**SGS-CSTC Standards Technical Services Co., Ltd.**
**Shenzhen Branch**

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Email: ee.shenzhen@sgs.com



# FCC REPORT

| | |
|---|---|
| **Application No:** | SZEM1611009296CR |
| **Applicant:** | Million Concept Electronic (Shenzhen) Co., Ltd |
| **Manufacturer:** | Million Concept Electronic (Shenzhen) Co., Ltd |
| **Factory:** | Million Concept Electronic (Shenzhen) Co., Ltd |
| **Product Name:** | Bluetooth Heart Rate Wristband |
| **Model No.(EUT):** | W311 |
| **Add Model No.:** | iSport 5Pro |
| **FCC ID:** | OVJ-W311 |
| **Standards:** | 47 CFR Part 15, Subpart C (2015) |
| **Date of Receipt:** | 2016-11-02 |
| **Date of Test:** | 2016-11-03 to 2016-11-08 |
| **Date of Issue:** | 2016-11-10 |
| **Test Result:** | **PASS *** |

* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:

Jack Zhang
EMC Laboratory Manager

The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or testing done by SGS International Electrical Approvals in connection with, distribution or use of the product described in this report must be approved by SGS International Electrical Approvals in writing.
The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government. All test results in this report can be traceable to National or International Standards.

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# 2 Version

| Revision Record | | | | |
|---|---|---|---|---|
| **Version** | **Chapter** | **Date** | **Modifier** | **Remark** |
| 00 | | 2016-11-10 | | Original |
| | | | | |
| | | | | |

| | | | | |
|---|---|---|---|---|
| **Authorized for issue by:** | | | | |
| **Tested By** | | Edison Li<br>**(Edison Li) /Project Engineer** | | 2016-11-08<br>**Date** |
| **Checked By** | | Eric Fu<br>**(Eric Fu) /Reviewer** | | 2016-11-10<br>**Date** |

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# 3 Test Summary

| Test Item | Test Requirement | Test method | Result |
|---|---|---|---|
| **Antenna Requirement** | 47 CFR Part 15, Subpart C Section 15.203/15.247 (c) | ANSI C63.10 2013 | PASS |
| **AC Power Line Conducted Emission** | 47 CFR Part 15, Subpart C Section 15.207 | ANSI C63.10 2013 | PASS |
| **Conducted Peak Output Power** | 47 CFR Part 15, Subpart C Section 15.247 (b)(3) | ANSI C63.10 2013 | PASS |
| **6dB Occupied Bandwidth** | 47 CFR Part 15, Subpart C Section 15.247 (a)(2) | ANSI C63.10 2013 | PASS |
| **Power Spectral Density** | 47 CFR Part 15, Subpart C Section 15.247 (e) | ANSI C63.10 2013 | PASS |
| **Band-edge for RF Conducted Emissions** | 47 CFR Part 15, Subpart C Section 15.247(d) | ANSI C63.10 2013 | PASS |
| **RF Conducted Spurious Emissions** | 47 CFR Part 15, Subpart C Section 15.247(d) | ANSI C63.10 2013 | PASS |
| **Radiated Spurious Emissions** | 47 CFR Part 15, Subpart C Section 15.205/15.209 | ANSI C63.10 2013 | PASS |
| **Restricted bands around fundamental frequency (Radiated Emission)** | 47 CFR Part 15, Subpart C Section 15.205/15.209 | ANSI C63.10 2013 | PASS |

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# 5 General Information

## 5.1 Client Information

| | |
|---|---|
| Applicant: | Million Concept Electronic (Shenzhen) Co., Ltd |
| Address of Applicant: | No.98, Xiashanmen Road, Songgang Town, Bao'an District, Shenzhen, China |
| Manufacturer: | Million Concept Electronic (Shenzhen) Co., Ltd |
| Address of Manufacturer: | No.98, Xiashanmen Road, Songgang Town, Bao'an District, Shenzhen, China |
| Factory: | Million Concept Electronic (Shenzhen) Co., Ltd |
| Address of Factory: | No.98, Xiashanmen Road, Songgang Town, Bao'an District, Shenzhen, China |

## 5.2 General Description of EUT

| | |
|---|---|
| Product Name: | Bluetooth Heart Rate Wristband |
| Model No.: | W311 |
| Operation Frequency: | 2402MHz~2480MHz |
| Bluetooth Version: | Bluetooth V4.0 single mode |
| Modulation Type: | GFSK |
| Number of Channel: | 40 |
| Antenna Type: | PCB Antenna |
| Antenna Gain: | 0dBi |
| Power Supply: | DC 3.7V,150mAh |
| Test Voltage: | DC 3.7V |
| USB cable: | 20cm unshielded(charge only) |

**Remark:**

Model No.: W311, iSport 5Pro

Only the model W311 was tested, since the circuitry design, PCB layout, electrical components used, internal wiring and functions were identical for all above models. Only different on model name.

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| Operation Frequency each of channel | | | | | | | |
|---|---|---|---|---|---|---|---|
| Channel | Frequency | Channel | Frequency | Channel | Frequency | Channel | Frequency |
| 0 | 2402MHz | 10 | 2422MHz | 20 | 2442MHz | 30 | 2462MHz |
| 1 | 2404MHz | 11 | 2424MHz | 21 | 2444MHz | 31 | 2464MHz |
| 2 | 2406MHz | 12 | 2426MHz | 22 | 2446MHz | 32 | 2466MHz |
| 3 | 2408MHz | 13 | 2428MHz | 23 | 2448MHz | 33 | 2468MHz |
| 4 | 2410MHz | 14 | 2430MHz | 24 | 2450MHz | 34 | 2470MHz |
| 5 | 2412MHz | 15 | 2432MHz | 25 | 2452MHz | 35 | 2472MHz |
| 6 | 2414MHz | 16 | 2434MHz | 26 | 2454MHz | 36 | 2474MHz |
| 7 | 2416MHz | 17 | 2436MHz | 27 | 2456MHz | 37 | 2476MHz |
| 8 | 2418MHz | 18 | 2438MHz | 28 | 2458MHz | 38 | 2478MHz |
| 9 | 2420MHz | 19 | 2440MHz | 29 | 2460MHz | 39 | 2480MHz |

Note:
In section 15.31(m), regards to the operating frequency range over 10 MHz, the lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

| Channel | Frequency |
|---|---|
| The lowest channel (CH0) | 2402MHz |
| The middle channel (CH19) | 2440MHz |
| The highest channel (CH39) | 2480MHz |

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## 5.3 Test Environment

| Operating Environment: | |
|---|---|
| Temperature: | 25.0 °C |
| Humidity: | 53 % RH |
| Atmospheric Pressure: | 1010mbar |

## 5.4 Description of Support Units

The EUT has been tested with associated equipment below.

| Description | Manufacturer | Model No. |
|---|---|---|
| Adapter | Apple | A1357 W010A051 |

## 5.5 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen Branch
No. 1 Workshop, M-10, Middle Section, Science & Technology Park, Shenzhen, Guangdong, China. 518057.
Tel: +86 755 2601 2053 Fax: +86 755 2671 0594
No tests were sub-contracted.

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## 5.6 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

• **CNAS (No. CNAS L2929)**

CNAS has accredited SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

• **A2LA (Certificate No. 3816.01)**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

• **VCCI**

The 10m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-823, R-4188, T-1153 and C-2383 respectively.

• **FCC – Registration No.: 556682**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration No.: 556682.

• **Industry Canada (IC)**

Two 3m Semi-anechoic chambers and the 10m Semi-anechoic chamber of SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab have been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 4620C-1, 4620C-2, 4620C-3.

## 5.7 Deviation from Standards

None.

## 5.8 Abnormalities from Standard Conditions

None.

## 5.9 Other Information Requested by the Customer

None.

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## 5.10 Equipment List

| Conducted Emission | | | | | | |
|---|---|---|---|---|---|---|
| **Item** | **Test Equipment** | **Manufacturer** | **Model No.** | **Inventory No.** | **Cal. date (yyyy-mm-dd)** | **Cal.Due date (yyyy-mm-dd)** |
| 1 | Shielding Room | ZhongYu Electron | GB-88 | SEM001-06 | 2016-05-13 | 2017-05-13 |
| 2 | LISN | Rohde & Schwarz | ENV216 | SEM007-01 | 2016-10-09 | 2017-10-09 |
| 3 | LISN | ETS-LINDGREN | 3816/2 | SEM007-02 | 2016-04-25 | 2017-04-25 |
| 4 | 8 Line ISN | Fischer Custom Communications Inc. | FCC-TLISN-T8-02 | EMC0120 | 2016-09-28 | 2017-09-28 |
| 5 | 4 Line ISN | Fischer Custom Communications Inc. | FCC-TLISN-T4-02 | EMC0121 | 2016-09-28 | 2017-09-28 |
| 6 | 2 Line ISN | Fischer Custom Communications Inc. | FCC-TLISN-T2-02 | EMC0122 | 2016-09-28 | 2017-09-28 |
| 7 | EMI Test Receiver | Rohde & Schwarz | ESCI | SEM004-02 | 2016-04-25 | 2017-04-25 |
| 8 | DC Power Supply | Zhao Xin | RXN-305D | SEM011-02 | 2016-10-09 | 2017-10-09 |

| RF connected test | | | | | | |
|---|---|---|---|---|---|---|
| **Item** | **Test Equipment** | **Manufacturer** | **Model No.** | **Inventory No.** | **Cal. date (yyyy-mm-dd)** | **Cal.Due date (yyyy-mm-dd)** |
| 1 | DC Power Supply | ZhaoXin | RXN-305D | SEM011-02 | 2016-10-09 | 2017-10-09 |
| 2 | Spectrum Analyzer | Rohde & Schwarz | FSP | SEM004-06 | 2016-10-09 | 2017-10-09 |
| 3 | Signal Generator | Rohde & Schwarz | SML03 | SEM006-02 | 2016-04-25 | 2017-04-25 |
| 4 | Power Meter | Rohde & Schwarz | NRVS | SEM014-02 | 2016-10-09 | 2017-10-09 |

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| RE in Chamber | | | | | | |
|---|---|---|---|---|---|---|
| **Item** | **Test Equipment** | **Manufacturer** | **Model No.** | **Inventory No.** | **Cal. Date (yyyy-mm-dd)** | **Cal. Due date (yyyy-mm-dd)** |
| 1 | 3m Semi-Anechoic Chamber | ETS-LINDGREN | N/A | SEM001-01 | 2016-05-13 | 2017-05-13 |
| 2 | EMI Test Receiver | Agilent Technologies | N9038A | SEM004-05 | 2016-10-09 | 2017-10-09 |
| 3 | BiConiLog Antenna (26-3000MHz) | ETS-LINDGREN | 3142C | SEM003-01 | 2014-11-01 | 2017-11-01 |
| 4 | Double-ridged horn (1-18GHz) | ETS-LINDGREN | 3117 | SEM003-11 | 2015-10-17 | 2018-10-17 |
| 5 | Horn Antenna (18-26GHz) | ETS-LINDGREN | 3160 | SEM003-12 | 2014-11-24 | 2017-11-24 |
| 6 | Pre-amplifier (0.1-1300MHz) | Agilent Technologies | 8447D | SEM005-01 | 2016-04-25 | 2017-04-25 |
| 7 | Band filter | Amindeon | Asi 3314 | SEM023-01 | N/A | N/A |
| 8 | DC Power Supply | Zhao Xin | RXN-305D | SEM011-02 | 2016-10-09 | 2017-10-09 |
| 9 | Loop Antenna | Beijing Daze | ZN30401 | SEM003-09 | 2015-05-13 | 2018-05-13 |

| RE in Chamber | | | | | | |
|---|---|---|---|---|---|---|
| **Item** | **Test Equipment** | **Manufacturer** | **Model No.** | **Inventory No.** | **Cal. Date (yyyy-mm-dd)** | **Cal. Due date (yyyy-mm-dd)** |
| 1 | 3m Semi-Anechoic Chamber | AUDIX | N/A | SEM001-02 | 2016-05-13 | 2017-05-13 |
| 2 | EMI Test Receiver | Rohde & Schwarz | ESIB26 | SEM004-04 | 2016-04-25 | 2017-04-25 |
| 3 | BiConiLog Antenna (26-3000MHz) | ETS-Lindgren | 3142C | SEM003-02 | 2014-11-15 | 2017-11-15 |
| 4 | Amplifier (0.1-1300MHz) | HP | 8447D | SEM005-02 | 2016-10-09 | 2017-10-09 |
| 5 | Horn Antenna (1-18GHz) | Rohde & Schwarz | HF907 | SEM003-07 | 2015-06-14 | 2018-06-14 |
| 6 | Horn Antenna (18-26GHz) | ETS-Lindgren | 3160 | SEM003-12 | 2014-11-24 | 2017-11-24 |
| 7 | Horn Antenna(26GHz-40GHz) | A.H.Systems, inc. | SAS-573 | SEM003-13 | 2015-02-12 | 2018-02-12 |
| 8 | Low Noise Amplifier | Black Diamond Series | BDLNA-0118-352810 | SEM005-05 | 2016-10-09 | 2017-10-09 |
| 9 | Band filter | Amindeon | Asi 3314 | SEM023-01 | N/A | N/A |

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# 6 Test results and Measurement Data

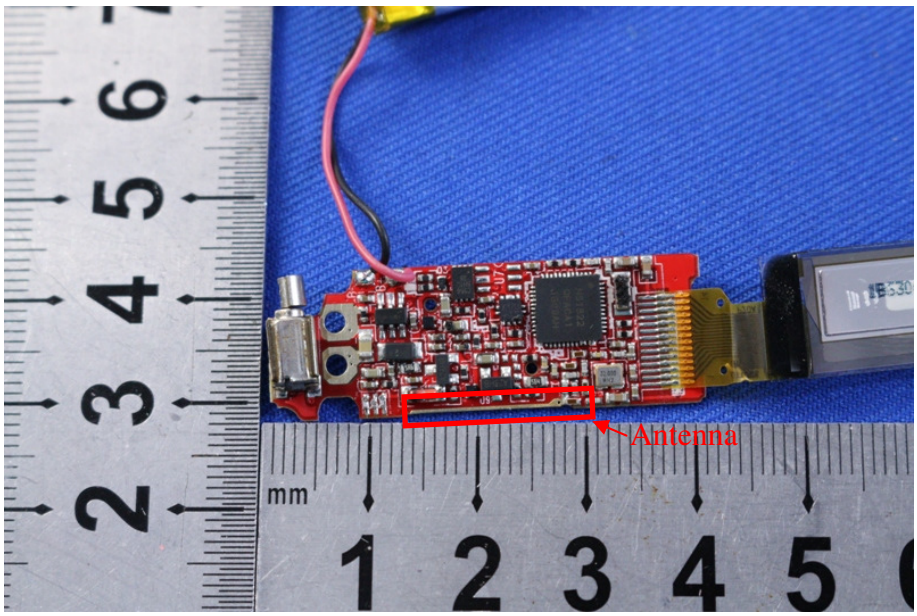
## 6.1 Antenna Requirement

| **Standard requirement:** | 47 CFR Part 15C Section 15.203 /247(c) |
|---|---|

15.203 requirement:
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, 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.
15.247(b) (4) requirement:
The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

| **EUT Antenna:** | |
|---|---|

The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 0dBi.

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## 6.2 Conducted Emissions

| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.207 |
| Test Method: | ANSI C63.10: 2013 |
| Test Frequency Range: | 150kHz to 30MHz |
| Limit: | |

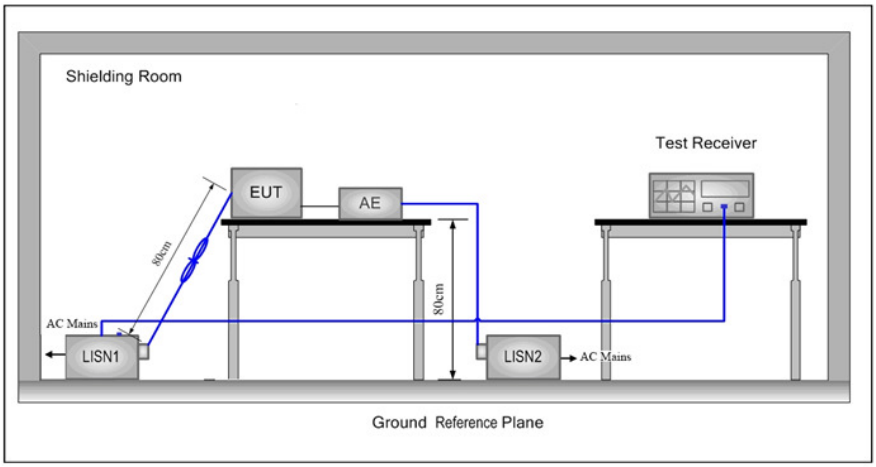
| Frequency range (MHz) | Limit (dBuV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56* | 56 to 46* |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

* Decreases with the logarithm of the frequency.

**Test Procedure:**

1) The mains terminal disturbance voltage test was conducted in a shielded room.
2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50Ω/50μH + 5Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane.
4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.
5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10: 2013 on conducted measurement.

**Test Setup:**




**Test Mode:**

Transmitting with GFSK modulation.
Charge +Transmitting mode.

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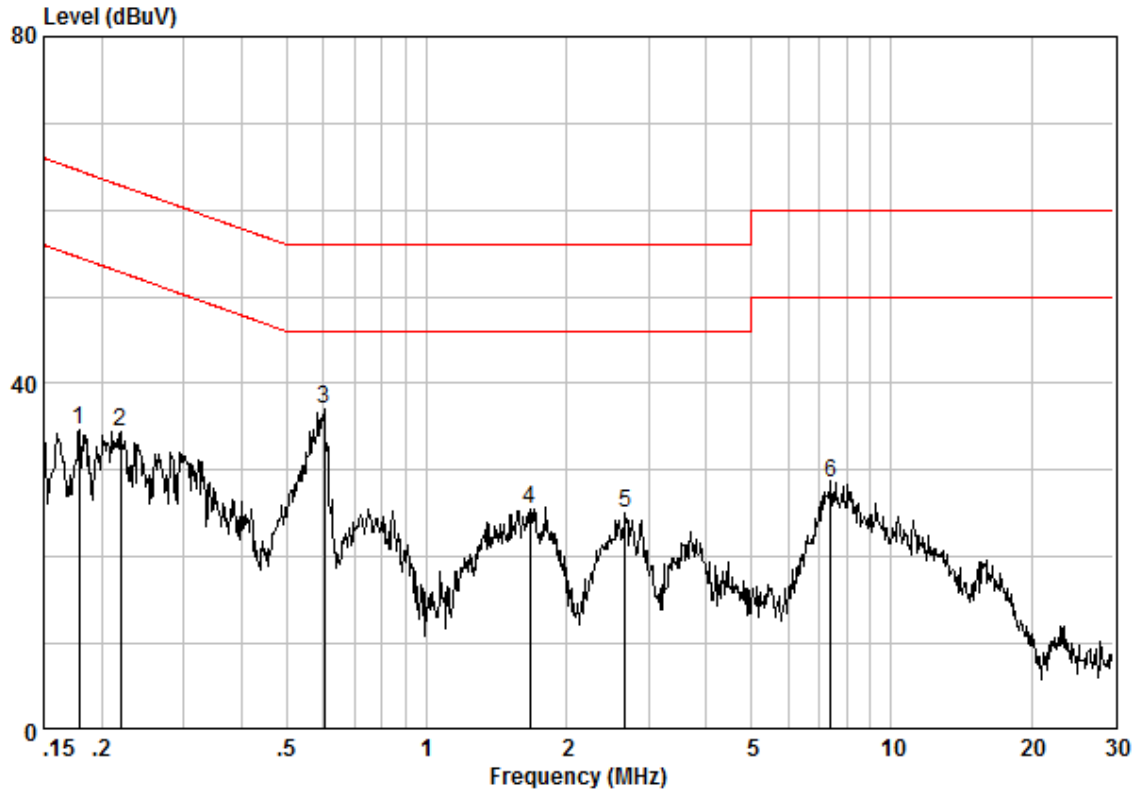
| Instruments Used: | Refer to section 5.10 for details. |
|---|---|
| Test Results: | Pass |

**Measurement Data**

An initial pre-scan was performed on the live and neutral lines with peak detector.

Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

Live line:




Site : Shielding Room
Condition : CE LINE
Job No. : 9296CR
Test Mode : Charge+TX

| | Freq | Cable Loss | LISN Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB | dBuV | dBuV | dBuV | dB | |
| 1 | 0.17866 | 0.02 | 9.60 | 25.00 | 34.62 | 54.55 | -19.93 | Peak |
| 2 | 0.21967 | 0.02 | 9.60 | 24.87 | 34.49 | 52.83 | -18.35 | Peak |
| 3 @ | 0.60112 | 0.02 | 9.61 | 27.41 | 37.04 | 46.00 | -8.96 | Peak |
| 4 | 1.671 | 0.03 | 9.60 | 15.86 | 25.49 | 46.00 | -20.51 | Peak |
| 5 | 2.678 | 0.03 | 9.62 | 15.44 | 25.08 | 46.00 | -20.92 | Peak |
| 6 | 7.407 | 0.09 | 9.68 | 18.88 | 28.66 | 50.00 | -21.34 | Peak |

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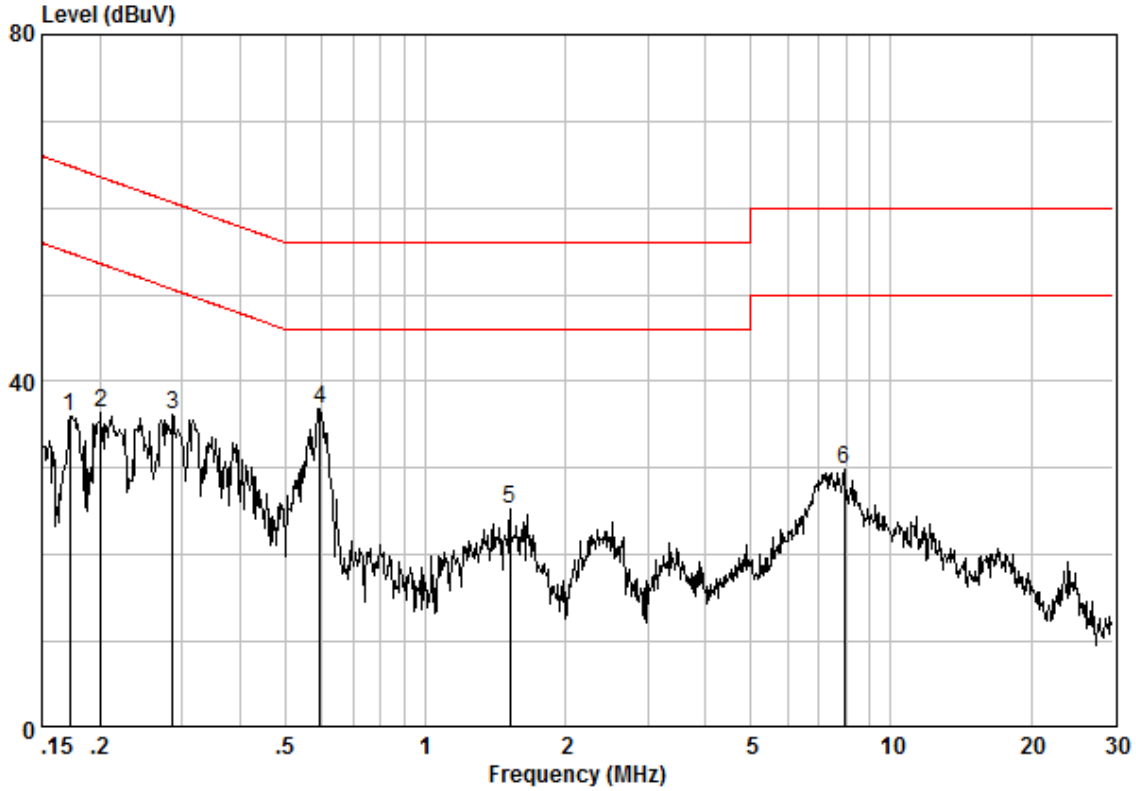
Neutral line:




Site : Shielding Room
Condition : CE NEUTRAL
Job No. : 9296CR
Test Mode : Charge+TX

| | Freq | Cable Loss | LISN Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB | dBuV | dBuV | dBuV | dB | |
| 1 | 0.17215 | 0.02 | 9.60 | 26.42 | 36.04 | 54.86 | -18.81 | Peak |
| 2 | 0.20075 | 0.02 | 9.62 | 26.72 | 36.36 | 53.58 | -17.22 | Peak |
| 3 | 0.28630 | 0.02 | 9.62 | 26.48 | 36.11 | 50.63 | -14.52 | Peak |
| 4 | 0.59478 | 0.02 | 9.63 | 27.23 | 36.88 | 46.00 | -9.12 | Peak |
| 5 | 1.519 | 0.03 | 9.64 | 15.66 | 25.33 | 46.00 | -20.67 | Peak |
| 6 | 7.935 | 0.10 | 9.76 | 20.07 | 29.93 | 50.00 | -20.07 | Peak |

*Notes:*

*1. The following Quasi-Peak and Average measurements were performed on the EUT:*

*2. Final Test Level =Receiver Reading + LISN Factor + Cable Loss.*

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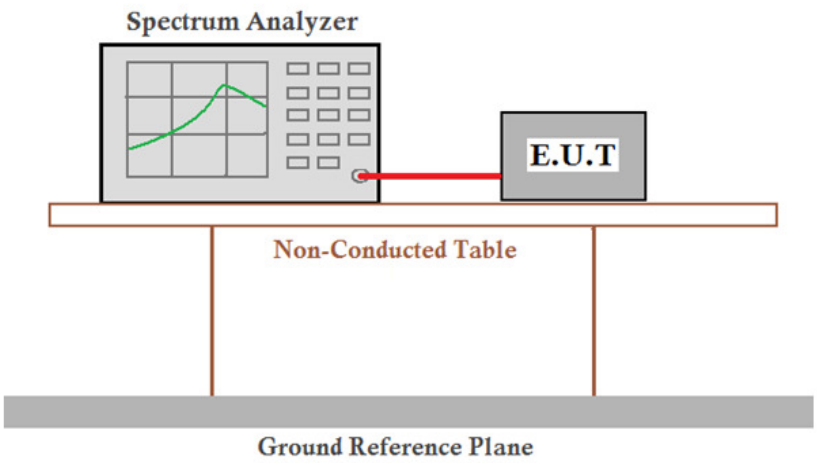
## 6.3 Conducted Peak Output Power

| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (b)(1) |
| Test Method: | ANSI C63.10 :2013 Section 11.9.1 |
| Test Setup: |  <br>*Remark:*<br>*Offset the High-Frequency cable loss 1.5dB in the spectrum analyzer.* |
| Limit: | 30dBm |
| Test Mode: | Transmitting with GFSK modulation. |
| Instruments Used: | Refer to section 5.10 for details. |
| Test Results: | Pass |

**Measurement Data**

| GFSK mode | | | |
|---|---|---|---|
| Test channel | Peak Output Power (dBm) | Limit (dBm) | Result |
| Lowest | -2.64 | ≤30.00 | Pass |
| Middle | -3.25 | ≤30.00 | Pass |
| Highest | -4.59 | ≤30.00 | Pass |

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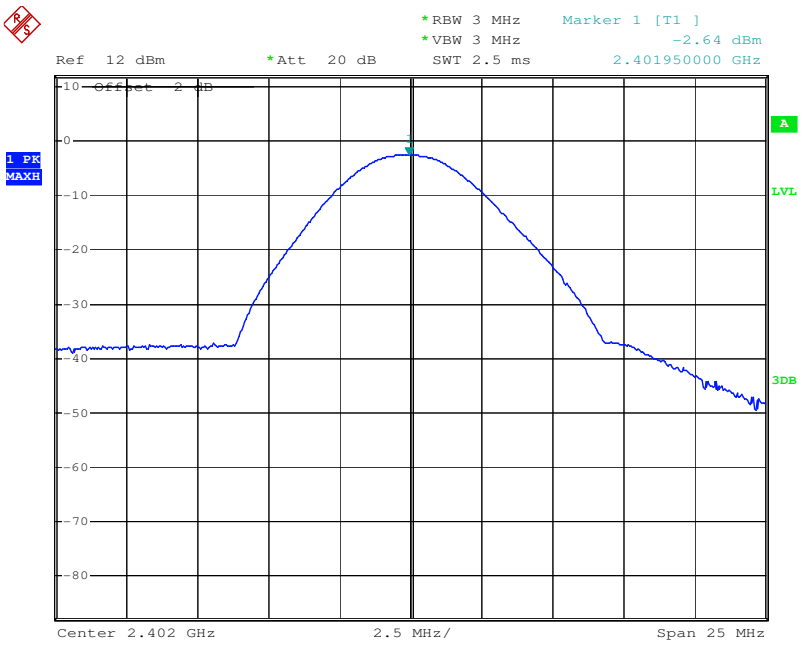
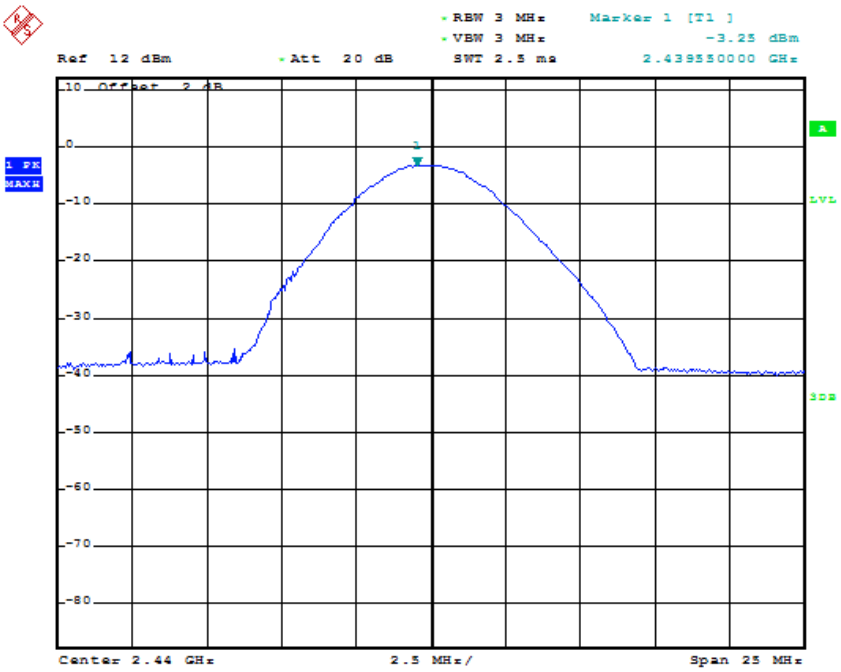
**Test plot as follows:**

| Test mode: | GFSK | Test channel: | Lowest |
|---|---|---|---|




| Test mode: | GFSK | Test channel: | Middle |
|---|---|---|---|

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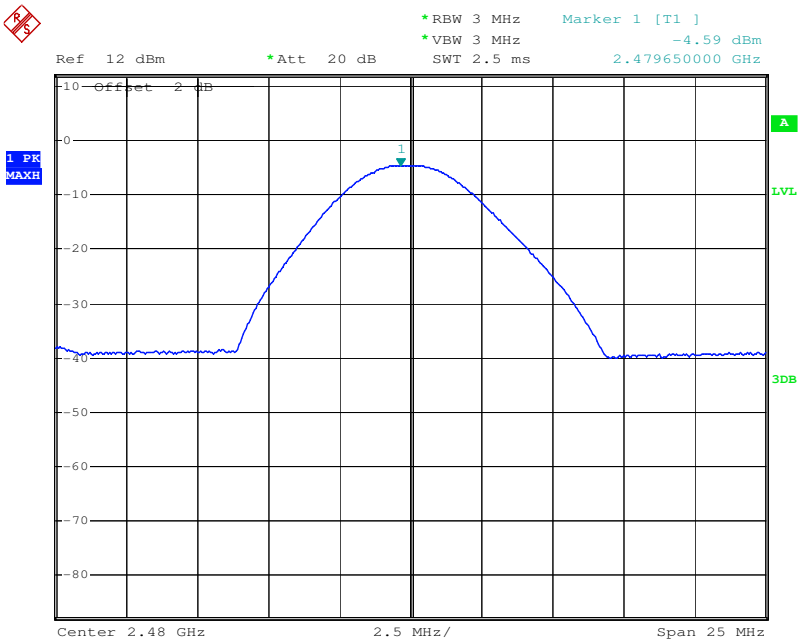
| Test mode: | GFSK | Test channel: | Highest |
|---|---|---|---|

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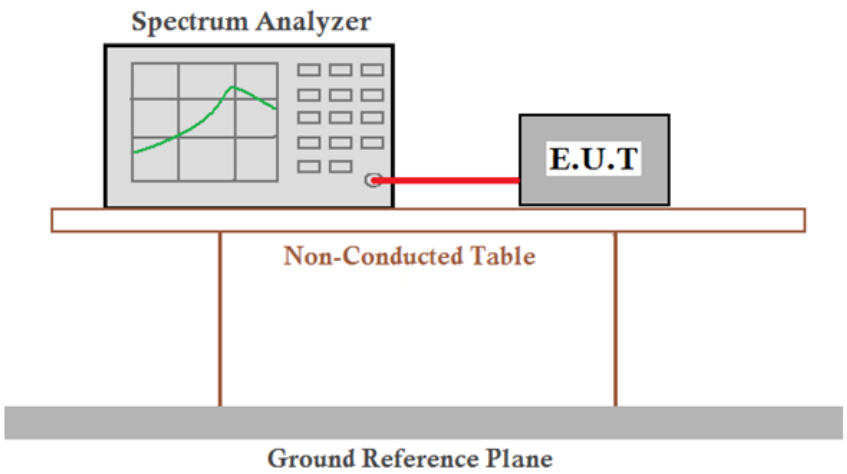
## 6.4 6dB Occupy Bandwidth

| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (a)(2) |
| Test Method: | ANSI C63.10: 2013 Section 11.8 |
| Test Setup: |  |
| Limit: | ≥ 500 kHz |
| Test Mode: | Transmitting with GFSK modulation. |
| Instruments Used: | Refer to section 5.10 for details. |
| Test Results: | Pass |

**Measurement Data**

| GFSK mode | | | |
|---|---|---|---|
| Test channel | 6dB Occupy Bandwidth (MHz) | Limit (kHz) | Result |
| Lowest | 0.666 | ≥500 | Pass |
| Middle | 0.660 | ≥500 | Pass |
| Highest | 0.666 | ≥500 | Pass |

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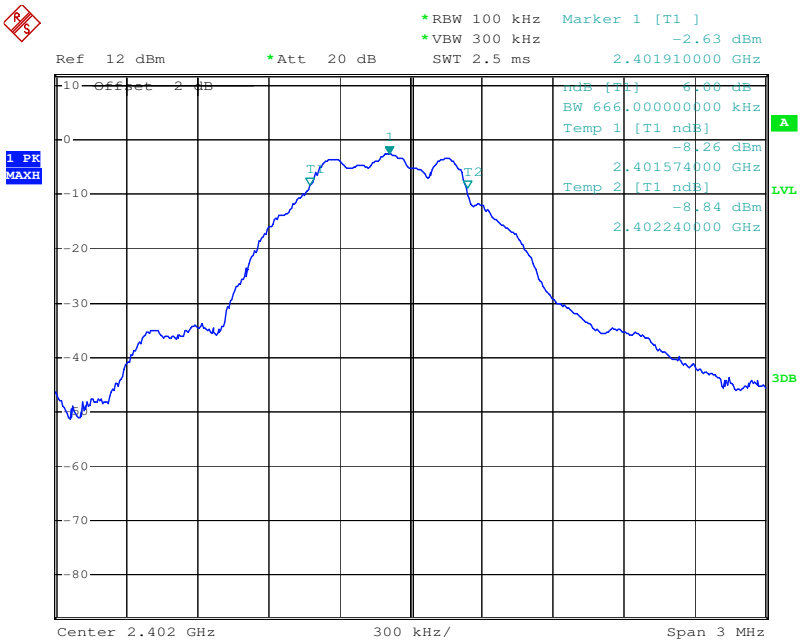
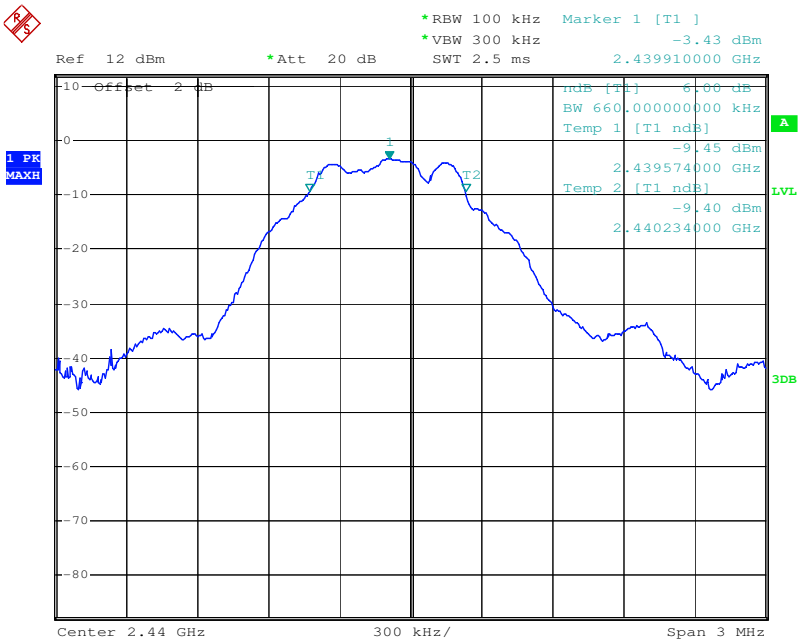
**Test plot as follows:**

| Test mode: | GFSK | Test channel: | Lowest |
|---|---|---|---|




| Test mode: | GFSK | Test channel: | Middle |
|---|---|---|---|

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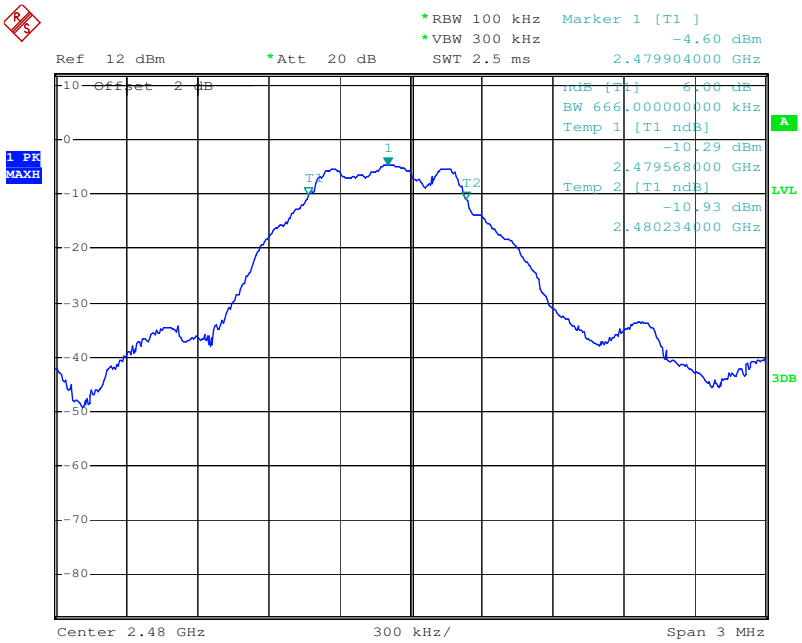
| Test mode: | GFSK | Test channel: | Highest |
|---|---|---|---|

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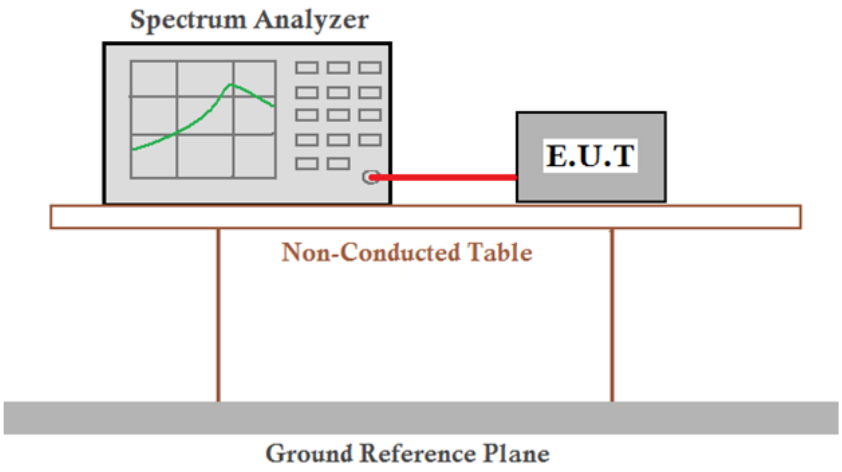
## 6.5 Power Spectral Density

| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (e) |
| Test Method: | ANSI C63.10 :2013 Section 11.10.2 |
| Test Setup: |  |
| Limit: | ≤8.00dBm/3kHz |
| Test Mode: | Transmitting with GFSK modulation. |
| Instruments Used: | Refer to section 5.10 for details. |
| Test Results: | Pass |

**Measurement Data**

| GFSK mode | | | |
|---|---|---|---|
| Test channel | Power Spectral Density (dBm/3kHz) | Limit (dBm/3kHz) | Result |
| Lowest | -16.66 | ≤8.00 | Pass |
| Middle | -18.62 | ≤8.00 | Pass |
| Highest | -19.82 | ≤8.00 | Pass |

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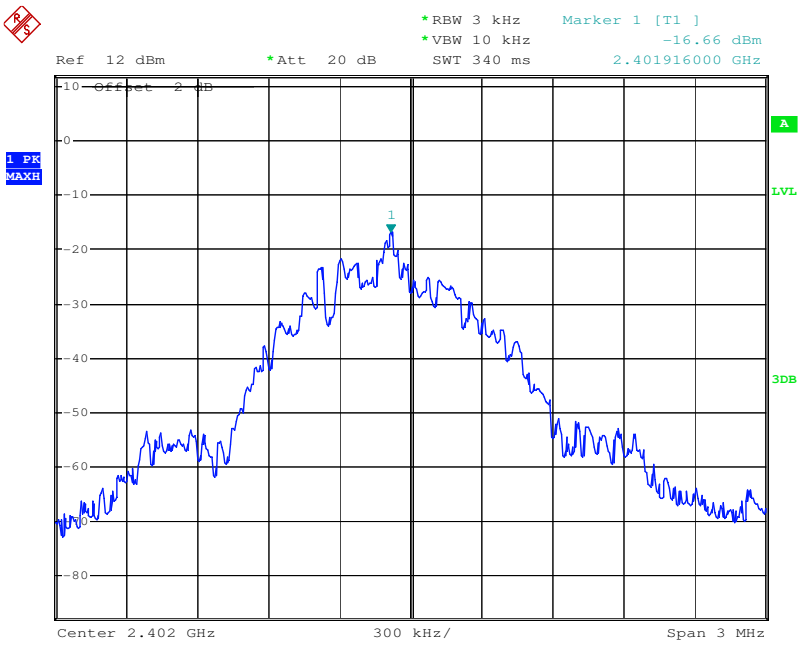
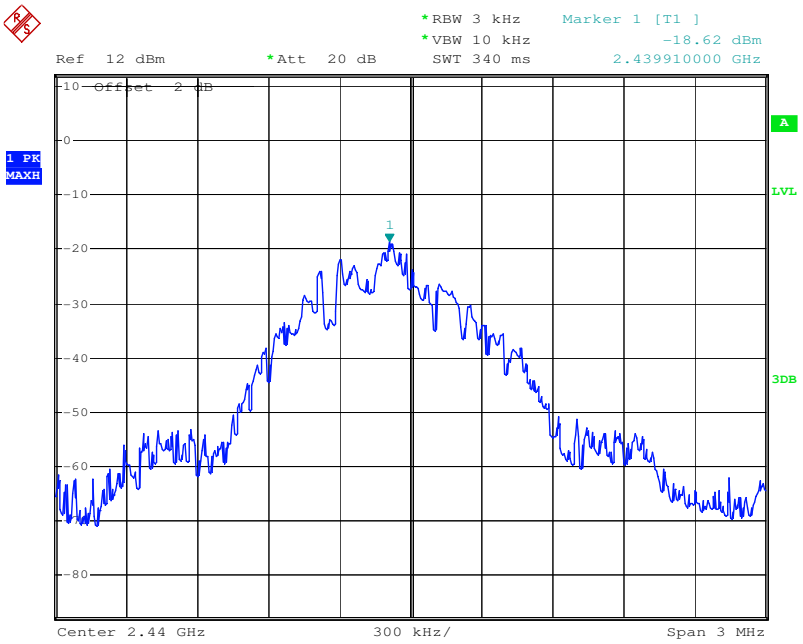
**Test plot as follows:**

| Test mode: | GFSK | Test channel: | Lowest |
|---|---|---|---|




| Test mode: | GFSK | Test channel: | Middle |
|---|---|---|---|

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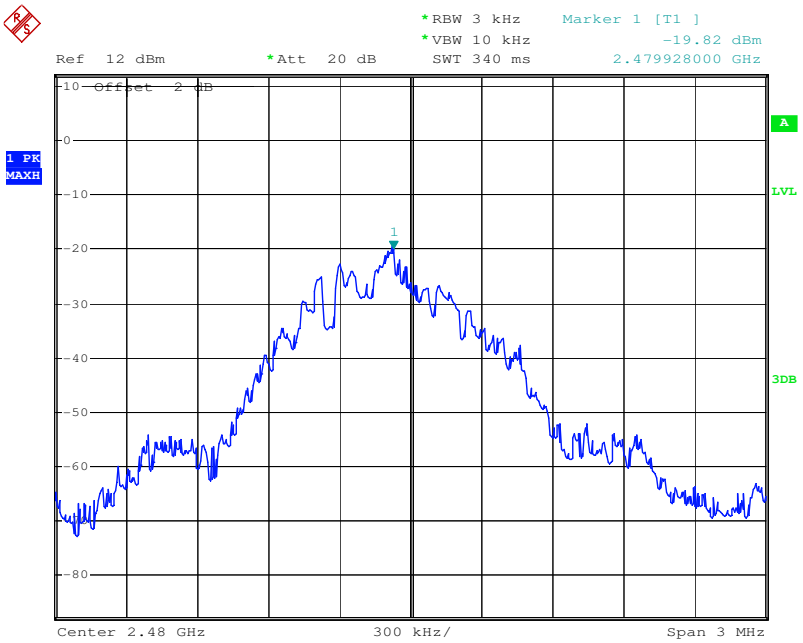
| Test mode: | GFSK | Test channel: | Highest |
|---|---|---|---|

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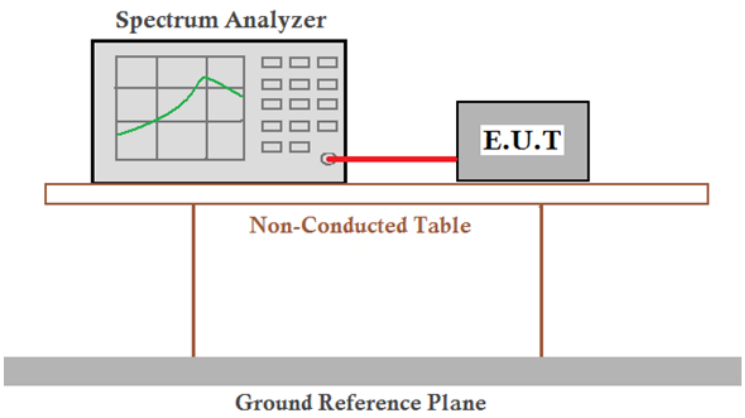
## 6.6 Band-edge for RF Conducted Emissions

| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (d) |
| Test Method: | ANSI C63.10: 2013 Section 11.13 |
| Test Setup: |  <br>Remark:<br>Offset the High-Frequency cable loss 1.5dB in the spectrum analyzer. |
| Limit: | In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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. |
| Test Mode: | Transmitting with GFSK modulation. |
| Instruments Used: | Refer to section 5.10 for details. |
| Test Results: | Pass |

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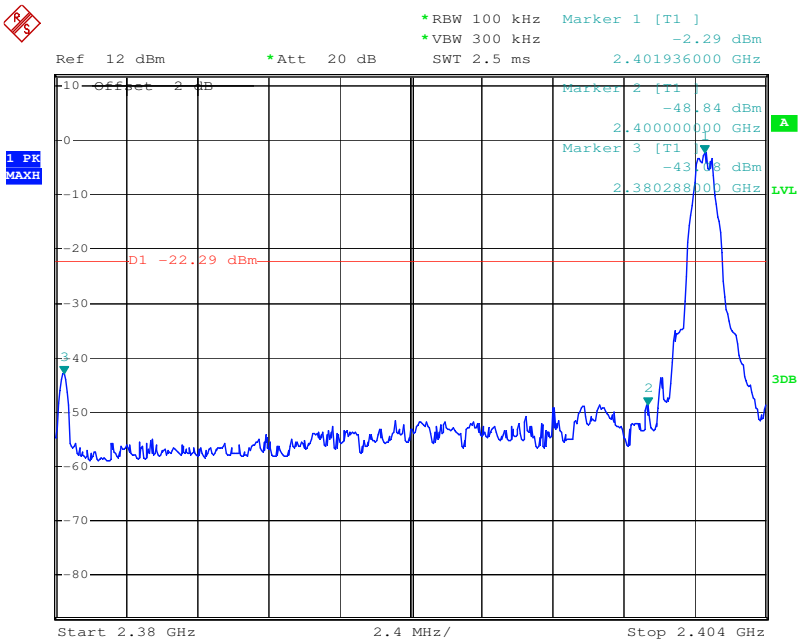
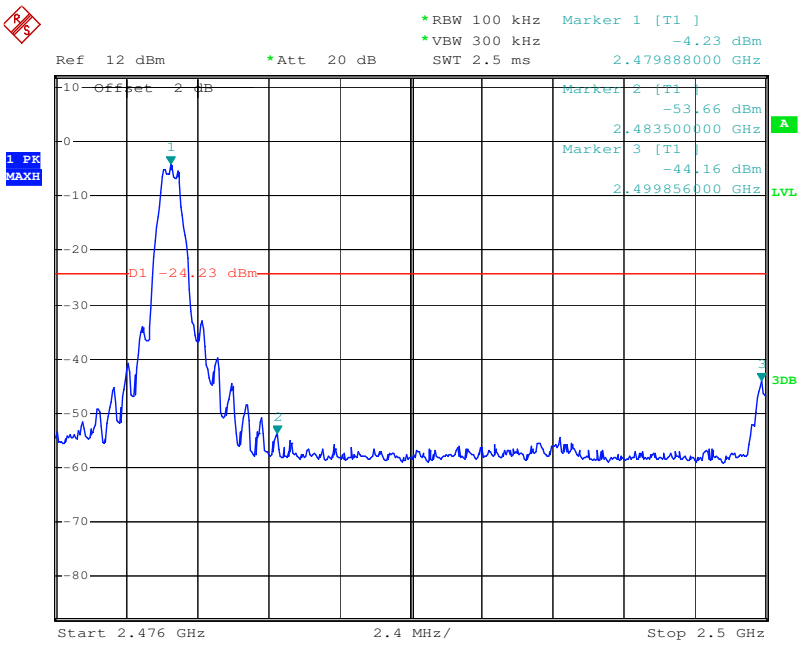
**Test plot as follows:**

| Test mode: | GFSK | Test channel: | Lowest |
|---|---|---|---|




| Test mode: | GFSK | Test channel: | Highest |
|---|---|---|---|

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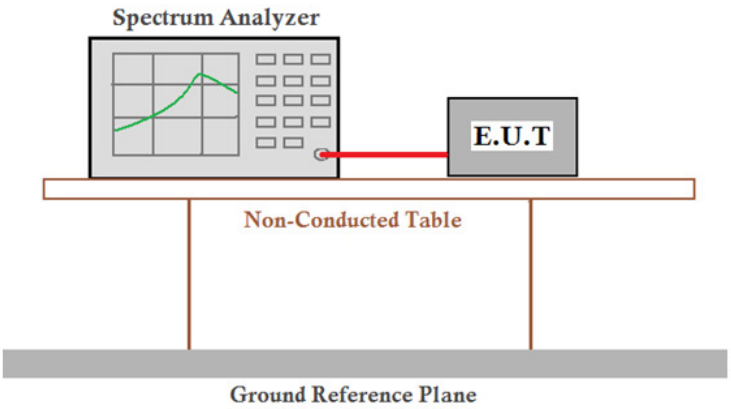
## 6.7 Spurious RF Conducted Emissions

| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (d) |
| Test Method: | ANSI C63.10: 2013 Section 11.11 |
| Test Setup: |  <br>Remark:<br>Offset the High-Frequency cable loss 1.5dB in the spectrum analyzer. |
| Limit: | In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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. |
| Test Mode: | Transmitting with GFSK modulation. |
| Instruments Used: | Refer to section 5.10 for details. |
| Test Results: | Pass |

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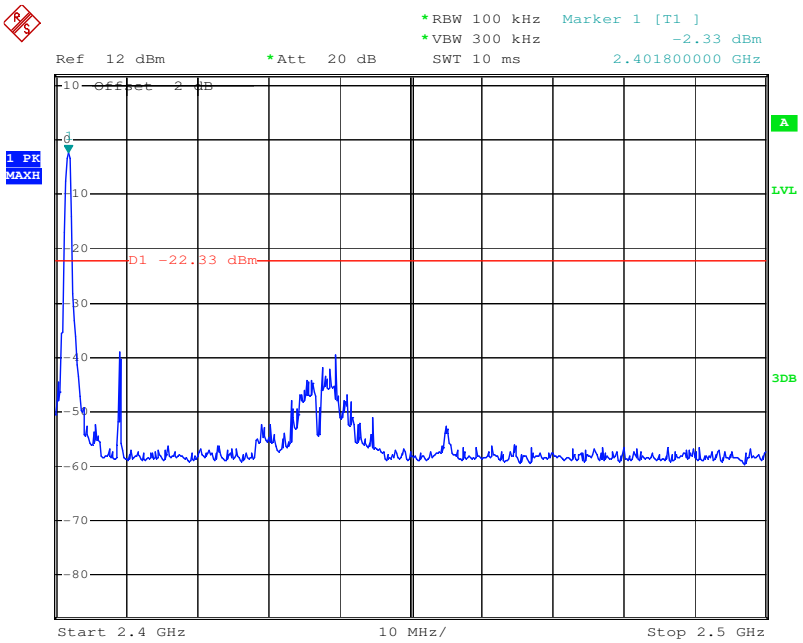
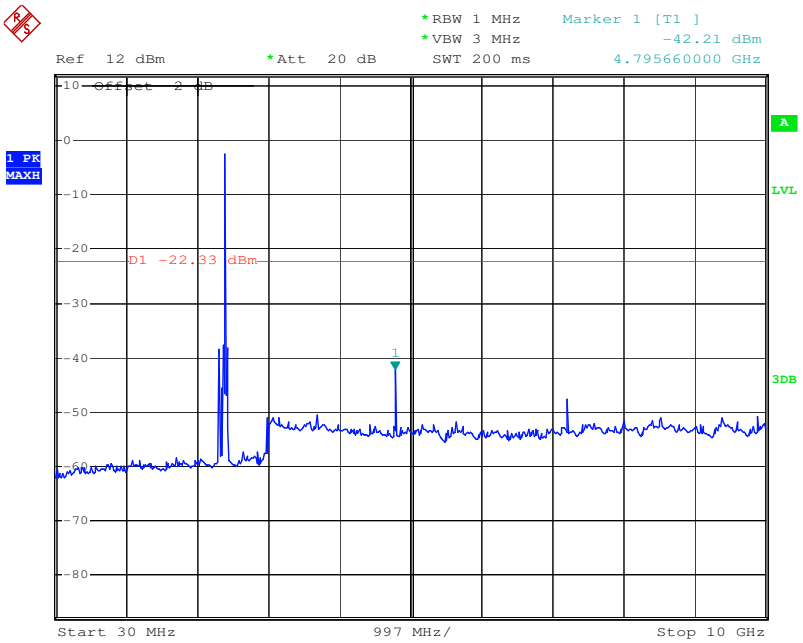
**Test plot as follows:**

| Test mode: | GFSK | Test channel: | Lowest |
|---|---|---|---|

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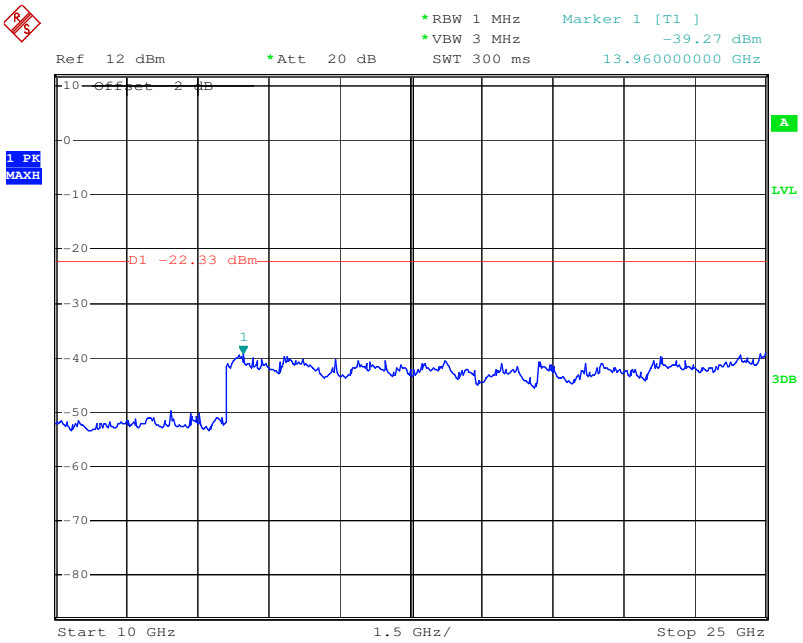
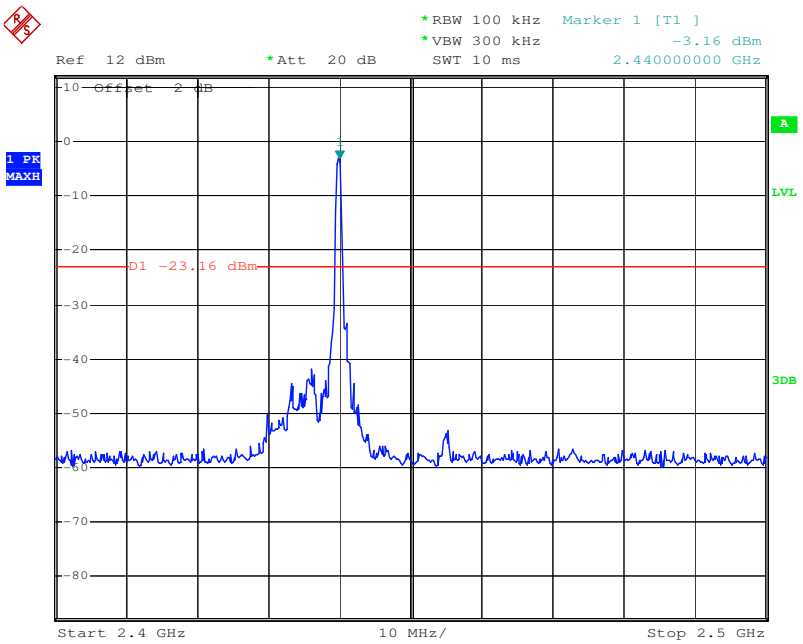



| Test mode: | GFSK | Test channel: | Middle |
|---|---|---|---|

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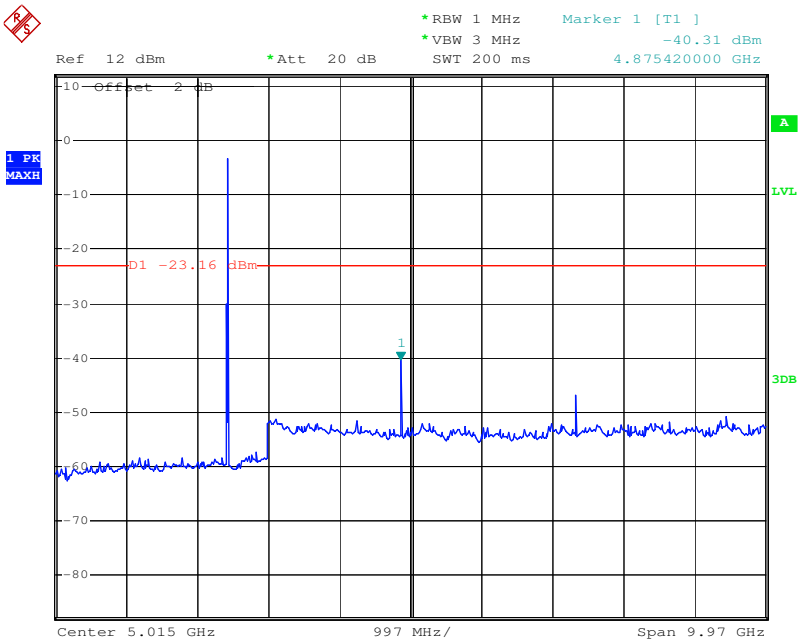


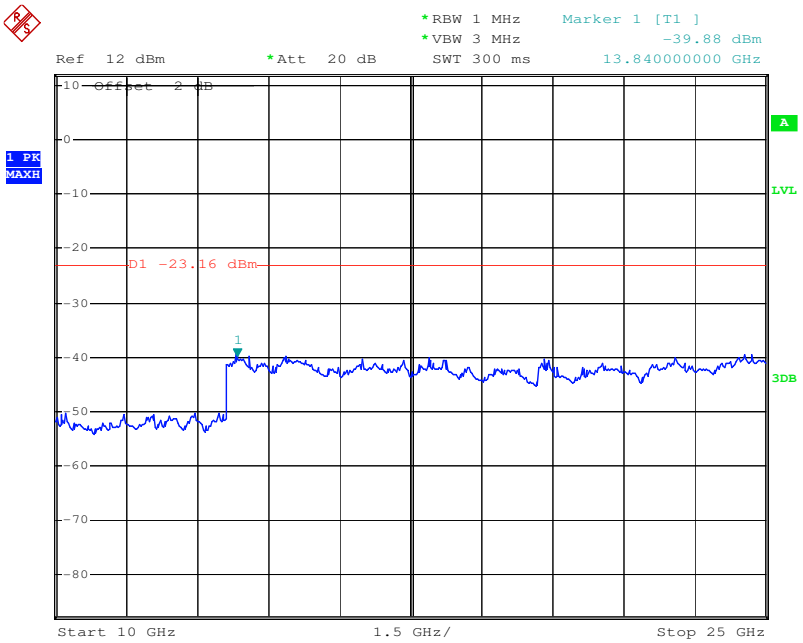


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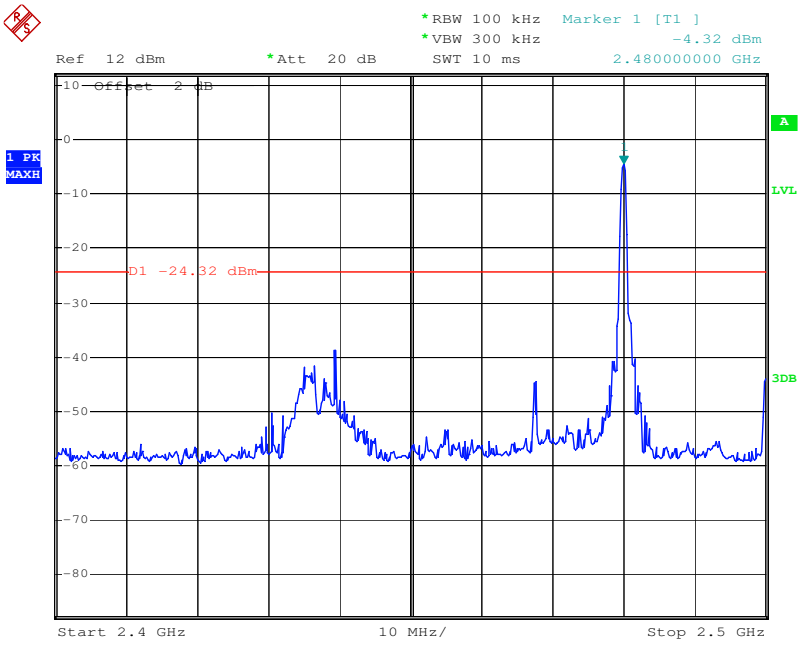
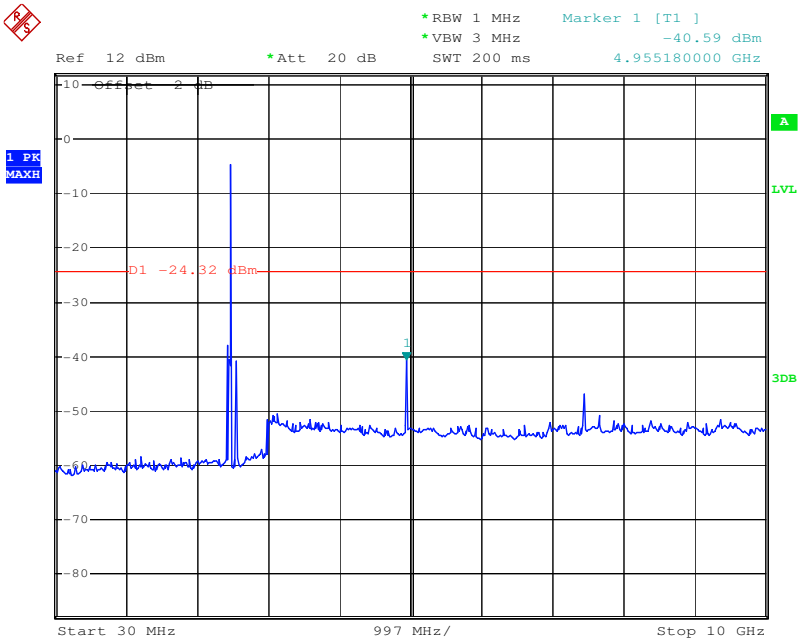
| Test mode: | GFSK | Test channel: | Highest |
|---|---|---|---|

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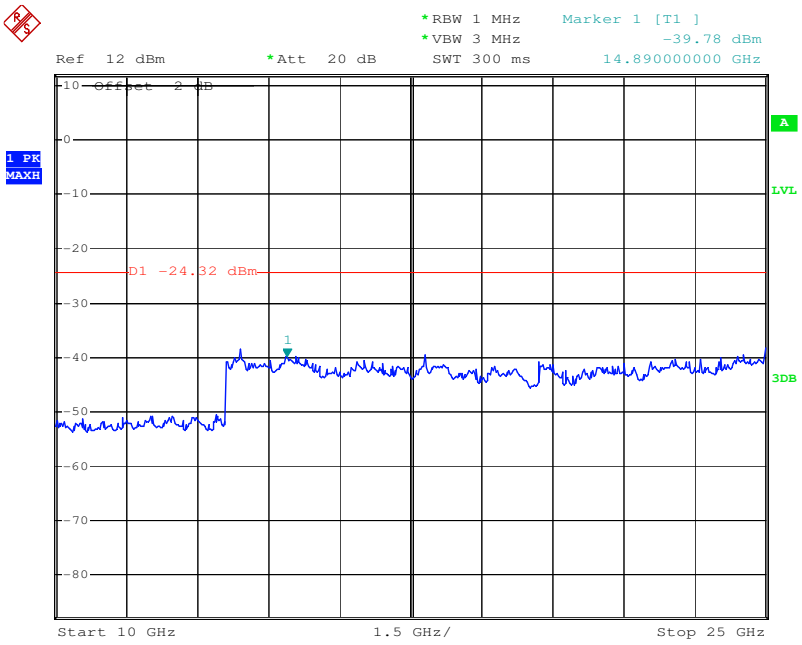


Remark:

Use 100kHz RBW to determine the relative limit in the band 2.4GHz to 2.5GHz, and Use 1MHz RBW to measure spurious emissions in the band 30MHz to 10GHz and 10GHz to 25GHz. The sweep points set to 30001.

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## 6.8 Radiated Spurious Emission

### 6.8.1 Spurious Emissions

| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.209 and 15.205 |
| Test Method: | ANSI C63.10 :2013 Section 11.12 |
| Test Site: | Below 1GHz:<br>Measurement Distance: 3m (Semi-Anechoic Chamber)<br>Above 1GHz:<br>Measurement Distance: 3m (Full-Anechoic Chamber) |

Receiver Setup:

| Frequency | Detector | RBW | VBW | Remark |
|---|---|---|---|---|
| 0.009MHz-0.090MHz | Peak | 10kHz | 30kHz | Peak |
| 0.009MHz-0.090MHz | Average | 10kHz | 30kHz | Average |
| 0.090MHz-0.110MHz | Quasi-peak | 10kHz | 30kHz | Quasi-peak |
| 0.110MHz-0.490MHz | Peak | 10kHz | 30kHz | Peak |
| 0.110MHz-0.490MHz | Average | 10kHz | 30kHz | Average |
| 0.490MHz -30MHz | Quasi-peak | 10kHz | 30kHz | Quasi-peak |
| 30MHz-1GHz | Quasi-peak | 100 kHz | 300kHz | Quasi-peak |
| Above 1GHz | Peak | 1MHz | 3MHz | Peak |
| | Peak | 1MHz | 10Hz | Average |

Limit:

| Frequency | Field strength (microvolt/meter) | Limit (dBuV/m) | Remark | Measurement distance (m) |
|---|---|---|---|---|
| 0.009MHz-0.490MHz | 2400/F(kHz) | - | - | 300 |
| 0.490MHz-1.705MHz | 24000/F(kHz) | - | - | 30 |
| 1.705MHz-30MHz | 30 | - | - | 30 |
| 30MHz-88MHz | 100 | 40.0 | Quasi-peak | 3 |
| 88MHz-216MHz | 150 | 43.5 | Quasi-peak | 3 |
| 216MHz-960MHz | 200 | 46.0 | Quasi-peak | 3 |
| 960MHz-1GHz | 500 | 54.0 | Quasi-peak | 3 |
| Above 1GHz | 500 | 54.0 | Average | 3 |

Note: 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.

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| Test Setup: | |
|---|---|

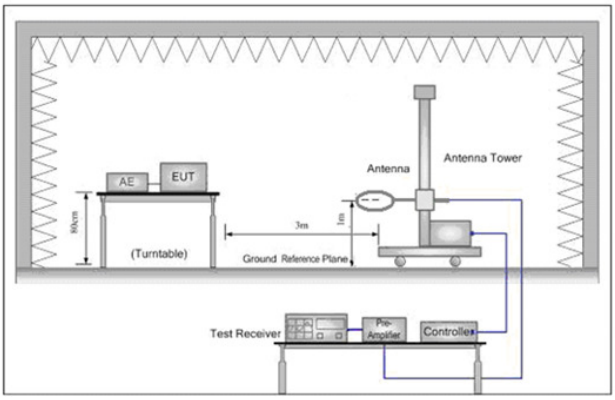


Figure 1. Below 30MHz

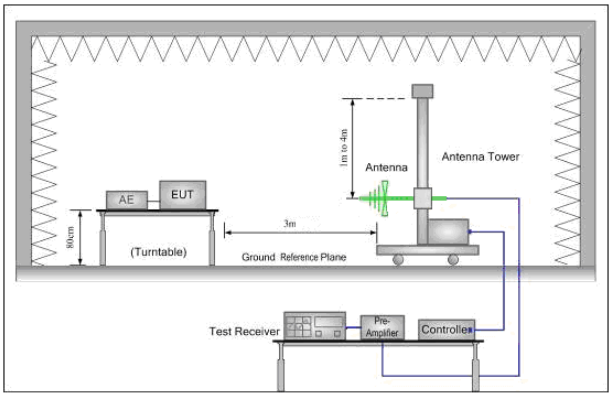


Figure 2. 30MHz to 1GHz

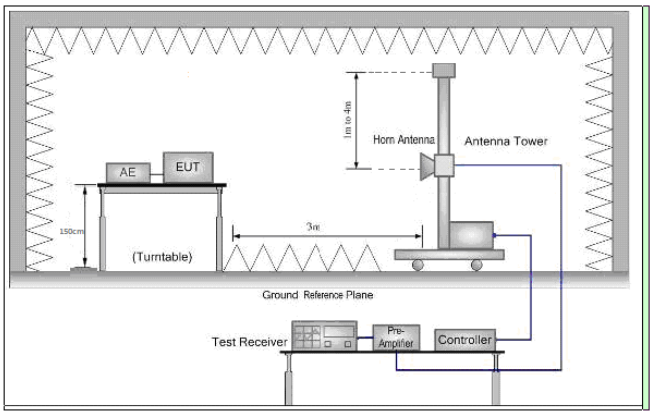


Figure 3. Above 1 GHz

| Test Procedure: | |
|---|---|

a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter full-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

c. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB

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| | |
|---|---|
| | margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.<br>h. Test the EUT in the lowest channel (2402MHz),the middle channel (2440MHz),the Highest channel (2480MHz)<br>i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.<br>j. Repeat above procedures until all frequencies measured was complete. |
| Exploratory Test Mode: | Transmitting with GFSK modulation.<br>a.Charge + Transmitting mode.<br>b.Transmitting mode. |
| Final Test Mode: | Transmitting with GFSK modulation.<br>Pretest the EUT at Charge + Transmitting mode and Transmitting mode<br>For below 1GHz part, through pre-scan, the worst case is the lowest channel.<br>Only the worst case is recorded in the report. |
| Instruments Used: | Refer to section 5.10 for details. |
| Test Results: | Pass |

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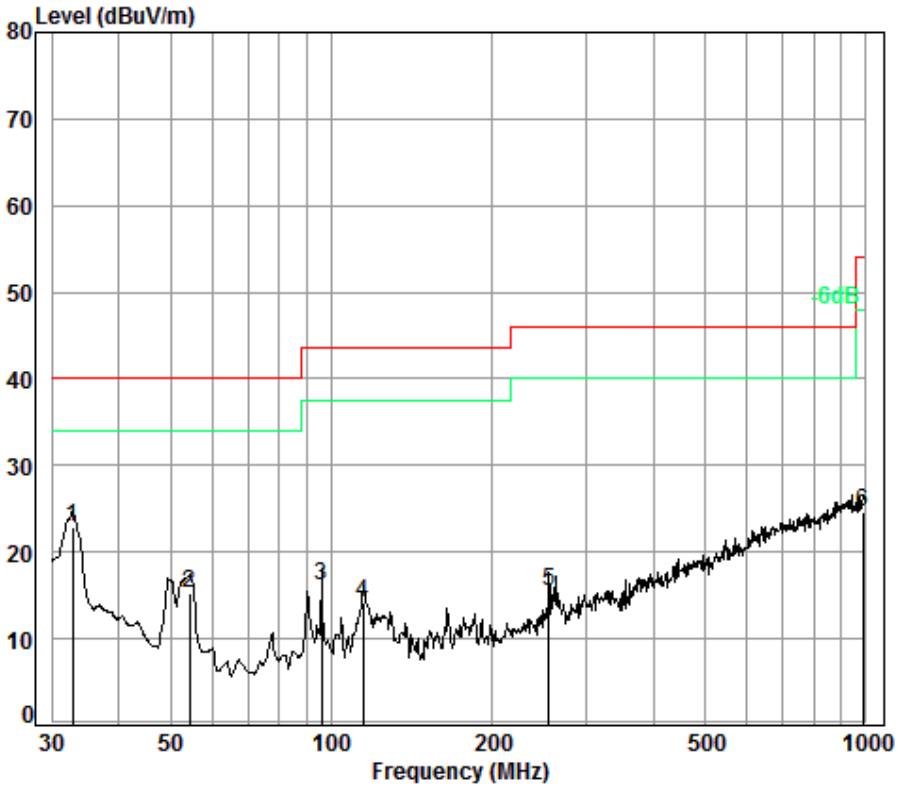
| Radiated Emission below 1GHz | | |
|---|---|---|
| 30MHz~1GHz (QP) | | |
| Test mode: | Charge + Transmitting mode | Vertical |




Condition: 3m VERTICAL
Job No. : 9296CR
Mode: : Charge +TX

| | Freq | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit |
|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB |
| 1 pp | 32.86 | 0.60 | 17.10 | 27.35 | 32.48 | 22.83 | 40.00 | -17.17 |
| 2 | 54.26 | 0.80 | 8.06 | 27.28 | 33.76 | 15.34 | 40.00 | -24.66 |
| 3 | 96.10 | 1.16 | 8.94 | 27.21 | 33.23 | 16.12 | 43.50 | -27.38 |
| 4 | 114.51 | 1.24 | 8.28 | 27.10 | 31.75 | 14.17 | 43.50 | -29.33 |
| 5 | 255.62 | 1.70 | 12.41 | 26.52 | 27.97 | 15.56 | 46.00 | -30.44 |
| 6 | 986.07 | 3.69 | 23.74 | 26.37 | 23.50 | 24.56 | 54.00 | -29.44 |

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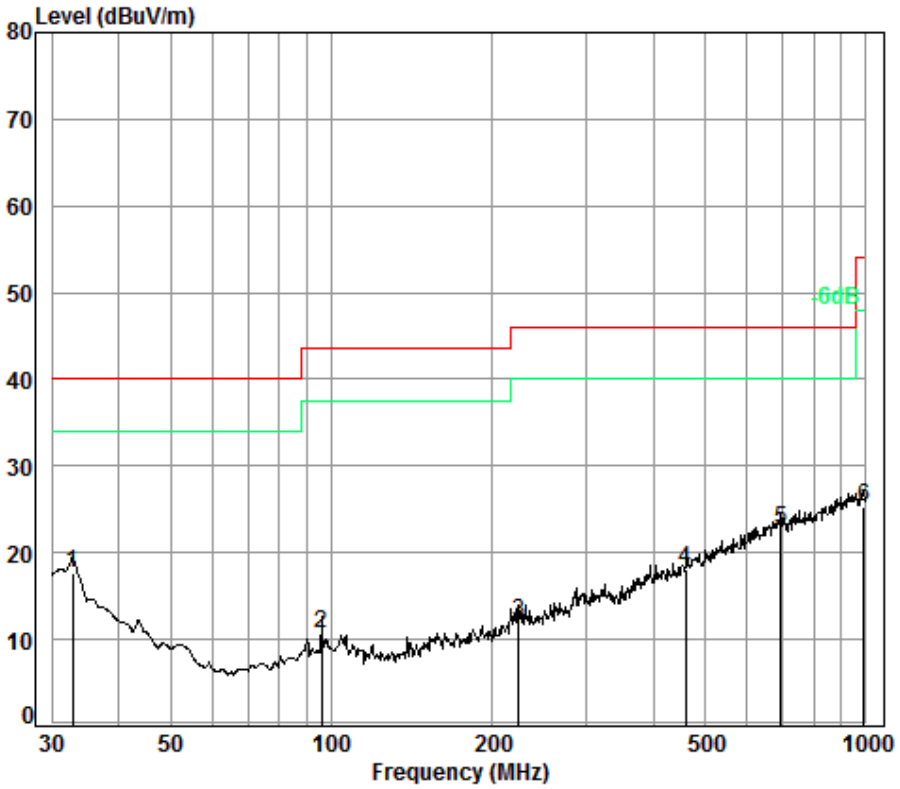
| Test mode: | Charge + Transmitting mode | Horizontal |
|---|---|---|




Condition: 3m HORIZONTAL
Job No. : 9296CR
Mode: : Charge +TX

| | Freq | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit |
|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB |
| 1 pp | 32.86 | 0.60 | 17.10 | 27.35 | 27.20 | 17.55 | 40.00 | -22.45 |
| 2 | 96.10 | 1.16 | 8.94 | 27.21 | 27.80 | 10.69 | 43.50 | -32.81 |
| 3 | 223.73 | 1.54 | 11.43 | 26.62 | 25.69 | 12.04 | 46.00 | -33.96 |
| 4 | 460.73 | 2.45 | 17.29 | 27.50 | 25.93 | 18.17 | 46.00 | -27.83 |
| 5 | 691.99 | 2.89 | 21.54 | 27.42 | 25.65 | 22.66 | 46.00 | -23.34 |
| 6 | 989.54 | 3.69 | 23.88 | 26.37 | 24.10 | 25.30 | 54.00 | -28.70 |

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| Transmitter Emission above 1GHz | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Test mode: | GFSK | | Test channel: | | Lowest | Remark: | | Peak |
| Frequency (MHz) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Read Level (dBuV) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | Polarization |
| 3589.562 | 32.46 | 7.66 | 38.51 | 45.37 | 46.98 | 74.00 | -27.02 | Vertical |
| 4804.000 | 34.16 | 8.87 | 39.03 | 47.46 | 51.46 | 74.00 | -22.54 | Vertical |
| 6087.002 | 34.77 | 10.45 | 38.94 | 45.33 | 51.61 | 74.00 | -22.39 | Vertical |
| 7206.000 | 36.42 | 10.68 | 38.18 | 43.66 | 52.58 | 74.00 | -21.42 | Vertical |
| 9608.000 | 37.52 | 12.50 | 36.99 | 40.10 | 53.13 | 74.00 | -20.87 | Vertical |
| 12173.120 | 38.71 | 14.42 | 38.48 | 38.95 | 53.60 | 74.00 | -20.40 | Vertical |
| 3765.116 | 32.97 | 7.73 | 38.59 | 44.65 | 46.76 | 74.00 | -27.24 | Horizontal |
| 4804.000 | 34.16 | 8.87 | 39.03 | 52.77 | 56.77 | 74.00 | -17.23 | Horizontal |
| 5930.516 | 34.66 | 10.37 | 39.01 | 45.24 | 51.26 | 74.00 | -22.74 | Horizontal |
| 7206.000 | 36.42 | 10.68 | 38.18 | 43.78 | 52.70 | 74.00 | -21.30 | Horizontal |
| 9608.000 | 37.52 | 12.50 | 36.99 | 40.13 | 53.16 | 74.00 | -20.84 | Horizontal |
| 11877.340 | 38.48 | 14.43 | 38.18 | 38.61 | 53.34 | 74.00 | -20.66 | Horizontal |

| Test mode: | GFSK | | Test channel: | | Lowest | Remark: | | Average |
|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Read Level (dBuV) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | Polarization |
| 4804.000 | 34.16 | 8.87 | 39.03 | 45.52 | 49.52 | 54.00 | -4.48 | Horizontal |

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| Test mode: | GFSK | | Test channel: | Middle | | Remark: | Peak |
|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Read Level (dBuV) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | Polarization |
| 3909.457 | 33.36 | 7.78 | 38.66 | 45.63 | 48.11 | 74.00 | -25.89 | Vertical |
| 4880.000 | 34.29 | 8.97 | 39.06 | 49.47 | 53.67 | 74.00 | -20.33 | Vertical |
| 6043.124 | 34.74 | 10.50 | 38.97 | 44.69 | 50.96 | 74.00 | -23.04 | Vertical |
| 7320.000 | 36.37 | 10.72 | 38.07 | 43.01 | 52.03 | 74.00 | -21.97 | Vertical |
| 9760.000 | 37.55 | 12.58 | 36.92 | 40.38 | 53.59 | 74.00 | -20.41 | Vertical |
| 12137.940 | 38.68 | 14.45 | 38.44 | 39.05 | 53.74 | 74.00 | -20.26 | Vertical |
| 3700.306 | 32.78 | 7.71 | 38.56 | 43.37 | 45.30 | 74.00 | -28.70 | Horizontal |
| 4880.000 | 34.29 | 8.97 | 39.06 | 54.59 | 58.79 | 74.00 | -15.21 | Horizontal |
| 6069.413 | 34.76 | 10.47 | 38.96 | 44.85 | 51.12 | 74.00 | -22.88 | Horizontal |
| 7320.000 | 36.37 | 10.72 | 38.07 | 43.98 | 53.00 | 74.00 | -21.00 | Horizontal |
| 9760.000 | 37.55 | 12.58 | 36.92 | 40.12 | 53.33 | 74.00 | -20.67 | Horizontal |
| 11723.670 | 38.33 | 14.26 | 38.03 | 38.68 | 53.24 | 74.00 | -20.76 | Horizontal |

| Test mode: | GFSK | | Test channel: | Middle | | Remark: | Average |
|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Read Level (dBuV) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | Polarization |
| 4880.000 | 34.29 | 8.97 | 39.06 | 46.24 | 50.44 | 54.00 | -3.56 | Horizontal |

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| Test mode: | GFSK | | Test channel: | Highest | | Remark: | Peak |
|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Read Level (dBuV) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | Polarization |
| 3563.687 | 32.39 | 7.65 | 38.50 | 43.93 | 45.47 | 74.00 | -28.53 | Vertical |
| 4960.000 | 34.43 | 9.09 | 39.09 | 51.14 | 55.57 | 74.00 | -18.43 | Vertical |
| 6025.661 | 34.72 | 10.53 | 38.98 | 44.78 | 51.05 | 74.00 | -22.95 | Vertical |
| 7440.000 | 36.32 | 10.77 | 37.94 | 43.01 | 52.16 | 74.00 | -21.84 | Vertical |
| 9920.000 | 37.58 | 12.67 | 36.84 | 39.83 | 53.24 | 74.00 | -20.76 | Vertical |
| 12137.940 | 38.68 | 14.45 | 38.44 | 38.35 | 53.04 | 74.00 | -20.96 | Vertical |
| 3803.444 | 33.07 | 7.74 | 38.61 | 45.46 | 47.66 | 74.00 | -26.34 | Horizontal |
| 4960.000 | 34.43 | 9.09 | 39.09 | 54.51 | 58.94 | 74.00 | -15.06 | Horizontal |
| 6087.002 | 34.77 | 10.45 | 38.94 | 45.63 | 51.91 | 74.00 | -22.09 | Horizontal |
| 7440.000 | 36.32 | 10.77 | 37.94 | 43.06 | 52.21 | 74.00 | -21.79 | Horizontal |
| 9920.000 | 37.58 | 12.67 | 36.84 | 39.60 | 53.01 | 74.00 | -20.99 | Horizontal |
| 11740.650 | 38.34 | 14.28 | 38.05 | 38.52 | 53.09 | 74.00 | -20.91 | Horizontal |

| Test mode: | GFSK | | Test channel: | Highest | | Remark: | Average |
|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Read Level (dBuV) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | Polarization |
| 4960.000 | 34.43 | 9.09 | 39.09 | 43.29 | 47.72 | 54.00 | -6.28 | Vertical |
| 4960.000 | 34.43 | 9.09 | 39.09 | 46.35 | 50.78 | 54.00 | -3.22 | Horizontal |

Remark:

1) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
   Final Test Level =Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor
2) Scan from 9kHz to 25GHz, the disturbance above 13GHz and below 30MHz was very low, and the above harmonics were the highest point could be found when testing, so only the above harmonics had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.
3) As shown in this section, for frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. So, only the above measurement data were shown in the report.

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## 6.9 Restricted bands around fundamental frequency

| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.209 and 15.205 |
| Test Method: | ANSI C63.10: 2013 Section 11.12 |
| Test Site: | Below 1GHz:<br>Measurement Distance: 3m (Semi-Anechoic Chamber)<br>Above 1GHz:<br>Measurement Distance: 3m (Full-Anechoic Chamber) |
| Limit: | |

| Frequency | Limit (dBuV/m @3m) | Remark |
|---|---|---|
| 30MHz-88MHz | 40.0 | Quasi-peak Value |
| 88MHz-216MHz | 43.5 | Quasi-peak Value |
| 216MHz-960MHz | 46.0 | Quasi-peak Value |
| 960MHz-1GHz | 54.0 | Quasi-peak Value |
| Above 1GHz | 54.0 | Average Value |
| | 74.0 | Peak Value |

Test Setup:

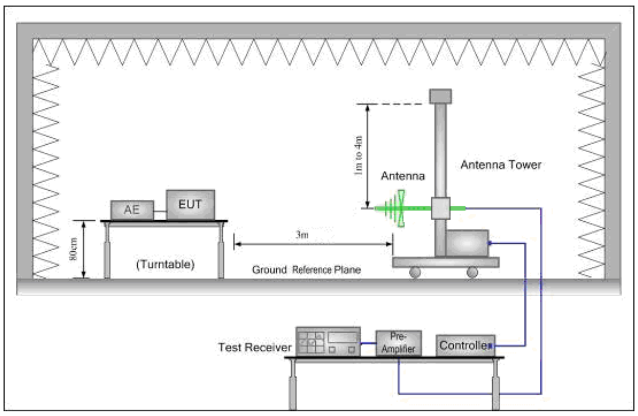


Figure 1. 30MHz to 1GHz

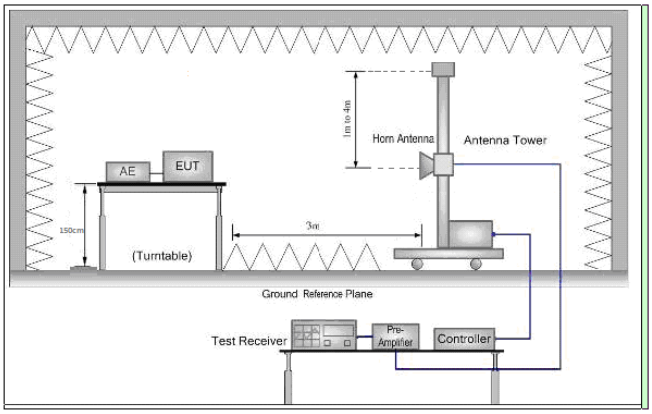


Figure 2. Above 1 GHz

Test Procedure:

a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter full-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
c. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
g. Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands. Save the spectrum analyzer plot. Repeat for each power and modulation for lowest and highest channel

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| | |
|---|---|
| | h. Test the EUT in the lowest channel , the Highest channel<br>i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.<br>j. Repeat above procedures until all frequencies measured was complete. |
| Exploratory Test Mode: | Transmitting with GFSK modulation.<br>a.Charge + Transmitting mode.<br>b.Transmitting mode. |
| Final Test Mode: | Transmitting with GFSK modulation.<br>Pretest the EUT at Charge + Transmitting mode and Transmitting mode.<br>Only the worst case is recorded in the report. |
| Instruments Used: | Refer to section 5.10 for details. |
| Test Results: | Pass |

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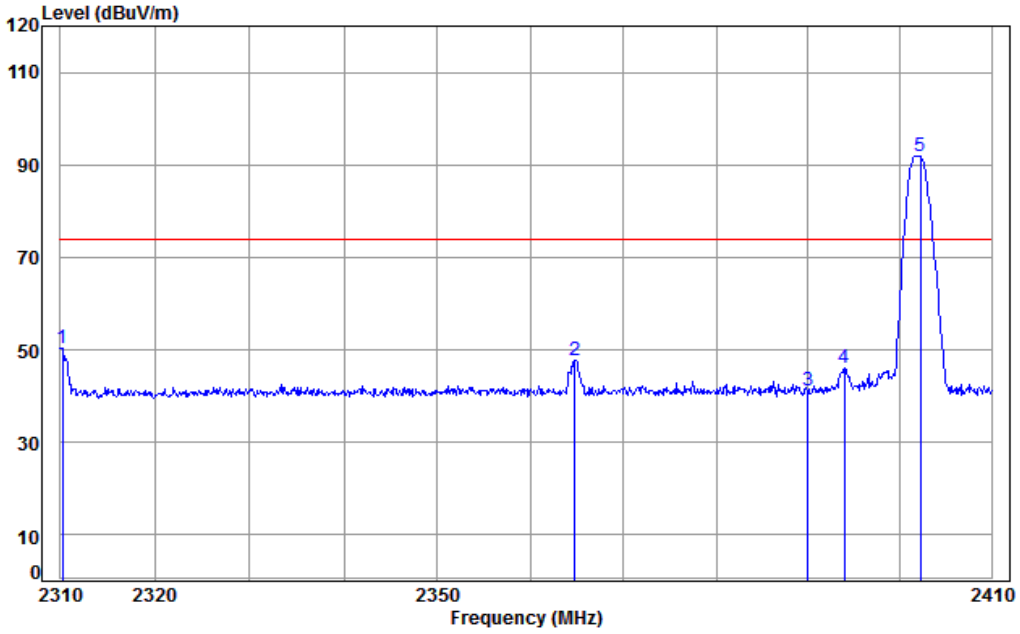
**Test plot as follows:**

| Test channel: | Lowest | Remark: | Peak | Vertical |
|---|---|---|---|---|




Condition: 3m VERTICAL
Job No: : 9296CR
Mode: : 2402 Band edge
: BLE

| | Freq | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | |
| 1 | 2310.196 | 5.27 | 28.83 | 38.14 | 54.38 | 50.34 | 74.00 | -23.66 | |
| 2 | 2364.776 | 5.32 | 29.00 | 38.14 | 51.68 | 47.86 | 74.00 | -26.14 | |
| 3 | 2390.000 | 5.34 | 29.08 | 38.14 | 44.93 | 41.21 | 74.00 | -32.79 | |
| 4 | 2393.917 | 5.34 | 29.09 | 38.14 | 49.92 | 46.21 | 74.00 | -27.79 | |
| 5 pp | 2402.250 | 5.35 | 29.11 | 38.15 | 95.69 | 92.00 | 74.00 | 18.00 | |

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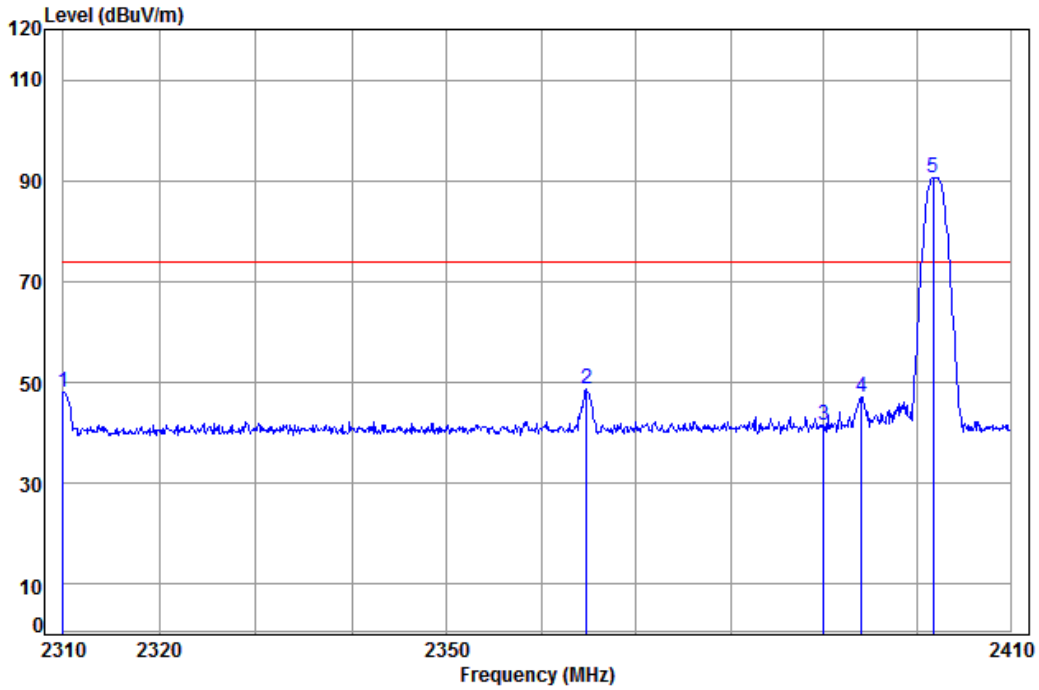
| Test channel: | Lowest | Remark: | Peak | Horizontal |
|---|---|---|---|---|




Condition: 3m Horizontal
Job No: : 9296CR
Mode: : 2402 Band edge
: BLE

| | Freq | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | |
| 1 | 2310.000 | 5.27 | 28.83 | 38.14 | 52.14 | 48.10 | 74.00 | -25.90 | |
| 2 | 2364.776 | 5.32 | 29.00 | 38.14 | 52.58 | 48.76 | 74.00 | -25.24 | |
| 3 | 2390.000 | 5.34 | 29.08 | 38.14 | 45.24 | 41.52 | 74.00 | -32.48 | |
| 4 | 2394.018 | 5.34 | 29.09 | 38.14 | 50.77 | 47.06 | 74.00 | -26.94 | |
| 5 pp | 2401.741 | 5.35 | 29.11 | 38.15 | 94.29 | 90.60 | 74.00 | 16.60 | |

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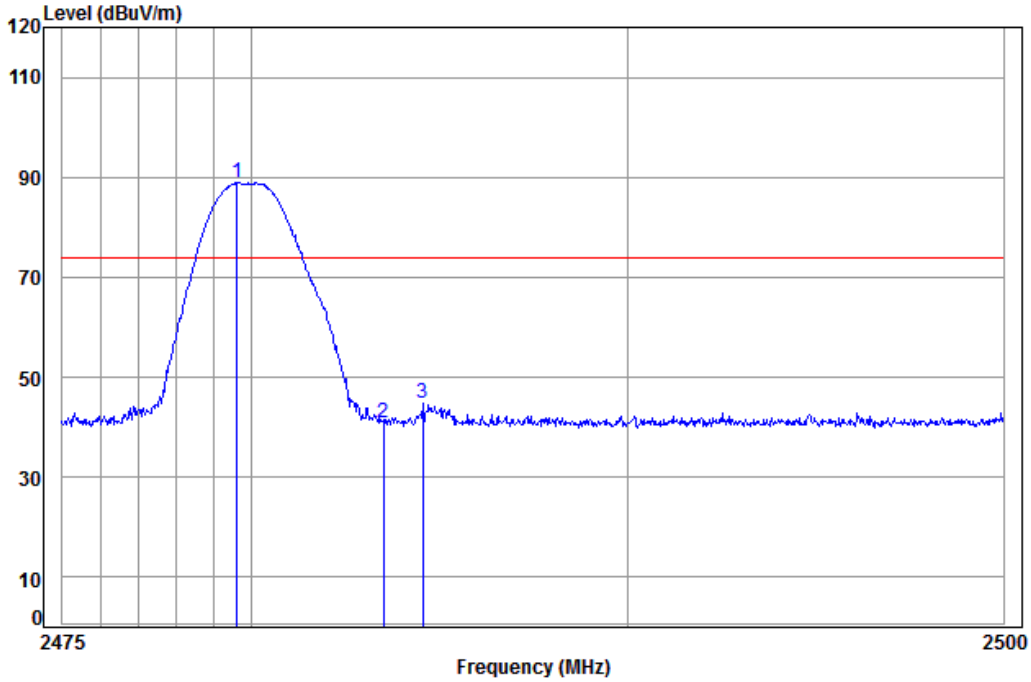
| Test channel: | Highest | Remark: | Peak | Vertical |
|---|---|---|---|---|




Condition: 3m VERTICAL
Job No: : 9296CR
Mode: : 2480 Band edge
: BLE

| | | Freq | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | |
| 1 | pp | 2479.631 | 5.40 | 29.34 | 38.15 | 92.26 | 88.85 | 74.00 | 14.85 | |
| 2 | | 2483.500 | 5.41 | 29.35 | 38.15 | 44.28 | 40.89 | 74.00 | -33.11 | |
| 3 | | 2484.545 | 5.41 | 29.36 | 38.15 | 48.25 | 44.87 | 74.00 | -29.13 | |

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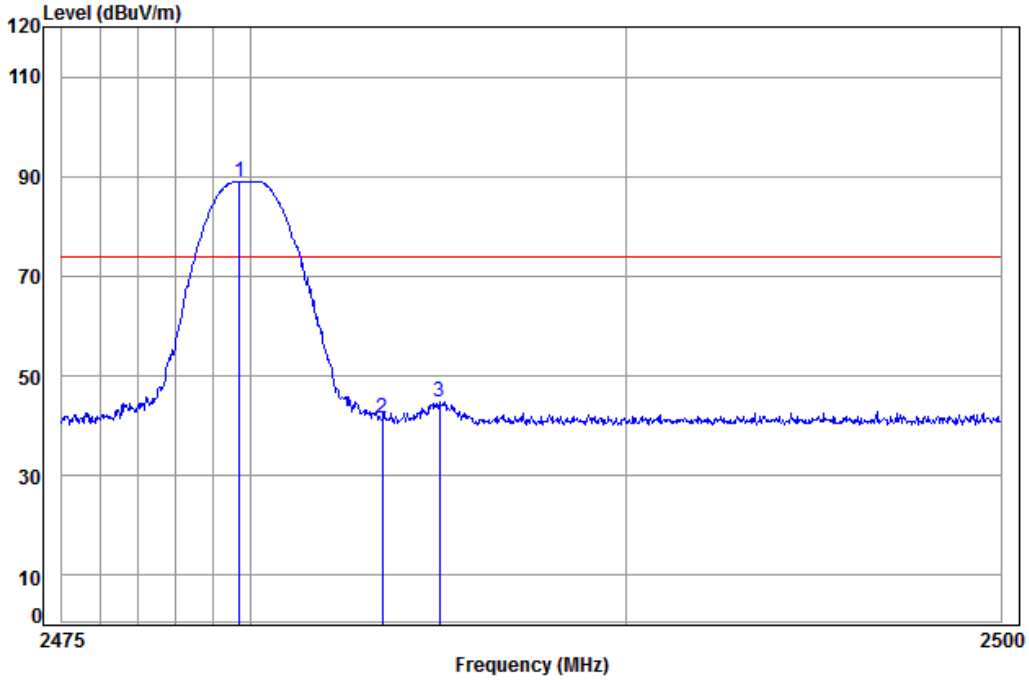
| Test channel: | Highest | Remark: | Peak | Horizontal |
|---|---|---|---|---|




Condition: 3m Horizontal
Job No: : 9296CR
Mode: : 2480 Band edge
: BLE

| | Freq | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | |
| 1 pp | 2479.706 | 5.41 | 29.34 | 38.15 | 92.50 | 89.10 | 74.00 | 15.10 | |
| 2 | 2483.500 | 5.41 | 29.35 | 38.15 | 45.04 | 41.65 | 74.00 | -32.35 | |
| 3 | 2485.020 | 5.41 | 29.36 | 38.15 | 48.32 | 44.94 | 74.00 | -29.06 | |

*Note:*
*The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:*

*Final Test Level =Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor*

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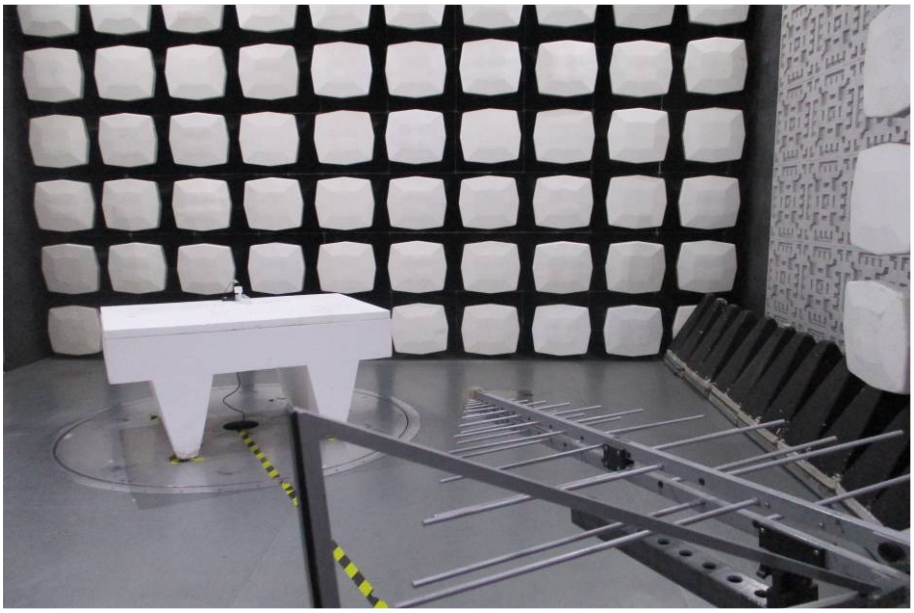
# 7 Photographs - EUT Test Setup

**Test model No.: W311**

## 7.1 Conducted Emission

## 7.2 Radiated Emission



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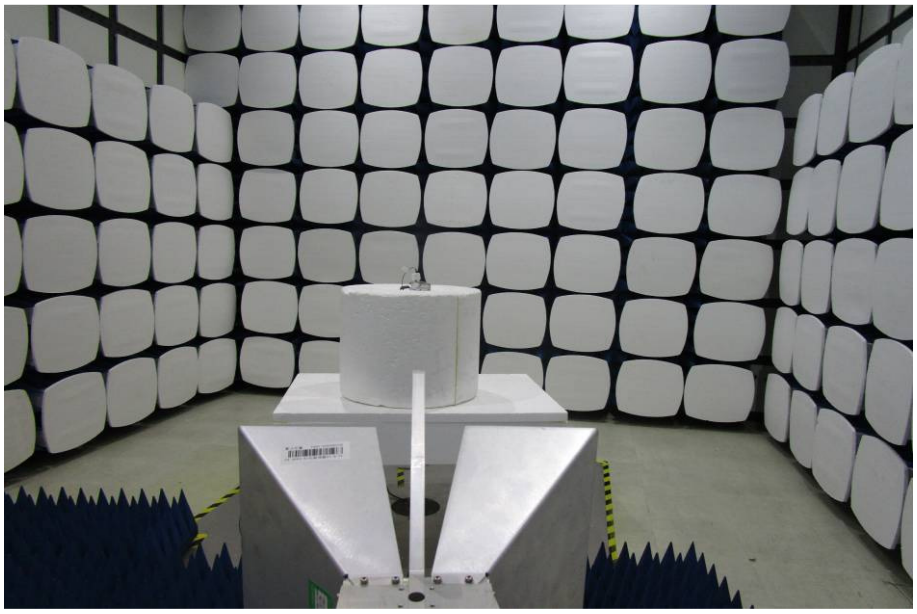
## 7.3 Radiated Spurious Emission



# 8 Photographs - EUT Constructional Details

Refer to Appendix A - Photographs of EUT Constructional Details for SZEM1611009296CR.

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