SGS-CSTC Standards Technical Services
(Shanghai) Co., Ltd.

588 West Jindu Road, Xinqiao, Songjiang, 201612 Shanghai, China
Telephone: +86 (0) 21 6191 5666
Fax: +86 (0) 21 6191 5678
ee.shanghai@sgs.com



# 1 Cover Page

# *RF TEST REPORT*

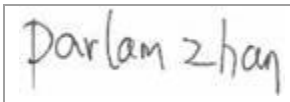
| | |
|---|---|
| **Application No.:** | SHEM1608005395CR |
| **Applicant:** | MINE SITE TECHNOLOGIES PTY LTD |
| **FCC ID:** | N73-PRX-TAG |
| **IC:** | 7449B-PRXTAG |
| **Equipment Under Test (EUT):**<br>**NOTE:** The following sample(s) was/were submitted and identified by the client as | |
| **Product Name:** | Proximity Tag |
| **Model No.(EUT):** | PRX-TAG |
| **Standards:** | FCC PART 15 Subpart C<br>RSS-247 Issue 2 (February 2017)<br>RSS-Gen Issue 5 (April 2018) |
| **Date of Receipt:** | 2015-10-10 |
| **Date of Test:** | 2017-12-29 to 2018-05-10 |
| **Date of Issue:** | 2018-05-15 |
| **Test Result:** | **Pass*** |

*In the configuration tested, the EUT detailed in this report complied with the standards specified above.

**Parlam Zhan**
**E&E Section Manager**
**SGS-CSTC (Shanghai) Co., Ltd.**

# 2 Version

| Revision Record | | | | |
|---|---|---|---|---|
| **Version** | **Chapter** | **Date** | **Modifier** | **Remark** |
| 00 | / | 2018-05-15 | / | Original |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

| | | | | |
|---|---|---|---|---|
| **Authorized for issue by:** | | | | |
| **Engineer** | | Vincent Zhu<br>**Print Name** | |  |
| **Reviewer** | | Parlam Zhan<br>**Print Name** | |  |

# 3 Test Summary

| Test Item | FCC Requirement | IC Requirement | Test method | Result |
|---|---|---|---|---|
| Antenna Requirement | FCC Part 15, Subpart C Section 15.203/15.247 (c) | RSS-Gen Section8.1.3 | --- | PASS |
| AC Power Line Conducted Emission | FCC Part 15, Subpart C Section 15.207 | RSS-Gen Clause 8.8 | ANSI C63.10 (2013) Section 6.2 | N/A |
| Minimum 6dB Bandwidth | FCC Part 15, Subpart C Section 15.247 (a)(2) | RSS-247 Clause 5.2(1) | ANSI C63.10 (2013) Section 11.8.1 | PASS |
| Conducted Peak Output Power | FCC Part 15, Subpart C Section 15.247 (b)(3) | RSS-247 Clause 5.4(4) | ANSI C63.10 (2013) Section 11.9.1.2 | PASS |
| Power Spectrum Density | FCC Part 15, Subpart C Section 15.247 (e) | RSS-247 Clause 5.2(2) | ANSI C63.10 (2013) Section 11.10.2 | PASS |
| RF Conducted Spurious Emissions and Band-edge | FCC Part 15, Subpart C Section 15.247(d) | RSS-247 Clause 5.5 | ANSI C63.10 (2013) Section 11.11&11.13.3.2 | PASS |
| Radiated Spurious Emissions and Band-edge | FCC Part 15, Subpart C Section 15.209&15.205 | RSS-247 Clause 5.5 | ANSI C63.10 (2013) Section 6.4&6.5&6.6&6.10 | PASS |
| 99% Occupied bandwidth | --- | RSS-Gen Clause 6.6 | RSS-Gen Issue 4 section 6.6 | PASS |

N/A: This EUT is powered by battery only; therefore the test on mains terminals is not applicable.

# 4 Contents

# 5 General Information

## 5.1 Client Information

| | |
|---|---|
| Applicant: | MINE SITE TECHNOLOGIES PTY LTD |
| Address of Applicant: | Level 5, 113 Wicks Rd., North Ryde NSW 2113 |

## 5.2 General Description of E.U.T.

| | |
|---|---|
| Product Description: | Mobile Product with2.4GHz band Zigbee function |
| Power Supply: | 3.7V rechargeable Li-ion battery |

## 5.3 Technical Specifications

| | |
|---|---|
| Operation Frequency: | 2405MHz-2470MHz |
| Modulation Type: | DSSS |
| Number of Channel: | 14 |
| Data Rate: | 250kbps |
| Antenna Type | Ceramic antenna |
| Antenna Gain | 3.2dBi |

## 5.4 Description of Support Units

The EUT has been tested with associated equipment below.

| Description | Manufacturer | Model No. | Supplied by |
|---|---|---|---|
| / | / | / | / |

## 5.5 Details of Test Mode

| Test Mode | Description of Test Mode |
|---|---|
| Engineering Mode | Using test software to control EUT working in continuous transmitting and, and select channel and modulation type |

## 5.6 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.
588 West Jindu Road, Xinqiao, Songjiang, 201612 Shanghai, China
Tel: +86 21 6191 5666
Fax: +86 21 6191 5678

## 5.7 Test Facility

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

- **CNAS (No. CNAS L0599)**

CNAS has accredited SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. 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.

**• NVLAP (Certificate No. 201034-0)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. is accredited by the National Voluntary Laboratory Accreditation Program(NVLAP). Certificate No. 201034-0.

**• FCC –Designation Number: CN5033**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been recognized as an accredited testing laboratory.

Designation Number: CN5033. Test Firm Registration Number: 479755.

- **Industry Canada (IC) – IC Assigned Code: 8617A**

The 3m Semi-anechoic chamber of SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 8617A-1.

- **VCCI (Member No.: 3061)**

The 3m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-3868, C-4336, T-12221, G-10830 respectively.

## 5.8 Measurement Uncertainty

| No. | Parameter | Measurement Uncertainty |
|---|---|---|
| 1 | Radio Frequency | < ±1 x $10^{-5}$ |
| 2 | Total RF power, conducted | < ±1.5 dB |
| 3 | RF power density, conducted | < ±3 dB |
| 4 | Spurious emissions, conducted | < ±3 dB |
| 5 | All emissions, radiated | < ±6 dB (Below 1GHz)<br>< ±6 dB (Above 1GHz) |
| 6 | Temperature | < ±1°C |
| 7 | Humidity | < ±5 % |
| 8 | DC and low frequency voltages | < ±3 % |

# 6 Equipments List

| Equipment | Manufacturer | Model No | Inventory No | Cal Date | Cal Due Date |
|---|---|---|---|---|---|
| **Conducted Emission at AC Power Line** | | | | | |
| EMI test receiver | R&S | ESR7 | SHEM162-1 | 2017-12-20 | 2018-12-19 |
| LISN | Schwarzbeck | NSLK8127 | SHEM061-1 | 2017-12-20 | 2018-12-19 |
| LISN | EMCO | 3816/2 | SHEM019-1 | 2017-12-20 | 2018-12-19 |
| Pulse limiter | R&S | ESH3-Z2 | SHEM029-1 | 2017-12-20 | 2018-12-19 |
| CE test Cable | / | CE01 | / | 2017-12-26 | 2018-12-25 |
| **Conducted Test** | | | | | |
| Spectrum Analyzer | R&S | FSP-30 | SHEM002-1 | 2017-12-20 | 2018-12-19 |
| Spectrum Analyzer | Agilent | N9020A | SHEM181-1 | 2017-09-26 | 2018-09-25 |
| Power meter | R&S | NRP | SHEM057-1 | 2017-12-26 | 2018-12-25 |
| Power Sensor | R&S | NRP-Z22 | SHEM136-1 | 2017-07-22 | 2018-07-21 |
| Power Sensor | R&S | NRP-Z91 | SHEM057-2 | 2017-12-26 | 2018-12-25 |
| Signal Generator | R&S | SMR40 | SHEM058-1 | 2017-07-03 | 2018-07-02 |
| Signal Generator | Agilent | N5182A | SHEM182-1 | 2017-09-26 | 2018-09-25 |
| Communication Tester | R&S | CMW270 | SHEM183-1 | 2017-10-22 | 2018-10-21 |
| Switcher | Tonscend | JS0806 | SHEM184-1 | 2017-09-26 | 2018-09-25 |
| Splitter | Anritsu | MA1612A | SHEM185-1 | / | / |
| Coupler | e-meca | 803-S-1 | SHEM186-1 | / | / |
| High-low Temp Cabinet | Suzhou Zhihe | TL-40 | SHEM087-1 | 2017-09-26 | 2018-09-25 |
| AC Power Stabilizer | WOCEN | 6100 | SHEM045-1 | 2017-12-26 | 2018-12-25 |
| DC Power Supply | QJE | QJ30003SII | SHEM046-1 | 2017-12-26 | 2018-12-25 |
| Conducted test Cable | / | RF01, RF 02 | / | 2017-12-26 | 2018-12-25 |
| **Radiated Test** | | | | | |
| EMI test receiver | R&S | ESU40 | SHEM051-1 | 2017-12-20 | 2018-12-19 |
| Spectrum Analyzer | R&S | FSP-30 | SHEM002-1 | 2017-12-20 | 2018-12-19 |
| Loop Antenna (9kHz-30MHz) | Schwarzbeck | FMZB1519 | SHEM135-1 | 2017-04-10 | 2020-04-09 |
| Antenna (25MHz-2GHz) | Schwarzbeck | VULB9168 | SHEM048-1 | 2017-02-28 | 2020-02-27 |
| Antenna (25MHz-3GHz) | Schwarzbeck | HL562 | SHEM010-1 | 2017-02-28 | 2020-02-27 |
| Horn Antenna (1-8GHz) | Schwarzbeck | HF906 | SHEM009-1 | 2017-10-24 | 2020-10-23 |
| Horn Antenna (1-18GHz) | Schwarzbeck | BBHA9120D | SHEM050-1 | 2017-01-14 | 2020-01-13 |
| Horn Antenna (14-40GHz) | Schwarzbeck | BBHA 9170 | SHEM049-1 | 2017-12-03 | 2020-12-02 |
| Pre-amplifier (9KHz-2GHz) | CLAVIIO | BDLNA-0001-412010 | SHEM164-1 | 2017-08-22 | 2018-08-21 |
| Pre-amplifier (1-18GHz) | CLAVIIO | BDLNA-0118-352810 | SHEM050-2 | 2017-08-22 | 2018-08-21 |
| High-amplifier (14-40GHz) | Schwarzbeck | 10001 | SHEM049-2 | 2017-12-20 | 2018-12-19 |
| Band filter | LORCH | 9BRX-875/X150-SR | SHEM156-1 | / | / |
| Band filter | LORCH | 13BRX-1950/X500-SR | SHEM083-2 | / | / |
| Band filter | LORCH | 5BRX-2400/X200-SR | SHEM155-1 | / | / |
| Band filter | LORCH | 5BRX-5500/X1000-SR | SHEM157-2 | / | / |
| High pass Filter | Wainwright | WHK3.0/18G-100SS | SHEM157-1 | / | / |
| High pass Filter | Wainwright | WHKS1700-3SS | SHEM157-3 | / | / |
| Semi/Fully Anechoic | ST | 11*6*6M | SHEM078-2 | 2017-07-22 | 2020-07-21 |
| RE test Cable | / | RE01, RE02, RE06 | / | 2017-12-26 | 2018-12-25 |

# 7 Antenna Requirement

## 7.1 E.U.T. test conditions

**Requirements:** 15.31(e) For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

**Operating Environment:**

| | |
|---|---|
| Temperature: | 20.0 -25.0 °C |
| Humidity: | 35-75 % RH |
| Atmospheric Pressure: | 99.2 -102 kPa |

**Test frequencies:** According to the 15.31(m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and. if required. reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

| Frequency range over which device operates | Number of frequencies | Location in the range of operation |
|---|---|---|
| 1 MHz or less | 1 | Middle |
| 1 to 10 MHz | 2 | 1 near top and 1 near bottom |
| More than 10 MHz | 3 | 1 near top. 1 near middle and 1 near bottom |

Pursuant to Part 15.31(c) For swept frequency equipment, measurements shall be made with the frequency sweep stopped at those frequencies chosen for the measurements to be reported.

Test frequency is the lowest channel (2405MHz), middle channel (2440MHz) and highest channel (2470MHz)

## 7.2 Antenna Requirement

**Standard requirement:**

15.203 requirement:

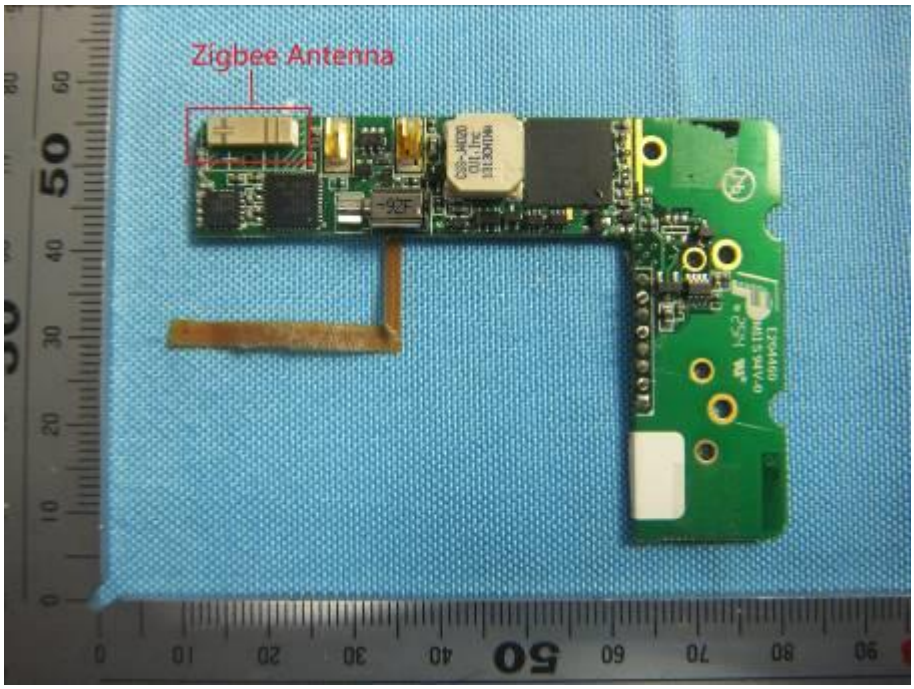
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit 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 integral antenna and no consideration of replacement. The gain of the antenna is less than 3.2dBi.



## 7.3 Conducted Emissions on Mains Terminals

**Frequency Range:** 150 KHz to 30 MHz

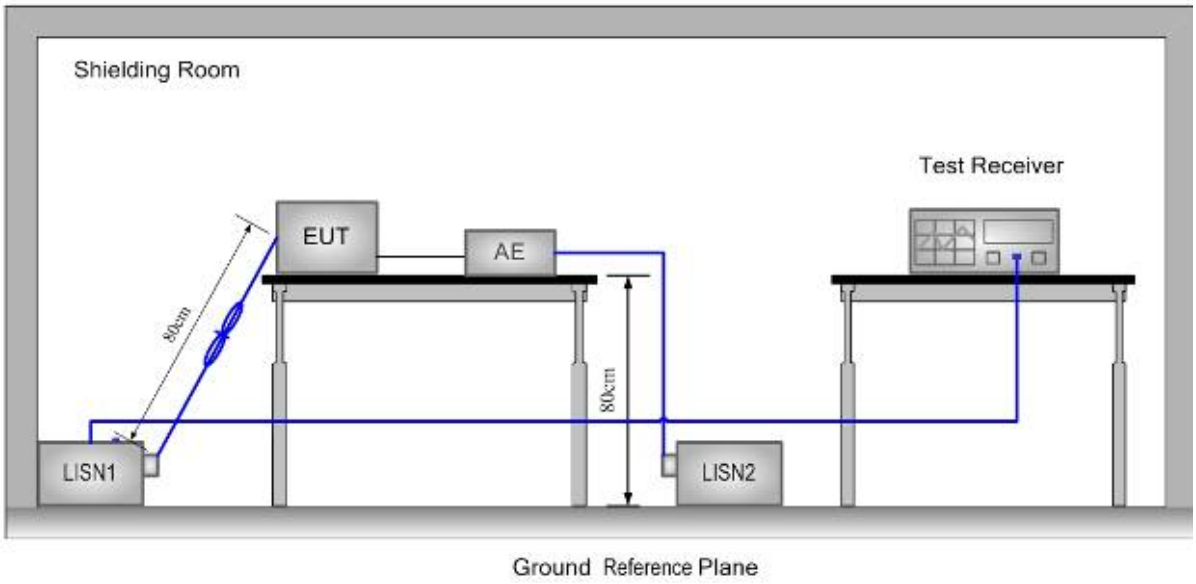
**Limit:**

| Frequency range MHz | Class B Limits: dB (μV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15 to 0.50 | 66 to 56 | 56 to 46 |
| 0.50 to 5 | 56 | 46 |
| 5 to 30 | 60 | 50 |

Note1: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50MHz.

Note2: The lower limit is applicable at the transition frequency.

**Test Setup:**




**Test Procedure:**

1) The mains terminal disturbance voltage was measured with the EUT in a shielded room.
2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides 50Ω/50μH + 5Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN, which was bonded to the ground reference plane in the same way as the LISN 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, but separated from metallic contact with the ground reference plane by 0.1m of insulation.
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 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISN mounted on top of the ground reference plane. This distance was between the closest points of the LISN and the EUT. The mains lead of EUT excess 0.8m was folded back and forth parallel to the lead so as to form a horizontal bundle with a length between 0.3m and 0.4m. All other units of the EUT and associated equipment were at least 0.8 m from the LISN.

Remark: Pre-scan was performed with peak detected on all ports, Quasi-peak & average measurements were performed at the frequencies at which maximum peak emission level were detected. Pretest under all modes; choose the worst case mode (in Middle channel) record on the report. Please see the attached Quasi-peak and Average test results.

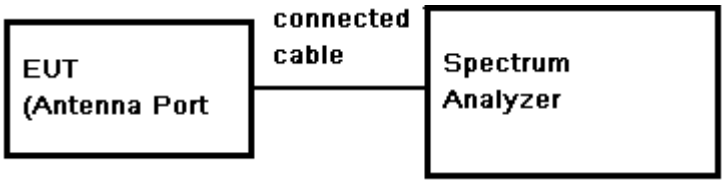
**Test Result:** N/A

**Test Data:**

This EUT is powered by battery only; therefore the test on mains terminals is not applicable.

## 7.4 6dB Occupied Bandwidth

**Test Configuration:**




**Test Procedure:**

1). Place the EUT on the table and set it in transmitting mode.
2). Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3). Set the spectrum analyzer as RBW=100KHz, VBW≥3* RBW, Span=3MHz, Sweep=auto
4). Mark the peak frequency and –6dB (upper and lower) frequency.
5). Repeat above procedures until all frequency measured was complete.

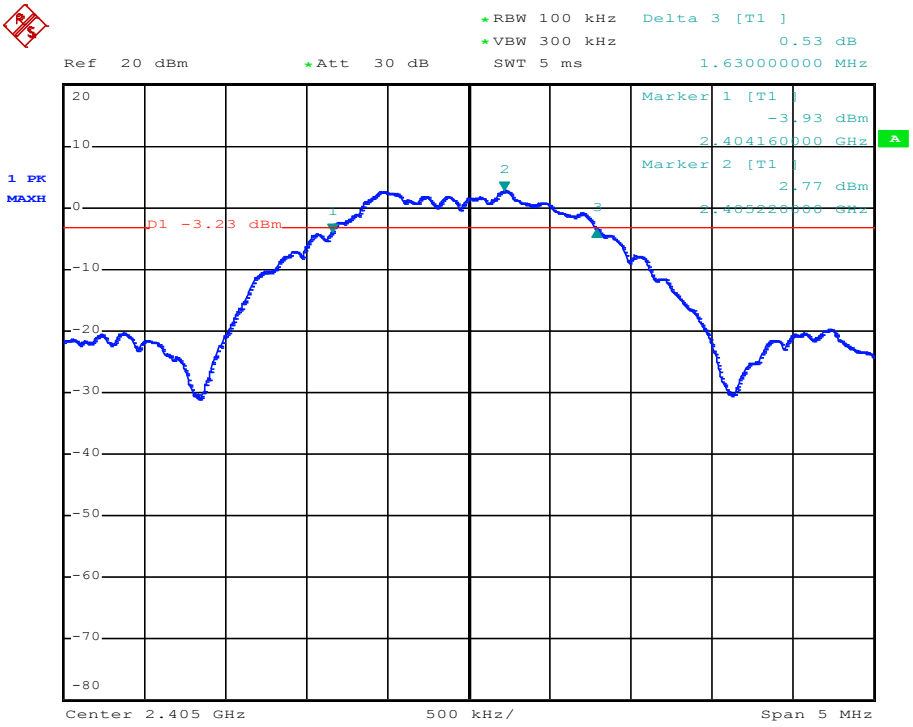
**Limit:** ≥ 500 kHz

**Test date:**

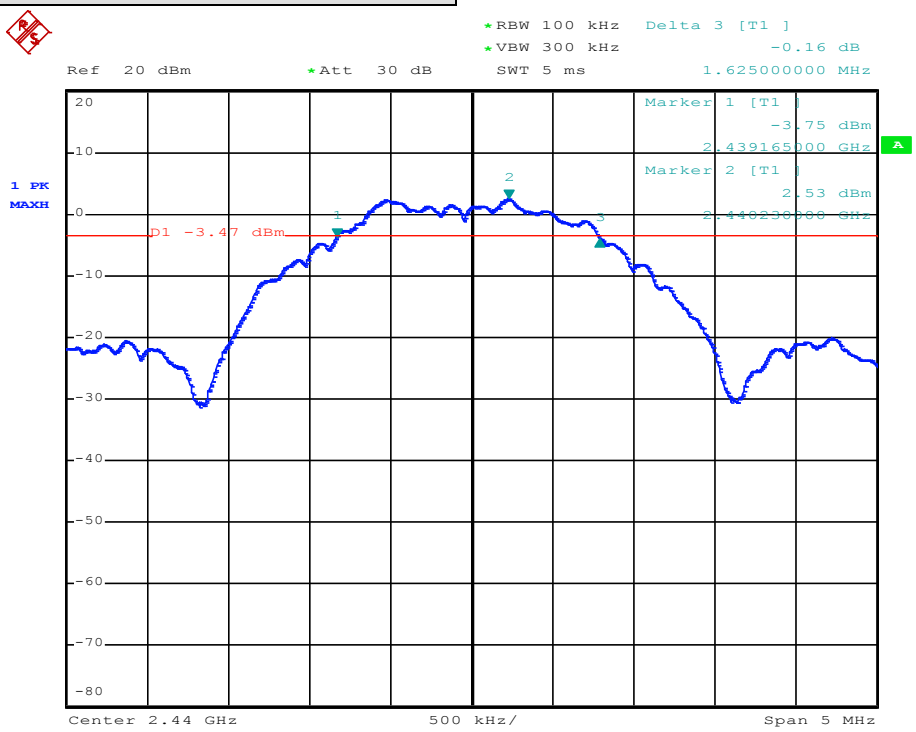
| Test Channel | 6dB Bandwidth (KHz) | Limit (KHz) | Test Result |
|---|---|---|---|
| Lowest | 1630 | 500 | Pass |
| Middle | 1625 | 500 | Pass |
| Highest | 1630 | 500 | Pass |

**Test plot as follows:**

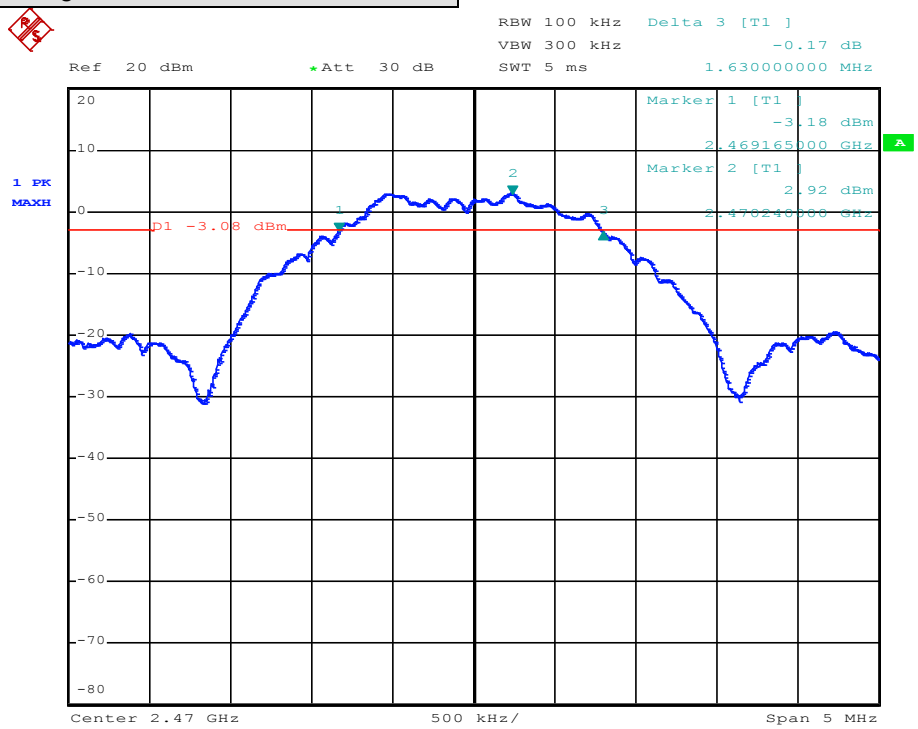
Test channel: Lowest




Test channel: Middle

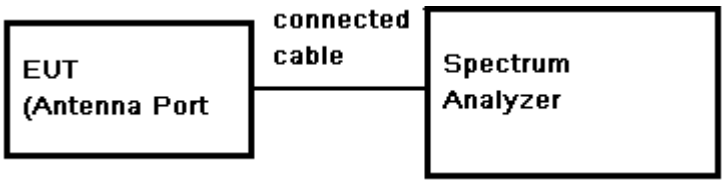


Test channel: Highest



## 7.5 Conducted Peak Output Power

**Test Configuration:**




**Test Procedure:**

1) Place the EUT on the table and set it in transmitting mode.
2) Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum.
3) Set the spectrum analyzer: RBW = 3 MHz, VBW = 3 MHz, Span= fully encompass the bandwidth, Sweep = auto; Detector Function = Peak Trace mode=max hold
4) Use the peak marker function to determine the maximum amplitude level within the RBW.
5) Record the max. Power reading.
6) Repeat above procedures until all the frequency measured were complete.

**Test Limit:** 30dBm

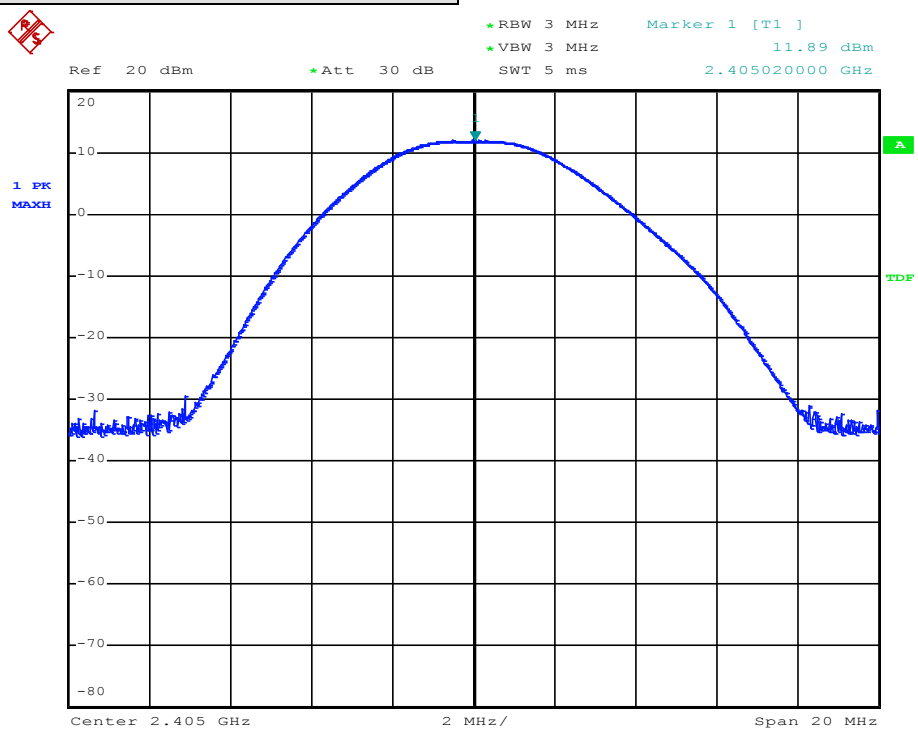
**Test data:**

| Test Channel | Reading Power (dBm) | Cable Loss (dB) | Output Power (dBm) | Limit (dBm) | Test Result |
|---|---|---|---|---|---|
| Lowest | 11.89 | 0.5 | 12.39 | 30 | Pass |
| Middle | 7.15 | 0.5 | 7.65 | 30 | Pass |
| Highest | 11.20 | 0.5 | 11.70 | 30 | Pass |

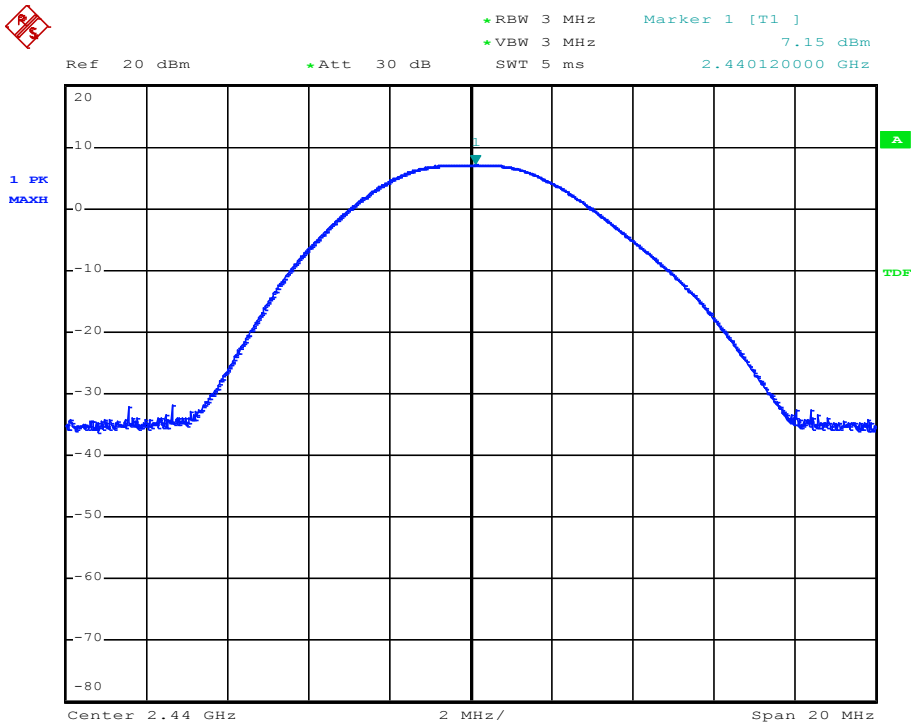
Output Power = Reading Power + Cable Loss

**Test plot as follows:**

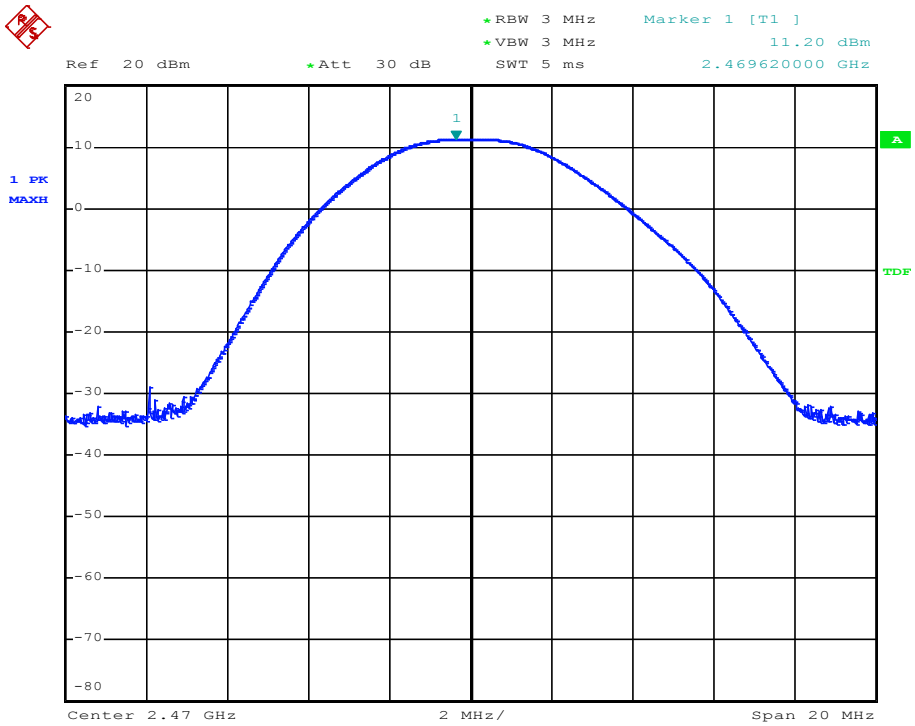
Test channel: Lowest




Test channel: Middle

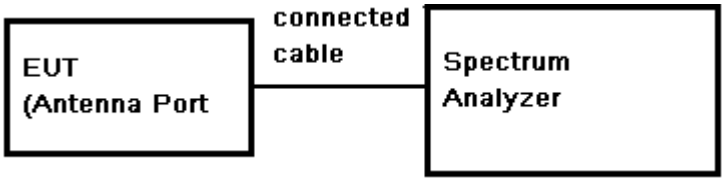


Test channel: Highest



## 7.6 Peak Power Spectral Density

**Test Configuration:**




**Test Procedure:**

1) Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2) Set the spectrum analyzer: Center Frequency= Channel Frequency, RBW = 3 kHz VBW = 10 kHz. Span= 1.5 times the DTS bandwidth, Sweep = auto; Detector = Peak; Trace mode=max hold, Trace=Max hold.
3) Use the peak marker function to determine the maximum amplitude level within the RBW.
4) Record the marker level for the particular mode.
5) Repeat these steps for other channel and modes.

**Test Limit:** 8dBm/3kHz

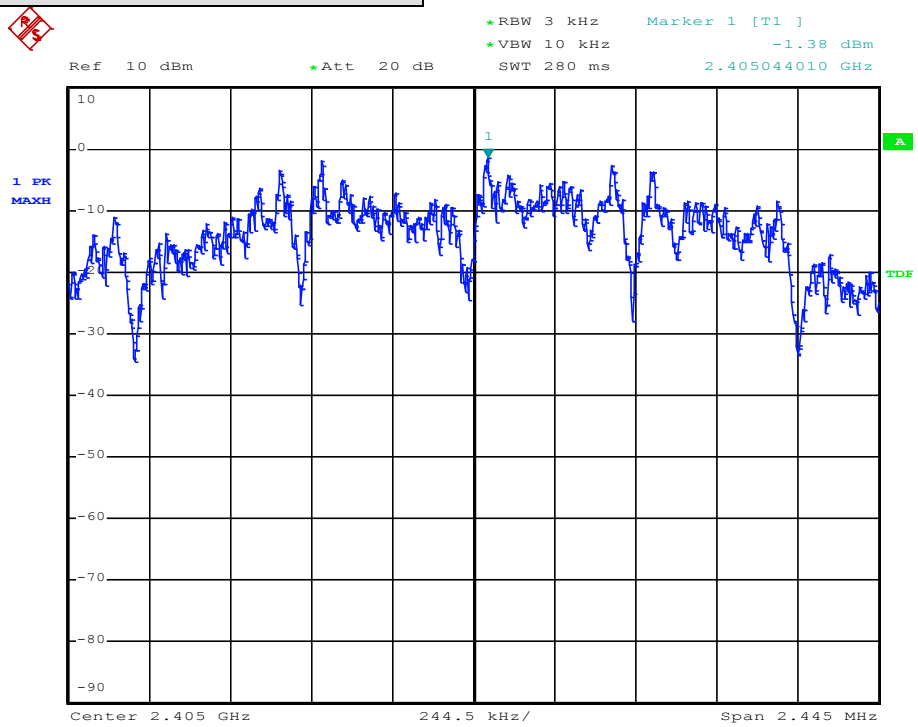
**Test data:**

| Test Channel | Reading (dBm/3KHz) | Cable Loss | PSD (dBm/3KHz) | Limit (dBm/3KHz) | Test Result |
|---|---|---|---|---|---|
| Lowest | -1.38 | 0.5 | -0.88 | 8 | Pass |
| Middle | -6.68 | 0.5 | -6.18 | 8 | Pass |
| Highest | -2.82 | 0.5 | -2.32 | 8 | Pass |

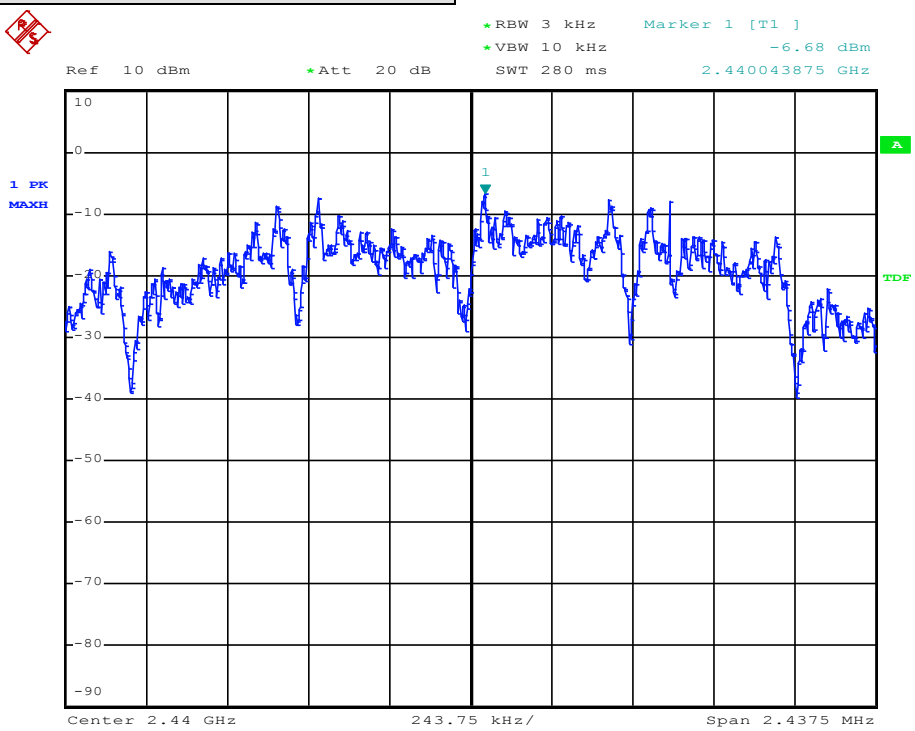
RF Power Density = Reading Power + Cable Loss

**Test plot as follows:**

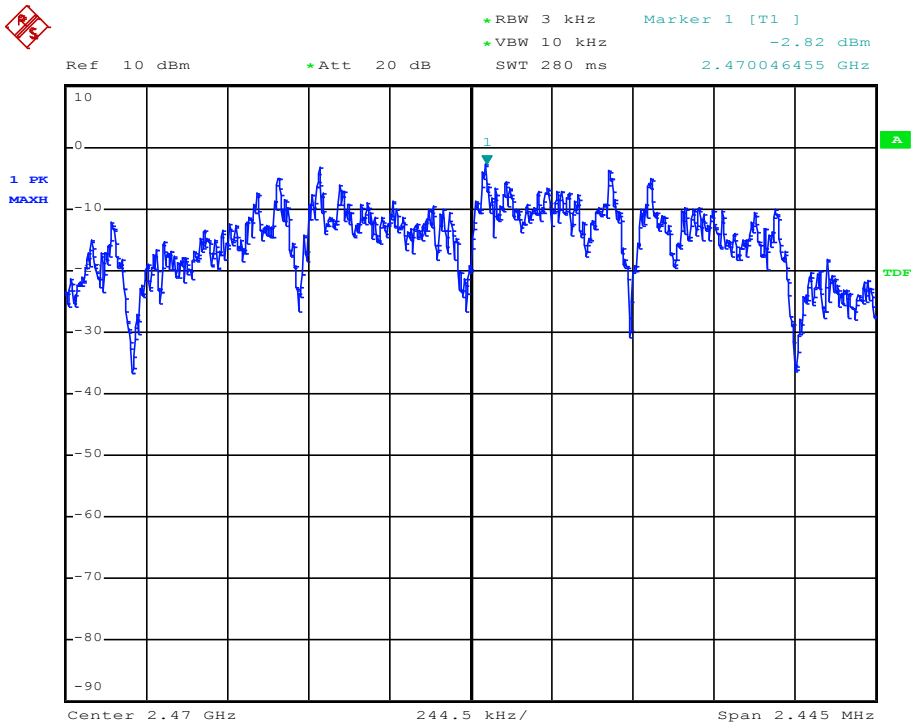
Test channel: Lowest




Test channel: Middle

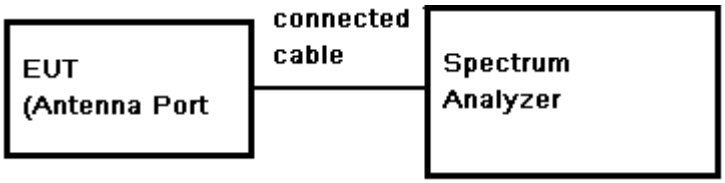


Test channel: Highest



## 7.7 Conducted Spurious Emissions and Band edge

**Test Configuration:**




**Test Procedure:**

1) Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2) Set the spectrum analyzer: RBW = 100 KHz. VBW = 300 KHz. Sweep = auto; Detector Function = Peak (Max. hold).
3) Measurement were investigated while operating in MIMO mode, however, it was determined that single antenna operation produced the worst emissions. Since the data of MIMO mode are not report.

**Limit:**

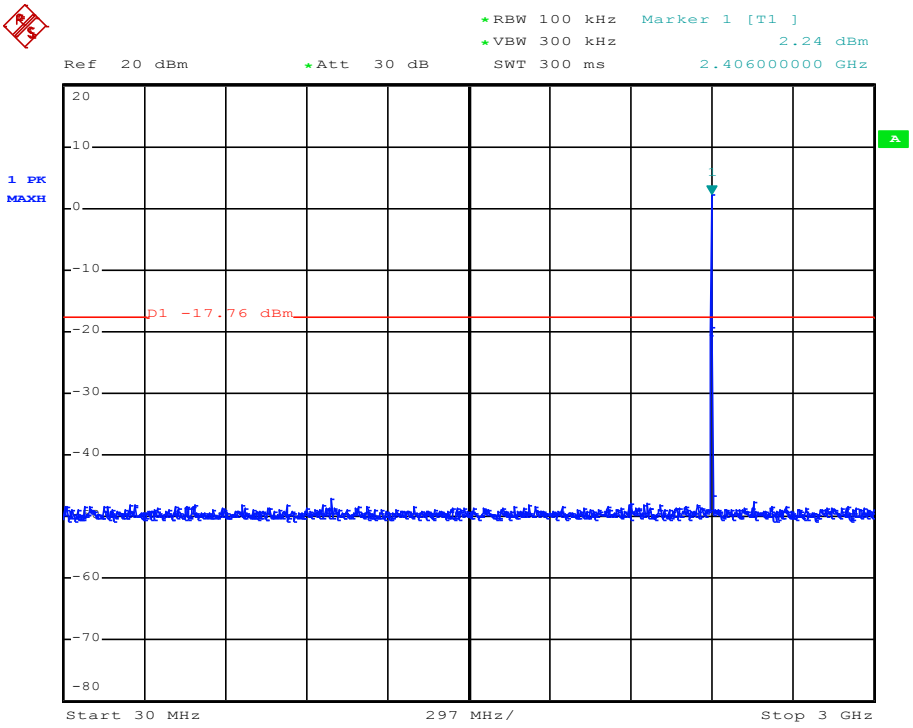
(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the Highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

## 7.7.1 Conducted Spurious Emissions

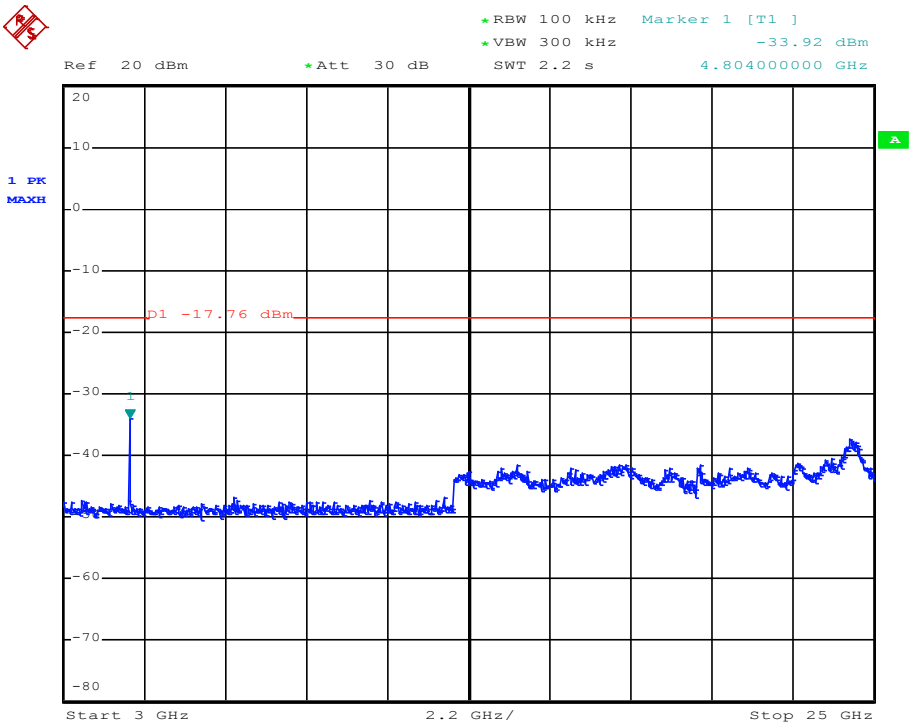
**Test plot as follows:**

Test channel: Lowest

30MHz-3GHz:

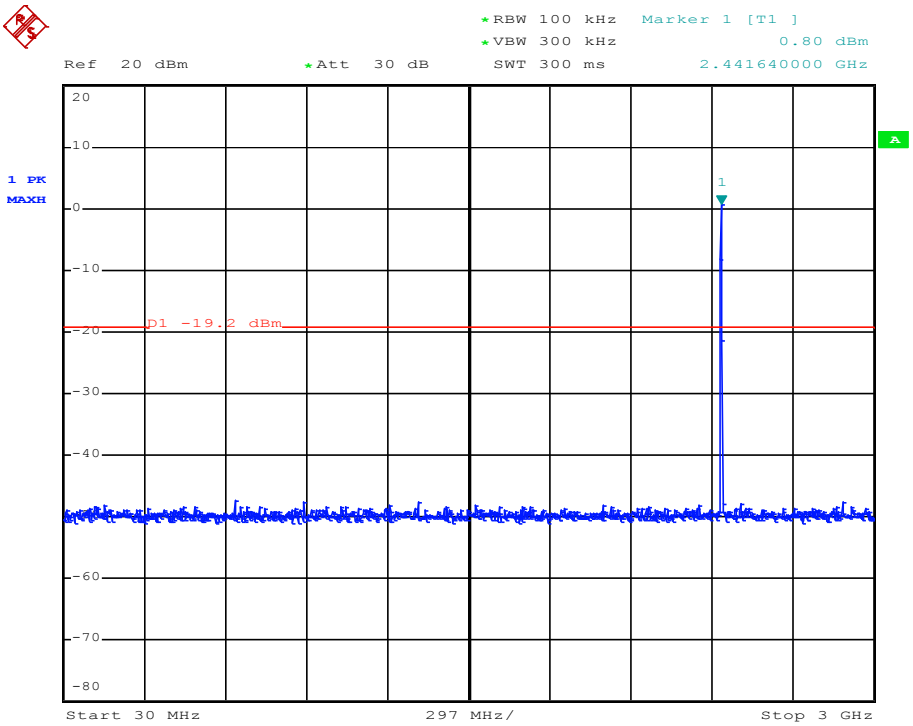



3GHz-25GHz:

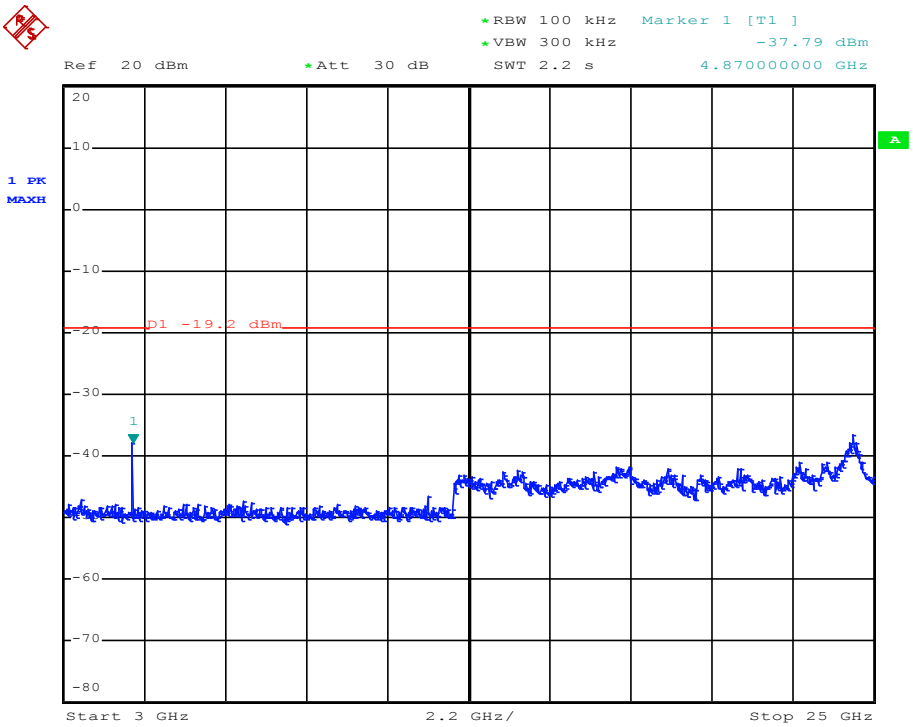


Test channel: Middle

30MHz-3GHz:

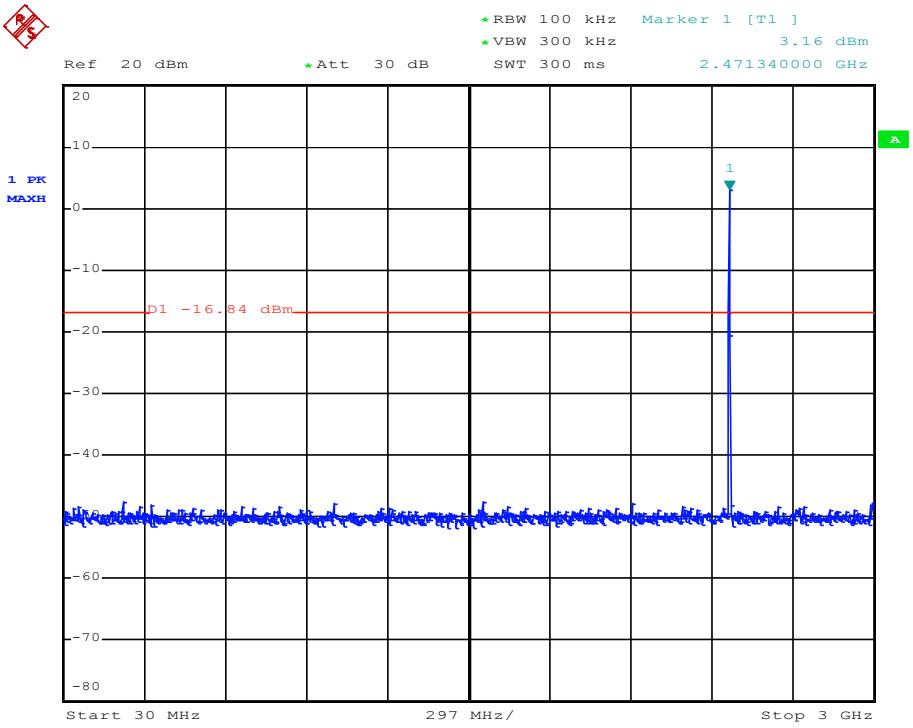



3GHz-25GHz:

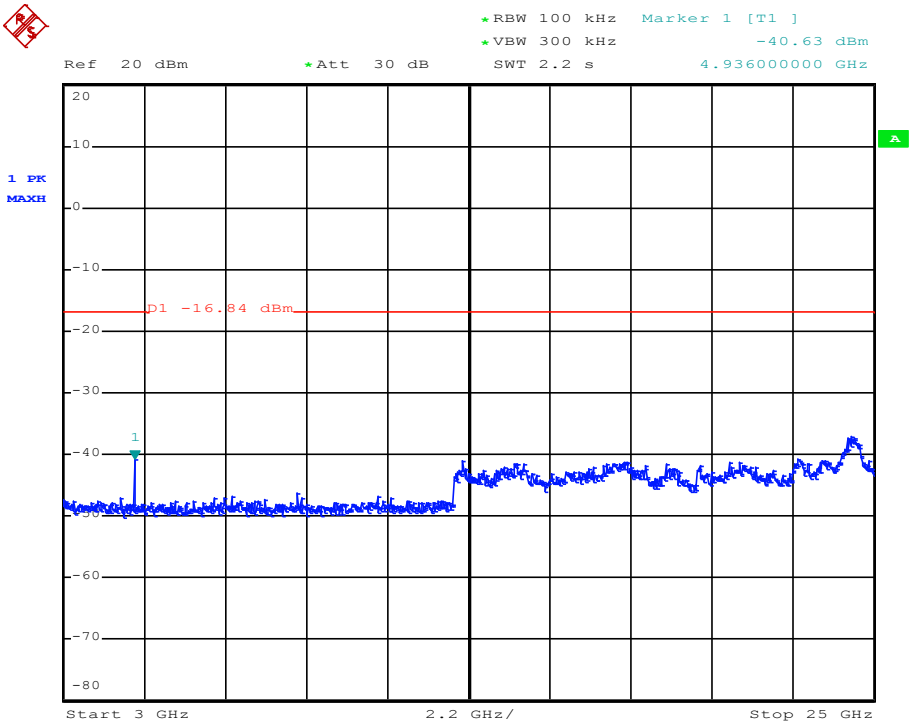


Test channel: Highest

30MHz-3GHz:



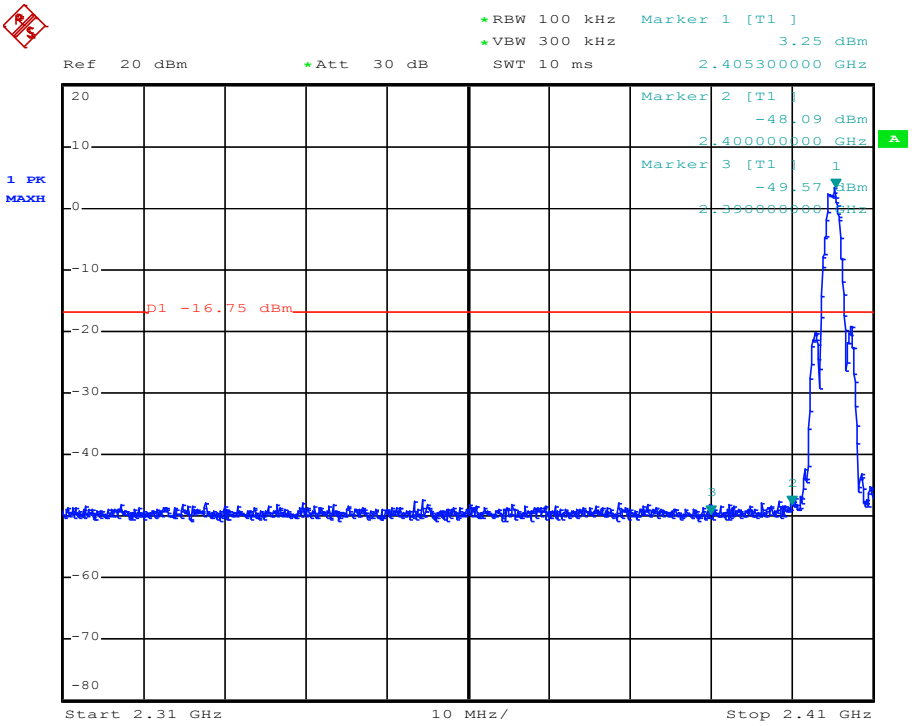

3GHz-25GHz:



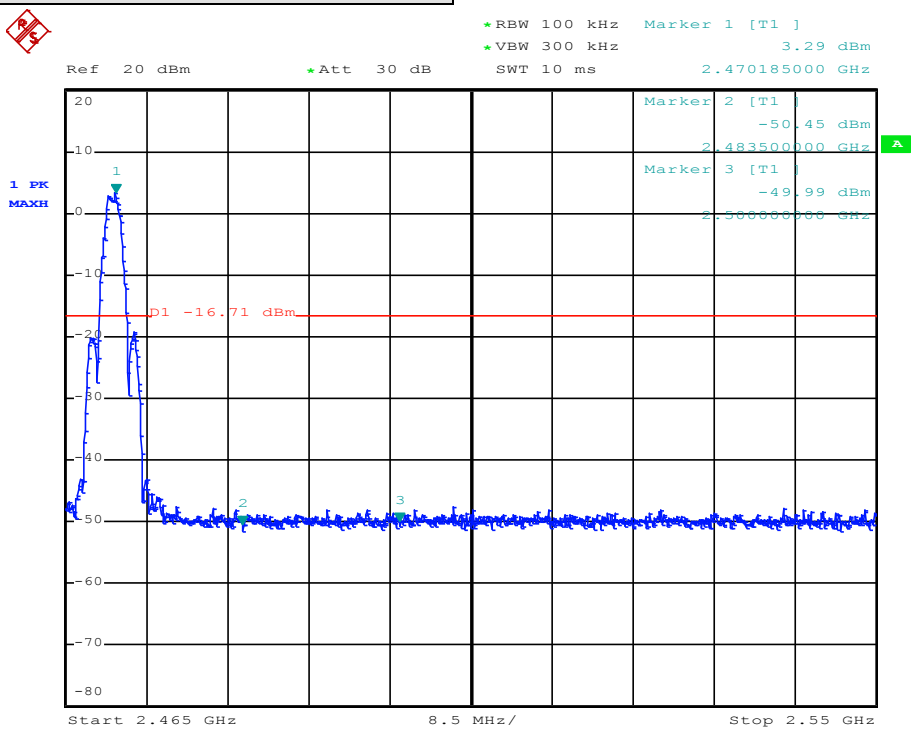
## 7.7.2 Conducted Band-edge

**Test plot as follows:**

Test channel: Lowest




Test channel: Highest



## 7.8 Radiated Spurious Emissions and Band-edge

**Frequency Range:** 9KHz to 25GHz

**Test site/setup:** Measurement Distance: 3m
Test instrumentation set-up:

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

Sweep=Auto

**15.209 Limit:**

| Frequency | Field strength (microvolt/meter) | Limit (dBuV/m) |
|---|---|---|
| 0.009MHz-0.490MHz | 2400/F(KHz) | 128.5 ~ 93.8 |
| 0.490MHz-1.705MHz | 24000/F(KHz) | 73.8 ~63.0 |
| 1.705MHz-30MHz | 30 | 69.5 |
| 30MHz-88MHz | 100 | 40.0 |
| 88MHz-216MHz | 150 | 43.5 |
| 216MHz-960MHz | 200 | 46.0 |
| 960MHz-1GHz | 500 | 54.0 |
| Above 1GHz | 500 | 54.0 |

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.

**Test Configuration:** Receive antenna scan height 1 m - 4 m. polarization Vertical / Horizontal

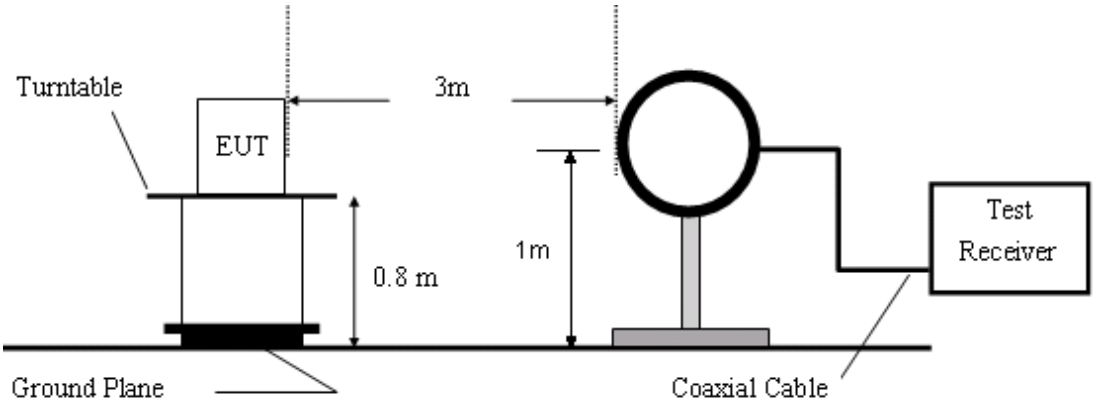



**Figure1. Below 30MHz radiated emissions test configuration**

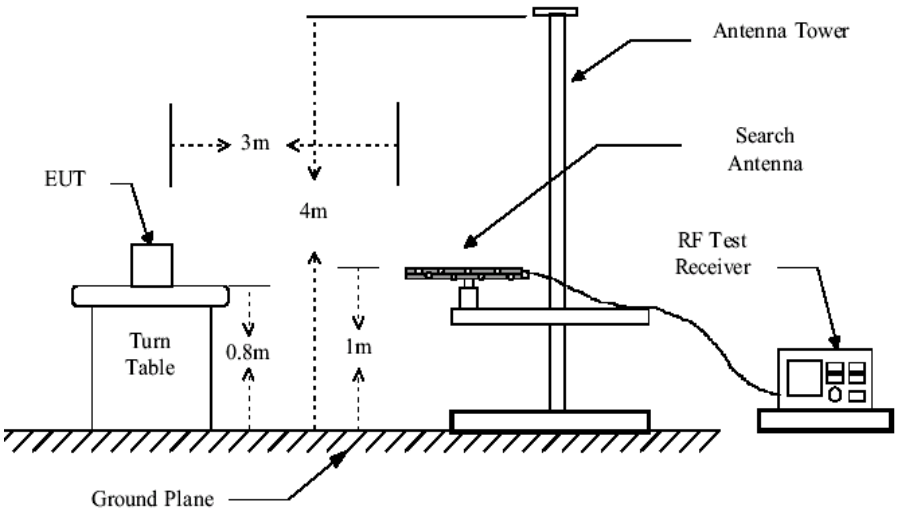



**Figure 2. 30MHz to 1GHz radiated emissions test configuration**

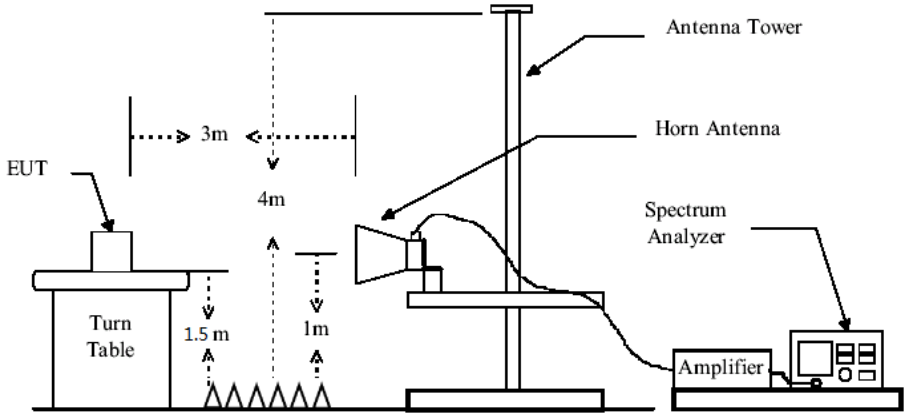



**Figure 3. Above 1GHz radiated emissions test configuration**

**Test Procedure:**

1) The procedure used was ANSI Standard C63.10. The receiver was scanned from 9 KHz to 25GHz.When an emission was found, the table was rotated to produce the maximum signal strength. An initial pre-scan was performed for in peak detection mode using the receiver. The EUT was measured for both the Horizontal and Vertical polarities and performed a pre-test three orthogonal planes. For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. The worst case emissions were reported.
2) Low noise amplifier was used below 1GHz, High pass Filter was used above 3GHz. We did not use any amplifier or filter between 1G and 3GHz.
3) Test were performed for their spatial orthogonal(X, Y, Z), the worst test data (X orthogonal) was submitted.
   a) For this intentional radiator operates below 25 GHz. the spectrum shall be investigated to the tenth harmonic of the highest fundamental frequency. And above the third harmonic of this intentional radiator, the disturbance is very low. So the test result only displays to 5rd harmonic.
   b) As shown in Section, for frequencies above 1000MHz. the above 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.
4) No spurious emissions were detected within 20dB of limit below 30MHz.

**Test Result:** Pass

### 7.8.1 Radiated Spurious Emissions

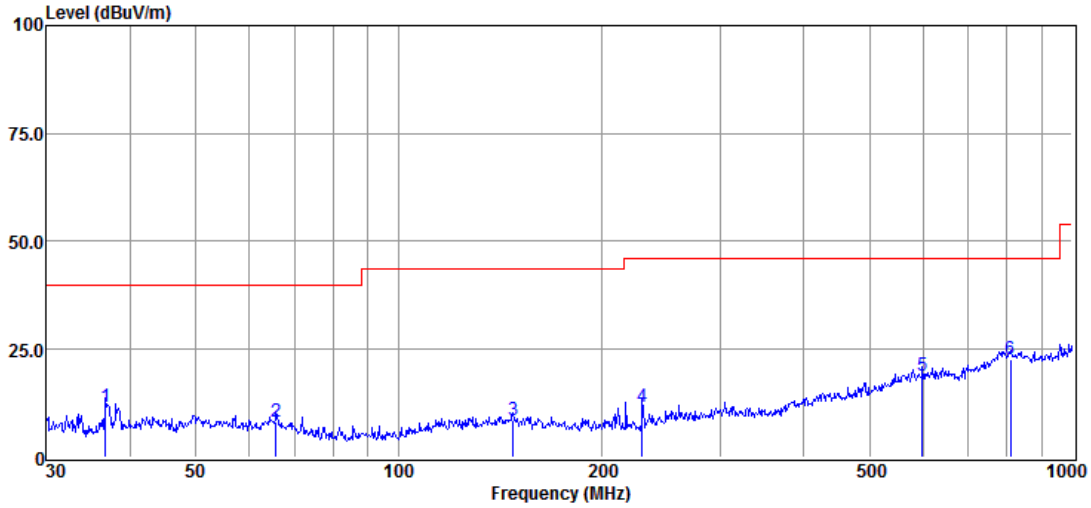
**30MHz-1GHz:**

**lowest Channel**

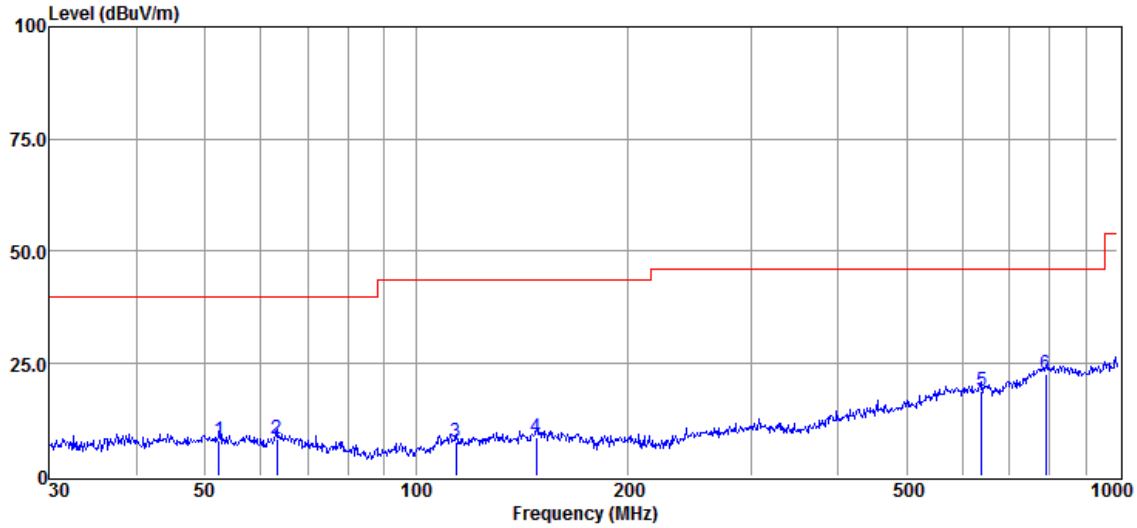
| Item | Freq. | Read Level | Antenna Factor | Preamp Factor | Cable Loss | Result Level | Limit Line | Over Limit | Detector | Polarization |
|---|---|---|---|---|---|---|---|---|---|---|
| (Mark) | (MHz) | (dBμV) | (dB/m) | (dB) | (dB) | (dBμV/m) | (dBμV/m) | (dB) | | |
| 1 | 52.39 | 37.05 | 13.52 | 43.76 | 1.15 | 7.96 | 40.00 | -32.04 | QP | Horizontal |
| 2 | 63.31 | 38.30 | 12.51 | 43.71 | 1.21 | 8.31 | 40.00 | -31.69 | QP | Horizontal |
| 3 | 114.11 | 38.38 | 11.27 | 43.56 | 1.30 | 7.39 | 43.50 | -36.11 | QP | Horizontal |
| 4 | 148.44 | 37.79 | 12.73 | 43.49 | 1.49 | 8.52 | 43.50 | -34.98 | QP | Horizontal |
| 5 | 640.61 | 38.41 | 20.31 | 43.11 | 3.38 | 18.99 | 46.00 | -27.01 | QP | Horizontal |
| 6 | 790.62 | 38.67 | 23.36 | 43.06 | 3.83 | 22.80 | 46.00 | -23.20 | QP | Horizontal |
| 1 | 36.77 | 41.74 | 12.94 | 43.85 | 0.98 | 11.81 | 40.00 | -28.19 | QP | Vertical |
| 2 | 65.80 | 38.22 | 12.50 | 43.70 | 1.24 | 8.26 | 40.00 | -31.74 | QP | Vertical |
| 3 | 147.92 | 37.74 | 12.70 | 43.49 | 1.49 | 8.44 | 43.50 | -35.06 | QP | Vertical |
| 4 | 230.10 | 43.19 | 10.00 | 43.38 | 1.95 | 11.76 | 46.00 | -34.24 | QP | Vertical |
| 5 | 599.32 | 38.51 | 20.24 | 43.13 | 3.23 | 18.85 | 46.00 | -27.15 | QP | Vertical |
| 6 | 810.27 | 38.14 | 23.61 | 43.05 | 3.87 | 22.57 | 46.00 | -23.43 | QP | Vertical |

Result Level = Read Level + Antenna Factor + Cable loss - Preamp Factor

Below is the plot of worst case on lowest channel:
Vertical:




Horizontal:



**Above 1GHz:**

**Lowest Channel**

| Mark | Frequency (MHz) | Reading (dBuV) | Factor (dB) | Emission (dBuV/m) | Limit (dBuV/m) | Over Limit (dB) | Detector | polarization |
|---|---|---|---|---|---|---|---|---|
| 1 | 4810 | 44.32 | 6.2 | 50.52 | 54 | -3.48 | peak | Horizontal |
| 2 | 7215 | 39.52 | 10.67 | 50.19 | 54 | -3.81 | peak | Horizontal |
| 3 | 9620 | 33.26 | 14.37 | 47.63 | 54 | -6.37 | peak | Horizontal |
| 4 | 4810 | 42.41 | 6.2 | 48.61 | 54 | -5.39 | peak | Vertical |
| 5 | 7215 | 38.36 | 10.67 | 49.03 | 54 | -4.97 | peak | Vertical |
| 6 | 9620 | 35.06 | 14.37 | 49.43 | 74 | -4.57 | peak | Vertical |

**Middle Channel**

| Mark | Frequency (MHz) | Reading (dBuV) | Factor (dB) | Emission (dBuV/m) | Limit (dBuV/m) | Over Limit (dB) | Detector | polarization |
|---|---|---|---|---|---|---|---|---|
| 1 | 4880 | 45.18 | 6.95 | 52.13 | 54 | -1.87 | peak | Horizontal |
| 2 | 7320 | 39.83 | 11.13 | 50.96 | 54 | -3.04 | peak | Horizontal |
| 3 | 9760 | 31.46 | 14.35 | 45.81 | 54 | -8.19 | peak | Horizontal |
| 4 | 4880 | 38.68 | 6.95 | 45.63 | 54 | -8.37 | peak | Vertical |
| 5 | 7320 | 39.24 | 11.13 | 50.37 | 54 | -3.63 | peak | Vertical |
| 6 | 9760 | 33.23 | 14.35 | 47.58 | 54 | -6.42 | peak | Vertical |

**Highest Channel**

| Mark | Frequency (MHz) | Reading (dBuV) | Factor (dB) | Emission (dBuV/m) | Limit (dBuV/m) | Over Limit (dB) | Detector | polarization |
|---|---|---|---|---|---|---|---|---|
| 1 | 4940 | 39.73 | 7.37 | 47.1 | 54 | -6.9 | peak | Horizontal |
| 2 | 7410 | 37.62 | 11.53 | 49.15 | 54 | -4.8 | peak | Horizontal |
| 3 | 9880 | 32.04 | 14.39 | 46.43 | 54 | -7.57 | peak | Horizontal |
| 4 | 4940 | 38.43 | 7.37 | 45.8 | 54 | -8.2 | peak | Vertical |
| 5 | 7410 | 39.84 | 11.53 | 51.37 | 54 | -2.63 | peak | Vertical |
| 6 | 9880 | 33.22 | 14.39 | 47.61 | 54 | -6.39 | peak | Vertical |

Remark: 1) Emission = Receiver Reading + Factor

2) Factor = Antenna Factor + Cable Loss + Pre-amplifier Factor.

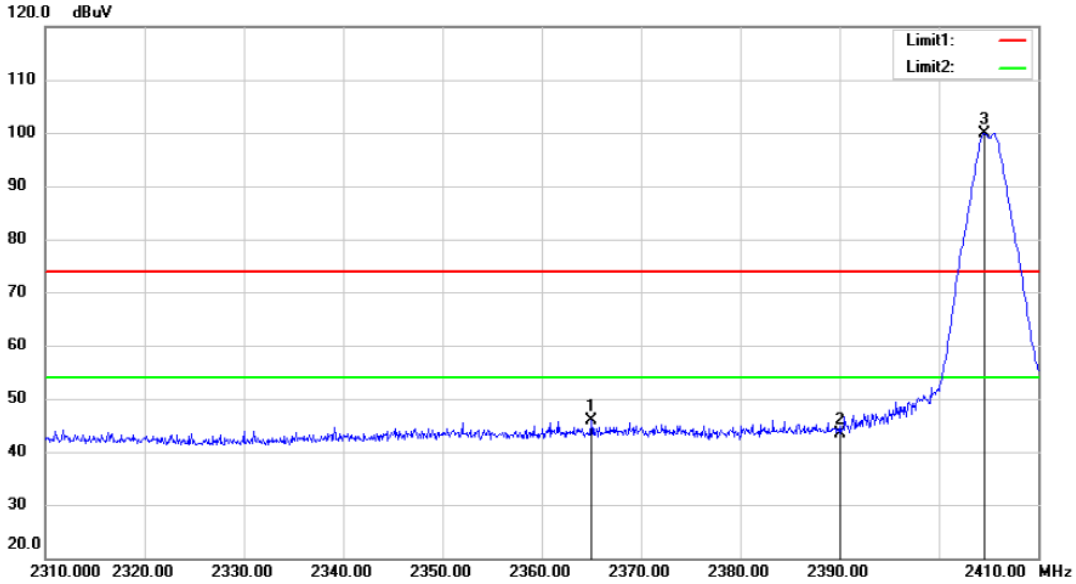
3) If the Peak value below the AV Limit, the AV test doesn't perform for this submission.

### 7.8.2 Radiated Band-edge

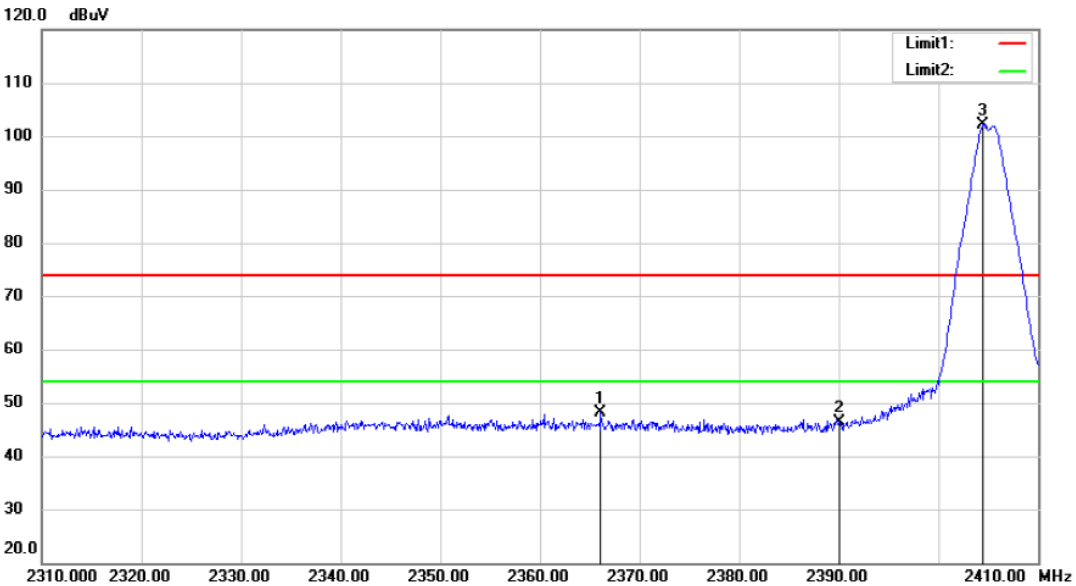
**Lowest Channel**

| MK. | Frequency (MHz) | Reading (dBuV/m) | Corrected factor(dB) | Result (dBuV/m) | Limit (dBuV/m) | Over Limit (dB) | Detector | Polarization |
|---|---|---|---|---|---|---|---|---|
| 1 | 2365 | 49.57 | -3.81 | 45.76 | 54 | -8.24 | Peak | Horizontal |
| 2 | 2390 | 47.3 | -3.89 | 43.41 | 54 | -10.59 | Peak | Horizontal |
| 3 | 2404.6 | 103.84 | -3.92 | 99.92 | 54 | 45.92 | Peak | Horizontal |
| 1 | 2366.1 | 51.86 | -3.81 | 48.05 | 54 | -5.95 | Peak | Vertical |
| 2 | 2390 | 50.19 | -3.89 | 46.3 | 54 | -7.7 | Peak | Vertical |
| 3 | 2404.5 | 106.08 | -3.92 | 102.16 | 54 | 48.16 | Peak | Vertical |

Horizontal



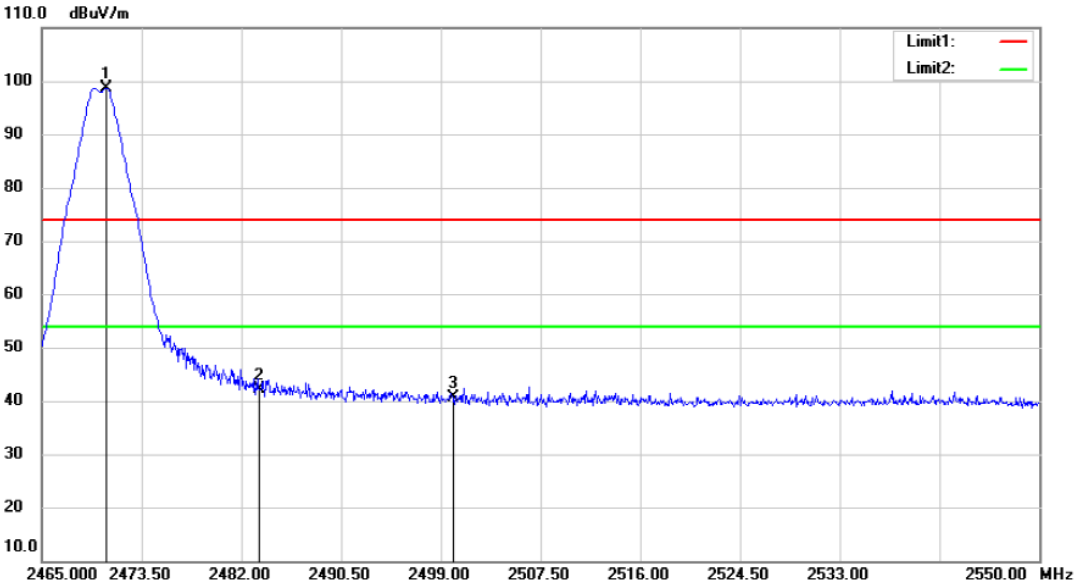

Vertical



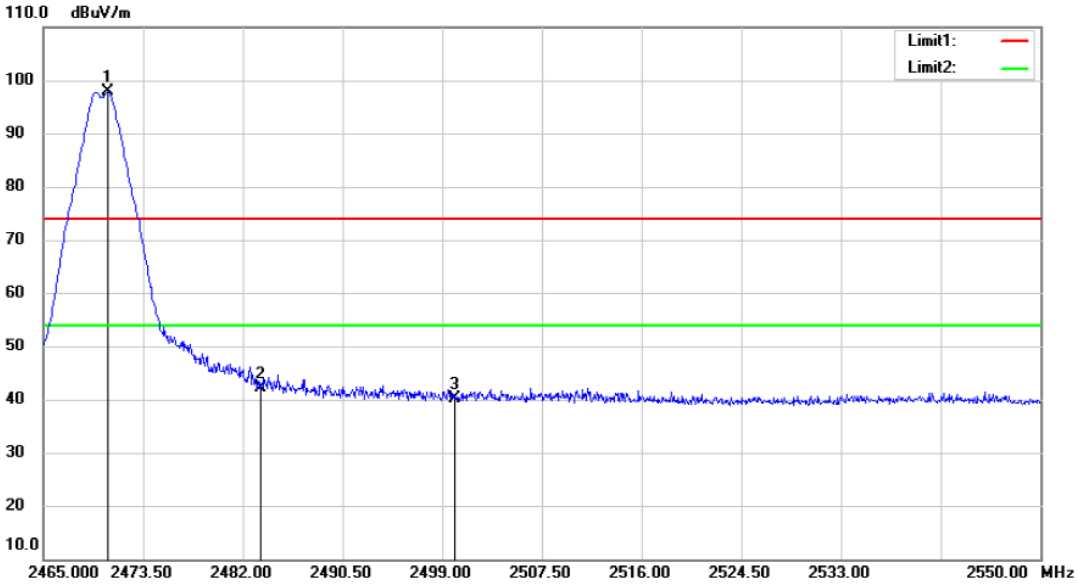
**Lowest Channel**

| MK. | Frequency (MHz) | Reading (dBuV/m) | Corrected factor(dB) | Result (dBuV/m) | Limit (dBuV/m) | Over Limit (dB) | Detector | Polarization |
|---|---|---|---|---|---|---|---|---|
| 1 | 2470.44 | 102.69 | -4 | 98.69 | 54 | 44.69 | Peak | Horizontal |
| 2 | 2483.5 | 46.25 | -4.01 | 42.24 | 54 | -11.76 | Peak | Horizontal |
| 3 | 2500 | 44.74 | -4.03 | 40.71 | 54 | -13.29 | Peak | Horizontal |
| 1 | 2470.44 | 101.8 | -4 | 97.8 | 54 | 43.8 | Peak | Vertical |
| 2 | 2483.5 | 46.03 | -4.01 | 42.02 | 54 | -11.98 | Peak | Vertical |
| 3 | 2500 | 44.16 | -4.03 | 40.13 | 54 | -13.87 | Peak | Vertical |

Horizontal




Vertical



Remark: 1). Test Level = Receiver Reading + Antenna Factor + Cable Loss- Preamplifier Factor

2). If the Peak value below the AV Limit, the AV test doesn't perform for this submission.

All frequencies within the "Restricted bands" have been evaluated to compliance. Except as shown in paragraph of this section, only spurious emissions are permitted in any of the frequency bands listed below:

a. FCC Part 15, Subpart C Section 15.205 Restricted bands of operation.

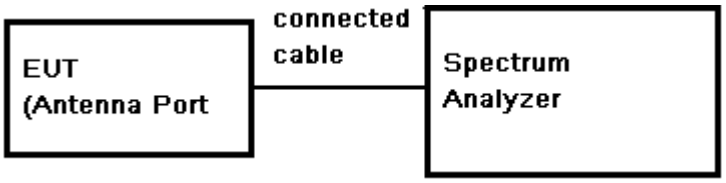
| MHz | MHz | MHz | GHz |
|---|---|---|---|
| 0.090 - 0.110 | 16.42 - 16.423 | 399.9 - 410 | 4.5 - 5.15 |
| [1]0.495 - 0.505 | 16.69475 - 16.69525 | 608 - 614 | 5.35 - 5.46 |
| 2.1735 - 2.1905 | 16.80425 - 16.80475 | 960 - 1240 | 7.25 - 7.75 |
| 4.125 - 4.128 | 25.5 - 25.67 | 1300 - 1427 | 8.025 - 8.5 |
| 4.17725 - 4.17775 | 37.5 - 38.25 | 1435 - 1626.5 | 9.0 - 9.2 |
| 4.20725 - 4.20775 | 73 - 74.6 | 1645.5 - 1646.5 | 9.3 - 9.5 |
| 6.215 - 6.218 | 74.8 - 75.2 | 1660 - 1710 | 10.5 - 12.7 |
| 6.26775 - 6.26825 | 108 - 121.94 | 1718.8 - 1722.2 | 13.25 - 13.4 |
| 6.31175 - 6.31225 | 123 - 138 | 2200 - 2300 | 14.47 - 14.5 |
| 8.291 - 8.294 | 149.9 - 150.05 | 2310 - 2390 | 15.35 - 16.2 |
| 8.362 - 8.366 | 156.52475 - 156.52525 | 2483.5 - 2500 | 17.7 - 21.4 |
| 8.37625 - 8.38675 | 156.7 - 156.9 | 2655 - 2900 | 22.01 - 23.12 |
| 8.41425 - 8.41475 | 162.0125 - 167.17 | 3260 - 3267 | 23.6 - 24.0 |
| 12.29 - 12.293 | 167.72 - 173.2 | 3332 - 3339 | 31.2 - 31.8 |
| 12.51975 - 12.52025 | 240 - 285 | 3345.8 - 3358 | 36.43 - 36.5 |
| 12.57675 - 12.57725 | 322 - 335.4 | 3600 - 4400 | |
| 13.36 - 13.41 | | | |

b. RSS-Gen section 7.2.2 Restricted bands of operation

| MHz | MHz | GHz |
|---|---|---|
| 0.090-0.110 | 240-285 | 9.0-9.2 |
| 2.1735-2.1905 | 322-335.4 | 9.3-9.5 |
| 3.020-3.026 | 399.9-410 | 10.6-12.7 |
| 4.125-4.128 | 608-614 | 13.25-13.4 |
| 4.17725-4.17775 | 960-1427 | 14.47-14.5 |
| 4.20725-4.20775 | 1435-1626.5 | 15.35-16.2 |
| 5.677-5.683 | 1645.5-1646.5 | 17.7-21.4 |
| 6.215-6.218 | 1660-1710 | 22.01-23.12 |
| 6.26775-6.26825 | 1718.8-1722.2 | 23.6-24.0 |
| 6.31175-6.31225 | 2200-2300 | 31.2-31.8 |
| 8.291-8.294 | 2310-2390 | 36.43-36.5 |
| 8.362-8.366 | 2655-2900 | Above 38.6 |
| 8.37625-8.38675 | 3260-3267 | |
| 8.41425-8.41475 | 3332-3339 | |
| 12.29-12.293 | 3345.8-3358 | |
| 12.51975-12.52025 | 3500-4400 | |
| 12.57675-12.57725 | 4500-5150 | |
| 13.36-13.41 | 5350-5460 | |
| 16.42-16.423 | 7250-7750 | |
| 16.69475-16.69525 | 8025-8500 | |
| 16.80425-16.80475 | | |
| 25.5-25.67 | | |
| 37.5-38.25 | | |
| 73-74.6 | | |
| 74.8-75.2 | | |
| 108-138 | | |
| 156.52475-156.52525 | | |
| 156.7-156.9 | | |

## 7.1 99% Occupied Bandwidth

**Test Configuration:**




**Test Procedure:**

1) Place the EUT on the table and set it in transmitting mode.
2) Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3) Set the spectrum analyzer: Span = approximately 2 to 3 times the 20dB bandwidth, RBW >= 1% of the 20dB bandwidth. VBW >= RBW. Sweep = auto; Detector Function = Peak. Trace = Max Hold.
4) Mark the peak frequency and 99% bandwidth points.
5) Repeat above procedures until all frequency measured was complete.

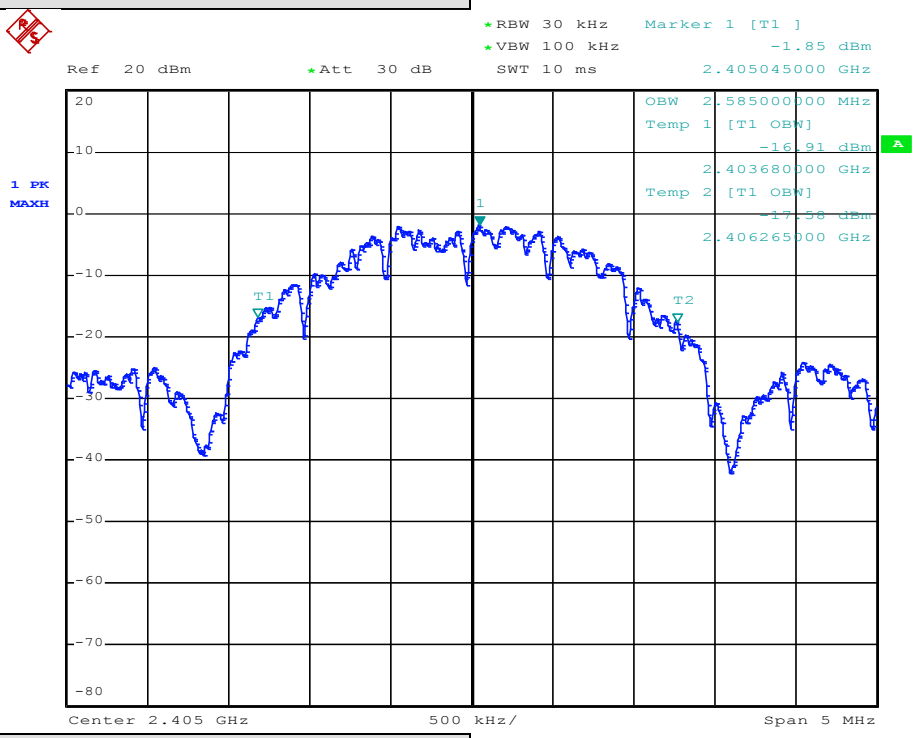
**Limit:** ≥ 500 kHz

**Test date:**

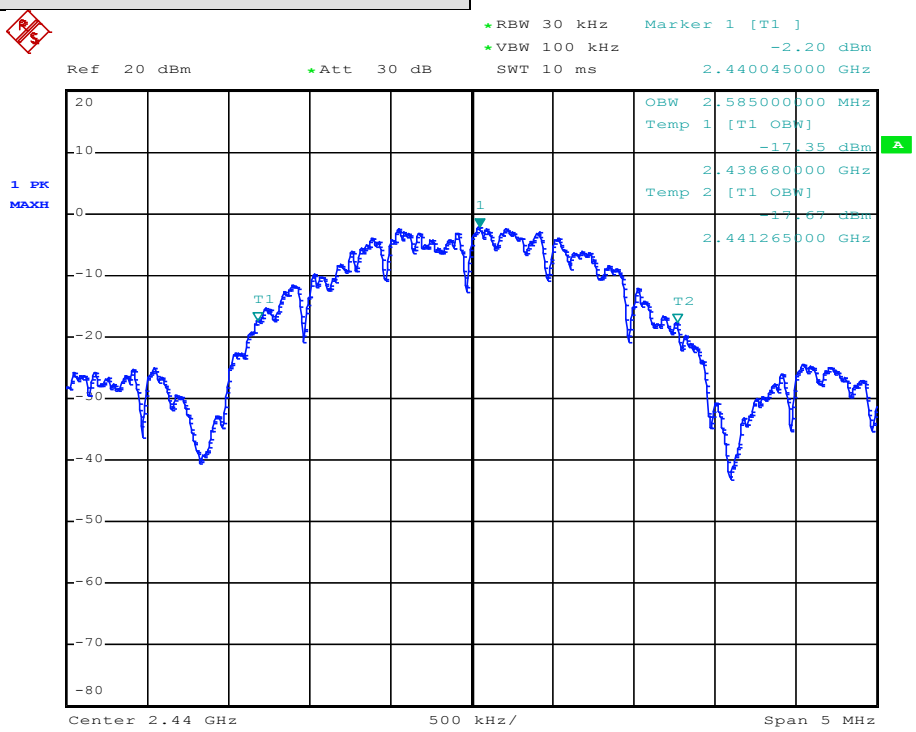
| Test Channel | Test Frequency (MHz) | Bandwidth (MHz) |
|---|---|---|
| Lowest | 2405 | 2.585 |
| Middle | 2440 | 2.585 |
| Highest | 2470 | 2.580 |

**Test plot as follows:**

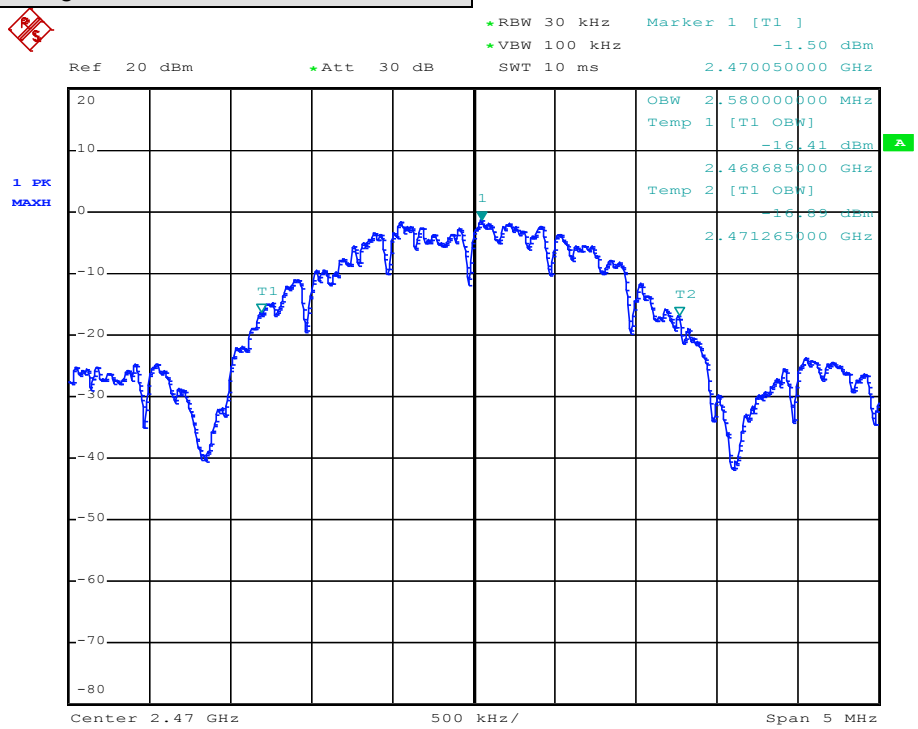
Test channel: Lowest




Test channel: Middle



Test channel: Highest



# 8 Test Setup Photographs

Refer to the < Test Setup photos-FCC>.

# 9 EUT Constructional Details

Refer to the < External Photos> & < Internal Photos>.

**--End of the Report--**