# RADIO TEST REPORT

The device described below is tested by Dongguan Nore Testing Center Co., Ltd. to determine the maximum emission levels emanating from the device, the severe levels which the device can endure and E.U.T.'s performance criterion. The test results, data evaluation, test procedures, and equipment of configurations shown in this report were made in accordance with the procedures in ANSI C63.10(2013).

| | | |
|---|---|---|
| Applicant | : | Fender Musical Instruments |
| Address | : | 17600 N. Perimeter Drive Suite 100, Scottsdale, Arizona, 85255, United States |
| Manufacturer /Factory | : | FN-LINK TECHNOLOGY LIMITED |
| Address | : | 5th Floor, A Building, Haoye Logistics Park, Shugang Channel, Bao'an District, Shenzhen City, China |
| E.U.T. | : | WIFI+BT Module |
| Brand Name | : | FN-LINK |
| Model No. | : | F23BUUM13-W2, Fender PCBA 7710065000<br>(For model difference, refer to section 1.1) |
| FCC ID | : | XQW-FMAPR4400 |
| Measurement Standard | : | FCC PART 15.247 |
| Date of Receiver | : | October 09, 2016 |
| Date of Test | : | October 09, 2016 to October 19, 2016 |
| Date of Report | : | October 19, 2016 |

This Test Report is Issued Under the Authority of :

| Prepared by | Approved & Authorized Signer |
|---|---|
| Rose Hu / Engineer | Iori Fan / Authorized Signatory |

This test report is for the customer shown above and their specific product only. This report applies to above tested sample only and shall not be reproduced in part without written approval of Dongguan Nore Testing Center Co., Ltd.

TEL: +86-769-22022444 FAX: +86-769-22022799 Web: www.ntc-c.com
Address: Building D, Gaosheng Science & Technology Park, Zhouxi Longxi Road, Nancheng District, Dongguan City, Guangdong, China

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# Revision History of This Test Report

| Report Number | Description | Issued Date |
|---|---|---|
| NTC1610212F | Initial Issue | 2016-10-19 |
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# 1. GENERAL INFORMATION

## 1.1 Product Description for Equipment under Test

This device is a WIFI+BT Module, it's powered by DC 3.3V come from external power source. For more details features, please refer to User's Manual.

| | | |
|---|---|---|
| Power Supply | : | DC 3.3V |
| Adapter | : | None |
| Test voltage | : | AC 120V 60Hz PC input |
| Model name | : | F23BUUM13-W2, Fender PCBA 7710065000 (All tests were carried on model F23BUUM13-W2) |
| Model difference | : | Both of models have the same circuitry, PCB layout and physical construction. The differences in model number due to trading purpose. |
| Hardware version | : | WIFI-FTSW-USB REV 3 |
| Software version | : | V1.0 |
| Serial number | : | N/A |
| Note | : | This report only applies to modulation technology DTS(WIFI). |

**Technical parameters**
**For WIFI Function**

| | | |
|---|---|---|
| Frequency Range | : | 2412-2462MHz for 802.11b/g/n(HT20)<br>2422-2452MHz for 802.11n(HT40) |
| Modulation | : | DSSS for 802.11b<br>OFDM for 802.11g/n(HT20)/n(HT40) |
| Number of Channel | : | 11 for 802.11b/g/n(HT20)<br>7 for 802.11n(HT40) |
| Channel space | : | 5MHz |
| Date Rate | : | 802.11b:1~11Mbps,<br>802.11g:6~54Mbps<br>802.11n: 6.5~135Mbps |
| Antenna Type | : | PCB Antenna |
| Antenna Gain | : | 1.0 dBi |

**For BT function**
BT Version: BLE(V4.0) and backward compatible 3.0, 2.1+EDR version.
We prepare version BLE(V4.0) and 2.1+EDR for RF test.

| Item | BT2.1+EDR | BLE(V4.0) |
|---|---|---|
| Frequency | 2402-2480MHz | 2402-2480MHz |
| Modulation | GFSK, π/4-DQPSK, 8DPSK | GFSK |
| Number of Channel | 79 | 40 |
| Channel space | 1MHz | 2MHz |
| Antenna Type | PCB antenna | PCB antenna |
| Antenna Gain | 1.0 dBi | 1.0 dBi |

## WIFI Channel List

| 802.11 b/g/n(HT20) | | 802.11 n(HT40) | |
|---|---|---|---|
| **Channel** | **Frequency MHz** | **Channel** | **Frequency MHz** |
| 1 | 2412 | --- | --- |
| 2 | 2417 | --- | --- |
| 3 | 2422 | 3 | 2422 |
| 4 | 2427 | 4 | 2427 |
| 5 | 2432 | 5 | 2432 |
| 6 | 2437 | 6 | 2437 |
| 7 | 2442 | 7 | 2442 |
| 8 | 2447 | 8 | 2447 |
| 9 | 2452 | 9 | 2452 |
| 10 | 2457 | --- | --- |
| 11 | 2462 | --- | --- |

**Note:** According to section 15.31(m), regards to the operating frequency range over 10MHz, the Lowest, middle, and the Highest frequency of channel were selected to perform the test. The selected frequency see below:

| 802.11b/g/n(HT20) | | 802.11 n(HT40) | |
|---|---|---|---|
| **Channel** | **Frequency MHz** | **Channel** | **Frequency MHz** |
| 1 | 2412 | 3 | 2422 |
| 6 | 2437 | 6 | 2437 |
| 11 | 2462 | 9 | 2452 |

| | |
|---|---|
| **Test SW version** | **REALTEK 11N 8723BS SDIO WLAN MP Diagnostic Program 32.20141201** |

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

This submittal(s) (test report) is intended for FCC ID: **XQW-FMAPR4400** filing to comply with Section 15.247 of the FCC Part 15(2016), Subpart C Rule.

## 1.3 Test Methodology

Both AC mains line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.10 (2013). Radiated emission measurement was performed in semi-anechoic chamber and conducted emission measurement was performed in shield room. For radiated emission measurement, preliminary scans were performed in the semi-anechoic chamber only to determine the worst case modes. All radiated tests were performed at an antenna to EUT distance of 3 meters. All other measurements were made in accordance with the procedures in 47 CFR part 2.

## 1.4 Equipment Modifications

Not available for this EUT intended for grant.

## 1.5 Support Device

| | | |
|---|---|---|
| PC | : | Manufacturer: HP<br>M/N: HP Pro 3005 MT<br>S/N: 4CV1324FBS<br>P/N: QG570PA#AB2<br>Power Cord: 1.8m Unshielded, with core<br>CE, FCC: DOC |
| LCD Monitor | : | Manufacturer: LENOVO<br>M/N: L2061WD<br>S/N: 3M04769B1102083Data Cable: 1.5m Shielded, with core<br>Power Cord: 1.5m Unshielded, with core<br>CE , FCC:DOC |
| Mouse | : | Manufacturer: Logitech<br>M/N: M-U0026<br>P/N: 810-002182<br>CE, FCC: DOC |
| Keyboard | : | Manufacturer: acer<br>M/N: 38184<br>S/N: N/A<br>CE, FCC: DOC |
| Printer | : | Manufacturer: Lenovo<br>M/N: 3518<br>Data Cable: 1.5m Shielded<br>Power Cord: 1.5m Unshielded with core<br>CE, FCC: DOC |

## 1.6 Test Facility and Location

Listed by FCC, July 03, 2014
The Certificate Registration Number is 665078.
Listed by Industry Canada, June 18, 2014
The Certificate Registration Number is 9743A.

Dongguan NTC Co., Ltd.
(Full Name: Dongguan Nore Testing Center Co., Ltd.)

Building D, Gaosheng Science and Technology Park, Hongtu Road, Nancheng District, Dongguan City, Guangdong, China
(Full Name: Building D, Gaosheng Science & Technology Park, Zhouxi Longxi Road, Nancheng District, Dongguan, Guangdong, China.

## 1.7 Summary of Test Results

| FCC Rules | Description Of Test | Uncertainty | Result |
|---|---|---|---|
| §15.207 (a) | AC Power Conducted Emission | ±1.06dB | Compliant |
| §15.247(b)(3) | Max. Conducted Output Power | ±1.06dB | Compliant |
| §15.247(a)(2) | 6dB Bandwidth | ±1.42 x$10^{-4}$% | Compliant |
| §15.247(e) | Power Spectral Density | ±1.06dB | Compliance |
| §15.247(d) | Band Edge and Conducted Spurious Emissions | ±1.70dB & ±2.51dB | Compliance |
| §15.247(d),§15.209, §15.205 | Radiated Spurious Emissions and Restricted Bands | ±3.70dB | Compliance |
| §15.203 | Antenna Requirement | ±0.60dB | Compliance |

# 2. System Test Configuration

## 2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

## 2.2 Special Accessories

Not available for this EUT intended for grant.

## 2.3 Description of test modes

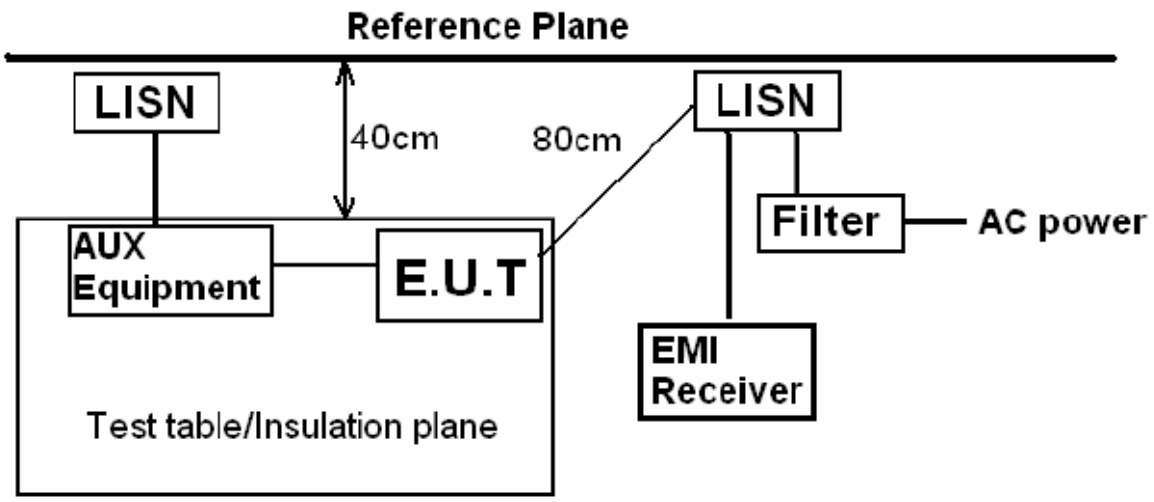
The EUT has been tested under continuous operating condition. Test program used to control the EUT staying in continuous transmitting mode. The Lowest, middle and highest channel were chosen for testing, and modulation type CCK, DQPSK, DBPSK, OFDM and all data rate were tested. But only the worst case data is shown in this report.

## 2.4 EUT Exercise

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements.

# 3. Conducted Emissions Test

## 3.1 Test SET-UP (Block Diagram of Configuration)




## 3.2 Test Condition

**Test Requirement: FCC Part 15.207**

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

**Detector: RBW 9KHz, VBW 30KHz**

**Operation Mode: WIFI Mode**

## 3.3 Measurement Results

**Please refer to following plots of the worst case.**

**Dongguan NTC Co., Ltd.**
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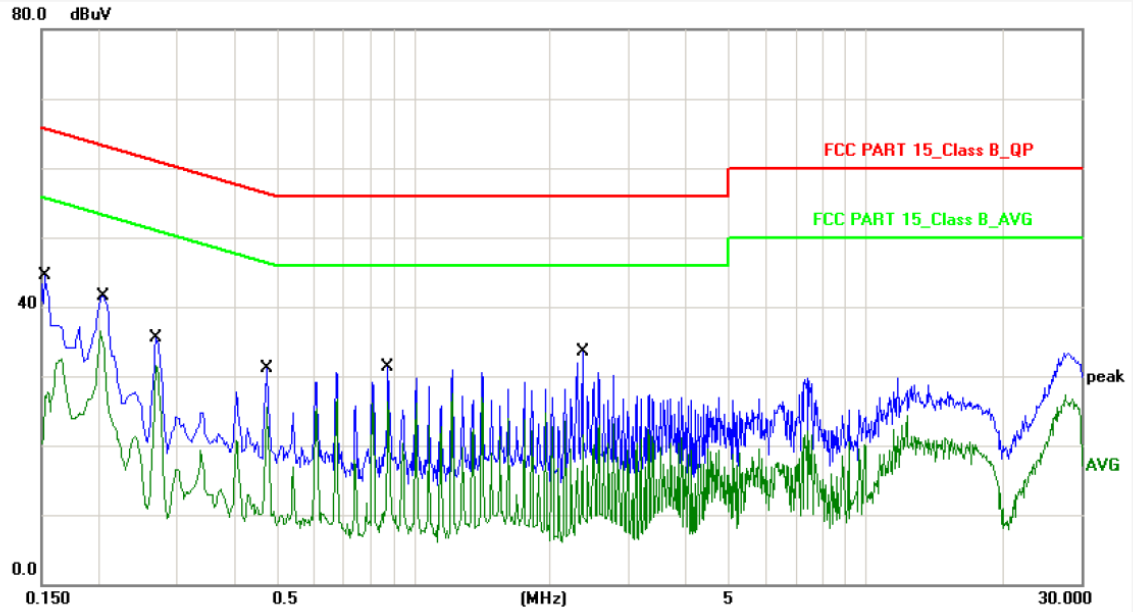
Web: Http://www.ntc-c.com

Site: Conduction

Test Time: 2016-10-16 18:34:03




**Report No.:** F23BUUM13-W2
**Test Standard:** FCC PART 15_Class B_QP
**Test item:** Conducted Emission
**Phase:** L1
**Applicant:** Fender Musical
**Temp.( )/Hum.(%):** 22(C) / 52 %
**Product:** WIFI+BT Module
**Power Rating:** AC 120V/60Hz
**Model No.:** F23BUUM13-W2
**Test Engineer:** Jerry

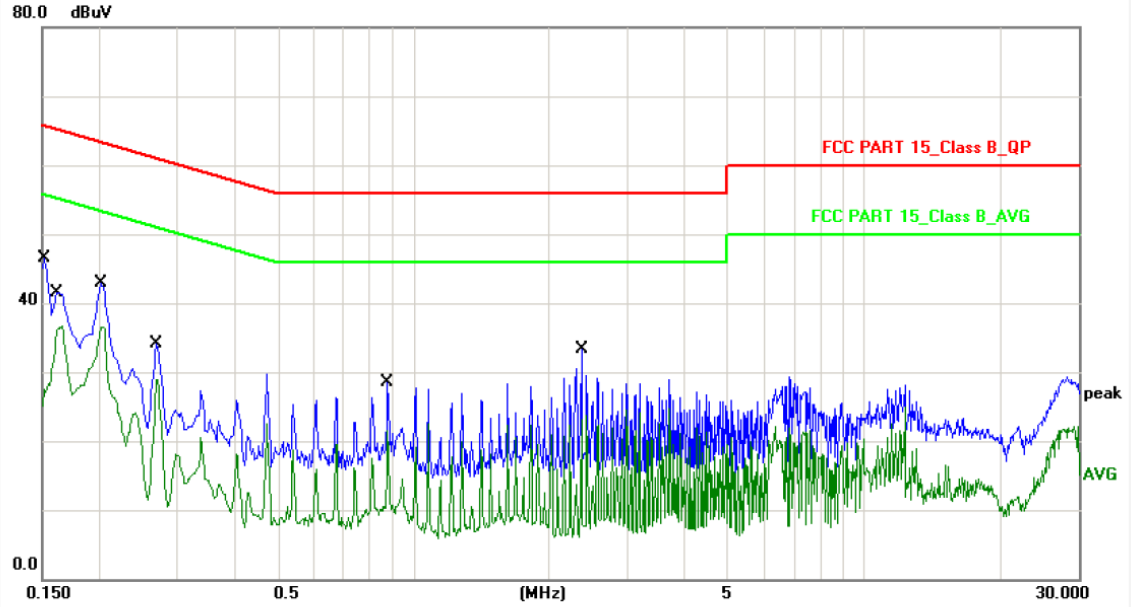
**Test Mode:** Wi-Fi Mode
**Remark:** 802.11g middle channel

| No. | Frequency (MHz) | Factor (dBuV) | Reading (dBuV) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | P/F | Remark |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.1524 | 10.80 | 31.20 | 42.00 | 65.86 | -23.86 | QP | P | |
| 2 | 0.1524 | 10.80 | 14.90 | 25.70 | 55.86 | -30.16 | AVG | P | |
| 3 | 0.2060 | 10.80 | 28.80 | 39.60 | 63.36 | -23.76 | QP | P | |
| 4 | 0.2060 | 10.80 | 23.40 | 34.20 | 53.36 | -19.16 | AVG | P | |
| 5 | 0.2700 | 10.80 | 22.70 | 33.50 | 61.12 | -27.62 | QP | P | |
| 6 | 0.2700 | 10.80 | 18.70 | 29.50 | 51.12 | -21.62 | AVG | P | |
| 7 | 0.4740 | 10.80 | 18.40 | 29.20 | 56.44 | -27.24 | QP | P | |
| 8 | 0.4740 | 10.80 | 12.60 | 23.40 | 46.44 | -23.04 | AVG | P | |
| 9 | 0.8780 | 10.80 | 18.50 | 29.30 | 56.00 | -26.70 | QP | P | |
| 10 | 0.8780 | 10.80 | 13.40 | 24.20 | 46.00 | -21.80 | AVG | P | |
| 11 | 2.3660 | 10.80 | 20.70 | 31.50 | 56.00 | -24.50 | QP | P | |
| 12 | 2.3660 | 10.80 | 8.70 | 19.50 | 46.00 | -26.50 | AVG | P | |

**Dongguan NTC Co., Ltd.**
**Tel: +86-769-22022444 Fax: +86-769-22022799**
Web: Http://www.ntc-c.com

Site: Conduction

Test Time: 2016-10-16 18:42:41




| | | | |
|---|---|---|---|
| **Report No.:** | **F23BUUM13-W2** | | |
| **Test Standard:** | **FCC PART 15_Class B_QP** | | |
| **Test item:** | **Conducted Emission** | **Phase:** | **N** |
| **Applicant:** | **Fender Musical** | **Temp.( )/Hum.(%):** | **22(C) / 52 %** |
| **Product:** | **WIFI+BT Module** | **Power Rating:** | **AC 120V/60Hz** |
| **Model No.:** | **F23BUUM13-W2** | **Test Engineer:** | **Jerry** |

**Test Mode:** **Wi-Fi Mode**

**Remark:** **802.11g middle channel**

| No. | Frequency (MHz) | Factor (dBuV) | Reading (dBuV) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | P/F | Remark |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.1515 | 10.80 | 33.60 | 44.40 | 65.91 | -21.51 | QP | P | |
| 2 | 0.1515 | 10.80 | 14.70 | 25.50 | 55.91 | -30.41 | AVG | P | |
| 3 | 0.1620 | 10.80 | 28.60 | 39.40 | 65.36 | -25.96 | QP | P | |
| 4 | 0.1620 | 10.80 | 23.80 | 34.60 | 55.36 | -20.76 | AVG | P | |
| 5 | 0.2020 | 10.80 | 30.10 | 40.90 | 63.52 | -22.62 | QP | P | |
| 6 | 0.2020 | 10.80 | 23.40 | 34.20 | 53.52 | -19.32 | AVG | P | |
| 7 | 0.2700 | 10.80 | 21.20 | 32.00 | 61.12 | -29.12 | QP | P | |
| 8 | 0.2700 | 10.80 | 16.10 | 26.90 | 51.12 | -24.22 | AVG | P | |
| 9 | 0.8780 | 10.80 | 15.80 | 26.60 | 56.00 | -29.40 | QP | P | |
| 10 | 0.8780 | 10.80 | 8.70 | 19.50 | 46.00 | -26.50 | AVG | P | |
| 11 | 2.3660 | 10.80 | 20.50 | 31.30 | 56.00 | -24.70 | QP | P | |
| 12 | 2.3660 | 10.80 | 10.90 | 21.70 | 46.00 | -24.30 | AVG | P | |

# 4. Max. Conducted Output Power

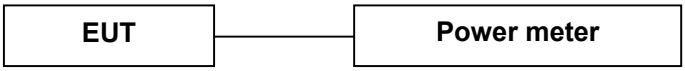
## 4.1 Measurement Procedure

Maximum Conducted Output power at Antenna Terminals, FCC Rules 15.247(b)(3):

One of the following procedures may be used to determine the maximum peak conducted output power of a DTS EUT.

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

## 4.2 Test SET-UP (Block Diagram of Configuration)




## 4.3 Measurement Results

**Pass**

Please refer to following table and plots.

| | | | |
|---|---|---|---|
| Temperature : | 24 ℃ | Humidity : | 50% |
| Test By: | Sance | Test Date : | October 11, 2016 |
| Test Result: | PASS | | |

| Frequency MHz | Data Rate Mbps | Peak Output Power dBm | Limit dBm |
|---|---|---|---|
| IEEE 802.11b Mode (CCK, Antenna Gain=1.0dBi) | | | |
| Low Channel: 2412 | 1 | 13.75 | 30 |
| Middle Channel: 2437 | 1 | 14.33 | 30 |
| High Channel: 2462 | 1 | 14.73 | 30 |
| IEEE 802.11g Mode (OFDM, Antenna Gain=1.0dBi) | | | |
| Low Channel: 2412 | 6 | 16.76 | 30 |
| Middle Channel: 2437 | 6 | 17.12 | 30 |
| High Channel: 2462 | 6 | 16.87 | 30 |
| IEEE 802.11n(HT20) Mode (OFDM, Antenna Gain=1.0dBi) | | | |
| Low Channel: 2412 | 6.5 | 16.71 | 30 |
| Middle Channel: 2437 | 6.5 | 17.02 | 30 |
| High Channel: 2462 | 6.5 | 16.71 | 30 |
| IEEE 802.11n(HT40) Mode (OFDM, Antenna Gain=1.0dBi) | | | |
| Low Channel: 2422 | 13 | 16.61 | 30 |
| Middle Channel: 2437 | 13 | 16.53 | 30 |
| High Channel: 2452 | 13 | 16.81 | 30 |

# 5. 6dB Bandwidth

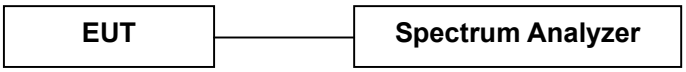
## 5.1 Measurement Procedure

DTS 6dB Channel Bandwidth, FCC Rule 15.247(a)(2):

The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer was set as below according to FCC KDB558074(v03r03):

1. For 6dB bandwidth, Set the RBW = 100KHz.
2. Set the VBW ⩾ 3 x RBW
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. 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.

## 5.2 Test SET-UP (Block Diagram of Configuration)



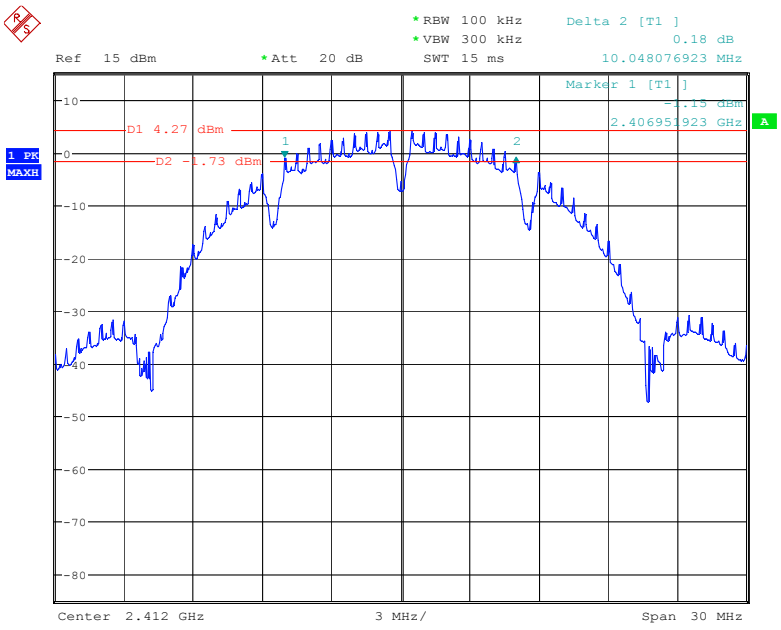

## 5.3 Measurement Results

**Pass**

Please refer to following table and plots.

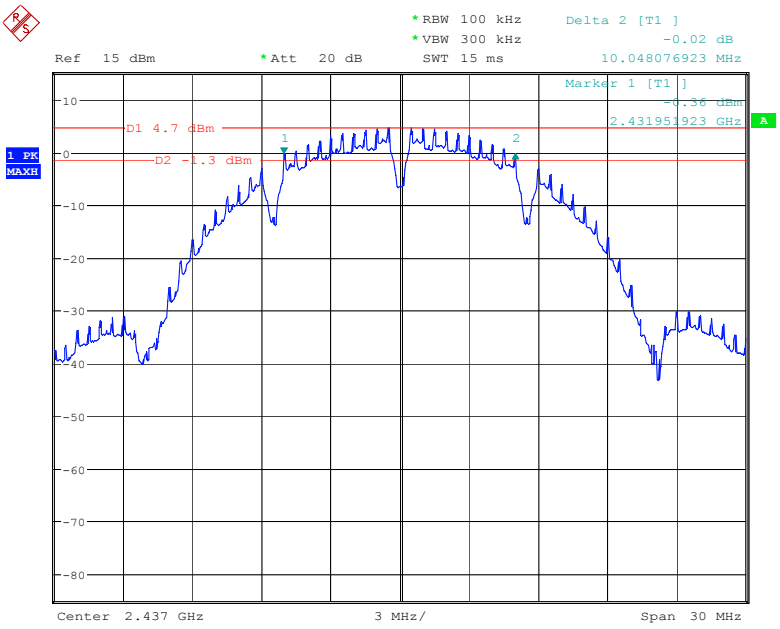
| | | | |
|---|---|---|---|
| Temperature : | 24 ℃ | Humidity : 50 % | |
| Test By: | Sance | Test Date : October 11, 2016 | |
| Test Result: | PASS | | |
| Frequency MHz | Data Rate Mbps | 6dB Bandwidth MHz | Limit |
| IEEE 802.11b Mode (CCK) | | | |
| Low Channel: 2412 | 1 | 10.05 | >500KHz |
| Middle Channel: 2437 | 1 | 10.05 | >500KHz |
| High Channel: 2462 | 1 | 10.05 | >500KHz |
| IEEE 802.11g Mode (OFDM) | | | |
| Low Channel: 2412 | 6 | 16.39 | >500KHz |
| Middle Channel: 2437 | 6 | 16.44 | >500KHz |
| High Channel: 2462 | 6 | 16.39 | >500KHz |
| IEEE 802.11n(HT20) Mode (OFDM) | | | |
| Low Channel: 2412 | 6.5 | 17.69 | >500KHz |
| Middle Channel: 2437 | 6.5 | 17.60 | >500KHz |
| High Channel: 2462 | 6.5 | 17.69 | >500KHz |
| IEEE 802.11n(HT40) Mode (OFDM) | | | |
| Low Channel: 2422 | 13 | 36.03 | >500KHz |
| Middle Channel: 2437 | 13 | 36.03 | >500KHz |
| High Channel: 2452 | 13 | 36.03 | >500KHz |

## 802.11b Low Channel



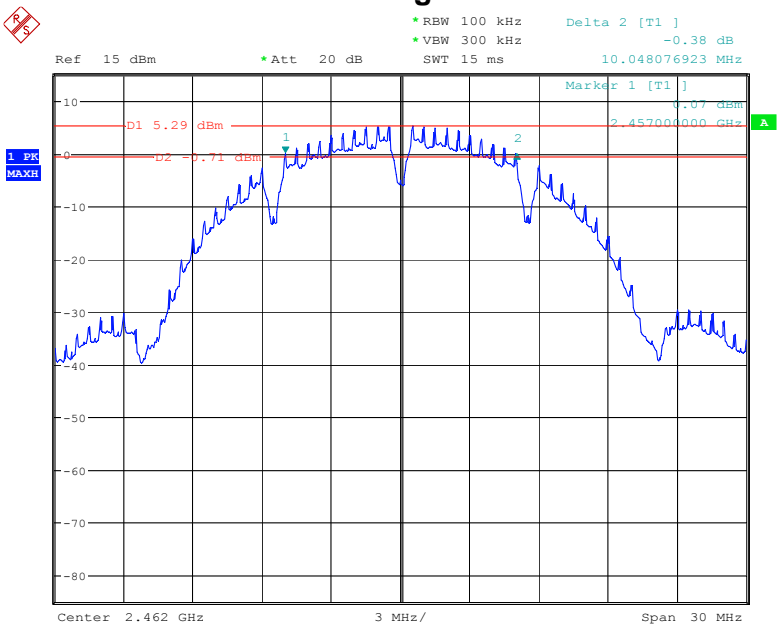

Date: 11.OCT.2016 15:52:22

## 802.11b Middle Channel



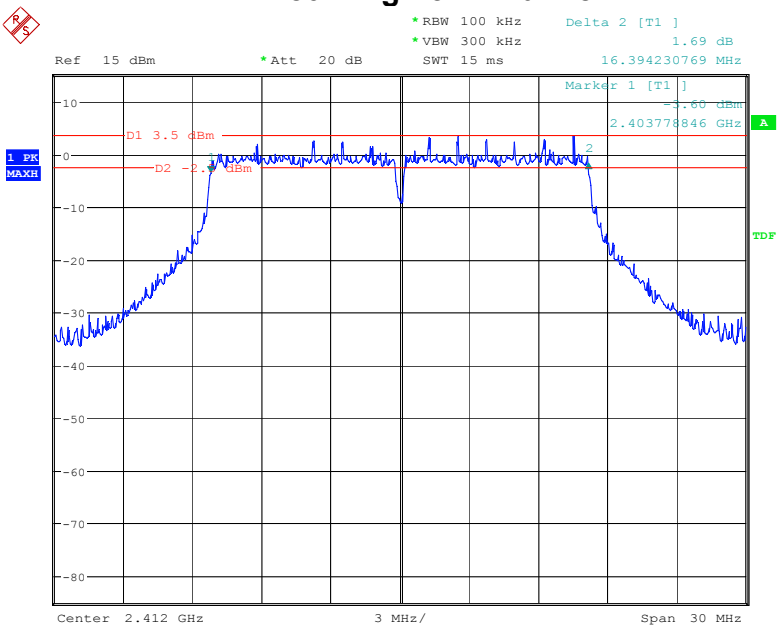

Date: 11.OCT.2016 15:55:04

## 802.11b High Channel



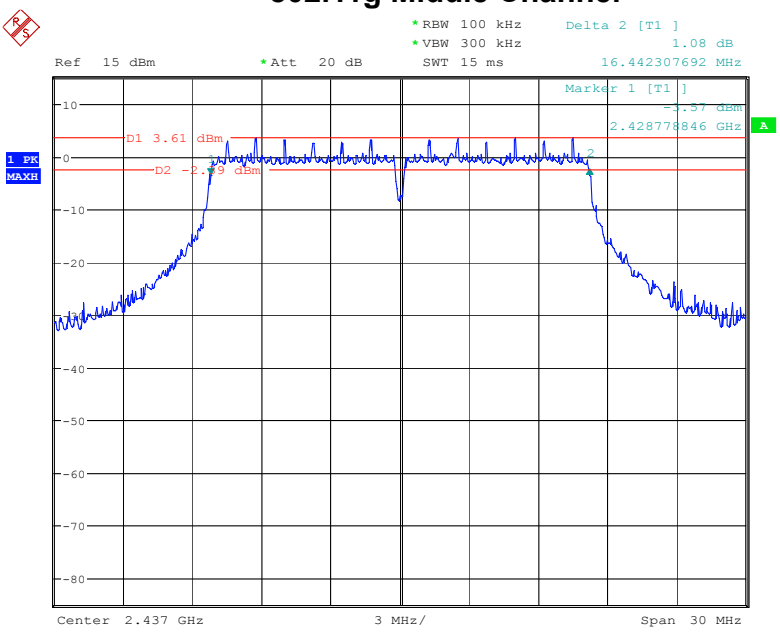

Date: 11.OCT.2016 15:58:05

## 802.11g Low Channel



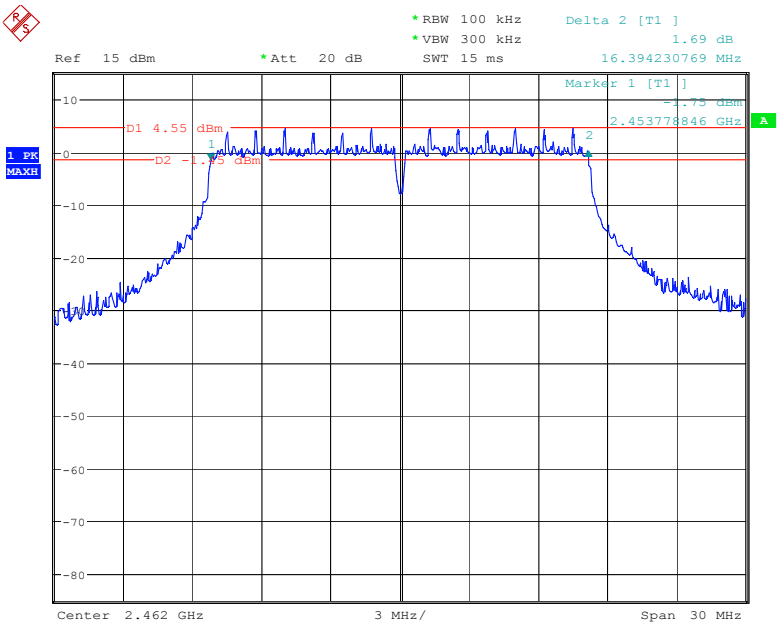

Date: 17.OCT.2016 09:57:06

## 802.11g Middle Channel



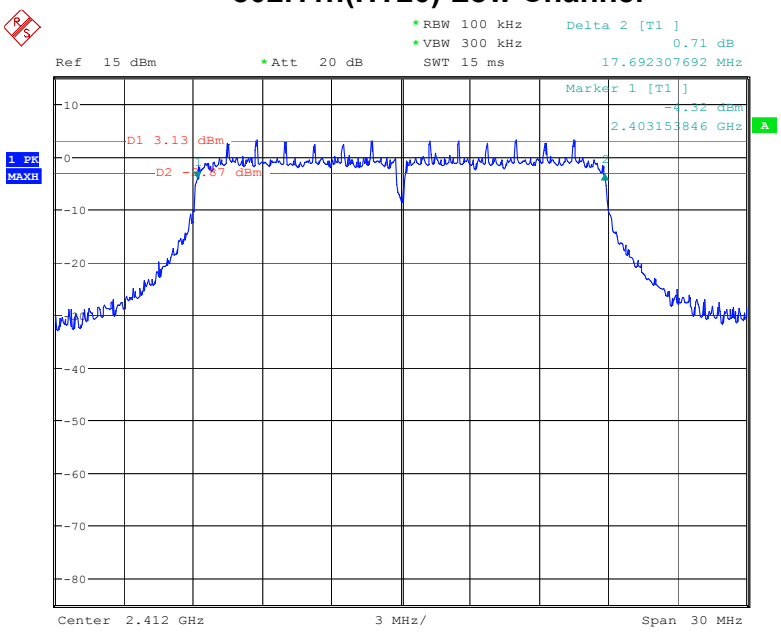

Date: 11.OCT.2016 16:05:31

## 802.11g High Channel



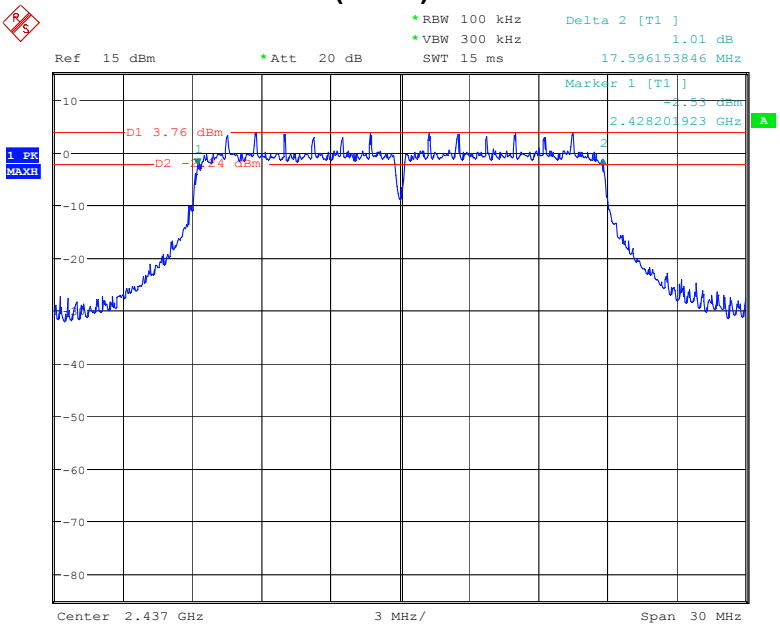

Date: 11.OCT.2016 16:08:33

## 802.11n(HT20) Low Channel



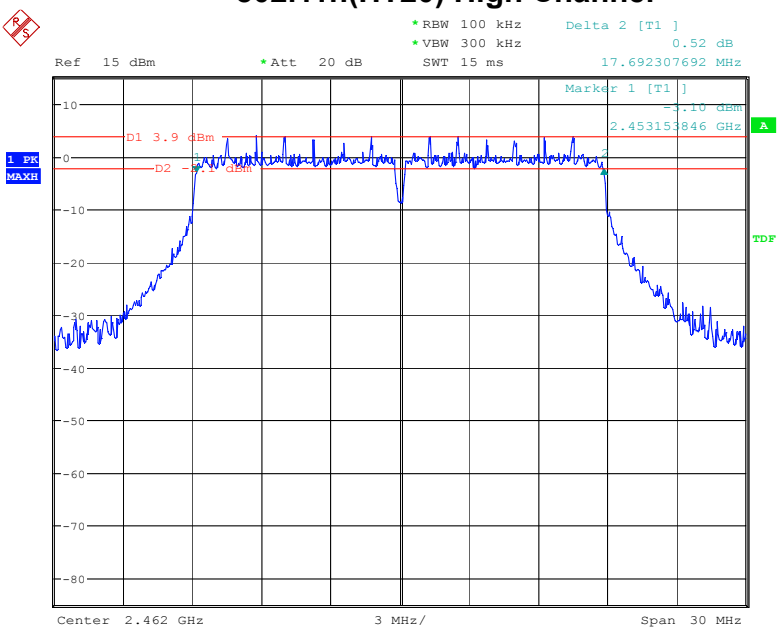

Date: 11.OCT.2016 16:12:21

## 802.11n(HT20) Middle Channel



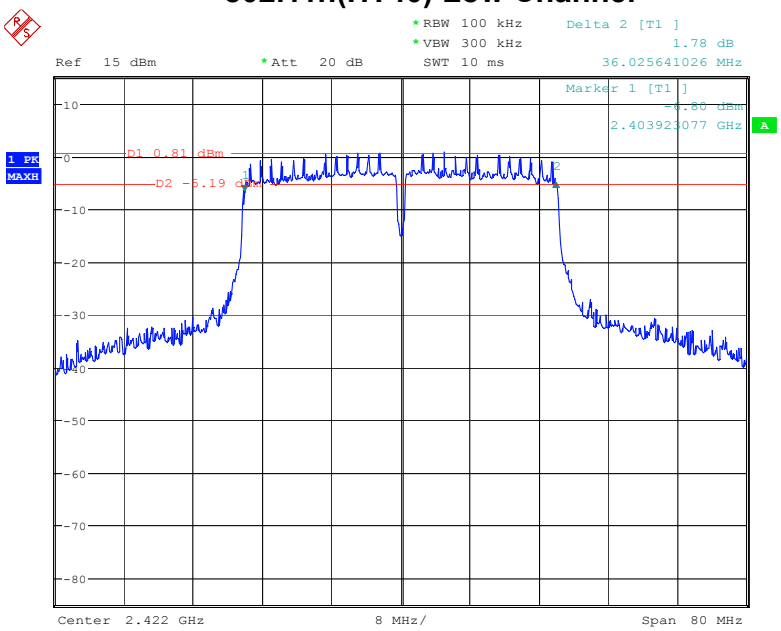

Date: 11.OCT.2016 16:18:02

## 802.11n(HT20) High Channel



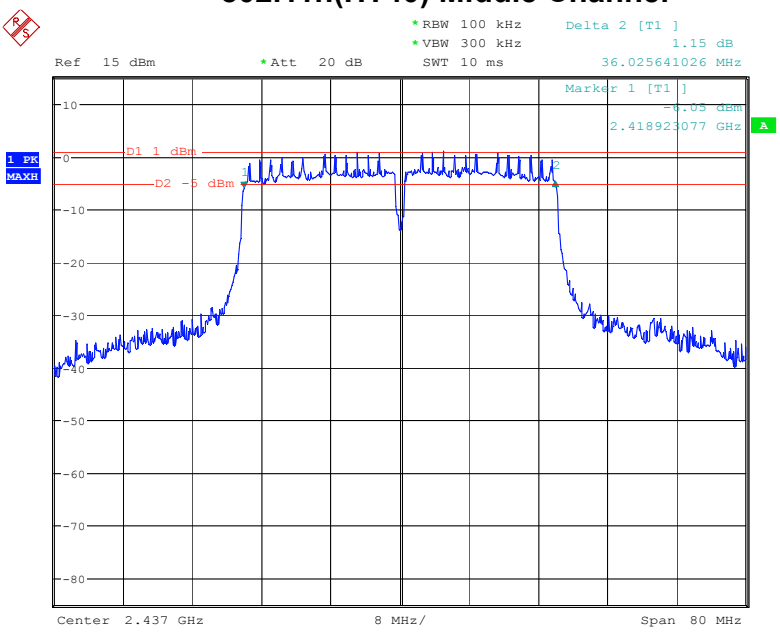

Date: 17.OCT.2016 09:58:52

## 802.11n(HT40) Low Channel



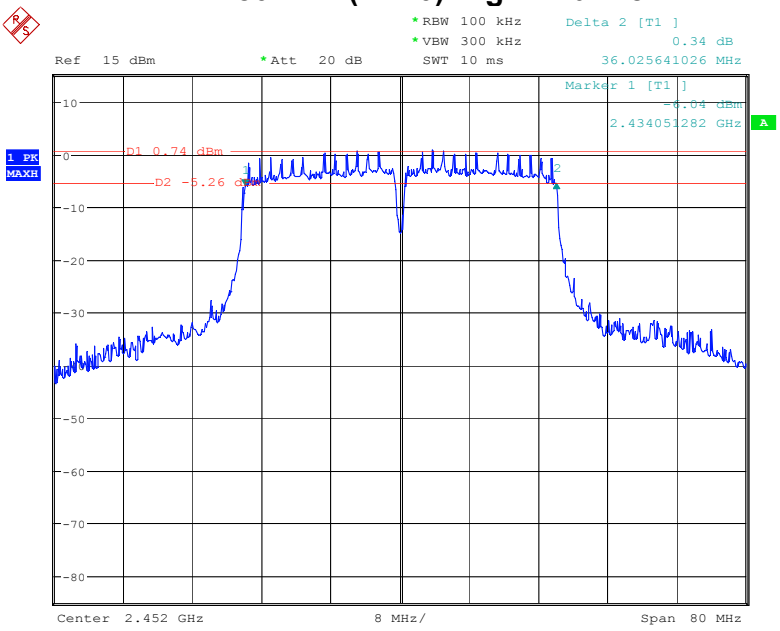

Date: 11.OCT.2016 16:24:10

## 802.11n(HT40) Middle Channel




Date: 11.OCT.2016 16:28:41

## 802.11n(HT40) High Channel




Date: 11.OCT.2016 16:33:38

# 6. Power Spectral Density

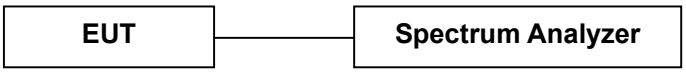
## 6.1 Measurement Procedure

DTS 6dB Channel Bandwidth, FCC Rule 15.247(a)(2):

The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer was set as below according to FCC KDB558074 (v03r03):

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS bandwidth.
3. Set the RBW to: 3 kHz⩽RBW⩽100KHz
4. Set the VBW ⩾ 3 x RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

## 6.2 Test SET-UP (Block Diagram of Configuration)



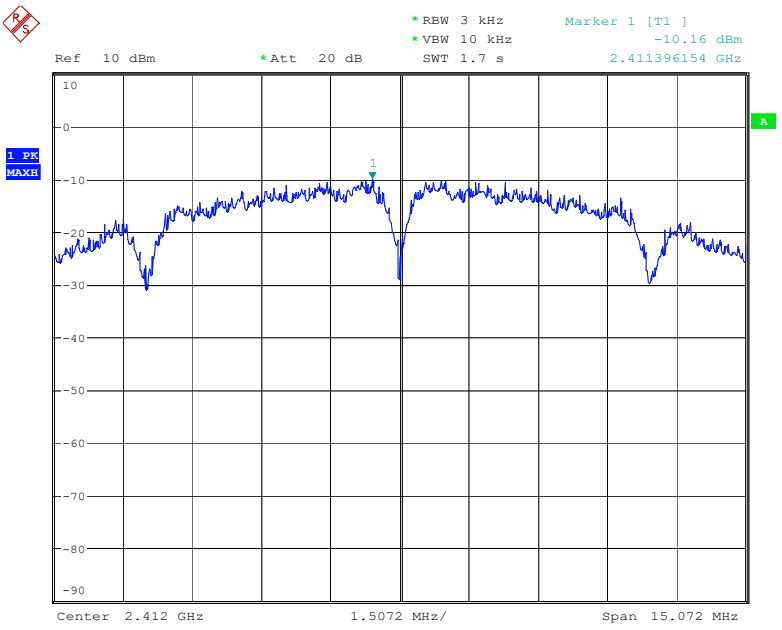

## 6.3 Measurement Results

**Pass**

Please refer to following table and plots.

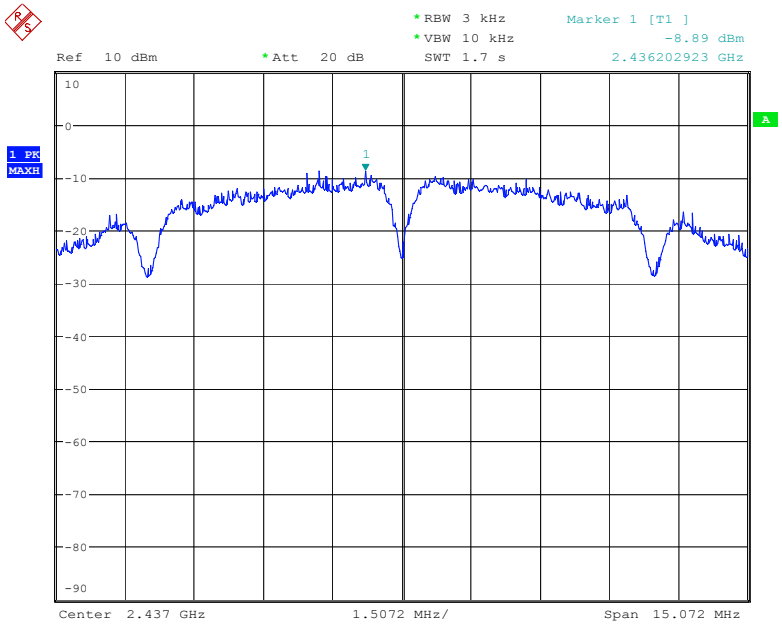
| | | | |
|---|---|---|---|
| Temperature : | 24 ℃ | Humidity : | 50 % |
| Test By: | Sance | Test Date : | October 11, 2016 |
| Test Result: | PASS | | |
| Frequency MHz | Data Rate Mbps | PSD dBm/3kHz | Limit dBm/3kHz |
| IEEE 802.11b Mode (CCK) | | | |
| Low Channel: 2412 | 1 | -10.16 | 8 |
| Middle Channel: 2437 | 1 | -8.99 | 8 |
| High Channel: 2462 | 1 | -8.92 | 8 |
| IEEE 802.11g Mode (OFDM) | | | |
| Low Channel: 2412 | 6 | -10.01 | 8 |
| Middle Channel: 2437 | 6 | -11.25 | 8 |
| High Channel: 2462 | 6 | -9.04 | 8 |
| IEEE 802.11n(HT20) Mode (OFDM) | | | |
| Low Channel: 2412 | 6.5 | -11.75 | 8 |
| Middle Channel: 2437 | 6.5 | -7.35 | 8 |
| High Channel: 2462 | 6.5 | -9.79 | 8 |
| IEEE 802.11n(HT40) Mode (OFDM) | | | |
| Low Channel: 2422 | 13 | -12.88 | 8 |
| Middle Channel: 2437 | 13 | -13.79 | 8 |
| High Channel: 2452 | 13 | -12.45 | 8 |

## 802.11b Low Channel



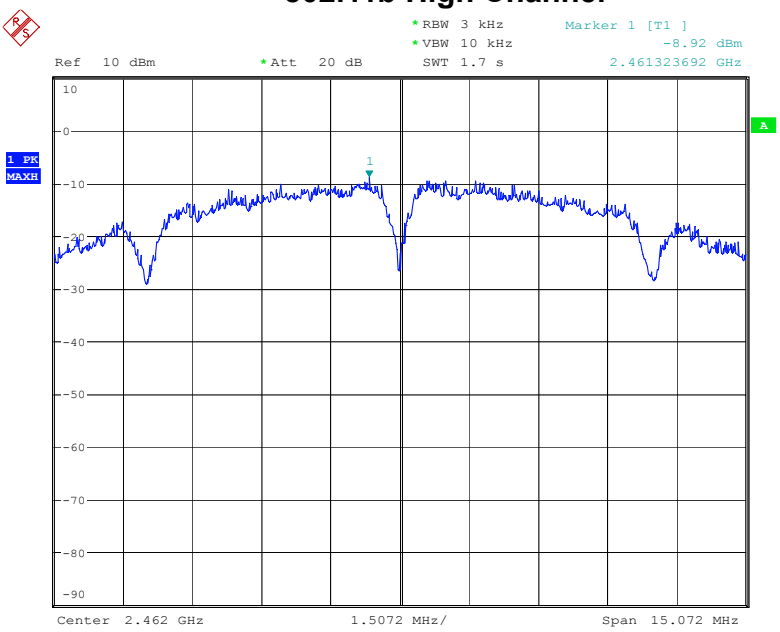

Date: 11.OCT.2016 16:46:49

## 802.11b Middle Channel



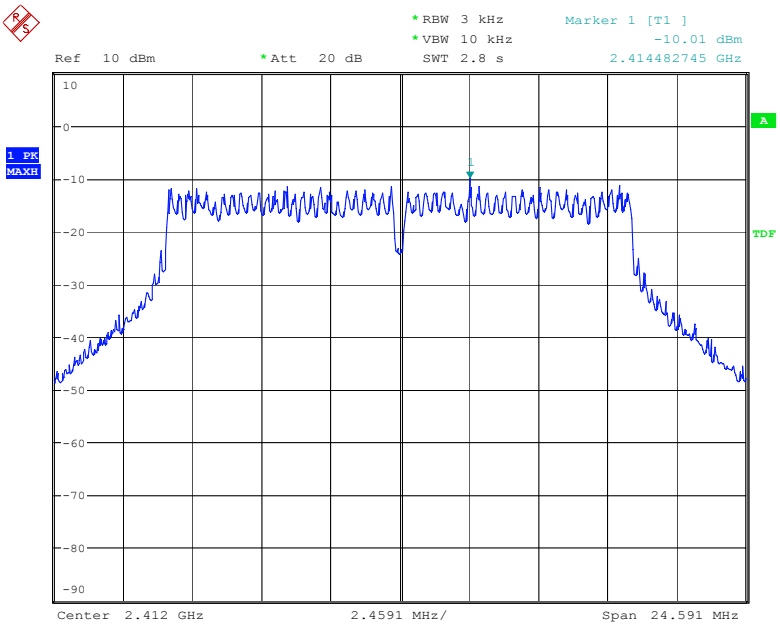

Date: 11.OCT.2016 16:48:46

## 802.11b High Channel



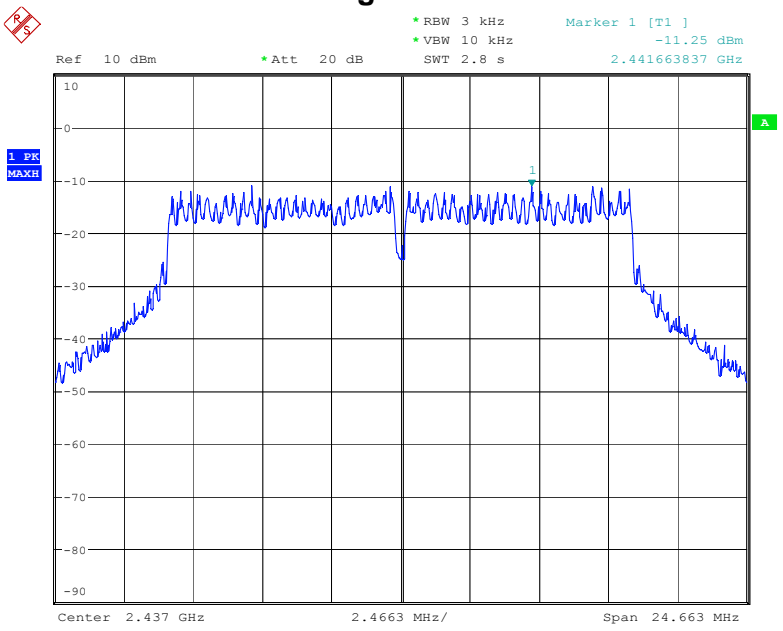

Date: 11.OCT.2016 16:49:52

## 802.11g Low Channel



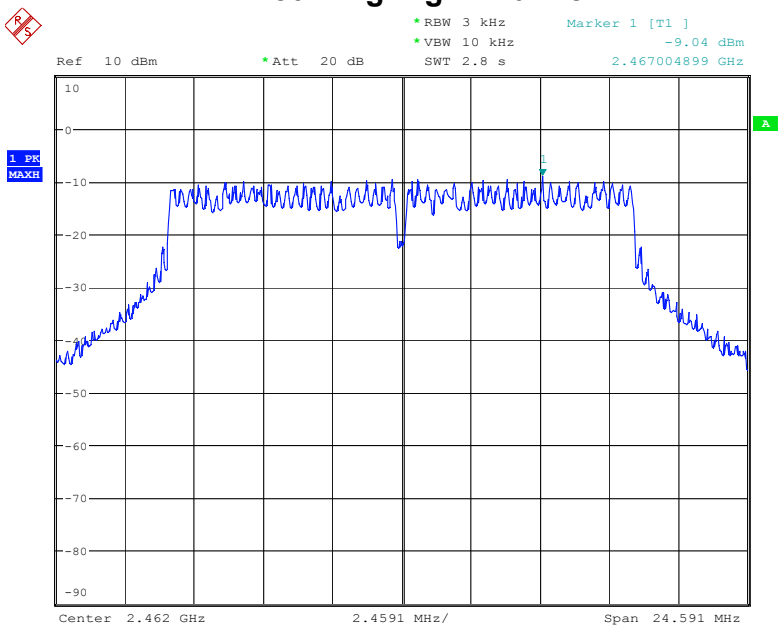

Date: 17.OCT.2016 10:02:19

## 802.11g Middle Channel



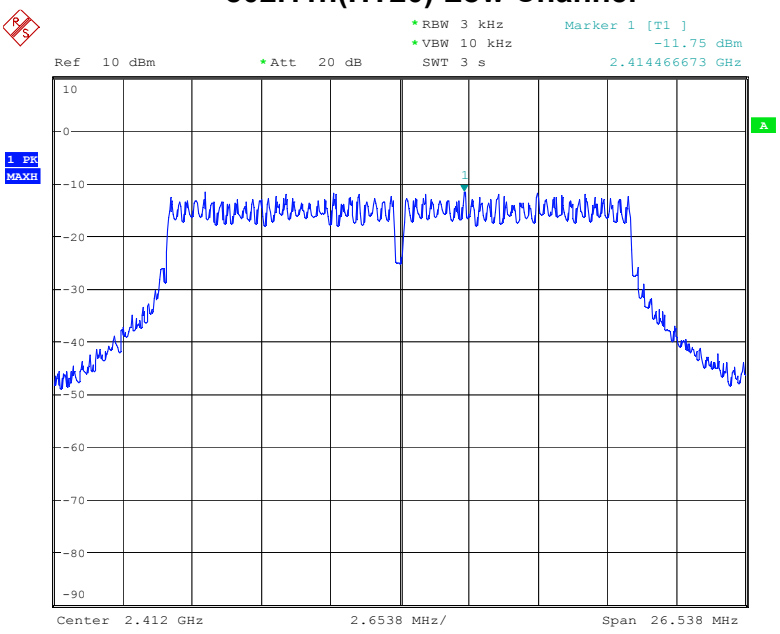

Date: 11.OCT.2016 16:53:10

## 802.11g High Channel



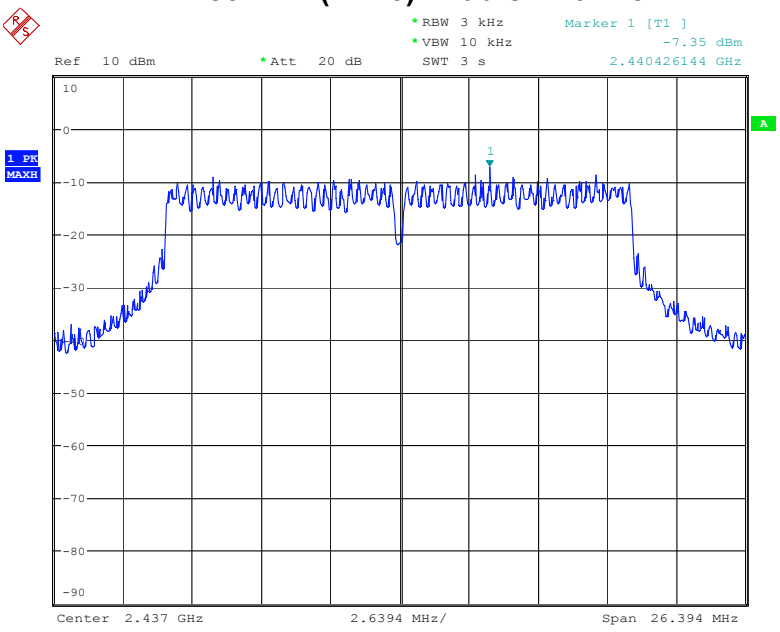

Date: 11.OCT.2016 17:01:09

## 802.11n(HT20) Low Channel



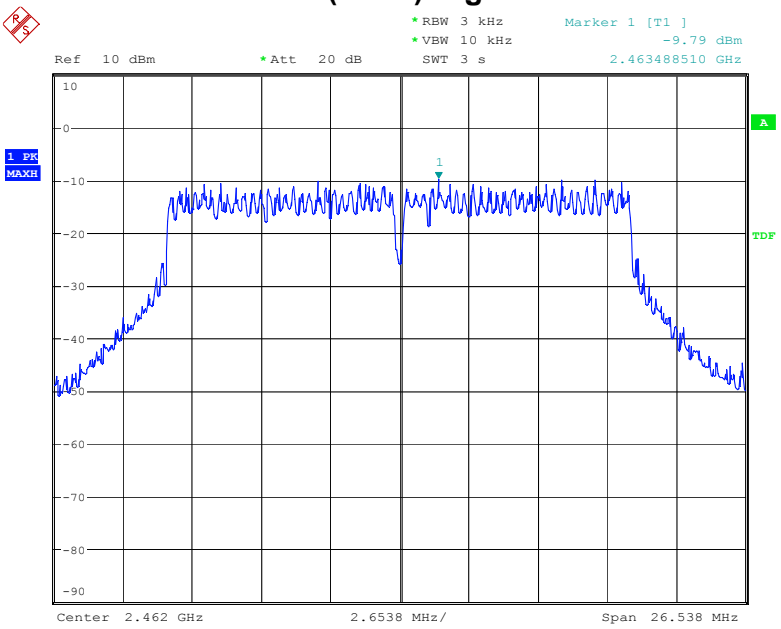

Date: 11.OCT.2016 17:02:14

## 802.11n(HT20) Middle Channel



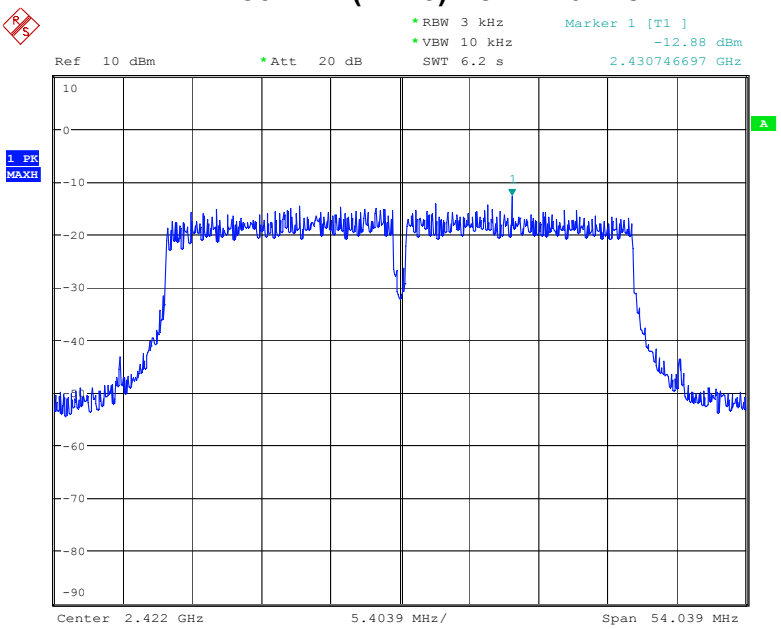

Date: 11.OCT.2016 17:04:00

## 802.11n(HT20) High Channel



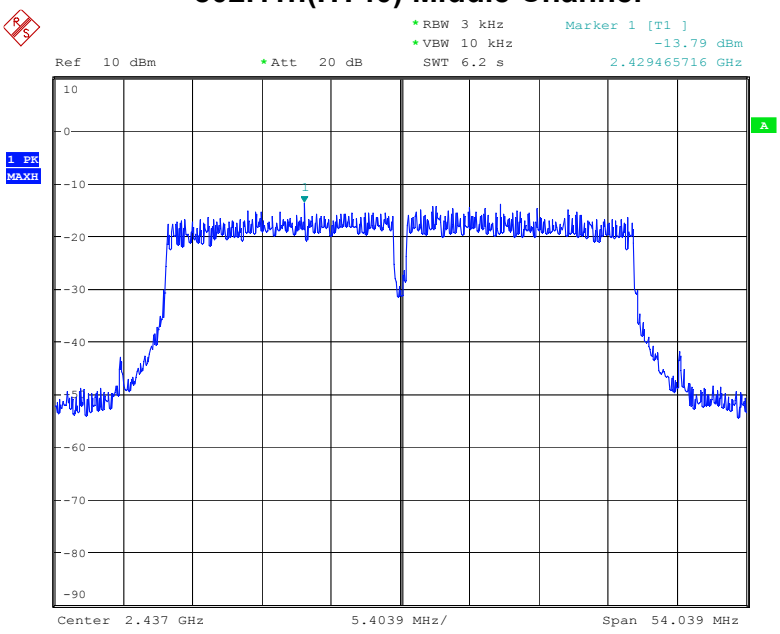

Date: 17.OCT.2016 10:04:22

## 802.11n(HT40) Low Channel



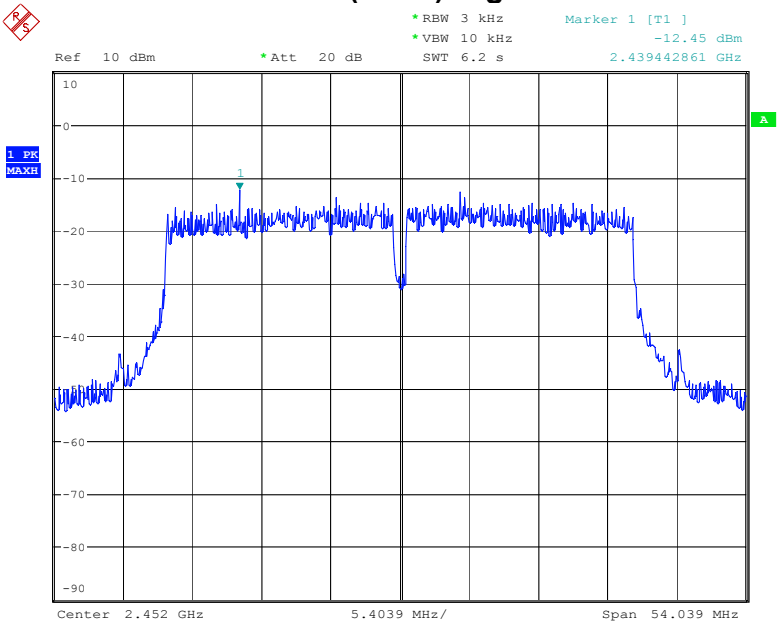

Date: 11.OCT.2016 17:06:26

## 802.11n(HT40) Middle Channel




Date: 11.OCT.2016 17:07:29

## 802.11n(HT40) High Channel




Date: 11.OCT.2016 17:08:49

# 7. Band Edge and Conducted Spurious Emissions

## 7.1 Requirement and Measurement Procedure

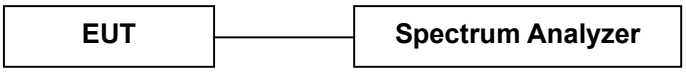
In any 100KHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100KHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.
The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer was set as below.

A Quasi-peak measurement was then made for that frequency point for below 1GHz test. PK and AV for above 1GHz emission test.

During the radiated emission test, the spectrum analyzer was set with the following configurations:

| Frequency Band (MHz) | Level | Resolution Bandwidth | Video Bandwidth |
|---|---|---|---|
| 30 to 1000 | QP | 120 kHz | 300 kHz |
| Above 1000 | Peak | 1 MHz | 3 MHz |
| | Average | 1 MHz | 10 Hz |

## 7.2 Test SET-UP (Block Diagram of Configuration)




## 7.3 Measurement Results

The test plots and table showed all spurious emission and up to the tenth harmonic was measured and they were found to be at least 20dB below the highest level of the desired power in the passband. Please refer to below plots.

Spurious Emission in restricted band:

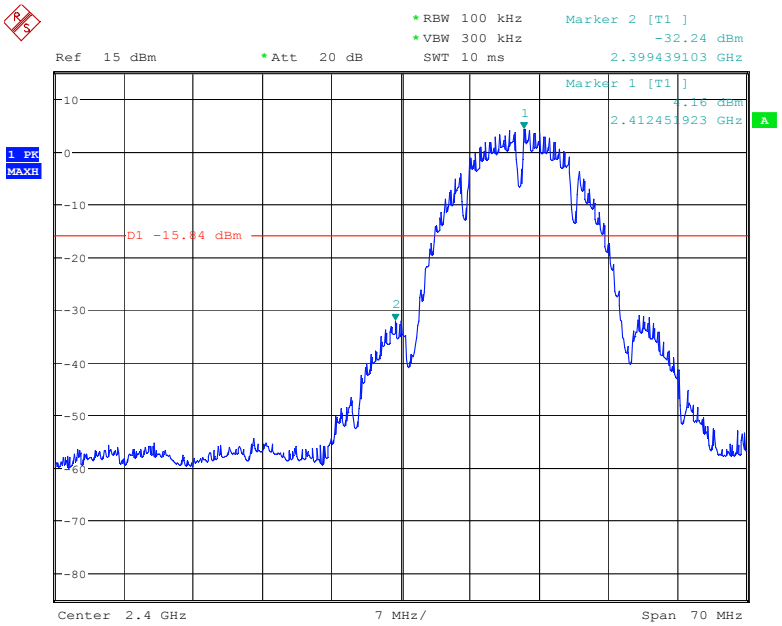
| | | | |
|---|---|---|---|
| Operation Mode: | TX | Test Date : | October 11, 2016 |
| Frequency Range: | Above 1GHz | Temperature : | 24 ℃ |
| Test Result: | PASS | Humidity : | 50 % |
| Measured Distance: | 3m | Test By: | Sance |

| Freq. (MHz) | Ant.Pol. (H/V) | Reading Level(dBuV) | | Factor (dB/m) | Emission Level (dBuV) | | Limit 3m (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | PK | AV | | PK | AV | PK | AV | PK | AV |
| **The worst case: Test Mode: 802.11g** | | | | | | | | | | |
| 2390.000 | H | 39.05 | 28.23 | 8.06 | 47.11 | 36.29 | 74.00 | 54.00 | -26.89 | -17.71 |
| 2390.000 | V | 39.27 | 27.56 | 8.06 | 47.33 | 35.62 | 74.00 | 54.00 | -26.67 | -18.38 |
| 2483.500 | H | 41.75 | 30.02 | 8.36 | 50.11 | 38.38 | 74.00 | 54.00 | -23.89 | -15.62 |
| 2483.500 | V | 37.82 | 27.40 | 8.36 | 46.18 | 35.76 | 74.00 | 54.00 | -27.82 | -18.24 |

**Note:** (1) All Readings are Peak Value and AV.
(2) Emission Level= Reading Level+Probe Factor +Cable Loss
(3) Measurement uncertainty : ±3.7dB

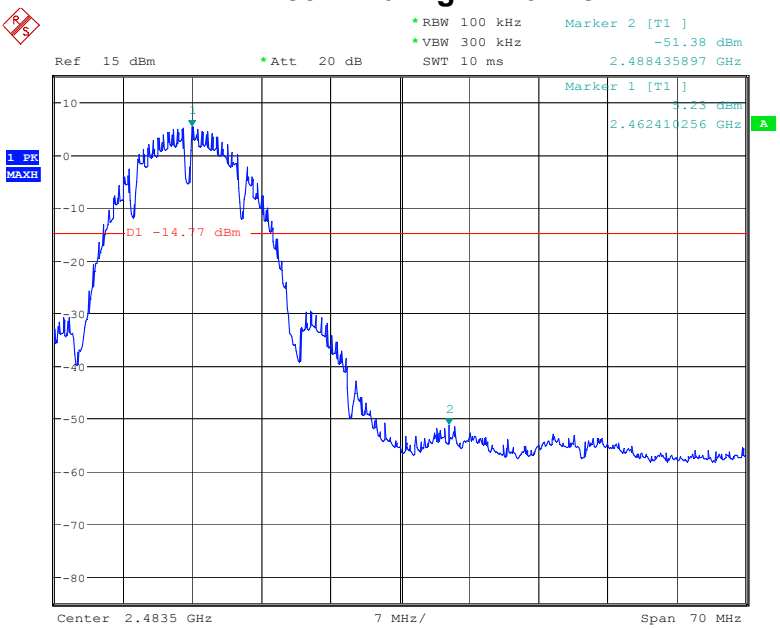
# Band Edge

## 802.11b Low Channel



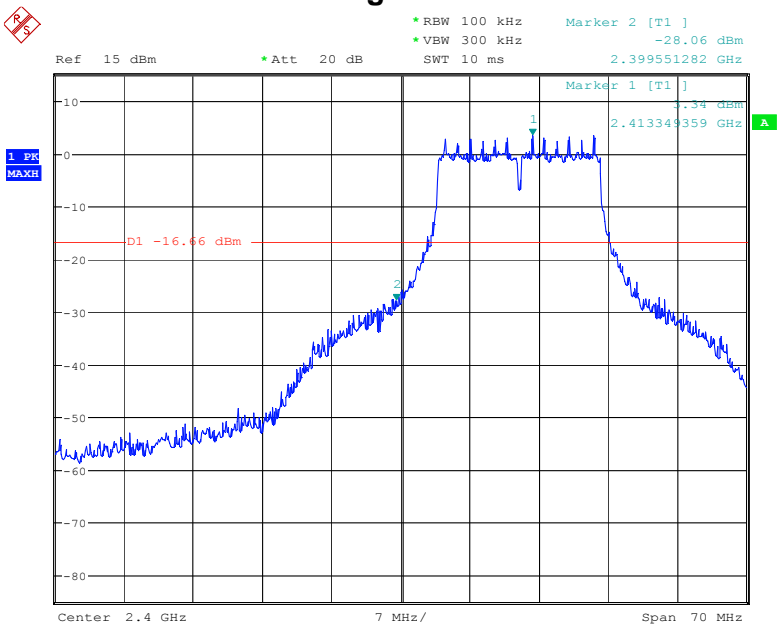

Date: 11.OCT.2016 17:11:29

## 802.11b High Channel



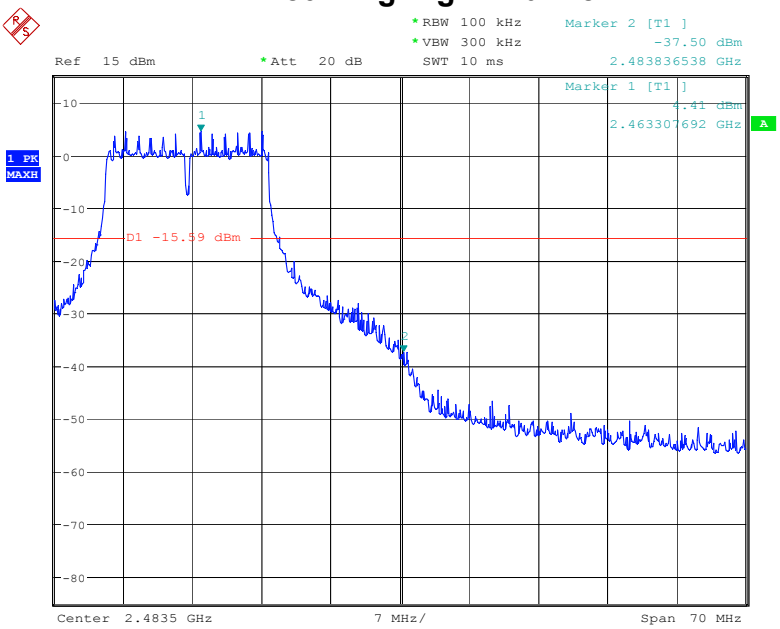

Date: 11.OCT.2016 17:13:17

## 802.11g Low Channel



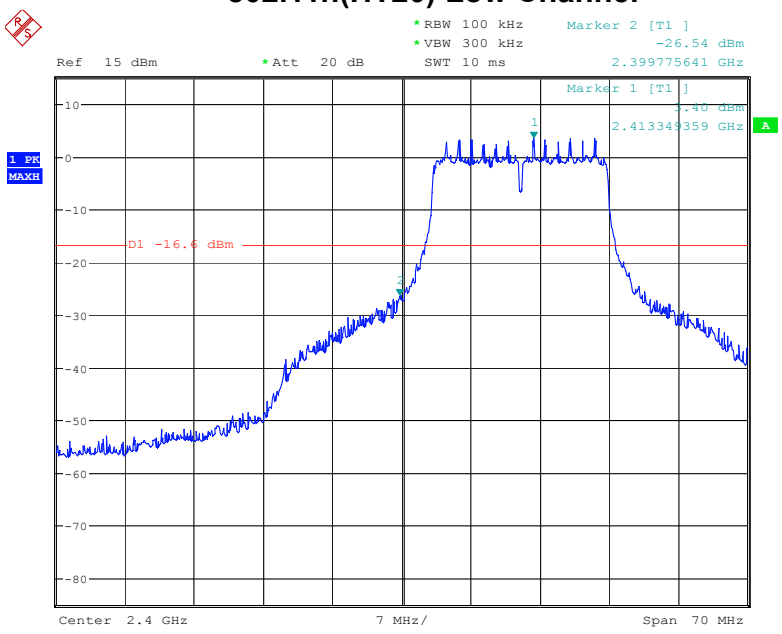

Date: 11.OCT.2016 17:14:40

## 802.11g High Channel



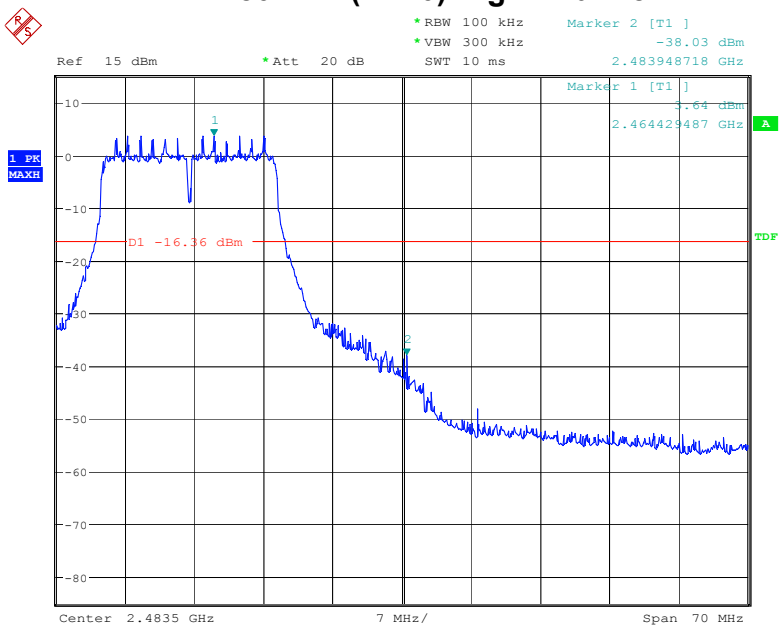

Date: 11.OCT.2016 17:16:02

## 802.11n(HT20) Low Channel



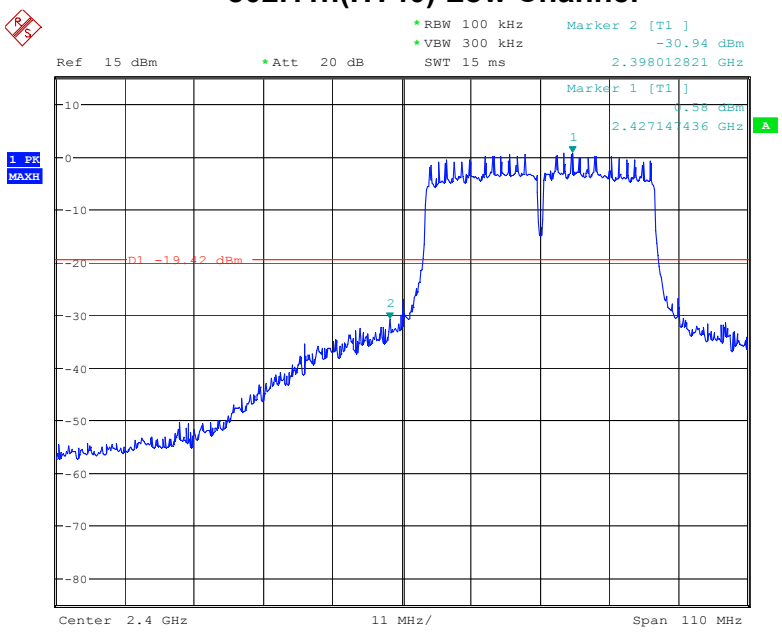

Date: 11.OCT.2016 17:18:30

## 802.11n(HT20) High Channel



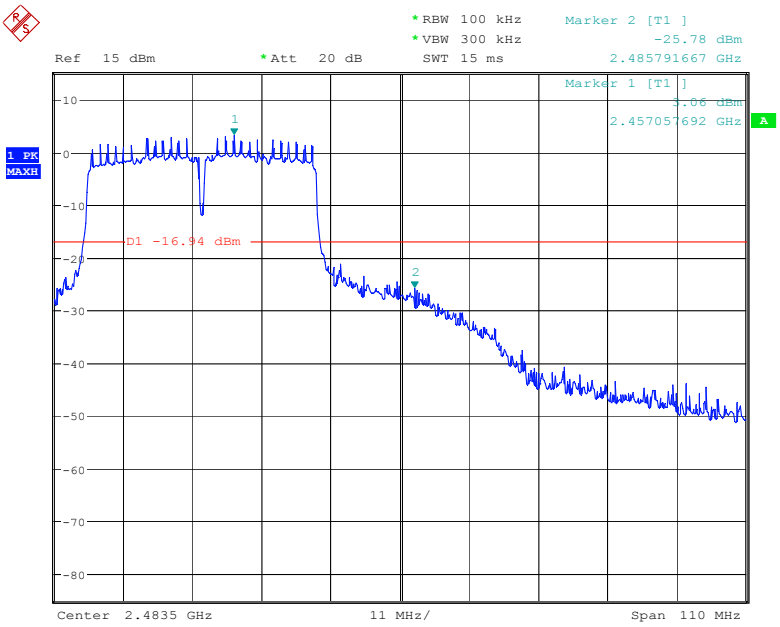

Date: 17.OCT.2016 10:07:27

## 802.11n(HT40) Low Channel




Date: 11.OCT.2016 17:21:22

## 802.11n(HT40) High Channel

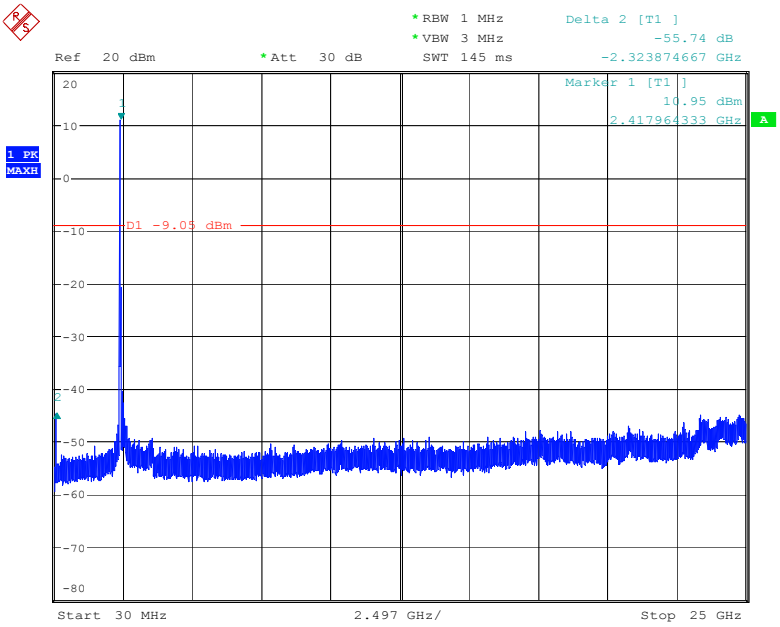



Date: 11.OCT.2016 17:24:06

# Conducted Spurious Emissions

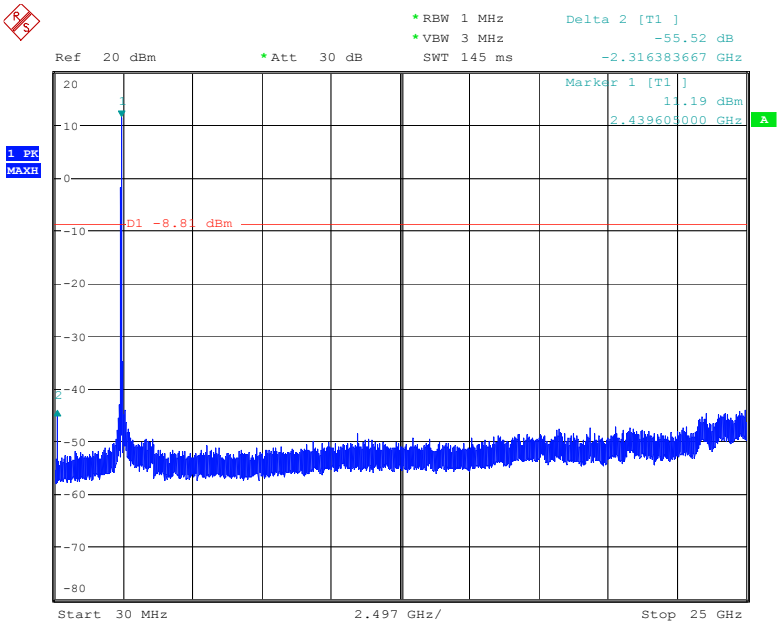
## The worst case: 802.11g

## Low Channel



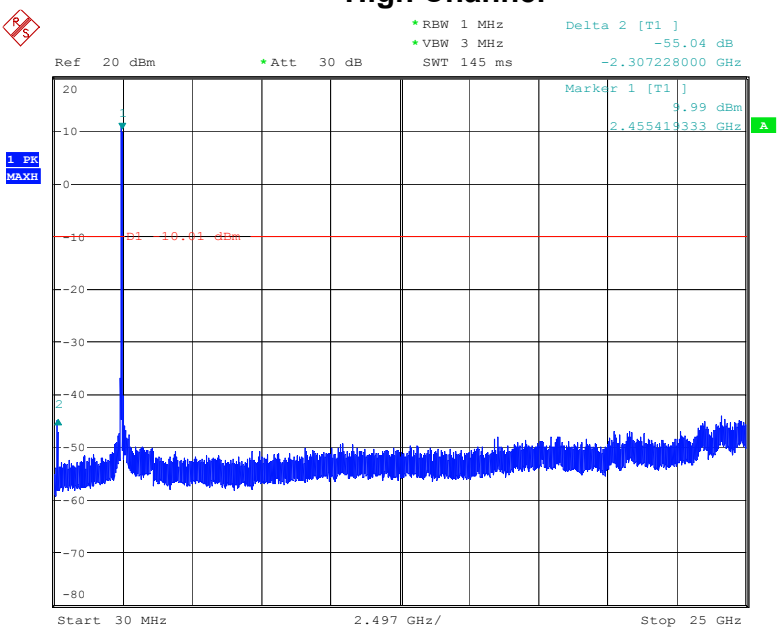

Date: 11.OCT.2016 17:29:12

## Middle Channel




Date: 11.OCT.2016 17:31:39

## High Channel



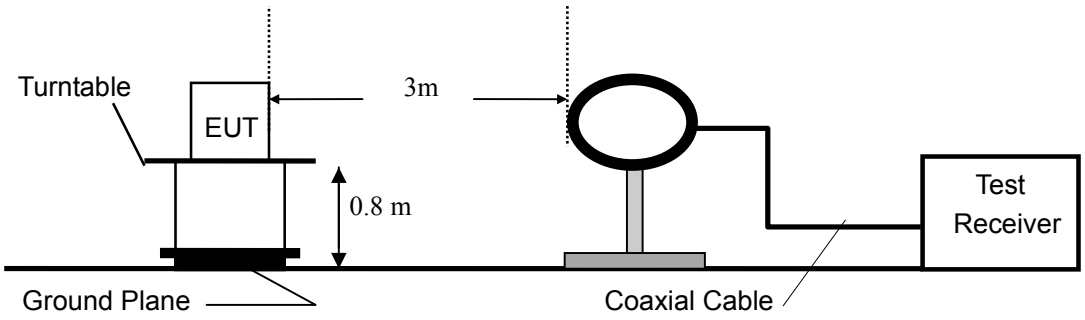

Date: 11.OCT.2016 18:13:35

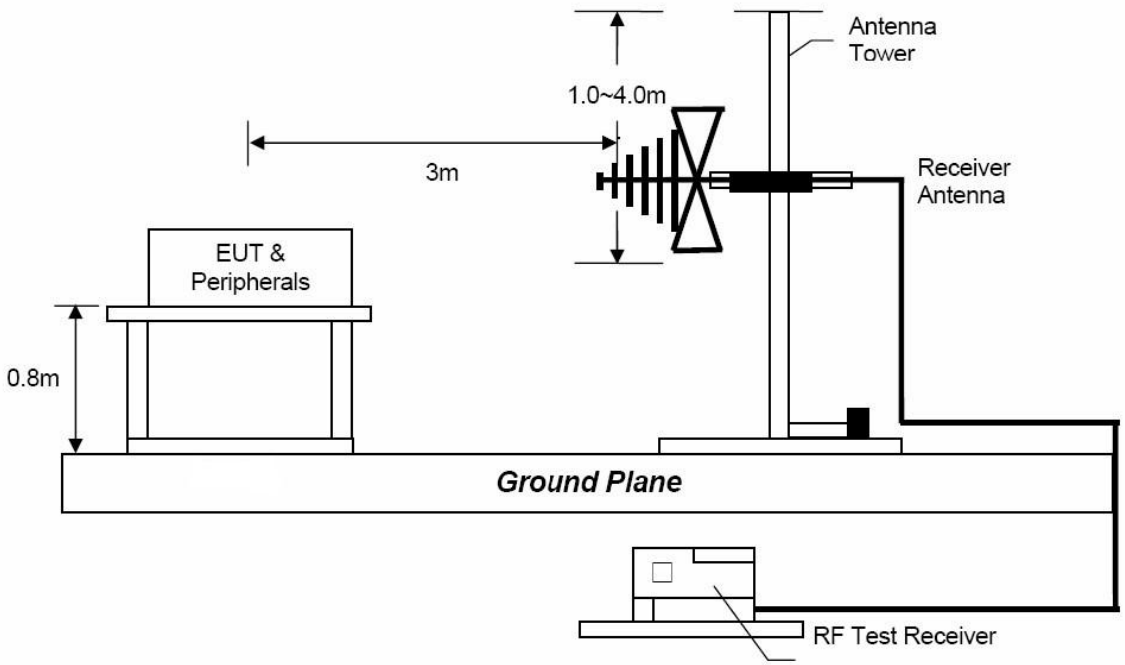
**Note: Sweep points=30001pts**

# 8. Radiated Spurious Emissions and Restricted Bands

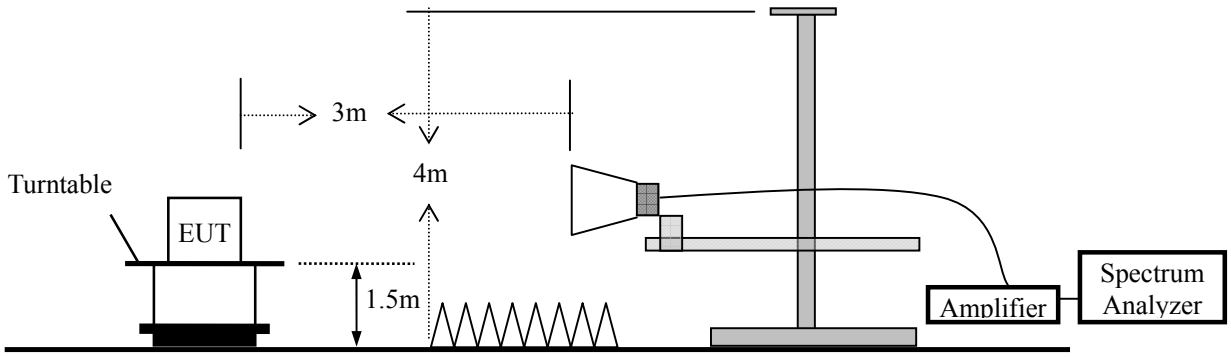
## 8.1 Test SET-UP (Block Diagram of Configuration)

### 8.1.1 Radiated Emission Test Set-Up, Frequency Below 30MHz



8.1.2 Radiated Emission Test Set-Up, Frequency above 1GHz




## 8.2 Measurement Procedure

a. Blow 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi- anechoic chamber room.
b. For the radiated emission test above 1GHz:
   The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter full anechoic chamber room. The table was rotated 360 degrees to determine the position of the highest radiation. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
c. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
d. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. The test-receiver system was set to peak detect function and specified bandwidth with maximum hold mode.
f. A Quasi-peak measurement was then made for that frequency point for below 1GHz test. PK and AV for above 1GHz emission test.

During the radiated emission test, the spectrum analyzer was set with the following configurations:

| Frequency Band (MHz) | Level | Resolution Bandwidth | Video Bandwidth |
|---|---|---|---|
| 30 to 1000 | QP | 120 kHz | 300 kHz |
| Above 1000 | Peak | 1 MHz | 3 MHz |
| | Average | 1 MHz | 10 Hz |

## 8.3 Limit

| Frequency range MHz | Distance Meters | Field Strengths Limit (15.209) μV/m |
|---|---|---|
| 0.009 ~ 0.490 | 300 | 2400/F(kHz) |
| 0.490 ~ 1.705 | 30 | 24000/F(kHz) |
| 1.705 ~ 30 | 30 | 30 |
| 30 ~ 88 | 3 | 100 |
| 88 ~ 216 | 3 | 150 |
| 216 ~ 960 | 3 | 200 |
| Above 960 | 3 | 500 |

Remark：(1) Emission level (dB)μV = 20 log Emission level μV/m
(2) The smaller limit shall apply at the cross point between two frequency bands.
(3) As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.
(4) The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.
(5) §15.247(d) specifies that emissions which fall in the restricted bands, as defined in §15.205 comply with radiated emission limits specified in §15.209.

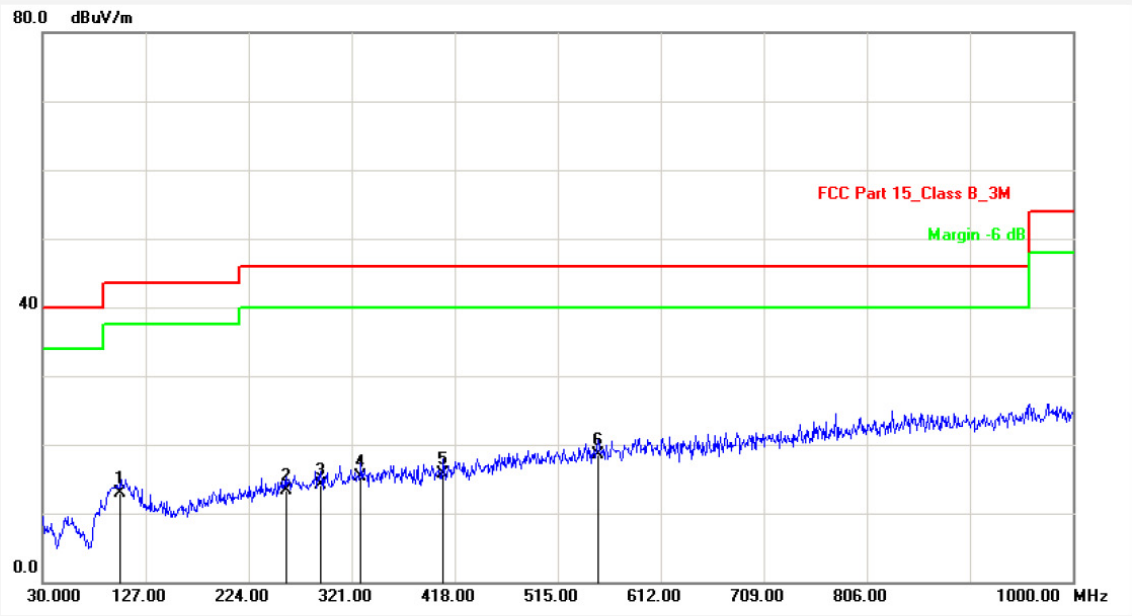
## 8.4 Measurement Results

**Please refer to following plots of the worst case.**

Dongguan NTC Co., Ltd.
Tel:+86-769-22022444 Fax:+86-769-22022799
Web: Http://www.ntc-c.com

Site: Radiation

Test Time: 2016-10-11 10:39:22




| | | | |
|---|---|---|---|
| Report No.: | F23BUUM13-W2 | | |
| Test Standard: | FCC Part 15_Class B_3M | Test Distance: | 3m |
| Test item: | Radiation Emission | Ant. Polarization: | Horizontal |
| Applicant: | Fender Musical | Temp.(C)/Hum.(%): | 22(C) / 54 % |
| Product: | WIFI+BT Module | Power Rating: | AC 120V/60Hz |
| Model No.: | F23BUUM13-W2 | Test Engineer: | Ryan |

Test Mode: Wi-Fi Mode

Remark: 802.11g middle channel

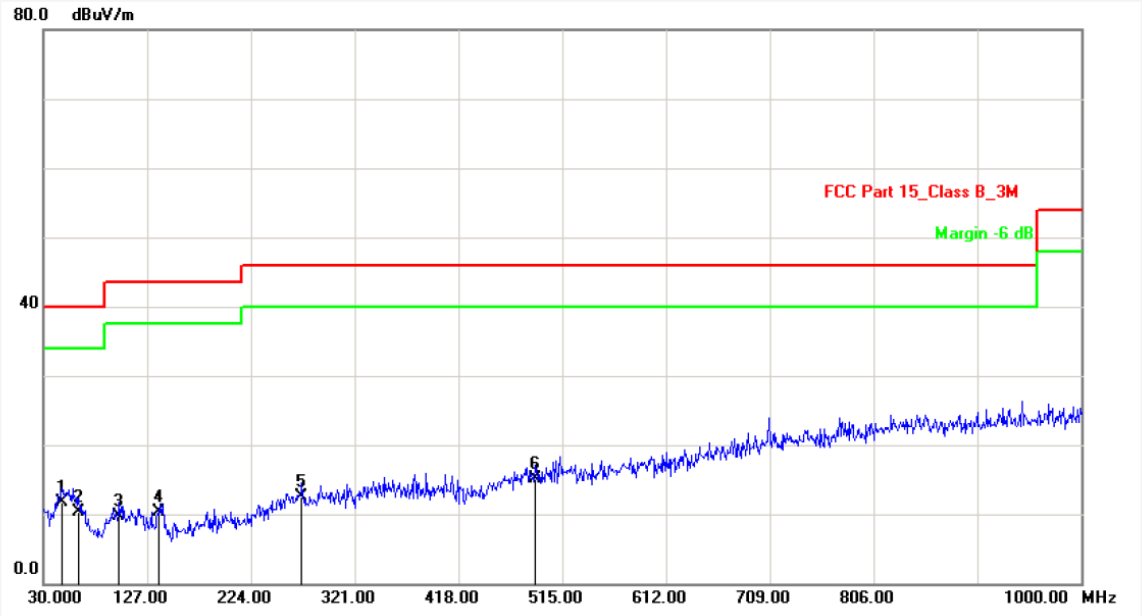
| No. | Frequency (MHz) | Factor (dB/m) | Reading (dBuV) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Height (cm) | Azimuth (deg.) | P/F | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 103.7198 | -11.99 | 24.89 | 12.90 | 43.50 | -30.60 | QP | | | P | |
| 2 | 258.9200 | -11.46 | 24.86 | 13.40 | 46.00 | -32.60 | QP | | | P | |
| 3 | 291.8999 | -10.70 | 24.90 | 14.20 | 46.00 | -31.80 | QP | | | P | |
| 4 | 329.7300 | -9.62 | 24.92 | 15.30 | 46.00 | -30.70 | QP | | | P | |
| 5 | 407.3299 | -8.93 | 24.73 | 15.80 | 46.00 | -30.20 | QP | | | P | |
| 6 | 552.8300 | -6.46 | 25.06 | 18.60 | 46.00 | -27.40 | QP | | | P | |

**Note: Below 30MHz, the emissions are lower than 20dB below the allowable limit.**

Dongguan NTC Co., Ltd.
Tel:+86-769-22022444 Fax:+86-769-22022799
Web: Http://www.ntc-c.com

Site: Radiation

Test Time: 2016-10-11 10:46:58




| | | | |
|---|---|---|---|
| Report No.: | F23BUUM13-W2 | | |
| Test Standard: | FCC Part 15_Class B_3M | Test Distance: | 3m |
| Test item: | Radiation Emission | Ant. Polarization: | Vertical |
| Applicant: | Fender Musical | Temp.(C)/Hum.(%): | 22(C) / 54 % |
| Product: | WIFI+BT Module | Power Rating: | AC 120V/60Hz |
| Model No.: | F23BUUM13-W2 | Test Engineer: | Ryan |

Test Mode: Wi-Fi Mode

Remark: 802.11g middle channel

| No. | Frequency (MHz) | Factor (dB/m) | Reading (dBuV) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Height (cm) | Azimuth (deg.) | P/F | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 47.4600 | -13.50 | 25.30 | 11.80 | 40.00 | -28.20 | QP | | | P | |
| 2 | 62.9799 | -15.07 | 25.37 | 10.30 | 40.00 | -29.70 | QP | | | P | |
| 3 | 100.8100 | -16.11 | 25.91 | 9.80 | 43.50 | -33.70 | QP | | | P | |
| 4 | 138.6399 | -18.53 | 28.93 | 10.40 | 43.50 | -33.10 | QP | | | P | |
| 5 | 271.5299 | -13.15 | 25.65 | 12.50 | 46.00 | -33.50 | QP | | | P | |
| 6 | 489.7799 | -8.99 | 24.19 | 15.20 | 46.00 | -30.80 | QP | | | P | |

**Note: Below 30MHz, the emissions are lower than 20dB below the allowable limit.**

| | | | |
|---|---|---|---|
| Test Mode: | The worst case: 802.11g | Test Date : | October 11, 2016 |
| Frequency Range: | Above 1GHz | Temperature : | 24℃ |
| Test Result: | PASS | Humidity : | 50 % |
| Measured Distance: | 3m | Test By: | Sance |

| Freq. (MHz) | Ant.Pol. (H/V) | Reading Level(dBuV) | | Factor (dB/m) | Emission Level (dBuV) | | Limit 3m (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | PK | AV | | PK | AV | PK | AV | PK | AV |
| **Operation Mode: TX Mode (Low)** | | | | | | | | | | |
| 4824 | V | 39.84 | 27.46 | 14.72 | 54.56 | 42.18 | 74.00 | 54.00 | -19.44 | -11.82 |
| 7236 | V | 35.61 | 23.42 | 20.74 | 56.35 | 44.16 | 74.00 | 54.00 | -17.65 | -9.84 |
| --- | | | | | | | | | | |
| 4824 | H | 36.91 | 24.40 | 14.72 | 51.63 | 39.12 | 74.00 | 54.00 | -22.37 | -14.88 |
| 7236 | H | 33.69 | 21.45 | 20.74 | 54.43 | 42.19 | 74.00 | 54.00 | -19.57 | -11.81 |
| --- | | | | | | | | | | |
| **Operation Mode: TX Mode (Mid)** | | | | | | | | | | |
| 4874 | V | 35.19 | 23.44 | 14.93 | 50.12 | 38.37 | 74.00 | 54.00 | -23.88 | -15.63 |
| 7311 | V | 32.41 | 20.44 | 20.88 | 53.29 | 41.32 | 74.00 | 54.00 | -20.71 | -12.68 |
| --- | | | | | | | | | | |
| 4874 | H | 37.70 | 25.59 | 14.93 | 52.63 | 40.52 | 74.00 | 54.00 | -21.37 | -13.48 |
| 7311 | H | 36.76 | 25.95 | 20.88 | 57.64 | 46.83 | 74.00 | 54.00 | -16.36 | -7.17 |
| --- | | | | | | | | | | |
| **Operation Mode: TX Mode (High)** | | | | | | | | | | |
| 4924 | V | 38.69 | 26.97 | 15.15 | 53.84 | 42.12 | 74.00 | 54.00 | -20.16 | -11.88 |
| 7386 | V | 33.29 | 21.55 | 21.04 | 54.33 | 42.59 | 74.00 | 54.00 | -19.67 | -11.41 |
| --- | | | | | | | | | | |
| 4924 | H | 35.54 | 24.12 | 15.15 | 50.69 | 39.27 | 74.00 | 54.00 | -23.31 | -14.73 |
| 7386 | H | 32.14 | 20.47 | 21.04 | 53.18 | 41.51 | 74.00 | 54.00 | -20.82 | -12.49 |
| --- | | | | | | | | | | |

**Note:**
(1) All Readings are Peak Value and AV.
(2) Emission Level= Reading Level + Factor
(3) Factor= Antenna Gain + Cable Loss – Amplifier Gain
(4) Data of measurement within this frequency range shown " ---" in the table above means the reading of emissions are attenuated more than 10dB below the permissible limits.
(5) Measurement uncertainty : ±3.7dB.
(6) Horn antenna used for the emission over 1000MHz.

# 9. Antenna Application

## 9.1 Antenna requirement

According to of FCC part 15C section 15.203 and 15.240:

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.
Systems operating in the 2400-2483.5MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

## 9.2 Measurement Results

The antenna is PCB antenna and no consideration of replacement, and the best case gain of the antenna is 1.0dBi. So, the antenna is consider meet the requirement.

## 10. Test Equipment List

| Description | Manufacturer | Model Number | Serial Number | Characteristics | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|---|
| Test Receiver | Rohde & Schwarz | ESCI7 | 100837 | 9KHz~7GHz | Nov. 23, 2015 | Nov. 22, 2016 |
| Antenna | Schwarzbeck | VULB9162 | 9162-010 | 30MHz~7GHz | Nov. 26, 2015 | Nov. 25, 2016 |
| Positioning Controller | UC | UC 3000 | N/A | 0~360°, 1-4m | N/A | N/A |
| Color Monitor | SUNSPO | SP-140A | N/A | N/A | N/A | N/A |
| Single Phase Power Line Filter | SAEMC | PF201A-32 | 110210 | 32A | N/A | N/A |
| 3 Phase Power Line Filter | SAEMC | PF401A-200 | 110318 | 200A | N/A | N/A |
| DC Power Filter | SAEMC | PF301A-200 | 110245 | 200A | N/A | N/A |
| Cable | Huber+Suhner | CBL2-NN-1M | 22390001 | 9KHz~7GHz | Nov. 07, 2015 | Nov. 06, 2016 |
| Cable | Huber+Suhner | CIL02 | N/A | 9KHz~7GHz | Nov. 07, 2015 | Nov. 06, 2016 |
| RF Cable | Huber+Suhner | SF-104 | MY16559/4 | 9KHz~25GHz | Mar. 06, 2016 | Mar. 05, 2017 |
| Power Amplifier | HP | HP 8447D | 1145A00203 | 100KHz~1.3GHz | Nov. 07, 2015 | Nov. 06, 2016 |
| Horn Antenna | Schwarzbeck | BBHA9170 | 9170-372 | 15GHz~26.5GHz | Oct.23, 2015 | Oct.22, 2016 |
| Horn Antenna | Com-Power | AH-118 | 071078 | 1GHz~18GHz | Nov. 05, 2015 | Nov. 04, 2016 |
| Loop antenna | Daze | ZA30900A | 0708 | 9KHz~30MHz | Oct.09, 2016 | Oct.08, 2017 |
| Spectrum Analyzer | Rohde & Schwarz | FSU26 | 200409/026 | 20Hz~26.5GHz | Aug. 31, 2016 | Aug. 30, 2017 |
| Pre-Amplifier | Agilent | 8449B | 3008A02964 | 1GHz~26.5GHz | Nov. 03, 2015 | Nov. 02, 2016 |
| L.I.S.N. | Rohde & Schwarz | ENV 216 | 101317 | 9KHz~30MHz | Nov. 07, 2015 | Nov. 06, 2016 |
| Temporary antenna connector | TESCOM | SS402 | N/A | 9KHz-25GHz | N/A | N/A |
| Power Meter | Anritsu | ML2495A | 1139001 | 100k-65GHz | Nov. 05, 2015 | Nov. 04, 2016 |
| Power Sensor | Anritsu | MA2411B | 100345 | 300M-40GHz | Nov. 05, 2015 | Nov. 04, 2016 |

Note: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

---End---