# FCC Part 15.247

# TEST REPORT

For

# ALATECH Technology Limited

**39F., No. 758, Jungming S.RD. Taichung, Taiwan**

## FCC ID: YQOWB001

| **Report Type:** | **Product Type:** |
|---|---|
| Original Report | Star ONE |

**Report Producer:** Kaylee Chiang

**Report Number:** RTWA170707003-00A

**Report Date:** 2017-08-21

**Reviewed By:** Jerry Chang

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# REVISION HISTORY

| Revision | No. | Report Number | Issue Date | Description | Author/ Revised by |
|---|---|---|---|---|---|
| 1.0 | RTWA170707003 | RTWA170707003-00A | 2017.08.21 | Original Report | Kaylee |
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# 1 General Information

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

| | |
|---|---|
| **Applicant:** | ALATECH Technology Limited<br>39F., No. 758, Jungming S. RD. Taichung, Taiwan |
| **Manufacturer:** | ZHEJIANG ALA FITNESS TECHOLOGY LTD<br>NO.405 Tongxin Road, Tongxiang Economic Development Zhejiang 314500, China |
| **Product:** | Star ONE |
| **Model:** | WB001 |
| **Trade Name:** | ALATECH |
| **Frequency Range:** | 2402-2480 MHz |
| **Transmit Power:** | BLE Mode: -1.77 dBm |
| **Modulation Technique:** | BLE Mode: GFSK |
| **Transmit Data Rate:** | BLE Mode: 1 Mbps |
| **Number of Channels:** | BLE Mode: 40 Channels |
| **Antenna Specification:** | Monopole Antenna/Gain: 2.08 dBi |
| **Voltage Range:** | 3.7Vdc from Battery |
| **Date of Test:** | Jul. 18, 2017 ~ Aug. 21, 2017 |

**All measurement and test data in this report was gathered from production sample serial number: 170707003 (Assigned by BACL, Taiwan) The EUT supplied by the applicant was received on 2017-07-04.*

## 1.2 Objective

This report is prepared on behalf of *ALATECH Technology Limited* in accordance with Part 2, Subpart J, Part 15, Subparts A 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, 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: YQOWB001

## 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

☒70, Lane 169, Sec. 2, Datong Road, Xizhi Dist., New Taipei City 22183, Taiwan, R.O.C.

☐68-3, Lane 169, Sec. 2, Datong Road, Xizhi Dist., New Taipei City 22183, Taiwan, R.O.C.

Bay Area Compliance Laboratories Corp. (Taiwan) Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 3180) and the FCC designation No.TW3180 under the Mutual Recognition Agreement (MRA) in FCC Test. 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.: 974454. 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, there are totally 40 channels.

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

For BLE Modes were testd with channel 1, 21 and 40

## 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/DOC | S/N |
|---|---|---|---|---|---|
| NB | DELL | E6410 | N/A | PD98260NGU | 10912240367 |

## 2.5 External Cable List and Details

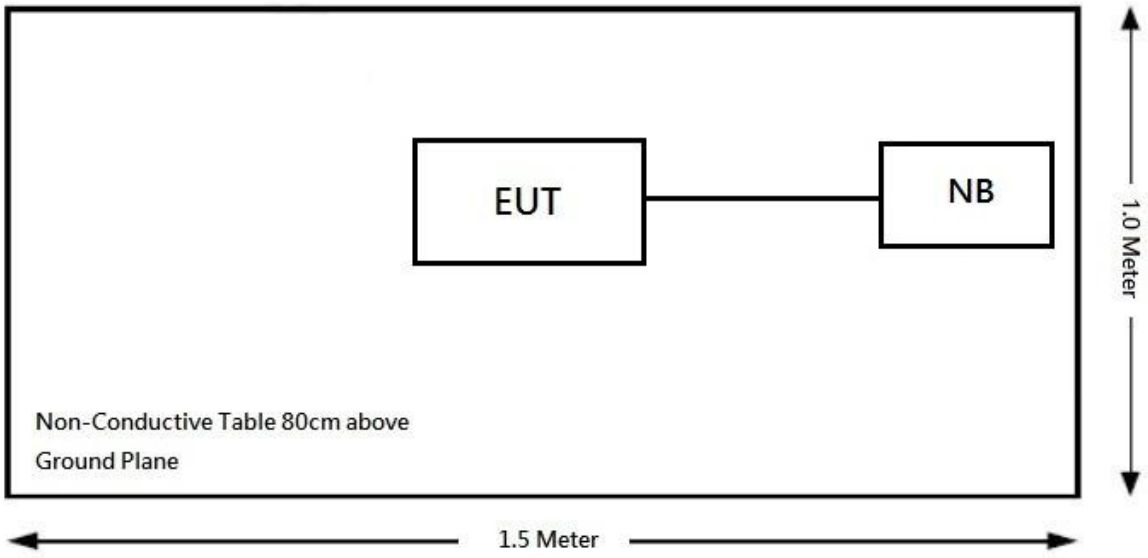
| Cable Description | Length (m) | From | To |
|---|---|---|---|
| Mini USB Cable | 1.5 | NB | EUT |

## 2.6 Block Diagram of Test Setup

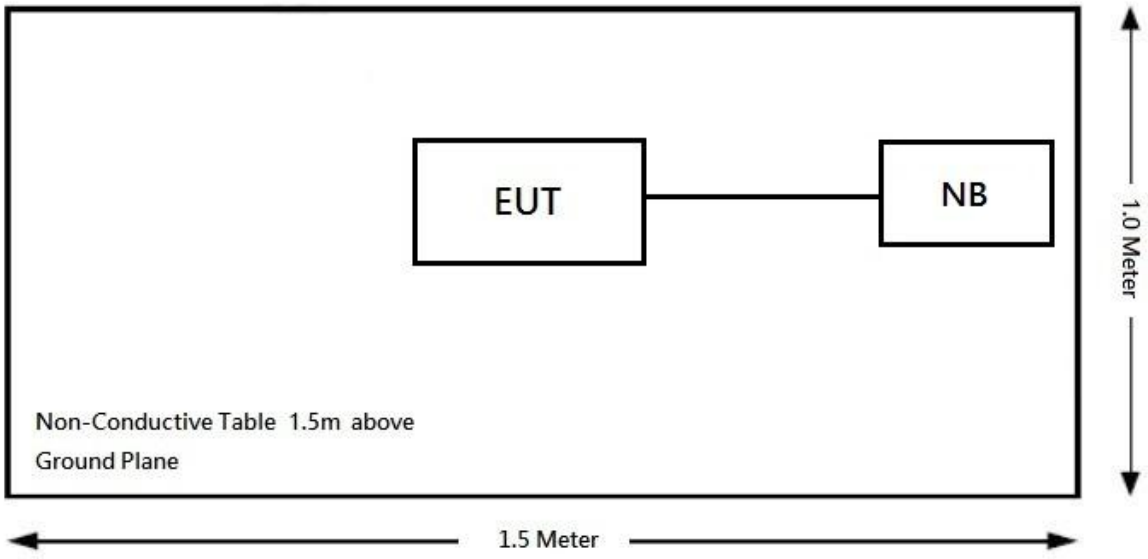
See test photographs attached in Exhibit A for the actual connections between EUT and support equipment.

### Radiation:

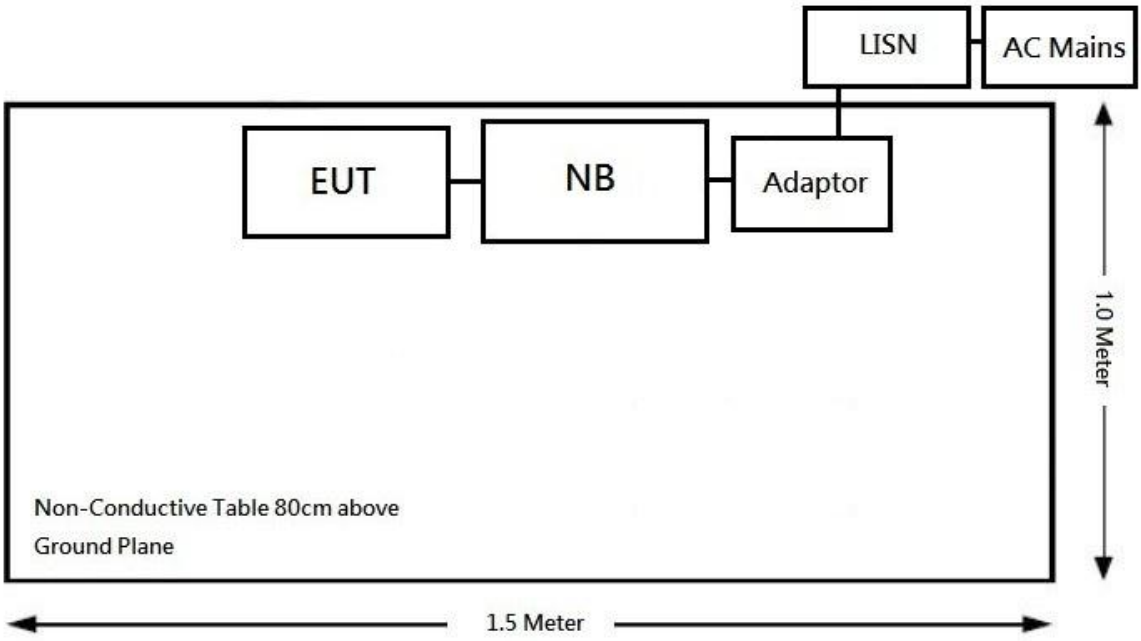
Below 1GHz:




Above 1GHz:

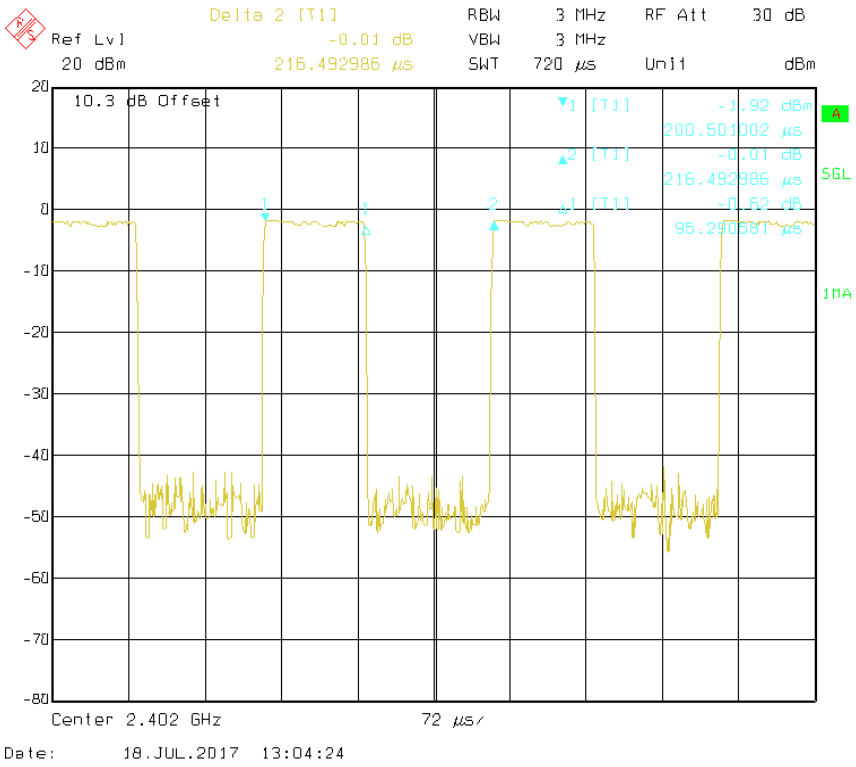


**Conduction:**


LISN
AC Mains
EUT
NB
Adaptor
1.0 Meter
Non-Conductive Table 80cm above
Ground Plane
1.5 Meter

## 2.7 Duty Cycle

BLE Mode: Duty cycle = 0.44, Duty factor = 10 * log( 1/0.44) = 3.57dB



# 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 | Compliance |
| §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 |

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

## 4.1 Applicable Standard

According to FCC §2.1093 and §1.1307(b) (1), 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.

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 4.1 f) 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 | -1 | 0.79 | 5 | 0.3 | 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 | monopole Antenna | 2.08 dBi | Compliance |

# 6 FCC §15.207 - AC Line Conducted Emissions

## 6.1 Applicable Standard

According to FCC §15.207 Conducted limits:

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

| Frequency of Emission (MHz) | Conducted Limit (dBuV) | |
|---|---|---|
| | Quasi-Peak | Average |
| 0.15-0.5 | 66 to 56 Note 1 | 56 to 46 Note 2 |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

*Note 1: Decreases with the logarithm of the frequency.*
*Note 2: A linear average detector is required*

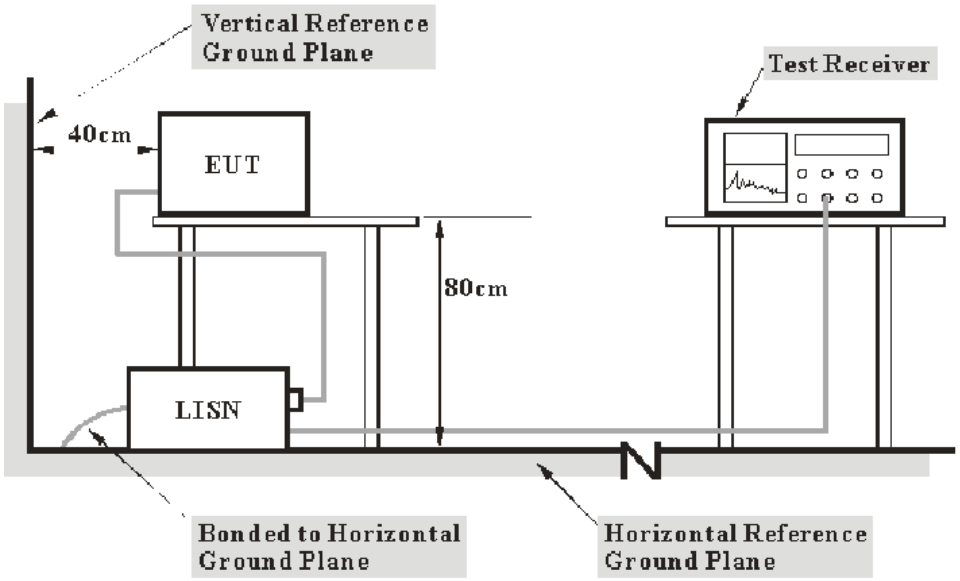
## 6.2 Measurement Uncertainty

Input quantities to be considered for conducted disturbance measurements maybe receiver reading, attenuation of the connection between LISN/ISN and receiver, LISN/ISN voltage division factor, LISN/ISN VDF frequency interpolation and receiver related input quantities, etc.

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

| Port | Expanded Measurement uncertainty |
|---|---|
| AC Mains | 4.64 dB (k=2, 95% level of confidence) |

## 6.3 EUT Setup




Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

## 6.4 EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz. During the conducted emission test, the EMI test receiver was set with the following configurations

| Frequency Range | IF B/W |
|---|---|
| 150 kHz - 30 MHz | 9 kHz |

## 6.5 Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN. Maximizing procedure was performed on the six (6) highest emissions of the EUT. All data was recorded in the Quasi-peak and average detection mode.

## 6.6 Corrected Factor & Margin Calculation

The factor is calculated by adding LISN/ISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

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

Over Limit = Level – Limit Line

## 6.7 Test Equipment List and Details

| Manufacturers | Descriptions | Models | Serial Numbers | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| LISN | Rohde & Schwarz | ENV216 | 101248 | 2017/07/20 | 2018/07/19 |
| LISN | EMCO | 3816/2 | 75848 | 2016/08/02 | 2017/08/01 |
| EMI Test Receiver | Rohde & Schwarz | ESCI | 100540 | 2017/05/24 | 2018/05/23 |
| Pulse Limiter | Rohde & Schwarz | ESH3Z2 | TXZEM025 | 2016/08/11 | 2017/08/10 |
| RF Cable | EMEC | EM-CB5D | 001 | 2017/07/24 | 2018/07/23 |
| Software | AUDIX | E3 | V9.150826k | N.C.R | N.C.R |

**** Statement of Traceability:*** BACL Corp. attests that all calibrations have been performed according to TAF requirements, traceable to the ETC.

## 6.8 Test Environmental Conditions

| | |
|---|---|
| **Temperature:** | 25 ℃ |
| **Relative Humidity:** | 58 % |
| **ATM Pressure:** | 1020 hPa |

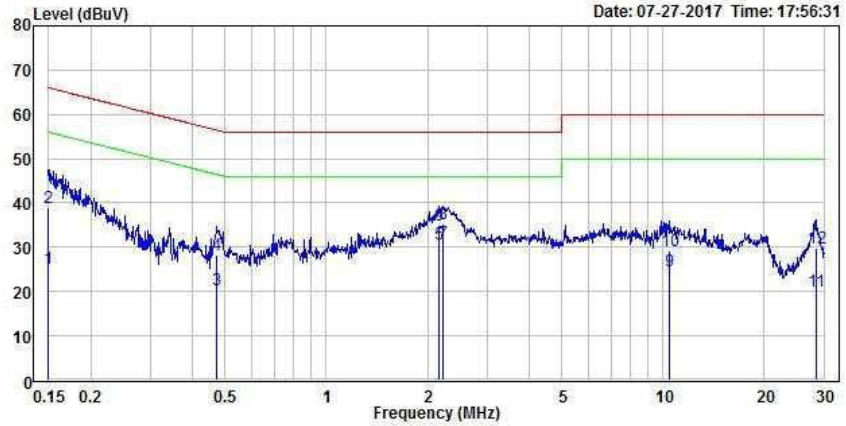
*The testing was performed by Andy Shih on 2017-07-27.*

## 6.9 Test Results

Test Mode: Charge+ Transmitting

Please refer to the following plots and tables.

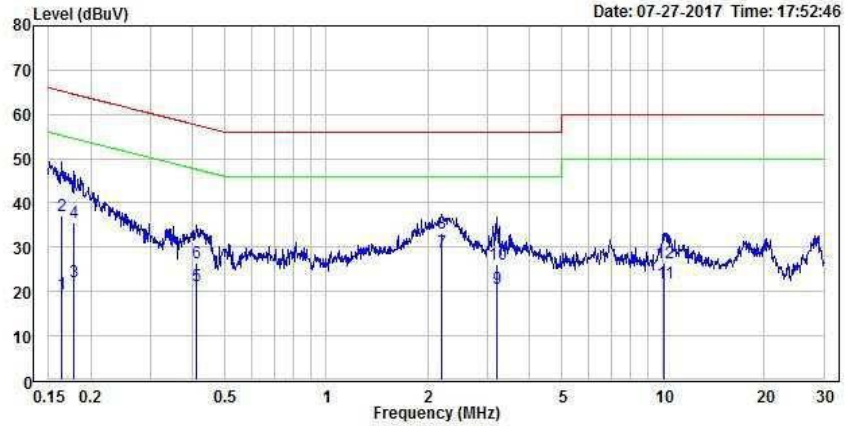
**Main: AC 120V/60 Hz, Line**




Condition: Line
EUT :
Mode :
Note :

| | Freq | Level | Limit Line | Over Limit | Factor | Read Level | Remark | Pol/Phase |
|---|---|---|---|---|---|---|---|---|
| | MHz | dBuV | dBuV | dB | dB | dBuV | | |
| 1 | 0.150 | 25.30 | 56.00 | -30.70 | 19.56 | 5.74 | Average | Line |
| 2 | 0.150 | 38.92 | 66.00 | -27.08 | 19.56 | 19.36 | QP | Line |
| 3 | 0.474 | 20.35 | 46.45 | -26.10 | 19.55 | 0.80 | Average | Line |
| 4 | 0.474 | 28.30 | 56.45 | -28.15 | 19.55 | 8.75 | QP | Line |
| 5 | 2.160 | 30.59 | 46.00 | -15.41 | 19.66 | 10.93 | Average | Line |
| 6 | 2.160 | 34.91 | 56.00 | -21.09 | 19.66 | 15.25 | QP | Line |
| 7 | 2.212 | 31.17 | 46.00 | -14.83 | 19.67 | 11.50 | Average | Line |
| 8 | 2.212 | 35.40 | 56.00 | -20.60 | 19.67 | 15.73 | QP | Line |
| 9 | 10.414 | 24.71 | 50.00 | -25.29 | 19.82 | 4.89 | Average | Line |
| 10 | 10.414 | 29.35 | 60.00 | -30.65 | 19.82 | 9.53 | QP | Line |
| 11 | 28.483 | 20.09 | 50.00 | -29.91 | 19.92 | 0.17 | Average | Line |
| 12 | 28.483 | 29.74 | 60.00 | -30.26 | 19.92 | 9.82 | QP | Line |

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




Condition: Neutral
EUT :
Mode :
Note :

| | Freq | Level | Limit Line | Over Limit | Factor | Read Level | Remark | Pol/Phase |
|---|---|---|---|---|---|---|---|---|
| | MHz | dBuV | dBuV | dB | dB | dBuV | | |
| 1 | 0.163 | 19.38 | 55.30 | -35.92 | 19.55 | -0.17 | Average | Neutral |
| 2 | 0.163 | 37.14 | 65.30 | -28.16 | 19.55 | 17.59 | QP | Neutral |
| 3 | 0.178 | 22.24 | 54.57 | -32.33 | 19.54 | 2.70 | Average | Neutral |
| 4 | 0.178 | 35.51 | 64.57 | -29.06 | 19.54 | 15.97 | QP | Neutral |
| 5 | 0.412 | 21.24 | 47.61 | -26.37 | 19.54 | 1.70 | Average | Neutral |
| 6 | 0.412 | 26.50 | 57.61 | -31.11 | 19.54 | 6.96 | QP | Neutral |
| 7 | 2.195 | 28.77 | 46.00 | -17.23 | 19.66 | 9.11 | Average | Neutral |
| 8 | 2.195 | 33.05 | 56.00 | -22.95 | 19.66 | 13.39 | QP | Neutral |
| 9 | 3.220 | 20.76 | 46.00 | -25.24 | 19.68 | 1.08 | Average | Neutral |
| 10 | 3.220 | 26.12 | 56.00 | -29.88 | 19.68 | 6.44 | QP | Neutral |
| 11 | 10.086 | 22.00 | 50.00 | -28.00 | 19.86 | 2.14 | Average | Neutral |
| 12 | 10.086 | 26.48 | 60.00 | -33.52 | 19.86 | 6.62 | QP | Neutral |

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

## 7.1 Applicable Standard

FCC§15.247 (d); §15.209; §15.205

## 7.2 Measurement Uncertainty

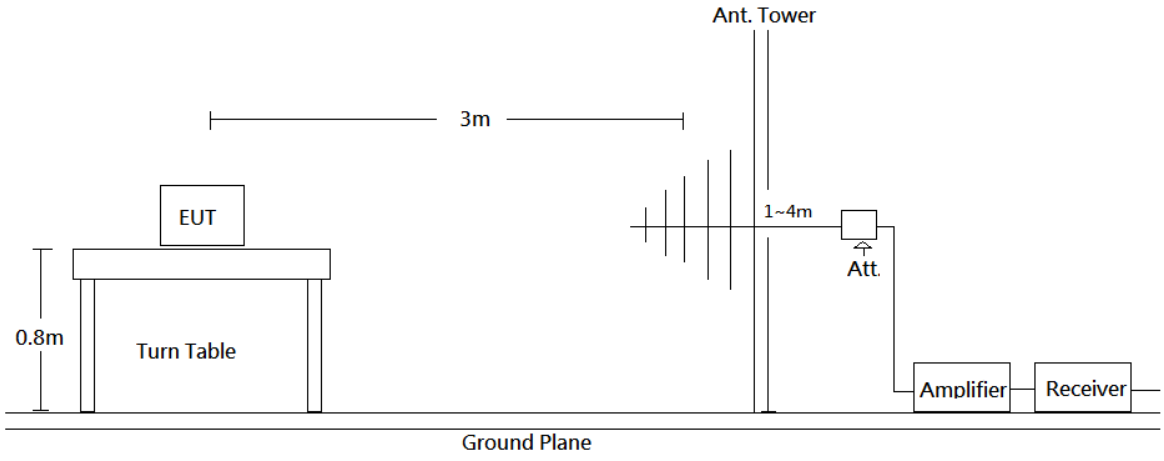
All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency 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.

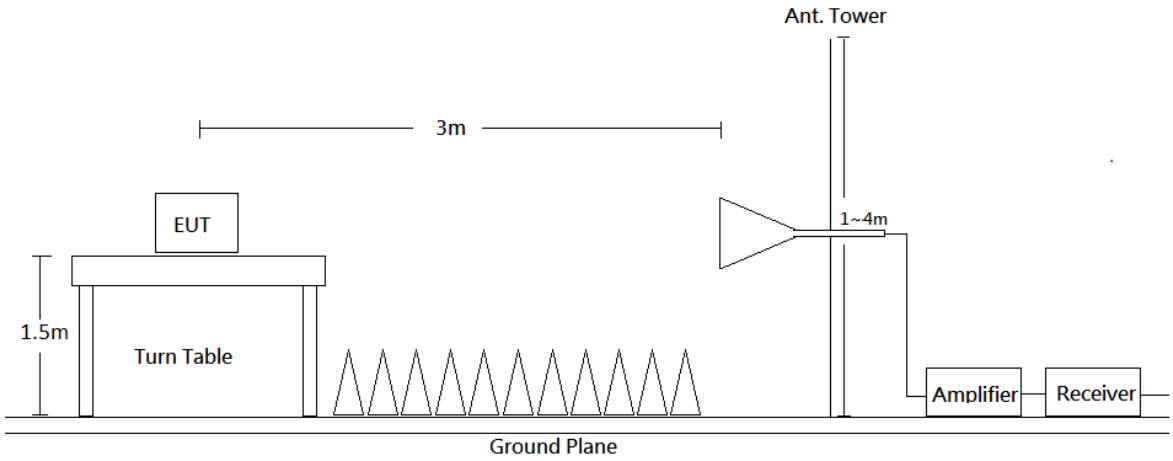
| Frequency | Measurement uncertainty |
|---|---|
| 30 MHz~200 MHz | 3.76 dB (k=2, 95% level of confidence) |
| 200 MHz~1 GHz | 4.12 dB (k=2, 95% level of confidence) |
| 1 GHz~6 GHz | 4.84 dB (k=2, 95% level of confidence) |
| 6 GHz~18 GHz | 5.16 dB (k=2, 95% level of confidence) |
| 18 GHz~26 GHz | 4.84 dB (k=2, 95% level of confidence) |
| 26 GHz~40 GHz | 4.30 dB (k=2, 95% level of confidence) |

## 7.3 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.

## 7.4 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.

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

## 7.5 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.

## 7.6 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

## 7.7 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.

## 7.8 Test Equipment List and Details

| Description | Manufacturer | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| 966A Room | | | | | |
| Bilog Antenna | Sunol & Mini-Circuits | JB6/ UNAT-6+ | A050115 / 15542_01 | 2016/11/16 | 2017/11/15 |
| Horn Antenna | EMCO | 3115 | 9311-4158 | 2017/05/31 | 2018/05/30 |
| Horn Antenna | ETS-Lindgren | 3116 | 00062638 | 2016/09/05 | 2017/09/04 |
| Preamplifier | Sonoma | 310N | 130602 | 2017/07/03 | 2018/07/02 |
| Preamplifier | EMEC | EM01G18G | 060697 | 2017/04/14 | 2018/04/16 |
| Preamplifier | EMEC | EM18G40G | 060656 | 2016/12/13 | 2017/12/12 |
| EMI Test Receiver | R & S | ESR7 | 101419 | 2016/11/03 | 2017/11/03 |
| Spectrum Analyzer | Rohde & Schwarz | FSV40 | 101203 | 2017/07/13 | 2018/07/12 |
| Microflex Cable | UTIFLEX | UFB311A-Q-1440-300300 | 220490-006 | 2016/11/02 | 2017/11/01 |
| Microflex Cable | UTIFLEX | UFA210A-1-3149-300300 | MFR64639 226389-001 | 2016/11/29 | 2017/11/28 |
| Microflex Cable | ROSNOL | K1K50-UP0264-K1K50-450CM | 160309-1 | 2017/03/24 | 2018/03/23 |
| Microflex Cable | ROSNOL | K1K50-UP0264-K1K50-80CM | 160309-2 | 2017/01/20 | 2018/01/19 |
| 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 | Farad | EZ_EMC | BACL-03A1 | N.C.R | N.C.R |
| Conducted Room | | | | | |
| Spectrum Analyzer | Rohde & Schwarz | FSEK30 | 825084/006 | 2016/12/15 | 2017/12/14 |
| Cable | WOKEN | SFL402 | S02-160323-07 | 2017/02/22 | 2018/02/21 |
| Attenuator | MINI-CIRCUITS | BW-S10W5+ | N/A | 2017/03/09 | 2018/03/08 |

*** *Statement of Traceability:*** BACL Corp. attests that all calibrations have been performed according to TAF requirements, traceable to the ETC.

## 7.9 Test Environmental Conditions

| | |
|---|---|
| **Temperature:** | 25.2° C |
| **Relative Humidity:** | 58 % |
| **ATM Pressure:** | 1010 hPa |

*The testing was performed by Andy Shih on 2017-07-18.*

## 7.10 Test Results

*(Pre-scan with three orthogonal axis, and worse case as Y axis.)*

Mode: Transmitting

**Horizontal**

| Frequency (MHz) | Reading (dB $\mu$V) | Correct Factor(dB/m) | Result (dB $\mu$V/m) | Limit (dB $\mu$V/m) | Margin (dB) | Height (cm) | Degree ( ˚ ) | Remark |
|---|---|---|---|---|---|---|---|---|
| BLE, Low channel | | | | | | | | |
| 201.69 | 28.11 | -11.09 | 17.02 | 43.50 | -26.48 | 100 | 142 | QP |
| 390.84 | 28.40 | -7.92 | 20.48 | 46.00 | -25.52 | 100 | 189 | QP |
| 487.84 | 28.51 | -5.92 | 22.59 | 46.00 | -23.41 | 100 | 189 | QP |
| 685.72 | 27.87 | -2.97 | 24.90 | 46.00 | -21.10 | 100 | 179 | QP |
| 817.64 | 27.49 | -0.22 | 27.27 | 46.00 | -18.73 | 100 | 341 | QP |
| 927.25 | 27.68 | 2.08 | 29.76 | 46.00 | -16.24 | 100 | 356 | QP |
| 2390.00 | 63.16 | -4.89 | 58.27 | 74.00 | -15.73 | 160 | 161 | peak |
| 2390.00 | 52.14 | -4.89 | 47.25 | 54.00 | -6.75 | 160 | 161 | AVG |
| 2402.00 | 97.44 | -4.86 | 92.58 | N/A | N/A | 143 | 18 | peak |
| 2402.00 | 96.50 | -4.86 | 91.64 | N/A | N/A | 143 | 18 | AVG |
| 4804.00 | 41.61 | 0.98 | 42.59 | 74.00 | -31.41 | 100 | 243 | peak |
| 4804.00 | 27.61 | 0.98 | 28.59 | 54.00 | -25.41 | 100 | 243 | AVG |
| 7206.00 | 45.46 | 6.56 | 52.02 | 74.00 | -21.98 | 100 | 326 | peak |
| 7206.00 | 30.40 | 6.56 | 36.96 | 54.00 | -17.04 | 100 | 326 | AVG |
| BLE, Middle channel | | | | | | | | |
| 134.76 | 29.08 | -10.72 | 18.36 | 43.50 | -25.14 | 100 | 81 | QP |
| 313.24 | 28.32 | -9.56 | 18.76 | 46.00 | -27.24 | 100 | 196 | QP |
| 382.11 | 28.34 | -8.10 | 20.24 | 46.00 | -25.76 | 100 | 290 | QP |
| 585.81 | 28.40 | -4.25 | 24.15 | 46.00 | -21.85 | 100 | 198 | QP |
| 655.65 | 28.43 | -3.29 | 25.14 | 46.00 | -20.86 | 100 | 12 | QP |
| 795.33 | 27.88 | -0.68 | 27.20 | 46.00 | -18.80 | 100 | 359 | QP |
| 2442.00 | 95.08 | -4.76 | 90.32 | N/A | N/A | 110 | 32 | peak |
| 2442.00 | 94.09 | -4.76 | 89.33 | N/A | N/A | 110 | 32 | AVG |
| 4884.00 | 45.26 | 1.25 | 46.51 | 74.00 | -27.49 | 100 | 57 | peak |
| 4884.00 | 38.39 | 1.25 | 39.64 | 54.00 | -14.36 | 100 | 57 | AVG |
| 7326.00 | 45.47 | 7.04 | 52.51 | 74.00 | -21.49 | 100 | 321 | peak |
| 7326.00 | 30.53 | 7.04 | 37.57 | 54.00 | -16.43 | 100 | 321 | AVG |
| BLE, High channel | | | | | | | | |
| 133.79 | 28.12 | -10.68 | 17.44 | 43.50 | -26.06 | 100 | 1 | QP |
| 199.75 | 28.30 | -10.76 | 17.54 | 43.50 | -25.96 | 100 | 167 | QP |
| 416.06 | 27.28 | -7.34 | 19.94 | 46.00 | -26.06 | 100 | 245 | QP |
| 528.58 | 29.56 | -5.31 | 24.25 | 46.00 | -21.75 | 100 | 225 | QP |
| 706.09 | 27.86 | -2.70 | 25.16 | 46.00 | -20.84 | 100 | 11 | QP |
| 793.39 | 29.06 | -0.73 | 28.33 | 46.00 | -17.67 | 100 | 165 | QP |
| 2480.00 | 94.23 | -4.68 | 89.55 | N/A | N/A | 140 | 331 | peak |
| 2480.00 | 93.09 | -4.68 | 88.41 | N/A | N/A | 140 | 331 | AVG |
| 2483.50 | 63.24 | -4.69 | 58.55 | 74.00 | -15.45 | 190 | 193 | peak |
| 2483.50 | 52.35 | -4.69 | 47.66 | 54.00 | -6.34 | 190 | 193 | AVG |
| 4960.00 | 43.99 | 1.51 | 45.50 | 74.00 | -28.50 | 100 | 187 | peak |
| 4960.00 | 36.05 | 1.51 | 37.56 | 54.00 | -16.44 | 100 | 187 | AVG |
| 7440.00 | 45.28 | 7.49 | 52.77 | 74.00 | -21.23 | 100 | 53 | peak |
| 7440.00 | 29.79 | 7.49 | 37.28 | 54.00 | -16.72 | 100 | 53 | AVG |

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

**Vertical**

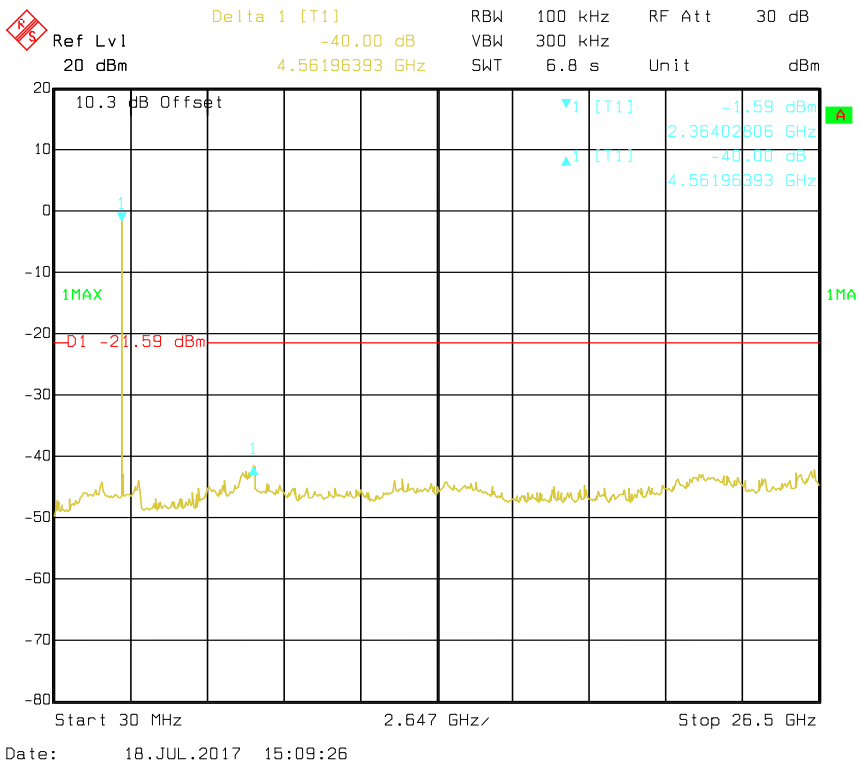
| Frequency (MHz) | Reading (dB μV) | Correct Factor(dB/m) | Result (dB μV/m) | Limit (dB μV/m) | Margin (dB) | Height (cm) | Degree ( ˚ ) | Remark |
|---|---|---|---|---|---|---|---|---|
| BLE, Low channel | | | | | | | | |
| 81.41 | 44.30 | -16.77 | 27.53 | 40.00 | -12.47 | 100 | 268 | QP |
| 310.33 | 31.82 | -9.61 | 22.21 | 46.00 | -23.79 | 100 | 280 | QP |
| 485.90 | 28.53 | -5.95 | 22.58 | 46.00 | -23.42 | 100 | 276 | QP |
| 652.74 | 28.35 | -3.32 | 25.03 | 46.00 | -20.97 | 100 | 335 | QP |
| 715.79 | 27.70 | -2.51 | 25.19 | 46.00 | -20.81 | 100 | 352 | QP |
| 817.64 | 28.87 | -0.22 | 28.65 | 46.00 | -17.35 | 100 | 279 | QP |
| 2390.00 | 63.44 | -4.89 | 58.55 | 74.00 | -15.45 | 175 | 290 | peak |
| 2390.00 | 52.51 | -4.89 | 47.62 | 54.00 | -6.38 | 175 | 290 | AVG |
| 2402.00 | 94.08 | -4.86 | 89.22 | N/A | N/A | 136 | 290 | peak |
| 2402.00 | 93.27 | -4.86 | 88.41 | N/A | N/A | 136 | 290 | AVG |
| 4804.000 | 45.97 | 0.98 | 46.95 | 74.00 | -27.05 | 100 | 329 | peak |
| 4804.00 | 35.81 | 0.98 | 36.79 | 54.00 | -17.21 | 100 | 329 | AVG |
| 7206.00 | 45.10 | 6.56 | 51.66 | 74.00 | -22.34 | 100 | 358 | peak |
| 7206.00 | 29.84 | 6.56 | 36.40 | 54.00 | -17.60 | 100 | 358 | AVG |
| BLE, Middle channel | | | | | | | | |
| 47.46 | 39.92 | -15.06 | 24.86 | 40.00 | -15.14 | 100 | 125 | QP |
| 101.78 | 34.38 | -14.05 | 20.33 | 43.50 | -23.17 | 100 | 48 | QP |
| 166.77 | 31.12 | -11.98 | 19.14 | 43.50 | -24.36 | 100 | 360 | QP |
| 310.33 | 30.71 | -9.61 | 21.10 | 46.00 | -24.90 | 100 | 101 | QP |
| 639.16 | 28.05 | -3.49 | 24.56 | 46.00 | -21.44 | 100 | 46 | QP |
| 942.77 | 27.42 | 2.48 | 29.90 | 46.00 | -16.10 | 100 | 275 | QP |
| 2442.00 | 93.97 | -4.76 | 89.21 | N/A | N/A | 120 | 245 | peak |
| 2442.00 | 92.86 | -4.76 | 88.10 | N/A | N/A | 120 | 245 | AVG |
| 4884.00 | 45.09 | 1.25 | 46.34 | 74.00 | -27.66 | 100 | 96 | peak |
| 4884.00 | 37.25 | 1.25 | 38.50 | 54.00 | -15.50 | 100 | 96 | AVG |
| 7326.00 | 45.60 | 7.04 | 52.64 | 74.00 | -21.36 | 100 | 355 | peak |
| 7326.00 | 30.25 | 7.04 | 37.29 | 54.00 | -16.71 | 100 | 355 | AVG |
| BLE, High channel | | | | | | | | |
| 62.01 | 38.19 | -17.41 | 20.78 | 40.00 | -19.22 | 100 | 345 | QP |
| 166.77 | 31.22 | -11.98 | 19.24 | 43.50 | -24.26 | 100 | 32 | QP |
| 314.21 | 30.66 | -9.54 | 21.12 | 46.00 | -24.88 | 100 | 169 | QP |
| 567.38 | 28.92 | -4.63 | 24.29 | 46.00 | -21.71 | 100 | 360 | QP |
| 638.19 | 28.74 | -3.50 | 25.24 | 46.00 | -20.76 | 100 | 52 | QP |
| 813.76 | 27.83 | -0.30 | 27.53 | 46.00 | -18.47 | 100 | 48 | QP |
| 2480.00 | 95.20 | -4.68 | 90.52 | N/A | N/A | 100 | 249 | peak |
| 2480.00 | 93.85 | -4.68 | 89.17 | N/A | N/A | 100 | 249 | AVG |
| 2483.50 | 63.89 | -4.69 | 59.20 | 74.00 | -14.80 | 145 | 354 | peak |
| 2483.50 | 52.29 | -4.69 | 47.60 | 54.00 | -6.40 | 145 | 354 | AVG |
| 4960.00 | 43.78 | 1.51 | 45.29 | 74.00 | -28.71 | 100 | 98 | peak |
| 4960.00 | 35.61 | 1.51 | 37.12 | 54.00 | -16.88 | 100 | 98 | AVG |
| 7440.00 | 44.58 | 7.49 | 52.07 | 74.00 | -21.93 | 100 | 320 | peak |
| 7440.00 | 29.56 | 7.49 | 37.05 | 54.00 | -16.95 | 100 | 320 | AVG |

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

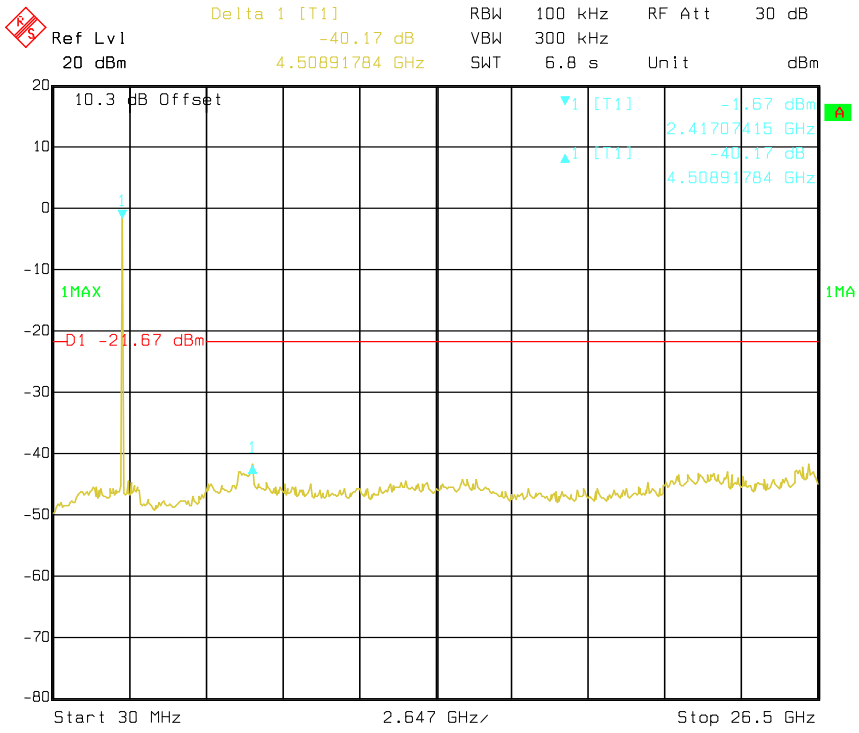
**Conducted Spurious Emissions:**

| Channel | Frequency (MHz) | Delta Peak to Band Emission (dBc) | Limit (dBc) | RESULT |
|---|---|---|---|---|
| Low | 2402 | 40.00 | ≥ 20 | PASS |
| Mid | 2442 | 40.17 | ≥ 20 | PASS |
| High | 2480 | 39.54 | ≥ 20 | PASS |

**Low Channel**

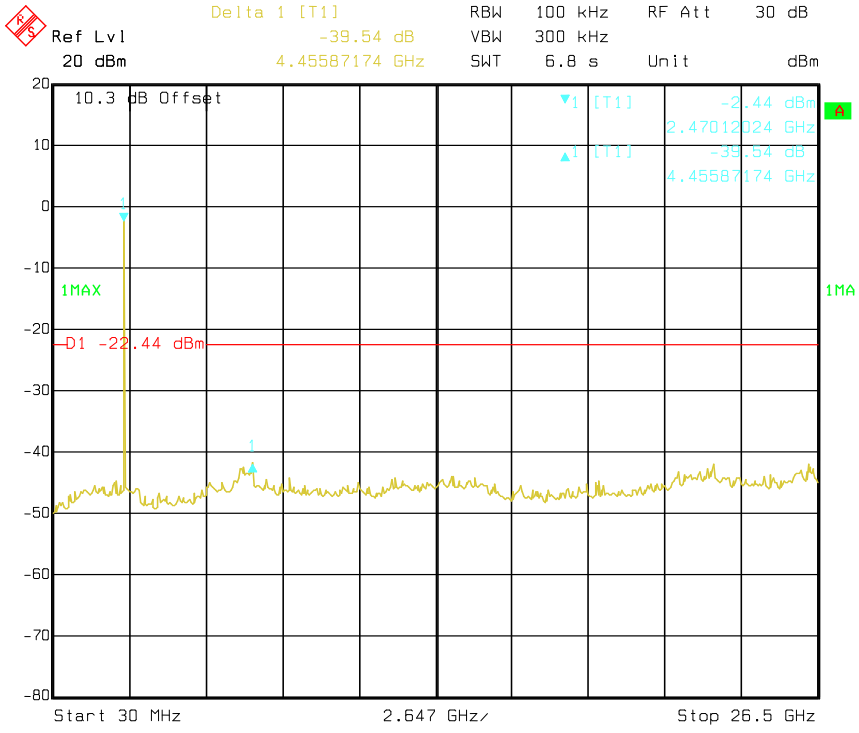


## Middle Channel




Date: 18.JUL.2017 15:10:57

## High Channel




Date: 18.JUL.2017 15:07:02

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

## 8.1 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.

## 8.2 Test Procedure

The steps for the first option are as follows:

a) Set RBW = 100 kHz.

b) Set the VBW ≥ [3 × RBW].

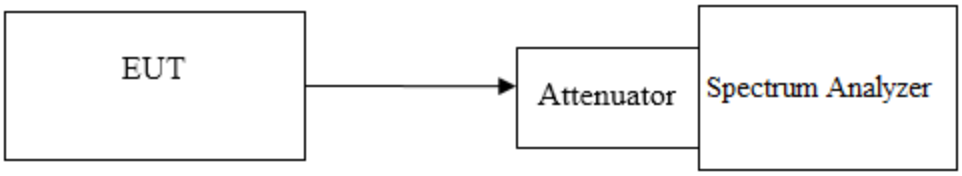
c) Detector = peak.

d) Trace mode = max hold.

e) Sweep = auto couple.

f) Allow the trace to stabilize.

g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.




## 8.3 Test Equipment List and Details

| Descriptions | Manufacturers | Models | Serial Numbers | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| Spectrum Analyzer | Rohde & Schwarz | FSEK30 | 825084/006 | 2016/12/15 | 2017/12/14 |
| Cable | WOKEN | SFL402 | S02-160323-07 | 2017/02/22 | 2018/02/21 |
| Attenuator | MINI-CIRCUITS | BW-S10W5+ | N/A | 2017/03/09 | 2018/03/08 |

*** *Statement of Traceability:*** BACL Corp. attests that all calibrations have been performed according to TAF requirements, traceable to the ETC.

## 8.4 Test Environmental Conditions

| | |
|---|---|
| **Temperature:** | 26° C |
| **Relative Humidity:** | 58 % |
| **ATM Pressure:** | 1010 hPa |

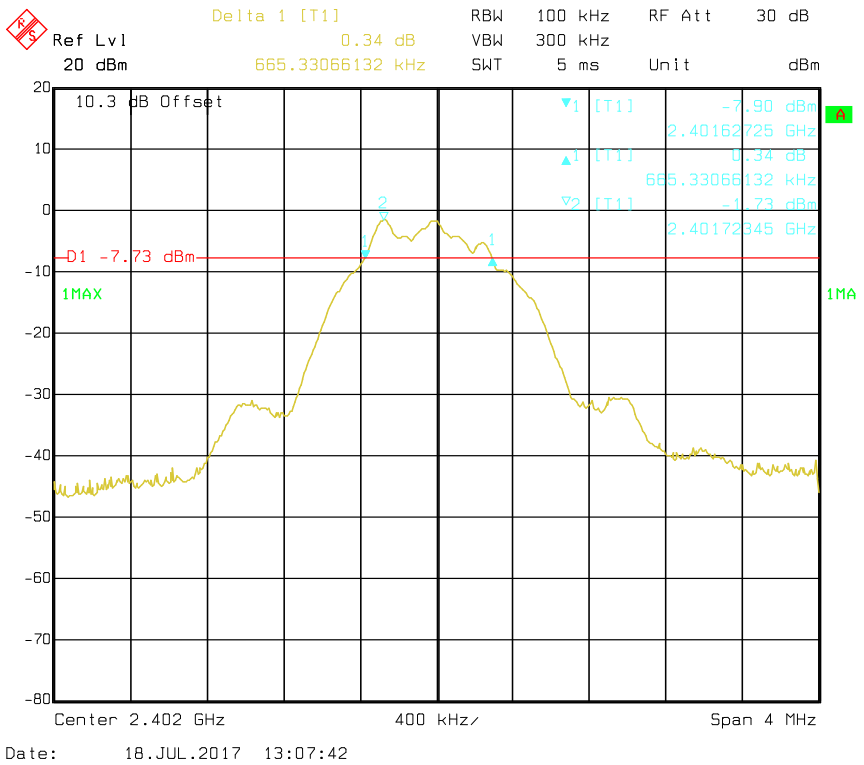
*The testing was performed by Andy Shih on 2017-07-18.*

## 8.5 Test Results

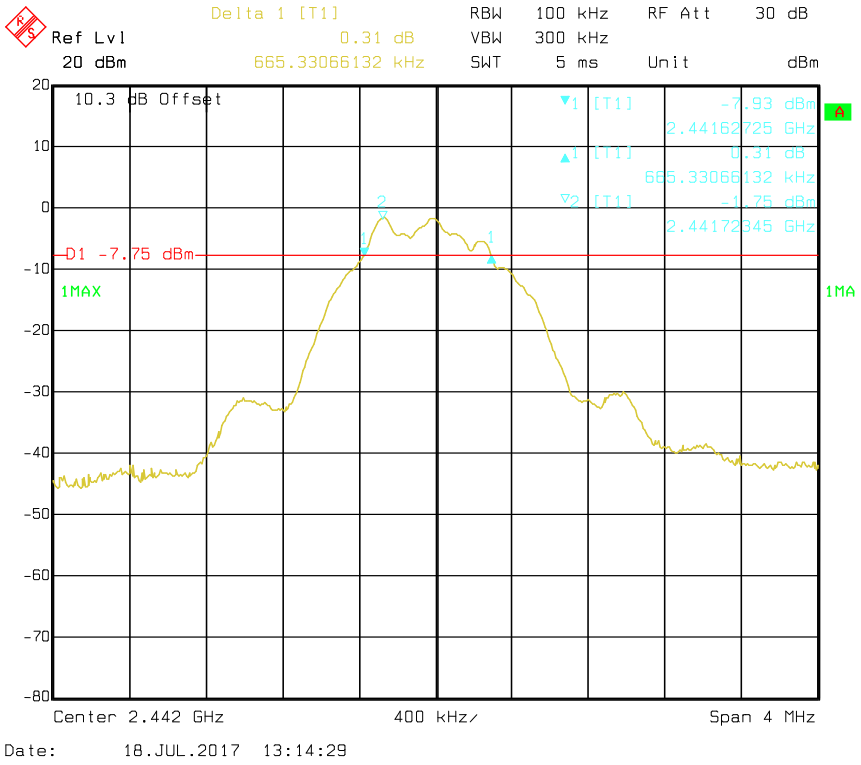
| Channel | Frequency (MHz) | 6 dB OBW (MHz) | Limit (MHz) | Result |
|---|---|---|---|---|
| Low | 2402 | 0.67 | > 0.5 | Compliance |
| Middle | 2442 | 0.67 | > 0.5 | Compliance |
| High | 2480 | 0.66 | > 0.5 | Compliance |

Please refer to the following plots

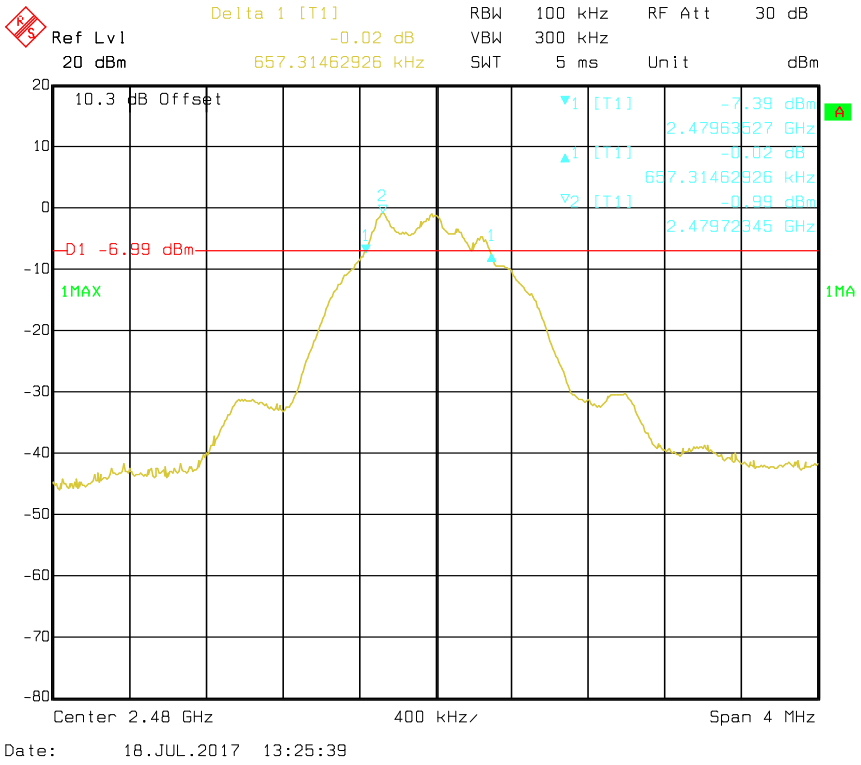
**Low Channel**



## Middle Channel




## High Channel



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

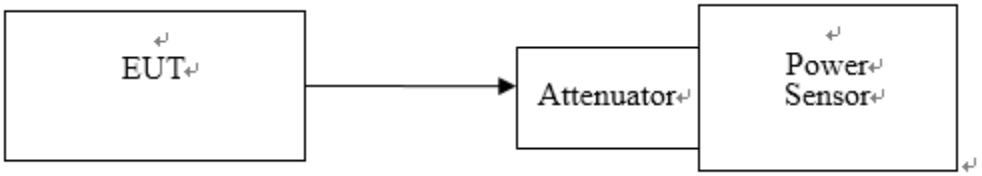
## 9.1 Applicable Standard

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.

## 9.2 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 measuring equipment.




## 9.3 Test Equipment List and Details

| Descriptions | Manufacturers | Models | Serial Numbers | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| Power Sensor | KEYSIGHT | U2021XA | MY54080018 | 2017/03/21 | 2018/03/20 |
| Cable | WOKEN | SFL402 | S02-160323-07 | 2017/02/22 | 2018/02/21 |
| Attenuator | MINI-CIRCUITS | BW-S10W5+ | N/A | 2017/03/09 | 2018/03/08 |

*** *Statement of Traceability:*** BACL Corp. attests that all calibrations have been performed according to TAF requirements, traceable to the ETC.

## 9.4 Test Environmental Conditions

| | |
|---|---|
| **Temperature:** | 26° C |
| **Relative Humidity:** | 58 % |
| **ATM Pressure:** | 1010 hPa |

*The testing was performed by Andy Shih on 2017-07-18.*

## 9.5 Test Results

| Channel | Frequency (MHz) | Conducted Output Power (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|
| Low | 2402 | -1.97 | 30 | Compliance |
| Middle | 2442 | -1.89 | 30 | Compliance |
| High | 2480 | -1.77 | 30 | Compliance |

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

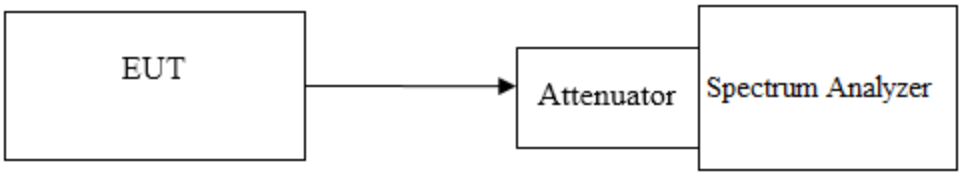
## 10.1 Applicable Standard

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)).

## 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 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.



## 10.3 Test Equipment List and Details

| Descriptions | Manufacturers | Models | Serial Numbers | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| Spectrum Analyzer | Rohde & Schwarz | FSEK30 | 825084/006 | 2016/12/15 | 2017/12/14 |
| Cable | WOKEN | SFL402 | S02-160323-07 | 2017/02/22 | 2018/02/21 |
| Attenuator | MINI-CIRCUITS | BW-S10W5+ | N/A | 2017/03/09 | 2018/03/08 |

*** *Statement of Traceability:*** BACL Corp. attests that all calibrations have been performed according to TAF requirements, traceable to the ETC.

## 10.4 Test Environmental Conditions

| | |
|---|---|
| **Temperature:** | 26° C |
| **Relative Humidity:** | 58 % |
| **ATM Pressure:** | 1010 hPa |

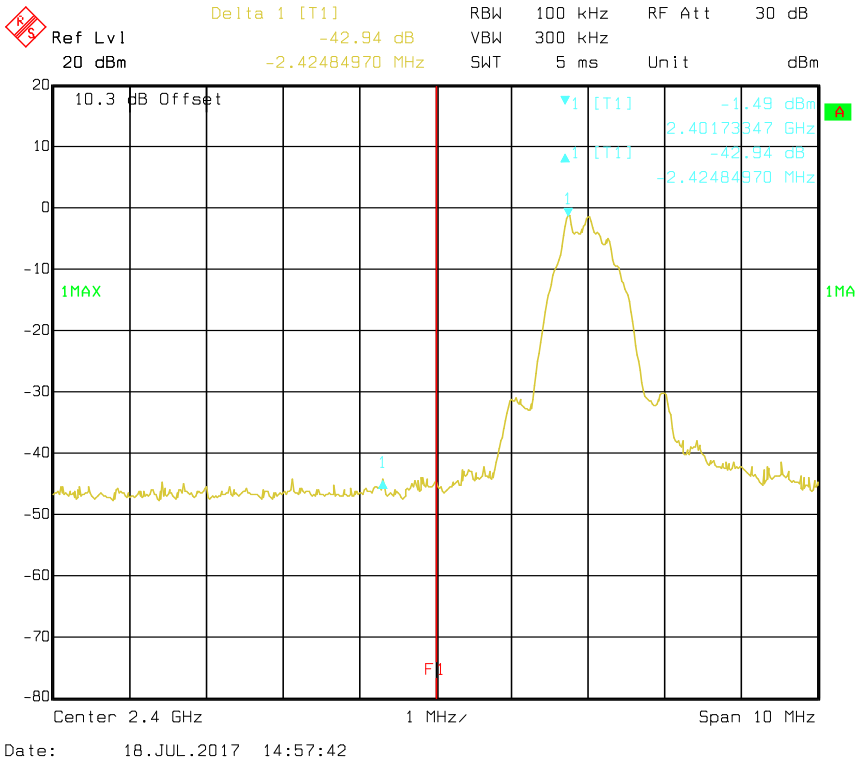
*The testing was performed by Andy Shih on 2017-07-18.*

## 10.5 Test Results

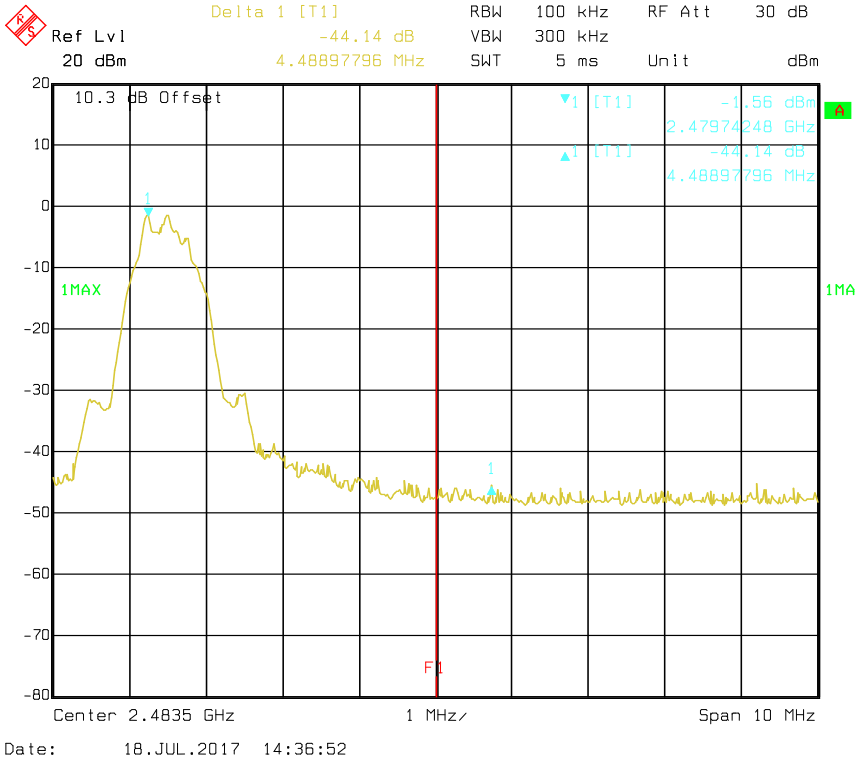
| Channel | Frequency (MHz) | Delta Peak to Band Emission (dBc) | Limit (dBc) | RESULT |
|---|---|---|---|---|
| Low | 2402 | 42.94 | ≥ 20 | PASS |
| High | 2480 | 44.14 | ≥ 20 | PASS |

Please refer to the following plots

## Band Edge, Left Side




## Band Edge, Right Side



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

## 11.1 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.

## 11.2 Test Procedure

According to ANSI C63.10-2013

a) Set analyzer center frequency to DTS channel center frequency.

b) Set the span to 1.5 times the DTS bandwidth.

c) Set the RBW to 3 kHz ≤ RBW ≤ 100 kHz.

d) Set the VBW ≥ [3 × RBW].

e) Detector = peak.

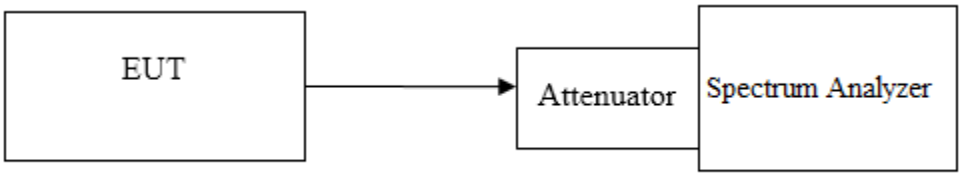
f) Sweep time = auto couple.

g) Trace mode = max hold.

h) Allow trace to fully stabilize.

i) Use the peak marker function to determine the maximum amplitude level within the RBW.

j) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat



## 11.3 Test Equipment List and Details

| Descriptions | Manufacturers | Models | Serial Numbers | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| Spectrum Analyzer | Rohde & Schwarz | FSEK30 | 825084/006 | 2016/12/15 | 2017/12/14 |
| Cable | WOKEN | SFL402 | S02-160323-07 | 2017/02/22 | 2018/02/21 |
| Attenuator | MINI-CIRCUITS | BW-S10W5+ | N/A | 2017/03/09 | 2018/03/08 |

*** *Statement of Traceability:*** BACL Corp. attests that all calibrations have been performed according to TAF requirements, traceable to the ETC.

## 11.4 Test Environmental Conditions

| | |
|---|---|
| **Temperature:** | 26° C |
| **Relative Humidity:** | 58 % |
| **ATM Pressure:** | 1010 hPa |

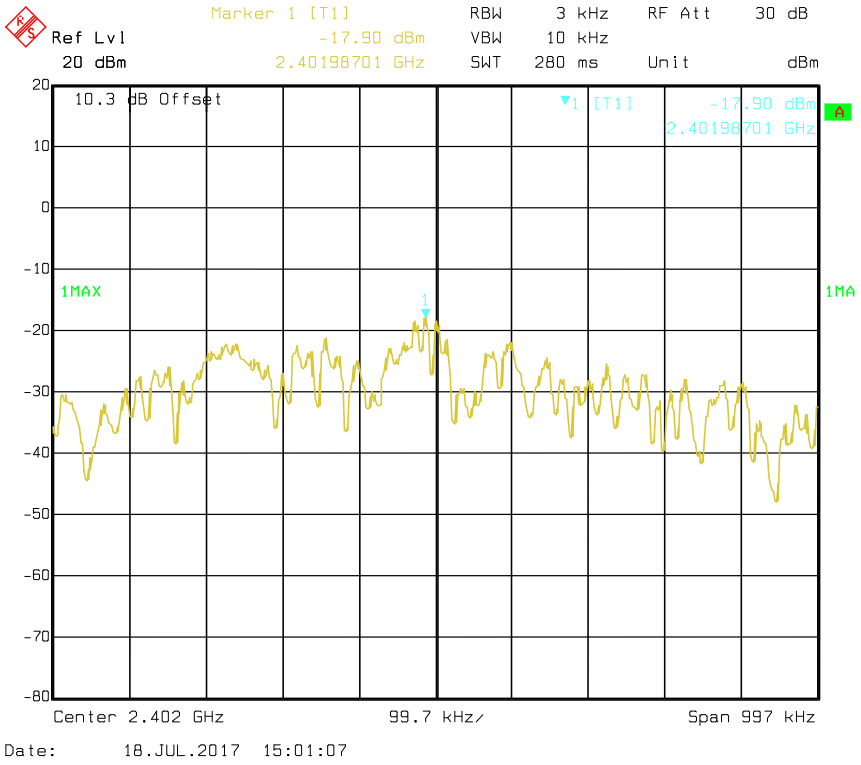
*The testing was performed by Andy Shih on 2017-07-18.*

## 11.5 Test Results

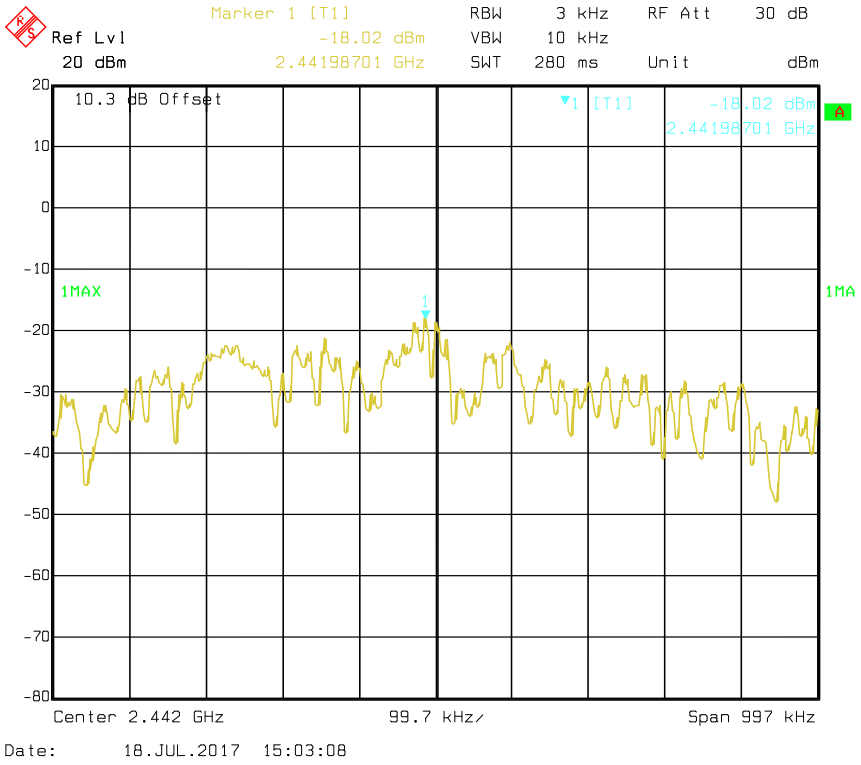
| Channel | Frequency (MHz) | PSD (dBm/3 kHz) | Limit (dBm/3 kHz) | Result |
|---|---|---|---|---|
| Low | 2402 | -17.90 | 8 | Compliance |
| Middle | 2442 | -18.02 | 8 | Compliance |
| High | 2480 | -17.96 | 8 | Compliance |

Please refer to the following plots

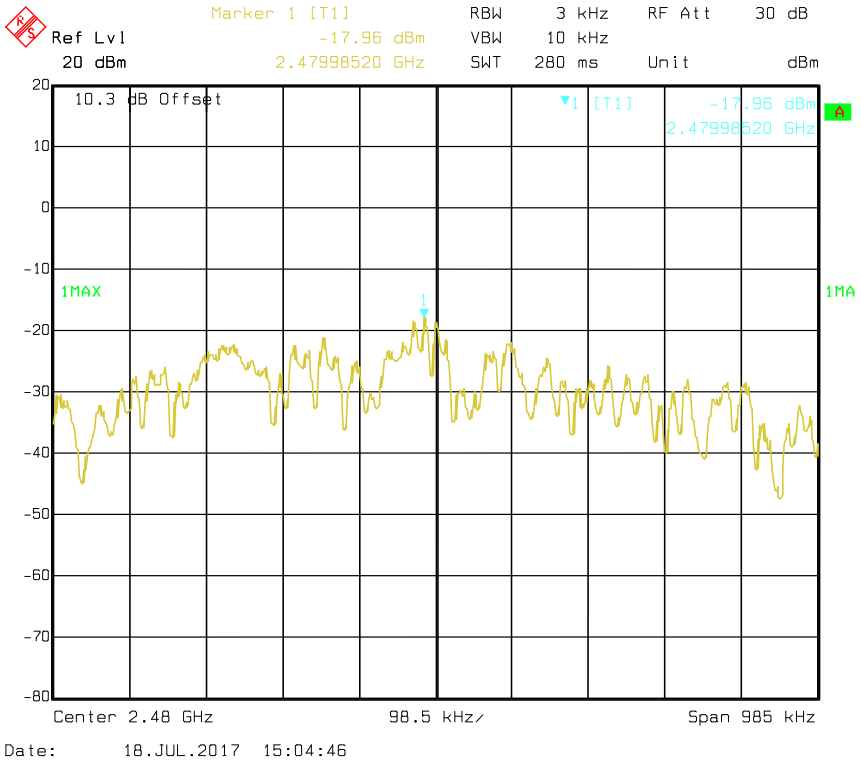
## Low Channel




## Middle Channel



## High Channel




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