



FCC PART 15.247 TEST REPORT

For

Zeeva International Limited

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Hong Kong

FCC ID: 2ADM5-SP-0862

| | |
|---|---|
| Report Type: Original Report | Product Type: BT HOME SPEAKER |
| Report Number: RSZ200715830-00 | |
| Report Date: 2020-08-03 | |
| Reviewed By: RF Engineer | <i>Jimmy Xiao</i> |
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

| | |
|-----------------------------|---|
| Product | BT HOME SPEAKER |
| Tested Model | SP-0862 |
| UPC No. | 192234062982 |
| SKU No. | 3358389 |
| Frequency Range | Bluetooth: 2402~2480MHz |
| Peak Conducted Output Power | Bluetooth: -3.49dBm |
| Modulation Technique | Bluetooth: GFSK, $\pi/4$ -DQPSK, 8DPSK |
| Antenna Specification | -0.68 dBi |
| Voltage Range | DC 3.7 V from battery |
| Date of Test | 2020-07-22 to 2020-07-31 |
| Sample serial number | RSZ200715830-S1(Assigned by BACL, Shenzhen) |
| Received date | 2020-07-15 |
| Sample/EUT Status | Good condition |

Objective

This test report is prepared on behalf of Zeeva International Limited in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

Related Submittal(s)/Grant(s)

No related submittal(s).

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

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

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

| Parameter | | Uncertainty |
|------------------------------------|------------|-------------|
| Occupied Channel Bandwidth | | ±5% |
| RF Output Power with Power meter | | ±0.73dB |
| RF conducted test with spectrum | | ±1.6dB |
| AC Power Lines Conducted Emissions | | ±1.95dB |
| Emissions, Radiated | Below 1GHz | ±4.75dB |
| | Above 1GHz | ±4.88dB |
| Temperature | | ±1°C |
| Humidity | | ±6% |
| Supply voltages | | ±0.4% |

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

Test Facility

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

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 342867, the FCC Designation No.: CN1221.

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

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in an engineering mode.

EUT Exercise Software

“FCC_assist_1.0.2.2” exercise software was used and the power level is 6.

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

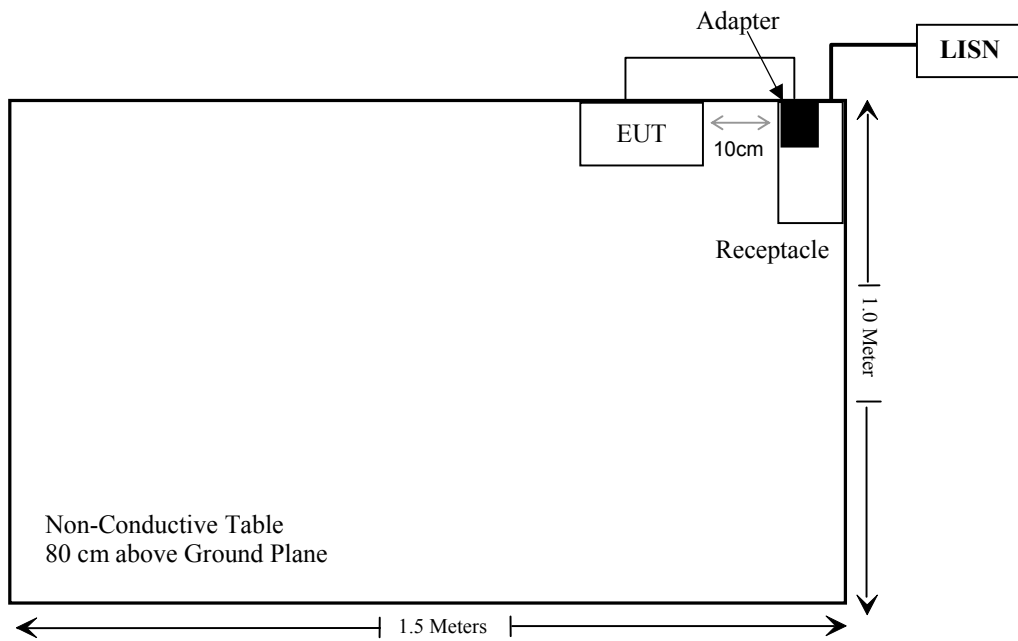
Support Equipment List and Details

| Manufacturer | Description | Model | Serial Number |
|--------------|-------------|-----------------|---------------|
| Unknown | Adapter | HJ-0501000E1-US | E362552 |

External I/O Cable

| Cable Description | Length (m) | From Port | To |
|-----------------------------------|------------|-----------|---------|
| Un-shielding Detachable USB Cable | 0.5 | EUT | Adapter |

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

| FCC Rules | Description of Test | Result |
|-------------------------------|-----------------------------------|---------------|
| §15.247 (i), §2.1091 | Maximum Permissible Exposure(MPE) | Compliance |
| §15.203 | Antenna Requirement | Compliance |
| §15.207(a) | AC Line Conducted Emissions | Compliance |
| §15.205, §15.209 & §15.247(d) | Radiated Emissions | Compliance |
| §15.247(a)(1) | 20 dB Emission Bandwidth | Compliance |
| §15.247(a)(1) | Channel Separation Test | Compliance |
| §15.247(a)(1)(iii) | Time of Occupancy (Dwell Time) | Compliance |
| §15.247(a)(1)(iii) | Quantity of hopping channel Test | Compliance |
| §15.247(b)(1) | Peak Output Power Measurement | Compliance |
| §15.247(d) | Band edges | Compliance |

TEST EQUIPMENT LIST

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---------------------------------|---------------------------|-------------------------|------------------------|------------------|----------------------|
| Conducted Emissions Test | | | | | |
| Rohde & Schwarz | EMI Test Receiver | ESCI | 101120 | 2020/7/9 | 2021/7/8 |
| Rohde & Schwarz | LISN | ENV216 | 101613 | 2020/1/22 | 2021/1/21 |
| Rohde & Schwarz | Transient Limiter | ESH3Z2 | DE25985 | 2019/11/29 | 2020/11/28 |
| Unknown | CE Cable | CE Cable | UF A210B-1-0720-504504 | 2019/11/29 | 2020/11/28 |
| Rohde & Schwarz | CE Test software | EMC 32 | V8.53.0 | NCR | NCR |
| Radiated Emission Test | | | | | |
| R&S | EMI Test Receiver | ESR3 | 102455 | 2020/7/9 | 2021/7/8 |
| Sonoma instrument | Pre-amplifier | 310 N | 186238 | 2020/4/20 | 2021/4/20 |
| Sunol Sciences | Broadband Antenna | JB1 | A040904-1 | 2017/12/22 | 2020/12/21 |
| Unknown | Cable 2 | RF Cable 2 | F-03-EM197 | 2019/11/29 | 2020/11/28 |
| Unknown | Cable | Chamber Cable 1 | F-03-EM236 | 2019/11/29 | 2020/11/28 |
| Rohde & Schwarz | Auto test software | EMC 32 | V9.10 | NCR | NCR |
| Rohde & Schwarz | Spectrum Analyzer | FSV40-N | 102259 | 2019/7/22 | 2021/07/21 |
| COM-POWER | Pre-amplifier | PA-122 | 181919 | 2019/11/29 | 2020/11/28 |
| Quinstar | Amplifier | QLW-18405536-J0 | 15964001002 | 2019/11/29 | 2020/11/28 |
| Sunol Sciences | Horn Antenna | DRH-118 | A052604 | 2017/12/22 | 2020/12/21 |
| Insulted Wire Inc. | RF Cable | SPS-2503-3150 | 02222010 | 2019/11/29 | 2020/11/28 |
| Unknown | RF Cable | W1101-EQ1 OUT | F-19-EM005 | 2019/11/29 | 2020/11/28 |
| SNSD | Band Reject filter | BSF2402-2480MN-0898-001 | 2.4G filter | 2020/4/20 | 2021/4/20 |
| Ducommun Technologies | Horn antenna | ARH-4223-02 | 1007726-021304 | 2017/12/6 | 2020/12/5 |
| RF Conducted Test | | | | | |
| Agilent | USB Wideband Power Sensor | U2021XA | MY54250003 | 2020/7/10 | 2021/7/9 |
| Rohde & Schwarz | SPECTRUM ANALYZER | FSU26 | 200120 | 2020/3/2 | 2021/3/1 |
| WEINSCHEL | 3dB Attenuator | Unknown | Unknown | 2019/11/29 | 2020/11/28 |
| Unknown | RF Cable | Unknown | 2301 276 | 2019/11/29 | 2020/11/28 |

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

FCC §15.247 (i) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

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

Limits for General Population/Uncontrolled Exposure

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

f = frequency in MHz

* = Plane-wave equivalent power density

Result

Calculated Formulary:

Predication of MPE limit at a given distance

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

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

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

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

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

| Frequency (MHz) | Antenna Gain | | Tune up conducted power | | Evaluation Distance (cm) | Power Density (mW/cm ²) | MPE Limit (mW/cm ²) |
|-----------------|--------------|-----------|-------------------------|------|--------------------------|-------------------------------------|---------------------------------|
| | (dBi) | (numeric) | (dBm) | (mW) | | | |
| 2402-2480 | -0.68 | 0.86 | -3.0 | 0.5 | 20 | 0.00009 | 1 |

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

Result: Compliance

FCC §15.203 – ANTENNA REQUIREMENT

Applicable Standard

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

Antenna Connector Construction

The EUT has one internal PCB antenna arrangement, which was permanently attached and the antenna gain is -0.68dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Pass

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207(a)

EUT Setup



- Note: 1. Support units were connected to second LISN.
 2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The measurement procedure of EUT setup is according with ANSI C63.10-2013. The related limit was specified in FCC Part 15.207.

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

| Frequency Range | IF B/W |
|------------------|--------|
| 150 kHz – 30 MHz | 9 kHz |

Test Procedure

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

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

Corrected Factor & Margin Calculation

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

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

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

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

Test Data

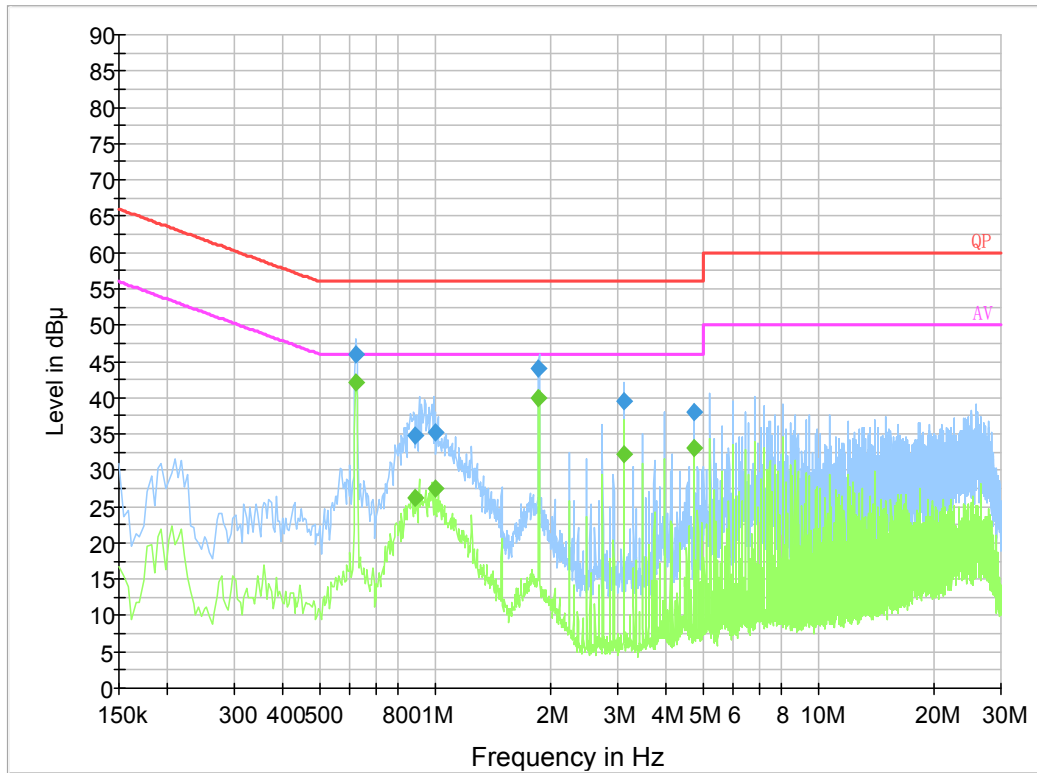
Environmental Conditions

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

The testing was performed by Haiguo Li on 2020-07-22.

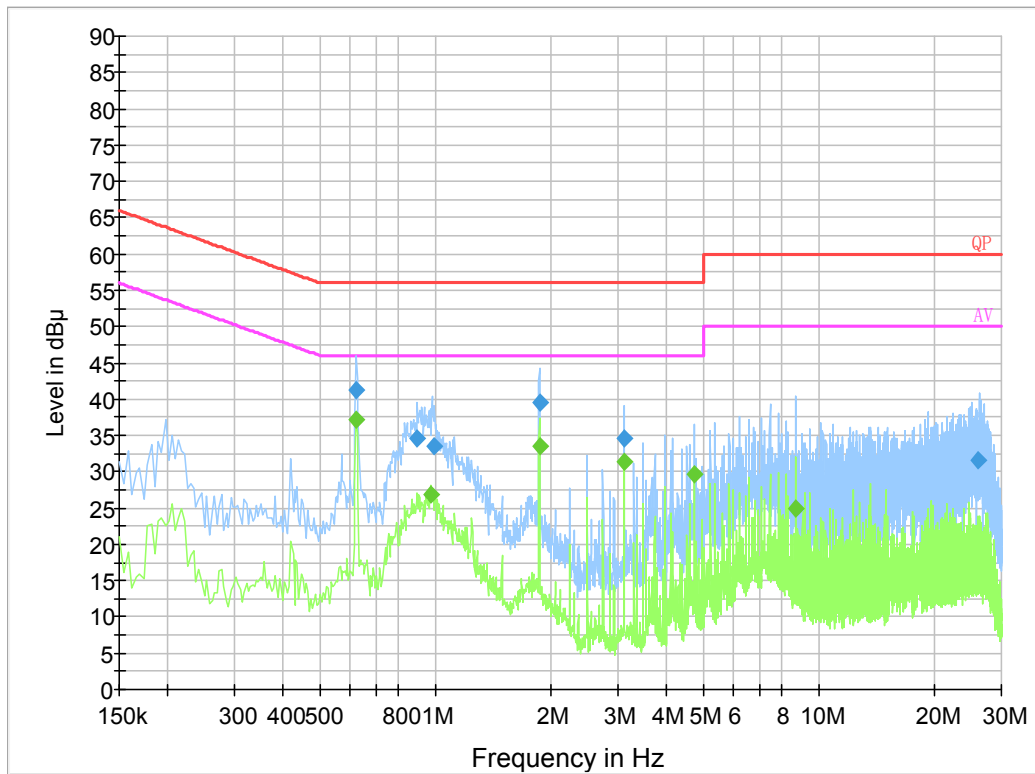
EUT operation mode: Charging & Transmitting

AC 120V/60 Hz, Line



| Frequency (MHz) | Corrected Amplitude (dBμV) | Correction Factor (dB) | Limit (dBμV) | Margin (dB) | Detector (PK/Ave./QP) |
|-----------------|----------------------------|------------------------|--------------|-------------|-----------------------|
| 0.620670 | 45.9 | 19.8 | 56.0 | 10.1 | QP |
| 0.884770 | 34.8 | 19.8 | 56.0 | 21.2 | QP |
| 0.999090 | 35.2 | 19.9 | 56.0 | 20.8 | QP |
| 1.865950 | 44.0 | 19.9 | 56.0 | 12.0 | QP |
| 3.115290 | 39.5 | 19.9 | 56.0 | 16.5 | QP |
| 4.730990 | 38.1 | 19.9 | 56.0 | 17.9 | QP |
| 0.620670 | 42.0 | 19.8 | 46.0 | 4.0 | Ave. |
| 0.884770 | 26.3 | 19.8 | 46.0 | 19.7 | Ave. |
| 0.999090 | 27.5 | 19.9 | 46.0 | 18.5 | Ave. |
| 1.865950 | 40.0 | 19.9 | 46.0 | 6.0 | Ave. |
| 3.115290 | 32.2 | 19.9 | 46.0 | 13.8 | Ave. |
| 4.730990 | 33.1 | 19.9 | 46.0 | 12.9 | Ave. |

AC 120V/60 Hz, Neutral



| Frequency (MHz) | Corrected Amplitude (dBμV) | Correction Factor (dB) | Limit (dBμV) | Margin (dB) | Detector (PK/Ave./QP) |
|-----------------|----------------------------|------------------------|--------------|-------------|-----------------------|
| 0.624670 | 41.3 | 19.8 | 56.0 | 14.7 | QP |
| 0.896530 | 34.5 | 19.7 | 56.0 | 21.5 | QP |
| 0.991270 | 33.6 | 19.8 | 56.0 | 22.4 | QP |
| 1.869950 | 39.6 | 19.9 | 56.0 | 16.4 | QP |
| 3.115290 | 34.5 | 19.9 | 56.0 | 21.5 | QP |
| 26.129730 | 31.5 | 20.2 | 60.0 | 28.5 | QP |
| 0.622000 | 37.1 | 19.8 | 46.0 | 8.9 | Ave. |
| 0.974000 | 26.8 | 19.8 | 46.0 | 19.2 | Ave. |
| 1.870000 | 33.6 | 19.9 | 46.0 | 12.4 | Ave. |
| 3.114000 | 31.5 | 19.9 | 46.0 | 14.5 | Ave. |
| 4.734000 | 29.6 | 19.9 | 46.0 | 16.4 | Ave. |
| 8.722000 | 25.0 | 19.9 | 50.0 | 25.0 | Ave. |

Note:

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

FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS

Applicable Standard

FCC §15.205; §15.209; §15.247(d)

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209 and FCC 15.247 limits.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, according to the DA 00-705 Released March 30, 2000, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

| Frequency Range | RBW | Video B/W | IF B/W | Measurement |
|-------------------|---------|-----------|---------|-------------|
| 30 MHz – 1000 MHz | 100 kHz | 300 kHz | 120 kHz | QP |
| Above 1 GHz | 1 MHz | 3 MHz | / | PK |
| | 1 MHz | 10 Hz | / | Average |

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

All final data was recorded in Quasi-peak detection mode for frequency range of 30 MHz -1 GHz and peak and Average detection modes for frequencies above 1 GHz.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

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

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

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

Test Data

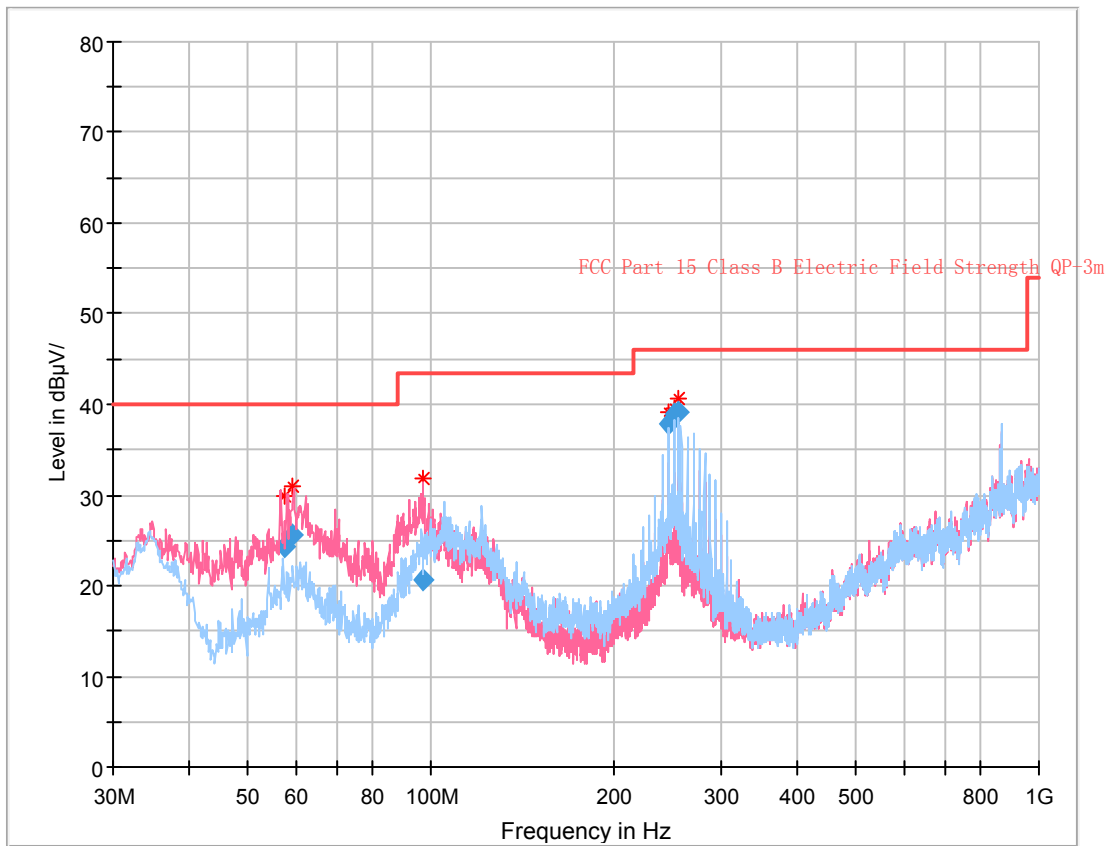
Environmental Conditions

| | |
|---------------------------|-----------|
| Temperature: | 23~26 °C |
| Relative Humidity: | 55~60 % |
| ATM Pressure: | 101.0 kPa |

The testing was performed by Charlie Cha on 2020-07-26 for below 1GHz and by Leven Gan on 2020-07-25 for above 1GHz.

EUT operation mode: Transmitting

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



| Frequency (MHz) | Corrected Amplitude (dBµV/m) | Antenna height (cm) | Antenna Polarity | Turntable position (degree) | Correction Factor (dB/m) | Limit (dBµV/m) | Margin (dB) |
|-----------------|------------------------------|---------------------|------------------|-----------------------------|--------------------------|----------------|-------------|
| 57.285750 | 24.40 | 102.0 | V | 48.0 | -20.0 | 40.00 | 15.60 |
| 59.290625 | 25.52 | 103.0 | V | 29.0 | -20.1 | 40.00 | 14.48 |
| 97.220125 | 20.67 | 252.0 | V | 111.0 | -17.7 | 43.50 | 22.83 |
| 246.007125 | 37.76 | 114.0 | H | 243.0 | -14.1 | 46.00 | 8.24 |
| 251.984625 | 38.86 | 122.0 | H | 242.0 | -14.0 | 46.00 | 7.14 |
| 255.981750 | 39.20 | 118.0 | H | 237.0 | -13.7 | 46.00 | 6.80 |

1 GHz - 25 GHz: (Scan with GFSK, $\pi/4$ -DQPSK, 8DPSK mode, the worst case is in 8DPSK Mode)

| Frequency (MHz) | Receiver | | Turntable Degree | Rx Antenna | | Corrected Factor (dB/m) | Corrected Amplitude (dB μ V/m) | Limit (dB μ V/m) | Margin (dB) |
|---------------------------|----------------------|------------|------------------|------------|-------------|-------------------------|------------------------------------|----------------------|-------------|
| | Reading (dB μ V) | PK/QP/Ave. | | Height (m) | Polar (H/V) | | | | |
| Low Channel (2402 MHz) | | | | | | | | | |
| 2389.41 | 28.44 | PK | 342 | 1.4 | H | 31.87 | 60.31 | 74 | 13.69 |
| 2389.41 | 13.80 | Ave. | 342 | 1.4 | H | 31.87 | 45.67 | 54 | 8.33 |
| 2484.55 | 28.04 | PK | 228 | 2.0 | H | 31.87 | 59.91 | 74 | 14.09 |
| 2484.55 | 13.71 | Ave. | 228 | 2.0 | H | 31.87 | 45.58 | 54 | 8.42 |
| 4804.00 | 45.80 | PK | 325 | 2.4 | H | 6.28 | 52.08 | 74 | 21.92 |
| 4804.00 | 35.11 | Ave. | 325 | 2.4 | H | 6.28 | 41.39 | 54 | 12.61 |
| Middle Channel (2441 MHz) | | | | | | | | | |
| 4882.00 | 44.44 | PK | 228 | 1.0 | H | 6.76 | 51.20 | 74 | 22.80 |
| 4882.00 | 32.72 | Ave. | 228 | 1.0 | H | 6.76 | 39.48 | 54 | 14.52 |
| High Channel (2480 MHz) | | | | | | | | | |
| 2388.69 | 28.17 | PK | 164 | 2.4 | H | 31.87 | 60.04 | 74 | 13.96 |
| 2388.69 | 13.75 | Ave. | 164 | 2.4 | H | 31.87 | 45.62 | 54 | 8.38 |
| 2483.51 | 30.51 | PK | 117 | 1.5 | H | 32.13 | 62.64 | 74 | 11.36 |
| 2483.51 | 19.77 | Ave. | 117 | 1.5 | H | 32.13 | 51.90 | 54 | 2.10 |
| 4960.00 | 44.46 | PK | 301 | 2.3 | H | 6.80 | 51.26 | 74 | 22.74 |
| 4960.00 | 33.93 | Ave. | 301 | 2.3 | H | 6.80 | 40.73 | 54 | 13.27 |

Note:

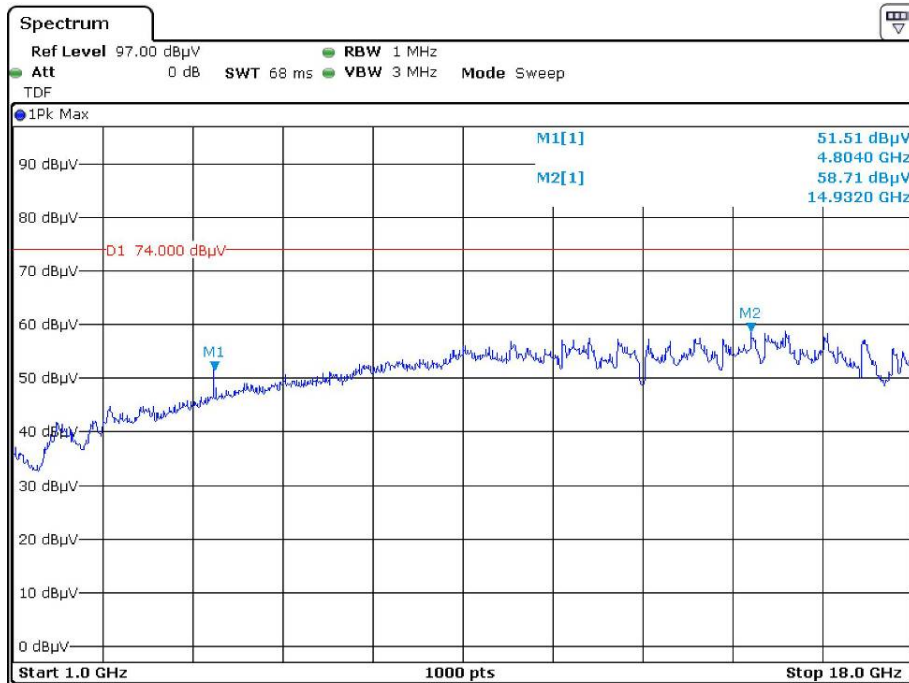
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Corrected Amplitude = Corrected Factor + Reading

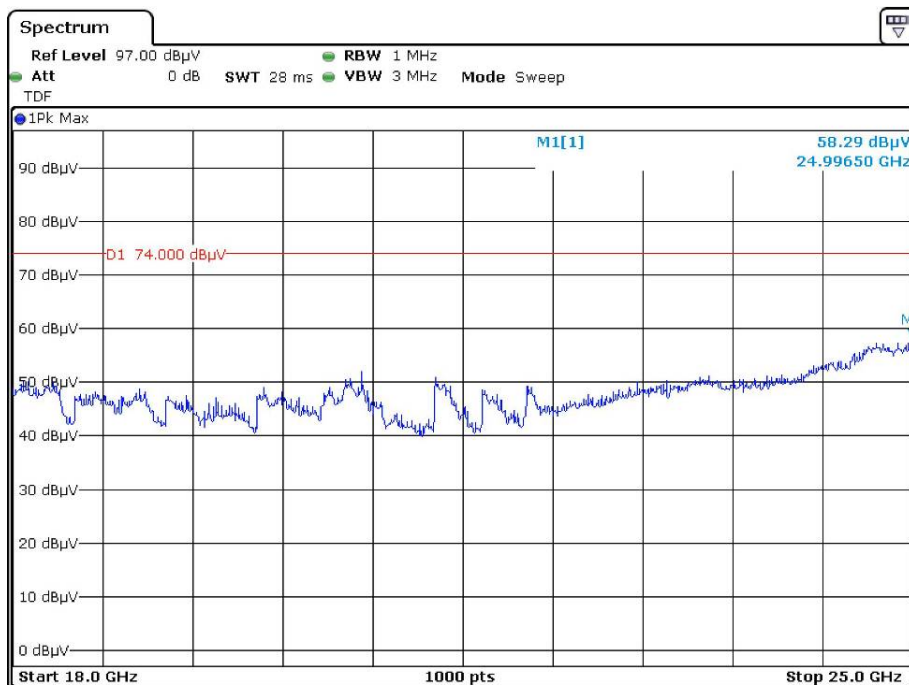
Margin = Limit - Corrected. Amplitude

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

**Pre-scan with low channel Peak
Horizontal**

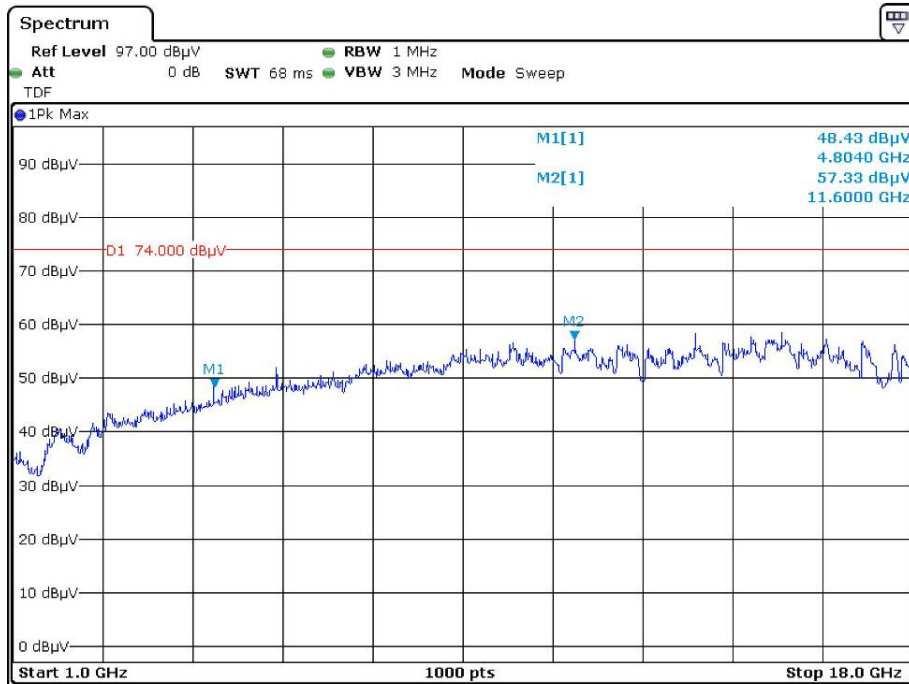


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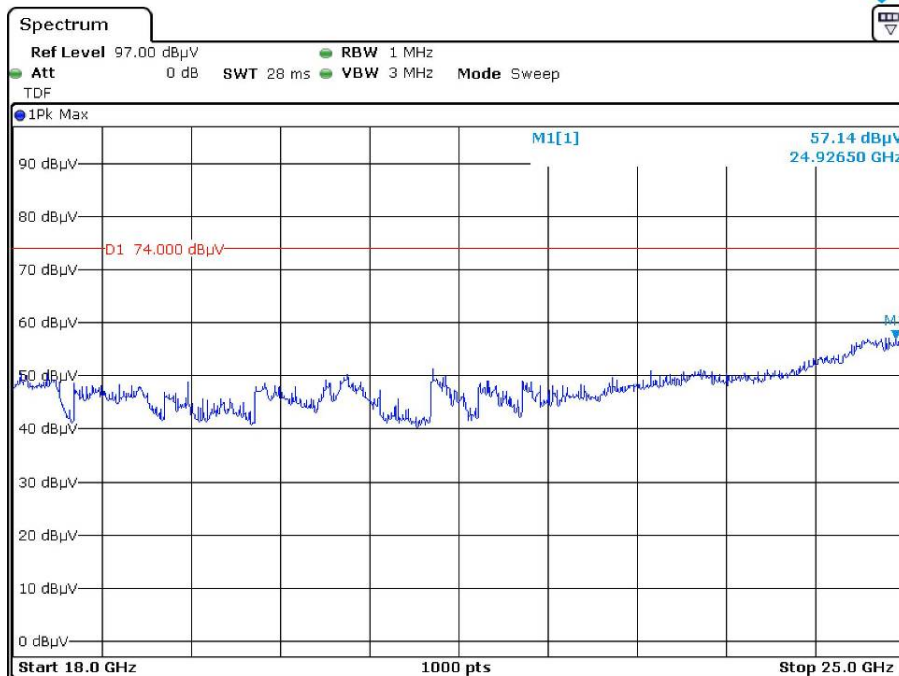


Date: 25.JUL.2020 18:45:47

Vertical

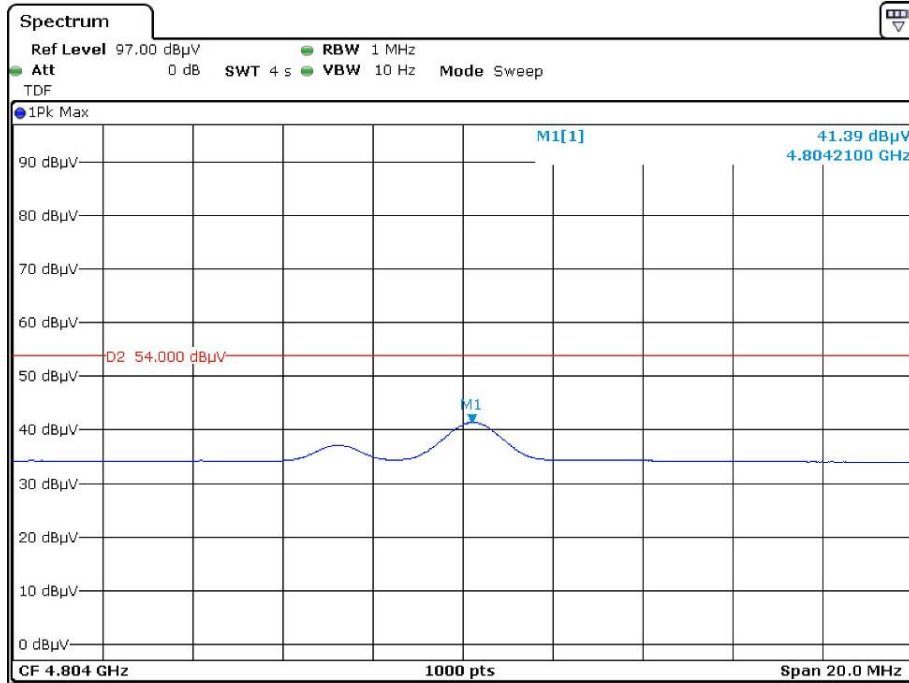


Date: 25.JUL.2020 18:20:21

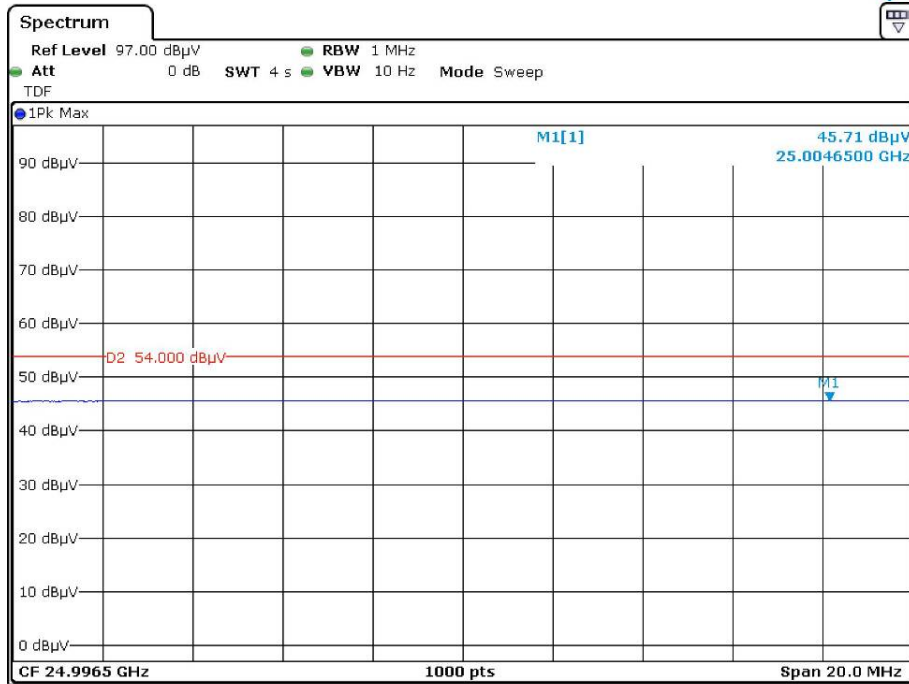


Date: 25.JUL.2020 18:53:45

Pre-scan for Average Horizontal

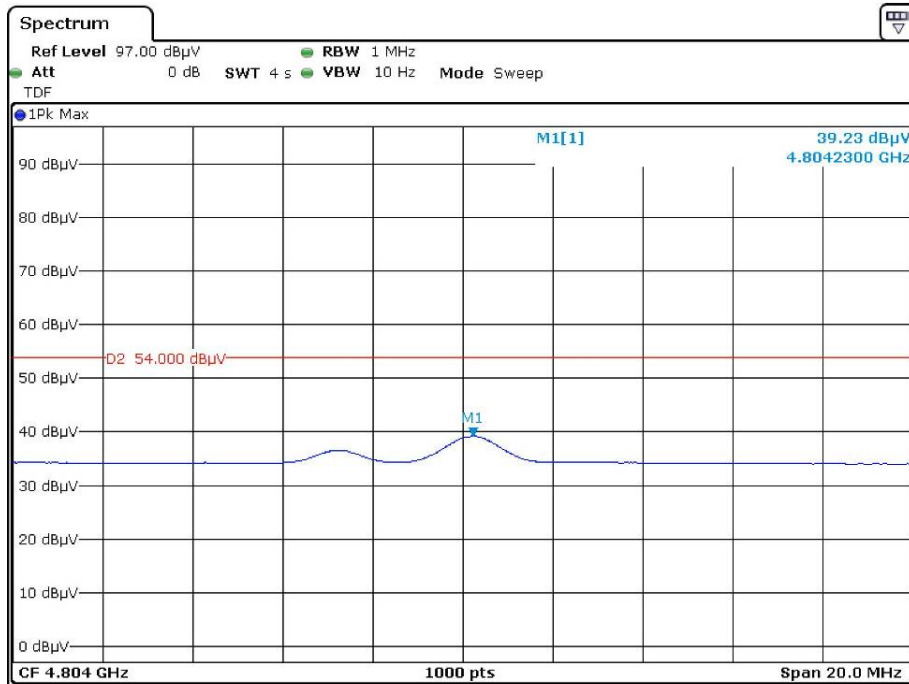


Date: 25.JUL.2020 18:14:43

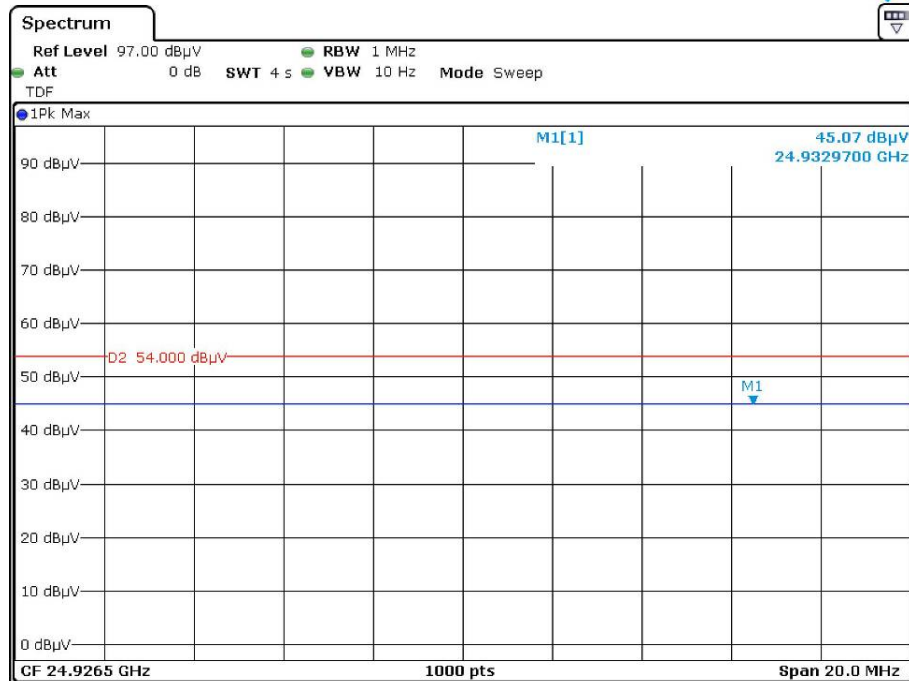


Date: 25.JUL.2020 18:50:19

Vertical



Date: 25.JUL.2020 18:24:16



Date: 25.JUL.2020 18:58:11

FCC §15.247(a) (1)-CHANNEL SEPARATION TEST

Applicable Standard

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Test Procedure

1. Set the EUT in transmitting mode, maxhold the channel.
2. Set the adjacent channel of the EUT and maxhold another trace.
3. Measure the channel separation.

Test Data

Environmental Conditions

| | |
|---------------------------|-----------|
| Temperature: | 24 °C |
| Relative Humidity: | 50 % |
| ATM Pressure: | 101.0 kPa |

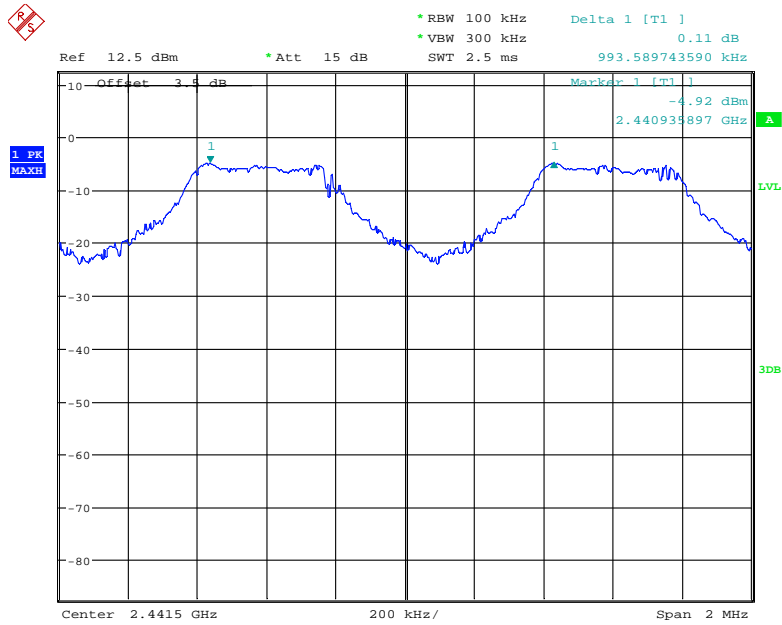
The testing was performed by Blaker Zhang on 2020-07-31.

EUT operation mode: Transmitting

Test Result: Compliance. Please refer to following table and plots.

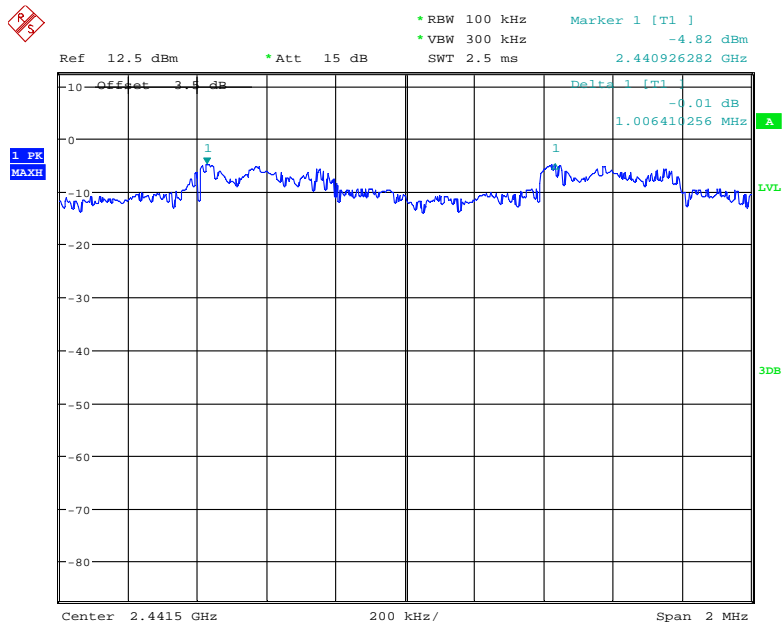
| Test Mode | Channel Separation (MHz) | 20 dBc BW (MHz) | Two-thirds of the 20 dB bandwidth (MHz) | Channel Separation Limit | Result |
|--------------------------------------|--------------------------|-----------------|---|-------------------------------------|------------|
| BDR(GFSK) | | | | | |
| Hopping | 0.994 | 0.887 | 0.591 | > two-thirds of the 20 dB bandwidth | Compliance |
| EDR($\pi/4$-DQPSK) | | | | | |
| Hopping | 1.006 | 1.251 | 0.834 | > two-thirds of the 20 dB bandwidth | Compliance |
| EDR(8DPSK) | | | | | |
| Hopping | 1.000 | 1.238 | 0.825 | > two-thirds of the 20 dB bandwidth | Compliance |

BDR (GFSK)



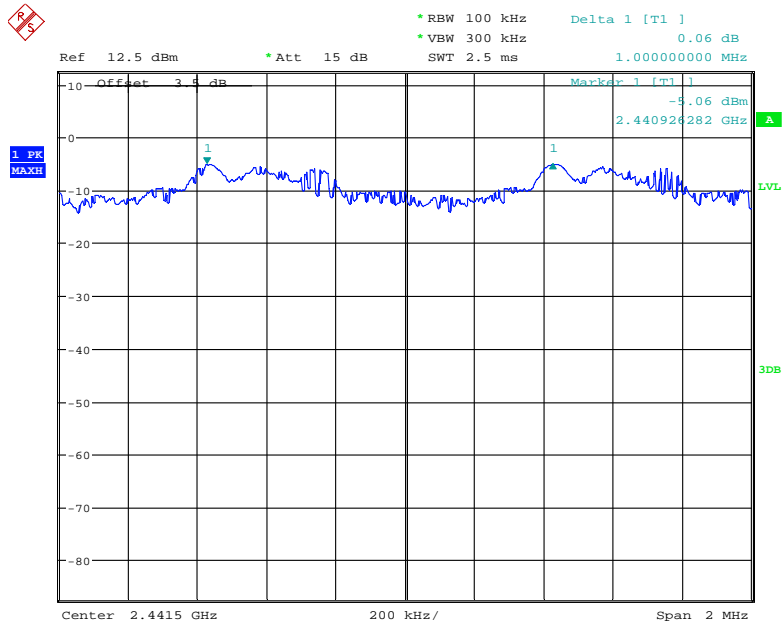
Date: 31.JUL.2020 09:20:31

EDR ($\pi/4$ -DQPSK)



Date: 31.JUL.2020 09:17:49

EDR (8DPSK)



Date: 31.JUL.2020 09:15:27

FCC §15.247(a) (1) – 20 dB EMISSION BANDWIDTH

Applicable Standard

Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

Test Data

Environmental Conditions

| | |
|---------------------------|-----------|
| Temperature: | 24 °C |
| Relative Humidity: | 50 % |
| ATM Pressure: | 101.0 kPa |

The testing was performed by Blaker Zhang on 2020-07-31.

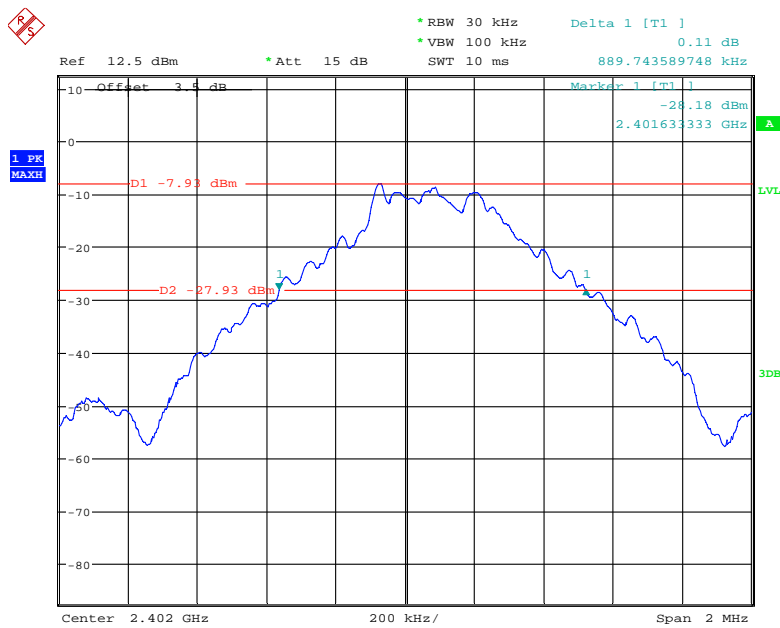
EUT operation mode: Transmitting

Test Result: Pass

Test Result: Compliance. Please refer to following table and plots.

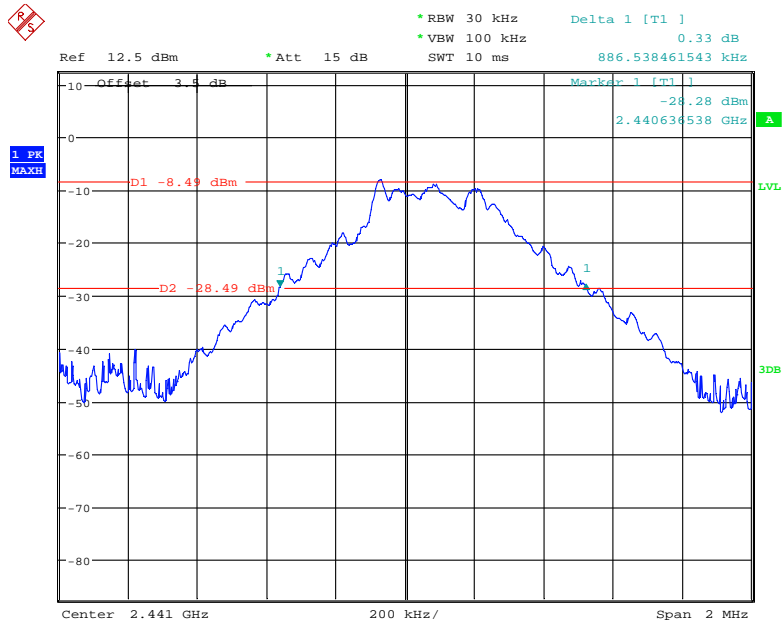
| Mode | Channel | Frequency (MHz) | 20 dB Emission Bandwidth (MHz) |
|---------------------------------------|---------|-----------------|--------------------------------|
| BDR (GFSK) | Low | 2402 | 0.890 |
| | Middle | 2441 | 0.887 |
| | High | 2480 | 0.887 |
| EDR ($\pi/4$-DQPSK) | Low | 2402 | 1.251 |
| | Middle | 2441 | 1.276 |
| | High | 2480 | 1.251 |
| EDR (8DPSK) | Low | 2402 | 1.238 |
| | Middle | 2441 | 1.276 |
| | High | 2480 | 1.242 |

BDR (GFSK): Low Channel



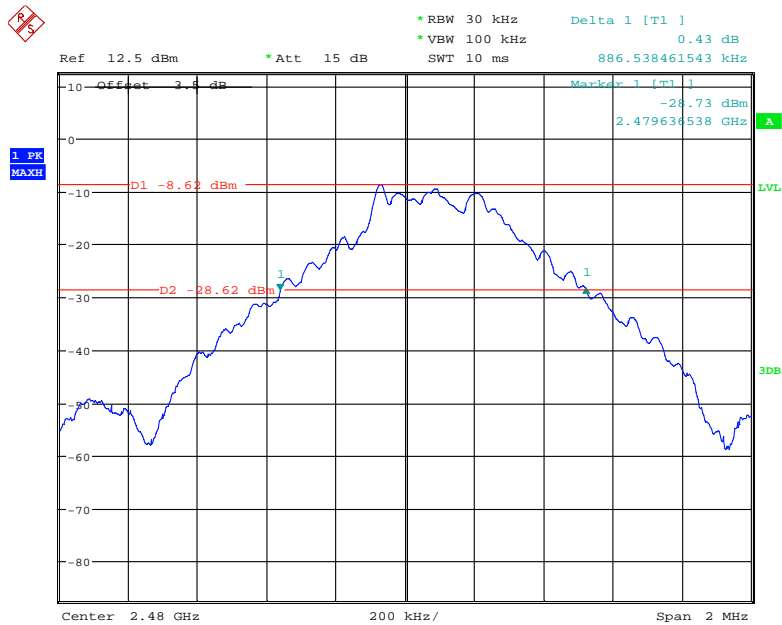
Date: 31.JUL.2020 09:05:00

BDR (GFSK): Middle Channel



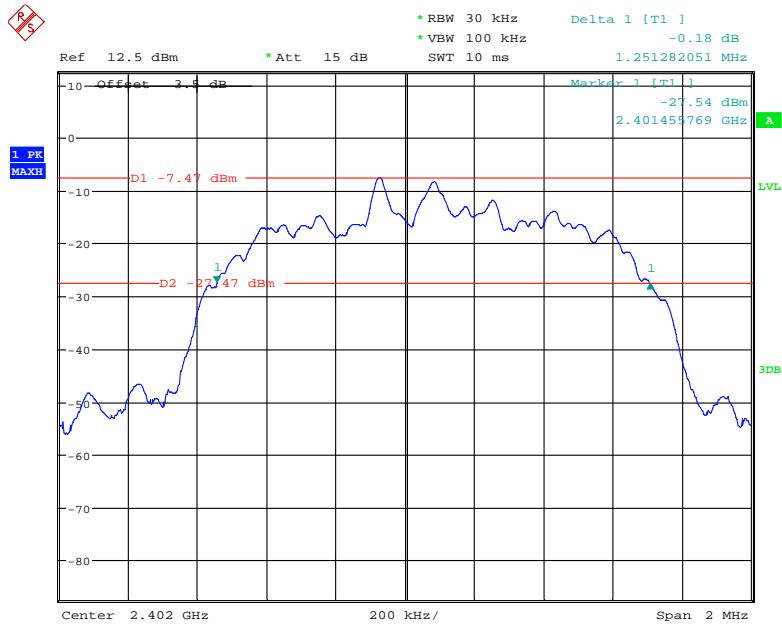
Date: 31.JUL.2020 08:47:24

BDR (GFSK): High Channel



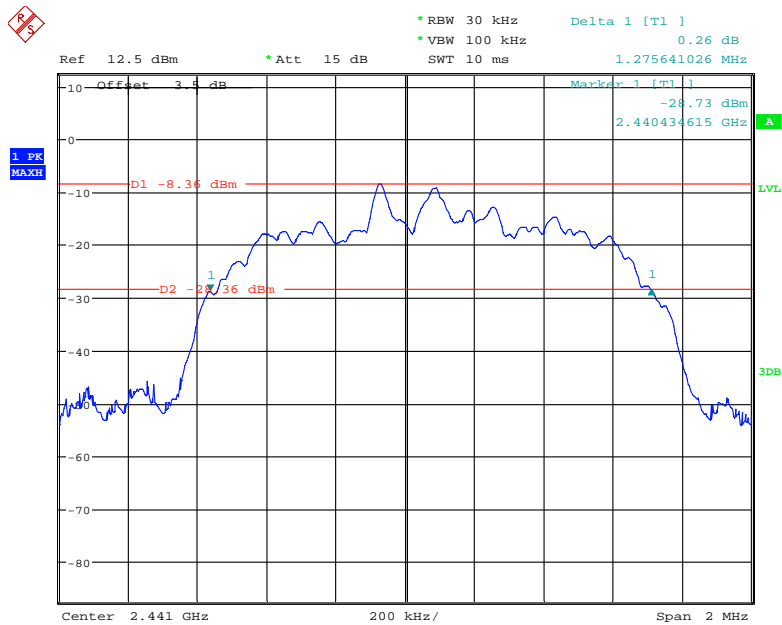
Date: 31.JUL.2020 09:02:28

EDR ($\pi/4$ -DQPSK): Low Channel



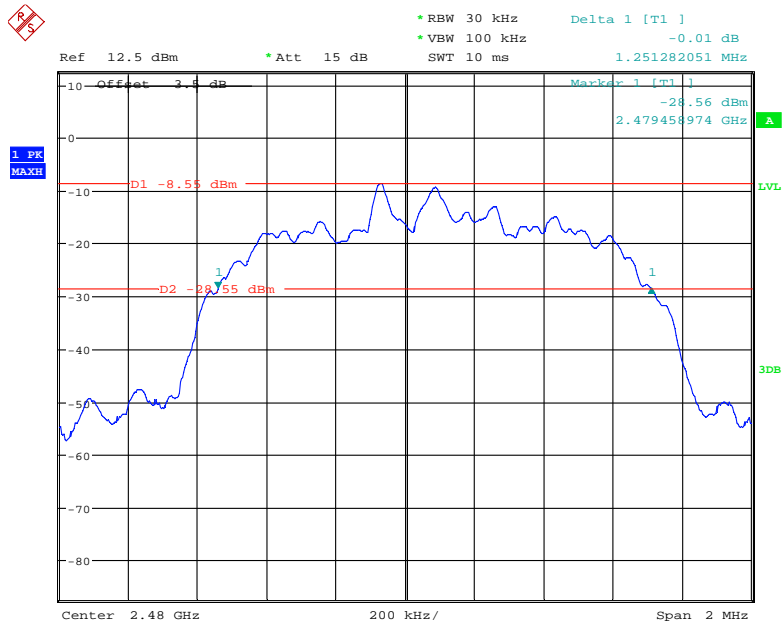
Date: 31.JUL.2020 09:06:58

EDR ($\pi/4$ -DQPSK): Middle Channel



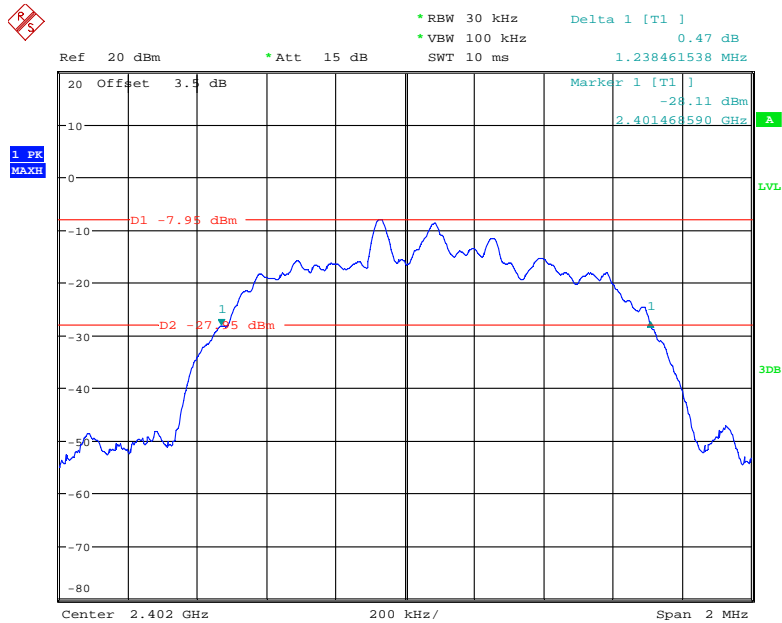
Date: 31.JUL.2020 08:51:19

EDR ($\pi/4$ -DQPSK): High Channel



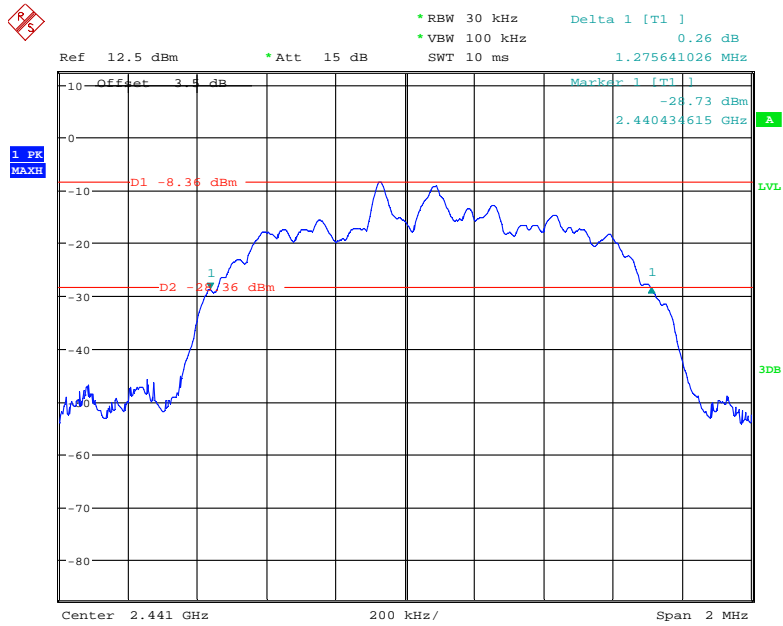
Date: 31.JUL.2020 08:59:49

EDR (8DPSK): Low Channel



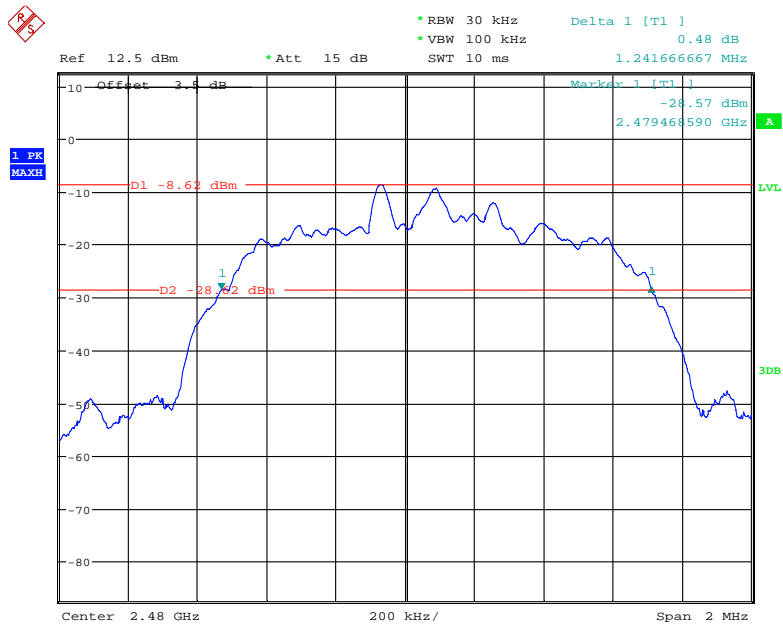
Date: 31.JUL.2020 13:36:22

EDR (8DPSK): Middle Channel



Date: 31.JUL.2020 08:51:19

EDR (8DPSK): High Channel



Date: 31.JUL.2020 08:57:11

FCC §15.247(a) (1) (iii)-QUANTITY OF HOPPING CHANNEL TEST

Applicable Standard

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

Test Procedure

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

Test Data

Environmental Conditions

| | |
|---------------------------|-----------|
| Temperature: | 24 °C |
| Relative Humidity: | 50 % |
| ATM Pressure: | 101.0 kPa |

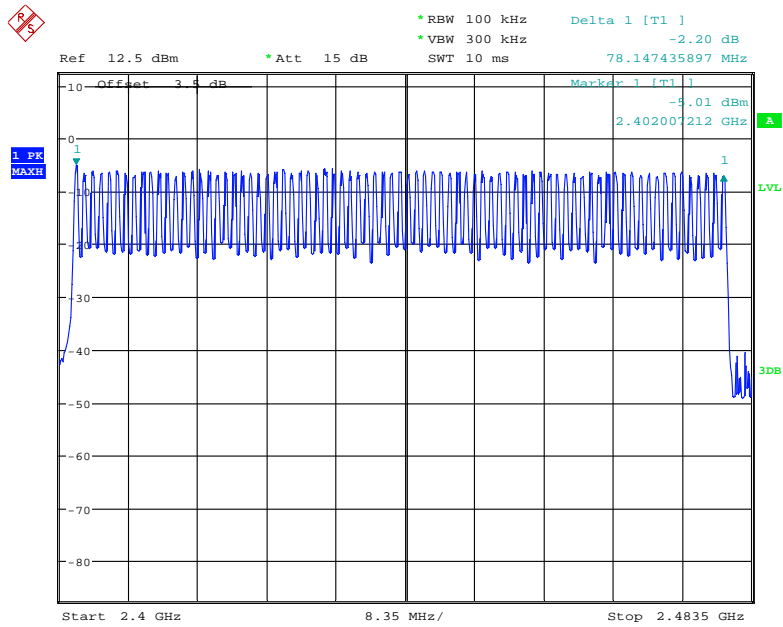
The testing was performed by Blaker Zhang on 2020-07-31.

EUT operation mode: Transmitting

Test Result: Compliance. Please refer to following table and plots.

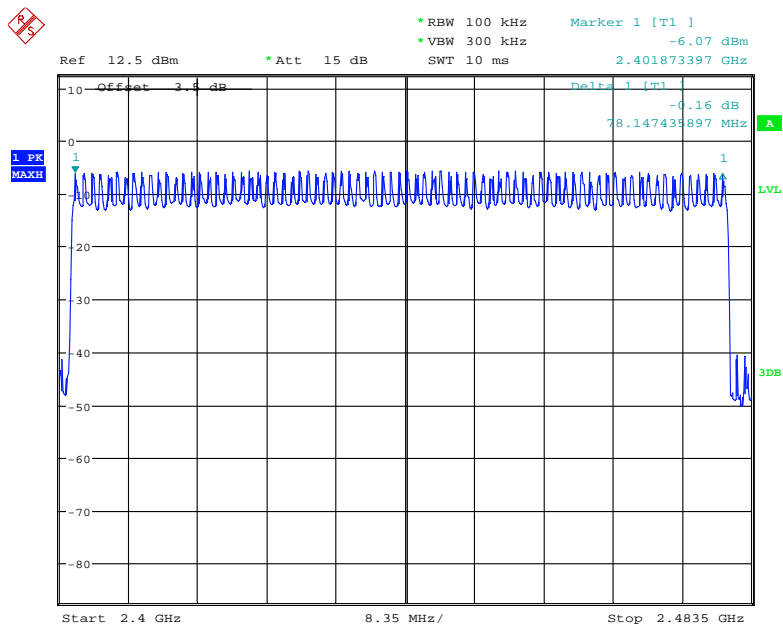
| Mode | Frequency Range (MHz) | Number of Hopping Channel (CH) | Limit (CH) |
|-----------------|------------------------------|---------------------------------------|-------------------|
| BDR (GFSK) | 2400-2483.5 | 79 | ≥15 |
| EDR (π/4-DQPSK) | 2400-2483.5 | 79 | ≥15 |
| EDR (8DPSK) | 2400-2483.5 | 79 | ≥15 |

BDR (GFSK): Number of Hopping Channels



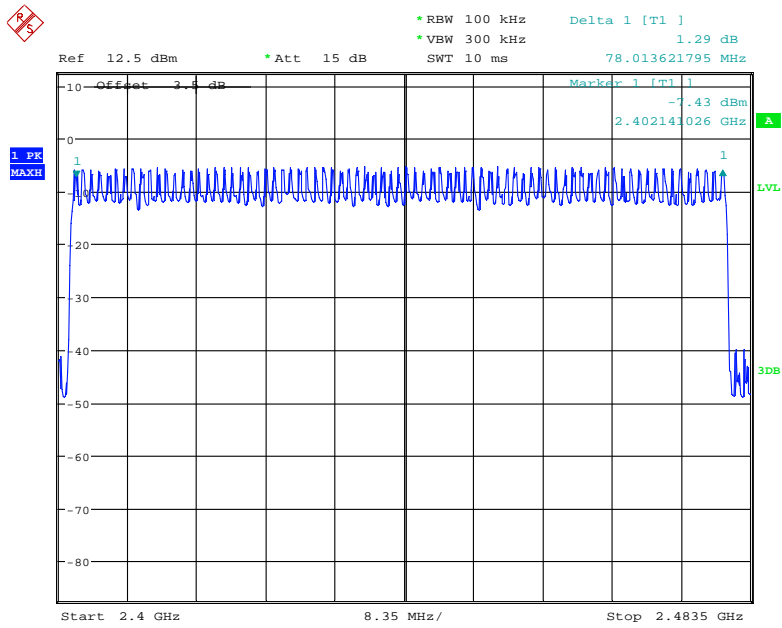
Date: 31.JUL.2020 10:58:58

EDR ($\pi/4$ -DQPSK): Number of Hopping Channels



Date: 31.JUL.2020 10:52:29

EDR (8DPSK): Number of Hopping Channels



Date: 31.JUL.2020 10:46:20

FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME)**Applicable Standard**

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

Test Procedure

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

Test Data**Environmental Conditions**

| | |
|---------------------------|-----------|
| Temperature: | 24 °C |
| Relative Humidity: | 50 % |
| ATM Pressure: | 101.0 kPa |

The testing was performed by Blaker Zhang on 2020-07-31.

EUT operation mode: Transmitting

Test Result: Compliance. Please refer to following table and plots.

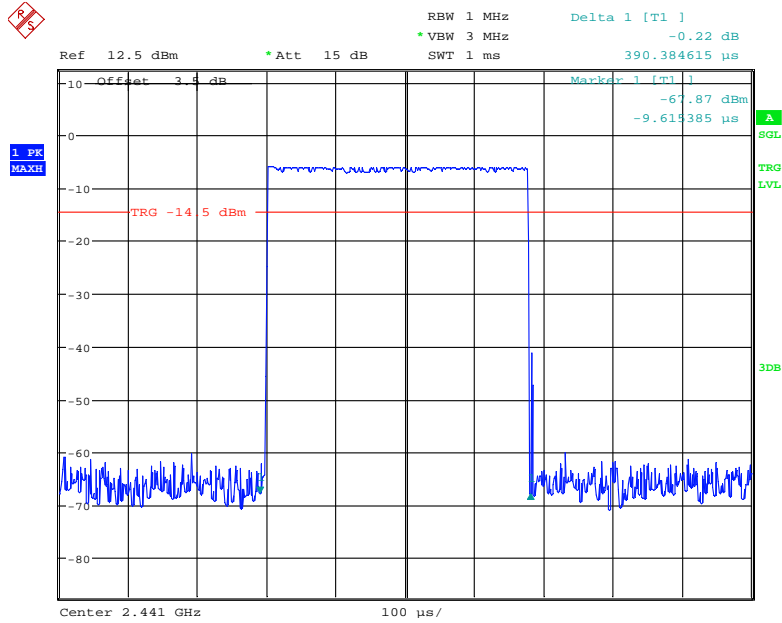
| Test Mode | Channel | Pulse Time (ms) | Total Hops | Period Time (s) | Dwell Time (ms) | Limit (ms) | Result |
|--------------------------------------|---------|-----------------|------------|-----------------|-----------------|------------|--------|
| Test mode: BDR mode(GFSK) | | | | | | | |
| DH 1 | Hop | 0.390 | 320 | 31.6 | 124.80 | 400 | Pass |
| DH 3 | Hop | 1.656 | 150 | 31.6 | 248.40 | 400 | Pass |
| DH 5 | Hop | 2.934 | 110 | 31.6 | 322.74 | 400 | Pass |
| Test mode: EDR mode($\pi/4$ -DQPSK) | | | | | | | |
| 2DH 1 | Hop | 0.402 | 320 | 31.6 | 128.64 | 400 | Pass |
| 2DH 3 | Hop | 1.661 | 180 | 31.6 | 298.98 | 400 | Pass |
| 2DH 5 | Hop | 2.912 | 110 | 31.6 | 320.32 | 400 | Pass |
| Test mode: EDR mode(8 DPSK) | | | | | | | |
| 3DH 1 | Hop | 0.400 | 320 | 31.6 | 128.00 | 400 | Pass |
| 3DH 3 | Hop | 1.671 | 160 | 31.6 | 267.36 | 400 | Pass |
| 3DH 5 | Hop | 2.920 | 100 | 31.6 | 292.00 | 400 | Pass |

Note 1: A period time=0.4*79=31.6(S), Dwell Time= Pulse Time* Total Hops

Note 2: Total hops =Hopping Number in 3.16s*10

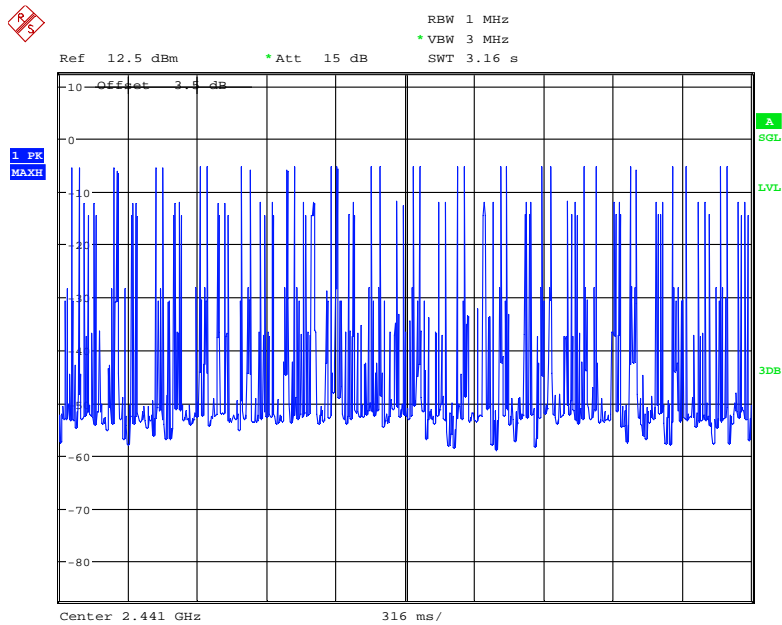
Note 3: Hopping Number in 3.16s = Total of highest signals in 3.16s (Second high signals were other channel)

Pulse time, Middle Channel, DH1



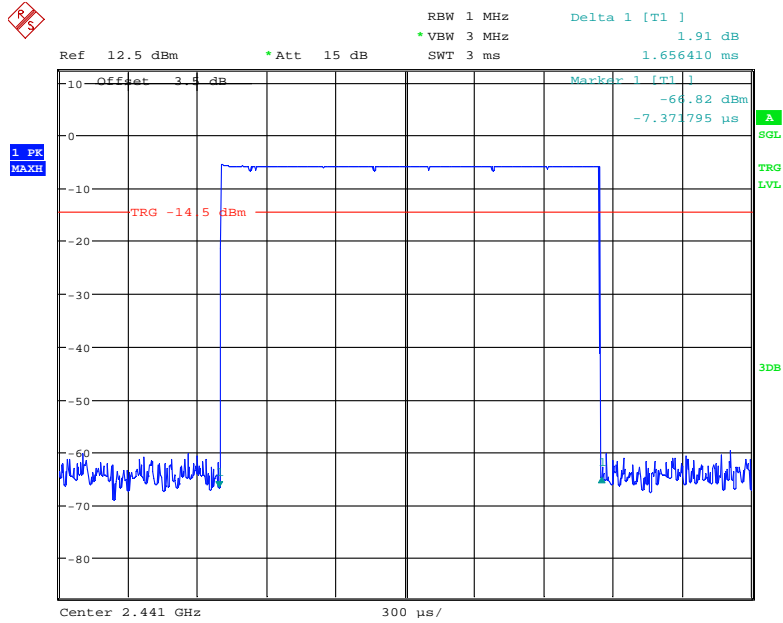
Date: 31.JUL.2020 10:06:25

Hopping Number in 3.16s



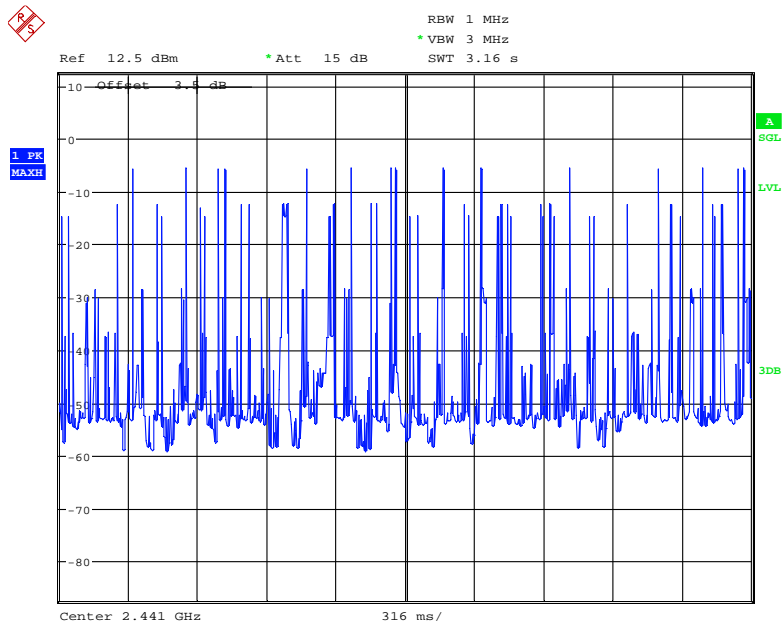
Date: 31.JUL.2020 09:31:28

Pulse time, Middle Channel, DH3



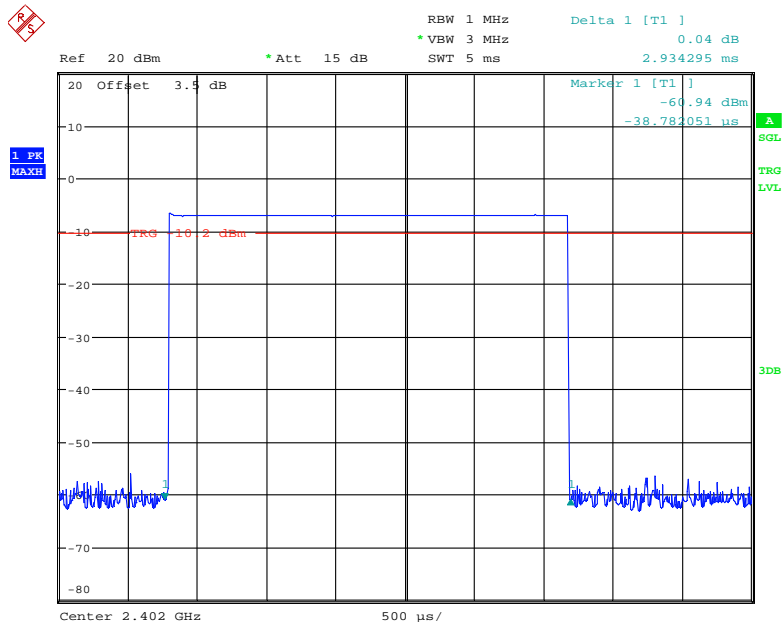
Date: 31.JUL.2020 09:51:50

Hopping Number in 3.16s



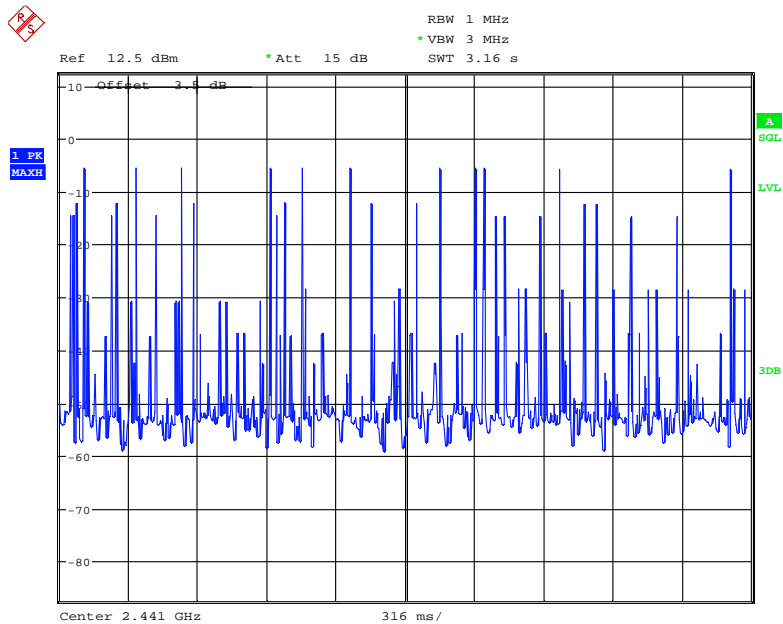
Date: 31.JUL.2020 09:35:06

Pulse time, Middle Channel, DH5



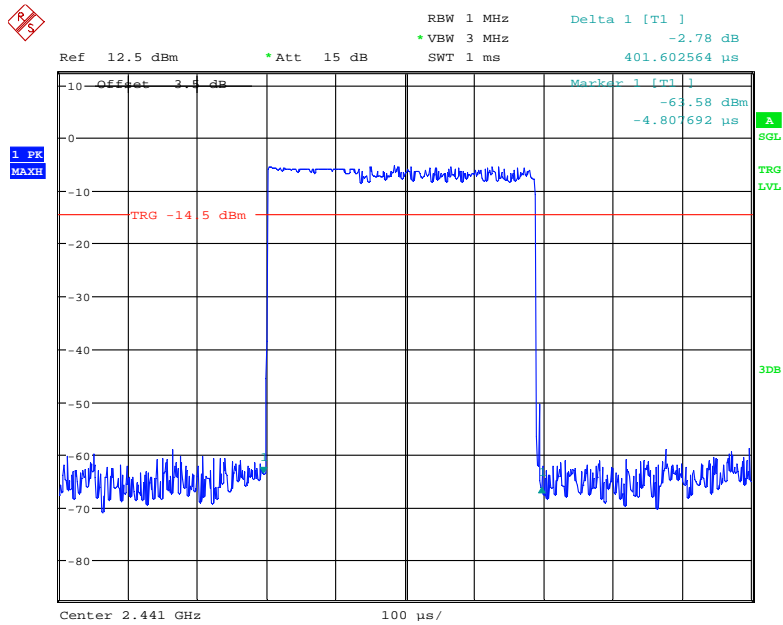
Date: 31.JUL.2020 13:30:38

Hopping Number in 3.16s



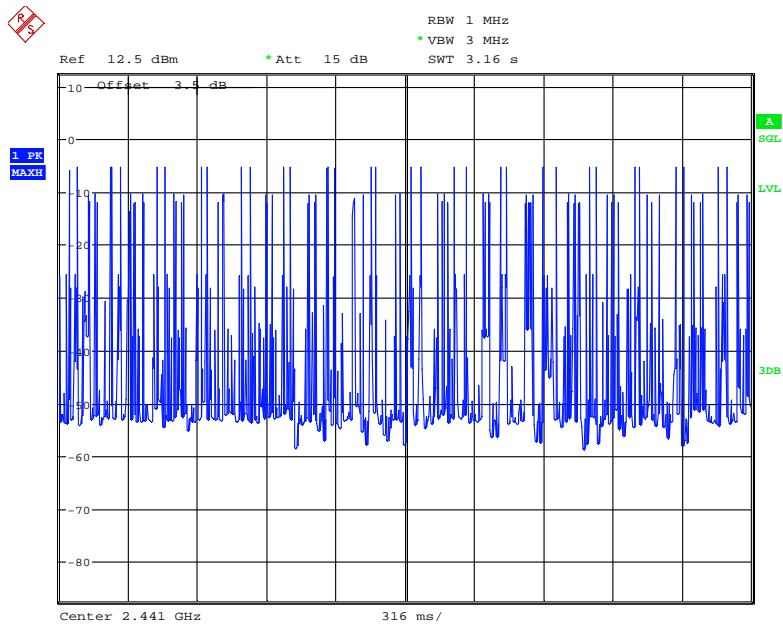
Date: 31.JUL.2020 09:37:25

Pulse time, Middle Channel, 2DH1



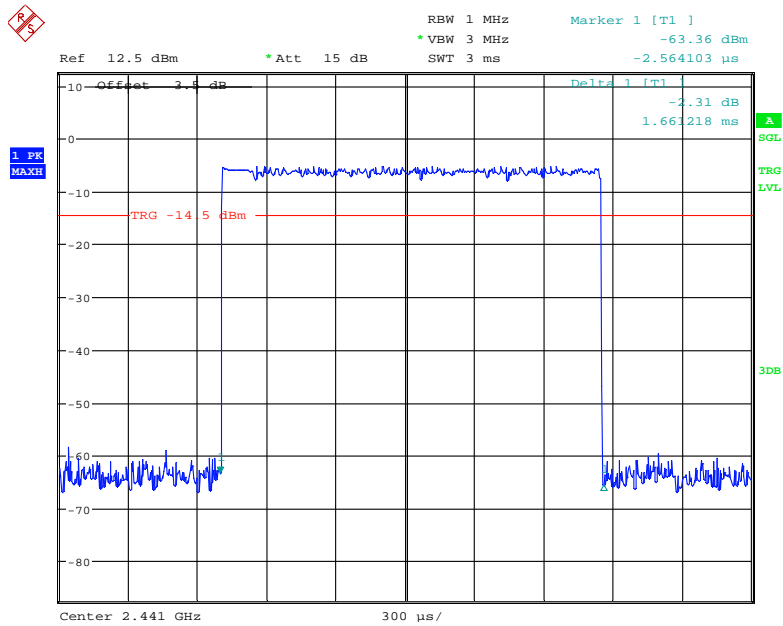
Date: 31.JUL.2020 10:04:19

Hopping Number in 3.16s



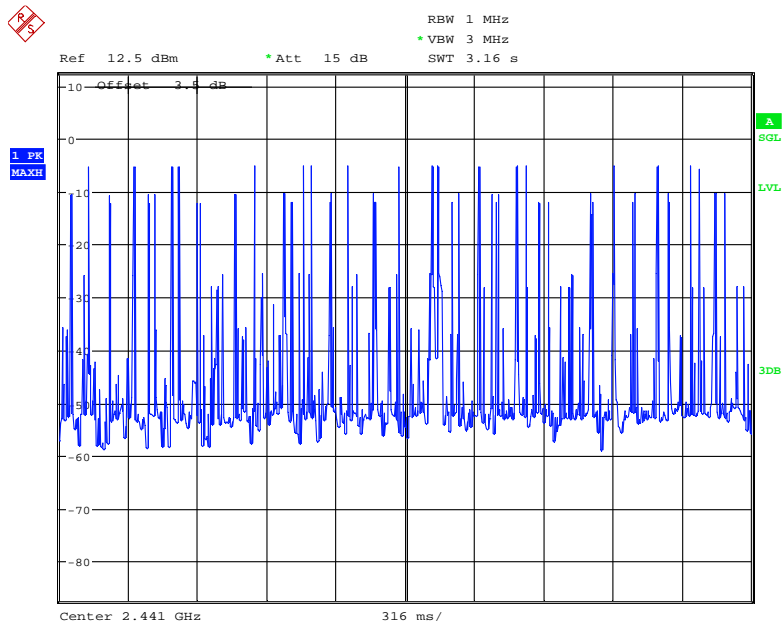
Date: 31.JUL.2020 09:38:09

Pulse time, Middle Channel, 2DH3



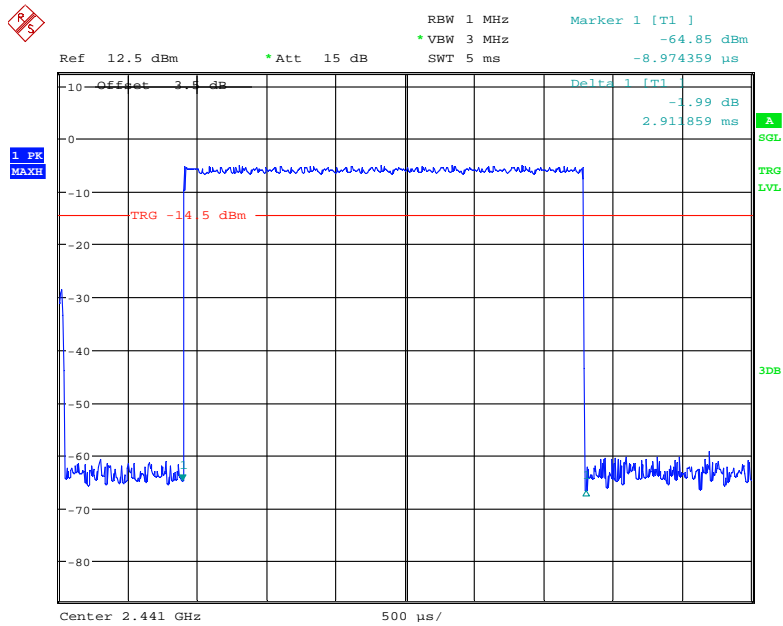
Date: 31.JUL.2020 09:52:55

Hopping Number in 3.16s



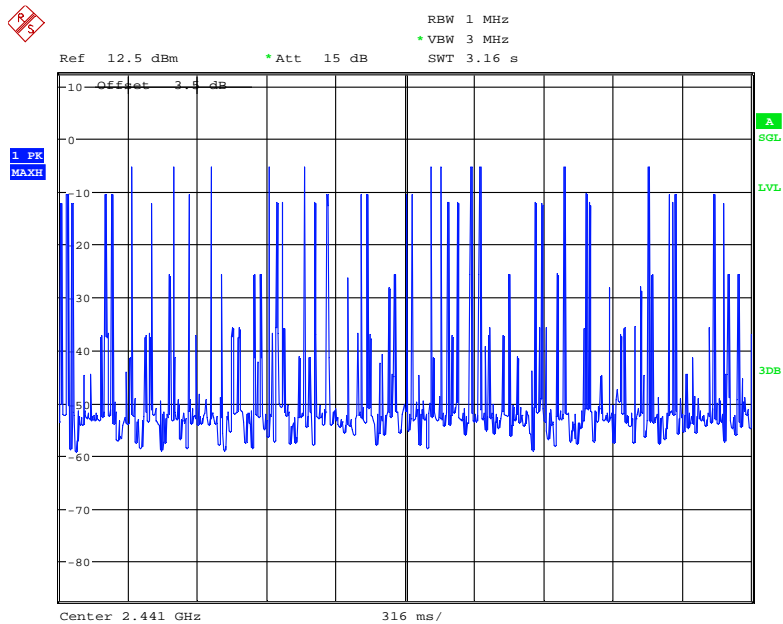
Date: 31.JUL.2020 09:39:10

Pulse time, Middle Channel, 2DH5



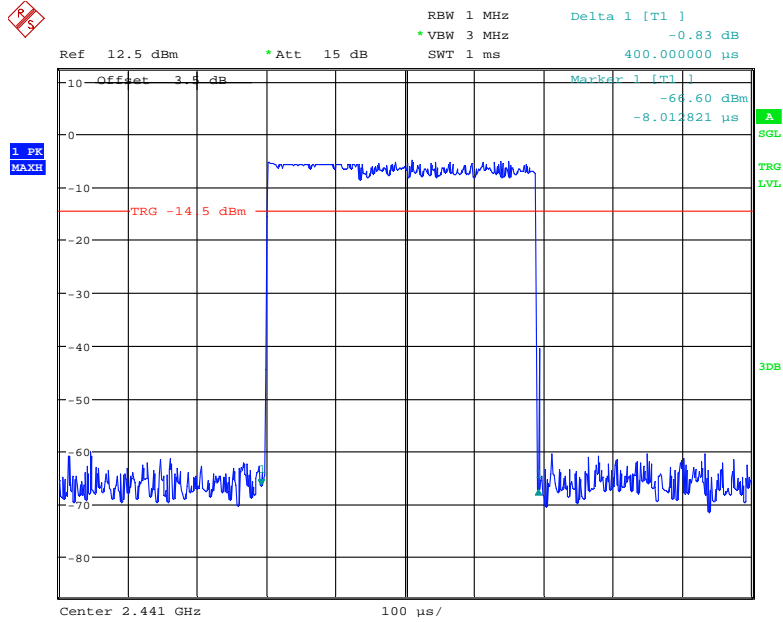
Date: 31.JUL.2020 09:47:27

Hopping Number in 3.16s



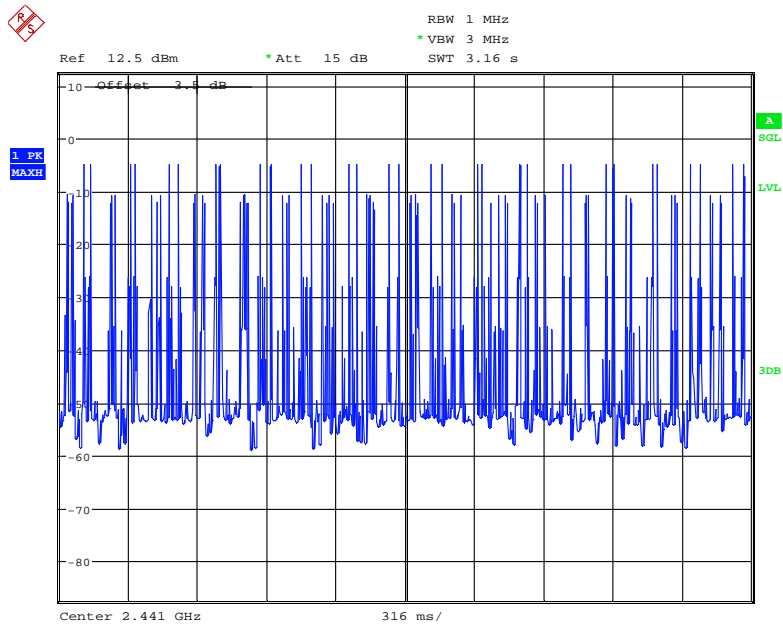
Date: 31.JUL.2020 09:40:00

Pulse time, Middle Channel, 3DH1



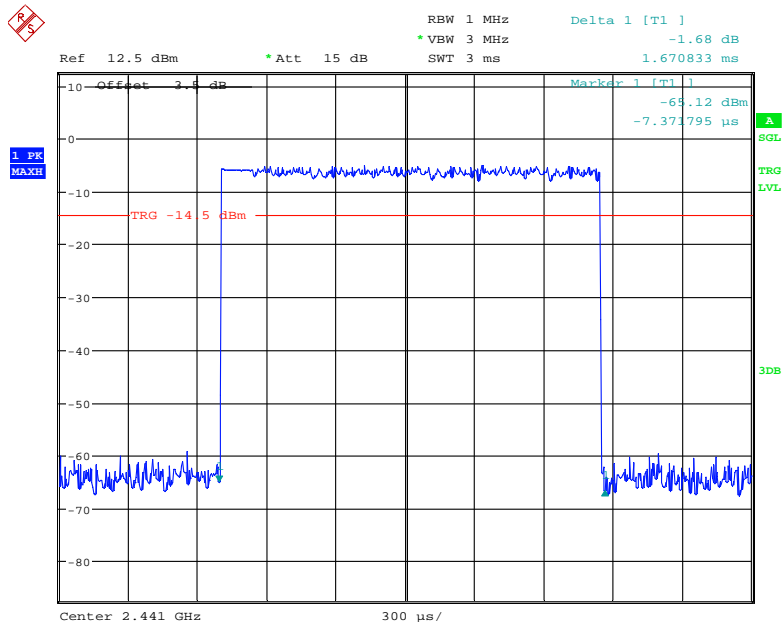
Date: 31.JUL.2020 09:58:54

Hopping Number in 3.16s



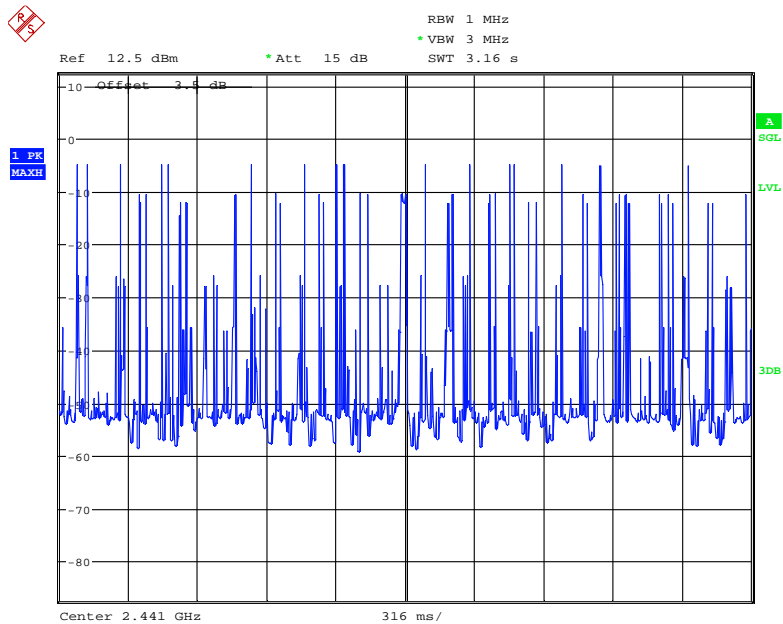
Date: 31.JUL.2020 09:40:50

Pulse time, Middle Channel, 3DH3



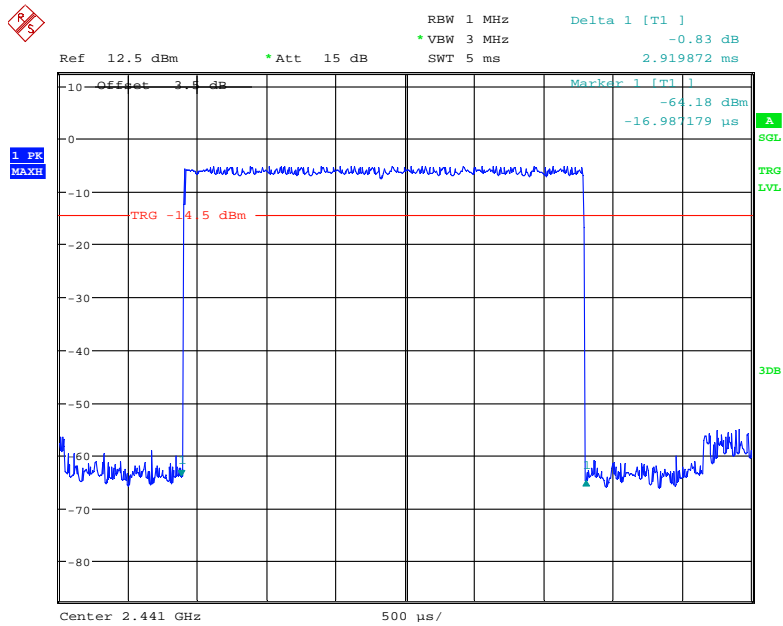
Date: 31.JUL.2020 09:54:12

Hopping Number in 3.16s



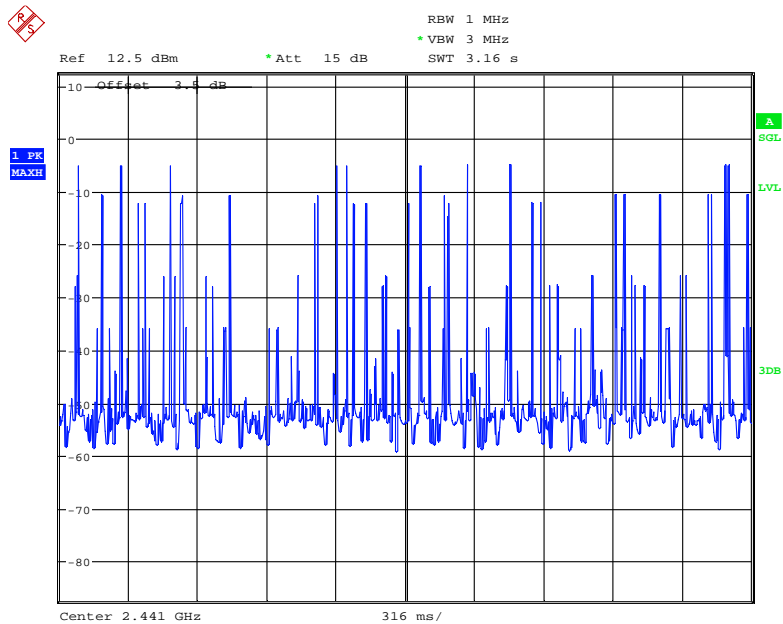
Date: 31.JUL.2020 09:42:04

Pulse time, Middle Channel, 3DH5



Date: 31.JUL.2020 09:46:11

Hopping Number in 3.16s



Date: 31.JUL.2020 09:43:13

FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT

Applicable Standard

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

Test Procedure

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

Test Data

Environmental Conditions

| | |
|---------------------------|-----------|
| Temperature: | 24 °C |
| Relative Humidity: | 50 % |
| ATM Pressure: | 101.0 kPa |

The testing was performed by Blaker Zhang on 2020-07-31.

EUT operation mode: Transmitting

Test Result: Compliance. Please refer to following table and plots.

| Mode | Channel | Frequency (MHz) | Peak Conducted Output Power (dBm) | Limit (dBm) |
|---------------------------------------|---------|-----------------|-----------------------------------|-------------|
| BDR (GFSK) | Low | 2402 | -4.02 | 21 |
| | Middle | 2441 | -4.77 | 21 |
| | High | 2480 | -5.79 | 21 |
| EDR ($\pi/4$-DQPSK) | Low | 2402 | -3.90 | 21 |
| | Middle | 2441 | -4.07 | 21 |
| | High | 2480 | -4.52 | 21 |
| EDR (8DPSK) | Low | 2402 | -3.49 | 21 |
| | Middle | 2441 | -3.57 | 21 |
| | High | 2480 | -4.19 | 21 |

FCC §15.247(d) - BAND EDGES TESTING

Applicable Standard

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Test Procedure

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

Test Data

Environmental Conditions

| | |
|---------------------------|-----------|
| Temperature: | 24 °C |
| Relative Humidity: | 50 % |
| ATM Pressure: | 101.0 kPa |

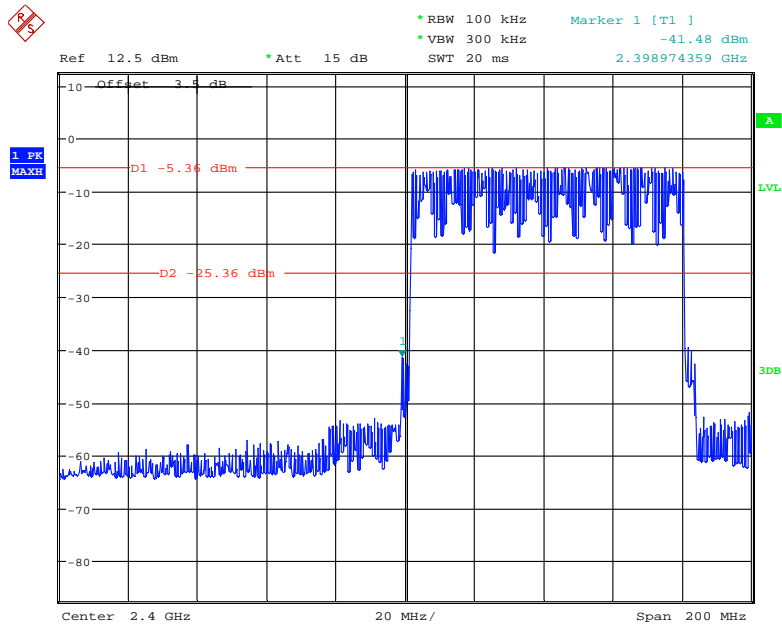
The testing was performed by Blaker Zhang on 2020-07-31.

EUT operation mode: Transmitting

Test Result: Compliance. Please refer to following table and plots.

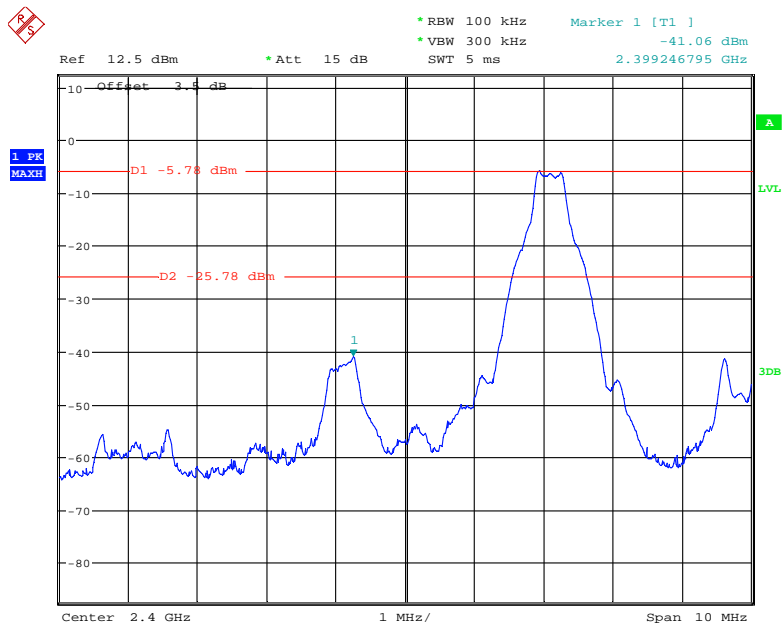
BDR (GFSK): Band Edge-Left Side

Hopping



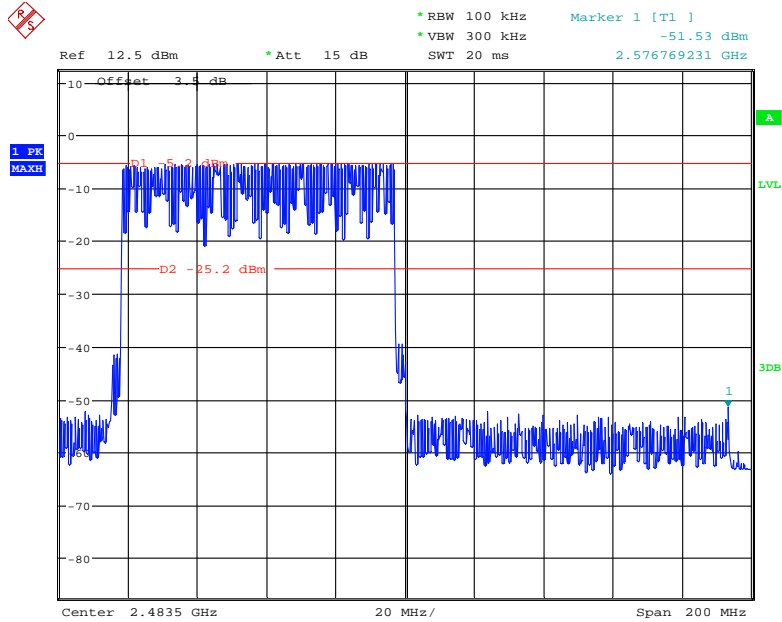
Date: 31.JUL.2020 10:11:18

Single



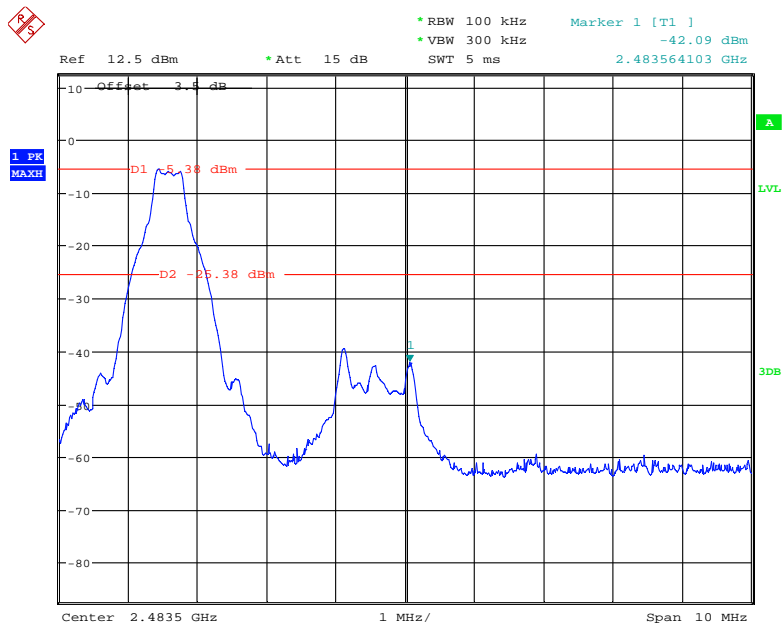
Date: 31.JUL.2020 10:29:59

BDR (GFSK): Band Edge-Right Side Hopping



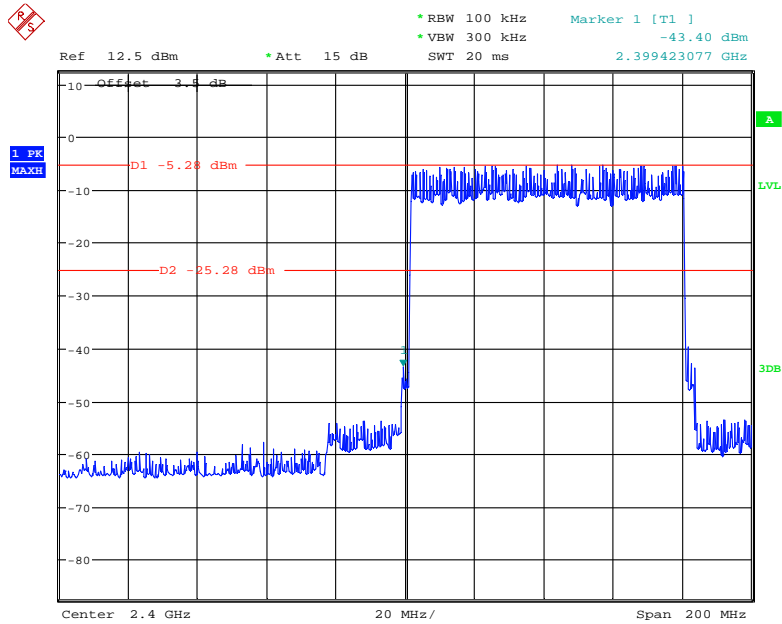
Date: 31.JUL.2020 10:15:47

Single



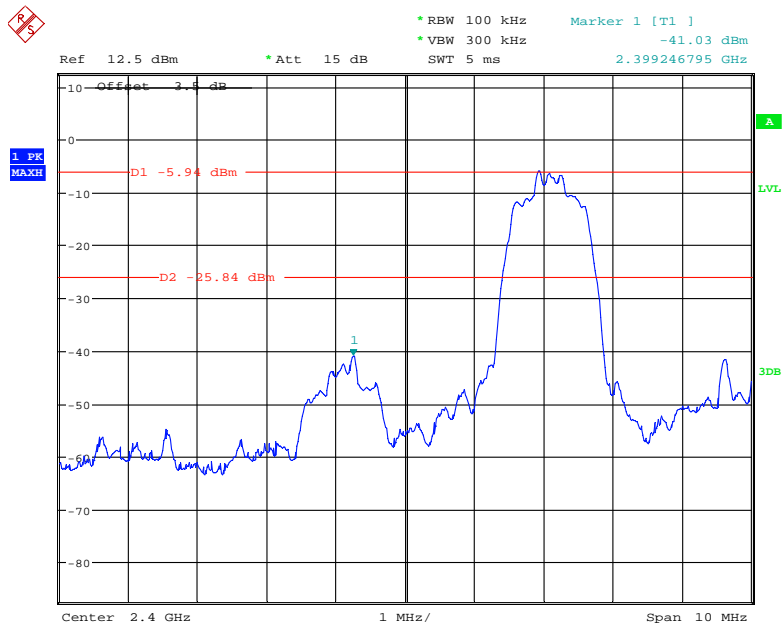
Date: 31.JUL.2020 10:31:30

EDR ($\pi/4$ -DQPSK): Band Edge-Left Side Hopping



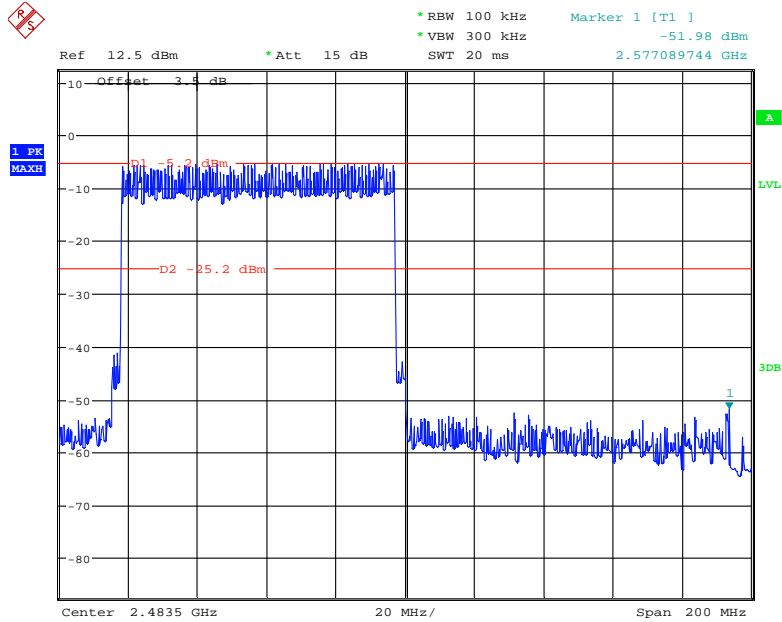
Date: 31.JUL.2020 10:19:56

Single



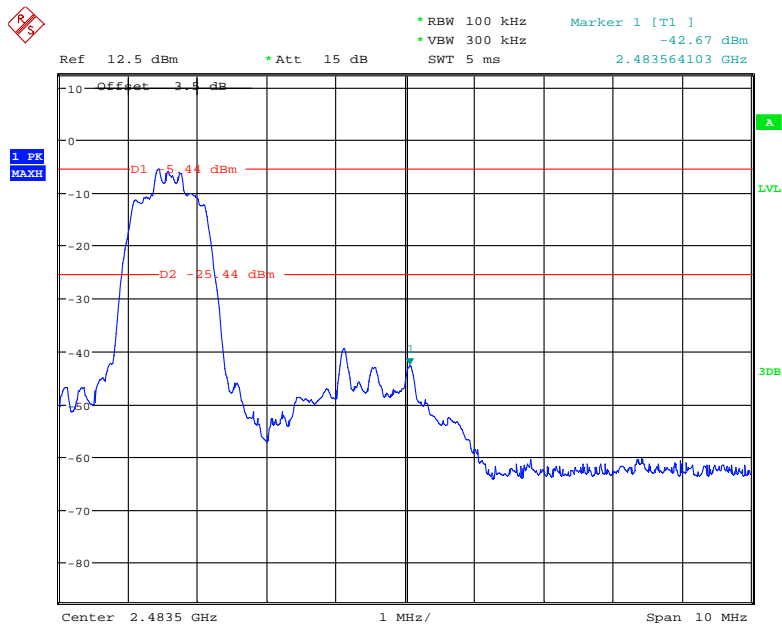
Date: 31.JUL.2020 10:28:30

EDR ($\pi/4$ -DQPSK): Band Edge-Right Side Hopping



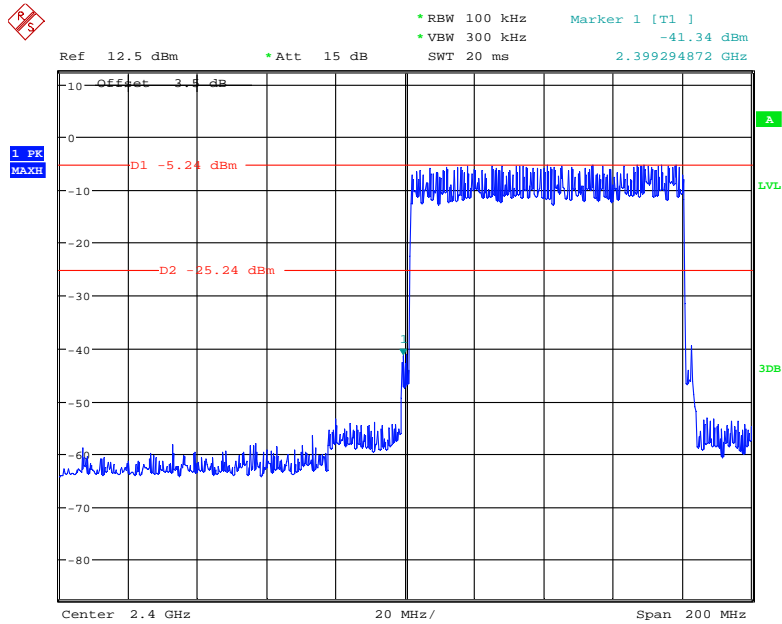
Date: 31.JUL.2020 10:18:04

Single



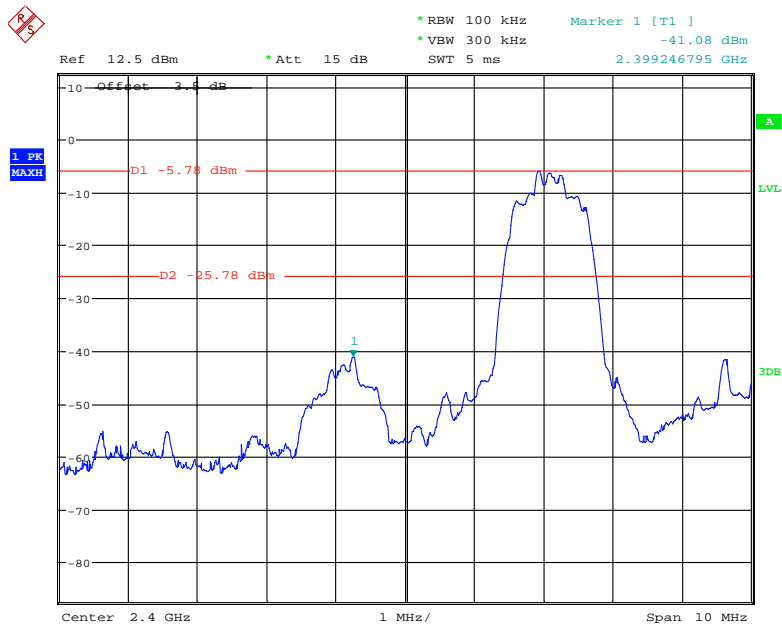
Date: 31.JUL.2020 10:32:52

EDR (8DPSK): Band Edge-Left Side Hopping



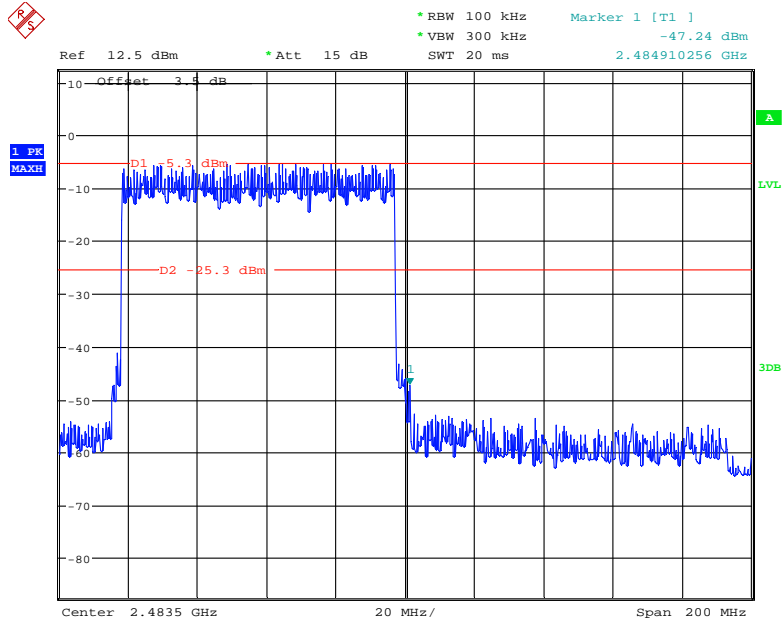
Date: 31.JUL.2020 10:22:27

Single



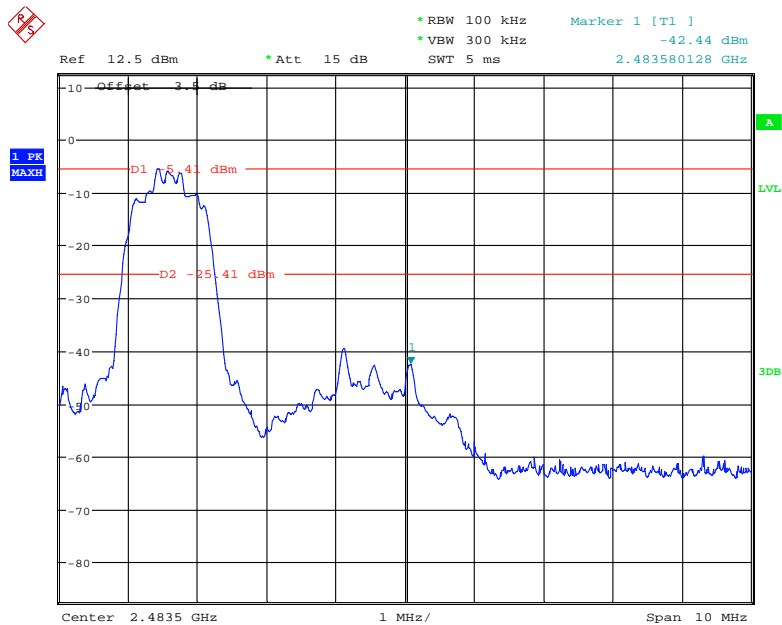
Date: 31.JUL.2020 10:26:28

EDR (8DPSK): Band Edge-Right Side Hopping



Date: 31.JUL.2020 10:24:17

Single



Date: 31.JUL.2020 10:34:41

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