# FCC PART 15.247
# TEST REPORT

For

# VTech Telecommunications Ltd

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

## FCC ID: EW780-1385-01

| Report Type: | Product Type: |
|---|---|
| Original Report | Video Baby Monitor |

| | |
|---|---|
| **Report Number:** | RSZ200622003-00B |
| **Report Date:** | 2020-08-26 |
| **Reviewed By:** | Jimmy Xiao<br>RF Engineer |
| **Prepared By:** | Bay Area Compliance Laboratories Corp. (Shenzhen)<br>6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China<br>Tel: +86-755-33320018<br>Fax: +86-755-33320008<br>www.baclcorp.com.cn |

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# GENERAL INFORMATION

## Product Description for Equipment under Test (EUT)

| | |
|---|---|
| Product | Video Baby Monitor |
| Tested Model | VM320 PU |
| Multiple Models | VM320-2 PU, VM320-ab PU, VM2251 PU, VM2251-2 PU, VM2x51-ab PU (x=any alphanumeric character is presenting different type packaging; 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 |
| Frequency Range | 2405~2475MHz |
| Maximum conducted Peak output power | 14.69dBm |
| Modulation Technique | GFSK |
| Antenna Specification | 0dBi |
| Voltage Range | DC 6.0V from adapter or DC 3.6V from battery |
| Date of Test | 2020-06-23 to 2020-08-26 |
| Sample serial number | RSZ200622003-RF-S1 ( Assigned by BACL, Shenzhen) |
| Received date | 2020-06-22 |
| Sample/EUT Status | Good condition |
| Adapter 1 information | Model: VT05EUS06040<br>Input: AC 100-240V, 50/60Hz 0.15A<br>Output: DC 6.0 V, 0.4A, 2.4W |
| Adapter 2 information | Model: S003GU0600040<br>Input: AC 100-240V, 50/60Hz 150mA<br>Output: DC 6.0 V, 400mA |

## Objective

This test report is prepared on behalf of VTech Telecommunications Ltd 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)

Part of system submission with FCC ID: EW780-1385-00

## 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℃ |
| 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.

32 channels are provided to testing:

| Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---|---|---|---|
| 1 | 2405 | 17 | 2441 |
| 2 | 2407 | 18 | 2443 |
| 3 | 2409 | 19 | 2445 |
| 4 | 2411 | 20 | 2447 |
| 5 | 2413 | 21 | 2451 |
| 6 | 2415 | 22 | 2453 |
| 7 | 2419 | 23 | 2455 |
| 8 | 2421 | 24 | 2457 |
| 9 | 2423 | 25 | 2459 |
| 10 | 2425 | 26 | 2461 |
| 11 | 2427 | 27 | 2463 |
| 12 | 2429 | 28 | 2467 |
| 13 | 2431 | 29 | 2469 |
| 14 | 2435 | 30 | 2471 |
| 15 | 2437 | 31 | 2473 |
| 16 | 2439 | 32 | 2475 |

EUT was tested with Channel 1, 16 and 32.

The frequency range of the system is operating from 2405MHz to 2475MHz. There are totally 32 non-overlapping channels with 2MHz channel separation. There are 16 active channels out of the 32 channels. 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

“MBP483 Test mode.cts” software was made to the EUT tested.

## Special Accessories

No special accessory.

## Equipment Modifications

No modification was made to the EUT tested.

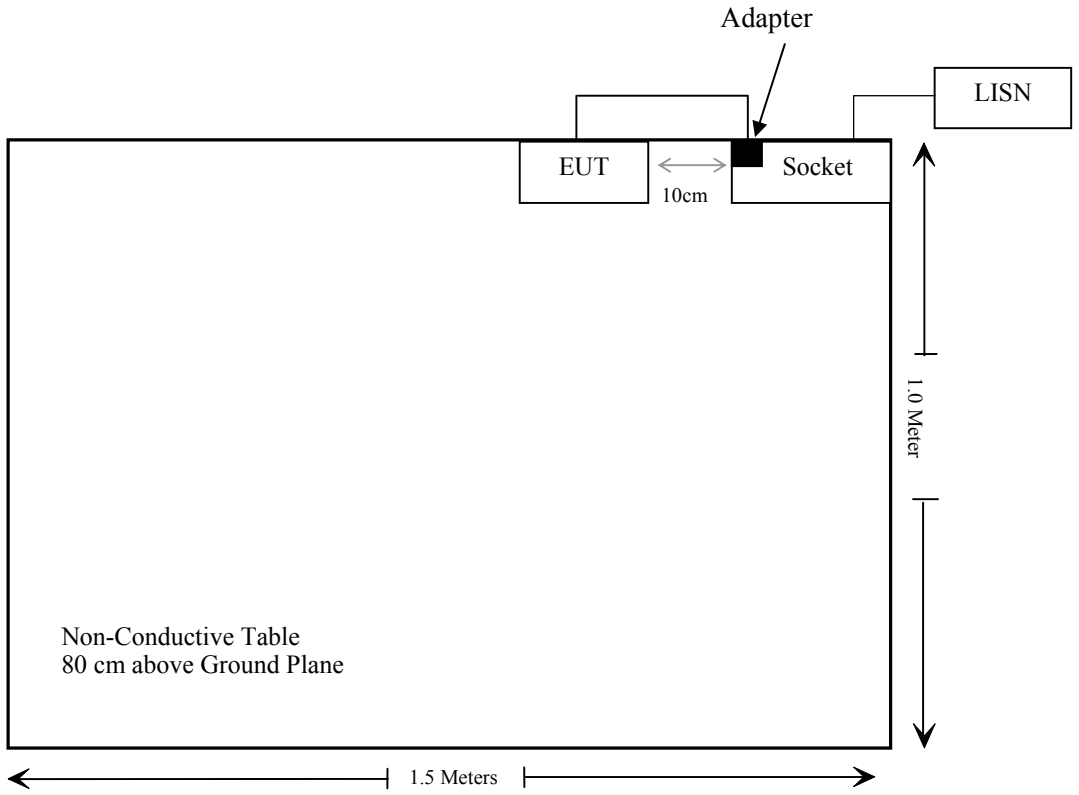
## Support Equipment List and Details

| Manufacturer | Description | Model | Serial Number |
|---|---|---|---|
| / | / | / | / |

## External I/O Cable

| Cable Description | Length (m) | From Port | To |
|---|---|---|---|
| Unshielded Un-detachable DC cable | 2.0 | EUT | Adapter |
| Unshielded Un-detachable AC cable | 1.2 | Socket | AC Mains |

## 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 | 2020/7/7 | 2021/7/6 |
| Rohde & Schwarz | LISN | ENV216 | 101613 | 2020/1/22 | 2021/1/21 |
| Rohde & Schwarz | Transient Limitor | 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 | 2020/7/7 | 2021/7/6 |
| 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 | 2020/7/21 |
| COM-POWER | Pre-amplifier | PA-122 | 181919 | 2019/11/29 | 2020/11/28 |
| Quinstar | Amplifier | QLW-18405536-J0 | 15964001002 | 2019/11/29 | 2020/11/28 |
| Sunol Sciences | Horn Antenna | DRH-118 | A052604 | 2017/12/22 | 2020/12/21 |
| Insulted Wire Inc. | RF Cable | SPS-2503-3150 | 02222010 | 2019/11/29 | 2020/11/28 |
| Unknown | RF Cable | W1101-EQ1 OUT | F-19-EM005 | 2019/11/29 | 2020/11/28 |
| SNSD | Band Reject filter | BSF2402-2480MN-0898-001 | 2.4G filter | 2020/4/20 | 2021/4/20 |
| Ducommun Technolagies | Horn antenna | ARH-4223-02 | 1007726-02 1304 | 2017/12/6 | 2020/12/5 |

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| **RF Conducted Test** | | | | | |
| Rohde & Schwarz | SPECTRUM ANALYZER | FSU26 | 200120 | 2020/3/2 | 2021/3/1 |
| WEINSCHEL | 10dB Attenuator | 5324 | AU3842 | 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** | | **Max Conducted Power** | | **Evaluation Distance (cm)** | **Power Density ($mW/cm^2$)** | **MPE Limit ($mW/cm^2$)** |
|---|---|---|---|---|---|---|---|
| | **(dBi)** | **(numeric)** | **(dBm)** | **(mW)** | | | |
| 2405-2475 | 0 | 1 | 15.0 | 31.62 | 20 | 0.006 | 1.0 |

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

**Result: Pass**

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

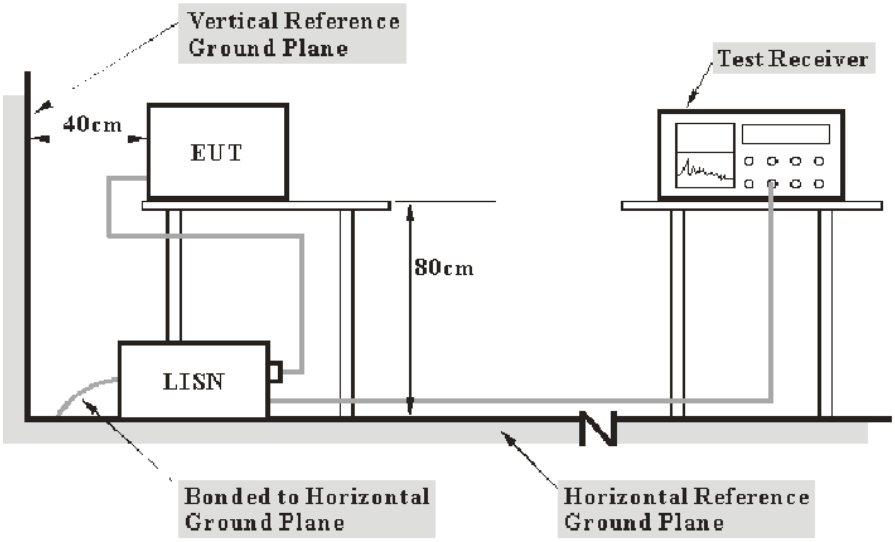
**Result: Pass**

# 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

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:

Correction Factor = LISN VDF + Cable Loss + 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:

Margin = Limit – Corrected Amplitude

## Test Data

### Environmental Conditions

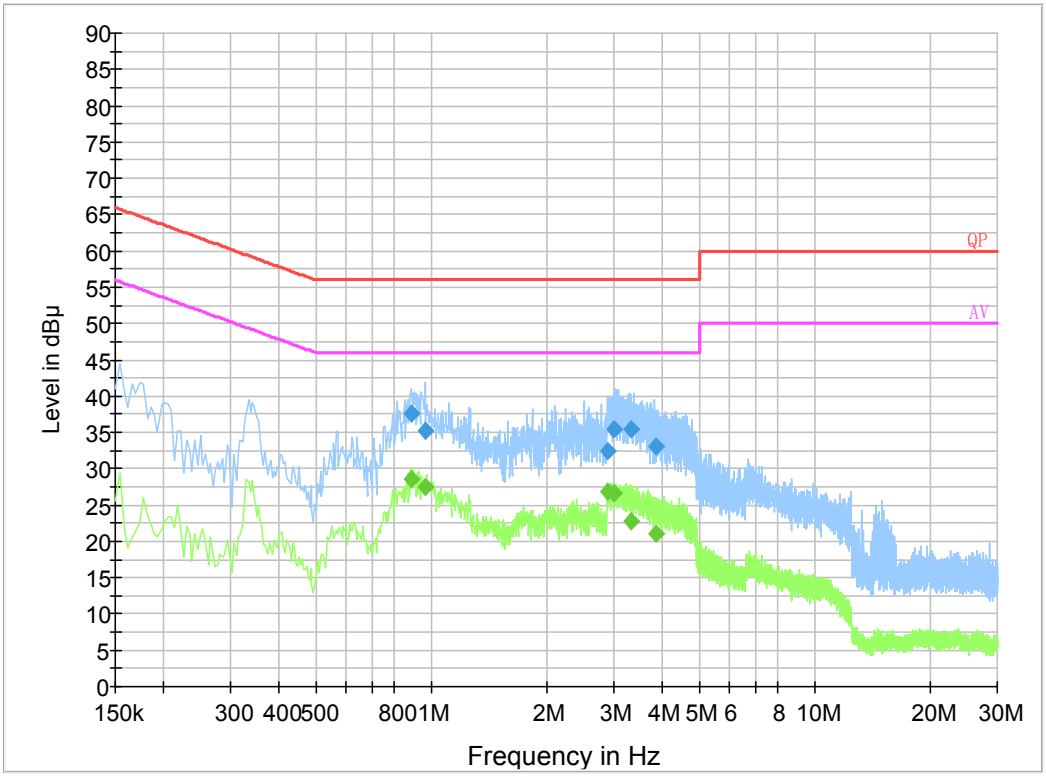
| | |
|---|---|
| **Temperature:** | 25 ℃ |
| **Relative Humidity:** | 65 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Haiguo Li on 2020-07-17.*

*EUT operation mode: Transmitting & Charging*

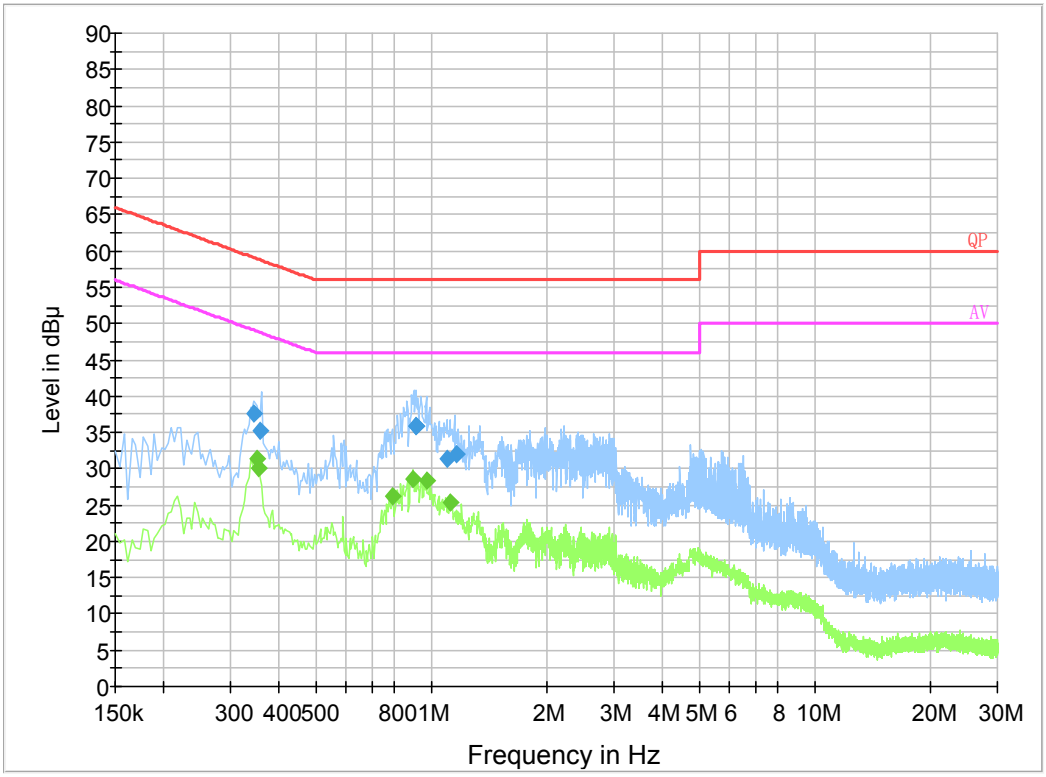
**Adapter 1 (VT05EUS06040):**

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




| Frequency (MHz) | Corrected Amplitude (dBµV) | Correction Factor (dB) | Limit (dBµV) | Margin (dB) | Detector (PK/Ave./QP) |
|---|---|---|---|---|---|
| 0.884710 | 37.6 | 19.8 | 56.0 | 18.4 | QP |
| 0.967510 | 35.2 | 19.9 | 56.0 | 20.8 | QP |
| 2.902590 | 32.5 | 19.9 | 56.0 | 23.5 | QP |
| 3.004430 | 35.4 | 19.9 | 56.0 | 20.6 | QP |
| 3.312530 | 35.5 | 19.9 | 56.0 | 20.5 | QP |
| 3.844730 | 33.2 | 19.9 | 56.0 | 22.8 | QP |
| 0.884710 | 28.6 | 19.8 | 46.0 | 17.4 | Ave. |
| 0.967510 | 27.6 | 19.9 | 46.0 | 18.4 | Ave. |
| 2.902590 | 26.8 | 19.9 | 46.0 | 19.2 | Ave. |
| 3.004430 | 26.7 | 19.9 | 46.0 | 19.3 | Ave. |
| 3.312530 | 22.8 | 19.9 | 46.0 | 23.2 | Ave. |
| 3.844730 | 21.0 | 19.9 | 46.0 | 25.0 | Ave. |

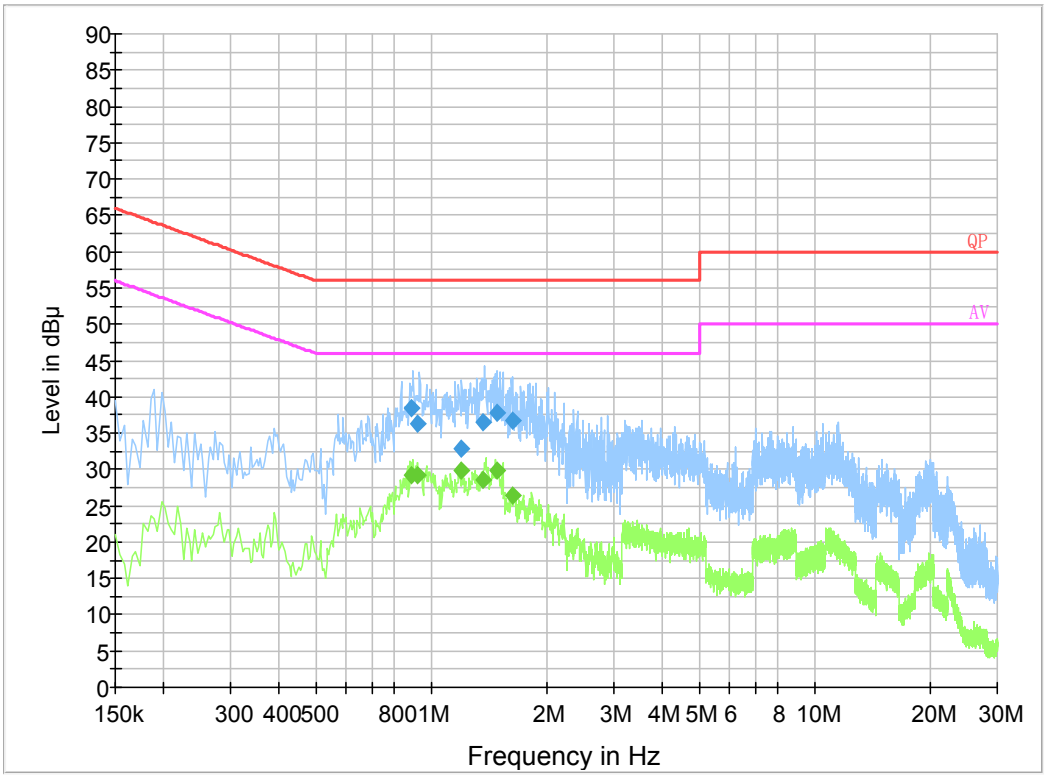
**AC 120V/60 Hz, Neutral**




| Frequency (MHz) | Corrected Amplitude (dBµV) | Correction Factor (dB) | Limit (dBµV) | Margin (dB) | Detector (PK/Ave./QP) |
|---|---|---|---|---|---|
| 0.344810 | 37.5 | 19.8 | 59.1 | 21.6 | QP |
| 0.356570 | 35.2 | 19.9 | 58.8 | 23.6 | QP |
| 0.915530 | 35.8 | 19.7 | 56.0 | 20.2 | QP |
| 0.916350 | 35.9 | 19.7 | 56.0 | 20.1 | QP |
| 1.105230 | 31.3 | 19.8 | 56.0 | 24.7 | QP |
| 1.160750 | 32.1 | 19.8 | 56.0 | 23.9 | QP |
| 0.350000 | 31.3 | 19.9 | 49.0 | 17.6 | Ave. |
| 0.354000 | 30.2 | 19.9 | 48.9 | 18.7 | Ave. |
| 0.794000 | 26.3 | 19.8 | 46.0 | 19.7 | Ave. |
| 0.898000 | 28.6 | 19.7 | 46.0 | 17.4 | Ave. |
| 0.974000 | 28.4 | 19.8 | 46.0 | 17.6 | Ave. |
| 1.118000 | 25.3 | 19.8 | 46.0 | 20.8 | Ave. |

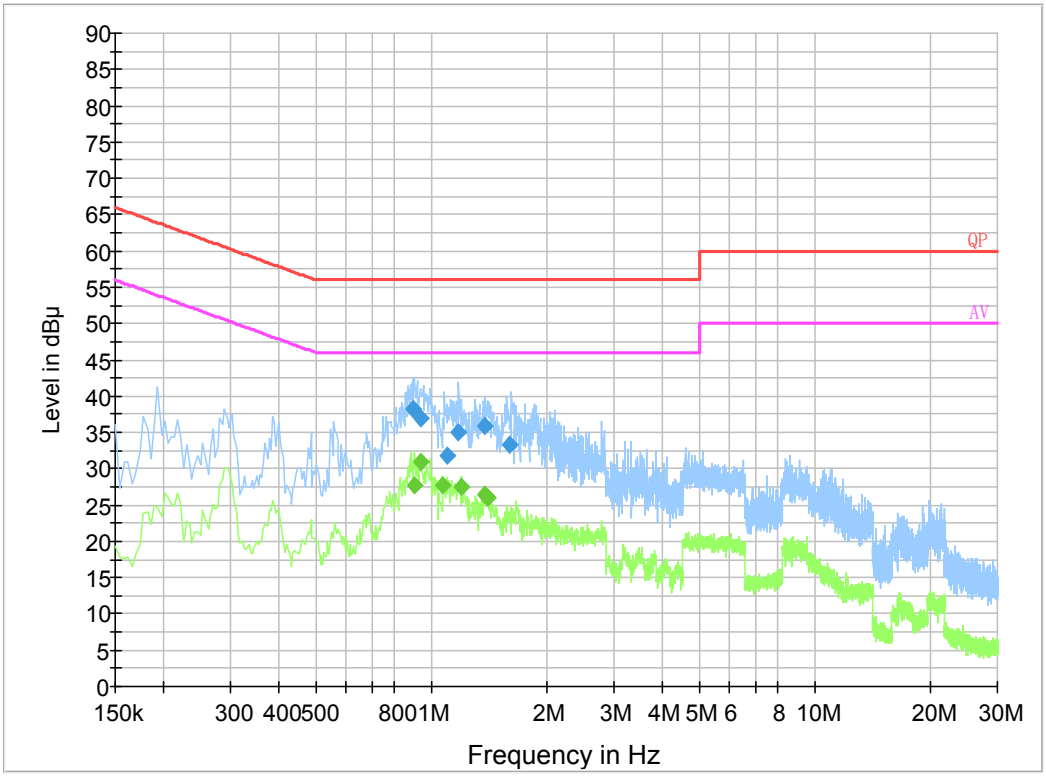
**Adapter 2 (S003GU0600040):**

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




| Frequency (MHz) | Corrected Amplitude (dBµV) | Correction Factor (dB) | Limit (dBµV) | Margin (dB) | Detector (PK/Ave./QP) |
|---|---|---|---|---|---|
| 0.884530 | 38.4 | 19.8 | 56.0 | 17.6 | QP |
| 0.919990 | 36.3 | 19.8 | 56.0 | 19.7 | QP |
| 1.199970 | 32.9 | 19.8 | 56.0 | 23.1 | QP |
| 1.361330 | 36.5 | 19.8 | 56.0 | 19.5 | QP |
| 1.483770 | 37.7 | 19.8 | 56.0 | 18.3 | QP |
| 1.629550 | 36.8 | 19.9 | 56.0 | 19.2 | QP |
| 0.884530 | 29.3 | 19.8 | 46.0 | 16.7 | Ave. |
| 0.919990 | 29.1 | 19.8 | 46.0 | 16.9 | Ave. |
| 1.199970 | 29.9 | 19.8 | 46.0 | 16.1 | Ave. |
| 1.361330 | 28.5 | 19.8 | 46.0 | 17.5 | Ave. |
| 1.483770 | 29.9 | 19.8 | 46.0 | 16.1 | Ave. |
| 1.629550 | 26.5 | 19.9 | 46.0 | 19.5 | Ave. |

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




| Frequency (MHz) | Corrected Amplitude (dBµV) | Correction Factor (dB) | Limit (dBµV) | Margin (dB) | Detector (PK/Ave./QP) |
|---|---|---|---|---|---|
| 0.892590 | 38.2 | 19.7 | 56.0 | 17.8 | QP |
| 0.935830 | 36.8 | 19.8 | 56.0 | 19.2 | QP |
| 1.101710 | 31.8 | 19.8 | 56.0 | 24.2 | QP |
| 1.180330 | 34.9 | 19.8 | 56.0 | 21.1 | QP |
| 1.377270 | 35.8 | 19.8 | 56.0 | 20.2 | QP |
| 1.601670 | 33.3 | 19.8 | 56.0 | 22.7 | QP |
| 0.906000 | 27.6 | 19.7 | 46.0 | 18.4 | Ave. |
| 0.938000 | 30.9 | 19.8 | 46.0 | 15.1 | Ave. |
| 1.074000 | 27.7 | 19.8 | 46.0 | 18.3 | Ave. |
| 1.202000 | 27.4 | 19.8 | 46.0 | 18.6 | Ave. |
| 1.382000 | 26.4 | 19.8 | 46.0 | 19.6 | Ave. |
| 1.406000 | 25.9 | 19.8 | 46.0 | 20.1 | 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

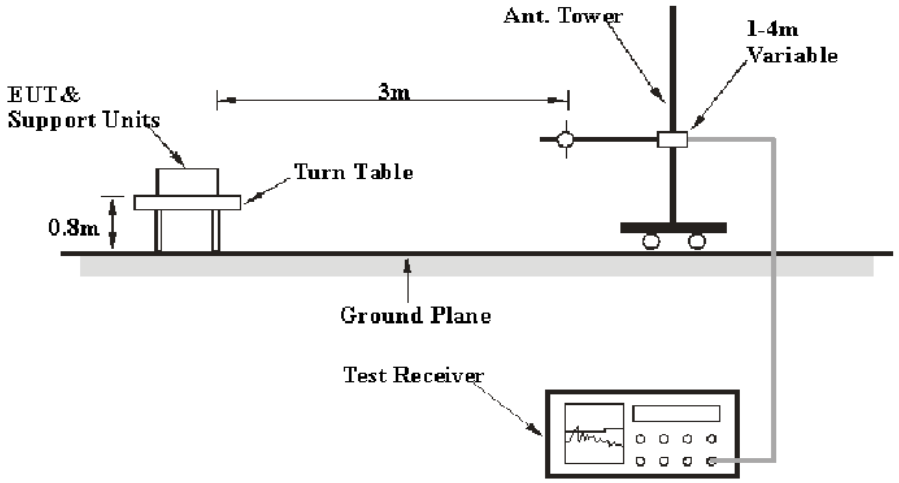
# FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS

## Applicable Standard

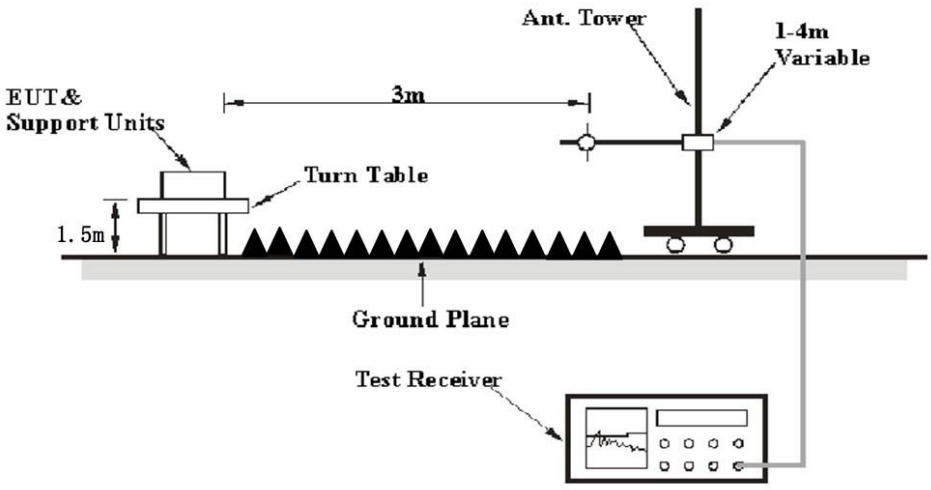
FCC §15.205; §15.209; §15.247(d)

## 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:

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - 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:

Margin = Limit – Corrected Amplitude

## Test Data

### Environmental Conditions

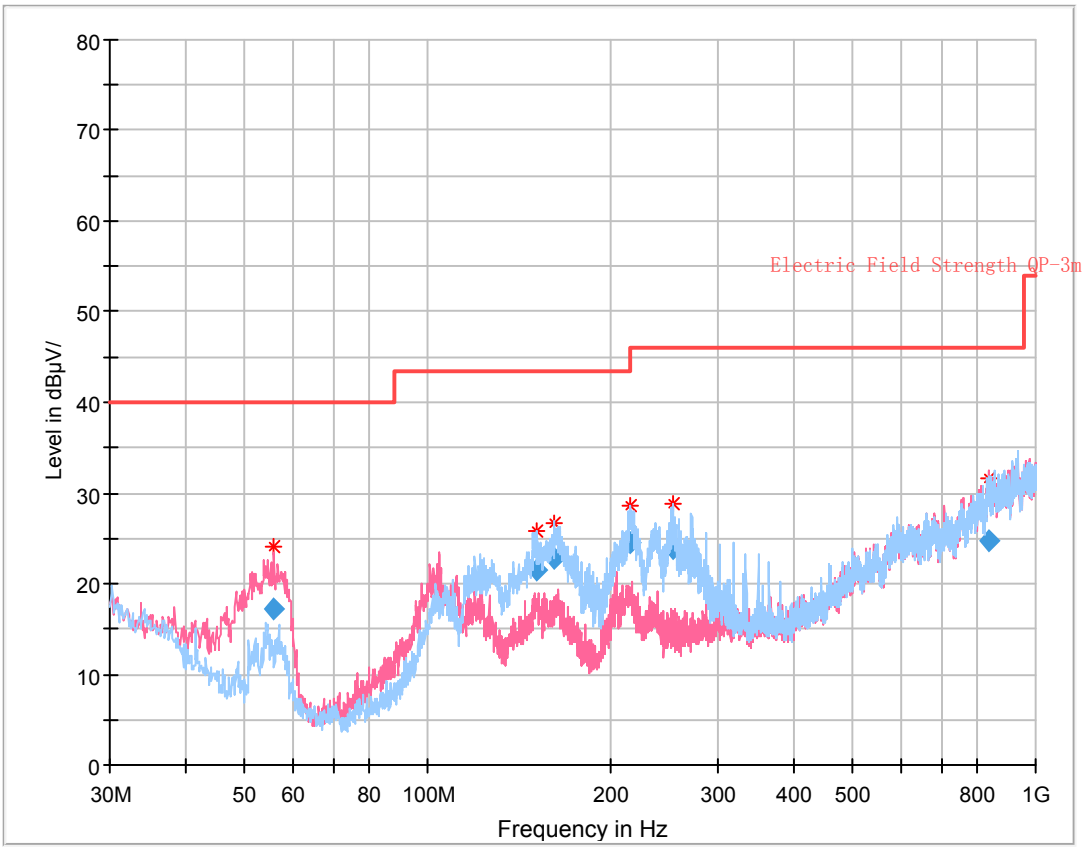
| | |
|---|---|
| **Temperature:** | 24~28 ℃ |
| **Relative Humidity:** | 56~58 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Hams He on 2020-07-14 for below 1GHz and by Leo Huang on 2020-07-14 for above 1GHz.*

*EUT operation mode: Transmitting*

**Adapter 1 (VT05EUS06040):**

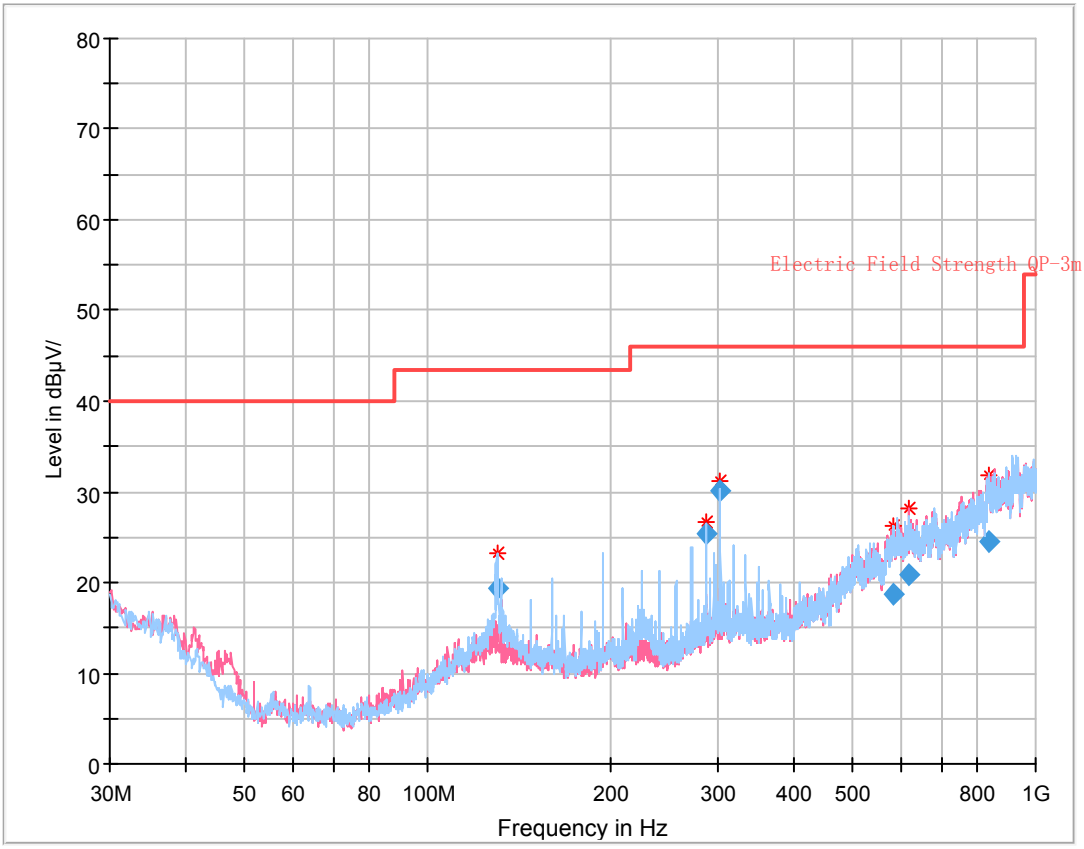
**30 MHz~1 GHz:** *(the worst case at High channel)*




| Frequency (MHz) | Corrected Amplitude (dBµV/m) | Antenna height (cm) | Antenna Polarity | Turntable position (degree) | Correction Factor (dB/m) | Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 55.917375 | 17.11 | 126.0 | V | 350.0 | -20.0 | 40.00 | 22.89 |
| 150.879625 | 21.61 | 220.0 | H | 104.0 | -14.2 | 43.50 | 21.89 |
| 161.716750 | 22.74 | 164.0 | H | 87.0 | -14.5 | 43.50 | 20.76 |
| 215.146750 | 24.50 | 114.0 | H | 231.0 | -13.9 | 43.50 | 19.00 |
| 252.697250 | 23.89 | 111.0 | H | 81.0 | -13.9 | 46.00 | 22.11 |
| 836.033375 | 24.70 | 114.0 | V | 183.0 | 2.7 | 46.00 | 21.30 |

**Adapter 2 (S003GU0600040):**

**30 MHz~1 GHz:** *(the worst case at High channel)*



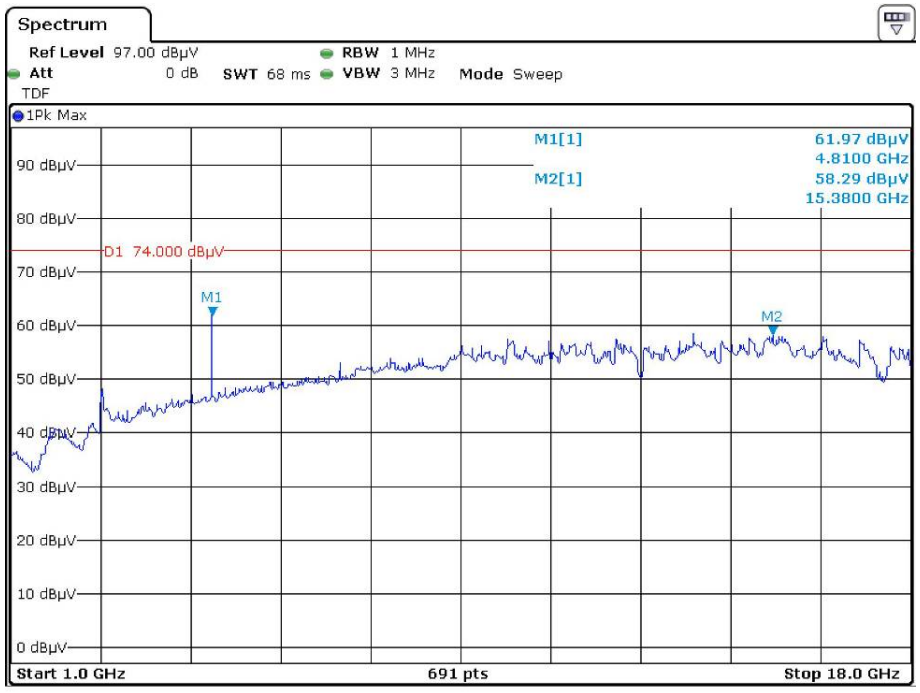

| Frequency (MHz) | Corrected Amplitude (dBµV/m) | Antenna height (cm) | Antenna Polarity | Turntable position (degree) | Correction Factor (dB/m) | Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 130.152250 | 19.28 | 324.0 | H | 259.0 | -13.6 | 43.50 | 24.22 |
| 287.258500 | 25.40 | 109.0 | H | 74.0 | -11.5 | 46.00 | 20.60 |
| 302.803500 | 30.11 | 109.0 | H | 86.0 | -10.6 | 46.00 | 15.89 |
| 583.417750 | 18.76 | 115.0 | H | 117.0 | -2.4 | 46.00 | 27.24 |
| 620.445375 | 20.81 | 397.0 | V | 62.0 | -1.6 | 46.00 | 25.19 |
| 838.456500 | 24.47 | 374.0 | H | 0.0 | 2.8 | 46.00 | 21.53 |

**1 GHz - 25 GHz:**

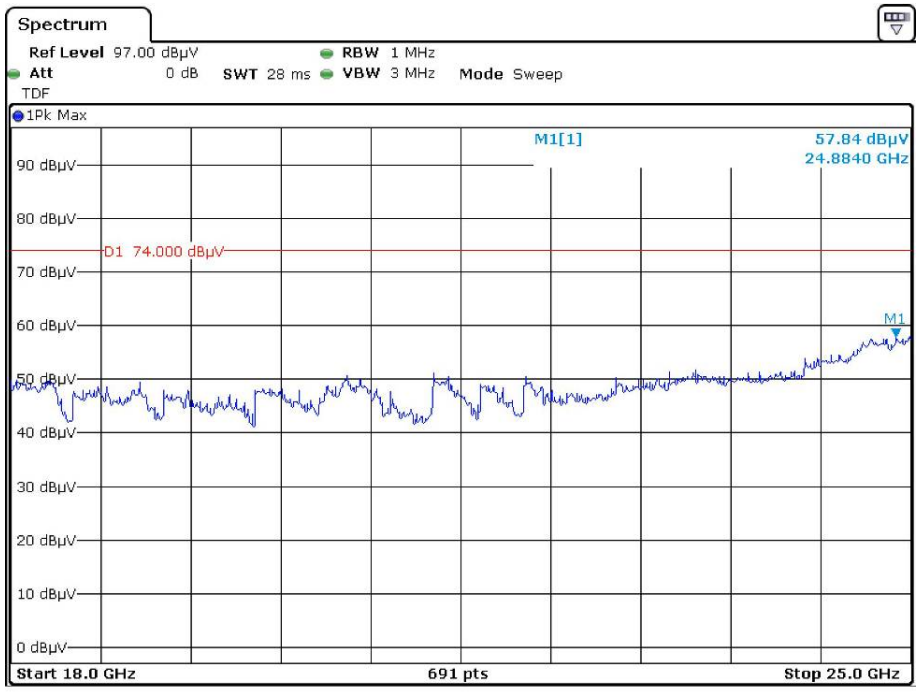
| Frequency (MHz) | Receiver | | Turntable Degree | Rx Antenna | | Corrected Factor (dB/m) | Corrected Amplitude (dBµV/m) | Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| | Reading (dBµV) | PK/QP/Ave. | | Height (m) | Polar (H/V) | | | | |
| Low Channel (2405 MHz) | | | | | | | | | |
| 2388.47 | 28.22 | PK | 10 | 1.7 | H | 31.87 | 60.09 | 74 | 13.91 |
| 2388.47 | 14.29 | Ave. | 10 | 1.7 | H | 31.87 | 46.16 | 54 | 7.84 |
| 2484.36 | 28.17 | PK | 117 | 1.6 | H | 32.13 | 60.30 | 74 | 13.70 |
| 2484.36 | 14.25 | Ave. | 117 | 1.6 | H | 32.13 | 46.38 | 54 | 7.62 |
| 4810.00 | 56.77 | PK | 119 | 1.7 | H | 6.28 | 63.05 | 74 | 10.95 |
| 4810.00 | 41.28 | Ave. | 119 | 1.7 | H | 6.28 | 47.56 | 54 | 6.44 |
| 7215.00 | 44.01 | PK | 356 | 2.3 | H | 11.93 | 55.94 | 74 | 18.06 |
| 7215.00 | 32.63 | Ave. | 356 | 2.3 | H | 11.93 | 44.56 | 54 | 9.44 |
| Middle Channel (2439 MHz) | | | | | | | | | |
| 4878.00 | 55.80 | PK | 164 | 2.4 | H | 6.76 | 62.56 | 74 | 11.44 |
| 4878.00 | 40.75 | Ave. | 164 | 2.4 | H | 6.76 | 47.51 | 54 | 6.49 |
| 7317.00 | 44.01 | PK | 21 | 2.2 | H | 11.56 | 55.57 | 74 | 18.43 |
| 7317.00 | 32.63 | Ave. | 21 | 2.2 | H | 11.56 | 44.19 | 54 | 9.81 |
| High Channel (2475 MHz) | | | | | | | | | |
| 2389.63 | 28.10 | PK | 82 | 2.5 | H | 31.87 | 59.97 | 74 | 14.03 |
| 2389.63 | 14.33 | Ave. | 82 | 2.5 | H | 31.87 | 46.20 | 54 | 7.80 |
| 2484.36 | 29.14 | PK | 167 | 1.4 | H | 32.13 | 61.27 | 74 | 12.73 |
| 2484.36 | 16.23 | Ave. | 167 | 1.4 | H | 32.13 | 48.36 | 54 | 5.64 |
| 4950.00 | 54.87 | PK | 125 | 1.4 | H | 6.80 | 61.67 | 74 | 12.33 |
| 4950.00 | 40.24 | Ave. | 125 | 1.4 | H | 6.80 | 47.04 | 54 | 6.96 |
| 7425.00 | 42.74 | PK | 230 | 1.3 | H | 12.39 | 55.13 | 74 | 18.87 |
| 7425.00 | 31.99 | Ave. | 230 | 1.3 | H | 12.39 | 44.38 | 54 | 9.62 |

**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**

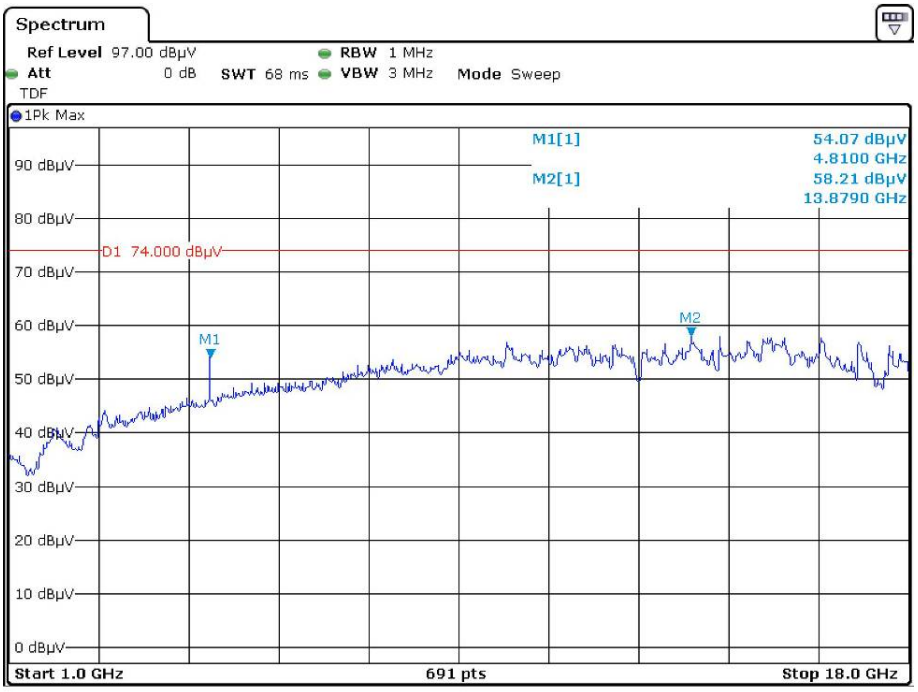



Date: 14.JUL.2020 23:00:42

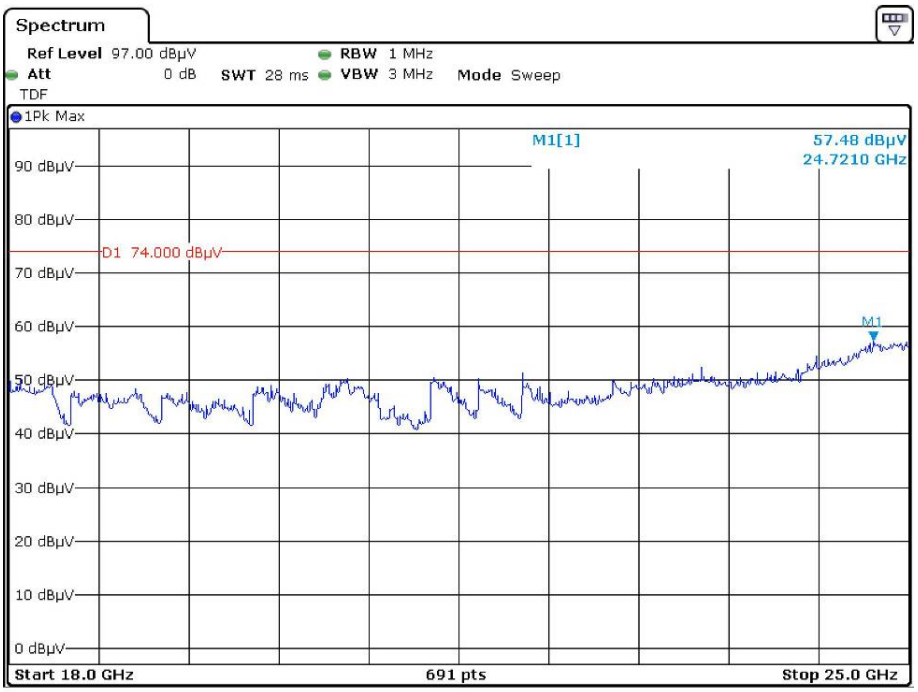



Date: 14.JUL.2020 23:45:37

**Vertical**

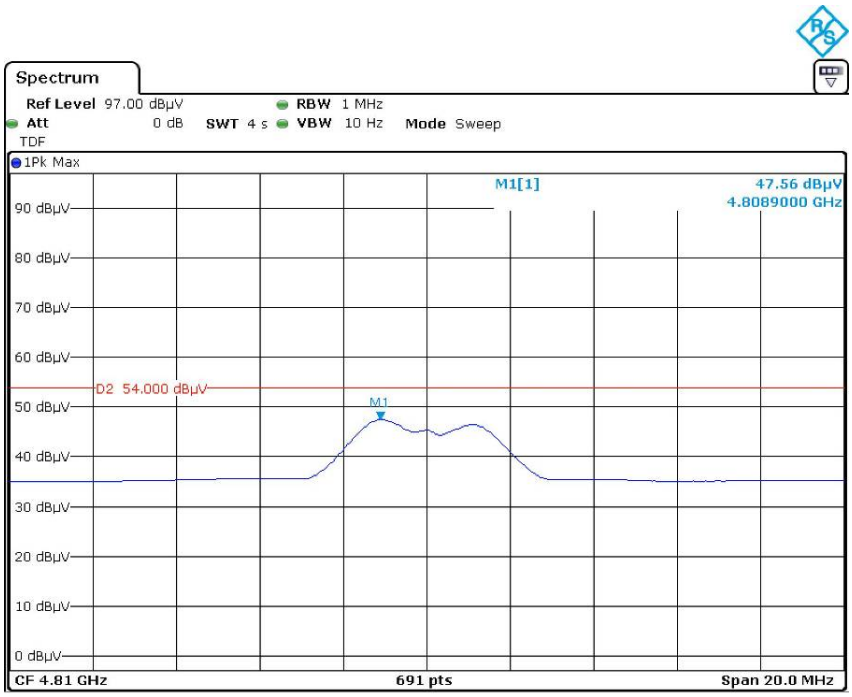



Date: 14.JUL.2020 23:08:09

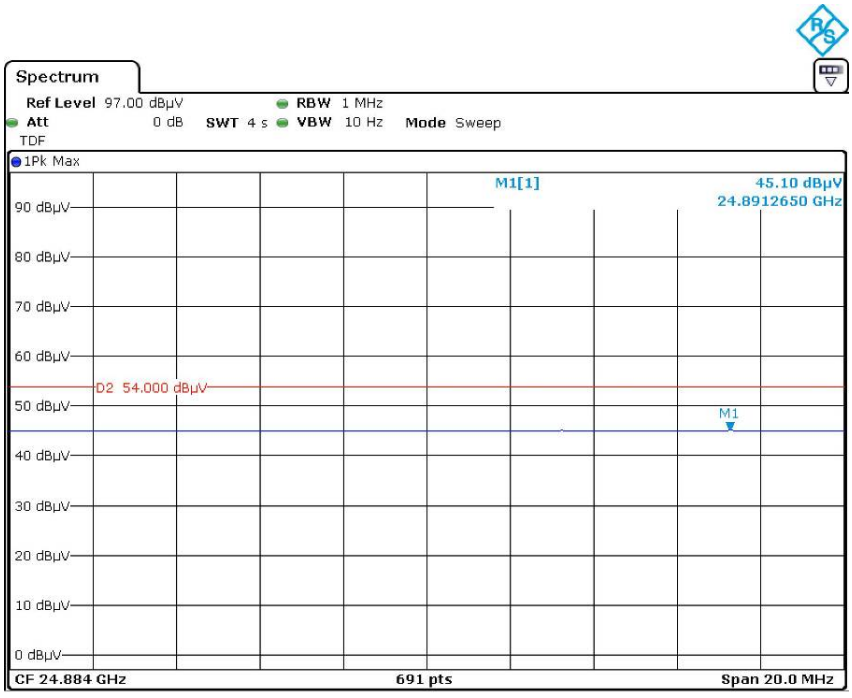



Date: 14.JUL.2020 23:52:24

**Pre-scan for Average**
**Horizontal**

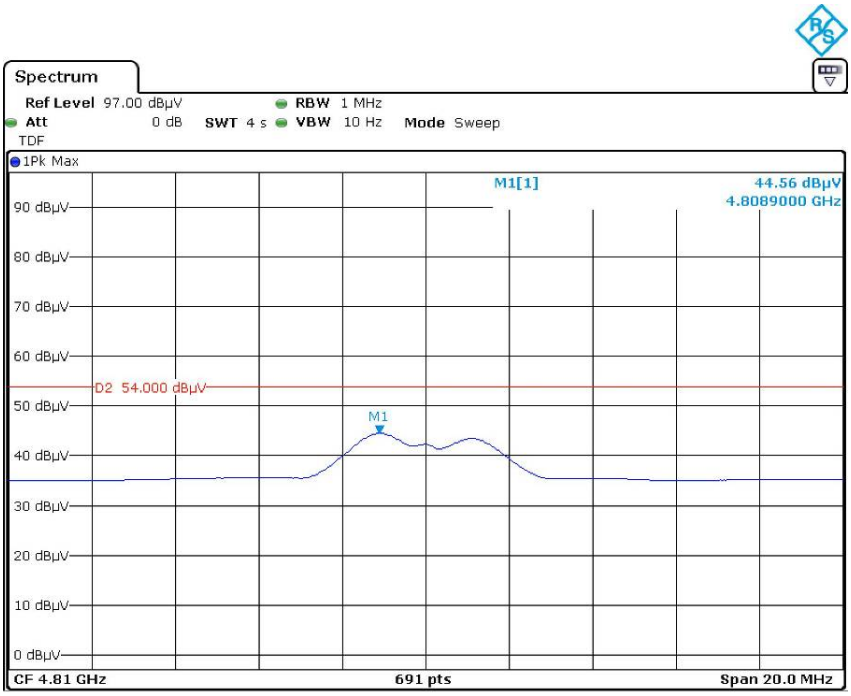



Date: 14.JUL.2020 23:04:08

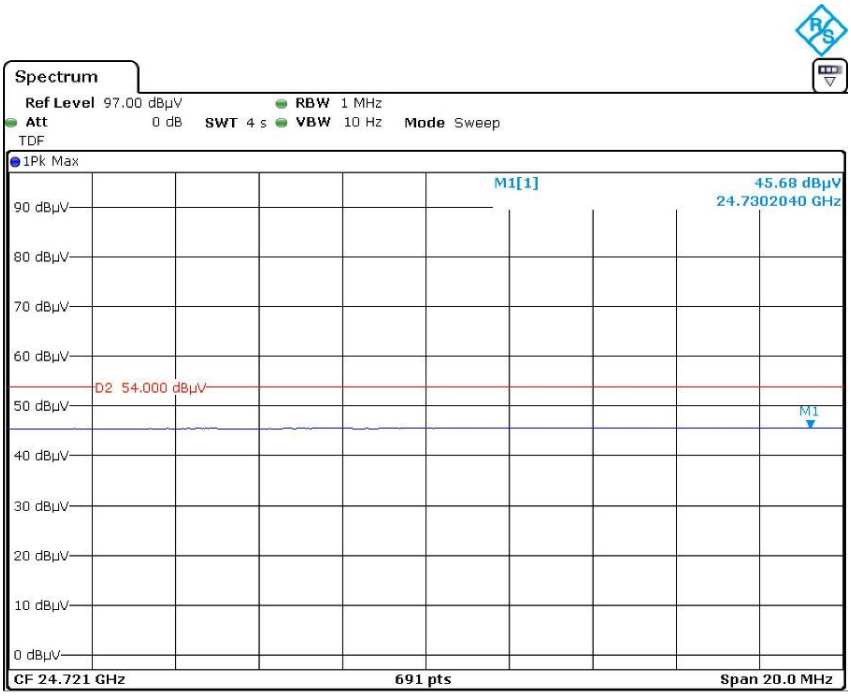



Date: 14.JUL.2020 23:49:00

**Vertical**




Date: 14.JUL.2020 23:15:58




Date: 14.JUL.2020 23:55:44

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

## Applicable Standard

Frequency hopping systems shall have hoping 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, max hold the channel.
2. Set the adjacent channel of the EUT and max hold another trace.
3. Measure the channel separation.

## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 24 ℃ |
| **Relative Humidity:** | 56 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Black Chen on 2020-06-23.*

*EUT operation mode: Transmitting*

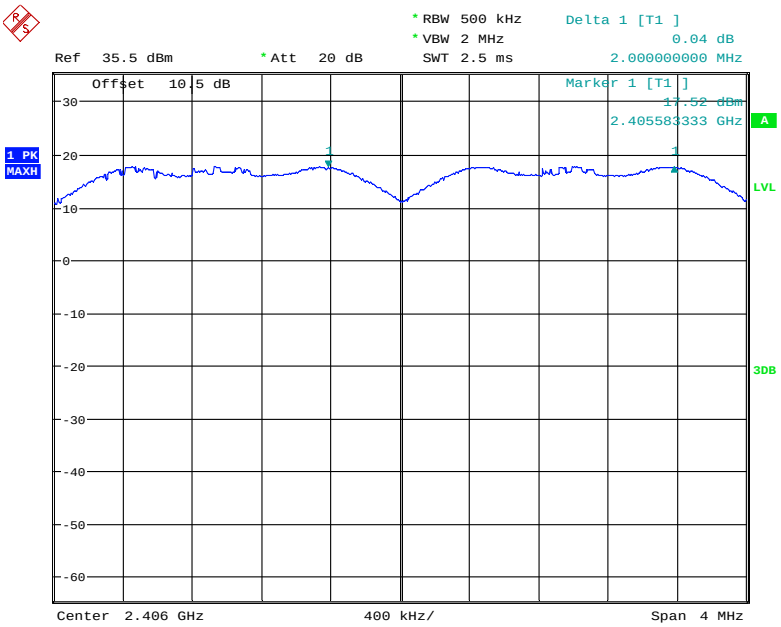
**Test Result: Pass**

*Please refer to following table and plots.*

| Test Channel | Reading (MHz) | Limit (MHz) | Result |
|---|---|---|---|
| L | 2.000 | >=1.607 | Pass |
| M | 2.000 | >=1.613 | Pass |
| H | 2.000 | >=1.587 | Pass |

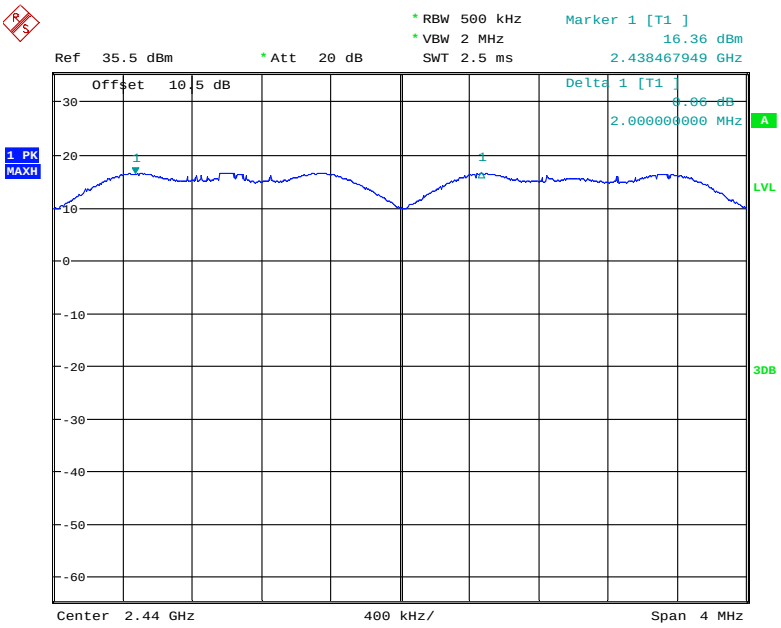
Note: Limit = (2/3) * 20dB bandwidth.

## Low Channel



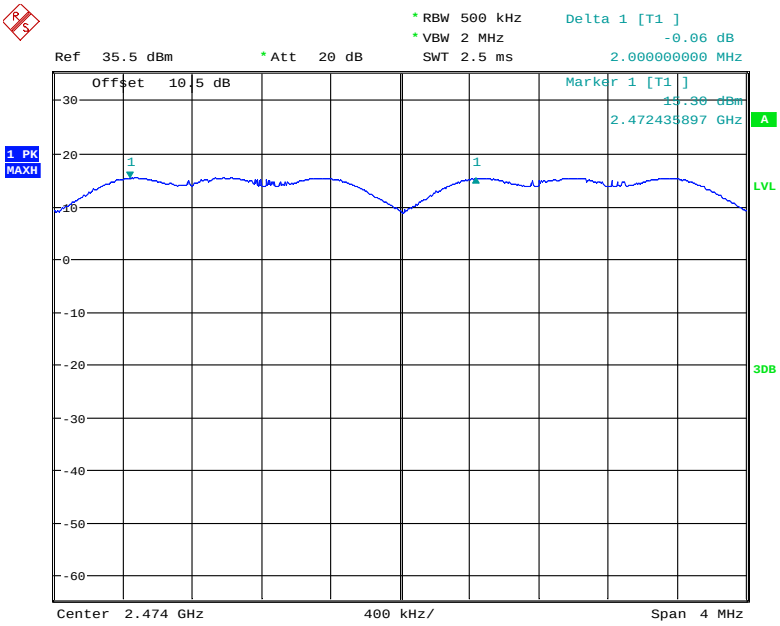

Date: 23.JUN.2020 18:55:46

## Middle Channel




Date: 23.JUN.2020 18:52:30

## High Channel




Date: 23.JUN.2020 19:18:39

# 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:** | 23 ℃ |
| **Relative Humidity:** | 56 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Black Chen on 2020-06-23.*

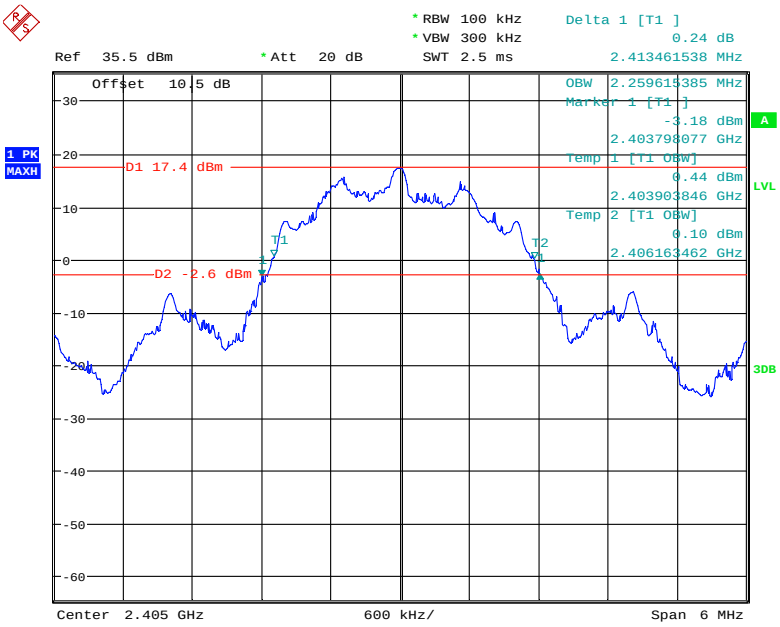
*EUT operation mode: Transmitting*

**Test Result: Pass**

*Please refer to following table and plots.*

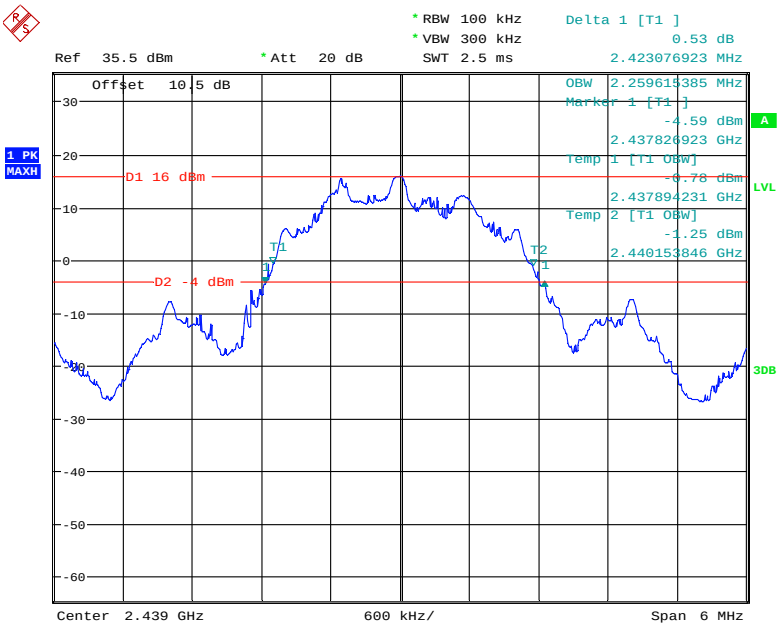
| Test Channel | 20dB Bandwidth (MHz) | OBW (MHz) | Result |
|---|---|---|---|
| L | 2.41 | 2.26 | Pass |
| M | 2.42 | 2.26 | Pass |
| H | 2.38 | 2.25 | Pass |

## Low Channel



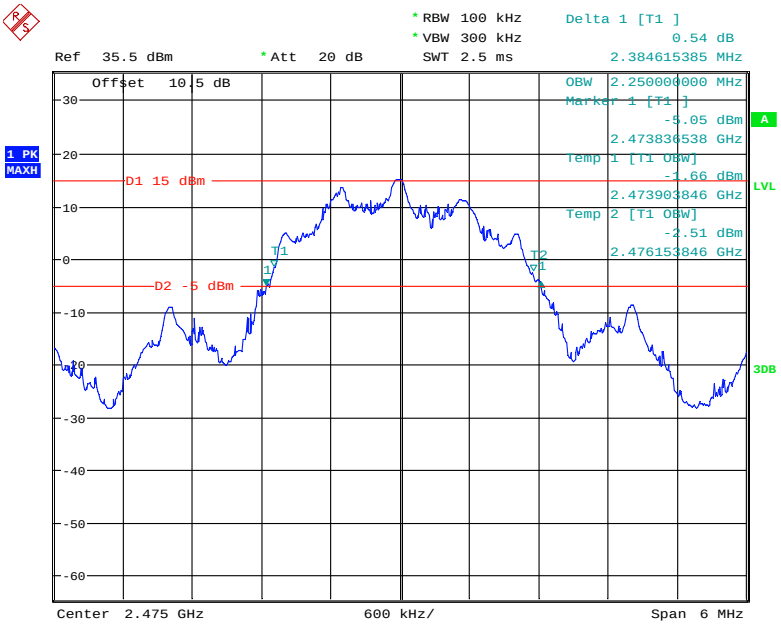

Date: 23.JUN.2020 20:29:52

## Middle Channel




Date: 23.JUN.2020 20:31:37

## High Channel




Date: 23.JUN.2020 20:32:55

# 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 ℃ |
| **Relative Humidity:** | 56 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Black Chen on 2020-08-26.*

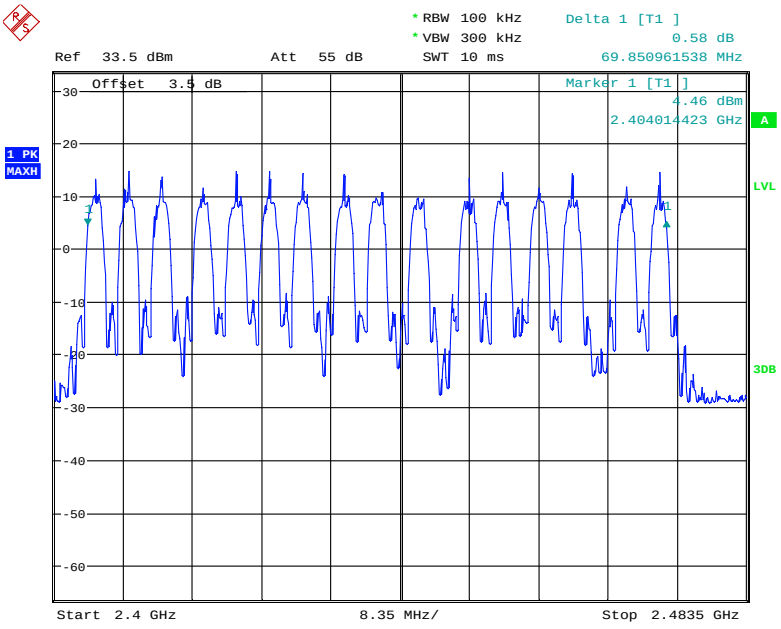
*EUT operation mode: Transmitting*

**Test Result: Pass**

*Please refer to following table and plots.*

| Test Mode | Hopping Number | Limit | Result |
|---|---|---|---|
| Hopping | 16 | >=15 | Pass |

## Number of Hopping Channels




Date: 26.AUG.2020 09:21:02

# 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 ≥ 3×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 ℃ |
| **Relative Humidity:** | 56 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Black Chen on 2020-06-23 and 2020-06-30.*

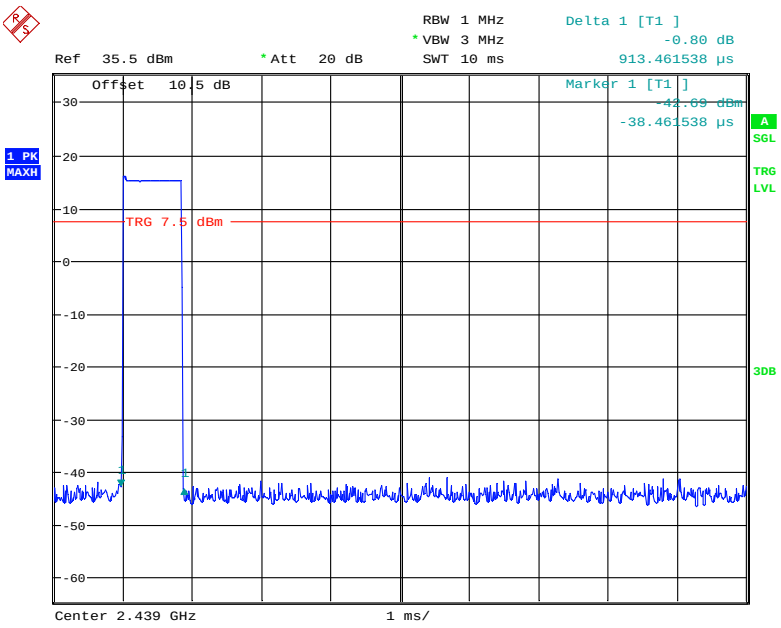
*EUT operation mode: Transmitting*

**Test Result: Pass**

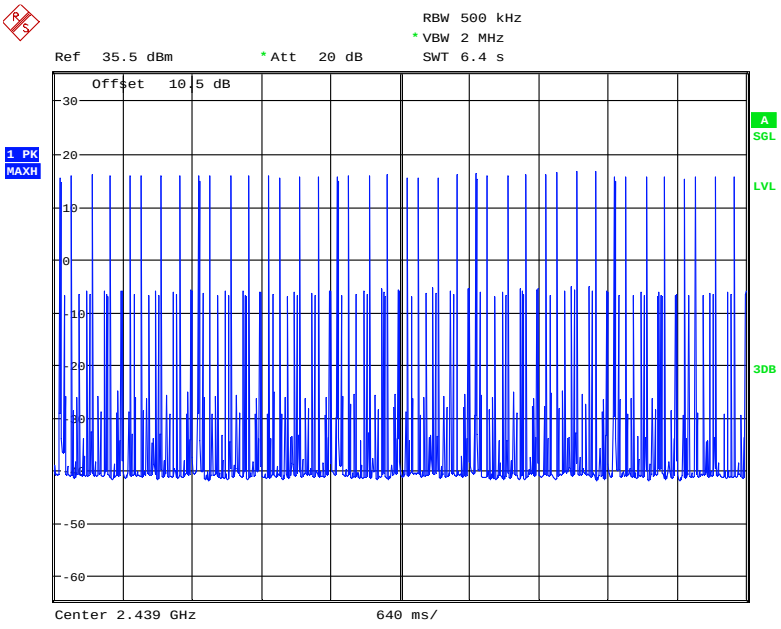
*Please refer to following table and plots*

| Channel | Burst Width (ms) | Total Hopping Number in 6.4s | Total Dwell Time (s) | Limit (s) | Result |
|---|---|---|---|---|---|
| Hop | 0.913 | 40 | 0.037 | <=0.4 | Pass |

Note: 1. Total Dwell Time= Burst Width* Total Hopping Number
2. There are total 32 channels but only 16 channels were active at any time. So the test period is 0.4*16s=6.4s.




Date: 23.JUN.2020 18:24:48




Date: 30.JUN.2020 18:01:28

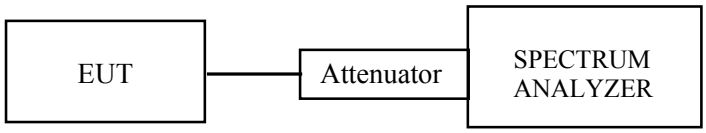
# FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT

## 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 it 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 ℃ |
| **Relative Humidity:** | 56 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Black Chen on 2020-06-23.*

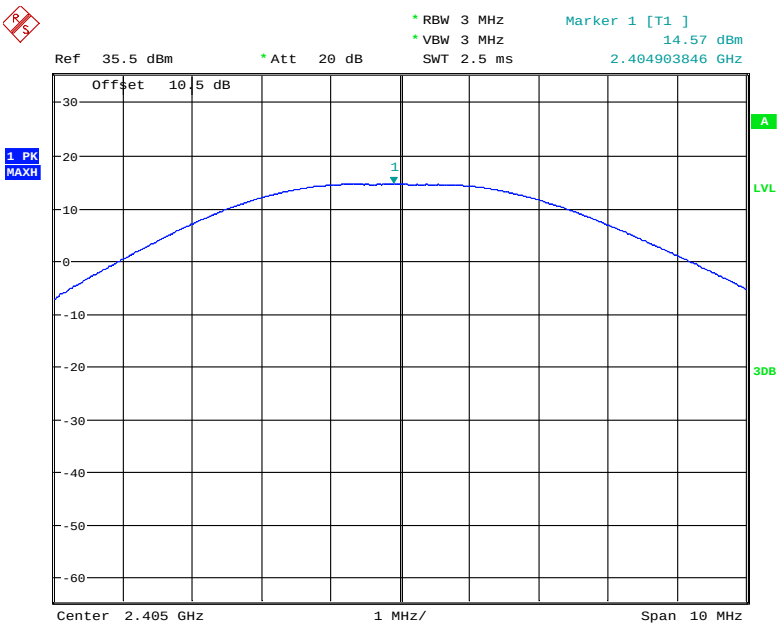
*EUT operation mode: Transmitting*

**Test Result: Pass**

*Please refer to following table.*

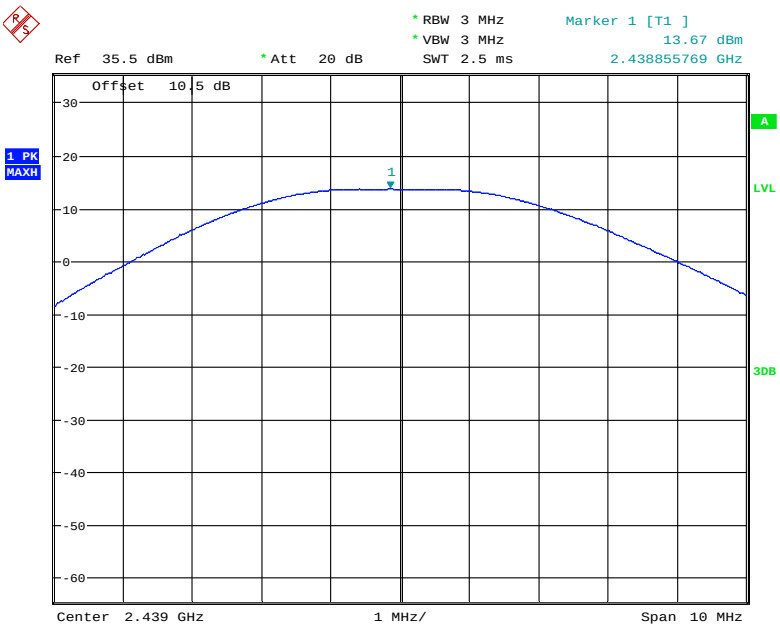
| Test Channel | Conducted Peak Output Power (dBm) | Limit (dBm) | Result |
|---|---|---|---|
| L | 14.57 | <=20.97 | Pass |
| M | 13.67 | <=20.97 | Pass |
| H | 14.69 | <=20.97 | Pass |

## Low Channel



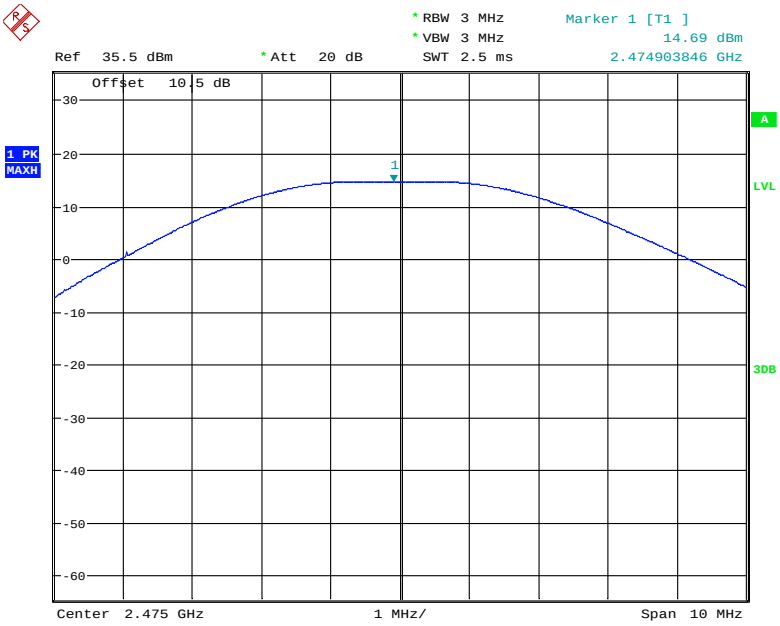

Date: 23.JUN.2020 17:39:23

## Middle Channel




Date: 23.JUN.2020 17:39:11

## High Channel




Date: 23.JUN.2020 17:25:54

# 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 ℃ |
| **Relative Humidity:** | 56 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Black Chen on 2020-06-23.*

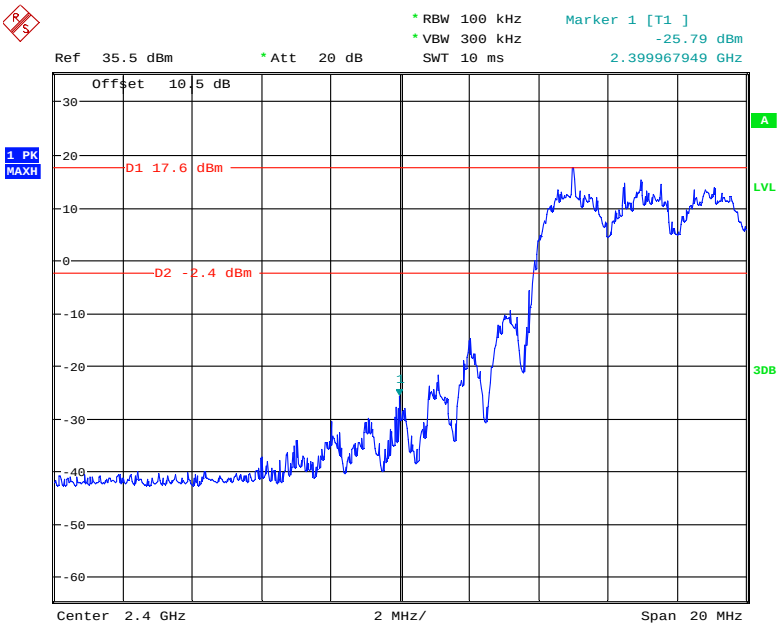
*EUT operation mode: Transmitting*

**Test Result: Pass**

*Please refer to following plots.*

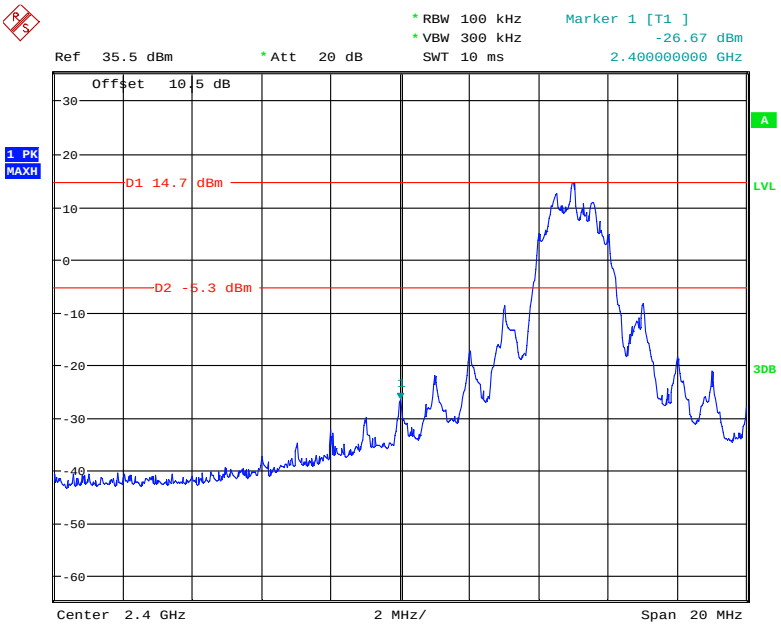
## Band Edge-Left Side

### Hopping




Date: 23.JUN.2020 19:21:31

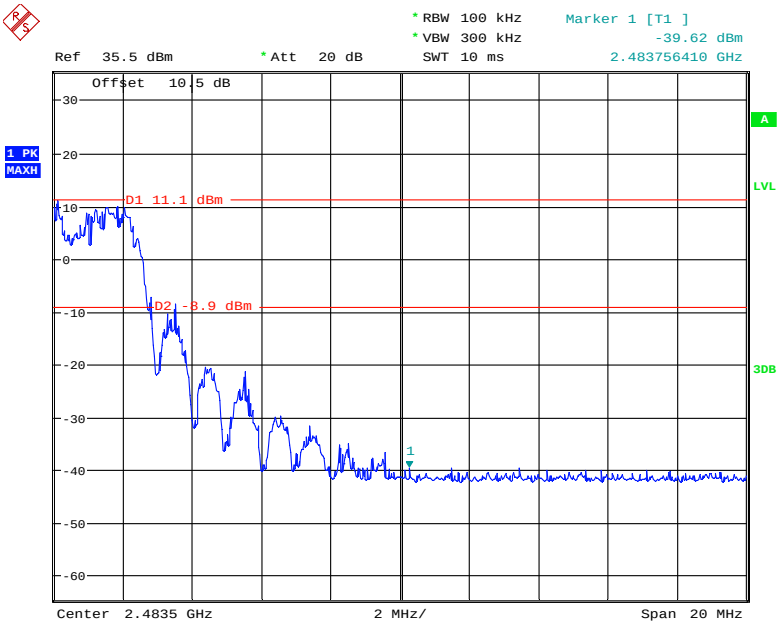
### Single




Date: 23.JUN.2020 17:52:58

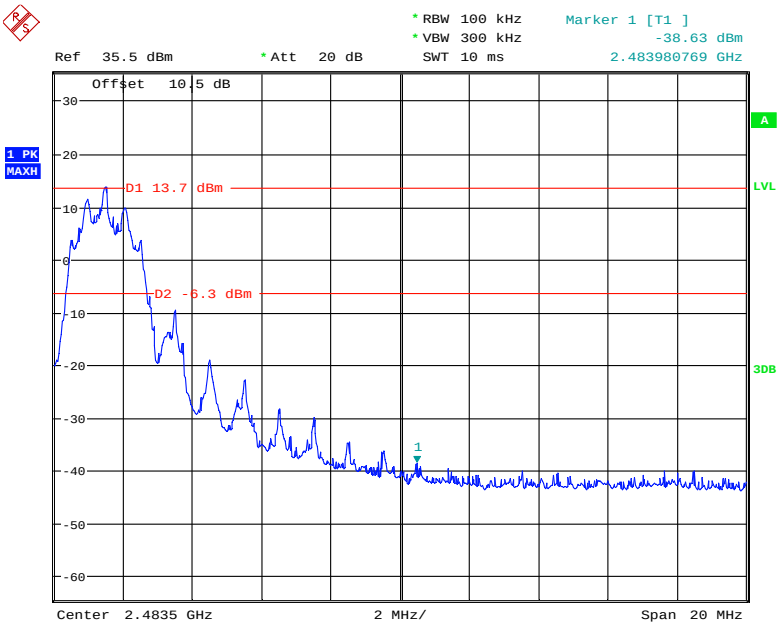
## Band Edge-Right Side

### Hopping




Date: 23.JUN.2020 19:25:32

### Single




Date: 23.JUN.2020 17:53:36

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