.00	46.07	PK	61	2.4	H	6.76	52.83	74	21.17
4882.00	34.89	Ave.	61	2.4	H	6.76	41.65	54	12.35
High Channel (2480 MHz)									
2377.79	28.84	PK	44	2.1	H	31.87	60.71	74	13.29
2377.79	14.48	Ave.	44	2.1	H	31.87	46.35	54	7.65
2488.17	29.43	PK	35	1.5	H	32.13	61.56	74	12.44
2488.17	14.63	Ave.	35	1.5	H	32.13	46.76	54	7.24
4960.00	47.52	PK	70	1.4	H	6.80	54.32	74	19.68
4960.00	35.42	Ave.	70	1.4	H	6.80	42.22	54	11.78

Note:

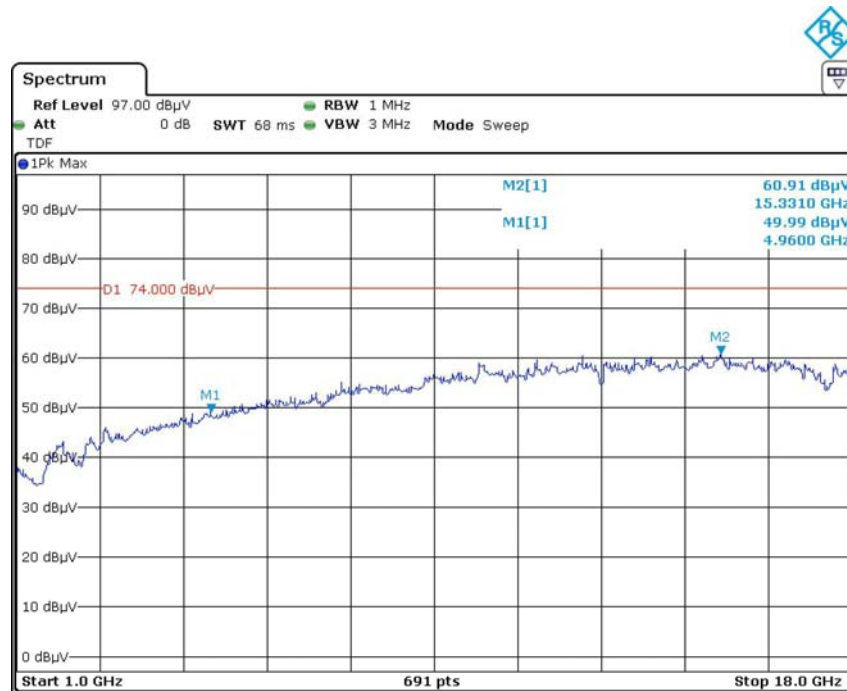
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Corrected Amplitude = Corrected Factor + Reading

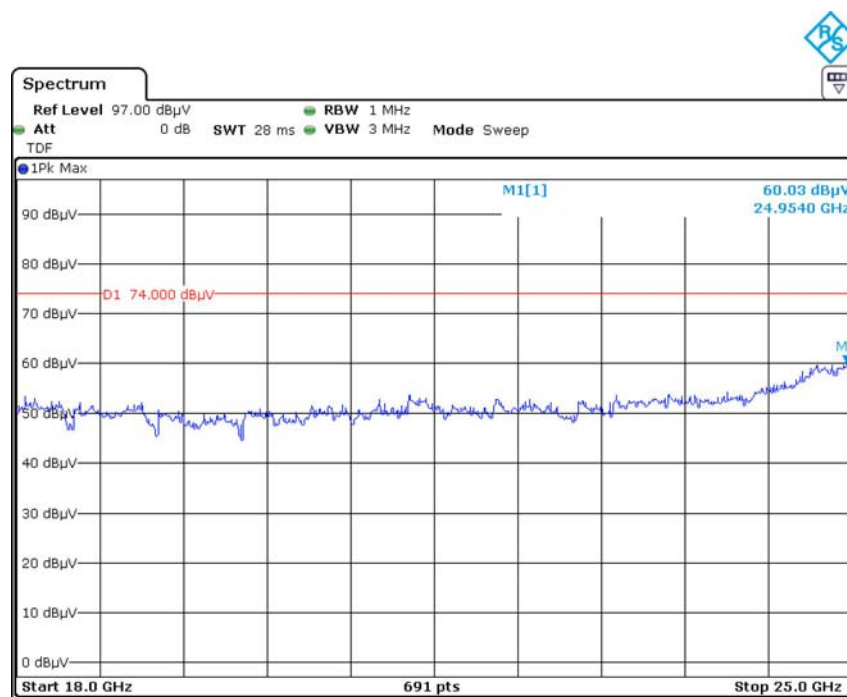
Margin = Limit - Corrected. Amplitude

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

Pre-scan with High channel Peak Horizontal

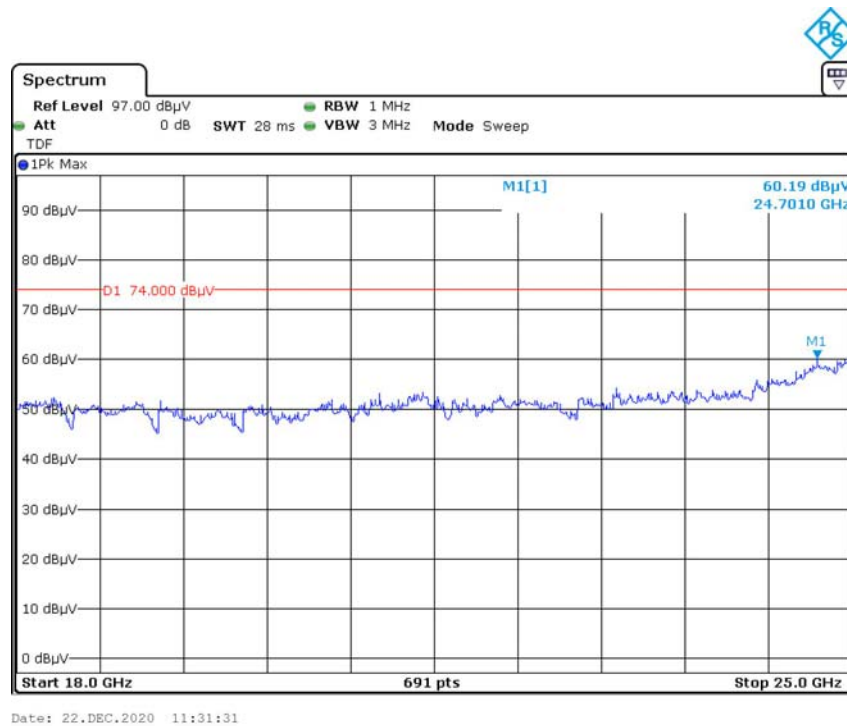
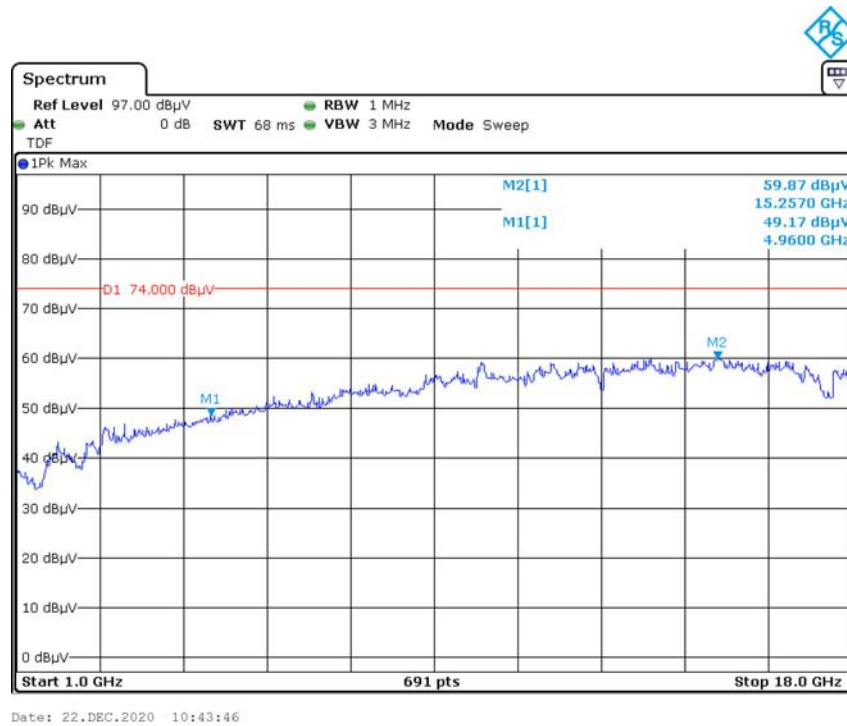


Date: 22.DEC.2020 10:32:11

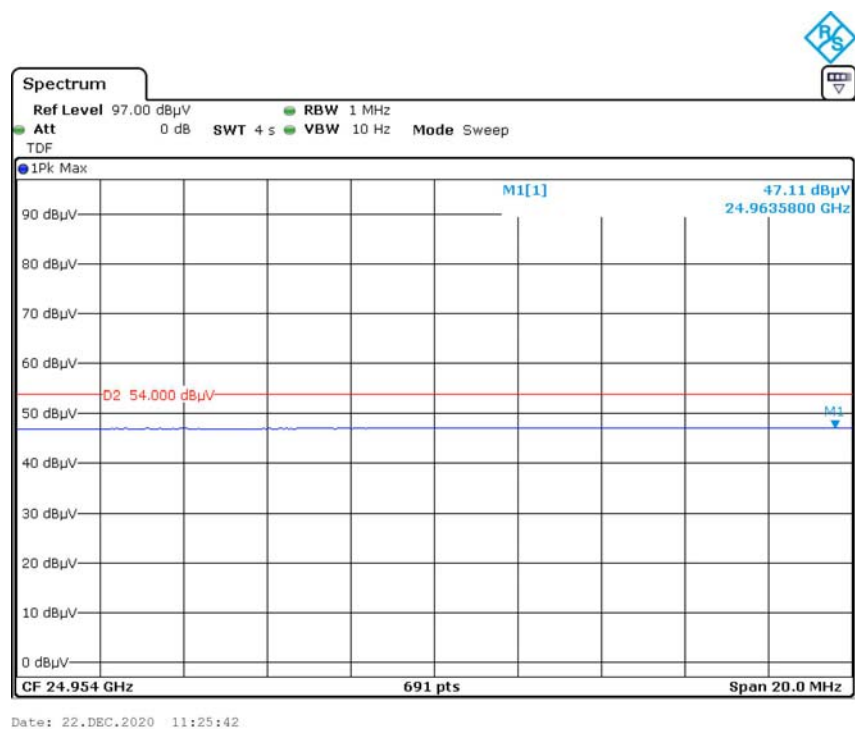
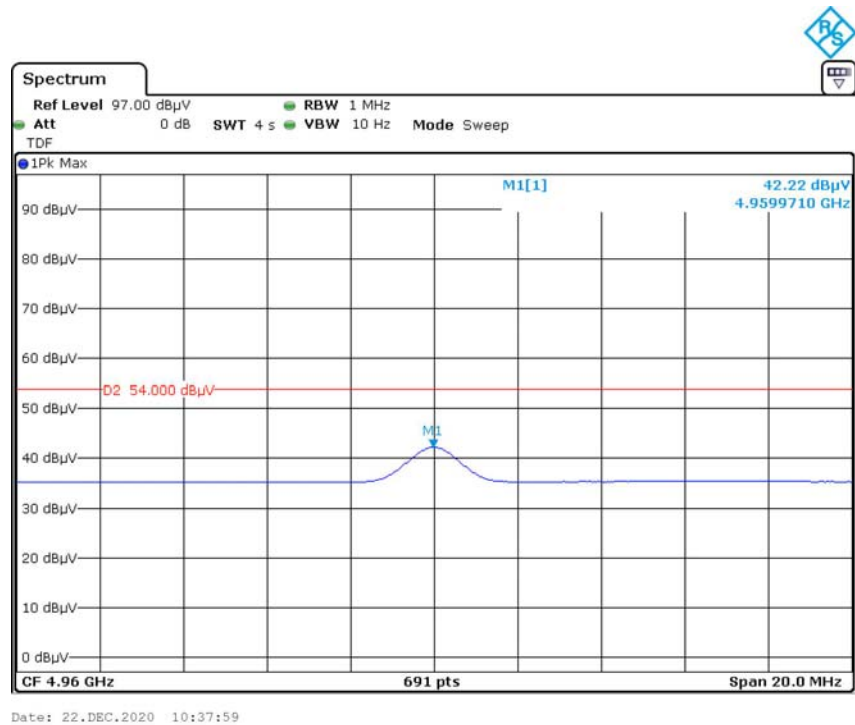


Date: 22.DEC.2020 11:19:55

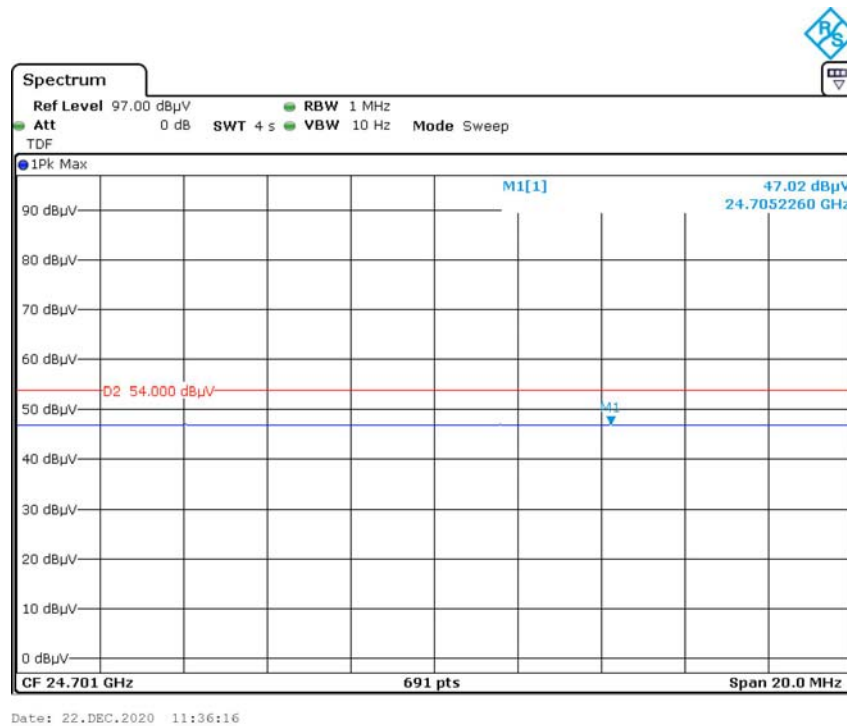
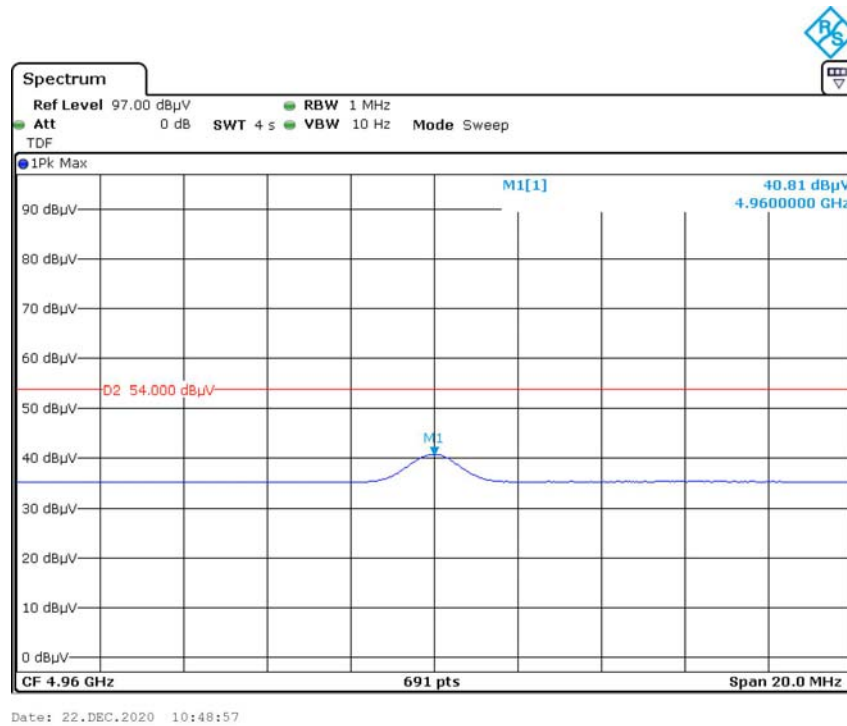
Vertical



Average Horizontal



Vertical



FCC §15.247(a) (1) & RSS-247 § 5.1 (b)-CHANNEL SEPARATION TEST**Applicable Standard**

Frequency hopping systems (FHSs) 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 and in Operating mode, RBW was set at 30 kHz, VBW $\geq$ 3RBW max-hold the channel.
2. Set the adjacent channel of the EUT and maxhold another trace.
3. Measure the channel separation.

Test Data**Environmental Conditions**

Temperature:	23 °C
Relative Humidity:	57 %
ATM Pressure:	101.0 kPa

The testing was performed by Gavin Guo on 2020-12-21.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

FCC §15.247(a) (1) & RSS-GEN § 6.7 & RSS-247 § 5.1 (a)–99% OCCUPIED BANDWIDTH & 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.

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

In some cases, the “20 dB bandwidth” is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated 20 dB below the maximum in-band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.

Test Procedure

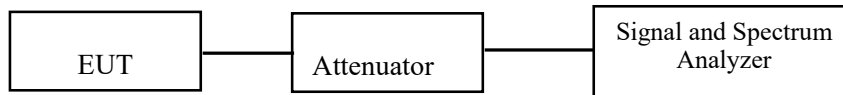
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency 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.

The following conditions shall be observed for measuring the occupied bandwidth and 20 dB bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / 20 dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / 20 dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).



Test Data

Environmental Conditions

Temperature:	23 °C
Relative Humidity:	57 %
ATM Pressure:	101.0 kPa

The testing was performed by Gavin Guo on 2020-12-21.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

FCC §15.247(a) (1) (iii) & RSS-247 § 5.1 (d)-QUANTITY OF HOPPING CHANNEL TEST

Applicable Standard

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

Test Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Set the EUT in hopping mode from first channel to last.
3. By using the max-hold function record the quantity of the channel.

Test Data

Environmental Conditions

Temperature:	23 °C
Relative Humidity:	57 %
ATM Pressure:	101.0 kPa

The testing was performed by Gavin Guo on 2020-12-21.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

FCC §15.247(a) (1) (iii) & RSS-247 § 5.1 (d) - TIME OF OCCUPANCY (DWELL TIME)

Applicable Standard

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

Test Procedure

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

Test Data

Environmental Conditions

Temperature:	23 °C
Relative Humidity:	57 %
ATM Pressure:	101.0 kPa

The testing was performed by Gavin Guo from 2020-12-21 to 2021-01-19.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

FCC §15.247(b) (1) & RSS-247§ 5.1(b) &§ 5.4(b) - PEAK OUTPUT POWER MEASUREMENT

Applicable Standard

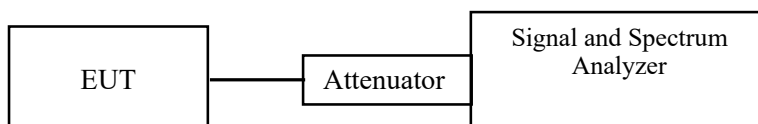
According to §15.247(b) (1), for frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. And for all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

For frequency hopping systems (FHSs) operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. The e.i.r.p. shall not exceed 4 W (see Section 5.4(e) for exceptions).

Frequency hopping systems (FHSs) 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, FHSs operating in the band 2400-2483.5 MHz 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 that the systems operate with an output power no greater than 0.125 W.

Test Procedure

1. Place the EUT on a bench and set in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.



Test Data

Environmental Conditions

Temperature:	23 °C
Relative Humidity:	57 %
ATM Pressure:	101.0 kPa

The testing was performed by Gavin Guo on 2020-12-21.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

FCC §15.247(d) & RSS-247 § 5.5 - BAND EDGES TESTING

Applicable Standard

According to FCC §15.247(d) & RSS-247 § 5.5.

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)) & RSS-Gen.

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

Test Data

Environmental Conditions

Temperature:	23 °C
Relative Humidity:	57 %
ATM Pressure:	101.0 kPa

The testing was performed by Gavin Guo on 2020-12-21.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

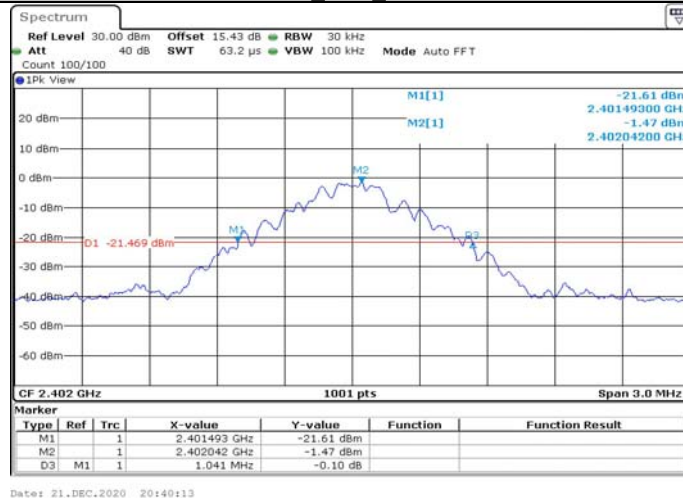
APPENDIX

Appendix A: 20dB Emission Bandwidth Test Result

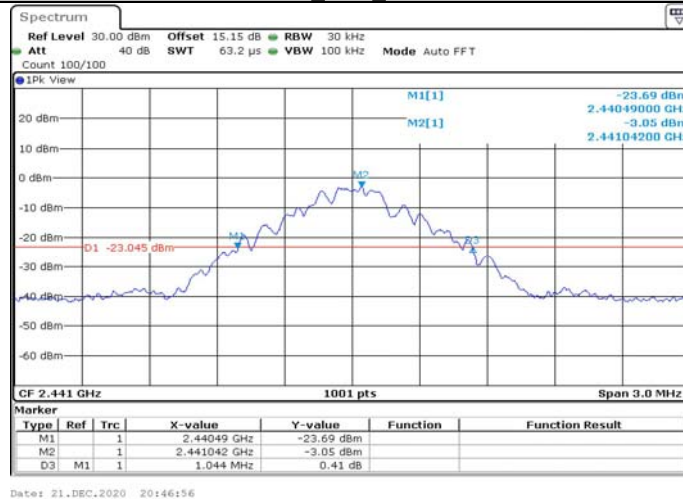
TestMode	Antenna	Channel	20db EBW[MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	1.041	---	PASS
		2441	1.044	---	PASS
		2480	1.044	---	PASS
2DH1	Ant1	2402	1.365	---	PASS
		2441	1.371	---	PASS
		2480	1.374	---	PASS
3DH1	Ant1	2402	1.308	---	PASS
		2441	1.308	---	PASS
		2480	1.329	---	PASS

Test Graphs

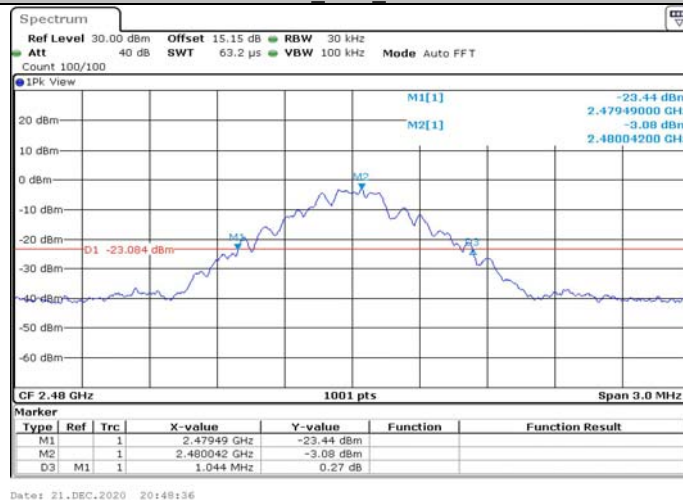
DH1_Ant1_2402



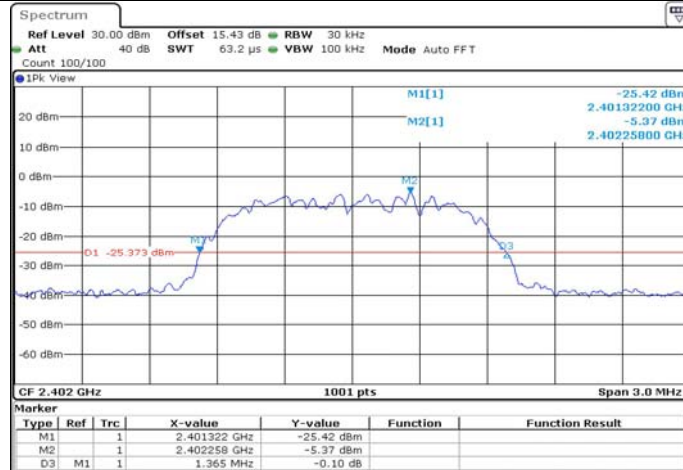
DH1_Ant1_2441



DH1_Ant1_2480

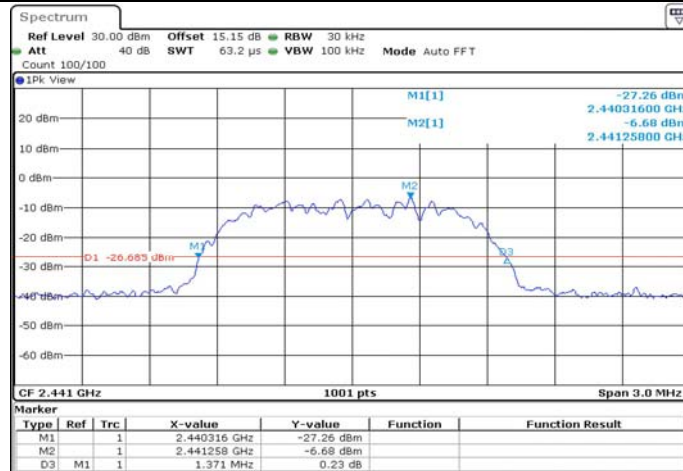


2DH1 Ant1 2402



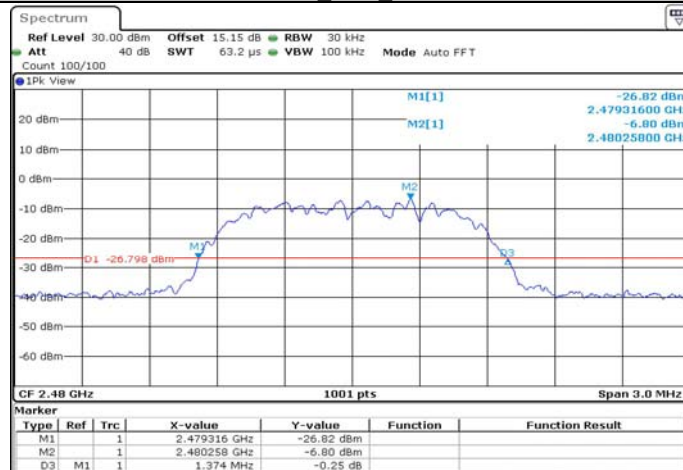
Date: 21.DEC.2020 20:58:53

2DH1 Ant1 2441

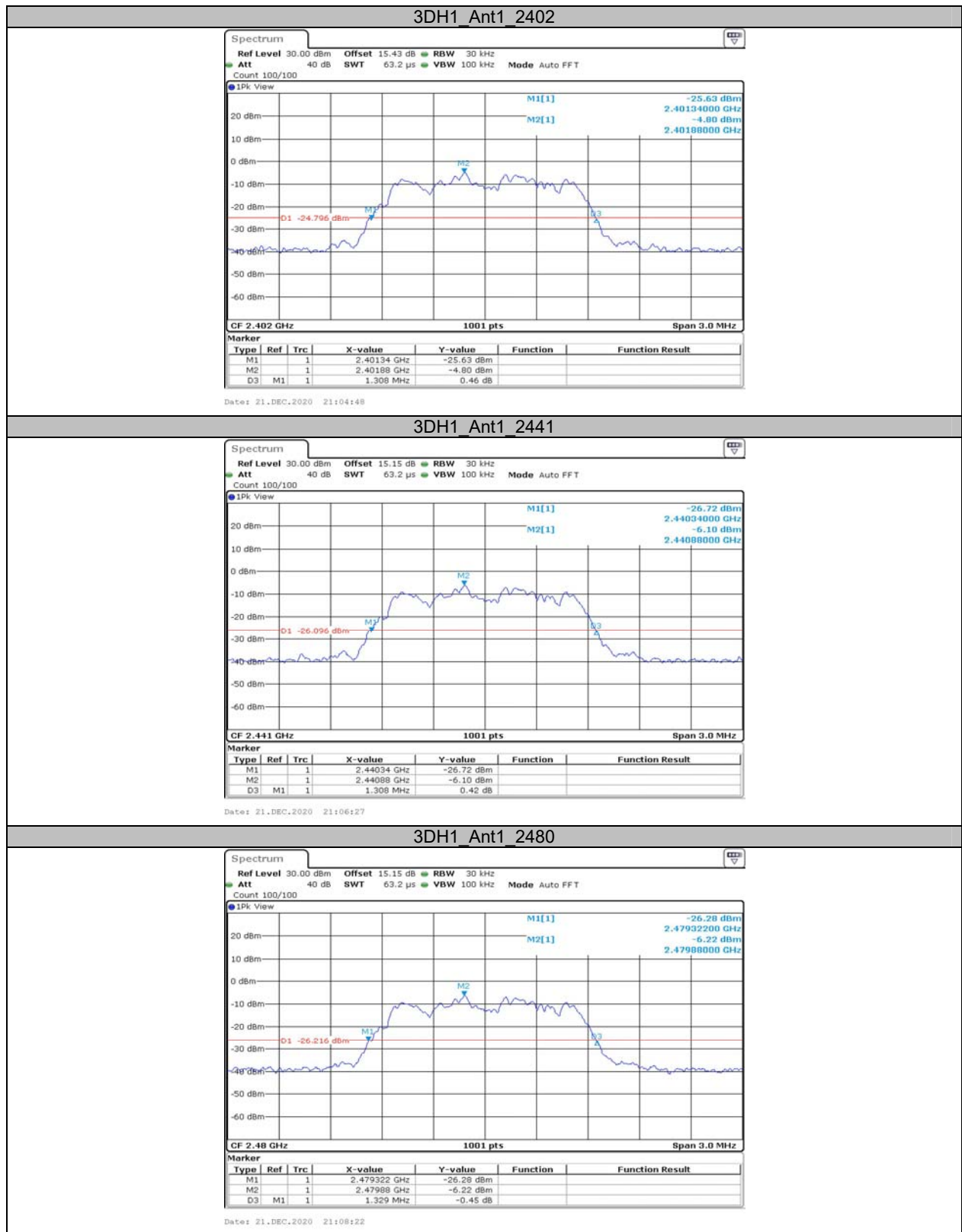


Date: 21.DEC.2020 21:00:42

2DH1 Ant1 2480



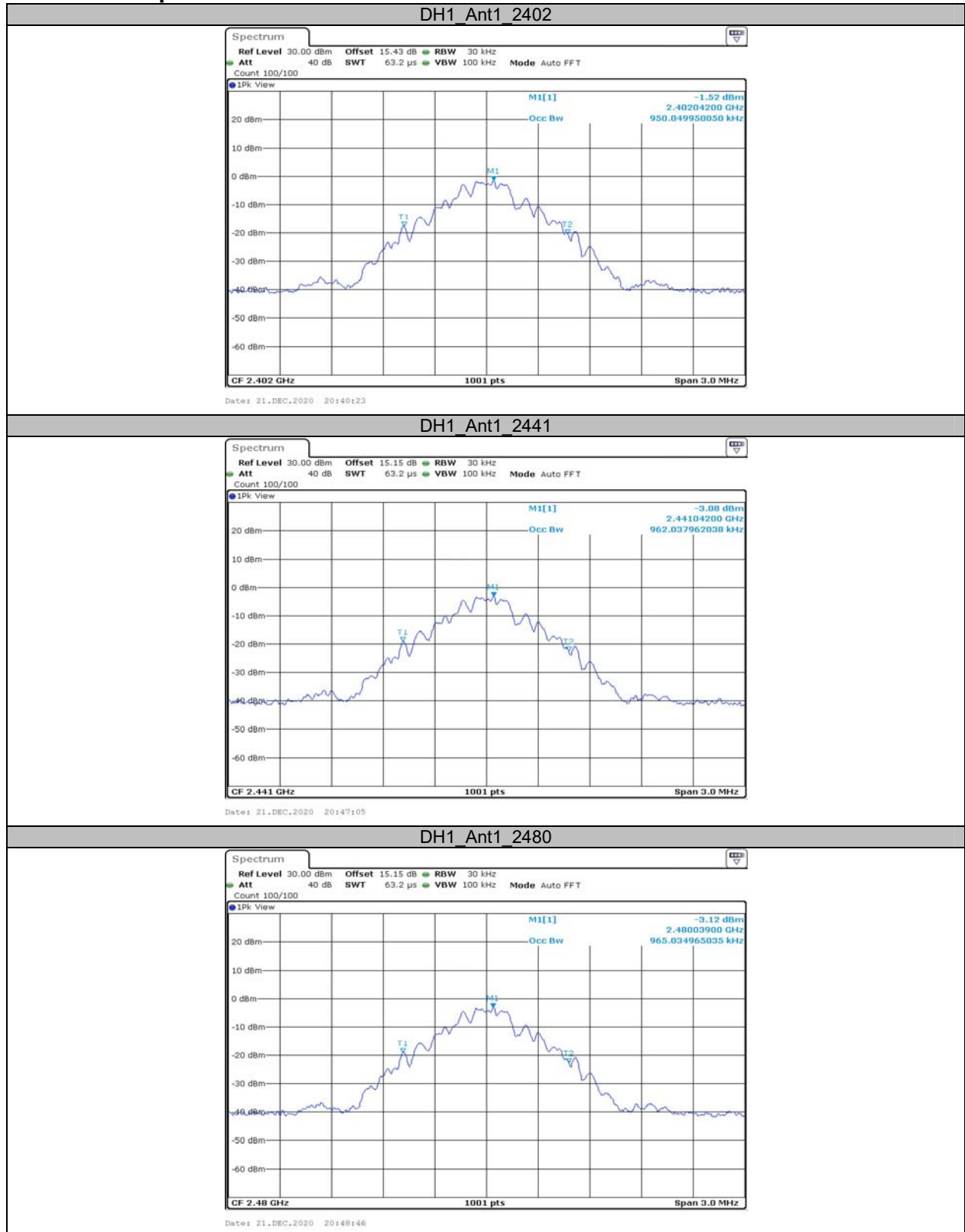
Date: 21.DEC.2020 21:02:33



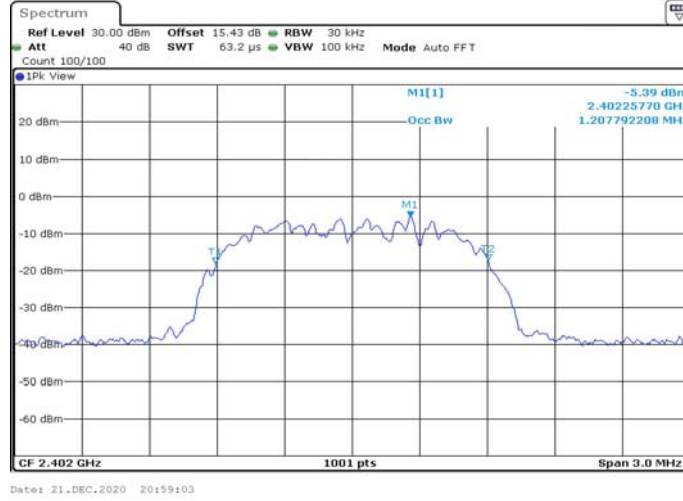
**Appendix B: Occupied Channel Bandwidth
Test Result**

TestMode	Antenna	Channel	OCB [MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	0.950	---	PASS
		2441	0.962	---	PASS
		2480	0.965	---	PASS
2DH1	Ant1	2402	1.208	---	PASS
		2441	1.214	---	PASS
		2480	1.220	---	PASS
3DH1	Ant1	2402	1.196	---	PASS
		2441	1.202	---	PASS
		2480	1.208	---	PASS

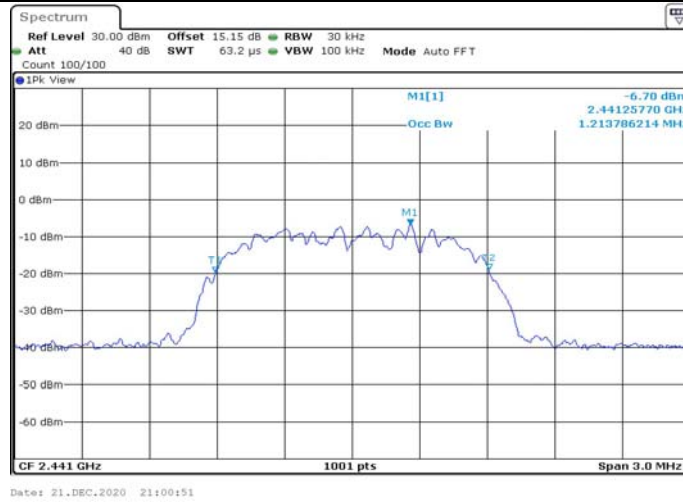
Test Graphs



2DH1 Ant1 2402

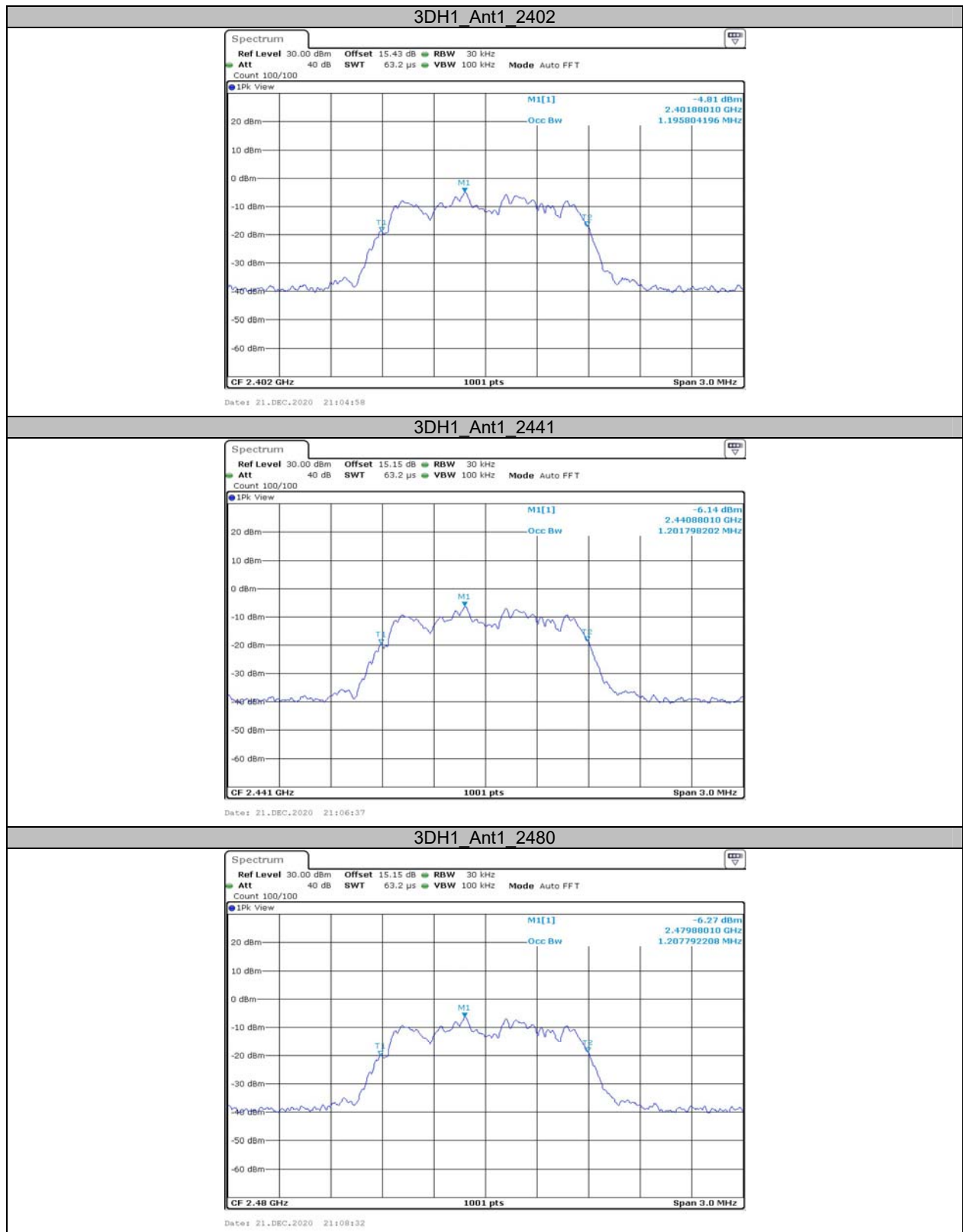


2DH1 Ant1 2441



2DH1 Ant1 2480





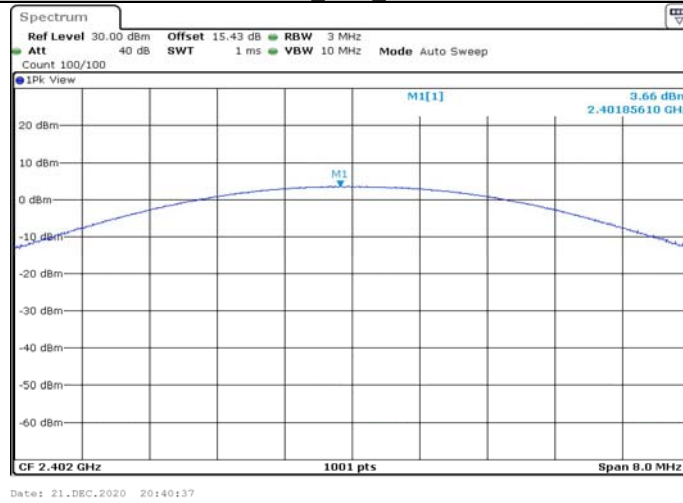
**Appendix C: Maximum conducted output power
Test Result**

TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
DH1	Ant1	2402	3.66	<=20.97	PASS
		2441	2.25	<=20.97	PASS
		2480	2.13	<=20.97	PASS
2DH1	Ant1	2402	4.65	<=20.97	PASS
		2441	3.47	<=20.97	PASS
		2480	3.35	<=20.97	PASS
3DH1	Ant1	2402	4.97	<=20.97	PASS
		2441	3.76	<=20.97	PASS
		2480	3.44	<=20.97	PASS

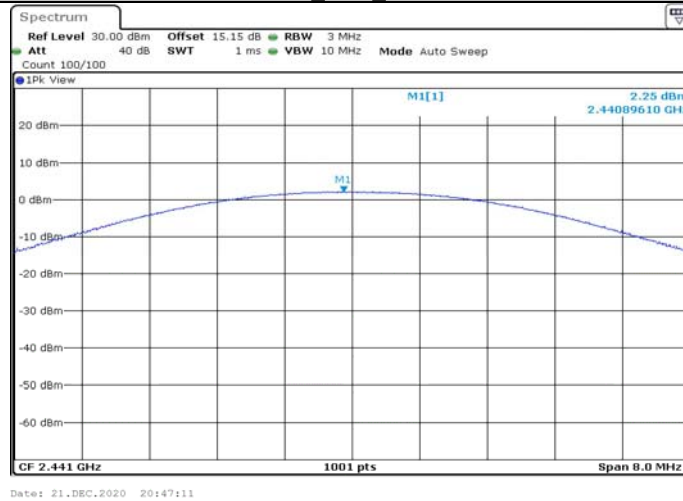
Note: the antenna gain is 0dBi, so the EIRP can meet the ISEDG' limit.

Test Graphs

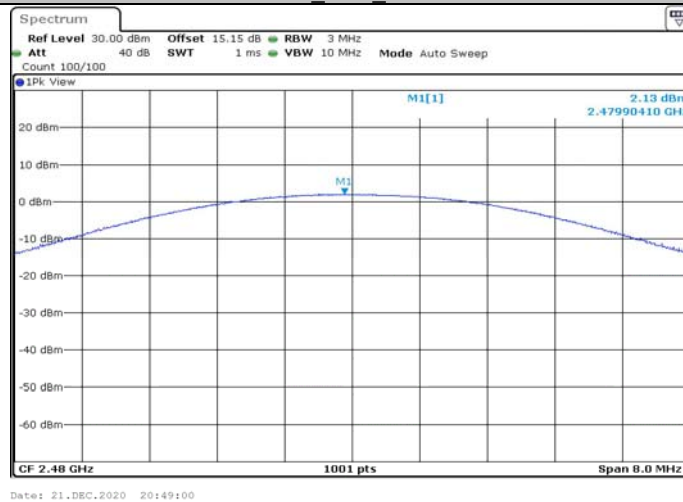
DH1_Ant1_2402



DH1_Ant1_2441



DH1_Ant1_2480

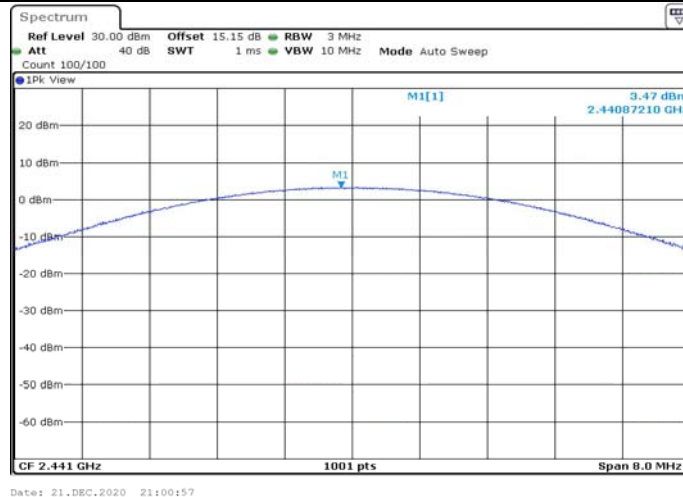


2DH1 Ant1 2402



Date: 21.DEC.2020 20:59:17

2DH1 Ant1 2441

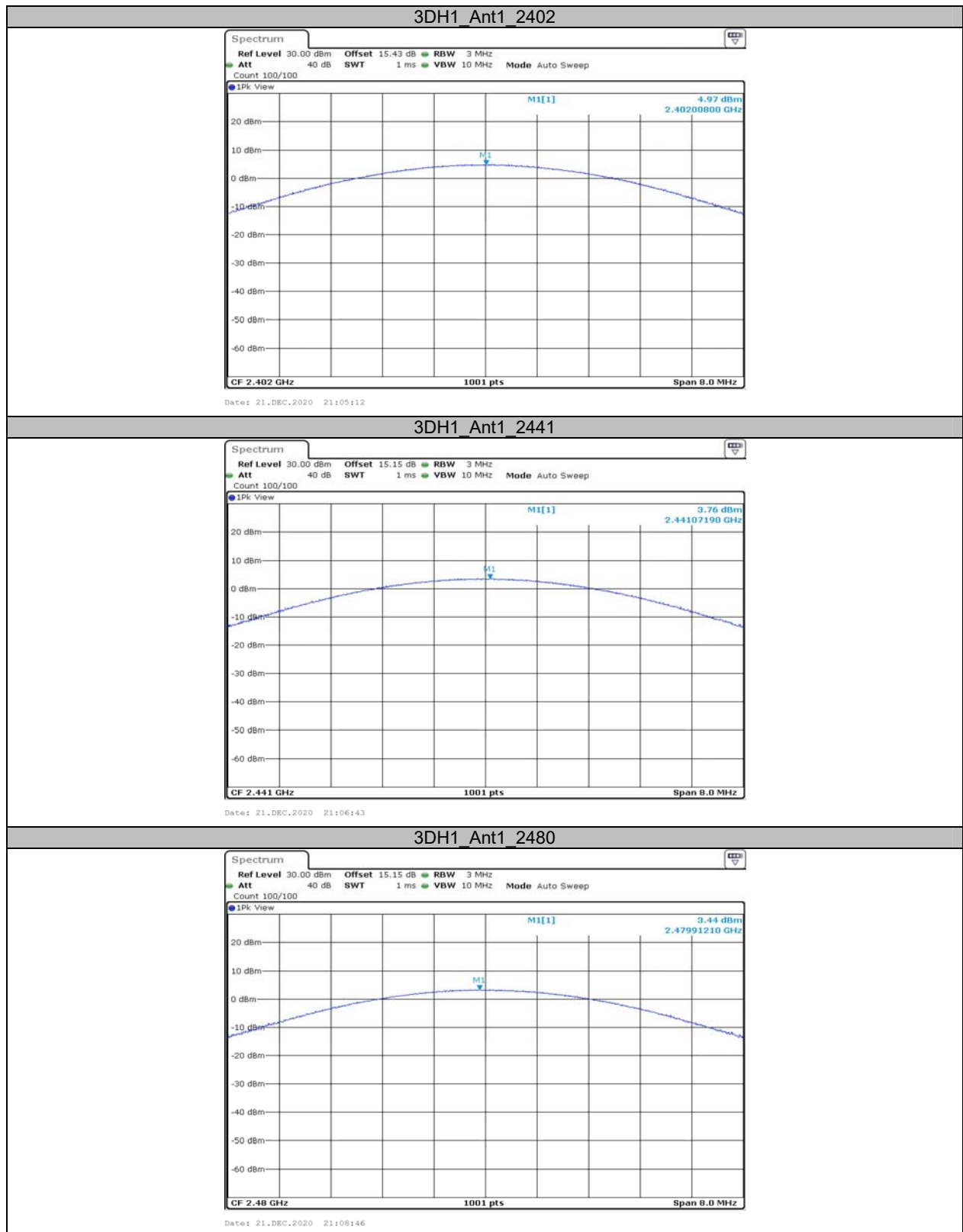


Date: 21.DEC.2020 21:00:57

2DH1 Ant1 2480



Date: 21.DEC.2020 21:02:57



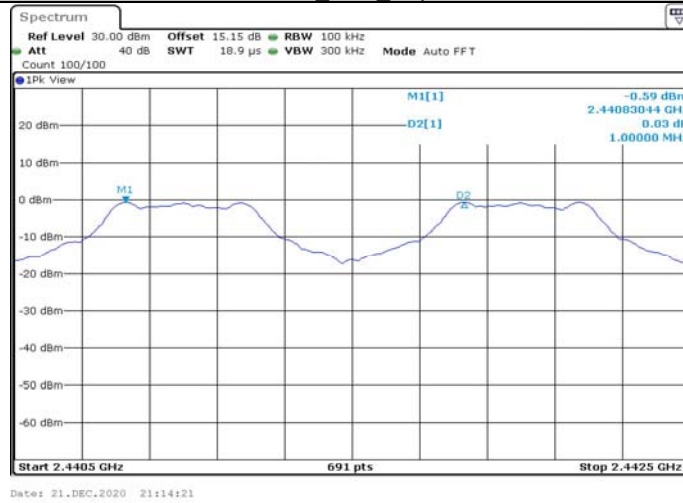
**Appendix D: Carrier frequency separation
Test Result**

TestMode	Antenna	Channel	Result[MHz]	Limit[MHz]	Verdict
DH1	Ant1	Hop	1.000	≥ 0.696	PASS
2DH1	Ant1	Hop	1.000	≥ 0.914	PASS
3DH1	Ant1	Hop	1.000	≥ 0.872	PASS

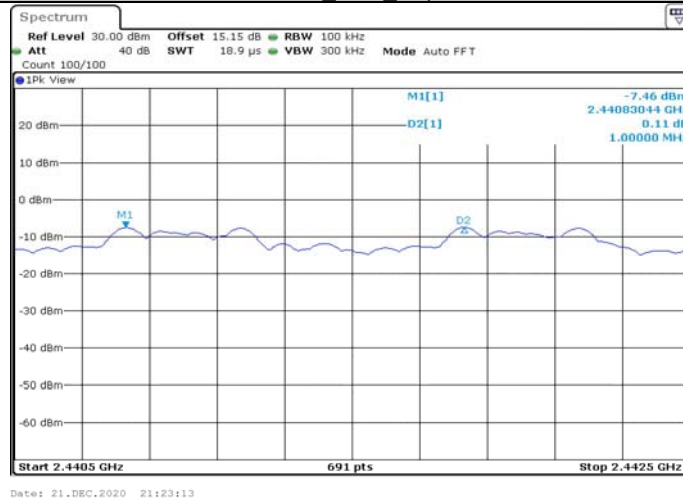
Note: the limit = $(2/3) * 20\text{dB}$ bandwidth

Test Graphs

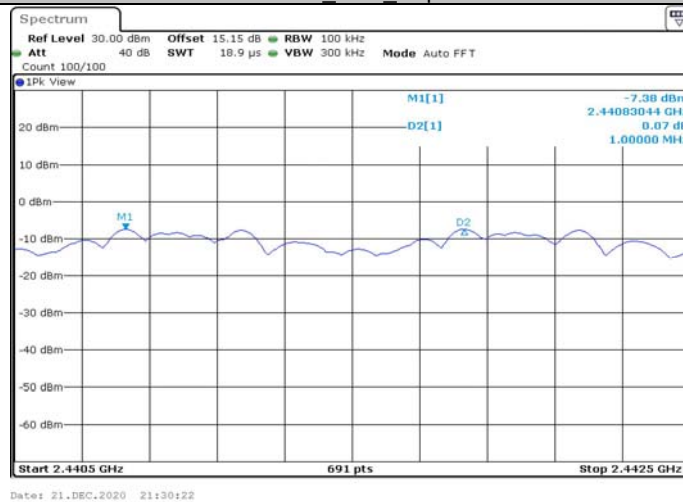
DH1_Ant1_Hop



2DH1_Ant1_Hop



3DH1_Ant1_Hop



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

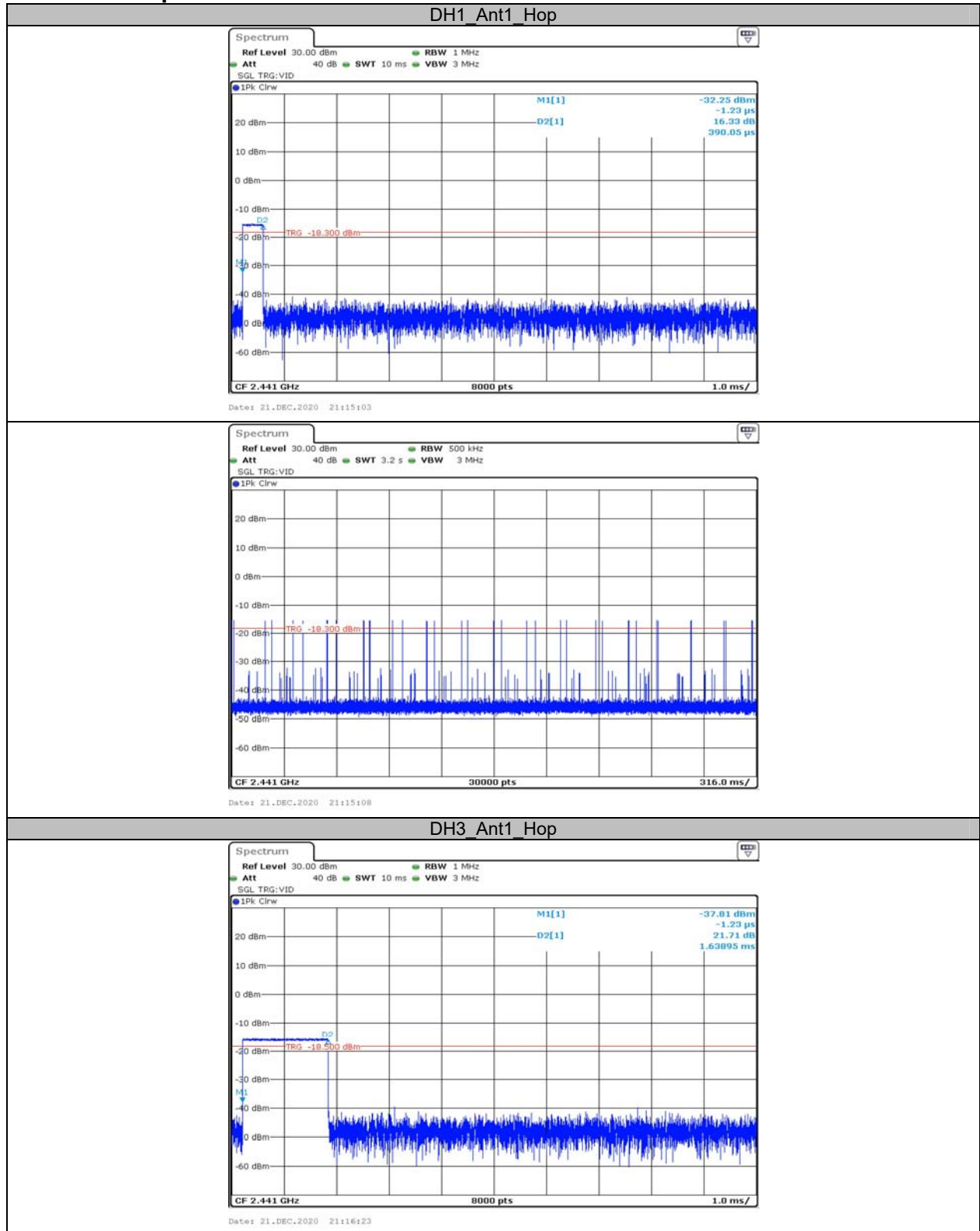
TestMode	Antenna	Channel	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH1	Ant1	Hop	0.39	330	0.129	<=0.4	PASS
DH3	Ant1	Hop	1.64	190	0.311	<=0.4	PASS
DH5	Ant1	Hop	2.88	110	0.317	<=0.4	PASS
2DH1	Ant1	Hop	0.404	330	0.133	<=0.4	PASS
2DH3	Ant1	Hop	1.646	160	0.263	<=0.4	PASS
2DH5	Ant1	Hop	2.886	120	0.346	<=0.4	PASS
3DH1	Ant1	Hop	0.403	320	0.129	<=0.4	PASS
3DH3	Ant1	Hop	1.645	160	0.263	<=0.4	PASS
3DH5	Ant1	Hop	2.89	130	0.376	<=0.4	PASS

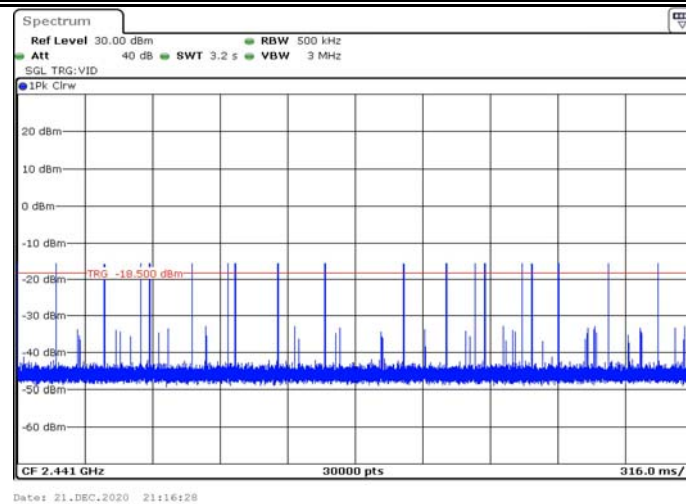
Note 1: A period time= $0.4 \times 79 = 31.6$ (S), Result=BurstWidth*Totalhops

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

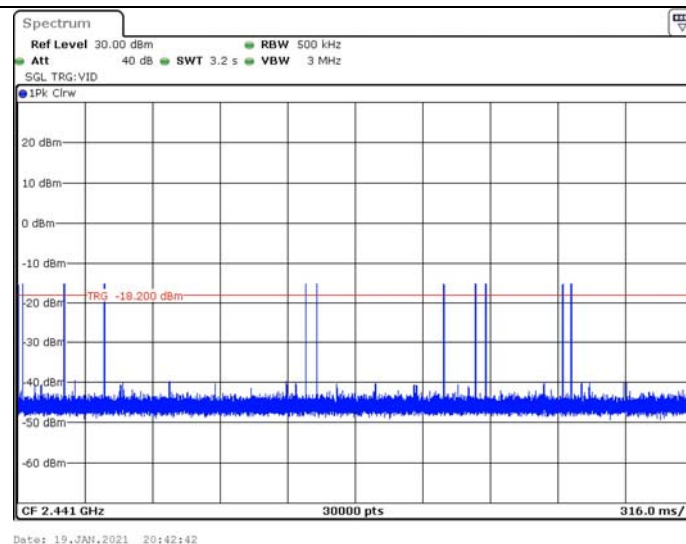
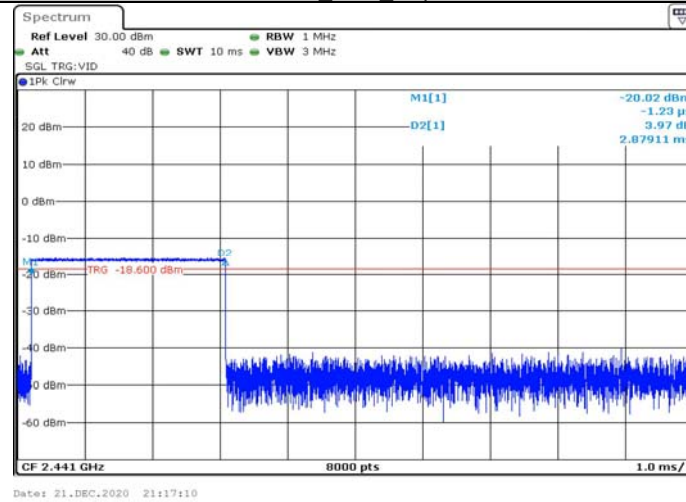
Note 3: Hopping Number in 3.16s=Total of highest signals in 3.16s (Second high signals were other channel)

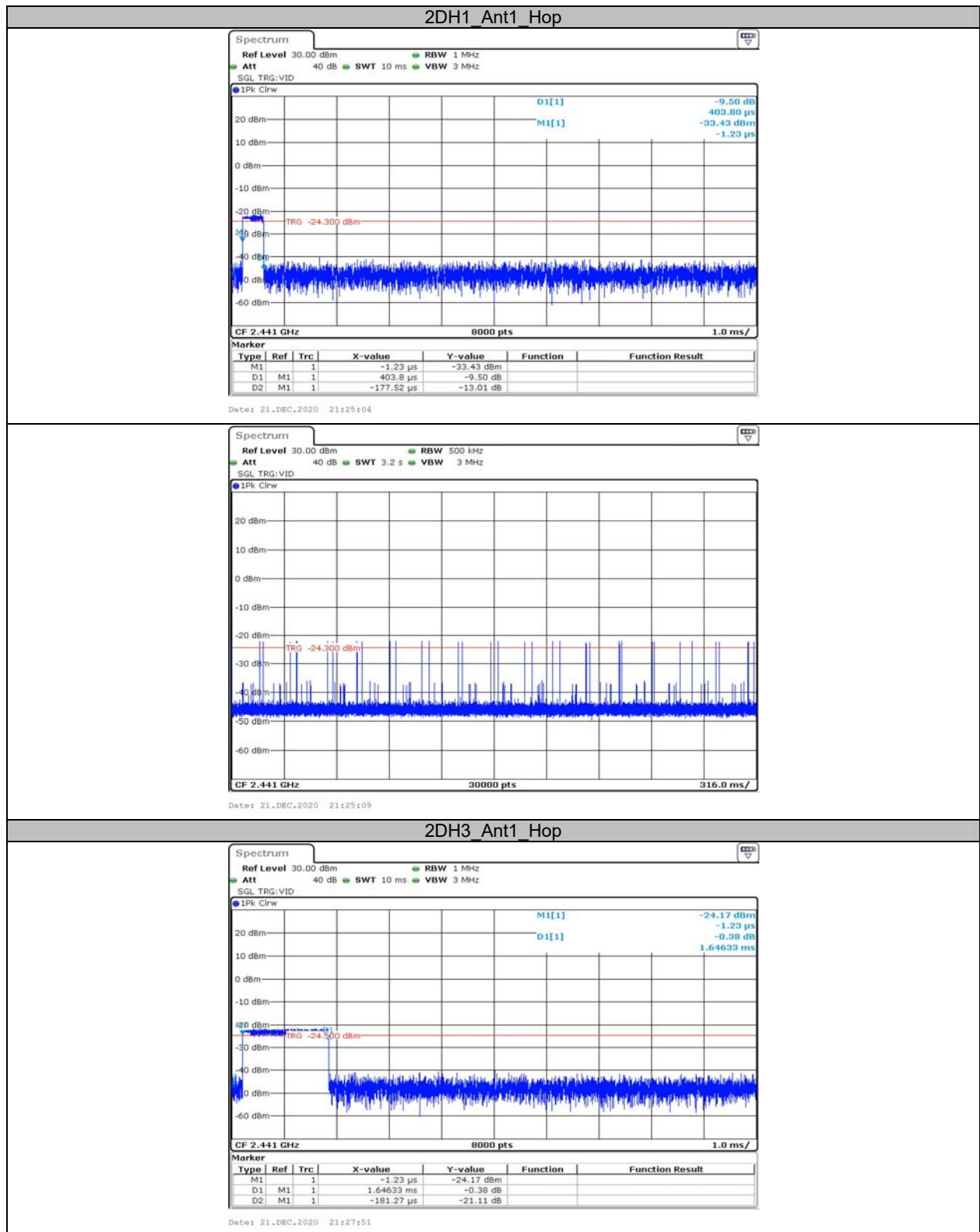
Test Graphs

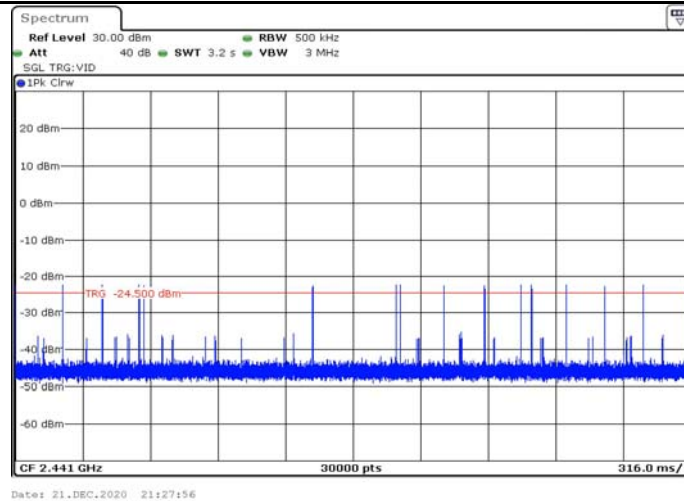




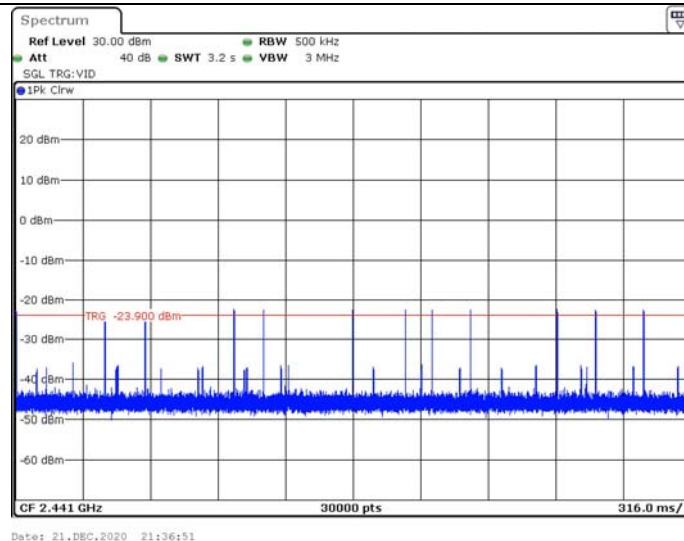
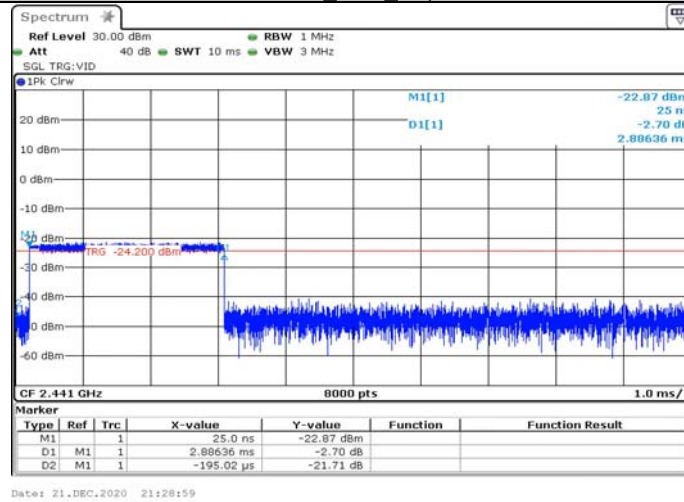
DH5 Ant1 Hop

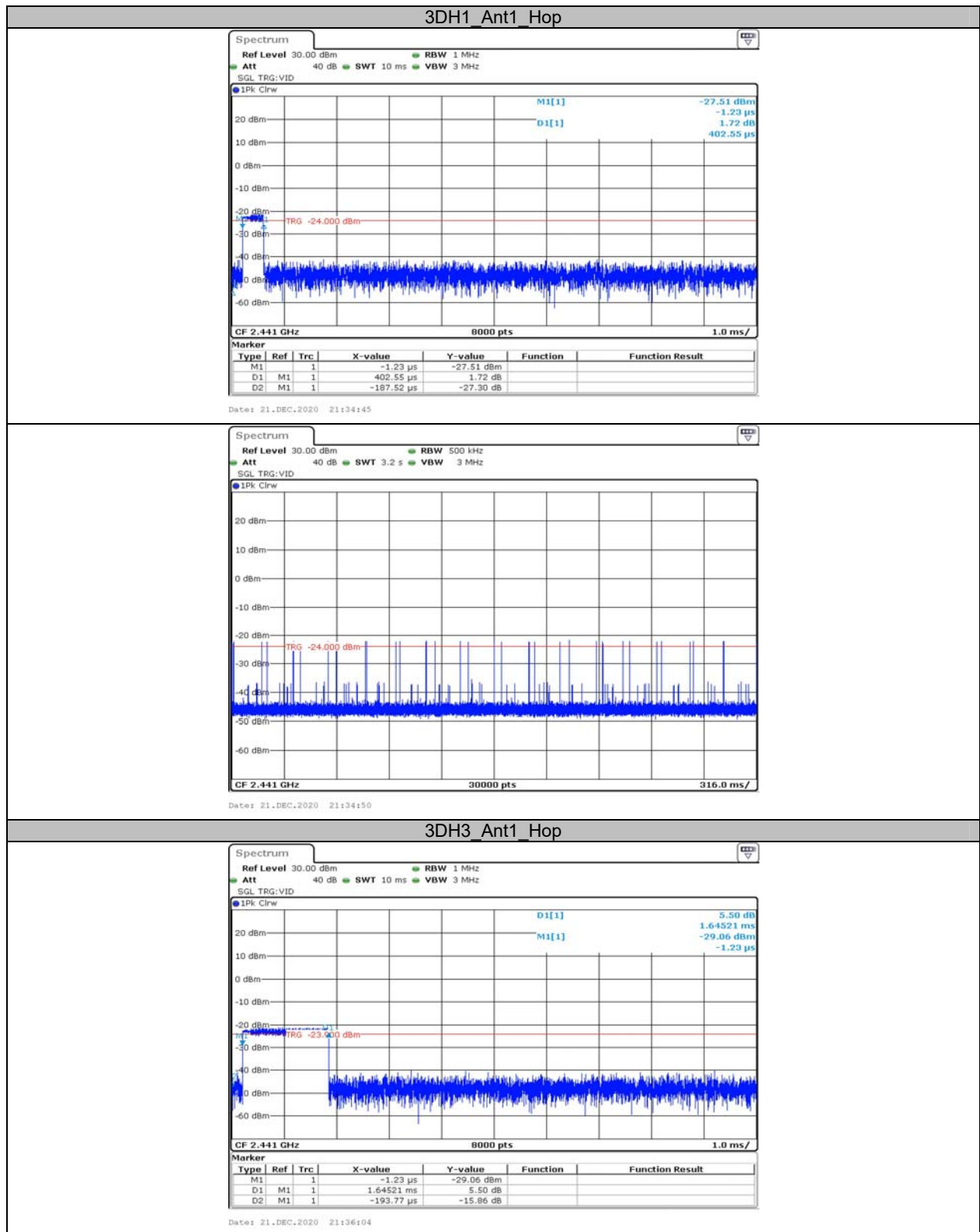


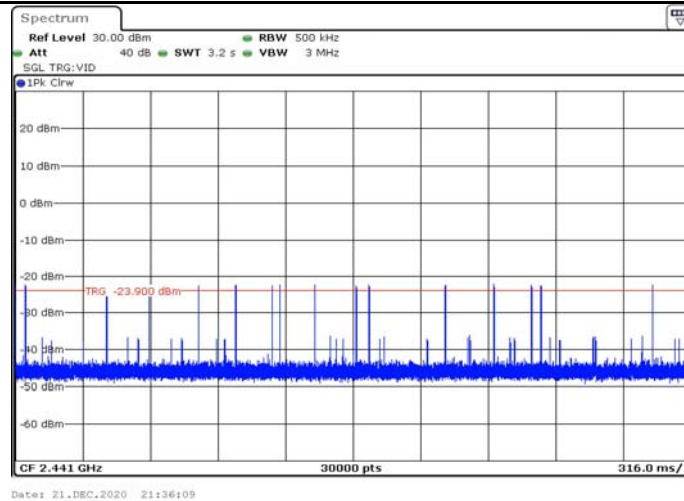




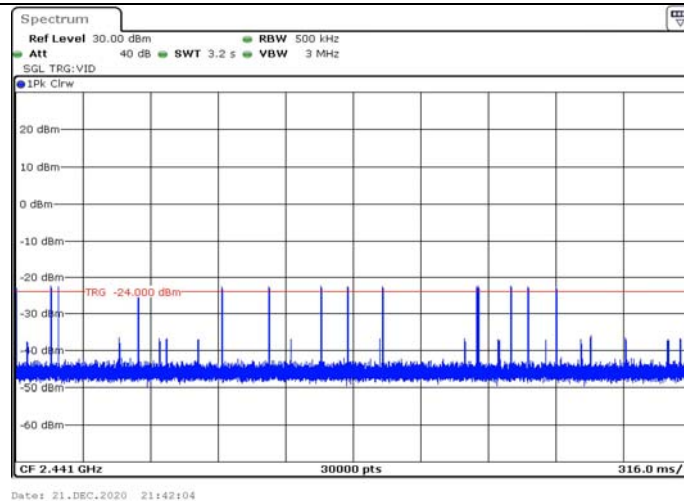
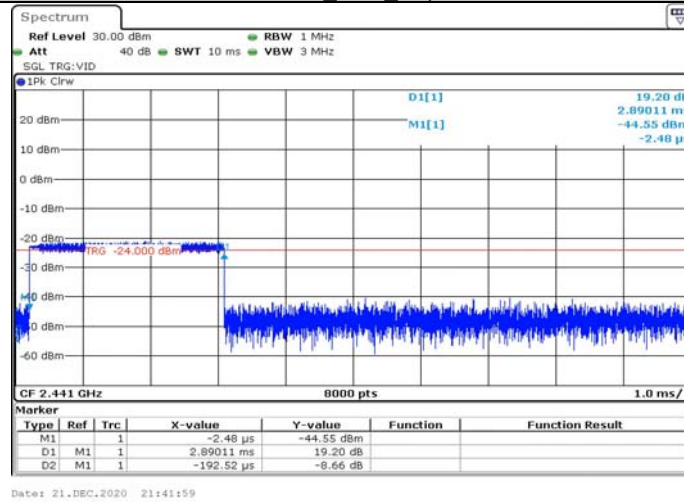
2DH5_Ant1_Hop





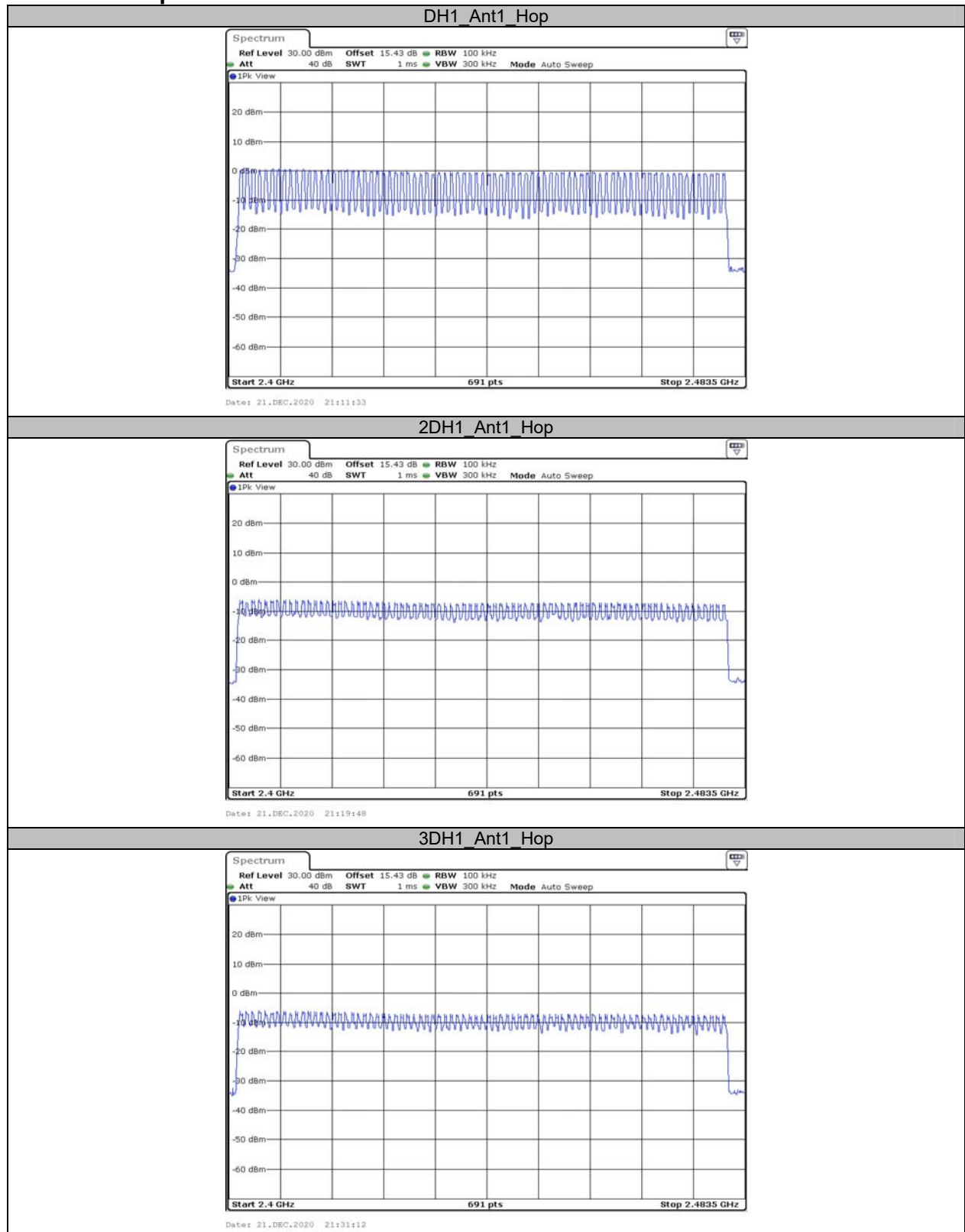


3DH5_Ant1_Hop

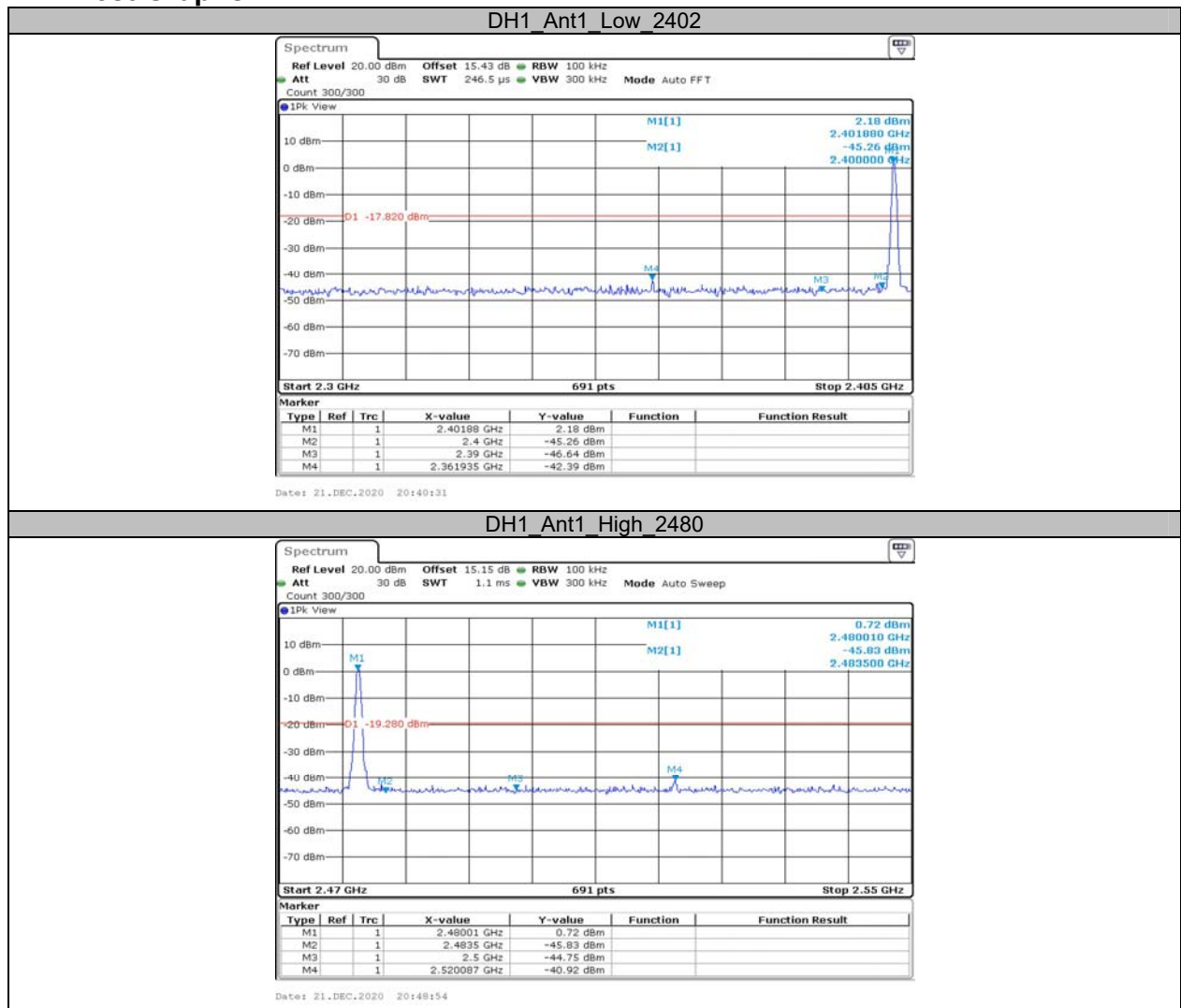


**Appendix F: Number of hopping channels
Test Result**

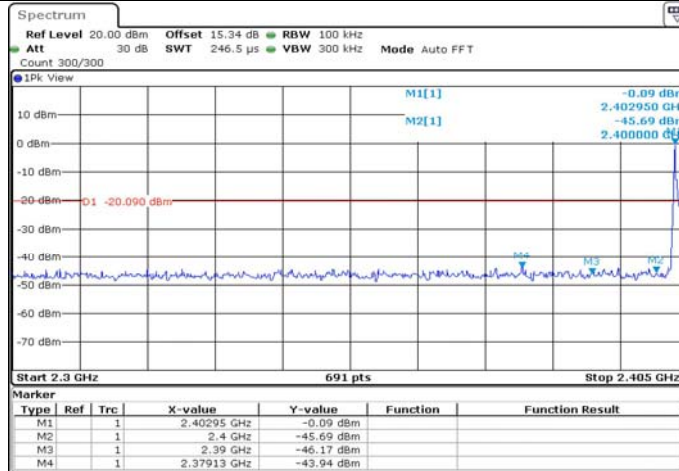
TestMode	Antenna	Channel	Result[Num]	Limit[Num]	Verdict
DH1	Ant1	Hop	79	>=15	PASS
2DH1	Ant1	Hop	79	>=15	PASS
3DH1	Ant1	Hop	79	>=15	PASS

Test Graphs

Appendix G: Band edge measurements Test Graphs

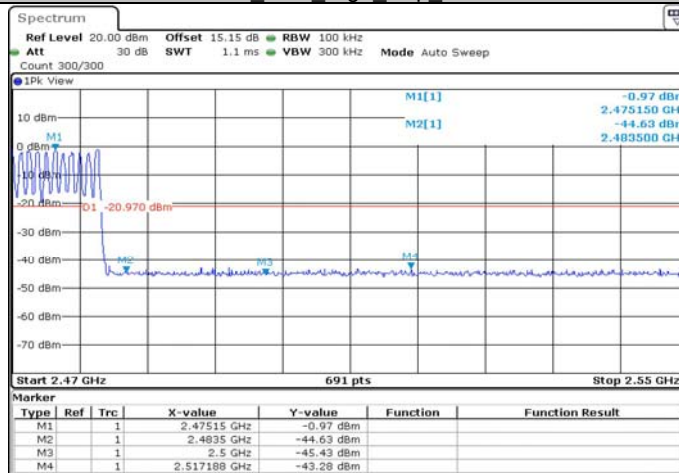


DH1_Ant1_Low_Hop_2402



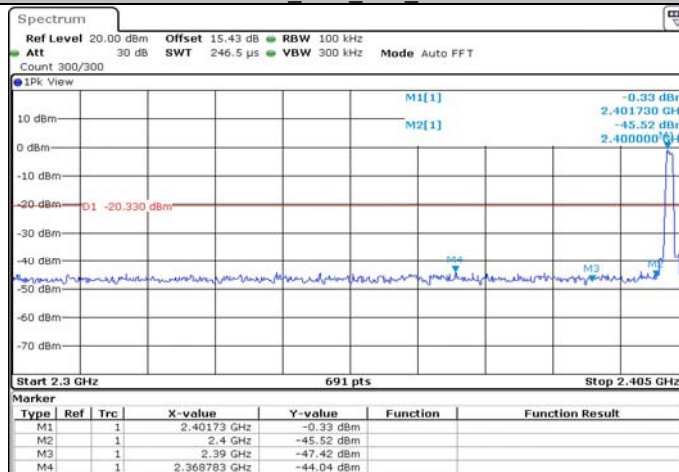
Date: 21.DEC.2020 21:10:40

DH1_Ant1_High_Hop_2480



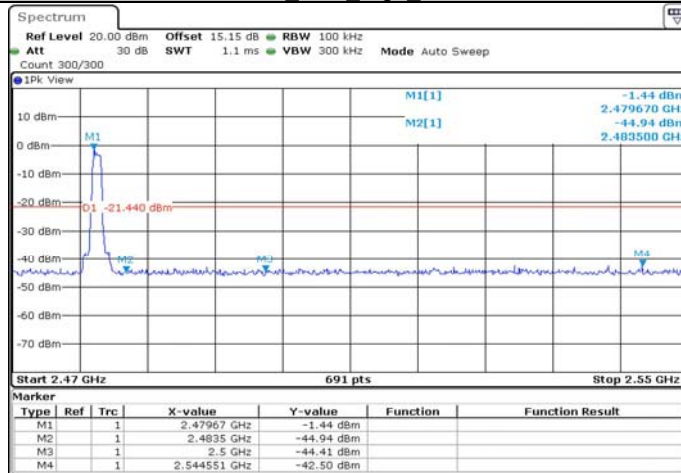
Date: 21.DEC.2020 21:12:01

2DH1_Ant1_Low_2402



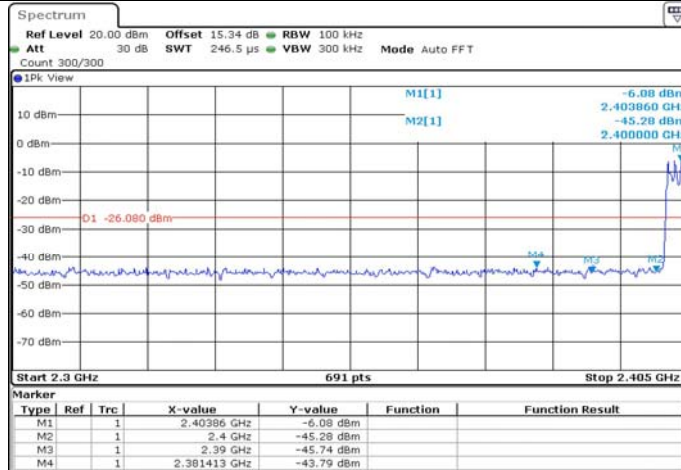
Date: 21.DEC.2020 20:59:11

2DH1_Ant1_High_2480



Date: 21.DEC.2020 21:02:51

2DH1_Ant1_Low_Hop_2402

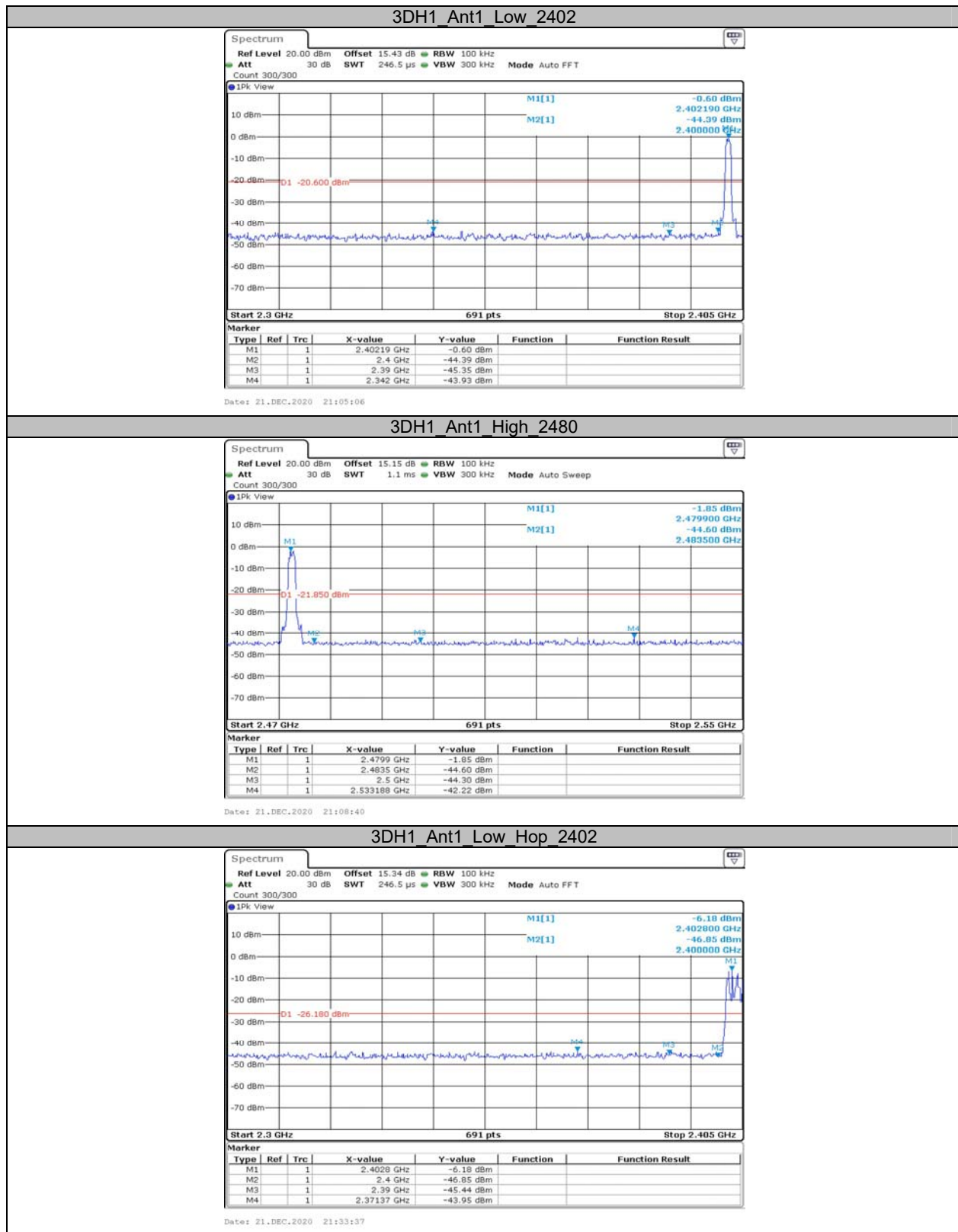


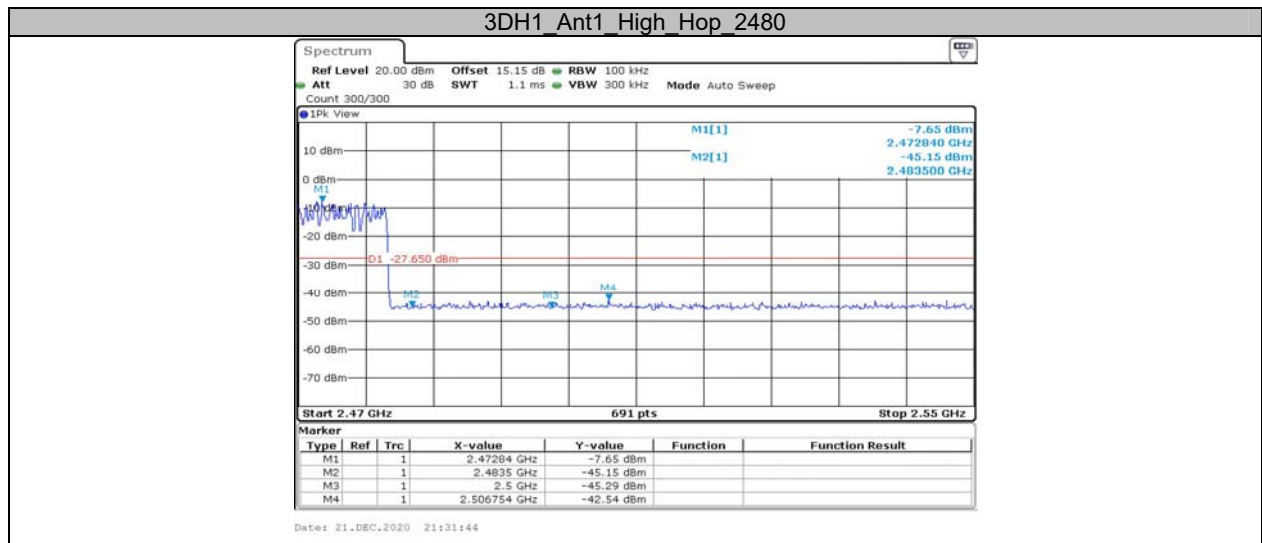
Date: 21.DEC.2020 21:22:16

2DH1_Ant1_High_Hop_2480



Date: 21.DEC.2020 21:20:15





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