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RSS-GEN ISSUE 5, FEBRUARY 2021 AMENDMENT 2  
RSS-247, ISSUE 2, FEBRUARY 2017  
TEST REPORT

For

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**ISED: VTECH TELECOMMUNICATIONS LIMITED**

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**FCC ID: EW780-1962-01**  
**IC: 1135B-80196201**

<b>Report Type:</b> Original Report	<b>Product Type:</b> Baby Monitor
<b>Report Number:</b> SZ1211008-51393E-RF-00B	
<b>Report Date:</b> 2021-11-02	
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## GENERAL INFORMATION

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

Product	Baby Monitor
Tested Model	VM5255 PU
Multiple Models	VM5255-2 PU, VM5255-ab PU, VM5263 PU, VM5263-2 PU, VM5263-ab PU, VM5463 PU, VM5463-2 PU, VM5463-ab PU, LM918-2W PU, VM5254 PU (a=any alphanumeric character or blank is presenting number of baby unit; b = any alphanumeric character or blank is presenting color of enclosure.)
Model Differences	Refer to the DoS letter
HVIN	35-201795PU
Frequency Range	2405~2475MHz
Maximum conducted Peak output power	17.47dBm
Modulation Technique	GFSK
Antenna Specification*	0dBi(It is provided by the applicant)
Voltage Range	DC 3.8V from battery or DC 5.0V from adapter
Sample number	SZ1211008-51393E-RF-S2 (for RF Conducted test) SZ1211008-51393E-RF-S4 (for radiated test) ( Assigned by ATC)
Received date	2021-10-08
Sample/EUT Status	Good condition
Adapter information	Model: VT05EUS05100 Input: AC 100-240V~50/60Hz, 0.15A Output: DC 5.0V, 1.0A

### Objective

This test report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission rules and RSS-GEN Issue 5, February 2021 Amendment 2 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, 15.247 rules, RSS-GEN and RSS-247.

### 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 and RSS-GEN Issue 5, February 2021 Amendment 2 and RSS-247, Issue 2, February 2017.

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

## Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		5%
RF output power, conducted		0.73dB
Unwanted Emission, conducted		1.6dB
AC Line conducted emission		2.72dB
Emissions, Radiated	30MHz - 1GHz	4.28dB
	1GHz - 18GHz	4.98dB
	18GHz - 26.5GHz	5.06dB
Temperature		1 °C
Humidity		6%
Supply voltages		0.4%

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

## Test Facility

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

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

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

## SYSTEM TEST CONFIGURATION

### Description of Test Configuration

The system was configured for testing in an engineering mode.

32 channels are provided:

Channel	TX Frequency (MHz)	Channel	TX Frequency (MHz)
1	2405	17	2439
2	2407	18	2441
3	2409	19	2444
4	2411	20	2446
5	2413	21	2450
6	2415	22	2452
7	2418	23	2454
8	2420	24	2456
9	2422	25	2458.5
10	2424	26	2460.5
11	2426	27	2462.5
12	2428	28	2467
13	2430	29	2469
14	2433	30	2471
15	2435	31	2473
16	2437	32	2475

EUT was tested with Channel 1, 17 and 32.

The frequency range of the system is operating from 2405MHz to 2475MHz. There are totally 32 non-overlapping channel, and 16 active channels out of the 32 channels at same time. The 16 active channels are selected in pseudo random manner by default. The remaining 16 channels are spare channels which will be exchanged with active channels one at a time when any one of the active channels jamming with noise. Once an active channel has noise jamming during frequency hopping, it will be marked as dirty channel and exchanged with a spare channel after a dwell time. The spare channel is selected randomly so that at any time the active channels are always equally used in a pseudo random manner. The dirty channel become part of spare channels and can be used in active channels again after all the other spare channels have been used.

### EUT Exercise Software

“SecureCRTPortable.exe” software was used to the EUT tested and power level is default\*. The software and power level was provided by the applicant.

### Special Accessories

No special accessory.

## Equipment Modifications

No modification was made to the EUT tested.

## Support Equipment List and Details

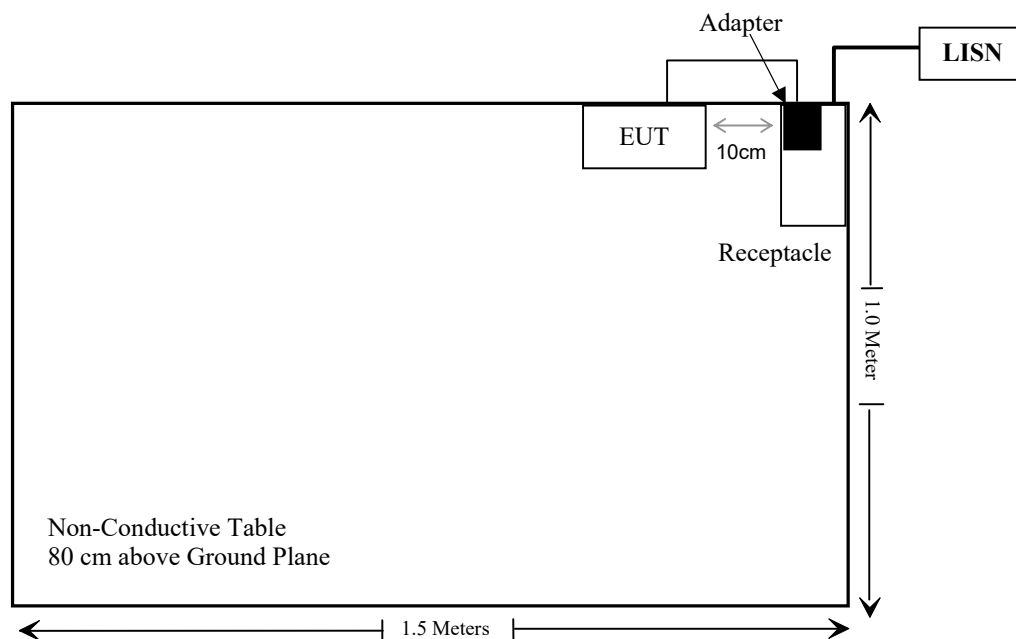
Manufacturer	Description	Model	Serial Number
/	/	/	/

## External I/O Cable

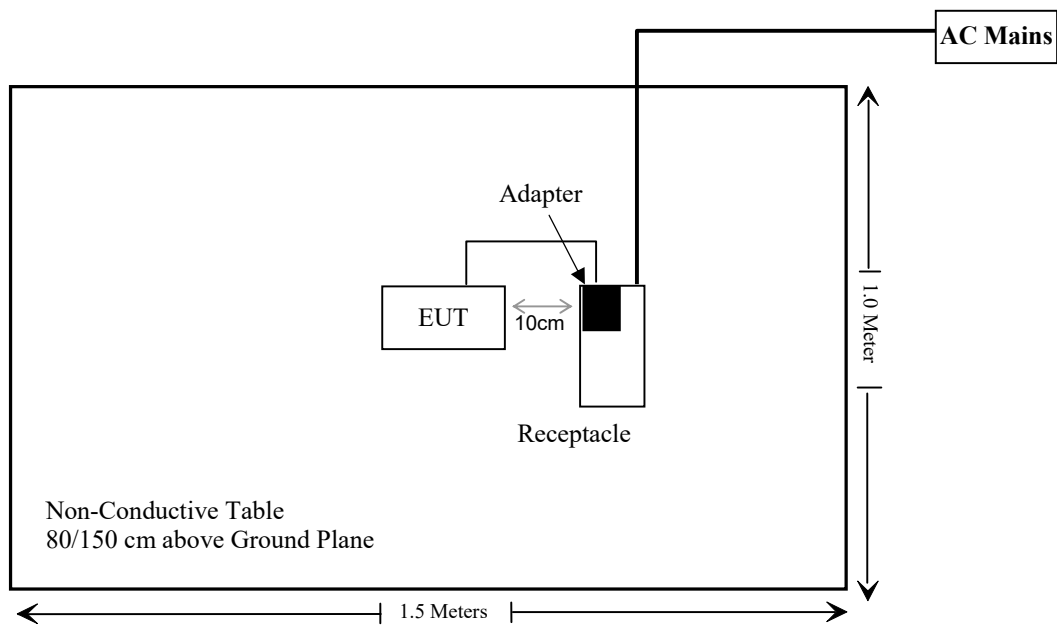
Cable Description	Length (m)	From Port	To
Un-shielding Un-Detachable DC Cable	2.0	Adapter	EUT

## Block Diagram of Test Setup

For conducted emission



For radiated emission





## SUMMARY OF TEST RESULTS

FCC Rules	ISED Rules	Description of Test	Result
FCC§15.247 (i), §1.1307 (b) (1) & §2.1093	RSS-102	RF Exposure (SAR)	Compliant
§15.203	RSS-Gen §6.8	Antenna Requirement	Compliant
§15.207(a)	RSS-Gen §8.8	AC Line Conducted Emissions	Compliant
§15.205, §15.209 & §15.247(d)	RSS-247 § 5.5	Radiated Emissions	Compliant
§15.247(a)(1)	RSS- Gen§6.7, RSS-247 § 5.1 (a)	99% Occupied Bandwidth & 20 dB Emission Bandwidth	Compliant
§15.247(a)(1)	RSS-247 § 5.1 (b)	Channel Separation Test	Compliant
§15.247(a)(1)(iii)	RSS-247 § 5.1 (d)	Time of Occupancy (Dwell Time)	Compliant
§15.247(a)(1)(iii)	RSS-247 § 5.1 (d)	Quantity of hopping channel Test	Compliant
§15.247(b)(1)	RSS-247 § 5.1(b) & § 5.4(b)	Peak Output Power Measurement	Compliant
§15.247(d)	RSS-247 § 5.5	Band edges	Compliant

**TEST EQUIPMENT LIST**

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
<b>Conducted Emissions Test</b>					
Rohde& Schwarz	Test Receiver	ESPI3	100396	2020/12/24	2021/12/23
R & S	L.I.S.N.	ENV216	101314	2020/12/25	2021/12/24
Anritsu Corp	50ΩCoaxial Switch	MP59B	6200506474	2020/12/25	2021/12/24
Unknown	RF Coaxial Cable	N-2m	No.2	2020/12/25	2021/12/24
Conducted Emission Test Software: e3 19821b(V9)					
<b>Radiated Emission Test</b>					
Rohde& Schwarz	Test Receiver	ESR	101817	2020/12/24	2021/12/23
SONOMA INSTRUMENT	Amplifier	310 N	186131	2020/12/25	2021/12/24
Anritsu Corp	50 Coaxial Switch	MP59B	6100237248	2020/12/25	2021/12/24
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2020/01/05	2023/01/04
OREGON SCIENTIFIC	Temperature & Humidity Meter	JB913R	GZ-WS004	2020/01/02	2023/01/01
Radiated Emission Test Software: EZ_EMC V 1.1.4.2					
Unknown	RF Coaxial Cable	N-5m	No.3	2020/12/25	2021/12/24
Unknown	RF Coaxial Cable	N-1m	No.5	2020/12/25	2021/12/24
Rohde&Schwarz	Spectrum Analyzer	FSV40	101495	2020/12/24	2021/12/23
A.H. Systems, inc.	Preamplifier	PAM-0118P	531	2021/07/08	2022/07/07
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	2020/01/05	2023/01/04
Schwarzbeck	HORN ANTENNA	BBHA9170	9170-359	2020/01/05	2023/01/04
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2020/11/28	2021/11/27
Wainwright	High Pass Filter	WHKX3.6/18 G-10SS	5	2020/12/25	2021/12/24
<b>RF Conducted Test</b>					
Rohde & Schwarz	Spectrum Analyzer	FSV-40	101495	2020/12/24	2021/12/23
Rohde & Schwarz	Open Switch and Control Unit	OSP120 +OS P-B157	101244 + 100866	2020/12/24	2021/12/23

**\* Statement of Traceability:** Shenzhen Accurate Technology Co., Ltd. attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

## **FCC§15.247 (i), §1.1307 (b) (1) &§2.1093 & RSS-102- RF EXPOSURE INFORMATION**

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### **Applicable Standard**

FCC§1.1307(b) and §2.1093.

According to RSS-102, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

### **Test Result**

**Pass**

Please refer to the SAR report: SZ1211008-51393E-SA.

## 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 arrangements which were permanently attached and the gain is 0dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Type	Antenna Gain	Impedance
Monopole	0dBi	50 Ω

**Result:** Compliance.

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

### **Applicable Standard**

FCC §15.207(a), RSS-GEN § 8.8

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  $\mu$ H / 50  $\Omega$  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.

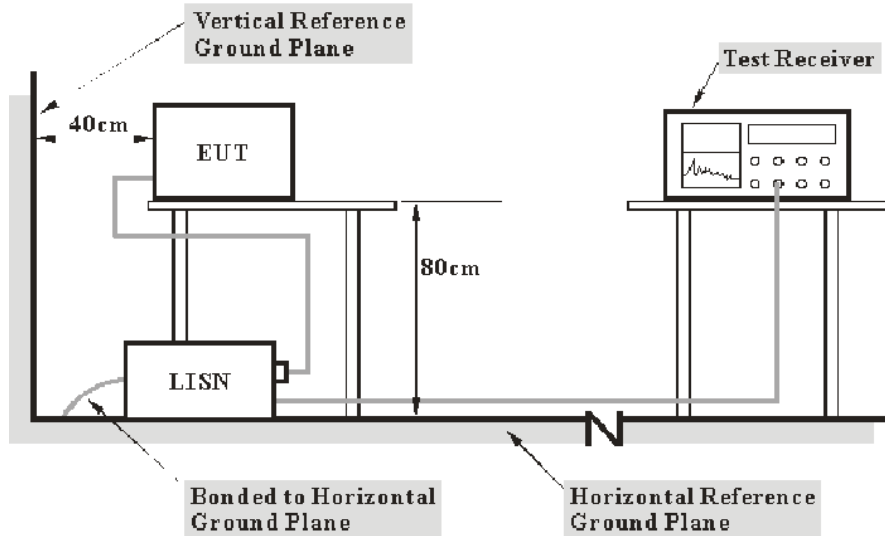
<b>Table 4 - AC Power Lines Conducted Emission Limits</b>		
<b>Frequency range (MHz)</b>	<b>Conducted limit (dB<math>\mu</math>V)</b>	
	<b>Quasi-Peak</b>	<b>Average</b>
0.15 – 0.5	66 to 56 <sup>1</sup>	56 to 46 <sup>1</sup>
0.5 – 5	56	46
5 – 30	60	50

**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 adapter was connected to the outlet of the LISN.

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

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

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

$$\text{Over limit} = \text{Result} - \text{Limit}$$

## Test Data

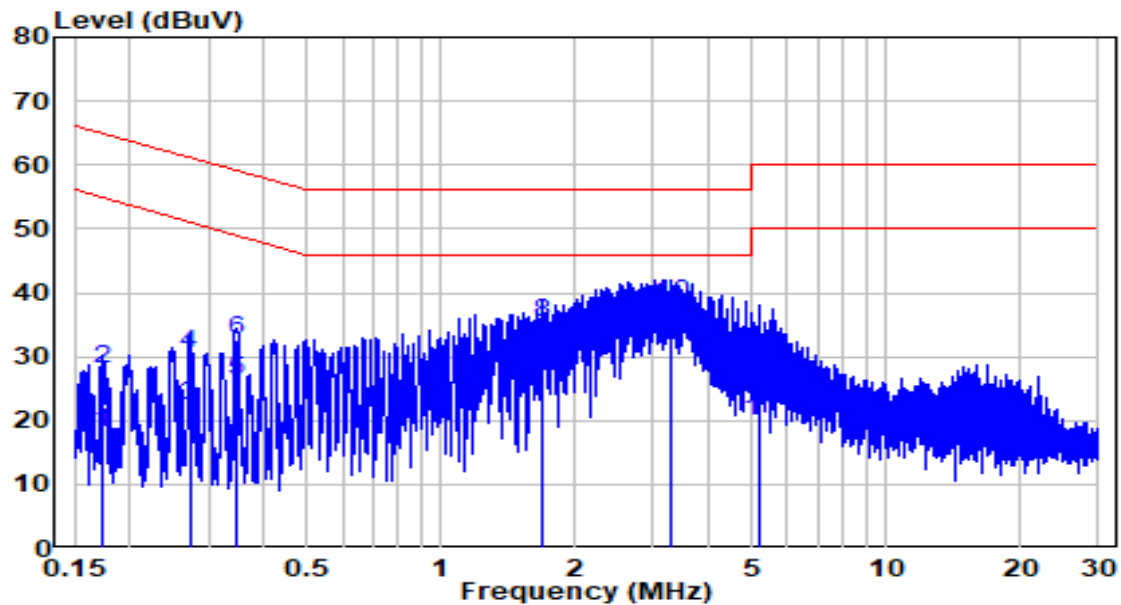
### Environmental Conditions

<b>Temperature:</b>	23 °C
<b>Relative Humidity:</b>	48 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Bin Deng on 2021-10-26.*

*EUT operation mode: Transmitting*

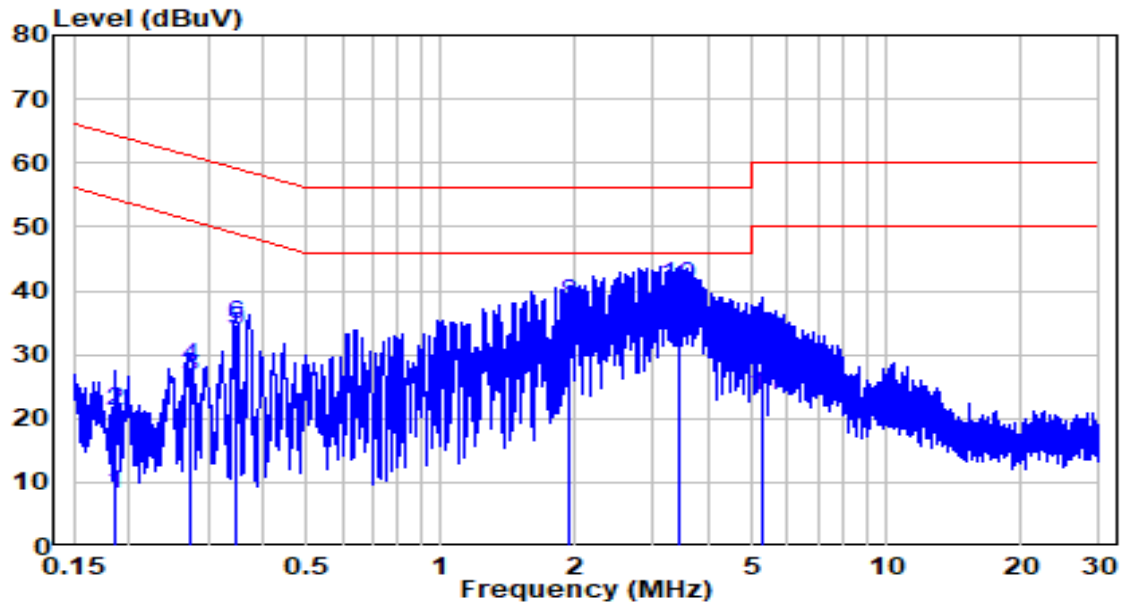
## AC 120V/60 Hz, Line



No.	Frequency	Reading	Correct	Result	Limit	Over Limit	Remark	Phase
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)		
1	0.172	8.16	9.85	18.01	54.85	-36.84	Average	Line
2	0.172	18.08	9.85	27.93	64.85	-36.92	QP	Line
3	0.272	12.50	9.80	22.30	51.05	-28.75	Average	Line
4	0.272	20.63	9.80	30.43	61.05	-30.62	QP	Line
5	0.345	16.40	9.80	26.20	49.07	-22.87	Average	Line
6	0.345	22.68	9.80	32.49	59.07	-26.58	QP	Line
7	1.687	18.11	9.89	28.01	46.00	-17.99	Average	Line
8	1.687	25.44	9.89	35.34	56.00	-20.66	QP	Line
9	3.269	22.60	9.93	32.53	46.00	-13.47	Average	Line
10	3.269	28.53	9.93	38.46	56.00	-17.54	QP	Line
11	5.166	9.86	10.00	19.86	50.00	-30.14	Average	Line
12	5.166	18.77	10.00	28.77	60.00	-31.23	QP	Line



## AC 120V/60 Hz, Neutral



No.	Frequency	Reading	Correct	Result	Limit	Over Limit	Remark	Phase
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)		
1	0.186	-1.73	9.98	8.25	54.21	-45.96	Average	Neutral
2	0.186	11.04	9.98	21.01	64.21	-43.20	QP	Neutral
3	0.274	16.73	9.97	26.70	51.00	-24.30	Average	Neutral
4	0.274	18.05	9.97	28.02	61.00	-32.98	QP	Neutral
5	0.347	23.86	9.94	33.80	49.04	-15.24	Average	Neutral
6	0.347	24.77	9.94	34.71	59.04	-24.33	QP	Neutral
7	1.951	18.54	9.92	28.46	46.00	-17.54	Average	Neutral
8	1.951	28.13	9.92	38.05	56.00	-17.95	QP	Neutral
9	3.404	22.80	10.01	32.81	46.00	-13.19	Average	Neutral
10	3.404	30.65	10.01	40.66	56.00	-15.34	QP	Neutral
11	5.291	13.47	10.05	23.53	50.00	-26.47	Average	Neutral
12	5.291	22.29	10.05	32.35	60.00	-27.65	QP	Neutral

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

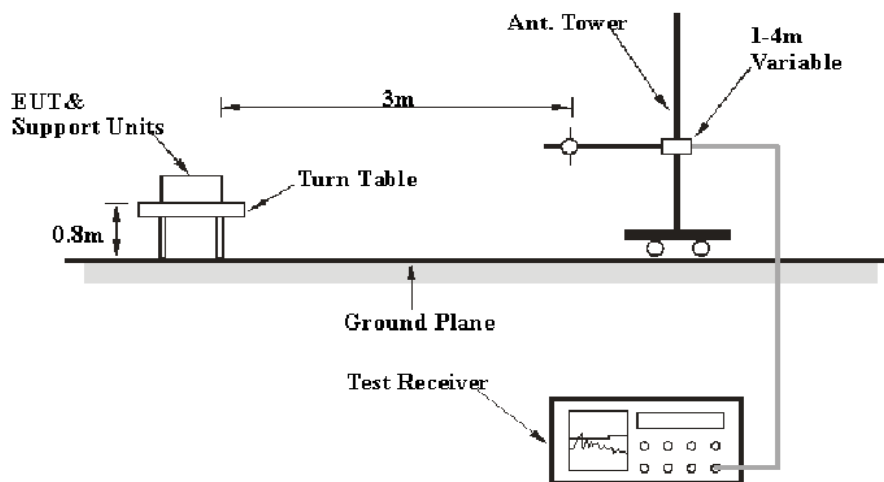
### Applicable Standard

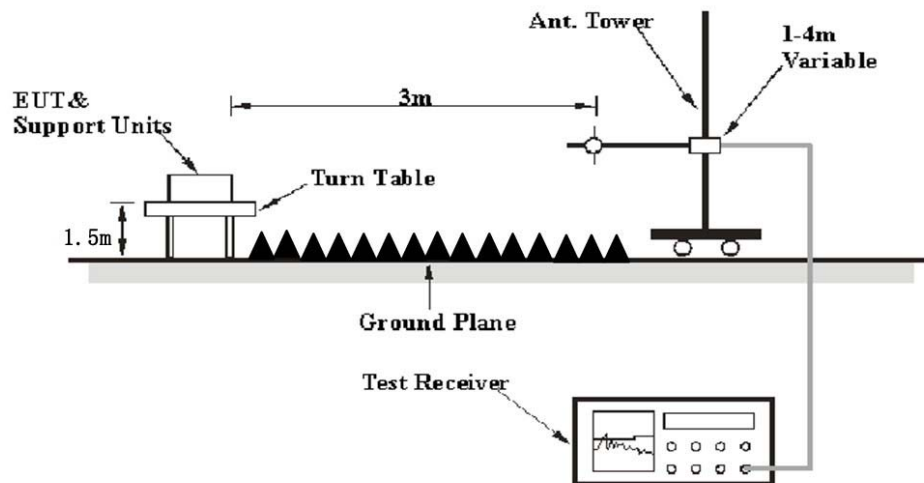
FCC §15.205; §15.209; §15.247(d) and RSS-247 §5.5

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, 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:

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

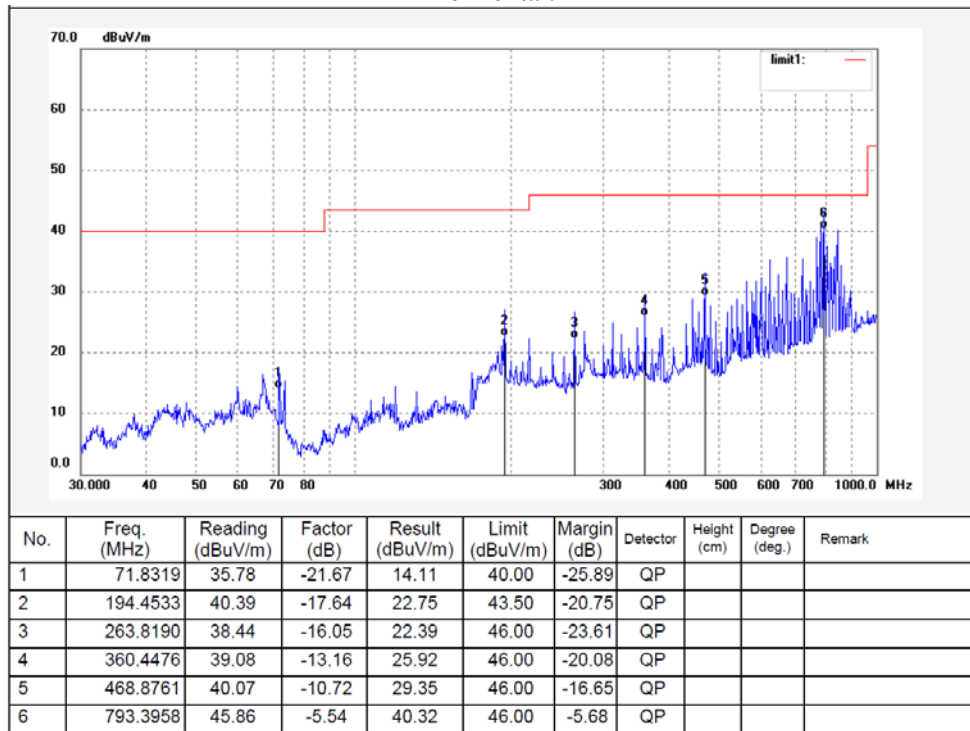
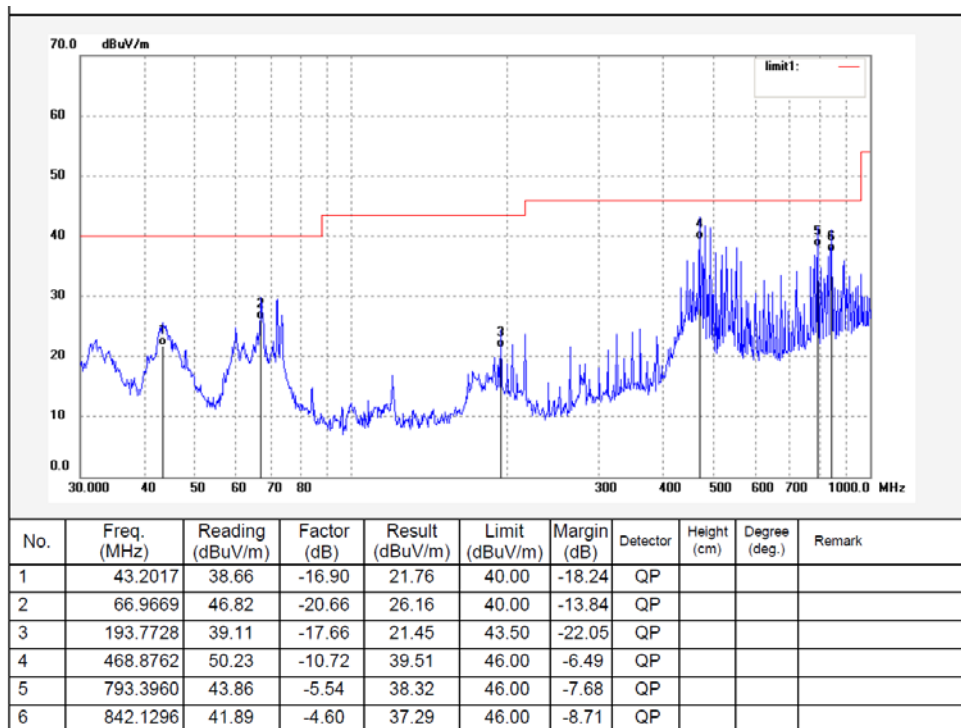
## Test Data

### Environmental Conditions

Temperature:	20~27.3 °C
Relative Humidity:	45~56 %
ATM Pressure:	101.0 kPa

The testing was performed by Bin Deng on 2021-10-22 and 2021-10-26.

EUT operation mode: Transmitting

**30MHz-1GHz: (worst case for Middle channel)****Horizontal:****Vertical**

**Above 1GHz:**

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 (2405 MHz)									
2310	67.27	PK	121	2.3	H	-6.84	60.43	74	-13.57
2310	52.74	Ave	121	2.3	H	-6.84	45.90	54	-8.10
2310	67.43	PK	144	1.5	V	-6.84	60.59	74	-13.41
2310	52.71	Ave	144	1.5	V	-6.84	45.87	54	-8.13
2390	67.42	PK	82	2.4	H	-6.44	60.98	74	-13.02
2390	53.02	Ave	82	2.4	H	-6.44	46.58	54	-7.42
2390	67.61	PK	318	1.5	V	-6.44	61.17	74	-12.83
2390	52.92	Ave	318	1.5	V	-6.44	46.48	54	-7.52
4810.00	53.69	PK	125	2.4	H	2.83	56.52	74	-17.48
4810.00	34.55	Ave	125	2.4	H	2.83	37.38	54	-16.62
4810.00	52.49	PK	299	1.7	V	2.83	55.32	74	-18.68
4810.00	34.27	Ave	299	1.7	V	2.83	37.10	54	-16.90
Middle Channel (2439 MHz)									
4878.00	49.08	PK	335	1.1	H	3.04	52.12	74	-21.88
4878.00	51.12	PK	16	2.3	V	3.04	54.16	74	-19.84
4878.00	34.01	Ave	16	2.3	V	3.04	37.05	54	-16.95
High Channel (2475 MHz)									
2483.5	68.21	PK	311	1.5	H	-5.96	62.25	74	-11.75
2483.5	53.10	Ave	311	1.5	H	-5.96	47.14	54	-6.86
2483.5	67.50	PK	280	1.7	V	-5.96	61.54	74	-12.46
2483.5	52.92	Ave	280	1.7	V	-5.96	46.96	54	-7.04
2500	67.80	PK	119	2.2	H	-5.88	61.92	74	-12.08
2500	53.06	Ave	119	2.2	H	-5.88	47.18	54	-6.82
2500	67.42	PK	76	1.8	V	-5.88	61.54	74	-12.46
2500	52.89	Ave	76	1.8	V	-5.88	47.01	54	-6.99
4950.00	48.23	PK	346	1.7	H	3.23	51.46	74	-22.54
4950.00	49.13	PK	79	1.8	V	3.23	52.36	74	-21.64

**Note:**

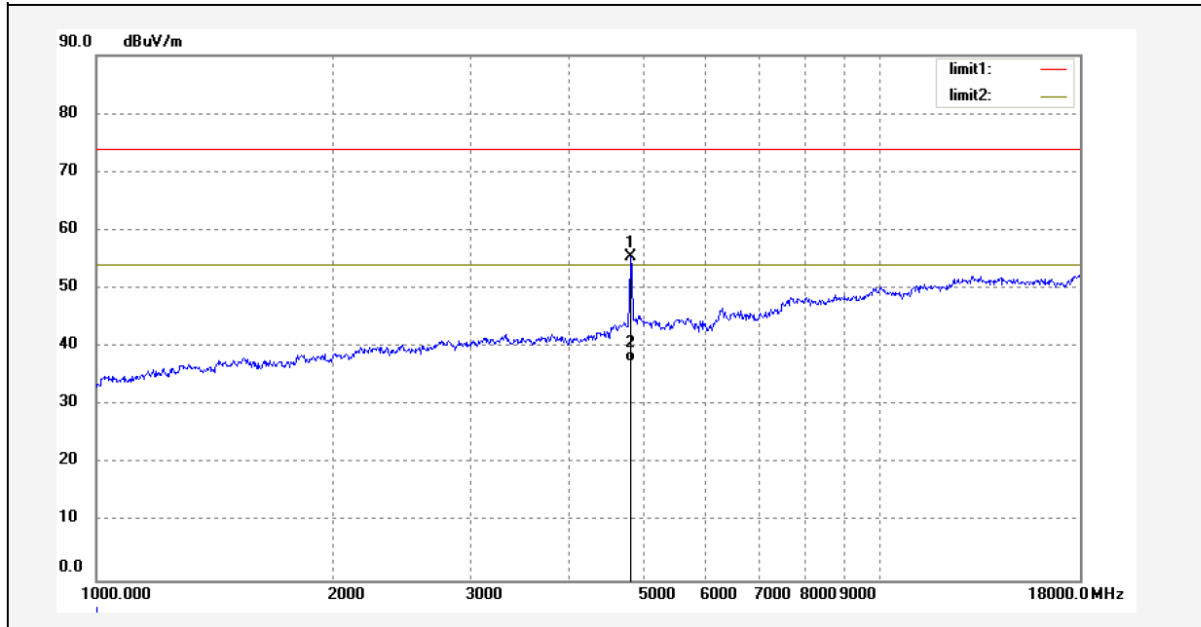
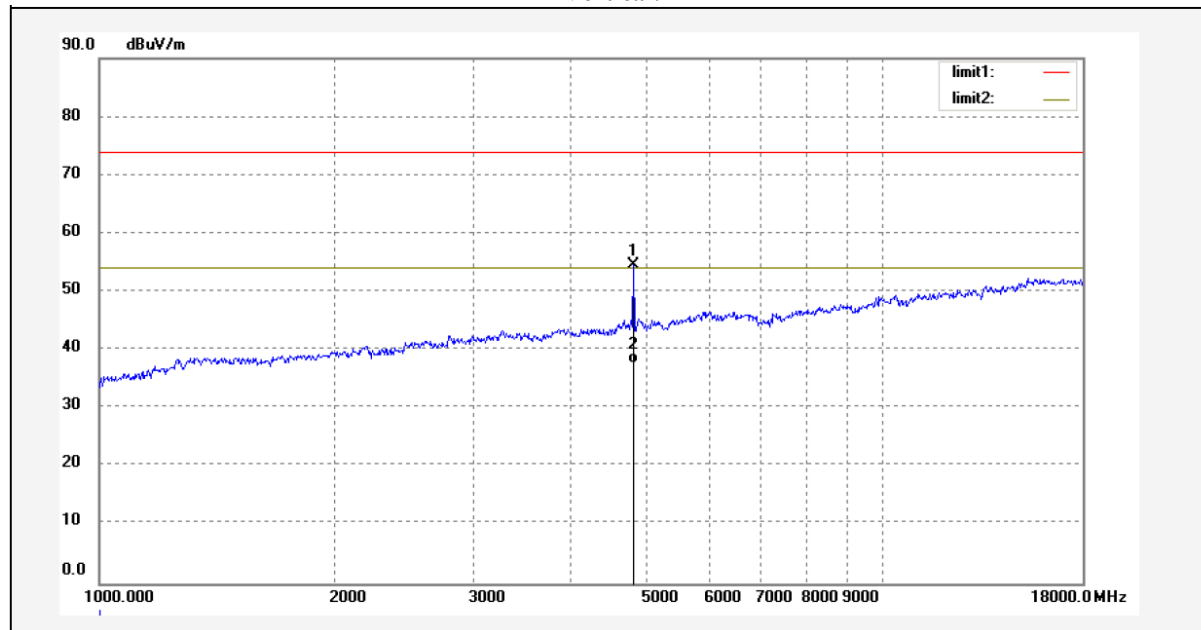
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

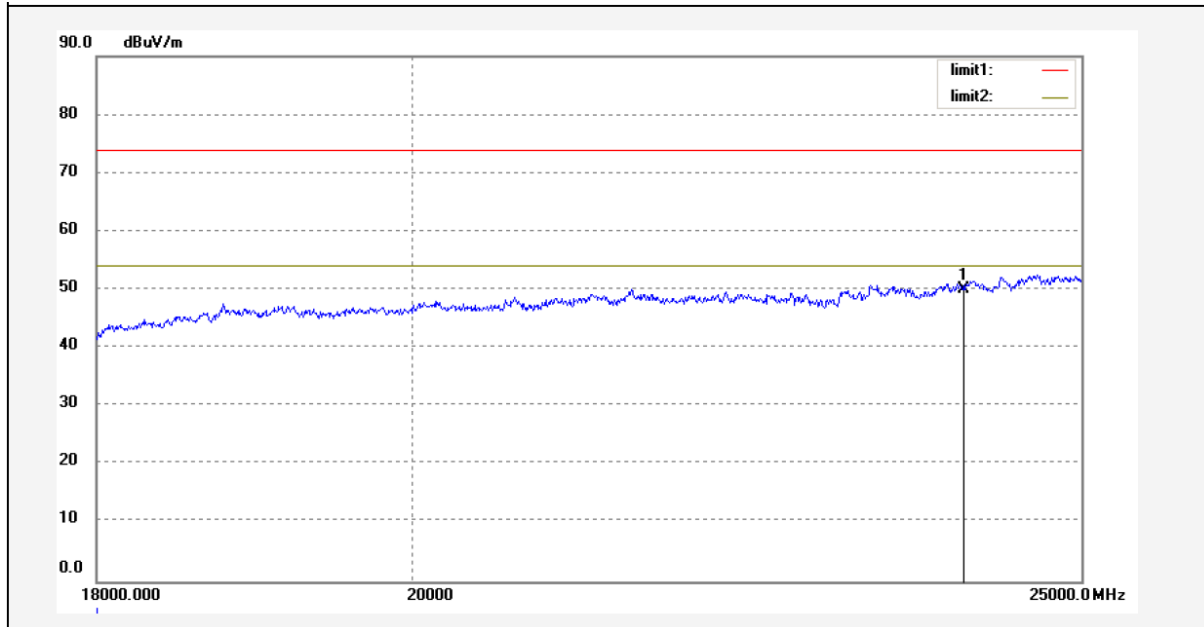
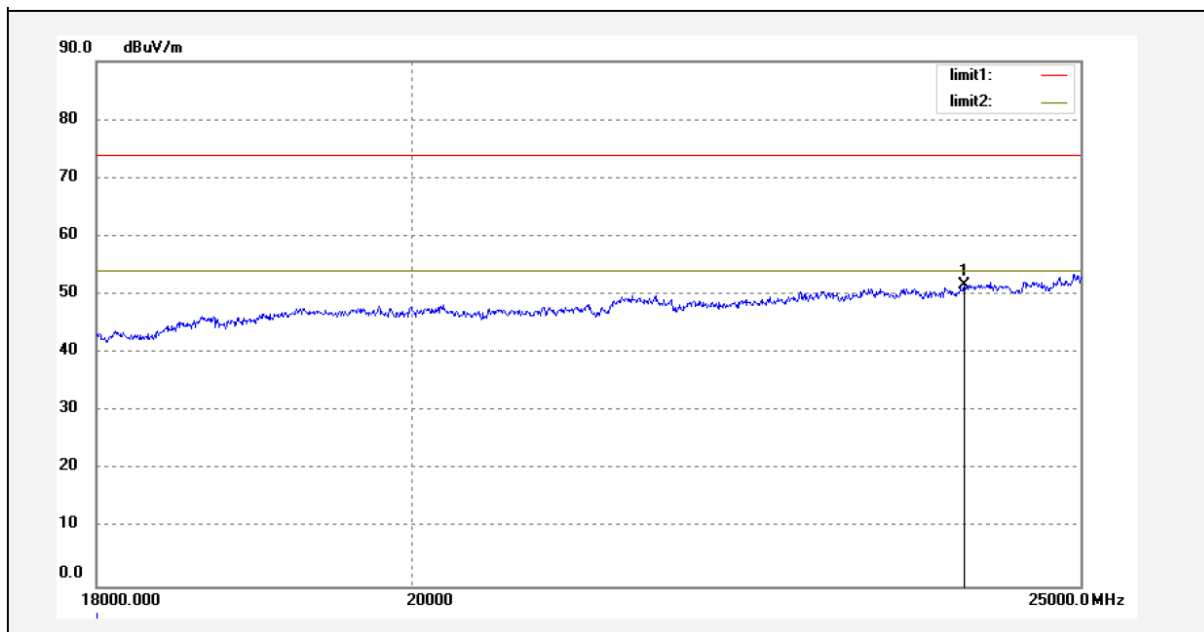
Corrected Amplitude = Corrected Factor + Reading

Margin = Corrected. Amplitude - Limit

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

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

**1-18GHz****Pre-scan for Peak****Low Channel****Horizontal:****Vertical:**

**18-25GHz****Pre-scan for Peak****Low Channel****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

<b>Temperature:</b>	26.4 °C
<b>Relative Humidity:</b>	50 %
<b>ATM Pressure:</b>	101.0 kPa

The testing was performed by Fan Yang on 2021-10-26.

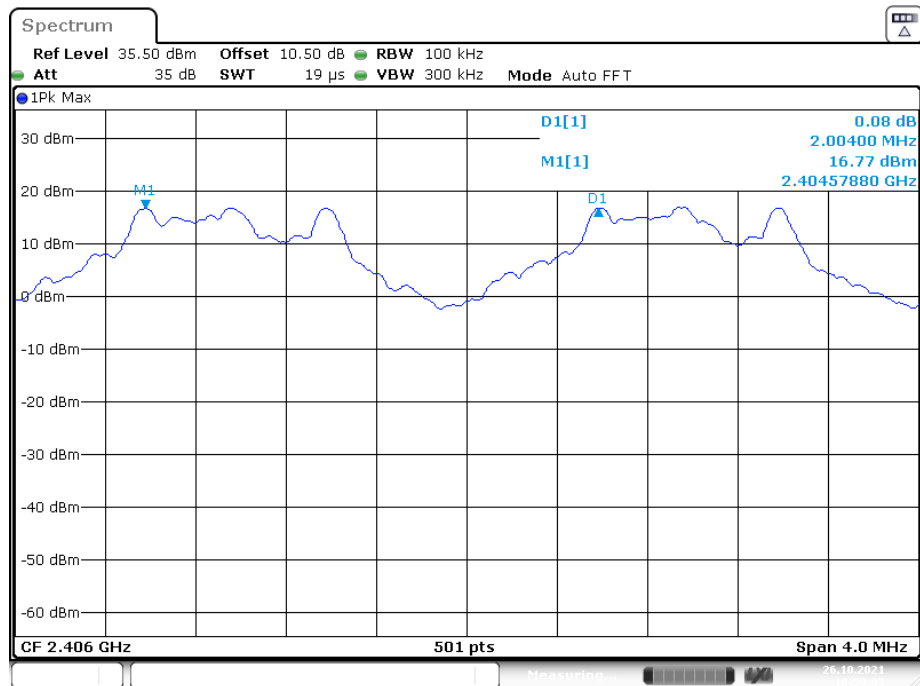
EUT operation mode: Transmitting

Test Result: Compliant.

Channel	Channel Separation (MHz)	20 dBc BW (MHz)	Two-thirds of the 20 dB bandwidth (MHz)	Channel Separation Limit
Low	2.004	1.615	1.077	> two-thirds of the 20 dB bandwidth

Please refer to the below plots:

## Hop



Date: 26.OCT.2021 18:59:05

## **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**

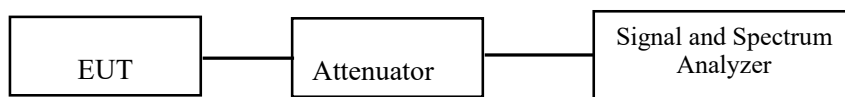
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency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

<b>Temperature:</b>	26.4 °C
<b>Relative Humidity:</b>	50 %
<b>ATM Pressure:</b>	101.0 kPa

The testing was performed by Fan Yang on 2021-10-26.

EUT operation mode: Transmitting

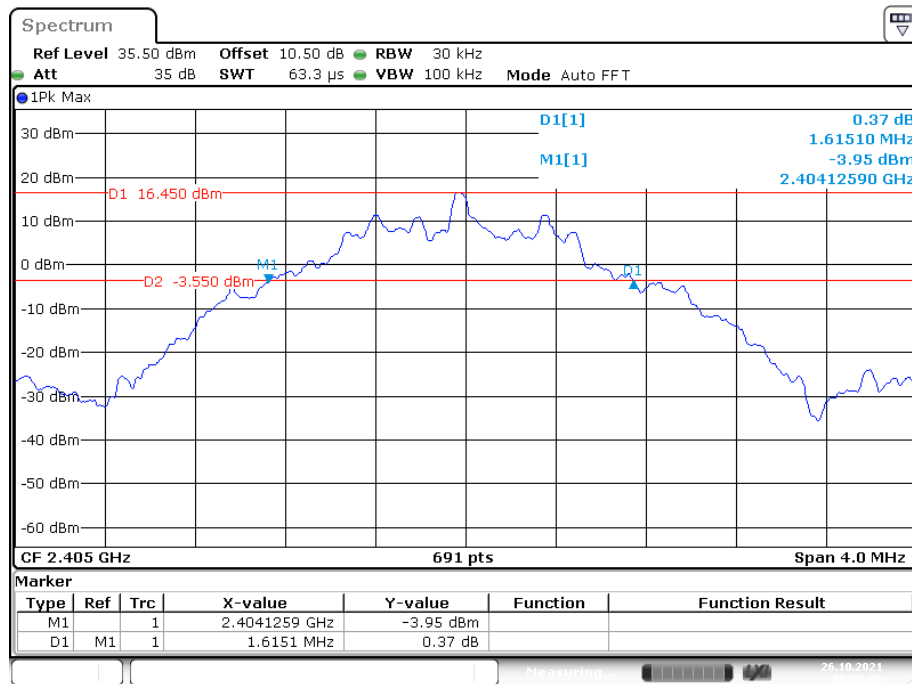
Test Result: Compliant.

Channel[MHz]	20db EBW[MHz]	99% Occupied Bandwidth [MHz]	Verdict
Low	1.615	1.754	PASS
Middle	1.580	1.777	PASS
High	1.609	1.800	PASS

Please refer to the below plots:

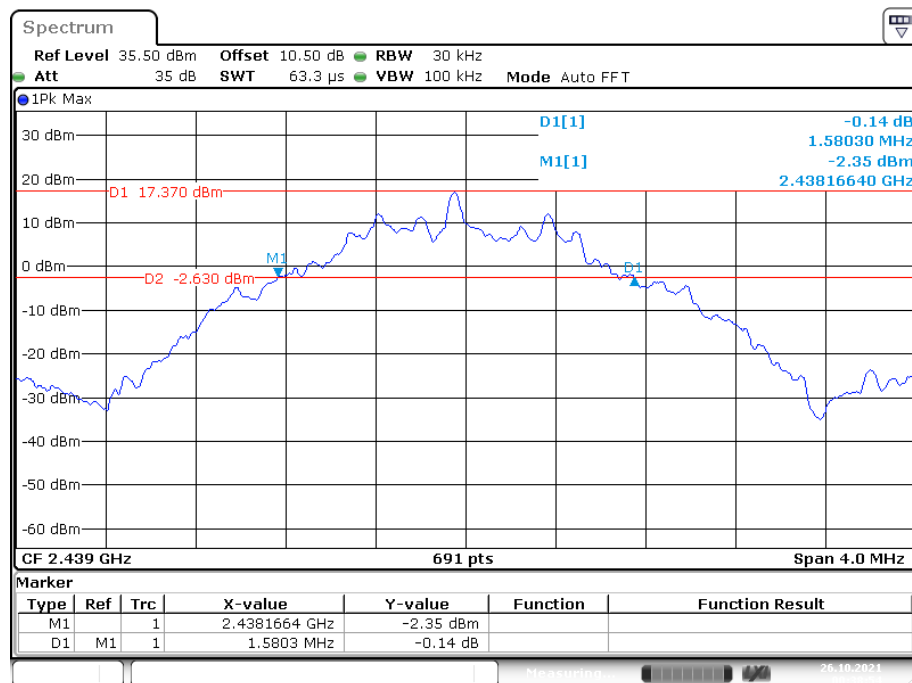
## 20 dB EMISSION BANDWIDTH

## Low Channel



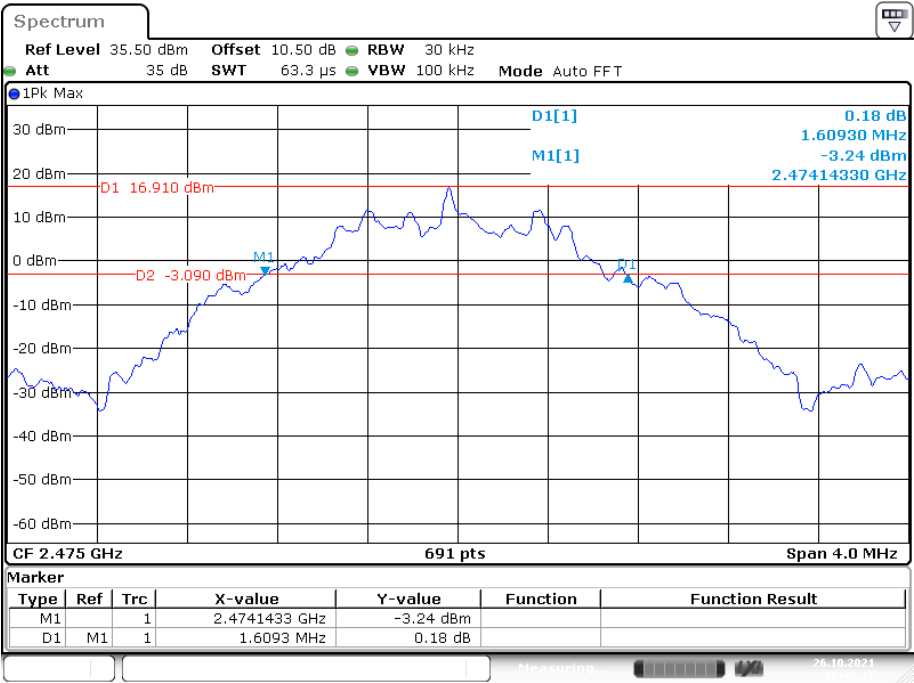
Date: 26.OCT.2021 00:37:05

## Middle Channel



Date: 26.OCT.2021 00:38:54

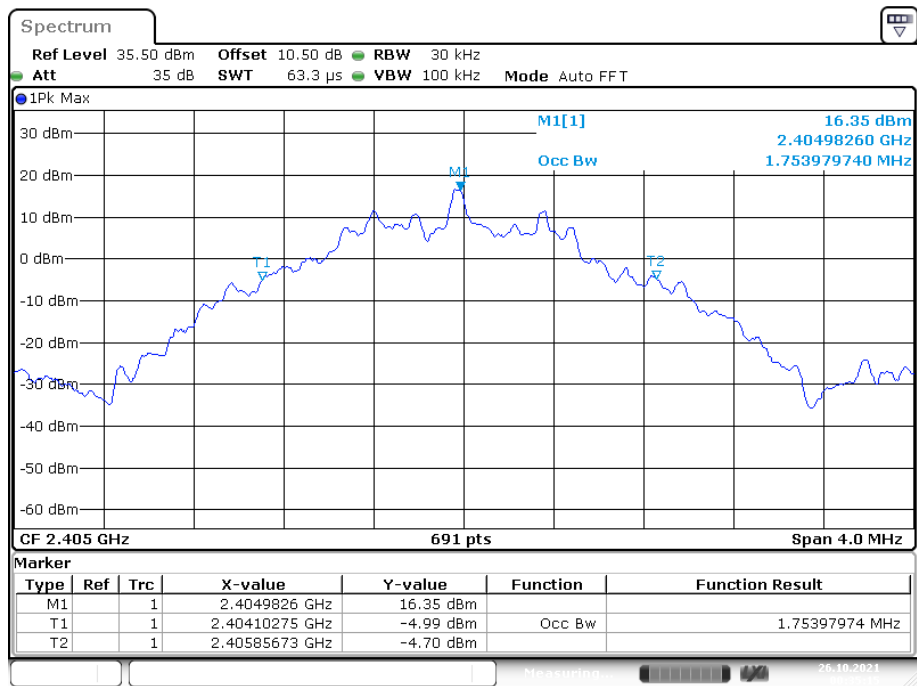
High Channel



Date: 26.OCT.2021 00:40:27

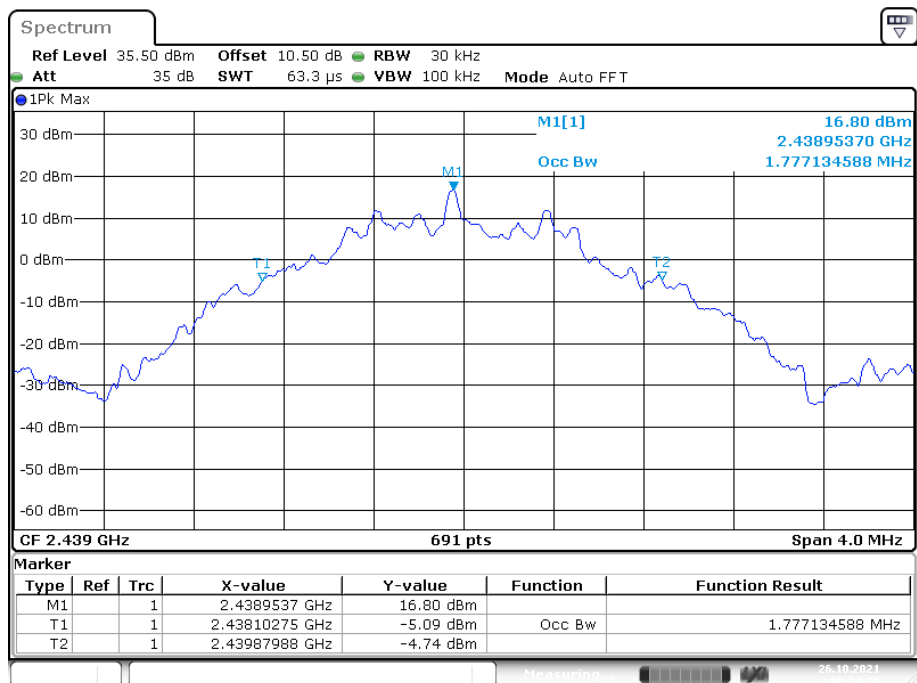
## 99% OCCUPIED BANDWIDTH

## Low Channel



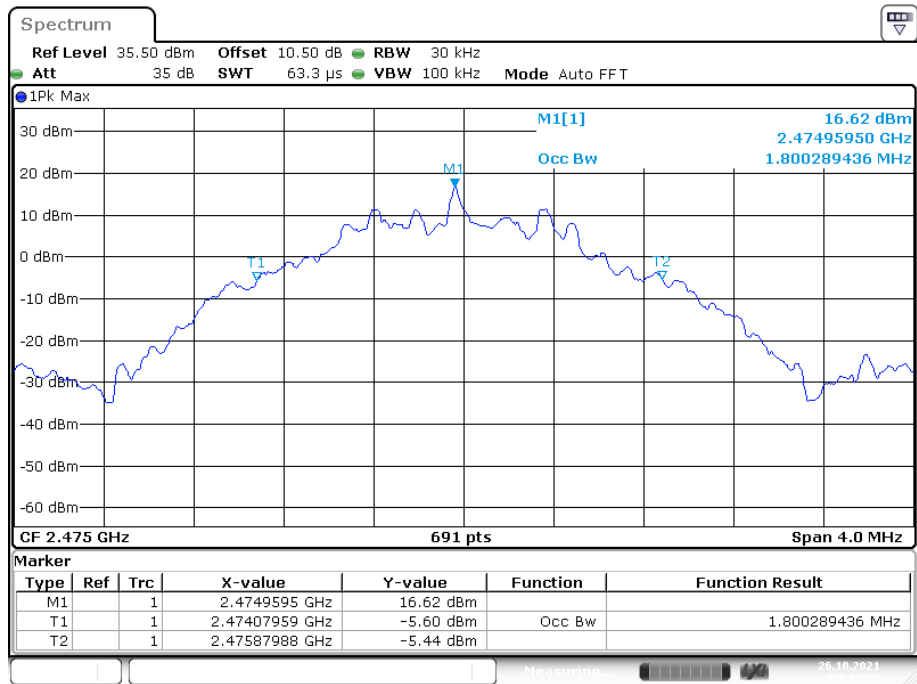
Date: 26.OCT.2021 00:35:15

## Middle Channel



Date: 26.OCT.2021 00:34:38

## High Channel



Date: 26.OCT.2021 00:33:35



## 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:	26.4 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

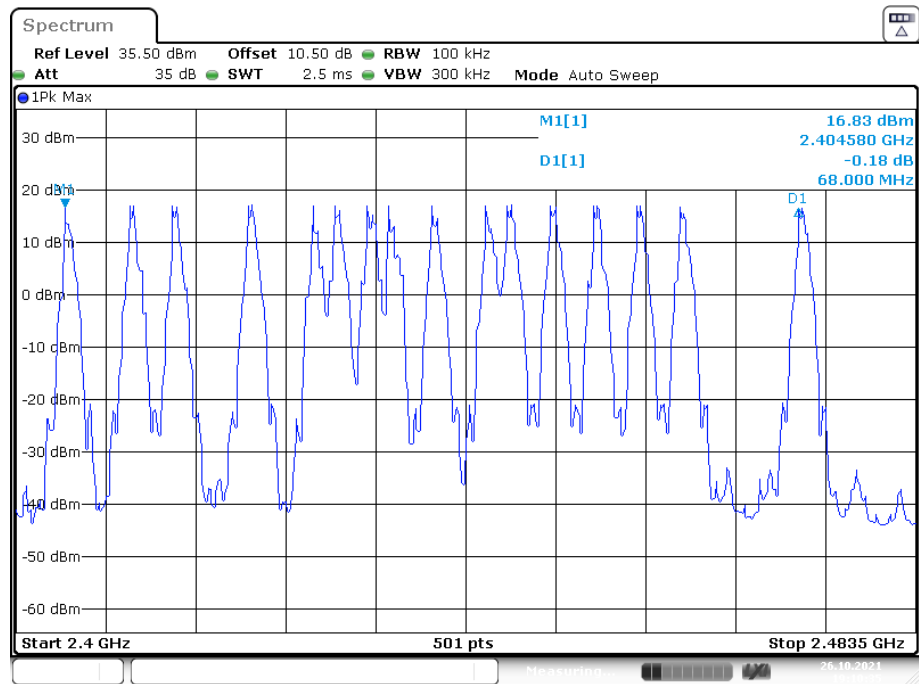
The testing was performed by Fan Yang on 2021-10-26.

EUT operation mode: Transmitting

Test Result: Compliant.

Frequency Range (MHz)	Number of Hopping Channel (CH)	Limit (CH)
2400-2483.5	16	≥15

## Hop



Date: 26.OCT.2021 19:10:36

## 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:	26.4 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Fan Yang on 2021-10-26.

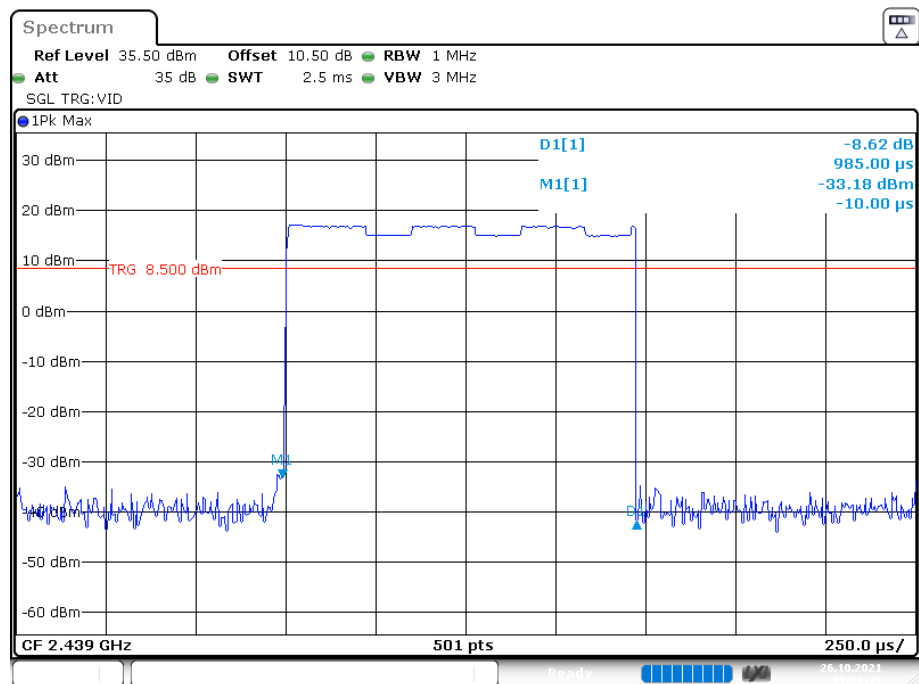
EUT operation mode: Transmitting

Test Result: Compliant.

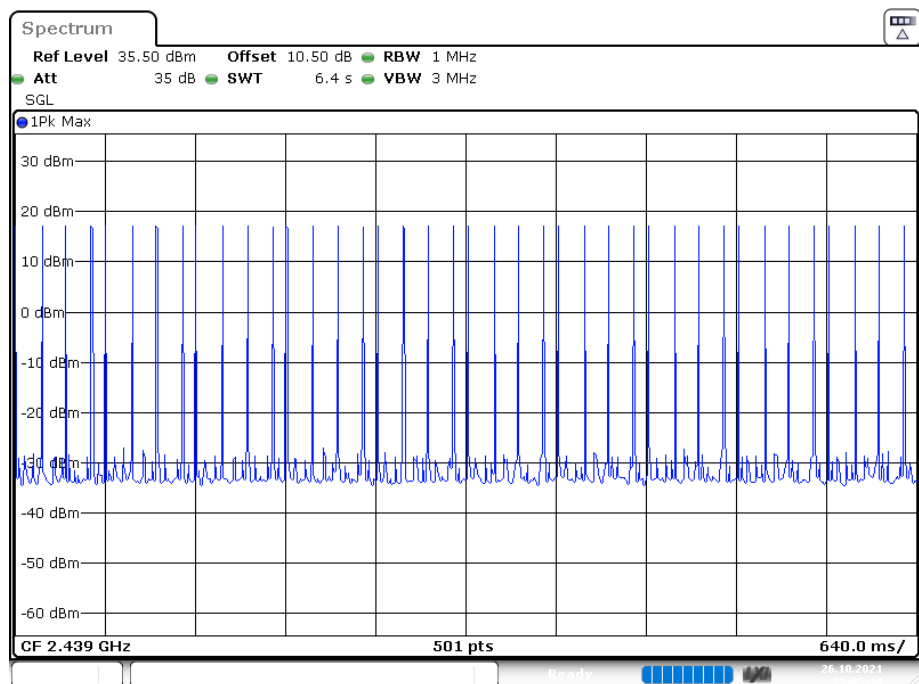
Test Mode	Channel	Pulse Time [ms]	Total Hops [Num]	Result[s]	Limit[s]	Verdict
GFSK	Hop	0.99	42	0.042	$\leq 0.4$	PASS

Note: A period time= $0.4 \times 16 = 6.4$ (S), Result=Pulse Time\* Total Hops

## Hop



Date: 26.OCT.2021 19:01:39



Date: 26.OCT.2021 19:05:34

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

### Applicable Standard

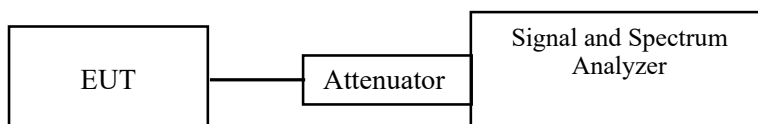
According to §15.247(b) (1), for frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. And for all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 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:	26.4 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

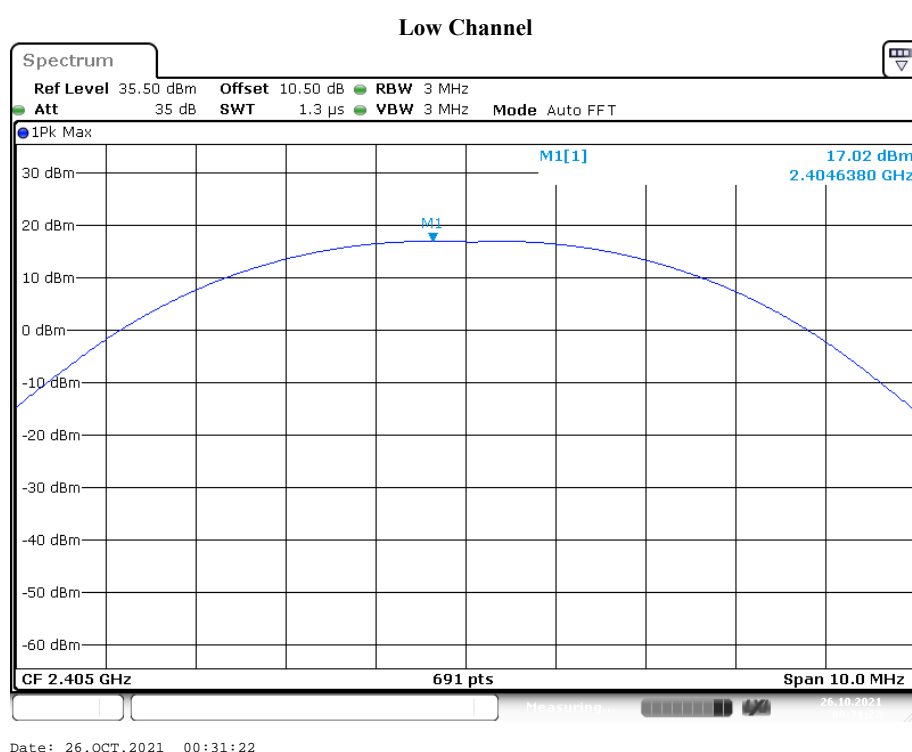
The testing was performed by Fan Yang on 2021-10-26.

EUT operation mode: Transmitting

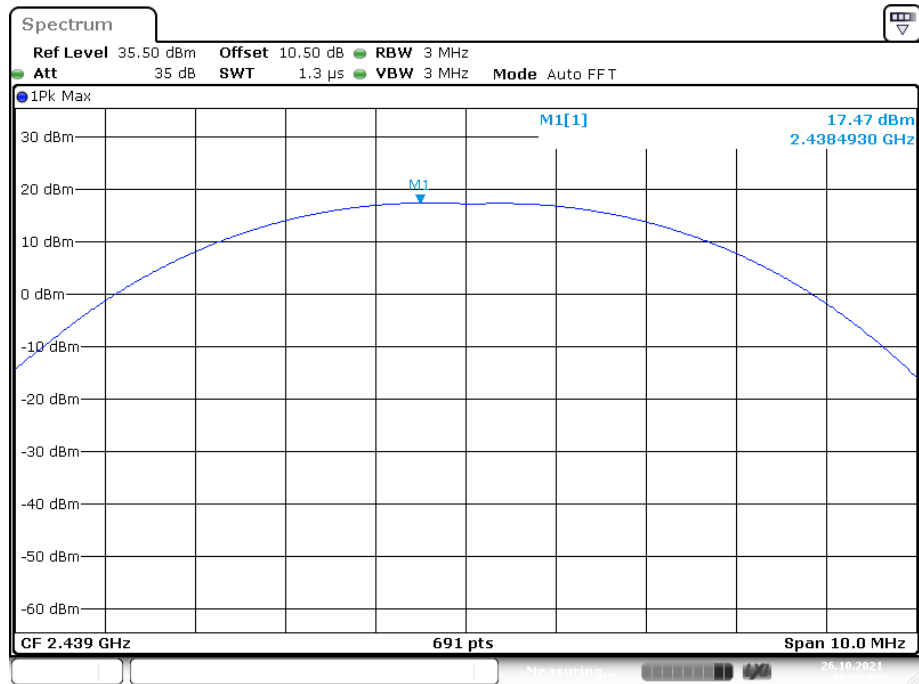
Test Result: Compliant.

Mode	Channel	Frequency (MHz)	Peak Output Power	Limit (dBm)
			(dBm)	
GFSK	Low	2405	17.02	21
	Middle	2439	17.47	21
	High	2475	17.27	21

Note: the antenna gain is 0dBi, the maximum conducted output power is 17.47dBm, the maximum EIRP=17.47dBm+0dBi=17.47dBm<36dBm, so it's compliance with ISSED EIRP limit.

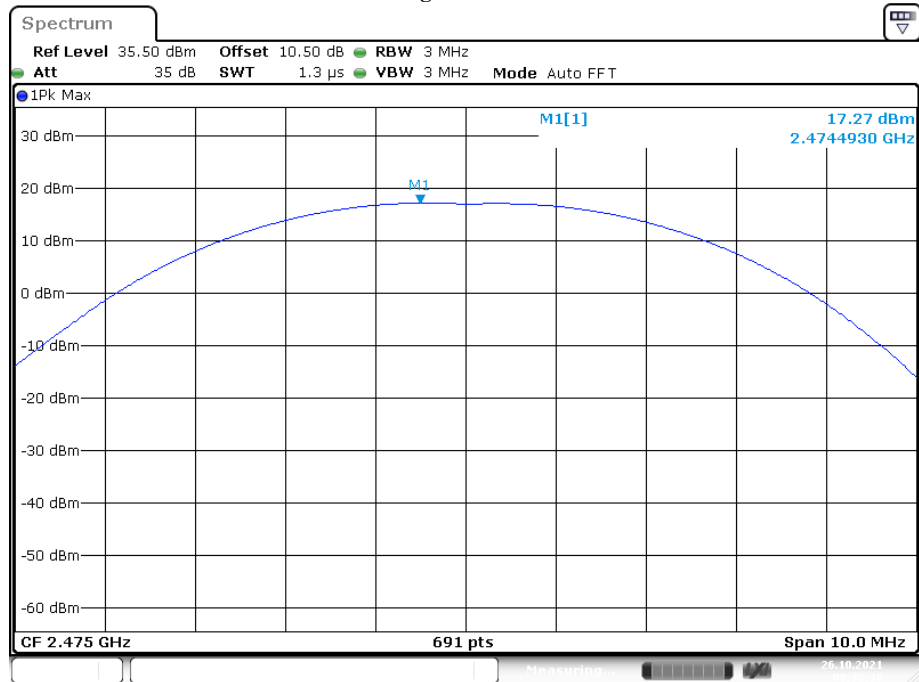


## Middle Channel



Date: 26.OCT.2021 00:32:03

## High Channel



Date: 26.OCT.2021 00:32:38

## 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

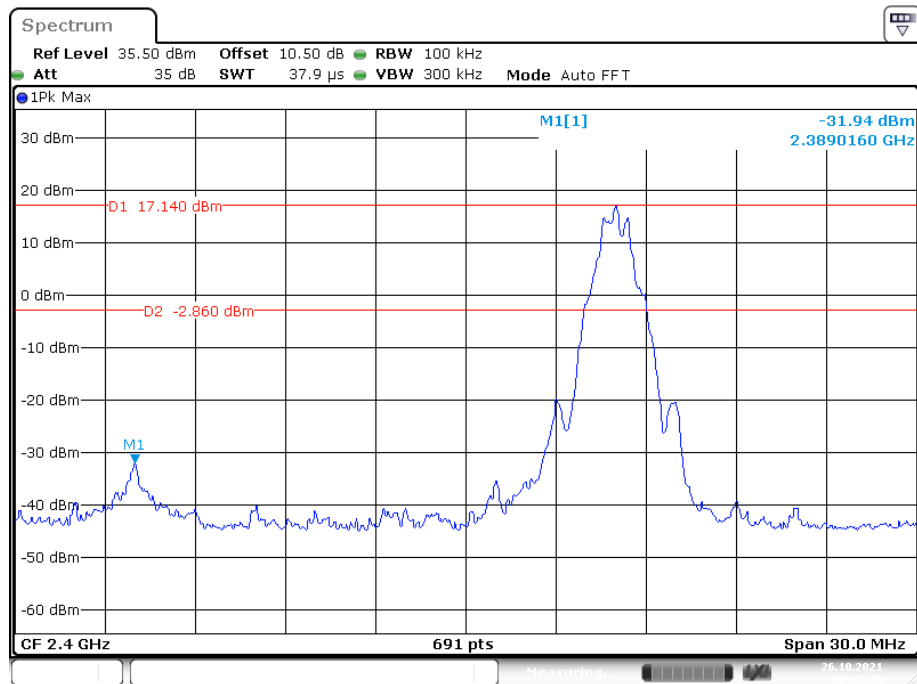
Temperature:	26.4 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Fan Yang on 2021-10-26.

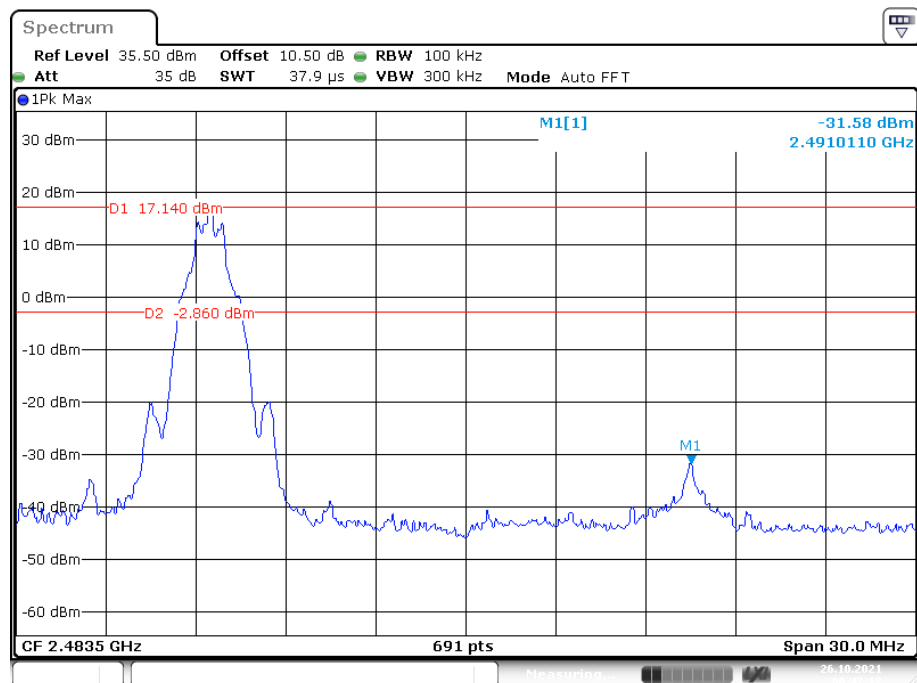
EUT operation mode: Transmitting

Test Result: Compliant.



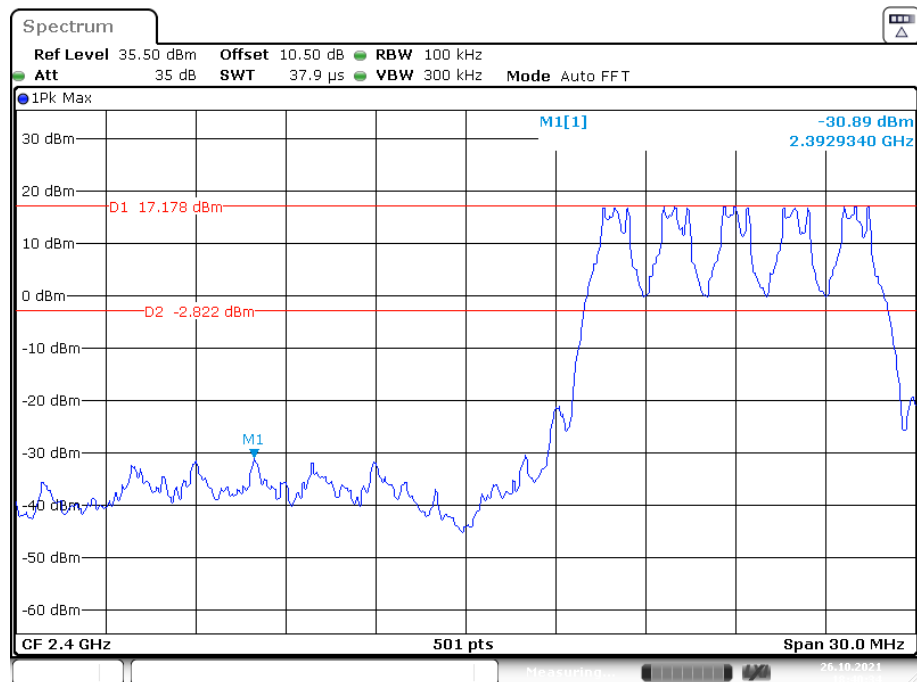
**Conducted Band Edge Result:****GFSK\_Low Channel**

Date: 26.OCT.2021 00:43:29

**GFSK\_High Channel**

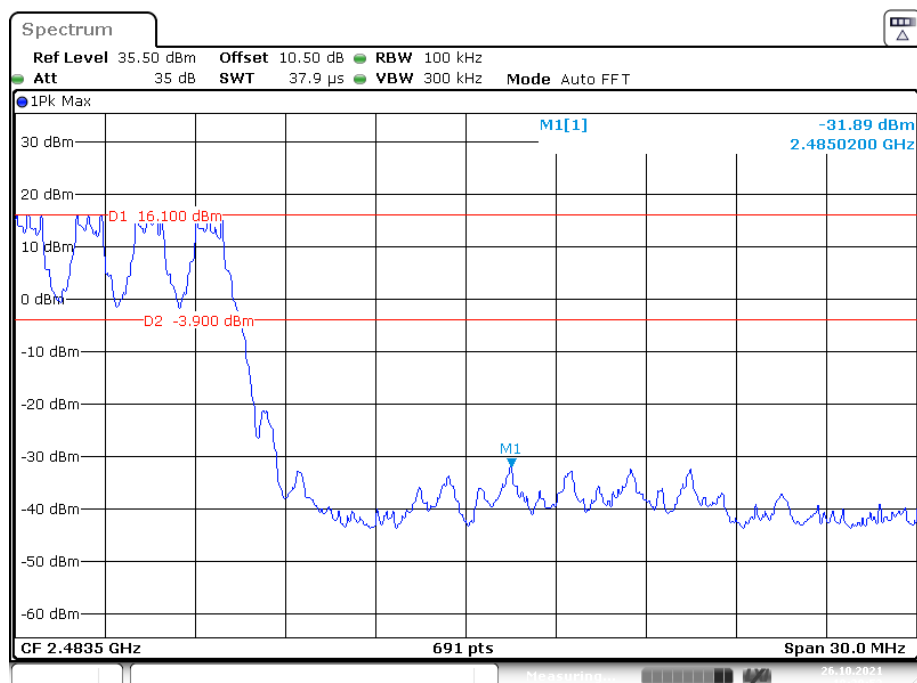
Date: 26.OCT.2021 00:42:13

## GFSK\_Hop\_Low Channel



Date: 26.OCT.2021 18:40:35

## GFSK\_Hop\_High Channel



Date: 26.OCT.2021 18:39:54

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