# RF TEST REPORT

ISSUED BY
Shenzhen BALUN Technology Co., Ltd.

FOR

**Dock**

ISSUED TO
Analogue Enterprises Ltd.

Flat J, 2/F, Po Ming Building, 2-6 Foo Ming Street, Causeway Bay, Hong Kong China

| | |
|---|---|
| Report No.: | BL-SZ2130159-601 |
| EUT Name: | Dock |
| Model Name: | AP-D01 |
| Brand Name: | Analogue |
| Test Standard: | 47 CFR Part 15 Subpart C (refer section 3.1) |
| FCC ID: | 2AZVE-AP-D01 |
| Test conclusion: | Pass |
| Test Date: | Jul. 22, 2021 ~ Aug. 28, 2021 |
| Date of Issue: | Sep. 17, 2021 |

Tested by: Ye Hongji
Date Sep. 17, 2021

Approved by: Liao Jianming
(Technical Director)
Date Sep. 17, 2021

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**Revision History**

| Version | Issue Date | Revisions Content |
|---|---|---|
| Rev. 01 | Sep. 17, 2021 | Initial Issue |

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# 1 ADMINISTRATIVE DATA (GENERAL INFORMATION)

## 1.1 Identification of the Testing Laboratory

| | |
|---|---|
| Company Name | Shenzhen BALUN Technology Co., Ltd. |
| Address | Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China |
| Phone Number | +86 755 6685 0100 |

## 1.2 Identification of the Responsible Testing Location

| | |
|---|---|
| Test Location | Shenzhen BALUN Technology Co., Ltd. |
| Address | Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China |
| Accreditation Certificate | The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196. |
| Description | All measurement facilities used to collect the measurement data are located at Block B, FL 1, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China 518055 |

## 1.3 Laboratory Condition

| | |
|---|---|
| Ambient Temperature | 20℃ to 25℃ |
| Ambient Relative Humidity | 45% to 55% |
| Ambient Pressure | 100 kPa to 102 kPa |

## 1.4 Announce

(1) The test report reference to the report template version v5.7.

(2) The test report is invalid if not marked with the signatures of the persons responsible for preparing and approving the test report.

(3) The test report is invalid if there is any evidence and/or falsification.

(4) The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein.

(5) This document may not be altered or revised in any way unless done so by BALUN and all revisions are duly noted in the revisions section.

(6) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.

(7) The laboratory is only responsible for the data released by the laboratory, except for the part provided by the applicant.

# 2 PRODUCT INFORMATION

## 2.1 Applicant Information

| | |
|---|---|
| Applicant | Analogue Enterprises Ltd. |
| Address | Flat J, 2/F, Po Ming Building, 2-6 Foo Ming Street, Causeway Bay, Hong Kong China |

## 2.2 Manufacturer Information

| | |
|---|---|
| Manufacturer | Shenzhen Zhong Xing Da Electronics Co., Ltd. |
| Address | 2/F., Block 10, Tongfuyu Industrial Zone, Lezhujiao Village, Xixiang Bao'an District, Shenzhen, 518057, China |

## 2.3 Factory Information

| | |
|---|---|
| Factory | Shenzhen Zhong Xing Da Electronics Co., Ltd. |
| Address | 2/F., Block 10, Tongfuyu Industrial Zone, Lezhujiao Village, Xixiang Bao'an District, Shenzhen, 518057, China |

## 2.4 General Description for Equipment under Test (EUT)

| | |
|---|---|
| EUT Name | Dock |
| Model Name Under Test | AP-D01 |
| Series Model Name | N/A |
| Description of Model name differentiation | N/A |
| Hardware Version | 004 |
| Software Version | 1 |
| Dimensions (Approx.) | N/A |
| Weight (Approx.) | N/A |

## 2.5 Technical Information

| | |
|---|---|
| Network and Wireless connectivity | Bluetooth BR<br>2.4G ISM Band (GFSK modulation) |

The requirement for the following technical information of the EUT was tested in this report:

| | |
|---|---|
| Modulation Technology | FHSS |
| Modulation Type | GFSK |
| Product Type | ☒ Mobile<br>☐ Portable<br>☐ Fix Location |
| Transfer Rate | DH5: 1 Mbps |
| Frequency Range | The frequency range used is 2400 MHz to 2483.5 MHz. |
| Number of Channel | 79 (at intervals of 1 MHz) |
| Tested Channel | 0 (2402 MHz), 39 (2441 MHz), 78 (2480 MHz) |
| Antenna Type | PCB Antenna |
| Antenna Gain | -5.2 dBi (In test items related to antenna gain, the final results reflect this figure. This value is provided by the applicant.) |
| Antenna Impedance | 50Ω |
| Antenna System (MIMO Smart Antenna) | N/A |

All channel was listed on the following table:

| Channel number | Freq. (MHz) | Channel number | Freq. (MHz) | Channel number | Freq. (MHz) | Channel number | Freq. (MHz) |
|---|---|---|---|---|---|---|---|
| **0** | **2402** | 21 | 2423 | 42 | 2444 | 63 | 2465 |
| 1 | 2403 | 22 | 2424 | 43 | 2445 | 64 | 2466 |
| 2 | 2404 | 23 | 2425 | 44 | 2446 | 65 | 2467 |
| 3 | 2405 | 24 | 2426 | 45 | 2447 | 66 | 2468 |
| 4 | 2406 | 25 | 2427 | 46 | 2448 | 67 | 2469 |
| 5 | 2407 | 26 | 2428 | 47 | 2449 | 68 | 2470 |
| 6 | 2408 | 27 | 2429 | 48 | 2450 | 69 | 2471 |
| 7 | 2409 | 28 | 2430 | 49 | 2451 | 70 | 2472 |
| 8 | 2410 | 29 | 2431 | 50 | 2452 | 71 | 2473 |
| 9 | 2411 | 30 | 2432 | 51 | 2453 | 72 | 2474 |
| 10 | 2412 | 31 | 2433 | 52 | 2454 | 73 | 2475 |
| 11 | 2413 | 32 | 2434 | 53 | 2455 | 74 | 2476 |
| 12 | 2414 | 33 | 2435 | 54 | 2456 | 75 | 2477 |
| 13 | 2415 | 34 | 2436 | 55 | 2457 | 76 | 2478 |
| 14 | 2416 | 35 | 2437 | 56 | 2458 | 77 | 2479 |
| 15 | 2417 | 36 | 2438 | 57 | 2459 | **78** | **2480** |
| 16 | 2418 | 37 | 2439 | 58 | 2460 | - | - |
| 17 | 2419 | 38 | 2440 | 59 | 2461 | - | - |
| 18 | 2420 | **39** | **2441** | 60 | 2462 | - | - |
| 19 | 2421 | 40 | 2442 | 61 | 2463 | - | - |
| 20 | 2422 | 41 | 2443 | 62 | 2464 | - | - |

## 2.6 Additional Instructions

EUT Software Settings:

| | |
|---|---|
| Mode | ☒ Bluetooth test mode loop back enabled.<br>EUT is controlled over CBT / CMW. |

| Power level setup in software | | | |
|---|---|---|---|
| Mode | Channel | Frequency (MHz) | Soft Set |
| DH5 | CH0 | 2402 | TX LEVEL is built-in set parameters and cannot be changed and selected. |
| | CH39 | 2441 | |
| | CH78 | 2480 | |

# 3 SUMMARY OF TEST RESULTS

## 3.1 Test Standards

| No. | Identity | Document Title |
|---|---|---|
| 1 | 47 CFR Part 15, Subpart C | Miscellaneous Wireless Communications Services |
| 2 | ANSI C63.10-2013 | American National Standard for Testing Unlicensed Wireless Devices |
| 3 | KDB 558074 D01 15.247 Meas Guidance v05r02 | Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules |

## 3.2 Verdict

| No. | Description | FCC Part No. | Channel | Test Result | Verdict | Remark |
|---|---|---|---|---|---|---|
| 1 | Antenna Requirement | 15.203 | N/A | -- | Pass | Note [1] |
| 2 | Number of Hopping Frequencies | 15.247(a) | Hopping Mode | ANNEX A.1 | Pass | Note [2] |
| 3 | Peak Output Power | 15.247(b) | Low/Middle/High | ANNEX A.2 | Pass | -- |
| 4 | Occupied Bandwidth | 15.247(a) | Low/Middle/High | ANNEX A.3 | Pass | Note [2] |
| 5 | Carrier Frequency Separation | 15.247(a) | Hopping Mode | ANNEX A.4 | Pass | Note [2] |
| 6 | Time of Occupancy (Dwell time) | 15.247(a) | Hopping Mode | ANNEX A.5 | Pass | Note [2] |
| 7 | Conducted Spurious Emission & Authorized-band band-edge | 15.247(d) | Hopping Mode, Low/Middle/High | ANNEX A.6 | Pass | Note [2] |
| 8 | Conducted Emission | 15.207 | Low/Middle/High | ANNEX A.7 | Pass | Note [2] |
| 9 | Radiated Spurious Emission | 15.209 15.247(d) | Hopping Mode, Low/Middle/High | ANNEX A.8 | Pass | Note [2] |
| 10 | Band Edge(Restricted-band band-edge) | 15.209 15.247(d) | Hopping Mode, Low/High | ANNEX A.9 | Pass | Note [2] |
| 11 | Receiver Spurious Emissions | -- | -- | -- | N/A | Note [3] |

Note [1]: Please refer to section 5.1

Note [2]: π/4-DQPSK is the EDR 2M rate mode, 8-DPSK is the EDR 3M rate mode. The consistency of test results in π/4-DQPSK and 8-DPSK is very high. So we chose 8-DPSK as a typical representative to appear on the report. Another we will show all the modes on the RF output power test item.

Note [3]: Only radio communication receivers operating in stand-alone mode within the band 30-960 MHz, as well as scanner receivers, are subject to Industry Canada requirements, so this test is not applicable.

# 4 GENERAL TEST CONFIGURATIONS

## 4.1 Test Environments

During the measurement, the normal environmental conditions were within the listed ranges:

| | | |
|---|---|---|
| Relative Humidity | 45% to 55% | |
| Atmospheric Pressure | 100 kPa to 102 kPa | |
| Temperature | NT (Normal Temperature) | +22℃ to +25℃ |
| Working Voltage of the EUT | NV (Normal Voltage) | 5 V |

## 4.2 Test Equipment List

| Description | Manufacturer | Model | Serial No. | Cal. Date | Cal. Due |
|---|---|---|---|---|---|
| Spectrum Analyzer | ROHDE&SCHWARZ | FSV-40 | 101544 | 2021.04.01 | 2022.03.31 |
| Bluetooth Signaling Unit | ROHDE&SCHWARZ | CMW500 | 142028 | 2021.06.01 | 2022.05.31 |
| EMI Receiver | KEYSIGHT | N9038A | MY53220118 | 2021.06.01 | 2022.05.31 |
| EMI Receiver | ROHDE&SCHWARZ | ESRP | 101036 | 2021.06.01 | 2022.05.31 |
| LISN | SCHWARZBECK | NSLK 8127 | 8127-687 | 2021.06.01 | 2022.05.31 |
| Test Antenna-Loop(9 kHz-30 MHz) | SCHWARZBECK | FMZB 1519 | 1519-037 | 2019.10.29 | 2021.10.28 |
| Test Antenna-Bi-Log(30 MHz-3 GHz) | SCHWARZBECK | VULB 9163 | 9163-624 | 2019.07.02 | 2022.07.01 |
| Test Antenna-Horn(1-18 GHz) | SCHWARZBECK | BBHA 9120D | 9120D-1917 | 2019.07.02 | 2022.07.01 |
| Test Antenna-Horn (18-40 GHz) | A-INFO | LB-180400KF | J211060273 | 2021.01.05 | 2023.01.04 |
| Anechoic Chamber | RAINFORD | 9m*6m*6m | N/A | 2017.02.21 | 2022.02.20 |
| Anechoic Chamber | EMC Electronic Co., Ltd | 20.10*11.60 *7.35m | N/A | 2019.08.08 | 2022.08.07 |
| Shielded Enclosure | ChangNing | CN-130701 | 130703 | -- | -- |

## 4.3 Measurement Uncertainty

The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2.

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

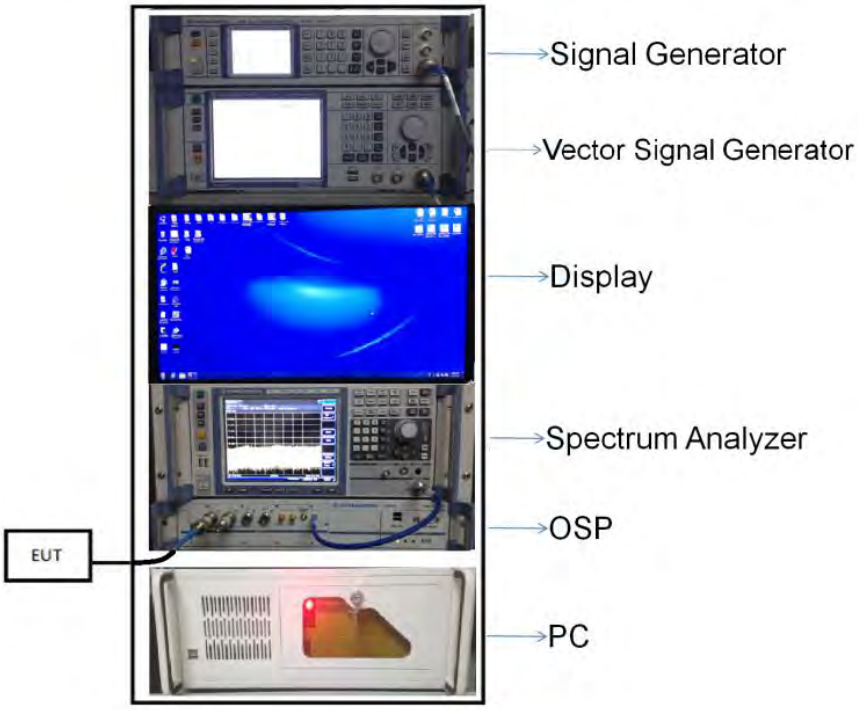
| Parameters | Uncertainty |
|---|---|
| Occupied Channel Bandwidth | 2.8% |
| RF output power, conducted | 1.28 dB |
| Power Spectral Density, conducted | 1.30 dB |
| Unwanted Emissions, conducted | 1.84 dB |
| All emissions, radiated | 5.36 dB |
| Temperature | 0.82℃ |
| Humidity | 4.1% |

## 4.4 Description of Test Setup

### 4.4.1 For Antenna Port Test

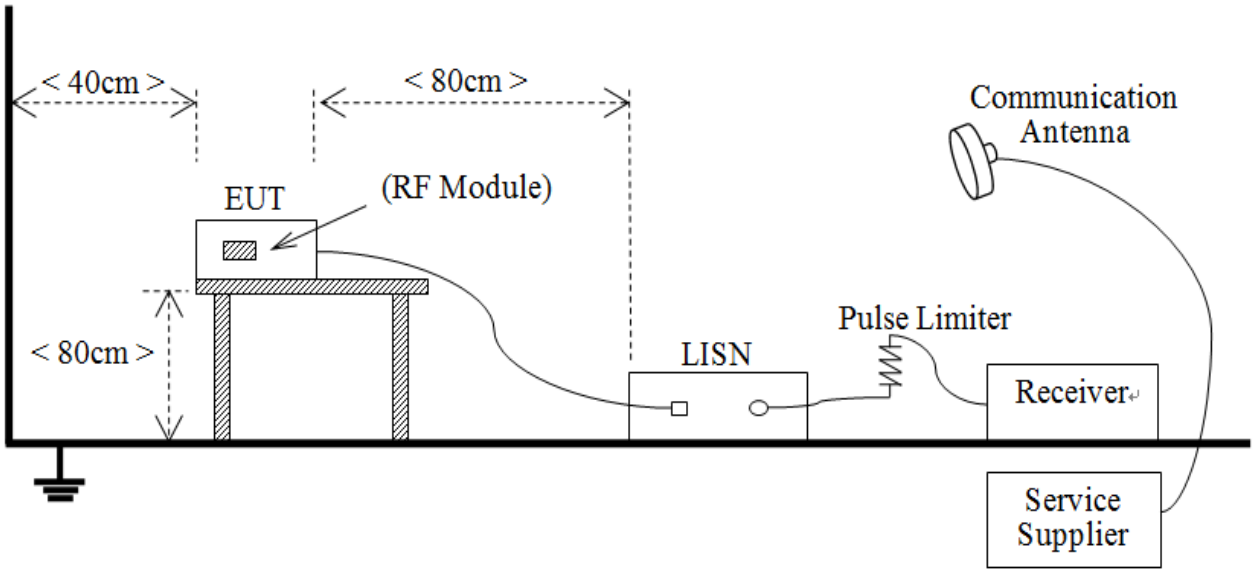
Conducted value (dBm) = Measurement value (dBm) + cable loss (dB)

For example: the measurement value is 10 dBm and the cable 0.5dBm used, then the final result of EUT:
Conducted value (dBm) = 10 dBm + 0.5 dB = 10.5 dBm



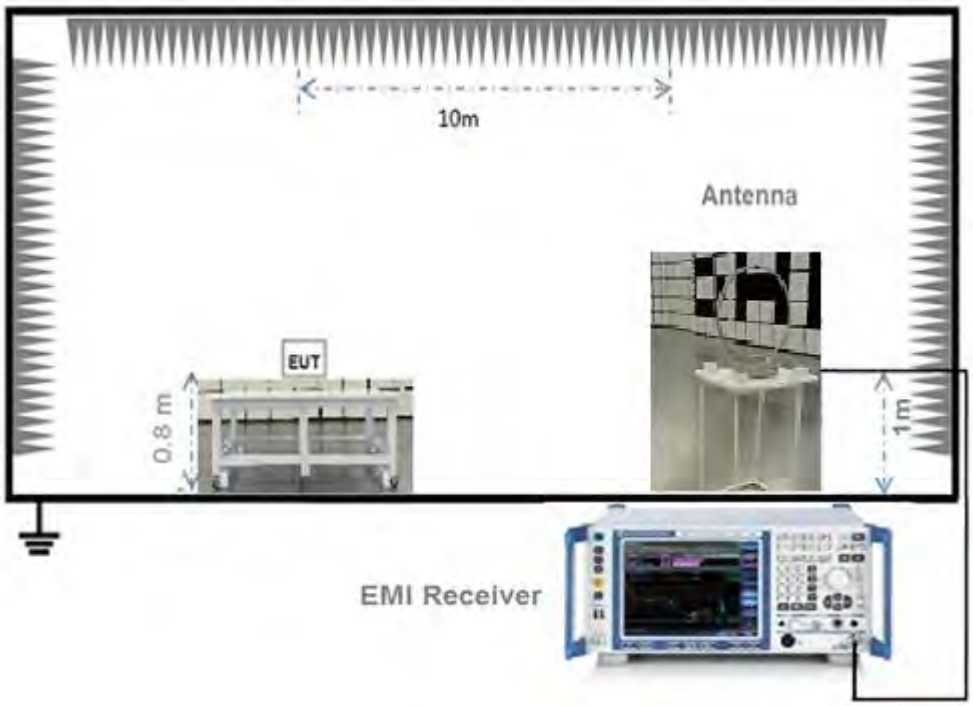

**(Diagram 1)**

### 4.4.2 For AC Power Supply Port Test



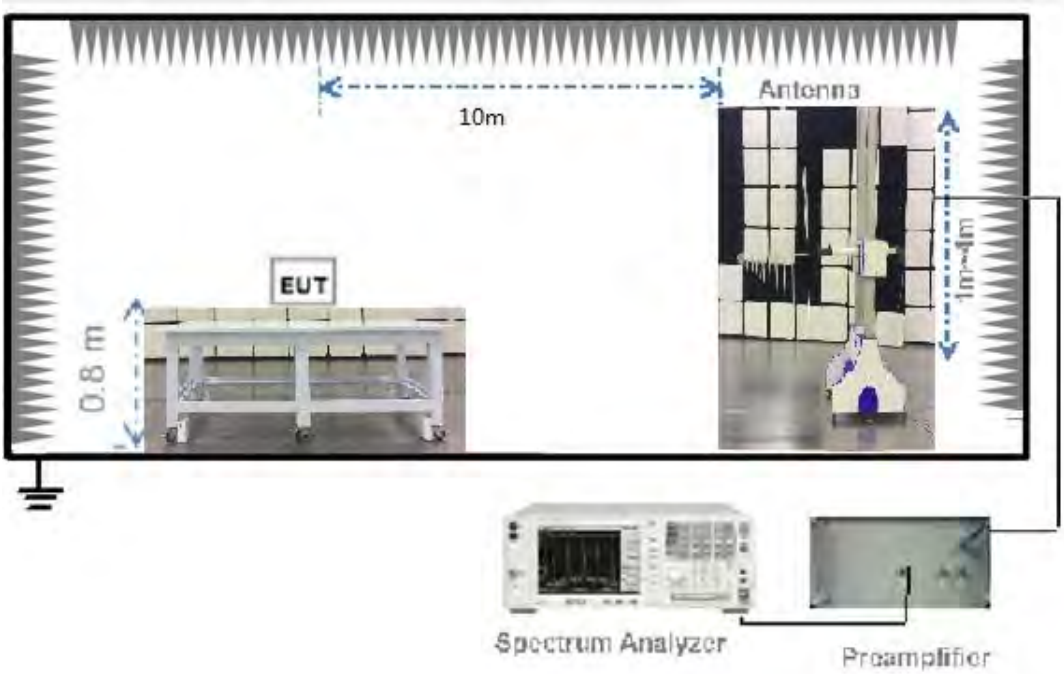

**(Diagram 2)**

### 4.4.3 For Radiated Test (Below 30 MHz)



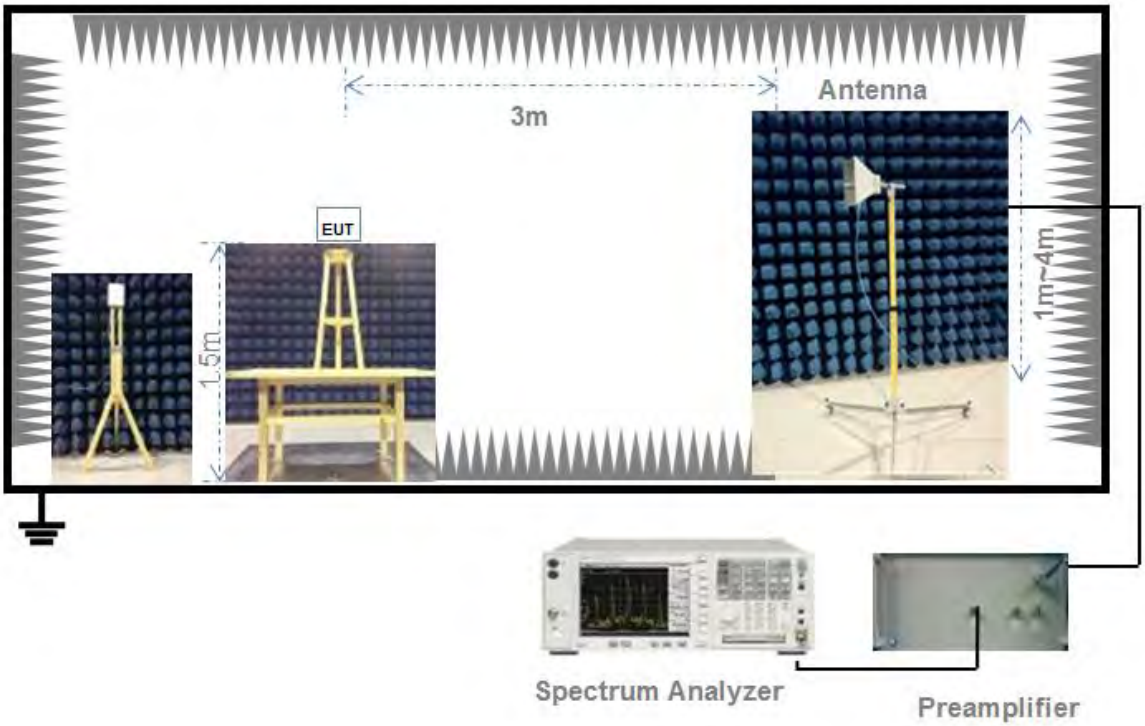

**(Diagram 3)**

### 4.4.4 For Radiated Test (30 MHz-1 GHz)




**(Diagram 4)**

4.4.5 For Radiated Test (Above 1 GHz)




**(Diagram 5)**

## 4.5 Measurement Results Explanation Example

### 4.5.1 For conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.
The spectrum analyzer offset is derived from RF cable loss and attenuator factor.
Offset = RF cable loss + attenuator factor.

# 5 TEST ITEMS

## 5.1 Antenna Requirements

### 5.1.1 Relevant Standards

FCC §15.203 & 15.247(b); RSS-247, 5.4 (f)

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. This requirement does not apply to carrier current devices or to devices operated under the provisions of § 15.211, § 15.213, § 15.217, § 15.219, or § 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

If directional gain of transmitting antennas is greater than 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6 dBi. For the fixed point-to-point operation, the power shall be reduced by one dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi. 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 FCC rule.

### 5.1.2 Antenna Anti-Replacement Construction

The Antenna Anti-Replacement as following method:

| Protected Method | Description |
|---|---|
| The antenna is embedded in the product. | An embedded-in antenna design is used. |

| Reference Documents | Item |
|---|---|
| Photo | Please refer to the EUT Photo documents. |

### 5.1.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

## 5.2 Frequency Hopping Systems

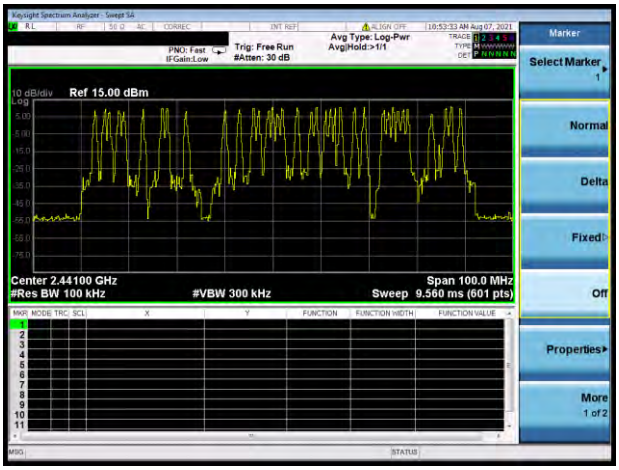
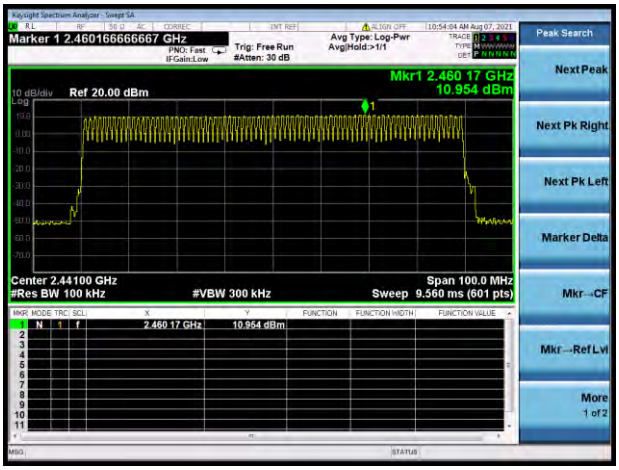
### 5.2.1 Relevant Standards

FCC §15.247(a) (1) (i) (ii) (iii) (iv); FCC §15.247(g); FCC §15.247(h)

Describe how the hopping sequence is generated. Provide an example of the hopping sequence channels, to demonstrate that the sequence meets the requirement specified in the definition of an FHSS system. Per the definition in Section 2.1(c), the hop set shall appear as random in the near term, shall appear as evenly distributed in the long term, and sequential hops shall be randomly distributed in both direction and magnitude of change.
Describe how each individual EUT meets the requirement that each of its hopping channels is used equally on average (e.g., that each new transmission event begins on the next channel in the hopping sequence after the final channel used in the previous transmission event).
Describe how the associated receiver(s) complies with the requirement that the input bandwidth (either RF or IF) matches the bandwidth of the transmitted signal.
Describe how the associated receiver(s) has the ability to shift frequencies in synchronization with the transmitted signals.
For short burst systems, describe how the EUT complies with the requirement that it be designed to be capable of operating as a true frequency hopping system. Specifically, the device shall comply with the equal frequency use and pseudorandom hopping sequence requirement when transmitting in short bursts, and shall be designed to comply when presented with continuous data (or information) stream.
Describe how the EUT complies with the requirement that it not have the ability to be coordinated with other FHSS systems in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

### 5.2.2 Description of the systems

1. According to the preset procedure of the whole network, all the stations in the automatic control network synchronously change the frequency multiple times within one second, and temporarily stay on each frequency hopping channel. Periodic synchronization signaling is sent from the primary station, instructing all slaves to simultaneously change the operating frequency, then the hopping sequence is generated.
2. The hop set shall appear as random in the near term, shall appear as evenly distributed in the long term, and sequential hops shall be randomly distributed in both direction and magnitude of change.

| Reference Documents | |
|---|---|
|   |   |

3. Channels are classified into two categories, used and unused, where used channels are part of the hopping sequence and unused channels are replaced in the hopping sequence by used channels in a pseudo-random way. Make each individual EUT meets the requirement that each of its hopping channels is used equally on average.
4. The input bandwith and transmitted bandwith are both 1MHz, the associated receiver(s) complies with the requirement that the input bandwidth matches the bandwidth of the transmitted signal.
5. Connected devices communicate on the same physical channel by synchronizing with a common clock and hopping sequence.
6. EUT isn’t short burst systems.
7. EUT can’t have the ability to be coordinated with other FHSS systems in an effort.

## 5.3 Number of Hopping Frequencies

### 5.3.1 Limit

FCC §15.247(a) (1) (iii); RSS-247, 5.1 (d)

Frequency hopping systems operating in the 2400 MHz to 2483.5 MHz bands shall use at least 15 hopping frequencies.

### 5.3.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

### 5.3.3 Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = The frequency band of operation

RBW = To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize

### 5.3.4 Test Result

Please refer to ANNEX A.1.

## 5.4 Peak Output Power

### 5.4.1 Test Limit

FCC § 15.247(b)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

RSS-247, 5.4 (b)

For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W and the e.i.r.p. shall not exceed 4 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W and the e.i.r.p. shall not exceed 0.5 W if the hopset uses less than 75 hopping channels (see Section 5.4(5) for exceptions).

### 5.4.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

### 5.4.3 Test Procedure

The Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to verify the conducted RF output peak power of the Module.

Use the following spectrum analyzer settings:

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel

RBW > the 20 dB bandwidth of the emission being measured

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize.

### 5.4.4 Test Result

Please refer to ANNEX A.2.

## 5.5 Occupied Bandwidth

### 5.5.1 Limit

FCC §15.247(a); RSS-247, 5.1 (a)

Measurement of the 20dB bandwidth of the modulated signal.

### 5.5.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

### 5.5.3 Test Procedure

Use the following spectrum analyzer settings:

Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel

RBW = in the range of 1% to 5% of the OBW

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

The EUT should be transmitting at its maximum data rate, Allow the trace to stabilize.

### 5.5.4 Test Result

Please refer to ANNEX A.3.

## 5.6 Carrier Frequency Separation

### 5.6.1 Limit

FCC §15.247(a); RSS-247, 5.1 (b)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 2/3 of the 20 dB bandwidth of the hopping channel, whichever is greater.

### 5.6.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

### 5.6.3 Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span

Video (or Average) Bandwidth (VBW) ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

### 5.6.4 Test Result

Please refer to ANNEX A.4.

## 5.7 Time of Occupancy (Dwell time)

### 5.7.1 Limit

FCC §15.247(a); RSS-247, 5.1 (d)

Frequency hopping systems in the 2400 MHz - 2483.5 MHz band shall use at least 15 non-overlapping 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.

### 5.7.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

### 5.7.3 Test Procedure

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:
Span: Zero span, centered on a hopping channel
RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel
Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel
Detector function: Peak
Trace: Max hold

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

The average time of occupancy on any channel within the Period can be calculated with formulas:
For GFSK and 8-DPSK:
For DH1 package type

{Total of Dwell} = {Pulse Time} * (1600 / 2) / {Number of Hopping Frequency} * {Period}
{Period} = 0.4 s * {Number of Hopping Frequency}

For DH3 package type

{Total of Dwell} = {Pulse Time} * (1600 / 4) / {Number of Hopping Frequency} * {Period}
{Period} = 0.4 s * {Number of Hopping Frequency}

For DH5 package type

{Total of Dwell} = {Pulse Time} * (1600 / 6) / {Number of Hopping Frequency} * {Period}
{Period} = 0.4 s * {Number of Hopping Frequency}

For AFH Mode:
For DH1 package type

{Total of Dwell} = {Pulse Time} * (800 / 2) / {Number of Hopping Frequency} * {Period}
{Period} = 0.4 s * {Number of Hopping Frequency}

For DH3 package type

{Total of Dwell} = {Pulse Time} * (800 / 4) / {Number of Hopping Frequency} * {Period}
{Period} = 0.4 s * {Number of Hopping Frequency}

For DH5 package type

{Total of Dwell} = {Pulse Time} * (800 / 6) / {Number of Hopping Frequency} * {Period}

{Period} = 0.4 s * {Number of Hopping Frequency}

The lowest, middle and highest channels are selected to perform testing to record the dwell time of each occupation measured in this channel, which is called Pulse Time here.

### 5.7.4 Test Result

Please refer to ANNEX A.5.

## 5.8 Conducted Spurious Emission & Authorized-band band-edge

### 5.8.1 Limit

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.

### 5.8.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

### 5.8.3 Test Procedure

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
RBW = 100 kHz
VBW = 300 kHz
Sweep = auto
Detector function = peak
Trace = max hold
Allow the trace to stabilize

### 5.8.4 Test Result

Please refer to ANNEX A.6.

## 5.9 Conducted Emission

### 5.9.1 Limit

FCC §15.207; RSS-GEN, 8.8

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN).

| Frequency range (MHz) | Conducted Limit (dBμV) | |
|---|---|---|
| | Quai-peak | Average |
| 0.15 - 0.50 | 66 to 56 | 56 to 46 |
| 0.50 - 5 | 56 | 46 |
| 0.50 - 30 | 60 | 50 |

### 5.9.2 Test Setup

See section 4.4.2 for test setup description for the AC power supply port. The photo of test setup please refer to ANNEX B.

### 5.9.3 Test Procedure

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.
Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz) for which the device is capable of operation. A device rated for 50/60 Hz operation need not be tested at both frequencies provided the radiated and line conducted emissions are the same at both frequencies.

### 5.9.4 Test Result

Please refer to ANNEX A.7.

## 5.10 Radiated Spurious Emission

### 5.10.1 Limit

FCC §15.209&15.247(d); RSS-247, 5.5

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency (MHz) | Field Strength (μV/m) | Measurement Distance (m) |
|---|---|---|
| 0.009 - 0.490 | 2400/F(kHz) | 300 |
| 0.490 - 1.705 | 24000/F(kHz) | 30 |
| 1.705 - 30.0 | 30 | 30 |
| 30 - 88 | 100 | 3 |
| 88 - 216 | 150 | 3 |
| 216 - 960 | 200 | 3 |
| Above 960 | 500 | 3 |

Note:

1. Field Strength (dBμV/m) = 20*log[Field Strength (μV/m)].
2. In the emission tables above, the tighter limit applies at the band edges.
3. For Above 1000 MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.
4. For above 1000 MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK).

### 5.10.2 Test Setup

See section 4.4.3 to 4.4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

### 5.10.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW

Sweep = auto
Detector function = peak
Trace = max hold
For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

### 5.10.4 Test Result

Please refer to ANNEX A.8.

## 5.11 Band Edge (Restricted-band band-edge)

### 5.11.1 Limit

FCC §15.209&15.247(d)

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

### 5.11.2 Test Setup

See section 4.4.3 to 4.4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

### 5.11.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

### 5.11.4 Test Result

Please refer to ANNEX A.9.

# ANNEX A TEST RESULT

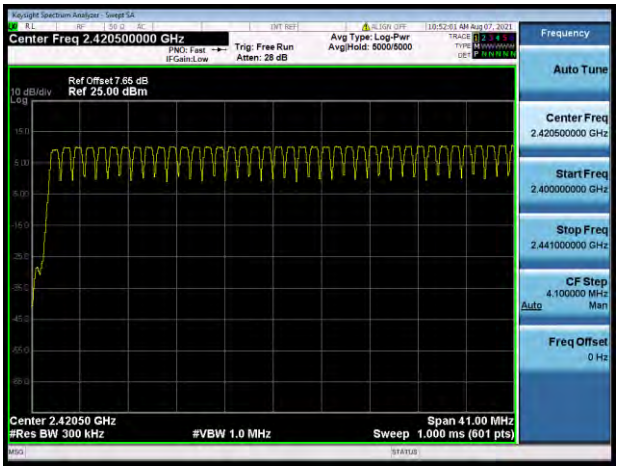
## A.1 Number of Hopping Frequency

Test Data

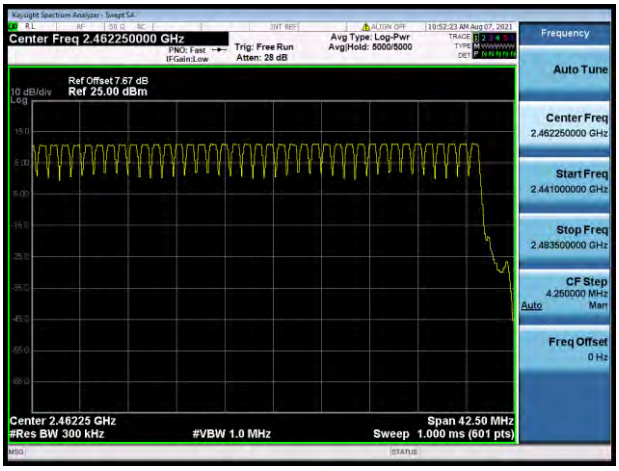
| Test Mode | Frequency Block (MHz) | Measured Channel Numbers | Min. Limit | Verdict |
|---|---|---|---|---|
| GFSK | 2400 - 2483.5 | 79 | 15 | Pass |

Test plots

GFSK 2.4 GHz ~ 2.4415 GHz




GFSK 2.4415 GHz ~ 2.4835 GHz



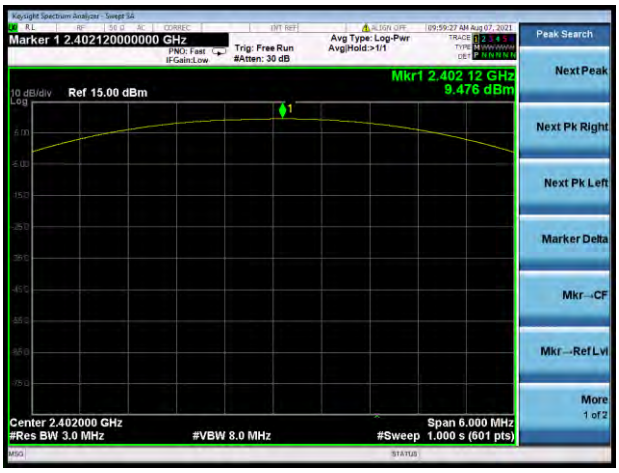
## A.2 Peak Output Power

Peak Power Test Data

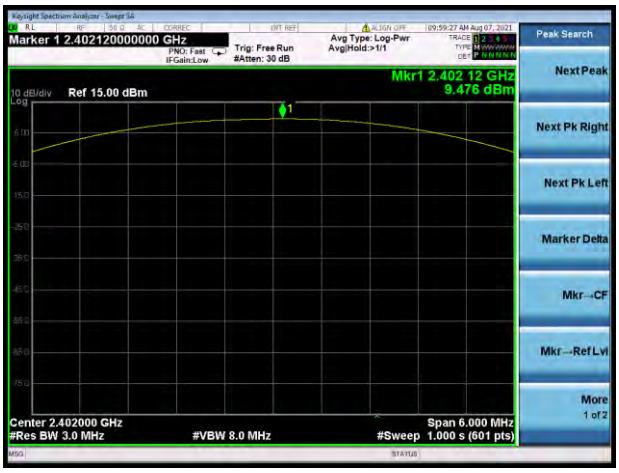
| Channel | Measured Output Peak Power | | Limit | | Verdict |
|---|---|---|---|---|---|
| | GFSK | | dBm | mW | |
| | dBm | mW | | | |
| Low | 9.48 | 8.86 | 21 | 125 | Pass |
| Middle | 10.97 | 12.51 | | | Pass |
| High | 11.36 | 13.68 | | | Pass |

Test plots

GFSK LOW CHANNEL




GFSK MIDDLE CHANNEL




GFSK HIGH CHANNEL

## A.3 20 dB and 99% bandwidth

Test Data

| GFSK | | |
|---|---|---|
| Channel | 20 dB Bandwidth (MHz) | 99% Bandwidth (MHz) |
| Low | 0.960000 | 0.878490 |
| Middle | 0.960000 | 0.875850 |
| High | 0.960000 | 0.878870 |

Test plots

20 dB Bandwidth

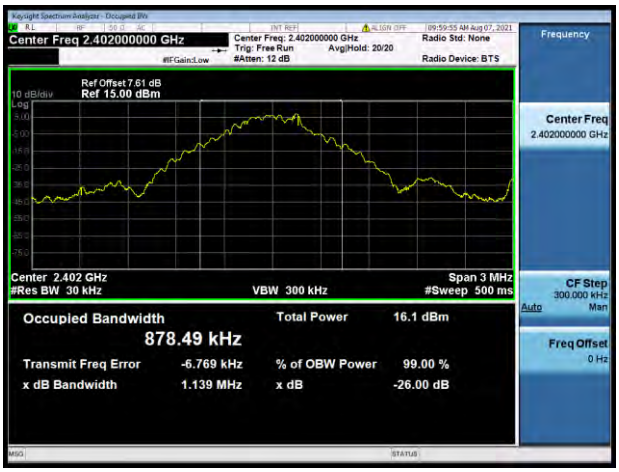
GFSK LOW CHANNEL

GFSK MIDDLE CHANNEL

GFSK HIGH CHANNEL

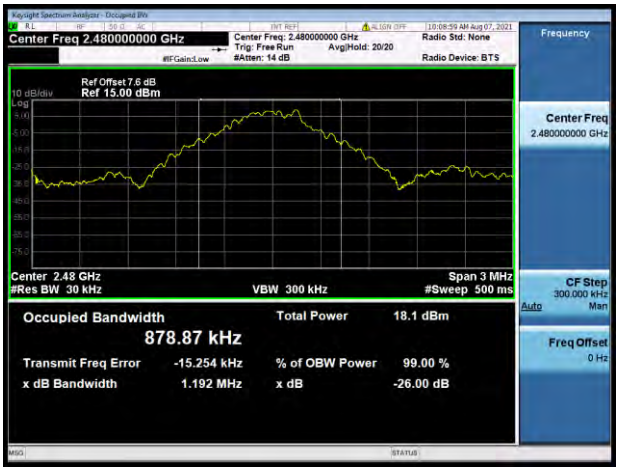
99% Bandwidth

GFSK LOW CHANNEL




GFSK MIDDLE CHANNEL

GFSK HIGH CHANNEL



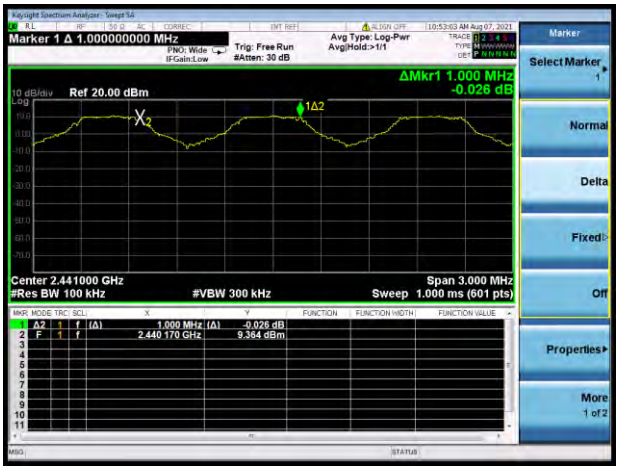
## A.4 Hopping Frequency Separation

Test Data

| Mode | Frequency separation (MHz) | 2/3 of the 20 dB Bandwidth (MHz) | Verdict |
|---|---|---|---|
| GFSK | 1.00 | 0.64 | Pass |

Test Plots

GFSK



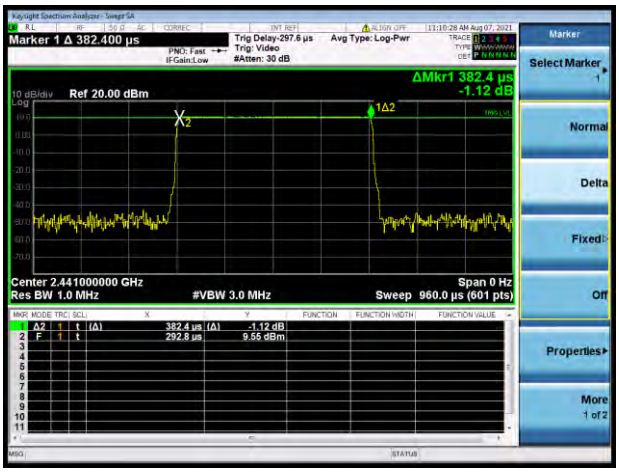
## A.5 Average Time of Occupancy

Test Data

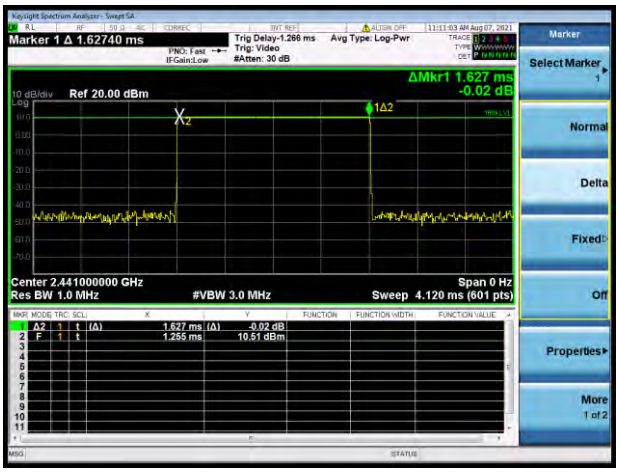
| GFSK | | | | |
|---|---|---|---|---|
| DH Packet | Pulse Width (ms) | Total of Dwell (ms) | Limit (sec) | Verdict |
| DH 1 | 0.38240 | 122.368 | 0.4 | Pass |
| DH 3 | 1.62700 | 260.320 | 0.4 | Pass |
| DH 5 | 2.88800 | 308.053 | 0.4 | Pass |
| AFH Mode | | | | |
| DH Packet | Pulse Width (ms) | Total of Dwell (ms) | Limit (sec) | Verdict |
| DH 1 | 0.37760 | 60.416 | 0.4 | Pass |
| DH 3 | 1.64100 | 131.280 | 0.4 | Pass |
| DH 5 | 2.87600 | 153.387 | 0.4 | Pass |

Test Plots

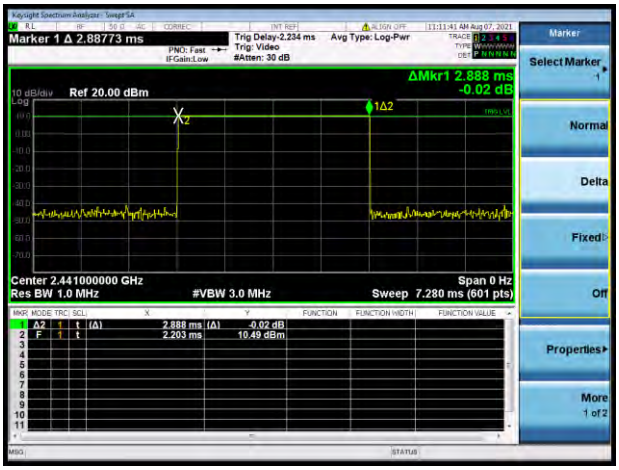
GFSK DH1



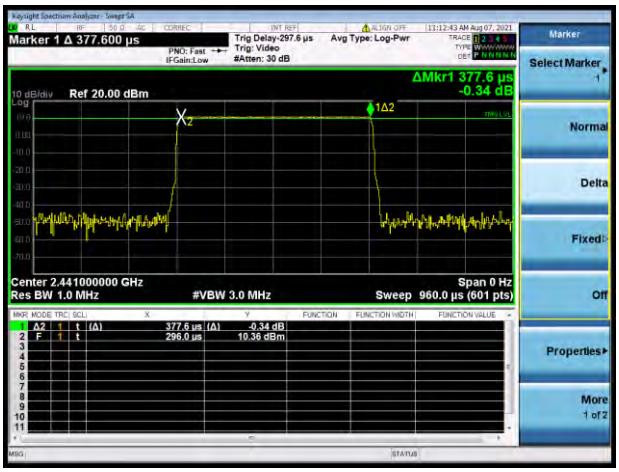

GFSK DH3



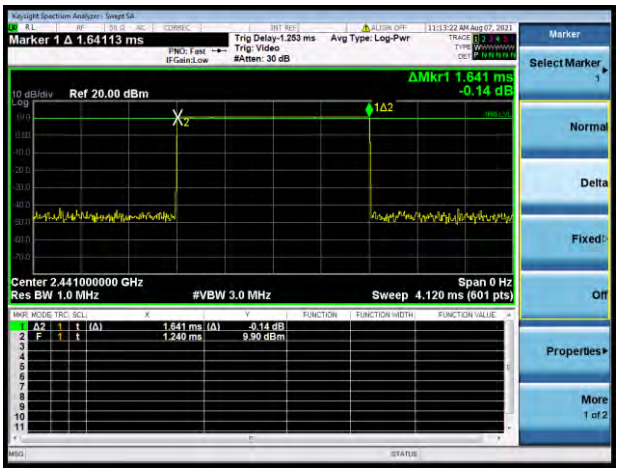

GFSK DH5



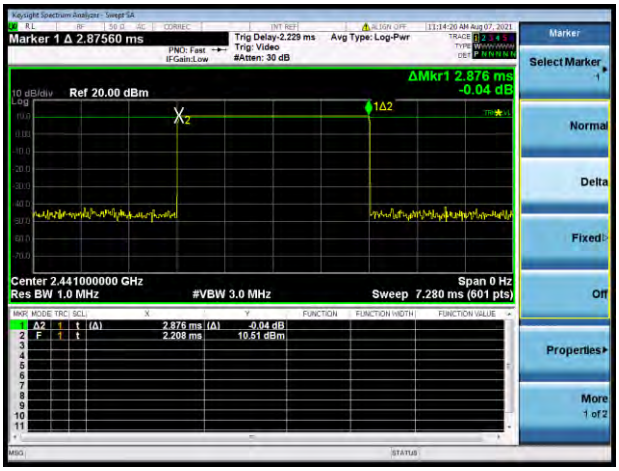
## AFH Mode DH1




## AFH Mode DH3




## AFH Mode DH5



## A.6 Conducted Spurious Emissions & Authorized-band band-edge

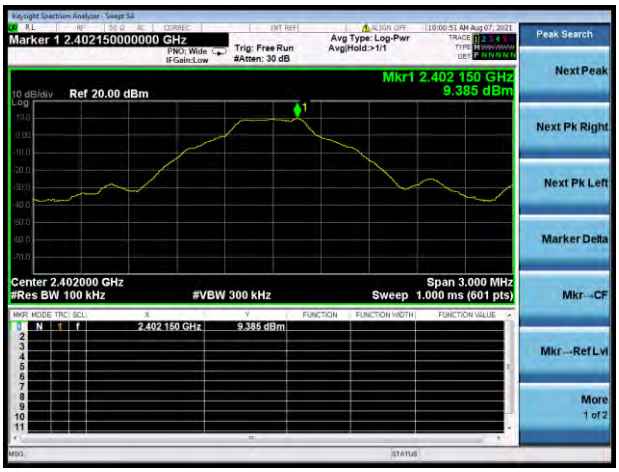
Test Data

| GFSK | | | | |
|---|---|---|---|---|
| Channel | Measured Max. Out of Band Emission (dBm) | Limit (dBm) | | Verdict |
| | | Carrier Level | Calculated 20 dBc Limit | |
| Low | -35.82 | 9.39 | -10.62 | Pass |
| Middle | -25.55 | 10.86 | -9.14 | Pass |
| High | -18.32 | 11.26 | -8.74 | Pass |

| Hopping Mode | | | | |
|---|---|---|---|---|
| Mode | Measured Max. Out of Band Emission (dBm) | Limit (dBm) | | Verdict |
| | | Carrier Level | Calculated 20 dBc Limit | |
| GFSK | -21.28 | 10.95 | -9.05 | Pass |

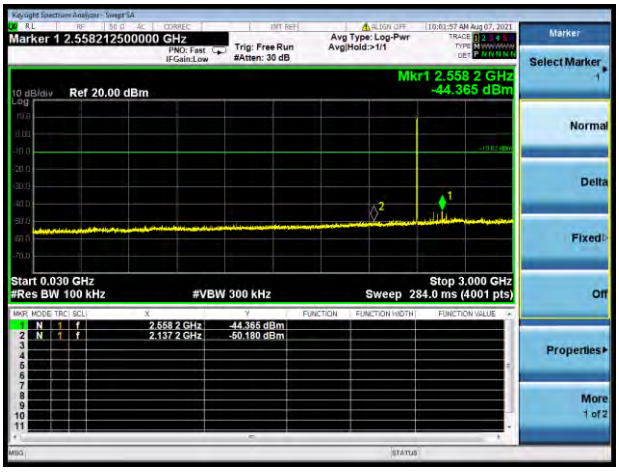
## Test Plots

### GFSK LOW CHANNEL, CARRIER LEVEL

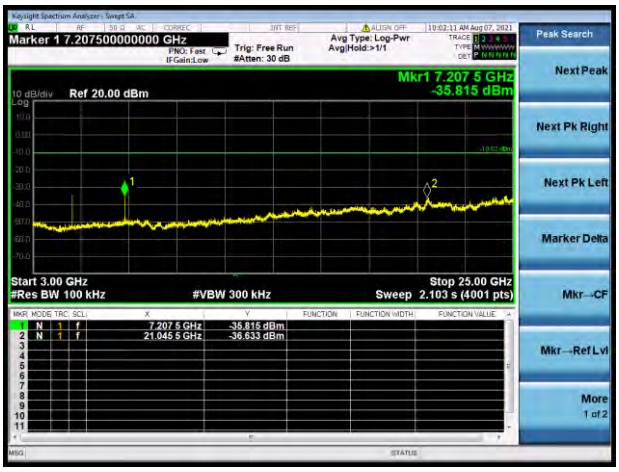



### GFSK LOW CHANNEL, BAND EDGE

### GFSK LOW CHANNEL, SPURIOUS 30 MHz ~ 3 GHz

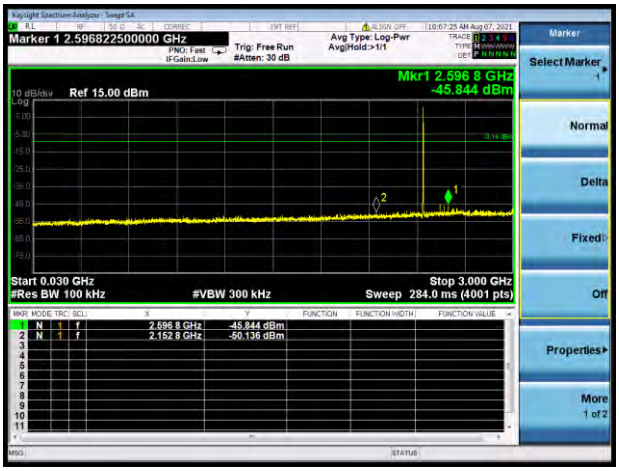



### GFSK LOW CHANNEL, SPURIOUS 3 GHz ~ 25 GHz

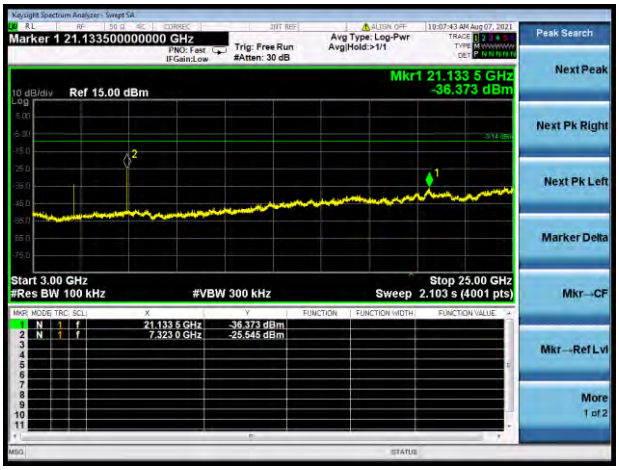



### GFSK MIDDLE CHANNEL, CARRIER LEVEL

GFSK MIDDLE CHANNEL, SPURIOUS 30 MHz ~ 3 GHz



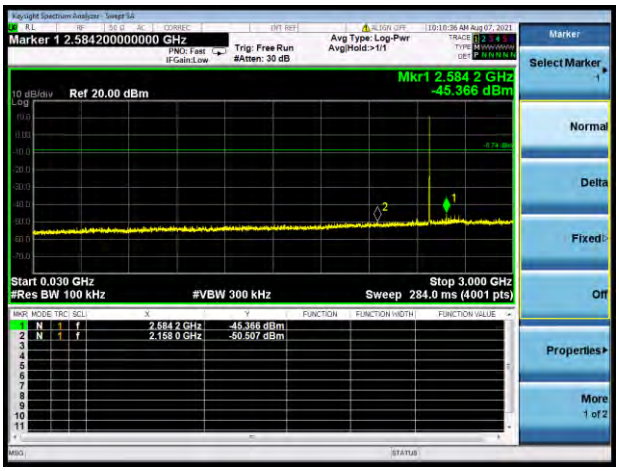

GFSK MIDDLE CHANNEL, SPURIOUS 3 GHz ~ 25 GHz



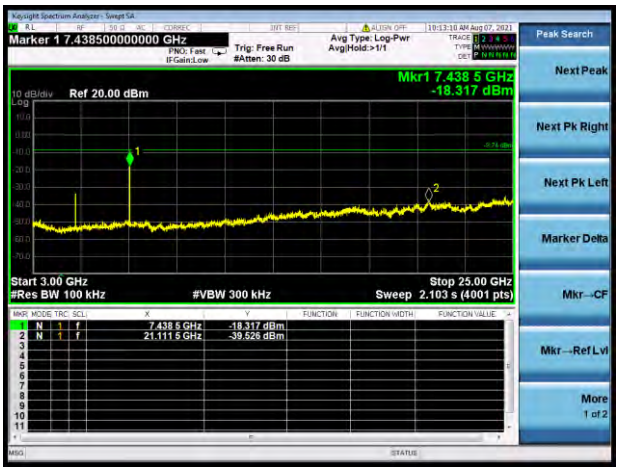

GFSK HIGH CHANNEL, CARRIER LEVEL

GFSK HIGH CHANNEL, BAND EDGE

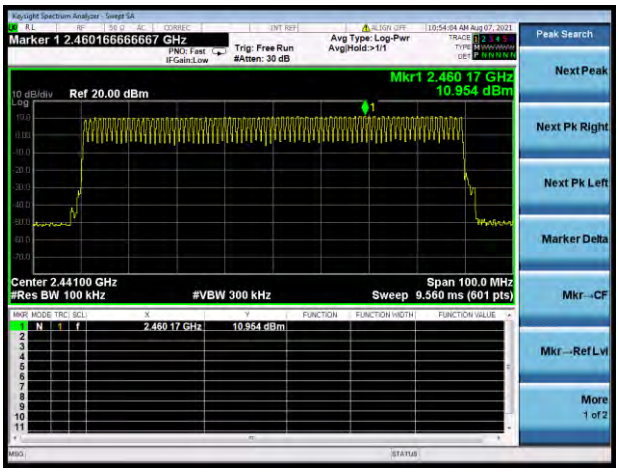
GFSK HIGH CHANNEL, SPURIOUS 30 MHz ~ 3 GHz




GFSK HIGH CHANNEL, SPURIOUS 3 GHz ~ 25 GHz



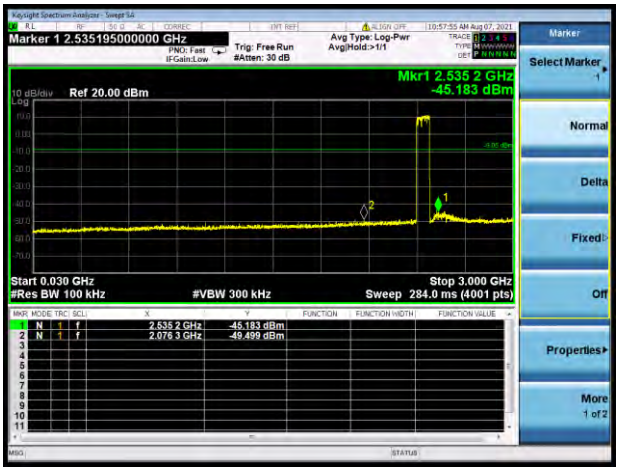
## GFSK HOPPING, CARRIER LEVEL



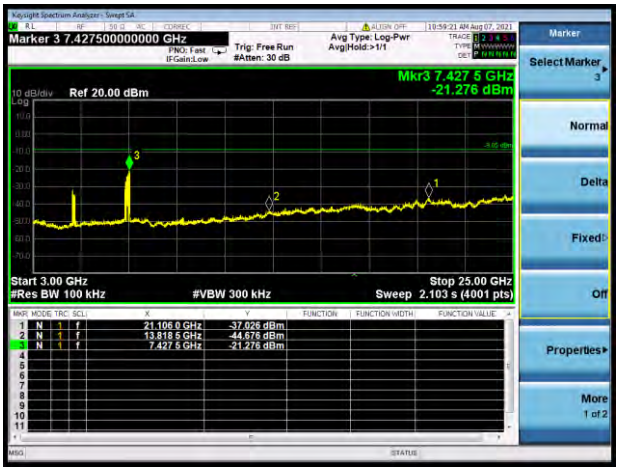

## GFSK HOPPING BAND EDGE (LOW)

## GFSK HOPPING BAND EDGE (HIGH)

## GFSK Hopping Mode, SPURIOUS 30 MHz ~ 3 GHz




## GFSK Hopping Mode, SPURIOUS 30 3GHz ~ 25 GHz

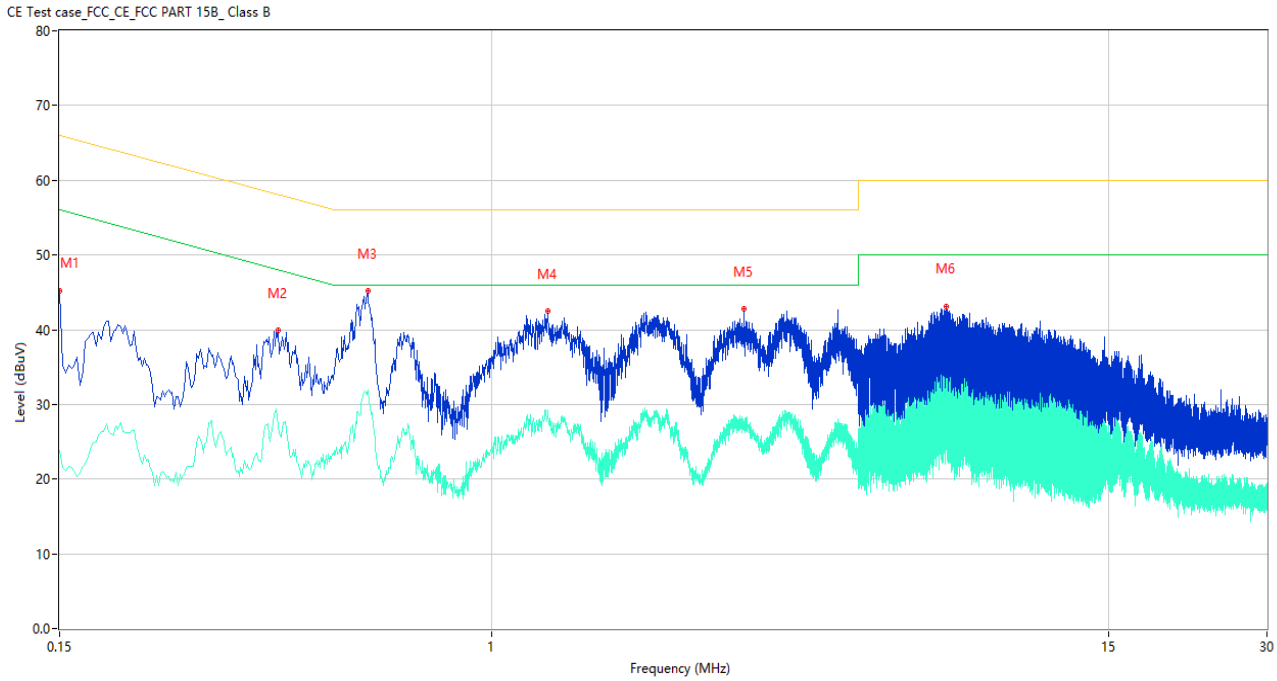


## A.7 Conducted Emissions

Note [1]: The EUT is working in the Normal link mode. All modes have been tested and normal link mode is worst.
Note [2]: Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 60 Hz and 240 VAC, 50 Hz) for which the device is capable of operation. So, The configuration 120 VAC, 60 Hz and 240 VAC, 50 Hz were tested respectively, but only the worst configuration (120 VAC, 60 Hz) shown here.
Note [3]: Results (dBuV) = Original reading level of Spectrum Analyzer (dBuV) + Factor (dB)

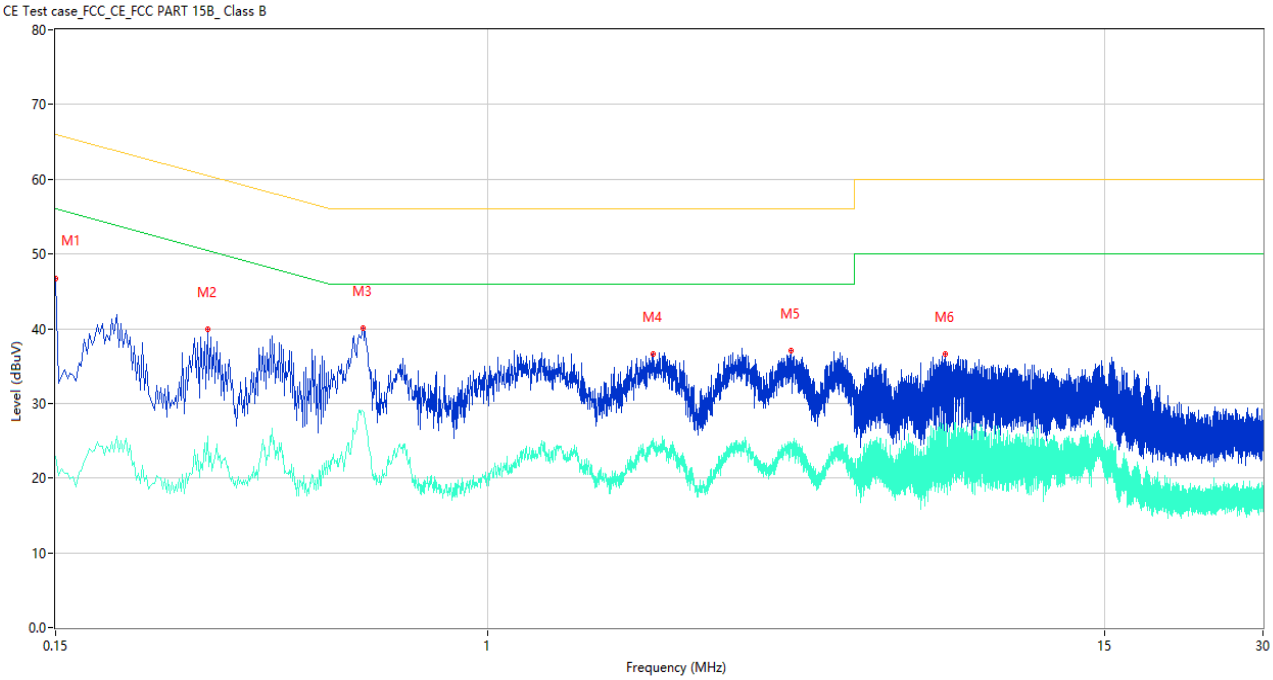
Test Data and Plots

PHASE L




| No. | Frequency (MHz) | Results (dBuV) | Factor (dB) | Limit (dBuV) | Over Limit (dB) | Detector | Line | Verdict |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.150 | 45.21 | 10.41 | 66.00 | -20.79 | Peak | L | Pass |
| 1** | 0.150 | 23.83 | 10.41 | 56.00 | -32.17 | AV | L | Pass |
| 2 | 0.392 | 39.94 | 10.30 | 58.02 | -18.08 | Peak | L | Pass |
| 2** | 0.392 | 27.24 | 10.30 | 48.02 | -20.78 | AV | L | Pass |
| 3 | 0.580 | 45.15 | 10.27 | 56.00 | -10.85 | Peak | L | Pass |
| 3** | 0.580 | 31.91 | 10.27 | 46.00 | -14.09 | AV | L | Pass |
| 4 | 1.276 | 42.46 | 10.25 | 56.00 | -13.54 | Peak | L | Pass |
| 4** | 1.276 | 28.46 | 10.25 | 46.00 | -17.54 | AV | L | Pass |
| 5 | 3.028 | 42.81 | 10.28 | 56.00 | -13.19 | Peak | L | Pass |
| 5** | 3.028 | 27.42 | 10.28 | 46.00 | -18.58 | AV | L | Pass |
| 6 | 7.328 | 43.16 | 10.34 | 60.00 | -16.84 | Peak | L | Pass |
| 6** | 7.328 | 27.69 | 10.34 | 50.00 | -22.31 | AV | L | Pass |

## PHASE N




| No. | Frequency (MHz) | Results (dBuV) | Factor (dB) | Limit (dBuV) | Over Limit (dB) | Detector | Line | Verdict |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.150 | 46.70 | 10.41 | 66.00 | -19.30 | Peak | N | Pass |
| 1** | 0.150 | 22.92 | 10.41 | 56.00 | -33.08 | AV | N | Pass |
| 2 | 0.292 | 39.85 | 10.34 | 60.47 | -20.62 | Peak | N | Pass |
| 2** | 0.292 | 25.59 | 10.34 | 50.47 | -24.88 | AV | N | Pass |
| 3 | 0.578 | 40.03 | 10.27 | 56.00 | -15.97 | Peak | N | Pass |
| 3** | 0.578 | 28.90 | 10.27 | 46.00 | -17.10 | AV | N | Pass |
| 4 | 2.068 | 36.57 | 10.26 | 56.00 | -19.43 | Peak | N | Pass |
| 4** | 2.068 | 25.36 | 10.26 | 46.00 | -20.64 | AV | N | Pass |
| 5 | 3.774 | 37.11 | 10.30 | 56.00 | -18.89 | Peak | N | Pass |
| 5** | 3.774 | 24.77 | 10.30 | 46.00 | -21.23 | AV | N | Pass |
| 6 | 7.430 | 36.56 | 10.34 | 60.00 | -23.44 | Peak | N | Pass |
| 6** | 7.430 | 22.55 | 10.34 | 50.00 | -27.45 | AV | N | Pass |

## A.8 Radiated Spurious Emission

Test Data and Plots

Note [1]: The symbol of "--" in the table which means not application.

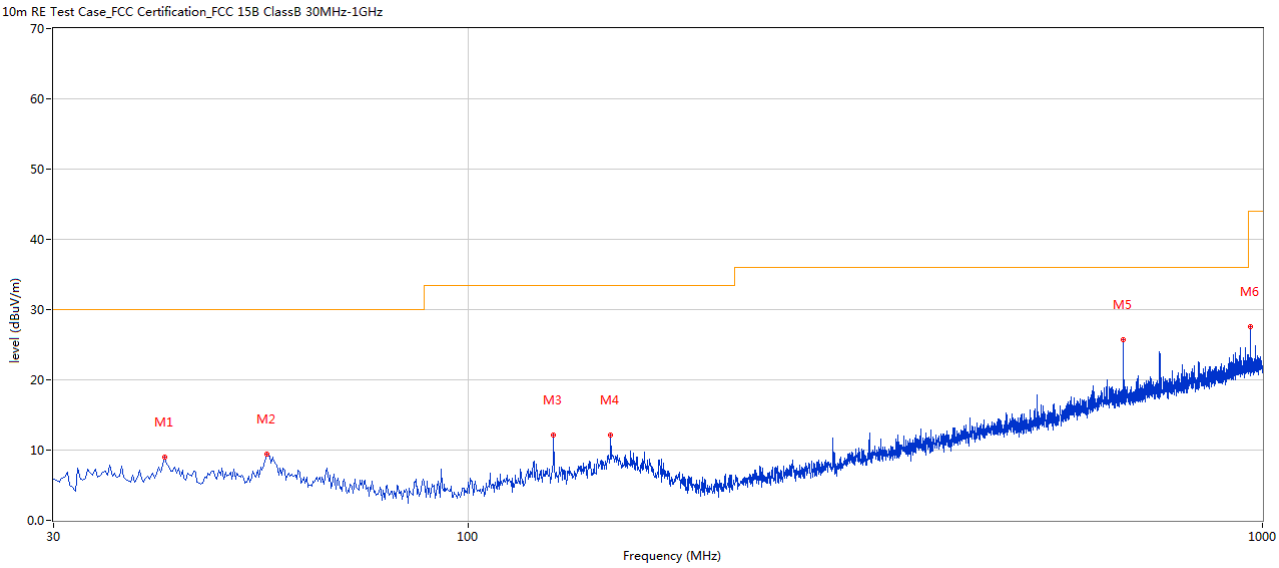
Note [2]: For the test data above 1 GHz, according the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Note [3]: The EUT is working in the Normal link mode below 1 GHz. All modes have been tested and DH5-Hopping mode is the worst.

Note [4]: Results (dBuV/m) = Original reading level of Spectrum Analyzer (dBuV/m) + Factor (dB)

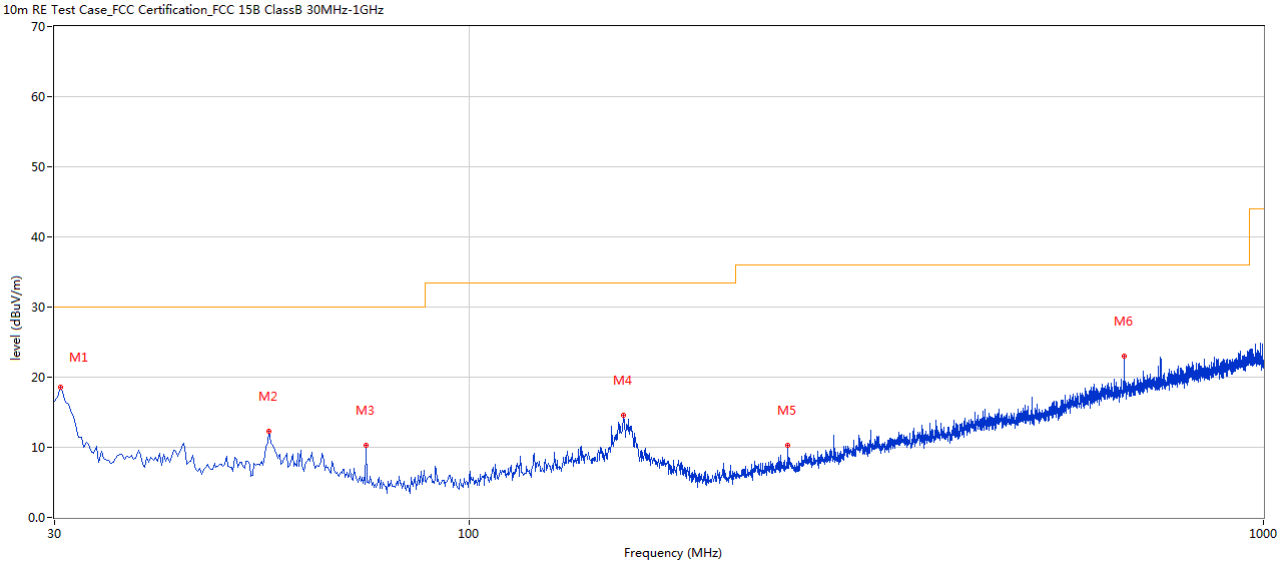
The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

30 MHz to 1 GHz, ANT H




| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Over Limit (dB) | Detector | Table (Degree) | Height (cm) | Antenna | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 41.395 | 9.05 | -26.77 | 30.0 | -20.95 | Peak | 80.00 | 100 | Horizontal | Pass |
| 2 | 55.699 | 9.45 | -27.47 | 30.0 | -20.55 | Peak | 191.00 | 100 | Horizontal | Pass |
| 3 | 127.946 | 12.15 | -27.34 | 33.5 | -21.35 | Peak | 252.00 | 200 | Horizontal | Pass |
| 4 | 150.977 | 12.11 | -26.02 | 33.5 | -21.39 | Peak | 267.00 | 100 | Horizontal | Pass |
| 5 | 668.100 | 25.73 | -16.44 | 36.0 | -10.27 | Peak | 221.00 | 100 | Horizontal | Pass |
| 6 | 965.089 | 27.64 | -11.28 | 44.0 | -16.36 | Peak | 140.00 | 200 | Horizontal | Pass |

## 30 MHz to 1 GHz, ANT V



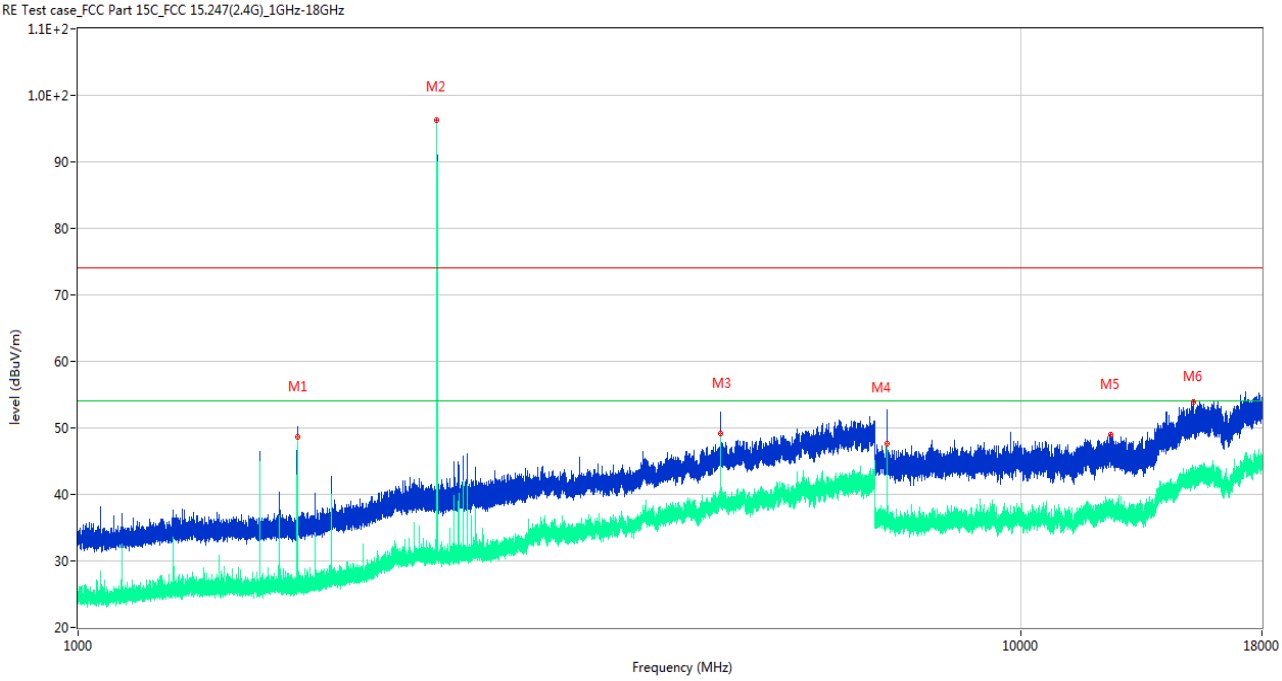

| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Over Limit (dB) | Detector | Table (Degree) | Height (cm) | Antenna | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 30.485 | 18.61 | -27.46 | 30.0 | -11.39 | Peak | 360.00 | 200 | Vertical | Pass |
| 2 | 55.941 | 12.24 | -27.51 | 30.0 | -17.76 | Peak | 275.00 | 200 | Vertical | Pass |
| 3 | 74.124 | 10.26 | -30.52 | 30.0 | -19.74 | Peak | 124.00 | 200 | Vertical | Pass |
| 4 | 156.311 | 14.63 | -25.72 | 33.5 | -18.87 | Peak | 277.00 | 100 | Vertical | Pass |
| 5 | 251.832 | 10.34 | -27.31 | 36.0 | -25.66 | Peak | 246.00 | 100 | Vertical | Pass |
| 6 | 668.100 | 23.05 | -16.44 | 36.0 | -12.95 | Peak | 226.00 | 100 | Vertical | Pass |

Test Data and Plots (1 GHz ~ 10th Harmonic)

Note 1: The marked spikes near 2400 MHz with circle should be ignored because they are Fundamental signal.

Note 2: The spurious from 18GHz-25GHz is noise only, do not show on the report.

## GFSK LOW CHANNEL 1 GHz to 18 GHz, ANT H

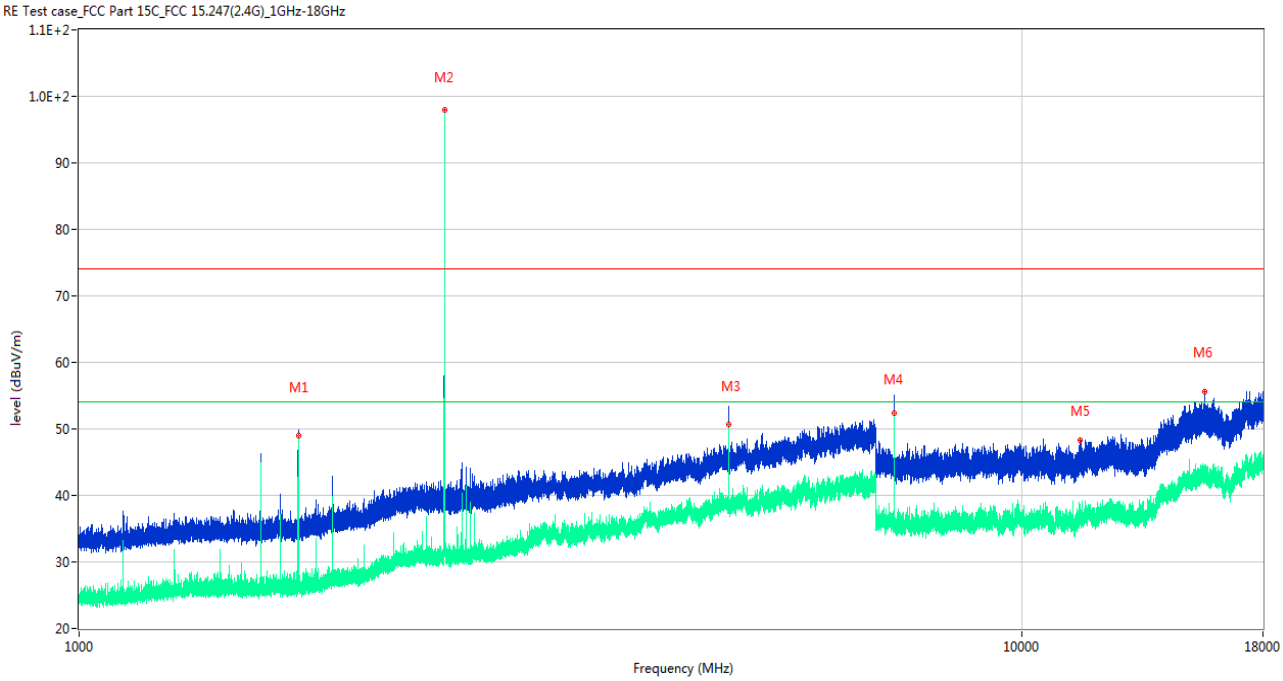



| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Over Limit (dB) | Detector | Table (Degree) | Height (cm) | Antenna | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1707.700 | 49.86 | -14.95 | 74.0 | -24.14 | Peak | 133.00 | 150 | Horizontal | Pass |
| 1** | 1707.700 | 48.67 | -14.95 | 54.0 | -5.33 | AV | 133.00 | 150 | Horizontal | Pass |
| 2 | 2401.800 | 96.19 | -10.75 | 74.0 | 22.19 | Peak | 21.00 | 150 | Horizontal | N/A |
| 2** | 2401.800 | 94.75 | -10.75 | 54.0 | 40.75 | AV | 21.00 | 150 | Horizontal | N/A |
| 3 | 4804.200 | 52.34 | -1.20 | 74.0 | -21.66 | Peak | 360.00 | 150 | Horizontal | Pass |
| 3** | 4804.200 | 49.19 | -1.20 | 54.0 | -4.81 | AV | 360.00 | 150 | Horizontal | Pass |
| 4 | 7206.138 | 51.09 | 17.27 | 74.0 | -22.91 | Peak | 285.00 | 150 | Horizontal | Pass |
| 4** | 7206.138 | 47.64 | 17.27 | 54.0 | -6.36 | AV | 285.00 | 150 | Horizontal | Pass |
| 5 | 12444.387 | 49.01 | 18.71 | 74.0 | -24.99 | Peak | 0.00 | 150 | Horizontal | Pass |
| 5** | 12444.387 | 37.87 | 18.71 | 54.0 | -16.13 | AV | 0.00 | 150 | Horizontal | Pass |
| 6 | 15232.463 | 53.98 | 22.01 | 74.0 | -20.02 | Peak | 193.00 | 150 | Horizontal | Pass |
| 6** | 15232.463 | 43.75 | 22.01 | 54.0 | -10.25 | AV | 193.00 | 150 | Horizontal | Pass |

## GFSK LOW CHANNEL 1 GHz to 18 GHz, ANT V

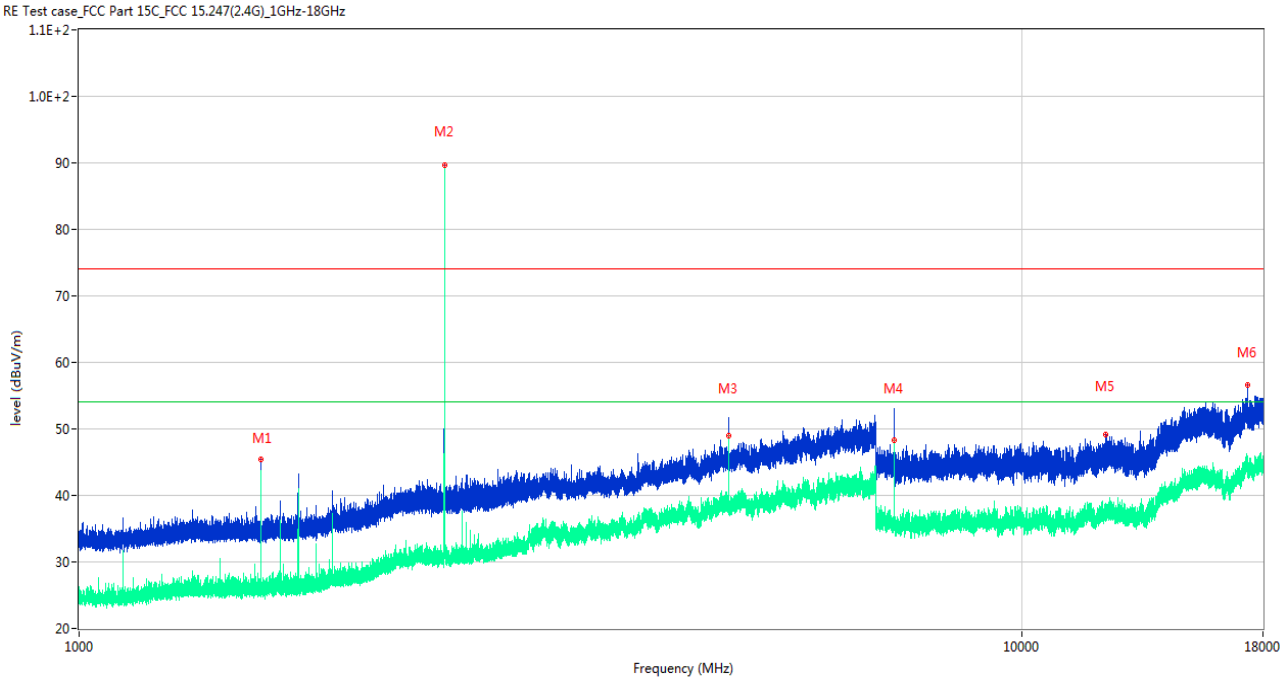
| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Over Limit (dB) | Detector | Table (Degree) | Height (cm) | Antenna | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1559.400 | 45.36 | -15.08 | 74.0 | -28.64 | Peak | 1.00 | 150 | Vertical | Pass |
| 1** | 1559.400 | 43.81 | -15.08 | 54.0 | -10.19 | AV | 1.00 | 150 | Vertical | Pass |
| 2 | 2402.100 | 90.72 | -10.74 | 74.0 | 16.72 | Peak | 43.00 | 150 | Vertical | N/A |
| 2** | 2402.100 | 90.36 | -10.74 | 54.0 | 36.36 | AV | 43.00 | 150 | Vertical | N/A |
| 3 | 4804.600 | 48.16 | -1.18 | 74.0 | -25.84 | Peak | 275.00 | 150 | Vertical | Pass |
| 3** | 4804.600 | 44.23 | -1.18 | 54.0 | -9.77 | AV | 275.00 | 150 | Vertical | Pass |
| 4 | 7206.425 | 49.34 | 17.28 | 74.0 | -24.66 | Peak | 96.00 | 150 | Vertical | Pass |
| 4** | 7206.425 | 44.34 | 17.28 | 54.0 | -9.66 | AV | 96.00 | 150 | Vertical | Pass |
| 5 | 12752.888 | 50.20 | 18.93 | 74.0 | -23.80 | Peak | 188.00 | 150 | Vertical | Pass |
| 5** | 12752.888 | 38.06 | 18.93 | 54.0 | -15.94 | AV | 188.00 | 150 | Vertical | Pass |
| 6 | 17290.463 | 55.36 | 24.55 | 74.0 | -18.64 | Peak | 235.00 | 150 | Vertical | Pass |
| 6** | 17290.463 | 44.53 | 24.55 | 54.0 | -9.47 | AV | 235.00 | 150 | Vertical | Pass |

## GFSK MIDDLE CHANNEL 1 GHz to 18 GHz, ANT H



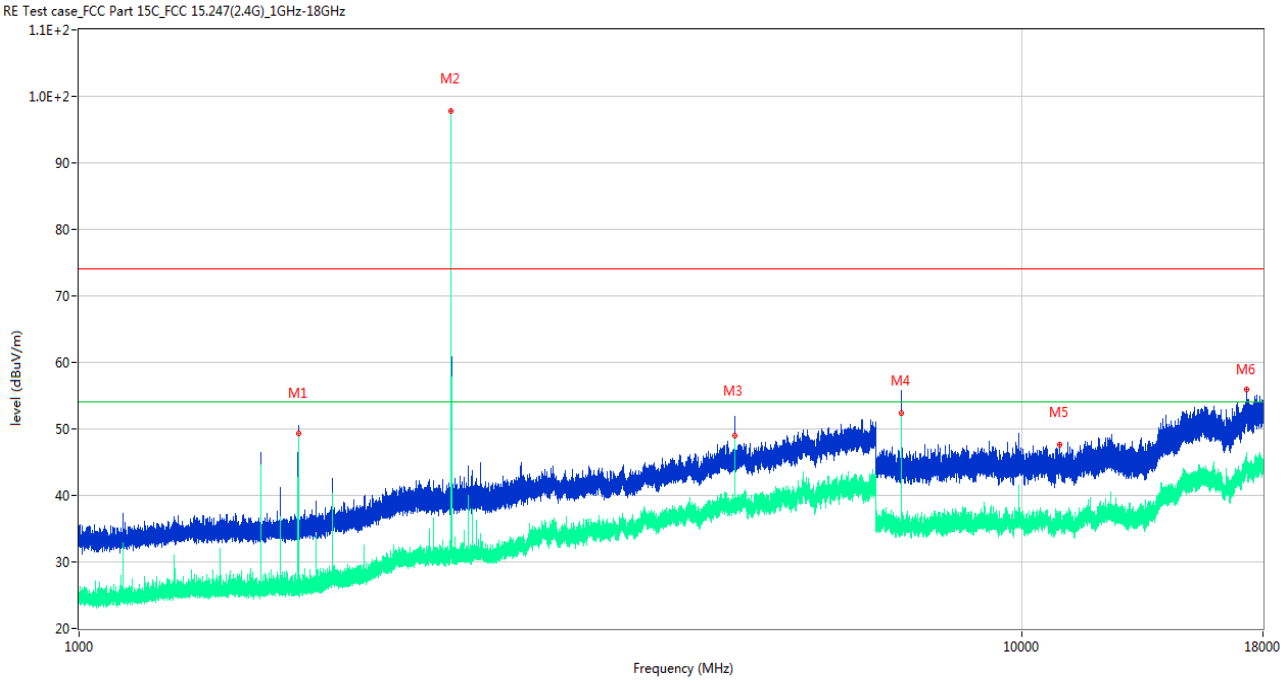

| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Over Limit (dB) | Detector | Table (Degree) | Height (cm) | Antenna | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1707.800 | 49.63 | -14.95 | 74.0 | -24.37 | Peak | 132.00 | 150 | Horizontal | Pass |
| 1** | 1707.800 | 49.06 | -14.95 | 54.0 | -4.94 | AV | 132.00 | 150 | Horizontal | Pass |
| 2 | 2440.800 | 97.91 | -10.52 | 74.0 | 23.91 | Peak | 316.00 | 150 | Horizontal | N/A |
| 2** | 2440.800 | 96.45 | -10.52 | 54.0 | 42.45 | AV | 316.00 | 150 | Horizontal | N/A |
| 3 | 4882.000 | 53.08 | -1.18 | 74.0 | -20.92 | Peak | 221.00 | 150 | Horizontal | Pass |
| 3** | 4882.000 | 50.64 | -1.18 | 54.0 | -3.36 | AV | 221.00 | 150 | Horizontal | Pass |
| 4 | 7323.725 | 54.06 | 16.86 | 74.0 | -19.94 | Peak | 297.00 | 150 | Horizontal | Pass |
| 4** | 7323.725 | 52.36 | 16.86 | 54.0 | -1.64 | AV | 297.00 | 150 | Horizontal | Pass |
| 5 | 11519.500 | 48.27 | 19.44 | 74.0 | -25.73 | Peak | 263.00 | 150 | Horizontal | Pass |
| 5** | 11519.500 | 37.80 | 19.44 | 54.0 | -16.20 | AV | 263.00 | 150 | Horizontal | Pass |
| 6 | 15621.750 | 55.52 | 23.46 | 74.0 | -18.48 | Peak | 238.00 | 150 | Horizontal | Pass |
| 6** | 15621.750 | 42.99 | 23.46 | 54.0 | -11.01 | AV | 238.00 | 150 | Horizontal | Pass |

## GFSK MIDDLE CHANNEL 1 GHz to 18 GHz, ANT V



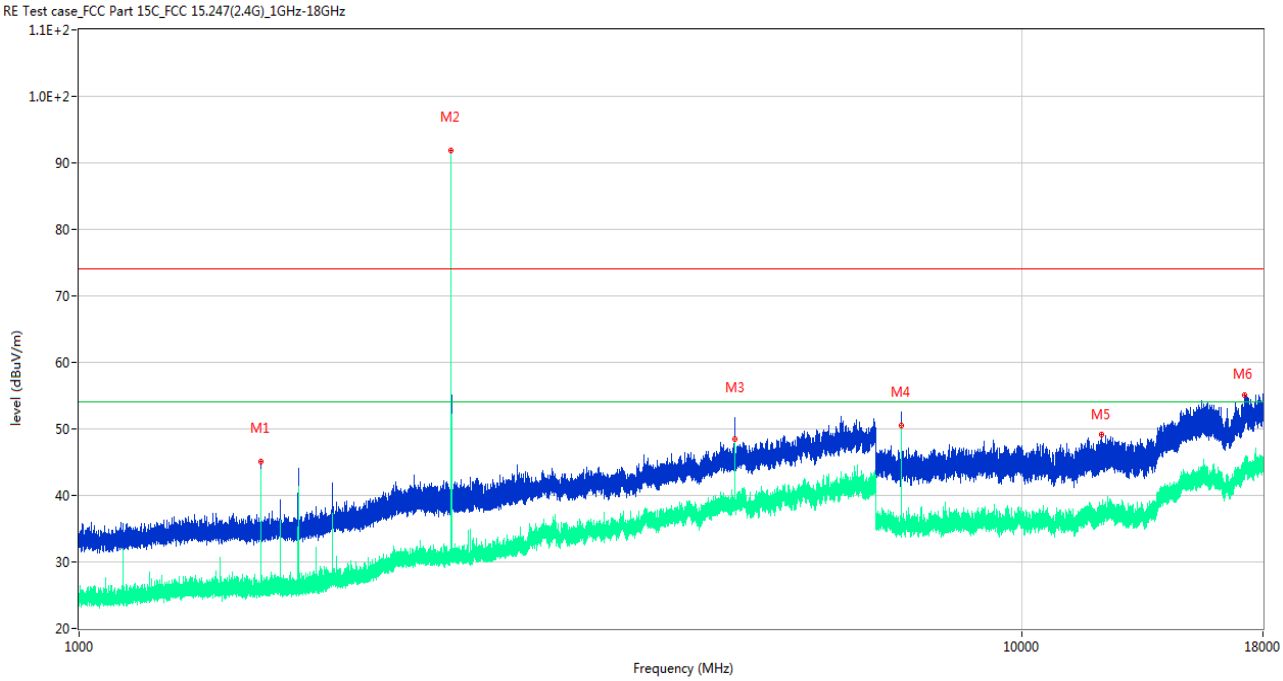

| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Over Limit (dB) | Detector | Table (Degree) | Height (cm) | Antenna | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1559.200 | 45.46 | -15.08 | 74.0 | -28.54 | Peak | 360.00 | 150 | Vertical | Pass |
| 1** | 1559.200 | 43.00 | -15.08 | 54.0 | -11.00 | AV | 360.00 | 150 | Vertical | Pass |
| 2 | 2440.800 | 89.68 | -10.52 | 74.0 | 15.68 | Peak | 47.00 | 150 | Vertical | N/A |
| 2** | 2440.800 | 88.09 | -10.52 | 54.0 | 34.09 | AV | 47.00 | 150 | Vertical | N/A |
| 3 | 4882.200 | 51.64 | -1.18 | 74.0 | -22.36 | Peak | 278.00 | 150 | Vertical | Pass |
| 3** | 4882.200 | 48.95 | -1.18 | 54.0 | -5.05 | AV | 278.00 | 150 | Vertical | Pass |
| 4 | 7323.150 | 50.49 | 16.87 | 74.0 | -23.51 | Peak | 83.00 | 150 | Vertical | Pass |
| 4** | 7323.150 | 48.24 | 16.87 | 54.0 | -5.76 | AV | 83.00 | 150 | Vertical | Pass |
| 5 | 12270.737 | 49.11 | 20.30 | 74.0 | -24.89 | Peak | 307.00 | 150 | Vertical | Pass |
| 5** | 12270.737 | 37.59 | 20.30 | 54.0 | -16.41 | AV | 307.00 | 150 | Vertical | Pass |
| 6 | 17319.862 | 56.61 | 24.32 | 74.0 | -17.39 | Peak | 297.00 | 150 | Vertical | Pass |
| 6** | 17319.862 | 44.93 | 24.32 | 54.0 | -9.07 | AV | 297.00 | 150 | Vertical | Pass |

## GFSK HIGH CHANNEL 1 GHz to 18 GHz, ANT H




| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Over Limit (dB) | Detector | Table (Degree) | Height (cm) | Antenna | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1707.800 | 49.57 | -14.95 | 74.0 | -24.43 | Peak | 137.00 | 150 | Horizontal | Pass |
| 1** | 1707.800 | 49.35 | -14.95 | 54.0 | -4.65 | AV | 137.00 | 150 | Horizontal | Pass |
| 2 | 2479.900 | 97.81 | -10.36 | 74.0 | 23.81 | Peak | 314.00 | 150 | Horizontal | N/A |
| 2** | 2479.900 | 96.92 | -10.36 | 54.0 | 42.92 | AV | 314.00 | 150 | Horizontal | N/A |
| 3 | 4960.200 | 51.89 | -1.72 | 74.0 | -22.11 | Peak | 227.00 | 150 | Horizontal | Pass |
| 3** | 4960.200 | 48.91 | -1.72 | 54.0 | -5.09 | AV | 227.00 | 150 | Horizontal | Pass |
| 4 | 7439.875 | 54.09 | 17.01 | 74.0 | -19.91 | Peak | 285.00 | 150 | Horizontal | Pass |
| 4** | 7439.875 | 52.41 | 17.01 | 54.0 | -1.59 | AV | 285.00 | 150 | Horizontal | Pass |
| 5 | 10959.450 | 47.61 | 18.71 | 74.0 | -26.39 | Peak | 2.00 | 150 | Horizontal | Pass |
| 5** | 10959.450 | 36.01 | 18.71 | 54.0 | -17.99 | AV | 2.00 | 150 | Horizontal | Pass |
| 6 | 17290.199 | 55.97 | 24.55 | 74.0 | -18.03 | Peak | 27.00 | 150 | Horizontal | Pass |
| 6** | 17290.199 | 43.90 | 24.55 | 54.0 | -10.10 | AV | 27.00 | 150 | Horizontal | Pass |

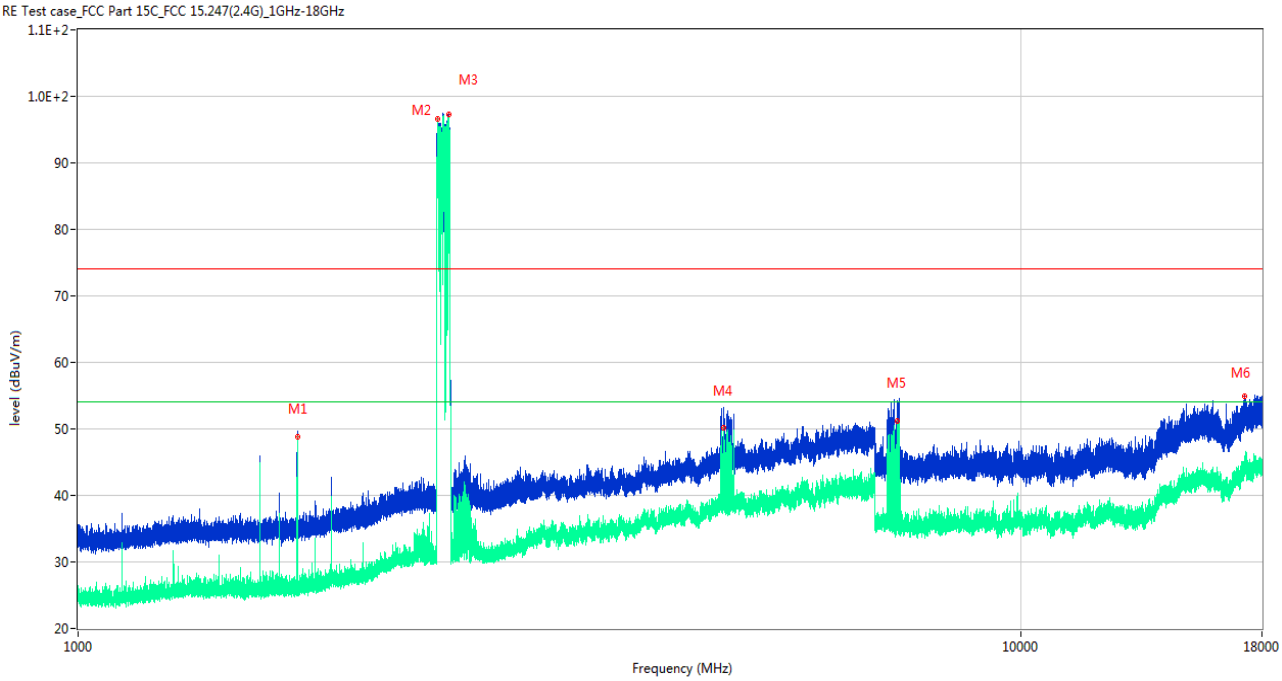
## GFSK HIGH CHANNEL 1 GHz to 18 GHz, ANT V




| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Over Limit (dB) | Detector | Table (Degree) | Height (cm) | Antenna | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1559.300 | 45.09 | -15.08 | 74.0 | -28.91 | Peak | 360.00 | 150 | Vertical | Pass |
| 1** | 1559.300 | 43.93 | -15.08 | 54.0 | -10.07 | AV | 360.00 | 150 | Vertical | Pass |
| 2 | 2479.800 | 91.91 | -10.36 | 74.0 | 17.91 | Peak | 24.00 | 150 | Vertical | N/A |
| 2** | 2479.800 | 91.03 | -10.36 | 54.0 | 37.03 | AV | 24.00 | 150 | Vertical | N/A |
| 3 | 4960.200 | 51.74 | -1.72 | 74.0 | -22.26 | Peak | 287.00 | 150 | Vertical | Pass |
| 3** | 4960.200 | 48.48 | -1.72 | 54.0 | -5.52 | AV | 287.00 | 150 | Vertical | Pass |
| 4 | 7439.875 | 51.85 | 17.01 | 74.0 | -22.15 | Peak | 91.00 | 150 | Vertical | Pass |
| 4** | 7439.875 | 50.51 | 17.01 | 54.0 | -3.49 | AV | 91.00 | 150 | Vertical | Pass |
| 5 | 12133.599 | 49.08 | 19.78 | 74.0 | -24.92 | Peak | 125.00 | 150 | Vertical | Pass |
| 5** | 12133.599 | 37.33 | 19.78 | 54.0 | -16.67 | AV | 125.00 | 150 | Vertical | Pass |
| 6 | 17203.313 | 55.12 | 23.83 | 74.0 | -18.88 | Peak | 241.00 | 150 | Vertical | Pass |
| 6** | 17203.313 | 43.28 | 23.83 | 54.0 | -10.72 | AV | 241.00 | 150 | Vertical | Pass |

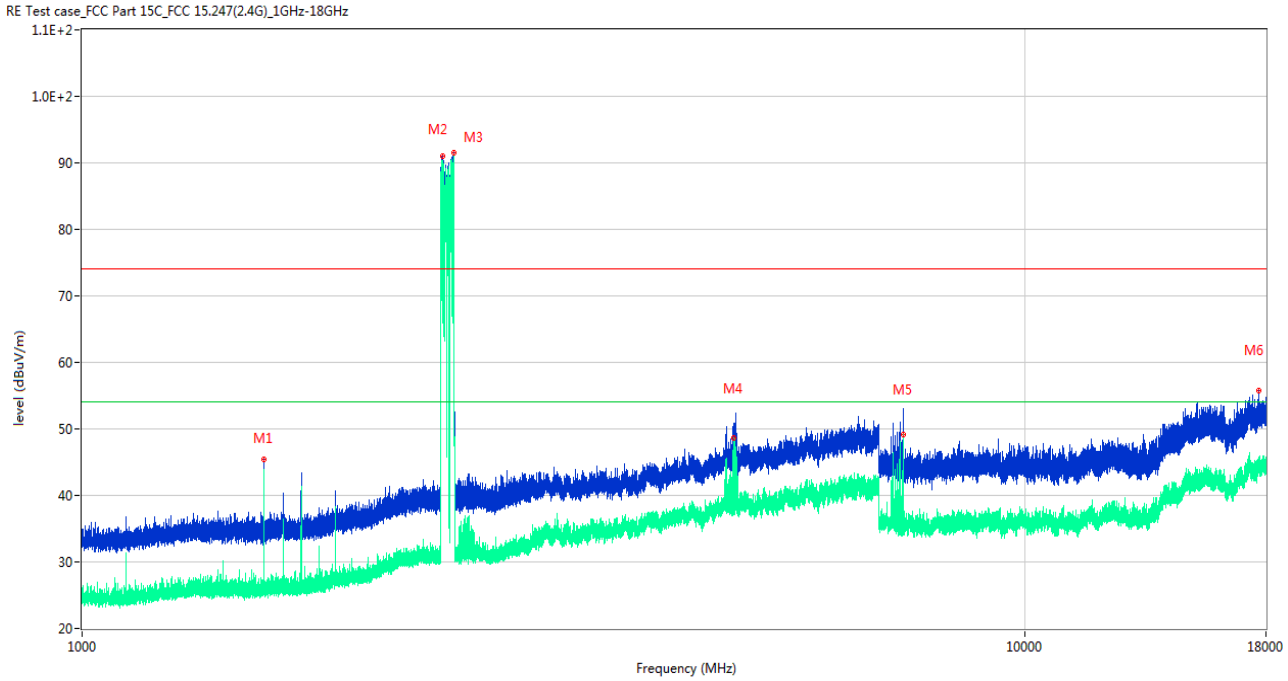
Hopping Mode:

GFSK MODE 1 GHz to 18 GHz, ANT H




| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Over Limit (dB) | Detector | Table (Degree) | Height (cm) | Antenna | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1707.900 | 49.16 | -14.95 | 74.0 | -24.84 | Peak | 134.00 | 150 | Horizontal | Pass |
| 1** | 1707.900 | 48.87 | -14.95 | 54.0 | -5.13 | AV | 134.00 | 150 | Horizontal | Pass |
| 2 | 2407.700 | 96.88 | -10.60 | 74.0 | 22.88 | Peak | 22.00 | 150 | Horizontal | N/A |
| 2** | 2407.700 | 93.94 | -10.60 | 54.0 | 39.94 | AV | 22.00 | 150 | Horizontal | N/A |
| 3 | 2470.800 | 97.30 | -10.74 | 74.0 | 23.30 | Peak | 22.00 | 150 | Horizontal | N/A |
| 3** | 2470.800 | 95.21 | -10.74 | 54.0 | 41.21 | AV | 22.00 | 150 | Horizontal | N/A |
| 4 | 4840.400 | 51.38 | -1.32 | 74.0 | -22.62 | Peak | 228.00 | 150 | Horizontal | Pass |
| 4** | 4840.400 | 50.19 | -1.32 | 54.0 | -3.81 | AV | 228.00 | 150 | Horizontal | Pass |
| 5 | 7395.313 | 53.94 | 16.91 | 74.0 | -20.06 | Peak | 285.00 | 150 | Horizontal | Pass |
| 5** | 7395.313 | 51.27 | 16.91 | 54.0 | -2.73 | AV | 285.00 | 150 | Horizontal | Pass |
| 6 | 17244.525 | 54.97 | 24.20 | 74.0 | -19.03 | Peak | 0.00 | 150 | Horizontal | Pass |
| 6** | 17244.525 | 45.08 | 24.20 | 54.0 | -8.92 | AV | 0.00 | 150 | Horizontal | Pass |

## GFSK MODE 1 GHz to 18 GHz, ANT V




| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Over Limit (dB) | Detector | Table (Degree) | Height (cm) | Antenna | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1559.200 | 45.39 | -15.08 | 74.0 | -28.61 | Peak | 361.00 | 150 | Vertical | Pass |
| 1** | 1559.200 | 43.37 | -15.08 | 54.0 | -10.63 | AV | 361.00 | 150 | Vertical | Pass |
| 2 | 2410.900 | 90.94 | -10.38 | 74.0 | 16.94 | Peak | 71.00 | 150 | Vertical | N/A |
| 2** | 2410.900 | 89.65 | -10.38 | 54.0 | 35.65 | AV | 71.00 | 150 | Vertical | N/A |
| 3 | 2475.800 | 91.54 | -10.49 | 74.0 | 17.54 | Peak | 26.00 | 150 | Vertical | N/A |
| 3** | 2475.800 | 87.89 | -10.49 | 54.0 | 33.89 | AV | 26.00 | 150 | Vertical | N/A |
| 4 | 4912.400 | 49.99 | -0.94 | 74.0 | -24.01 | Peak | 276.00 | 150 | Vertical | Pass |
| 4** | 4912.400 | 48.62 | -0.94 | 54.0 | -5.38 | AV | 276.00 | 150 | Vertical | Pass |
| 5 | 7434.413 | 51.68 | 17.18 | 74.0 | -22.32 | Peak | 68.00 | 150 | Vertical | Pass |
| 5** | 7434.413 | 49.07 | 17.18 | 54.0 | -4.93 | AV | 68.00 | 150 | Vertical | Pass |
| 6 | 17679.749 | 55.74 | 24.44 | 74.0 | -18.26 | Peak | 63.00 | 150 | Vertical | Pass |
| 6** | 17679.749 | 44.25 | 24.44 | 54.0 | -9.75 | AV | 63.00 | 150 | Vertical | Pass |

## A.9 Band Edge (Restricted-band band-edge)

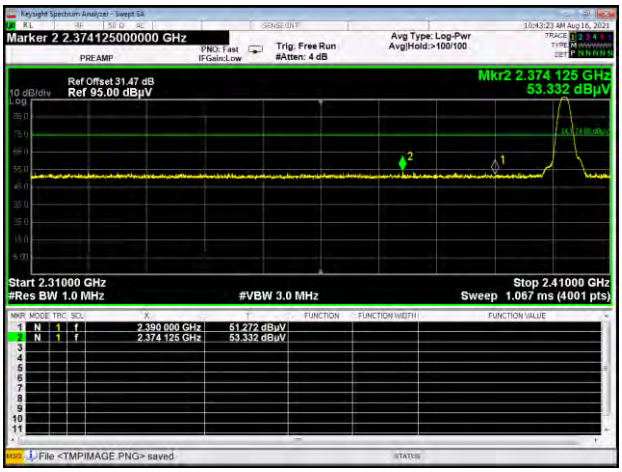
Note [1]: The lowest and highest channels are tested to verify the band edge emissions. Please refer to the following the plots for emissions values.
Note [2]: The test data all are tested in the vertical and horizontal antenna which the trace is max hold. So these plots have shown the worst case.
Note [3]: According the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.
Note [4]: The Level (dBuV/m) has been corrected by factor.

Test Data

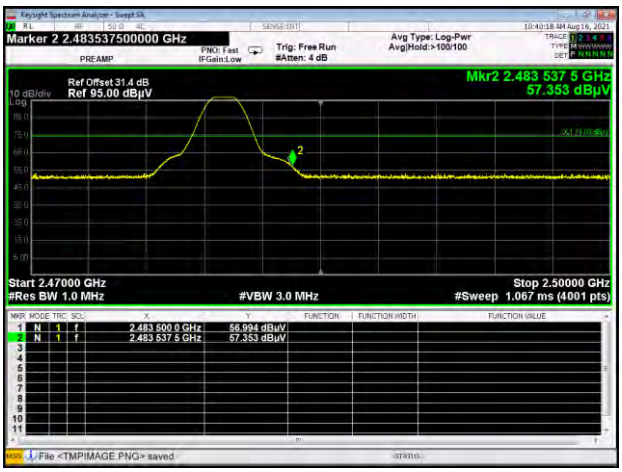
| Test Mode | Test Channel | Frequency (MHz) | Level (dBuV/m) | Factor (dB) | Limit Line (dBuV/m) | Margin (dB) | Remark | Verdict |
|---|---|---|---|---|---|---|---|---|
| GFSK | Low | 2390.00 | 53.332 | 31.47 | 74 | 20.668 | PEAK | Pass |
| | | 2390.00 | N/A | N/A | 54 | N/A | AVERAGE | Pass |
| GFSK | HIGH | 2483.50 | 57.353 | 31.40 | 74 | 16.647 | PEAK | Pass |
| | | 2483.50 | 49.776 | 31.40 | 54 | 4.224 | AVERAGE | Pass |
| GFSK(Hopping) | Low | 2390.00 | 53.388 | 31.47 | 74 | 20.612 | PEAK | Pass |
| | | 2390.00 | N/A | N/A | 54 | N/A | AVERAGE | Pass |
| GFSK(Hopping) | HIGH | 2483.50 | 56.100 | 31.40 | 74 | 17.900 | PEAK | Pass |
| | | 2483.50 | 44.796 | 31.40 | 54 | 9.204 | AVERAGE | Pass |

Test Plots

GFSK LOW CHANNEL, PEAK




GFSK HIGH CHANNEL, PEAK

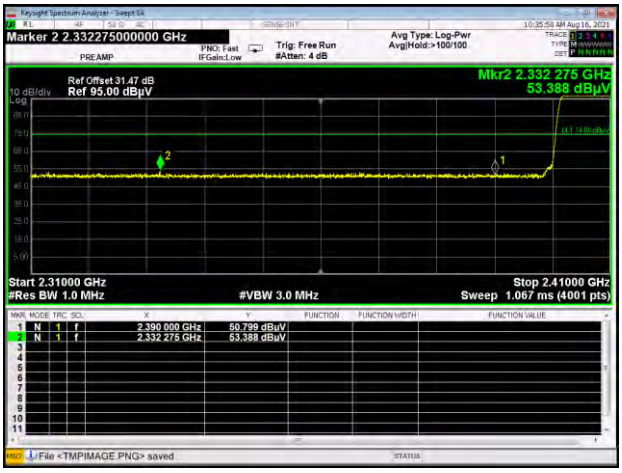


GFSK HIGH CHANNEL, AV

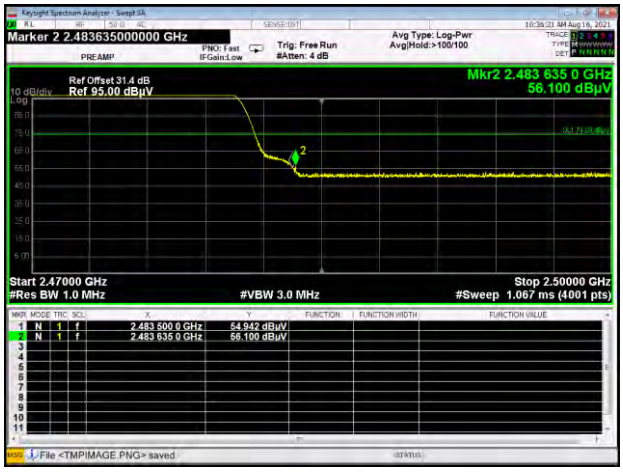
GFSK HIGH CHANNEL, AV

Hopping Mode:

GFSK LOW CHANNEL, PEAK




GFSK HIGH CHANNEL, PEAK




GFSK HIGH CHANNEL, AV

GFSK HIGH CHANNEL, AV

# ANNEX B TEST SETUP PHOTOS

Please refer the document “BL-SZ2130159-AR.PDF”.

# ANNEX C EUT EXTERNAL PHOTOS

Please refer the document “BL-SZ2130159-AW.PDF”.

# ANNEX D EUT INTERNAL PHOTOS

Please refer the document “BL-SZ2130159-AI.PDF”.

--END OF REPORT--