# FCC Part 15.247

# TEST REPORT

For

# Topeak, Inc

**8F-4, No.20, Dalong Road, Taichung, Taiwan.**

FCC ID: R3S-HRM05

| **Report Type:** | **Product Type:** |
|---|---|
| Original Report | Duoband Heart Rate Monitor |

| | |
|---|---|
| **Report Producer:** | Kaylee Chiang |
| **Report Number:** | RTWA161118001-00A |
| **Report Date:** | 2016-12-02 |
| **Reviewed By:** | Jerry Chang |

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# REVISION HISTORY

| Revision | Issue Date | Description |
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# 1 General Information

## 1.1 Product Description for Equipment Under Test (EUT)

| | |
|---|---|
| **Applicant:** | Topeak, Inc<br>8F-4, No.20, Dalong Road, Taichung, Taiwan. |
| **Manufacturer:** | Alatech Technology Limited<br>39F,No.758, JungMing S. Rd., South Dist., Taichung City 40255, Taiwan |
| **Product:** | Duoband Heart Rate Monitor |
| **Model:** | TPB-HRM05 |
| **Trade Name:** | TOPEAK |
| **Frequency Range:** | 2402-2480 MHz |
| **Transmit Power:** | BT BLE Mode: -3.79 dBm |
| **Modulation Technique:** | BT BLE Mode: GFSK |
| **Transmit Data Rate:** | BT BLE Mode: 1 Mbps |
| **Number of Channels:** | BT BLE Mode: 40 Channels |
| **Antenna Specification:** | PCB Antenna/Gain: 4.21 dBi |
| **Voltage Range:** | 3Vdc from Battery |
| **Date of Test:** | Nov 28, 2016~Dec 02, 2016 |

**All measurement and test data in this report was gathered from production sample serial number: 161118001 (Assigned by BACL, Taiwan) The EUT supplied by the applicant was received on 2016-11-23.*

*Designation Number: TW1101*

## 1.2 Objective

This report is prepared on behalf of *Topeak, Inc* in accordance with Part 2, Subpart J, Part 15, Subparts A, B and C of the Federal Communication Commission's rules.

The objective is to determine compliance with FCC Part 15.247 rules for Output Power, Antenna Requirements, 6 dB Bandwidth, and power spectral density, 100 kHz Bandwidth of Band Edges Measurement, Conducted and Radiated Spurious Emissions.

## 1.3 Related Submittal(s)/Grant(s)

FCC Part 15.249 DXX submission with FCC ID: R3S-HRM05

## 1.4 Test Methodology

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

## 1.5 Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Taiwan) to collect test data is located on the 70, Lane 169, Sec. 2, Datong Road, Xizhi Dist., New Taipei City 22183, Taiwan, R.O.C.

Test site at Bay Area Compliance Laboratories Corp. (Taiwan) has been fully described in reports submitted to the Federal Communication Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on December 06, 2014. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.10.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 431084. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

# 2 System Test Configuration

## 2.1 Description of Test Configuration

For BT BLE mode, 40 channels are provided to testing:

| Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---|---|---|---|
| 1 | 2402 | 21 | 2442 |
| 2 | 2404 | -- | -- |
| 3 | 2406 | -- | -- |
| 4 | 2408 | 38 | 2476 |
| -- | -- | 39 | 2478 |
| 20 | 2440 | 40 | 2480 |

## 2.2 Equipment Modifications

No modification was made to the EUT

## 2.3 EUT Exercise Software

N/A

## 2.4 Support Equipment List and Details

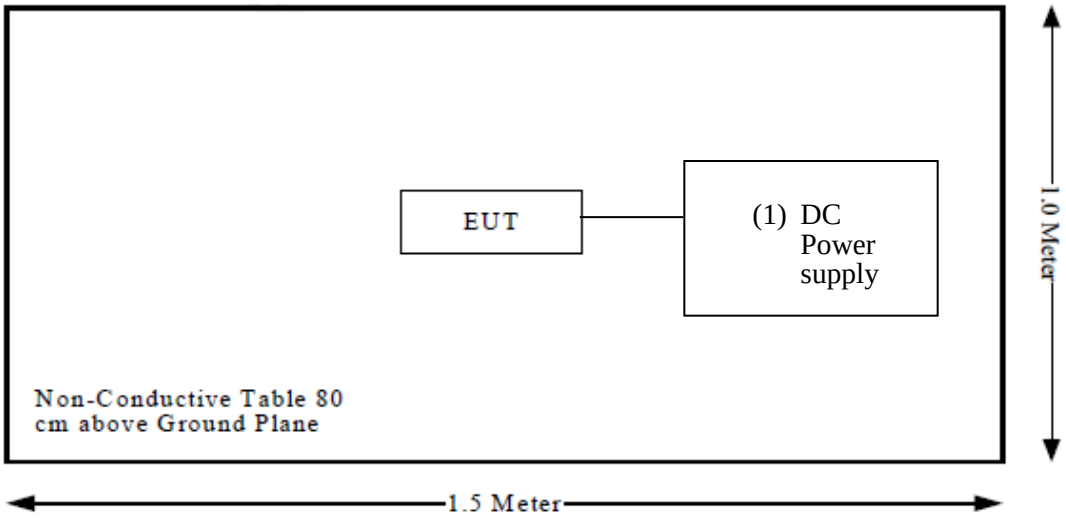
| Description | Manufacturer | Model Number | BSMI | FCC ID | S/N |
|---|---|---|---|---|---|
| Power supply | Instek | GPC-3030BQ | N/A | N/A | B843809 |

## 2.5 External Cable List and Details

| Cable Description | Length (m) | From | To |
|---|---|---|---|
| N/A | N/A | N/A | N/A |

## 2.6 Block Diagram of Test Setup

See test photographs attached in Exhibit A for the actual connections between EUT and support equipment.



# 3 Summary of Test Results

| FCC Rules | Description of Test | Result |
|---|---|---|
| §15.247(i), §2.1093 | RF Exposure | Compliance |
| §15.203 | Antenna Requirement | Compliance |
| §15.207(a) | AC Line Conducted Emissions | Not Applicable |
| §15.205, §15.209, §15.247(d) | Spurious Emissions | Compliance |
| §15.247(a)(2) | 6 dB Emission Bandwidth | Compliance |
| §15.247(b)(3) | Maximum Peak Output Power | Compliance |
| §15.247(d) | 100 kHz Bandwidth of Frequency Band Edge | Compliance |
| §15.247(e) | Power Spectral Density | Compliance |

Note: It is battery operated equipment.

# 4 FCC §15.247(i) & 2.1093 - RF Exposure

## 4.1 Applicable Standard

According to FCC §15.247(i)

Systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

According to KDB 447498 D01 General RF Exposure Guidance, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances
≤ 50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] ·
[ √ f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

1. f(GHz) is the RF channel transmit frequency in GHz.
2. Power and distance are rounded to the nearest mW and mm before calculation.
3. The result is rounded to one decimal place for comparison.
4. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test Exclusion.

## 4.2 RF Exposure Evaluation Result

FCC
Worse case:

| Frequency (MHz) | Tune-up Power | | Evaluation Distance (mm) | SAR Exclusion Result | SAR Exclusion Limit (1g SAR) |
|---|---|---|---|---|---|
| | (dBm) | (mW) | | | |
| 2480 | -3.79 | 0.418 | 5 | 0.133 | 3 |

Result: SAR test is exempted.

# 5 FCC §15.203 – Antenna Requirements

## 5.1 Applicable Standard

According to § 15.203,

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

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceed 6 dBi.

## 5.2 Antenna List and Details

| Manufacturer | Type | Antenna Gain | Result |
|---|---|---|---|
| Alatech Technology Limited | PCB Antenna | 4.21 dBi | Compliance |

The EUT has one integral antenna arrangement, which was permanently attached; fulfill the requirement of this section. Please refer to the internal photos.

# 6 FCC §15.209, §15.205 , §15.247(d) – Spurious Emissions

## 6.1 Applicable Standard

FCC§15.247 (d); §15.209; §15.205

## 6.2 Measurement Uncertainty

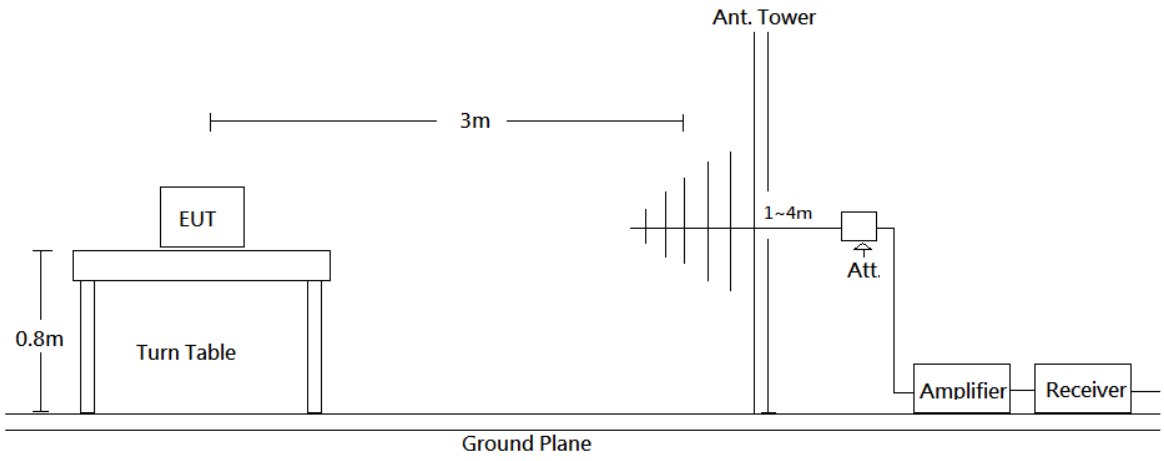
All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on CISPR 16-4-2:2011, the expended combined standard uncertainty of radiation emissions at Bay Area Compliance Laboratories Corp. (Taiwan) is shown in below table. And the uncertainty will not be taken into consideration for the test data recorded in the report.

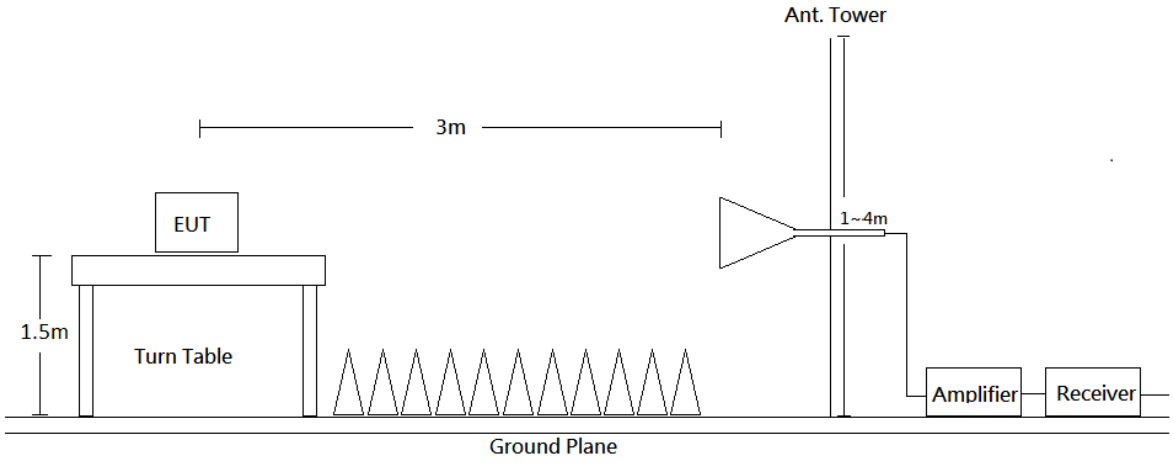
| Frequency | Measurement uncertainty |
|---|---|
| 30 MHz~200 MHz | 4.21 dB (k=2, 95% level of confidence) |
| 200 MHz~1 GHz | 4.41 dB (k=2, 95% level of confidence) |
| 1 GHz~6 GHz | 4.51 dB (k=2, 95% level of confidence) |
| 6 GHz~18 GHz | 4.88 dB (k=2, 95% level of confidence) |
| 18 GHz~26 GHz | 4.30 dB (k=2, 95% level of confidence) |
| 26 GHz~40 GHz | 4.30 dB (k=2, 95% level of confidence) |

## 6.3 EUT Setup

Blow 1 GHz:



Above 1 GHz:




Radiated emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC Part 15.209 and FCC 15.247 Limits.

## 6.4 EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 26.5 GHz. During the radiated emission test, the EMI test receiver was set with the following configurations measurement method 6.3 in ANSI C63.10.

Set RBW = 1 MHz, VBW= 3MHz for f > 1 GHz for peak measurement. For average measurement: VBW = 10 Hz, when duty cycle is no less than 98 percent. VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

| Frequency Range | RBW | VBW | IF BW | Detector |
|---|---|---|---|---|
| 30-1000 MHz | 100 kHz | 300 kHz | 120 kHz | QP |
| Above 1 GHz | 1 MHz | 3 MHz | / | PK |
| | 1 MHz | 10 Hz | / | Ave |

## 6.5 Test Procedure

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

All data was recorded in the Quasi-peak detector mode from 30 MHz to 1 GHz and PK and average detector modes for frequencies above 1 GHz.

## 6.6 Corrected Factor & Margin Calculation

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

Correct Factor = Antenna Factor + Cable Loss - Amplifier Gain

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

Margin = Result –Limit

## 6.7 Test Results Summary

According to the data in the following table, the EUT complied with the FCC §15.209 Limit. Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$Lm + U(Lm) \leq Llim + Ucispr$

In BACL, U(Lm) is less than Ucispr, if Lm is less than Llim, it implies that the EUT complies with the limit.

## 6.8 Test Equipment List and Details

| Description | Manufacturer | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| Broadband Antenna | Sunol Sciences | JB6 | A050115 | 2016/11/16 | 2017/11/15 |
| Attenuator | Mini-Circuits | UNAT-6+ | 15542_01 | 2016/11/16 | 2017/11/15 |
| Preamplifier | Sonoma | 310N | 130602 | 2016/7/15 | 2017/7/14 |
| Horn Antenna | EMCO | 3115 | 9311-4158 | 2016/5/10 | 2017/5/9 |
| Horn Antenna | ETS-Lindgren | 3116 | 00062638 | 2016/9/5 | 2017/9/4 |
| Preamplifier | EMEC | EM01G18G | 060657 | 2015/12/21 | 2016/12/20 |
| Preamplifier | EMEC | EM18G40G | 060656 | 2015/12/21 | 2016/12/20 |
| Active Loop Antenna | ETS-Lindgren | 6502 | 00035796 | 2015/7/23 | 2018/7/22 |
| EMI Test Receiver | Rohde & Schwarz | ESR7 | 101419 | 2016/11/3 | 2017/11/2 |
| Mircoflex Cable | UTIFLEX | UFB311A-Q-1440-300300 | 220490-006 | 2016/11/2 | 2017/11/1 |
| Mircoflex Cable | UTIFLEX | UFB197C-1-2362-70U-70U | 225757-001 | 2016/7/15 | 2017/7/14 |
| Mircoflex Cable | UTIFLEX | UFA210A-1-3149-300300 | MFR64639 226389-001 | 2015/12/2 | 2016/12/1 |
| Spectrum Analyzer | Rohde & Schwarz | FSEK30 | 825084/006 | 2015/12/24 | 2016/12/23 |
| Mircoflex Cable | ROSNAL | K1K50-UP0264-K1K50-80CM | 160309-2 | 2016/3/24 | 2017/3/23 |
| Mircoflex Cable | ROSNAL | K1K50-UP0264-K1K50-450CM | 160309-1 | 2016/3/24 | 2017/3/23 |
| Turn Table | Champro | TT-2000 | 060772-T | N.C.R | N.C.R |
| Antenna Tower | Champro | AM-BS-4500-B | 060772-A | N.C.R | N.C.R |
| Controller | Champro | EM1000 | 060772 | N.C.R | N.C.R |
| software | Rohde & Schwarz | EMC32 | BACL-03A1 | N.C.R | N.C.R |
| Spectrum Analyzer | Rohde & Schwarz | FSU26 | 200268 | 2016/5/7 | 2017/5/6 |
| Cable | WOKEN | SFL402 | 00100A1F6A192S | 2015/12/18 | 2016/12/17 |

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

## 6.9 Test Environmental Conditions

| | |
|---|---|
| **Temperature:** | 25.2° C |
| **Relative Humidity:** | 58 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by David Hsu on 2016-11-28 to 2016-11-29.*

## 6.10 Test Results

Mode: Test Mode

**Below 1 GHz, 2402 MHz**

**Horizontal**

| No. | Frequency | Reading | Correct | Result | Limit | Margin | Height | Degree | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | Factor(dB/m) | (dBuV/m) | (dBuV/m) | (dB) | (cm) | ( ˚ ) | |
| 1 | 30.9700 | 26.55 | -4.33 | 22.22 | 40.00 | -17.78 | 100 | 341 | QP |
| 2 | 137.6700 | 26.68 | -10.96 | 15.72 | 43.50 | -27.78 | 100 | 304 | QP |
| 3 | 372.4100 | 27.25 | -8.52 | 18.73 | 46.00 | -27.27 | 100 | 302 | QP |
| 4 | 599.3900 | 27.82 | -4.32 | 23.50 | 46.00 | -22.50 | 100 | 311 | QP |
| 5 | 839.9500 | 27.16 | -0.26 | 26.90 | 46.00 | -19.10 | 100 | 13 | QP |
| 6 | 956.3500 | 26.60 | 2.61 | 29.21 | 46.00 | -16.79 | 100 | 237 | QP |

Note: Result = Reading + Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

**Vertical**

| No. | Frequency | Reading | Correct | Result | Limit | Margin | Height | Degree | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | Factor(dB/m) | (dBuV/m) | (dBuV/m) | (dB) | (cm) | ( ˚ ) | |
| 1 | 119.2400 | 34.05 | -11.10 | 22.95 | 43.50 | -20.55 | 100 | 240 | QP |
| 2 | 325.8500 | 30.00 | -9.48 | 20.52 | 46.00 | -25.48 | 100 | 336 | QP |
| 3 | 489.7800 | 27.85 | -6.10 | 21.75 | 46.00 | -24.25 | 100 | 37 | QP |
| 4 | 714.8200 | 27.94 | -2.83 | 25.11 | 46.00 | -20.89 | 100 | 330 | QP |
| 5 | 855.4700 | 26.50 | 0.07 | 26.57 | 46.00 | -19.43 | 100 | 65 | QP |
| 6 | 940.8300 | 25.95 | 2.21 | 28.16 | 46.00 | -17.84 | 100 | 39 | QP |

Note: Result = Reading + Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

**2442MHz**

**Horizontal**

| No. | Frequency | Reading | Correct | Result | Limit | Margin | Height | Degree | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | Factor(dB/m) | (dBuV/m) | (dBuV/m) | (dB) | (cm) | ( ˚ ) | |
| 1 | 115.3600 | 27.12 | -11.58 | 15.54 | 43.50 | -27.96 | 100 | 25 | QP |
| 2 | 292.8700 | 27.36 | -10.11 | 17.25 | 46.00 | -28.75 | 100 | 218 | QP |
| 3 | 434.4900 | 28.06 | -7.12 | 20.94 | 46.00 | -25.06 | 100 | 275 | QP |
| 4 | 600.3600 | 28.11 | -4.31 | 23.80 | 46.00 | -22.20 | 100 | 94 | QP |
| 5 | 802.1200 | 28.82 | -1.01 | 27.81 | 46.00 | -18.19 | 100 | 267 | QP |
| 6 | 950.5300 | 26.43 | 2.46 | 28.89 | 46.00 | -17.11 | 100 | 20 | QP |

Note: Result = Reading + Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

**Vertical**

| No. | Frequency | Reading | Correct | Result | Limit | Margin | Height | Degree | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | Factor(dB/m) | (dBuV/m) | (dBuV/m) | (dB) | (cm) | ( ˚ ) | |
| 1 | 30.9700 | 26.79 | -4.33 | 22.46 | 40.00 | -17.54 | 100 | 225 | QP |
| 2 | 119.2400 | 33.90 | -11.10 | 22.80 | 43.50 | -20.70 | 100 | 57 | QP |
| 3 | 166.7700 | 29.97 | -12.13 | 17.84 | 43.50 | -25.66 | 100 | 26 | QP |
| 4 | 388.9000 | 27.81 | -8.18 | 19.63 | 46.00 | -26.37 | 100 | 171 | QP |
| 5 | 686.6900 | 28.80 | -3.27 | 25.53 | 46.00 | -20.47 | 100 | 4 | QP |
| 6 | 981.5700 | 25.49 | 3.24 | 28.73 | 54.00 | -25.27 | 100 | 23 | QP |

Note: Result = Reading + Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

**2480 MHz**

**Horizontal**

| No. | Frequency | Reading | Correct | Result | Limit | Margin | Height | Degree | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | Factor(dB/m) | (dBuV/m) | (dBuV/m) | (dB) | (cm) | ( ˚ ) | |
| 1 | 30.0000 | 26.32 | -3.62 | 22.70 | 40.00 | -17.30 | 100 | 345 | QP |
| 2 | 127.0000 | 27.52 | -10.78 | 16.74 | 43.50 | -26.76 | 100 | 81 | QP |
| 3 | 286.0800 | 27.13 | -10.23 | 16.90 | 46.00 | -29.10 | 100 | 99 | QP |
| 4 | 468.4400 | 27.68 | -6.44 | 21.24 | 46.00 | -24.76 | 100 | 150 | QP |
| 5 | 663.4100 | 27.82 | -3.56 | 24.26 | 46.00 | -21.74 | 100 | 144 | QP |
| 6 | 810.8500 | 27.09 | -0.84 | 26.25 | 46.00 | -19.75 | 100 | 268 | QP |

Note: Result = Reading + Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

**Vertical**

| No. | Frequency | Reading | Correct | Result | Limit | Margin | Height | Degree | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | Factor(dB/m) | (dBuV/m) | (dBuV/m) | (dB) | (cm) | ( ˚ ) | |
| 1 | 119.2400 | 33.24 | -11.10 | 22.14 | 43.50 | -21.36 | 100 | 351 | QP |
| 2 | 166.7700 | 31.41 | -12.13 | 19.28 | 43.50 | -24.22 | 100 | 344 | QP |
| 3 | 266.6800 | 28.05 | -10.89 | 17.16 | 46.00 | -28.84 | 100 | 228 | QP |
| 4 | 450.0100 | 28.11 | -6.74 | 21.37 | 46.00 | -24.63 | 100 | 176 | QP |
| 5 | 786.6000 | 27.90 | -1.35 | 26.55 | 46.00 | -19.45 | 100 | 50 | QP |
| 6 | 967.9900 | 26.44 | 2.89 | 29.33 | 54.00 | -24.67 | 100 | 101 | QP |

Note: Result = Reading + Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

**Above 1 GHz, 2402 MHz**

**Horizontal**

| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor(dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Height (cm) | Degree ( ˚ ) | Remark |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2318.740 | 60.55 | -5.46 | 55.09 | 74.00 | -18.91 | 100 | 73 | peak |
| 2 | 2318.740 | 46.25 | -5.46 | 40.79 | 54.00 | -13.21 | 100 | 73 | AVG |
| 3 | 2375.455 | 61.34 | -5.31 | 56.03 | 74.00 | -17.97 | 100 | 1 | peak |
| 4 | 2375.455 | 46.18 | -5.31 | 40.87 | 54.00 | -13.13 | 100 | 1 | AVG |
| 5 | 2402.000 | 92.57 | -5.25 | 87.32 | N/A | N/A | 100 | 68 | peak |
| 6 | 2402.000 | 91.89 | -5.25 | 86.64 | N/A | N/A | 100 | 68 | AVG |
| 7 | 4804.000 | 60.58 | 0.63 | 61.21 | 74.00 | -12.79 | 100 | 350 | peak |
| 8 | 4804.000 | 51.92 | 0.63 | 52.55 | 54.00 | -1.45 | 100 | 350 | AVG |

Note: Result = Reading + Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

**Vertical**

| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor(dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Height (cm) | Degree ( ˚ ) | Remark |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2318.645 | 64.02 | -5.46 | 58.56 | 74.00 | -15.44 | 100 | 136 | peak |
| 2 | 2318.645 | 47.38 | -5.46 | 41.92 | 54.00 | -12.08 | 100 | 136 | AVG |
| 3 | 2375.075 | 62.84 | -5.31 | 57.53 | 74.00 | -16.47 | 100 | 160 | peak |
| 4 | 2375.075 | 47.10 | -5.31 | 41.79 | 54.00 | -12.21 | 100 | 160 | AVG |
| 5 | 2402.000 | 96.64 | -5.25 | 91.39 | N/A | N/A | 100 | 135 | peak |
| 6 | 2402.000 | 95.79 | -5.25 | 90.54 | N/A | N/A | 100 | 135 | AVG |
| 7 | 4804.000 | 58.58 | 0.63 | 59.21 | 74.00 | -14.79 | 100 | 145 | peak |
| 8 | 4804.000 | 49.05 | 0.63 | 49.68 | 54.00 | -4.32 | 100 | 145 | AVG |

Note: Result = Reading + Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

**2442 MHz**

**Horizontal**

| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor(dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Height (cm) | Degree ( ˚ ) | Remark |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2442.000 | 94.83 | -5.14 | 89.69 | N/A | N/A | 100 | 354 | peak |
| 2 | 2442.000 | 93.87 | -5.14 | 88.73 | N/A | N/A | 100 | 354 | AVG |
| 3 | 4884.000 | 60.13 | 0.94 | 61.07 | 74.00 | -12.93 | 100 | 167 | peak |
| 4 | 4884.000 | 51.24 | 0.94 | 52.18 | 54.00 | -1.82 | 100 | 167 | AVG |

Note: Result = Reading + Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

**Vertical**

| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor(dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Height (cm) | Degree ( ˚ ) | Remark |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2442.000 | 94.73 | -5.14 | 89.59 | N/A | N/A | 100 | 352 | peak |
| 2 | 2442.000 | 94.10 | -5.14 | 88.96 | N/A | N/A | 100 | 352 | AVG |
| 3 | 4884.000 | 59.56 | 0.94 | 60.50 | 74.00 | -13.50 | 100 | 153 | peak |
| 4 | 4884.000 | 50.93 | 0.94 | 51.87 | 54.00 | -2.13 | 100 | 153 | AVG |

Note: Result = Reading + Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

**2480 MHz**

**Horizontal**

| No. | Frequency | Reading | Correct | Result | Limit | Margin | Height | Degree | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | Factor(dB/m) | (dBuV/m) | (dBuV/m) | (dB) | (cm) | ( ˚ ) | |
| 1 | 2480.000 | 92.75 | -5.06 | 87.69 | N/A | N/A | 100 | 123 | peak |
| 2 | 2480.000 | 91.57 | -5.06 | 86.51 | N/A | N/A | 100 | 123 | AVG |
| 3 | 2497.960 | 63.50 | -5.00 | 58.50 | 74.00 | -15.50 | 100 | 169 | peak |
| 4 | 2497.960 | 45.95 | -5.00 | 40.95 | 54.00 | -13.05 | 100 | 169 | AVG |
| 5 | 4960.000 | 58.40 | 1.23 | 59.63 | 74.00 | -14.37 | 100 | 196 | peak |
| 6 | 4960.000 | 49.51 | 1.23 | 50.74 | 54.00 | -3.26 | 100 | 196 | AVG |

Note: Result = Reading + Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

**Vertical**

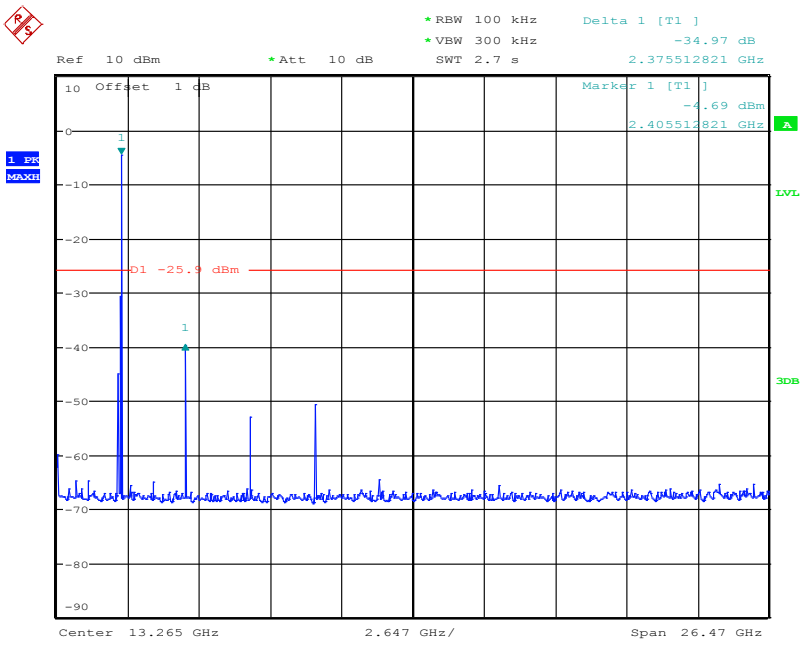
| No. | Frequency | Reading | Correct | Result | Limit | Margin | Height | Degree | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | Factor(dB/m) | (dBuV/m) | (dBuV/m) | (dB) | (cm) | ( ˚ ) | |
| 1 | 2480.000 | 96.58 | -5.06 | 91.52 | N/A | N/A | 100 | 346 | peak |
| 2 | 2480.000 | 95.48 | -5.06 | 90.42 | N/A | N/A | 100 | 346 | AVG |
| 3 | 2498.080 | 66.15 | -5.00 | 61.15 | 74.00 | -12.85 | 100 | 96 | peak |
| 4 | 2498.080 | 49.36 | -5.00 | 44.36 | 54.00 | -9.64 | 100 | 96 | AVG |
| 5 | 4960.000 | 60.21 | 1.23 | 61.44 | 74.00 | -12.56 | 100 | 100 | peak |
| 6 | 4960.000 | 51.16 | 1.23 | 52.39 | 54.00 | -1.61 | 100 | 100 | AVG |

Note: Result = Reading + Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

**Conducted Spurious Emissions:**

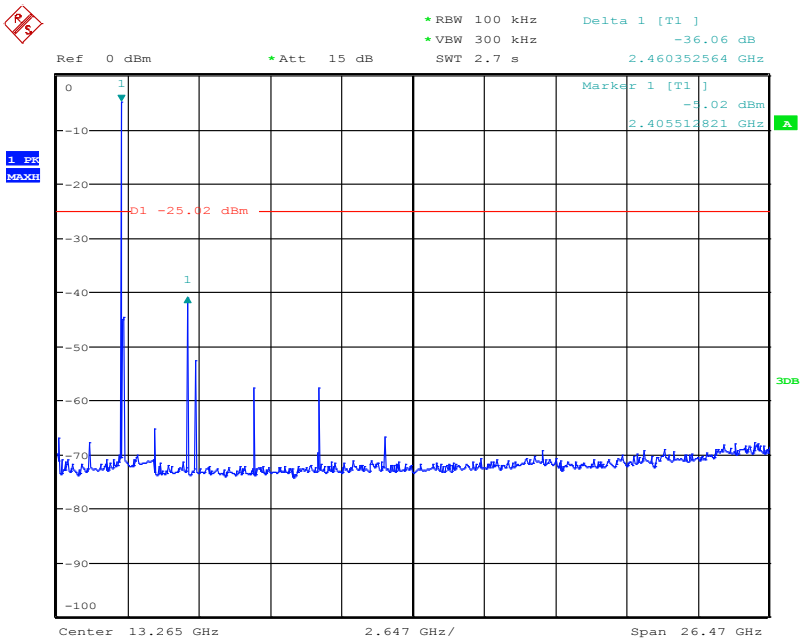
| Channel | Frequency (MHz) | Delta Peak to Band Emission (dBc) | Limit (dBc) | RESULT |
|---|---|---|---|---|
| Low | 2402 | 34.97 | ≥ 20 | PASS |
| Mid | 2442 | 36.06 | ≥ 20 | PASS |
| High | 2480 | 35.5 | ≥ 20 | PASS |

Low Channel



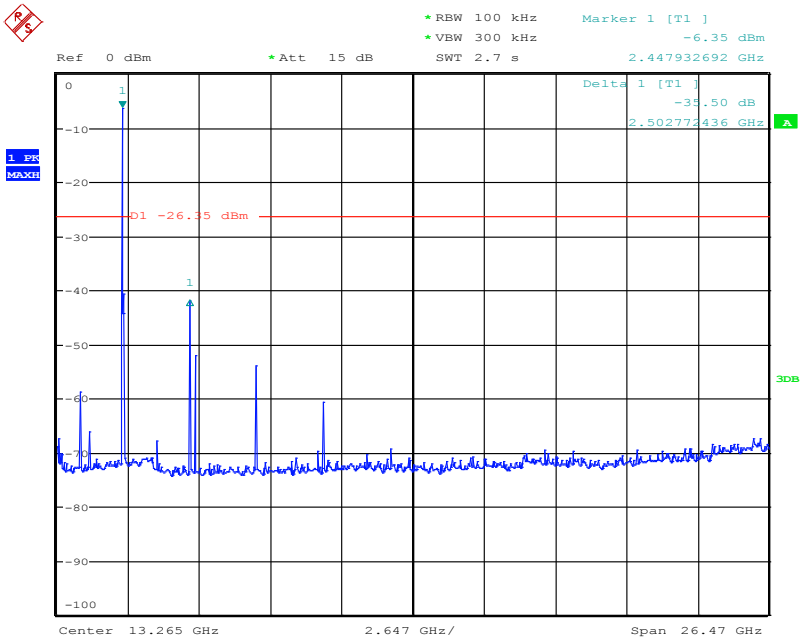

Date: 28.NOV.2016 16:22:09

## Middle Channel




Date: 29.NOV.2016 14:06:01

## High Channel




Date: 29.NOV.2016 15:23:18

# 7 FCC §15.247(a)(2) – 6 dB Emission Bandwidth

## 7.1 Applicable Standard

According to FCC §15.247(a) (2).

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

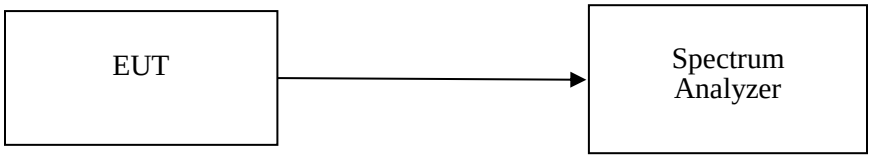
## 7.2 Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.

2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.

3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth.

4. Repeat above procedures until all frequencies measured were complete.




## 7.3 Test Equipment List and Details

| Descriptions | Manufacturers | Models | Serial Numbers | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| Spectrum Analyzer | Rohde & Schwarz | FSU26 | 200268 | 2016/5/7 | 2017/5/6 |
| Cable | WOKEN | SFL402 | 00100A1F6A192S | 2015/12/18 | 2016/12/17 |

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

## 7.4 Test Environmental Conditions

| | |
|---|---|
| **Temperature:** | 26° C |
| **Relative Humidity:** | 58 % |
| **ATM Pressure:** | 101.0 kPa |

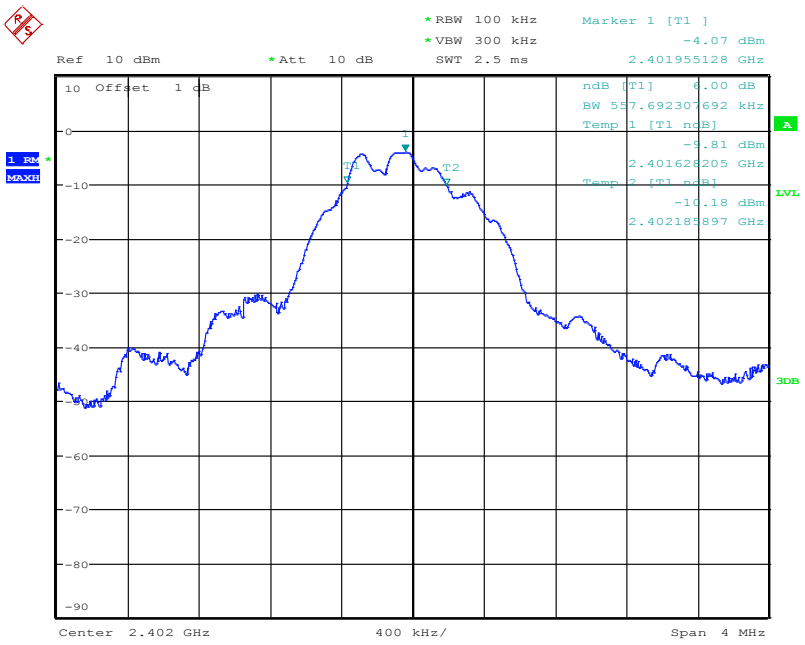
*The testing was performed by David Hsu on 2016-11-28 to 2016-11-29.*

## 7.5 Test Results

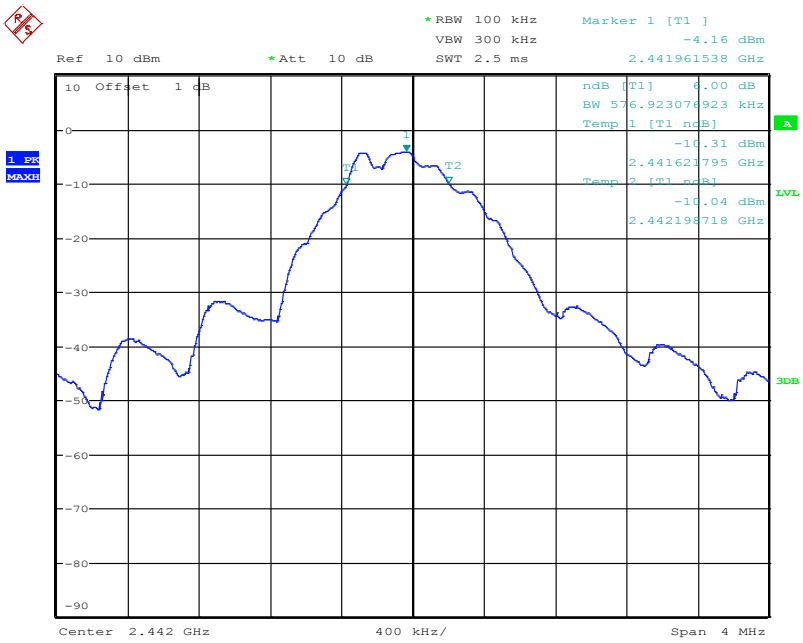
| Channel | Frequency (MHz) | 6 dB OBW (MHz) | Limit (MHz) | Result |
|---|---|---|---|---|
| Low | 2402 | 0.55 | > 0.5 | Compliance |
| Middle | 2442 | 0.57 | > 0.5 | Compliance |
| High | 2480 | 0.57 | > 0.5 | Compliance |

Please refer to the following plots

**Low Channel**

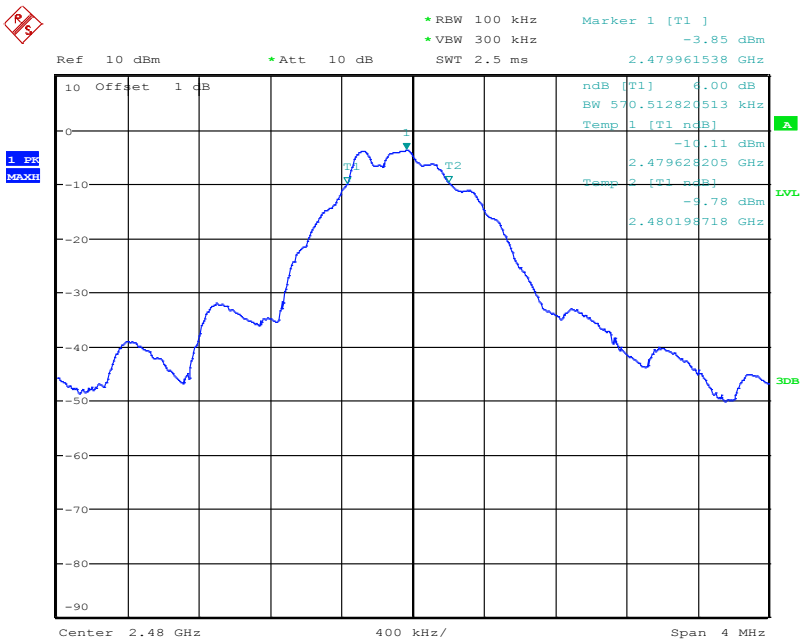


## Middle Channel




Date: 29.NOV.2016 13:53:01

## High Channel




Date: 29.NOV.2016 15:09:55

# 8 FCC §15.247(b)(3) – Maximum Output Power

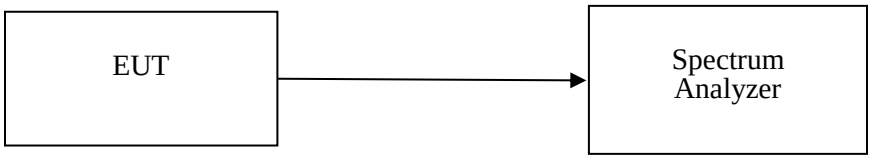
## 8.1 Applicable Standard

According to FCC §15.247(b) (3).

Systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

## 8.2 Test Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to an EMI Test Receiver.
3. Add a correction factor to the display.




## 8.3 Test Equipment List and Details

| Descriptions | Manufacturers | Models | Serial Numbers | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| Spectrum Analyzer | Rohde & Schwarz | FSU26 | 200268 | 2016/5/7 | 2017/5/6 |
| Cable | WOKEN | SFL402 | 00100A1F6A192S | 2015/12/18 | 2016/12/17 |

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

## 8.4 Test Environmental Conditions

| | |
|---|---|
| **Temperature:** | 26° C |
| **Relative Humidity:** | 58 % |
| **ATM Pressure:** | 101.0 kPa |

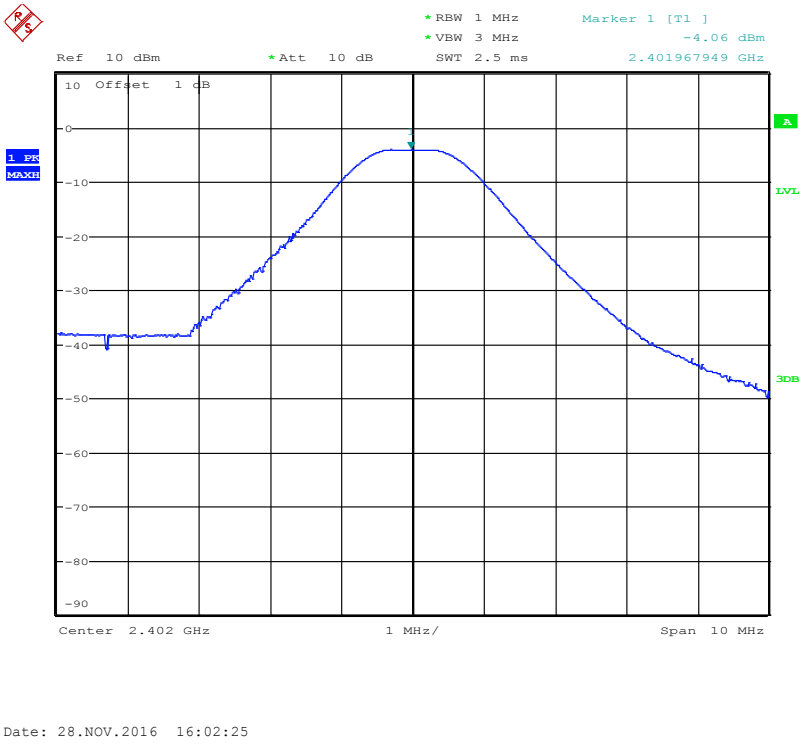
*The testing was performed by David Hsu on 2016-11-28 to 2016-11-29.*

## 8.5 Test Results

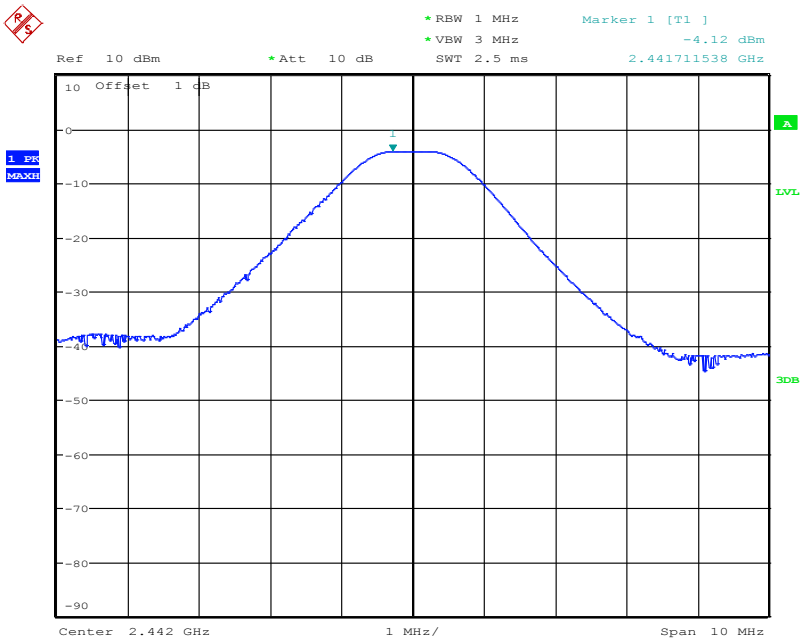
| Channel | Frequency (MHz) | Conducted Output Power (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|
| Low | 2402 | -4.06 | 30 | Compliance |
| Middle | 2442 | -4.12 | 30 | Compliance |
| High | 2480 | -3.79 | 30 | Compliance |

Please refer to the following plots

**Low Channel**

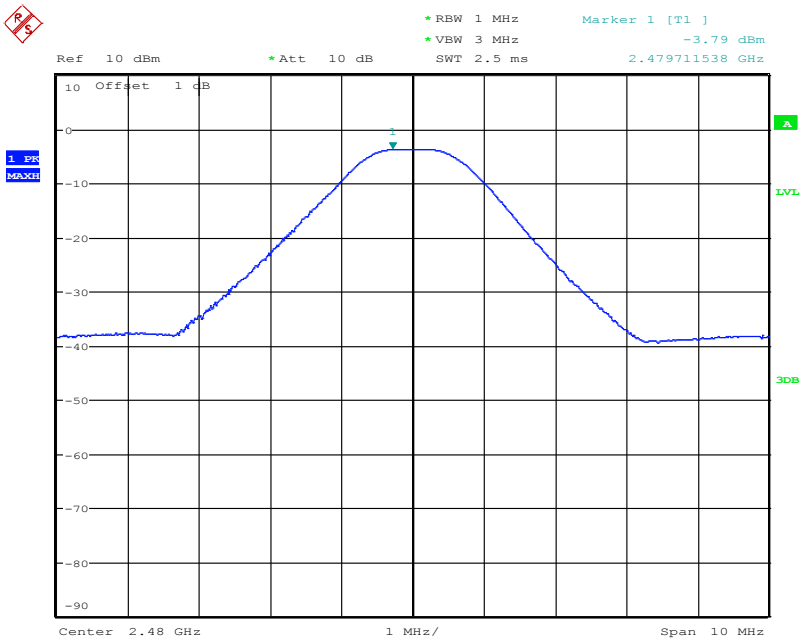


## Middle Channel




Date: 29.NOV.2016 13:57:55

## High Channel




Date: 29.NOV.2016 15:18:20

# 9 FCC §15.247(d) – 100 kHz Bandwidth of Frequency Band Edge

## 9.1 Applicable Standard

According to FCC §15.247(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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

## 9.2 Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

## 9.3 Test Equipment List and Details

| Descriptions | Manufacturers | Models | Serial Numbers | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| Spectrum Analyzer | Rohde & Schwarz | FSU26 | 200268 | 2016/5/7 | 2017/5/6 |
| Cable | WOKEN | SFL402 | 00100A1F6A192S | 2015/12/18 | 2016/12/17 |

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

## 9.4 Test Environmental Conditions

| | |
|---|---|
| **Temperature:** | 26° C |
| **Relative Humidity:** | 58 % |
| **ATM Pressure:** | 101.0 kPa |

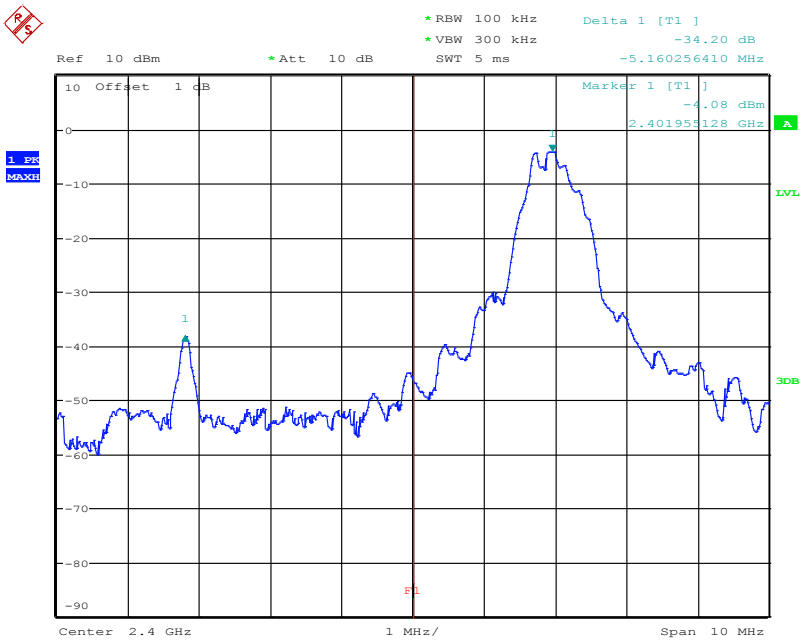
*The testing was performed by David Hsu on 2016-11-28 to 2016-11-29*

## 9.5 Test Results

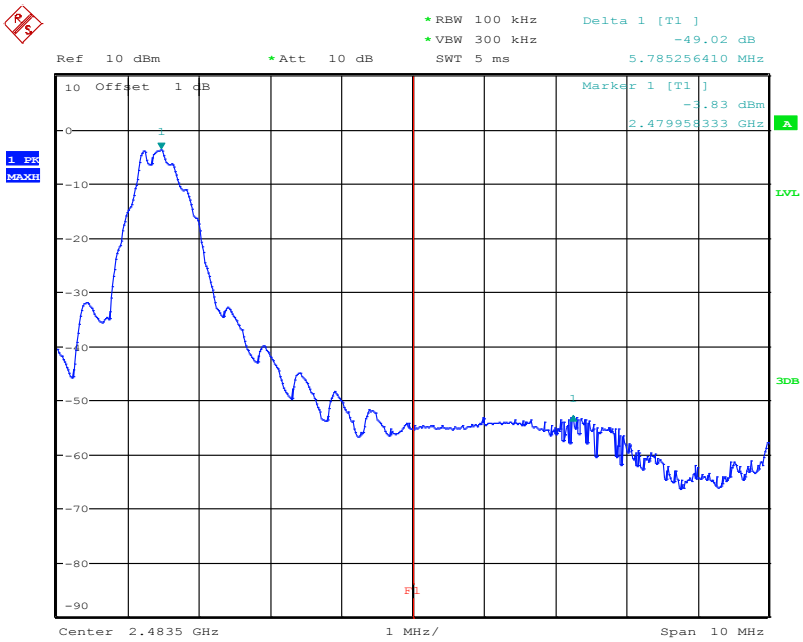
Please refer to the following plots

| Channel | Frequency (MHz) | Delta Peak to Band Emission (dBc) | Limit (dBc) | RESULT |
|---|---|---|---|---|
| Low | 2402 | 34.20 | ≥ 20 | PASS |
| High | 2480 | 49.02 | ≥ 20 | PASS |

**Band Edge, Left Side**



## Band Edge, Right Side

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# 10 FCC §15.247(e) – Power Spectral Density

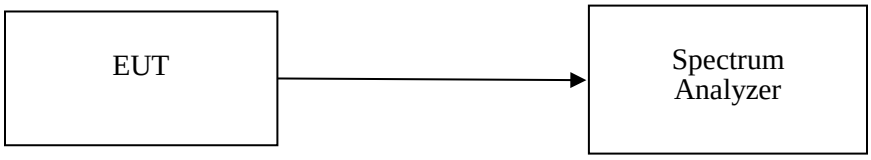
## 10.1 Applicable Standard

According to FCC §15.247(e).

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

## 10.2 Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of SA on any frequency be measured and set SA to 1.5MHz span mode. And then, set RBW and VBW of spectrum analyzer to proper value. (DTS)
4. Repeat above procedures until all frequencies measured were complete.




Test Equipment List and Details

| Descriptions | Manufacturers | Models | Serial Numbers | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| Spectrum Analyzer | Rohde & Schwarz | FSU26 | 200268 | 2016/5/7 | 2017/5/6 |
| Cable | WOKEN | SFL402 | 00100A1F6A192S | 2015/12/18 | 2016/12/17 |

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

## 10.3 Test Environmental Conditions

| | |
|---|---|
| **Temperature:** | 26° C |
| **Relative Humidity:** | 58 % |
| **ATM Pressure:** | 101.0 kPa |

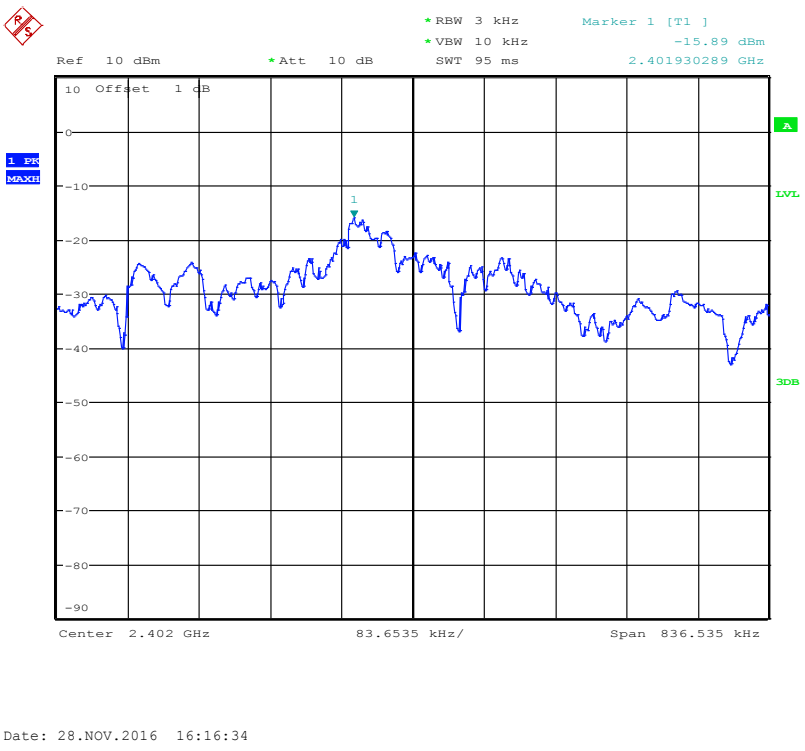
*The testing was performed by David Hsu on 2016-11-28 to 2016-11-29*

## 10.4 Test Results

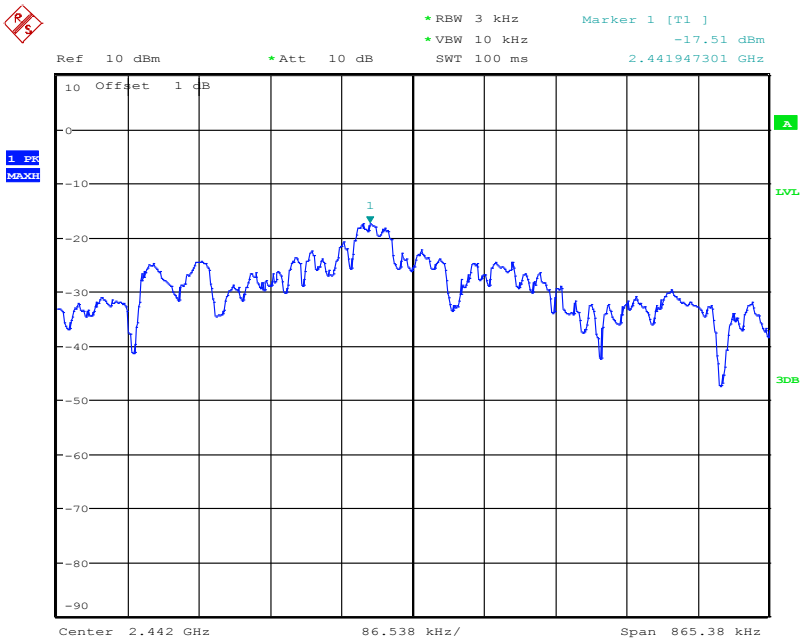
| Channel | Frequency (MHz) | PSD (dBm/3 kHz) | Limit (dBm/3 kHz) | Result |
|---|---|---|---|---|
| Low | 2402 | -15.89 | 8 | Compliance |
| Middle | 2442 | -17.51 | 8 | Compliance |
| High | 2480 | -17.00 | 8 | Compliance |

Please refer to the following plots

**Low Channel**

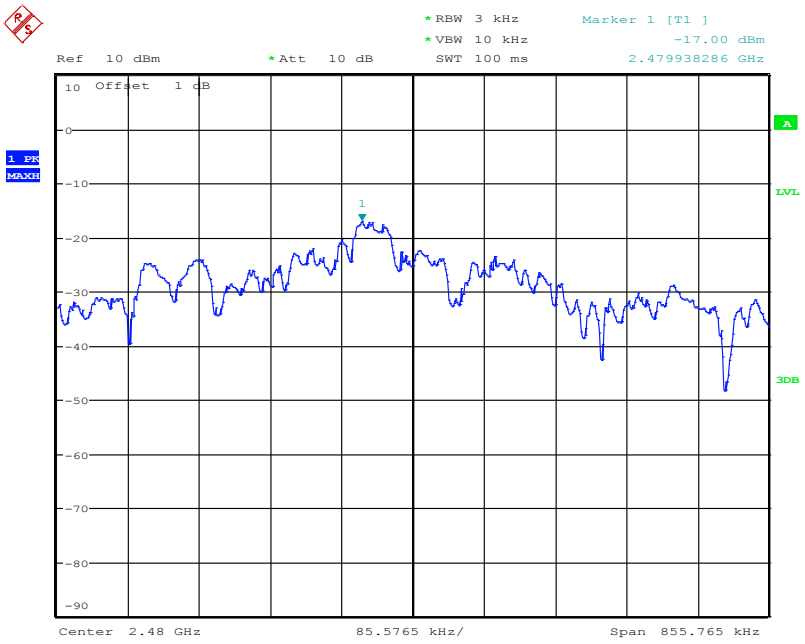


## Middle Channel




Date: 29.NOV.2016 13:55:53

## High Channel

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